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MIPAS observations and GEM-AQ model results of the Australian bush fires of February 2009

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Starting on February 7, 2009, Southeast Australia was devastated by large bush fires, which burned an area of about 3000 km^2 on this day alone. This event was extraordinary, because a large number of combustion products was transported into the uppermost troposphere and lower stratosphere within a few days. Various biomass burning products released by the fire were observed by the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) on the ENVISAT satellite. We tracked the plume using MIPAS C_2H_2, HCN and HCOOH single-scan measurements on a day-to-day basis. The measurements were compared with a high-resolution model run of the Global Environmental Multiscale-Air Quality (GEM-AQ) model. Generally there is good agreement between the spatial distribution of measured and modelled pollutants. Both MIPAS and GEM-AQ show a fast south-eastward transport of the pollutants to New Zealand within one day. During the following 3-4 days the plume remained north-eastward of New Zealand and was located at altitudes of 15 to 18 km. Thereafter its lower part was transported eastward, followed by westward transport of its upper part. On February 17 the eastern part had reached southern South America and on February 20 the central Southern Atlantic. On the latter day a second relic of the plume was observed moving eastward above the Southern Pacific. Between February 20 and the first week of March the upper part of the plume was transported westward over Australia and the Indian Ocean towards Southern Africa. First evidence for entry of the pollutants into the stratosphere was found in MIPAS data of February 11, followed by larger amounts on February 17 and the days thereafter. From MIPAS data, C_2H_2/HCN and HCOOH/HCN enhancement ratios of 0.76 and 2.16 were calculated for the first days after the outbreak of the fires, which are considerably higher than the emission ratios assumed for the model run and at the upper end of values found in literature. From the temporal decrease of the enhancement ratios, mean lifetimes of 16–17 days and of 8–9 days were calculated for measured C_2H_2 and HCOOH. The respective lifetimes calculated from the model data are 18 and 12 days.