COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP
ON INTEGRATED OBSERVING SYSTEMS

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EXPERT TEAM ON AIRCRAFT-BASED OBSERVING SYSTEMS

FIRST SESSION

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STATUS OF THE AIRCRAFT-BASED OBSERVATIONS PROGRAMS

Reports of Operational National & Regional Programs

E-AMDAR Programme Status Report
(*Submitted by Steve Stringer, E-AMDAR Programme Manager)*

SUMMARY AND PURPOSE OF DOCUMENT

The Report provides a progress and activity report of E-AMDAR with some additional detailed information from its national contributions.

ACTION PROPOSED

The Session is invited to review and discuss the content of the document.

Appendices

1. Program Metadata
2. Additional Program Metadata provided as Excel Spreadsheet.

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PROGRESS AND ACTIVITY REPORT

Current Status

Since 1st January 2013 responsibility for management of the E-AMDAR programme lies with the Met Office, UK. This follows a successful 11-year programme phase that was managed by SMHI which saw a sustained growth in the number of airlines participating in E-AMDAR, up to the present day value of 13 (See annex 1 for details). Fortunately, the management team has not completely changed - the much valued E-AMDAR technical coordinator from the previous phase, Stewart Taylor, continues in this role into the new programme phase.

In taking over management of the E-AMDAR programme, on behalf of the 30 members of EUMETNET, the Met Office has committed to achieving the following objectives:

- ➢ Continued, sustainable access to high quality upper air observations from commercial aircraft;
- ➢ Delivery of the Extended Humidity Trial and a business case - setting out the investment options and related costs for an extension of capability to include humidity data;
- ➢ Increased number of airports providing 3-hourly observations;
- ➢ Increased horizontal coverage in data sparse areas;
- ➢ Flexibility to facilitate additional data required by individual NMSs

However, to reflect the current economic conditions facing Members, the programme has been forced to accept a reduced level of funding over the next 5 years. This has impacted the nominal data purchase capability with a resulting reduction in performance targets, as can be seen in Table 1 below.

| Performance targets for E-AMDAR	Target 2012	Target 2013
Number of airports in EUCOS area observed daily	140	129
Number of 3 hourly observed airports	40	37
Total daily number of profiles within EUCOS area	780	718
WWW contribution	12%	11%
Annual number of E-AMDAR funded observations	12M	11M
Total number of E-AMDAR aircraft equipped with development WVSS-II units	3	3
Timeliness T + 50	90%	90%
Timeliness T + 100	95%	95%

Table 1. E-AMDAR Performance requirements for 2013.

Nonetheless, despite reduced funding the new management team takes it as a challenge to increase, rather than decrease, the number of observations generated by E-AMDAR. Key to this is increasing the efficiency of observations, i.e. reducing data duplication or data generated that is not utilised due to 'thinning', through increased use of data optimisation.

A good start has been made to the new phase, making a relatively smooth handover and transition to the new team with no interruption in data services. The high quality data continues to be produced and delivered in timely manner, utilising the existing infrastructure and systems.

Hopefully this can be seen from Figures 1 & 2 shown below where modest increases in the number of observations and the number of regular airport profiles can be seen.

Fig.1: Monthly Gross and Net number of observations
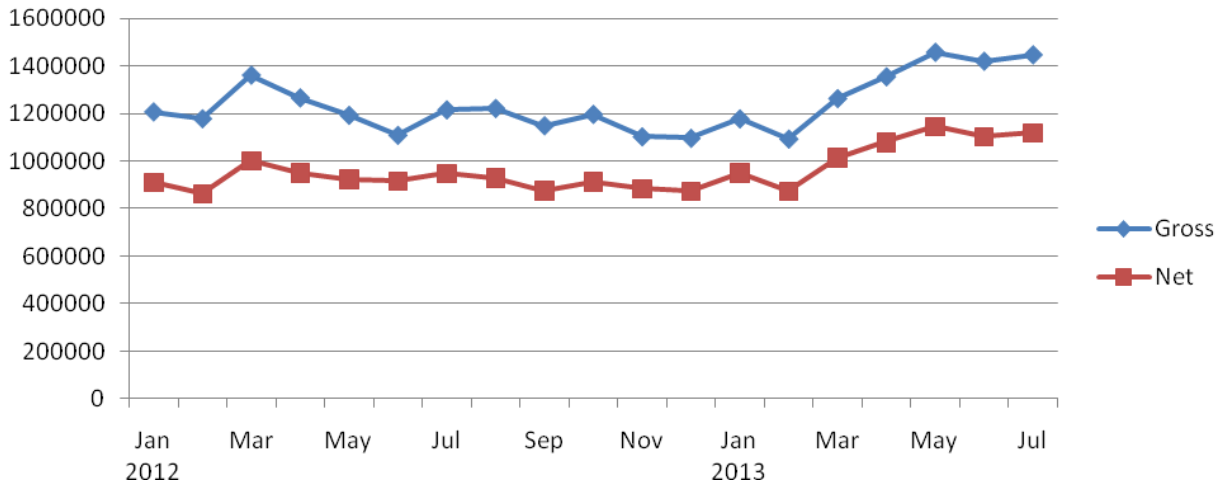
Note: The Net figure represents that funded by E-AMDAR based on European regional requirements, which aims to provide observations on a horizontal spacing of approx. 250km and with a temporal resolution of an observation every 3 hours. The current Net target, 11 million observations a year, equates to a monthly Net requirement of 916,000.
The Gross figure includes the additional observations funded by individual NMHSs for their own national requirements. At present MétéoFrance, DWD, KNMI and Met Office fund provision of additional observations within their own countries. Generally the national requirements are for hourly observations from as many regional airports within country as possible.

Fig.2: Daily profile and 3-Hourly profile Airports
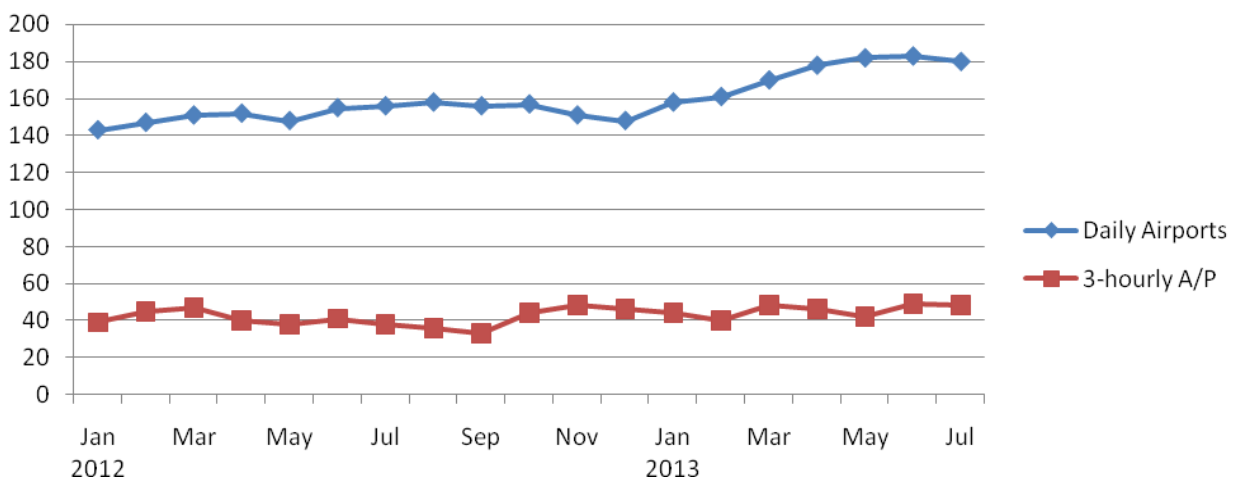
The number of airports at which E-AMDAR profiles are generated have so far managed to be sustained, even increased, despite funding reductions due to a couple of factors. Firstly the inclusion of the Germanwings airline (since Dec'12) and efficiencies in the easyJet flight selection has opened up a few more airports for reporting. This has also led to improved geographic coverage, i.e. with more regional airports, airports in the Mediterranean and east Europe. Secondly, increased use of the E-ADOS optimiser has cut down some duplication of routes/airports. Some reductions have also been made to the more expensive Satcom data – mainly on the trans-Atlantic routes.

The number of observations is now fairly stable, with the usual day-to-day schedule variations (see Fig.3), being generated by approx 850 aircraft each month with a daily average of ~600 aircraft reporting. The occasional minor interruption to service continues to occur, e.g. due to infrastructure issue or industrial action, as can in Fig.3 where French air traffic industrial action (9th-11th July) impacted the number of AFR flights and subsequent E-AMDAR observations generated.

Fig.3: Daily observations per airline during July 2013
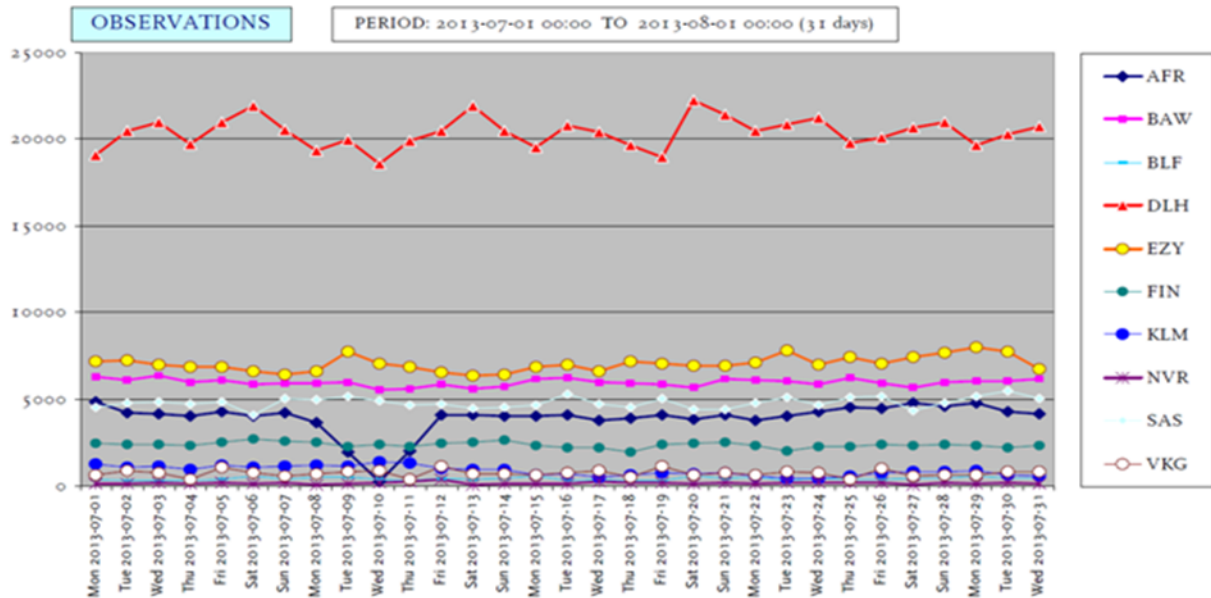
Development & Other Activities

The first 6-months of the new E-AMDAR programme phase have been focussed on continuity of service while considering priorities for developments and next steps for the programme. The current developments, i.e those started before January 2013, have been continued unchanged. These are:

1. E-AMDAR Portal
   Development of a replacement for the E-AMDAR Portal, a password protected site provided by DWD on behalf of the programme used by the management team on a day-to-day operational basis which provides monitoring and generation of observing statistics in near real time. The new portal has been through a number of test phases and is now in final acceptance. Some of the pages are being made available direct to the airlines – so they too can monitor their own performance.

2. Extended Humidity Trial
   Continuation of the EHT which replaces the WVSS-II v2 humidity sensors on the three Lufthansa A319 with the WVSS-II v3 sensors and to install new sensors on another 6 Lufthansa A319 aircraft. The aim was to have nine aircraft with humidity sensors in daily operation in Europe by the end of 2013.
   The seven sensors delivered in early 2013 have been tested at a DWD laboratory. These tests covered the mechanical integrity, electrical operation, function of interfaces, sample gas flow, internal readings of pressure and temperature, mixing ratio readings at relative humidities of 0 % and 75 %. All units passed testing and have been presented to DLH for installation, which was due for completion by August 2013 but airline priorities have slipped the schedule. DWD are in the process of discussing the delays with Lufthansa and agreeing new dates for Engineering Bulletin release and installation schedule. Currently completion is not expected until mid-2104. Discussions will also cover the STC for the

WVSS-II humidity sensor on aircraft of the Airbus A320 family in other fleets within Europe. Lufthansa are currently only considering certification for their own aircraft.

3. BUFR Data
   New BUFR template work has been completed and planning for GTS dissemination in BUFR only from FM42 and current BUFR format is going ahead. Current plans are to migrate to the new template during 2013 – ahead of the WMO deadline of Nov 2014.

4. Humidity Business Case
   An outline of expected costs for implementing a aircraft humidity observing programme within E-AMDAR was provided to EUMETNET Members in Autumn 2012. Progress on establishing the business case now relies on understanding the expected benefits that of such a humidity programme. An Observing Sensitivity Experiment (OSE) is being run by ECMWF to gather the impact evidence of aircraft humidity observations, the results of which may be available in early 2014. The WMO initiative to document impact evidence will also aid the business case.
   EUMETNET Members also agreed to installation of a TAMDAR sensor on the UK FAAM research aircraft (which is also fitted with WVSS-II sensors). Originally hoped for Oct'13 it now looks like Feb'14 will be the earliest for completion. Comparison flights will follow.

5. Boeing B777 software
   Negotiations continue with AFR/KLM regarding proposal for development of software for the AFR/KLM B777 fleet. Aim is to start implementation early 2014 with software available for use by other AMDAR fleets.

Future Plans

A number of issues/objectives have been identified for the E-AMDAR programme that will be driving the future plans and related developments over the next few years. These are:

1. Performance Requirements
   Many of the performance requirements placed on E-AMDAR were generated 12-15 years ago, primarily to meet the needs of Regional NWP. Advances in NWP over this period have changed significantly, resulting in much higher spatial & temporal resolution requirements. The requirements for E-AMDAR will be reviewed and will likely result in some changes being made. For instance, while spatial resolution of profiles for E-AMDAR is restricted to where the airports are, the timeliness of data (especially for profiles) needs to be improved to match the hourly update cycles of the newer high resolution/SRNWP model needs. A T+15 timeliness target is envisaged that may mean developments are needed to the existing E-AMADR infrastructure in order to achieve faster delivery.

2. Data Optimisation
   While the E-ADOS system provides very effective optimisation in flight selection it is only used for DLH, FIN and KLM B737 fleets. The remainder of airline fleets are selected by individual Flight Selection Systems (FSS), which being un-coordinated leads to some duplication of data being generated which in many cases is wasted, either through 'thinning' by NWP assimilation or just not being needed, such as 2 profiles at the same airport within 5 minutes of each other. The objective will be use of just one optimisation system to control the whole E-AMDAR fleet, i.e through expanded use of E-ADOS.
   Linked with this is potential to save money spent on duplicate data through closer cooperation over optimisation between AMDAR programmes, such as between MDCRS and E-AMDAR fleets which often have flights/aircraft in each others' area/airports.

3. Humidity observations (& affordability)
   The current estimates for installing a sizable fleet of E-AMDAR aircraft (50-100) fitted with WVSS-II sensors is probably considered unaffordable to EUMETNET Members, unless the case can be made for the value or benefit of the humidity data that would be generated. These benefits would have to be in terms of impact on NMHS services. However, even if funding is forthcoming we still need to convince airlines to 'cut holes' in their aircraft and

carry the extra weight, hence there also need to be clear benefits for the airlines identified as well. Nevertheless, from discussion held already, two airlines are showing some interest in our desire to install humidity sensors – BAW & SAS – but both need to be convinced of the benefits! Much work will be required to develop the benefits side of the business case but to be truly successful the aim will be to engage airlines as partners to jointly fund the required investment

4. Future of Aircraft Based Observing with Mode-S/ ADS-B
   The techniques demonstrated by KNMI for using aircraft ADS-B/Mode-S data to generate Wind (& temperature) data, are expected to develop into an operational service for certain parts of Europe over the coming years. This could provide the potential to reduce AMDAR observing at some locations, which will allow budget to be spent elsewhere – either to purchase AMDAR data at other, less well covered locations and areas throughout Europe or to be put towards increased costs for aircraft humidity observing. A development plan would therefore be needed to assess quality and practicality of supplementing E-AMDAR data with that from Mode-S.

5. Infrastructure Portability
   The E-AMDAR infrastructure is mature, stable and has been working reliably for many years. However some, like E-ADAS, is running on fairly old servers that maybe limited in terms of expansion should many more airlines join the programme. E-ADAS is fully supported but consideration has been given in the past to resilience of service should any major incident occur at site. (This applies to the other E-AMDAR infrastructure as well.) As was the case when Met Office took on management responsibility for E-AMDAR, future E-AMDAR coordinating members may want to run the E-AMDAR systems themselves so the question of portability was raised. This will be assessed but current thoughts are towards potential efficiencies (and increased resilience) that might be gained through moving the E-AMDAR infrastructure to a Cloud IT architecture. Possibilities will be explored but could provide unrestricted expansion capability, operable from anywhere and provide increased resilience.

6. Monitoring
   Consideration is already being given to simplifying the day-to-day monitoring of performance and generation of programme statistics which is fairly time consuming as it is a heavily manual process and currently draws information from a number of sites (Met Office, KNMI, DWD). The developments that have taken place so far for the new E-AMDAR Portal mean that most of the required data is now available at one site and with some development it should be possible to automate generation of most of the required output, plus will provide an independent check on performance.

APPENDIX 1

PROGRAM METADATA (BASED ON JULY 2013 INFORMATION).

Operational Fleet

Airline	Country of Airline	Aircraft Type (e.g. B737-400)[4]	Number of Aircraft	AMDAR Software	Format On GTS (BUFR / FM42)
Air France (AFR)	France	A318	18	Developed by AFR (based on A620)	FM42
		A319	32		FM42
		A320	53		FM42
		A321	5		FM42
British Airways (BAW)	UK	A318	2	AAA v3	FM42
		B737	19	AAA v2	FM42
		B747	52	AAA v2	FM42
		B767	21	AAA v2	FM42
Blue1 (BLF)	Finland	B717	9	A620 v2	BUFR
Lufthansa (DLH)[1]	Germany	A319	60	A620-3 v2	BUFR
		A320	51	A620-3 v2	BUFR
		A321	61	A620-3 v2	BUFR
		A330	17	A620-3 v2	BUFR
		A340	49	A620-3 v2	BUFR
		A380	10	A620-3 v2	BUFR
		B737	42	A620-3 v2	BUFR
		B747	27	A620-3 v2	BUFR
		CRJ	12	A620-3 v2	BUFR
		MD11	18	A620-3 v2	BUFR
easyJet (EZY)[5]	UK	A319	170	A620 v2	FM42
		A320	61	A620 v2	FM42
		A321	4	A620 v2	FM42
Finnair (FIN)	Finland	A319	9	A620-3 v2	FM42
		A320	10	A620-3 v2	FM42
		A321	6	A620-3 v2	FM42
KLM	Netherlands	B737	51	AAA v3	FM42

		B747	26	AAA v1	FM42
		MD11	7	AAA v1	FM42
Novair (NVR)	Scandinavia	A321	3	A620 v2	FM42
SAS	Scandinavia	A321	12	A620 v2	FM42
		A330	4	A620 v2	FM42
		A340	7	A620 v2	FM42
		B737	78	A620 v2/4[2]	FM42
		CRJ	1[3]	A620 v2	FM42
Thomas Cook (VKG)	Scandinavia	A321	9	A620 v2	FM42
		A330	5	A620 v2	FM42

Notes:

1. *DLH includes Lufthansa, CityLine, LHCargo and Germanwings fleets.*
2. *Several of the SAS aircraft have a Honeywell Proprietary software version.*
3. *Only one aircraft reporting at this time (fleet software to be rolled out on further 11 aircraft).*
4. *Due to the various Aircraft Type/Series in use, this information has been restricted to Type only. If further information required, this can be supplied.*
5. *The version of ARINC 620 on EZY fleets still to be confirmed.*

Program Coverage

The current E-AMDAR Programme Objectives are based on number of airports and profiles delivered to provide spatial and temporal network coverage – as described above.
The Programme provides around ~1.4m observations per month – daily average for July was 43,467 observations – with profiles produced at ~450 airports during July.

Due to size of the list, of current Program Coverage, this information is contained in an accompanying spreadsheet to this document.

Of this monthly total, approx 315k observations are related to additional data provided to European NMHS (in support of national NWP) and support to other Regional AMDAR programmes. This monthly total also includes a contribution of data – outside of the EUCOS domain – in support of WMO WWW (currently around 9%).

Airport Country	Airport Name	Airport ID (IATA)	Profiles per day/week
See accompanying spreadsheet...			

Notes

a) Metadata information was obtained using the E-AMDAR Portal. The Portal has the capability to provide daily/monthly profile tables by airport and airline. This provides a very useful tool in monitoring the E-AMDAR daily network.
b) The number of profiles is based on "weekly average" for July.

Program Potential Coverage

The E-AMDAR Programme funding allows for an optimised network coverage over the EUCOS domain. If there was no limitation on funds for data procurement, the E-AMDAR fleets could provide further data.
Again, the size of the list is restrictive to this document and is included in the accompanying spreadsheet.

Airport Country	Airport Name	Airport ID (IATA)	Profiles per day/week
See accompanying spreadsheet...			

Notes

a) Information is gathered from the route networks on the websites of the current participating airlines.
b) The assumption here is that AMDAR software is available for all fleet types. This would be achieved if AMDAR software was developed for fleet types not already covered by the AAA and ARINC620 software applications.

Program Potential International Coverage

With the E-AMDAR Programme being a European collaboration, the airlines provide short, medium and long haul capabilities.

The potential from medium and long haul international flights from E-AMDAR airlines has been captured in the associated spreadsheet.

Airport Country	Airport Name	Airport ID (IATA)	Airline & Fleet (Aircraft model)	Profiles per day/week
See accompanying spreadsheet...				

Notes

a) The spreadsheet provides information on E-AMDAR airlines that fly to these "potential" airports at least once per week.
b) There are many variations of long haul aircraft (type/model) in use and it is assumed that the following aircraft are (or will be) used: A330, A340, A350, A380, B747, B767, B777 and B787. At present, AMDAR software would need to be developed for A350, B777 and B787 and any future "next-gen" aircraft purchased by the airlines.