Big Data Analysis using Fast Radiative Transfer Models and Retrieval Algorithms

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Satellite-based hyperspectral observations provide high information content for the Earth’ s atmospheric and surface properties; however, in order to analyze hyperspectral data efficiently, fast and accurate radiative transfer models are needed. We have developed a Principal Component-based radiative transfer model (PCRTM) which can simulate radiative transfer in the cloudy atmosphere from far IR to visible and UV spectral regions quickly and accurately. Multi-scatterings of multiple layers of clouds/aerosols are included in the model. The PCRTM model is capable of simulating top of atmospheric radiance or reflectance spectral from 50 wavenumber to 30000 wavenumber. The PCRTM has a very good accuracy relative to reference line-by-line radiative transfer models and it saves orders of magnitude computational time. We will show comparisons of the PCRTM model to AIRS, CrIS, IASI, NAST-I, and SCIAMACHY data. We will demonstrate the application of the PCRTM forward model for atmospheric and surface property inversions and for climate observation studies. We will describe a hyperspectral retrieval algorithm that is designed to use information from multiple spectral regions. For example, by combining microwave and infrared remote sensing data, we can achieve better atmospheric temperature retrievals below clouds. We will further show results of applying the PCRTM retrieval algorithm to these remote sensing data to retrieve 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.

Keywords: Radiative Transfer Model, Retrieval, remote sensing

