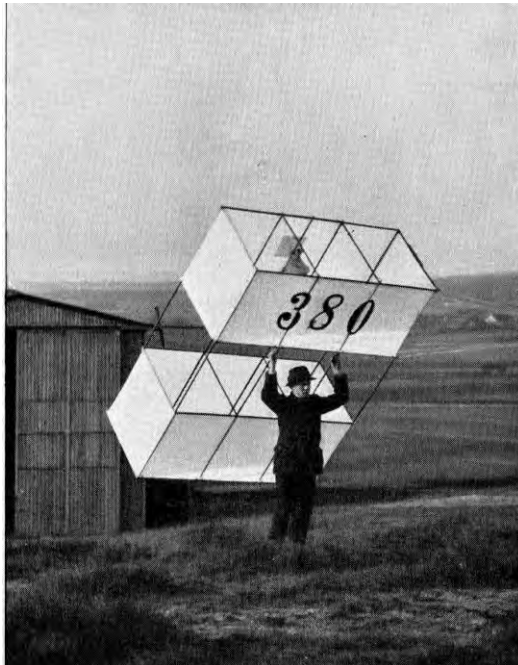


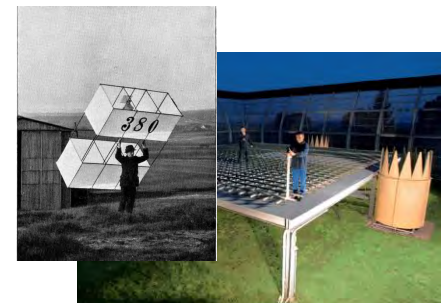
Lindenberg Meteorological Observatory – Richard Aßmann Observatory (since 1905)



Franz H. Berger

Brief historical overview

1893	<i>first radiation measurements at Potsdam Observ.</i>
April 1905	first tethered balloons, kite
October 1905	inauguration ceremony (emperor Wilhelm II)
April 1911	introduction of a first air traffic warning system
August 1919	Kite – World record (9750m)
since 1930	development of a radiosonde system
since 1947	routine radiosonde launches (4x daily)
since 1992	surface based remote sensing
since 1994	ABL measurements (GM Falkenberg, Kehrigker Forst)
2003	Merging of Lindenberg und Potsdam (radiation) observatories
since 2008	GRUAN Lead Centre
since 2011	WMO/CIMO Testbed



Measurements 1905-1932 at Lindenberg Aeronautical Observatory



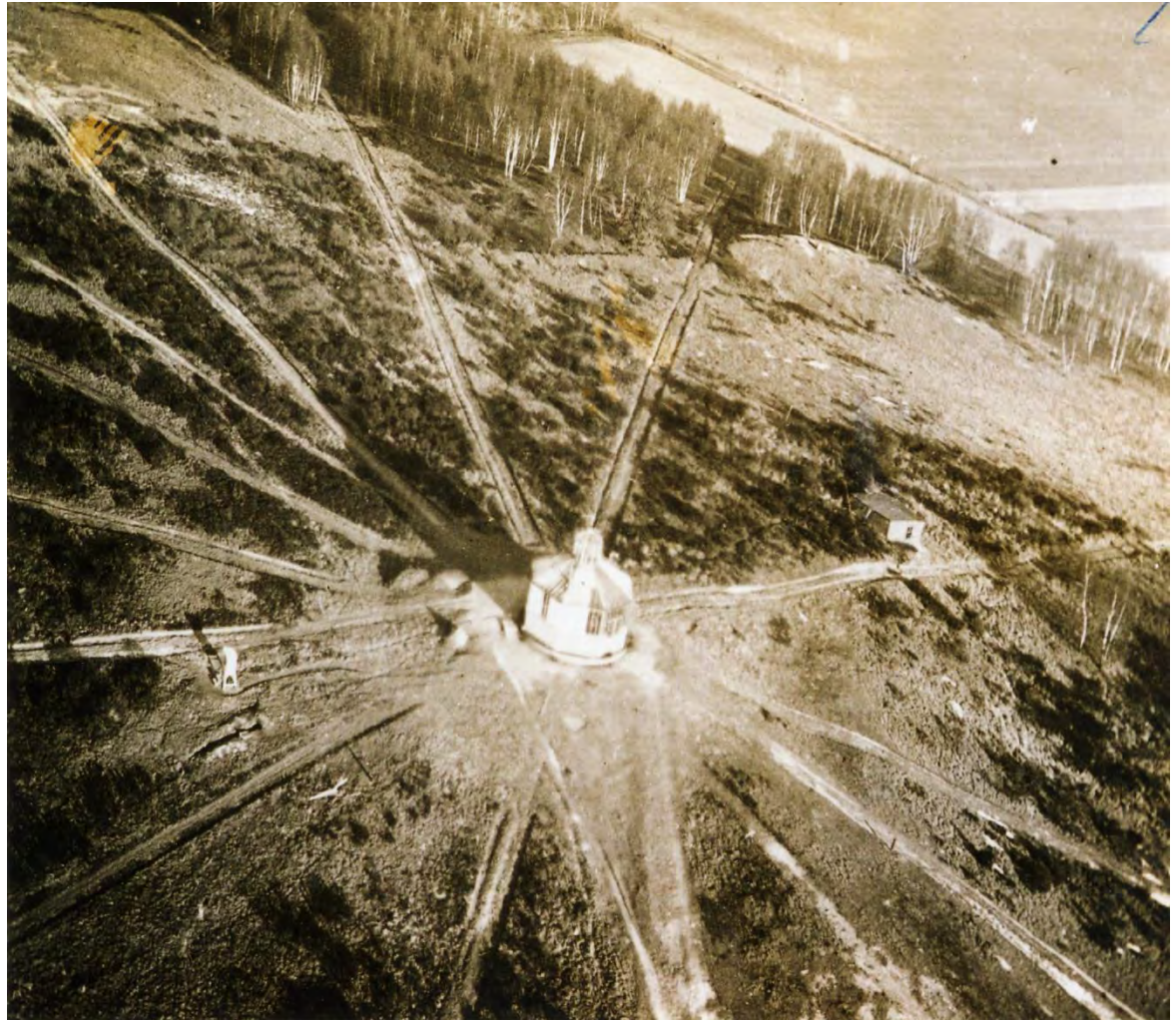
Am Aeronautischen Observatorium Lindenberg (1914—1931)
mit Fesselaufstiegen erreichte Höhen in m

Jahr	mit Drachen			mit Fesselballonen		
	Anzahl	max. Höhe	mittl. tägl. Höhe	Anzahl	max. Höhe	mittl. tägl. Höhe
1914	778	6200	3340	454	8000	3668
1915	701	5610	3517	439	5500	3089
1916	755	7500	3998	400	9200*	4532
1917	720	8240	4025	360	—	4160
1918	703	7300	3661	311	3990	2869
1919	601	9750*	3811	182	5334	2484
1920	697	6700	3306	91	3950	2427
1921	711	5710	2968	30	2560	1867
1922	697	5860	2880	—	—	—
1923	630	4720	2560	55	4080	1677
1924	410	4660	2800	203	3260	2089
1925	456	4470	2488	166	4270	2462
1926	431	5403	2551	203	4788	2384
1927	461	4708	2535	222	4219	2182
1928	508	4260	2321	320	4070	2309
1929	703	5705	2308	220	4175	2567
1930	640	5865	2553	233	4421	2594
1931	609	5772	3030	142	4131	2385
1914—1931	11211			4032		

*) 1. 8. 1919 9750 m kites & **) 26. 9. 1920 9200 m balloons

History:

- **Radiation**
(since 1906;
Postdam since 1893)
 - **Aerology – *in-situ***
(since 1905)
-
- **Ground based
remote sensing**
(since 1992)
 - **Energyflux / ABL
measurements**
(since 1995)



Deutscher Wetterdienst
Standortkarte
- Stand: 01. April 2010 -



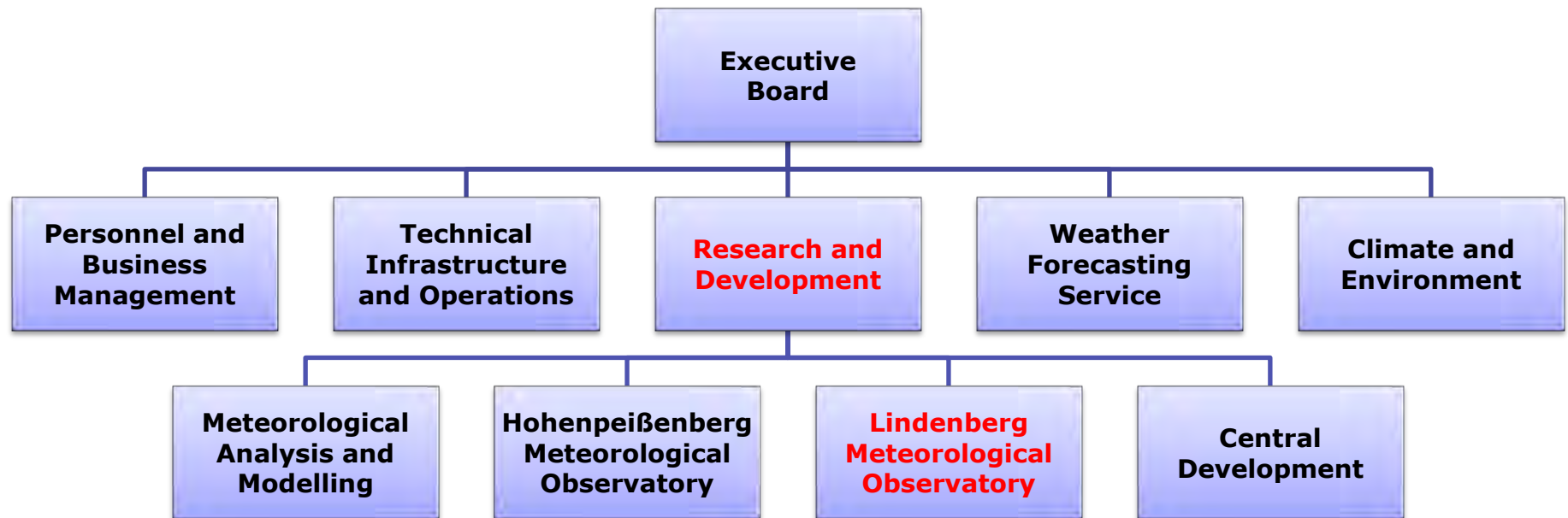
Schematische Darstellung; Standorte nicht maßstabgetreu

Lindenberg Meteor. Obs.

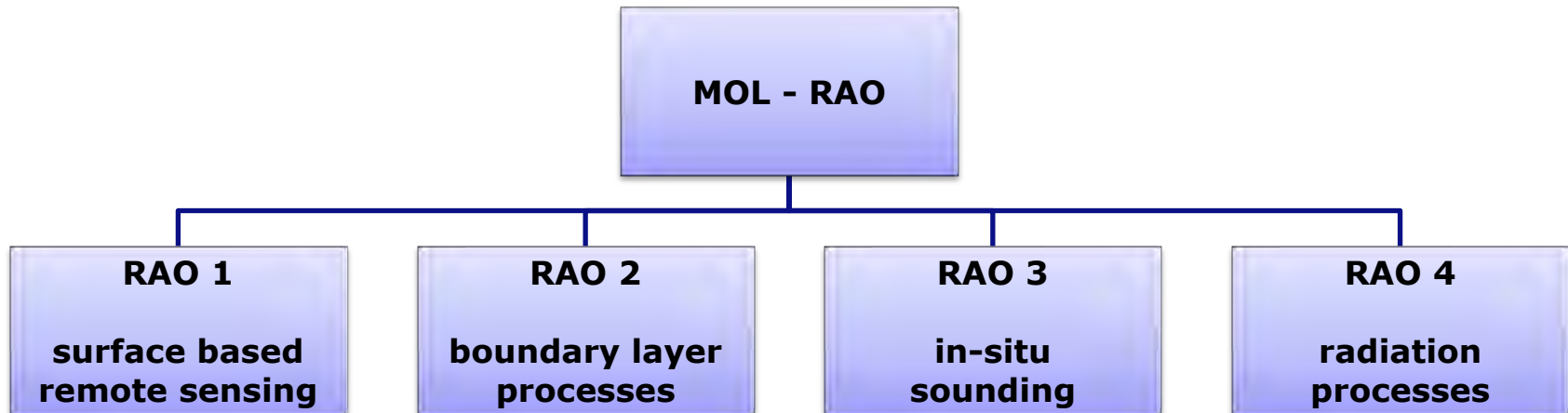
*Main Task: Monitoring of **physical** atmospheric processes*

Hohenpeißenberg Meteor. Obs.

*Main Task: Monitoring of **chemical** atmospheric processes*



DWD - organigram

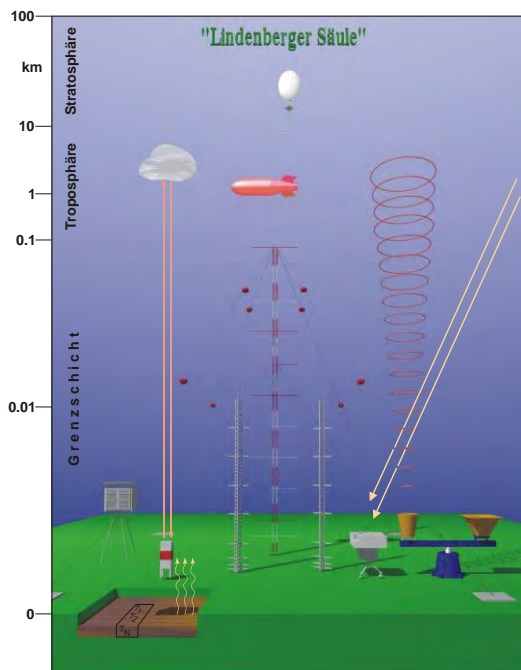


Furthermore, MOL-RAO is a reference climate site & has 24 hours weather station

- 1. operation / maintenance of various instruments**
- 2. instrument calibration**
- 3. quality assurance / quality control**
- 4. updating & application of improved measuring techniques**
- 5. data analysis and interpretation**

25 scientists, 6 engineers, 40 technicians

Core activities 2018



Lindberger Säule - Meßsystem

bestehend aus : Bodenbeobachtungen, aerologischen Messungen,
aktiven und passiven Fernerkundungsmethoden

- **Longterm Monitoring of atmospheric Processes** (24/7) → Reference Observation: **Lindberger Säule**
- 24h-weather station and climate reference site
- contributions to WMO-Programmes (GCOS, WCRP)
- contributions to European Meteorological Infrastructure (ECMWF, Eumetsat, Eumetnet)
- continuous improvements of observation strategies incl. introduction of new instruments and of updated analysis techniques
- supporting activities for the DWD Business areas FE, TI, WV, and KU
- supervision of DWD networks and DWD research activities
- research activities (currently: process oriented research on cloud processes and ABL processes)

Our Mission

Reference-observation of atmospheric, physical processes

- **Operational / Routine Monitoring Programme:**

Longtermmonitoring (**24/7**) of atmospheric state parameters and atmospheric processes incl. detailed QA/QC – both for weather and climate (scale dependence)

- **Research and development:**

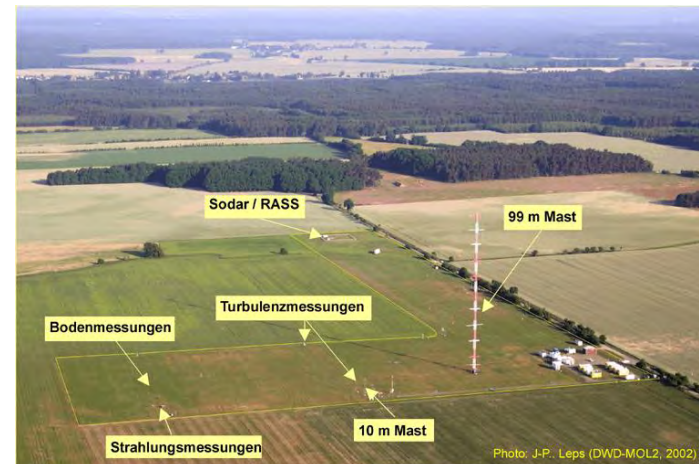
continuous research on instrument technology, measurement techniques, and analysis techniques – together with universities and research institutes

Monitoring Programme at Lindenberg



Radiation measurements

ABL measurements



in-situ
observation



surface based remote sensing

MOL-RAO 24/7 Measurement Programme:

Longterm Monitoring of Physical Processes

GCOS: GRUAN, GUAN, GSN, BSRN
WCRP: CEOP, GABLS, GVaP

Evaluation of Satellite Products

ESA: ADM-Aeolus, EarthCARE
Eumetsat: MetOp IASI, CM-SAF, GERB

Assistance of WMO Programmes

WMO/CIMO Testbed & Lead Centre
WIGOS Pilot Project (GRUAN)

Reference Data for Research Activities

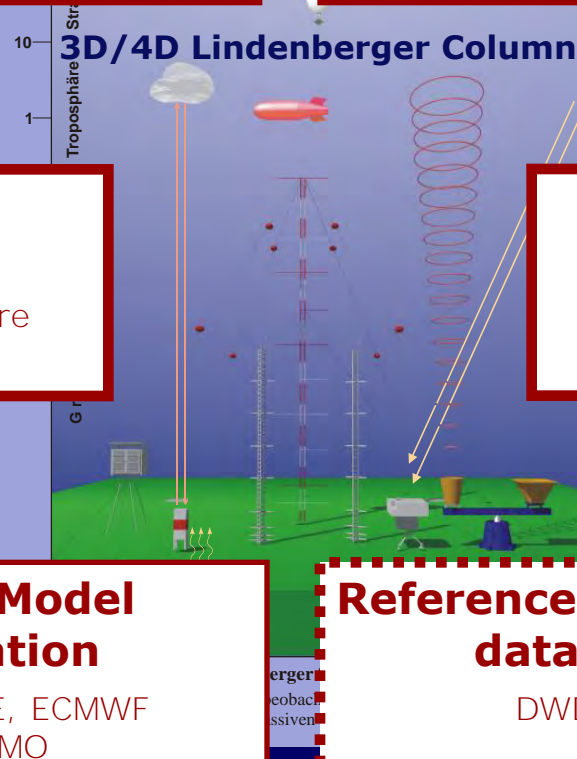
DWD: HERZ, extramural Research
D, EU: nat./intern. Programmes

Evaluation of Model Parametrization

NWP: COSMO-EU/DE, ECMWF
RCM: CLM, REMO

Reference Data for real-time data assimilation

DWD: COSMO/ICON
ECMWF: IFS



Thank you!

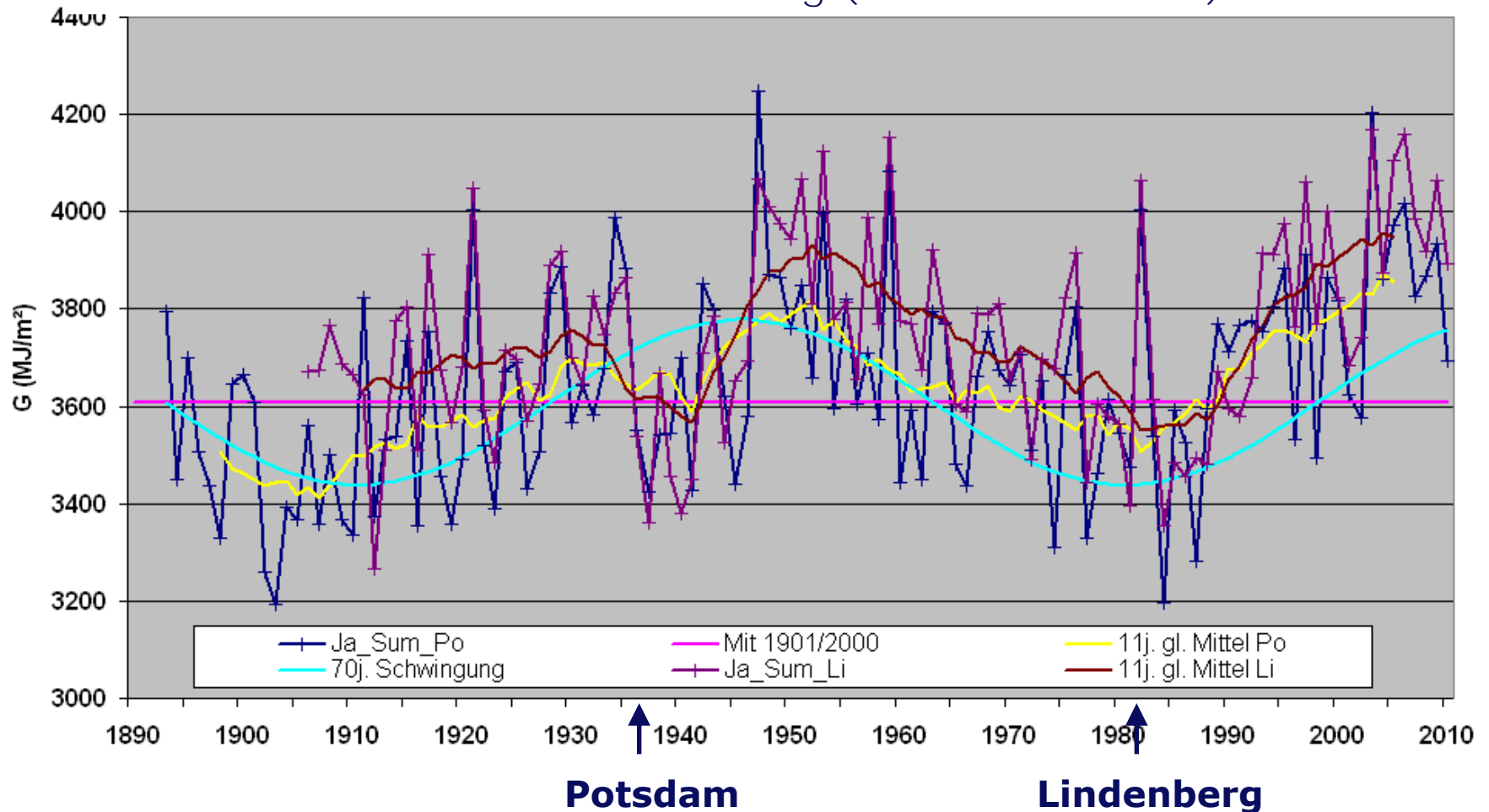
MOL-RAO highlights (12/2017)

- 112 years of vertical profiling (kites/balloons, radiosondes, remote sensing)
- since 1919: world record holder reaching an altitude of 9750 m with meteorological kites
- 112 years of radiation measurements (117 years in Potsdam)
- 70 years of radiosounding (daily / more than 91500 sondes)
- 43 years of ozone sounding (weekly / about 2250 sondes in total)
- 31 years of aerosol optical depth (continuous)
- 24 years of tropospheric windprofiling (continuous)
- 22 years of ABL measurements (continuous)
- 19 years of microwave profiling (continuous)
- 15 years of cloud radar use (continuous)
- 11 years of Raman-lidar observations

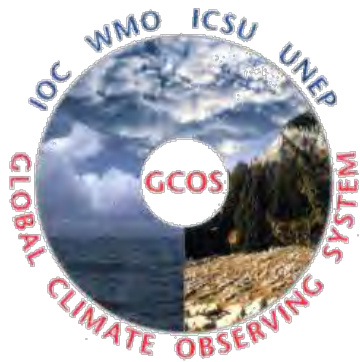
➔ www.dwd.de/mol

Global Radiation

Potsdam and Lindenberg (1893/1906-2010)



GCOS / BSRN

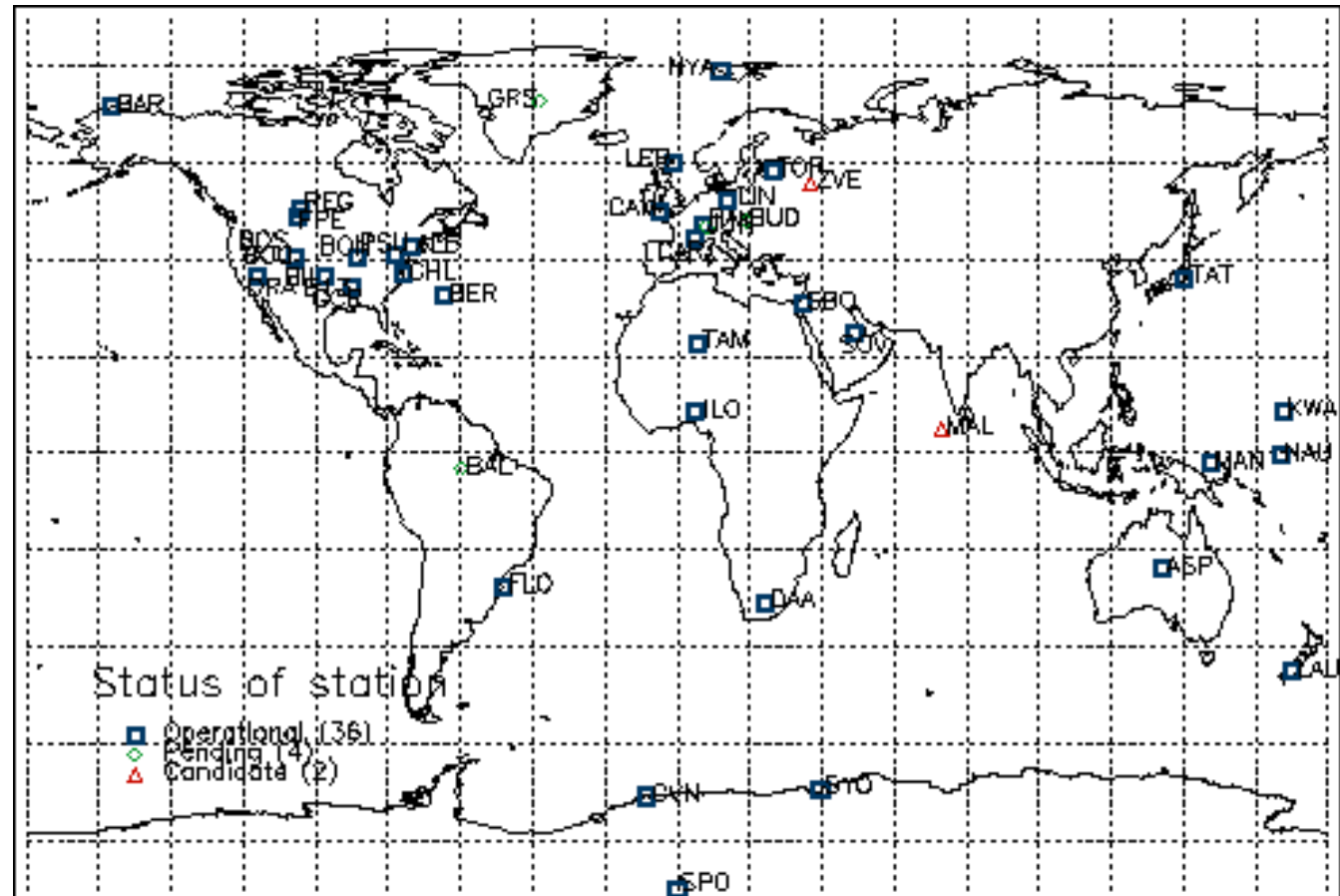


Baseline Surface Radiation Network

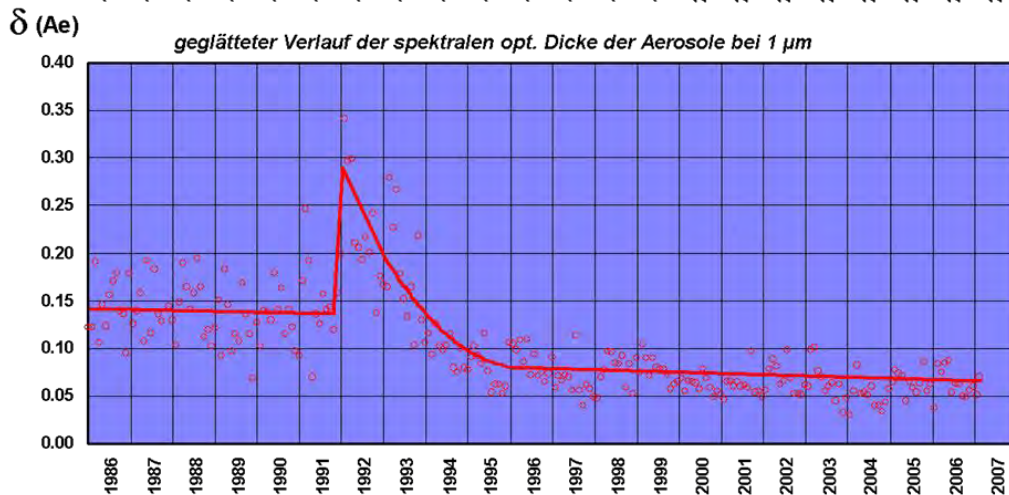
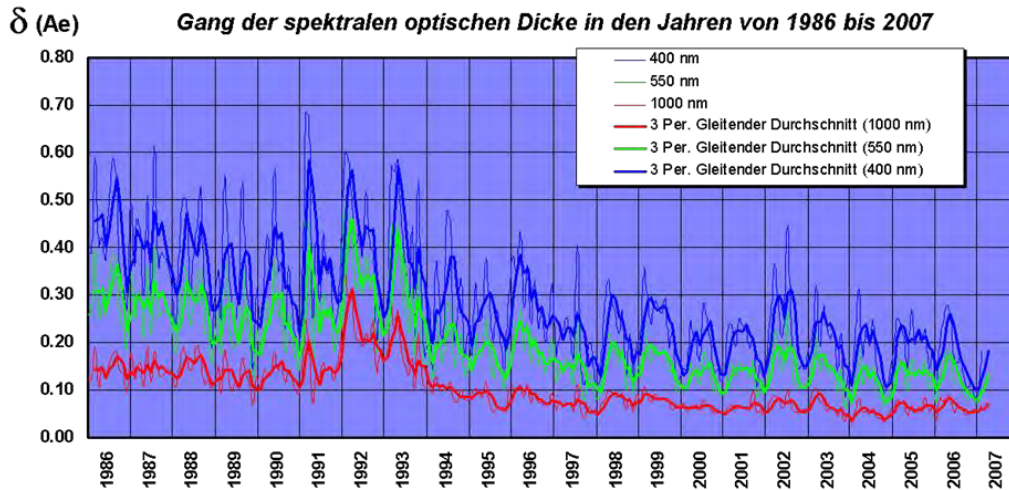
Start: 1992

Status: 36 Stations
(34 activ)

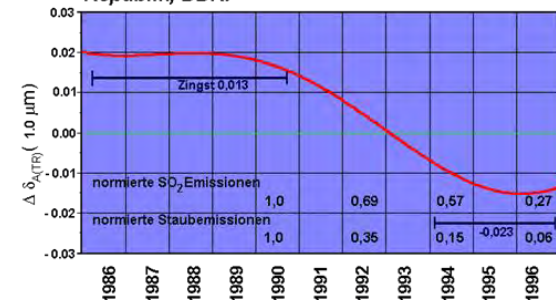
MOL-RAO: since 1994



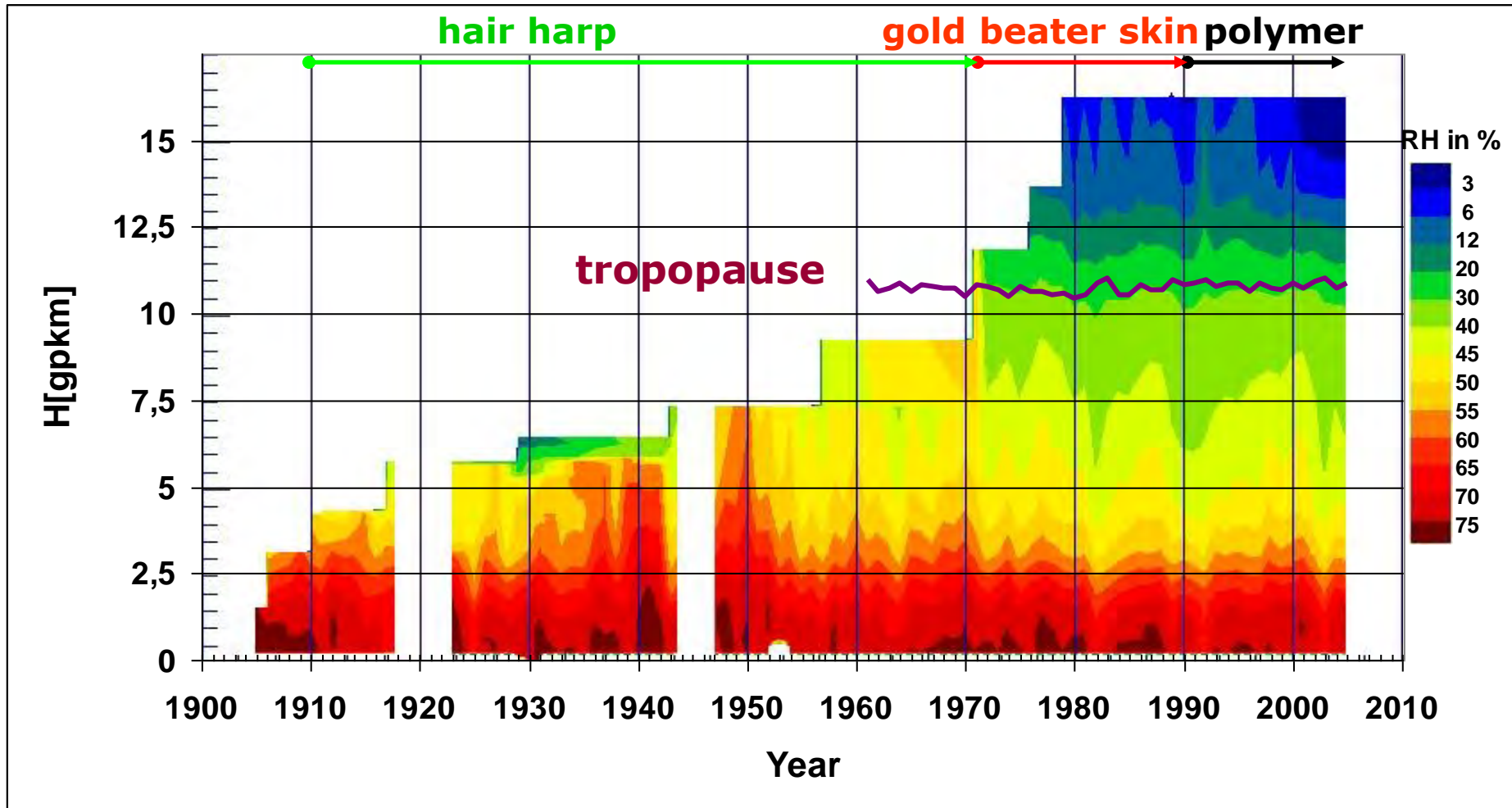
aerosol optical thickness (since 1986)



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.



Humidity profiles - Lindenberg / corrected:



- | | |
|------------|--|
| since 1947 | daily radiosondes –
every 6 hours
(more than 91.500 sondes) |
| since 1974 | weekly ozone sonde
(more than 2250 sondes) |
| since 1992 | standard VAISALA ground
check (0% humidity) |
| since 1999 | additional 100% check
(RS80-A and RS90FN in
a research mode) |
| since 2006 | 100% check for all RS92 |
| since 2008 | RS92FN & CFH (every 2 nd week) |



VAISALA FN calibration / routinely:

0%, 11.3%, 33.1%, 75.5%, and 100 %

PLUS

research sondes, like

- optical (lyman- α) sonde
- frostpoint - hygrometer sonde
- backscatter sonde



**climate chamber under
specific atmospheric
conditions:**

P ... 10-1015 hPa

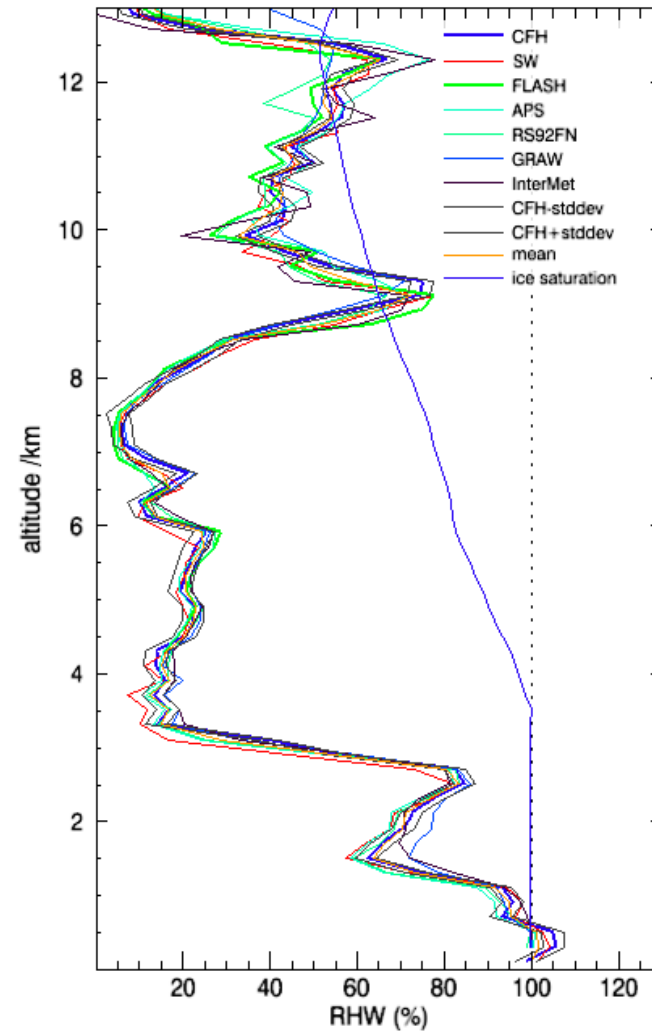
T ... -78°C – 40°C

RH... 0% til saturation

V ... 0-10 ms⁻¹



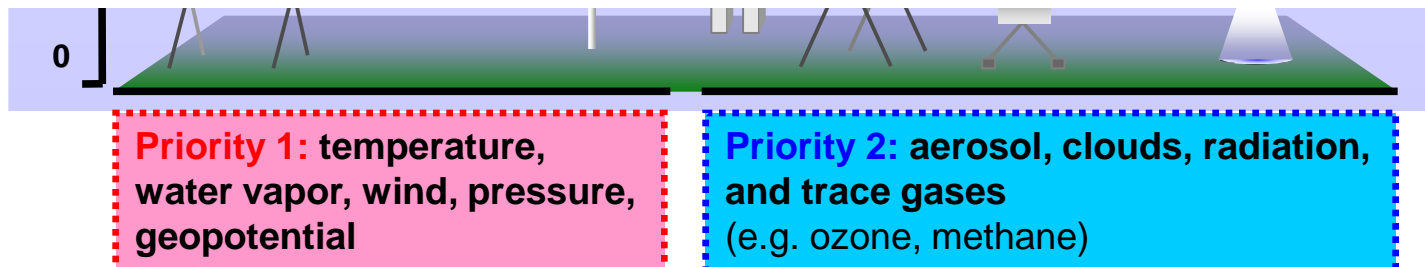
L003b Start: 06.11.2008 00:09:15 altitude smooth 200 m



GRUAN site



www.gruan.org



active ground based remote sensing

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



passive ground based remote sensing

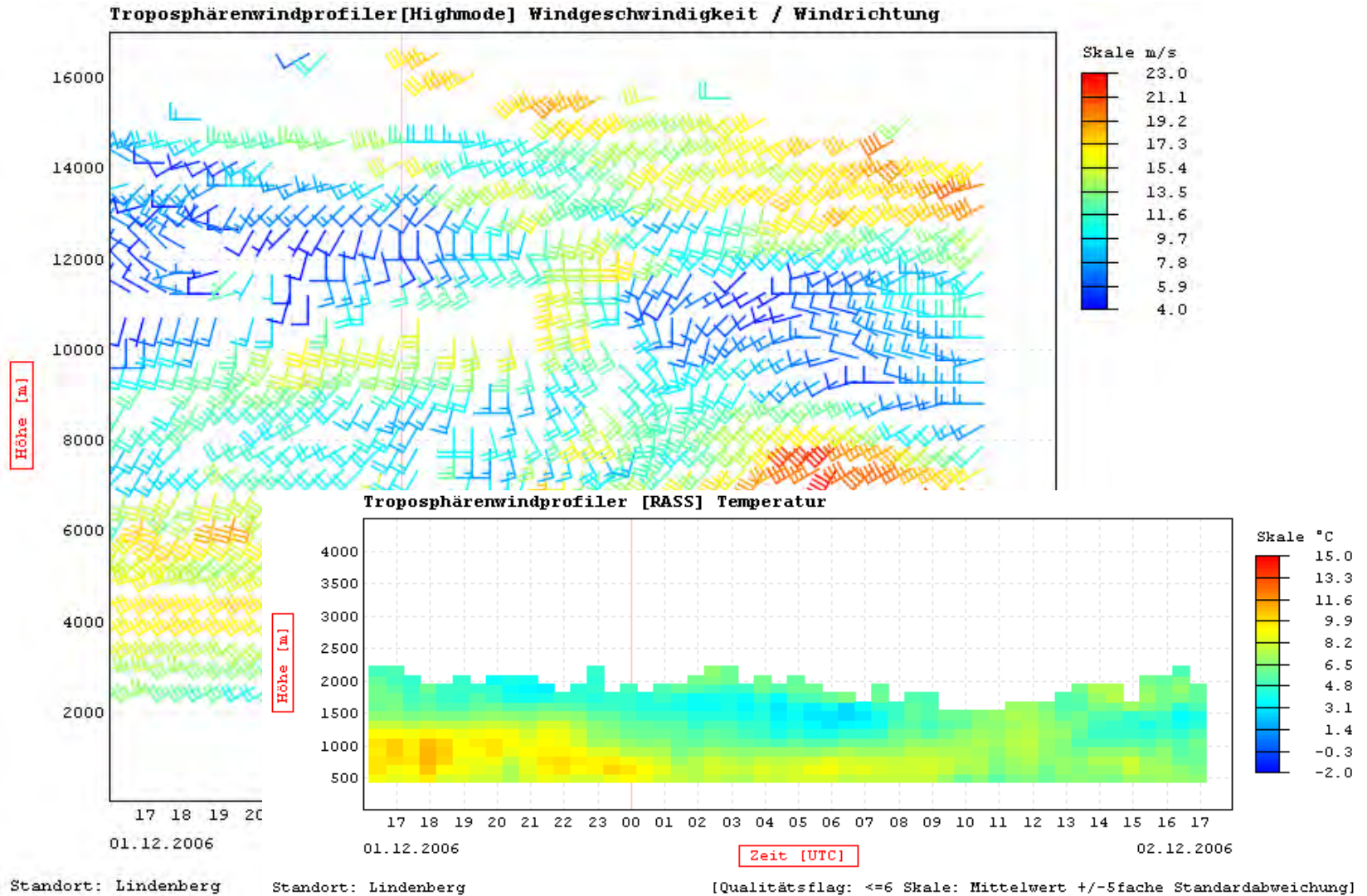
- microwave profiler / radiometer
- Whole Sky Imager
- GPS- receiver



validationsystems

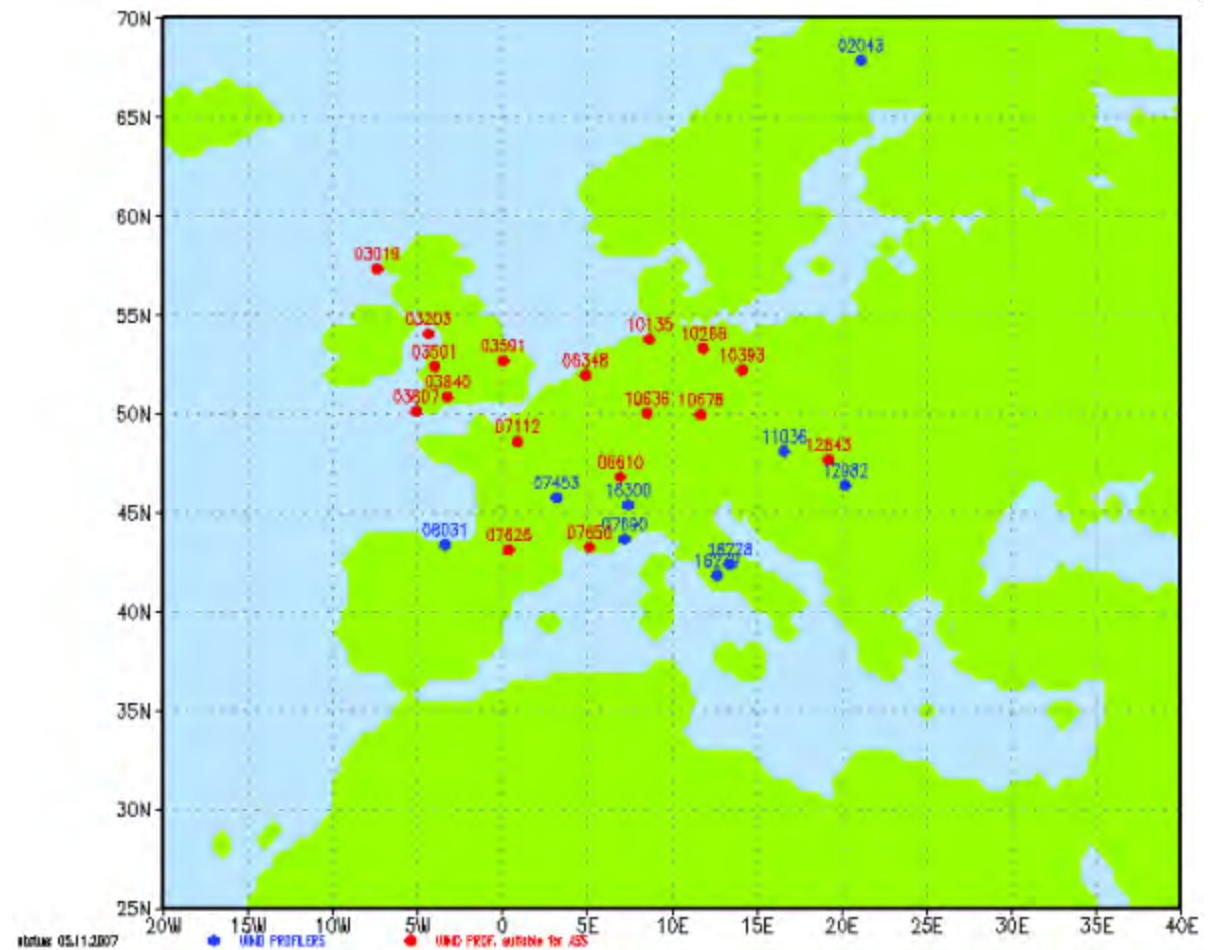
- 4-radiosonden/day (8 profiles)
- 6-sonde-thettered balloon
- sun- and starphotometer
- [99m tower ($dx = 5km$)]

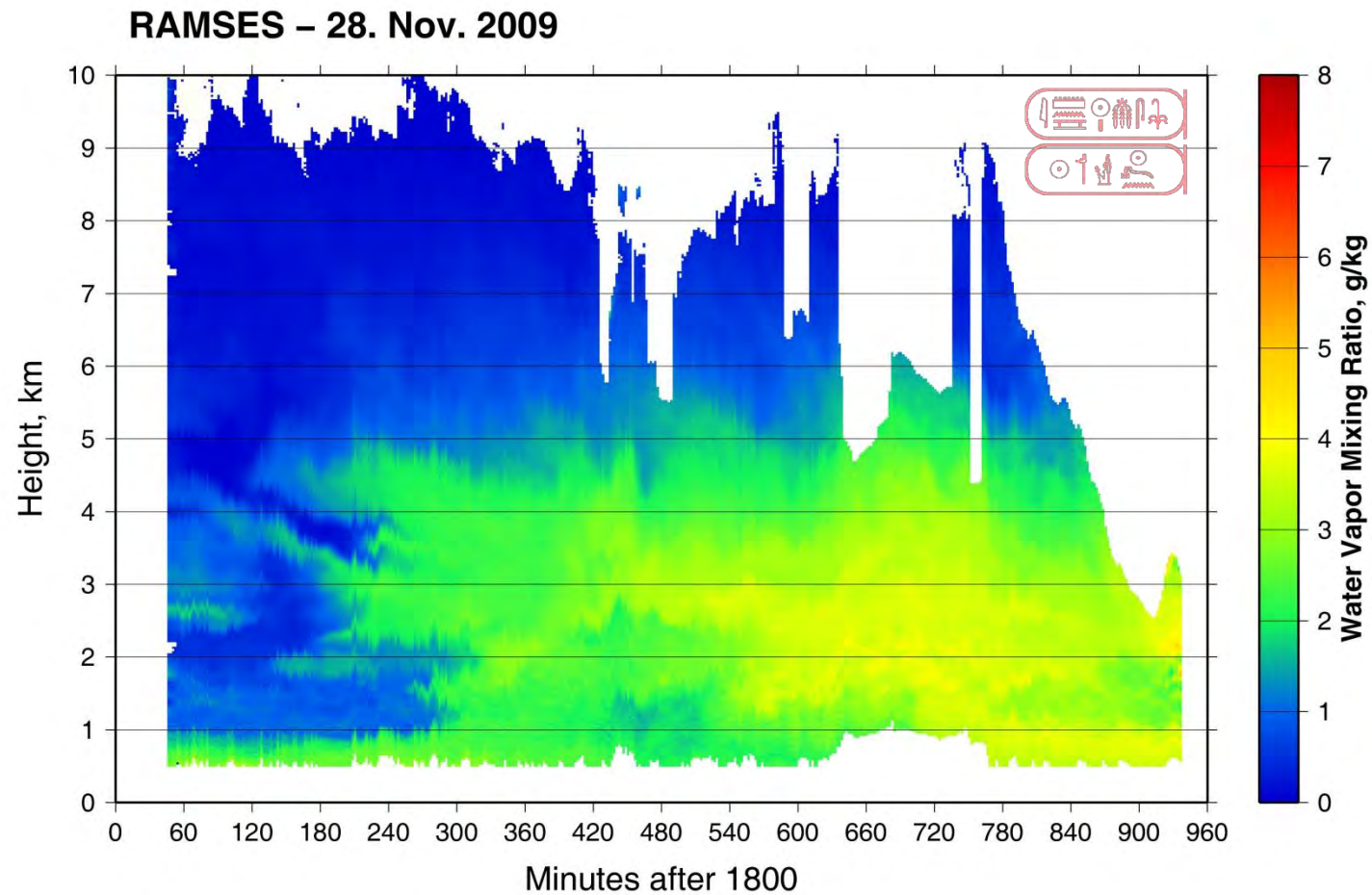




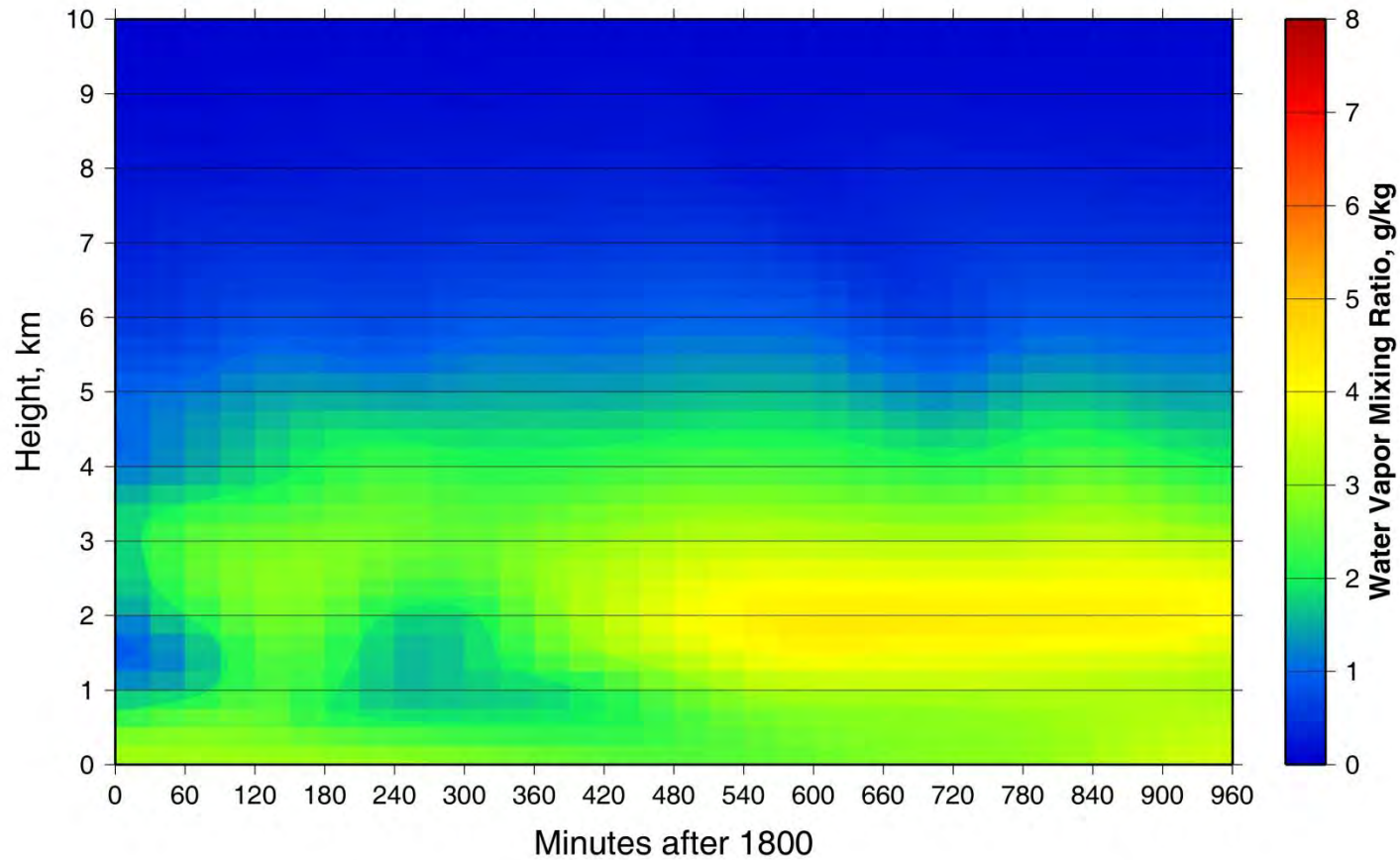
E-WINPROF:

Integration in EUCOS

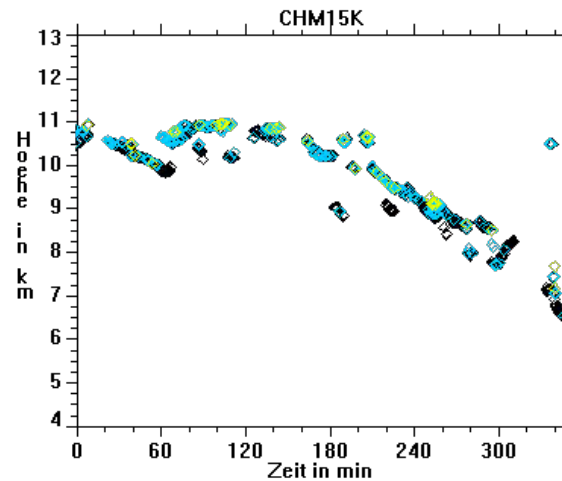
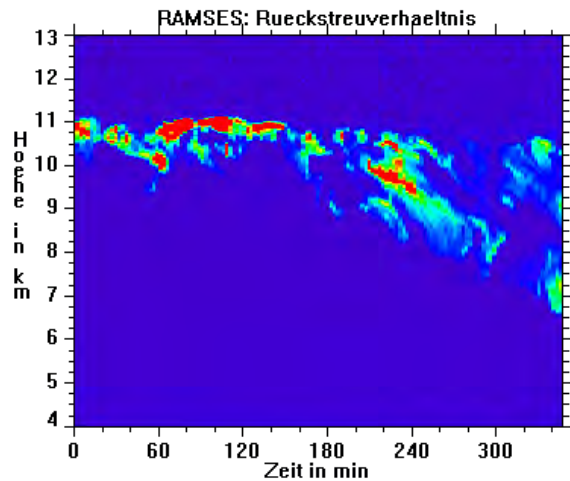




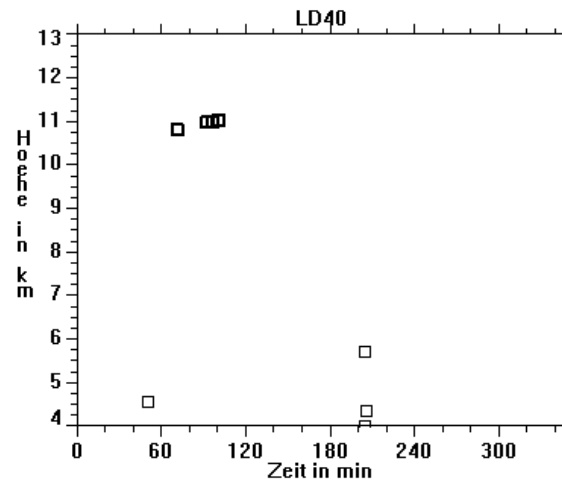
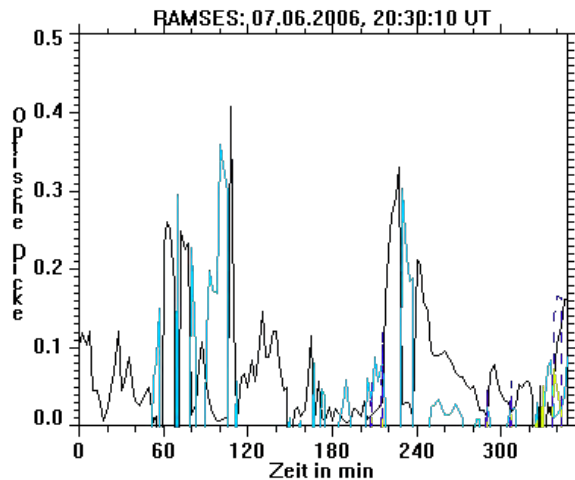
Model Forecast – 28. Nov. 2009



Cloud Base Height / Ice Clouds: 7.6.2006



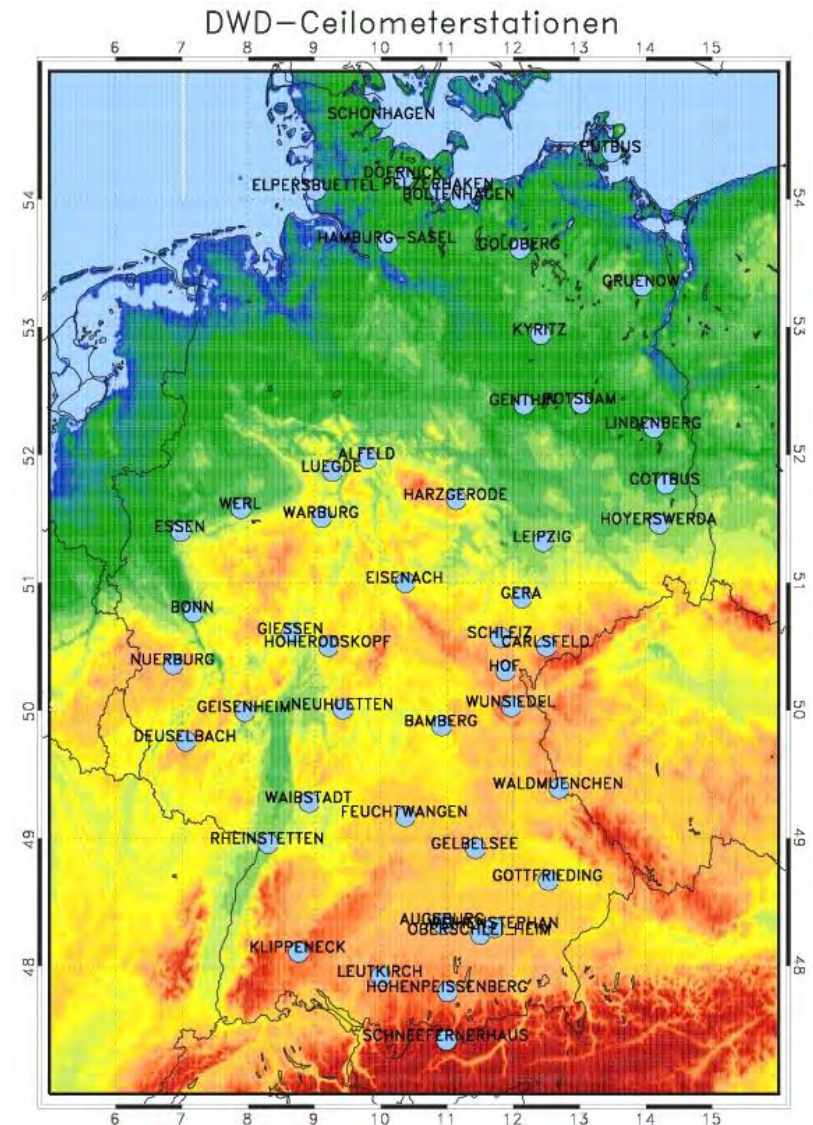
CHM 15k

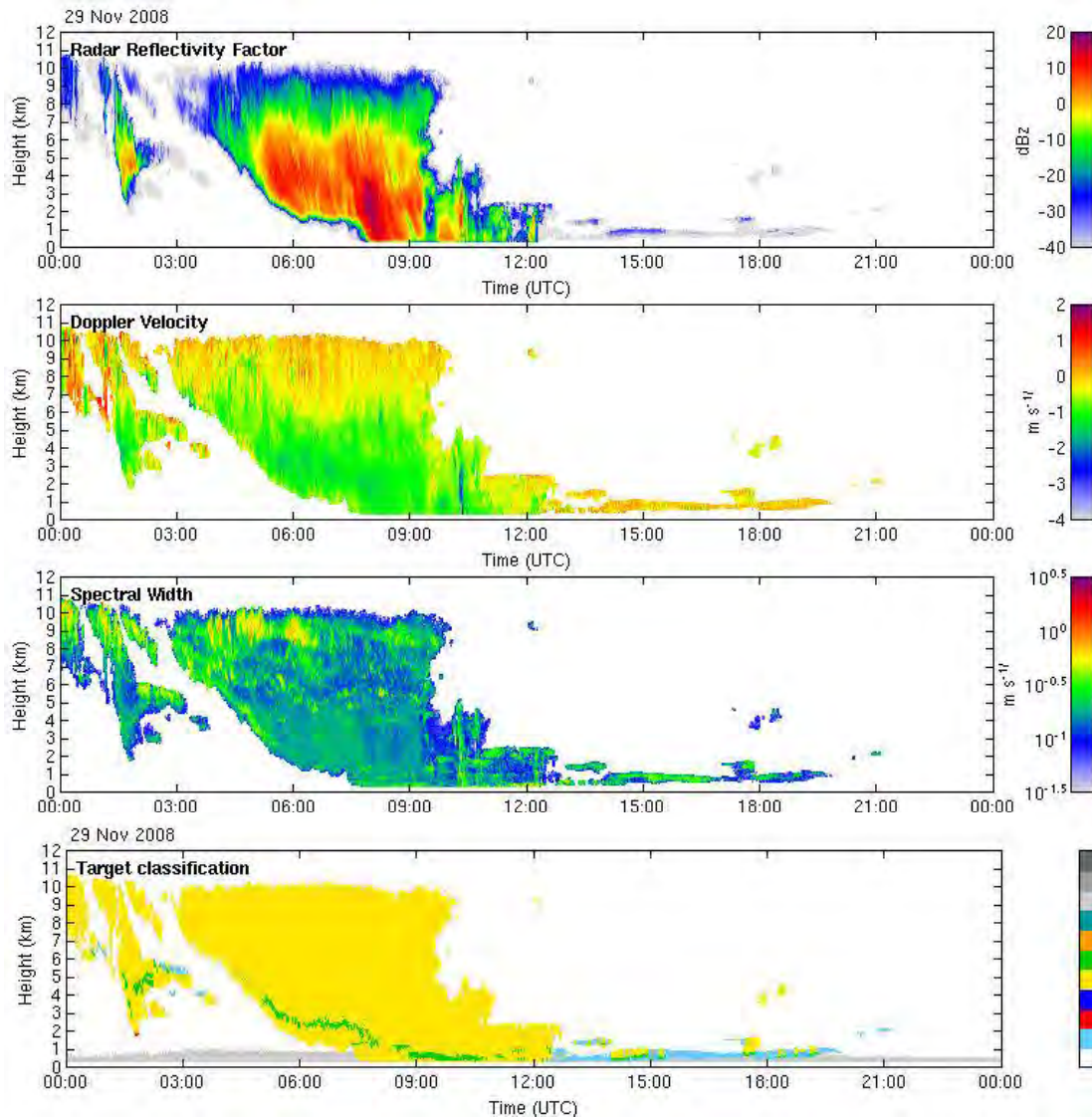


LD-40

DWD Ceilometernetwork – Cloud base height

- current 54 stations
- CHM15k Lidar Ceilometer (Jenoptik)
- Aerosol verticalprofile: ~0.3-15 km
- temporal resolution: 1-3 min





Cloudradar MIRA (since 2002)

www.cloud-net.org

Measuring site Falkenberg since 1995

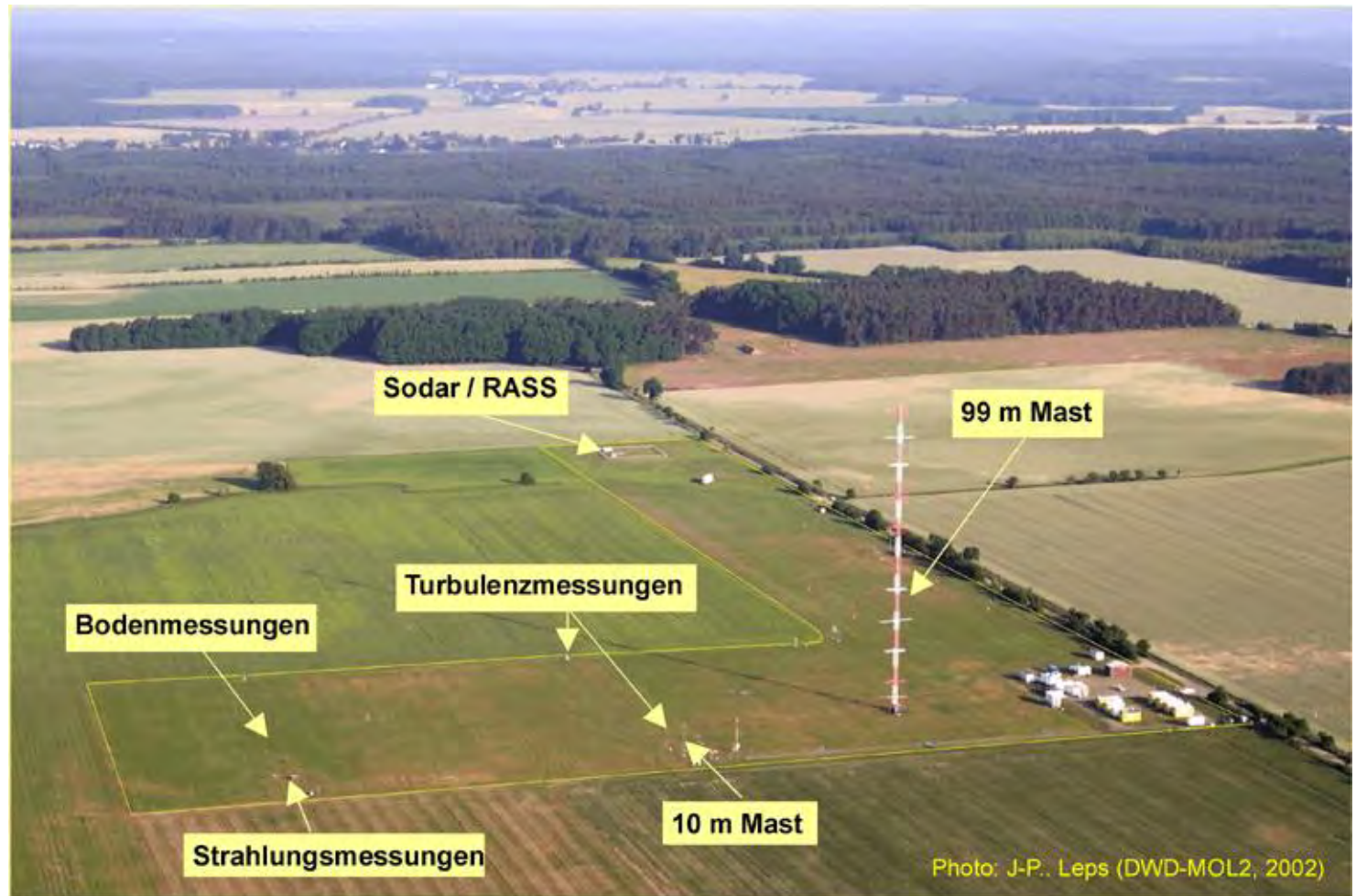
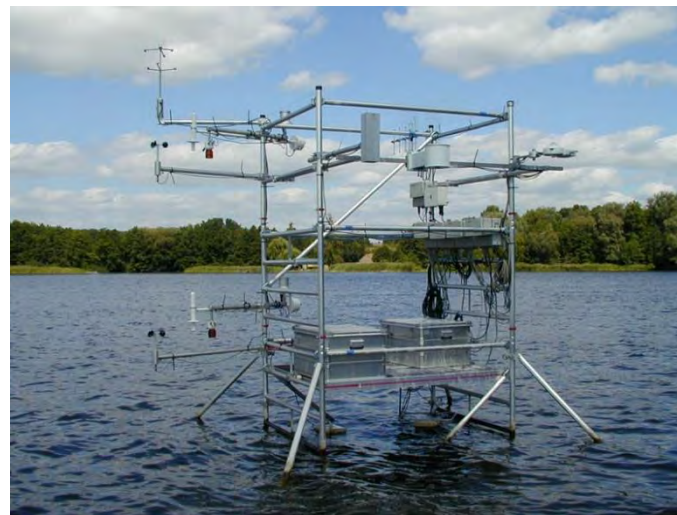




Foto: D. H. M. O. C. (G. H. H. H. H.)



local network

(energy fluxes,
precipitation,
insolation)

turbulent flux measurements

momentum, sensible and latent heat fluxes
based on Eddy- Covariance - method



Foto: DWD-MOL (G. Hollatz)



Foto: DWD-MOL (G. Hollatz)



Foto: DWD-MOL (J.-P. Leps)

path integrated measurements

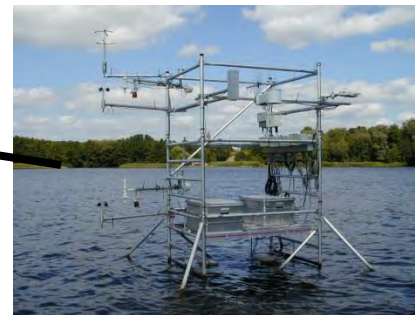
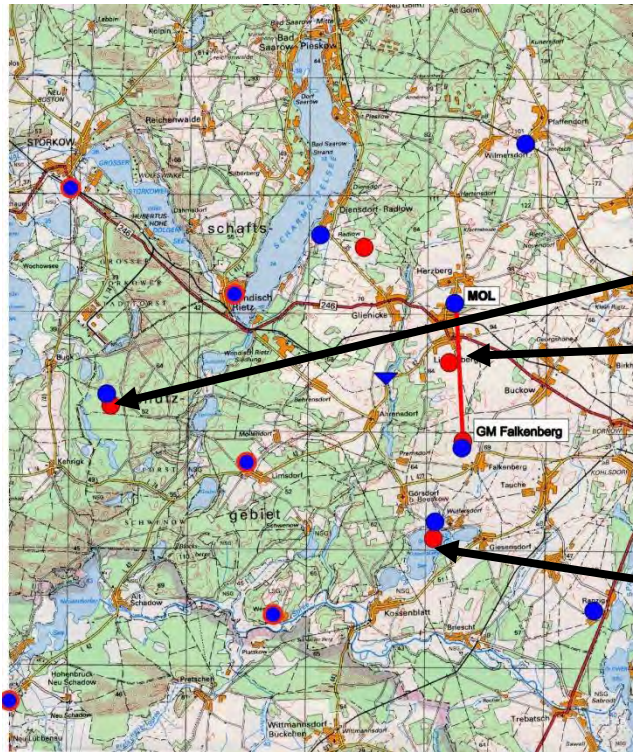
scintillometer



$$B_i, (r) \rightarrow C_N^2, (I_0) \rightarrow C_T^2, (\epsilon) \rightarrow H, (u_*)$$

local network for energy flux measurements

micrometeorological sites



SUMMARY - OUTLOOK

- **long-term monitoring / climate monitoring (WCRP / GCOS) – process oriented observation**
- **satellite product development & evaluation (ESA / Eumetsat)**
- **model validation (COSMO / RCM)**
- **network activities**
 - windprofiler network
 - ceilometer network
 - radiosonde network
 - radiation network
- **various research activities (cloud/aerosol, boundary layer)**
- **WIGOS – GOS 2030**