CONVOLUTION CALCULATION OF DIFFERENTIAL CROSS SECTIONS OF RING EFFECT

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The Ring effect [1] is one significant limitation to the accuracy of the retrieval of trace gas constituents in atmosphere, while using satellite data with Differential Optical Absorption Spectroscopy [2] technique. The Ring effect refers to the filling in of Fraunhofer lines, which is known as solar absorption lines, caused almost entirely by Rotational Raman scattering [3]–[8]. The inelastic component of the molecular scattering results in a net increase of radiance in the line because more radiation is shifted to the wavelength of an absorption line than shifted from this wavelength to other wavelengths. The Rotational Raman scattering by N₂ and O₂ in the atmosphere is the main factor that leads to Ring effect. Basically, the Ring effect is considered as a pseudo-absorption process in retrieval of trace gas constituents in atmosphere [9]. The solar spectrum in Fig. 1 measured by OMI/AURA is convolved with rotational Raman cross sections of N₂ and O₂, divided by the original solar spectrum, with a cubic polynomial subtracted off, to create a differential Ring spectrum. This method has been suggested in order to obtain an effective differential Ring cross-section for the DOAS fitting process. The differential Ring spectrum could be used to improve the accuracy of the retrieval of the trace gases concentration. The results in this paper have been in basic agreement with the corresponding results calculated with radiative transfer model in Fig. 3, and the R² statistics are R²(B)=0.9663, R²(C)=0.9639, and R²(D)=0.9624. At last but not the least, the computational complexity calculated at fixed wavelength of 410nm or of 488nm is 0.128% of that calculated with wavelengths from 410nm to 488nm.
Fig. 1 The solar spectrum measured by OMI/AURA on February 6, 2008

Fig. 2 The solar spectrum convolved with rotational Raman cross sections of \(\text{N}_2\) and \(\text{O}_2\) to create Ring spectrums

(A) Convolved with rotational Raman cross sections of \(\text{N}_2\) and \(\text{O}_2\) at wavelengths from 410nm to 488nm.
(B) Convolved with rotational Raman cross sections of \(\text{N}_2\) and \(\text{O}_2\) at wavelength of 488nm.
(C) Convolved with rotational Raman cross sections of \(\text{N}_2\) and \(\text{O}_2\) at wavelength of 410nm.
REFERENCES
