Geophysical Research Abstracts
Vol. 19, EGU2017-19336-1, 2017
EGU General Assembly 2017

Spectral analysis of one-way and two-way downscaling applications for a tidally driven coastal ocean forecasting system

Miguel Solano (1), Juan Gonzalez (2), Miguel Canals (2), Jorge Capella (2), Julio Morell (2), and Stefano Leonardi (1)

(1) The University of Texas at Dallas, (2) University of Puerto Rico Mayaguez

A prevailing problem for a tidally driven coastal ocean has been the adequate imposition of open boundary conditions. This study aims at assessing the role of open boundary conditions and tidal forcing for one and two way downscaling applications at high resolution. The operational system is based on the Caribbean Coastal Ocean Forecasting System (COFS) that uses the Regional Ocean Modeling System (ROMS), a split-explicit ocean model in which the barotropic (2D) and baroclinic (3D) modes advance separately. This COFS uses a uniform horizontal grid with 1km resolution, but a grid sensitivity analysis is performed for both one and two way downscaling methodologies with horizontal resolutions up to 700m. Initial and lateral boundary conditions are derived from the U.S Naval Oceanographic Office (NAVOCEANO) operational AmSeas model forecast, a 3-km resolution of the regional Navy Coastal Ocean Model (NCOM) that encompasses the Gulf of Mexico and Caribbean Sea. Meteorological conditions are interpolated from the Navy's COAMPS model with the exception of surface stresses, which are computed from a 2-km application of the WRF model used by NCEP's National Digital Forecast Database. Tidal forcing is performed in two different ways: 1) tidal and sub-tidal variability is imposed to the barotropic and baroclinic modes by downscaling from the AmSeas NCOM regional model and 2) tidal variability is imposed using ROMS harmonic tidal forcing from OTPS and sub-tidal conditions are imposed by filtering high frequencies out the NCOM regional solution. Special focus is given to the latter approach, where the nudging time scales and the boundary update frequency play an important role in the evolution of the ocean state for short 3-day forecasts. A spectral analysis of the sea surface height and barotropic velocity is performed via Fourier's transform, continuous 1-D wavelet transforms, and classic harmonic analysis. Tide signals are then reconstructed and removed from the OBC's in 3 ways: 1) using Rich Pawlowicz's t_tide package (classic harmonic analysis), 2) with traditional band-pass filters (e.g. Lanczos) and 3) using Proper Orthogonal Decomposition. The tide filtering approach shows great improvement in the high frequency response of tidal motions at the open boundaries. Results are validated with NOAA tide gauges, Acoustic Doppler Current Profilers, High Frequency Radars (6km and 2km resolution). A floating drifter experiment is performed in coastal zones, in which 12 drifters were deployed at different coastal zones and tracked for several days. The results show an improvement of the forecast skill with the proper implementation of the tide filtering approach by adjusting the nudging time scales and adequately removing the tidal signals. Significant improvement is found in the tracking skill of the floating drifters for the one-way grid and the two-way nested application also shows some improvement over the offline downscaling approach at higher resolutions.