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Bottom friction optimization for a better barotropic tide modelling

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At a regional scale, barotropic tides are the dominant source of variability of currents and water heights. A precise representation of these processes is essential because of their great impacts on human activities (submersion risks, marine renewable energies, ...). Identified sources of error for tide modelling at a regional scale are the followings: bathymetry, boundary forcing and dissipation due to bottom friction. Nevertheless, bathymetric databases are nowadays known with a good accuracy, especially over shelves, and global tide models performances are better than ever. The most promising improvement is thus the bottom friction representation.

The method used to estimate bottom friction 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 tangent linear and adjoint version of the circulation model.

Experiments are carried out to estimate bottom friction with the HYbrid Coordinate Ocean Model (HYCOM) in barotropic mode (one isopycnal layer). The study area is the Northeastern Atlantic margin which is characterized by strong currents and an intense dissipation. Bottom friction is parameterized with a quadratic term and friction coefficient is computed with the water height and the bottom roughness. The latter parameter is the one to be estimated. Assimilated data are the available tide gauge observations. First, the bottom roughness is estimated taking into account bottom sediment natures and bathymetric ranges. Then, it is estimated with geographical degrees of freedom. Finally, the impact of the estimation of a mixed quadratic/linear friction is evaluated.