



Development of a wide band radiative transfer model based on a fast correlated k-distributions generation

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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 radiances, sky radiances or local illumination around a target point. Spectral bandwidth ranges from 700 to 25000 cm⁻¹ wavenumber (i.e. from 0.4 to 14 μm).

As far as molecular absorption is concerned, MATISSE v2.0 is based on a correlated K (CK) model and needs a pre-generation of the k-distributions. This method is very precise but is time consuming and is done as an offline calculation. In answer to the increasing need of rapid radiative transfer codes, the future version of the MATISSE v3.0 will include a fast radiative transfer model at low and at medium spectral resolution. This work aims to develop a fast wide band CK model for the acceleration of radiative transfer calculation.

As a first step, a statistical k-distributions fast generator was developed. It allows generating k-distributions from 700 to 25000 cm⁻¹ with a spectral resolution of 1 cm⁻¹ in less than 30 ms(*) for one altitude (that means about three orders of magnitude faster than before). Such speed allows generating k-distributions online. To validate the model, we have compared the obtained transmission spectra with reference spectra using a mix of 6 molecules (H₂O, CO₂, O₃, N₂O, CO, CH₄) in homogenous atmosphere corresponding to different altitudes from 0 to 105 km. Reference spectra were calculated as the convolution of a spectrum obtained with a line by line model and a gate function of 1 cm⁻¹ wide. An average difference of 3×10⁻³ % and a standard deviation of 3.3% were typically obtained. As a second step, this method of rapid k-distributions generation is now being coupled with a wideband radiative transfer model.

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

(*) Application mono-thread win32 (compiled with Visual c++ 2012), processor Intel Xeon W3530 2.8Ghz