Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 7, 3261-3284, 2007
www.atmos-chem-phys.net/7/3261/2007/

Validation of MIPAS-ENVISAT NO_2 operational data

G. Wetzel[1], A. Bracher[2], B. Funke[3], F. Goutail[4], F. Hendrick[5], J.-C. Lambert[5], S. Mikuteit[1], C. Piccolo[6], M. Pirre[7], A. Bazureau[4], C. Belotti[8], T. Blumenstock[1], M. De Mazière[5], H. Fischer[1], N. Huret[7], D. Ionov[4], M. López-Puertas[3], G. Maucher[1], H. Oelhaf[1], J.-P. Pommereau[4], R. Ruhnke[1], M. Sinnhuber[2], G. Stiller[1], M. Van Roozendael[5], and G. Zhang[1,*]

[1] Institut für Meteorologie und Klimaforschung (IMK), Forschungszentrum Karlsruhe, Karlsruhe, Germany
[2] Institute of Environmental Physics and Remote Sensing (IUP/IFE), University of Bremen, Bremen, Germany
[3] Instituto de Astrofísica de Andalucía (IAA), Consejo Superior de Investigaciones Cientificas, Granada, Spain
[4] Service d'Aéronomie, CNRS, Verrières-le-Buisson, France
[5] Belgian Institute for Space Aeronomy (IASB-BIRA), Brussels, Belgium
[6] Oxford University, Oxford, UK
[7] Laboratoire de Physique et Chimie de l'Environnement (LPCE), CNRS, Orléans, France
[8] IFAC-CNR, Firenze, Italy
[*] now at: Shangqiu Normal College, Shangqiu, China

Abstract. The Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) instrument was launched aboard the environmental satellite ENVISAT into its sun-synchronous orbit on 1 March 2002. The short-lived species NO_2 is one of the key target products of MIPAS that are operationally retrieved from limb emission spectra measured in the stratosphere and mesosphere. Within the MIPAS validation activities, a large number of independent observations from balloons, satellites and ground-based stations have been compared to European Space Agency (ESA) version 4.61 operational NO_2 data comprising the time period from July 2002 until March 2004 where MIPAS measured with full spectral resolution. Comparisons between MIPAS and balloon-borne observations carried out in 2002 and 2003 in the Arctic, at mid-latitudes, and in the tropics show a very good agreement below 40 km altitude with a mean deviation of roughly 3%, virtually without any significant bias. The comparison to ACE satellite observations exhibits only a small negative bias of MIPAS which appears not to be significant. The independent satellite instruments HALOE, SAGE II, and POAM III confirm in common for the spring-summer time period a negative bias of MIPAS in the Arctic and a positive bias in the Antarctic middle and upper stratosphere exceeding frequently the combined systematic error limits. In contrast to the ESA operational processor, the IMK/IAA retrieval code allows accurate inference of NO_2 volume mixing ratios under consideration of all important non-LTE processes. Large differences between both retrieval results appear especially at higher altitudes, above about 50 to 55 km. These differences might be explained at least partly by non-LTE under polar winter conditions but not at mid-latitudes. Below this altitude region mean differences

between both processors remain within 5% (during night) and up to 10% (during day) under undisturbed (September 2002) conditions and up to 40% under perturbed polar night conditions (February and March 2004). The intercomparison of ground-based NDACC observations shows no significant bias between the FTIR measurements in Kiruna (68° N) and MIPAS in summer 2003 but larger deviations in autumn and winter. The mean deviation over the whole comparison period remains within 10%. A mean negative bias of 15% for MIPAS daytime and 8% for nighttime observations has been determined for UV-vis comparisons over Harestua (60° N). Results of a pole-to-pole comparison of ground-based DOAS/UV-visible sunrise and MIPAS mid-morning column data has shown that the mean agreement in 2003 falls within the accuracy limit of the comparison method. Altogether, it can be indicated that MIPAS NO_2 profiles yield valuable information on the vertical distribution of NO_2 in the lower and middle stratosphere (below about 45 km) during day and night with an overall accuracy of about 10–20% and a precision of typically 5–15% such that the data are useful for scientific studies. In cases where extremely high NO_2 occurs in the mesosphere (polar winter) retrieval results in the lower and middle stratosphere are less accurate than under undisturbed atmospheric conditions.

Final Revised Paper (PDF, 2174 KB) Discussion Paper (ACPD)

Citation: Wetzel, G., Bracher, A., Funke, B., Goutail, F., Hendrick, F., Lambert, J.-C., Mikuteit, S., Piccolo, C., Pirre, M., Bazureau, A., Belotti, C., Blumenstock, T., De Mazière, M., Fischer, H., Huret, N., Ionov, D., López-Puertas, M., Maucher, G., Oelhaf, H., Pommereau, J.-P., Ruhnke, R., Sinnhuber, M., Stiller, G., Van Roozendael, M., and Zhang, G.: Validation of MIPAS-ENVISAT NO_2 operational data, Atmos. Chem. Phys., 7, 3261-3284, 2007. Bibtex EndNote Reference Manager