Met Office User Forum / 14

Thursday 9th November 2017

Venue: CAA House, London, Time 1100

Agenda Item 1: Welcome and Introductions

Agenda Item 2: Regulatory service provision (JD)

a. Review of MOUF/13 actions
b. Review of Met Costs
c. Volcanic Ash update

Agenda Item 3: National services (DH)

a. Review of Met Service performance
b. Changes to UK regulated service provision
c. Development of new TAF verification scheme
d. Regulatory oversight

Agenda Item 4: Regulated Aviation activities (PB)

a. Aviation R&D progress report
b. Update on future R&D programme
c. Update on supercomputing capabilities

Agenda Item 5: Specific Issues

- Height terminology in aviation forecasts (PC)
- Wind in TAFs (PC)

Agenda Item 6: Any Other Business

Agenda Item 7: Date of next meeting

Attendees

Jon Dutton	Met Office	JD
Darren Hardy	Met Office	DH
Piers Buchanan	Met Office	PB
Colin Hord	CAA	CH
.David Gibbs	CAA	DG
James Carr	NATS	JC
Huw Murray	NATS	HM
John Hamshare	Heathrow Airport ltd/UKFSC	JH
Peter Cox	Hon Comp of Air Pilots	PC
Steve Stebbings	BA (rep IATA)	SS
Russell Harvey	BA City Flyer	RH
Steve Cook	BA City CFlyer	SC

Summary of Outstanding Actions & New Actions

OUTSTANDING ACTIONS

None.

NEW ACTIONS

Reference:	MOUF/14/2017/01
Action:	Provide an analysis comparing fog warnings to model low visibility forecasts that are provided on Open Runway.
Action on:	DH
Status:	OPEN

Reference:	MOUF/14/2017/02
Action:	Provide an update on the operation of the new TAF verification schema, including initial results.
Action on:	Met Office
Status:	OPEN

Reference:	MOUF/14/2017/03
Action:	Review the reference terminology in its area forecasts and, where appropriate, refer to their height as ‘Altitude Above Mean Sea Level’.
Action on:	Met Office
Status:	OPEN

Agenda Item 1: Welcome and Introductions

JD opened the meeting, and thanked everyone for attending. Introductions were made and JD expressed his thanks to the CAA for their kind invitation to host this meeting.

All presentations provided during this meeting are available at **Annex D**.

Agenda Item 2: Regulatory service provision

JD provided a presentation on regulatory service provision.

a. Review of MOUF/13 actions

Reference:	MOUF/11/2014/05
Action:	Low temperature forecasts: Consider the provision of a 'cold weather correction information package' to support altimeter corrections for low temperatures. CH reported that this was discussed in Eurocontrol and ICAO, and a working paper was subsequently submitted by Eurocontrol to the ICAO Air Traffic Management Operations Panel (ATMOPSP). This paper is attached as an annex to this document for reference. CH confirmed that that such corrections are a pilot responsibility (using available briefing material) rather than an ATS one. The role of the CAA is to identify conditions during which a correction may be appropriate. CH also explained that any change to UK guidance in this regard would need to be co-ordinated with our European neighbours as part of a future harmonisation of Transition Altitude, but this would be several years away. However the CAA would continue to review these activities and would keep the group informed of any developments. Met Office and CAA will report back and act upon the outcome of ICAO ATM Panel discussions
Action on:	CH
Status:	CLOSED

Reference:	MOUF/13/2016/01
Action:	TAF verification statistics for lower thresholds: Provide statistics summarising the performance of TAF against the current verification scheme against low cloud and visibility thresholds.
Action on:	DH
Status:	CLOSED

Reference:	MOUF/13/2016/02
Action:	Missing OPMET data from States: Discuss with NATS the availability of any statistics on data missing from the OPMET databanks. Please see paper at Annex A.
Action on:	DH
Status:	CLOSED

Reference:	MOUF/13/2016/03
Action:	Pilot briefing guidance material: Keep the MOUF informed of developments to increase and improve the material available to help pilots brief effectively. Please see paper at Annex B.
Action on:	DH
Status:	CLOSED

Reference:	MOUF/13/2016/04
Action:	To consider and provide NATS with a summary of available forecast weather information and/or models that could potentially be available to support the NATS activities described JD reported on discussions had with NATS
Action on:	NG
Status:	CLOSED

b. Review of Met Costs

JD summarised the composition of the Met Office's designated aviation service provision remit, then described a number of developments undertaken during the past year and areas identified for development in 2018. Area of focus for 2018 include implementing transposed ICAO regulations, renewal of the agreement to provide the Met Office Civil Contingency Aircraft (MOCCA), developing on site meteorological support at Swanwick, development to the WAFS and ongoing aviation R&D activities

A summary of regulated aviation MET costs for the period 2015 to 2019 was provided by JD, and the composition of the costs was described. It was noted that discussions would soon commence on establishing the nominal determined costs for Reporting Period 3 (2020-2024).

c. Volcanic Ash issues

JD summarized activities relating to volcanic ash, including the outcomes from the ICAO MET Panel and IAVW meetings in June 2017, and a volcanic ash exercise held during October 2016 simulating an Icelandic eruption. One notable outcome from the IAVW meeting was the agreement to develop ash concentration charts for 3 ranges of flight levels rather than column mass loading charts.

Recent enhancements to the Met Office HPC supercomputing capabilities has offered the opportunity to upgrade the Met Office dispersion model (called 'NAME') with higher resolution global model data (from 17KM horizontal resolution to 10KM, giving 220 million extra grid points). Further improvements are planned enabled by the HPC that will focus on the source components of particulates.

An update was also provided on observation capabilities for volcanic ash. Observations help to track and validate the forecast dispersion of ash (and also SO_2 concentration) following a volcanic eruption.

PC enquired how the Met Office verify the outputs from the dispersion model. JD commented that this was primarily from satellite and LiDAR data both in terms of 'live' verification during an event and post event analysis. Verification has been helped by significantly more satellite data available, which in turn allows the Met Office to have greater confidence in the VAAC products generated.

As well as improvements to satellite detection capabilities, the surface network of LiDARs is now fully operational. The network comprises 9 fixed locations and 1 mobile LiDAR and are capable of providing vertical profiling of ash concentrations, such as the height and nature of the particulates. PC asked where the mobile unit was normally stationed. JD confirmed that it was currently at Nottingham, but can be deployed elsewhere at short notice in response to the likely track of any volcanic activity. SS asked who has sight of the LiDAR data. JD reported that the data from LiDARs is used internally by the Met Office who have personnel able to interpret the graphical outputs from the LiDAR. CH further commented that the Met Office will provide to operators a graphic showing the latest location of ash every 6 hours during an event.

The MOCCA aircraft, based at Bournemouth, continues to be available to take measurements in flight. Negotiations are well advanced for an extension to the current agreement to use the Cessna 421 aircraft. CH noted that given the age of the Cessna aircraft, the cost of spares and maintenance was likely to increase. As a result future arrangements may consider alternative options such as the use of a aircraft on a shared asset basis or drones. Regarding the use of drones it was noted that a study was underway to assess the value of these – initial results appear to suggest that a large drone would be required to house the instrumentation necessary of monitoring ash, along with an operator. HM asked what instrumentation is held on the MOCCA. JD commented that equipment exists that will assess the nature of particulates (i.e. the levels of ash and SO_2), down facing LiDAR and a caps probe. More widely the Met Office are reviewing various drone trials to assess their value of all types of weather.

Finally JD described ongoing improvements to the forecaster VA intervention tool . This is the forecaster production tool for generating VA products – it will also be capable in the

future of delivering the products in IWXXM format and in other forms that are more easily assessable.

Agenda Item 3: National services

DH provided a presentation on regulatory service provision. A presentation relating to each item has been circulated**.**

a. Review of Met Service performance

DH provided a summary of service performance for a range of national aviation regulated aviation meteorological products, including TAF accuracy, compliance and timeliness, SIGMET compliance, TREND timeliness and aerodrome warnings accuracy. The meeting reviewed that latest TAF SQI scores and noted that overall accuracy (as determined by the current verification system) had increased by 1.5% over the period of RP2 to date. JD commented that the Met Office were also increasingly working closely with NATS to provide the additional information necessary to supplement TAFs. SS enquired about how the Met Office manage improvements to TAFs where verification scores suggest they are less accurate. DH commented that where TAFs are consistently performing poorly an action will be taken to understand the most likely root cause, and implement a rectification plan to address this. Over the past year a number of training days and visits to airfields have assisted. The Met Office has also undertaken reorganisations to help ensure an additional focus of some airports such as Bristol and Leeds Bradford. Increasingly forecasters are using verification data to assess where behavioural changes can address any deficiencies identified.

The meeting also discussed the first set of verification results for aerodrome warnings. It was agreed to circulate these results to the group, and these are shown at ***Annex C.*** JH considered that it would be useful to compare the aerodrome warnings with model low visibility forecasts that are provided on Open Runway. It was agreed that the Met Office would undertake and an analysis and report back.

Reference:	MOUF/14/2017/01
Action:	Provide an analysis comparing fog warnings to model low visibility forecasts that are provided on Open Runway.
Action on:	DH
Status:	OPEN

b. Changes to UK regulated service provision

DH provided a summary of changes and activities concerning national aviation services. These included new forecasts for helicopters operating over the London CTA, and number changes to TAF and aerodrome warnings provision, a range of new initiatives aimed at ensuring users gain the fullest possible benefit of regulated aviation products, and enhanced services to support the LTMA. PC enquired where the London CTA

forecast are available and who may assess them. DH conformed the are hosted on the Aviation Briefing portal, so available to all who register.

JD summarised additional support to NATS en-route through the commencement of a full time roster of meteorologists at Swanwick (on a trial basis currently) and enhanced TS/CB advice at both the planning and tactical phases. One principle behind having on site meteorologists is to improve consistency of information to NATS with guidance from Ops Centre and also Heathrow Met Office and responsiveness, thereby improving certainty for tactical decisions making (i.e. when to initiate flow restrictions) and also for planning. The feedback received to date has been positive and work continues to quantify the value of the this service to airlines.

With regards to the CB/TS tactical product described by JD, SC asked if the product is available to airlines. JD reported that whilst the planning forecasts are distributed to airlines, the tactical forecasts were not at present. However during the trial consideration will be given to sharing the tactical forecasts more widely. JC commented that on occasions differences between the tactical forecasts and information available to pilots from on board radar meant that decisions were sometimes taken by pilots that were inconsistent with the information on the movement of CB/TS activity given in the tactical forecasts. JD noted that the Met Office would investigate the feasibility of undertaking a comparison between Met Office and on board radars.

PC asked whether the on-site team at Swanwick will manage VA products. JD confirmed that the intention is for the on-site meteorologists to the focal point for NATS operations for all activity including VA.

c. Development of new TAF verification scheme

DH and PB provided a summary of progress made on the development of a new TAF verification scheme. It was noted that the existing scheme is based upon the provision of results based upon a single cloud and visibility threshold. The proposed new scheme considers elements of an alternative verification scheme used by the Met Alliance, a group of 6 European Met services along with an assessment the entire range of cloud and visibility conditions forecast in the TAF.

Examples of potential outputs were provided. It was noted that development of the new schema is expected to complete by March 2018. Thereafter, the new verification scheme will operate alongside the current method – this will help the Met Office to assess the behaviour of the system and to establish a set of baseline results before the scheme becomes fully operational from April 2019. It was agreed to present progress of the new verification schema to the next MOUF.

JH noted the value in being able to separate out the results for cloud and visibility for each threshold. DH confirmed that the new scheme should enable this, thereby helping to identify the particular strengths and weaknesses of TAFs for all airports, for each thresholds and for both cloud and visibility.

Reference:	MOUF/14/2017/02
Action:	Provide an update on the operation of the new TAF verification schema, including initial results.
Action on:	Met Office
Status:	OPEN

d. Regulatory oversight

DH reported on the outcomes from the 2017 CAA audit of elements of the Met Office's air navigation service provision, and also from the Met Office involvement in the EASA audit of CAA oversight activities.

Finally, a summary was provided on the timelines associated with the implementation of the transposed ICAO Annex 3 standards and recommended practices into EU legislation, and updated Common Requirements for ANSPs.

Agenda Item 4: Regulated Aviation activities

PB provided a presentation on regulatory service provision. A presentation relating to each item has been circulated**.**

a. Aviation R&D progress report

PB summarised the activities undertaken over the past 12 months in respect of developing forecasts of en-route hazards and to improve forecasting of weather over the UK airspace. There has been a particular emphasis on the development and evaluation of very high resolution modelling for fog, which often present particular challenges especially in forecasting the precise onset and dissipation times of fog. Other activities included improved detection of rapidly developing TS activity, turbulence forecasts and an icing severity diagnostic.

b. Update on future R&D programme

PB then summarised the work plan for the coming year. This plan include continued work on fog forecasting, and diagnostics for high altitude ice crystals and CB satellite detection.

c. Update on HPC

PB reported that this new supercomputer delivers a 15 fold increase in computing power compared to the currently supercomputer. This allows for an increased global model resolution to 10km in the horizontal, improved probabilistic forecasting and hourly model updates over the UK.

d. High Altitude Ice Crystals research

PB then summarised work undertaken to identify and forecast areas of high altitude ice crystals. These have been responsible for a number of aircraft incidents and case studies were described by PB. Future development activities were also described to the group.

Agenda Item 5: Specific Issues

- **Height terminology in aviation forecasts**

PC commented that Aviation has unambiguous definitions for height and altitude. For example:

> Height is always above ground level at the aerodrome/point concerned, such as cloud above an aerodrome in a METAR, or circuit height based on QFE for light aircraft.
>
> Altitude is always above mean sea level, such as en-route cloud, or altitude based on QNH for commercial aviation and the more enlightened light aircraft

PC noted that the Met Office does not always follow this convention for aviation ,for example 'Height amsl' is a misnomer and enquired whether there is support for the Met Office adopting standard aviation terminology in this respect.

DH noted that, following the ICAO convention (Annex 3, App 8, para 4.2.3 refers), the reference to cloud base will differ between forecasts products, i.e. referenced to sea level for area forecasts and height above ground level for site specific forecasts). For area forecasts ICAO permits a number of ways to express height. The meeting agreed that the Met Office would review the reference terminology in its area forecasts and, where appropriate, refer to their height as 'Altitude Above Mean Sea Level'.

Reference:	MOUF/14/2017/03
Action:	Review the reference terminology in its area forecasts and, where appropriate, refer to their height as 'Altitude Above Mean Sea Level'.
Action on:	Met Office
Status:	OPEN

- **Wind in TAFs**

PC commented that a GA flying instructor operating civil light aircraft at RAF Waddington recently raised an issue concerning gusting Westerly winds. He felt that when planning a flight, the TAF change group criteria for wind can conceal an increase in wind strength that would be outside the aircraft's wind limits with no indication in the TAF. In particular the +/- 10 knot envelope in the TAF wind group itself, when coupled with the criteria for issuing a TAF AMD, could mask an increase in wind that would be very significant to light aircraft.

DH noted that in common with international regulations Waddington TAFs are managed according to change criteria defined by ICAO (which, in the case of wind, is almost the same for UK Mil sites). However these standard criteria allow for a considerable range of wind, within which the TAF is considered accurate and should not be amended.

For example:
A TAF wind of 25012G25KT allows for the actual wind to be between 230-270 degrees, between 3 and 21KTs, with gusts between 16-34KTs

When considering this in the context of crosswind components the permissible range could deviate through an aircraft's operational threshold.

As such, the Met Office there do respond to local calls to provide finer wind detail in their TAFs if will be beneficial to specific aircraft operating from Waddington, which may be susceptible to crosswind limitations. The following extract from their Ops procedures document refers:

> *N.B. The Waddington TAF can include 'non-TAFable' surface wind changes which show significant cross wind issues either before or after the change group (the E3-D has a 13 KT cross wind limit for landing on a wet runway). Therefore with an initial surface wind forecast of 18007KT with an approaching warm front you could, for example, put in a 'non-standard' change group of 'BECMG 1109/1112 14013KT -RA' - this would indicate both the cross wind and also the possibility of a wet runway*

It's also worth noting that all customers operating from Waddington benefit from a full face to face weather brief before departure, which is designed to provide amplification on the forecasts.

Agenda Item 6: Any Other Business

HM mentioned that Enhanced Time Based Separation (ETBS) is scheduled to be implemented in the coming months at Heathrow. NATS R&D are investigating other (possible) future arrival and departure concepts as part of SESAR, and specific wind monitoring capabilities, such as a need for accurate high resolution wind speed and direction data, may be required to support future weather dependent arrival and/or departure concepts. HM enquired how the Met Office might assist NATS in this activity. JD commented that this was something that the Met office could support NATS with and agreed to discussing this in more detail offline and would be raised at the next NATS/Met Office/CAA service meeting.

SS appreciated the value of having forecasters embedded at Swanwick, and enquired whether consideration had been given to a form of TAF for the TMA. JD commented that the current thinking is that having a graphical depiction offered greater flexibility to respond quickly to rapidly changing weather situations such as TS and CB development.

Agenda Item 7: Date of next meeting

This will be agreed by correspondence, but most likely in October/November 2018.

There being no other business the meeting closed at 1515.

Annex A

MOUF/13/2016/02 - Missing OPMET data from States

1. Introduction

During the last MOUF, the Met Office reported that new statistics relating to the timeliness of METARs were being used during airport MET audits and to understand corresponding statistics relating to the timeliness of Trends which are appended to selected airport METARs.

This led to a discussion around the wider ICAO deficiency reporting process and how this may help identify missing or erroneous OPMET data to airlines. The Met Office took an action to liaise with NATS regarding the availability of these statistics.

Reference:	MOUF/13/2016/02
Action:	Missing OPMET data from States: Discuss with NATS the availability of any statistics on data missing from the OPMET databanks.
Action on:	DH
Status:	OPEN

2. Discussion

Subsequent discussion with the NATS Data Services team confirmed that such data does exist. On behalf of ICAO, NATS assist with twice yearly audits of missing (deficient) data within Europe. The results from these analyses are presented to the ICAO European Air Navigation Planning Group (EANPG) who add these states to their deficiencies lists and publish this data in their report.

The scope of deficiency assessments covers the entirety of ICAO Annex 3. It is understood that the action was raised in the context of TAFs and METARs, and the latest report points to the following outstanding deficiencies in these areas.

DEF ID	DEF Priority	State	DEF Type	DEF Req - ICAO Doc	DEF Req - Detail	DEF Descr	Reported by	Date Reported	Cor Act Recom ICAO
EUR-MET-01-07	A	Monaco	METAR availability	EUR FASID	Table MET 1A	LNMC METAR not available internationally	DMG of METG	01-Jun-15	Make LNMC METAR available internationally

EUR-MET-01-11	A	Tajikistan	24-hour TAF	EUR FASID	Table MET 1A	24-hour TAF required, but 12-hour TAF provided for UTDD	DMG of METG	01-Jun-15	Make 24-hour TAF available for UTDD

A priority = Top priority requirements necessary for air navigation safety.

An extract from the EANPG/58 report is provided at App1. It should be noted that other ICAO regional offices have similar deficiency reporting requirements for States within their region. This data was not available, however the CAA may be able to contact other Regional Office to obtain the data if the MOUF desires.

3. Action by the group

The meeting is asked to note the content of this Paper and consider any requests for further information.

Darren Hardy
November 2017

App1

6.2 **MET DEFICIENCIES**

6.2.1 The EANPG was informed that the deficiency for Norway (WAFS forecasts not provided for briefing and flight documentation) would be removed from the list of EUR Air Navigation Deficiencies because the SADIS FTP Service was operational as of 0100 UTC on 19 August 2016 (COG Conclusion 66/01 refers).

6.2.2 With reference to migrating from SADIS 2G to SADIS FTP, the updated status of implementation of SADIS revealed Uzbekistan was not registered with SADIS FTP and therefore the EANPG agreed that Uzbekistan would be added to the list of EUR Air Navigation Deficiencies since WAFS forecasts were needed for briefing and flight documentation (Annex 3, 9.1.4, 9.3.1, 9.4.1 and Appendix 2, 2.1.1).

6.2.3 In this respect, the EANPG noted that there were no updates for the same deficiency for Belarus, Kyrgyzstan, Tajikistan and Turkmenistan.

6.2.4 The EANPG noted that COG/65 agreed to remove the deficiency for Finland since compliance was verified by ICAO in coordination with the Regional OPMET Centre London in that METAR was received on SADIS with indication type, *METAR.*

6.2.5 The EANPG was pleased to note that Regional OPMET Centre London and ICAO confirmed on 29 June 2016 that the required 24-hour TAF was produced and disseminated for UTAA (Ashgabat, Turkmenistan) and that the associated deficiency for Turkmenistan would be removed from the list of EUR Air Navigation Deficiencies (COG Conclusion 66/01 refers).

6.2.6 Furthermore, the EANPG noted there were no updates provided for the required OPMET data for Monaco (METAR required for LNMC) and Tajikistan (24-hour TAF required for UTDD).

6.2.7 Given the above, the EANPG agreed to the following EANPG Conclusion:

EANPG Conclusion 58/29 – Update to Air Navigation Deficiencies in the EUR Region for MET
That the ICAO Regional Director, Europe and North Atlantic, on behalf of the EANPG, update the list of *Air Navigation Deficiencies in the EUR Region* for MET as provided at **Appendix W** to this report which adds the deficiency EUR-MET-01-14 for Uzbekistan.

6.2.8 The comprehensive list of Air Navigation Deficiencies in the EUR Region provided at **Appendix X** takes into consideration EANPG Conclusion 58/28 and 58/29.

Annex B

MOUF/13/2016/03 - Pilot briefing guidance material

1. Background

During MOUF13 a discussion was had regarding the typical briefing process made by aircrew prior to flying. The following action was generated:

Reference:	MOUF/13/2016/03
Action:	Pilot briefing guidance material: Keep the MOUF informed of developments to increase and improve the material available to help pilots brief effectively.
Action on:	DH
Status:	OPEN

Since this meeting, the Met Office and CAA have commenced a number of activities designed to ensure that best use is made of the range of available regulated weather briefing information.

Furthermore, recent improvements to analytics software have provided an opportunity for the Met Office to identify the products viewed as most valuable to the aviation community.

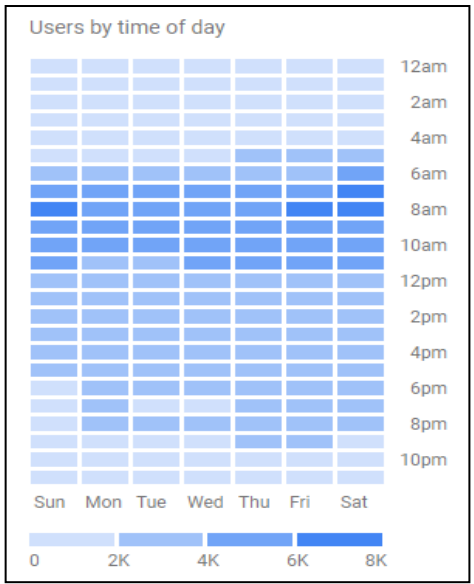
The paper provides a summary of:

a. The recent web analytics data, identifying the products most and least favoured by aircrew, and
b. The activities commenced by the Met Office and CAA designed to offer guidance on interpreting and deriving full benefit from these regulated aviation products

2. Web analytics

The Met Office operates analytics software its aviation weather briefing portal. The purpose of this software is to help us better understand user behaviour, i.e. peak access time and what pilots view most etc. Results from the analytics assist the Met Office in adapting and fine tuning the web site so that that it provides the best possible user experience all aviation sectors.

The following provides a summary covering June 2017.

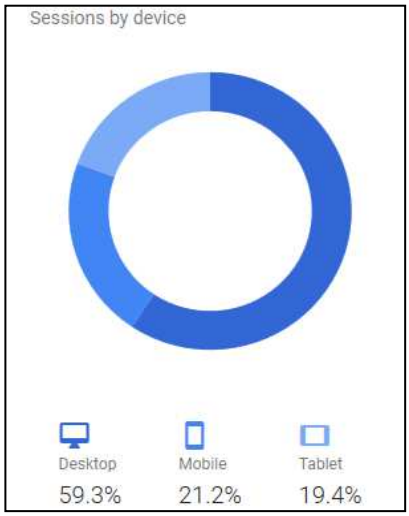


2.1. General Statistics

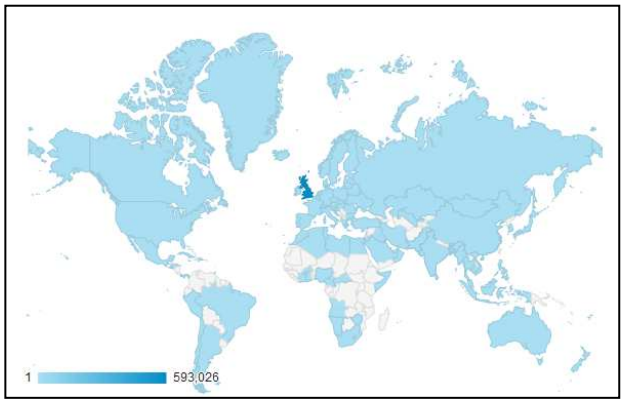
- Average number of different users per day: approx. 2100

- Average number of different users per week: approx. 8000
- Average number of different users per month: 20,000
- Average session duration:: 4min 10 sec

- Most access is made from a desktop (60%)
- Almost 90% of mobile/tablet devices used to access the portal are iPads and iPhones



- Users are accessing the web portal from across the globe!



2.2. What data is being accessed

(June 2016 figures in brackets)

Data type	% of GA users	Comments
TAF/METAR lists	62	Viewing at least one of these lists (but we can't tell which one(s))
Individual airport details	54	Most popular: • EGHH 8% • EGNX 4% • EGLL 3.5% • EGKK 3%

		• EGKA 3%
F215	36	
F214	28	
Used the map	28	Most popular map quick links used: • Rain radar 7% • Precip-cloud-fog 2% • Precip rate 2%
Surface pressure chart	15	
Balloon forecast	7	
AIRMET(any)	3	Most popular: • Central 0.8% • South East 0.6% Least popular: • UK Sig Wx 0.07% • UK upper winds 0.03%
Regional Pressure Settings	0.6	
Wind and Temp chart	0.7	
WAFC chart	0.6	
SIGMET	0.2	

2.3. Results

Based on these statistics there's little evidence to suggest that a 'top down' approach to briefing is widely applied. By that we mean, firstly looking at the wider weather picture, then honing into the area of flight, then finally the specific weather along the route and at the departure & arrival airfields.

There is an emphasis on aircrew focussing at site specific data (i.e. TAFs and METARs) and less so at area forecasts (i.e. F215 – Low Level Sig. Weather, and the map weather layers) that provide weather information during the en-route phase.

The results appear to also show that pilots' use of weather products during briefing may be related to how well the weather phenomena they describe are understood. For example, some valuable products (i.e. synoptic charts) may be overlooked due in part due to a perceived lack of confidence in interpreting them. This may possibly be a result of how weather training is focussed during pilot training (i.e. focussing on products such as TAFs, METARs). A different emphasis on training may well influence how pilot briefs, and may benefit the next generation of pilots. Another reason may be how the products are presented. For example, AIRMETs and F215s contain a lot of abbreviated information, especially on days where there is a lot of weather detail to convey succinctly (a fairly frequent occurrence in the UK!).

Overall it seems that pilots operating in the UK make the most use of the weather products that they consider they understand best, trust, and had more experience with during their flight training. Other products that may aid situational awareness are often overlooked, perhaps because of how they are presented and how to interpret them.

3. Weather guidance for pilots

Taking consideration of the above results, the Met Office and CAA have commenced a number of activities, which are designed to:

- Improve understanding and awareness of the regulated aviation briefing products themselves, and
- Provide practical guidance to ensure best use is made of these products to operate safely and efficiently.

These are explained more fully below.

3.1. Pilot resource portal

Over recent months the Met Office has been developing a range of activities designed to improve the guidance material available so that pilots may fully and confidently utilise the extensive array of weather briefing information provided on behalf of the CAA.

This followed a shared opinion (as demonstrated at para 2) that pilots may avoid potentially valuable briefing information because they do not always feel confident enough to fully interpret and draw conclusions from these products.

A first step is the creation of a 'pilot resource portal'. This is now available from the aviation briefing website log in page at http://www.metoffice.gov.uk/aviation/ga/pilot-resource-portal.

A significant amount of guidance material now exists on these pages, for example on interpreting WAFC SIGWX forecasts and synoptic charts, as well as practical guidance on interpreting TAFs, aerodrome warnings and F215s amongst others.

The Met Office intends to regularly review and update this portal with additional information. For example, we hope to add guidance on applying Threat & Error Management principles for weather.

To complement this portal, the Met Office has in its annual plan an objective to generate a small e-newsletter periodically. This would be issued to CAA approved training organisations (ATOs) and registered training facilities (RTFs) across the UK and comprise detail on some/all of the following subjects:

- future forecast developments (i.e. changes to TAF codes)
- awareness of safety services such as aerodrome warnings, forecast clarification
- links to guidance material
- courses available to develop weather knowledge further
- developments to the aviation weather briefing portal
- other items as appropriate

This newsletter was published in October and can be viewed at https://www.metoffice.gov.uk/aviation/ga .

3.2. Met Office support for the CAA Met Authority

The Met Office is supporting the CAA Met Authority in a review of the guidance provided by the CAA which is available to pilots on making effective weather-related decisions. It is felt that it would be useful to create a single document including all existing guidance, plus new guidance, to provide practical assistance to pilots in making the most of the weather information provided by the Met Office. It would be intended that such a document would complement the Skyway Code (CAP1535), which has in it a brief MET section (http://caa.co.uk/General-aviation/Safety-information/The-Skyway-Code).

4. Next steps

The meeting is invited to note the contents of this paper and provide feedback on how the Met Office can further improve the guidance material available on regulated aviation products.

Darren Hardy, October 2017

Met Office

Annex C

Met Office

CAA Aerodrome Warnings Verification Report

April 2016 - March 2017

This report includes verification of strong wind, fog and air frost warnings at 22 UK aerodromes. This includes 15 enhanced service airports and 7 standard service airports. Results for Cardiff, Doncaster Sheffield, Leeds Bradford, Norwich and Prestwick have been omitted from this report, as their service changed from enhanced to standard in October 2016 so 12 months of consistent data was unavailable.

Parameter	Business rules for 'hit' observed in one METAR
Strong Wind	Mean speed of 20kt and/or a gust of 28kt
Fog	Visibility 600m or less
Air Frost	Air temperature less than 0.0°C

Observed	Forecast Y	Forecast N
Y	Hit	Miss
N	False alarm	

All Enhanced Airports

Strong Wind

Observed	Forecast Y	Forecast N
Y	714	136
N	694	
Hit Rate	0.84	
False Alarm Ratio	0.49	
Threat Score	0.46	

Fog

Observed	Forecast Y	Forecast N
Y	487	219
N	303	
Hit Rate	0.69	
False Alarm Ratio	0.38	
Threat Score	0.48	

Air Frost

Observed	Forecast Y	Forecast N
Y	350	68
N	311	
Hit Rate	0.84	
False Alarm Ratio	0.47	
Threat Score	0.48	

Heathrow

Strong Wind

Observed	Forecast Y	Forecast N
Y	18	1
N	27	
Hit Rate	0.95	
False Alarm Ratio	0.60	
Threat Score	0.39	

Fog

Observed	Forecast Y	Forecast N
Y	17	11
N	5	
Hit Rate	0.61	
False Alarm Ratio	0.23	
Threat Score	0.52	

Air Frost

Observed	Forecast Y	Forecast N
Y	26	2
N	8	
Hit Rate	0.94	
False Alarm Ratio	0.24	
Threat Score	0.73	

Gatwick

Strong Wind

Observed	Forecast Y	Forecast N
Y	21	2
N	23	
Hit Rate	0.93	
False Alarm Ratio	0.53	
Threat Score	0.46	

Fog

Observed	Forecast Y	Forecast N
Y	23	13
N	27	
Hit Rate	0.65	
False Alarm Ratio	0.54	
Threat Score	0.37	

Air Frost

Observed	Forecast Y	Forecast N
Y	35	6
N	16	
Hit Rate	0.85	
False Alarm Ratio	0.31	
Threat Score	0.62	

Aberdeen

Strong Wind

Observed	Forecast Y	Forecast N
Y	63	14
N	50	
Hit Rate	0.82	
False Alarm Ratio	0.44	
Threat Score	0.50	

Fog

Observed	Forecast Y	Forecast N
Y	22	14
N	14	
Hit Rate	0.61	
False Alarm Ratio	0.39	
Threat Score	0.44	

Air Frost

Observed	Forecast Y	Forecast N
Y	23	7
N	36	
Hit Rate	0.77	
False Alarm Ratio	0.60	
Threat Score	0.35	

Belfast

Strong Wind

Observed	Forecast Y	Forecast N
Y	54	5
N	68	
Hit Rate	0.91	
False Alarm Ratio	0.56	
Threat Score	0.42	

Fog

Observed	Forecast Y	Forecast N
Y	13	11
N	21	
Hit Rate	0.54	
False Alarm Ratio	0.63	
Threat Score	0.28	

Air Frost

Observed	Forecast Y	Forecast N
Y	25	7
N	17	
Hit Rate	0.79	
False Alarm Ratio	0.40	
Threat Score	0.52	

Birmingham

Strong Wind

Observed	Forecast Y	Forecast N
Y	14	1
N	62	
Hit Rate	0.93	
False Alarm Ratio	0.82	
Threat Score	0.18	

Fog

Observed	Forecast Y	Forecast N
Y	31	11
N	24	
Hit Rate	0.73	
False Alarm Ratio	0.44	
Threat Score	0.47	

Air Frost

Observed	Forecast Y	Forecast N
Y	21	1
N	27	
Hit Rate	0.98	
False Alarm Ratio	0.57	
Threat Score	0.43	

Bristol

Strong Wind

Observed	Forecast Y	Forecast N
Y	70	12
N	54	
Hit Rate	0.85	
False Alarm Ratio	0.43	
Threat Score	0.51	

Fog

Observed	Forecast Y	Forecast N
Y	110	22
N	49	
Hit Rate	0.83	
False Alarm Ratio	0.31	
Threat Score	0.61	

Air Frost

Observed	Forecast Y	Forecast N
Y	13	3
N	18	
Hit Rate	0.83	
False Alarm Ratio	0.59	
Threat Score	0.38	

East Midlands

Strong Wind

Observed	Forecast Y	Forecast N
Y	69	11
N	42	
Hit Rate	0.87	
False Alarm Ratio	0.38	
Threat Score	0.57	

Fog

Observed	Forecast Y	Forecast N
Y	36	11
N	24	
Hit Rate	0.77	
False Alarm Ratio	0.40	
Threat Score	0.51	

Air Frost

Observed	Forecast Y	Forecast N
Y	20	2
N	27	
Hit Rate	0.91	
False Alarm Ratio	0.57	
Threat Score	0.41	

Edinburgh

Strong Wind

Observed	Forecast Y	Forecast N
Y	70	10
N	64	
Hit Rate	0.87	
False Alarm Ratio	0.47	
Threat Score	0.49	

Fog

Observed	Forecast Y	Forecast N
Y	15	24
N	10	
Hit Rate	0.39	
False Alarm Ratio	0.39	
Threat Score	0.31	

Air Frost

Observed	Forecast Y	Forecast N
Y	33	18
N	17	
Hit Rate	0.65	
False Alarm Ratio	0.33	
Threat Score	0.49	

Glasgow

Strong Wind

Observed	Forecast Y	Forecast N
Y	48	14
N	44	
Hit Rate	0.77	
False Alarm Ratio	0.47	
Threat Score	0.46	

Fog

Observed	Forecast Y	Forecast N
Y	12	38
N	9	
Hit Rate	0.23	
False Alarm Ratio	0.42	
Threat Score	0.20	

Air Frost

Observed	Forecast Y	Forecast N
Y	34	10
N	11	
Hit Rate	0.78	
False Alarm Ratio	0.24	
Threat Score	0.62	

Liverpool

Strong Wind

Observed	Forecast Y	Forecast N
Y	75	12
N	42	
Hit Rate	0.86	
False Alarm Ratio	0.36	
Threat Score	0.58	

Fog

Observed	Forecast Y	Forecast N
Y	16	6
N	7	
Hit Rate	0.74	
False Alarm Ratio	0.31	
Threat Score	0.55	

Air Frost

Observed	Forecast Y	Forecast N
Y	11	0
N	18	
Hit Rate	1.00	
False Alarm Ratio	0.62	
Threat Score	0.38	

London City

Strong Wind

Observed	Forecast Y	Forecast N
Y	39	13
N	28	
Hit Rate	0.75	
False Alarm Ratio	0.42	
Threat Score	0.49	

Fog

Observed	Forecast Y	Forecast N
Y	20	4
N	4	
Hit Rate	0.83	
False Alarm Ratio	0.17	
Threat Score	0.71	

Air Frost

Observed	Forecast Y	Forecast N
Y	8	0
N	14	
Hit Rate	1.00	
False Alarm Ratio	0.64	
Threat Score	0.36	

Luton

Strong Wind

Observed	Forecast Y	Forecast N
Y	35	9
N	43	
Hit Rate	0.80	
False Alarm Ratio	0.55	
Threat Score	0.41	

Fog

Observed	Forecast Y	Forecast N
Y	78	17
N	32	
Hit Rate	0.82	
False Alarm Ratio	0.29	
Threat Score	0.62	

Air Frost

Observed	Forecast Y	Forecast N
Y	27	1
N	28	
Hit Rate	0.98	
False Alarm Ratio	0.51	
Threat Score	0.48	

Stansted

Strong Wind

Observed	Forecast Y	Forecast N
Y	32	3
N	45	
Hit Rate	0.93	
False Alarm Ratio	0.58	
Threat Score	0.41	

Fog

Observed	Forecast Y	Forecast N
Y	58	20
N	31	
Hit Rate	0.75	
False Alarm Ratio	0.35	
Threat Score	0.53	

Air Frost

Observed	Forecast Y	Forecast N
Y	28	1
N	23	
Hit Rate	0.97	
False Alarm Ratio	0.45	
Threat Score	0.54	

Manchester

Strong Wind

Observed	Forecast Y	Forecast N
Y	32	5
N	61	
Hit Rate	0.86	
False Alarm Ratio	0.66	
Threat Score	0.32	

Fog

Observed	Forecast Y	Forecast N
Y	17	10
N	18	
Hit Rate	0.63	
False Alarm Ratio	0.52	
Threat Score	0.38	

Air Frost

Observed	Forecast Y	Forecast N
Y	22	3
N	26	
Hit Rate	0.88	
False Alarm Ratio	0.54	
Threat Score	0.43	

Newcastle

Strong Wind

Observed	Forecast Y	Forecast N
Y	74	24
N	41	
Hit Rate	0.76	
False Alarm Ratio	0.36	
Threat Score	0.53	

Fog

Observed	Forecast Y	Forecast N
Y	19	7
N	28	
Hit Rate	0.73	
False Alarm Ratio	0.60	
Threat Score	0.35	

Air Frost

Observed	Forecast Y	Forecast N
Y	24	7
N	25	
Hit Rate	0.77	
False Alarm Ratio	0.51	
Threat Score	0.43	

All Standard Airports

Strong Wind

Observed	Forecast Y	Forecast N
Y	1795	243
N	900	
Hit Rate	0.88	
False Alarm Ratio	0.33	
Threat Score	0.61	

Fog

Observed	Forecast Y	Forecast N
Y	104	118
N	230	
Hit Rate	0.47	
False Alarm Ratio	0.69	
Threat Score	0.23	

Air Frost

Observed	Forecast Y	Forecast N
Y	172	69
N	266	
Hit Rate	0.71	
False Alarm Ratio	0.61	
Threat Score	0.34	

Humberside

Strong Wind

Observed	Forecast Y	Forecast N
Y	81	33
N	72	
Hit Rate	0.71	
False Alarm Ratio	0.47	
Threat Score	0.44	

Fog

Observed	Forecast Y	Forecast N
Y	28	33
N	79	
Hit Rate	0.46	
False Alarm Ratio	0.74	
Threat Score	0.20	

Air Frost

Observed	Forecast Y	Forecast N
Y	20	3
N	52	
Hit Rate	0.89	
False Alarm Ratio	0.73	
Threat Score	0.26	

Inverness

Strong Wind

Observed	Forecast Y	Forecast N
Y	183	47
N	97	
Hit Rate	0.80	
False Alarm Ratio	0.35	
Threat Score	0.56	

Fog

Observed	Forecast Y	Forecast N
Y	3	25
N	22	
Hit Rate	0.10	
False Alarm Ratio	0.89	
Threat Score	0.06	

Air Frost

Observed	Forecast Y	Forecast N
Y	68	27
N	49	
Hit Rate	0.72	
False Alarm Ratio	0.42	
Threat Score	0.47	

Kirkwall

Strong Wind

Observed	Forecast Y	Forecast N
Y	304	32
N	180	
Hit Rate	0.91	
False Alarm Ratio	0.37	
Threat Score	0.59	

Fog

Observed	Forecast Y	Forecast N
Y	18	14
N	25	
Hit Rate	0.57	
False Alarm Ratio	0.58	
Threat Score	0.32	

Air Frost

Observed	Forecast Y	Forecast N
Y	6	1
N	37	
Hit Rate	0.92	
False Alarm Ratio	0.86	
Threat Score	0.14	

Scatsta

Strong Wind

Observed	Forecast Y	Forecast N
Y	399	53
N	114	
Hit Rate	0.88	
False Alarm Ratio	0.22	
Threat Score	0.70	

Fog

Observed	Forecast Y	Forecast N
Y	14	4
N	31	
Hit Rate	0.77	
False Alarm Ratio	0.69	
Threat Score	0.28	

Air Frost

Observed	Forecast Y	Forecast N
Y	21	7
N	26	
Hit Rate	0.76	
False Alarm Ratio	0.56	
Threat Score	0.39	

Southend

Strong Wind

Observed	Forecast Y	Forecast N
Y	51	15
N	81	
Hit Rate	0.78	
False Alarm Ratio	0.61	
Threat Score	0.35	

Fog

Observed	Forecast Y	Forecast N
Y	10	14
N	32	
Hit Rate	0.43	
False Alarm Ratio	0.76	
Threat Score	0.18	

Air Frost

Observed	Forecast Y	Forecast N
Y	38	7
N	51	
Hit Rate	0.85	
False Alarm Ratio	0.57	
Threat Score	0.40	

Stornoway

Strong Wind

Observed	Forecast Y	Forecast N
Y	316	31
N	180	
Hit Rate	0.91	
False Alarm Ratio	0.36	
Threat Score	0.60	

Fog

Observed	Forecast Y	Forecast N
Y	1	7
N	21	
Hit Rate	0.07	
False Alarm Ratio	0.98	
Threat Score	0.02	

Air Frost

Observed	Forecast Y	Forecast N
Y	8	24
N	25	
Hit Rate	0.26	
False Alarm Ratio	0.75	
Threat Score	0.15	

Sumburgh

Strong Wind

Observed	Forecast Y	Forecast N
Y	461	32
N	176	
Hit Rate	0.93	
False Alarm Ratio	0.28	
Threat Score	0.69	

Fog

Observed	Forecast Y	Forecast N
Y	30	21
N	20	
Hit Rate	0.59	
False Alarm Ratio	0.40	
Threat Score	0.42	

Air Frost

Observed	Forecast Y	Forecast N
Y	11	0
N	26	
Hit Rate	1.00	
False Alarm Ratio	0.70	
Threat Score	0.30	

Annex D

pdf of presentations attached separately