

Project PRISTINE aims at developing a polarimetric radar forward operator that is based on realistic snow particle properties. A reliable forward operator is an essential tool for the overall PROM program since it is a core component of data assimilation algorithms and model evaluation studies. The existing forward operators based on the T-matrix approximation for homogeneous, spheroid-shaped cloud and precipitation particles have shown substantial deviations with respect to the observed polarimetric signatures of frozen hydrometeors. Those deviations have been linked to the simplifications introduced by the T-matrix approximation. PRISTINE will build upon the efficient polarimetric radar simulator framework EMVORADO, which covers many other aspects of radar simulation and is coupled to the weather models COSMO and ICON. The project will perform novel single-scattering computations using the Discrete Dipole Approximation (DDA) method. The accurate DDA calculations require additional assumptions regarding the detailed hydrometeor structure. PRISTINE will address this issue by means of an innovative modeling technique. The snow particle shapes will be generated using a combination of detailed Lagrangian cloud modeling and an explicit snow particle simulator. By doing so, PRISTINE aims at finding the snow shapes that are representative of the ensemble mean properties of snow. Moreover, the uncertainties, in terms of snow particle microphysical and polarimetric scattering properties, that arise from the stochastic nature of snow growth processes and the irregular shape of snow particles will be evaluated. The single-scattering properties will be used to replace the scattering modules for cloud ice and snow in EMVORADO that are currently based on the T-Matrix approximation. The performance of the updated scattering simulations will be evaluated against multi-frequency, Doppler-resolved, polarimetric radar observations. The successively updated versions of EMVORADO and of the DDA scattering data will be made available to the PROM project partners and the larger scientific community.