In Situ and Satellite Sea Surface Temperature (SST) Analyses

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Project Summary

The purposes of this project are: 1) to improve the climate-scale sea surface temperature (SST) analyses produced at NOAA for climate research and monitoring as well as applications to societal benefits; and 2) to monitor and report the performance of the global ocean SST observing system in terms of a Government Performance and Results Act (GPRA) Performance Measure, for an optimum integration of the in-situ and satellite observation systems for climate scale SST. This project supports the NOAA's Next Generation Strategy Plan (NGSP) goal of "Climate Adaptation & Mitigation" through sufficient climate observation and analysis. This project directly serves the COD's Program Deliverables in: 1) To identify climate variability through surface marine observations including SST and sea surface winds; and 2) To identify changes in forcing functions through the air-sea exchange processes. Our SST analyses are available via http://www.ncdc.noaa.gov/oa/climate/research/sst/oi-daily.php and http://www.ncdc.noaa.gov/ersst.

One of the important goals of the Sustained Ocean Observing System for Climate is to improve the SST accuracy over the global ocean for climate change monitoring and assessment. Because of the dense spatial coverage of satellite data, in situ data tends to be overwhelmed by satellite data. Thus, the most important role of the in situ data in the analysis is to correct large-scale satellite biases. Simulations with different buoy densities showed the need for at least two buoys on a 10° spatial grid to reduce a satellite bias of 2°C to not exceeding 0.5°C (minimum requirement; citations in Zhang et al 2009). Using this criterion, regions were identified where additional buoys are needed, and a metric was designed to measure the adequacy of the present observing system as a GPRA performance measure. The work presented here follows the Global Climate Observing System (GCOS) Ten Climate Monitoring Principles.

NOAA has combined the in-situ and satellite SST observations into gridded SST products. The NOAA's Optimum Interpolation (OI) SST analysis products (often also referred to as Reynolds SST Analyses) are among the most utilized SST products (more than 3000 citations). Currently two operational versions of the OISSTs are maintained at NOAA/NCDC; both of them are bias-corrected by in-situ observations, and with spatial and temporal resolutions of ¼-degrees and daily, respectively. 1) The AVHRR-only OISST uses infrared satellite data from the Advanced Very High Resolution Radiometer (AVHRR). The dataset spans ~30 years (from September 1981 to the present). Among many other applications, it has been used for intercomparison studies and as a first guess for retrieval algorithms for past and current sensors (e.g., MODIS, TRMM, VIIRS, PATHFINDER, etc). 2) The AMSR+AVHRR OISST uses AVHRR and microwave satellite data from the Advanced Microwave Scanning Radiometer (AMSR-E), which has the advantage of nearly all-weather coverage, and therefore is better for forecasting and hurricane tracking. The product is available for the lifetime of the AMSR-E instrument (from June 2002 to Oct. 6, 2011). Improvements are being made to the above two operational products. In particular, a replacement microwave instrument for AMSR-E needs to be

investigated if this version of time series is to continue. The data are available at http://www.ncdc.noaa.gov/oa/climate/research/sst/oi-daily.php.

Additional work has been carried out to improve the historic Extended Reconstruction SST (ERSST) analysis which begins in 1854. This analysis uses in-situ data only, and is computed monthly on a 2° spatial grid. The reconstructions are produced from a low frequency (or decadal-scale component) and from a residual high-frequency component. The high frequency analysis was performed by fitting the observed high frequency anomalies to a set of large-scale spatial-covariance modes. A merged surface temperature product uses both SSTs and land surface temperatures (LSTs), and is produced monthly on a 5° grid beginning in 1880. Both the SST-only and merged products are important in monitoring long-term changes in climate and are available at http://www.ncdc.noaa.gov/ersst/ and http://www.ncdc.noaa.gov/cmb-faq/anomalies.php, respectively.