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Contactless and high-frequency optical hygrometry in LACIS-T

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A narrow-band optical hygrometer FIRH (Fast Infrared Hygrometer, Nowak et al., 2016), based on absorption of laser light at wavelength λ=1364.6896 nm was used for contactless measurements of humidity inside the measurement volume of LACIS-T (turbulent Leipzig Aerosol Cloud Interaction Simulator, Niedermeier et al., 2020). LACIS-T is a multi-purpose moist-air wind tunnel for investigating atmospherically relevant interactions between turbulence and cloud microphysical processes under well-defined and reproducible laboratory conditions. Main goals of the experiment were:

1) characterization and evaluation of the FIRH hygrometer in controlled conditions,

2) characterization of fast turbulent humidity fluctuations inside LACIS-T.

Collected results indicate, that FIRH can be used to characterize turbulent fluctuations of humidity in scales of tens of centimeters with the temporal resolution of 2 kHz and presumably more. Interestingly, scanning of LACIS-T measurement volume indicated existence of turbulence and wave-like features for the investigated measurement setup in its central part, where air streams of different thermodynamical properties, yet the same mean velocity mix intensively. , However, the setup for cloud measurements include an additional flow (i.e., an aerosol flow) in the central part strongly reducing the wave-like features. In other words, cloud process studies are most likely unaffected by these features.

Finally, the experiments proved that contactless measurements of humidity conducted from outside the measurement volume of LACIS-T are useful, on condition of corrections of glass window transmission and interferences.

Niedermeier, D., Voigtländer, J., Schmalfuß, S., Busch, D., Schumacher, J., Shaw, R. A., and Stratmann, F. (2020): Characterization and first results from LACIS-T: a moist-air wind tunnel to study aerosol–cloud–turbulence interactions, Atmos. Meas. Tech., 13, 2015-2033, doi:10.5194/amt-13-2015-2020.

Nowak J., Magryta P., Stacewicz T., Kumala W., Malinowski S.P., 2016: Fast optoelectronic sensor of water concentration, Optica Applicata, vol. 46(4) , pp. 607-618 , doi: 10.5277/oa160408