Future of AMDAR in the National Weather Service

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What is AMDAR?

- Basically, it is a system that involves the regular real-time transmission of automated weather observations (wind & temperature) via equipment mounted on commercial aircraft.

- In the United States, the system used to collect and transmit real-time automated weather observations from sensors on commercial aircraft was originally referred to as the **Meteorological Data Collection and Reporting System (MDCRS)**.

- With the advent of GPS and enhancements of onboard communications systems, availability of automated aircraft reports expanded globally. The system used to collect and transmit aircraft observations is now part of a broader **World Meteorological Organization (WMO)** program referred to as the Aircraft Meteorological Data Relay (AMDAR).
NWS Sponsored Aircraft Data Workshop in Annapolis, Maryland in 2014. Meeting highlights:

- Establishment of **Office of Observations** at NWSHQ. Strong support for aircraft observation expansion and formalization of the aircraft observation program. (Louis Uccellini – NWS Director)

- NWS will maintain and expand the aircraft observation program and devote resources required to greatly improve the display of aircraft data in AWIPS II and the AMDAR webpage. (Steve Pritchett – Chief of the NWS Aircraft Observation Program)
450,000 individual data reports per day from over 3000 aircraft from 39 airlines worldwide.

Over the past 3 decades, data collected from commercial aircraft have helped reduce flight level wind/temperature forecast errors by nearly 50%.

Aircraft wind and temperature observations constitute the 3rd most important data set for global NWP and single most important data set for use in shorter-term regional NWP applications (e.g., RAP and HRRR).

Extremely cost effective data source. Sounding profiles typically cost less than 5% of a full RAOB launch.

Presents an economical alternative for obtaining tropospheric profiles both in areas of diminishing conventional observation and as a supplement to existing data sets, both in time and space.
Sample distribution of all automated wind and temperature observations over a 24 hour period from all commercial aircraft (left) and daily average takeoffs and/or landings (right).

AMDAR Data Expansion

- 3–year NOAA contract awarded to Rockwell–Collins in September 2014 for provision of new sources of meteorological observations from commercial aircraft.

- Contract provides for augmentation of current observations in both space and time and in the number of airlines reporting.
Increase Sounding Profiles

- Number of soundings from Southwest Airline (SWA) routes over U.S., Mexico and Caribbean will increase.
- UPS and FedEx will provide soundings outside the CONUS.
- American Airlines (AA) and United Airlines (UA) will expand data collection over Pacific countries and Guam.
- SkyWest and Air Wisconsin will provide new sources of observations in areas not covered by the major carriers including soundings from more data sparse regions of North America.
AM DAR Data Expansion

Route Map
AMDAR Data Expansion

- Increase en-route (flight-level) data over oceanic areas.
  - Alaska Airlines will report temperature and wind data from its Hawaii–Alaska and Hawaii–CONUS routes.
  - FedEx and UPS will report over Ocean areas outside of CONUS.
  - New source of aircraft observations from U.S. West Coast destinations from UA and AA aircraft incoming from the Pacific.
Increased Observations Over Oceans

ADS-C vs MDCRS report positions – January 26-30, 2015 from ADS-C reporting aircraft

ADS-C allows additional observation reports over the oceans.
Most – but not all – ADS-C data contained within NAM grid.
Water Vapor Sensing System (WVSS–II) was designed specifically for measuring atmospheric water vapor from commercial aircraft in support of the global AMDAR program.

WVSS–II has undergone numerous independent assessments and evaluations that revealed WVSS–II measurements are at least as accurate as water vapor observations from high-quality RAOBs.

The network of aircraft equipped with the Water Vapor Sensing System (WVSS–II) has grown steadily over last 5 years and has become a significant contributor of in-situ data for the U.S. Upper Air Observations Program.

Currently 132 aircraft equipped with WVSS–II sensors. Southwest Airlines (SWA) = 107 and UPS = 25.

With the benefits to forecast operations demonstrated, plans are for further expansion of the WSVV–II network and research into new applications leveraging this data.
WVSS II Hardware

System Electronics Box (SEB)

Hoses

Air Sampler

DB-26 for RS-232 Data Output in Research and Test Configurations

Standard Aircraft Power/Data Connector
24 hours of WVSS II Soundings


29-Jul-2015 15:00:00 -- 30-Jul-2015 14:59:59 (71535 obs loaded, 69563 in range, 20643 shown)
WVSS II Soundings

LES Environment
26 February 2015 (right)
(MDW Ascent Sounding)

Icing Environment
21 December 2013 (left)
(MDW Descent Sounding)
WVSS II Soundings – Temporal Resolution

4 MKE profiles between 1346 and 1432 UTC
WVSS II Soundings – Temporal Resolution

4 MDW profiles between 1219 and 1352 UTC
WVSS-II Examples

12 August 2015

Strengthening CAP
WVSS-II Examples

Strengthening CAP

1 August 2015
WVSS-II Examples

18 July 2015

GRR Soundings
1925 & 2021 UTC

2105 UTC

severe/tornado risk to spread ewd – possibly requiring wrw
March 2, 2012 Severe Storms

- Special 18 UTC RAOB launches were requested by SPC in support of an anticipated significant severe weather outbreak.

- Seven NWS offices conducted special releases that afternoon.

- At least three of them were not needed, as suitable aircraft soundings were available.

- The following slide has the
Cost Saving Measure

Locations of special 18 UTC releases and tracks of WVSS–II aircraft.

AMDAR Web Page

Special NWS Radiosonde Locations Denoted By Stars

WVSS-II Soundings available between 1600 and 1900 UTC on 3/2/2012
Currently requires several steps to display aircraft sounding in AWIPS. Inefficient and tedious. Hinders operational use.

One year contract awarded to UW Madison/CIMSS.

Primary focus to improve display capability of aircraft profiles within AWIPS II and develop forecaster training material (particularly value of WVSS II observations).

Other areas of focus include:
- WVSS–II / NWS RAOB comparisons
- GFS sensitivity studies for possible incorporation of WVSS–II into the GFS.
AMDAR Data Display Improvements

Clickable Points Feature

- Simply click on point (black dots) to display sounding.
- Overlay on any image. Time Matching.
AMDA Data Display Improvements in AWIPS II

AMDA Web Page

Load Select Show: WindSpd Barbs Soundings
Un-zoom Default World Overlays Overall

Slider Bar Capability

24-Aug-2015 12:00:00 -- 24-Aug-2015 15:33:00 (110140 obs loaded, 12326 in range, 264 shown)

NOAA / ESRL / GSD  Altitude: -500 ft. to 17000 ft.

All data
Clickable Points Feature

- Simply click on point (black dot) to display sounding.
- Overlay on any image. Time Matching.
- Slider bar to constrain reporting altitude.
- Distinguish soundings containing moisture.
- Overlay with other sounding data (Model, RAOB).
- Animation/trends?
- Your Ideas?
Will transition from ESRL to MADIS
Will allow for 24 hour support
WMO considering display capability to member nations
Provide Archive
AMDAR data have been restricted by the airlines to the airlines themselves, the NWS, defense department and university researchers.

A new contract will permit the NWS to distribute the WVSS–II data to the private sector and public in real-time starting at the end of this year.

Moving these data to the public domain will allow it to be leveraged by pilots, dispatchers, private weather companies, etc.

Data will be provided via the MADIS web page.
WMO AMDAR Web Page

AMDAR and Aircraft-based Observations
Papers and References

Contents
1. ABO & AMDAR Systems Operation
2. ABO & AMDAR Use in & Impact on NWP
3. Upper Air Comparisons
4. ABO & AMDAR Use in Forecast Applications

Links
NOAA, GSD References

ABO & AMDAR Systems Operation

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Title</th>
<th>Published</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barth, M.F., P.A. Miller, and A.E. MacDonald</td>
<td>2002</td>
<td>MADIS: The Meteorological</td>
<td>Symposium on Observations, Data Assimilation, and Probabilistic</td>
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Questions?

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