Impact of Assimilating Observations into the Coastal Ocean Forecast System (COFS)

H. Jean Thiébaux, John G. W. Kelley[1], Dmitry Chalikov[1],
David W. Behringer, and Bhavani Balasubramaniyan
NOAA/NWS/NCEP/EMC

Comparative time series plots of SST, as well as the comparative plots of temperature *versus* depth and salinity *versus* depth, show strong positive impacts of the assimilation of surface data on the accuracy of COFS 24-hour forecasts. The differences between time series of SSTs predicted by the model and corresponding time series of *in situ* SST observations, are significantly diminished with assimilation of surface data. Profiles of forecast subsurface temperature and subsurface salinity generally show very marked improvements in their agreement with observed temperature and the Navy's analyzed salinity, respectively, compared with non-assimilating forecast COFS profiles.

The Coastal Ocean Forecast System (COFS) is being developed by NOAA to produce nowcasts and 24-h forecasts of currents, salinity, temperature and water levels for the U.S. coastal waters. COFS uses the three dimensional Princeton Ocean Model with the east coast version covering the region from approximately 30 to 47N and from the coast to 50W. The spatial resolution of the model varies from 20 km offshore to about 10 km nearshore with 18 vertical sigma layers. The model uses forecasts from NCEP's Eta atmospheric prediction model as surface boundary conditions. COFS runs semi-operationally to generate 24-h simulations using the results from the previous day as its initial conditions.

A preliminary experiment was conducted to determine impact of assimilating real-time *in situ* and remotely sensed SST observations into COFS. The SST observations are assimilated into the ocean model in a three step process. First, a surface correction field is calculated at each time step by assimilating the observed SSTs with the model's top layer temperatures from the previous time step. This surface correction field is determined by an optimum interpolation scheme framed as an equivalent variational problem. Next the surface correction field is used with a simple mixed-layer assimilation scheme to determine a three-dimensional correction field. Finally, this correction field is applied gradually to the model using Newtonian relaxation.

The impact of assimilating SST observations into COFS has been evaluated at the surface with comparisons between 24-hour forecast SST values and SST reports from moored buoys in the COFS region. The experimental data-assimilating version of COFS was run for the first 14 days of March 1997. This experimental period provides a 14-day sea surface temperature time series for comparisons with SSTs forecast by the non-assimilating version of COFS which is run continuously, and with time series assembled from *in situ* SST observations. See Figure 1.

COFS forecast subsurface temperature profiles were also evaluated. "Virtual soundings" of forecast temperature values were created at those model gridpoints nearest the latitude/longitude locations of XBT reports. COFS' virtual temperature soundings were compared with XBT temperature soundings, available during the 14-day experimental period. COFS' virtual salinity soundings are compared with "salinity soundings" created from FNMOC's multilevel salinity analyses for the same dates. Surface-to-800 meter plots show the two versions of COFS: with and without surface data assimilation and mixed-layer adjustment, with XBT reports in the case of temperature and with FNMOC's analyses in the case of salinity. See Figure 2.

---

[1] UCAR Visiting Scientist

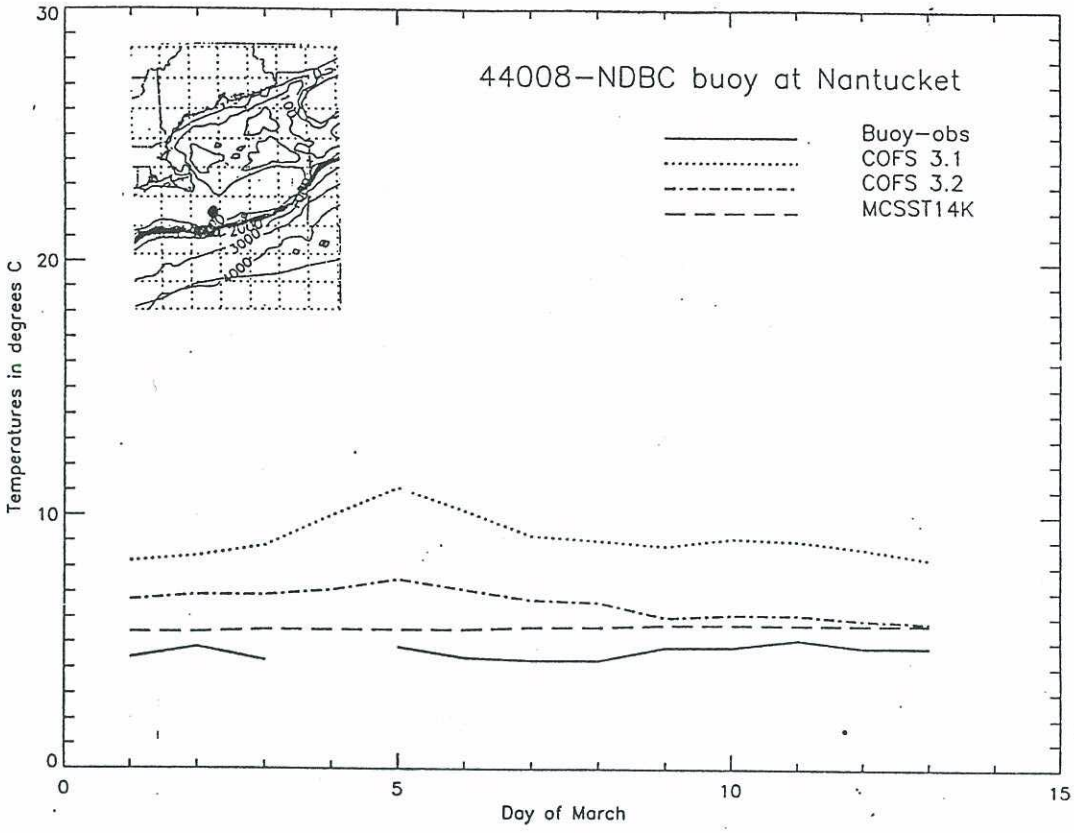

Figure 1. COFS 3.1 and COFS 3.2, buoy-observed and analyzed satellite SST

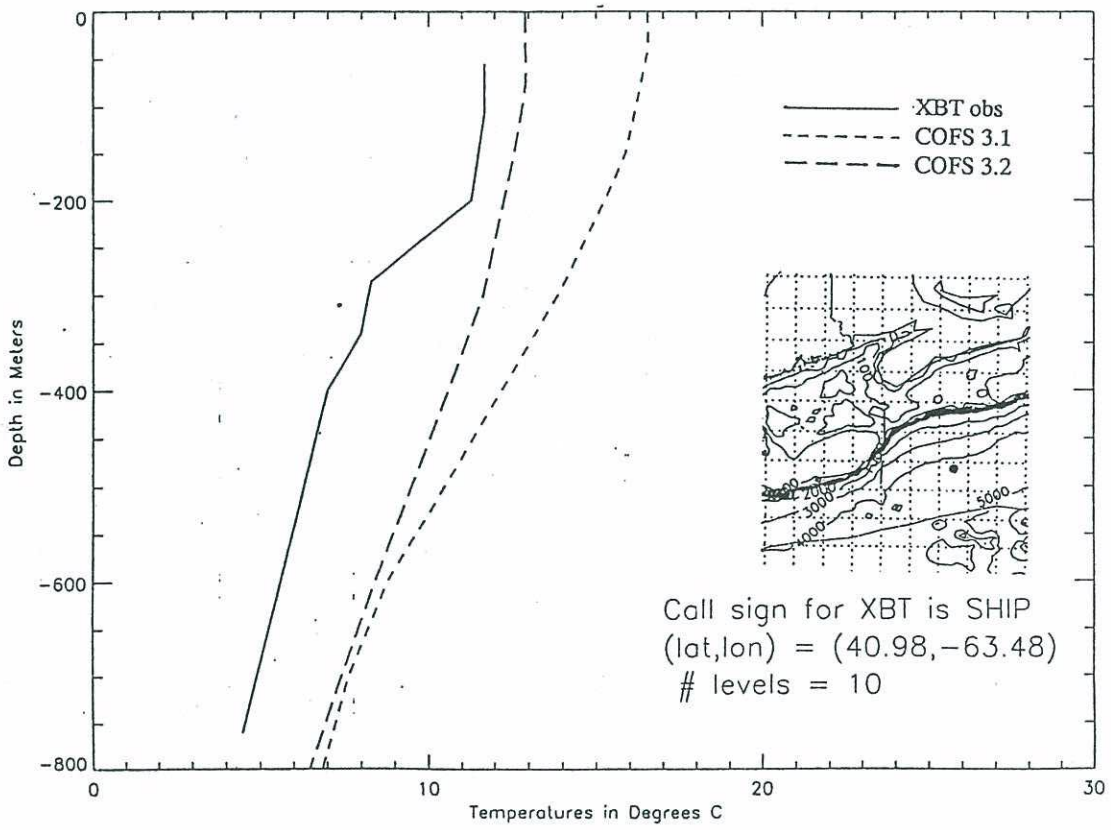

Figure 2. COFS 3.1 and COFS 3.2 soundings with XBT values for 970304