Application of a model-based mapping tool for Argo observations

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objective

We are motivated to develop a system for producing routine, near real-time, global maps of potential temperature and salinity observations from the Argo array.

Analysis System

We calculate two-dimensional maps of potential temperature (T) and salinity (S) using two different mapping tools; a traditional Optimal Interpolation (OI) system with isotropic, homogeneous Gaussian covariances; and a model-based Ensemble OI (EnOI) with anisotropic, inhomogeneous covariances.

The covariances for EnOI are derived from a 144-member ensemble of seasonal-interannual anomalies. These anomalies are generated by removing 2-month averages from a 12-year average field using output from the Ocean Forecasting Australia Model[1]. The EnOI covariances are localized using the same 10x10º Gaussian correlation function that is used for OI.

Both OI and EnOI require estimates of the observation and background field errors. In practice, all that is important is the ratio of these estimates. To facilitate a fair comparison, the ratio of the observation error, to background error is set to 0.2 for both mapping tools. We have produced weekly maps of T and S for 2004, using a 7-day centered data window and a seasonal climatology as the background field.

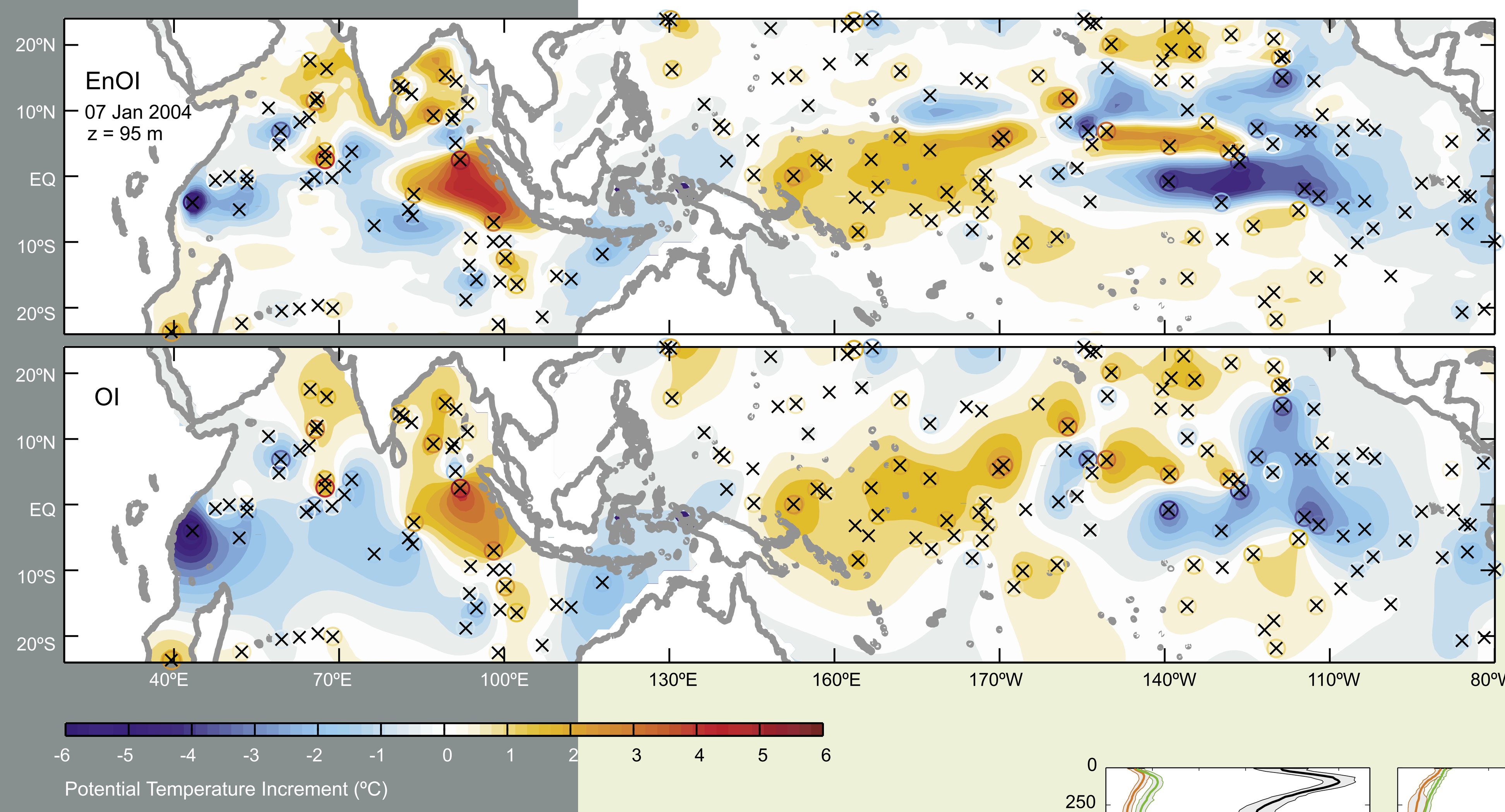

Figure 1: Potential temperature at 95 m depth produced using EnOI (top) and OI (bottom); locations of Argo observations are denoted by crosses.

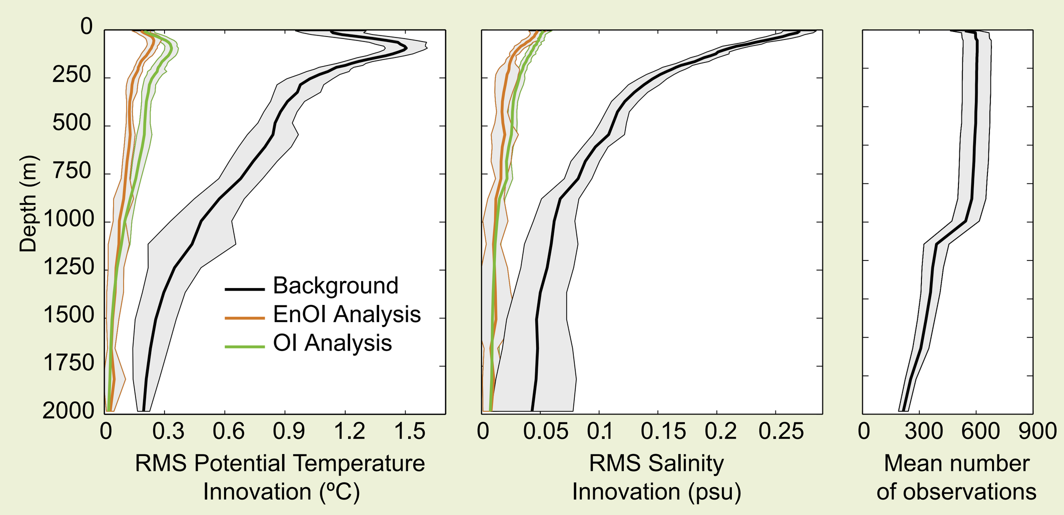

Figure 2: Root-mean-squared innovations of T (left) and S (middle); and the mean number of observations used for each map (right).

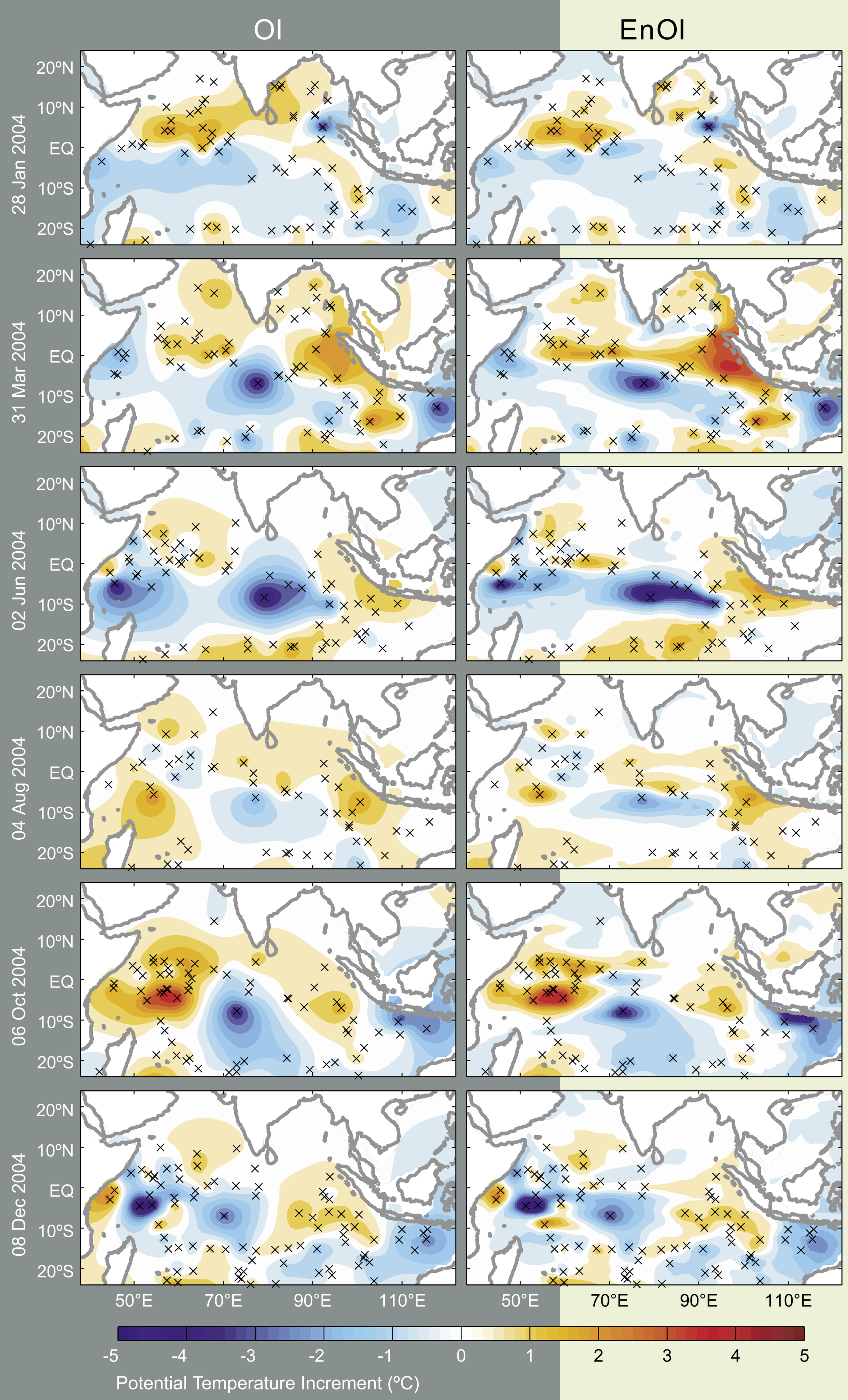

Figure 3: Maps of T anomalies at 55 m depth in the tropical Indian Ocean produced using OI (left) and EnOI (right) during 2004.

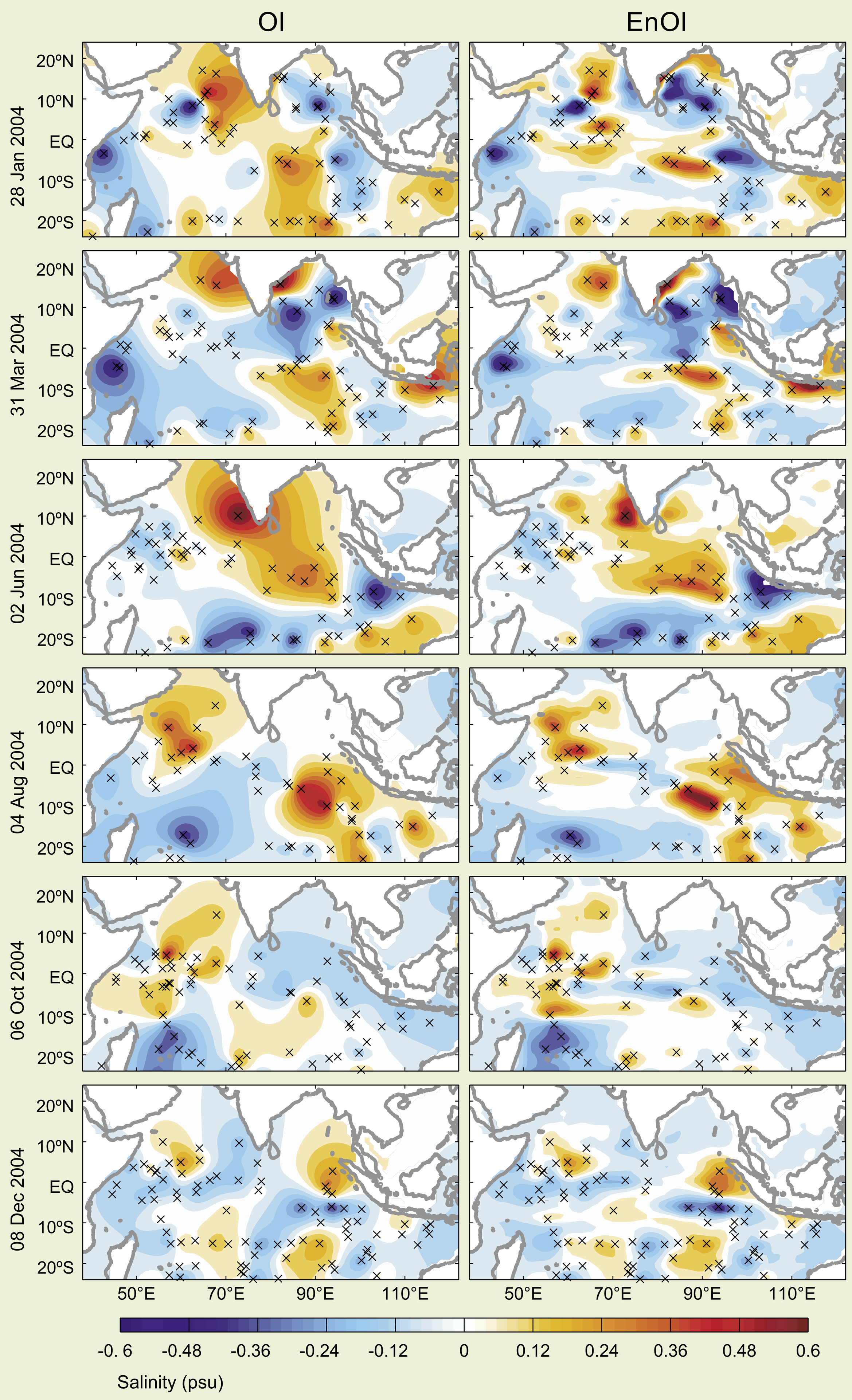

Figure 4: As for Figure 3, except for S.

Results

An example of the T increments (anomalies) across the equatorial Indian and Pacific basin is shown in **Figure 1**. This example demonstrates that EnOI produces fields that are arguably more realistic with longer (shorter) zonal (meridional) length-scales that better represent the equatorial and coastal wave fields.

The root-mean-squared (RMS) misfits, or innovations, between the observed T and S and the background and analysed fields are shown in **Figure 2**. These statistics demonstrate that EnOI produces a better fit to observations than OI.

A series of examples of mapped T and S anomalies in the tropical Indian Ocean are shown in **Figure 3** and **4**. Again the comparison between OI and EnOI demonstrates that EnOI produces fields that are more realistic.

Salinity mapping

We are motivated to routinely produce maps of S on potential density surface in order to monitor interannual variability and possibly to identify drift in salinity observations. Towards this end, spatial auto-correlation functions (ACFs) for S and pressure (P) are produced from Argo observations. Examples of these ACFs (**Figure 5**) highlight the different length-scales for S and P along sigma-surfaces. **Figure 5** also demonstrates that near the equator, the zonal length-scales are much longer than the meridional length-scales; owing to the strong zonal currents. Similar characteristics are evident in model-based estimates of S-S correlations (**Figure 6**) that are produced from the ensemble referred to above.

Conclusions

A system for routinely mapping T and S fields from Argo observations has been developed. We argue that the model-based mapping tool (EnOI) produces more realistic features and scales; and is a better alternative to OI.

[1] http://www.cmar.csiro.au/bluelink/

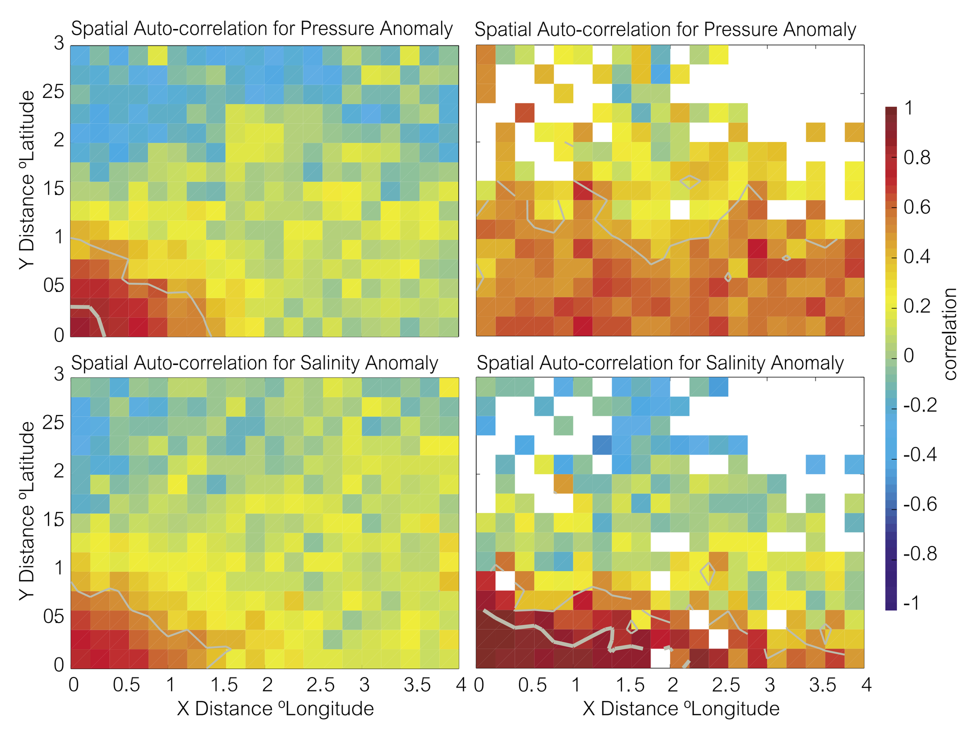

Figure 5: Observation-based estimates of the spatial ACFs for S and P along the 26.7-sigma surface in the Western Pacific near 45ºN (left) and the Eastern Pacific near 5ºS (right) for pressure anomalies (top) and salinity anomalies (bottom).

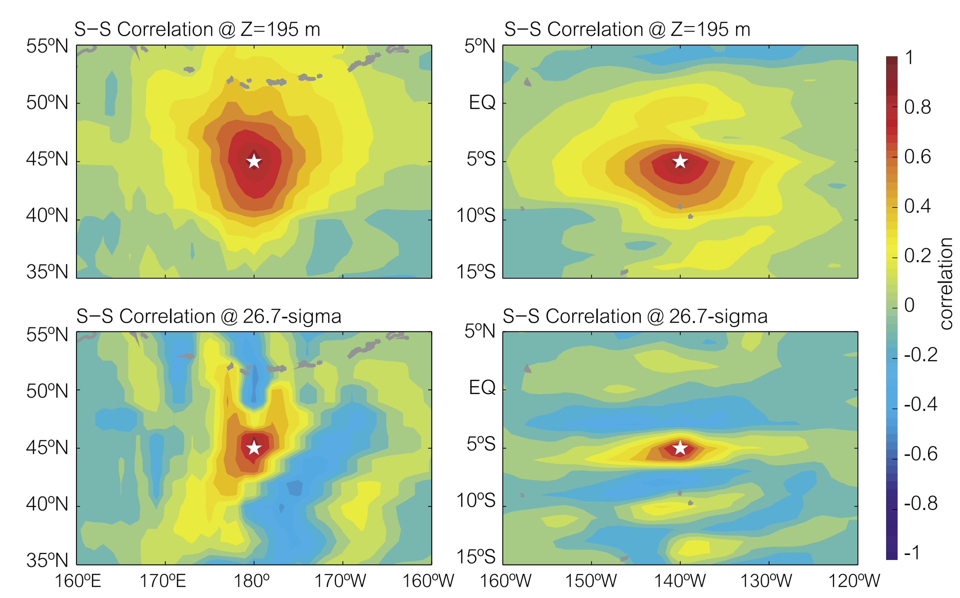

Figure 6: Model-based estimates of correlations between S at a reference point (denoted by the star) and S in the surrounding region for the Western Pacific (left) and Eastern Pacific (right) at 195 m depth (top) and along the 26.7 sigma-surface (bottom).

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