Manual on the Global Observing System

Volume I – Global Aspects

Annex V to the WMO Technical Regulations

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APPENDIX. PROCEDURES FOR AMENDING WMO MANUALS AND GUIDES THAT ARE THE RESPONSIBILITY OF THE COMMISSION FOR BASIC SYSTEMS

1. Designation of responsible committees

The Commission for Basic Systems (CBS) shall, for each Manual and Guide, designate one of its Open Programme Area Groups (OPAGs) as being responsible for that Manual and its associated technical guides. The Open Programme Area Group may choose to designate one of its Expert Teams as the designated committee for managing changes to all or part of that Manual; if no Expert Team is designated, the Implementation Coordination Team for the OPAG takes on the role of the designated committee.

2. General validation and implementation procedures

2.1 Proposal of amendments

Amendments to a Manual or a Guide managed by CBS shall be proposed in writing to the Secretariat. The proposal shall specify the needs, purposes and requirements and include information on a contact point for technical matters.

2.2 Drafting recommendation

The designated committee for the relevant part of a Manual or a Guide, supported by the Secretariat, shall validate the stated requirement (unless it is consequential to an amendment to the WMO Technical Regulations) and develop a draft recommendation to respond to the requirement, as appropriate.

2.3 Procedures for approval

After a draft recommendation of the designated committee is validated in accordance with the procedure given in section 7 below, depending on the type of amendments, the designated committee should select one of the following procedures for the approval of the amendments:

(a) Simple (fast-track) procedure (see section 3 below);

(b) Standard (adoption of amendments between CBS sessions) procedure (see section 4 below);

(c) Complex (adoption of amendments during CBS sessions) procedure (see section 5 below).

2.4 Date of implementation

The designated committee should define an implementation date in order to give WMO Members sufficient time to implement the amendments after the date of notification. For procedures other than the simple (fast-track) one, if the time between the date of notification and implementation date is less than six months, the designated committee shall document the reasons for its decision.

2.5 Urgent introduction

Regardless of the above procedures, as an exceptional measure, the following procedure accommodates urgent user needs to introduce elements in lists of technical details, or to correct errors:

(a) A draft recommendation developed by the designated committee shall be validated according to the steps defined in section 7 below;

(b) The draft recommendation for pre-operational use of a list entry, which can be used in operational data and products, shall be approved by the chairperson of the designated committee and the chairperson of the responsible OPAG, and the president of CBS. A listing of pre-operational list entries is kept online on the WMO web server;

(c) Pre-operational list entries shall then be submitted for approval by one of the procedures in 2.3 above for operational use;

(d) Any version numbers associated with the technical implementation should be incremented at the least significant level.

2.6 Issuing updated version

Once amendments to a Manual or a Guide are adopted, an updated version of the relevant part of the Manual shall be issued in the languages agreed for its publication. The Secretariat shall inform all Members of the availability of a new updated version of that part at the date of notification mentioned in 2.4 above. If amendments are not incorporated into the published text of the relevant Manual or Guide at the time of the amendment, there should be a mechanism to publish the amendments at the time of their implementation and to retain a permanent record of the sequence of amendments.

3. Simple (fast-track) procedure

3.1 Scope

The simple (fast-track) procedure shall be used only for changes to components of the Manual that have been designated and marked as “technical specifications to which the simple (fast-track) procedure for the approval of amendments may be applied”.

Note: An example would be the addition of code list items in the Manual on Codes (WMO-No. 306).

3.2 Endorsement

Draft recommendations developed by the responsible committee, including a date for implementation of the amendments, shall be submitted to the chairperson of the relevant OPAG for endorsement.

3.3 Approval

3.3.1 Minor adjustments

Correcting typographical errors in descriptive text is considered a minor adjustment, and will be done by the Secretariat in consultation with the president of CBS. See Figure 1.

Figure 1. Adoption of amendments to a Manual by minor adjustment

3.3.2 Other types of amendments

For other types of amendments, the English version of the draft recommendation, including a date of implementation, should be distributed to the focal points for matters concerning the relevant Manual for comments, with a deadline of two months for the reply. It should then be submitted to the president of CBS for consultation with presidents of technical commissions affected by the change. If endorsed by the president of CBS, the change should be passed to the President of WMO for consideration and adoption on behalf of the Executive Council (EC).

3.3.3 Frequency

The implementation of amendments approved through the simple (fast-track) procedure can be twice a year in May and November. See Figure 2.

Figure 2. Adoption of amendments to a Manual by simple (fast-track) procedure

4. Standard (adoption of amendments between CBS sessions) procedure

4.1 Scope

The standard (adoption of amendments between CBS sessions) procedure shall be used for changes that have an operational impact on those Members who do not wish to exploit the change, but that have only minor financial impact, or that are required to implement changes in the Technical Regulations (WMO-No. 49), Volume II – Meteorological Service for International Air Navigation.

4.2 Approval of draft recommendations

For the direct adoption of amendments between CBS sessions, the draft recommendation developed by the designated committee, including a date of implementation of the amendments, shall be submitted to the chairperson of the responsible OPAG and president and vice-president of CBS for approval. The president of CBS shall consult with the presidents of technical commissions affected by the change. In the case of recommendations in response to changes in the Technical Regulations (WMO-No. 49), Volume II – Meteorological Service for International Air Navigation, the president of CBS shall consult with the president of the Commission for Aeronautical Meteorology.

4.3 Circulation to Members

Upon approval of the president of CBS, the Secretariat sends the recommendation to all Members, in the languages in which the Manual is published, including a date of implementation of the amendments, for comments to be submitted within two months following the dispatch of the amendments. If the recommendation is sent to Members via electronic mail, there shall be public announcement of the amendment process including dates, for example by WMO Operational Newsletter on the WMO website, to ensure all relevant Members are informed.

4.4 Agreement

Those Members not having replied within the two months following the dispatch of the amendments are implicitly considered as having agreed with the amendments.

4.5 Coordination

Members are invited to designate a focal point responsible to discuss any comments/disagreements with the designated committee. If the discussion between the designated committee and the focal point cannot result in an agreement on a specific amendment by a Member, this amendment will be reconsidered by the designated committee. If a Member cannot agree that the financial or operational impact is minor, the redrafted amendment shall be approved by the complex (adoption of amendments during CBS sessions) procedure described in section 5 below.

4.6 Notification

Once amendments are agreed by Members, and after consultation with the chairperson of the responsible OPAG, the vice-president of CBS and the president of CBS (who should consult with presidents of other commissions affected by the change), the Secretariat notifies at the same time the Members and the members of the Executive Council of the approved amendments and of the date of their implementation. See Figure 3.

Figure 3. Adoption of amendments between CBS sessions

5. Complex (adoption of amendments during CBS sessions) procedure

5.1 Scope

The complex (adoption of amendments during CBS sessions) procedure shall be used for changes for which the simple (fast-track) procedure or standard (adoption of amendments between CBS sessions) procedure cannot be applied.

5.2 Procedure

For the adoption of amendments during CBS sessions, the designated committee submits its recommendation, including a date of implementation of the amendments, to the Implementation Coordination Team of the responsible Open Programme Area Group. The recommendation is then passed to the presidents of technical commissions affected by the change for consultation, and to a CBS session that shall be invited to consider comments submitted by presidents of technical commissions. The document for the CBS session shall be distributed not later than 45 days before the opening of the session. Following the CBS session, the recommendation shall then be submitted to a session of the Executive Council for decision. See Figure 4.

Figure 4. Adoption of amendments during CBS sessions

6. Procedure for the correction of existing Manual contents

6.1 Correcting errors in items within Manuals

Where a minor error in the specification of an item that defines elements within a Manual is found, for example, a typing error or an incomplete definition, the item shall be amended and re-published. Any version numbers associated with items edited as a result of the change should be incremented at their lowest level of significance. If, however, the change has an impact on the meaning of the item, then a new item should be created and the existing (erroneous) item marked as deprecated. This situation is considered a minor adjustment according to 3.3.1 above.

Note: An example of an item for which this type of change applies is a code list entry for the Table Driven Code Forms or WMO Core Metadata Profile, in which the description contains typographical errors that can be corrected without changing the meaning of the description.

6.2 Correcting an error in the specification of how conformance with the requirements of the Manual can be checked

If an erroneous specification of a conformance-checking rule is found, the preferred approach is to add a new specification using the simple (fast-track) procedure or standard (adoption of amendments between CBS sessions) procedure. The new conformance-checking rule should be used instead of the old. An appropriate explanation shall be added to the description of the conformance-checking rule to clarify the practice along with the date of the change.

Note: An example of such a change would be correcting a conformance-checking rule in the WMO Core Metadata Profile.

6.3 Submission of corrections to errors

Such changes shall be submitted through the simple (fast-track) procedure.

7. Validation procedure

7.1 Documentation of need and purpose

The need for, and the purpose of, the proposal for changes should be documented.

7.2 Documentation of result

This documentation shall include the results of validation testing of the proposal as described in 7.3 below.

7.3 Testing with relevant applications

For changes that have an impact on automated processing systems, the extent of the testing required before validation should be decided by the designated committee on a case-by-case basis, depending on the nature of the change. Changes involving a relatively high risk and/or impact on the systems should be tested by the use of at least two independently developed tool sets and two independent centres. In that case, results should be made available to the designated committee with a view to verifying the technical specifications.

DEFINITIONS

A. Meteorological observing facilities and related services

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

Agricultural meteorological station: A station that provides meteorological and biological information for agricultural and/or biological applications. Agricultural meteorological stations are classified as follows:

– Principal agricultural meteorological station: A station that provides detailed simultaneous meteorological and biological information. The instrumental facilities, the range and frequency of observations in both meteorological and biological fields, and the professional personnel are such that fundamental investigations into agricultural meteorological questions of interest to the countries or Regions concerned can be carried out.

– Ordinary agricultural meteorological station: A station that provides, on a routine basis, simultaneous meteorological and biological information and may be equipped to assist in research into specific problems; in general the programme of biological or phenological observations for research will be related to the local climatic regime of the station.

– Auxiliary agricultural meteorological station: A station that provides meteorological and biological information. The meteorological information may include such items as soil temperature, soil moisture, potential evapotranspiration, detailed information on the very lowest layer of the atmosphere; the biological information may cover phenology, onset and spread of plant diseases, etc.

– Agricultural meteorological station for specific purposes: A station set up temporarily or permanently that provides meteorological data for specific agricultural purposes.

Aircraft Communication Addressing and Reporting System (ACARS): Automated aviation meteorological data collection system from aircraft fitted with appropriate software packages..

Aircraft Meteorological Data Relay (AMDAR): The collective name for the automated aviation meteorological data collection systems from aircraft fitted with appropriate software packages.

Anchored platform station: An observing station on a platform anchored in deep water. (see also Fixed platform station).

Atmospherics detection station: A station contributing observations to an atmospheric detection system.

Atmospherics detection system: An instrumental system consisting of a number of stations for the detection and location of atmospherics.

Automated aircraft meteorological system: A series of devices integrated into the instrumentation of an aircraft, which records and/or transmits observations automatically.

Automatic weather station (AWS): Meteorological station at which observations are made and transmitted automatically, i.e. without human observations, but may be manned for management.

Auxiliary ship station: A mobile ship station, normally without certified meteorological instruments, that transmits reports in code form or in plain language, either as routine or on request, in certain areas or under certain conditions. (see also ‘Selected ship station’)

Climatological station: A station whose observations are used for climatological purposes. Climatological stations are classified as follows:

– Reference climatological station: A climatological station the data of which are intended for the purpose of determining climatic trends. This requires long periods (not less than 30 years) of homogeneous records, where human-induced environmental changes have been and/or are expected to remain at a minimum. Ideally, the records should be of sufficient length to make possible the identification of secular changes of climate.

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Coastal station: A station on a coast that may be able to make some observations of conditions at sea.

Drifting automatic sea (drifting buoy) station: A floating automatic station that is free to drift under the influence of wind and current. (see also fixed buoy)

Environmental data buoy station: A fixed or drifting buoy which records or transmits environmental and/or marine data.

Environmental observation satellite: An artificial Earth satellite providing data on the Earth system which are of benefit to WMO Programmes.

Note: These data support a variety of disciplines including, but not limited to, meteorology, hydrology, climatology, oceanography, climate and global change related disciplines.

Fixed platform station: An observing station on a platform at a fixed site in shallow water. (see also Anchored platform station)

Fixed sea station: An ocean weather ship or a station situated on a lightship, a fixed or anchored platform, a small island or in certain coastal areas.

Global Climate Observing System Reference Upper-air Network (GRUAN) station: An upper-air station included in the network of stations specially selected and certified to provide long-term high-quality climate records.

Global Climate Observing System Surface Network (GSN) station: A land station included in the specially selected network of stations to monitor daily and large-scale climate variability on a global basis.

Global Climate Observing System Upper-air Network (GUAN) station: An upper-air station included in the specially selected global baseline network of upper-air stations to meet the requirements of the Global Climate Observing System.

Global Data-processing and Forecasting System (GDPFS): The coordinated global system of centres operating under established arrangements for the analysis, forecasting, processing, storage and retrieval of meteorological, climatological, hydrological, oceanographic and environmental-related information.

Global Telecommunication System (GTS): The coordinated global system of telecommunication facilities and arrangements for the rapid collection, exchange and distribution of observational and processed information within the framework of the World Weather Watch.

Ice-floe station: An observing station on an ice floe.

Island station: A station on a small island on which conditions are similar to those in the marine environment and from which some observations of conditions at sea can be made. (see also coastal station and Fixed sea station)

Land station: An observing station situated on land.

Lightship station: A surface synoptic station situated aboard a lightship.

Meteorological element: Atmospheric variable or phenomenon which characterizes the state of the weather at a specific place at a particular time (see Section B below).

Meteorological reconnaissance aircraft station: A meteorological station on an aircraft equipped and assigned for the specific purpose of making meteorological observations.

Meteorological reconnaissance flight: An aircraft flight for the specific purpose of making meteorological observations.

Meteorological rocket station: A station equipped to make atmospheric soundings using rockets.

Mobile sea station: A station aboard a mobile ship or an ice floe. (see also Ice-floe station, Auxiliary ship station and selected ship station)

National Meteorological Centre (NMC): A centre responsible for carrying out national functions including those under the World Weather Watch.

Ocean weather station: A station aboard a suitably equipped and staffed ship that should remain at a fixed sea position and that makes and reports surface and upper-air observations, and may also make and report subsurface observations.

Ozone sounding station: A station at which observations of atmospheric ozone are made.

Pilot-balloon observation: A determination of upper winds by optical tracking of a free balloon.

Pilot-balloon station: A station at which upper winds are determined by tracking of a free balloon.

Planetary boundary layer: The lowest layer in the atmosphere, usually taken to be up to 1 500 m, in which meteorological conditions are affected significantly by the Earth’s surface.

Planetary boundary-layer station: A station equipped to provide detailed meteorological data on the planetary boundary layer.

Precipitation station: A station at which observations of precipitation only are made.

Radar wind profiler observation: A vertical profile of the horizontal wind vector and, under some conditions, the vertical wind component, determined by transmitting radar signals and analysing the reflected information contained in the backscattered electromagnetic wave using system-specific data-processing techniques.

Radar wind profiler station: A surface-based station at which radar wind profiler observations are made.

Radar wind profiler system: A system that makes radar wind profiler observations.

Note: The system includes observational data-processing and telecommunications hardware and software, documentation, monitoring, maintenance and certain facilities and support capabilities such as power supply and air conditioning, together with the human expertise and resources required to operate and manage all of these components.

Radiation station: A station at which observations of radiation are made.

– Principal radiation station: A radiation station the observing programme of which includes at least the continuous recording of global solar radiation and of sky radiation and regular measurements of direct solar radiation.

– Ordinary radiation station: A radiation station whose observing programme includes at least the continuous recording of the global solar radiation.

Note: The terminology of radiation quantities and measuring instruments is given in the Guide to Meteorological Instruments and Methods of Observation.

Radiosonde observation: An observation of meteorological elements in the upper air, usually atmospheric pressure, temperature and humidity, by means of a radiosonde.

Note: The radiosonde may be attached to a balloon, or it may be dropped (dropsonde) from an aircraft or a rocket.

Radiosonde station: A station at which observations of atmospheric pressure, temperature and humidity in the upper air are made by electronic means.

Radiowind observation: A determination of upper winds by tracking of a free balloon by electronic means.

Radiowind station: A station at which upper winds are determined by the tracking of a free balloon by electronic means.

Rawinsonde observation: A combined radiosonde and radiowind observation.

Rawinsonde station: A combined radiosonde and radiowind station.

Reference level data: Data for a specified level, normally 1 000 hPa, which enable absolute heights to be ascribed to satellite temperature-sounding data.

Regional Basic Climatological Network (RBCN): A network composed of climatological stations within a WMO Region with a specified observational programme, which is a minimum regional requirement to permit Members to fulfil their World Weather Watch responsibilities, and also serves as a target list for WWW monitoring of climatological data.

Regional Basic Synoptic Network (RBSN): A network composed of synoptic stations within a WMO Region with a specified observational programme, which is a minimum regional requirement to permit Members to fulfil their World Weather Watch responsibilities and in the application of meteorology.

Regional Meteorological Centre (RMC): A centre of the Global Data-Processing and Forecasting System which has the primary purpose of issuing meteorological analyses and prognoses on a regional scale.

Regional Specialized Meteorological Centre (RSMC): A centre of the Global Data-processing and Forecasting System that has the primary purpose of issuing meteorological analyses and prognoses on a regional scale for a specified geographical area or of providing products and related information in a designated field of activity specialization.

Research and special-purpose vessel station: A vessel making voyages for research or other purposes, which is recruited to make meteorological observations during the voyages.

Sea station: An observing station situated at sea. (see also coastal station, island station and Fixed sea station)

Selected ship station: A mobile ship station that is equipped with sufficient certified meteorological instruments for making observations and that transmits the required observations in the appropriate code form for ships. (see also auxiliary ship station)

Special report: A report made at a non-standard time of observation when specified conditions or changes of conditions occur.

Special station: A station for a special purpose as specified in Part III, paragraph 1, of this Manual.

Standard time of observation: A time specified in this Manual for making meteorological observations.

Note: The term Coordinated Universal Time (UTC) is used in this Manual.

Supplementary ship station: A mobile ship station that is equipped with a limited number of certified meteorological instruments for making observations and that transmits the required observations in an abbreviated code form for ships.

Surface observation: A meteorological observation, other than an upper-air observation, made from the Earth’s surface.

Surface station: A surface location from which surface observations are made and reported. (see also Land station)

Synoptic observation: A surface or upper-air observation made at a standard time.

Synoptic station: A station at which synoptic observations are made.

Tide-gauge station: A station at which tidal measurements are made.

Upper-air observation: A meteorological observation made in the free atmosphere either directly or indirectly.

Upper-air report: A report of an upper-air observation.

Upper-air station: A surface location from which upper-air observations are made.

Upper-wind observation: An observation at a given height or the result of a complete sounding of wind direction and speed in the atmosphere.

Weather radar observation: Evaluation of atmospheric characteristics obtained by transmitting electromagnetic waves (radar signals) and analysing the reflected information from the targets in the sample volume.

Note: Such evaluation is typically repeated over a sequence of samples, as determined by the scan strategy, and reported as a spatially continuous dataset.

Weather radar station: A surface-based station at which weather radar observations are made.

Weather radar system: A system that makes weather radar observations.

Note: The system includes observational data-processing and telecommunications hardware and software, documentation, monitoring, maintenance and certain facilities and support capabilities such as power supply and climate control, together with the human expertise and resources required to operate and manage all of these components.

World Meteorological Centre (WMC): A centre of the Global Data-Processing and Forecasting System which has the primary purpose of issuing meteorological analyses and prognoses on a global scale.

World Weather Watch (WWW): The worldwide, coordinated, developing system of meteorological facilities and services provided by Members for the purpose of ensuring that all Members obtain the meteorological and other environmental information they require both for operational work and for research. The essential elements of the World Weather Watch are the:

– Global Observing System (GOS);

– Global Data-Processing and Forecasting System (GDPFS);

– Global Telecommunication System (GTS).

B. Meteorological elements and other observed variables

Aerosol: Substances, divided into solid particles or liquid droplets, held in suspension in the atmosphere.

Air temperature: The temperature indicated by a thermometer exposed to the air in a place sheltered from direct solar radiation.

Aircraft icing: Formation of ice, rime or hoar frost on an aircraft.

Atmospheric pressure: Pressure equivalent to the weight (force) of a vertical column of air extending above a surface of unit area to the outer limit of the atmosphere.

– Pressure tendency: Character and amount of a station pressure change over three hours (over 24 hours in tropical regions).

– Characteristic of pressure tendency: Shape of the curve recorded during the three-hour period preceding an observation.

Cloud: A hydrometeor consisting of minute particles of liquid water or ice, or of both, suspended in free air and usually not touching the ground.

– Cloud amount: The fraction of the sky covered by the clouds of a certain genus, species, variety or layer; or by a combination of clouds.

– Height of cloud base: Height above the surface of the Earth of the base of the lower cloud layer, when its amount exceeds a specific value.

– Direction and speed of cloud movement: Direction from which the cloud is coming and the horizontal component of its speed.

– Cloud type (classification): Type or variety of cloud as described and classified in the International Cloud Atlas.

Contrail: Cloud which forms in a wake of an aircraft when the air at flight level is sufficiently cold and moist.

Dew point: Temperature to which a volume of air must be cooled at constant pressure and constant moisture in order to reach saturation.

Humidity: Water vapour content of the air.

Precipitation: Hydrometeor consisting of a fall of an ensemble of particles. The forms of precipitation are: rain, drizzle, snow, snow grains, snow pellets, diamond dust, hail and ice pellets.

Precipitation chemistry: Nature and amount of the impurities dissolved or suspended in the precipitation.

Sea ice: Any form of ice found at sea which has originated from the freezing of sea water.

Sea-surface temperature: Temperature of the surface layer of the sea.

Soil moisture: Moisture contained in that portion of the soil which lies above the water table, including the water vapour contained in the soil pores.

Soil temperature: Temperature observed at different depths in the soil.

Solar radiation: Radiation emitted by the sun, sometimes called short-wave radiation, with wavelengths between 290 nm and about 4 000 nm.

State of ground: The characteristics of the surface of the ground, especially resulting from the effect of rain, snow and temperatures near freezing point.

Sunshine duration: The sum of the time, during a given period, for which the direct solar irradiance exceeds 120 W m–2.

Turbidity: Reduced transparency of the atmosphere to radiation (especially visible) caused by absorption and scattering by solid or liquid particles other than clouds.

Turbulence: Random and continuously changing air motions which are superposed on the mean motion of the air.

Upper wind: The wind speed and direction at various levels in the atmosphere, above the domain of surface weather.

Visibility: Greatest distance at which a black object of suitable dimensions can be seen and recognized against the horizon sky during daylight or could be seen and recognized during the night if the general illumination were raised to the normal daylight level.

Wave height: The vertical distance between the trough and crest of the wave.

Wave period: Time between the passage of two successive wave crests past a fixed point.

Waves, direction of movement of: Direction from which the waves arrive at a given point.

Weather: State of the atmosphere at a particular time, as defined by the various meteorological elements.

– Present weather: Weather existing at a station at a time of observation.

– Past weather: Predominant characteristic of the weather which existed at an observing station during a given period of time.

Wind direction: Direction from which the wind blows.

Wind speed: Ratio of the distance covered by the air to the time taken to cover it.

Note: A more detailed list of geophysical parameters used to state observational data requirements and their associated definitions is contained in the Guide to the Global Observing System.

3.4

REQUIREMENTS FOR OBSERVATIONAL DATA

1. Requirements in special circumstances

1.1 Special requirements for environmental emergency response activities

In order for the designated Regional Specialized Meteorological Centres (RSMCs) to be in a position to provide Members with transport model products for environmental emergency response, meteorological and non-meteorological (radiological) data requirements need to be met. These are specified in Attachment II.1. These data, particularly from the site of an accident, are also needed by Members so that they may take appropriate preventive and remedial action in case of an accidental release of radioactive material into the environment. Data should be made available promptly in accordance with the Convention on Early Notification of a Nuclear Accident (Article 5 (e)).

1.2 Requirements in the event of volcanic activity

Requirements in the event of volcanic activity potentially hazardous to aviation should be related to the observational data needed by Members for taking appropriate action; these data are specified in Attachment II.2.

ATTACHMENT II.1. SPECIAL OBSERVATIONAL REQUIREMENTS FOR
ENVIRONMENTAL EMERGENCY RESPONSE ACTIVITIES

A. Meteorological data requirements

1. Data needed to run transport models are the same as those specified for the production of weather forecasts based on numerical weather prediction models, and are given in the Manual on the Global Data-processing and Forecasting System (WMO-No. 485) and the Guide to the Global Observing System (WMO‑No. 488), Appendix II.1.

2. Additional data[[1]](#footnote-1) from the accident site[[2]](#footnote-2) and potentially affected area[[3]](#footnote-3) are desirable, and should be available to the designated RSMC to improve the quality of information about the transport of pollutants. These should include:

(a) Wind, temperature and humidity, upper-air data;

(b) Precipitation data (type and amount);

(c) Surface air temperature data;

(d) Atmospheric pressure data;

(e) Wind direction and speed (surface and stack height) data;

(f) Humidity data.

3. The following systems should be in place to provide the data needed from the accident site in combination, as necessary and possible:

(a) At least one radiosonde station should be located at a suitably safe distance, to enable continued operation in an emergency situation and to provide data representative of conditions at or near the accident site;

(b) In an emergency, at the two or three stations closest to the site of the accident (and within 500 km) frequency of reporting should be increased to every three hours for the duration of the emergency. Stocks of consumables should be stored for use in emergency situations;

(c) At least one surface station should be located at the accident site or, if this is not possible, at a nearby site. It should be convertible to an hourly automated mode for both operations and telecommunications in case of emergency;

(d) Additional information should be provided at or near the accident site by instrumented towers or masts (up to 100 m) and conventional or Doppler radars, Sodars and boundary layer sondes with automatic transmission of data.

4. The data needed from the potentially affected area should be provided as follows:

(a) All upper-air stations within the potentially affected area should make observations every six hours for the duration of the emergency;

(b) Where possible, one or more additional observing systems (including use of wind profilers, mobile radiosounding equipment, and ascent/descent data from aircraft) should be provided;

(c) All surface stations within the potentially affected area, including those that do not normally exchange data internationally, should provide observational data to designated RSMCs. Platforms and buoys should also provide observational data to ensure adequate coverage of sea areas;

(d) A series of best estimates of precipitation should be made by combining information from direct measurements (automated or manual) of surface stations, composite radar information extending over the whole WMO Region and satellite-derived data.

B. Non-meteorological data requirements

1. In case of emergency, non-meteorological data to be provided to designated RSMCs from the accident site should include:

(a) Start of release (date, time);

(b) Duration;

(c) Radionuclide species;

(d) Total release quantity or pollutant release rate;

(e) Effective height of release.

Points (a) and (b) are necessary for running transport models, while (c), (d) and (e) are desirable additional data.

2. In order to calibrate and validate the atmospheric transport model forecasts processed, radiological data from potentially affected areas are needed. The most suitable radiological data are:

(a) Time-integrated air pollutant concentration;

(b) Total deposition.

3. The required data from the accident site and potentially affected area may be obtained by the following means:

(a) Fixed radiological monitoring stations;

(b) Mobile surface units;

(c) Radiological sounding; or

(d) Instrumental aircraft.

The frequency of observations should be increased from once per hour to once per 10 minutes during the accident (routine frequency of observations varies from once per hour to once per six hours).

C. Exchange of meteorological and non-meteorological data

1. Non-meteorological data and, to some extent, additional meteorological data are likely to be provided by non-meteorological national authorities. The National Meteorological or Hydrometeorological Services (NMSs) should encourage the provision of these data by non‑meteorological agencies/operators to National Meteorological Centres (NMCs) for onward transmission to their associated RSMCs.

2. For the exchange of relevant meteorological and non-meteorological (radiological) data, a complete list of abbreviated heading bulletins, including all the regional meteorological and radiological observations, should be sent by Members to the Secretariat for insertion into Weather Reporting (WMO-No.  9), Volume C1 – Catalogue of Meteorological Bulletins.

3. Radiological data available in the early phase of a nuclear accident that assist in characterizing the nuclear accident (containment radiation reading, on-site radiation levels, etc.) should be provided by national authorities to the International Atomic Energy Agency (IAEA) as soon as is practicable via the most reliable means of communication. The IAEA will verify and assess the information, and then provide these data to the appropriate RSMC, which should distribute them to NMCs via the GTS. In case of environmental emergencies, all relevant observational (meteorological and non-meteorological) data should be transmitted to both RSMCs and NMSs through the GTS as quickly as possible.

4. End-to-end testing of procedures for data acquisition, quality control, communication use and product dissemination should be carried out periodically to ensure system performance.

ATTACHMENT II.2. OBSERVATIONAL REQUIREMENTS IN THE EVENT OF VOLCANIC ACTIVITY

The International Airways Volcano Watch (IAVW) is coordinated and developed by the International Civil Aviation Organization (ICAO) Secretariat with the assistance of the Volcanic Ash Warnings Study Group. The Handbook on the International Airways Volcano Watch (IAVW) (ICAO Doc  9766) describes the operational procedures and the contact list for the implementation of the IAVW in the event of pre-eruption volcanic activity,[[4]](#footnote-4) volcanic eruptions and volcanic ash clouds.

A. Meteorological data requirements

The data needed to run transport models are the same as specified for the production of weather forecasts based on numerical weather prediction models, and are given in the Manual on the Global Data-Processing and Forecasting System and the Guide to the Global Observing System (WMO-No. 488), Appendix II.I.

1. Additional data[[5]](#footnote-5) are desirable from the area in the vicinity of the volcano and should be made available to the designated Meteorological Watch Offices and Volcanic Ash Advisory Centre (VAAC)[[6]](#footnote-6) to improve the quality of information about the transport of volcanic ash. These data are the same as specified for the special observation requirements for environmental emergency response activities, and are given in Attachment II.1 of this Manual.

2. Imagery data from geostationary and polar-orbiting satellites are required by the designated VAAC to ascertain whether a volcanic ash cloud is identifiable and to determine its extent, both vertical and horizontal (see the Handbook on the International Airways Volcano Watch (IAVW), section 4.1.1 (c) and section 4.5.1 (b)). These data are also required to validate the transport model trajectory forecast and to determine when the volcanic ash has dissipated. The imagery data should:

(a) Be multi-spectral, covering visible and infrared wavelengths;

(b) Have adequate spatial resolution to detect small volcanic ash clouds (5 km or less);

(c) Have global coverage to provide data for all the VAACs;

(d) Have a frequent repeat cycle (30 minutes or less for the detection of volcanic ash and at least every six hours for the tracking of volcanic ash for transport model validation) (see Handbook on the International Airways Volcano Watch (IAVW), section 4.4.1 (c) and section 4.5.1 (d) and (e));

(e) Be processed and delivered to the VAAC with a minimal delay.

3. Additional satellite data that can assist in the detection of pre-eruption volcanic activity, a volcanic eruption, or a volcanic ash cloud should be made available to the designated VAAC. These may include satellite data that can be used to detect volcanic hot‑spots or sulphur dioxide emissions.

4. Data obtained from surface-based radar within range of the volcano should be made available to the designated VAAC. These data can be used to detect the presence of a volcanic ash cloud and measure its height.

B. Non-meteorological data requirements

1. The occurrence of pre-eruption volcanic activity, volcanic eruptions and volcanic ash clouds, because of the potential hazard to aviation, should be reported without delay to the designated Area Control Centres, Meteorological Watch Offices and VAAC, as described in the Handbook on the International Airways Volcano Watch (IAVW). The report, in plain language, should be made in the form of a volcanic activity report comprising the following information, if available, in the order indicated:

(a) Message type: VOLCANIC ACTIVITY REPORT;

(b) Station identifier, location indicator or name of station;

(c) Date/time of message;

(d) Location of volcano and name, if known;

(e) Concise description of event including, as appropriate, level of intensity of volcanic activity, occurrence of an eruption and its date and time, and existence of a volcanic ash cloud in the area (with the direction of ash cloud movement and height, as best estimated).

2. Available geological data that indicates the occurrence of pre-eruptive volcanic activity or a volcanic eruption should be passed immediately to the designated Area Control Centres, Meteorological Watch Offices and VAAC (see Handbook on the International Airways Volcano Watch (IAVW), section 4.1.1 (a)). These data include:

(a) Vulcanological observations;

(b) Seismological activity reports.

3. Pilot reports of pre-eruption volcanic activity, volcanic eruptions and volcanic ash clouds should be sent without delay to the designated Area Control Centres, Meteorological Watch Offices and VAAC (see Handbook on the International Airways Volcano Watch (IAVW), section 4.1.1 (a)).

C. Exchange of meteorological and non-meteorological data

The exchange of all the above data is described in the Handbook on the International Airways Volcano Watch (IAVW).

PART III. SURFACE-BASED SUBSYSTEM

1. Composition of the subsystem

The main elements of the surface-based subsystem shall be:

Global networks

2.1.2.1 Members shall establish and sustain a global basic observing network, based upon the Regional Basic Observing Networks (RBONs).

2.1.2.2 The global basic observing network should provide observations that have the necessary accuracy, and spatial and temporal resolution, to describe the state of temporal and spatial changes in the environmental phenomena and processes occurring on the large and planetary scales to meet the needs of WMO Application Areas.

Note: Guidance as to the determination of requirements for accuracy and time and spatial resolution of the observational data is given in the Guide to the Global Observing System.

2.1.2.3 .

2.1.2.4 Members should sustain their Global Climate Observing System (GCOS) Surface Network (GSN) to monitor daily global and large-scale climate variability.

2.1.2.5 Members should sustain their GCOS Upper-air Network (GUAN) to meet requirements of GCOS.

2.1.2.4 Members shall sustain their Global Climate Observing System (GCOS) Surface Network (GSN) and Upper-Air Network (GUAN) to meet the requirements of GCOS.

Note: Details are available in the Guide to the GCOS Surface Network (GSN) and GCOS Upper-Air Network (GUAN) (GCOS – 144; WMO/TD No. 1558).

2.1.2.5 Members should implement GSN and GUAN stations, in consultation with GCOS, in particular for data-sparse areas highlighted as requiring additional stations.

2.1.2.6 Members should also establish and sustain the GCOS Reference Upper-air Network (GRUAN) to provide long-term high‑quality climate records.

2.1.3

2.1.4 National networks

 When Members establish their national observing network they shall take into account global and regional observational requirements.

Note: A complete list of all surface and upper-air stations in operation which are used for synoptic purposes is given in Weather Reporting (WMO-No.  9), Volume A – Observing Stations.

2.2 Observing stations

2.2.1 General

2.2.1.7 If in certain desert and other sparsely populated areas it is not possible to establish networks with the recommended densities, networks with densities as near as possible to those recommended should be established. Special efforts should be made to establish an adequate network in such areas when they border a populated area or are traversed by a regularly used air route.

2.2.1.8 observations should be taken when necessary to complement observations from the synoptic networks and in a manner that increases the overall observational spatial or temporal density.

2.2.1.9 Members should make observations in areas where special phenomena are occurring or are expected to develop. As many meteorological elements of standard observations as possible should be reported. Information should be communicated in real time.

2.2.1.10 Members shall ensure that a record of all observations is made and preserved.

2.2.2 Operation of automatic weather station systems

3. The provisions in this section are directed to Members who operate AWSs and provide data to the WMO Information System (WIS).

4. Guidance on making measurements using AWSs can be found in Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 1.

5. Guidance on network planning and site selection in relation to AWSs can be found in the Guide to the Global Observing System, Part III, section 3.2.1.4.

General requirements

2.2.2.1

2. Guidance on the operations of AWS networks in support of the surface-based subsystem of the GOS is provided in the Guide to the Global Observing System (WMO-No. 488), Part III, section 3.1.4.3 and *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8), Part II, Chapters 1 and 2.

2.2.2.2

Notes:

1.

2. It is recommended that Members designate an AWS network manager who will be responsible for ensuring that the network addresses user requirements on an ongoing basis, through a review process that takes into consideration WIGOS requirements.

3. The Guide to the Global Observing System, Part III, Appendix III.2, offers guidance to Members on variables that should be reported from an AWS so as to meet minimum requirements in several areas.

4. The Guide to the Global Observing System, Appendix III.1, provides information on measurement performance requirements for a range of variables associated with various WMO application areas.

2.2.2.4

2.2.2.5

Quality control

Notes:

1. The *Guide to the Global Observing System* (WMO-No. 488), Part VI, and in the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8), Part II, section 1.3.2.8 and Part III provide guidance on quality control of AWS observational data.

2.2.2.6 Members shall make and report observations from AWSs a minimum of eight times per day at the main and intermediate times.

2.2.2.8 Members who report AWS observations to the WIS shall maintain a copy of all reported AWS observations.

Incident management

2.2.2.9

Notes:

1. Some incidents, such as those related to internal factors, may be detected automatically and reported without delay to international recipients of observational data. Other incidents may be detected with delay or through periodic checks and reported accordingly. Automatic incident detection can be performed using either built‑in test equipment or external monitoring systems. A centralized system can be used for monitoring the performance and health of AWS systems and networks.

2.2.2.10

Change management

2.2.2.11

2.2.2.12

Maintenance

2.2.2.16

Note: Remote maintenance cannot replace on-site maintenance for many tasks, but the ability to perform some tasks remotely can contribute to preventive maintenance practices thus helping to achieve higher overall system uptime and quality of operation.

2. Any planned or corrective maintenance which has reduced or is expected to reduce the normal AWS data availability or quality is to be treated in the same manner as an incident, by following provisions under 2.2.2.9 and 2.2.2.10 above.

2.2.2.19 Members should either flag, remove or not report, as appropriate, observational data that is adversely impacted by maintenance activities.

Inspection and supervision

Notes:

1. The objective of inspection and supervision is to determine whether the AWS and its sensors are functioning correctly (within performance tolerances) and, if not, to understand the deviations and initiate a response.

2. Remote monitoring and diagnostic systems can significantly increase the effectiveness of inspection and supervision activities.

3.

2.2.2.21

2.2.2.22

Notes:

1. It is recommended that the inspections should be frequent enough to ensure a high probability of detecting issues that might affect the integrity and quality of observational data.

2.

Calibration procedures

Notes:

1. Any calibration or verification activity which has reduced or is expected to reduce availability or quality of AWS observations is to be treated in the same manner as an incident, by following provisions under 2.2.2.9 and 2.2.2.10 above.

2.

2.3

2.3.1.1 2.3.1.2 Each synoptic station shall be located so as to give meteorological data representative of the area in which it is situated.

2.3.1.3 The main standard times for surface synoptic observations shall be 0000, 0600, 1200 and 1800 UTC.

2.3.1.4 The intermediate standard times for surface synoptic observations shall be 0300, 0900, 1500 and 2100 UTC.

2.3.1.5 Atmospheric pressure measurements should be made as close as possible to the standard time while the observation of other meteorological elements should be made within the 10 minutes preceding the standard time.

2.3.1.6 Every effort should be made to obtain surface synoptic observations four times daily at the main standard times, with priority being given to the 0000 and 1200 UTC observations, which are required for global exchanges.

2.3.1.7 Additionally, Members should endeavour to obtain surface synoptic observations at the intermediate standard times and, furthermore, at regular hourly intervals or less, e.g. at 10 minute intervals.

2.3.1.8

2.3.2 Land stations

General

2.3.2.1 Each synoptic station on land shall be uniquely identified by a WIGOS station identifier.

Note: Requirements relating to station identifiers are to be found under 2.2.1.4 above. Some of the now‑expired identification requirements for synoptic stations are reproduced below because they may be adopted by an issuer of identifiers as a convention to be followed in defining local identifiers for new stations:

A synoptic station on land shall be identified by a station index number assigned by the Member concerned, from within the allocations made to that Member, in compliance with the scheme prescribed in the Manual on Codes. Before issuing a station index number, Members should ensure that the operator of the station or platform has committed to complying with the relevant Technical Regulations.

When a Member establishes a synoptic station on land, it shall send the following information to the Secretariat at least two months before the station becomes operational:

(a) Name, and where appropriate, station index number (stating whether the station is automatic or manned and, if both, the type of each);

(b) Geographical coordinates in degrees, minutes and integer seconds of arc and elevation of the station, in metres (up to two decimals) above mean sea level;

(c) Geopotential of the datum level in whole metres to which the pressure is reduced, or the reference isobaric surface the geopotential of which is reported;

(d) Times at which synoptic observations are made and reported;

(e) Topographical situation;

(f) Any other information required for completion of the entries in Weather Reporting (WMO-No. 9), Volume A.

Each Member of WMO shall designate a national focal point to communicate with the Secretariat on matters regarding the contents of Weather Reporting (WMO‑No.  9), Volume A. The national focal point shall be authorized to act in this capacity on behalf of the Permanent Representative concerned.

2.3.2.2

Note: As a general rule, during the first decade of the twenty-first century, the interval was not supposed to exceed 250 km (or 300 km in sparsely populated areas).

2.3.2.3 Surface synoptic observations recorded at a manned synoptic land station shall consist of observations of the following meteorological elements:

(a) Present weather;

(b) Past weather;

(c) Wind direction and speed;

(d) Cloud amount;

(e) Type of cloud;

(f) Height of cloud base (or extinction profile);

(g) Visibility;

(h) Air temperature;

(i) Humidity;

(j) Atmospheric pressure;

together with such of the following meteorological elements as are determined by resolutions of regional associations:

(k) Pressure tendency;

(l) Characteristic of pressure tendency;

(m) Extreme temperature;

(n) Amount of precipitation;

(o) State of ground;

(p) Direction of cloud movement;

(q) Special phenomena.

2.3.2.4 Surface synoptic observations at an automatic land station shall consist of observations of the following meteorological elements:

(a) Atmospheric pressure;

(b) Wind direction and speed;

(c) Air temperature;

(d) Humidity;

(e) Precipitation, yes or no (at least in tropical areas);

together with the following additional meteorological elements, which should be included if possible, or as determined by resolutions of regional associations:

(f) Amount of precipitation;

(g) Intensity of precipitation;

(h) Visibility;

(i) Optical extinction profile (height of cloud base);

(j) Special phenomena;

(k) Snow depth or snow cover.

Notes:

1. The set of automatic weather station metadata required for operational purposes is presented in Attachment III.1.

2. The height of cloud base and cloud extent can be derived directly from the optical extinction profile without further measurement, using one-minute time series.

3. Snow cover and snow depth are reported from stations where snow is experienced and the capabilities to observe and measure these variables exist, as determined by resolutions of regional associations.

Frequency and timing of observations

2.3.2.5 At synoptic land stations, surface synoptic observations should be made and reported eight times per day (at the main and intermediate standard times) in extratropical areas, and four times per day (at the main standard times) in the tropics.

2.3.2.6 At a (manned or automatic) land station, surface synoptic observations shall be made and reported at least at the main standard times, except for snow depth or snow cover to which 2.3.2.7 and 2.3.2.8 apply.

2.3.2.7 At a (manned or automatic) land station, snow cover or snow depth observations should be reported four times per day, at the main standard times, namely 0000, 0600, 1200, 1800 UTC.

2.3.2.8 At a (manned or automatic) land station, snow cover or snow depth shall be reported at least once per day, together with the time of observation.

2.3.2.9 Snow depth shall be reported as zero (0 cm) when snow is not present, for the entire period during which snow is be expected but is not present, as determined by resolutions of regional associations.

2.3.2.10 Snow cover should be reported in the state of ground field, where possible, and zero snow depth (absence of snow) should be reported in the quantitative snow depth field.

2.3.3 Marine stations

General

2.3.3.2 Members shall recruit as many mobile ship stations as possible that traverse data-sparse areas and regularly follow routes through areas of particular interest.

2.3.3.3 Members concerned shall provide metadata of their ship stations in operation in accordance with section 2, 2.5.

Note: … metadata to JCOMMOPS

2.3.3.5 Members should consider using fixed or mobile automatic sea stations or drifting buoy stations in data-sparse areas.

Note: These stations are located on fixed or mobile ships, fixed or anchored platforms, and drifting platforms and ice floes.

2.3.3.6 Each fixed sea station should be located so as to provide data which are representative of the marine area. As a minimum, observations should be made at the main synoptic times. The observations should include as many meteorological elements of a full synoptic report as possible.

2.3.3.7 Members should establish, either individually or jointly, ocean weather stations or other suitable observing facilities in ocean areas where there are large gaps in the global network.

2.3.3.8 In its recruitment programme, each Member should aim for its mobile sea stations to contribute as much as possible to the attainment of an adequate density of observations in all oceanic areas.

2.3.3.9

2.3.3.10 At ocean weather stations, surface synoptic observations shall consist of observations of the following elements:

(a) Present weather;

(b) Past weather;

(c) Wind direction and speed;

(d) Cloud amount;

(e) Type of cloud;

(f) Height of cloud base;

(g) Visibility;

(h) Air temperature;

(i) Humidity;

(j) Atmospheric pressure;

(k) Pressure tendency;

(l) Characteristic of pressure tendency;

(m) Ship’s course and speed;

(n) Sea-surface temperature;

(o) Direction of movement of waves;

(p) Wave period;

(q) Wave height;

(r) Sea ice and/or icing of ship superstructure, when appropriate;

(s) Special phenomena.

2.3.3.15 At a fixed automatic sea station, surface synoptic observations shall consist of observations of the following elements:

(a) Atmospheric pressure;

(b) Wind direction and speed;

(c) Air temperature;

(d) Sea-surface temperature.

In addition to the elements listed above, a surface synoptic observation made at a fixed automatic sea station should include, if possible, the following elements:

(e) Precipitation, yes or no (especially in tropical areas);

(f) Waves.

2.3.3.16 At a drifting automatic sea station (drifting buoy), a surface synoptic observation should consist of as many as possible of elements (a) to (d), and (f), in 2.3.3.15 above.

Note: The position of the drifting buoy shall also have to be determined.

2.3.3.17 Members should endeavour to equip mobile ships to make subsurface observations.

Note: Guidance on steps to be taken while recruiting a selected supplementary or auxiliary observing ship, on the organization needed to collect ships’ weather reports, and on the use of marine meteorological logs on board ships is contained in the Guide to Marine Meteorological Services (WMO-No. 471).

Frequency and timing of observations

2.3.3.18

2.3.3.21 When operational difficulties on board ship make it impracticable to make a surface synoptic observation at a main standard time, the actual time of observation should be as near as possible to the main standard time.

2.3.3.22 Whenever storm conditions threaten or prevail, surface synoptic observations should be made and reported from mobile sea stations more frequently than at the main standard times.

2.3.3.23 When sudden and dangerous weather developments are encountered at sea stations, surface observations should be made and reported as soon as possible without regard to the standard observation times.

Note: For specific instructions relative to the provision by ships of special reports, in accordance with the International Convention for Safety of Life at Sea, see Weather Reporting.

2.3.3.24 Members shall report and make available observations through the WIS immediately after completion of observation.

Note: Details of observing and reporting programmes are given in the Guide to Marine Meteorological Services (WMO-No. 471), Chapter 5. In case of difficulties resulting from fixed radiowatch hours on board single-operator ships, the procedures set out in the Manual on the Global Telecommunication System (WMO-No.  386), Part I, Attachment I‑1, should be followed.

2.4 Upper-air synoptic stations

General

2.4.1

2.4.2 The standard times of upper-air synoptic observations shall be 0000, 0600, 1200 and 1800 UTC.

2.4.3 As upper-air data from the ocean areas are particularly sparse, Members should give consideration to equipping suitable ships to make soundings and, if possible, to measure upper winds.

2.4.4 In the tropics, priority should be given to upper-air wind observations.

2.4.5 Upper-air stations making observations of pressure, temperature, humidity and wind should be spaced at intervals not exceeding the minimum horizontal resolution required by application areas supported by the network and as described in the Rolling Review of Requirements and the OSCAR database.

2.4.6 An upper-air synoptic observation shall consist of measurement of one or more of the following meteorological elements:

(a) Atmospheric pressure;

(b) Air temperature;

(c) Humidity;

(d) Wind direction and speed.

2.4.7 At upper-air synoptic stations, the frequency of synoptic observations should be four per day, and these should be made at the standard times of upper-air synoptic observations.

2.4.8 At upper-air synoptic stations, upper-air observations shall be made and reported at least at 0000 and 1200 UTC.

2.4.9 At ocean weather stations, upper-air synoptic observations should comprise rawinsonde observations at 0000 and 1200 UTC and/or radiowind observations at 0600 and 1800 UTC.

2.4.10 The launch time of regular upper-air synoptic observations should be as close as possible to H-30 and should not fall outside the time range from H-45 to H.

Note: The launch time of a pilot-balloon observation may deviate from the range indicated above if such deviation is expected to enable wind observations to considerably greater heights.

2.4.11 In areas where it is not possible to meet the frequency requirements mentioned above, every effort should be made to obtain at least the following observations:

(a) Upper-air observations from the RBSNs and other networks of stations on land and at sea, twice daily, at 0000 and 1200 UTC;

(b) In the tropics, at stations where two complete radiosonde/radiowind observations are not made, priority should be given to the implementation of one complete radiosonde/radiowind observation and one radiowind observation daily.

2.5 Aircraft meteorological stations

General

Notes:

2. The provisions for observations from aircraft are specified in Technical Regulations (WMO-No. 49), Volume II – Meteorological Service for International Air Navigation, Part I, 5. The following provisions are to be read in conjunction with that material.

2.5.1 Members should arrange for meteorological observations to be made and reported by aircraft of their national registry.

Notes:

1. This provision applies to aircraft operating both on national and international air routes and in all phases of flight.

2. In general, three categories of aircraft-based observations (ABO) are described in the Guide to Aircraft-based Observations which Members should consider utilizing:

(a) WMO aircraft-based observations;

(b) ICAO aircraft-based observations;

(c) Other aircraft-based observations.

 WMO ABOs are derived from aircraft-based observing systems operated by WMO Members in collaboration with cooperating airlines. In this case, requirements for ABO are specified by WMO and its Members so as to meet meteorological needs.

 ICAO ABOs are observations derived from ICAO regulated aircraft observations, which are made available to WMO and its Members under the provisions of ICAO as set out in the Technical Regulations, Volume II.

 Other ABOs are those derived from aircraft-based observing systems operated by other entities. In this case, while Members do not define specifications for the operation of the observing system, they are urged to ensure that the observations are fit for purpose.

3.

2.5.2 Members should participate in the WMO Aircraft Meteorological Data Relay (AMDAR) observing system.

Note: Guidance on AMDAR programme development and operation is provided in the Guide to Aircraft-based Observations

Requirements

Notes:

2. It is recommended that aircraft-based observations consist of at least the following variables, with desirable and optional variables as indicated:

(a) (Static) Air temperature;

(b) Wind speed;

(c) Wind direction;

(d) Pressure altitude;

(e) Latitude;

(f) Longitude;

(g) Time of observation;

(h) Turbulence: mean, peak and event-based Eddy Dissipation Rate (EDR) – desirable;

(i) Geometric altitude – desirable;

(j) Humidity – desirable (highly recommended);

(k) Icing – desirable;

(l) Turbulence: derived equivalent vertical gust (DEVG) – optional.

3. For more details and further requirements concerning measurement and data processing associated with these and additional optional variables, see AMDAR Onboard Software Functional Requirements Specification, Instruments and Observing Methods, Report No. 115, Chapter 3.

4. For more detailed guidance on the provision of aircraft-based observations in support of requirements for upper‑air observations, see Guide to Aircraft-based Observations (in preparation).

2.5.4

Note: Some relevant specifications and guidance on practices include:

(a) Guide to Aircraft-based Observations

(b) The AMDAR Onboard Software Functional Requirements Specification, which provides a standard for the meteorological functionality of AMDAR software applications and air-ground data formats;

(c) The ARINC 620-8 Data Link Ground System Standard and Interface Specification (DGSS/IS), which provides a specification of the meteorological report;

(d) Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 3.

2.5.5 Members operating AMDAR observing systems shall provide measurement of air temperature, wind speed, wind direction, pressure altitude, latitude, longitude and time of observation.

2.5.6 Members who operate AMDAR observing systems should include measurement of humidity or water vapour, turbulence and icing as additional components of AMDAR observations.

2.5.7 Members making aircraft-based observations available to the WIS shall have the authorization to do so from the observational data owner.

2.5.8 Members making aircraft-based observations available to the WIS should retain a copy of all such observations.

Quality management

2.5.10

Note:

2.5.11 WMO Members who make available aircraft-based observations to the WIS shall develop and implement procedures for quality monitoring and quality assessment of such observations.

Notes:

1. Further information on quality monitoring of aircraft-based observational data can be found in the Guide to the Global Observing System, the Guide to Aircraft-based Observations (in preparation), and in Guidance on Quality Monitoring of Aircraft-based Observational Data (in preparation).

Guide to Aircraft-based Observations (in preparation).

2.5.12

2. Key sources of advice on quality of aircraft-based observational data are the WMO lead centre on aircraft-data and other WMO Members.

3. The WMO lead centre on aircraft data undertakes quality monitoring of aircraft-based observations and makes monitoring information available to Members on the WMO website.

2.5.13 Members operating AMDAR observing systems shall ensure that on-board data quality control is applied in accordance with WMO specifications.

Note: WMO Specifications for on-board data quality control are described in the AMDAR Onboard Software Functional Requirements Specification. (IMO Report, No. ?)

2.5.14 Members who receive and process aircraft-based observational data from any source, including AMDAR, ICAO and other aircraft-based observing systems, shall make such data available through the WIS in accordance with WMO regulations.

Notes:

 2. Guidance on the encoding and provision of aircraft-based observations to the WIS can be found in the Guide to Aircraft-based Observations (in preparation).

2.5.15

2.5.16 Members who receive, process and make available to the WIS aircraft-based observational data from any source shall record, retain, and make available observational metadata in accordance with 2.5.

Notes:

1. Best practices for reporting and recording of such incidents within aircraft-based observational metadata are provided in the Guide to Aircraft-based Observations (in preparation).

2.

3.

4. It is recommended that Members report such incidents to the relevant WMO lead centre on aircraft data and to WMO Focal Points on Aircraft-based Observations.

2.5.19 Members making aircraft-based observations available to the WIS shall develop procedures for the detection, communication and timely rectification of issues and errors that adversely affect the quality of observations.

2.5.20

Notes:

1.

2.6 Radar wind profiler stations

Notes:

1.

2. Wind profile observations can be provided by a range of remote sensing systems, such as Doppler lidars, Doppler sodars and Doppler weather radars. A general description of surface-based remote sensing profiling techniques and systems is given in the Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 5, section 5.2; for radar wind profilers in particular, see section 5.2.2.

2.6.1.1 Members should consider the establishment of radar wind profiler (RWP) stations in their network of upper-air stations.

2.6.1.2 Members operating RWPs shall comply with national regulations for the use of radio frequencies.

Notes:

1. Extensive information about the use of radio frequencies can be found in the Handbook – Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction (ITU/WMO, 2008), noting that Resolution 217 of the World Radiocommunication Conference 1997 (WRC-97) is the basis for frequency allocation for RWPs. Further information is provided in the Guide to Participation in Radio-frequency Coordination (WMO-No. 1159).

2. Physical constraints in selecting systems are described in the Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 5, section 5.2.2. The vertical range of a radar wind profiler is strongly related to the operating frequency.

2.6.1.3 Members who operate RWPs shall make horizontal wind vector observations.

2.6.1.4 Members who operate RWPs should make vertical wind component observations.

Notes:

1.

2. RWP operations may pose safety hazards to operators and maintenance personnel, so the requirement to ensure proper safety procedures (see section 2.4.1.7) is particularly relevant. Typically, safety hazards for RWPs include electric shock, radiofrequency (RF) radiation, high levels of noise (for systems equipped with a Radio-acoustic Sounding System (RASS)), tripping, lifting and electrostatic discharge. Hazards may also include high voltage and radiation exposure.

2.6.2.1 Members shall operate their RWPs continuously so as to acquire and provide horizontal winds at time intervals not exceeding 60 minutes.

Note: Data acquisition at shorter time intervals, for example every five or ten minutes, may be preferable or required depending on the user requirements and applications that the observations are intended to support. Users must then be cautious about a potential degradation of data quality under certain atmospheric conditions.

2.6.2.2

Note:

2.6.2.3 Members should retain a copy of all RWP observations they report to the WIS.

2.6.3

Notes:

1.

2. To the extent possible, the procedures are to operate automatically in real time and enable the characterization of data quality. They are to be part of a quality assurance programme which includes at least system and test equipment calibration, hardware and software maintenance, technical instructions and reporting. Note: check CIMO guide how much is there …

2.6.3.1

Note: It is recommended that monitoring of RWP observational data quality be based on frequent and ongoing comparison with a reliable reference standard. A commonly used method relies on the use of “observation minus background” statistics from NWP output. Comparison may also be made with co-located upper-air wind measurements from other observing systems if available. Note: check CIMO Guide is sth there …

2.6.4 Data and metadata reporting

Notes:

1. WMO standard RWP BUFR codes are to be used for international exchange.

2.6.5

2.6.5.1 Members who exchange RWP observations shall report any major incidents they detect to international recipients of observational data, and shall state when such incidents have been resolved, in accordance with the incident management systems under WIGOS.

Notes:

1. Some incidents, such as those related to internal factors, may be detected automatically and reported without delay to international recipients of observational data. Other incidents may be detected with delay or through periodic checks and reported accordingly. Automatic incident detection can be performed using either built-in test equipment or external monitoring systems. A centralized system can be used for monitoring the performance and health of RWP systems and networks.

2. It is important to take corrective action in response to incidents, including analysis and recording of the event, as soon as possible.

2.6.5.2 Members who exchange RWP observations should include information about incidents in the metadata that they record and make available.

2.6.6

2.6.6.1

Note: An important aspect of such careful planning is to define clear roles and responsibilities for each given change.

2.6.6.2

 Edit. Note: check how already covered in the guidance material

2.6.7

2.6.7.1

Notes:

2. The complete RWP system includes hardware, software, telecommunications and ancillary systems. Where possible and practical, the maintenance programme should be based on relevant manufacturer specifications and guidelines.

2.6.7.2

2.6.7.3 Members who operate RWPs should, where appropriate, implement and perform maintenance tasks remotely.

Note: Remote maintenance cannot replace on-site maintenance for many tasks, but the ability to perform some tasks remotely can contribute to preventive maintenance practices, thus helping to achieve higher overall system uptime and quality of operation.

2.6.7.4 Members who operate RWPs should maintain their sites to minimize the effect on the system of external factors (for example, blockage by vegetation). Check how much already covered by CIMO Guide

2.6.7.5

2.6.7.6 Members who exchange RWP observational data should record and report details of corrective and preventive maintenance completed in accordance with the WIGOS metadata standard.

Notes:

1.

2. Any planned or corrective maintenance which has reduced or is expected to reduce the normal RWP data availability or quality is to be treated in the same manner as an incident, by following provisions 2.6.5.1 and 2.6.5.2 above.

2.6.8

2.6.8.1

Notes:

1. The objective of inspection and supervision is to determine whether the RWP is functioning correctly (within performance tolerances) and, if not, to understand the deviations and initiate a response.

2. Remote monitoring and diagnostic systems can significantly increase the effectiveness of inspection and supervision activities. Check how already covered by the CIMO Guide

3.

2.6.8.2 Members who exchange RWP observational data shall record and report inspection results.

2.6.9

2.6.9.1

2.6.9.2 Members who exchange RWP observational data shall record and report details of calibrations in accordance with the WIGOS metadata standard.

Notes:

1. Relevant calibration details, in the case of the spaced antenna method of wind determination, would include the statistical bias correction applied.

2. Any calibration activity which has reduced or is expected to reduce the normal RWP data availability or quality is to be treated in the same manner as an incident, by following provisions 2.6.5.1 and 2.6.5.2.

2.7 Weather radar stations

Notes:

1.

2. A general description of weather radars is given in the Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 7.

2.7.1

2.7.1.1 Members should establish a network of weather radar stations either nationally or in collaboration with other Members.

2.7.1.2 Members operating weather radars shall comply with national regulations for the use of radio frequencies.

Note: Extensive information about the use of radio frequencies is provided in the Handbook –Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction (ITU/WMO, 2008) and also in the Guide to Participation in Radio-frequency Coordination.

2.7.1.3 Members who operate weather radars shall operate radars capable of transmitting and receiving horizontally polarized signals.

2.7.1.4 Members who operate weather radars should operate radars capable of transmitting and receiving both horizontally and vertically polarized signals.

Note: Such radars are generally known as dual-polarization or polarimetric radars.

2.7.1.5 Members shall ensure that their weather radars provide observations of the radar reflectivity factor.

Note: Radar reflectivity is related to precipitation intensity and may also be generated by non-meteorological phenomena.

2.7.1.6 Members should ensure that their single-polarization weather radars provide the following observations:

(a) Radial velocity;

(b) Spectral width.

2.7.1.7 Members should ensure that their weather radars with dual-polarization capability provide the following observations:

(a) Differential reflectivity;

(b) Cross-polar correlation;

(c) Differential phase;

(d) Specific differential phase.

Notes:

1. Further information about the observations made by weather radars is provided in the Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 7, Tables 7.1, 7.2 and 7.4.

2. Weather radar operations may pose safety hazards to operators and maintenance personnel as well as the surrounding community, so the requirement to ensure proper safety procedures is particularly relevant. Typically, on-site safety hazards for weather radars include high voltage, radiation exposure, working in confined spaces, heavy moving components, climbing and working at heights. Further information is available in the Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 7, section 7.8.

2.7.2

Note: The Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 7, provides guidance on weather radar observing practices.

2.7.2.1 Members who operate weather radars should make observations available at least every 15 minutes.

Notes:

1.

2. It is recognized that Members may have seasonal differences in the operation of weather radars. The above recommended reporting frequency applies during those periods when the radar is in operation.

3. Requirements to make available metadata related to all observations, including weather radar observations, can be found in the Manual on the WMO Integrated Global Observing System, section 2.5.

2.7.2.2 Members should retain a copy of all weather radar observations they report to the WIS.

Note: Non-destructive storage of observations is important to ensure that data and metadata quality and information content are not altered.

2.7.3

Notes:

1. With regard to weather radars, the procedures will improve both qualitative and quantitative uses of weather radar observations.

2. The Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 7, provides some guidance on quality control of weather radar observations. To the extent possible, the procedures are to include quality control of both internal and external factors in order to enable the characterization of data quality and the inclusion of a record of the quality control methods used with the observations they were applied to.

2.7.4

2.7.4.1 Members who operate weather radars should make weather radar observational data available for international exchange.

Note: A standard WMO data format is under development. It will ensure that real-time weather radar observational data and metadata can be represented and exchanged in a way that preserves the required precision, accuracy and information content.

2.7.4.2 Members who exchange observational data shall provide real-time metadata together with the observational data to which they apply in accordance with 2.5.

Notes:

1. Key amongst such metadata is information on quality and it should accompany as closely as possible the observational data to which it applies.

2. It is recommended that such metadata include information on calibration, timing, beam pointing, and other system settings.

2.7.4.3 Members who exchange weather radar observational data shall provide the associated non-real-time metadata to the WMO Radar Database.

Note: Members are strongly urged to provide non-real-time metadata to the WMO Radar Database for all of their weather radars, including those from which observational data are not exchanged.

2.7.5

2.7.5.1 Members who exchange weather radar observational data shall report any major incidents they detect to international recipients of observational data, and shall state when such incidents have been resolved, in accordance with the incident management systems under WIGOS.

Notes:

1. Some incidents, such as those related to internal factors may be detected automatically and reported without delay to international recipients of observational data. Other incidents may be detected with delay or through periodic checks and reported accordingly. Automatic detection is facilitated through the use of built-in test equipment and/or external monitoring systems.

2.

2.7.5.2 Members who exchange weather radar observations should provide incident information within the metadata that they report in real time.

2.7.6

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2.7.6.2 When making changes to weather radar systems and networks, Members should notify both national and international stakeholders and observational data users in advance, record and document such changes and update relevant metadata.

Notes:

1. These notifications include information on the expected impacts and the time period over which the change will take place and, importantly, when the period of change is complete. A future standard mechanism and format for such notifications will be useful.

2. The record of changes includes the nature and characteristics of the change, the date and time of implementation and the reason for making the change.

2.7.7

Note: the Guide to Meteorological Instruments and Methods of Observation, Part II, Chapter 7, section 7.7.1, provides guidance on weather radar maintenance.

Note: Remote maintenance cannot replace on-site maintenance for many tasks, but the ability to perform some tasks remotely can contribute to preventive maintenance practices thus helping to achieve higher overall system uptime and quality of operation.

2.7.7.6

2.7.7.7 Members who exchange weather radar observational data shall record and report details of corrective and preventive maintenance completed in accordance with the WIGOS metadata standard.

Notes:

1.

2. Any planned or corrective maintenance that has reduced or is expected to reduce the normal availability or quality of weather radar observational data is to be treated in the same manner as an incident, by following provisions 2.7.5.1 and 2.7.5.2.

2.7.8

2.7.8.1

Notes:

2.7.8.2 Members who exchange weather radar observational data shall record and report inspection results in accordance with the WIGOS metadata standard.

2.7.9

2.7.9.1

2.7.9.3 Members who exchange weather radar observational data shall record and report details of calibrations in accordance with the WIGOS metadata standard.

Notes:

1. Relevant details include calibration variables and their settings or levels, and the terms of the weather radar equation along with the calibration constant.

2. Calibrations shall be reported with the observational data to which they apply, in accordance with provision 2.7.4.2.

3. Any calibration activity which has reduced or is expected to reduce the normal availability or quality of weather radar observational data is to be treated in the same manner as an incident, by following provisions 2.7.5.1 and 2.7.5.2

2.8 Aeronautical meteorological stations

2.8.1

Note: Detailed information on aeronautical meteorological stations, observations and reports is given in the Technical Regulations, Volume II, Part I, sections 4 and 5.

2.8.2

2.8.3

2.8.4

2.8.6

2.9 Research and special-purpose vessel stations

General

2.9.1 Members operating research and special-purpose vessels should do their utmost to ensure that all such vessels make meteorological observations.

Location and composition

2.9.2 In addition to as many as possible of the meteorological elements of surface and upper-air observations, subsurface observations (e.g. temperature and salinity profiles), down to the thermocline and below, should also be made and transmitted (in real time), in accordance with the procedures agreed between WMO and the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization.

Frequency and timing of observations

2.9.3 In addition to meeting requirements for research, special-purpose vessels should, when possible, make surface and upper-air observations that meet and supplement basic observational requirements.

2.10 Climatological stations

General

2.10.1 Each Member shall establish in its territory a network of climatological stations.

2.10.2 Just Note with ref to App. 2.2.

2.10.3 Each Member shall establish and maintain at least one reference climatological station.

2.10.4

2.10.5

2.10.6 2.10.7 Each reference climatological station should have adequate and unchanging exposure that allows observations to be made in representative conditions. The surroundings of the station should not alter over time to such an extent that they affect the homogeneity of the series of observations.

2.10.8 At a principal climatological station, observations shall be made of all or most of the following meteorological elements, where appropriate:

(a) Weather;

(b) Wind direction and speed;

(c) Cloud amount;

(d) Type of cloud;

(e) Height of cloud base;

(f) Visibility;

(g) Air temperature (including extreme temperatures);

(h) Humidity;

(i) Atmospheric pressure;

(j) Precipitation amount;

(k) Snow cover and/or snow depth;

(l) Sunshine duration and/or solar radiation;

(m) Soil temperature.

2.10.9 At a principal climatological station, soil temperature should be measured at some or all of the following depths: 5, 10, 20, 50, 100, 150 and 300 cm.

2.10.10 At an ordinary climatological station, observations shall be made of extreme temperatures and amount of precipitation and, if possible, of some of the other meteorological elements listed under 2.10.8 above.

2.10.11

Frequency and timing of observations

2.10.12 ? Each Member should arrange for observations at all climatological stations to be made at fixed times, according to either UTC or Local Mean Time, which remain unchanged throughout the year.

2.10.13 ? When two or more observations are made at a climatological station, they should be made at times that reflect the significant diurnal variations of the climatic meteorological elements.

2.10.14

2.11 Global Climate Observing System Surface Network stations

In implementing the observing programme at GCOS Surface Network (GSN) stations, Members should adhere to the GCOS Climate Monitoring Principles in accordance with 2.2.2.2.

(b) CLIMAT data should be accurate and provided in a timely manner: CLIMAT reports should be transmitted by the fifth day of the month (and no later than the eighth day of the month);

(c) Rigorous quality control of the measurements and their message encoding should be exercised: CLIMAT reports require quality control not only of the measurements themselves, but also of their message encoding to ensure their accurate transmission to national, regional and world centres. Quality-control checks should be made on site and at a central facility designed to detect equipment faults at the earliest stage possible. The Guide to Meteorological Instruments and Methods of Observation, Part IV, Chapter 3, provides the appropriate recommendations;

2.12 Global Climate Observing System upper-air stations

2.12.1 Global Climate Observing System Upper-air Network stations

Note: GUAN is a subset of the upper-air network described in section XXXX

Note: In implementing observing programmes at GCOS Upper-air Network (GUAN) stations, Members should adhere to the GCOS Climate Monitoring Principles adopted by Resolution 9 (Cg-XIV). In particular, they should comply with the following best practices:

(a)

(b) Soundings should preferably be made at least twice per day and should reach as high as possible, noting the GCOS requirements for ascents up to a minimum height of 30 hPa. every effort should be made to maintain soundings regularly up to a level as high as 5 hPa where feasible;

(c)

(d) Basic checks should be made before each sounding to ensure accurate data: the accuracy of a radiosonde’s sensors should be checked in a controlled environment immediately before the flight. Checks should also be made during and/or at the end of each sounding to ensure that incomplete soundings or soundings containing errors are corrected before transmission;

(e) Back-up radiosondes should be released in cases of failure: in the event of failure of a sounding instrument or incomplete sounding resulting from difficult weather conditions, a second release should be made to maintain the record from the GUAN station, noting that the minimum requirement for GUAN is 25 daily soundings per month; (Q: 1 or 2 per day?)

(f)

Edit. Note: to check with Luis if WMDS allows “batch ident. OR in BUFR template”

(g) To achieve suitable global coverage, Members should consider operating or resourcing stations outside of national boundaries.

2.12.2 Global Climate Observing System Reference Upper-air Network stations

Stations contributing to the GCOS Reference Upper-air Network (GRUAN) shall undergo the GRUAN site assessment and certification process. In particular, GRUAN stations shall comply with the following:

Edit. Note: Try to retain a very brief ver. of these points below

(a)

(b)

(c) ?? Sufficient raw data and metadata shall be collected at contributing sites to permit the processing of measurements, at a centralized processing facility, into a reference measurement. This requires, at least, that the uncertainty of the measurement (including corrections) has been determined, the entire measurement procedure and set of processing algorithms are properly documented and accessible, and that every effort has been made to tie the observations to an internationally accepted traceable standard. Sufficient metadata must also be collected and archived to allow reprocessing of the data at any future date;

(d) ?? In addition to ensuring long-term homogeneity of measurement series at each site within the network, sites shall also be operated in such a way that homogeneity of measurements across the network will ensure that significant site-specific differences between GRUAN data and co-located measurements do not result from the GRUAN data products;

(e) ?? GRUAN sites shall perform regular traceable pre-launch ground checks for balloon-borne systems and record the results. Other instruments that provide vertical profiles extending from the surface require regular checks to assure correct operation;

(f) ?? GRUAN sites shall provide redundant reference observations of the essential climate variables selected for measurement at the site at intervals sufficient to validate the derivation of the uncertainty in the primary measurement;

(g) ?? To achieve suitable global coverage, Members should consider operating stations outside of national boundaries.

Members **shall** comply with a certification process …

Members shall follow … The mandatory practices required of GRUAN sites, as detailed in the GCOS Reference Upper-Air Network (GRUAN) Manual (GCOS-170, WIGOS Technical Report No. 2013-02).

Note: The mandatory practices required of GRUAN sites, as detailed in the GCOS Reference Upper-Air Network (GRUAN) Manual (GCOS-170, WIGOS Technical Report No. 2013-02), reflect GRUAN’s primary goal of providing reference-quality observations of the atmospheric column while accommodating the diverse capabilities of sites within the network. However, certification of measurement programmes at a GRUAN site goes beyond considering the extent to which the site adheres to the mandatory practices outlined in the GRUAN Manual and considers the added value that the site brings to the network. The added value is assessed by experts forming the Working Group on the GCOS Reference Upper-air Network, whose judgement is guided by considerations 8.17 to 8.26 in the GRUAN Manual. The GRUAN Manual is supplemented by a more detailed GCOS Reference Upper-Air Network (GRUAN) Guide (GCOS-171, WIGOS Technical Report No. 2013-03) which provides guidelines on how the protocols detailed in the GRUAN Manual might be achieved, and by a series of technical documents available from the GRUAN website at <http://www.gruan.org>.

Members should follow …

2.13 meteorological stations for an agricultural meteorology

General

2.13.1 Each Member should establish in its a network of surface land stations capabilities to meet the requirements of agricultural meteorology.

Notes:

1. Detailed guidance on observing practices of agricultural meteorological observing systems and instruments is given in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8) and the Guide to Agricultural Meteorological Practices (WMO-No. 134), Chapter 2.

2. The requirements for agricultural meteorology are documented in OSCAR/Requirements.

2.13.3 Each Member should make available metadata for stations supporting agricultural meteorology in accordance with 2.5.

Note: For stations supporting agricultural meteorology details for Code table 4.01 of the WIGOS Metadata Standard (WMO-No. 1192) include natural biomass, main agrosystems and crops of the area, types of soil, physical constants and profile of soil.

*Edit. Note: check the accuracy of the note above*

2.13.4 Members should locate those stations that support agricultural meteorology at a place that is representative of agricultural and natural conditions in the area concerned.

(a) At experimental stations or research institutes for agriculture, horticulture, animal husbandry, forestry, hydrobiology and soil sciences;

(b) At agricultural and allied colleges;

(c) In areas of present or future importance for agricultural crops and animal husbandry;

(d) In forest areas;

(e) In national parks and reserves.

2.13.5 Members should, at stations supporting agricultural meteorology, conduct an observing programme which, in addition to the standard climatological observations, includes some or all of the following:

Edit. Note: check with Rob:

(1) a phrase “standard climatological observations” (precise meaning or just a generic statement). Can we change it to the following words: “other meteorological observations being made”?

(2) if should can be replaced by “shall” OR “shall at least one of the following “

(a) Observations of physical environment:

(i) Temperature and humidity of the air at different levels in the layer adjacent to the ground (from ground level up to about 10 metres above the upper limit of prevailing vegetation), including extreme values of these meteorological elements;

(ii) Soil temperature at depths of 5, 10, 20, 50 and 100 cm and at additional depths for special purposes and in forest areas;

(iii) Soil water (volumetric content) at 5, 10, 20, 50 and 100 cm and at additional depths for special purposes and deep soils, with at least three replications when the gravimetric method is used;

(iv) Turbulence and mixing of air in the lower layer (including wind measurements at different levels);

(v) Hydrometeors and water-balance components (including hail, dew, fog, evaporation from soil and from open water, transpiration from crops or plants, rainfall interception, runoff and water table);

(vi) Sunshine duration, global and net radiation as well as the radiation balance over natural vegetation, and crops and soils (over 24 hours);

(vii) Observations of weather conditions causing direct damage to crops, such as frost, hail, drought, floods, gales and extremely hot, dry winds;

(viii) Observations of damage caused by sandstorms and duststorms, rainfall erosivity, atmospheric pollution and acid deposition as well as forest, bush and grassland fires;

(ix) Observations of greenhouse gas concentrations and fluxes in the context of climate change processes(b) Observations of a biological nature:

(i) Phenological observations;

(ii) Observations on growth (as required for the establishment of bioclimatic relationships);

(iii) Observations on qualitative and quantitative yield of plant and animal products;

(iv) Observations of direct weather damage on crops and animals (adverse effects of frost, hail, drought, floods, gales);

(v) Observations of damage caused by diseases and pests;

(vi) Observations of damage caused by sandstorms and duststorms and atmospheric pollution, as well as forest, bush and grassland fires.

2.13.6 Members should make agricultural meteorological observations of the physical environment at the main standard times.

2.13.7 Members should make agricultural meteorological observations of a biological nature regularly, at least every 2 or three days, or as frequently as significant changes occur.

2.14

2.14.2 Radiation stations

General

2.14.2.1 Members should establish at least one principal radiation station in each climatic zone of their territory.

2.14.2.2 Members should maintain a network of radiation stations of sufficient density for the study of radiation climatology.

2.14.2.3 Each Member shall make available the metadata of their radiation stations in accordance with section 2.5.

2.14.2.4 Member shall install a radiation station so as to provide adequate exposure that will not change over time.

Note: Detailed guidance is given in the Guide to Meteorological Instruments and Methods of Observation, Part  I, Chapter 7.

2.14.2.5 At principal radiation stations, the observing programme should include:

(a) Continuous recording of global solar radiation and sky radiation, using pyranometers of the first or second class;

(b) Regular measurements of direct solar radiation;

(c) Regular measurements of net radiation (radiation balance) over natural and crop soil cover (made over a 24-hour period);

(d) Recording of duration of sunshine.

Note: The terminology of radiation qualities and measuring instruments and the classification of pyranometers are given in the Guide to Meteorological Instruments and Methods of Observation, Part  I, Chapter 7.

2.14.2.6 At ordinary radiation stations, the observing programme should include:

(a) Continuous recording of global solar radiation;

(b) Recording of duration of sunshine.

2.14.2.7 Pyrheliometric measurements shall be expressed in accordance with the World Radiometric Reference.

2.14.2.8 When automatic recording is not available, measurements of direct solar radiation should be made at least three times a day, provided the sun and the sky in the vicinity are free from cloud, corresponding to three different solar heights, one of them being near the maximum.

2.14.2.9 During clear-sky conditions, measurements of long-wave effective radiation should be made every night, one of them being made soon after the end of the evening civil twilight.

2.14.3 Other remote-sensing profiler stations

General

2.12.31 Members should consider the establishment of other remote-sensing profilers.

Note: In addition to radar wind profilers, addressed in section 2.6, a range of other remote-sensing technologies are being used to collect wind and thermal profiles of the atmosphere. The Guide to Meteorological Instruments and Methods of Observation, Part  II, Chapter 5, section 5.2, provides further information about acoustic sounders (sodars), radio-acoustic sounding systems, microwave radiometers, laser radars (lidars) and the Global Navigation Satellite System. Doppler weather radars may also be used to derive wind profiles.

Location

2.14.3.2 The location and spacing of stations should be consistent with the requirements for the observations.

2.14.4 Lightning location stations

2.14.4.1 Members should consider acquiring observations from lightning location systems.

Note: A detailed description of methods in use is provided in the Guide to Meteorological Instruments and Methods of Observation, Part  II, Chapter 6. A surface-based sensor at a single station can detect the occurrence of lightning, but cannot be used to locate it on an individual flash basis. A network of stations is needed for accurate lightning location.

2.14.4.2 The spacing and number of stations should be consistent with the technique used and the desired coverage, detection efficiency and accuracy of location.

2.14.4.3 Continuous monitoring by the station should be maintained.

2.14.5 Meteorological reconnaissance aircraft stations

Edit. Note: to be covered under aircraft obs. and also adaptive/targeted obs.

General

2.14.5.1 Members should organize and communicate, either individually or jointly, routine and special aircraft weather reconnaissance flights.

Location and composition

2.14.5.2 Aircraft reconnaissance facilities should be located near prevalent storm tracks in data-sparse areas. Reconnaissance flights should be initiated in locations where additional observational information is required for the investigation and prediction of developing or threatening storms.

2.14.5.3 Meteorological reconnaissance flight observations should include:

(a) Altitude and position of aircraft;

(b) Observations made at frequent intervals during a horizontal flight at low level;

(c) Observations made during flights at higher levels, as near as possible to standard isobaric surfaces;

(d) Vertical soundings, either by remote sensing or by the GPS dropsonde.

2.14.5.4 The meteorological elements to be observed during meteorological reconnaissance flights should include:

(a) Atmospheric pressure at which the aircraft is flying;

(b) Air temperature;

(c) Humidity;

(d) Wind (type of wind, wind direction and speed);

(e) Present and past weather;

(f) Turbulence;

(g) Flight conditions (cloud amount);

(h) Significant weather changes;

(i) Icing and contrails.

Notes:

1. For detailed guidance regarding observations made during meteorological reconnaissance flights, see the . Hurricane Operational Plan (WMO-No. 1163), Chapter 6.

2. Type of wind refers to how the wind was determined and whether it was a mean or a spot wind.

Frequency and timing of observations

2.14.5.5 Reconnaissance flights should be scheduled in response to requirements for data from data-sparse areas, or in response to special phenomena.

2.14.5.6 Flight times and frequency should be selected so that reconnaissance information supplements upper-air information.

2.14.7 Planetary boundary-layer stations

General

2.14.7.1 Members should establish an adequate network of stations for making measurements in the planetary boundary layer.

Location and composition

2.14.7.2 Members should, whenever possible, provide a capability to obtain detailed knowledge of the profiles of temperature, humidity, pressure and wind in the lowest 1 500 m of the atmosphere.

Notes:

1. This information is required in the study of diffusion of atmospheric pollution, the transmission of electromagnetic signals, the relation between free-air variables and boundary-layer variables, severe storms, cloud physics, convective dynamics, etc.

2.

3. Some of the vertical and horizontal sounding systems which could be applied to specific problems for limited periods in a variety of locations are described in the Guide to the Global Observing System.

2.14.8 Tide-gauge stations

General

2.14.8.1 Members should establish an adequate network of tide-gauge stations along coasts subject to storm surges.

Location and composition

2.14.8.2 Gauges should be placed in a manner that allows determination of the full range of water heights.

Frequency and timing of observations

2.14.8.3 Observations of tide height should be made at the main synoptic times: 0000, 0600, 1200 and 1800 UTC. In coastal storm situations, hourly observations should be made.

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3.1.7 All synoptic land stations should be inspected at least once every two years.

3.1.8 Agricultural meteorological and special stations should be inspected at least once a year.

3.1.9 Principal climatological stations should be inspected at least once a year; ordinary climatological and precipitation stations should be inspected at least once every three years. If possible, relevant inspections should occasionally be carried out during the winter season.

3.1.10 Automatic weather stations should be inspected at least once every six months.

3.1.11 At sea stations, barometers should be checked at least twice a year with reference to a standard barometer.

3.2

3.2.1

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3.2.6

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3.3.1.5

3.3.2 Atmospheric pressure

3.3.2.1 Barometric readings shall be reduced from local acceleration of gravity to standard (normal) gravity. The value of standard (normal) gravity (g­­n) shall be regarded as a conventional constant:

g­­­­n = 9.806 65 m s–2

3.3.2.2 The hectopascal (hPa), equal to 100 pascals (Pa), shall be the only unit in which pressures are reported for meteorological purposes.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* WEdB-2 stopped here; the rest on WIGOS-PO & OSD\*\*\*\*\*\*\*\*\*\*\*

3.3.2.6 Members shall reduce the observed atmospheric pressure at a station to mean sea level in accordance with the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8)*,* Part  I, Chapter 3, 3.11, except at those stations specified in the Manual on Codes, Regional Codes and National Coding Practices (WMO-No. 306), Volume II, section A.1, 12.1 for each Regional Association and the Antarctic.3.3.2.7

3.3.2.8

3.3.2.9

Note: Detailed guidance on measurement of atmospheric pressure is given in the Guide to Meteorological Instruments and Methods of Observation, Part  I, Chapter 3.

3.3.3 Air temperature

3.3.3.1 All temperature shall be reported in degrees celsius (°C).

3.3.3.2 Members should ensure that sensor situated inside a screen is mounted at a height within 1.25 and 2.0 m above ground.

Note: At a station where considerable snow cover may occur, a greater height is permissible or, alternatively, a moveable support can be used allowing the thermometer housing to be raised or lowered in order to maintain the correct height above the snow surface.

3.3.3.3 Members should protect their thermometer using the radiation shield that minimizes radiation effects and at the same time allows free influx and circulation of air.

3.3.3.4 Thermometers should be checked against a reference standard instrument at least once a year.

3.3.4 Humidity

Note: Definitions and specifications of water vapour in the atmosphere are given in the Guide to Meteorological Instruments and Methods of Observation, Part I, Chapter 4, Annex 4.A.

3.3.4.1

3.3.4.2

3.3.4.3 In surface observations, the height requirements for humidity measurements shall be the same as for air temperature measurements.

Comment: should be there something on the units used for the humidity?

3.3.5 Surface wind

3.3.5.1 The exposure of wind instruments over level, open terrain shall be 10 metres above the ground.

Note: Open terrain, according to the Guide to Meteorological Instruments and Methods of Observation, Part I, Chapter 5, 5.9.2, is defined as an area where the distance between the anemometer and any obstruction is at least 10 times the height of the obstruction.

3.3.5.2 If a station is located at an aerodrome, Members should install the wind sensor in accordance with the *Technical Regulations* (WMO-No. 49), Volume II, 4.6.1.3.

Note: In the case of aeronautical stations, reference is made to …

3.3.5.3 Wind speed should be primarily measured in metres per second. )

Note: ref to 306 on reporting practices

Note: In observations used at an aerodrome for aircraft taking off and landing, the averaging period is two minutes).

3.3.5.4 Wind direction should be measured in degrees and should represent a scalar average over 10 minutes or, if the wind changes significantly in the 10-minute period, an average over the period after the change.

Note: ref to 306 on reporting practices

3.3.5.5 “Calm” should be indicated when the average wind speed is less than 0.5  m s–1. The direction is not reported.

3.3.5.6 In the absence of a wind sensor, the wind speed may be estimated using the Beaufort scale.

Note: The Beaufort scale is given in the Guide to Meteorological Instruments and Methods of Observation, Part I, Chapter 5.

3.3.5.7 At sea stations, in the absence of an appropriate instrument, the wind speed may be estimated by reference to the Beaufort scale and the wind direction by observing the motion of sea waves.

3.3.6 Clouds

3.3.6.1 For all cloud observations, the tables of classification, definitions and descriptions of clouds as given in the International Cloud Atlas – Manual on the Observation of Clouds and other Meteors (WMO-No.  407) (Annex I to the Technical Regulations), shall be used.

Note: Ref to 8, 49-Vol. II

3.3.7 Present and past Weather

Present and past weather shall be observed in accordance with the International Cloud Atlas – Manual on the Observation of Clouds and other Meteors (WMO-No. 407).

Note: See the Guide to Meteorological Instruments and Methods of Observation, Part I, Chapter 14, section 14.2 for further details.

3.3.8 Precipitation

3.3.8.1 The amount of precipitation shall be the sum of the amounts of liquid precipitation and the liquid equivalent of solid precipitation. Edit note: It should go under Definitions (the one from No. 8)

3.3.8.2 Daily amounts of precipitation should be measured to the nearest 0.2 mm and, if feasible, to the nearest 0.1 mm. Daily measurements of precipitation should be made at fixed times.

3.3.8.3

 Ref to No. 8 …

3.3.9 Sea-surface temperature

3.3.10 Waves

3.3.11 Radiation

Note: For details of calibration of radiation sensors, refer to the Guide to Meteorological Instruments and Methods of Observation, Part I, Chapter 7.

3.3.12 Soil temperature

3.3.12.1

3.3.12.2

3.3.13 Soil moisture

3.3.13.1

3.3.13.2

3.3.14 Evapotranspiration

3.3.15 Evaporation

3.3.15.1

3.3.15.2

3.3.15.3 The amount of evaporation should be read in millimetres.

3.3.16 Sunshine duration

3.3.17 Snow depth and snow cover

Note: The measurement and observation of snow depth and snow cover according to the description provided in the Guide to Meteorological Instruments and Methods of Observation (WMO‑No.8), Part I, 6.7.

3.4 Upper-air observations

3.4.1 At upper-air stations, temperature and humidity (PTU) observations shall be made by means of a radiosonde attached to a fast-ascending free balloon.

Note: For detailed guidance on the radiosonde and balloon techniques, see the Guide to Meteorological Instruments and Methods of Observation, Part I, Chapters 12 and 13.

3.4.2 Computations of upper-air observations shall be in accordance with the Technical Regulations (WMO-No. 49), Volume I, Part III, 1.2.1 - 1.2.3, based on the description provided in the Guide to Meteorological Instruments and Methods of Observation (WMO-No.8), Part I, 1, 12, particularly 12.9.1, and the relevant definitions of physical functions and values of constants given in ISO 2533.

3.4.3 navaid tracking systems

3.4.4

3.4.5 Each upper-air synoptic station shall promptly report any changes in the types of radiosonde and windfinding systems in operational use to the Secretariat for communication to all Members, in accordance with 2.5.

3.4.6

3.4.7 Members shall ensure that new radiosonde types are compared with sondes accepted as having the most stable and accurate performance before adoption for operational use.

3.4.8

 XXX

Note: The Manual on the WMO Integrated Global Observing System specifies the WIGOS metadata standard, defined in its Appendix 2.4 and detailed in The WIGOS Metadata Standard (WMO-No. 1192), for all WIGOS observations. This attachment provides further details relevant only to automatic weather stations.

A metadata database should provide detailed information to enable users to gain adequate background knowledge about the station and observational data, together with updates due to changes that occur.

Major database elements include information on the following:

(a) Network;

(b) Station;

(c) Individual instrument;

(d) Data processing;

(e) Data handling;

(f) Data transmission.

Station information

There is a great deal of information related to a station’s location, local topography, etc. Basic station metadata include:

(a) Station name and index number(s);

(b) Geographical coordinates;

(c) Elevation above mean sea level;

(d) Types of soil, physical constants and profile of soil;

(e) Types of vegetation and condition;

(f) Local topography description;

(g) Type of automatic weather station, manufacturer, model, serial number;

(h) Observing programme of the station: parameters measured, reference time, times at which observations/measurements are made and reported;

(i) The datum level to which atmospheric pressure data of the station refer.

Individual instrument information

Information related to sensors installed at the station, including recommended, scheduled and performed maintenance and calibration.

Metadata provided should be:

(a) Sensor type, manufacturer, model, serial number;

(b) Principle of operation, method of measurement/observation, type of detection system;

(c) Performance characteristics;

(d) Unit of measurement, measuring range;

(e) Resolution, accuracy (uncertainty), time constant, time resolution, output averaging time;

(f) Siting and exposure: location, shielding, height above ground (or level of depth);

(g) Data acquisition: sampling interval, averaging interval and type;

(h) Correction procedures;

(i) Calibration data and time of calibration;

(j) Preventive and corrective maintenance: recommended/scheduled maintenance and calibration procedures, including frequency, procedure description;

(k) Results of comparison with travelling standard.

Data-processing information

For each individual meteorological element, metadata related to processing procedures include:

(a) Measuring/observing programme: time of observations, reporting frequency, data output;

(b) Data-processing method/procedure/algorithm;

(c) Formula to calculate the element;

(d) Mode of observation/measurement;

(e) Processing interval;

(f) Reported resolution;

(g) Input source (instrument, element, etc.);

(h) Constants and parameter values.

Data handling information

Metadata elements of interest include:

(a) Quality control procedures/algorithms;

(b) Quality control flags definition;

(c) Constants and parameter values;

(d) Processing and storage procedures.

Data transmission information

The transmission-related metadata of interest are:

(a) Method of transmission;

(b) Data format;

(c) Transmission time;

(d) Transmission frequency.

1. The words “additional data” are used with their usual meaning and not as in Resolution 40 (Cg-XII). [↑](#footnote-ref-1)
2. Due to the wide variety of types of nuclear accidents, a precise definition of “accident site” is not possible. The accident site should be understood as the location where the accident occurs and the immediate surrounding zone within a range of a few kilometres. [↑](#footnote-ref-2)
3. The area potentially affected is dependent on the state and evolution of the atmosphere over an extended area around the accident site, as well as on the nuclear event itself, and cannot be precisely defined in advance. The “potentially affected area” should be understood, therefore, as the area where (according to all the information available, including the air transport pollution products, if already issued) the nuclear pollutants are likely to be transported in the air or on the ground at a significant level over the natural (background) radioactivity. Advice on the extent of the potentially affected area may be obtained from the RSMC concerned. [↑](#footnote-ref-3)
4. Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity, which could presage an eruption. [↑](#footnote-ref-4)
5. The words “additional data” are used with their usual meaning and not as in Resolution 40 (Cg-XII). [↑](#footnote-ref-5)
6. Volcanic Ash Advisory Centres are designated by ICAO and WMO to issue advisories on the presence and forecasted trajectory of volcanic ash. [↑](#footnote-ref-6)