Geophysical Research Abstracts, Vol. 9, 11509, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-11509

A study of the scale invariance of rainfall in time and space to derive intensity duration frequency relationships

L.M. Nhat (1), Y. Tachikawa (2), T. Sayama (2) and K. Takara (2)

(1) Dept. of Urban and Environmental Eng., Kyoto University, (2) DPRI, Kyoto University (e-mail: nhat@flood.dpri.kyoto-u.ac.jp)

The Intensity Duration Frequency (IDF) relationship of heavy storms is one of the most important hydrologic tools utilized by engineers for designing flood alleviation and drainage structures in urban and rural areas. Local IDF equations are often estimated on the basis of records of intensities abstracted from rainfall depths of different durations, observed at a given recording rainfall gauging station. In some regions, there may exist a number of recording rainfall gauging stations operating for a time period sufficiently long to yield a reliable estimation of IDF relationships; in many other regions, especially in developing countries, however, these stations are either non-existent or their sample sizes are too small. Because daily precipitation data is the most accessible and abundant source of rainfall information, it seems natural, at least for the regions where data at higher time resolution are scarce, to develop and apply methods to derive the IDF characteristics of short-duration events from daily rainfall statistics.

Over the last two decades, concepts of scale invariance have come to the fore in both modelling and data analysis in hydrological precipitation research. *Gupta and Waymire* studied rainfall spatial variability by introducing the concepts of simple and multiple scaling to characterise the probabilistic structure of the precipitation processes. *Kuzuha et al.* showed the scaling framework and regional flood frequency analysis. *Burlando and Rosso* showed that both the simple scaling and multiscaling lognormal models can be used to derive DDF curves of point precipitation. *Menabde et al.* developed a simple scaling methodology to use daily rainfall statistics to infer the DDF curve for rainfall duration less than 1 day. The scaling hypothesis was verified

by fitting the model to two different sets of data (from Australia and South Africa). *Yu et al.* is an example of methodology in which the theories of scaling properties and employed to infer the IDF characteristics of short-duration rainfall from daily data.

Until now, time scaling characteristics are studied by many researchers, while space scaling properties that will link to derivation of AIDF, Area-Intensity-Duration-Frequency relationship is not well studied. Thus, in this paper, the properties of time and space scale invariance of rainfall are examined in the Yodo River catchment. Then an IDF relationship for short-duration rainfall from daily data are derived according to *Menabde* and compared with the obtained from the traditional method.

The properties of time and space scale invariance of rainfall are investigated and applied to Intensity-Duration-Frequency (IDF) relationships. The hypothesis of the simple scaling is examined in time and space in Yodo River basin and the simple scaling properties in time are confirmed, which is used to derive IDF relationships for short-duration rainfall of several hours from the statistical characteristics of daily data only. The derived IDF matches well with the one derived from historical observed data. Also, the simple scaling properties in space are examined. It is found that two ranges less than 1000 km^2 and more than 1000 km^2 show different scale properties.