

Atmospheric Trace Gas Retrievals from Hyperspectral Satellite Remote Sensors

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Satellite-based hyperspectral observations provide high information content for the Earth's atmospheric and surface properties. We have developed two methods for retrieving atmospheric trace gases from hyperspectral satellite sounders such as AIRS and CrIS. The first method performs an optimal estimation retrievals using single field of view (SFOV) hyperspectral satellite data. The second method performs a spectral fingerprinting on spatiotemporally averaged hyperspectral data. The retrieved geophysical parameters include atmospheric temperature and moisture profiles, CO₂, CO, CH₄, N₂O, and O₃ profiles, cloud optical depth, size, phase, and height. Surface properties such as surface emissivity spectra and surface skin temperatures are also retrieved simultaneously. The key to our retrieval algorithm is a Principal Component-based Radiative Transfer Model (PCRTM), which can simulate radiance or reflectance spectra in the cloudy atmosphere from far IR to visible and UV spectral regions (50 wavenumber to 30000 wavenumber) quickly and accurately. Multi-scatterings of multiple layers of clouds/aerosols are included in the model. The PCRTM has a very good accuracy relative to reference line-by-line radiative transfer models and it saves orders of magnitude computational time. Results of applying both the SFOV PCRTM retrieval and spectral fingerprinting methods to CrIS and AIRS data will be presented.

Keywords: Trace gas retrievals, hyper spectral remote sensing, inversion algorithm, satellite data