Geophysical Research Abstracts
Vol. 13, EGU2011-12207, 2011
EGU General Assembly 2011


# Spatial interpolation of extreme-precipitation with intermittent records

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Intensity-duration-frequency (IDF) curves are the standard tools used to estimate design rainfall. The IDF curve estimation at gauged sites requires the elaboration of precipitation extremes, which are traditionally recorded as the annual maximum precipitation depths measured in time intervals of predefined duration. The information from the IDF curve is usually transposed to ungauged sites by estimating the IDF parameters at all locations where data are available, and then interpolating in space these parameter-values, for instance by applying a kriging technique. The methodological hindrance to this procedure resides in the intermittent nature of precipitation records, both in space and time. Precipitation gauging stations, in fact, are sometimes subjected to activation, relocation or dismissal. Tracing the historical consistence and migration of the measuring points, especially when dealing with large databases, hence requires either a direct expertise about the studied region or the set up of specifically-conceived methods to bypass the possible inconsistencies that would derive from the spotty nature of these spatial data.

We propose to tackle the problem by adopting the following approach: (i) for each available duration and for each year (with a minimum consistency of active gauging stations in the region) we spatially interpolate the random field of precipitation. We obtain a map of interpolated values for each year and duration, along with a map of the corresponding estimation variances (which will be larger in years with fewer active stations and in regions with more sparse measurements); (ii) Single-year maps are then combined by averaging the cell-values (weighted by the inverse of their respective variance), and an average map is obtained for each duration; (iii) From these fixed-duration (temporally averaged) maps, the parameters of the IDF curve are finally estimated for each cell of the considered region.

The proposed procedure is amenable for application with any spatial interpolation method. We present an application to North-Western Italy and use detrended kriging (with duration-dependent semivariograms) as the interpolation technique. The example we present represents a rather typical situation at least in Italy: we have a total of nearly 250 gauging stations in the study area, with measurements starting in 1928 and lasting until the present days. Only very few of these stations have a full uninterrupted record, while the large majority have experienced dismissal or relocation, or interruptions, in particular during the world war II period, replacement/renewal of the instrument, etc. We demonstrate that application of our spatial interpolation technique allows one to obtain reliable estimates of the IDF curve even with this rather challenging data setting.