

Use of AMDAR data by Desk Aviation Forecasters

Presentation to
CAeM Technical Conference
21 November 2006

by

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System Description

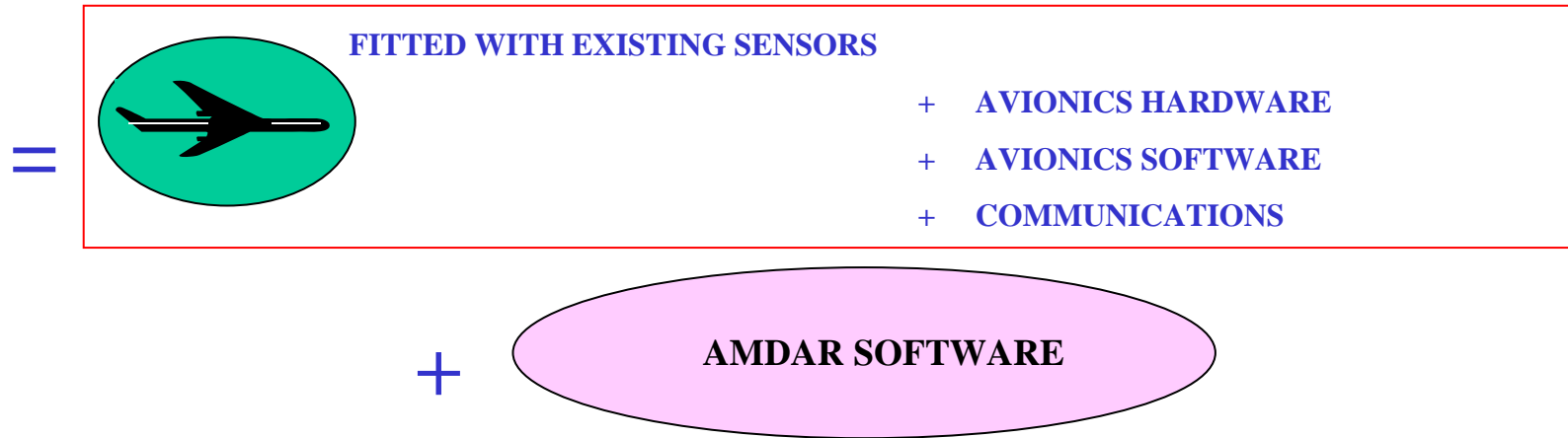
AMDAR = Aircraft Meteorological DAta Relay

AMDAR is:

- A fully automated upper air observing system;
- Collects high quality upper air observations of wind speed and direction, temperature, and can include turbulence and humidity;
- Available from many existing commercial aircraft; and
- In collaboration with national domestic and international airlines.



System Description



Uses existing aircraft and airline infrastructure including:

- standard installed high quality sensors for wind, temperature and turbulence plus height (pressure), time and position;
- onboard avionics and communications hardware and software; and
- Airlines normally use the international communications system called Aircraft Communications And Reporting System (ACARS). Global services are provided by 2 companies – ARINC and SITA.

Why is AMDAR Data Needed?

- To meet the NWP community's requirement for greater quantities and improved coverage of relevant upper air data;
- For forecast verification;
- To provide data from data sparse areas around the world to improve local forecasts and to contribute to the WMO World Weather Watch Global Observing System; and
- AMDAR data have similar accuracy to that of radiosonde data and can be used in the same manner. A typical AMDAR vertical sounding of temperature and wind produces a profile that is typically less than 1% of the cost of a radiosonde profile.



Why is AMDAR Data Needed?

Real time high quality vertical profiles of AMDAR temperature and wind have proven to contribute significantly to the improvement in short to medium-term forecasting applications. AMDAR is particularly useful for now-casting situations where conditions are changing rapidly and are therefore of special use to the aviation industry. Such applications include:

- Surface and upper air forecasts of wind and temperature;
- Thunderstorm genesis, location and severity;
- Wind-shear location and intensity e.g. dangerous low-level jets;
- Low cloud and fog formation, location and duration;
- Turbulence location and intensity; and
- Jetstream location and intensity.



AMDAR Data Requirements

Desirable Horizontal Spatial and Temporal Density:

1 profile on 250 km grid at 3 hourly intervals

BASIC Data

Element	Unit	Range	Output resolution	Desired accuracy
Pressure Altitude	Foot (ft)	-1000 to 50000	10	100 ⁽¹⁾
Static Air Temperature	°C	-99 to 99	0.1	0.5 ⁽²⁾
Wind Direction	° from true N	1 to 360	1	Note (2,3)
Wind Speed	Knot (kt)	0 to 800	1	Note (2,3)
Latitude	Degree:minute	90:00S to 90:00N	1.0min	Note (4)
Longitude	Degree:minute	180:00E to 180:00W	1.0min	Note (4)
Time (UTC)	Hour:Minute:Second	00:00:00 to 23:59:59	1 min	1s

Notes:

- (1) required to preserve temperature accuracy
- (2) WMO requirement for NWP in troposphere
- (3) 2ms^{-1} (4kt) vector error
- (4) 5Nm equivalent (specified for ASDAR)



AMDAR Data Requirements (cont.)

Additional Data

Element	Unit		Output resolution	Desired accuracy
Maximum wind	kt	0 to 800	1	4
Turbulence (g)	$g^{(4)}$	-3 to 6	0.1	$0.15^{(1)}$
Turbulence(DEVG)	ms^{-1}	0 to 20	0.25	$0.5^{(1)}$
Turbulence(EDR)	$m^{2/3}s^{-1}$	0 to 1	0.05	$0.1^{(1)}$
Humidity(RH)	%	0 to 100	1	$5^{(2)}$
Humidity (dew pt)	$^{\circ}C$	-99 to +49	0.1	Note 5
Humidity(mixing ratio)	gram/kg	0 to 100	0.001	$1:10^3$ (measurement) ⁽³⁾

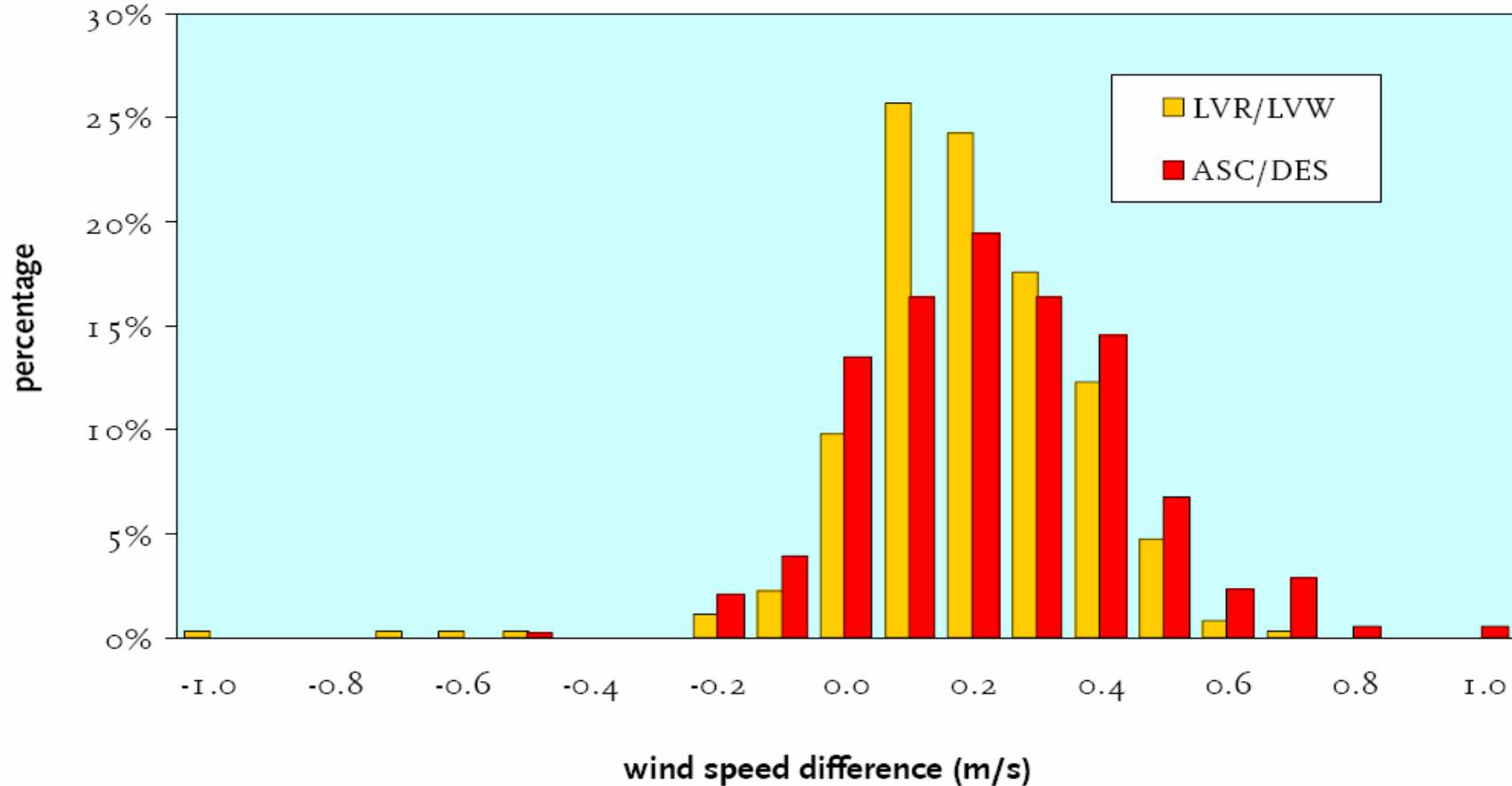
Notes:

- (1) Determined by output categories required
- (2) WMO requirement for NWP in troposphere
- (3) To meet stratospheric humidity requirement
- (4) Acceleration due to gravity. 'Zero' reference on aircraft is usually +1.
- (5) Equivalent to 5% RH error.



Data Quality

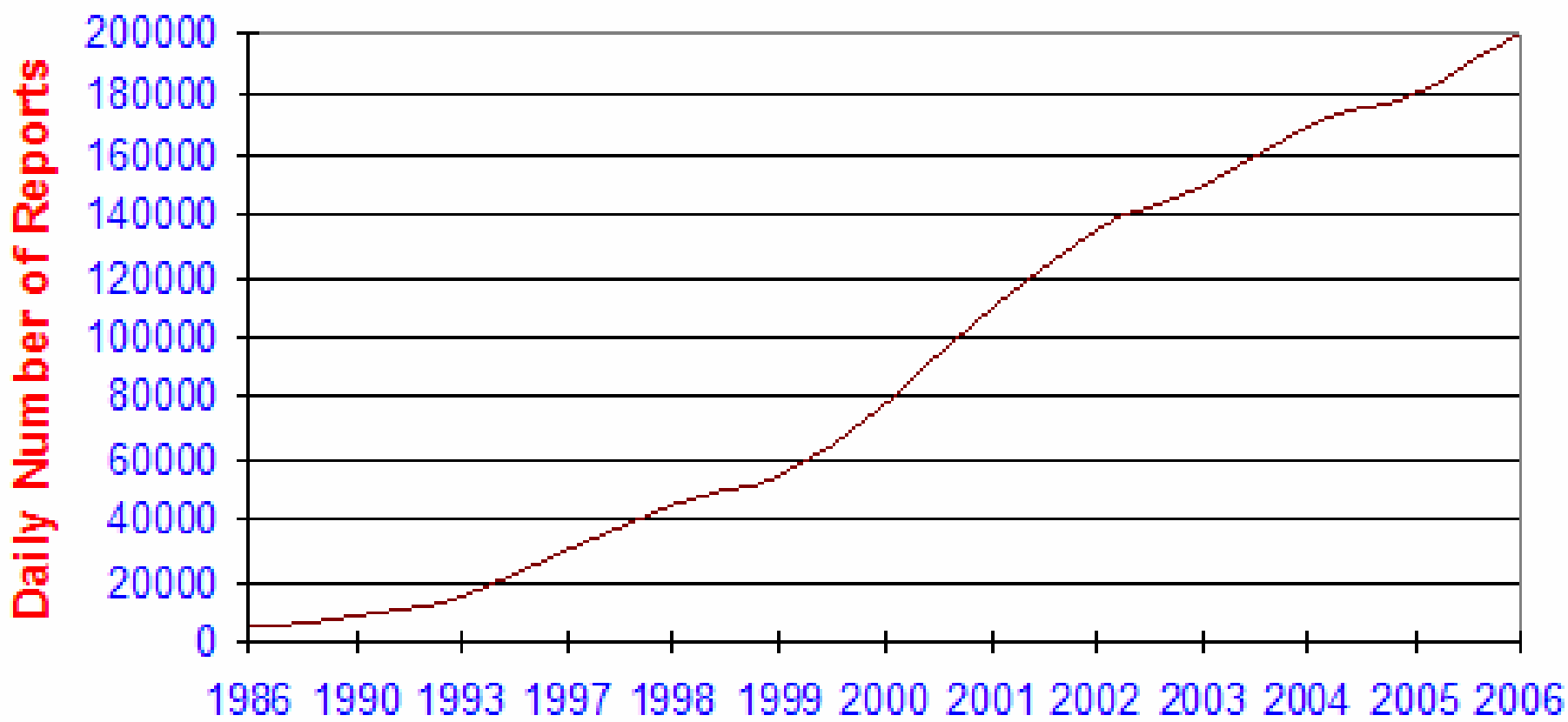
O-B wind speed difference distribution
QEvC 2004Q01



Frequency distribution OBS-Background KNMI QEV Report – January – March 2004



Growth in AMDAR Data



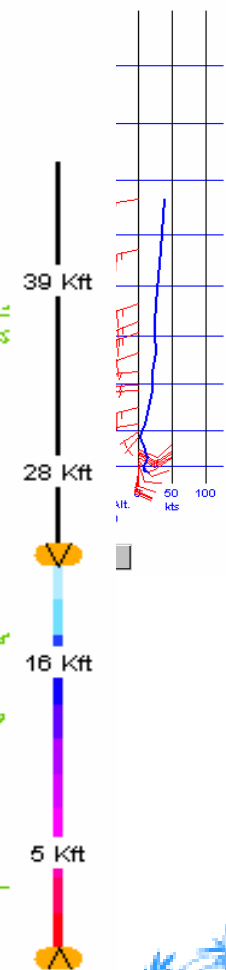
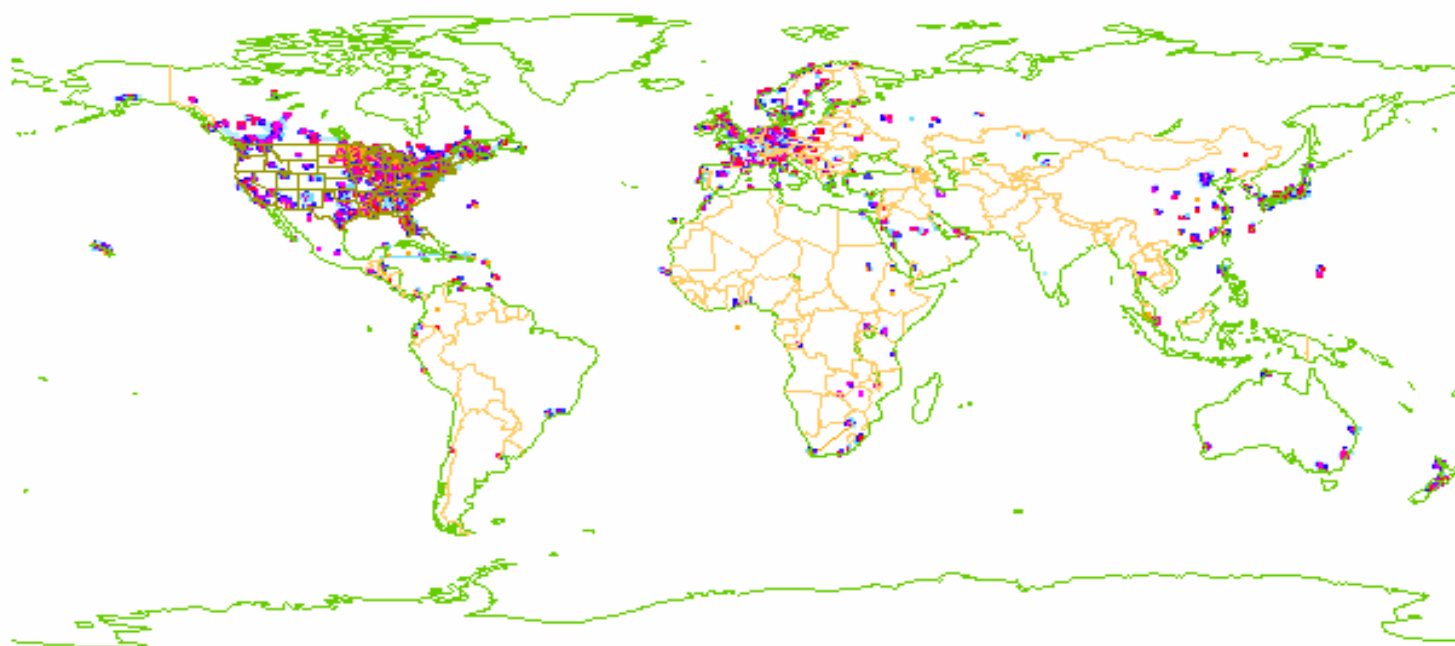
24 Hour AMDAR Coverage

9 November 2006

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Load Select Show: WindSpd Barbs Soundings

Un-zoom Default World Overlays Overview



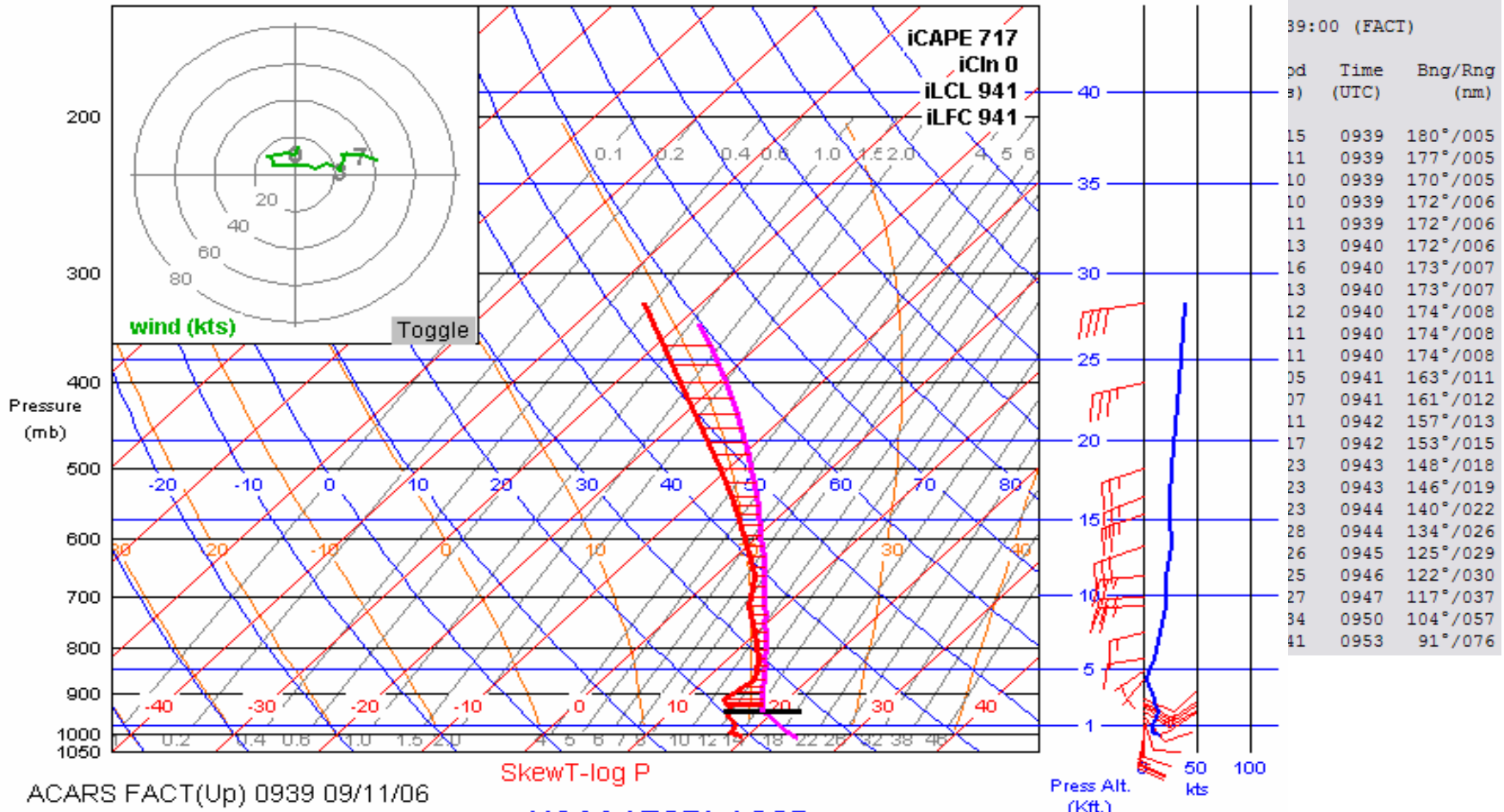
08-Nov-2006 00:00:00 -- 08-Nov-2006 23:59:59 (266748 obs loaded, 153052 in range, 2836 shown)
09-Nov-2006 00:00:00 -- 09-Nov-2006 23:59:59 (200001 obs loaded, 1707 in range, 730 shown)

Courtesy NOAA ESRL/GSD



AMDAR Soundings

Ascent (AC# 8652), 09-Nov-2006 09:39:00 (FACT)



Courtesy NOAA ESRL/GSD

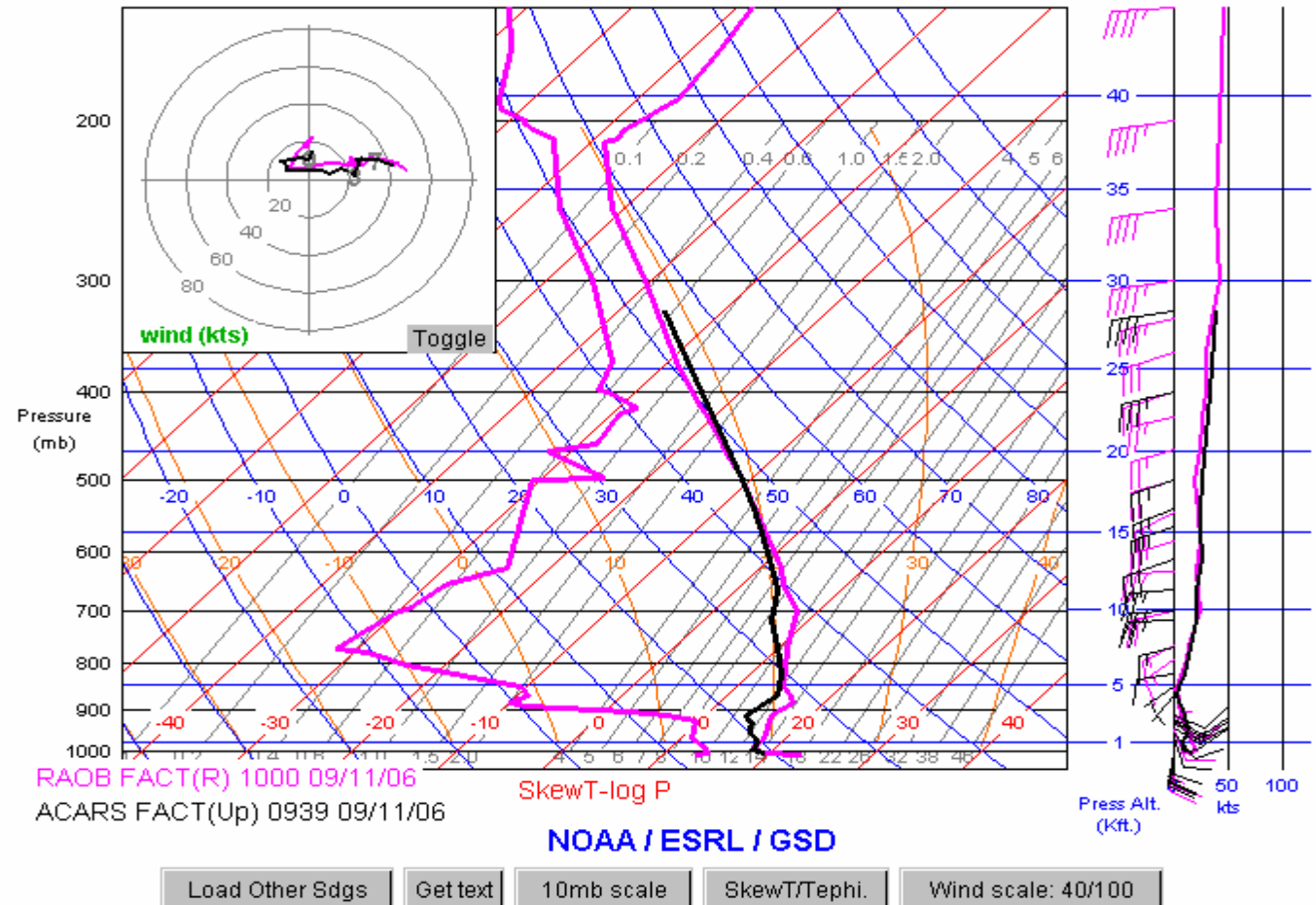


Loading Other Soundings

Ascent (AC# 8652). 09-Nov-2006 09:39:00 (FACT)

OPTIONS:

- User can select additional soundings, including radiosonde soundings.
- Additional soundings can be added to existing sounds for comparison

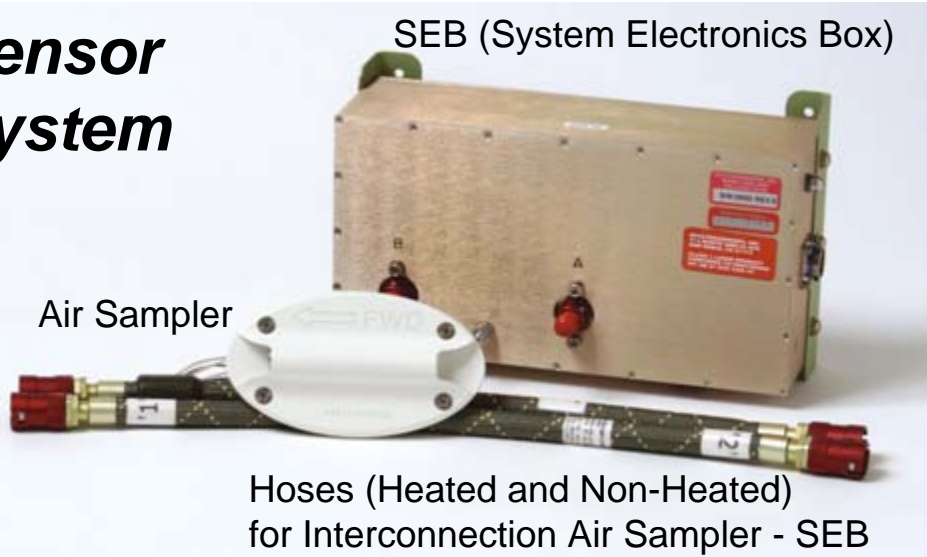


Courtesy NOAA ESRL/GSD



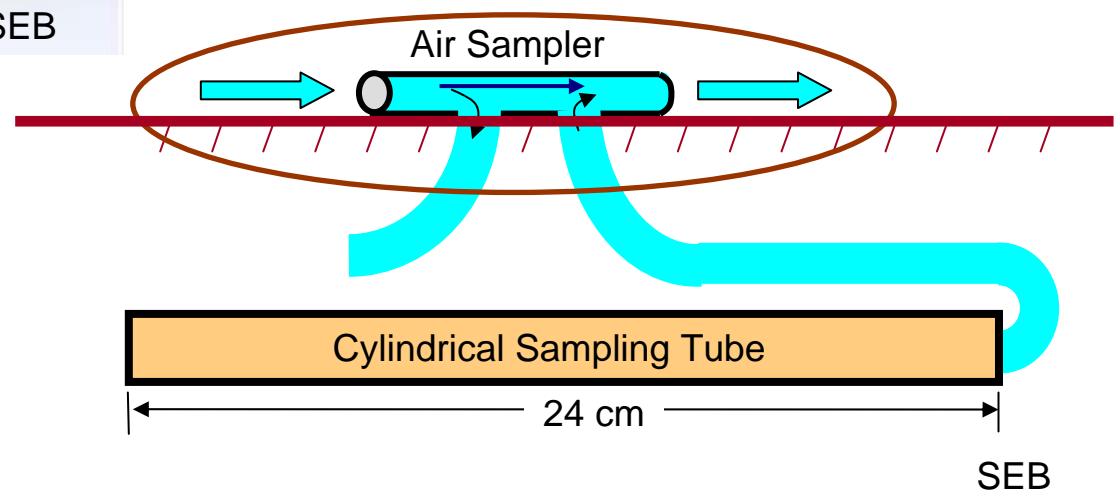
AMDAR Humidity Measurement

Sensor System



SpectraSensors, WVSS-II

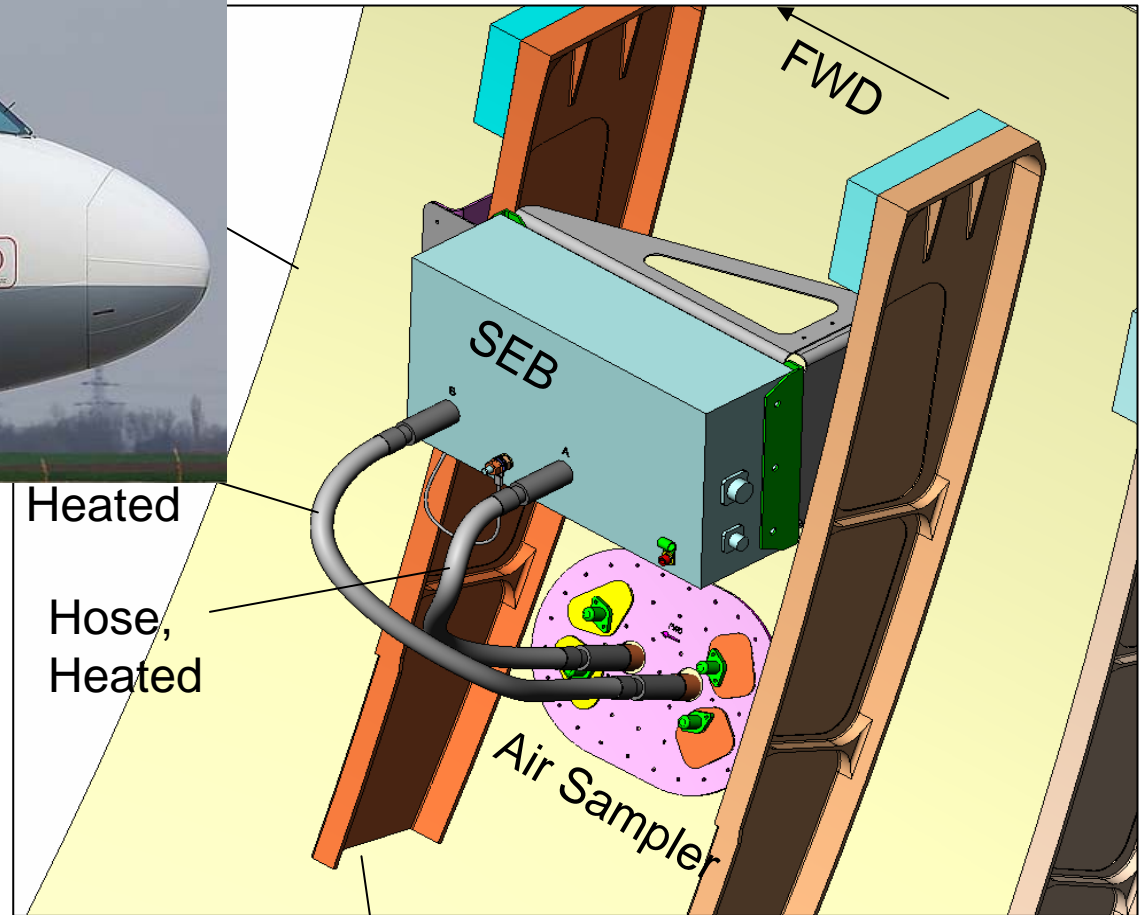
- Near-Infrared Absorption Spectrometer Based on Tunable Diode Laser
- Heated Inlet Hose
- Output:
Water Vapor Mass Mixing Ratio



AMDAR Humidity Measurement



Air Sampler



Heated

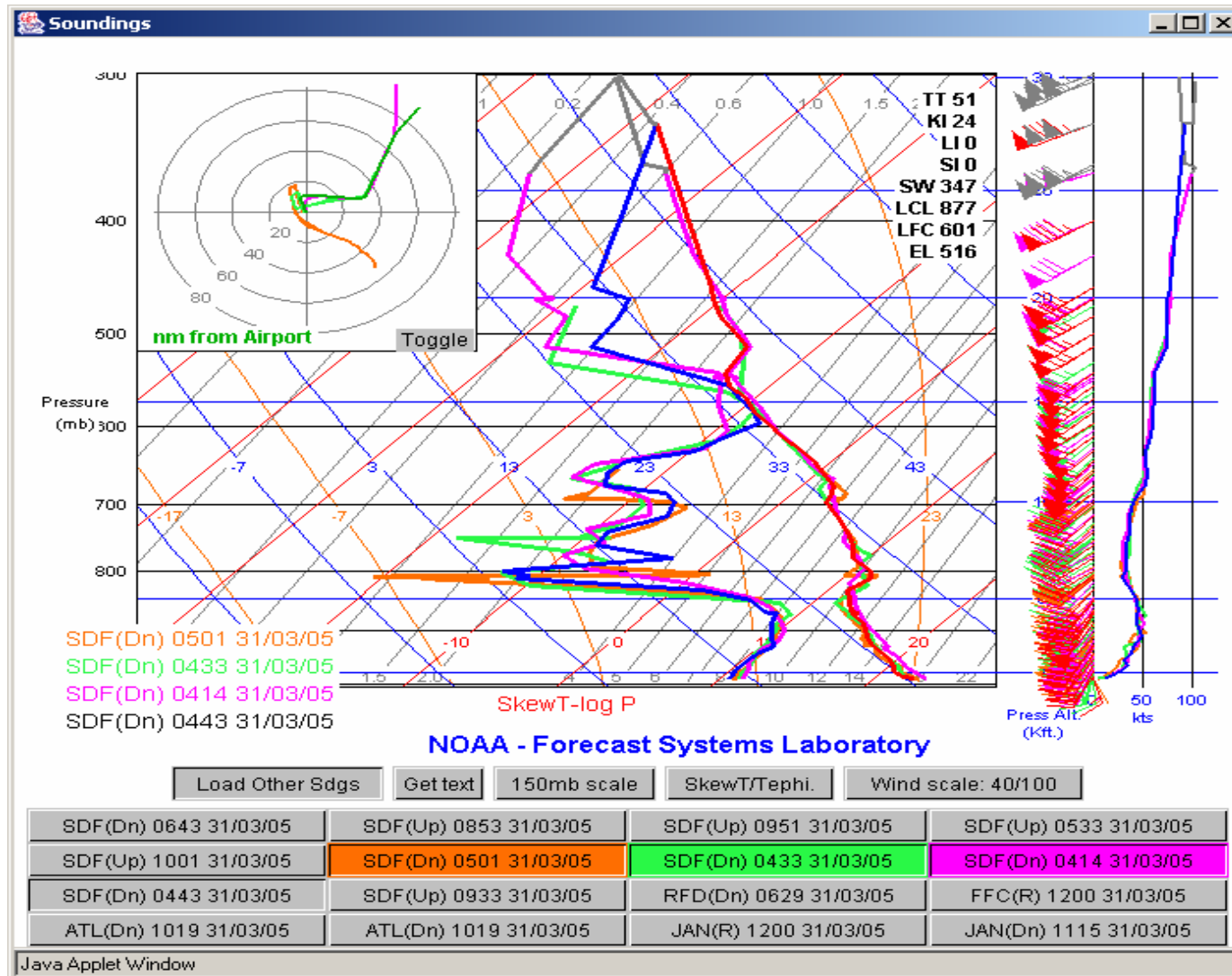
Hose,
Heated

Air Sampler

Frame

WVSS-2 Comparisons 31 MAR 05

Comparisons of 4 WVSS-2 aircraft on descent.



Developing Regional or National Programmes

The AMDAR Panel can help you organize a regional or national program by:

- Working with the NMS to evaluate the potential for developing a national AMDAR program;
- Assisting with technical support and training;
- Providing technical material and manuals needed to establish a National AMDAR program; and
- Working with the NMS and the airline to create the necessary documents and infrastructure agreements.

