Improved Understanding and Prediction Application of Altimetry Measurements to Observational and Modeling Studies of the Low-Frequency Upper Ocean Mass and Heat Circulation to Studies of Tropical Ocean Variability

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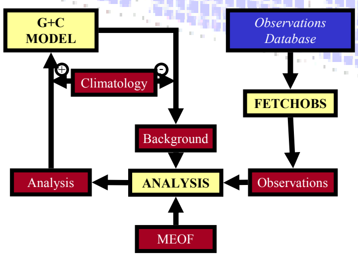
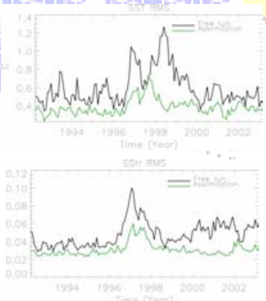
ABSTRACT

Improved understanding and prediction of seasonal to interannual climate variability is a priority of the WCRP CLIVAR Program (Climate Variability and Predictability), the US Climate Change Science Program, and the climate program of France. In support of this priority, NASA and CNES are developing the use of remotely-sensed and in situ observations to monitor, describe, and understand seasonal-to-interannual variability, with the aim of developing and improving the capability to predict socio-economically important climate system events. Studies of the interannual variability of the tropical Oceans are extremely well suited for the utilization of satellite altimeter data. This poster is designed to summarize the latest work in this area.

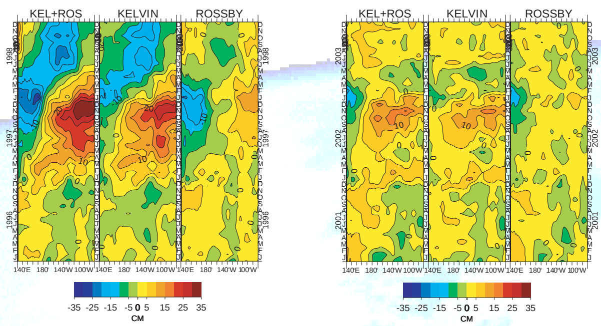
ENSEMBLE REDUCED ORDER KALMAN FILTER DATA ASSIMILATION SYSTEM





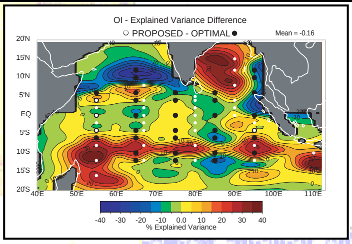
A multivariate data assimilation system has been implemented to simultaneously assimilate multiple ocean parameters into the Gent and Cane ocean model. The method is based upon the equations of the SEEK filter. In such an approach, the multivariate EOFs of the model are used to propagate the information from the observations to the model space. Previous experiments with the SEEK filter required the system to be reinitialized every 12 months because of the collapse of the background error covariance matrix. An ensemble approach has been successfully applied here allowing a continuous data assimilation experiment from January 1993 through December 2003. Validation of the data assimilation is done by withholding 400 observation points of each parameter being assimilated. Assimilation is shown to reduce the error at the withheld points both at the beginning and the end of the assimilation period, which is expected in stable data assimilation systems. For more information on this data assimilation technique see Poster G2.

COMPARISON BETWEEN 1997 AND 2002 EL Niño Events



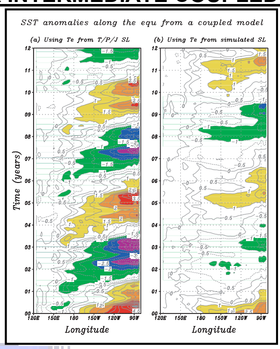
A way to differentiate between the 1997 and 2002 El Niño events is to decompose the sea level signal from TOPEX/Poseidon/Jason gridded product into Kelvin and Rossby components. These results show that the two events are remarkably similar up until February of the El Niño year. At that time the 1996-97 event intensified whereas the 2001-02 event weakened before returning in summer of 2002. Above - Assimilation of the Kelvin+Rossby, Kelvin, and Rossby components of the sea level signal is performed on a climatologically forced ocean model and shows the key role of the Rossby wave has on the 1997 event. During the 2002 event the Rossby component showed no appreciable contribution to the warming. For more detailed information regarding the comparison between the 1997 and 2002 events see poster G14.

INDIAN OCEAN OBSERVING SYSTEM SIMULATION EXPERIMENT



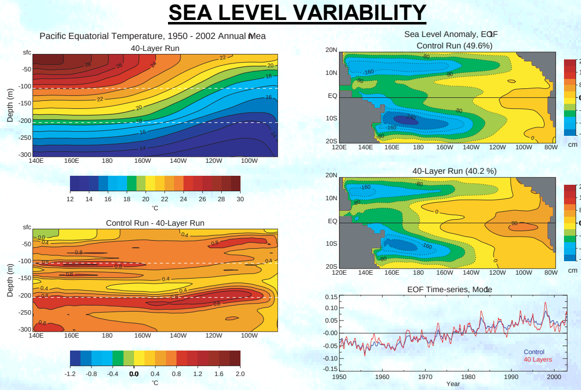
The Indian Ocean Panel of CLIVAR has proposed an array of 35 moorings that is designed to observe the large-scale dynamical variability in the tropical Indian ocean. These stations span the region 55°E to 95°E and vary in latitude between 12°S to 8°N. The goal of this research is twofold: first, we objectively determine the OPTIMAL locations through analysis of the error field of a reduced-space Kalman filter. Second, we investigate the simplification of the proposed array by identifying stations providing redundant information. The difference between the variance explained by our OPTIMAL results and the PROPOSED mooring locations (above) show that an array set-up with evenly divided mooring lines along the equator best reproduces the entire error field from this limited subset. For more information on the results of the Indian Ocean OSSE see Poster G15.

IMPROVEMENT OF TEMPERATURE ENTRAINMENT MODEL FOR INTERMEDIATE COUPLED MODELS



The impact of using T/P/J sea level data on interannual variability is examined using the intermediate ocean model and coupled model (ICM). Observed Topex/Poseidon/Jason-1 altimeter sea level data are used to improve an empirical parameterization of temperature of subsurface water entrained into the mixed layer (T_e). As a result, the use of T/P/J SL data leads to better SSTA simulations in the region, with the largest coherent area of improvement in the eastern equatorial basin. Furthermore, as shown in the above figure, the coupled system using the T_e^{obs} model exhibits more realistic properties of interannual variability (the oscillation period, spatial structure, and temporal evolution), consistent with the 1997-98 El Niño -Southern Oscillation (ENSO) evolution. See Poster G40 for more on this subject.

IMPACT OF THERMOCLINE IMPROVEMENTS ON SEA LEVEL VARIABILITY



It has been shown that the sea level variability in the coupled climate models serves as a good indicator of the early ENSO recharge phase and is also seen to be an important indicator for accurate salinity initialization for 9-12 month lead ENSO forecasts. A forced ocean model is employed to investigate the impact of thermocline improvements on sea level variability. Model experiments include enhanced vertical resolution and sensitivity to vertical mixing in addition to a colder bottom boundary condition which directly impact the mean and variability of the thermocline. It is shown that improvements in model thermocline greatly improve model sea level variability and model simulations of ENSO events in a forced mode. Potential application to coupled climate models are discussed. Poster G24 has more on this subject.

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