NOAA's Deployment of the Water Vapor Sensor System (WVSS II)

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Through a partnership with the Federal Aviation Administration, University Corporation for Atmospheric Research, United Parcel Service (UPS), and SpectraSensors, NOAA is developing a new water vapor sensor which will eventually fly along with the packages and passengers of many of the Nation's commercial air carriers. The Water Vapor Sensing System (WVSS II) sensor, contained in a cigar box-sized housing, consists of a diode laser which samples the air and reports environmental humidity to meteorologists every six seconds. Installation of the first 25 WVSS units is projected to be completed by May 31 with a field assessment scheduled for mid June. A national installation of WVSS sensors on UPS and other commercial aircraft is planned, contingent on field test results and program funding. WVSS will provide the first operational, climate quality, water vapor sensor information available routinely in between the 12 hour intervals when NOAA launches its radiosonde weather balloons. This weather sensor development activity is part of NOAA's contribution to the Global Earth Observation System of Systems (GEOSS).

Development and Installation: A Public/Private Partnership

Public/Private Partners in the Developers of the WVSS II: UCAR, NOAA, FAA, SpectraSensors, and United Parcel Service

WVSS II Diode Laser

WVSS II Sampler installed On a NOAA P-3 Research Aircraft

Photo Credit: Rex Fleming and NOAA/NMAO

WVSSII Installation at United Parcel Service Maintenance Facility

Photo Credit: UPS Dispatch
Contact for Usage: Randy Baker/UPS; Email: air1rtb@ups.com

"Cargo-Door" View WVSSII
WVSSII Located on Forward-Port Side of UPS B-757

Photo Credit: UPS Dispatch
Contact for Usage: Randy Baker/UPS; Email: air1rtb@ups.com

Field Assessment: Collecting Research Quality Data for Sensor Performance Assessment

Cooperative Institute for Meteorological Studies (CIMSS)
http://cimss.ssec.wisc.edu/wvssii/

UW-Madison

The objective of this study was to: ***To assess the accuracy of WVSS-II humidity data by comparing it with radiosonde and ground based remote sensing systems,***

25 UPS B757 aircraft providing WVSS-II data through MDCRS for assessment during June 2005.

In order to avoid the logistical complications of launching radiosonde in areas of congested air traffic near major airports, the tests will be conducted at the UPS hub in *Louisville* – where about 80% of the WVSS-II equipped planes land / take off daily.

Assessment data sets available from the UW mobile system and CIMSS include:

- ✓ **A infrared AERI system** *(very high time frequency T/Q profiles)*
- ✓ **Surface GPS** *(Total moisture content)*
- ✓ **Surface Observations** *(Temp, Wind, Moisture, Ceiling)*
- ✓ **Portable GPS rawinsonde system**
- ✓ **Geostationary and Polar Satellite data**

Approximately 2 weeks of collocated radiosonde and aircraft data were be collected with radiosonde launched 3 times nightly, immediately before, between and after periods of multiple aircraft arrivals/departures. ***More than 5 co-locations (with less than 1 hour time difference) were obtained daily.***

Measurements included the full complement of atmospheric state variables – Temperature, Wind Direction / Speed, and Humidity.

Because the accuracy of the B757temperature and wind sensors is known, WVSS-II assessments focused on the accuracy of water vapor measurements throughout the full depth of the troposphere

Comparisons available in near real timeshowed generally excellent agreement, especially in the lower troposphere.

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Data Analysis: Assessment of Field Testing Data Against Performance Standards

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WVSS II EVALUATION METHODS

Ongoing evaluations are being made of the performance of a variety of factors important for the optimal objective use of the aircraft data in combination with other data sources by assessing:

Similarity **of reports from the different observing systems,**

Biases **that exist between ascent and descent reports from individual aircraft,**

Variability **in reports between different aircraft *(to assess accuracy of individual instrument calibration and the effects of instrument aging),* and**

Capabilities **of the systems to capture sharp moisture gradients accurately, including after an aircraft emerges from clouds.**

- **Data assessment results will be presented at the 2006 American Meteorological Society annual meeting in Atlanta**
- **A follow-on assessment is expected after completion of the second field test in March 2006**

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Data Monitoring and Application: Accelerating Research to Operations

NOAA Office of Oceanic and Atmospheric Research Forecast System Laboratory

http://acweb.fsl.noaa.gov/

- **Decode UPS Tail #s ACARS messages containing WVSS II data into Forecast Systems Lab (FSL) Aircraft Observations**
- **Include CIMSS AERIBAGO RS-92 Radiosonde Soundings in ACARS Database**
- **Support archive and retrieval of WVSS II field assessment data**
- **Distribution of WVSSII data via the web and netCDF formatted data**

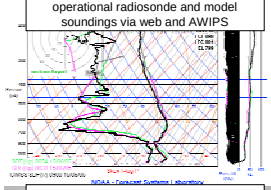
WVSS II: Currently available 40 Airports and 90+ soundings per day

NOAA National Weather Service Field Assessment

http://www.crh.noaa.gov/tamdar/

- **Distribution of WVSS II via NOAAPORT**
- **Display of WVSS II data in AWIPS within MDCRS Data Stream**
- **Performance Feedback through**
  - ✓ **Area Forecast Discussions**
  - ✓ **On-line Surveys**
  - ✓ **Case Studies**

WVSS II: Real-time Comparisons with operational radiosonde and model soundings via web and AWIPS

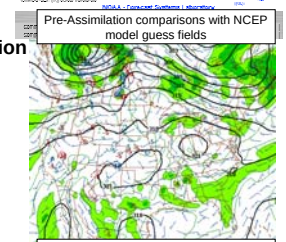


NOAA National Weather Service National Centers for Environmental Prediction

http://www.ncep.noaa.gov/

- **Pre-implementation testing:**
- **Quality control for model runs**
  - ✓ **Automated QC on incoming data stream**
  - ✓ **Manual QC for cases of egregious moisture problems**
- **Reporting**
  - ✓ **Monthly reports on WVSS2 moisture quality**
  - ✓ **Weekly updates to the reject-list for problem units**
  - ✓ **Data monitoring results posted to a public web-site**

Pre-Assimilation comparisons with NCEP model guess fields

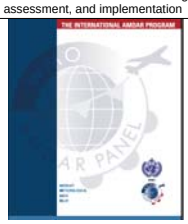


World Meteorological Organization AMDAR Panel

http://www.nws.noaa.gov/ost/amdar/WMO_AMDAR_Flyer_2004.pdf

- **Coordination of internationally accepted testing protocols**
- **Development of communications formats and standards**
- **Accelerated flight certification of sensor on wide variety of aircraft, including Boeing and Airbus**
- **Coordination of WVSS II testing and exploitation with EUMETNET/EUCOS, Australia, and South Africa**
- **Seeding successes of National Aircraft Observation Programs, like U.S. MDCRS, to other countries like China, South Africa, and Brazil.**

International coordination of testing, assessment, and implementation



WVSS II End-State: Integral component of NOAA's Integrated Earth Observing System

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