WORLD AREA FORECAST SYSTEM MANAGEMENT REPORT

March 2018 – February 2019

World Area Forecast Centre (WAFC) London
World Area Forecast Centre (WAFC) Washington

1. EXECUTIVE SUMMARY

Overview:

1) Both WAFCs continue to provide a valuable and reliable service to the aviation community, as evidenced by the detailed availability, timeliness and verification statistics provided in this Management Report.

2) The WAFCs are receptive to feedback and to the continued development of the WAFC portfolio to meet the stated requirements under the Aviation System Block Upgrade (ASBU) methodology, and this is demonstrated through separate papers presented to the WG-MOG/9 (WAFS) meeting.

3) Significant outages and issues that have affected WAFS service provision are detailed in section 3 of this report.

(24 pages)
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2. ROUTINE OPERATION OF THE WAFS

2.1 **WAFS Operational Product Changes -** No changes were made to the forecast data sets provided by WAFS.

2.2 **Harmonization of WAFS data -** No changes were made to the harmonised cumulonimbus CB cloud, icing and turbulence data sets during the period. The reliability of the harmonisation process is very high, and the contingency processes by which non-harmonised data are issued at a specified cut-off time have been demonstrated to be effective.

2.3 **WAFS Internet File Service (WIFS) Enhancements** – WIFS experienced multiple outages and slowdowns during this period, all for different reasons. The initial problems were due to a few users downloading all the data on WIFS multiple times per minute. These users were asked to modify their behaviour. The next problem was when the service provider still could not handle the load, so WAFC Washington contracted with a private web caching vendor to serve data that does not update very quickly, such as WAFS grids. When the service provider continued to have problems handling the load, WAFC Washington built its own web server farm to supplement the service provider until the provider completes a plan to double its capacity by late 2019. This combination of caching data, supplemental web servers and modifying user behaviour has stabilized WIFS since September 2018.

2.4 **Secure Aviation Data Information Service (SADIS) Enhancements**

2.4.1 The bandwidth capping applied to SADIS was removed in mid 2018, and the system now makes use of the full bandwidth available to the SADIS provider. SADIS data package priority is set below that of critical traffic, but above general web traffic, thereby ensuring a consistent service even in times of high internet traffic during severe weather days. Some minor adjustments to the directory structure were made in January 2019 to separate out Tropical Cyclone SIGMETS, and to prepare for the introduction of Space Weather forecasts

2.4.2 Development of a SADIS test server is underway, which will provide users with access to early IWXXM format data sets, and test gridded data sets. This will allow SADIS users to familiarise themselves and prepare for the new data sets ahead of November 2020 without putting the operational SADIS server at any risk.

2.5 **WAFC Significant Weather (SIGWX) Backup Tests**

2.5.1 The WAFCs conducted quarterly scheduled SIGWX backup tests during the management report period – see **Appendix B** to this **Attachment** for details. It should be noted that, in accordance with WG-MOG/3 (WAFS) Decision 3/1, two of the scheduled backup operations (11 July 2018 and 30 January 2019) were purposefully delayed by 1 hour.

2.5.2 Some problems were encountered during the backup on the 24 October 2018. The WAFC Washington png files were successfully created by WAFC Washington, but the BUFR files were not. They were subsequently issued approximately 55 minutes later than normal.

2.5.3 There was one additional scheduled SIGWX backup events on the VT 12 UTC on 6 December 2018, so that WAFC Washington could undertake some system upgrade work. This was followed by an additional unplanned backup for the 18 UTC run due to the upgrade work taking longer than expected. During both backups, all data was issued on time.

2.5.4 The backup test schedule and test results are also available from the WG-MOG web site at URL https://www.icao.int/airnavigation/METP/Pages/Public-Documents.aspx . Select ' Forthcoming and Historical Record of WAFC Backup Tests'.

2.6 **WAFC Coordination:**– The WAFCs continue to coordinate their activities:

- A WAFC coordination meeting was scheduled to be held at the National Center for Atmospheric Research (NCAR) laboratories in Boulder, Colorado, USA 28 – 31 January 2019, but was postponed until August 2019 due to a partial government shut down in the USA. In lieu of the January meeting the WAFCs convened three telcons to discuss actions and deliverables for WG-MOG 9 and 10 in April 2019.

- WAFC Washington hosted a WAFC London scientist in September 2019. The newly developed (re-coded) SIGWX object creator software was shared and tested. It should be noted that the WAFCs are awaiting IWXXM code to be developed for SIGWX objects.

- WAFC Science discussions take place via WebEx when required.

- Several 'Webinar' virtual meetings have been undertaken as necessary between the WAFCs during the period.

- Appendix D provides a list of ICAO and other meetings with content related to the operation of the WAFS.

2.6.1 **WAFC 'Web Chat' Coordination -** The WAFCs continue to convene a 'Web Chat' prior to the finalization of the each SIGWX forecast cycle. The WAFCs wish to thank the participants who have provided WAFC forecasters with valued input to the SIGWX forecasts. Details for joining the 'Web chats' can be obtained by contacting (wifs.admin@noaa.gov).

2.6.2 **WAFC Quality Management System** –

WAFC London – as a function of the Met Office – is ISO 9001:2015 and ISO 14001:2015 compliant. Twice per year, SGS (certification partners) visit the Met Office to monitor its compliance. Both the ISO 9001:2015 and the ISO 14001:2015 certificates are valid until 13 August 2020.

WAFC Washington, as a function of the National Weather Service's Aviation Weather Center in Kansas City, is ISO 9001:2015 compliant. The certificate is valid until December 28, 2021.

3. SERVICE CONTINUITY

3.1 Service Interruptions

3.1.1 WAFC London –

- There has been no interruption to WAFC London's capability to provide SIGWX forecasts during the period during the period of this report.

- There has been one interruption to WAFC London's capability to provide upper air gridded hazard forecasts (CB cloud, Icing and Turbulence) during the period. On 12 July for the 00Z and 06Z runs, the CB cloud, Turbulence and Icing data sets were not able to be published at all due to an internal system failure which stopped the data from being transferred properly. Additional procedures and monitoring have been put in place to so that should a similar incident re-occur, it is identified and rectified more quickly.

3.1.2 WAFC Washington –

- SIGWX Outage 6th Dec due to systems upgrade (see paragraph 2.5.3)

- Numerous WIFS outage due to IT problems (see paragraph 2.3)

4. WAFS Performance

A detailed, month by month analysis is provided in **Appendix A** to this report, and a high-level summary of that analysis is presented below:

4.1 WAFC London - Summary of availability and timeliness statistics:

4.1.1 SIGWX Forecasts:

- The availability and timeliness of WAFC London SIGWX BUFR and PNG data is very high. Through the period there was only 1 instance of WAFC London SIGWX BUFR/PNG data being later than the ICAO requirement. This was due to an internal system “go slow” on the 18th May 2018 which caused a 10 minute delay to the files reaching SADIS.

- There were only 3 occasions where WAFC London SIGWX corrections were issued. All instances were related to human error.

4.1.2 Upper air gridded forecast data

- The availability and timeliness of WAFC London upper air grid point data is very high, and all data was produced available prior to the ICAO requirement. The system used for the calculation of tropopause height and temperature was retired in May 2018 and due to the way its replacement works, these two parameters are now the last to become available on SADIS. On four occasions this delay was responsible for the T+4:20 threshold being missed, however an additional adjustment has been put in place that seems to have improved the timeliness of these parameters.

- There were two occasions, on consecutive model runs on 12th July, in which no CB cloud, icing and turbulence data was issued due to technical problems. This was caused by an unexpected communication fault between internal systems, and additional monitoring and documentation has been put in place to help prevent any further outages should the fault ever re-occur.

- There were 11 occasions where WAFC London issued non-harmonised CB cloud, icing and turbulence data. On 7 consecutive model runs on the 21st and 22nd August WAFC Washington had technical problems which preventing their unblended files from being sent out to WAFC London

	SIGWX BUFR	SIGWX PNG	Upper air gridded forecast data	Upper air gridded forecast data CB, icing, turbulence
Complete datasets issued later than ICAO target:	2 (0.14%)	3 (0.27%)	4 (0.27%)	2 (0.14%)
SIGWX Correction events	6 (0.41%)	6 (0.41%)	N/A	N/A
Non-harmonised GRIB2 data events	N/A	N/A	N/A	11 (0.75%)

4.2 WAFC Washington - Summary of availability and timeliness statistics:

4.2.1 SIGWX Forecasts:

The availability and timeliness of WAFC Washington SIGWX BUFR and PNG data is generally very high. However, there were a few instances where IT problems prevented the data from making it to the WIFS. The data in the tables also appears worse than it is, because the old issue of multiple copies making it to the WIFS has reoccurred. The accounting software only counts the arrival time of the last copy, so when it arrives past the due time, the data appears to be late, even though the first copy was on time. This also explains why the timeliness of PNGs is different than the BUFR data, even though they are both transmitted at the same time, as the BUFR files are more likely to be received at WIFS multiple times.

4.2.2 Upper air gridded forecast data

There were no occasions were WAFC Washington issued non-harmonised CB, icing and turbulence data. There were 6 occasions on August 21st and 22nd where WAFC Washington delivered incomplete gridded data sets, due to communications problems between the WAFC and its web host.

	SIGWX BUFR	SIGWX PNG	Upper air gridded forecast data	Upper air gridded forecast data CB, icing, turbulence
Complete datasets issued later than ICAO target:	1	1	0	0
SIGWX Correction events	7	6	N/A	N/A
Non-harmonised GRIB2 data events	N/A	N/A	N/A	0

4.3 WAFS Model Verification

Appendix C contains a selection of verification plots for wind, temperature, clear air turbulence potential, icing potential and CB cloud horizontal extent. Plots are provided for the North Atlantic and North Pacific areas along with a commentary.

- The full set of WAFC London performance indicators can be found here: http://www.metoffice.gov.uk/public/weather/aviation-wafc/#?tab=wafcPerformance

- The full set of WAFC Washington performance indicators can be found here: http://www.emc.ncep.noaa.gov/gmb/icao/

Please note that London provides combined WAFC verification for CAT and CB cloud horizontal extent while Washington provides the combined icing results, since these forecasts are harmonized by computer processing

Unfortunately, due to technical issues WAFC Washington has not been able to provide updated verification plots for this management report. Instead the plots and comments from last years management report have been included.

5. Development activities

5.1 The introduction of new icing severity and turbulence severity algorithms are planned for Amendment 79 to ICAO Annex 3, effective in November 2020.

5.1.1 Both WAFC Washington and WAFC London will use the same underpinning Graphical Turbulence Guidance (GTG) algorithms as developed by the US National Center for Atmospheric Research (NCAR). This will enable turbulence forecasts to be output in terms of an Eddy Dissipation Rate (EDR) measure, which is an aircraft-independent measure of turbulence.

5.1.2 WAFC London will be implementing an improved icing algorithm that takes into account different parameters such as cloud fraction instead of relative humidity, and will provide a categorical assessment of icing severity.

5.1.3 WAFC Washington has implemented a version of the NCAR Forecast Icing Severity algorithm to provide an assessment of icing severity.

5.1.4 With the November 2020 introduction of the improved hazard algorithms, the WAFCs will be offering these data sets at 0.25 degree resolution in addition to 1.25 degrees.

5.2 Plans have been formulated for the introduction of the next generation of WAFS gridded data sets (at 0.25 degree resolution, additional levels and timesteps) to be introduced with Amendment 80 to ICAO Annex 3 in November 2022. This change will also bring SWIM compliant services with data offered via API's (Application Programmer Interface)

Appendix A: WAFS Performance Indicator Tables (01 March 2018 to 28 February 2019)

The following tables provide information on:

- WAFC London GRIB2 availability (not including CB cloud, icing or turbulence parameters) on SADIS FTP and WAFC Washington availability on WIFS
- WAFC GRIB2 CB cloud, Icing and Turbulence availability on SADIS FTP and WAFC Washington availability on WIFS
- WAFC London SIGWX BUFR availability on SADIS FTP and WAFC Washington availability on WIFS
- WAFC London SIGWX PNG availability on SADIS FTP and WAFC Washington availability on WIFS
- The number of WAFC SIGWX Correction messages, by month
- The number of harmonization failures of WAFS GRIB2 CB cloud, icing, and turbulence

Note: The time reference, T+hh:mm is the time in hours and minutes measured from the nominal observation time of the data on which forecasts are based. For example, a complete WAFC GRIB2 forecast dataset based on 1200 UTC 'observations' is expected to be made available by T+4:20 (4 hours and 20 minutes after 1200 UTC). Forecasts necessarily require time for processing before they can be made available. It is important to note that while the WAFC's numerical weather prediction models typically make the GRIB2 forecasts available by T+4:20, the requirement in Annex 3 is for T+6:00 hours. WAFC forecasts are made available 4 times per day, based on 0000, 0600, 1200 and 1800 UTC 'observation' times; hence in a 30 day month 120 such forecasts would be expected to be issued.

WAFC GRIB2 Availability (not including CB, icing or turbulence parameters)

	WAFC London					WAFC Washington				
	Complete Sets on SADIS by					Complete Sets on WIFS by				
Month	T+4:20	T+6:00	Earliest	Latest	Average	T+4:20	T+6:00	Earliest	Latest	Average
Mar 2018	100 %	100 %	03:25	04:20	03:34	98.39%	99.19%	03:40	11:25	03:52
Apr 2018	100 %	100 %	03:30	03:50	03:32	100%	100%	03:40	03:55	03:47
May 2018	99.19 %	100 %	03:30	04:25	03:34	100%	100%	03:45	03:55	03:47
Jun 2018	98.33 %	100 %	03:15	04:30	03:35	98.33%	98.33%	03:40	07:00	03:49
04Jul 2018	100 %	100 %	03:20	03:55	03:34	100%	100%	03:45	04:00	03:47
Aug 2018	100 %	100 %	03:30	04:20	03:35	99.14%	100%	03:40	05:20	03:48
Sep 2018	99.17 %	100 %	03:30	04:40	03:35	100%	100%	03:45	04:05	03:46
Oct 2018	100 %	100 %	03:30	03:55	03:37	100%	100%	03:45	03:55	03:46
Nov 2018	100 %	100 %	03:30	03:50	03:34	100%	100%	03:35	03:50	03:45
Dec 2018	100 %	100 %	03:30	03:50	03:35	100%	100%	03:40	04:15	03:45
Jan 2019	100 %	100 %	03:25	03:50	03:35	100%	100%	03:40	03:45	03:44
Feb 2019	100 %	100 %	03:30	04:00	03:33	100%	100%	03:40	03:45	03:45
TOTAL	**99.73%**	**100%**	**03:15**	**04:40**	**03:34**	97.97%	98.18%	**03:30**	**11:25**	**03:42**

Notes:

The ICAO target is T+6, whilst T+4:20 is an additional metric that better reflects the time the gridded data set is normally available.

WAFC London

- On 18 May, 06 UTC run, an internal system was on a "go slow" which delayed the arrival of all files into SADIS by approximately 45 minutes.
- Changes to the production method of the Tropopause Height field, has meant that these files are usually the last to reach SADIS, leading to an occasional "miss" in reaching the T+4:20 timeliness target between June and September. Additional changes made in October 2018 have enabled the production time to be reduced further and appears to have resolved the issue

WAFC Washington

- On 26 March, unannounced server maintenance performed. Purposely resent data presented itself as "late".
- On 21 and 22 August, the system was down while local server implementation took place to correct the problem. Data absent two days from August calculations.
- All other misses were due to data being erroneously counted as late when a late second copy arrived after the first copy was on time.

WAFC GRIB2 CB, Icing and Turbulence Availability

	WAFC London						WAFC Washington					
	Complete Sets on SADIS by						Complete Sets on WIFS by					
Month	T+4:35	T+4:50	T+6:00	Earliest	Latest	Average	T+4:35	T+4:50	T+6:00	Earliest	Latest	Average
Mar 2018	98.39%	100 %	100 %	04:10	04:45	04:10	72.58%	98.39%	99.19%	04:35	11:25	04:41
Apr 2018	100 %	100 %	100 %	04:10	04:15	04:10	69.17%	99.17%	99.17%	04:35	07:51	04:40
May 2018	98.39%	100 %	100 %	04:10	04:45	04:10	62.90%	99.19%	99.19%	04:35	06:55	04:39
Jun 2018	99.17%	100 %	100 %	04:10	04:50	04:10	57.50%	98.33%	98.33%	04:35	07:00	04:40
Jul 2018	97.58%	98.39%	98.39%	04:10	n/a	04:12	66.94%	100%	100%	04:35	04:45	04:38
Aug 2018	93.55%	100 %	100 %	04:10	04:10	04:10	71.55%	98.28%	100%	04:35	05:20	04:38
Sep 2018	99.17%	100 %	100 %	04:10	04:40	04:10	74.17%	100%	100%	04:35	04:45	04:38
Oct 2018	100 %	100 %	100 %	04:10	04:15	04:10	56.45%	100%	100%	04:35	04:45	04:38
Nov 2018	100 %	100 %	100 %	04:10	04:15	04:10	70.83%	100%	100%	04:35	04:45	04:38
Dec 2018	100 %	100 %	100 %	04:10	04:15	04:10	75.00%	99.19%	99.19%	04:35	06:50	04:38
Jan 2019	100 %	100 %	100 %	04:10	04:15	04:10	75.00%	100%	100%	04:35	04:45	04:37
Feb 2019	100%	100%	100%	04:10	04:15	04:10	74.11%	100%	100%	04:35	04:45	04:38
TOTAL	**98.84%**	**99.86%**	**99.86%**	**04:10**	**04:50**	**04:10**	**68.80%**	**99.38%**	**99.59%**	**04:35**	**11:25**	**04:38**

Notes:
The ICAO target is T+6, whilst T+4:50 is an additional metric that better reflects the time the gridded data set is normally available. T+4:35 is an additional target set by the UK CAA for WAFC London data sets.

WAFC London

- On 12 July 00UTC and 06UTC run, the WAFS hazard data sets were not able to be published at all due to an internal system failure. The fault was rectified for the 12UTC run. Additional measures put in place to ensure that the fall back data set to be issued should the problem re-occur.
- All other "misses" to the T+4:35 target were due to the late arrival, or non-arrival of the WAFC Washington CB cloud, Icing and Turbulence files for blending (see log for details) and instead the contingency unblended WAFC London data set was issued by T+04:45.

WAFC Washington

- On 26 March, unannounced maintenance performed. Purposely resent data presented itself as "late".
- On 21 and 22 August, the system was down while local server implementation took place to correct the problem. Data absent two days from August calculations.
- All other misses were due to data being erroneously counted as late when a late second copy arrived after the first copy was on time.

SIGWX BUFR Availability Statistics on SADIS FTP and WIFS

	WAFC London						WAFC Washington					
	Complete Sets on SADIS by						Complete Sets on WIFS by					
Month	T+7:00	T+7:30	T+9:00	Earliest	Latest	Average	T+7:00	T+7:30	T+9:00	Earliest	Latest	Average
Mar 2018	100 %	100 %	100 %	06:50	06:55	06:50	95.97%	100%	100%	06:00	07:15	06:53
Apr 2018	100 %	100 %	100 %	06:50	06:55	06:50	97.50%	99.17%	100%	06:00	08:16	06:53
May 2018	99.19%	100 %	100 %	06:50	07:05	06:50	97.58%	100%	100%	06:00	07:05	06:53
Jun 2018	100 %	100 %	100 %	06:50	06:50	06:50	99.17%	100%	100%	06:00	07:05	06:53
Jul 2018	100 %	100 %	100 %	06:50	06:55	06:50	98.39%	99.19%	100%	06:00	07:46	06:53
Aug 2018	100 %	100 %	100 %	06:50	06:55	06:50	96.55%	100%	100%	06:00	07:14	06:53
Sep 2018	100 %	100 %	100 %	06:50	06:50	06:50	100%	100%	100%	06:00	07:00	06:53
Oct 2018	100 %	100 %	100 %	06:50	06:55	06:50	95.93%	99.19%	100%	06:00	07:57	06:53
Nov 2018	100 %	100 %	100 %	06:50	06:55	06:50	96.67%	100%	100%	06:00	07:24	06:53
Dec 2018	100 %	100 %	100 %	06:50	06:55	06:50	97.58%	99.19%	100%	06:00	08:07	06:53
Jan 2019	99.63%	100 %	100 %	06:50	07:05	06:50	95.93%	99.19%	100%	06:00	08:04	06:53
Feb 2019	100 %	100 %	100 %	06:50	06:50	06:50	93.75%	100%	100%	06:00	7:30	06:53
TOTAL	**99.86%**	**100%**	**100%**	**06:50**	**07:05**	**06:50**	**97.10%**	**100%**	**100%**	**06:00**	**08:16**	**06:53**

Notes:

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WAFC London

- On 18 May, 06 UTC run, an internal system was on a “go slow” which delayed the arrival of the SIGWX BUFR files into SADIS by 10 minutes.
- On 16 January, 12 UTC run, WAFC Washington was backing up WAFC London during a planned backup test. Several of the BUFR files arrived a few minutes after T+7:00 UTC.

WAFC Washington

- On 26 March, unannounced maintenance performed. Purposely resent data presented itself as “late”.
- On 21 and 22 August, the system was down while local server implementation took place to correct the problem. Data removed from two days of August calculations.
- All other misses were due to data being erroneously counted as late when a late second copy arrived after the first copy was on time.

Log of occasions where non-harmonized WAFS CB cloud, Icing and Turbulence data sets were issued:

Month	WAFC London		WAFC Washington	
	Number of occasions	Notes	Number of occasions	Notes
Mar 2018	2	16th, 06UTC run. 26th 06 UTC run.	0	
Apr 2018	0		0	
May 2018	2	3rd, 00 UTC run 23rd, 12 UTC run	0	
Jun 2018	0		0	
Jul 2018	0		0	
Aug 2018	7	21st, 06, 12 and 18 UTC runs 22nd, 00, 06, 12, and 18 UTC runs	0	
Sep 2018	0		0	
Oct 2018	0		0	
Nov 2018	0		0	
Dec 2018	0		0	
Jan 2019	0		0	
Feb 2019	0		0	
	11	----------	**0**	----------

SIGWX PNG Availability Statistics on SADIS FTP and WIFS

	WAFC London						WAFC Washington					
	Complete Sets on SADIS by						Complete Sets on WIFS by					
Month	T+7:00	T+7:30	T+9:00	Earliest	Latest	Average	T+7:00	T+7:30	T+9:00	Earliest	Latest	Average
Mar 2018	100 %	100 %	100 %	06:50	07:25	06:50	97.58%	100%	100%	06:00	07:04	06:52
Apr 2018	100 %	100 %	100 %	06:50	06:55	06:50	98.33%	100%	100%	06:00	07:04	06:53
May 2018	98.39%	100 %	100 %	06:50	07:25	06:50	96.77%	100%	100%	06:00	07:05	06:53
Jun 2018	100 %	100 %	100 %	06:50	06:50	06:50	100%	100%	100%	06:00	07:00	06:52
Jul 2018	100 %	100 %	100 %	06:50	06:55	06:50	98.39%	99.19%	100%	06:00	07:45	06:53
Aug 2018	100 %	100 %	100 %	06:50	06:55	06:50	96.55%	100%	100%	06:00	07:15	06:53
Sep 2018	100 %	100 %	100 %	06:50	06:50	06:50	100%	100%	100%	06:00	07:00	06:53
Oct 2018	100 %	100 %	100 %	06:50	06:55	06:50	94.31%	100%	100%	06:00	07:25	06:53
Nov 2018	100 %	100 %	100 %	06:50	06:55	06:50	96.67%	100%	100%	06:00	07:24	06:53
Dec 2018	100 %	100 %	100 %	06:50	07:00	06:50	98.37%	100%	100%	06:00	07:22	06:52
Jan 2019	99.19%	100 %	100 %	06:50	07:05	06:50	95.16%	99.19%	100%	06:00	07:44	06:53
Feb 2019	100 %	100 %	100 %	06:50	06:50	06:50	94.64%	100%	100%	06:00	07:29	06:53
TOTAL	**99.73%**	**100%**	**100%**	**06:50**	**07:25**	**06:50**	**97.24%**	**99.86%**	**100%**	**06:00**	**07:45**	**06:50**

Notes:

WAFC London

- On 18 May, 06 UTC run, an internal system was on a “go slow” which delayed the arrival of the SIGWX BUFR files into SADIS by 10 minutes.
- On 16 January, 12 UTC run, WAFC Washington was backing up WAFC London during a planned backup test. Several of the BUFR files arrived a few minutes after T+7:00 UTC.

WAFC Washington

- On 26 March, unannounced maintenance performed. Purposely resent data presented itself as “late”.
- On 21 and 22 August, the system was down while local server implementation took place to correct the problem. Data removed from two days of August calculations.
- All other misses were due to data being erroneously counted as late when a late second copy arrived after the first copy was on time.

Log of SIGWX Correction Messages:

Month	WAFC London		WAFC Washington	
	Number of occasions	Notes	Number of occasions	Notes
Mar 2018	0		0	
Apr 2018	0	VT011800 – Volcano Dukono added	2	VT031800 removed extra hash marches on a jet stream in North Atlantic. VT111800 extended severe turbulence area further south over New Zealand
May 2018	0		0	
Jun 2018	0		2	VT031800 Cb label over western Russia was somehow not in BUFR VT240600 Corrected CB label for tops near New Zealand
Jul 2018	1		0	
Aug 2018	1		0	
Sep 2018	0	VT191200 – Volcano Garibaldi included in error, and Volcano Turriabla added.	0	
Oct 2018	2		1	VT231200 Volcano Dukono was erroneously included on the charts.
Nov 2018	0		0	
Dec 2018	1	VT 231800 – An area of CAT over New Zealand was incorrectly labelled	0	
Jan 2019	0		1	VT121200 Omission of Turb area over western Canada.
Feb 2019	1	VT 260600 – TC NN was incorrectly located.	1	VT271200 FRQ CB omitted around TC WUTIP in western Pacific
TOTAL	**6**	----------	**7**	----------

Appendix B: History of Scheduled and un-scheduled WAFS SIGWX Backups

Scheduled WAFS SIGWX backup events

DATE	NOTES
11 April 2018 - WAFC Washington provided backup SIGWX products on behalf of WAFC London.	Implemented successfully.
25 April 2018 - WAFC London provided backup SIGWX products on behalf of WAFC Washington.	Implemented successfully.
11 July 2018 - WAFC Washington provided backup SIGWX products on behalf of WAFC London.	Implemented successfully, with purposeful and planned 1 hour delay (as per WG-MOG Decision 3/1)
25 July 2018 - WAFC London provided backup SIGWX products on behalf of WAFC Washington.	Implemented successfully.
10 October 2018 - WAFC Washington provided backup SIGWX products on behalf of WAFC London.	Implemented successfully.
24 October 2018 - WAFC London provided backup SIGWX products on behalf of WAFC Washington.	Problem on sending files meant that whilst the WAFC Washington png files went out, the accompanying BUFR did not. Transmission process was repeated, and missing files were eventually sent 55 minutes later than normal.
6 December 2018 – WAFC London provided backup SIGWX products on behalf of WAFC Washington for data VT 12:00UTC	This backup was required due to software upgrades taking place at WAFC Washington.
16 January 2019 - WAFC Washington provided backup SIGWX products on behalf of WAFC London.	Implemented successfully.
30 January 2018 - WAFC London provided backup SIGWX products on behalf of WAFC Washington.	Implemented successfully, with purposeful and planned 1 hour delay (as per WG-MOG Decision 3/1).

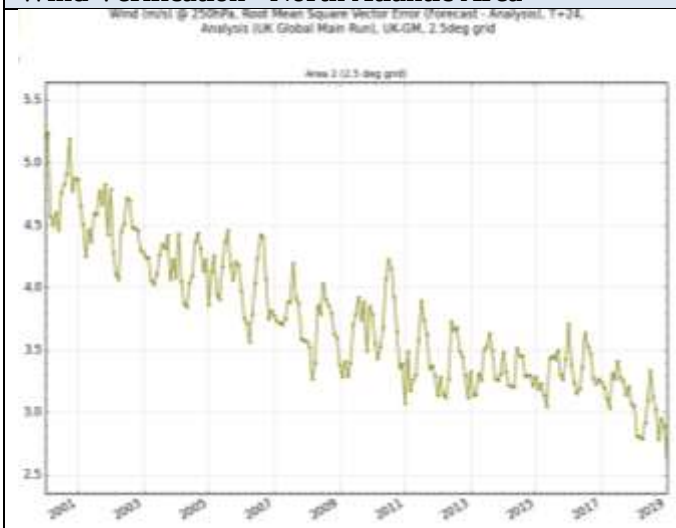
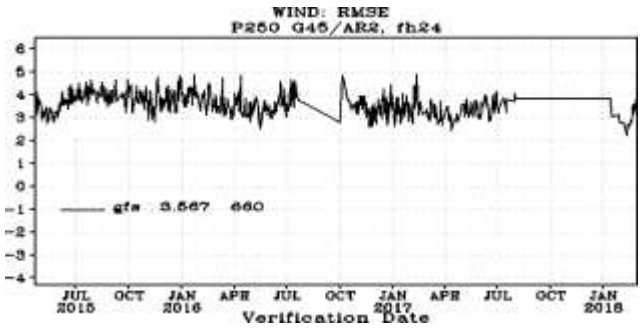
Non-scheduled WAFS SIGWX backup events

DATE	ISSUES
6 December 2018 – Data VT 18:00UTC was issued by WAFC London on behalf of WAFC Washington.	Short notice additional backup required, due to an over run of the software upgrades taking place at WAFC Washington.

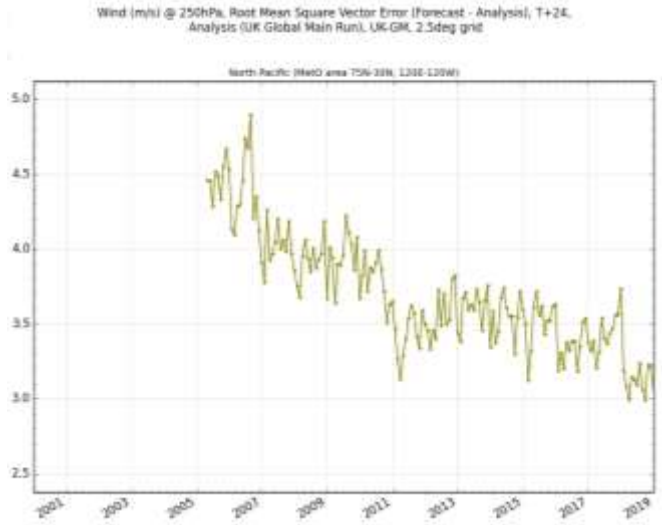
Appendix C: Verification Statistics

Note: Due to technical issues WAFC Washington has not been able to provide updated verification plots. There plots and comments from last years management report are included for reference.

Wind

Wind Verification - North Atlantic Area	
	**WAFC London 250hPa T+24 Wind** The Root Mean Square Error (RMSE) for the 24 hour forecast of the FL340 (250hPa) wind over the North Atlantic against model analyses has improved from approximately 4.7 m/s in 2000, to 2.8 m/s by the end of January 2019. *Note: For both the wind and temperature data, the verification data shows a degree of oscillation - often related to seasons*
	**WAFC Washington 250hPa T+24 Wind** The RMSE for the 24 hour forecast of the FL340 wind over the North Atlantic against model analyses has been holding steady at around 3.0 m/s

Wind Verification - North Pacific Area

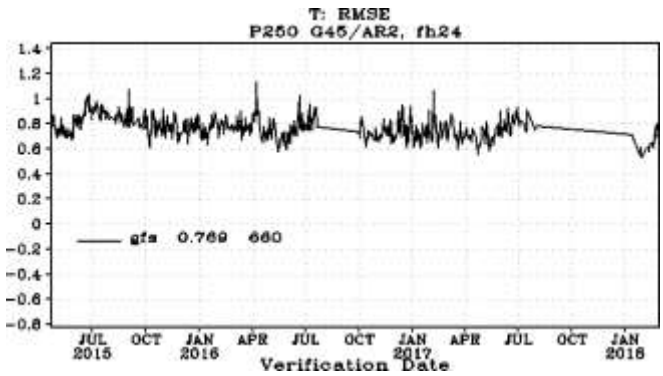


WAFC London 250hPa T+24 Wind

For the North Pacific area the RMSE has improved from 4.4 m/s in 2005 to 3.1 m/s by the end of January 2019.

This is an improvement of 0.4C since the end of 2017.

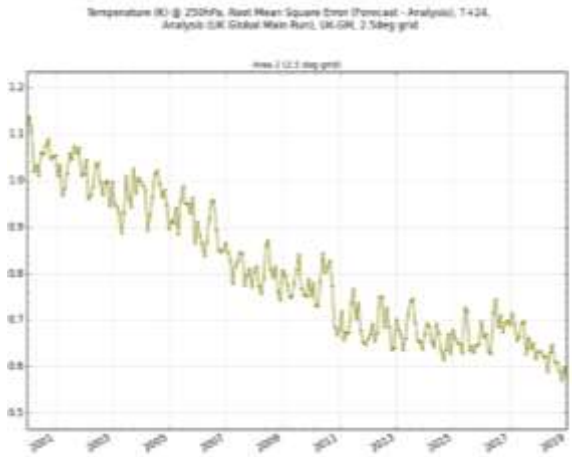
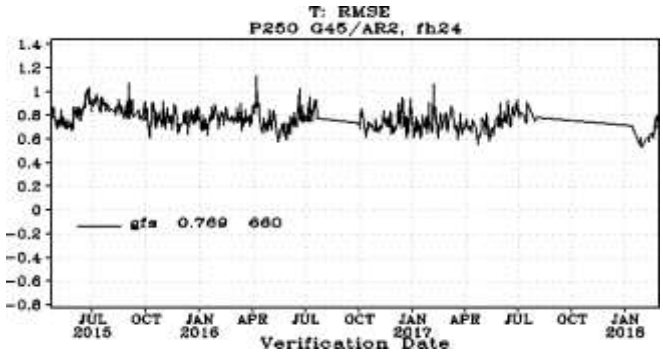
The sudden improvement RMSE in early 2018 corresponds to a model upgrade which improved the data assimilation process and the use of satellite data.

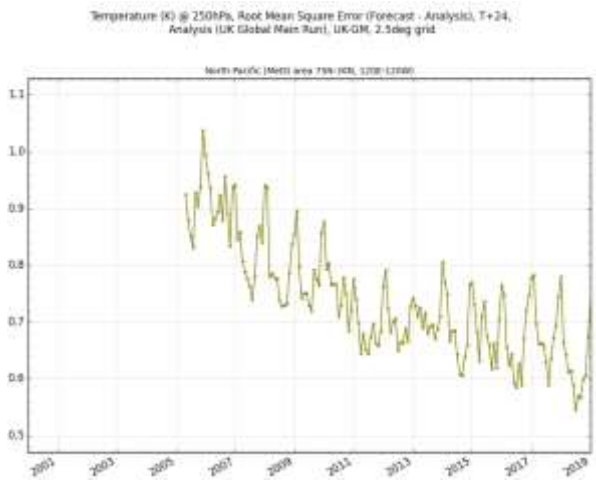
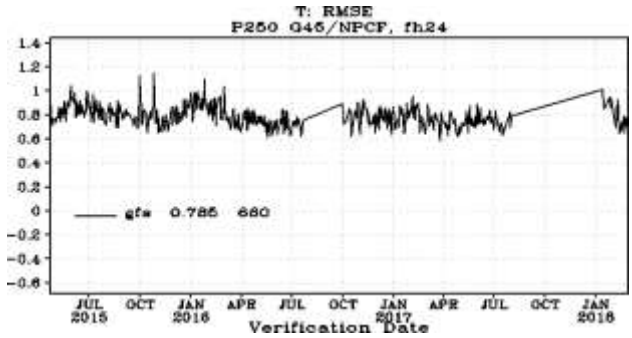


WAFC Washington 250hPa T+24 Wind

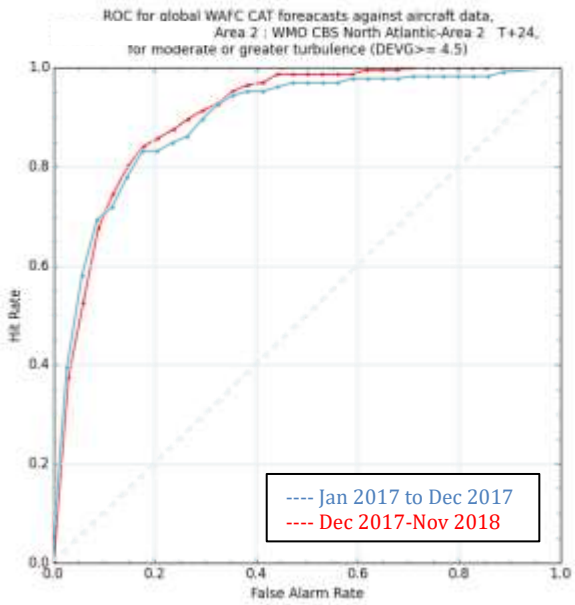
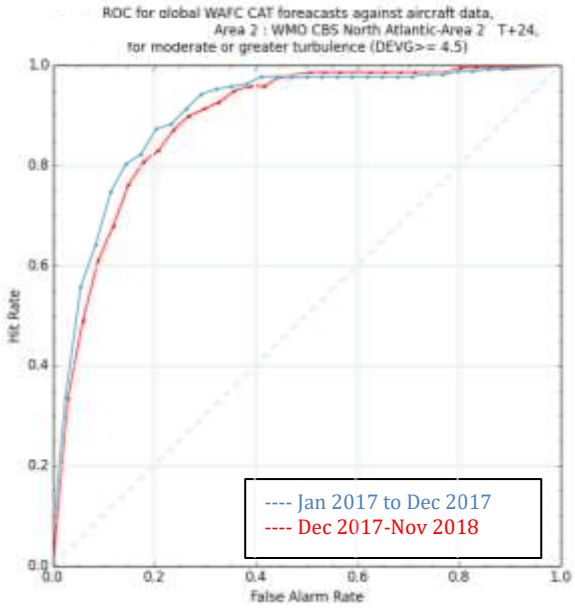
The RMSE for the 24 hour forecast of the FL340 wind over the North Pacific against model analyses has been holding steady at around 6.0 m/s

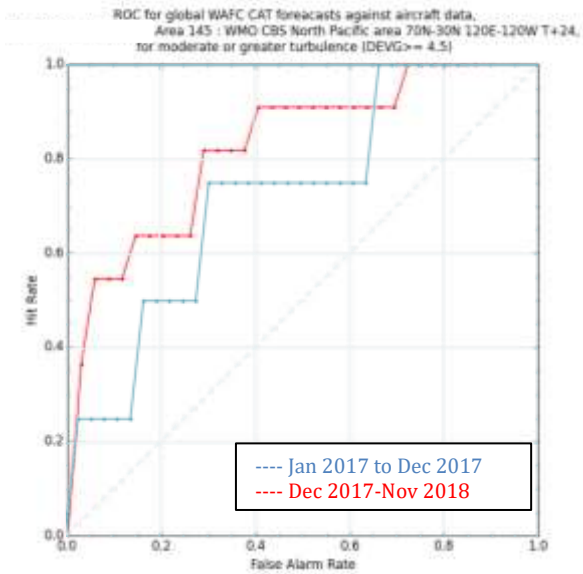
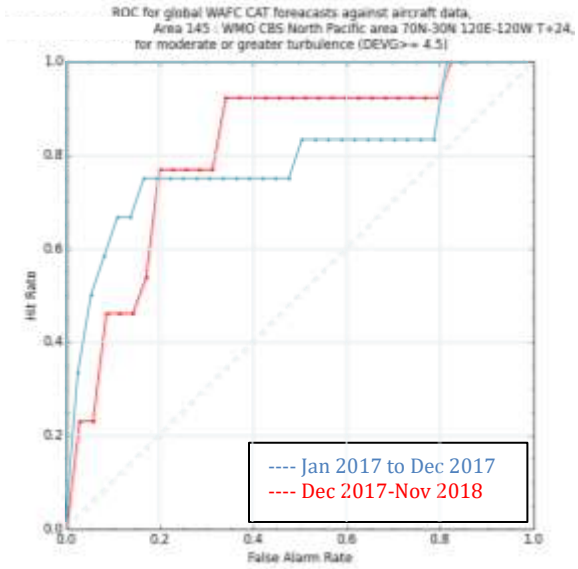
Temperature

Temperature Verification – North Atlantic Area	
	**WAFC London 250hPa T+24 Temperature** The RMSE for the 24 hour forecast of FL340 temperature over the North Atlantic against model analyses has improved from approximately 1.1 C in 2000, to 0.6 C by end of January 2019. This is an improvement of 0.1C since the end of 2017.
	**WAFC Washington 250hPa T+24 Temperature**

Temperature Verification – North Pacific Area	
	**WAFC London 250hPa T+24 Temperature** For the North Pacific area the RMSE has improved from 0.9 C in 2005 to ~0.6 C by the end of January 2019. This is an improvement of 0.1C since the end of 2017.
	**WAFC Washington 250hPa T+24 Temperature**

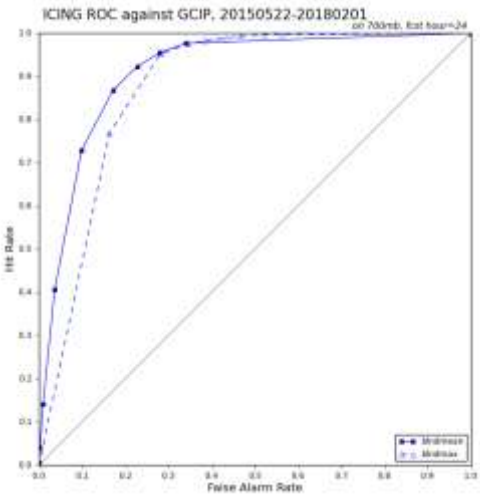
Clear Air Turbulence potential:

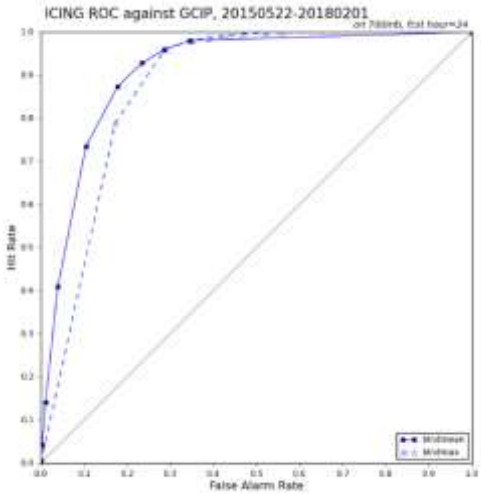
Clear Air Turbulence Verification – North Atlantic Area	
	**Harmonized T+24 Mean CAT** This ROC plot shows mean CAT verified against automated aircraft data for the North Atlantic (Area 2). The red line shows data from Dec 2017 to Nov 2018, and demonstrates clear skill. For comparison, the blue line shows the plot included in last years WAFC Management report The skill scores for both periods is only marginally different.
	**Harmonized T+24 Max CAT** This ROC plot shows maximum CAT verified against automated aircraft data, over the North Atlantic The skill score for Dec 2017-Nov 2018 is very similar to that for last year.

Clear Air Turbulence Verification – North Pacific Area	
	Harmonized Mean CAT (T+24) This ROC plot shows mean CAT verified against automated aircraft data for the North Pacific. The red line shows data from Dec 2017 to Nov 2018, and demonstrates clear skill. For comparison, the blue line shows the plot included in last years WAFC Management report. There has been a clear increase in skill in the last year.
	Harmonized Max CAT (T+24) This ROC plot shows max CAT verified against automated aircraft data for the North Pacific. On balance, the level of skill in both years is comparable.

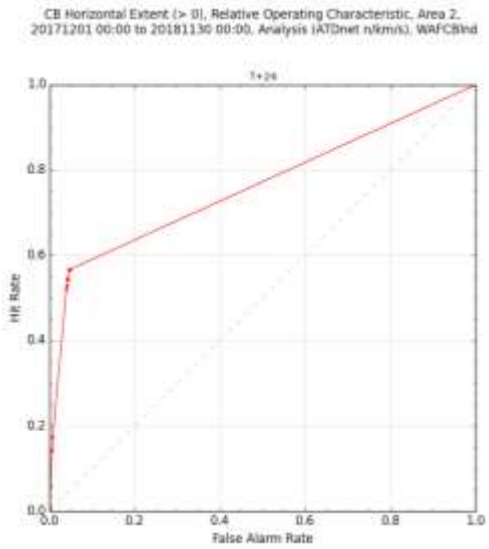
Icing potential:

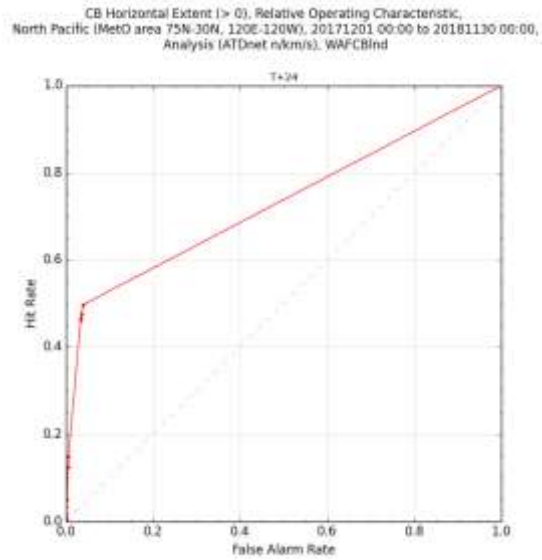
Note: Due to technical issues WAFC Washington has not been able to provide updated verification plots. There plots and comments from last years management report are included for reference.

Icing Verification – North Atlantic Area	
	**Harmonized T+24 Mean and Max Icing** For the North Atlantic, skill is demonstrated and is comparable to the skill of the previous year. It should be noted that due to the miniscule number of direct observations, the existence of icing is inferred using a combination of satellite imagery (existence of cloud), surface observations (rules out snow), lightning data, and model temperature analysis.

Icing Verification – North Pacific Area	
	**Harmonized T+24 Mean and Max Icing** For both the North Pacific, skill is demonstrated and is comparable to the skill of the previous year.

CB horizontal extent:

CB Horizontal Extent Verification – North Atlantic Area	
	**Harmonized T+24 CB Horizontal Extent** For the North Atlantic skill is demonstrated, and the level of skill is virtually identical to the previous year.

Cumulonimbus Verification – North Pacific Area	
	**Harmonized T+24 CB Horizontal Extent** It should be noted that the coverage over the North Pacific is more limited using lighting data to verify the forecasts. In future satellite data will enable fuller coverage to extend the area verified. The level of skill for the North Pacific is identical to the previous year.

Appendix D: WAFC Meetings and Seminar Participation

To add – DMG Meetings (Matt W)

Meeting	Location	Date	WAFC London	WAFC Washington
Sixth and Seventh Meetings of the Met Operations Group working group to the Met Panel (WG-MOG 6 (SADIS)) (WG-MOG 7 (WAFS))	Offenbach, Germany	10 to 13 April 2018	Yes	Yes
Fourth meeting of the Met Information Exchange Working Group to the Met Panel (WG-MIE/4)	Boulder, USA	1 to 4 May 2018	Yes	Yes
MIE Webex Meetings	Webex	monthly	Yes	Yes
Fourth Meeting of the working Met Requirements and Integration group to the Met Panel (WG-MRI/4)	Washington DC, USA	9-10 May 2018	Yes	Yes
Twenty second meeting of the Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG	Bangkok, Thailand	18 to 21 June 2018	Yes	Yes
Sixteenth session of the for Aeronautical Meteorology (CAeM-16)	Exeter, UK	24 to 27 July 2018	Yes	Yes
Fourth meeting of the Met Panel	Montreal, Canada	10-14 September 2018	Yes	Yes
EUMETNET AVIMET meeting	Paris, France	17 Sept 2018	Yes	No
Twenty eighth meeting of the European/North Atlantic Meteorological Group (METG/28)	Paris, France	18 to 21 September 2018	Yes	Yes
Joint meeting of the WG-MIE and WG-MRI (Workshop)	Brussels, Belgium	26-28 November 2018	Yes	Yes

— END —