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Evaluation of state-of-the-art polarimetric ice microphysical retrievals exploiting ground based radar and airborne in-situ measurements

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Polarimetric microphysical retrievals bear great potential for the evaluation of numerical models and data assimilation. However, a solid database is still lacking to evaluate their accuracy. In order to evaluate these retrievals and assess their accuracy, ground based polarimetric radar measurements are collocated spatially and temporally with airborne in-situ microphysical data collected during the OLYMPEX campaign (Olympic Mountain Experiment). Retrievals for ice water content, total number concentration, and mean volume diameter of ice particles are assessed exploiting both X-band Doppler on Wheels (DOW) measurements and an in-situ measurements obtained by the University of Dakota (UND) Citation aircraft. Vertical profiles of the microphysical retrievals are derived from sector-averaged RHI scans. The comparison of the retrievals with in-situ data above the freezing level reveals new insights into the strengths, weaknesses, and accuracies of the different retrievals, as well as the advantages using polarimetric retrievals rather than non-polarimetric ones. Results clearly demonstrate the superiority of the polarimetric retrievals. Furthermore, the recently introduced hybrid ice water content retrieval exploiting reflectivity ZH, differential reflectivity ZDR and specific differential phase KDP outperforms other retrievals based on either (ZH, ZDR) or (ZH, KDP) or non-polarimetric retrievals in terms of correlations with in-situ measurements and the root mean square error. ZH-based retrievals for the mean volume diameter partly exhibit significant deviations from airborne in-situ measurements, while polarimetric retrievals show a good agreement.