Identifying spatial and temporal oceanic scales constrained by existing and future observations

Ocean monitoring and predicting systems combine information from ocean observations and numerical models through advanced data assimilation techniques and are essential to monitor and report on past, present and future marine conditions. However, given the continuous development of oceanic models and data assimilation techniques in addition to the increased diversity of assimilated in situ platforms, it becomes more and more difficult (i) to establish how information from observations is used, and (ii) to determine the utility and relevance of a change of the global ocean observing system on ocean analyses. Here, based on a series of observing system simulation experiments (OSSE), we will first demonstrate that satellites information, mostly through altimetric data, strongly constrain mesoscale variability, while impacts of in situ temperature and salinity profiles dominate at large scale variability. It is also shown that future enhancements of Argo and tropical mooring arrays observations will likely be beneficial to ocean analyses at both intermediate and large scales, with a higher impact for salinity-related quantities. In the second part, the ability of the GLORYS12 reanalysis to represent oceanic processes at intraseasonal and higher-frequency scales will be investigated by comparing to a twin-free simulation (with no assimilation) in the Tropical Pacific Ocean. Spectral analyses show that data assimilation improves the realism of sea surface height intraseasonal variability in the entire Tropical Pacific Ocean, both in amplitude and phase, with an increase in amplitude of more than 50% for the 20-90 days band, and up to 15% for the 2-20 days band. The improvement is largest along the 5°N/S latitudes, where the magnitude of tropical instability waves is maximum, but is limited along the equator where steric height variability is dominated by intraseasonal oceanic Kelvin waves, already well-represented in the free simulation. This highlights the significant value of both in situ and satellite observations in constraining ocean models across various timescales.

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