EGU2020-4990
https://doi.org/10.5194/egusphere-egu2020-4990
EGU General Assembly 2020
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Hydro-morphodynamics 2D modelling using a discontinuous Galerkin discretisation

Mariana Clare[1], James Percival[2], Stephan Kramer[2], Athanasios Angeloudis[3], Colin Cotter[2], and Matthew Piggott[2]

[1]Imperial College London, United Kingdom of Great Britain and Northern Ireland (mc4117@imperial.ac.uk)
[2]Imperial College London, United Kingdom of Great Britain and Northern Ireland
[3]University of Edinburgh, United Kingdom of Great Britain and Northern Ireland

The development of morphodynamic models to simulate sediment transport accurately is a challenging and highly complex process given the non-linear and coupled nature of the sediment transport problem. We implement a new depth-averaged coupled hydrodynamic and sediment transport model within the coastal ocean model Thetis, built using the code generating framework Firedrake which facilitates code flexibility and optimisation benefits. To the best of our knowledge, this represents the first full morphodynamic model using a discontinuous Galerkin based finite element discretisation, to include both bedload and suspended sediment transport. We apply our model to problems with non-cohesive sediment and account for effects of gravity and helical flow by adding slope gradient terms and parametrising secondary currents. For validation purposes and to demonstrate model capability, we present results from the common test cases of a migrating trench and a meandering channel comparing against experimental data and the widely used model Telemac-Mascaret.

There is a high degree of uncertainty associated with morphodynamic models, in part due to incomplete knowledge of various physical, empirical and numerical closure related parameters in both the hydrodynamic and morphodynamic solvers. We therefore also present examples of how an adjoint model can be used to calibrate or invert for the values of these parameters from either experimental results or real-world erosion profiles.