

Environment and Climate Change Canada Environnement et Changement climatique Canada

# Impact of CMIP6 in IPCC AR6

WGCM Meeting Greg Flato 7/Dec/2021





## 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<sub>2</sub> and 1%/yr CO<sub>2</sub>)



Fig. 7.8

Equilibrium climate sensitivity (gregory method) and transient climate response



#### **DECK** historical and ScenarioMIP

'observational constraints' applied to some variables

ipcc s climate change

1

SEP. 7

SPS 7.0

Future emissions cause future additional warming, with total warming dominated by past and future CO<sub>2</sub> emissions

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140

120

100

90

60

-20



	10	56P1-2.4 55P1-1.0		
	0 2015 2050 2	100		
	One air pollutant and contributor to	aerosols		
5592 4.5	Sulfur disside (MtSO <sub>p</sub> /yr) 120			
SSP1-2.6	80	- 5593-7.0		
3591-1.9	40	5582-4.5		
2100	0,	SSP5-8.5 SSP1-1.9 SSP1-2.6		
	2015 2050 2	100		

Figure SPM.4

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Human activities affect all the major climate system components, Figure SPM.8 with some responding over decades and others over centuries





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a) Global surface temperature change relative to 1850-1900

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Human activities affect all the major climate system components, Figure SPM.8 with some responding over decades and others over centuries





With every increment of global warming, changes get larger in regional mean temperature, precipitation and soil moisture

Figure SPM.5



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

Figure SPM.6



#### DAMIP



Fig. 3.8

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### PMIP



Fig. 3.2

#### C4MIP



44%

SSP3-7.0

38%

SSP5-8.5

GtCO₂





For scenarios with higher cumulative

...the amount of CO<sub>2</sub> emissions taken up by land and ocean

...meaning that the proportion of CO<sub>2</sub> emissions taken up by

land and ocean carbon sinks

with higher CO2 emissions.

carbon sinks is larger, but more of the emitted CO<sub>2</sub> emissions remains

in the atmosphere...

from the atmosphere

is smaller in scenarios

CO<sub>2</sub> emissions



## **DCPP** and large ensembles



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 <u>science</u> – 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).