

SPATIAL MODELS FOR THE ASSESSMENT OF THE STORM-SURGE AFFECTED REGIONS IN COASTAL AREAS: CASE STUDY OF THE CYCLONE NARGIS IN MYANMAR

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Cyclones are one of the most destructive forces in the nature causing catastrophic damages to infrastructure and death of people in coastal areas. Therefore, it is vital to determine affected coastal areas and population to help mitigation and recovery efforts. Among destructive effects of cyclones such as storm surges, violent winds and heavy rainfalls, the most devastating one is the storm surge that can reach up to 10 m during extreme events.

Determination of coastal areas affected by surges during cyclones is a complex problem requiring estimation of surge heights along the coastline and the length of their propagation across the land. Surge heights are driven primarily by directional and circular wind velocities, duration and extent of winds, angle of wind track relative to the coastline, offshore bathymetry and tidal level changes. The effect of surges on coastal areas depends on coastline topography and physiographic properties.

Event based, complex numerical model applications are widely used to define spatial dynamics of the wind driven surge structure. While these complex numerical models provide an explicit physical description of storm events they have few drawbacks: 1. They can be set only after the hurricane landfall when most of physical data become available; 2. They are used for approximate cyclone tracks and intensities; 3. They cannot be verified and calibrated immediately; 4. They can't be used for the post-disaster management since they require long time to run and set up; 5. Many parameters used in these models make them highly uncertain and unreliable.

The drawbacks of numeric models can be compensated by the use of qualitative Geographic Information Systems (GIS) analysis during or after hurricane events. Timely obtained spatial information on potential surge hazards can be supplied immediately to governmental agencies, civil organizations and the public prior to the landfall of cyclone or immediately after. Unfortunately, in the literature there is no established, uniform and reliable GIS methodology that can account for the unique conditions of each storm surge and physiographic features of affected coastlines. Existing GIS models generally focus on historical cyclone tracks to determine the statistical risk of vulnerability or use constant values of the wave heights to determine potentially flooded coastal areas.

This paper presents a GIS methodology estimating spatial extent of coastal areas affected by storm surges and population at risk within these areas during cyclones. Developed method was applied to the cyclone Nargis in the Indian Ocean, which made landfall in

Myanmar on May 2, 2008. This methodology uses the most efficient method of wind and surge values estimations from historical data to define wind and surge profiles along the coastline of Myanmar. Then submerged areas were modeled in GIS using effects of the direct strike / wave run-up / gravitational movement of the storm surge. Comparison of results obtained by different methods allowed developing a spatial model representing affected coastal areas. Spatial overlay of affected areas and distributed population in GIS provided estimates of affected population.

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