Geophysical Research Abstracts
Vol. 20, EGU2018-13971, 2018
EGU General Assembly 2018

Extension of a model-based flood forecasting system for decision support utilizing the dimension of risk

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Effective early warning systems illicit actions, which significantly lower the damage inflicted on people and on property exposed to natural hazards, thus increase resilience. Contemporary flood forecast systems assess weather predictions mostly to forecast hydraulic values (e.g. discharge or water level). During crisis situations the interpretation of this information represents a critical step for real time decision making and can result in disproportionate and inappropriate response actions. The flood risk is often available for strategic planning, but is not in an appropriate format for operational purposes.

It is desired to close this gap between model-based forecasting of pure hydraulic values and decision making by evolving the forecast parameter from hazard (hydraulic values) towards impact (on people and property) and conclusive risk. Therefore, probabilities provided by a cyclone ensemble generation tool, the forecasting of flood impacts, and finally the forecasted flood risk is implemented into the forecasting chain.

This work presents the demo case about Manila Bay where storm surges frequently occur. Two highlights are set in the perspective of a flood forecast system: Firstly, the flood forecast system is shifted to a risk-based forecast system. The second focus is based on a method to visualize the inhered dimensions in order to ensure the accessibility of the system.

Forecast parameter: Hazard → Impact → Risk

A forecasting system is set up to utilize a published deterministic forecast of a storm pathway and creates an ensemble of storm pathways, including associated probabilities. Subsequently created wind profiles for every ensemble member are applied to a Delft3D model of Manila Bay and the hinterland in order to gain the spatial distribution of water depths resulting from the tracks. The translation from water depths towards impacts is executed with the Flood Impact Assessment Tool (Delft-FIAT) based on stage-damage functions and land use maps of the area. As a final step the flood risk for a forecasted event is generated by multiplying the probabilities of each ensemble with their associated impacts.

Visualization Method: Dimension Board

At the end of this forecast system 6 different dimensions are available: hazard, impact, risk, time, space, and categorization. To approach the content of the dimension in an emergency case different dimensions in combination deliver the valuable information. The Dimension Board displaying the available information is utilized as a medium to arrange the desired output together with stakeholders. Exemplary combinations have been configured and deliver results for Manila Bay improving the basis of decision making:

- Risk sum of people being affected
- Risk sum for mobile and immobile damages
- Band of possible water levels