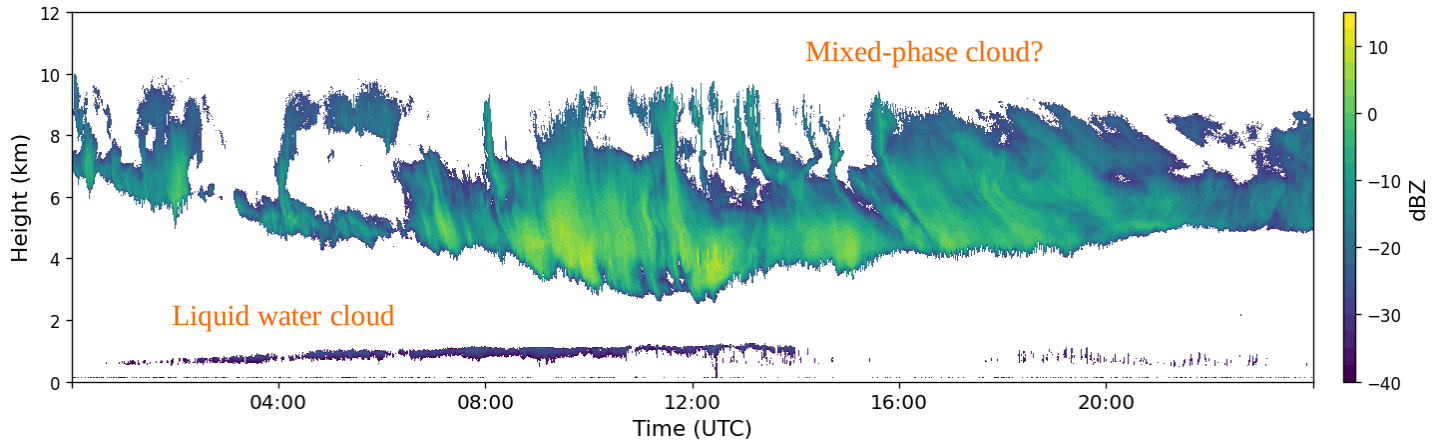
MSc Thesis in Remote Sensing of the Atmosphere

Unravelling Mixed-Phase Clouds

The interaction of liquid water droplets and ice crystals leads to an enhanced growth of the ice crystals while falling through layers of supercooled liquid water. In the midlatitudes, this is an important process for precipitation formation. Nevertheless, the implications of the microphysical processes on precipitation formation are currently not well understood. Such microphysical processes involve a variety of hydrometeor sizes, shapes, phases, all affected by cloud dynamics, making the observation particularly challenging. Nowadays, ground-based cloud radar measurements have the advanced capabilities to observe and study microphysical processes within mixed-phase cloud systems, containing both liquid water and ice. Analyses of ice particle growth processes within mixed-phase cloud systems are primarily based on cloud radar data. Lidar data can complement the radar data by the measurement of the super-cooled liquid water layer.

Within the Ruisdael Observatory a new dual-frequency polarimetric cloud radar was acquired end 2020 for cloud and precipitation studies. This cloud radar is coupled with a microwave radiometer, which provides profiles of thermodynamic variables like temperature and relative humidity. A ceilometer (lidar) is also present on the atmospheric site. This suite of different types of measurements allows building retrievals of microphysical properties of mixed-phase clouds. They can lead to the liquid water and ice water content, or they can target the retrieval of the particle size distributions present in this medium, the latter being challenging.

After a literature study, a step-wise-approach has to be selected/designed/implemented for obtaining a physical quantity. Several choices are possible.



For the interested student, this topic provides a great experience in data analysis, research and methodology development, which can be applicable to other instruments and media. The societal impact, creating retrievals of physical quantities for studying mixed-phased clouds in the context of precipitation formation in a warming climate, is large.

Contact information

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