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Radiative transfer simulation in the atmosphere: Radiative transfer code *MOMO* and *k-distribution* method. Simulation of a large band middle-infrared satellite channel

L. Doppler (1,2), J. Fischer (1), R. Preusker (1), and R. Bennartz (3)

(1) Freie Universität Berlin / UPMC Paris, Institut für Weltraumwissenschaften, Berlin, Germany (lionel.doppler@wew.fu-berlin.de), (2) LATMOS, IPSL, Université Pierre et Marie Curie, Paris, France, (3) University of Wisconsin, Atmospheric & Oceanic Sciences, Madison, WI, USA

Radiative transfer code *MOMO* is the radiative transfer code of the Free University of Berlin. It is used for remote sensing inversions or radiative budget calculations. This code is based on the combination of *matrix-operator* and *adding-doubling* methods. It simulates the radiative transfer in the atmosphere and the ocean. It can solve all kind of atmospheric radiative transfer problems, in scattering or in clear sky media. The spectral range of this code has been recently extended from [200 – 3600 nm] to [0.2 – 100μm]. This constrained us to make some changes in the code because we had to take the emission of light by gases and particles into account for the thermal infrared spectral range.

MOMO uses a subprogram named *KBIN*. The aim of *KBIN* is to reduce the computation time, using a *k-binning* method. This *k-binning* method is an art of *k-distribution*. Like other *k-distribution* methods, *KBIN* groups the many spectral sub-intervals needed to model the gaseous absorption of light in a much smaller number N of groups of sub-intervals named "*bins*".

KBIN get two improvements compared to standard *k-distribution* methods. The first improvement brings flexibility regarding the instrument function. We compute the *k-distribution* and make the tests on transmission and emission of light, not only for the whole band covered by the instrument function, but also for each spectral sub-intervals. Thus, the accuracy of the *k-distribution* does not depend on the instrument function, and if we have to apply the computed *k-distribution* to another instrument function, we only need to change the weights of each bin of the *k-distribution* and not the *k-distribution* itself. This is a big advantage if we apply the *k-distribution* to interferometers instruments like *OCO* or *IASI*. The second improvement is for the thermal-infrared range: *KBIN* combine the high spectral variations of absorption/emission coefficients and the variations of the blackbody radiance. That permits to apply the *k-distribution* method to instrument having spectral bands in middle infrared even if the spectral band is large and include consequent changes in the blackbody radiance as function of the wavelength. The method used will be presented in this presentation. Tests have been done on the case of a middle-infrared space-borne instrument: channel 3 (12.05μm) of *Imaging Infrared Radiometer* (*IIR*) of *NASA* satellite *CALIPSO*. Results show that in this spectral range, if we use the *k-binning* method of *KBIN*, we need to make 30 times less simulations than if we use a *line-by-line* method. And the error due to the *k-distribution* method on the Top of Atmosphere Brightness Temperature is smaller than the instrument precision (0.11 K is the dispersion in brightness temperature due to the instrument noise of *IIR*).