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# Bottom friction optimization for barotropic tide modelling using the HYbrid Coordinate Ocean Model

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We can list several ways to improve tide modelling at a regional or coastal scale: a more precise and refined bathymetry, better boundary conditions (the way they are implemented and the precision of global tide atlases used) and the representation of the dissipation linked to the bottom friction. Nevertheless, the most promising improvement is the bottom friction representation. Indeed, bathymetric databases, especially in coastal areas, are more and more precise and global tide models performances are better than ever (mean discrepancy between models and tide gauges is about 1 cm for M2 tide).

Bottom friction is often parameterized with a quadratic term and a constant coefficient generally taken between 2.5 10-3 and 3.0 10-3. Consequently, we need a more physically consistent approach to improve bottom friction in coastal areas. The first improvement is to enable the computation of a time- and space-dependent friction coefficient. It is obtained by vertical integration of a turbulent horizontal velocity profile. The new parameter to be prescribed for the computation is the bottom roughness, z0, that depends on a large panel of physical properties and processes (sediment properties, existence of ripples and dunes, wave-current interactions, ...).

The context of increasing computer resources and data availability enables the possibility to use new methods of data assimilation and optimization. The method used for this study is the simultaneous perturbation stochastic approximation (SPSA) which consists in the approximation of the gradient based on a fixed number of cost function measurements, regardless of the dimension of the vector to be estimated. Indeed, each cost function measurement is obtained by randomly perturbing every component of the parameter vector. An important feature of SPSA is its relative ease of implementation. In particular, the method does not require the development of linear and adjoint version of the circulation model. The algorithm is tested and validated with the HYbrid Coordinate Ocean Model (HYCOM) in barotropic mode (one isopycnal layer), using twin experiments (the observations are obtained with the direct model, prescribing the reference parameter distribution). The modeled area is the Bay of Biscay and the English Channel and the estimated parameter is the bottom roughness (z0).