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Comprehensive comparison of precipitation measurement systems for convective and non-convective events

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During the field phase of Convective and Orographically-induced Precipitation Study (COPS) the supersite "S" was equipped with several collocated precipitation measuring devices including rainfall weighing gauge, tipping bucket gauge, optical disdrometer, and vertically pointing micro rain radar. Precipitation measurements from two scanning C-band radars covering the area of the eastern Black Forest were available for comparison with the surface-based measurements, as well as data of a wind-temperature radar collocated with above mentioned rainfall instruments at the supersite "S". In this study we present a comprehensive comparison of precipitation measurements for selected IOP-days during the COPS field phase.
One issue of this study was to compare the rainfall amount estimated by several measurement devices during defined rainfall episodes under consideration of the differences in sampling strategy of the different instruments. Another goal was to test the rainfall sensors for their ability to catch the temporal variability of rainfall. We investigate time correlation of the rainfall and the autocorrelation of the measurements stratified after convective and non-convective events. Dependence of the observed measurement differences on the rainfall intensity was also investigated. Since the sampling characteristics (sample volume, sampling time) varies notably between the instruments used for comparison appropriate matching of the temporal and spatial scale of the different observations was done with a particular attention given to the differences in the height of the measurements.
Due to the simultaneous observations of the two scanning C-band radars over the area of the supersite "S" it is possible to estimate the specific measurement error of the radars, relative to the precipitation amount observed on the ground. Using disdrometer and vertically pointing micro rain radar in conjunction with scanning radar data above, reflectivity factor of a scanned precipitation volume above the supersite is extended to the ground and the direct comparison with the precipitation amount observed by gauges can be used to reveal insight into the governing Z-R relationship.
Findings of the intercomparison of multiple collocated precipitation data sources with different sampling characteristics points to the effects the specific instrument has on the merging data from different sources. The elevation difference between remote sensing and surface-based observations could only be partially reduced by the often used means of spatial and/or temporal averaging. Particular attention has to be given by merging observations from rain gauges and scanning radars due to the wind drift effect, especially by high resolution data, since this approach is probably most widely used in the practice, e. g. for hydrological uses.