



International Civil Aviation Organization

**MIDANPIRG Meteorology Sub-Group
Ninth Meeting (MET SG/9)**

(Virtual Meeting, 7 - 9 December 2020)

Agenda Item 4: Review of the implementation of WAFS and SADIS

SADIS AND WAFS UPDATE

(Presented by the SADIS Provider)

SUMMARY

This paper provides an update on changes to the World Area Forecast System (WAFS) and changes in the operation of the WAFS London operated Secure Aviation Data Information System (SADIS).

Action by the meeting is at para 6.

1. INTRODUCTION

1.1 This paper reports on SADIS operational matters and significant upcoming changes in the provision of data on SADIS. These changes have been agreed through the ICAO Met Panel Meteorological Operations Group (MOG) at its annual meetings. The reports from these meetings are published publicly and are available here: <https://www.icao.int/airnavigation/METP/Pages/MOG.aspx>.

1.2 The upcoming changes to SADIS and WAFS data are in line with the ICAO Global Air Navigation Plan, Aviation System Block Upgrades.

2. Operational SADIS matters

2.1 SADIS Efficacy Survey

2.1.1 The annual SADIS efficacy survey has now commenced, and the ICAO Secretariat has sent out a memo to all regional offices imminently, so an additional State level notification should be received soon.

2.1.2 The survey is available via: <https://response.questback.com/metoffice/0hsdv4qtmh> and will close on 31 December 2020.

2.1.3 The SADIS provider would like to thank those who responded last year and would like to encourage all SADIS users to participate in the 2020 Survey.

2.2 SADIS Data Catalogue

2.2.1 A catalogue of data usually present on SADIS has been created (from data obtained during

the February 2020 monitoring period) so that missing TAF and METAR data can be more easily identified. The latest edition of the catalogue is hosted within the documentation section on the SADIS server, and the WG-MOG public webpage (<https://www.icao.int/airnavigation/METP/Pages/Public-Documents.aspx>).

2.2.2 If a SADIS user identifies that some METAR or TAF data is absent, the list should be consulted to see if it is usually present before reporting it to the SADIS Manager (sadis.manager@metoffice.gov.uk). There are two courses of action:

- The aerodrome is listed: the SADIS manager will raise the issue with ROC London who will investigate and work with the other ROCs to try and restore the data.
- If the aerodrome is not listed: the data feeds will be checked to see if the data is available however it may be necessary for the SADIS user to contact the State in question to ask for it to be disseminated internationally.

2.3 WAFS Verification Data

2.3.1 Verification data for harmonized WAFS gridded upper air forecasts for Clear Air Turbulence potential and Cumulonimbus cloud forecasts is available from the "WAFC London Performance Indicators" webpage: <http://www.metoffice.gov.uk/aviation/responsibilities/icao>. Information on the timeliness of these data sets is also provided.

2.3.2 Verification data for harmonized WAFS gridded upper air forecasts for Icing potential is available from the "WAFC Washington webpage: <http://www.emc.ncep.noaa.gov/gmb/icao/>.

2.3.3 The verification data should be used in conjunction with the guidance material available on the WG-MOG public webpage (in the MOG-WAFS Reference Documents section).

2.4 SADIS Workstation Evaluations

2.4.1 The SADIS provider has put together a SADIS evaluation guide which users can use to evaluate their own systems. The intention of this guide is to assist users in identifying problems with their SADIS data visualization system/software by clearly showing what constitutes an acceptable standard. Users can then feed back any "non-compliance" issues to their software provider.

2.4.2 The new guide is called the 'SADIS Workstation Evaluation Guide' and is hosted in the documentation section on SADIS as well as on the WG-MOG public webpage.

2.4.3 Individual SADIS Workstation evaluations can still be carried out by the SADIS provider if required, however this work will be chargeable. Please contact the SADIS to discuss costs and an evaluation schedule should this be required.

3. 5 November 2020 SADIS Upgrades

3.1 IWXXM format data

3.1.1 On 5 November 2020, ICAO Annex 3 - *Meteorological Service for International Air Navigation* makes it mandatory for States to produce their METARs, TAFs, SIGMETs, AIRMETs, VAA and TCAs in IWXXM format (ICAO Meteorological Information Exchange Model).

3.1.2 Development work on SADIS is partially complete, and SADIS is now publishing any IWXXM data that is internationally disseminated and sent to ROC London as "last 1-minute" and "last

5-minute” files. At the time of writing, only European data is being received. Development work will be completed by the end of November which will add archives of 5-minute files and hourly files to SADIS.

3.1.3 IWXXM data will be provided on SADIS as sets of nested zipped files, with 1 minute, 5 minute and hourly files available. For example the 5 minute zip file will contain up to 5 of the 1 minute files (note: a 1 minute file is only created if any new data comes in, so there may not be a file for every minute).

3.2 0.25 degree WAFS hazard data

3.2.1 On 5 November 2020, improved WAFS data sets were introduced in line with changes listed in ICAO Annex 3 Amendment 79.

3.2.2 The new turbulence field called “Turbulence Severity” uses the Graphical Turbulence Guidance forecast techniques that were developed by the National Center for Atmospheric Research (NCAR). These algorithms are able to forecast both clear air turbulence and orographic turbulence, and provide an eddy dissipation rate (EDR) which is a turbulence measure that is independent of aircraft type.

3.2.3 The new icing field called “Icing Severity” gives a categorical assessment of icing (Nil, Trace, Slight, Moderate and Severe) and uses improved icing algorithms.

3.2.4 Turbulence Severity and Icing Severity, along with the three cumulonimbus fields (extent, base and top) are being produced with a horizontal resolution of 0.25 degrees. Timesteps remain unchanged, with data provided for 6-hours to 36-hours at 3 hourly intervals. The levels the data is provided for is largely unchanged, however there will be three new turbulence layers which compensate for the retirement of the in-cloud turbulence field.

3.2.5 A useful summary document about the changes is included as Appendix A to this document. Additional training material is currently being prepared.

3.2.6 The new data sets are available on SADIS in the /GRIB2/COMPRESSED/EGRR/ directory.

3.2.7 The existing Turbulence Potential, Icing Potential and 1.25 degree cumulonimbus fields will be left unchanged, and will continue to be published on SADIS until November 2022. The in-cloud turbulence field will be retired.

3.2.8 No changes will be made to the wind, temperature, relative humidity and geopotential height fields in November 2020.

4. November 2023 WAFS and SADIS upgrades

4.1 Both WAFCs have been working to define the next generation WAFS provision, which will bring an upgrade in the horizontal, vertical and temporal resolution to all WAFS data sets. This includes:

- the provision of wind, temperature, relative humidity and geopotential height at 0.25 degree resolution
- data at 1000ft flight level intervals
- data at 1-hourly intervals from 6-hours to 24-hours, three hourly intervals from 27-hours to 48-hours, and wind and temperature data at 6-hourly intervals out to 120-hours.

4.2 Increasing the resolution of the data has a huge impact on the volume of data available, and therefore the delivery mechanism also needs to be upgraded. Up to now SADIS users have only been able to download complete global data sets. The next generation WAFS Delivery System (system name still to be determined) will be SWIM¹ compliant, use web-coverage services (WCS²) and APIs³ to enable users to customize the data sets that are downloaded. For example, it will be possible to only download data for a specific flight information region, or certain vertical levels, which should make managing the volume of data easier for downstream users.

4.3 OPMET data, mainly in IWXXM format, will also be made available in the same way, with users given the ability to choose which specific data they would like.

4.4 The WAFS SIGWX forecasts will get a radical overhaul in November 2023 when SIGWX forecasts will be produced for 3-hourly intervals for the 6-hour to 48-hour period. Medium level SIGWX charts will be retired, and instead a single SIGWX forecast that covers the airspace between FL100 and FL600 will be produced in IWXXM format. BUFR format SIGWX will be retired 2 years later, and WAFS produced “paper copy” SIGWX charts for T+24 will cease in 2028. It should be noted that ICAO Annex 3 has stated for many years that the digital version of SIGWX forecasts should be used, and should be integrated into flight planning and meteorological visualization software from which a customized “paper copy” chart relevant for a specific flight can be created if needed.

4.5 The exact changes that have been agreed by the MET Panel can be found in https://www.icao.int/airnavigation/METP/MOG%20Meeting%20Reports/METP_WG-MOG-12-WAFS_Meeting_Report_final.pdf

4.6 Further information on the planned changes can be found on <https://www.metoffice.gov.uk/services/transport/aviation/regulated/wafs-2022>. It should be noted that these changes were originally planned to become operational in November 2022, however COVID-19 has impacted project planning, and the implementation date has been pushed back to November 2023.

4.7 The existing SADIS FTP server will continue to run until November 2028, however it will not host the upgraded WAFS gridded or SIGWX data sets.

4.8 The SADIS manager (sadis.manager@metoffice.gov.uk) is happy to answer any questions relating to the planned changes.

5. CONCLUSION

5.1 Significant changes to the data provided on SADIS have recently been implemented (in November 2020), and further changes will come in November 2023. The group is invited to consider formulating the following Draft Conclusions:

DRAFT CONCLUSION 9/XX: 0.25 DEGREE WAFS HAZARD DATA

That, the SADIS users be invited to start integrating the new 0.25 degree WAFS hazard data into their systems and software.

¹ <https://www.eurocontrol.int/concept/system-wide-information-management>

² https://en.wikipedia.org/wiki/Web_Coverage_Service

³ https://en.wikipedia.org/wiki/Application_programming_interface

DRAFT CONCLUSION 9/XX NOVEMBER 2023 WAFS AND SADIS UPGRADES

That, the SADIS users familiarize themselves with the proposed WAFS and SADIS changes planned for November 2023, and commence preliminary discussions with their technical departments about how their organization could adapt to these technological changes.

6. ACTION BY THE MEETING

6.1 The meeting is invited to:

- a) note the information contained in this paper; and
- b) discuss any relevant matters as appropriate.

In November 2020 the WAFS hazard gridded data sets available on SADIS and WIFS will be updated.

New Icing Severity, and Turbulence fields at a 0.25 degree horizontal resolution will be published, along with 0.25 degree cumulonimbus extent/base/top.

On SADIS the files will be published in GRIB2 format using the following file naming conventions:

	T ₁	T ₂	A ₁	A ₂ (Timestep)	ii (first two digits of pressure in hPa)	CCCC
Icing Severity	Y	I	Y	C, D, E, F, G, H, I, J, K, L, M	80, 70, 60, 50, 40, 30	EGRR / KWBC
Turbulence	Y	L	Y	C, D, E, F, G, H, I, J, K, L, M	70, 60, 50, 40, 35, 30, 25, 20, 15	EGRR / KWBC
CB Horizontal Extent	Y	B	X, Y	C, D, E, F, G, H, I, J, K, L, M	01	EGRR / KWBC
ICAO Height at CB Base	Y	H	X, Y	C, D, E, F, G, H, I, J, K, L, M	02	EGRR / KWBC
ICAO Height at CB Top	Y	H	X, Y	C, D, E, F, G, H, I, J, K, L, M	03	EGRR / KWBC

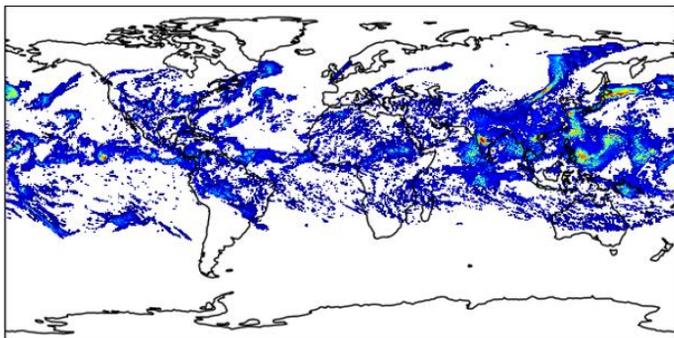
The A1 indicator “Y” denotes that this is a 0.25 degree data set.

Icing Severity

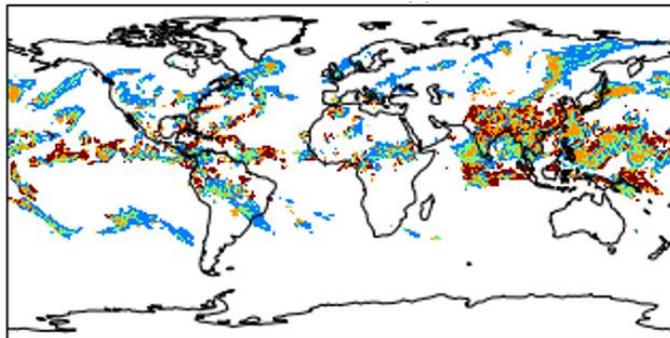
The new icing severity forecasts, provided for FL060, FL100, FL140, FL180, FL240 and FL300, brings improved algorithms and incorporates temperature, cloud fraction, vertical velocity and cloud liquid + cloud frozen water content. Instead of providing a value in the 0 to 1 (or 0 to 100% range) the data is categorized into to icing intensities.

A comparison of the old Icing Potential and new Icing Severity fields is shown below:

WAFS Icing Potential, FL240



WAFS Icing Severity, FL240



It can be seen that the new Icing Severity field contains much more distinct icing areas. More moderate/severe icing is forecast, particularly in the tropics; this is due to an improvement in the way convective icing is calculated.

IMPORTANT NOTE: Within the GRIB 2 coding, a new parameter number “37” is used. This is being added to the WMO No. 306 FM-92 GRIB code form in May 2020 into code table 4.2-0-19, and a new code table is being created.

The new code table will be as shown to the right:

Please be aware that there is a possibility that the parameter number could change to 37 before this data becomes operational

Code Figure	Meaning
0	None
1	Trace
2	Light
3	Moderate
4	Severe
5-191	Reserved
192-254	Reserved for local use
255	Missing value

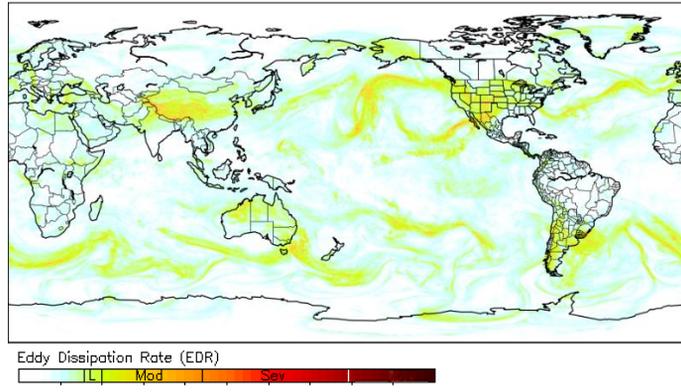
For further information e-mail SADISmanager@metoffice.gov.uk or ncep.awcweb@noaa.gov

Turbulence

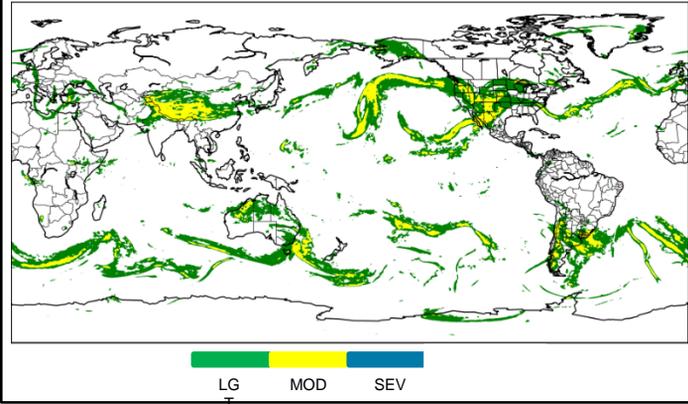
The new turbulence hazard grids, provided for FL100, FL140, FL180, FL240, FL300, FL340, FL390 and FL450 uses a multi-diagnostic algorithm, Graphical Turbulence Guidance (GTG) developed by the National Center for Atmospheric Research (NCAR). GTG forecasts clear air and orographic turbulence, and will provide output in terms of Eddy Dissipation Rate (EDR). EDR is an aircraft independent measure of turbulence, represented by values of 0 to 1.

Two ways of displaying this data are shown below:

WAFS Turbulence Severity , FL240



WAFS Turbulence Severity, FL240



IMPORTANT NOTE: ICAO Annex 3, Appendix 4, Section 2.6 describes how the EDR values relate to turbulence intensity for a medium sized aircraft – but please note that a revision to these figures have been proposed for Amendment 79 (applicable Nov 2020). These values are shown in the table to the right.

Further information on how GTG works can be found here:
<https://journals.ametsoc.org/doi/full/10.1175/JAMC-D-16-0205.1>

Turbulence shall be considered:

- Severe when the peak value of the EDR equals or exceeds 0.45;
- Moderate when the peak value of EDR is equal to or above 0.20 and below 0.45;
- Light when the peak value of EDR is equal to or above 0.10 and below 0.20
- Nil when the peak value of EDR is below or equal to 0.10

The EDR values given above describe the severity levels for a medium-sized transport aircraft under typical en-route conditions (i.e. altitude, airspeed and weight).

Cumulonimbus

There is no change to the algorithms being used to calculate cumulonimbus extent, base and top but they will be provided at 0.25 degree resolution.