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| WEATHER CLIMATE WATER | **World Meteorological Organization**  **COMMISSION FOR OBSERVATION, INFRASTRUCTURE AND INFORMATION SYSTEMS**  **First Session (Third Part)** 12 to 16 April 2021, Virtual Session | **INFCOM-1(III)/ Doc. 5.1.4(1)** |
| Submitted by: Secretary-General  25.III.2021  **DRAFT 1** |

**AGENDA ITEM 5: TECHNICAL REGULATIONS AND OTHER TECHNICAL DECISIONS**

**AGENDA ITEM 5.1: Recommendations from INFCOM Standing Committees and Study Groups**

***AGENDA ITEM 5.1.4: Standing Committee on Data-Processing for Applied Earth System Modelling and Prediction (SC-ESMP)***

# Amendment to the Manual on the Global Data-processing and Forecasting System (WMO-No. 485) reflecting new WMO governance structure

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| --- | --- |
| **Summary** | |
| Reference: | [Resolution 6 (Cg-XVI)](https://library.wmo.int/doc_num.php?explnum_id=3429#page=188), [Resolution 11 (Cg-18)](https://library.wmo.int/doc_num.php?explnum_id=9827#page=63), [Decision 2 (EC-72)](https://library.wmo.int/doc_num.php?explnum_id=10504#page=105) |
| Strategic Objective: | 2.3 |
| Recommended by: | INFCOM |
| Recommended for: | Adoption without debate  Adoption with debate |
| Financial implications: | Operating Plan 2021, Output 2.3.10 |
| Content: | 1 Recommendation |
| Related INF(s): | N/A |
| Main changes to previous version: | [For DRAFT 2, 3, etc. and APPROVED versions only] |

# DRAFT RECOMMENDATION

## Draft Recommendation 5.1.4(1)/1 (INFCOM-1(III))

### Amendment to the [*Manual on the Global Data-processing and Forecasting System* (WMO-No. 485](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YEjPVGhKiUl)) reflecting new WMO governance structure

The Commission for Observation, Infrastructure and Information Systems,

**Recalling** [Resolution 6 (Cg-XVI)](https://library.wmo.int/index.php?lvl=notice_display&id=6907#.Xxaxb54za70) – Revised [*Manual on the Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvd0BFyUm) (WMO-No. 485), [Resolution 11 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.YEjPr2hKiUk) - WMO reform – next phase and [Decision 2 (EC-72)](https://library.wmo.int/index.php?lvl=notice_display&id=21788#.YEjQHmhKiUk) - Consideration of reports,

**Emphasizing** that the new WMO structure should be reflected into the [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO-No. 485),

**Recognizing** the need to rearrange the designated Global Data-processing and Forecasting System centres in the [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO‑No. 485), in compliance with the forecast range and purpose of the centres’ activities,

**Recognizing further** that certain minor editorial changes need to be made to ensure consistency within the [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO‑No. 485),

**Having examined** the draft amendments to the [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO‑No. 485), as provided in the annex to the draft Resolution #/# (EC-73),

**Recommends** to Executive Council the adoption of amendment to the [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO‑No. 485), throughthe draft Resolution #/# (EC-73) provided in the annex to the present recommendation.

**Recalling** (a) the request of the seventeenth Congress (Cg-17) that the contents and the reporting method of the WMO Technical Progress Report on Global Data-processing and Forecasting Systems (GDPFS) and Numerical Weather Prediction (NWP) Research, as a single source of information on operational NWP systems and relevant research activities should be reviewed to facilitate the Members’ contribution to the Report, and (b) the request of Resolution 18 (EC-69) that performance requirements for monitoring GDPFS Centres should be included in the Manual and the Guide to the Global Data-processing System ([WMO-No.305](https://library.wmo.int/index.php?lvl=notice_display&id=6832" \l ".YHVhdEBuKMo)), [Canada]

**Requests** the Standing Committee on Data Processing for Applied Earth System Modelling and Prediction (SC-ESMP), in collaboration with the Research Board and its relevant subsidiary bodies to review the contents and the reporting method of the Report to facilitate the ability of Members to contribute and develop performance requirements for monitoring GDPFS Centres. [Canada]

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[Annex: 1](#_Annex_to_draft_1)

## Annex to draft Recommendation 5.1.4(1)/1 (INFCOM-1(III))

**Draft Resolution #/# (EC-73)**

### Amendment to the [*Manual on the Global Data-processing and Forecasting System* (WMO-No. 485](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YEjPVGhKiUl)) reflecting new WMO governance structure

THE EXECUTIVE COUNCIL,

**Recalling** [Resolution 6 (Cg-XVI)](https://library.wmo.int/index.php?lvl=notice_display&id=6907#.YEjQqGhKiUl) – Revised [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO‑No. 485), [Resolution 11 (Cg-18)](https://library.wmo.int/index.php?lvl=notice_display&id=21440#.YEjPr2hKiUk) - WMO reform – next phase and [Decision 2 (EC-72)](https://library.wmo.int/index.php?lvl=notice_display&id=21788#.YEjQHmhKiUk) - Consideration of reports,

**Having examined** Recommendation 5.1.4(1)/1 (INFCOM-1(III)) - Amendment to the [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO‑No. 485), reflecting new WMO governance structure,

**Adopts** the amendment to the [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO‑No. 485), as provided in the annex to the present resolution,

**Authorizes** the Secretary-General, in consultation with the president of the Commission for Observation, Infrastructure and Information Systems concerned to make editorial amendments to the [*Manual on Global Data-processing and Forecasting System*](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YFxvmkBFyUl) (WMO‑No. 485).

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[Annex: 1](#_Annex_to_draft_3)

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## Annex to draft Resolution #/# (EC-73)

**Amendment to the**[***Manual on the Global Data-processing and Forecasting System* (WMO-No. 485**](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YEjPVGhKiUl)**)**

APPENDIX. PROCEDURES FOR AMENDING WMO MANUALS AND GUIDES THAT ARE THE RESPONSIBILITY OF THE ~~COMMISSION FOR BASIC SYSTEMS~~Commission for observation, Infrastructure and Information Systems

Note: This Appendix will be amended by a revised version to be developed by the Commission for Observation, Infrastructure and Information Systems as requested by Recommendation 5.1.1(3)/1 (INFCOM-1(III)) to ensure consistency with other relevant Manuals and Guides [Japan, Secretariat]

1. DESIGNATION OF RESPONSIBLE ~~Committees~~ BODIES

The ~~Commission for Basic Systems (CBS)~~ Commission for Observation, Infrastructure and Information Systems (INFCOM) shall, for each Manual and Guide, designate one of its ~~Open Programme Area Groups (OPAGs)~~ Standing Committees (SCs) as being responsible for that Manual and its associated technical guides. The ~~Open Programme Area Group~~ Standing Committee may choose to designate one of its Expert Teams as the designated ~~committee~~ body for managing changes to all or part of that Manual; if no Expert Team is designated, ~~the Implementation Coordination Team for the OPAG~~ or the designated Expert Team is not in force, the Standing Committee takes on the role of the designated ~~committee~~ body.

2. GENERAL VALIDATION AND IMPLEMENTATION PROCEDURES

2.1 Proposal of amendments

Amendments to a Manual or a Guide managed by ~~CBS~~ INFCOM 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~~ body 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~~ body is validated in accordance with the procedure given in section 7 below, depending on the type of amendments, the designated ~~committee~~ body 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~~ INFCOM sessions) procedure (see section 4 below);

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

2.4 Date of implementation

The designated ~~committee~~ body 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~~ body 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~~ body 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 chair of the designated ~~committee~~ body and the chair of the responsible ~~OPAG~~ SC, and the president of ~~CBS~~ INFCOM. 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](https://library.wmo.int/index.php?lvl=notice_display&id=19508#.YEj6BmhKiUk)).

3.2 Endorsement

Draft recommendations developed by the responsible committee, including a date for implementation of the amendments, shall be submitted to the chair of the relevant ~~OPAG~~ SC 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~~ INFCOM. See Figure 1.

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Designated ~~committee~~ body

Chair of ~~OPAG~~ Standing Committee

President of ~~CBS~~ INFCOM (in consultation with presidents of technical commissions)

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~~ INFCOM for consultation with presidents of technical commissions affected by the change. If endorsed by the president of ~~CBS~~ INFCOM, 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.

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Designated ~~committee~~ body

Chair of ~~OPAG~~ Standing Committee

Focal points for matters concerning the Manual

President of ~~CBS~~ INFCOM (in consultation with presidents of technical commissions) and then to the President of WMO

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

4. STANDARD (ADOPTION OF AMENDMENTS BETWEEN ~~CBS~~ INFCOM SESSIONS) PROCEDURE [Hong Kong, China]

4.1 Scope

The standard (adoption of amendments between ~~CBS~~ INFCOM 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](https://library.wmo.int/index.php?lvl=notice_display&id=21806#.YEotfWhKg2w)), Volume II – Meteorological Service for International Air Navigation.

4.2 Approval of draft recommendations

For the direct adoption of amendments between ~~CBS~~ INFCOM sessions, the draft recommendation developed by the designated ~~committee~~ body, including a date of implementation of the amendments, shall be submitted to the chair of the responsible ~~OPAG~~ SC and president and vice-president of ~~CBS~~ INFCOM for approval. The president of ~~CBS~~ INFCOM 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](https://library.wmo.int/index.php?lvl=notice_display&id=21806#.YEotfWhKg2w)), Volume II – Meteorological Service for International Air Navigation, the president of ~~CBS~~ INFCOM shall consult with the president of the ~~Commission for Aeronautical Meteorology~~ Commission for Weather, Climate, Water and Related Environmental Services and Applications (SERCOM).

4.3 Circulation to Members

Upon approval of the president of ~~CBS~~ INFCOM, 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~~ body. If the discussion between the designated ~~committee~~ body 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~~ body. 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~~ INFCOM sessions) procedure described in section 5 below.

4.6 Notification

Once amendments are agreed by Members, and after consultation with the chair of the responsible ~~OPAG~~ SC, the vice-president of ~~CBS~~ INFCOM and the president of ~~CBS~~ INFCOM (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 EC of the approved amendments and of the date of their implementation. See Figure 3.

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Designated ~~committee~~ body

Chair of ~~OPAG~~ Standing Committee and president/vice-president of ~~CBS~~ INFCOM in consultation with presidents of technical commissions

Agreed by WMO Members

WMO Members and EC informed

**Figure 3. Adoption of amendments between ~~CBS~~ INFCOM sessions**

5. COMPLEX (ADOPTION OF AMENDMENTS DURING CBS INFCOM SESSIONS) PROCEDURE

5.1 Scope

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

5.2 Procedure

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

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.

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Designated ~~committee~~ body

Meeting of Implementation Coordination Team of responsible ~~OPAG~~ Standing Committee

~~CBS~~ INFCOM session

EC session

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Consult presidents of technical commissions affected by the change

**Figure 4. Adoption of amendments during ~~CBS~~ INFCOM sessions**

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~~ INFCOM 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~~ body 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~~ body with a view to verifying the technical specifications.

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INTRODUCTION

General

1. The Manual on the Global Data-processing and Forecasting System ([WMO-No. 485](https://library.wmo.int/index.php?lvl=notice_display&id=12793#.YEj6u2hKiUk)) is the single source of Technical Regulations for all operational data-processing and forecasting systems of Members designated by WMO as meteorological centres. The Manual is designed to ensure adequate uniformity and standardization of data, information and production practices, procedures and specifications employed among WMO Members in the operation of the Global Data-processing and Forecasting System (GDPFS) as it supports the mission of the Organization.

2. The Manual is Annex IV to the WMO Technical Regulations (Technical Regulations ([WMO-No. 49](https://library.wmo.int/index.php?lvl=notice_display&id=21806#.YEj6_mhKiUk)), Volume I – General Meteorological Standards and Recommended Practices), in which it is stated that GDPFS is established and shall be operated in accordance with the practices, procedures and specifications described in the present Manual.

3. The GDPFS cuts across a number of WMO-related disciplines. It intersects many WMO practices, procedures and specifications that are primarily defined in publications dedicated specifically to them, for example, the Manual on the WMO Information System ([WMO-No. 1060](https://library.wmo.int/index.php?lvl=notice_display&id=9254#.YEj7ImhKg2w)) and the Manual on the WMO Integrated Global Observing System ([WMO-No. 1160](https://library.wmo.int/index.php?lvl=notice_display&id=19223#.YEj7QWhKg2w)).

4. The advances in numerical weather prediction (NWP) in the last few decades have been tremendous: higher accuracy and resolution, longer lead time, and a wider range of relevant applications. Consequently, the emphasis in operational meteorology, hydrology and climatology has been shifting towards the implementation of increasingly sophisticated and diverse numerical models and applications, for an ever-increasing variety of users. GDPFS enables Members to make use of these advances by providing a framework for the sharing of data related to operational meteorology, hydrology and climatology.

5. As part of the WMO Technical Regulations, the Manual on the Global Data-processing and Forecasting System sets out standard and recommended practices and procedures. The General Provisions, included in this publication, define the meaning of the phrase “standard and recommended practices and procedures”. The General Provisions also contain information on the procedure for amending, updating or issuing a new edition of the Technical Regulations (including Manuals and Guides).

6. This edition has been developed in accordance with quality management principles, which ensures its sustainability as part of the WMO Quality Management Framework.

How to read this Manual

7. The Manual consists of three parts, as follows:

(a) Part I: Outline of WMO GDPFS – presenting the overall purpose of GDPFS, its organization and the general characteristics of the various activities to be performed;

(b) Part II: Specifications of GDPFS activities – providing detailed information on the various activities: mandatory functions including production, verification and documentation; and additional recommended functions and products. Part II also specifies overall requirements applicable to all types of activities regarding dissemination, verification, training, and the like;

(c) Part III: Current designated GDPFS centres.

8. The reader seeking general information on GDPFS and its applications should refer to Part I, whereas Parts II and III provide detailed information on the various components of the system, available products and information, status of implementation, as well as compliance criteria.

9. The Manual is designed so that it can be modified as frequently as necessary to keep it up-to-date. While Part I should be rather stable and seldom require updating, it is expected that the evolution of science, techniques and user requirements will continue to induce developments requiring frequent changes to Parts II and III.

10. In line with quality management requirements, the bodies in charge of managing the information contained in the Manual are explicitly specified for every type of GDPFS activity. This information is contained in Part II, 2.2, Tables 2–25. The following explanations and example (Table 1) are provided:

(a) The three entries under “Changes to activity specification” indicate the team(s) and body(ies) in charge of preparing specification updates, approving them, and deciding to update the Manual accordingly;

(b) The two entries under “Centres designation” indicate the bodies responsible for approving the designation of a GDPFS centre for the activity under consideration and for deciding accordingly;

(c) The two entries under “Compliance” indicate the team(s) and body(ies) in charge of ensuring that the designated GDPFS centres remain compliant with the activity specification.

Table 1. Example of a table specifying responsibilities for modifications to a GDPFS activity, for designation of centres and review of compliance

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~INFCOM/ET-OWFS |  |  |
| To be recommended by: | ~~CBS~~INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

Acronyms not previously defined: EC – Executive Council; ~~ET-OWFPS – Expert Team on Operational Weather Forecasting Process and Support; ICT-DPFS – Implementation Coordination Team on Data-processing and Forecasting Systems~~; Expert Team on Operational Weather Forecasting System; SC-ESMP – Standing Committee on Data-Processing for Applied Earth System Modelling, Prediction and Projection.

11. The following procedure is applied for the incorporation of new types of GDPFS centres into this Manual:

(a) The relevant technical commission or programme expert team will develop the criteria and functions for the new type of centre, including the list of mandatory products to be made available in the context of GDPFS;

(b) The criteria and functions for the new type of centre will be endorsed by the relevant technical commission management group or programme steering committee, and submitted to ~~CBS~~ INFCOM through its president;

(c) The president of ~~CBS~~ INFCOM will then decide on an expert team of the commission that will be responsible for reviewing the proposal according to the standard procedure for amendments as defined in the General Provisions.

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PART I. OUTLINE OF THE WMO GLOBAL DATA-PROCESSING AND FORECASTING SYSTEM

1.1 PURPOSE AND SUPPORTED ACTIVITIES

1.1.1 General description

1.1.1.1 The Global Data-processing and Forecasting System (GDPFS) shall be the worldwide network of operational centres operated by WMO Members. Its purpose shall be to make operationally available among WMO Members and relevant operational organizations defined products and services for applications related to weather, climate, water and environment.

1.1.1.2 The GDPFS shall enable scientific and technological advances made in meteorology and related fields to be accessible and exploitable by WMO Members.

1.1.1.3 The activities, organizational structure and operations of GDPFS shall be systematically designed in accordance with Members’ needs and their ability to contribute to, and benefit from, the system in an efficient manner and with a minimum of duplication.

1.1.1.4 A key objective of GDPFS should be to facilitate cooperation and the exchange of information, thereby also contributing to capacity development among developing countries.

1.1.1.5 Defined products and services for applications related to weather, climate, water and environment shall include:

(a) Numerical weather, oceanographic and climate prediction products (analysis and forecast, including probabilistic information);

(b) Specialized products tailored for specific applications.

1.1.1.6 Additional information necessary for an appropriate use of the identified products and services shall be available. This includes non-real-time information as follows:

(a) Systems description and characteristics;

(b) Product metadata;

(c) Verification and monitoring results.

1.1.2 Activities supported by the Global Data-processing and Forecasting System

1.1.2.1 Through GDPFS, Members shall provide and have access to meteorological, hydrological, oceanographic and climatological information supporting a range of operational activities.

1.1.2.2 The GDPFS shall be organized as a three-tier system of activities as follows:

Note: A distinction is made between general-purpose and specialized activities: general-purpose activities are those that encompass essential data-processing required for a wide range of end use, while specialized activities are those that make forecasting products, which may include guidance based on human interpretation, tailored for a specific type of application or user community. In addition to these activities conducted in real-time, non-real-time operational coordination activities are also part of GDPFS. Associated commitments and other appropriate details are specified in Part II.

(a) General-purpose activities:

– Global deterministic NWP

– Limited-area deterministic NWP

– Global ensemble NWP

– Limited-area ensemble NWP

– Global numerical long-range prediction

– Annual to decadal climate prediction

– Numerical ocean wave prediction

– Global numerical ocean prediction

– Nowcasting

(b) Specialized activities:

– Regional climate prediction and monitoring

– Coordination of multi-model ensemble prediction for long-range forecasts (LRFs)

~~– Annual to decadal climate prediction~~

– Coordination of annual to decadal climate prediction

– Regional severe weather forecasting

– Tropical cyclone forecasting, including marine-related hazards

– Nuclear environmental emergency response

– Non-nuclear environmental emergency response

– Atmospheric sand and dust storm forecasts

– Volcano watch services for international air navigation (see 2.2.2.10)

– Marine meteorological services

– Marine environmental emergency response

(c) Non-real-time coordination activities:

– Coordination of deterministic NWP verification (DNV)

– Coordination of Ensemble Prediction System (EPS) verification

– Coordination of LRF verification

– Coordination of wave forecast verification (WFV)

– Coordination of tropical cyclone forecast verification (TCFV)

– Coordination of observation monitoring

Note: It is hoped that other activities, including those related to hydrology, agriculture, polar regions, storm-surge prediction, and space weather, will be developed in future.

1.2 Global Data-Processing and Forecasting System CENTRES

1.2.1 Definitions

1.2.1.1 The meteorological forecasting ranges shall be those defined in Appendix 1.1.

1.2.1.2 The GDPFS shall be organized as a three-level system of World Meteorological Centres (WMCs), Regional Specialized Meteorological Centres (RSMCs) and National Meteorological Centres (NMCs), which carry out GDPFS functions at the global, regional and national levels, respectively. These centres are referred to as GDPFS centres.

1.2.2 National Meteorological Centres

1.2.2.1 An NMC shall carry out functions to meet the national and international requirements of the Member concerned.

Note: To fulfil their national and international obligations, NMCs need to be adequately staffed and equipped to enable them to participate effectively in the World Weather Watch system.

1.2.2.2 The functions of an NMC shall include the preparation of forecasts and warnings at all forecasting ranges necessary to meet the requirements of the Member.

1.2.2.3 Depending on the context, other activities of an NMC should include the production of:

(a) Special-application products, including climate and environmental quality monitoring and prediction products;

(b) Non-real-time climate-related products.

1.2.3 Regional Specialized Meteorological Centres

1.2.3.1 A Member, having accepted the responsibility for providing an RSMC, shall arrange for this centre to carry out operationally at least one of the general-purpose or specialized activities listed in 1.1.2.2, for which specified standards are described in Part II.

1.2.3.2 An RSMC for general-purpose activities should provide products that an RSMC carrying out at least one of the specialized activities considers necessary and makes a request to produce.

Notes:

1. The designation as RSMC does not preclude the use of other names as defined in other contexts, for example, Global Producing Centre for long-range forecasts (GPC-LRF).

2. An RSMC that leads a coordination activity is also referred to as a Lead Centre.

1.2.4 World Meteorological Centres

A Member, having accepted the responsibility for providing a WMC, shall arrange for this centre to carry out operationally at least the following activities, for which specified standards are described in Part II:

(a) Global deterministic NWP;

(b) Global ensemble NWP;

(c) Global numerical long-range prediction.

1.2.5 Regional Specialized Meteorological Centre Networks

1.2.5.1 An RSMC Network (an association of RSMCs participating in an identified activity of GDPFS) shall follow the same specifications and adhere to the same criteria and commitments as individual RSMCs carrying out the same activity.

1.2.5.2 Appropriate documentation shall be produced and made available by Members having accepted the responsibility to contribute to the RSMC Network to distribute the tasks and responsibilities among the participating RSMCs. A unique focal point shall be designated to answer requests from users of the RSMC Network products.

1.2.6 Designation process

1.2.6.1 Each Member shall designate an NMC.

1.2.6.2 The WMCs, RSMCs and RSMC Networks shall be designated by a decision of the World Meteorological Congress (Congress) or the Executive Council. The designation of such centres shall include the specification of the activity and function (or activities and functions) to be carried out.

1.2.6.3 Requests for designation as a WMC or RSMC shall be put forward by the Permanent Representative of the country of the candidate centre, or, in the case of international organizations, by either the Permanent Representative of the country where the candidate centre is located or the president of the relevant regional association(s) (RA(s)).

1.2.6.4 Requests for designation as an RSMC Network shall be put forward by the president of the relevant RA, or, in the case of networks established across two or more RAs, jointly by their presidents.

Note: Centres constituting a network will organize themselves as appropriate, depending on their own context and specificities, so as to ensure that the documentation requested as per paragraph 1.2.5.2 is available.

1.2.6.5 Requests for designation shall be addressed to the WMO Secretariat, which will forward them to the relevant constituent bodies as indicated in Tables 2–~~25~~ 26 in Part II of the present Manual. Supporting information demonstrating compliance with designation criteria shall be included with the request.

1.2.6.6 Depending on the type of activity, endorsement by the RA(s) and technical commission(s) should be required before designation by the Congress or the Executive Council.

1.3 COORDINATION WITH OTHER SYSTEMS OR PROGRAMMES

The GDPFS shall support all WMO Programmes and related programmes of other international organizations in accordance with decisions of the Organization.

Notes:

1. In many cases the activities undertaken by GDPFS centres constitute the operational component of a system developed under another structure or programme, either by WMO on its own or jointly with other international organizations. In such cases the regulations pertaining to these activities cover both:

(a) The specific requirements defined by the relevant structure;

(b) The general GDPFS criteria regarding operational quality and reliability, verification, documentation and compliance (described in Part II of the present Manual).

2. Coordination mechanisms appropriate for the context and characteristics of the various categories of activity are specified in Part II.

\_\_\_\_\_\_\_\_\_\_

PART II. SPECIFICATIONS OF Global Data-Processing and Forecasting System ACTIVITIES

2.2 Specification of activities and procedures for introducing modifications

2.2.1 General-purpose activities

2.2.1.1 Global deterministic numerical weather prediction

Regional Specialized Meteorological Centres conducting global deterministic NWP shall:

(a) Produce global analyses of the three-dimensional structure of the atmosphere;

(b) Produce global forecast fields of basic and derived atmospheric parameters;

(c) Make available on the WMO Information System (WIS) a range of these products; the list of mandatory and highly recommended global deterministic NWP products to be made available is given in Appendix 2.2.1;

(d) Produce verification statistics according to the standard defined in Appendix 2.2.34, and make them available to the Lead Centre(s) for DNV;

(e) Make available on a website up-to-date information on the characteristics of their global NWP systems. The minimum information to be provided is given in Appendix 2.2.2.

Note: The bodies in charge of managing the information contained in the present Manual related to global deterministic NWP are specified in Table 2.

Table 2. WMO bodies responsible for managing information related to global deterministic NWP

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~INFCOM/ET-OWFS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.1.2 Limited-area deterministic numerical weather prediction

Centres conducting limited-area deterministic NWP shall:

(a) Produce limited-area analyses of the three-dimensional structure of the atmosphere;

(b) Produce limited-area forecast fields of basic and derived atmospheric parameters;

(c) Make available on WIS a range of these products; the list of mandatory and highly recommended limited-area deterministic NWP products to be made available, including metadata, is given in Appendix 2.2.3;

(d) Produce verification statistics according to the standard defined in Appendix 2.2.34, adapted for the region covered by the model, at an appropriate resolution, and make available consistent up-to-date graphical displays of the verification results on a website;

(e) Make available on a website up-to-date information on the characteristics of their limited-area NWP systems; the minimum information to be provided is given in Appendix 2.2.4.

Note: The bodies in charge of managing the information contained in the present Manual related to limited-area deterministic NWP are specified in Table 3.

Table 3. WMO bodies responsible for managing information related to limited-area deterministic NWP

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.1.3 Global ensemble numerical weather prediction

Centres conducting global ensemble NWP shall:

(a) Produce global ensemble forecast fields of basic and derived atmospheric parameters;

(b) Make available on WIS a range of these products; the list of mandatory and highly recommended global ensemble NWP products to be made available is given in Appendix 2.2.5;

(c) Make verification statistics available to the Lead Centre(s) for EPS verification according to the standard defined in Appendix 2.2.35;

(d) Make available on a website up-to-date information on the characteristics of their global EPS; the minimum information to be provided is given in Appendix 2.2.6.

Note: The bodies in charge of managing the information contained in the present Manual related to global ensemble NWP are specified in Table 4.

Table 4. WMO bodies responsible for managing information related to global ensemble NWP

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.1.4 Limited-area ensemble numerical weather prediction

Centres conducting limited-area ensemble NWP shall:

(a) Produce limited-area ensemble forecast fields of basic and derived atmospheric parameters;

(b) Make available on WIS a range of these products; the list of mandatory and highly recommended limited-area ensemble NWP products to be made available is given in Appendix 2.2.7;

(c) Produce verification statistics according to the standard defined in Appendix 2.2.35, adapted for the region covered by the model, and make available consistent up-to-date graphical displays of the verification results on a website;

(d) Make available on a website up-to-date information on the characteristics of their limited-area EPS; the minimum information to be provided is given in Appendix 2.2.8.

Note: The bodies in charge of managing the information contained in the present Manual related to limited-area ensemble NWP are specified in Table 5.

Table 5. WMO bodies responsible for managing information related to limited-area   
ensemble NWP

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.1.5 Global numerical long-range prediction

2.2.1.5.1 Centres conducting global numerical long-range prediction (GPCs-LRF) shall:

Note: Functions are defined for the seasonal (1–6 month) prediction activity.

(a) Generate LRF products with global coverage;

(b) Make available on WIS a range of these products; mandatory and highly recommended products to be made available are listed in Appendix 2.2.9;

(c) Produce verification statistics according to the standard defined in Appendix 2.2.36, and make them available to the Lead Centre(s) for the standardized verification system for long-range forecasts (SVSLRF) (Lead Centre(s) for SVSLRF) and on a website;

(d) Make available on a website up-to-date information on the characteristics of their global long-range numerical prediction systems; the minimum information to be provided is given in Appendix 2.2.10.

2.2.1.5.2 In addition to the mandatory activities above, GPCs-LRF should:

(a) Provide forecast output to the Lead Centre(s) for LRF multi-model ensembles (Lead Centre(s) for LRFMME), as detailed in Appendix 2.2.17 (section 1);

(b) Make available on WIS the highly recommended products listed in Appendix 2.2.9;

(c) Make available, on request by Regional Climate Centres (RCCs) or NMCs, the additional data, products and services listed in Attachment 2.2.1, noting that these services may be subject to conditions attached by GPCs.

Note: The bodies in charge of managing the information contained in the present Manual related to global numerical long-range prediction are specified in Table 6.

Table 6. WMO bodies responsible for managing information related to global numerical long-range prediction

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS–CCl/IPET-OPSLS~~INFCOM/ET-OCPS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM | ~~CCl~~SERCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS–CCl/IPET-OPSLS~~INFCOM/ET-OCPS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~INFCOM |  |

Acronyms not previously defined: ~~CCl – Commission for Climatology; IPET-OPSLS – Inter-programme Expert Team on Operational Prediction from Sub-seasonal to Longer~~ ET-OCPS – Expert Team on Operational Climate Prediction System.

2.2.2.X Annual to decadal climate prediction

Centres conducting annual to decadal climate prediction (Global Producing Centres for Annual to Decadal Climate Prediction (GPCs-ADCP)) shall:

(a) Prepare, with at least annual frequency, global forecast fields of parameters relevant to ADCP;

(b) Prepare verification statistics as defined in Appendix 2.2.21;

(c) Provide an agreed set of forecasts and hindcast variables (as defined in Appendix 2.2.20) to the Lead Centre(s) for ADCP;

(d) Make available on a website up-to-date information on the characteristics of their global decadal prediction systems.

Notes:

1. Non-designated centres with capacity to provide the minimum requirement may also contribute ADCP to the Lead Centre(s) for ADCP;

2. Centres who wish to make available their products worldwide may use WIS as a dissemination platform;

3. The bodies in charge of managing the information contained in the present Manual related to coordination of ADCP are specified in Table X.

Table X. WMO bodies responsible for managing information related to ADCP

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS–CCl/IPET-OPSLS~~ INFCOM/ET-OCPS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM | ~~CCl~~ SERCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS–CCl/IPET-OPSLS~~ INFCOM/ET-OCPS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.1.6 Numerical ocean wave prediction

Centres conducting numerical ocean wave prediction shall:

(a) Prepare global analyses of ocean wave parameters;

(b) Prepare global forecast fields of basic and derived ocean wave parameters;

(c) Make available on WIS a range of these products; the list of mandatory and highly recommended products to be made available is given in Appendix 2.2.11;

(d) Prepare verification data and make them available to the Lead Centre(s) for WFV;

(e) Make available on a website up-to-date information on the characteristics of their global numerical ocean wave prediction systems; the minimum information to be provided is given in Appendix 2.2.12.

Note: The bodies in charge of managing the information contained in the Manual related to numerical ocean wave prediction are specified in Table 7.

Table 7. WMO bodies responsible for managing information related to numerical   
ocean wave prediction

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~JCOMM/ET-DRR~~SERCOM/SC-MMO |  |  |
| To be recommended by: | ~~CBS~~ INFCOM | ~~JCOMM~~SERCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM | ~~JCOMM~~SERCOM |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~JCOMM/ET-DRR~~SERCOM/SC-MMO |  |  |
| To be reported to: | ~~CBS~~ INFCOM | ~~JCOMM~~SERCOM |  |

Acronyms not previously defined: ~~ET-DRR: Expert Team on Disaster Risk Reduction; JCOMM: WMO–IOC Joint Technical Commission for Oceanography and Marine Meteorology~~ SC-MMO – Standing Committee on Marine Meteorological and Oceanographic Services.

2.2.1.7 Global numerical ocean prediction

Centres conducting global numerical ocean prediction shall:

(a) Prepare global analyses of oceanographic parameters;

(b) Prepare global forecast fields of basic and derived oceanographic parameters;

(c) Make available on WIS a range of these products; the list of mandatory and highly recommended products to be made available is given in Appendix 2.2.13;

(d) Prepare verification statistics and make them available on a website;

(e) Make available on a website up-to-date information on the characteristics of their global numerical ocean prediction systems; the minimum information to be provided is given in Appendix 2.2.14.

Note: The bodies in charge of managing the information contained in the present Manual related to global numerical ocean prediction are specified in Table 8.

Table 8. Bodies responsible for managing information related to global numerical   
ocean prediction

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~JCOMM/ET-DRR~~ SERCOM/SC-MMO |  |  |
| To be recommended by: | ~~CBS~~ INFCOM | ~~JCOMM~~ SERCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM | ~~JCOMM~~ SERCOM |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~JCOMM/ET-DRR~~ SERCOM/SC-MMO |  |  |
| To be reported to: | ~~CBS~~ INFCOM | ~~JCOMM~~ SERCOM |  |

~~Acronyms not previously defined: ET-OOFS – Expert Team on Operational Ocean Forecast Systems.~~

2.2.1.8 Nowcasting

Centres conducting nowcasting shall:

(a) Operate a system, including a web-based or generic graphical service, describing in real-time or near-real-time the current state of the weather in detail and the prediction of its changes for several hours ahead over their area of interest or parts of that area;

(b) Provide access to this service to National Meteorological and Hydrological Services (NMHSs) whose operational warning services may benefit from it;

(c) Prepare verification statistics and evaluations of the system;

(d) Make available on a website up-to-date information on the characteristics of their systems; the minimum information to be provided is given in Appendix 2.2.15.

Note: The bodies in charge of managing the information contained in the present Manual related to nowcasting are specified in Table 9.

Table 9. WMO bodies responsible for managing information related to nowcasting

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.2 Specialized activities

2.2.2.1 Regional climate prediction and monitoring

Centres conducting regional climate prediction and monitoring (RCCs) shall:

(a) Conduct operational activities for long-range forecasting, both dynamical and statistical, within the range of a one-month to two-year timescale, based on regional needs:

– Interpret and assess relevant LRF products from GPCs-LRF; make use of the products from the Lead Centre(s) for ~~SVSLRF~~LRFMME (refer to 2.2.3.3); distribute relevant information to users and provide feedback to GPCs-LRF (refer to guidelines given in Attachment 2.2.3);

– Generate regional and subregional tailored products relevant to user needs, including seasonal outlooks;

– Generate “consensus” statements on forecasts;

– Generate and display forecast verification;

– Provide online access to products and services;

– Assess use of products and services through feedback from users;

(b) Conduct operational activities for climate monitoring:

– Perform climate diagnostics including analyses of climate variability and extremes, at the regional and subregional scales;

– Establish a historical reference climatology for the region and/or subregions;

– Implement a regional climate watch;

(c) Provide operational data services, to support operational long-range forecasting and climate monitoring:

– Develop quality-controlled regional climate datasets, gridded where applicable;

– Provide climate database and archiving services;

(d) Provide training in the use of operational RCC products and services:

– Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use;

– Coordinate training for RCC users in interpretation and use of mandatory RCC products.

Notes:

1. Recipients of RCC products and services will be NMHSs, other RCCs and international institutes recognized by the RA, and will be referred to as RCC users.

2. Details on RCC functions are provided in Appendix 2.2.16. Additional requirements for RCC functions may vary in detail from region to region. A list of highly recommended, but not mandatory, RCC functions is given in Attachment 2.2.2.

3. The bodies in charge of managing the information contained in the Manual related to regional climate prediction and monitoring are specified in Table 10.

Table 10. WMO bodies responsible for managing information related to regional climate prediction and monitoring

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CCl–CBS/ET-RCC~~ SERCOM/ET-CSISO | ~~CBS–CCl/IPET-OPSLS~~ |  |
| To be recommended by: | ~~CBS~~ INFCOM | ~~CCl~~SERCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM | ~~CCl~~SERCOM |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CCl–CBS/ET-RCC~~SERCOM/ET-CSISO |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~INFCOM |  |

~~Acronyms not previously defined: ET-RCC – Expert Team on Regional Climate Centres.~~ ET-CSISO – Expert Team on Climate Services Information System Operations.

2.2.2.2 Coordination of multi-model ensemble prediction for long-range forecasts

Centre(s) coordinating LRF multi-model ensembles (Lead Centre(s) for LRFMME) shall:

(a) Collect an agreed set of forecast data from RSMCs participating in long-range forecast numerical prediction under activity 2.2.1.5 (GPCs-LRF);

(b) Make available on a website appropriate minimum (Appendix 2.2.17) and additional (Attachment 2.2.4) products and GPC forecasts in standard format;

(c) Redistribute digital forecast data as described in Appendix 2.2.18 for those GPCs that allow it;

(d) Maintain an archive of the real-time GPC and multi-model ensemble forecasts;

(e) Maintain a repository of documentation for the system configuration of all GPC systems;

(f) Verify the products using SVSLRF (Appendix 2.2.36);

(g) Based on comparison among different models, provide feedback to GPCs about model performance and make available on a website the verification results;

(h) Promote research and experience in multi-model ensemble techniques and provide guidance and support on multi-model ensemble techniques to GPCs, RCCs and NMHSs;

(i) Make available on a website Global Seasonal Climate Updates (GSCU) and maintain of its archive

Note: The bodies in charge of managing the information contained in the present Manual related to coordination of multi-model ensemble prediction for LRFs are specified in the table below.

Table 11. WMO bodies responsible for managing information related to multi-model ensemble prediction for LRFs

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS–CCl/IPET-OPSLS~~INFCOM/ET-OCPS |  |  |
| To be recommended by: | ~~CBS~~INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS–CCl/IPET-OPSLS~~INFCOM/ET-OCPS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~INFCOM |  |

~~2.2.2.3 Annual to decadal climate prediction~~

~~Centres conducting annual to decadal climate prediction (GPCs for annual to decadal climate prediction (GPCs-ADCP)) shall:~~

~~(a) Prepare, with at least annual frequency, global forecast fields of parameters relevant to ADCP;~~

~~(b) Prepare verification statistics as defined in Appendix 2.2.21;~~

~~(c) Provide an agreed set of forecast and hindcast variables (as defined in Appendix 2.2.20) to the Lead Centre(s) for ADCP;~~

~~(d) Make available on a website up-to-date information on the characteristics of their global decadal prediction systems.~~

~~Notes:~~

~~1. Non-designated centres with capacity to provide the minimum requirement may also contribute ADCP to the Lead Centre(s) for ADCP;~~

~~2. Centres who wish to make available their products worldwide may use WIS as a dissemination platform;~~

~~3. The bodies in charge of managing the information contained in the present Manual related to coordination of ADCP are specified in Table 12.~~

~~Table 12. WMO bodies responsible for managing information related to ADCP~~

|  |  |  |  |
| --- | --- | --- | --- |
| ~~Responsibility~~ | | | |
| ~~Changes to activity specification~~ | | | |
| ~~To be proposed by:~~ | ~~CBS–CCl/IPET-OPSLS~~ ~~INFCOM/ET-OCPS~~ | ~~SERCOM/ET-CSISO~~ |  |
| ~~To be recommended by:~~ | ~~CBS INFCOM~~ | ~~CCl~~ ~~SERCOM~~ |  |
| ~~To be decided by:~~ | ~~EC/Congress~~ |  |  |
| ~~Centres designation~~ | | | |
| ~~To be recommended by:~~ | ~~CBS~~ ~~INFCOM~~ |  |  |
| ~~To be decided by:~~ | ~~EC/Congress~~ |  |  |
| ~~Compliance~~ | | | |
| ~~To be monitored by:~~ | ~~CBS–CCl/IPET-OPSLS~~ ~~INFCOM/ET-OCPS~~ |  |  |
| ~~To be reported to:~~ | ~~CBS/ICT-DPFS INFCOM/SC-ESMP~~ | ~~CBS~~ ~~INFCOM~~ |  |

2.2.2.4 Coordination of annual to decadal climate prediction

2.2.2.4.1 The centre(s) conducting coordination of ADCP (Lead Centre(s) for ADCP) shall:

(a) Select a group of modelling centres to contribute to the Lead Centre(s) for ADCP (the “contributing centres”) that meet the GPC-ADCP designation criteria and have been approved by ~~IPET-OPSLS~~ ET-OCPS and manage changes in the membership of the group, as and when they occur, to maintain sufficient contributions;

(b) Maintain a list of the active contributing centres and the specification of their prediction systems;

(c) Collect an agreed set of hindcast, forecast and verification data (Appendices 2.2.20 and 2.2.21) from the contributing centres;

(d) Make available (on a password-protected website) agreed forecast products in standard format, including multi-model ensemble products (Appendix 2.2.20);

(e) Make available on the website agreed hindcast verification products in standard format, including verification of the multi-model ensemble products (Appendix 2.2.21);

(f) Redistribute digital hindcast and forecast data for those contributing centres that allow it;

(g) Maintain an archive of the real-time forecasts from individual contributing centres and from the multi-model ensemble system;

(h) Promote research and experience in ADCP techniques and provide guidance and support on ADCP to RCCs and NMHSs;

(i) Based on comparison among different models, provide feedback to the contributing centres on model performance;

(j) Coordinate, in liaison with relevant World Climate Research Programme activities, an annual consensus prediction product giving global prospects for the next 1–5 years.

2.2.2.4.2 Access to data and visualization products held by a Lead Centre for ADCP should follow the rules as detailed in Appendix 2.2.19.

Note: The bodies in charge of managing the information contained in the present Manual related to coordination of ADCP are specified in Table 13.

Table 13. WMO bodies responsible for managing information related to   
coordination of ADCP

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS–CCl/IPET-OPSLS~~ INFCOM/ET-OCPS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM | ~~CCl~~ |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM | ~~CCl~~ |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS–CCl/IPET-OPSLS~~ INFCOM/ET-OCPS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.2.5 Regional severe weather forecasting

Note: This activity includes a network of RSMCs and associated NMCs.

2.2.2.5.1 Regional Specialized Meteorological Centres conducting regional severe weather forecasting shall:

(a) Agree on the targeted severe events, phenomena, criteria for guidance and extent of regional domain with associated NMCs;

(b) Prepare, at least once per day, severe weather forecasting guidance products for associated NMCs containing an interpretation of deterministic NWP, EPS and remote sensing-based guidance products;

(c) Make available on a dedicated website (with password protection as appropriate), relevant deterministic NWP, EPS and remote sensing-based guidance products;

(d) Where severe weather is associated with tropical cyclones, centres will take guidance from the appropriate RSMC for tropical cyclone forecasting and interpret it in terms of severe weather guidance.

2.2.2.5.2 National Meteorological Centres associated in this activity shall:

(a) Provide criteria for severe weather warnings to the relevant RSMCs participating in this activity;

(b) Evaluate products, including the daily severe weather forecasting guidance, and provide feedback to the RSMCs;

(c) Ensure that appropriate warnings of severe weather are issued.

Note: The bodies in charge of managing the information contained in the present Manual related to regional severe weather forecasting are specified in Table 14.

Table 14. WMO bodies responsible for managing information related to regional severe weather forecasting

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS | ~~SG-SWFDP~~ SERCOM/SC-DRR |  |
| To be recommended by: | ~~CBS~~ INFCOM | SERCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | RA | ~~CBS~~ INFCOM | SERCOM |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~SG-SWFDP~~ SERCOM/SC-DRR |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM | SERCOM |

Acronyms not previously defined: ~~SG-SWFDP – Steering Group for the Severe Weather Forecasting Demonstration Project~~ SC-DRR – Standing Committee on Disaster Risk Reduction and Public Services.

2.2.2.6 Tropical cyclone forecasting, including marine-related hazards

Note: This activity is performed within the five Tropical Cyclone Programme regional bodies, each composed of an RSMC and a number of NMCs forming a network.

2.2.2.6.1 Regional Specialized Meteorological Centres conducting tropical cyclone forecasting shall:

(a) Monitor continuously meteorological phenomena such as convective activities to predict or detect tropical cyclone formation;

(b) Analyse and forecast tropical cyclones based on all available observational data and forecasting guidance, including NWP, EPS and satellite-based products;

(c) Issue tropical cyclone advisories to associated NMCs;

(d) As appropriate, add information in tropical cyclone advisories on hazardous phenomena associated with tropical cyclones such as heavy rains, strong winds and storm surges;

(e) Name tropical cyclones when they have been analysed with maximum wind speeds of 34 knots or more;

(f) Conduct post-event analysis of tropical cyclones based on quality-assured observational data and issue best-track data within an appropriate period of time (preferably on an annual basis); issue such data to the tropical cyclone community, including the International Best-Track Archive for Climate Stewardship (IBTrACS);

(g) Promote research and development, and training in tropical cyclone analysis, forecasting and warning techniques.

2.2.2.6.2 National Meteorological Centres associated with this activity shall:

(a) Issue forecasts and warnings of tropical cyclones to threatened communities;

(b) Coordinate with national agencies responsible for disaster risk reduction;

(c) Provide relevant regional centres with observational data of tropical cyclones on a real-time basis.

2.2.2.6.3 All six RSMCs for tropical cyclone forecasting together with Tropical Cyclone Warning Centre~~Darwin~~, which are designated as Tropical Cyclone Advisory Centres (TCAC) by regional air navigation agreement within the framework of the tropical cyclone watch of the International Civil Aviation Organization (ICAO), shall issue tropical cyclone advisories for aviation in accordance with the provisions made in Meteorological Service for International Air Navigation, Annex 3 to the Convention on International Civil Aviation, ICAO; and Technical Regulations ([WMO-No. 49](https://library.wmo.int/index.php?lvl=notice_display&id=21806#.YEotfWhKg2w)), Volume II, Parts I and II. SIGMET information concerning tropical cyclones shall be issued by the meteorological watch offices for the flight information region concerned and should be based on the tropical cyclone advisory issued by TCACs in accordance with ICAO Annex 3 and Technical Regulations ([WMO-No. 49](https://library.wmo.int/index.php?lvl=notice_display&id=21806#.YEotfWhKg2w)), Volume II, 3.4 and 7.

2.2.2.6.4 Members holding METAREA responsibility within the Global Maritime Distress and Safety System (GMDSS) protocols – established by the International Maritime Organization in Chapter IV of the International Convention of Safety Of Life At Sea – shall include information on tropical cyclones as needed in their GMDSS maritime weather information for shipping.

Note: The bodies in charge of managing the information contained in the present Manual related to tropical cyclone forecasting are specified in Table 15.

Table 15. WMO bodies responsible for managing information related to tropical cyclone forecasting [Secretariat]

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~Technical coordination meeting~~ SERCOM/SC-DRR |  |  |
| To be recommended by: | ~~CBS~~ INFCOM | Regional tropical cyclone committee | SERCOM |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | INFCOM | Regional tropical cyclone committee | SERCOM |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~Technical coordination meeting~~ SERCOM/SC-DRR |  |  |
| To be reported to: | ~~CBS~~ INFCOM | SERCOM |  |

2.2.2.7 Nuclear environmental emergency response

Centres conducting nuclear environmental emergency response shall:

(a) Contribute to support for WMO Members and the International Atomic Energy Agency (IAEA);

(i) Prepare, on request from a delegated authority[[1]](#footnote-2) and/or IAEA, basic information relating to events in which nuclear contaminants have been released into the atmosphere; the activation of the support for nuclear emergency response is described in Appendix 2.2.22;

(ii) Within two to three hours of reception of a request, make a range of products available to the NMHS operational contact point[[2]](#footnote-3) and/or IAEA on WIS.[[3]](#footnote-4) The minimum list, including parameters, forecast range, time steps and frequency, is given in Appendix 2.2.23;

(iii) Use agreed standard emission source parameters for atmospheric transport and dispersion modelling (ATDM) when source information is not available; default source parameters are given in Appendix 2.2.24;

(iv) Make available up-to-date information on the characteristics of their ATDM systems (minimum information to be provided is given in Appendix 2.2.25) and a user interpretation guide for ATDM products.

Note: The forms to request WMO support by a delegated authority and by IAEA are given in Appendix 2.2.26.

(b) Contribute to support for the Comprehensive Nuclear-test-ban Treaty Organization (CTBTO):

(i) Prepare, on request from CTBTO, relevant atmospheric backtracking products;

(ii) Make the requested products available to CTBTO.

Notes:

1. Arrangements for activation and product specifications are given in Appendix 2.2.27.

2. The bodies in charge of managing the information contained in the Manual related to nuclear environmental emergency response are specified in Table 16.

Table 16. WMO bodies responsible for managing information related to nuclear environmental emergency response

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS~~ INFCOM/ET-ERA |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS~~ INFCOM /ET-ERA |  |  |
| To be reported to: | ~~CBS~~ ~~/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

Acronyms not previously defined: ET-ERA – Expert Team on Emergency Response Activities.

2.2.2.8 Non-nuclear environmental emergency response

Note: This activity includes a network of regional centres and NMCs within a geographical region.

Centres conducting non-nuclear environmental emergency response shall:

(a) Prepare, on request from an authorized person,[[4]](#footnote-5) ATDM forecast or hindcast products relating to events in which hazardous non-nuclear contaminants have been released into the atmosphere; the criteria for activation of the regional support procedures and the request form are given in Appendices 2.2.28 and 2.2.32, respectively;

(b) As soon as possible, but usually within two hours of a request from an authorized person, make available a range of products to the NMHS operational contact point[[5]](#footnote-6) by email or retrieval from the RSMC password-protected designated website; the list of mandatory and highly recommended products to be made available, including parameters, forecast range, time steps and frequency, is given in Appendix 2.2.29;

(c) Use agreed default emission source parameters for essential parameters when actual source information is not available; default source parameters for a range of release scenarios are given in Appendix 2.2.30;

(d) Make available on a website up-to-date information on the characteristics of their ATDM systems (minimum information to be provided is given in Appendix 2.2.31) and a user interpretation guide for ATDM products.

Note: The bodies in charge of managing the information contained in the present Manual related to non-nuclear environmental emergency response are specified in Table 17.

Table 17. WMO bodies responsible for managing information related to non-nuclear environmental emergency response

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS~~ INFCOM/ET-ERA |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS~~ INFCOM /ET-ERA |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.2.9 Atmospheric sand and dust storm forecasts

Centres conducting atmospheric sand and dust storm forecasts shall:

(a) Operate an NWP model incorporating parameterizations of all the major phases of the atmospheric dust cycle;

(b) Prepare limited-area analyses of variables relevant to atmospheric sand and dust storms;

(c) Prepare limited-area forecast fields of variables relevant to atmospheric sand and dust storms;

(d) Make available on WIS and on a web portal a range of these products; the list of mandatory products to be made available is given in Appendix 2.2.33.

Note: The bodies in charge of managing the information contained in the present Manual related to atmospheric sand and dust storm forecasts are specified in Table 18.

Table 18. WMO bodies responsible for managing information related to atmospheric sand and dust storm forecasts

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CAS~~ RB/SDS-WAS Steering Committee | ~~CBS~~ INFCOM/ET-ERA |  |
| To be recommended by: | ~~CAS~~ RB (WWRP/SSC) | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation\* | | | |
| To be recommended by: | ~~CAS~~ RB (WWRP/SSC, SDS-WAS Steering Group) | ~~CBS~~ INFCOM | RA |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS~~ INFCOM /ET-ERA |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

Acronyms not previously defined: ~~CAS – Commission for Atmospheric Sciences~~ RB – Research Board; SDS-WAS – Sand and Dust Storm Warning Advisory and Assessment System; WWWRP/SSC – WMO World Weather Research Programme Scientific Steering Committee.

\* The detailed designation procedure of RSMCs with activity specialization on atmospheric sandstorm and dust storm forecasts (RSMC-ASDF) is referred to in Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) Science and Implementation Plan 2015–2020 ([WWRP 2015–5](https://library.wmo.int/index.php?lvl=notice_display&id=19816#.YEoaKWhKg2w)), Geneva, WMO, 7 – Transition to operational activities: Proposed designation as regional specialized meteorological centre with specialization on atmospheric sand and dust forecasting (RSMC-ASDF).

2.2.2.10 Volcano watch services for international air navigation

The nine Volcanic Ash Advisory Centres (VAACs), designated by the ICAO, shall issue volcanic ash advisories for aviation in accordance with the provisions set out in Meteorological Service for International Air Navigation, Annex 3 to the Convention on International Civil Aviation, and in Technical Regulations (WMO‑No. 49), Volume II, 3.5. Eight of the nine VAACs are co-located with RSMCs. SIGMET information concerning volcanic ash shall be issued by meteorological watch offices for the flight information region concernedand should be based on the volcanic ash advisory issued by the VAACs, in accordance with ICAO Annex 3 and Technical Regulations (WMO-No. 49), Volume II, 3.4 and 7. Service provision arrangements for volcano observatories in support of aviation are described in ICAO Annex 3 and in Technical Regulations (WMO-No. 49), Volume II, 3.6.

2.2.2.11 Marine meteorological services

Notes:

1. Operations, including practices, procedures and specifications are described in the *Manual on Marine Meteorological Services* ([WMO-No. 558](https://library.wmo.int/index.php?lvl=notice_display&id=9784#.YEovRWhKg2w))*,* Volume I;

2. This activity includes a network of National Meteorological ~~Services~~ Centres.

2.2.2.11.1 National Meteorological Centres conducting marine meteorological services (including preparation services) shall:

(a) Issue forecasts of marine environmental conditions for coastal and offshore areas, as defined in Appendix 2.2.39;

(b) Issue warnings of marine meteorological hazards for coastal and offshore areas, as defined in Appendix 2.2.39;

(c) Coordinate with national agencies responsible for marine matters, including disaster risk reduction and search and rescue.

2.2.2.11.2 In compliance with the Joint IMO/IHO/WMO Manual on Maritime Safety Information, Members holding METAREA responsibility under the WMO/IMO Worldwide Met-ocean Information and Warning Service (WWMIWS), shall:

(a) Issue forecasts of marine environmental conditions for the high seas, as defined in Appendix 2.2.39;

(b) Issue warnings of marine meteorological hazards for the high seas, as defined in Appendix 2.2.39;

(c) Organize the broadcast of marine forecasts and warnings on broadcast systems compliant with the GMDSS;

(d) Undertake METAREA Coordinator duties, including verification activities as defined in Appendix 2.2.40.

Note: The bodies in charge of managing the information contained in manuals related to marine meteorological services are specified in Table 19.

Table 19. Bodies responsible for managing information related to marine   
meteorological services

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~JCOMM/WWMIWS-C~~ SERCOM/SC-MMO |  |  |
| To be ~~approved~~ recommended by: | ~~JCOMM~~ SERCOM | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be approved by: | ~~JCOMM~~ SERCOM | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~JCOMM/WWMIWS-C~~ SERCOM/SC-MMO |  |  |
| To be reported to: | ~~CBS~~ INFCOM | ~~JCOMM~~ SERCOM |  |

~~Acronym not previously defined: WWMIWS-C – WMO/IMO Worldwide Met-ocean Information and Warning Service Committee~~

2.2.2.12 Marine environmental emergencies

Notes:

1. Operations, including practices, procedures and specifications are described in the *Manual on Marine Meteorological Services* ([WMO-No. 558](https://library.wmo.int/index.php?lvl=notice_display&id=9784#.YEovRWhKg2w))*,* Volume I;

2. Functions and responsibilities to be defined by the ~~JCOMM/ET-MEER (Expert Team on Marine Environmental Emergency Response)~~ SERCOM/SC-MMO during the intersessional period;

3. The bodies in charge of managing the information contained in the *Manual* related to marine environmental emergencies are specified in Table 20.

Table 20. Bodies responsible for managing information related to marine   
environmental emergencies

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~JCOMM/ET-MEER~~ SERCOM/SC-MMO |  |  |
| To be ~~approved~~ recommended by: | ~~JCOMM~~ SERCOM | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be approved by: | ~~JCOMM~~ SERCOM | ~~CBS~~ INFCOM |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~JCOMM/ET-MEER~~ SERCOM/SC-MMO |  |  |
| To be reported to: | ~~CBS~~ INFCOM | ~~JCOMM~~ SERCOM |  |

2.2.3 Non-real-time coordination activities

2.2.3.1 Coordination of deterministic numerical weather prediction verification

2.2.3.1.1 The centre(s) coordinating DNV (Lead Centre(s) for DNV) shall:

(a) Provide the facility for GDPFS centres producing global NWP to automatically deposit their standardized verification statistics as defined in Appendix 2.2.34, and provide access to these verification statistics;

(b) Maintain an archive of the verification statistics to allow the generation and display of trends in performance;

(c) Monitor the received verification statistics and consult with the relevant participating centres if data are missing or suspect;

(d) Collect annually from the participating centres information on their implementation of the standardized verification system, confirm any changes to their implementation (including the annual change of station list and changes in additional statistics) and changes in their NWP models;

(e) Provide access to standard datasets needed to perform the standard verification, including climatology and lists of observations, and keep this up-to-date according to CBS recommendations;

(f) Provide on their website(s):

– Consistent up-to-date graphical displays of the verification results from participating centres through processing of the received statistics;

– Relevant documentation, including access to the standard procedures required to perform the verification, and links to the websites of GDPFS-participating centres;

– Contact details to encourage feedback from NMHSs and other GDPFS centres on the usefulness of the verification information.

2.2.3.1.2 Lead Centre(s) for DNV should also provide access to standardized software for calculating scoring information.

Note: The bodies in charge of managing the information contained in the present Manual related to coordination of DNV are specified in Table 21.

Table 21. WMO bodies responsible for managing information related to coordination of DNV

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.3.2 Coordination of Ensemble Prediction System verification

2.2.3.2.1 The centre(s) conducting coordination of EPS verification (Lead Centre(s) for EPS verification) shall:

(a) Provide the facility for the GDPFS centres producing global EPS data to automatically deposit their standardized verification statistics as defined in Appendix 2.2.35, and provide access to these verification statistics;

(b) Maintain an archive of the verification statistics to allow the generation and display of trends in performance;

(c) Monitor the received verification statistics and consult with the relevant participating centres if data are missing or suspect;

(d) Provide access to standard datasets needed to perform the standard verification, including climatology and lists of specified observation sites, and keep this up-to-date according to INFCOM recommendations; [Hong Kong, China]

(e) Provide on its website(s) (for example, http://epsv.kishou.go.jp/EPSv/):

– Consistent up-to-date graphical displays of the verification results from participating centres through processing of the received statistics;

– Relevant documentation, including access to the standard procedures required to perform the verification, and links to the websites of GDPFS-participating centres;

– Contact details to encourage feedback from NMHSs and other GDPFS centres on the usefulness of the verification information.

2.2.3.2.2 Lead Centre(s) for EPS verification should also provide access to standardized software for calculating scoring information.

Note: The bodies in charge of managing the information contained in the present Manual related to coordination of EPS verification are specified in Table 22.

Table 22. WMO bodies responsible for managing information related to coordination   
of EPS verification

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.3.3 Coordination of long-range forecast verification

*Note from the Secretariat: INFCOM decided to table the deletion of this section to EC-73 at the INFCOM-1(II) (9–13 November 2020). Please refer* [*INFCOM-1-d04–1-4(1)*](https://meetings.wmo.int/INFCOM-1/English/2.%20PROVISIONAL%20REPORT%20(Approved%20documents)/INFCOM-1-d04-1-4(1)-AMENDMENTS-MANUAL-ON-GDPFS-approved_en.docx?Web=1) *for further information.*

2.2.3.4 Coordination of wave forecast verification

2.2.3.4.1 The centre(s) coordinating WFV (Lead Centre(s) for WFV) shall:

(a) Provide the facility for ~~JCOMM-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO that produce global or ocean-basin scale wave forecasts to automatically deposit their gridded forecast fields as defined in Appendix 2.2.37, and provide access to the verification statistics computed for these fields;

(b) Maintain an archive of the verification statistics to allow the generation and display of trends in performance;

(c) Monitor the received forecast fields and consult with the relevant ~~JCOMM-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO if data are missing or suspect;

(d) Collect annually from the participating centres information on any changes to their wave forecast systems;

(e) Provide access to the datasets used to perform the standard verification, including lists of observations, and keep this up-to-date according to ~~JCOMM~~ SERCOM/SC-MMO recommendations;

(f) Provide on their websites:

– Consistent up-to-date graphical displays of the verification results from ~~JCOMM~~ ~~-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO based on verification of the received forecast fields;

– Relevant documentation including access to the standard procedures required to perform the verification, and links to the websites of ~~JCOMM -participating~~ ~~centres~~ WMO designated centres endorsed by SERCOM/SC-MMO;

– Contact details to encourage feedback from ~~JCOMM-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO on the usefulness of the verification information.

2.2.3.4.2 The Lead Centre(s) for WFV should also provide access to standardized software for calculating scoring information.

Note: The bodies in charge of managing the information contained in the present Manual related to WFV are specified in Table 24.

Table 24. Bodies responsible for managing information related to coordination of WFV

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS | ~~JCOMM/ET-DRR~~ SERCOM/SC-MMO |  |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

2.2.3.5 Coordination of tropical cyclone forecast verification

2.2.3.5.1 The centre(s) coordinating TCFV (Lead Centre(s) for TCFV) shall:

(a) Provide the facility for GDPFS centres, including RSMCs participating in global deterministic NWP defined in 2.2.1.1, that produce tropical cyclone forecasts to deposit their gridded forecast fields as defined in Appendix 2.2.38, and have access to the verification statistics computed for these fields;

(b) Maintain an archive of the verification statistics to allow the generation and display of trends in performance;

(c) Monitor the received forecast fields and consult with the relevant GDPFS-participating centres if data are missing or suspect;

(d) Provide access to the datasets used to perform the standard verification, including best-track data produced by RSMCs participating in tropical cyclone forecasting defined in 2.2.2.6;

(e) Provide on their websites:

– Consistent up-to-date graphical displays of the verification results from participating centres through processing of the statistics received;

– Relevant documentation, including access to the standard procedures required to perform the verification, and links to the websites of GDPFS-participating centres;

– Contact details to encourage feedback from NMHSs and other GDPFS centres on the usefulness of the verification information.

2.2.3.5.2 The Lead Centre(s) for TCFV should also provide access to standardized software for calculating scoring information.

Note: The bodies in charge of managing the information contained in the Manual related to TCFV are specified in Table 25.

Table 25. WMO bodies responsible for managing information related to coordination of TCFV

|  |  |  |  |
| --- | --- | --- | --- |
| Responsibility | | | |
| Changes to activity specification | | | |
| To be proposed by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS | ~~CAS~~ RB/JWGFVR | RB/WGNE |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Centres designation | | | |
| To be recommended by: | ~~CBS~~ INFCOM |  |  |
| To be decided by: | EC/Congress |  |  |
| Compliance | | | |
| To be monitored by: | ~~CBS/ET-OWFPS~~ INFCOM/ET-OWFS |  |  |
| To be reported to: | ~~CBS/ICT-DPFS~~ INFCOM/SC-ESMP | ~~CBS~~ INFCOM |  |

Acronyms not previously defined: JWGFVR – Joint Working Group on Forecast Verification Research; WGNE – Working Group on Numerical Experimentation.

2.2.3.6 Coordination of observation monitoring

2.2.3.6.1 For each type of observation, a Lead Centre for coordination of observation monitoring shall be nominated from time to time by the president of ~~CBS~~ INFCOM.

2.2.3.6.2 The Lead Centre(s) should liaise with the participating centres to coordinate all the monitoring results of that observation type and to define common methods and criteria to be used for compiling the monthly statistics.

2.2.3.6.3 The Lead Centre(s) should draw the attention of appropriate focal points where they have been identified and of the WMO Secretariat to obvious problems as they are detected.

2.2.3.6.4 The Lead Centre(s) should also produce every six months a consolidated list of observations of the relevant observation type believed to be of consistently low quality. Information on problems with observing systems, as well as individual observations, should also be included. When compiling the consolidated lists of suspect stations, the Lead Centre(s) should be rigorous so as to identify only those stations that the Lead Centre(s) are confident are producing observations of consistently low quality. It should state which elements of the observations are considered to be of low quality and provide as much information as possible concerning the problem. The list should be passed on to the participating centres and to WMO Secretariat.

2.2.3.6.5 Where focal points have not been identified, the Secretariat should notify Members of agencies responsible for observations that appear to be of low quality, and request them to make an investigation with a view to identifying and correcting any possible cause of error. Members should be asked to reply within a fixed period of time, reporting on any remedial action and stating if any assistance is required.

2.2.3.6.6 Monitoring results, including follow-up actions, should be made available to ~~CBS~~ INFCOM, the Executive Council and Congress. In the case of enquiries made by WMO, feedback to the Lead Centres is requested.

Notes:

1. Lead Centre(s) for data quality monitoring are given in the Guide to the Global Observing System ([WMO-No. 488](https://library.wmo.int/index.php?lvl=notice_display&id=12516#.YEosgmhKg2w)), Part VII, 7.2.2.1.

2. The WMO Integrated Global Observing System (WIGOS) Quality Management System is being developed to incorporate the observational quality monitoring process described above. The coordination will be defined in this section in due course.

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APPENDIX 2.2.16. REGIONAL CLIMATE CENTRE MANDATORY FUNCTIONS

| Functions | Activities | Criteria |
| --- | --- | --- |
| Operational activities for LRF(both dynamical and statistical, within the range of a one-month to two-year timescale, based on regional needs) | Interpret and assess relevant LRF products from GPCs-LRF, make use of the Lead Centre(s) for ~~SVSLRF~~LRFMME, distribute relevant information to RCC users, and provide feedback to GPCs-LRF (see Attachment 2.2.2) | Product: Assessment of the reliability and outcomes of GPCs-LRF or Lead Centre(s) for LRFMME products, including the reasoning ~~(make use of the Lead Centre(s) for SVSLRF~~ , make use of verification metrics as defined in [WMO-No. 1220](https://library.wmo.int/index.php?lvl=notice_display&id=20618#.YDkINF1KjX0)), for the region of interest, in the form of texts, tables, figures, etc.  Element: 2-m mean temperature, total precipitation  Update frequency: Monthly or at least quarterly |
| Generate regional and subregional tailored products, relevant to RCC user needs, including seasonal outlooks | Product: Probabilities for tercile (or appropriate quantile) categories for the region or subregion  Element: 2-m mean temperature, total precipitation  Output type: Rendered images (maps, charts), text, tables, digital data  Forecast period: one month up to six months  Update frequency: Ten days to one month |
| Generate consensus\* statement on regional or subregional forecasts  \* A collaborative process involves discussion with experts in the region (e.g., through Regional Climate Outlook Forums (RCOFs) and teleconferencing).  Consensus is both the agreed process and its joint conclusion, and the consensus can be that there is limited skill in the prediction for a region or subregion | Product: Consensus statement on regional or subregional forecast  Element: 2-m mean temperature, total precipitation  Output type: Report  Forecast period: A climatologically significant period (from one month to one year)  Update frequency: At least once per year (to be defined by the region) |
| Perform verification of RCC quantitative LRF products, including the exchange of basic forecasts and hindcast data | Products: Verification datasets (e.g., SVSLRF scores, Brier skill score; relative operating characteristic (ROC); hit rate skill score)  Element: 2-m mean temperature, total precipitation |
| Provide online access to RCC products and services to RCC users | Product: An online data/information portal |
| Assess use of RCC products and services through feedback from  RCC users | Product: Analysis of feedback (which is made available using a template)  Update frequency: Annually, as part of a regular reporting of RCCs to WMO Ras |
| Operational activities for climate monitoring | Perform climate diagnostics, including analysis of climate variability and extremes, at the regional and subregional scales | Products: Climate diagnostics bulletin including tables, maps and related products  Element: Mean, maximum and minimum temperatures, total precipitation; other elements (especially Global Climate Observing System (GCOS) essential climate variables) to be determined by region  Update frequency: Monthly |
| Establish a historical reference climatology for the region and/or subregions | Product: Database of climatological means for various reference periods (e.g., 1931–1960; 1951–1980; 1961–1990; 1971–2000)  Spatial resolution: By station  Temporal resolution: Monthly at a minimum  Elements: Mean, maximum and minimum temperatures; total precipitation; other elements (especially GCOS essential climate variables) to be determined by region  Update frequency: At least 30 years, preferably 10 years |
| Implement a regional climate watch | Products: Climate advisories and information for RCC users  Update: Whenever required, based on the forecast of significant regional climate anomalies |
| Operational data services, to support operational LRF and climate monitoring | Develop quality-controlled regional climate datasets, gridded where applicable | Products: Regional, quality-controlled climate datasets, gridded where applicable, following ~~CCl~~ SERCOM/SC-CLI guidance on procedures for quality control and assurance  Elements: Mean, maximum and minimum temperature, and total precipitation, at a minimum  Temporal resolution: Daily  Update: Monthly |
| Provide climate database and archiving services, at the request of NMHSs | Products: National databases with metadata, accessible to the NMHS in question (backup service, development site, etc.)  Elements: As determined by NMHS  Update: At the request of NMHS |
| Training in the use of operational RCC products and services | Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use | Products: Manuals, guidance documents and information notes  Update frequency: When methods/products are revised, introduced or discontinued |
| Coordinate training for RCC users in interpretation and use of mandatory RCC products | Products: Survey and analysis of regional training needs, and proposals for training activities |

Note: An RCC is expected to perform certain functions (for example, for homogeneity testing; database management; metadata management; statistical evaluation of climate data) using procedures proposed in the Guide to Climatological Practices (WMO-No. 100) and in other official ~~CCl~~ SERCOM/SC-CLI guidance documents.

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APPENDIX 2.2.18. ACCESS TO GLOBAL PRODUCING CENTRE DATA AND VISUALIZATION PRODUCTS HELD BY THE LEAD CENTRE(S) FOR LONG-RANGE FORECAST MULTI-MODEL ENSEMBLES

(a) Access to GPC data from the Lead Centre(s) for LRFMME websites will be password-protected;

(b) Digital GPC data will be redistributed only in cases where the GPC data policy allows it. In other cases, requests for GPC output should be referred to the relevant GPC;

(c) Formally designated GPCs and RCCs, NMHSs and institutions coordinating RCOFs are eligible for password-protected access to information held and produced by the Lead Centre(s) for LRFMME. Entities that are in demonstration phase to seek designation as GPCs or RCCs are also eligible for password-protected access to information held and produced by the Lead Centre(s) for LRFMME, provided a formal notification has been issued in this regard by the WMO Secretary-General;

(d) Institutions other than, but providing contributions to, those identified in (c) may also request access to Lead Centre(s) for LRFMME products. These institutions, referred to as “supporting institutions”, which include research centres, require endorsement letters from: (i) the Permanent Representative of the country where they are hosted, and (ii) the executive manager of the entity they wish to provide contributions to (that is, RCCs, institutions coordinating RCOFs and NMHSs). The use by supporting institutions of products from the Lead Centre(s) for LRFMME is restricted to assistance of the organizations identified in (c) in their production of official forecast outputs. Supporting institutions may not use such products to generate and display or disseminate independent forecast products. Supporting institutions must agree with these restrictions to be eligible for access. Prior to access being granted to an applicant supporting institution, the Lead Centre(s) for LRFMME will refer the application to the ~~CBS–CCl Expert Team on Operational Predictions from Sub-seasonal to Longer-time Scales (ET-OPSLS)~~ INFCOM/ET-OCPS through the WMO Secretariat, for final consultation and review. Decisions to allow access must be unanimous. The Lead Centre(s) will be informed by the WMO Secretariat of such new users accepted for access;

(e) A list of users provided with password access will be maintained by the Lead Centre(s) for LRFMME and reviewed periodically by the ~~CBS–CCl ET-OPSLS~~ INFCOM/ET-OCPS, to measure the degree of effective use and also to identify any changes in status of eligible users, and determine further necessary follow-up.

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APPENDIX 2.2.19. ACCESS TO DATA AND VISUALIZATION PRODUCTS HELD BY THE LEAD CENTRE(S) FOR ANNUAL TO DECADAL CLIMATE PREDICTION

(a) Access to data from the Lead Centre(s) for ADCP websites will be password-protected;

(b) Digital data will be redistributed only in cases where the contributing centre data policy allows it. In other cases, requests for contributing centre output should be referred to the relevant contributing centre;

(c) Contributing centres, RCCs, NMHSs and institutions coordinating RCOFs are eligible for password-protected access to information held and produced by the Lead Centre(s) for ADCP;

(d) Institutions other than those identified in (c) above may also request access to Lead Centre(s) for ADCP products. These institutions, including research centres, may not use Lead Centre(s) for ADCP products to generate and display/disseminate independent products for operational forecasting. These institutions must agree with these restrictions to be eligible for access. Prior to access being granted to an applicant institution, the Lead Centre(s) for ADCP will refer the application to the ~~CBS–CCl IPET-OPSLS~~ INFCOM/ET-OCPS through the WMO Secretariat for final consultation and review. Decisions to allow access must be unanimous. The Lead Centre(s) will be informed by the WMO Secretariat of such new users accepted for access;

(e) A list of users provided with password access will be maintained by the Lead Centre for ADCP and reviewed periodically by the ~~CBS–CCl IPET-OPSLS~~ INFCOM/ET-OCPS, to measure the degree of effective use and also to identify any changes in status of eligible users, and determine further necessary follow-up.

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APPENDIX 2.2.22. ACTIVATION OF THE SUPPORT FOR NUCLEAR EMERGENCY RESPONSE AND STANDARDS IN THE PROVISION OF INTERNATIONAL SERVICES BY REGIONAL SPECIALIZED METEOROLOGICAL CENTRES

Notification of WMO

Within the framework of the Convention on Early Notification of a Nuclear Accident, IAEA informs the WMO Secretariat and the Data Collection or Production Centre (DCPC) of Regional Telecommunication Hub (RTH) Offenbach (Germany) of the status of the emergency. If needed, IAEA will request support from the WMO RSMCs. Beginning with a site area emergency, the DCPC of RTH Offenbach will disseminate the EMERCON messages on the Global Telecommunication System (GTS) and WIS in the form of an alphanumeric bulletin in plain-text English language under the abbreviated heading WNXX01 IAEA for global distribution to the NMCs and RSMCs (see also the Manual on the Global Telecommunication System ([WMO-No. 386](https://library.wmo.int/index.php?lvl=notice_display&id=21811#.YEoyu2hKg2w)) and the Manual on the WMO Information System ([WMO-No. 1060](https://library.wmo.int/index.php?lvl=notice_display&id=9254#.YEob12hKg2w))for details on the dissemination of the EMERCON messages).

When IAEA no longer requires WMO RSMC support, IAEA will send an EMERCON termination message to the RSMCs, the WMO Secretariat and the DCPC of RTH Offenbach. The DCPC of RTH Offenbach will disseminate the EMERCON termination message on the GTS and WIS in the form of an alphanumeric bulletin in plain-text English language under the abbreviated heading WNXX01 IAEA for global distribution to the NMCs and RSMCs.

Regional arrangements

The RSMCs designated by WMO for the provision of ATDM products for nuclear environmental emergency response shall:

(a) Provide products only when either the delegated authority[[6]](#footnote-7) of any country in the RSMC region of responsibility or IAEA requests RSMC support. Upon receipt of a request from the delegated authority[[7]](#footnote-8) or from IAEA, the RSMC shall provide basic information to the ~~NHMS~~ NMHS of that country or to IAEA, respectively. If multiple requests are received, highest priority shall be given to IAEA requests;

(b) Upon receipt of a first request for products related to a nuclear incident and in the absence of a prior notification by IAEA, inform the WMO Secretariat, all designated RSMCs and IAEA of the request;

(c) For an IAEA request “all RSMCs generate products and distribute with their region(s)”, (lead RSMCs only) distribute the basic products to IAEA, and (all RSMCs) distribute to all NMHS operational contact points in their region(s) of responsibility[[8]](#footnote-9) and WMO; for a request for support from a delegated authority and without a request by IAEA, basic information provided to the NMHS operational contact point of the requesting country shall not be disclosed to the public in that country nor distributed by RSMCs to other NMHS operational contact points;

(d) Provide, on request, support and advice to the IAEA and WMO Secretariats in the preparation of public and media statements; the WMO Secretariat informs relevant NMHSs of the public and media statements beforehand, when necessary;

(e) Determine the standard set of basic products and the method of delivery in consultation with users and IAEA;

(f) Provide product interpretation guidelines to users;

(g) Provide support and technology transfer to national and regional meteorological centres that want to become designated RSMCs;

(h) Make arrangements to provide backup services; these shall normally be between the designated centres in a region. Interim arrangements shall be made by centres in regions with a single designated RSMC;

(i) Provide a joint response, which means that the collaborating RSMCs shall immediately inform one another of any request received; initially all centres within the region shall produce and send the basic set of products (charts) independently and then move rapidly towards providing fully coordinated responses and services for the duration of the response;

(j) Following the initial response, develop, provide and update as required, a joint statement to describe a synopsis of the current and forecast meteorological conditions over the area of concern, and the results from the transport models, their differences and similarities and how they apply to the event.

Global arrangements

Until such time as new RSMCs have been designated, it is proposed that RA VI-designated RSMCs be responsible for providing services for radiological emergencies to RA I; RA IV-designated RSMCs be responsible for providing services to RA III; and the RA V-designated RSMC, in collaboration with RA IV-designated RSMCs, be responsible for providing services to RA V and the Antarctic.

National arrangements

The regional and global arrangements are designed to respect the authority of a State with regards to information flow within its boundaries. The NMHSs receiving the RSMC products should determine to which agencies or authorities they should be distributed, based on the arrangements within their State. The ATDM products and relevant information provided by the RSMCs are to be made available to NMHSs to help them assist nuclear agencies and authorities within their State with the interpretation of meteorological and ATDM products.

Standards in the provision of international services by Regional Specialized Meteorological Centres for nuclear emergency response activities

The delegated authority requests support from RSMCs for ATDM products by using the form entitled “Environmental Emergency Response Alert Request for WMO RSMC Support by Delegated Authority” (Appendix 2.2.26). The delegated authority then sends the completed form to the RSMCs as per the regional and global arrangements and ensures receipt of the form by phone. This will initiate a joint response from the RSMCs in their region of responsibility.

The IAEA requests support from WMO RSMCs for ATDM products by using the form agreed between WMO and IAEA entitled “Environmental Emergency Response Request for WMO RSMC Support by IAEA” (Appendix 2.2.26). The IAEA then sends the completed form by email (preferred) or by fax, to the RSMCs as per the regional and global arrangements and ensures receipt of the form by phone. The lead RSMCs shall confirm receipt of IAEA request by email (preferred) or by fax to IAEA. This will initiate a joint response from the RSMCs in their region of responsibility. An information copy of its request form is sent by IAEA by email (preferred) or by fax to the DCPC of RTH Offenbach. When the lead RSMCs’ products become available, the lead RSMCs shall send an announcement to IAEA stating that their respective products are available and where they can be found (RSMC dedicated website), by email (preferred) or by fax.

The designated RSMCs shall implement agreed standard procedures and products by:

(a) The provision of the standard set of basic products (see Appendix 2.2.23) within two to three hours of reception of a request and according to the general rules for displaying results;

(b) The adoption of the forecast periods (see Appendix 2.2.23) for the numerical calculations;

(c) The adoption of a joint response approach (paragraphs (i) and (j) of the regional arrangements, above);

(d) The adoption of the general rules for displaying results.

The RSMCs will distribute their standard products to the NMHS operational contact points by email and retrieval from RSMC password-protected designated web pages. Standard products in the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) T.4 format suitable for both group three facsimile machines and transmission on parts of WIS will be maintained by exception and only if requested by the NMHS operational contact point. The RSMC may also make use of other appropriate technologies.

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APPENDIX 2.2.26. REQUEST FORM TO ACTIVATE REGIONAL SPECIALIZED METEOROLOGICAL CENTRE SUPPORT (NUCLEAR)

**ENVIRONMENTAL EMERGENCY RESPONSE REQUEST FOR WMO RSMC SUPPORT BY IAEA**

*The IAEA sends the completed form by fax to all RSMCs and RTH Offenbach. At the same time the IAEA calls the 'Lead' RSMCs (selected on the form) to ensure receipt of this form.*

*(to be completed by RSMC)*

Date/time of receipt of request:………………………………………………………………………………………………..(UTC)

FOR LEAD RSMC(s) ONLY

DATE/TIME OF RETURN CONFIRMATION OF RECEIPT:………………………………………………………………..(UTC)

NOTE: All times in UTC.

*(helpful information for improved simulation)*

SITE ELEVATION:………………………….(m)

LOCAL METEOROLOGICAL CONDITIONS NEAR ACCIDENT:……………………………………………………………………

(wind speed and direction/weather/cloudiness, etc.)

OTHER INFORMATION: ……………………………………………………………………………………………………………………….

(nature of accident, cause fire, explosion, controlled release, foreseeable development, normal activity, projected conditions, etc.)

*(essential accident information for model simulation – if not available, model will execute with standard default values)*

RELEASE CHARACTERISTICS:

START OF RELEASE: Date/time: / (UTC)

DURATION: (hours) or END OF RELEASE: Date/time: (UTC)

RADIONUCLIDE SPECIES:………………………………………………………………………………………………………………………

TOTAL RELEASE QUANTITY:……………………………………………………………………………………………..……………………(Becquerel)

OR POLLUTANT RELEASE RATE: ………………………………….……………………………………………………..………. (Becquerel/hour)

EFFECTIVE HEIGHT OF RELEASE: □ Surface or

□ release height: base: (m), top: (m)

DECLARED EMERGENCY CLASS:

□ NONE □ Other, specify: ………………………………………………………………………………………………………………….…

ACTION REQUIRED:

~~□ NONE~~

□ GO ON STANDBY (request for products or for assistance on weather conditions is to be expected)

□ LEAD RSMCs ONLY GENERATE PRODUCTS AND SEND TO IAEA ONLY

□ ALL RSMCs GENERATE PRODUCTS AND DISTRIBUTE WITHIN THEIR REGIONS

□ OTHER ACTION: ………………………………………………………………………………………………………………………

Date/time of request: yyyy-MM-dd/HH:mm (UTC)

STATUS: □ EMERGENCY □ EXERCISE

REQUESTED RSMCs: (indicate the lead RSMCs by a checkmark below)

□ EXETER □ TOULOUSE □ OFFENBACH □ VIENNA □ MONTREAL □ WASHINGTON

□ BEIJING □ TOKYO □ OBNINSK □ MELBOURNE □ RTH Offenbach

SENDER’S NAME: INTERNATIONAL ATOMIC ENERGY AGENCY

COMMUNICATION DETAILS: Tel.: +413 1 2600 22023 Use to confirm receipt of request

Fax: +43 1 26007 29309 Use to confirm receipt of request

E-mail: iec23@iaea.org Use to confirm receipt of request

NAME OF RELEASE SITE AND COUNTRY: ………………………………………………………..……………………………………..(facility and place)

GEOGRAPHICAL LOCATION OF RELEASE:

(MUST BE COMPLETED) - Decimal degrees □ N □ S

- Decimal degrees □ E □ W

APPENDIX 2.2.34. STANDARDIZED VERIFICATION OF DETERMINISTIC NUMERICAL WEATHER PREDICTION PRODUCTS

1. Introduction

This appendix presents detailed procedures for the production and exchange of a standard set of verification scores for deterministic NWP forecasts produced by GDPFS centres. The goal is to provide consistent verification information on the NWP products of GDPFS-participating centres for forecasters in the NMHSs and to help the GDPFS centres compare and improve their forecasts. Scores will be exchanged between the participating Producing Centres via the Lead Centre(s) for DNV. The Lead Centre functions, as described in 2.2.3.1, include creating and maintaining a website for DNV (<http://apps.ecmwf.int/wmolcdnv/>) information so that potential users will benefit from a consistent presentation of results.

The term “deterministic NWP” refers to single integrations of NWP models providing products defining single future states of the atmosphere (as distinct from EPSs, where multiple integrations provide a range of future states).

The standardized verification should provide key relevant information appropriate to the state of the art in NWP, while being as simple and as easy to implement as possible, and ensuring a consistent implementation across participating centres.

The mathematical formulation of the scores is documented on the Lead Centre(s) for DNV website(s), together with supplementary information on score calculation, the observational and climate datasets to be used for verification, and procedures for submitting scores.

2. Verification statistics

The following sections define two sets of verification statistics. A mandatory set shall be provided by all participating centres. The procedures for upper-airfields and for surface fields are different and are presented separately. The detailed procedures are required to ensure it is possible to compare results from the different participating centres in a scientifically valid manner.

A set of additional recommended statistics is also defined that all centres should provide if possible.

3. Exchange of scores

Each centre shall provide scores monthly to the Lead Centre(s) for DNV. Details of the procedure and the required format for the data are provided on the website(s) of the Lead Centre(s). All scores for all forecasts verified within a month shall be provided as soon as possible after the end of that month.

4. Documentation

Participating centres shall provide to the Lead Centre(s) for DNV information on their implementation of the standardized verification system annually, shall confirm to the Lead Centre(s) any changes to the implementation (including the annual change of station list for upper-air verification, changes in additional statistics), and shall inform the Lead Centre(s) of changes in their NWP model.

5. STANDARDIZED VERIFICATION OF UPPER-AIRFIELDS

*5.1 Parameters*

Extra-tropics:

– Mandatory:

– MSLP (verification against analysis only);

– Geopotential height at 850, 500 and 250 hPa;

– Temperature at 850, 500 and 250 hPa;

– Wind at 850, 500 and 250 hPa.

– Additional recommended:

– Geopotential height, temperature, wind at 100 hPa;

– Relative humidity at 700 hPa.

Tropics:

– Mandatory:

– Geopotential height at 850 and 250 hPa;

– Temperature at 850 and 250 hPa;

– Wind at 850 and 250 hPa.

– Additional recommended:

– Relative humidity at 700 hPa.

*5.2 Forecast times*

Scores shall be computed daily for forecasts initialized at 0000 UTC and 1200 UTC separately. For those centres not running forecasts from either 0000 UTC or 1200 UTC, scores shall be provided for forecasts initiated at other times and must be labelled as such.

*5.3 Forecast steps*

Mandatory: Forecast steps 24, 48, 72, … 240 hours or end of forecast;

Additional recommended: 12-hourly throughout forecast (12, 24, 36 h, …).

*5.4 Areas*

|  |  |
| --- | --- |
| Northern hemisphere extra-tropics | 90°N–20°N, inclusive, all longitudes |
| Southern hemisphere extra-tropics | 90°S–20°S, inclusive, all longitudes |
| Tropics | 20°N–20°S, inclusive, all longitudes |
| North America | 25°N–60°N 50°W–145°W |
| Europe/North Africa | 25°N–70°N 10°W–28°E |
| Asia | 25°N–65°N 60°E–145°E |
| Australia/New Zealand | 10°S–55°S 90°E–180°E |
| Northern polar region | 90°N–60°N, inclusive, all longitudes |
| Southern polar region | 90°S–60°S, inclusive, all longitudes |

Verification against analyses for grid points within each area includes points on the boundary.

*5.5 Verification against analyses*

Grid and interpolation

All parameters shall be verified against the centre’s own analysis on a regular 1.5° x 1.5° grid.

In selecting the verification grid, consideration has been given to the variety of resolutions of current global NWP models, the resolved scales of models (several grid lengths), the resolution of the available climatologies, the potential to monitor long-term trends in performance (including earlier, lower-resolution forecasts), and computational efficiency.

Interpolation of higher-resolution model fields to the verification grid shall be performed to retain features at the scale of the verification grid but not to introduce any additional smoothing. The following procedures shall be used:

– Spectral fields: Truncate to equivalent spectral resolution (T120) for the verification grid;

– Grid point fields: Use area weighting to interpolate to the verification grid.

For scores requiring a climatology, the climatology is made available via the Lead Centre(s) for DNV website(s) on the verification grid and needs no further interpolation.

*5.6 Verification against observations*

5.6.1 Observations

All parameters defined in section 5.1, above, except MSLP, shall be verified against a common set of radiosondes. The list of radiosonde observations for each area is updated annually by the CBS Lead Centre(s) for radiosonde monitoring. The data from the chosen stations must be available to all the centres, be of sufficient quality, and be available on a regular basis. Consultation with all centres (usually by email) is desirable before establishing the final list. The current list is available via the website(s) of the Lead Centre(s) for DNV. The Lead Centre(s) shall contact all participating centres when the new list is available and inform them of the date from which the new list shall be used.

The observations used for verification shall be screened to exclude those with large errors.

In order to do this, it is recommended that centres exclude values rejected by their objective analysis. Moreover, centres which apply a correction to the observations received on the GTS to remove biases (for example, radiation correction) should use the corrected observations to compute verification statistics. Whenever possible, these correction procedures should be documented (for example, by reference to a technical report or journal paper).

5.6.2 Interpolation

Verification shall be made using the nearest native model grid point to the observation location.

5.6.3 Areas

The nine networks used in verification against radiosondes consist of radiosonde stations located in the geographical areas indicated in section 5.4, above.

The list of radiosonde stations to be used for each area is updated annually by the Lead Centre(s) for radiosonde monitoring (see section 5.6.1).

5.6.4 Scores for individual stations

It is recommended that, in addition to the areas listed in section 5.4, scores against observations should be computed for each station individually. The exchange of scores over areas is to be phased out over time.

5.7 Scores

The mathematical formulation of the scores is documented on the Lead Centre(s) for DNV website(s), together with supplementary information on score calculation.

*5.8 Climatology*

To ensure consistency between results from different centres, a common climatology shall be used for those scores requiring a climatology. All centres shall use the climatology provided via the Lead Centre(s) for DNV website.

A daily climatology of upper-air parameters is available for both 0000 and 1200 UTC. This provides an up-to-date estimate of climate characteristics for each day of the year, including climate mean, standard deviation and selected quantiles of the climate distribution. These latter statistics are required for the CBS standardized verification of EPS forecasts.

The data are made available in GRIB format. Information on access to the data and further documentation is provided on the Lead Centre(s) for DNV website.

*5.9 Monthly and annual averaged scores*

Where average scores are required over a defined period, the averaging shall be made using the following procedures:

– Linear scores (mean error, mean absolute error) – mean;

– Non-linear scores shall be transformed to appropriate linear measure for averaging:

– Mean of mean square error (MSE);

– Z-transform for correlation.

For a defined period, the average shall be computed over all forecasts verified during the period. Averages shall be computed separately for forecasts initiated at 0000 and 1200 UTC and both sets of average values provided.

Annual averages of the daily scores are included in the yearly Technical Progress Report on the Global Data-processing and Forecasting System ([~~https://www.wmo.int/pages/prog/www/DPFS/GDPFS-Progress-Reports.htm~~l](https://www.wmo.int/pages/prog/www/DPFS/GDPFS-Progress-Reports.html) <https://community.wmo.int/activity-areas/global-data-processing-and-forecasting-system-gdpfs> – GDPFS and NWP Annual Progress Reports). These statistics are for the 24, 72- and 120-hour forecasts and include the RMS vector wind error at 850 (tropics area only) and 250 hPa (all areas), as well as the RMS error of geopotential heights at 500 hPa (all the areas except for tropics). A table of the number of observations per month should also be part of the yearly report.

*5.10 Confidence intervals*

Bootstrapping\*: This will be performed by the Lead Centre(s) for DNV if daily scores are provided.

\*Note: Introduction

Any verification score must be regarded as a sample estimate of the “true” value for an infinitely large verification data set. There is, therefore, some uncertainty associated with the score’s value, especially when the sample size is small or the data are not independent. Some estimate of uncertainty (confidence intervals) must be used to set bounds on the expected value of the verification score. This also helps to assess whether differences between competing forecast systems are statistically significant. Typically, confidence intervals of 5% and 95% are used.

Suggested method to calculate the confidence intervals

Mathematical formulae are available for computing confidence intervals (CIs) for distributions that are binomial or normal. In general, most verification scores cannot be expected to satisfy these assumptions. Moreover, the verification samples are often spatially and temporally correlated, especially at longer forecast ranges. A non-parametric method such as the block bootstrap method handles spatially or temporally correlated data.

As described in Candille et al. (2007), a bootstrap technique for computing CIs involves recomputing scores numerous times after randomly extracting samples from the data set and then replacing them, again randomly, from the original data set. The correlation between forecasts on subsequent days is accounted for by extracting and replacing blocks of samples from the data set, rather than individual samples. Based on a calculation of the autocorrelation between forecasts on subsequent days, it is concluded that blocks of three days may be used to calculate the 5% and 95% confidence intervals.

References

Candille, G., C. Côté, P.L. Houtekamer and G. Pellerin, 2007: Verification of an ensemble prediction system against observations. Monthly Weather Review, 135:2688–2699.

World Meteorological Organization, 2008: Recommendations for the Verification and Intercomparison of QPFS and PQPFS from Operational NWP Models ([WMO/TD-No. 1485](https://wmoomm.sharepoint.com/sites/wmocpdb/eve_activityarea/Forms/AllItems.aspx?id=%2Fsites%2Fwmocpdb%2Feve%5Factivityarea%2FWorld%20Weather%20Research%20Programme%20%28WWRP%29%5Fed35626e%2D1373%2De911%2Da965%2D000d3a396ff4%2FWWRP2009%5F1%2Epdf&parent=%2Fsites%2Fwmocpdb%2Feve%5Factivityarea%2FWorld%20Weather%20Research%20Programme%20%28WWRP%29%5Fed35626e%2D1373%2De911%2Da965%2D000d3a396ff4&p=true&originalPath=aHR0cHM6Ly93bW9vbW0uc2hhcmVwb2ludC5jb20vOmI6L3Mvd21vY3BkYi9FU2FJWk9RYmhUTkdvLUdwMVhQZDNCb0JvOEMyeF9BS05yOFR2Ml84NndOS29nP3J0aW1lPVZydUdTSmJrMkVn&CT=1615480301960&OR=OWA-NT&CID=900b60bc-e431-fbf9-eff2-3af1befabc2e)). Revision 2. Geneva.

*6. STANDARDIZED VERIFICATION OF SURFACE FIELDS*

*6.1 Parameters and units*

Mandatory:

|  |  |  |
| --- | --- | --- |
| – | 2-metre temperature | K |
| – | 10-metre wind speed | m s–1 |
| – | 10-metre wind direction | deg |
| – | 24-hour precipitation | mm |

Additional recommended:

|  |  |  |
| --- | --- | --- |
| – | Total cloud cover | 0–1 (convert to oktas for contingency tables) |
| – | 6-hour precipitation | ~~M~~mm |
| – | 2-metre relative humidity | % |
| – | 2-metre dewpoint | K |

For two-metre temperature, a simple height correction between model altitude and station elevation shall be applied using a constant lapse rate of 0.0065 K m-1. For two-metre dewpoint an analogous height correction shall be applied using a constant lapse rate of 0.0012 K m-1. This approximates the dewpoint lapse rate in an atmosphere with a temperature lapse rate of 0.0065 K m–1 and constant specific humidity. [Hong Kong, China]

*6.2 Forecast times*

Scores shall be computed daily for forecasts initialized at 0000 and 1200 UTC separately. For those centres not running forecasts from either 0000 or 1200 UTC, scores may be provided for forecasts initiated at other times and must be labelled as such.

*6.3 Forecast steps*

Mandatory forecast steps shall be:

– Every six hours up to **T**+72; 12-hourly up to **T**+240 or end of the forecast;

– For 24-hour precipitation: 24-hourly up to **T**+240 or end of the forecast.

Additional recommended:

– Every three hours up to T+72; 6-hourly up to T+240 or end of the forecast (for improved representation of diurnal cycle);

– For six-hour precipitation: six-hourly up to T+240 or end of the forecast.

*6.4 Grid and interpolation*

Verification shall be based on the native model grid using the grid point nearest to the observation location.

*6.5 Observations*

Verification shall be carried out for synoptic surface observation code (SYNOP) surface stations distributed via the GTS. Each participating centre shall aim to include as many stations as possible to ensure good global coverage.The list of stations used in the verification is allowed to differ between centres.This is made possible by the fact that scores for individual stations shall be exchanged.

Centres are encouraged to make use of the quality control procedures available to them to reduce the effect of observation errors on scores. This includes removal of occasional unphysical values as well as data at individual stations that have been systematically rejected over a certain time period. Whenever possible, the quality control procedures should be documented (for example, by reference to a technical report or journal paper).

*6.6 Scores*

Scores shall be computed for each station individually. A station for which scores are computed shall have at least 90% data availability during the verification period.

For 2-metre temperature, 2-metre relative humidity, 2-metre dewpoint, 10-metre wind speed, 10-metre wind direction, and total cloud cover, the following error scores shall be computed:

– Mean error;

– Mean absolute error;

– RMSE.

Ten-metre wind direction is verified only when the observed wind speed is 3 m s–1. For 10-metre wind direction, the equivalence of 360° and 0° needs to be taken into account (cyclic continuation).

For 10-metre wind speed, precipitation and total cloud cover, contingency tables for the following thresholds shall be provided:

|  |  |
| --- | --- |
| – 10-metre wind speed: | 5, 10 and 15 m s–1; |
| – 24-hour precipitation: | 1, 10 and 50 mm; |
| – 6-hour precipitation: | 1, 5 and 25 mm; |
| – Total cloud cover: | 2 and 7 oktas. |

For total cloud cover, the model output should be rounded to the nearest okta prior to verification (for the contingency tables only).

Error scores shall be reported with a precision of at least four significant digits, for example, 3.142 for an error of π. In the contingency tables, absolute number of counts shall be given rather than relative frequencies so that the sample size can be derived.

The contingency tables for each parameter shall contain all thresholds given above. The mathematical formulation of the scores is documented on the Lead Centre(s) for DNV website(s), together with supplementary information on score calculation.

*6.7 Temporal and spatial aggregation*

For any given one-month period, error scores and contingency tables are computed for each station individually. This forms the basis for aggregation by users of the exchanged verification data, both in time and space. For a defined period, the average shall be computed over all forecasts verified during the period.

Spatial aggregation is not part of the exchange, and is left to user discretion. Exchanging scores in this way allows forecast users to obtain detailed information on model performance for individual stations. It also ensures a high level of transparency and flexibility for model intercomparison studies. Furthermore, it removes the requirement of coordinating, circulating and updating whitelists of surface stations for verification. For model intercomparison studies the intersection of the different sets of stations used by global modelling centres would be used for comparison (“smallest common denominator”).

If users would like to aggregate the exchanged scores, they can refer to the Lead Centre(s) for DNV website(s), which provides guidelines for the choice of aggregation areas. Compared to upper-air verification, more emphasis needs to be put on aggregating over climatologically relatively homogeneous areas (since absolute thresholds are used for the contingency tables).

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APPENDIX 2.2.37. STANDARDIZED VERIFICATION OF WAVE FORECASTS

1. Introduction

This appendix presents detailed procedures for the generation of a standard set of verification scores for wave forecasts produced by the Lead Centre(s) for WFV, based on gridded wave forecast fields provided by ~~JCOMM-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO. The goal is to provide consistent verification information on the wave forecast products from different centres for forecasters in the ocean forecast services and to help ~~JCOMM-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO compare and improve their forecasts. The Lead Centre functions, as described in 2.2.3.4, include creating and maintaining a website for wave verification information, so that potential users will benefit from a consistent presentation of the results.

The standardized verification should provide key relevant information appropriate to the state of the art in wave forecasting, ensuring a consistent verification methodology applied to forecasts from different ~~JCOMM-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO, and the use of a common set of observations.

2. Parameters

Atmospheric forcing:

– 10-metre wind speed u and v components (10-metre u, 10-metre v).

Wave fields:

– Significant wave height;

– Peak period;

– Mean wave period based on the second moment of the frequency spectrum;

– Mean wave direction.

3. Forecast times

If available, forecasts from 0000, 0600, 1200 and 1800 UTC should be provided.

4. Forecast steps

In as fine temporal granularity as available but at least every six hours to the end of the forecast range.

5. Verifying observations

Forecasts of the above parameters will be evaluated against in situ observations from buoys and platforms available at the Lead Centre(s) for WFV. If additional in situ observations become available over time they will be added following a careful selection and quality control. ~~JCOMM-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO are encouraged to promote the exchange of in situ wind and wave observations.

6. Interpolation

Verification shall be made using the nearest native model ocean grid point to the observation location.

7. Scores

The following scores shall be calculated for all parameters against observations:

– Mean error;

– RMSE;

– Error standard deviation;

– Scatter index (error standard deviation normalized by observed mean);

– Symmetric slope (variance ratio);

– Quantile-quantile plots.

8. Exchange of forecast fields

Each ~~JCOMM-participating centre~~ WMO designated centre endorsed by SERCOM/SC-MMO shall provide fields to the Lead Centre(s) for WFV on a regular latitude–longitude grid at the resolution that best matches the native resolution of the direct model output. Details of the procedure and the required format for the data are provided on the website(s) of the Lead Centre(s) for WFV.

9. Documentation

Information shall be provided by ~~JCOMM-participating centres~~ WMO designated centres endorsed by SERCOM/SC-MMO to the Lead Centre(s) for WFV on any changes to the production of exchanged forecast fields and changes in their wave forecast systems.

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PART III. CURRENT DESIGNATED GLOBAL DATA-PROCESSING AND FORECASTING SYSTEM CENTRES

LOCATION OF WORLD METEOROLOGICAL CENTRES, AND REGIONAL SPECIALIZED METEOROLOGICAL CENTRES WITH GEOGRAPHICAL SPECIALIZATION OR ACTIVITY SPECIALIZATION

1. The World Meteorological Centres are located in:

Beijing

ECMWF

Exeter

Melbourne (southern hemisphere only)

Montreal

Moscow

Offenbach

Tokyo

Washington

2. The Regional Specialized Meteorological Centres with geographical specialization are located in:

|  |  |  |
| --- | --- | --- |
| Algiers | Darwin | New Delhi |
| Brasilia | Jeddah | Tashkent |
| Buenos Aires | Melbourne | Tunis/Casablanca |
| Cairo | Miami |  |

Broadened RSMC functions:

Offenbach – Provision of ultraviolet-index forecasts for Region VI (Europe)

3. General purpose activities

Provision of global deterministic numerical weather prediction:

RSMC Beijing

RSMC ECMWF

RSMC Exeter

RSMC Montreal

RSMC Moscow

RSMC Offenbach

RSMC Tokyo

RSMC Washington

Provision of limited-area deterministic numerical weather prediction:

RSMC Khabarovsk

RSMC Moscow

RSMC Novosibirsk

RSMC Offenbach

RSMC Pretoria

RSMC Rome

Provision of global ensemble numerical weather prediction:

RSMC Beijing

RSMC ECMWF

RSMC Exeter

RSMC Montreal

RSMC Moscow

RSMC Offenbach

RSMC Tokyo

Provision of limited-area ensemble numerical weather prediction:

RSMC Offenbach

RSMC Rome

Provision of nowcasting:

RSMC Hong Kong, China

RSMC Offenbach

RSMC Tokyo

Global Producing Centres for Long-range Prediction:

|  |  |
| --- | --- |
| GPC Beijing | GPC Offenbach |
| GPC CPTEC (Brazil) | GPC Pretoria |
| GPC ECMWF | GPC Seoul |
| GPC Exeter | GPC Tokyo |
| GPC Melbourne | GPC Toulouse |
| GPC Montreal | GPC Washington |
| GPC Moscow |  |

Acronyms not previously defined: CPTEC – Centro de Previsão de Tempo e Estudos Climáticos; ECMWF – European Centre for Medium-range Weather Forecasts.

Global Producing Centres for Annual to Decadal Climate Prediction:

GPC Barcelona

GPC Exeter

GPC Montreal

GPC Offenbach

4. The Regional Specialized Meteorological Centres for specialized   
activities are:

Tropical cyclone forecasting, including marine-related hazards:

RSMC Honolulu – Hurricane centre

RSMC La Réunion – Tropical cyclone centre

RSMC Nadi – Tropical cyclone centre

RSMC New Delhi – Tropical cyclone centre

RSMC Miami – Hurricane centre

RSMC Tokyo – Typhoon centre

Atmospheric sand and dust storm forecasting:

RSMC-ASDF Barcelona

RSMC-ASDF Beijing (RA II)

Atmospheric transport and dispersion modelling (for environmental emergency response and/or backtracking) – Nuclear:

|  |  |
| --- | --- |
| RSMC Beijing | RSMC Offenbach |
| RSMC Exeter | RSMC Tokyo |
| RSMC Melbourne | RSMC Toulouse |
| RSMC Montreal | RSMC Vienna (backtracking only) |
| RSMC Obninsk | RSMC Washington |

Atmospheric transport and dispersion modelling (for environmental emergency response) – Non-nuclear:

RSMC Montreal

RSMC Offenbach

RSMC Toulouse

Severe weather forecasting:

RSMC Dakar

RSMC Dar-es-Salam

RSMC Nairobi

RSMC Pretoria

RSMC Wellington

Marine meteorological services:

|  |  |
| --- | --- |
| RSMC Athens | RSMC Ottawa |
| RSMC Beijing | RSMC Pretoria |
| RSMC Buenos Aires | RSMC St Petersburg |
| RSMC Callao | RSMC Tokyo |
| RSMC Edmonton | RSMC Toulouse |
| RSMC Exeter | RSMC TromsØ |
| RSMC Karachi | RSMC Vacoas |
| RSMC La Réunion | RSMC Valparaiso |
| RSMC Melbourne | RSMC Vladivostok |
| RSMC Miami | RSMC Washington DC |
| RSMC New Delhi | RSMC Wellington |
| RSMC Niteroi | RSMC Winnipeg |

Numerical ocean wave prediction:

RSMC Melbourne

RSMC Montreal

RSMC Tokyo

RSMC Toulouse

ICAO-designated Volcanic Ash Advisory Centres (VAACs) responsible for the provision of volcano watch services for international air navigation:

– VAAC Anchorage

– VAAC Buenos Aires (co-located with RSMC Buenos Aires)

– VAAC Darwin (co-located with RSMC Melbourne)

– VAAC London (co-located with RSMC Exeter)

– VAAC Montreal (co-located with RSMC Montreal)

– VAAC Tokyo (co-located with RSMC Tokyo)

– VAAC Toulouse (co-located with RSMC Toulouse)

– VAAC Washington (co-located with RSMC Washington)

– VAAC Wellington (co-located with RSMC Wellington)

Regional climate prediction and monitoring:

RCC Africa hosted by the African Centre of Meteorological Applications for Development (RA I)

RCC Beijing (RA II)

RCC Caribbean hosted by the Caribbean Institute for Meteorology and Hydrology (RA IV)

RCC Intergovernmental Authority on Development (IGAD) hosted by the IGAD Climate Prediction and Applications Centre (RA I)

RCC Moscow (RA II)

RCC Network (RA VI): De Bilt node on climate data services, Offenbach node on climate monitoring, and Toulouse and Moscow node on long-range forecasting

RCC Network Northern Africa (RA I)

RCC Network Southern South America (RA III)

RCC Pune (RA II)

RCC Tokyo (RA II)

RCC Washington (RA IV)

RCC Western South America hosted by the International Research Centre on El Niño (RA III)

Notes:

1. RCC Moscow (RA II) – North Eurasian Climate Centre.

2. The RA VI RCC network consists of three nodes: (a) climate data services, led by the Koninklijk Nederlands Meteorologisch Instituut (KNMI), Netherlands; (b) climate monitoring, led by Deutscher Wetterdienst (DWD), Germany; (c) long-range forecasting, jointly led by Météo-France and Roshydromet, Russian Federation. These Lead Centres are fully responsible for discharging the mandatory functions of the RA VI RCC network, with the support of the following contributing NMHSs:

– RA VI RCC node on climate data services:  
KNMI (lead), Météo-France, Országos Meteorológiai Szolgálat/Hungary, Meteorologisk Institutt (met.no)/Norway, Republic Hydrometeorological Servise (RHMS)/Serbia, Swedish Meteorological and Hydrological Institute/Sweden and the Turkish State Meteorological Service (TSMS)/Turkey;

– RA VI RCC node on climate monitoring:  
DWD (lead), Armstatehydromet/Armenia, Météo-France, KNMI, RHMS and TSMS;

– RA VI RCC node on long-range forecasting:  
Météo-France and Roshydromet (joint leads), met.no, RHMS and TSMS;

– Overall coordination:  
DWD is responsible for the overall coordination.

Lead Centre for coordination of LRFMME:

Seoul and Washington (joint centre)

Lead Centre for coordination of ADCP:

Exeter

5. The Regional Specialized Meteorological Centres for non-real-time coordination activities:

Lead Centre for coordination of DNV:

ECMWF

Lead Centre for coordination of EPS verification:

Tokyo

Lead Centre for coordination of LRF verification:

Melbourne and Montreal (joint centre)

~~Lead Centre for coordination of LRFMME:~~

~~Seoul and Washington (joint centre)~~

~~Lead Centre for coordination of ADCP:~~

~~Exeter~~

Lead Centre for coordination of wave forecast verification

ECMWF

\_\_\_\_\_\_\_\_\_\_

1. The person authorized by the Permanent Representative of the WMO Member to request support. [↑](#footnote-ref-2)
2. Designated by the Permanent Representative. [↑](#footnote-ref-3)
3. Via a password-protected dedicated website. [↑](#footnote-ref-4)
4. The person authorized by the Permanent Representative of the WMO Member to request RSMC support; normally the NMHS operational contact point. [↑](#footnote-ref-5)
5. Designated by the Permanent Representative. [↑](#footnote-ref-6)
6. The person authorized by the Permanent Representative of the country to request RSMC support. [↑](#footnote-ref-7)
7. The RSMC products will be provided to the NMHS operational contact point designated by the Permanent Representative. [↑](#footnote-ref-8)
8. The basic information will normally be provided by the NMHS to the IAEA national contact point and to other agencies as needed based on the specific arrangements defined within the State as discussed in the paragraph on National Arrangements. [↑](#footnote-ref-9)