UNIVERSITY OF MIAMI
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Comparisons of Shipboard Infrared Skin Sea Surface Temperature Data With Satellite and Model Data

GHRSST Group for High Resolution Sea Surface Temperature

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Abstract

The accuracy of the Sea Surface Temperature (SST) derived from satellite measurements and model is one of the key factors of climate monitoring and prediction. We compare model and satellite-derived SST with measurments from the shipboard Infrared Skin Sea Surface Temperature by Marine-Atmospheric Radiance Interferometers (M-AERI) from 11 November - 14 December 2015. The results indicate that SSTs retrieved from MODIS (Moderate Resolution Imaging Spectroradiometer) aboard the Terra and Aqua satellites (data quality flag ≥1) and Meteosat Spinning Enhanced Visible and Infrared Imager (SEVIRI) (data quality level ≤4) have significant negative (cool) biases (0.83K, 0.85K, 0.96K) compared to shipboard radiometric measurements. The exception is SEVIRI towards the end of the cruise which exhibits a positive bias. The accuracies of the MODIS SST's are better than for SEVIRI. Using the ECMWF Total Water Vapor and Aerosol Optical Thickness data and Radiosonde atmosphere data, we find that during Dec. 9th to 3th there is an unusual atmospheric dry layer aloft and a positive Aerosol Optical Thickness Anomaly. The Saharan Air Layer outflow causes SEVIRI SST's higher than from M-AERI during the end of the cruise period. Compared to satellite datasets, the model data are highly correlated (98.56%) with the ship data; the standard deviation is only 0.36K.

Data

- **Period:** From *Nov. 17th to Dec.14th, 2015*
- **Region:** *3°S to 30°N, 10°W to 40°W (Atlantic)*

Data	Description and Method
Shipboard: M-AERI	➢ An accurate, self-calibrating, Fourier transform IR spectroradiometer that measures emission spectra from the sea and atmosphere. ➢ Data Points: 5583
Model: ECMWF	➢ From European Center for Medium-Range Weather Forecasts(ECMWF) ➢ Spatial Resolution:0.75° ➢ Area: Global ➢ Temporal Resolution: Every 6 Hour ➢ Method: nearest 4*4 Point Interpolation ➢ Match-up data points: 5583
Satellite sensor: MODIS	➢ From NASA Jet Propulsion Laboratory (JPL) and GHRSST ➢ L2 product with Quality flag ≤ 1 ➢ Twice a day. Satellite overpass time (SOT) is at about 2:00 AM and 14:00 PM ➢ Spatial resolution: 0.01° ➢ Method: The nearest point within 0.1° in lat/lon ➢ Time window: 20 minutes ➢ Match-up data points: 160
Satellite sensor: SEVIRI	➢ The SEVIRI Meteosat-8/10 data is from GHRSST and OSI-SAF, for the Eastern Atlantic Region from the Spinning Enhanced Visible and InfraRed Imager (SEVIRI) on the Meteosat Second Generation (MSG-3) satellites ➢ Spatial resolution: 0.05° ➢ Every hour data ➢ Method: nearest 2*2 Point Interpolation ➢ Quality Level ≥4 ➢ Match-up data points: 2122

Comparisons

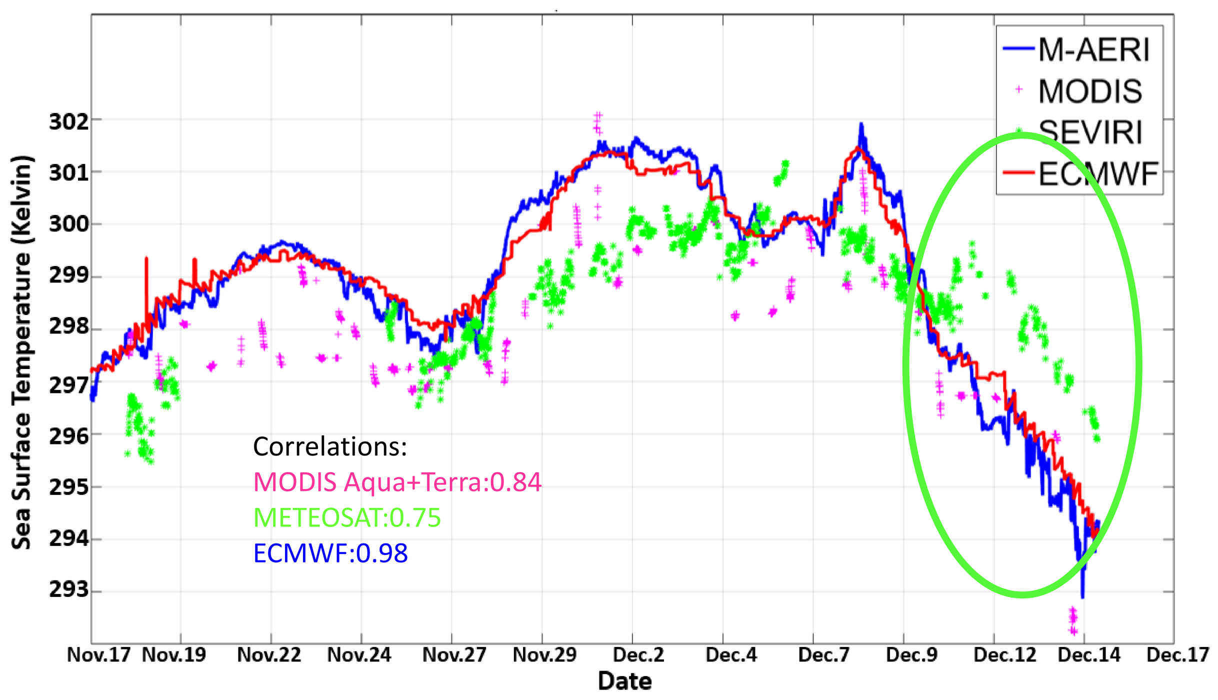

Figure 1. Comparison of different SST data

1. The results of this preliminary validation show that MODIS and METEOSAT SST's are lower than ship data.
2. The correlation between MODIS and M-AERI SST's is 90.0%, but for SEVIRI it is only 75.0%. MODIS has higher sensitivity and lower noise than Meteosat, which is advantageous for environmental monitoring.
3. Compared to satellite datasets, the model data is highly correlated (98.56%) with the ship data. The standard deviation is only 0.36K.
4. SEVIRI SST's is higher than M-AERI's during the end of the cruise.

Aerosol effect

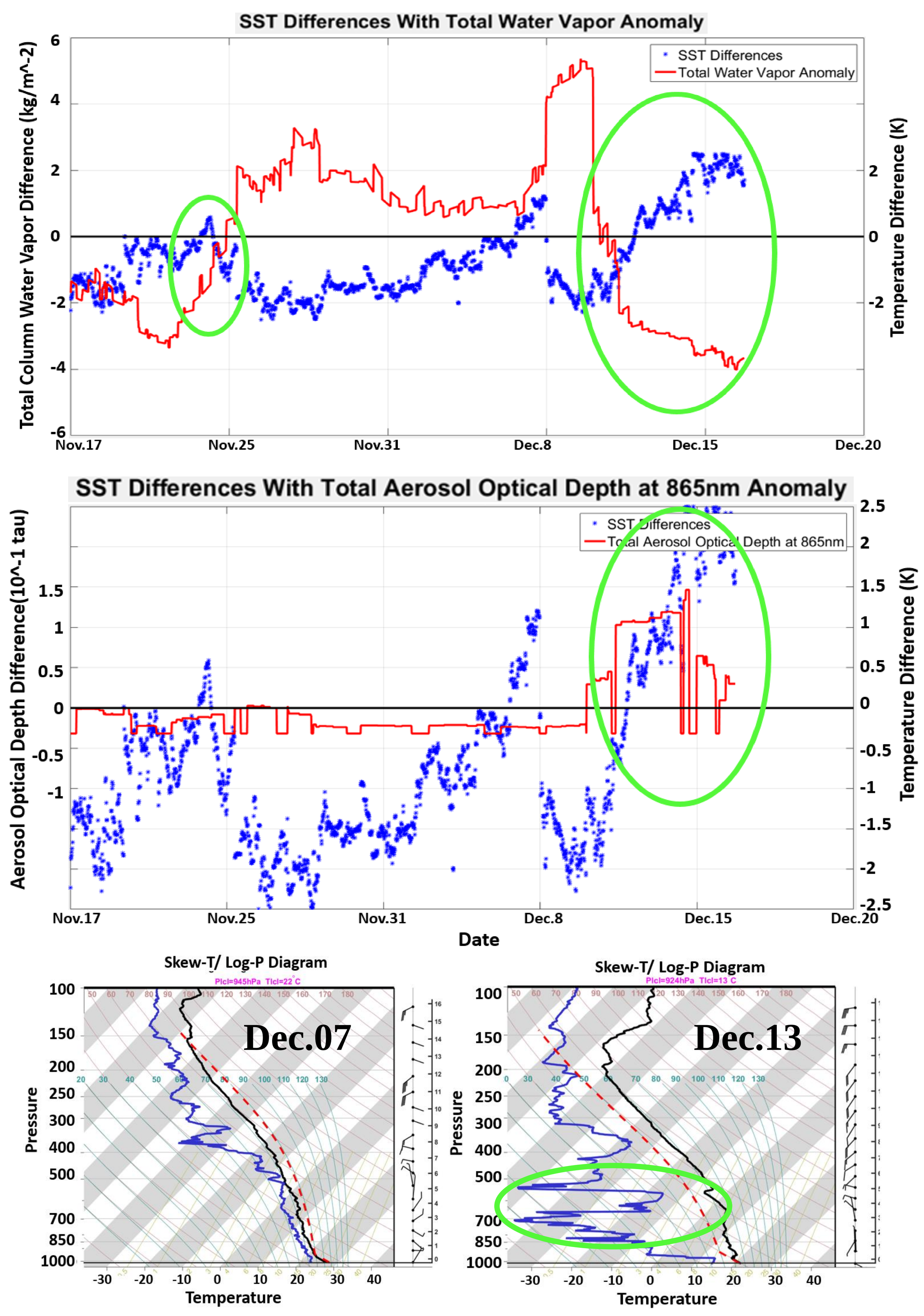

Figure 2. ECMWF and Radiosonde atmosphere data

During Dec. 9th to 3th there is an unusual atmospheric dry layer aloft in and a positive Aerosol Optical Thickness anomaly. The high tropospheric aerosol concentrations significantly modifies the infrared signal from the sea surface and prevent the retrieval of accurate SST's.

Error Distribution

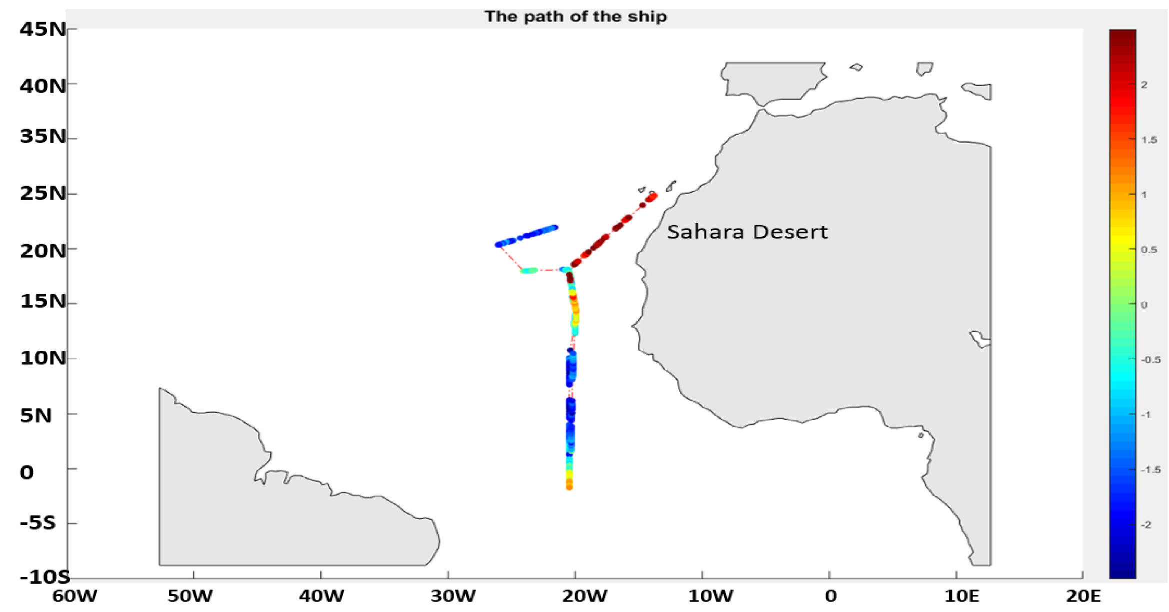

Figure 3. The distribution of the SEVIRI SST error.

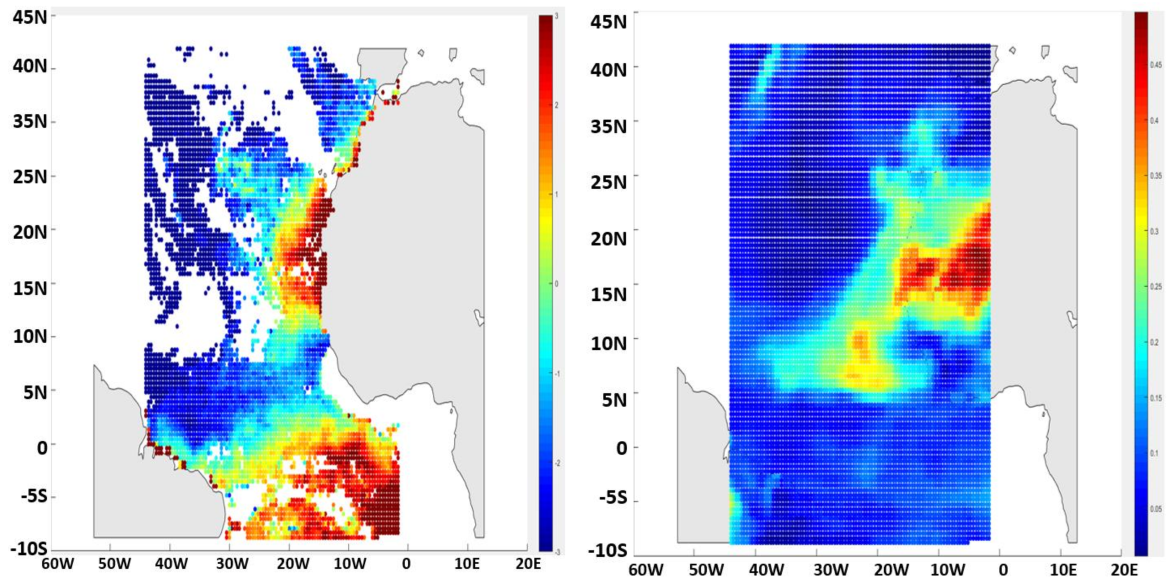

Figure 4. Left: SEVIRI SST difference compared to ECMWF SST. Right: ECMWF Aerosol Optical Depth at 865nm.

When the ship was near the Sahara area, the SST error is larger. Since the ECMWF data are highly correlated with the M-AERI shipboard data, the difference between the SEVIRI SST and ECMWF SST, compared to the ECMWF Aerosol Optical Depth data reveals that the layers in the atmosphere with anomalously low moisture effect the accuracy of the SST derived from SEVIRI.

Conclusions

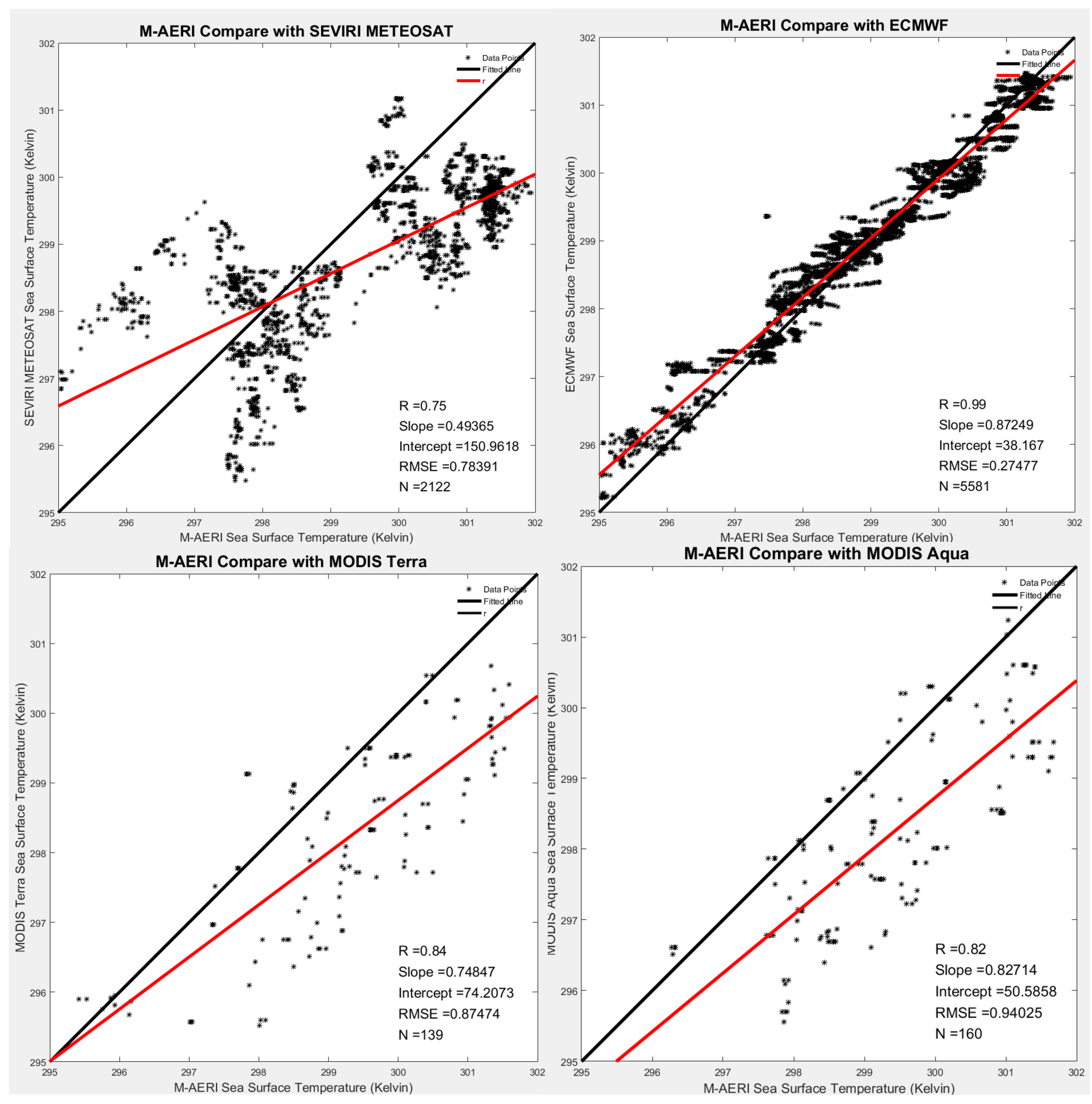

Figure 5. Satellite SST's compared to M-AERI data.

1) M-AERI and ECMWF have very good agreement.
2) Differences between M-AERI and satellite SST's are large.
3) Satellite instruments show typically cooler SST's than M-AERI, except SEVIRI towards the end of the cruise.
4) The unusual dry layer aloft and aerosol optical thickness influence the accuracy of the satellite SST during the end of the cruise period.