

Model calculations of the contribution of tropospheric SO₂ to the stratospheric aerosol layer

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Summary

- The main sources of SO₂ were found to be degassing volcanoes and anthropogenic sources
- The amount of SO₂ reaching the Aerosol layer is 3-10 GgS/yr
- The most sensitive parameter was pH(OH and DMS were also significant)

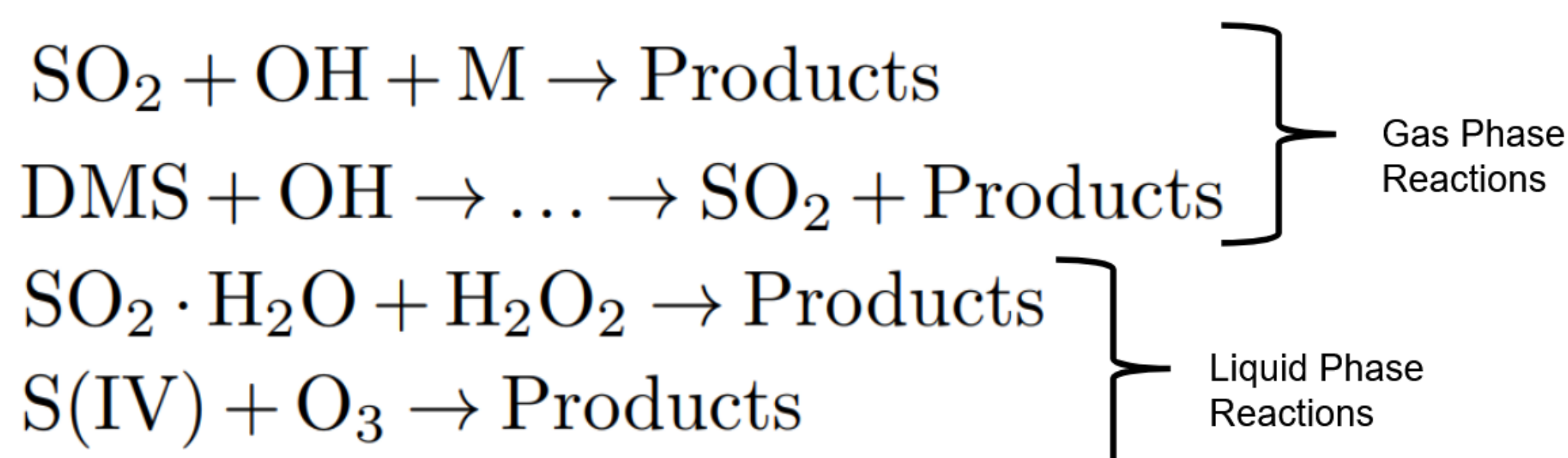
Introduction

- The stratospheric aerosol layer is important for stratospheric chemistry, climate change and in geo-engineering.
- The transport of sulfur to the stratosphere are poorly quantified.
- We present model calculations of the chemistry of sulfur dioxide (SO₂) and its transport to the stratosphere.

Methods

- The transport model is based on backward trajectories from the ATLAS model driven by ECMWF ERA 5 and ERA Interim.
- A simplified chemical box model constrained by CAMS data is used to calculate the SO₂ chemistry.
- Sensitivity experiments explore the sensitivity to changes in OH, H₂O₂, DMS, cloud water, cloud pH value and in the driving analysis data.
- Input parameters were varied and their differences have been explored.
- The SO₂ reaching the stratosphere was quantified and the sources in the troposphere were determined.
- The model's results were compared to POSIDON Aircraft measurements.

Reactions



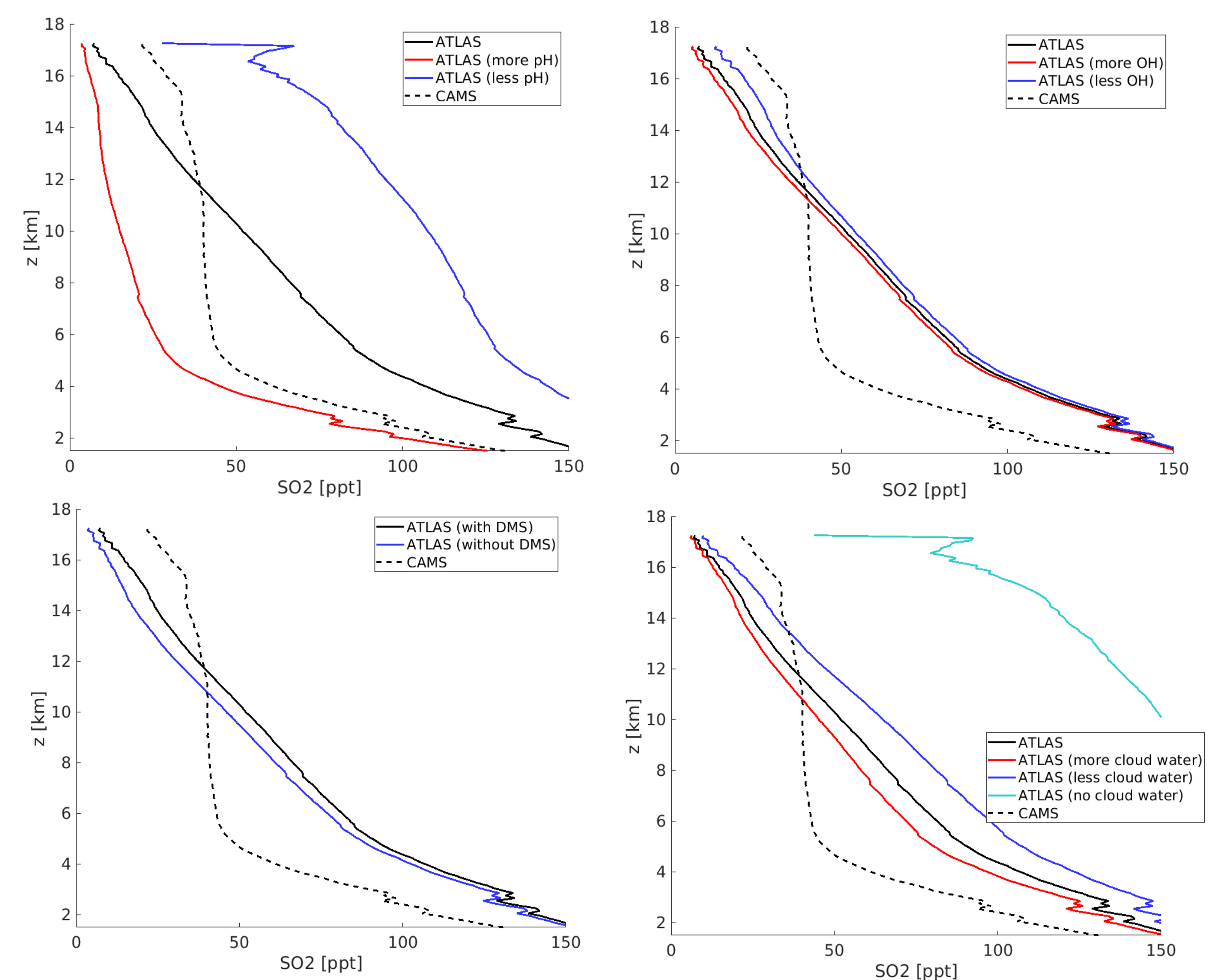
Results

- The mass flux of SO₂ for the ERA5 and ERA interim datasets were found to be 3.1 and 9.8 GgS/yr respectively
- The mixing ratio of SO₂ at the tropopause were 13.6 and 42.8 pptv respectively

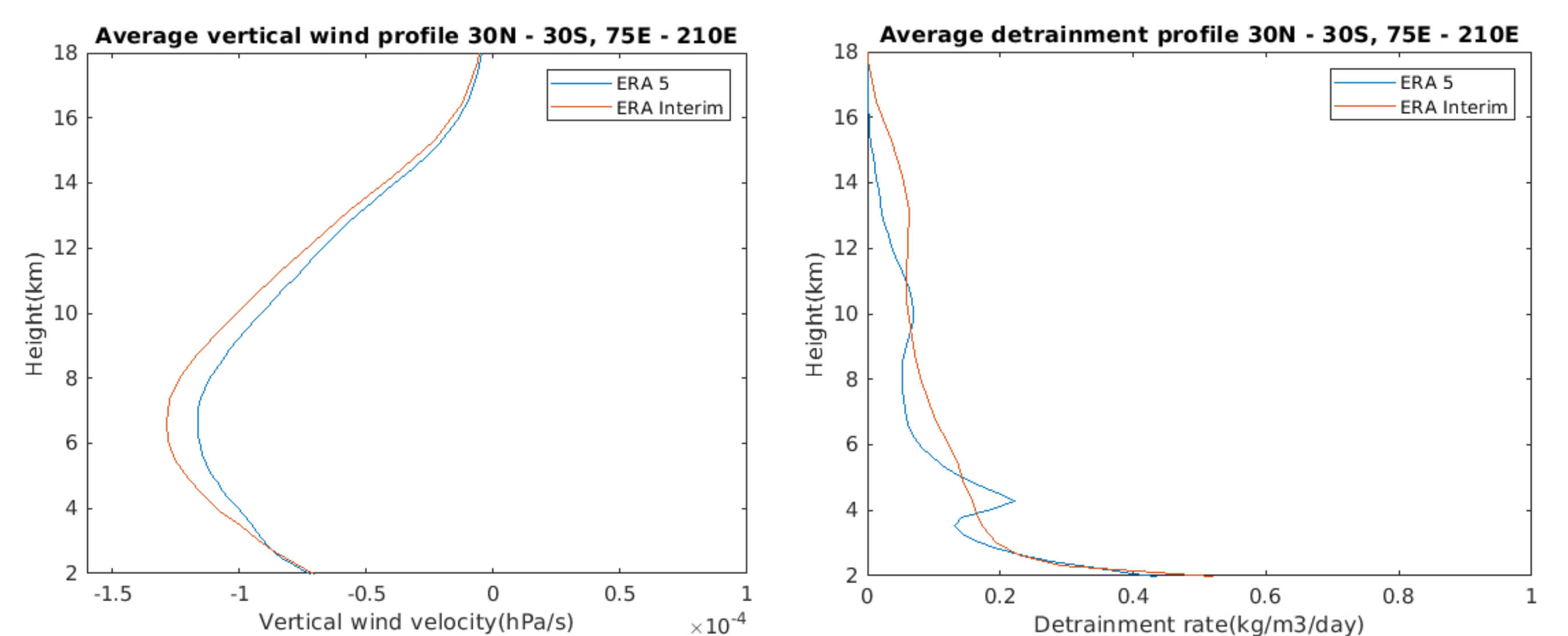
Sources

- Percentile density weighted values at tropopause plotted at 80 percent surface pressure level for ERA5 and ERA interim respectively

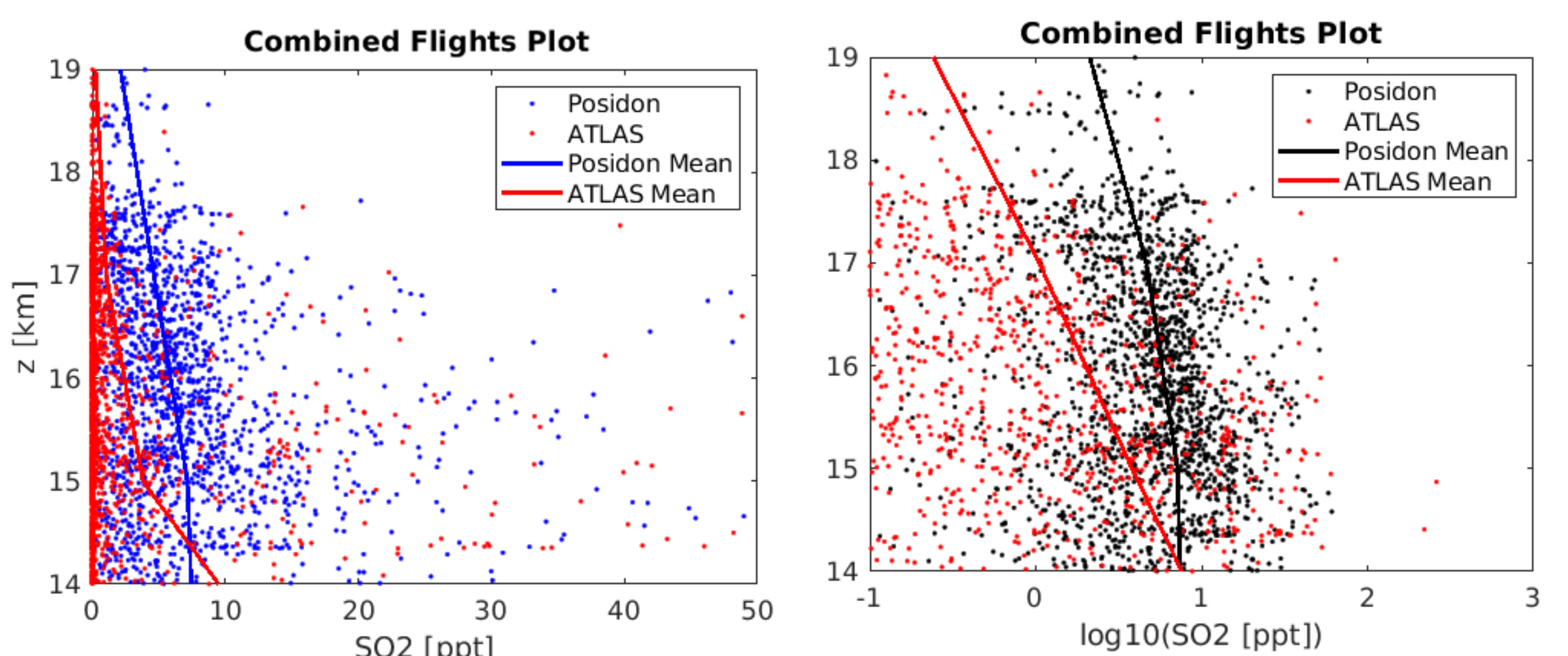
Sensitivities



Updraft and Detrainment rates

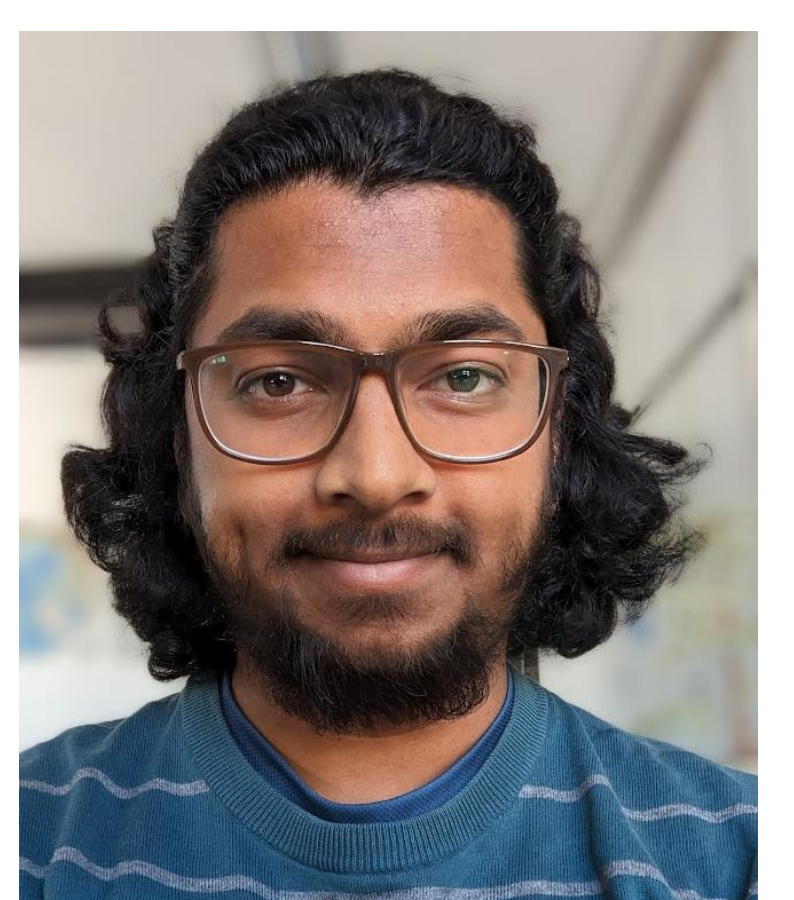
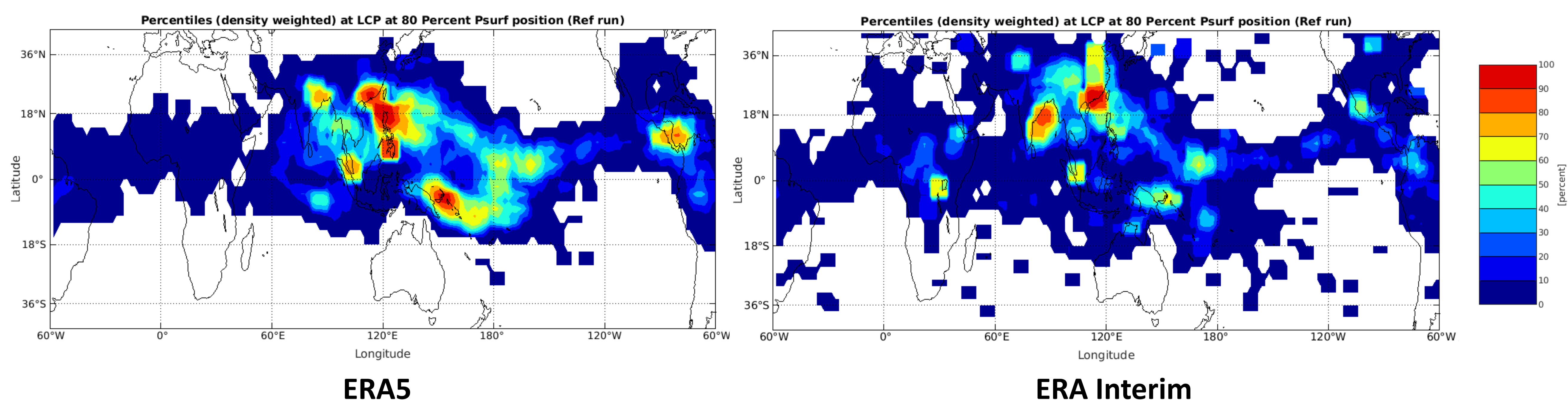


Comparison with POSIDON mission



References

- Wohltmann, I et al., 2019: Geosci. Model Dev. doi: 10.5194/gmd-12-4387-2019



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