

Relationship between Zdr columns, updraft intensity and hail growth deduced from Dual-Doppler retrievals and Polarimetric radar

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Zdr columns are known to be spatially related to updrafts and their maximum altitude to updraft intensity. The importance of Zdr column detection relies on the fact that they precede convective precipitation enhancements and potentially hail at the surface, and thus serve as a nowcasting tool for hail. The severity of the resulting precipitation, as for example maximum hail size, is related to the intensity of the updraft. However, these relations were up to now mostly demonstrated through simulations and very little work has been done so far with observations to verify the claims.

Using Dual-Doppler retrievals of 3D wind fields combined with a simple cell tracking and Zdr column detection algorithm we follow the life-cycle of convective cells and analyse the above relationships with independent radar products, from polarimetry to wind fields. Observational studies up to now have attempted to calculate lead times between the Zdr column intensification and hail proxies close to the ground. With the added information of the wind field we are able to correlate the updraft strength with the height of the Zdr column and with the enhanced values of Zdr, based on actual observations. So far quantification of relationships between vertical velocity and Zdr column heights have been restricted to simulations.

In addition, we have a method for deriving hail sizes from polarimetry recently developed and tested. Used in combination with *in situ* observations (when available) we analyze the dependency of hail size on updraft intensity, throughout the life cycle of a cell to better understand how it plays a role in hail growth.

This methodology will be applied to several cases that produced hail at the surface and were observed by the Deutsche Wetterdienst (DWD) C-band radar network as well as with the couplet of X-band radars BoXPol and JuXPol. Figure 1 shows an example of a 3D wind field retrieved by the JuXPol and BoXPol for an event that produced large hail in Bonn, with reports of up to 10 cm. It shows the spatial relation between the Zdr column and the updraft.

Keywords: Hail, Zdr Columns, Updraft

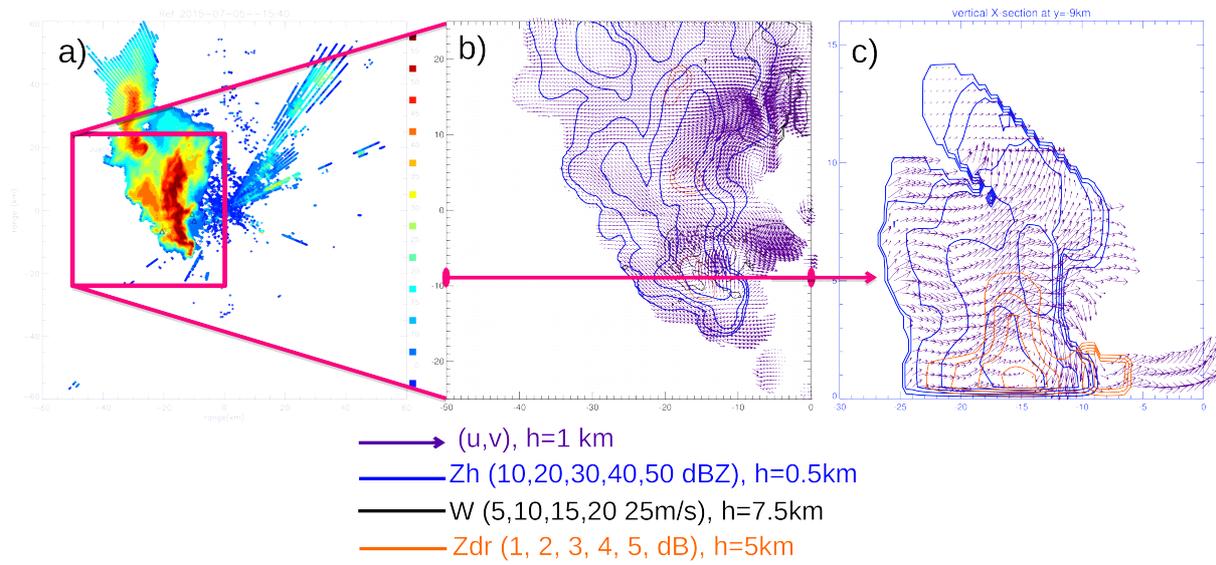


Figure 1. a) PPI at 1° elevation. b) Dual-Doppler analysis at 1km height (arrows), reflectivity contours (blue), Zdr contours (orange) and vertical velocity contours (black). c) Vertical cross section showing wind vectors (arrows), reflectivity contours (blue) and Zdr contours (orange) depicted by the red line in b).