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Validation of MIPAS $ClONO_2$ measurements

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Abstract. Altitude profiles of $ClONO_2$ retrieved with the IMK (Institut für Meteorologie und Klimaforschung) science-oriented data processor from MIPAS/Envisat (Michelson Interferometer for Passive Atmospheric Sounding on Envisat) mid-infrared limb emission measurements between July 2002 and March 2004 have been validated by comparison with balloon-borne (Mark IV, FIRS2, MIPAS-B), airborne (MIPAS-STR), ground-based (Spitsbergen, Thule, Kiruna, Harestua, Jungfraujoch, Izaña, Wollongong, Lauder), and spaceborne (ACE-FTS) observations. With few exceptions we found very good agreement between these instruments and MIPAS with no evidence for any bias in most cases and altitude regions. For balloon-borne measurements typical absolute mean differences are below 0.05 ppbv over the whole altitude range from 10 to 39 km. In case of ACE-FTS observations mean differences are below 0.03 ppbv for observations below 26 km. Above this altitude the comparison with ACE-FTS is affected by the photochemically induced diurnal variation of $ClONO_2$. Correction for this by use of a chemical transport model led to an overcompensation of the photochemical effect by up to 0.1 ppbv at altitudes of 30–35 km in case of MIPAS-ACE-FTS comparisons while for the balloon-borne observations no such inconsistency has been detected. The comparison of MIPAS derived

total column amounts with ground-based observations revealed no significant bias in the MIPAS data. Mean differences between MIPAS and FTIR column abundances are $0.11 \pm 0.12 \times 10^{14}$ cm^{-2} (1.0±1.1%) and $-0.09 \pm 0.19 \times 10^{14}$ cm^{-2} (−0.8±1.7%), depending on the coincidence criterion applied. χ^2 tests have been performed to assess the combined precision estimates of MIPAS and the related instruments. When no exact coincidences were available as in case of MIPAS – FTIR or MIPAS – ACE-FTS comparisons it has been necessary to take into consideration a coincidence error term to account for χ^2 deviations. From the resulting χ^2 profiles there is no evidence for a systematic over/underestimation of the MIPAS random error analysis.

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