Geophysical Research Abstracts
Vol. 16, EGU2014-2098, 2014
EGU General Assembly 2014

Probability modeling of high flow extremes in Yingluoxia watershed, the upper reaches of Heihe River basin

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Probability modeling of hydrological extremes is one of the major research areas in hydrological science. Most basins in humid and semi-humid south and east of China are concerned for probability modeling analysis of high flow extremes. While, for the inland river basin which occupies about 35% of the country area, there is a limited presence of such studies partly due to the limited data availability and a relatively low mean annual flow. The objective of this study is to carry out probability modeling of high flow extremes in the upper reach of Heihe River basin, the second largest inland river basin in China, by using the peak over threshold (POT) method and Generalized Pareto Distribution (GPD), in which the selection of threshold and inherent assumptions for POT series are elaborated in details. For comparison, other widely used probability distributions including generalized extreme value (GEV), Lognormal, Log-logistic and Gamma are employed as well. Maximum likelihood estimate is used for parameter estimations. Daily flow data at Yingluoxia station from 1978 to 2008 are used. Results show that, synthesizing the approaches of mean excess plot, stability features of model parameters, return level plot and the inherent independence assumption of POT series, an optimum threshold of 340m3/s is finally determined for high flow extremes in Yingluoxia watershed. The resulting POT series is proved to be stationary and independent based on Mann-Kendall test, Pettitt test and autocorrelation test. In terms of Kolmogorov-Smirnov test, Anderson-Darling test and several graphical diagnostics such as quantile and cumulative density function plots, GPD provides the best fit to high flow extremes in the study area. The estimated high flows for long return periods demonstrate that, as the return period increasing, the return level estimates are probably more uncertain. The frequency of high flow extremes exhibits a very slight but not significant decreasing trend from 1978 to 2008, while the intensity of such flow extremes is comparatively increasing especially for the higher return levels.