



*International Civil Aviation Organization*

**FOURTEENTH MEETING OF THE  
COMMUNICATIONS/NAVIGATION/SURVEILLANCE  
AND METEOROLOGY SUB-GROUP OF  
APANPIRG (CNS/MET SG/14)**



Jakarta, Indonesia, 19 – 22 July 2010

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**Agenda Item 8: Regional Implementation of World Area Forecast System (WAFS)**

**REGIONAL PROGRESS IN WAFS IMPLEMENTATION**

(Presented by Chairman, WAFS Implementation Task Force)

**SUMMARY**

This paper reports on the progress of WAFS implementation in the ASIA/PAC Region.

This paper relates to:

**Strategic Objectives:**

A: Safety – Enhance global civil aviation safety

D: Efficiency – Enhance the efficiency of aviation operations

**Global Plan Initiatives:**

GPI-18 Aeronautical information

GPI-19 Meteorological Systems

**1. Introduction**

1.1 This paper reports on the progress of WAFS implementation in the ASIA/PAC Region subsequent to CNS/MET SG/13 and discusses the follow-up actions that are needed to ensure implementation and utilization of the WAFS products in the ASIA/PAC Region.

**2. Regional progress**

2.1 The progress of WAFS implementation in the ASIA/PAC Region has been tracked by the document ASIA/PAC WAFS Implementation Plan and Procedures developed and maintained by the WAFS/I TF since 1998. This document was last updated by CNS/MET SG/13 in July 2009 and is included as Appendix A to this paper for review and necessary updating by this meeting.

2.2 The meeting is invited to review the progress of WAFS implementation in the ASIA/PAC Region against the “Indicative Timetable for Implementation of WAFS” given in the ASIA/PAC WAFS Implementation Plan and Procedures (see Attachment 1 of Appendix A), in particular the progress of the following items which are already due for completion or will be due for completion within the next year:

<b>Item</b>	<b>Task/Stage of Implementation of WAFS</b>	<b>Anticipated Date</b>
15	Implementation of ISCS G3 service	TBD
16	Implementation of WAFS Internet File Server (WIFS)	March 2010
17	Workshop on gridded forecasts of icing, turbulence and convective clouds	September 2009
18	WAFCs begin parallel broadcast of WAFS forecasts in the GRIB2 code form	mid-late 2009

2.3 Regarding the implementation of ISCS G3 to replace ISCS G2 (item 15), it is noted from the discussion at SADISOPSG/15 held in 26-28 May 2010 that the ISCS satellite broadcast is planned to be terminated by 2012. Furthermore, the need for continued SADIS satellite broadcast beyond 2015 will also be studied by SADISOPSG. While updates from the WAFCs on these developments are expected for planning by the WAFS user States in the Asia/Pacific Region, since they are fundamental changes to the entire framework of the WAFS since its inception in the 1980s, the meeting may wish to exchange views on these changes at this stage and recommend that the subject be deliberated at the next Conjoint ICAO MET/AIM Divisional Meeting / WMO CAeM-XV session which is tentatively scheduled to be held in 2014.

2.4 The meeting may wish to note that items 16 and 17 have been completed.

2.5 Regarding item 18, the meeting may wish to note that GRIB2 data, including the trial forecasts of cumulonimbus, icing and turbulence, have been made available via SADIS FTP and WIFS only.

2.6 Arising from the WAFSOPSG/5 meeting, in addition to regional training on the use of the gridded forecasts in 2011 (item 20 in Attachment 1 of Appendix A), the provision of computer-based training products and web-based training package will be considered by the WAFSOPSG/6 meeting.

2.7 The meeting may also wish to note that, at the WAFSOPSG/5 meeting, the users reiterated their continual need for receiving information presented similar to the existing SIGWX charts; therefore, the WAFSOPSG requested that the WAFS Provider States develop a proposal for the future visualization of SIGWX forecasts making increased use of automated forecast data (e.g. new gridded forecasts) which would allow the presentation of the information similar to the current SIGWX charts. In this connection, the task on the cessation of the WAFS SIGWX forecasts in the BUFR code form and PNG chart form has been removed from the WAFS long-term plan (2009-2013).

### **3. Future work programme**

3.1 In the light of the above discussion, the meeting may wish to consider the necessary changes to the ASIA/PAC WAFS Implementation Plan and Procedures, and to review the work programme and composition of the WAFS/I TF (Appendix B) and formulate the following decision:

**Decision 14/xx – ASIA/PAC WAFS Implementation Plan and WAFS Implementation Task Force**

That,

- (a) the ASIA/PAC WAFS Implementation Plan and Procedures be amended as shown in Appendix xx to the report;
- (b) the work programme and composition of the WAFS Implementation Task Force be amended as given in Appendix xx to the report.

**4. Issues on the WAFS trial gridded forecasts**

4.1 The meeting may recall the discussion at CNS/MET SG/13 regarding observations by Hong Kong, China on the WAFS trial gridded forecasts of icing, turbulence and cumulonimbus clouds which indicated the compatibility issue of forecasts of the two WAFCs, amongst other issues. Since CNS/MET SG/13, the five selected gridded forecasts from the two WAFCs, together with the difference maps (i.e. maps showing the absolute difference in the forecasts of the two WAFCs for the same parameter at the same valid time) and the corresponding SIGWX charts and satellite pictures continued to be made available on the dedicated website of the Hong Kong Observatory (<http://wafs-grid-fc.weather.gov.hk/>) for evaluation by aviation users.

4.2 The monthly mean absolute differences of the gridded forecast data between the two WAFCs for the five selected products have been compiled since May 2009. The mean absolute differences for “Maximum CAT potential” appear to have decreased (since December 2009), with the area of small differences (4-8%) significantly reduced (compare Figures 1(a) and (b)). However, relatively large differences can still be found near certain mountainous regions (e.g. Andes over South America). The mean absolute differences for “Mean in-cloud turbulence potential” also appear to have decreased (since December 2009) at high latitudes in the Northern Hemisphere (compare Figures 1(c) and (d)). On the other hand, no significant changes can be observed for “ICAO height at CB top”, “CB horizontal extent” and “Maximum icing potential” during the 1-year period (compare Figures 1(e) and (f), 1(g) and (h), and 1(i) and (j)). It is believed that the above observations may be due to changes made by WAFc Washington (in respect of “Maximum CAT potential”) and WAFc London (in respect of “Mean in-cloud turbulence potential”) but will need to be confirmed by the WAFCs.

4.3 In view of the above discussions, it is apparent that the identified issues in the compatibility of the gridded forecasts of the two WAFCs will need to be further addressed before their operational use. Considerations should also be made for the WAFCs to inform users in advance about forthcoming changes to the contents of the WAFS forecasts.

**5. Issues on retrieval of WAFS GRIB2 data**

5.1 As pointed out in WAFSOPSG/5, uncompressed GRIB2 WAFS forecast data for each model run amounts to approximately 50 MB, about five fold of the volume of the GRIB1 data. The underlying reason for the increase in data volume is attributable to the higher spatial and temporal resolutions as well as the inclusion of the trial icing/turbulence/CB gridded forecasts. With data compression and placing the trial forecasts in a separate directory, the GRIB2 data volume of the operational forecasts data is approximately 17 MB per model run, contained in 11 files corresponding to the 11 forecast hours. For each forecast hour, all the forecast elements are contained in the same file.

5.2 In accordance with ICAO Annex 3 para. 9.3.1, flight documentation shall comprise forecasts of upper wind and upper-air temperature, and of SIGWX phenomena. As regards the other WAFS forecasts, viz. forecasts of upper-air humidity, geopotential altitude of flight levels, flight level

and temperature of tropopause, and direction, speed and flight level of maximum wind, they shall be supplied to operators and flight crew members as established by meteorological authority in consultation with operators concerned. In other words, it may not be necessary for certain States to supply these latter forecasts to the operators and flight crew members.

5.3 In view of para. 5.2, the dissemination of the WAFS data could be streamlined, making it more user-friendly, by separating the GRIB2 data file for each forecast hour into two parts: (a) about 11 MB of upper wind and upper-air temperature (similar in size to existing GRIB1 data) and (b) about 6 MB of upper-air humidity, geopotential altitude of flight levels, flight level and temperature of tropopause, and direction, speed and flight level of maximum wind. If this dissemination scheme is implemented, flexibility will be enhanced to enable users to retrieve, decompress and process the data file (a) first for timely preparation of the flight documentation. For the other forecasts not required by the operators, there is no urgent need to retrieve the remaining 6 MB file (b). As such, available communication bandwidth could be used in a more efficient way.

## **6. Issues on the WAFS administrative message**

6.1 In accordance with WAFSOPSG Decision 4/5, the WAFC Provider States are not required to correct and re-issue the original SIGWX BUFR bulletin and/or PNG charts that contained an error. However, to comply with QMS principles, the WAFC Provider States have implemented the issue of a plain-text administrative message drawing users' attention to an error identified in the most recently issued WAFS SIGWX forecast. In response to APANPIRG Conclusion 19/44, WAFSOPSG/5 requested the WAFSOPSG Secretary, in coordination with the WAFSOPSG Member from China and WAFC Provider States, to finalise by 31 March 2010 guidance for WAFS users on the use of the above administrative message, for inclusion on the WAFSOPSG website.

6.2 The recently published "Guidance for Users Regarding WAFC Administrative Messages Issued in Events of Errors Identified in WAFS SIGWX Forecast (in BUFR Code and/or PNG Chart Form)" stipulates that "The content of such administrative messages shall be brought to the attention of users of the WAFS SIGWX forecast at the pre-flight planning stage. Where relevant to a particular flight, such correction information may be forwarded to aircraft in flight, but is not mandatory". The guidance also provides examples of the administrative messages identifying corrections to issued SIGWX BUFR data and/or PNG charts.

6.3 In a recent case in April 2010, the following administrative message was issued by WAFC London: "USERS ARE ADVISED THAT DUE TO PRODUCTION PROBLEMS BUFR DATASETS ARE MISSING JETSTREAMS. CORRECT CHARTS INCLUDING JETSTREAMS CAN BE FOUND IN THE PNG FORMAT". A SIGWX chart generated from the BUFR data and the corresponding PNG chart for this case are given in Figure 2 for reference.

6.4 Based on the above guidance (para. 6.2), the content of the administrative message in para. 6.3 shall be brought to the attention of users at the pre-flight planning stage. However, the WAFS SIGWX forecasts are not just used for pre-flight planning. It would also be difficult for the MET service providers to identify which WAFS users are in the pre-flight planning stage and which are not, and to notify them accordingly. In addition, it is unclear what the end users of WAFS are supposed to do on receipt of the administrative message, e.g. not to use the incorrect SIGWX forecast, or to use another chart instead (e.g. PNG instead of BUFR), or in the event that no corrected chart is available, whether the part that is subject to error should be ignored or corrected manually? As such, further guidance should be provided on the specific actions to be taken by the MET service providers and all relevant end users.

**7. Issues on the provision of graphical advisories**

7.1 Amendment 75 to ICAO Annex 3 requires the provision of volcanic ash (VA) and tropical cyclone (TC) advisory information relevant to the whole route to operators and flight crew members.

7.2 With the availability of VA advisories in graphical format from a number of centres which are currently made available from WAFS in PNG/T4 format and the future availability of TC graphical advisories, end users (operators and flight crew) could have better visualization of the impact of VA/TC. However, for the currently available VA graphical advisory, there are difficulties in identifying and extracting the information regarding the volcano/ash cloud (e.g. location, name or region being affected) solely from the file header of graphical VA advisory (e.g. the header code “X” for area designator indicates global region). Also there is no direct match with the corresponding textual advisory for the same volcano. This has led to difficulties in automatically extracting or selecting those VA graphical advisory information relevant to the flight route and matching with the corresponding VA textual advisory information.

7.3 To promote the use of graphical VA/TC advisories and to facilitate their inclusion in flight documentation relevant to the flight route, especially after Amendment 75 to Annex 3, it is suggested that VAACs and TCACs should be requested to include the file name of the graphical advisory, if issued, under “Remarks” (RMK) of the corresponding textual VA/TC advisory so that the appropriate graphical advisory could be identified and included.

**8. Action by the Meeting**

8.1 The meeting is invited to note the information provided in this paper and to exchange views on the progress of WAFS implementation in the Asia/Pacific Region. Following discussions on the issues highlighted in Sections 4 to 7 above, the meeting may wish to formulate the following draft Conclusion:

**Draft Conclusion 14/xx – Improvements to WAFS Implementation**

That,

- a) the WAFS Provider States continue to work on harmonizing the gridded forecasts issued by the two WAFSs before their operational use;
- b) the WAFS Provider States inform users in advance about forthcoming changes to the contents of the WAFS forecasts;
- c) the WAFSs consider separating the GRIB2 data file into two parts, one containing upper wind and upper-air temperature, and the other one containing upper-air humidity, geopotential altitude of flight levels, flight level and temperature of tropopause, and direction, speed and flight level of maximum wind, to facilitate more efficient transmission and use of the data;
- d) ICAO provides further guidance regarding the specific actions to be taken by the MET service providers and all relevant end users of WAFS upon receiving the administrative message;
- e) the VAACs and TCACs include the file name of the graphical advisories, if issued, under “Remarks” of the corresponding textual advisories.

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Fig. 1(a)

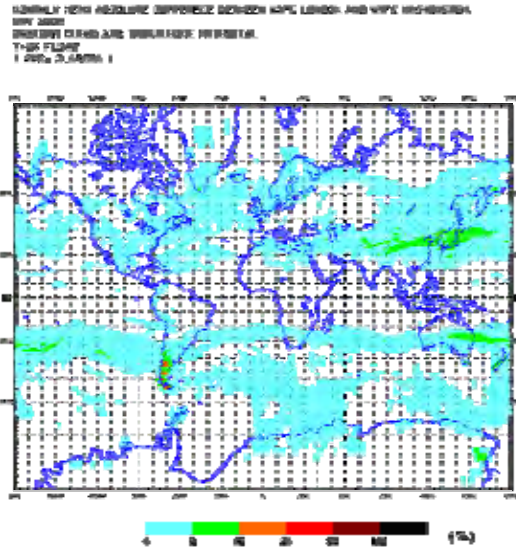
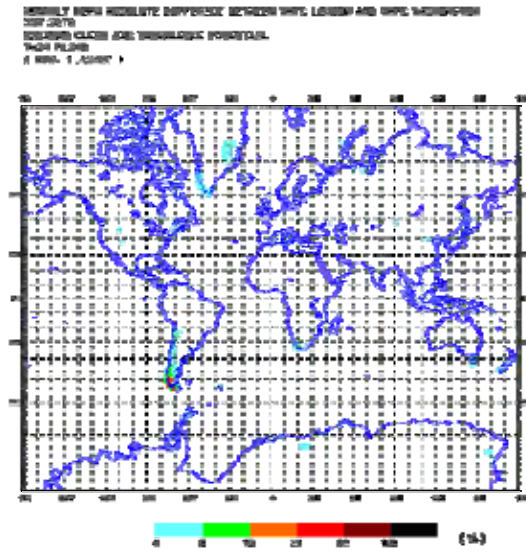


Fig. 1(b)



Mean Monthly Absolute Difference in the T+24 h Gridded Forecasts  
of the two WAFCs (“Maximum CAT potential at FL340” for (a) May 2009 (b) May 2010)

Fig. 1(c)

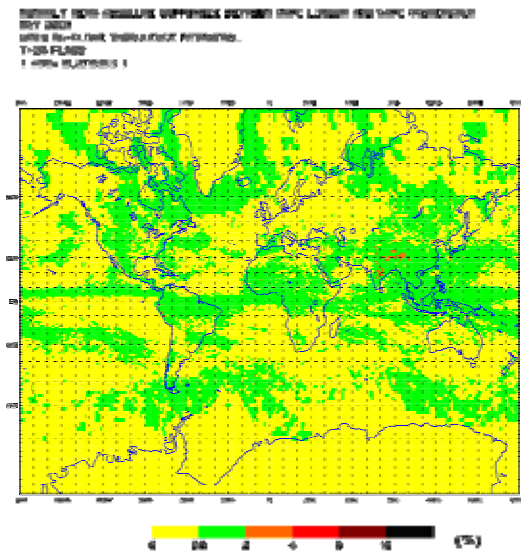
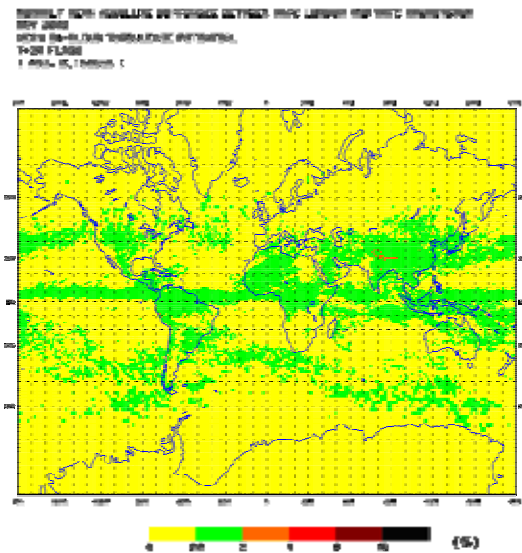


Fig. 1(d)



Mean Monthly Absolute Difference in the T+24 h Gridded Forecasts  
of the two WAFCs (“Mean in-cloud turbulence potential at FL 300” for (c) May 2009 (d) May 2010)

Fig. 1(e)

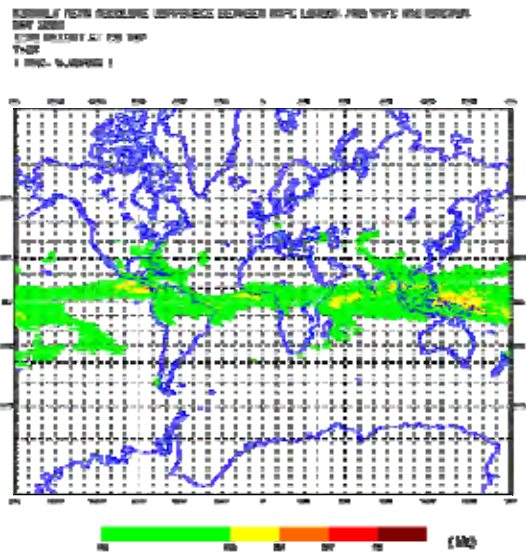
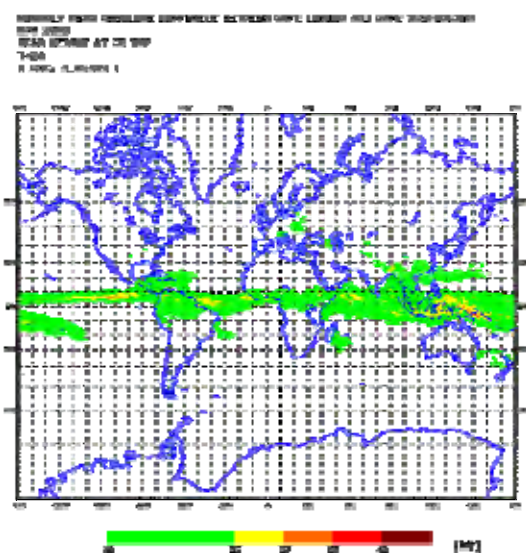


Fig. 1(f)



Mean Monthly Absolute Difference in the T+24 h Gridded Forecasts  
of the two WAFCs (“ICAO height at CB top (kft)” for (e) May 2009 (f) May 2010)

Fig. 1(g)

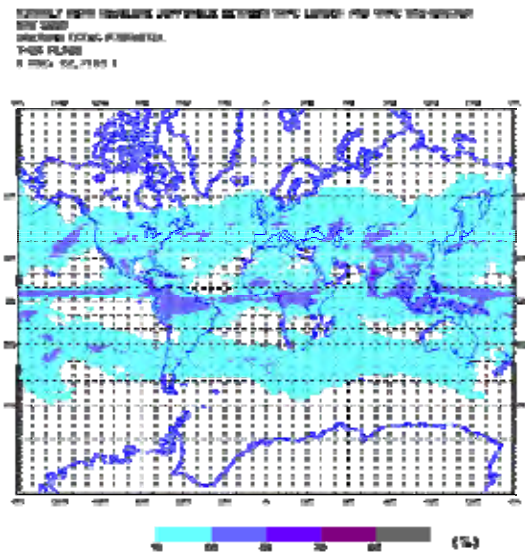
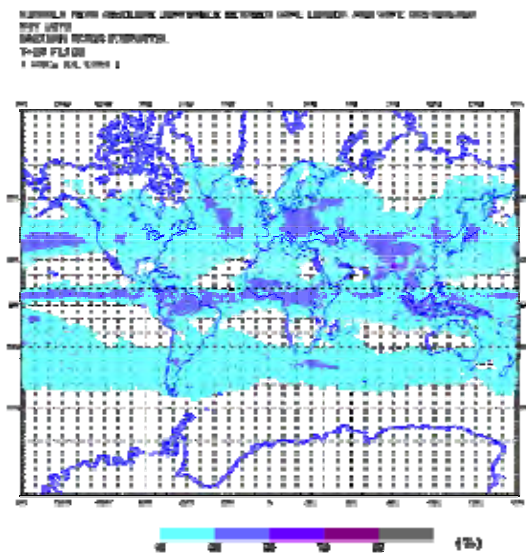


Fig. 1(h)



Mean Monthly Absolute Difference in the T+24 h Gridded Forecasts  
of the two WAFCs (“Maximum icing potential at FL180” for (g) May 2009 (h) May 2010)

Fig. 1(i)

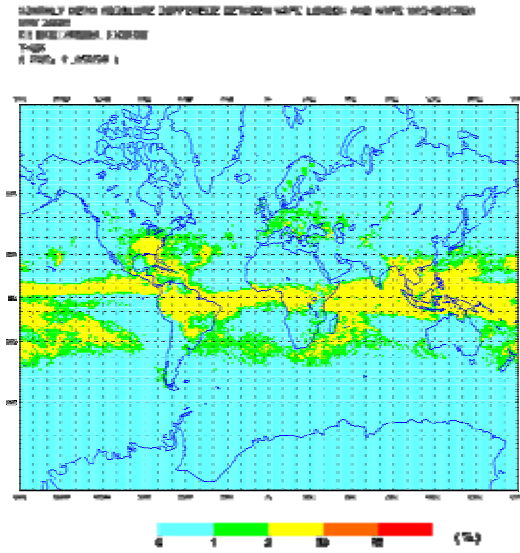
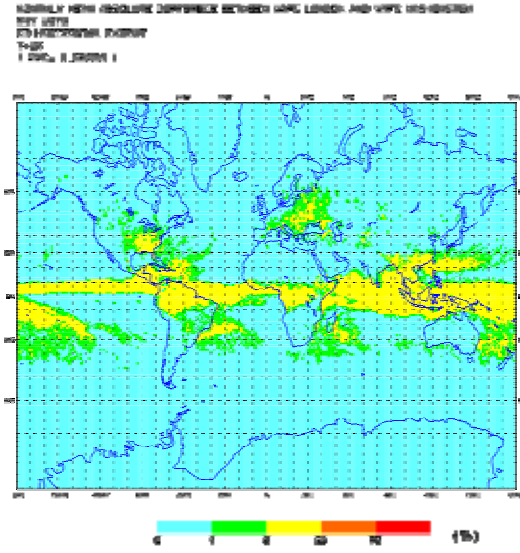


Fig. 1(j)



Mean Monthly Absolute Difference in the T+24 h Gridded Forecasts  
of the two WAFCs ("CB horizontal extent" for (i) May 2009 (j) May 2010)

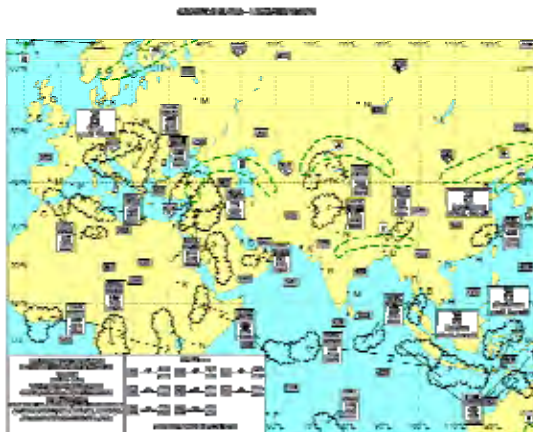


Fig.2(a) SIGWX forecast (BUFR format)  
issued by WAFC London  
(jetstream information missing)



Fig. 2(b) SIGWX forecast (PNG format)  
issued by WAFC London  
(jetstream information included)



# **ASIA/PAC WAFS Implementation Plan and Procedures**

12<sup>th</sup> Edition - July 2009

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# ASIA/PAC WAFS Implementation Plan and Procedures

12th Edition - July 2009

## Introduction

1. The Asia/Pacific WAFS Implementation Plan and Procedures has been revised to take account of progress made in the region.

## The Implementation of WAFS

2. This plan is based on the understanding that the implementation of WAFS in the Asia/Pacific Region involves:

- a. Production and dissemination by the WAFCs of global forecast winds, temperatures, tropopause height, tropopause temperature and humidity in GRIB format.
- b. The implementation of a communication system/s for the distribution of WAFS products in the Asia/Pacific Region, to all the States that require the products in support of international air navigation. This will be achieved via satellite broadcast (SADIS and ISCS/2). States may need to use an alternative distribution system.
- c. The production and distribution (via satellite broadcast) by the WAFCs, of Global, quality controlled SWH (FL 250 - 630) in BUFR format and in PNG format for the ICAO standard areas.
- d. The production and distribution (via satellite broadcast) by the WAFCs of quality controlled SWM (FL 100 - 250) in BUFR format and in PNG format over limited geographical areas where required by PIRGs.
- e. The capability of States to convert current BUFR and GRIB messages to graphical products on an operational basis.
- f. Transition from SADIS 1G to SADIS 2G service.
- g. Transition from ISCS G2 to ISCS G3 service.
- h. Implementation of WAFS Internet File Server (WIFS).
- i. Development and utilization of gridded forecasts of icing, turbulence and convective clouds.
- j. Transition from GRIB1 to GRIB2 WAFS data.

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## **SIGWX Forecasts**

3. There will be an ongoing requirement for NMSs to monitor the quality of WAFC products.
4. Action required to be taken by States to adhere to the provision of Annex 3 to ensure the relevant advisories for tropical cyclones, volcanic ash, the accidental release of radioactive material and SIGMETs are made available to the WAFCs in a timely manner. The WAFS Implementation Task Force will coordinate with the ICAO Secretariat and the VAACs in the Region to also make available ASHTAMs and NOTAMs for VA to the WAFCs in a timely manner.
5. The SIGWX forecasts produced by WAFC Washington are also available on the US NWS Aviation Weather Center Internet site at: <http://www.nws.noaa.gov/iscs>. All WAFC London and WAFC Washington products are available on the internet-based SADIS FTP server, together with appropriate GRIB and BUFR decoding facilities (Note: not including the visualization software).
6. States are encouraged to provide inputs to the surveys on the operational efficacy of SADIS and ISCS/2 for the purpose of improving the quality of service and to send comments to the WAFCs about the quality and accuracy of SIGWX on a frequent and regular basis. Contact details for comments are:

### **WAFC Washington**

- i. NWS/Aviation Weather Center  
Attention: Mr Michael Pat Murphy  
Science Officer  
7220 NW 101<sup>st</sup> Terrace  
Kansas City, Missouri  
USA 64153-2371
- ii. E-mail addressed to: Michael.Pat.Murphy@noaa.gov
- iii. Fax number: 1 816 880 0650

### **WAFC London**

- i. The Met. Office  
Attention: Mr. Nigel Gait  
International Aviation Manager  
Fitzroy Road  
Exeter  
Devon EX1 3PB  
United Kingdom
- ii. E-mail addressed to: nigel.gait@metoffice.com
- iii. Fax number: +44 (1392) 885 681

## **Gridded Forecasts of Icing, Turbulence and Convective Clouds**

7. Gridded forecasts of icing, turbulence and convective clouds are made available on a trial basis by the two WAFCs via the Internet for evaluation by NMSs. Visualization of the gridded forecasts to provide “at a glance” products for flight planning purposes is being developed by the WAFCs. Regional training will be provided to WAFS users on the utilization of the gridded forecasts.

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## **Distribution of WAFS Products**

8. The two WAFCs distribute by satellite broadcast global forecast winds, temperatures, tropopause height, tropopause temperature and humidity in GRIB format, global quality controlled SWH and quality controlled SWM for limited geographical areas in PNG and BUFR formats. Suitable decoding and visualization software is required by States in the Asia/Pacific Region to operationally construct graphical SIGWX from the BUFR messages. The provision of PNG formatted SIGWX charts is expected to continue at least until 2010.

## **Transition from SADIS 1G to SADIS 2G service**

9. On 12 November 2004, WAFc London launched the SADIS 2G service that was required as a result of SADISOPSG Conclusion 9/15. This new service is available to new and current SADIS users. The SADIS 1G service has ceased operation on 5 January 2009. States should arrange for the procurement of the necessary hardware, and as necessary, compliant visualization software for transition to the SADIS 2G service in time. Guidance material for users accessing the SADIS 2G broadcast is available at the SADIS web site – <http://www.metoffice.gov.uk/sadis/index.html>.

## **Transition from ISCS G2 to ISCS G3 service**

10. WAFc Washington plans to implement the ISCS G3 service and to terminate the existing ISCS G2 service by 30 June 2012. The WAFS Internet File Server (WIFS) will also be implemented by March 2010. Upon advice of the implementation plan from WAFc Washington, States should make the arrangements for the installation of the necessary hardware for transition to the ISCS G3 in time.

## **Indicative Timetable for Implementation of WAFS**

11. The table given in Attachment 1 provides an indicative timetable for the implementation of WAFS within the Asia/Pacific Region.

## **Volcanic Ash Advisory Centres (VAACs)**

12. The VAACs are encouraged to monitor WAFS SIGWX forecasts that cover their areas of responsibility, and to advise the appropriate WAFc to ensure the accurate inclusion of the volcanic ash symbol.

## **Tropical Cyclone Advisory Centres (TCAC)**

13. The TCACs are encouraged to monitor WAFS SIGWX forecasts that cover their areas of responsibility, and to advise the appropriate WAFc to ensure the accurate inclusion of the tropical cyclone symbol.

14. The operational contact points in the WAFcs for coordination with the VAACs and TCACs are:

### **WAFc Washington**

- i. NWS/Aviation Weather Center

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- 7220 NW 101<sup>st</sup> Terrace  
Kansas City, Missouri  
USA 64153-2371
  - ii. Tel: 1 816 584 7269

**WAFC London**

- i. The Met. Office  
Attention: WAFC London Forecaster  
Fitzroy Road  
Exeter  
Devon EX1 3PB  
United Kingdom
- ii. Tel: 00-44-1392-884926 or 00-44-1392-884908

**ASIA/PAC WAFS Implementation Plan and Procedures****Attachment 1***Indicative Timetable for Implementation of WAFS*

<b>Item</b>	<b>Task/Stage of Implementation of WAFS</b>	<b>Anticipated Date</b>
1	W AFC London products on access controlled internet site	Completed
2	The establishment of back-up distribution arrangements for WAFS products	Completed
3	Training in the operational conversion of GRIB forecasts to Wind / Temp charts	Completed
4	All states that receive GRIB products capable of converting GRIB forecasts to Wind / Temp charts	Completed
5	Removal of T4 Facsimile Wind / Temp charts from the satellite broadcast	Completed
6	Training in the operational conversion of BUFR to SIGWX charts	Completed
7	States having the ability to operate the decoding software to convert BUFR SIGWX messages into graphical format	Completed
8	The satellite distribution by the two WAFCs of global SWH and of SWM for limited geographical areas in BUFR format	Completed
9	Launch of SADIS 2G service	Completed
10	SADIS 2G seminar for ASIA/PAC States	Completed
11	Removal of T4 Facsimile SIGWX products from the satellite broadcast	Completed
12	Procurement of SADIS 2G hardware by SADIS user States	Completed
13	Termination of the SADIS 1G service	Completed

<b>Item</b>	<b>Task/Stage of Implementation of WAFS</b>	<b>Anticipated Date</b>
14	Launch of trial gridded forecasts of icing, turbulence and convective clouds	Completed
15	Implementation of ISCS G3 service	TBD
16	Implementation of WAFS Internet File Server (WIFS)	March 2010
17	Workshop on gridded forecasts of icing, turbulence and convective clouds	September 2009
18	WAFCs begin parallel broadcast of WAFS forecasts in the GRIB2 code form	mid-late 2009
19	WAFCs provide web-based gridded forecasts of icing, turbulence and convective clouds	2010/2011
20	Regional training on the use of the gridded forecasts	2010-11
21	WAFS end-user workstations upgraded to accept the GRIB2 code form	November 2011 – November 2013
22	Termination of the ISCS G2 service	30 June 2012
23	Broadcast of WAFS forecasts in the GRIB 1 and WAFS SIGWX forecasts in the BUFR code form and PNG chart form ceases	November 2013

## ASIA/PAC WAFS IMPLEMENTATION TASK FORCE

### 1. Terms of Reference

Expedite the implementation of the World Area Forecast System (WAFS) in the Asia and Pacific Regions.

### 2. Work Programme

The work to be addressed by the ASIA/PAC WAFS Implementation Task Force (WAFS/I TF) includes:

- (a) Coordinating the outstanding implementation of SADIS 2G service in the Asia and Pacific Regions.
- (b) Coordinating the migration of ISCS G2 service to ISCS G3 service in the Asia and Pacific Regions.
- (c) Coordinating the arrangement of training and providing user's feedback on the utilization of gridded forecasts of icing, turbulence and cumulonimbus clouds.
- (d) Coordinating the migration of GRIB1 to GRIB2 WAFS data.
- (e) Coordinating the provision of assistance to States to ensure that WAFS can be effectively implemented in the Asia and Pacific Regions.
- (f) Providing inputs (via the CNS/MET SG) to APANPIRG on the regional planning and development of WAFS for coordination with the WAFSOPSG.
- (g) Keeping the ASIA/PAC WAFS Implementation Plan and Procedures up to date.

The work is expected to be carried out primarily by correspondence.

### 3. Composition

The Task Force is composed by experts from:

Australia; Hong Kong, China (Chairman); India; Japan; New Zealand; Singapore; Thailand; United Kingdom; United States and IATA.

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