



**INTERNATIONAL CIVIL AVIATION ORGANIZATION
WESTERN AND CENTRAL AFRICAN OFFICE**

AFI PLANNING AND IMPLEMENTATION REGIONAL GROUP (APIRG)

**SEVENTH MEETING OF THE METEOROLOGY SUB GROUP
(METS/7)**

(Dakar, 11 – 13 April 2005)

Agenda Item 3: WAFS in the AFI Region

Summary of Recent Changes to the WAFS and SADIS

(Presented by WAFC London)

Summary

A number of important changes to the WAFS and SADIS have been introduced during the past 12 months. Some of these changes have a direct impact on the end user. These impacts are raised in this working paper. The main changes include the introduction of the SADIS 2nd Generation (2G) service, BUFR encoded medium level SIGWX (SWM) data, and the introduction of new jet depth information.

1. Introduction

1.1 During the past 12 months a number of important changes to the WAFS and SADIS have been introduced. These changes include:-

- Introduction of the SADIS 2nd Generation (2G) Service;
- Introduction of jet depth information on SIGWX products;
- Introduction of BUFR encoded SWM data;
- Completion of the first round of WAFS software evaluations;
- Software procurement;
- Icing and Turbulence Conference;
- WAFC Backup Provision;
- Changes to BUFR data provision.

1.2 A number of further changes are anticipated within the next 12 months. These changes include:-

- Cessation of the WAFS T4 products;
- Introduction of WAFC London gridded icing and turbulence products for evaluation;
- Enhancements to the WAFS FTP Service.

1.3. These issues are considered in this paper, with particular emphasis given to the impact on the end user.

2. Discussion

2.1 Introduction of the SADIS 2G Service

On the 12 November 2004 WAFS 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 who would like to change to modern technology to receive their aviation data.

SADIS 2G offers the user many benefits, including:

- Access to ICAO Annex 3 products including all of the WAFS (World Area Forecast System) data and global quality controlled OPMET data.
- Use of the latest technology and up-to-date hardware making the service much more cost effective - savings in excess of 50 % of the cost of current generation SADIS hardware.
- SADIS 2G uses modern industry standard formats and protocols, including internet protocol (IP), making the service immediately compatible with most new end systems.
- SADIS 2G receivers are 'off-the-shelf' units, available from a variety of different suppliers.
- 24 hour, 365 day support available.
- Internet back-up service available to all users: SADIS data can be downloaded over the internet, direct to your desktop, covering any exceptional circumstances when the satellite broadcast is unavailable.
- Resolves problems of hardware obsolescence which is increasingly affecting the current SADIS service.

Annex 1 contains guidance material for current and prospective SADIS users who would like to access the SADIS 2G broadcast service.

Suggested Action: Consideration needs to be given by all users of the current (1G) SADIS service to change to the SADIS 2G service. Please review the guidance material contained in Annex 1 to this paper.

2.2 Termination of the SADIS 1G Broadcast

Conclusion 9/15 of the SADISOPSG requires the SADIS 1G service to be available in addition to the SADIS 2G service until 31 December 2008. To ensure that all SADIS users have migrated to the SADIS 2G service prior to this date it is recommended that States are regularly reminded via the PIRG meetings of their responsibility to make this change to the 2G service. An ICAO State letter was issued during mid-2004 informing users of the imminent introduction of the SADIS 2G service and the termination of the 1G service on 1 January 2009.

It will be proposed to the WAFS Operations Group and SADIS Operations Group that an international SADIS seminar is held during 2006 to assist users in the procurement of SADIS 2G hardware, and as necessary, compliant visualisation software.

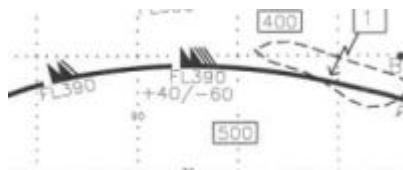
Summary: The current (1G) SADIS service will cease on 31 December 2008. All existing SADIS users must have migrated to the SADIS 2G service before this date

Suggested Action: It is strongly recommended that consideration is given to procuring the necessary SADIS 2G hardware well ahead of this final date. Consider attending the SADIS conference expected to occur during 2006.

2.3 Introduction of Jet Depth on WAFS SIGWX Products

Software changes have been made at WAFS London which enabled the production of jet depth information to commence from 25 November 2004 as required by amendment 73 to Annex 3. To minimise clutter on the SIGWX charts it was agreed with ICAO HQ via correspondence that jet depths (format +DD/-DD; DD height in hundreds of feet of 80kt isotach above and below the core of the jet-stream) would only be assigned at the jet vertex which marks the location of maximum speed, and only if the jet stream is of speed 120kt or more. Further information about this new data is included below.

- The vertical depth of a jet-stream at the point of maximum speed is now included on the SIGWX charts and in the BUFR data. In the example below we see a jet-stream west to east across central Asia. The jet-stream has a maximum speed of 130 knots at a height of FL390. Beneath the flight level we see some other information: +40/-60. This new information relates to the height of the 80 knot isotach in hundreds of feet above and below this position. In our example the 80 knot isotach is 4000 ft above and 6000 ft below the vertex, i.e. between 43000 ft and 33000 ft the wind is greater than or equal to 80 knots in speed.



- The new depiction scenario for jet-streams also enables crossing jets to be accurately displayed. The convention that has been agreed with ICAO displays the upper most jet-stream as a solid bold line, and the lower jet displayed with a physical break at the point of crossing.

The physical break referred to in the bullet point above is not explicitly encoded into BUFR. The lower jet-stream is encoded as a series of discreet latitude and longitude points from which user visualisation software needs to construct a smooth jet-stream (using a cubic spline routine) that includes a small break at the point of interaction with the uppermost jet.

Suggested Action: It is suggested that you contact your software vendor with a view to obtaining a software upgrade which includes the new BUFR depiction scenario for jet-streams.

2.4 Introduction of BUFR Encoded SWM Data

WAFS London commenced dissemination of operational BUFR encoded SWM data in early March 2005. Development work was carried out at both centres to ensure that production methods are consistent with current working practices and the methodologies employed to produce the BUFR encoded SWH data. To meet these objectives a number of significant technical challenges have had to be overcome. In addition one further bulletin (JUME00 EGRR) is required by the WAFSs to disseminate the SWM data. The complete SWM and SWH BUFR bulletin schedule is provided below.

BUFR FEATURES	COMMON NAME	WMO HEADER used by WAF C London	WMO HEADER used by WAF C Washington
Jet-streams	JETS	JUWE96 EGRR	JUWE96 KKCI
Clear Air Turbulence (C.A.T.)	CAT	JUCE00 EGRR	JUCE00 KKCI
Embedded Cumulo-nimbus	CLOUD	JUBE99 EGRR	JUBE99 KKCI
Tropopause height	TROP	JUTE97 EGRR	JUTE97 KKCI
Frontal Systems	FRONTS	JUFE00 EGRR	JUFE00 KKCI
Tropical Cyclone, Sandstorms & Volcanoes	V_T_S	JUVE00 EGRR	JUVE00 KKCI
SWM Tropopause height	M-TROP	JUOE00 EGRR	JUOE00 KKCI
SWM jet-streams	M-JETS	JUTE00 EGRR	JUTE00 KKCI
SWM fronts	M-FRONTS	JUJE00 EGRR	JUJE00 KKCI
SWM cloud, in-cloud icing and turbulence	M-CLOUD	JUNE00 EGRR	JUNE00 KKCI
SWM Clear Air Turbulence (C.A.T.)	M-CAT	JUME00 EGRR	JUME00 KKCI

The WAFS BUFR specification document titled “Representing WAFS SIGWX Data in BUFR” has been updated to a V2.5 to incorporate the SWM BUFR specification. This document is available from the WAFSOPSG web site at URL <http://www.icao.int/anb/wafsopsg/guidelinesUK.pdf>

Suggested Action: It is suggested that you contact your software vendor with a view to obtaining a software upgrade which includes the new SWM BUFR depiction. *Consideration needs to be given to the financing and implementation of subsequent software upgrades that will be required in the future as further changes to the BUFR standard are required.*

2.5 Software Evaluations

Five WAFS visualisation systems can now be considered compliant to the SADISOPSG software criteria. Details of these systems and the results obtained from the latest software evaluation are available from URL: <http://www.metoffice.gov.uk/sadis/software/index.html>

Following a Conclusion from the recent Asia/Pacific CNS-MET SG/8 meeting that will be studied by WAFSOPSG/2 in a global context, it is very likely, subject to available resource, that a further round of software assessments will be scheduled during 2005. The new requirement that has been proposed will make it a mandatory requirement for the commercial visualisation packages to have the capability of producing SIGWX charts for the standard ICAO areas in an automated way.

Suggested Action: Study the results from the first round of software evaluations - <http://www.metoffice.gov.uk/sadis/software/index.html> Consider using this information as a component of your future procurement process for new workstation software.

2.6 Software Procurement

The SADISOPSG Workstation Software Team reported to SADISOPSG/9 about the outcomes of its work regarding the possibility of assisting States in the procurement of new workstation software. Unfortunately few options appear to be available because funding via the SCRAG had been ruled out, and it was considered that WMO VCP funding was the only viable option for upgrading SADIS workstations. In this regard SADISOPSG/9 formulated Conclusion 9/16 that invited WMO to encourage donor States to contribute to the WMO Voluntary Cooperation Programme (VCP) for upgrading SADIS workstations.

Suggested Action: If required, consider approaching WMO with regards to seeking VCP funding for new workstation software.

2.7 Icing and Turbulence Conference

W AFC London in conjunction with ICAO and WMO hosted a scientific workshop at its headquarters in Exeter, UK during 21 to 22 February 2005.

The objective of the workshop was to bring together experts in the field of operational forecasting of icing and turbulence in order to improve the forecast algorithms to be used in the development of automated global forecasts of these parameters by the World Area Forecast Centres.

Full details of the event were posted on the Met Office website with a link from the ICAO WAFSOPSG page.

http://www.metoffice.gov.uk/aviation/services/workshop_dagfit.html

Suggested Action: No action required.

2.8 W AFC Backup Provision

The W AFCs have carried out a series of backup tests during 2004 and 2005 to confirm the effectiveness of the current backup plan. The backup test schedule and subsequent test results are available from the WAFSOPSG web site at URL: <http://www.icao.int/anb/wafsopsg/index.html> The recent series of backup tests have been largely transparent to end users.

Operational backup has been used on a small number of occasions by both centres. All of these events were executed successfully.

W AFC London is enhancing its backup arrangements for provision of GRIB data. The objective is to continue to provide consistent operational data using routine bulletin headers in the event of successive model and system failures. An on-going programme of development will help W AFC London work towards achieving this objective but it is clear that W AFC London must reserve the right to issue unmodified W AFC Washington GRIB data in the unlikely event of a sequence of system failures. In this regard it is strongly recommended that all end user systems are configured to accept both London and Washington GRIB data. SADIS users were reminded about this requirement on 11 June 2004, which is consistent with one of the SADISOPSG software criteria.

The SADIS ftp service has been renamed to more appropriately reflect its global customer basis. This service should now be called the "WAFS FTP Service". The user base has expanded rapidly and now exceeds one hundred recipients of the data covering both the SADIS and ISCS footprints.

Suggested Action: Review the W AFC backup plan available from the ICAO web site at <http://www.icao.int/anb/wafsopsg/index.html> Ensure that your workstation can accept data issued by both W AFC London and W AFC Washington.

2.9 Changes to BUFR Data Provision

W AFC London has been issuing operational BUFR encoded SWH data throughout the year. A number of changes to the BUFR encoding sequence were made during 2004 and early 2005 which necessitated changes to end user software. This impact on the end users is a natural consequence and disadvantage of using the BUFR code where responsibility for SIGWX chart production shifts from central control by the W AFC to the end user. Specific changes that have been made to the BUFR encoding sequence are detailed below:-

- On 15 April 2004 we informed users that the decode of figure 12 in BUFR table 011031 should be "MOD OCNL SEV" [CAT]. This decode applies to any BUFR encoded WAFS SIGWX information issued by either W AFC London or W AFC Washington. This advice was a departure from earlier guidance, and a departure from the normal category assigned to figure 12 in this BUFR table (Extreme CAT), but to ensure that current WAFS BUFR data is correctly decoded it was recommended that the change was made with immediate affect. Notification was provided via a

SADIS administrative message (NOUK10 EGRR) and via a direct email to known users of the BUFR encoded SIGWX data.

- On 2 August 2004 we informed users that changes would be introduced to the way in which jet-streams are encoded in BUFR. This change was required to enable the WAFCs to commence issue of vertical height information at points of maximum jet speed as required by amendment 73 to Annex 3.

The second of these changes did cause some difficulties to a small number of users and highlights the importance of having previously agreed implementation dates for changes to BUFR sequences. This important topic is addressed in section 5.4 and Annex 1 to this report.

The following more recent changes (March 2005) were brought to the attention of users on 12 November 2004 and again 6 January 2005 and are summarised below.

- WAFc London started using descriptor 011030 (degree of turbulence) in association with data contained within bulletin JUCE00 EGRR which is used to encode Clear Air Turbulence (CAT). This descriptor replaces 011031 which is currently used. This change will affect all users of SWH BUFR and users are advised to contact their software vendor immediately with the intention of receiving a software upgrade.
- WAFc London changed the BUFR descriptor used for height in bulletin JUWE96 EGRR (SWH jet-streams). The current descriptor 0 10 002 changed to descriptor 0 07 010. This change will affect all users of SWH BUFR who are advised to contact their software vendor immediately with the intention of receiving a software upgrade.
- WAFc London made a minor change to the message header information contained within BUFR bulletin JUVE00 EGRR (tropical cyclones, volcanoes, sandstorms, radiation events). This was required so that the heights listed within the header reflect the fact that the bulletin is equally applicable to SWH and SWM data. An example of the new message header is provided in the BUFR Guidelines document.
- WAFc London provided developers with new BUFR decode software that was compliant with these changes during January 2005. This new software was *not* backward compatible with current BUFR encoded bulletins. Test SWM BUFR encoded bulletins was made available at the same time.

Suggested Action: Check that your workstation software can fully utilise the latest BUFR encoded SWM and SWH issued by both WAFCs. Consider approaching your software supplier for a software upgrade if the BUFR data cannot be displayed correctly.

2.10 Cessation of the WAFS T4 Products

The 2002 MET Divisional Meeting concluded that the WAFS SIGWX and wind & temperature charts in the T4 format would be removed from the SADIS and ISCS broadcast on 1 July 2005. From this date these products would be formally replaced by the BUFR and GRIB encoded products respectively. At the time of writing this paper there is some uncertainty as to whether this date will remain valid for termination of the T4 SIGWX products. The WAFS Operations Group will be asked to consider extending the period of distribution until 31 December 2006. This position would be endorsed by WAFc London which believes that 1 July 2005 is too early for some States. However it is the expectation that the T4 wind & temperature charts will be removed from the broadcasts on 1 July 2005.

It is the expectation of WAFc London that PNG versions of the WAFS SIGWX charts issued by WAFc London will be available from the WAFS FTP server for trial and evaluation by the time of the AFI MET/SG7 meeting. PNG versions of the WAFc Washington SIGWX charts will become available at a later date during the year.

These PNG formatted charts can be viewed via a standard web browser. There is no need to have bespoke visualisation software to display them.

Suggested Action: Ensure that compliant WAFS visualisation software is available prior to 1 July 2005 so that the GRIB and BUFR encoded products can be used effectively. Consider accessing the PNG versions of the SIGWX charts from the WAFS FTP server and provide feedback to ICAO and WAFS London about the usefulness of these products.

2.11 Introduction of WAFS London Gridded Icing and Turbulence Products

Regional guidance on where aircraft might encounter icing conditions and turbulence is currently provided by WAFS forecasters in the graphical form of significant weather charts. In April 2003 the Met Office began developing software that will eventually allow WAFS London to produce global forecasts relating to icing and turbulence in the form of gridded numerical data. Various algorithms for producing such forecasts from the output of the Met Office's Numerical Weather Prediction model are under investigation. These include algorithms based on the methods used by forecasters to produce significant weather charts as well as alternative algorithms. The initial gridded numerical data fields that have been produced have been found to highlight approximately the same areas of the atmosphere as significant weather charts. Consideration is being given to placing some experimental fields on the WAFS FTP server for trial and evaluation.

Suggested Action: No action recommended at the current time.

2.12 Enhancements to the WAFS FTP Service

The WAFS FTP service is a key component of the WAFS service provision. Approximately 100 user accounts have been activated for both SADIS and ISCS. Any SADIS users within the AFI region who are not already users of this free service are invited to contact WAFS London (Richard Orrell: richard.orrell@metoffice.com) to establish an account.

Consideration is being given to further improve the resilience and security of the WAFS FTP service. Issues being considered include:-

- distributing data with digital certificates;
- using secure FTP (sftp);
- duplicating service provision at a remote site; and
- implementing NIPS (Network Intrusion Prevention System) and HIPS (Host Intrusion Prevention System).

Suggested Action: Contact WAFS London to establish an account on the WAFS FTP server if one is not currently in use.

3. Action

The MET SG is invited to review the content of this paper and to consider the suggested actions.

Annex 1 - Guidance Material for Users Accessing the SADIS 2G Broadcast

What do I need to do to access SADIS 2G?

A) Existing SADIS customers who want to access SADIS 2G

- 1) Visit the SADIS web site - <http://www.metoffice.gov.uk/sadis/index.html> for the latest information. Review the hardware and software procurement guidelines available at - http://www.metoffice.gov.uk/sadis/news/sadis_s_h_procure.html

Note: the current SADIS service will be terminated on 31 December 2008.

- 2) Contact the Met Office (Richard Orrell: Telephone +44 (0)1392 884892; Fax +44 (0)1392 885681; Email richard.orrell@metoffice.gov.uk) to register your intent to move to the SADIS 2G service.
- 3) Contact the SADIS 2G hardware suppliers – see attachment for contact details - with a view to obtaining quotations for an upgrade to the 2G service. Users will need to purchase the following components:-
 - a 2G compatible receiver (available from companies BURS Ltd., L-Teq, and Satelcom); and
 - a Satelcom MegaPAC.

Note 1: If you decide to purchase a BURS Ltd. receiver and you require the data to be available to you using the TCP/IP sockets protocol then there is no need to purchase a Satelcom MegaPAC as well. This output is a standard function of the BURS receiver.

Note 2: Satelcom and L-Teq can provide a “one-box” solution for the 2G receiver and MegaPAC which incorporates the two components inside one physical unit. This unit can be supplied as a hardened case if required.

Note 3: Users located very close to the edge of the SADIS footprint may have to purchase a new low noise block (LNB) and/or antenna. Discuss this potential requirement with the hardware suppliers.

- 4) Please inform the Met Office (Contact: Richard Orrell) when complete migration to the SADIS 2G service has taken place.

B) New SADIS users wanting to access the SADIS 2G service

- 1) Visit the SADIS web site - <http://www.metoffice.gov.uk/sadis/index.html> for the latest information. Review the hardware and software procurement guidelines available at - http://www.metoffice.gov.uk/sadis/news/sadis_s_h_procure.html
- 2) Contact the Met Office (Richard Orrell: Telephone +44 (0)1392 884892; Fax +44 (0)1392 885681; Email richard.orrell@metoffice.gov.uk) to register your intent to access the SADIS 2G service.
- 3) Contact your State Meteorological Authority to seek written authorisation that a SADIS system can be operated by your organisation within your State. Please send copies of this authorisation to:-
 - Bernard Perry, UK Met Authority, Civil Aviation Authority, CAA House., 45-59 Kingsway, London WC2B 6TE.
 - Your regional ICAO office.
 - Richard Orrell, Met Office, Fitzroy Road, Exeter, EX1 3PB, UK.
- 4) Contact the SADIS 2G hardware suppliers – see appendix for contact details– with a view to obtaining quotations for a full SADIS 2G VSAT (very small aperture terminal). Users will need to purchase, as a minimum, the following components:-
 - a 2G compatible receiver (available from BURS Ltd., L-Teq, and Satelcom);

- a Satelcom MegaPAC;
- an LNB (low noise block);
- an antenna (1.8metre or 2.4 metre are the standard diameter sizes); and
- appropriate low loss cable.

Note 1: If you decide to purchase a BURS Ltd. receiver and you require the data to be available to you using the TCP/IP sockets protocol then there is no need to purchase a Satelcom MegaPAC as well. This output is a standard function of the BURS receiver.

Note 2: Satelcom and L-Teq can provide a “one-box” solution for the 2G receiver and MegaPAC which incorporates the two components inside one physical unit. This unit can be supplied as a hardened case if required.

Note 3: Users located very close to the edge of the SADIS footprint may have to purchase a new low noise block (LNB) and/or antenna. Discuss this potential requirement with the hardware suppliers. Users located towards the centre of the satellite footprint may be able to use a smaller sized antenna. Seek guidance from the hardware suppliers prior to making your purchase.

5) Please inform the Met Office (Contact: Richard Orrell) when your system has been installed.

Contact Details for Supplier of SADIS 2G Hardware

Bradford University Remote Sensing (BURS) Ltd.

Services provided:-

- Provision of antennas, LNBS, and 2G compatible receivers*.
- On-site installation and training.
- Support and maintenance.
- Hardware repair.
- General satellite communications provision and troubleshooting.

**Note: the 2G compatible receiver is a “one-box” solution offering IP output only. A MegaPAC is not required in addition to this 2G receiver unless an alternative output protocol (e.g. X.25) is required.*

Contact Details:

Mr. Richard Stephenson.
 Bradford University Remote Sensing (BURS) Limited.
 Byril Barn, Wilsill, Nr. Pateley Bridge, Harrogate, HG3 5EA, UK.
 Telephone: +44 (0)1423 711933
 Fax: +44 (0)1423 711496
 E-mail: richard@bursrs.demon.co.uk

L-Teq

Services provided:-

- Provision of antennas, LNBS, 2G compatible receivers*, configured MegaPAC units.
- On-site installation and training.
- Support and maintenance.
- Hardware repair.
- General satellite communications provision and troubleshooting.

**Note: the 2G compatible receivers can be provided as standalone units, or incorporated into a single unit along with a MegaPAC.*

Contact Details:

Mr. Russell Rixon
 L-Teq
 Lapwing 440, Frimley Business Park, Frimley, Surrey, GU16 7SZ, UK
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 Fax: +44(0)1276 686550
 E-mail: rrixon@lteq.com
 Web: <http://www.lteq.com>

Satelcom

Services provided:-

- Provision of antennas, LNBS, 2G compatible receivers*, configured MegaPAC units.
- On-site installation and training.
- Support and maintenance.
- Hardware repair.
- Network provision.

**Note: The 2G compatible receivers can be provided as a standalone system, or incorporated into a single unit, along with a configured MegaPAC. Either option can be supplied as a "one box solution" which includes pre-delivery installation & configuration in a hardened flight case which is suitable for inclement conditions.*

Sales Contact Details:

Mr. Andrew Hughes
 Satelcom Ltd.
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 E-mail: andy.hughes@satelcom.co.uk