Geophysical Research Abstracts
Vol. 15, EGU2013-11580, 2013
EGU General Assembly 2013

Intense summer storms identified on the basis of lightning strikes in Switzerland

Ladislav Gaal (1,2,3), Peter Molnar (2), and Jan Szolgay (3)

(1) Institute of Hydraulic Engineering and Water Resources Management, Vienna University of Technology, Vienna, Austria (ladislav.gaal@stuba.sk), (2) Institute of Environmental Engineering, ETH Zurich, Zurich, Switzerland (molnar@ifu.baug.ethz.ch), (3) Department of Land and Water Resources Management, Faculty of Civil Engineering, Slovak University of Technology, Bratislava, Slovakia (jan.szolgay@stuba.sk)

A differentiation between the two basic types of precipitation, i.e. convective and stratiform, is of great importance in hydrological modeling and engineering practice. In this study we propose a methodology for the estimation of the character of precipitation events exclusively on the basis of local high resolution meteorological data (lightning strikes, precipitation), and not taking into consideration any information on the character of precipitation on the basis of remote measurements (radars, satellites). Identification of convective events is based on the hypothesis that thunderstorms with strong convective lifting are commonly associated with lightning.

The study is based on precipitation depth measurements at a 10-min time step with a heated tipping-bucket gauge with tip resolution 0.1 mm from the SwissMetNet (MeteoSwiss) network at 63 stations that cover altitudes ranging from 200 up to 3300 m a.s.l. over the period 1981-2012 (32 years). Additionally, the same stations also measure the number of lightning strikes within a range of 30 km from the station. Although these data are available for the period 1987-2012 (25 years), we confine the lightning information to the period 1987-2005 (18 years) only, since changes made to the lightning observation methodology in the years 2005-2006 raise concerns about the homogeneity of the whole observation record.

Independent rainfall events that occurred during the warm half-year (April to September) are first identified from this database, with the requirement that the inter-arrival time between two subsequent events is at least 2 hours. Then, for each rainfall event, the key storm characteristics (total rainfall depth R, storm duration D, and peak 10-min intensity I) are computed, and the number of lightning strikes is assigned in the case the event was accompanied by lightning activity.

We found that peak rainfall intensity I during events accompanied by lightning is significantly higher than during those events where no lightning was observed. There are smaller differences in the distributions of event durations and rainfall totals. On this basis, we define a threshold of peak intensity I^* that differentiates between events with and without lightning with an acceptably small probability of misclassification. This allows us to identify intense summer events with convective character as those where $I > I^*$ regardless of their duration or total rainfall depth. In a final step, the spatial variability of I^* across the analyzed stations in Switzerland is examined. The results suggest that threshold intensities I^* are not constant in space and vary with a strong topographic and climatological signature.