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Scientific Themes: Atmospheric Measurement Science

Comparison of GPS/SAC-C and MIPAS/ENVISAT Temperature Profiles and Its Possible Implementation for EOS MLS Observations

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Summary

This paper presents a comparison of atmospheric temperatures measured by two different limb-viewing space observation systems. One temperature data set is obtained from GPS/SAC-C radio occultation observations using the JPL retrieval software; another is retrieved from MIPAS/ENVISAT infrared spectral measurements using the IMK data processor. The different spatial and temporal sampling of the two datasets makes it difficult to achieve excellent correlative pairings of GPS/SAC-C and MIPAS profiles. As a first order approximation, individual paired-profile comparisons are conducted for those measurements with latitude and longitude differences smaller than 5° and 10°, respectively. The time differences between the paired profiles are limited to < 6 hour. The paired profiles are then interpolated to a common altitude grid. Soon after the ENVISAT launch, we compared ~800 correlative profiles of MIPAS and SAC-C temperatures between 5 and 30 km, and helped in validation of MIPAS version 1.0 temperature data. Our results show that both the individual profiles and the zonal means of the atmospheric temperature at different seasons and geo-locations show reasonable agreement. The mean differences between the correlative measurements are estimated to be less than 2 K with root-mean-square (rms) deviations less than ~5 K. Daily zonal means show MIPAS temperatures to be biased 6-10 K warm relative to SAC-C measurements at 20-25 km altitude in high-southern (60 S) latitudes during 22-27 September, 2002, when the MIPAS temperature measurements reported a major polar stratospheric warming event. The cause of this MIPAS warm-bias over SAC-C is currently under investigation by the MIPAS team.

This work benefits society by improving our ability to accurately measure the spatial and temporal temperature structure of the Earth's atmosphere, which is vitally important in assessments of human impact on the climate system. This study also provides a useful comparison and validation tool for the temperature measurements from the Earth Observing System (EOS) Microwave Limb Sounder (MLS) instrument, scheduled for launch in 2004. EOS MLS has a vertical and global coverage similar to that of MIPAS, so experience gained from this study will be directly applicable to a cross-validation of MLS temperatures with MIPAS and SAC-C, leading to a rapid analysis and validation of these data once they become available.

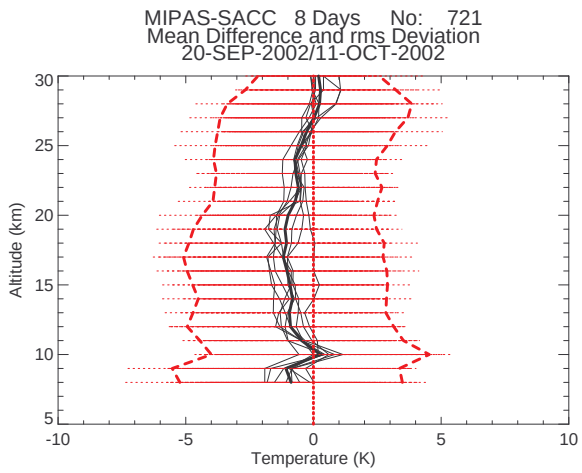

Figure 1: Mean differences (solid-line) and rms deviations (dotted-line) of MIPAS and SAC-C temperatures (K). The light-lines are data averaged over all available paired profiles on a single day; the dark-lines are averaged over all the available MIPAS measurement days between 20 September and 11 October, 2002.

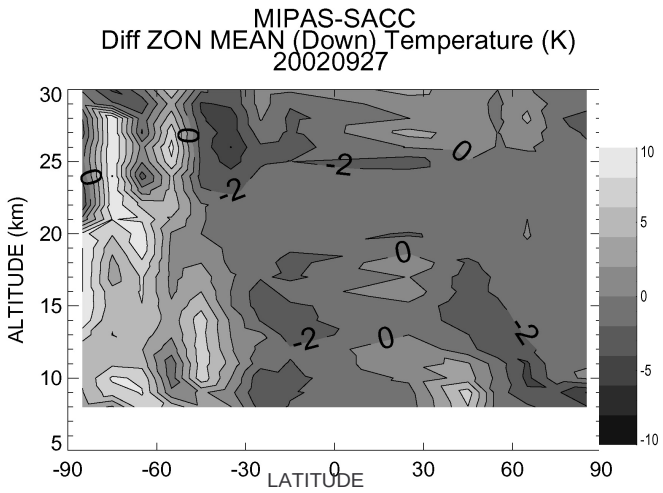

Figure 2: This picture shows the 27 September, 2002 daily zonal averaged temperature differences (K) of correlative MIPAS and SAC-C measurements. MIPAS observations are taken from the descending mode. The temperatures are contoured at 2-K intervals. There is a noticeable warm-bias in the MIPAS temperatures relative to SAC-C during a major polar stratospheric warming event on this date.