A HIGH RESOLUTION GLOBAL OCEAN MODEL with VARIABLE FORCING of WIND, HEAT, & FRESHWATER: I) INITIAL EVALUATION

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Goal: Understand ocean’s low freq. variability

Model Simulation Details
(Semtner & Chervin '92, Stammer, et al. '96, Tokmakian, '96)
• 1/4° avg. Semtner/Chervin Primitive Eq. OGCM
• Parallel Ocean Climate Model POCM-vers 4C
• Forced with ECMWF reanalysis (79-93) + oper. (94-96)
---> heat, freshwater, wind stress - varying daily (river out flow included)
• Parallel Ocean Climate Model POCM-vers 4C
(Semtner & Chervin '92, Stammer, et al. '96, Tokmakian, '96)

Contour: 0.05 cm^2/s^2.

Forcing produces a narrower Kuroshio current.

In the mean, the two velocity sections are very similar. Run 4C, with variable forcing produces a narrower Kuroshio current. Contours are 0.05 cm^2/s^2.

The mean temperature over 8 years has been modified with the use of variable surface fluxes and is cooler than when climatological fluxes are used. Observations (Bryden, et al. ‘91) fall some where in between the two simulations. Contours are 1°C.

The temperature field shows higher variability down to 200 meters with variable surface forcing. In the mean, the model with variable forcing is cooler (top 500 m) than run 4B: & resembles observations better (Roemmich & Wunsch, ’85). Contours are 1°C.

The variability in the velocity of the Gulf Stream is reduced in the 4C run. Contours are 0.05 cm^2/s^2.

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Low Frequency Variability

Empirical Orthogonal Functions were formed from 2°x2° binned model SSH for each 3-day field over 17 years.

The annual and semi-annual cycles were removed and the resulting eof patterns and amp time series are shown at left for the first 5 EOFs.

The predominant signal globally is the ENSO signal.

Comparisons of EOFs of 3 years of T/P altimeter data and model SSH anomalies show similar patterns (includes annual).

For the model SSH, the North Atlantic regional EOFs show the NAO (Hurrell, ’95) index (red line) is related to the second and fourth EOF amp. time series, explaining 15% of the variability. Contours: 3cm

For the North Pacific region, the second EOF amp. is closest to the NP index (Trenberth & Hurrell, ’94). Contours are 10cm.

Evaluation of Model with Observational Data

Tide Gauges

Correlations between tide gauge measurements and model estimates of SSH anomalies.

Excellent correlations can be found in the tropics and above 30°N. Lack of high correlations in the Southern Ocean is partly due to inadequate winds and to the very turbulent character of the flow.

Time series at various locations in the Pacific.

Red: Tide Gauge, Black: POCM 4C

TOGA/TOA

The variance of zonal velocity at 2 locations in the tropical Pacific are simulated well, as compared to TOGA/TOA. The model’s mean velocity is too weak @ 50m depth.

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Previous analysis of POCM 4B, has shown the model SSH is related to temperature at depth, in some locations. Future analysis will explore this relationship in this new simulation.

Acknowledgements:
Funding provided by NSF-WOCE, DOE, under CHAMMP and NASA, under OCEANUS.