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High-resolution barotropic tide modelling in the South China Sea

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The South China Sea (SCS) links two of the largest open oceans, the Pacific and the Indian, mainly through the Luzon-Taiwan Straits in the northeast and the Malacca-Karimata Straits in the southwest, respectively. It has a rhino-like shape of 3000-km long, whose belly is contiguous to Vietnam and back leans on the Philippines. The highly irregular topography includes the Gulf of Tonkin in the north, the Gulf Thailand in the southwest, and several small islands in the middle of SCS (i.e. the Spratly and the Paracels) resulting in complicated astronomic tides and tidal dynamics in this region. In this study, we present high-resolution simulation of tides in the SCS using the Semi-Implicit Eulerian–Lagrangian Finite-Element (SELFE) model. We derive the bathymetry from the Shuttle Radar Topography Mission (SMRT) 15-arc second dataset, one of the finest global topography data sources. Our particular interest is to resolve small bathymetry features and islands in the middle of the SCS which we obtained by digitizing very-high resolution satellite images (30-m accuracy). An unstructured triangular mesh comprising of up to 5 million nodes is generated to resolve these features with very high accuracy, while maintaining fairly coarse resolution in rest of the domain. The model is configured to run in barotropic mode by forcing harmonic oscillations from FES2012 global tide predictions along open boundaries, adjusted to account for volume transport at key channels in the SCS. Computed surface elevations and currents agree well with available tide predictions and measurements. Sensitivity study is performed to analyze the role of the small bathymetry features on distorting tides in the SCS.