3-D MODELING OF NEARSHORE CIRCULATION USING ROMS-SWAN: MODEL UPGRADES AND EVALUATION

By

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ABSTRACT

Regional Ocean Modeling System (ROMS v 3.0), a three dimensional numerical model, was recently modified for shallow water applications by including wave induced radiation stresses provided through coupling with a wave propagation model (e.g., SWAN, REF/DIF). The coupled model has been applied to surf zone applications like oblique incidence of waves on a planar beach, rip current formation in alongshore bar trough morphology (e.g., Haas and Warner, 2009). In this thesis, I present an updated version of the coupled model which implements a new vertical distribution of the radiation stress term based on Mellor (2008) that is more appropriate for sigma coordinates. This is further modified for applications in very shallow waters. In addition, a new wave roller model has been included which solves the roller evolution model for roller energy. The improvements of the updated model are shown through simulations of various cases that include: (a) obliquely incident spectral waves on a planar beach; (b) alongshore variable offshore wave forcing on a planar beach; (c) alongshore varying bathymetry with constant offshore wave forcing; and (d) nearshore barred morphology with rip-channels. Qualitative and quantitative comparisons to previous analytical, numerical and laboratory studies show that the updated model is able to replicate surf zone recirculation patterns (onshore drift at the surface and undertow at the bottom) not observed in previous model versions that included vertical distribution for radiation stresses based on Mellor (2003) and Mellor (2005). The capability of model is further evaluated with comparison to in-situ wave and current parameters measured in the surf zone environment of Long Bay, SC. The effect of wave rollers on velocity profiles has also been discussed.