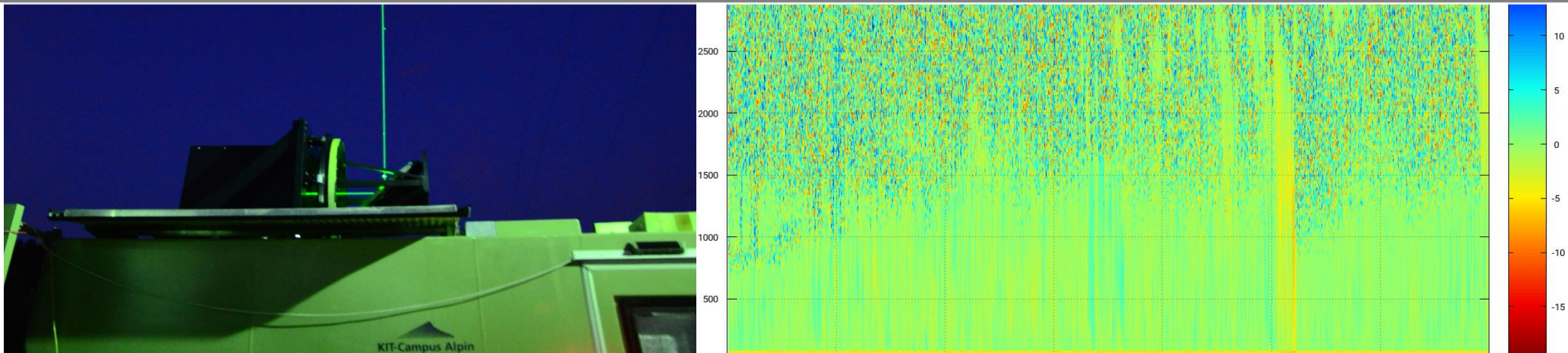


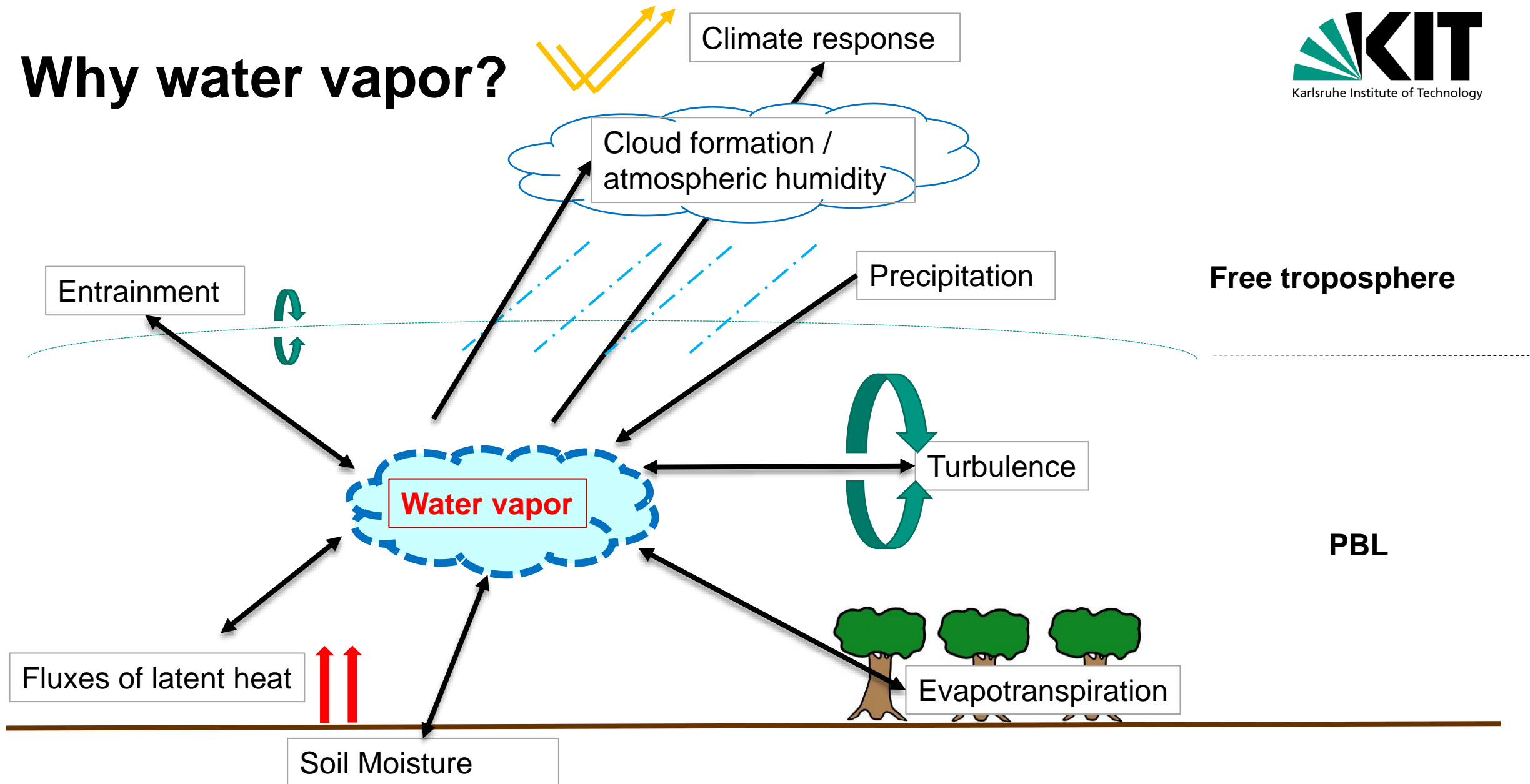
Water vapor transport in the turbulent PBL measured over heterogeneous terrain using multiple LiDAR systems

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Why water vapor?

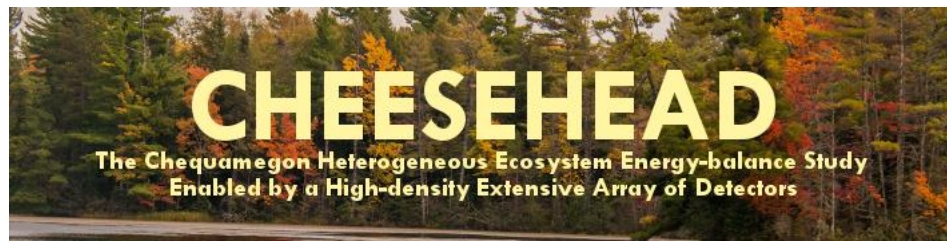


Motivation – Why water vapor?

- **Water vapor** is **relevant** for multiple processes on **many temporal** and **spatial scales**.
- Vertical fluxes of **latent heat** throughout the entire PBL are a key feature inside the **energy balance closure problem**.
- The influence of **heterogeneous terrain** on tropospheric water vapor is of special interest.
- **LiDARs** are predestined for temporally and vertically high resolved measurements of water vapor throughout the PBL.

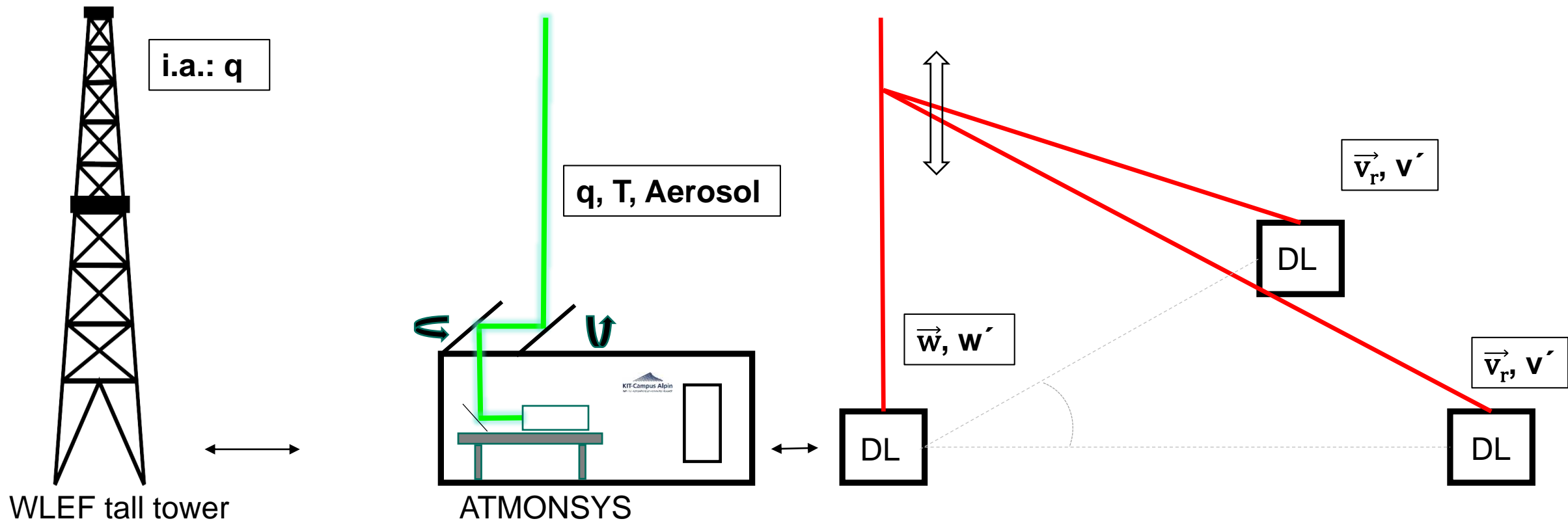
Data and experimental setup

- The KIT **ATMONSYS LiDAR system** has been operated with a new DIAL setup (EGU2020-16517) for the first time at the **CHEESEHEAD** campaign in 2019, aiming towards deeper understanding of PBL responds to spatial surface heterogeneity.
- In the following, first insights in data from the ATMONSYS **WV DIAL** are given for a randomly picked date (25.09.2019).
- The combination of 3 Doppler wind LiDARs next to the ATMONSYS delivers direct information on the movement of water vapor.

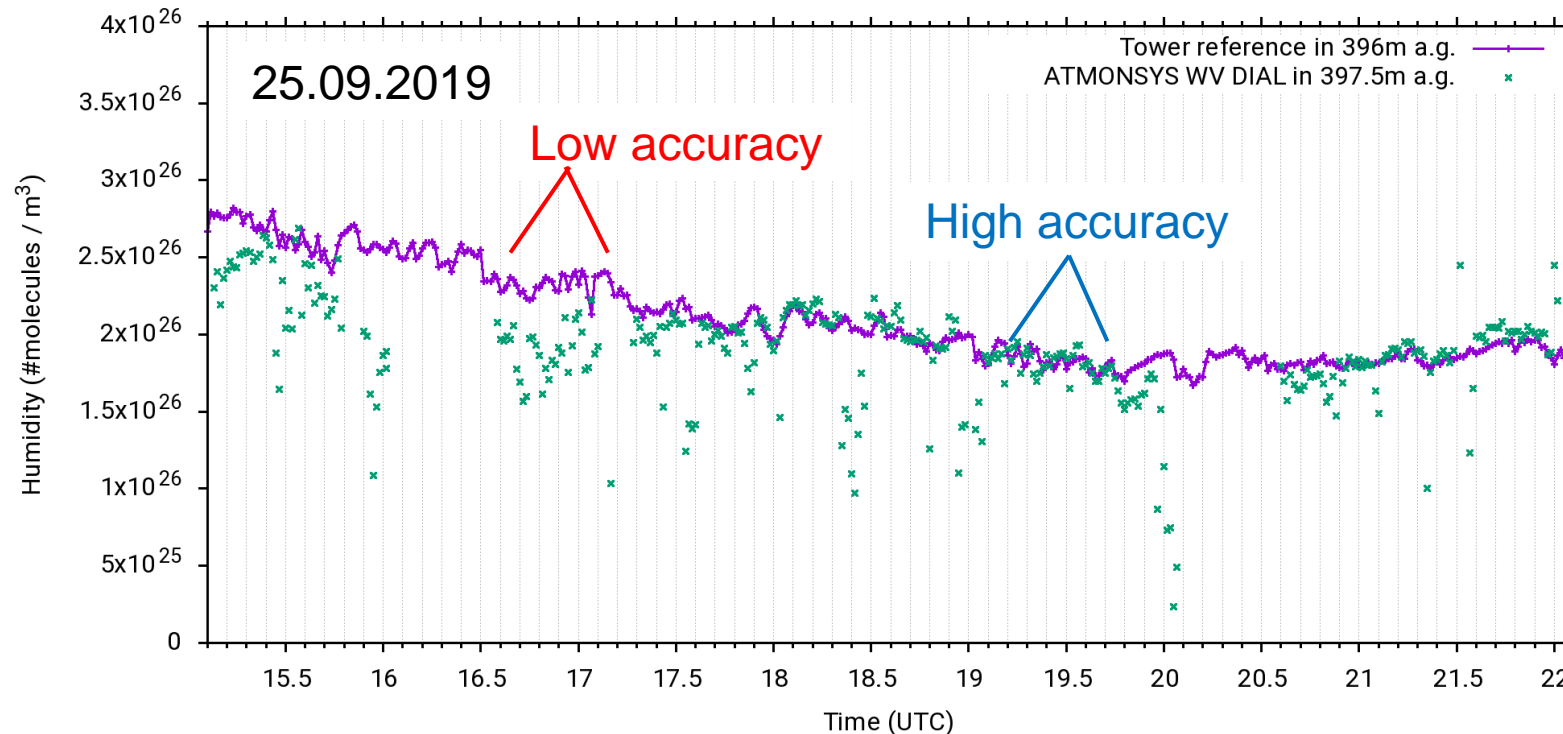


Experimental setup

- The doppler LiDARs have been operated in a **virtual tower setup**.
- A very **tall tower** with meteorological instrumentation next to the LiDARs allows for proper **signal calibration**.



Data comparison

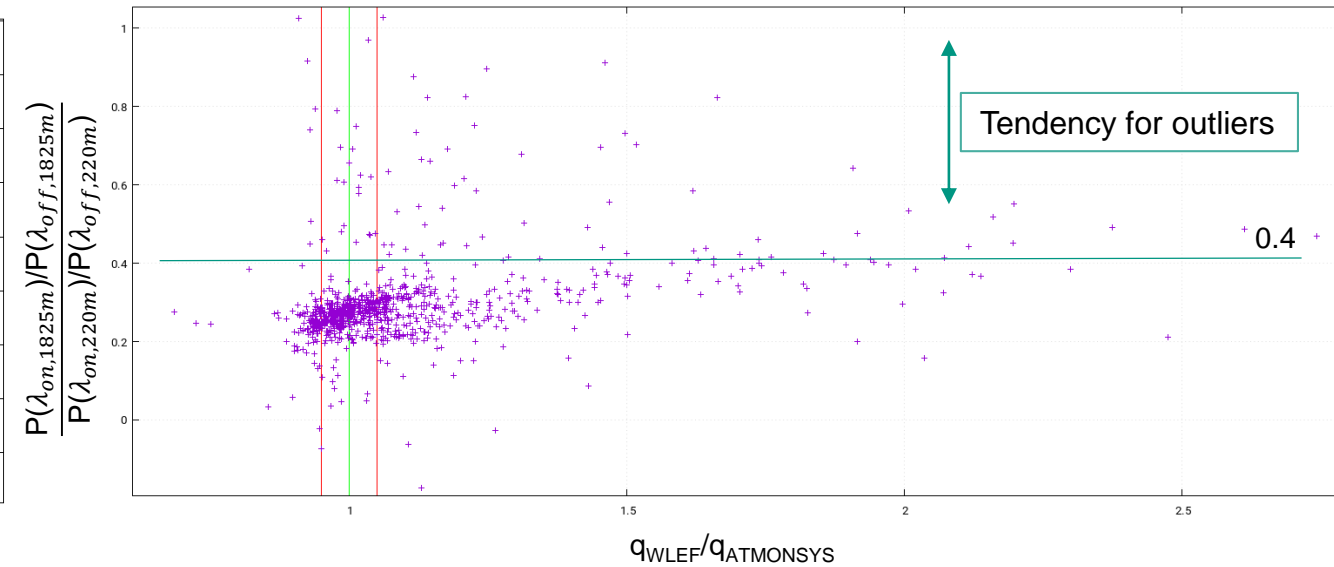
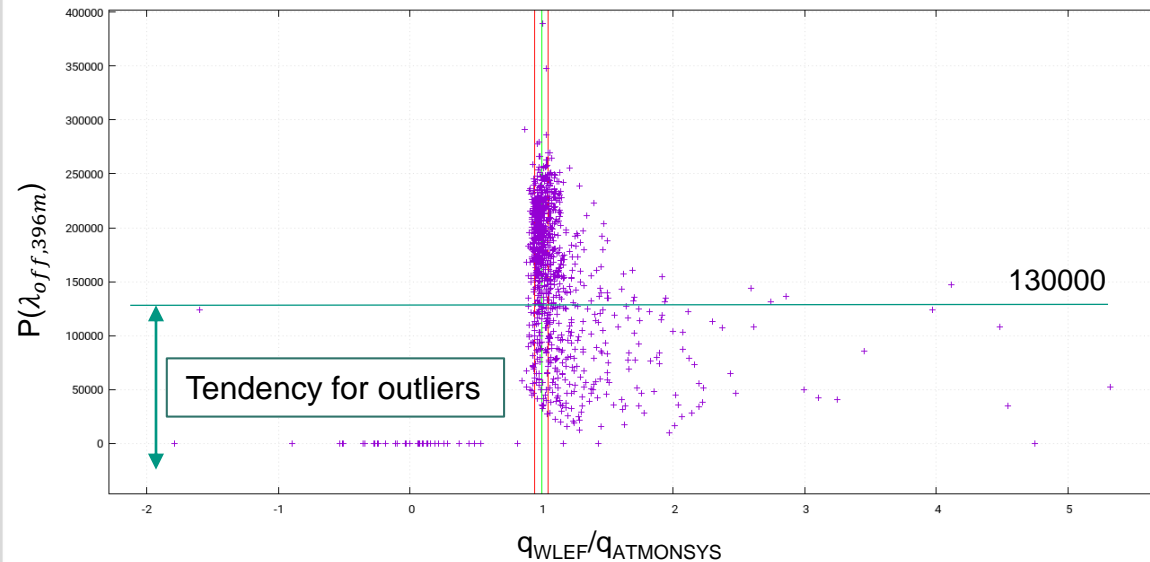


- 1-min average data on a random sunny day reveals **time periods** with **low data accuracy**. This is most probably due to **vibrations** of the internal **air conditioning** system, leading to unseeded laser pulses.

Can those errors be „smoothened“ by a correction function?

Data comparison

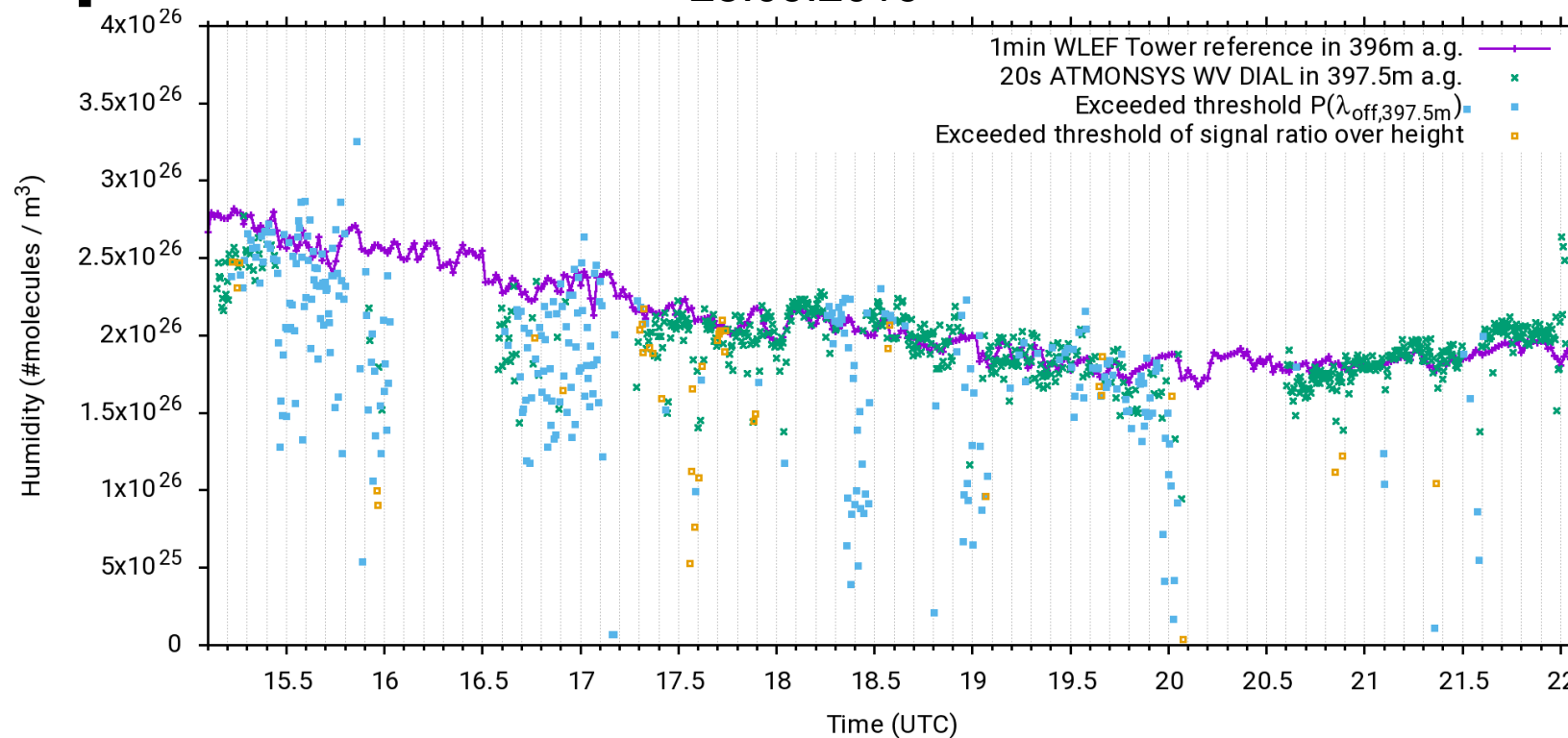
$$\begin{aligned} \text{---} q_{WLEF}/q_{ATMONSYS} &= 1 \\ \text{---} q_{WLEF}/q_{ATMONSYS} &= 0.95 \text{ (1.05)} \end{aligned}$$



- Possible methods to detect **unseeded laser operation** are the **signal strength of λ_{off}** or **signal ratios in different heights**.
- Missing structures of correlation plots show, that there seems to be **no physical relationship** for potential error removing functions.
- **Thresholds in signal strength of λ_{off}** combined with the **ratio of signal strengths** in upper and lower heights are combined as **filter criteria**.

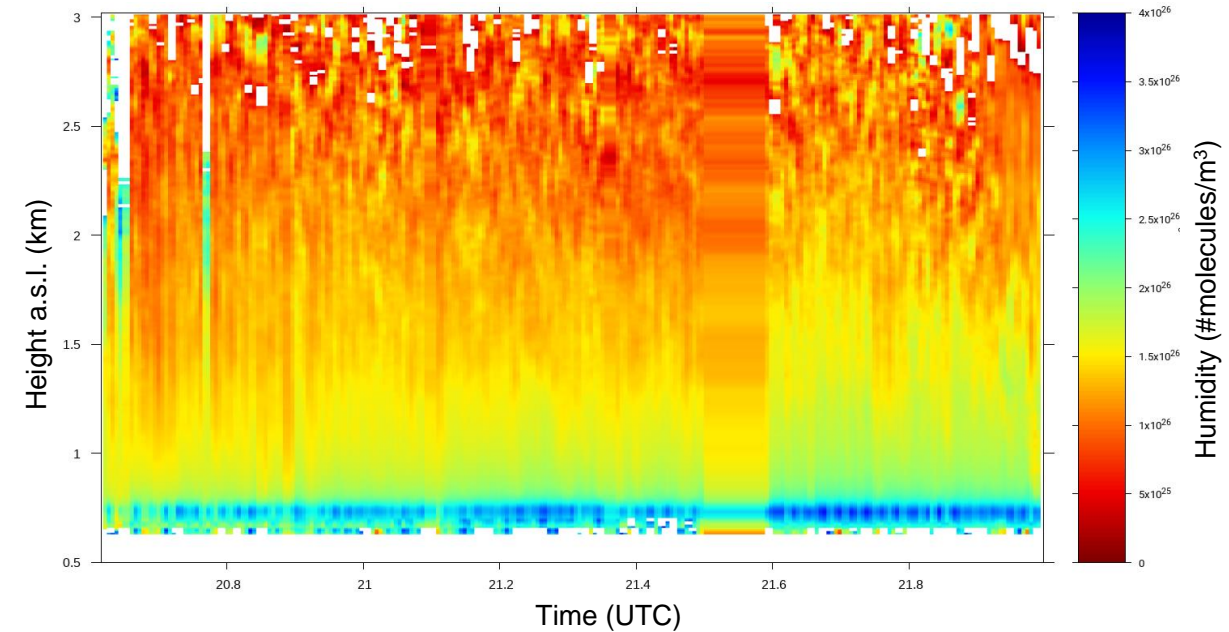
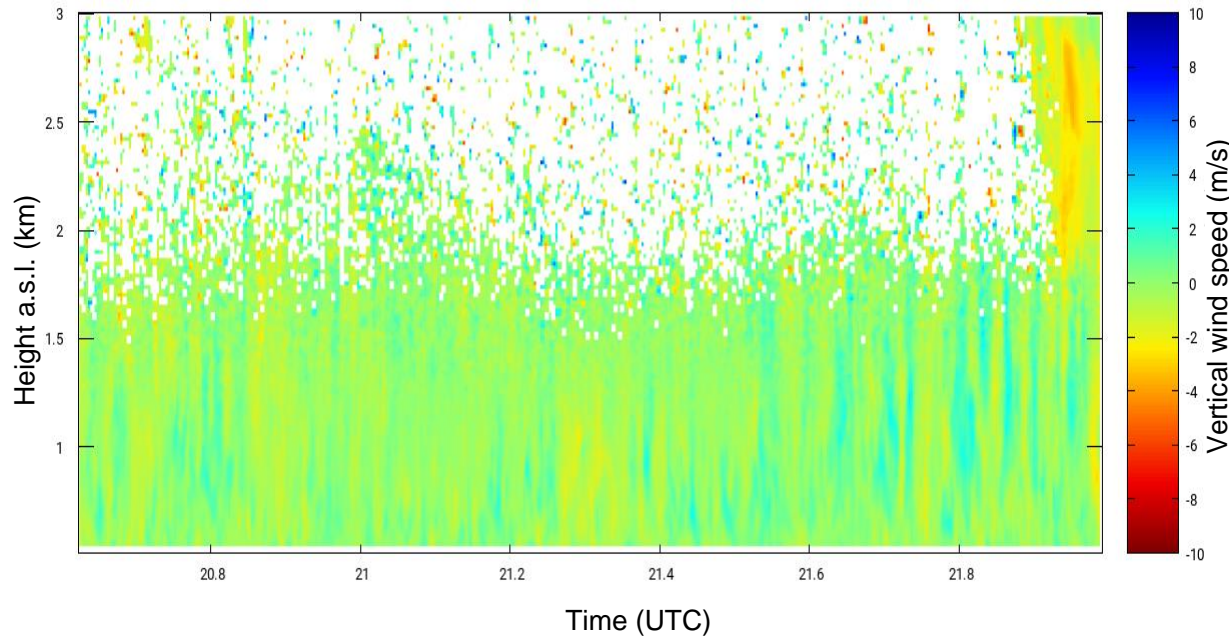
Data comparison

25.09.2019



- Filter criteria reliably **remove unrealistic outliers**.
- Unfortunately, depending on the general **daily quality** of measurements, the available **data amount has to be reduced** to ensure proper data quality.

Data comparison



- **Technical issues** with the LiDAR system led to the need of unexpected efforts in the improvement of data quality.
- As a further step, vertical **wind data** from the doppler LiDAR will be **combined with the water vapor DIAL** data to actually describe the transport of water vapor.

Take home message

- The new **ATMONSYS** water vapor **DIAL** has measured **reasonable data** during the **CHEESEHEAD** campaign, although **technical issues** caused time periods with unplausible outliers.
- **This biased data** due to unseeded laser operation is captured well by filter criteria and can therefore be **removed**. This finally allows water vapor data analysis in further steps.
- The implementation of an **aerosol retrieval** will deliver information on aerosol distribution soon. This data is expected to be **free of** such **biased time periods** as there haven't been issues with the quality of the laser pulses in this wavelength.