



Using a spectrally refined Monte-Carlo code taking into account cloud overlap to estimate the Earth cooling integrated over a climate period

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The Earth's radiative cooling is a key driver of climate and due to the complexity of the radiative transfer processes, current estimates of this cooling require the development and use of a suite of radiative transfer models of decreasing accuracy when moving from local, instantaneous estimates to estimates over the whole globe and for long periods (decades). Here we address how recent advances in non-linear Monte Carlo methods allow a paradigm shift by producing in a single step and at a very low computational cost a completely unbiased estimate of the Earth's infrared cooling to space on a global scale and for years, while including the most refined spectroscopic models of molecular gas energy transitions. We also show it is possible to take exponential-random cloud overlap as well as the vertical subgrid heterogeneity of the cloud fraction into account directly during the Monte Carlo computations. The use of Monte-Carlo allows to have access to some interesting diagnostics, as the emission height and the emission agent. For illustration, we will show the emission altitudes of each atmospheric components and how these altitudes shift when the greenhouse gas (CO₂, H₂O, etc.) concentration varies.