

Global warming - physicist's perspective - 05

Szymon P. Malinowski

University of Warsaw, Faculty of Physics, Institute of Geophysics



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DLA SCEPTYCZNYCH



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WCRP Coupled Model Intercomparison Project (CMIP)



A Short Introduction to Climate Models - CMIP & CMIP6

This short movie gives insight into the world of climate modelling, particularly WCRP's initiative CMIP. It stresses the importance of sharing, comparing and analyzing the outcomes of global climate models to deliver high quality climate information, serving as the basis for climate assessments and negotiations.

The objective of the Coupled Model Intercomparison Project (CMIP) is to better understand past, present and future climate changes arising from natural, unforced variability or in response to changes in radiative forcing in a multi-model context. This understanding includes assessments of model performance during the historical period and quantifications of the causes of the spread in future projections. Idealized experiments are also used to increase understanding of the model responses.

WGCM

- [Overview](#)
- [Members](#)
- [Meetings](#)
- [Publications](#)
- [CMIP](#)
 - [A Short Introduction \(Video\)](#)
 - [CMIP Panel](#)
 - [Call for proposals to host a CMIP-IPO](#)
 - [WGCM Infrastructure Panel \(WIP\)](#)
 - [CMIP3](#)
 - [CMIP5](#)
 - [CMIP6](#)
- [Catalogue of MIPs](#)
 - [CMIP6-Endorsed MIPs](#)
 - [Other active MIPs](#)
 - [Former MIPs](#)
- [Sessions](#)

[← Modelling Overview](#)

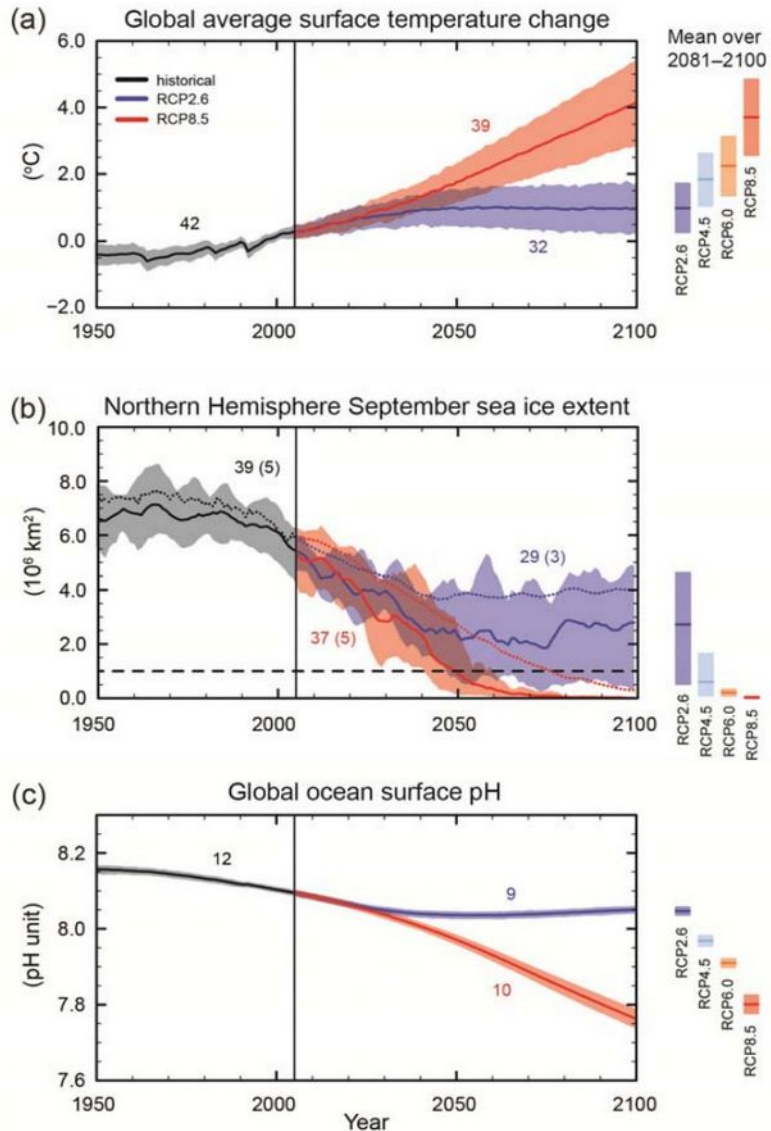
Coupled Model Intercomparison Project (CMIP)

- Understanding past, present and future climate -

- CMIP is a project of the World Climate Research Programme (**WCRP**)'s Working Group of Coupled Modelling (**WGCM**).
- Since 1995, **CMIP** has coordinated climate model experiments involving multiple international modeling teams worldwide.
- CMIP has led to a better understanding of past, present and future climate change and variability in a **multi-model framework**.
- CMIP defines **common experiment protocols, forcings and output**.
- CMIP has developed in phases, with the simulations of the fifth phase, CMIP5, now completed, and the planning of the sixth phase, i.e. CMIP6, well underway.
- CMIP's central goal is to advance scientific understanding of the Earth system.
- CMIP model simulations have also been regularly assessed as part of the IPCC Climate Assessments Reports and various national assessments.

Climate Model Projections WG I AR5

- Largely based on Coupled Model Intercomparison Phase 5 (CMIP5) simulations -
Relative to the 1986-2005 average



WG I

Paleoclimate Archives (Chapter 5)

Process Understanding

Chapter 6: Carbon and other Biogeochemical Cycles

Chapter 7: Clouds and Aerosols

From Forcing to Attribution of Climate Change

Chapter 8: Anthropogenic & Natural Radiative Forcing

Chapter 9: Evaluation of Climate Models

Chapter 10: Detection and Attribution of Climate Change: from Global to Regional

Future Climate Change and Predictability

Chapter 11: Near-term Climate Change

Chapter 12: Long-term Climate Change: Projections, Commitments and Reversibility

Integration

Chapter 13: Sea Level Change

Chapter 14: Climate Phenomena and their Relevance for Future Regional Climate Change

Atlas of Global and Regional Climate Projections

Process understanding and projections including uncertainty estimates also relevant for

WG II and III

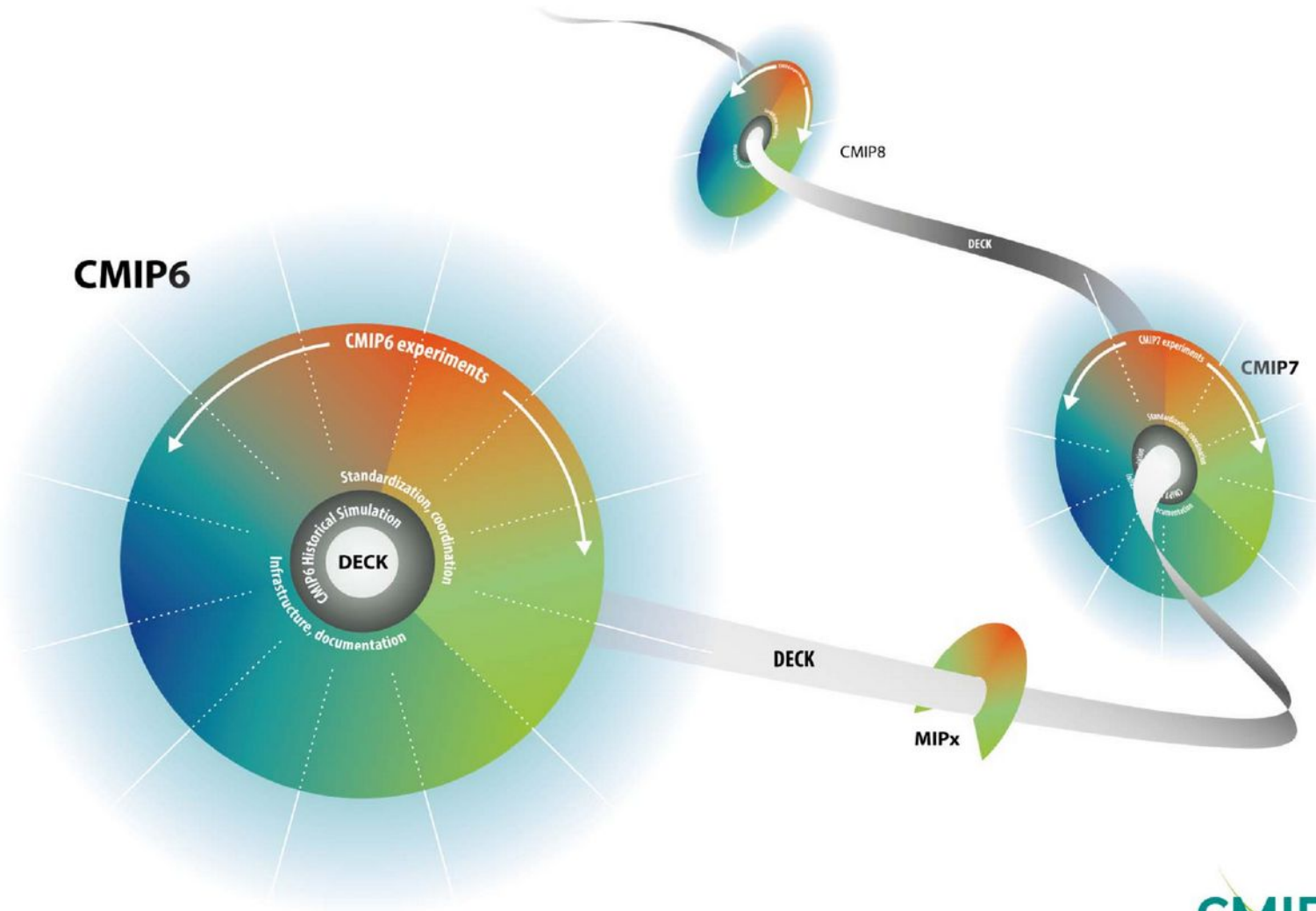
Figure SPM.7

CMIP6 Design: Scientific Focus

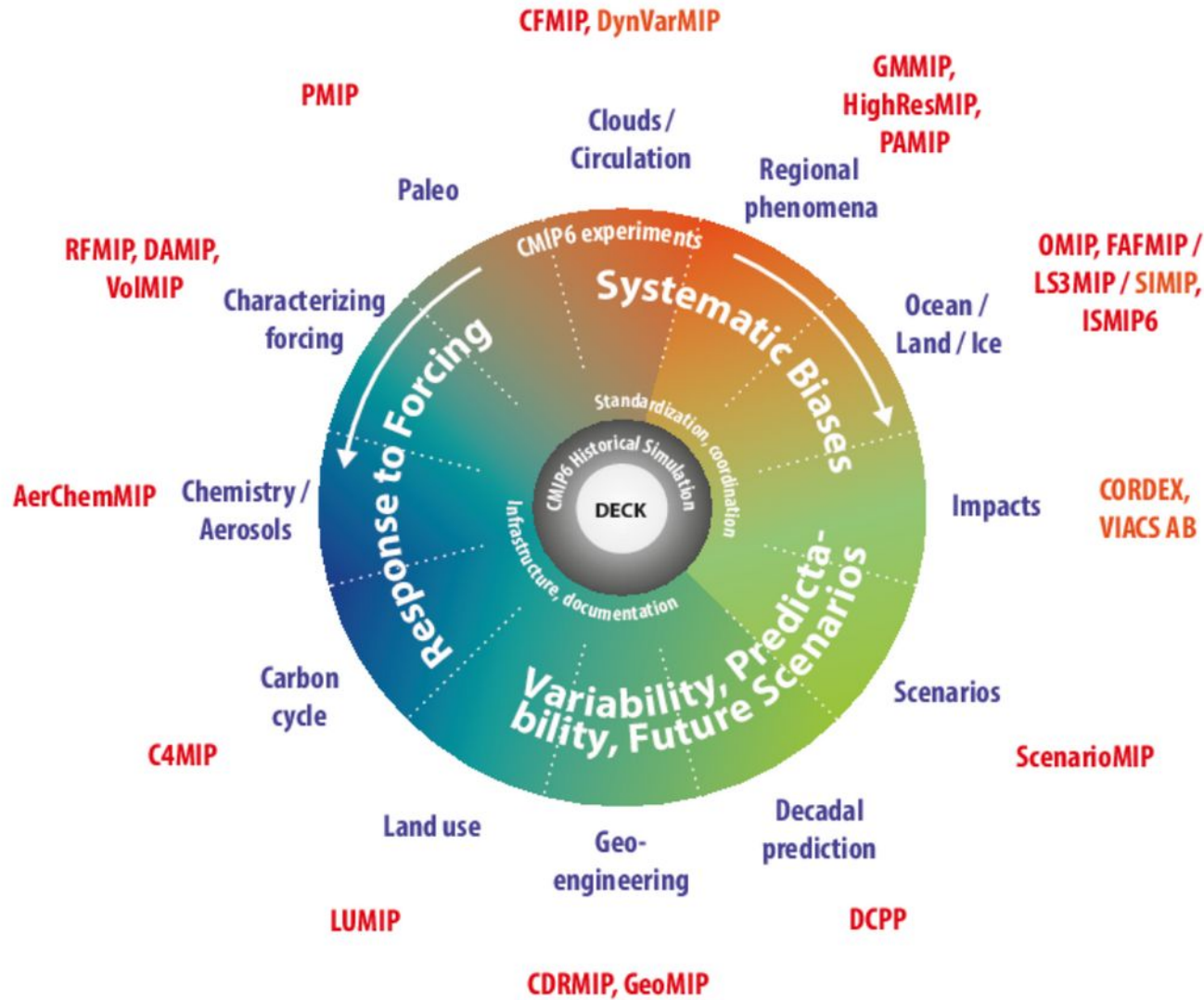
- The **scientific backdrop** for CMIP6 is the **WCRP Grand Science Challenges**:
 1. Clouds, Circulation and Climate Sensitivity
 2. Changes in Cryosphere
 3. Climate Extremes
 4. Regional Sea-level Rise
 5. Water Availability
 6. Near-Term Climate Prediction
 7. Biogeochemical Cycles and Climate Change
- The specific experimental design is focused on **three broad scientific questions**:
 1. How does the Earth System respond to forcing?
 2. What are the origins and consequences of systematic model biases?
 3. How can we assess future climate changes given climate variability, predictability and uncertainties in scenarios?

CMIP Continuity

A common suite of experiments for each phase of CMIP provides an opportunity to construct a multi-model ensemble using model output from various phases of CMIP



23 CMIP6-Endorsed MIPs



Diagnostic MIPs

CMIP6: Participating Model Groups

	Institution	Country		Institution	Country		Institution	Country
1	AWI	Germany	12	DOE	USA	23	MRI	Japan
2	BCC	China	13	EC-Earth-Cons	Europe	24	NASA-GISS	USA
3	BNU	China	14	FGOALS	China	25	NCAR	USA
4	CAMS	China	15	FIO-RONM	China	26	NCC	Norway
5	CasESM	China	16	INM	Russia	27	NERC	UK
6	CCCma	Canada	17	INPE	Brazil	28	NIMS-KMA	Republic of Korea
7	CCCR-IITM	India	18	IPSL	France	29	NOAA-GFDL	USA
8	CMCC	Italy	19	MESSY-Cons	Germany	30	NUIST	China
9	CNRM	France	20	MIROC	Japan	31	TaiESM	Taiwan, China
10	CSIR-CSIRO	South Africa	21	MOHC	UK	32	THU	China
11	CSIRO-BOM	Australia	22	MPI-M	Germany	33	Seoul Nat.Uni	Republic of Korea

New in CMIP:

- 2 new model groups from Germany (AWI, MESSY-Consortium)
- 4 new model groups from China (CAMS, CasESM, NUIST, THU)
- 1 new model group from Brazil (INPE)
- 1 new model group from India (CCCR-IITM)
- 1 new model group from Taiwan, China (TaiESM)
- 1 new model group from USA (DOE)
- 2 new model group from Republic of Korea (NIMS-KMA, SAM0-UNICON)
- 1 new model group from South Africa / Australia (CSIR-CSIRO)

=====

⇒ **13 new model groups so far**

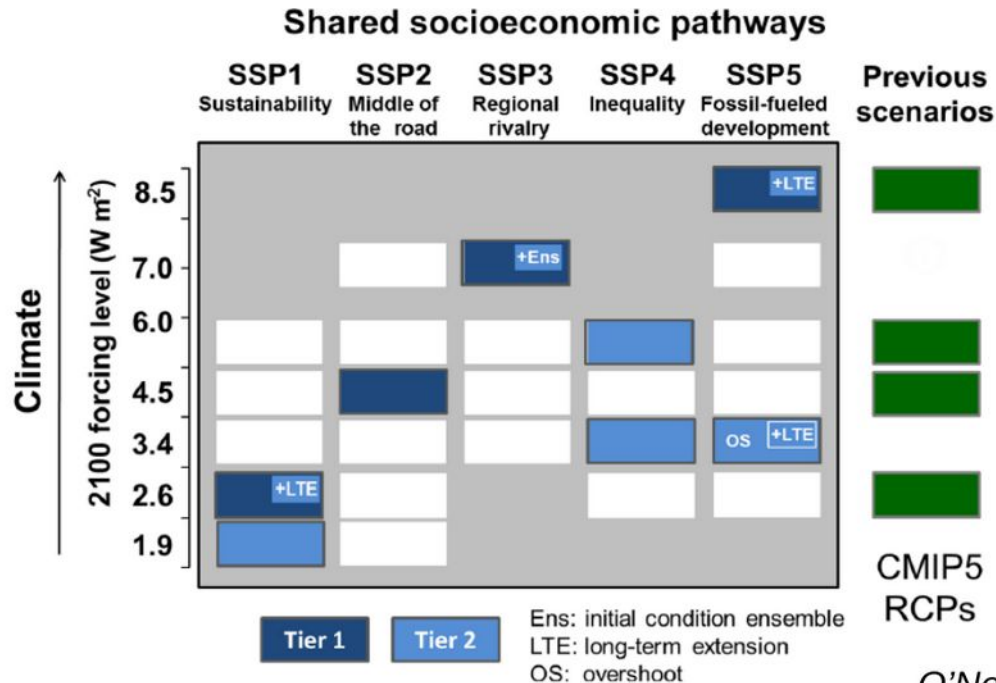
* Other models can join providing DECK and historical simulations are submitted

More models (>70)
 New models
 More complex models
 Higher resolution models

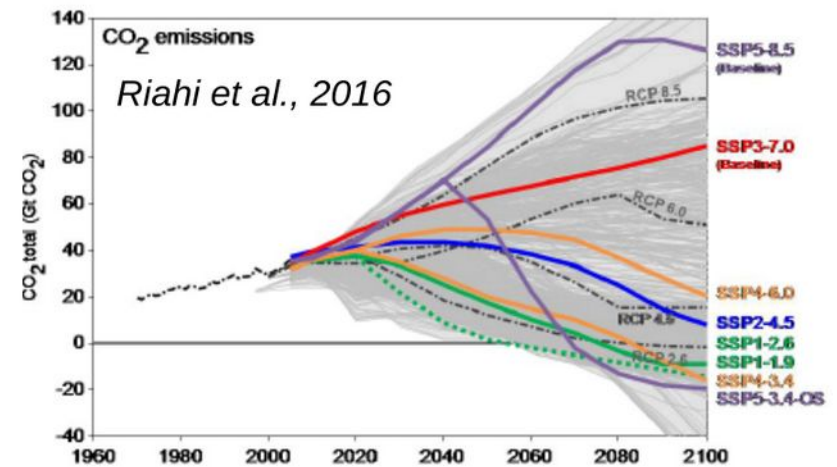


Key Messages: Model Projections / Predictions (2)

SSPs: set of baselines, with future developments in absence of new climate policies beyond those in place today



Future in CMIP6: 2015-2100 plus Extensions to 2300



O'Neill et al., ScenarioMIP for CMIP6, GMD, 2016

ScenarioMIP: New scenarios span a similar range as the RCPs, but fill critical gaps, including

- Role of specific forcings such as land use and short-lived species (air quality)
- The effect of a peak and decline in forcing,
- The consequences of scenarios that limit warming to below 2 °C,

DCPP: Improvements in models, reanalysis, methods of initialization and ensemble generation, and data analysis will provide extended comprehensive decadal predictions

CMIP6 Timeline





CMIP6 - Coupled Model Intercomparison Project Phase 6

Overview:

The WCRP Working Group on Coupled Modelling (WGCM) oversees the Coupled Model Intercomparison Project, which is now in its 6th phase. Background information about CMIP and its phases can be found on [WGCM website](#) as well as on the [PCMDI-hosted pages](#). An [introductory overview](#) of CMIP6 is also provided by the WGCM.

Practical information for those interested in participating in CMIP6 is provided in [three guides](#), tailored to different groups:

1. **Modelers** carrying out CMIP6 simulations,
2. **Data managers** responsible for data node operations, and
3. **Data users** analyzing and making use of CMIP6 model output

Model output Access:

- First see the [Data Users Guide](#)
- [Summary table](#) of currently available data
- The complete archive of CMIP6 output is accessible from any one of the following portals:
 - USA, PCMDI/LLNL (California) - <https://esgf-node.llnl.gov/projects/cmip6/>
 - France, IPSL - <https://esgf-node.ipsl.upmc.fr/projects/cmip6-ipsl/>
 - Germany, DKRZ - <https://esgf-data.dkrz.de/projects/cmip6-dkrz/>
 - UK, CEDA - <https://esgf-index1.ceda.ac.uk/projects/cmip6-ceda/>

CMIP6 Endorsed MIPs:

- [WCRP Endorsed \(Model Intercomparison Project\) MIPs overview page](#)
- [CMIP6 Ocean Model Intercomparison Project \(OMIP\) overview page](#)

Additional information for CMIP6:

- [CMIP6 license and terms of use](#)

CMIP6 Modeling Groups (click on flags to reveal identity)



Document version: 13 February 2019

WCRP CMIP6

World Climate Research Programme

You are at the [ESGF@DOE/LLNL](#) node

[Home](#) [Contact Us](#) [Data Nodes Status](#)

[Technical Support](#)

- MIP Era
- Activity
- Model Cohort
- Product

- Source ID
- Institution ID
- Source Type
- Nominal Resolution

- Experiment ID
- Sub-Experiment
- Variant Label
- Grid Label

- Table ID
- Frequency
- Realm
- Variable
- CF Standard Name

- Data Node

WARNING: Not all models include a variant "r1i1p1f1", and across models, identical values of variant_label do not imply identical variants! To learn which forcing datasets were used in each variant, please check modeling group publications and documentation provided through ES-DOC.

CMIP6 project data downloads are unrestricted. Downloads should be performed with the -s option to a wget script without the need to login. When using this method for download, ensure you are not using additional options, eg. -s and -H should never be combined.

Enter Text: Display results per page [\[More Search Options \]](#)

- Show All Replicas Show All Versions Search Local Node Only (Including All Replicas)

The search returned 0 results.



CMIP6 Visualisation Tool

Search Results Download Recent searches

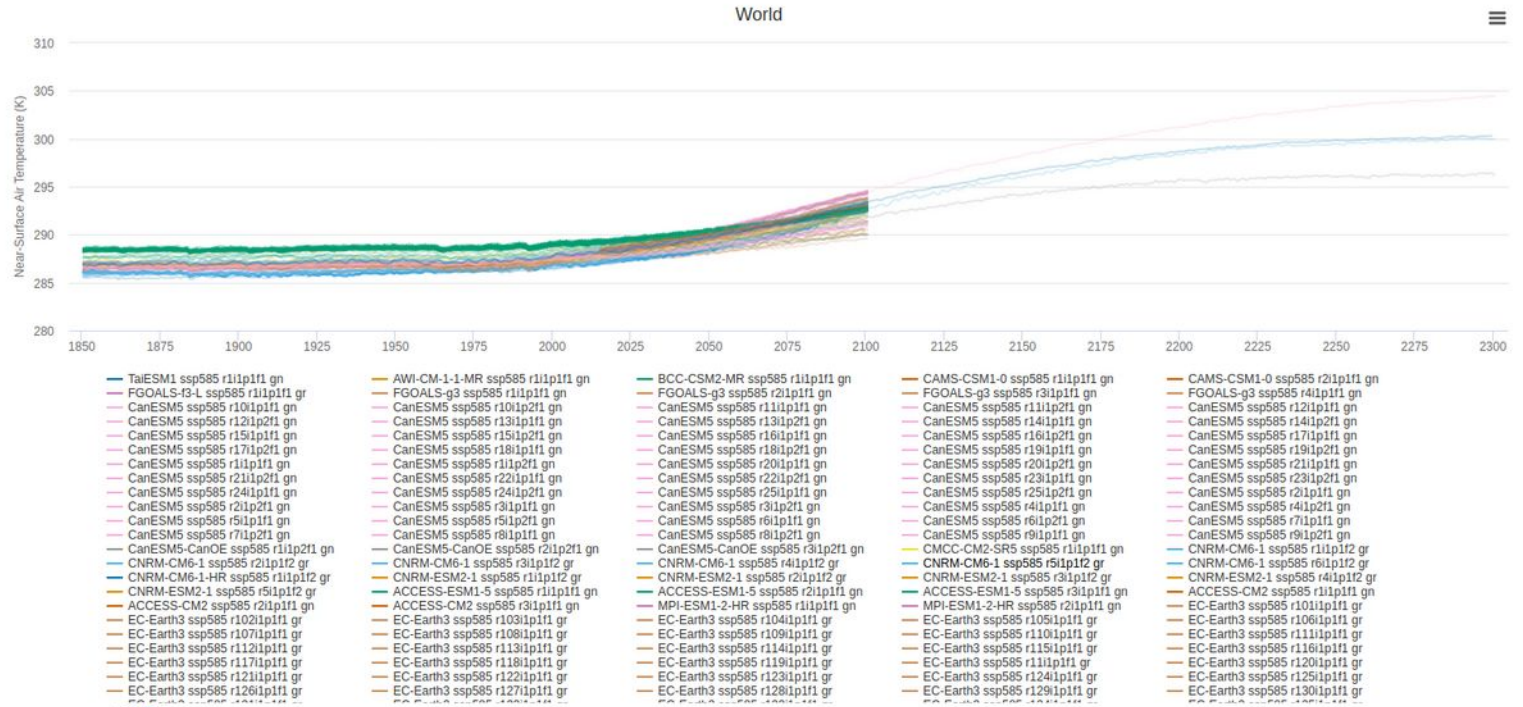
We found a total of 250 datasets

Your data for

World

Colour by

Model



cmp6 OBJECTS CONFIGURATION PERMISSIONS RETENTION LIFECYCLE

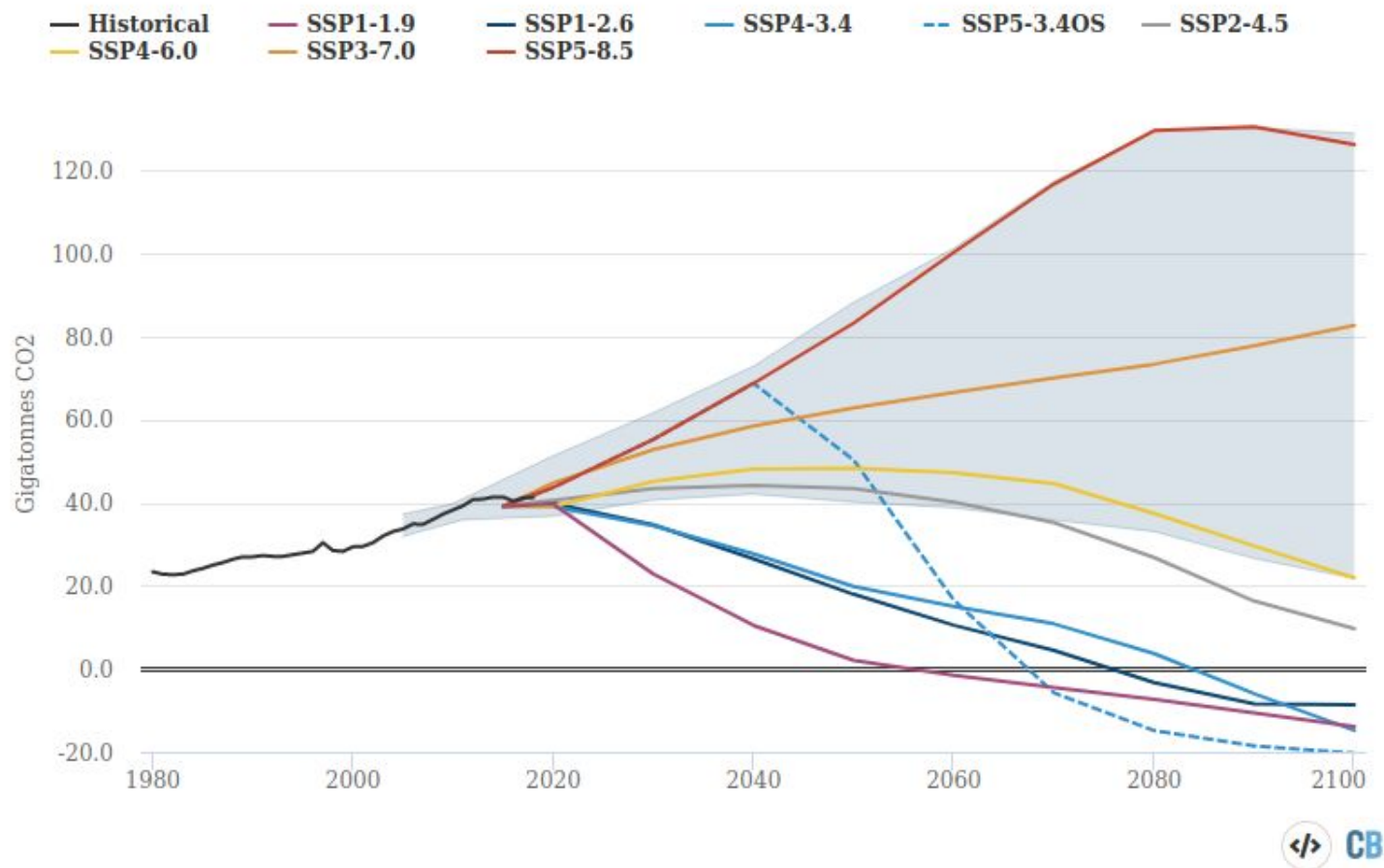
Buckets > cmp6
UPLOAD FILES UPLOAD FOLDER CREATE FOLDER MANAGE HOLDS DOWNLOAD DELETE

Filter Filter by object or folder name prefix

<input type="checkbox"/>	Name	Size	Type	Created time	Storage class	Last modified	Public access	Encryption	Retention expiration date	Holds	
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<input type="checkbox"/>	C4MIP/	--	Folder	--	--	--	--	--	--	--	
<input type="checkbox"/>	CDRMIP/	--	Folder	--	--	--	--	--	--	--	
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<input type="checkbox"/>	gsutil_test_filelz288ljb.bin	1 KB	application/octet-stream	Aug 25, 2020, 12:21:25 AM	Standard	Aug 25, 2020, 12:21:25 AM	Not authorized	Google-managed key	--	None	
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<input type="checkbox"/>	pangeo-cmp5.csv	435.5 KB	text/csv	Nov 26, 2019, 6:12:19 PM	Standard	Nov 26, 2019, 6:12:19 PM	Not authorized	Google-managed key	--	None	
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<input type="checkbox"/>	tracmp.json	986 B	application/json	Feb 25, 2020, 7:23:41 PM	Standard	Feb 25, 2020, 7:23:41 PM	Not authorized	Google-managed key	--	None	
<input type="checkbox"/>	tracmp/	--	Folder	--	--	--	--	--	--	--	

A number of new scenarios are also being used for CMIP6 in order to give a wider selection of futures for scientists to simulate. These scenarios are included in the chart below, which shows the annual CO2 emissions assumed under each scenario out to 2100. The new scenarios include SSP1-1.9 (purple line), SSP4-3.4 (blue solid), SSP5-3.4OS (blue dashed) and SSP3-7.0 (orange).

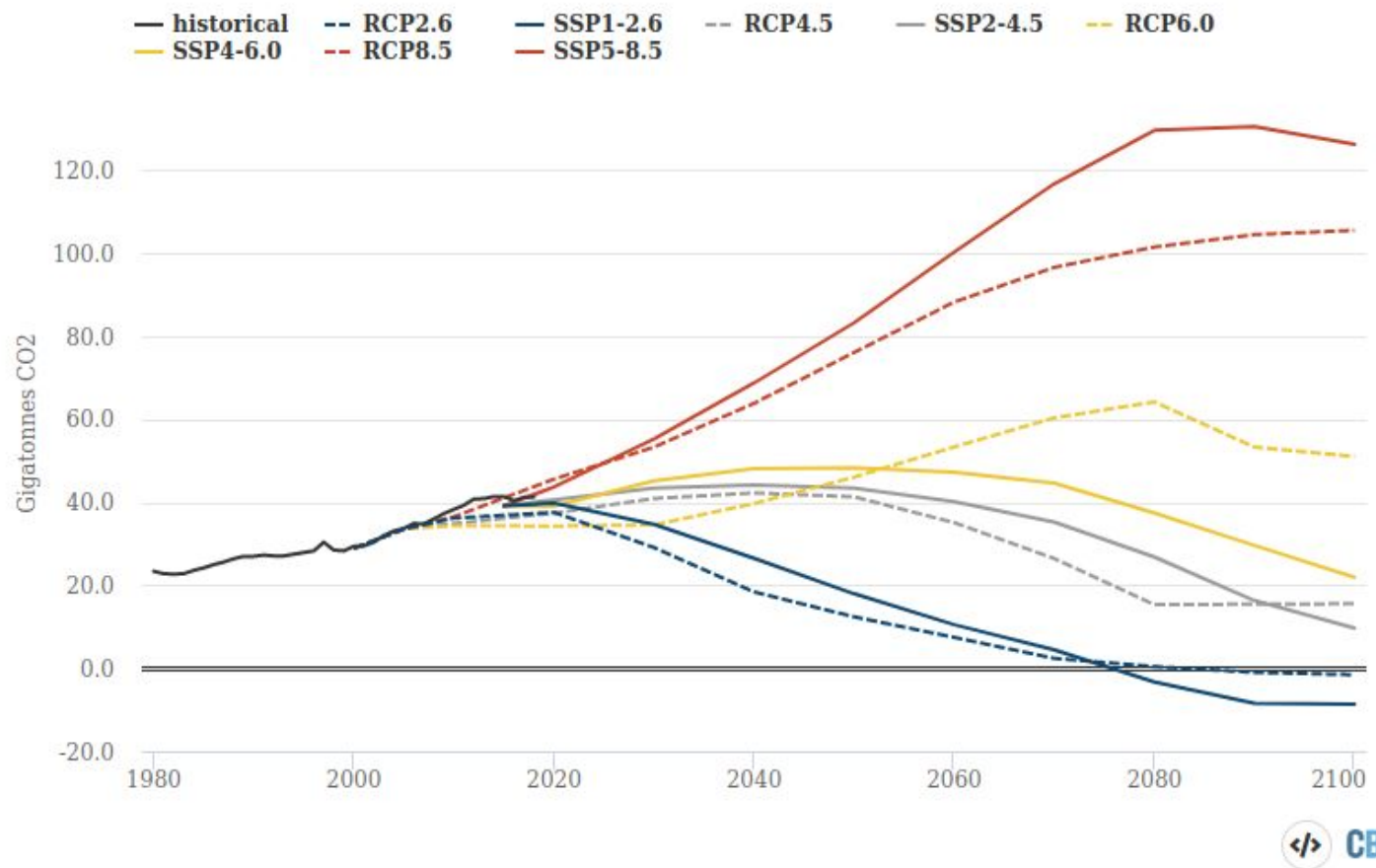
CO2 emissions in CMIP6 scenarios



Future CO2 emissions scenarios featured in CMIP6, as well as historical CO2 emissions (in black). The shaded area represents the range of *no-policy baseline scenarios*. Data from the [SSP database](#); chart by Carbon Brief using [Highcharts](#).

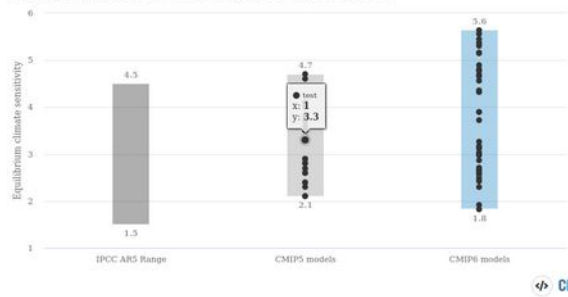
CMIP6 features new scenarios that result in 2100 forcing similar to the CMIP5 RCP scenarios. However, even though their end-of-century forcing is the same, the emissions pathways and mix of CO₂ and non-CO₂ emissions are different. The figure below compares the CO₂ emissions in the old RCP scenarios (dashed lines) and their new SSP counterparts (solid lines).

CO₂ emissions in comparable CMIP5 and CMIP6 scenarios



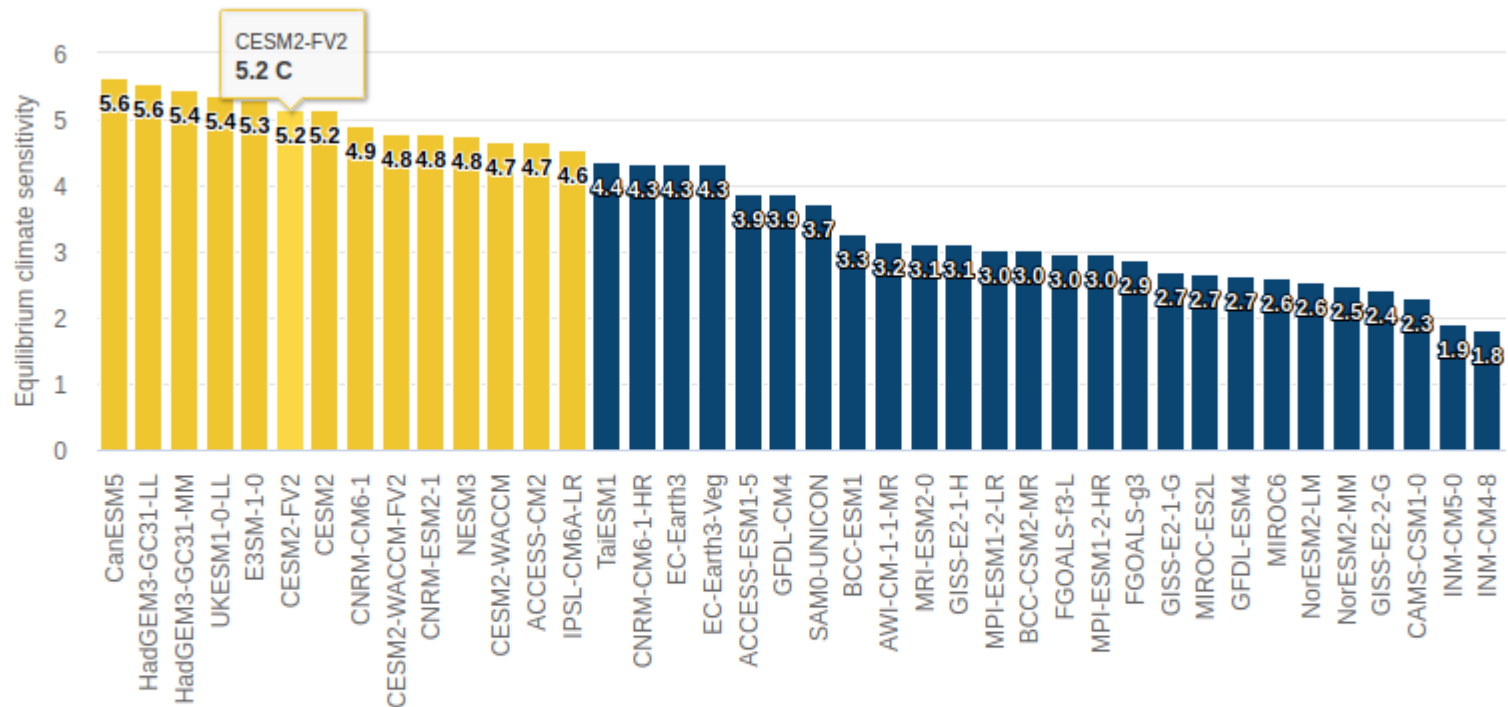
Future RCP CO₂ emissions scenarios featured in CMIP5 and their CMIP6 counterparts, as well as historical CO₂ emissions (in black). Data from the [SSP database](#); chart by Carbon Brief using [Highcharts](#).

CMIP6 models show a wider range of climate sensitivity



Likely ECS range (e.g. with an estimated 66% chance of occurring) from the IPCC AR5 (black bar), CMIP5 model ECS values (grey), and

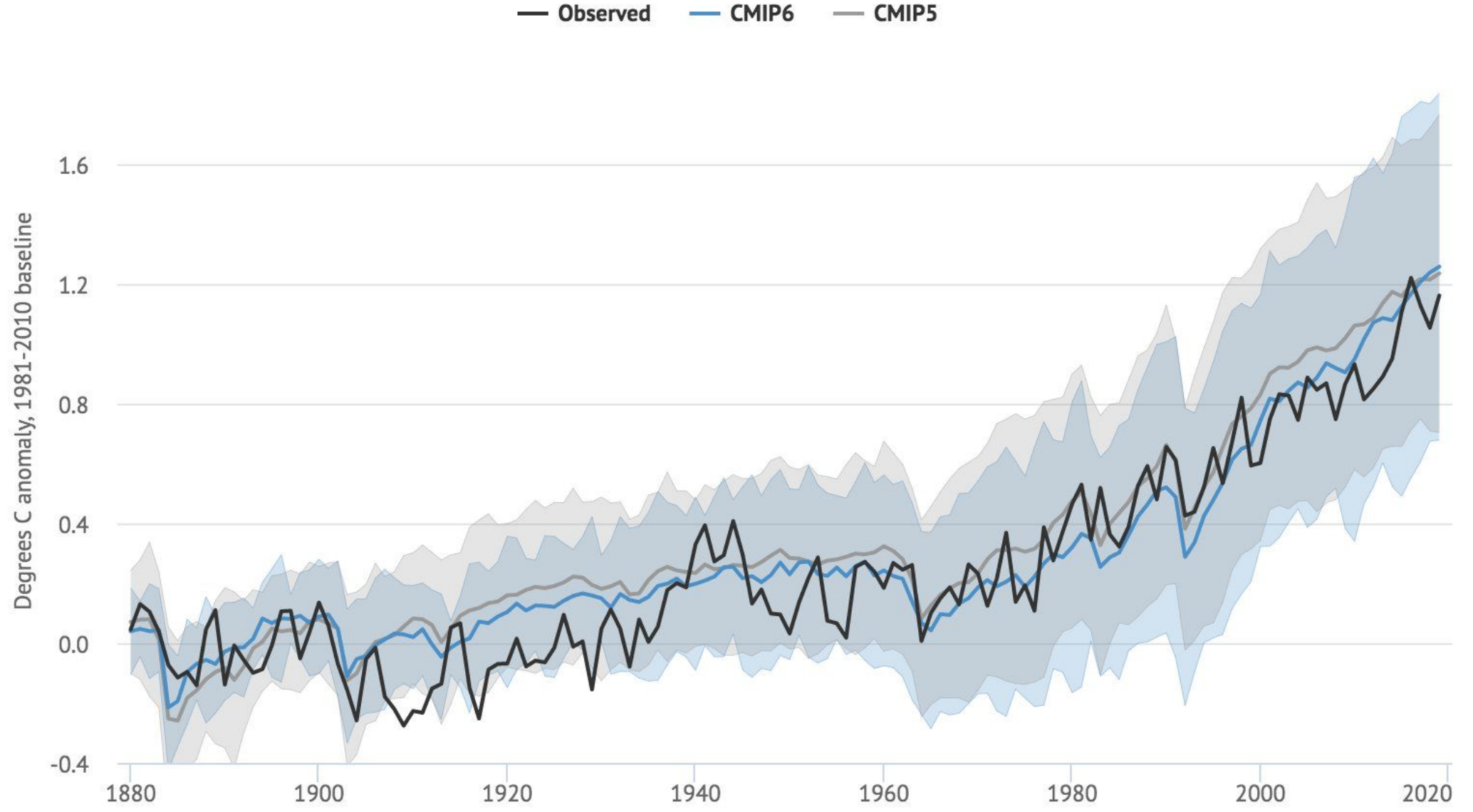
Climate sensitivity in CMIP6 models



ECS values from the 40 CMIP6 models available as of May 2020 where necessary experiments to calculate ECS (using the [Gregory method](#)) are currently available. Models with an ECS above the IPCC AR5 likely range are shown in yellow. Note that not all models shown are independent, as some modeling groups – such as CESM2 – have multiple versions. Chart by Carbon Brief using [Highcharts](#).

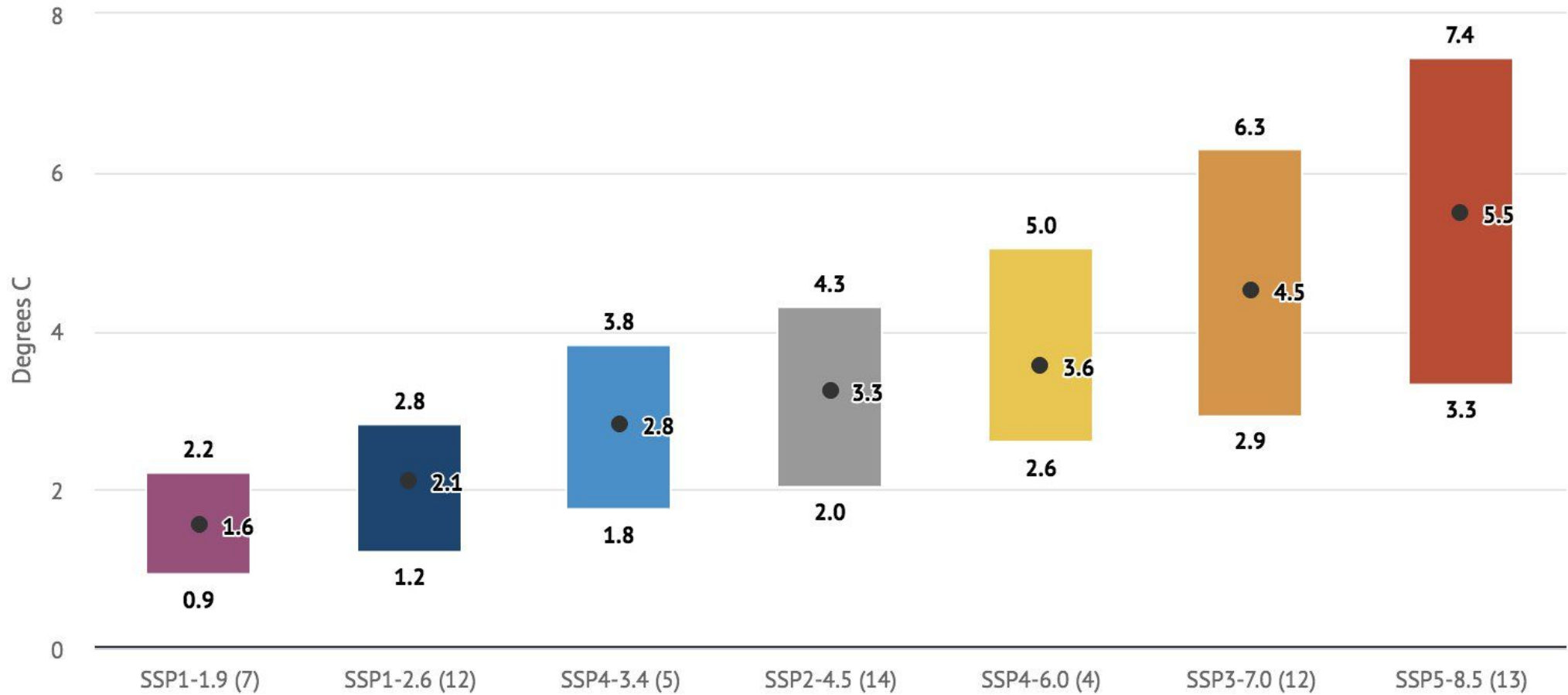
Global surface temperatures 1880-2019: CMIP5, CMIP6 and observations

For currently available CMIP6 runs. Observational data from NASA GISTEMP.



Warming by scenario in current CMIP6 model runs

For currently available runs, from 1880-1900 to 2090-2100.



More soon... new analyses, new developments.

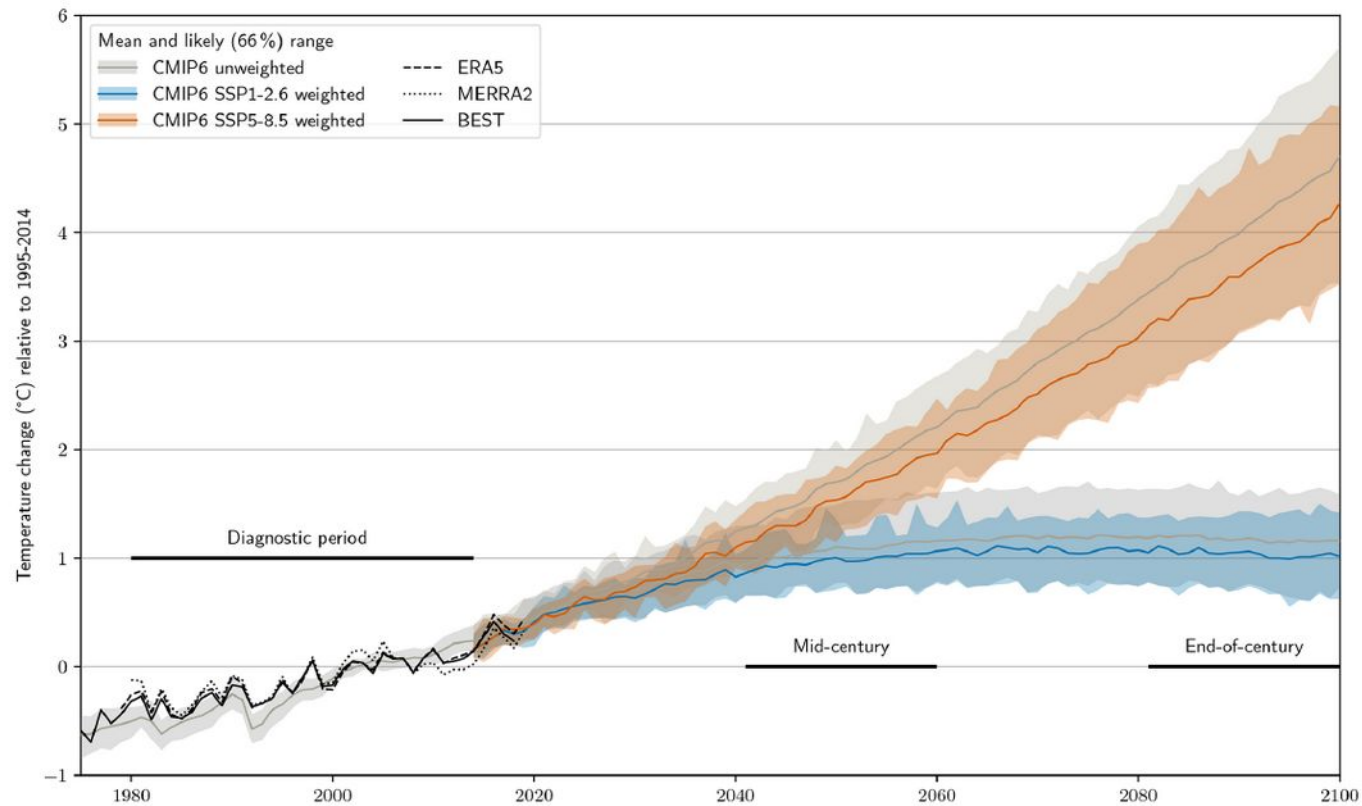


Figure 7. Time series of temperature change (relative to 1995–2014) for the unweighted (gray) and weighted (colored) CMIP6 mean (lines) and likely (66 %) range (shading). Three observational datasets are also shown in black; note that BEST is not used to inform the weighting and is only shown for comparison here.

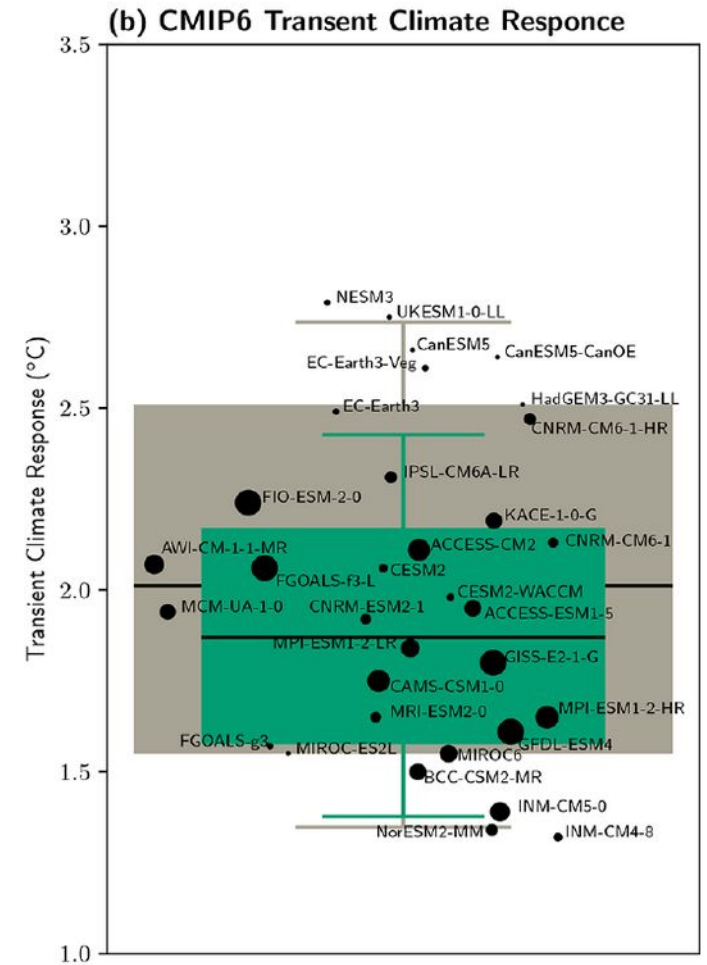
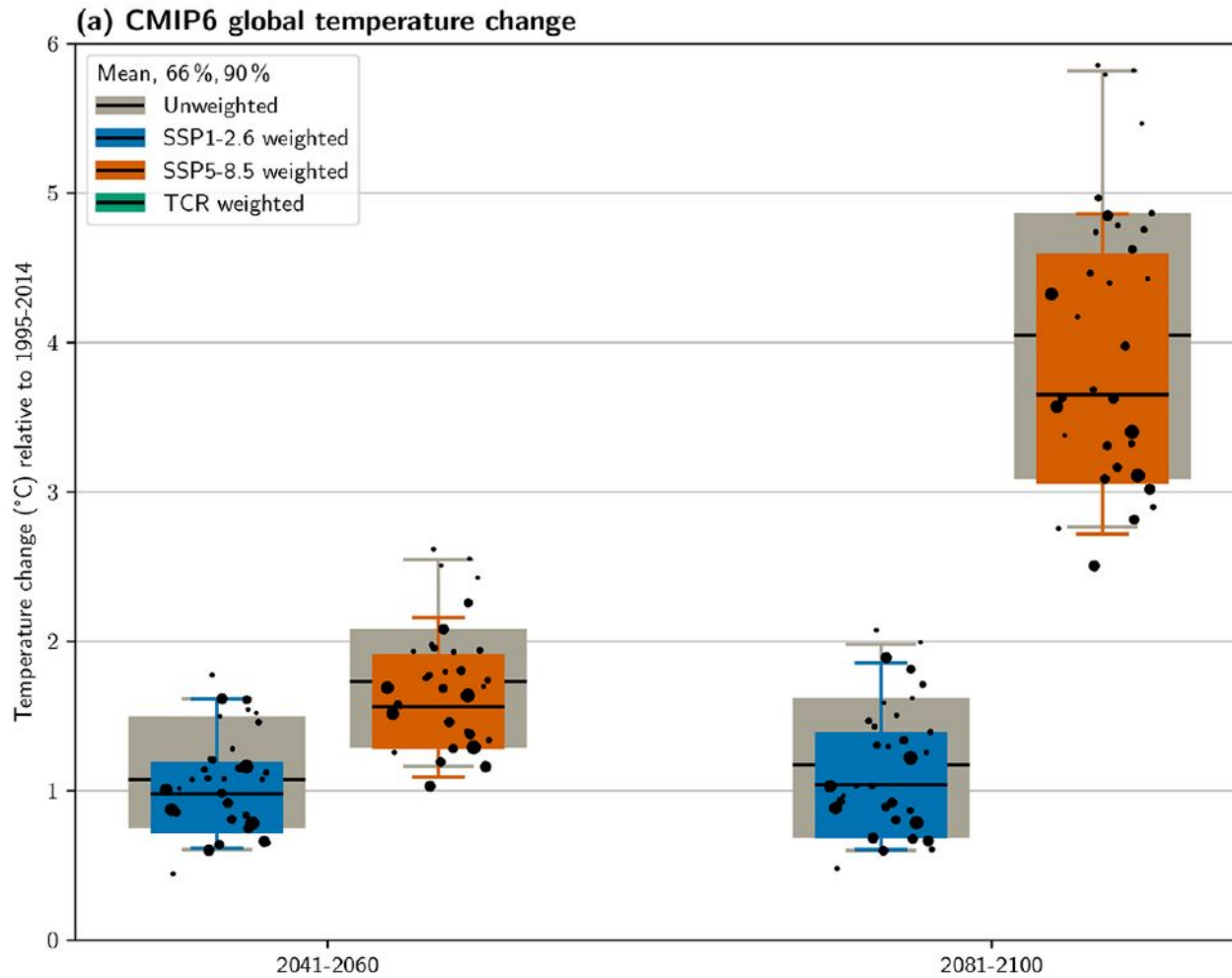


Figure 8. (a) Unweighted (gray) and weighted (colors) temperature change (relative to 1995–2014) for both periods and scenarios. (b) Unweighted (gray) and weighted (green) transient climate response (TCR). The dots show individual models as labeled, with the size of the dot indicating the weight. The horizontal dot position is arbitrary.