AMDAR Global Status, Benefits and Development Plans*

WMO CBS ET Aircraft Based Observations Bryce Ford

* Adapted from Presentation at WMO Congress XVII, June 2015 by WMO CBS President, reviewed by WMO Technical Coordinator for Aircraft Based Observations
AMDAR is the core WMO Aircraft Based Observing System (ABO):
- AMDAR is ~95% of all ABO data
- Supplemented by AIREPs & ADS

Data per meteorological specifications
- Data Quality equivalent to radiosondes
- Vertical profiles plus enroute reports

Global coverage slowly increasing
- Currently 39 participating airlines
- Over 4000 participating aircraft
- Over 700,000 observations per day

But more is needed in Space and Time
- Fill missing Locations and Times of the day
- Expansion in US, EU, Australia, & E-Asia
- Development in Africa, So America, Asia
AMDAR Benefit to Global Numerical Weather Prediction (NWP)

- AMDAR ranks 3\textsuperscript{rd} in reduction to GLOBAL NWP forecast error (~10%)
  - Behind satellite vertical sounders and radiosondes
  - Even with limited global coverage
- Satellites provide
  - High data volume & global coverage
  - But less accuracy
- Radiosondes provide
  - Poor horizontal & temporal coverage
  - But good accuracy when available
- AMDAR Provides
  - Higher temporal coverage than radiosondes
  - Better accuracy than satellites
  - Lowest cost of these systems

AMDAR Benefit will Increase with
- Improved horizontal and temporal coverage
- Increased Water Vapour measurement
AMDAR Benefit to U.S. Numerical Weather Prediction (NWP)

- The U.S. NOAA HRRR/RAP NWP models are the backbone for most aviation hazard guidance products for 1-18 hour duration
- Skill of NOAA’s regional HRRR/NAM models is strongly dependent on high-quality hourly observations over the US and North America
  - Aircraft Obs are the single most important source for 1-18 hr U.S. forecasts
  - Forecast accuracy further improves with additional aircraft data and methodology (e.g., addition of expanded Alaska Airlines, WVSS-II, ADS-C)
  - Ongoing effort within NOAA to improve assimilation of ABO into global scale NWP such as NOAA’s Global Forecast System (GFS) model

- New 2013 HRRR data denial study
  - Aircraft obs more dominant than in 2011 for RAP obs denial experiments
  - Now ABO is most important obs type also for moisture/RH in HRRR

- Improved NWP by ABO Supports Aviation
  - Improved planning for higher efficiency in aviation operations
  - Less aviation delays due to unexpected weather
  - Fewer aviation incidents due to unexpected weather
Water Vapor Sensing System (WVSS-II)

**WVSS-II**

- WVSS-II enables AMDAR aircraft to report Water Vapor, for a complete profile
  - WVSS-II is specifically designed for use in the WMO AMDAR Programme
  - WVSS-II is as accurate as radiosonde instruments, as determined by WMO organized evaluations

- WVSS-II equipped aircraft satisfy WMO accuracy requirements
  - Upper Air Observations
  - Regional Forecast applications
Water Vapor Sensing System (WVSS-II)

WVSS-II Networks

**U.S. NWS WVSS-II Network**
- Currently 130 aircraft equipped
  - 25 UPS aircraft (757s)
  - 105 Southwest Airlines (737s)
  - At least 3 more SWA aircraft by end of 2015
- Looking to add others in 2015/2016
- Expanding throughout WMO Region-IV (NA) and beyond

**E-AMDAR WVSS-II Network**
- Currently 8 aircraft equipped
  - 3 Lufthansa aircraft (A319)
  - 5 Lufthansa aircraft (A320)
  - 4 more Lufthansa aircraft in 2015
- Expanding throughout WMO Region-VI (EU)
Benefits of Using WVSS-II

**WVSS-II Benefits**

- WVSS-II aircraft provide a high volume of complete Upper Air Observations
- High Data Quality, suitable for all meteorological applications
  - Traditional Thermodynamic Analysis
  - Numerical Weather Prediction assimilation
- Better Quantity/Quality of Upper Air Observations Improves Forecasting
  - Thunderstorms - Convective initiation, stability
  - Fog, Ceilings, Visibilities, and Icing
  - Precipitation intensity and type
  - Winter Weather
  - Fire Weather support
Benefits of Using WVSS-II

WVSS-II Benefits

• Regional Implementations of WVSS-II are easily achieved
  - International Cooperation with established AMDAR partners
  - Shared Network Infrastructure to minimize implementation costs
  - Can be established through partnership with a service provider

• A very low Cost / Observation
  - Under 10% the cost of radiosondes over 5 years
  - Even lower with Regional Cooperation and Cost Sharing

• Networks are Sustainable into the Future
  - No operational labor needs - sensor is fully automated
  - No training required for sensor operation
  - No routine sensor maintenance requirements
  - No costly expendable probes
AMDAR Plans

Plans

• WMO Congress-XVII - Resolution 4.2.2(1)/2 (June 2015)
  (2) Recommendation 17 (CBS-Ext. (2014)) - Enhancement and expansion of aircraft based observations
    (a) Approves this recommendation;
    (b) Requests the General Secretary;
      (i) To invite regional associations to consider further development of aircraft-based observations, primarily through wider implementation of the AMDAR programme;
      (ii) To invite regional associations to develop, maintain and implement regional plans for the enhancement and expansion of aircraft-based observations and AMDAR;
      (iii) To provide support for the coordination of the development and maintenance of these planning and implementation activities through appropriate promotion to Members and at each regional association session;

• Expand to include use of ADS-C for Met Data Reporting
  - Particularly for Oceanic Routes
  - Extensive evaluation conducted by NOAA and E-AMDAR
AMDAR – Vertical Profile Coverage

Plans - Expand the Current Coverage

- Coverage very good over USA & Western Europe;
- Coverage good over parts of Asia and Australasia;
- Coverage is poor elsewhere.

Week commencing 26 October 2014
What are WMO and Its Members doing?

• Working to develop and implement Regional AMDAR Implementation Plans as part of WIGOS implementation
  – Defining AMDAR standards (onboard software, downlink, processing, etc.)
  – Planning expansions in global spatial and temporal coverage
  – Collaborating with World Bank to enable expansion into developing nations


• Promoting AMDAR globally through COMET: https://www.meted.ucar.edu/training_module.php?id=1114#.VLTb4CvF9xB

• The WMO AMDAR Observing System: http://www.wmo.int/pages/prog/www/GOS/ABO/AMDAR/index_en.html

Thank you for your attention