Ocean Data Assimilation at ECMWF

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1 In situ temperature observing system experiment

The relative merits of the TAO/TRITON and PIRATA mooring networks, the VOS XBT network, and the ARGO float network are evaluated through their impact on ocean analyses and seasonal forecast skill. An ocean analysis is performed in which all available data are assimilated. In two additional experiments the moorings and the VOS data sets are withheld from the assimilation. To estimate the impact on seasonal forecast skill, the set of ocean analyses is then used to initialise a corresponding set of coupled ocean-atmosphere model forecasts. A further set of experiments is conducted to assess the impact of the more recent ARGO array. The forecasts mainly indicate that, in the tropical pacific, the TAO in-situ temperature observations are essential to obtain optimum forecast skill. They are best combined with XBT, however, as the combination with XBT data results in better predictions for the east pacific area (Fig. 1 left panel).

2 Altimetry data assimilation in ECMWF seasonal forecast system

In the current ECMWF seasonal forecast system the ocean is initialised by the mean of an Optimal Interpolation scheme using in situ temperature. Three ways of assimilating altimetry data into ECMWF System have been explored. In both the sea level anomaly is translated into a vertical displacement of the Temperature and Salinity profile following Cooper and Haines, 1999 (CH99). This sea-level-derived profiles are then either use as background fields for the OI or used as pseudo-observation and then fed into the temperature OI. The third way is to perform the OI analysis and then apply the CH99 scheme tho this analysis.

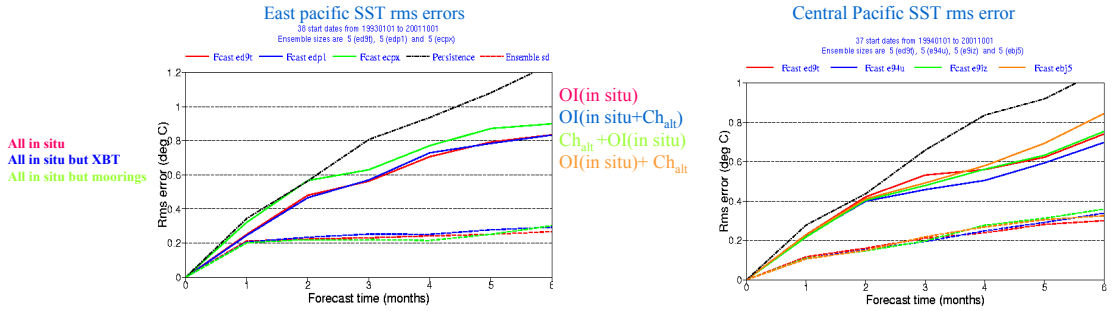

Figure 1: SSTA forecast skill measured by rms-error for coupled experiments. The dot-dash curve is a measure of skill for persistence.

Although both these methods are somewhat more skillful than the temperature only assimilation (see

for instance Fig. 1 right panel), since to compute sea level anomaly, we use the mean sea level from a previous model run, the analysis is far to biased toward this run. Ongoing plans are to use other mean seal levels, such as CLS mean dynamic topography or products derived from the GRACE geoid mission.

3 Assimilation of salinity data

Assimilating salinity data, along with temperature, into ocean models should allow for the better analysis of water properties and volumes over whole regions of the ocean. This would allow for better assessment of climatically important changes in water characteristics, that are normally only possible from repeat section hydrography.

A two-stage process is used. (1) Temperature (from Argo and other data sources, XBT, TAO ...) is assimilated and the salinity is incremented to retain the S(T) relationship present in the model. This has previously been shown to greatly improve the salinity reproduction in the ECMWF model compared with leaving the salinity field unchanged. (2) Then the S(T) (from Argo) is assimilated directly, using a covariance function which is dependent on both horizontal separation and separation in temperature space. The method allows for larger spatial scales to be used, thus allowing a wider influence of the salinity data as a measurement of S(T). Some illustrations of this scale difference from using a conventional covariance function for S will be shown.

Ongoing plans are to produce a 40 year reanalysis of ocean properties and circulation, from which changes in S(T) properties and volumes of water masses can be diagnosed, where and when sufficient data are available.