Microphysics in a Turbulent Channel

Atmospheric clouds are highly non-stationary, inhomogeneous, and intermittent, and embody an enormous range of spatial and temporal scales. Strong couplings across those scales between turbulent fluid dynamics and microphysical processes are integral to cloud evolution.

Generally, we are aiming at gaining fundamental and quantitative understanding concerning

- the relative roles of turbulence vs. aerosol particle physical and chemical properties in cloud microphysical processes,
- the influences of entrainment and detrainment processes on the microphysical properties of clouds.

Examples for that are, the relative influences of turbulent fluctuations in temperature and vapor pressure compared to the variability in aerosol particle properties (i.e., composition, morphology, size, and/or number) on the formation (cloud droplet activation) and glaciation (droplet freezing) of clouds.

The turbulent moist air wind tunnel LACIS-T (Turbulent Leipzig Aerosol Cloud Interaction Simulator) is an ideal facility for pursuing mechanistic understanding concerning these processes and interactions under well-defined and reproducible laboratory conditions. The experimental investigations at LACIS-T are accompanied and complemented by Computational Fluid Dynamics (CFD) modeling using OpenFoam in order to design and interpret the experiments.

The results and knowledge to be gained are highly interesting on a fundamental process level, and will also help in interpreting the results from in-situ measurements in clouds. The investigations performed will significantly enhance our understanding concerning the interactions between cloud microphysics and turbulence, and consequently cloud processes in general. First results on the influence of turbulence on cloud drop activation will be submitted soon.

Sketch of LACIS-T in the TROPOS cloud lab building: © Schulz und Schulz Architekten GmbH; Ingenieurbüro Mathias Lippold, VDI; TROPOS

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