Assessment of the hail hazard from a combination of radar and insurance data
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OVERVIEW

Over the last decades, loss due to severe hailstorms has been increased significantly in Central Europe. In the state of Baden-Württemberg, for example, most of the damage to buildings is caused by large hailstorms (1986-2008). Examples of severe hailstorms include the local-scale Villingen-Schwenningen hailstorm on 28 June 2006 or the large-scale hail-storm on 25 May 2009 with a track length in excess of 600 km. Due to the high damage potential, quantifications of the hail hazard and risk as accurate as possible are essential for the economy, especially for the insurance industry. Within the frame of the project HARS-CC (Hail Risk and Climate Change) it is aimed at quantifying the hail hazard for Germany in a high spatial resolution.

First results reveal a high spatial variability of the intensity and probability of hail tracks that can be (partly) explained by orographic flow modifications. In the future, a hail loss model will be created to convert measured and modelled intensities (e.g., radar reflectivity or hail kinetic energy) into monetary parameters like mean loss or maximum loss. From that, it will be possible to quantify the local-scale hail risk for certain return periods.

Hazard assessment for Germany I: case study

On 26.05.2009, a Mesoscale Convective System (MCS) with a track length > 600 km caused significant damage over Switzerland, Germany and Czech Republic. Both the track of the MCS and the damage patterns are reproduced well by byradar data at different levels and overshooting top signals.

Hazard assessment for Germany II: first results

Over Germany, the number of days above a radar reflectivity of 55 dBZ (“hail signal”) shows a high spatial variability (Fig. 15). In general, this reflectivity show a good agreement to the VH hail data damage as confirmed by high values of the Heidke Skill Score (HSS; Fig. 16).

Partly high HSS, especially in areas with high density of hailstorms.

Low HSS in areas with no insurance data (e.g. mountain areas).

Appropriate threshold for hail identification by radar is 55.6 dBZ, average HSS is 0.29.

Several errors and inaccuracies in radar data that have to be corrected.

RESULTS FOR TEST AREA

In a preliminary study, the conditions in the northwest part of Baden-Württemberg (test area) were analysed. For this area, 3D radar data from C-band Radar operated by (MK) KIT were combined with insurance data of the SV.

Good agreement between density and intensity of hailstorms.

Significant spatial variability due to orographic influences (Fig. 8).

Highest reflectivity values between the two mountain ridges of Black Forest and Swabian Jura (Fig. 5).

Lowest annual reflectivity values over the north and the elevated terrain in the south-west and south of the test area (Fig. 9).

FLow modification by orography

High spatial variability of hail events that may be caused by orographic effects. On the selected hail days, the "pre-convective" non-dimensional mountain height was \( \frac{H}{L} \approx 1.0 \pm 0.05 \) on average (mean ± standard deviation). In that range, the flow from southwest may be partly deflected at the southern Black Forest mountains and to go around them. Downstream, the two branches of the flow will meet again, causing horizontal flow convergence that favors the onset or intensification of deep convection.

The results for the test area show a high spatial variability in the hazard assessment for Germany II: first results

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It is possible to identify hailstorm tracks and intensity from a combination of different meteorological data (e.g., radar reflectivity at different altitudes) that are related to hail damage.

Hail probability shows a high spatial variability; in the test region, a hail hot spot is the region south of Stuttgart, whereas the lowest hazard is given for the mountains of Black Forest and Swabian Jura.

Orographic effects on the flow such as channelling or local wind systems are decisive for the spatial variability of the hail tracks. Further investigations, e.g. by model studies, are necessary to quantify this effect.

Further investigations and combination with other meteorological parameters (lighting density, overshooting top analysis, convective parameters, ) are necessary to classify the hail risk with high spatial resolution.