How are Open-Ocean Dynamic Sea Level Signals Communicated to the Coast?

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The mainstay of ocean dynamics theory is geostrophic balance. However, a purely geostrophic flow would result in each coastline being a line of constant dynamic topography, i.e. sea level would be constant along the coast. This is clearly not the case, a fact which may be the result of either processes local to the coastal region, or the influence of dynamical processes from the deep ocean. Here, we investigate the latter. Using a combination of high resolution ocean model data, tide gauges and geodetic observations, and theoretical investigations, we find that the continental slope acts to smooth ocean-driven variations over very large length scales (over 10,000 km on the ocean's eastern boundary), that eastern boundary mean slopes are very robust, that sharp steps in the mean and the long period variability are associated with western boundary currents, and that some quite surprising geometrical properties of the continental slope determine where those steps occur. We also find that European time-mean sea level is significantly influenced by the surface inflow into the Mediterranean Sea. These findings emphasize the importance of processes at the (often very poorly resolved) continental slope, and suggest useful future directions to assess the reliability of climate model predictions of coastal dynamical sea level change.

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