Geophysical Research Abstracts
Vol. 16, EGU2014-922-1, 2014
EGU General Assembly 2014

Flood risk assessment and robust management under deep uncertainty: Application to Dhaka City

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The socio-economic changes as well as climatic changes have been the main drivers of uncertainty in environmental risk assessment and in particular flood. The level of future uncertainty that researchers face when dealing with problems in a future perspective with focus on climate change is known as Deep Uncertainty (also known as Knightian uncertainty), since nobody has already experienced and undergone those changes before and our knowledge is limited to the extent that we have no notion of probabilities, and therefore consolidated risk management approaches have limited potential..
Deep uncertainty is referred to circumstances that analysts and experts do not know or parties to decision making cannot agree on: i) the appropriate models describing the interaction among system variables, ii) probability distributions to represent uncertainty about key parameters in the model 3) how to value the desirability of alternative outcomes. The need thus emerges to assist policy-makers by providing them with not a single and optimal solution to the problem at hand, such as crisp estimates for the costs of damages of natural hazards considered, but instead ranges of possible future costs, based on the outcomes of ensembles of assessment models and sets of plausible scenarios. Accordingly, we need to substitute optimality as a decision criterion with robustness. Under conditions of deep uncertainty, the decision-makers do not have statistical and mathematical bases to identify optimal solutions, while instead they should prefer to implement "robust" decisions that perform relatively well over all conceivable outcomes out of all future unknown scenarios.
Under deep uncertainty, analysts cannot employ probability theory or other statistics that usually can be derived from observed historical data and therefore, we turn to non-statistical measures such as scenario analysis. We construct several plausible scenarios with each scenario being a full description of what may happen in future and based on a meaningful synthesis of parameters' values with control of their correlations for maintaining internal consistencies. This paper aims at incorporating a set of data mining and sampling tools to assess uncertainty of model outputs under future climatic and socio-economic changes for Dhaka city and providing a decision support system for robust flood management and mitigation policies.
After constructing an uncertainty matrix to identify the main sources of uncertainty for Dhaka City, we identify several hazard and vulnerability maps based on future climatic and socio-economic scenarios. The vulnerability of each flood management alternative under different set of scenarios is determined and finally the robustness of each plausible solution considered is defined based on the above assessment.