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A novel large-scale phase-resolved wave modelling approach for complex coastlines solving the Non-Hydrostatic Navier-Stokes equations

Arun Kamath, Weizhi Wang, and Hans Bihs
Department of Civil and Environmental Engineering, NTNU Trondheim, Norway (arun.kamath@ntnu.no)

The Norwegian coastline presents unique challenges for numerical wave modelling. These coasts are characterised by a steep continental shelf, deep water, fjords and scattered islands in front of the mainland. Typical large scale wave modelling approaches are based on assumptions such as a mildly sloped bottom and shallow water. As a result, the interaction of waves with obstacles such as wave diffraction and wave dispersion are not accurately accounted for. The different wave interaction processes, wave dispersion and transformation under atypical conditions can be studied using a high-resolution phase-resolving model, which efficiently utilizes the high performance computational resources available today. In this study, the capabilities of a fully parallel, large-scale, phase-resolving numerical wave modelling approach based on the Navier-Stokes equations is presented. The computing cost is reduced by calculating the free surface using the continuity equation which can represent the free surface accurately with coarser computational grids. This novel approach can be used to obtain further insight into the wave propagation and transformation problems from offshore waters into special conditons at the coast.