Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10098, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10098
EGU General Assembly 2008

Temporal and spatial resolution of rainfall estimates required for flash flood monitoring and modelling

D. Norbiato (1), M. Borga (1)
(1) DTEASF, University of Padova, Italy (daniele.norbiato@unip.it)

A key question in flash flood monitoring and forecasting is how spatial variability in rainfall impacts on the flow response at various spatial scales. This question has important practical implications in terms of the accuracy of flood predictions from catchment runoff models which use data from weather radar. Such flood predictions may underpin flood warning procedures in real-time and form a key role in the design and planning of flood defence measures.

The purpose of this study is to employ a unique dataset, encompassing rainfall and discharge data from several extreme flash flood events, together with a distributed rainfall-runoff model to provide recommendations on the temporal and spatial resolution of rainfall measurements required for flash flood monitoring and forecasting.

Several studies presented in the literature review examine the effects of rainfall resolution on distributed hydrologic models, without general consideration of length and time scales. Time scales are analyzed with reference to the temporal rainfall-runoff dynamics, examined using lag times values derived from rainfall and discharge data time series observed for a set of flash flood events. A simple power law relation allows to link the lag time to watershed length scale (function of the watershed area), and so to link the temporal and the spatial scales of the study catchments. Temporal scale of aggregation (temporal resolution) is determined as a function of lag time.

Using the variogram within the geostatistics framework, the space-time structure of rainfall is examined and in particular the effect of time averaging. Again a simple relation links the spatial scale (defined as the decorrelation distance) and the time step.

Requirements for the spatial resolution of rainfall field are examined with reference to the analysis of input smearing, which occurs as a result of spatial averaging over increasingly large areas. In this study, we focus on two distinct types of input smearing: storm smearing and watershed smearing. Storm smearing occurs when the rainfall resolution approaches or exceeds the rainfall correlation length, which tends to decrease rain rates in high intensity regions and increase rain rates in low intensity regions, effectively reducing rain rate gradients. Watershed smearing occurs when rainfall resolution approaches the watershed length scale, which tends to increase the uncertainty of the location of rainfall, and results in the transfer of rainfall across basin boundaries.

Two dimensionless similarity parameters, which describe different aspects of the relationship between rainfall data spatial aggregation and distributed hydrologic model response are identified, together with their relationship with the temporal scale of aggregation. The storm smearing parameter, which is the ratio between rainfall resolution and rainfall correlation length, describes the reduction in rain rate gradients. The watershed smearing parameter, which is the ratio between rainfall resolution and the watershed length scale, describes the uncertainty of rainfall location with respect to the watershed boundary.

Combining these relations, guidelines are developed concerning the temporal and spatial resolution of rainfall estimates for flash flood hydrological analysis with distributed hydrological models.