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Fast Radiative Transfer Model to Simulate Spectroscopic Measurements of Outgoing IR Radiances in Cloudy Conditions

A. Rublev (1,2) and A. Trotsenko (2)

(1) Scientific and Research Centre on Space Hydrometeorolgy "Planeta", Moscow, Russia (alex.rublev@mail.ru), (2) National Research Centre "Kurchatov Institute", Moscow, Russia

Many publications quoted the importance to take into account the scattering effects in calculating IR outgoing radiances in the atmosphere. The main emphasis in these papers was placed upon cirrus clouds. The mean annual probability of their existence over the globe averages 14-20 % and even exceeds 80-90 % in some tropical regions. Being located at the top layers of the troposphere and consisted of ice crystals they have rather high optical thicknesses in the infrared that often attain the magnitudes about several units (1-5). In composition with the single scattering albedo of the ice particles being about 0.5-0.7 such magnitudes result in the following effect: the diffuse component of the upward radiation emanated from the lower (warmer) atmospheric layers will be significantly greater than its direct component and thus essentially contribute to the outgoing radiance beyond the strong absorption bands of the atmospheric gases.

In some geographical areas essential effect on the outgoing IR radiance can be also associated to the scattering by optically thick layers of the dust aerosol. For example, according to the MAR-II aerosol model that is typically considered in simulating dust releases in Sahara the aerosol optical thickness of the dust layer in the infrared reaches the magnitude of 3. In doing so about 60 % of this value is associated to the scattering optical thickness. It should be outlined in this context that the measurements will be performed at diverse meteorological conditions and types of cloud and aerosol contamination. That is why it is required to develop corresponding radiative transfer model that will be able to accurately take into account the scattering effects in the atmosphere actually at its arbitrary state. Surely such “accurate” consideration is possible only in frame of define cloud and/or aerosol models which can be however changed or modified using accumulated statistics available for example from the very satellite measurements. Hence one of the key requirements in developing the proposed method for the IR scattering correction is to provide maximum flexibility regarding the inclusion of new (both micro-physical and spatial) cloud and aerosol models.

The presentation contains general description of methodological approaches to be applied in context of the activity associated to extending the capabilities of existing clear-sky fast radiative transfer model to simulate measurements of IR satellite sounders with due regard for the absorption and scattering effects in aerosols and clouds.