Use of integrated profiling techniques for studying cloud-radiation interactions

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The calculation of radiative flux profiles requires the knowledge of the atmospheric state, i.e. temperature, humidity, cloud liquid water and cloud ice profiles. These properties have been derived for a continuous nine month period for a site in the Black Forest, Germany, using the Integrated Profiling Technique (IPT) and the CloudNet retrieval algorithms. The IPT employs multiple measurements of active and passive remote sensing instruments for various wavelengths, namely ground-based microwave radiometers, a cloud radar and ceilometer, as well as a priori information from radiosondes. In combination with the CloudNet target classification product these measurements are integrated via via a one-dimensional variational technique to derive vertical profiles of temperature, humidity and liquid water content. This framework also yields error estimates for the derived profiles. Given the atmospheric profiles and their uncertainties, the effects of clouds on the vertical distribution of radiation can be investigated in a comprehensive way. Radiative flux closure studies are performed using the IPT results as input data for COSMO-GRAALS, the radiation scheme of the German Weather Service's COSMO-Model. In this context, the cloud radiative effects and forcings will be investigated as well as their limitations due to the uncertainty of the retrieval technique. Since differences in observed and simulated fluxes may not only be attributed to uncertainties in the input data, but also to deficiencies in the model itself, the results of COSMO-GRAALS are compared to those of the rapid radiative transfer model RRTMG, which is implemented in the ECMWF Integrated Forecast System.