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# A non-stationary index-flood model for precipitation extremes in transient RCM runs

M. Hanel and T. A. Buishand
Royal Netherlands Meteorological Institute (KNMI), De Bilt, Netherlands

The Generalized Extreme Value (GEV) distribution has often been used to describe the distribution of daily maximum precipitation in observed and climate model data. The model developed in this paper allows the GEV location parameter to vary over the region, while the dispersion coefficient (the ratio of the GEV scale and location parameters) and the GEV shape parameter are assumed to be constant over the region. This corresponds to the index-flood assumption in hydrology. It is further assumed that all three GEV parameters vary with time such that the relative change in a quantile of the distribution is constant over the region.

The non-stationary GEV model is applied to the 1-day summer and 5-day winter precipitation extremes in the river Rhine basin in several transient RCM simulations for the periods 1951–2050 and 1951–2100, produced within the ENSEMBLES project. This provides an informative summary of the changes in the distribution of extremes. Looking at the parameters of the GEV distribution gives a better insight into the differences in distribution than looking at a single quantile only.

Although, there are differences in the results for different RCM-GCM configurations, some common features can be found. The changes in quantiles of the 1-day summer precipitation maxima can be largely attributed to the increase of the dispersion coefficient. This implies that the relative increase of a quantile increases with increasing return period in most cases. The changes in quantiles of the 5-day winter precipitation maxima are mainly determined by the increase of the location parameter. However, in a number of cases this increase is counterbalanced by a decrease of the shape parameter, which leads to a decrease of the relative change of a quantile with increasing return period.

There is a strong indication that the magnitude of the trend in the GEV location parameter decreases with increasing altitude in the Swiss part of the Rhine basin in the winter season, showing that the assumption of a regionally constant trend in this parameter can be too restrictive in regions with strong orography. In the summer season, local non-homogeneities caused by the spatial variation of the dispersion coefficient have been found.