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VALIDATION OF MIPAS TEMPERATURE PROFILES WITH OTHER SATELLITE MEASUREMENTS

Abstract

The MIPAS temperatures retrieved by IMK processor are compared with a number of satellite observations, and show good agreement in the range of 10-50 km. Some significant deviations are also found to exist due to characteristics of the individual data sets. This indicates the reliability of MIPAS-IMK data products and their capability for providing valuable scientific information.

Data used for Comparisons

Table 1. Numbers of Coincident Profiles Used for Comparison. See the text for coincidence criteria. The numbers of available MIPAS measurements are equal or close to coincidence events for ECMWF data, which are used as input gases for the IMK retrievals. For other data sets, one MIPAS profile may have multiple coincidences. This is indicated by paired numbers with the first for MIPAS and the second for the correlative measurements.

Time	ECMWF	UKMO	CHAMP-GFZ	SAC-C	HALOE
18-SEP-2002	479	86	101/115		30
19-SEP-2002	514	66	88/102		
20-SEP-2002	480	86	121/146	117/136	
21-SEP-2002	384	41	81/97	85/96	
22-SEP-2002	412		89/100	96/107	25
23-SEP-2002	214	72	39/47	16	8
24-SEP-2002	213		55/69	52/58	8/9
25-SEP-2002	232	28	58/67	36/43	
26-SEP-2002	475	69	115/126	101/114	
27-SEP-2002	568	40	119/144	109/139	48
28-SEP-2002	30		7	6	4
11-OCT-2002	292		63/74	61/66	
12-OCT-2002	292	87	70/75	76/94	
13-OCT-2002	509		103/114	119/134	5

MIPAS temperatures are the IMK products version V1.0. They are calculated based on the operational ESA level-1B data. Local thermodynamic equilibrium (LTE) is assumed. The retrieval is performed between 6 and 70 km on a 1-km grid below 44 km and 2-km above. The observations provide global coverage with 14.4 orbit per day. The sampling rate is ~500 km along-track and ~2800 km across-track

ECMWF data are obtained from ENVISAT validation database NADIR at NILU, and used as initial guess in the IMK retrievals. They are on standard pressure levels and a regular 1.25° by 1.25° longitude-latitude grid in a time interval of 6 hours, and interpolated onto the geo-locations and times of the MIPAS measurements.

UKMO data taken from BADC archive. They are available daily at GMT 12:00 on a global grid of 2.5° latitude by 3.75° longitude at the 22 standard UARS pressure levels from 1000 hPa to 0.316 hPa (0 to 55 Km approx.)

GPS-RO/CHAMP and SAC-C temperatures are taken from GFZ (GeoForschungsZentrum Potsdam) version V004 and JPL Level 2 version 1.0 data, respectively. Each satellite provides ~200 globally distributed profiles per day in the heights of 0-50 km. The vertical resolution ranges from 0.5 km in the lower troposphere to 1.5 km in the stratosphere and the resolution along the ray path is around a few hundreds km.

HALOE data are taken from Level 2-version 19 database through BADC. The solar occultation measurements tend to be in two distinct latitude bands for a given day and to sweep across the full longitude range. The temperatures between 35 and 85 km are retrieved at a 1.5 km vertical spacing and are then interpolated to 0.3 km.

Latitude/Longitude/Time Differences for Coincidence

ECMWF:	Interpolated (See above)
UKMO:	1.25° by 1.875°, 1 hr
CHAMP/SAC-C:	5° by 10°, 6 hrs
HALOE:	5° by 10°, 12 hrs

MIPAS *vs* ECMWF and UKMO

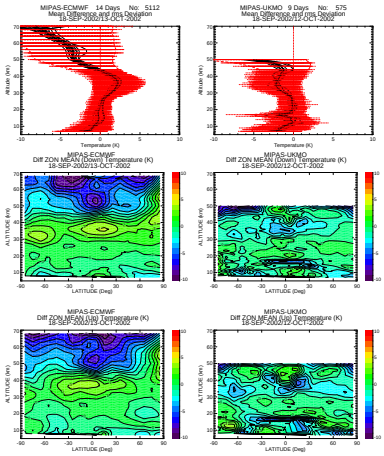

Figure 1. Temperature Differences of MIPAS/ECMWF and MIPAS/UKMO

MIPAS *vs* CHAMP and SAC-C

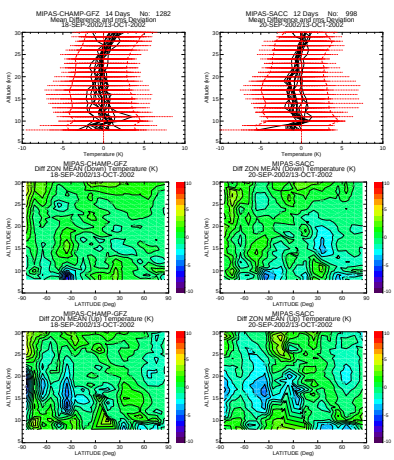

Figure 2. Temperature Differences of MIPAS/CHAMP and MIPAS/SAC-C

Comparison Method

All profiles are interpolated to the MIPAS altitude grid. No averaging kernel is applied. The zonal mean differences are averaged over the observation period with a latitude width of 10° for the MIPAS descending (daytime, middle row) and ascending (nighttime, bottom row) orbit observations separately. The global means and root-mean-squared deviations (top row) are computed for each day (thin line) and for all days (thick line) available.

MIPAS *vs* HALOE

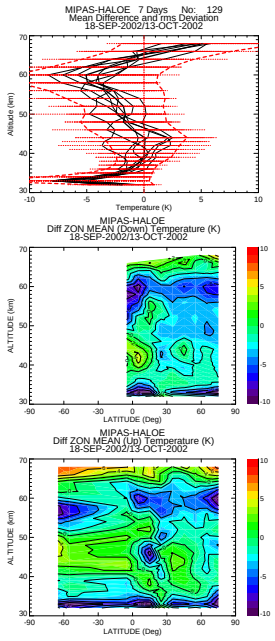

Figure 3. Temperature Differences of MIPAS/HALOE

Concluding Remarks

1. Reasonable consistencies with ECMWF, UKMO, CHAMP and SAC-C between 10-30 km, and with HALOE between 35–45 km. The global mean differences are less than 1 K, with the rms deviations of ~2-5 K. The zonal mean differences are less than 1-2 K in a wide latitude region.

2. Significant discrepancies occurred at

2.1) Near tropopause between 30°S-30°N, MIPAS is colder than UKMO by 10 K or more. This feature is not seen in ECMWF, CHAMP, and SAC-C, suggesting a hot bias in UKMO.

2.2). At 30–45 km in both polar regions and around the equator, MIPAS is hotter than ECMWF, but colder than UKMO, with deviations peaked around 35 km. At these levels ECMWF has know cold bias [Randel et al.,2002].

2.3). Above 50 km, MIPAS is colder than ECMWF, HALOE, and UKMO, in particular, around the equator. Near and above stratopause, UKMO has known hot bias (not shown). HALOE has large uncertainty and tidal influences on the comparisons (12 hour time difference is allowed) may also increase [Wang et al. 2003]. Non-LTE effect is enhanced for the lower mesosphere in the polar winter regions. More studies are needed to draw conclusion.

2.4). Below 10 km, MIPAS is colder than ECMWF, UKMO, CHAMP and SAC-C at both mid-latitudes between 30°-60°, but hotter around the equator. Global mean differences are less than ~2 K in ECMWF, UKMO, and SAC-C, but 1 K in CHAMP.

References

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