Geophysical Research Abstracts, Vol. 7, 05112, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05112

A model fitting analysis of monthly precipitation data including probability assessments of extreme events

S. Trömel, C.-D. Schönwiese

Institute for Atmosphere and Environment, Johann Wolfgang Goethe-University, Frankfurt a.M., Germany

Temporal significant changes in time series of observed precipiation are mostly estimated under the assumption that the time series can be seen as a realization of a Gaussian distributed random variable with constant variance. The use of the least-squares method in trend analysis is one example. But the implied statistical assumptions are not fullfilled and induce eratic estimators.

Consequently, a generalized time series decomposition technique is presented allowing a free choice of the underlying probability density function (pdf). The signal (structured components like trends, annual cycle etc.) is detected in two instead of one parameter of a pdf, which can be chosen without any further restriction. In particular, the method introduced provides a consistent decomposition of precipitation time series in a statistical and a deterministic component. The full analytical description in terms of the estimated pdf for every time step of the observation period allows probability assessments of extreme values for any time step either. Additionaly, estimates of trends in the mean value based on the method introduced take changes in the location, the scale and the shape of the distribution into account.

The analysis of a global station-based data set of recent monthly totals shows that the majority of the time series can be interpreted as a realization of a Gumbel distributed random variable with time-dependent scale and location parameter or a Weibull distributed random variable with time-dependent scale and shape parameter.

As exemplary results, ameliorated precipitation trend maps of Germany can be opposed to the least-squares estimates. With regard to changes in the probability of extreme values, a shift of the maximum probability exceeding the 95th percentiles from summer to winter is detected in the western part of Germany. This is closely related to an increasing scale parameter in winter and a decreasing one in summer.

In the United States some stations near the Appalachian Mountains show, that extreme precipitation events have increased despite the fact, that total precipitation has decreased. This is attributed to a change in the shape of the distribution.

In Europe, changes in the probability of extreme monthly precipitation totals are most pronounced in Norway, Sweden and Irland.