



## **Seasonality of heavy precipitation in mid-elevation mountain systems in Central Europe: a case study of the Vosges (France)**

Jana MINAROVA (1,2), Miloslav MÜLLER (3), Alain CLAPPIER (4), and Georges NAJJAR (5)

(1) Department of Physical Geography and Geoecology, Charles University in Prague, Prague, Czech Republic (jana.minarova@natur.cuni.cz), (2) Laboratoire Image, Ville, Environnement, National Center for Scientific Research & University of Strasbourg, Strasbourg, France (jana.minarova@live-cnrs.unistra.fr), (3) Institute of Atmospheric Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic (muller@ufa.cas.cz), (4) Geographic Information Systems Laboratory, Ecole polytechnique fédérale de Lausanne, Lausanne, Switzerland (alain.clappier@epfl.ch), (5) Faculty of Geography and Planning, University of Strasbourg, Strasbourg, France (georges.najjar@unistra.fr)

The aim of this work is to study the spatial distribution of heavy precipitation in the area of the Vosges mountain range in north-eastern France from a seasonal point of view. This area was chosen as an example of mid-elevation mountain systems of Central Europe because the lee (i.e. the Upper Rhine Plain) is densely populated and thus concentrates high human stakes frequently subject to heavy precipitation (e.g., flood).

Based on the precipitation daily totals from 168 rain gauges over the period 1960-2013, it is demonstrated that due to its position almost perpendicular to the prevailing western airflow, the Vosges represent a barrier and have a regional influence on the spatial and temporal distribution of precipitation: the main precipitation season being winter on the windward side as well as on the crest; and summer on the leeward side. The alteration of precipitation seasonality from West to East concurs with a decrease in the mean annual precipitation total, and greater temporal concentration of precipitation. It is stated that the orographic enhancement of precipitation is stronger in winter when the zonal western circulation is more pronounced and convective precipitation that occurs rather randomly is rarer than stratiform one.

However, the seasonality of general precipitation and of heavy precipitation do not match. For the analysis, we chose heavy precipitation reference events from the dataset using a modified version of event-adjusted evaluation method of extremes. It is shown that the distribution of these events differs from the distribution of simple daily totals, itself dependent on the outliers. Hence, the heavy precipitation events do not necessarily occur within the month with the highest mean precipitation concentration.