HAIL RISK AREAS IN AUSTRIA, ON THE BASIS OF REPORTS 1971-2011 AND WEATHER RADAR IMAGES 2002-2011

Otto SVABIK[1], Vera MEYER[1], Lukas TÜCHLER[1], Gernot ZENKL[1]

[1] *Central Institute for Meteorology and Geodynamics (ZAMG), Hohe Warte 38, 1190, Vienna, Austria, otto.svabik@zamg.ac.at*

I. INTRODUCTION

A comprehensive hail risk map of Austria has been developed by ZAMG. The work has been performed for the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management and is published within eHORA (www.hora.gv.at), the website for "Natural Hazard Overview & Risk Management Austria", which demonstrates actual state analyses of risk areas for storms, floods and earthquake.

II. METHOD

Basic data are on the one hand 435 suitable hail damage reports which are recorded in the severe weather event chronicle of ZAMG between 1991 and 2011 and the radar data archive of ZAMG. This archive comprises two-dimensional maximum projection Composites maps (MaxCAPPI) which are available in 14 intensity classes every 10 minutes on a 2 km x 2 km grid for the year 2002 and every 5 Minutes on a 1 km x 1 km grid since 2003.

The hail damage reports were classified following the TORRO hail intensity scale which is defined by the Tornado and storm research organisation (http://www.torro.org.uk/site/hscale.php). The scale extends from H0 to H10 with its increments of intensity or damage potential related to hail size.

The recently established thunderstorm tracking and nowcasting algorithm A-TNT (Austrian Thunderstorm Nowcasting Tool) has been used to identify and track intense precipitation cells based on MaxCAPPI radar data and to map potential hail regions. A-TNT (Austrian Thunderstorm Nowcasting Tool) is a further development of the method ec-TRAM (Meyer et al., 2013) and adopted to Austrian conditions (Meyer and Schaffhauser, 2012).

The basic cell tracks were generated using the relatively low intensity threshold of 38 dBZ (resp. 8.5 mm/hr). Out of 183 hail damage reports which are dated between 2002 and 2011, 162 reports could be assigned to contemporaneous heavy precipitation cells. Based on the respective cell history and using a higher radar intensity threshold of 50 dBZ "potential hail risk areas" have been derived. These risk areas are called "potential" only, because the radar data used for the analyses do not allow a reliable identification of hail. But the fact, that the selected intense precipitation cells did verifiably produce hail at least once during their lifetime, suggest that they might have produced hail at another period during their life cycle, too. When that happened to be over an uninhabited area or over an area which is not vulnerable to hail damage, no report would be available in the chronicle. In this way, the local damage reports of the ZAMG chronicle and the areal information of intense precipitation cells with hail potential complement each other. The highest TORRO class, which could be assigned to the hailing cell, has been allocated to the potential hail risk area.

These areas are not limited to districts anymore, as the reports are, but they are authentic storm regions that were identified in the radar image as potentially affected by hail. Not a complete but a more comprehensive picture of potential hail-risk areas could be obtained, which provides insight into the storm paths of hail cells. The final hail risk map, which is presented in the next chapter, has been achieved by blending the local reports with the potential hail risk area map. The blending had to be finalized by expert knowledge. Only regions below 1500 meters above sea level are considered, because the highest concentration of agricultural and industrial goods is situated below this height.

III. RESULTS AND CONCLUSIONS

It has been found that the tracks north of the main ridge of the Alps are oriented from southwest to northeast mainly. South and southeast of the main ridge of the Alps corresponding tracks are directed from west to east or from northwest to southeast (see figure 1).

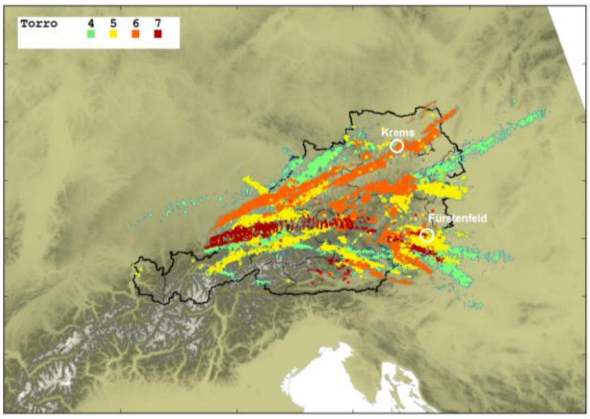

FIG. 1: Illustration of detected storm pathes of hailing cells. The potential hail risk areas are colored and the damage reports are marked with crosses following the TORRO hail intensity scale.

The Integration of analysed radar images into the graphical interpolation makes a two-dimensional representation of hail prone regions in Austria possible. An up-to-date representation on the regional hail risk in Austria is achieved and shown in figure 2.

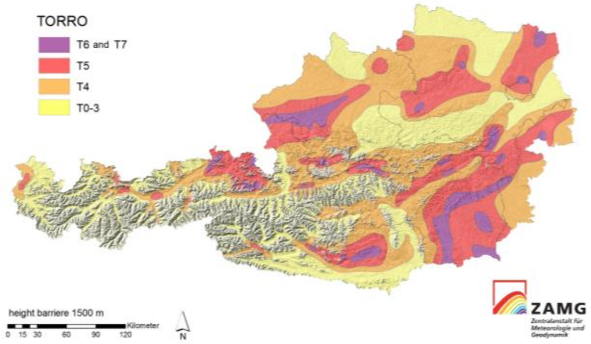

FIG. 2: Hail Risk Areas in Austria for TORRO hail intensity classes T0 to T7.

The complex topography of the Alps has an influence on frequency and intensity of the hail events, which is reflected by the detected tracks (see figure 1) of hailing cells and the spatial distribution of the different hail intensities (see figure 2). The strongest hailstorms (correlating with the intensity TORRO 7) which cause total losses on fields, severe roof damages and risk of serious injuries are located along the foothills of the Alps (within Styria the districts Weiz und Fuerstenfeld, northeast and east of the capital Graz, close to the Hungarian border) and along the hilly regions close to the lowlands as for instance in the Bohemian Massif close to the Danube valley (the district Krems, Lower Austria). The examples are marked in figure 1. These findings agree with previous studies published in Svabik, 1989 and Svabik, 2009.

Oral discussions with experts of the Austrian Hail Insurance showed that their analyses of the local distribution of reported damages and impacts on insured fields agree well with figure 2.

V. REFERENCES

Meyer V. K., Höller H., Betz H. D., 2013: Automated thunderstorm tracking and nowcasting: utilization of three-dimensional lightning and radar data. *Manuscript accepted for publication in ACP*.

Meyer V., Schaffhauser A., 2012: Systematic investigations of intense convective precipitation events in Austria based on radar cell tracking, *in: Proceedings of the 7th European Conference on Radar in Meteorology and Hydrology (ERAD)*, Toulouse, France, 25 – 29 June.

Svabik, O., 1989: Review of Meteorological Aspects on Hail Defense Activities in Austria, *Theoretical and Applied Climatology*, 40 247 – 254.

Svabik, O., 2009: Severe Storm Regions in Austria on the basis of the TORRO hailstorm intensity scale, poster presentation, *5th European Conference on Severe Storms (ESSL)*, Landshut, Germany, 12-16 October.