National Radio Science Meeting

◆ January 9-12, 2024

Eleventh Liebe Lecture, January 12, 2024

Ground-based microwave radiometers: Missing puzzle pieces in laying the picture of the atmospheric state

Ulrich Löhnert

University of Cologne, Cologne, Germany

Abstract: Currently, there is a world-wide observation gap of wind, temperature, and humidity profiles in the Atmospheric Boundary Layer (ABL), particularly as operational numerical models are approaching the km to sub-km scale. Ground-based passive microwave radiometers (MWR) can simultaneously deliver information on atmospheric humidity and temperature profiles, as well as on the column integrated liquid water path. As opposed to other remote sensing methods, MWRs can profile continuously throughout the entire troposphere, even in the case of optically thick water clouds. State-of-the-art MWR operate robustly 24/7 during all-weather conditions, are commercially available (and affordable) and are consequently being implemented in different observational networks worldwide. However, their vertical resolution is limited, especially above the atmospheric boundary layer, constraining the information content of the measurements.

This lecture will review stand-alone performance of state-of-the-art MWR and give a status report on their implementation within current observational networks. A major focus will be on how MWR can be used complementary with other (remote) sensors to fill the existing observational gap in the ABL. This includes the synergy with standard meteorological observations, collocated ground-based remote sensors such as lidar, radar or infrared spectrometer, as well as different current and future satellite sensors (e.g., geostationary infrared sounders). Existing and future network configurations of MWR will be presented and what benefits these provide for applications such as nowcasting of atmospheric stability and short-term weather forecasting. Also, the potential of using elevation and azimuth scanning MWR configurations for measurement quality control as well as for detecting horizontal atmospheric inhomogeneities will be discussed.

Biography: Prof. Ulrich Löhnert is professor for Meteorology at the University of Cologne, and since 2020 leads the research group Exploiting Observations in Meteorology. Before becoming an extraordinary professor in 2020, he co-led the research group on Integrated Ground-based Remote Sensing since 2007. In 2012 he obtained his habilitation in Meteorology from the University of Cologne following a time as assistant professor at the Meteorological Institute, Ludwig-Maximilians-University Munich (2004−2006). His main research interest lies in using ground-based remote sensing for enhanced atmospheric process understanding and improving numerical models. He has been coordinator of German research network projects funded by the German Ministry for Research and Education (BMBF) and has acted as PI in numerous nationally funded projects (German Research Foundation, DFG and BMBF). He has established strong research with the German Weather Service (DWD) and since 2020, he is PI within the ACTRIS-D initiative, which is part of the ACTRIS ERIC (European Infrastructure Consortium). He is currently co-chair of the WMO WWRP working group on Data Assimilation and Observation Systems (DAOS) and has also been working group leader and management committee member of several EU-funded COST actions. His research also benefits from long lasting collaborations with US-researchers in active and passive atmospheric remote sensing.