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Driving processes for deep convection over complex terrain: COPS observations and respective COSMO simulations

U. Corsmeier, Ch. Barthlott, N. Kalthoff, H. Konow, Ch. Kottmeier, and the COPS TEAM
Institut für Meteorologie und Klimaforschung, Karlsruhe Institute of Technology, Karlsruhe, Germany
(ulrich.corsmeier@imk.fzk.de)

The "Convective and Orographically induced Precipitation Study" (COPS), mainly aims on the forecast improvement of convectively driven precipitation by mesoscale models. COPS took place from June to August 2007 in southwestern Germany and eastern France.

During IOP 9c a mesoscale convective system (MCS) over eastern France, propagated north-eastward and a gust front of the MCS reached the COPS region in the morning. During the passage of the gust front from west to east through the Rhine valley, the convective weather activity was significantly reduced. When the air reached the western slope of the Black Forest, it has been lifted to propagate over the mountains. More to the east the sky was still free of clouds and radiation led to a high air temperature of up to 30 °C, to the formation of local slope and valley circulations, and on larger scale to the development of a north – south orientated convergence line over the Black Forest. The interaction of local scale orographic winds, the regional scale gust front, the mesoscale convergence line and the cold front led to organized deep convection over the eastern Black Forest.

The transformation of stable air masses passing the Rhine Valley into air masses of high instability when passing the Black Forest is studied by airborne measurements and data of ground based in situ and remote sensing instruments. Upper tropospheric forcing and ground based lifting are discussed with special emphasis of the high variability of the stability and humidity within the PBL.

Model simulations of COSMO-DE without convection parameterisation are compared with the measurements. It is shown that features with scales above the model resolution of 2.8 km like the cold front of the MCS and partly the convergence line with the resulting moisture convergence are well represented in the model. The amplification of the convergent flow by small scale forcing (gust front and orgraphic winds) are suboptimal resolved. This results in missing deep convection and precipitation along the convergence line and leads to poor precipitation forecast.