

HAILPAD DATA ANALYSIS FOR CONTINENTAL PART OF CROATIA

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I. INTRODUCTION

Mainly in the summer months, Croatia is exposed to the thunderstorms with severe rain and hail, especially in its continental part. In the 1960s, aiming to protect and reduce heavy damage in agriculture and other mobile and immobile properties, a hail suppression system was introduced to this area. Several authors (Fraile et al. 2003; Dessens et al. 2009; Siutas et al. 2009) accent importance of hail measuring with hailpads for climatology and evaluation studies in different countries. In order to receive precise and objective hailstone parameters, hailpads were installed during the season 2001 on each main meteorological and hail suppression station in continental part of Croatia. The total number of hailpads today is 730 (stations and polygon).

II. PRESENTATION OF RESEARCH

During the hail season (01.May-30.September) in time period from 1891 to 2008, around 12500 reports of hail are collected. These reports contain exact information about the location, date and time of hail fall. Unfortunately there are not physical parameters of hail in these reports. They contain only a short description or size comparison with other objects (corn, pea, walnut, golf ball, etc.). Spatial analysis of mean number of days with hail, based on this reports (Pocakal et al. 2009) shows that the area with maximum hail days (Zagorje) is in the west continental part of Croatia near the Slovenian border.

The hailpad polygon (POL), 30 x 20 km in size was established in this area before the hailfall season in 2002. Hailpads were installed between the existing hailpads on hail suppression stations. This way, a dense network with 150 hailpads with linear spacing of 2 km (1 hailpad /4km²) was obtained.

This paper present analysis of all hailpad data (2049 cases) collected in period from 2002 to 2008, for the whole protected area, different sub regions and especially for hailpad polygon.

III. RESULTS AND CONCLUSIONS

On the bases of all 2049 hail cases recorded on hailpads in the continental part of Croatia average values per square meter, for max. diameter, number of stones, mass and kinetic energy are calculated: ($d_{max.} = 13.2$ mm; $n = 1197$; $m = 492.0$ g and $K.E. = 36.5$ J). Annual average values for continental part of Croatia are shown in Tab.1. For easier comparison with similar analysis in other countries, Torro scale (Webb et al. 2001; Siutas et al. 2009) is used for kinetic energy distribution.

This distribution shows that 65.3 % of all recorded hail cases in continental part of Croatia have kinetic energy less than 20 Joule /m². Only three hail cases with intensity scale H5 and maximum hail stone size between 31.3-35.4 mm, are recorded in time period 2002-2008. Spatial analysis show that the location of these three cases was in eastern flat part of continental part of Croatia. Relative frequency distribution of kinetic energy (point hail fall) for Croatia and polygon are shown in Fig. 1.

Average / Year	2002	2003	2004	2005	2006	2007	2008
number of stones/ m ²	1197	1089	1220	1363	900	990	1172
max. diam. (mm)	11.8	14.1	12.3	12.4	12.7	13.6	14.4
mass (g/m ²)	555.4	470.3	472.6	483.1	317.7	459.7	643.5
K.E. (J/m ²)	30.3	35.9	37.6	33.1	22.1	32.2	53.9

TABLE I: Average values for hail parameters in continental part of Croatia.

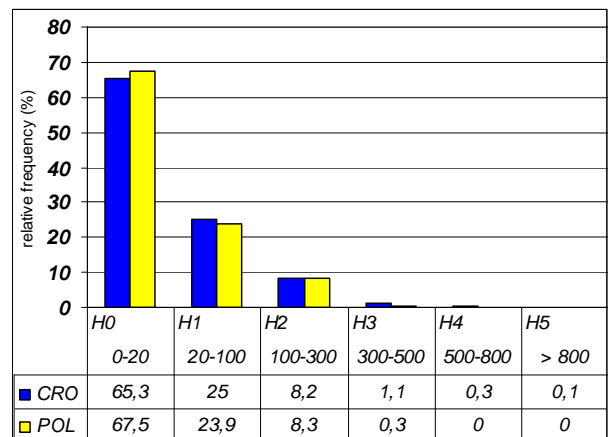


FIG. 1: Hail kinetic energy distribution for Croatia and polygon based on the Torro scale (2002-2008).

Relative frequency distribution of hailstone size, show that the first four size classes (interval 2.5 mm) from 5.0 mm till 15.0 mm, contain more than 95 % of all stones. Annually distribution for these four size classes show decreasing trend of smaller stones (5.0 – 7.5 mm) and increasing trend for

greater stones (10.1 – 15.0 mm). This trend is larger for the polygon, then for the whole protected area in Croatia (Fig. 2.).

Results show that the western parts have the highest frequency of hail fall with intensity between H0 – H4 of Torro scale. Increase of damaged hailpads per hail day on polygon from 2.1 in 2002 to 7.8 in 2008, together with the greater number of larger stones indicate a possible increase of hailstorm intensity in continental part of Croatia.

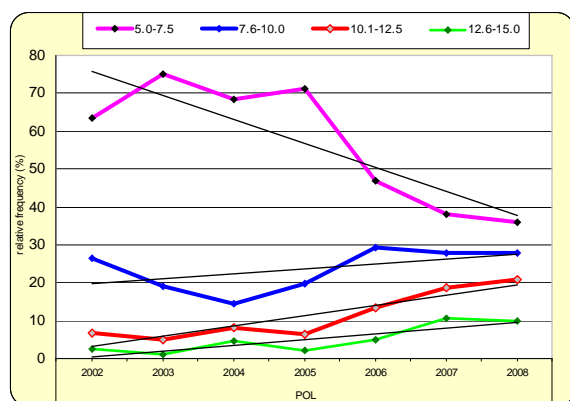


FIG. 2: Distribution and trend of different hail stone sizes (mm) on polygon (2002-2008).

IV. REFERENCES

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