

## Abstract

Sulfur hexafluoride (SF<sub>6</sub>) is a greenhouse gas that is emitted at the surface because of its use in electrical transmission equipment and electronic devices. Due to its quasi-linear emission growth and its very long lifetime, SF<sub>6</sub> has been used in the literature as a tracer for the Age of Air (AoA) to diagnose changes in the Brewer Dobson Circulation (BDC). The chemistry of SF<sub>6</sub> has been implemented in the Chemistry Transport Model (CTM) of the Belgian Assimilation System for Chemical Observations (BASCOE). The chemical reaction scheme follows that of Löffel et al. (2022) while the reaction rates and electron climatology were obtained from Reddmann et al. (2001)

In this contribution, BASCOE-CTM simulations driven by ERA5 and MERRA2 are discussed considering SF<sub>6</sub> with mesospheric sinks. During the course of the simulations, the computed mixing ratios have also been saved in the space of MIPAS observations (version V5R\_224/225) to analyze the impact of sampling on the final picture.

## Method

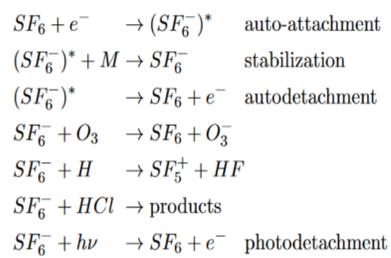
### Model set-up

- Initial conditions from EMAC model output (2002-01)
- Lower boundary conditions adjusted from Meinhausen et al. 2016 and Gidden et al. 2019 to compare with EMAC
- Model top at 1Pa, 42 vertical levels, horizontal resolution of 2°x2.5°
- No assimilation was done in these simulations
- For MERRA2 and ERA-interim we use a subset of the vertical levels

### AoA calculation

- Using a tropospheric reference curve
- Correction for nonlinearity of emissions

### SF<sub>6</sub> chemistry

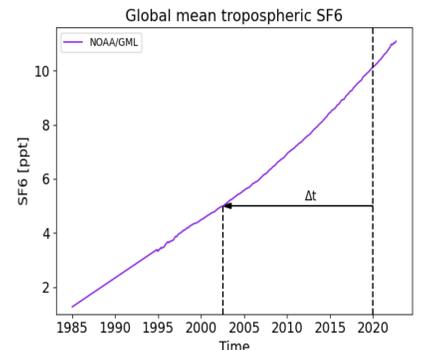


### The age spectrum

SF<sub>6</sub> is “propagated” from the troposphere to the stratosphere by the age spectrum  $G$ .

$$[SF_6]_{\text{modeled}} = \int_t G(\Gamma, \Delta, t) \cdot [SF_6]_{\text{trop}}(t) dt$$

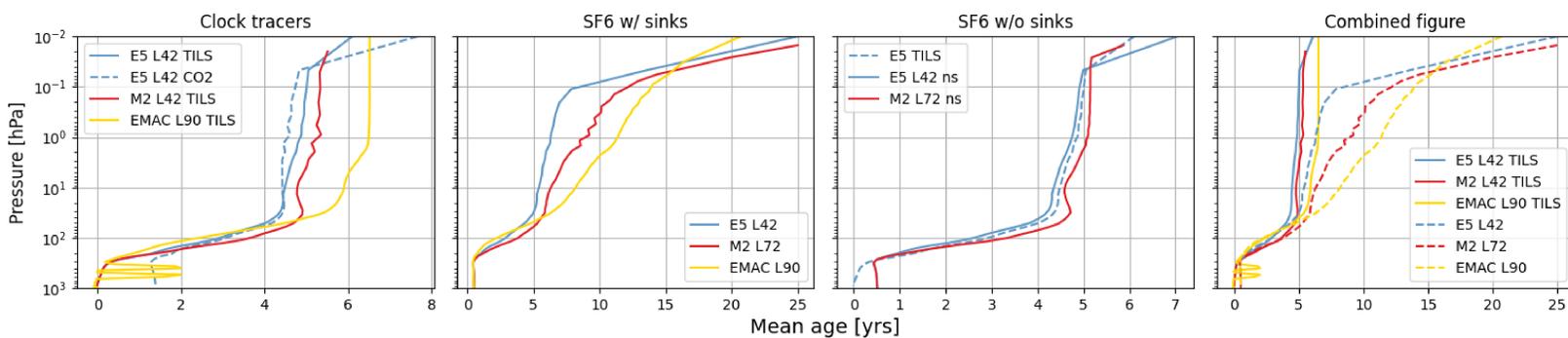
$$G(\Gamma, \Delta, t') = \frac{1}{2\Delta\sqrt{\pi t'^3}} \exp\left[-\frac{\Gamma^2(t'-1)^2}{4\Delta^2 t'}\right]$$



Almost linear increase of SF<sub>6</sub> in the troposphere. Reference curve linearly extrapolated below 1995.

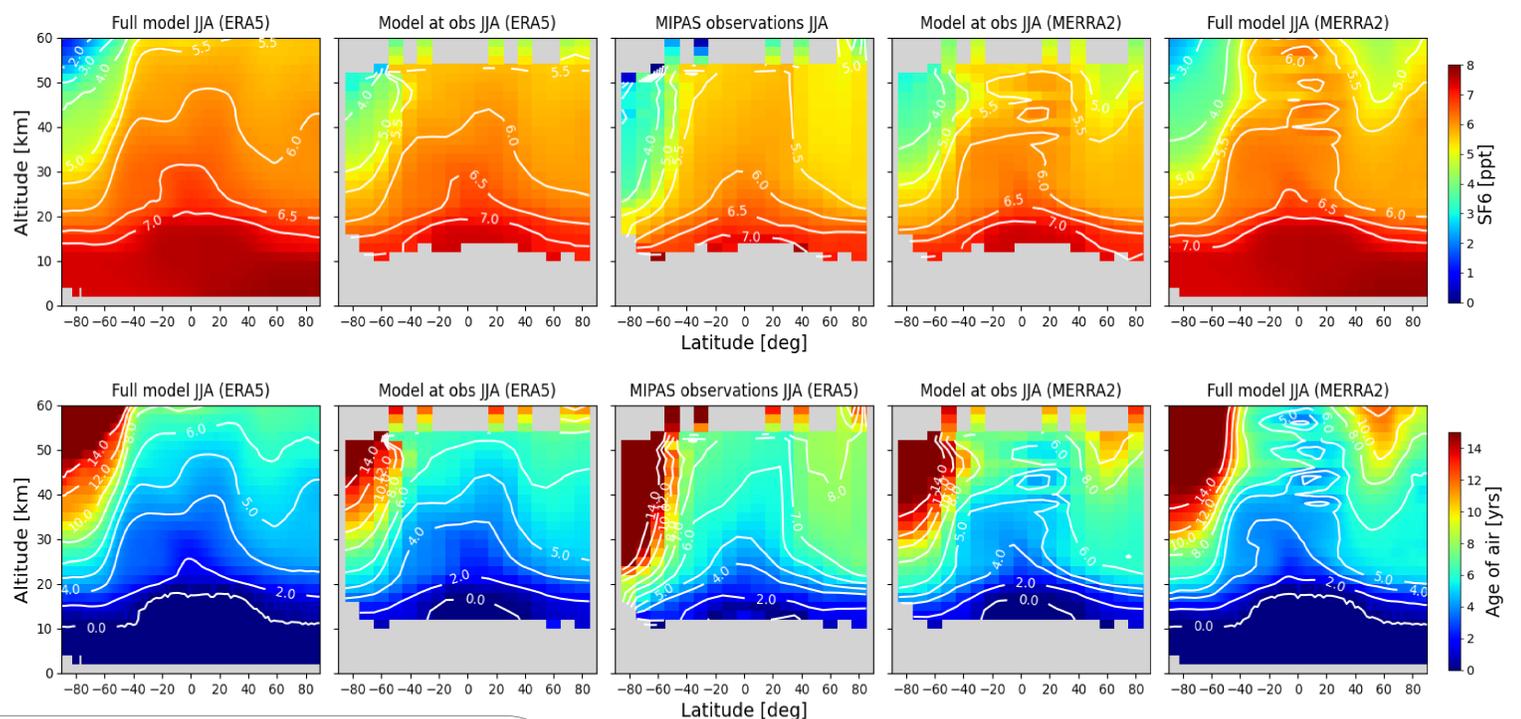
## Evaluation of BASCOE: how does BASCOE compare with EMAC? Pure transport vs transport with chemistry?

### Mean (apparent) age of air 2009-01 90°S-70°S



## Evaluation of the importance of sampling: BASCOE driven by ERA5 and MERRA2 (JJA 2011)

**Top:** SF<sub>6</sub> concentrations. **Bottom:** corresponding mean apparent age of air. **Left to right:** full model output with ERA5, model interpolated at the observations, MIPAS observations, model interpolated at the observations with MERRA2 and full model output with MERRA2. All plots are zonal means.



**To do:** compute the age of air trends and see what the impact of sampling is on the trends.

## Conclusions

- The mean apparent AoA is younger in the model than in the observations
- Sampling the full model output with the same sampling as the observations, brings the output closer to observational picture
- It seems that simulations with MERRA2 lie a little closer to the observations than simulations with ERA5 at this stage of the study

### Future research

- Weaker mixing barriers/faster transport in BASCOE?
- Why is the impact of sampling so important?

### Acknowledgements

Special thanks to S. Löffel, H. Garny, R. Eichinger and T. Reddmann for sharing their electron climatology and model output and for answering many questions. We also thank G. Stiller for explaining the method to correct age of air for the nonlinearity of the emissions. This work uses the global mean SF<sub>6</sub> flask and in-situ data from NOAA/GML.

### References

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