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Polarimetric signatures indicative of severe storm development - the Pentecost event 2014

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The 2014 Pentecost weekend storms in Europe were a series of severe supercell storms which followed a heatwave in early June 2014, resulting from a Spanish plume synoptic weather pattern. Outbreaks of severe weather were reported from these storm developments with the worst damages occurring over the German state of North Rhine-Westphalia on 9 June, where the storm was described as one of the most violent in decades by the German weather service (DWD). During this event six fatalities, wind gusts up to 150km/h, hail and a flash flood in Düsseldorf has been reported. Monitoring and analysis of high-impact weather using weather radars of shorter wavelength (X- and C-bands) requires special methods, i.e. anomalous high attenuation and differential attenuation due to very large raindrops originating from melting large hail has to be investigated and corrected. During the Pentecost event a record breaking Z_{DR} bias of up to -25dB has been observed. Different strategies for reliable attenuation correction and rainfall estimation for this extreme event are explored and will be presented. A national 3D composite of polarimetric moments covering Germany with 1km horizontal, 250m vertical, and 5 minutes temporal resolution has been generated. 10 C-band radars from the DWD radar network, recently upgraded to polarimetry, have been included. Meanie3D, a 3D scale space tracking algorithm, is applied to the composite to investigate the magnitudes and temporal development of the 3 fundamental steps of a storms lifecycle: 1) high values of differential reflectivity Z_{DR} aloft first indicate a developing cell, 2) Z_{DR}-columns (these are vertical columns of high differential reflectivity) then indicate the updraft zone of a cell in the mature state. The vertical extent of the Z_{DR}-column is thus a measure of the strength of the updraft and for the ensuing rainfall enhancement. 3) The very first big drops reach the surface before the most intense rain begins. This is reflected by the polarimetric fingerprint for differential sedimentation. While preliminary correlation analysis of moderate storms hints at a lag-time between updraft strength and rainfall of 5-10 minutes, the case study on hand suggest increasing lead time depending on the strength of the storm. Magnitudes of Z_{DR} enhancements associated with convective updrafts and differential sedimentation and associated lead times for the Pentecost event will be presented.