Towards the assimilation of polarimetry-derived hydrometeor mixing ratios in Germany

The assimilation of radar polarimetric information into numerical weather prediction models carries the promise of significant improvements especially in short-term forecasts of quantitative precipitation. However, directly assimilating polarimetric observables is still challenging due to the rather rudimentary appreciation of particles size and shape distributions in the NWP models. Due to this difficulty, pioneering studies try to assimilate model state variables linked to radar polarimetric observables, such as different hydrometeor mixing ratios. Thus, assimilating polarimetric information via model state variables requires polarimetric retrieval relations, which allow to estimate these state variables from the polarimetric observations. In this study, previous work done on polarimetric hydrometeor mixing ratio retrievals is evaluated for and adjusted to the German C-Band polarimetric weather surveillance radar network operated by German Weather Service (DWD) for the purpose of a later assimilation of polarimetric measurements into DWD's models COSMO-DE/ICON. To do so, a large drop-size-distribution data set of DWD from northwestern and southeastern Germany, including stratiform and convective rainfall events, is investigated based on simulations with a T-matrix code by comparison with the results from earlier studies. First results show that previous C-Band retrieval algorithms derived for other climate regimes are not suitable for representing the whole range of mixing ratios in Germany, which underlines the need for improved relations prior to the assimilation of the derived mixing ratios into the DWD models. A first try to find simple power law relations between polarimetric moments and mixing ratios (as done in previous studies) covering all scales appeared to be insufficient, as relations were either more suitable for relatively small or for high mixing ratios, respectively. The usage of polynomial or broken rational relations instead of power law relations, which to our knowledge have not been widely used so far, enables considerable improvements.