WORLD METEOROLOGICAL ORGANIZATION

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JOINT MEETING:
CBS EXPERT TEAM ON AIRCRAFT BASED OBSERVATIONS
(Third Session)
AND
AMDAR PANEL
(Fourteenth Session)

ITEM: 3.4.1

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AMDAR PROGRAMME STATUS

Status Reports on National and Regional Programmes

Established AMDAR Programmes
Unites States of America

(Submitted by USA)

SUMMARY AND PURPOSE OF DOCUMENT

This document provides an update on the activities and plans, since the 13th Meeting of the AMDAR Panel, for the USA AMDAR Programme.

ACTION PROPOSED

1. The Panel is invited to note the information contained in the document.

GSD ACTIVITIES

Current Status:

1. Repeated reports from NCEP plus actions by Dean Lockett and various South Africans have resulted in a fix to the prolonged problem of groups of AMDAR reports at wrong locations.

2. Diagnostic reports from NCEP to Stewart Taylor led to fixes of different E-AMDAR aircraft reports where the reported locations would bounce off the Equator like light hitting a mirror.

3. Diagnostic reports from NCEP to Stewart Taylor led to fixes of different E-AMDAR aircraft that had reported temperatures that where one tenth the correct value.

Development and other Activities:

4. Codes are being developed at NCEP to give very timely alerts for aircraft with quality problems, where combinations of large problems and rapid reporting rates will yield the quickest diagnoses of problems.

Future Plans:

5. In cooperation with Dave Helms, NCEP could use current diagnostics on MDCRS data to allow ARINC to add data quality flags to the data before transmission on the GTS.

TAMDAR

Current Status:

6. In November 2010, NOAA entered a new contract with AirDat, LLC for the continued provision of TAMDAR data. As was the case with the previous contract, data from airports in Alaska and across the eastern CONUS are purchased.

7. To ensure value for the price, only "qualified"* soundings are being provided. These qualified* soundings average 53 daily.

Development and other Activities:

8. To support NWS watch/warning/forecast efforts during Hurricane Irene, NOAA purchased all available TAMDAR data from August 25, 2011 through August 29, 2011. During this period, sounding volume grew to more than 800 per day.

Future Plans:

9. Again, all future plans for purchasing TAMDAR data continue to be budget/pricing dependent. Under the current situation, NOAA likely will continue to make the PenAir TAMDAR data available to our Alaska offices.

*"Qualified" is defined in the 2009 data thinning strategy.

MDCRS ACTIVITIES

Current Status:

10. In late September, the FAA and ARINC signed a new MDCRS contract. The base period is for one year with four option years to follow.
11. 110 Alaska Airline (AS) B737 aircraft were added to the USA AMDAR fleet in April 2011. These data made the largest increase in USA AMDAR observations (40%) in the last 10 years (noting a substantial increase in 2007 with the entry of 50 B737 Southwest Airlines aircraft into the USA AMDAR fleet).
12. Approximately 1,700 aircraft operated by seven US airlines (American, Alaska, Delta/Northwest, FedEx, United, United Parcel Service, and Southwest) participate in the US AMDAR program.
13. These aircraft provide an average of nearly 200,000 observations daily.

Development and other Activities:

14. The implementation of an optimization capability is being discussed by NOAA and ARINC. This would allow selection of reporting aircraft based on their time of departure or arrival at specific airports. Reporting from other aircraft could be turned off to reduce the required communications bandwidth.

Future Plans:

15. The new MDCRS contract will help steer plans for the next 5 years. Also, future budgets will play a key role in expansion and optimization activities.

TURBULENCE ACTIVITIES

Current Status:

16. Graphical Turbulence Guidance 2 (GTG2) operational on NWS Aviation Weather Center’s Aviation Digital Data Service (ADDS) web page.
17. EDR Deployments:
    a. United Airlines B-757s - ~100
    b. Delta Air Lines B-737s - ~80
    c. Southwest Airlines B737s - ~10

Development and other Activities:

18. GTG2.5 (with calculations modified to accommodate finer grid resolution of the Weather Research and Forecasting Model Rapid Refresh [WRF-RR]) passed Technical Review Panel Aug 25, 2011; scheduled for operational implementation concurrent with WRF-RR ~1 quarter FY12.

19. Deployment of EDR onto Delta Airlines (DAL) B-767s began in FY11. Scheduled for completion in FY12. This will give additional CONUS coverage, as well as some transoceanic/trans-equatorial flights.

20. Eighteen month FAA/DAL EDR Proof of Concept Demonstration completed in January 2011. Demonstration involved Dispatchers and Flight Crews at DAL utilizing EDR and GTG via Experimental ADDS in strategic and tactical flight routing decisions. Goal was to document NAS capacity improvements and fuel burn cost savings to airline due to decreased time off altitude. Final report in coordination.

Future Plans:

21. Enhance GTG product to include Clear Air Turbulence and Mountain Wave Turbulence for all flight-levels Surface to FL450. Planned operational date: Late FY13.
22. Begin EDR Uplink Demo with DAL in FY12. The purpose of the DEMO is to:
    a. identify the feasibility of providing GTG/EDR information to the flight deck,
    b. identify human factors considerations, and
    c. quantify the safety, efficiency, and capacity benefits to the NAS.

ICING ACTIVITIES

Current Status:

23. Forecast Icing Product (FIP) Severity with probabilities became operational in ADDS in FY2011.

Development and other Activities:

24. Current Icing Product (CIP) and FIP software to be updated from RUC model to WRF-Research Applications Program (RAP) model in FY2012.

25. Developing updated versions of CIP and FIP for NextGen Initial Operating Capability

Future Plans:

26. Develop FIP Alaska tentatively scheduled to be operational in FY2014

27. Develop CIP Alaska tentatively scheduled to be operational in FY2015

WVSS-II CONTRACT ACTIVITIES

Current Status:

28. To date, WVSS-II installations have been completed on 29 Southwest Airlines (SWA) aircraft.
29. Twenty-five WVSS-II units installed on UPS aircraft are operating normally.
30. These 54 aircraft report an average of nearly 18,000 moisture observations daily.

Development and other Activities:

31. The last two of the first lot of 31 WVSS installations are now scheduled to be completed in December.
32. Installation of the second lot of 36 WVSS will begin early next year and is expected be completed within 18 months.
33. SpectraSensors, Inc. is expected to receive a Supplemental Type Certificate (STC) for installation of the WVSS on 737-700 aircraft at the start of 2012.

Future Plans:

34. Again, the budget situation and any WVSS-II price changes ultimately will be the determining factor on the rate the units will be purchased and installed.

WVSS-II EVALUATION ACTIVITIES

Assessment of WVSS-II vs. Rawinsonde data during 2009-2010 at Rockford, IL

Current Status:

Background: The Cooperative Institute for Meteorological Satellite Studies (CIMSS) University of Wisconsin-Madison (UW) has continued intercomparison analyses of the co-located rawinsonde and WVSS-II data taken on evenings during fall 2009, spring 2010 and summer 2010 at Rockford, IL (RFD). Rawinsonde observations were taken using Vaisala model RS-92 instruments with new humidity sensors at approximately 3-hourly intervals, immediately before, after and between periods when UPS-757 aircraft equipped with the WVSS-II instruments landed and departed. Unlike previous intercomparisons, the analysis shown here was done using all available data from all aircraft, excluding those with known engineering failures.

Development and other Activities:

Several new assessment activities were outlined in the last report. These included:

1 – Interpolating the two rawinsonde reports bounding the WVSS-II observations to the WVSS-II observations should remove accounting for large scale, systematic advection processes that could bias the comparisons.

2 – Adjusting distance criteria used in filtering the WVSS-II data to be more consistent with the parcel displacement distance expected from the mean winds observed during the test period.

3 – Adding wind observation variability limits to the statistical analysis process to provide an independent standard for identifying periods of low and high natural atmospheric variability.

Results of these activities are discussed below.

Results:

Statistical Assessment: Summary statistics were re-calculated over the entire test period comparing all aircraft observations (ascent and descent) to the nearest rawinsonde report. For these calculations, an additional set of criteria were used to limit the temporal difference in relative humidity (RH) between successive reports to be <7% and vertical differences between adjacent vertical levels to <10%. The effect of this was to eliminate both the effects of scattered clouds that could have been along the rawinsonde trajectory and to eliminate cases where shallow banks of moisture and fronts were moving vertical during the test period.

Although only time differences of less that 1 hour were allowed in the previous inter-comparisons, tests were performed to assess the impact that linear time interpolation of the rawinsonde observations would have on the colocation results. Overall, the effect of adding the time-change information to the rawinsonde observations reduced both the standard deviation and bias of the differences between the WVSS-II and raob data for the full 3-season observation period by 15 to 20%. The overall values for specific humidity (SH) bias and standard deviation were lowered from 0.18 to 0.14 g/kg and 0.71 to 0.61 g/kg respectively.

As another measure of the robustness of the WVSS-II observation, intercomparisons were computed between WVSS-II observation pairs made within specific time, height and spatial limits. The results presented in Figure 1 indicate both that the variability decreases systematically with both time and space separation, and more importantly, that WVSS-II observations taken within 15 minutes, 20 km and 55 m altitude of each other agreed to within better than 0.18 g/kg. Even using the longer 60-minute and 60-km limits (periods comparable to those used in the rawinsonde-to-WVSS-II comparisons), the variability is <0.45 g/kg. The fact that this figure is much lower than that obtained in the rawinsonde-to-WVSS-II inter-comparisons, indicates that a substantial portion of the difference detected in the multiple instrument intercomparisons may have been due to errors in the rawinsonde reports.

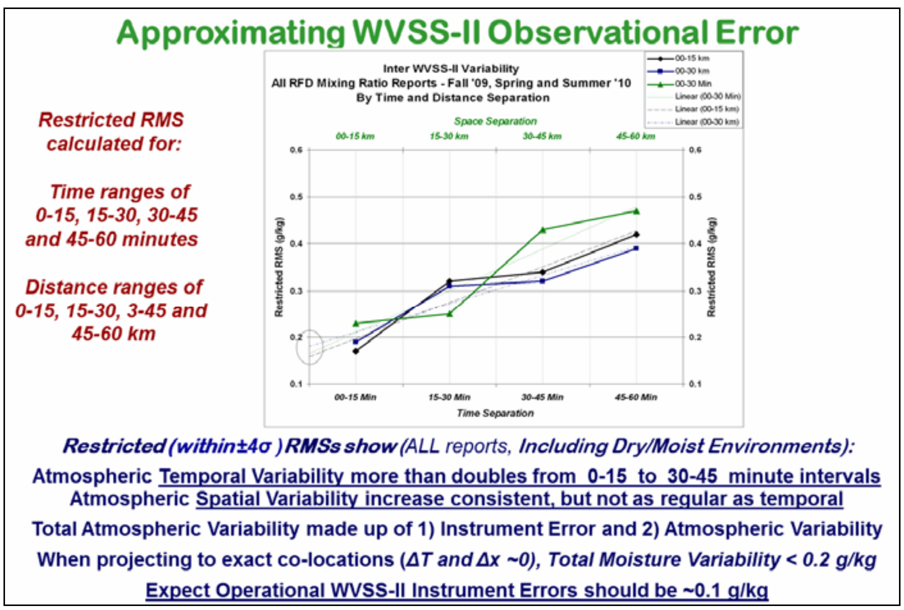

Figure 1 – Variability (Restricted RMS) of specific humidity observations between nearby WVSS-II observations by time difference and range interval for all levels from the surface to 5km throughout the full intercomparison period.

For other variables, the inter-aircraft comparison improvements that resulted from decreasing the inter-comparison ranges from 45-60 minutes (distance range between 0-15 km) and 45-60 km (distance range between 0-30 minutes) were:

Variable	*Derived Variability for perfect co-locations*	*Observed Variability @ 45-60 km and 45-60 minutes*
Specific Humidity	*~0.18 g/kg*	*~0.45 g/kg (both)*
Temperature	*~0.6°C*	*~1.0°C (both)*
Derived Relative Humidity	*~4%*	*~11% and ~6% (respectively)*
Vector Wind RMS	*~2.5m/s*	*~3.5 m/s (both)*

The regular availability of repeated observations at and around individual airports from different aircraft equipped with high-quality in-situ sensors provides both:

1 – A means to monitor the quality of WVSS-II observations from individual aircraft at a-synoptic times,

2 – A basis for separating analyses of not only spatial and temporal variability required for optimal use of the data in numerical weather prediction, but also

3 – A framework for separating instrument error from atmospheric variability (if other baseline observations are available), another important aspect not yet included in mesoscale data assimilation systems.

Summary: When the large match-up differences that are probably due to small-scale natural variability are excluded, the re-engineered WVSS-II systems appear to meet WMO observing requirements across all SH ranges and in both ascent and descent. The engineering changes made to the WVSS-II since 2008 seem to have alleviated the problems with data taken during descent observed in earlier tests.

Overall, the WVSS-II SH observations match the rawinsonde data very closely, with random differences ranging from 0.2 to 0.7 g/kg at all levels, well within WMO recommendations. Although the data show a slight moist Bias (ranging from 0.1 to 0.4 g/kg), the Bias should be correctable in post-processing if the WVSS-II data are monitored regularly. Intercomparison within the WVSS-II data set observations made within 15 minutes, 60 km distance and 55 m altitude showed variability of less than 0.18 g/kg, exceeding the performance of most, if not all, other operational data sets. These aircraft-to-aircraft inter-comparisons also provide important information about changes in atmospheric variability both with time and space that will be important in optimal use of all AMDAR observations in future mesoscale NWP systems.

Future Plans:

1. As part of a project funded by the NOAA GOES-R program, data bases are being established at CIMSS to allow the WVSS-II data to be compared to a variety of land- and space-based observations. Although the primary objective will be to use the WVSS-II data as a validation standard, the results also should provide information as to other means of monitoring the quality of individual asynoptic WVSS-II reports using existing operational data sets.
2. If funding is available, aircraft-to-aircraft monitoring will continue to assess both sensor performance and sensor aging.
3. Interactions also should be considered in which the information about spatial and temporal variability already available from the limited WVSS-II sets are used to improve the assimilation of the WVSS-II data in mesoscale NWP systems.