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Climatologies of subtropical mixing derived from 3D models

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Abstract. Fingerlike structures reaching from lower into extra-tropical latitudes significantly contribute to the tropical-extratropical exchange of air masses. This is also an exchange of upper tropospheric and stratospheric air. Those so called streamers can, on a horizontal plane, be detected in N_2O or O_3 since they are characterised by high N_2O or low O_3 values compared to undisturbed mid-latitude values. A climatology of streamer events has been established, employing the chemical-transport model KASIMA, which is driven by ECMWF re-analyses (ERA) and operational analyses. For the first time, the seasonal and geographical distribution of streamer frequencies has been determined on the basis of 9 years of meteorological analyses.

For the current investigation, a meridional gradient criterion has been newly formulated and applied to the N_2O distributions calculated with KASIMA. A climatology has been derived by counting all streamer events between 21 and 25 km for the years 1990 to 1998. The results have been compared with a streamer climatology which has been established in the same way employing data of a multi-year simulation with the coupled chemistry-climate model ECHAM4.L39(DLR)/CHEM (E39/C). Both climatologies are qualitatively in agreement, in particular in the northern hemisphere, where much higher streamer frequencies are found in winter than in summer. In the southern hemisphere, the KASIMA analyses indicate strongest streamer activity in September. E39/C streamer frequencies clearly displays an offset from June to October, pointing to model deficiencies with respect to tropospheric dynamics. KASIMA and E39/C results agree well from November to May. Some of the findings give strong indications that the streamer events found in the altitude region between 21 and 25 km are mainly forced from the troposphere and are not directly related to the dynamics of the stratosphere, in particular not to the dynamics of the polar vortex.

Sensitivity simulations with E39/C, which represent recent and possible future atmospheric conditions, have been employed to answer the question how climate change would alter streamer frequencies. This shows that the seasonal cycle does not change but that significant changes occur in months of minimum and maximum streamer frequencies. This could have an impact on the mid-latitude distribution of chemical tracers and

compounds.

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