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Assessing the vertical structure of baroclinic tidal currents in a global model

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Tidal forcing plays an important role in many aspects of oceanography. Mixing, transport of particulates and internal wave generation are just three examples of local phenomena that may depend on the strength of local tidal currents. Advances in satellite altimetry have made an assessment of the global barotropic tide possible. However, the vertical structure of the tide may only be observed by deployment of instruments throughout the water column. Typically these observations are conducted at pre-determined depths based upon the interest of the observer. The high cost of such observations often limits both the number and the length of the observations resulting in a limit to our knowledge of the vertical structure of tidal currents. One way to expand our insight into the baroclinic structure of the ocean is through the use of numerical models.

We compare the vertical structure of the global baroclinic tidal velocities in 1/12 degree HYCOM (HYbrid Coordinate Ocean Model) to a global database of current meter records. The model output is a subset of a 5 year global simulation that resolves the eddying general circulation, barotropic tides and baroclinic tides using 32 vertical layers. The density structure within the simulation is both vertically and horizontally non-uniform. In addition to buoyancy forcing the model is forced by astronomical tides and winds. We estimate the dominant semi-diurnal (M2), and diurnal (K1) tidal constituents of the model data using classical harmonic analysis. In regions where current meter record coverage is adequate, the model skill in replicating the vertical structure of the dominant diurnal and semi-diurnal tidal currents is assessed based upon the strength, orientation and phase of the tidal ellipses. We also present a global estimate of the baroclinic tidal energy at fixed depths estimated from the model output.