Production of an Enhanced Blended Infrared and Microwave Sea Surface Temperature Product

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Motivation

Infrared and passive microwave satellite sensors provide highly complementary information for the creation of SST products.

- Infrared sensors provide high resolution and high accuracy but are obscured by clouds.
- Microwave sensors provide coverage through non-precipitating clouds but have coarser resolution and generally poorer accuracy

Note how over 5 days, large regions are still not sampled by infrared sensors while the microwave data provides near-complete coverage.

The objective of this work is to produce an enhanced SST analysis that combines the relative strengths of both sensors.

Product Summary

- Daily global (40ºN - 40ºS), 0.25º resolution merged and analyzed SST products are being produced from AVHRR and TMI data for the period from 1998-2001.
- All products are referenced to a nighttime, predawn value to eliminate the effect of diurnal warming. Separate diurnal amplitude estimates are being developed.
- Initial products are bulk or subsurface values, but separate skin products will also be produced.

To obtain the data, go to:

http://www.etl.noaa.gov/satres/blended_sst.html
anonymous ftp to ftp.etl.noaa.gov, cd user/gwick/blended_sst

Acknowledgements:

The original TMI SST product is provided by Remote Sensing Systems and the operational AVHRR SST product is created by the US Naval Oceanographic Office. Our analyses are derived from these existing products. Funding is provided by the Climate Change Data and Detection element of the NOAA Climate and Global Change Program.

Differences Between Infrared and Microwave Products

Before the infrared and microwave products can be combined, we must fully understand the differences between them.

Initial examination of the individual products suggests both have good accuracy

Detailed comparisons between the infrared and microwave products, however, show complex spatial and temporal differences.

Individual product accuracy relative to nighttime drifting and moored buoy observations

Diurnal Effects

Diurnal effects are particularly important for application of the TMI data since the sensor samples throughout the diurnal cycle.

Simple diurnal adjustments to daytime data were applied following Gentemann et al., 2003.

The differences can result from both measurement difficulties associated with key environmental parameters and geophysical effects.

Bias adjustments were applied to the TMI data to account for the effects of wind speed, water vapor, and SST and to the AVHRR data to account for water vapor effects.

The adjustments reduce the differences between the products, but important differences remain. This suggests additional dependence on effects such as radiation penetration depth, skin layer effects, and heat flux. These impacts on the differences are considered further in poster P4.24 by S. Castro.

Merged Products

Using the derived corrections, the infrared and microwave SST products can be more accurately merged.

Merged products are composed only of direct satellite retrievals (with appropriate adjustments). No attempts are made to fill in gaps in the coverage.

Dependencies Considered

TMI	AVHRR
Time of day	Time of day
Wind speed	Water vapor
SST	*Clouds*
Water Vapor	
Rain	

Accuracy Comparison with and without bias adjustments

Product	Bias (K)	RMS (K)	Matches
Merged (w/ Adj)	-0.01	0.61	22,626
Merged (w/o Adj)	0.15	0.67	22,626
AVHRR Only (ngt)	-0.10	0.57	3,170
TMI Only (ngt)	0.26	0.69	10,167

Strong winds cause perceived over cooling and large swath edge effects are visible

Diurnal warming effects are aliased into the product if not corrected.

Analyzed Products

Additional objective analysis provides daily products free from gaps

Analysis Characteristics

- Based on Reynolds and Smith, 1994
- Currently using constant correlation length scales
- Incorporates bias adjustments as in merged products
- Relative product uncertainties derived from difference analysis relative to buoys

Analysis Accuracy Assessment

Impact of exclusion of TMI data

Impact of exclusion of daytime data

Product	Bias (K)	RMS (K)	Matches
Full Analysis	0.13	0.68	28,926
Night Obs Only	-0.08	0.58	28,926
AVHRR Obs Only	-0.01	0.56	28,926
TMI Obs Only	0.22	0.74	28,926
TMI Night Only	0.08	0.59	28,926

Revised diurnal corrections are the most needed improvement