Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09247, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09247
EGU General Assembly 2008

Effects of runoff thresholds on flood frequency distributions

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Runoff generation during extreme floods usually occurs whenever rainfall forcing exceeds a given threshold. In many cases, different thresholds may be identified as responsible of the hydrological losses during ordinary events or extraordinary events at the basin scale. Such thresholds are shown to be related to the dynamics of soil saturation of the river basin and to account for the high skewness of their annual flood distributions. In basins where ordinary floods are mostly due to a small portion of the surface which is particularly prone to produce runoff, depending on permeability of a river basin and its antecedent soil moisture conditions, severe rainfall may exceed a basin-wide soil storage threshold and produce the so-called outlier events responsible of the high skewness of floods distributions. In this context, the derived theoretical model based on the concept of variable contributing area to peak flow proposed by Iacobellis and Fiorentino (2000) was generalized with the aim of incorporating such kind of dynamics in the description of the phenomena. The work produced a new formulation of the derived distribution where the two runoff components are explicitly considered. The present work was validated by using as test site a group of basins belonging to Southern Italy and characterized by flood distributions with high skewness. The application of the proposed model provided a good fitting to the observed distributions. Moreover, model parameters were found to be strongly related to physiographic basin characteristics giving consistency to the modelling assumptions.