New Sea Surface Salinity Product in the Tropical Indian Ocean

Bulusu Subrahmanyam, V.S.N. Murty*, and James J. O'Brien
Center for Ocean-Atmospheric Prediction Studies, The Florida State University, Tallahassee, FL 32306-2840, USA.
*Physical Oceanography Division, National Institute of Oceanography, Goa, India
(e-mail: sub@coaps.fsu.edu, vsnmurty@darya.nio.org, jim.obrien@coaps.fsu.edu)

Abstract

A Sea Surface Salinity (SSS) product derived from satellite measurements would be very welcome by the researchers for assimilation into OGCMs as studies have shown that salinity is important for the simulation of tropical ocean dynamics. The reason for this is that the *in situ* measurements are poorly distributed. We have estimated SSS from satellite measurements of Outgoing Longwave Radiation (OLR) over the tropical oceans during 1979 to present. The algorithms are based on the inter-relationships between OLR, the Effective Oceanic Layer (EOL), climatological SSS (World Ocean Atlas 2001; WOA01) and freshwater flux (P-E). Preliminary results in the tropical Indian Ocean show higher correlation coefficients for the relationships between OLR vs. EOL, EOL vs. WOA98 SSS and OLR vs. P-E. The former relationship couples the atmospheric convection (OLR) and the geopotential thickness of the near-surface stratified layer (EOL). The estimated SSS at 2.5°x2.5° grid on monthly scale is nearer to the WOA98 SSS with lesser differences within ±0.5 psu away from the coastal region. The mixing and advection processes will have to be considered using the Hybrid Coordinate Ocean Model (HYCOM) for the refinement of estimated SSS.

Method

Murty *et al*. [2004] showed the methodology (Figure 1) to estimate the SSS in the tropical Indian Ocean and the statistical relationships (algorithms) between OLR and EOL, between EOL and SSS and between OLR and SSS in the tropical Indian Ocean. The monthly algorithms developed are suitable for both the convection and non-convection regions for the tropical Indian Ocean. After examining the utility of these monthly algorithms for the daily/synoptic scales, the estimation of daily SSS on routine basis are attempted.

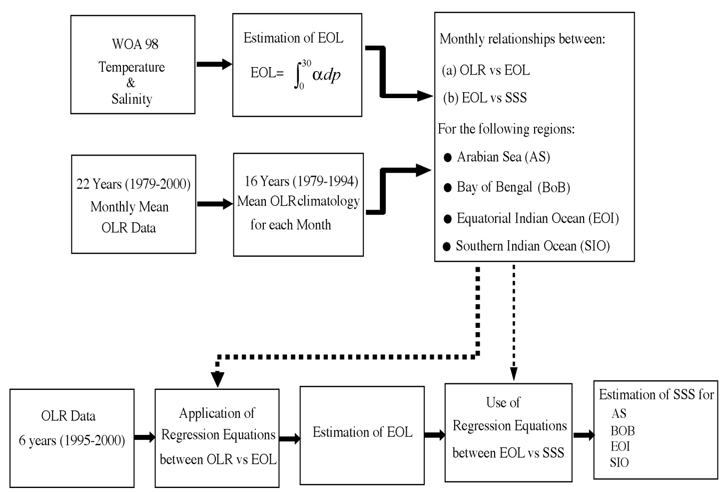

Figure1. Schematic diagram explaining the computational methodology for the estimation of SSS from OLR (taken from Murty et al. 2004).

Subrahmanyam et al. [2004] successfully attempted a case study and estimated the SSS from OLR to understand the air-sea coupling during tropical cyclones in the Arabian Sea and Bay of Bengal.

Results

One important feature of the present algorithms is their ability to simulate the interannual variation of the SSS. The interannual variation of estimated SSS for a 6 year period (1995-2000) is presented for two locations in the EIO (0°N, 55°E and 0°N, 90°E) (Figure 2). The impact of 1997 El Niño signal is evident in the time series of estimated SSS. Higher SSS at the eastern location in 1997 clearly identifies the impact of weaker convection associated with the El Niño. The annual variation of WOA98 SSS is repeated over the 6-year period for a better comparison with the estimated SSS. However, differences in some months are relatively high (0.8 to 1.3) with larger values of estimated SSS than WOA98 in the El Niño period.

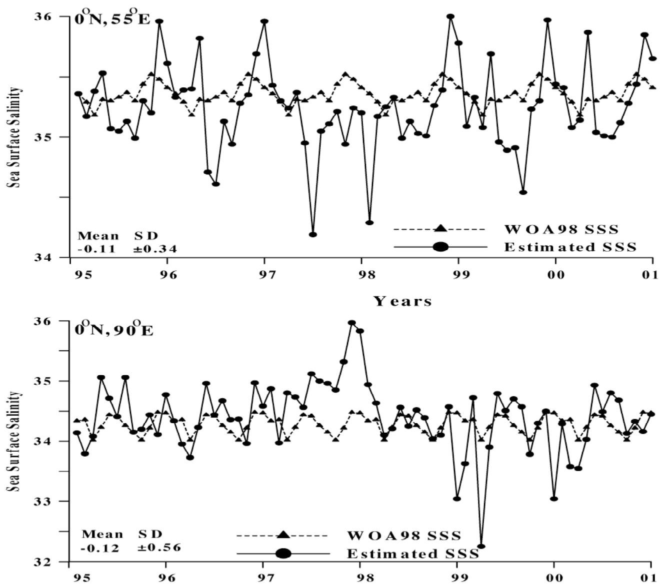

Figure 2. Inter-annual variation of the estimated SSS (solid line) at two selected locations in the equatorial Indian Ocean: 0°, 55°E (top panel) and 0°, 90°E (bottom panel) during 1995-2000. The annual variation of WOA98 SSS (dashed line) at this location is repeated for all the 6 years for easy comparison and to assess the deviation in the estimated SSS from the WOA98 SSS (Taken from Murty et al. 2004)

Conclusions

This new salinity monthly product (2.5°x2.5°) in the tropical Indian Ocean (30°N-30°S, 40°E-100°E) is useful to further studies on coupled models, El Niño-Southern Oscillation forecast models and Ocean Global Circulation Models or regional scale circulation models. In future using 25 years (1979-present) of daily OLR data at 1°x1° grid and the algorithms, the daily SSS will be estimated in the tropical oceans. This method has only been tested in the tropical Indian Ocean; further research is still required to see its applicability to other oceans. We hope that this work will be useful for the validation of the SSS products to be obtained from the two salinity satellite missions – the US 'Aquarius' and the European Space Agency Soil Moisture and Ocean Salinity (SMOS), that are planned for launch in 2008.

References

Murty, V.S.N., B. Subrahmanyam, V. Tilvi, and James J. O'Brien, A New Technique for Estimation of Sea Surface Salinity in the tropical Indian Ocean from OLR, J. Geophys. Res., 109, doi:10.1029/2003JC001928, 2004.

Subrahmanyam, B., V.S.N. Murty, R.J. Sharp, and J.J. O'Brien (2004). Air-Sea Coupling during the tropical cyclones in the Indian Ocean - a case study using satellite observations, Special Addition of the Pure and Applied Geophysics on "Weather and Climate" (in press).

Acknowledgements

The COAPS at the FSU receives its base support from the NASA Physical Oceanography program and through the Applied Research Center, funded by NOAA Office of Global Programs awarded to Dr. James J. O'Brien.