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

Atmos. Chem. Phys., 8, 677-695, 2008
www.atmos-chem-phys.net/8/677/2008/

Global distribution of mean age of stratospheric air from MIPAS SF_6 measurements

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Abstract. Global distributions of profiles of sulphur hexafluoride (SF_6) have been retrieved from limb emission spectra recorded by the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) on Envisat covering the period September 2002 to March 2004. Individual SF_6 profiles have a precision of 0.5 pptv below 25 km altitude and a vertical resolution of 4–6 km up to 35 km altitude. These data have been validated versus in situ observations obtained during balloon flights of a cryogenic whole-air sampler. For the tropical troposphere a trend of 0.230±0.008 pptv/yr has been derived from the MIPAS data, which is in excellent agreement with the trend from ground-based flask and in situ measurements from the National Oceanic and Atmospheric Administration Earth System Research Laboratory, Global Monitoring Division. For the data set currently available, based on at least three days of data per month, monthly 5° latitude mean values have a 1σ standard error of 1%. From the global SF_6 distributions, global daily and monthly distributions of the apparent mean age of air are inferred by application of the tropical tropospheric trend derived from MIPAS data. The inferred mean ages are provided for the full globe up to 90° N/S, and have a 1σ standard error of 0.25 yr. They range between 0 (near the tropical tropopause) and 7 years (except for situations of mesospheric intrusions) and agree well with earlier observations. The seasonal variation of the mean age of stratospheric air indicates episodes of severe intrusion of mesospheric air during each Northern and Southern polar winter observed, long-lasting remnants of old, subsided polar winter air over the spring and summer poles, and a rather short period of mixing with midlatitude air and/or upward transport during fall in October/November (NH) and April/May (SH), respectively, with small latitudinal gradients, immediately before the new polar vortex starts to form. The mean age distributions further confirm that SF_6 is destroyed in the mesosphere to a considerable degree. Model calculations with the Karlsruhe simulation model of the middle atmosphere (KASIMA) chemical transport model agree well with observed global distributions of the mean age only if the SF_6 sink reactions in the mesosphere are included in the

model.

Final Revised Paper (PDF, 4139 KB) Supplement (365 KB) Discussion Paper (ACPD)

Citation: Stiller, G. P., von Clarmann, T., Höpfner, M., Glatthor, N., Grabowski, U., Kellmann, S., Kleinert, A., Linden, A., Milz, M., Reddmann, T., Steck, T., Fischer, H., Funke, B., López-Puertas, M., and Engel, A.: Global distribution of mean age of stratospheric air from MIPAS SF_6 measurements, Atmos. Chem. Phys., 8, 677-695, 2008. Bibtex EndNote Reference Manager