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Using a photochemical model for the validation of NO_2 satellite measurements at different solar zenith angles

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Abstract. SCIAMACHY (Scanning Imaging Spectrometer for Atmospheric Chartography) aboard the recently launched Environmental Satellite (ENVISAT) of ESA is measuring solar radiance upwelling from the atmosphere and the extraterrestrial irradiance. Appropriate inversion of the ultraviolet and visible radiance measurements, observed from the atmospheric limb, yields profiles of nitrogen dioxide, NO_2, in the stratosphere (SCIAMACHY-IUP NO_2 profiles V1). In order to assess their accuracy, the resulting NO_2 profiles have been compared with those retrieved from the space borne occultation instruments Halogen Occultation Experiment (HALOE, data version v19) and Stratospheric Aerosol and Gas Experiment II (SAGE II, data version 6.2). As the HALOE and SAGE II measurements are performed during local sunrise or sunset and because NO_2 has a significant diurnal variability, the NO_2 profiles derived from HALOE and SAGE II have been transformed to those predicted for the solar zenith angles of the SCIAMACHY measurement by using a 1-dimensional photochemical model. The model used to facilitate the comparison of the NO_2 profiles from the different satellite sensors is described and a sensitivity ananlysis provided. Comparisons between NO_2 profiles from SCIAMACHY and those from HALOE NO_2 but transformed to the SCIAMACHY solar zenith angle, for collocations from July to October 2002, show good agreement (within +/-12%) between the altitude range from 22 to 33km. The results from the comparison of all collocated NO_2 profiles from SCIAMACHY and those from SAGE II transformed to the SCIAMACHY solar zenith angle show a systematic negative bias of 10 to 35% between 20km to 38km with a small standard deviation between 5 to 14%. These results agree with those of Newchurch and Ayoub (2004), implying that above 20km NO_2 profiles from SAGE II sunset are probably somewhat high.

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