Ice optical sensitivities of cloud-radiative heating in ICON

Ice optical parameterizations used in numerical weather prediction (NWP) models determine high-cloud radiative properties by describing how much incoming shortwave radiation is scattered and how much outgoing longwave radiation can be absorbed by cloud ice crystals. The gradient of the radiation fluxes, known as the cloud-radiative heating rate (CRH), is a key variable to evaluate the impact of clouds on circulation, by changing atmospheric temperature and pressure gradients. Evidence has accumulated that CRH helps determine circulation features from the Madden-Julian Oscillation and El Niño Southern Oscillation to the Asian monsoon and Northern Hemisphere jet stream. At smaller scales, CRH is also influential on the genesis and evolution of both tropical and extratropical cycles.

This project uses DKRZ resources to ***evaluate the impact of different ice cloud optical schemes on simulated tropical cloud-radiative heating rates*** in ICON at convection-permitting resolutions. As an initial region of interest, we focus on the convectively active zone of the South Asian Monsoon region and run limited-area, convection-permitting ICON simulations together with the ecRad radiative transfer module. Preliminary results of this project have quantified the sensitivity of CRH to ice optical schemes through offline radiative transfer calculations with ecRad. These idealized single-column simulations of tropical ice clouds have helped build our intuition for and understanding of the ice optical schemes available in ICON+ecRad; however, they do not include microphysical-radiative feedbacks and 3D online simulations are the necessary next step.