Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09132, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09132
EGU General Assembly 2008


# Resuspension of sediments in the shoals of Venice Lagoon

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In this work we investigate the role of wind acting on the free surface of a flat shoal. The latter effect is twofold: on one hand, it generates wind waves the amplitude of which is strongly dependent on the shoal depth and on the wind fetch; on the other hand it generates currents driven by the surface setup induced by the shear stress acting on the free surface. The role of wind waves on the stability of the tidal flats in Venice lagoon has been recently investigated by Fagherazzi et al. (Proc. National Academy of Sciences 103, 2006) and Defina et al. (J. Geophys. Res., 112, F03001, 2007) by means of a conceptual model. The hydrodynamics of wind generated currents in closed basins has been lately given some attention by Colombini and Stocchino (Adv. Water Resour. 28, 2005). Since tidal fluxes alone are typically unable to produce the bottom shear stresses necessary to mobilize sediments, then wind waves are left as the main mechanism responsible for sediment resuspension in shoals. However, both the tidal currents and the currents driven by the wind stress and wind setup contribute to determine the sediment flux. As a first step, each contribution is analysed separately. We start neglecting wave breaking and considering the simplest case of linear Stokes waves in shallow depth, generated by a uniform wind field with a constant speed and a limited fetch. The spectra of the linear wave are determined as a function of local depth and fetch length using the field observations of Breugem and Holthuijsen (J. Wtrwy., Port, Coast., and Oc. Engrg., 2007). The maximum bottom shear stress is then calculated by solving for the flow field in the turbulent wave boundary layer following the momentum integral method proposed by Fredsoe and Deigaard (Mechanics of Coastal Sediment Transport, 1992). Results show that since the ability of a Stokes wave to

resuspend sediments is naturally related to its ability to produce turbulence, a correct estimate of the equivalent roughness of the bed is crucial in order to reach any conclusion about the morphological evolution and equilibrium of tidal flats. As for the bottom shear stress induced by a steady wind setup, as a first step we have ignored the finite length of the shoal and evaluated it employing a simple parabolic distribution of eddy viscosity resulting in a double-logarithmic velocity distribution with a zero mean value in the vertical plane. Results show that the values of the bottom shear stress induced by wind setup is small compared with those associated with the wind waves. However, the flow field induced by wind setup turns out to be as significant as tidal currents in determining the direction and the intensity of the advected sediment flux. The consequences of the above picture on shoal stability are finally outlined.