Probabilistic Multi-Hazard Risk Analysis

The assessment of urban elements at risk can serve as a base to guide development planning

GeoAdaptive has developed and implemented a standardized method to conduct probabilistic exposure, vulnerability, and risk assessments for numerous cities worldwide, including many cities in the Global South. We have specific experience managing and integrating hazards and risk information into planning procedures and instruments, and disaster preparedness. These assessments are used to guide decision-making and planning, and provide a solid base to develop Disaster Risk Management (DRM), Climate Change adaptation (CCA), and resilient urban strategies.

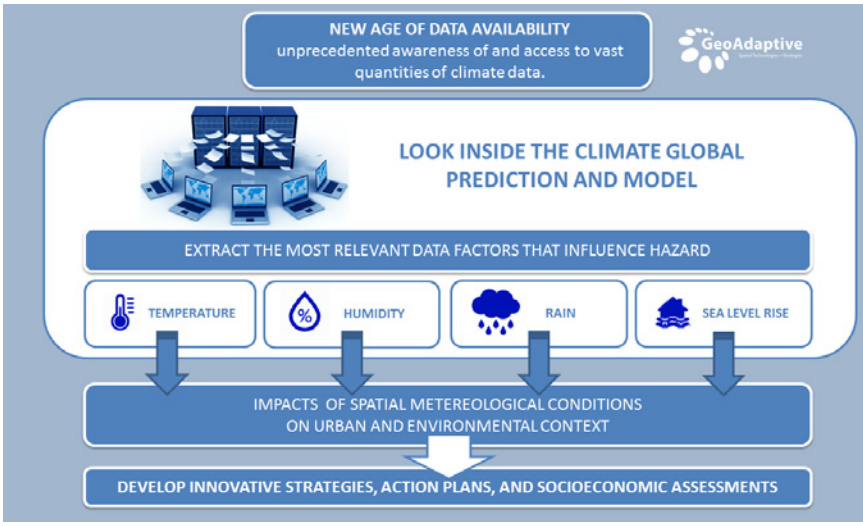
Risk is defined by UNISDR as "the combination of event probability and its negative consequences". Therefore, risk assessments consider hazard modeling, element exposure, and the element's vulnerability to the hazard. Risk calculations are done to understand and quantify the assets and human lives that may potentially be affected or impacted during a natural hazard event.

A Probabilistic Multi-Hazard Risk Analysis involves the following analytical components:

Hazard assessment

For each assessed hazard, a set of events are defined along with their respective frequencies of occurrence, which are an integral representation of the related hazard (flood, tsunami, storm surge, cyclones[1]). Each hazard scenario contains certain spatial distribution parameters, which allow the construction of the distribution of the probability of intensities produced by events with specified return periods. The assessment also integrates the manner in which climate change can exacerbate or reduce the impacts of natural hazards in the future, including climate change scenario data in order to calculate exposure and risk.

1 For landslides, earthquakes and drought, susceptibility analyses may be conducted.



GeoAdaptive's approach to climate change

We approach climate change analysis through the application of open-source data and new technologies, which can provide a large quantity of data and information required to study the earth's climate and its impact upon developed areas.

Our primary focus is the application of the most relevant factors, extracted from global prediction models, that influence hazards and affect the levels of risk. The variations in this data help define how spatial meteorological conditions, in particular hydrometeorological conditions, will affect a specific region. Our overall integrated approach allows us to incorporate the results of spatial analysis, socioeconomic assessments, feasibility studies and climate variability into the development of innovative and truly resilient strategies and action plans.

Inventory of exposed elements

An inventory of the exposed elements is developed, including the characteristics of the element that is exposed, its geographic location, and the following parameters:

- Physical value or cost of replacement of asset.
- Structural classification for structures (based on construction material, number of floors, year of construction, etc.).
- Human population and demographics (age, gender, etc.).

Vulnerability

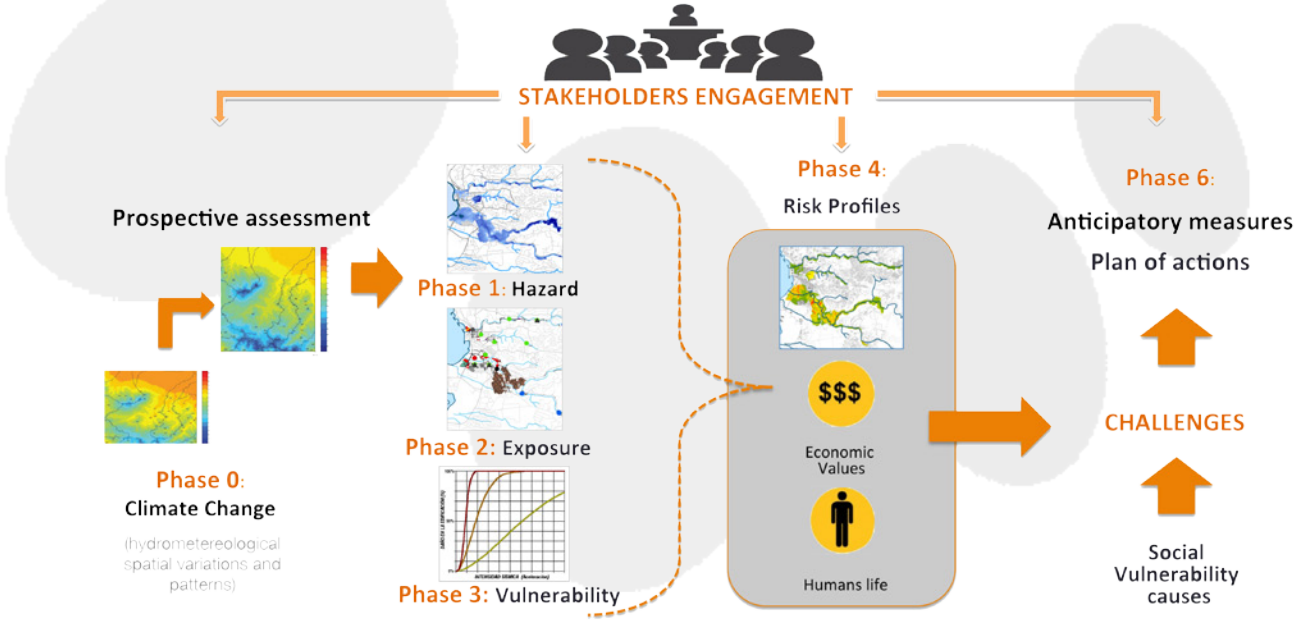
Each element must be assigned a physical or human vulnerability function based on the type of hazard (flood, tsunami, storm surge, cyclones). This function characterizes the behavior of the asset or population during the occurrence of the hazard phenomena. The functions related to physical and human vulnerability define the distribution of probability of loss as a factor of the hazard intensity during a specific scenario. This is defined through vulnerability curves, which relate the expected value of damage and standard deviation of damage with the intensity of the phenomenon (such as those determined by the CAPRA platform).

Risk evaluation

The term risk implies a probabilistic analysis for potential impact loss, estimating monetary value and human lives. Risk is calculated using the equation:

$$\text{Risk} = \text{Hazard} * \text{Exposure} * \text{Vulnerability}$$

The risk profiles will provide quantitative information regarding the areas where risk is concentrated as well as considering different types of exposed assets and populations. These results provide a clear picture for decision makers in areas where implementation of risk mitigation measures are required. Additional results that are beneficial for decision makers are: total losses for different return periods (PML) and risk premiums (Annual Average Loss, AAL).



GeoAdaptive
Spatial Technologies + Strategies

GeoAdaptive is a global sustainability research consultancy group based in Boston, Massachusetts. We use spatial technology to understand these challenges and the inherent spatial relationships between vital components of the natural and urban landscape, as well as to highlight future opportunities for adaptation and increasing resilience.

We work closely with partners, clients and communities helping them explore the risks and opportunities associated with future regional change in urban development patterns, climate change, and natural hazards. We do this in a number of ways including defining appropriate best management strategies for the region, highlighting areas of the region or city where these strategies might be implemented (through geospatial analyses), and recommending changes in policy or planning.

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