A CLIMATE STUDY OF SEVERE CONVECTIVE STORMS OVER BULGARIA: FREQUENCY DISTRIBUTION AND SEVERITY

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I. INTRODUCTION

The subjects of the present research are severe convective storms (SCS) from the Small-scale Weather Phenomena (SCSWP). This problem had been faced for example by Brazdil (2002). Such SCSWP events are spars in space and time but cause significant property damages and losses of life with considerable impact on the economics and society in small countries. The problem concerning the climate variability and change impact on frequency, intensity and scope of SCS phenomena especially thunderstorms, wind storms, and hailfall, is actual and discussible

II. METHOD OF INVESTIGATION

In this work a set of severe storms over Bulgaria are selected on the basis of defined criteria for extreme values and space-dissemination of complex meteorological records for the cases of thunders and hail storms during the period 1961-2006. The selection of SCS over Bulgaria at the risk of causing disasters was completed on the basis of defined criteria for severe meteorological events (SME), as follows:

- total precipitation amount $Q \geq 30$ mm/24 h;
- thunderstorms and/or hail-fall occurrence, registered at least in 4 districts of the country;
- highest wind speed ≥ 14m/s, etc.

Meteorological data from Meteorological database of the NIMH for 67 climatological and 26 precipitation stations with altitude below 1000 m, were processed by program procedures for the warm half of the year from the period 1961-2006.

The time-space variation of the thunderstorm days (as well as the ratio to hail days) is investigated.

III. RESULTS AND CONCLUSIONS

It was obtained an increase of the mean annual thunderstorm and heavy rain day's frequency for the period 1991-2006 versus those for 1961-1990 (Fig.1).

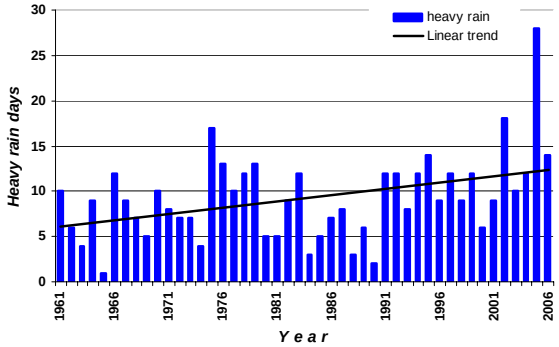

FIG. 1: Distribution of heavy rain days in 4 or more districts of the country during the warm half of the year (April-September).

The regime of thunderstorms and heavy rainstorms is compared with local temperature variation for whole period 1961-2006.

The increasing tendency of hail / thunderstorm cases in comparatively cold months (April and September) during the warm half of the year, especially after 1991, was obtained (Fig.2). Inter-monthly distribution of the average number of hail-fall days in 4 or more districts shows not typical shift of the maximum number of the days towards decades of August and September during the period 1991–2006 in comparison with the period 1961-1990. In May (typical for hail events) the average number of hail-fall days decreases in all decades while in the last decade of August during the period 1991-2006 this number increases almost two times and in the first and third decades of September this phenomenon occurs for the first time.

Not typical increase of the mean seasonal number of days with extreme precipitation (with about 60% during the period 1991-2006 in comparison with 1961-1990) is observed while the seasonal rainfall sums as a whole decreases (Alexandrov et al., 2004). During the last 10-15 years the same tendency is observed also in other Mediterranean countries (Alpert et al., 2002).

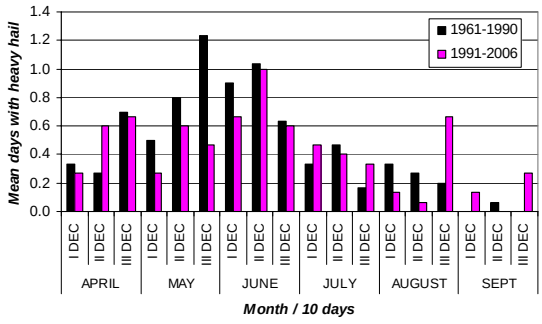

FIG. 2: Inter-monthly distribution of mean number of hailfall days in 4 or more districts of the country.

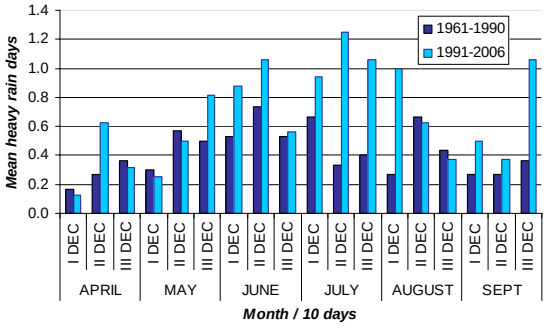

FIG. 3: Inter-monthly distribution of mean number of heavy rain days in 4 or more districts of the country.

Synoptic analyses and classifications

The synoptic situations, connected with development of 96 SCS (during the period 1991-2006), which caused disasters with damages over the country, were analyzed (large-scale damages, affected mostly crop and property at least in 4 districts).

The distribution of SCS events for 6 typical synoptic situations is presented in Table 2. The genesis and development of these cloud systems connected with severe weather events like torrential and heavy precipitation, hail-fall and intense thunderstorms, are mostly associated with cold fronts (43%), cyclonal pressure field (20%) and Mediterranean cyclones (19%). The penetration of new humidity-instable air masses is predominantly from the west sector that supports the obtained results only for hail-storms over Thracian lowland (Simeonov et al., 1990). The special geographical location of the Bulgarian mountains is an important factor for increasing of precipitation intensity and amount, as it stimulates the vertical development of convective clouds and their precipitation potential.

TABLE 1: Distribution of severe convective storms during the warm half of the year according to synoptic situation types.

Synoptic situation	Number of SCS	% of total number of SCS
Cold front	41	43
Mediterranean cyclone	18	19
Cyclonal pressure field	19	20
Unstable air mass	9	9
Anticyclone from North and Cyclone from South	8	8
Front of the ridge	1	1
TOTAL	96	100

Conclusions

- The number of the days with extreme precipitation increases (about 60 % during the period 1991-2006) in spite of the fact that as a whole the total rainfall decreases.
- During the last decade the frequency of SME connected with them as thunderstorms, hail and heavy rainfall are registered more frequently in August and September in contrast to the period 1961–1990.
- Inter-seasonal distribution of the two kinds of SME (extreme precipitation and hail) shows the highest probability for their occurring in June – II decade, in May – III decade, in July – II decade. During the last years these phenomena are observed more frequently in the III decade of September.
- The obtained results are an additional information concerning SCS variation and should be in serve for improving the long-term prediction approaches.

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