WORLD METEOROLOGICAL ORGANIZATION
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WIGOS-PP-5-AMDAR-MG/Doc.2.4
(17.II.2011)
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WMO INTEGRATED GLOBAL OBSERVING SYSTEMS (WIGOS) PILOT PROJECT FOR AMDAR,
Fifth Session
&
AMDAR PANEL MANAGEMENT GROUP MEETING

ITEM: 2.4

ORIGINAL: ENGLISH

DE BILT, THE NETHERLANDS,
28 FEBRUARY – 4 MARCH 2011

STATUS OF THE WIGOS PILOT PROJECT FOR AMDAR

Validation of the Available Water Vapor Sensors

(Submitted by Axel Hoff)

Summary and Purpose of Document

This document contains information on the validation of available Water Vapor Sensors.

ACTION PROPOSED

The Fifth Session is invited to note the information contained in this presentation.

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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Validation of the Available Water Vapor Sensors

1. Assessments
   - 1.1 Laboratory
     - Research Centre Jülich
     - DWD
     - NOAA SBIR report (Small Business Innovation Research)
   - 1.2 Tests on research aircraft (planned)
     - FAAM

2. Application in AMDAR (status and planings)
   - 2.1 NOAA
   - 2.2 EUMETNET-AMDAR
   - 2.3 BoM
   - 2.4 KNMI

1. Assessments
1.1 Laboratory

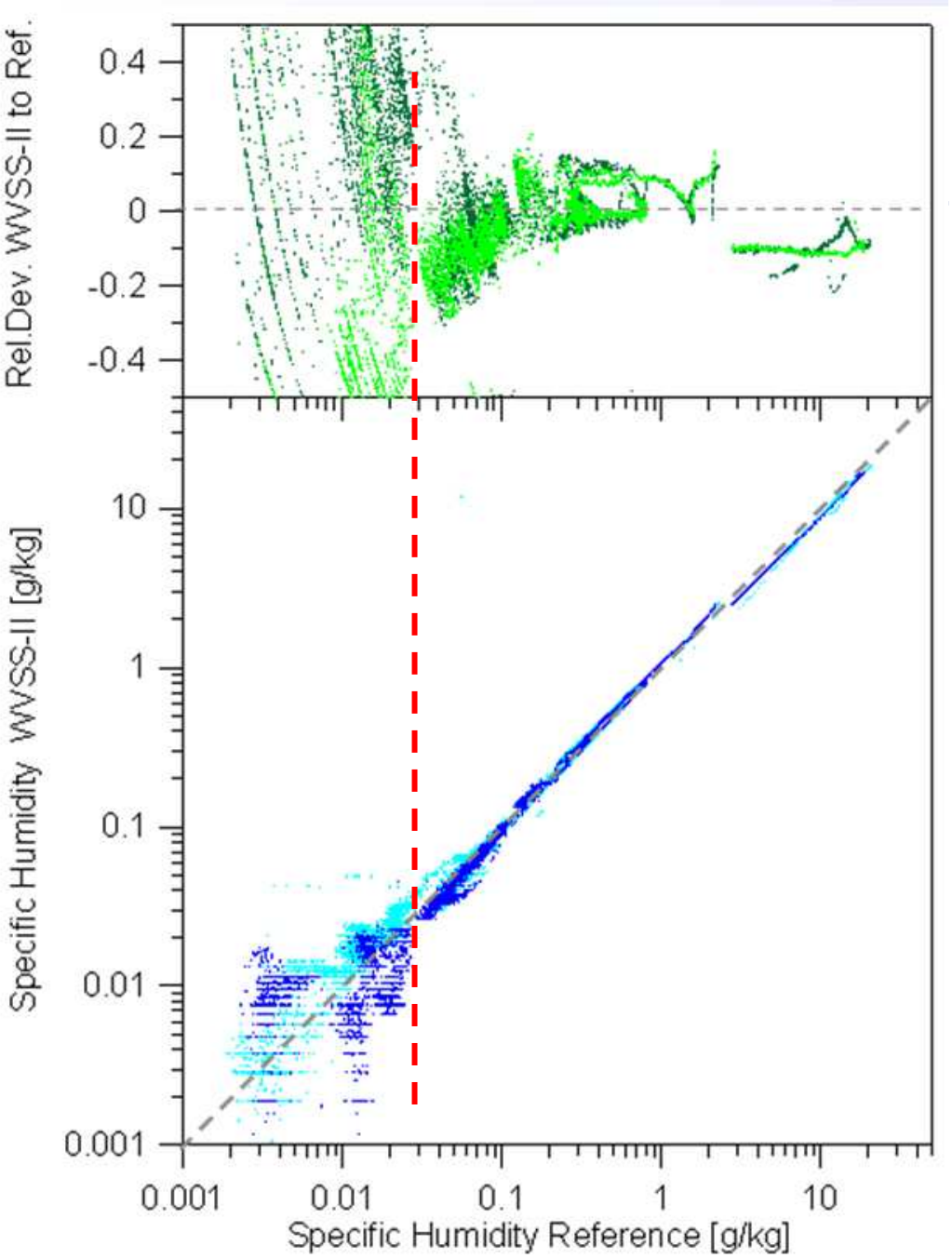
Climate chamber
Research Centre Jülich (FZJ)

SpectraSensors, Inc
WVSS-II

- sensitivity limit
  at 0.02 g/kg (30 ppmv)

  Altitude: 200 hPa

  Temperature: - 60 ℃



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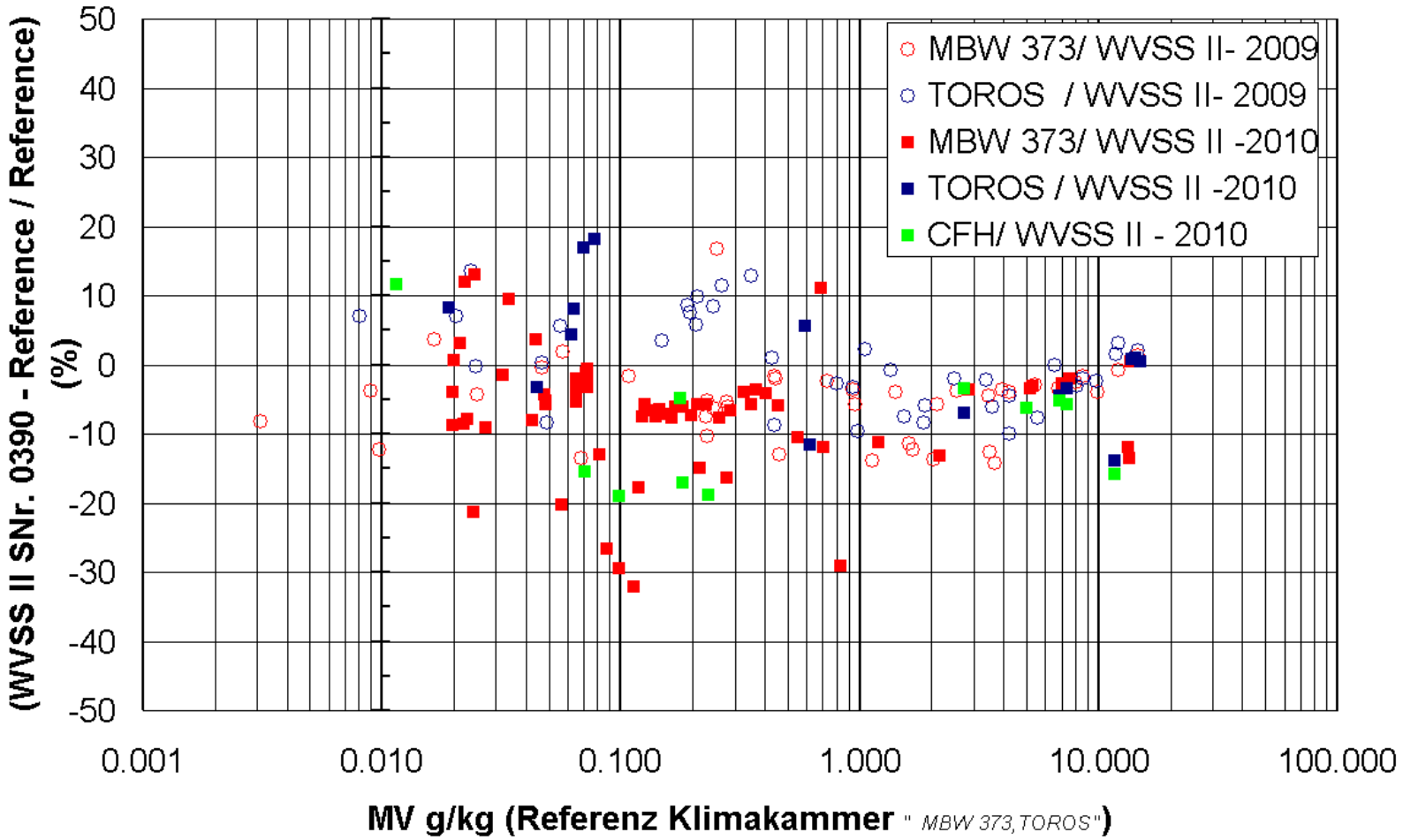
Climate chamber DWD
WVSS-II S/N 0390, accepted



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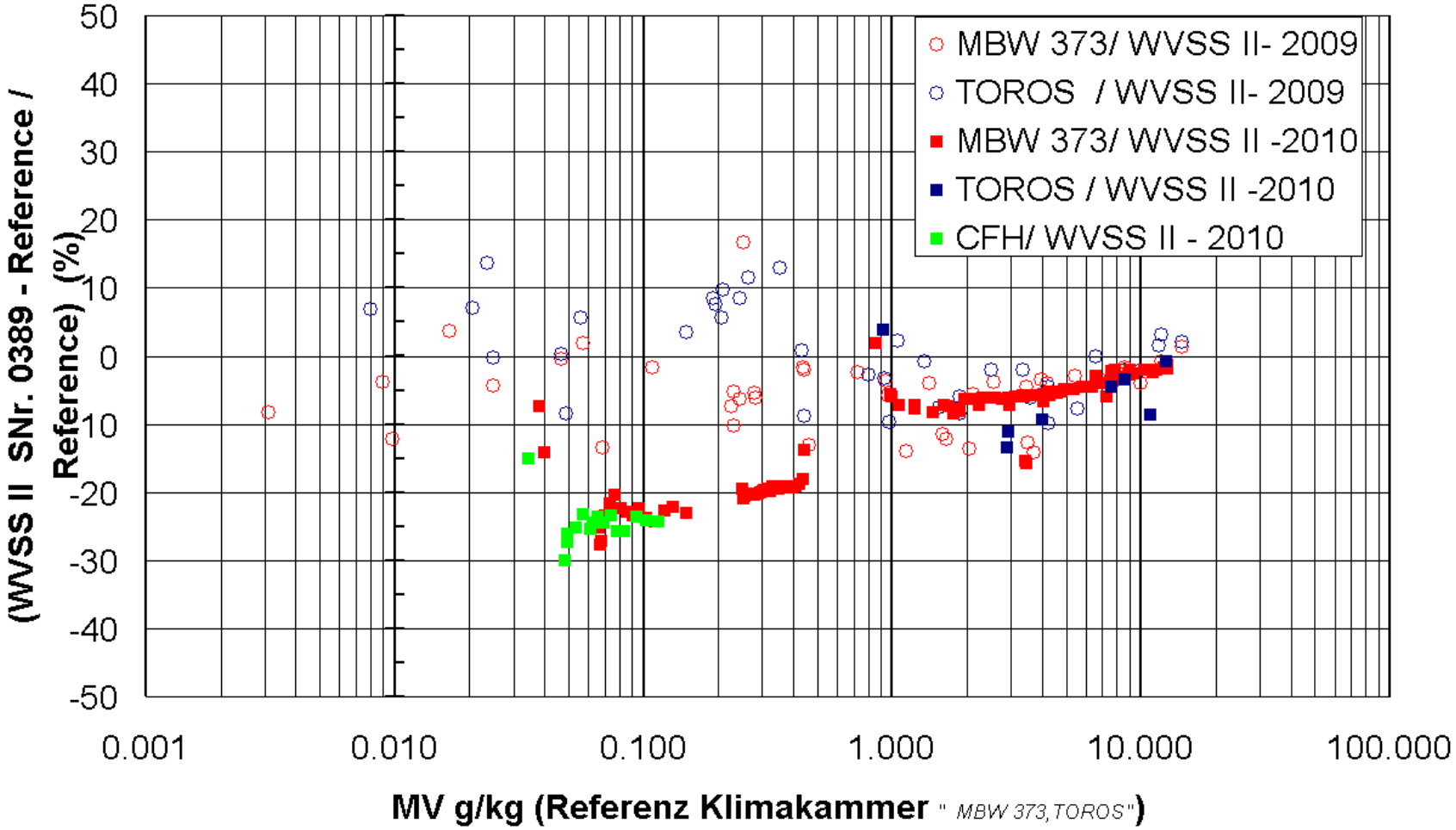
Climate chamber results from DWD
WVSS-II S/N 0389, rejected



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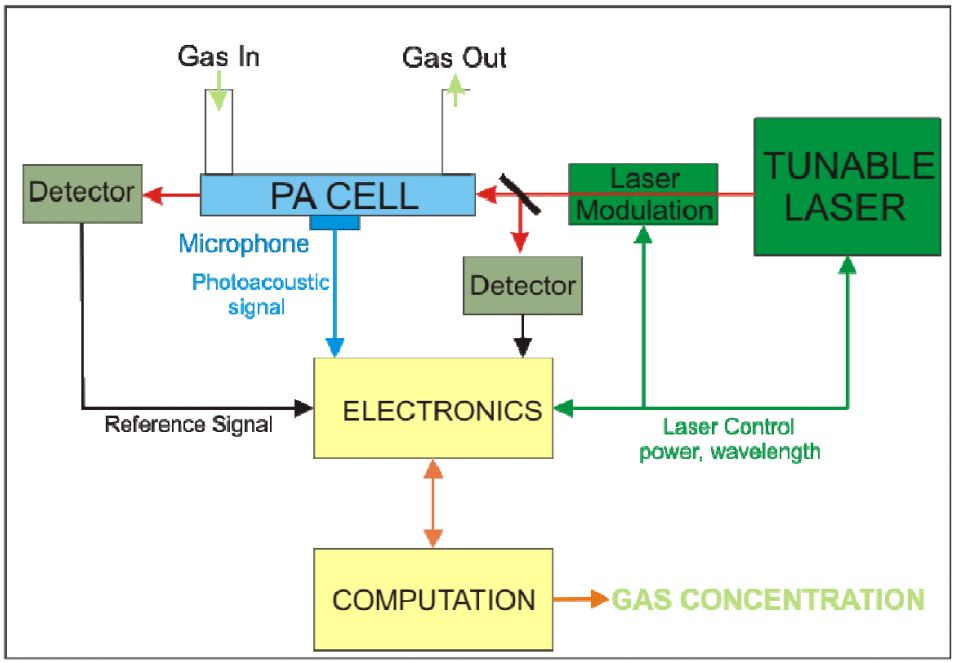
NOAA SBIR final report from MassTech, Inc (Small Business Innovation Research)

- Laser Photoacoustic Sensor (LPAS) for High-sensitivity Measurement of Water Vapor
  - Predicated sensitivity down to 7 ppmv (0.004 g/kg)
  - Lab tests show sensitivities down to 2 ppmv (0.001 g/kg)



  - Critical item (comment by A. Hoff): Absolute absorption principle may get influenced by contaminations

1. Assessments
1.1 Tests on Research Aircraft

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Two WVSS-II units on separate window plates

Flights planned to begin on 21 Feb 2011

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TAT housing with special insert

as a new intake / outlet unit of WVSS-II

"Air Sampler"

as the conventional intake / outlet unit of WVSS-II

1. Assessments
1.1 Tests on Research Aircraft

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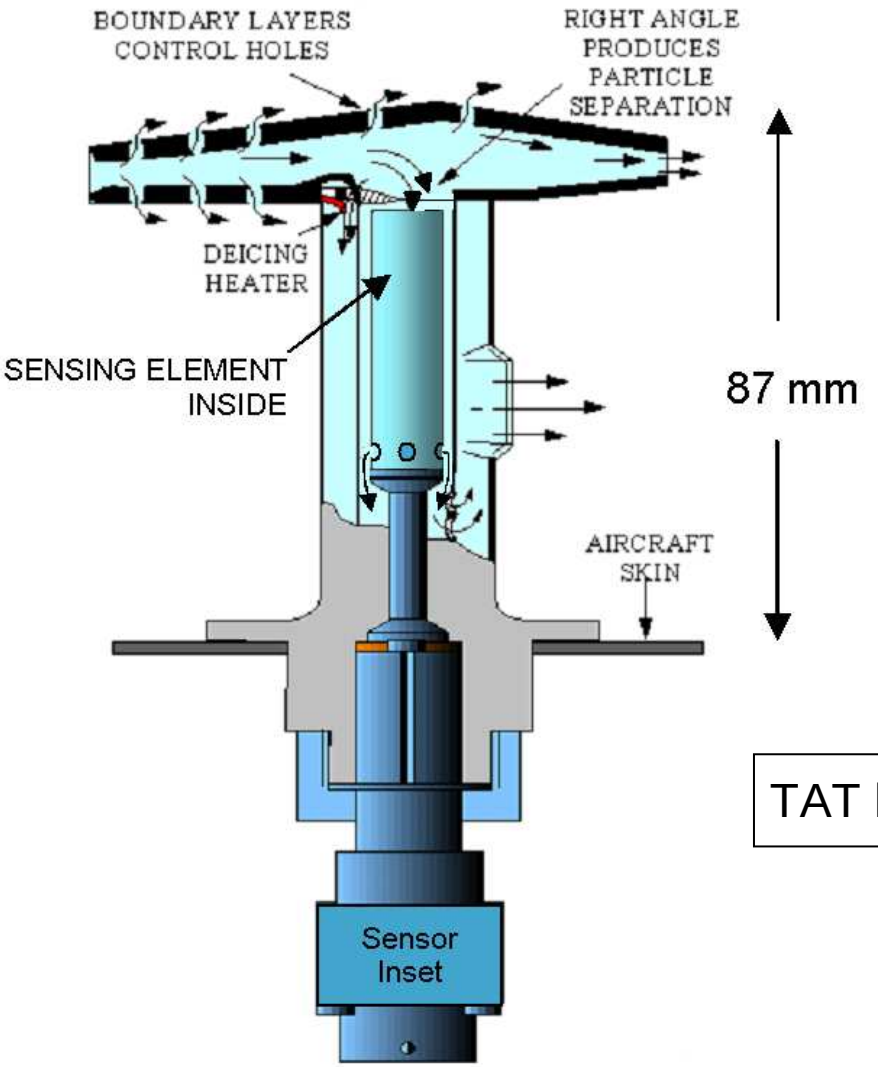
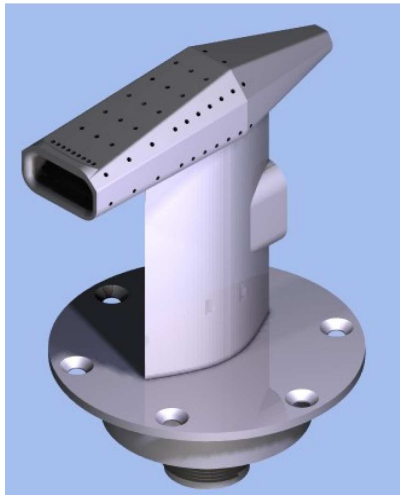
airflow





TAT housing

1. Assessments
1.1 Tests on Research Aircraft

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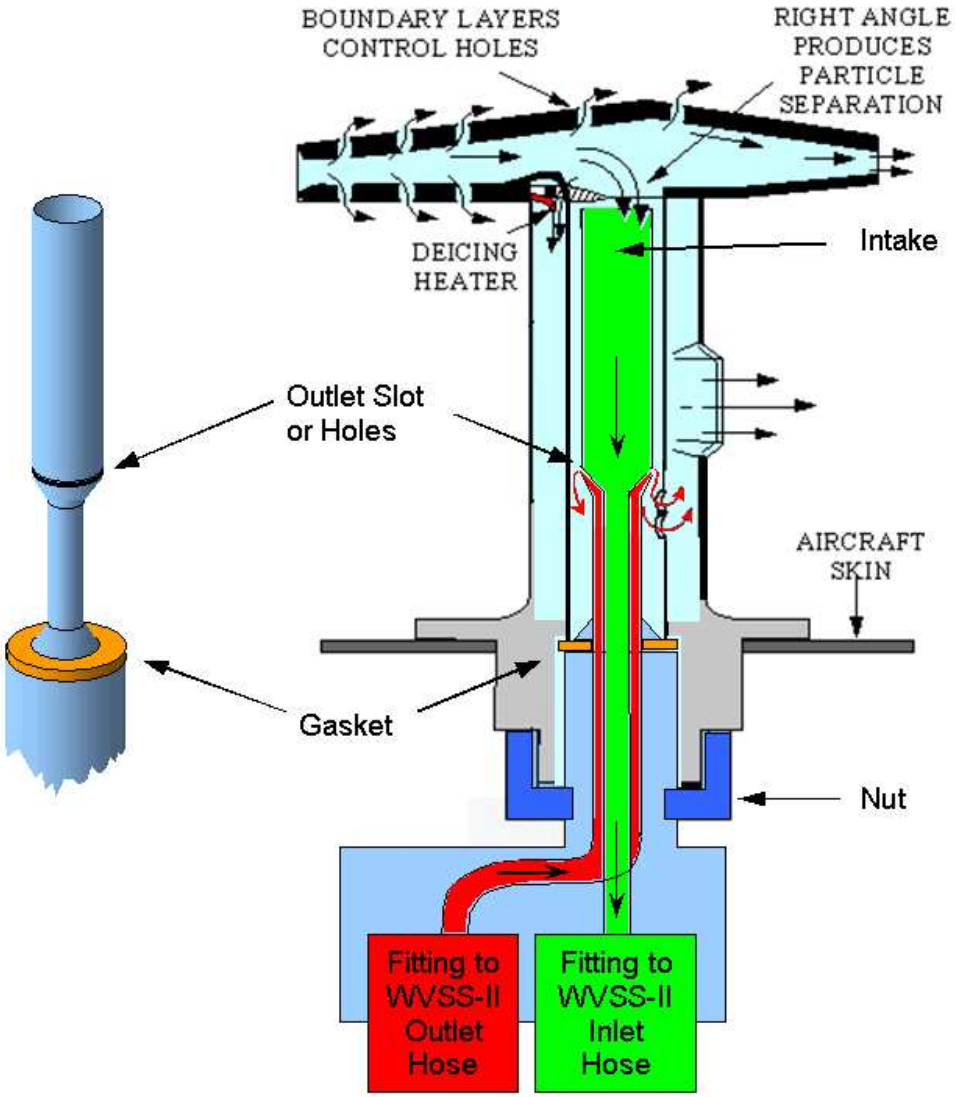

1. Assessments
1.1 Tests on Res. Acft.

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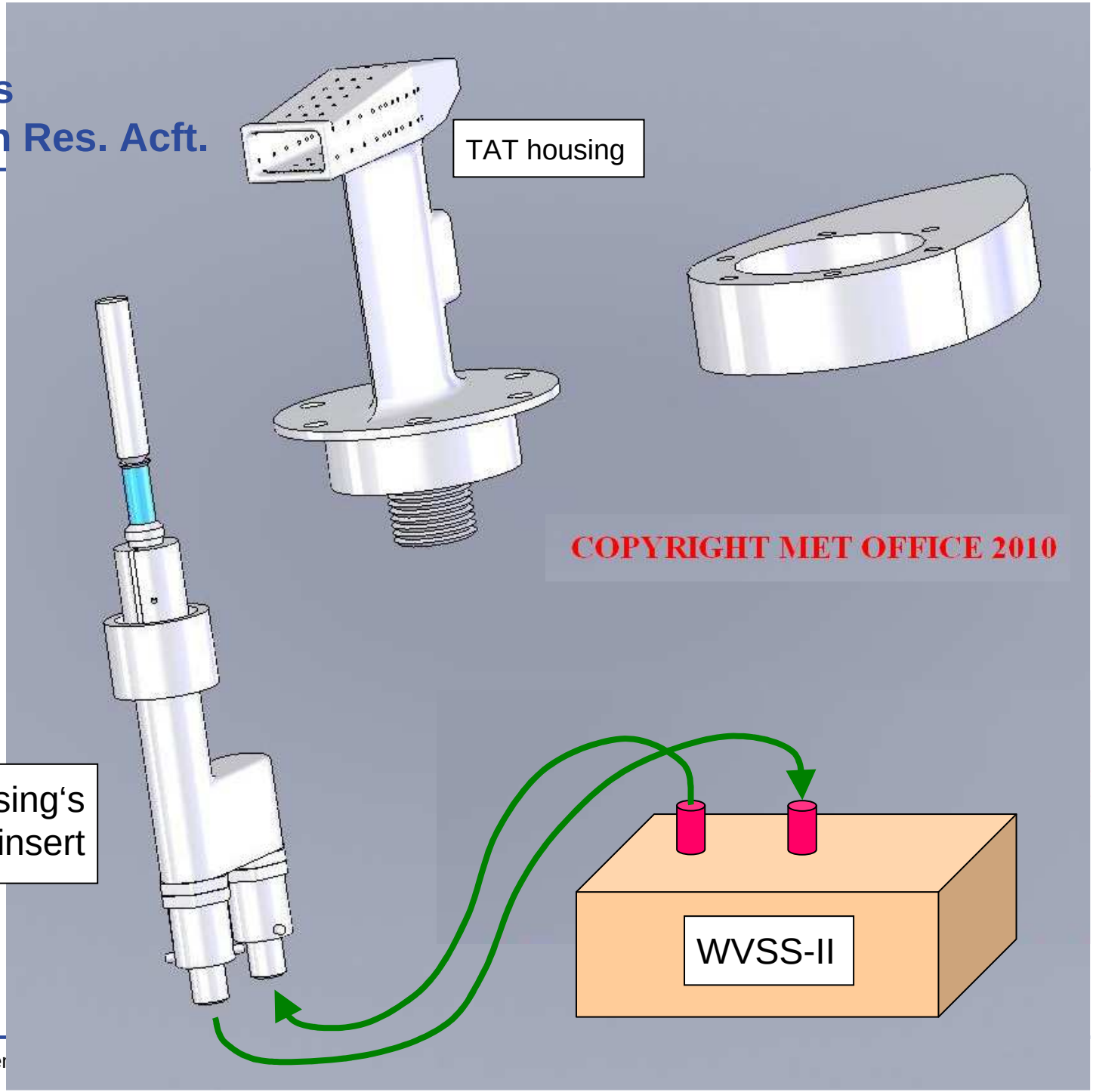

1. Assessments
1.1 Tests on Research Aircraft

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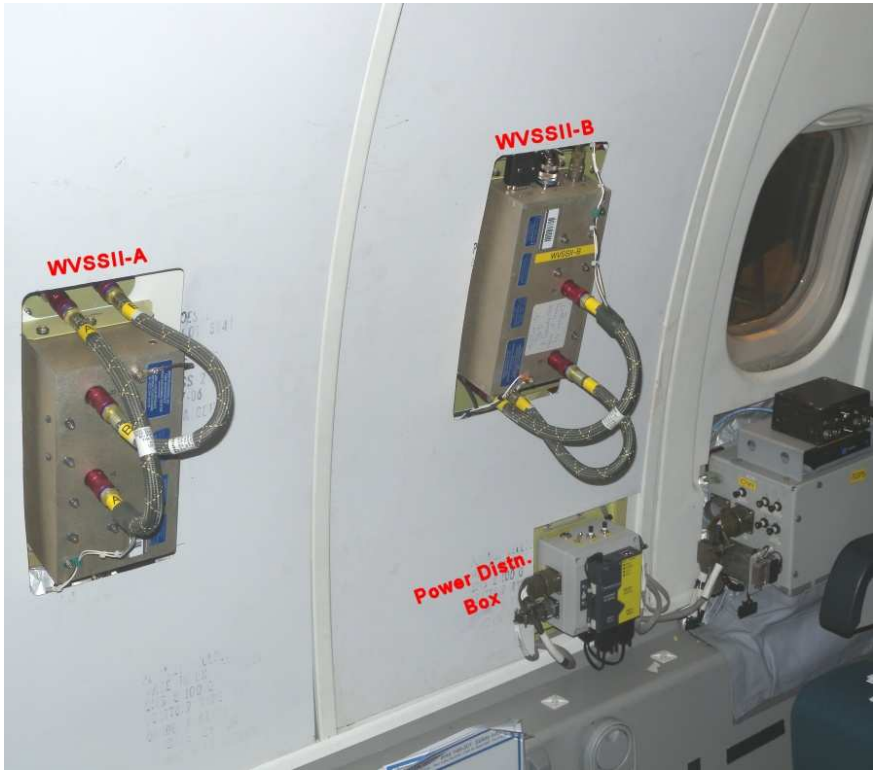
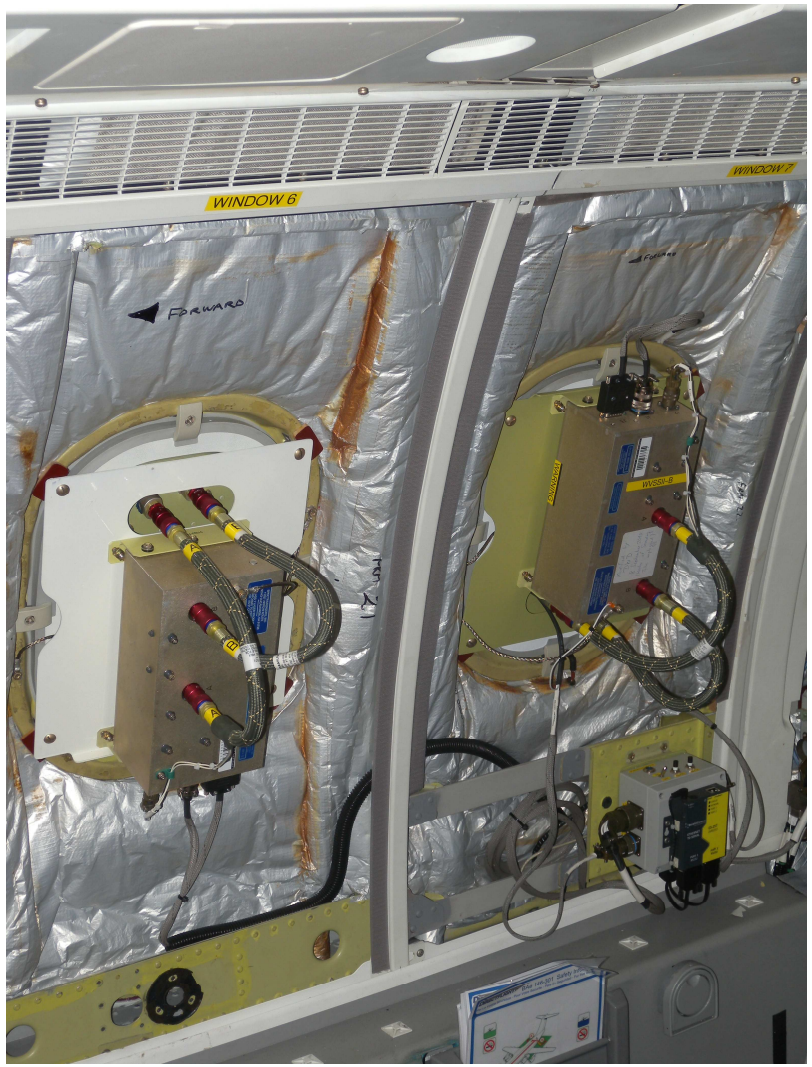
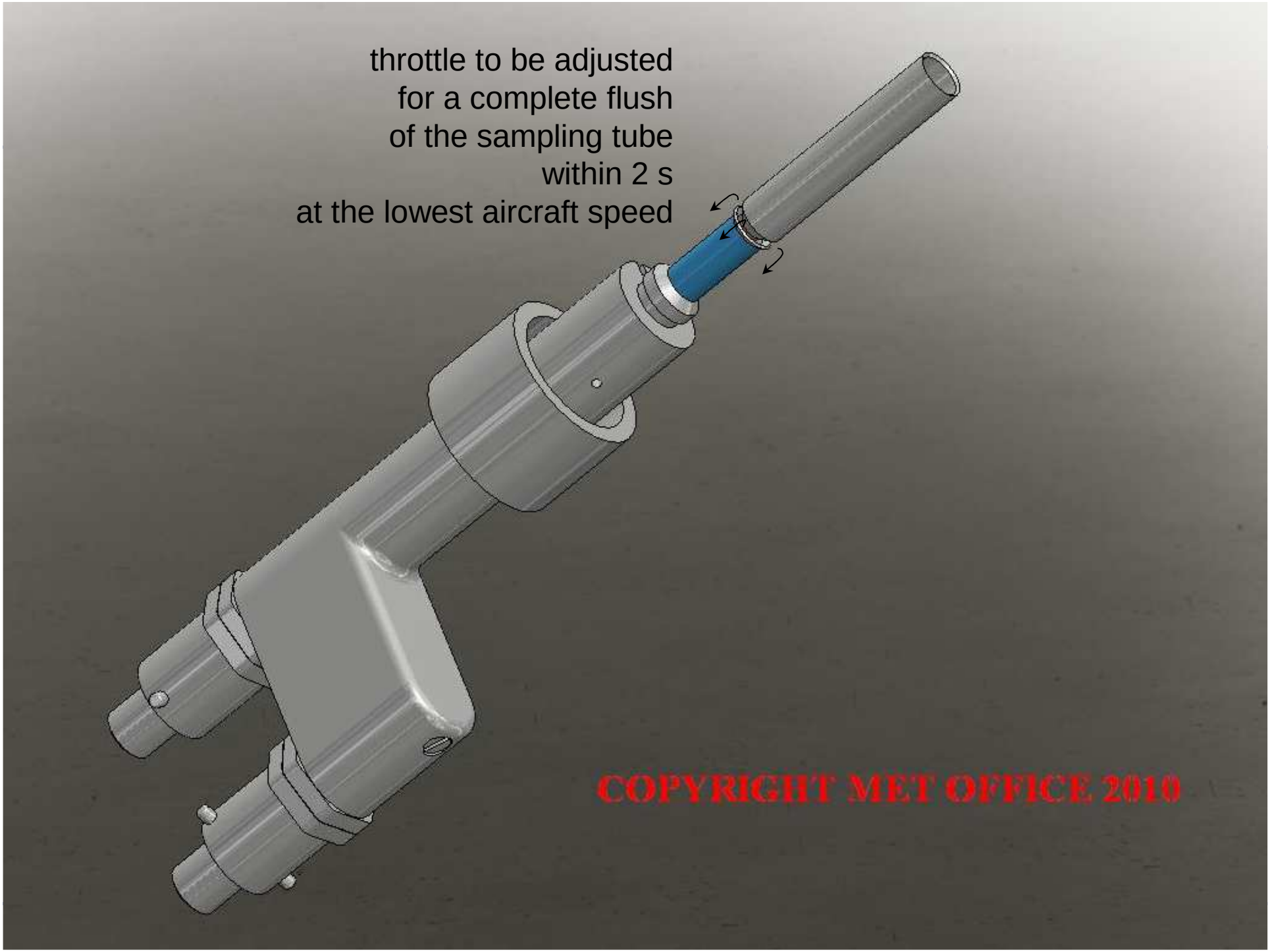
Interior view from the cabin






throttle to be adjusted
for a complete flush
of the sampling tube
within 2 s
at the lowest aircraft speed
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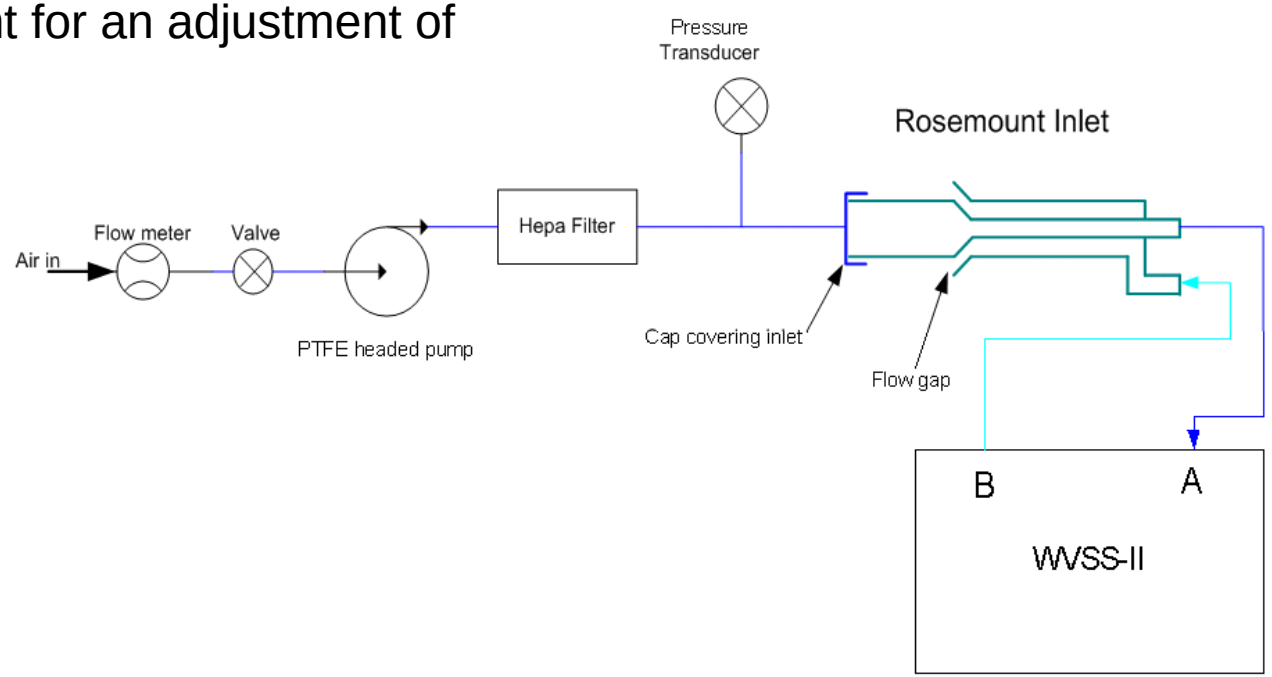
Laboratory arrangement for an adjustment of

- required flow

and

- system‘s internal pressure



Results

Flow Gap	Pressure (mb)	Inlet Flow (l/min)
5mm (wide open)	+20	5.5
Almost closed	+20	3.5
Tightly pushed closed	+20	2.7

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Advantages of the use of TAT housing:

- Impact pressure inside of the sampling tube leads to
  - increased temperature, “total temperature“
    avoids unwanted condensation
  - increased water vapour density
    gives a **higher absorption signal at the same altitude**
- No extra heating required (switched off) for the sampling tube:
  - **no density gradient** along the absorption path
  - **lower power** consumption on the non-essential bus
- Electrically de-iced:
  - **flight safety**
  - no certification problems

1. Assessments
1.1 Tests on Research Aircraft

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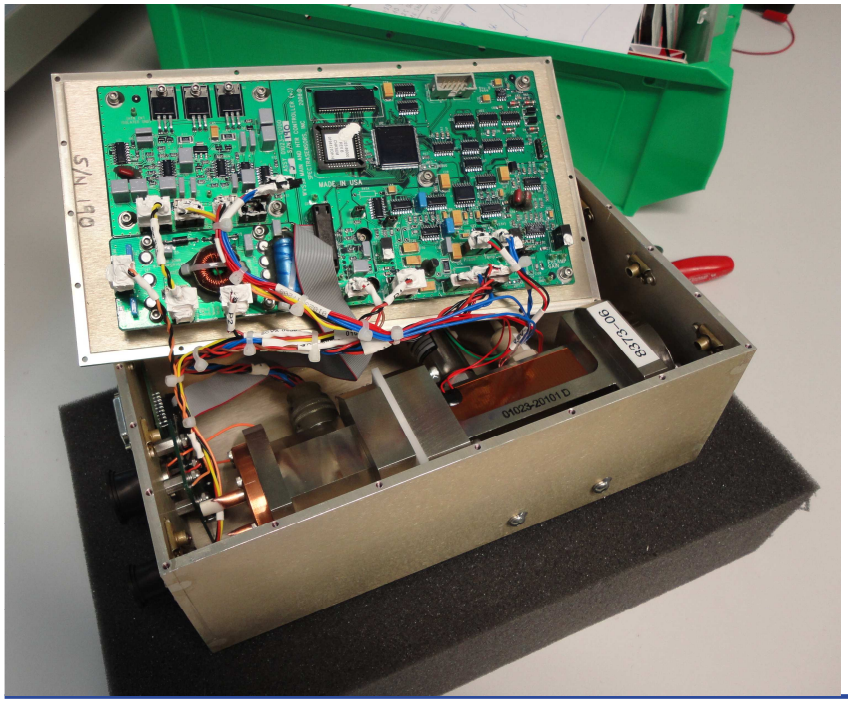
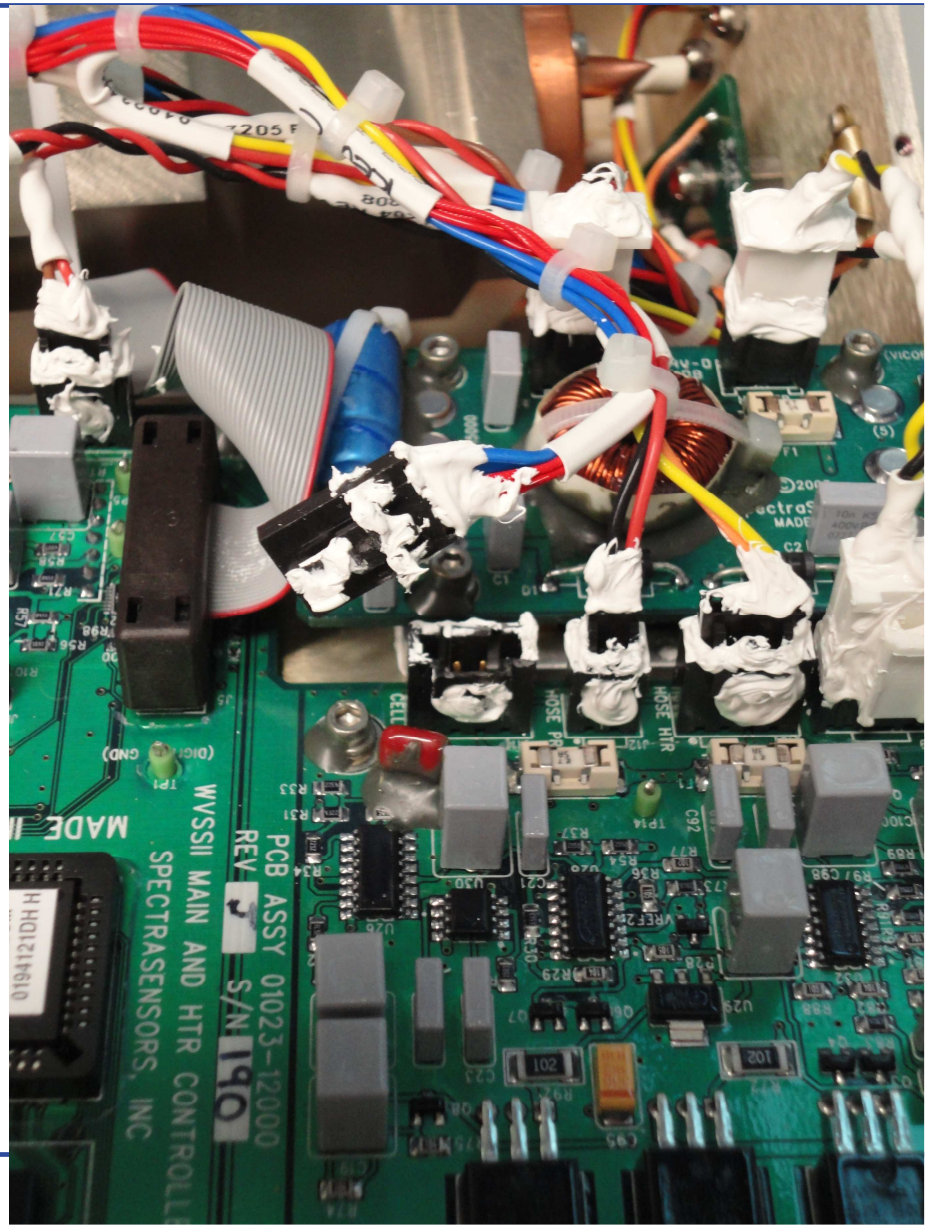
- Modified WVSS-II unit





Validation of the Available Water Vapour Sensors

1. Assessments
   - 1.1 Laboratory
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     - NOAA SBIR report (Small Business Innovation Research)
   - 1.2 Tests on Research Aircraft (planned)
     - FAAM

2. **Application in AMDAR (status and planings)**
   - **2.1 NOAA**
   - **2.2 EUMETNET-AMDAR**
   - **2.3 BoM**
   - **2.4 KNMI**

2. Application in AMDAR
2.1 NOAA

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- SpectraSensors WVSS-II Version 3:
  - United Parcel Service
    - 25 aircraft type B757-200 in operation
  - Southwest Airlines (SWA)
    - 12 aircraft type B737-300 in operation
    - 19 aircraft type B737-300 to be equipped until fall 2011
    - 18 (+ 18 optionally) aircraft type B737
    - Supplemental Type Certificate in store for aircraft type B737-700 (300 units available at SWA)
- TAMDAR:
  - several units on regional aircraft

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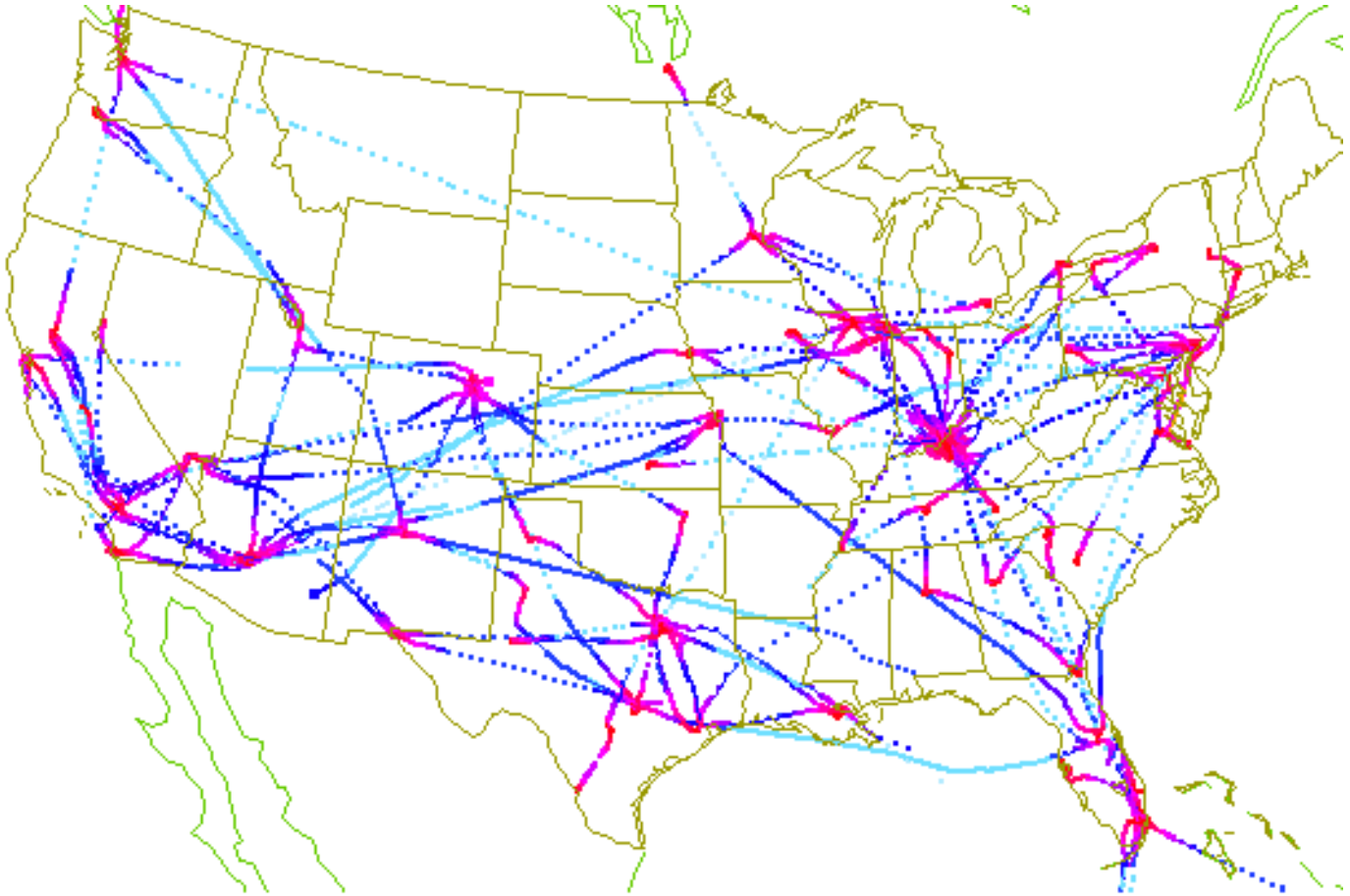
24 Hours of WVSS-II

January 21, 2011

All Data –
37 Aircraft



2. Application in AMDAR
2.1 NOAA

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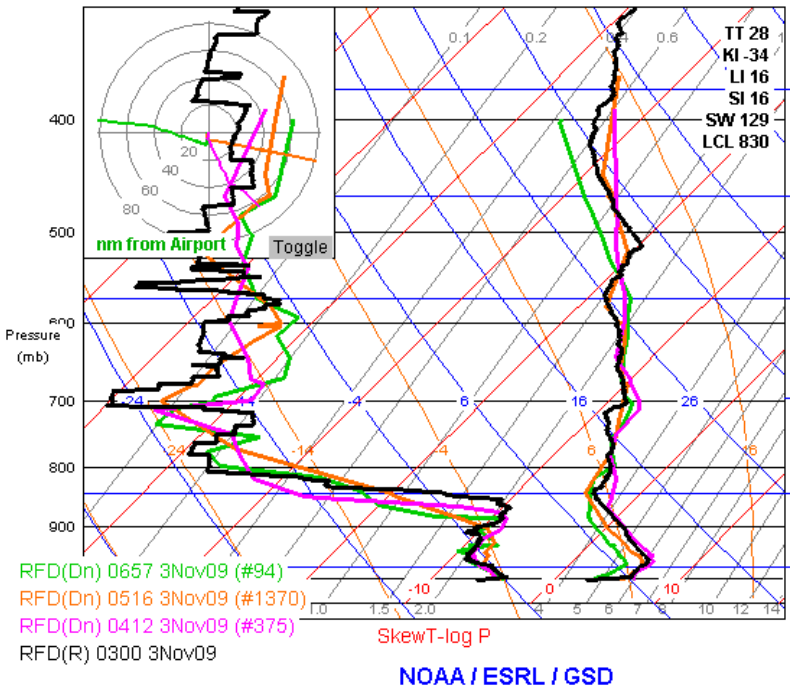
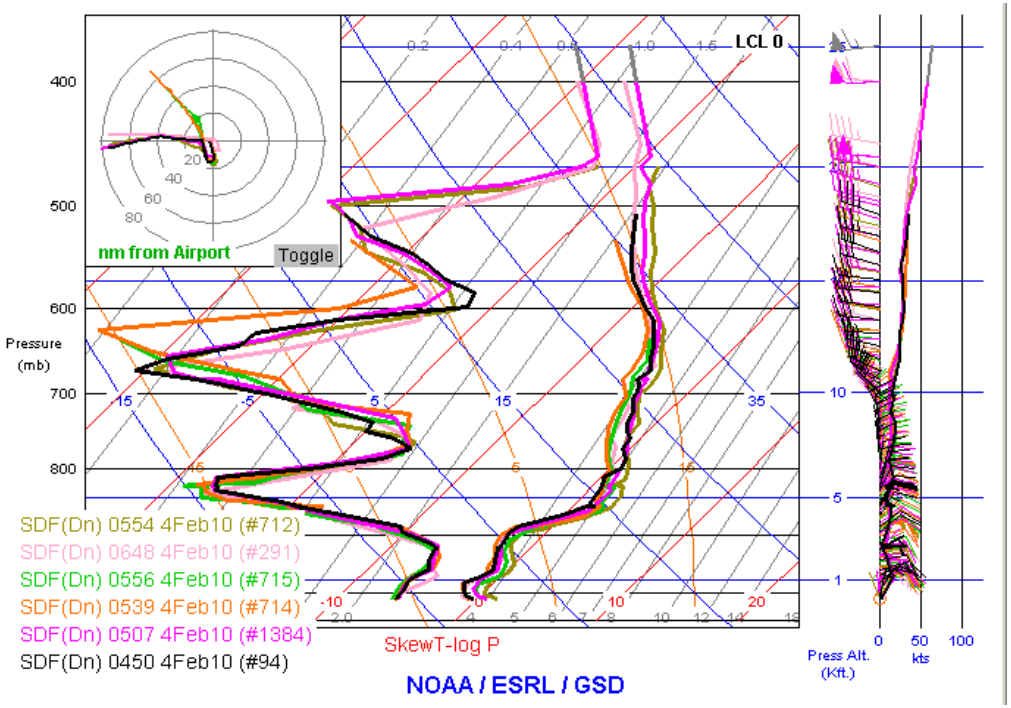
Examples of NOAA's WVSS-II results





- SpectraSensors WVSS-II Version 3:
  - Consistency with radiosonde results
  - Congruence between different aircraft at coincident starts and landings

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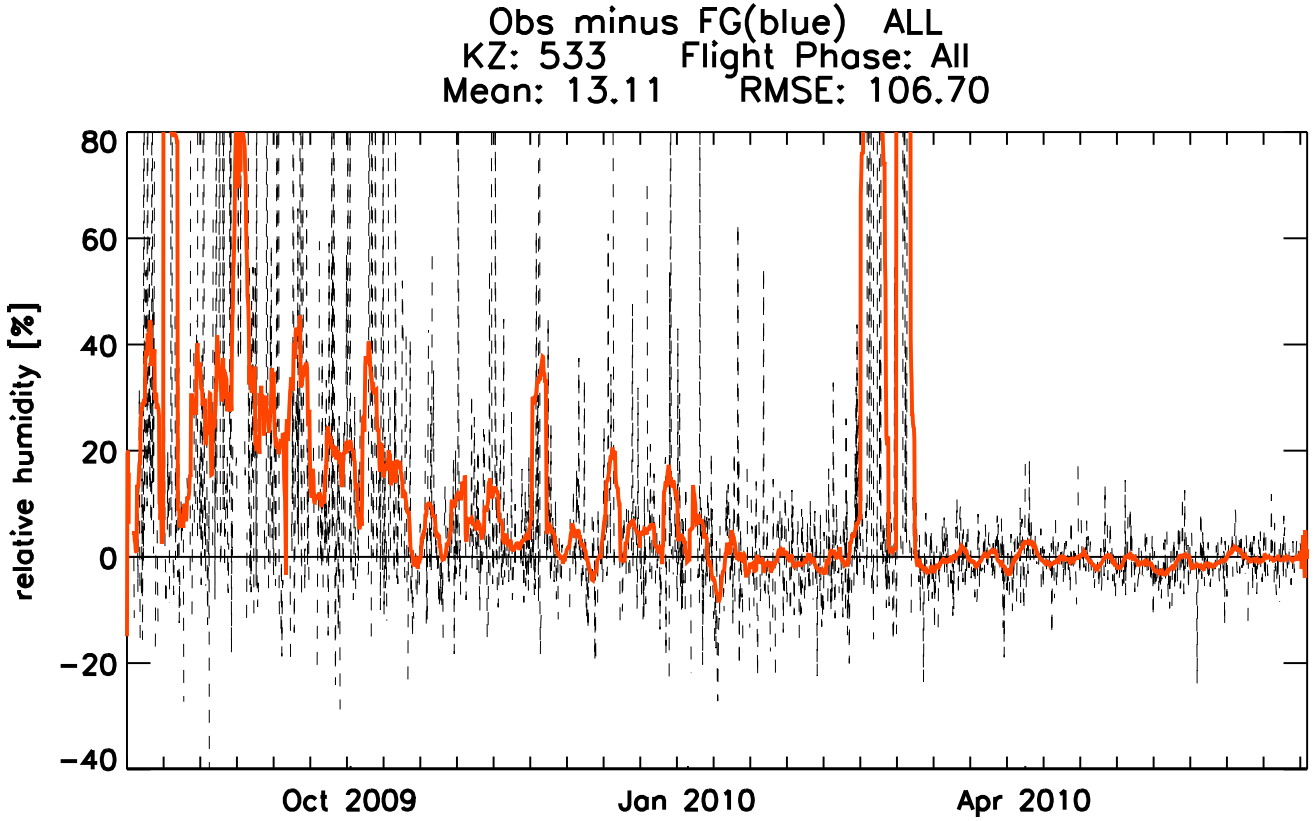
Comparison against First Guess of GME (DWD global model)

- Mean Bias of all WVSS-II observations



2. Application in AMDAR
2.2 EUMETNET-AMDAR

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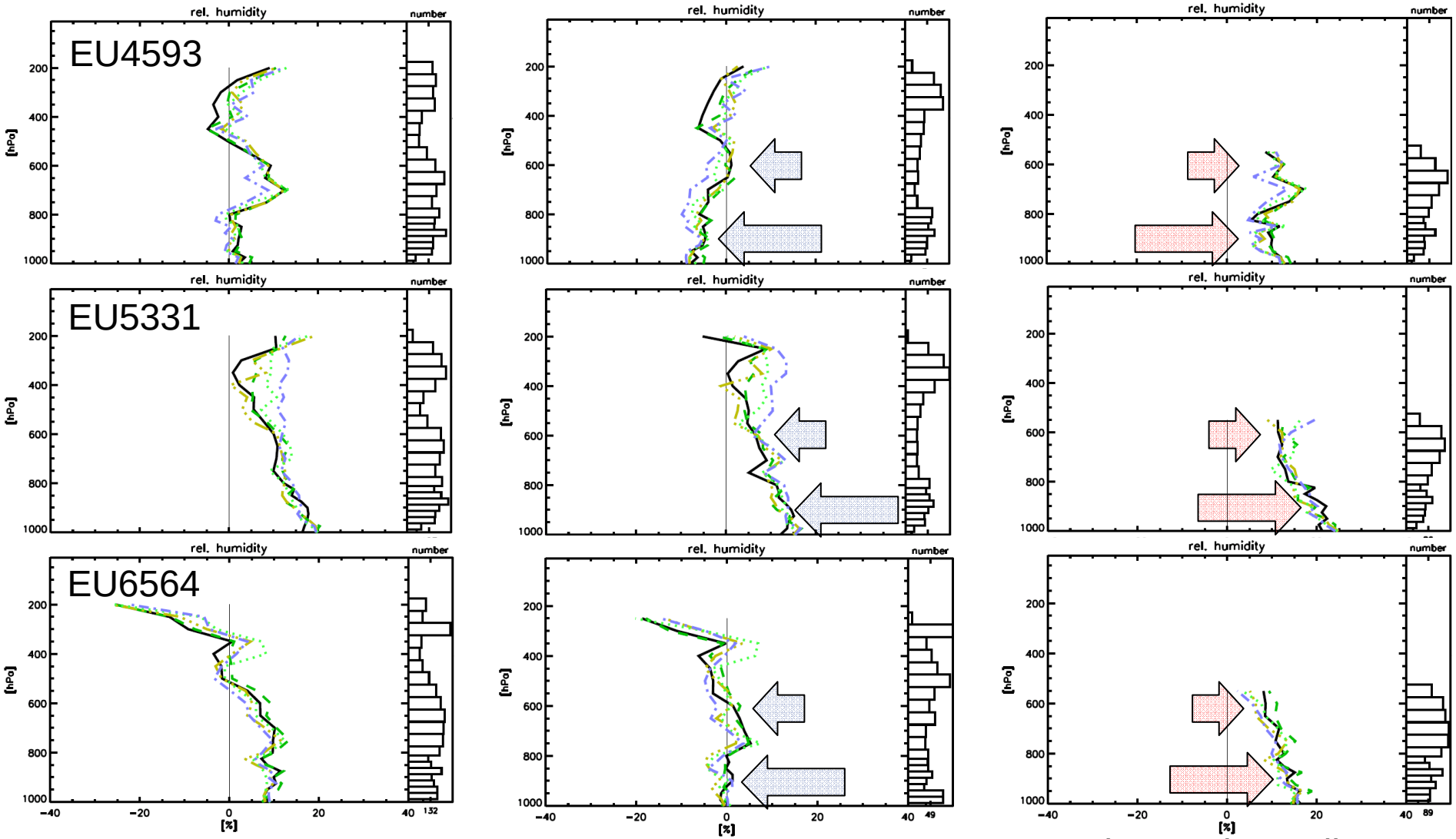
- SpectraSensors WVSS-II Version 2:
  - Lufthansa
    - 3 aircraft type Airbus A319 in operation

- SpectraSensors WVSS-II Version 3:
  - Lufthansa
    - 2 aircraft type Airbus A319 old units to be replaced until 2012
    - 5 - 7 aircraft of Airbus A320 family to be equipped until 2012 / 13
    - optionally another 6 aircraft of Airbus A320 family

2. Application in AMDAR
2.2 EUMETNET-AMDAR

Comparison against first guess of COSMO-EU (model – observation)



all
in September 2010

ascends tending
to humid side

descends tending
to dry side

2.3 BoM

- Qantas, Business Case Study until April / May 2011
  for use of SpectraSensors WVSS-II:
  - 4 aircraft type Boeing B737-300 envisaged

  and / or later on
  - up to 20 aircraft type Boeing B737-800
  - What are the individual advantages
    for the airline being engaged in AMDAR humidity measurements?

2.4 KNMI

- KLM, Business Case Study
  for use of SpectraSensors WVSS-II:
  - aircraft type Boeing B737 envisaged

Questions?