3D RANS Modeling of Bottom and Bank Stability Subjected by Ship Propeller Jets

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In coastal engineering practice, strong currents generated by ship propellers jets are known to affect biological resources, sediment quality in marine industrial areas, and in some cases are the design condition for bank/slope protection near marine terminals. The Vessel Hydrodynamics Propwash Unsteady (VH-PU) model is a 3-D, non-hydrostatic free-surface model linked with Lagrangian model of sediment transport. Unlike previous propeller wash models, it describes three-dimensional fields of velocities generated by ship propellers, turbulence intensity and length scale in the given domain of arbitrary bottom and coastal topography. The time and space varying bottom shear stresses that cause bottom erosion are calculated, as well as forces due to pressures on submerged boundaries and sediment erosion processes.

The model was developed based on the non-hydrostatic model of Kanarska and Maderich[1] (2003) and uses the 3-D Reynolds-Averaged Navier-Stokes equations. The model of turbulence is a q-q^2l model. The model uses the terrain-following sigma vertical coordinate system and orthogonal curvilinear horizontal coordinate system.

The simulations agree well with the laboratory experiment of Schokking[2] (2002) with propeller jet impacting on an inclined laboratory tank bottom (Figure 1 (a)) and field experiment in (Figure 1 (b)) where bottom velocities predicted by the model shown for a ferry landing at the Port Townsend Ferry Terminal, Puget Sound, WA.

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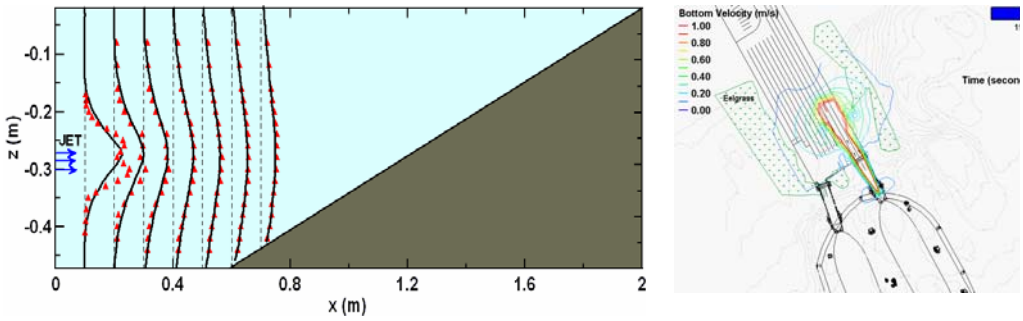

(a) **(b)**

Figure 1. Computed and measured (Schokking 2002[2]) profiles of mean velocities along the jet axis (a). Calculated bottom velocities generated by the ferry (b)

[1] *Kanarska Y, Maderich V.*, Ocean Dynamics **53,** 176 (2003).
[2] *Schokking L.* MS thesis, TUDelft (2002).