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Spatial scales for extreme rainfall return periods - characteristic parameters for use in urban drainage design

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The detected increase of extreme precipitation over Europe in recent years has emphasized the importance in understanding the physical properties and extent of extreme precipitation events. The environmental and socioeconomic consequences of the effects in the form of flooding of urban and rural areas caused by extreme rainfall are severe. Recent research in Denmark suggests that increase in extreme rainfall intensities must be addressed in the design code for urban drainage systems [Madsen et al., 2006]. The existing drainage systems are not designed for these more intense extreme rainfalls and since it is not realistic to re-engineer the complete drainage system other options like real time control, routing of water and local detention basins will become more in demand.

A traditional approach is to design the drainage system for a chosen return period of a given intensity and duration or according to a range of durations using a design rainfall such as the Chicago Design Storm. The return periods have until know been determined on the basis data of from rain gauges, but since precipitation is a spatial dynamic phenomenon there is a great risk of missing the extreme events due to the small area a gauge represent. The recorded time series from radars are by today starting to reach a sufficient length to be used for determination of design rainfalls. Weather radars has the advantage of measuring precipitation over an area with a spatial resolution ranging from 2-4 km pixel sizes for traditional S-band and C-band radars down to 500-100 meters pixel size for the new generation of cost-effective meteorological radars based on X-band technology. The latter type may be the only source of data for this type of information since the continuous scan technology used by these radars

guarantees that few minutes extreme intensity are detected.

Initial studies of return periods based on X-band radar data (Pedersen et al, 2006) show that there seems to be a cluster effect of the intense rainfall. Within individual events it has been observed that intensities corresponding to the high return periods tend to be bound within areas. Under Danish conditions the diameter of an 80 - 100 year IDF event is in the order of 0.5 - 2.5 km. The aim of this study is to characterize the parameters describing the spatial extent of intensities with large return periods.

Data from four X-band weather radars of the type Local Area Weather Radar (LAWR) installed in Denmark has been used. The radars are operating with two different spatial resolutions: 500x500 meter and 100x100 meter and a temporal resolution of 5 minutes. The reason for choosing this type of radar is due to the fact that field experiments has shown that there can be more that 100% variability in accumulated rainfall measured within 200 meters with rain gauges [Jensen and Pedersen, 2005]. Further more urban catchments are often of corresponding size and it is therefore the proper scale to work on. The LAWR's has been operating for up to 5 years and therefore is it necessary to relate the radar intensities to return periods by use of a regional statistical model describing the relation between intensity, duration and return period based on longer records of rain gauge data.

References: Jensen, N. E. and Pedersen, L (2005) Spatial Variability of Rainfall. Variations within a Single Radar Pixel, Atmospheric Research 77 (2005) pp. 269-277

Madsen, H., Arnbjerg-Nielsen, K and Mikkelsen, P. S. (2006) Evidence of Increased Storm Intensities in Denmark from the Augmented Rain Database (1997-2005), Proceedings of the 7th International Workshop in Precipitation in Urban Areas, St. Moritz, 7-10 December 2006, Edited by Molnar et al., pp. 129-133

Pedersen, L, Jensen N.E. and Madsen, H. (2006) Return Period for Radar Rainfall - Spatial Validity of Return Period, Proceedings of the 7th International Workshop in Precipitation in Urban Areas, St. Moritz, 7-10 December 2006, Edited by Molnar et al., pp. 54-57