# Modes of Natural and Forced Climate Variability In 6 Years of AIRS and AMSU Data

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We use the Atmospheric Infrared Sounder (AIRS) and Advance Microwave Sounding Unit (AMSU) data obtained on Aqua spacecraft (Aumann et al., 2004) to study temperature variability in 2002-2008. The AIRS and AMSU deliver accurate, simultaneous measurements of the atmosphere at the surface and in the mid-troposphere. The data provide twice per day coverage of the Earth's atmosphere from the sea level to the stratosphere. All-sky (including cloudy), day and night data are analyzed. We investigate the temperature variability in selected zonally averaged regions and in masked Atlantic, Pacific and Indian oceans areas, including the South Atlantic and Indian Oceans that bound African Continent.

Taking into account the nonlinear and non-stationary behavior of the temperature we use the data analysis adaptive to the data. We apply the Empirical Mode Decomposition (Huang et al., 1998) to better separate modes of climate variability. In addition to the dominant annual variation, which is latitude dependent, we identified the modes with higher frequency and the inter-annual modes. Apparent trends appear and we apply stringent criteria using the method outlined in Wu et al., (2007) to test their statistical significance.

To put the result of our data analysis into the context of baseline climate and global climate change we take into consideration the known forcing and natural variabilities that took place in the 6-year time span under consideration. As a proxy for anthropogenic forcing we analyze the daily record of $CO_2$ at Mauna Loa. The Atlantic Ocean variability is characterized by the Northern and Southern Atlantic Oscillations (NAO and SAO) and by the Atlantic Multi-decadal Oscillation (AMO). We employ the NAO, SAO and AMO indices available from http:// www.cdc.noaa.gov to identify the strength and phases of these modes of variability. For the Pacific Ocean basin we investigate the El Nino – La Nino and the related Pacific Decadal Oscillation influence.

During the 2002-2007 time period solar activity declined from solar maximum to solar minimum. Tang and Camp (2008) estimate the peak-to peak amplitude of the temperature response to solar cycle to be around 0.2 K based on the 45-year reanalysis of ERA-40. (ERA is a second-generation reanalysis carried out by the European Centre for Medium-Range Weather Forecasts.) The spatial distribution of the response has maxima in the polar regions and three substantial maxima in Africa. We test this estimate of the temperature response to the solar forcing using the AIRS remote-sensing data.

References:

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