Development of Enhanced Ocean Climate Products

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Project Summary

The Global Ocean Data Assimilation System (GODAS) at the National Centers for Environmental Prediction (NCEP) uses a statistics based algorithm to combine a numerical ocean model with ocean observations to provide a global estimate of the ocean state (fully three dimensional fields of temperature, salinity, velocity, and sea surface height). In effect, Ocean Data Assimilation (ODA) systems use model ocean dynamics to interpolate in time and space between the locations of individual observations and to compute those parts of the ocean state that may not be directly observed. For example, there are currently many more observations of temperature and salinity in the ocean than there are of velocity. Assimilation of these data adjusts the model temperature and salinity fields to be in accord with the observations (within specified statistical bounds) and the model then computes a velocity field in balance with the distribution of mass established by the temperature and salinity. The GODAS assimilates temperature profile observations from eXpendable BathyThermographs (XBTs), fixed moorings, and autonomous Argo floats, salinity from Argo floats and synthetic salinity from temperature observations and the observed correlation between temperature and salinity, and sea surface altimetry observations from TOPEX/Poseidon, Jason-1 and Jason-2 satellite missions. Tide gauge and velocity observations are reserved for validation.

The work covered by this project is the construction, maintenance and development of ODA at NCEP. The GODAS uses the Modular Ocean Model (MOM) developed over the last several decades at NOAA's Geophysical Fluid Dynamic Laboratory (GFDL). The current uncoupled operational GODAS uses the MOM3, while the new version of the GODAS incorporated in thecoupled operational CFSv2 uses the MOM4p0. The assimilation algorithm in both cases is a sequential 3-Dimensional Variational (3DVAR) method that estimates the ocean state through minimization of a cost function that balances statistically weighted contributions from the model and from the observations. The original purpose of the GODAS was to provide initial conditions for the ocean component of the coupled Climate Forecast System (CFS) used for operational seasonal to interannual (S-I) prediction At NCEP. S-I prediction has a well established social benefit and it remains the primary rationale for the maintenance and further development of the GODAS. The GODAS has a second important use as a means for monitoring the changing ocean state, which derives from its operational, near real-time, 3D synthesis of global ocean observations. The Climate Prediction Center (CPC) of NCEP maintains an interactive web site (http://www.cpc.ncep.noaa.gov/products/GODAS/) that allows the visitor to view GODAS output in a variety of ways. The same site provides links for acquiring the GODAS output data.

NCEP is committed to developing advanced techniques for ocean ODA. For this reason, we have undertaken in 2011 a new collaboration with the University of Maryland to develop an ensemble Kalman filter based on MOM4p1. We anticipate eventually combining this new method with our existing 3DVAR ODA to create a hybrid variational-ensemble ODA. We further expect that the experience gained in developing this system for MOM will provide the

starting point for a similar development with NCEP's Real-Time Ocean Forecasting System (RTOFS) based on HYCOM. The first steps in this project are included as item 4 in the Work Plan.