NHWAVE is a surface and terrain-following 3D code in sigma coordinates, originally designed to model fully dispersive and nonlinear surface wave propagation, breaking and runup/inundation. The model employs a MUSCL-TVD Godunov-type finite volume formulation together with Runge-Kutta time stepping. Non-hydrostatic pressure corrections are computed from the solution of the pressure Poisson equation, using the package HYPRE. The code is written using MPI for parallelization. It is copyrighted under the GPL and is freely available as source code. The original development of the model is described in Ma et al. (2012), where the first use of the code to model landslides is described based on the motion of a solid object on the bottom, using the case given as Benchmark 2 in this workshop. Derakhti et al (2016) revised several aspects of the basic formulation and improved the k-epsilon turbulence closure using a RNG-based approach. This revised code is the basis for the benchmark testing here.

The model has since been extended to incorporate a number of additional features. For tsunami applications, Ma et al. (2013b) first incorporated a concentration field treating the landslide volume as a continuous and variable density field. Ma et al. (2015) alternately introduced a formulation based on a discrete, depth-integrated lower slide layer coupled to the 3D hydrodynamic field above, with the lower layer using a granular debris flow formulation for a saturated medium. Alternately, Kirby et al. (2016) and Grilli et al. (2016) have used a lower layer based on a viscous Newtonian fluid with uniform viscosity. Results from each of these formulations are described in the workshop. The model has further been extended to incorporate the effects of vegetation (Ma et al. 2013a), and immersed boundary techniques have been incorporated to allow for modeling of flow around three dimensional objects (Ma et al, 2016).

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