Joint altimetric and in-situ data assimilation using the GRACE mean dynamic topography: a 1993-1998 hindcast experiment in the Tropical Pacific Ocean

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The altimetric satellite signal is the sum of the geoid and the dynamic topography, but only the latter is relevant to oceanographic applications. Poor knowledge of the geoid has prevented oceanographers from fully exploiting altimetric measurements through its absolute component, and applications have concentrated on ocean variability through analyses of sea level anomalies. Recent geodetic missions like CHAMP, GRACE and the forthcoming GOCE are changing this perspective. In this study, data assimilation is used to reconstruct the Tropical Pacific Ocean circulation during the 1993–1996 period. Multivariate observations are assimilated into a primitive equation ocean model (OPA) using a reduced order Kalman filter (the Singular Evolutive Extended Kalman filter). A 6-year (1993–1998) hindcast experiment is analyzed and validated by comparison with observations. In this experiment, the new capability offered by an observed absolute dynamic topography (built using the GRACE geoid to reference the altimetric data) is used to assimilate, in an efficient way, the in-situ temperature profiles from the TAO/TRITON moorings together with the Topex/Poseidon and ERS1&2 altimetric signal. GRACE data improves compatibility between both observation data sets. The difficulties encountered in this regard in previous studies such as Parent et al. (JMar Syst 40–41: 381–401, 2003) are now circumvented. This improvement helps provide more efficient data assimilation, as evidenced, by assessing the results against independent data. This leads in particular to significantly more realistic currents and vertical thermal structures.

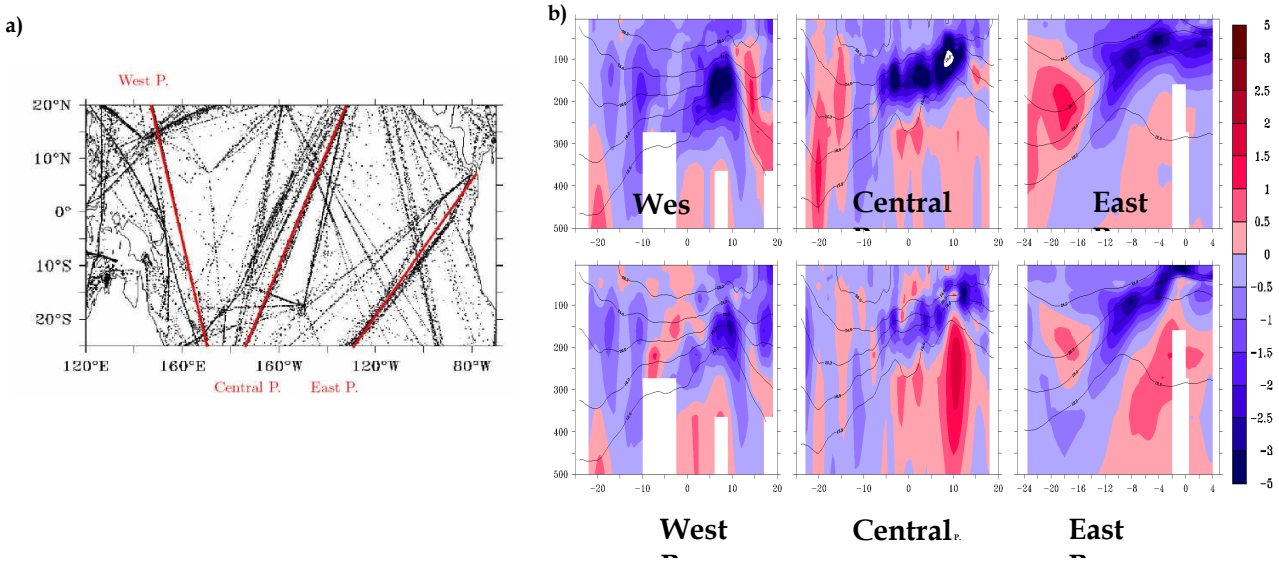

Figure: (a) Selection of the Western, Central, and Eastern Pacific ship lines. (b) Mean temperature difference between the XBT data and the simulations without (top) /with (bottom) assimilation.

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