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# Introducing stochastics into the simulation of convective precipitation events

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In a joint project, the Central Institute for Meteorology and Geodynamics (ZAMG) and the Vienna University of Technology aimed to characterize strong precipitation events and their impact in the Bucklige Welt region in Eastern Austria. Both the region's hydrological and meteorological characteristics, namely its composition of virtually countless small catchments with short response times and a high frequency of summertime convective storms, cause the occurrence of flooding to be strictly tied to convective rainfall events, which is why this study has been focused on this type of precipitation.
The meteorological database consists of the ZAMG's high-resolution analysis and nowcasting system INCA ("Integrated Nowcasting through Comprehensive Analysis"), which provides a set of precipitation analyses generated by a statistically optimized combination of rain gauge measurements and radar data with a temporal resolution of 15 minutes and a spatial resolution of 1 kilometre. An intensity threshold of 3.8mm/15min has been used to classify any observed precipitation as a convective one, thus extracting 245 convection days with a total number of almost 1600 individual storm events over the project region out of the 5-year data set from 2003 to 2007. Consecutive analyses were used to compute the motion of these storms, a complex process that could not be completely automatized; due to the repeated occurrence of storm splits or coalescences, a manual control of the automatically provided "suggestion" of movement had to be performed in order to merge two or more precipitation maxima to a single storm if necessary, thus yielding the smoothest and most plausible storm tracks and ensuring a high quality of the database.

In the first part of the project, distributions for all characteristic parameters have been derived, including the number of storms per day, their place and time of initiation, their motion, lifetime, maximum intensity and maximum "cell volume" (i.e. overall precipitation per time step). Both components of the mean motion as well as of its deviations could be approximated by normal distributions, whereas the number of storms per day, their lifetime, maximum intensity and maximum cell volume roughly followed exponential distributions. The shapes of the convective cells were approximated by Gaussian bells with the peak intensity and the cell volume as boundary conditions. The temporal courses of the peak intensities and cell volumes were assumed to follow parabolas which are symmetric with respect to the half of the lifetime.
In the second part of the project, these distributions were used to drive a random generator that allows simulating an arbitrary number of convection days in order to obtain pseudo time series of convective precipitation for each grid point. An algorithm to create correlated samples of random numbers enabled to also account for the observed correlation between some of the parameters, i.e. lifetime and maximum intensity or maximum cell volume.

The spatial structures of the return periods of simulated convective precipitation events may provide valuable additional information when being assimilated to the time series measured by the (unfortunately rather sparse) rain gauges in this region. Thus, further studies have to investigate to what extent the "convection simulator" is able to reproduce these time series. Some iterative fine-tuning of the parameters' distributions as well as an extension of the database to a longer time span may further improve the results and enable to simulate realistic spatio-temporal convection scenarios ("design storms") that have the potential to feed hydrological models and, together with vegetation and soil characteristics, hopefully enable to better assess and regionalize the torrent hazard over the project region.