Future trends in flood risk in Indonesia - A probabilistic approach

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Indonesia is one of the 10 most populous countries in the world and is highly vulnerable to (river) flooding. Catastrophic floods occur on a regular basis; total estimated damages were US$ 0.8 bn in 2010 and US$ 3 bn in 2013. Large parts of Greater Jakarta, the capital city, are annually subject to flooding. Flood risks (i.e. the product of hazard, exposure and vulnerability) are increasing due to rapid increases in exposure, such as strong population growth and ongoing economic development. The increase in risk may also be amplified by increasing flood hazards, such as increasing flood frequency and intensity due to climate change and land subsidence. The implementation of adaptation measures, such as the construction of dykes and strategic urban planning, may counteract these increasing trends. However, despite its importance for adaptation planning, a comprehensive assessment of current and future flood risk in Indonesia is lacking.

This contribution addresses this issue and aims to provide insight into how socio-economic trends and climate change projections may shape future flood risks in Indonesia. Flood risk were calculated using an adapted version of the GLOFRIS global flood risk assessment model. Using this approach, we produced probabilistic maps of flood risks (i.e. annual expected damage) at a resolution of 30"x30" (ca. 1km x 1km at the equator). To represent flood exposure, we produced probabilistic projections of urban growth in a Monte-Carlo fashion based on probability density functions of projected population and GDP values for 2030. To represent flood hazard, inundation maps were computed using the hydrological-hydraulic component of GLOFRIS. These maps show flood inundation extent and depth for several return periods and were produced for several combinations of GCMs and future socioeconomic scenarios. Finally, the implementation of different adaptation strategies was incorporated into the model to explore to what extent adaptation may be able to decrease future risks.

Preliminary results show that the urban extent in Indonesia is projected to increase within 211 to 351% over the period 2000-2030 (5 and 95 percentile). Mainly driven by this rapid urbanization, potential flood losses in Indonesia increase rapidly and are primarily concentrated on the island of Java. The results reveal the large risk-reducing potential of adaptation measures. Since much of the urban development between 2000 and 2030 takes place in flood-prone areas, strategic urban planning (i.e. building in safe areas) may significantly reduce the urban population and infrastructure exposed to flooding. We conclude that a probabilistic risk approach in future flood risk assessment is vital; the drivers behind risk trends (exposure, hazard, vulnerability) should be understood to develop robust and efficient adaptation pathways.