Comprehensive Uncertainty Estimates for Satellite-Derived Temperature Climate Data Records.

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1. MOTIVATION

- Satellite-Derived Atmospheric Temperature Climate Data Records from MSU and AMSU are used in a variety of climate analysis projects.
- Often, conclusions have been drawn with little regard to the statistical uncertainty in the MSU/AMSU datasets.
- Most error analysis for the MSU/AMSU datasets has focused on decadel-scale trends in global-scale means, while many applications are focused on shorter time scales and smaller spatial scales.
- Here we describe a comprehensive analysis of the internal uncertainty in the RSS MSU/AMSU datasets. The results can be used to evaluate the estimated uncertainty on all relevant temporal and spatial scales.

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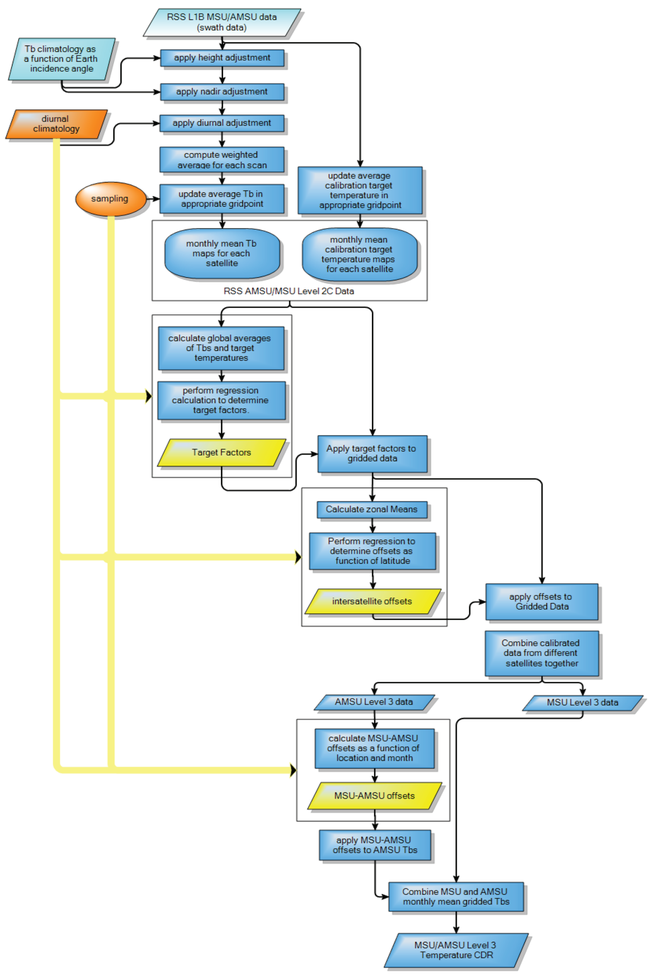
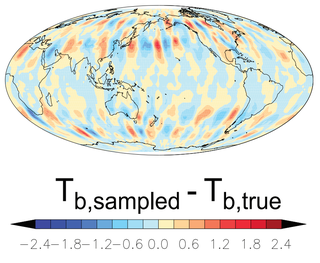
2. ISSUES

- Our MSU/AMSU datasets use data from 14 different satellites. The data need to be intercalibrated before being merged together. This is a complex process (see flow chart)
- First, adjustments are made for changes in local measurement time (diurnal adjustment) and Earth incidence angle.
- Then, intercalibration is performed by comparing measurements from co-orbiting satellites, yielding a set of "merging parameters".
- Uncertainty earlier in the process can cause uncertainty in these merging parameters, which adds to the uncertainty in the final results. This indirect flow of uncertainty is represented by the yellow arrows in the flow chart.
- To account for all the source of uncertainty is the entire system, we use a Monte Carlo technique.

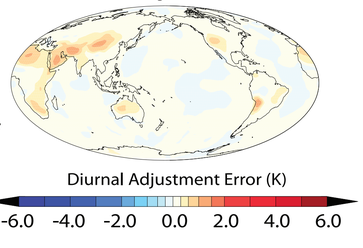


3. MONTE-CARLO APPROACH

Take a series of instances of the estimated sampling uncertainty.....



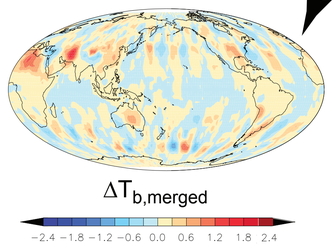
and an instance of the estimated uncertainty in each monthly diurnal adjustment....



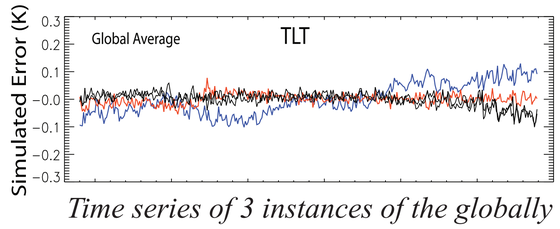
which are combined to make a combined error instance for each satellite and month

These are combined into a single dataset using the same merging system as the actual measurements. (See flowchart in Section 2.)

To obtain an instance of the estimated error. Each instance is a gridded monthly dataset of the same size as the measured data



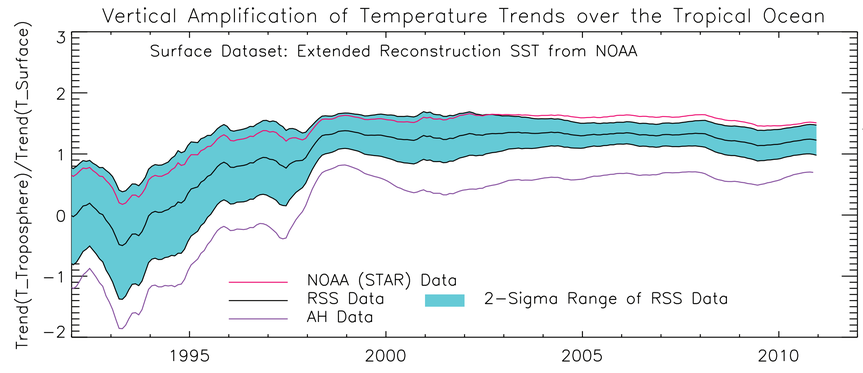
Map of an instance of simulated errors for a single month.



Time series of 3 instances of the globally averaged errors. 400 such instances were generated in total.

4. EXAMPLE OF USE

The degree of vertical amplification of long-term temperature trends in the tropics has been controversial over the past decade. Here we plot the ratio between trends in the tropical troposphere (1.1*TMT - 0.1*TLS as defined by Fu and Johansen 2005), and the surface for 3 different satellite datasets. For RSS, we show the 2-σ error range from our uncertainty analysis. (We assume NO error in the surface dataset, so the true error range is likely to be larger)



Each trend calculation begins in January 1979, and ends at the time on the x-axis.

5. DATA AVAILABILITY:

The error dataset is available upon request from Remote Sensing Systems. We are working on providing a reduced-size version that we will provide via our website

References

Q. Fu and C. M. Johanson, "Satellite-derived vertical dependence of tropospheric temperature trends," Geophysical Research Letters, vol. 32, 2005.
Mears, CA, FJ Wentz, P Thorne and others, 2011, Assessing uncertainty in estimates of atmospheric temperature changes from MSU and AMSU using a Monte-Carlo estimation technique, Journal of Geophysical Research, 116, D08112, doi:10.1029/2010JD014954.