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Detailed analysis of valley flows in complex terrain - A case study from the COPS field experiment

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ABSTRACT

The Convective & Orographically-induced Precipitation Study (COPS) was a large international field campaign that took place in the complex low-mountain region of the Black Forest, Germany, during summer 2007. Intensive Observations Period (IOP) 9c (20th July) aimed to observe the development & modification of a Mesoscale Convective System (MCS), which had convection embedded within its frontal zone, as it passed over the COPS region from south-west to north-east.

A gust front, emanating from MCS outflow, together with orographic lifting & a thermally-driven convergence line combined to generate an arc of severe convective activity east of the COPS region & ahead of the MCS. In-situ & remote sensing surfaceobservations show that the complex COPS orography significantly modified the shape, structure & path of the gust front. This, in turn, locally enhanced the pre-frontal convergence zone, eventually leading to convective initiation.

This paper will discuss the way in which the MCS gust front became decoupled from the synoptic flow aloft. Observations show substantial differences in the magnitude & direction of the gust front between sites located on mountain tops & those located in valleys. Differences between valley sites are also identified depending on the valley orientation. Valleys aligned perpendicular to the synoptic-scale MCS track appear to be sheltered from the gust front by steep valley gradients. Valleys in the eastern COPS region that are roughly aligned parallel to the MCS track, appear to organise the path of the gust front out of the Black Forest & into the regions of strong convergence where the convective cells subsequently form. Flow features are explained & further analysed by comparison with high resolution simulations of the IOP using the Weather Research & Forecasting numerical model (WRF).