Abstract View

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Tidal Spectroscopy of the English Channel with a Numerical Model

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ABSTRACT

The possibility of reproducing the complexity of tides in shallow water areas with a classical finite difference numerical model is examined. This hydrodynamic model is two-dimensional but incorporates topography, nonlinear advection and quadratic bottom friction. Particular care is taken to prescribe sea surface elevations at the open boundaries.

A one-month simulation of “real” tides is run with a simplified spectrum restricted to only 24 constituents, corresponding to the nine main astronomical tides and their nonlinear significant interactions. The results are analyzed by spectral decomposition (elevations and vertically integrated currents) and compared with observational data from the tide gages and current meters, and with other solutions produced in the literature.

It is found that:

1. the dominant M_2 constituent greatly influences the damping of the other constituents, so that it is necessary to run them together for any correct simulation; however, the quadratic friction law introduced in the present simulation appears to overdamp these secondary waves by about 5%, without any possible compromise.
2. the nonlinear interaction constituents are remarkably reproduced: for the semidiurnal, quarter-diurnal and six diurnal groups, the precision is within some few centimeters.
3. coherent vertically integrated residual current patterns can be deduced from that simulation, with semimonthly and monthly modulations, which correspond to local nonlinear processes and to permanent inflow–outflow boundary forcing.

A hindcast of the tidal flow observed at a particular area shows the possibility of using that set of results for tidal current predictions.

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