WMO OMM
World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
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Anexos: 2 (disponibles en inglés solamente)

Asunto: Informe anual de la Organización Meteorológico Mundial sobre los progresos técnicos del Sistema Mundial de Proceso de Datos y de Predicción y las actividades de investigación conexas en materia de predicción numérica del tiempo de 2019

Finalidad: Presentar su contribución al Informe mencionado de 2019 a más tardar el **15 de septiembre de 2020**

Estimado señor/Estimada señora:

El Informe anual de la Organización Meteorológica Mundial (OMM) sobre los progresos técnicos del Sistema Mundial de Proceso de Datos y de Predicción (SMPDP), junto con el informe sobre las actividades de investigación conexas en materia de predicción numérica del tiempo (PNT) —en adelante, el "Informe"—, permite mantener informados a los Miembros sobre la situación de las instalaciones, las investigaciones y las aplicaciones que se van creando o poniendo en marcha en los centros del SMPDP, y cuya rápida transformación obedece a los avances tecnológicos y la evolución de las necesidades. El Informe tiene por objeto informar a los expertos operacionales y a los investigadores sobre lo siguiente: 1) instalación y actualización de equipo operacional y medios conexos en los centros del SMPDP y, en particular, de sistemas de análisis y predicción del tiempo, sistemas de PNT y sus sistemas especializados para aplicaciones concretas; y 2) actividades de investigación y desarrollo encaminadas a la comprensión de los procesos meteorológicos, y la evolución constante de los modelos numéricos y de las técnicas para facilitar la predicción operativa. Además, el hecho de examinar exhaustivamente todos los informes recibidos contribuye sobremanera a que la OMM pueda entender el funcionamiento del SMPDP a escala mundial, regional y nacional, y prestarle una atención constante.

En este contexto, me gustaría dar las gracias a los Miembros que han presentado los informes de 2018 y de años anteriores (véase el anexo I) para su publicación en el sitio web de la OMM (https://community.wmo.int/wmo-technical-progress-report-global-data-processing-and-forecasting-system-gdpfs-and-numerical-weather-prediction-nwp-research-2018).

Se invita a los Miembros a preparar sus contribuciones al Informe del año 2019 y presentarlas a la Secretaría de la OMM. A fin de facilitar la presentación de información pertinente sobre las actividades de su centro del SMPDP y/o sobre su colaboración en un consorcio en ámbitos que van desde la predicción inmediata hasta la previsión a largo y de plazo ampliado, o en relación con aplicaciones especializadas de la PNT y de proceso posterior de datos (por ejemplo, para las olas oceánicas, las mareas de tempestad, el hielo marino, el transporte y la desagregación de los contaminantes marinos, los ciclones tropicales, el transporte y la dispersión de los contaminantes atmosféricos, la radiación solar ultravioleta, la calidad del aire, el humo, la arena y el polvo, etc.), se ha preparado una plantilla siguiendo el índice del Informe (véase el anexo II), que puede consultarse en el sitio web de la OMM indicado con anterioridad.

A los Representantes Permanentes (o Directores de los Servicios Meteorológicos o Hidrometeorológicos) de los Miembros de la OMM y Directora del ECMWF

Le agradecería que completase su contribución al Informe de 2019, únicamente en formato electrónico, de preferencia en MS Word u otros formatos compatibles, y la mandase a la Secretaría de la OMM no más tarde del **15 de septiembre de 2020**, por correo electrónico (dpfsmail@wmo.int) a la atención de la señora Pascale Gomez.

Quisiera expresarle mi agradecimiento por su continuo apoyo y contribución a este Informe e instar encarecidamente a aquellos Miembros que aún no hayan aportado su contribución, o que no hayan actualizado sus informes respectivos desde hace varios años, a que lo hagan, en beneficio de todos los Miembros de la Organización.

Le saluda atentamente.

Dr. Wenjian Zhang
por el Secretario General

Ref.: 14771/2020-1.0 GS

# Annual WMO Technical Progress Reports on the GDPFS and related Research Activities on NWP (for 2018, or latest report year)

## 2018 GDPFS / NWP REPORTS

| | |
|---|---|
| ECMWF (2015) | Lithuania (2016) |
| Algeria (**2018**) | Lybia (**2018**) |
| Argentina (2016) | Madagascar (2008) |
| Armenia (**2018**) | Malaysia (2017) |
| Australia (2010) | Montenegro (2008) |
| Austria (**2018**) | Morocco (2017) |
| Belarus (2012) | Mozambique (2015) |
| Belgium (2008) | Myanmar (2015) |
| Bolivia (2010) | Netherlands (**2018**) |
| Bosnia and Herzegovina (2017) | New Zealand (**2018**) |
| Botswana (2010) | Oman (2015) |
| Brazil (2016) | Pakistan (2017) |
| Bulgaria (2006) | Paraguay (2016) |
| Canada en - fr (2017) | Panama (2005) |
| Chile (**2018**) | Peru (**2018**) |
| China (**2018**) | Philippines (**2018**) |
| Côte d'Ivoire (2004) | Poland (**2018**) |
| Croatia (**2018**) | Portugal (2011) |
| Cyprus (2015) | Qatar (2012) |
| Czech Republic (2016) | Republic of Korea (**2018**) |
| Denmark (**2018**) | Romania (2015) |

| | |
|---|---|
| Ecuador (2008) | Russian Federation (**2018**)<br>Khabarovask en - ru<br>Moscow en - ru<br>Novosibirsk en - ru |
| Egypt (2017) | Saudi Arabia (2017) |
| Estonia (2008) | Serbia (2017) |
| Fiji (2010) | Singapore (**2018**) |
| Finland (**2018**) | Slovakia (**2018**) |
| France (**2018**) | Slovenia (2012) |
| Georgia (2004) | Spain (**2018**) |
| Germany (**2018**) | Sri Lanka (**2018**) |
| Greece (2013) | Sudan (2016) |
| Hong Kong, China (**2018**) | Sweden (**2018**) |
| Hungary (**2018**) | Switzerland (**2018**) |
| India (2011) | Thailand (**2018**) |
| Indonesia (2009) | The former Yugoslav Republic of Macedonia (2010) |
| Ireland (2015) | Tanzania (**2018**) |
| Islamic Republic of Iran (2006) | Tunisia (**2018**) |
| Israel (2012) | Turkey (2009) |
| Italy (**2018**) | Ukraine (**2018**) |
| Japan (**2018**) | United Kingdom (2015) |
| Kazakhstan (**2018**) | United Republic of Tanzania (2017) |
| Kenya (2016) | United States of America (2013) |
| Kyrgyzstan (2004) | Uruguay (2008) |
| Latvia (2013) | Uzbekistan (2015) |

**W O R L D  M E T E O R O L O G I C A L  O R G A N I Z A T I O N**
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# ANNUAL JOINT WMO TECHNICAL PROGRESS REPORT ON THE GLOBAL DATA-PROCESSING AND FORECASTING SYSTEM (GDPFS) INCLUDING NUMERICAL WEATHER PREDICTION (NWP) RESEARCH ACTIVITIES FOR 2019

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4.3.2 Model

4.3.2.1 In operation
4.3.2.2 Research performed in this field

4.3.3 Operationally available NWP products

4.3.4 Operational techniques for application of NWP products (MOS, PPM, KF, Expert Systems, etc..)

4.3.4.1 In operation
4.3.4.2 Research performed in this field

4.3.5 Ensemble Prediction System (Number of members, initial state, perturbation method, model(s) and number of models used, perturbation of physics, post-processing: calculation of indices, clustering)

4.3.5.1 In operation
4.3.5.2 Research performed in this field
4.3.5.3 Operationally available EPS products

## 4.4 Nowcasting and Very Short-range Forecasting Systems (0-12 hrs)

4.4.1 Nowcasting system

4.4.1.1 In operation
4.4.1.2 Research performed in this field

*Note: please also complete the CBS/PWS questionnaire on Nowcasting Systems and Services, 2014)*

4.4.2 Models for Very Short-range Forecasting Systems

4.4.2.1 In operation
4.4.2.2 Research performed in this field

## 4.5 Specialized numerical predictions (on sea waves, storm surge, sea ice, marine pollution transport and weathering, tropical cyclones, air pollution transport and dispersion, solar ultraviolet (UV) radiation, air quality forecasting, smoke, sand and dust, etc.)

4.5.1 Assimilation of specific data, analysis and initialization (where applicable)

4.5.1.1 In operation
4.5.1.2 Research performed in this field

4.5.2 Specific models (as appropriate related to 4.5)

4.5.2.1 In operation
4.5.2.2 Research performed in this field

4.5.3 Specific products operationally available

4.5.4 Operational techniques for application of specialized numerical prediction products (MOS, PPM, KF, Expert Systems, etc.) (as appropriate related to 4.5)

4.2.4.1 In operation
4.2.4.2 Research performed in this field

4.5.5 Probabilistic predictions (where applicable)

4.5.5.1 In operation
4.5.5.2 Research performed in this field
4.5.5.3 Operationally available probabilistic prediction products

## 4.6 Extended range forecasts (10 days to 30 days) (Models, Ensemble, Methodology)

4.6.1 In operation

4.6.2 Research performed in this field

## EXPLANATORY NOTES

### to the suggested contents of Annual Joint WMO Technical Progress Report on the Global Data-Processing and Forecasting System (GDPFS) and Numerical Weather Prediction (NWP) Research Activities

The WMO progress report will be jointly compiled annually by the WDS and AREP Departments of the WMO Secretariat on the basis of contributions from WMO Members and/or GDPFS centres.

The publication will begin with an introduction prepared by the WMO Secretariat explaining the major purposes of the publication with the appropriate references.

Each individual contribution should contain appropriate parts of the following items.

**1. Summary of highlights**. This should reflect the major changes in the data-processing and forecasting system during the last year.

**2. Equipment in use at the centre**. This paragraph should contain information on the major data-processing units, especially in the large centres. Here and in the following paragraphs the information for the first national contribution to the Progress Report should be given in a complete form to avoid too many references. In the next contribution, the information can be restricted to the indication of major changes during the year being reported on.

**3. Data and products from GTS in use**. It is suggested that only the bulletin headings with the basic information (SYNOP, SHIP, TEMP, SATEM etc.) and the types of products (GRID, GRIB, facsimile charts etc.) received through the GTS or other means and used at the centre will be indicated in this paragraph. The daily statistics for each type of bulletin and the product should be included, if such statistics are available. For example, SYNOP-500, TEM-600, GRID-20.

**4. Forecasting system**. There are several aspects of this system since some centres run several models which have different approaches to the data assimilation, use different numerical techniques and so on. Consequently, this paragraph is divided into several sub paragraphs.

**4.1 *System run schedule***. It is suggested that the general structure of a prognostic system should be described in the paragraph with an indication of models in operational use, including those for specialized applications, the run schedule and the forecast ranges.

**4.2-4.6** These sub-paragraphs are a series of similarly structured texts describing different operational sub-systems of a numerical weather forecasting system: Medium-range forecasting (section 4.2); Short-range forecasting (section 4.3); Nowcasting and very-short-range forecasting (section 4.4), Specialized numerical predictions for various sector specific applications, including sea waves, storm surge, sea ice, marine pollution transport and weathering, tropical cyclones, air pollution transport and dispersion, solar ultraviolet (UV) radiation, air quality forecasting, smoke, sand and dust, etc. (section 4.5), extended-range forecasting (section 4.6) and long-range forecasting (section 4.7). Each sub-paragraph contains the same components starting with data assimilation and objective analysis, description of the model, of operational techniques for application of NWP products, and a section on Ensemble Prediction Systems if used for that range. List of products available for WMO members should be indicated. All sub-paragraphs should include information regarding any performed research activities in the related field.

The list of suggested items in each sub-paragraph is given for 4.2 (it is assumed that for 4.3-4.7 they will be similar).

## 4.2 *Medium range forecasting system (4-10 days).*

4.2.1 *Data assimilation objective analysis and initialization*

*4.2.1.1 In operation*

. Assimilated data,
. Assimilation cycles, including cut-off time,
. Method of analysis (e.g. 3 D-VAR, 4D-VAR)
. Analysed variables
. First guess
. Coverage
. Horizontal resolution
. Vertical resolution (levels)
. Initialization (non linear normal mode, diabatic etc.)

*4.2.1.2 Research performed in this field*

4.2.2 *Model*
*(If no model is operationally runs for this time range, indicate, if any, the other GDPFS centre and its model from which you use products)*

*4.2.2.1 In operation*

. Basic equations
. Independent variables
. Dependent variables
. Numerical technique (in horizontal, vertical and in time), hydrostatic or non hydrostatic
. Integration domain (in horizontal and vertical)
. Horizontal and vertical resolution
. Time step
. Orography, gravity wave drag, bathymetry (ocean models)
. Horizontal diffusion
. Vertical diffusion
. Planetary boundary layer
. Treatment of sea surface earth surface and soil
. Radiation
. Convection (deep and shallow)
. Atmospheric moisture
. Boundaries
. Type of ocean model (deep and shallow waters)
. Source of input (e.g. wind etc.) data (ocean models).

*4.2.2.2 Research performed in this field*

4.2.3 Operationally available *Numerical weather prediction products*. This item should contain a brief description of variables which are outputs from the model integration and the list of products available for WMO Members on Internet and on GTS. *(If no model is operationally runs for this time range, indicate the list of products, if any, you use from another GDPFS centre)*

4.2.4 *Operational techniques for application of NWP products*. This item should include only a brief description of automated (formalized) procedures in use for interpretation of NWP output (MOS, PPM, Kalman filter, Expert System, etc.) for example, “the MOS from ECMWF NWP is used to derive extreme temperatures and daily precipitation”.

*4.2.4.1 In operation*

*4.2.4.2 Research performed in this field*

4.2.5 *Ensemble Prediction System (Number of members, initial state perturbation method, number and different models used, perturbation of physics, post-processing: calculation of indices, clustering).* This item should be a brief but clearer description of the techniques used for the ensemble prediction system, including the main post-processing techniques applied.

*4.2.5.1 In operation*
*4.2.5.2 Research performed in this field*
*4.2.5.3 Operationally available EPS products.* This item should contain a brief description of variables which are outputs from the EPS integration and the list of products available for WMO Members on Internet and on GTS.

**5. Verification of prognostic products**. Centres producing standard scores are requested to produce an annual summary for insertion in the WMO Progress Report on the GDPFS. The recommended content of this summary is given below:

**VERIFICATION SUMMARY FOR INCLUSION IN THE ANNUAL WMO PROGRESS REPORT ON THE GDPFS**

| | | |
|---|---|---|
| RSMC error | Z 500 | NH, SH: against analysis<br>4 extra tropical standard area: against observations |
| RMS vector wind error | W 250 | Same areas |
| RMS vector wind error | W 250 | Tropics: against analysis |
| RMS vector wind error | W 850 | Tropical standard area: against observations |

Forecast range: 1, 3 and 5 days

All values to be the average of the monthly values over the year.

For ensemble system, provide annual and seasonal averages of the Brier Skill Score at 24, 72, 120, 168 and 240 hours for Z500 and T850.

## 6. Plans for the future *(next 4 years)*

### *6.1 Development of GDPFS.*

*6.1.1* Indicate major changes in the data processing and forecasting system which are expected in the next year.
*6.1.2* Indicate major changes in the data processing and forecasting system which are envisaged within the next 4 years.

***6.2 Planned Research activities in NWP, Nowcasting, Long-range Forecasting and Specialized Numerical Predictions.*** Indicate your planned research and development efforts in the area of understanding of physical processes, models, EPS and other techniques for the next 4 years.

*6.2.1* Planned Research Activities in NWP
*6.2.2* Planned Research Activities in Nowcasting
*6.2.3* Planned Research Activities in Long-range Forecasting
*6.2.4* Planned Research Activities in Specialized Numerical Predictions

## 7. Consortium *(if appropriate)*

There are a number of GDPFS Centres participating in Consortia. Those Centres participating in and/or responsible for a Consortium should indicate it in this item. Details on the system and/or model developed and/or operated by a Consortium, including approaches to the data

assimilation, use of different numerical techniques and so on, should be reported in sub-paragraphs 7.1-7.7, using a similar approach as described in item 4.

7.1 *System and/or Model*
*7.1.1 In operation*
*7.1.2 Research performed in this field*

7.2 *System run schedule and forecast ranges*

7.3 *List of countries participating in the Consortium*

7.4 *Data assimilation, objective analysis and initialization*
*7.4.1 In operation*
*7.4.2 Research performed in this field*

7.5 *Operationally available Numerical Weather Prediction (NWP) Products*

7.6 *Verification of prognostic products*

7.7 *Plans for the future (next 4 years)*
*7.7.1 Major changes in operations*
*7.7.2 Planned Research Activities*

**8. References:** Give references to the sources where more detailed descriptions of different components of the data processing and forecasting system can be found, including WEB sites addresses.