

Choice of Random Wave Simulation in Surf Zone Process Models

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As waves approach the shore they become increasingly skewed (peaked crests and flat troughs) and asymmetric (forward-leaning crests). Recently, Gonzales-Rodriguez and Madsen (2007), GRM hereafter, developed a model for bedload transport under skewed and asymmetric waves, and showed that both these wave characteristics have pronounced effects on the prediction of net (period-averaged) bedload transport rates. Thus, for a model of surf zone processes to be realistic, it must be able to predict and account for both the skewness and asymmetry of the near-bottom orbital velocities of the incident random waves.

Tajima and Madsen (2006), TM hereafter, developed a model of surf zone processes based on a representation of random waves as a narrow-banded spectrum with Rayleigh-distributed wave heights and a wave period $T = T_p$, the peak period. The model successfully predicts rms wave heights and near-bottom orbital velocities as the waves approach breaking, break and travel across the surf zone as broken waves. The TM model can also be used to predict skewness, $Skw = (U_c - U_t)/(U_c + U_t)$ where U_c and U_t are the orbital velocities under crest and trough, respectively, and asymmetry, $Asy = (T_t - T_c)/(T_t + T_c)$ where T_c is the time of rapid velocity increase from U_t to U_c and T_t is the time of decreasing velocity from U_c to U_t . Note that, with these definitions, Skw and Asy are zero for a sinusoidal wave. The prediction of Skw and Asy afforded by the spectral representation of the random waves is, however, based on a single wave characteristic, U_{rms} and T_p , and its accuracy is uncertain. An alternative to the *spectral approach* by TM is a *wave-by-wave approach*, in which the random sea is represented by a series of individual periodic waves, each associated with a certain probability, and the contributions of individual waves are added probabilistically. We have conducted numerical experiments to compare the *spectral* and the *wave-by-wave* approaches, and have reached the following conclusions:

- Hydrodynamic quantities such as H_{rms} , U_{rms} , set-up and undertow are virtually identical for the two approaches
- Skewness and Asymmetry are significantly different, with the *wave-by-wave approach* yielding the better result when compared with experiments [Figure 1 (a) and (b)]
- Net bedload transport predictions by GRM depend strongly on (i) the inclusion of asymmetry; and (ii) on the approach used to represent the random waves [Figure 1(c)]

At the ICCE further details, including the sensitivity of predictions of mean cross-shore suspended sediment transport rates to choice of random wave representation, will be presented and discussed.

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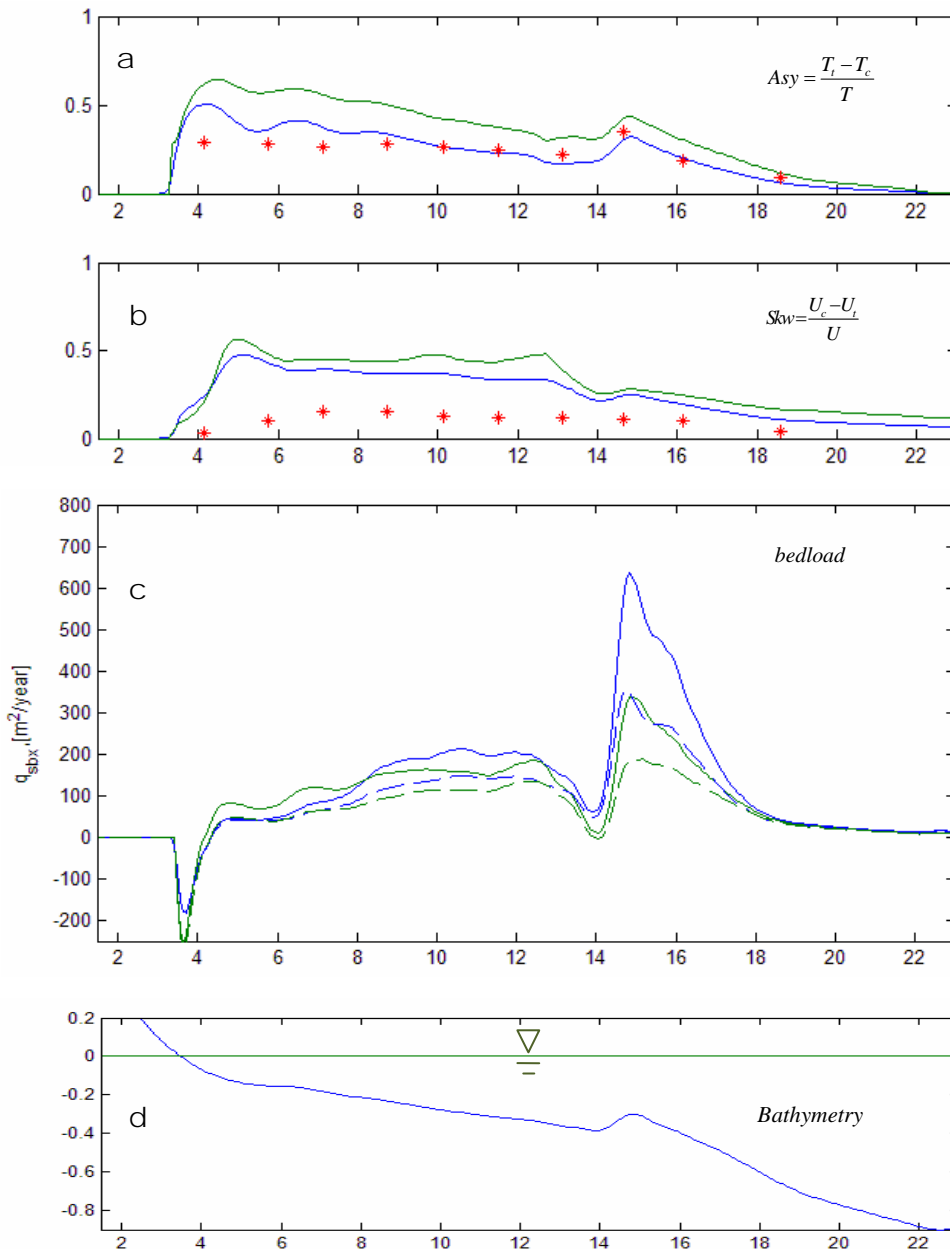


Figure 1 (a) Asymmetry, (b) Skewness (c) Cross-shore net bedload transport rate: *wave-by-wave approach* (blue solid line) with asymmetry, without asymmetry (blue dash line), *spectral approach* (green solid line) with asymmetry, without asymmetry (green dash line) (d) Bathymetry. Experimental results (red asterisks) from Wang et al. (2002) for plunging waves.

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