

Validation of IMK Ozone Profiles from MIPAS-Envisat

T. Steck¹, T. Blumenstock¹, T. von Clarmann¹, H. Fischer¹, N. Glatthor¹, U. Grabowski¹, F. Hase¹, M. Höpfner¹, S. Kellmann¹, M. Kiefer¹, A. Linden¹, G. Mengistu Tsidu¹, M. Milz¹, H. Oelhaf¹, G. P. Stiller¹, G. Wetzel¹, G. Zhang¹, B. Funke², D. Y. Wang³, M. Allaart⁴, P. von der Gathen⁵, G. Hansen⁶, K. Stebel⁶, E. Kyro⁷, U. Raffalski⁸, A. Redondas⁹, J. Russell III¹⁰, W. Steinbrecht¹¹, M. Yela¹². (e-mail: tilman.steck@imk.fzk.de)

¹Universität Karlsruhe/Forschungszentrum Karlsruhe GmbH, IMK, Postfach 3640, D-76021 Karlsruhe, Germany. ²Instituto de Astrofísica de Andalucía (CSIC), Spain ³Physics Department, University of New Brunswick, Canada. ⁴KNMI (Royal Netherlands Meteorological Institute), De Bilt, The Netherlands ⁵Alfred Wegener Institute for Polar and Marine Research, Research Unit Potsdam, Potsdam, Germany ⁶Norwegian Institute for Air Research (NILU), Polar Environmental Centre, Troms, Norway ⁷Finnish Meteorological Institute (FMI), Sodankylä Finland ⁸Swedish Institute of Space Physics (IRF), Kiruna, Sweden ⁹Instituto Nacional de Meteorología (INM), Santa Cruz de Tenerife, Spain ¹⁰Department of Physics, Hampton University, Hampton, USA ¹¹Deutscher Wetterdienst (DWD), Hohenpeißenberg, Germany ¹²Instituto Nacional de Técnica Aeroespacial (INTA), Torrejón de Ardoz, Spain

1. Introduction

Vertical profiles of ozone are retrieved with the IMK scientific non-operational processor [1] from spectra measured by the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) [2] aboard the environmental satellite Envisat. The results are compared to profiles obtained by ground-based, balloon-borne, and satellite instruments.

2. Overview of comparison instruments

Table 1: Geolocations of considered instruments together with mean spatial distance $\overline{\Delta d}$, mean temporal difference $\overline{\Delta t}$, and number of comparison pairs. Time period covered by comparison instruments: July 2002 – March 2004.

Instrument location (type)	lat/lon [deg]	$\overline{\Delta d}$ [km]	$\overline{\Delta t}$ [h]	coinc. [#]
Ny-Ålesund (lidar)	78.9/11.9	464	2.7	248
Alomar (lidar)	69.3/16.0	462	2.7	81
Sodankylä (sonde)	67.8/26.6	451	2.9	98
Kiruna (FTIR)	67.8/20.4	486	1.5	279
Kiruna (microwave)	67.8/20.4	351	2.8	288
Kiruna (MIPAS-B)	66.6/19.7	496	0.3	1
Hohenpeißenberg (lidar)	47.8/11.0	457	1.6	133
Hohenpeißenberg (sonde)	47.8/11.0	462	3.8	88
Zugspitze (microwave)	47.4/11.0	514	2.3	74
Aire sur l'Adour (MIPAS-B)	46.2/0.8	10	0.2	1
Izana (sonde)	28.5/-16.3	544	0.4	46
Izana (FTIR)	28.5/-16.3	489	2.5	123
Paramaribo (sonde)	5.8/-55.2	339	1.3	18
Belgrano (sonde)	-77.8/-34.6	382	2.8	119
HALOE (satellite)	globally	227	3.8	314
POAM (satellite)	N + S poles	214	3.2	524

3. Validation with ground-based lidar

Comparison of MIPAS and lidar measurements (Hohenpeißenberg, 47.8°N, 11.0° E) show good agreement with mean absolute differences below ± 0.2 ppmv up to 30 km altitude (Fig. 1, middle). Mean relative differences (Fig. 1, right) are mainly within ± 10 %.

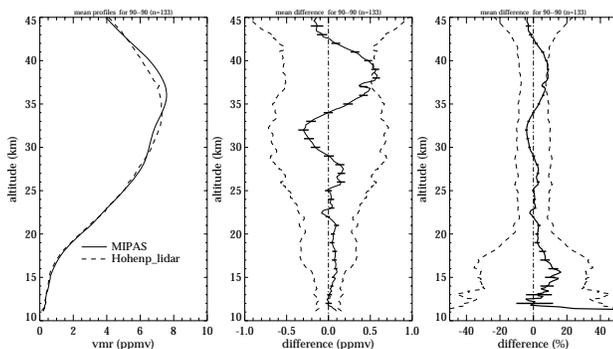


Figure 1: Comparison of MIPAS and lidar (Hohenpeißenberg) ozone profiles for 133 coincidences. Left: MIPAS (solid) and Hohenpeißenberg (dashed) mean profiles, middle: absolute mean difference (solid) between MIPAS and Hohenpeißenberg with uncertainty of the mean (error bars) and standard deviation (dashed), right: relative mean difference (solid) between MIPAS and Hohenpeißenberg with uncertainty of the mean (error bars) and standard deviation (dashed).

4. Validation with ozonesonde

Comparison of MIPAS and ozonesonde measurements (Sodankylä, 67.8°N, 26.6° E) show very good agreement with mean absolute differences below ± 0.2 ppmv (Fig. 2, middle). Mean relative differences (Fig. 2, right) are mainly within ± 6 %, except around 15 km and below 10 km altitude.

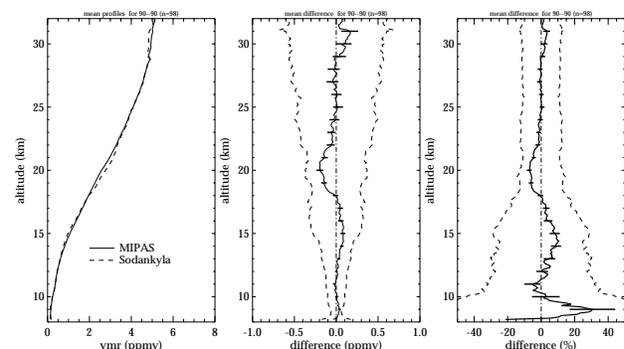


Figure 2: Comparison of MIPAS and ozonesonde (Sodankylä) profiles for 98 coincidences. Description of curves as in Fig. 1.

5. Comprehensive Comparison

Comprehensive comparison between MIPAS ozone data and the entirety of data from all other correlative measurements (Tab. 1) is performed. The mean profiles agree very well (Fig. 3, left) with mean absolute differences below ± 0.2 ppmv (Fig. 3, middle). Mean relative differences (Fig. 3, right) are within ± 3 % between 20 km and 56 km altitude.

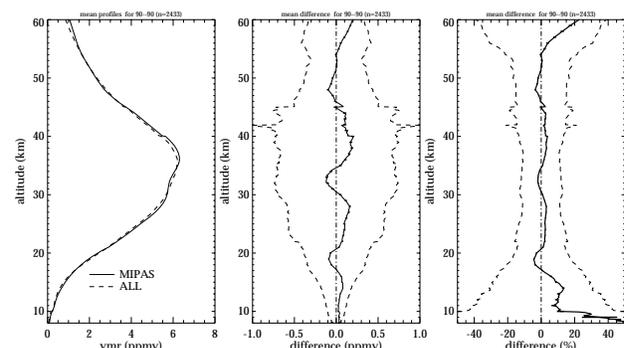


Figure 3: Global comparison of ozone from MIPAS and other instruments (ALL) for 2433 coincidences. Description of curves as in Fig. 1.

6. Summary

- MIPAS IMK ozone profiles have been compared with a large number of correlative measurements resulting in very good agreement.
- A minor positive bias in MIPAS measurements of only 2 % between 21 and 45 km altitude has been found.

Acknowledgments. We thank ESA for providing the MIPAS spectra (Level-1B data) and the POAM Team (NRL) for providing the data.

References

- [1] T. VON CLARMANN ET AL., J. Geophys. Res., 108, 2003.
- [2] H. FISCHER AND H. OELHAF, Appl. Opt., 35, 2787–2796, 1996.