Geophysical Research Abstracts, Vol. 8, 00562, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00562
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Wave propagation in non-uniform mangrove forests in water of arbitrary depth

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Mangroves are very important eco-systems at the boundary of terrestrial and marine environment in the tropic zones and subtropical zones. Covering over about 181,000 km^2 of the coastal areas in the tropics, mangroves are considered highly productive but vulnerable to the impacts of nature and human being. Mangroves have beneficial impact on the surrounding environment in that they are an important food supply for humans, protect the land from erosion, facilitate alluvium deposition, and mitigate the effects of typhoons and floods, etc. (Tuan et al., 2002; Snedaker et al., 1984).

The present study aims to develop a predictive model for the propagation of wind induced random surface waves through the non-uniform mangrove forest in water of arbitrary depth. Following the approach taken by Massel et al. (1999), the present model solves a full boundary value problem for wave propagation with dissipation. In particular, dissipation due to the interaction of mangroves with wave motion and due to wave breaking is considered. A modified mild-slope equation including dissipation is applied to model wave propagation over changing water depth within the mangrove forest. The non-linear governing equations for wave-trunk interactions are linearised using the concept of stochastic minimalisation.

Numerical calculations and some results from observations of wave attenuation through Can Gio Mangrove Biosphere Reserve in Southern Vietnam are given. They indicate that most of energy dissipated within mangrove forest even of relatively small widths and is mainly due to wave trunk interaction and wave breaking. Wave action plays a dominant role as a main forcing factor for induced sediment transport and erosion. Results also prove that the establishment of mangrove vegetation encourages the deposition of sediment, or at least the retention of flood-tide sediment influx.