Modeling wave induced pore pressure and effective stress in an inelastic seabed

Luc Scholtès [1], Bruno Chareyre [2] and Hervé Michallet [3]
[1] CNRS/Université de Lorraine, UMR GeoRessources, 54518 Vandoeuvre-lès-Nancy cedex
[2] CNRS/UJF/G-INP, UMR 3S-R, 38041 Grenoble cedex 9
[3] CNRS/UJF/G-INP, UMR LEGI, 38041 Grenoble cedex 9

The response of a sandy seabed under wave loading is investigated on the basis of numerical modeling using a multi-scale approach. To that aim, the discrete element method is coupled to a finite volume method specially enhanced to describe compressible fluid flow. Both solid and fluid phase mechanics are upscaled from considerations established at the pore level. Model's predictions are validated against poroelasticity theory and discussed in comparison with experiments where a sediment analog is submitted to wave action in a flume. Special emphasis is put on the mechanisms leading the seabed to liquefy under wave induced pressure variation on its surface. Liquefaction is observed in both dilative and compactive regimes. It is shown that the instability can be triggered for a well identified range of hydraulic conditions. Particularly, the results confirm that the gas content, together with the permeability of the medium are key parameters affecting the transmission of pressure inside the soil.