P6.3 A CLIMATOLOGY OF LARGE HAIL IN FINLAND

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1. INTRODUCTION

The research of severe hail storms in Central Europe is already well under way but in Northern Europe very little effort has been made so far to gain knowledge of this matter. As far as the authors know, no climatological studies of large hail north of latitude 60N have been published. In Finland, no earlier studies of hail climatology have been made either, although every now and then as large as tennis ball size hail occur causing locally tremendous property damage; injuring people, breaking car and house windows and destroying wheat fields. Agriculture has been, and is still very vulnerable to severe weather phenomena.

Finland is situated roughly between the latitudes of 60N and 70N with huge seasonal variations in weather. Hail is a typical phenomenon during summer thunderstorms basically all over the country, but often the size of the hailstones is no bigger than a pea. These kinds of events are often undetected due to the very limited extent of the hail swaths and low population density in Finland (an average of 16 persons in each km²). Still, almost every year large hail (≥ 2 cm in diameter, also the term severe hail is used) is observed mainly because of the damage they cause. Warm summers are related to the increased amount of severe hail events. This study summarizes the spatial and temporal distribution of large hail in Finland from 1930 to 2006.

2. DATA

Several different methods were used to collect large hail cases in this study. Firstly, old newspapers provided valuable information especially from the older cases. Many local newspapers were looked through via library microfilms for possible hail cases. Newspaper articles of severe weather events between 1994 and 2005 were found with the aid of the main newspapers' internet databases.

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Secondly, a brief request was placed on the front page of the Finnish Meteorological Institute's web site (www.fmi.fi), which was used for collecting for both recent and historical large hail observations from the general public. It proved to be an efficient way to collect hail cases, because most of the observations included a photo of either damage or hail itself. A credibility classification was done for all of the large hail cases, although all probability classes are included in this study.

Third way of getting hail reports from the recent years was through a small network of storm spotters. A group of about 50 storm spotters has been cooperating with Finnish Meteorological Institute on a hail observation program since 2004. The program aims to develop an operationally tested radar hail product in the coming years. With the aid of the storm spotters and generally more widespread enthusiasm for severe weather, even marginally severe hail cases have been better documented lately.

All the collected large hail cases are from summer months or late spring and early autumn (May to September), between 1930 and 2006. In the war years' newspapers (late 1930's and early 1940's), severe weather events were hard to find. To ease the work load for this period of time, only warm summers' newspapers were browsed through. All the reported large hail cases published in a nationwide newspaper have been searched day by day from the mid 1960's to today.

The hail cases were separated from each other if the time difference between two observations was more than 15 minutes or the distance between them more than 20 kilometres. Altogether, almost two hundred cases (190) were collected. The statistics includes a few days with more than five separate severe hail cases.

3. HAIL DISTRIBUTIONS IN FINLAND

3.1 Monthly distribution

Large hail occurs in Finland between late May and early September. The peak period of large hail is from late June to early August, when over 85 % of the cases occur (Fig. 1). The most active month is July. The largest hailstones (over 4 cm

in diameter) mainly occur in July, but the peak period is primarily during the first half of the month.

Figure 2 represents the monthly severe hail day distribution. Severe hail day is defined as a day with at least one large hail observation in Finland. Large hail most often occurs in Finland during July.

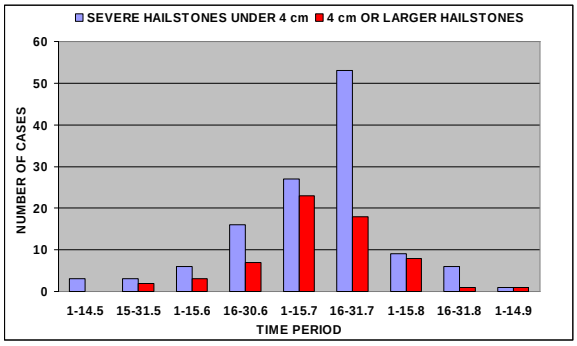

Fig. 1. *Monthly distribution of large hail cases in Finland 1930-2006. Every month has been divided in two, starting from May and ending to mid-September. Blue bars indicate severe hailstones under 4 cm and red bars 4 cm or larger hailstones.*

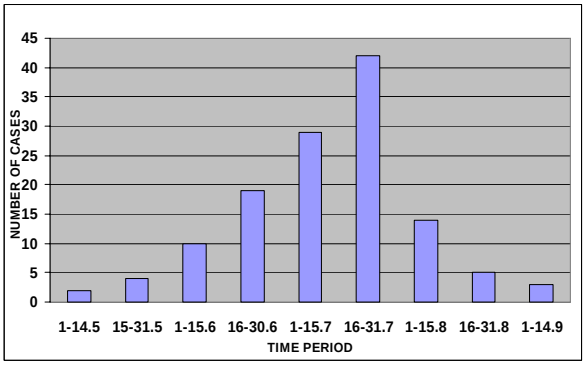

Fig. 2. *Monthly distribution of severe hail days in Finland 1930-2006.*

3.2 Maximum hail size

The distribution of maximum hail size is shown in Figure 3. The category with the smallest hailstones, 2–3 cm in diameter (actually 2.0–2.99 cm) contains the largest amount of observations (43 %). About 40 % of the cases are 4 cm in diameter or larger. Giant hailstones (5 cm or larger; Ludlam 1980) were observed in 41 cases (23 %), but only 5 % of the cases were at least 7 cm in diameter (Fig. 3). It must be remembered that this study includes only large hail cases. Hail size smaller than 2 cm is expected to be the most common one. Currently, the largest known hailstone ever observed in Finland was 8 cm in diameter and it occurred in the southeastern part of the country in August 1968.

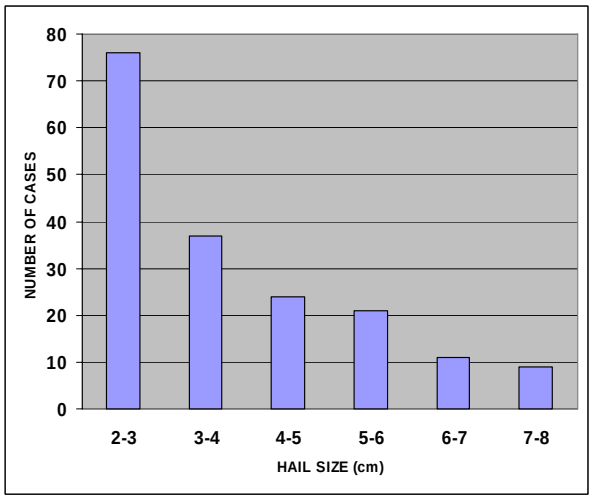

Fig. 3. *Maximum hail size distribution of severe hail cases in Finland 1930-2006.*

3.3 Diurnal distribution

The diurnal distribution of large hail cases is shown in Figure 4. Large hail is most frequently observed during the afternoon hours (1400–1800 LT) and early evening (1800–2000 LT). Around 70 % of the cases occur between 1400 and 2000 LT. Larger hailstones (4 cm or larger) occur mainly between 1600 and 2000 LT. At night, large hail observations are rare. The afternoon and early evening peaks have been found to be typical for large hail in the other parts of the world as well (Dessens 1986, Paul 1980, Webb et al. 2001).

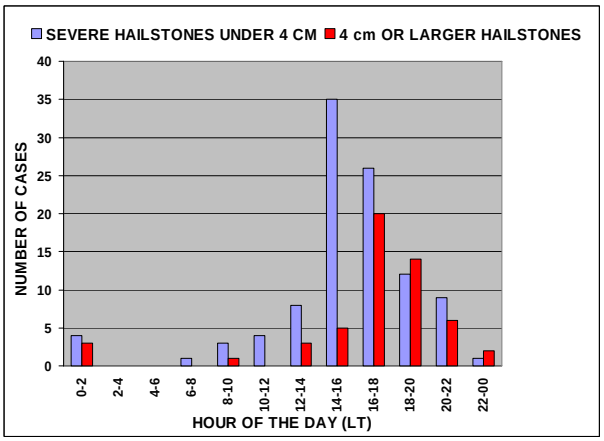

Fig. 4. *Diurnal distribution of large hail cases in Finland 1930-2006.*

3.4 Annual distribution

In Figure 5, the annual distribution of severe hail days in Finland (1930-2006) is presented. The

number of observations in the 1930's and 1940's is small due to the war years. In July 1957, large hail occurred in several places during nine different days. In recent years, there has been some increase in the number of cases and severe hail days. This is presumably mostly due to more widespread interest in severe weather events among the general public and more systematic collecting reports. Based on the statistics from 1995 to today, on average, four to five separate large hail days can be expected in Finland every year, though the interannual variation is notable.

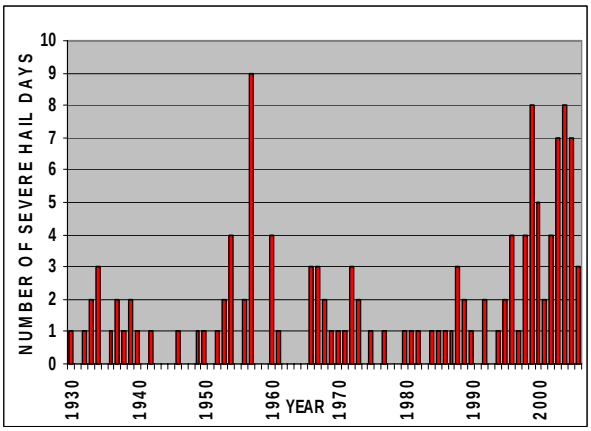

Fig. 5. *Annual distribution of severe hail days in Finland 1930-2006.*

3.5 Geographical distribution

Figure 6 shows the locations of large hail observations. The density of observations is high in western Finland, where farming is a common mean of livelihood. Farmers tend to report easily the damage to their fields to claim some insurance compensation, which might have a contribution to the geographical distribution. Most of the 4 cm or larger hail cases are located in the middle part of the country. The large amount of lakes in southeastern Finland (Fig. 6) might partly explain the gap of observations in that area. In north, large hailstone observations seem to be infrequent events. In Lapland (the northernmost county in Finland), only 12 cases are known, though the area is extremely sparsely populated (2 inh/ km²). The northernmost large hail case took place near latitude 68N and the 4 cm or larger case just north of Arctic Circle (66.5N). Of all reports, most are from near bigger cities and towns.

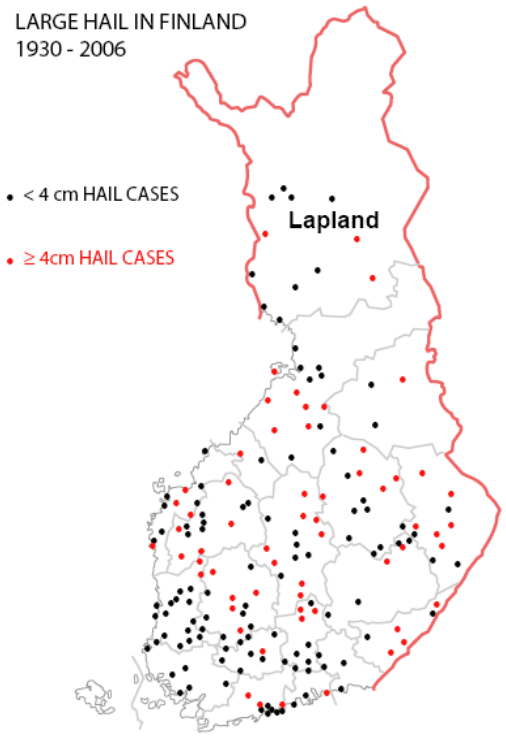

Fig. 6. *The geographical distribution of large hail cases in Finland. The black dots indicate under 4 cm diameter hailstone cases and the red 4 cm or larger. The red line is a land border with Russia, Norway and Sweden; in south and southwest, Finland is surrounded by sea.*

4. CONCLUSIONS

The climatology of large hail in Finland during a 76-year period (1930-2006) has been presented in this study. Cases were collected from old newspapers, from eyewitness observations and in recent years, from the storm spotter reports. Based on this study, large hail in Finland occurs more frequently than it is commonly believed. Almost 200 severe hail cases were found all around the country. The majority of the hail falls in Finland are sub-severe, but even a tennis ball size hail has been observed a few times. Because of low population density in Finland, it is expected that a large portion of the hail falls is not reported and thereby not in the statistics.

The season of large hail in Finland extends from May through mid-September. July, afternoon and early evening are the peak times of the large hail occurrence. The largest, over 4 cm hail cases, occur in the early July and mainly in the evening hours, while severe hail with maximum diameter smaller than 4 cm is observed generally little earlier in both diurnal and monthly distributions. In most of the severe hail cases, hailstone maximum diameters are smaller than 3 cm (43%). Of all severe hail cases, 23 % include giant hailstones of at least 5 cm in size.

Most of the observations are from the western part of the Finland which is an agriculture-intensive area. The largest hailstones are observed in the middle and eastern part of the country, mainly near big cities. In the north, large hail is observed more infrequently, possibly due to low population density. Nevertheless, the northernmost severe hail observation is placed near latitude 68N. The severe hail day distribution shows that large hail is most common in July. At present, four to five severe hail days occur during every summer. The annual distribution of large hail days shows an increasing amount of cases in recent years, which is expected to be mostly due to the more effective collecting of severe hail reports and growing interest in severe weather among the general public and the media.

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