

Pathway to regular and sustained delivery of climate forcing datasets workshop: 28-31 October 2024, ECMWF Reading

CMIP Drop-in Session: Forcings

Chairs: Paul Durack, Vaishali Naik

Session agenda

- Status of CMIP6Plus Forcings
- Q&A

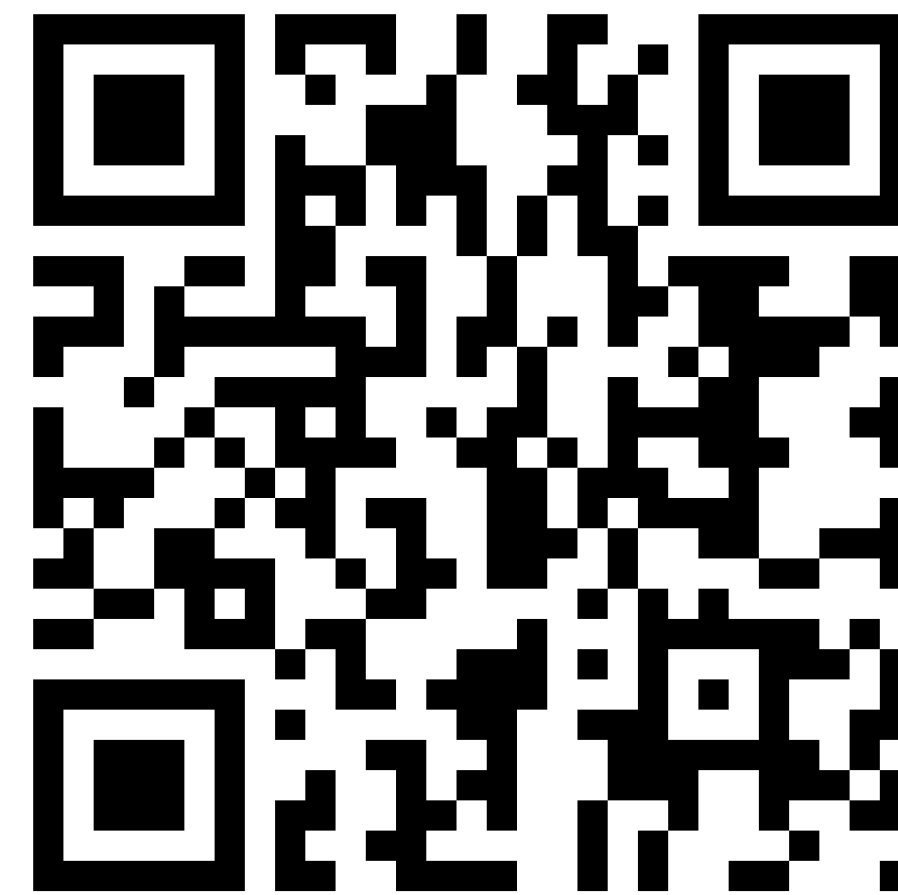
Housekeeping

- Participation should always be professional and respectful to all participants ([WCRP code of conduct](#))
- This drop in session is being recorded and recordings will be published on the CMIP website – if you do not wish to appear in the video do not turn your video on.
- During discussion and when raising a point/question for presenters, we encourage videos to be on but otherwise please feel free to turn your video off.
- Ask a question – please use the raise hand feature in Webex and the facilitator will invite you to speak or, if you have sound/connectivity difficulties, write QUESTION: Your question in the Chat and a facilitator will raise to the room.
- The Webex chat must only be used for technical issues and raising questions as above.

Engage through our Padlets

[The now...CMIP7 DECK forcing suite](https://bit.ly/DECK-forcings)
bit.ly/DECK-forcings

[Next generation sustained mode forcing](https://bit.ly/sustained-forcings)
bit.ly/sustained-forcings



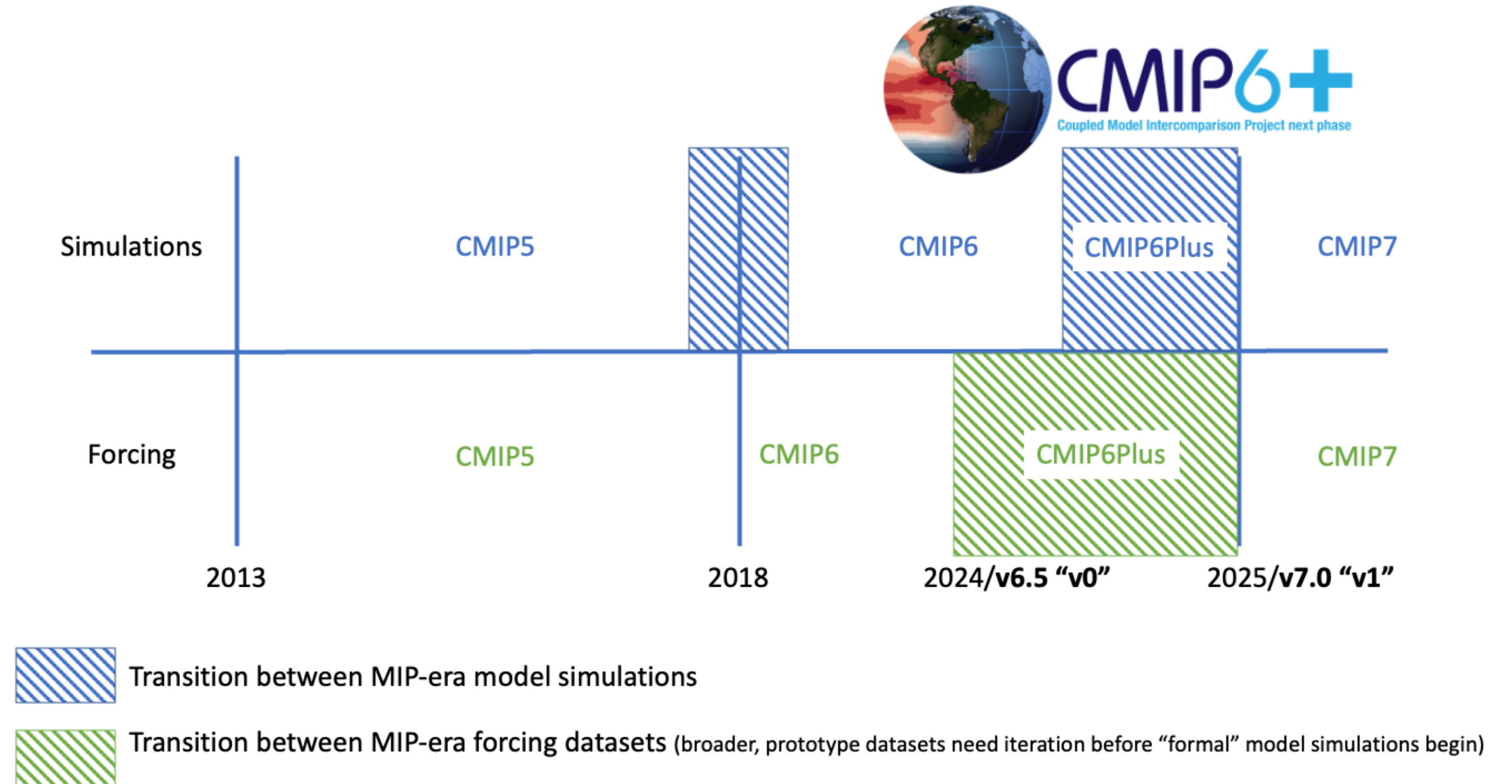
All contributions will be captured for the workshop report and to further populate the FAQs at https://wcrp-cmip.org/cmip7-task-teams/forcings/#frequently_asked_questions_faqs

Status of CMIP6Plus Forcings (pre-CMIP7)

What is CMIP6Plus with relevance to forcings?

- There was a recognition during CMIP6 that once data was made available, it was used
- Test data first, with a test label “CMIP6Plus”
 - Help us test prototype v0 datasets!
 - Availability next slide
- Once data validated new data published and extended as “CMIP7” for use in AR7 Fast-Track simulations

A forcing evolution following the continuous CMIP DECK paradigm



Available CMIP6Plus v0 forcing dataset collection - overview

Forcing datasets availability

The Climate Forcings TT is working to update the following CMIP DECK forcing suite:

| Data set | Forcing dataset | Status | Expected ESGF publication |
|----------|--|--|---|
| 1 | <u>Anthropogenic short-lived climate forcer (SLCF) and CO2 emissions</u> | Bugs being fixed, data in preparation | Expected: October 2024 |
| 2 | <u>Open biomass burning emissions</u> | Preliminary dataset available | <u>Available: v1.0 (1750-01 to 2022-12)</u> |
| 3 | <u>Land use</u> | Preliminary dataset available | <u>Available: v3.0 (0850 to 2024)</u> |
| 4 | Greenhouse gas historical concentrations | Preliminary dataset available | <u>v0.3.0 (0001-01 to 2022-12) available</u> |
| 5 | Stratospheric volcanic SO2 emissions and aerosol optical properties | Preliminary dataset available | <u>v1.1.3 available (1750-01 to 2023-12)</u> |
| 6 | Ozone concentrations | Depends on 1, 2, 4, 5 and 8 | ~January 2025; 3 months after dependent datasets |
| 7 | Nitrogen deposition | Depends on 1, 2, 4, 5 and 8 | ~January 2025; 3 months after dependent datasets |
| 8 | <u>Solar</u> | Preliminary dataset available | <u>Available: v4.4 (1850-01-01 to 2023-12-31)</u> |
| 9 | <u>AMIP sea-surface temperature and sea-ice boundary forcing</u> | Final v1 dataset available. v2 dataset awaiting HadISST v2.4 release | <u>v1.1.9 (1870-01 to 2022-12) available</u> |
| 10 | Aerosol optical properties/MACv2-SP | Depends on 1, test dataset being produced in the meantime | ~November 2024; Expected a month after dependent datasets |

<https://wcrp-cmip.org/cmip7-task-teams/forcings>

Please check the table above for the availability of datasets or on [input4MIPs ESGF Project](#). Once datasets become available, this website will be updated with the latest information, documentation, and download links. When available, the future CMIP7 version 1 data will be identified for modelling groups to begin their CMIP7 AR7 Fast Track simulations.

Available CMIP6Plus v0 forcing dataset collection - detailed

input4MIPs CMIP6Plus delivery summary: v6.5.24a1

https://github.com/PCMDI/input4MIPs_CVs

[Database views homepage](#) | [Delivery summary view](#) | [Source ID-level view](#) | [Dataset-level view](#) | [File-level view](#)

Show 25 entries

Search:

| Dataset # | Forcing dataset | Source ID | Status | ESGF publication status |
|-----------|---|---|--|---|
| 1 | Anthropogenic short-lived climate forcer (SLCF) and CO2 emissions | CEDS-CMIP-2024-07-08, CEDS-CMIP-2024-07-08-supplemental | Bugs being fixed, data in preparation | Expected: October 2024 |
| 2 | Open biomass burning emissions | DRES-CMIP-BB4CMIP7-1-0 | Preliminary dataset available | Available: v1.0 (1750-01 to 2022-12) |
| 3 | Land use | UofMD-landState-3-0 | Preliminary dataset available | Available: v3.0 (0850 to 2024) |
| 4 | Greenhouse gas concentrations | CR-CMIP-0-3-0 | Preliminary dataset available | Available: v0.3.0 (0001-01 to 2022-12) |
| 5 | Stratospheric volcanic SO2 emissions and aerosol optical properties | UOEXETER-CMIP-1-1-3 | Preliminary dataset available | Available: v1.1.3 (1750-01-01 to 2023-12-01) |
| 6 | Ozone concentrations | TBD | Depends on 1, 2, 4, 5 and 8 | Expected: ~January 2025; 3 months after dependent datasets |
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| 8 | Solar | SOLARIS-HEPPA-CMIP-4-4 | Preliminary dataset available | Available: v4.4 (1850-01-01 to 2023-12-31) |
| 9 | AMIP sea-surface temperature and sea-ice boundary forcing | PCMDI-AMIP-1-1-9 | Final v1 dataset available. v2 dataset awaiting HadISST v2.4 release | Available: v1.1.9 (1870-01 to 2022-12) |
| 10 | Aerosol optical properties/MACv2-SP | TBD | Depends on 1, test dataset being produced in the meantime | Expected: ~November 2024; Expected a month after dependent datasets |
| 11 | Population | TBD | Unknown: data provider TBD | Expected: Unknown: data provider TBD |

Showing 1 to 11 of 11 entries

Issues to-date:

Published, fixed and replaced after publication

- SOLARIS-HEPPA-CMIP-4-2 (retracted)
- SOLARIS-HEPPA-CMIP-4-3 (retracted)
- SOLARIS-HEPPA-CMIP-4-4 (latest, available)

Unpublished issues caught before publication

- CEDS-CMIP-2024-07-08
- CR-CMIP-0-2-0
- DRES-CMIP-BB4CMIP7-1-0 (pre-release)
- SOLARIS-HEPPA-CMIP-4-1
- UofMD-landState-3-0 (pre-release)
- UOEXETER-CMIP-0-1-0
- UOEXETER-CMIP-1-1-2

Plus much iteration before getting anywhere near publishing on input4MIPs ESGF project

https://input4mips-controlled-vocabularies-cvs.readthedocs.io/en/latest/database-views/input4MIPs_source-

How to access CMIP6Plus v0 forcing dataset collection

The screenshot shows a web browser at aims2.llnl.gov/search?project=input4MIPs. The page displays search results for the 'input4MIPs' project. On the left, there are filters for 'Select a Project' (set to 'input4MIPs'), 'Filter By Transfer Options' (set to 'Any'), and 'Filter with Facets' (General, Identifiers, Classifications, Additional Properties, Filename). The main content area shows '10,939 results found for input4MIPs' with a query string of 'latest = true'. A table lists several datasets with their IDs, file counts, sizes, and download options.

| Cart | Dataset ID | Files | Total Size | Download Options | Globus Ready |
|--------------------------|---|-------|------------|--|-------------------------------------|
| <input type="checkbox"/> | input4MIPs.CMIP6.C4MIP.ImperialCollege.ImperialCollege-REMINd-MAGPIE-ssp585-1-0.atmos.yr.Delta14co2_in_air.gm | 1 | 24.01 KB | wget <input type="button" value="v"/> <input type="button" value="d"/> | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | input4MIPs.CMIP6.C4MIP.ImperialCollege.ImperialCollege-AIM-ssp370-1-0.atmos.yr.delta13co2_in_air.gm | 1 | 24.01 KB | wget <input type="button" value="v"/> <input type="button" value="d"/> | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA55-do-1-5-0.atmos.fx.areacella.gr | 1 | 57.08 KB | wget <input type="button" value="v"/> <input type="button" value="d"/> | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA55-do-1-5-0.ocean.fx.areacello.gr | 1 | 78.33 KB | wget <input type="button" value="v"/> <input type="button" value="d"/> | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA55-do-1-5-0.land.day.friver.gr | 63 | 3.33 GB | wget <input type="button" value="v"/> <input type="button" value="d"/> | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA55-do-1-5-0.ocean.fx.areacello.gr | 63 | 98.75 GB | wget <input type="button" value="v"/> <input type="button" value="d"/> | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA55-do-1-5-0.ocean.fx.areacello.gr | 63 | 626.37 MB | wget <input type="button" value="v"/> <input type="button" value="d"/> | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA55-do-1-5-0.ocean.fx.areacello.gr | 63 | 74.92 GB | wget <input type="button" value="v"/> <input type="button" value="d"/> | <input checked="" type="checkbox"/> |

<https://aims2.llnl.gov/search?project=input4MIPs>

https://github.com/PCMDI/input4MIPs_CVs

How to access CMIP6Plus v0 forcing dataset

The screenshot shows the ESGF search results for 'input4MIPs'. The search bar at the top contains 'input4MIPs' and the results section shows '10,939 results found for input4MIPs'. The query string is 'latest = true'. The results table has columns for 'Cart' and 'Dataset ID'. The first few results are:

| Cart | Dataset ID |
|--------------------------|--|
| <input type="checkbox"/> | input4MIPs.CMIP6.C4MIP.ImperialColl REMIND-MAGPIE-ssp585-1-0.atmos... |
| <input type="checkbox"/> | input4MIPs.CMIP6.C4MIP.ImperialColl AIM-ssp370-1-0.atmos.yr.delta13co2_... |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA 0.atmos.fx.areacella.gr |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA 0.ocean.fx.areacello.gr |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA 0.land.day.frivier.gr |
| <input type="checkbox"/> | input4MIPs.CMIP6.OMIP.MRI.MRI-JRA ... |

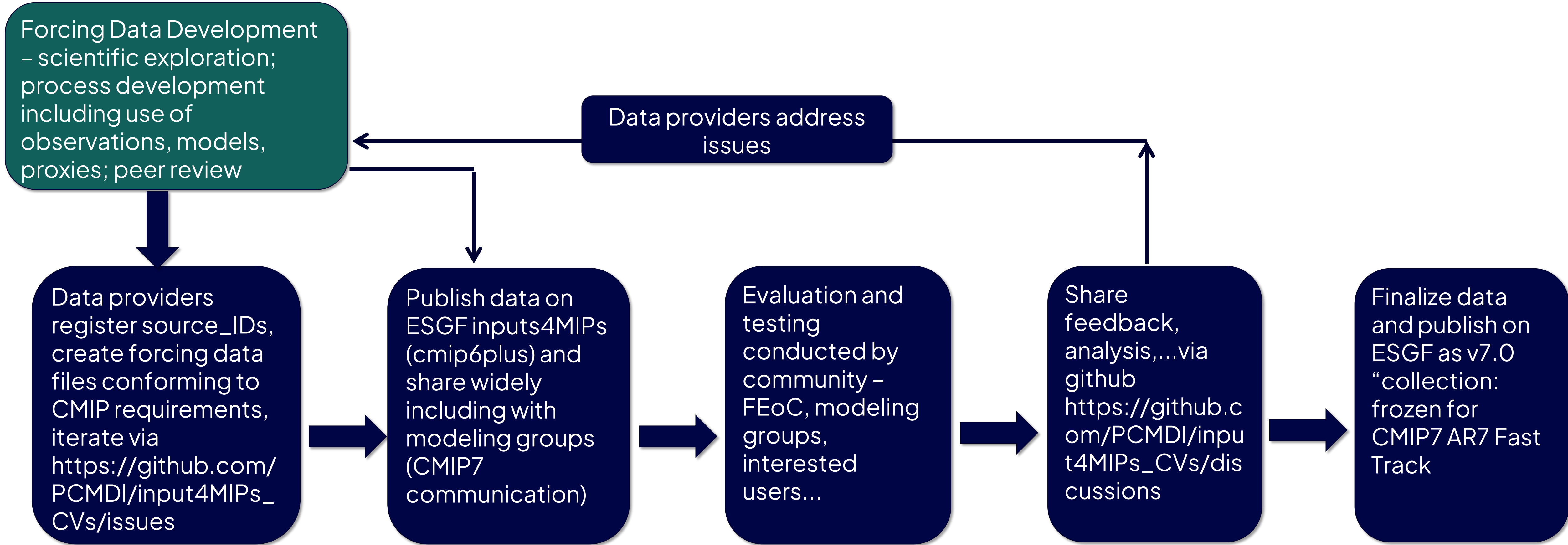
The screenshot shows the ESGF search filters. The 'Filter By Transfer Options' section has 'Any' selected. The 'Filter with Facets' section shows the following facets:

- MIP Era: [Select option(s)]
- Target MIP List: CMIP6 (10401)
- Dataset Status: CMIP6Plus (538)
- Data Node: [Select option(s)]

<https://aims2.llnl.gov/search?project=input4MIPs>

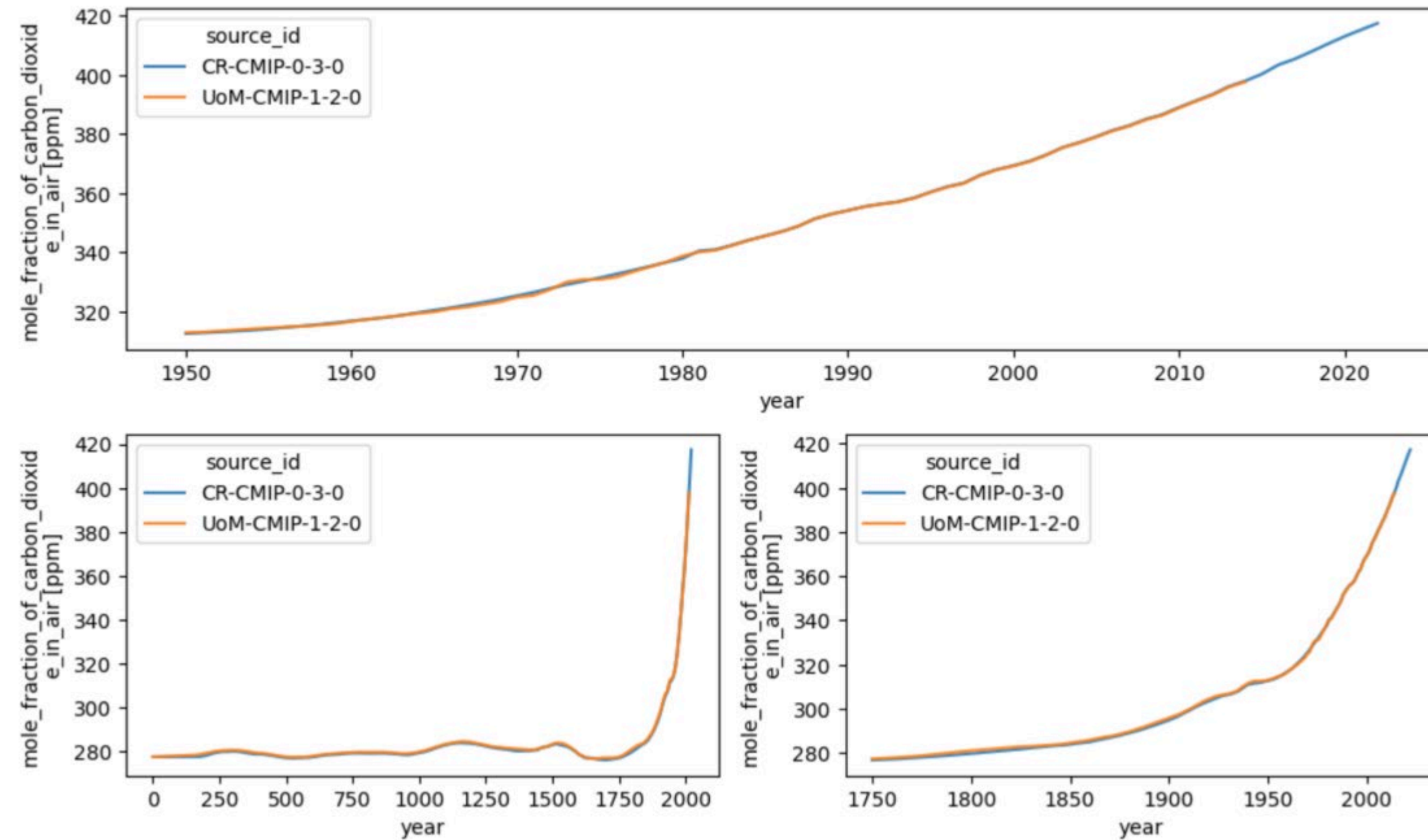
https://github.com/PCMDI/input4MIPs_CVs

CMIP7 Forcing Provisioning and Testing Workflow

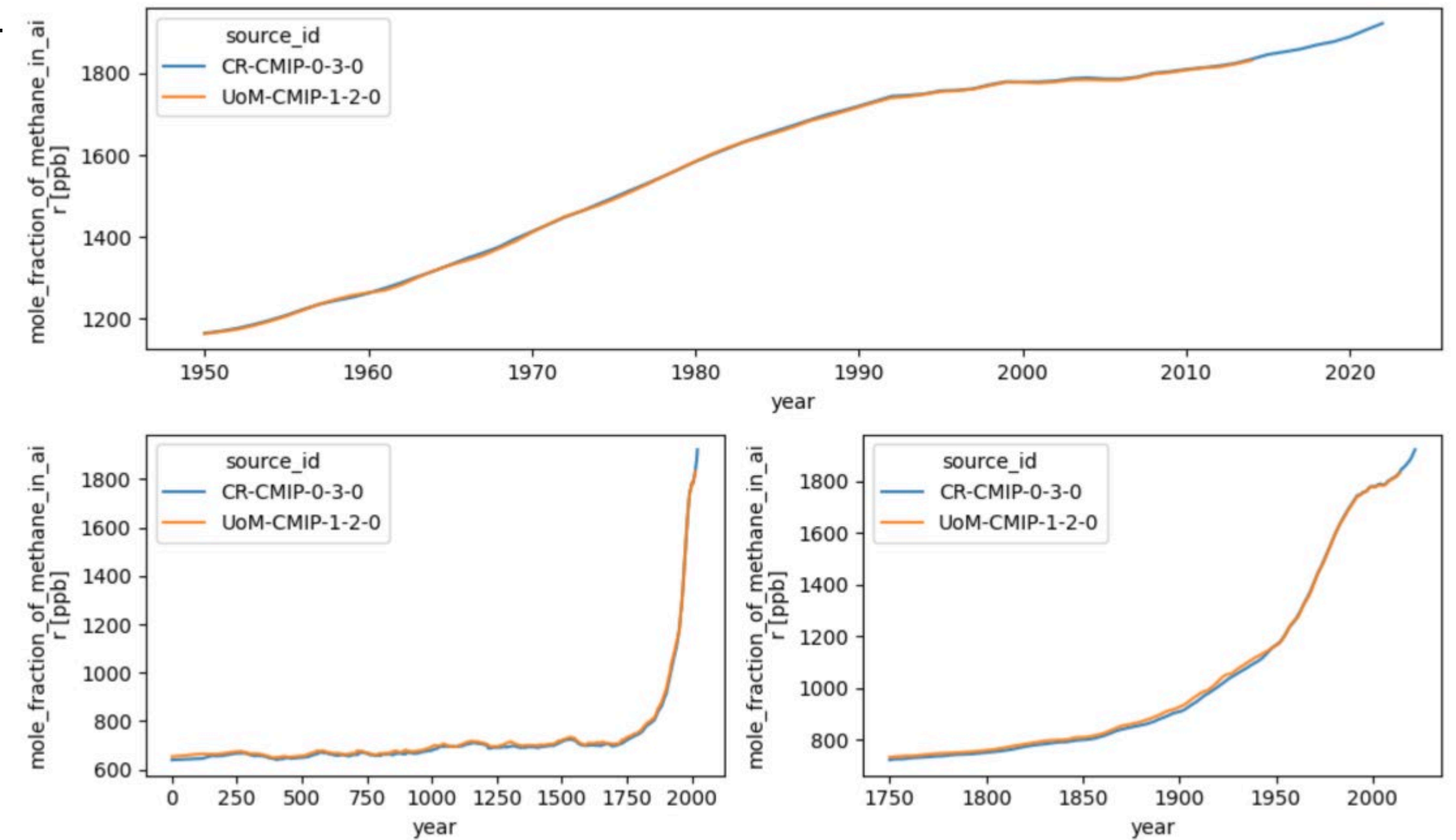


CMIP6Plus versus CMIP6: initial look at GHG concentrations

CO₂



CH₄

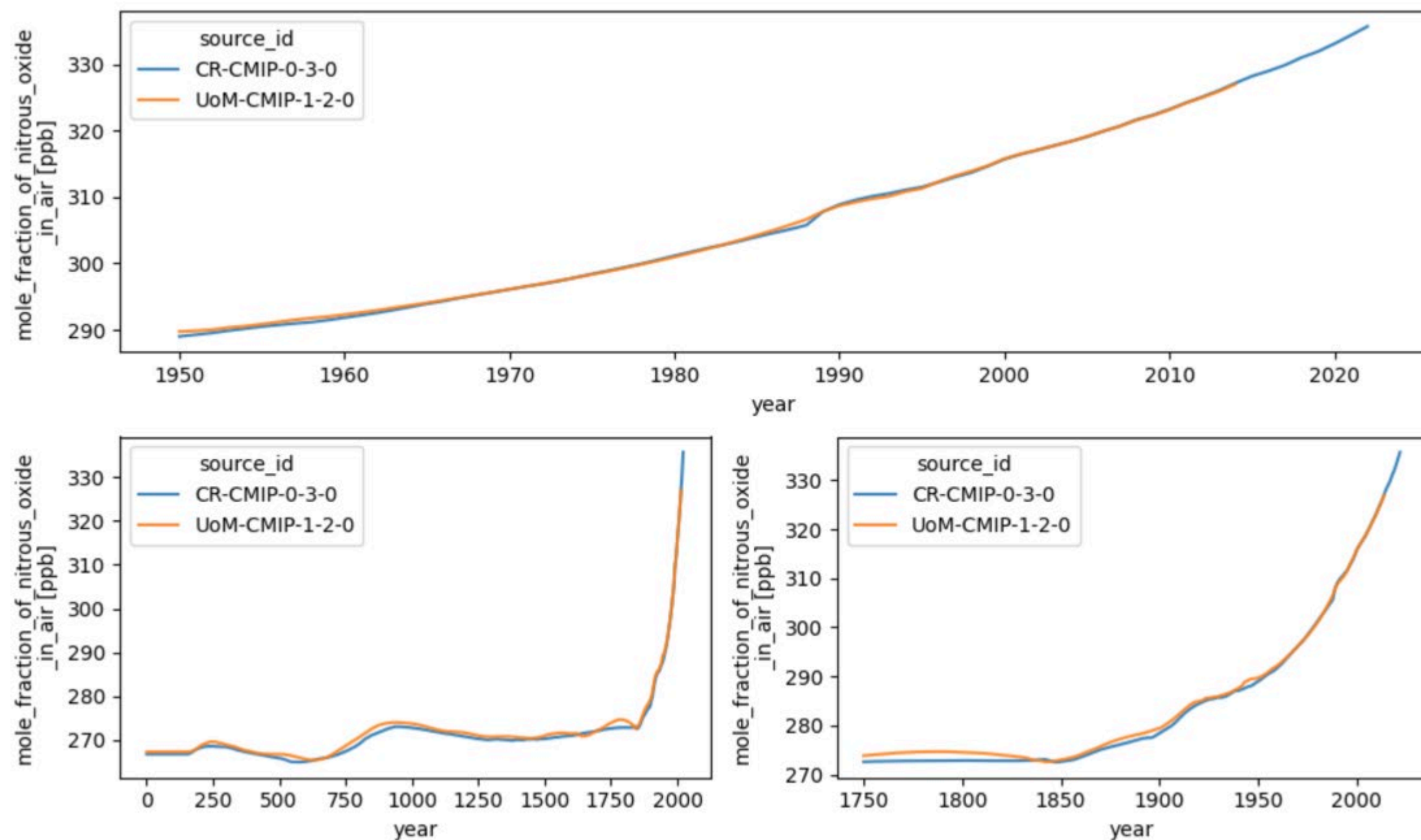


- Stable and consistent with CMIP6
- Extended to 2022

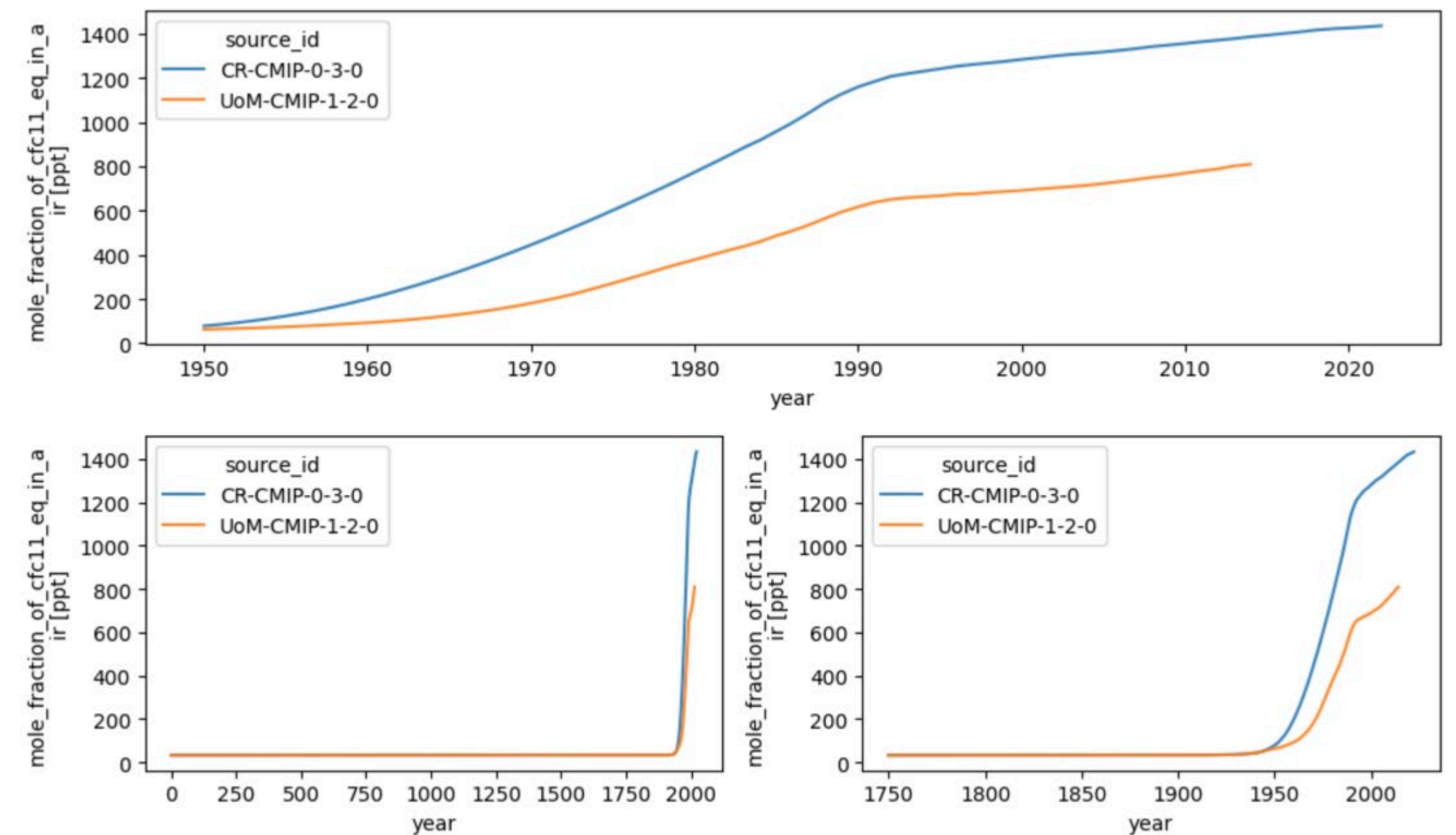
- Mostly stable, but differences of ~10-20 ppb (~3%) pre-1950 need further investigation
- Extended to 2022

CMIP6Plus versus CMIP6: initial look at GHG concentrations

N₂O



CFC11eq



- Mostly stable 1850 onwards, but differences of ~10-20 ppb (~3%) pre-1850 need further investigation

- Strikingly different from CMIP6 - obvious bug!
- Extended to 2022

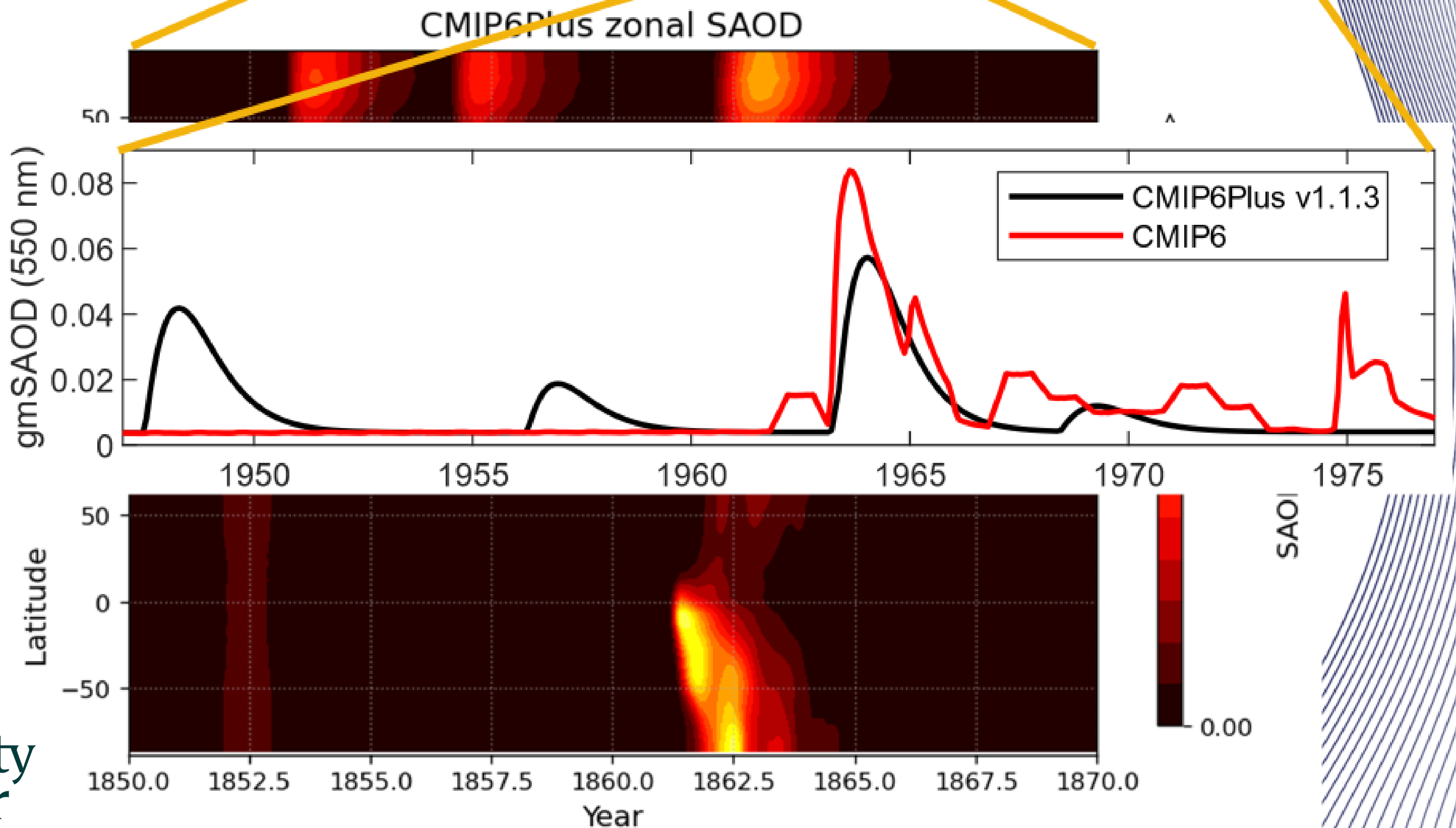
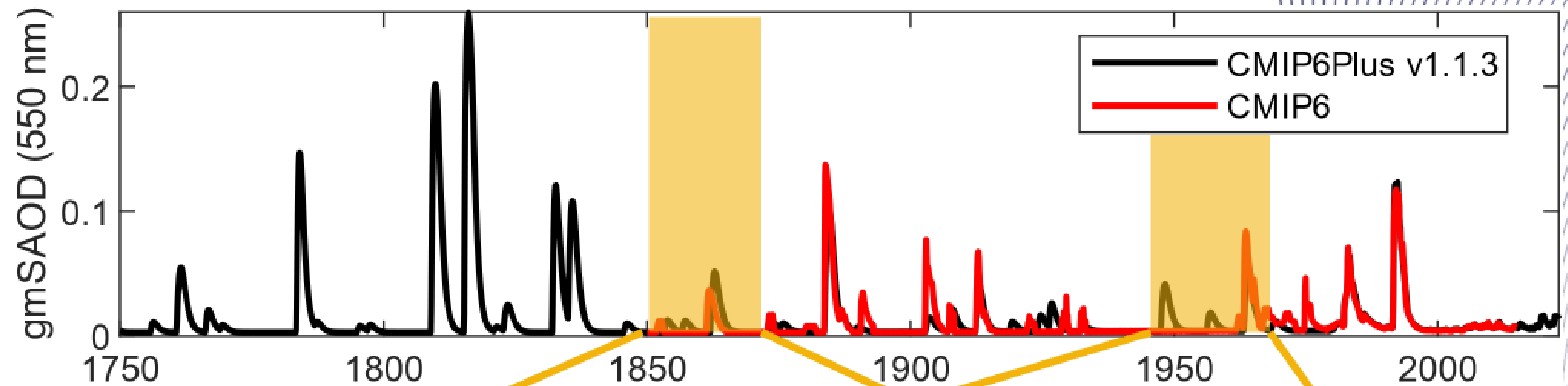
Extended to 2022

courtesy Zeb Nicholls

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. Makian (?) 1862 eruption)



Answers to Frequently Asked Questions

The background of the slide features a series of thin, wavy, golden-yellow lines that curve from the bottom left towards the top right, creating a sense of movement and depth.

Is there a document that provides more details on the forcing dataset?

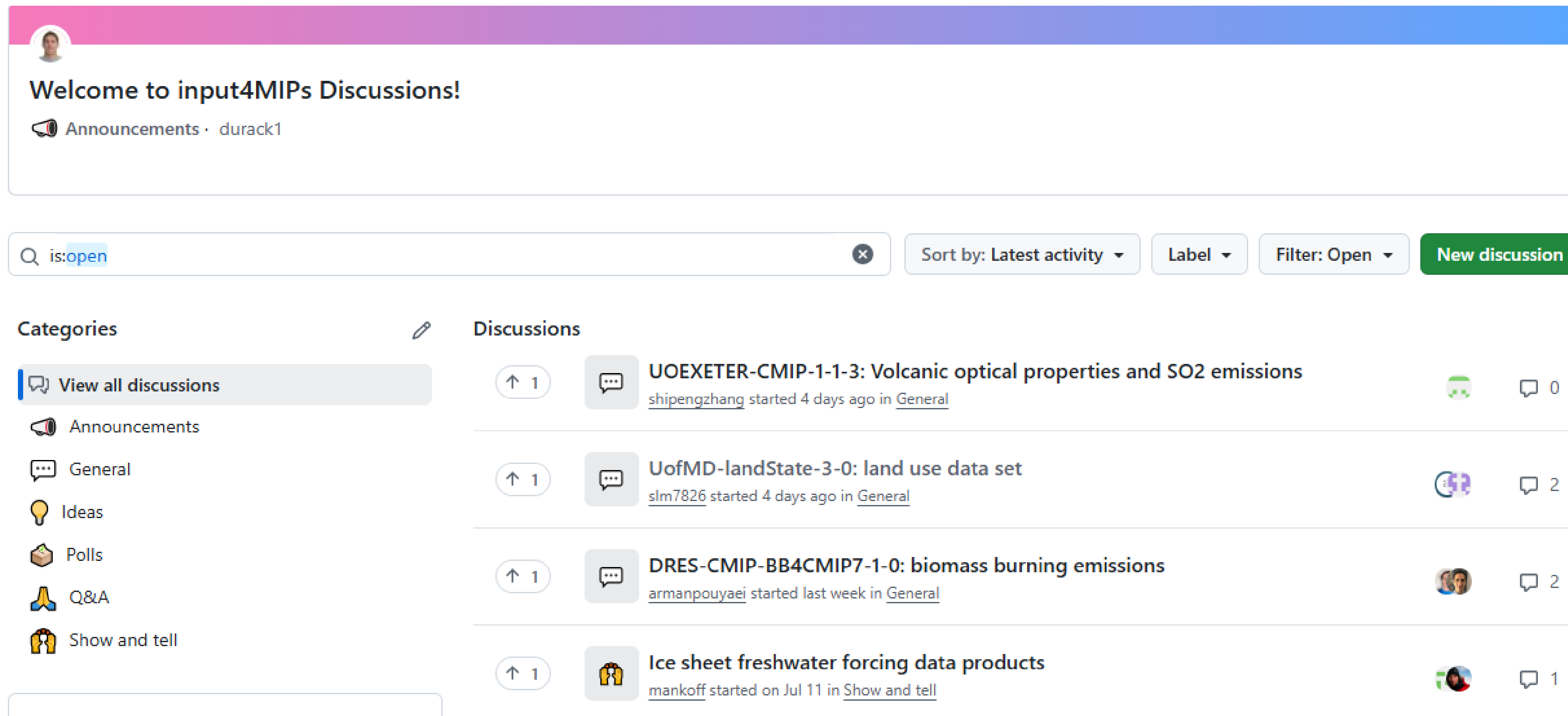
- Technical information is being collated and will be shared as zenodo link
 - This document will include answers to questions from modelers for help in implementing the forcing datasets correctly
- Peer-reviewed journal articles will appear on “forcings” [GMD/ESSD Special Issue](#)

How will updates be communicated to modeling centers/users?

- Latest dataset status/discussions occurring on input4MIPs_CVs github repo
- https://github.com/PCMDI/input4MIPs_CVs/releases (you can watch the repo!)
- https://github.com/PCMDI/input4MIPs_CVs/discussions

How do I provide feedback - issues, questions, etc?

- Github: https://github.com/PCMDI/input4MIPs_CVs/discussions – preferred
- Email: cmip-ipo@esa.int



The screenshot shows the GitHub Discussions interface for the repository 'input4MIPs Discussions'. At the top, there is a header with a profile picture and the text 'Welcome to input4MIPs Discussions!' followed by 'Announcements · durack1'. Below this is a search bar containing 'is:open', a 'Sort by: Latest activity' dropdown, a 'Label' dropdown, a 'Filter: Open' dropdown, and a 'New discussion' button. On the left, there is a 'Categories' sidebar with options: 'View all discussions', 'Announcements', 'General', 'Ideas', 'Polls', 'Q&A', and 'Show and tell'. The main 'Discussions' area lists four topics:

| Upvotes | Discussion Title | Author | Started | Category | Replies |
|---------|--|--------------|--------------------|---------------|---------|
| 1 | UOEXETER-CMIP-1-1-3: Volcanic optical properties and SO2 emissions | shipengzhang | started 4 days ago | General | 0 |
| 1 | UofMD-landState-3-0: land use data set | slm7826 | started 4 days ago | General | 2 |
| 1 | DRES-CMIP-BB4CMIP7-1-0: biomass burning emissions | armanpouyaei | started last week | General | 2 |
| 1 | Ice sheet freshwater forcing data products | mankoff | started on Jul 11 | Show and tell | 1 |

Is the dataset ready to be used for CMIP AR7 Fast-track simulations?

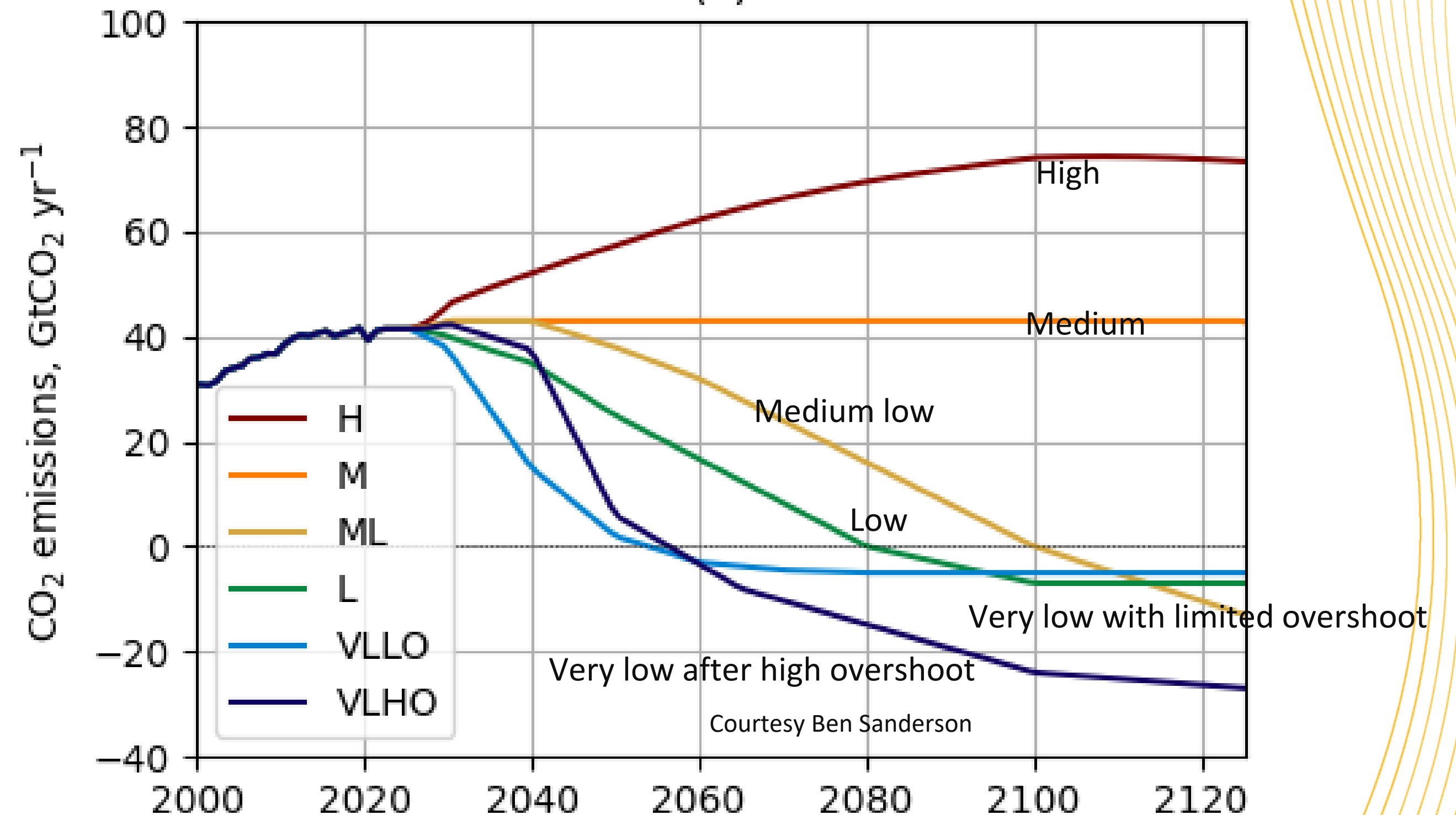
- CMIP6Plus v6.5 datasets are test “v0” versions
- Any issues found between now and early 2025 will be corrected
- Final “v1” datasets ready for simulations will be available as “**CMIP7 v7.0 collection**” on <https://aims2.llnl.gov/search/input4MIPs/>;
- All weblinks will be updated with CMIP7 information

When will scenarios be available?

Scenario Timeline

- Until December/January:
 - New scenarios: update.
 - Iteration with IAM teams on format for products
- Jan–May:
 - Iterative process between harmonization teams and IAM teams
 - Investigation of uncertainties, robustness, exploring methods
- June:
 - New scenarios: final scenarios.
 - Start harmonizing scenarios and producing datasets

Illustrative CO₂ Emissions Scenarios



Answers to more questions

https://wcrp-cmip.org/cmip7-task-teams/forcings/#frequently_asked_questions_faqs

Frequently Asked Questions (FAQs)

| <input type="checkbox"/> Hide fields Filter Group Sort ... Q | | | |
|---|--|------------------|---|
| <input type="checkbox"/> | Question | Topics | Response |
| | everything late. Will this be addressed this time round? And will funding for forcing dataset providers be addressed? | Data preparation | funding, and potential |
| 2 | Can forcing data sets documentation be mentioned or discussed? This is to enable better understanding of model data for improved evaluation and usage. | Forcings | Definitely! The Forcings configuration a CMIP-c |
| 3 | Can the structure and format of updates be kept consistent? | Forcings | Modelling centres are c changing data formats. then not change again. would require a one-of |
| 4 | Any discussion regarding potential ensemble of forcing datasets? Will there be alternative forcings available to help assess the impact of uncertainties in the historical forcings? Specifically solar, aerosols, land use etc. | Forcings | Addressing forcing unc LESFMIP). Currently loo timeframe. The core for With input4MIPs we are |
| 5 | To what extent is it now possible to operationalize the production of historical forcing data so | Forcings | Single additional years |

Questions?

Where can I get the data?

- <https://aims2.llnl.gov/search/input4MIPs/> – ESGF project page
 - https://github.com/PCMDI/input4MIPs_CVs – capturing forcing data information
 - https://input4mips-controlled-vocabularies-cvs.readthedocs.io/en/latest/database-views/input4MIPs_delivery-summary_CMIP6Plus.html – webpage views of data

input4MIPs CMIP6Plus delivery summary: v6.5.24a1

[Database views homepage](#) | [Delivery summary view](#) | [Source ID-level view](#) | [Dataset-level view](#) | [File-level view](#)

Show entries Search:

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| 1 | Anthropogenic short-lived climate forcer (SLCF) and CO2 emissions | CEDS-CMIP-2024-07-08, CEDS-CMIP-2024-07-08-supplemental | Bugs being fixed, data in preparation | Expected: October 2024 |
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| 9 | AMIP sea-surface temperature and sea-ice boundary forcing | PCMDI-AMIP-1-1-9 | Final v1 dataset available. v2 dataset awaiting HadISST v2.4 release | Available: v1.1.9 (1870-01 to 2022-12) |
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Showing 1 to 11 of 11 entries Previous Next

Model simulation identities – take 6

All experiments require the full forcing collection to begin a simulation



CMIP7 defined experiments:

DECK/CMIP historical (or esm-hist) 1850-2021

ScenarioMIP scenario-? 2022-2125



Observed period forcing datasets extended beyond 2021 have larger uncertainties - considered “unstable”

These additional extension forcing datasets (non-CMIP7) can be used to extend historical simulations

(historical-ext or esm-hist-ext)

docs.google.com/document/d/1pU9IiJvPJwRvlgVaSDdJ4O0Jeorv_2ekEttd34K9cA/edit... ☆

AR6-3-Mend US MastSwim SR15 LLNL CD-Greenhouse input4 AR5 SchHnd All Bookmarks

CMIP6_Forcing_Datasets_Summary ☆ ⓘ Share

File Edit View Tools Extensions Help

[Appendix 4: Document version information](#)

The document version number consists of 3 integers separated by “.”. The first integer is “6”, indicating the document applies to CMIP6. The second integer will be incremented if errors are found in the

DECK/Historical forcing data that had been previously released and approved by the CMIP panel. The third digit will be incremented whenever an amendment or update is made to this document, or when the download details for an existing contributing dataset (to the current 6.x release) are amended. The third digit will also be incremented if the version number of a contributed satellite MIP dataset changes, with these changes most commonly related to preparing data to conform to the input4MIPs specifications required for publishing on ESGF. **Note that red font is used to highlight those versions where corrections to the CMIP DECK and historical forcing data were made.**

6.0.0 (20th December 2016) - Initial DECK and historical forcings dataset release (This was also noted as v1.0 in the email and attachment sent out through email by Veronika Eyring)

6.0.1 (12th January 2017) - [Solar data \(Katja Matthes/Bernd Funke\)](#) made available through input4MIPs

6.0.2 (23rd January 2017) - [RFMIP data \(Robert Pincus\)](#) made available through input4MIPs

6.0.3 (25th January 2017) - [DCPP data \(Christophe Cassou\)](#) made available through input4MIPs

6.0.4 (27th January 2017) - [Land use data \(Ritvik Sahajpal\)](#) made available through input4MIPs

6.0.5 (21st February 2017) - Updated forcing dataset specifications to include documentation (and miscellaneous supporting files) that will be made available through input4MIPs

6.0.6 (6th April 2017) - Updated URLs from <https://pcmdi.llnl.gov> to <https://esgf-node.llnl.gov> after webserver updates at LLNL

6.0.7 (6th April 2017) - [ScenarioMIP](#) details updated; Minor type clarifications made

6.0.8 (12th April 2017) - [Stratospheric aerosol data \(Beiping Luo\)](#) made available through input4MIPs

6.0.9 (20th April 2017) - Updated example file ncdump reflecting latest CMIP6 controlled vocabulary

6.0.10 (21st April 2017) - [AMIP Boundary forcing v1.1.2 \(PCMDI\)](#) made available through input4MIPs

6.0.11 (1st May 2017) - [C4MIP/OMIP historical carbon isotopes \(Heather Graven\)](#) made available through input4MIPs

6.0.12 (15th May 2017) - [HighResMIP SSTs and sea-ice data \(Malcolm Roberts\)](#) made available through input4MIPs

6.0.13 (16th May 2017) - [Anthropogenic SLCF \(Short Lived Climate Forcings\) Emissions data v2017-05-01 \(Steven Smith\)](#) made available through input4MIPs

6.1.0 (17th May 2017) - This version is the updated official CMIP6 forcings dataset collection. It supersedes the original 6.0.0 version released on the 20th December 2016. Two key datasets from the original release have been revised:

- [Anthropogenic SLCF \(Short Lived Climate Forcings\), CO2, and CH4 Emissions data v2017-05-01 \(Steven Smith\)](#)
 - updated from 2016-06 and 2016-07 versions (corrected an error with earlier versions)
 - fixed two issues with the gridded historical data (see the [README](#) file for further details)
 - added CO2 and CH4 gridded products
- [AMIP Boundary forcing v1.1.2 \(PCMDI\)](#) - further details are available in the [release notes](#)
 - updated from the 1.1.1 version (extended temporal coverage from 2016-06 to 2016-12)

CMIP7 UTS volcanic SO₂ emissions (v0)

CMIP7 v0 = refer to versions currently available on ESGF labelled v1.1.3

Key limitation of v0: lack of small-magnitude eruptions (<<10 Tg SO₂) before satellite era.

