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**Agenda Item 2: Implementation of the World Area Forecast System (WAFS)**

**b) Review the status of implementation of ISCS**

**SUMMARY OF RECENT AND FORTHCOMING  
DEVELOPMENTS TO THE WAFS**

(Presented by the Washington WAFS Provider States)

**SUMMARY**

This paper describes WAFS developments since the last AERMETS/9 meeting. Some of these developments have had a direct impact on end users. A number of important developments are planned to the WAFS in future years and these are highlighted in this paper for the consideration of the group.

**1. Introduction**

1.1 This paper presents developments to the WAFS since the 9<sup>th</sup> meeting of the AERMETS. For more details of the activities of the WAFS, users may wish to review information available on the ICAO WAFS Operations Group website at URL: [www.icao.int/anb/wafsopsg/](http://www.icao.int/anb/wafsopsg/). More current information may be available based on the recent 5<sup>th</sup> meeting of the World Area Forecast System Operations Group, 16-18 September, 2009 in Paris, France.

1.2 Also provided at the end of this paper in Appendix A is the long term plan for the WAFS and some additional supplemental information in Appendix B that provides further guidance on the work underdevelopment. Again members are encouraged to review the WAFSOPSG/5 report to ensure that the information provided in this paper reflects what was reported at WAFSOPSG/5.

**2. Recent Developments**

**2.1 Development of WAFS upper-air data in the GRIB 2 code form**

2.1.1 WAFSOPSG/4 endorsed the WAFS Provider States to continue with the development of WAFS upper-air forecasts in the GRIB 2 code form, including new forecasts for icing, turbulence and CB cloud. The two WAFSs have been coordinating their development efforts to ensure that these gridded forecasts are harmonised with respect to content, encoding and compression algorithms. Coordination activities have included a science co-ordination meeting in Washington DC in April 2009.

2.1.2 GRIB 2 WAFS data benefits from higher spatial and temporal resolution, and additional fields, compared to its GRIB 1 predecessor – for example, the GRIB 2 WAFS data is based on a regular 1.25\*1.25 degree (unthinned) grid, T+6 to T+36 at 3-hourly time intervals, and includes additional flight level information at FL270, FL320 and FL360 and icing, turbulence and CB cloud forecasts.

2.1.3 The WAFCs have provided a progress report to the WAFSOPSG/5 meeting (September 2009) outlining the steps taken towards delivery of GRIB 2 WAFS data. The progress report includes a summary of verification that both WAFCs have conducted with respect to icing, turbulence and CB cloud forecasts. In addition, the WAF Provider States have prepared a general guidance document on the intended use of the gridded WAFS forecasts for icing, turbulence and CB cloud.

2.1.4 WAFSOPSG/5 will be expected to review the status of development of the GRIB 2 forecasts and determine their future operational implementation.

**Suggested action:** *Review discussions at WAFSOPSG and associated guidance material.*

## 2.2 Coordination between the WAFCs and the TCACs

2.2.1 In response to WAFSOPSG Conclusion 4/8, the WAF Provider States have conducted a coordination trial with the Tropical Cyclone Advisory Centres, with a view to determining the feasibility of, and benefits for the WAFS from, establishing and maintaining contact with the TCACs in order to harmonise the information on TC in the WAFS SIGWX forecasts and the TCAC advisories.

2.2.2 The findings from the web-based trial will be presented to the WAFSOPSG/5 meeting in order to determine whether such coordination activities should become standard practice.

**Suggested action:** *Note this information only.*

## 2.3 WAFC backup tests

2.3.1 The WAF Provider States have continued to test their SIGWX backup procedures in the event that one WAF Provider State was unable to produce SIGWX forecasts in the BUFR-code and PNG-chart format. Routine backup tests are conducted quarterly, with the results posted on the WAFSOPSG website at URL:

<http://www.icao.int/anb/wafsopsg/Recent%20Chronology%20of%20WAFS%20Backup%20Tests.pdf>.

Tests over the last 12 months have been successful, and transparent for the overwhelming majority of WAFS users.

2.3.2 Forthcoming backup tests are outlined at URL:

<http://www.icao.int/anb/wafsopsg/Forthcoming%20WAFS%20Backup%20Tests.pdf>.

Notification of WAFS backup tests is promulgated on the SADIS broadcasts in advance, by way of administrative messages.

2.3.3 In addition, WAFS backup procedures are outlined at:

<http://www.icao.int/anb/wafsopsg/backup.pdf>.

**Suggested action:** *Note this information and consider visiting the WAFSOPSG website to obtain information pertaining to WAFS backup tests and procedures.*

### 3. **Forthcoming developments**

#### 3.1 **Corrections to WAFS SIGWX forecasts**

3.1.1 WAFSOPSG/4 endorsed the WAFS Provider States to introduce a practical and minimal procedure to handle corrections to WAFS SIGWX forecasts (in BUFR code and/or PNG chart form). The procedure would involve the issuance of a plain text administrative message drawing user attention to the identified error. The BUFR data and/or PNG charts themselves, which contain erroneous data, would not be re-issued due to downstream implications detailed in the WAFSOPSG/4 report.

3.1.2 In view of concerns expressed by the 12<sup>th</sup> meeting of the CNS/MET sub-group of the APANPIRG, implementation of WAFS SIGWX corrections in 2008 was deferred. General guidance on how an operator may wish to handle the receipt of such administrative messages has been drafted by the WAFCs for WAFSOPSG/5. Subject to endorsement by WAFSOPSG/5, corrections to WAFS SIGWX may be introduced before the end of 2009.

3.1.3 The WAFCs intend to use the following WMO bulletin headers to issue the plain text administrative messages: FXUK65 EGRR (for corrections to WAFS London SIGWX) and FXUS65 KKCI (for corrections to WAFS Washington SIGWX). Implementation will be communicated via the WAFS Change Implementation Notice Board at URL:  
<http://www.icao.int/anb/wafsopsg/WAFS%20change%20notice%20board.pdf>.

**Suggested action:** *Monitor the progress towards corrections to WAFS SIGWX through the WAFSOPSG and WAFS Change Notice Board.*

#### 3.2 **Development of WAFS web-based server**

3.2.1 In addition to the endorsement of the development of GRIB 2 WAFS data, outlined above, WAFSOPSG/4 also endorsed the development by the WAFS Provider States of a web-based distribution of WAFS forecasts for the intended use in flight documentation for improved access and visualisation of WAFS forecasts (WAFSOPSG Conclusion 4/20 refers).

3.2.2 This new offering from the WAFCs will deliver a minimum set of WAFS charts, providing objective gridded forecasts of icing, turbulence and CB cloud derived from GRIB 2 formatted data. The web service, one from each WAFS, will be targeted primarily at the least developed countries which may not be in a position to convert the GRIB and/or BUFR coded SIGWX forecasts into chart form.

3.2.3 A progress report on the development of the WAFS web services has been submitted to WAFSOPSG/5. The WAFCs expect this new service offering to be available in 2010 or 2011.

3.2.4

**Suggested action:** *Monitor the development of the web-based distribution of WAFS forecasts through the WAFSOPSG.*

#### 3.3 **Workshop on the gridded WAFS forecasts for icing, turbulence and CB cloud**

3.3.1 In order to facilitate the implementation of the gridded forecasts for icing, turbulence and CB cloud, the WAFS Provider States, in co-ordination with ICAO and WMO, will be convening a two-day workshop on the intended use and visualisation of these new products.

3.3.2 The workshop will take place at the ICAO regional office on Paris on 14 and 15 September 2009, immediately prior to WAFSOPSG/5.

**Suggested action:** *Consider participating in the workshop, where resources allow.*

### 3.4 Training for States on the use and visualisation of new gridded WAFS forecasts

3.4.1 In addition to the WAFS workshop, outlined above, the WAFS Provider States have been tasked to design training for States on the use and visualisation of the gridded forecasts for icing, turbulence and CB cloud.

3.4.2 A training proposal in the form of web-based interactive tutorials will be presented by the WAFS Providers at WAFSOPSG/5. Subject to endorsement, the training material may become available in 2010 or 2011.

**Suggested action:** *Consider what training needs your State will have regarding the use and visualisation the new gridded products.*

### 3.5 Improved visualisation of WAFS forecasts

3.5.1 An ad-hoc group of the WAFSOPSG (China as Rapporteur) has been studying how the visualisation of WAFS forecasts could be improved to ensure that the most relevant WAFS forecasts be presented in terms of space and time in flight documentation. These improvements to visualisation are expected to better serve the needs of the long-haul community.

3.5.2 Initial findings were presented to WAFSOPSG/4 (February 2008), with further proposals expected at WAFSOPSG/5 (September 2009). The proposals are likely to include the concatenation of charts based on the gridded WAFS forecasts for icing, turbulence and CB cloud.

**Suggested action:** *Monitor the progress of developing concatenated WAFS forecasts through the WAFSOPSG.*

### 3.6 WAFS output performance indicators

3.6.1 WAFSOPSG/4 invited the WAFS Provider States to assess the possibility of providing additional WAFS output performance indicators. This invitation included wind and temperature performance indicators for the WMO defined area covering Australia and New Zealand, as well as globally for all standard forecast levels (in digital and chart form).

3.6.2 Wind and temperature performance indicators for Australia and New Zealand were added to the WAFS Providers websites during 2008. WAFS London data can be viewed at <http://www.metoffice.gov.uk/icao/index.html> and WAFS Washington data at [http://www.emc.ncep.noaa.gov/gmb/icao/ncep\\_scores.html](http://www.emc.ncep.noaa.gov/gmb/icao/ncep_scores.html).

3.6.3 WAFS Washington has added performance indicators for the 850, 700, 500, 400, 300, 275, 225, 200, 150 and 100hPa standard levels, whilst WAFSOPSG/5 will be expected to endorse corresponding levels be added to the WAFS London web site.

3.6.4 The WAFCs have studied the cost and feasibility of providing global performance indicators in digital and chart format. The findings of this study will be presented to WAFSOPSG/5 in order for the group to determine whether such an undertaking should be pursued.

***Suggested action:*** *Access the output performance indicator websites of the two WAFCs and monitor the further development of these products through the WAFSOPSG.*

4. **Action required**

4.1 The meeting is invited to take note of the information provided in this paper.

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## APPENDIX A

## WAFS LONG-TERM PLAN FOR YEARS 2009-2013

WAFS MILESTONES	WAFSOPSG MEETING SCHEDULE	ICAO Annex 3 Amendment Cycle
<b>September 2009:</b> <ul style="list-style-type: none"> <li>Workshop on the new gridded forecasts of cumulonimbus clouds, icing and turbulence.</li> </ul>	WAFSOPSG/5	
<b>September 2009 to March 2010:</b> <ul style="list-style-type: none"> <li>GRIB 2 available on ISCS and SADIS FTP services, in parallel with GRIB 1. Composition subject to endorsement at WAFSOPSG/5.</li> </ul>		
<b>December 2009 to December 2010</b> <ul style="list-style-type: none"> <li>WAFCs develop and test web-based distribution of WAFS forecasts, providing objective forecasts of automated gridded icing, turbulence and convective clouds, derived from the GRIB 2 formatted data.</li> </ul>		
<b>December 2009 to November 2011:</b> <ul style="list-style-type: none"> <li>WAFS workstation vendors develop GRIB 2 decoders and software to enable the visualisation of WAFS upper-air forecasts (including higher-resolution fields and gridded icing, turbulence and cumulonimbus cloud forecasts).</li> </ul>		
<b>March 2010 to March 2011:</b> <ul style="list-style-type: none"> <li>WAFCs make available web-based WAFS forecasts, providing objective forecasts of the gridded cumulonimbus clouds, icing and turbulence. The web based services (one from each WAFc) will be targeted primarily at LDC recognised States.</li> </ul>		
<b>January 2010 to November 2010:</b> <ul style="list-style-type: none"> <li>WAFc to deliver a web-based training package on the intended use and visualisation of gridded WAFS forecasts for icing, turbulence and cumulonimbus clouds.</li> </ul>		
<b>November 2010:</b> <ul style="list-style-type: none"> <li>Enabling clauses in Annex 3 for the use of gridded WAFS forecasts for icing, turbulence and cumulonimbus clouds;</li> <li>Elimination of the requirement to include radioactive clouds, and sand- and dust storms in SIGWX forecasts.</li> </ul>		Amendment 75
<b>February 2011:</b> <ul style="list-style-type: none"> <li>Determine date for the cessation of WAFS forecasts in the GRIB1 code form and WAFS SIGWX forecasts in the BUFR code form and PNG chart form, in view of the implementation of GRIB 2 WAFS forecasts.</li> </ul>	WAFSOPSG/6	
<b>March 2011 to May 2012:</b> <ul style="list-style-type: none"> <li>Study of the planned Initial Operating Capability (IOC) of Network Centric Operations for potential WAFS applications.</li> </ul>		
<b>November 2011 to November 2013:</b> <ul style="list-style-type: none"> <li>WAFS end-user workstations upgraded to accept GRIB 2 code form WAFS forecasts.</li> </ul>		
<b>September 2012:</b> <ul style="list-style-type: none"> <li>Consideration of the results of the study of the planned IOC of Network Centric Operations for potential WAFS applications (to be referred to the conjoint ICAO/WMO MET Divisional Meeting)</li> <li>Consideration of any other proposals related to the future of WAFS to be tabled for the conjoint ICAO/WMO MET Divisional Meeting.</li> </ul>	WAFSOPSG/7	
<b>November 2013:</b> <ul style="list-style-type: none"> <li>Cessation of WAFS forecasts in the GRIB 1 code form, and WAFS SIGWX forecasts in the BUFR code form and PNG chart form.</li> </ul>		Amendment 76



**APPENDIX B****BACKGROUND INFORMATION RELATED TO WAFS MILESTONES IN YEARS  
2009 TO 2013**

To assist WAFS workstation vendors and users alike to better understand the proposals outlined in this long-term plan, the WAFS Provider States offer the following background information relating to the milestones:

1. In accordance with WAFSOPSG Conclusion 4/24, the WAFS Provider States will lead a WAFS workshop on the intended use and visualisation of gridded binary forecasts for icing, turbulence and CB cloud. To afford maximum participation, the workshop will take place on 14 and 15 September 2009, immediately prior to WAFSOPSG/5, at the ICAO regional office in Paris.
2. The long-term plan endorsed by WAFSOPSG/4 (Appendix G of the last report refers) expressed that GRIB 2 WAFS forecasts would be made available on the ISCS and SADIS FTP services. The WAFSs expect to complete this activity between September 2009 and March 2010<sup>1</sup>. WAFSOPSG/5 will be invited to determine whether the new gridded icing, turbulence and CB GRIB 2 forecasts should be available in a “GRIB 2 test products” directory (or similar).
3. In accordance with WAFSOPSG Conclusion 4/20, the WAFS Provider States are developing a web-based distribution of WAFS forecasts for intended use in flight documentation for improved access and visualisation of WAFS forecasts. Subject to endorsement by WAFSOPSG/5, WAFS London expects to deliver their web-based service around March 2010, whilst WAFS Washington expects to deliver their web-based service in 2011.
4. The consensus of opinion amongst many WAFS workstation vendors and users is that the WAFSs must provide upper-air forecasts in GRIB1 and GRIB2 code forms in parallel for up to 3 years, to afford sufficient time to develop and test software decoders and upgrade user visualisation systems. Given the major implication that a migration to GRIB2 will have on WAFS users, the WAFS Provider States support this recommendation. Accordingly, the WAFS long-term plan outlines that WAFS workstation vendors will be afforded 2 years to develop appropriate GRIB2 decoders and visualisation software for users, with a further 2 years to then upgrade end-user systems.
5. Subject to endorsement by WAFSOPSG/5, the WAFS Provider States intend to deliver a web-based training package on the intended use and visualisation of gridded WAFS forecasts of icing, turbulence and CB clouds. The web-based package will be available to all WAFS users via the public internet.
6. The need for WAFS SIGWX forecasts in BUFR-code and PNG chart forms will need to be addressed by the WAFSOPSG, taking into account the timescales outlined in the plan related to GRIB 2 migration and the dedicated WAFS web services. Replacing the human generated forecasts (high- and medium-level) with automated icing, turbulence and convective cloud forecasts will, potentially, have significant downstream impacts on users – particularly in terms of how the data should be visualised and how it should be used in the flight planning process. The WAFSs believe that the implementation of the web-based distribution of WAFS forecasts, as discussed above, will provide an enhanced range of products, particularly for those users who are unable to convert the GRIB and/or BUFR-coded forecasts into chart form.
7. In addition to the continued availability of WAFS SIGWX in BUFR code and PNG chart form, the WAFSOPSG will be expected to determine the continued availability of GRIB 1 coded WAFS forecasts on ISCS and SADIS in view of GRIB 2 implementation.
8. The WAFS Provider States recognise that information technology constantly evolves, with ever advancing products entering the market place. In the latter stages of 2012, a planned initial operating capability of network centric operations may offer the next generation of WAFS applications. These advancements could potentially

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<sup>1</sup> WAFS London expects the GRIB 2 data to be available on SADIS FTP between September and December 2009. Washington WAFS is in the process of developing a File Server to provide WAFS products in lieu of the NWS FTP Server that is used for ISCS. This service is expected to be operational March 2010.

allow aircraft to act as nodes on a network, with access to SIGWX data, say, in the cockpit. Trajectory based flight planning in future years may also influence the direction the WAFS will take. Of course, the objective of the WAFS at present is to supply meteorological authorities and other users with global aeronautical meteorological en-route forecasts in digital form over the ICAO AFS, rather than, say, to provide data uplink direct to the cockpit. Nevertheless, it is important that the group recognises that advances in technology will necessitate changes in future WAFS provision. And, it is also important to recognise that some States, particularly those recognised as Least Developed Countries, can find the rate of technological change to be exasperating. It is for these reasons that future WAFS provision must reap the benefits of the new technological capabilities, whilst also recognising that some users may continue to require a basic set of WAFS products to view on a flight planning system.

– END –