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The impact of urbanization on an extreme precipitation event over Jakarta

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Extreme precipitation events over Jakarta have become more frequent and intense in recent years. A clear example was the record-high precipitation event of 8-10 February 2015, in which 6 people died and 20000 were displaced. Large-scale phenomena, like climate change and El Nino, could have influenced this increase in extreme precipitation over Jakarta. However, recent studies suggest that the rapid urbanization of Jakarta in the 20th century could have modified the intensity of extreme precipitation events. In this study, we investigated the potential urban influences of Jakarta, induced by the urban heat island and the enhanced surface roughness, on the intensity and spatial distribution of precipitation in the 8-10 February 2015 extreme precipitation event. Towards this goal, three experiments with the HARMONIE model were conducted. In the first experiment the current land use extent of Jakarta was replaced by three different nature covers, while in the second experiment the current spatial distribution was replaced by six historical extents of Jakarta. In the last experiment, the individual influences of the urban heat island and the enhanced surface roughness were investigated. The results from the first experiment showed that the urban area of Jakarta itself acts to increase precipitation (up to 30%) within the boundaries of the urban area, while it decreases precipitation around the city, especially in the upwind part. The second experiment showed that the six model runs, with the historical extents of Jakarta, had less precipitation falling within the urban area and more in the upwind part of the city, compared to the model run with the current extent. This shift in the position of precipitation could be related to influences of the urban area in the position and intensity of the sea/land-breeze circulation over the bay of Jakarta. Finally, the last experiment showed that both the urban heat island and the enhanced surface roughness increase precipitation within the urban area of Jakarta by 12% and 4% respectively.