Karlsruhe Institute of Technology

KIT-Campus Alpin
IMK-IFU: Atmospheric Environmental Research

The ATMONSYS lidar system for PBL observations –

Experiences and results from 2 field-campaigns

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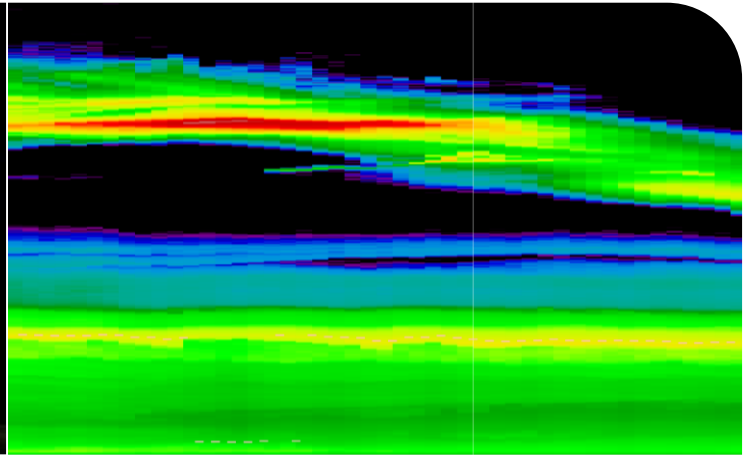
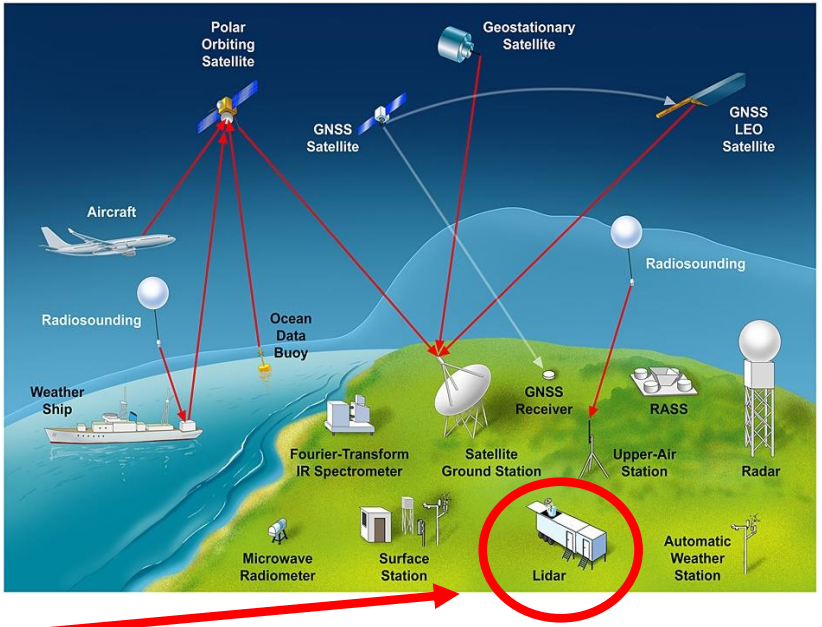


Why do we need mobile PBL lidar systems?

- Earth's surface: emissions of water vapor and aerosols, vertical heat fluxes
- **P**lanetary **B**oundary **L**ayer connects Earth and free troposphere by turbulent transport
- Local surface heterogeneity alters PBL state and transport dynamics
- Need for dense measurements to improve model parameterization and transport understanding
- Targeted measures by ATMONSYS: Water vapor, aerosol and temperature



(Wulfmeyer et al., 2015)

The ATMONSYS lidar

The mobile ATMONSYS (Atmospheric Monitoring System) Lidar:

- **Boundary layer** lidar
- **In-house development** with experimental water vapor DIAL system
- Installed inside standard 20ft container → **Uncomplicated transport** with cargo trucks
- Involved in **2 campaigns** (CHEESEHEAD 2019 and FESSTVaL 2022)
  → Revealed **initial problems** (especially with mechnical decoupling and stable DIAL operation) which **have been resolved.** ✔

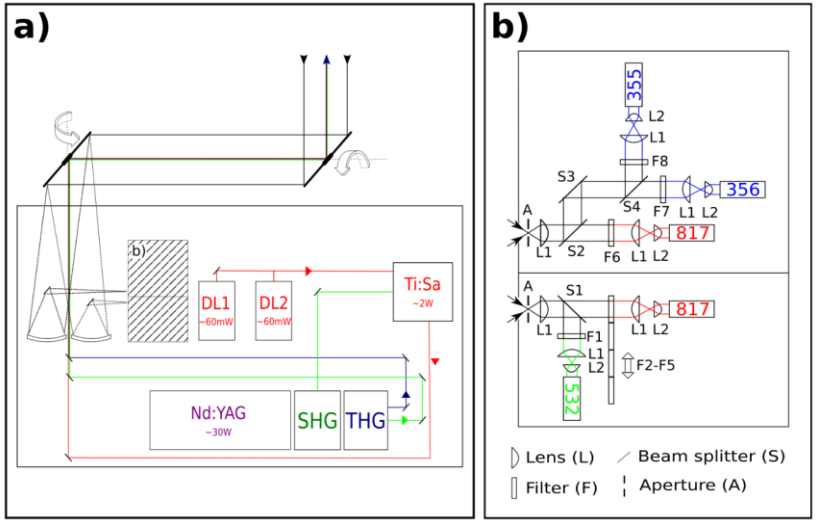
The ATMONSYS lidar

100Hz Nd:YAG laser as power source for all three channels:

- ~1W @355nm: **Rotational Raman Temperature**
- ~1W @532nm: **Elastic backscatter aerosol**
- ~ 25W @532nm: Pump energy for **water vapor DIAL** Ti:Sa @817nm
  → For details on DIAL system: **visit poster** *Monday_02_P08* 👈

Optical concept

- Complete mechanical decoupling is key! Isolation of vibrating components and pneumatically controlled laser bench
- Periscope covers full hemisphere
- Two Newtonian-receiving telescopes:
  1. Raman channel
  2. Aerosol and water vapor channel



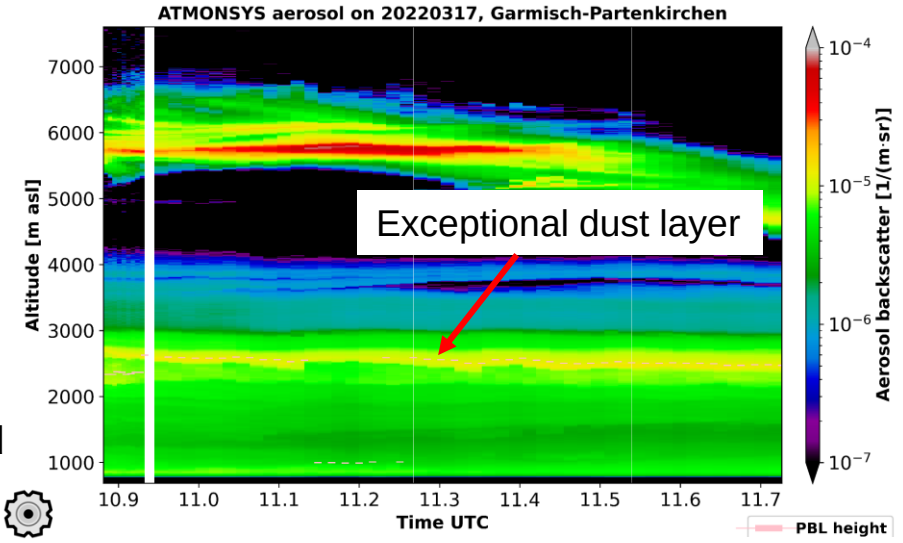
Data examples

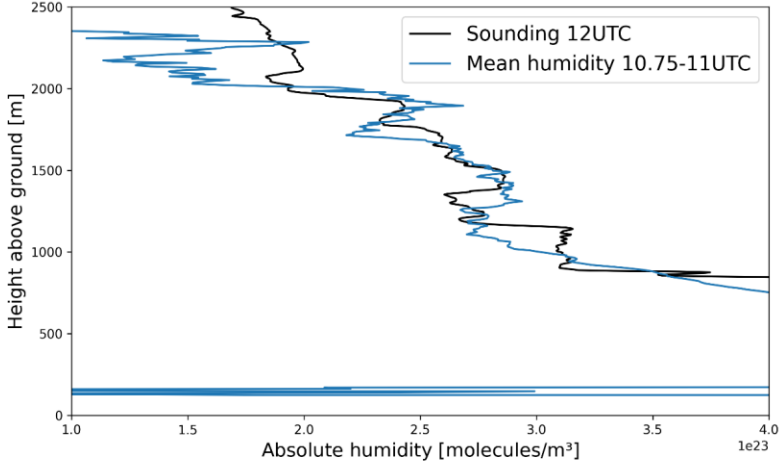
Aerosol (Δt=10s; Δz=7.5m)

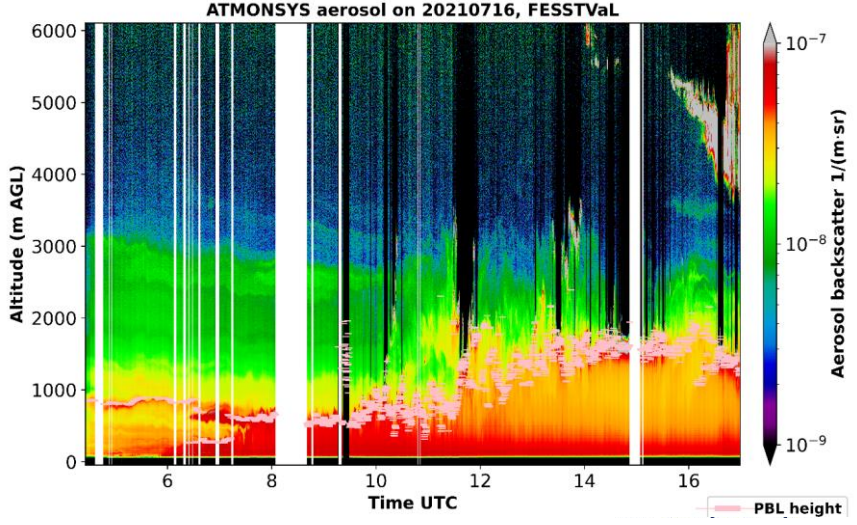
- Saharan dust event 2022
- Automatic height detection shows diurnal PBL development during FESSTVaL campaign

Water vapor (Δt=10s; Δz~100m)

- Preliminary comparison between sounding and DIAL shows good agreement despite low retrieval resolution → Optimization in progress







Take-home message

- ATMONSYS is a mobile boundary layer system measuring:
  - **Water vapor** (DIAL)
  - **Aerosol** (elastic backcscatter)
  - **Temperature** (Rotational Raman)
- In-house development with **new DIAL laser concept**
- **Initial system problems** revealed in the field and **cured**

- Ready-to-go **aerosol retrieval** including **PBL height detection**
- **Water vapor retrieval** has to be slightly adjusted and further tested.

Wanna get in contact?
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