Systematic Differences Among The MODIS, NCEP And TMI Sea Surface Temperature Data Sets

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1. INTRODUCTION

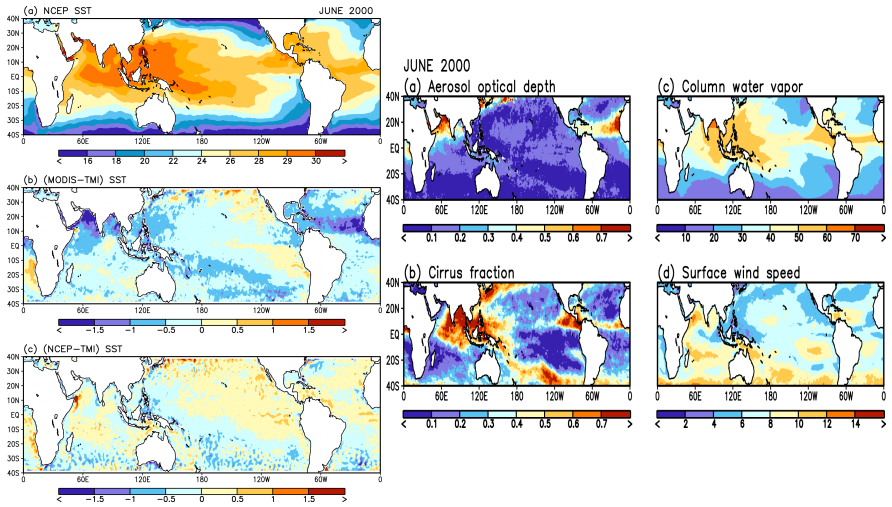
Sea surface temperature (SST) is important in determining atmospheric and oceanic circulations. Accuracy of 0.3K or better is desired for oceanographic and climate research. The MODIS, NCEP and TMI SST data sets are compared for the period March 2000 to June 2003. The MODIS SST considered here is an infrared retrieval at 11-12 μm, TMI SST is a microwave retrieval while the NCEP SST incorporates in-situ measurements and the AVHRR retrieval at 3 infrared channels.

2. INFRARED AND MICROWAVE RETRIEVALS

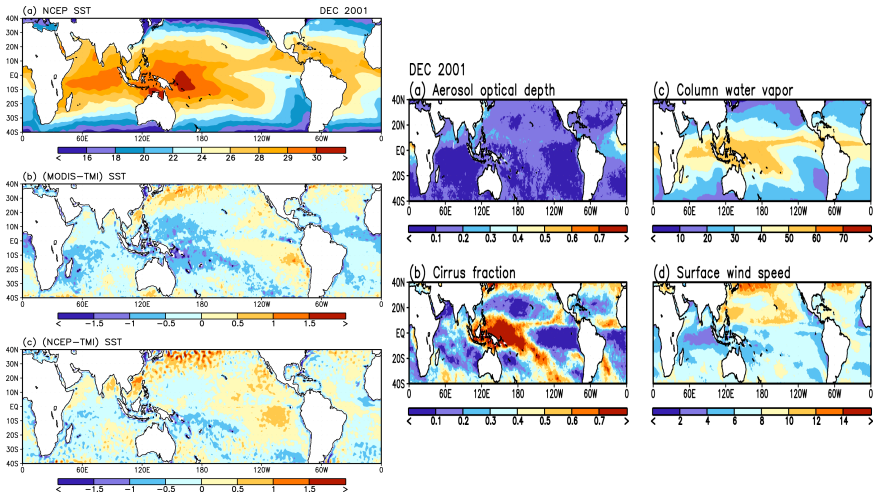
Satellite retrievals of SST measure emitted IR or microwave radiation from the ocean surface at window regions where atmospheric attenuation is small. Infrared retrieval can only be made in clear sky regions; water vapor absorption and aerosol attenuation can be large in very moist and high aerosol loading areas. Microwave retrieval can be made in cloudy sky regions; it is not sensitive to aerosols and water vapor absorption in microwave region is much smaller than in infrared region. However, uncertainty in surface emissivity due to wind-generated roughness and foam causes error in microwave retrieval.

3. RESULTS & COMPARISONS

(A) Boreal Summer



(B) Boreal Winter



(A) (During boreal summer, large discrepancies (>0.5K) occur at:

(1) Tropical Atlantic → aerosol attenuation in IR retrieval

(2) Tropical Pacific, Bay of Bengal → water vapor absorption and cirrus contamination in IR aerosol attenuation and cirrus contamination in IR retrieval

(4) Storm track → cirrus contamination in IR retrieval retrieval

(3) Arabian Sea → (5) Cold/dry tongues in Pacific and Atlantic -- water vapor absorption in IR retrieval

(6) East African coast → uncertainty in surface emissivity in microwave retrieval

(B) During boreal winter, large discrepancies (> 0.5K) occur at:

(1) Tropical Atlantic → aerosol attenuation in IR retrieval

(2) Tropical Pacific → water vapor absorption and cirrus contamination in IR retrieval

(3) Cold/dry tongues in Pacific and Atlantic → water vapor absorption in IR retrieval

(4) South China Sea, storm track → uncertainty in surface emissivity related to high wind speed or large wind direction variation in microwave retrieval

4. DISCUSSION AND SUMMARY

We have compared MODIS, NCEP and TMI SST data sets for a period of 3 years. Large differences exceeding 0.5 K, especially between MODIS and TMI, are found over extensive areas. Probable causes for these discrepancies are related to the biases inherent in infrared and microwave retrieval methods: cirrus contamination, lack of or insufficient correction for aerosol attenuation and atmospheric water vapor absorption in infrared retrieval as well as uncertainty in microwave surface emissivity in areas of strong wind. Also, differences between bulk and skin SST contribute to discrepancies between NCEP and TMI SSTs. There may be other problems in TMI retrieval that we are not aware of that also contribute to the large discrepancies. Further studies are needed to correct for these biases so that the SST data sets can be made more useful for climate studies. More research is needed to resolve the problems inherent in the infrared and microwave SST retrieval methods. Climate researchers should be aware of the large systematic errors in various regions in the currently available SST data products before reaching any conclusion on long-term regional and global SST trends.