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Oceanic signals in rapid polar motion: results from a barotropic forward model with explicit consideration of self-attraction and loading effects

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Numerical modeling of non-tidal variations in ocean currents and bottom pressure has played a key role in closing the excitation budget of Earth's polar motion for a wide range of periodicities. Non-negligible discrepancies between observations and model accounts of pole position changes prevail, however, on sub-monthly time scales and call for examination of hydrodynamic effects usually omitted in general circulation models. Specifically, complete hydrodynamic cores must incorporate self-attraction and loading (SAL) feedbacks on redistributed water masses, effects that produces ocean bottom pressure perturbations of typically about 10% relative to the computed mass variations. Here, we report on a benchmark simulation with a near-global, barotropic forward model forced by wind stress, atmospheric pressure, and a properly calculated SAL term. The latter is obtained by decomposing ocean mass anomalies on a 30-minute grid into spherical harmonics at each time step and applying Love numbers to account for seafloor deformation and changed gravitational attraction. The increase in computational time at each time step is on the order of 50%. Preliminary results indicate that the explicit consideration of SAL in the forward runs increases the fidelity of modeled polar motion excitations, in particular on time scales shorter than 5 days as evident from cross spectral comparisons with geodetic excitation. Definite conclusions regarding the relevance of SAL in simulating rapid polar motion are, however, still hampered by the model's incomplete domain representation that excludes parts of the highly energetic Arctic Ocean.