Impact of CMIP6 in IPCC AR6

WGCM Meeting

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Overview

• As in previous IPCC Assessments, the CMIP multi-model archive serves a crucial underpinning role.

• The CMIP ensemble, with its easy access and standardized format, facilitates widespread usage in the climate research community. It entrains scientists from many countries and many disciplines who would otherwise be unable to do this kind of research.

• Much of the literature that relates to climate modelling is based on or linked to CMIP.

• The archive also allows consistent presentation of model results (graphics, methods) in the IPCC report that makes it much more valuable and readable.
DECK idealized forcing (abrupt 4xCO$_2$ and 1%/yr CO$_2$)
DECK historical and ScenarioMIP

‘observational constraints’ applied to some variables
With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture.

Figure SPM.5

c) Annual mean precipitation change (%) relative to 1850-1900

- Precipitation is projected to increase over high latitudes, the equatorial Pacific, and parts of the monsoon regions, but decrease over parts of the sub-tropics and in limited areas of the tropics.

- Relatively small absolute changes may appear as large % changes in regions with dry baseline conditions.

Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming.

Figure SPM.6

Heavy precipitation over land

10-year event

Frequency and increase in intensity of heavy 3-day precipitation events that occurred once in 10 years on average in a climate without human influence.

- Future global warming levels:
  - 1.5°C: 10.5% increase
  - 2°C: 13.5% increase
  - 4°C: 23.5% increase

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Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years.

Fig. 3.8
Fig. 3.2

a) Last Glacial Maximum reconstructed and modelled land and ocean tropical temperature change

b) Global temperature change over land and ocean for a range of climates

c) Volcanic forcing and reconstructed and modelled GMST over the past millennium
Every tonne of CO₂ emissions adds to global warming. Figure SPM.10

Graphs showing the impact of CO₂ emissions on global warming and the uptake of CO₂ by land and oceans under different scenarios.
Chapter 4
Consistent Graphics
DCPP and large ensembles

![Graph showing climate projections and ensemble results.](image)

*Fig. 1, Box 4.1, IPCC AR6*
Interactive Atlas – contains a large amount of CMIP output
Summary and Discussion Topics

• CMIP and the ESGF system have become *essential* to IPCC and other international and national assessments. The multi-model ensemble, and large individual model ensembles, are vital to quantifying aspects of uncertainty (and confidence!)

• Some aspects of CMIP are now more in the realm of ‘services’ rather than ‘science’. This reflects the maturity of the climate modelling enterprise.

• In my view, there is a growing need for the ‘service’ capability, and many modelling centres have this as a part of their mandate.

• Of course, there is still an important need for collaborative, international climate modelling *science* – a need for increasingly comprehensive, higher-resolution models used to undertake cutting edge research. We have to encourage that.

• We should take full advantage of the careful assessment done by the IPCC to identify shortcomings in our modelling/analysis capability, and have that inform our priorities going forward.
Summary and Discussion Topics

• We need to think carefully about how CMIP7 can continue to evolve to satisfy the dual need for driving the frontier of climate modelling while also delivering results to support adaptation planning, mitigation policy, and climate services.

• And, we need to think about how we optimally deploy our international modelling resources, and balance the needs of individual modelling centres and engage researchers from around the world, e.g.:

  • Divide up MIPs amongst centres according to their interest and capabilities (don’t need all models to do all experiments). Some may focus on high resolution, some on large ensembles, some on certain processes or forcings, etc.
  • Dedicate more effort to the analysis of a growing, heterogeneous multi-model ensemble to get the most out of it and to allow for ‘flexibility’ in contributions.
  • Note that many modelling centres are being established to enhance scientific capacity in different parts of the world. WCRP should encourage this. Rather than move toward exclusivity, we should embrace diversity (and put effort into how best to do so).