Lecture Notes on

Aviation Meteorology

Prepared by

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Foreword

It is the first time an elaborate module for Aviation Meteorology is being prepared. The content of this course material satisfies the training requirements as stipulated by WMO in its Document No. 258 Supplement No.1 and meets the job requirements of Aeronautical Meteorological Observers (AMO).

Service to Aviation is one of the most important activities of India Meteorological Department. Meteorological support contributes towards the safety, economy, regularity and efficiency of aviation operations. Towards achieving these objectives, an aeronautical observer is required to constantly monitor the meteorological conditions at the aerodrome and its vicinity and make routine meteorological observations at fixed intervals and to make special observations whenever specified changes occur. They should have skills and knowledge in the use of aviation specific codes and practices also. As specified by WMO in its Document No. 258 Supplement No.1, AMO should have the following knowledge and skills in order to carry out their duties and tasks:

(a) *Surface observations.* Make surface meteorological observations; observe and record the parameters that make up a meteorological message; encode the observations in the standard format; transmit coded information.
(b) *Weather watch*. Analyse observations in the local area and be in a position to identify probable significant changes in weather at the station; know and understand the region-specific weather phenomena; be aware of likely weather sequences that are expected to affect the station.
(c) *Weather alert*. Understand a basic weather briefing or forecast, so as to be able to identify changes from the expected evolution at the station; alert the duty forecaster and external users to observed changes in the weather within the local area.
(d) *Product distribution*. Distribute data and information; disseminate messages to users; issue routine and non-routine reports in accordance with normal working practice; answer questions from users.

(e) *Equipment maintenance.* Carry out routine maintenance of observing/ office equipment; operate and maintain automated weather stations, as appropriate.

Keeping the above in view, this study material is designed for those who are being trained to serve in aviation meteorological offices who meet the pre-requisite of having initiated to the basic concepts of meteorology and methods of observation. Some of the topics are elaborated on depending on the nature of the topic and might exceed the number of periods mentioned in the course design. The instructors are therefore requested to prepare the course plan accordingly by involving different teaching methods. The instructors are also requested to carry out few guided exercises utilising the near real time information.

The procedures in aviation meteorology undergoes changes always, hence the readers of this material are requested to kindly ensure that they are referring to the latest version of the training material. The standard reference documents are listed at the end. Here again, the readers need to be careful about referring to the latest versions. Even though the national procedures are based on the international regulations, there can be variations in the national practices of various countries. Hence, the readers are cautioned about the use of reading material available through internet, especially about the procedures in reporting and preparation of meteorological messages. It is requested kindly to contact Central Aviation Meteorological Division in case the readers have suggestions on improving the content of this document or require clarification through aviationsection@yahoo.com

Hoping that this material meets its purpose in the making of an Aviation Meteorological Personnel who will contribute significantly to the objectives of meteorological support to aviation,

Wishing all success,

(M.K. Bhatnagar)

Scientist F and Deputy Director General of Meteorology (Aviation Services)

Course content of Aviation Meteorology for Integrated Meteorological Training Course

TOPIC	Sub topic	Objective: On completion the trainees should be able to:	No. of periods
An overview of Aviation Organisations and their functioning.	1. Definitions	a. List the mandate of the organisations	1
	2. WMO, ICAO, CAeM	b. Describe the functioning of MWO, AMO and AMS	1
	3. Functioning of IMD's Aeronautical Meteorological Organisation	c. Describe the role and responsibilities of Current Weather Assistant	2
	4. Provisions of CAR	d. Documents and procedures to be maintained	1
Effect of Weather on aviation	Effect of various atmospheric parameters on different phases of flight operation	a. Explain the effect of weather elements on aircraft operation	1
	Weather hazards to aviation	b. List the weather hazards and explain its effect on aircraft operation	1
	Climatology of weather hazards	c. Describe broad features of climatology of hazardous weather for each FIR	2

Observation and reporting of weather for Aviation services	1. METAR/ SPECI code	a. Explain the latest METAR/ SPECI code form and SPECI criteria b. Prepare a METAR/ SPECI message using the given observations c. Explain the latest MET Report/ SPECIAL Report template d. Prepare a MET REPORT/ SPECIAL message using the given observations e. Explain the basic concepts of TREND forecast	2
	2. SPECI Criteria		1
	3. Reporting of meteorological elements in METAR/ SPECI		1
	4. Basic concepts of TREND forecast		1
	5. Prepare a METAR/ SPECI message using the given observations		1
	6. MET Report/ SPECIAL Report Template		1
	7. Difference in reporting of elements in METAR and MET Report		1
	8. Examples of preparation of MET REPORT/ SPECIAL		1
Terminal Aerodrome Forecast (TAF)	1. Description of the TAF code form	a. Explain TAF code b. Decode a coded TAF into a plain language message	2
	2. Decoding of the coded TAF into plain language message		1
Area/ Local forecast	Description of Area/ Local forecast template	Explain an Area/ Local Forecast	2
ROFOR	1. ROFOR Code	a. Describe ROFOR code b. Decode a ROFOR and prepare the route forecast in MET-T3/ MET- T4 format.	1
	2. Decoding of the coded ROFOR in plain language		1
	3. Instructions on preparation of MET- T3		1
	4. Instructions on preparation of MET- T4		1
	5. Preparation of a route forecast in MET- T3 form- T4 form		
	6. Preparation of a route forecast in MET		

SIGMET	1. Template for SIGMET 2. Elements of SIGMET	a. Explain the SIGMET template b. Explain an actual SIGMET	1
Aerodrome warning, Warning for light aircrafts and Wind shear warning	1. Responsibility of AMO and AMS 2. Warning elements 3. Warning format	a. Explain the responsibilities of AMO and AMS in relation to issuance of warnings b. List the warning elements c. Explain the format of the warnings and explain a given warning	2 1
Tropical Cyclone Advisory Centre and Volcanic Ash Advisory Centre	1. Responsibility of TCAC and VAAC 2. Template of TCAC advisory with example 3. Template of VAAC Advisory with example	a. List the responsibilities of TCAC and VAAC b. 2. Explain the templates of TCAC advisory and VAAC advisory and explain given advisories.	1 1
World Area Forecast Centre (WAFC) Products	1.Type of WAFC charts available 2. Chart specifications 3. Contents of charts 4. Description of SIGWX elements depicted 5. Interpretation of SIGWX charts	a. List the WAFC products available b. Describe a given SIGWX chart. c. Describe sources and procedure for receiving the WAFC products	1 1 1 1
Briefing and documentation	1. List of documents to be provided 2. List of items to be displayed in met offices 3. Briefing of low level flights 4. OLBS-products available and its updation schedules and methods	a. List the items to be provided in documentation b. List the items to be displayed in an aviation met office Explain the special requirements of low-level flights c. To download the products from OLBS or other sources.	1 1

Aeronautical Telecommunication Network (ATN)	1. Basics about aeronautical telecommunication net work	a. Explain the aviation telecommunication network b. Describe the filing time and transmission time of aviation met messages c. Explain ROBEX scheme d. Explain VOLMET	1
	2. Filing time, transmission time and priority of various aviation meteorological messages		1
	3. Basic concept of ROBEX scheme		
	4. Basics of VOLMET broadcast		
Accident Investigation	1. Introduction	Explain the procedures to be followed by various offices	1
	2. Responsibilities of a Met observer		
	3. Responsibilities of an Aviation met office		
	4. Preparation of Reports		
VIP/VVIP movement	1. Basic procedure to be followed during VIP/ VVIP Flights	Explain the procedures to be followed by various offices	1
Airport Meteorological Instruments	1. Basic functions and use of airport meteorological system	List and Describe the components of airport met instruments system	2
Total classes			**45**

CONTENTS

Chapter 1

AN OVERVIEW OF AVIATION ORGANISATIONS AND THEIR FUNCTIONING

Objectives: On completion the trainees should be able to:

a) List the mandate of the organisations

b) Describe the functioning of MWO, AMO and AMS

c) Describe the role and responsibilities of Current Weather Assistant

d) List the Documents and procedures to be maintained

Sub Topics:

1. Definitions

2. WMO, ICAO, CAeM

3. Functioning of IMD's Aeronautical Meteorological Organisation

4. Provisions of CAR

1. DEFINITIONS

When the following terms are used in the practices for Meteorological Service for national and international Air Navigation, they have the following meanings:

Aerodrome. A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Aerodrome climatological summary. Concise summary of specified meteorological elements at an aerodrome, based on statistical data.

Aerodrome climatological table. Table providing statistical data on the observed occurrence of one or more meteorological elements at an aerodrome.

Aerodrome control tower. A unit established to provide air traffic control service to aerodrome traffic.

Aerodrome elevation. The elevation of the highest point of the landing area.

Aerodrome meteorological office. An office, located at an aerodrome, designated to provide meteorological service for air navigation.

Aerodrome reference point. The designated geographical location of an aerodrome

Aeronautical fixed service (AFS). A telecommunication service between specified fixed points provided primarily for the safety of air navigation and for the regular, efficient and economical operation of air services.

Aeronautical fixed telecommunication network (AFTN). A worldwide system of aeronautical fixed circuits provided, as part of the aeronautical fixed service, for the exchange of messages and/or digital data between aeronautical fixed stations having the same or compatible communications characteristics.

Aeronautical meteorological station. A station designated to make observations and meteorological reports for use in air navigation.

Aircraft. Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

Air traffic services unit. A generic term meaning variously, air traffic control unit, flight information centre or air traffic services reporting office.

Alternate aerodrome. An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing. Alternate aerodromes include the following:

Take-off alternate. An alternate aerodrome at which an aircraft can land shall this become necessary shortly after take-off and it is not possible to use the aerodrome of departure.

En-route alternate. An aerodrome at which an aircraft would be able to land after experiencing an abnormal or emergency condition while en route.

Destination alternate. An alternate aerodrome to which an aircraft may proceed shall it become impossible or inadvisable to land at the aerodrome of intended landing.

Altitude. The vertical distance of a level, a point or an object considered as a point, measured from mean sea level (MSL).

Approach and landing operations using instrument approach procedures. Instrument approach and landing operations are classified as follows:

Non-precision approach and landing operations. An instrument approach and landing, which utilises lateral guidance but does not utilise vertical guidance.

Approach and landing operations with vertical guidance. An instrument approach and landing which utilises lateral and vertical guidance but does not need the requirements established for precision approach and landing operations.

Precision approach and landing operations. An instrument approach and landing using precision lateral and vertical guidance with minima as determined by the category of operation.

Note: Lateral and vertical guidance refers to the guidance provided either by;

a) a ground-based navigation aid; or
b) computer generated navigation data.

Categories of precision approach and landing operations:

Category I (CAT I) operation. A precision instrument approach and landing with:
a) A decision height not lower than 60 m (200 ft); and
b) With either a visibility not less than 800 m or a runway visual range not less than 550 m.

Category II (CAT II) operation. A precision instrument approach and landing with:
a) A decision height lower than 60 m (200 ft), but not lower than 30 m (100 ft); and
b) A runway visual range not less than 300 m.

Category IIIA (CAT IIIA) operation. A precision instrument approach and landing with:
a) A decision height lower than 30 m (100 ft), but not lower than 15 m (50 ft); and
b) A runway visual range not less than 175 m.

Category IIIB (CAT IIIB) operation. A precision instrument approach and landing with:
a) A decision height lower than 15 m (50 ft), or no decision height; and
b) A runway visual range less than 175 m but not less than 50 m.
Category IIIC (CAT IIIC) operation. A precision instrument approach and landing with no decision height and no runway visual range limitations.

Note.— Where decision height (DH) and runway visual range (RVR) fall into different categories of operation, the instrument approach and landing operation would be

conducted in accordance with the requirements of the most demanding category (e.g. an operation with a DH in the range of CAT IIIA but with an RVR in the range of CAT IIIB would be considered a CAT IIIB operation or an operation with a DH in the range of CAT II but with an RVR in the range of CAT I would be considered a CAT II operation).

Approach control unit. A unit established to provide air traffic control service to controlled flights arriving at, or departing from, one or more aerodromes.

Area control centre. A unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction.

ASHTAM. A special series of NOTAM notifying by means of a specific format, change in activity of a volcano, a volcanic eruption and/or volcanic ash cloud that is of significance to aircraft operations.

Aviation meteorological office. A general term used for the meteorological offices designated to provide meteorological service for air navigation.

Briefing. Oral commentary on existing and/or expected meteorological conditions.

Cloud of operational significance. A cloud with the height of cloud base below 1500 m (5000 ft) or below the highest minimum sector altitude, whichever is greater, or a cumulonimbus cloud or a towering cumulus cloud at any height.

CAMD. Central Aviation Meteorological Division

Consultation. Discussion with a meteorologist or another qualified person of existing and/or expected meteorological conditions relating to flight operations; a discussion includes answers to questions.

Control area. A controlled airspace extending upwards from a specified limit above the earth.

Cruising level. A level maintained during a significant portion of a flight.

Elevation. The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.

Flight crew member. A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Flight documentation. Written or printed documents, including charts or forms, containing meteorological information for a flight.

Flight information centre. A unit established to provide flight information service and alerting service.

Flight information region. An airspace of defined dimensions within which flight information service and alerting service are provided.

Flight level. A surface of constant atmospheric pressure, which is related to a specific pressure datum 1013.2 hectopascals (hPa), and is separated from other such surfaces by specific pressure intervals.

Note 1 – A pressure type altimeter calibrated in accordance with the Standard Atmosphere:

a) when set to a QNH altimeter setting, will indicate altitude;
b) when set to a QFE altimeter setting, will indicate height above the QFE reference datum; and
c) when set to a pressure of 1013.2 hPa, may be used to indicate flight levels

Note 2 – The terms “height” and “altitude”, used in Note 1, indicate altimetric rather than geometric heights and altitudes.

Forecast. A statement of expected meteorological conditions for a specified time or period, and for a specified area or portion of airspace.

Height. The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

Heliport. An aerodrome or a defined area on a structure intended to be used wholly or in part for the arrival, departure and surface movement of helicopters.

International airways volcano watch (IAVW). International arrangements for monitoring and providing warnings to aircraft of volcanic ash in the atmosphere.

Level. A generic term relating to vertical position of an aircraft in flight and meaning variously height, altitude or flight level.

Meteorological authority. The authority providing or arranging for the provision of meteorological service for international air navigation on behalf of a Contracting State.

Meteorological Bulletin. A text comprising meteorological information preceded by an appropriate heading.

Meteorological information. Meteorological report, analysis, forecast, and any other statement relating to existing or expected meteorological conditions.

Meteorological report. A statement of observed meteorological conditions related to a specified time and location.

Minimum sector altitude. The lowest altitude which may be used which will provide a minimum clearance of 300 m (1000 ft) above all objects located in the area contained within a sector of a circle of 46 km (25 NM) radius centred on a radio aid to navigation.

NOTAM. A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

Observation (meteorological). The evaluation of one or more meteorological elements.

Operator. A person, organisation or enterprise engaged in or offering to engage in an aircraft operation.

Pilot-in-command. The pilot designated by the operator, or in the case of general aviation, the owner, as being in command and charged with the safe conduct of flight.

Prognostic chart. A forecast of a specified meteorological element(s) for a specified time or period and a specified surface or portion of airspace, depicted graphically on a chart.

Quality management. Coordinated activities to direct and control an organisation with regard to quality (ISO 9000).

Runway. A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

Runway visual range (RVR). The range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

SIGMET information. Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather phenomena, which may affect the safety of aircraft operations.

Threshold. The beginning of that portion of the runway usable for landing.

Displaced Threshold: A threshold not located at the extremity of a runway.

Touchdown zone. The portion of a runway, beyond the threshold, where it is intended landing aeroplanes first contact the runway.

Tropical cyclone. Generic term for a non-frontal synoptic-scale cyclone originating over tropical or sub-tropical waters with organised convection and definite cyclonic surface wind circulation.

Tropical cyclone advisory centre (TCAC). A meteorological centre designated by regional air navigation agreement to provide advisory information to meteorological watch offices, world area forecast centres and international OPMET data banks regarding the position, forecast direction and speed of movement, central pressure and maximum surface wind of tropical cyclones.

Upper-air chart. A meteorological chart relating to a specified upper-air surface or layer of the atmosphere.

Visibility. Visibility for aeronautical purposes is the greater of:

a) the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognised when observed against a bright background;
b) the greatest distance at which lights in the vicinity of 1000 candelas can be seen and identified against an unlit background.

Volcanic ash advisory centre (VAAC). A meteorological centre designated by regional air navigation agreement to provide advisory information to meteorological watch offices, area control centres, flight information centres, world area forecast centres and international OPMET data banks regarding the lateral and vertical extent and forecast movement of volcanic ash in the atmosphere following volcanic eruptions.

VOLMET broadcast. Provision, as appropriate, of current METAR, SPECI, TAF and SIGMET by means of continuous and repetitive voice broadcasts.

World area forecast centre (WAFC). A meteorological centre designated to prepare and issue significant weather forecasts and upper-air forecasts in digital form on a global basis direct to States by appropriate means as part of the aeronautical fixed service.

World area forecast system (WAFS). A worldwide system by which world area forecast centres provide aeronautical meteorological en-route forecasts in uniform standardised formats.

2. INTRODUCTION

Weather affects aviation activities at various stages of operation. In order to ensure safe operations in all weather situations, National Meteorological Services throughout the world are obliged by law to make meteorological observations and forecasts and to establish and to maintain monitoring and warning systems in their countries. The objective of Aeronautical Meteorology is to contribute towards the safety, economy, regularity and efficiency of air navigation.

World Meteorological Organisation (WMO) sets standards and guidelines for meteorological service for aviation through its Commission for Aeronautical Meteorology. International Civil Aviation Organisation (ICAO) which is responsible for civil aviation regulations co-operates closely with WMO in all matters related to meteorology and common regulations are agreed to by both organisations.

3. WORLD METEOROLOGICAL ORGANISATION (WMO)

WMO is an intergovernmental Organization and acts as a specialised agency of the United Nations (UN) for meteorology (weather and climate), operational hydrology and related sciences. It is the UN system's authoritative voice on the state and behaviour of the earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources that regulates all activities related to meteorology and climate.

3.1 HISTORY

WMO was evolved from the International Meteorological Organisation (IMO). On 23rd March 1950, the WMO was formally established. To mark this important event, a few years later, the WMO declared 23rd March as World Meteorological Day – a day, which has since been appropriately celebrated each year.

It has more than 180 members. During the first congress, Geneva, Switzerland, was accepted as WMO's Head Quarter. In December 20th 1951, WMO became a specialized agency of UN. WMO is open to all states and territories, which administers a meteorological service of its own.

3.2 THE PURPOSES OF WMO

i. To facilitate world-wide cooperation in the establishment of networks of stations for making meteorological observations as well as Hydrological and other Geophysical observations related to meteorology and to promote the establishment and maintenance of centres charged with the provision of meteorological and related services.
ii. To promote establishment and maintenance of systems for the rapid exchange of meteorological and related information

iii. To promote standardisation of meteorological and related observations and to ensure the uniform publication of observations and statistics.
iv. To further the application of meteorology to aviation, shipping, water problems, agriculture and other human activities
v. To promote activities in operational Hydrology and to further close cooperation between meteorological and Hydrological services
vi. To encourage research and training in meteorology and, as appropriate, in related fields, and to assist in coordinating the international aspects of such research and training.

3.3 WMO- ORGANISATION

WMO comprises of the following constituent bodies:

i. The Congress
ii. The Executive Council
iii. The Regional Associations
iv. The Technical Commissions
v. The Secretariat

3.3.1 THE CONGRESS

It is the general assembly of delegates representing members and as such is the supreme body of WMO. Some of other important functions of the congress are:

- To adopt technical regulations covering meteorological practices and procedures.
- To establish Regional Association, to determine their geographical limits, co-ordinate their activities, and consider their recommendations.
- To establish Technical Commissions, to define their terms of reference, co-ordinate their activities, and consider their recommendations

3.3.2 THE EXECUTIVE COUNCIL

This is the main executive body of the Organization. Its responsibility, therefore, cover the whole wide range of WMO activities. The main functions of the executive council are;

- Implementing the decisions of congress within the financial resources made available.
- Keeping under review all developments, which directly or indirectly have a bearing on the effectiveness of the Organisation.

- Submitting proposals and recommendations to the subsequent congress, including the proposed program and budget for the coming four-year period; on the basis of the secretary-general's proposal in this respect.

The Council also is responsible for selection and distribution of WMO awards and making arrangements for the IMO lecture, delivered at each congress.

3.3.3 REGIONAL ASSOCIATIONS

The aim of a Regional Association (RA) is to provide co-operation among National Meteorological and Hydrological Services (NMHS) in a given geographical region in dealing with special problems of a regional nature. There are six RAs, which are given below.

- RA I : Africa
- RA II : Asia
- RA III : South America
- RA IV : North and Central America
- RA V : South west Pacific
- RA VI : Europe

India comes under RA II – Asia. The functions of RA are:

- To promote the execution of the resolutions of Congress and the Executive Council in its Region;
- To consider matters brought to its attention by the Executive Council;
- To discuss matters of general interest and to coordinate meteorological and related activities in its Region;
- To make recommendations to congress and the Executive Council on matters within the purposes of the Organization; and
- To perform such other functions as may be conferred on it by Congress.

3.3.4 TECHNICAL COMMISSIONS

There are 8 Technical Commissions and these are composed of individuals who are experts in the technical fields concerned and who are designated by the member countries. The Technical commissions are responsible for studying meteorological and hydrological operational systems, applications and research.

The present structure of the commissions is as follows:

I. Basic Commissions
   a. Commission for Basic System (CBS)
   b. Commission for Instrument and methods of observations (CIMO)

c. Commission for Hydrology (Chy)
d. Commission for Atmospheric Science (CAS)

II. Applications Commissions
a. Commission for Aeronautical Meteorology (CAeM)
b. Commission for Agricultural Meteorology (CAgM)
c. Commission for Climatology (CCl)
d. Commission for Marine Meteorology (CMM)

Each Technical Commission elects its president and vice-president. The presidents of Technical Commissions may participate without vote in the meetings of the Congress and of the Executive Committee.

3.3.5 THE SECTRETARIAT

The permanent Secretariat of the Organization is composed of a Secretary-General and such technical and clerical staff as may be required for the work of the organization. The Secretary–General is appointed by the Congress on such terms as the Congress may approve. The staff of the Secretariat are appointed by the Secretary–General with the approval of the Executive Council in accordance with regulations established by the Congress.

The general functions of the Secretariat are as follows:

- To serve as the administrative, documentary and information centre of the Organization;
- To perform day-to-day program-management functions under the guidance of the Executive Council and in close co-operation with the Technical Commission in connection with the scientific and technical programs approved by Congress;
- To make technical studies as directed by Congress or the Executive Council;
- To organize and perform secretarial duties at sessions of Congress, the Executive Council, the Regional Associations and the Technical Commissions within the limits of the appropriate provisions of these Regulations;
- To arrange for the issue with the provisional agenda of an explanatory memorandum summarising the problems to be discussed in respect of each item on the agenda of each constituent body;
- To prepare or edit, arrange for the publication of and distribute the approved publications of the Organization;
- To provide an appropriate public relations service for the Organization;
- To maintain records of the extent to which each Member implements the decisions of the Organization;

- To maintain files of the correspondence of the Secretariat;
- To carry out the duties allocated to the Secretariat in the Convention and the regulations of the Organization, and such other work as Congress, the Executive Council and the President of the Organization may decide.

3.4 COMMISSION OF AERONAUTICAL METEOROLOGY (CAeM)

The technical commission directly concerned with the service to Aviation Meteorology is the CAeM. This commission examines and deals with all aspects of meteorological service to International Aviation. It keeps constant watch on technological advances and changes in aviation so that meteorological services can be improved or adjusted to meet them. CAeM has a working arrangement with ICAO. All regulations of WMO and ICAO concerning the provision of meteorological services to aviation are identically worded and have same status in the two organizations.

4 INTERNATIONAL CIVIL AVIATION ORGANISATION

The ICAO officially came into being on 4th April 1947. It has its Head Quarters at Montreal, Canada. In October 1947, ICAO became the specialized agency of the United Nations (UN). Non- governmental organizations which also participate in ICAO's work include the International Air Transport Association (IATA), the Airports Council International, the International Federation of Air Line Pilot's Associations, and the International Council of Aircraft Owner and Pilot Associations.

4.1 OBJECTIVES

The main purpose of ICAO is to develop the principles and techniques for international air navigation and to foster the planning and development of international air transport so as to:

- Ensure the safe and orderly growth of international civil aviation throughout the world;
- Encourage the arts of aircraft design and operation for peaceful purposes;
- Encourage the development of airways, airports and air navigation facilities for international civil aviation;
- Meet the needs of the peoples of the world for safe, regular, efficient and economical air transport;
- Prevent economic waste caused by unreasonable competition;
- Ensure that the rights of contracting states are fully respected and that every contracting state has a fair opportunity to operate international airlines;
- Avoid discrimination between contracting states;
- Promote safety of flight in international air navigation;

- Promote generally the development of all aspects of international civil aeronautics.

4.2 ORGANISATION

ICAO is made up of an Assembly, a Council of limited membership with various subordinate bodies and a Secretariat. The chief officers are the President of Council and the Secretary General.

4.2.1 THE GENERAL ASSEMBLY

The sovereign body of ICAO is the Assembly and is composed of representation from all contracting states. The Assembly meets once in every 3 years, reviewing in detail the work of the Organization in technical, economic, legal and technical assistance fields and setting policy for the coming years. It also votes a triennial budget.

4.2.2 THE COUNCIL

The governing body of ICAO is the Council. It is composed of 33 contracting states elected by the assembly for a 3 years term. The assembly chooses the council member states. The Council together with its sub-ordinate bodies, the Air Navigation Commission, Air Transport Committee, The Committee on joint support for Air Navigation Services and Finance Committee provide the continuing direction of work of the Organization. One of the major duties of the Council is to adopt "International Standard and Recommended Practices" and to incorporate these Annexes to the Convention on International Civil Aviation. Both ICAO Assembly and the Council function from ICAO's Head Quarters at Montreal, Canada.

4.2.3 THE SECRETARIAT

The Secretariat is headed by a Secretary General. It is divided into five main divisions, the Air Navigation Bureau, the Air Transport Bureau, the Technical Assistance Bureau, the legal Bureau and Bureau of Administration and Services. Corresponding to each ICAO committee and Division, is a Section of the ICAO Secretariat, made up of staff members selected for technical competence in their respective fields, which supplies technical and administrative aid to the governmental representatives who make up the ICAO Council Committees and Divisions.

In order that the work of the Secretariat shall reflect a truly international approach, professional personnel are recruited on a broad geographical basis. In addition to the regular staff, the services of experts are obtained from member states.

4.3 AIR NAVIGATION COMMISSION AND METEOROLOGICAL DIVISION

The requirements of meteorological facilities for civil aviation during different phases of operation of aircraft are discussed along with other related problems concerning Aviation by periodical Air Navigation Conference held by ICAO. Matters of purely meteorological interests are discussed in Meteorological Division meetings. To coordinate action between ICAO and WMO in respect of provision of meteorological services to civil aviation, the meetings are held conjointly with the CAeM of WMO whenever meteorological aspects are to be discussed.

4.4 THE REGIONAL OFFICES

In dealing with international civil aviation on a world wide scale, there are many subjects which ICAO has had to consider on a regional basis. The Organization has set up eight geographical regions, both to facilitate detailed planning and to cater to different types of flying operations. The eight regions are:

1. The North American Region (NAM)
2. The South American Region (SAM)
3. The North Atlantic Region (NAT)
4. The South Atlantic Region (SAT)
5. The European Mediterranean Region (EUM)
6. The Middle East Region (MID)
7. The South East Asia Region (SEA)
8. The Pacific Region (PAC)

India is located in MID and SEA Regions and takes part in the Regional Air Navigation Meetings (RAN) of these regions which is held as a combined meeting. Similar combined RAN meetings are also held by NAM & NAT and SAM & SAT.

The ICAO Regional Offices to cater to the specific aviation needs of the regions are at Bangkok, Dakar, Cairo, Paris, Lima, Mexico City. The Regional Office at Bangkok is concerned with the MID/SEA region and is known as the Far East Asia and Pacific (FEAP) Office.

4.5 REGULATION AND PROCEDURES

The precision in procedures and systems of aviation activities worldwide is made possible by the existence of universally accepted Standards and Recommended Practices, commonly known as SARPs. SARPs cover all technical and operational aspects of International Civil aviation, such as safety, personnel licensing, operation of aircraft, aerodromes, air traffic services, accident investigation and the environment. The SARPs are incorporated as Annexes to the Convention on International Civil Aviation.

Sixteen out of Eighteen Annexes to the Convention are of technical in nature and fall within the responsibilities of the Air Navigation Bureau and its sections. The remaining two Annexes, Facilitation and Security, are under the purview of the Air Transport Bureau.

ICAO standards and other provisions are developed in the following forms:

Standards and Recommended Practices - collectively referred to as SARPs;
Procedures for Air Navigation Services - called PANS;
Regional Supplementary Procedures - referred to as SUPPs; and
Guidance Material in several formats.

Standard Practices in Annexes are recognised as *necessary* for the safety or regularity of international air navigation and to which Contracting States *will conform* in accordance with the Convention.

Recommended Practices are recognised as *desirable in the interest* of safety, regularity or efficiency of international air navigation, and to which Contracting States will *endeavour to conform* in accordance with the Convention.

Standards and Recommended Practices relating to meteorology were first adopted by the Council on 16 April 1948, pursuant to the provisions of Article 37 of the Convention on International Civil Aviation (Chicago, 1944), and designated as Annex 3 to the Convention. The Contracting states are obliged by Article 38 of the Convention by which Contracting States are required to notify the Organisation of any differences between their national regulations and practices and the International Standards contained in the Annex and any amendments thereto

4.6 RELATION TO CORRESPONDING WMO PUBLICATIONS

The regulatory material contained in Annex 3 is, except for a few minor editorial differences, identical with that appearing in the Technical Regulations (Chapter C.3.1) of the World Meteorological Organisation (WMO).

The aeronautical meteorological code forms referred to in Annex 3 are developed by WMO on the basis of aeronautical requirements contained in Annex3, or stated by the Council from time to time. The aeronautical meteorological code forms are promulgated by WMO in its Manual on Codes, Volume I (WMO No.306).

4.7 ICAO ADVISORY CENTRES

Volcanic Ash Advisory Centres (VAAC): The role of a VAAC is to provide expert advice to Area Control Centres (ACCs)/ Meteorological Watch Offices (MWOs) in its area of responsibility regarding the extent and forecast movement of a volcanic ash cloud. This information is required by the MWOs in order to issue SIGMETs for volcanic ash. ICAO has designated the following VAACs to provide advice to MWOs on the extent and forecast movement of volcanic ash within an

agreed area of responsibility: Anchorage (United States), Buenos Aires (Argentina), Darwin (Australia), London (United Kingdom), Montreal (Canada), Tokyo (Japan), Toulouse (France), Washington (United States), and Wellington (New Zealand). In order to provide guidance to States, a set of International Airways Volcanic Watch (IAVW) procedures has been developed by ICAO and circulated to States in addition to the provisions in the relevant Annexes.

Tropical Cyclone Advisory Centre: It is a meteorological centre designated to provide advisory information to meteorological watch office regarding the position, forecast direction and speed of movement, central pressure and maximum surface wind of tropical cyclones. The following are the Designated TCACs: Miami (USA), Tokyo (Japan), New Delhi (India), La Reunion (France), and Nadi (Fiji).

5. INDIA METEOROLOGICAL DEPARTMENT- AVIATION METEOROLOGICAL ORGANISATION

India Meteorological Department is the national agency which is responsible in all matters related to provision of Meteorological support to aviation in India. The principal requirements in the aviation point of view are: (1) Supply of Current Weather Observations to all aeronautical users, (2) Issue of forecast and warnings on meteorological hazards to aviation and (3) Adherence to procedures and formats for dissemination of products to aviators. Service to International Civil Aviation is in accordance with the Standards and Recommended Practices (SARPs) of ICAO (Annex 3). Domestic Aviation (Civil, Defence, Chartered flights, Explorative missions, relief & rescue operations, VVIP/ VIP flights, flying clubs etc.) is governed by the aviation legislation, Civil Aviation Requirements (CAR) of Director General of Civil Aviation (DGCA), India. It is essentially an extension of SARPs of ICAO with some National Practices of IMD as accepted and required by the users.

India Meteorological Department caters to the needs of Aviation Services through a network of 4 Meteorological Watch Offices (MWOs – Chennai, Delhi, Kolkata and Mumbai), 18 Aerodrome meteorological offices (including four MWOs) and 54 Aeronautical meteorological stations.

Central Aviation Meteorological Division (CAMD) is the nodal office for the aviation services in the country. It also maintains liaison with ICAO, WMO, Airlines, DGCA, AAI, on technical aspects of aviation. Meteorological Training Institute (MTI), Pune, takes care of the training requirements. The installation and maintenance of Airport Meteorological Instruments are done by the DDGM (SI) at Pune. The telecommunication requirements for aviation are managed by the Telecommunication Division (ISSD) functioning at New Delhi and by the telecommunication unit of Airport Authority of India. Tropical Cyclone Advisory Centre (TCAC) of ICAO is functioning at IMD New Delhi.

The guidelines for meteorological service to aviation in India are given in “Manual on Procedures for Meteorological Services for Aviation in India” published

by CAMD, India Meteorological Department. It is essentially the Annex 3, incorporating national practices also. The Aviation Weather Code Book, also published by CAMD, IMD closely resembles “Manual on Codes- WMO 306”. These two publications are updated and revised from time to time in order to incorporate all the amendments and changes by WMO and ICAO.

5.1 FLIGHT INFORMATION REGION (FIR): An airspace of defined dimensions within which flight information service and alerting service are provided. Indian airspace is divided into five FIRs, namely, Chennai, Delhi, Kolkata, Guwahati and Mumbai. The associated meteorological office providing services to an FIR should be a MWO. However, the responsibility of meteorological watch over Guwahati FIR is being handled by MWO Kolkata.

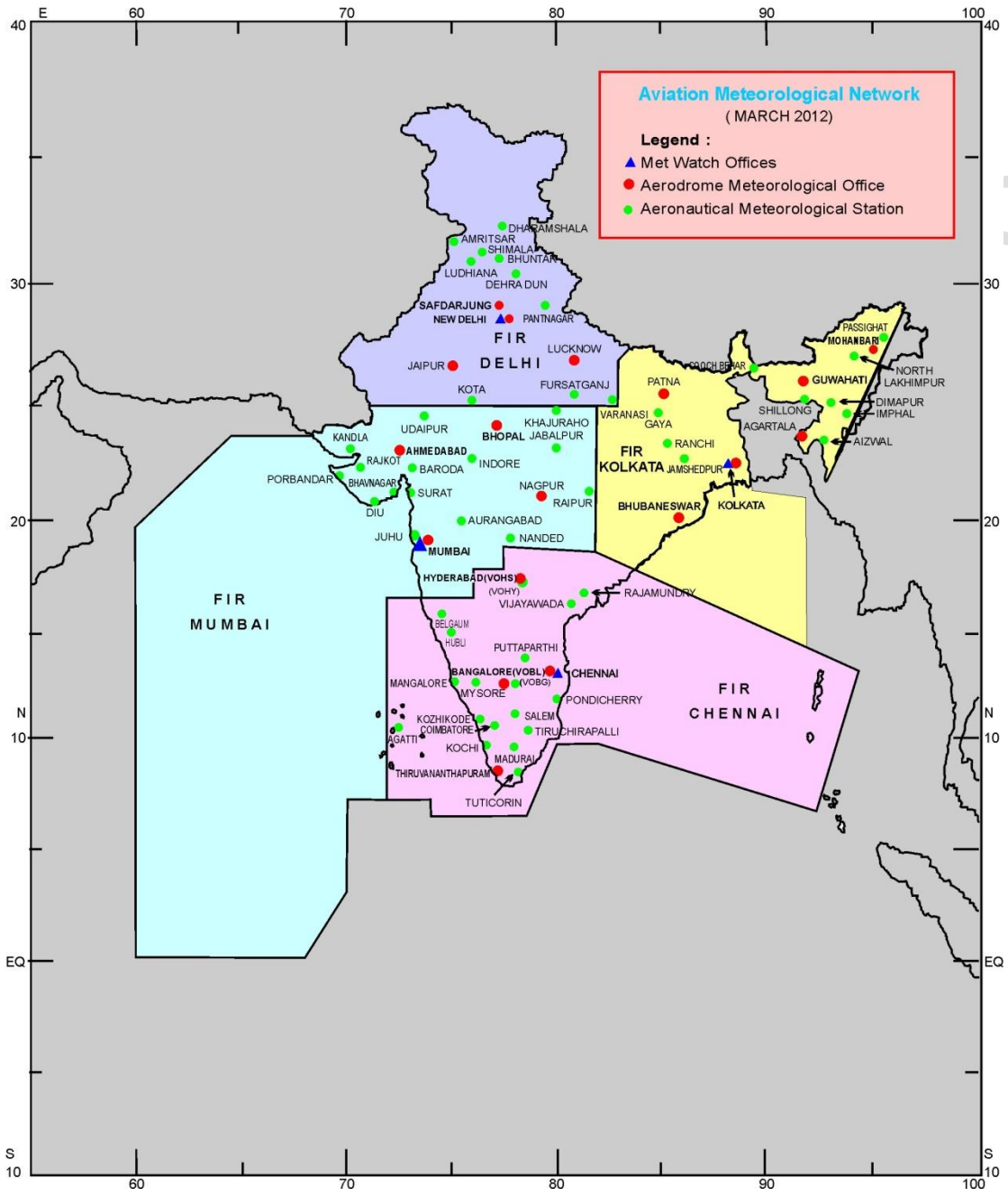
5.2 METEOROLOGICAL INFORMATION IN SUPPORT OF AVIATION:

The meteorological information for the use of aviation activities are:

1. Current weather observations (METAR/ SPECI, MET REPORT/ SPECIAL)
2. Forecasts (Terminal Aerodrome Forecast (TAF), Area/ Local Forecast, Route Forecast, Take-off and Landing (TREND) Forecast)
3. Warnings (Aerodrome warnings, Warning for Light Aircrafts, Wind shear warnings, SIGMET)
4. Climatology (Climatology of aerodromes, Climatological summary, Climatology of upper wind and temperature).

India Meteorological Department

Aviation Meteorological Network



5.3 RESPONSIBILITIES OF AMO:

The following are the major responsibilities of Aerodrome Meteorological Offices:

(a) Preparation and/or obtaining forecasts, such as, output products of the world area forecast system WAFS), and other relevant information for flights operating from their aerodromes.

(b) Preparation and/or obtaining forecasts of local meteorological conditions.

(c) Keeping a continuous watch over the meteorological conditions over their local aerodrome as well as over other aerodromes served by their associated Aeronautical Meteorological Stations and issue necessary forecasts and warnings.

(d) Provision of briefing, consultation and flight documentation to flight crewmembers and/or other flight operations personnel.

(e) Supply of meteorological information to aeronautical users, such as, Hourly/ half hourly current weather observations and special reports, RVR observations, Landing/ take-off reports, Pressure data, Radar and Satellite Observations, SIGMETs of FIR of which the Aerodrome Meteorological Office is a part, SIGMETs of other FIRs, Air Reports (AIREP), METARs /SPECIs of other stations as appropriate, and information on Low level wind shear or turbulence.

(f) Display of available meteorological information.

(g) Exchange of meteorological information with other meteorological offices.

(h) Issue of landing and take-off forecasts.

(i) Supply of flight planning information.

(l) To issue aerodrome warnings for local aerodrome as well as for their associated Aeronautical Meteorological Stations.

(m) Supply information received on pre-eruptive volcanic activity, volcanic eruption or volcanic ash cloud to its associated air traffic services unit, aeronautical information service unit and other MWOs and AMOs.

5.4 RESPONSIBILITIES OF AMS

The Aeronautical Meteorological Stations are responsible for:

a) supply to aeronautical users, of current weather observations of their own stations and those of other stations as required, by obtaining them from the stations concerned.

b) providing documentation for flights originating from their stations after obtaining the forecasts from their associated Aerodrome Meteorological Office(s).

c) supply of forecasts and warnings to aeronautical users of their aerodrome after obtaining from their associated Aerodrome Meteorological Office.

d) supply of information received on pre-eruptive volcanic activity, volcanic eruption or volcanic ash cloud to aeronautical users.

e) Supply of SIGMET as and when received.

5.5 RESPONSIBILITIES OF MWO:

The following are the responsibilities of the Meteorological Watch Offices:

a) Maintain continuous watch of meteorological conditions affecting flight operations within its Flight Information Region (FIR).
b) Prepare and disseminate SIGMET and other information relating to its FIR.
c) Exchange SIGMET information with other MWOs in the neighbouring countries.
d) Supply SIGMET information and other meteorological information to associated air traffic services units, including SIGMET messages of other MWOs.
e) Supply information received on pre-eruptive volcanic activity, a volcanic eruption and volcanic ash cloud for which a SIGMET has not already been issued to its associated Flight Information Centres (FIC)/ Area Control Centers (ACC) and to its associated VAAC.

5.6 DUTIES AND TASKS OF AERONAUTICAL METEOROLOGICAL OBSERVERS (AMO):

The primary duties of an Observer are as follows:

(a) Make routine meteorological observations at fixed intervals.
(b) Make special weather observations whenever specified changes occur in respect of surface wind, visibility, runway visual range, present weather, clouds and/or air temperature.

In order to carry out these duties, observers need to constantly monitor the local meteorological conditions and for that the following tasks are to be performed:

(a) *Surface observations.* Make surface meteorological observations; observe and record the parameters that make up a meteorological message; encode the observations in the standard format; transmit coded information.
(b) *Weather watch*. Analyse observations in the local area and be in a position to identify probable significant changes in weather at the

station; know and understand the region-specific weather phenomena; be aware of likely weather sequences that are expected to affect the station.

(c) *Weather alert*. Understand a basic weather briefing or forecast, so as to be able to identify changes from the expected evolution at the station; alert the duty forecaster and external users to observed changes in the weather within the local area.

(d) *Product distribution*. Distribute data and information; disseminate messages to users; issue routine and non-routine reports in accordance with normal working practice; answer questions from users.

(e) *Equipment maintenance.* Carry out routine maintenance of observing/office equipment; operate and maintain automated weather stations, as appropriate.

5.7 KNOWLEDGE:

In addition to the general observing skills, an aeronautical observer is required to constantly monitor the meteorological conditions at the aerodrome and its vicinity; and to have skills and knowledge in the use of aviation specific codes and practices as well as an appreciation of the impact of their observations on aviation operations. The knowledge an AMO has to possess is as follows:

a) *Aeronautical observations.* Knowledge of the procedures for the making of routine and special observations and reports.
b) *Hazardous phenomena.* Elementary knowledge of the phenomena hazardous to aviation.
c) *Meteorological aspects of flight planning.* Knowledge of the technical regulations.
d) *Reporting, coding, and dissemination of weather information.* Knowledge of the technical regulations.
e) *Definitions*. Knowledge of the aeronautical definitions.
f) *Procedures for meteorological services for international aviation.*
g) *Air traffic services.* Knowledge of the technical regulations.
h) *Operation of aircraft.* Elementary knowledge of the operations.
i) *Aeronautical telecommunications.* Elementary knowledge of the general organization of aeronautical telecommunications.
j) *WMO and ICAO documentation.* Knowledge of the documents.

5.8 UP-KEEP AND MAINTENANCE OF AVIATION METEOROLOGICAL OFFICES

- The up-keep and maintenance of the briefing room and aviation meteorological office is very important and crucial.

- The briefing room shall always have a tidy look about it.
- The pilots regularly visit the meteorological office and a systematic display of all charts, satellite pictures, Radar pictures and other informative materials, is vital for their understanding of the weather.
- The latest charts and weather information have to be prominently displayed in the briefing room so that they are easily accessible to the persons visiting the briefing room.

5.9 MAINTENANCE OF REGISTERS

In order to streamline the routine activities of an aviation meteorological office, it is necessary to have certain registers maintained regularly. The list of registers to be maintained by MWOs, AMOs and AMSs are given below:

List of registers to be maintained by different types of offices

	Registers/ log books			
Sl. No.		MWO	AMO	AMS
1	Accident register	X	X	X
2	Registers for noting lapses, deficiencies, procedural mistakes etc.	X	X	
3	Current Weather Register	X	X	X
4	Briefing Register	X	X	X
5	De-briefing Register	X	X	
6	Aviation Action Diary (Routine)	X	X	
7	Aviation Action Diary (Non- Routine)	X	X	
8	In-flight and Post-flight report register	X	X	
9	Aviation Log book	X	X	X
10	FIR Warning/ SIGMET Register	X		
11	Aerodrome Warning Register	X	X	X
12	Register for coded ROFORs, TAFs etc.	X	X	
13	Verification of Aviation Forecasts	X	X	
14	Register regarding Implementation of instructions and circulars	X	X	X
15	NOTAM Register	X	X	X
16	Radar Scope Observation Register	X	X	

17	METAR Plotting Register (*Format not provided)* Carbon copies of METAR/ SPECI, where ever in use shall be destroyed after three months, if it is not required in connection with accident investigation and enquiries	X	X	At AMSs where TREND forecast is issued

5.10 UPDATION OF HANDBOOK PAGES

- The hand book pages which give the basic information about an aviation meteorological office are to be kept up to date.
- Any change in the information contained in the Hand book shall be communicated to CAMD without delay, so that the contents remain current.

5.11 UPDATION OF AIP INDIA:

- Aeronautical Information Publication (India) gives details of services and facilities available at an aerodrome.
- The meteorological facilities available at an airport also are included in it.
- The aviation meteorological offices should send the changes in services for amending the AIP India on a quarterly basis to CAMD.

5.12 ROUTINE REPORTS:

The following are the routine reports to be forwarded to CAMD:

S.No 1	Description of reports/returns 2	Originating office 3	Periodicity of report 5	Date on which statemen to reach CAMD 6
	Statement verification of Aviation forecast	All A. M. Os	Monthly	By 10th of following month
	Statement of verification of Aerodrome Warning	All A. M. Os	Monthly	By10 th of following month
	Statement of verification of Trend Forecast	All A. M. Os	Monthly	By10 th of following month
	Statistics of Aviation Forecast	All A. M. Os	Monthly	By10 th of following month
	Delay in reception of Aviation Met. Messages	All A. M. Os	Quarterly	By10 th of following month
	Implementation of aviation circulars	All AMOs/ AMSs	Monthly	By10 th of following month
	Amendment to AIP India	All RMCs	Quarterly	After 15 days of quarter ending
	Half yearly TAF statement	All AMOs	Half Yearly	After 15 days of half Year ending
	Installations and working status of AMI	All AMOs and AMSs	Monthly	By 5th of following month
	List of in-charges of aviation met. Offices	All RMC's	Half Yearly	By 10 th of Jan and July Every year

	Changes in Handbook pages	All AMOs and AMSs	As and when required	----
	Random scrutiny of Forecasts	DDGM (RMC)	Monthly	15th of the following month
	List of officers for undertaking Familiarisation flight	RMC	Annual	By end of January every year

CHAPTER 2

EFFECT OF WEATHER ON AVIATION

Objectives:

d. Explain the effect of weather elements on aircraft operation
e. List the weather hazards and explain its effect on aircraft operation
f. Describe broad features of climatology of hazardous weather for each FIR

Sub topics:

1. Effect of various atmospheric parameters on different phases of flight operation
2. Weather hazards to aviation
3. Climatology of weather hazards.

1. INTRODUCTION:

The need of meteorological services for the safe, economic and efficient navigation of an aircraft to reach its destination is well known. The knowledge of jet streams and pressure patterns or a broader combination of these two can save time and fuel. However, the present day wide-bodied Jet aircraft fly much above the weather and, therefore, except for significant weather elements, importance of adverse weather during cruise has decreased. The influence of many other meteorological parameters on the aerodynamics and engine efficiency during various phases of aircraft operation is also very significant. With the advent of jet aviation and heavily loaded passenger or freighter aircraft doing long haul flights at high speed and at a very high rate of fuel consumption, flight planning, which takes into account all the meteorological parameters has become an absolute must to obtain maximum efficiency without compromising safety of aircraft operations.

2. WEATHER ELEMENTS:

Following weather elements affect the aircraft operations and payload:

i. Pressure
ii. Temperature
iii. Wind
iv. Humidity
v. Clouds
vi. Visibility
vii. Weather phenomena

Pressure, Temperature and Wind have direct impact on:

i. Take-off Weight
ii. Landing weight
iii. Fuel Requirement
iv. Flying Time.

3. METEOROLOGICAL FACTORS AFFECTING AIRCRAFT OPERATIONS

Flight of an aircraft is dependent on the following four essential factors:

a) Total weight (W) of the aircraft
b) Lift (L) of the aircraft, which is generated by airflow over the wings.
c) Drag (D), which is the resistance to forward motion caused of the air
d) Thrust (T), which is supplied by the engines of the aircraft.

There are three phases in an aircraft flight. They are:

i) Take-off phase
ii) Cruise phase
iii) Landing phase

Surface meteorological observations made at an aeronautical meteorological stations, are required for each phase of the flight.

4. EFFECTS OF WEATHER ON AIRCRAFT AT VARIOUS PHASES OF FLIGHT

4.1 Wind

***Upper wind*:** Information on upper wind is required by the pilot and the operator for two reasons:

i) To navigate the aircraft between two places: In steady flight the aircraft moves forward in straight line in relation to the air in which it is flying. When there is a wind, the path of the aircraft is displaced in relation to the earth. Hence, the forecast wind velocities have an important influence on the route and altitude selected for a particular flight. The aim is to select a route and altitude which will give maximum tail-wind components. Knowledge of presence of jet streams is a necessity while planning the route.

ii) *Planning of fuel load:* If there is a strong Headwind, the aircraft will take longer time to fly from one place to another than in still air. This means it needs more fuel, which may mean reducing the payload. If there is a strong tail wind the time taken is

reduced and the fuel load can be reduced. For e.g. an aircraft that can cruise at 500 kts will take 6 hours to fly 3000 nautical miles in still air. If there is a 50 knot tail wind, the flight will take 5 hrs. 27 minutes, approximately 10% less time. Thus 10% less cruise fuel need be carried as compared to the still air load. This increases the potential payload.

***Surface wind*:** The pilot and the air traffic controller need to know both the surface wind speed and direction. The change of wind velocity with height is also taken into account in the flight planning calculations.

For in-flight conditions, for a given weight, there is a critical speed at which the aircraft ceases to be supported in the air. This is the stalling speed (Vs) and is the air speed at which an aircraft takes off or touches down. If the take-off or landing is directed into the wind of say Y knots speed, the ground speed of take-off or landing is V_s - Y. This slower speed permits safer operation. The pilot and ATC use surface wind observations for the selection of runway. The pilot also uses the surface wind in planning the take-off weight.

If there is a strong headwind, take-off run is reduced, meaning aerodrome with short runways operations can be carried out with high value of W. On the other hand, if there is only a light headwind or calm, the aircraft may have to reduce weight (pay-load) in order to take off.

Knowledge of variations in wind speed is important in determining the stability of aircraft in take-off and landing phases.

Vertical wind shear: It is the change in horizontal wind velocity between one level and another. The pilot needs to know if there is a vertical wind shear in the descent to land and climb out areas. Some of the problems that may arise are:

- *When descending into decreasing wind speed the aircraft undershoots;*
- *When descending into increasing wind speed the aircraft overshoots.*
- *When climbing into increasing wind speeds the angle of climb increases; when climbing into decreasing wind speed, the angle of climb decreases.*

4.2 Cloud and Visibility

The pilot is required to see the ground throughout the final stage of an approach. There is a decision-making height from where the pilot should be able to see the runway. The visibility should be above a minimum value, which varies with aircraft type. Low clouds at destination may require the making of a diversion. Low clouds can cover the high grounds and can pause threat to the safety of aircraft. Clouds of vertical growth will have all adverse weather, like, turbulence, hail, lightning and icing. Reduction of in-cloud visibility can cause loss of situational awareness of a pilot if flown through.

4.3 Temperature

Upper air temperature:

For flight planning purposes, full details of horizontal and vertical temperature variations on the route will be required for the calculation of true airspeeds and corrections to indicated altitude as the instruments are calibrated at standard conditions. Also, the efficiency of engine depends on the temperature at the cruising altitude. Forecast air temperatures and heights of the tropopause are therefore important in deciding the optimum cruising altitude. The engine efficiency is greater with lower outside temperature. If the temperature is high, more fuel than the normal has to be used to maintain cruising power. The information is required during the planning stage of the flight when fuel load is being determined. The information on upper air temperature also tells the pilot the height of the O^{o} C isotherm above which icing can occur.

Surface temperature:

Engine efficiency is higher with lower temperatures. Lift is more with high pressure and lower temperature and hence runway length can be shorter for the given conditions for take-off.

4.4 Atmospheric pressure and density

Air pressure and temperature determine the air density and in turn determine the lift of the aircraft. Other factors being equal an aircraft must fly faster to maintain the height, when density of air is reduced. This faster speed induces a greater drag that has to be equaled by the engine thrust. The greater the thrust needed, the greater will be the fuel load required. This is the reason why high flying, high speed jet aircraft need so much fuel.

Another effect of reduced air density is to cause a decrease in engine power and in effect affects the climbing power of the aircraft. If the air density falls below a certain value, it may be necessary to reduce gross weight of the aircraft.

Considerable fluctuations of atmospheric pressure may occur near mountains, particularly in high winds. This will lead to erroneous readings of an aneroid altimeter. The pressure will be higher on the windward side of the mountain and lower on the leeward side. This effect is taken into account by the pilots while deciding the clearing altitude.

5. WEATHER HAZARDS

5.1. TURBULENCE AND WINDSHEAR

Introduction:

Wind shear can be defined as 'layers or columns of air, flowing with different velocities (i.e. speed and/or direction) to adjacent layers or columns'. Wind shear is a major hazard for aviation especially when operating at low levels. Depending on the flight direction relative to the velocity changes, shear may be felt as turbulence, but also as a sudden tail or head wind with respective consequences. It is seen that, besides convection, shear is the second major source for turbulence.

Light aircraft are prone to be buffeted, and are significantly affected even by light turbulence. Relatively few reports of turbulence are received from fast military jets which are designed to give a high degree of tolerance.

Categorisation:

The intensity of turbulence is categorized by the ICAO as follows:

- **Light**
  Effects are less than those of moderate intensity.

- **Moderate**
  There may be moderate changes in aircraft attitude and/or height but the aircraft remains in control at all times.

  Air speed variations are usually small.

  Changes in accelerometer readings of 0.5-1.0g at the aircraft's centre of gravity.

  Occupants, feel strain against seat belts. There is difficulty in walking. Loose objects move about.

- **Severe**
  Abrupt changes in aircraft attitude and/or height. The aircraft may be out of control for short periods.

  Air speed variations are usually large

  Changes in accelerometer greater than 1.0 g at the aircrafts, centre of gravity.

  Passengers are forced violently against seat belts. Loose objects are tossed about.

- **Extreme**
  Effects are more pronounced than for severe intensity.

Wind shear, of itself, is not categorized in the same way, although when it ultimately makes its presence felt, the above turbulence categorized may become applicable.

Types of Turbulence:

- Convective turbulence
- Mechanical, mostly low-level turbulence
- Orographically induced turbulence
- Clear air turbulence (CAT)
- Low level jets
- Wake turbulence/wake vortices

Engine lost due to turbulence from
http://climate.dot.gov/documents/workshop1002/kulesa.pdf

Convective Turbulence

a) Description

Convection is always associated with turbulence, which for that reason is referred to as convective turbulence. The origin and physical cause of turbulence are:

- The vertical currents within and around convective clouds are turbulent;
- Growing convective towers may generate gravity waves which propagate either radially away, for instance within the anvil or may also propagate vertically;
- Dry thermals (i.e. non-saturated ascending air);
- Downdraughts associated with precipitation or mid-level cold layers of air. These can produce line squalls near showers.

Thermal turbulence over land has a marked diurnal variation, with a maximum during the afternoon and a minimum overnight. Thunderstorms, in contrast, may last during the whole night and propagate over large distances of several hundred kilometers.

b) Effects on Aircraft

At its simplest, convective turbulence will result in 'bumpiness' in flight. As the intensity of turbulence increases, its effect will increase. Depending on aircraft type, severe turbulence may cause structural damage to an aircraft and injuries to passengers.

In association with large storms, strong downdraughts or micro-bursts can occur producing a violent outflow of air which spreads outward on hitting the ground. Those downdraughts usually are caused by cool air sinking in the surrounding rising warmer updraught air. Though downdraughts originate very often from deep in the cloud, the associated risk is highest below cloud base. The downdraught forces the air close to the ground to spread radially outwards. The aircraft first experiences a headwind, lifting the aircraft up, then a sudden downdraught, followed by a strong tailwind. Both latter winds lead to a substantial loss of height if not counterbalanced. Downdraughts, therefore, can result in fatal accidents, particularly for small aircraft. A micro-burst can cause the aircraft to lose altitude, due to physical downdraught and loss of airspeed due to rapid change in wind speed and direction.

Updraught strength varies from 1 m/s in fair weather cumuli, to 5 m/s in shower clouds up to 65 m/s in severe Cumulonimbus. Downdraughts vary in a similar way with a maximum observed value of -25 m/s in CB.

Dry thermals are felt as light to maximum moderate turbulence.

The gravity waves close or above convective towers may either lead to related upward and downward motions, or they may be felt as turbulence, especially if their wave-lengths is of the order of 100 m or less, or, more significantly if the gravity waves break and cause turbulence. Prior to breaking, waves overturn which may lead to significant and immediate height losses.

A micro-burst can cause the aircraft to lose altitude, due to physical downdraught and loss of airspeed due to rapid change in wind direction and strength.

Mechanical Turbulence

Mechanical turbulence results solely from shear. The latter is always found close to the surface where wind speed vanishes. Within the boundary layer and typically at night a low-level-jet may be found, which also might produce turbulence.

Furthermore, turbulence may also be found close to the edge of the jet-stream at tropopause heights.

a) ***Description***

Close to the ground mechanical turbulence is also often referred to as low-level turbulence. Surface friction is the primary cause of the vanishing wind at the surface. The intensity of mechanical turbulence depends upon (1) Wind strength, (2) Terrain roughness and (3) Atmospheric stability near the surface. In general, the stronger the wind and the rougher the terrain, the more intense the turbulence experienced. Light winds over a smooth sea give the least turbulence.

The steeper the lapse rate, the more readily vertical gusts develop and thus the more vigorous the turbulence is. In more stable air, vertical eddies are suppressed and turbulence is more damped – but very stable air and a sufficient displacement over large obstacles (hills/mountains) may lead to mountain or lee wave development. Details are given in Orographic Turbulence section of the notes.

b) ***Effects on Aircraft***

At its simplest, mechanical turbulence will result in 'bumpiness' in flight. The intensity of turbulence will increase in accordance with the above mentioned criteria and flight speed. For any given intensity of turbulence, the faster the aircraft flies, the more it will be accelerated. The closer it is to the ground, the less time there is available to react to those accelerations. Ultimately, depending on aircraft type, severe turbulence may cause structural damage to an aircraft.

Orographic Turbulence

a) ***Description***

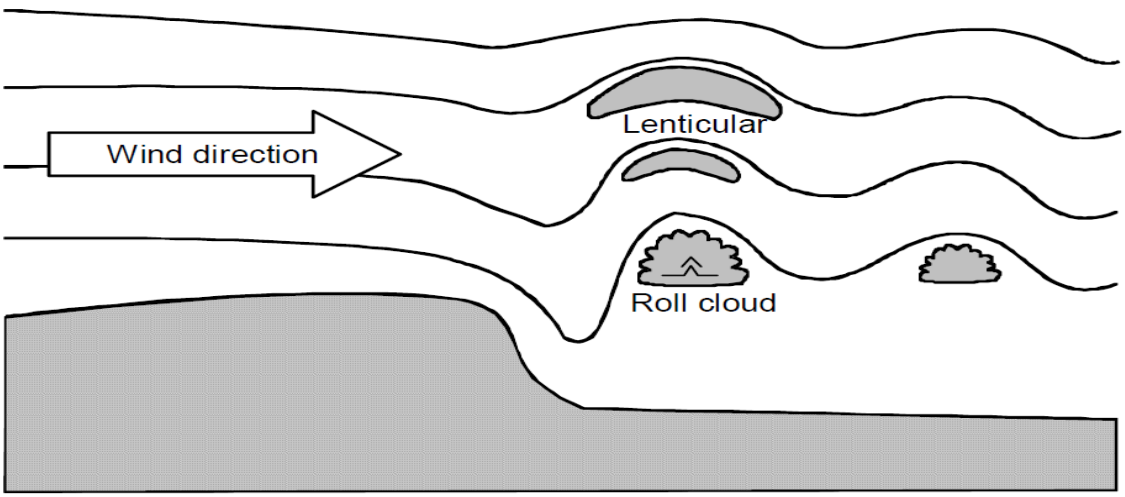
If surface roughness increases and characteristic roughness heights increase as well, eg over cities, forests, small hills and larger hills, and finally mountains, the airflow suffers large corresponding displacements from its original level. Depending upon the stability of the air mass, this may result in triggering convection and associated turbulence. It may also generate gravity waves, commonly known as mountain waves, or may tend to return the airflow to its original level giving 'standing waves' and rotors. Orographic structure might be complex and so is the associated flow pattern. The airflow may be funnelled along valleys creating marked deviations from what might be expected from the undisturbed flow. Because of the blocking of the flow by mountains or hills, increased turbulence close to the ridges also may be found.

Turbulence may be experienced in association with mountain wave motions, particularly if the vertical currents are strong and the wave length is short. Turbulence-prone areas are most likely to be near wave crests and troughs, while at

mid-levels, the flow may be quite smooth and laminar. Mountain waves may also break and can cause severe turbulence.

Rotors

Turbulent rotors in the lower troposphere are usually associated with high amplitude lee waves. Two types of rotors have been observed. The first type, often visible as harmless-looking cumulus or cumulus fractus lines paralleling the mountain rage, comprises a well-defined circulation under the crests of resonant mountain waves. This type of rotor contains moderate or severe turbulence and is often confined below the height of a frequently-observed upstream, near-mountain-top inversion. A second, less common, rotor type extends much higher than the upstream inversion. This type has been observed to contain severe or extreme turbulence, and is thought to be associated with a high-amplitude mountain-wave system resembling a hydraulic jump. Both rotor types present a hazard to aviation, although the second type of rotor is far more dangerous.



From WMO/ TD No. 1390 (June 2007) Aviation Hazards

c) Effects on Aircraft

Mountain waves can be both an advantage and a disadvantage to aviation; mostly however the latter is the case. Experienced glider pilots look for the updraught side of mountain waves in order to gain altitude.

The inherent dangers are:

1) The rapid change in height can mean that a pilot caught unawares may very quickly conflict with aircraft at different flight levels, and more importantly, if caught in a downdraught may rapidly erode any terrain clearance margins, and ultimately cause impact with the ground. Such

effects will be most pronounced if the aircraft track is parallel with the ridge.

2) The laminar and smooth flow will break down to give rotors in the crests of the first one or two lower level waves of the flow – turbulence should be expected to be severe in these regions, and may or may not be marked with 'roll cloud'.

3) If the wavelength is short, then an aircraft travelling swiftly through and perpendicular to the wave-train will experience a prolonged series of rapid fluctuations of vertical velocity. This will result in turbulent flight.

CLEAR AIR TURBULENCE (CAT)

a) Description

CAT is the term used to describe medium- or high-level turbulence produced in regions of marked wind shear. CAT often - though not necessarily- occurs in the absence of cloud, making it difficult to detect visually.

b) Effects on the Aircraft

The degree of turbulence is categorised as per the ICAO definitions. For civil aviation, passengers may be made uncomfortable, or suffer injuries when not wearing their seat belts. In recent years, fatalities have also occurred. In extreme cases, structural damage may occur.

CAT is often reported:

1. on the cold (pole-ward) side of a jet-stream, near and below the core where the wind shear is greatest;
2. on the warm (equator-ward) side of a jet-stream, above the core. The stronger the jet, the more likely that CAT will be present;
3. in developing upper ridges where the speed of the wind flow around the ridge approaches its limit due to curvature;
4. in sharp upper troughs where wind direction changes abruptly;
5. in regions of confluence and diffluence in jet-streams;
6. in cold areas where a narrow but marked line of CAT may occur;
7. If the core speed exceeds 100 kt and vertical wind shear 4kt/ 1000ft, moderate CAT within 150 nautical miles may be forecast;
8. CAT is rare above a well defined tropopause,
9. CAT may occur, or be intensified, over a region of convection, especially embedded frontal convection.

CAT occurs more often over land, especially over mountainous land, than over the sea. 60% of CAT reports are near jet-streams. The severity of CAT may be estimated if the horizontal and vertical wind shear values are known

Climatologically, CAT can be expected over North India in association with the sub-tropical westerly Jet in the winter season. Over Peninsular India, CAT in association with easterly jet can be anticipated during monsoon season.

LOW LEVEL JETS

a) Description

There are several forms of low level jets. The low-level jet seen over Indian region is the 'Somali Jet'. The Somali Jet is a feature of the northern hemisphere summer, and the development of the Asian Monsoon. When fully developed a SE'ly low level flow crosses the northern tip of Madagascar, before veering S'ly and then SW'ly across the Horn of Africa to become a SW'ly flow running parallel to the coasts of Yemen and Oman. The jet has important climatological effects, but with maximum winds of some 40 or 50 kt at the 850 hPa level, there is an aviation aspect to always consider.

b) Effects on Aircraft

The presence of low level jet implies that terrain clearance may be compromised, and difficulties during the landing phase may be encountered. Also the turbulence associated while crossing the boundary and the change of airflow across the wings may have adverse effect on the aircraft.

Wake Turbulence/ Wake Vortices

a) Description

Wake turbulence is a result of the vortices formed in the wake of aircraft. Vortices form on the top surface of each wing, and are left in the aircraft's wake. Helicopters also produce wake turbulence, with vortices generated from the main rotor blades.

Primarily, they are a function of the weight, size, and aerodynamic properties of the aircraft. However, once formed, they are known to sink with a speed of 1-2 m/s, and will be transported with the general wind flow.

b) Effects on Aircraft

As with all forms of turbulence, encounters at low level can prove fatal, with little room or time for recovery. Light aircraft which encounter the wake turbulence of heavy airliners may be violently tossed around.

The simplest precaution for pilots to take is to remain a safe distance behind the leading aircraft.

5. 2. ICING

Icing occurs if precipitation aggregates on the aircraft or at or within parts of it. The dominant impact mechanism is that super-cooled liquid water impinges on the aircraft and freezes instantaneously. Icing may occur in-flight or at the surface (ground icing). The icing may also be categorized as airframe icing and engine icing.

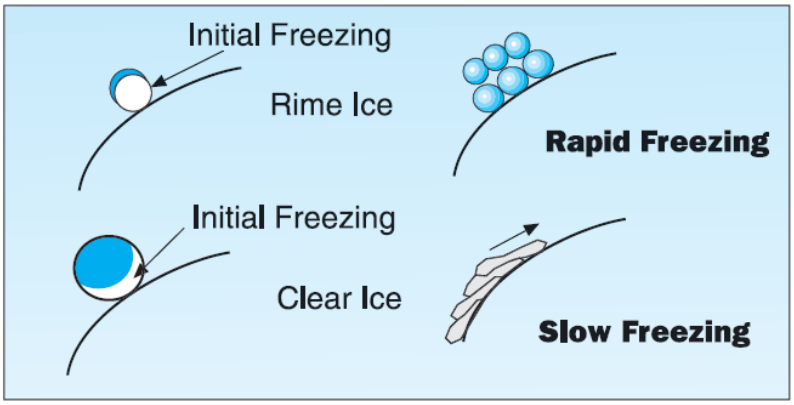
5.2.1 Airframe Icing

a) Description

Airframe icing normally occurs when the ambient air temperature is below 0ºC and super-cooled water droplets are present.

There are five types of airframe icing:

- Rime Ice – white, porous, opaque, brittle and rough, hence disruptive to airflow. This occurs at low temperatures (<10ºC) and/or low liquid water contents as under those circumstances the released heat during the freezing process can be transported immediately to the environment.
- Clear Ice (glaze ice) – clear, tough, adhesive, dense and heavy, smooth hence little effect on airflow. It occurs usually at warm temperatures >10ºC and/or high liquid water contents, as then, during the freezing process, an ice-water mixture is formed which remains semi-liquid for about several seconds. Due to the relatively warm temperatures the released heat needs a longer time to be carried away by the ambient air flow. Super-cooled large drops or drizzle drops- with diameters ranging between 50 and 500 µm- may flow after impingement behind the protected zones on the wing and then freeze there (freezing drizzle).
- Mixed Ice – impingement of super-cooled water and ice. If super-cooled rain drops with diameter larger 500 µm hit the aircraft, extreme accretion of ice may occur (freezing rain).
- Hoar frost – thin 'coating' occurring in the absence of rain or cloud usually when aircraft is parked outside on cold winter nights. It has to be removed prior to take-off.
- Rain and snow mixed (sleet) is similar to freezing rain and can also lead to 'pack snow' that can block air intakes and other aircraft openings.



(http://www.navcanada.ca/ContentDefinitionFiles/publications/lak/CanadianPrairies/2-P32E.PDF)

b) Effects on Aircraft

Small super-cooled cloud droplets freeze rapidly on contact with the aircraft, trapping in the ice to give a deposit of white rime on forward-facing surfaces. Larger droplets take longer to freeze, spreading out across the airframe before solidifying.

The intensity of icing is defined as follows:

Light — Accumulation rate may create a problem if flight in this environment exceeds 1 hour.

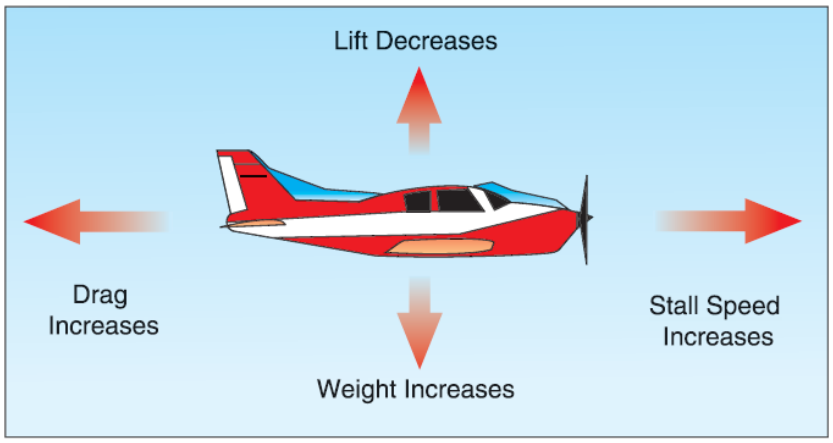
Moderate — Rate of accumulation is such that even short encounters are potentially hazardous. Anti-icing equipment must be used.

Severe — Rate of accumulation is such that use of anti-icing equipment fails to reduce or control the hazard. Immediate diversion from the region is necessary

Apart from meteorological factors, the rate of ice build-up on the airframe also depends on the characteristics of the aircraft. Fast aircraft with thin wing cross-sections are more susceptible to deteriorating aerodynamics, and hence are more susceptible to ice accretion.

Helicopters are particularly vulnerable to icing, since build-up of ice on the rotors can lead to imbalance, de-stabilizing the aircraft.

Airframe icing is a serious aviation hazard. The possible range of effects on an aircraft listed below:



(http://www.navcanada.ca/ContentDefinitionFiles/publications/lak/CanadianPrairies/2-P32E.PDF)

- Reduction in the aerodynamic properties
- Change in flight performance
- Increase in weight and uneven loading
- Engine intakes become blocked
- Undercarriage retraction/ extension problems
- Control surfaces jam or become stiff
- Pilot tubes become blocked
- Communications affected
- Vision impaired

Engine or piston icing occurs under conditions of high relative humidity close to freezing when the under-pressure in a piston causes the humidity to condensate and freeze within the engine. A fundamental requirement of airframe icing is the presence of sub-zero cloud droplets.

It may be noted that prolonged flight within a super-cooled, layered cloud can give rise to a greater degree of icing than suggested here. Also stratocumulus (SC) can sometimes give unexpected severe icing, particularly when it lies in a sub-zero layer just below an inversion over the sea. A special risk exists in embedded convection, and especially near the overshooting tops.

The time actually spent flying in an icing environment is also an important consideration. Icing layers in clouds are usually only 2000-3000 ft. thick and rarely greater than 5000 ft. Cumulus-type clouds can usually be flown around whilst icing in layer clouds can usually be dealt with by altering height, either upwards or, if terrain permits, downwards.

5.2.2 Carburetor and Engine Icing

Some aircraft are prone to icing in the carburetor and air intakes. This is caused by a reduction in pressure leading to adiabatic cooling as the air expands.

Carburetor icing is by far the most common form of ice-related problem affecting piston-engined aircraft. When humid air enters the venture in the carburetor, ice crystals are deposited. This constricts the venture and causes progressive power reduction. Carburettor icing frequently occurs when the ambient air temperature is above 0º C, the dominant factor being the moisture content of the air. The more humid the air, the higher the risk; hence engine icing is more likely on a warm, humid, cloud summer day, than on a cold, dry, clear winters day.

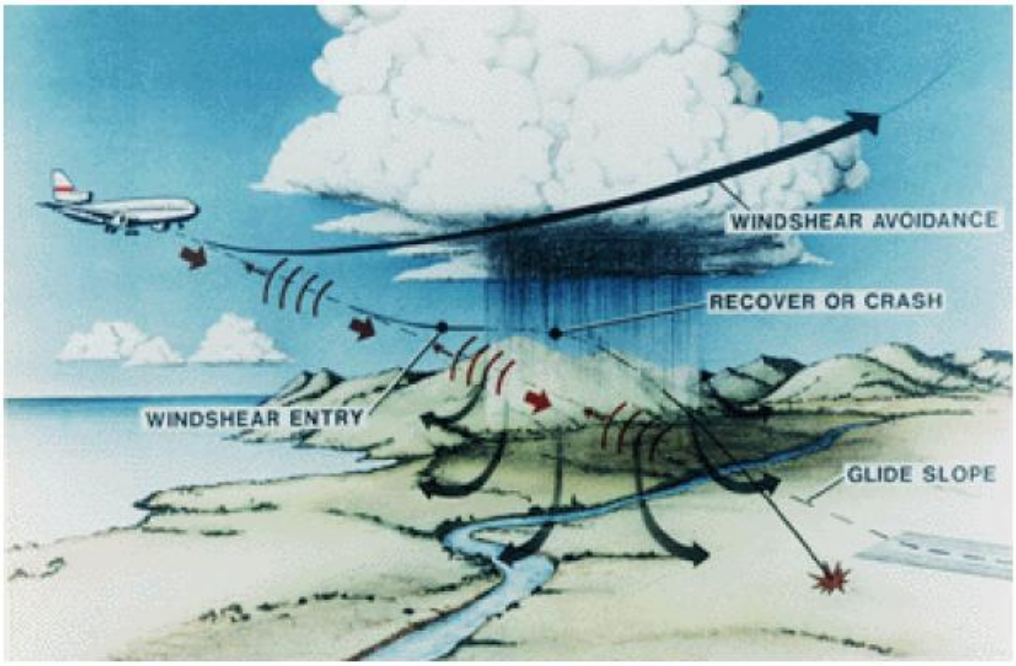
An additional problem for the engine is the build-up of ice on the rims and struts of intakes. In extreme cases large pieces of ice can break off and cause damage to the engine.

Engine icing is most common when the air temperature is a few degrees above 0ºC and the relative humidity is greater than 60%. Pilots, therefore, use forecasted temperature data and an estimate of humidity to assess the engine icing risk. Typical high humidity scenarios are mist after heavy rain and the air just below stratiform cloud.

5.3 CUMULONIMBUS AND THUNDERSTORMS

Cumulonimbus (CB) clouds are a severe hazard to aviation, due to the likelihood of: a) severe turbulence, b) severe icing, c) micro-bursts, generating squalls or gust fronts giving severe low-level turbulence; d) lightning, e) high liquid water content, and f) hail.

Whilst individual Cumulonimbus clouds may have a lifetime of 1½ hours, the most intense Cumulonimbus development and thunderstorm/ lightning activity is associated with Multi Cell Convective systems which may develop further into Supercells. Such systems are long lived due to the spawning of daughter cells and may last for many hours.



Windshear and windshear avoidance (from http://www.nasa.gov/centers/langley/news/factsheets/Windshear.html)

Hazards associated with thunderstorms:

For discussion on turbulence, icing, and microburst, the relevant sections of the note may be referred to.

5.3.1 Thunderstorms and Lightning

a) Description

Lightning can occur in and near Cumulonimbus clouds including the anvil layers and the sub-anvil atmosphere. The Meteorological glossary describes lightning as an electrical discharge of some 20 coulombs and a potential difference of some 108 or 109 volts. Electrical discharges may occur within the cloud, referred to as intra-cloud lightning, and between cloud and ground, referred to as cloud-to-ground-lightning. Generally, intra-cloud lightning is weaker than cloud-to-ground-lightning, but still may reach the same strength.

Thunder is the audible manifestation of the electrical discharge, caused by the violent heating and expansion of the atmosphere surrounding the path of the lightning strike.

b) Effects on aircraft

The effects of lighting on an aircraft (and its crew and passengers) are many. If lightning strikes a previously sound, metal bonded structure, the aircraft will remain structurally sound, and the passengers and crew will not be directly affected by the strike's voltage and current, due to the Faraday Cage effect. However, entrance and exit burn marks will be evident on the skin of the aircraft. If the discharge is adjacent to or through structures such as aerials, then these structures may be destroyed. The effect of a lightning strike on both passengers and crew will induce shock, and possibly fear. At night a lightning strike may cause the crew to suffer temporary blindness, or degraded vision.

Lighting strikes on modern composite materials will cause de-lamination of the material. If such strikes are upon structurally important areas of the aircraft, its integrity may be compromised. For this reason, lightning strikes on composite helicopter blades are particularly hazardous.

Following a lightning strike, electrical/ electronic systems may fail, with circuit breakers tripping. Magnetic compasses will become untrustworthy. Radio communications and navigation equipment may be adversely affected.

5.3.2 Heavy rain

a) Description

There is no agreed international definition regarding rainfall intensity. Some use the following criteria:

Heavy rain is defined as rates in excess of 4 mm per hour.

Heavy showers are defined as rates in excess of 10 mm per hour.

Terms such as 'very heavy' have no official definition, but they, and terms like them, are used below to describe rainfall rates that are much greater than normally expected, and would be associated with thunderstorm activity. For aviation purposes rain rates are essentially a measure of rain water content.

b) Effects on Aircraft

Heavy or very heavy rates of rainfall will clearly have a detrimental impact upon general visibility. However, in addition to any true meteorological reduction of visibility, raindrops impacting the windscreen/ canopy will additionally reduce visibility.

Light, non-pressurised aircraft may find the heaviest rain rates allow water ingestion into the cabin/ cockpit/ engine compartments with subsequent risks to electronic equipment. Civil airliner engines are tested and certified to ensure that engines will normally not 'flame out' under conditions of intense rainfall and water ingestion.

Runway flooding or areas of deep standing water will affect braking action, and may result in asymmetric braking and possible sliding off runways. Low cloud (stratus pannus) may form in periods of moderate or heavy rain, when it had not previously been expected.

5.3.3 Hail

Military plane after exposure to hail

(from WMO/ TD No. 1390 (June 2007) Aviation Hazards)

a) Description

Small hail (METAR code GS) is hail or graupel of less than 5 mm in diameter. True hail (METAR code GR) is hail of 5 mm or more in diameter. GS and GR may fall from Cumulonimbus. GS (not GR) may fall from Cumulus congestus (TCU). The phenomena should not be confused with Ice Pellets (METAR code PE) that originates from stratiform cloud.

Hail is formed in the updraughts of convective (TCU or CB) cloud. The stronger the updraught and the greater the cloud vertical extent, the larger the hailstone that can be sustained.

b) Effects on Aircraft

Hail of small size will have little effect on the structure of an aircraft, merely bouncing off the airframe. However, even small hailstones have a marked detrimental effect upon visibility. The onset can be rapid, surprising the pilot. Hailstones can attain sufficient size to cause damage to the skin of aircraft, which may affect the aircraft's aerodynamics, and possibly shatter windscreens. Hail may severely damage propellor blades and engine blades. Hail may block air inlets or may be deposited somewhere within air intakes. Sudden hail showers may leave an

extremely slippery surface on runways and taxiways. So, even if the shower has passed and the visibility and cloud may be described as fit for attempting a landing, breaking action may be adversely affected.

5.4. HEAVY RAIN

For details of heavy rain, kindly refer to the discussion on heavy rain within the Cumulonimbus and Thunderstorm section.

Note that heavy rain may occur without the presence of a Cumulonimbus cloud. On such occasions, the cause will be due to thick, deep layers of cloud, as in the case of frontal or monsoon clouds, perhaps enhanced by orographic forcing. Nimbostratus ought to be reported (and indeed forecast) if such rainfall is expected to fall from non-convective clouds.

(From http://www.yantai-life.com/images/yantai_airport_flood2.gif&imgrefurl =http://biotek.tumblr.com/post/330240343)

5.5. SNOW

a. Description

Snow is solid precipitation in the form of individual, usually branched, ice crystals, or an agglomeration of those ice crystals. The precise nature will depend upon the temperature and conditions in which they develop. At temperatures warmer than about -5º C the crystals tend to agglomerate.

(from http://timesofindia.indiatimes.com/photo/7136257.cms&imgrefurl= http://articles.timesofindia.indiatimes.com/2010-12-21/india)

b. Effects on Aircraft

Even slight rates of snowfall have a serious detrimental effect upon visibility. Non-melting snow flakes at sub-zero temperatures will be largely deflected in the air stream and may not adversely affect the majority of the airframe. However, where snow is deflected into engine nacelles or into cavities such as open wheel wells, the snow may collect and 'pack' to create obstructions. Such obstructions may restrict airflow into engines, or prevent retraction of landing gear.

On the ground, whilst stationary or taxiing, snowfall may accumulate on the airframe, disturbing the aerodynamics and adding to the all up weight of the aircraft. Windscreens may become obscured with snow, with windscreen wipers becoming ineffective. Pitot tubes may become blocked, with resultant errors in airspeed and altitude indication.

Wet (melting) snow may not get so easily be deflected by airflow, and may get readily 'pack' against blunt surfaces of the airframe. As noted above, when snow packs into and against engine nacelles, wheel wells, or engine intake grilles, significant consequences may result.

Runway contamination by snow will significantly degrade braking action. Snow accumulations will also obscure runway lights and possibly make it difficult to discern the runway from the adjacent grass areas, especially given that visibility will be anyway degraded.

Snow must be removed completely from an aircraft prior to take-off by appropriate means, usually through the application of a de-icing fluid. It is a fatal error to assume that snow on the aircraft, respectively on the wing, will be removed by aerodynamic forces during start and take-off.

Indian airfields generally do not get affected by snowfall.

5.6 FOG

a) Description

Fog is the suspension of microscopic droplets of water, or in the case of ice fog, particles of ice. For aviation purposes, it is a condition that the horizontal visibility due to such phenomena is reduced to less than 1000 m.

Fog may cover a large, continuous area or it may form in patches possibly only covering small parts of an airfield. If the fog layer is less than 2 meters deep overland it is termed shallow fog.

(from http://www.livemint.com/rf/Image-621x414/LiveMint/Period1/2013/02/02/Photos/)WeatherAirport

b) Effects on Aircraft

Fog seriously degrades visibility, to such a degree that landing may be impossible. Only the most expensive of aircraft (Civil Airliners/ military aircraft) may be able to 'auto land' under such circumstances, and then only at suitably equipped airports. Even allowing for the technical ability, airline and military procedures may prohibit 'auto landings' under certain conditions.

Ice fog has similar visibility restrictions, but in addition untreated taxiways and runways may be coated with a thin layer of ice.

Pilots may be given a false sense of security when over-flying an airfield, since structures and runways may be quite clear to the pilot when looking down from directly above the airfield. However, when descending onto the approach, and trying to view the airfield at a slant angle through the fog, the pilot may very quickly lose all visual cues and find themselves in very serious difficulty.

5.7 LOW CLOUD/POOR VISIBILITY

a. Description

Low cloud and poor visibility may be overlooked as being potentially hazardous. They are also quite difficult to define since they will depend upon aircraft type, pilot skill and experience, the precise role the aircraft is performing, and the navigation aids available en route or at the departure/ destination/ alternate airfields.

Whilst the precise values may differ under the many varied possibilities, perhaps low cloud and poor visibility might best be described as having values that fall below the operating minima of either or both that of the aircraft and pilot.

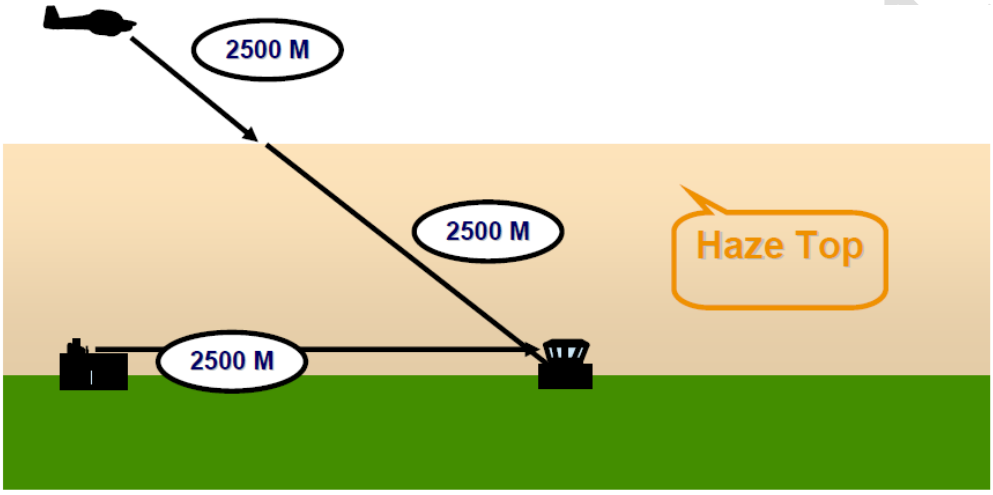
Small amounts of low cloud (1 or 2 oktas say) may not generally be hazardous. As cloud amounts increase, then the risk to aircraft also increases.

Poor visibility may likewise only affect small areas (in the form of showers, or in fog patches), and may be caused for many reasons (rain, mist, haze, smoke etc).

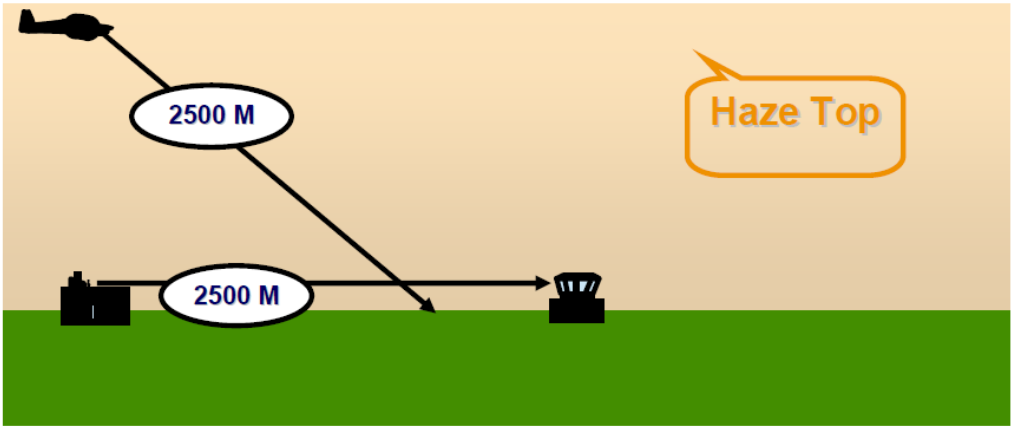
Under such circumstances a pilot may be able to 'navigate around' the problems. Conversely, reductions to visibility can and often do affect very large areas and as such dealing with the problem can be much more difficult.

b Effects on Aircraft

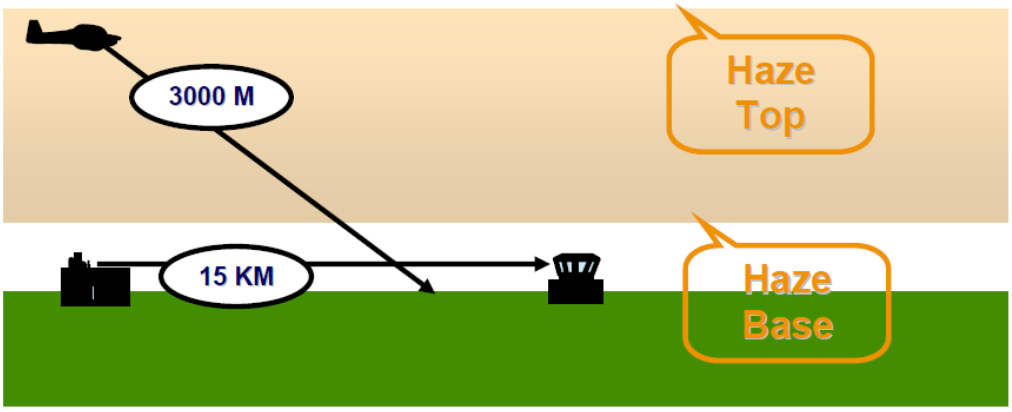
When cloud base and/or visibility fall below acceptable values, the pilot is in a situation where there will not be sufficient time to take avoiding action should an obstacle be sighted. That obstacle may be natural (hill, or simply the ground), a structure (building/tower), or another aircraft.



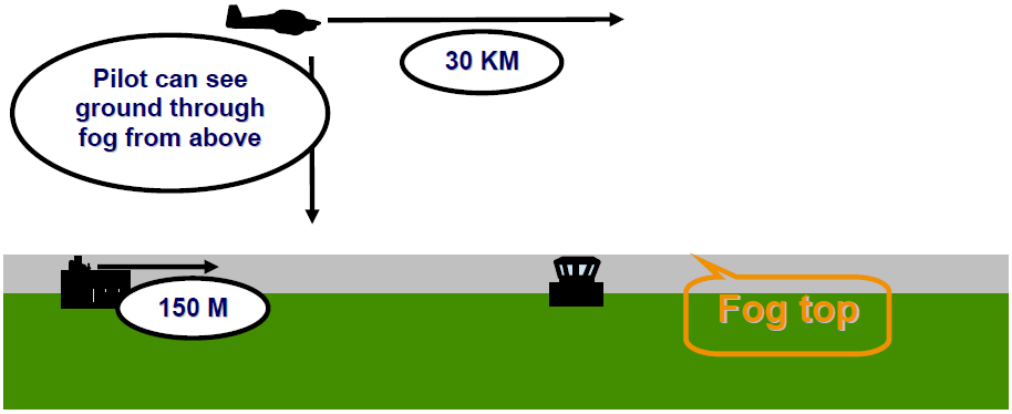
Example of pilot above a haze layer, experiencing a greater visibility than reported by the observer



Example of a pilot within a haze layer, perceiving a lower visibility than reported, due to the slant visibility



Example of a pilot in an elevated layer of haze, experiencing very much lower visibility than (correctly) reported



Example of a pilot overflying a layer of fog. The pilot may see the ground and building from above, possibly quite clearly. However, on approach to land and on descent into the fog the pilot will experience a rapid reduction of visibility into fog limits.

(from WMO/ TD No. 1390 (June 2007) Aviation Hazards)

5.8. SANDSTORMS AND DUSTSTORMS

(From http://timesofindia.indiatimes.com/photo/8537506.cms&imgrefurl= http://articles.timesofindia.indiatimes.com/2011-05-23/india)

a. Description

Duststorms and sandstorms are regions of raised dust and sand. The dust and sand are essentially raised by the wind, and are lofted to various heights dependent upon turbulence and instability and persistency of the flow that lifted the particles.

The size of dust and sand particles ranges from slightly sub-micron to several hundreds of micron. Clearly, smaller and lighter particles will be lifted more readily and to greater heights, and take longer to settle out, while the larger particles may remain airborne only for short distances of a few hundred meters.

b. Effects on Aircraft

Drastic reductions in visibility are likely to accompany dust and sand storms. Effective visibility may very likely be close to zero in some circumstances. Dust and sand ingestion into aircraft engines may cause reductions in power till complete engine failure.

5.9. SQUALLS/ LINE SQUALLS

a. Description

A squall is simply defined as a sudden, temporary increase of the wind. It is specified as an increase in the mean wind by at least 16 kt, to a minimum value of 22 kt, and sustained for a period of 1 minute, then dying away comparatively suddenly. Squalls may be associated with the gust front/ microburst from an individual Cumulonimbus cell. They may occur in a more organised fashion, when they are known as a ‘line squall’. For details section on turbulence may be referred to.

5.10. VOLCANIC ASH:

(from http://volcanoes.usgs.gov/ash/trans/index.php#aircraft)

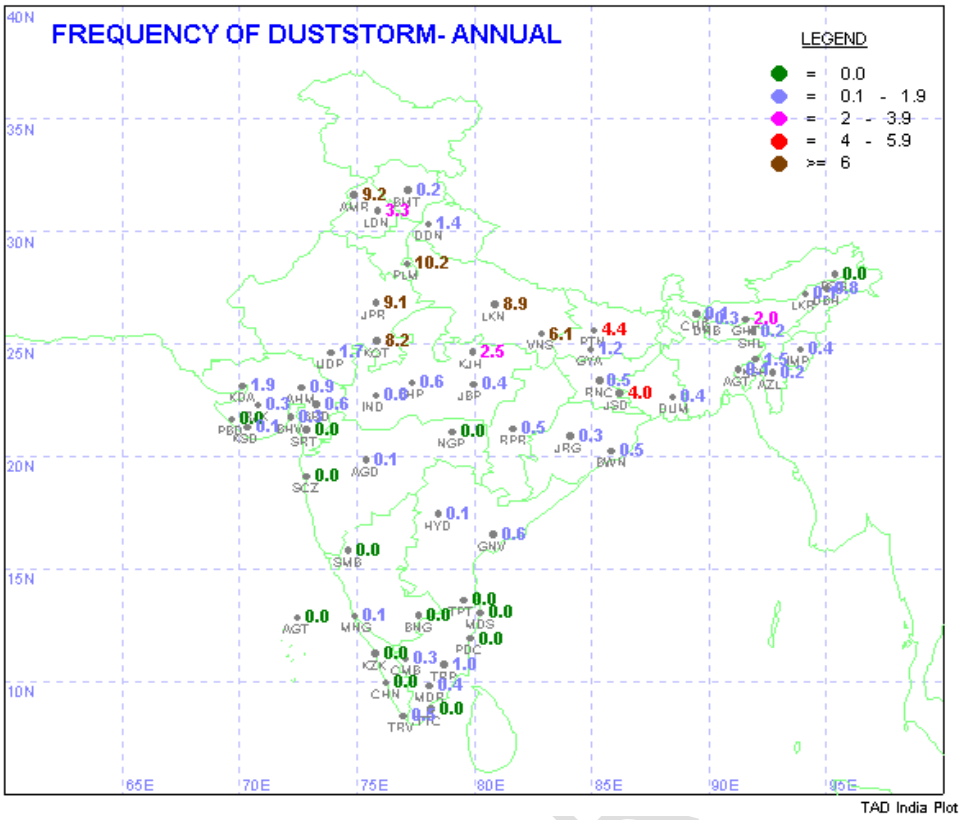
Volcanic ash is another major threat to aviation. Truly speaking this is not a meteorological phenomenon, however, issuance of relevant warnings have become part of the routine meteorological services. During volcanic eruptions, large amounts of pulvarised rock are blasted upwards. The height to which they reach is determined by the severity of the blast. At times the ash plumes will reach stratospheric levels. The ash is then spread downwind by the winds aloft in the troposphere and stratosphere.

The dust in the troposphere settles fairly rapidly and can limit visibility over a large area. The major concern about volcanic ash is that it get ingested by aircraft engines at flight level. Cases of engine failures in different types of aircraft have been reported.

The volcanic dust also contains considerable pumice material. Leading edges such as wings, struts, and turbine blades can all be abraded to the point where replacement becomes necessary. Windscreens have been abraded until they become opaque.

6. CLIMATOLGY (1961-1990) OF SOME OF THE AVIATION WEATHER HAZARDS OVER INDIAN REGION

Climatology of the most common aviation hazards over Indian airfields are presented here. Nearby synoptic station data was also used in preparing this climatology. The annual features and the months in which the frequencies of the hazards are considerable only are presented.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LEGEND
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= 0.1 - 1.9
= 2 - 3.9
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40N
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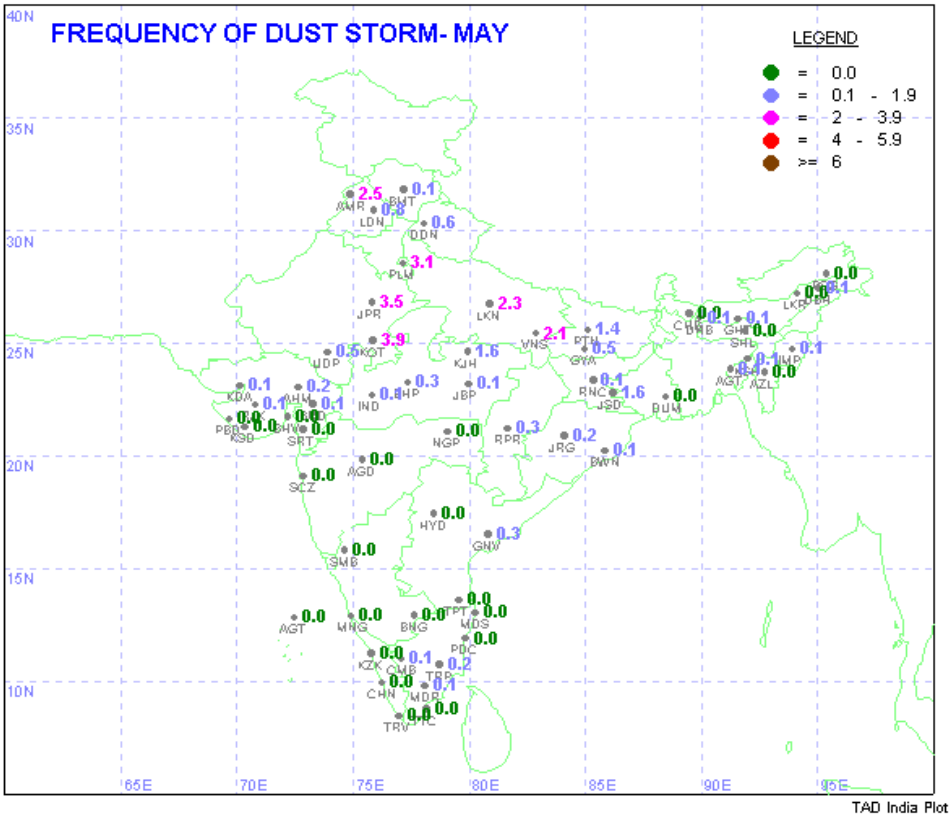
TAD India Plot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LEGEND
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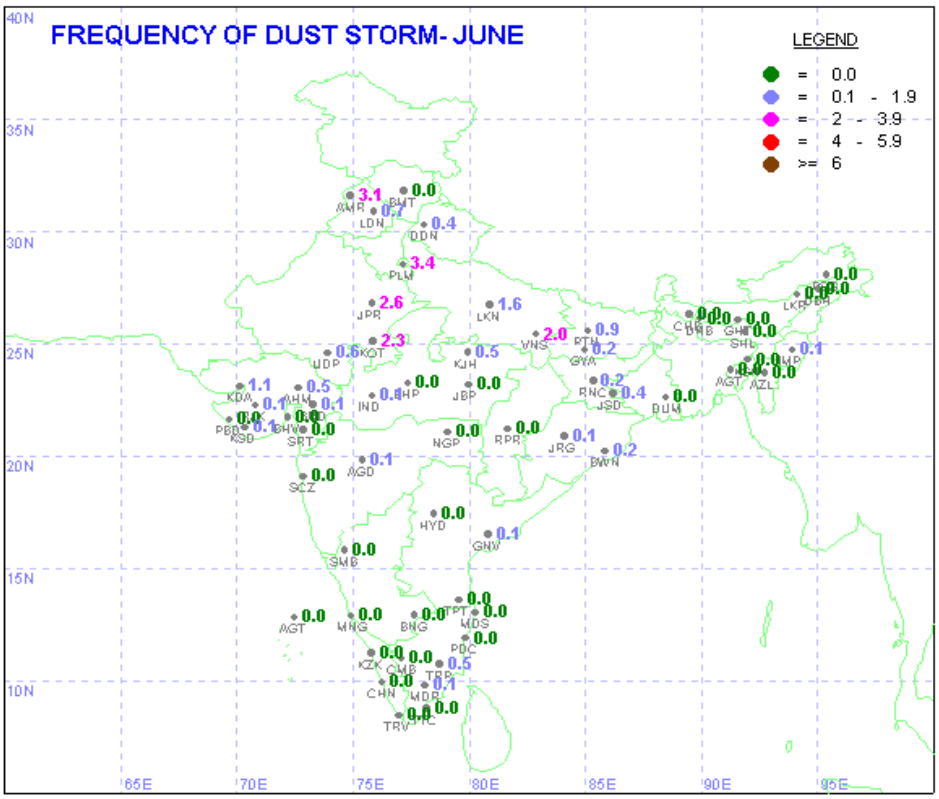
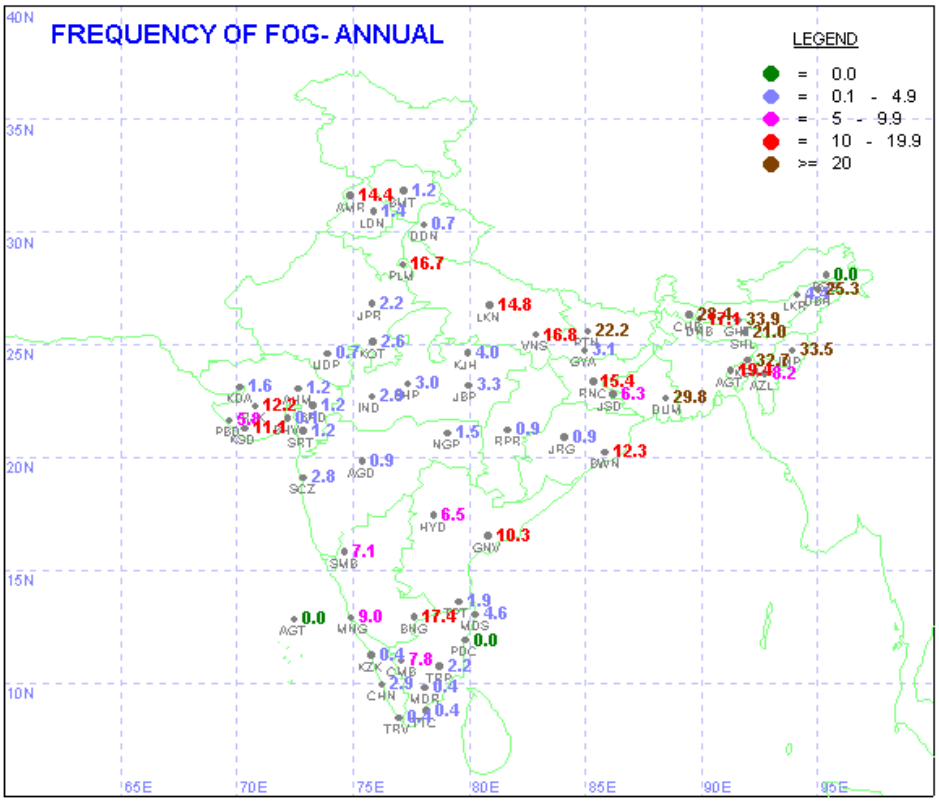
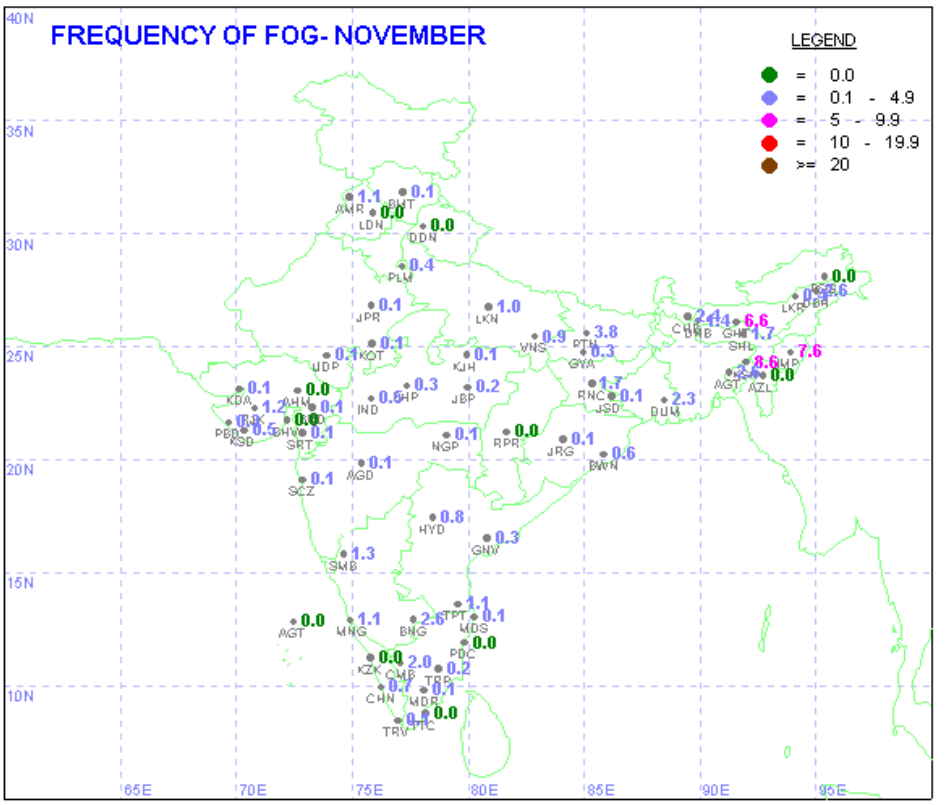
TAD India Plot



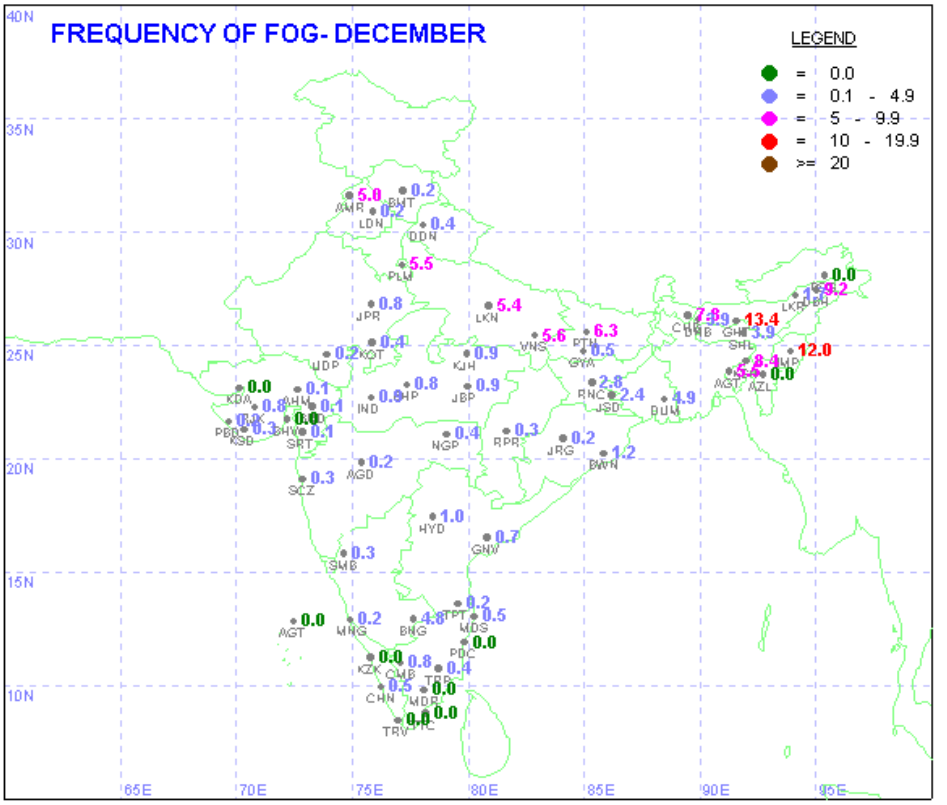
TAD India Plot



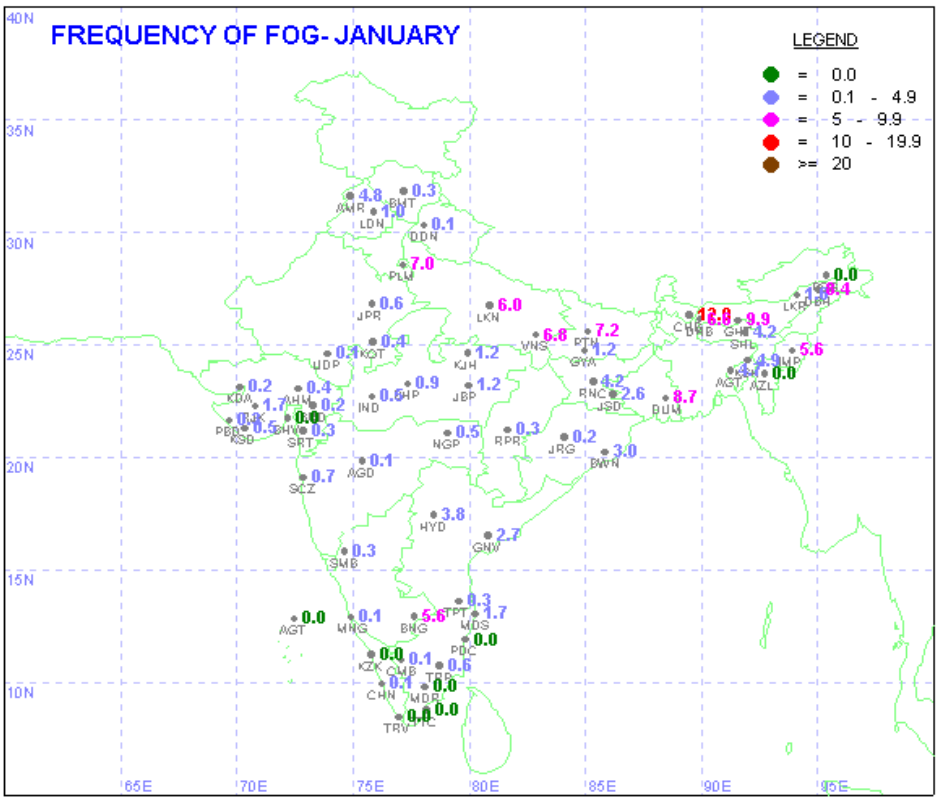
TAD India Plot



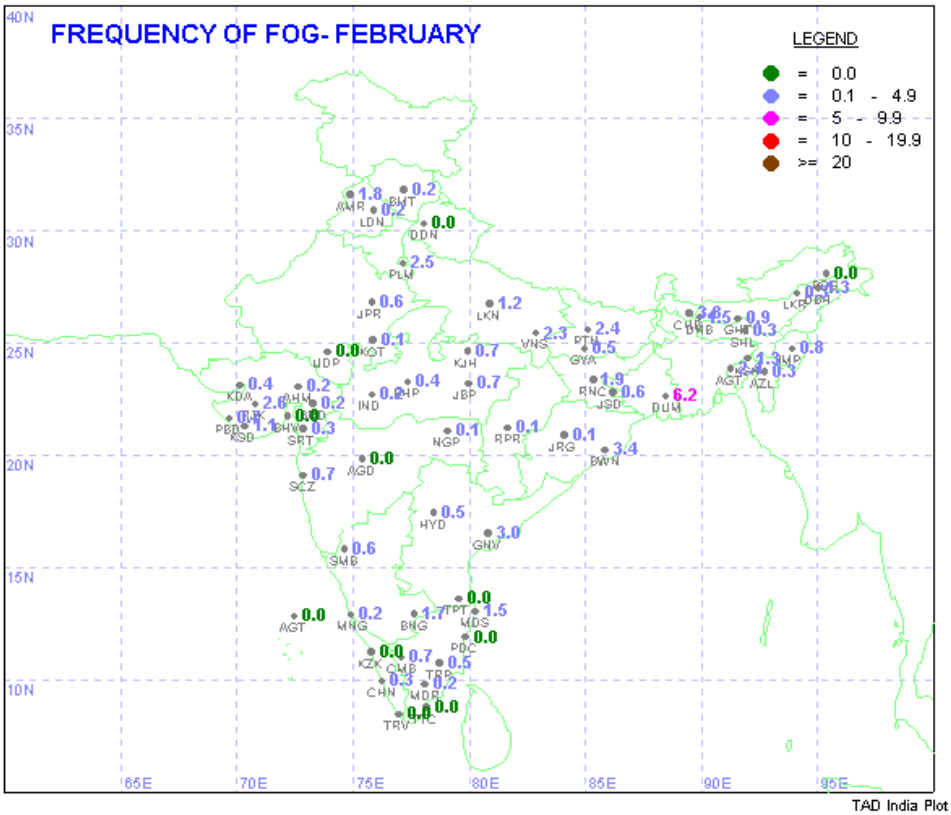
TAD India Plot



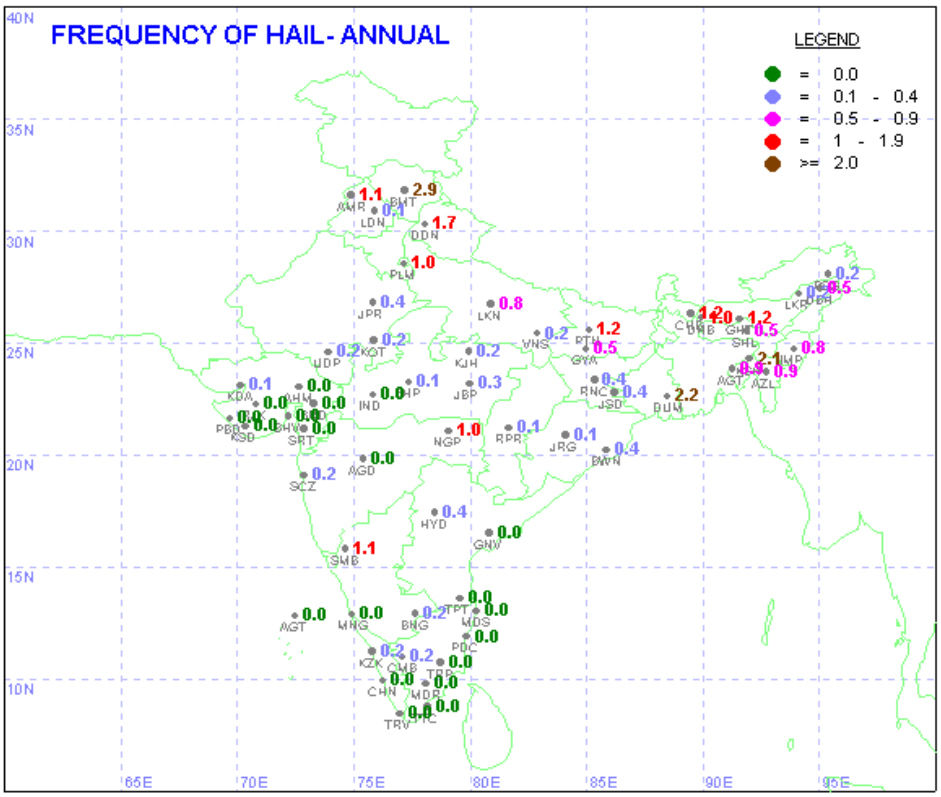
TAD India Plot

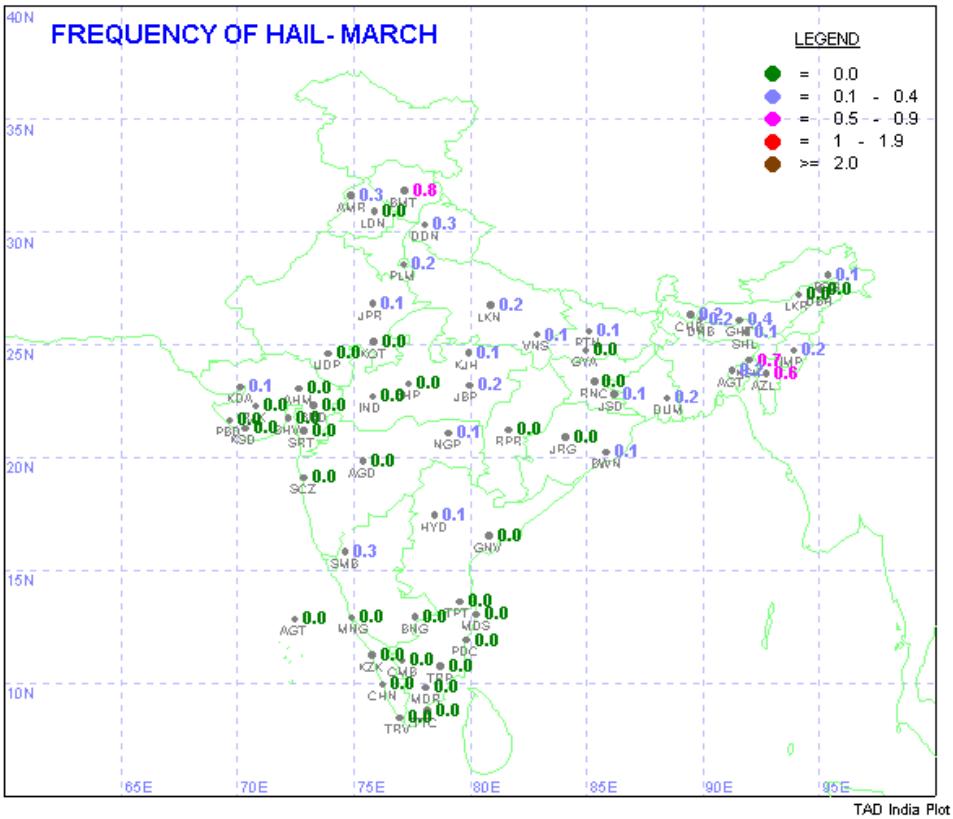


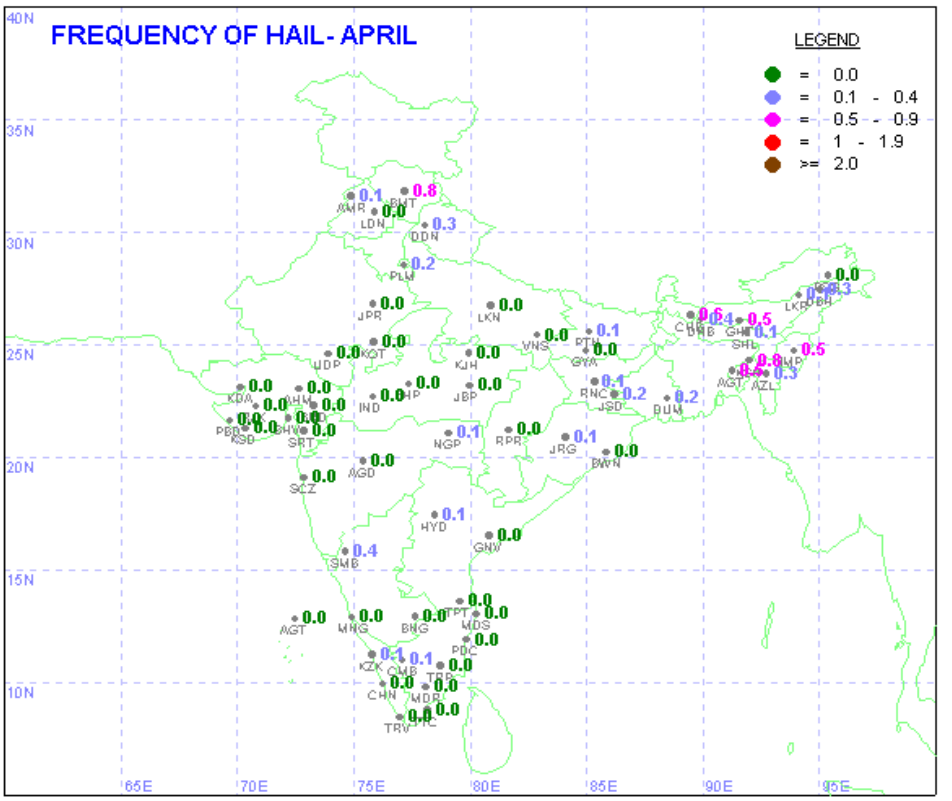
TAD India Plot



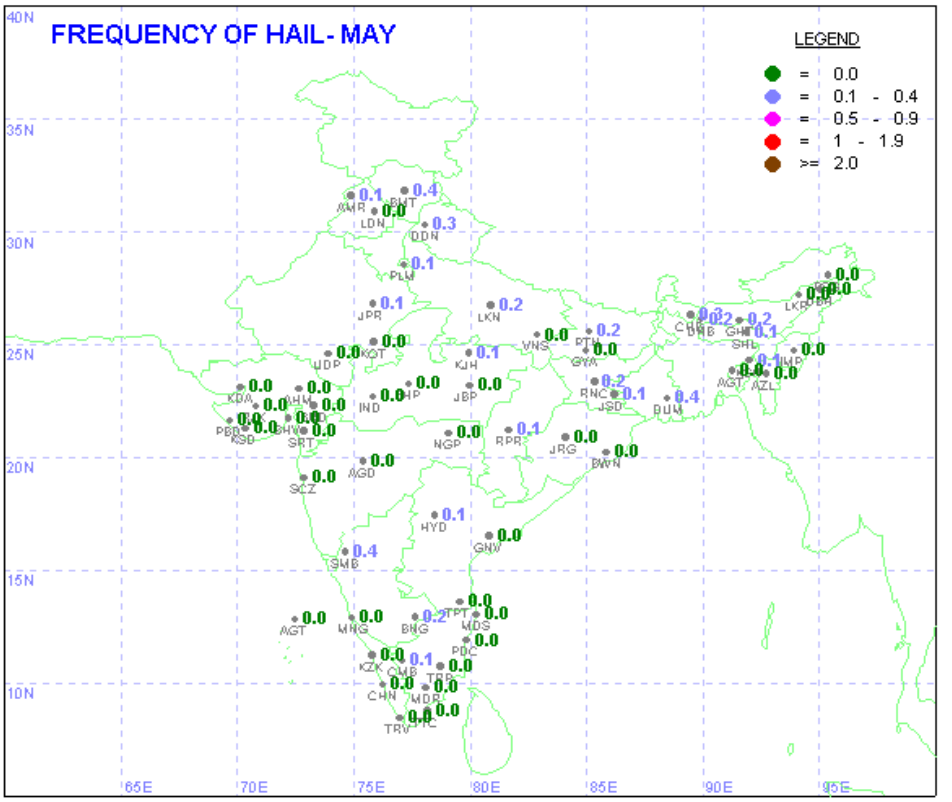
TAD India Plot


FREQUENCY OF HAIL- ANNUAL
LEGEND
= 0.0
= 0.1 - 0.4
= 0.5 - 0.9
= 1 - 1.9
>= 2.0
40N
35N
30N
25N
20N
15N
10N
65E
70E
75E
80E
85E
90E
95E
TAD India Plot

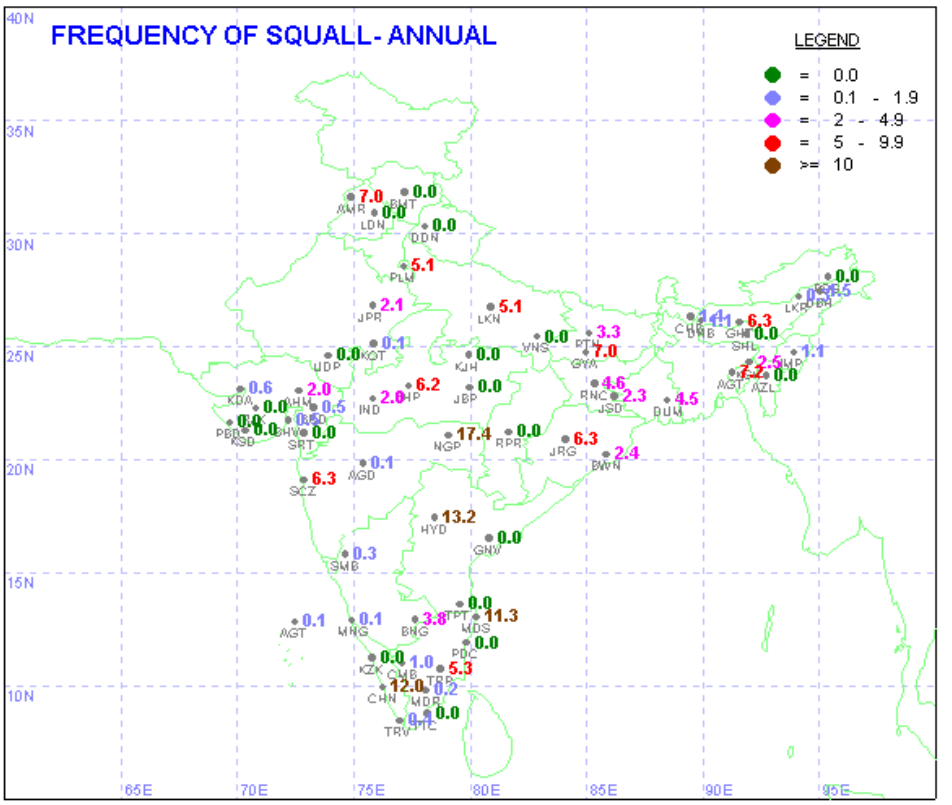

FREQUENCY OF HAIL- MARCH
LEGEND
= 0.0
= 0.1 - 0.4
= 0.5 - 0.9
= 1 - 1.9
>= 2.0
40N
35N
30N
25N
20N
15N
10N
65E
70E
75E
80E
85E
90E
95E
TAD India Plot



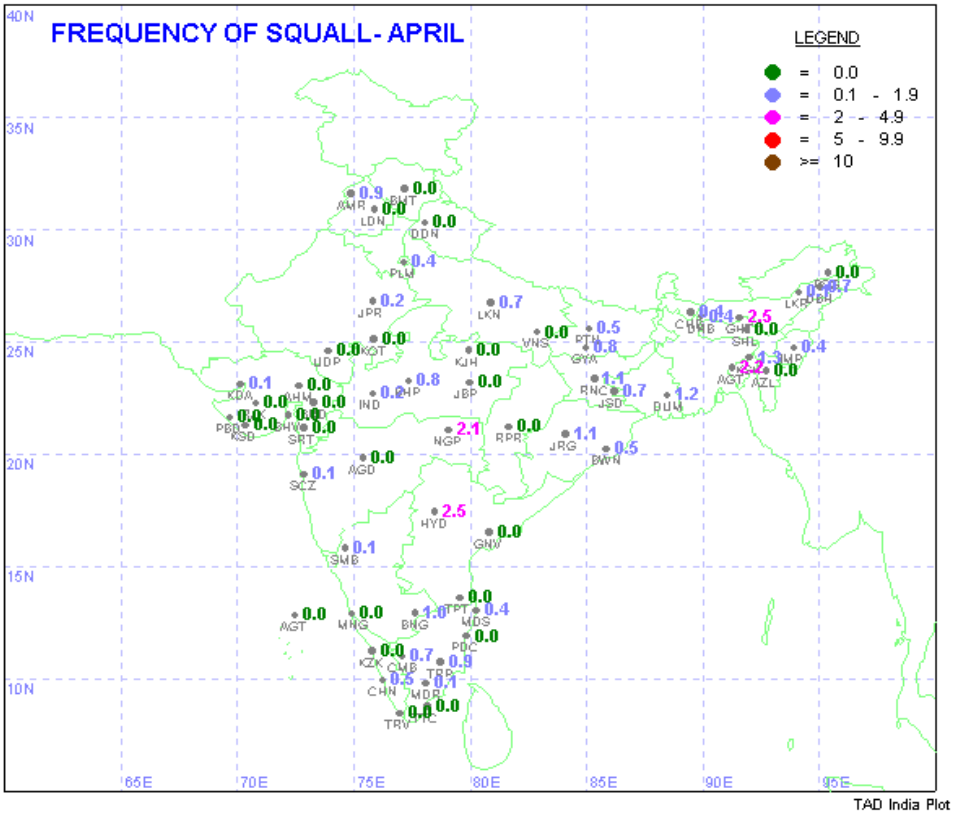
TAD India Plot



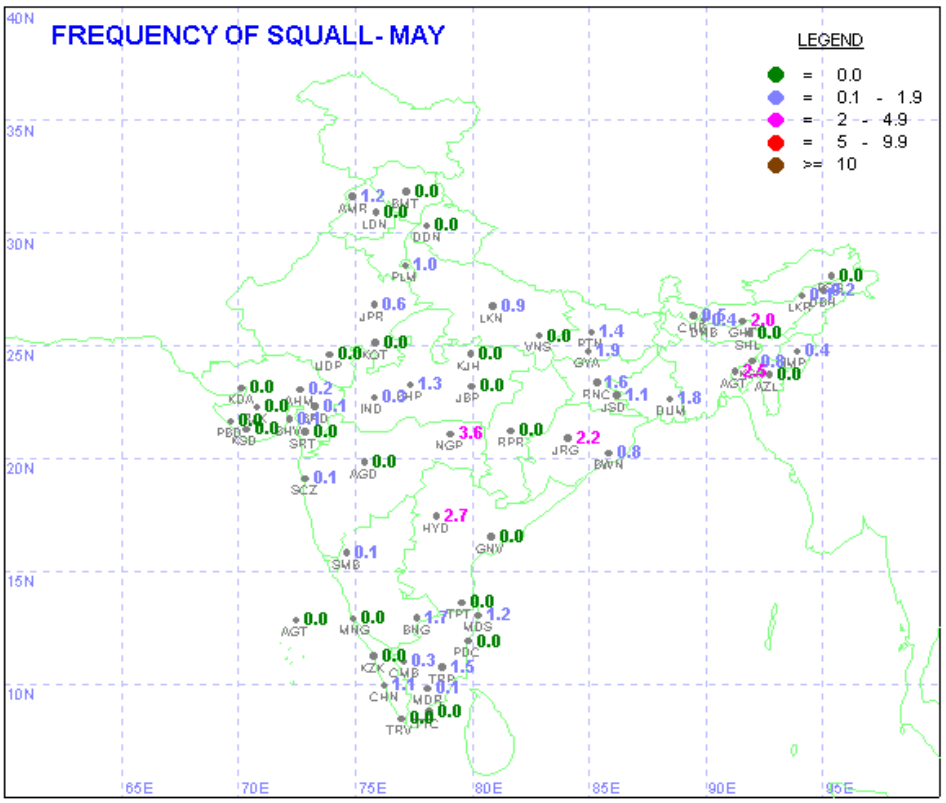
TAD India Plot



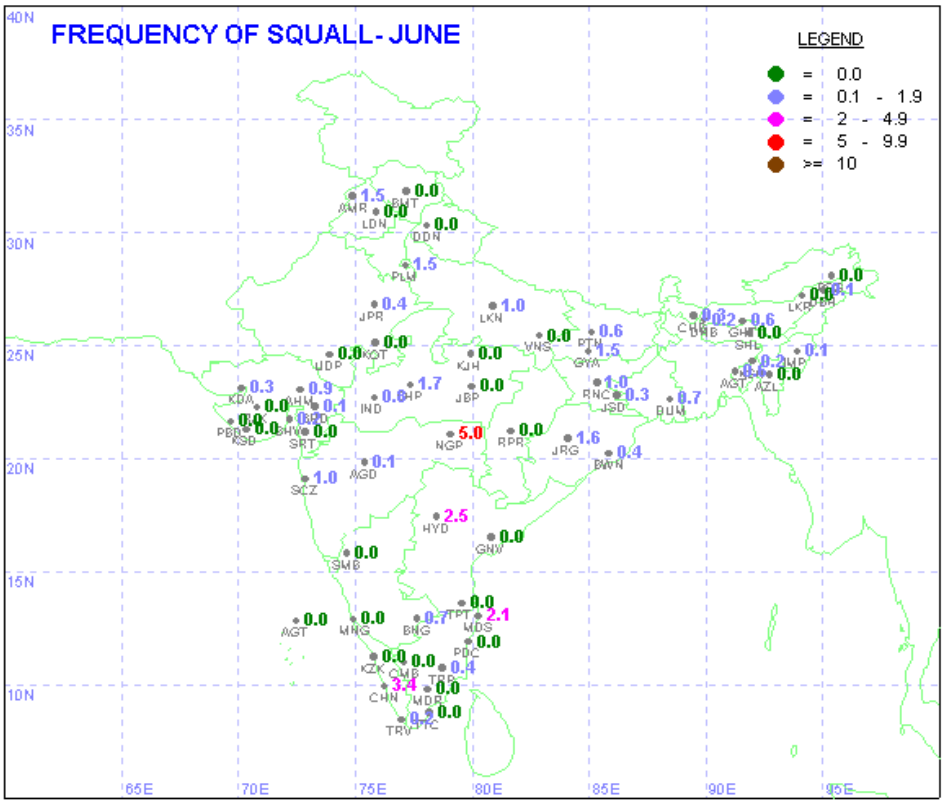
TAD India Plot



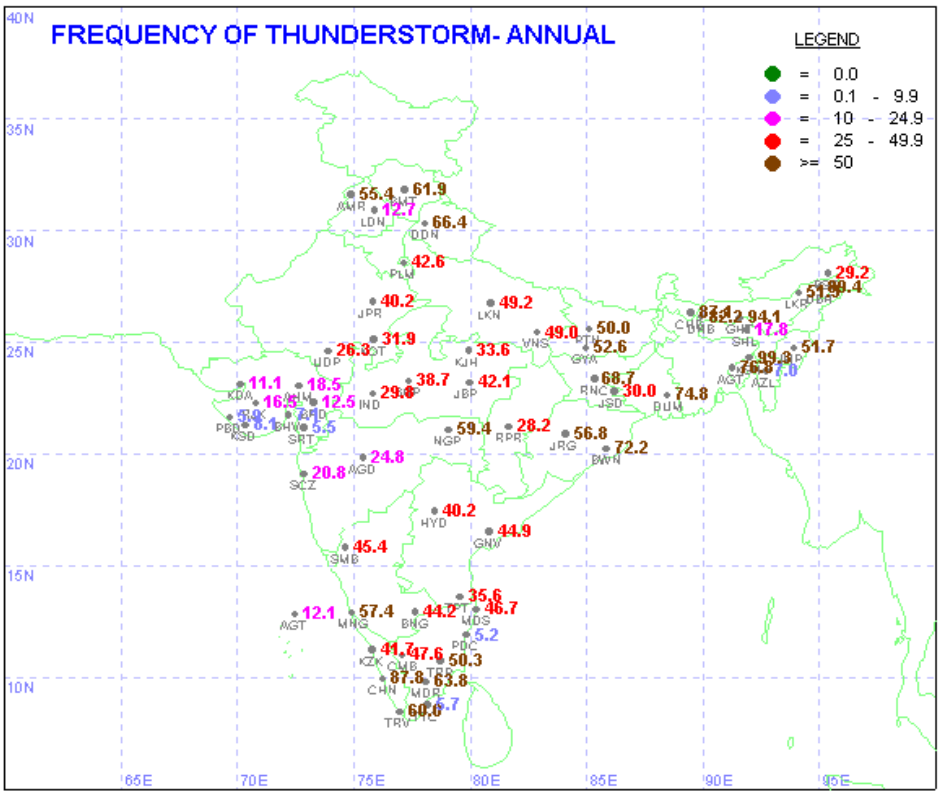
TAD India Plot



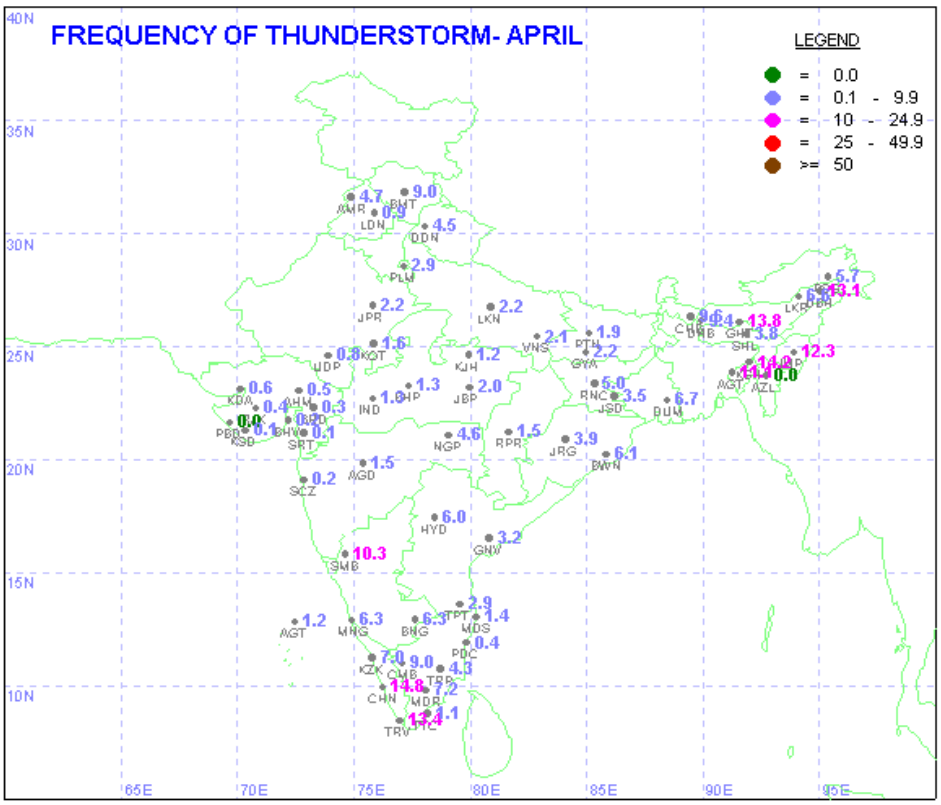
TAD India Plot



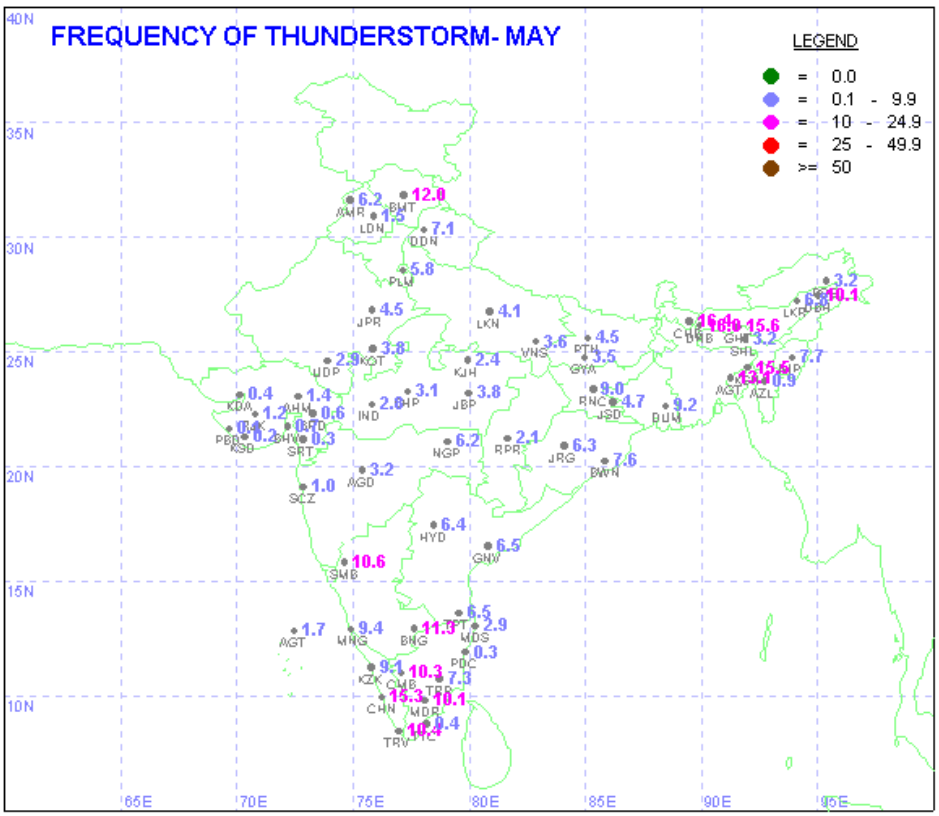
TAD India Plot



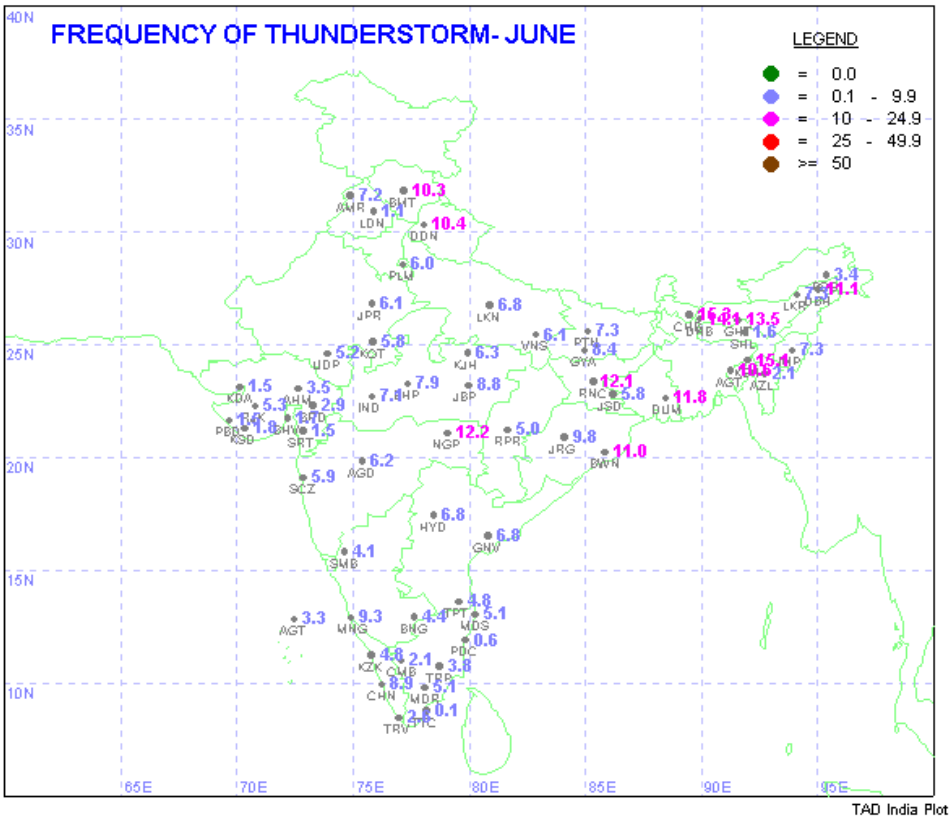
TAD India Plot



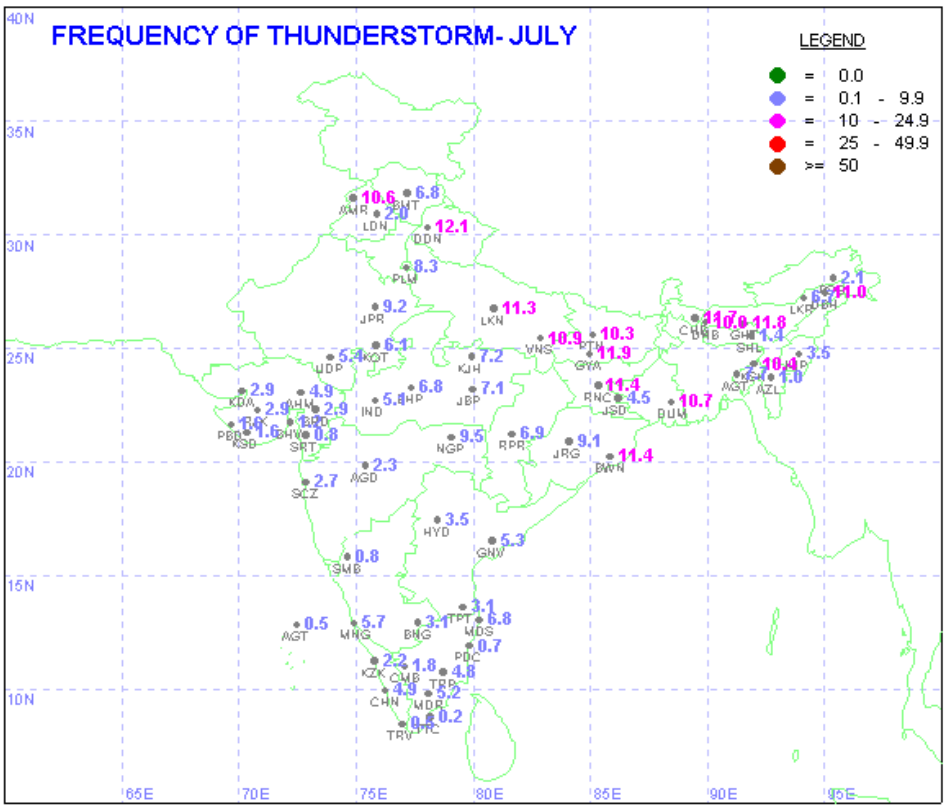
TAD India Plot



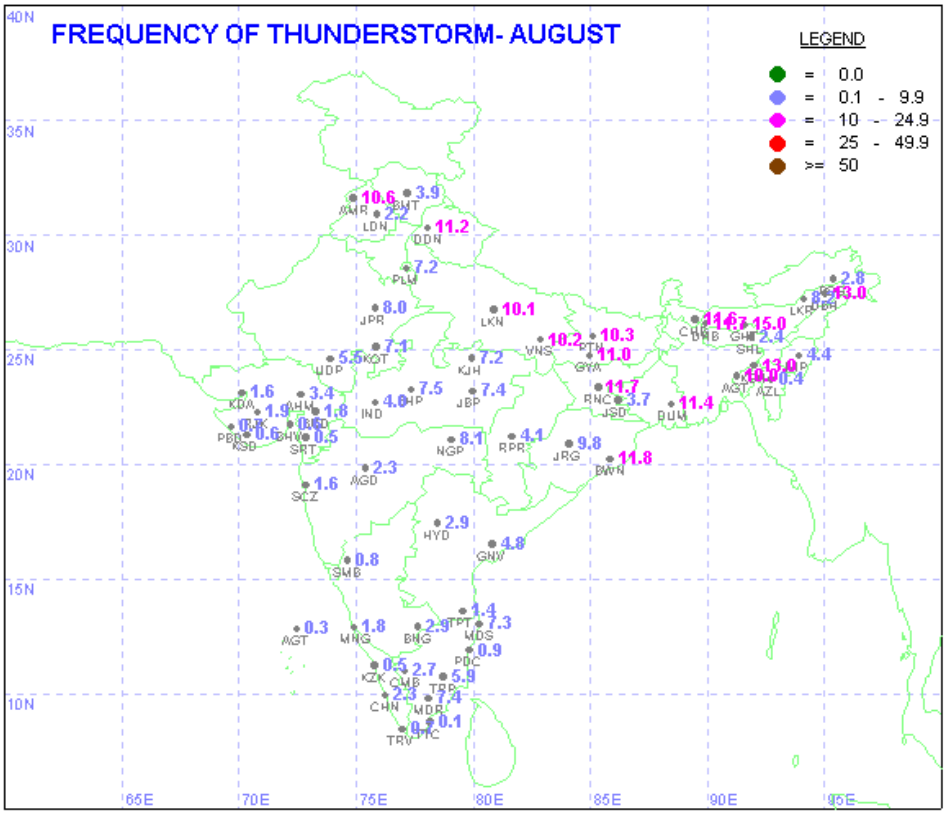
TAD India Plot



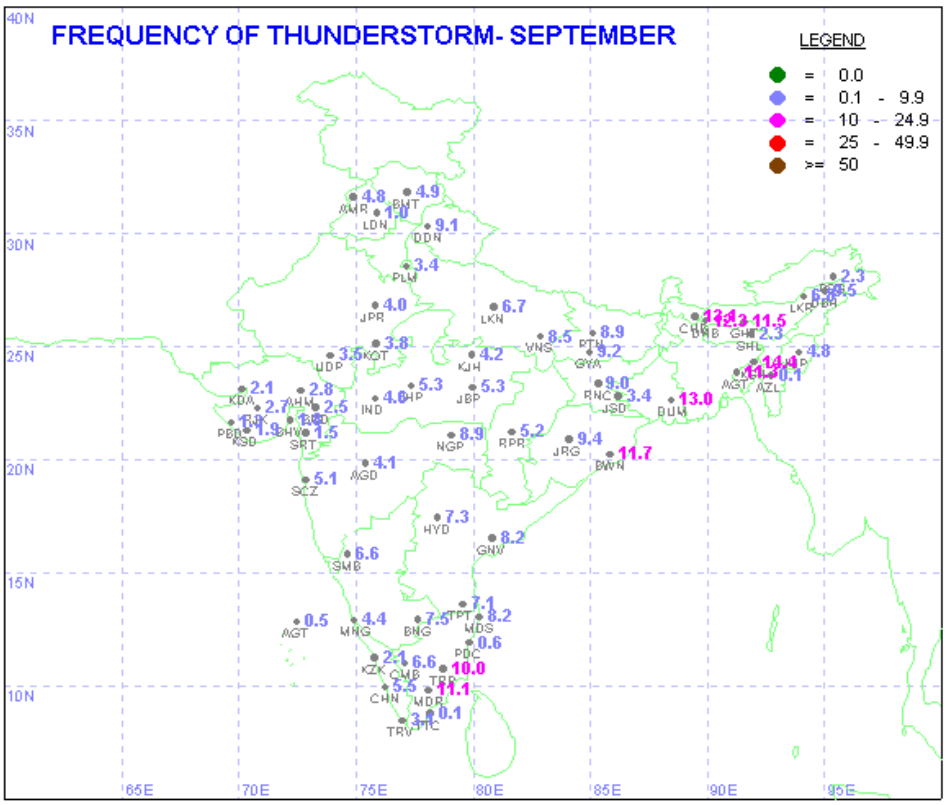
TAD India Plot



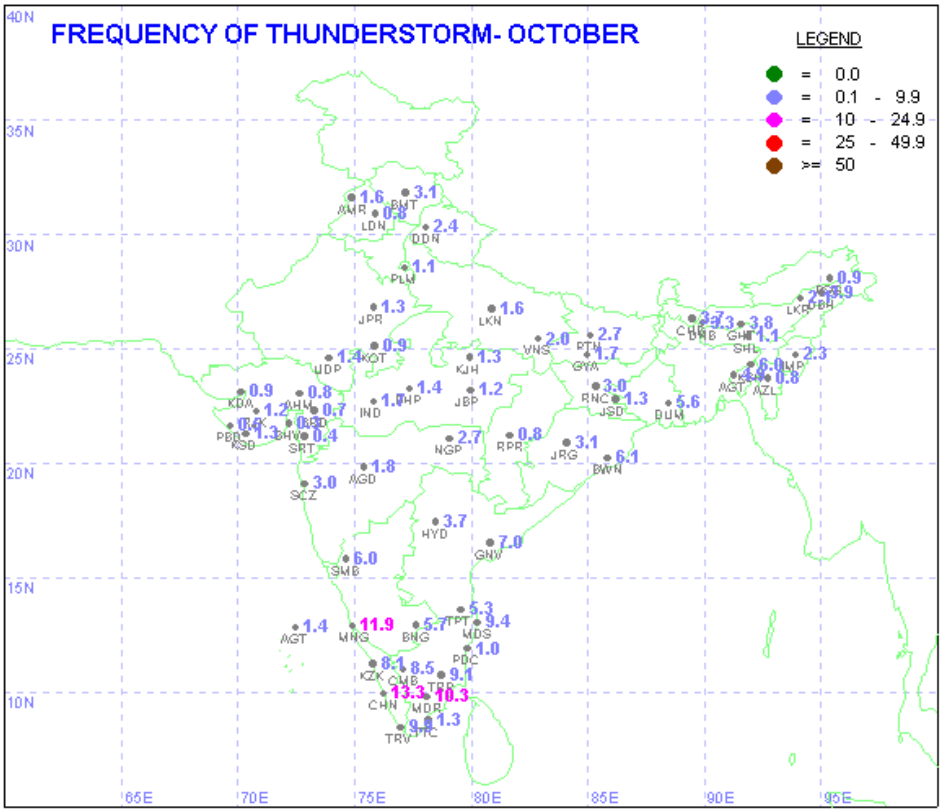
TAD India Plot



TAD India Plot



TAD India Plot



TAD India Plot

Chapter 3

OBSERVATION AND REPORTING OF WEATHER FOR AVIATION SERVICES

Objectives:

1. Explain the latest METAR/ SPECI code form and SPECI criteria
2. Prepare a METAR/ SPECI message using the given observations
3. Explain the latest MET Report/ SPECIAL Report template
4. Prepare a MET REPORT/ SPECIAL message using the given observations
5. Explain the basic concepts of TREND forecast

Sub topics:

1. METAR/ SPECI code
2. SPECI Criteria
3. Reporting of meteorological elements in METAR/ SPECI
4. Basic concepts of TREND forecast
5. Prepare a METAR/ SPECI message using the given observations
6. MET Report/ SPECIAL Report Template
7. Difference in reporting of elements in METAR and MET Report
8. Examples of preparation of MET REPORT/ SPECIAL

1. METAR and SPECI:

METAR and SPECI are weather reports encoded from the airport weather observations. METAR is the name of the code for an aviation routine weather report. A METAR is issued at half- hourly intervals in India. SPECI is the name of the code for an aviation special weather report. A SPECI can be issued at any time when certain criteria are met. Both METAR and SPECI have the same code form and both

may have a TREND forecast appended. METAR and SPECI are disseminated beyond the aerodrome of origin.

Reports of routine observations are also issued as Local Routine Reports, only for dissemination at the aerodrome of origin. These are issued to local ATC units on white paper in abbreviated plain language and identified by the prefix “MET REPORT”. Similarly reports of special observations (conditions are given in a separate section) are also issued for local use as local special reports on red colour paper in abbreviated plain language. They are identified by the prefix “SPECIAL”.

1.1 CONTENTS OF REPORTS:

1.1.1 Content and order: METAR or SPECI and MET REPORT and SPECIAL contain the following information in the given order.

1. Identification of the type of report
2. Location indicator
3. Time of Observation
4. Identification of an automated or missing report, when applicable
5. Surface Wind (Direction and Speed)
6. Visibility
7. Runway Visual Range (if available)
8. Present Weather
9. Cloud amount, cloud type (only for cumulonimbus and towering cumulus clouds) and height of cloud base or where measured, Vertical Visibility
10. Air Temperature and Dew Point Temperature
11. Pressure- QNH and, when applicable, QFE (QFE included only in local routine and special reports)
12. Supplementary Information (included in accordance with regional air navigation agreement)
13. RMK group

1.1.2 ***CAVOK:*** The code word CAVOK is used to replace the visibility, present weather and cloud groups when the following conditions occur simultaneously at the time of observation:

a) The visibility is 10 km or more;
b) There is no cloud of operational significance; (cloud of operational significance: A cloud with the height of cloud base below 1500m (5000ft) or below the highest minimum sector

altitude, whichever is greater, or a Cumulonimbus cloud or a towering cumulus cloud at any height);

c) There is no significant weather phenomenon.

1.1.3 ***RMK group***: At the end of a METAR or SPECI a section starting with the code word RMK may be appended. This section contains information required by the national authority of each country and is not disseminated internationally.

Template for METAR and SPECI

Key: M = inclusion mandatory, part of every message;
C = inclusion conditional, dependent on meteorological conditions or method of observation;
O = inclusion optional.

Element	Detailed content	Template(s)				Examples
Identification of the type of report (M)	Type of report (M)	METAR or SPECI				METAR SPECI
Location indicator (M)	ICAO location indicator (M)	Nnnn				VABB
Time of the observation (M)	Day and actual time of the observation in UTC (M)	nnnnnnZ				221630Z
Surface wind (M)	Wind direction (M)	Nnn	VRB			24008KT VRB02KT
	Wind speed (M)	[P]nn[n]				19011KT 00000KT 140P99KT
	Significant speed variations (C)	G[P]nn[n]				12006G18KT 24016G27KT
	Units of measurement(M)	KT				
	Significant directional variations(C)	nnnVnnn	-			02010KT 350V070
Visibility (M)	Minimum visibility (M)	nnnn			C A V O K	0350 CAVOK 7000 9999
	Direction of the minimum visibility(C)	N or NE or E or SE or S or SW or W or NW				0800E
	Maximum visibility(C)	nnnn				1100SE 7000NW 1200S 6000W
	Direction of the maximum visibility(C)	N or NE or E or SE or S or SW or W or NW				
RVR (C)	Name of the element (M)	R				R32/0400 R12R/1700 R10/M0050 R14L/P2000
	Runway (M)	nn[L]/or nn[C]/or nn[R]/				R16L/0650 R16C/0500 R16R/0450 R17L/0450
	RVR (M)	[P or M]nnnn				R12/1100U R26/05500N R20/0800D
	RVR past tendency(C)	U,D or N				
Present weather (C)	Intensity or proximity of present weather (C)	-or+	---	VC		RA HZ VCFG +TSRA FG VCSH +DZ VA VCTS -SN MIFG VCBLSA +TSRASN -SNRA
	Characteristics and type of present weather (M)	DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN	IC or FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG	FG or PO or FC or DS or SS or TS or SH or BLSN or BLSA or BLDU or VA		DZ FG +SHSN BLSN
Cloud (M)	Cloud amount and height of cloud base or vertical visibility (M)	FEWnnn or SCTnnn or BKNnnn or OVCnnn	VVnnn or VV///	NSC		FEW015 VV005 OVC030 VV/// NSC SCT010 OVC020

						BKN009TCU
	Cloud type (C)	CB or TCU	-			SCT008 BKN025CB
Air and dew-point temperature (M)	Air and dew-point temperatures (M)	[M]nn/[M]nn				17/10 02/M08 M01/M10
Pressure values (M)	Name of the element (M)	Q				Q0995 Q1009 Q1022 Q0987
	QNH (M)	Nnnn				
Supplementary information (C)	Recent weather (C)	REFZDZ or REFZRA or REDZ or RE[SH]RA or RERASN or RE[SH]SN or RESG or RESHGR or RESHGS or REBLSN or RESS or REDS or RETSRA or RETSSN or RETSGR or RETSGS or RETS or REFC or REVA or REPL				REFZRA RETSRA
	Wind shear (C)	WS Rnn[l] or WS Rnn[C] or WS Rnn[R] or WS ALL RWY				WS R03 WS ALL RWY WS R18C
Trend forecast (O)	Change indicator (M)	NOSIG	BECMG or TEMPO			NOSIG BECMG FEW020
	Period of change (C)		FMnnnn *and/or* TLnnnn or ATnnnn			
	Wind (C)		nnn[P]nn[G[P]nn]KT			TEMPO 25036G50KT
	Visibility (C)		nnnn		C A V O K	BECMG FM1030 TL1130 CAVOK BECMG TL1700 0800 FG BECMG AT1800 9000 NSW BECMG FM1900 0500 +SNRA BECMG FM1100 SN TEMPO FM1130 BLSN TEMPO FM0330 TL0430 FZRA
	Weather phenomenon: Intensity (C)		- or +	-	N S W	
	Weather phenomenon: characteristics and type(C)		DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or FC[1] SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN	IC or FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG		
	Cloud amount and height of cloud base *or* vertical visibility (C)		FEWnnn or SCTnnn or BKNnnn or OVCnnn	VVnnn or VV///	N S C	TEMPO TL 1200 0600 BECMG AT1200 8000 NSW NSC BECMG AT1130 OVC010
	Cloud type (C)		CB or TCU	-		TEMPO TL1530 +SHRA BKN012CB

Notes-

1. Heavy used to indicate tornado or water spout; moderate (no qualifier) to indicate funnel cloud not reaching the ground

Template for the local routine (MET REPORT) and local special (SPECIAL) REPORTS

Key: M =inclusion mandatory, part of every message;
C = inclusion conditional, dependent on meteorological conditions;
O = inclusion optional.

Element	Detailed content	Template(s)			Examples
Identification of the type of report (M)	Type of report	MET REPORT or SPECIAL			MET REPORT SPECIAL
Location indicator (M)	ICAO location indicator (M)	Nnnn			VABB
Time of the observation (M)	Day and actual time of the observation in UTC	nnnnnnZ			221630Z
Surface wind (M)	Name of the element (M)	WIND			WIND 240/8KT WIND RWY 18 TDZ 190/11KT WIND VRB2KT WIND CALM WIND VRB BTN 350/AND 050/2KT WIND 270/ABV 99KT WIND 020/10KT VRB BTN 350/AND 070/ WIND RWY 14R MID 140/11KT
	Runway(O)2	RWY nn[L] or RWY nn[C] or RWY nn[R]			
	Runway section (O)3	TDZ			
	Wind direction (M)	nnn/	VRB BTN nnn/ AND nnn/ or VRB	CALM	
	Wind speed (M)	[ABV] n[n]KT			
	Significant speed variations(C)4	MAX [ABV] nn [n] MNM n [n]			
	Significant directional variations(C) 5	VRB BTN nnn/ AND nnn/	--		
	Runway Section(O)3	MID			
	Wind Direction(O)3	nnn/	VRB BTN nnn/ AND nnn/ or VRB	CALM	
	Wind speed(O)3	[ABV] n[n]KT			
	Significant speed variations(C)4	MAX [ABV]nn[n] MNM n [n]			
	Significant directional variations(C)5	VRB BTN nnn/AND nnn/	-		
	Runway Section(O)3	END			WIND RWY 27 TDZ 240/16KT MAX27 MNM10 END 250/14KT
	Wind Direction(O)3	nnn/	VRB BTN nnn/ AND nnn/ or VRB	CALM	
	Wind speed(O)3	[ABV] n[n]KT			
	Significant speed variations(C)	MAX [ABV]nn[n] MNM n [n]			
	Significant directional variations (C)	VRB BTN nnn/AND nnn	-		
Visibility(M)	Name of the element (M)	VIS		CAVOK	VIS 350M CAVOK VIS 7KM VIS 10KM VIS RWY 09 TDZ 800M END 1200M
	Runway (O)2	RWY nn[L] or RWY nn[C] or RWY nn[R]			
	Runway section (O)3	TDZ			
	Visibility (M)	nn[n][n]M or n[n]KM			

	Runway section (O)3	MID				
	Visibility (O)3	nn[n][n]M or n[n]KM				
	Runway section (O)3	END				VIS RWY 18C TDZ 6KM RWY 27 TDZ 4000M
	Visibility (O)3	nn[n][n]M or n[n]KM				
RVR (C)	Name of the element (M)	RVR				RVR RWY 32 400M RVR RWY 20 1600M
	Runway (C)	RWY nn[L] or RWY nn[C] or RWY nn[R]				
	Runway section (C)	TDZ				
	RVR (M)	[ABV or BLW] nn[n][n]M				RVR RWY 10L BLW 50M RVR RWY 14 ABV 2000M RVR RWY 10 BLW 150M RVR RWY 12 ABV 1200M
	Runway section (C)	MID				RVR RWY 12 TDZ 1100M MID ABV 1400M
	RVR (C)	[ABV or BLW] nn[n][n]M				
	Runway section (C)	END				RVR RWY 16 TDZ 600M MID 500M END 400M RVR RWY 26 500M RWY 20 800M
	RVR (C)	[ABV or BLW] nn[n][n]M				
Present weather (C)	Intensity of present weather (C)	FBL or MOD or HVY	-			
	Characteristics and type of present weather (C)	DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN	IC or FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG			MOD RA HZ HVY TSRA FG HVY DZ VA FBL SN MIFG HVY TSRASN FBL SNRA FBL DZ FG HVY SHSN BLSN
Cloud (M)	Name of the element (M)	CLD				
	Runway (O)2	RWY nn[L] or RWY nn[C] or RWY nn[R]				
	Cloud amount (M) or vertical visibility (O)	FEW or SCT or BKN or OVC	OBSC	NSC		CLD NSC CLD SCT 300M OVC 600M (CLD SCT 1000FT OVC 2000FT) CLD OBSC VER VIS 150M (CLD OBSC VER VIS 500FT)
	Cloud type (C)	CB or TCU	-			CLD BKN TCU 270M (CLD BKN TCU 900FT)
	Height of cloud base or the value of vertical visibility(C)	nn[n][n]M(or nnn[n]FT)	[VER VIS nn[n]M(or VER VIS nnn[n]FT)]			CLD RWY 08R BKN 60M RWY 26 BKN 90M (CLD RWY 08R BKN 200FT RWY 26 BKN 300FT)

Air temperature (M)	Name of the element (M)	T					T17 TMS08
	Air temperature (M)	[MS]nn					
Dew –point temperature (M)	Name of the element (M)	DP					DP15 DPMS18
	Dew-point temperature (M)	[MS]nn					
Pressure values (M)	Name of the element (M)	QNH					QNH 0995HPA QNH 1009HPA QNH 1022HPA QFE 1001HPA QNH 0987HPA QFE RWY 18 0956HPA RWY 24 0955HPA
	QNH (M)	nnnnHPA					
	Name of the element (O)	QFE					
	QFE (O)	[RWY nn[L] or RWY nn[C] or RWY nn[R]]nnnnHPA [RWY nn[L] or RWY nn[C] or RWY nn[R] nnnnHPA]					
Supplementary information (C)	Significant meteorological phenomena(C)	CB or TS or MOD TURB or SEV TURB or WS or GR or SEV SQL or MOD ICE or SEV ICE or FZDZ or FZRA or SEV MTW or SS or DS or BLSN or FC13					FC IN APCH WS IN APCH 60M-WIND: 360/25KT WS RWY 12
	Location of the phenomenon(C)	IN APCH[nnnM-WIND nnn/nnKT] or IN CLIMBOUT[nnnM-WIND nnn/nnKT] or RWY nn[n]					
	Recent weather(C)	REFZDZ or REFZRA or REDZ or RE[SH]RA or RERASN or RE[SH]SN or RESG or RESHGR or RESHGS or REBLSN or RESS or REDS or RETSRA or RETSSN or RETSGR or RETSGS or REFC or REPL or REVA or RETS					REFZRA CB IN CLIMB-OUT RETSRA
Trend Forecast (O)	Name of the element (M)	TREND					
	Change indicator (M)	NOSIG	BECMG or TEMPO				TREND NOSIG TREND BECMG FEW 600M
	Period of change (C)		FMnnnn *and/or* TLnnnn or ATnnnn				
	Wind (C)		nnn/ [ABV] n[n]KT [MAX[ABV]nn]				TREND TEMPO 250/35KT MAX 50
	Visibility (C)		VIS nn[n][n]M or VIS n[n]KM			C A V O K	TREND BECMG AT1800 VIS 10KM NSW TREND BECMG TL1700 VIS 800M FG TREND BECMG FM1030 TL1130 CAVOK
	Weather phenomenon: intensity (C)		FBL or MOD or HVY	-	NSW		TREND TEMPO TL1200 VIS 600M BECMG AT1230 VIS 8KM NSW CLD NSC
	Weather phenomenon: characteristics and type(C)		DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN	IC or FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG			TREND TEMPO FM0300 TL0430 MOD FZRA TREND BECMG FM1900 VIS 500M HVY SNRA TREND BECMG FM1100 MOD SN TEMPO FM1130 BLSN
	Name of the element (C)		CLD				

	Cloud amount and vertical visibility (C)		FEW or SCT or BKN or OVC	OBSC	NSC		TREND BECMG AT1130 CLD OVC 300M
	Cloud type (C)		CB or TCU	-			TREND TEMPO TL1530 HVY SHRA CLD BKN CB360M
	Height of cloud base or the value of vertical visibility (C)		nn[n][n]M	[VER VIS nn[n]M]			

Notes-

1. Fictitious location.
2. Optional values for one or more runways.
3. Optional values for one or more sections of the runway.

2. METAR/ SPECI Code form:

2.1 IDENTIFICATION GROUPS

METAR or SPECI } **COR CCCC YYGGggZ NIL (AUTO)**

2.1.1 This has three parts:

(a) The report code name (METAR or SPECI and MET REPORT/SPECIAL)
(b) The ICAO location indicator of the reporting station, e.g. VOMM (Chennai Airport)
(c) The day of the month and the time of the observation in hours and minutes UTC, followed by the letter Z. Example: 211030Z (CW observation of 21st day of the month and time of observation 1030 UTC).

2.1.2 The code words COR and NIL are to be inserted after the code name and the time group, for indicating a corrected message or as an indication of a NIL message. Usually NIL is not being used in India.

2.1.3 The indicator AUTO is inserted when the report contains a fully automated observation, that is, without human intervention. But in India it is not being practiced.

2.2 SURFACE WIND

$$\left\{\begin{array}{l}\text{KMH or}\\ \text{KT or}\\ \text{MPS}\end{array}\right\} \quad d_n d_n d_n V d_x d_x d_x$$

2.2.1 Reporting steps: Knots (KT) is the primary unit used in India for reporting wind speeds in aviation messages. The mean true direction in degrees rounded off to the nearest 10 degrees from which the wind is blowing and the mean speed of the wind over the 10-minute period immediately preceding the observation shall be reported for dddff followed, without a space, by the abbreviation KT. Values of wind direction less than 100^{o} shall be preceded by 0 and a wind from true north shall be reported as 360. Values of wind speed less than 10 units shall be preceded by 0.

2.2.2 Reporting: Normally there will be a five-figure group to indicate the ten-minute mean wind followed by an abbreviation to indicate the wind speed units used. The first three figures indicate the wind direction and the last two the wind speed.

Example: 31015KT, 09008KT

2.2.3 Averaging periods for wind observations:

(a) The wind reported in METAR and SPECI should be the mean over the ten minutes preceding the observation. If during this period there has been a marked discontinuity lasting at least two minutes, the mean values should be assessed over the period after the discontinuity. A marked discontinuity occurs when there is a wind direction change of 30 degrees or more with a wind speed of 10kt or more, before or after the change or a wind speed change of 10 kt or more.

(b) The averaging period for measuring variations from the mean wind speed (gusts) should be three seconds.

(c) For inclusion in MET REPORT and SPECIAL and for displays in air traffic service units, two minutes averaged wind is used.

2.2.4 WIND REPORTING- SPECIAL CASES:

a) In the case of variable wind direction, ddd shall be encoded as VRB when the mean wind speed is less than 3 knots. A variable wind at higher speeds, shall be reported only when the variation of wind direction is 180° or more or when it is impossible to determine a single wind direction, for example when a thunderstorm passes over the aerodrome.

Example: VRB02KT (variable wind with mean wind speed of 2 knots)

VRB20KT (mean wind speed is 20 knots the wind direction is varying by 180° or more.)

In MET REPORT as “WIND VRB2KT” and as “WIND VRB28KT”

b) If, during the 10-minute period preceding the observation, the total variation in wind direction is 60° or more but less than 180° and the mean wind speed is 3 knots or more, the observed two extreme directions between which the wind has varied shall be given for $d_nd_nd_nVd_xd_xd_x$ in clockwise order. The wind shall be reported in METAR/ SPECI as 31015KT 280V020. (clockwise variation of wind from 280° to 20°) In local reports, it shall be reported as "WIND 310/15KT VRB BTN 280/ AND 020/"

c) Variation from the mean wind speed (gusts) during the past ten minutes shall be reported when the maximum wind speed exceeds the mean speed by 10 knots or more. The wind shall be reported in METAR/ SPECI as 31015KTG30KT. In METREPORT it shall be reported as WIND 310/15KT MAX 30 MIN 5.

d) When a wind speed of less than 1 knot is reported, it shall be indicated as calm. "Calm" shall be coded as 00000 followed immediately, without a space, by the abbreviation KT, in the form 00000KT. In MET REPORT it shall be indicated as WIND CALM.

e) In MET REPORT and SPECIAL, if the surface wind is observed from more than one location along the runway, the locations for which these values are representative should be indicated.
Example: WIND RWY 27 TDZ 240/16KT MAX27 MNM10 END 250/14KT

2.3 VISIBILITTY:

2.3.1 CODE FORMAT: VVVVDvVxVxVxVxDv

When there is NO marked directional variation in visibility, the minimum visibility will be reported in metres using four figures. The visibility is assessed manually with the help of visibility polar diagrams.

Example: 4000 (Four thousand metres)

2.3.2 Reporting steps:

Visibility shall be reported as follows:

(a) in steps of 50M when the visibility is less than 800M,

(b) in steps of 100M, when it is 800M or more but less than 5 km;

(c) in kilometers steps when the visibility is 5km or more but less than 10km;

(d) as 10 km when the visibility is 10 km or more, except when the conditions for the use of CAVOK apply.

Any observed value, which does not fit the reporting scale in use, shall be rounded down to nearest lower step in the scale.

2.3.4 Directional variations:

Directional variations are NOT considered MARKED unless the minimum visibility is less than 5000M and the variations are at least 50 percent of the minimum visibility.

When there is a marked directional variation in the visibility, the reported minimum visibility will be followed by one of the eight points of the compass to indicate the direction of this visibility.

Example: 4000NE (Four thousand meters to the North East).

If the lowest visibility is observed in more than one direction, then the most operationally significant direction shall be reported.

EXCEPTION:

When the minimum visibility is less than 1500 m and the visibility in another direction is more than 5000 m, the maximum visibility and its direction should also be reported.

Example: 1400SW 6000N (One thousand four hundred metres to the Southwest and 6 km to the North)

If the maximum visibility is observed in more than one direction, then the most operationally significant direction is reported.

2.4 RUNWAY VISUAL RANGE

2.4.1 CODE FORMAT

$RD_RD_R/V_RV_RV_Ri$

Or

$RD_RD_R/V_RV_RV_RV_RVV_RV_RV_RV_Ri$

Where the Runway Visual Range (RVR) can be determined and when it is reported, the group starts with the letter R followed by the Runway designator D_RD_R and a "/" followed by the RVR in metres. Upto a maximum of four groups may be reported in METAR.

Example: R24/1100 (Runway visual range on Runway 24, greater than one thousand one hundred metres)

Directional variation of RVR as indicated in $RD_RD_R/V_RV_RV_RV_RVV_RV_RV_RV_Ri$ is not reported in India.

2.4.2 *SPECIAL CASES*:

(a) When the RVR is assessed to be more than 2000 m it should be reported as P2000. Example: R24/P2000 (Runway visual range on Runway 24, greater than 2000 metres). In MET REPORT, it will be reported as “RVR RWY 24 ABV 2000M”

(b) When the RVR is below the minimum value that can be assessed the RVR should be reported as M followed by the appropriate minimum value that can be assessed.
Example: R24/M0050 (Runway visual range on Runway 24, less than one hundred and fifty metres). In MET REPORT it is reported as RVR RWY 24 BLW 50M.

2.4.3 Reporting and reporting scales:

- In METAR and SPECI, where there is more than one runway available for landing, touchdown zone runway visual range values shall be included for all such runways, up to a maximum of four.
- In local reports, the available runway visual range values shall be reported indicating the locations, in the order touchdown zone, mid and end.

- Reporting scales of RVR are as follows:
  (a) Increments of 25 m, if RVR below 400 m
  (b) Increments of 50 m, if RVR between 400 and 800 m
  (c) Increments of 100 m, if RVR above 800 m

Any observed value, which does not fit the report scale in use, shall be rounded down to the nearest step in the scale.

2.4.5 National practice:

- Runway visual range observations should be made, and reported in current weather reports, throughout periods when either the horizontal visibility or the runway visual range is less than 1500m.
- Whenever the general visibility and / or RVR is from 1500 m to 2000 m, the RVR should be included in the METAR/SPECI and in local routine and special reports as supplementary information under “RMK” group.
- This supplementary information is not to be disseminated internationally.

- If the horizontal visibility is 2000 m or less but RVR is more than 2000 m the same shall be reported as “RVR ABV 2000 M” as supplementary information, with indicator RMK.

Manual RVR:

Whenever the visibility become 1500m or less, all aviation forecasting offices should take manual RVR observation if instrumental recording facility of RVR is not available or is not functioning.

When the visibility is expected to reach 1500m or fall below 1500m, the ATC should be asked to provide transport with communication facility. An observer should be sent to the observing point for RVR observations as soon as the transport is made available by ATC. The current runway end in use, Touch Down Zone (TDZ) should be ascertained from ATC well in advance and the observer should be sent to the corresponding observing point of runway in use to take RVR observations. Where runway visual range is determined by human observers, runway visual range should be reported to the appropriate local air traffic services units, whenever there is a change in the value to be reported in accordance with the reporting scale. The transmission of such reports shall normally be completed within 15 seconds after the termination of observation.

2.4.7 AVERAGING OF RVR

Where instrumented systems are used for the assessment of RVR, the averaging period of RVR should be:

a) 1 minute for local routine and special reports and for RVR displays in ATS units, and

b) 10 minutes for METAR and SPECI, except that when the 10-minute period immediately preceding the observation includes a marked discontinuity in runway visual range values, only those values occurring after the discontinuity shall be used for obtaining mean values. A marked discontinuity occurs when there is an abrupt and sustained change in runway visual range, lasting at least 2 minutes, which reaches or passes through the values included in criteria for the issuance of SPECI reports.

2.5.2 RVR Tendency:

In METAR and SPECI when instrumented systems are used for the assessment of runway visual range, the variations in runway visual range during the 10-minute period immediately preceding the observation shall be indicated as follows:

- If the runway visual range values during the 10-minute period have shown a distinct tendency, such that the mean during the first 5 minutes varies by 100

m or more from the mean during the second 5 minutes of the period, this shall be indicated.

- When the variation of the runway visual range values shows an upward or downward tendency this shall be indicated by the abbreviation “U” or “D” respectively.
- In circumstances when actual fluctuations during the 10-minute period indicate no distinct tendency this shall be reported using the abbreviation “N”.
- When indications of tendency are not available, no abbreviations shall be included.

2.5 PRESENT WEATHER

w’w’ Significant present weather

QUALIFIER		**WEATHER PHENOMENA**		
INTENSITY OR PROXIMITY 1	DESCRIPTOR 2	PRECIPITATION 3	OBSCURATION 4	OTHER 5
- Light	**MI** Shallow	**DZ** Drizzle	**BR** Mist	**PO** Dust/sand whirls (dust devils)
	BC Patches	**RA** Rain	**FG** Fog	
Moderate (no qualifier)	**PR** Partial (covering part of the aerodrome)	**SN** Snow	**FU** Smoke	**SQ** Squalls
+ Heavy (well developed in the case of dust/sand whirls (dust devils) and funnel clouds)	**DR** Low drifting	**SG** Snow grains	**VA** Volcanic ash	**FC** Funnel cloud(s) (tornado or water-spout)
	BL Blowing	**IC** Ice crystals diamond dust)	**DU** Wide-spread dust	
	SH Shower(s)	**PL** Ice pellets	**SA** Sand	**SS** Sand-storm

VC In the vicinity	**TS** Thunderstorm **FZ** Freezing (super-cooled)	**GR** Hail **GS** Small hail and/or snow pellets	**HZ** Haze	**DS** Duststorm

2.5.1: Example

Having decided there is a weather phenomenon to be reported, the present weather is encoded by considering each column in the table above.

For example:
There is rain - RA
It is heavy - +
It is a shower - SH
The encode becomes +SHRA

2.5.2: Explanations

- One or more groups w´w´, but not more than three, should be used to report all present weather phenomena observed at or near the aerodrome and of significance to aeronautical operations in accordance with the above Code table.
- Appropriate intensity indicators and letter abbreviations should be combined in groups of two to nine characters to indicate present weather phenomena.
- The w´w´ groups shall be reported in the following order:
  - ***(a)*** First, if appropriate, the qualifier for intensity ***or*** for proximity, followed without a space by;
  - ***(b)*** If appropriate, the abbreviation for the descriptor followed without a space by;
  - ***(c)*** The abbreviation for the observed weather phenomenon or combinations thereof.

2.5.3: Intensity description

- Intensity should be indicated only with precipitation, precipitation associated with showers and/or thunderstorms, duststorm or sandstorm.
- If the intensity of the phenomena reported in the group is either light or heavy, this shall be indicated by the appropriate sign.
- No indicator shall be included in the group when the intensity of the reported phenomenon is moderate.
- The following may be referred to:

	Local routine and	METAR and SPECI

	local special reports	
Light	FBL	–
Moderate	MOD	(no indication)
Heavy	HVY	+

- The intensity of present weather phenomena reported in the group w´w´ shall be determined by the intensity at the time of observation.

2.5.4: Qualifiers

- If more than one significant weather phenomenon is observed, separate w´w´ groups should be included in the report in accordance with the Code table.
- If more than one form of precipitation is observed, the appropriate letter abbreviations should be combined in a single group with the dominant type of precipitation being reported first.
- In such a single group, the intensity should refer to the total precipitation and be reported with one or no indicator as appropriate.

The qualifier SH:

- Should be used to indicate precipitation of the shower type.
- When associated with the indicator VC, the type and intensity of precipitation should not be specified.

The qualifier TS:

- Should be used whenever thunder is heard or lightning is detected at the aerodrome within the 10-minute period preceding the time of observation.
- When appropriate, TS should be followed immediately, without a space, by relevant letter abbreviations to indicate any precipitation observed.
- The letter abbreviation TS on its own should be used when thunder is heard or lightning detected at the aerodrome but no precipitation observed.
- A thunderstorm should be regarded as being at the aerodrome from the time thunder is first heard, whether or not lightning is seen or precipitation is observed at the aerodrome.
- A thunderstorm should be regarded as having ceased or being no longer at the aerodrome at the time thunder is last heard, and the cessation is confirmed if thunder is not heard for 10 minutes after this time.

The qualifier FZ:

- Should be used only to indicate supercooled water droplets or supercooled precipitation and is used only with FG, DZ and RA.

- Any fog consisting predominantly of water droplets at temperatures below 0°C should be reported as freezing fog (FZFG) whether it is depositing rime ice or not.
- Whether or not the supercooled precipitation is of the shower type need not be specified.

The qualifier VC:

- Should be used to indicate the significant weather phenomena TS, DS, SS, FG, FC, SH, PO, BLDU, BLSA, BLSN and VA observed in the vicinity of the aerodrome.
- Vicinity means “Not at the aerodrome but not further away than approximately 8 km from the aerodrome perimeter and used only in METAR and SPECI.

2.5.8: Phenomena

- GR is used to report hail only when the diameter of the largest hailstones observed is 5 mm or more.
- GS should be used to report small hail (diameter of the hailstones less than 5 mm) and/or snow pellets.
- IC should be used to indicate the phenomenon ice crystals (diamond dust). For w´w´ = IC to be reported, the visibility should be reduced by this phenomenon to 5000 metres or less.
- The abbreviations FU, HZ, DU and SA (except DRSA) should be used only when the obstruction to vision consists predominantly of litho-meteors and the visibility is reduced by the reported phenomenon to 5000 metres or less.
- The abbreviation BR should be used when the obstruction to vision consists of water droplets or ice crystals. For w´w´= BR to be reported, the visibility reported in the group VVVV should be at least 1000 metres but not more than 5 000 metres.
- The letter abbreviation FG should be used when the obstruction to vision consists of water droplets or ice crystals (fog or ice fog). For w´w´= FG to be reported without the qualifiers MI, BC or VC, the visibility reported in the group VVVV should be less than 1 000 metres.
- For w´w´= MIFG to be reported, the visibility at two metres above ground level should be 1 000 metres or more and the apparent visibility in the fog layer shall be less than 1 000 metres.
- The abbreviation VCFG can be used to report any type of fog observed in the vicinity of the aerodrome.
- The abbreviation BCFG is used to report fog patches. BCFG should be used only when the visibility in parts of the aerodrome is 1000 metres or more although, when the fog is close to the observing point, the minimum visibility reported will be less than 1000 metres.

- The abbreviation PRFG is used to report fog covering part of the aerodrome. The apparent visibility in the fog patch or bank should be less than 1000 metres, and the fog should be extending to at least two metres above ground level.
- BL (blowing) is used to report DU, SA or SN raised by the wind to a height of 2m or more above the ground.
- DR (Low drifting) is used with DU, SA, or SN raised by the wind to less than 2m above ground level.
- SQ is used to report squalls when a sudden increase of at least 16 knots in wind speed is observed, the speed rising to 22 knots or more and lasting for at least one minute.

2.6 CLOUD or VERTICAL VISIBILITY

2.6.1: Code form

$N_sN_sN_sh_sh_sh_s$
or
$VVh_sh_sh_s$
Or
SKC
Or
NSC

2.6.2: Reporting: Cloud groups consist of six characters under normal circumstances. The first three indicate cloud amount with:

1/8 to 2/8 reported as	FEW (Few)
3/8 to 4/8 reported as	SCT (Scattered)
5/8 to 7/8 reported as	BKN (Broken) and
8/8 reported as	OVC (Overcast)

The last three characters indicate the height of the base of the cloud in units of 30 m or 100 ft upto 3000 m (10000 ft).

Example: 3/8 of Stratocumulus with a base of 1850 will be encoded : SCT018.

2.6.3: CLOUD TYPE

- Types of cloud other than significant convective clouds are not identified.
- Significant convective clouds are; Cumulonimbus indicated by CB and Cumulus congestus of great vertical extent indicated by TCU.
- The contraction TCU, taken from “Towering Cumulus”, is an ICAO abbreviation used to describe this type of cloud.

2.6.4: REPORTED CLOUD GROUPS

The cloud group can be repeated to report different layers or masses of cloud but the number of groups should not normally exceed three.

The following criteria should be followed for reporting cloud layers:

- The lowest individual layer (mass) of any amount as FEW, SCT, BKN or OVC
- The next individual layer of more than 2/8 as SCT, BKN, or OVC as appropriate
- The next higher layer of more than 4/8 as BKN or OVC; and
- Cumulonimbus (CB) and/or towering cumulus clouds (TCU), whenever observed and not already reported

Example: There are 1/8 at 500 ft
2/8 Cumulonimbus at 1000 ft
3/8 Cumulus at 1800 ft
5/8 Stratocumulus at 2500 ft

At mountain stations, when cloud base is below station level, the cloud group should read NsNsNs///.

Example: SCT///, FEW///CB

The reported cloud would be:

FEW005 FEW010CB SCT018 BKN025

2.6.5 Explanations:

1. The cloud groups are reported in ascending order of height.
2. When there are no clouds of operational significance and no restriction on vertical visibility and the abbreviation CAVOK is not appropriate, the abbreviation NSC (Nil Significant Cloud) should be used. (Cloud of operational significance:- A cloud with the height of cloud base below 1500 m (5000 ft) or below the highest minimum sector altitude whichever is greater, or a cumulonimbus cloud or a towering cumulus cloud at any height).
3. When Cumulonimbus (CB) and Towering Cumulus (TCU) have a common cloud base, the type of cloud is reported as CB and the amount of clouds is encoded as the sum of CB and TCU amounts at that cloud base.

2.6.6: VERTICAL VISIBILITY

When the sky is obscured and cloud details cannot be assessed but information on vertical visibility is available, the cloud group should be replaced by a five character group, the first two characters being VV followed by the vertical visibility in units of 30 m or 100 ft as for cloud base. When the sky is obscured but the vertical visibility cannot be assessed the group will read VV///.

Example: VV003 (Vertical visibility three hundred feet/ 90 meters)

2.7: AIR AND DEW POINT TEMPERATURE:

2.7.1: Code format: T'T'/ TdTd

The observed air temperature and dew point temperature, each as two figures rounded to the nearest whole degree Celsius, should be reported next.

Temperatures below 0 degrees Celsius will be preceded by M to indicate minus.

Example: Minus 9.5 degrees Celsius is reported as M09.

2.7.2: Explanations: Air temperature and dew point values of 0.5 degrees will be rounded up to the higher whole degree.

Example: Air temperature of 9.5 degree Celsius and Dew point temperature of 3.3 degree Celsius will be reported as 10/03

2.8: PRESSURE – QNH

2.8.1: CODE FORMAT: $QP_HP_HP_HP_H$

- The last group of the main part of the report should indicate the QNH rounded down to the nearest whole hectopascal.
- The group starts with the letter Q followed by four figures.
- In local reports, QFE also is to be reported.

Example: A QNH of 995.6 hPa is reported as Q0995

2.9 SUPPLEMENTARY INFORMATION:

2.9.1: CODE FORMAT:

RE w^iw^i { WS RWYDRDR / Or / WS ALL RWY / (WT_sT_s/SS^i) / ($R_RR_RE_RC_Re_Re_RB_RB_R$) }

For international dissemination this section is used for reporting

- Recent weather phenomena of operational significance;
- Information on wind shear in the lower layers; and

- Other information in accordance with regional air navigation agreement including (a) sea surface temperature and the state of the sea, and (b) state of the runway
- The other information group is not being used in India.

Observations made at aerodromes should include the available supplementary information concerning significant meteorological conditions, particularly those in the approach and climb-out areas, and specifically the location of cumulonimbus or thunderstorm, moderate or severe turbulence, wind shear, hail, severe line squall, moderate or severe icing, freezing precipitation, marked mountain waves, sandstorm, dust-storm, blowing snow or funnel cloud (tornado or waterspout). Where practicable, the information should identify the vertical extent and direction and rate of movement of the phenomenon. As turbulence, wind shear and icing cannot, for the time being, be satisfactorily observed from the ground, evidence of their existence should be derived from aircraft observations during the climb out or approach phases of flight to be made in accordance with Chapter IV.

In local routine and special reports and in METAR and SPECI, the following recent weather phenomena, i.e. weather phenomena observed at the aerodrome during the period since last hour, whichever is the shorter, but not at the time of observation, should be reported, up to a maximum three groups, in the supplementary information:

freezing precipitation	**REFZDZ, REFZRA**
moderate or heavy precipitation(including showers thereof**)**	**REDZ, RERA, RESN, RESG, REPL, RESHRA, RESHSN, RESHGR, RESHGS**
blowing snow	**REBLSN**
dust-storm or sandstorm	**RESS, REDS**
thunderstorm	**RETS**
funnel cloud (tornado or water spout)	**REFC**
volcanic ash	**REVA**

In local routine and special reports, the following significant meteorological conditions, or combination thereof, should be reported in supplementary information:

Cumulonimbus cloud	CB
thunderstorm	TS
moderate or severe turbulence	MOD TURB, SEV TURB
wind shear	WS
hail	GR
severe line squall	SEV SQL
moderate or severe icing	MOD ICE, SEV ICE
freezing precipitation	FZDZ, FZRA
severe mountain wave	SEV MTW

duststorm, sandstorm	SS, DS
blowing snow	BLSN
funnel cloud (tornado or water spout)	FC

- Information on recent weather of operational significance observed at the aerodrome within the period since the last issued routine report or last hour, whichever is the shorter, but not at the time of observation should be reported
- Where local circumstances warrant, information on wind shear should be added in reports disseminated beyond the aerodrome.
- Information on wind shear should be added in the form “WS RWY 12” or “WS ALL RWY”.
- Information on recent significant weather should be added in the form “REFZRA”.
- Significant directional variations in visibility particularly, those affecting the approach area, should be observed and reported.
- Directional variations in visibility should be reported with an indication of the direction of observation, for example, “VIS 2000M TO S”.
- RVR values above 1500 m and up to 2000 m are to be reported in METAR/SPECI and in special MET REPORTS as supplementary information which should not be disseminated internationally.
- If the horizontal visibility is 1500 m or less but RVR is more than 2000 m the same should be reported as “RVR ABV 2000 M” as supplementary information.

3. CRITERIA FOR ISSUANCE OF LOCAL SPECIAL REPORTS AND SPECI

Local special report and SPECI should be issued whenever changes in accordance with the following criteria occur:

a) Surface Wind

i) When the mean surface wind direction has changed by 60^0 or more from that given in the latest report, the mean wind speed before and/or after the change being 10 knots or more;

ii) When the mean surface wind speed has changed by 10 knots or more from that given in the latest report;

iii) When the variation from the mean surface wind speed (gusts) has increased by 10 knots or more from that given in the latest report, the mean speed before and/or after the change being 15 knots or more.

b) Visibility

When the visibility is improving and changes to or passes through one or more of the following values, or when the visibility is deteriorating and passes through one or more of the following values:

800, 1500, 3000 or 5000 meters.

c) Runway Visual Range (RVR)

When the runway visual range is improving and changes to or passes through one or more of the following values, or when the runway visual range is deteriorating and passes through one or more of the following values:

150, 350, 600 or 800 metres.

d) Present Weather

(i) When the onset, cessation or change in intensity of any of the following weather phenomena occurs:

freezing precipitation

moderate or heavy precipitation (including showers thereof)

thunderstorm (with precipitation)

duststorm

sandstorm

funnel cloud (tornado or waterspout)

(ii) When the onset or cessation of any of the following weather phenomena occurs:

ice crystals

freezing fog

low drifting dust, sand or snow

blowing dust, sand or snow

thunderstorm (without precipitation)

squall

e) Cloud

i) When the height of base of the lowest cloud layer of BKN or OVC extent is lifting and changes to or passes through one or more of the following values, or when the height of base of the lowest cloud layer of BKN or OVC extent is lowering and passes through one or more of the following values:

30, 60, 150, 300, or 450 m (100, 200, 500, 1000 or 1500 ft.)

ii) When the amount of a cloud layer below 450 m (1500 ft) changes:

a) from SCT or less to BKN or OVC; or

b) from BKN or OVC to SCT or less.

f) Vertical Visibility

When the sky is obscured and the vertical visibility is improving and changes to or passes through one or more of the following values, or when the vertical visibility is deteriorating and passes through one or more of the following values:

30, 60, 150 or 300M (100, 200, 300, 1000FT)

g) Air temperature

When air temperature has increased by 2^0 C or more from that given in the latest report.

Dissemination of SPECI and SPECIAL REPORT:

1) When a deterioration of one weather element is accompanied by an improvement in another element, a single SPECI / local special report should be issued. It should be treated as a deterioration report.

2) SPECI representing a deterioration in conditions shall be disseminated immediately after the observation.

3) A SPECI representing a deterioration of one weather element and an improvement in another element shall be disseminated immediately after the observation.

4) A SPECI representing an improvement in conditions shall be disseminated only after the improvement has been maintained for 10 minutes; it shall be amended before dissemination, if necessary, to indicate the conditions prevailing at the end of that 10 minute period.

5) Local Special Reports shall be transmitted to local air traffic services units as soon as the specified conditions occur, even if it represents an improvement in conditions.

6) Local Special Reports shall also be made available to the operators and to other users at the aerodrome.

4 ADDITIONAL REPORTS

4.1 This message is identified with the prefix “ADDITIONAL” and supplied on red colour paper. However, these are not disseminated outside the aerodrome of origin. These are issued to local ATC units in addition to the local routine reports and local special reports.

4.2 ADDITIONAL reports shall be issued for changes in cloud base height and visibility by all aeronautical meteorological offices in India as per the following criteria:

Element	Criteria	*Issued by*
i) Cloud base	Whenever the height of base of cloud covering more than half the sky changes to or passes 90 or 120 metres (300 or 400 feet)	All stations equipped with ceilometers/ ceilographs.
ii) Visibility	Whenever visibility changes to or passes 2000 or 4000 metres.	By all aerodrome meteorological offices/ aeronautical meteorological stations recording routine observations.

5 TREND FORECAST

General:

- Landing forecasts issued in India as a routine are called trend forecast.
- These forecasts are intended to meet the requirements of local users and of aircraft within about one hour’s flying time from the aerodrome.
- All Aerodrome Meteorological Offices (with forecasting facility) issue TREND forecasts during the forecast watch hours.
- The AMSs at Kochi and Kozhikode also issue TREND forecasts.
- They are appended to a local routine or local special report, or a METAR or SPECI.
- The period of validity of a trend forecast shall be 2 hours from the time of the report, which forms part of the landing forecast.

Inclusion of meteorological elements in trend forecasts

- The trend forecast indicates significant changes in respect of one or more of the elements: surface wind, visibility, weather and clouds.
- Only those elements are included for which a significant change is expected.
- However, in the case of significant changes in respect of cloud, all cloud groups, including layers, or masses not expected to change, shall be indicated.
- In the case of a significant change in visibility, the phenomenon causing the reduction of visibility should also be indicated.
- When no change is expected to occur, this shall be indicated by the term “NOSIG”.

Use of change indicators

When a change is expected to occur, the trend forecast message should begin with one of the change indicators “BECMG” or “TEMPO”.

BECMG

- The change indicator “BECMG” is used to describe forecast changes where the meteorological conditions are expected to reach or pass through specified values at a regular or irregular rate.
- The period during which, or the time at which, the change is forecast to occur is indicated, using the abbreviations “FM”, “TL”, or “AT”, as appropriate.
- They should be followed by a time group in hours and minutes.
- When the change is forecast to begin and end wholly within the trend forecast period, the beginning and end of the change shall be indicated by using the abbreviations “FM” and “TL” respectively with their associated time groups.

For example, for a trend forecast period from 1000 to 1200 UTC in the form, “BECMG FM1030 TL1130” (in both METAR and local routine report).

TEMPO

- The change indicator “TEMPO” is used to describe forecast temporary fluctuations in the meteorological conditions which reach or pass specified values and last for a period of less than one hour in each instance and, in the aggregate, cover less than one-half of the period during which the fluctuations are forecast to occur.
- The period during which the temporary fluctuations are forecast to occur shall be indicated, using the abbreviations “FM” and/or “TL”, as appropriate
- They should be followed by a time group in hours and minutes.

Example, for a trend forecast period from 1000 to 1200 UTC in the form “TEMPO FM1030 TL1130” (in both METAR and local routine report).

Surface wind

The trend forecast for surface wind is issued for the following conditions:

a) a change in the mean wind direction of 60^0 or more, the mean speed before and/or after the change being 10 kt or more;

b) a change in mean wind speed of 10 kt or more.

Example:

An expected temporary fluctuation of surface wind from 250^o at 35 kt with maximum speed (gusts) to 50 kt throughout the period of the trend forecast is indicated in the form:

“TEMPO 25035G50KT” in METAR and

“TEMPO 250/35KT MAX50” in METREPORT

Visibility

- Trend forecast for visibility is issued when it is expected to change to or pass through any one of the values 150, 350, 600, 800, 1500, 3000 or 5000 m.
- Whenever reduction of visibility is indicated in trend forecasts in locally disseminated reports, the reasons for such reduction in visibility is also specified in the trend part of the message.

Example:

A temporary reduction throughout the period of the trend forecast of the visibility to 750 m in fog shall be rounded down to 700 m and indicated in the form

“TEMPO 0700” in METAR or

“TEMPO VIS 700M” MET REPORT.

Weather phenomena

a) The trend forecast should indicate the expected onset, cessation or change in intensity of one or more of the following weather phenomena or combinations thereof:

-freezing precipitation

-moderate or heavy precipitation (including showers thereof)

-thunderstorm (with precipitation)

-duststorm

-sandstorm

-other weather phenomena if they are expected to cause a significant change in visibility.

b) The trend forecast should indicate the expected onset or cessation of one or more of the following weather phenomena or combinations thereof:

-ice crystals

-freezing fog

-low drifting dust, sand or snow

-blowing dust, sand or snow

-thunderstorm (without precipitation)

-squall

-funnel cloud (tornado or waterspout)

c) The total number of phenomena reported in (a) and (b) should not exceed three.

d) The expected end of the weather phenomena shall be indicated by the abbreviation “NSW”.

Example:

(1) “TEMPO FM0300 TL0430 TSRA” (METAR) and “TEMPO FM0300 TL0430 MOD TSRA” (local routine report).

(2) An expected cessation at 1630 UTC, of significant weather, such as a thunderstorm, is indicated in the form “BECMG AT1630 NSW” (in both METAR and local routine report).

Clouds

- Trend forecast should be issued when the height of the base of a cloud layer of BKN or OVC extent is expected to change to or pass through one or more of the following values: 30, 60, 150, 300 and 450 m (100, 200, 500, 1000 and 1500 ft).
- When the height of the base of a cloud layer is below or is expected to fall below or rise above 450 m (1500 ft), the trend forecast should also indicate changes in cloud amount from FEW, or SCT increasing to BKN or OVC, or changes from BKN or OVC decreasing to FEW, or SCT.

- When no clouds of operational significance are forecast and “CAVOK” is not appropriate, the abbreviation “NSC” should be used.

Vertical visibility

When the sky is expected to remain or become obscured and vertical visibility observations are available at the aerodrome, and the vertical visibility is forecast to change to or pass through one or more of the following values: 30, 60, 150, or 300m (100, 200, 500, or1000 ft), the trend forecast should indicate the change.

Chapter 4

TERMINAL AERODROME FORECAST (TAF)

Objectives:

1. Explain TAF code

2. Decode a coded TAF into a plain language message

Sub topics

1. Description of the TAF code form

2. Decoding of the coded TAF into plain language message

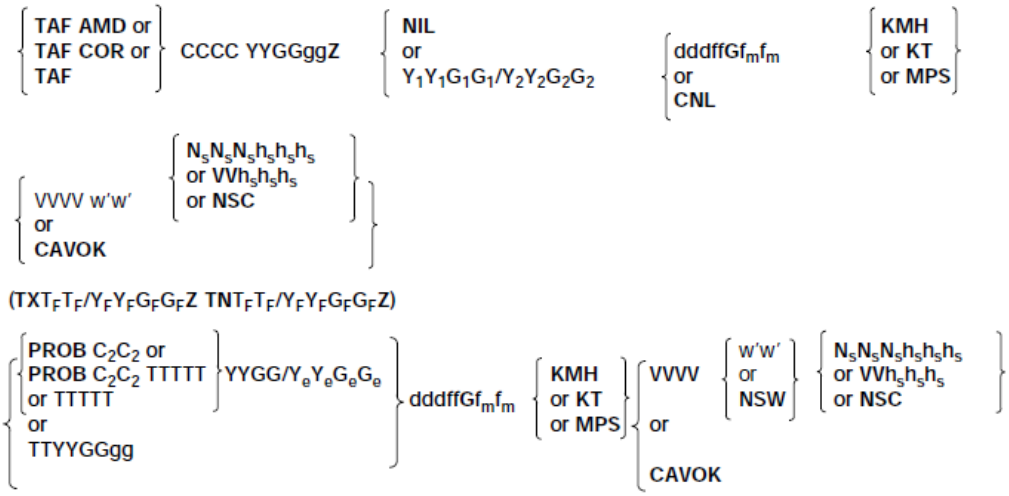
4.1 TERMINAL AERODROME FORECAST- GENERAL:

- A Terminal Aerodrome Forecast is a concise statement of the expected meteorological conditions at an aerodrome for a specified period.
- TAF is being issued by all Aerodrome meteorological offices in India aerodrome forecast for their own aerodromes and their associated Aeronautical Meteorological Stations.
- In the case of Aerodrome meteorological offices with restricted watch, the Aerodrome meteorological office at the Regional Centre or the associated Aerodrome meteorological office at the Meteorological Centre at the State Capital or the respective MWO will assume the responsibility of issuing the relevant aerodrome forecast during the closed period of forecast watch of the concerned meteorological offices.
- Aerodrome forecast and amendments thereto should be issued only in accordance with the template given and shall be disseminated in the TAF code form.

TAF include the following information in the order indicated:

a) identification of the type of forecast
b) location indicator;
c) time of issue of forecast;
d) date and period of validity of forecast;
e) surface wind;
f) visibility;
g) weather;
h) cloud; and
i) expected significant change to one or more of these elements.

4.2 TAF CODE FORM



4.3 TEMPLATE FOR TAF

Key:

M= inclusion mandatory, part of every message

C= inclusion conditional, dependent on meteorological conditions or method of observation

O= inclusion optional

Elements	Detailed content	Template		Examples	
Identification of the type of forecast (M)	Type of forecast (M)	TAF or TAF AMD		TAF TAF AMD	
Location indicator (M)	ICAO location indicator (M)	Nnnn		VABB	
Time of issue of forecast (M)	Day and Time of issue of the forecast in UTC (M)	nnnnnnZ		160000Z	
Days and period of validity of forecast (M)	Days and period of the validity of the forecast in UTC (M)	nnnn/nnnn		1606/1615 0812/0918	
Surface wind (M)	Wind Direction (M)	nnn or VRB		24008KT VRB02KT 19011KT 00000KT 140P99KT 12006G18KT 24016G27KT	
	Wind speed (M)	(P)nn(n) (P *indicates that the forecast wind speed is more than 99 knots. There is no aeronautical requirement to report surface winds of 100 knots or more; however, provision has been made by giving "(n)" for reporting wind speeds up to 199 knots for non-aeronautical purposes, as necessary)*			
	Significant speed variations (C)	G(P)nn(n) *"G" Indicates the forecast maximum wind speed (gust)*			
	Units of measurement (M)	KT			
Visibility (M)	Minimum visibility (M)	Nnnn			0350 CAVOK 7000 9000 9999
Weather (C)	Intensity of weather phenomena (C)	- or +			
	Characteristics and type of weather phenomena (C)	DZ or RA or SN or SG or PL or DS or	IC or FG or BR or SA or DU or HZ or	C	RA HZ +TSRA FG -FZDZ PRFG

		SS or FZDZ or FZRA or SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or TSSN	FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or FZFG or MIFG or PRFG	A V O K	 +TSRASN SNRAFG

Cloud (M)	Cloud amount and height of base or vertical visibility (M)	FEWnnn or SCTnnn or BKNnnn or OVCnnn	VVnnn or VV///	NSC		FEW010 VV005 OVC020 VV/// SCT005 BKN012 SCT008 BKN025CB NSC
	Cloud type (C)	CB or TCU	--			
Expected significant changes to one or more of the above elements during the period of validity (C)	Change or probability indicator (M)	PROB30 (TEMPO) or PROB40 (TEMPO) or BECMG or TEMPO or FM				TEMPO 0815/0818 25035G50KT TEMPO 2212/2214 17012G25KT 1000 TSRA SCT010CB BKN 020 BECMG 3010/3011 00000KT 2400 OVC010 PROB30 1412/1414 0800 FG BECMG 1412/1414 RA TEMPO 2503/2504 FZRA TEMPO 0612/0615 BLSN PROB40 TEMPO 2923/3001 0500 FG
	Period of occurrence or change (M)	nnnn/nnnn				
	Wind (C)	nnn(P)nn(G(P)nn)KT or VRBnnKT ((P *indicates that the forecast wind speed is more than 99 knots)* *"G" Indicates the forecast maximum wind speed (gust)*				
	Minimum visibility (C)	Nnnn			C A V O K	
	Weather phenomena: intensity (C)	- or +		NSW		
	Weather phenomena: characteristics and type (C)	DZ or RA or SN or SG or PL or DS or SS or FZDZ or FZRA or SHGR or SHGS or SHRA or SHSN or TSGR or TSGS or TSRA or	IC or FG or BR or SA or DU or HZ or FU or VA or SQ or PO or FC or TS or BCFG or BLDU or BLSA or BLSN or DRDU or DRSA or DRSN or			

		TSSN	FZFG or MIFG or PRFG			
	Cloud amount and height of base or vertical visibility (C)	FEWnnn or SCTnnn or BKNnnn or OVCnnn	VVnnn Or VV///	NSC		FM051230 15008KT 9999 BKN020 BECMG 1618/1620 8000 NSW NSC
	Cloud type (C)	CB or TCU	--			BECMG 2306/2308 SCT015CB BKN020

4.4 VALIDITY AND FREQUENCY OF UPDATION:

- TAF of 30 hr are issued for the purpose of international flights.
- 9 hr TAF is issued for serving the domestic flights and for VOLMET/ D-VOLMET broadcast.
- The 9 hr TAFs are not exchanged/ disseminated internationally.

The schedule of issuance of the 9 hour TAF and 30 hour TAF is as follows:

Based on Chart (UTC)	Time of Issue (UTC)	Period of validity (UTC)	
		9 hourly	30 hourly
1800	2100	00-09	00-06
2100	0000	03-12	-
0000	0300	06-15	06-12
0300	0600	09-18	
0600	0900	12-21	12-18
0900	1200	15-24	-
1200	1500	18-03	18-00
1500	1800	21-06	-

4.5 INCLUSION OF METEOROLOGICAL ELEMENTS IN TAF

Surface wind:

- The expected prevailing surface wind direction is given.
- When it is not possible to forecast a prevailing direction, the forecast wind direction is indicated as “variable” using “VRB”. (for example, during light wind conditions (less than 3kt) or thunderstorms)
- When the wind is forecast to be less than 1 knot (calam), it will be indicated as 00000KT.
- When the forecast maximum wind speed (gust) exceeds the forecast mean wind speed by 10kt or more, the forecast maximum wind speed shall be indicated.
- When the wind speed of 100kts or more is forecast it shall be indicated to be more than 99kt in the form P99KT.

Visibility:

When the visibility is forecast to be;

less than 800 m it is expressed in steps of 50 m;
between 800 m and 5 km, in steps of 100 m;
between 5 km and 10 km in kilometre steps; and
more than 10 km, it is expressed as 10 km, except when conditions of CAVOK are forecast to apply.

Weather phenomena:

- One or more, up to a maximum of three of the following weather phenomena
- or combinations thereof, together with their characteristics and,
- where appropriate, their intensity:

  - freezing precipitation
  - freezing fog
  - moderate or heavy precipitation (including showers thereof)
  - low drifting dust, sand or snow
  - blowing dust, sand or snow
  - duststorm
  - sandstorm
  - thunderstorm (with or without precipitation)
  - squall
  - funnel cloud (tornado or waterspout)
  - other weather phenomena if they are expected to cause a significant change in visibility.

- The expected end of occurrence of those phenomena shall be indicated by the abbreviation “NSW”.

Cloud:

- Cloud amount is given using “FEW”, “SCT,” “BKN” or “OVC”.
- When several layers or masses of cloud are forecast, they should be included in the following order:

    - the lowest layer or mass regardless of amount, to be forecast as FEW, SCT, BKN or OVC as appropriate;
    - the next layer or mass covering more than 2/8, to be forecast as SCT, BKN or OVC as appropriate;
    - the next higher layer or mass covering more than 4/8 to be forecast as BKN or OVC as appropriate; and
    - cumulonimbus clouds and/or towering cumulus clouds, whenever forecast and not already included under a) to c) above.
    - Cloud information shall be limited to cloud of operational significance
    - when no cloud of operational significance is forecast, and “CAVOK” is not appropriate, the abbreviation “NSC” shall be used.
- Vertical visibility is to be forecast in the form “VV” followed by the forecast value of the vertical visibility when the sky is expected to remain or become obscured and clouds cannot be forecast and information on vertical visibility is available.

4.6 USE OF CHANGE GROUP

- The criteria for inclusion of change groups:
    a. when the mean surface wind direction is forecast to change by 60º or more, the mean speed before and/or after the change being 10 kt or more;
    b. when the mean surface wind speed is forecast to change by 10 kt or more;
    c. when the variation from the mean surface wind speed (gusts) is forecast to increase by 10 knots or more, the mean speed before and/or after the change being 15 knot or more;
    d. diurnal changes of surface wind (onset of sea breeze etc.), even if the changes do not meet the above criteria.
    e. when the visibility is forecast to change to or pass through one or more of the following values: 150, 350, 600, 800, 1500, 3000 or 5000m;
    f. when any of the following weather phenomena or combinations thereof are forecast to begin or end or change in intensity:
        freezing precipitation
        moderate or heavy precipitation (including showers thereof)
        thunderstorm (with precipitation)
        duststorm
        sandstorm

g. when any of the following weather phenomena or combinations thereof are forecast to begin or end:

ice crystals
freezing fog
low drifting dust, sand or snow
blowing dust, sand or snow
thunderstorm (without precipitation)
squall
funnel cloud (tornado or waterspout)

h. when the height of base of the lowest layer or mass of cloud of BKN or OVC extent is forecast pass through one or more of the following values:

30, 60, 150, 300 or 450 m (100, 200, 500, 1000 or 1500 ft);

i. when the amount of a layer or mass of cloud below 450 m (1500 ft) is forecast to change:

1) from NSC, FEW or SCT to BKN or OVC; or
2) from BKN or OVC to NSC, FEW or SCT;

j. when the vertical visibility is forecast to pass through one or more of the following values:

30, 60, 150, or 300m (100,200,500 or 1000ft)

- When a change in any of the elements is required to be indicated, the change indicators “BECMG” or “TEMPO” is to be used followed by the time period.
- “BECMG” is used to describe changes where the meteorological conditions are expected to reach or pass through specified threshold values at a regular or irregular rate and at an unspecified time during the time period. The time period shall normally not exceed 2 hours but in any case shall not exceed 4 hours.
- “TEMPO” is used for frequent or infrequent temporary fluctuations in the meteorological conditions which reach or pass specified threshold values and last for a period of less than one hour in each instance and, in the aggregate, cover less than one-half of the forecast period.

4.6 FILING TIME OF TAF

- The 9 hourly TAF and 30 hourly are filed for departmental exchange 3 hours before the start of the validity period.
- The 30 hr TAF to international destination are filed one hour before the beginning of validity period.

Chapter 5

AREA/ LOCAL FORECAST

Objectives:

Explain an Area/ Local Forecast

Sub topic

Description of Area/ Local forecast template

5.1 AREA AND LOCAL FORECASTS- GENERAL

- AMOs in India should issue Local forecasts for their own aerodromes
- Area forecasts for the AMSs under their control as per requirement.
- These are issued for the use of low-level flights including helicopters.
- Both Local and Area forecasts are issued in the same template.
- Both are valid over the aerodrome and 100 NM around.
- Local and Area forecasts are to be issued three times a day, where ATC watch is maintained for 24 hrs.
- Each forecast shall be valid for the next 8 hours

- The schedule is as indicated below:

Issued at (UTC)	Valid for (UTC)
i) 2130	2200 – 0600
ii) 0530	0600 – 1400
iii) 1330	1400 – 2200

- At aerodromes, where the ATC maintains only restricted watch, Local and Area forecasts are to be issued to cover the ATC watch

5.2 Template

TEMPLATE FOR AREA/ LOCAL FORECAST

MET.T-2

INDIA METEOROLOGICAL DEPARTMENT

METERROLOGICAL OFFICE _____ *XXXX AIRPORT*

LOCAL / AREA FORECAST *FOR VXXX AND 100 NM AROUND*

from *0600* hours UTC *2010-10-26* date
till *1400* hours UTC *2010-10-26* date

Time of Origin *2010-10-26 hours 0530 UTC*

SURFACE WIND : *020/10KT MAX20 BECMG 11/13 VRB/02KT*

UPPER WIND

16000M	100 / 15	-78	4500M	050 / 10	+03
13500M	120 / 20	-68	3000M	020 / 10	+10
12000M	110 / 20	-55	2100M	050 / 05	+15
10500M	090 / 20	-43	1500M	050 / 05	+20
9000M	070 / 15	-32	900M	020 / 05	+25
7500M	070 / 20	-15	600M	020 / 05	+27
6000M	070 / 15	-04	300M	020 / 05	+28

WEATHER: *HZ TEMPO 09 / 14 MOD TSRA(.) TEMPO 09/14 SEV TURB AND MOD ICING IN CB*

VISIBILITY: *4000M IN HZ TEMPO 09 / 14 3000M IN MOD TSRA*

CLOUD *SCT SC* 450/600 *M* *BKN AC* 2400/2700 *M* *TEMPO 09 / 14*

BKN ST 240 *M* *SCT SC* 360/540 *M* *ISOL CB* 900/7000 *M*

FREEZING LEVEL: *4800M*

ADDITIONAL NOTES: *TEMPO 09 / 14 SEV TURB AND MOD ICING IN CB*

WARNING: VISIBILITY LIKELY 4000M IN HZ AND 3000M IN MOD TSRA BETWEEN 09/14 MOD TSRA LIKELY BETWEEN 09/14 WHEN LOW CLOUD BASE 240 M WITH 5 OKTA OR MORE LIKELY.

WARNING FOR LIGHT AIRCRAFT: WIND SPEED MAY REACH 20KTS IN GUST WITH DIRECTION FROM 020

Sunrise *27/ 0643EF* Sunset *26/ 1729EF* Moonrise *27 / 0834EF* Moonset *26/ 1841EF*
Phase of Moon Issued at *0530* hrs. UTC *2010-10-26*

"All heights are above M.S.L."

Meteorological Officer

Chapter 6

ROUTE FORECAST (ROFOR)

Objectives:
1. Describe ROFOR code
2. Decode a ROFOR and prepare the route forecast in MET-T3/ MET-T4 format

Sub topic
1. ROFOR Code
2. Decoding of the coded ROFOR in plain language
3. Instructions on preparation of MET- T3
4. Instructions on preparation of MET-T4
5. Preparation of a route forecast in MET-T3 form
6. Preparation of a route forecast in MET-T4 form

6.1 GENERAL:

Route forecast are issued in:

1. Code form

2. Chart form and

3. Pictorial form

ROFOR is issued in coded form by AMOs and transmitted to AMSs for preparation of route forecast between two specified aerodromes. ROFOR is then decoded and MET-T4/ MET-T3 are prepared for handing over to pilot.

MET-T4 is used for flights beyond 500 nautical miles and MET- T3 is used for flight below 500 nautical miles.

6.2 ROFOR CODE FORM:

The code form is divided into four sections as follows:

Section number	Symbolic figure group	Contents
1	--	Code identification and time groups; route forecast
2	*11111*	Jet-stream data (optional)
3	*22222*	Data of maximum wind and vertical wind shear (optional)
4	--	Supplementary phenomena

Sections 2, 3 and 4 are not transmitted separately.

SECTION 1	**ROFOR**	**(YYGGggZ)**	**$Y_1Y_1G_1G_1G_2G_2$**	**KMH or KT**	
	CCCC	**($QL_aL_aL_oL_o$)**	**CCCC**	**$0i_2zzz$**	
	(VVVV)	**($w_1w_1w_1$)**	**$N_sCCh_sh_sh_s$**	**$7h_th_th_th_fh_fh_f$**	**$6I_ch_ih_ih_it_L$**
	$5Bh_Bh_Bh_Bt_L$	**($4h_xh_xh_xT_hT_h$**	**$d_hd_hf_hf_hf_h$)**	**($2h'_ph'_pT_pT_p$)**	
SECTION 2	**(11111**	**$QL_aL_aL_oL_o$**	**$h'_jh'_jf_jf_jf_j$)**		
SECTION 3	**(22222**	**$h'_mh'_mf_mf_mf_m$**	**(d_md_mvv))**		
SECTION 4	**$9i_3nnn$**				

REGULATIONS:

Section 1

The code name ROFOR shall appear as a prefix to individual coded area forecasts, followed by the group YYGGggZ.

Group **YYGGggZ**	shall be included in each individual forecast to report the date and time of origin of forecast
YY	Day of the month
GGggZ	Time of origin of forecast , in hours and minutes UTC, followed by the letter Z as an abbreviated indicator of UTC
Group **$Y_1Y_1G_1G_1G_2G_2$**	shall be immediately followed, with a space, by the unit of wind speed used and indicated by one of the letter code indicators **KT or MPS,** as the case may be.

Y_1Y_1	Day of the month of the beginning of the period of validity
G_1G_1	Time of commencement of period of forecast in whole hours UTC. When the period of forecast commences at midnight, G_1G_1 shall be encoded 00
G_2G_2	Time of ending of period of forecast in whole hours UTC. When the period of forecast ends at midnight, G_2G_2 shall be encoded 24. And When the period is between 25 and 48 hours after G_1G_1, G_2G_2 shall be encoded by adding 50 to the time of ending of period of forecast.
Group **YYGGggZ**	Shall be included in each individual forecast to report the date and time of origin of forecast.
YY	Day of the month
GGggZ	Time of origin of forecast , in hours and minutes UTC, followed by the letter Z as an abbreviated indicator of UTC
Group **$Y_1Y_1G_1G_1G_2G_2$**	shall be immediately followed, with a space, by the unit of wind speed used and indicated by one of the letter code indicators **KMH, KT or MPS,** as the case may be
Y_1Y_1	Day of the month of the beginning of the period of validity
G_1G_1	Time of commencement of period of forecast in whole hours UTC. When the period of forecast commences at midnight, G_1G_1 shall be encoded 00
G_2G_2	Time of ending of period of forecast in whole hours UTC. When the period of forecast ends at midnight, G_2G_2 shall be encoded 24. And When the period is between 25 and 48 hours after G_1G_1, G_2G_2 shall be encoded by adding 50 to the time of ending of period of forecast
	In describing forecast conditions, one of the two following methods shall be used: (a) By dividing the route into sections (i_2 = 0 to 5 inclusive) and giving the details of conditions expected during the period over the extent of each section. Five-degree zones (i_2 = 5) may be combined if weather elements are sufficiently uniform; (b) By selecting series of points along the route (i_2 = 6 to 9 inclusive) and forecasting the conditions at these points. Sufficient points must be selected to provide an adequate sampling of the various weather and wind conditions expected along the route.
Route designation	The route to which the forecast applies shall be given by the international four-letter location indicators CCCC of the aerodromes at either end of the route. Where it is desirable to specify the route in greater detail, group(s) $QL_aL_aL_oL_o$ shall be included between CCCC groups to identify a sufficient number of additional points. The forecast detail shall be given starting from the aerodrome of departure indicated by the first CCCC group. ICAO location indicators shall be used

Group QLaLaLoLo	
Q	**Octant of the globe** Q is quadrant in which forecast lie. For India Q is 3
$0i_2zzz$	The group $0i_2zzz$ shall be used at the beginning of the forecast for each section or point
0	This is zero sector
i_2	Zone type indicator
zzz	Zone specification
00000	Upto the turning point indicated by the first group $QL_aL_aL_oL_o$ which appears between the index numbers at the beginning of the message
$01QL_aL_a$	Up to latitude L_aL_a
$02QL_oL_o$	Up to longitude L_oL_o
03CCCC	Upto the aerodrome identified by CCCC
Group **VVVV (Visibility group)**	this group shall be omitted when visibility is not forecast. When the horizontal visibility is forecast not to be the same in different directions, the minimum visibility shall be given for VVVV
Group $\mathbf{w_1w_1w_1}$ **(weather group)**	this group shall be used in coded form when any of the following phenomena are forecast: for thunderstorm(TS) it is 111, tropical cyclone(TRS)-222, severe line squall(LRS)-333, hail(HAIL)-444, marked mountain waves(MTW)-555, widespread sandstorm(SAND)-666, dust storm(DUST)-777, freezing rain(FZR)-888. The corresponding equivalents in the form of letter abbreviations shall be added and the letter abbreviations shall immediately follow the $w_1w_1w_1$ figures without the insertion of any space.
Cloud Group $\mathbf{N_sCCh_sh_sh_s}$ **or** $\mathbf{(VVh_sh_sh_s)}$ **or NSC**	
$\mathbf{N_s}$	Amount of individual cloud layer or mass whose genus is indicated by CC
CC	Genus (Type of cloud) of cloud in two letters
$\mathbf{h_sh_sh_s}$	Height of base of cloud layer or mass, or observed or forecast vertical visibility
Cloud amount and cloud height	The cloud amount $N_sN_sN_s$ shall be given as few (1 to 2 oktas), scattered (3 to 4 oktas), broken (5 to 7 oktas) or overcast (8 oktas), using the three-letter abbreviations FEW, SCT, BKN and OVC followed, without a space, by the height of the base of the cloud layer (mass) $h_sh_sh_s$ The cloud group shall be repeated to indicate different layers or masses of cloud forecast. The number of groups shall not exceed three, except that Cumulonimbus clouds, when forecast, shall always be included
	The selection of forecast layers or masses of cloud to be

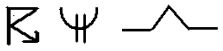
	included shall be made in accordance with the following criteria	
	1st group	the lowest individual layer (mass) of any amount, to be indicated as FEW, SCT, BKN or OVC
	2nd group	the next individual layer (mass) covering more than two oktas, to be indicated as SCT, BKN or OVC
	3rd group	the next higher individual layer (mass) covering more than four oktas, to be indicated as BKN or OVC
	Additional groups	*Cumulonimbus clouds (CB) when forecast if not* already included in one of the three groups above
	The order of inclusion of the groups shall be from lower to higher levels	
$h_sh_sh_s$	The height of the base of forecast cloud layer (mass) shall be coded in units of 30 metres (100 ft) in the form $h_sh_sh_s$	
NSC	shall be used when there are no clouds of operational	
VV*///*	*Vertical visibility* when the sky is expected to be obscured and clouds cannot be forecast it shall be indicated as VV/// in lieu of **$N_sCCh_sh_sh_s$**	
Group *7***$h_th_th_th_fh_fh_f$**	Indicator of the height of top of the cloud and 0°C isotherm forecast above mean sea level	
$h_th_th_t$	Altitude of cloud layer or mass. The altitude is reported in terms of flight level	
$h_fh_fh_f$	Altitude of the 0°C isotherm. The altitude is reported in terms of flight level	
	When the heights above mean sea level of both the base and top of a number of layers are forecast, the cloud and 7-groups shall be used in pairs for each layer. When the 0°C isotherm is forecast but no forecast is made for top of clouds, the 7-group shall have the form $7///h_fh_fh_f$. If two cloud groups are given but only one 0°C isotherm is forecast, the order of the groups shall be cloud group, 7-group, cloud group, 7-group, and 0°C isotherm as $7h_th_th_th_fh_fh_f$ and the second cloud group 7-group and for 0°C isotherm /// shall be given as $7h_th_th_t///$. If one cloud group and two 0°C isotherms are forecast, the groups shall be given as cloud group, 7-group, 7-group, with the second 7-group given as $7///h_fh_fh_f$	
Group **$6I_ch_ih_ih_it_L$**	Icing group indicator of the height of base and top of the icing	
I_c	Code for type of forecast ice accretion on the external parts of aircraft Code for no icing is 0 for light icing 1-3 for Moderate icing 4-6 for severe Icing 7-9	

$\mathbf{h_ih_ih_i}$	Height of lowest level of icing in coded form. The code is directly in unit of 30metres code 001 means 30metres, 002 means 60metres, 003 means 90 meters and so on.
$\mathbf{t_L}$	Thickness of icing layer in code form (0-9). It is in multiple of 300.That is code multiplied by 300 gives thickness in meters. And then add it to lowest level (in meter) of icing which will give top of icing in meter. If required this group shall be repeated as often as necessary to indicate more than one type or more than one layer of icing If the thickness of the layer for any one type of icing is greater than 2700 metres, the group shall be repeated and the base indicated in the second group shall coincide with the top of the layer as given in the preceding group.
Group $\mathbf{5Bh_Bh_Bh_Bt_L}$	Turbulence group indicator of the height of base and top of turbulence
B	Code for type of forecast of turbulence. Code for no turbulence is 0; for light turbulence-1; for Moderate turbulence 2-5; and for severe turbulence 6-9
$\mathbf{h_Bh_Bh_B}$	Height of lowest level of turbulence in code form. The code is directly in unit of 30meter. code 001 is 30meter for 002 is 60meter for 003 is 90 and so on
$\mathbf{t_L}$	Thickness of turbulence layer in code form(0-9). It is multiple of 300.That is code multiply by 300 gives thickness in meters. And then add it to lowest level (in meter) of turbulence it gives top of turbulence in meter
	If required this group shall be repeated as often as necessary to indicate more than one type or more than one layer of turbulence. If the thickness of the layer for any one type of turbulence is greater than 2700 meters, the group shall be repeated and the base indicated in the second group shall coincide with the top of the layer as given in the preceding group.
Groups $\mathbf{(4h_xh_xh_xT_hT_h}$ $\mathbf{d_hd_hf_hf_hf_h)}$	Height to which temperature and wind is to be reported
$\mathbf{h_xh_xh_x}$	Altitude to which temperature and wind reported. It is in the form of flight level
$\mathbf{T_hT_h}$	Air temperature, in whole degrees Celsius, at the height $h_xh_xh_x$. For negative values, T_hT_h shall be preceded by the letter M
$\mathbf{d_hd_h}$	True direction, in tens of degrees, from which wind will blow at the height h_x h_x h_x.
$\mathbf{f_hf_hf_h}$	Wind speed, in knots or metres per second, at the level given by $h_xh_xh_x$ These groups shall always be used together and repeated for each level for which temperature and wind are forecast

Group **(2h'$_p$h'$_p$T$_p$T$_p$)**	this group gives the height and temperature of tropopause
h'$_P$h'$_P$	Height of the tropopause level. These heights are indicated in ICAO flight level numbers with last figure omitted
T$_P$T$_P$	Air temperature, in whole degrees Celsius, at the level given by h'$_p$h'$_p$. For negative values, T$_p$T$_p$ shall be preceded by the letter M. This group shall be omitted when tropopause data are not forecast.
Section 2	Jet-stream data. It is an optional group Section 2 shall be omitted when jet-stream data are not forecast
Group **QL$_a$L$_a$L$_o$L$_o$** **h'$_j$h'$_j$f$_j$f$_j$f$_j$**	This is group for reporting location of JET Stream
Q	Octant of the globe
L$_a$ L$_a$	Latitude, in whole degrees in two figure
L$_o$L$_o$	Longitude, in whole degrees in two figures and hundred unit of longitude is to be omitted
h'$_J$h'$_J$	Height of the level of the jet stream core. These heights are indicated in ICAO flight level numbers with last figure omitted
f$_j$f$_j$f$_j$	Wind speed, in kilometres per hour or knots or metres per second, in the jet core This group shall be repeated as often as necessary to indicate the position of the jet core and the wind to be encountered in the core of a jet which extends through a large portion of the area or through several zones
Section 3	Data of maximum wind and vertical wind shear it is optional group
h'$_m$h'$_m$f$_m$f$_m$f$_m$	Location and strength of Maximum wind
h'$_m$h'$_m$	Height of the maximum wind level. The heights are indicated in ICAO flight level numbers with last figure omitted
f$_m$f$_m$	Maximum wind speed, in kilometres per hour or knots or metres per second
d$_m$d$_m$vv	Direction & strength of vertical wind
d$_m$d$_m$	True direction, in tens of degrees, from which maximum wind will blow at the flight level given by n$_m$n$_m$n$_m$
vv	Vertical wind shear, in knots per 300 metres When the maximum wind is forecast but no forecast is made for the vertical wind shear, the last group of the section shall have the form d$_m$d$_m$// When only information for vertical wind shear is to be provided, the group h'$_m$h'$_m$f$_m$f$_m$f$_m$ is omitted from the coded forecast and the group d$_m$d$_m$vv shall have the form //vv
Section 4 *Group* **9i$_3$nnn**	This is a change group used for indicating supplementary phenomena and is used in accordance with regional air navigation agreements. In India only 96GGG$_P$ 97GGG$_P$ are used as BECMG and TEMPO respectively
91 P$_2$ P$_2$ P$_2$	Forecast lowest QFF (e.g. "Forecast QFF 1002'')

$92F_tL_aL_a$	The term FRONT should be used; the type is not normally designated; e.g. ”FRONT 40 N”
$93F_tL_oL_o$	The term FRONT should be used; the type is not normally designated; e.g.” FRONT 30 E”
$94F_tGG$	The term FRONT should be used; the type is not normally designated; e.g.,” FRONT 1200 UTC”
951//	The term BECMG (without the time group) should be used for this type of change
$952L_aL_a$	The form FM L_aL_aN should be used for this type of change where L_aL_a indicates the latitude (north) at which the change takes place
953 L_aL_a	The form FM L_aL_aS should be used for this type of change where L_aL_a indicates the latitude (south) at which the change takes place
$954L_oL_o$	The form FM L_oL_oE should be used for this type of change where L_oL_o indicates the longitude (east) at which the change takes place
$955L_oL_o$	The form FM L_oL_oW should be used for this type of change where L_oL_o indicates the longitude (west) at which the change takes place
$96GGG_p$	(a) The form FMGG should be used to indicate the beginning of self-contained part of the forecast indicated by GG. All forecast conditions before FMGG are superseded by the conditions indicated thereafter (b) The form BECMG GGG_eG_e should be used to indicate a change to forecast meteorological conditions expected to occur at either a regular or irregular rate at an unspecified time within the period beginning at GG and ending at G_eG_e The duration of the period beginning at GG and ending at G_eG_e shall normally not exceed two hours and in any case shall not exceed four hours
$97GGG_p$	The form TEMPO GGG_eG_e should be used to indicate frequent or infrequent temporary fluctuations to forecast meteorological conditions which are expected to last less than one hour in each instance and, in the aggregate cover, less than half of the period beginning at GG and ending at G_eG_e
$9999C_2$	The form PROB (percent) should be used for this group, either followed by GGG_eG_e to indicate the probability of occurrence of an alternative value of a forecast element (e.g. PROB30 1216), or followed by TEMPO GGG_eG_e to indicate the probability of occurrence of temporary fluctuations (e.g.PROB 30 TEMPO 1216)

6.3 GENERAL RULES FOR PREPARING ROUTE FORECAST (MET-T4)

1. 0° C isotherm is to be drawn as a dashed line in blue or black and labelled 0° C on either end.
2. Cloud amounts are to be indicated as SCT, BKN or OVC for all clouds other than CBs. For CBs the terms ISOL, OCNL, or FRQ are to be used to indicate the frequency of occurrence. The above terms are to be written either within the cloud or above it in capital letters. Cloud types are to be indicated after the terms SCT, ISOL, etc.
3. The portion of the cloud depicted below the 0^0 C isotherm is to be shaded green while the portion above 0^0 C isotherm is to be shaded red.
4. The following symbols are to be depicted in blue or black: 
5. General information about flight should be entered in first page of MET-T4 form. It contain Serial No. of flight, date of flight, flight number, ICAO name of AMO issuing route forecast, route for which forecast is valid, date and time of issuing route forecast, date and time of validity and Name of forecaster. And any other special information
6. TAFORS of originating and destination along with their alternates and inference may be given on first page under special information
7. Route forecast on MET-T4 is prepared in pictorial form

6.4 ROUTE FORECAST (ROFOR) (FOR DECODING INTO MET--T4 FORM)

General Information:

Serial No.PQR-01

Flight number: IC-849

Date of flight: 20-12-2012

ROFOR 200100Z 200310KT VOHY- VISR 01323 8000 FEW020 7070140 FEWCB030 7360/// BKN100 651406 580906 4185M04 27010 4300M24 22020 BECMG 25020 4400M38 34030 03VIDP 6000 SCT015 SCT025 7140130 BKN100 4185M08 34020 4300M32 33015 BECMG 30025 4400M44 33010 BECMG 29020 03 VISR 6000 FEW 008 SCT 025 7170120 TEMPO 2007/2010 1500 111TS FEWCB 030 7340/// OVC100 651206 580908 4185M10 33020 BECMG 31015 4300M34 28030 4400M49 27020 BECMG 33030.

Preparation for plotting MET-T4

ROFOR	Message indicator
200100Z	Date and Time of issue in UTC Issued on 20th day at 0100 UTC
200310KT	Period of validity On 20 Day of the month & valid from 0300 to 1000UTC
VOHY- VISR	ROFOR is from Hyderabad to Srinagar
01323	This division of route on latitude basis ie Route forecast is up to point 23 deg North eg 01 for latitude, 3 for quadrant, 23 is the point at latitude
8000	Visibility group , Vis is 8Km
FEW020	Cloud group. FEW is amount & type of cloud, 020 base of cloud
7070140	This group is top (height) of cloud & height of freezing level. 070 is top of cloud whose base is 020 & freezing level is 140
FEWCB030	FEW amount & type of cloud is CB, 030 base of CB cloud
7360///	360 is Top of CB. /// is given in place of freezing level as it has already given(140)
BKN100	BKN amount &type of cloud, 100 base of cloud
651406	This is icing group, 5 is type of icing at base height(flight level) 140 and thickness is 6.The base of icing is at 140 and top is (140*30 +6*300)/30=200
580906	This is turbulence group,8 is type of turbulence at base height 090 flight level and thickness 6.The base of turbulence 090 & top is (090*30 +6*300)/30=150
4185M04	Indicator of flight level (height) and corresponding temperature, 185 is flight level (height) and M04 (minus04) is temperature at flight level (height)
27010	This is wind direction and wind speed,270 is wind direction & 10Kt is wind speed at flight level(height) 185
4300M24	Indicator of flight level(height) and corresponding temperature, 300 is flight level(height) and M24(minus24^{0}C) is temperature at flight level(height) 300
22020 BECMG 25020	This is wind direction and wind speed group, 220^0 is wind direction and 20Kt is wind speed which changes to 250^0 direction and 20Kt at flight level (height) 300
4400M38	Indicator of flight level (height) and corresponding temperature, 400 is flight level (height) and M38 (minus38^{0}C) is temperature at flight level (height) 400
34030	This is wind direction and wind speed group , 340^0 is wind direction & 30Kt is wind speed at flight level (height) 400
03VIDP	This is division of route via airport i.e. 03 is indicator for route forecast is up to specific aerodrome. That route forecast is upto VIDP aerodrome
6000	Visibility is 6000 M

SCT015	Cloud group SCT is amount &type of cloud, 015 base of cloud
SCT025	Cloud group SCT is amount &type of cloud, 025 base of cloud
7140130	140 is top (height) of cloud whose base is at 025 & freezing level is 130
BKN100	BKN amount & type of cloud, 100 is the base of cloud
4185M08	Indicator of flight level(height) and corresponding temperature, 185 is flight level (height) and M08(minus08^{0}C) is temperature at flight level(height) 185
34020	This is wind direction and wind speed,340^0 is wind direction & 20Kt is wind speed at flight level(height) 185
4300M32	Indicator of flight level (height) and corresponding temperature, 300 is flight Level (height) and M32 (minus32^{0}C) is temperature at flight level(height) 300
33015 BECMG 30025	This is wind direction and wind speed group ,330^0 is wind direction and 15Kt is wind speed which changes to 300^0 direction and 25Kt at flight level (height) 300
4400M44	Indicator of flight level(height) and corresponding temperature, 400 is flight level(height) and M44(minus44^{0}C) is temperature at flight level(height) 400
33010 BECMG 29020	This is wind direction and wind speed group, 330^0 is wind direction &10Kt is wind speed which changes to 290^0 direction and 20Kt at flight level (height) 400
03VISR	This indicator of route forecast is upto VISR (Srinagar) aerodrome
6000	Visibility
FEW008	Cloud group FEW is amount &type of cloud, 008 base of cloud
SCT025	Cloud group SCT is amount &type of cloud, 025 base of cloud
7170120	170 is top(height) of cloud whose base is 025 & freezing level is 120
BKN100	BKN amount &type of cloud, 100 base of cloud
TEMPO	This is the change indicator, temporary fluctuation in met. Parameter
2007/2010	Date and validity temporary fluctuation, 20 is date, change is expected from 0700 to 1000 UTC
1500	Reduction in visibility to 1500M
111TS	weather group as the supplementary phenomena is Thunderstorm
FEWCB030	FEW amount & type of cloud is CB, 030 base of CB cloud
7340///	340 is Top of CB, /// - no freezing level forecast as it has already given (120)
OVC100	Cloud group OVC is amount &type of cloud, 1001 base of cloud

651206	This is icing group, 5 is type of icing at base height 120 flight level & thickness is 6. The base of icing is at 120 and top is (120*30 +6*300)/30=180
580908	This is turbulence group, 8 is type of turbulence at base height 090 flight level & thickness is 8. The base of turbulence 090 & top is (090*30 +8*300)/30=170
4185M10	Indicator of flight level(height) and corresponding temperature, 185 is flight level (height) and M10(minus10^{0}C) is temperature at flight level(height) 185
33020 BECMG 31015	This is wind direction and wind speed group ,330^0 is wind direction & 20Kt is wind speed which changes to 310^0 direction and 15Kt at flight level(height) 185
4300M34	Indicator of flight level (height) and corresponding temperature, 300 is flight level (height) and M34 (minus34^{0}C) is temperature at flight level (height) 300.
28030	This is wind direction and wind speed,280^0 is wind direction & 30Kt is wind speed at flight level(height) 300.
4400M49	Indicator of flight level (height) and corresponding temperature, 400 is flight level (height) and M49 (minus49^{0}C) is temperature at flight level (height) 49
27020 BECMG 33030	This is wind direction and wind speed group, 270^0 is wind direction and 20Kt is wind speed which changes to 330^0 direction and 30Kt at flight level (height) 400

मेट टी०-4
MET T.-4

उड़ान पूर्वानुमान/FLIGHT FORECAST

क्रम संख्या Serial No. P O R-01

उड़ान संख्या Flight No. I C-849

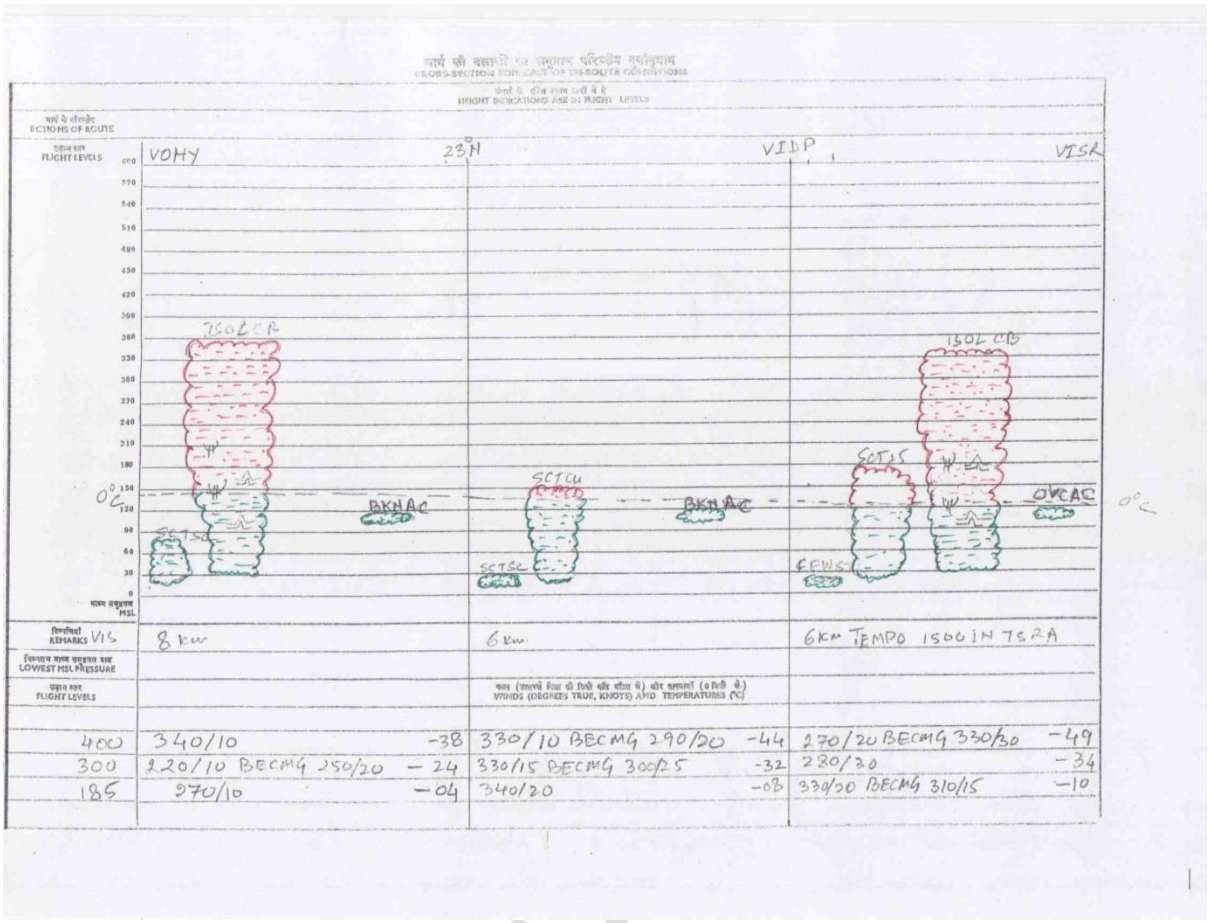
मौसम कार्यालय द्वारा Issued by CLASS I (VOHY) Meteorological Office 2012-12-20/0100 UTC
(दिनांक, समय जी० मा० स०)
(Date, Time G. M. T.)

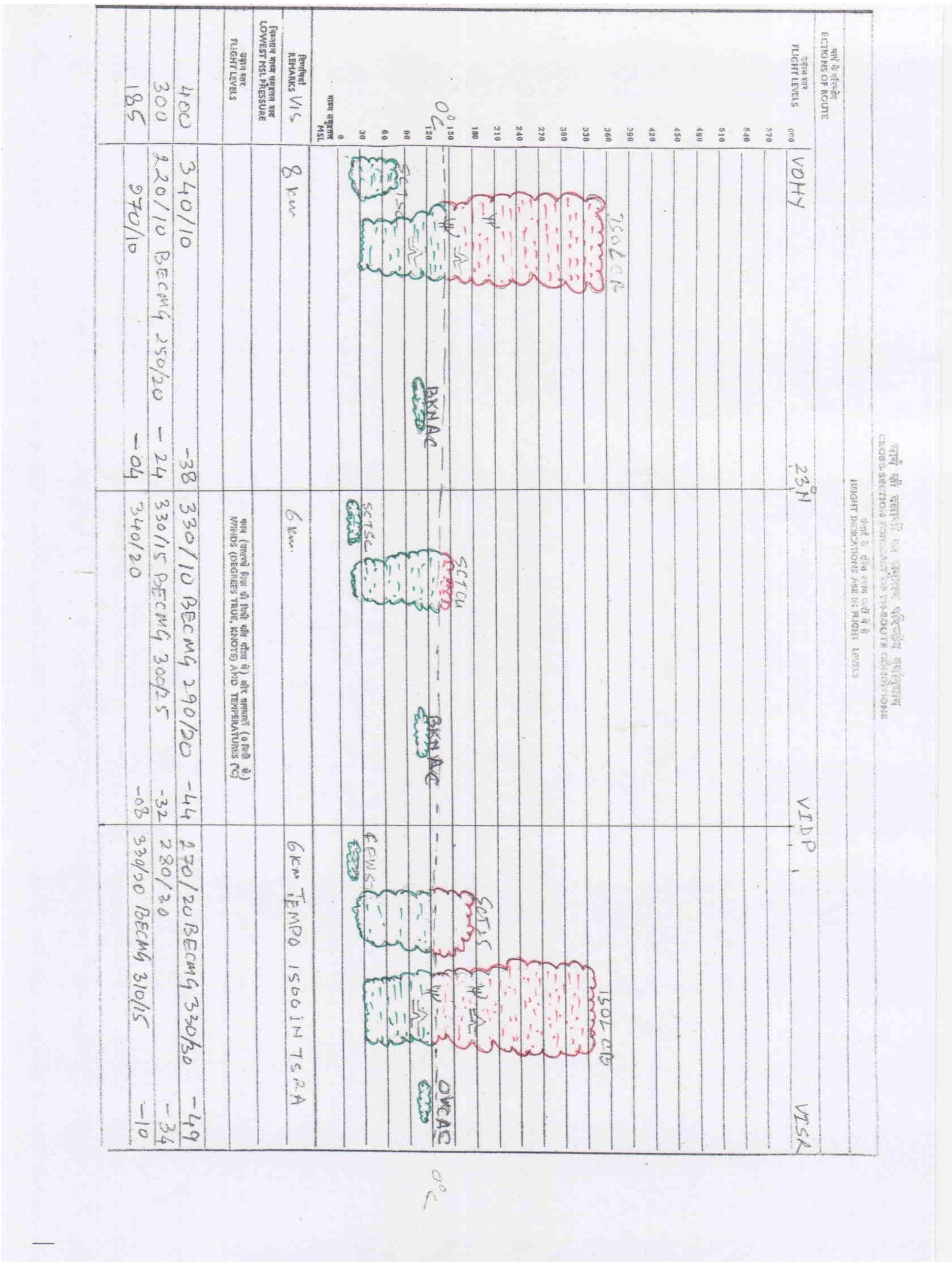
मार्ग Route VOHY से To VISR तक Via VIDP बरास्ता

प्रस्थान के लिए मान्य Valid for departure 2012-12-20/0300UTC
(दिनांक, समय जी० मा० स०)
(Date, Time G. M. T.)

आगमन के लिए मान्य Valid for arrival 2012-12-20/1000UTC
(दिनांक, समय जी० मा० स०)
(Date, Time G. M. T.)

विशेष सूचना
Special Information


CROSS-SECTION FORECAST OF EN-ROUTE CONDITIONS
HEIGHT INDICATIONS ARE IN FLIGHT LEVELS
SECTIONS OF ROUTE
FLIGHT LEVELS
VOHY
23°N
VIDP
VISR
TSRA CB
SCT CU
BKN AC
SCT SC
SCT CU
BKN AC
SCT SC
ISOL CB
SCT SC
OVC AC
FEW S
0°C
0°C
REMARKS VIS
8 KM
6 KM
6KM TEMPO 1500 IN TSRA
LOWEST MSL PRESSURE
FLIGHT LEVELS
WINDS (DEGREES TRUE, KNOTS) AND TEMPERATURES (°C)
400 340/10 -38 330/10 BECMG 290/20 -44 270/20 BECMG 330/30 -49
300 220/10 BECMG 250/20 -24 330/15 BECMG 300/25 -32 280/30 -34
185 270/10 -04 340/20 -03 330/20 BECMG 310/15 -10



मार्ग की दशाओं का अनुमान्य परिच्छेद पूर्वानुमान
CROSS-SECTION FORECAST OF EN-ROUTE CONDITIONS
ऊंचाई के संकेत उड़ान स्तरों में हैं
HEIGHT INDICATIONS ARE IN FLIGHT LEVELS
मार्ग के परिच्छेद
ECTIONS OF ROUTE
उड़ान स्तर
FLIGHT LEVELS
600 570 540 510 480 450 420 390 360 330 300 270 240 210 180 150 120 90 60 30 0
माध्य समुद्रतल MSL
VOHY
23°N
VIDP
VISR
ISOL CB
SCT SC
0°C
BKN AC
SCT CU
SCT SC
BKN AC
SCT CS
ISOL CB
FEW SC
OVC AC
0°C
टिप्पणियां
REMARKS VIS
8 km
6 km
6 km TEMPO 1500 IN TSRA
निम्नतम माध्य समुद्रतल दाब
LOWEST MSL PRESSURE
उड़ान स्तर
FLIGHT LEVELS
पवन (डिग्री ट्रू और नॉट में) और तापमानों (°C)
WINDS (DEGREES TRUE, KNOTS) AND TEMPERATURES (°C)
400 340/10 -38 330/10 BECMG 290/20 -44 270/20 BECMG 330/30 -49
300 220/10 BECMG 250/20 -24 330/15 BECMG 300/25 -32 280/30 -34
185 270/10 -04 340/20 -08 330/20 BECMG 310/15 -10

6.5 GENERAL RULES FOR PREPARING ROUTE FORECAST (MET-T3)

1. MET T.3 is the route forecast in tabular form.
2. General information about flight should be entered in first page of MET-T3 form. It contain Serial No. of flight, date and time of flight forecast issued, flight number, ICAO name of AMO issuing route forecast, route for which forecast is valid, and Name of forecaster. And any other special information which is significant for the flight also may be provided.
3. Date and time of issuing route forecast, date and time of validity.
4. TAFORS of originating and destination along with their alternates and inference may be given on first page under special information.
5. Cloud amounts are to be indicated as SCT, BKN or OVC for all clouds other than CBs. For CBs the terms ISOL, OCNL, or FRQ are to be used to indicate the frequency of occurrence. Cloud types are written in capital letters.

6.6 ROUTE FORECAST (FOR DECODING INTO MET-T3 FORM)

General Information

Serial No.PQR-02

Flight number: IC-900

Date of flight: 20-12-2012

ROFOR 200100Z 200310KT VIDP- VIAG 2000 BR FEW025 7070140 BKN090 550806 403015 22010 BECMG 13010 405012 24020 BECMG 09005 407010 25015 410005 26020 TEMPO 2007/2010 1200 111TS FEWCB030 7250///.

ROFOR	Message identifier
200100Z	Date and Time of issue in UTC eg On 20th Date & issued at 0100Z
200310KT	Date & time of validity eg On 20th Date & valid from of 0300 to 1000UTC
VIDP- VIAG	ROFOR is from Delhi Hyderabad to Agra
2000	Visibility
BR	Weather along the route here weather is mist
FEW025	Cloud group, FEW amount & type of cloud, 025 base of cloud
7070140	This group is top (height) of cloud & height of freezing level. 070 is top of cloud whose base is 020 & freezing level is 140
BKN090	Cloud group: BKN amount & type of cloud, 090 base of cloud

550806	This is turbulence group, 5 is type of turbulence at base height 090 flight level & thickness is 6. The base of turbulence 090 & top is (080*30 +6*300)/30=140
403015	Indicator of flight level(height) and corresponding temperature, 030 is flight level(height) and 15(Plus15^{0}C) is temperature at flight level(height) 030
22010 BECMG 13010	This is wind direction and wind speed group, 220^0 is wind direction & 10Kt is wind speed which changes to 130^0 direction and 10Kt at flight level(height) 030
405012	Indicator of flight level(height) and corresponding temperature, 050 is flight level (height) and 12(Plus12^{0}C) is temperature at flight level(height) 050
24020 BECMG 09005	This is wind direction and wind speed group, 240^0 is wind direction & 20Kt is wind speed which changes to 090^0 direction and 05Kt at flight level (height) 050
407010	Indicator of flight level (height) and corresponding temperature, 070 is flight level (height) and 10 (plus10^{0}C) is temperature at flight level (height) 070
25015	This is wind direction and wind speed, 250^0 is wind direction & 15Kt is wind speed at flight level (height) 070
410005	Indicator of flight level (height) and corresponding temperature, 100 is flight level (height) and 05 (plus05^{0}C) is temperature at flight level (height)100
26020	This is wind direction and wind speed,260^0 is wind direction & 20Kt is wind speed at flight level(height) 100
TEMPO	Change group indicator
2007/2010	Date and validity period of the temporary fluctuation, 20 is date, The fluctuation in conditions are expected from 0700 to 1000 UTC.
1200	Reduction in visibility to 1200M in TSRA
111TS	weather group as the supplementary phenomena is Thunderstorm
FEWCB030	FEW is the cloud amount & type of cloud is CB, 030 base of CB cloud
7250///	Top of CB, /// is no freezing level as the it has already given (140)

क्रम सं. P&R-02
Serial No .....

मेट टी - ३
Met.T-3

भारत

मौसम विज्ञान विभाग

उड़ान और हवाई अड्डा पूर्वानुमान
FLIGHT AND AERODROME FORECASTS

उड़ान सं IC-900
Flight No. .....

मार्ग VIDP — VIAG
Route .....

..... के द्वारा जारी किया गया ..... मौसम विज्ञान कार्यालय का स्थान
issued by CLASS I ..... Meteorological Office at VIDP .....

दर 0100 यू. टी. सी. 2012-12-20 19
At ..... UTC 19

द्वारा XXX
By .....

उड़ान पूर्वानुमान / FLIGHT FORECAST

मार्ग Route VIDP में To VIAG बरास्ता Via – वायु की अनुमानित वास्तविक गति Assumed True Air speed _____ नाट Kts.

छूटने के लिए मान्य Valid for departure 0300 (समय यु. टी. सी. और तारीख) (Time U.T.C. and Date) 2012-12-20 पहुँचने के लिए मान्य Valid for arrival 1000 (समय यु. टी. सी. और दिनांक) (Time U.T.C and Date) 2012-12-20

मौसम स्थिति के विशेष लक्षण / Special Features of Meteorological Situation.

ऊपरी वायु / Upper wind (वास्तविक डिग्री व नाट) और तापमान (में) (Degree true and knots) and Temperatures (°C)		मार्ग के सैक्शन (क्षेत्र सं अक्षांश और देशान्तर या भौगोलिक सूचक) SECTION OF ROUTE (ZONE Nos., LATITUDE AND LONGITUDE OR GEOGRAPHICAL INDICATORS) VIDP	VIAG
उड़ान स्तर FLIGHT LEVELS	100	260/20	+05
	070	250/15	+10
	050	240/15 BECMG 090/05	+12
	030	220/10 BECMG 130/05	+15
निम्नतम परत / LOWEST LAYER मात्रा और किस्म / AMOUNT AND TYPE उड़ान स्तर FLIGHT LEVELS आधार पर / of Base		SCT SC 025	ISOL CB 030
शिखर पर / of top		070	250
बादल / CLOUD उच्चतर परत / HIGHER LAYER मात्रा और किस्म / Amount and Type उड़ान स्तर FLIGHT LEVELS आधार पर / of Base		BKN AS 090	
शिखर पर / of top		----	
सतह दृश्यता / SURFACE VISIBILITY		2500M IN BR TEMPO 1200M IN TSRA	
सार्थक मौसम / SIGNIFICANT WEATHER		MOD TURB IN CB	
0° से. की समतापीय उड़ान स्तर FLIGHT LEVELS OF 0 °C ISOTHERM		140	
न्यूनतम माध्य समुद्रतल का दाब LOWEST MSL PRESSURE		–	
टिप्पणियाँ / REMARKS			

Chapter 7

SIGMET

Objectives:

1. Explain the SIGMET template

2. Explain an actual SIGMET

Sub topics:

1. Template for SIGMET

2. Elements of SIGMET

7.1 SIGMET GENERAL INFORMATION:

- It gives a concise description of specified en-route weather phenomenon, which may affect the safety of aircraft operations.
- The warning may be about a phenomenon already occurring or it may be for the expected occurrence of a phenomenon.
- It is prepared in abbreviated plain language
- SIGMET information is issued by a Meteorological Watch Office.
- In India, SIGMET messages are issued by the MWOs at Mumbai, Kolkata, New Delhi and Chennai for the respective Flight Information Regions.
- These messages are then be passed on to the FIC / ACC
- It is the responsibility of the FIC / ACC to communicate the information to aircraft-in-flight.
- SIGMET information shall be cancelled when the phenomena are no longer occurring or no longer expected to occur in the FIR.
- VA SIGMET and TC SIGMET messages should be based on advisory information provided by the designated VAACs and TCACs.
- SIGMET information shall be cancelled when the phenomena are no longer occurring or no longer expected to occur in the FIR

7.2 TYPES OF SIGMETS:

There are three types of SIGMETs:

1. SIGMET for volcanic ash, denoted as VA SIGMET or WV SIGMET
2. SIGMET for Tropical Cyclones, denoted as TC SIGMET or WC SIGMET

3. SIGMET for en-route weather phenomena other than VA and TC, (includes TS, CB, TURB, ICE, MTW, DS, SS and RDOACT CLD) denoted as WS SIGMET.

7.3 DATA TYPE DESIGNATORS:

The WMO data type designators used for dissemination of the SIGMETs are:

- WC- for SIGMET for tropical cyclones
- WV- for SIGMET for volcanic ash
- WS- for SIGMET other than volcanic ash cloud or tropical cyclone.

7.4 PERIOD OF VALIDITY:

- The validity of a SIGMET message should not be more than 4 hours.
- In case of VA SIGMET and TC SIGMET, the period of validity can be extended up to 6 hours.

7.5 TIME OF ISSUE AND UPDATING FREQUENCY:

- SIGMET messages should be issued not more than 4 hours before the commencement of the period of validity.
- In case of VA SIGMET and TC SIGMET, these messages can be issued as soon as practicable but not more than 12 hours before the commencement of the period of validity.
- SIGMET messages for volcanic ash and tropical cyclones should be updated at least every 6 hours.

7.6 DISSEMINATION

- SIGMET priority indicator is **FF** as it is a flight safety messages
- SIGMET information is part of the operational meteorological (OPMET) information.
- The telecommunication facilities used for the exchange of the information should be the aeronautical fixed service (AFS).
- The AFS consists of a terrestrial segment, AFTN or ATN (AMHS), and a satellite segment which comprises the SADIS and ISCS satellite broadcasts provided by the UK and the USA respectively. Note that.
- AFTN links of AFS should be used by the MWOs to send the SIGMETs
- SIGMET should be send to the adjacent MWOs and ACCs using direct AFTN addressing
- When required for VOLMET or D-VOLMET, SIGMET should be sent to the relevant centre providing the VOLMET service (Mumbai and Kolkata in our case).
- SIGMET should be sent to all regional OPMET Data Banks (RODB);
- SIGMETs should be relayed to the SADIS and ISCS providers for satellite dissemination

- Should be send to the WAFCs London and Washington, either through the ROBEX scheme, or directly by the issuing MWO
- SIGMET for volcanic ash should be disseminated to the responsible VAAC.

7.7 SPECIFICATION RELATED TO ISSUANCE OF SIGMET INFORMATION:

- SIGMET messages should be prepared in abbreviated plain language, using ICAO approved abbreviations.
- Should be prepared in the template given**.**
- Messages containing SIGMET information shall be identified as “SIGMET”.
- The sequence number referred to in the template shall correspond with the number of SIGMET messages issued for the FIR since 0001 UTC on the day concerned, e.g., “5” will be related to the fifth SIGMET message issued by MWO since 0001 UTC on the day concerned.
- In accordance with the template, only one of the following phenomena shall be included in a SIGMET message

The following are the phenomena for which SIGMETs are to be issued irrespective of altitude.

Phenomenon	Description	Meaning
TS	OBSC TS	Obscured thunderstorm(s)
	EMBD TS	Embedded thunderstorm(s)
	FRQ TS	Frequent thunderstorm(s)
	SQL TS	squall line thunderstorm(s)
	OBSC TSGR	obscured thunderstorm(s) with hail
	EMBD TSGR	Embedded thunderstorm(s) with hail
	FRQ TSGR	frequent thunderstorm(s) with hail
	SQL TSGR	squall line thunderstorm(s) with hail
TC	TC (+ cyclone name)	tropical cyclone (with 10-minute mean surface wind speed of 34 kt or more)
TURB	SEV TURB	severe turbulence
ICE	SEV ICE	severe icing
	SEV ICE (FZRA)	severe icing due to freezing rain
MTW	SEV MTW	severe mountain wave
DS	HVY DS	heavy duststorm
SS	HVY SS	heavy sandstorm

VA	VA (+volcano name, if known)	volcanic ash
RDOACT CLD	RDOACT CLD	radioactive cloud

7.8: TEMPLATE

TEMPLATE FOR SIGMET MESSAGES

Key **M** = inclusion mandatory, part of every message;
C = inclusion conditional, included wherever applicable.

Elements as specified	Detailed contents	Templates	Examples
		SIGMET	
Location indicators of FIR(**M**)	ICAO location indicator of the ATS unit serving the FIR to which the SIGMET refers (**M**)	Nnnn	VECF VOMF VIDF VABF
Identification (**M**)	Message identification and sequence number (**M**)	SIGMET (nn)n	SIGMET 5
Validity period (**M**)	Date-time groups indicating the period of validity in UTC(**M**)	VALID nnnnnn/nnnnnn	VALID 221215/221600 VALID 101520/101800 VALID 251600/252200
Location indicator of MWO (**M**)	Location indicator of MWO originating the message with a separating hyphen (**M**)	nnnn --	VECC --- VOMM --- VIDP --- VABB ---
Name of FIR	Location indicator and name of the FIR for which the SIGMET is issued(**M**)	nnnn nnnnnnnnnn FIR	VECF KOLKATA FIR VOMF CHENNAI FIR VIDF DELHI FIR VABF MUMBAI FIR

Phenomena (**M**)	Description of phenomenon causing the issuance of SIGMET (**C**)	OBSC TS (GR) EMBD TS (GR) FRQ TS (GR) SQL TS (GR) TC nnnnnnnnnn or NN [6] SEV TURB SEV ICE SEV ICE (FZRA) SEV MTW HVY DS HVY SS (VA ERUPTION) [MT] [nnnnnnnnnn] PSN Nnn(nn) or Snn(nn) Ennn(nn) or Wnnn(nn)) VA CLD RDOACT CLD	SEV TURB FRQ TS OBSC TSGR EMBD TSGR *TC GLORIA *[Fictitious name] TC NN *VA ERUPTION MT ASHVAL PSN S15 E073 VA CLD SEV ICE RDOACT CLD *[Fictitious location]
Observed or forecast phenomena (**M**)	Indication whether the information is observed and expected to continue, or forecast (**M**)	OBS (AT nnnnZ) FCST [AT nnnnZ]	OBS AT 1210Z OBS FCST AT 1815Z
Location (**C**)[7]	Location (referring to latitude and longitude (in degrees and minutes) or locations or geographic features well-known internationally)	Nnn(nn) Wnnn(nn) or Nnn(nn) Ennn(nn) or Snn(nn) Wnnn(nn) or Snn(nn) Ennn(nn) or N OF Nnn(nn) or S OF Nnn(nn) or N OF Snn(nn) or S OF Snn(nn) or (AND) W OF Wnnn (nn) or E OF Wnnn (nn) or W OF Ennn (nn) or E OF Ennn (nn) or (N OF, NE OF, E OF, SE OF, S OF, SW OF, W OF, NW OF) (LINE) Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) – Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn)	S OF N54 N OF N50 N2020 W07005 AT YUSB[3] N2706 W07306 N48 E010 N OF N1515 AND W OF E13530 W OF E 1554 N OF LINE S2520 W11510-S2520 W12010 WI N6030 E02550 – N6055 E02500 – N6050 E02630

		or (N OF, NE OF, E OF, SE OF, S OF, SW OF, W OF, NW OF, AT) nnnnnnnnnnn or WI Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) – Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) – (Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) – (Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn))	[WI-within]
Level (**C**)[7]	Flight level or altitude and extent (**C**) [3]	[SFC/]FLnnn or [SFC/]nnnnM (or [SFC/]nnnnFT) or FLnnn/nnn or TOP FLnnn or [TOP] ABV FLnnn or[1] CB TOP (ABV) FLnnn WI nnnKM OF CENTRE (or CB TOP (ABV) FLnnn WI nnnNM OF CENTRE) or CB TOP (BLW) FLnnn WI nnnKM OF CENTRE (or CB TOP (BLW) FLnnn WI nnnNM OF CENTRE) or[2] FLnnn/nnn (APRX nnnKM BY nnnKM) (nnKM WID[£] LINE[4] BTN (nnNM WID LINE BTN)) (Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) - Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) (-Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn)) (-Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn (nn))) (or FLnnn/nnn (APRX nnnNM BY nnnNM) (Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) -Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) (- Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn))	FL 180 FL050/080 TOP FL390 SFC/FL070 TOP ABV FL100 FL310/450 CB TOP FL500 WI 270KM OFCENTRE (CB TOP FL500 WI 150NM OF CENTRE) FL310/350 APRX 220KM BY 35KM FL390

		(-Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn)))) [WID[E] - width]	
Movement or expected movement (**C**)[7]	Movement or expected movement (direction and speed) with reference to one of the sixteen points of compass, or stationary (**C**)	MOV N (nnKMH) or MOV NNE [nnKMH] or MOV NE (nnKMH) or MOV ENE [nnKMH] or MOV E (nnKMH) or MOV ESE [nnKMH] or MOV SE (nnKMH) or MOV SSE [nnKMH] or MOV S (nnKMH) or MOV SSE [nnKMH] or MOV SW (nnKMH) or MOV WSW [nnKMH] or MOV W (nnKMH) or MOV WNW [nnKMH] or MOV NW (nnKMH) or MOV NNW [nnKMH] (or MOV N (nnKT) or MOV NNE [nnKT] or MOV NE (nnKT) or MOV ENE [nnKT] or MOV E (nnKT) or MOV ESE [nnKT] or MOV SE (nnKT) or MOV SSE [nnKT] or MOV S (nnKT) or MOV SSW [nnKT] or MOV SW (nnKT) or MOV WSW [nnKT] or MOV W (nnKT) or MOV WNW [nnKT] or MOV NW (nnKT) or MOV NNW [nnKT]) or STNR	MOV E 40KMH (MOV E 20KT) MOV SE STNR
Changes in intensity (**C**)[7]	Expected changes in intensity (**C**)	INTSF or WKN or NC	WKN
Forecast position (**C**) [3,7]	Forecast position of volcanic ash cloud or the center of the TC at the end of the validity period of the SIGMET message (**C**)	FCST nnnnZ TC CENTRE Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) or FCST nnnnZ VA CLD APRX (nnKM WID LINE BTN (nnNM WID LINE BTN)) Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn) – Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn)	FCST 2200Z TC CENTRE N2740 W07345 FCST 1700Z VA CLD APRX S15 E075 – S15 E081 – S17 E083 – S18 E079 – S15 E075

		(– Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn)) (– Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn)) [AND] [8]	
Cancellation of SIGMET (**C**) [5]	Cancellation of SIGMET referring to its identification	CNL SIGMET (nn)n nnnnnn/nnnnnn or CNL SIGMET (nn) n nnnnnn/nnnnnn (VA MOV TO nnnn FIR)	CNL SIGMET 2 101200/101600[5] CNL SIGMET 3 251030/251430 VA MOV TO *YUDO FIR[5] *[Fictitious location]

Notes -

1 Only for SIGMET messages for tropical cyclones.
2 Only for SIGMET messages for volcanic ash.
3 Only for SIGMET messages for volcanic ash cloud and tropical cyclones.
4 A straight line between two points drawn on a map in the Mercator projection or a straight line between two points which crosses lines of longitude at a constant angle.
5 *End of the message (as the SIGMET message is being cancelled*)
6 Used for unnamed tropical cyclones
7 In the case of the same phenomenon covering more than one area within the FIR, these elements can be repeated, as necessary.
8 To be used for two volcanic ash clouds or two centers of tropical cyclones simultaneously affecting the FIR concerned.

***Note**--severe icing and severe turbulence (SEV ICE, SEV TURB) associated with thunderstorms, cumulonimbus clouds or tropical cyclones should not be included.*

CHAPTER 8

AERODROME WARNING, WARNING FOR LIGHT AIRCRAFT, AND WIND SHEAR WARNING

Objectives:

1. Explain the responsibilities of AMO and AMS in relation to issuance of warnings

2. List the warning elements

3. Explain the format of the warnings and explain a given warning

Sub topic

1. Responsibility of AMO and AMS

2. Warning elements

3. Warning format

8.1 AERODROME WARNINGS-GENERAL:

- Aerodrome Warnings give concise information of meteorological conditions, which could adversely affect aircraft on the ground, including parked aircraft and the aerodrome facilities and services.
- They can be issued for an observed phenomenon or for the expected occurrence of a phenomenon.
- The aerodrome warnings are to be issued in the template given.

8.2 RESPONSIBILITY OF AMO AND AMS:

- It is issued by Aerodrome Meteorological Offices functioning during the hours of 'forecasting watch'.
- Outside the forecast watch period, the responsibility is transferred to the AMO at state centre or at regional centre or to the MWO.
- For aerodromes with AMS, these warnings are issued by the associated Aerodrome Meteorological Office, on requisition by AMSs.
- If necessary, local forecasts and other forecasts issued earlier are to be amended suitably to include this warning.
- The warnings are to be passed on to local ATS units for further dissemination over the aerodrome and to the operators, etc.

- Aerodrome warnings are issued only for the local aerodrome as they are meant for protection of the aircraft parked and other aerodrome facilities. Hence, these are not to be disseminated beyond the aerodrome of origin.

8.3 VALIDITY AND UPDATION:

- The aerodrome warnings for the expected occurrence of the phenomena shall be issued at least half to one hour prior to the expected occurrence of the warning elements.
- The beginning of the validity period of the warning for an observed phenomenon should be very close to the issuing time.
- The period of warning shall preferably be short, not exceeding 4 hours. If the phenomena are expected to continue for a longer time, a fresh warning may be issued suitably.
- Aerodrome warnings shall be cancelled when the phenomena are no longer occurring or are no longer expected to occur at the aerodrome.
- Cancellation message also should be issued as per the template.

8.4 WARNING ELEMENTS:

Aerodrome warnings shall relate to the occurrence or expected occurrence of one or more of the following phenomena:

1. Tropical cyclone: (To be included if the 10 minute mean surface wind speed at the aerodrome is expected to be 34kts or more)
2. Thunderstorm
3. Hail
4. Snow (including the expected or observed snow accumulation)
5. Freezing precipitation
6. Hoar Frost or rime
7. Duststorm
8. Sandstorm
9. Rising sand or dust
10. Strong surface wind and gusts:
    (a) Speed expected to reach 30 KT or more even in gusts
    (b) Direction change rapidly by 45 degrees or more, wind speed before and after expected to be 20 KT or more.
11. Squall: Whenever expected, the expected direction and speed shall be indicated.
12. Frost
13. Volcanic ash
14. Tsunami

Reduction in visibility and lowering of cloud base associated with the warning elements should not be mentioned in warnings separately.

8.5 TEMPLATE:

- The use of text additional to the abbreviations listed in the template should be kept to a minimum.
- The additional text shall be prepared in abbreviated plain language using approved ICAO abbreviations and numerical values.
- If no ICAO approved abbreviations are available, English plain language text shall be used.

8.6 WARNING FOR LIGHT AIRCRAFTS:

- Apart from the aerodrome warnings issued, warnings for gliders, light aircraft and helicopters are to be issued separately when wind speed is expected to reach 17KT or more.
- They should also be appended to local forecast.
- They are to be issued with the prefix "Warnings for Light Aircraft" in abbreviated plain language.

Template for aerodrome warnings

Key: M = inclusion mandatory, part of every message;
C = inclusion conditional, included whenever applicable.

Element	Detailed content	Template	Example
Location indicator of the aerodrome(M)	Location indicator of the aerodrome	nnnn	VABB
Time of issue (M)	Day and time of issue of the warning in UTC	nnnnnnZ	110300Z
Identification of the type of message(M)	Type of message and sequence number	AD WRNG [n]n	AD WRNG 2
Validity period (M)	Day and time of validity period in UTC	VALID nnnnnn/nnnnnn	VALID 110330/110630
IF THE AERODROME WARNING IS TO BE CANCELLED, SEE DETAILS AT THE END OF THE TEMPLATE.			
Phenomenon(M)[1]	Description of phenomenon causing the issuance of the aerodrome warning	TC nnnnnnnnnn or [HVY] TS or GR or [HVY] SN [nnCM][2] or [HVY] FZRA or [HVY] FZDZ or RIME[3] or [HVY] SS or [HVY] DS or SA or DU or SFC WSPD nn[n]KT MAX nn[n]or SQ or FROST or TSUNAMI or VA or Free text up to 32 characters[4]	TC PHYAN HVY SN 25CM SFC WSPD 40KT MAX 60 VA TSUNAMI
Observed or forecast phenomenon(M)	Indication whether the information is observed and expected to continue, or forecast	OBS [AT nnnnZ] or FCST	OBS AT 1200Z OBS FCST
Changes in intensity(C)	Expected changes in intensity	INTSF or WKN or NC	WKN
OR			
Cancellation of aerodrome warning[5]	Cancellation of aerodrome warning referring to its identification	CNL AD WRNG [n]n nnnnnn/nnnnnn	CNL AD WRNG 2 211230/211530[5]

Notes:

1. One phenomenon or a combination there of, in accordance with para 2.3.
2. In accordance with para 2.3.
3. Hoar frost or rime in accordance with para 2.3.
4. In accordance with 2.5.
5. End of the message (as the aerodrome warning is being cancelled).

8.7 WIND SHEAR WARNINGS

- Wind shear warnings should be prepared by Aerodrome Meteorological Offices.
- It should give concise information on the observed or expected existence of wind shear which could adversely affect aircraft on the approach path or take-off path or during circling approach between runway level and 500 m (1600 ft) above that level and aircraft on the runway during the landing roll or take-off run.
- Wind shear warning for arriving aircraft and/or departing aircraft shall be cancelled when aircraft reports indicate that wind shear no longer exists, or alternatively after an elapsed time of two hours.

8.7.1 Detection of wind shear

- In India, evidence of the existence of wind shear shall be derived from aircraft observations during the climb-out or approach phases of flight to be made in accordance with the provisions of Aircraft Observations and Reports; or

8.7.2 Format and dissemination of wind shear warning

- Information on wind shear is also to be included as supplementary information in local routine and special reports and METAR and SPECI in accordance with the respective templates.

- When an aircraft report is used to prepare a wind shear warning, or to confirm a warning previously issued, the corresponding aircraft report, including the aircraft type, shall be disseminated unchanged in the warning, in the form, “WS WRNG B747 REPORTED MOD WS IN APCH RWY 34 AT 1510”.

- Following reported encounters by both arriving and departing aircraft two different wind shear warnings may exist: one for arriving aircraft and one for departing aircraft.

CHAPTER 9

TROPICAL CYCLONE ADVISORY CENTRE AND VOLCANIC ASH ADVISORY CENTRE

Objectives

1. List the responsibilities of TCAC and VAAC

2. Explain the templates of TCAC advisory and VAAC advisory and explain given advisories.

Sub topic

1. Responsibility of TCAC and VAAC

2. Template of TCAC advisory with example

3. Template of VAAC Advisory with example

9.1 TROPICAL CYCLONE ADVISORY CENTRE (TCAC)

The responsibility of TCAC is to:

a) Monitor the development of tropical cyclones in its area of responsibility, using geostationary and polar-orbiting satellite data, radar data and other meteorological information;

b) Issue advisory information concerning the position of the cyclone centre, its direction and speed of movement, central pressure and maximum surface wind near the centre, in abbreviated plain language to:

1) meteorological watch offices in its area of responsibility

2) other TCACs whose areas of responsibility may be affected; and

3) world area forecast centres, international OPMET data banks, and centres designated for the operation of aeronautical fixed service satellite distribution systems; and

c) Issue updated advisory information to meteorological watch offices for each tropical cyclone, as necessary, but atleast every six hours.

The advisory information on tropical cyclones shall be issued for tropical cyclones when the maximum of the 10 minute mean surface wind speed is expected to reach or exceed 34kts during the period covered by the advisory. The advisory information from TCAC New Delhi can be obtained from the link www.imd.gov.in/section/nhac/dynamic/cyclone.htm.

9.2 TEMPLATE FOR TCAC ADVISORY

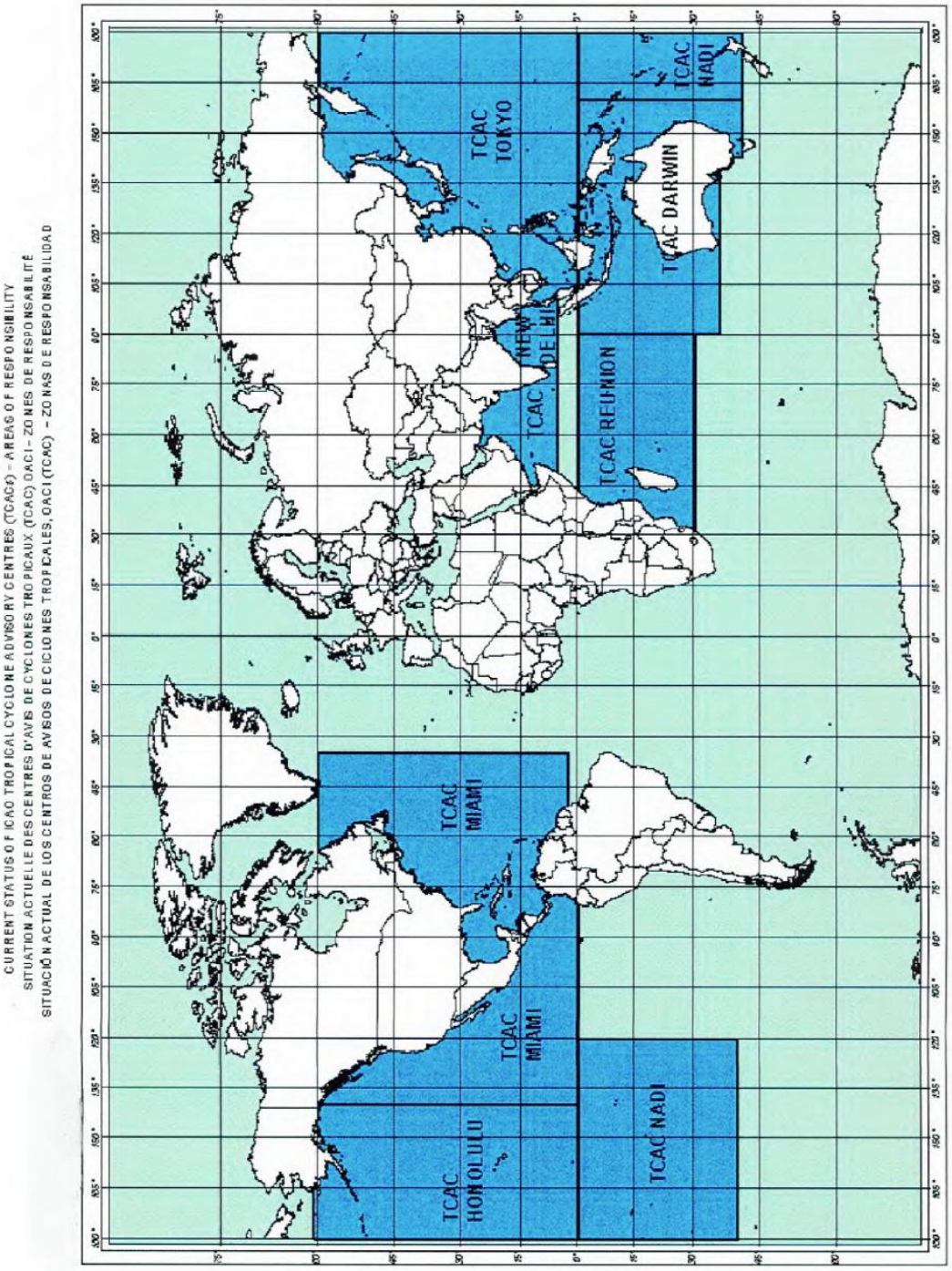
Template for Tropical Cyclones advisory messages

Note 1: All the elements are mandatory
Note 2: Inclusion of a "colon" after each element heading is mandatory
Note 3: The numbers 1 to 19 are included only for clarity and they are not part of the advisory message, as shown in the example.

Element		Detailed content	Template(s)		Example	
1	Identification of the type of message	Type of message	TC ADVISORY		TC ADVISORY	
2	Time of origin	Year, Month, day and time in UTC of issue	DTG:	nnnnnnnn/nnnnZ	DTG:	20040925/1600Z
3	Name of TCAC	Name of TCAC (location indicator or full name)	TCAC:	nnnn *or* nnnnnnnnnn	TCAC: TCAC:	YUFO* MIAMI * Fictitious location
4	Name of Tropical cyclone	Name of tropical cyclone or "NN" for unnamed tropical cyclone	TC:	nnnnnnnnnnnn *or* NN	TC:	GLORIA
5	Advisory number	Advisory number (starting with "01" for each cyclone)	NR:	nn	NR:	01
6	Position of the center	Position of the centre of the tropical cyclone (in degrees and minutes)	PSN:	Nnn(nn) *or* Snn(nn) Wnnn(nn) *or* Ennn(nn)	PSN:	N2706 W07306
7	Direction and speed of movement	Direction and speed of movement given in sixteen compass points and knot (kt), respectively, or moving slowly (<3kt) or stationary (<1kt)	MOV:	N nnKT or NNE nnKT or NE nnKT or ENE nnKT or E nnKT or ESE nnKT or SE nnKT or SSE nnKT or S nnKT or SSW nnKT or SW nnKT or WSW nnKT or W nnKT or WNW nnKT or NW nnKT or NNW nnKT or SLW or STNR	MOV:	NW 10KT
8	Central pressure	Central pressure (in hPa)	C:	nnnHPA	C:	965HPA
9	Maximum surface wind	Maximum surface wind near the centre (mean over 10 minutes, in kt)	MAX WIND:	nn[n]KT	MAX WIND:	45KT
10	Forecast of center position (+6 HR)	Day and time (in UTC) (6 hours from the "DTG" given in	FCST PSN +6 HR:	nn/nnnnZ Nnn(nn) or Snn(nn)	FCST PSN +6 HR:	25/2200Z N2748 W07350

		item 2); Forecast position (in degrees and minutes) of the center of the tropical cyclone		Wnnn(nn) or Ennn(nn)		
11	Forecast of maximum surface wind (+6 HR)	Forecast of maximum surface wind (6 hours after the "DTG" given in item 2)	FCST MAX WIND +6 HR:	nn(n)KT	FCST MAX WIND + 6 HR:	45KT
12	Forecast of centre position (+12 HR)	Day and time (in UTC) (12 hours from the "DTG" given in item 2); Forecast position (in degrees and minutes) of the centre of the tropical cyclone	FCST PSN +12 HR:	nn/nnnnZ Nnn(nn) or Snn(nn) Wnnn (nn) or Ennn(nn)	FCST PSN +12 HR:	26/0400 Z N2830 W07430
13	Forecast of maximum surface wind (+12 HR)	Forecast of maximum surface wind (12 hours after the " DTG" given in item 2)	FCST MAX WIND +12 HR:	nn(n)KT	FCST MAX WIND +12 HR:	45KT
14	Forecast of centre position (+18 HR)	Day and time (in UTC) (18 hours from the "DTG" given in item 2); Forecast position (in degrees and minutes) of the centre of the tropical cyclone	FCST PSN +18 HR:	nn/nnnnZ Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn)	FCST PSN + 18HR:	26/1000Z N2852 W07500
15	Forecast of maximum surface wind (+18 HR)	Forecast of maximum surface wind (18 hours after the "DTG" given in Item2)	FCST MAX WIND +18 HR:	nn(n)KT	FCST MAX WIND +18 HR:	43KT
16	Forecast of center position (+24 HR)	Day and time (in UTC) (24 hours from the "DTG" given in item 2); Forecast position (in degrees and minutes) of the centre of the tropical cyclone	FCST PSN +24 HR:	nn/nnnnZ Nnn(nn) or Snn(nn) Wnnn(nn) or Ennn(nn)	FCST PSN +24 HR:	26/1600Z N2912 W07530
17	Forecast of maximum surface wind (+24 HR)	Forecast of maximum surface wind (24 hours after the "DTG" given in item 2)	FCST MAX WIND +24 HR:	nn(n)KT	FCST MAX WIND +24HR:	40KT
18	Remarks	Remarks, as necessary	RMK:	Free text up to 256 characters or NIL	RMK:	NIL
19	Expected time of issuance of next advisory	Expected year, month, day and time (in UTC) of issuance of next advisory	NXT MSG:	[BFR] nnnnnnnn/nnnnZ or NO MSG EXP	NXT MSG:	20040925/2000Z

FASID CHART MET 1 - AREAS OF RESPONSIBILITY OF THE TCACs

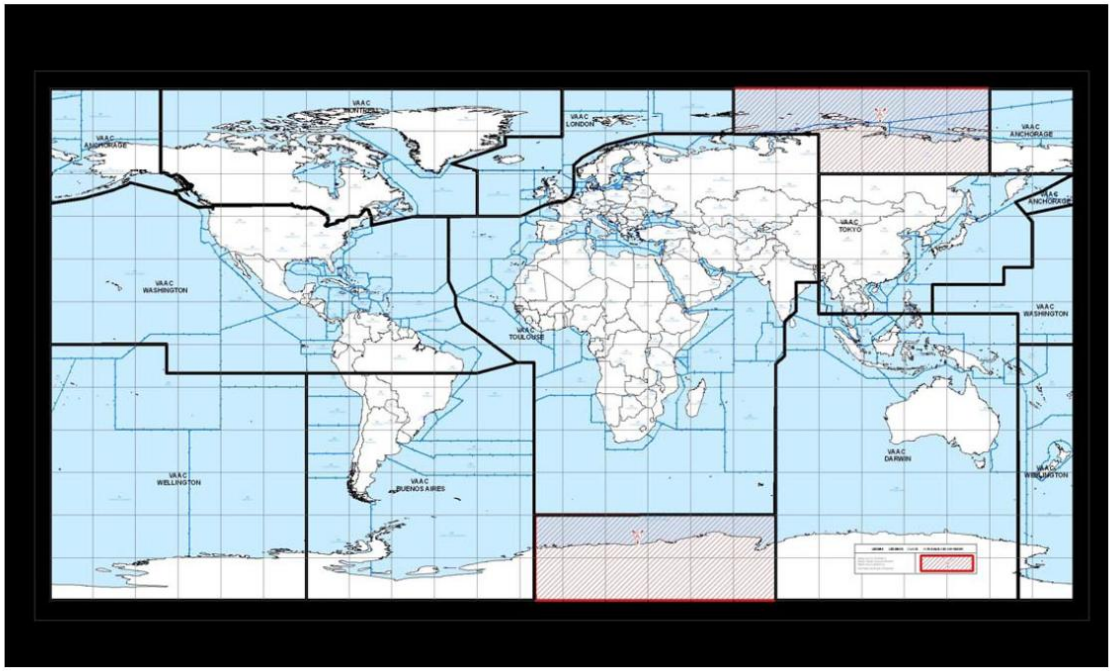


9.3 VOLCANIC ASH ADVISORY CENTRES

9.3.1 Creation:

The International Civil Aviation Organization (ICAO) and other Aviation concerns recognized the need to keep aviators informed of volcanic hazards. Thus, nine Volcanic Ash Advisory Centers were created. These centers are tasked with monitoring Volcanic Ash plumes within their assigned airspace.

FASID CHART MET 2 – MAP OF AREAS OF RESPONSIBILITIES OF VAAC AND CORRESPONDING FIR



Responsibility of a VAAC is to respond to a notification that a volcano has erupted, or is expected to erupt or volcanic ash is reported in its area of responsibility, through:

a) monitoring relevant geostationary and polar-orbiting satellite data to detect the existence and extent of volcanic ash in the atmosphere in the area concerned;

b) activating the volcanic ash numerical trajectory/dispersion model in order to forecast the movement of any ash “cloud” which has been detected or reported;

c) issue advisory information regarding the extent and forecast movement of the volcanic ash “cloud” to:

1) meteorological watch offices, area control centres and flight information centres serving flight information regions in its area of responsibility which may be affected;

2) other VAACs whose areas of responsibility may be affected;

3) world area forecast centres, international OPMET databanks, international NOTAM offices, and centres designated by regional air navigation agreement for the operation of aeronautical fixed service satellite distribution systems; and

4) airlines requiring the advisory information through the AFTN address provided specifically for this purpose;

d) issue updated advisory information to the meteorological watch offices, area control centres, flight information centres and VAACs referred to in c), as necessary, but at least every six hours until such time as the volcanic ash "cloud" is no longer identifiable from satellite data, no further reports of volcanic ash are received from the area, and no further eruptions of the volcano are reported.

Volcanic ash advisory centres shall maintain a 24-hour watch. In case of interruption of the operation of a VAAC, its functions shall be carried out by another VAAC or another meteorological centre, as designated by the VAAC Provider State concerned.

9.3.2: TEMPLATE

Key: M = inclusion mandatory, part of every message;
O = inclusion optional;
= = a double line indicates that the text following it should be placed on the subsequent line.

Note 1.— The ranges and resolutions for the numerical elements included in advisory messages for volcanic ash are shown in Appendix 6, Table A6-4.

Note 2.— The explanations for the abbreviations can be found in the Procedures for Air Navigation Services — ICAO Abbreviations and Codes *(PANS-ABC, Doc 8400).*

Note 3.— Inclusion of a "colon" after each element heading is mandatory.

Note 4.— The numbers 1 to 18 are included only for clarity and they are not part of the advisory message, as shown in the example.

	Element	*Detailed content*	*Template(s)*		*Examples*	
1	Identification of the type of message (M)	Type of message	VA ADVISORY		VA ADVISORY	
2	Time of origin (M)	Year, month, day, time in UTC	DTG:	nnnnnnnn/nnnnZ	DTG:	20080923/0130Z
3	Name of VAAC (M)	Name of VAAC	VAAC:	nnnnnnnnnnnn	VAAC:	TOKYO
4	Name of volcano (M)	Name and IAVCEI[1] number of volcano	VOLCANO:	nnnnnnnnnnnnnnnnnnnn [nnnnnn] *or* UNKNOWN *or* UNNAMED	VOLCANO: VOLCANO:	KARYMSKY 1000-13 UNNAMED
5	Location of volcano (M)	Location of volcano in degrees and minutes	PSN:	Nnnnn *or* Snnnn Wnnnnn *or* Ennnnn *or* UNKNOWN	PSN: PSN:	N5403 E15927 UNKNOWN
6	State *or* region (M)	State, *or* region if ash is not reported over a State	AREA:	nnnnnnnnnnnnnnn	AREA:	RUSSIA
7	Summit elevation (M)	Summit elevation in m (*or* ft)	SUMMIT ELEV:	nnnnM (*or* nnnnnFT)	SUMMIT ELEV:	1536M
8	Advisory number (M)	Advisory number: year in full and message number (separate sequence for each volcano)	ADVISORY NR:	nnnn/nnnn	ADVISORY NR:	2008/4
9	Information source (M)	Information source using free text	INFO SOURCE:	*Free text up to 32 characters*	INFO SOURCE:	MTSAT-1R KVERT KEMSD
10	Colour code (O)	Aviation colour code	AVIATION COLOUR CODE:	RED *or* ORANGE *or* YELLOW *or* GREEN *or* UNKNOWN *or* NOT GIVEN *or* NIL	AVIATION COLOUR CODE:	RED
11	Eruption details (M)	Eruption details (including date/time of eruption(s))	ERUPTION DETAILS:	*Free text up to 64 characters* *or* UNKNOWN	ERUPTION DETAILS:	ERUPTION AT 20080923/0000Z FL300 REPORTED

Element		Detailed content	Template(s)		Examples	
12	Time of observation of ash (M)	Day and time (in UTC) of observation of volcanic ash	OBS VA DTG:	nn/nnnnZ	OBS VA DTG:	23/0100Z
13	Observed *or* estimated ash cloud (M)	Horizontal (in degrees and minutes) and vertical extent at the time of observation of the observed *or* estimated ash cloud *or*, if the base is unknown, the top of the observed *or* estimated ash cloud; Movement of the observed *or* estimated ash cloud	OBS VA CLD *or* EST VA CLD:	TOP FLnnn *or* SFC/FLnnn *or* FLnnn/nnn [nnKM WID LINE[2] BTN (nnNM WID LINE BTN)] Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn][– Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn]][3] *or* TOP FLnnn *or* SFC/FLnnn *or* FLnnn/nnn MOV N nnKMH (*or* KT) *or* MOV NE nnKMH (*or* KT) *or* MOV E nnKMH (*or* KT) *or* MOV SE nnKMH (*or* KT) *or* MOV S nnKMH (*or* KT) *or* MOV SW nnKMH (*or* KT) *or* MOV W nnKMH (*or* KT) *or* MOV NW nnKMH (*or* KT)[4] *or* VA NOT IDENTIFIABLE FM SATELLITE DATA WIND FLnnn/nnn nnn/nn[n]MPS (*or* KT)[4] *or* WIND FLnnn/nnn VRBnnMPS (*or* KT) *or* WIND SFC/FLnnn nnn/nn[n]MPS (*or* KT) *or* WIND SFC/FLnnn VRBnnMPS (*or* KT)	OBS VA CLD:	FL250/300 N5400 E15930 – N5400 E16100 – N5300 E15945 MOV SE 20KT SFC/FL200 N5130 E16130 – N5130 E16230 – N5230 E16230 – N5230 E16130 MOV SE 15KT TOP FL240 MOV W 40KMH VA NOT IDENTIFIABLE FM SATELLITE DATA WIND FL050/070 180/12MPS
14	Forecast height and position of the ash clouds (+6 HR) (M)	Day and time (in UTC) (6 hours from the "Time of observation of ash" given in Item 12); Forecast height and position (in degrees and minutes) for each cloud mass for that fixed valid time	FCST VA CLD +6 HR:	nn/nnnnZ SFC *or* FLnnn/[FL]nnn [nnKM WID LINE[2] BTN (nnNM WID LINE BTN)] Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn][– Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn]][3] *or* NO VA EXP *or* NOT AVBL *or* NOT PROVIDED	FCST VA CLD +6 HR:	23/0700Z FL250/350 N5130 E16030 – N5130 E16230 – N5330 E16230 – N5330 E16030 SFC/FL180 N4830 E16330 – N4830 E16630 – N5130 E16630 – N5130 E16330 NO VA EXP NOT AVBL NOT PROVIDED

	Element	Detailed content	Template(s)		Examples	
15	Forecast height and position of the ash clouds (+12 HR) (M)	Day and time (in UTC) (12 hours from the "Time of observation of ash" given in Item 12); Forecast height and position (in degrees and minutes) for each cloud mass for that fixed valid time	FCST VA CLD +12 HR:	nn/nnnnZ SFC *or* FLnnn/[FL]nnn [nnKM WID LINE[2] BTN (nnNM WID LINE BTN)] Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn][– Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn]][3] *or* NO VA EXP *or* NOT AVBL *or* NOT PROVIDED	FCST VA CLD +12 HR:	23/1300Z SFC/FL270 N4830 E16130 – N4830 E16600 – N5300 E16600 – N5300 E16130 NO VA EXP NOT AVBL NOT PROVIDED
16	Forecast height and position of the ash clouds (+18 HR) (M)	Day and time (in UTC) (18 hours from the "Time of observation of ash" given in Item 12); Forecast height and position (in degrees and minutes) for each cloud mass for that fixed valid time	FCST VA CLD +18 HR:	nn/nnnnZ SFC *or* FLnnn/[FL]nnn [nnKM WID LINE[2] BTN (nnNM WID LINE BTN)] Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn][– Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn] – Nnn[nn] *or* Snn[nn] Wnnn[nn] *or* Ennn[nn]][3] *or* NO VA EXP *or* NOT AVBL *or* NOT PROVIDED	FCST VA CLD +18 HR:	23/1900Z NO VA EXP NOT AVBL NOT PROVIDED
17	Remarks (M)	Remarks, as necessary	RMK:	*Free text up to 256 characters* *or* NIL	RMK:	LATEST REP FM KVERT (0120Z) INDICATES ERUPTION HAS CEASED. TWO DISPERSING VA CLD ARE EVIDENT ON SATELLITE IMAGERY NIL
18	Next advisory (M)	Year, month, day and time in UTC	NXT ADVISORY:	nnnnnnnn/nnnnZ *or* NO LATER THAN nnnnnnnn/nnnnZ *or* NO FURTHER ADVISORIES *or* WILL BE ISSUED BY nnnnnnnn/nnnnZ	NXT ADVISORY:	20080923/0730Z NO LATER THAN nnnnnnnn/nnnnZ NO FURTHER ADVISORIES WILL BE ISSUED BY nnnnnnnn/nnnnZ

Notes.—

1. International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI).
2. A straight line between two points drawn on a map in the Mercator projection or a straight line between two points which crosses lines of longitude at a constant angle.
3. Up to 4 selected layers.
4. If ash reported (e.g. AIREP) but not identifiable from satellite data.

9.3.3 EXAMPLE FOR VAAC ADVISORY:

FVFE01 RJTD 230130
VA ADVISORY

DTG:	20080923/0130Z
VAAC:	TOKYO
VOLCANO:	KARYMSKY 1000-13
PSN:	N5403 E15927
AREA:	RUSSIA
SUMMIT ELEV:	1536M
ADVISORY NR:	2008/4
INFO SOURCE:	MTSAT-1R KVERT KEMSD
AVIATION COLOUR CODE:	RED
ERUPTION DETAILS:	ERUPTION AT 20080923/0000Z FL300 REPORTED
OBS VA DTG:	23/0100Z
OBS VA CLD:	FL250/300 N5400 E15930 – N5400 E16100 – N5300 E15945 MOV SE 20KT SFC/FL200 N5130 E16130 – N5130 E16230 – N5230 E16230 – N5230 E16130 MOV SE 15KT
FCST VA CLD +6 HR:	23/0700Z FL250/350 N5130 E16030 – N5130 E16230 – N5330 E16230 – N5330 E16030 SFC/FL180 N4830 E16330 – N4830 E16630 – N5130 E16630 – N5130 E16330
FCST VA CLD +12 HR:	23/1300Z SFC/FL270 N4830 E16130 – N4830 E16600 – N5300 E16600 – N5300 E16130
FCST VA CLD +18 HR:	23/1900Z NO VA EXP
RMK:	LATEST REP FM KVERT (0120Z) INDICATES ERUPTION HAS CEASED. TWO DISPERSING VA CLD ARE EVIDENT ON SATELLITE IMAGERY
NXT ADVISORY:	20080923/0730Z

CHAPTER 10

WORLD AREA FORECAST CENTRE (WAFC) PRODUCTS

Objectives:

1. List the WAFC products available

2. Describe a given SIGWX chart.

3. Describe sources and procedure for receiving the WAFC products

Sub topic

1. Type of WAFC charts available

2. Chart specifications

3. Contents of charts

4. Description of SIGWX elements depicted

5. Interpretation of SIGWX charts

10.1 WAFS- OBJECTIVES

The objective of the World Area Forecast System is to supply meteorological authorities and other users with global aeronautical meteorological en-route forecasts in digital form. Under this world wide system, two centres are functioning, one at London and the other at Washington.

10.2 RESPONSIBILITIES OF WAFC:

a) to prepare gridded global forecasts of:
   1) upper wind;
   2) upper air temperature and humidity;
   3) geopotential altitude of flight levels;
   4) flight level and temperature of tropopause;
   5) direction, speed and flight level of maximum wind;
   6) cumulonimbus clouds;
   7) icing; and
   8) turbulence;

b) to prepare global forecasts of significant weather (SIGWX) phenomena;
c) to issue the forecasts referred to in a) and b) in digital form to meteorological authorities and other users.
d) to receive information concerning the accidental release of radioactive materials into the atmosphere from its associated WMO Regional Specialised Meteorological Center (RSMC) for the provision of transport model products for radiological environmental emergency response, in order to include the information in significant weather forecasts; and
e) to establish and maintain contact with VAACs for the exchange of information on volcanic activity in order to coordinate the inclusion of information on volcanic eruptions in significant weather forecasts.

10.3 PRODUCTS

The grid point forecasts prepared by a WAFC comprise:

a) wind and temperature data for flight levels 50 (850 hPa), 100 (700 hPa), 140 (600 hPa), 180 (500 hPa), 240 (400 hPa), 270 (350hPa), 300 (300 hPa), 320 (275 hPa), 340 (250 hPa), 360 (225hPa), 390 (200 hPa), 450 (150 hPa) and 530 (100 hPa);

b) flight level and temperature of tropopause;

c) direction, speed and flight level of maximum wind;

d) humidity data for flight levels 50 (850 hPa), 100 (700 hPa), 140 (600 hPa), and 180 (500 hPa);

e) horizontal extent and flight levels of base and top of cumulonimbus clouds;

f) icing for layers centered at flight levels 60 (800hPa), 100 (700hPa), 140 (600 hPa), 180 (500 hPa), 240 (400 hPa) and 300 (300 hPa);

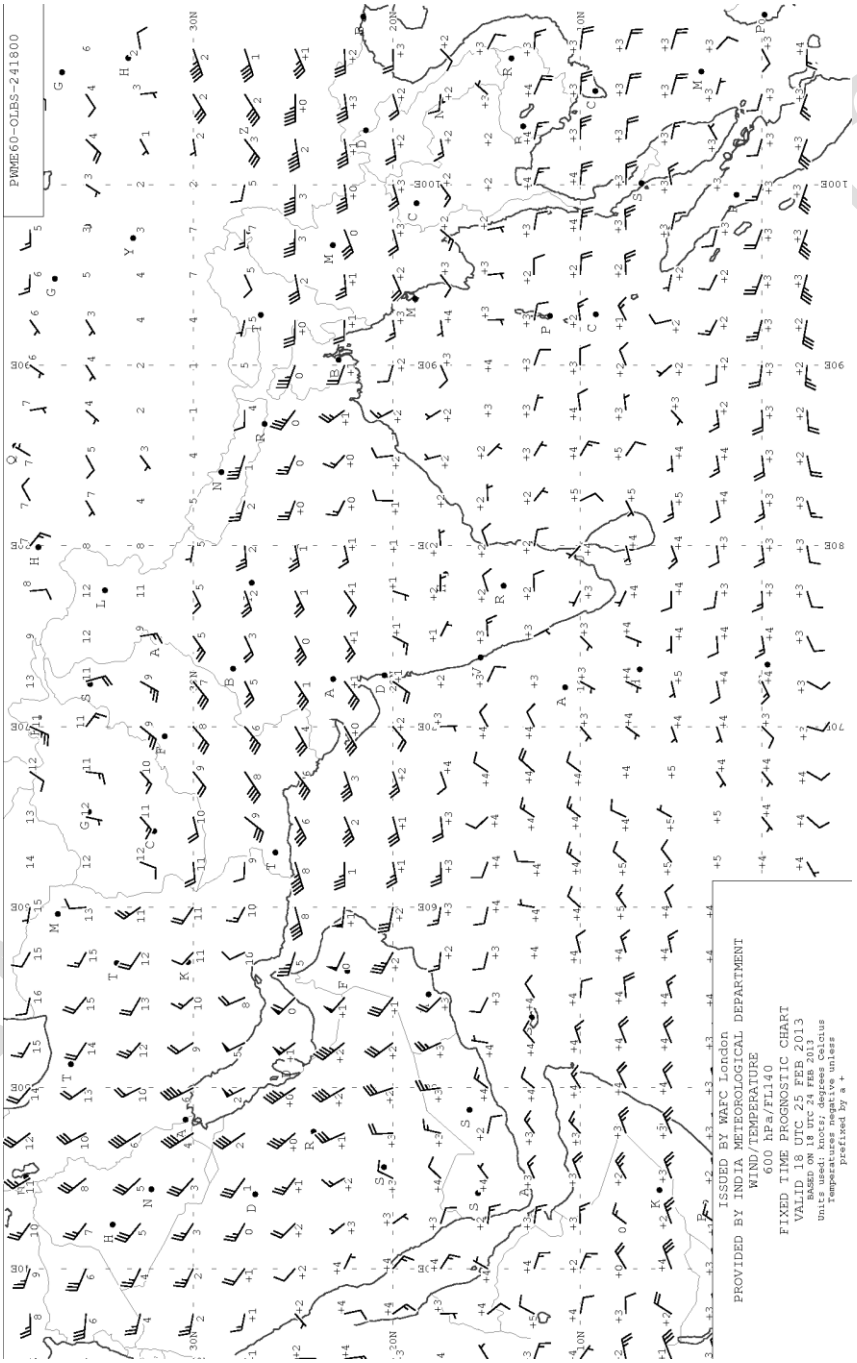
g) clear-air turbulence for layers centered at flight levels 240 (400 hPa), 270 (350 hPa), 300 (300 hPa), 340 (250 hPa), 390 (200 hPa) and 450 (150 hPa);

h) in-cloud turbulence for layers centered at flight levels 100 (700 hPa), 140 (600 hPa), 180 (500 hPa), 240 (400 hPa) and 300 (300 hPa); and

Note 1: Layers centered at a flight level referred to in (f) and (h) have a depth of 100 hPa.

Note 2: Layers centered at a flight level referred to in (g) have a depth of 50 hPa.

f) geopotential altitude data for flight levels 50 (850 hPa), 100 (700 hPa), 140 (600 hPa), 180 (500 hPa), 240 (400 hPa), 300 (300 hPa), 320 (275 hPa), 340 (250 hPa), 360 (225 hPa), 390 (200 hPa), 450 (150 hPa) and 530 (100 hPa).



10.4 SIGNIFICANT WEATHER (SIGWX) FORECASTS

General provisions

- Forecasts of significant en-route weather phenomena are prepared as SIGWX forecasts four times a day by WAFC.
- They are valid for fixed valid times at 24 hours after the time (0000, 0600, 1200 and 1800 UTC) of the synoptic data on which the forecasts were based.

Types of SIGWX forecasts

a) high- level SIGWX forecasts for flight levels between 250 and 630; and
b) medium-level forecasts for flight levels between 100 and 250.

Criteria for including items in WAFC SIGWX forecasts

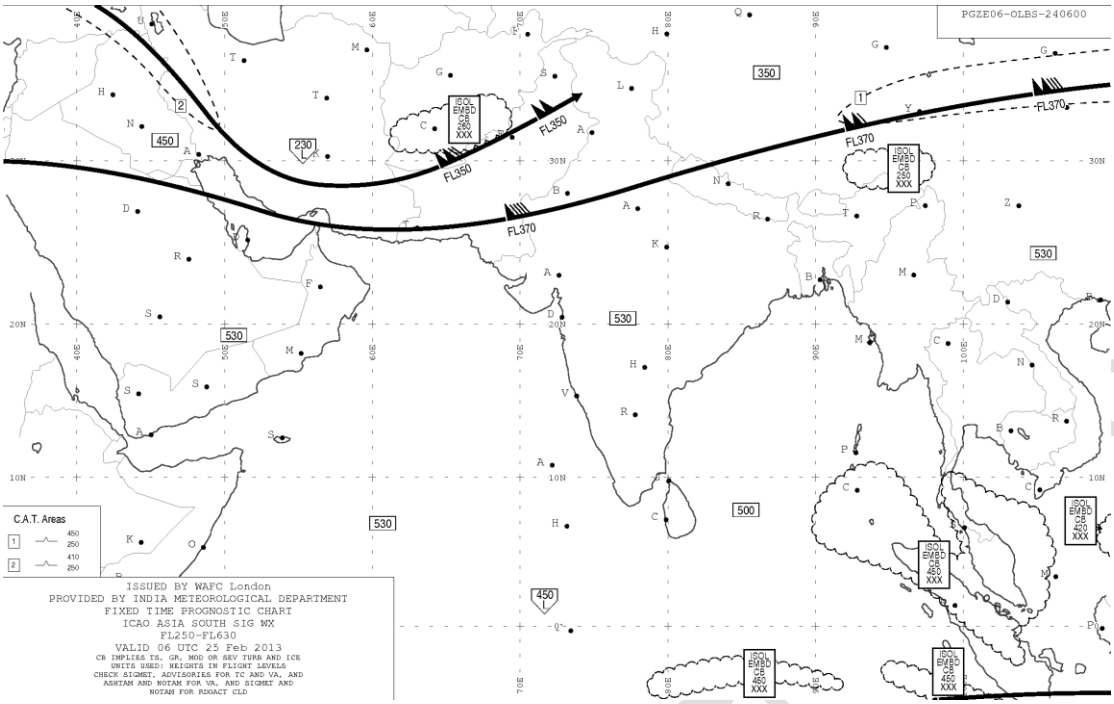
The following criteria are applied for SIGWX forecasts:

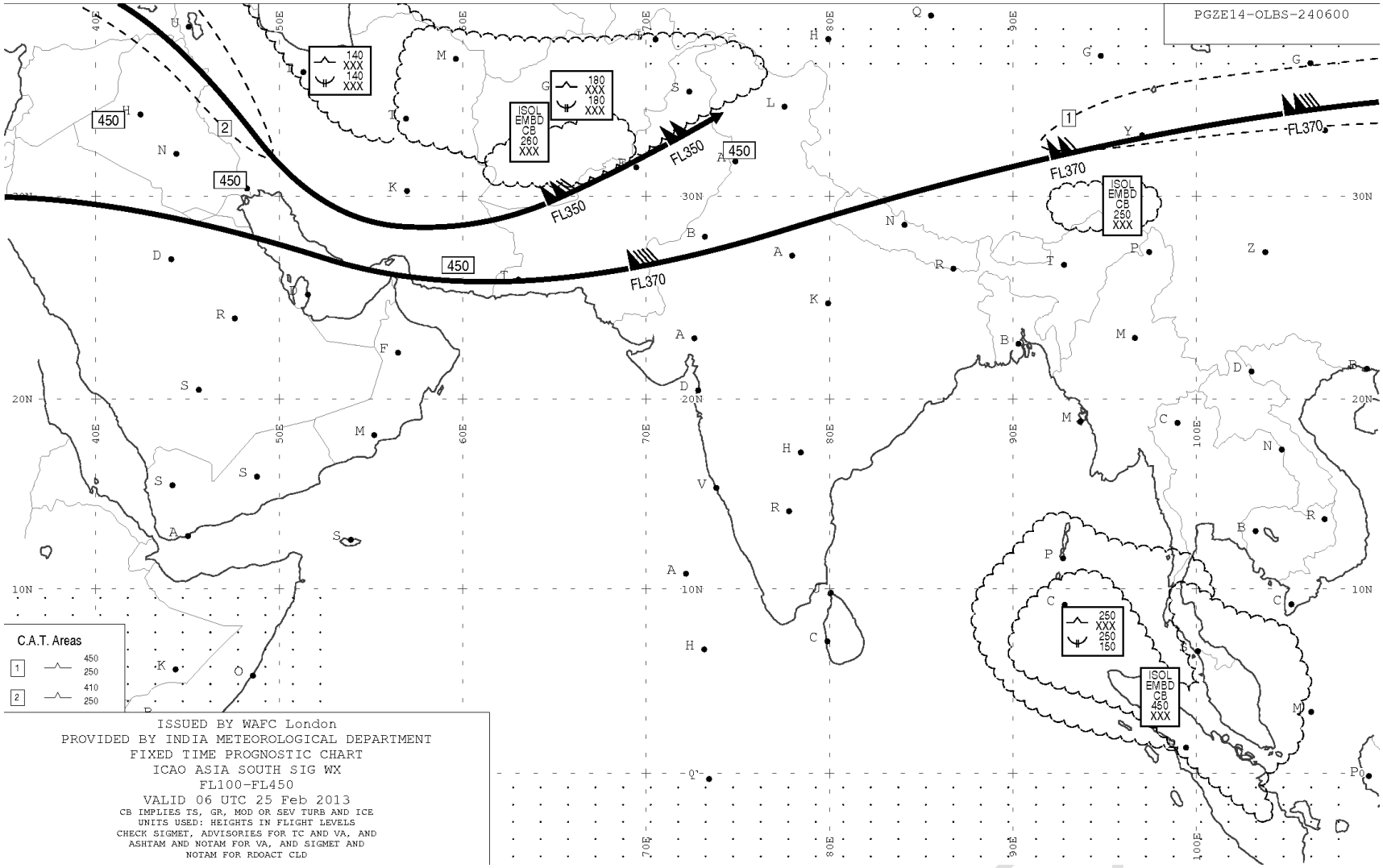
a) "CB" is included only when it refers to the occurrence or expected occurrence of cumulonimbus clouds:
   1) affecting an area with a maximum spatial coverage of 50 per cent or more of the area concerned;
   2) along a line with little or no space between individual clouds; or
   3) embedded in cloud layers or concealed by haze.

b) the inclusion of "CB" shall be understood to include all weather phenomena normally associated with cumulonimbus clouds, i.e. thunderstorm, moderate or severe icing, moderate or severe turbulence and hail;

c) where a volcanic eruption or an accidental release of radioactive materials into the atmosphere warrants the inclusion of the volcanic activity symbol or the radioactivity symbol in SIGWX forecasts, the symbols shall be included on SIGWX forecasts irrespective of the height to which the ash column or radioactive material is reported or expected to reach; and

d) in the case of co-incident or the partial overlapping of items a) [tropical cyclones], i) [volcanic eruptions] and j) [accidental release of radioactive materials], the highest priority is given to volcanic eruptions, followed by release of radioactive materials and by tropical cyclones. The item with the highest priority is placed at the location of the event, and an arrow is used to link the location of the other item(s) to its associated symbol or text box.


PGZE06-OLBS-240600
C.A.T. Areas
ISSUED BY WAFC London
PROVIDED BY INDIA METEOROLOGICAL DEPARTMENT
FIXED TIME PROGNOSTIC CHART
ICAO ASIA SOUTH SIG WX
FL250-FL630
VALID 06 UTC 25 Feb 2013
CB IMPLIES TS, GR, MOD OR SEV TURB AND ICE
UNITS USED: HEIGHTS IN FLIGHT LEVELS
CHECK SIGMET, ADVISORIES FOR TC AND VA, AND
ASHTAM AND NOTAM FOR VA, AND SIGMET AND
NOTAM FOR RDOACT CLD
FL350
FL370
ISOL EMBD CB 250 XXX
ISOL EMBD CB 450 XXX

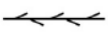

PGZE14-OLBS-240600
140
XXX
140
XXX
180
XXX
180
XXX
ISOL
EMBD
CB
260
XXX
ISOL
EMBD
CB
250
XXX
ISOL
EMBD
CB
450
XXX
250
XXX
250
150
450
FL350
FL370
C.A.T. Areas
1
450
250
2
410
250
ISSUED BY WAFC London
PROVIDED BY INDIA METEOROLOGICAL DEPARTMENT
FIXED TIME PROGNOSTIC CHART
ICAO ASIA SOUTH SIG WX
FL100-FL450
VALID 06 UTC 25 Feb 2013
CB IMPLIES TS, GR, MOD OR SEV TURB AND ICE
UNITS USED: HEIGHTS IN FLIGHT LEVELS
CHECK SIGMET, ADVISORIES FOR TC AND VA, AND
ASHTAM AND NOTAM FOR VA, AND SIGMET AND
NOTAM FOR RDOACT CLD

10.5 WEATHER SYMBOLS

WEATHER SYMBOLS

	Thunderstorm		Drizzle
	Tropical cyclone		Rain
	Severe squall line		Snow
	Moderate turbulence		Shower
	Severe turbulence		Widespread blowing snow
	Mountain waves		Severe sand or dust haze
	Slight aircraft icing		Widespread sandstorm or duststorm
	Moderate aircraft icing		Widespread haze
	Severe aircraft icing		Widespread mist
	Widespread fog		Widespread smoke
	Hail		Freezing precipitation
	Volcanic eruption	CAT	Clear Air Turbulence
	Visible ash cloud		Radiaoactive materials in the atmosphere
	Mountain obstruction		

FRONTS, CONVERGENCE ZONES & OTHER SYMBOLS

	Cold front at the surface		Quasi-stationary front at the surface
	Warm front at the surface		Quasi-stationary front above the surface
	Occluded front at the surface		Freezing level
	Occluded front above the surface		Convergence line
	Position speed & level of max wind		Inter-tropical convergence zone
	Tropopause High		State of the sea
	Tropopause Low		Sea surface Temperature
	Tropopause Level		Widespread strong surface wind

- Wind arrows indicate the maximum wind in jet and the fight level at which it occurs. Significant changes (speed of 20 knots or more. 3000 ft (less if practicable in flight level) are marked by the double bar. In the example at the double bar the wind speed is 225 km/h (120 kt)
- The heavy line delineating the jet axis begins / ends at the points where a wind speed of 150 km/h (80 kt)is forecast.
- This symbol refers to widespread surface wind speeds exceeding 60 km/h (30 kt)

BOUNDARIES

	Boundaries of Significant weather		CAT Boundary

Severe squall line symbol: In flight documentation for flights operating up to FL 100. This symbol refers to “squall line”.

Radioactive materials in the atmosphere symbol: The following information shall be included at the side of the chart: radioactive material symbol; latitude/longitude of the accident site; date and time of accident; check NOTAM for further information.

Volcanic eruption symbol: The following information shall be included at the side of the chart: volcanic eruption symbol; name an international number of volcano (if known); latitude/longitude; date and time of the first eruption (if known); check SIGMETs and NOTAM or ASHTAM for volcanic ash.

Freezing precipitation: This symbol does not refer to icing due to precipitation coming into contact with an aircraft, which is at a very low temperature.

Visible ash cloud symbol: Visible ash cloud symbol applies only to model VAG not to SIGWX charts.

NOTE: Height indications between which phenomena are expected, top above base as per chart legend.

Abbreviations used to describe clouds:

Type

CI = Cirrus AS = Altostratus ST = Stratus

CC = Cirrocumulus NS = Nimbostratus CU = Cumulus

CS = Cirrostratus SC = Stratocumulus

CB= Cumulonimbus

AC = Altocumulus

Amount

Clouds except CB

SKC = sky clear (0/8)

FEW = few (1/8 to 2/8)

SCT = scattered (3/8 to 4/8)

OVC = overcast (8/8)

CB only

ISOL = individual CBs (isolated)

OCNL = well-separated CBs (occasional)

FRQ = CBs with little or no separation (frequent)

EMBD= CBs embedded in layers of clouds or concealed by haze (embedded)

Heights

Heights are indicating on SWH and SWM charts in flight levels (FL), top over base.

When XXX is used, tops or bases are outside the layer of the atmosphere to which the chart applies.

In SWL charts:

i) Heights are indicated as altitudes above mean sea level;
ii) The abbreviation SFC is used to indicate ground level.

Depicting of lines and systems on specific charts

Models SWH and SWM – Significant weather charts (high and medium)

Scalloped line	demarcation of areas of significant weather
Heavy broken line	delineation of area of CAT
Heavy solid line Interrupted by wind arrow and flight level	position of jet stream axis with indication of wind direction position of jet stream axis with indication of wind direction, speed in kt and height in flight level. The vertical extent of the jet stream is indicated (in flight levels) below the flight level, e.g. FL 270 accompanied by + 20 / -30 indicates that the height of the jet extends from FL 240 to FL 290.
Figures on arrows	Speed in kt of movements of frontal systems
Flight levels inside small rectangle	height in flight levels of tropopause at spot locations e.g.. 340 Low and high points of the tropopause topography are indicated by the letters L or H, respectively inside a pentagon with the height in flight level.

10.6 RECEPTION OF WORLD AREA FORECAST CENTRE (WAFC) PRODUCTS:

Wind and temperature charts for different flight level are given in GRIB (Gridded Data In Binary) format and Significant Weather charts are in BUFR (Binary Universal Forecast Representation) format.

These data and information is distributed either through Secured FTP or through satellite-based broadcast system. The data disseminated by UK Met Office is through SADIS (SAtellite DIstribution System) and it mainly covers Europe, Asia, Indian Ocean and Africa. The data disseminated by U.S. NOAA broadcast system is through ISCS (International Satellite Communications System) and mainly covers America and the Pacific Ocean. Both these centres work in dual redundancy mode and in event of failure of one centre, the other centre automatically takes over the responsibility.

10.7 DATA FORMATS ON THE SECURE SADIS FTP SERVICE

i. OPMET, AIRMETs, GAMETs – Alphanumeric format
ii. SIGWX Charts – PNG2 format
iii. BUFR3 encoded high level SIGWX information – BUFR; FM 94 BUFR (Binary Universal Form for the Representation of meteorological data
iv. GRIB1 (GRIB4 edition 1) encoded wind, temperature and humidity information
v. GRIB2 (GRIB edition 2) encoded wind, temperature and humidity information GRIB2 format
vi. Volcanic ash advisory graphics and tropical cyclone advisory graphics – PNG format in the PNG_FORMAT subfolders.
vii. Volcanic ash and tropical cyclone advisory statements - Alphanumeric format

General login information for the service:

i. Host name sadisftp/metoffice.gov.uk
ii. Domain name metoffice.gov.uk
iii. IP Address 151.170.240.15

Access via web browser ftp://[username]:[password]@sadisftp.metoffice.gov.uk

CHAPTER 11

BRIEFING AND DOCUMENTATION

Objectives:

1. List the items to be provided in documentation

2. List the items to be displayed in an aviation met office

3. Explain the special requirements of low-level flights

4. To download the products from OLBS or other sources

Sub topic

1. List of documents to be provided

2. List of items to be displayed in meteorological offices

3. Briefing of low level flights

4. OLBS-products available and its updation schedules and methods

11.1 BRIEFING: GENERAL PROVISIONS

- Aviation Meteorological Offices should supply the meteorological information to operators and flight crewmembers for:
  (a) pre-flight planning by operators;
  (b) in-flight re-planning by operators using centralised operational control of flight operations;
  (c) use by flight crew members before departure; and
  (d) aircraft in flight.
- Forecasts for supplying to international flights should be generated from the forecasts provided by the WAFCs

11.2 INFORMATION TO BE PROVIDED:

Meteorological information supplied to operators and flight crewmembers should be up to date and include the following information:

(a) Forecasts of
1) Upper wind and upper air temperature;
2) flight level and temperature of tropopause;

3) direction, speed and flight level of maximum wind; and
4) SIGWX phenomena

(b) METAR and SPECI (including trend forecasts) for the aerodromes of departure and intended landing, and for take-off, en-route and destination alternate aerodromes;

(c) TAF or amended TAF for the aerodromes of departure and intended landing, and for take-off, en-route and destination alternate aerodromes;

(d) Forecasts for take-off;

(e) SIGMET information, and appropriate special air-reports relevant to the whole route, those not already used in the preparation of SIGMET;

(f) Volcanic ash and tropical cyclone advisory information relevant to the whole route;

(g) area forecast/ local forecast;

(h) aerodrome warnings for local aerodrome;

(i) meteorological satellite images; and

(j) ground- based weather radar information

11.3 MODE OF SUPPLY:

Meteorological information can be supplied by one or more of the following methods:

a) written or printed material, including specified charts and forms;
b) data in digital form;
c) briefing;
d) consultation; or
e) display.

- The purpose of briefing is to supply the latest available information on existing and expected meteorological conditions along the route to be flown, at the aerodrome of intended landing, alternate aerodromes as relevant, either to explain and amplify the information contained in the flight documentation or in lieu of flight documentation.

11.4 ON LINE BRIEFING SYSTEM (OLBS)

In INDIA there is also an arrangement for providing the documentation through “On line Briefing System” or OLBS. This facility is Web-based and it is password-protected. It is available to registered users like scheduled airlines operators. In addition, access to this facility is also available to all the AMO & AMS of IMD. The server for this system is located at AMO Delhi and AMO Chennai and registered users can access any of the two systems at following URL.

I. http://olbs.amsschennai.gov.in/nsweb/FlightBriefing/#showLogin
II. http://olbs.amssdelhi.gov.in/nsweb/FlightBriefing/#showLogin

The authorized AMO/AMS can also upload/update the information in respect of their stations in the system.

If required most of the meteorological information, required for briefing & documentation can be obtained from following sites.

I. http://aviationweather.gov/iffdp/
II. http://aviationweather.gov/products/swm/info

However the official OLBS site will remain the primary source of information for briefing & documentation in India.

11.5 SPECIFIC NEEDS OF LOW-LEVEL FLIGHTS

- Briefing and/or consultation for low-level flights including those in accordance with the visual flight rules, should include meteorological information covering altitudes up to flight level 100 (or up to flight level 150 in mountainous areas or higher, when necessary).
- Particular mention should be made of the occurrence or expected occurrence of any phenomena causing widespread reduction of visibility to less than 5000 m, as well as the occurrence or expected occurrence of clouds, which may affect the flight.
- Information from relevant SIGMET message also may be provided.

11.6 INFORMATION REQUIRED TO BE DISPLAYED

To assist the flight crewmembers and others concerned with the preparation of the flight and for use in briefing and consultation, the meteorological office shall display the latest available information for ready access to the users.

11.7 FLIGHT DOCUMENTATION

- Flight documentation shall cover the whole route to be flown and comprise information listed below:
  - i) forecasts of Upper wind and upper air temperature; and SIGWX phenomena
  - j) METAR and SPECI (including trend forecasts) for the aerodromes of departure and intended landing, and for take-off, en-route and destination alternate aerodromes;
  - k) TAF or amended TAF for the aerodromes of departure and intended landing, and for take-off, en-route and destination alternate aerodromes;

l) SIGMET information, and appropriate special air-reports relevant to the whole route, those not already used in the preparation of SIGMET;

m) volcanic ash and tropical cyclone advisory information relevant to the whole route (the information received from other meteorological offices shall be included in flight documentation without change); and

n) area forecast/ local forecast;

- METAR, SPECI, TAF, and SIGMET received from other meteorological offices shall be included in flight documentation without change.
- The forms and the legend of charts included in flight documentation should be printed in English.
- The units employed for each element shall be indicated.
- The location indicators and the abbreviations used should be explained in the flight documentation.
- Flight documentation should normally be supplied as shortly before departure as is practicable.
- The documentation is to be handed over only to DGCA certified Flight Dispatcher/ Pilots.
- For flight documentation of international flights, meteorological offices shall provide information received within the framework of WAFS.
- The flight documentation for national flights shall be presented in the form of charts, tabular forms or abbreviated plain language texts.

CHAPTER 12

AERONAUTICAL TELECOMMUNICATION NETWORK (ATN)

Objectives:

1. Explain the aviation telecommunication network

2. Describe the filing time and transmission time of aviation met messages

3. Explain ROBEX scheme

4. Explain VOLMET

Sub topic

1. Basics about aeronautical telecommunication net work

2. Filing time, transmission time and priority of various aviation meteorological messages

3. Basic concept of ROBEX scheme

4. Basics of VOLMET broadcast

12.1 AERONAUTICAL TELECOMMUNICATION NETWORK (ATN)

AFTN (Aeronautical Fixed Telecommunication Network) is the dedicated telecommunication network used for exchange of aeronautical messages and data between different aeronautical stations. It is also the primary channel for exchange of Operational Met Messages (OPMET) between different Aerodrome Met Offices and Aeronautical Met Stations. The technology used for transmission and reception in AFTN is based on the Telex protocols and is limited to text only messages with a maximum length of 1800 characters. It is gradually being replaced with Internet based **ATN (Aeronautical Telecommunication Network)** which enables seamless communications between ground users (e.g. ANSPs, Airlines) and aircraft and vice versa. The ATN has two types of applications.

The air-ground applications

i. Context management (CM);
ii. Automatic dependent surveillance (ADS);
iii. Controller-pilot data link communications (CPDLC);
iv. Flight information service (FIS);

The ground-ground applications

i. ATS message handling service (AMHS);
ii. ATS inter-facility data communications (AIDC).

The AFTN infrastructure consists of landline /leased line circuits between major centers with suitable DTE/DCE. The IMD departmental telecommunication network is linked to AFTN through six AMSS centers located at Delhi, Kolkata, Mumbai, Chennai, Nagpur and Guwahati. Each destination under the AFTN is identified by a unique code.

Facility code	refers to
YNYX	"NOTAM Office"
YZYX	"Met Data Bank"
YMYX	"Local Met Office"
YFYX	"AFTN Office"
ZTZX	"Control tower"
ZPZX	"ATS Reporting Office"
ZQZX	"Area Control Center"

As per the above addressing system VIDP YMYX will refer to Met Office of Delhi (Palam) airport and VOMM ZTZX will refer to Control Tower Chennai airport.

12.2 PRIORITY INDICATORS:

All the messages exchanged over AFTN carry any of the following priority indicators

a. Priority Indicator **SS** for Distress Messages
b. Priority Indicator **DD** for Urgency Messages
c. Priority Indicator **FF** for Flight Safety Messages
d. Priority Indicator **GG** for Meteorological Messages, Flight Regularity Messages and Aeronautical Information Services Messages.

12.3 BASIC CONCEPT OF ROBEX SCHEME

ROBEX or Regional OPMET Bulletin Exchange is a scheme for exchange of operational meteorological messages (OPMET) within the region (ASIA/PAC, MID) as well with other ICAO regions. As it is a bulletin it contains one or more meteorological messages, however each ROBEX bulletin consists of message of same type.

Type of messages exchanged under ROBEX scheme:

Data type	Abbreviated name	WMO designator
Aerodrome report	METAR	SA
	SPECI	SP
Aerodrome forecasts	TAF (Long TAF 12 or 30 Hrs)	FT
	TAF(Short 9 Hrs)	FC
SIGMET information	SIGMET	WS
	SIGMET for TC (Tropical cyclone)	WC
	SIGMET for VS(Volcanic ashes)	WV
Advisory for Volcanic ash or Tropical cyclone	Volcanic ash Advisory	FV
	Tropical cyclone Advisory	FC
Air-reports	AIREP SPECIAL (ARS)	UA
Administrative	ADMIN	NO

12.4 ROBEX BULLETIN COMPILING CENTRE (ROBEX BCC or, in brief, ROBEX centre)

ROBEX centers are responsible for collection of OPMET messages from the originating stations or NOCs in their area of responsibility and for compiling these messages into ROBEX bulletins and to transmit them to other ROBEX centres, according to predefined distribution lists, specific for each bulletin. They are also responsible to transmit them to their respective RODB (Regional OPMET Data Bank). For INDIA the designated RODB is Bangkok (**VTBBYZYX).** In INDIA, Chennai, Kolkata, Delhi, and Mumbai are the ROBEX bulletin compiling centre.

ROBEX CENTRE					Bulletin time	Disseminated to	AFTN address
Name	**CCCC**	**BUL NO**	**CCCC**	Aerodrome			
KOLKATA	VECC	SAIN33			HH+50	BANGKOK	VTBBYPYX
			VECC	KOLKATA			
			VEPT	PATNA			
			VGHS	DHAKA			
			VGEG	CHTTAGOAN			
			VNKT	KATHMANDU			
			VQPR	PARO			

ROBEX CENTRE							
NAME	**CCCC**	**BUL NO**	**CCCC**	**AERODROME**	**BUL TIME**	**DISSEMINATED TO**	**AFTN ADDRESS**
DELHI	VIDP	SAIN32				BANGKOK	VTBBYPYX
			VIDP	DELHI	HH+00		
			VILK	LUCKNOW	HH+30		
			VIAR	AMRITSAR			
			VIBN	VARANASI			
			VIJP	JAIPUR			

ROBEX CENTRE							
NAME	**CCCC**	**BUL NO**	**CCCC**	**AERODROME**	**BUL TIME**	**DISSEMINATED TO**	**AFTN ADDRESS**
MUMBAI	VABB	VABB31				BANGKOK	VTBBYPYX
			VAAH	AHMEDABAD	HH+10		
			VABB	MUMBAI	HH=40		
			VANP	NAGPUR			
			VOHS	HYDRABAD			
			VOMM	CHENNAI	HH+40		
			VOTR	TIRUCHPLLAI			
			VOTV	TRVNDRUM			
			VOHS	HYDRABAD			

ROBEX CENTRE									
NAME	**CCCC**	**BUL NO**	**CCCC**	**AERODROME**	**FILING TIME**	**START OF VALIDITY**	**TAF VALIDITY**	**DISSEMINATED TO**	**AFTN ADDRESS**
MUMBAI	**VABB**	**FTIN31**							
			VAAH	AMHBAD	0300	0600	30		
			VABB	MUMBAI	0900	1200	30		
			VANP	NAGPUR	1500	1800	30		
			VECC	KOLKATA	2100	0000	30		
			VEPT	PATNA			30		
			VIAR	AMRITSAR			30		
			VIBN	VARANASI			30		
			VIDP	DELHI			30		
			VIJP	JAIPUR			30		
			VILK	LUCKNOW			30		
	VABB	**FTIN32**	VCBI	COLOMBO	0400				
			VNKT	KTHMNDU	1000				
			VOCI	COCHIN					
			VOCL	CALICUT					
			VOHY	HYDABAD					
			VOMM	CHENNAI					
			VOTR	TRICHI					
			VOTV	TRVNDUM					
			VRMM	MALE					
			VRMG						
			VOHS	HYDBAD					

12.5 PRIORITY

OPMET bulletins transmitted via AFTN should use the following priority indicators:

SIGMET, AIREP SPECIAL (special air-reports), VAA, TCA and TAF AMD – **PRIORITY - FF**

TAF, METAR and SPECI – **PRIORITY – GG**

12.6 FILING AND TRANSMISSION TIME

Required transit times of meteorological information:

AFTN messages and bulletins containing operational meteorological information should achieve transit times of less than the following:

SIGMET messages, volcanic ash and tropical cyclone advisory information and special air-reports		5 minutes
Abbreviated plain-language amendments to significant weather and upper air forecasts		5 minutes
Amended TAF and corrections to TAF		5 minutes
METAR	0-900 km	
Trend forecasts	(500 NM)	5 minutes
TAF		
SPECI	more than 900 km	
	(more than 500 NM)	10 minutes

Filing time of bulletins

Meteorological bulletin required for scheduled transmission over AFTN shall be filed regularly and at the prescribed scheduled times. METARs shall be filed for transmission not later than 5 minutes after the actual time of observations. 30 hour TAFs for international dissemination shall be filed for transmission one hour before the commencement of their period of validity.

12.7 RESPONSIBILITIES AND PROCEDURES TO BE FOLLOWED BY ORIGINATING AERODROME METEOROLOGICAL OFFICES (AMO) AND NOC

- Originating AMOs (or other designated forecasting offices) should prepare the required TAF messages. TAFs should be sent by the AMOs or NOCs to the responsible ROBEX center before the cut-off time set up by this centre.
- TAFs should be monitored by the originating AMOs and amended TAF (TAF AMD) should be issued according to the established criteria.
- Amended TAFs should be sent by the originating station to the responsible ROBEX centre with no delay.
- The optional group BBB should be used in the WMO abbreviated heading to indicate amended TAF as per the procedure.
- All TAFs in a ROBEX TAF bulletin should have a common period of validity.
- It is not allowed to mix TAF with different periods of validity in one bulletin.

TAF of VECC, VIDP, VCCC, VNKT and VGHS are also required for HF VOLMET broadcasts.

Note:

i. Bulletins are required to be compiled during the 15 minutes before filing.
ii. The TAF issuance time (official filing time) is used in the DTG – YYGGgg of the bulletin header.
iii. The actual filing time is used in the AFTN header and should be after the time given in the bulletin header also referred to as the WMO Abbreviated Heading in the ROBEX HB. TAF should be filed for transmission at least one hour before the commencement of their period of validity, unless otherwise determined by regional air navigation agreement.

12.8 VOLMET

i. It is a broadcast for providing meteorological information for aircraft in flight.

ii. These Meteorological information are supplied by a meteorological office to its associated air traffic services unit which in turn transmits it to overflying aircraft through D-VOLMET or VOLMET broadcasts as determined by regional air navigation agreement.

i. It contents the current METAR/SPECI, TAF SIGMET of selected aerodromes. In addition D-VOLMET may also contain Special air report, AIRMET.

ii. It is transmitted to the overflying aircraft, either through **Data-link** (D-VOLMET) or in form of continuous and repetitive voice broadcast (**VOMLET Broadcast**). Continuous VOLMET broadcast is normally made on VHF, while the schedule VOLMET broadcast is made on HF. The aircraft can tune to specified frequency to receive the VOLMET.

iii. In INDIA the VOLMET broadcast is made from Kolkata and Mumbai as per the schedule given below.

VOLMET	**TRANSMITTING STATIONS**			
	KOLKATA		**MUMBAI**	
BROADCAST SCHEDULE	H+05	H+35	H+25	H+55
FREQUENCY	**2.965, 6.676, 11.387 MHz**		**2.965, 6.676,11.387 MHz**	
STATIONS	VIDP	VIDP	VABB	VABB
	VECC	VECC	VAAH	VAAH
	VGHS	VGHS	VOMM	VOMM
	VNKT	VNKT	VCCC	VCCC
	VYYY	VYYY	OPKC	OPKC
			VRMM	VRMM

CHAPTER13

AIRCRAFT ACCIDENT INVESTIGATION

Objectives:

1. Explain the procedures to be followed by various offices

Sub topic

1. Introduction

2. Responsibilities of a Met observer

3. Responsibilities of Aviation met offices

4. Preparation of Reports

13.1 INTRODUCTION

Mishap may occur to an aircraft during any phase of its operation. Mishap to an aircraft may be divided into two categories – **accidents and incidents.**

Damage may also be caused to parked or moored aircraft by weather phenomena.

13.2 DEFINITIONS

Accident: An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which:

(a) a person is fatally or seriously injured as a result of being in or upon the aircraft or by direct contact with the aircraft or anything attached thereto; or

(b) the aircraft incurs damage or structural failure which adversely affects the structure, strength, performance or flight characteristics of the aircraft and which would normally require major repair or replacement of the affected component; or

(c) the aircraft is missing or is completely inaccessible.

Incident: An occurrence, other than an accident associated with the operation of an aircraft which affects or could affect the safety of operation.

13.3 . ACCIDENTS

13.3.1 Intimation to headquarters' offices

Whenever an Aerodrome Meteorological Office (AMO) comes to know from any source of an accident, the duty officer/officer-in-charge of the AMO should immediately obtain the official time of occurrence of the accident from the local aerodrome authorities. If it is an AMS, the message containing available information should be send to the Director/ Meteorologist-in-charge of the controlling Aerodrome Meteorological Office **by name**. All available details should be immediately communicated through any available communication channel like AMSS network, IMD VPN, Phone, or Telefax, by name to the Deputy Director General of Meteorology (DDGM) of the parent Regional Meteorological Centre (RMC). The DDGM (RMC) will in turn communicate the information using the above modes of communication by name to Scientist F, Central Aviation Meteorological Division (CAMD) and DDGM (RMC) of the region from which the flight has originated. The first intimation shall contain the following:

a) Name of the airline

b) Type and call sign of the aircraft

c) Route followed or local flying

d) Details of Meteorological Briefing and documentation provided

e) Description of accident/ incident

f) Time of occurrence

g) Place of accident/ incident

h) No. of persons on board

i) Casualty details, if any

j) Extent of the damage to the aircraft

k) Reason of accident, if known

l) From whom the Message was received by the met office

m) Time of receipt of information

n) Whether entries have been made in the accident register and aviation log book and signed by the officer-in-charge

o) Action taken on receipt of the information (Whether documents sealed and kept under safe custody)

p) Whether Special Current weather observation was recorded as per

para 3.2.5 or not

q) Description of weather prevailed around the time of accident at the place/ site of accident

r) Any other relevant details

In case of serious accidents involving loss of life or substantial damage to the aircraft, the messages should commence with the identifier **"AIRCRASH"** and should be sent without any delay. In addition, the information should be conveyed to the DDGM (RMC) by telephone. The DDGM (RMC) in turn should convey the information, by Telefax and telephone to Scientist F, CAMD/ DGM and DDGM (RMC) of the region from which the flight had originated.

13.3.2 RESPONSIBILITY OF AMO AND AMS

Soon on getting information of an accident all relevant original documents connected with the service rendered to the flight in question should be taken possession of by the Officer-in-charge.

List of Documents to be kept in safe custody

1. Office copy of documentation provided to the aircraft.
2. Office copies of relevant forecasts, aerodrome forecasts, and landing forecasts
3. Relevant SIGMET warnings
4. Routine, special and additional reports.
5. Current Weather Diary.
6. Radarscope Polar Diagrams/ Office copy of the DWR products, if used in briefing
7. Office copies of satellite images, if used in documentation/ briefing.
8. Briefing register/ relevant log page of OLBS
9. Log Books, if relevant
10. SIGMET information register
11. Office copies of relevant Aerodrome Warnings.

12. Office copies of WAFC WINTEMP charts, WAFC SIGWX charts, if used in documentation.

13. Office copies of National SIGWX charts

14 All relevant information furnished to ATC, with proof, if possible, of receipt by the recipient.

15. Autographic charts.

16. Any other document that may be significant

Where the meteorological briefing is being provided through web based briefing system, the hard copies of the briefing materials should be taken possession of in the same manner as in the case of manual briefing. Soft copies of the relevant documents should also be preserved.

No correction/alteration/modification shall be made in the original documents. Immediately 5 copies of the original documents are to be readied.

The documents in original together with two sets of copies should then be sealed by the Officer-in-charge, **in the presence of another officer/ member of staff** and kept under his safe custody.

The officers sealing the documents should append their signatures together with the time of sealing on the outer cover**.**

In case the Officer-in-charge is not promptly available for sealing the documents it shall be done by another officer/member of staff on duty.

Three sets of copies duly attested by the Officer-in-charge should be forwarded immediately under sealed cover to the Regional Meteorological Centre concerned by Registered Post.

Original sealed documents should be handed over to the Director of Air Safety/ Inspector of Accidents/ Investigator-in-charge or to an officer deputed by him for the purpose, after obtaining a written request from him.

The DDGM (RMC) should be kept informed of the action taken.

The documents sealed may be replaced in the Office records **as soon as they are received back from the Director of Air Safety/Inspector of Accidents/Investigator-in-charge or from the officer deputed by him.**

In case no officials of DGCA call to collect the sealed documents, the documents may be replaced in office records as soon as the final recommendations and report of the investigating authority are received.

In case no request is received for sealed documents, and no official communication is received about the final recommendations and reports, the officer-in-charge of the concerned AMO/ AMS could open the sealed covers and the documents may be replaced in office records after the completion of one year from the date of occurrence of accident/ incident.

Proper entry in this regard may be made in the accident register under intimation to DDGM (RMC).

An **'Aircraft Accident Register'** shall be maintained by all AMOs and AMSs and entries shall be made regarding details of action taken in respect of each accident.

List of original documents sealed for safe custody and subsequently handed over to the Inspector of Accidents or other authorised representative of the Civil Aviation Department, details of copies taken and furnished to the Regional Meteorological Centre, details of current weather information supplied to Airline Operators, current meteorological registers withdrawn from use etc., shall be entered in the register..

The 'Aircraft Accident Register' should be put up for perusal to DDGM (RMC)/ Scientist F, CAMD/ DGM/ IMD Safety Oversight Auditors during their inspection visits to the office concerned.

If during a particular quarter no aircraft accident occurs, a **NIL** entry may be made for that quarter.

Immediately after a meteorological office becomes aware of an aircraft accident occurred at or in the vicinity of the local aerodrome, a special current weather observation shall be recorded in case more than 5 minutes have elapsed since the recording of the previous routine/ special/ additional report at the station.

The duty officer/ officer-in-charge should initial this Special Current Weather observation. However, in cases when the aircraft accident has occurred more than half an hour earlier, no special observation need be taken.

13.3.3 COURT OF ENQUIRY

In order to avoid any controversy and embarrassment, all IMD officials should desist from making any public statement expressing technical opinion or personal views on meteorological factors/ services concerning the accident to the press or other media or any agency or individual not authorised by government to investigate the accident.

It is not necessary or obligatory to obtain prior permission of the DDGM (RMC) concerned either for attending a Court of Enquiry or for producing meteorological documents to the Inspector of Accidents or the Committee of Enquiry or the Court of Enquiry.

A written request may be obtained from the Inspector of Accidents or the Committee of Enquiry for releasing the documents required by them.

The officer-in-charge of the meteorological office shall inform the DDGM (RMC) about attendance at Court of Enquiry or the supply of meteorological documents.

The DDGM (RMC) will in turn keep Scientist F, CAMD /DGM informed of such attendance at Courts of Enquiry or supply of documents.

DDGM, Regional Meteorological Centres may nominate officers, preferably the Directors/ Meteorologists-in-charge of aviation forecasting offices or Meteorological Centres to attend the investigation board as “observers” without prior approval of Scientist F, CAMD or DGM.

The officer concerned should send a report to Scientist F, CAMD and DGM through his DDGM (RMC) on his attendance at the investigation board.

In giving evidence, only factual information about the weather at the time of accident based on available recorded data, charts, and details of forecasts or warning issued for the flight should be given. No attempt should be made to express a view as to whether or not the accident has been caused by weather conditions. Answers to all questions should be strictly factual, to the point and precise. When specifically questioned by the Court of Enquiry, the Officer may give information of a general nature on meteorological phenomena. It is desirable that the officer tendering evidence before Courts of Enquiry goes prepared to answer the probable questions (and supplementary) that might be asked and gives precise answers.

Under the existing provisions of the Indian Aircraft Act, the Inspector of Accidents/ Court of Enquiry has the legal authority to question any member of the meteorological staff on aspects, which may, or may not, be concerned with the weather. There is no objection to the concerned persons answering questions on aspects which may not be concerned with weather, but they should restrict their answers to facts of which they have direct personal knowledge.

Care should be taken not to offer opinions or remarks on the role of individual officials, especially in fields in which the meteorological office has no concern.

In the event of the meteorological staff expressing an opinion on non-meteorological subjects, the responsibility of substantiating their statements before a Committee of Enquiry (or other relevant investigating authority) rests entirely on the persons concerned.

Details of evidence given before Courts of Enquiry together with original summons for giving evidence, should be sent to RMC concerned within a week of tendering the evidence. RMC concerned should supply a copy of the same to Scientist F, CAMD/ DGM along with their comments, if any.

During the course of enquiry into aircraft accidents the Inspector of Accidents may call for signed statements from concerned meteorological officials. Whenever such requests are made, they should give the required signed statements. The instructions contained in paragraphs 3.2.8 and 3.2.9 should be strictly followed while giving such signed statements.

The procedures are same in respect of investigation by I.A.F. Courts of Enquiry also.

Whenever any interested party other than Director General of Civil Aviation(DGCA)/Court of Enquiry makes a request in writing for supply of factual weather information covering the period of the accident, Meteorological offices may supply the available observational data with the prior permission of DDGM (RMC) concerned. Director/Met-in-charge of Meteorological Centres may supply only factual information to parties and DDGM (RMC) concerned should be kept informed. This authority should not be delegated by him to any lower cadre. Scientist F,

CAMD/ DGM should be informed by concerned DDGM (RMCs) of such requests received and replies issued.

13.3.4 RESPONSIBILITIES OF REGIONAL METEOROLOGICAL CENTRES:

Preliminary inquiry into all cases of aircraft accidents whether due to weather or not, should be initiated by the DDGM concerned and the findings reported to Scientist F, CAMD /DGM.

In cases of accidents occurring in bad weather detailed investigation is necessary. While forwarding the report of any aircraft accident to Scientist F, CAMD/ DGM, the weather situation associated with the accident should be specifically commented upon by the DDGM (RMCs).

Detailed report may not be sent in case of accidents which are clearly not due to weather conditions.

However, this point may be brought out in the preliminary report and approval of Scientist F, CAMD obtained for not submitting a detailed report. The same procedure will apply for cases of incidents also.

In the case of accidents, where more than one region is involved, the DDGM (RMC) controlling the AMO or the AMS or the meteorological unit which provided briefing and documentation or any other service for the flight in question will send a report to Scientist F, CAMD/ DGM. The DDGM (RMC) in whose region the accident occurred will also initiate a factual inquiry regarding the weather conditions at the time and place of occurrence and supply of meteorological data, if any, from meteorological offices in his region to the Airport/ Air Traffic Control/ other Aviation Meteorological Offices and send his report to Scientist F, CAMD / DGM.

In the case of a major accident, the DDGM (RMC) may visit the site of accident whenever necessary, for making an on-the-spot investigation. This authority should not normally be delegated by him to any lower cadre.

13.3.5 REPORTS ON AIRCRAFT ACCIDENTS:

The nature of all the correspondences pertaining to an aircraft accident/ incident investigation shall be confidential and shall only be signed by DDGM (RMCs). Detailed reports of investigation of accidents should be prepared by DDGM (RMCs) and sent to Scientist F, CAMD /DGM as soon as possible after the occurrence of the accident, preferably not later than a week after the accident.

Contents of the report:

I General Description:

This part shall contain a general description of the accident with all relevant details such as:

a) Name of the airline

b) Type and call sign of the aircraft

c) Route followed or local flying

d) Details of Meteorological Briefing and documentation provided

e) Description of accident/ incident

f) Time of occurrence

g) Place of accident/ incident

h) No. of persons on board

i) Casualty details, if any

j) Extent of the damage to the aircraft

k) Reason of accident, if known

l) From whom the Message was received by the met office

m) Time of receipt of information

n) Whether entries have been made in the accident register and aviation log book and signed by the officer-in-charge

o) Action taken on receipt of the information (Whether documents sealed and kept under safe custody)

p) Whether Special Current weather observation was recorded or not

q) Description of weather prevailed around the time of accident at the place/ site of accident

r) Any other relevant details

II Brief on Meteorological services rendered:

A brief account of the meteorological services rendered to the aircraft in question with copies of relevant documents as detailed below:

(a) Documentation provided

i) Reports

1 Routine, Special and Additional weather reports

ii) Forecasts

1 Route forecast (Chart form as well as Tabular form), Terminal Aerodrome Forecast (TAF), SIGMET messages and advisories, if any, utilised in the preparation of documentation

2 Local/ Area forecast, aerodrome warnings for Parked and Moored Aircraft and Take-off/ Landing Forecast (TREND).

b) Extracts from briefing registers, current weather registers, aviation log book, telephonic discussions with ATC, operators etc.

c) Autographic charts; where relevant

d) Radar imageries/ Satellite imageries; where relevant

e) Any other items having a bearing on the accident.

III Description of the weather situation

The weather situation at the time of the accident with a short description of the development leading to it with copies of inferences, Bulletins etc., issued/received.

IV Brief on media reports

Reference to press reports together with relevant cuttings

V Comments on adequacy of meteorological services provided

Findings regarding adequacy or otherwise of meteorological services rendered; remarks on the availability of basic data, state of completion of charts at the time of issue of forecasts, quality of relevant analysis/prognosis, standards of forecasting etc. may be included as necessary

VI Comments on procedural deficiencies

Remarks regarding adherence to current departmental instructions regarding writing of forecasts, preparation of aerodrome reports etc.

VII Local action taken on deficiencies noticed

VIII Additional remarks, if any.

All documents relating to the meteorological services provided to the ill-fated aircraft are required to be checked

All the meteorological elements for which forecast was issued in TAF, TREND Forecast, Local/Area Forecast, Route Forecast, Aerodrome Warning, etc., covering the event are to be verified individually and a report along with comments are to be sent to Scientist F, CAMD/ DGM.

DDGM (RMC) may also send his remarks on duration of current weather watch, frequency and period of validity of all types of forecasts issued by the concerned office and serviceability of aviation meteorological instruments in the airport to CAMD /DGM.

Reports of investigations received from DDGM (RMCs) shall be examined in CAMD. A consolidated report would be submitted by Scientist F, CAMD to DGM giving his findings and recommendations.

13.4 INCIDENTS

In cases of occurrence of incidents, the relevant documents ***need not be*** taken possession of and sealed.

The same procedures as in cases of aircraft accidents should be followed for supply of any information or for tendering any evidence or for giving signed statements required by the investigating officer of the Director General of Civil Aviation (DGCA).

The procedure followed in cases of accidents by the aviation meteorological offices in informing the Regional Meteorological Centre and by the latter to Scientist F, CAMD/ DGM and the Regional Meteorological Centre from which the flight had originated should also be followed in cases of incidents. However, the intimation about the incident may be sent by post.

The DDGM (RMCs) and Scientist F, CAMD should investigate the cases of incidents in the same way as in cases of accidents.

For supply of information to any party other than the investigation officer of the Civil Aviation Department, instructions given for accidents may be followed.

13.5. DAMAGE TO PARKED AND MOORED AIRCRAFT

Certain cases of damage to aircraft while parked and/or moored on ground are also investigated by the Director General of Civil Aviation (DGCA) or by the airlines themselves. When such investigations are done and information about weather conditions are asked for by the investigating officer, a full report on the same as in cases of accidents should be sent by the aviation meteorological office concerned to the Regional Meteorological Centre. The DDGM (RMC) in turn shall send a report to the Scientist F, CAMD/ DGM in the same manner as in cases of accidents.

Chapter 14

VIP/ VVIP MOVEMENT

Objective

1. Explain the procedures to be followed by various offices

Sub topic

1. Basic procedure to be followed during VIP/ VVIP Flights

1. GENERAL- DEFINITION OF VIP/VVIP FLIGHTS

1.1 A non-scheduled flight by chartered or IAF aircraft arranged by the Government for any important person and details of which are notified to the India Meteorological Department by the Director General of Civil Aviation, Air HQ, the Protocol Division of the External Affairs Ministry, the Ministry of Civil Aviation etc., may be considered as a VIP flight.

1.2 The term VVIP is used for President, Vice-President, Prime Minister and Deputy Prime Minister of India as well as the Heads of States and Prime Ministers of foreign countries. Messages dealing with the programmes of such dignitaries should be prefixed with the term “VVIP”, but the actual identity of the party should not be indicated in the messages. Similarly the identity of the party should not be indicated in VIP messages also.

2. RESPONSIBILITY OF THE METEOROLOGICAL DEPARTMENT

2.1 Necessary Meteorological services will be rendered by the Aerodrome Meteorological Office (AMO)/ Aeronautical Meteorological Station (AMS) located at the respective aerodrome. At aerodromes where no meteorological unit is available, special facilities by way of current weather observations, briefing and documentation is to be provided, if the Civil Aviation Department makes corresponding arrangements for ATC and Communication (COM) facilities. The Regional Meteorological Centers concerned should liaise closely with the Regional Controller of Aerodromes and Regional Controller of Communication to find out if arrangements for providing ATC/COM facilities are being made and then arrange for provision of meteorological facilities accordingly. If no arrangements are made by Airport Authority of India (AAI), IMD also need not make any special arrangements. For reaching remote airfields, the AAI sometimes organise a service party consisting of ATC and communication officers. The DDGM (RMC) concerned may attach the IMD personnel to the service party for the sake of convenience.

2.2 In case of inadequate notice, if it is not possible to make any arrangement for providing meteorological facilities to VIP/VVIP flights, no arrangements may

be made for the same. In such cases the Collectors concerned may be informed about the weather conditions on telephone/ fax or e-mail. Acknowledgement of them having received the message shall be obtained.

2.3 If the VIP flight starts or terminates at an IAF air field, it is the responsibility of the Air H. Q. to provide all facilities including the meteorological services. IMD need to provide necessary service only on request from Air H. Q. (Directorate of Meteorology) depending upon the communication facilities provided either by Air H.Q., or AAI. Request to India Meteorological Department for rendering meteorological services in connection with VIP/VVIP flights at IAF aerodromes (with or without meteorological units) should come from Air H.Q. New Delhi. In special cases, request from local IAF authorities for provision of Meteorological facilities may be entertained; provided IAF agrees to place necessary facilities like transport, etc, at the disposal of the visiting IMD officials.

2.4 Helicopter flights, at stations where no meteorological offices exist, need not be covered unless AAI makes special arrangements for providing ATC/ COM facilities.

3. ACTION ON VIP/VVIP FLIGHT PROGRAMMES

3.1. INTIMATIONS

a) Intimations regarding VVIP/VIP flights are generally received from Air Headquarters, Director General of Civil Aviation, Ministry of External Affairs etc., by the meteorological office at Delhi (Palam) airport.

b) On receipt of intimation of a projected VIP/VVIP flight, AMO Delhi (Palam) should sent a copy of the same to the concerned DDGM (RMC) and CAMD by available fastest mode of communication. Messages relating to VIP/VVIP movements in boarder areas should be exchanged by T/P, Telex, or Landline and not by W/T or R/T. As a routine, an acknowledgement of the message shall be send by the in-charge of the receiving office to the originating office in all communications made with respect to VIP/ VVIP flights.

c) Clarifications, if any, required by RCs may be addressed direct to AMO Delhi (Palam), who should consult with the authorities concerned and promptly issue the clarifications required.

d) Intimations regarding VIP/VVIP flights received at a Met. Office other than at New Delhi should be transmitted by that office to the concerned DDGM (RMCs) for necessary instructions. CAMD, A.M.O. Delhi (Palam) and DGM may be kept informed.

3.2 BRIEFING OF VVIP FLIGHTS

a) At all aerodromes where a forecasting office is functioning, briefing for VVIP flights should be provided by the Meteorologist-in-charge or, in his absence on leave, tour etc., by the Senior-most officer at the station.

b) Forecasts for VVIP flights whether originating at the station where an Aerodrome Meteorological Office is located or elsewhere in the area of its

jurisdiction should, invariably, be issued in consultation with the in-charge of the Aerodrome Meteorological Offices. The forecasts should be kept under constant review and amendments should be issued promptly as and when necessary.

c) Full details of what is told to the pilots of VVIP flights by the briefing officers at the time of briefing should be entered in the column 'Briefing Notes' of the briefing register.

3.3. ARRANGEMENTS TO BE MADE BY THE RMC

As soon as the intimation is received regarding the programme of VIP/VVIP flight, the RMCs should make the following arrangements:

a) The concerned MWO should be alerted.

b) The concerned Meteorological offices at the stations of departure and arrival of the flight should be alerted.

c) If there are no suitable meteorological staff available at the aerodrome of departure for a flight, a Group A officer or an experienced Assistant Meteorologist if a Group A officer cannot be spared, should be deputed for providing briefing and documentation, provided AAI makes the corresponding arrangements as envisaged in para 2.1. This officer should reach the station a day before the flight, if possible, for covering the same. If there is an AMS at the aerodrome of departure, manned by Assistant Meteorologist possessing the requisite experience, briefing and documentation may be done by him. Every effort should be made to send a gazetted officer on tour, if time permits, to provide briefing and documentation for VIP flights, at an AMS manned by a Scientific Assistant.

d) Special efforts are to be made to obtain the latest METAR and TAF of the destination aerodrome and the designated alternate. If VVIP/VIP flight goes to a place where there is no meteorological office, a gazetted officer or an experienced Assistant Meteorologist may be sent on tour with portable instruments to provide the necessary Current Weather observations (Local Routine and Local special) required. The documentation and briefing may be provided, if, suitable communication facilities are available to receive the same from the associated AMO. The above arrangement may be done only if AAI authorities are making special arrangements for communication at the station concerned.

e) In the case of VVIP flights to unmanned aerodromes, ATC and communication facilities are normally provided. A gazetted officer /an experienced Assistant Meteorologist should be deputed to cover VVIP flights to such aerodromes.

f) At Intermediate halts, where Aerodrome Meteorological Offices exist, generally fresh briefing and documentation need be provided only if the halt at such places exceeds 45 minutes. For flights with the halts of shorter duration, through forecast from the departure aerodrome to the final

aerodrome of landing should be provided with an outlook of weather from the destination aerodrome to a designated alternate.

g) At Intermediate halts without Aerodrome Meteorological Offices, fresh briefing and documentation need be provided only if the halt exceeds 3 hours at the station. In such cases, the required forecast should be sent to the concerned station sufficiently in time to enable it been decoded and documentation to be provided before the departure of the flight from the station.

h) Fresh briefing and documentation are to be provided at intermediate halts where there is no AMO even if the halt is less than three hours in the case of (I) VVIP flight, (II) in case where a number of aircraft are involved (eg: visits by Heads of Foreign Governments).

i) In all cases whether fresh briefing and documentation are provided or not, arrangements for current weather watch should be made to cover the arrival and departure of the flights and for the reception of Current Weather observations of the en-route stations, next halt and destination and alternates. These should be passed to the Captain of the aircraft.

j) Current Weather reports of IAF stations connected by AFTN or meteorological T/P channel may be obtained by these channels. TAFs of IAF stations having a forecasting office may be obtained on AFTN or T/P channel if available at the station. Otherwise, the TAFs may be originated by the Aerodrome Meteorological Office in whose area the IAF station is located.

4. PROVISION OF FACILITIES FOR THE FLIGHT

All meteorological facilities provided for a scheduled flight should be provided for VIP/VVIP flights. **The facilities provided are as follows:**

a) An official going on tour to an aerodrome to provide met. facilities for VIP/VVIP flights should carry with him an altimeter, a portable wind vane and a portable anemometer and psychrometer, if no met. unit is available at the aerodrome.

b) On arrival at the aerodrome, the officer must familiarise himself with the topography in the vicinity of the aerodrome as quickly as possible. In case there is already a met unit at the place, he should arrange with the local met staff for the current weather observations required in connection with the flight. If there is no met unit, he should himself plan the method of taking non-instrumental observations, like, visibility, cloud height etc. He should contact AAI and if necessary, other local authorities, such as, Collector, Revenue or Police Officials etc., and make suitable arrangements for expeditious reception and dispatch of met messages and for necessary facilities.

c) The Met. Unit (already existing or the one temporarily set up for the purpose of the VIP/VVIP flight in question) serving the aerodrome of arrival should supply hourly/ half hourly METAR /SPECI messages, if any, to the aerodrome of

departure commencing atleast two hours before ETD, by all available departmental communication channels.

d) After take- off of the flight from the previous station, hourly or half hourly current weather messages should be supplied as necessary, to the local ATC till the plane arrives at the station. Just before landing, all operational meteorological information required for landing should be supplied.

e) All or part of these messages should be sent to the AMO who will issue the forecast for the flight.

f) All these messages should also be sent to the MWO concerned, when required.

g) After arrival of the plane, the pilot should be de-briefed if feasible. The de-briefing report may be immediately transmitted to the associated A.M.O as per prior instructions. Otherwise, the same may be submitted to the associated A.M.O along with other documents concerning the flight. If, however, the de-briefing report contains such vital information which in the opinion of the de-briefing officer is necessary to be immediately communicated to the associated A.M.O he should do so, even in the absence of such instructions.

h) Pre-flight planning information as is available at the station or obtaining the same expeditiously from the associated A.M.O. concerned, should be supplied whenever required.

i) If there is an AMS at the aerodrome of departure, it is the responsibility of the AMS to decode the ROFOR and TAFs and other information received from the associated A.M.O. and provide the necessary briefing and documentation. The efforts made to get the above reports should be entered in briefing register. The forms used for documentation should be the same as for scheduled flights.

j) Briefing should be done with the help of current weather reports and any analyses, inferences etc., received from the associated A.M.O.

k) Current weather reports alongwith other relevant information available, of destination and alternates will be passed on to ATC till the aircraft lands.

l) Soon after the conclusion of VVIP/VIP flight, the officer deputed should submit a report regarding the action taken by him and also indicate the shortcomings experienced by him. He should also indicate the type of discussions he had with the crew of VIP/VVIP flight or other authorities.

5. RESPONSIBILITY OF ASSOCIATED AMO

The associated AMO will send whenever necessary ROFORs/ TAFs and SIGMET to the office providing briefing and documentation by all communication channels available at its disposal so as to reach well in advance for rendering adequate met service. If such information is to be received from other offices the associated A.M.O. should arrange for the receipt for the required information by sending suitable requisitions. Arrangements for expeditious reception of C.W. observations of relevant stations should be made. The associated A.M.O should intimate in advance the concerned station of the arrangement.

6. RESPONSIBILITY OF M.W.O

Area meteorological watch will be maintained as usual in the FIR of jurisdiction. The M.W.O should ensure that SIGMET information of interest to the flight is passed to the aircraft through the appropriate A.T.C. channels.

7. RESPONSIBILITY OF RCS AFTER THE FLIGHT

On receipt of the report as envisaged in para 5.13, the DDGM (RMC) should satisfy himself that the officer concerned had rendered the meteorological facilities satisfactorily. Any important points mentioned in the report such as, difficulties experienced by the officer, may be communicated to CAMD, who if necessary may bring to the notice of DGM with suitable remarks.

8. RETENTION OF DOCUMENTS

a) Copies of documents supplied to VVIP/VIP flights should be collected at R.Cs and preserved for a period of 180 days as in the case of other documents.
b) These instructions do not apply to flights of VIPs by scheduled services. No special arrangement need be made for such flights.
c) If VIP/VVIP flight crew do not turn up either for collection of forecast or for briefing, entries may be made to that effect in the briefing register. Such instances may also be brought to the notice of CAMD New Delhi.

CHAPTER15

AIRPORT METEOROLOGICAL INSTRUMENTS

Objective

1. Basic functions and use of airport meteorological system.

Sub topic

1. Basic functions and use of airport meteorological instrument system

1. AIRPORT METEOROLOGICAL INSTRUMENTS SYSTEM (AMI)

In addition to the conventional instruments available in a surface observatory, there are some special instruments installed at airfields to meet the specific requirements of aviation. They are known as Airport Meteorological Instruments or popularly as AMIs. Surface Instrument Division of IMD in Pune has the responsibility of design, development, procurement, installation and maintenance of the Airport Meteorological Instruments system. The AMIs consists of:

a. Current Weather Instruments System (CWIS)
b. Distant Indicating Wind Equipment (DIWE)
c. Transmissometer
d. Ceilometer

1.1 CURRENT WEATHER INSTRUMENTS SYSTEM (CWIS)

Current Weather instruments System is used for continuous monitoring of wind direction, wind speed, air temperature, and dew point temperature representing the runway conditions. They are installed at the touchdown zone or mid-point or end of the runways. If there is only one system, then it is installed at the touch down zone.

There are both analog and digital current weather instrument systems installed at various airports in the country. In an analog CWIS there is only instantaneous display of wind direction, wind speed, temperature and dew point available. The facility for averaging is not available as required for reporting in METAR and MET REPORT is not available in such systems.

CWIS consists of:

- ♦ Sensors at site near touchdown zone.
- ♦ Main console in Met. Briefing Room (MBR).
- ♦ Slave display in Air Traffic Control (ATC).

Sensors:

The four sensors used in CWIS are:

- Thermistor for temperature
- Dewcel for dew-point
- Selsyn type wind vane for wind direction
- Cup generator anemometer for wind speed

a) Thermistor:

Thermistors are temperature sensing devices wherein the resistance of thermistor increases with falling temperature. Their characteristic is usually exponential. However, for use in CWIS, thermistors whose resistance will vary linearly with temperature are required. Such thermistors are not readily available. Hence in CWIS a thermistor composite consisting of thermistors and precision resistances is used. They are connected in such a way that their output varies linearly with changing temperature. Depending upon range of temperature required, combinations of thermistor composite are used. In CWIS two types are used - one from -5°C to +45°C and the other from 0°C to 100°C.

b) Dewcel:

The sensor for the measurement of dew-point is a dewcel which makes use of the hygroscopic properties of the lithium chloride salt through a unique temperature measuring system. The dewcel consists of a thin German silver tube closed at one end. It is insulated on its outer surface with moisture proof varnish MPV 179 and covered with a fibreglass tape coated with lithium chloride solution. A pair of thin silver wires are separated from each other and secured to an insulating hylam plug at one end of the tube. The other two ends are connected to two terminals fixed on a hylam adapter. A perforated protective metal guard is screwed on to the hylam adapter. A 24 volts a.c. power is applied to the silver wires. When the power is switched on, the dewcel soon attains automatically an equilibrium temperature which is a measure of the dew-point. A YSI thermilinear thermistor composite No. 44201 with a range of 0°C to 100°C similar to the one used for air temperature measurement is placed inside the German silver tube through its open end to sense this equilibrium temperature. This temperature is linearly related to dew-point.

c) Selsyn windvane:

The vane assembly consists of the windvane with its spindle coupled to a Selsyn (self-synchronous) motor in a weatherproof housing, a five-way terminal block, four direction arms and base clamps for fastening the vane to a support. The motor is of the "Magslip" type and the method of transmission of the vane positions to the indicator is by an a.c. self-synchronising system. The system consists of two "magslip" type motors, one constituting a "transmitter" fitted in the windvane weatherproof housing with its spindle shaft coupled directly to the vane for transmitting the wind direction and the other a "repeater" fitted in the wind panel, its shaft carrying a small pointer for indicating the wind direction of a dial indicator. Each of the magslip motors consists of one rotor and three stators and possesses similar electrical characteristics. A typical connection diagram for an a.c. self-aligning remote-indicating system using "magslip" transmitter and repeater. As the rotor of the transmitter is turned by the windvane, the repeater rotor automatically follows the transmitter rotor instantaneously and the points attached to its rotor indicates the windvane direction on the panel. A third motor connected in parallel operates the wind direction recorder. All the three motors operate on 50 V, 50 Hz a.c. The distance between the transmitter and repeater units can be as great as desired, provided the resistance of each of the five leads does not exceed 10 ohms and all the motors are fed from the same mains electric supply.

d) Cup Generator Anemometer (CGA):

The cup generator anemometer consists of a generator unit driven by a three cup rotor. The generator unit is a small permanent magnet a.c. generator mounted in a weatherproof housing. The permanent magnet has six poles and is rotated by the cup shaft within a stator consisting of six coils wound on a laminated core. When the cup frame rotates in the wind, the rotation of the magnet produces an alternating current in the stator windings, the voltage and frequency of the alternating current being nearly proportional to the wind speed. The alternating current is rectified by a full wave dry disc rectifier and measured on a d.c. voltmeter. The rectifier is mounted inside the meter. The distance between the generator unit and the indicator/recorder can be of any value as long as the total resistance of the two leads does not exceed 20 ohms. The scale is linear for moderate and high speed winds though not for the lower range.

The rotor cups have a diameter of 125 mm (5") and are conical in form with beaded edges. The cups are mounted on arms detachable from the central spider. The cup rotor with its shaft is mounted on two ball bearings which are easily accessible. The housing base carries a 50 mm (2" BSP) thread and also incorporates a flange with three holes for mounting purposes.

1.2 DISTANT INDICATING WIND EQUIPMENT (DIWE)

The Distant Indicating Wind Equipment is used for the continuous monitoring of wind direction and wind speed at the runway site in an airport. They work in a similar fashion as that of CWIS. There are Digital and Analogue versions of DWIE installed at various airports.

1.3 TRANSMISSOMETERS AND RUNWAY VISUAL RANGE OBSERVING PRACTICES

RVR is defined as the maximum distance in the direction of take-off or landing at which the runway or the specified lights or markers delineating it can be seen from a position above a special point on its centre-line at a height corresponding to the average eye level of the pilot at touchdown. RVR is not an observation or measurement of a meteorological parameter like surface wind, temperature etc., but is an assessment based on calculations taking the factors (a) the atmospheric transparency, (b) Background luminance, and (c) Runway light intensity into consideration.

There are two main observing techniques that are used:

1. Instrumented technique
2. Human observer technique

1.3.1 INSTRUMENTED TECHNIQUE:

The instrument which is used in assessing runway visual range is known as Transmissometer. It measures the transmittance of the atmosphere. RVR is then calculated taking into account the measured quantity (i.e. transmittance or extinction coefficient), the characteristics of the runway lights and the expected detection sensitivity of the pilot's eye under the prevailing conditions of background luminance.

TRANSMISSOMETER SYSTEM:

For the measurement of visibility and RVR, transmissometer systems have been installed in all the international airports in India. The transmissometer is designed for the automatic and continuous measurement of horizontal visibility. The instrument employs a pulsed optical system and is capable of measuring visibility ranging from 9 km down to 50 m. The instrument consists of a projector, a receiver, a recorder, an indicator and an RVR computer.

Measuring procedure:

The transmitter emits short high power light pulses with a frequency at approximate 180 flashes/min. Intensity of the light pulses, i.e. the average of several light pulses is constant. Receiver responds only to those short light pulses and

measures their intensity. Increasing visibility deterioration within the baseline causes the light emitted by the transmitter into the receiver to decrease constantly.

A data control unit indicates this decreasing light transmittance of the atmosphere by showing lower visibility values.

1.3.2 REPORTING OF MANUAL RVR

Visual observations using lights

In the visual observations method using lights, the RVR should ideally be assessed at a height of 5 m above the centre line of the runway and the observer should count runway lights from the runway threshold or from the touchdown zone. If it were possible to assess RVR this way, the observing position would correspond best to what the pilot sees. However, during flight operations, the observer, with the observation vehicle, must be removed from the runway and its immediate area. Because it is also necessary for continuous RVR information to be available to the pilot during flight operations, it is clear that human RVR assessments cannot be made from the runway itself. Instead, an observing position is chosen so that continuous RVR assessment can be carried out from a safe location. Moreover, RVR observing structures are made as frangible as possible consistent with their purpose. In all applications of human observer RVR systems, the observers should meet a specified vision standard and be subject to periodic vision checks. If no suitable platform is available as observing point, a jeep can be taken to the observing location and standing over the bonnet of the jeep, the observer counts the number of runway edge lights. As the distance between two lights is known, it is possible to assess the RVR.

Normally, the runway edge lights on the side of the runway opposite the observing position are counted; centre line lights, being flush fittings, are not sufficiently visible therefrom. (Furthermore, runways with centre line lights tend to be equipped with instrumented RVR systems.) Using the far side lights provides a better assessment of conditions along the runway than would be achieved by using the same side lights. In a basic human observer system, the straight line distance from the observing position to each light is measured and this becomes the reported RVR, but this method has considerable inaccuracy. The edge lights are usually 60 m apart, except at taxiway intersections, where the distance is different (e.g. 120 m). The RVR assessed visually is the distance in the runway direction between the observer and the furthest visible edge light. A simple conversion table is often compiled relating the number of observed lights to RVR to be reported.

Counting runway edge lights that are visible on either the near or far side of the runway is a difficult task because the edge lights may become confused with other white lights on the aerodrome; also, the observer's perception of the spacing between lights becomes progressively less as range increases making it difficult to accurately count the number of lights. Therefore, some States use separate lights — identical to the runway lights in use and varied in intensity in the same way — for assessing RVR. Because the observer and the light rows used are beyond the obstacle limits, RVR assessments can be made during flight operations provided that these lights do not give false indication of the runway position to pilots (see Annex 14, 5.3.1.2). Some systems include the possibility of switching separate lights on and off to assist the observer. The use of separate light rows requires special calibration procedures (see 10.3), which may be difficult to perform. These kind of lights also need periodic cleaning like the runway lights.

CALIBRATION OF VISUAL OBSERVATIONS

Because the RVR assessment point is different from that located at a height of 5 m above the centre line of the runway, a calibration of the system must be carried out. The direct method of calibrating the RVR observations is to make simultaneous observations from the Runway Observing Point (ROP) and from the correcsponding touchdown point on the central line of the runway during poor visibility conditions when there is no air traffic. If no suitable platform of 5 meter height is available, the bonnet of another jeep can be used for locating the observer at central line.Now the two observers are count the number of edge lights- the observer at the central line counts the number lights along the runway on his left hand side visible to him and the observer at ROP facing the runway counts the number of runway edge lights visible to him on the other side of the runway, same row of lights as the other observer. This experiment is to be done during poor visibility conditions when there is no air traffic and the same has to be repeated in a variety of visibility conditions covering the required reporting range and under different background conditions, like, day, twilight and night and for various runway edge light intensities. Thus a conversion table for various above conditions for actual RVR is originated from the number of runway edge lights observed as shown in the sample table.

Station:	----------Airport	No. of the Runway	----------
Intensity of runway edge lights:		Background condition: Day/ Twilight/ Night	
Sl. No. (1)	No. of lights visible from ROP (2)	Number of lights visible from central line at touchdown point (3)	Runway Visual Range to be reported (in Meters) (4)
1	1	2	120
2	2	3	180
3	3	4	240
4	4	5	300

5	5	6	360
6	6	7	420
-	-	-	-
-	-	-	-

As the distance between two consecutive lighted lamps is normally 60 meter, the columns 3 and 4 of the table are accordingly indicated. Similar tables are to be prepared for all the various intensities of the runway edge lights normally in operation under different visibility conditions. With these repeated experiments and calibration, it will be possible to report RVR whenever required from the conversion tables by just counting the number of visible runway edge lights from ROP during poor visibility conditions.

METHOD OF OBSERVATION:

An observer having normal vision should go to the site either with a walkie-talkie set or a telephone and establish communication with the current weather observer at the ATC. At site, he should stand on the platform available and count the edge lights on the other side of the runway. He should record the observations in a log book, check again and confirm the observations taken and transmit the information to the control tower. The following procedure may be followed:

a) The observer to stand on the elevated platform
b) Designate the nearest illuminated edge light opposite to him, on the other side of the runway as No.1 of the count.
c) Count the number of illuminated edge lights on the other side of the runway that is just distinguishable.
d) Note the number of lights counted in the log book.
e) Check again and confirm the number of lights counted.
f) Pass on the number of lights counted to the C.W. assistant at the tower by telephone or walkie-talkie.
g) The tower Assistant will read off from the RVR table, reportable RVR value corresponding to the number of lights counted.
h) The ATC Assistant will report the value so obtained according to the reporting steps to be used.
i) Observations may be taken and reported at desired interval and also whenever there is a change in the reportable value and/or as often as the weather situation warrants.

Since many a time, these observations have to be made in the night or early morning, it is advisable to depute two persons to the “touchdown” site for taking manual RVR observations. They will help each other in counting edge lights confirming the counts, recording the observations and passing on the data to ATC. Also, this will provide moral support so necessary in carrying out the difficult job satisfactorily.

ERRORS WITH HUMAN OBSERVER SYSTEMS

Ideally, the RVR reported should correspond to the conditions on the runway experienced by the pilot when landing or taking off. However, errors in the visual observations occur due to a number of factors:

a) *Differences in the exposure to lights.* Significant differences may occur in the background luminance and extraneous lights to which an observer and a pilot are exposed. This can be important where observations are not made at the runway centre line (e.g. using a separate row of lights in a direction different from that of the runway in use)

b) *Variations in vision among observers.* Pilots must check their eyesight periodically and have generally high demands on their vision, but this does not necessarily apply to personnel making RVR assessments. A group of observers may have a different distant visual acuity, significant variations in the visual threshold of illumination in different background luminance conditions or other degraded vision characteristics.

c) *Exposure of an observer to high levels of illumination.* If this happens just before making visual observations using lights, as would be the case when an observer leaves a lighted area to make night observations, it would degrade the observer's ability to see the lights, and the RVR values would be underestimated, which could result in the unnecessary deviations of aircraft to alternative aerodromes. This difficulty can be overcome by allowing several minutes for adjustment to illumination conditions outside the station.

d) *Beaming of the runway edge lights*. The runway edge lights are so directed that the beam intensities have a high value at the runway centre line while the intensity falls off rapidly towards the edges. Because runway lights are not observed at the centre line, the intensities directed towards the observer are lower. If the calibration of visual observations as is not undertaken carefully, errors in reported RVR values will occur.

1.4 CEILOMETER -DETECTION OF HEIGHT OF BASE OF CLOUDS:

The height of base of low clouds is required especially during landing of an aircraft as the pilot must have an idea at what height he will be able to see the runway and its markings. Visual estimates made from an observing point, far away from the touch-down area, are subjective and at times highly erroneous. Ceiling balloon filled with hydrogen gas for predetermined rate of ascent is released and its time up to the point of disappearance into the cloud is noted, from which the cloud height is estimated. This method is unsatisfactory as the balloon will be drifted in the horizontal direction by winds and its rate of ascent may not be known accurately. Further, ceiling balloons can be used only during day time. Cloud search light, fixed beam ceilometer and rotating beam ceilometer are some of the instruments used for cloud height estimation.

Ceilograph:

The projector emits vertically high intensity light pulses of short duration (about one microsecond) at a frequency of about 300 flashes per minute from a xenon filled arc lamp. The receiver consists of a photocell coupled to an amplifier. The receiver scans from 20° to 88.5° in a plane that intercepts the pulsed beam of the projector. The baseline distance is 76 metres. The reflected pulse from a cloud when received in the receiver causes an electrical signal. This is amplified by the broach band amplifier and fed to a monovibrator to operate an electrical relay. Each received pulse is marked as a point on the electrosensitive paper of the recorder. The receiver and recorder pen move in synchronisation. The recorder is calibrated in terms of height from 30 to 3000 metres (100 to 10,000 ft). One up and down cyclone of the receiver is completed in one minute.

Advantage: Flash lamp produces pulses of peak luminosity 10^7 to 10^8C Cd/cm^2 which is very much brighter than continuous daylight.

Limitations:

- The cloud has to be over the projector.
- The cloud has to remain over the projector at least for one minute.
- Clouds over the projector area will not be recorded during moderate and continuous precipitation due to attenuation of the projector beam.

Laser Ceilometer:

The laser ceilometer computes the cloud height by the LIDAR principle. The laser ceilometer uses a pulsed injection laser diode of Gallium Arsenide type. The wavelength of emission is in the infra-red region. The receiver used silicon avalanche photodiode array with associated electronic circuitry to give high sensitivity in cloud detection. Both the transmitter and receiver are housed in a single compact housing. The trans-receiver unit gives output both in digital and analog form, so that the data can be transmitted through cables to the MBR where the digital data may be used to print on a printer and the analog data on the chart of a recorder.

Advantages:

- High sensitivity
- Single TR unit
- Can discriminate cloud, rain and fog.
- Low attenuation of projector beam during moderate rain.
- No moving parts.

Disadvantages: Low laser diode life needing frequent replacement of the costly component.

2. LOCATION OF INSTRUMENTS AT AERODROME:

At aerodromes there is a range of requirements and conditions in addition to adequate exposure which instrument location must satisfy and in particular these include the following:

i) Representative measurement for the aerodrome as a whole and for take-off and landing operations in particular.

ii) Compliance with obstacle restriction provisions.

iii) Suitability of location in respect of terrain conditions, power supply and communication facilities.

LOCATION OF METEOROLOGICAL INSTRUMENTS AT AERODROMES

Met. elements measured	Typical equipment	Typical dimensions of equipment	Operational area for which element is to be representative	Siting provision in Annex. 3
Surface wind speed and direction	Anemometer and Windvane	Usually mounted on tubular mast 6 to 10m (20-30ft) high. Single tube mast for both instruments appropriate in proximity to runways.	Take-off areas and touchdown zone.	No specific provision so long as observations are representative of relevant operational areas.
RVR	Transmisso-meter	Dual baseline (10m to 75m)	Up to three transmisso-meters per runway	Not more than 120m laterally from runway central line. For touchdown zone units should be 300m along runway from threshold.

Height of cloud	Ceilometer	Usually less than 1.5m high but rather solid structure including foundation plinth.	Generally representative of the approach area, but for precision approach runways representative for the middle marker site.	No specific provision so long as observation representative of relevant operational areas.

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11. Instruction on VIP/VVIP Flights
12. ICAO Doc No. 9328 Manual of Runway Visual Range Observing and Reporting Practices (3rd Edition- 2005)
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