Microwave SSTs & climatologies

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- TMI/AMSR-E
- MW SST algorithm development
- Validation Results
- Sensor Issues
- Useful for Climate research
Outline of Talk

- Current status of TMI & AMSR-E SSTs
  - Sensor description
  - RSS MW SST algorithm
- Validation Results
- Calibration problems
- Useful for Climate research
TRMM Orbit

- 35° inclination.
- Altitude of 350km.
- Full coverage in ~2 days.

- 50 km footprint
- Swath width: 760 km
- 5 channels:
  10.7, 19.4, 21.3, 37, 85.5 GHz

TRMM SST, November 23, 2000
Better Coverage: IR/MW retrievals
Climate Stability

- Water Vapor is a greenhouse gas – IR SST are susceptible to biases due to water vapor
- Volcanic aerosols, Saharan Dust, & Asian Dust events result in cool biases (minimized in more advanced instruments)
Spatial Resolution

AMSRE     MODIS

www.misst.org
TMI/AMSR-E
Suite of Ocean Products

Wind Speed
SST
Rain Rate
Water Vapor
Cloud
Algorithm Derivation

Environmental Scenes
- 42,195 Radiosondes
- 5 Cloud Models
- SST Randomly Varied \( \pm 5^\circ C \) about climatology
- Wind Speed Randomly Varied from 0 to 25 m/s
- Wind Direction Randomly Varied from 0 to 360\(^\circ\)

Truth: \( T_s, W, V, L \)

Simulated TMI TB's

Gaussian Noise Added

Withheld Data Set

Complete Radiative Transfer Model

Derive Coefficients for Multiple Linear Regression Algorithm

Algorithm Coefficients

Evaluate Algorithm Performance

Retrieved values for \( T_s, W, V, L \)

Run Algorithm

Performance and Cross Talk Statistics

TMI, AMSR-E, AATSR coefficients calculated by regression to RTM generated TBs.

AVHRR SST monthly coefficients calculated by blind regressions to in-situ (drifters/buoys/ship) measurements.
# TMI SST Validation

## Orbital Collocations

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<th>Mean Dif.</th>
<th>STD</th>
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## AMSRE SST Validation

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</table>

Legend:
-1 -0.5 0 0.5 1
Mean Residual (°C)

= 0.5°C STD

Remote Sensing Systems
www.remss.com
AMSR-E/TMI Validation

AMSR-E vs. Reynolds

STD=0.67 C

TMI vs. Buoy SSTs

STD=0.57 C
Near real time AMSR-E SST Validation Using Buoys & Ship Measurements from NRL-Monterey

- Updated twice daily
- Figures show last 50 days bias/std & locations of previous day collocations
- Complete collocated dataset available
Land contamination in TMI

- Microwave observations within 50-100 Km from land affected by warm emission by land
- WARM bias of coastal SSTs
SSM/I Versus TMI Comparisons

- 19 V-pol
- 19 H-pol
- 21 V-pol
- 37 V-pol
- 35 H-pol
- 85 V-pol
- 85 H-pol

TRMM Pitch-Over

- Hot load
- Scene
- Cold Mirror
• On August 25, 2001 TRMM finished a maneuver to boost the altitude from 350 to 402 km.

• TRMM’s attitude control system (ACS) controls yaw/pitch/roll based on onboard attitude estimates. Pre-boost ACS utilized an Earth horizon sensor for roll and pitch.

• The altitude increase resulted in the loss of the Earth horizon sensor, the ACS backup system uses a ‘Kalman filter’ with weighted input from the gyros, sun sensor, magnetometer.

• Post-boost errors in the PR rain and TMI SST were immediately apparent. Independent estimates of errors in roll from GSFC PR team (Red) and RSS TMI SST team (Black) are in close agreement.

• Post-boost roll errors peaked at 0.5 degrees at the end of September -- these errors translate to 3 C errors in SST before correction. Using the RSS calibration developed, SST errors due to roll were reduced to < 0.2 C.
On-Orbit Calibration of AMSR-E Hot Load

SSM/I

TMI

AMSR-E

Solution for Effective Hot Load Temperature

Earth Temperature from Satellite Network

Deep Space Observation = 2.7 K

AMSR-E Radiometer Observations (Counts)

On-Orbit Calibration significantly improves accuracy of AMSR-E retrievals
Aqua Pitch Error

Daytime AMSR V03 - Reynolds

Nighttime AMSR V03 - Reynolds

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Global Difference: June 2001 – October 2003

AMSR-E Day - Reynolds

Bias = 0.07 °C
STD = 0.67 °C

AMSR-E Night - Reynolds

Bias = -0.12 °C
STD = 0.66 °C
3-day average: Polar SST

AMSR SST Date: 06/03/2002
Climatologies

Reynolds

JPL Pentad

PF clim

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Climatologies:

\[ \Delta T \text{ (K)} \]

Number obs

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Conclusions

• Satellite SSTs provide data in in situ data sparse regions
• GHRSST data provide bias/std for each retrieval
• ICOADS useful for satellite validation and calibration. Satellites useful for ICOADS validation and calibration.
• www.ghrsst-pp.org