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Idealized modelling of tide propagation in large-scale semi-enclosed basins

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To investigate the influence of basin geometry and topography on tidal dynamics in large-scale semi-enclosed basins, an idealized model is presented. Key aspects of the model are its geometry, solution method and validation strategy. The geometry is a sequence of adjacent rectangular compartments of uniform width and depth that can be fitted to the coastline and topography of e.g. the North Sea. The solution in each compartment, satisfying the depth-averaged shallow water equations including rotation and bottom friction, is written as the sum of fundamental wave solutions (Kelvin and Poincaré modes). To validate the model, widely available coastal tide observations of several tide constituents are projected onto the schematized model boundaries. This leads to good agreement and helps to unravel the dominant processes for various basins. We thus encounter examples of topographically induced resonance (Gulf of California), weak amplification (Adriatic Sea) and lateral depth changes (Persian Gulf). Finally, the complexity of tides in the North Sea is highlighted by discussing the roles of the Southern Bight and the two open boundaries.