Convergence zone development in complex terrain during the Convective and Orographically-induced Precipitation Study (COPS)

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Clear air atmospheric structures, such as convergence boundaries, are difficult to detect and study in regions of complex terrain. These terrain-induced convergence boundaries can provide favorable regions for convection initiation (CI) to form and therefore it is important to understand where, when and how the boundaries will develop. During the Convective and Orographically-induced Precipitation Study (COPS), two Doppler On Wheels (DOW) mobile radars observed a variety of convergence boundaries in the Rhine River Valley and slopes of the Vosges and Black Forest Mountains in southwestern Germany and eastern France during the summer of 2007.

DOW reflectivity and radial velocities were manually examined for each of the 37 operational days. Of those days, 15 had some form of visible convergence by means of a zone of enhanced reflectivity combined with opposing radial winds across that zone. A total of 24 boundaries were identified, including frontal boundaries, outflow boundaries, and terrain-induced (including upslope) boundaries, of which, only the terrain-induced boundaries are examined for this research study. These boundaries each had variable orientations, locations and strengths. The DOW data, along with soundings, wind profilers and the Vienna Enhanced Resolution Analysis (VERA) data are combined to further understand boundary development, which is believed to rely strongly on the characteristic wind flow through and around the mountains as well as stability within the valley. Additionally, model runs using the Weather Research and Forecasting (WRF) model have shown promise in replicating areas of convergence similar to those observed, and can therefore assist in filling in observational gaps. The focus of this research is to determine primary factors which lead to the development of these observed terrain-induced boundaries.