

*Investigating stratospheric changes between 2009 and
2018 with aircraft, AirCores, a global model and a
focus on CFC-11*

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What we have done

- AirCores were invented by NOAA* and allow the collection of air samples from altitudes of up to >35 km using weather balloons, which is very cost-effective
- We present data from 15 AirCore flights since 2016 and expand the set of measurable trace gases to include the important ozone-depleting substances CFC-11, CFC-12, HCFC-22, H-1211, and H-1301 as well as SF₆
- Due to its recent unusual atmospheric trend we focus on CFC-11** and use runs of the CLaMS model driven with three reanalyses to
 - a) compare with the observational record and
 - b) derive CFC-11 strat-trop mass fluxes over a 10-year period

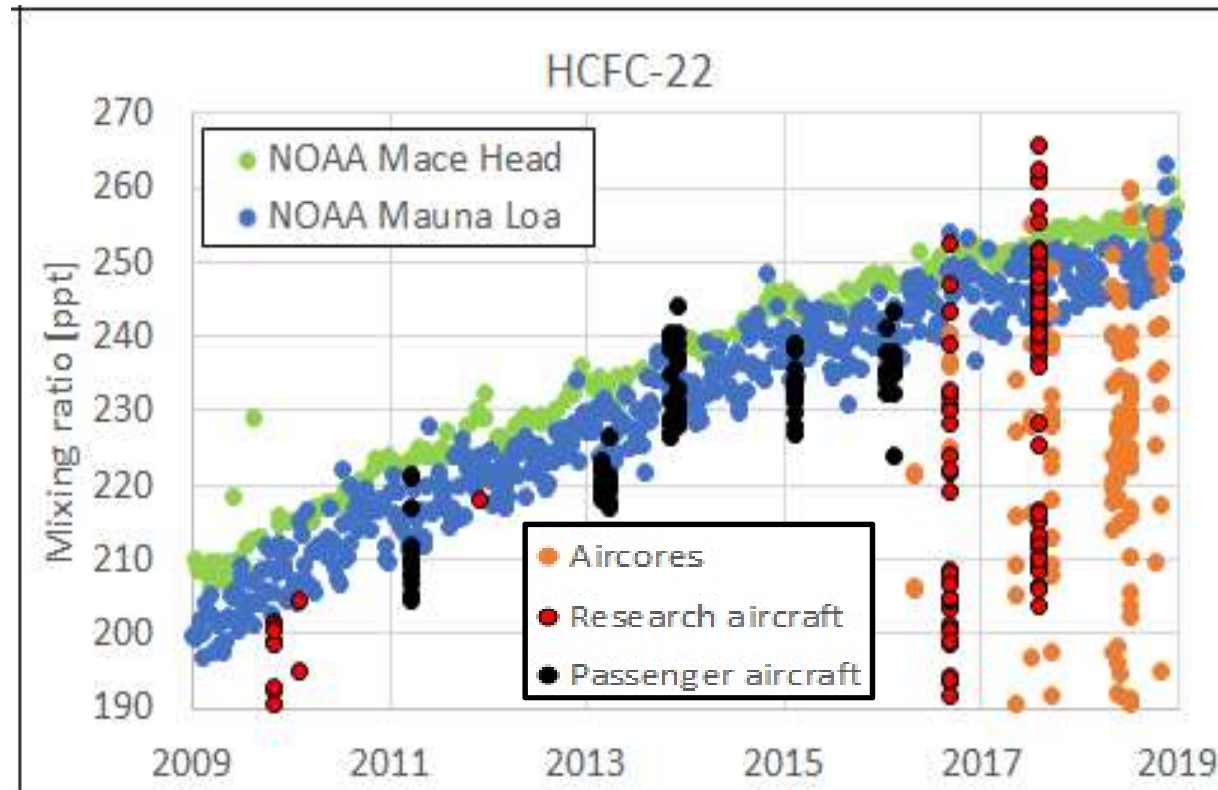


*Karion et al., 2010

** Montzka et al., 2018, Rigby et al., 2019

Message 1: Quality assurance

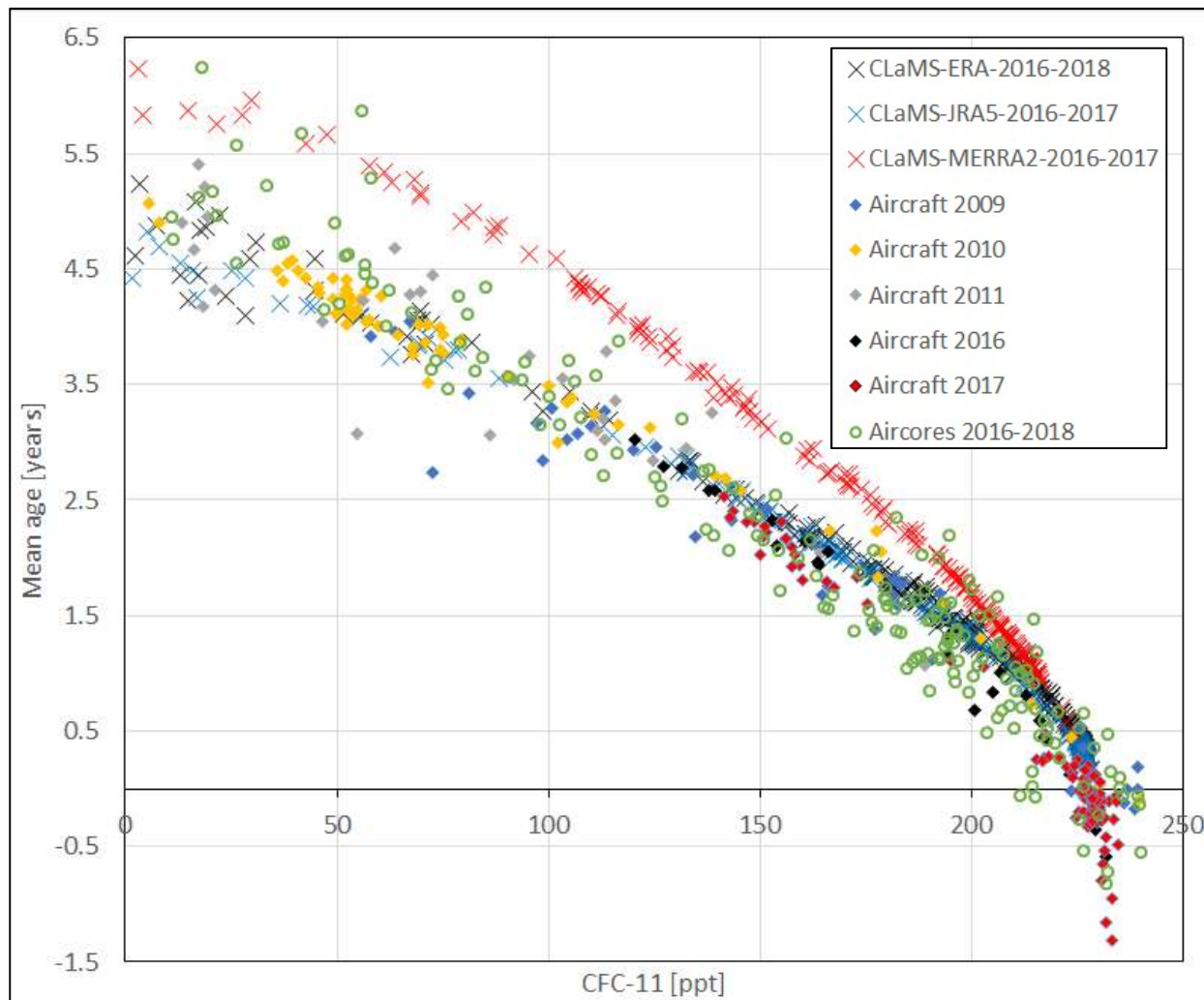
- AirCore data agrees well with NOAA background data from ground-based stations



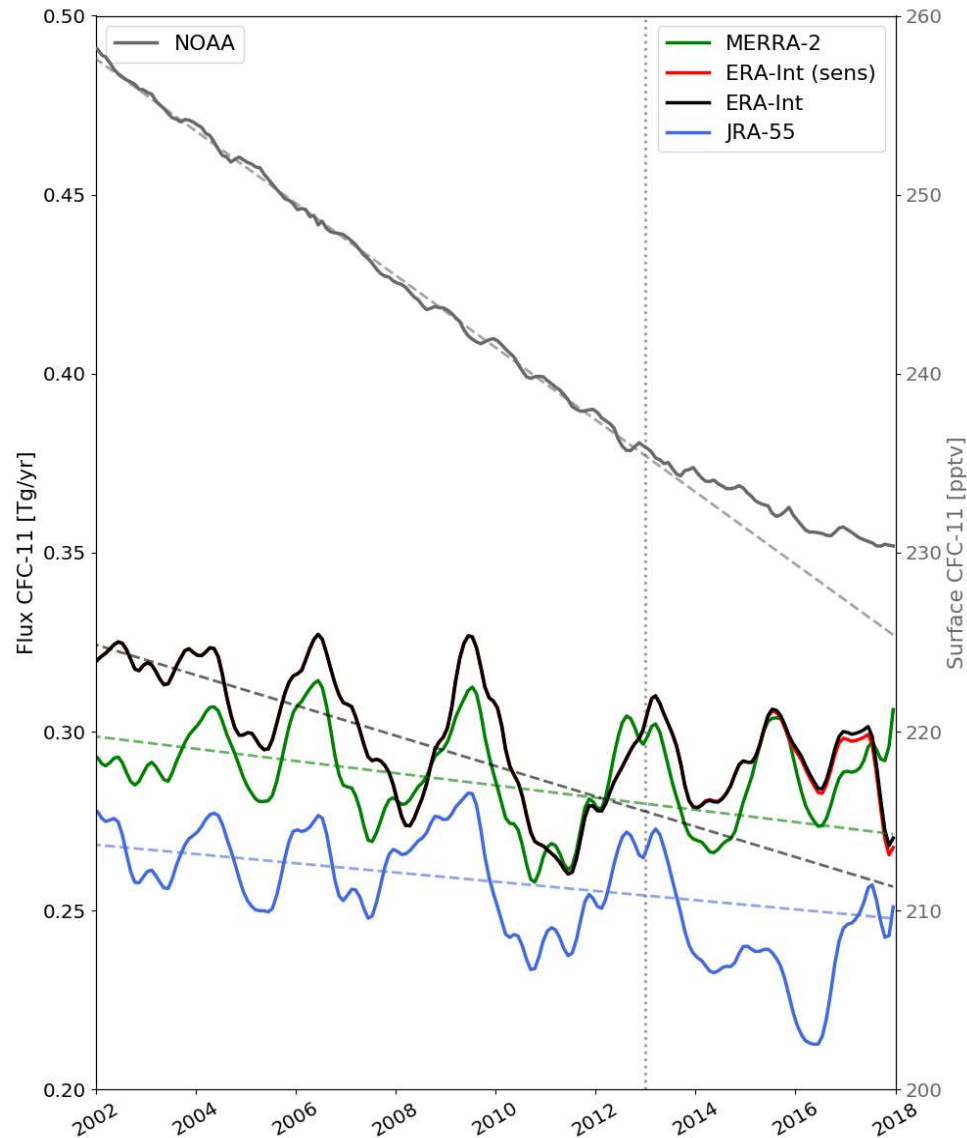
- Average precisions are slightly worse (e.g., 0.9 vs. 0.4 % for CFC-11) due to the amount of air retrieved by more than an order of magnitude smaller

Message 2: Model comparisons

- Tracer correlations of AirCore, aircraft and CLaMS model data agree well, except for the model run driven by MERRA-2 which shows higher mean ages of air



Message 3: CFC-11 strat-trop mass fluxes from 3 reanalyses



- Recent renewed emissions of CFC-11 have been reported, but how much of this signal could be due to stratospheric changes remains unclear
- The CLaMS runs driven by the ERA-Interim, JRA-55, and MERRA-2 reanalyses give very different answers in terms of the amount of CFC-11 transported back to the troposphere – and when looking at CFC-11 trends on different mean age levels none agrees well enough with observations to derive quantitative conclusions



Conclusion

- Currently available global meteorological reanalyses are insufficient to constrain the stratospheric part of the CFC-11 budget
- Atmospheric observations are also still too sparse and infrequent to help with this quantification
- For more details please see our paper in ACPD:

<https://www.atmos-chem-phys-discuss.net/acp-2020-62/>

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