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Long-term variability and changes in thunderstorm induced extreme precipitation in Slovakia over 1951-2010

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It is well known that extreme precipitation associated with intensive rains, in summer induced mostly by local thunderstorm activity, could cause very significant problems in economical and social spheres of the countries. Heavy precipitation and consecutive flash-floods are the most serious weather-related hazards over the territory of Slovakia. The extreme precipitation analyses play a strategic role in many climatological and hydrological evaluations designed for the wide range of technical and engineering applications as well as climate change impact assessments. A thunderstorm, as a violent local storm produced by a cumulonimbus cloud and accompanied by thunder and lightning, represents extreme convective activity in the atmosphere depending upon the release of latent heat, by the condensation of water vapor, for most of its energy. Under the natural conditions of Slovakia the incidence of thunderstorms has been traditionally concentrated in the summer or warm half-year (Apr.-Sept.), but increasing air temperature resulting in higher water vapor content and more intense short-term precipitation is associated with more frequent thunderstorm occurrence in early spring as well as autumn. It is the main reason why the studies of thunderstorm phenomena have increased in Slovakia in recent years. It was found that thunderstorm occurrence, in terms of incidence of storm days, has profoundly changed particularly in spring season ($\sim$ 30 % in April and May). The present contribution is devoted to verifying the hypothesis that recently the precipitation has been more intense and significant shifts in seasonal incidence have occurred in particular regions in Slovakia. On the basis of the 60-year (1951-2010) meteorological observation series obtained from more than 20 synoptic stations, the analysis of trends and long-term variability of the days with thunderstorms and the accompanying precipitation for seasons was undertaken. Contribution also attempts to explain the main causes of the thunderstorm as well as extreme precipitation variability. Furthermore, differentiation of daily sums of precipitation for the days with thunderstorms, their long-term variability and probability of occurrence is also presented.

Key words: thunderstorm occurrence, trend analysis, extreme precipitation, day with thunderstorm, climate change, climate variability, Slovakia