

DIFFERENCES BETWEEN INFRARED AND MICROWAVE
SEA SURFACE TEMPERATURE PRODUCTSGary A. Wick¹ and Donna J. Scott²¹NOAA Environmental Technology Laboratory, Boulder, CO²CIRES, University of Colorado, Boulder, CO**1. INTRODUCTION**

Infrared and passive microwave satellite sensors provide highly complementary information for the creation of sea surface temperature (SST) products. Infrared sensors provide high resolution and high accuracy estimates of the SST but the measurements are completely obscured by clouds. Passive microwave sensors, in contrast, have poorer resolution but are able to obtain measurements through non-precipitating clouds. By combining the measurements from the two sensors it is possible to produce an all-weather, high-resolution SST product. We are currently developing a blended SST product using infrared data from the Advanced Very High Resolution Radiometer (AVHRR) and passive microwave data from the Tropical Rainfall Mapping Mission (TRMM) Microwave Imager (TMI).

The first important step in developing a method for combining the two products is understanding the error characteristics and differences between the products. In this work we examine the differences between the products in detail. We devote special attention to the relationship between the differences and both diurnal warming and the temperature gradient that commonly exists at the skin of the ocean. Infrared sensors measure radiation emitted only from the top 10 microns of the ocean while microwave radiometers measure radiation from depths down to approximately 1 mm. The skin layer of the ocean can lead to significant and variable differences between the temperatures at these depths. We examine whether differences between the products are consistent with the presence of the skin layer and whether there are circumstances where the skin layer complicates or prevents the combination of the products.

2. OBSERVATIONS OF DIFFERENCES

We have analyzed over a year of separate

SST products computed from the AVHRR and TMI sensors. The AVHRR-based data is the nonlinear sea surface temperature (NLSST) product from the NOAA-14 satellite produced operationally by the Naval Oceanographic Office (May et al., 1998). The TMI SST product is produced and distributed by Frank Wentz and Remote Sensing Systems, Inc. We did not apply additional processing to these datasets with the exception of gridding the NLSST data to a 0.25° grid common to the TMI SST and separating the TMI SST into day and nighttime observations. All our initial comparisons were performed at the 0.25° resolution of the TMI SST.

Differences were computed between daily daytime and nighttime averages of the two products. These daily differences were then further averaged over a month to provide a better spatial pattern of the differences for comparison with environmental conditions and the expected behavior of the skin layer. Example average differences for November, 2000 are shown in Figure 1. The mean daytime difference is -0.43 K (TMI SST larger) and the mean nighttime difference is -0.55 K. RMS differences are on the order of 0.8 K.

These mean differences are generally consistent with an assessment of the accuracy of each product relative to quality controlled drifting and moored buoys. We independently constructed matchups between each product and buoy data that showed (for the same month) the TMI SST data to be biased warm by approximately 0.25 K and the NLSST to be biased cold by near 0.1 K.

Significantly different mean differences were obtained if the NLSST and TMI products were composited over a week or month before being compared. This illustrates the importance of the contrasting SST sampling characteristics (e.g. clear sky only vs. clear and cloudy) of the sensors.

In addition to the mean offsets, the differences show significant spatial variations. Understanding the source and nature of these variations is critical to developing a strategy to combine these products. In our presentation we will provide a detailed analysis of these differences relative to such factors as sampling characteristics,

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environmental conditions, diurnal heating, and presence of a skin layer.

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4. REFERENCE

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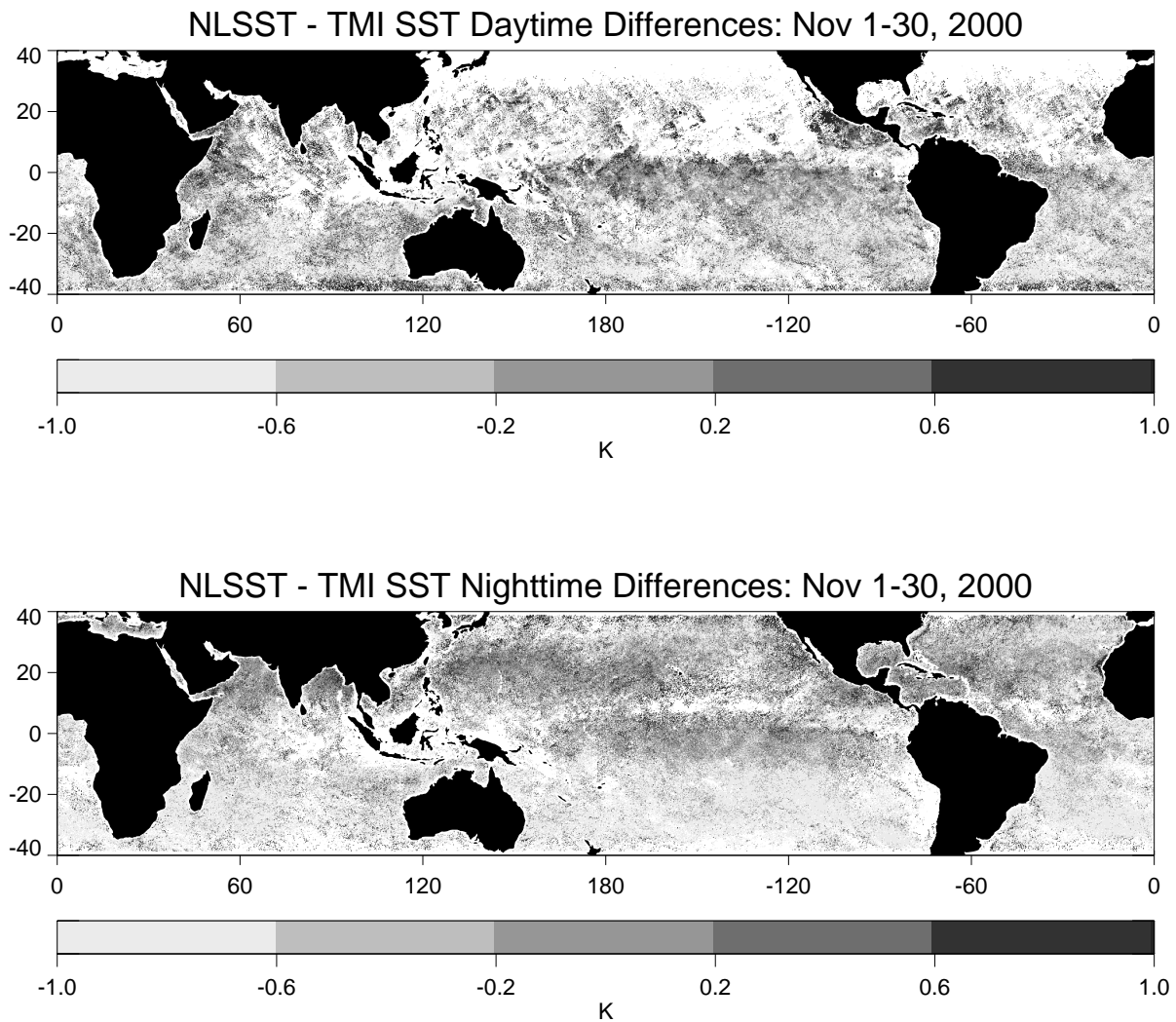


Figure 1. Average daily daytime (top) and nighttime (bottom) difference between the TMI SST and NLSST products.