
Wave dissipation in mangroves: parameterization of the drag coefficient based on field data

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Mangrove forests dwell in relatively sheltered intertidal areas in the tropics and subtropics. Over the past decades, the interest in mangrove forests has increased because of their unique ecosystem services, one of the most important ones being the attenuation of incident waves, thereby protecting the shoreline. Several theoretical and field studies have been performed in the past, studying this wave damping. The most recent numerical model, developed by Suzuki et al. (2011), simulates wave attenuation in mangroves accurately but still requires calibration of a drag coefficient. The aim of this research is to derive a parameterization for this drag coefficient that is based on both wave properties and vegetation characteristics observed in the field.

We used field observations from two different cross-shore transects with a large variation in vegetation density and wave characteristics (Horstman et al., 2012). With the SWAN vegetation module we reconstructed the drag coefficients corresponding to the wave attenuation observed in the field data. A multi-variable regression analysis on these drag coefficients, combined with knowledge from literature, resulted in an accurate parameterization of the drag coefficient.

The multi variable analysis lead to an adaptation of the Keulegan-Carpenter number, including a vegetation length scale as developed by Mazda et al. (1997) instead of the vegetation diameter. This length scale includes the density and frontal surface of the vegetation. This adapted Keulegan-Carpenter number correlates well with the drag coefficient. The obtained parameterization of the drag coefficient allows for the calculation of the drag coefficient from observed wave and vegetation characteristics. This eliminates the need for the calibration of the SWAN vegetation module in the drag coefficient, thus reducing the demand for field data while improving the predictive capacity of the model.

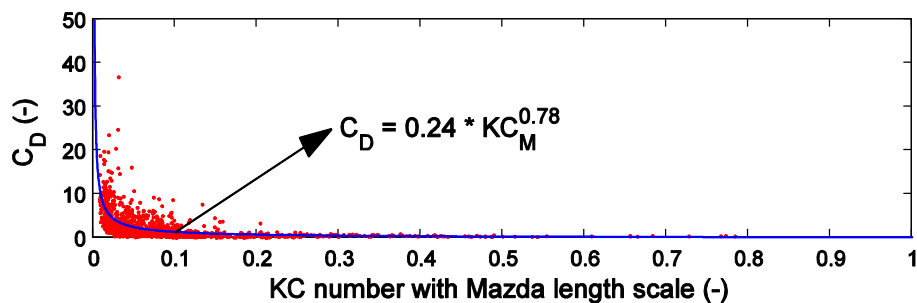


Figure 1. Drag coefficients vs. adapted Keulegan-Carpenter numbers.