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A convergence zone triggering deep convection over complex terrain: COSMO simulations of a case study from COPS

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A case study of an isolated deep convective cell from the Convective and Orographically induced Precipitation Study (COPS) is analysed with respect to its representation in the numerical weather prediction model of the Deutscher Wetterdienst COSMO-DE. The international field campaign COPS was performed in southwestern Germany and eastern France in summer 2007 as part of the Priority Programme SPP 1167 of the Deutsche Forschungsgemeinschaft (DFG). The overall goal of COPS was to advance the quality of forecasts of orographically-induced convective precipitation by four-dimensional observations and modeling of its life cycle.

On July 15, deep convection developed in an area east of the Black Forest crest although convective available potential energy (CAPE) was only moderate and convective inhibition (CIN) was high. Data analysis revealed that convection was triggered by the superposition of a synoptically generated eastward moving mesoscale convergence zone and a thermally induced convergence zone along the mountain crests in the northern Black Forest. More in the south, radar observations also showed a convergence line hours before a single cell was initiated. The question if these convergence lines are connected can not be answered by measurements only.

In the standard configuration (2.8 km grid resolution), COSMO simulations reveal a near-surface convergence line and the evolution of a line of low clouds northeast of Freiburg in good agreement with radar and satellite observations. In addition, model-derived values of CAPE were high ($>$ 2000 J/kg) accompanied by almost vanishing CIN. However, no deep convective cell developed out of this line of clouds. For an improved representation of orographic effects, simulations with 1 km grid resolution were performed and compared to the results of the standard configuration. Although both simulations did not initiate deep convection, the results suggest hat in a situation with air mass convection without mid-tropospheric forcing, the simulation of the location and timing of convergence lines in combination with high values of CAPE and low values of CIN can be used for forecasting deep convection.