Multi-sensor Measurements of a Convective Storm Cluster over a Low Mountain Range: Adaptive Observations During PRINCE

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I. Introduction

The nature of a convective storm is dependent on the environmental conditions in which it is embedded. Such conditions include the vertical distribution of wind velocity, moisture, vertical lapse rates and the nature of the triggering mechanism. The convection itself influences its environment as well so that a two-way interaction exists. Well-known processes include the evaporation of hydrometeors produced by the storm, shading by the storm's anvil cloud and the interaction with stable, dry layers or lids. All processes play a role in determining if secondary convective cells will form.

An understanding of the various interactions is crucial to enhance the capability to describe deep convection in numerical models. Field campaigns employing many different sensor systems deliver the data to develop this understanding. The measurement campaign PRINCE, an acronym for PRediction, Identification and trackiNg of Convective CEll̲s, has been carried out to assess the feasibility of a number of new measurement strategies. These include the deployment of mobile teams releasing drop-up sondes whose locations are adapted to the developing convective activity. Moreover, the use of equipping a research aircraft with real-time satellite information and radar data from ground-based operational radars has been evaluated, and lightning data from LINET is available. Finally, the benefits of positioning two types of LIDARs at the summit of a low mountain have been evaluated.

II. Results

Measurements of a developing storm cluster have been carried out during the field campaign that took place in the Black Forest in southwest Germany in July 2006. This area is particularly interesting because the mountain and valley breezes that often develop during daytime can be responsible for triggering deep convection (Barthlott et al., 2005). A number of phenomena have been observed. Observations of a wind-finding Doppler LIDAR on the summit of the mountain Hornisgrinde at 1160 m above mean sea-level has revealed an upslope valley breeze and displays a pattern of convergent radial winds under one of the developing convective updrafts of the storm system.

The Raman temperature and back-scatter LIDAR of the University of Hohenheim (Radlach et al, 2007) has detected how various layers of enhanced particle backscatter have been influenced by turbulence resulting from solar heating and, possibly, developing convective storms. Measurements of the Dornier-128 research aircraft (Corsmeier et al., 2001) indicate the presence of a warm and dry layer of air under the anvil clouds of the storm system. Measurements by drop-up sondes released from the mobile teams and the aircraft indicate how a dry mid-tropospheric layer interacted with the convective system. They, too, sampled an developing convective cloud above the cold pool of the storm.

III. Conclusions

The deployment of mobile teams equipped with radiosondes has delivered valuable data at locations where otherwise no similar data would have been available. The challenge of sending the mobile teams to specific locations neither too early nor too late has proven to be a difficult but manageable one. The summit of the Hornisgrinde has proven to be a good position for the two LIDARs. The choice for this location has enabled the instruments to collect valuable data on the flow in the mountains vicinity. The site will be one of the "super-sites" where LIDARs will be situated during the large measurement campaign COPS, the Convective and Orographically-induced Precipitation Study (Wulfmeyer et al., 2005), that will be carried out in an area including the Black Forest during the summer of 2007.

IV. References

Barthlott, Ch., U. Corsmeier, C. Meißner, F. Braun and Ch. Kottmeier, 2005: The influence of mesoscale circulation systems on triggering convective cells over complex terrain, *Atmos. Res.* 81, 150-175.

Corsmeier, U., R. Hankers and A. Wieser, 2001: Airborne turbulence measurements in the lower troposphere onboard the research aircraft Dornier 128-6, D-IBUF, *Meteor. Zeitschr*. 10, 315-329.

Radlach M., A. Behrendt, and V. Wulfmeyer, 2007: Scanning rotational Raman lidar at 355 nm for the measurement of tropospheric temperature fields, submitted to Atmospheric Chemistry and Physics.

Wulfmeyer V., A. Behrendt, Ch. Kottmeier, and U. Corsmeier, 2005: COPS, Convective and Orographically-induced Precipitation Study, Science Overview Document, available at: http://www.uni-hohenheim.de/spp-iop/