Cloud Thermodynamic Phase in the Infrared with AIRS

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Whether clouds are composed of water droplets, ice crystals, or mixture of water and ice impacts precipitation, radiation, modeling, and remote sensing. In this presentation, I'll focus on the remote sensing of cloud thermodynamic phase using infrared satellite observations from the MODIS and AIRS instruments on the Aqua satellite. While cloud phase is a microphysical cloud property, from the perspective of satellite-based remote sensing, it is frequently more of a macroscopic property due to the size of the satellite field of view. Therefore, it is helpful to think of satellite-based cloud phase retrievals as providing information about the dominant thermodynamic phase of the cloud. This retrieval is weighted toward cloud top in the case of optically thick clouds.

I will discuss the theory behind thermodynamic phase sensitivity in the infrared and its strengths and limitations. This theory forms the backbone of a new method of detecting ice clouds in data from the Atmospheric Infrared Sounder (AIRS) on the Aqua satellite. This is a computationally fast ice cloud detection algorithm that also includes information from the AIRS Level 2 effective cloud fraction and UW-Madison MODIS baseline fit global land surface emissivity. Results of application of the algorithm to one month of AIRS data and comparisons with CALIPSO/CALIOP V3 1-km cloud-layer retrievals of layer-integrated depolarization ratio, layer-integrated attenuated backscatter at 532 nm, mid-layer cloud temperature, and cloud thermodynamic phase will be presented.