



TOPROF, E-PROFILE and ACTRIS

Sustained automatic lidar and ceilometer networking



M. Haeffelin¹, I. Mattis², J-A. Bravo Aranda¹, M-A. Drouin¹, A. Haeefe³, M. Hervo³, E. Hopkin⁴, A. Illingworth⁴, S. Kotthaus^{1,4}, Q. Laffineur⁵, Y. Poltera³, M. Wiegner⁶
¹IPSL, ²DWD, ³Meteoswiss, ⁴U. of Reading, ⁵RIMB, ⁶LMU

ALC, TOPROF, E-PROFILE and ACTRIS in 2017



- ALC: Automatic Lidars and Ceilometers, low-cost instruments for cloud and aerosol profiling
- TOPROF: a EU COST action; a group of Lidar experts working on ALC performance
- E-PROFILE: EUMETNET programme to coordinate operational wind, cloud and aerosol measurements using radar and lidar
- ACTRIS-2: European H2020 infrastructure in support of aerosol, clouds and trace gas research

FUTURE ORGANISATION

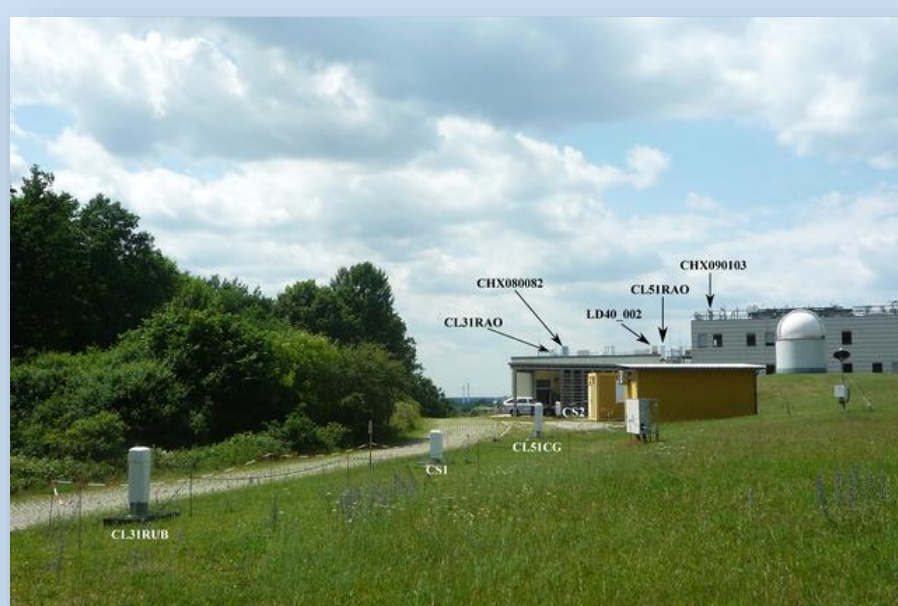
- COST Action: Development of sustained Cloud Profiling Centre of Expertise (CE)
- ACTRIS-RI: Long-term implementation of Cloud Profiling CE
- E-PROFILE: Heavy end-user of the Cloud Profiling CE

ALC MEASUREMENT NETWORK

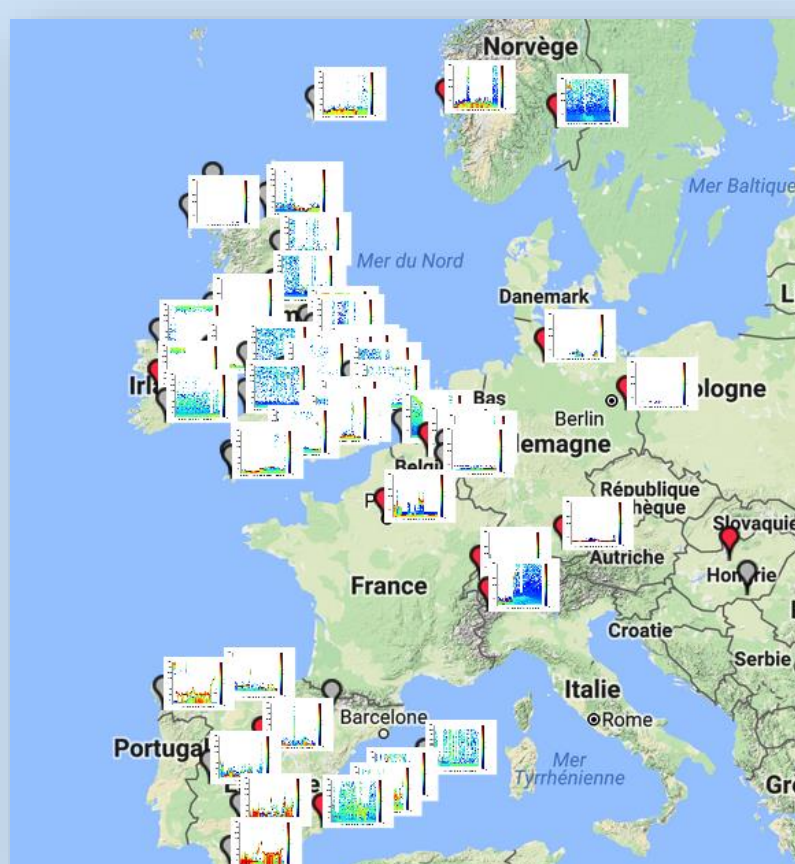


Worldwide ALC-location database
<http://www.dwd.de/>
 Search „Ceilomap“

TOPROF Ceilometer Lidar Intercomparison Experiment
<http://ceilnex2015.de/>
 3 months – 12 ALCs

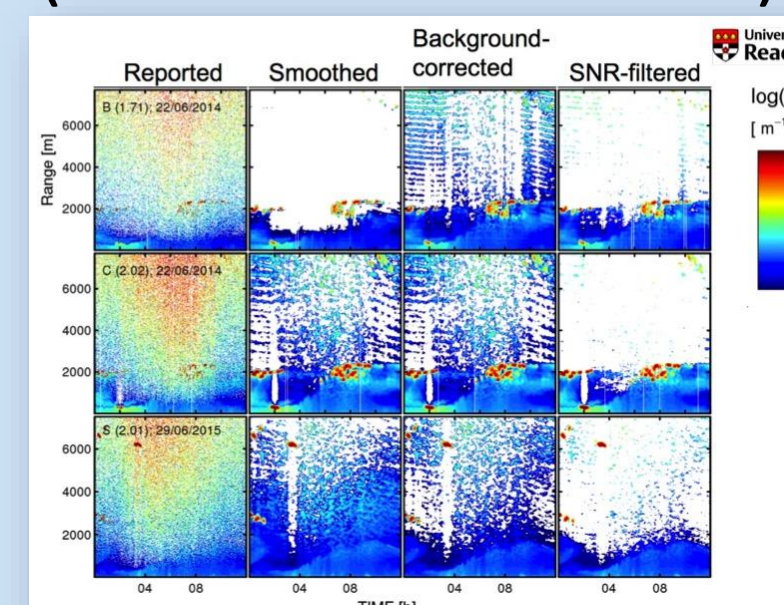


E-PROFILE ALC data
 2017: central processing of 80 ALC
 Future: 700 ALC
<http://eumetnet.eu/>
 Search „alc-network“

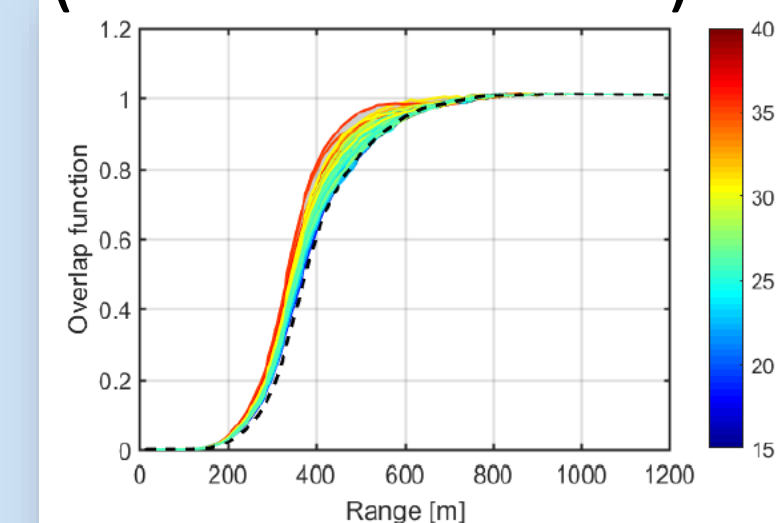


ALC MEASUREMENT PROCESSING

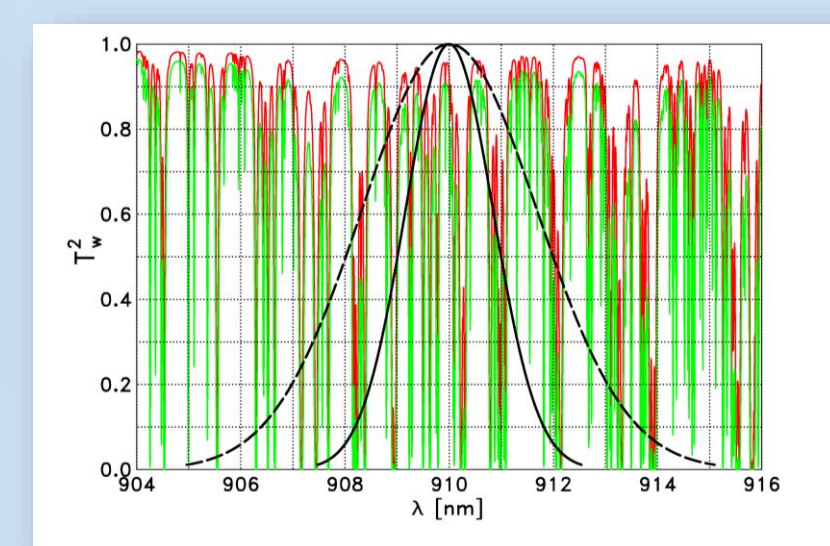
Signal correction
 (Kotthaus et al. 2016)



Overlap function
 (Hervo et al. 2016)

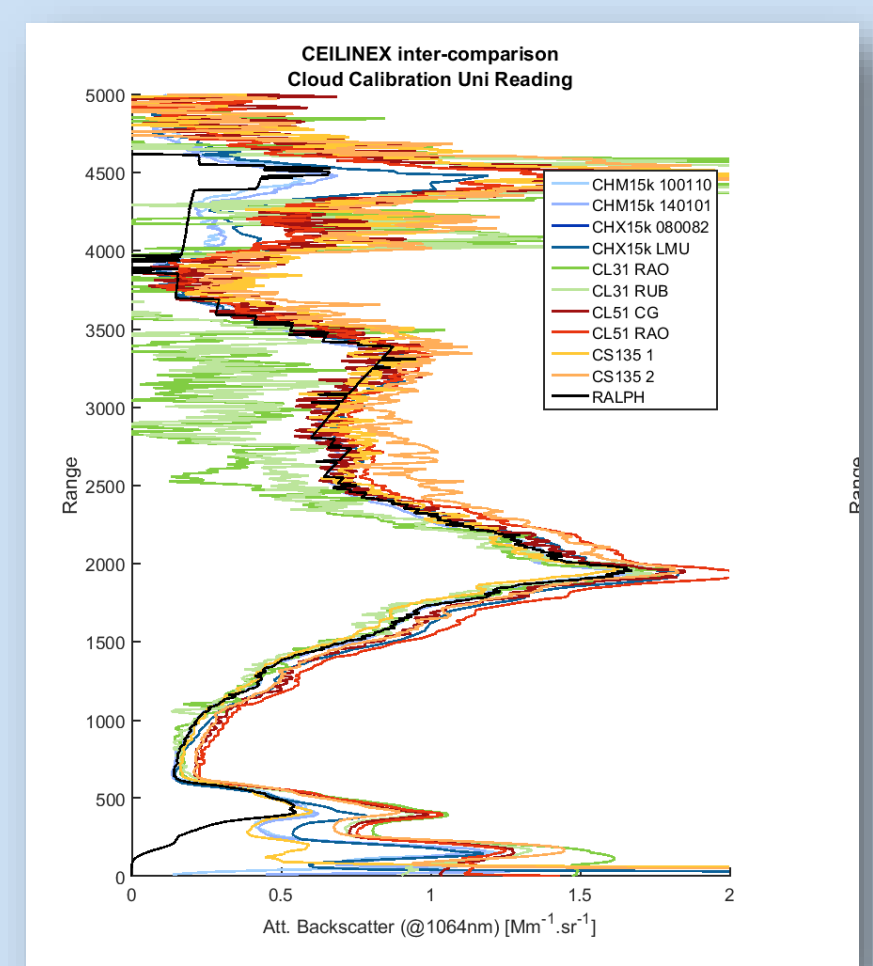


Water vapor absorption correction (Wiegner and Gasteiger 2015)



Harmonized format using RAW2L1 software (Drouin et al. 2015)

Calibrated attenuated backscatter based on Rayleigh and Cloud calibrations methods

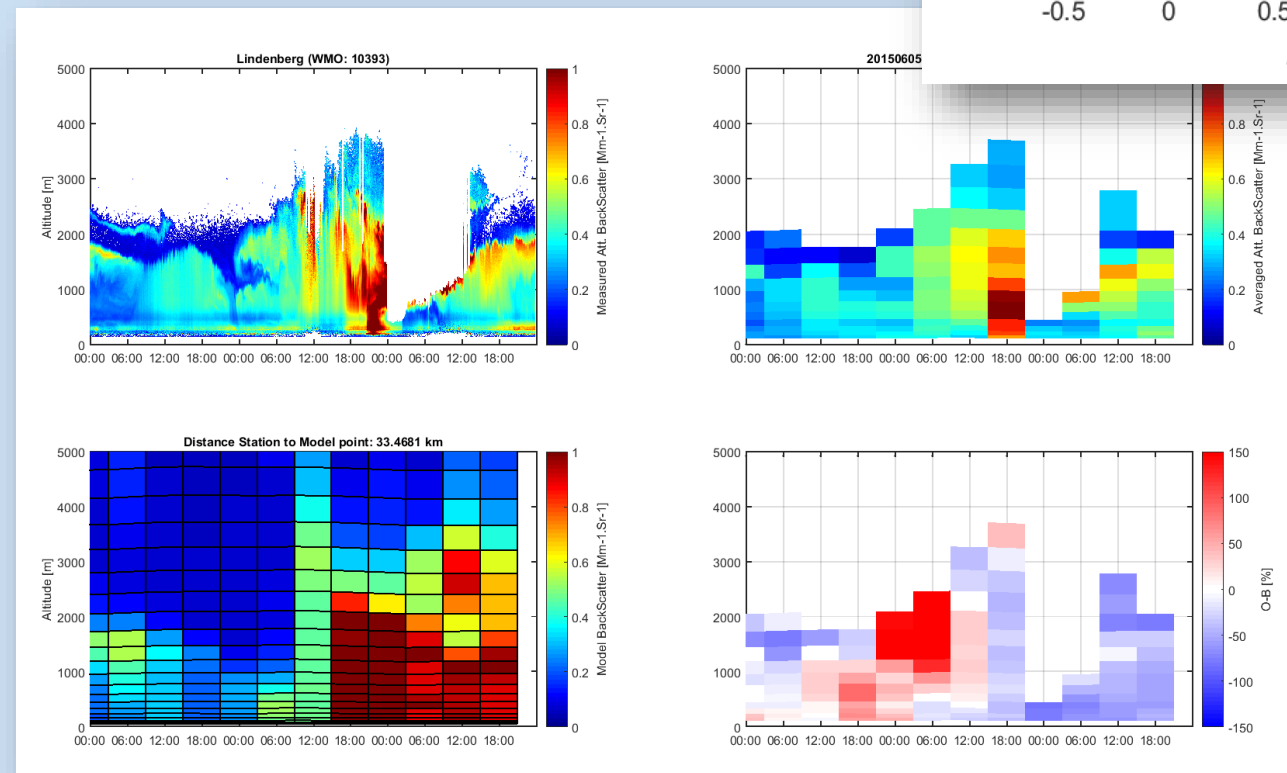
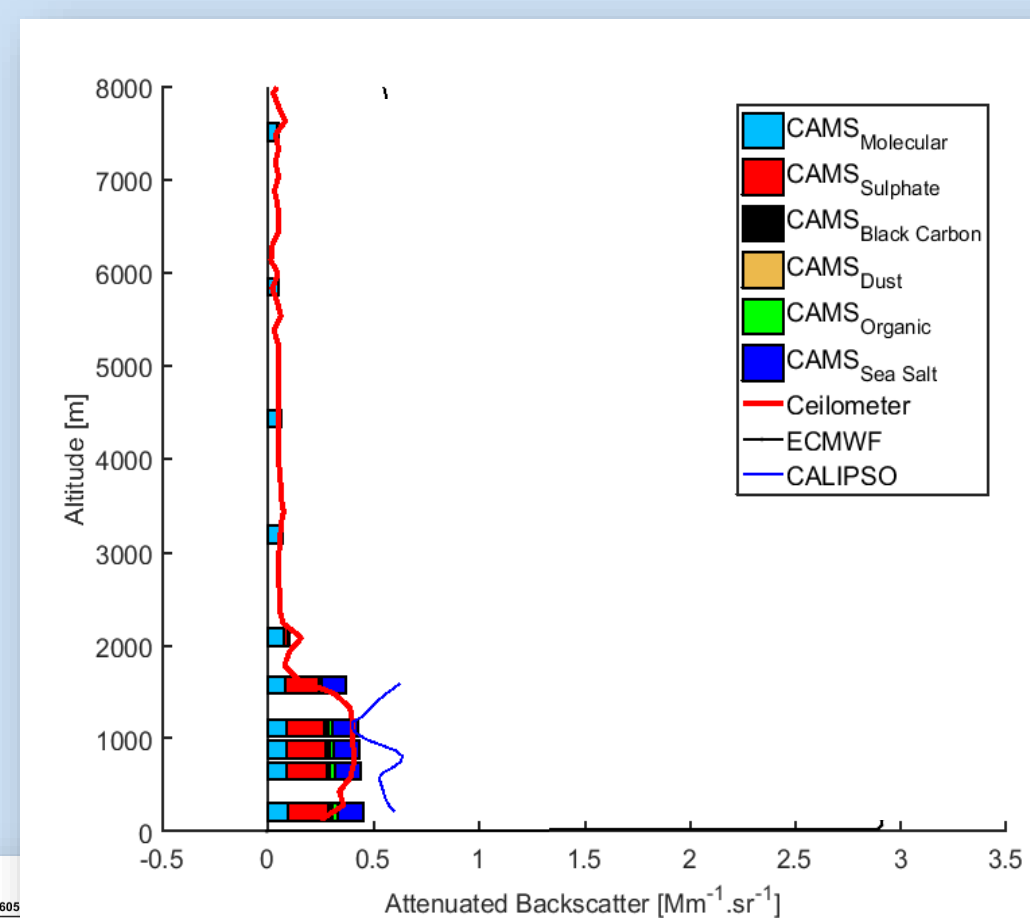


ALC measurement uncertainties (Mattis et al. 2017)

ALC MEASUREMENT APPLICATIONS

Model Evaluation

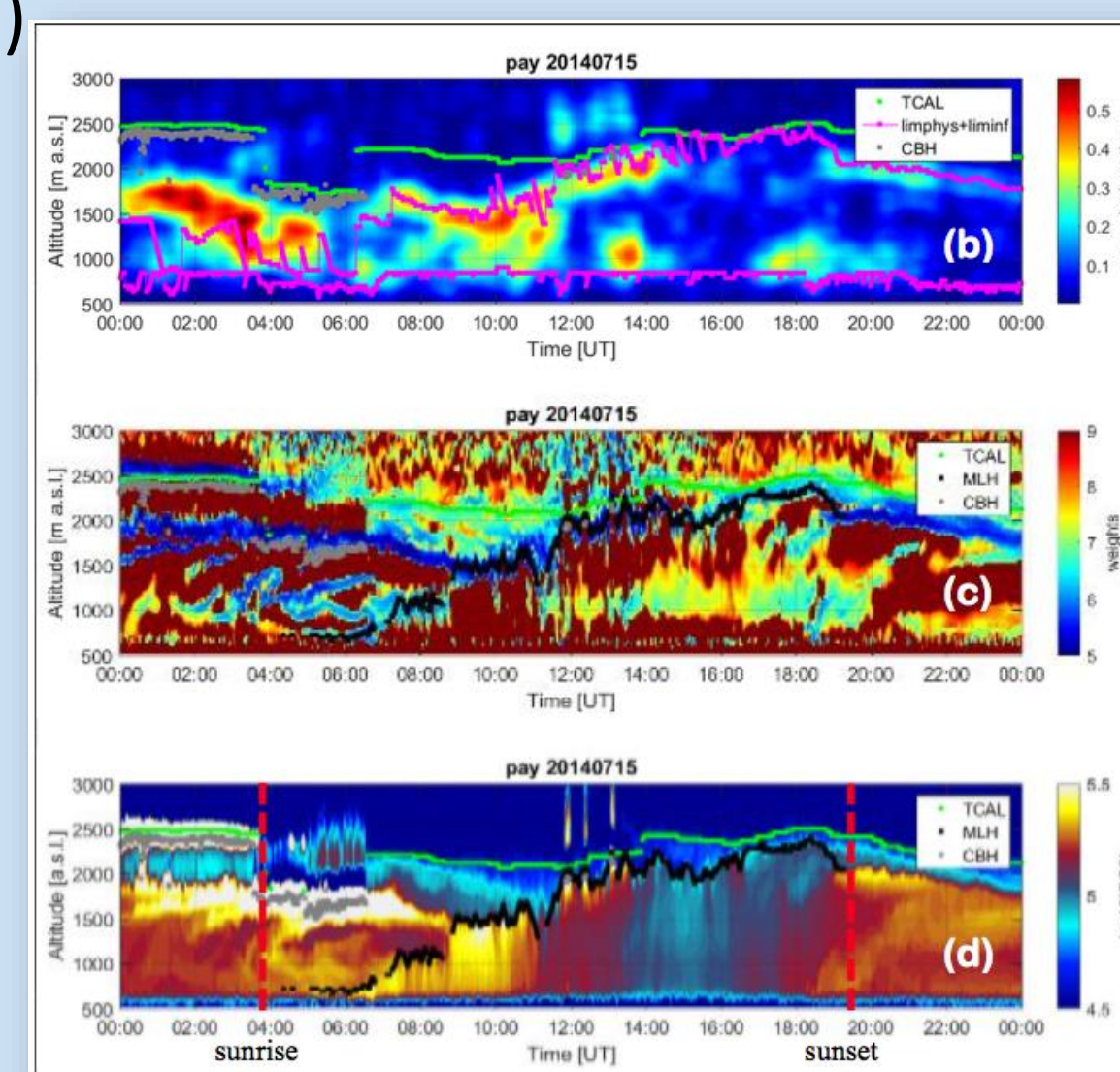
Lidar forward models used to simulate attenuated backscatter
 Direct comparisons of observed – simulated
 Evaluation of sources of discrepancies.



(Figures courtesy of M. Hervo)

Atmospheric boundary layer detection

New methods are proposed to improve gradient attribution allowing improved boundary layer depth estimation & boundary layer classification.
 (see Pal and Haeffelin, 2015; Poltera et al. 2017; Geiss et al. 2017)

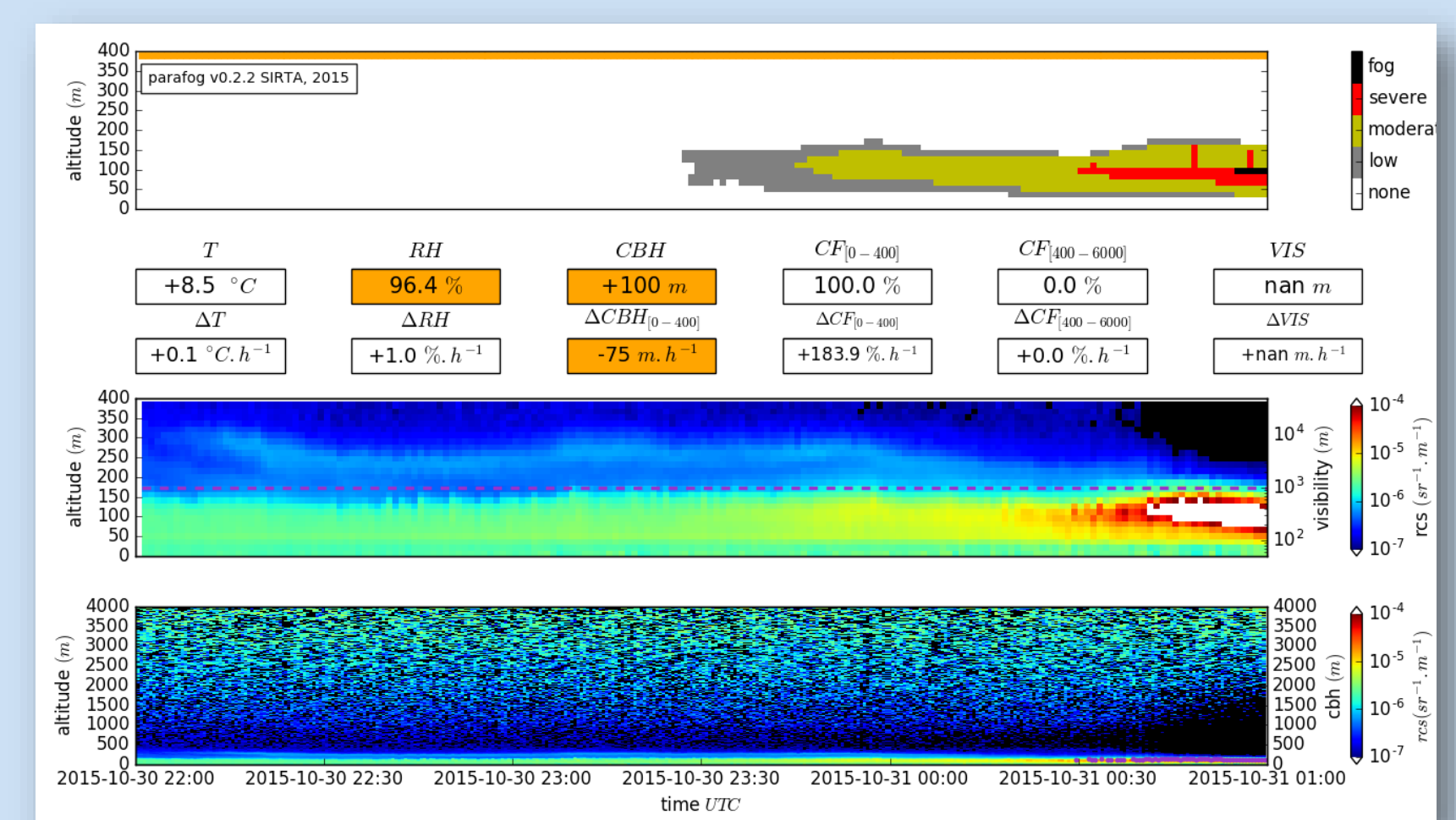


(Figure from Poltera et al. 2017)

Fog diagnostics for near-range forecast

Hygroscopic growth of aerosol prior to radiation fog formation tracked by ALC attenuated backscatter.

The rate of change of ALC attenuated backscatter is used to provide pre-fog alerts
 (see Haeffelin et al. 2016)



PUBLICATIONS

Technical documents:

Mattis and Wagner 2013; E-PROFILE Glossary of Lidar and ceilometer variables. Drouin et al. 2015; RAW2L1 documentation and ALC format. Hervo et al. 2016; E-PROFILE ALC format description. Mattis et al. 2017; Errors and uncertainties of aerosol profiling with ALCs.

Scientific publications:

- Haeffelin et al. 2016; Radiation fog formation alerts using attenuated backscatter power from automatic Lidars and ceilometers, Atmos. Meas. Tech., 9, 5347-5365.
- Hervo et al. 2016; An empirical method to correct for temperature-dependent variations in the overlap function of CHM15k ceilometers. Atmos. Meas. Tech, 9(7), 2947-2959
- Kotthaus et al. 2016; Recommendations for processing atmospheric attenuated backscatter profiles from Vaisala CL31 ceilometers, Atmos. Meas. Tech., 9, 3769–3791
- Poltera et al. 2017; PathfinderTURB: an automatic boundary layer algorithm. Development, validation and application to study the impact on in-situ measurements at the Jungfraujoch. ACPD.
- Wiegner et al. 2015; Correction of water vapor absorption for aerosol remote sensing with ceilometers, Atmos. Meas. Tech., 8, 3971–3984

TOPROF ALC WG Chairs: martial.haeffelin@ipsl.fr, ina.mattis@dwd.de