A Traceable Observing System Experiment in NCEP GODAS

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The National Centers for Environmental Prediction (NCEP) currently operates two versions of the Global Ocean Data Assimilation System (GODAS, Behringer, 2007). The first of these runs is in a stand-alone format forced by the surface fluxes from the NCEP Climate Data Assimilation System (CDAS2) atmospheric reanalysis. It runs in near real-time on a daily basis and serves as a tool for monitoring the evolution of the global ocean state. The second version runs as part of the NCEP operational Climate Forecast System (CFSv2) based on the Modular Ocean Model (MOM4) at a resolution of one half degree, and provides the initial states for the ocean component of CFSv2. Analysis products from GODAS are fundamental to NCEP's operational efforts for not only monitoring the ocean state but also for forecasting multi-week to seasonal variability in the NCEP CFS.

NCEP GODAS assimilates remotely sensed sea surface temperatures, and in situ profiles of temperature and salinity from EXpendable BathyThermograph (XBT) and Conductivity Temperature Depth (CTD), stationary fixed moorings, and autonomous Argo floats. These ocean observing systems play a critical role in the quality of GODAS products. In order to evaluate the impact of the observing system on NCEP operational products, a series of observing system experiments have been carried out, and the observational innovations and the analysis increments associated with individual ocean observations in NCEP's GODAS are evaluated.

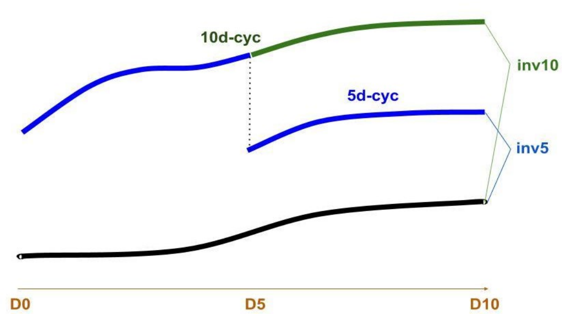

Figure 1. Two trajectories of 10day (green) and 5day (blue) cycle runs, and real Observations (black) in time. 10day and 5day cycle runs start at the same time, and the restart of 5day cycle run from Analysis field (dashed line).

In the traceable observing system experiments (tOSE), the impacts of the observing systems on the GODAS are defined from the squared differences of observation innovations between 5 day and 10 day cycle runs. Fig. 1 shows a schematic diagram of the tOSE for 5 day/10 day cycle runs. At the end of the two runs, the differences are due to the updated initial states of the 5 day run. From the results of these differences, it is possible to estimate the impacts of each observing system on the GODAS, which is traceable at each observation in space and time.

Fig. 2 shows the seasonal trajectories of analysis increments along the Argo floats. As shown in Fig. 2, the increments from Argo floats are generally positive in the central and eastern tropical Pacific in spring and summer of 2015, which corrects the cold bias in GODAS. Overall, the increments in the spring-summer seasons are larger than that in the fall-winter seasons, and it is

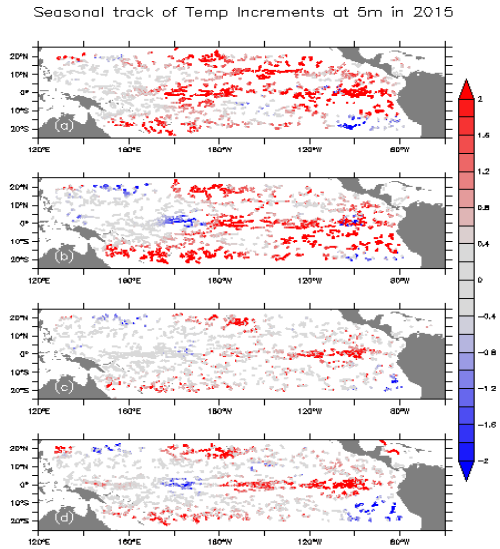

Figure 2. Seasonal trajectories of analysis increments of temperature at 5 m depth along the Argo floats in JFM (a), AMJ (b), JAS (c) and OND (d) from the 5 day cycle run (ºK).

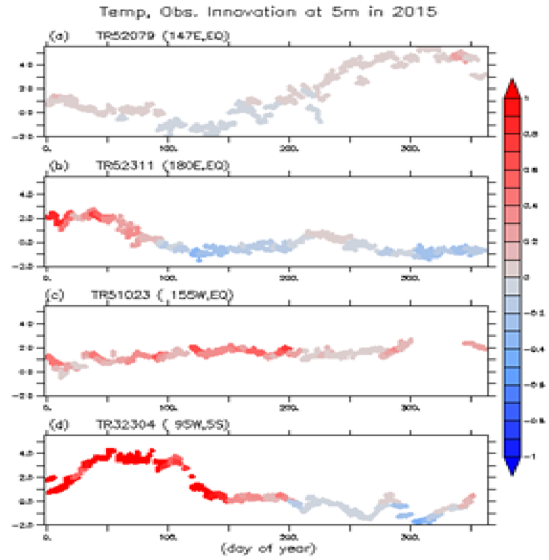

Figure 3. Time variations of observational increments of temperature at 5 m depth innovation of 5m depth temperature from mooring buoys at (147E,EQ) (a), (180E,EQ) (b), (155W,EQ) (c), (95W,5S) (d). Analysis

suggested that the impacts of Argo floats are stronger in northern winter and spring than during the other half of this year in the tropical Pacific. At 50 m depth (not shown here), the impacts of Argo mainly take place along the seasonal thermocline.

Fig. 3a shows that in the western warm pool region, there occurs a relatively large model – observation differences for moored buoys in late autumn and early winter. While the signs of the increments are consistent with the differences there is not a simple linear relationship between their magnitudes. In Fig. 3b, differences in the mooring buoys are relatively large in winter and early spring 2015, and it suggests that the mooring buoy is having a strong impact on the model analysis in this season. There is clearly useful information on the impacts of mooring buoys, but care should be taken in interpreting that information. The question as to whether it indicates a fault with the mooring or a persistent bias in the GODAS analysis could be resolved by considering the differences at adjacent moorings or at Argo floats which are nearby in space and time.

Acknowledgements: This study was supported by NOAA's Global Ocean Monitoring and Observing Program.

Reference: Behringer, D. W., 2007: The Global Ocean Data Assimilation System (GODAS) at NCEP. Proc. 11th Symp. Integr. Obs. Assim. Systems, San Antonio, TX, Amer. Meteor. Soc. 3.3.