Topic: C2.1 Dynamics and impact of ice formation in clouds

Title: Combining ground-based active and passive microwave instruments for remote sensing of ice and mixed phase cloud properties

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Text: Microphysical properties and processes of ice and mixed phase clouds are still poorly understood and as a result, their representation in numerical weather models is simplified and incomplete. Especially, super cooled liquid water (SCLW) has a strong impact on cloud processes and is frequently present with a surprisingly long lifetime - sometimes down to temperatures around -40 °C. Direct measurements of cloud properties could help filling this knowledge gap, but in situ measurements of cloud properties are rare and only available during aircraft campaigns. Besides uncertainties caused by measurement errors, these datasets cannot provide continuous observations. Microwave remote sensing instruments could contribute to fill that gap, but measurements of cloud properties are, however, challenging, especially for ice and mixed-phase clouds: The scattering properties of ice hydrometeors depend much more on the type and shape of hydrometeor than its mass and only limited number of degrees of freedom can be extracted from the measurements. One strategy to overcome these limitations is the combination of different active and passive observation frequencies to exploit different scattering properties at different wavelengths. Extinction of solid hydrometeors is proportional to their mass, but generally weak in the microwave range. This reduces attenuation problems for radars, but makes observations using microwave radiometers challenging and requires the use of higher frequencies. Another strategy is not only to exploit traditional bulk radar properties like reflectivity, but also the full Doppler spectrum properties provided by zenith pointing cloud radars. Here, we present a sensitivity study to evaluate the use of these strategies for deriving properties of ice and mixed phase clouds, such as hydrometeor type, presence of SCLW, ice and/or liquid water content. We show simulated radiometer and radar measurements using a radiative transfer model based on RT4 extended by a radar Doppler spectra simulator.

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