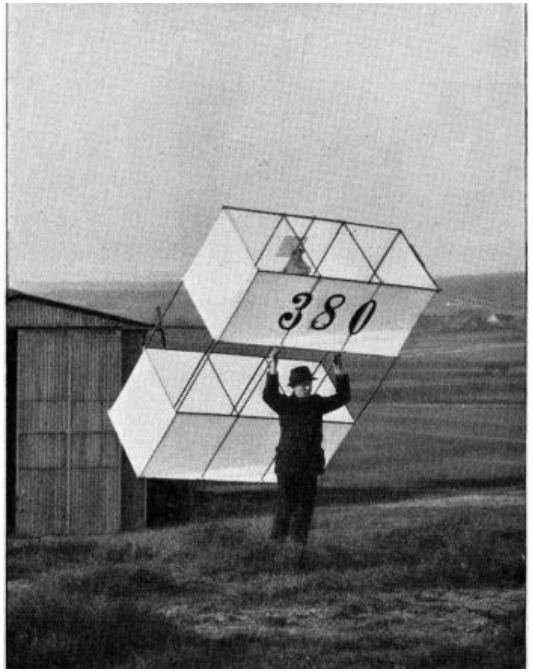
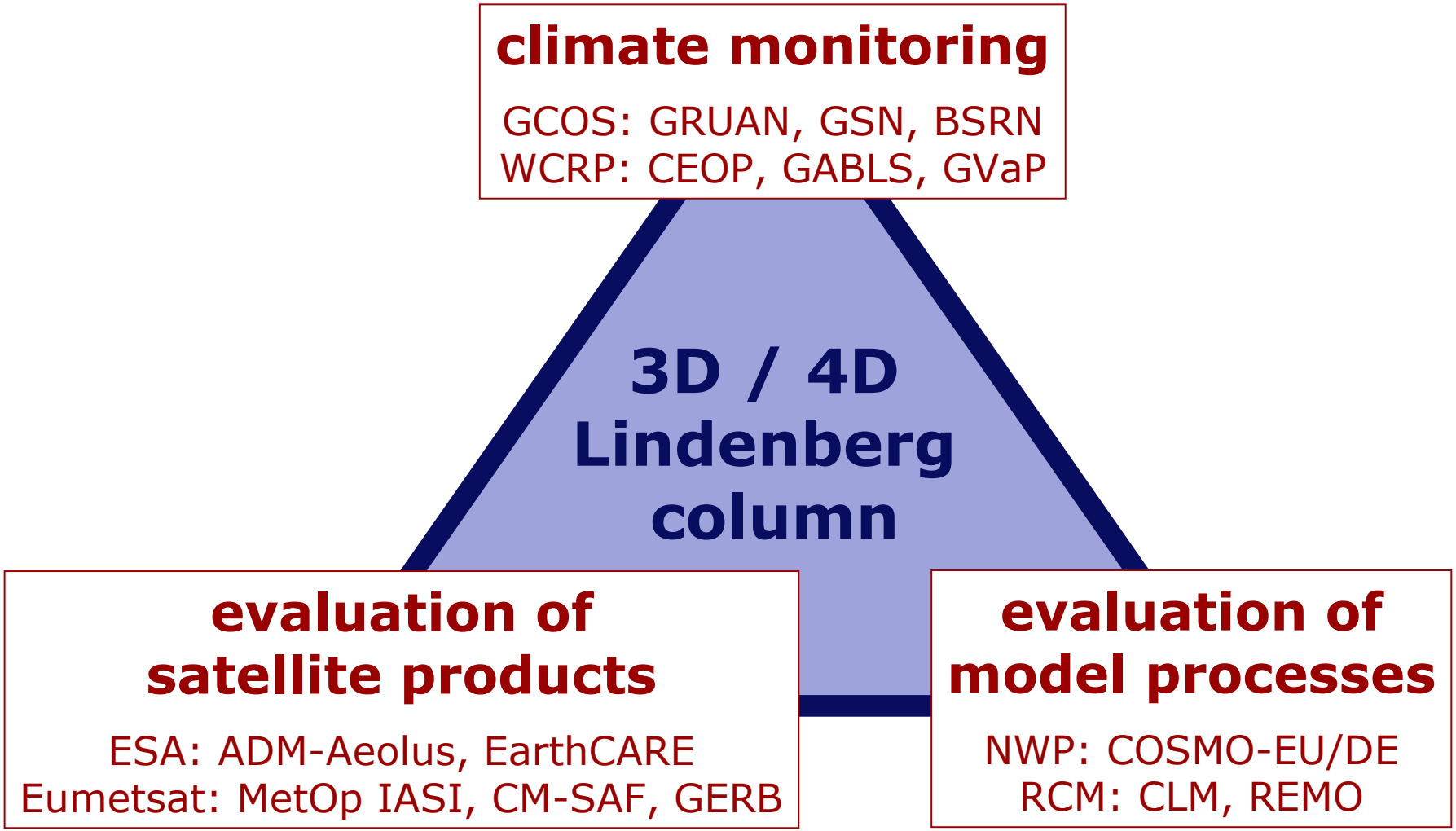
GCOS / WCRP activities carried out in Lindenberg



Franz H. Berger


climate monitoring
GCOS: GRUAN, GSN, BSRN
WCRP: CEOP, GABLS, GVaP
3D / 4D
Lindenberg
column
evaluation of
satellite products
ESA: ADM-Aeolus, EarthCARE
Eumetsat: MetOp IASI, CM-SAF, GERB
evaluation of
model processes
NWP: COSMO-EU/DE
RCM: CLM, REMO

3D / 4D Lindenberg column - started 1996 / finalized 2006

(approx. 20 km x 20 km x 35 km / approx. 7x7 COSMO-DE grids)

measurements in ABL, in 2m-level, and in soil

temperature, pressure, humidity, wind
radiant flux densities, radiances
energy fluxes (latent, sensibel)
precipitation

local measurements
↓
path integrated meas.
↓
spatial integrated calculation

measurements of vertical profiles

temperature
pressure
humidity incl. aerosol / cloud properties
wind (-direction, -velocity)

composit of indiv. measurements
↓
vertical profiles

measurements at top of atmosphere

radiances, radiant flux densities

spatial integrated measurement

1. operation / maintanance of a set of instruments

- 24h weather / reference climate station
- reference radiosounding
- radiation measurements
- active and passive remote sensing
- ABL (energy flux) measurements

- **instrument calibration**
  - calibration climate chamber
  - blackbody radiation calibration rooms
  - wind tunnel (in Hamburg)
  - cross-calibration (➔ complementary / not redundant instruments)

4. quality assurance / quality control

6. updates / improved measuring techniques

8. data analysis and interpretation

climate chamber under specific atmospheric conditions:

P … 10-1015 hPa
T … -78°C – 40°C
RH… 0% til saturation
V … 0-10 ms^{-1}

quality-controled *Reference Data* – measured at MOL-RAO

GCOS (*Global Climate Observing System*)

- GCOS Surface Network (GSN)
- GCOS Upper-Air Network (GUAN)
- GCOS Reference Upper-Air Network (GRUAN)
- GCOS Baseline Surface Radiation Network (BSRN)

WCRP (World Climate Research Programme)

- Co-ordinated Energy and water cycle Observation Project (CEOP)
- GEWEX Water Vapor Project (GVaP)
- GEWEX Atmospheric Boundary Layer Studies (GABLS)

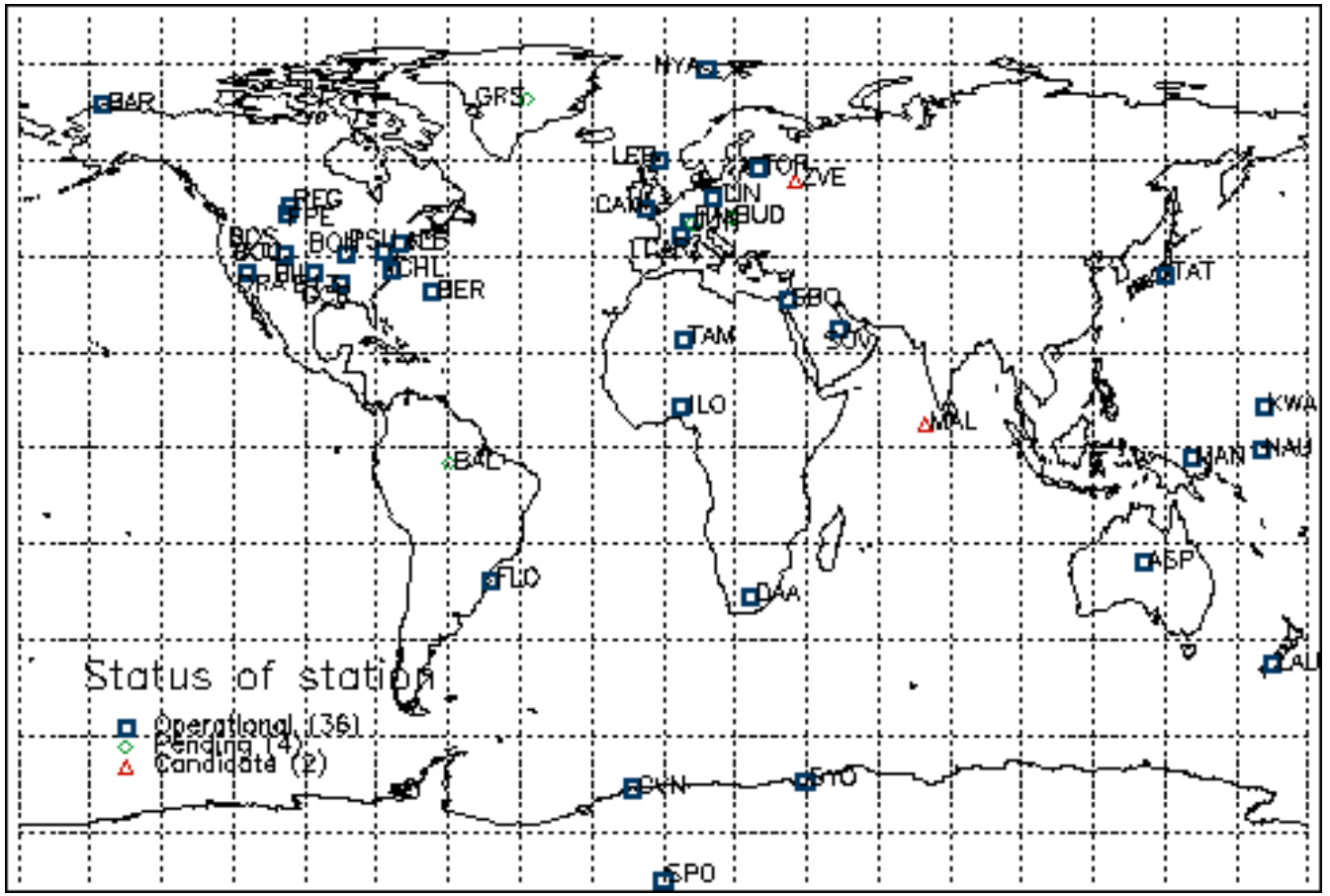
International Climate Data Base

- World Ozone and UV Radiation Data Centre
- WMO World Data Centre for Aerosols

GCOS / BSRN

Baseline Surface Radiation Network

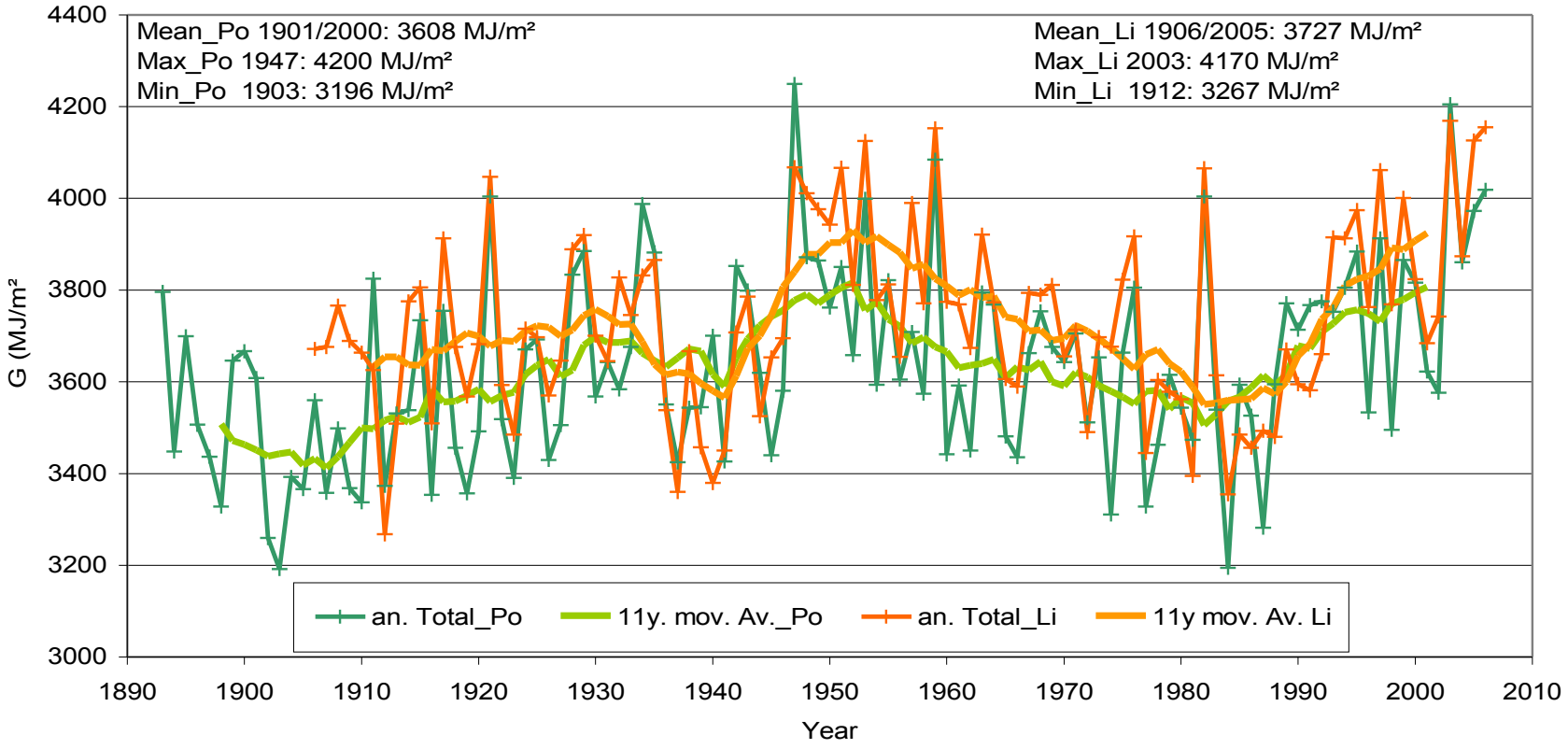
start: 1992
status: 36 stations (34 active)
MOL-RAO: since 1994



radiation measurements
RA VI calibration center

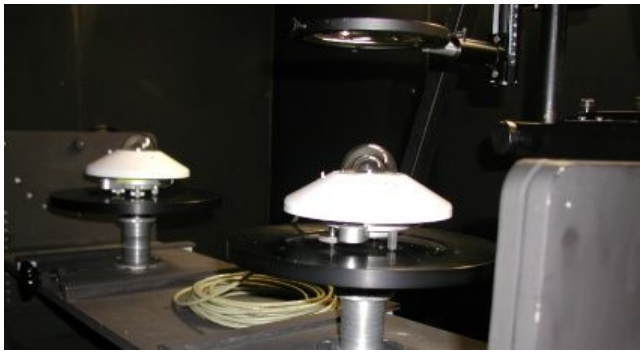
- BSRN -

Annual totals of Global Radiation (G) Potsdam 1893/2006 and Lindenberg 1906/2006



calibration

shortwave

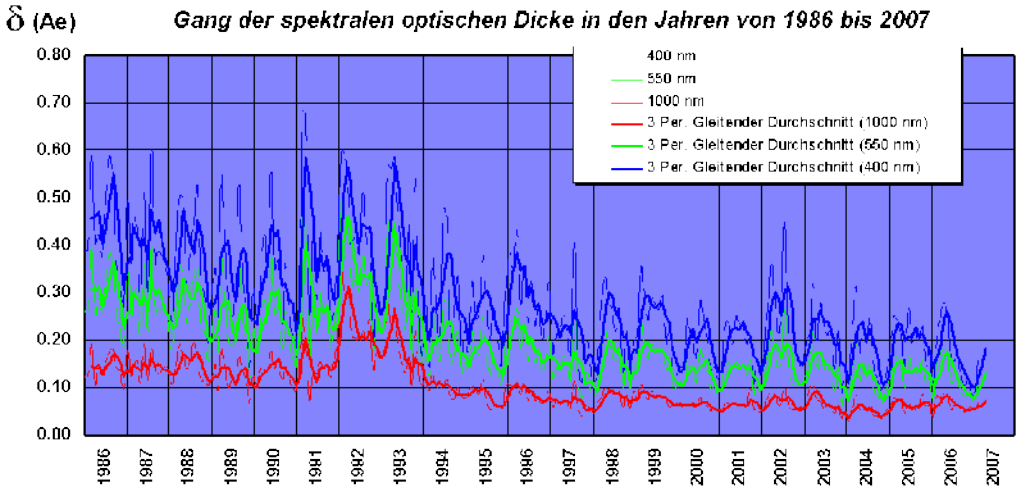


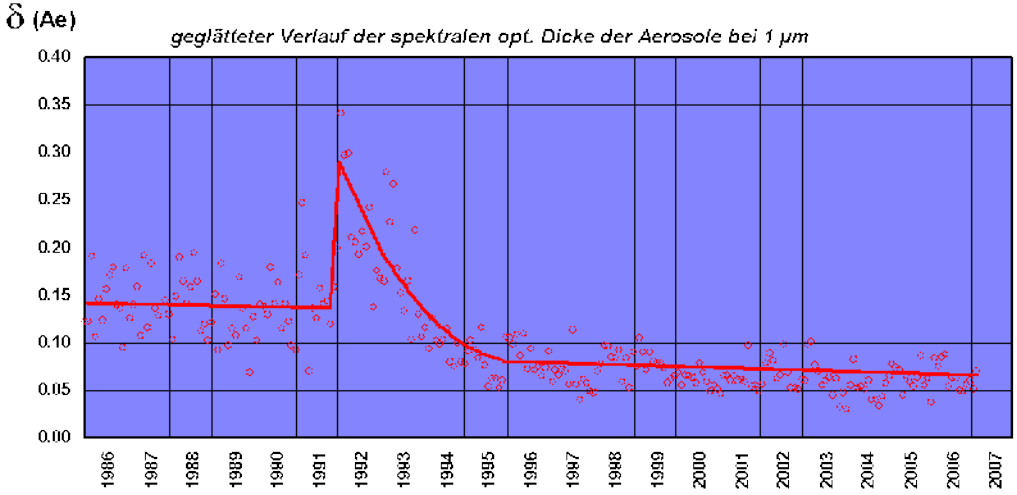
shortwave
in the lab

longwave

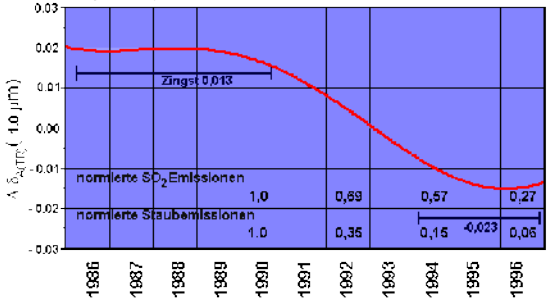
Parameter	1991	1997	2004
direct solar radiation		1% or 2 Wm^{-2}	**0.5%** or **1.5 Wm^{-2}**
diffuse solar radiation	10 Wm^{-2}	4% or 5 Wm^{-2}	**2%** or **3 Wm^{-2}**
insolation	15 Wm^{-2}	2% or 5 Wm^{-2}	**2%** or **5 Wm^{-2}**
atmospheric down. rad.	30 Wm^{-2}	5% or 10 Wm^{-2}	**2%** or **3 Wm^{-2}**

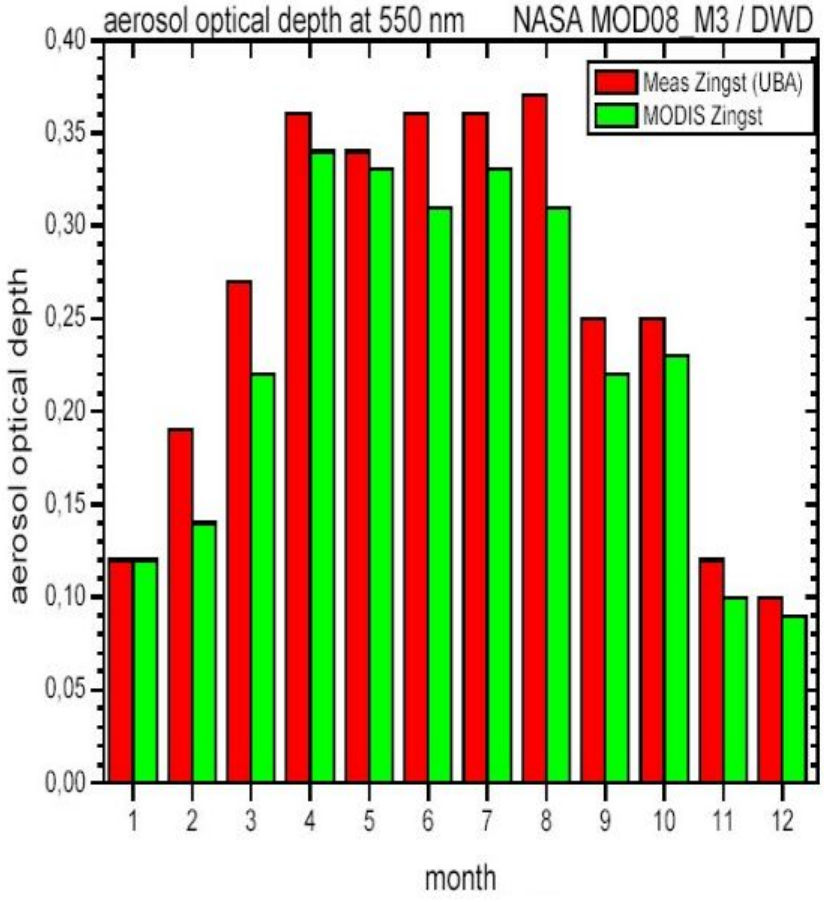
aerosol optical thickness (since 1986)

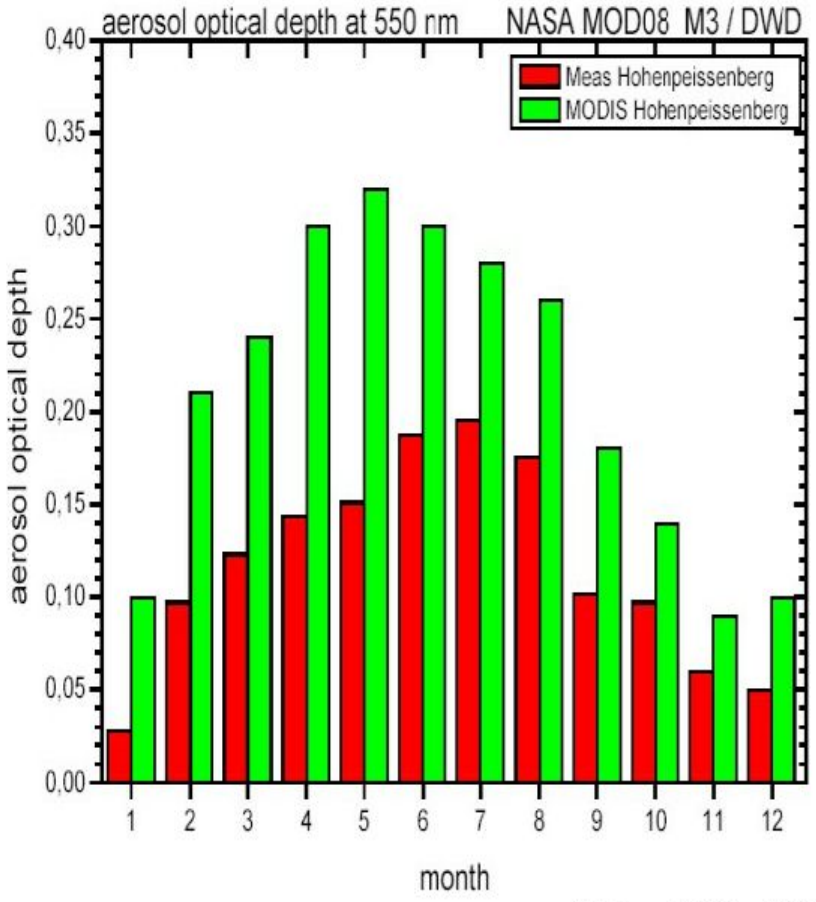




Änderung des Verlaufs der optischen Dicke der troposphärischen Aerosole (bei der Wellenlänge 1 µm) durch die Reduzierung der SO_2 und Schwebstaubbelastung im Gebiet der ehemaligen DDR bzw. im sog. "Black Triangle" Polen, Tschechische Republik, DDR.



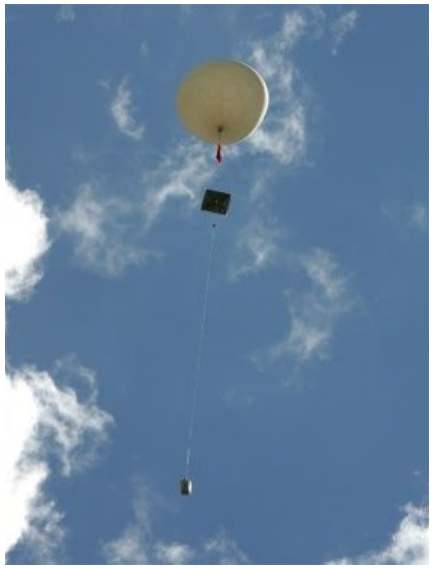




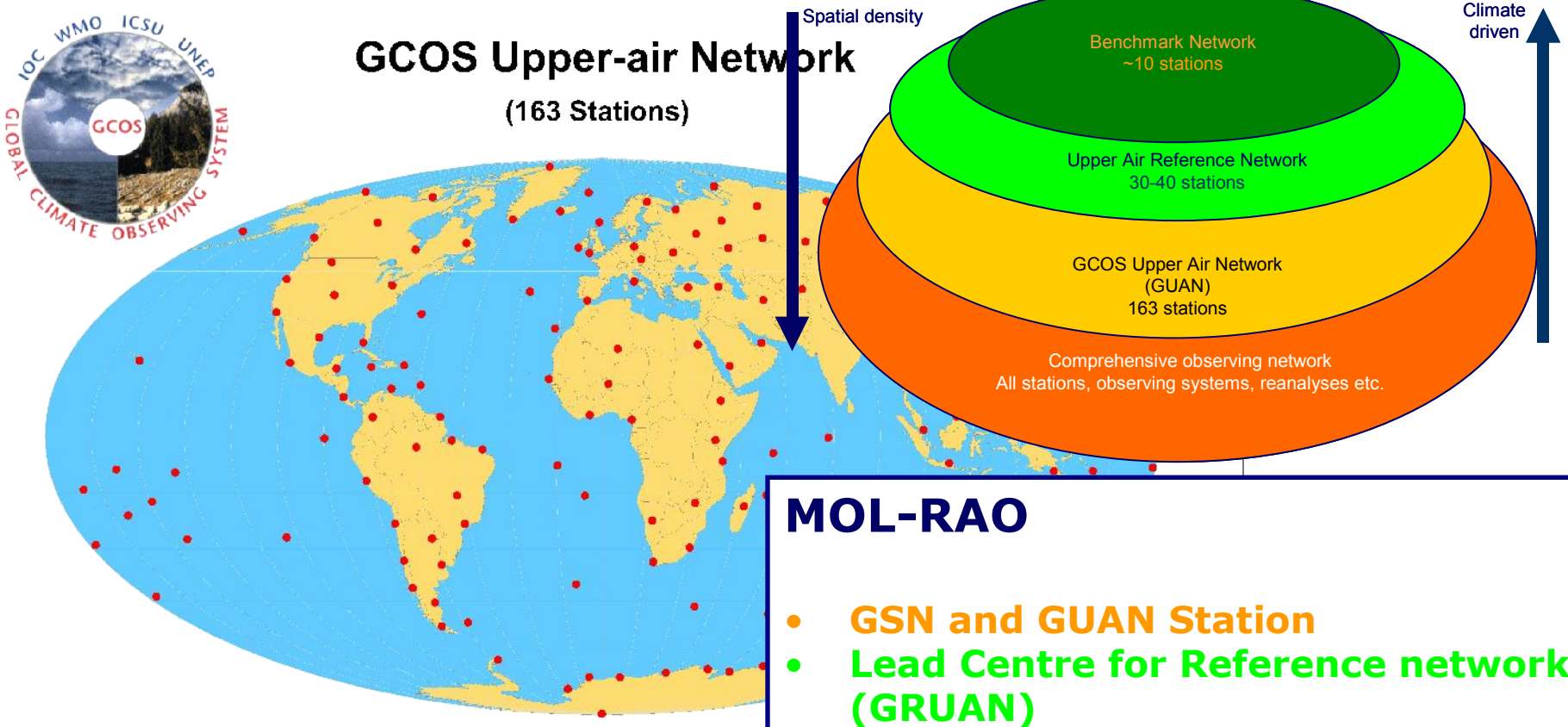
Staiger, Weller 2004

Deutscher Wetterdienst

Meteorological Observatory Lindenberg
Richard Aßmann Observatory



GCOS: GSN, GUAN and GRUAN

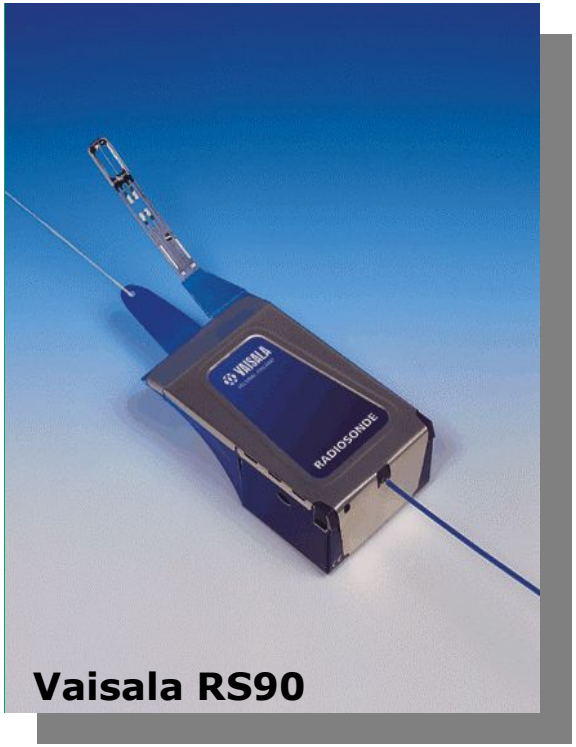


MOL-RAO

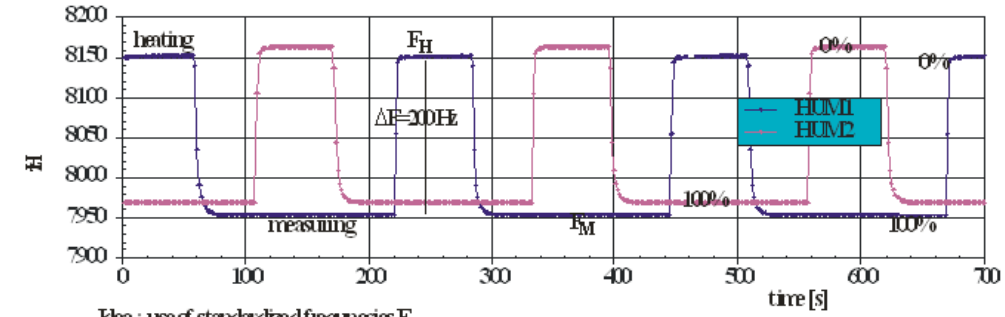
- **GSN and GUAN Station**
- **Lead Centre for Reference network (GRUAN)**
- **Reference Site for GUAN**
- **candidate for *Benchmark* network**

GSN: 1003 stations / 128 countries

FN-Method



Vaisala RS90



Idea : use of standardized frequencies F_H

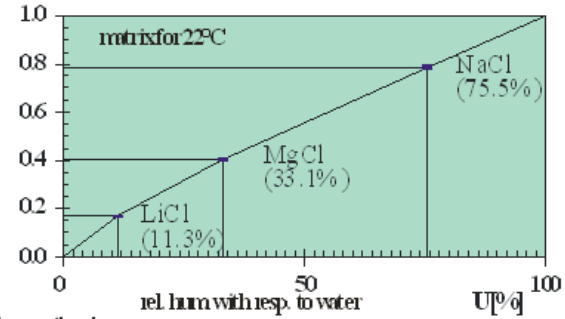
during flight, in situ "calibration"

$$F_n = \frac{F_H(U\,\%) - F_M(U\,\%)}{F_H(100\,\%) - F_M(100\,\%)} = 0.00\ldots1.00 = \frac{e}{e_w}$$

(0..200 Hz; ΔF : individual difference, about 200 Hz)

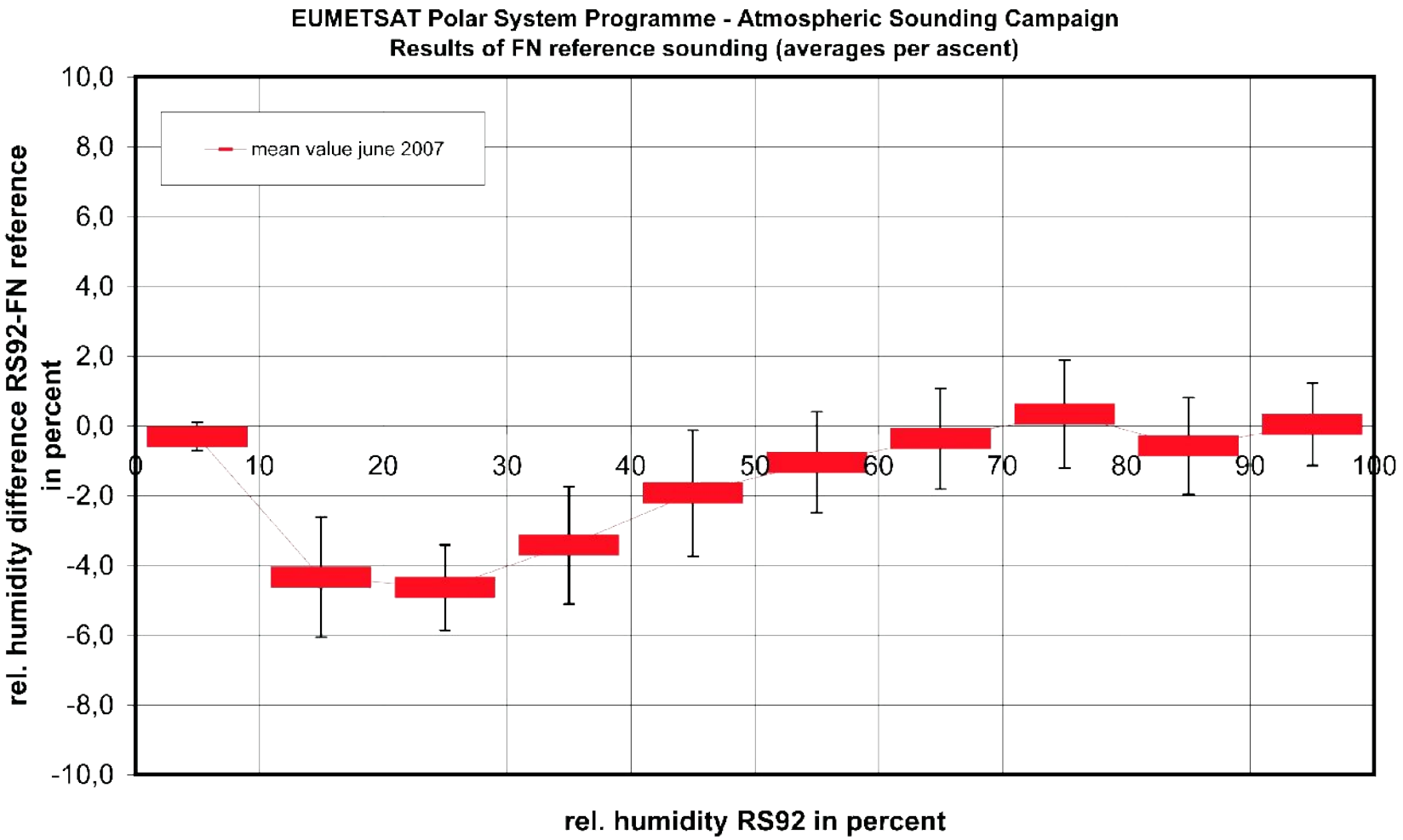
from ground check, before flight at room temperature (18....25°C), with $F_H(U\%) \approx F_H(100\%) \approx F(0\%)$

$$F_n = \frac{e}{e_w}$$



Standardized frequencies method

Leiterer, U. at al.; 2004: *A Correction Method for RS80-A Humicap Profiles and their Validation by Lidar Backscattering Profiles in Tropical Cirrus Clouds*. JAOT, Vol. 22, No. 1, 18-29.


EUMETSAT Polar System Programme - Atmospheric Sounding Campaign
Results of FN reference sounding (averages per ascent)
mean value june 2007
rel. humidity difference RS92-FN reference in percent
10,0
8,0
6,0
4,0
2,0
0,0
-2,0
-4,0
-6,0
-8,0
-10,0
0
10
20
30
40
50
60
70
80
90
100
rel. humidity RS92 in percent

Deutscher Wetterdienst

Meteorological Observatory Lindenberg
Richard Aßmann Observatory

active ground based remote sensing

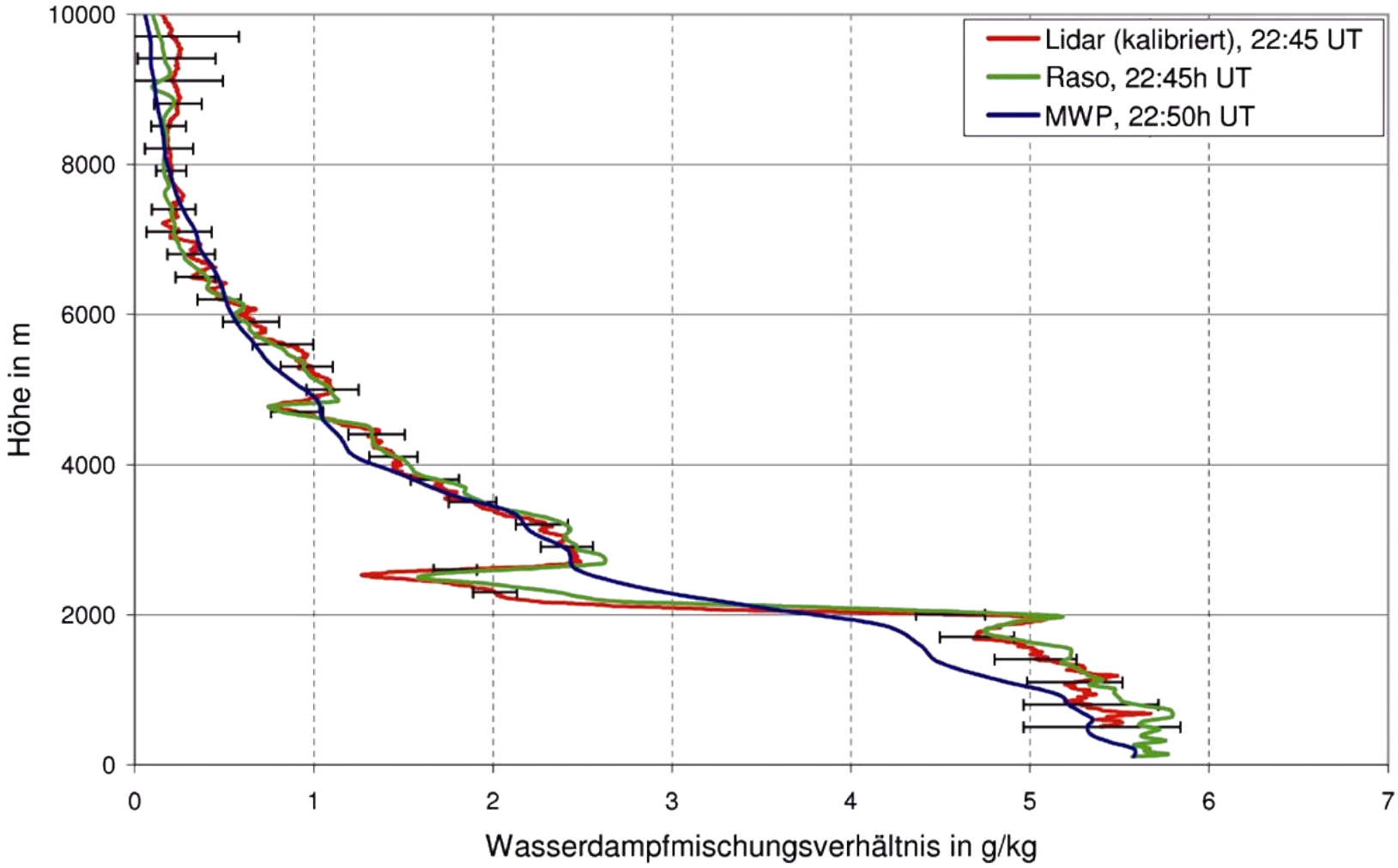
- 2 wind profiler/RASS
- Sodar/RASS
- Raman-LIDAR RAMSES
- Ka-band cloud radar MIRA
- micro - rainradar
- 3 laser - ceilometer

passive ground based remote sensing

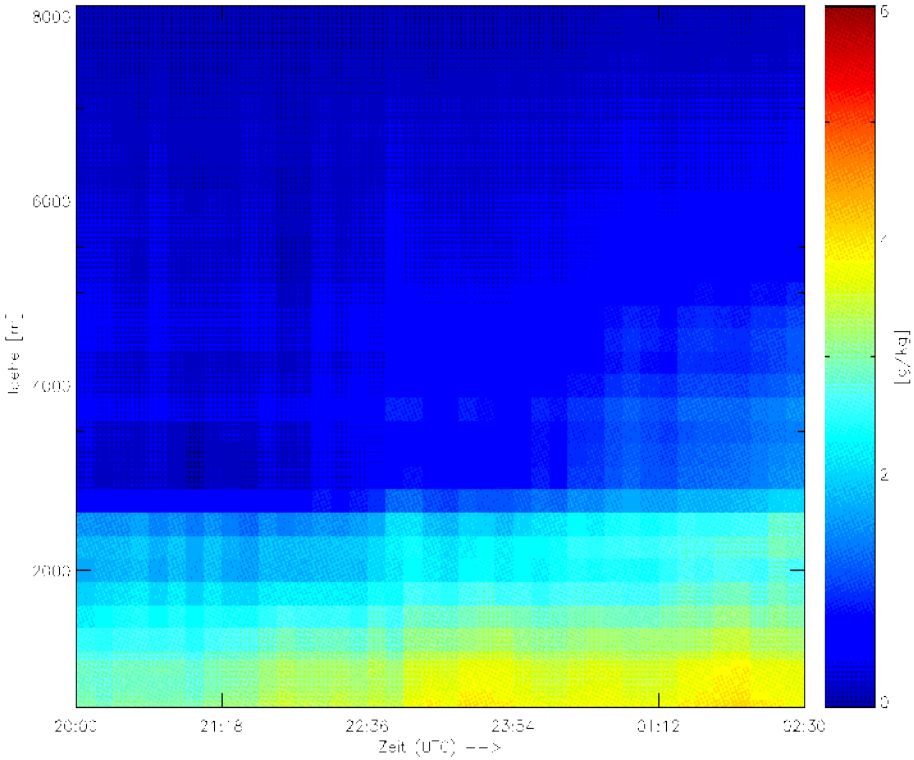
- microwave profiler / radiometer
- FTIR- spectrometer
- Whole Sky Imager
- GPS- receiver

validationsystems

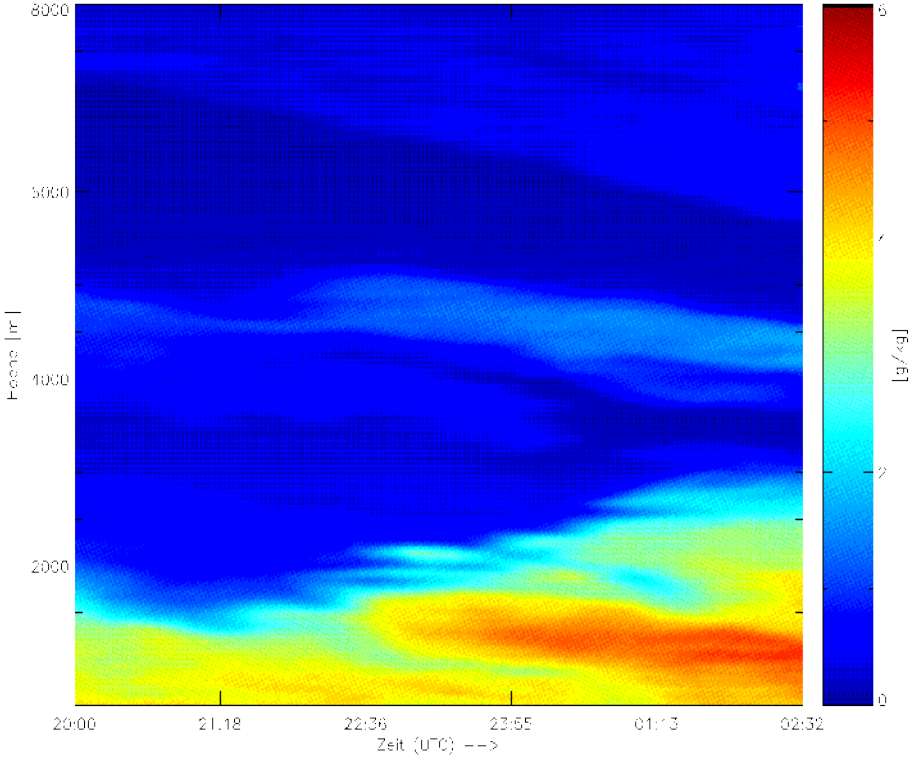
- **4**-radiosonden/day (**8** profiles)
- 6-sonde-thettered balloon
- sun- and starphotometer
- [*99m tower (dx = 5km)*]


Lidar (kalibriert), 22:45 UT
Raso, 22:45h UT
MWP, 22:50h UT
Höhe in m
10000
8000
6000
4000
2000
0
0
1
2
3
4
5
6
7
Wasserdampfmischungsverhältnis in g/kg

Intercomparison MRP – Lidar: 2 - 3. Sep. 2003

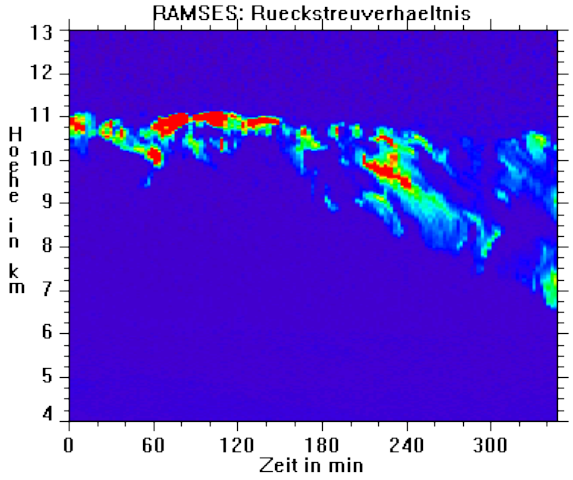


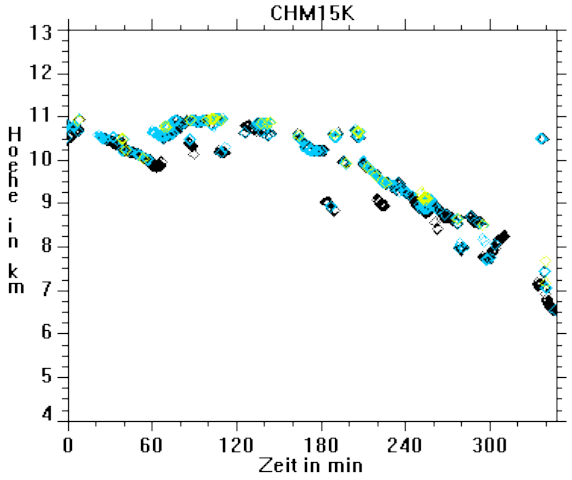
MWP



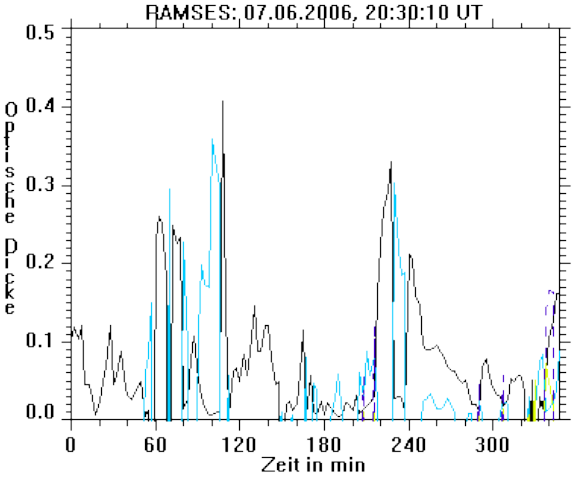
Lidar

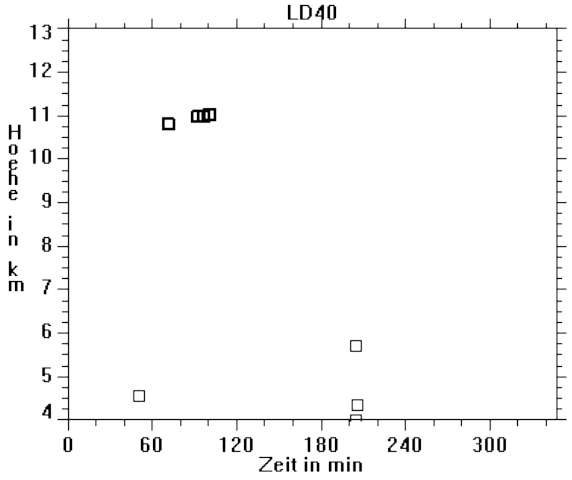
Cloud Base Height / Ice Clouds: 7.6.2006





CHM 15k



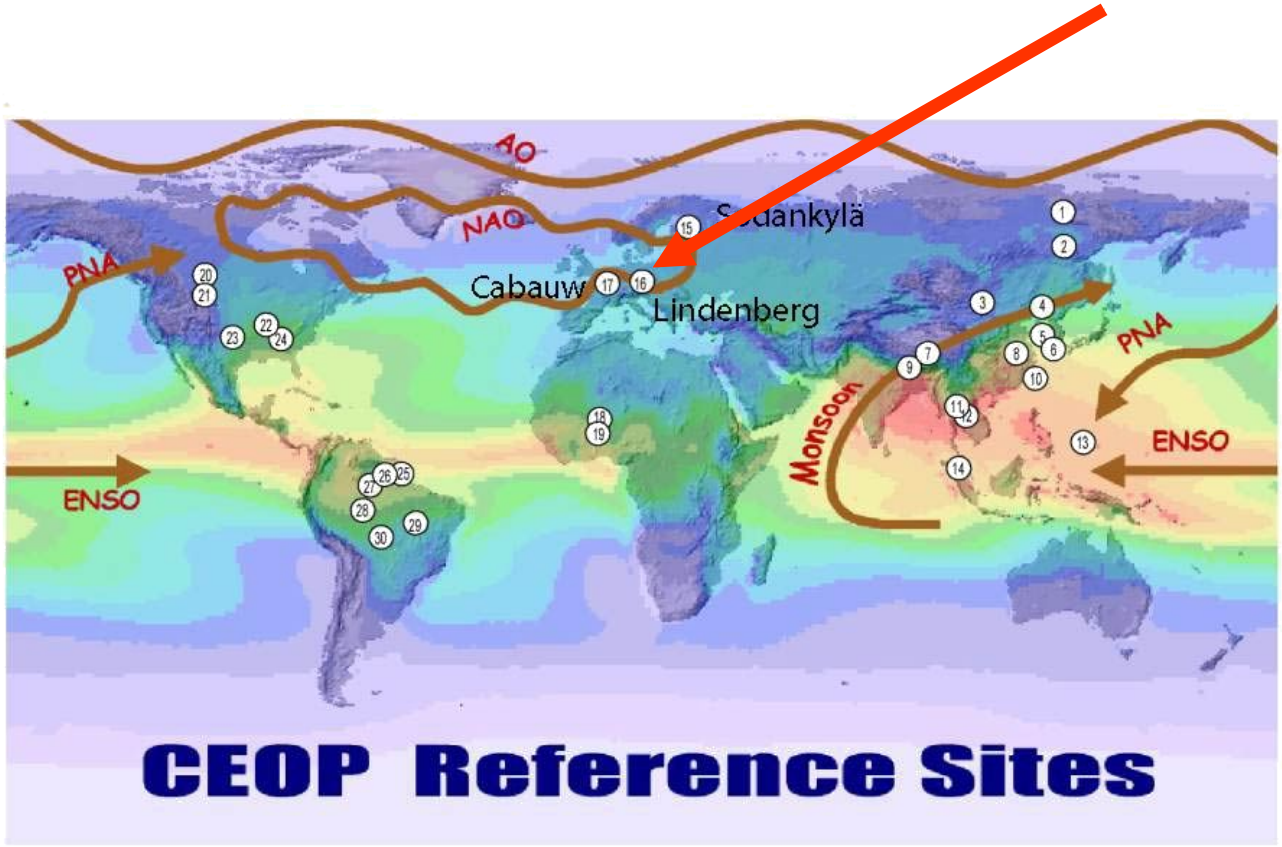


LD-40

WCRP / CEOP and WCRP / BALTEX

Coordinated Enhanced Observing Period (until 2006)

Co-ordinated Energy and water cycle Observation Project (since 2007)

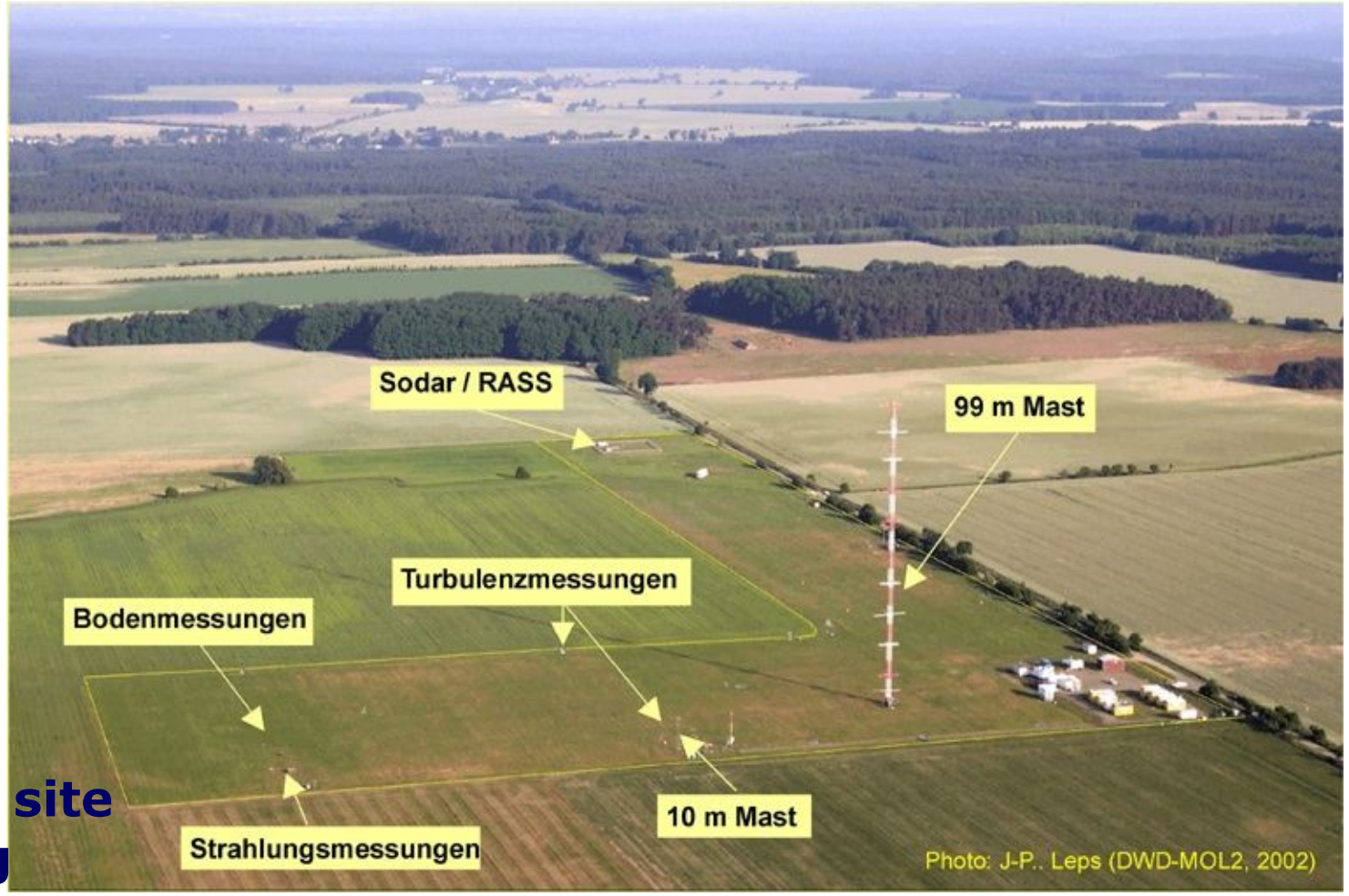


start : 2001

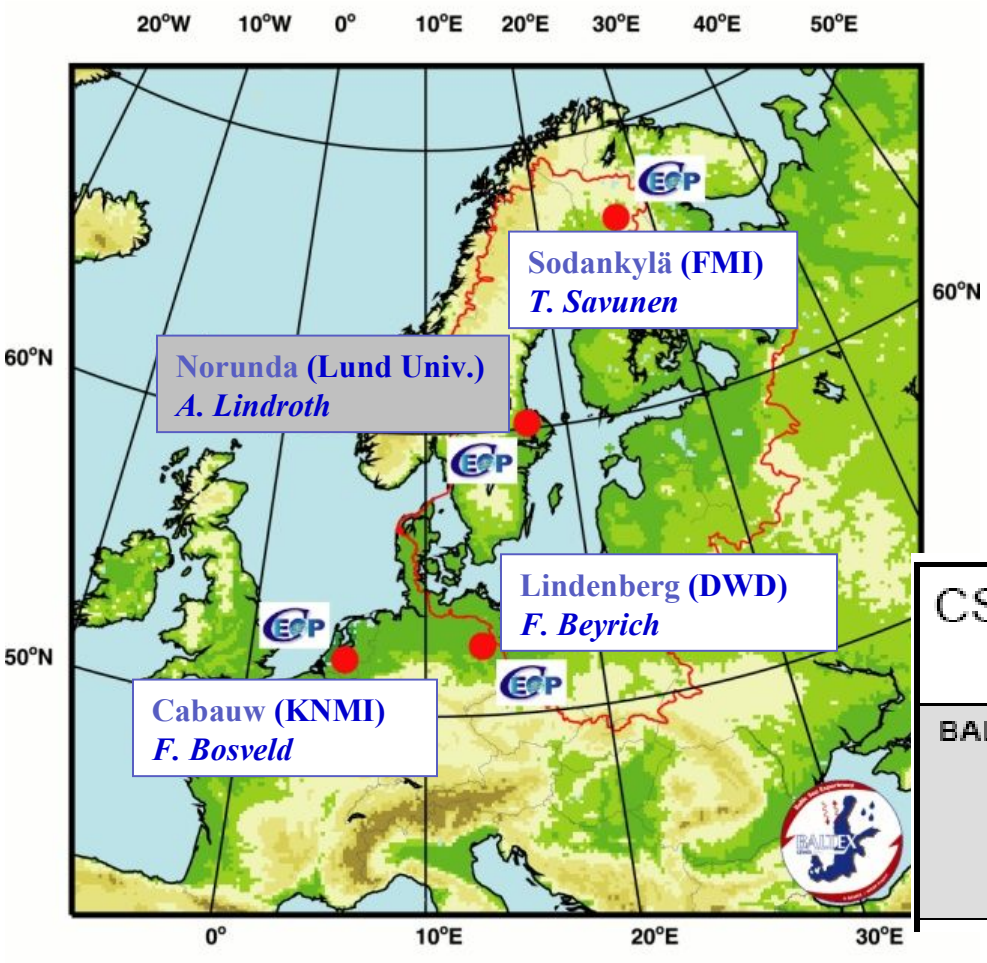
status: 36 /20 stations

MOL-RAO: since 2001

measuring site Falkenberg



BALTEX in-situ Reference Sites in CEOP

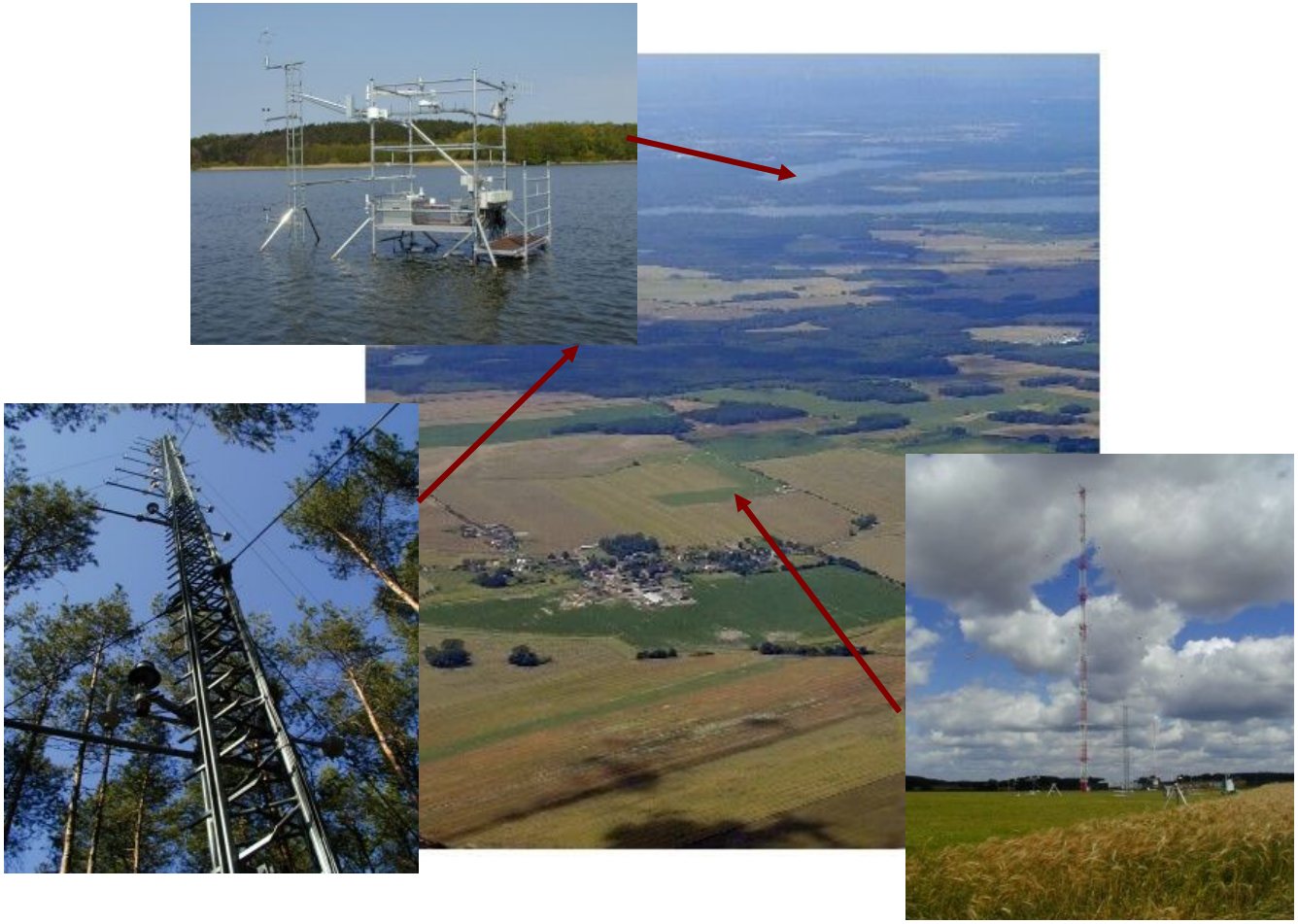


Coordinated Enhanced Observing Period (until 2006)

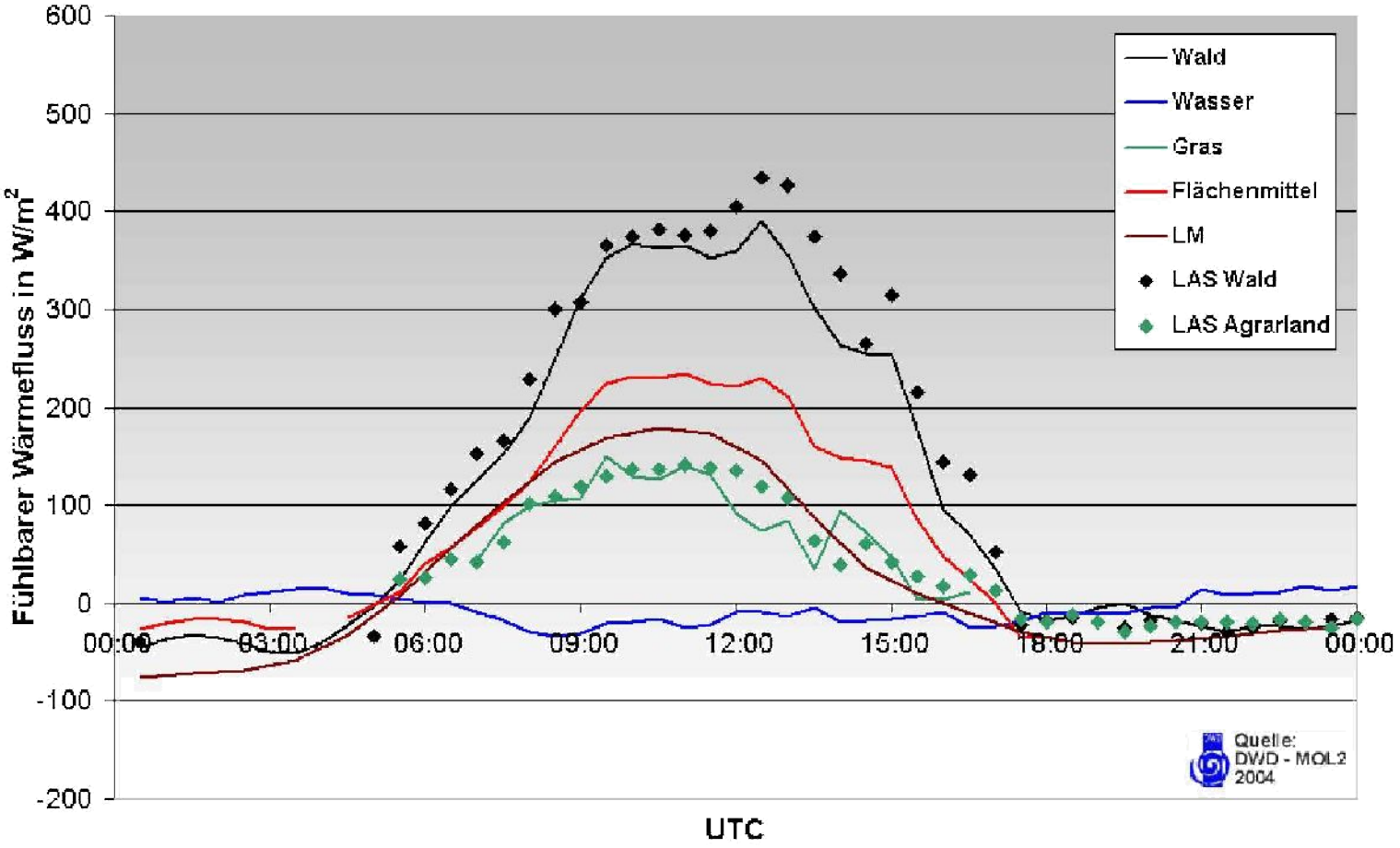
Co-ordinated Energy and water cycle Observation Project (since 2007)

CSE	Reference Site	EOP-3	EOP-4
BALTEX	Cabauw		
	Lindenberg		
	Norunda		
	Sodankyla		

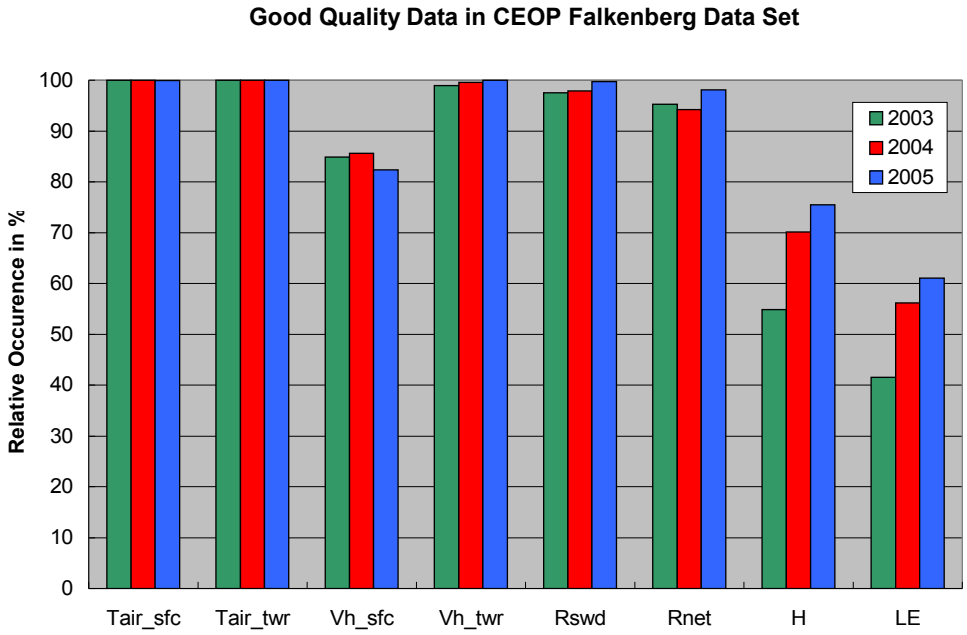
energy fluxes (incl. spatial integration)

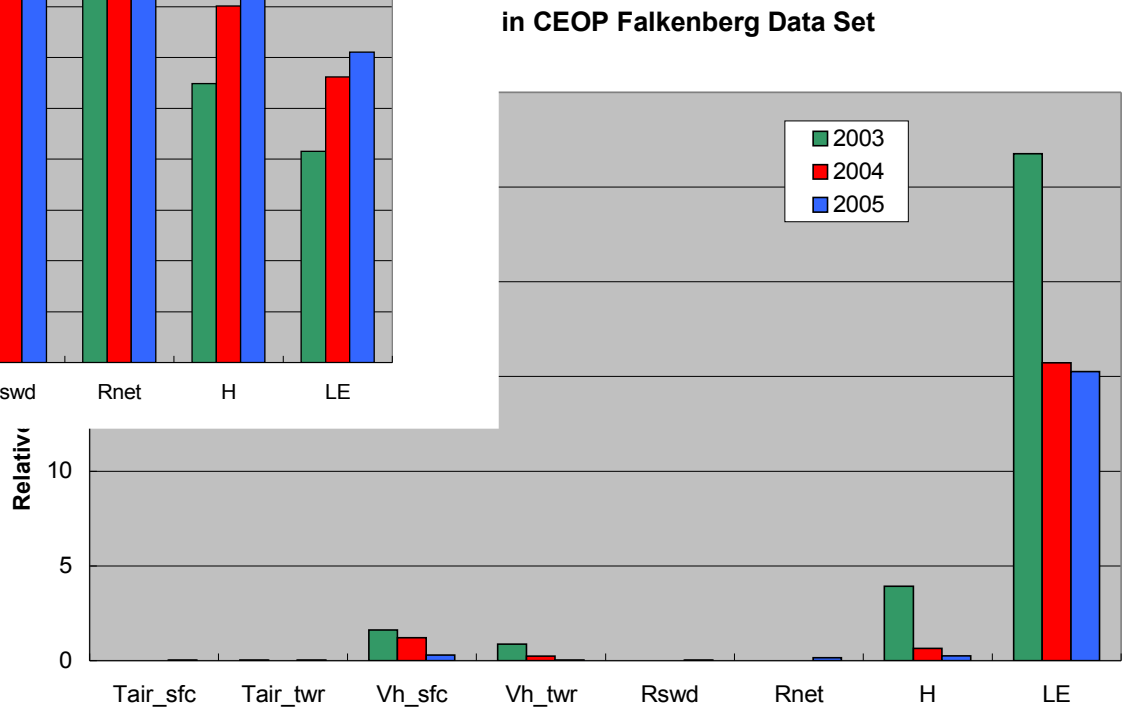


Diurnal variation of sensible heat fluxes – LITFASS 2003

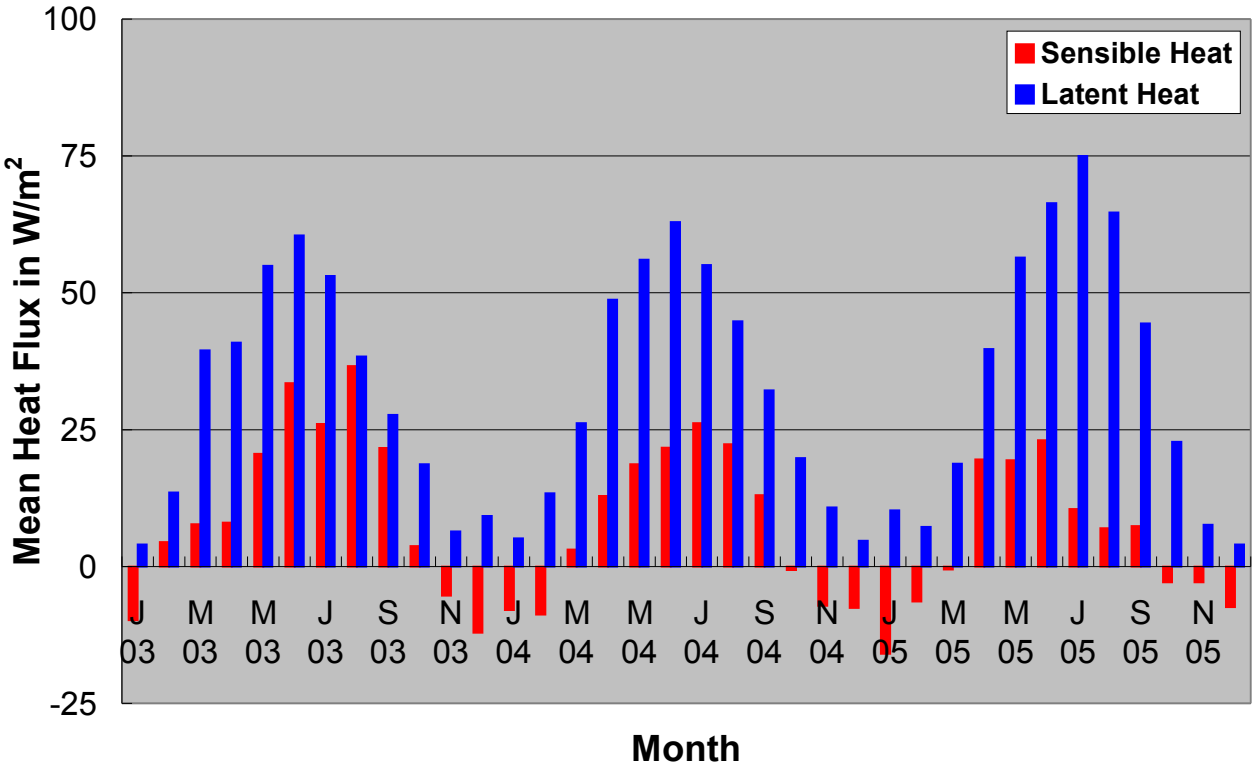


data availability & data quality





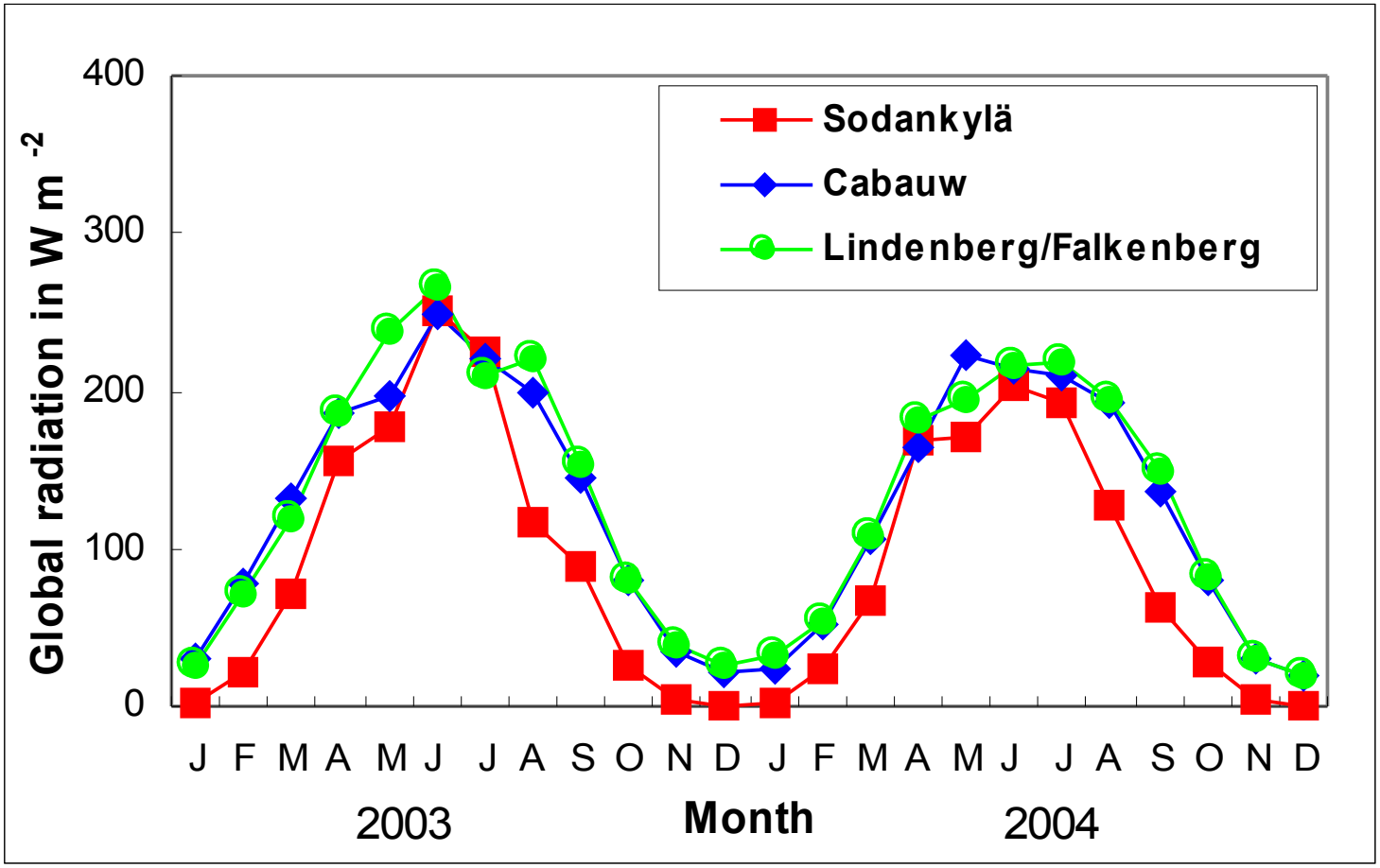
Energyfluxes – Lindenberg / Falkenberg



Sum of Mean Precipitation / May - September:
167 mm (2003), 265 mm (2004) and 351 mm (2005)

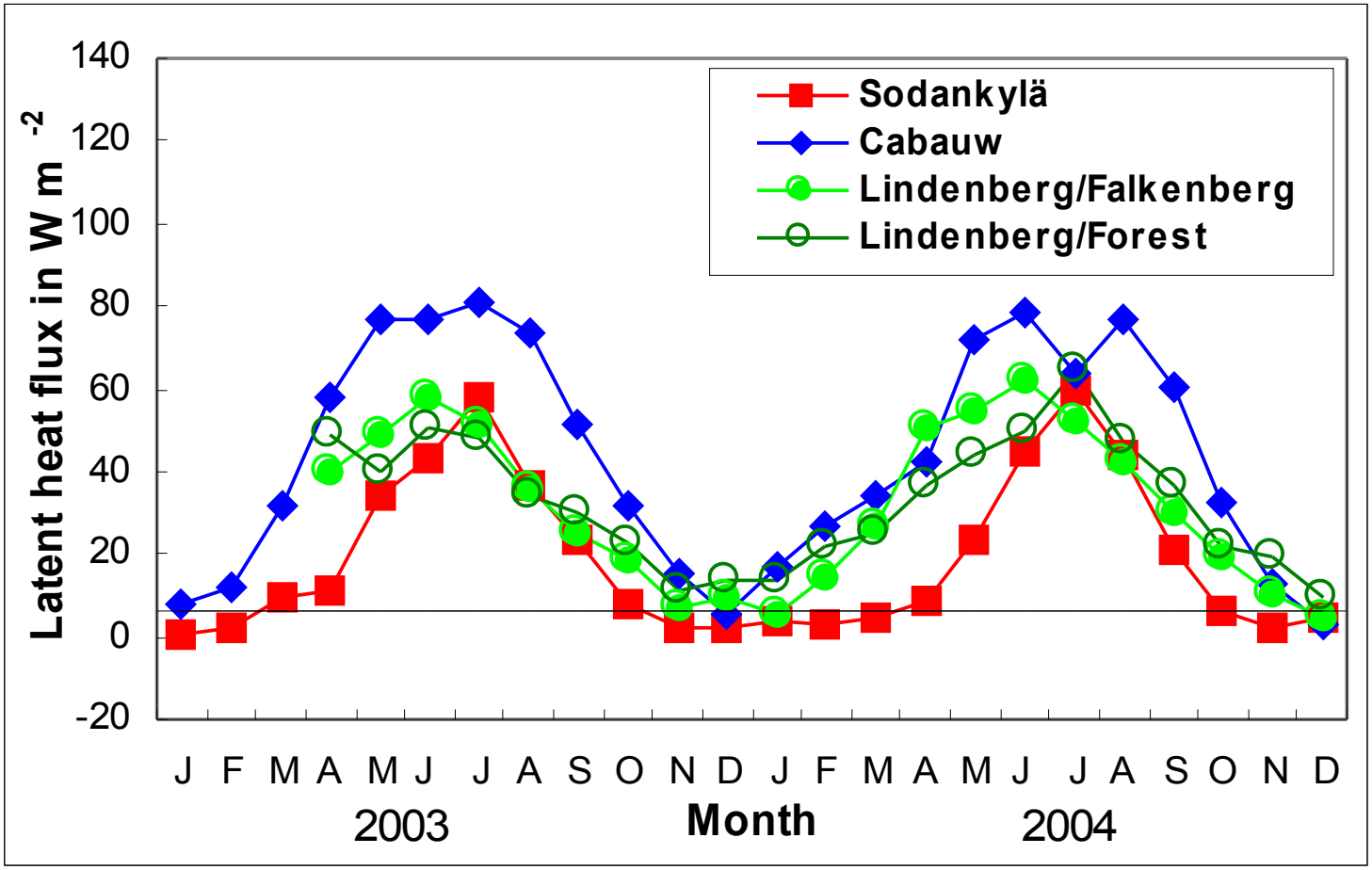
site comparison – BALTEX sites

latent and sensible heat flux



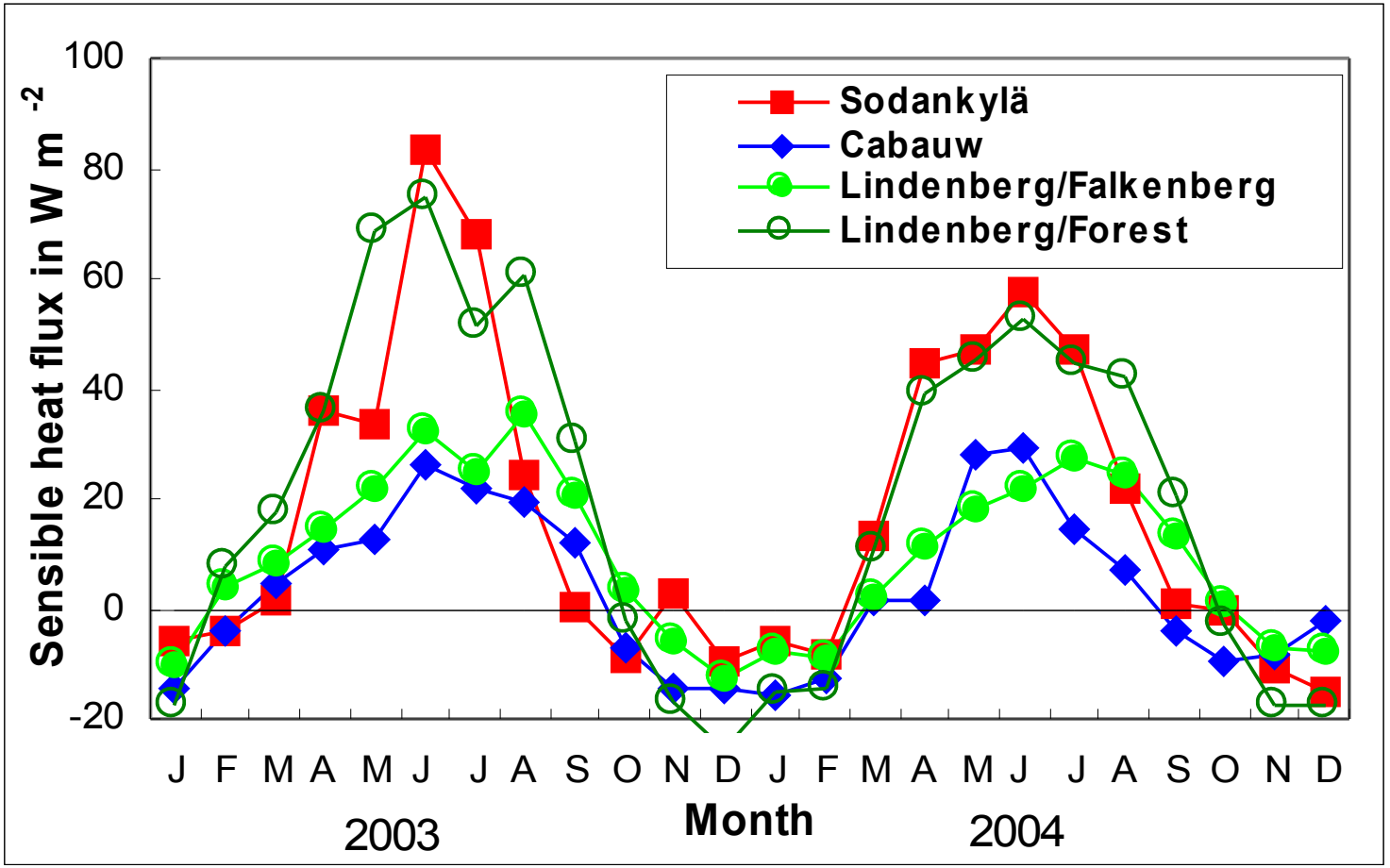
site comparison – BALTEX sites

latent and sensible heat flux



site comparison – BALTEX sites

latent and sensible heat flux



MOL-RAO

reference site for

1. long-term / climate observation (GCOS principle)

3. model evaluation

5. satellite product validation

7. national network (wind profiler, radiation)

assistance in the DWD network activities

reserach site for national and international activities

thank you.