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Large-scale upper tropospheric pollution observed by MIPAS HCN and C_2H_6 global distributions

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Abstract. We present global upper tropospheric HCN and C_2H_6 amounts derived from MIPAS/ENVISAT limb emission spectra. HCN and C_2H_6 are retrieved in the spectral regions 715.5–782.7 cm^{-1} and 811.5–835.7 cm^{-1}, respectively. The datasets consist of 54 days between September 2003 and March 2004. This period covers the peak and decline of the southern hemispheric biomass burning period and some months thereafter. HCN is a nearly unambiguous tracer of biomass burning with an assumed tropospheric lifetime of several months. Indeed, the most significant feature in the MIPAS HCN dataset is an upper tropospheric plume of enhanced values caused by southern hemispheric biomass burning, which in September and October 2003 extended from tropical South America over Africa, Australia to the Southern Pacific. The spatial extent of this plume agrees well with the MOPITT CO distribution of September 2003. Further there is good agreement with the shapes and mixing ratios of the southern hemispheric HCN and C_2H_6 fields measured by the ACE experiment between September and November 2005. The MIPAS HCN plume extended from the lowermost observation height of 8 km up to about 16 km altitude, with maximum values of 500–600 pptv in October 2003. It was still clearly visible in December 2003, but had strongly decreased by March 2004, confirming the assumed tropospheric lifetime. The main sources of C_2H_6 are production and transmission of fossil fuels, followed by biofuel use and biomass burning. The C_2H_6 distribution also clearly reflected the southern hemispheric biomass burning plume and its seasonal variation, with maximum amounts of 600–700 pptv. Generally there was good spatial overlap between the southern hemispheric distributions of both pollution tracers, except for the region between Peru and the mid-Pacific. Here $C_2H_6$was considerably enhanced, whereas the HCN amounts were low. Backward trajectory calculations suggested that industrial pollution was responsible for the elevated C_2H_6 concentration in these particular air masses.

Except for the Asian monsoon anticyclone in September 2003, there were only comparably small regions of enhanced HCN in the Northern Hemisphere. However, C_2H_6 showed an equally strong northern hemispheric signal between the equator and low midlatitudes, persisting

over the whole observation period. Backward trajectory calculations for air masses from this region also point to industrial sources of this pollution. Generally, C_2H_6/HCN ratios between 1 and 1.5 indicate biomass burning and ratios larger than 1.5 industrial pollution. However, in March 2004 ratios of up to 2 were also found in some regions of the former southern biomass burning plume.

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