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A New Ultra High Resolution Sea Surface Temperature Analyses

From GOES-R and NPOESS-VIIRS

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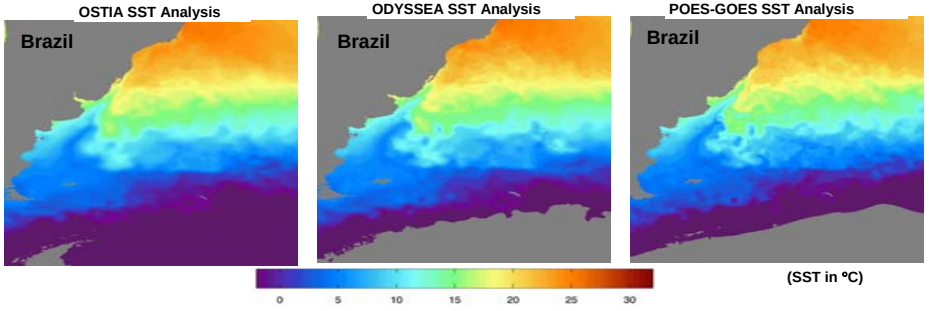
Sea surface temperature (SST) is designated an Essential Climate Variable by WMO GCOS and is one of only two key performance parameters for the NPOESS VIIRS mission. In order to meet the increasing scientific and end-user needs for higher resolution SST information (i.e. higher than the ~0.5° – 1° of traditional global products), NOAA/NESDIS developed a new daily SST analysis combining Geostationary (GOES, MT-SAT and Meteosat) SST and POES (AVHRR) and MetOp data into a single high-resolution (0.1°×0.1°) product. This resolution was chosen to approximately match the Nyquist sampling criterion for the mid-latitude Rossby radius (~20 km) to ensure preservation of mesoscale oceanographic features such as eddies and frontal meanders. The methodology employs a rigorous multi-scale optimal interpolation which approximates the Kalman filter, together with a data-adaptive correlation length scale to ensure the balance between detail preservation and noise reduction. The new analysis has been a significant success, even when compared to other modern products which purport to be similar or higher resolution.

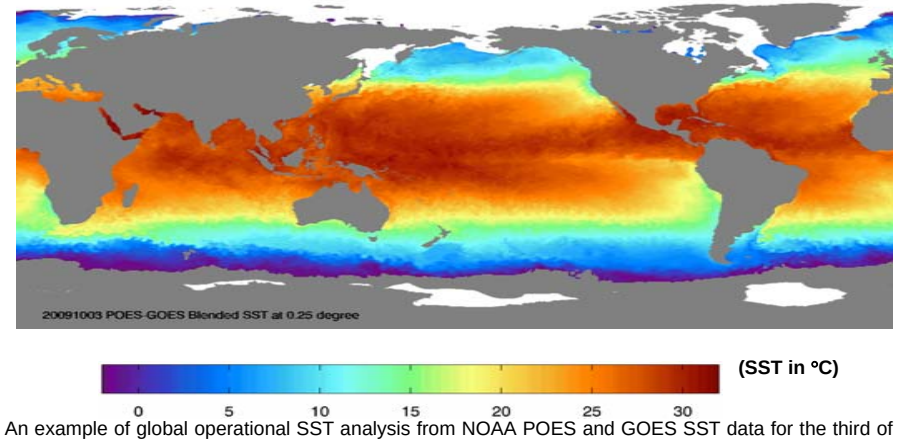
One of the biggest challenges in the new NOAA analysis has been the bias correction of the different data sets. The error characteristics of the GOES and POES data are substantially different. A major focus has been to ensure that the benefits of each data source are maximized while minimizing their respective weaknesses. The GOES SST data, while being somewhat coarser resolution (~4-km at the sub-satellite point, and closer to ~6 km at mid-latitudes) and slightly poorer accuracy (~0.5 K vs. ~0.4 K), sample the SST field at a temporal frequency (an order of magnitude greater than that achievable from polar-orbiting instruments). This sampling density permits very good coverage of the underlying SST even in conditions of broken cloud. However, the geostationary data are more subject to regional bias errors (typically of order 0.5 – 1 Kelvin) than the polar orbiting data. At the moment, bias corrections are derived in a statistical manner and are updated on a daily basis. However, such corrections have to be smoothed over correlation length scales much greater than the analysis resolution in order to avoid spurious correction.

Validation against global analysis



The imageries depict the south-western Atlantic region, 30–46°S, 35–55°W, on the Nov-12-2007 of the confluence of the warm Brazil Current and the cold Falkland Current, as well as the eddies created from the two systems. From left to right: UK Met Office OSTIA 1/20° analysis, MERSEA ODYSSEA 0.1° analysis, and POES-GOES 0.1° analysis. The GOES data are not currently being ingested by the ODYSSEA system, which is also not computationally efficient enough to permit inclusion of full analysis of separate datasets. It seems that the correlation length scales for the OSTIA analysis are not sufficient to permit Mesoscale oceanic features to be well-resolved. The POES-GOES analysis shows more details of Mesoscale structures.

Global POES-GOES Blended SST Product (11 km, OCT-03-2009)



An example of global operational SST analysis from NOAA POES and GOES SST data for the third of October, 2009. The blended high spatial resolution daily SST product is generated employing the dynamic data-fusion scheme.

CONCLUSION: The new instrument technologies that will be available in the GOES-R and NPOESS era should permit higher resolution, better accuracy and an opportunity to derive physically-based SST retrievals and bias-corrections within a common retrieval framework. This should allow statistical bias correction to be relegated to the role of residual adjustment.

90th AMS Annual Meeting 6th Annual Symposium on Future National Operational Environmental Satellite Systems-NPOESS and GOES-R 17 –21 January 2010, Atlanta, Georgia

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