



Supplement of

The impact of sulfur hexafluoride (SF_6) sinks on age of air climatologies and trends

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S1.1 Submodel SF6



Figure S1. Reactions of SF_6 in the mesosphere, following the schemes put forward by Reddmann et al. (2001) and Totterdill et al. (2015). The left hand side depicts the reactions leading to the recycling of SF_6 , whereas the right hand side illustrates the chemical degradation schemes of SF_6 in the mesosphere.

S2 Results

S2.1 SF₆ mixing ratios



Figure S2. Timeseries of modelled SF_6 averaged over 30°N-50°N at 30 km. The tracers with mesospheric sinks are shown as solid lines, those without sinks as dashed lines. Tracers with non-linear and linear boundary conditions are depicted in black and blue, respectively.



Figure S3. Latitudinal distribution of AoA at 20 km. Modelled AoA from EMAC simulations $SD(WS, SF_6)$ for 2007 - 2010 and 1992 - 1998 are shown in blue as solid and dashed lines, respectively. The solid green line depicts modelled AoA from SD(NS, lin). Black crosses show MIPAS AoA (Stiller, 2021), which consists of a complete data set for the time period 2007 - 2010. The spread of MIPAS AoA is depicted as error bars. Balloon flights spanning the period 1992 - 1998 are shown as triangles.



Figure S4. 2007 - 2010 seasonal means of AoA from MIPAS (Stiller, 2021) and from the simulations REF(WS, SF₆) and SD(WS, SF₆). a-c show seasonal means for December-January-February (DJF), d-f March-April-May (MAM), g-i June-July-August (JJA), and j-l September-October-November (SON).



Figure S5. Modelled AoA subtracted from MIPAS (Stiller et al., 2008, 2012; Haenel et al., 2015) (a,c) and the MIPAS AoA using new SF_6 absorption spectra (Harrison, 2020; Stiller et al., 2020; Stiller, 2021) (b,d). Values averaged over 2007-2010.

S2.3 Apparent age of air trends

Table S1. EMAC AoA trends at 30 km averaged over 30° N- 50° N. Values are provided for the two relevant simulations REF(WS, SF₆) and SD(WS, SF₆), and are shown for two scenarios: excluding the QBO (no QBO), and using the QBO from the respective EMAC simulation (QBO (EMAC)).

Simulation	2002-2011 Trend (years/decade)	
	No QBO	QBO (EMAC)
$REF(WS, SF_6)$	0.23 ± 0.12	0.22 ± 0.12
SD(WS, SF ₆)	0.52 ± 0.13	0.50 ± 0.13



Figure S6. AoA trend from the reference simulation in colours calculated over 1965- 2011: AoA from the idealised tracer [AoA(NS, lin)_{*REF*}] is shown in a), AoA from SF₆ emissions without sinks is shown in b). The bottom row shows AoA with mesospheric sinks, from the linear tracer (c) and non-linear tracer (d). Contours show the AoA climatology (years), averaged over 1990-2011. Dotted regions indicate where the trend is not significant, i.e. the statistical significance of the trend is below the 5% threshold. Note that the results for the AoA from the idealised tracer are statistically significant on the 95% level throughout the presented region.

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10

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