ABSTRACT

ABDUL WAHID MUKLIS. Establishing Hazard Map for Tidal Flood in Coastal Region (Case Study: Surabaya, East Java, Indonesia).
Under the direction of I NENGAH SURATI JAYA and IBNU SOFIAN.

This study examined the use of MRI-CGCM (Meteorological Research Institute-Coupled Atmosphere Ocean General Circulation Model) to predict sea level rise from 2010 to 2100. The DEM SRTM 30 m spatial resolution and sea level rise prediction were used to determine the level of inundation classes. In 2010 the prediction of sea level rise is about 2.1 m high and inundated about 1048 hectare of Surabaya area, causing total loss amounted to 370 billion rupiahs. The study also shows that the sea level at 2100 will rise around 2 m higher than occurred in 2010. The ground verification survey shows that there is a good prediction of sea level rise in 2010, where the predicted sea level rise is about 2.13 m while the actual rise is 2 m. The study concludes that the MRI-CGCM model was quite good to predict sea level rise having accuracy of 93.3%.

Keywords: Sea level projection, MRI-CGCM model, tidal hazard, common climate condition, risk damage.
ABSTRAK

ABDUL WAHID MUKLIS. Membangun Peta Bahaya Banjir Rob di Wilayah Pesisir (Studi Kasus: Surabaya, Jawa Timur, Indonesia). Dibawah bimbingan I NENGAH SURATI JAYA dan IBNU SOFIAN.

Penelitian ini mengkaji penggunaan MRI-CGCM (Meteorology Research Institute - Coupled Atmosphere Ocean General Circulation Model) untuk memprediksi kenaikan air laut dari tahun 2010 sampai dengan 2100. DEM SRTM dengan resolusi spasial 30 m dan hasil prediksi kenaikan air laut digunakan untuk menentukan kelas genangan. Pada tahun 2010, diprediksi kenaikan permukaan laut sekitar 2,1 m dan akan menggenangi areal seluas 1.048 hektar, dengan perkiraan total kerugian sebesar 370 miliar rupiah. Hasil penelitian menunjukkan bahwa permukaan laut pada 2100 diprediksi akan meningkat sekitar 2 m lebih tinggi dari 2010. Hasil verifikasi di lapangan menunjukkan bahwa diperoleh tingkat prediksi yang cukup baik untuk tahun 2010 dan dimana prediksi kenaikan permukaan laut berdasarkan model adalah sekitar 2,13 m, sementara kenaikan sesungguhnya adalah 2 m. Penelitian menyimpulkan bahwa model MRI-CGCM cukup baik untuk memprediksi kenaikan permukaan air laut dengan tingkat akurasi sebesar 93,3%.

Kata kunci: Proyeksi kenaikan air laut, model MRI-CGCM, kondisi iklim umum, bahaya rob, resiko kerugian.
SUMMARY

ABDUL WAHID MUKLIS. Establishing Hazard Map for Tidal Flood in Coastal Region (Case Study: Surabaya, East Java, Indonesia).
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Several studies and observations have proven that the sea level is rising globally. Since 1990 sea level has been rising at 3.4 millimetres per year, twice as fast as on average over the 20th century. The researchers predicted the global sea levels will rise exceed to 200 cm in the 21st century (Vermeer, 2009; Grinsted et al., 2009; and Jevrejeva et al., 2010). Rising of sea level has an impact that includes: decimate the national territory, decreases coral reef populations, sinking islands, economic loss, etc. The sea level has not risen uniformly from region to region, as well as the impact of sea level rise is also diverse among coastal regions. The impact depends on each characteristic of the regional coastal which is influenced by interaction between lithology, geomorphology, wave climate condition, currents and storm frequencies.

As a part of East Java province, Surabaya city is located on coastal region, which located at 112°36'-112°21’ East and 7°12'-7°21’ South. The extent of Surabaya city area is 34,465 ha, consisting of 31 sub-districts with 163 villages. Historically, the lowland of Surabaya city came from the sediment formation of the sea area. Surabaya city has high potency in economic and infrastructure asset. Surabaya city has PDRB (Domestic Bruto Regional Product in million) is about 154 billion rupiahs and population is about 3 million (BPS, 2009). The tidal flood frequently occurs in Northern and Eastern part of Surabaya city, where located nearby the coastal.

This research was focused on the prediction of sea level rise in common and extreme condition on the basis of MRI-CGCM data model, as well as establishment vulnerability affected by tidal flood in coastal region of Surabaya city. The main objective of this research is to establish a hazard map on the basis of the prediction inundation area in 2010, 2030 and 2100, where the 2010 was threat as reference year. The loss estimation also developed for 2010, 2030 and 2100.

The applied methodology comprises four phases, namely; (1) Preparation and data acquisition: literatures review, primary data collection, and problem identification. (2) Pre-processing: development of vulnerable map as a reference to determine feasible area at the fieldwork phase. (3) Fieldwork: observation and measurement of inundation, and interviewed with local residents; (4) Processing and reporting: processing data, analysis data and reporting.

SRTM/DEM data with 30 m spatial resolution were used, to generate the contour line and surface elevation. Meanwhile, the sea level projection was derived from MRI-CGCM data model using high wave, tidal, land subsidence, high wave anomaly data, as well as satellite altimeter data. The RBI (Indonesian topographic) map was used base map for thematic mapping, tidal flood analysis and loss hazard estimation. The field survey was conducted from July to December 2010, to check and observe height of inundation level and interviewed with local residents.
Loss estimation involves the calculation of the vulnerable area with the landuse cost damage. The estimation is only limited to the tangible damage or physical direct damage caused by tidal flood. Hypothetical prices of the landuse types were assigned based on previous of hazards flood report and on personal experience of the author in field survey. The predominant vulnerable landuse areas are residential, building and embankment. The embankment zone is divided into fish and salt pond.

The research results shows that the values of sea level projection on common condition in 2010, 2030 and 2100 are 2.13 m, 2.54 m and 4.13 m respectively; while the value of sea level projection on extreme condition in 2010, 2030 and 2100 are 2.93 m, 3.34 m and 4.93 m respectively. The estimated total loss are about 370 billion rupiahs, 2 trillion rupiahs and 3.6 trillion rupiahs for 2010, 2030 and 2100 respectively. On the basis of ground survey performed in 2010, the actual inundation in 2010 is ranging from 0.3 m to 0.35 m in area with elevation 1.7 m and about 0.6 m asl within area with elevation 1.4 m asl. The prediction derived from the model provides a good performance having 93% accuracy level.

From the findings obtained, the future study needed includes analysis of the latest condition of infrastructure asset price for each land use, by considering duration of flood inundation (characteristic), socio-economic (intangible) impact, and penetration flood energy to the mainland as well as relief of front coast material. The sea level projection model should also be examined the reliability of the sea level projection equation developed. The standard price of land use types for natural disaster in Indonesia are required to make estimation of loss more easily. Actions that should be performed to reduce the tidal flood impact are: re-planning vulnerable area, by relocate settlement within 6 km from the coastline, mangrove reforestation and development of the breakwater.