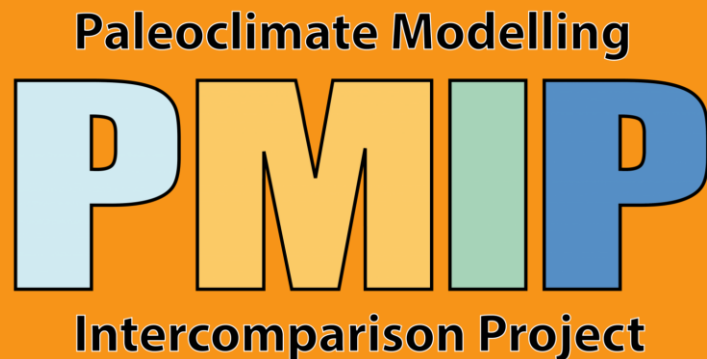


Using simulation results from the Palaeoclimate Model Intercomparison Project

Chris Brierley (UCL Geography)



Session Outline

- Background
 - What is a climate model?
 - PMIP (and its relation to CMIP)
 - What simulations performed and freely available
- Navigating the ESGF
- Using the IPCC's Interactive Atlas
- Other available resources

The two kinds of “model”

Empirical

- Collect relevant observations
- Look at relationships between those observations
- The model is a numerical representation of those relationships
- Hard to capture things outside of observed data
- Can range from linear regression to machine learning

Dynamical

- Derive the fundamental physical equations from theory & lab. Work
- Introduce simplifications to make them solvable manageable
- Code those equations on a computer
- Set any unknown parameters (preferably from observations)
- Run on (super)-computer

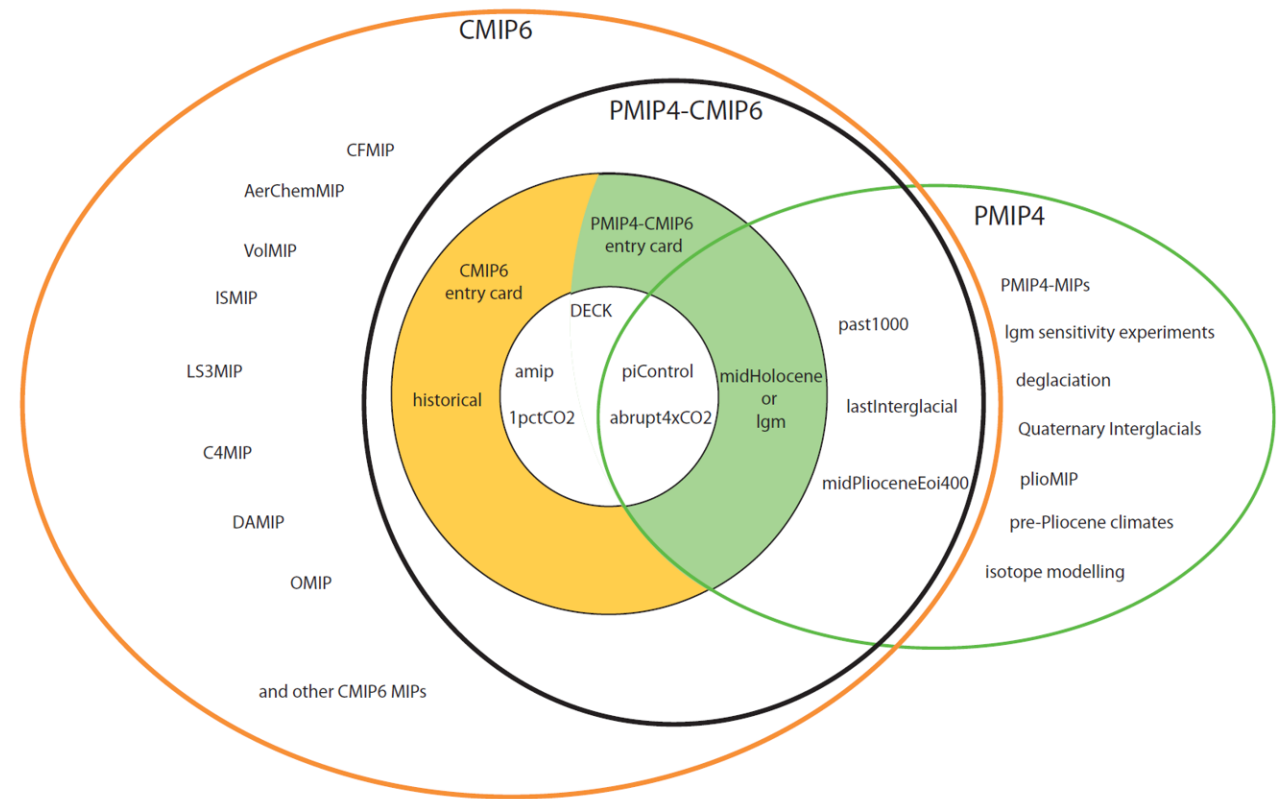
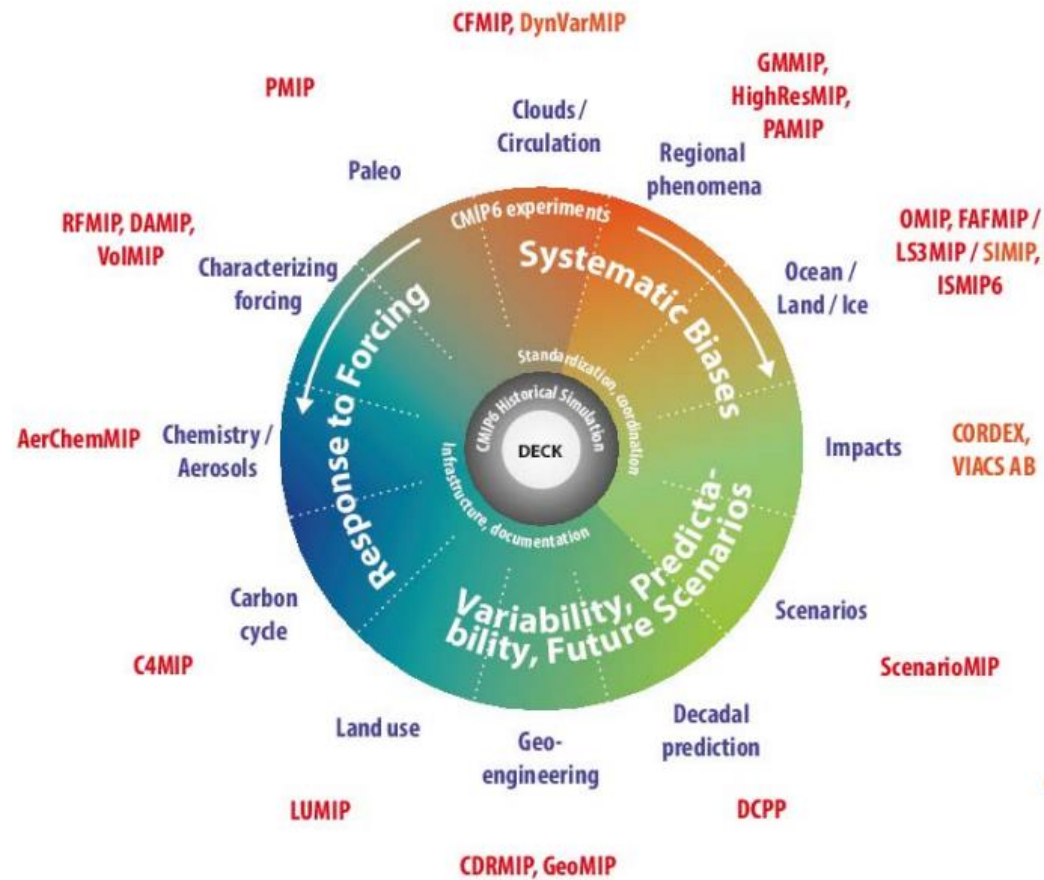
The Climate System (with response timescales)



- Different components have different characteristic timescales

PMIP4 is a sub-project of CMIP6

A larger one with 17 models [ScenarioMIP has 48 models]



PMIP₄ / CMIP6 Simulations

Equilibrium






- piControl (Preindustrial)
- abrupt4xCO₂ (Instantaneous quadrupling of carbon dioxide)
- midHolocene (6,000 yrs ago)
- lgm (last glacial maximum at 21ka)
- lig127k (Last Interglacial, 127ka)
- midPliocene-eoi₄₀₀ (3.205 Ma)
- DeepMIP (Early Eocene, ~50 Ma)

Transient

- historical (1850-2014): *Free-running simulations of industrial era*
- 1pctCO₂ (Concentrations increase by 1% per year)
- past1000 (last millennium, 850CE onwards)
- LDv1 (last deglaciation, 21,000 years ago to present): *Very-long simulation that encompasses all forcings (PMIP-only)*
- ScenarioMIP experiments

Earth System Grid Federation

- Distributed network of large data servers
- Search from a single tool
- All data stored in common format with “controlled vocabulary”
 - Same names used across all different models for variables, dimensions etc.
- Download NetCDF files
- Roughly 16 PB of data



Welcome, **Guest** | [Login](#) | [Create CEDA Account](#)

ESGF Portal at CEDA

[Home](#) [About Us](#) [Contact Us](#)

You are at the [esgf-index1.ceda.ac.uk](#) node

[Technical Support](#)

CEDA ESGF Search Portal

Search & Download Data ?

[More search options](#)

Use this portal to find, select and download data held in the globally distributed [Earth System Grid Federation](#) (ESGF) archives.

Start searching now

- For a faceted search across all projects, click [here](#), or the "Search with options" link on the right.
- For a free-text search, type some text in the box on the right and click "Go".

What can you find here?


The ESGF consists of federated data centres that enable access to the largest archive of climate data world-wide. This portal allows you to find, select and download data files from the federation.

You will find data from **CMIP5**, **CMIP6**, **CORDEX** and many other high-profile projects through this portal.

For more information about the projects, please use the links on the right (under "child projects").

Project-specific searches

The following projects require an **account** at CEDA ([create CEDA account](#)) or an openID from an ESGF peer site, and some also require a **Group Registration** (see links below) to access their data. Exceptions are flagged as "publicly available".



Federated ESGF-CoG Nodes

- CoG-CU
- ESGF@DKRZ
- ESGF@DOE/LLNL
- ESGF@IPSL
- ESGF@NASA/NCCS
- ESGF@NCI
- ESGF@NOAA/GFDL
- ESGF@NSC/LIU
- ESGF@PIK

Browse Projects

[This](#) [All](#) [My](#) [Tags](#)

Parent projects (0)

Peer projects (0)

Child projects (7)

- CLIPC-CEDA
- CMIP5-CEDA
- CMIP6-CEDA
- CORDEX-CEDA
- EUCLEIA-CEDA
- Obs4MIPs-CEDA
- SPECS-CEDA

Start typing, or use the 'Delete' key to show all available tags.

ESGF-CEDA Tags: None

PMIP on ESGF

- Data on the ESGF
 - https://pcmdi.llnl.gov/CMIP6/ArchiveStatistics/esgf_data_holdings/PMIP/index.html
- Lots of interglacial runs
- A few LGM runs (more elsewhere)
- 3 transient runs

ESGF CMIP6 data holdings for activity PMIP as of Thursday 02 December 2021 00:55:03

The cells are shaded by how recently their latest datasets were published.

More than 28 days More than 7 days Less than 7 days

Number of 'datasets' [variables x (# of simulations)] from each model in support of each CMIP6 PMIP experiment.

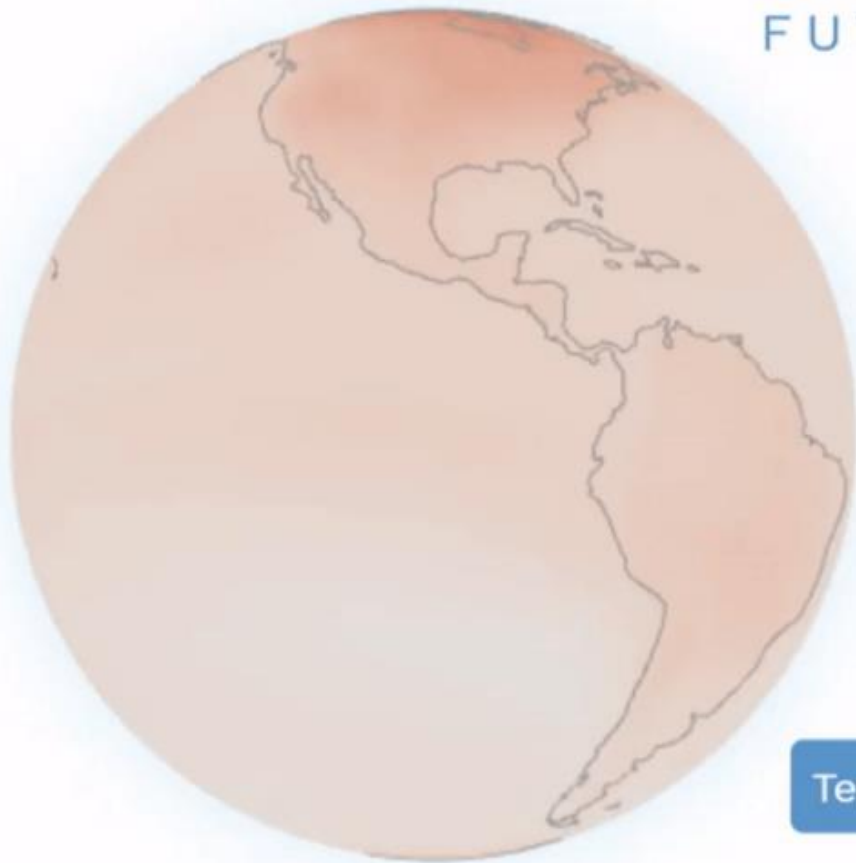
model	# of experiments	lgm	lig127k	midHolocene	midPliocene-eoi400	past1000	past2k
# of models	44	4	15	16	6	2	1
ACCESS-ESM1-5	2		163	170			
AWI-ESM-1-1-LR	3	365	394	313			
CESM2	3		438	370	262		
CNRM-CM6-1	1		172				
EC-Earth3-LR	3		191	191	139		
FGOALS-f3-L	2		184	208			
FGOALS-g3	2		176	580			
GISS-E2-1-G	3		167	167	156		
HadGEM3-GC31-LL	3		3	3	3		
INM-CM4-8	3	102	172	219			
IPSL-CM6A-LR	3		411	1771	540		
MIROC-ES2L	4	349	351	358		344	
MPI-ESM1-2-LR	3	514		638			641
MRI-ESM2-0	2			337		382	
NESM3	2		98	111			
NorESM1-F	3		146	146	100		
NorESM2-LM	2		447	457			

Walkthrough to find AMOC during last interglacial

- Search node: CEDA
- Activity = "PMIP"
- Experiment_ID = "lig127k"
- Source_ID = "EC-Earth3-LR"
- Variable = shows lots... ([translations available from here](#))
- Realm = "Ocean"
- CF standard name = "ocean y overturning mass streamfunction"
- Show files (all 210)
- I then downloaded a file over HTTP and opened it with Panoply ([available from NASA GISS](#))
- Add all the files to the 'data cart' and make a 'wget script' to bulk download them

Interactive atlas

OUR POSSIBLE
CLIMATE
FUTURES



+1.5°C

+2°C

+3°C

+4°C

Temperature

Precipitation

<https://interactive-atlas.ipcc.ch/>

#IPCCData

#IPCCAtlas

PMIP in Interactive Atlas

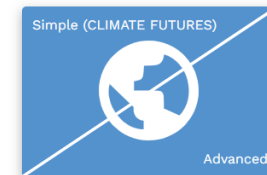
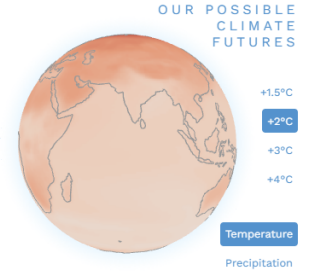
- Only in “Advanced” version
- “Paleoclimate” is listed under Dataset
- Limited variables
- PMIP₄ shows anomalies under four equilibrium simulations
- Only 2 for PMIP₃

IPCC WGI Interactive Atlas

A novel tool for flexible spatial and temporal analyses of much of the observed and projected climate change information underpinning the Working Group I contribution to the Sixth Assessment Report, including regional synthesis for Climatic Impact-Drivers (CIDs).

[Participate in the user testing survey](#)

[Errata and problem reporting](#)



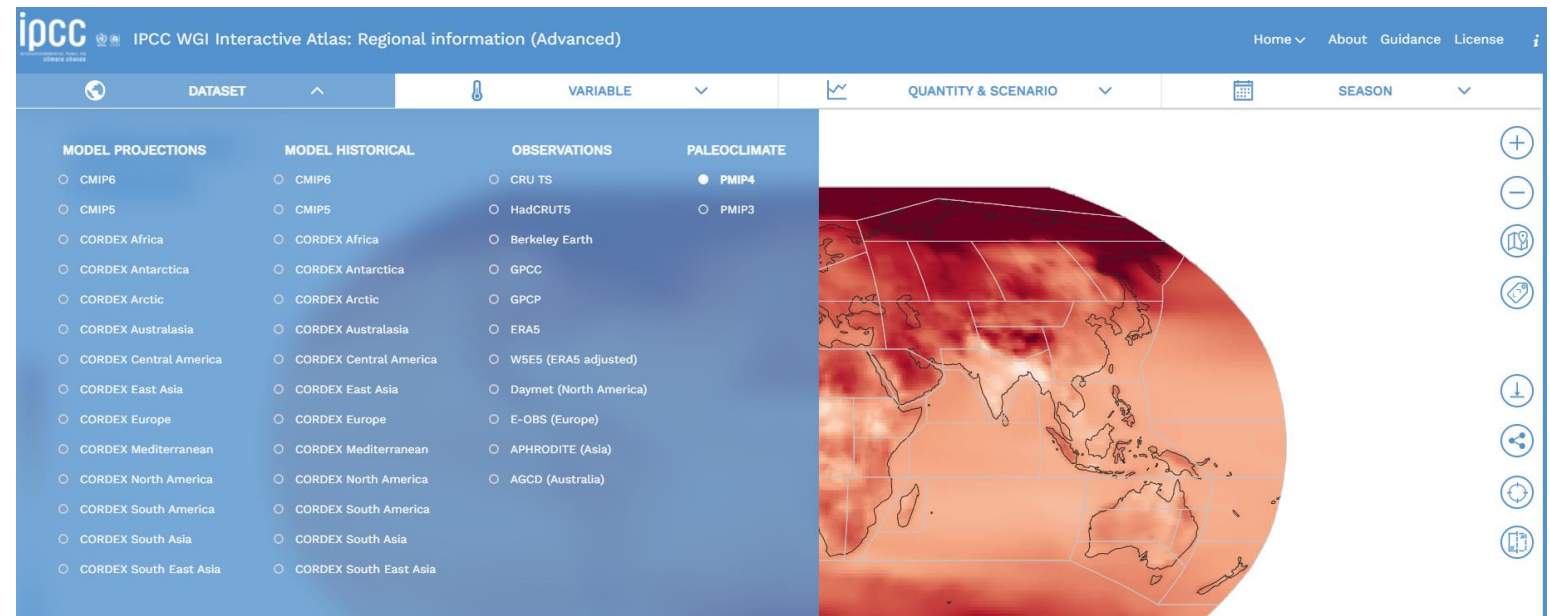
REGIONAL INFORMATION



REGIONAL SYNTHESIS

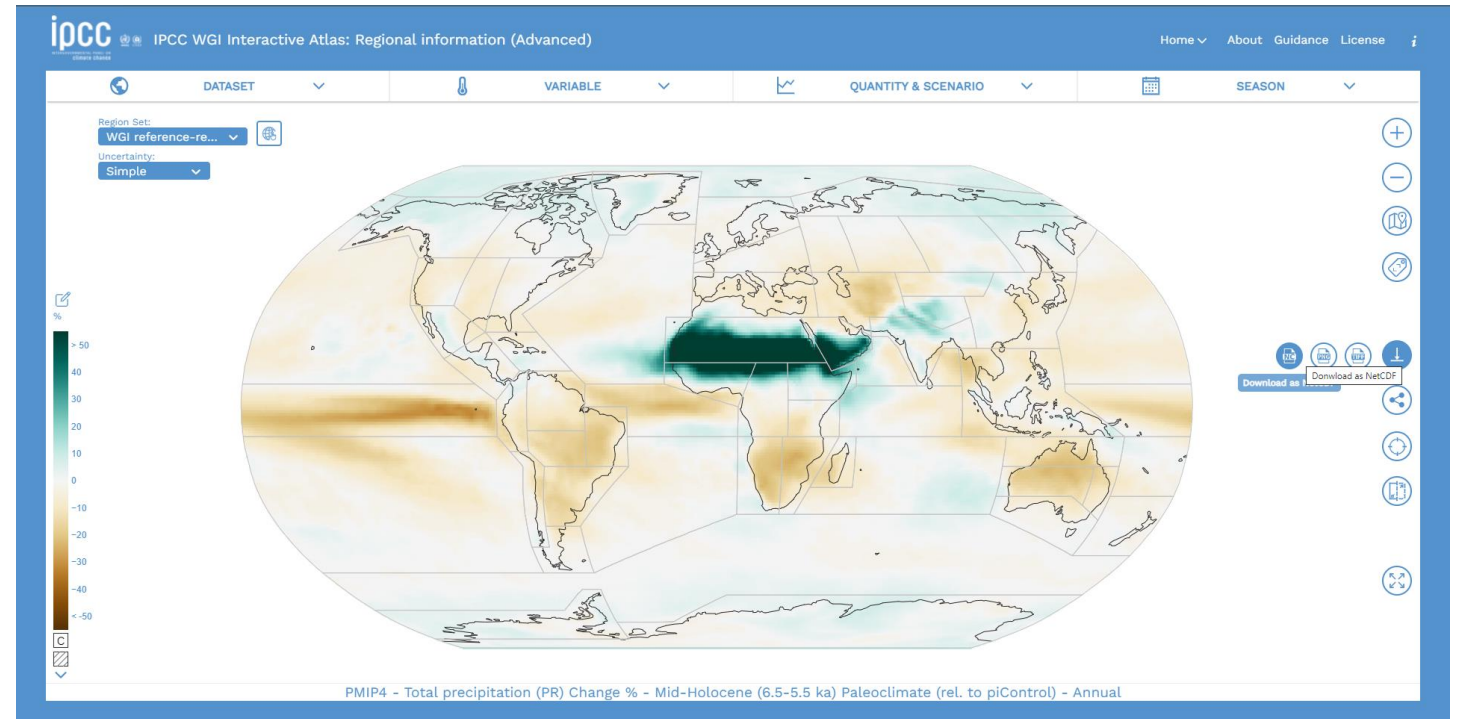


DOCUMENTATION



Walkthrough on Interactive Atlas

- Dataset = PMIP₄
- Variable = PR (rainfall)
- Scenario = Mid Holocene
- Season = Annual
- Show Annual cycle for a region (click on, say, Madagascar)
- Download image
- Download NetCDF file (provides ensemble mean of whole globe)
- Can be opened in [Panoply](#)



Other pre-processed data

- Interactive Atlas is not only source of data that has already been summarized
- [PMIP4 organization on GitHub](#)
- Has my version of the IPCC files
- Related to a GMD “workflow” paper
- Climate Variability Diagnostics Package
- [pmip_p2fvar_analyzer](#)
 - data_frames (spreadsheets)
 - data_netcdf
 - notebooks (eg ensemble AMOC change)

<https://doi.org/10.5194/gmd-2021-290>

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Submitted as: development and technical paper

25 Aug 2021

Review status: a revised version of this preprint is currently under review for the journal GMD.

Analyzing the PMIP4-CMIP6 ensemble: a workflow and tool (pmip_p2fvar_analyzer v1)

Anni Zhao , Chris M. Brierley , Zhiyi Jiang, Rachel Eyles, Damián Oyarzún, and Jose Gomez-Dans

Dept of Geography, University College London, London, WC1E 6BT, UK

Received: 20 Aug 2021 – Accepted for review: 25 Aug 2021 – Discussion started: 25 Aug 2021

Abstract. Experiment outputs are now available from the Coupled Model Intercomparison Project’s 6th phase (CMIP6) and the past climate experiments defined in the Model Intercomparison Project’s 4th phase (PMIP4). All of this output is freely available from the Earth System Grid Federation (ESGF). Yet there are overheads in analysing this resource that may prove complicated or prohibitive. Here we document the steps taken by ourselves to produce ensemble analyses covering past and future simulations. We outline the strategy used to curate, adjust the monthly calendar aggregation and process the information downloaded from the ESGF. The results of these steps were used to perform analysis for several of the initial publications arising from PMIP4. We provide post-processed fields for each simulation, such as climatologies and common measures of variability. Example scripts used to visualise and analyse these fields is provided for several important case studies.

How to cite. Zhao, A., Brierley, C. M., Jiang, Z., Eyles, R., Oyarzún, D., and Gomez-Dans, J.: Analyzing the PMIP4-CMIP6 ensemble: a workflow and tool (pmip_p2fvar_analyzer v1), Geosci. Model Dev. Discuss. [preprint], <https://doi.org/10.5194/gmd-2021-290>, in review, 2021.

Download

- Preprint (1912 KB)
- Metadata XML
- BibTeX
- EndNote

Short summary

We describes the way that our group have chosen to perform our recent analyses of the...
► Read more

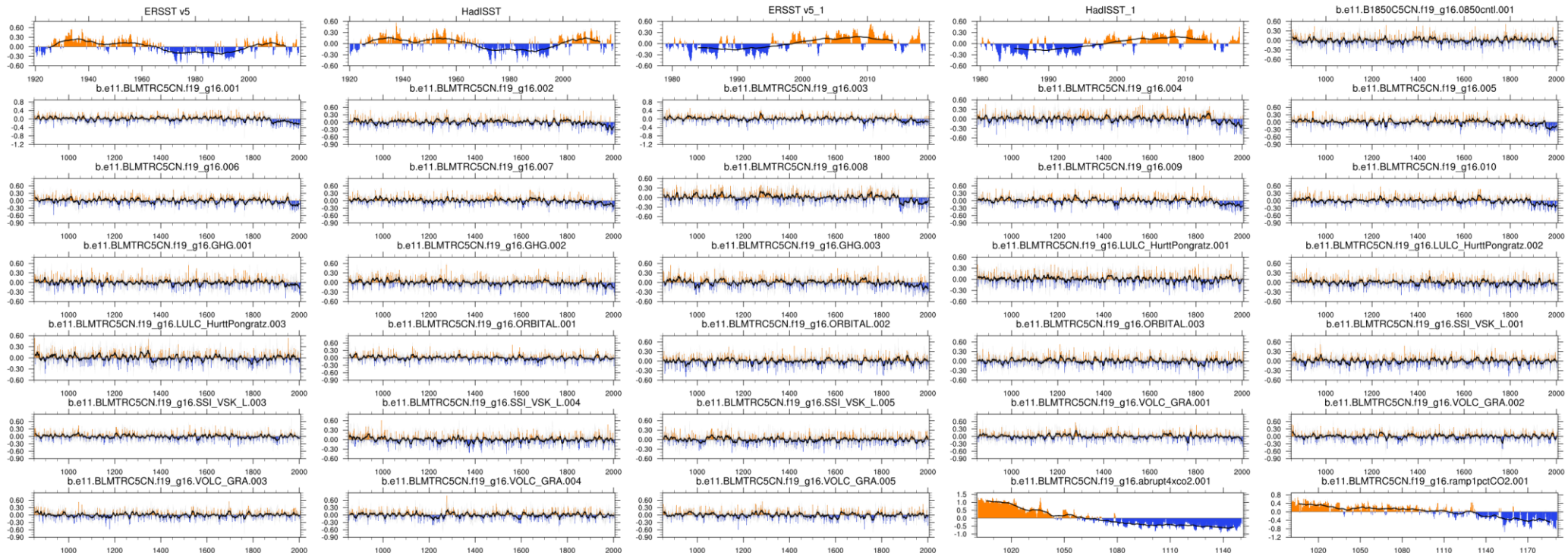
Share



Others (CESM Last Millennium Ensemble)

- Open access set of 36 simulations with CESM, running from 850 to 2005
 - Inc. 6 hourly data, single forcing runs, water isotopes
- Climate Variability Diagnostics Package has been run on it all – [files here](#)

AMO (Monthly)



Recommended steps to get model data

1. Collaborating is easier than you doing all the work. So, talk to a modeler.
2. Is there a relevant PMIP simulation?
3. Is pre-processed data available?
 - Supplement of a published paper
 - [IPCC Interactive Atlas](#)
 - My [pmip_p2fvar_analyzer](#) - [scripts/data](#)
4. Is the relevant data available on the ESGF?
 - Can you get access to some server-side compute? (Maybe try [ENES](#))
 - Download it – try using [Synda](#) from the command (install via conda)
5. Models have loads of fields, such as water isotopes. So, talk to a modeler.