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Identifying the influence of bottom topography and friction on tidal simulations via automatic differentiation

S. Massmann

Alfred-Wegener-Institut, Bremerhaven, Germany (silvia.massmann@awi.de)

We run several 2D finite element and finite volume shallow water models for tidal simulations. The amplitude and phase of the tidal elevation are sensitive to uncertainties in bottom topography and bottom friction. The bottom friction parameter is mainly unknown and often taken as constant over the whole computational domain. The bottom topography can contain unknown errors too. Both are leading to systematics errors in simulations.
With the help of automatic differentiation tools we generate the adjoint model and are able to determine sensitivities to model parameters and boundary conditions. By comparing the spatial distribution and the magnitude of the sensitivities we distinguish the relative importance of uncertainties in bottom friction and bottom topography.
First we apply the adjoint model to a channel test case to validate the automatic generation of the derivatives and the physical output of the model. The next step is to run the model on a North and Baltic Sea grid and to use tide gauges or altimeter data in a point-wise sense to map the regions where topography and bottom friction have the strongest impact on the deviation of model from the observational data. In this sense we hope to determine regions that should be well represented in order to have good results in the whole domain.