Dealing with clouds from space-based ultraspectral IR observations

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Hyperspectral infrared sounders with nadir observations are limited by the cloud cover. It is critical to detect the clouds in satellite measurements and to accurately retrieve the atmospheric and surface parameters with cloud contamination measurements. An inversion scheme has been developed, dealing with cloudy as well as cloud-free radiances observed with ultraspectral infrared sounders, to simultaneously retrieve surface, atmospheric thermodynamic, and cloud microphysical parameters. A fast radiative transfer model which applies to the clouded atmosphere is used for atmospheric profile and cloud parameter retrieval. A one-dimensional (1-d) variational multi-variable inversion solution is used to iteratively improve the background state defined by an eigenvector-regression-retrieval. The solution is iterated in order to account for non-linearity in the 1-d variational solution. NPOESS Airborne Sounder Testbed – Interferometer (NAST-I) retrievals are compared with coincident observations obtained from dropsondes and the nadir-pointing Cloud Physics Lidar (CPL). This work was motivated by the need to obtain solutions for atmospheric soundings from infrared radiances observed for every individual field of view, regardless of cloud cover, from future ultraspectral geostationary satellite sounding instruments such as the Geosynchronous Imaging Fourier Transform Spectrometer (GIFTS) and the Hyperspectral Environmental Suite (HES). However, this retrieval approach can also be applied to the ultraspectral sounding instruments to fly on polar satellites such as the Infrared Atmospheric Sounding Interferometer (IASI) on the European MetOp satellite, the Cross-track Infrared Sounder (CrIS) on the NPOESS Preparatory Project and the following NPOESS series of satellites.