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Inelastic scattering in ocean water and its impact on trace gas retrievals from satellite data

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Abstract. Over clear ocean waters, photons scattered within the water body contribute significantly to the upwelling flux. In addition to elastic scattering, inelastic Vibrational Raman Scattering (VRS) by liquid water is also playing a role and can have a strong impact on the spectral distribution of the outgoing radiance. Under clear-sky conditions, VRS has an influence on trace gas retrievals from space-borne measurements of the backscattered radiance such as from e.g. GOME (Global Ozone Monitoring Experiment). The effect is particularly important for geo-locations with small solar zenith angles and over waters with low chlorophyll concentration.

In this study, a simple ocean reflectance model (Sathyendranath and Platt, 1998) accounting for VRS has been incorporated into a radiative transfer model. The model has been validated by comparison with measurements from a swimming-pool experiment dedicated to detect the effect of scattering within water on the outgoing radiation and also with selected data sets from GOME. The comparisons show good agreement between experimental and model data and highlight the important role of VRS.

To evaluate the impact of VRS on trace gas retrieval, a sensitivity study was performed on synthetic data. If VRS is neglected in the data analysis, errors of more than 30% are introduced for the slant column (*SC*) of BrO over clear ocean scenarios. Exemplarily DOAS retrievals of BrO from real GOME measurements including and excluding a VRS compensation led to comparable results as in the sensitivity study, but with somewhat smaller differences between the two analyses.

The results of this work suggest, that DOAS retrievals of atmospheric trace species from measurements of nadir viewing space-borne instruments have to take VRS scattering into account over waters with low chlorophyll concentrations, and that a simple correction term is enough to reduce the errors to an acceptable level.

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