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RAPID COMPUTATION OF THE TOTAL BAND RADIANCE BY USING THE SPECTRALLY INTEGRATED VOIGT FUNCTION

Abstract

In our earlier publication we introduced the Spectrally Integrated Voigt Function (SIVF) as an alternative to the traditional Voigt function for the HITRAN-based applications [Quine Abrarov, JQSRT 2013]. It was shown that application of the SIVF enables us to reduce spectral resolution without loss of accuracy in computation of the spectral radiance. As a further development, in this study we present more efficient SIVF approximations derived by using a new sampling method based on incomplete cosine expansion of the sinc function [Abrarov Quine, Appl. Math. Comput. 2015]. Since the SIVF mathematically represents the mean value integral of the Voigt function, this method accounts for area under the curve of the Voigt function. Consequently, the total band radiance, defined as the integrated spectral radiance within a given spectral region, can also retain its accuracy even at low spectral resolution. Our numerical results demonstrate that application of the SIVF may be promising for more rapid line-by-line computation in atmospheric models utilizing the HITRAN molecular spectroscopic database. Such an approach may be particularly efficient to implement a retrieval algorithm for the greenhouse gases from the NIR space data collected by Earth-orbiting micro-spectrometers like Argus 1000 for their operation in a real-time mode. The real-time mode operation of the micro-spectrometers can be advantageous for instant decision making during flight for more efficient data acquisition from space.