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Validation of radiative transfer model ARTS through model inter -comparison and Radiosonde profiles: An overview for infrared frequency.

Ajil Kottayil and Stefan Buehler
Department of Space Science, Lulea University Of Technology, Kiruna, Sweden

An inter-comparison of line by line radiative transfer model ARTS (Atmospheric Radiative Transfer Simulator) against LBLRTM (Line by Line Radiative Transfer Model) as reference has been performed. The model to model comparison was performed on water vapor channels 11 (7.33 microns) and 12 (6.52 microns) of HIRS (High resolution Infrared Sounder) on board NOAA (National Oceanic and Atmospheric Administration) satellite -14 using 42 diverse radiosonde dataset. While the bias values reveal a good agreement between ARTS and LBLRTM, the former shows a warm bias of 0.1K for channel 11 and 0.3 K for channel 12. A comparison between measured and simulated radiances of upper tropospheric humidity channels from infrared (6.52 microns) and microwave (183 Ghz) frequencies of satellite -17 on board NOAA, for the periods 2003-2008 has been performed. The weighting function of these channels peak in the upper troposphere and lie approximately within 200-500 mb level in the atmosphere. These are the primary channels for deriving the UTH (upper tropospheric humidity) from satellite measurements. The radiances were simulated from collocated radiosonde profiles of Atmospheric Radiation Measurement (ARM) campaign undertaken at mid-latitude (36.61N & 97.49W) and tropical (12.42S & 130.88E) sites using line by line radiative transfer model ARTS . The collocated dataset was restricted to a time and distance of +/-2 hours and 50 km radius of the radiosonde measurements. The time constraint also accounts for the time to reach the radiosonde at satellite measurement altitude. The comparison was performed under clear sky conditions. The pixels contaminated by clouds were excluded based on the threshold values between the surface channels of HIRS. The day time collocations have been excluded from the current study since the observed biases were significantly larger than the night time values which may be attributed to solar radiation dry bias. The warm biases clearly indicate an under prediction of humidity values by the radiosonde in the upper troposphere, irrespective of the frequency differences. These observations are well in conformance with earlier studies which showed the dry behavior of radiosonde measurements in the upper troposphere. The comparisons from infrared and microwave platforms show a warm bias of 0.6 K and 0.4 K respectively, for mid-latitude site where as it is 2.30 and 1.81 for the tropical site. These results question the quality of the radiosonde launched from the tropical site. The elevated bias values might indicate a poor sampling of humidity values by radiosonde at the tropical site than at the mid-latitude and are capable of introducing an error of more than 10 % in the measurement of UTH.