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Evaluation of ground-based remotely sensed water cloud properties using aircraft in-situ measurements

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High temporal resolution of ground-based remote sensing measurements enables long-term observations of the effect of aerosols on cloud microphysical and optical properties on a regional scale. The greatest challenge of this possibility is to retrieve and to relate the relevant parameters involved in the processes from increased anthropogenic aerosol production to changes of the cloud albedo from the observations. Our work introduces a retrieval technique of microphysical (concentration, effective radius) and optical properties (extinction, optical thickness) of low level water clouds using different ground-based observations to obtain the temporal and spatial variation of water cloud properties. The technique combines microwave radiometer, cloud radar and lidar measurements with a vertical cloud model, which is based on the inherent relation between cloud optical and microphysical properties as a function of height. The quality of the retrieval products is strongly depending on the model assumptions and on the accuracy of the ground-based observations. In previous evaluation studies the optical retrieval products have been used as input for radiation transfer model calculations to simulate narrowband fluxes and to compare them with radiation measurements at the ground. The simulated fluxes show agreement in the order of the measured fluxes, but the trend is shifted in time. This is due to the fact, that the simulated fluxes are based on a vertical column approximation in contrast to the hemispherical radiation measurements, which implies an additional uncertainty factor in the comparison and evaluation process. A more accurate evaluation of the quality of the products will be analyzed by using aircraft in-situ measurements of water clouds. On the basis of an accepted EUFAR proposal (European Fleet for Airborne

Research) aircraft measurements of water cloud microphysics (liquid water content, droplet size distribution and concentration) have been performed during the measurement campaign COPS (Convective and Orographically-induced Precipitation Study). In four different flight mission simultaneous Raman lidar, cloud radar and microwave radiometer measurements at three different observation sites located in Southern Germany in the period of July 2007 could be coordinated. These data will be used for a detailed intercomparison of the in-situ and ground based measurements in order to validate the observations and to optimize the retrieval technique.