A wideband and narrow band radiative transfer model based on a fast correlated k-distributions generation for MATISSE V3.0

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MATISSE which acronym means Advanced Modeling of the Earth for Environment and Scenes Simulation is developed by ONERA since the mid 1990's. The code main functionality is to compute spectral or integrated natural background radiance images. Natural backgrounds include the atmosphere, low and high altitude clouds, sea and land. It can also provide specific radiative atmospheric terms as path transmission, path radiance, sky radiance or local illumination around a target point. Spectral bandwidth ranges from 700 to 25000 cm^{-1}(i.e. from 0.4 to 14 μm).

MATISSE v2.0 was based on a Correlated K-distribution (CK). This method is very precise but is time consuming and is done as an offline calculation of the k-distribution for each new atmospheric description at each spectral resolution. In answer to the increasing need of rapid radiative transfer codes, the new release of MATISSE v3.0 includes a fast radiative transfer model at low and at medium spectral resolution. This work aims to develop a method for the stochastic generation of k-distributions. Then, this method was coupled with a wideband CK (WBCK) model for the acceleration of radiative transfer calculation at spectral resolution greater than 25 cm^{-1}.

The model allows calculating both spectral and integrated transmission and radiance in spectral windows include in the range from 700 to 25000 cm^{-1} for atmospheric gas mixture. It allows performing calculations with a spectral resolution from 1 cm^{-1} to several thousand cm^{-1}. Results are globally satisfactory and there is a good agreement between line by line transmittance calculations and calculations based on the statistical generation of k-distributions, MATISSE V2 CK model and MATISSE V3 WBCK.

In this paper, after a brief presentation of MATISSE and a description of the method, results will be presented and discussed.