USING HISTORICAL INFORMATION SOURCES TO RECONSTRUCT HISTORICAL SEVERE STORM CASES IN CENTRAL EUROPE

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I. INTRODUCTION

With the foundation of the European Severe Storm Laboratory (ESSL, 2002) and the establishment of the European Severe Weather Database (ESWD, 2004), severe storm events could be listed from all over Europe. Furthermore, a strongly rising interest in severe weather in Europa and foundations of volunteer observation networks (e.g. Skywarn Deuitschland, Skywarn Polska, etc.) contributed to the fact that severe events are better recorded than ever before. Notwithstanding, there is a great lack of information regarding severe storm events from the period before the year 2000.

In the period from 2008 to 2011, extensive research work on historical events were carried out with the aim to expand the knowledge about severe events over the past centuries in its details, analyzing the qualities of historical data and the potentials whether historical storms can be reconstructed.

II. PRESENTATION OF RESEARCH

Data used in the study contains collected research work from the time period from 2008 to 2011 (Kühne, 2008-2011) combined with data researched by Nikolai Dotzek (†2010) for his former TorDACH Archive (1998-2006). Most data was collected from local chronicles, regional chronicles, newspapers, church records, historical scientific works and, in very rare cases, written records of individuals / witnesses (e.g. Genzmer, 1765).

The researched material contains 3.451 reports (types of events: Heavy rain, large hail, windstorms and tornadoes) from the time period from the year 500 to 1950. Most of the reports could be found from central / western Central Europe and from the period from 1730 to 1950 ($n \approx 2.255$). The decision was made to limit the investigation period on a 250-year period from 1700 to 1949 ($n \approx 2.341$) and to limit the investigation area on 47°N – 55°N and 5°E – 19°E, including Germany, Czech Republic, most parts of Austria, parts of Poland, Belgium, Switzerland, France, Slovak Republic, Hungary and the Netherlands.

The collection of the first results showed a high number of large hail / hailstorm events within the investigated types of events (FIG. 1). In addition, it should be noted that the proportion of tornado reports from this time period was slightly less. The total number of 957 hailstorm reports (FIG. 2), and the potential versatility of detailed information of this type of event, was the occasion for a special content analysis through assessment of context factors.

Dividing every single report into its substantive components, the first step involved extracting reported quantities from qualities by using information classifications graduated into "place / exact place", "date / exact date", "movement direction", limiting the local time frame of an event into "within 6 hours / within 1 hour", and recording over what surface an event has been observed ("village / town", "farmland", etc.).

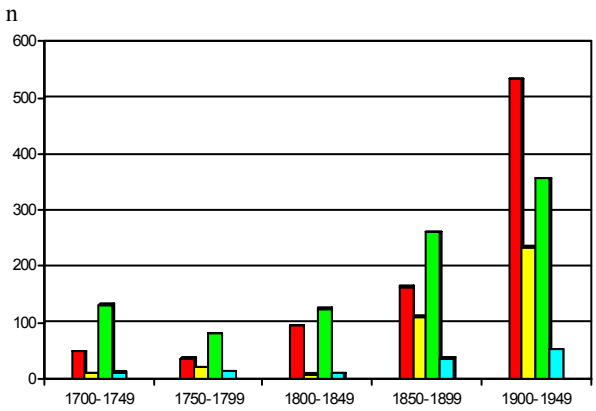

FIG. 1: Total amount of reports by event types. Time period from 1700 to 1949, devided into 50-year periods. (red): Tornadoes; (yellow): Windstorms; (green): Hailstorms; (blue): Heavy rain.

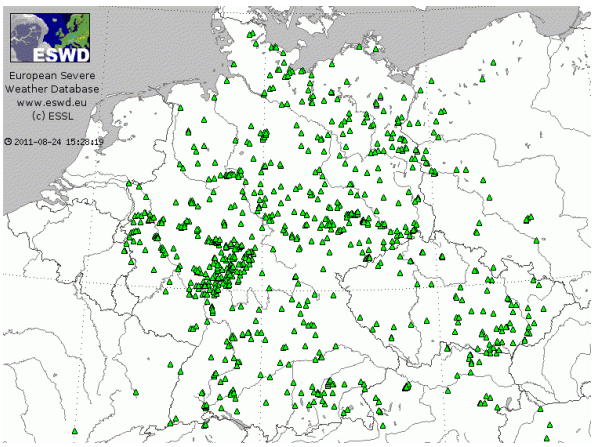

FIG. 2: Map showing the local distribution of hailstorm events from 1700 to 1949. Map and Data: European Severe Weather Database (ESWD).

Furthermore, a second step involved extracting reported qualities of the events. In relation to large hail or hailstones it means extracting into "size of hailstones", "measured weight", information about "hail layer" and "duration". Additionally, based on the hail reports and analysis, it should be examined whether these data are suitable to reconstruct historical storms.

III. RESULTS AND CONCLUSIONS

Analyzing the quantities of the hail events, it was noted that there are large differences within the data. Information about the exact locations had the largest share with about 91.0 %, followed by information about the exact day of an event (86.0 %). Considering on reconstrucing storms, the assumption was needing accurate data about the local time of an event, but based on the hail data it was shown that this value is only at 26.9 %. In conclusion, this means that 699 reports had no specified information about exact time (within +/- 1 hour) of storm occurrence. Analyzing the surface types it was shown that 86.5 % of the events contained information about damaged farmland or terrible losses of harvests. In general, this can be explained with the fact of having an agrarian society in Europe before the 1850s and even ongoing in most parts of the continent outside large agglomerations until the end of World War I. The parameter of "movement direction" was available within 55 % of the events, but with differences by naming "directions". Some reports include information about observation from where a storm arrived, while other reports are naming affected villages in chronological order.

Extracting the qualities of the hail data, it was shown that most reports contain no information about hail size. Some reports contain size comparisons, e.g. "chicken egg-sized hail" or "fist-sized hail". These symbolic representations can be assigned numerical values. In investigating further details about given hail sizes, the data was seperated into given hail sizes of 2 cm to 5 cm in diameter (f.: i.d.) and into hail sizes >5 cm i.d..

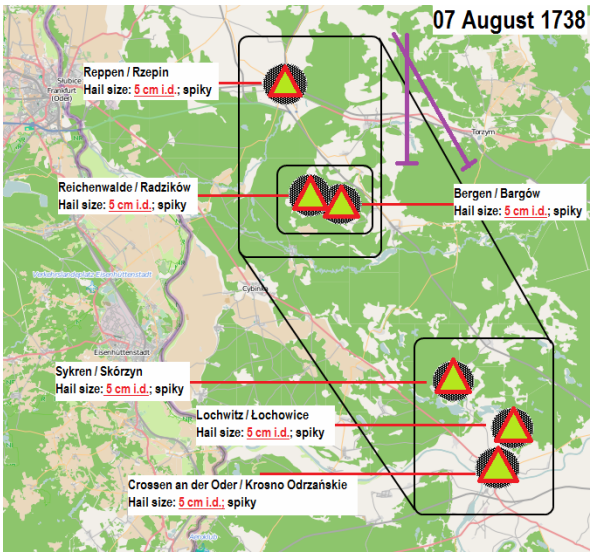

FIG. 3: Map showing prototype reconstruction of a severe storm on 07 August 1738 over Western Poland. Each triangle symbol represents a hail report. Additional event information(place, hail size, etc.) is given in the text fields. The violet lines represent the potential direction of movement.

By setting all reports containing hail size information equal 100 %, 30.4 % of them contain very large hail >5cm i.d.. Comparing with hail data from 1998 to 2010, this result shows a larger amount of reported hail size when very large hail occurred. Furthermore, there are four events known reporting a hail size of about 15 cm i.d..

Additional information about hail layers and event duration were very rare. Consequently, these parameters were removed from further analysis.

Combining the quantities and qualities of the data set, the conclusion is that it is possible to reconstruct local storm events, if basic data is available. The basic data should contain, at least, information about the exact day, the exact places and movement direction. Information about the exact time (+/- 1 hour) is not mandatory, but it could make the reconstruction more accurate. Furthermore, details about hail size and/or damage amount should be included, giving the storms a quality in its effects. Based on this restrictions, some test prototypes of reconstructions were created (FIG. 3). If further types of severe events (e.g. tornadoes, wind reports , heavry rain) are available, they can also be embedded into the reconstruction.

IV. ACKNOWLEDGMENTS

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