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A fast method to compute Three-Dimensional Infrared Radiative Transfer in non scattering medium

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The Atmospheric Radiation field has seen the development of more accurate and faster methods to take into account absoprtion in participating media. Radiative fog appears with clear sky condition due to a significant cooling during the night, so scattering is left out. Fog formation modelling requires accurate enough method to compute cooling rates. Thanks to High Performance Computing, multi-spectral approach of Radiative Transfer Equation resolution is most often used. Nevertheless, the coupling of three-dimensionnal radiative transfer with fluid dynamics is very detrimental to the computational cost. To reduce the time spent in radiation calculations, the following method uses analytical absorption functions fitted by Sasamori (1968) on Yamamoto's charts (Yamamoto,1956) to compute a local linear absorption coefficient. By averaging radiative properties, this method eliminates the spectral integration. For an isothermal atmosphere, analytical calculations lead to an explicit formula between emissivities functions and linear absorption coefficient. In the case of cooling to space approximation, this analytical expression gives very accurate results compared to correlated k-distribution. For non homogeneous paths, we propose a two steps algorithm. One-dimensional radiative quantities and linear absorption coefficient are computed by a two-flux method. Then, three-dimensional RTE under the grey medium assumption is solved with the DOM. Comparisons with measurements of radiative quantities during ParisFOG field (2006) shows the cability of this method to handle strong vertical variations of pressure/temperature and gases concentrations.