

Mears, Carl, Remote Sensing Systems; co-I, Wentz, Frank

Lower Tropospheric Temperatures Based on AMSU Channels 3 and 4

2011

**Abstract** The accurate measurement of long-term changes in tropospheric temperature is a difficult problem. Currently, three observing systems can be used to make these measurements. Radiosondes provide direct *in situ* measurements of the temperature, but are plagued by both measurement homogeneity problems, and by insufficient spatial coverage, particularly in the Southern Hemisphere. Radio occultation measurements made using the global positioning system are beginning to show promise, but have not been demonstrated to be accurate for near-surface temperatures, where their performance is complicated by the presence of water vapor. Satellite-borne microwave sounders, which include the MSU and AMSU series of instruments, offer global coverage but have been difficult to calibrate accurately, with different analyses yielding different values for long-term trends. To date, measurements of the temperature of the lower troposphere have been made by processing MSU channel 2 and AMSU channel 5 data using an extrapolation procedure to remove the stratospheric influence from these channels, and to lower the peak of the temperature weighting function into the lower troposphere. Since this procedure involves differencing measurements at different viewing angles, it increases the noise substantially and adds an inadvertent spatial derivative into the final results, limiting the accuracy. Both MSU and AMSU have additional channels with temperature weighting functions that peak in the lower troposphere. These channels have the advantage of making a direct measurement of tropospheric temperature without the need for extrapolation. Because their weighting functions peak low in the troposphere, the raw brightness temperatures measured by the satellite are determined not only by the temperature profile in the atmosphere, but also by microwave emission from the surface, and atmospheric emission water vapor, clouds and rain. The complication due to these confounding geophysical parameters has so far limited work on these channels for climate analysis.

The instrument suite on the AQUA satellite contains both a microwave sounder (AMSU), and a microwave imager (AMSR-E). AMSR-E provides measurements of sea surface temperature, surface roughness (wind speed), water vapor, clouds, and rain which are closely collocated with AMSU sounding measurements. AQUA thus provides a unique opportunity to characterize and remove the effects of these confounding geophysical parameters from AMSU channel 4 over the world's oceans. In this work, we propose to develop an algorithm that finds an atmosphere-only effective temperature for AMSU channel 4 on AQUA after adjusting the raw brightness temperatures to remove geophysical parameter effects. Lessons learned from this process will be applied to AMSU channel 4 measurements on NOAA and EUMETSAT satellites as well, using less ideal measurements of confounding parameters. We will also study the feasibility of extending these methods to AMSU channel 3 and MSU channel 1.