

support from ICOS, ACTRIS, E-PROFILE, IPSL, AERIS, EU COST

Automatic detection of atmospheric boundary layer heights at European scale



PROBE ABL - testbed

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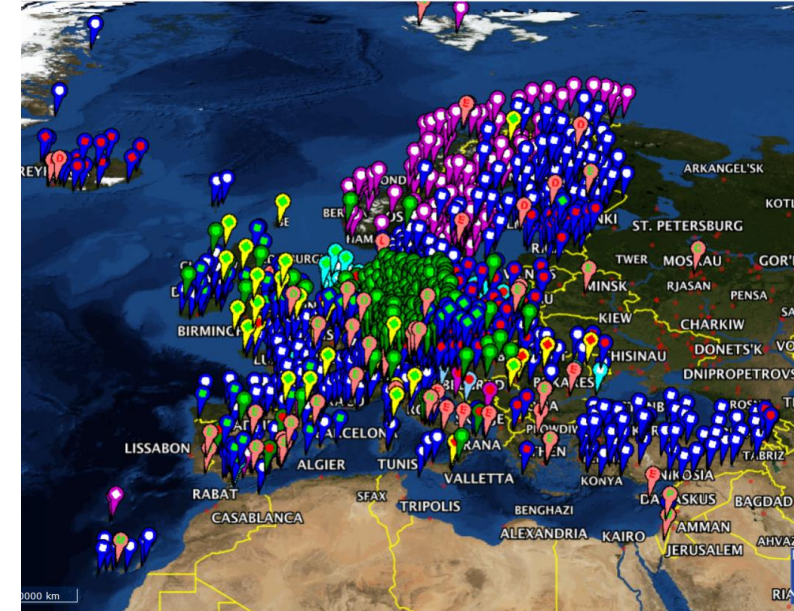


Profile observations at European scale

https://www.dwd.de/DE/forschung/projekte/ceilomap/ceilomap_node.html

Automatic lidars+ceilometers (ALC)

- Continuous operation, low maintenance
- Capability to capture information close to the surface
- High number of sites (> 400 ALC in EUMETNET E-PROFILE)
- Diverse sensor network (manufacturers, models, hardware, firmware)



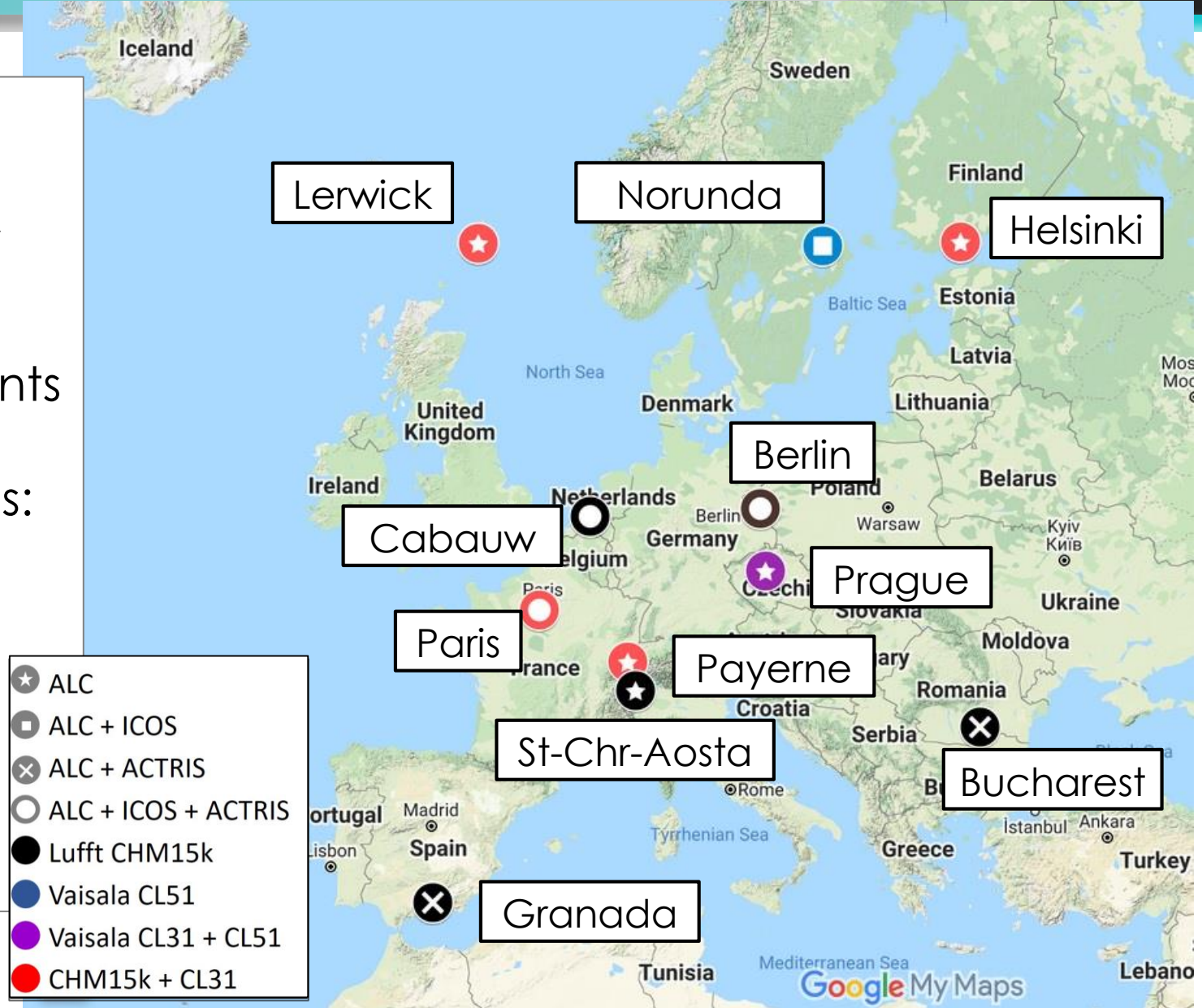
ABL testbed objectives

- 1) Demonstrate performance of automatic layer height retrievals for Mixed layer height (**MLH**) & atmospheric boundary layer height (**ABLH**)
- 2) Formulate recommendations for implementation across diverse network

ABL testbed – Europe: observation network

ABL testbed: 11 sites

- Diverse station network (geographic location, orography, surface cover)
- Overlap with RI (ICOS, ACTRIS)
- Minimum hardware requirements
- 17 ALC, comparison possibilities:
 - CABAM/CL31 + SF/CHM15k (Palaiseau, Payerne, Lerwick)
 - CABAM/CL31 + CABAM/CL51 (Prague)
 - 2 x CABAM/CL51 (Helsinki)
 - 2 x STRATfinder/CHM15k (Bucharest)
- Most sites with rich auxiliary observations



Automatic layer height retrievals

Advanced algorithms ([Kotthaus et al. 2020](#)):

STRATfinder
CABAM

for ALC with high SNR* (e.g. Lufft CHM15k)
for ALC with low SNR (e.g. Vaisala CL31)

Recent improvements include
STRATfinder:

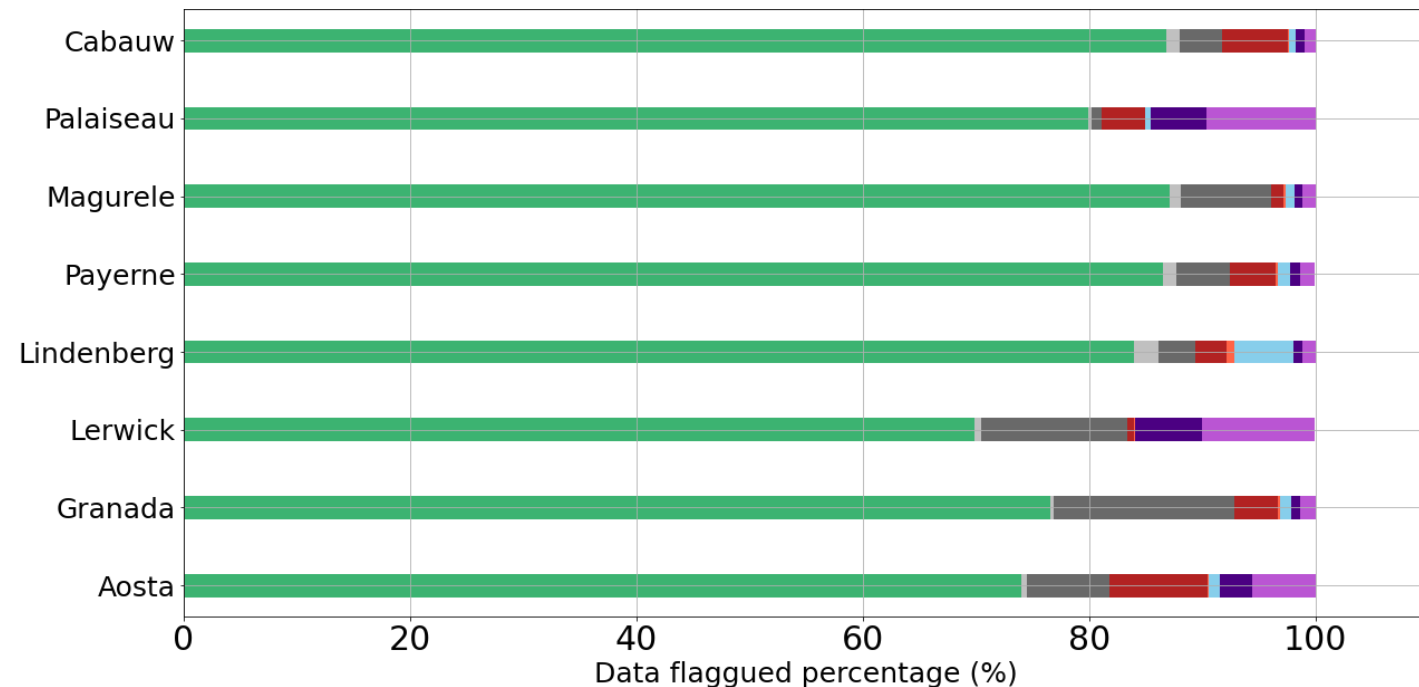
- Absolute calibration, dynamic overlap model implementation
- More flexibility during morning growth

CABAM:

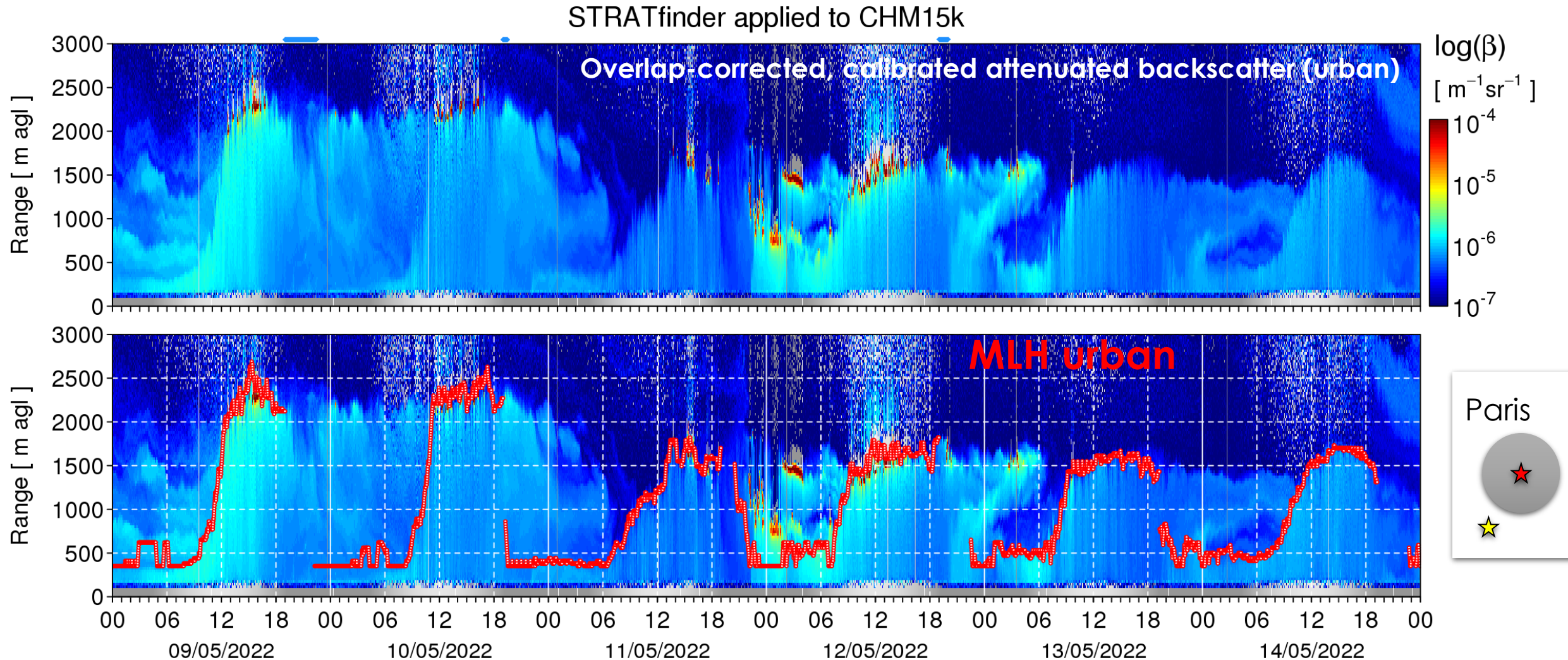
- Compare relative strength of gradient in different vertical layers
- Reduction of nocturnal overestimation
- Robust quality control in post processing

STRATfinder 2018-2021:

High availability of results after QC (70-90%)

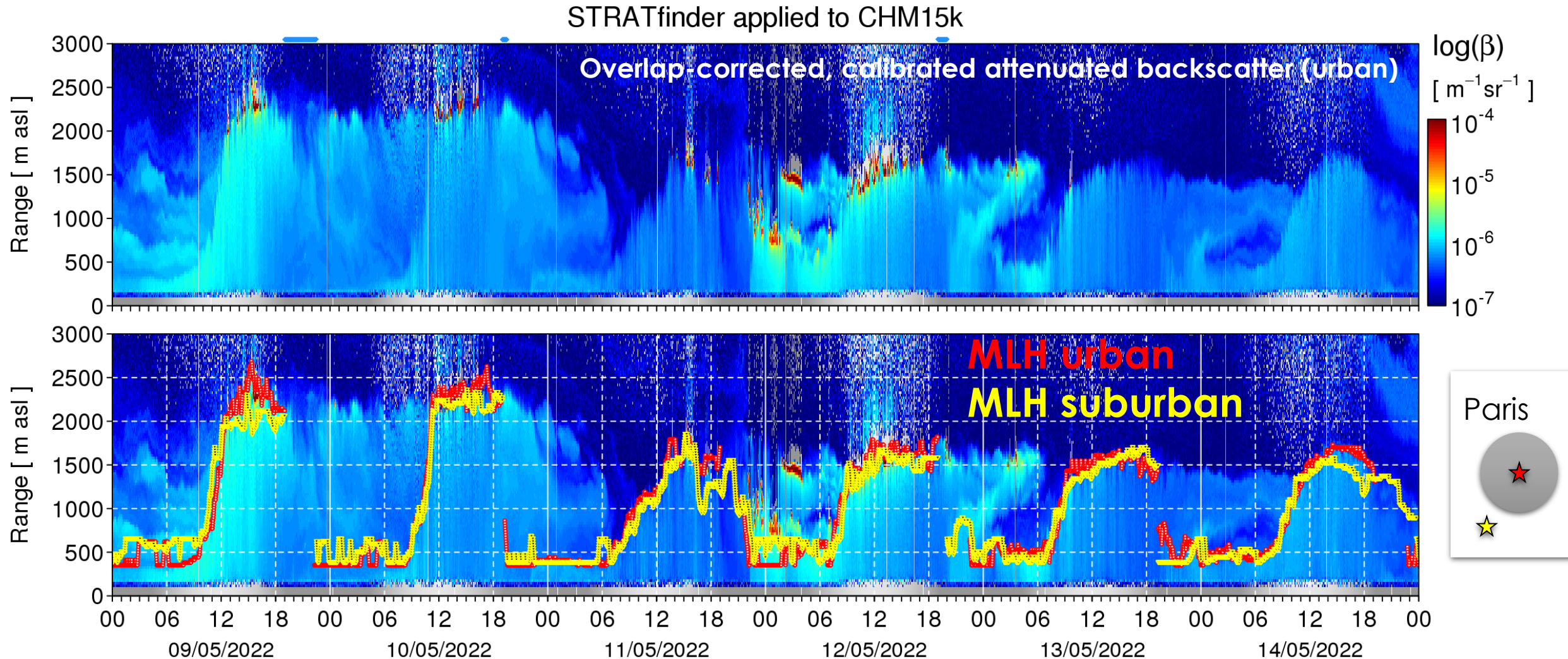


Starting to capture urban effects on ABL



Suburban ~ 20 km SW of urban site in central Paris

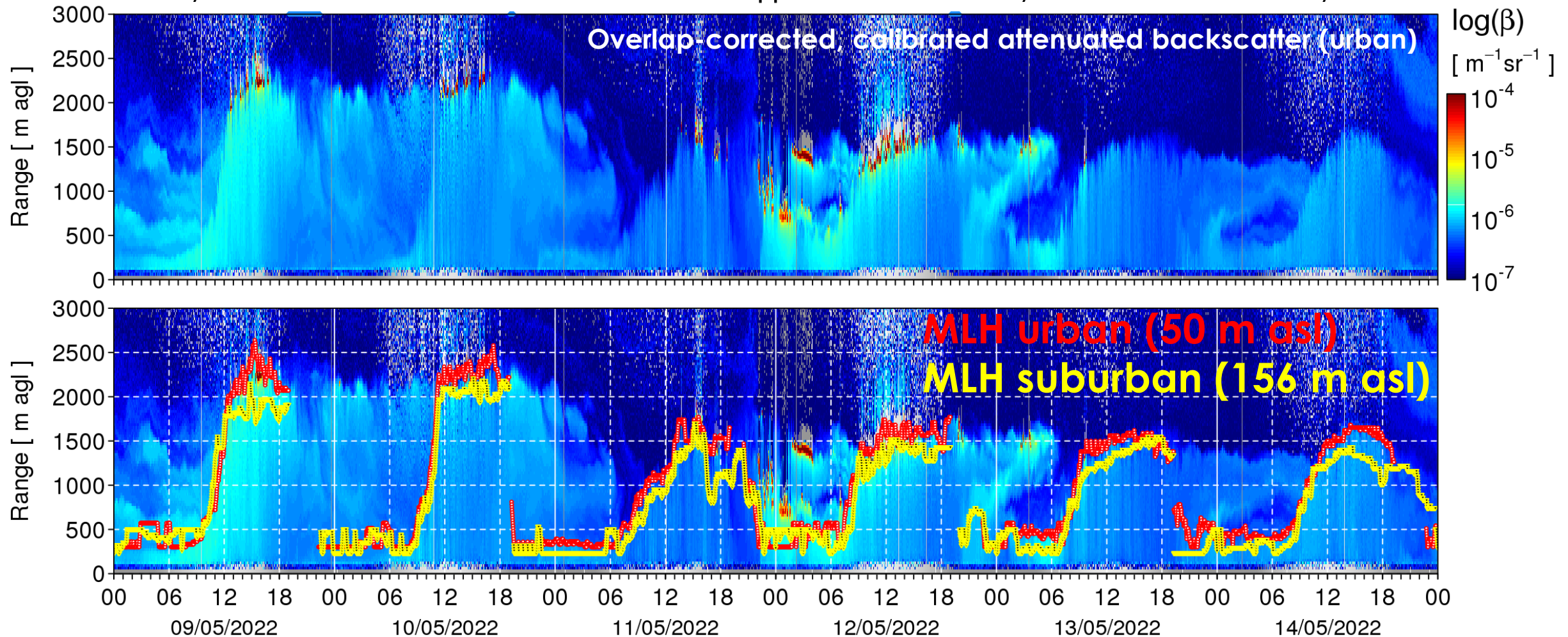
Starting to capture urban effects on ABL



Suburban ~ 20 km SW of urban site in central Paris

Starting to capture urban effects on ABL

Daytime urban increment in MLH can occur on both cloudy and cloud-free days

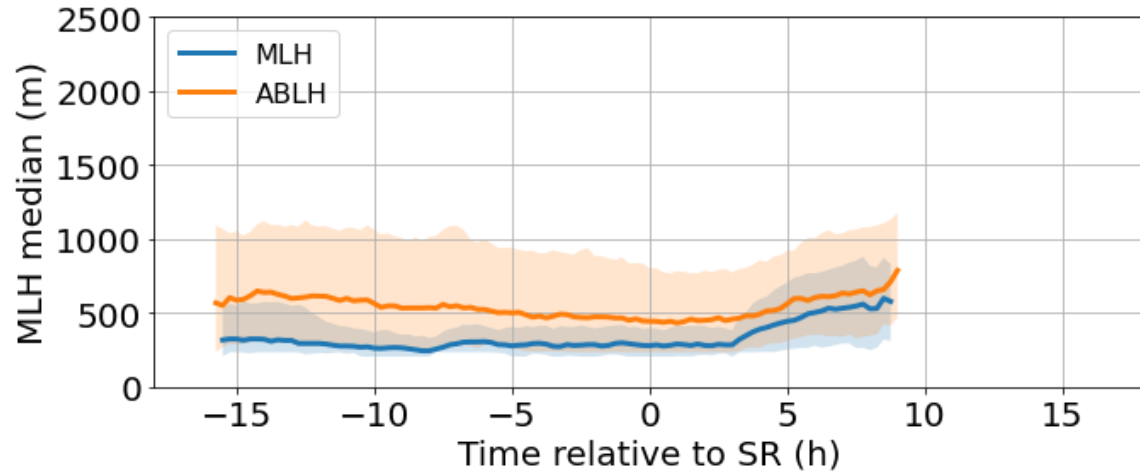


Suburban ~ 20 km SW of urban site in central Paris

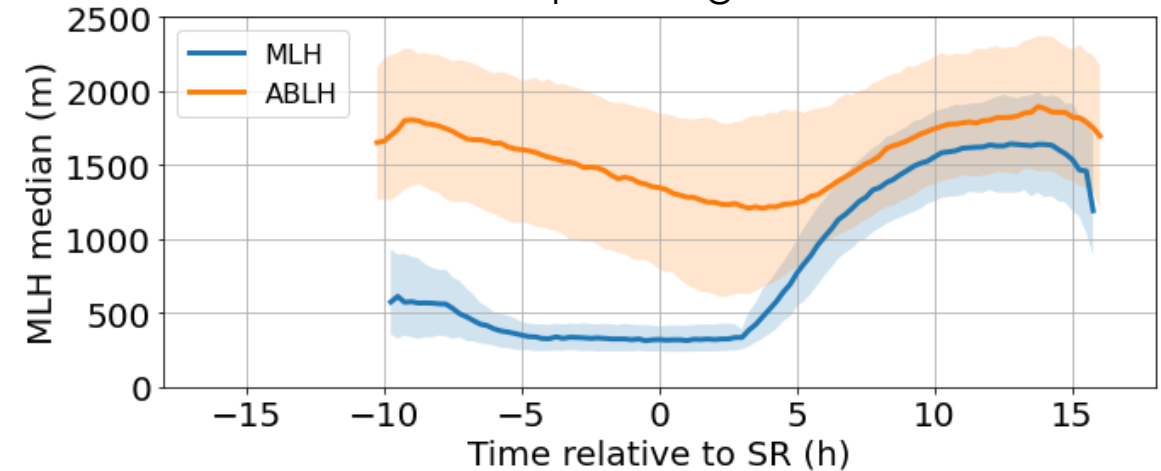
MLH and ABLH at Palaiseau (2015-2022)

First-order tracking of **ABLH** in addition to **MLH** → assessment of **residual layer**

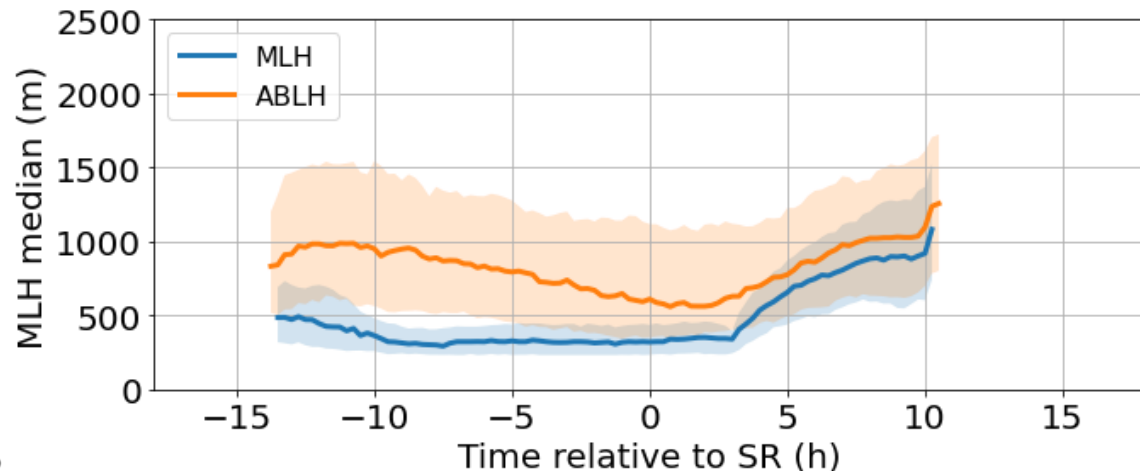
Nov - Jan



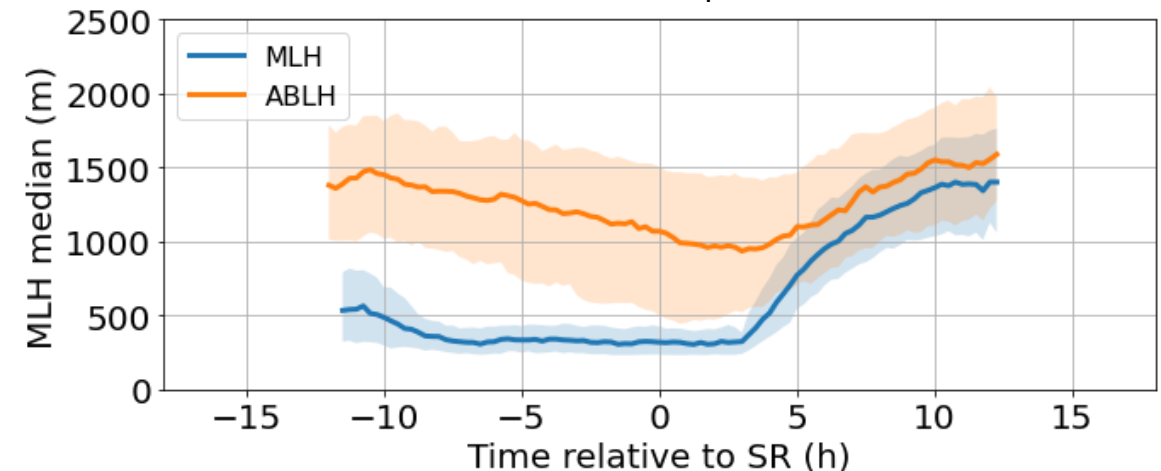
April - August



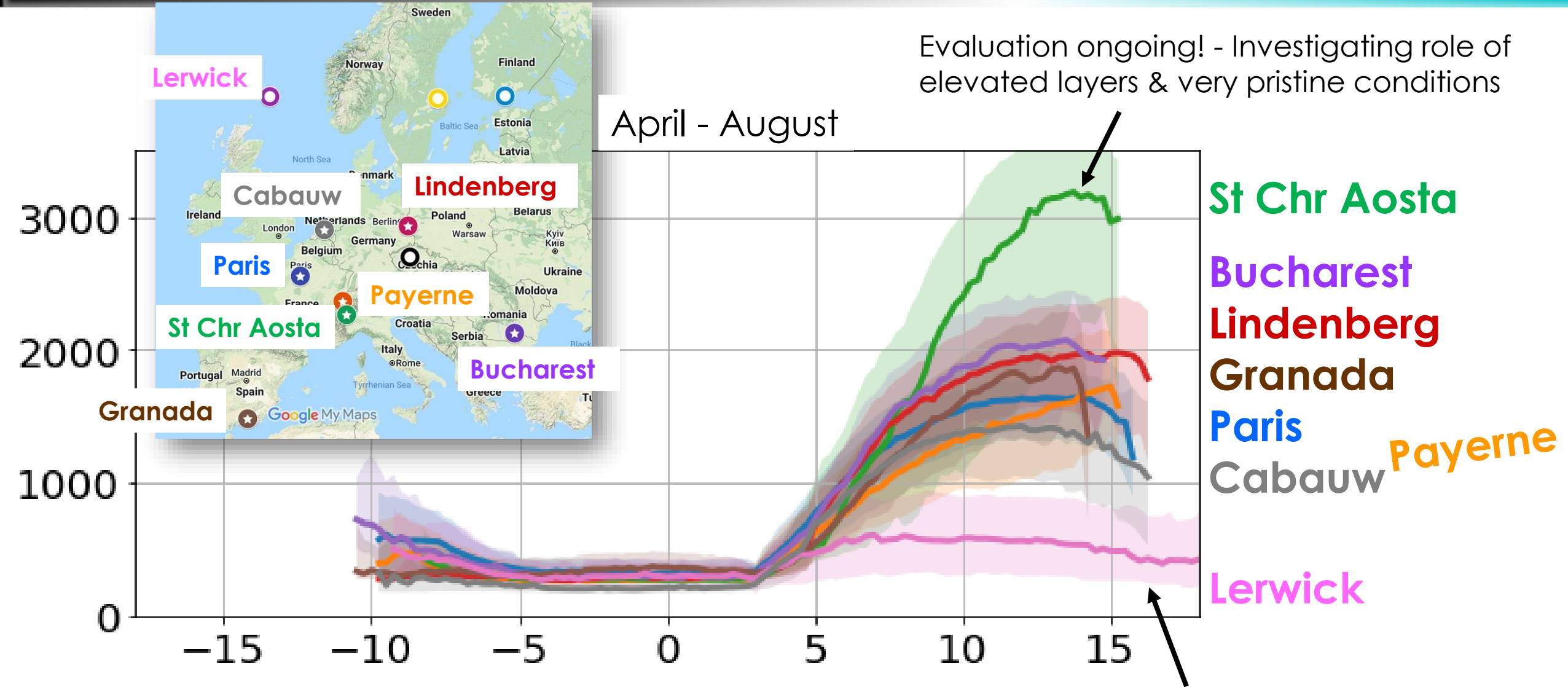
Oct & Feb



Mar & Sept



MLH variation at European scale



Investigating role of clouds and sea salt aerosols

- Automatic retrieval of high-quality MLH and ABLH across **11 sites (2018-2022)**
- Layer heights derived from ALC with **higher SNR** (e.g. Lufft CHM15k), provide detailed insights into spatial and temporal ABL variability during day
- ALC with **negligible optical overlap effects** (e.g. CL31) required to monitor shallow layer heights (e.g. at night)
- Detailed analysis and evaluation of ABL testbed results now starting to utilise **auxiliary observations** (e.g. Doppler lidar) supported by PROBE collaborations
- AERIS working on **website**: display retrieval methods/ results & share data

currently, quick looks available here (soon in near-real time):

<https://observations.ipsl.fr/aeris/e-profile/>



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Profiling the atmospheric boundary layer at European scale (PROBE)

www.probe-cost.eu