SCORE: **S**imulating **O**ceanic **C**ontributions to **E**arth **R**otation

A multi-faceted project is proposed that explores hitherto unconsidered aspects of Earth rotation dynamics in relation to the ocean's circulation and its mass-field variability on sub-monthly time scales. The immediate motivation behind this study is for accurate oceanic angular momentum (OAM) estimates to be used in a priori models of Earth rotation and in the analysis of space geodetic observations, but implications also exist for satellite gravimetry-based climate sensors. The principal method consists of a forward integration of the barotropic (depth-independent) ocean state in response to atmospheric pressure and wind stress forcing. Control runs with an elaborate multi-layer model are also part of the project, which spans two distinct areas of operation.

First, it is suggested that the seesawing of the tropical weather and atmospheric pressure between warm and cold phases of the El Niño-Southern Oscillation (ENSO) entails significant modulations of the diurnal oceanic S_1 tide and that the associated redistribution of water masses alters the prograde annual nutation of the Earth in space. This hypothesis draws on previous reports of an ENSO signature in the diurnal atmospheric tide and the fact that air pressure loading in low latitudes determines the global character of S_1 in the oceans. We will address this subject matter with well-configured multi-year S_1 forward integrations, using an explicit account of self-attraction and loading (SAL) effects at each time step and a parameterized formulation of internal wave drag in all barotropic runs. Three-hourly pressure forcing fields come from a selection of modern-day atmospheric assimilation systems, though cases of artificial long-term variability in the diurnal band should be identified and removed based on comparisons to tidally-analyzed in situ recordings from equatorial island and buoy barometers. Forward-modeled OAM integrals of S_1 will ultimately allow for an estimation of recent ENSO signals in Earth's nutation and lend themselves to an independent validation against observed celestial pole offsets.

The project is complemented by a systematic study of the dynamic ocean response to atmospheric disturbances on time scales dominated by barotropic motions (2–20 days). The particular objective is to clarify the relevance of SAL, interval wave drag, fine horizontal resolution, and Arctic ocean mass redistributions in simulating rapid polar motion and in reducing remaining discrepancies between observed and geophysically modeled Earth rotation signals. Guidance in optimizing the barotropic model in terms of dissipation and horizontal discretization will be provided by space geodetic polar motion series as well as measurements of ocean bottom pressure variability from daily satellite-based gravity field solutions.

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