

WORLD METEOROLOGICAL ORGANIZATION

WMO AMDAR Panel (15th Session)

Boulder, USA, 6 - 9 November 2012



FINAL REPORT



EXECUTIVE SUMMARY

The WMO Aircraft Meteorological DATA Relay (AMDAR) Panel (the Panel) is a WMO affiliated body made up of Members of WMO operating under the Terms of Reference (ToR) that have been put in place and maintained by the Panel Membership. AMDAR Panel Members contribute on an annual basis to the AMDAR Panel Trust Fund, which is managed and overseen by WMO and supports the coordination, activities and work programme of the Panel and the AMDAR Programme.

The Panel in cooperation with the Commission for Basic Systems (CBS) Expert Team on Aircraft Observations (ET-AIR) and the Commission for Instruments and Methods of Observation (CIMO) Theme Leaders on Aircraft Measurements forms the WMO AMDAR Programme and together have continued to work towards further development of AMDAR observing system and its full integration into the WMO Integrated Global Observing System (WIGOS) under the WMO World Weather Watch Programme.

This document provides the Final Report of the 15th Session of the WMO AMDAR Panel, which, was also the final Meeting of the Panel, having agreed to hand over full programmatic management and governance of the Aircraft-based and AMDAR observing systems to WMO and its Technical Commissions, CBS and CIMO. Most importantly, Members should be aware that this does not mean the end of AMDAR related developmental activities and there remains a strong need to continue supporting the work programme of the WMO Aircraft-based Observations programme. This programme will be managed jointly by a CBS Expert Team on Aircraft-based Observations (ET-ABO) and a CIMO Task Team (TT), supported by the AMDAR Trust Fund and having responsibility for carrying forward the work of the AMDAR Panel which includes critical activities and actions based on the CBS Implementation Plan for Evolution of the GOS.

In addition to reviewing the current status of the Global AMDAR Observing System formed from its component national and regional AMDAR Programmes, the Session also reviewed, discussed and updated plans for ongoing and new work activities associated with AMDAR system expansion to Regions I and III and other data-sparse areas, water vapour measurement implementation, turbulence measurement, AMDAR software standardization and development, data and metadata management, training and outreach, data quality issues and impact of AMDAR data.

WMO and the Panel expresses its gratitude to the USA, NOAA/NWS and NCAR for jointly hosting the Panel Meeting and for the contribution of the Federal Aviation Administration (FAA) in organizing the Technical Workshop on Turbulence and EDR, held prior to the Panel Meeting at NCAR on 5 November 2012.

WMO thanks all of the current and previous Members of the WMO AMDAR Panel for all contributions that had been made to the work programme and resources of the AMDAR Panel since its inception.

ADOPTED AGENDA

- 1. Opening of the Meeting**
- 2. Organization of the Meeting**
- 3. AMDAR Programme Status**
 - 3.1. Report on the status of the AMDAR Programme
 - 3.2. Status of the AMDAR Panel and Transition of the AMDAR Observing System to WMO
 - 3.3. Status Reports on National and Regional Programmes
- 4. Projects, Planning and Work Programme**
 - 4.1. Enhancement of AMDAR Observing System Coverage
 - 4.2. Extension of the AMDAR System
 - 4.3. Research and Development of New Aircraft Observations Technologies
 - 4.4. Development and Maintenance of the Aircraft Observing System QMS
 - 4.5. Aircraft Observing System Training and Outreach
 - 4.6. Aircraft Observations Work Plan
- 5. AMDAR Panel Financial Matters**
 - 5.1. Status of AMDAR Trust Fund
 - 5.2. Transfer of AMDAR Trust Fund to WMO and CBS
 - 5.3. Budget 2013-2014
- 6. Any Other Business**
- 7. AMDAR Panel Administrative Matters**
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APPENDICES

- I [List of Participants](#)
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- III [Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR](#)
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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE MEETING

- 1.1. The 15th Session of the WMO AMDAR Panel was opened by the acting Chair, Mr Carl Weiss, USA, at 10am on 6 November 2012 at the offices of NCAR, Boulder, Colorado, USA. The Meeting was informed that the Chairman of the Panel, Mr Frank Grooters was unable to physically attend the Meeting due to a health issue but would join the Panel for several sessions via teleconference. The WMO Secretariat was represented by Mr Dean Lockett, Scientific Officer Aircraft-based and Remotely-sensed Observations, who emphasized the importance of this meeting of the Panel, given the status of the transition of the AMDAR programme to the WMO World Weather Watch Programme under the governance of the WMO Technical Commissions, CBS and CIMO, leading to an expectation that this would be the final Meeting of the Panel on the recommendation of the AMDAR Panel Management Group and subject to the approval of Panel Members. Mr Lockett expressed to the Panel, the appreciation of WMO and its Members for the excellent achievements of the Panel within its work programme over the past 12 months since the 14th Session in November 2012, Quebec City, Canada.
- 1.2. The Panel expressed gratitude to the USA, NOAA/NWS and NCAR for jointly hosting the Panel Meeting and for the contribution of the Federal Aviation Administration (FAA) in organizing the Technical Workshop on Turbulence and EDR, held prior to the Panel Meeting at NCAR on 5 November 2012. In particular, the Panel thanked Mr Carl Weiss (NOAA/NWS), Dr Marcia Politovich (NCAR), Ms Marybeth Zarlingo (NCAR), Dr William Moninger (NOAA, retired) and Ms Tammy Farrar (FAA) for their dedicated work in this regard.

2. ORGANIZATION OF THE MEETING

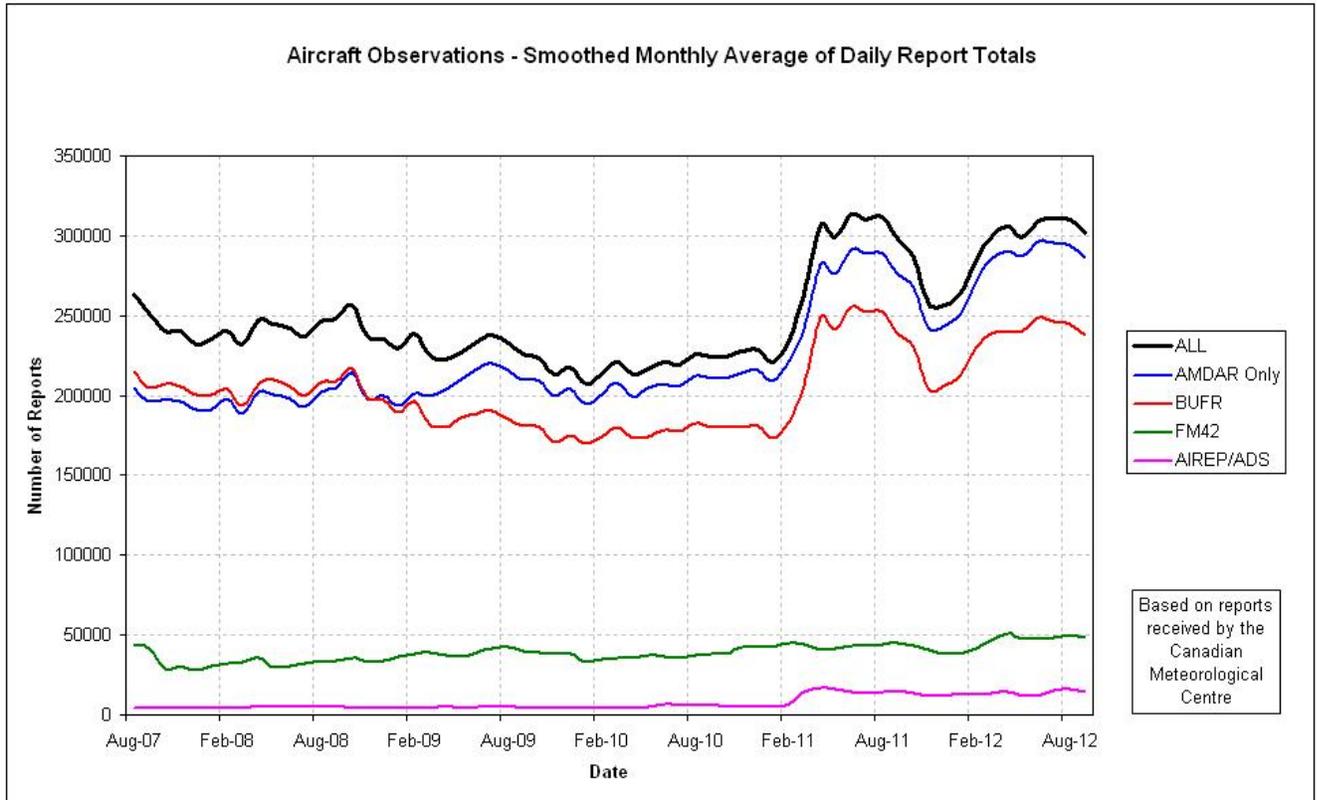
- 2.1. The Chairman and the Secretariat outlined the proposed schedule and Agenda for the Meeting, which was adopted unchanged and as above.

3. AMDAR PROGRAMME STATUS

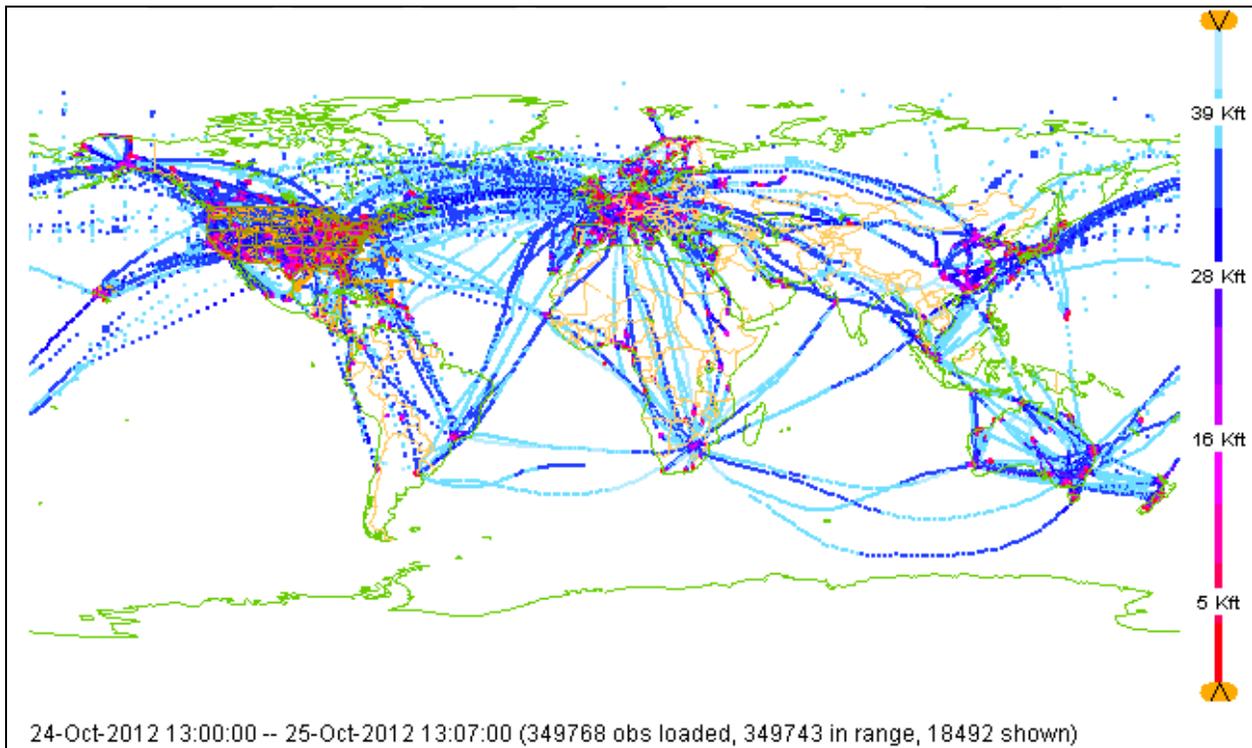
3.1. Report on the status of the AMDAR Programme

Status of the Global AMDAR Programme

- 3.1.1. The Panel was informed that, currently, ten operational National and Regional programmes in collaboration with 39 airlines contributed to the Global AMDAR Programme, utilizing a fleet of over 2800 aircraft.
- 3.1.2. Although the AMDAR Programme output, as measured in terms of the number of observations transmitted on the Global Telecommunications System (GTS) has fluctuated markedly in recent years, most particularly due to economic cycles, the developments over 2011 and the first quarter of 2012, combined with an improved economic situation for airlines, have meant that the Programme now provides an average of around 300,000 upper air observations per day in support of the WMO World Weather Watch Programme. The figure below shows the 5-year trend in GTS daily output of aircraft observations, with the contribution by the AMDAR Programme depicted by the blue line.



- 3.1.3. Since The 14th Session of the AMDAR Panel (Panel-14) (November 2011), the significant change to the global AMDAR fleet has been the addition of 2 airlines and over 20 aircraft to the Australian programme, namely, Jetstar Australia and Jetstar Asia operating out of Singapore. The addition of Jetstar Asia has enabled the collection of observations from many Southeast Asian locations and areas within a relatively data sparse region.
- 3.1.4. The figure below, courtesy of the AMDAR Data Display from NOAA, ESRL/GSD, provides an indication of the global coverage of aircraft observations on the GTS.



Activity Highlights

- 3.1.5. Since July 2008, the AMDAR Panel, in cooperation with CBS Expert Team on Aircraft-based Observations (ET-AIR), has managed the WIGOS Pilot Project for AMDAR for the Integration of AMDAR into WIGOS (WIGOS-PP-AMDAR) through 6 key activities. With the activation of the WIGOS Implementation Plan (EC-64, 2012), the outstanding tasks associated with the WIGOS-PP-AMDAR would now be integrated separately into the Aircraft-based Observations Work Programme. Excellent progress on these tasks has been made in 2012, with several now complete as outlined below.
- 3.1.6. In relation to Global AMDAR Programme expansion and enhancement:
- A WMO Special Services Agreement (SSA) was put in place (Feb 2012) with a consultant to carry out the Study on AMDAR Coverage and Targeting for Future Airline Recruitment;
 - The Coordinator of the Science and Technical Sub-Group and the Secretariat commenced work on the development of an Implementation Plan for Water Vapour Sensing Capability for AMDAR;
 - The Panel has collaborated with the USA Federal Aviation Authority and NCAR towards the definition of a standardized approach to turbulence and the application of Eddy Dissipation Rate within the AMDAR system. Algorithms and software for potential test programmes outside of the USA have been obtained;
 - Work has progressed on the development of the Mexican AMDAR Programme in cooperation with Aeromexico and ARINC. It is expected that the required agreements will be in place in the last quarter of 2012 with data quality to be tested before the programme becomes operational shortly after; and,

- Some strong leads on potential AMDAR Programme development have been identified and followed up for Argentina (Aerolineas and LAN Argentina), Brazil, Qatar (Qatar Airways) and others.
- 3.1.7. In relation to development and maintenance of the aircraft-based observing system Quality Management System:
- The Panel and the Secretariat have overseen the specification of Version 5 of the Meteorological Report within Supplement 7 to the Airlines Electronic Engineering Committee (AEEC) ARINC 620 Standard; and,
 - The Secretariat has established several email group aliases in support of Aircraft-based Observations Programme collaboration and data monitoring.
- 3.1.8. In relation to training and outreach:
- The Panel, the Coordinator for the Training and Outreach Sub-Group and the Secretariat established a News & Events website in support of AMDAR outreach activities and have overseen the production and publication of the first four editions of the WMO AMDAR Panel Newsletter;
 - The AMDAR Panel Management Group (APMG) and the Secretariat collaborated with The COMET® Program (Cooperative Program for Operational Meteorology, Education and Training) regarding the possible development of a training and outreach module for the AMDAR programme;
 - A WMO SSA was established with a consultant for the commissioning of a paper on AMDAR data impact assessment; and,
 - The Panel was represented at the AEEC DataLink Users Forum held in September 2012, Dublin, by Mr Stewart Taylor.
- 3.1.9. The Workshop on Aircraft Observing System Data Management was held in Geneva over 5-8 June 2012 and was considered a great success. It has significantly advanced the development of the Data Management Framework for the Aircraft-based Observing System.

Meetings Held or Attended

- 3.1.10. The Panel and the Secretariat held or attended many meetings throughout 2012, including:
- AMDAR Panel Management Group Session 3, Silver Spring, United States, 27 February - 2 March 2012 (AMDAR Panel Management Group, the Secretariat);
 - E-AMDAR Programme, Technical Advisory Group 19th Meeting, 13-15 March 2012, De Bilt, the Netherlands (Panel Chairman, the Secretariat);
 - CBS Expert Team on Evolution of Global Observing System, Seventh Session (ET-EGOS-7), Geneva, Switzerland, 7-11 May 2012 (Panel Chairman and the Secretariat);
 - Workshop on Aircraft Observing System Data Management, Geneva, Switzerland, 5 – 8 June 2012 (Panel Chairman, Dr Jitze Van der Meulen, the Secretariat);

- CBS OPAG-IOS, Implementation/Coordination Team on the Integrated Observing System, Seventh Session, Geneva, Switzerland, 18 – 22 June 2012 (Panel Chairman, the Secretariat); and,
- AMDAR Panel Management Group Session 4, Geneva, Switzerland, 29-31 August 2012 (AMDAR Panel Management Group, the Secretariat).

3.1.11. The Panel Chairman and the Secretariat gratefully acknowledge the following people and organizations for assistance to the AMDAR Panel and its work programme:

- Those WMO AMDAR Panel Member National Meteorological and Hydrological Services (NMHS) providing financial and in-kind contributions to the AMDAR Panel Trust Fund;
- Mr Carl Weiss, USA, for the roles as Vice-chair of the Panel and Coordinator of the Training and Outreach Sub-group;
- Dr Axel Hoff, Germany, for roles as Coordinator of the Science and Technical Sub-group and representation as CIMO Theme Leader on Aircraft-based Measurements;
- Dr Jitze Van der Meulen for representation as CIMO Theme Leader on Aircraft-based Measurements and for the role as Leader on AMDAR Quality Management Framework;
- Mr Stewart Taylor for the role as Coordinator for the Improvement in Data Exchange & Quality Control;
- Ms Eva Červená, Czech Republic, for assistance in finalisation of the AMDAR BUFR Template;
- USA NOAA/National Weather Service and Mr Carl Weiss, USA, for hosting the AMDAR Panel Management Group Meeting 3rd Session;
- USA NOAA/National Weather Service and the National Center for Atmospheric Research, Mr Carl Weiss, Dr Marcia Politovich, and Dr William Moninger, USA, for hosting and coordination of the AMDAR Panel 15th Session and the Technical Workshop on Turbulence and EDR;
- USA NOAA/Earth System Research Laboratory (ESRL), Global Systems Division (GSD) for maintenance and provision of the online AMDAR Data Display;
- USA Federal Aviation Administration and Ms Tammy Farrar for representation to the Panel, organisation and coordination of the Technical Workshop on Turbulence and EDR;
- The Environment Canada, Canadian Meteorological Centre, the USA NOAA National Center for Environmental Prediction (NCEP) for provision of monitoring and statistical services and information on the AMDAR Programme; and,
- All those that have contributed to articles and the compilation of the WMO AMDAR Panel Newsletters.

3.2. Status of the AMDAR Panel and Transition of the AMDAR Observing System to WMO

Background

- 3.2.1. The Meeting was informed that the highest priority activity in 2012 for the Panel and its Management Group (APMG) had been the finalization of the transition of the governance of the AMDAR Programme and the AMDAR Observing System to WMO under its Technical Commissions, CBS and CIMO.
- 3.2.2. The Meeting recalled that, at the Joint Meeting of the WMO AMDAR Panel (14th Session) and the ET-AIR (3rd Session), Quebec, Canada, 2-4 November 2011, the proposal for the new governance necessary for the integration of the AMDAR Observing System into the WIGOS under the WWW was presented and extensively discussed. Although the Joint Meeting had reaffirmed that the AMDAR Panel and the ET-AIR would inevitably become unified under a single programmatic and governance structure within the WMO and WWW Programme framework, concerns were expressed regarding the inevitable cessation of the Panel activities, the use and management of the Trust Fund for continued support of AMDAR associated activities, the opportunity for members to meet in one forum on at least an annual basis and that there might be insufficient representation for AMDAR within CIMO. The AMDAR Panel therefore requested the AMDAR Panel Management Group (APMG) to consult with CBS and CIMO Management and the Secretariat to ensure that the issues raised by the Panel could be suitably addressed, thereby allowing the finalisation of the transition process.
- 3.2.3. The APMG at its 3rd Session (Silver Spring, USA, 27 February-2 March 2012) considered the issues raised by the Joint Meeting and was able to discuss them directly with the President of CBS and the Chairman of the CBS OPAG ICT-IO (Open Programme Area Group, Implementation and Coordination Team on Integrated Observing Systems). Significant input and advice was received and assurance was given that the functions and roles as they were successfully employed by the AMDAR Panel could be continued under the WMO Technical Commission structure, including the maintenance of the AMDAR Trust Fund in support of the work programme. The President of CBS urged that the Panel act decisively and advance the process towards finalisation by the end of 2012 so as to remove the issue as a distraction to the Aircraft-based Observations and AMDAR work programme and also to reduce the administrative burden on the Secretariat.
- 3.2.4. The APMG, in consultation with the Secretariat, developed a proposal for a programmatic governance structure for aircraft-based observations and the AMDAR programme under the WWW Programme, which would address the concerns of the Panel members and have the following elements:
 - (a) The continuation of a CBS Expert Team on Aircraft-based Observations to provide ongoing oversight and management of the operational and regulatory aspects of the aircraft-based observations programme and the aircraft-based observing system;
 - (b) The formation of a new CIMO Expert or Task Team within the CIMO Technical Commission to provide oversight and management of the scientific and technical developmental aspects of aircraft-based observing systems; and,
 - (c) Updated Terms of Reference for the AMDAR Trust Fund to ensure the continued use of the Fund under the new governance structure and in support of the work programme of the CBS and CIMO teams.
- 3.2.5. The proposed Terms of Reference for each of the above elements of the aircraft-based observations programme are provided within [Appendix II](#).

- 3.2.6. Envisaging that the two teams would meet every 2nd year in alternative years, this proposal would potentially allow those Members with an interest in meeting annually to attend both meetings. It is expected that, within the limitations of reasonable logistics and resources, Members will be able to continue to have representation in addition to the core membership at Team Meetings, at the expense of their own organization as is consistent with current arrangements for attending AMDAR Panel meetings. The existing work programme of the AMDAR Panel would be fully integrated into the formal Work Plans of the Teams and supported by the AMDAR Trust Fund. With a division of the work programme in this way and more formal responsibilities falling to a second (CIMO) Team, this arrangement would also cut down on the coordinative and administrative load of the Secretariat.
- 3.2.7. The proposal was first provided to the CBS Implementation and Coordination Team for OPAG-IOS (June 2012) and then to CBS (15th Session, September 2012), where it received support and approval for those aspects relevant to CBS. The proposal was then submitted to CIMO Management Group (Session 10, October 2012), where support was also provided for the proposal and for the formation of a CIMO Task Team for the remainder of the current CIMO inter-sessional period.
- 3.2.8. In July 2012, the Panel Chairman wrote to AMDAR Panel Focal Points advising of the proposed governance and programmatic structure, the outcome from ICT-IOS-7, the intention to submit the proposal to CBS and CIMO, the implications for the AMDAR Programme and the likely cessation of AMDAR Panel activities subsequent to AMDAR Panel Session 15.
- 3.2.9. At the AMDAR Panel Management Group, Session 4, August 2012, the APMG, considering the positive response to and support for the proposal from all stakeholders, determined the finalization of the transition process would be recommended to the AMDAR Panel and that the Panel should therefore cease activities after the 15th Session of the AMDAR Panel and formally hand over full programmatic and governance management of the AMDAR Programme to WMO under the WWW Programme.

Finalisation of the Transition of the AMDAR Programme to WMO and Cessation of Panel Activities

- 3.2.10. The Panel reviewed the ToR for each of the proposed elements and recommended that the Secretariat and the Chair of ET-ABO review clause 2 of the ToR for the AMDAR Trust Fund.
- 3.2.11. The Panel agreed with the following recommendations made by the Chairman of the AMDAR Panel and the Secretariat for the completion of the transition process:
- (a) The AMDAR Panel would approve cessation of AMDAR Panel activities (AMDAR Panel Session 15);
 - (b) The Panel Chairman to write to Members to advise of the cessation of the AMDAR Panel;
 - (c) The Secretariat to work with the CIMO and CBS Management Groups in order to finalise the ToR for the AMDAR Trust Fund, in particular considering the Panel's recommendation to remove clause 2, and, subsequent to finalization, submit them to the WMO Secretary General for approval;

- (d) The Secretariat, the Chair of ET-ABO and the CIMO Theme Leader on Aircraft-based Measurements to work with the CIMO MG to finalise ToR for the CIMO Task Team on aircraft-based observations;
- (e) The Chairs of ET-ABO and the CIMO TT in consultation with the Secretariat to finalise their recommendations for team memberships and submit to CBS and CIMO respectively for approval;
- (f) A Joint Meeting of ET-ABO and the CIMO TT to be held in the first half of 2013 to finalise the working arrangements for the operation of the aircraft-based observations programme; and,
- (g) The Chair of the CIMO Task Team to work with the Secretariat to make an appropriate submission to CIMO-XVI proposing the formation of a CIMO Expert Team to replace the Task Team.

3.3. Status Reports on National and Regional Programmes

3.3.1. Australia

- 3.3.1.1. The Bureau informed the Panel that the Australian AMDAR Program currently consisted of a fleet of one hundred and five (105) aircraft contributing typically around 13,000 observations per day to the Global AMDAR Programme. This was around a 50% increase in scale since 2011.
- 3.3.1.2. Since the last Panel meeting, the Bureau had started receiving AMDAR data from Jetstar Airways over Australia (15 × A320s), and from Jetstar Asia over a number of data sparse destinations in SE Asia (5 × A320s). The Qantas 737-800 fleet also underwent some expansion. The Australian AMDAR Data Optimisation System (ADOS), has been significantly augmented through the development of the ADOSMon web-based quality monitoring system.
- 3.3.1.3. Over the next 12 months, further expansion of aircraft and observation numbers was considered unlikely. Rather, efforts would focus on (a) initiating WVSS-II water vapour measurements on Qantas 737-800 aircraft; (b) implementing uplinking for the Jetstar fleet; and (c) continuing refinement of the ADOS and ADOSMon systems to maximise data value by minimising redundancy.

3.3.2. Canada

- 3.3.2.1. Currently 20 CRJ-100/200 Jazz Air-operated aircraft, out of a diminishing fleet of 45 AMDAR-capable CRJ-100/200 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 Air has been delayed with a new anticipated completion in the spring of 2013.
- 3.3.2.2. WestJet plans to launch a regional airline in the second half of 2013 but its fleet will be composed exclusively of Q400 NextGen aircraft.
- 3.3.2.3. Canada is developing a strategy for its future optimum vertical atmospheric profiling system. If AMDAR is selected as one of the 2-3 'low hanging fruit' technologies to be pushed in the short-term for the development of this system, recommendations to pursue activities to sustain and further enhance the Canadian AMDAR Program will be developed and presented to management of Environment Canada.

3.3.3. China

- 3.3.3.1. The China AMDAR Programme has been operating smoothly in the past year under the work and cooperation of the Civil Aviation Administration of China (CAAC) and China Meteorological Administration (CMA).
- 3.3.3.2. With the effort of CAAC, 2 airlines (Southern Airline and Shandong Airline) with 22 aircraft have continued to participate in the China AMDAR Programme. After being examined and evaluated by the Quality Control System, about 6100 meteorological reports are disseminated via GTS per day.
- 3.3.3.3. AMDAR data have been used operationally by CAAC in aviation meteorological service for several airports such as Beijing Capital, Cheng airport and Guangzhou international airports for several years. The main warning or forecast products include frontal weather systems, trough and shear-lines and low level wind shear.
- 3.3.3.4. In recent years, CMA has developed an AMDAR display capability within its Meteorological Information Comprehensive Analysis and Process System (MICAPS), a processing, display, and telecommunication network which is the standard operational platform of the national-wide weather service. It is used by CMA to analyze AMDAR data more conveniently and efficiently.
- 3.3.3.5. CMA continued its endeavors on the application of AMDAR data. CMA has worked on integrating AMDAR data to different NWP models, such as T213, WRF and MM5. Assimilation of AMDAR Data to CMA Global/Regional Assimilation and Prediction System (GRAPES) NWP model has been conducted.

3.3.4. E-AMDAR

- 3.3.4.1. The E-AMDAR programme has performed well and fulfilled or exceeded all of its targets and produced meteorological data of high quality. However, small reductions in data production were necessary due to financial reasons.
- 3.3.4.2. The programme has access to more than 900 aircraft in ten airlines and now produces about 38 000 to 40,000 observations per day on the GTS. Some additional, nationally-funded data is produced by the programme in order to meet the supplementary requirements of six NMHSs.
- 3.3.4.3. British Airways is currently developing software for its Airbus fleet.
- 3.3.4.4. A contribution was made to the work carried out for revision of the ARINC 620 standard and for the development of a universal AMDAR BUFR Template.
- 3.3.4.5. Two humidity sensors have been tested on two different research aircraft. Excellent results from one of the test programmes have been published.
- 3.3.4.6. The current three humidity sensors on Lufthansa aircraft will be replaced with the newest version during 2013 and six more aircraft will be similarly equipped, with the nine equipped aircraft expected to be in operation by the end of 2013.

3.3.5. Hong Kong, China

- 3.3.5.1. Six B-747 aircraft of the Cathay Pacific Airways continued to provide AMDAR data to the AMDAR programme of Hong Kong, China during the past year. The average number of AMDAR observations received at the Hong Kong International Airport (HKIA) stayed at around 1,000 per day.

- 3.3.5.2. Dissemination of AMDAR data in FM42 format was discontinued on 15 December 2011 and AMDAR data from Hong Kong, China are now disseminated on GTS in BUFR format.
- 3.3.5.3. Apart from providing actual wind information along flight path and supporting aviation weather forecasting at HKIA, the high-resolution AMDAR data available from departure flights are utilized for identification of windshear.
- 3.3.5.4. Hong Kong, China plans to expand its AMDAR programme to include Airbus aircraft over the next few years, subject to the outcome on discussions regarding downlink issues with the local airline concerned.

3.3.6. Japan

- 3.3.6.1. The Japan Meteorological Agency (JMA) has been receiving AMDAR weather data from the two airlines of Japan, All Nippon Airways (ANA) and Japan Airlines (JAL). Approximately 16,000 reports are collected from 220 aircraft per day over Japan via VHF data link. JMA has been disseminating AMDAR data in BUFR format since December 2006.
- 3.3.6.2. The AMDAR data are used in the data assimilation system for the Global model with a horizontal resolution of 20km and Mesoscale model with that of 5km. JMA has started the operation of the Local Forecast Model with a horizontal resolution of 2km since August 2012. The AMDAR data are also used in the data assimilation system for the Local Forecast Model.

3.3.7. New Zealand

- 3.3.7.1. The size of the Air New Zealand fleet producing AMDAR data has increased. Regular reports were being received from eight A320 aircraft which generally fly the trans-Tasman routes between New Zealand and Australia, and thirteen B737-300 flying domestic routes within New Zealand. Averages of 15,000 messages (approximately 80,000 AMDAR observations) per month were transmitted on the GTS from this source.
- 3.3.7.2. The cost-sharing arrangement with the Australian Bureau of Meteorology for Qantas AMDAR reports within the area 160E to 160W and 0S to 50S contributes to about 45,000 observations each month.

3.3.8. Republic of Korea

- 3.3.8.1. The Korea Meteorological Administration (KMA) manages the AMDAR programme in Republic of Korea, and currently receives AMDAR data from 19 Korean aircraft (Korean Air 14, Asiana Airlines 5), which is transmitted on the Global Telecommunication System (GTS).
- 3.3.8.2. KMA has been assimilating AMDAR data into global NWP model and also utilized AMDAR observations for the initial field of very short range forecast systems. KMA continues to upgrade its AMDAR data processing system in order to increase the amount of transmitted data via GTS, and plans to increase the number of data providers in the near future.

3.3.9. South Africa

- 3.3.9.1. The size of the South African AMDAR fleet remains unchanged at 32 aircraft and contributes over 3800 observations per month to the Global AMDAR Programme, a

significant increase since the completion of the software upgrades in October 2011 to AAA.V3.

- 3.3.9.2. The South African Weather Service (SAWS) and South African Airways (SAA), its main aircraft data generating partner, have discussed the prospects of growth and sustainability of the SA AMDAR Programme. In the discussions SAA had indicated its future plans of expanding their flight operations network in the sub-continent and their plans to purchase twenty (20) new aircraft over the period 2013 to 2017. SAA had also indicated that Kenya, Morocco and Namibia airlines have fleets that are or will be equipped with ACARS and that some of their aircraft could already be capable of providing AMDAR data.
- 3.3.9.3. SAA indicated that it is content with the current volumes of the AMDAR data for its operational usage. Both parties (SAWS and SAA) agreed to consider the utilization of an optimisation system at later stages when significant participation of the Airlines in the region has been achieved.
- 3.3.9.4. SAWS is still interested in acquiring water-vapour sensors for the SA AMDAR Programme but has not yet secured any financial assistance in this regard. It is believed that the growth in numbers of the participating airlines within the region could assist in the cost-sharing for this purpose.

3.3.10. United Kingdom

- 3.3.10.1. The Met Office, United Kingdom (UKMO) is using the upper air wind and temperature data available from AMDAR in their UKV 1.5km Atmosphere Model.
- 3.3.10.2. The British Airways (BAW) and easyJet (EZY) components of the E-AMDAR Programme provide the bulk of the data to meet requirements.
- 3.3.10.3. The E-AMDAR development with BAW (Airbus software) has the potential to supplement current levels of data over the UKV domain.
- 3.3.10.4. The integration of TAMDAR sensors on the flyBe fleets will provide the addition of humidity to the model.

3.3.11. United States of America

- 3.3.12. The USA programme currently consists of 9 airlines with a fleet of around 2000 aircraft producing around 200,000 reports per day on the GTS in BUFR format.
- 3.3.13. The current FAA MDCRS contract with ARINC is now in the first of four optional extension years.
- 3.3.14. The FAA is in formal discussions with ARINC regarding the possible development of an optimization capability for MDCRS data.
- 3.3.15. NOAA's Earth System Research Laboratory/Global Systems Division continues to provide an online global data display system for AMDAR and other upper air data (<http://amdar.noaa.gov/>). The NOAA/National Weather Service MADIS program plans to take over operation of the NOAA AMDAR display over the next few years.

4. PROJECTS, PLANNING AND WORK PROGRAMME

4.1. Enhancement of AMDAR Observing System Coverage

4.1.1. Extension of Global AMDAR Coverage

- 4.1.1.1. The Secretariat presented a document on the recent developments and issues related to the global expansion of the AMDAR programme.
- 4.1.1.2. While AMDAR data coverage ranged from good to very good where operational programmes existed, it was clear that many areas of the globe still had either poor or no coverage, including Central and Northern Africa, Western Asia, South and Central America, the Caribbean, the Southwest Pacific and Eastern Europe.
- 4.1.1.3. However, WMO and the Panel were aware of several endeavours and developments that showed great promise as outlined below.

Region I

- 4.1.1.4. For Region I, it was reported that Ethiopian Airlines and Rwandair are considering fleet expansion in the future and that these airlines, in addition to Kenya Airways should be considered when targeting airlines for programme development. The AMDAR Focal Point for Kenya, Mr Sospeter Muiruri requested that the Panel consider a proposal for the Panel to provide direct assistance in order to facilitate discussions between the national carrier Kenya Airways and Meteorological Department and the Panel agreed that this should be taken up within the context of the new approach to Regional and Global AMDAR Programme development.

Region III

- 4.1.1.5. The AMDAR Focal Point for Argentina, Mr Juan Horler advised that Argentina was currently receiving test AMDAR data from Aerolineas from the Airline's Embraer fleet and there were plans to address the reporting frequency, assess data quality and meet the requirements for eventual transmission on the GTS. Mr Horler also advised that LAN Argentina also has expressed an interest in participating in the programme.
- 4.1.1.6. A report from the focal point for Brazil was provided to the Panel advising that Brazil was now receiving and utilizing Automatic Dependant Surveillance (ADS) data and was seeking to develop an AMDAR Programme with national airlines.

Region IV

- 4.1.1.7. 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.
- 4.1.1.8. The Panel was advised of the interest of Hawaiian Airlines in developing an AMDAR Programme in cooperation with NOAA and within the USA MDCRS Programme.

Study on AMDAR Coverage and Targeting for Future Airline Recruitment

- 4.1.1.9. A WMO Special Services Agreement (SSA) was put in place (Feb 2012) with a consultant, Mr Graham Bruce, Canada, to carry out the Study on AMDAR Coverage and Targeting for Future Airline Recruitment. The SSA is expected to be completed by the end of 2012. The results of this study would be utilized by the Aircraft-based Observations programme to guide future developments and activities associated with global AMDAR programme development.

Strategy and Planning for Global AMDAR Programme Development

- 4.1.1.10. The Panel was advised that the APMG at its 4th Session had discussed the need to seek new ways to address the actions relevant to global development of aircraft-based observations and AMDAR within the CBS Implementation Plan for the Evolution of the GOS. It was made clear from the Workshop on Aircraft Observing System Data Management that, given that the most optimal approach to data management was through a collaborative regional approach, as demonstrated by the success and utility of the E-AMDAR programme, this should be reflected in the approach to AMDAR programme development. Therefore, there should be effort made to more actively engage the WMO Regional Associations in the development of AMDAR Programmes.
- 4.1.1.11. The Panel considered and agreed on the appointment of an AMDAR Development Officer (ADO) funded from the AMDAR Trust Fund and reporting to the Aircraft Observation Unit in the Secretariat and that this position would be responsible for the oversight of and, provision of technical support and assistance to, regional and national development and implementation activities. It was emphasized that, rather than being responsible for maintaining and administering these developmental projects and plans, the role would involve assisting and nurturing self-initiated and administered Regional or National project developments in accordance with: a) Priority for development (e.g. RA I and RA III); b) Availability of Regional and/or National expertise and technology; and, c) Greatest likelihood of success.
- 4.1.1.12. It was agreed that Global AMDAR Programme development should be based on the outcomes of the Study on Data Coverage and Airline Capabilities currently underway and expected to be completed in the 2nd half of 2012.
- 4.1.1.13. The Panel recommended that the Secretariat and the Chair of ET-ABO should compile a duty statement for the AMDAR Development Officer role and consult with WMO Resources Management regarding the optimal employment status to ensure at least a half-time, temporary appointment for 1 year at the appropriate salary level.

Global Approach to Administration of Supplementary AMDAR Data

- 4.1.1.14. Following on from discussions at the APMG, the Panel discussed the issue of the provision, administration and accounting of "Supplementary AMDAR Data", being data that is provided by AMDAR Programmes outside of and in addition to normal national or regional programme requirements. It was agreed that there may be an advantage to the centralized administration of global supplementary AMDAR data and that it may be appropriate that WMO takes on such a role.
- 4.1.1.15. It was recommended that a survey of operational AMDAR programmes be undertaken to assess the extent of potential supplementary data and the feasibility of making it available, with the results to be reported to ET-ABO.

4.1.2. National, Regional and Global Optimization

- 4.1.2.1. Some development was reported on the optimization system at Bureau of Meteorology in Australia. All airlines in E-AMDAR are included in optimization systems. The South African Weather Service and the National Weather Service (NOAA) in the USA indicate interest in developing optimization systems.
- 4.1.2.2. The recent WMO Workshop on Aircraft Observation System Data Management discussed optimization from the viewpoint of data management including data quality.

- 4.1.2.3. The Panel recommended that Members of national and regional AMDAR Programmes should continue to endeavour to develop and install optimization systems in order to ensure that AMDAR data is produced as efficiently as possible and also to realize the potential benefit of the AMDAR system in allowing near-real-time configuration for the provision of weather and climate-related targeted data.
- 4.1.2.4. The Panel recommended that the WMO Technical Commission Expert Teams on Aircraft-based Observations should in the future work towards development of standards for AMDAR data optimisation functionality in order to define and facilitate optimization procedures and processes within designated Data Processing Centres under the developing Aircraft-based Observations Data Management Framework.

4.2. Extension of the AMDAR System

4.2.1. Water Vapour Sensing

In-flight Testing of WVSS

- 4.2.1.1. Dr Axel Hoff reported that two separate in-flight validation trials of WVSS-II sensors would continue in 2013.
- 4.2.1.2. Firstly, the trial of two sensors onboard the Research Aircraft BAe 146 of FAAM (Facility for Airborne Atmospheric Measurements, UK), for which a test report was received in 2011, will continue to test the sensors in varying operational conditions and also further test the two different air sample inlets.
- 4.2.1.3. Secondly, the trial of two WVSS-II sensors onboard the DENCHAR (Development and Evaluation of New Compact Hygrometers for Airborne Research) under the EUFAR (European Facility for Airborne Research) programme will allow testing of two WVSS-II sensors against highly sophisticated scientific humidity instruments to be exposed to a large spread of conditions in the troposphere as well as in the lower stratosphere. The WVSS-II units have been mounted on different locations on the aircraft, with one unit coupled to a common inlet system with its intake beyond the fuselage's boundary layer and the other mounted using the conventional flush mounted air sampling system. Initial tests in 2012 have shown that the first unit has shown good congruence with the reference signal down to about 50 ppmv (0.03 g/kg), while the 2nd unit was not able to measure below 100 ppmv (0.06 g/kg), possibly due to a small leak in the pressurized cabin in the upstream region of the air sampler.

Impacts on NWP

- 4.2.1.4. At the 5th WMO Workshop on Impact of Various Observing Systems on NWP a paper was presented on the impact of the USA AMDAR humidity measurements on NWP, which showed that with a network of the order of only 60 aircraft, their impact on the global model exceeded that of the full radiosonde network. An even greater impact was demonstrated on the NOAA rapid updated cycle model (RAP).

Operational Implementation of WVSS

- 4.2.1.5. The USA advised that a new water vapor sensing contact with ARINC was signed in September 2012. This and a Supplemental Type Certificate (STC) granted for the B737-700 series will allow for WVSS-II installations (6 per month) on an additional 55 Southwest Airlines (SWA) aircraft by June/July 2013. These new 55 aircraft will be added to the current 57 WVSS-II fleet bringing the total of equipped aircraft to 112 producing about 1200 moisture profiles daily.

- 4.2.1.6. Within the E-AMDAR Programme, it is expected that the 3 WVSS-II version 2 sensors on Lufthansa A320 aircraft will be updated to version 3 units. However, it is not yet determined whether this process will lead to the development of an engineering bulletin or STC that might be utilized or applicable outside the airline.
- 4.2.1.7. Since 2010 the Bureau of Meteorology, Australia has been in discussions with airline partner, Qantas, regarding water vapour sensor integration within the Australian AMDAR fleet and in early 2012 have indicated their readiness to proceed. The Bureau, Qantas and SpectraSensors are still in the process of planning and costing a project to deliver STC certification and installation of the WVSS-II on 1-3 Qantas 737-800 aircraft, initially. However, the cost of the certification was expected to be the major cost component of the project and the Bureau requested that the Panel consider an international, collaborative funding approach to the certification, particularly given the likely benefit to other national AMDAR programmes. The Panel agreed that, while such an approach was desirable for reasons of viability and economic efficiency, the fact that a limited number only of Members were currently committed to or considering water vapour implementation made it difficult to justify any immediate contribution from the AMDAR Trust Fund.
- 4.2.1.8. Given the plan of the Bureau of Meteorology (Australia) to implement WVSS-II on 1-3 B737-800 aircraft from Qantas and recognizing that the B737-800 aircraft is the second most common commercial passenger jet in the world, the Panel recommended that its Chair, and/or the Chair of ET-ABO and the Secretariat, investigate funding sources, other than use of the AMDAR Trust Fund, to finance the STC certification of WVSS-II for the B737-800 airframe. This might include an approach to NMHSs that would have a particular interest in the certification and also investigating other possible funding sources.

International Implementation Plan for Water Vapour Sensing Capability for AMDAR

- 4.2.1.9. Dr Axel Hoff presented a document that had been developed to formulate a proposed strategy for an international collaborative approach to global implementation of water vapour measurement (WVM) within the AMDAR platform (See [Appendix III](#), *Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR*)
- 4.2.1.10. The Implementation Plan has several aspects and aims which include key elements: 1) Ensuring optimal WVM sensor performance including further research and validation; 2) Retrofitting of existing AMDAR fleets with sensors; and, 3) Integration of WVM into the aircraft engineering and manufacturing standards and processes.
- 4.2.1.11. While the 3rd element should be considered the most important and the ultimate aim, it is recognized that the other elements are necessary to undertake in parallel in order to lay a foundation for eventual industry acceptance and integration of the technology. Some Panel members pointed out that it was critical that opportunities should be taken to investigate additional and more direct benefits to Airlines and the Aviation Industry (e.g. improvement to flight operations, safety and aircraft performance) and that, whenever possible, activities should be done with their collaboration.
- 4.2.1.12. The Panel agreed with the approach and the key activities set out within the Implementation Plan and recommended that the Plan is developed further and presented to ET-ABO for consideration and implementation.

4.2.2. Turbulence Measurement

- 4.2.2.1. The Panel reviewed the outcomes of the Technical Workshop on Turbulence held on 5 November prior to the Panel Meeting and agreed that international implementation of Eddy Dissipation Rate (EDR) within the AMDAR Programme should be a high priority.
- 4.2.2.2. The Panel was informed during the Workshop that the FAA, in conjunction with the NextGen project and RTCA SC-206, had in July 2012 undertaken an EDR Standards Project that will: 1) Provide the analysis, inputs, and recommendations required to adopt in situ EDR performance standards, and, 2) Provide supporting research required to adopt standards for EDR value and label definitions. While the Panel acknowledged that this project would likely lead to confirmation and documentation on the requirements for EDR implementation within AMDAR, it was clear that, given the history of research and operational deployment on EDR in the USA within the FAA and NCAR/UCAR over the past decade, there was already a well-defined and understood approach to EDR measurement on the aircraft platform that, with the cooperation of the FAA, could readily be implemented within the AMDAR system.
- 4.2.2.3. However, the Meeting agreed that there were several aspects of EDR implementation that required addressing including:
 - How to harmonise the requirements for routine reporting within AMDAR with the event-based (3 types) reporting for EDR;
 - Whom should be responsible for the additional programme costs;
 - How to manage any additional communications requirements associated with message recognition and relay; and,
 - How to manage the necessary algorithmic, aircraft-dependant, parameter “tuning” associated with EDR implementation.
- 4.2.2.4. The Panel considered several options for AMDAR implementation and agreed that the following guidelines for EDR implementation should be adopted:
 - 1) With the assistance of the FAA and NCAR, EDR should be specified within the new AMDAR Onboard Software specification;
 - 2) Use should be made of the proposed new downlink format that allows for parameter identification within the AMDAR observations via the report header thus allowing ground systems to discriminate between EDR and non-EDR AMDAR reports and also between EDR triggered and heartbeat reports;
 - 3) Both the “heartbeat” and “event” EDR reports should be configurable to be reported independently from routine AMDAR reports and should in principle not be subject to meteorologically-based optimization programming requests;
 - 4) EDR should not be activated operationally until tuning is completed and validated; and,
 - 5) EDR implementation should: Include sufficient AMDAR software configuration parameterization so as to allow each report type to be uplink activated and deactivated; allow for modification of the EDR heartbeat reporting frequency; and, be made optimal with AMDAR reporting for maximal efficiency.

4.3. Research and Development of New Aircraft Observations Technologies

4.3.1. *Report on activities by the Science and Technical Sub-Group*

Measurement of Air Constituents by Commercial Aircraft

- 4.3.1.1. Mr Yvan Lemaitre, Meteo France reported that the IAGOS-ERI project has just been extended up to mid-2013. There is some delay to finalize the status of the infrastructure. The goal is to finalize the status of an AISBL (International Non Profit Association) which will be legally settled in Belgium and will allow for the cost-effective handling of the real time data transmission.
- 4.3.1.2. Towards technical implementation, the RTTU has been built, tested and approved. Tests were also successfully carried out with E-ADAS (E AMDAR switch) to relay all messages on the GTS (in BUFR format).
- 4.3.1.3. The next project IGAS (IAGOS for GMES Atmospheric Services) will start on the 1st of January 2013. Meteo France deliverables are the installation and the certification of the RTTU on the D AIGT Airbus A340.

Icing

- 4.3.1.4. Mr Gilles Fournier, Canada reported that there appears to have been little development over the year regarding the development of icing related activities under the WMO Aircraft Observing System core and long-term activity list of the AMDAR Panel and ET-AIR work plan.
- 4.3.1.5. It is recommended that, in order to advance/promote the activities related to icing in the Aircraft-based Observing System the appropriate Team work programmes should include activities to refine the concept of using airborne humidity measurements for icing detection and forecasting.

4.3.2. *Future Avionics & Communications Risks & Opportunities*

- 4.3.2.1. The Secretariat presented a document on the current status and future of the avionics and communications technology that supports the AMDAR programme and advised that the AMDAR Panel Management Group (Session 4) had considered that there were several areas in which study and analysis should be undertaken to determine the risks and potential benefits to AMDAR including but not limited to: satellite IP (Internet Protocol) communications, ADS, Mode S, TAMDAR (AirDat), AFIRS (FlyHt).
- 4.3.2.2. The Panel agreed that this technological “horizon scanning” should continue to be an integral component of the Aircraft-based Observations work plans and combined with the continuing activities associated with ensuring that the AMDAR system becomes more fully integrated into the aviation industry software and communications standards.
- 4.3.2.3. In particular, the Panel agreed and recommended that:
 - 1) A formalized study should be undertaken on the topic of *Future Avionics and Communications Risks & Opportunities for AMDAR* in 2013 through the employment of a suitably qualified consultant on a WMO SSA;
 - 2) A strategy should be developed within the Aircraft-based Observations programme for a wider approach to the key avionics vendors to seek support for AMDAR software integration into off-the-shelf avionics products and systems, including an initial approach to Teledyne Controls where an interest in such a development has already been indicated to the APMG (Session 4);
 - 3) Given the near completion of the AMDAR Onboard Software Functional Requirements Specification, the update of the ARINC 620 Meteorological Report and the validation of

the WVSS-II v3 unit, consideration should be given to a renewed approach to aircraft manufacturers regarding AMDAR software and water vapour sensor airframe integration.

4.4. Development and Maintenance of the Aircraft Observing System QMS

4.4.1. WIGOS Pilot Project for AMDAR

4.4.1.1. The Secretariat reported that, in relation to the aims and tasks under WIGOS-PP-AMDAR the following progress has been made:

(1) Development of a standardised BUFR Template for AMDAR: This activity has been completed with the new BUFR AMDAR Template (Code Table 3 11 10, Version 7) having been approved under the Fast-track Procedure of the WMO Technical Regulations relating to Procedure for Amending the Manual on Codes. The amendments were approved by the president of CBS, on behalf of Executive Council (EC) and were to be implemented on 2 May 2012.

(2) Application of WMO Metadata relevant to AMDAR: This task has been advanced under the activity of the Workshop on Aircraft Observations Data Management (June, 2012), which will be further discussed under agenda item 4.4.

(3) Development of a standardised Quality Management Framework for AMDAR data: This activity has also been advanced under the activity of the Workshop on Aircraft Observations Data Management (June, 2012), and was further discussed under agenda item 4.4.

(4) Validation and preparation for inter-comparison of available Water Vapour sensor performance: This activity has been advanced under the 2012 work programme with the development of a draft Implementation Plan of Water Vapour Sensing Capability for AMDAR (for more details see agenda item 4.2).

(5) Update of the AMDAR Reference Manual WMO-No.958: No progress has been made on this task and should be incorporated into the future work programme and undertaken in coordination with the relevant ICG-WIGOS work teams and activities under the WIGOS Implementation Plan.

(6) Development of the framework for generic software specification for AMDAR: This activity has progressed markedly in 2012 with the appointment of a contractor under a WMO Special Services Agreement (SSA) to develop the AMDAR Onboard Software Functional Requirements Specification, which is expected to be complete later in 2012. This document will constitute the WMO standard for AMDAR software requirements.

4.4.1.2. The Panel agreed with the recommendation that, given that the development of WIGOS has now moved into the implementation phase, the outstanding tasks associated with the Pilot Project should be integrated into the WMO Aircraft-based Observations work programme and that, in particular, the WIGOS-PP-AMDAR Task 5, Update of the AMDAR Reference Manual WMO-No.958, should be incorporated into WIGOS activity 1.1.1. (Develop/Revise/Update WMO Regulatory Material). It was also agreed that ET-ABO should consider the future of the AMDAR Reference Manual and whether it will be updated and maintained as a WMO publication.

4.4.2. Workshop on Aircraft Observations Data Management

- 4.4.2.1. The Secretariat provided a presentation on the Outcomes from Workshop on Aircraft-based Observations Data Management (DM), which was held by the Panel over 5-8 June 2012 including a summary of the objectives and achievements, which include:
- Drafted a new definition of the Data Management Framework for Aircraft Observations.
 - Addressed the issue of ICAO data management and formulated recommendations for improved data management.
 - Further refined the AMDAR metadata set.
 - Made recommendations for improvement to QC and QM practice.
- 4.4.2.2. The Final Report from the Workshop is available from [the AMDAR Panel Meetings website](#).
- 4.4.2.3. The Panel agreed that the recommendations from the Workshop should be integrated into the work plans of the Aircraft-based Observations programme.

4.4.3. Data Management Framework for Aircraft Observations

- 4.4.3.1. Dr Jitze van der Meulen provided a presentation on the development of the data management framework for aircraft-based observations, which was advanced significantly at the Workshop. The Panel was informed that, for AMDAR-based data, appropriate DM and quality assessment (QA) are essential elements because data is provided by a third party. Although the AMDAR Reference Manual gives clear guidance and information on how observational data is, or should be generated and how appropriate data management should be organized, further refinement and standardization of procedures is still required and under development based on the outcomes and recommendations of the Workshop.
- 4.4.3.2. It was agreed that the process of further reviewing, refining and documenting the aircraft-based observations data management framework should be continued in line with the 20 identified key aspects and the Data Management Framework that was developed at the Workshop, as outlined in [Appendix IV](#). It was also agreed that this documentation should eventually be integrated into appropriate WMO regulatory material as part of the Quality Management System for Aircraft Observations and the AMDAR system.

4.4.4. Metadata Management Development

- 4.4.4.1. Following discussions at the WMO AMDAR Panel AO Data Management Workshop (June 2012), the WMO AMDAR Panel Management Group meeting in August 2012 (APMG-4) was presented with an update on the status of metadata development and implementation plan. The framework for metadata management will be formulated within the data management framework for Aircraft-based Observations (see [Appendix IV](#)).
- 4.4.4.2. A summary of the Status and Plan for Development of Aircraft-based Observations Metadata, which included information on Framework Definition, Technical Requirements and potential risks that could impact on implementation is provided in [Appendix V](#).

4.4.5. Data Representation & Codes

- 4.4.5.1. The CBS Inter-Programme Expert Team on Data Representation and Codes has approved the BUFR Template for AMDAR Version 7 (Code Table 3 11 10) through the Fast-track process effective from 2 May 2012.
- 4.4.5.2. The Panel recommended that National and Regional AMDAR Programmes should work towards implementation of the use of this standard for GTS AMDAR data as soon as possible.

4.4.6. Quality Management Framework for Aircraft Observations

- 4.4.6.1. The quality management framework for Aircraft-based Observations was discussed under item 4.4.2 and 4.4.3.

4.4.7. AMDAR Software Development & Standardisation

B777 Software Development

- 4.4.7.1. The Secretariat presented an update on the status of AMDAR software development.
- 4.4.7.2. The joint Panel, Meteo-France and E-AMDAR project to develop AAA AMDAR software for B777 Honeywell avionics is ongoing, with the development expected to be sub-contracted to KLM by Air France.
- 4.4.7.3. The E-AMDAR Programme Management will continue to include this issue into the discussions with Air France/KLM at the next bilateral meeting with Météo France and Air France/KLM and at the 20th meeting of the E-AMDAR TAG (Norrköping, 4-6 December 2012).

Development of the framework for generic software specification for AMDAR

- 4.4.7.4. A WMO Special Services Agreement (SSA) was put in place with consultant Mr Frank Tamis in October 2011 for the contracting of this work under the Statement of Work developed by the Panel and the Secretariat and is intended to provide a functional and meteorologically-based specification for onboard AMDAR software that will allow developers to implement AMDAR software for any avionics platform. While behind schedule due to the complexity of the task, work on this project has proceeded well and is expected to be finalized later in 2012 with the delivery of the AMDAR Onboard Software Functional Requirements Specification (AOSFRS).
- 4.4.7.5. The Panel agreed that, once complete, the AOSFRS should be offered to avionics vendors to implement as a standard avionics catalogue item (Teledyne have expressed an interest in this for their ACMS "Add-on Library").

AEEC ARINC 620 Meteorological Report Version 5 Completed

- 4.4.7.6. The project to update the AEEC ARINC 620 Meteorological Report specification to version 5 has now been completed with the publishing of Supplement 7 to ARINC 620 (ARINC 620-7) in June 2012.

4.4.8. Data Quality Issues

- 4.4.8.1. Dr Jitze van der Meulen presented a document on current data quality issues associated with both AMDAR and ADS data on the GTS and identified that problems tended to fall into one of four categories: 1) Observational errors of the reported physical quantities, like air temperature and wind; 2) Meta data errors related to the reported physical quantities, horizontal and vertical position, time of observation; 3)

Logistic and code errors in the dissemination and encoding data; and, 4) Data and data-quality management shortcomings.

Issues Reported by NCEP

- 4.4.8.2. In September 2012, a large number of suspect South African AMDAR reports were found that had many track-check errors and large differences to the model background. Analysis showed that there were over 1100 reports that were duplicates from a month earlier. The South African Weather Service subsequently reported that the problem was due to the processing system at the SAWS, where the standby server reprocessed a large set of old messages. A procedure for avoiding this occurrence in the future has been put in place.
- 4.4.8.3. Analysis has shown that there are many aircraft with “stuck data” problems or excessive track-check errors that are not reported in standard monthly reports and it is recommended that future changes to the quality management system should incorporate improved reporting and procedures for correction of excessive track-check errors.
- 4.4.8.4. In cooperation with the NWS, NCEP is investigating the use of current diagnostics for MDCRS data monitoring to allow the addition data quality flags to AMDAR data before transmission on the GTS. Such information could also be utilized by NCEP operational staff to send email alerts to other Data Users and the aviation community to alert on serious data issues.

Quality Management of ADS Data

- 4.4.8.5. At the Workshop on data management, the issue of improved quality management of ADS data was addressed and continues to require resolution through collaboration with ICAO. While ICAO regulations (ICAO PANS-ATM, Doc 4444, 4.11.4) stipulate that the meteorological component of ADS data should be made available on the GTS by World Area Forecast Centres (WAFc) for use by NMHSs, it is evident that this process is not strictly followed and that no quality management procedures are specified or applied to this growing aircraft-based observations data source.
- 4.4.8.6. The WMO Aeronautical Meteorology Division reported that, at the ICAO World Area Forecast System Operations Group (WAFSOPSG) in September in Lima, Peru, a working paper was presented on the matter of ADS data quality and the following conclusions were reached:
- 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 during enroute and terminal area phases of operation, are automatically forwarded by the Air Navigation Services Provider (ANSP) to the WAFcS in accordance with Annex 3, Chapter 5 and Appendix 4.
 - Quality management of ADS reports relating to meteorological information - That the [ICAO] Secretary investigates issues concerning the quality management of ADS reports relating to meteorological information and provide a report in time for WAFSOPSG/8.
- 4.4.8.7. The Panel agreed that these conclusions are consistent with the outcomes from the Workshop and the process for managing ADS data under the proposed data

management framework and that ET-ABO should continue to work with ICAO towards the implementation of a quality management system for ADS data.

- 4.4.8.8. A second issue related to ADS data is that of data representation and coding for transmission on the GTS, for which a well-defined and approved policy is currently lacking. Currently, ADS data is regarded as part of AIREP data (AIRcraft REPort) and although AIREPs may be encoded as FM42 AMDAR, FM 41 AIREP is preferred. However, while the bulletin header for alphanumeric codes distinguishes AIREP from AMDAR, allowing identification for filtering and data handling processes, for BUFR, such identification is not available because the bulletin header for AMDAR and AIREP reports are identical. It was therefore recommended that, in order to facilitate the eventual transmission of ADS data in BUFR, the bulletin header format (as defined in the Manual on the GTS) should be extended to allow differentiation between aircraft-based observation types and other upper-air data sources.

4.4.9. Data Impacts

- 4.4.9.1. Dr. Ralph Peterson provided a history of the results of studies on the impact of AMDAR observations on global Numerical Weather Prediction models. He concluded that results of studies show that although satellite microwave observations have the largest influence on 24 hours global forecasts with their global, all-weather coverage, AMDAR observations have become a critical component of operational NWP systems around the world. Although AMDAR data have their greatest influence in the areas and around the levels where they are most abundant, their impact on forecasts extends to 48 hours and beyond. Local impacts can be greater at shorter ranges in areas of higher data density.
- 4.4.9.2. The fifth WMO sponsored workshop on the impact of various observing systems on NWP was held in Sedona, Arizona, USA on 22-25 May, 2012. The Workshop concluded that AMDAR continues to increase its contribution to predictability relative to all other observing systems, and now rivals satellite data (global IR and microwave sounders and GPS-RO) for total contribution to NWP predictability.
- 4.4.9.3. Many methods, other than Observing System Experiments (OSE) and Observing System Simulation Experiments OSSE that diagnose the impact of assimilated observations on a given analysis or forecast now exist. They include Degrees of Freedom for Signal (DFS), Analysis Sensitivity, and Adjoint-Based Procedures. Each has its specific pros and cons and is usually complementary to each other. For example OSEs are used to estimate the data impact in a forecasting system, whereas the DFS calculations are used to assess the impacts of various observing systems on analyses. In that context DFS was used as a diagnostic to estimate the amount of information brought by subsets of observations in the context of OSEs. DFS show how observing system data can be complimentary (or redundant). DFS also show how the high temporal resolution of aircraft data is better exploited by 4DVAR assimilation systems than 3DVAR.
- 4.4.9.4. The AMDAR Panel Management Group and the Secretariat has again approached several potential consultants with the Statement of Work to develop an AMDAR Impacts and Benefits to Aviation document, seeking to address this important task, however, a suitable and willing contractor is still yet to be found to undertake the work. It is therefore recommended that the Aircraft-based Observations Programme to again seek to address the undertaking of this work in 2013.

- 4.4.9.5. In May 2012 Dr Ralph Petersen from the University of Wisconsin was awarded a Special Services Agreement (SSA) to develop a paper summarizing the historical and current status of AMDAR data on meteorological applications or applications areas. While the paper is being developed Dr. Petersen has contributed a presentation to the Fifth WMO Workshop on the Impact of Various Observing Systems on NWP, Sedona, May 2012 and to an article to the fourth edition of the AMDAR Panel Newsletter.
- 4.4.9.6. For the future it is recommended that the aircraft-based observations programme continues to monitor and review publications and activities associated with AMDAR data impact studies: studies the benefits to meteorological applications of a wider deployment of water vapour sensing within the AMDAR programme, as well as those of TAMDAR systems and of ADS-B (Mode S); and conducts further impact studies on human forecasting and other aircraft data users such as aviation operators.

4.5. Aircraft Observing System Training and Outreach

4.5.1. Report on activities by the Training and Outreach Sub-Group

The WMO AMDAR Panel Newsletter and the use of Social Media

- 4.5.1.1. As was agreed at AMDAR Panel Session 14, quarterly AMDAR Panel Newsletters have been published throughout 2012 and are available on the WMO Google web site that was established by the Secretariat to enable the compilation and publication of the Newsletters: <https://sites.google.com/a/wmo.int/amdar-news-and-events/newsletters>.
- 4.5.1.2. The Panel agreed that the publication of the Newsletters was extremely useful as an outreach tool to both NMHSs and the aviation industry and recommended that it continues to be published at least on a biannual basis under the banner of "WMO AMDAR Newsletter". It was also recommended that, to extend its outreach potential, the publishing of the Newsletter should be notified via other social media that have an aviation group focus, for example LinkedIn/ACARS.

Development of an Online AMDAR Training Module

- 4.5.1.3. The Panel has been collaborating with the Cooperative Program for Operational Meteorology, Education and Training (COMET) towards determining if the AMDAR Programme could benefit from the implementation of a training module that could be accessible both online and from media such as CD-ROM. The aim of such a module would be to provide both information and training on various aspects of the AMDAR Programme 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.
- 4.5.1.4. The Panel was provided with a presentation by COMET that demonstrated the features and material that might possibly be incorporated within such a training module and outlined the scope of the work involved in its development. COMET also provided an indication of the likely cost.
- 4.5.1.5. The Panel agreed that a cost of over US\$100K represented a significant investment that would be difficult to justify being covered solely from the Trust Fund and that it would likely be necessary to seek funding input and sponsorship from alternative sources if it were to go ahead.
- 4.5.1.6. The Panel recommended that ET-ABO further investigate the requirements for such a training module, possible sources for funding such a development and also take into

consideration the requirement to comply with WMO regulations in relation to the developmental and procurement process.

Other Training and Outreach Activities

4.5.1.7. The Coordinator of the Training and Outreach Sub-Group (TOSG) also reported that a range of other activities had occurred over 2012 including:

- At the 2012 Experimental Aircraft Association's (EAA) AirVenture (July 23-29), the National Weather Service (NWS) again promoted AMDAR activities at its exhibit.
- Bryce Ford (SpectraSensors, Inc.) promoted AMDAR and/or WVSS-II at several meteorological and aviation related events.
- Stewart Taylor attended the Airlines Electronic Engineering Committee (AEEC) DataLink Users Forum (DLUF), September 19-20, 2012; Dublin, Ireland.
- Carl Weiss represented NWS at the United States Senate Office of the Sergeant at Arms National Preparedness Month Fair 2012, September 28, 2012.

AEEC DataLink Users Forum

4.5.1.8. Mr Stewart Taylor provided a report on the Airlines Electronic Engineering Committee (AEEC) DataLink Users Forum (DLUF) Meeting, September 19-20, 2012; Dublin, Ireland, which he attended, providing representation of both E-AMDAR and the Panel and a presentation on the status and developments of the Global AMDAR Programme.

4.5.1.9. The Panel agreed that representation and attendance at such meetings was of critical importance to the AMDAR Programme as a means for keeping abreast of technological developments and opportunities associated with and related to ACARS and other avionics and communications systems. The Panel recommended that ET-ABO should ensure that an Aircraft-based Observations programme representative, preferably from the USA, should attend the next meeting scheduled for February 2013 and to be held in Pheonix, Arizona, USA.

4.6. Aircraft Observations Work Plan

4.6.1. The Secretariat provided a short presentation on the expectations for the operation of the Aircraft-based Observations programme under the new governance structure, jointly managed by the CBS Expert Team on Aircraft-based Observations and the CIMO Task Team. It was envisaged that the two teams would likely meet in alternative years with travel requirements minimised through the use of teleconferencing and other means as appropriate. Meetings would tend to be held in Geneva, although there remained the possibility to schedule AMDAR Panel-like forums and/or regional workshops, held in a strategic location for AMDAR Programme development, given appropriate justification and planning.

4.6.2. It was agreed that the primary focus of the teams should be the development and activation of the respective work programs, which should be formulated annually in close collaboration and based on sound budgetary planning for use of the AMDAR Trust Fund.

4.6.3. Membership of ET-ABO would be finalized early in 2013 subsequent to the next CBS Management Group Meeting. Management of the CIMO Task Team would be finalized subject to approval of nominations and Terms of Reference for the Task Team by CIMO Management Group, also expected to be complete by 1st quarter 2013

- 4.6.4. The Secretariat outlined the level of commitment required by Members of the teams, with Core Members expected to provide 15 to 20 days of their time in contributing to the work program and Associate WMO Members contributing as other work commitments and priorities allowed.
- 4.6.5. It was expected that a Joint meeting of ET-ABO and TT-AOS would be held in the 2nd or 3rd quarter of 2013.
- 4.6.6. A high priority initial task for the Aircraft-based Observations Programme Management Group and the 2 Teams would be the development of the work programmes and budget for 2013 and 2014. In relation to this, the Secretariat advised that the Panel should provide a draft work plan for the Aircraft-based Observations Programme based on the current ongoing work plan for the Panel and ET-ABO and also the outcomes from the 15th Session of the AMDAR Panel. The draft work plan is provided in [Appendix VI](#). It was recommended that the Chairs of ET-ABO and the CIMO Task Team utilize this plan in formulating the new work programmes of the Teams and a budget for 2013/14.

5. AMDAR PANEL FINANCIAL MATTERS

5.1. Status of AMDAR Trust Fund

- 5.1.1. The Secretariat presented a document on the current and projected status of the AMDAR Trust Fund. The full AMDAR Trust Fund Interim Statement from 1 January to 30 September 2012 is provided in [Appendix VII](#).

5.2. Transfer of AMDAR Trust Fund to WMO

- 5.2.1. Based on the discussion, deliberations and recommendations of the Panel under item 3.2, the Panel recommended the transfer of the AMDAR Trust Fund to WMO under the updated Terms of Reference and subject to approval by the CBS and CIMO Management Groups and the WMO Secretary General.

5.3. Budget 2013-2014

- 5.3.1. The Panel drafted a budget for 2013-14 within the draft work plan developed under agenda item 4.6 and as provided in [Appendix VI](#).

6. ANY OTHER BUSINESS

- 6.1. Mr Bryce Ford, HMEI, provided a presentation on the NCAR, Research Applications and Laboratory, Friends and Partners in Aviation Weather (FPAW) Forum, Oct 31 - Nov 1, 2012 Orlando, Florida.

7. AMDAR PANEL ADMINISTRATIVE MATTERS

7.1. Cessation of AMDAR Panel

- 7.1.1. The Panel agreed that, based on the outcomes of the discussions and deliberations and recommendations under agenda item 3.2 and 5.2, all activities of the AMDAR Panel should cease at the conclusion of its 15th Session.
- 7.1.2. The Secretariat, on behalf of WMO thanked both the current and previous Members of the AMDAR Panel for all contributions that had been made to the work programme and resources of the AMDAR Panel since its inception.

- 7.1.3. The Chairman of the Panel, Mr Frank Grooters moved a motion that all offices of the AMDAR Panel be vacated and that the WMO AMDAR Panel should cease operation and activity, effective immediately. The motion was seconded and unanimously carried.

8. CLOSURE OF THE MEETING

The Meeting closed at around 12pm on 9 November 2012.

APPENDIX I
List of Participants

<p>UNITES STATES OF AMERICA</p> <p>Carl WEISS (Acting Chair and Vice-chair)</p>	<p>NOAA - National Weather Service 1325 East-West Highway 20910-3283 SILVER SPRING MD United States of America Fax: +1 301 713 1520 Tel: +1 301 713 1726-149 Email: carl.weiss@noaa.gov</p>
<p>SWEDEN</p> <p>Stig CARLBERG</p>	<p>Swedish Meteorological and Hydrological Institute (SMHI) Folkborgsvaegen 1 SE-601 76 NORRKOEPING Sweden Tel: +46-31-7518976 Email: Stig.Carlberg@smhi.se</p>
<p>CANADA</p> <p>Gilles FOURNIER</p>	<p>Meteorological Service of Canada 373 Sussex Drive, E-124 K1A 0H3 OTTAWA ON Canada Fax: +1 613 992 4288 Tel: +1 613 992 0794 Email: gilles.fournier@ec.gc.ca</p>
<p>GERMANY</p> <p>Axel HOFF</p>	<p>Deutscher Wetterdienst Frankfurter Strasse 135 D-63067 OFFENBACH AM MAIN Germany Fax: +49 69 8062 3827 Tel: +49 69 8062 2852 Email: axel.hoff@dwd.de</p>
<p>ARGENTINA</p> <p>Juan Manuel HORLER</p>	<p>Servicio Meteorológico Nacional 25 de Mayo 658 1002 BUENOS AIRES Argentina Fax: info not provided Tel: +54 11 5167 6712 Email: jhorler@smn.gov.ar</p>

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List of Participants

<p>CHINA WU Kejun</p>	<p>Meteorological Observation Centre CMA China Tel: +8610 58995062 Email: wu_kejun@sina.com</p>
<p>CHINA ZOU Juan</p>	<p>Aviation Meteorological Centre Air Traffic Management Bureau CAAC CHWA Tel : +8610 87922180 Email: zoujuan@atmb.net.cn</p>
<p>CHINA ZHANG Qiang</p>	<p>National Meteorological Information CMA China Tel: +8610 68407032 Email; zhangQ@cma.gov.cn</p>
<p>SOUTH AFRICA Gaborekwe Esther KHAMBULE</p>	<p>South African Weather Service Department of Environment Affairs Private Bag X097 0001 PRETORIA South Africa Fax: +27-11-3909332 Tel: +27-11-3909326 Email: Gaborekwe.Khambule@weathersa.co.za</p>
<p>SOUTH AFRICA Luthando MASIMINI</p>	<p>South African Weather Service Department of Environment Affairs Private Bag X097 0001 PRETORIA South Africa Fax: +27 11 390 9332 Tel: +27 11390 9320/9333 Email: Luthando.Masimini@weathersa.co.za</p>
<p>REPUBLIC OF KOREA Jinah LEE</p>	<p>Korea Meteorological Administration (KMA) 460-18, Shindaebang-dong Dongjak-gu 156-720 SEOUL Republic of Korea Fax: +82 2 2191 0908 Tel: +82 2 2181 0734 Email: jalee815@korea.kr</p>

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List of Participants

<p>FRANCE</p> <p>Yvan LEMAITRE</p>	<p>Météo-France 42, avenue Gaspard Coriolis F-31057 TOULOUSE CEDEX France Fax: +33 561 079 559 Tel: +33 561 079 553 Email: yvan.lemaitre@meteo.fr</p>
<p>UNITED KINGDOM OF GREAT BRITAIN AND NORTHER IRELAND</p> <p>Stewart TAYLOR</p>	<p>Met Office Holland Business Park SPA Lane, Lathom Lancashire United Kingdom of Great Britain and Northern Ireland Tel: +44 1695 555128 or +44 775 3880518 Email: stewart.taylor@metoffice.gov.uk</p>
<p>NETHERLANDS</p> <p>Jitze van der MEULEN</p>	<p>Royal Netherlands Meteorological Institute Wilhelminalaan 10 NL-3730 AE DE BILT Netherlands Fax: +31 30 2210 407 Tel: +31 30 2206 432 Email: jitze.van.der.meulen@knmi.nl</p>
<p>ASECNA</p> <p>Jean NGAMINI</p>	<p>Agence pour la sécurité de la navigation aérienne en Afrique et à Madagascar 32-38 Ave Jean Joures BP 3144 Dakar Email: jbngamini@yahoo.com</p>
<p>FEDERAL AVIATION ADMINISTRATION</p> <p>Tammy FARRAR</p>	<p>Federal Aviation Administration 800 Independence Avenue 20591 Washington, D.C. United States of America Tel: +1 202 385 7163 Email: Tammy.Farrar@faa.gov</p>
<p>AERONAUTICAL RADIO INC.</p> <p>Jeannine HENDRICKS</p>	<p>Aeronautical Radio Inc. 2551 Riva Road 21401-7465 Annapolis Maryland United States of America Tel: +1-410-255-4560 Email: jh@arinc.com</p>

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<p>SITA</p> <p>Thierry LE GALL</p>	<p>SITA Aircraft Cockpit Communications Services 26 Chemin de Joinville B.P. 31 1216 Cointrin Geneva Switzerland Fax: +41-22-7476229 Tel: +41-22-7476437 Email: Thierry.Le_Gall@sita.aero</p>
<p>IATA</p> <p>Hans-Rudi SONNABEND</p>	<p>Lufthansa Systems AG Meteorological Services FRA AP/A-S-MET Am Prime Parc 2 D-65479 Raunheim Germany Fax: +49-69-6969473 Tel: +49-69-69690362 Email: hans-rudi.sonnabend@lhsystems.com</p>
<p>HMEI</p> <p>Bryce FORD</p>	<p>HMEI, Association of Hydro-Meteo Equipment Industry C/O WMO WMO Building 7 bis, avenue de la Paix CH-1211 Geneva 2 Switzerland Fax: +1-240-743-4406 Tel: +1-202-549-3477 Mobile: +1-202-549-3477 Email: bford@spectrasensors.com</p>
<p>AIRDAT LLC</p> <p>Jeffrey REX</p>	<p>VP, Engineering & Product Integration AirDat LLC 2535 S. Lewis Way, Suite 203 Lakewood, CO, USA 80227 Tel: 720-836-1335 Email: jrex@airdat.com</p>
<p>AIRDAT LLC</p> <p>Neil JACOBS</p>	<p>Chief Atmospheric Scientist AirDat LLC 1100 Perimeter Park Dr., Suite 104 Morrisville, NC 27560 Phone: 919.653.4358 Email: njacobs@airdat.com</p>

APPENDIX I
List of Participants

UNIVERSITY OF WISCONSIN Ralph PETERSEN	Email: ralph.petersen@ssec.wisc.edu
WMO Dean LOCKETT	World Meteorological Organization 7 bis, avenue de la Paix Case postale No. 2300 CH-1211 2 GENEVA Switzerland Fax: +41-22-7308021 Tel: +41-22-7308323 Email: dlockett@wmo.int

APPENDIX II

Proposed Terms of Reference for Elements of the Aircraft-based Observations Programme

Expert Team on Aircraft Based Observing Systems (ET-ABO)

Terms of Reference (as approved by CBS-XV)

- (a) Manage the programme for the aircraft observing system and the budget for the corresponding expenditure of the AMDAR Trust Fund in line with its ToR;
- (b) Oversee the development and maintenance of the aircraft observations Quality Management System;
- (c) Oversee the scientific and technical development and maintenance of the aircraft observing system;
- (d) Oversee and assist in the enhancement and optimization of the aircraft observing system in line with the requirements of Members and the recommendations and actions of the EGOS-IP;
- (e) Assist and provide support for training and outreach activities to support promotion and further development of the aircraft observing system; and,
- (f) Provide advice and support to the Chairperson of OPAG-IOS on the implementation of the WIGOS framework and its operational aspects.

APPENDIX II

Proposed Terms of Reference for Elements of the Aircraft-based Observations Programme

Updated Terms of Reference for the AMDAR Trust Fund (Version: 8 October 2012)

1. The AMDAR Trust Fund will be administered in accordance with the these Terms of Reference (ToR) and WMO rules, regulations and policies;
2. The rate of WMO Programme Support Cost Recovery is 0 percent for funds prior to these ToR, and will be 7 percent for all income made under these ToR;
3. The unit of account for the Trust Fund shall be the Swiss Franc. When commitments of contribution are made, the appropriate funds will be converted, as necessary, to the currency of account in at least the amount of the commitment;
4. The income of the AMDAR Trust Fund will include:
 - a. Voluntary contributions from Members and WMO partners;
 - b. Interest on investments as may be made by the Secretary-General (SG) in accordance with the provisions of Financial Regulations; and
 - c. Miscellaneous income.
5. The AMDAR Trust Fund shall be managed according to an annual budget (Budget) developed in accordance with these Terms of Reference by the Aircraft-based Observations Programme Management Group (AOPMG), which shall consist 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;
6. Expenditure of the Trust Fund shall be primarily based on the Budget supporting the aircraft-based observations related activities as defined under the work programmes of the relevant WMO Technical Commissions;
7. Requisitions for all expenditure from the AMDAR Trust Fund must be approved by the SG or their delegate within the Secretariat;
8. All expenditures of funds outside the Budget must be approved in writing by all Members of the AOPMG.
9. The expenditure of funds of the AMDAR Trust Fund will be used to:
 - a. Assist in the establishment and operation of programmes of automated meteorological reporting from aircraft;
 - b. Meet appropriate costs incurred by WMO in providing support to the aircraft-based observations work programme activities;
 - c. Meet other costs including such items as meetings and consultants;
 - d. Purchase specified items of equipment and software; and
 - e. Support other activities required to meet the ToR and work programme.
10. Any change to the terms of reference of the AMDAR Trust Fund shall require the approval in writing of all Member of the AOPMG.
11. In line with the request of Cg-XVI, the Secretariat should continue to seek contributions to the AMDAR Trust Fund from Members on an annual basis in support of technical developments and capacity-building related to the aircraft-based observations programme; and,
12. The AMDAR Trust Fund will be closed only at the discretion and direction of WMO Executive Council (EC). The use of the remaining balance at the closure of the Trust Fund should be determined in accordance with the EC decision.

APPENDIX II

Proposed Terms of Reference for Elements of the Aircraft-based Observations Programme

TASK TEAM ON AIRCRAFT-BASED OBSERVING SYSTEMS PROPOSED TERMS OF REFERENCE

- (a) Together with CBS ET-Aircraft-Based Observations, manage and harmonize the work programme for the Aircraft-based Observations Programme and the budget for expenditure of the AMDAR Trust Fund in line with its ToR;
- (b) Oversee the scientific and technical development and maintenance of the Aircraft Observing System, including the AMDAR Observing System;
- (c) Work closely with ET-A1 and oversee the development and maintenance of scientific and technical standards associated with aircraft observations; and,
- (d) Liaise closely with ET-A3 for testing and validation of the AMDAR system and aircraft based humidity sensors.

APPENDIX III

Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR

1. Background

Since the eighties of the last century airlines began to equip their fleets with systems enabling the aircraft to transmit flight operational data to their headquarters via a worldwide communication network. One component of this data flow consists of meteorological data like pressure, temperature and wind. Specific software puts these communication systems in the ability to transmit those data to an NMHS or directly into the GTS. This kind of in-situ measurement method yields an effective worldwide coverage with vertical profiles and en-route data series.

The assimilation processes of the NWP models are well attuned on AMDAR. To catch up with the parameter range of radiosondes AMDAR has to be completed with water vapour measurement (WVM). Then, these instrument platforms will be an economic and efficient complementation of the radiosondes. In some places and time slots the comparatively expensive radiosonde launches could be conserved.

Up to now, AMDAR just benefits of an instrumentation already existing on each aircraft because of immediate flight operational reasons. The equipment of the aircraft with humidity sensors needs to become a standard process.

2. Aims and Goals

- 2.1. Worldwide, the water vapor measurement shall coincide with temperature, pressure and wind measurement on a component (ideally all AMDAR aircraft) of the AMDAR fleet that provides optimal coverage for water vapour measurement based on the requirements of the WMO Integrated Global Observing System (WIGOS) and of WMO Member NMHSs.
- 2.2. The accuracy of the water vapor measurement shall meet or approach the requirements as specified in the WMO Guide to Instruments and Methods of Observation:
 - ± 5 to 3 % of relative humidity over the whole measurement range,
 - measurement range between 5 % RH at -75 °C in 200 hPa and 100 % RH at +35 °C in 1050 hPa.
 - ability to measure supersaturation (i.e. in ISSRs).
- 2.3. Ideally, the water vapor measurement sensor shall be a standard component of commercial aircraft and integrated with AMDAR software, standard avionics and communication systems like ACARS or successor systems.

3. Justification

The addition of water vapor measurements leads to the most complete usefulness of the infrastructure of already existing airborne measurement platforms. AMDAR could be used as a system being an equivalent complementation and replacement for radiosondes.

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Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR

4. Benefits

- AMDAR is a productive measurement data source for NWP.
- Radiosonde launches can be conserved.
- Airline's use of humidity data at their own internal meteorological centres, as practiced in the USA, such as support for fog warnings on airports).
- Improvement in met applications (see business case BoM).
- Improved NWP for clouds, icing, fog, precipitation.
- "Green" aircraft for airline's advertising.

5. Detailed Activities and Tasks

The WMO approach to the implementation of a water vapour measurement (WVM) capacity to AMDAR shall be undertaken in cooperation with operational AMDAR Programme Managers and shall incorporate the following major activities:

5.1. Definition of general necessities and frame conditions

5.1.1. Physical requirements for WVM implementation

A universal specification for inlet and outlet device has to be created. It has to cover the features outlined in the following subitems:

5.1.1.1. Location and orientation on the airframe

A set of rules has to be stated to be able to determine the best or even the only possible zones on the fuselage for WVM system's location:

- The upstream's path of the sampling air over the fuselage shall be as short as possible
- The depth of the boundary layer shall be either
 - as small as possible
 - or
 - smaller than the intake's distance to the fuselage.

The orientation of the intake shall be almost parallel to the airflow.

5.1.1.2. Aerodynamics and Thermodynamics

The impact process of the sampled air shall lead to an increased temperature-dew point spread.

5.1.1.3. Sample air pipes

The pipes or hoses need to have the most neutral behaviour in contact to water vapour as well as to liquid or solid water.

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Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR

5.1.2. Aeronautical requirements

5.1.2.1. Power Adaptor

The interface to the carrier system's power supply has to be compliant to international standards for commercial aircraft (115 VAC, 400 Hz).

5.1.2.2. Mechanical aircraft integration

For maintenance reasons the instrument's mounting has to comply with the aviation standards for avionics components (tray for fast assembly and disassembly).

5.1.2.3. Covering tools

The instrument has to be integrated in the standard procedures for aircraft care on airports. Covering caps with appropriate vanes are to be taken into the aircraft's standard equipment.

5.1.2.4. Maintenance

The instrument's maintenance cycles have to match with those of the aircraft.

5.2. Research & development for WVM

Carry out tasks and activities towards the research, development and testing of existing and developmental WVM sensors. Scientific flight trials such as DENCHAR (Development and Evaluation of Novel Compact Hygrometer for Airborne Research) or the piggy-back test operation of WVM systems on the research aircraft BAe 146 of FAAM (Facility for Airborne Atmospheric Measurements) are examples for appropriate assessments.

5.2.1. Monitor and coordinate requests and trials about

- sample air flow
 - sensor performance
 - electromagnetic ruggedness of the sensor's raw signal
- for
- the existing WVM type WVSS-II,
 - other existing WVM system solutions,
 - and new WVM techniques.

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Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR

5.2.2. Undertake performance and quality assessments

Request NWP to carry out investigations for measurements of existing sensors;

- Impact studies
- Quality evaluation against first guess of NWP
- Implement ongoing radiosonde/ WVM co-location comparison reporting.

5.2.3. Request NMHSs to carry out investigations about alternative sensors.

The WVM systems have to be improved to cover also extremely cold conditions in the upper troposphere.

5.3. The pathways for capturing commercial aircraft fleets

5.3.1. Retrofitting of AMDAR aircraft with WVM

This activity and its tasks encompasses the process of AMDAR Programme working together with partner airlines to advance the process of retrofitting of existing AMDAR aircraft platforms with a WVM.

5.3.1.1. Ensure that AMDAR including humidity is standardised within existing aviation communication frameworks

The AMDAR on-board software shall follow international standards.

5.3.1.2. Write generic letter from WMO/CBS to existing AMDAR airlines to request participation in the WVM project.

5.3.1.3. Consideration of new aircraft types

In future the aircraft's construction material will change to carbon fibre. Consequences in STCs and/ or in the WVM system's concept have to be envisaged.

5.3.1.4. Survey operational programmes

The airline's flight profiles of different aircraft types are to be chosen appropriately for equipping with WVM systems.

5.3.1.5. Survey airline's fleet planning

The selection of aircraft for humidity instrumentation depends on the perspective on a long-term use of each unit within the airline.

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Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR

5.3.1.6. Determine target aircraft model and fleets for retrofit:

Selection of platforms

- Aircraft types
 - flight ranges to achieve highest density of profiles,
 - climb rates,
 - suitable measurement system for True Track and True Heading,
- Fleets
 - sufficiently large number of appropriate aircraft,
 - sufficiently large period of aircraft use,
 - communication system ACARS,
- Airlines
 - covered regions,
 - cooperativeness.

5.3.1.7. Coordinate the attainment of supplemental type certificates (STCs)

- Develop a list of STCs to be attained based on target aircraft models
- Develop a process for streamlining initiation of STCs.
- Achieve grants given by CASA, EASA, FAA, JCAB.

5.3.2. Global ex-works implementation of AMDAR including WVM

This activity will encompass activities and tasks related to the process of working with appropriate aviation industry entities to ensure that WVMs are integrated into the standard manufacturing and avionics processes and systems with the ultimate aim of making the humidity measurement a standard component of aircraft platforms upon manufacture and delivery.

5.3.2.1. Implementation based on WMO/ NMHS requirements only

Cooperation partners: NMHS / WMO and aircraft manufacturers only

- Contact aircraft manufacturers for getting offers about ex-works integration of WVM or at least the provision of mechanical and electrical interfaces.
Concept of cost models based on license fees for
 - readily equipped and activated aircraft,
 - aircraft with the appropriate interfaces and quasi STC;
 - aircraft with STC and blocked zones for instruments and wiring
- Re-approach Airbus for refreshment of quotation of 2006.

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Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR

5.3.2.2. Implementation based on common interest of all aviation partners

- Ensure that the necessity of AMDAR and humidity is represented to the right aviation forums, e.g. AEEC, RTCA, NextGen, SESAR, etc.
- Ensure that AMDAR is standardised within developing and future aviation communications frameworks
- Carry out activities and tasks towards the goal of integration of both AMDAR and WVM sensors into aviation standard procedures, protocols and infrastructure.
- Undertake a study into current and likely future aviation communications developments and possible impact on AMDAR.
- Contact partners like
 - airlines,
 - ATM/ airports,
 - environmental control.
- Build a Business Case for humidity as a standard parameter for flight operations applications
- Commission or undertake research and studies into aviation benefits by cockpit's direct access to humidity for the purpose of:
 - Icing warning.
 - De-icing control (fuel saving by avoiding needless de-icing).
 - Control of engine performance (safety) because of the risk of ice accretion as an effect of ambient humidity.
 - Contrail avoidance.
- Determine what related research into the above applications is already underway and by whom.
- Contact research institutions who are concerned with impacts of humidity phenomena on flight safety. Example: NASA Glenn Research Centre re engine icing research being carried out and assess relevance to AMDAR and the WV business case.

6. Range of WMO Activities

To meet the goal of a maximal use of airborne meteorological platforms there are three different pathways to be considered. The priorities for WMO should be sorted as follows:

6.1. Top Priority

Comprehensive solution acquiescing a long lapse of time:

Ex-works integration primarily driven by the interest of all the parties of aviation as well as of environmental politics.

AMDAR plus humidity gets to a binding standard for aircraft.

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Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR

- to be coordinated by WMO
- to be performed by airlines stimulated by economics and environmental control

6.2. Medium Priority

Special solution with efficient impact:

Ex-works integration primarily driven by the interest of NMHSs,
if the solution 6.1 is too long apart:

- to be coordinated by WMO
- to be performed/ contracted by NMHSs and/ or regional programs

6.3. Low Priority

Local, transitory solution:

Integration as retrofit solutions,
if 6.2 is not viable:

- to be promoted by WMO
- to be performed by NMHSs and/ or regional programs
- STCs to be coordinated by WMO

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Draft Implementation Plan For Water Vapour Sensing Capability for AMDAR

7. WMO AMDAR Water Vapour Measurement Project

Bring the current national operational and developmental programs and projects together under the umbrella of an international WMO project with the following activities:

- 7.1. Develop a simple website promoting the project;
Incorporate and reference AMDAR impact assessment study (Petersen)
- 7.2. Obtain permission to promote the partner NMHSs and airlines on the website;
- 7.3. Develop high level project plan with aims, goals, timelines (add to website);
- 7.4. Develop business cases for AMDAR and WVM (add to website)
 - 7.4.1. Develop a business case for a cooperation between NMHS/ regional program with an airline:
Assign as a collaborative task to an appointed team of AMDAR focal points.
 - 7.4.2. Develop business cases for aviation participation
 - 7.4.2.1. Cooperation between NMHS/ regional program and aircraft manufacturer
Specify and undertake an SSA for the development of the BC.
 - 7.4.2.2. Cooperation between NMHSs/ regional programs with airlines, ATM as well as environmental control
Specify and undertake an SSA for the development of the BC.
- 7.5. Emphasise all 3 key aspects of the project:
 - Research & development,
 - Retrofitting of AMDAR aircraftand
 - Aviation integration of AMDAR and WVM.

APPENDIX IV

Outline for the Definition of the Global AO DM Framework

Items, relevant for developing an AO DM outline:

1. *3rd party data*
2. *ADS (ICAO), other new data sources (Mode-S)*
3. *Archiving (data and metadata)*
4. *Delivery (level II data; also profile data for local), relation to time/place resolution)*
5. *Optimization of observations*
6. *data targeting (additional, for applications)*
7. *data coverage (global), provision (e.g. Africa); programme extentions*
8. *Developing countries, special constraints (data comm. issues)*
9. *Data format (incl. resolution)*
10. *Code issues (incl. data header)*
11. *Data display*
12. *Data access*
13. *Data transfer*
14. *Typical data: Atmosph. Composition data*
15. *Phenomena: Icing, Turbulence, use of data (e.g. direct input, verification)*
16. *Timeliness (taking into account Q/C processes)*
17. *Data checking, filtering, flagging (relation with rules, M.GDPFS)*
18. *Excluding aircraft (how to manage)*
19. *Quality control: monitoring (availability), technics (NWP), stages (real time, off-line); flagging principles; archiving; logistics; feed back*
20. *Metadata (definition, use, archive)*

Documentation (overview and review for update)

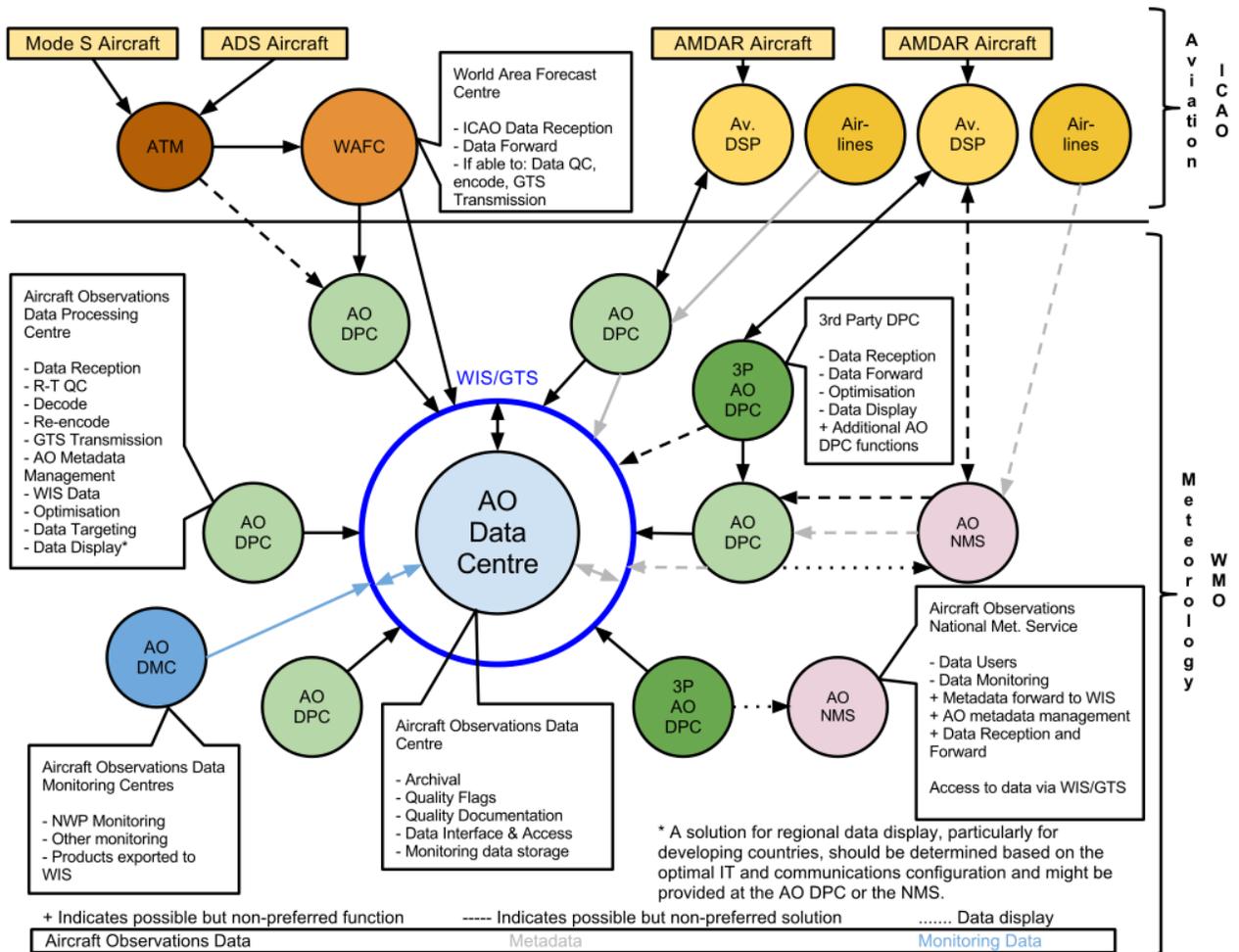
1. *AMDAR Reference Manual*
2. *WMO regulatory material (TR, incl. Manuals and Guides)*
3. *WWW/DM, ISS/DM*
4. *QMF documentation*

APPENDIX IV

Outline for the Definition of the Global AO DM Framework

Recommended Framework

Proposed Aircraft Observations Global Data Management Framework, Version 0.2



APPENDIX V

Status and Plan for Development of Aircraft-based Observations Metadata

1. BACKGROUND

- a. The requirements and application of AO Metadata management is a task included in the WIGOS Pilot project for AMDAR (WIGOS-PP-AMDAR).
 - i. WIGOS PP has agreed on components of metadata and in particular, identified Metadata required to describe data and products, Metadata required for the usage of the data and Metadata required for the operation of the AMDAR observing system.
 - ii. As reported in earlier documentation, a task for the E-AMDAR Programme was to approach participating airlines with a draft dataset for comments. Following discussions with the airlines, a slimmed down version was agreed. This would be more appropriate and manageable.
 - iii. The second draft (as discussed at AO Workshop June 2012), indicated which parameters were to be assigned Mandatory and Optional weighting. There were also parameters as seen as “short” and “long” term requirements.
 - iv. This second draft of the Metadata was populated with available data (provided by the airlines) and formed the basis for discussions at the AMDAR Panel AO Data Management meeting and subsequent APMG-4.

2. DEFINITION OF FRAMEWORK

- a. In order for the metadata (of a Regional Programme) to be obtained, several stakeholders will be required to contribute.
 - i. Metadata Manager (MM).
 - ii. Airlines.
 - iii. Data Service Providers (DSP).
 - iv. Avionics vendors.
 - v. Aircraft manufacturers.
 - vi. Aviation authorities.
 - vii. NWP Monitoring Centres.
- b. The responsibilities of the above identified stakeholders are seen as;
 - i. A member of the Regional AMDAR Management Team (in Europe this will be E-AMDAR Technical Co-ordinator) will be responsible for contact with the other stakeholders for data input to the metadata dataset.
 - ii. Point of contact for AMDAR/Datalink matters for provision of metadata information relating to aircraft identification and software equipage.
 - iii. Point of contact for AMDAR/Datalink matters for provision of metadata information relating to data communications
 - iv. Point of contact for information on airframe hardware and software implementation.
 - v. Point of contact for information on airframe sensor equipage (future metadata dataset requirements).
 - vi. Point of contact for information relating to Airport metadata.
 - vii. Point of contact for information relating to data quality of aircraft observations.
- c. There will also be a requirement for clearly defined processes and procedures for the population and maintenance of the metadata.
 - i. Identification of the MM for the Regional AMDAR Programme and assign responsibilities.
 - ii. Metadata template to be populated by MM.

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Status and Plan for Development of Aircraft-based Observations Metadata

- iii. Agree schedule of metadata maintenance (upkeep) – to ensure current and up to date information available (a weekly, monthly update or on ad hoc basis?).
- iv. Updates to metadata made known to all users of the dataset.
- v. Visibility of the metadata to all users. There is a requirement to consider IT infrastructure of developing countries – are they able to access metadata format.
- vi. Implement procedures for reporting faults/errors on aircraft.
- d. The defined processes and procedures will need to conform to a set of agreed standards.
 - i. Standard metadata template used by all AMDAR Regional Programmes.
 - ii. Metadata entries all conform to set reporting units (e.g. seconds for reporting intervals).
 - iii. Ensure maintenance schedule adhered to.
 - iv. Ensure access to metadata by all users.
 - v. Defined Fault reporting format.

3. TECHNICAL REQUIREMENTS

- a. The requirements for the implementation of a universal metadata dataset need to be defined – this is being worked on.
- b. Again we would need to consider the IT infrastructure available at NMHSs where the MM would populate and maintain their dataset.
 - i. Agree data format e.g. excel spreadsheet, csv file, xml etc (for transfer of Regional Metadata to the Global dataset).
- c. Along with point b above, consideration would also need to be given to the IT infrastructure of metadata users – especially those users in developing countries.
- d. Agreed data format would need to be accessible by all users.
- e. Acceptable update schedule.

4. AIMS AND GOALS

- a. The initial aim of this project is to have in place a dataset of all aircraft in a Regional AMDAR Programme (E-AMDAR).
- b. The following phase would be to extend this to one or two other Regional Programmes – perhaps South Africa and/or Canada.
- c. The ultimate goal is to have Global Metadata available for all AMDAR programmes.
- d. It is also envisaged to have Historical Records/Event Log – used to track events relative to AMDAR Metadata.
 - i. This should be separate from the AMDAR Metadata dataset and would need to have a management resource.
 - ii. Also would need to agree what constitutes an “Event”, e.g. changes to software configuration, reporting resolution, sensor upgrade.
 - iii. The Event Log would not to include Quality Control (QC) issues – this is not seen as pertaining to the AMDAR Metadata dataset.
 - iv. The Event Log would be maintained by the responsible UA Monitoring Centre and would be plain text with information boxes to be completed (Aircraft ID, Date, Types of Event etc). A VBasic script or perhaps utilisation of open source application for Fault Ticketing. The Event Log would also need to be intuitive and have “filter” capabilities, for instance;

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1. Ability to track an event.
2. Data retrieval - select Aircraft ID.
3. Selectable time period – otherwise an Aircraft Event Log could provide a lot of information!
4. Drop down menus to search for Types of Event (Configuration change, software upgrade/change etc).

5. BENEFITS

- a. Having Metadata available would provide additional data on an individual aircraft which would allow enhanced QC on the aircraft.
- b. When an error is reported with an aircraft – or a subset of aircraft – we would then potentially have the ability to “drill down” on these units to identify if there was an inherent problem/issue with;
 - i. the individual aircraft,
 - ii. a fleet type,
 - iii. aircraft model,
 - iv. avionics hardware,
 - v. AMDAR software version.
- c. The inclusion of an Event Log would assist in the monitoring of errors, allowing Monitoring Centres and NMHSs to maintain accurate and up to date “rejection lists”.
- d. Metadata would be available to Upper Air Monitoring Centres and could also be made available to the scientific community for research projects.

6. STATUS OF METADATA IMPLEMENTATION

- a. The E-AMDAR Technical Co-ordinator (as Metadata Manager for E-AMDAR Programme) has populated the metadata dataset – as agreed in Appendix III of the Final Report to AO DM Meeting (reference 5) – as far as possible given the information obtained from the airlines.
- b. A sub-set to this metadata dataset is included in Appendix I to this document. It should be noted that some elements of the metadata dataset are not available at this time. An issue of providing Aircraft Registration has been raised by some of the E-AMDAR airlines.
- c. In discussions with the airlines, it may be necessary to add another element regarding the aircraft information. As well as Type and Series, the aircraft will also have a Model Type. For example: Aircraft Type = A320 (Family), Aircraft Series = A319-100 and Aircraft Model = A319-112.

7. NEXT PHASES OF METADATA IMPLEMENTATION

- a. Further population of the E-AMDAR dataset will be carried out to complete data that has become available recently from a couple of the participating airlines.
 - i. This dataset will be made available to UA Monitoring Centres for comment. The obvious choice would be to start with one centre (e.g. NCEP).
 - ii. There will also be a need for discussions with UA Monitoring Centres as they may already have a dataset that they are using. We need to ensure that there is one definitive dataset being used by all data users.
- b. Following – or in parallel to – a period of the E-AMDAR sub-set being available to the UA Monitoring Centre, there is the need for discussion and agreement on how the

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Metadata dataset is to be integrated into WMO, with emphasis on any technical requirements, resource availability and timescales.

- c. The AO Metadata will be integrated into the WIGOS Portal under the terms of the AO Global Data Management Framework (AO Data Centre) and guidance from the WIGOS TT-WMD.

8. RISKS

- a. The need for appropriate level of resources for a MM to carry out the responsibilities listed above need to be factored into Regional Programmes costs.
 - i. Monitoring of MM resources should be carried out to ensure no overloading of workload is introduced – this could lead to the metadata dataset not being maintained correctly.
- b. The willingness of stakeholders to impart information required for the mandatory elements of the metadata dataset needs to be considered.
 - i. During the course of populating the E-AMDAR metadata dataset, the MM encountered various levels of co-operation.
 - ii. Several airlines provided Aircraft Tail Numbers/Registration Details (that could be linked to EU Identifier) to enable metadata fields to be completed. However, some of the major players – DLH, SAS and AFR (amounting to over 70% of the E-AMDAR fleets) would not impart this information citing Pilot Union Contracts and Airline Policies.
 - iii. The Tail Number/Aircraft Registration and Manufacturer Serial Number (MSN) are all connected and to be of any significance within the metadata need to have the correlation with the AMDAR Identifier. The need for the Airline Tail Number being matched to the AMDAR Identifier ensures that the AMDAR Identifier only relates to one aircraft at the airline.

9. CONCLUSION

- a. The development of a Metadata dataset is ambitious.
- b. It may be that we will have varying levels of information from individual airlines but should aim to have top level information pertaining to aircraft type, avionics and software versions as a minimum.
- c. Dependant on the level of data provision from airlines, there may be a need to review the Mandatory fields proposed in the AO Metadata dataset.

References:

1. AMDAR Metadata Practice (WIGOSPP5AMDARMG/Doc 2.2).
<http://www.wmo.int/pages/prog/www/OSY/Meetings/WIGOSPP5AMDARMG/DocPlan.html>
2. Definition of Metadata searches applicable to a wide variety of WMO Datasets.
http://www.wmo.int/pages/prog/www/WIS/metadata_en.html
3. Data and metadata representation.
http://www.wmo.int/pages/prog/www/WDM/wdm_representation.html
4. Development of the WMO Core Profile of the ISO Metadata standard.
<http://www.wmo.int/pages/prog/www/WDM/Metadata/documents.html>
5. Final Report from AO Data Management Workshop.
http://www.wmo.int/amdar/Reports/Aircraft_Observations_Data_Management_Workshop_June_2012_Final_Report.pdf

APPENDIX VI

Draft Recommended Work Programme for Aircraft-based Observations 2013

The Work Programme below was developed by the AMDAR Panel at its 15th and final Session and is intended to provide a recommendation and guidance for development of new work programmes for the CBS Expert Team on Aircraft-based Observations and CIMO Task Team on Aircraft-based Observing Systems, which together will form the Aircraft-based Observations Programme within WMO. The Work Programme is based on the current ongoing activities and the new recommended activities (AMDAR Panel 15) of the AMDAR Programme.

Colour Coding
Completed activities or tasks
Activities and tasks recommended to be adopted by CBS ET-ABO
Activities and tasks recommended to be adopted by CIMO TT
Activities and tasks not yet allocated
New activities and tasks not yet allocated (Responsibility given to AOPMG)
Revise
Remove

Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
1.1 (Enhancement of AMDAR Observing System Coverage - Extend global AMDAR coverage)	1.1.1	Study on data coverage and airline capabilities	1	1. Award SSA	1. ET-ABO	Q1 2012	Q4 2012	Completed	SSA in place	12K	17K
				2. Manage SSA	2. SO/ARO	Q4 2011	Q1 2013	Commenced	Nil		
				3. Review deliverables.	3. SO/ARO, A-FPs, (ET-ABO)	Q1 2012	Q1 2013	TBC	1. Study on Coverage; 2. Study on airlines; 3. Report.		
	1.1.2	Development of AMDAR Programmes for: <ul style="list-style-type: none"> • Northern Africa; • South and Central America; • Southwest Pacific 	1	1. Organise finance for AeroMexico programme.	1. ET-ABO, SO/ARO	Q4 2011	Q1 2013	Commenced	1. Contract with AeroMexico		54K
			2	2. Determine potential for data targeting over Africa	2. APMG	Q1 2012	Q3 2012	Completed	1. Report to APMG-4		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate	
		<ul style="list-style-type: none"> • Eastern Europe; • Middle East • Central Africa. 	2	3. Determine what capacity there is to use targeted data in Africa	3. APMG	Q1 2012	Q3 2012	Completed	1. Report to APMG-4			
			2	4. 1 or 2 members of the Panel to undertake fact-finding mission to Africa re programme potential	4. ET-ABO	Q1 2012	2013	TBC				10K
			3	5. Investigate approach for Emirates AMDAR Programme commencement – assess possibilities for Bahrain, Oman: <ul style="list-style-type: none"> • Write generic letter to appropriate PRs and contacts through the Secretariat. 	5. F.Grooters	Q1 2012	2013	TBC				
					6. Write to WMO Regional Association I	6. F.Grooters				1. Letter to RAs 2. ?		
				1	7. Employ a AMDAR Development Officer	7. AOPMG	Q4 2012	Q2 2013	TBC	3. ADO employed.		120K
				2	8. Commence development of RA AMDAR Implementation Plans.	AOPMG				4. RA Plans		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
			3	9. Investigate options for AO data display in accordance with DM Workshop recommendations.	AOPMG				5.		
			1	10. Establish ASECNA requirements for Supplementary AMDAR Data.	8. SO/ARO				6.		
	1.1.3	Improve and extend Targeted Data Activities	2	All programmes to identify potential for data targeting within their programs. 1. Request info from A-FPs 2. Submit information 3. Analyse data 4. Report to APMG-4	1. SO/ARO 2. A-FPs (Operational) 3. SO/ARO 4. SO/ARO	Q1 2012	Q3 2013	TBC	1. Report to ET-ABO		
	1.1.4	Develop guidelines for programme development	2	1. Write DoW 2. Review and approval 3. Compilation of Guidelines	1. SO/ARO 2. ET-ABO 3. SSA or A-FPs?	Q1 2012	Q3 2013	TBC	1. DoW		
	1.1.5	Contribute to the WMO/CBS RRR Process	1	1. Develop a methodology for defining the required capabilities for inclusion in the RRR database. 2. Provide data for input to the RRR Obs Systems Capabilities database	SO/ARO	Q3 2011	2013	TBC	1. Input in the RRR Database SoR document. 2. Input in the RRR OSC Database		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
1.2 (Enhancement of AMDAR Observing System Coverage - Address the requirement for national, regional and global optimization)	1.2.1	Develop optimization systems for: <ul style="list-style-type: none"> United States AMDAR Programme; Asia; Africa; South America. 	2	<ol style="list-style-type: none"> Study on optimization for Sth Africa AMDAR Programme Study on optimization for US AMDAR Programme (MDCRS) Report on Australian Data Optimisation System SITA Optimisation Development 	<ol style="list-style-type: none"> SO/ARO, G.Khambule SO/ARO, D. Helms SO/ARO, A-FP-Australia SO/ARO seek Pilot Project proposal from SITA. 	Q2 2012	Q3 2012	TBC	<ol style="list-style-type: none"> Report to APMG-4 Report to Panel-15 Report to APMG-4 Report to APMG-4 		
2.1 (Extension of the AMDAR System - Implement water vapour sensing measurement)	2.1.1	Implement water vapour sensing measurement	1	1. Investigate Panel ownership of general STC for Airbus 320 family.	1. A.Hoff	Q1 2012	2013	TBC	1. Report to TT-AOS		
			1	2. Investigate Panel ownership of general FAA STCs for Boeing 737 types and conversion to European EU/EASA certification.	2. A.Hoff/Y. Lemaitre	Q1 2012	2013	TBC	1. Report to TT-AOS		
			1	3. Seek funding sources for STC attainment for B737-800 and A320	3.	Q1 2013		TBC	2.		
			1	4. Write a letter to PRs seeking interest in international project for WV implementation	4. SO/ARO	Q1 2012	Q2 2012	TBC	1. Letters to PRs		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
			2	5. Request SSI to provide a "dynamic" document on STC status, issues and processes	5. SO/ARO	Q2 2012 (APMG-3)	Q4 2012	TBC	1. Document on STCs		
			1	6. Draft a strategic plan for WV implementation	6. AOPMG	Q2 2012 (APMG-3)	Q3 2012	TBC	1. Draft Strategic Plan.		
			2	7. Obtain statements of impact of WVSS-II on airline operations from USA airlines.	7. F. Grooters	Q2 2012 (APMG-3)	Q3 2012	Commenced	1. WVSS-II airline impact statements		
2.2 (Extension of the AMDAR System - Implement turbulence measurement)	2.2.1	Implement turbulence measurement	1	1. Obtain specification for EDR from FAA	1. SO/ARO	Q1 2012	Q3 2012	Completed	1. EDR Specification	10K 0K	
			1	2. Obtain EDR software package from FAA for use in E-AMDAR	2. SO/ARO	Q1 2012	Q3 2012	TBC	2. EDR Software		
			1	3. Add the EDR algorithm to the AOSFRS.	3. SO/ARO	Q4 2012	Q1 2013	TBC	3.		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
3.1 (Research and Development of New Aircraft Observations Technologies - Manage risks and opportunities associated with new and developing technologies in avionics, communications and metrology.			1	1. Fund a study on Current and Future Avionics and Communications Technology Impacts on AMDAR.	1. TT-ASO	Q1 2013	Q2 2014	TBC	4. Study		50K
4.1 (Development and Maintenance of the Aircraft Observing System Quality Management System - Implement a Quality	4.1.1	WIGOS Pilot Project for AMDAR	1	1. WIGOS-PP-AMDAR-1 Development of BUFR Template: <ul style="list-style-type: none"> • Coordinate validation; • Report to Code Group • Report to APMG-3; • Report to JM-4 	1. SO/ARO ECMWF/Met Office	Q4 2011	Q1 2012	Commenced	1. Validated template		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
Management Framework for AMDAR)			1	2. WIGOS-PP-AMDAR-2 Metadata Development: <ul style="list-style-type: none"> • AP-FPs and Review Group to review Metadata sets; • D.Helms to review and define metadata categories; • AP-FPs and Review Group to Review in preparation for AMDAR DM Workshop 	2. PL-IDEQC, SO/ARO, AP-FPs Review Group: SO/ARO, N.Halsey, D.Helms, J.v.d.Meulen,	Q4 2011	Q3 2012	Commenced	1. Refined metadata set; 2. Categorised metadata set. 3. PL-IDEQC report to APMG-4		
			1	3. WIGOS-PP-AMDAR-3 Develop AMDAR Data Management Procedures: <ul style="list-style-type: none"> • Hold a workshop of AMDAR data management experts in Q2 2012 (Geneva); • Develop a strategy for global AMDAR data management; • Address data display issues; 	3. J.v.d.Meulen, APMG	Q1 2012	Q4 2012	TBC	1. AMDAR Data Management Workshop; 2. Global AMDAR Data Management Strategy.	15K	

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
			1	<p>4. WIGOS-PP-AMDAR-4 Validation and Inter-comparison of WVSS-II:</p> <ul style="list-style-type: none"> • Paper on summary of results and conclusions: <ul style="list-style-type: none"> • DoW • Award SSA • Manage SSA • Seek endorsement by CIMO and CBS as a candidate system for operational deployment by Members; • Technique employed by the WVSS-II sensor should be appropriately integrated into the CIMO Guide and CBS guides. • Development of AMDAR Panel Statement of Support for WV implementation leading to WMO endorsement. 	4. APMG	Q1 2012	Q4 2012	TBC	<ol style="list-style-type: none"> 1. DoW 2. SSA 3. Paper 4. Statement of Support 	30K	

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
			1	5. WIGOS-PP-AMDAR-5: Update of AMDAR Reference Manual: 1. SSA to be compiled for: i) Review of WMO and AMDAR regulatory material ii). Integrate AMDAR RM into WMO regulatory material. I iii). Conduct a regulatory material review process as necessary to finalise item ii. 2. Review and update the CIMO Guide for water vapor sensing developments.	5. 1. APMG, SO/ARO 2. APMG 3. A.Hoff	Q1 2012	2005	TBC	1. DoW for SSA. 2. AMDAR System reviewed in WMO reg. material. 3. Draft AMDAR Implementation Manual 4. Update to CIMO Guide for water vapor sensing developments		40K
			1	6. WIGOS-PP-AMDAR-6 Generic Software Spec: 1. Manage SSA; 2. Review deliverables.	6. 1. SO/ARO; 2. Review group: SO/ARO, D.Helms, HR.Sonnabend, A.Hoff.	Q4 2011	Q1 2013	Commenced	1. Generic software specification.	24K	16K
4.1 (Development and Maintenance of the Aircraft Observing System Quality Management System - Implement a Quality Management Framework for AMDAR)	4.1.2	Establishment of National and International Metadata	2	1. Collection of metadata on AMDAR software to be completed	1. PL-IDEQC, SO/ARO, AP-FPs	Q1 2012	Q4 2012	TBC	1. Software metadata set		
				2. Complete metadata framework implementation plan.	2. ET-ABO (S.Taylor)	Q1 2013	Q3 2013	Commenced	2. IP Document		
				3. Implement a metadata pilot project.	3. ET-ABO (S.Taylor)	Q1 2013	Q4 2013	TBC	3. Pilot commenced		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
	4.1.3	Revision of AO Regulatory Material within WIGOS	1	Commence integration of AO Reg. Material into WIGOS.	J.v.d.Meulen.	Q1 2013	2014	TBC	Reg. Material update.		
	4.1.4	QC Procedure Development	2	Revise and update data processing QC procedures for AO including use of flags and DM Workshop recommendations.	AOP	Q3 2013	Q4 2013	TBC	Update in Reg. Material		
	4.1.5	QM Procedure Development	2	Revise and update QM procedures for AO for DM Workshop recommendations.	J.v.d.Meulen	Q3 2012	Q4 2013	TBC	Update in Reg. Material		
	4.1.6	Establishment of AO Data Centre	3	Commence planning and investigations into AO Data Centre establishment	AOP	Q1 2013	Q3 2013	TBC	Report		
	4.1.7	Investigate AMDAR Temperature bias	1	Investigate root cause of AMDAR temperature bias.	AOP	Q1 2013	2014	TBC	Report		
4.2 (Development and Maintenance of the Aircraft Observing System QMS - Develop a National and Global Aircraft Observations Data Management Framework)	4.2.1	Develop a National and Global Aircraft Observations Data Management Framework	2	1. Re NOAA/ESRL/GSD AMDAR data display determine: <ul style="list-style-type: none"> • Future maintenance of and for this system • Possible change to use of national aircraft IDs 	1. D.Helms	Q1 2012	Q3 2012	TBC	1. Report to APMG-4		
			1	2. Commence documentation of the Data Management Framework	2. J.v.d.Meulen	Q4 2012	2014	Commenced	Reg. Material Update		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
			3	3. Develop and document standards for AMDAR optimization system	TT-ASO	Q1 2013	2014	TBC	Reg. Material Update		
			1	4. With ICAO, develop a DM Framework for ADS data.	ET-ABO	Q1 2013	Q4 2013	TBC	Report		
			2	5. Encourage implementation of the BUFR Template for AMDAR V7.	ET-ABO	Q1 2013	Q3 2013	TBC			
4.3 (Development and Maintenance of the Aircraft Observing System QMS - Standardise AMDAR software function across avionics systems and optional sensors across aircraft)	4.3.1	Update of ARINC 620 Meteorological Report to Version 5	1	1. Finalise ARINC 620 Met. Report Version 5	1. SO/ARO, A.Hoff, HR.Sonnabend, D.Helms	Q4 2011	Q3 2012	Commenced	1. ARINC 620 V5		
	4.3.2	Standardisation of AMDAR within Aviation	3	1. Commence planning for an Aviation Industry event for 2013 re software implementation in new aircraft. 2. Attend the Airlines Association of South Africa AGM, South Africa	1. APMG 2. APMG 3. APMG G.Khambule,	Q1 2012	Q4 2012	TBC	1. Report to Panel-15 2. Report to Panel-15 3. Report to Panel-15		
			2	3. Consider a new approach to aircraft manufacturers for AMDAR integration.	AOP	Q1 2013		TBC			

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
	4.3.3	AMDAR Software Development	2	B777 Software Development: 1. Proposal of B777 software development to be made to Meteo-France and E-AMDAR at E-TAG (March 2012) 2. Ownership issues to be addressed at E-TAG (March 2012) 3. Chairman to report to Panel-15 (Q4)	1. F.Grooters 2. APMG	Q1 2012	Q4 2012	TBC	Letter to M-France and E-AMDAR	20K	
			2	B777 Software Development: 1. Activate contract for development.	AOP	Q1 2013	Q4 2013	TBC	B777 Software		20K
			1	Approach Teledyne Controls and other vendors re. AMDAR Software integration (AOSFRS)	AOP	Q2 2013	2014	TBC	Teledyne software application		?
4.4 (Development and Maintenance of the Aircraft Observing System QMS - Manage the data processing and quality assurance for other sources of aircraft data	4.4.1	Develop strategies for the management of ADS and Mode S data	2	Ensure item is addressed under 4.1.1(3): AMDAR Data Management Workshop	SO/ARO, J.v.d.Meulen	Q1 2012	Q3 2012	TBC	Report to APMG-4		
5.1 (Aircraft Observing System Training	5.1.1	Aircraft Observations System Website Maintenance	2	1. Review website.	2. C.Weiss, SO/ARO, Y.Lemaitre, J.v.d.Meulen	Q1 2012	Q3 2012	Commenced	1. Review report to APMG-3		

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Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
and Outreach - Develop methods and material for promoting Aircraft Observations)			3	2. Technical contractor to update website.	3. SO/ARO	Q2 2012	2013	TBC	1. SSA Website update plan 2. Website update commenced		40K
	5.1.2	Impacts and Benefits Document for Aviation	2	1. Identify contractors and obtain Eols and quotations 2. Award and manage SSA 3. Review deliverables 4. Write to USA and Australian airline contacts seeking evidence of AMDAR impacts and benefits.	AOP	Q1 2013	2013	Commenced	1. SSA Aviation Impacts and Benefits document 2. Nil 3. Examples of impacts and benefits.		40K
	5.1.3	AMDAR COMET Training Module	3	Contact COMET re development of a AMDAR course.	APMG(C. Weiss), SO/ARO	Q1 2012	Q1 2012	Commenced	Report to APMG-3		
			2	Continue development of a training module for AMDAR.							
	5.1.4	Impact Studies Assessment	3	Commission a paper summarizing results of AMDAR Impact studies including NWP and other Data Users	AOPMG, (ESRL, ECMWF, ABoM, MF, CMA,SAWS)	(Q2 2012)	Q2 2013	TBC	Commenced	30K	
	5.1.5	Attend Aviation Meetings	2	Panel to attend AEEC DLUF Meetings in Europe and USA	APMG	Q1 2012	Q4 2012	TBC	Report		
2			Attend 2 meetings of AEEC DLUF in Europe and USA	AOPMG	Q1 2013	Q4 2013	TBC	Report to ET-ABO		5K	

APPENDIX VI

Draft Recommended Work Programme for Aircraft-based Observations 2013

Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
5.2 (Aircraft Observing System Training and Outreach - Conduct training and outreach activities)	5.2.1	Aircraft Observations Newsletter production	2	Newsletters Q1, Q2, Q3, Q4	C-TOSG, SO/ARO,APMG, AP-FPs.	Q1 2012	Q4 2012	Commenced Volume 1 published.	Newsletters Q1, Q2, Q3, Q4		
			1	Compile and publish 2 volumes of the Newsletter	AOP	Q1 2013	Q4 2013	TBC	Newsletters V5, V6.		
	5.2.2.	Use of Social Media.	2	Investigate and utilize social media for AMDAR promotion.	AOP	Q1 2013	Q4 2013	TBC			
6 (Management and administration of the Aircraft Observing System Programme)	N/A	AMDAR Panel Admin	1	1. Update of AMDAR Panel ToR	APMG	Q1 2012	Q4 2012	Commenced	Updated ToR		
		AMDAR Panel Admin	1	2. Manage and finalise the transition of the AMDAR Observing System to WMO	APMG	Q1 2012	Q4 2012	Commenced	Manage and complete the transition process of the AMDAR System to WMO.		
		Finalisation of AMDAR Transition to WMO	1	1. Letter to PRs re completion of transition process and cessation of Panel	F.Grooters	Q4 2012	Q1 2013	TBC	Letter to PRs		
		Establishment of CIMO Task Team	1	1. Finalise Members 2. Finalise ToR 3. Obtain CIMO MG Approval 4. Finalise Work Plan	AOPMG	Q4 2012	Q1 2013	Commenced	<ul style="list-style-type: none"> • CIMO TT Established • CIMO TT Work Plan 		
		Establishment of ET-ABO	1	1. Finalise Members 2. CBS Approval for Membership 3. Finalise Work Plan	AOPMG	Q4 2012	Q1 2013	Commenced	<ul style="list-style-type: none"> • ET-ABO Work Pan 		
6.1 (Management and	6.1.1	Organization of Meetings	1	4. Confirm meeting location and date	APMG	Q1 2012	Q1 2012	Commenced	Location, dates	5K	
				5. Venue and meeting logistics	Host	Q2 2012	Q2 2012	TBC	Venue		

APPENDIX VI

Draft Recommended Work Programme for Aircraft-based Observations 2013

Core and L-T Activity	M-T Activity	Description	Pty (1-3)	2012 Activities	Responsibility	Commence	Complete	Status	Outputs / Deliverables	2012 Budget Estimate	2013 Budget Estimate
administration of the Aircraft Observing System Programme - Conduct meetings of members)				6. Info for participants	Host	Q3 2012	Q3 2012	TBC	Info for participants		
				7. Doc Plan draft	APMG	Q3 2012	Q3 2012	TBC	Doc Plan Draft		
				8. Doc Plan	APMG, SO/ARO, A-FPs	Q3 2012	Q3 2012	TBC	Doc Plan		
				9. 2012 Panel Meeting	SO/ARO, (APMG)	Q4 2012	Q4 2012	TBC	2012 Meeting Report		
				1	Hold a joint meeting of ET-ABO and TT-ASO	SO/ARO, AOPMG	Q1 2012	Q3 2012			30K (RB)
	6.1.2	Organization of AMDAR Panel Management Group Meetings	1	Organise and hold APMG Session 3	APMG, SO/ARO	Q1 2012	Q1 2012	TBC	APMG-3 Report	10K	
				Organise and hold APMG Session 4	APMG, SO/ARO	Q2 2012	Q3 2012	TBC	APMG-4 Report	5K	
6.2 (Management and administration of the Aircraft Observing System Programme - Coordinate planning activities)	6.2.1	Reporting and planning associated with ICT-IOS, CBS and ET-AIR	1	1. Finalisation of ET-Work Plan 2013 - 2016 2. ET-AIR Report to CBS	1. APMG 2. ET-AIR Chair	Q1 2012	Q3 2012	TBC	1. ET-AIR Work Plan Report to CBS 2.		
				3. Review of EGOS IP	3. APMG	Q4 2011	Q4 2011	TBC	3. Revision provided to ET-EGOS Chair-		

APPENDIX VII



World Meteorological Organization
Organisation météorologique mondiale

Secrétariat
 7 bis, avenue de la Paix – Case postale 2300 – CH 1211 Genève 2 – Suisse
 Tél.: +41 (0) 22 730 81 11 – Fax: +41 (0) 22 730 81 81
 wmo@wmo.int – www.wmo.int

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AMDAR TRUST FUND
 Interim Statement of Income and Expenditure
 For the period 1 January to 30 September 2012
 Amounts in Swiss Francs

1.	Balance brought forward, 1 January 2012	1,089,297.03
2.	Income	
	2.1 Voluntary contributions	66,366.41
	2.2 Voluntary contributions-Accrued (Pledges)	4,182.92
	2.3 Interest credited	915.09
	2.4 Unrealized gain on differences on exchange	16.33
	2.5 Total income	<u>71,480.75</u>
3.	Total available funds during reporting period	1,160,777.78
4.	Expenditure	
	4.1 Direct project costs	
	4.1.1 Individual consultants (honorarium)	11,832.65
	4.1.2 Travel -Other representatives to attend other WMO meetings	38,515.00
	4.1.3 Travel of staff to other WMO meetings	8,088.77
	4.1.4 Meteorological telecommunications equipment	919.19
	4.1.5 Total project direct costs	<u>59,355.61</u>
	4.2 Indirect project costs	
	4.2.1 Bank charges	76.93
	4.2.2 Total indirect project costs	<u>76.93</u>
	4.3 Total project expenditure	<u>59,432.54</u>
5.	Balance of fund at 30 September 2012	<u>1,101,345.24</u>

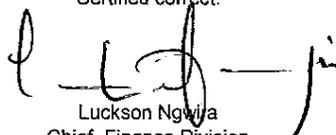
Contributions received

France (EUR 9,500)	11,409.31
Germany (EUR 25,565)	30,739.69
Korea, Rep. Of (USD 4,000)	3,588.00
Netherlands (EUR 1,000)	1,202.41
Sweden	5,000.00
United Kingdom (GBP 10,000)	14,427.00
	<u>66,366.41</u>

Contributions pledged

South Africa (ZAR 35,000)	4,182.92
	<u>4,182.92</u>

Certified correct:


 Luckson Ngwija
 Chief, Finance Division
 23 October 2012