

Fresh Eyes on CMIP Forcing subgroup

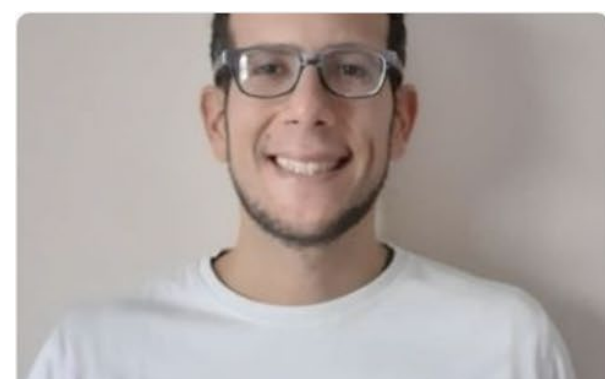
University of Reading Workshop
October 2024



Fresh Eyes on CMIP

Forcings subgroup co-leads: Camilla Mathison & Wandi Yu

FEOC – Forcings subgroup members: Arman Pouyaei, Chris Wells, Fanny Lhardy, May Chim, Daniele Minganti, Ellen Berntell, Felix Jäger, Iris de Vries, James Weber, Mark Dekker, Martin Renoult, Sandeep Mohapatra



Going forward two Forcing projects have been proposed:

Paleoclimate research; exploring the consistency between paleo forcings and modern run forcings.

- Aharna Sarkar
- Alicia Meng Xiao Hou
- Fanny Lhardy
- Mara McPartland
- Yiwen Li
- Wandu Yu
- Camilla Mathison

Evaluate and compare the CMIP7, CMIP6 and CMIP6Plus forcing datasets to support the Forcing Task team

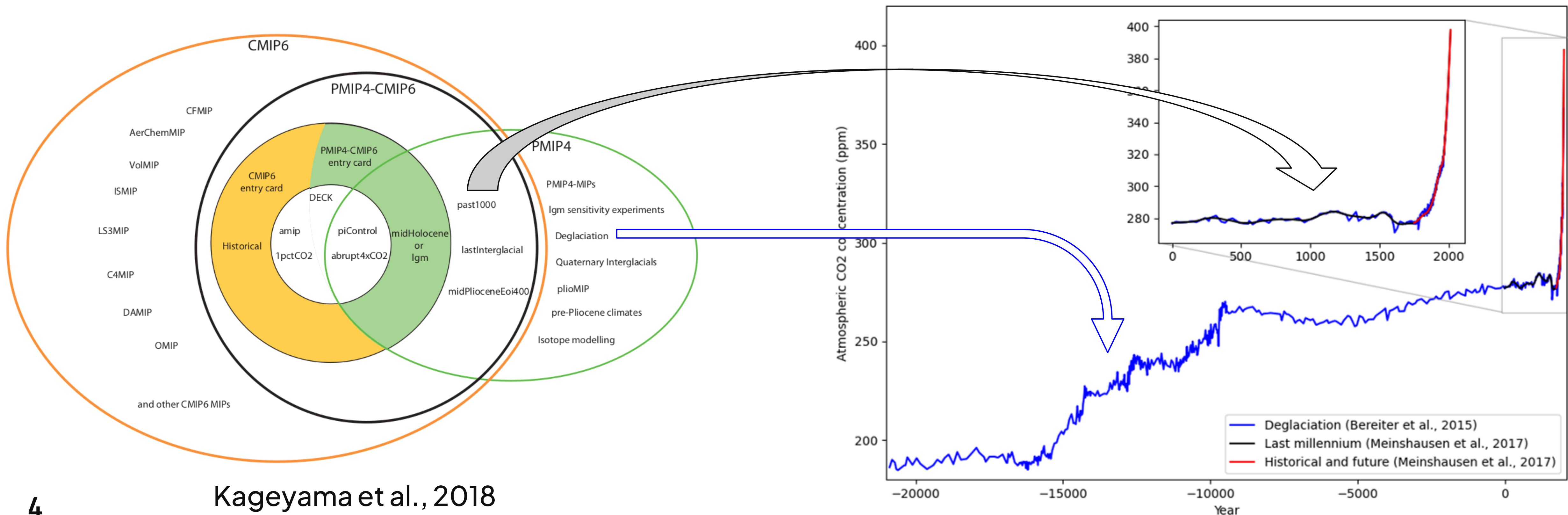
- | | |
|--------------------|-----------------------|
| ■ Aditya Sengupta | ■ May Chim |
| ■ Arman Pouyaei | ■ Mehmet Sedat Gozlet |
| ■ Chengfei He | ■ Nebiyu Waliyi |
| ■ Daniele Minganti | ■ Roberta Dagostino |
| ■ Jie Jiang | ■ Stuart Jenkins |
| ■ Chris Wells | ■ Yurong Gao |
| ■ Camilla Mathison | ■ Wandu Yu |

Please sign up here!



Paleo forcing comparison project – Get involved!

PMIP recommends various forcings (insolation, trace gases, volcanic forcing, dust, ice sheets, freshwater fluxes...). Some experiments (last millenium, last deglaciatiion) are **in continuity with historical runs**. We aim at reviewing all the forcings recommended in protocols to make sure that **consistency is ensured**.



Modern Forcing evaluation

Datasets currently being analysed up to October 2024:

GHGs – Mostly Chris Wells/ Camilla in support

Volcanic forcing – May Chim

Solar forcing – Wandu Yu

Biomass burning – Arman Pouyaei

Datasets not started analysing yet because either not available or no one identified to look at them:

Land use

Aerosols

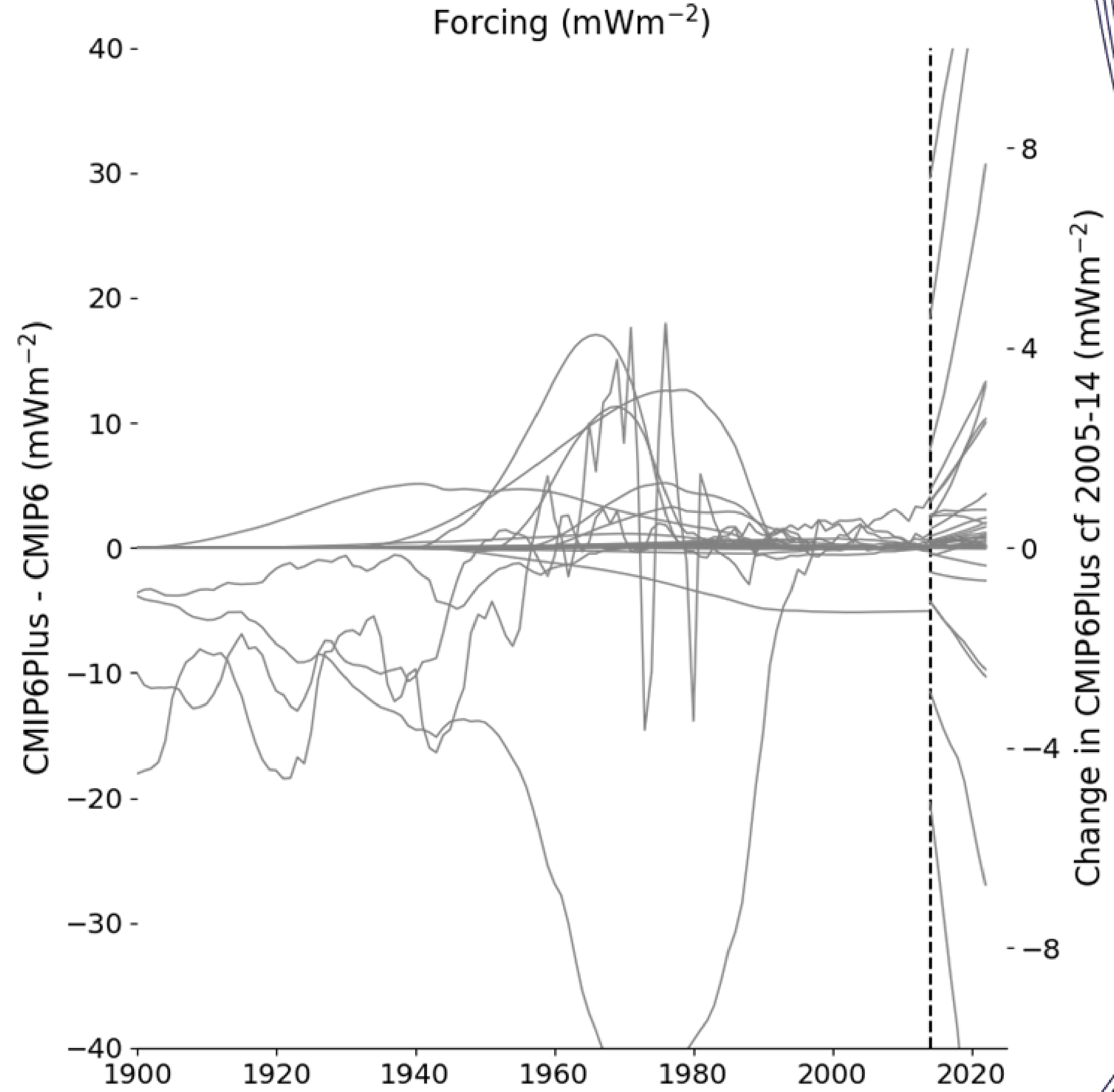
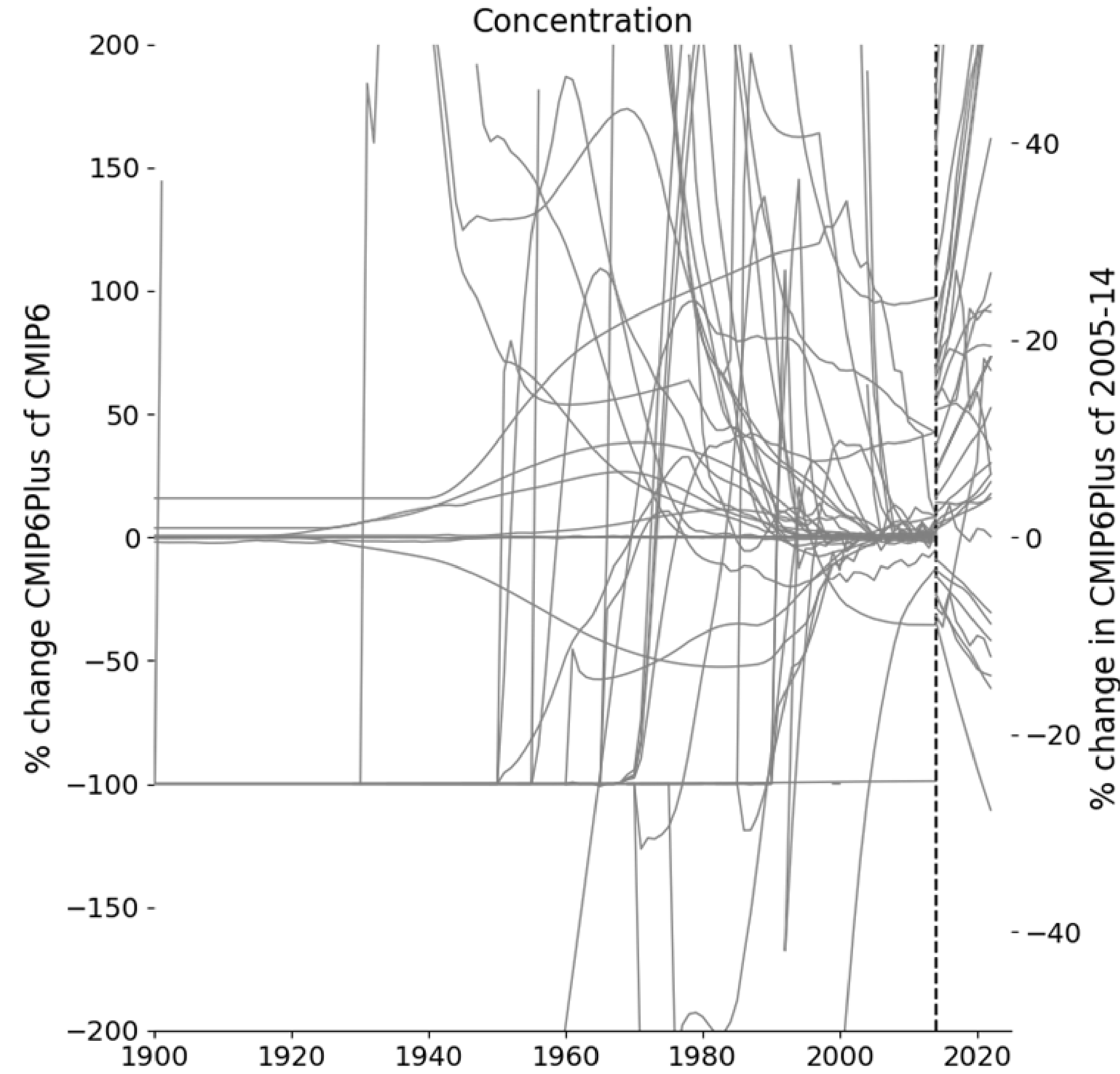
Ozone

Any others....

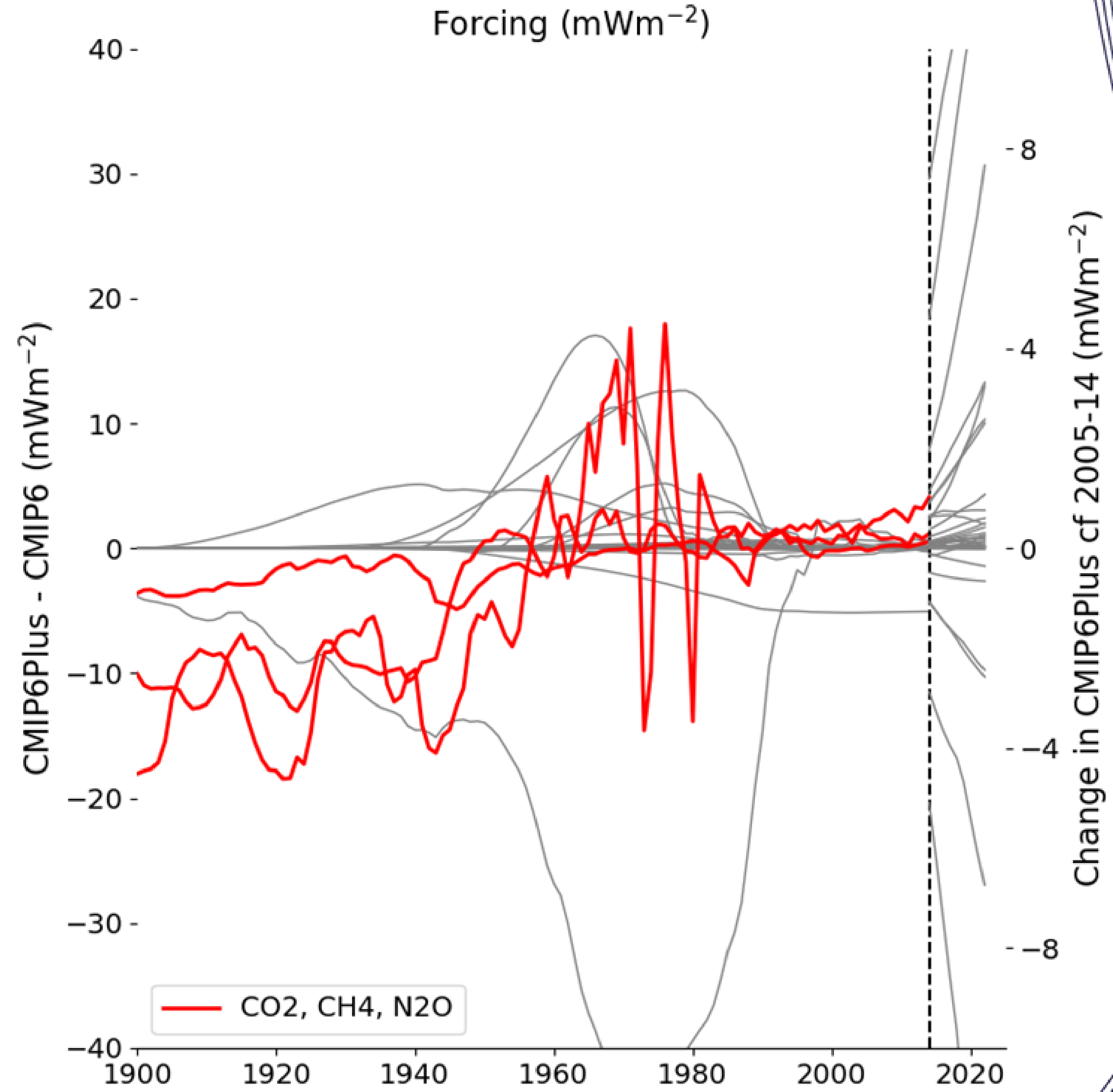
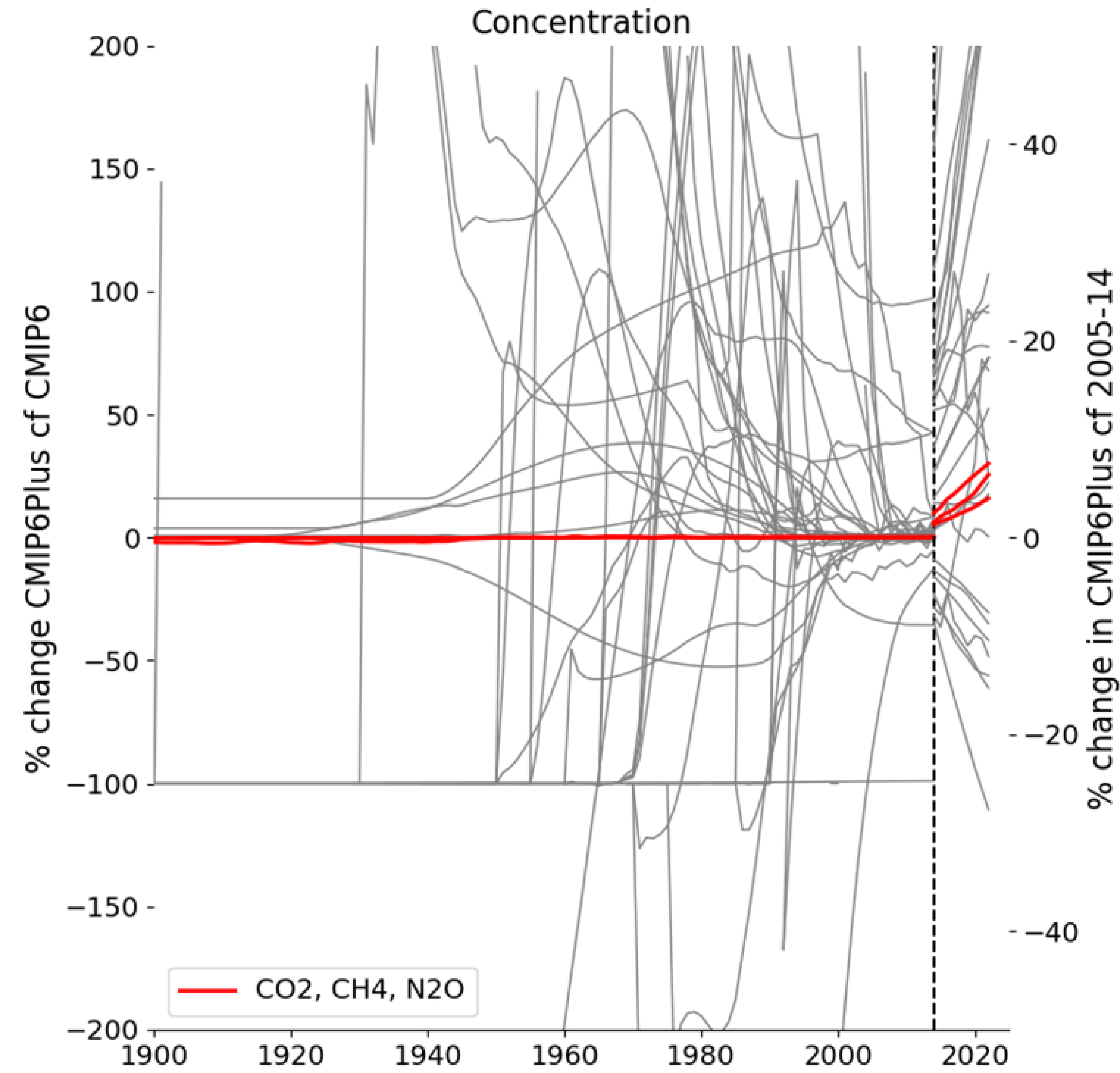
GHG Forcing evaluation

Concentrations from CMIP6Plus database

Forcings from FaIR SCM

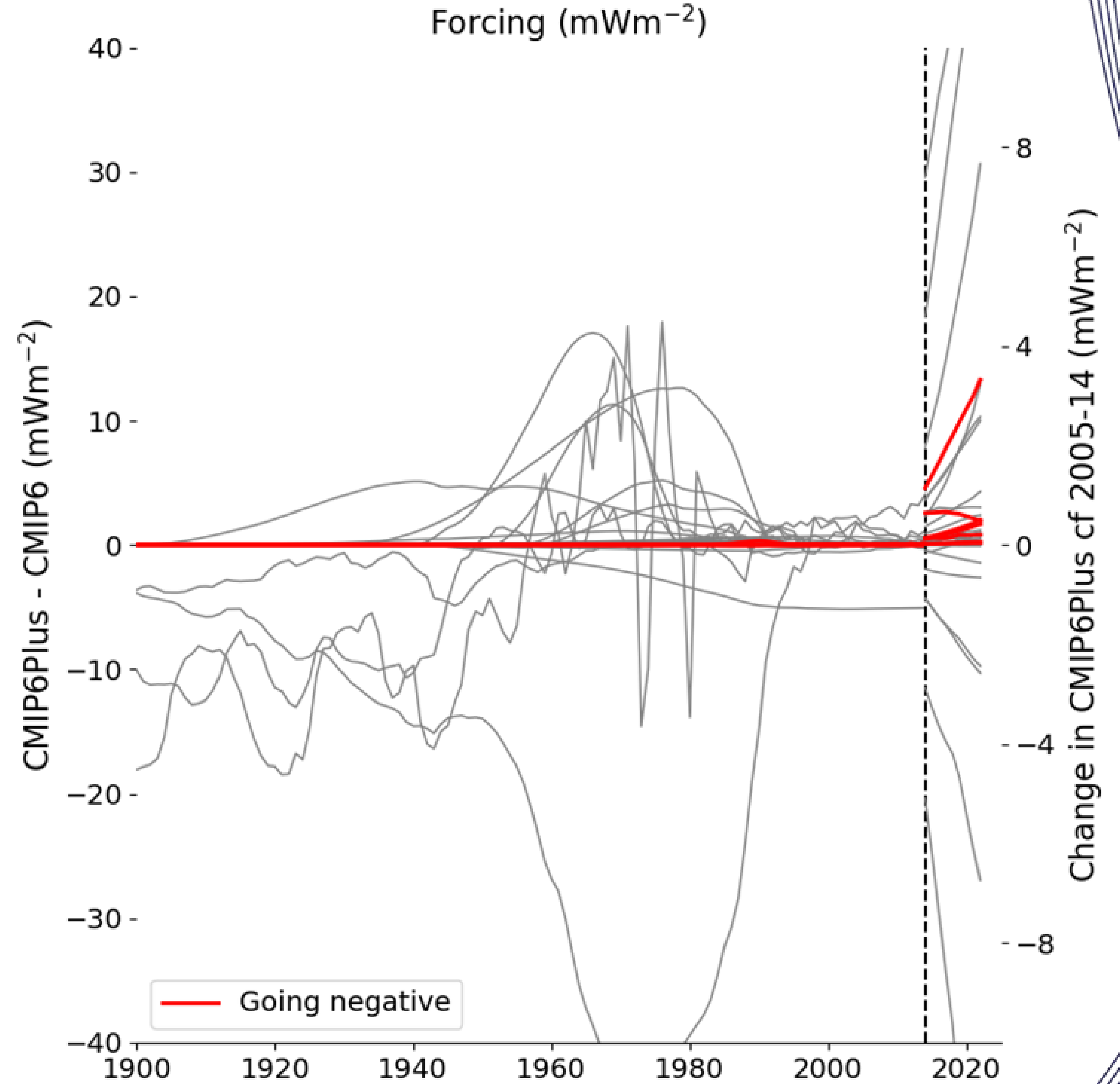
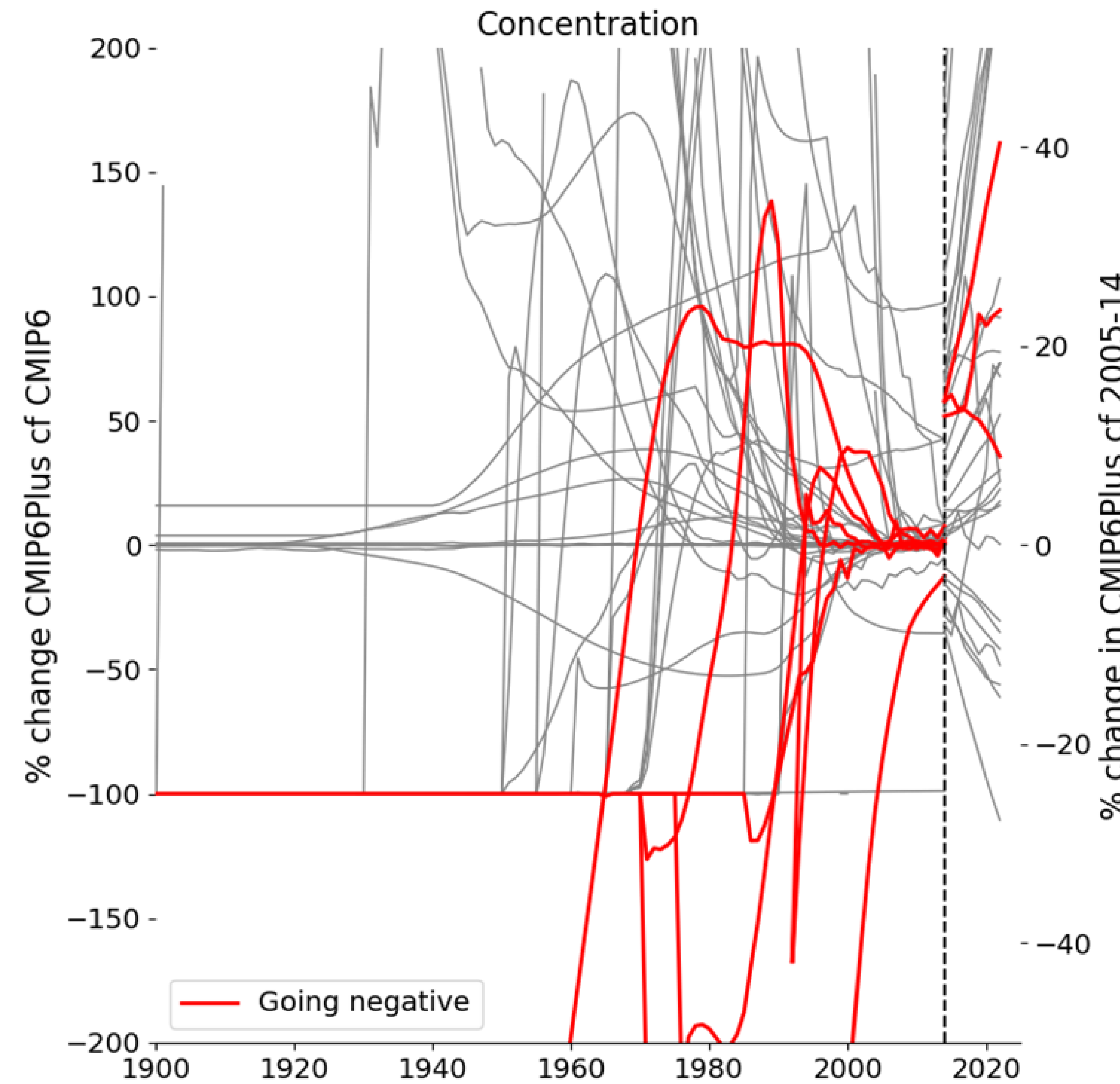


GHG Forcing evaluation



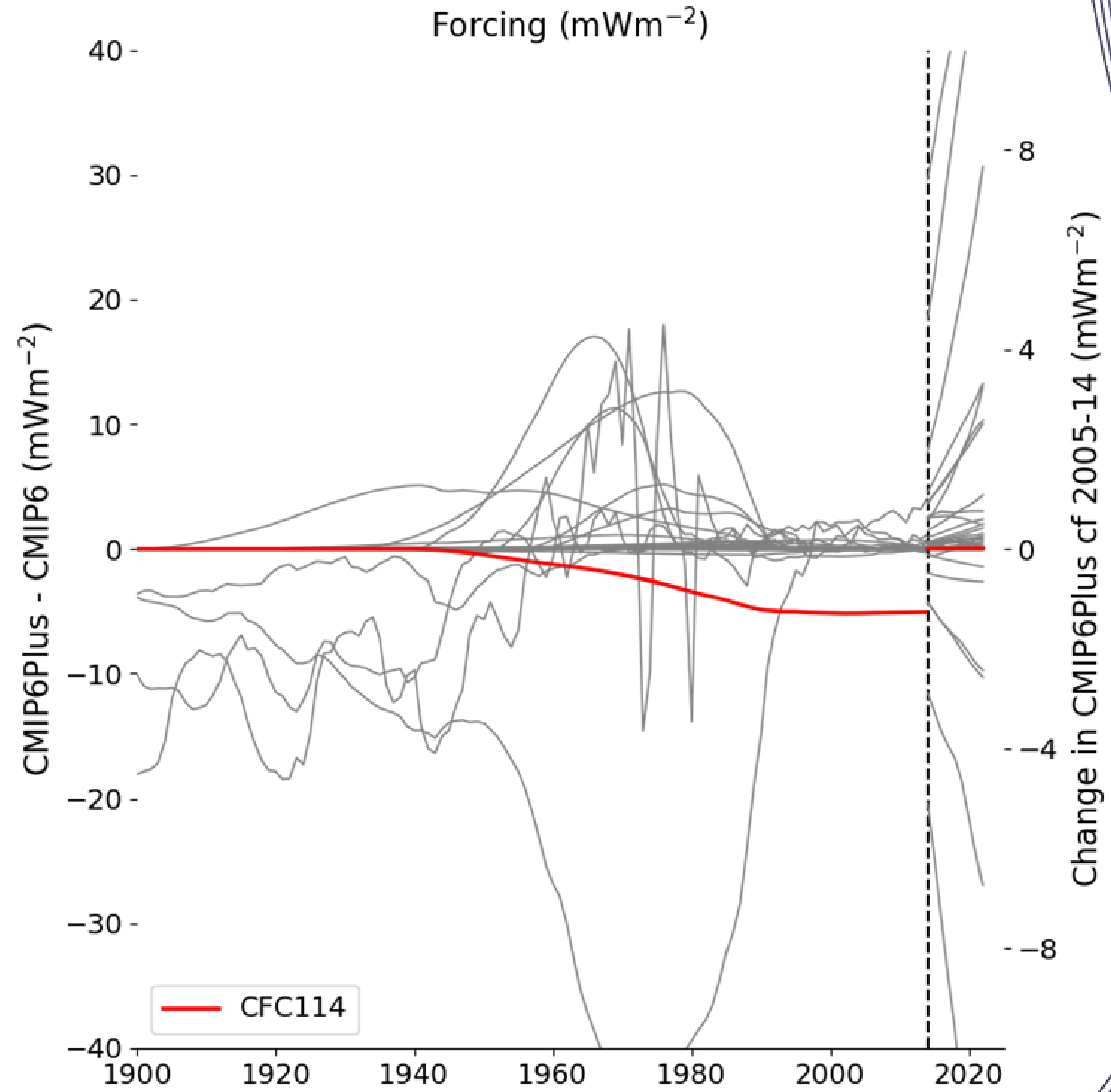
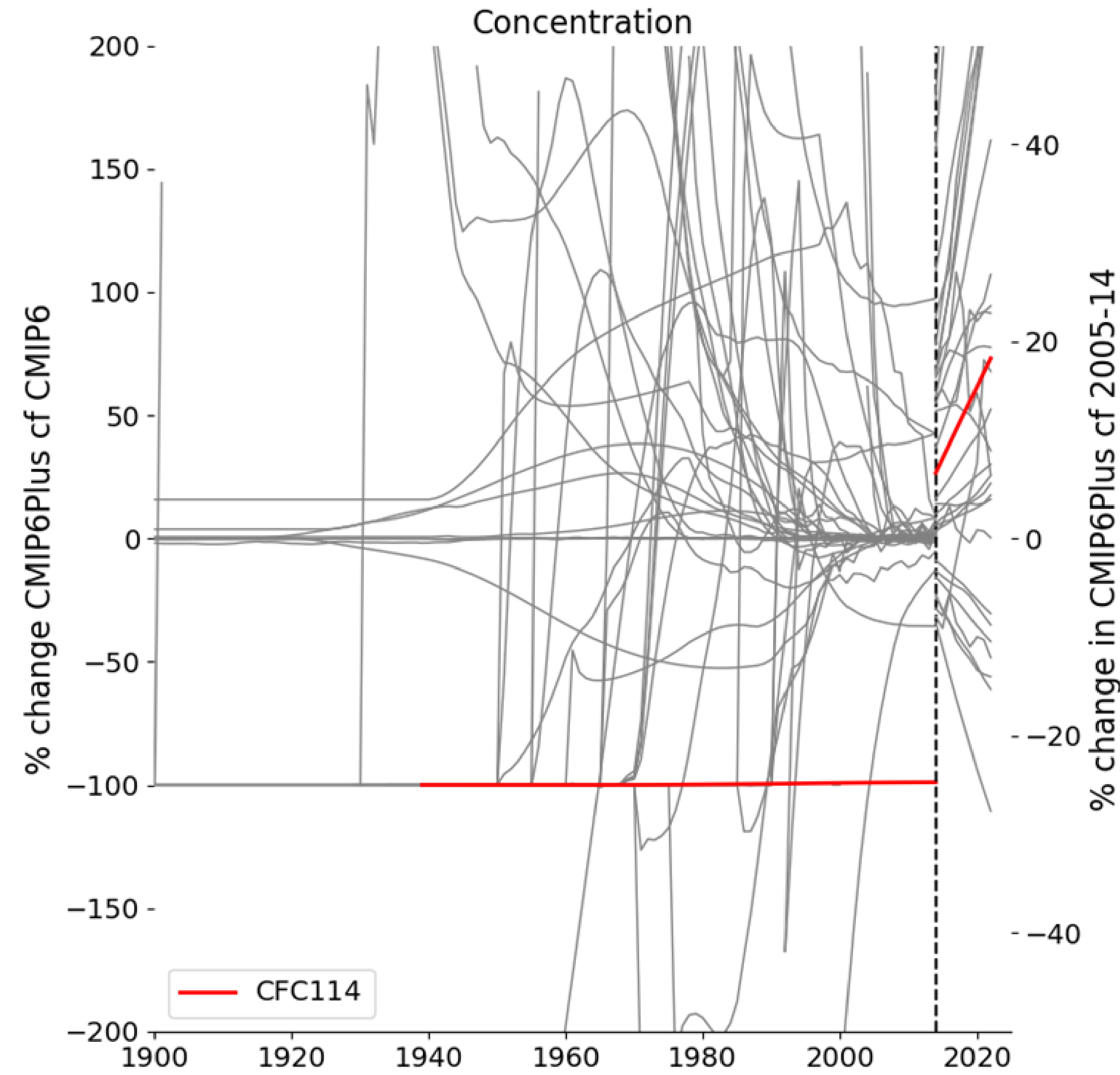
GHG Forcing evaluation

Negative concentrations occur in PFC218, HCFC142b, HFC143a, HFC152a, HFC227ea, HFC236fa, NF3



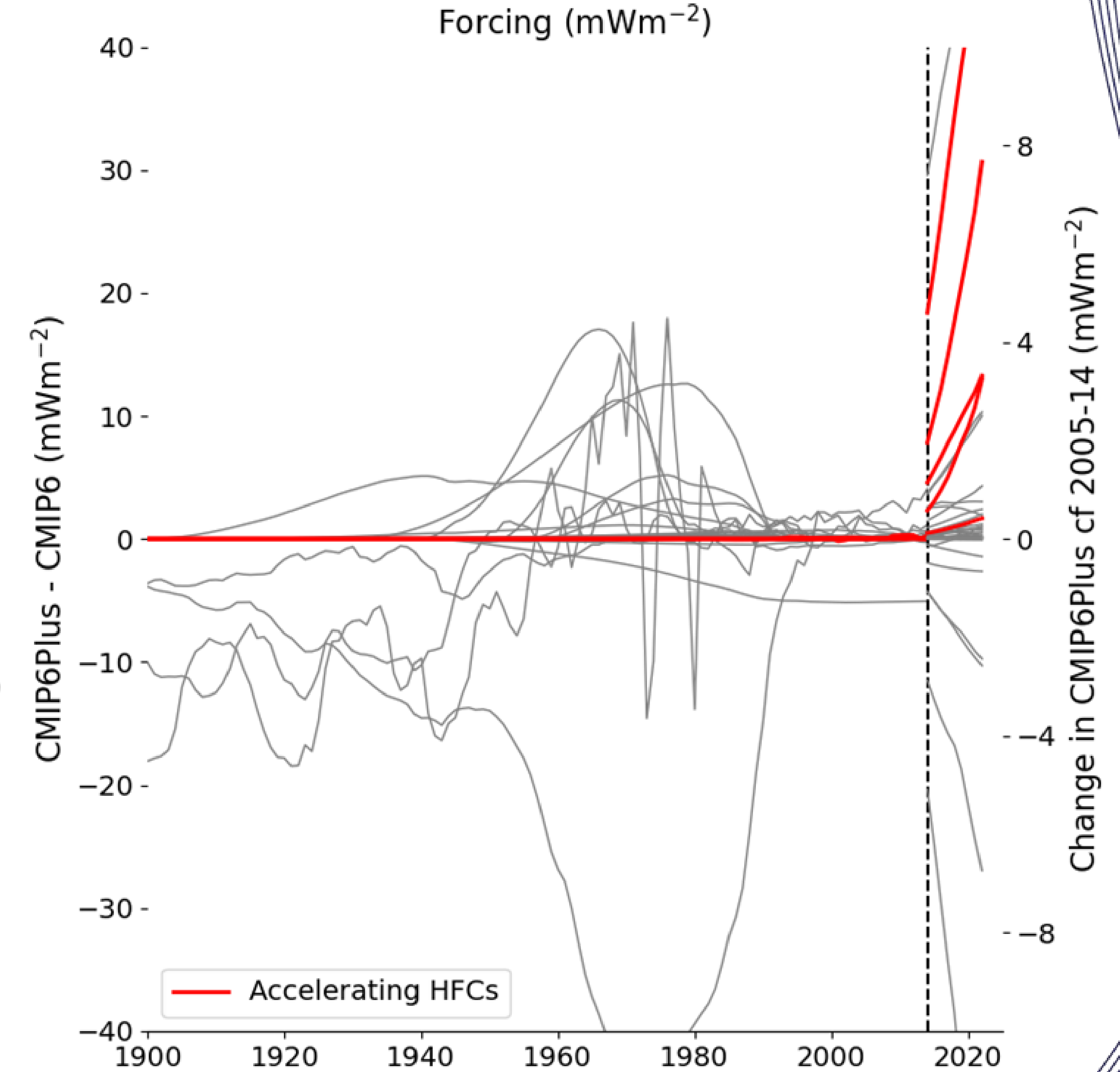
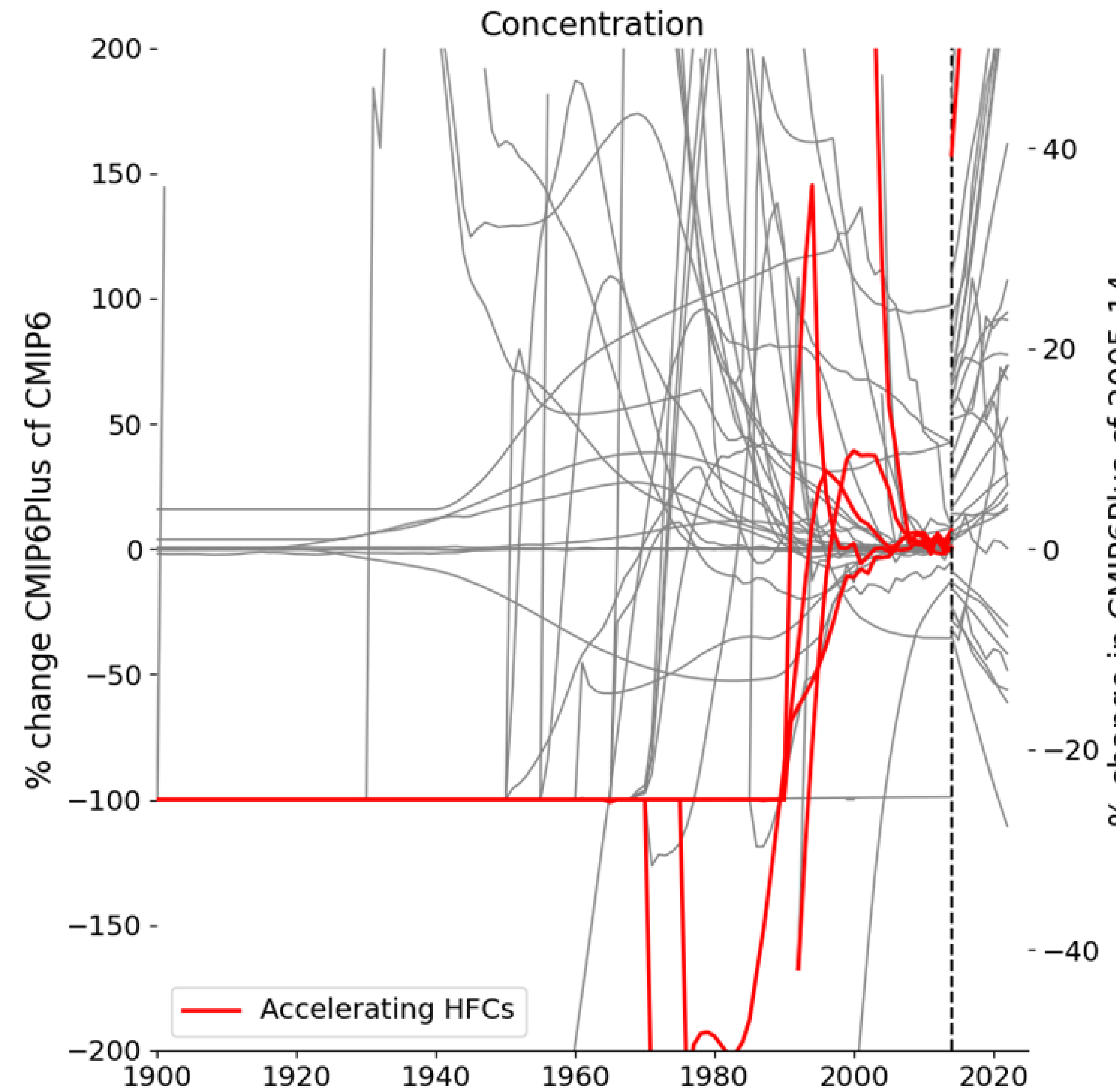
GHG Forcing evaluation

Anomalous low concentration in CFC114



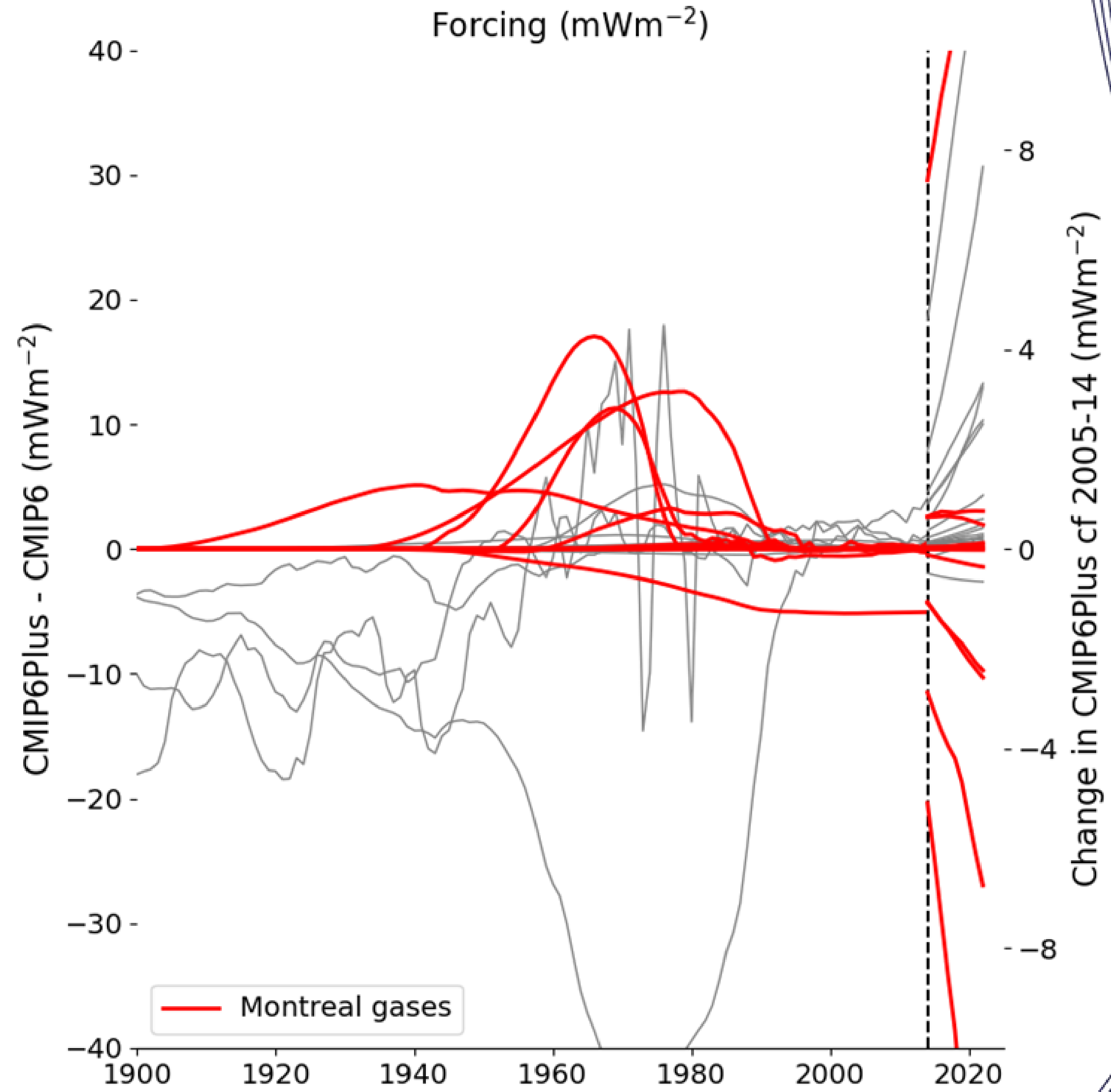
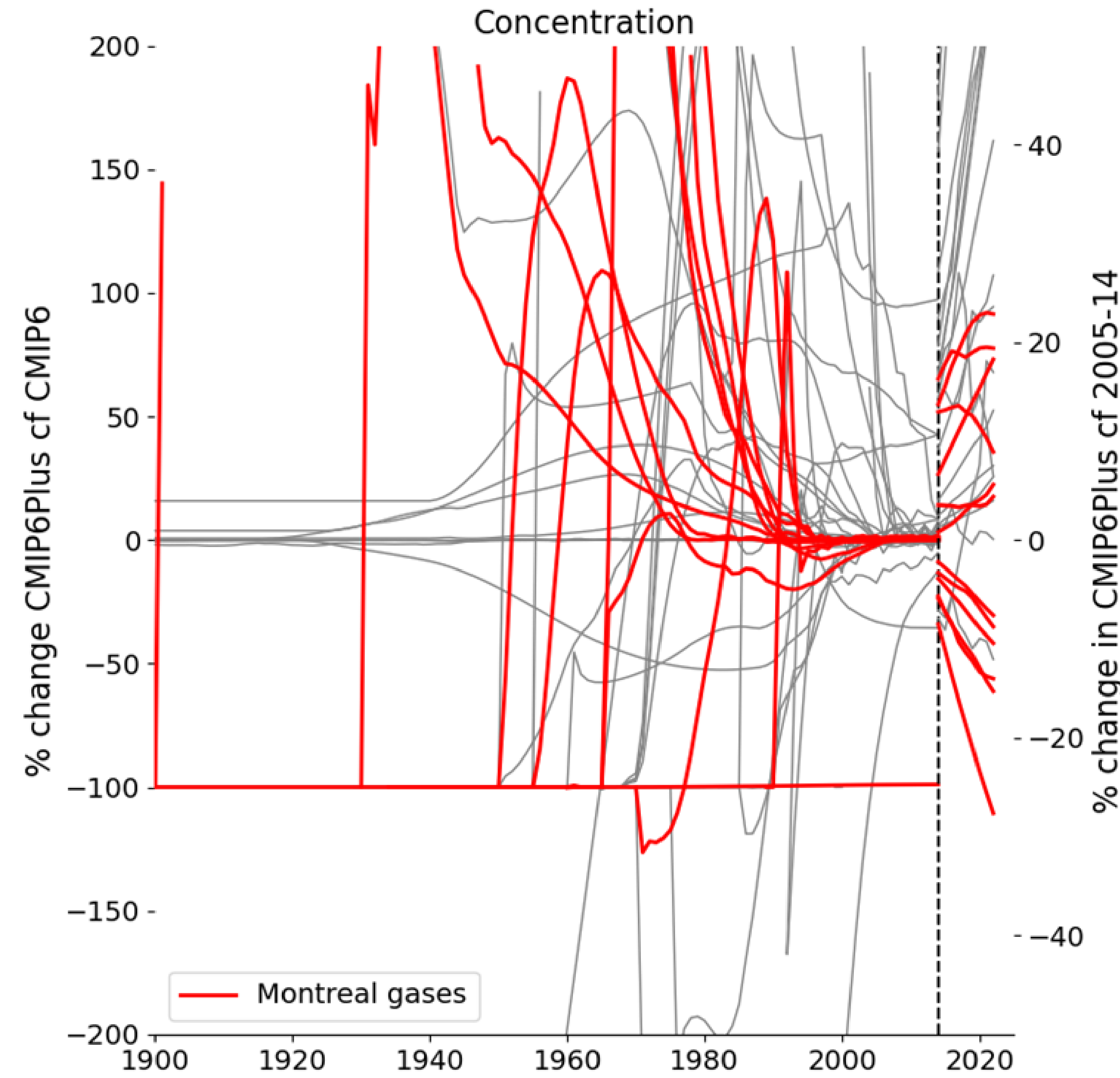
GHG Forcing evaluation

Expected acceleration in HFC32, HFC125, HFC134a, HFC143a, HFC227ea



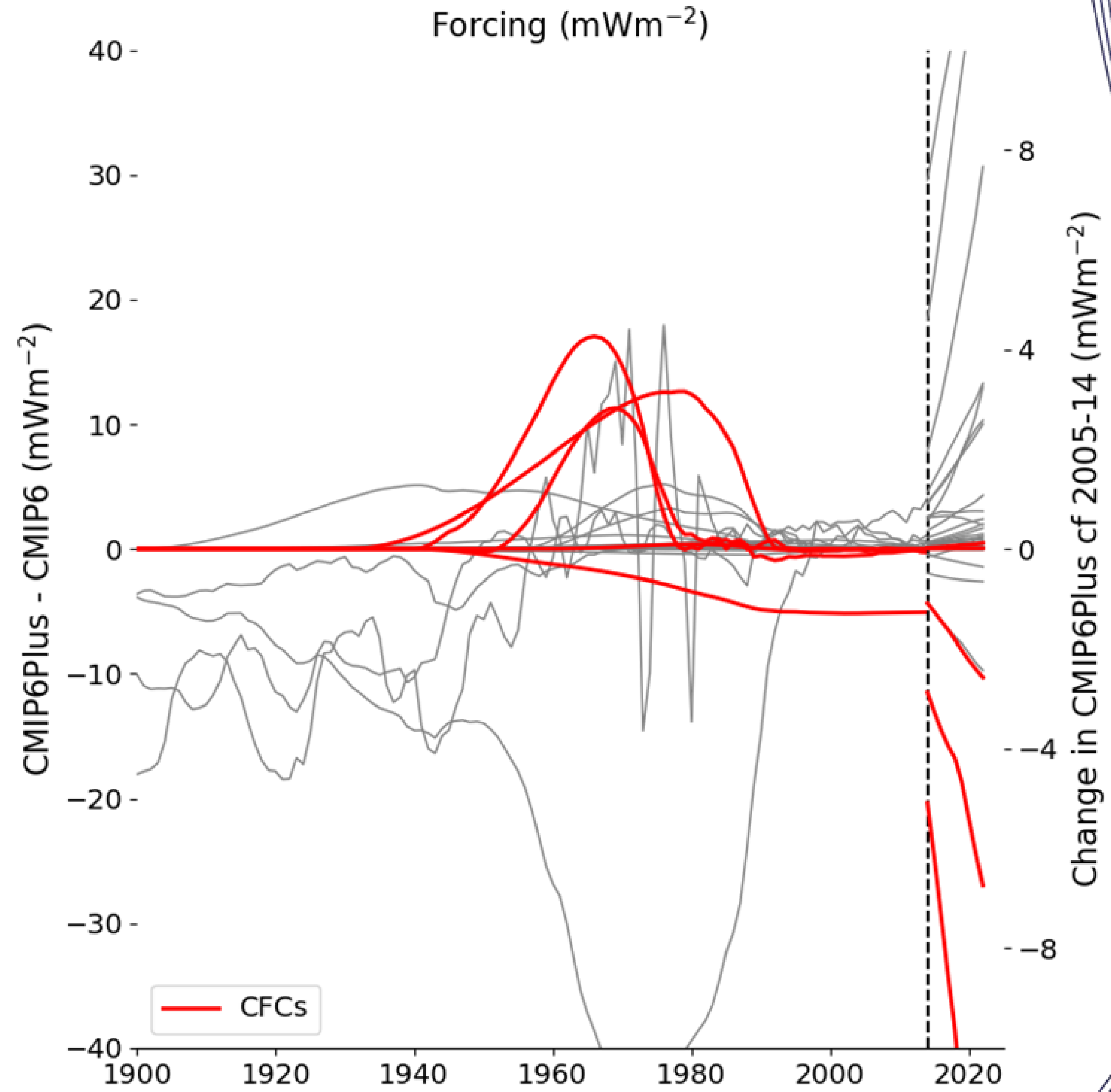
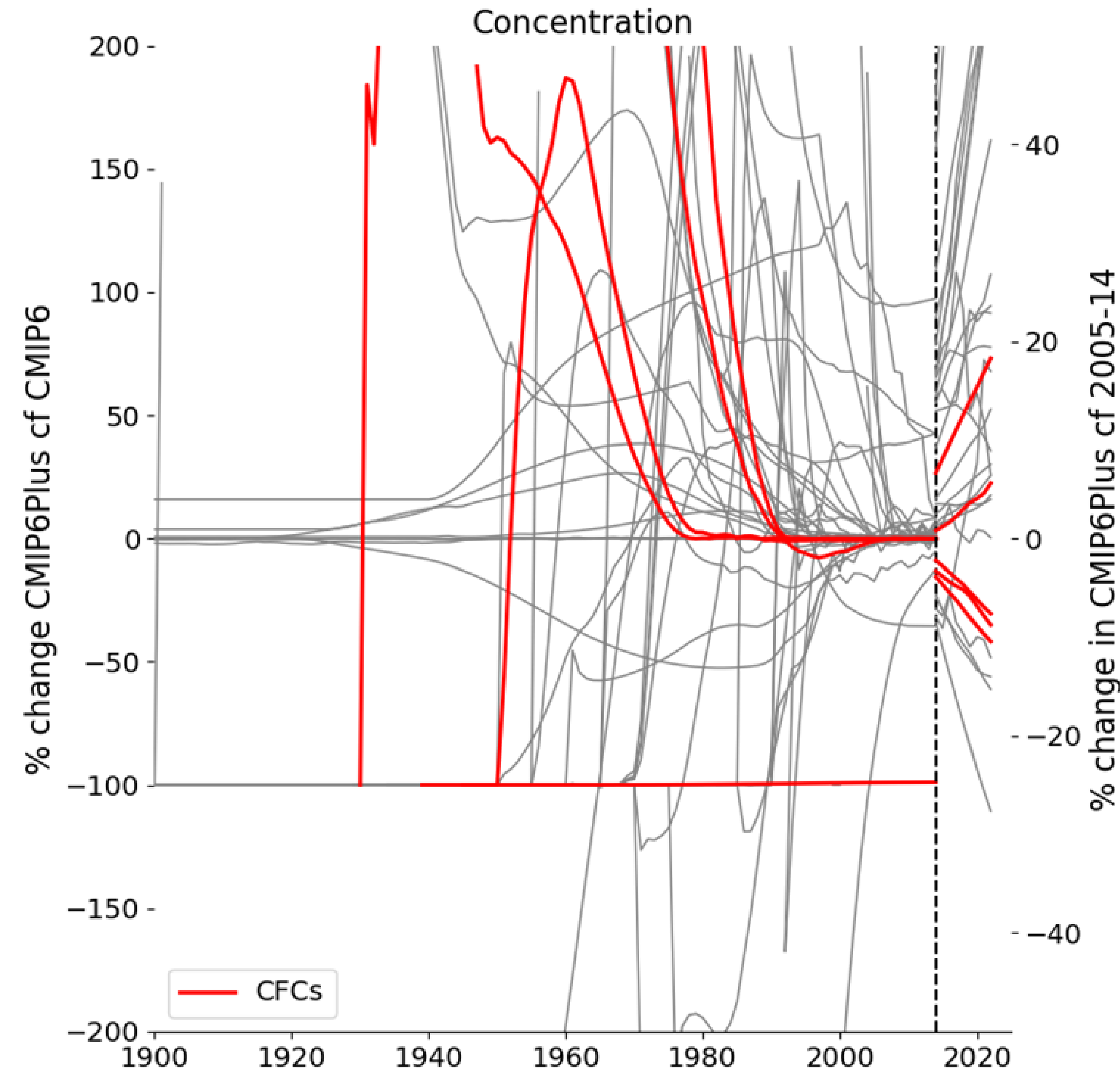
GHG Forcing evaluation

CFCs + HCFCs + Halons + CCl4



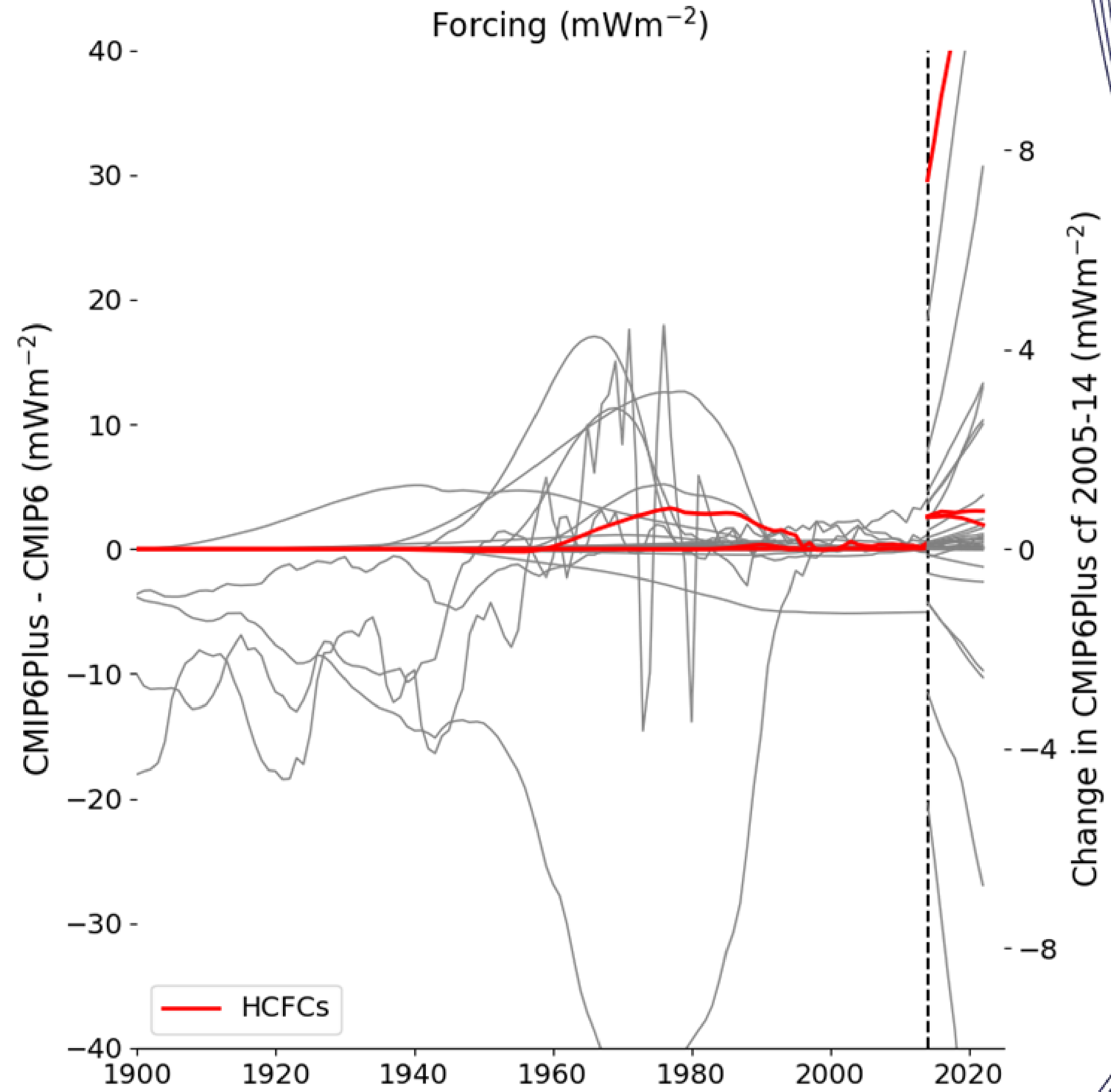
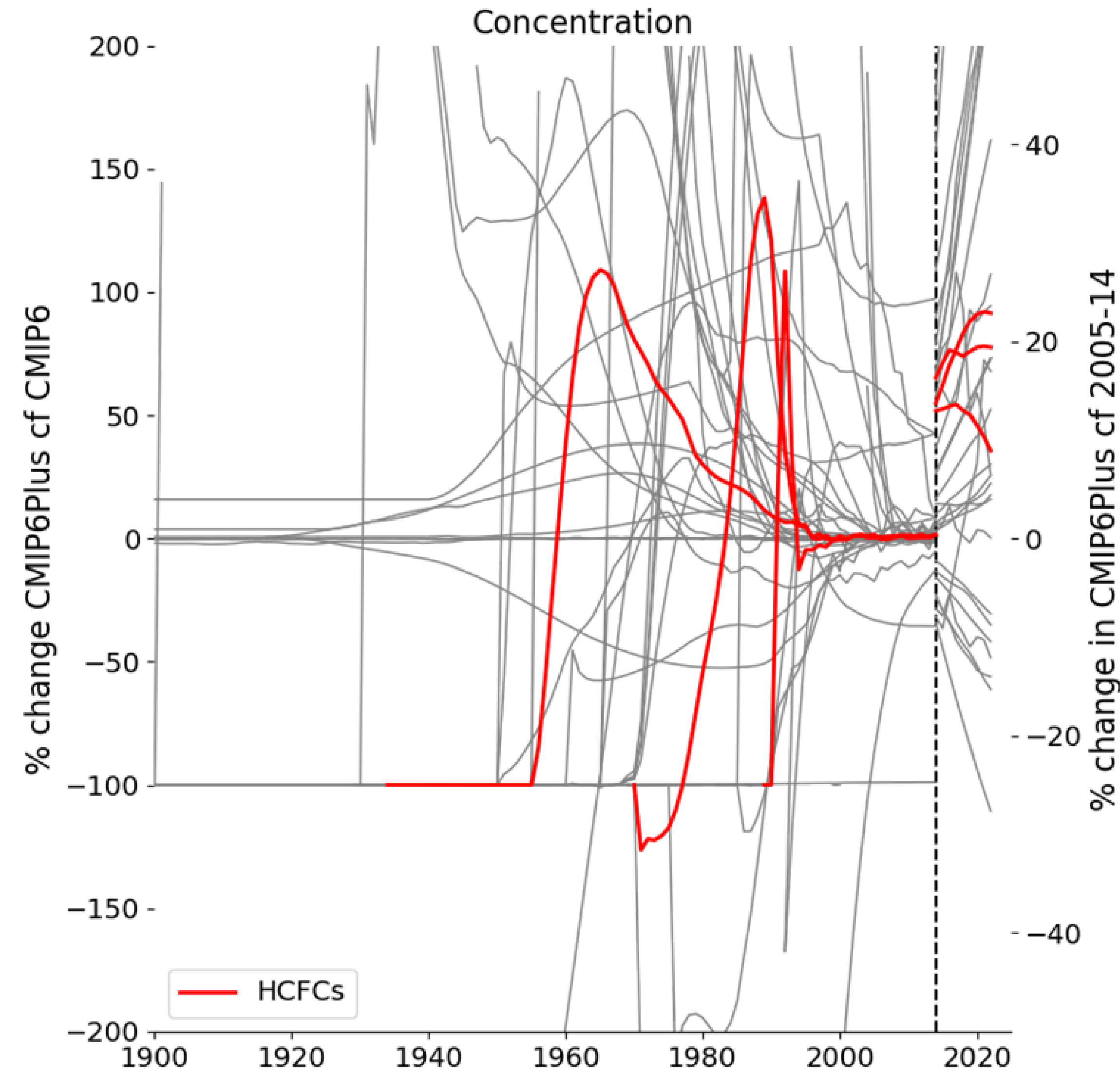
GHG Forcing evaluation

Expected drop in most CFCs



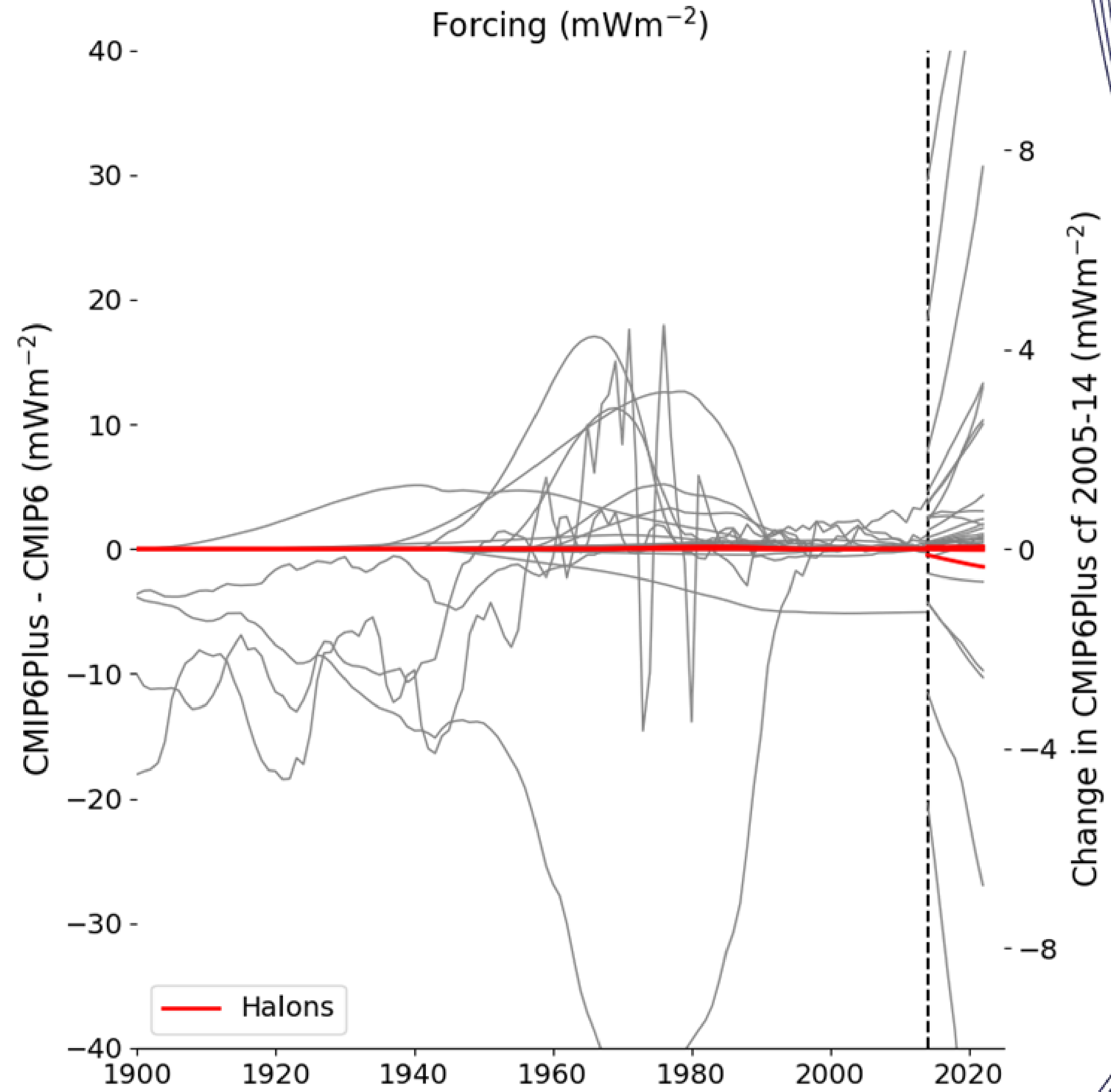
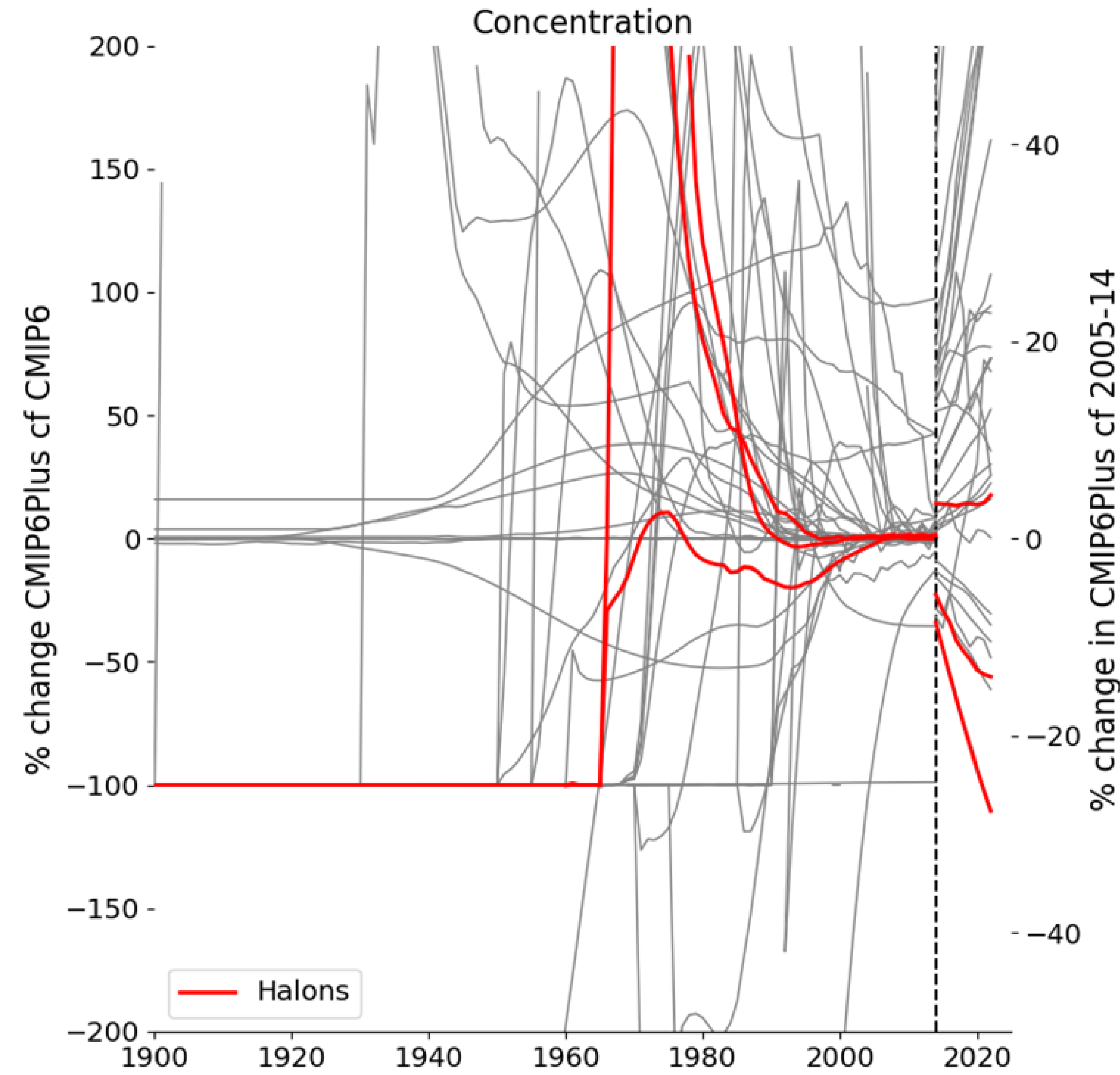
GHG Forcing evaluation

Increases in HCFCs



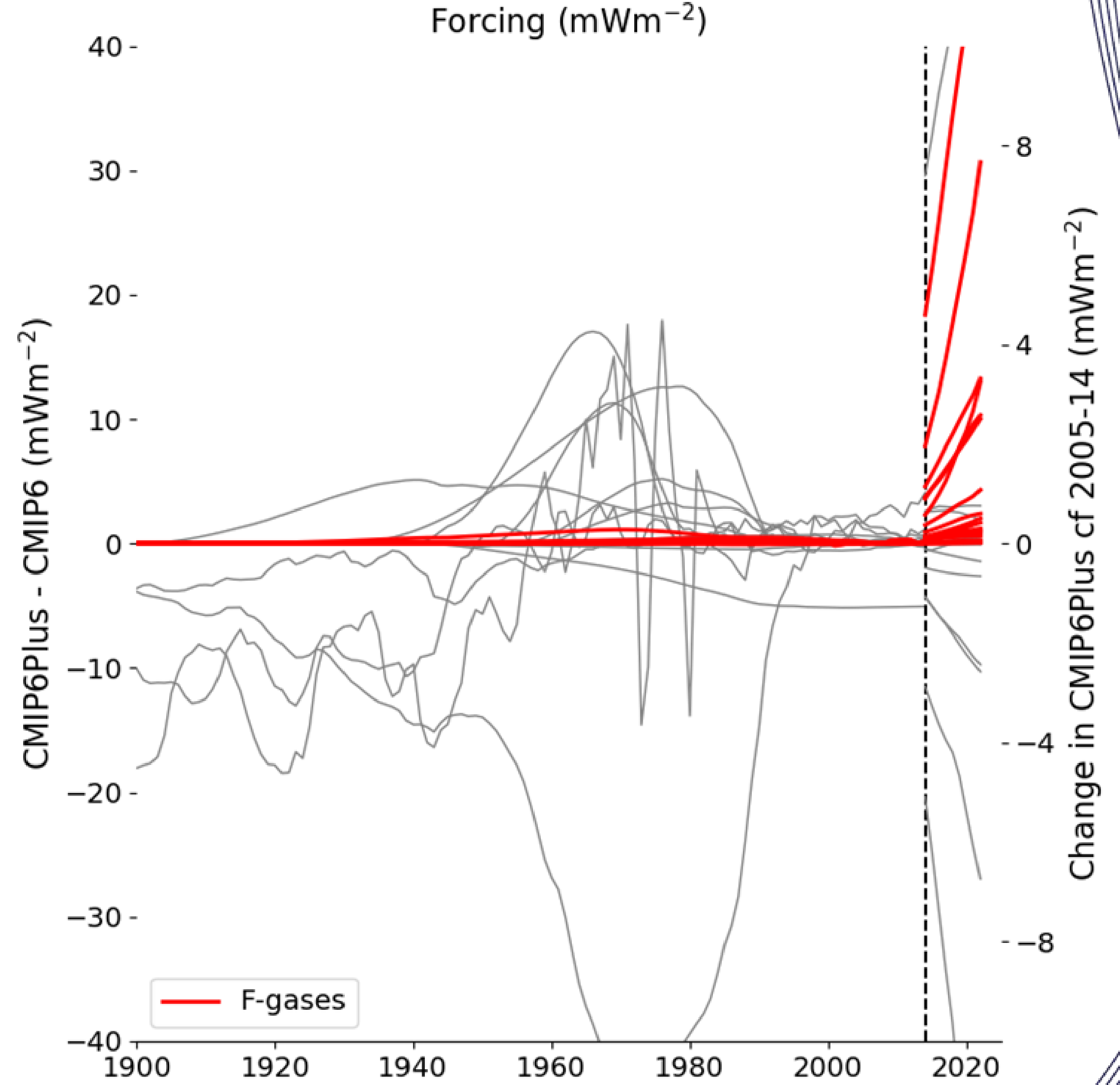
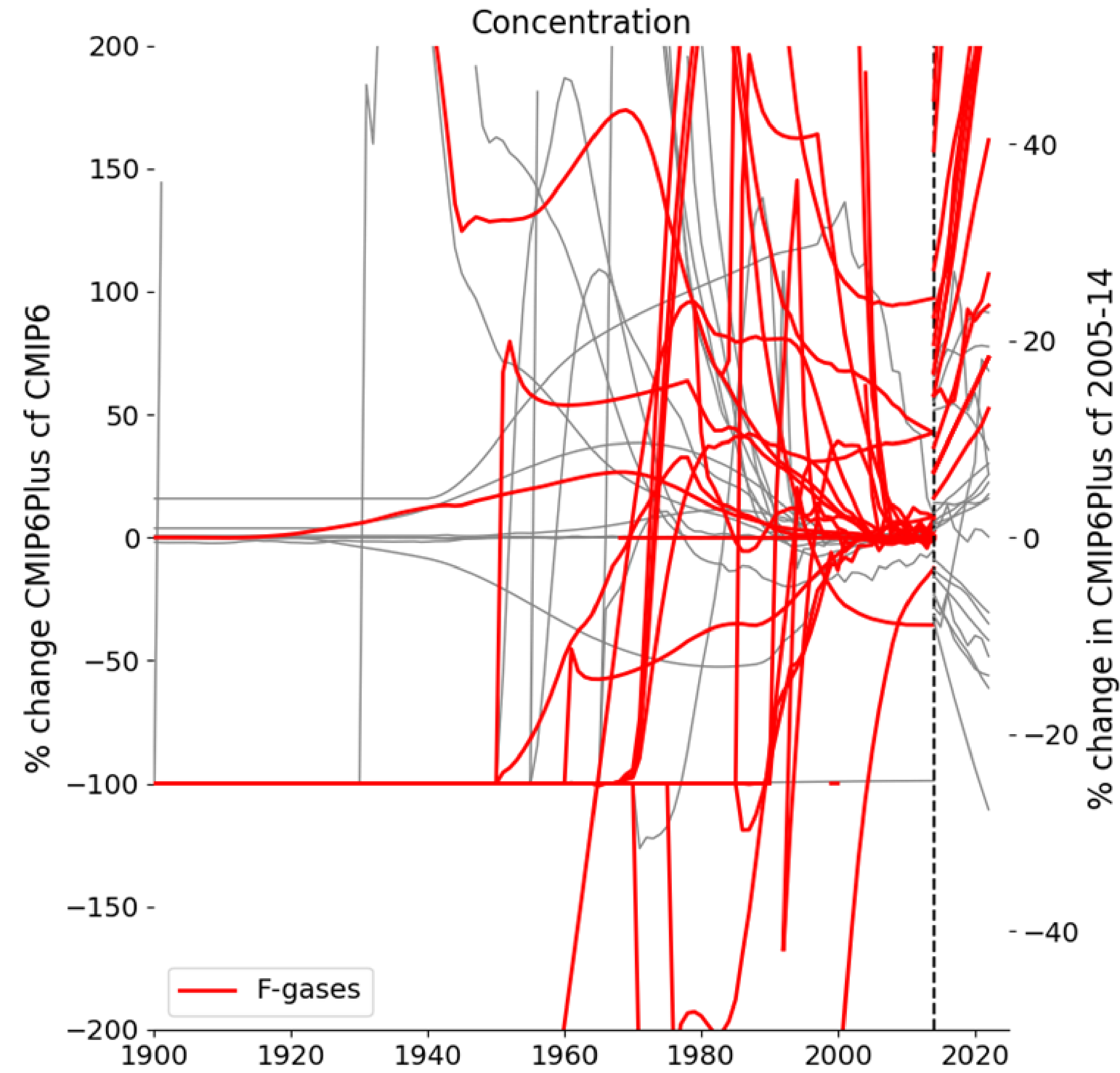
GHG Forcing evaluation

Decline in Halons



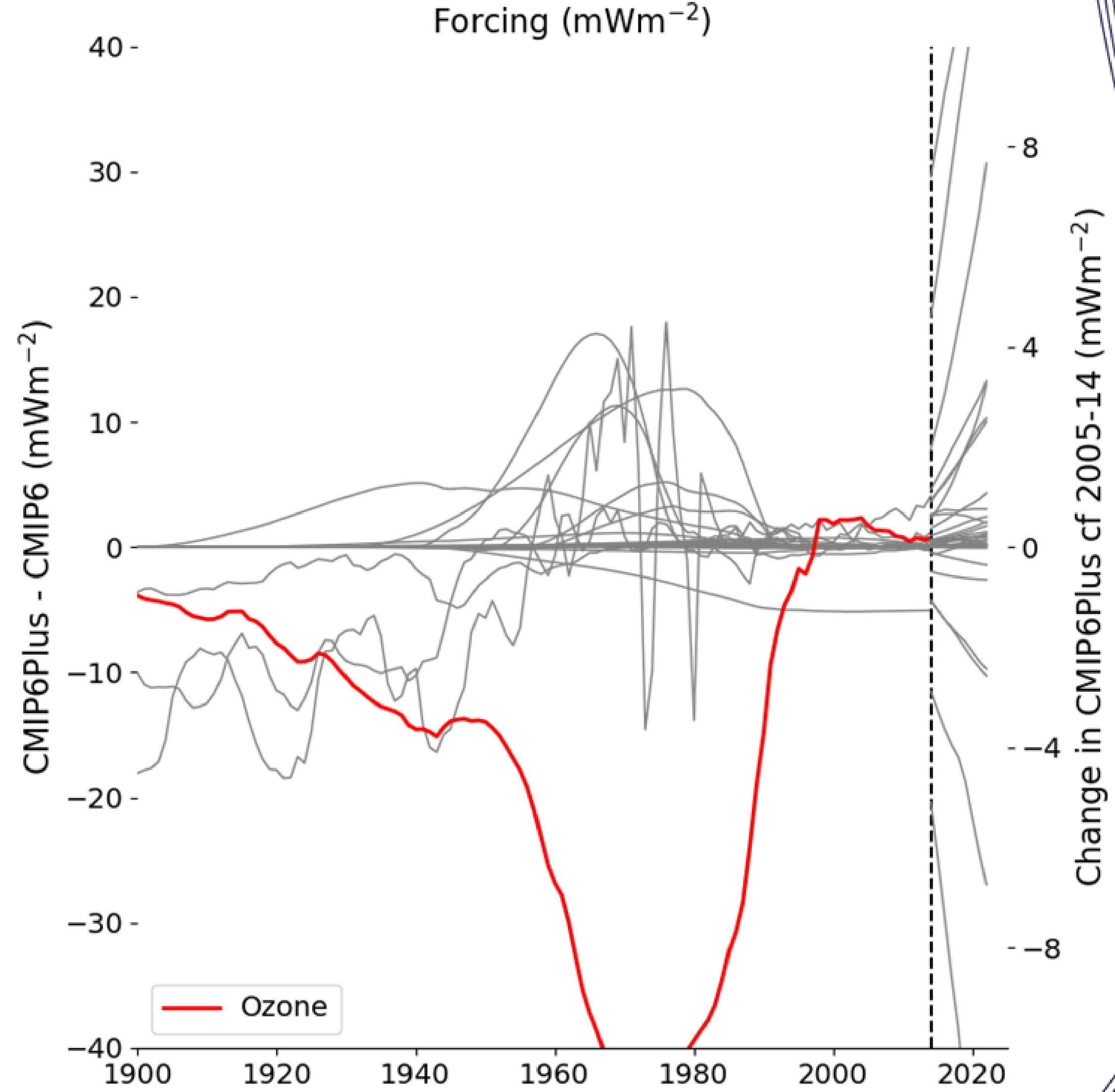
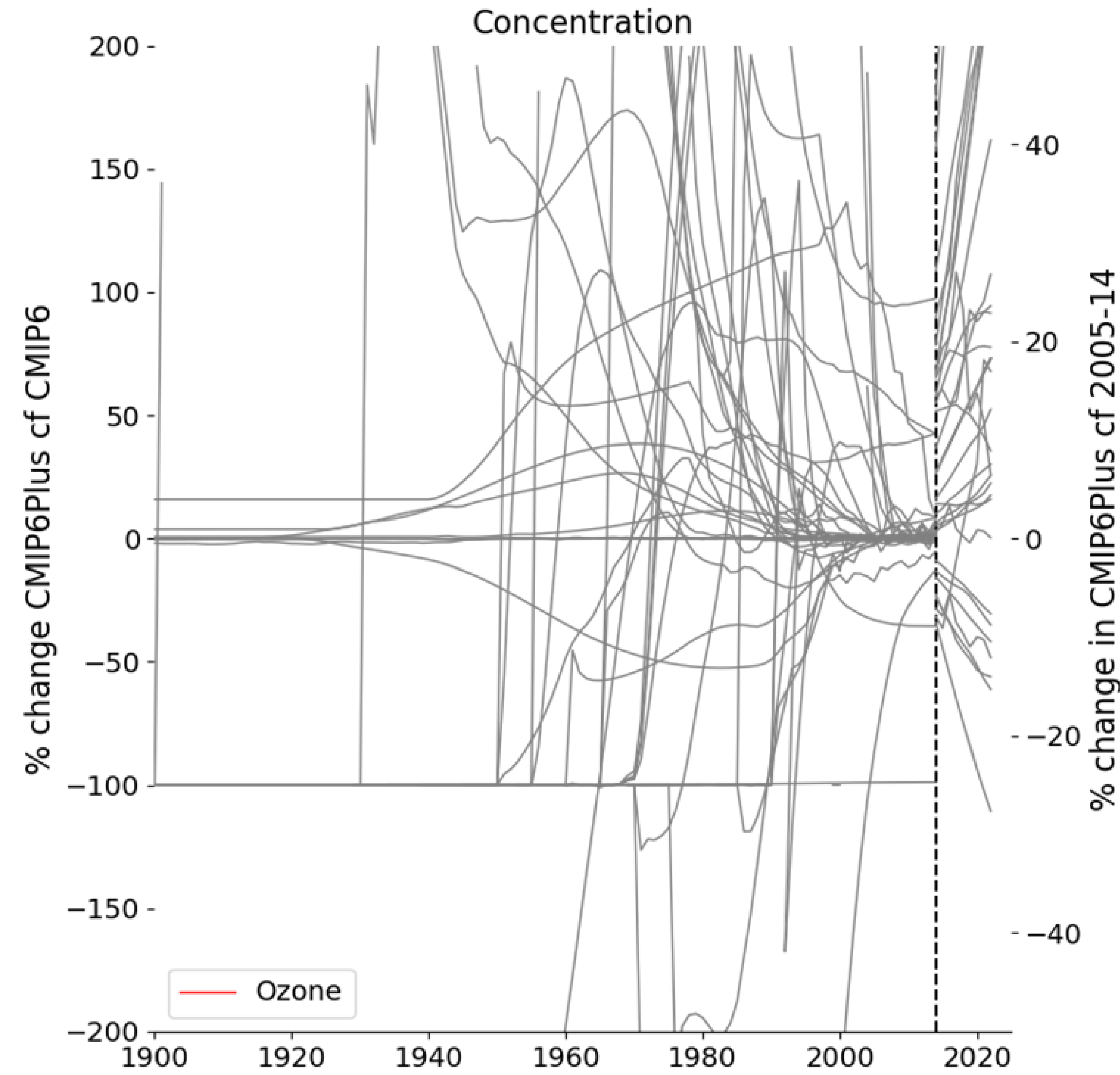
GHG Forcing evaluation

Rise in F-Gases

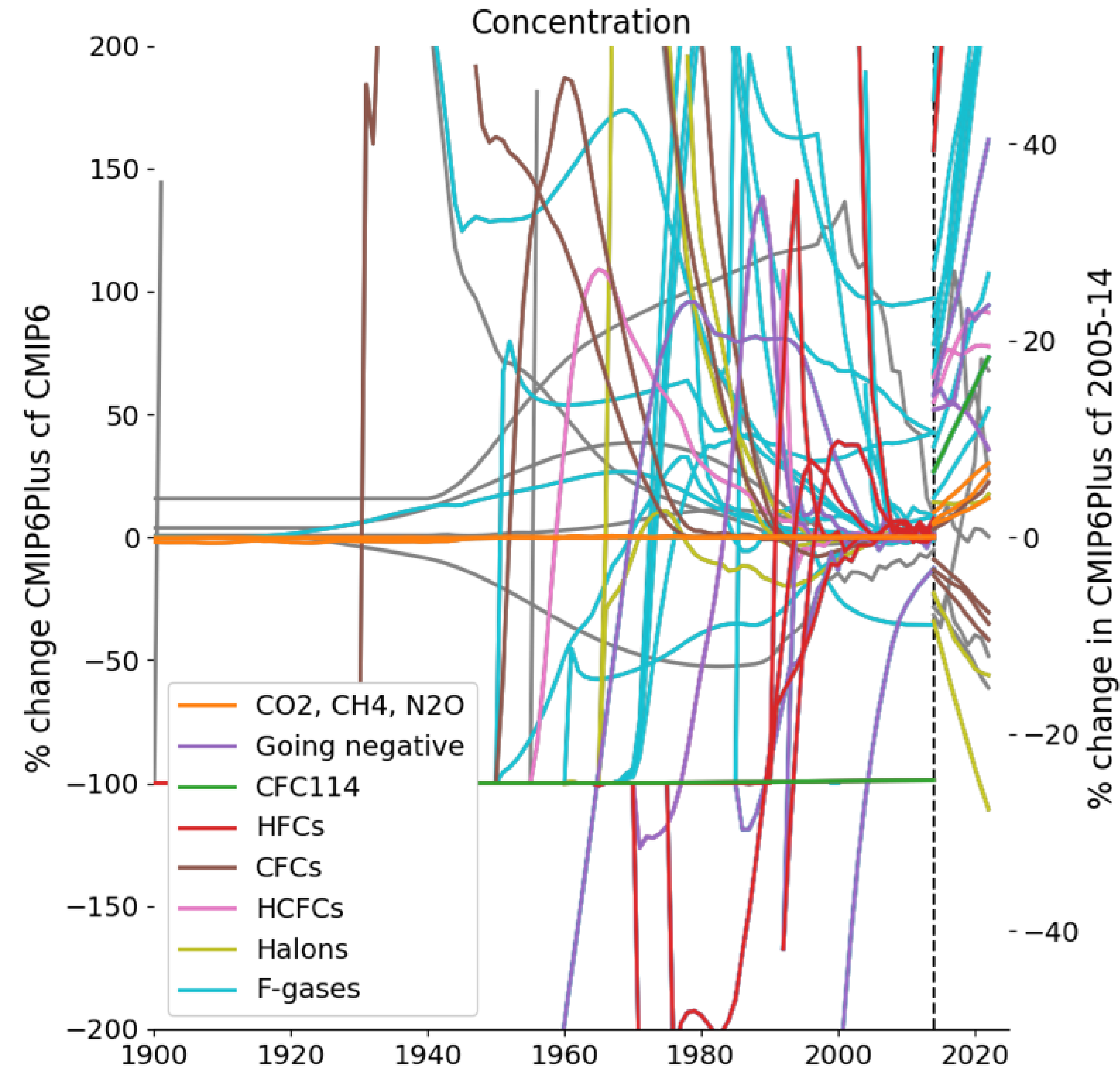


GHG Forcing evaluation

Ozone forcing lower historically



GHG Forcing evaluation

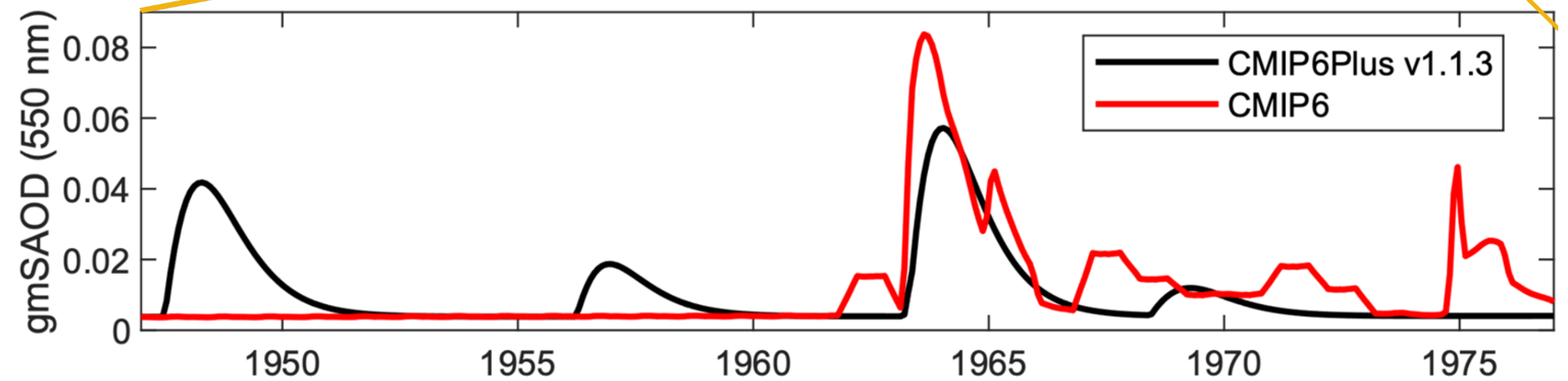
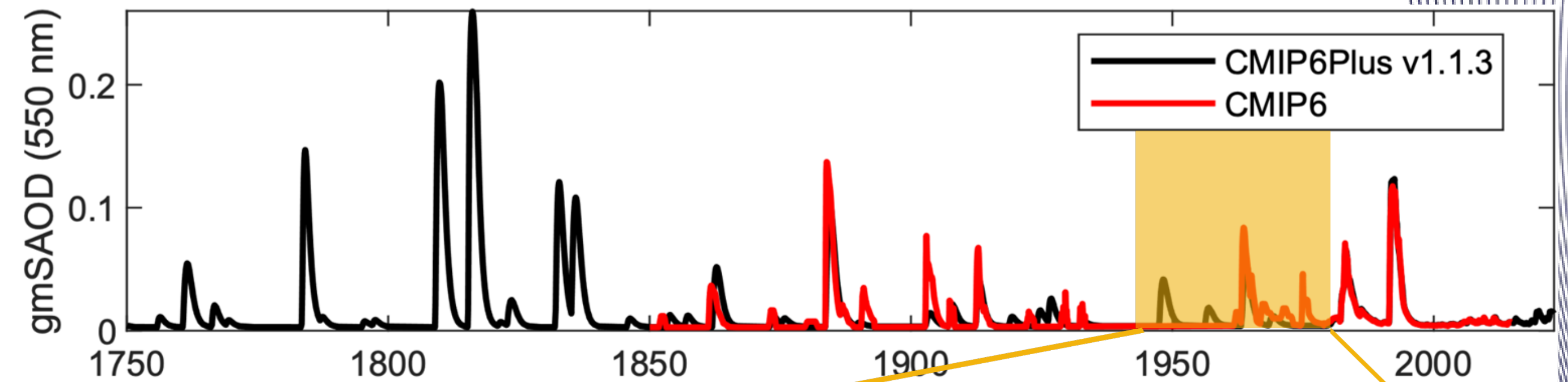


- CO₂, CH₄, N₂O consistent and increasing
- **Some species go negative in CMIP6Plus**
- **CFC114 anomalously low**
- HFCs accelerating
- CFCs mostly declining, some rising
- HCFCs rising
- Halons declining
- **Estimated Ozone forcing lower historically**

Volcanic Forcing

What are the key differences?

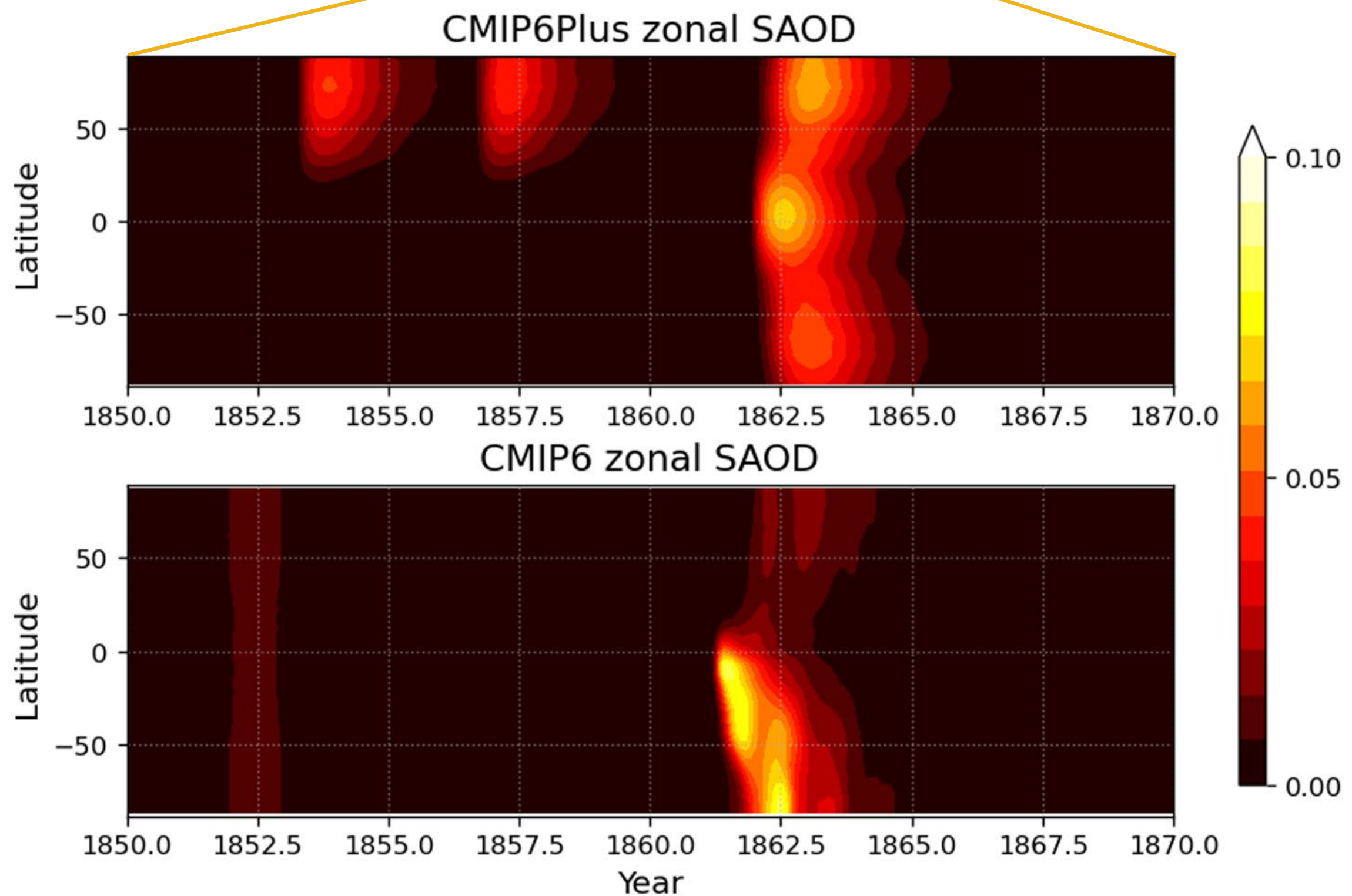
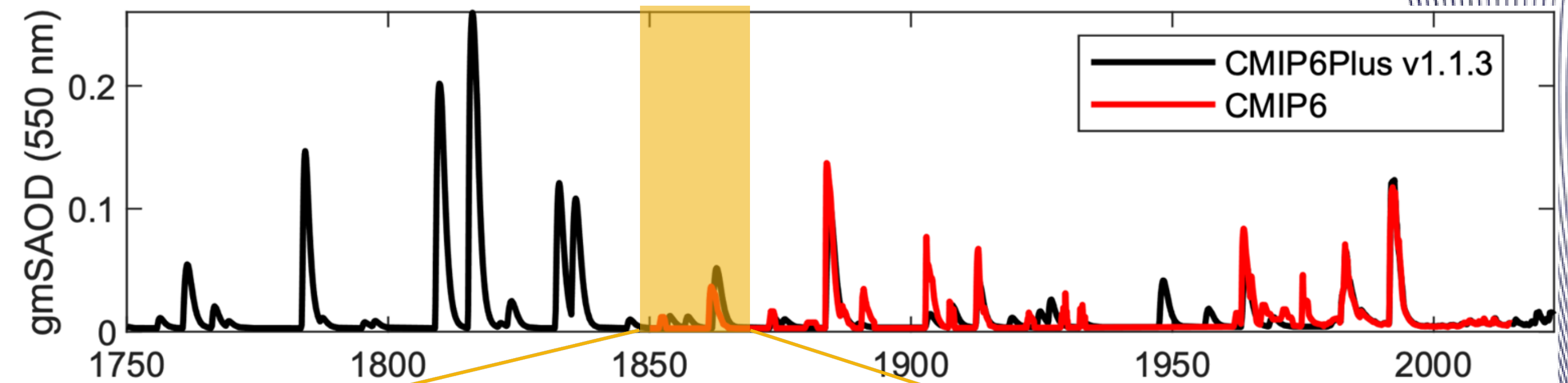
1. **Coverage:** 1850-2015 vs 1750-2023
2. **1850-2014 mean SAOD:** 0.01 in CMIP6Plus vs 0.011 in CMIP6
3. **Large-magnitude eruptions before 1979:** forcing can significantly differ
4. **Small-magnitude eruptions before 1979:** some "missing" & "new" eruptions
5. **SAOD perturbations with "unphysical" time evolution:** absent in CMIP6Plus
6. **SAOD latitudinal distribution** (e.g. 1862



Volcanic Forcing

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1. Coverage: 1850-2015 vs 1750-2023
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Solar forcing: pipeline for 1-D time series (example: f10.7)

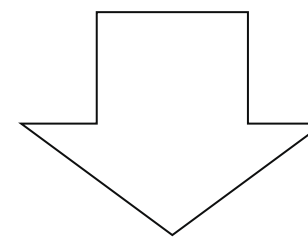
```
def plot_statistics(cmip6, cmip6plus,
                 |var_name, period='1ME',
                 show_ranges=True, show_sigma=True):
```

Overview: time series

Monthly mean

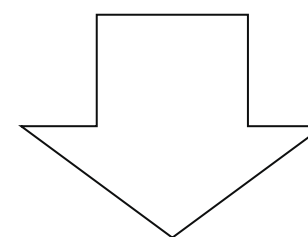
Range

2 sigma



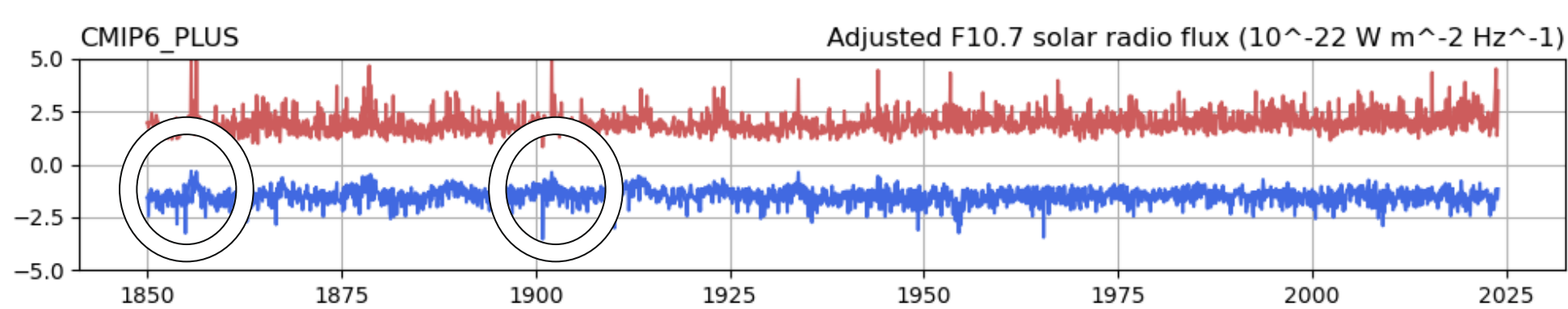
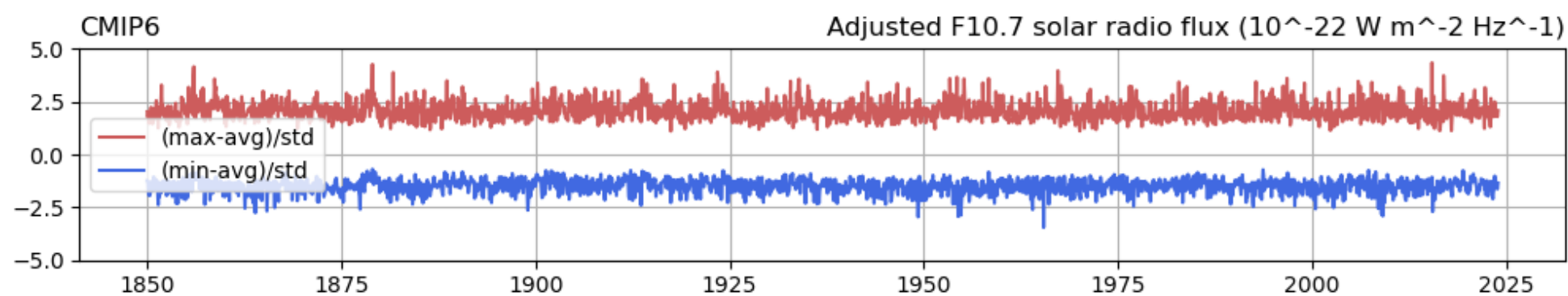
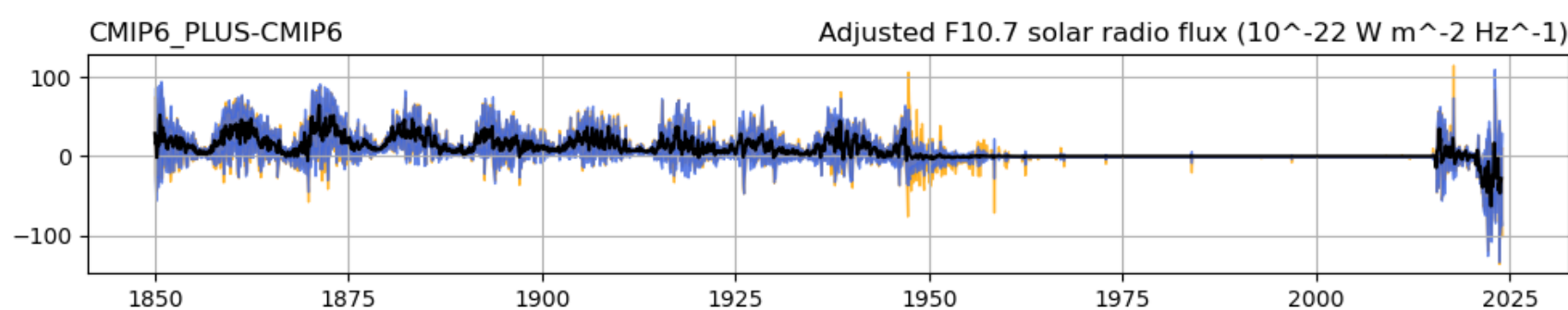
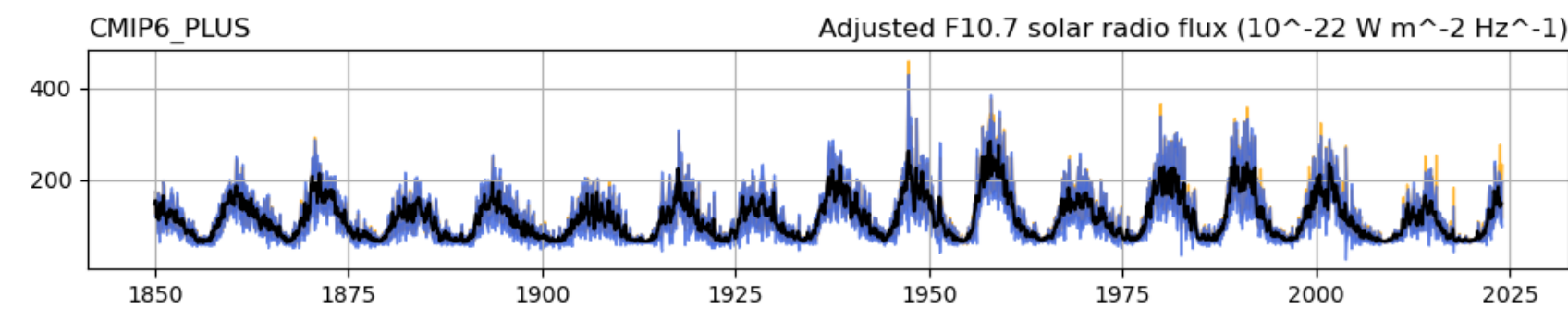
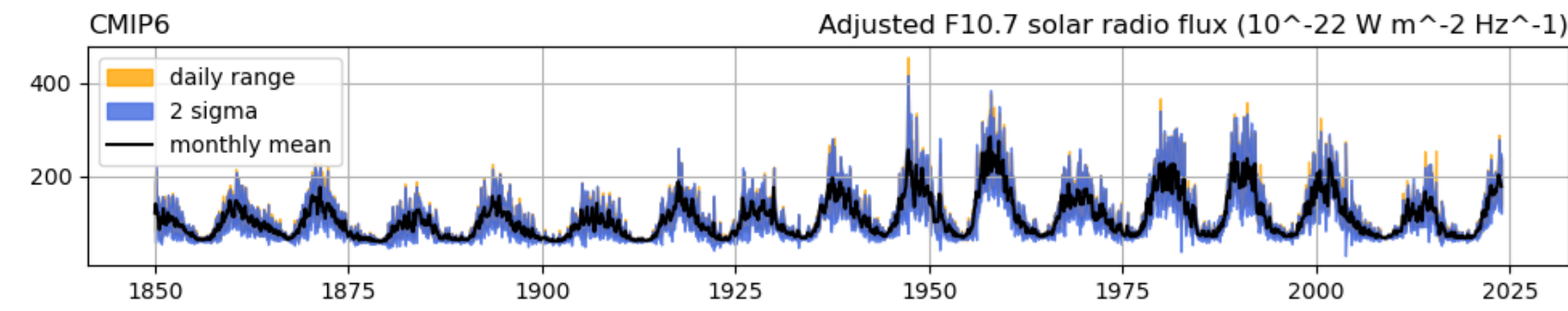
The ratio of outliers

(mean ± 2 sigma)



Is there any extreme outliers?

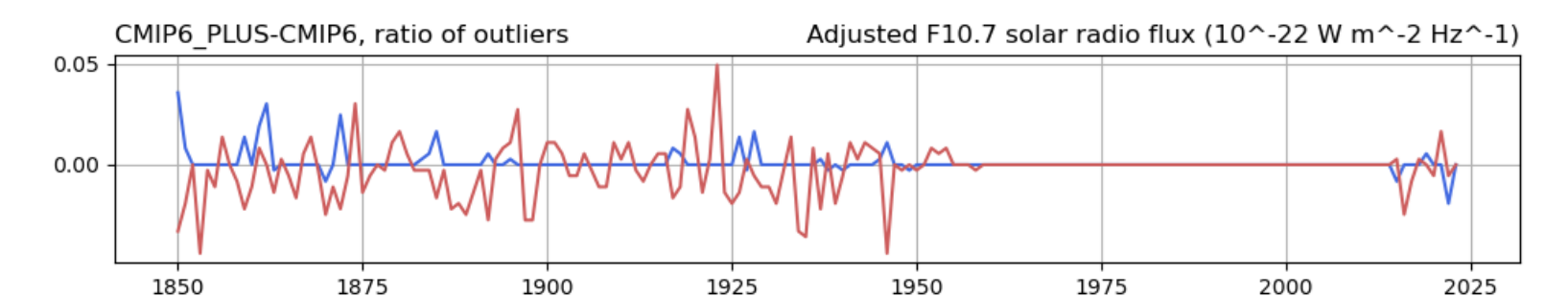
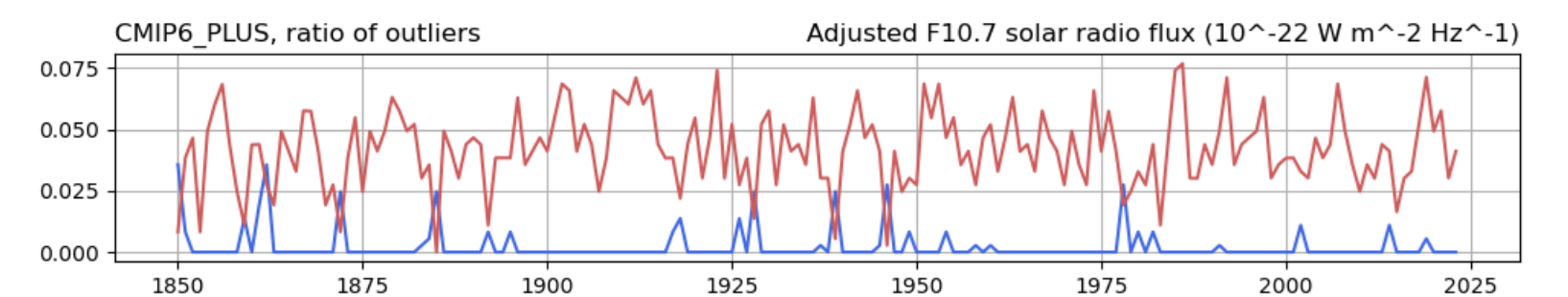
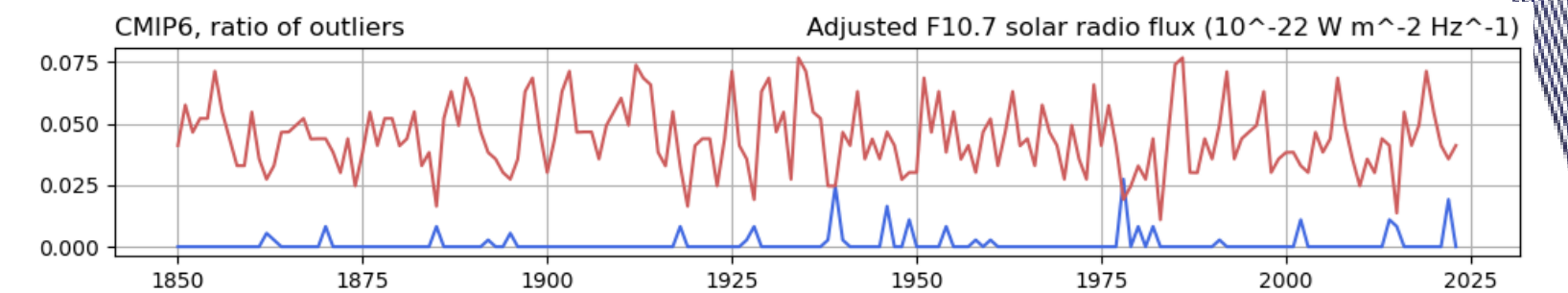
(max/min-mean)/std



1855.09;

20 1806.05

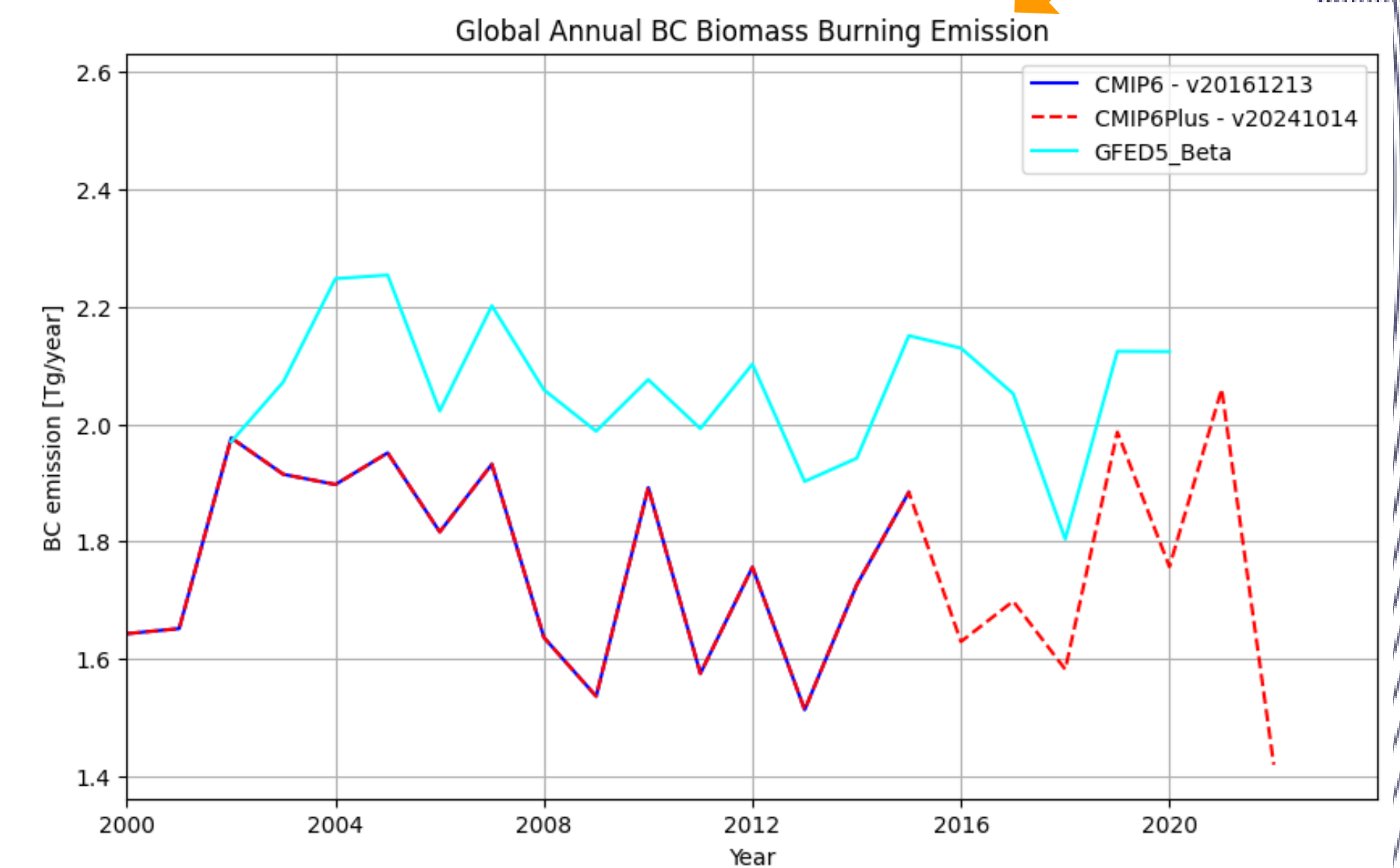
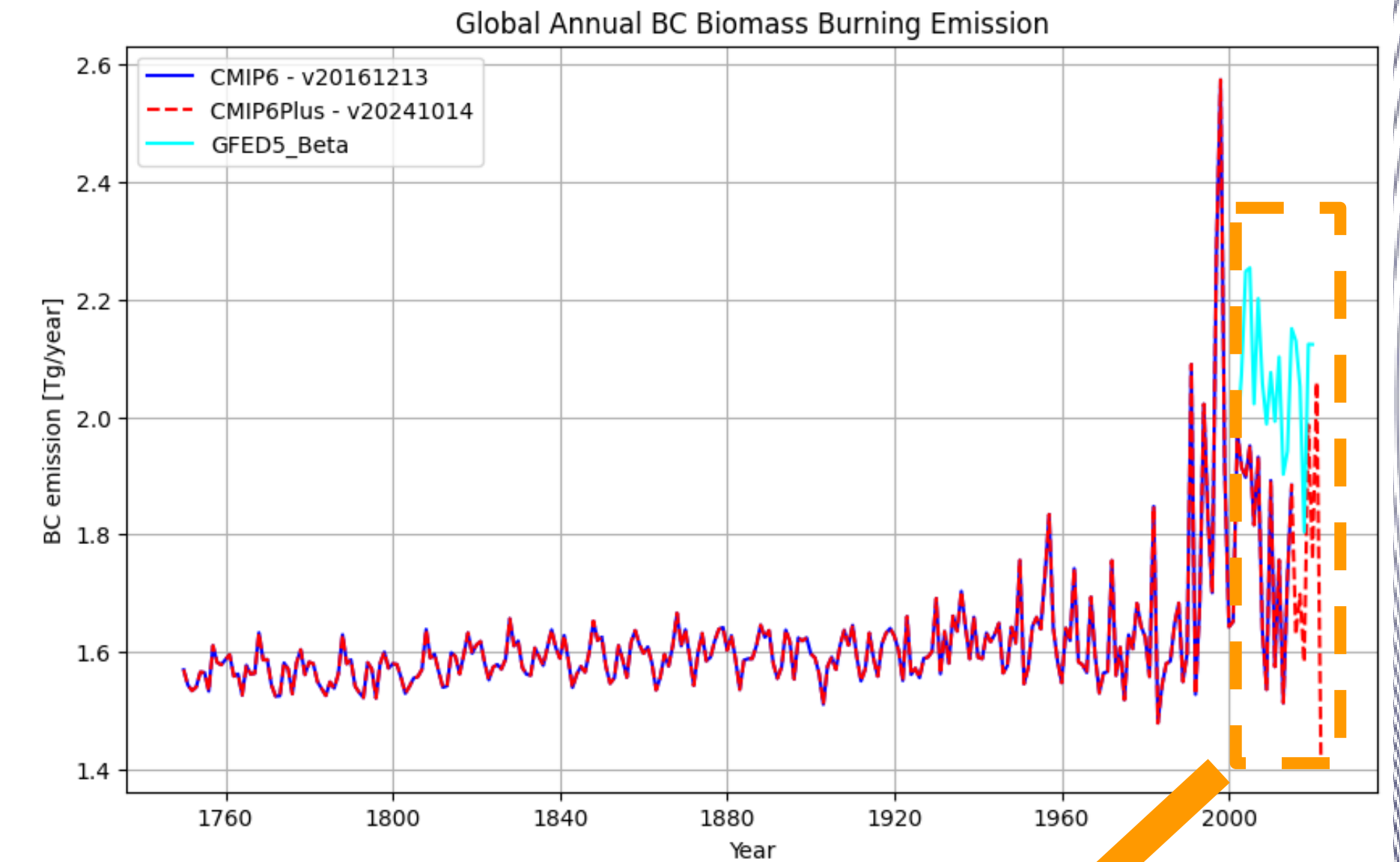
1902.02



Biomass Burning Emissions

Black Carbon (BC) Annual Emissions: comparing CMIP6Plus v20241014, CMIP6 v20161231, and GFED5_Beta

- CMIP6Plus v20241014 covers the period from January 1750 to December 2022.
- The current version of CMIP6Plus shows emission values similar to those of CMIP6 and serves as an extended version of CMIP6 v20161231, likely using GFED4.1s to extend the dataset beyond December 2015.
- Other variables, such as CO, NO_x, and OC, follow similar trends and global distribution patterns across CMIP6 and CMIP6Plus datasets.
- As expected, GFED5_Beta emissions for BC are higher. We hope that the data providers could integrate GFED5 emissions in future versions of CMIP6Plus.
- The file formatting of CMIP6Plus adheres to CMIP6 standards.



Thank You



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Original slides - Forcing Subgroup

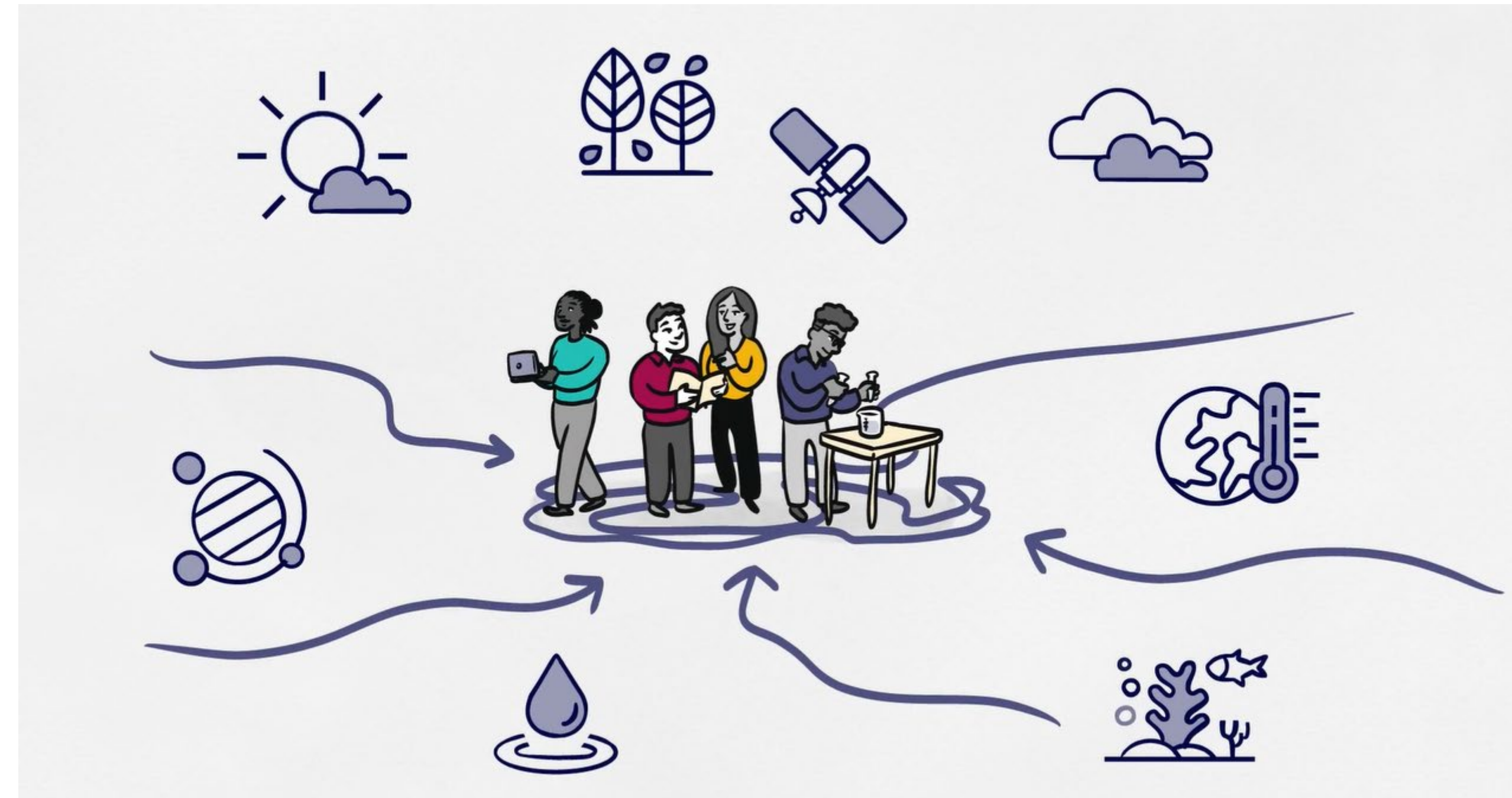
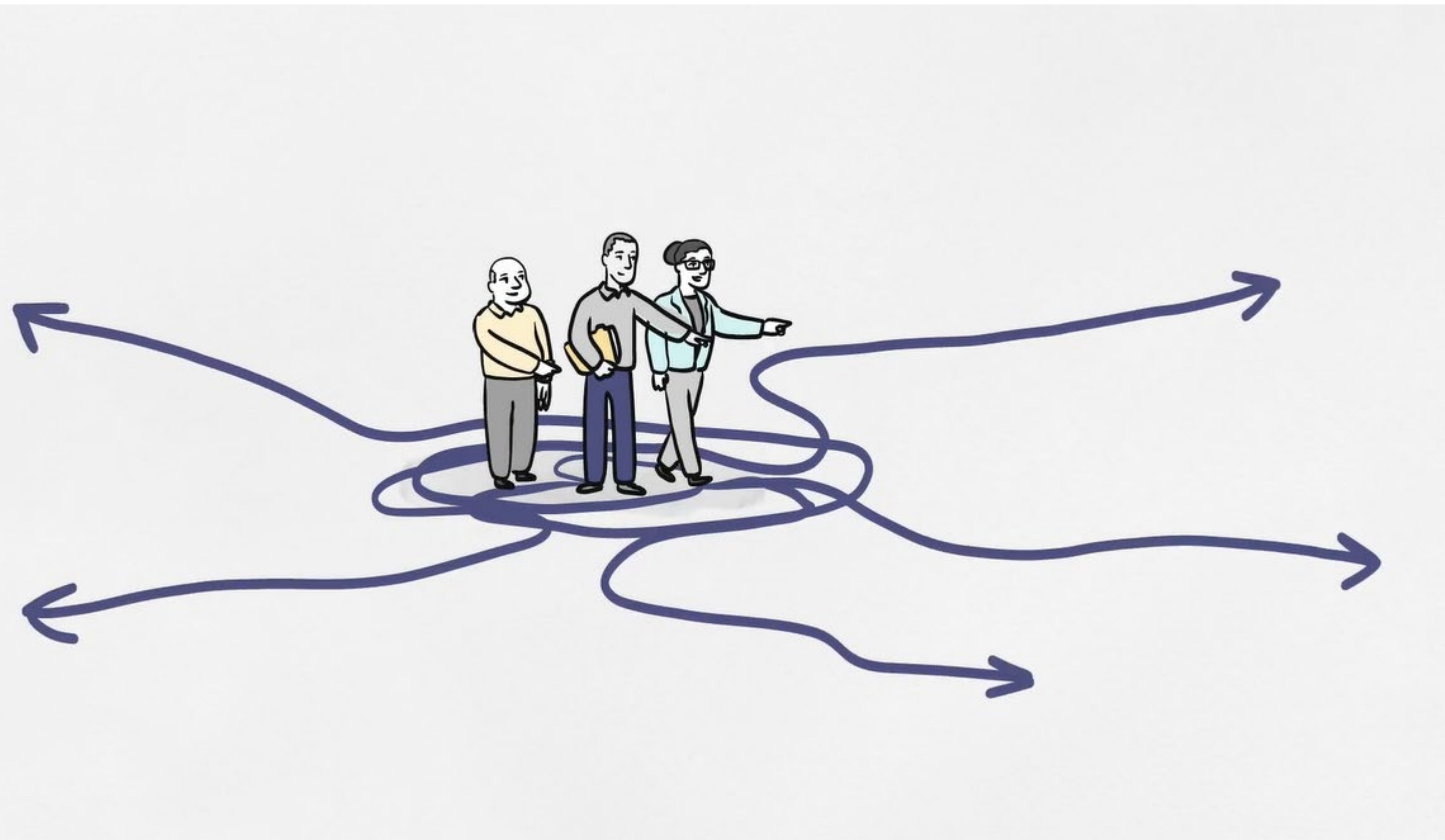
Each CMIP Task Team of senior scientists has an associated Fresh Eyes on CMIP subgroup

This task team will focus on how the CMIP required forcing agents will need to broaden for CMIP7.

Objectives:

1. Evaluate the CMIP6 forcing collection and identify issues, coverage gaps or omitted fields (e.g., natural, not anthropogenic, CH₄ emissions).
2. Identify next generation forcings for current and future generations of Earth System models.
3. Work with teams to deliver them.
4. Coordinate with modelling groups to perform evaluation and generate simulations using the newly generated/updated forcing datasets

CMIP split into Task Teams, each with associated Fresh Eyes subgroup



The day-to-day expertise gained by early career researchers utilising CMIP6 data can inform CMIP7:

- Best practices and data usability – e.g. availability of baselined globally/regionally averaged data
- Framing and structure – e.g. treatment of biomass burning emissions



Fresh Eyes on CMIP



New working group comprised of scientists, researchers and practitioners early in their career to sit alongside CMIP7 Task Teams.



Directly integrate the voices of ECRs into CMIP through participation in CMIP Panel, WIP, and Task Team meetings



Provide invaluable insight into the generation, access, and analysis of CMIP data

Watch the Fresh eyes on CMIP video [here](#)

Each CMIP Task Team of senior scientists has an associated Fresh Eyes on CMIP subgroup

- Climate Data Access Co-leads: Atef Ben Nasser, IPSL and Robert Pincus, Columbia
- Climate Data Citation Co-leads: Sasha Ames, LLNL and Martina Stockhause, DKRZ
- Climate Data Request Co-leads: Martin Juckes, STFC and Chloe Mackallah, CSIRO
- Climate Forcings Co-leads: Paul Durack PCMDI/LLNL and Vaishali Naik, NOAA
- Climate Model Benchmarking Co-leads: Birgit Hassler, DLR and Forrest Hoffman, ORNL
- Climate Model Documentation Co-leads: David Hassell, NCAS and Guillaume Levavasseur, IPSL
- Strategic Ensemble Design Co-leads: Ben Sanderson, CICERO and Isla Simpson, NCAR