Characteristics of radar observed hail storms in Germany

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Large hail event in Bonn

2015-07-05

Photo by Kai Mühlbauer

Source: ESWD
Large hail event in Bonn

- 39 hail reports in the Bonn area
- Sizes range from 2 to 10.5 cm

Hail size distribution according to reports

Source: ESWD
Outline

- Meteorological setup
- Attenuation and differential attenuation correction
- Evolution in PPIs of base reflectivity
- Distinct storm features
- Lifecycle
- Summary
Meteorological Setup

- **850 hPa**
- **SLP+500 hPa**
- **$\Theta_E$**
- **CAPE, LI**
Meteorological Setup
Meteorological Setup

Temperature (°C)

Dew point (°C)
Attenuation correction using the “hot spot” method for hail (Ryzhkov et al 2013).
Differential Attenuation Correction

Elev= 2.4°, Azim= 260°  20150705 1520 UTC

ΔZdr=3.5 dB
Development of the hail cell

PPI scan of Zh at 1.5° elevation
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PPI scan of Zh at 1.5° elevation
Distinct storm features

Size sorting: small and large drops are separated due to low level wind shear.
Distinct storm features

ρHV

Vr

Rho 2015-07-05—15:25

Vr 2015-07-05—15:25

Hail

Inflow
Distinct storm features

\[ \rho_{hv} \]

\[ Z_{dr} \]

\[ Z_h \]

\[ \rho_{hv} \]
Distinct storm features

Zh elevation 18 deg

Center of the BWER at an altitude of 7.5km

BWER
Distinct storm features

Zh elevation 18 deg

Dark dots: Zdr>1 dB elev=11 deg

Center of the BWER at an altitude of 7.5km

Altitude of Zdr column at 4.5km
Time evolution of max Zh

- Julich radar
- Bonn radar
Time evolution of max Zdr

Max Zdr in the Zdr column (above 4.25km)

Altitude corresponding to Zdr max

Julich radar

Bonn radar
Time evolution of max updraft speed

Max Zdr in the Zdr column

Axis ratio

Equivalent volume diameter: \( \text{Deq} \)

Terminal velocity: \( \text{Vt} \)

Updraft strength sufficient to suspend large drops

\begin{align*}
\text{Julich radar} & \quad \text{Bonn radar}
\end{align*}
Zdr Columns and hail

Jülich radar

Bonn radar

N Zh>55 (proxy for Hail)

N Zdr column
Zdr Columns and hail

Jülich radar

Corr 10 min lag = 0.78
Corr no lag = 0.81

Bonn radar

Corr 15 min lag = 0.28
Corr -5 min lag = 0.82
Summary

• Supercell formed in unstable conditions producing large hail near Bonn
• **Strong attenuation** and **differential attenuation** required correction techniques based on the detection of “hot spots“
• The supercell lasted **more than 2 hours**, and moved away from the radar domain while still very intense
• Evidence of **strong updrafts** from elevated BWER and Zdr column, colocated.
• **Updraft strength** was about **7 m/s** and persisted throughout the observation time, consistent with the track of hail reports.
• Growth of **Zdr columns** seem to **precede hail** at low levels only in the earlier times of observations.
• The **2 radars** show in general good **agreement**.