The use of Navier Stokes models in Coastal Engineering

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The use of Navier-Stokes (NS) equations applied to coastal engineering processes is one of the main advances of the field over the last decade. There are several reasons to explain the increasing popularity of that approach. The increment of the computational resources and the improvement of the numerical aspects mainly related with the boundary conditions has made possible to overcome the inherent limitations of classical depth averaged models. NS models overcome most of the simplifications behind wave theories. The highly non-linear and highly dispersive nature of the NS equations allows modelling complex wave transformation processes, as the ones that appears in the interaction of waves with coastal structures. Moreover, they do not require empirical formulations in order to trigger breaking and to determine the breakpoint location such as it is required for Boussinesq-type models. Two-dimensional Reynolds Averaged Navier-Stokes (RANS) models (Losada et al., 2008; Lara et al., 2008; Guanche et al., 2009) have revealed that structural functionality and stability can be studied with a high degree of accuracy, even in the presence of granular material layers. Volume-Averaged Reynolds-Averaged Navier-Stokes equations (VARANS) have been solved to characterize wave induced flows within porous structures. Nowadays the computational cost is suitable to be applied to solve real problems. Recently, VARANS equations has been extended to three-dimensional problems (del Jesus et al., 2012; Lara et al., 2012) showing a high degree of accuracy in predicting magnitudes related with the functionality and the stability of coastal porous structures. Wave transformation processes around coastal structures, such as wave reflection, wave penetration through porous structures, wave diffraction, run-up, and wave breaking can be now analyzed in three-dimensional problems. During the presentation, an overview of the two-dimensional applications of NS models to coastal engineering will be done. A methodology of applicability of such as models in real problems will be explained. Recent advances on the prediction of wave transformation processes in three-dimensional modelling will be shown, paying especial attention to boundary conditions and wave induced flow to within porous media.