

WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS
OPAG ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON AIRCRAFT-BASED OBSERVING SYSTEMS
First Session



Geneva, Switzerland

10 - 13, September, 2013

FINAL REPORT

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AGENDA

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GENERAL SUMMARY

1. OPENING AND ORGANIZATION OF THE SESSION

- 1.1. The First Session of the Commission for Basic Systems (CBS), Open Programme Area Group on Integrated Observing Systems (OPAG-IOS), Expert Team on Aircraft-Based Observing Systems (ET-ABO) was opened by the Chair of the team, Mr Frank Grooters, at 9:30am on 10th September 2013 at Geneva, Switzerland.
- 1.2. The participants of the session were welcomed to WMO and Geneva by Mr Dean Lockett on behalf of the Secretary General and the Director of the Observing and Information Systems Department. Mr Lockett provided an introduction to the session explaining the role of the Expert Team and its place within the CBS and OPAG-IOS structure. The importance and relevance of the development and extension of the aircraft-based and AMDAR observing systems in line with the CBS Implementation Plan for the Evolution of the GOS and in the context of the WMO Integrated Global Observing System (WIGOS) Framework Implementation Plan was underlined to the session.
- 1.3. The Chair provided an explanation of the procedures for the session and outlined the agenda and expected schedule for the meeting. The Provisional Agenda (doc. 1.1) was adopted unchanged.
- 1.4. The list of participants in the session is provided within [Annex I](#).

2. REPORT OF THE CHAIR

AMDAR Panel 15th Session

- 2.1. Mr Frank Grooters, Chair of the Expert Team presented his report which provided a context for the work of the team as part of a wider work programme, taking up the work of the WMO AMDAR Panel, which ceased activities at its 15th and final session (Panel-15) in November 2012 (Boulder, Colorado, USA). As the former Chair of the Panel and being unable to attend the final session, Mr Grooters expressed his appreciation and thanks to the former vice-Chair of the Panel, Mr Carl Weiss, for chairing the final Panel meeting. He also thanked the members of the Panel for their devotion and support to the WMO Global AMDAR programme over the last 16 years and expressed his gratitude to the WMO Secretariat for its continuous support to the AMDAR observing system and the work of the Panel.

New governance and Operation of the AMDAR Trust Fund

- 2.2. The Chairman reminded the team that at Panel-15, the Panel decided to adopt the proposal to transfer the AMDAR observing system to a new governance and programmatic structure under the World Weather Watch Programme (WWW) and that the Panel should cease operation at the conclusion of Panel-15.
- 2.3. The governance and programmatic structure (including the management of the AMDAR Trust Fund) was handed over to the CBS and CIMO Technical Commissions, to be managed jointly by the CBS, OPAG-IOS Expert Team on Aircraft-Based Observing Systems (ET-ABO) and the CIMO, OPAG-SI Task Team on Aircraft-based Observations (TT-AO). Together, these two teams and their work programmes would be referred to as the Aircraft-Based Observations Programme (ABOP).
- 2.4. CBS-15 (September 2012) established the Terms of Reference and Membership of the ET-ABO. The Terms of Reference, the Work Plan (incl. the financial allocation) and the membership of the TT-AO was agreed by the CIMO Management Group in 2013.
- 2.5. At its 16th Session, Congress had invited WMO Members to continue to contribute to the AMDAR Trust Fund in order to support future AMDAR and Aircraft-based Observations. As had been agreed by the Panel, subsequent to the transition of the AMDAR Programme into

the GOS of the WWW, the Trust Fund would be jointly managed and operated by CBS and CIMO under the continued administration of WMO. The Secretariat had in April 2013 written the annual letter to Members requesting their contribution to the Trust Fund.

- 2.6. In 2013 and leading up to the session, the Chair and the vice-Chair of ET-ABO, the Chair of the TT-AO and the Scientific Officer on Aircraft-based and Remotely-sensed Observations (SO/ARO) in the Secretariat had developed, reviewed and finalized a work plan and budget for the ABOP based on the recommended draft work plan of the Panel and according to the requirements of the new Terms of Reference for the AMDAR Trust Fund¹. The work plans and budgets are available to all WMO Members from the WMO Aircraft-based Observations website².

ET-ABO Work Program

- 2.7. In May 2013 the ET-ABO work plan was approved by the Co-Chairs of the CBS OPAG-IOS. The meeting would be informed in detail about the status of the tasks and activities in the work plan under appropriate agenda items.

Studies

- 2.8. In the work plan, some tasks do relate to studies for which contracts are or will be concluded with external consultants. The study on AMDAR Coverage & Targeting for Future Airline Recruitment (February 2013) had been completed and published³. The study on the Impact of AMDAR Data was still ongoing. The Chair, vice-Chair and SO/ARO had reviewed proposals for the study on AMDAR Impacts and Benefits for Aviation for which WMO would prepare a contract in October 2013.

AMDAR Development Officer

- 2.9. One of the important tasks in the work plan was the employment of an AMDAR Development Officer (ADO). The Secretariat had distributed a request for an Expression of Interest (EoI), together with the job description for the ADO consultancy position in April 2013. The Chair, vice-Chair and the SO/ARO evaluated the application of three candidates and Mr Stig Carlberg, former E-AMDAR Programme Manager, was offered a contract for the position of AMDAR Develop Officer under a WMO Special Services Agreement (SSA). The SSA commenced on 1 July 2013 and would continue for a 12 month period at 50% of full time equivalent. A Work Plan for the ADO was drafted based upon the job description, which initially included assistance with the development of a Strategy and Implementation Plan for the ABOP.

ABO Data Centre

- 2.10. Another important activity of ET-ABO was the maintenance and development of the Quality Management System (QMS) for global aircraft-based observations, including Data Management, Metadata management, Quality Control and Data Monitoring, based on WMO standards. As part of the data management framework for ABO, the ABOP had the aim of establishing and maintaining the global Aircraft-based Observations Data Centre (AODC).

CIMO Task Team on Aircraft-based Observations

- 2.11. Given the requirement to harmonize the work plan of ET-ABO with that of TT-AO, the meeting was to be informed about the Work Plan of TT-AO by its Chair.

3. STATUS OF THE AIRCRAFT-BASED OBSERVATIONS PROGRAMS

¹ http://www.wmo.int/pages/prog/www/GOS/ABO/documents/AMDAR_TF_ToR_Jan2013_Approved.pdf

² http://www.wmo.int/pages/prog/www/GOS/ABO/ABO_Work_Program.html

³ http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/resources/AMDAR_Coverage_Recruitment_Study.html

3.1. Reports of Operational National & Regional Programs

Australia

- 3.1.1 Dr Douglas Body briefly discussed the current status of, and future plans for the Australian AMDAR programme. The current Australian AMDAR fleet consisted of 117 aircraft, contributing around 12,400 observations per day on the WMO Global Telecommunications System (GTS). The fleet had increased by 12 aircraft since September 2012, with 7 new Qantas 737s, 6 Jetstar Airways A320s and 6 Jetstar Asia A320s but this had been offset by a reduction of 5 Qantas 747s and 2 767s. The changes to the fleet configuration result from the phasing out of older aircraft by Qantas in favour of the more modern A380 and A330 aircraft.
- 3.1.2 Plans to commence a water vapour monitoring programme with Qantas had not yet come to fruition because of the unexpectedly high cost of the certification of the WVSS-II sensor for deployment on the B737-800 fleet.
- 3.1.3 The Bureau had identified an issue with the Teledyne avionics of the Qantas B737 fleet, which had arisen as a result of an airline Teledyne avionics software update and which, while unrelated to the AMDAR onboard software, affected the reporting and optimization response of the AMDAR software. Qantas was able to develop a fix to temporarily circumvent the problem, which will be rolled out over August 2013. The issue with the Teledyne Avionics software and has been reported to the manufacturer but no date for a resolution has been identified.
- 3.1.4 At the current time, budgetary considerations would likely limit any significant future AMDAR fleet expansion and the Bureau was also considering turning off some of the aircraft within the fleet that were not able to be optimized by the AMDAR data optimization system. However, with the phasing out by Qantas of their 747-400 aircraft for international routes in favour of A380-800s and B767s in favour of A330-200S and A330-300s for international and domestic routes, the Bureau was investigating having AMDAR software developed for these platforms on the basis of no net increase in programme output.
- 3.1.5 The Bureau would continue to work toward integration of the Jetstar and Jetstar Asia fleets into the Australian AMDAR data optimization system.

Canada

- 3.1.6 Mr Gilles Fournier informed the session that currently 26 CRJ200 Jazz-operated aircraft and 2 CRJ-200 NAV CANADA Flight Inspection aircraft contribute to the Canadian AMDAR Programme. The development of a new long-term contract with Jazz has yet to be finalized.
- 3.1.7 Environment Canada management will consider additional capacity to better influence airlines. Environment Canada will be looking at opportunities to present AMDAR benefits at major airline managers meetings, and reassess the interests and opportunities.
- 3.1.8 Projects, implementation plans, business cases would have to be developed in support of the sustainability and further development of the Canadian AMDAR Programme.

China

- 3.1.9 Mr Li Wei provided a brief status report on the China AMDAR Programme, which he reported had been operating smoothly over the past year under the work and cooperation of the Civil Aviation Administration of China (CAAC) and China Meteorological Administration (CMA). The programme currently consisted of 2 airlines (Southern Airlines and Shandong Airlines) comprising a fleet of 27 aircraft.
- 3.1.10 The programme produced around 11,000 AMDAR observations per day on the GTS, which were subject to examination and evaluation by the Quality Control System.

- 3.1.11 The AMDAR data real-time analysis and application platform continues to be operated by CAAC and provides warning and forecast products derived from AMDAR data to forecasters in Beijing, Chengdu, Guangzhou and Urumqi airports and AOC personnel of Air China via intranet.
- 3.1.12 CMA has continued in its endeavor to further develop applications of AMDAR data and had been conducting research to further test the impact of AMDAR data on the output of CMA Global/Regional Assimilation and Prediction System (GRAPES) NWP meso-scale model. The work was expected to be completed in September 2013.

E-AMDAR

- 3.1.13 Mr Steve Stringer presented the current status and future plans of the E-AMDAR Programme, informing the session that the transition from SMHI to Met Office as Co-ordinating Member for the E-AMDAR Programme had been smooth with no interruption in service level or quality of data.
- 3.1.14 The E-AMDAR budget provided by EUMETNET Members has been reduced by approximately 8% with a resulting reduction available for the provision of data. However, performance requirements continue to be met or exceeded with the help of nationally funded data. Contribution to WWW outside of the EUCOS area remains at 11%..
- 3.1.15 The programme now had access to more than 1000 aircraft from 13 airlines, currently producing approx 45,000 observations per day on the GTS. This included additional, nationally-funded data which is produced by the programme to meet the supplementary requirements of six NMHSs.
- 3.1.16 Improved geographic coverage had been achieved with inclusion of more regional airports and airports in both the Mediterranean and east Europe areas.
- 3.1.17 The Extended Humidity Trial (EHT) project continued to work towards installation of WVSS-II sensors on 6 Lufthansa A319 aircraft. This was now expected to be completed by mid-2014, giving a total of 9 E-AMDAR aircraft providing operational humidity observations.
- 3.1.18 A key aim of the programme was to move all E-AMDAR fleet flight selection onto the Data Optimisation System (E-ADOS) in order to reduce over-sampling. Collaboration with other AMDAR programmes on flight selection would also be explored.

Hong Kong China

- 3.1.19 The session was provided with a document on the status of the Hong Kong China AMDAR Programme by Mr Choy Boon Leung. Six aircraft of the Cathay Pacific Airways continued to contribute to Hong Kong, China's AMDAR programme. On average around 1,000 AMDAR observations are received at the Hong Kong International Airport (HKIA) per day and relayed on the GTS.
- 3.1.20 Apart from supporting aviation weather forecasting and near real-time wind shear detection and reporting, AMDAR data are also used in the mesoscale NWP model system of Hong Kong, China to improve the initial condition and model forecast.
- 3.1.21 Hong Kong, China would continue to liaise with local airlines with a view to expansion of the AMDAR programme.

Japan

- 3.1.22 The session was provided with a document on the status of the Japan AMDAR Programme by Mr Junichi Ishida. Since April 2003, the Japan Meteorological Agency (JMA) has been receiving AMDAR data from airplanes in the Japan domestic airspace from the two Japanese airlines, All Nippon Airways (ANA) and Japan Airlines (JAL). While ANA airplanes

report observation data only in level flight, JAL airplanes report during all the flight phases including ascent and descent.

- 3.1.23 Approximately 18,970 reports (about 3,440 and 15,530 reports from ANA and JAL, respectively) are collected from 220 airplanes per day over Japan via the VHF data link. The data are generally of satisfactory quality, although they usually show slight high temperature biases. JMA started to disseminate AMDAR data operationally in April 2006 and also in the BUFR format in December 2006, in which QNH-corrected altitudes are converted to flight levels.
- 3.1.24 Temperature and wind AMDAR data are used to initialize the Global model (GSM) with a horizontal resolution of 20km, Mesoscale model (MSM) with a horizontal resolution of 5km, Local model (LFM) with a horizontal resolution of 2km, as well as the Hourly Analysis which is a real-time product to monitor the atmospheric condition around Japan. The data have a positive impact on these products.
- 3.1.25 Forecasters use the AMDAR data to issue aerodrome and area forecasts and the data are also used for other forecast applications.

New Zealand

- 3.1.26 Mr Wim van Dijk provided a document on the status of the New Zealand AMDAR programme. MetService works with Air New Zealand to provide AMDAR data within the area 20S to 50S and 155E to 160W. In July 2013 there were over 87,000 such reports.
- 3.1.27 MetService has a cost sharing arrangement with the Australian Bureau of Meteorology for AMDAR reports within the area 0S to 50S and 160E to 160W. In July 2013 there were over 42,000 AMDAR reports within this area.
- 3.1.28 Air New Zealand fleet was in the process of modifying its fleet composition with a move from Boeing 737 aircraft to A320 aircraft. This change had meant that the number of AMDAR reports from flights to South Pacific islands had slowly grown.
- 3.1.29 Currently, New Zealand intended to maintain the existing fleet and coverage. However, if resources allowed, would endeavour to increase the number of reporting aircraft.
- 3.1.30 In November 2014, MetService intends to cease transmission of alphanumeric AMDAR bulletins on the GTS and transmit binary (BUFR) bulletins only.

Republic of Korea

- 3.1.31 A status report was not received from the Republic of Korea.

South Africa

- 3.1.32 Mr Francis Mosetlho presented a document providing the current status and future plans for the South Africa AMDAR Programme. The session was informed that the current size of the SA-AMDAR fleet was thirty-four (34) aircraft and included two recently added A320-200 airbuses. More changes would be made on the SA-AMDAR fleet in the near future as some of the A319-100 airbuses were to be replaced with the A320-200 series.
- 3.1.33 A data transmission problem was identified towards the end of May 2013 emanating from a migration to a standby server by South African Weather Service (SAWS) ICT which was not properly configured for AMDAR scripts. This resulted in a brief outage and data loss from the programme.

United Kingdom

- 3.1.34 Mr Stewart Taylor presented the programme status report for the United Kingdom. As with the E-AMDAR Programme, service levels were maintained during and subsequent to the

transition from SMHI to Met Office as Co-ordinating Member for the E-AMDAR programme and the current UK AMDAR objectives continued to be met.

- 3.1.35 In addition to benefiting from any E-AMDAR developments, the UK AMDAR Programme was involved with a project with Met Office Aviation Teams and Heathrow Airport focused on improvement to fog forecasting.
- 3.1.36 The FAAM BAe-146 Research Aircraft continued to operate with the WVSS-II v3 installed on the sensor testing array. It was expected that a Panasonic Avionics (formerly AirDat) TAMDAR unit would be installed during 2013 to carry out further comparison testing of humidity sensors. The results from these tests would provide valuable information on the performance of the humidity sensors in Europe.

United States of America

- 3.1.37 Mr Carl Weiss provided a status report for the USA MDCRS (AMDAR) programme, informing the session that the programme of around 2025 aircraft was operated in collaboration with seven U.S. airlines (American, Alaska, Delta/Northwest, FedEx, United, United Parcel Service, and Southwest). On average, approximately 1500 of these aircraft provide an average of nearly 275,000 observations daily on the GTS.
- 3.1.38 NOAA and the FAA continue discussions with ARINC on development of an optimization capability for the programme, with the intent of these talks to examine the feasibility of entering into a contract for provision of data optimization services by ARINC.
- 3.1.39 The U.S. is planning to take steps to increase aircraft meteorological data coverage over data-sparse areas of the world. This 2-year project will complement radiosonde soundings for global and regional weather prediction. Specifically, this project will seek to expand current aircraft observational capability by: 1) Increasing availability of en-route data from Alaska Airlines off the U.S. west coast; 2) Extending the USA MDCRS carriers flying to destinations in Africa, South America and the Islands in the Western Pacific (Micronesia); 3) Partnering with the WMO AMDAR program to enlist countries in these same areas to begin their own AMDAR programs; and 4) Extending availability of data from regional U.S. carriers (including data from the TAMDAR system). Observing system experiments will play an important role in demonstrating the value of these aircraft observations for operational forecasting. Quality control of the data also will be a key component of the project. After the 2-year project period ends, support will be sought to maintain and optimize the flow of data operationally.
- 3.1.40 NOAA would continue to work with the WMO to bring Aeroméxico online as an AMDAR data provider.

WVSS-II Status & Plans

- 3.1.41 Over recent months, 20 additional Southwest Airlines (SWA) aircraft have been equipped with WVSS-II sensors, bringing the total for SWA to 87 operating units. Combined with the 25 systems on UPS aircraft, there was now 112 WVSS-II sensors reporting water vapor measurements. This fleet produces about 2000 profiles (around 50,000 observations) per day of water vapor.
- 3.1.42 NOAA continues to work with ARINC and SpectraSensors, Inc. to seek FAA Supplemental Type Certification (STC) for the B737 800-series airframe. This is an important activity as older 300-series airframes will be replaced by these more modern aircraft.
- 3.1.43 UPS had indicated an interest in installing additional WVSS-II systems using Airbus aircraft and United Airlines also had inquired about participating in the WVSS-II program. Southwest Airlines was also interested in the possibility of installing more WVSS-II units on their aircraft under the existing contracts with NOAA.

3.2. Reports on Developing Programs

3.2.1 Mr Dean Lockett, the Secretariat, informed the session that, in the lead-up to the ET-ABO session, WMO Member Focal Points on Aircraft-based Observations had been surveyed by email to provide any recent information on proposed new AMDAR programme or related developments and to identify any requirements for WMO assistance. In response to this request, 7 completed surveys were received and, of these, 5 were from focal points from Members of the EUMETNET community, whose AMDAR development plans predominantly related to coordination with the E-AMDAR Programme. The combined response represents approximately only 15% of Members with AMDAR focal points (45).

3.2.2 While the response to this survey was limited and disappointing, the session agreed that it provided a strong indication that there appeared to be a need for the Expert Team to engage with Members regarding the WMO and CBS recommendations (CBS Evolution of the Global Observing System, EGOS-IP) for Members to invest in AMDAR and ABO development so as to extend the coverage of AMDAR and ABO.

3.2.3 The session agreed with the recommendations made that:

1. ET-ABO should compile a list or table of WMO Members that would be responsible for high priority target airlines, based on the recently completed study⁴ undertaken by the former WMO AMDAR Panel and ET-ABO.
2. Letters should be composed and sent to the relevant Permanent Representative to WMO or an existing AMDAR Focal Point in the list, by the Secretariat, requesting that they consider collaboration with the target airlines towards AMDAR programme participation.
3. Responses to the correspondence and future activities arising from them should be documented within the AMDAR Regional Implementation Plans and followed up on by ET-ABO and the Secretariat.

3.2.4 It was also agreed that future AMDAR regional implementation plans (see item 5.2.3) should incorporate known existing potential new programme developments that were identified at the AMDAR Panel 15th Session (November 2012) within document 4.1.1.

3.2.5 Mr Lockett also provided an update on the status of the Mexico/Aeromexico programme development, including the process of establishment of a contract between WMO and ARINC for data service provision supporting the programme. The session was informed that a brief specification of requirements for the work and services had been developed by WMO in consultation with NOAA/NWS and an alternative supplier was approached and requested to submit a response for a proposal with quotation by January 2013. However, the alternative supplier was unable to meet the requirements and declined to submit a proposal. Subsequently the WMO Secretariat Procurement and Contracts Committee reconsidered the proposed ARINC contract in late-January 2013 and approved the process to finalise the contract for final approval and activation. From Feb to May 2013 WMO and ARINC proceeded to finalise the terms and conditions for the contract, however this took longer than expected due to changes in staffing within ARINC. Since June 2013, a legal issue had arisen that still required resolution by WMO and ARINC. It was expected that a decision on this matter would be made by October 2013.

3.3. Status of Other Aircraft-based Observing Systems

The Panasonic (AirDat) TAMDAR System

⁴ AMDAR Coverage & Targeting for Future Airline Recruitment, February 2013:
http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/resources/AMDAR_Coverage_Recruitment_Study.html

- 3.3.1 Mr Jeff Rex informed that the AirDat company had been acquired by Panasonic Avionics Corporation earlier in the year. He then proceeded to give an update of the TAMDAR System and its applications. TAMDAR (Tropospheric Airborne Meteorological Data Reporting) was a system for automatic collection and transmission of weather data from commercial aircraft particularly regional aircraft. The system has a self-contained sensor package that is easily mounted on the aircraft and the data and other information is then transmitted via Iridium satellite link. Also a minimized sensor unit has been developed for unmanned aerial systems (UAS). TAMDAR has a good coverage of observations in the US and also in Mexico and has now started to expand in Europe.
- 3.3.2 The company participates in development of NextGen Aviation Weather Impact Data for which they have developed an Augmented WRF Model Icing Impact Forecast. Several case studies e.g. concerning the hurricane Ike and the “Superstorm” Sandy were presented to demonstrate that weather forecasts were improved when TAMDAR data were combined with other regular meteorological observations.

The FLYHT AFIRS System

- 3.3.3 Mr Derek Taylor from the FLYHT company presented the Automated Flight Information Reporting System (AFIRS) as the most advanced Iridium SATCOM system on the market. Although not an ACARS system in itself it provides ACARS communication over Iridium satcom. The AFIRS transmits a multitude of information e.g. global communications and real-time flight tracking, automated block and flight time and fuel reporting as well as engine trend and data for future maintenance. The system can also include transmission of meteorological data and AFIRS is or has been involved in AMDAR programmes in Canada and Australia.
- 3.3.4 AFIRS offers opportunities for AMDAR expansion in data sparse regions as FLYHT has partner airlines with AFIRS equipment in Australia, Caribbean, Mexico, Central America, Asia and Pacific Region, Far East as well as in Africa. Several of these airlines have aircraft fleets suitable for AMDAR and their AFIRS systems can relatively easily be modified to include AMDAR observations.

ADS Data and other Matters Related to ICAO

- 3.3.5 The session had a scheduled teleconference with several colleagues from ICAO to discuss a number of issues relating to aircraft-based observations and ICAO support for AMDAR. The ICAO officers included Mr Neil Halsey, Mr Raul Romero and Mr Francois Robert.

Streamlining of reception and processing of ADS-C meteorological data including quality management

- 3.3.6 ICAO was informed that WMO and ET-ABO supported the Working Paper⁵ that was submitted by IATA to the World Area Forecast System Operations SubGroup, (WAFSOPSG), 7th Meeting, Lima, Peru, 17 to 21 September 2012, which requested that ICAO consider that “...proper quality management of ADS-C data [is] as important if not more important than quality management of AMDAR data” and led to the following conclusions from the meeting:

Conclusion 7/18 — Forwarding of ADS reports relating to meteorological information to WAFCs - That the relevant ICAO groups, in coordination with the WAFc Provider States, ensure that all ADS reports relating to meteorological information, including those obtained

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<http://www.icao.int/safety/meteorology/WAFSOPSG/WAFSOPSG%20Meetings%20Metadata/WAFSOPSG.7.WP.021.9.en.pdf>

during enroute and terminal area phases of operation, are automatically forwarded by the ANSP to the WAFCs in accordance with Annex 3, Chapter 5 and Appendix 4.

Conclusion 7/19 — Quality management of ADS reports relating to meteorological information - That the Secretary investigate issues concerning the quality management of ADS reports relating to meteorological information and provide a report in time for WAFSOPSG/8.

3.3.7 The Expert Team requested that ICAO consider the following proposed:

- 1) Both WMO and ICAO more strictly enforce the requirements for ADS meteorological data, that, in all instances, it must be routed to the WAFCs and this is the only avenue for the meteorological data derived from ADS to be transmitted on the GTS.
- 2) Each WAFC (or forwarding ATM entity) will carry out ICAO prescribed treatment/reformatting to the original ADS data (possibly none, possibly removal of proprietary data, etc).
- 3) Under an arrangement between the WAFC and a WMO appointed, ICAO approved Data Processing Centre (DPC), the WAFC will transfer the (treated) ADS data to the DPC to be decoded, quality controlled and then encoded for transmission on the GTS.
- 4) WMO and ICAO could also come to an agreement on an appropriate feedback mechanism for data quality issues notification and rectification.

The team offered to investigate and propose a prototype test system for processing of ADS-C data in coordination with the London WAFC.

3.3.8 ICAO agreed to further investigate the issue of ADS-C meteorological data and its quality control and report back to the team.

3.3.9 The Expert Team agreed to provide Mr Halsey with a brief set of requirements for quality control of ADS-C data before GTS transmission.

Access to more ADS-C Data

3.3.10 The team requested that ICAO investigate and report on the potential availability of additional sources of ADS data that were not currently made available to WMO Members on the GTS.

International and national developments in ADS-B systems and the potential for future provision of meteorological data

3.3.11 The team provided some background information to ICAO regarding some of the work that has been undertaken by WMO Members in deriving meteorological data from the Mode S system and requested that ICAO comment on this practice. Mr Halsey stated that, as far as he was aware, there was no ICAO position or directive that might affect the obtainment and utilization of such data by NMHSs and that, according to Annex III, there was no difference in regulation between ADS-C and ADS-B.

3.3.12 The team requested that ICAO provide information on the likely future potential of meteorological data availability from ADS-B systems, either implemented or being implemented by ICAO Members and ICAO agreed to investigate this matter and report back to the team. ICAO also agreed to investigate whether the Mode-S data might be able to in the future accommodate a more complete and accurate transmission of meteorological data.

ICAO regulations on turbulence and EDR and future aviation requirements for monitoring, prediction and warning

3.3.13 The team informed ICAO of its current endeavours to standardize and more widely implement Eddy Dissipation Rate (EDR) monitoring on the AMDAR platform in line with the reporting algorithms developed by the USA National Center for Atmospheric Research (NCAR) and requested information on any current and future ICAO requirements or developments for turbulence monitoring, prediction and warning. Mr Halsey was unaware of any increasing demand for changes to turbulence practices in relation to monitoring and prediction but suggested this would be more likely to come from IATA Members. ICAO was also informed by Dr Farrar that the FAA would likely be working towards forming a proposal to modify the EDR thresholds relating to the requirements for reporting turbulence severity within Annex III (Meteorological Service for International Air Navigation).

ICAO support to WMO in advocating wider airline participation in AMDAR and better integration of AMDAR into aviation systems

3.3.14 The Expert Team requested ICAO to consider that, given there is now a raft of information and evidence supporting the benefit of the AMDAR programme to both meteorology and aviation, how might ICAO assist WMO and ET-ABO in the further development and expansion of AMDAR programme and the integration of AMDAR systems and sensors (e.g. WVSS-II) within avionics and airframe systems and standards? Mr Halsey suggested that ICAO would likely be able to offer support for and promotion of the AMDAR programme via links to the WMO AMDAR website from appropriate places on the ICAO website. He also suggested that airline participation was likely more appropriately supported and promoted by IATA from its website. Mr Hans-Rudi Sonnabend representing IATA agreed that this would likely be advantageous and possible. The team agreed to work with Mr Halsey and Mr Sonnabend to investigate and implement these possible promotional opportunities.

3.3.15 The team and Mr Halsey also agreed to investigate opportunities to promote AMDAR at the ICAO MET/AIM Divisional Meeting (2014), conjoint with WMO CAeM in July 2014.

Developments in the use of data from Mode-S

3.3.16 Mr. Siebren de Haan (KNMI) presented an analysis and evaluation of the use of Mode-S Enhanced Surveillance (EHS) data and the impact of these data in NWP. Most commercial aircraft (in Europe) must be Mode-S EHS compliant and the data has a high volume in space and time. The study was limited to data collected at Schipol airport and used in NWP at KNMI. The data flow in Mode-S does not contain meteorological observations per se, but wind speed and direction and also air temperature can be derived. The temperature data are aircraft specific and, therefore, a calibration has to be established for each aircraft. Even after calibration these air temperature data are of lesser quality than AMDAR data. Wind data have to be corrected for the true airspeed and for magnetic heading. After correction the wind speed and direction data have similar quality to AMDAR wind data.

3.3.17 The Mode-S EHS data are available in time for assimilation. When the wind data were assimilated into the model HIRLAM v7.4 with 11 km resolution a positive impact could be seen up to 12 hours into the forecast.

3.3.18 KNMI also received Automatic-Dependent Surveillance-Contract (ADS-C) data from KLM. The data contains i.a. wind and temperature. The data are available in real-time and the quality is good.

4. THE WIGOS IMPLEMENTATION PLAN & IMPACTS ON ET-ABO

4.1. Mr Igor Zahumensky, WIGOS Project Office, WMO Secretariat, made a presentation to the session on the status of the WIGOS Framework Implementation Plan (WIP), providing information on the key activities of the WIP and the important tools and elements of the resulting framework.

4.2. Mr Lockett presented a document to the session that provided information on the working team and group structure that had been put in place by the WMO Executive Council and

CBS to support the WIP and outlined the Key Activity Areas (KAA) and tasks of the WIP that would likely impact on ET-ABO or in which the team should contribute or play a role.

4.3. **It was recommended** and the session agreed that:

- 1) The Chair of ET-ABO should consult with the Chair of the CBS Inter-Programme Expert Team on WIGOS Framework Implementation (IPET-WIFI) regarding appropriate WIGOS-related activities for ET-ABO to address in its updated Work Plan.
- 2) In relation to the KAA on Design, Planning and Optimized Evolution, ET-ABO should:
 - a. Monitor the Implementation Plan for the Evolution of the Global Observing System (EGOS-IP) with respect to global actions for development and evolution of aircraft-based observations;
 - b. Work with IPET-WIFI and its Sub-Group on Regulatory Material (SG-RM) in the process of developing guidance for Members on ABO system design by utilizing the Rolling review of Requirements (RRR) process and the WIGOS Operational Information Resource (WIR) and, in particular, assist the CBS IPET on Observing System Design and Evolution (IPET-OSDE) with the implementation of the Observing Systems Capability Analysis and Review tool (OSCAR) through the specification for determination of the capabilities of the aircraft-based observing system; and,
 - c. Ensure that the relevant ABO-related WMO/WIGOS regulatory material is reviewed and updated in relation to this KAA.
- 3) The process and timeline for review and revision of related ABO regulatory material is coordinated and harmonized with the process being undertaken and coordinated by ICG-WIGOS/TT-WRM and IPET-WIFI and its SG-RM.
- 4) ET-ABO should consider how it might, in the future and through its work plan, contribute more directly to the development of the WIGOS Information Resource.
- 5) So as to become more aligned with WIGOS framework development and to take advantage of the developmental and collaborative momentum that has been generated, the regional approach to ABO development and planning that has been instigated within the strategy and plans of the ABOP should be integrated into the WIP and the R-WIPs through coordination with WMO Regional Associations and the eventual incorporation and maintenance of Regional AMDAR Implementation Plans within the R-WIPs.

5. ET-ABO WORK PLAN & PROGRAM DEVELOPMENT

5.1. ET-ABO Approved Work Plan, Strategy and Program Development

5.1.1 The Chair of the Expert Team briefly presented to the session the 2013-14 work plan⁶ approved by the Co-chairs of OPAG-IOS that had been developed for ET-ABO by its Chair and Vice-Chair based on the tasks and work programme recommended by the WMO AMDAR Panel 15th Session. The Chair explained that the work plan was based on ensuring that the Global Actions of the CBS Implementation Plan for Evolution of the Global Observing System (EGOS-IP) relating to Aircraft Meteorological Stations⁷ were undertaken, coordinated and achieved.

Budget & Contributions

⁶ http://www.wmo.int/pages/prog/www/OSY/WorkingStructure/documents/ET-ABO_Work_Plan_2013.1A.pdf

⁷ Actions on Aircraft meteorological stations under Recommendations for the evolution of Surface-Based Sub-system of GOS, Section 5.3.1.3 http://www.wmo.int/pages/prog/www/GOS/ABO/ABO_EGOS-IP.html

- 5.1.2 The Secretariat informed the session on the current status of the AMDAR Trust Fund, including the changes to the Terms of Reference (ToR) that had been made in order to define the new arrangements for maintenance and operation of the Trust in support of the Aircraft-Based Observations Programme (ABOP). The new Terms of Reference⁸ for the Trust were approved by the WMO SG in December 2012. Under these ToR, the CBS and CIMO technical commissions were jointly responsible for ensuring that a work plan and a budget was compiled on an annual basis for the use of the AMDAR Trust in supporting the work programmes of ET-ABO and the CIMO Task Team on Aircraft-based Observations (TT-AO). The annual budget requires the approval of the Aircraft-based Observations Programme Management Group (AOPMG), which consisted of the SG or their delegate within the Secretariat and the Presidents of the relevant WMO Technical Commissions (nominally CBS and CIMO) or their respective delegate. The 2013-16 annual budget for the ABOP had been approved by the AOPMG in May 2013⁹.
- 5.1.3 The Statement for the AMDAR Trust for 1 January 2013 to July 31 was presented to the session and is provided within [Annex II](#). The final balance at the end of the statement period was 1,102,673.18 CHF.
- 5.1.4 In line with ToR for the Trust, the Secretariat had in April 2013 compiled a letter to all PRs to WMO requesting their contributions and, to the end of July 2013, nearly 110K CHF had been contributed by Members. The Chair expressed his thanks to all those Members that had made or pledged a contribution to the Trust.

Strategy for the Aircraft-Based Observations Programme

- 5.1.5 Since his appointment in July 2013, the WMO AMDAR Development Officer (ADO), Mr Stig Carlberg had been tasked with assisting the ABOP and the Secretariat to develop and document a comprehensive strategy and implementation plan for aircraft-based observations that would address the future development and evolution of the programme in line with the EGOS-IP. The session was informed that a draft of the Aircraft-Based Observations Programme Strategy and Implementation Plan to 2025, Including Development and Expansion of AMDAR (Version 2013.1D4) – to be referred to as the A-SIP - had been compiled and was submitted to the session as Information Document 5.1.1¹⁰.
- 5.1.6 Mr Carlberg made a presentation to the session on the structure and content of the document and recommended that ET-ABO work to finalise an approved version of the document and then maintain it in the future. The team agreed with this approach and requested that ADO should undertake a final review in collaboration with ET-ABO with the final version to be submitted to CBS OPAG-IOS and CIMO OPAG-SI by late October.

Joint Project with ICAO

- 5.1.7 The Secretariat briefly informed the session that SO/ARO and Dr Herbert Puempel, Chief Aeronautical Meteorology Division had been collaborating with the ICAO Environmental Branch towards the development of a proposal for a joint project between WMO and ICAO. The project encompassed the rapid extension and enhancement of aircraft-based observing

⁸ Terms of Reference for the AMDAR Trust Fund (Approved by WMO SG, December 2012): http://www.wmo.int/pages/prog/www/GOS/ABO/documents/AMDAR_TF_ToR_Jan2013_Approved.pdf

⁹ Aircraft-Based Observations Program Budget for the 2013-2014 Work Plan and Projection to 2016

(Version: 2013.1A, Approved, May 2013):

http://www.wmo.int/pages/prog/www/GOS/ABO/documents/ABOP_Budget_2013-2014_Version_2013.1A.pdf

¹⁰ http://www.wmo.int/pages/prog/www/OSY/Meetings/ET-ABO-1/ABOP_Strategy_Implementation_Plan_VD4.doc

systems in the interests of supporting improved severe weather monitoring and prediction and disaster mitigation and recovery applications, particularly over tropical and developing regions, where coverage was poor.

- 5.1.8 It was hoped that this project might be advanced enough and fully sanctioned by both organizations so as to allow an official launch at the ICAO MET/AIM Divisional Meeting (2014), conjoint with WMO CAeM in July 2014.

5.2. Status & Progress on ET-ABO Work Plan Tasks 2013-14

ABO Quality Management System

AMDAR Metadata Development

- 5.2.1 Mr Stewart Taylor presented a document on the current status of development and implementation of the metadata framework for aircraft-based observations and AMDAR which had been an ongoing activity under the WIGOS Pilot Project on AMDAR coordinated by the former Expert Team on Aircraft-based Observations (ET-AIR) and the AMDAR Panel.
- 5.2.2 The session was informed that a draft metadata model had been developed for AMDAR data and that an implementation plan for a metadata management framework was presented to the WMO AMDAR Panel 15th Session. As a member of the ICG-WIGOS Tasks Team on WIGOS Metadata (TT-WMD), Mr Taylor was in a good position to ensure that the metadata model was consistent with the global metadata model being developed under the WIGOS Framework Implementation Plan.
- 5.2.3 This work was to be further considered during the breakout sessions during the ET-ABO meeting, from which next steps and further action would be determined.

Aircraft-based Observations Data Centre

- 5.2.4 The Chair informed the meeting that the Workshop on Aircraft Observing System Data Management (Geneva, 5-8 June 2012) the current and future Aircraft Observations Data Management Framework was reviewed, discussed and a series of recommendations made for its development and improvement. One of the recommendations was that the development of a centralized international repository for aircraft-based observations would considerably strengthen the aircraft-based observations data management framework and provide substantial benefits for many data users.
- 5.2.5 This recommendation had been incorporated into the ET-ABO work plan as Task 4 (Establish AO Data Centre), with some work already having been done to define the high level requirements of the AO Data Centre (AODC). In September 2013, the Chair of ET-ABO wrote to four potential candidate organizations seeking an expression of interest in collaborating with WMO in the provision of the role of AODC and requesting a response by early October.

Data Quality Control & Quality Monitoring

- 5.2.6 Dr Jitze van der Meulen, the Netherlands, presented a document to the session relating to data quality control and monitoring, explaining that a series of recommendations relating to data quality management had been derived from the Workshop on Aircraft Observing System Data Management¹¹. Of these recommendations, five related specifically to data quality control that can be simplified into activities in the following areas:

¹¹ Workshop on Aircraft Observing System Data Management (Geneva, Switzerland, 2012):
http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/panel/reports/other/Aircraft_Observations_Data_Management_Workshop_June_2012_Final_Report.pdf

- 1) The use of NWP comparison and other methods to identify and prevent dissemination on the GTS of erroneous or poor quality data in “real-time”;
- 2) Implementation of a higher frequency of reporting on the quality of ABO and AMDAR data monitoring and reporting to facilitate more rapid detection and correction of systemic errors and data quality issues;
- 3) Review of the roles and requirements of monitoring and lead centres for ABO with consideration given to the designation of one or more centres to carry out international QC of Aircraft Observations (WMO and ICAO), possibly before transmission on the GTS.

5.2.7 In practice, NWP forecasts fields could be used for real time quality control, i.e. before dissemination over the GTS. However, it was recommended that this practice should incorporate the use of a flagging system, already available within the BUFR format, rather than a data removal or elimination process. Such a system would also require the definition and implementation of a framework of, and feedback processes to operational programme and data managers to ensure efficient and timely fault reporting and rectification. It was critical that such a system should not increase the data latency beyond the 15-minute requirements of most NWP applications.

5.2.8 Such a QC system could focus on detection of 3 types of observational errors: 1) Gross errors in wind, temperature and humidity parameters; 2) Spatial and temporal coordinate gross errors; and 3) Data consistency errors.

5.2.9 A major current issue with defining uniform and standard QC and monitoring practices is the use of different data transmission formats, including the continued use of FM42 and also the use of different varieties of FM94 (BUFR) templates, despite the approval of the new and now standard BUFR Template for AMDAR. **It was recommended** that all programmes should be endeavouring to meet the WMO timeline for transition from text codes to binary codes by November 2014 and to transition to use of the new BUFR Template for AMDAR as soon as possible.

5.2.10 Programme and data managers should also do all they can to remove data transmission bottle necks that delay the availability of the data on the GTS. For example, data processing frequency should be increased so as to endeavour to meet a target data latency of 15 minutes or less.

5.2.11 In order to improve both data quality control and monitoring practice, **it was recommended that:** as part of the wider process of reviewing and updating the ABO and AMDAR regulatory material in the WIGOS and GOS manuals, the practices and standards for quality control and quality monitoring should be reviewed and updated as necessary.

ABO & AMDAR Regulatory Material

5.2.12 Dr van der Meulen also presented to the session a paper on the current status and requirements for review of the ABO and AMDAR regulatory material.

5.2.13 While the review and update of the regulatory material relating to the AMDAR programme has been an ongoing and important activity since the inception of the WIGOS Pilot Project on AMDAR several years ago, this has now become one of the highest priority task for ET-ABO, given the requirement to coordinate and harmonise with the wider WMO task of revising and reorganizing all observational regulatory material under the WIGOS Framework Implementation Plan (WIP).

5.2.14 Essentially, this activity consists of these aspects:

- Review the AMDAR Reference Manual (WMO No. 958) and determine which material is still current and can be moved across to either the CIMO Guide (WMO No. 8) or to one of either the Manual (WMO No. 544) or Guide (WMO No. 488) on the GOS;
- Determine requirements and content for new material to be added to the regulatory material; and,
- Determine what should be done with the AMDAR Reference Manual while ensuring that Members retain a convenient means for finding and utilizing all ABO regulatory documentation.

5.2.15 Under CIMO, the Theme Leaders on Aircraft Measurements and TT-AO are currently coordinating an update of the CIMO Guide, Part III, Section 3.4 Aircraft Meteorological Stations, which is expected to be incorporated into the update process via CIMO-XVI (2014).

5.2.16 Given the requirement to address this urgent and high priority activity and to ensure harmonization of review processes and timelines with the WIP and TT-WRM it **was recommended** that ET-ABO should appoint a Regulatory Material Review Team consisting of Dr van der Meulen, Mr Frank Grooters, Dr Axel Hoff and Mr Dean Lockett to coordinate and finalise the review and reorganization of the ABO regulatory material. The timeline and tasks assignment for this activity would be determined at a first meeting to be held via Videoconference (WebEx) in early October.

Science & Technical Developments

CIMO Task Team on Aircraft-Based Observations

5.2.17 In the CIMO structure TT-AO sits as Task Team A5 in the Open Programme Area Group (OPAG) on Standardisation and Intercomparisons. The task team is a small group of designated experts. The chairman, Mr Stewart Taylor (UK Met Office), presented and explained the terms of reference for the task team. The workplan and associated budget for 2013-2014 had been approved in May 2013¹². So far the task team has met only by WebEx and a first session is planned to February 2014 before the CIMO MG meeting.

B777 Software Development

5.2.18 Mr Steve Stringer summarized the history and current status of an existing activity to develop AMDAR software for Boeing 777 aircraft that had been previously undertaken by the AMDAR Panel in collaboration with E-AMDAR and Météo-France through the engagement of the services of KLM and Air France.

5.2.19 Since the AMDAR Panel session in November 2013, a letter had been sent by Mr Frank Grooters to Air France outlining the partners concerns regarding the updated quotation that had been received in December 2012 from Air France. The letter portrayed the partner's concerns with and sought clarification on several aspects of the quotation, including: 1) The nature and cost of a study to be undertaken by Air France; 2) Ownership and licensing of the software product; and, 3) The apparent tying of the software application development to an implementation on the fleets of KLM and Air France at a cost of 0.5 KEuro per aircraft.

5.2.20 A response to the letter was received in March 2013 indicating that: 1) The study was actually a necessary Air France engineering activity to determine and put in place the requirements to facilitate the implementation of the software into the B777 avionics of the two airlines; 2) The ownership would be retained by KLM; and, 3) The development and implementation could be split into separate stages of the project.

¹² http://www.wmo.int/pages/prog/www/CIMO/WorkingStructure/WorkPlans/CIMO-XV/CIMO_TT-AO_Work_Plan_May_2013_v2013.1A.pdf

5.2.21 The partners again corresponded with Air France and advised of a requirement for unrestricted use of the software if the software development was to proceed.

5.2.22 E-AMDAR met with Air France in July 2013 where the final outstanding issue of licensing was discussed and in which Air France conveyed to the partners that KLM had withdrawn from the partnership to develop the software but that Air France would support the development alone. They offered the following relating to licensing of the software:

- Partnership would be granted to WMO and its airline partners for a freeware, non-exclusive but revocable license arrangement for a limited but extended period on a non profit basis;
- Air France would not be responsible or liable for the software usage and WMO and its partners must accept that the use of the software remains at their own risk;
- The software would be provided to WMO/AMDAR as executable code only; and,
- Air France would ensure free maintenance of the software and would commit to respond to requests for further developments at commercial rates and to be negotiated on a case by case basis.

5.2.23 The partners have since conferred in relation to this offer and have again sought clarification by Air France in relation to issue of provision of the executable code only and the options available to the partners in the event that source code required alteration to support implementation on other airline B777 systems. It was expected that a new written offer would be provided by Air France early in the 4th quarter of 2013 and that, if acceptable to the partners, the development would proceed.

AMDAR Onboard Software Specification

5.2.24 The Secretariat informed the session that the activity to develop the so-called “Generic Specification” of AMDAR onboard software had now been completed with the publication of the AMDAR Onboard Software Functional Requirements Specification (AOSFRS) as a CIMO Instruments and Observing Methods technical publication number 114¹³. Future version of the AOSFRS would be maintained and published through the IOM series with a new report number.

5.2.25 The AOSFRS now provided the primary WMO standard for AMDAR software and the team was asked to consider how the maintenance of this standard might be harmonized with the ongoing maintenance of the Meteorological Report (versions 1 to 5) within the ARINC 620-7 specification¹⁴. **It was recommended that:**

a) The AOSFRS would be the primary reference for, and specification of, the meteorological and functional requirements for applications development associated with the ARINC 620 Meteorological Report and changes to meet new or altered requirements for AOS would be first initiated through an update to the AOSFRS; and,

b) The ARINC 620 could be updated to include Meteorological Report, Version 6 to be consistent with the AOS format specifications (AOSFRS Version 1, Appendix A) and the supporting text in the ARINC 620 reduced to a minimum through reference to the AOSFRS.

¹³ AMDAR Onboard Software Functional Requirements Specification (Version 1.0, 16 July 2013), Instruments and Observing Methods Report No. 114:

http://www.wmo.int/pages/prog/www/IMOP/publications/IOM-114_AOSFRS_v1/IOM-114_AMDAR_AOSFRS_V1.pdf

¹⁴ See AMDAR Resources :

http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/resources/index_en.html#amdar_stds

It is possible that Version 1 to 5 could be moved to an Appendix of the ARINC 620 to avoid the further use of these older format standards in the future.

- 5.2.26 The Expert Team agreed to adopt this approach and recommended that TT-AO should undertake the task to work through the ARINC AEEC SubSystems Committee (AEEC SSC) process to update ARINC-620 accordingly.

USA Turbulence and EDR Status

- 5.2.27 Ms Tammy Farrar (Research Meteorologist at US FAA) presented an update on the status of the US Turbulence Programme. The goals of the programme are 1) to provide real-time turbulence observations and accurate forecasts to air traffic management, flight crews and dispatchers to aid in avoidance of turbulence and 2) to quantify the needs of providing such data in order to determine the most cost effective and optimal solutions for integrating turbulence data into flight operations.
- 5.2.28 The EDR algorithm developed for the programme was currently implemented in almost 200 Boeing 737, 757 and 767 aircraft in three US airlines and by a South Korean airline. A technology transfer package was being developed by NCAR to allow airlines to implement EDR with minimal assistance.
- 5.2.29 The session was informed that NCAR was doing statistical analysis of comparison of EDR data with PIREPS derived from the same or co-located aircraft. The results indicate that the EDR threshold values that defined the turbulence index given in ICAO Annex 3 may need to be modified. However, there was a need for independent peer-review of the study before this information could be presented to ICAO at the Divisional Meeting scheduled for July 2014.
- 5.2.30 The current operational version of the web based Graphical Turbulence Guidance (GTG) provides gridded forecasts of turbulence for FL 100-450 based on EDR observations as input and can be used as a preflight planning tool. The development will include explicit mountain wave turbulence forecasts for Sfc-FL450, convectively-induced turbulence as well as global coverage. The GTG has been used in a proof of concept in cooperation with dispatchers at Delta Airline. Anecdotal results pointed towards an improvement in dispatcher decision-making process but it was difficult to quantify the actual benefits.
- 5.2.31 A study is under way in cooperation with Delta Airline on the feasibility to uplinking GTG and EDR information to the flight deck and to quantify the resulting efficiency and capacity benefits to the airspace.
- 5.2.32 The interest in turbulence remains high in the US aviation community. The recent Aviation Turbulence Workshop held at NCAR 28-29 August gathered about 60 participants from the ATC community, US and international operators, aviation forecasters, GA, US NTSB, FAA Safety as well as commercial weather providers. Presentations are available on ftp://ftp.rap.ucar.edu/pub/sharman/Aviation_Turbulence_Workshop

Southwest Airlines AMDAR Participation and Benefits

- 5.2.33 Mr Rick Curtis (Chief Meteorologist, Southwest Airlines) presented the experiences from active participation in the US MDCRS Programme, including the implementation of the WVSS-II humidity sensor. The airline had 694 aircraft of which 157 were reporting wind and temperature and 87 of these were now equipped with the WVSS-II sensor for water vapour reporting. In addition to this, more than 85 aircraft were expected to start reporting EDR in the future. As a result of this the airline provided a very good coverage of AMDAR observations over USA: more than 82 000 observations per day of which more than 42 000 also included water vapour.
- 5.2.34 Mr Curtis described a number of key factors for establishing a successful project for installation of humidity sensors including the necessity to obtain executive level

sponsorship, having an internal project manager and identifying key individuals in all departments that would contribute in the decision making and implementation process.

- 5.2.35 The airline had experienced several benefits from participation in the AMDAR programme and with its extension to humidity measurement. The data contributed to improve weather forecasts in general and also assisted the airline's own internal forecasting efforts, particularly for applications such as fog, thunderstorm development and precipitation type forecasting. All this contributed to improved operations and cost reductions.
- 5.2.36 The participation also strengthened partnership with NWS as the data supplemented and complimented their radiosonde programme through improvement of upper air spatial and temporal coverage. The participation also contributed to the airline's public relations effort, demonstrating its commitment to a public-private partnership and environmental well-being.
- 5.2.37 The airline was now working towards integration of turbulence monitoring and prediction into operations to improve safety and also towards the more active use of AMDAR data for more precise and dynamic fuel planning.

ARINC Collaboration with AMDAR

- 5.2.38 Ms Jeannine Hendricks (Senior Programme Manager, ARINC) provided a report on the ARINC company and its services to about 100 airlines worldwide. ARINC provides data link communication through VHF radio and satcom and is the only service provider of data link through HF radio.
- 5.2.39 The company started in late 1980s developing the concept of automated weather data reporting from aircraft together with FAA and NWS and the MDCRS program commenced operations in 1991. The company has a central and coordinating role between NWS, SpectraSensors Inc and airlines in equipping UPS and Southwest Airline aircraft with the WVSS-II humidity sensors. Currently 112 aircraft were equipped with WVSS-II providing a very good coverage of upper air humidity observations over parts of the USA.
- 5.2.40 ARINC, through its OpCenter application, provided the possibility to optimize aircraft observations in real-time so that redundant observations can be reduced. This solution was already being utilised by E-AMDAR and ARINC was continuing to undertake discussion with the USA NWS in relation to provision of this function for the MDCRS programme.

Global and Regional ABO & AMDAR Program Development

- 5.2.41 The Chair informed the session that one of the fundamental aspects of the Aircraft-Based Observations Programme Strategy and Implementation Plan (A-SIP) was the plan to work with the WMO Regional Associations (RA) towards the development and implementation of Aircraft-based observations Regional Implementation Plans (A-RIP). This regional approach to coordinating the implementation of aircraft-based observations and AMDAR development would be initiated by ET-ABO led by a representative from each WMO region within the team to be responsible for ensuring collaboration and consultation with the respective WMO Regional Association. It was recommended that the development of each A-RIP should be undertaken in consultation with appropriate RA focal points and that endeavours should be made to ensure appropriate integration of the plans within existing RA planning documents and frameworks. The team agreed that this would likely be best managed through the eventual incorporation of each A-RIP into the Regional WIGOS Implementation Plans (R-WIPs).
- 5.2.42 Initially, the development of the A-RIPs would focus on the requirements for AMDAR programme development, including both the enhancement of existing AMDAR programmes and also the development of new programmes, incorporating the results of the recently completed study on AMDAR Coverage & Targeting for Future Airline Recruitment, February

2013¹⁵. However, it was also emphasized that the A-RIPs should also have a wider scope in consideration of both other sources of ABO data, such as meteorological data derived from ICAO Automatic Dependent Surveillance programmes and Mode S and other aircraft-based observations systems such as AMDAR and AFIRS.

5.2.43 In the lead-up to the session, the ET-ABO leads on regional ABO development were requested to submit a document that summarized their initial research and thoughts on the process and requirement for development of their respective A-RIPs. This material would later be used to seed and provide initial concepts and ideas for making a first draft of each A-RIP, for which a template had been developed and provided to the session as Information Document 5.2.3.1¹⁶. ET-ABO Regional Leaders were requested to work towards provision of a first draft of the A-RIP for their respective region by the end of October 2013.

Development of AMDAR Regional Implementation Plan for RA I

5.2.44 Mr Jean-Blaise Ngamini provided and presented to the session a document on considerations for development of strategy and plans for ABO implementation in Region I, which initially focused on ASECNA countries and airlines.

5.2.45 A survey at the Dakar airport shows that only Lufthansa and South African Airways (SAA) provide AMDAR data that can be used in the local forecasting applications, with the South Africa SAA AMDAR Programme the only operational AMDAR programme in Region I.

5.2.46 The airlines of Air France, Kenya Airways, Ethiopian and Royal Air Morocco were identified as key regional carriers that made regular flight in the majority of the airport in the region but do not provide any AMDAR data since the aircrafts used are not equipped for AMDAR data collection.

5.2.47 An initial focus of the A-RIP for Region I would be to develop plans to ensure that potential sources of AMDAR data from currently existing AMDAR programmes and currently equipped aircraft provided data wherever possible over Region I.

5.2.48 The A-RIP will also incorporate the new five-year plans of ASECNA starting on January 2014 which will incorporate ASECNA aims to have the AMDAR programme operational during that period.

Development of AMDAR Regional Implementation Plan for RA II

5.2.49 A document was not submitted in relation to development of strategy and plans for ABO implementation in Region II, however, Mr Li Wei agreed to lead initial discussions and development of plans for the region during the breakout session on this activity. The team discussed recent activities in the region that should be followed up on and incorporated into the draft A-RIP, including India, the United Arab Emirates and Qatar.

Development of AMDAR Regional Implementation Plan for RA III

5.2.50 A document was not submitted in relation to development of strategy and plans for ABO implementation in Region II, however Mr Juan Manuel Horler, who was unable to attend the session due to other commitments, had agreed to lead this work on the development of an A-RIP for Region III and would meet with the Secretariat later in September 2013 to discuss requirements and future activities to this end.

¹⁵ AMDAR Coverage & Targeting for Future Airline Recruitment, February 2013:
http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/resources/AMDAR_Coverage_Recruitment_Study.html

¹⁶ http://www.wmo.int/pages/prog/www/OSY/Meetings/ET-ABO-1/ABOP_Regional_Implementation_Plan_Template_vD4.doc

Development of AMDAR Regional Implementation Plan for RA IV

5.2.51 Mr Gilles Fournier provided and presented to the session a document on considerations for development of strategy and plans for ABO implementation in Region IV.

5.2.52 The meeting was informed that, while the region had very good coverage over some areas as a result of the operational status of the USA and Canada AMDAR programmes, there was still scope for considerable improvement and enhancement over and in many areas.

5.2.53 In terms of developments within these existing programmes that would impact on the A-RIP, the team had already been advised of the interest of Hawaiian Airlines in developing an AMDAR Programme in cooperation with NOAA within the USA MDCRS Programme. The development of the AMDAR Programme with the Mexican meteorological service (SMN) and Aeromexico in collaboration with ARINC has progressed with the terms for a programme and contract largely agreed between ARINC and WMO/Aircraft Observation Unit, however, the process of meeting the requirements of the WMO Procurements and Contracts Committee was still to be concluded.

5.2.54 The following were identified as key areas and aspects for improvement in Region IV:

- Coverage requires significant improvements over most of Region IV, excluding the USA and most populated areas of Canada (i.e. within 200 km north of the US-Canada border).
- Over the Caribbean, AMDAR data is produced by the USA and E-AMDAR programmes but no national programmes exist. Profiles are generated at 18 airports in the region, however the airports of San Juan, Puerto Rico accounts for more than a quarter of this data with 120 soundings over a week. Supplementary AMDAR data provided would be expected to be heavily impacted by changing airline operations associated with tourist traffic demands.
- The Central American region accounts for approximately 0.3 % of the Global AMDAR soundings although soundings were received from only 6 cities and is generated by USA MDCRS carriers.
- The WMO study isolated 5 airlines (2 high priority) with 55 aircraft that could contribute to the AMDAR programme and improve coverage over the Caribbean and Central America.
- In Canada there is potential to sustain and expand coverage of AMDAR.
- It is noted that Air Canada, Air Canada Rouge, Westjet, Air Transat and Canjet Airlines all operate modern Boeing and Airbus aircraft and, if they were AMDAR-enabled, could deliver target observations over Mexico and the Caribbean.

Development of AMDAR Regional Implementation Plan for RA V

5.2.55 Dr Douglas Body provided and presented to the session a document on considerations for development of strategy and plans for ABO implementation in Region V, with the following identified initially as key areas and aspects for improvement in the region:

- Australia and New Zealand operate AMDAR programmes in the region, together providing a total of 144 AMDAR equipped aircraft generating ~15,500 observations per day, however, there is currently very little scope to extend the size of these programmes and contribute to coverage improvement alone.
- Recently, Meteorological Service Singapore (MSS) made initial approaches to SIA/Silk Air about implementing AMDAR on their fleet, which were well received. MSS is now seeking assistance from the wider AMDAR community in developing this into an

AMDAR program. SIA and Silk Air were given High and Medium “recruitment ratings” in the AMDAR Coverage Recruitment Study.

Development of AMDAR Regional Implementation Plan for RA VI

5.2.56 Mr Stever Stringer provided and presented to the session a document on considerations for development of strategy and plans for ABO implementation in Region VI.

5.2.57 The EUMETNET AMDAR programme (E-AMDAR) represents only approx 60% of RAVI countries but, with a geographical area of interest between 40E to 70W and between 10N to 90N, the majority of European (RAVI) area is covered to a varying extent. Currently there are 13 airlines participating in E-AMDAR generating approx 45,000 observation pairs (of wind & temp) on average, every day. The requirements that drive the programme are primarily those of regional scale NWP – aiming at a horizontal spatial resolution of 250km and observing cycle of 3 hours.

5.2.58 The following were identified initially as key areas and aspects for improvement in ABO coverage over the region:

- Despite the volume data output and coverage of E-AMDAR, there is an uneven distribution of profiles which is emphasised even more by the national programmes of Germany and UK.
- At a recent EUMETNET scientific advisory meeting (OBS-SET) the need for more observations to the west of Europe was re-iterated but the NWP community also expressed desire for more EAMDAR observations over N.Africa – in order to better monitor transport of moisture at high levels from the Tropics.
- The 13 airlines participating in E-AMDAR are optimised by 5 separate flight selection systems (FSS) which makes efficient optimisation difficult. A single optimization system is a future aim and will provide scope to improve coverage with additional resource outlay.
- The WMO study can be used by RAVI, particularly when looking to expand coverage to the East of Europe where the airlines identified to improve coverage of RAll could also add to RAVI. It would make sense to extend E-AMDAR eastwards, should funding be made available.
- Implementation of humidity observations is a key objective. Affordability is an issue for members and currently the value/benefit to services and to airline industry is not well documented. The business case for investment is yet to be made. The current trial of installing 9 humidity sensors on Lufthansa aircraft will be completed but discussions to engage airlines as partners to jointly fund the required investment will continue.
- The techniques demonstrated by KNMI for using aircraft ADS-B/Mode-S data to generate Wind (& temperature) data, were expected to develop into an operational service for certain parts of Europe over the coming years. A development plan was needed to assess quality and practicality of supplementing E-AMDAR data and the potential to save some E-AMDAR funding for investment in humidity observing.
- The E-AMDAR infrastructure was mature, stable and had been working reliably for many years. Potential efficiencies and increased resilience might be gained through moving the E-AMDAR infrastructure to a Cloud IT architecture. Possibilities would be explored but could provide unrestricted expansion capability, operable from anywhere and provide increased resilience.
- Consideration would be given in the future to simplifying and automating the day-to-day monitoring of performance and generation of programme statistics through increased utilisation of the new EAMDAR Portal maintained by DWD.

Improving and Optimising Global Coverage With Supplementary AMDAR Data

- 5.2.59 The Secretariat presented to the session a document on improving and optimizing the global AMDAR coverage through the identification and provision of potential or “Supplementary” AMDAR data (SAMDAR) from existing operational programmes.
- 5.2.60 At the current time, there were several sources of SAMDAR already being provided by national and Regional AMDAR Programmes: The E-AMDAR Programme commits a percentage of its programme resources to the provision of SAMDAR in support of the World Weather Watch Programme; the E-AMDAR Programme has several bilateral agreements with WMO Member NMHSs to produce SAMDAR at a number of international airports outside of the EUCOS domain; and, the Australian Bureau of Meteorology has a bilateral agreement with New Zealand whereby the Australian AMDAR Programme produces a partially optimised data coverage over the New Zealand region, for which the NZ MetService reimburses the Bureau for the SAMDAR produced over that region.
- 5.2.61 Although not all programmes were able to fully comply, AMDAR programme managers were asked to submit with their status reports to the session, metadata relating to the potential of their programme to provide SAMDAR. This exercise had already identified that substantial volumes of data and vertical profiles over additional airports could potentially be produced and considerably improve the global AMDAR programme coverage. For example, the E-AMDAR programme identified around 80 airports where vertical profiles could be produced for (frequency currently undetermined) if funding were available to support the data and administrative costs to do so.
- 5.2.62 It was suggested that the process of developing and implementing bilateral agreements for the generation of SAMDAR could be streamlined by WMO taking on an intermediary role in assisting in developing and establishing agreements or MoUs between NMHSs and also between operational programmes and other data user organizations to support the production of the potential AMDAR data source. The AMDAR Trust might also be utilised in this process through: 1) reception and utilisation of targeted contributions by Members or organizations to support the production of global SAMDAR; and, 2) facilitating a method of payment for SAMDAR produced as a result of bilateral agreements.
- 5.2.63 It may also be possible that such an administrative system could eventually be extended to support a collaborative approach to the production of other 3rd party ABO data sources, such as TAMDAR and AFIRS.
- 5.2.64 The team agreed that:
- 1) ET-ABO should work towards obtaining from programme managers a complete programme metadata set that can be utilised to analyse and determine the full extent of potential Supplementary AMDAR data.
 - 2) The Expert Team recommended that up to 20K CHF should be allocated from the Trust Fund to facilitate work with FLYHT to develop a pilot project to derive AMDAR data from an appropriate AFIRS-equipped fleet, preferably over one of the data-sparse regions.

Polar ABO

- 5.2.65 The Secretariat presented to the session a document that identified a request to ET-ABO from the WMO EC Panel of Experts on Polar Observations, Research and Services (EC-PORS) to consider potential to extend and expand the coverage of ABO over Polar Regions in support of EC-PORS activities and monitoring of the Polar Regions in accordance with the Manual on the GOS.
- 5.2.66 It was identified that, at the current time, there appears to be only one source of aircraft-based observations over the Antarctic region and transmitted on the GTS, being data derived from the Australian Antarctic Division A319 aircraft (AU0500 / AC#10357) that is

equipped with the AFIRS system. This data is limited to infrequent and irregular vertical profiles from the aircraft into Antarctic airports, depending on the southern hemisphere summer schedule of Australian Antarctic Division flights. There is a very limited amount of Antarctic, near-polar region level flight data.

- 5.2.67 Over the Arctic region, there was some limited coverage of profiles at sites above 60N to around 70N from the USA MDCRS programme (Alaska Airways) and E-AMDAR over Norway, Finland and Sweden. Profiles from Svalbard (Norway) are generated by the E-AMDAR programme at around 78N. Some cruise level data is generated from trans-Atlantic traffic from both AMDAR and ADS-C sources.
- 5.2.68 Based on the High Frequency (HF) communications coverage maps provided by ARINC, the session was informed that there were several airlines operating aircraft that, while not currently part of the AMDAR programme, utilised routes and HF communications that had the potential to provide significantly more cruise level data over the upper tropospheric Arctic region if equipped with AMDAR.
- 5.2.69 The Expert Team requested that ARINC undertake to investigate and report on the airlines that use Arctic routes and might have the potential to extend Arctic coverage.
- 5.2.70 The team also requested that Mr Gilles Fournier investigate the possibility of the FLYHT AFIRS system contributing to extending the Arctic ABO coverage and that this information be included in the report of the Chair of ET-ABO to the next EC-PORS meeting to take place over 24-28 February 2014.

Guidelines for AMDAR Programme Development

- 5.2.71 The Chair informed the session that the ET-ABO Work Plan identified a task to develop Guidelines for AMDAR Program Development to be documented within the relevant WMO ABO-related regulatory or guidance material. This guide would support potential national and regional AMDAR programme managers specifying requirements for developing a new AMDAR programme.
- 5.2.72 The former AMDAR Technical Coordinator, Mr Jeff Stickland, had previously developed preliminary draft guidelines, including relevant budgetary estimates and, although not previously published, these guidelines had been used by the AMDAR Panel to provide guidance and advice in the possible establishment of new AMDAR programmes in the past.
- 5.2.73 The Expert Team requested the Chair and Mr Stewart Taylor to review and update these AMDAR Panel guidelines and then provide them to the team for further review and finalization, after which the team would determine a suitable forum for publication.

Training and Outreach

Regional Workshops in 2014

- 5.2.74 The session was informed that there were tentative plans for two regional workshops on AMDAR that might be held in the first half of 2014. The Expert Team has within its work plan a required activity to plan and hold a workshop in Region I to support the high priority of development of AMDAR in Region I. It was recommended that this activity should be incorporated into the A-RIP for Region I and that the team should identify and form a small working group to develop the plans for this workshop as soon as possible. This workshop would likely focus on AMDAR development in the northern half of Africa, possibly make use of ASECNA and Meteo-France connections and incorporate a development with Kenya and Kenya Airways.
- 5.2.75 A second workshop had been identified by WMO to possibly be held in Region II in Qatar and through the logistical organization and support of the Qatar Meteorological Service. Coordination between the PR of Qatar and the WMO Resource Mobilization Office was

currently underway and the Expert Team would be notified of its requirement for technical coordination and input later in 2013.

Impact of ABO Data

- 5.2.76 The Secretariat provided the meeting with an update on the status of the Expert Team task and consultancy with Dr Ralph Petersen through a WMO Special Services Agreement to produce a paper summarizing the historical and current status of AMDAR data impact on meteorological applications or applications areas. This deliverable would support the development of benefits and business case material in support of ABO and AMDAR programme development.
- 5.2.77 It was originally expected that this work would be concluded in the first half of 2013, however, because of a couple of issues, the contract for the WMO Special Services Agreement (SSA) with Dr Petersen has been updated and extended, so that the work is now expected to be concluded in the 4th quarter of 2013. The primary reason for the extension and delay in this activity was that Dr Petersen had identified, and both the AMDAR Panel (15th Session) and the ET-ABO leadership had agreed, that the body of work undertaken was beyond the scope of a single paper and that the work should be extended and the scope adjusted so as to incorporate the production of two papers on AMDAR data impact: One on the impact of AMDAR temperature and wind data; and a second on the impact of water vapour data. This adjustment in scope has increased the cost of the SSA remuneration by \$4200 USD to a total cost of \$34,700 USD.
- 5.2.78 The session was also informed on the status of an EUMETNET initiative in collaboration with Panasonic Avionics (formerly AirDat) and NOAA, that aims to conduct a series of Observing System Experiments (OSE) with several NWP models in order to assess the impact of additional aircraft based humidity observations (WVSS-II and TAMDAR) on numerical weather prediction skill.
- 5.2.79 Both DWD and ECMWF would run OSEs on 2011-2012 historical datasets with the initial results from DWD OSEs to be available by mid-October and from the ECMWF experiments in early 2014.
- 5.2.80 Additionally, when sufficient TAMDAR data over UK/Europe (from Flybe fleet) becomes available the Met Office UK would run similar OSE impact studies using its high resolution UK model, including any of the E-AMDAR humidity data that should begin to be available from early 2014.
- 5.2.81 It is expected that additional humidity observations would help to improve numerical weather prediction and hence the accuracy of weather hazards analyses and predictions. A summary of the results of the different OSEs would be provided in order to build the business case for further investment in new airborne humidity sensors.

AMDAR Benefits Documentation

- 5.2.82 The Secretariat advised the session that, in addition to the studies being undertaken in relation ABO data impact, two further activities were underway to develop benefits documents in support of AMDAR and ABO systems development. The first of these focuses on benefits to aviation as determined and espoused by aviation and was already underway as work plan activity number 19 (AMDAR Impacts and Benefits document for Aviation). The session was informed that this task has been progressed by the ET-ABO leadership and the Secretariat during 2013. The original Description of Work for the task had been revised and updated and prospective candidate consultants for undertaking the work had been approached. Three strong candidates had responded and submitted Eols. It was expected that the final assessment would be concluded by the end of September and the SSA award for commencement in October 2013 with the deliverable benefits document to be finalized and submitted by the 4th quarter of 2014.

- 5.2.83 While Task 19 had the specific requirement to address and provide benefits to aviation from the aviation perspective and as determined and/or endorsed by aviation, there exists an additional requirement to develop material that identifies the benefits of ABO and AMDAR from a meteorological Data User perspective. The resulting document or documents would be expected to be useful for the development of business cases by both NMHSs and airlines for prospective AMDAR programme developments.
- 5.2.84 In July 2013, a first draft was produced by the Secretariat based on existing material and circulated to ET-ABO, TT-AO and operational programme managers to comment initially on the structure and proposed content. Based on this feedback, a 2nd draft had been produced and was provided to the session as Information Document 5.2.4.2¹⁷.
- 5.2.85 The team agreed that this activity should be integrated into the ET-ABO work plan and that the team would undertake a collaborative process to finalise the document by the end of 2013 for publication by WMO in early 2014.

WMO ABO & AMDAR Website

- 5.2.86 The Secretariat informed the session that the WMO Aircraft-based Observations website¹⁸ including the AMDAR Observing System area¹⁹ had been completely restructured and revised by SO/ARO during the first quarter of 2013. The website included a description of the new governance structure and programme under the World Weather Watch Programme. Material, documents and historical information from the WMO AMDAR Panel activities had been retained. Importantly, the website now contained a revised and updated consolidated AMDAR Resources area²⁰ providing a convenient source of system standards, regulations, documents and programme information for Members.
- 5.2.87 The team was advised that the website lacked adequate technical descriptions of each operational AMDAR programme which might be useful to Members in determining AMDAR operational best practice and collaboration opportunities. The team agreed to undertake an activity, coordinated by the Secretariat, to work with operational programme managers to document each AMDAR programme using a consistent structure.

Report on Training and Outreach Activities

- 5.2.88 Mr Carl Weiss, USA, presented to the session a document on the training and outreach activities that the team was undertaking within its work plan.
- 5.2.89 The team had continued to produce the WMO AMDAR Observing System Newsletter (formerly the AMDAR Panel Newsletter) biannually and had published Volume 5 in April 2013²¹.
- 5.2.90 The team agreed that the newsletter continued to be an excellent AMDAR outreach tool that should be utilized by WMO Members to promote AMDAR both inside and outside their organizations and particularly to the Aviation Industry. Team Members should contact the Secretariat for advice on the best way to subscribe their national colleagues and aviation partners or contacts. Volume 6 was to be published by ET-ABO in October 2013.

¹⁷ <http://www.wmo.int/pages/prog/www/OSY/Meetings/ET-ABO-1/Benefit%20of%20AMDAR%20Data%20to%20Meteorology%20and%20Aviation%20Version%201D2.doc>

¹⁸ <http://www.wmo.int/pages/prog/www/GOS/ABO/>

¹⁹ http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/index_en.html

²⁰ http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/resources/index_en.html

²¹ <https://sites.google.com/a/wmo.int/amdar-news-and-events/newsletters/volume-5-april-2013>

- 5.2.91 Members of the team had also continued to be active in promoting AMDAR through and within various opportunities and forums. At the 2013 Experimental Aircraft Association (EAA) AirVenture (July 29 – August 4), the National Weather Service (NWS) again promoted AMDAR activities at its exhibit. Mr Bryce Ford, HMEI (SpectraSensors, Inc.) promoted AMDAR/WVSS-II at several events including the American Meteorological Society (AMS) 93rd Annual Meeting, January 5-10; Austin, TX. Dr Tammy Farrar provided an AMDAR-related talk at the Friends and Partners of Aviation Weather (FPAW) Summer Meeting in July 2013. Mr Stewart Taylor, E-AMDAR, promoted AMDAR and/or WVSS-II at several events including: provided information regarding AMDAR data provision to Luxembourg's Findel Airport (ELLX) to Luxembourg Met Service and gave an AMDAR presentation to a Met Office Training Course in April 2013.
- 5.2.92 The session was informed that Southwest Airlines, in conjunction with ARINC and the U.S. National Weather Service (NWS), was finalizing the production of a 2½-minute promotional video highlighting their participation in the WVSS-II program.
- 5.2.93 Mr Weiss advised that AMDAR data had been used in aviation weather training produced by COMET at the request of African nations to respond to WMO forecaster competency requirements. AMDAR soundings were used to show their utility in forecasting low stratus and fog, in addition to other applications.
- 5.2.94 Under the former WMO AMDAR Panel, the AMDAR community had been investigating the possibility of developing an online AMDAR educational and promotional module that would be developed with the aim to provide information on various aspects of the ABO and AMDAR in order to meet the needs of several audiences, including weather forecasters, observational development groups, airline operational staff and managers and national meteorological services managers.
- 5.2.95 Based on initial investigations, the determination of requirements for the module and discussions with the UCAR COMET programme, the Panel had determined that the likely cost of such a development would be over \$100K US, which was considered too high to be solely supported by the AMDAR Trust.
- 5.2.96 In 2013, a first draft of a Description of Work (DoW) for the development of the training module had been developed by Mr Weiss and provided to ET-ABO for review. The Expert Team considered the draft DoW and discussed the requirement for this development. Considering the concerted effort that the Expert Team was making to deliver the Actions of the EGOS-IP through expansion of aircraft-based observations, it was determined that the module would be of high value to WMO Members and potential aviation partners and that the team should therefore progress the development of the module over the coming year. The team made a recommendation that up to 90K CHF of funds from the AMDAR Trust should be committed to the project with the remaining funding required to be obtained from other sources. Mr Weiss was requested by the team to investigate and report on how NOAA and the NWS might collaborate with ET-ABO on this project.

Attendance at aviation forums

- 5.2.97 The Chair reported that the ET-ABO, represented by its members, was active in promoting the AMDAR observations programme in the Data Link Users Forum of the Airlines Electronic Engineering Committee (AEEC DLUF).
- 5.2.98 At the most recent meeting of the AEEC DLUF (Phoenix, Arizona, 5-7 February 2013) the ET-ABO was represented by Mr Carl Weiss, while at the next AEEC DLUF meeting (17-18 September 2013, London, UK) ABOP would be represented by Mr Stewart Taylor. At that meeting the benefits of Water Vapour data for the aviation industry would be emphasized, as well as the new ABO Structure and the ET-ABO objective to increase interaction with the different aviation groups and standards bodies.

5.2.99 It was agreed that the Expert Team would have to become more active in identifying other international forums related to the ABOP activities, such as relevant bodies in ICAO, SESAR and NextGen, the avionics industry and the aircraft manufacturers. It also might be advantageous to get access to the AEEC Airline-only Roundtable Discussion (following the DLUF meeting) for direct interaction and exchange of ideas with the participating airline representatives.

5.3. UPDATE OF ET-ABO WORK PLAN & BUDGET FOR 2014-15

Breakout Groups

5.3.1 The meeting agreed to dedicate some time from the session to working in smaller groups on development of planning for particular tasks and activities in the ET-ABO work plan. Given the limited time available, these breakout sessions focused on the development of the planning documents, including the Aircraft-based Observations Strategy and Implementation Plan (A-SIP) and the AMDAR Regional Implementation Plans (A-RIPs) and on the development of the Metadata Framework Implementation Plan.

5.3.2 In addition to the action to compile the first draft of each A-RIP by 31 October 2013, the Expert Team also agreed to revise and work towards the finalization of the A-SIP by the end of October. Mr Carlberg would update the current draft version and provide it to team members by the middle of October.

5.3.3 The reports and results of the Breakout Groups are provided within [Annex III](#).

Work Plan & Budget Development for 2014-15

5.3.4 The Expert Team agreed that an appropriate outcome from the meeting was that all recommendations and actions relating to the work plan that were determined within the session, were compiled within the Final Report and that this information was used by the ET-ABO leadership group to later develop the updated work plan and budget for 2014-15, which was required to be approved under the ToR of the Trust Fund by the end of 2013. The ET-ABO leadership group agreed to meet by Teleconference shortly following the ET-ABO session to compile the first draft of the updated work plan and budget.

5.3.5 The summary of recommendations and actions from the session are provide within [Annex IV](#).

6. ANY OTHER BUSINESS

6.1. No further business was raised for discussion.

7. CLOSURE OF THE MEETING

7.1. The Chair of ET-ABO thanked all those that had participated in the meeting for their valuable contributions. He wished the participants a safe return journey and closed the session at around mid-afternoon on 13 September 2013.

ANNEX I

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ANNEX II, AMDAR Trust Fund Statement, 1 January to 31 July 2013.

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AMDAR TRUST FUND
Interim Statement of Income and Expenditure
For the period 1 January to 31 July 2013
Amounts in Swiss Francs

1. Balance brought forward, 1 January 2013		1,076,446.86
2. Income		
2.1 Voluntary contributions (listed below)	109,574.92	
2.2 Interest credited	542.49	
2.3 Total income		110,117.41
3. Total available funds during reporting period		1,186,564.27
4. Expenditure		
4.1 Direct project costs		
4.1.1 Consultancies	48,743.91	
4.1.2 Travel	1,621.79	
4.1.3 Total project direct costs	50,365.70	
4.2 Indirect project costs		
4.2.1 Bank charges	92.83	
4.2.2 Unrealized loss on currency exchanges	3,432.56	
4.2.3 Total indirect project costs	3,525.39	
4.3 Total project expenditure		53,891.09
5. Balance of fund at 31 July 2013, including outstanding pledges		1,132,673.18
6. Less outstanding pledges		30,000.00
7. Balance of fund at 31 July 2013, excluding outstanding pledges		1,102,673.18

Voluntary Contributions

Australia	54,264.44
Austria	3,500.00
France	11,704.69
Germany	31,387.40
Netherlands	1,218.39
New Zealand	2,500.00
Sweden	5,000.00
	109,574.92

Certified correct:

Luckson Ngwira
Chief, Finance Division
29 August 2013

Annex III

REPORTS OF BREAKOUT GROUPS

Group 1: Regional Implementation Plans - working on the strategy and plans

Region I – Lead: Jean Blaise Ngamini

Some regions already have well-established AMDAR programmes with good geographic coverage but the Region I is not covered and have just one national AMDAR programmes (South Africa) and this leaves vast areas with no upper air ABO data coverage.

1. Current status of AMDAR in Region I

South Africa is the only country of the whole African continent which has a notional AMDAR programme. Only a very few airports actually collect data from South African Airlines (SAA), Lufthansa and a couple of American airlines in the coastal region, leaving the larger part of the continent with no ABO data.

2. Strategy and Approach to Regional Development

The whole continent requires data coverage improvement. With the help of the Regional Association and WMO, we will meet the airlines company based in the African region, to discuss the cost effective and the gain they will have in a well-covered continent with ABO data.

The discussion with Air France to implement AMDAR devices on the Boeing 777 which have daily flight in many countries of the region could help in the coverage of Region I.

The negotiation with E-AMDAR to extend its coverage at least part of the continent could be a way of finding a solution for ABA data.

The region being one of those where very few countries perform upper air observations, AMDAR might be the only way to solving the problem of upper air data in the region I.

Region II – Lead Li Wei

Planning work was undertaken but a report was not available from the breakout session.

Region IV Gilles Fournier

At breakout for IP for RA IV, four representatives from RA IV met to discuss their ideas on structure and content the IP should have and following course of actions to take. The four participants were Jeannine Hendricks, Carl Weiss and Bryce Ford, all from the USA, and Gilles Fournier from Canada.

The IP will start with a status and description of AMDAR programs (established, planned and non-existing) in RA IV. Information from status reports from USA and Canada provided to ET-ABO-1 will be used, including status of WVSS-II development in the USA and on the planned Mexico program. A map of the current AMDAR coverage over RA IV will be provided. This will be followed by a section on the current status of radiosonde coverage in RA IV.

The current status of radiosonde and AMDAR coverage, along with the data user requirements in terms of parameters, coverage, frequency, accuracy, latency will then be used to identify upper air data gaps and determine the requirements for coverage improvement over RA IV.

Then the results of the Study on Data Coverage and Targeting for Future Airline Recruitment along with other sources of airline information, such as their web sites to identify aircraft assets and flight routes will be used to analyze AMDAR candidate regional and national airlines to be targeted by the IP. Commercial data providers to address data sparse areas will be considered in this

analysis. As well an analysis of other aircraft-based observation data sources (e.g. ICAO ADC-C, ADS-B/Mode-S, AFIRS, TAMDAR...) will be completed. Bryce Ford will consolidate all coverage maps from HMEI members present at the meeting, and provide those to the Chair and Secretariat for use all Regional IPs.

Then risks to advancing the IP in RA IV will be identified, including financial and human resource issues, infrastructure issues and communications issues.

All this information will be used in the development of the IP that will contain a strategy and approach to RA IV development, the identification of stakeholders, management, coordination mechanism and resources required, and requirements for assistance and involvement of the WMO Regional Association (possible through the Regional WIGOS Implementation Plans). Good communications will be required (WMO – ET-ABO representative – WIGOS FP – RA IV, e.g. SG to RA IV President; from President to member PRs or Heads; between ET-ABO representative and identified focal point for each member, with WMO Secretariat, with WIGOS FP for RA IV). Coordination may also be done with civil aviation authorities, IATA, ICAO, airlines, data service providers... The strategy will include target observations from established programs, prioritization of airlines based on anticipated benefits, education-promotional activities (including participation in meetings of RA IV, workshop delivery, presentation of impacts and benefits, web-based promotional resources), conduct of regional OSE studies, consideration for data optimization, working in phase with WIGOS IP for RA IV, coordination with focal points in RA IV, establishing coordination among members (sub-regional developments), developing mentorship among members, finding champions in airlines. Regarding use of and access to resources responsibilities and expectations of various stakeholders will be established and clearly explained.

Region V – Douglas Body

An Aircraft-based observations Regional Implementation Plan (A-RIP) for RA V is very much a new concept and much of the session was spent understanding the current situation and the necessary steps. The WMO supplied RIP Template was very helpful in this respect.

Currently Australia and New Zealand run national AMDAR programs which also provide some additional data over RA V, primarily flights to and from Singapore. There has also been some recent interest from Singapore in augmenting the data they receive from the Australian Bureau of Meteorology and E-AMDAR to include AMDAR from SE-Asian based carriers.

Future directions should be apparent from the completion of the Template and following discussions.

Region VI – Steve Stringer

1) In addition to plans for extension, and more uniform, coverage of AMDAR obs across the RAVI area the future scope and objectives should include extending the programme to include water vapour, turbulence and icing as regular observations and to make more use of potential supplementary aircraft observations, namely ADS-C & Mode-S. To achieve this a specific objective will be to work more in collaboration/partnership with the entire airline industry rather than the current customer/supplier relationship.

2) E-AMDAR members account for 30 out of the 50 RAVI members and the RAVI region extends further into eastern Europe than covered by the E-AMDAR current programme. However, rather than considering a new E.Europe/Russia AMDAR programme, the E-AMDAR programme could form the basis of the RAVI plans, basing the requirements on those that already exist for E-AMDAR - namely spacing of 200-250km and 3-hourly observing cycle. Extending E-AMDAR to the east would need the cooperation and participation of E.European and Russian NMHSs and airlines but could utilise the existing E-AMDAR infrastructure in doing so. Optimisation of flight selection would be a consideration with any new airlines encouraged to use the existing E-ADOS capability.

3) A number of suitable candidate airlines are identified in the WMO document, “ AMDAR Coverage & Targeting for Future Airline Recruitment” that would greatly help expand coverage if they would participate, for instance S7 Airlines & Ural Airlines, but further work would be needed to assess the optimum coverage. The western approaches to mainland Europe remain as under

observed areas so plans will also target the islands of Azores, Canaries, Iceland, Greenland where possible, as well as Ireland for more/new profile observations.

4) It is fully expected that the national needs for increased resolution (space and time) will continue as higher resolution, rapid update cycle models become more widely used and relied upon. The RAVI implementation plan is also to allow for these individual, national needs to be met.

5) To date there has been no discussion between E-AMDAR and WMO RAVI regarding development of an AMDAR implementation plan for RAVI so it will be essential that EUMETNET/E-AMDAR works with the WMO regional office, WIGOS FP & RAVI President to develop the current draft into an agreed document consistent with the WIGOS implementation plan for RAVI. It should be noted that Lithuania, Bulgaria, Slovakia and Romanian NMHSs are already cooperating members of EUMETNET. Discussions and agreements would be needed with other RAVI members - Russia, Ukraine, Belarus, Turkey, etc. - on cooperation with the E-AMDAR programme.

Group 2: Metadata Framework implementation Plan

Lead: Stewart Taylor

1. During the breakout session, we were joined by Etienne Charpentier and Timo Proescholdt who are involved with defining the requirements for the observing system capabilities as a component of the WMO OSCAR. Discussion involved the metadata requirements for AMDAR for this system. These include items such as resolution of data, observation frequency (airports) and uncertainty.
2. It was suggested that a dataset of AMDAR metadata would be required to be made available for the first stage of data inputs to OSCAR – Stage 1 before 2015 and Stage 2 thereafter.
3. In addition to the WIGOS metadata requirements, programmatic metadata will be required in order to define the observing system capabilities for AMDAR. This metadata will likely include information such as:
 - geographical locations for AMDAR vertical profiles (airport metadata)
 - horizontal and vertical reporting frequencies and resolutions
 - temporal reporting frequencies for both vertical profiles and enroute data
 - measurement uncertainties
4. It was agreed that it may be a desirable solution for entry of AMDAR metadata by AMDAR Focal Points, to provide an interface and data repository utilising the WMO Country Profile Database (CPDB).
5. Several steps and associated Actions were identified. These will be taken on within the Metadata Framework Implementation Plan and reported back to ET-ABO:
 - 1) Review and edit AMDAR WIGOS metadata model
 - 2) Determine metadata requirements for WMO OSCAR
 - 3) Define requirements for international versus national/regional metadata sets.
 - 4) Revise and updated the implementation plans accordingly

Annex IV

ET-ABO Session 1, Adopted Recommendations and Actions

Agenda Item	Item Description	Recommendation or Action	Responsibility	Due
3.1	Hong Kong Programme	Action : SO/ARO to follow up with focal point for Hong Kong on difficulties associated with development of AMDAR software for Airbus aircraft	SO/ARO	Q4 2013
3.1	Japan Programme	Action : SO/ARO to follow up with focal point for Japan on reporting of temperature in whole degrees C in both FM42 and BUFR.	SO/ARO	Q4 2013
3.2	Developing Programmes & A-RIPs	ET-ABO should compile a list or table of WMO Members that would be responsible for high priority target airlines, based on the recently completed study undertaken by the former WMO AMDAR Panel and ET-ABO.	SO/ARO	Q4 2013
		Letters should be composed and sent to the relevant Permanent Representative to WMO or an existing AMDAR Focal Point in the list, by the Secretariat, requesting that they consider collaboration with the target airlines towards AMDAR programme participation.	Ch-ET-ABO, SO/ARO	Q4 2013
		Responses to the correspondence and future activities arising from them should be documented within the AMDAR Regional Implementation Plans and followed up on by ET-ABO and the Secretariat.	SO/ARO, ADO, ET-ABO Regional Leaders	Ongoing
		Action: AMDAR regional implementation plans (see item 5.2.3) should incorporate known existing potential new programme developments that were identified at the AMDAR Panel 15th Session (November 2013) within document 4.1.1.	ET-ABO Regional Leaders	Q4 2013
3.3	ADS-C Data Quality	ICAO agreed to further investigate the issue of ADS-C meteorological data and its quality control and report back to the team.	N. Halsey	Q4 2014
		The Expert Team agreed to provide Mr Halsey with a brief set of requirements for quality control of ADS-C data before GTS transmission.	ET-ABO	Q1 2014
3.3	ADS-C Data Access	The team requested that ICAO investigate and report on the potential availability of additional sources of ADS data that were not currently made available to WMO Members on the GTS.	N. Halsey	Q2 2014
3.3	ADS-B Data Access	The team requested that ICAO provide information on the likely future potential of meteorological data availability from ADS-B systems, either implemented or being implemented by ICAO Members and ICAO agreed to investigate this matter and report back to the team. ICAO also agreed to investigate whether the Mode-S data might be able to in the future accommodate a more complete and accurate transmission of meteorological data.	N. Halsey	Q4 2014
3.3	ICAO & IATA website promotion of AMDAR	The team agreed to work with Mr Halsey and Mr Sonnabend to investigate and implement these possible promotional opportunities.	ET-ABO, SO/ARO	Q1 2014

Agenda Item	Item Description	Recommendation or Action	Responsibility	Due
3.3	ICAO & WMO Promotion of AMDAR	The team and Mr Halsey also agreed to investigate opportunities to promote AMDAR at the ICAO MET/AIM Divisional Meeting (2014), conjoint with WMO CAeM in July 2014.	ET-ABO, SO/ARO, N. Halsey	Q2 2014
3.2	Russian Focal Point	Chair of ET-ABO to reestablish contact with focal point for Russia and request status report on development of AMDAR in Russia.	Ch-ET-ABO	Q4 2013
3.2	TAMDAR for UAV	TT-AO to consider whether investigation and trial of TAMDAR UAV is a requirement.	Ch-TT-AO	Q1 2014
4.3	WIGOS IP	Monitor the Implementation Plan for the Evolution of the Global Observing System (EGOS-IP) with respect to global actions for development and evolution of aircraft-based observation	ET-ABO	Ongoing
		Work with IPET-WIFI and SG-RM in the process of developing guidance for Members on ABO system design by utilizing the RRR process and the WIGOS Operational Information Resource (WIR) and, in particular, assist IPET-OSDE with the implementation of OSCAR through the specification for determination of the capabilities of the aircraft-based observing system	ET-ABO	Q4 2014
		The process and timeline for review and revision of related ABO regulatory material is coordinated and harmonized with the process being undertaken and coordinated by ICG-WIGOS/TT-WRM and IPET-WIFI and its SG-RM. Action: Ch-ET-ABO to correspond with Ch-IPET-WIFI to ensure harmonization of relevant ET-ABO activities in the work plan.	Ch-ET-ABO	Q4 2013
		ET-ABO should consider how it might, in the future and through its work plan, contribute more directly to the development of the WIGOS Information Resource	ET-ABO	Ongoing
		So as to become more aligned with WIGOS framework development and to take advantage of the developmental and collaborative momentum that has been generated, the regional approach to ABO development and planning that has been instigated within the strategy and plans of the ABOP should be integrated into the WIP and the R-WIPs through coordination with WMO Regional Associations and the eventual incorporation and maintenance of Regional AMDAR Implementation Plans within the R-WIPs	ET-ABO	Q4 2014
5.1	A-SIP	Action: ADO should undertake a final review in collaboration with ET-ABO with the final version to be submitted to CBS OPAG-IOS and CIMO OPAG-SI by late October	ADO, SO/ARO	Q4 2013
5.1	Development of A-RIPs	Action: Panasonic Aviation & FLYHT should be given the opportunity to provide input to each A-RIPs in consultation with ET-ABO Regional Leaders.	ADO, SO/ARO	Q1 2014
5.1	Trust Fund Contributions	Action: SO/ARO to check on Australian contribution amount to the trust fund for 2013.	SO/ARO	Q4 2013
5.2	Metadata Framework IP	Action: S. Taylor to update the AMDAR Metadata profile for various issues raised in the Breakout Session. Action: S. Taylor and SO/ARO to ensure metadata profile accommodates requirements for RRR process to determine capabilities of AMDAR observing system.	S. Taylor, SO/ARO	Q4 2013

Agenda Item	Item Description	Recommendation or Action	Responsibility	Due
5.2	AMDAR Data QC & QM	It was recommended that all programmes should be endeavouring to meet the WMO timeline for transition from text codes to binary codes by November 2013 and to transition to use of the new BUFR Template for AMDAR as soon as possible.	ET-ABO	Q4 2013
		In order to improve both data quality control and monitoring practice, it was recommended that: as part of the wider process of reviewing and updating the ABO and AMDAR regulatory material in the WIGOS and GOS manuals, the practices and standards for quality control and quality monitoring should be reviewed and updated as necessary.	J.v.d. Meulen, Ch-ET-ABO, A. Hoff, SO/ARO	Q4 2014
5.2	AMDAR Regulatory Material	Given the requirement to address this urgent and high priority activity and to ensure harmonization of review processes and timelines with the WIP and TT-WRM it was recommended that ET-ABO should appoint a Regulatory Material Review Team consisting of Dr van der Meulen, Mr Frank Grooters, Dr Axel Hoff and Mr Dean Lockett to coordinate and finalise the review and reorganization of the ABO regulatory material. The timeline and tasks assignment for this activity would be determined at a first meeting to be held via Videoconference (WebEx) in early October.	J.v.d. Meulen, Ch-ET-ABO, A. Hoff, SO/ARO	Q4 2014
5.2	B777 Software	Action: S. Stringer to follow up on B777 software development issues with Air France and report back to ET-ABO.	S. Stringer	Q4 2013
5.2	AOSFRS	The AOSFRS would be the primary reference for, and specification of, the meteorological and functional requirements for applications development associated with the ARINC 620 Meteorological Report and changes to meet new or altered requirements for AOS would be first initiated through an update to the AOSFRS; and,	Ch-TT-AO	Ongoing
		The ARINC 620 could be updated to include Meteorological Report, Version 6 to be consistent with the AOS format specifications (AOSFRS Version 1, Appendix A) and the supporting text in the ARINC 620 reduced to a minimum through reference to the AOSFRS. It is possible that Version 1 to 5 could be moved to an Appendix of the ARINC 620 to avoid the further use of these older format standards in the future. The Expert Team agreed to adopt this approach and recommended that TT-AO should undertake the task to work through the ARINC AEEC SubSystems Committee (AEEC SSC) process to update ARINC-620 accordingly.	Ch-TT-AO, TT-AO	Q2 2015
5.2	A-RIPs	ET-ABO Regional Leaders were requested to work towards provision of a first draft of the A-RIP for their respective region by the end of October 2013.	ET-ABO Regional Leaders	Q4 2013
		Action: SOI/ARO to provide regional profile coverage maps for A-RIPs	SO/ARO	Q4 2013
5.2	Supplementary AMDAR Data	ET-ABO should work towards obtaining from programme managers a complete programme metadata set that can be utilised to analyse and determine the full extent of potential Supplementary AMDAR data.	ET-ABO, SO/ARO	Q1 2014

Agenda Item	Item Description	Recommendation or Action	Responsibility	Due
5.2	Collaboration with FLYHT	The Expert Team recommend that up to 20K should be allocated from the Trust to facilitate work with FLYHT to develop a pilot project to derive AMDAR data from an appropriate AFIRS-equipped fleet, preferably over one of the data-sparse regions.	ET-ABO	Ongoing
5.2	Polar ABO	The Expert Team requested that ARINC undertake to investigate and report on the airlines that use Arctic routes and might have the potential to extend Arctic coverage.	J. Hendricks	Q3 2013
		The team also requested that Mr Gilles Fournier investigate the possibility of the FLYHT AFIRS system contributing to extending the Arctic ABO coverage.	G.Fournier	Q4 2013
		Chair of ET-ABO to provide report to the next EC-PORS meeting to take place over 24-28 February 2014.	Ch-ET-ABO	Q1 2014
5.2	Guidelines for AMDAR Programme Development	The Expert Team requested the Chair and Mr Stewart Taylor to review and update these AMDAR Panel guidelines and then provide them to the team for further review and finalization, after which the team would determine a suitable forum for publication.	Ch-ET-ABO, S. Taylor	Q1 2014
5.2	Collaboration on ABO Benefits Document	The team agreed that this activity should be integrated into the ET-ABO work plan and that the team would undertake a collaborative process to finalise the document by the end of 2013 for publication by WMO in early 2014.	SO/ARO, ET-ABO	Q1 2014
5.2	WMO AMDAR Website	The team agreed to undertake an activity, coordinated by the Secretariat, to work with operational programme managers to document each AMDAR programme using a consistent structure.	SO/ARO, ET-ABO, AMDAR FPs	Q4 2014
5.2	AMDAR Online Educational Module	Action: C. Weiss to update the DoW for the module to reflect that the module is more an education and information module rather than a training module.	C. Weiss	Q4 2013
		Considering the concerted effort that the Expert Team was making to deliver the Actions of the EGOS-IP through expansion of aircraft-based observations, it was determined that the module would be of high value to WMO Members and potential aviation partners and that the team should therefore progress the development of the module over the coming year. The team made a recommendation that up to 90K CHF of funds from the AMDAR Trust should be committed to the project with the remaining funding required to be obtained from other sources.	ET-ABO, C. Weiss	Q2 2014
		Action: Mr Weiss was requested by the team to investigate and report on how NOAA and the NWS might collaborate with ET-ABO on this project.	C. Weiss	Q4 2013
5.3	Work Plan & Budget	Action: The ET-ABO leadership group agreed to meet by Teleconference shortly following the ET-ABO session to compile the first draft of the updated work plan and budget.	Ch-ET-ABO, VCh-ET-ABO	Q4 2013