Central Aerological Observatory

FLASH-B

FLuorescent **A**dvanced **S**tratospheric **H**ygrometer
(for balloon)

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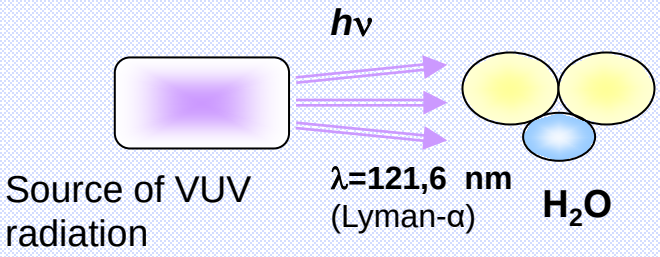
Instrument design.

Observations and comparison.

FLASH-B instrument



$H(^2S)$

I_{fl}

PMT

$300 < \lambda < 330$ nm

$H_2O + h\nu \rightarrow OH(A^2\Sigma^+) + H(^2S)$

$OH(A^2\Sigma^+)$

$OH(X^2\Pi)$

Fluorescense

$OH(A^2\Sigma^+) \rightarrow OH(X^2\Pi) + h\nu'$

$$I_{fl} = \frac{[H_2O] \cdot J \cdot \varphi \cdot A}{k_q \cdot [air] + A}$$

at P > 7 hPa $k_q \cdot [air] \gg A$

Quenching

$OH(A^2\Sigma^+) + N_2,\ O_2 \rightarrow$ products

I_{fl} _ fluorescense intensity

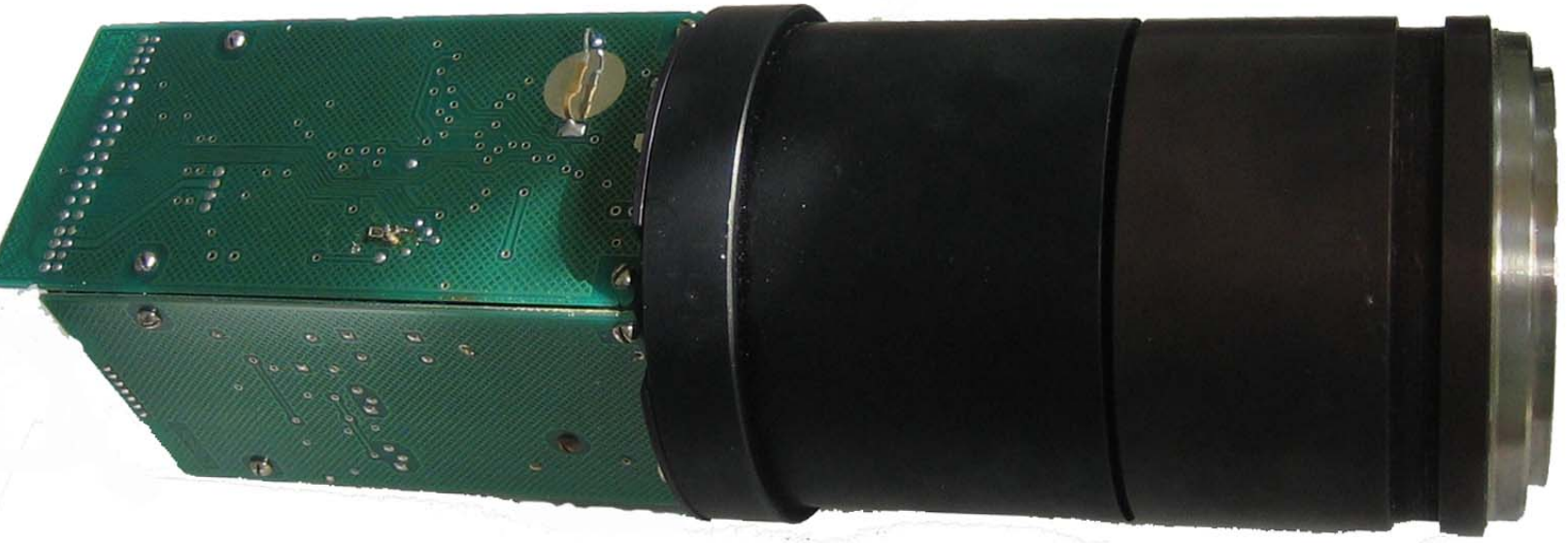
J - photodissotiation rate

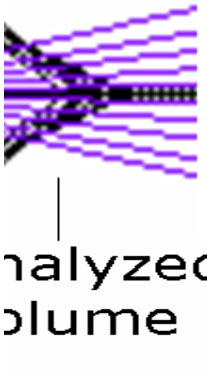
φ= 0,05 - quantum efficiency for excited OH production

A=1,26·10^6 s^{-1} – Einstein coefficient,

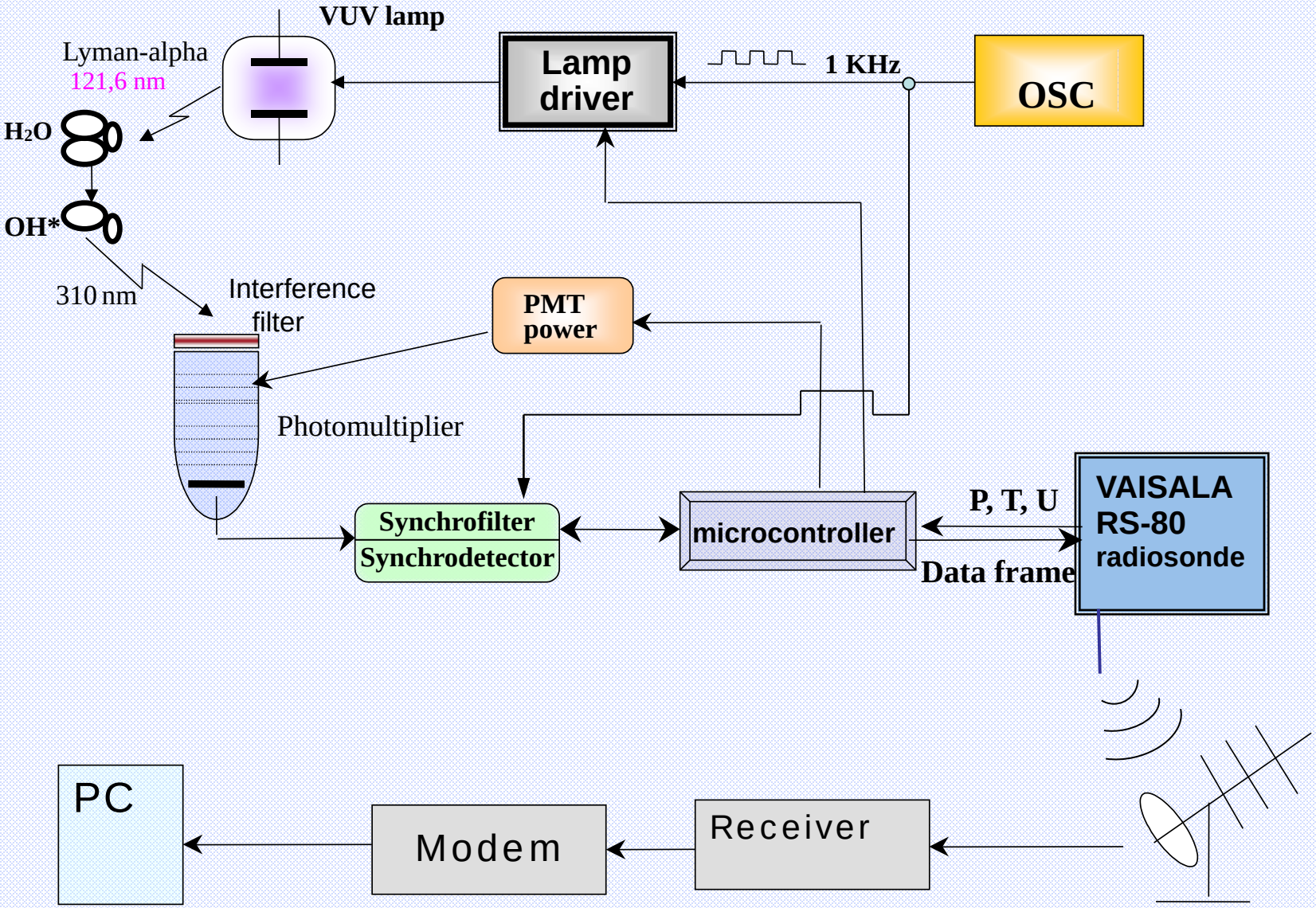
$k_q^{air.}$ = 2,3·10^{-11} sm^3 s^{-1} – quenching coefficient of the excited OH in air

FLASH-B optical layout

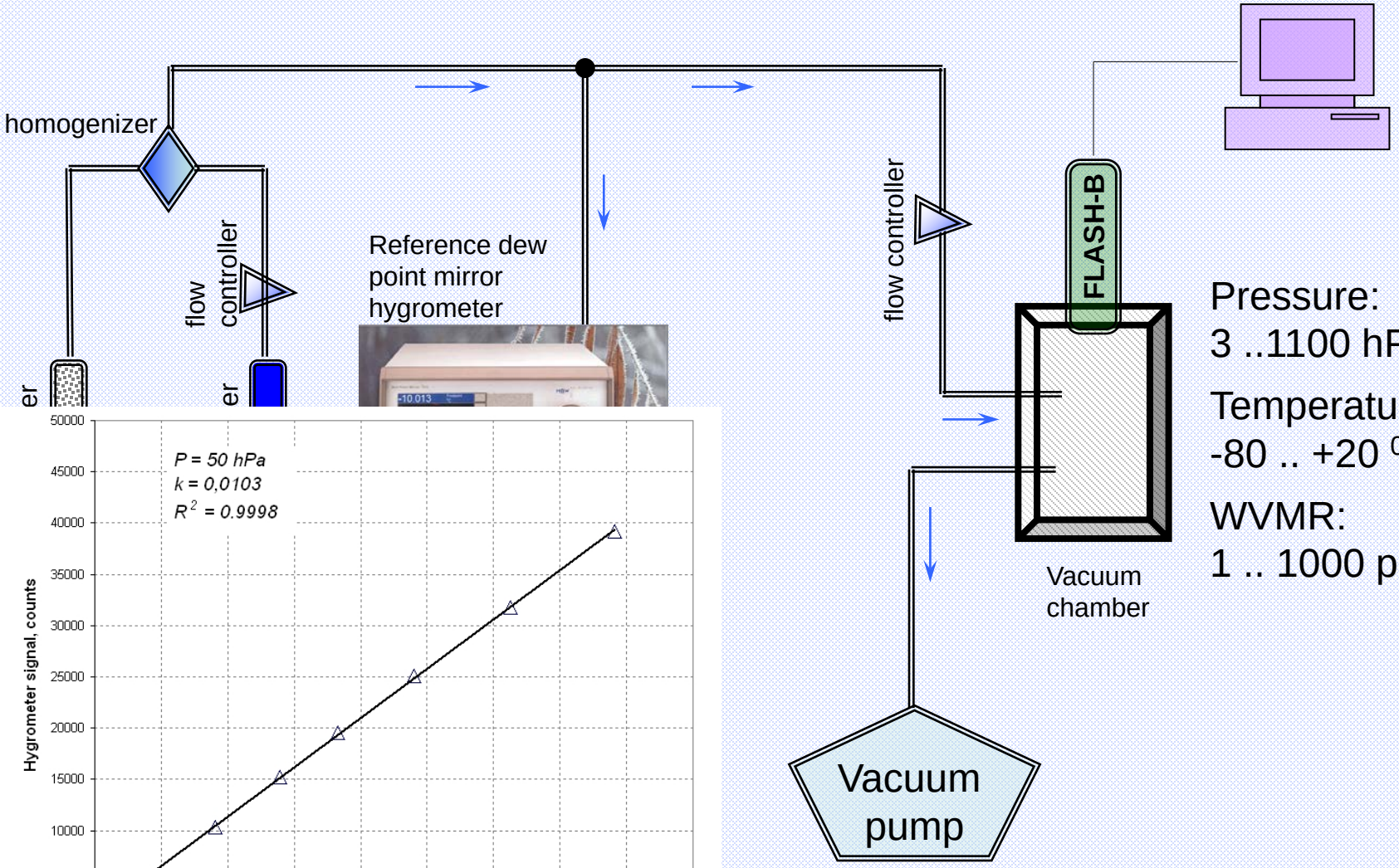




Electronic block-layout of FLASH-B



Calibration facility layout



Pressure:
3 ..1100 hPa

Temperature:
-80 .. +20 ^{0}C

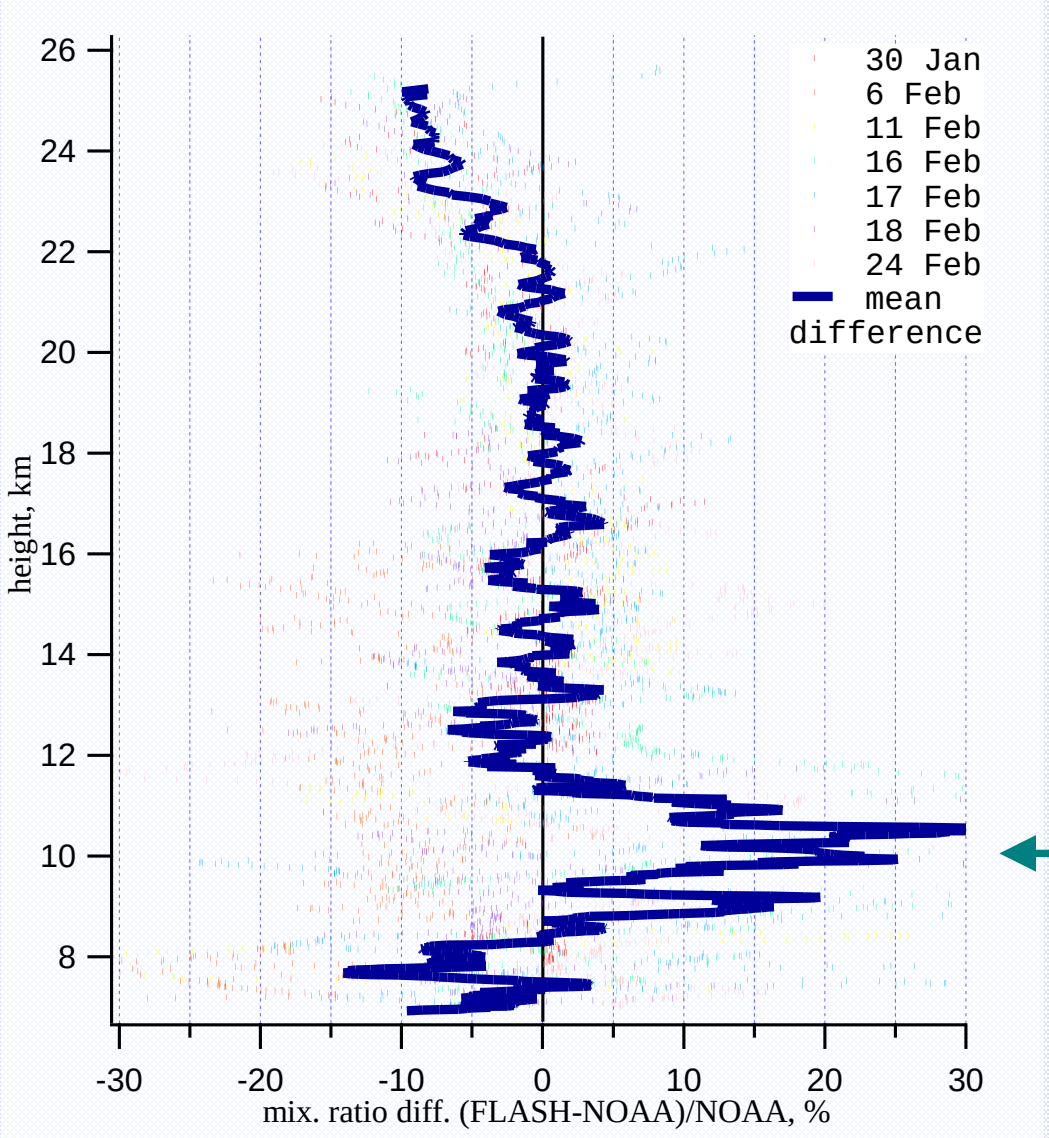
WVMR:
1 .. 1000 ppmv

FLASH-B characteristics

Range of water vapour measurements	***0.5...500 ppmv***
Response time	*0.2 sec*
Integration time	*4 sec*
Measurement precision	*5.5%*
Total uncertainty	*<10 % (1σ) at μ> 3 ppmv*
Temperature range	*-95^{0}C … +40^{0}C*
Height range	*7… 35 km*
Required power	*9-30V, 10W max*
Weight w/out batteries	*0.5 kg*
Interface card	*Built-in (T-MAX type)*
Radiosonde	*Vaisala RS80-15 A(L)*

Measurement sites since winter 2004

Intercomparison of FLASH-B and NOAA/CMDL hygrometers in the stratosphere



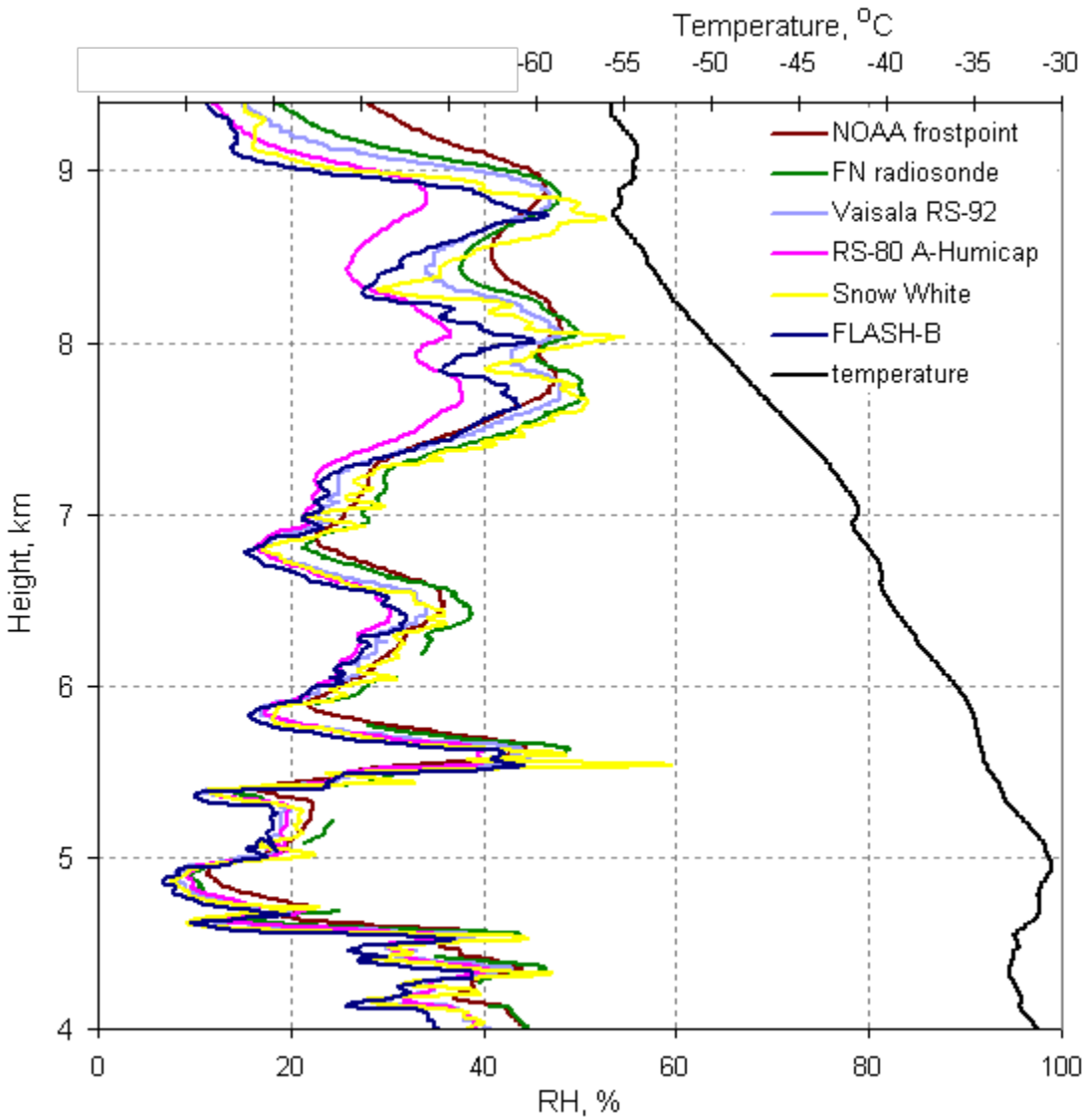
Descent data only

Mean difference in the 11,8 – 25,6 km range is:
2.6 ±3.1 % (1 σ)

Large disagreement in the 8,8 – 11,8 km range is caused by the feedback gain change in the NOAA hygrometer

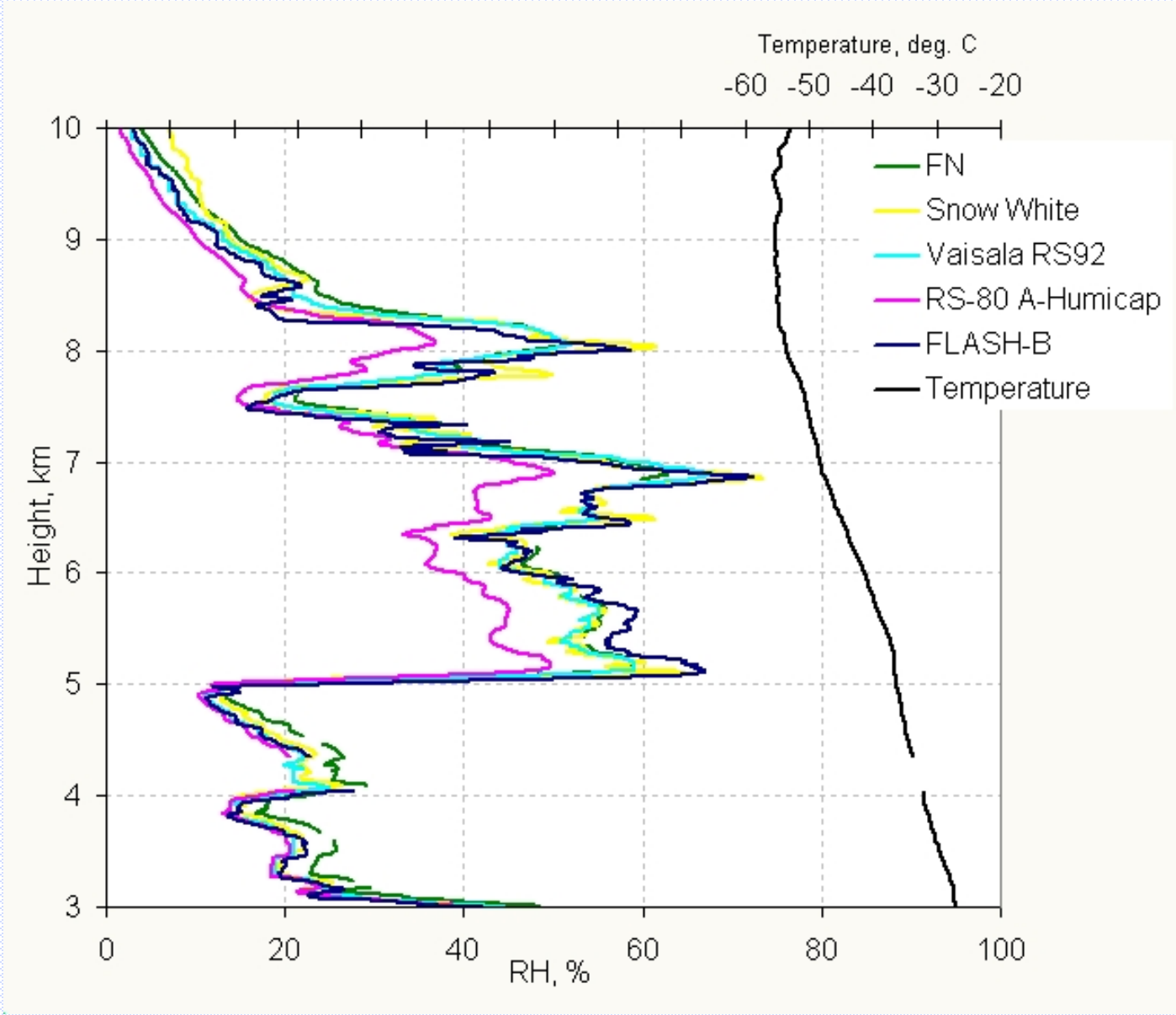
Simultaneous humidity measurements in the troposphere during LAUTLOS

11 February 2004

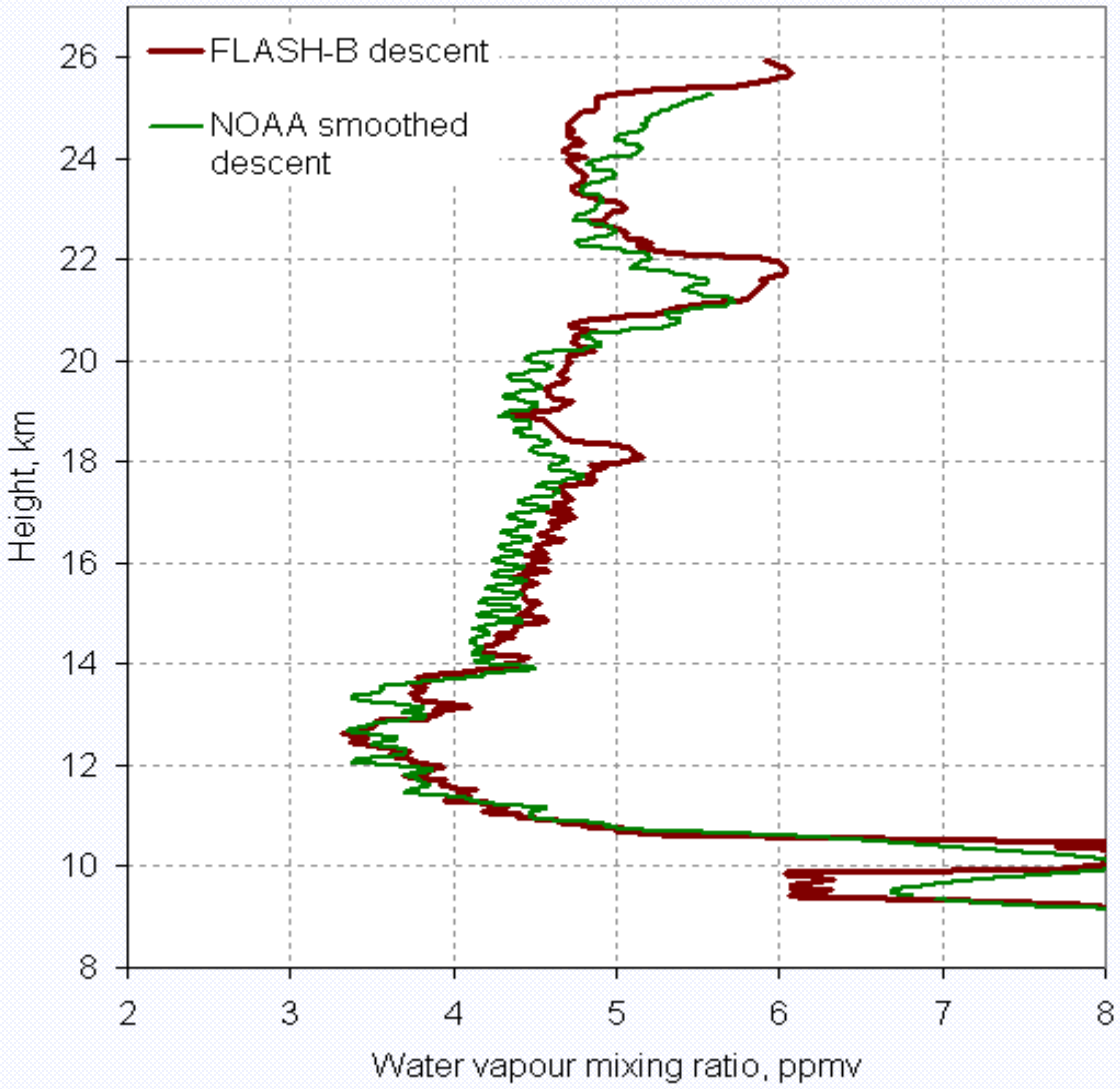


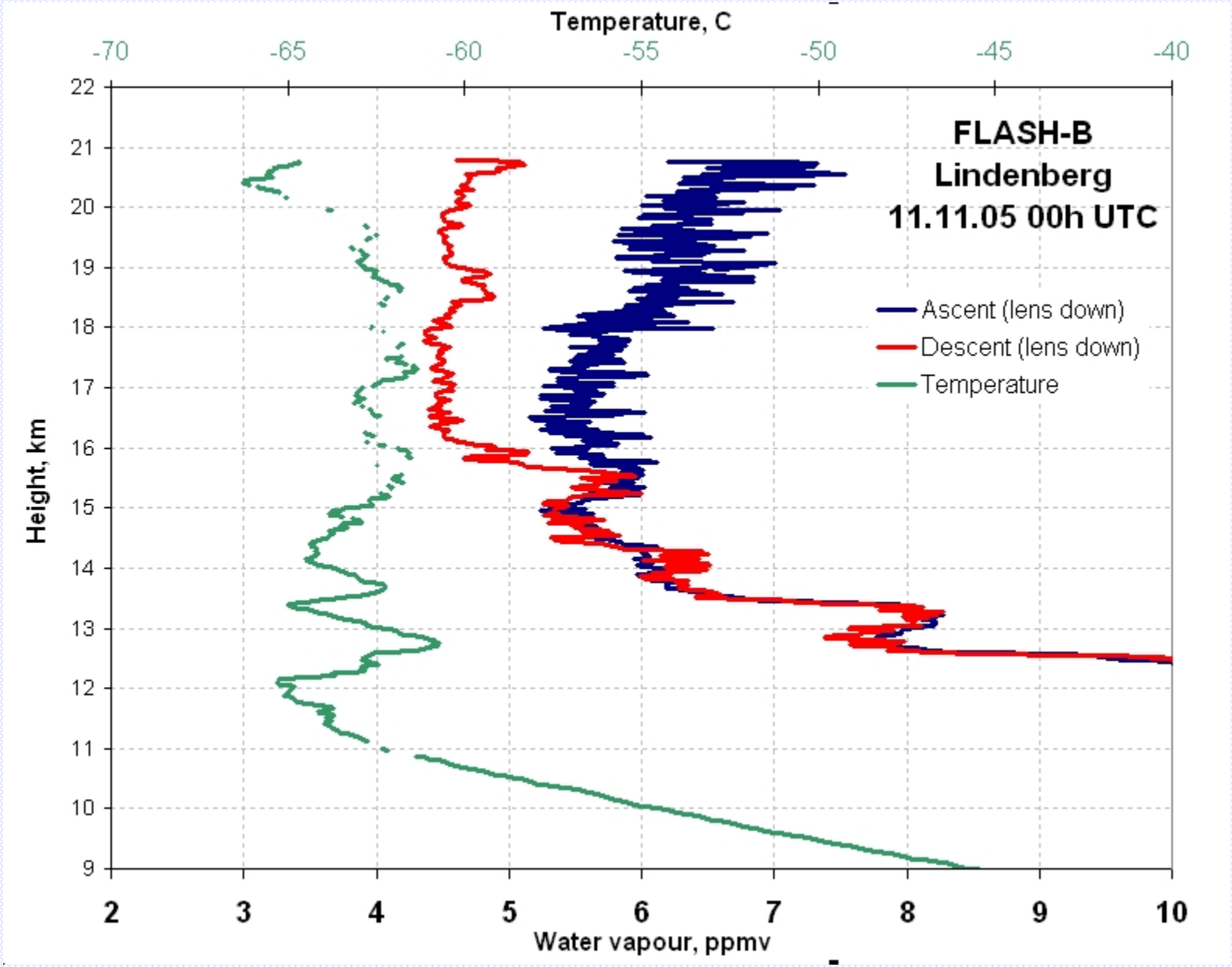
Simultaneous humidity measurements in the troposphere during LAUTLOS

23 February 2004



FLASH-B & NOAA/CMDL water vapour
17 February 2004 Sodankyla

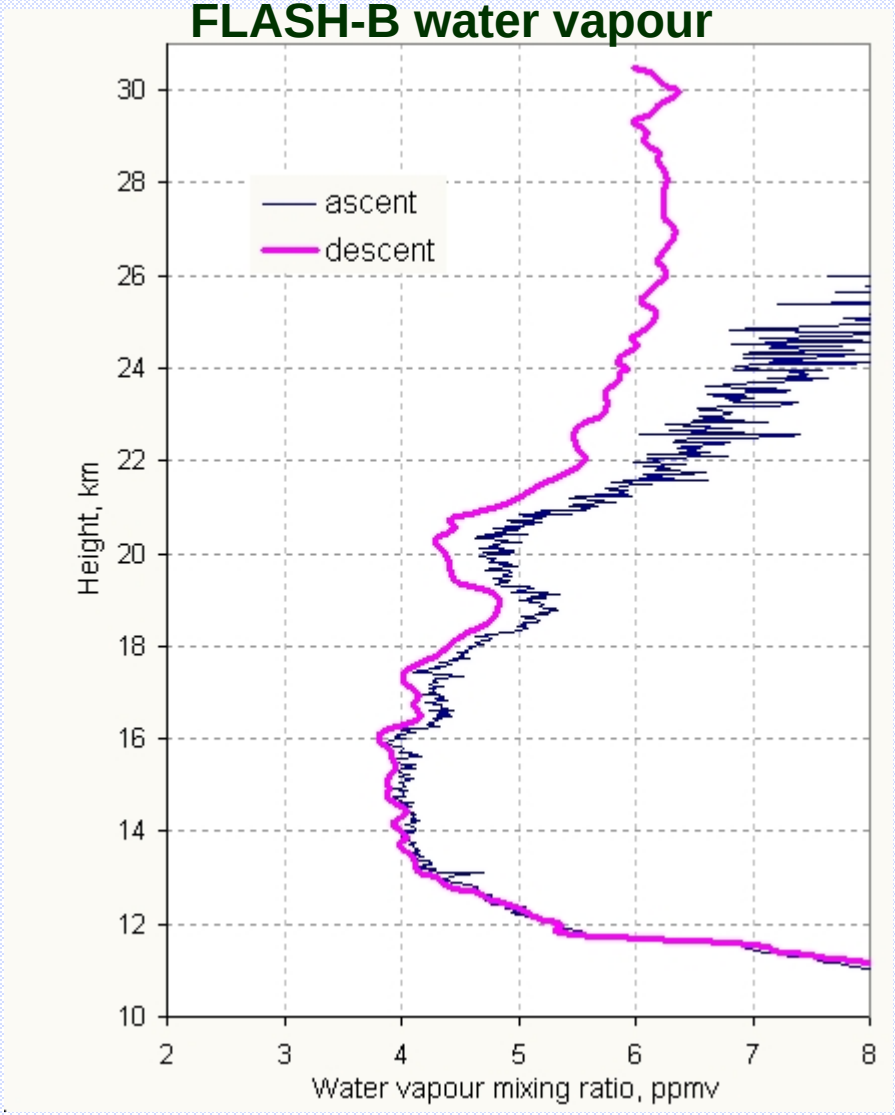



Temperature, C
-70
-65
-60
-55
-50
-45
-40
22
21
20
19
18
17
16
15
14
13
12
11
10
9
Height, km
FLASH-B
Lindenberg
11.11.05 00h UTC
Ascent (lens down)
Descent (lens down)
Temperature
2
3
4
5
6
7
8
9
10
Water vapour, ppmv

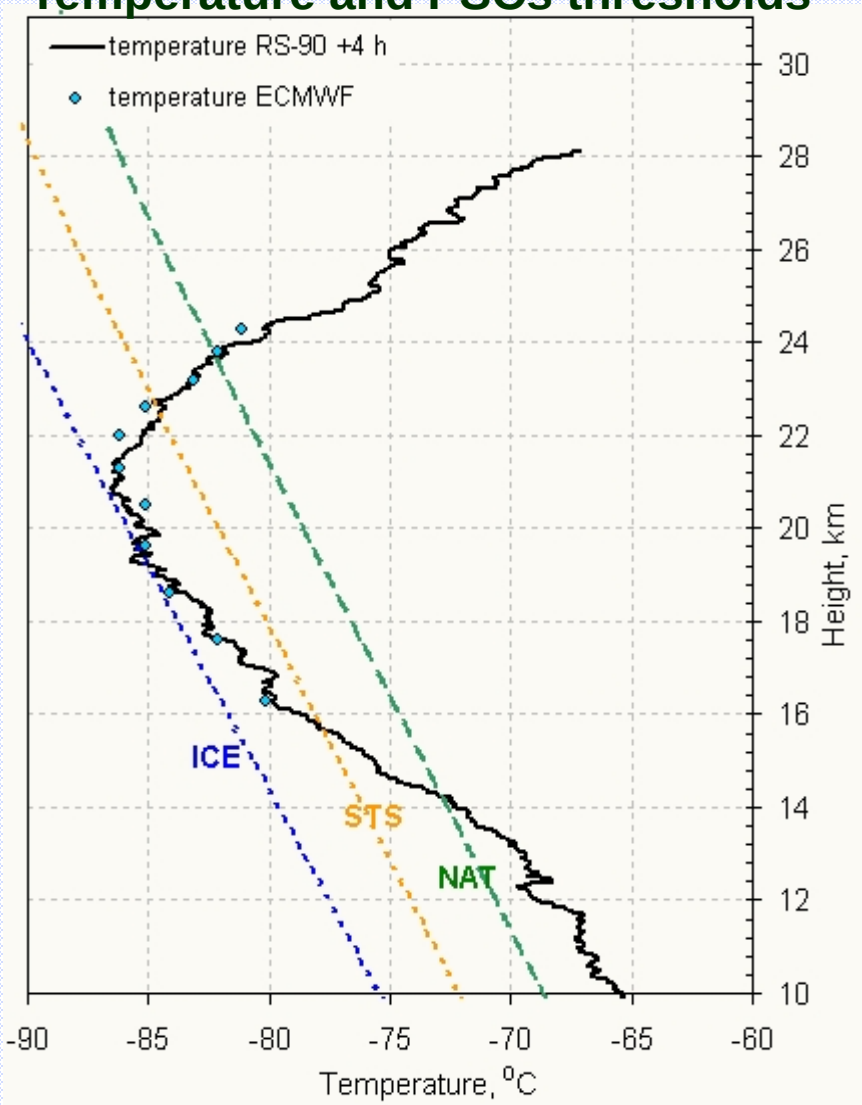
FLASH-B water vapour observations in the presence of PSCs

Ny-Alesund (78,9 N, 11,9 E) 6 January 2005

FLASH-B water vapour



Temperature and PSCs thresholds

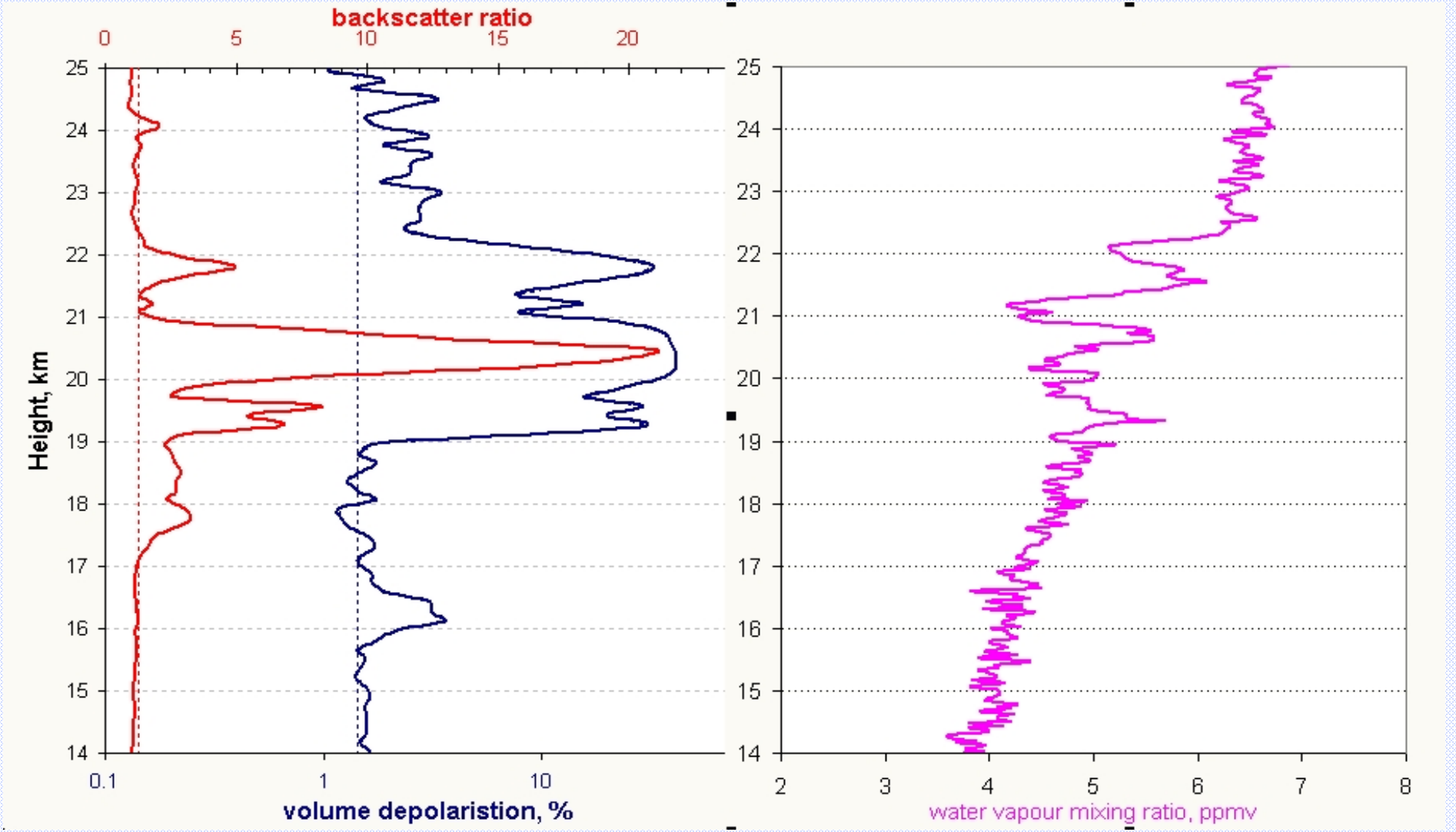


FLASH-B water vapour observations in the presence of PSCs

Ny-Alesund (78,9 N, 11,9 E) 26 January 2005

lidar

water vapour



Forthcoming campaigns with FLASH-B:

SCOUT-AMMA balloon campaign (CNRS)
July-August, 2006 West Africa, Niger.
up to 10 flights with BKS sonde

STRATEOLE campaign (CNES)
August 2006 West Africa, Niger
up to 2 flights on long-duration SPB balloons

Future perspectives:

- integration with Swiss Meteolabor radiosonde SRS-34

- Integration with Vaisala RS-92