CMIP6 Overview and Status

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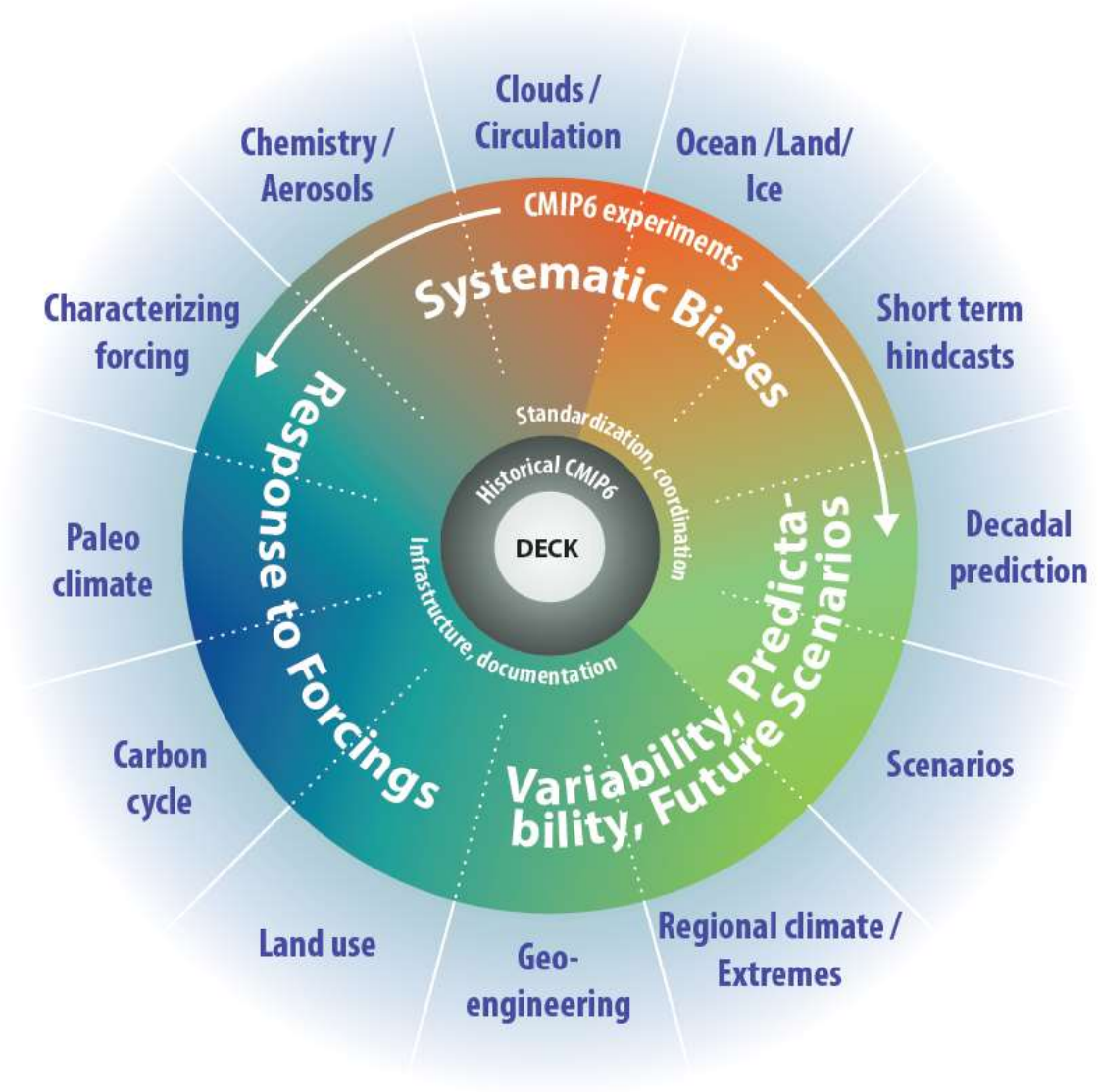
Presented to WGNE

11 October 2018

Purpose:

- Provide a status report
- Make you aware of CMIP resources that you might find useful

CMIP6 design overview:



DECK

- Small set of benchmark runs
- To evolve only slowly (e.g. OMIP, LMIP)

Historical CMIPX

- Forcing to be updated for each new phase

CMIP6-endorsed MIPs

- An evolving collection to address specific scientific issues

CMIP5/6 evolution: More institutions, more models, more experiments, more data

- 44 institutions/consortia have officially registered for CMIP6
- 100 models are registered
- 287 experiments defined
- order 20 PB of model output expected

CMIP6_CVs

https://github.com/WCRP-CMIP/CMIP6_CVs

Core Controlled Vocabularies (CVs) for use in CMIP6

Registering Institutions, Models, or requesting changes to CVs:

To register your institution or model or to request changes to a CV, please submit an issue/ticket following the instructions on the CMIP6_CVs issue page.

Some support for CMIP participating modeling groups is available: pcmdi-cmip@llnl.gov

To view the current Experiment entries point your browser to CMIP6_experiment_id.html

To view the current Institution entries point your browser to CMIP6_institution_id.html

To view the current Source entries point your browser to CMIP6_source_id.html

The CVs build on logic that is described in the CMIP6 Global Attributes, DRS, Filenames, Directory Structure, and CV's document

CMIP6 data availability and IPCC timeline

- Model output from a few models and a few experiments now available
- Much output to be made available over the next year
- Seems unlikely to me that very many multi-model CMIP6 results will be published in time for the IPCC's AR6.

2019	
January 7	Second Lead Author Meeting
April 29	First order draft expert review
August 26	Third Lead Author Meeting
2020	
March 2	Second order draft expert review
June 1	Fourth Lead Author Meeting
October 18	Submission of final draft
2021	
April 16	IPCC acceptance/adoption/approval

31 December 2019:
Journal articles submitted

30 September 2020:
Journal articles accepted

CMIP infrastructure improvements (1)

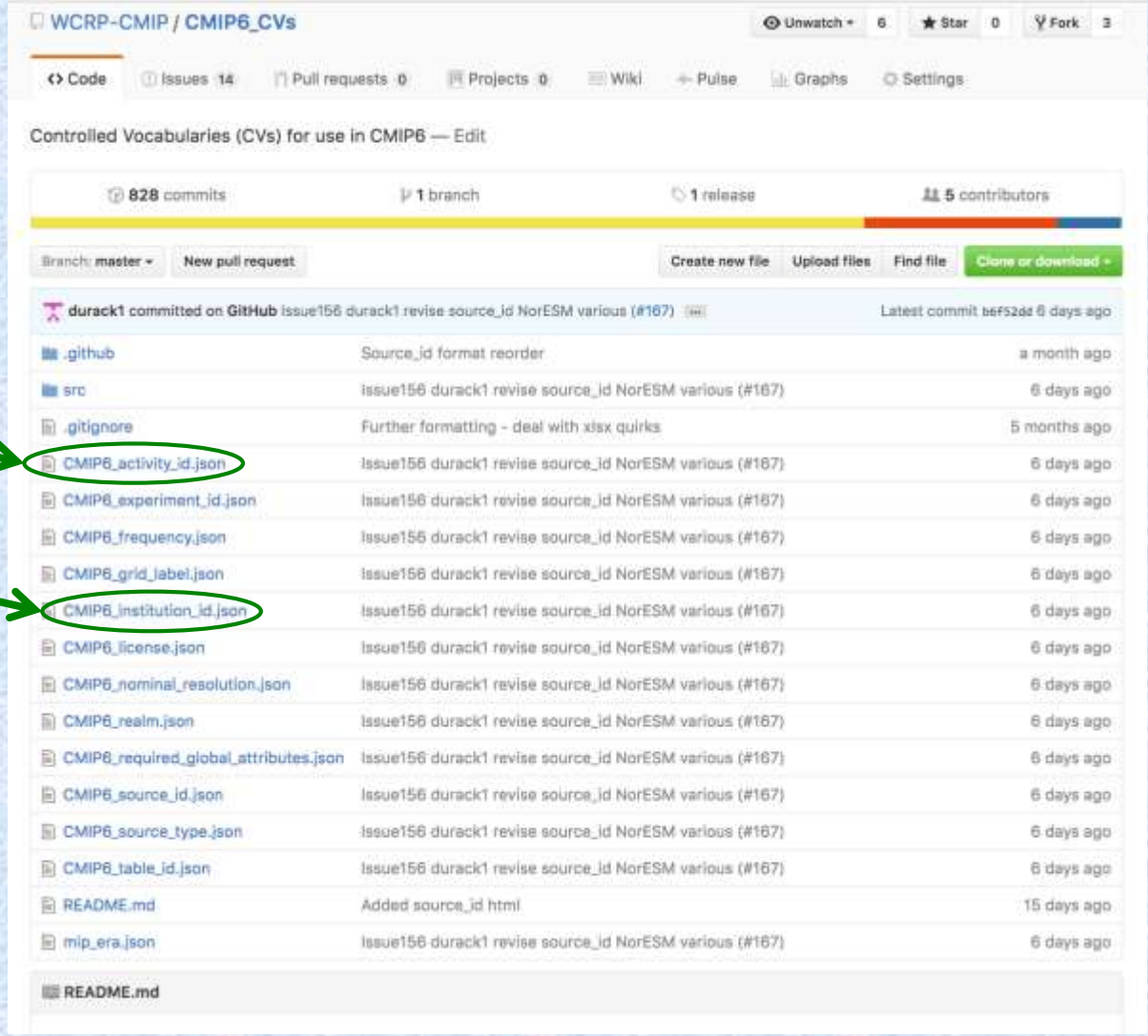
- Infrastructure specifications were developed and documented in a series of WIP position papers (see the summary by Balaji et al. (2018, doi.org/10.5194/gmd-9-1937-2016 and https://www.earthsystemcog.org/projects/wip)
- A reference set of controlled vocabularies was defined to enable independently-developed components of the infrastructure to smoothly interact (https://github.com/WCRP-CMIP/CMIP6_CVs).

Controlled vocabularies are specified in JSON files hosted by github

https://github.com/WCRP-CMIP/CMIP6_CVs

CMIP6_activity_id.json

CMIP6_institution_id.json



CMIP infrastructure improvements (2)

- QC code now run as part of the publication procedure to ensure metadata is consistent with controlled vocabulary (PrePARe).
- input4MIPs hosts a well-documented repository for CMIP6 forcing data sets (https://esgf-node.llnl.gov/projects/input4mips/)

Forcing datasets for CMIP6: Input4MIPs status

- Project initiated April 2016
- Purpose
  - → To collect, version-control, and archive CMIP6 forcing data sets
  - → To impose data and metadata standards facilitating use
- Forcing datasets description/status
  - https://esgf-node.llnl.gov/projects/input4mips/
- input4MIPs holdings to-date
  - → 5620 files & 1.5 Tb of data
- input4MIPs project has adopted the CMIP infrastructure

Input4MIPs DECK/historical forcing data status

Forcing Dataset	input4MIPs Status	Temporal Coverage	Latest Data Version(s)	Contact
SLCF Emissions	**Available**	1750-01 to 2014-12	2017-05-18, 2017-08-30 (Aircraft; **updated**)	Steven Smith
Biomass Burning	**Available**	1750-01 to 2015-12	1.2 (2016-12-13; **updated**)	Margreet van Marle
CO2 and CH4 Emissions	**Available**	1750-01 to 2014-12	2017-05-18, 2017-08-30 (Aircraft; **updated**)	Steven Smith
Land-use	**Available**	850 to 2015	2.1h (2017-01-26)	George Hurtt
GHG concentrations	**Available**	0-01 to 2015-12	1.2.0 (2016-07-01)	Malte Meinshausen
Ozone concentrations	**Available**	1850-01 to 2014-12	1.0 (2016-07-11)	Michaela Hegglin
Nitrogen deposition	**Available**	1850-01 to 2014-12	2.0 (2016-12-07; **updated**)	Michaela Hegglin
Simple plume aerosol	**Available**	1850 to 2100	1.0 (2017-02-01)	Bjorn Stevens
Solar	**Available**	1850-01 to 2299-12	3.2 (2017-01-03; **updated**)	Katja Matthes
Stratospheric aerosol	**Available**	1850-01 to 2014-12	3.0 (2017-10-04; **updated**)	Beiping Luo
AMIP SST and SIC	**Available**	1870-01 to 2016-06	1.1.2 (2017-04-19; **updated**)	PCMDI

Download links, input4MIPs website: https://esgf-node.llnl.gov/search/input4mips
Also see the live google doc at https://goo.gl/r8up31

Endorsed-MIP forcing status

Satellite MIP	Status	Host(s); Version	Contact
CFMIP	Host site	http://doi.org/10.5194/gmd-2016-70; 1.0	Mark Webb
DAMIP	input4MIPs	1.0 (2017-08-14)	David Plummer
DCPP	input4MIPs	1.1 (2017-01-23)	Christophe Cassou
FAFMIP	input4MIPs	http://www.met.reading.ac.uk/~jonathan/FAFMIP/; (2015-08-21)	Jonathan Gregory
HighResMIP	input4MIPs	2.2.0.0-r1 (2017-05-05)	Malcolm Roberts
LS3MIP	In prep.	Data is yet to be contributed	Sonia Seneviratne
OMIP	input4MIPs	http://data1.gfdl.noaa.gov/nomads/forms/core/COREv2.html http://amaterasu.ees.hokudai.ac.jp/~tsujino/JRA55-do-v1.2/ CORE (Ready); JRA55-do v1.2 (Ready)	Gokhan Danabasoglu
PMIP	Host site	https://pmip4.lsce.ipsl.fr/doku.php; ?	Masa Kageyama
RFMIP	Ready	0.4 (2017-01-18)	Robert Pincus
ScenarioMIP	In prep.	Land-use – 2.1f (2017-10-05); emissions (in prep.)	Detlef van Vuuren
VolMIP	Ready	3.0 (2017-10-04); EVA module (Ready – GMD below) https://doi.org/10.5194/gmd-9-4049-2016	Davide Zanchettin

Infrastructure improvements: CMIP6 Guide now available

This is the place to go first if you need CMIP6 help!

https://pcmdi.llnl.gov/CMIP6/Guide/dataUsers.html

- Experiment design
- Model output specifications
- Accessing model output
- Terms of use and citation requirements
- Model and experiment documentation
- Reporting suspected errors
- Registering published work based on CMIP6
- CMIP6 organization and governance

CMIP infrastructure improvements (4)

- Advanced planning and extensive testing have resulted in a smooth launch of the ESGF CMIP6 archive.
- A data citation service is in place to facilitate proper acknowledgment in scientific publications.
- Central documentation will be provided via ES-DOC's, which is undergoing testing and should be ready in spring 2019.

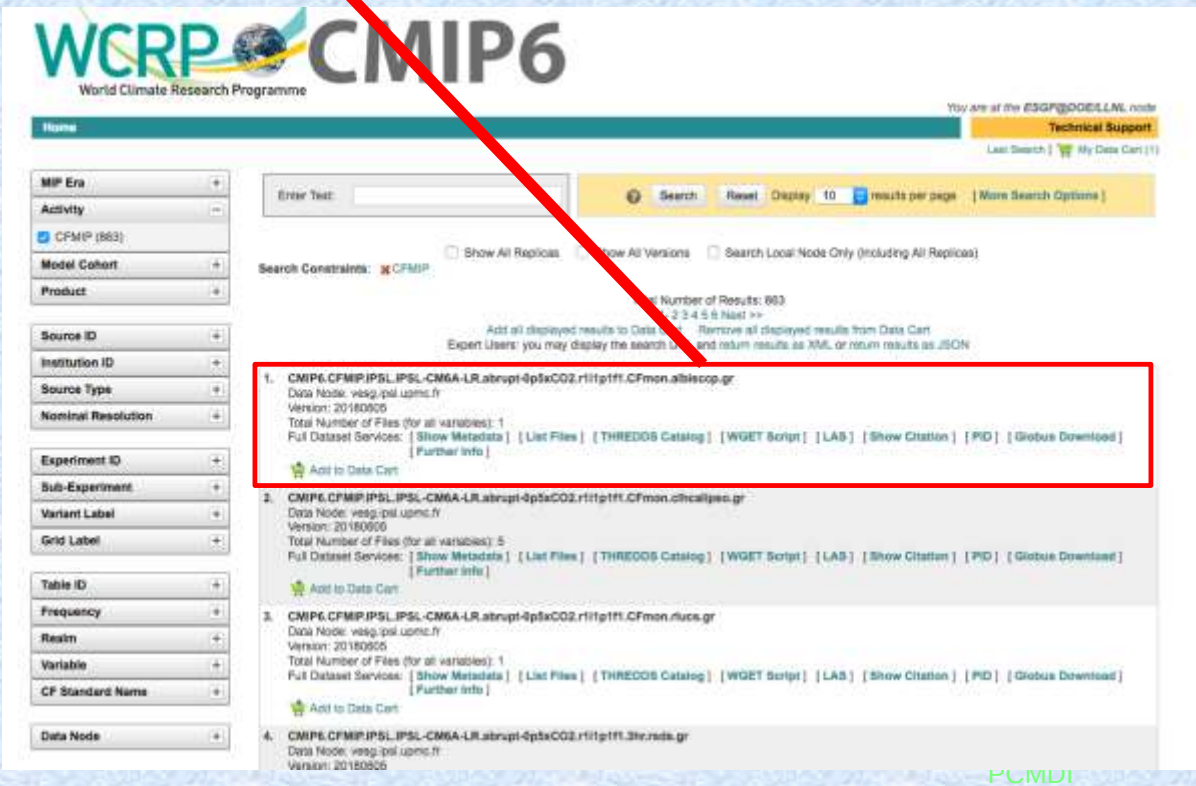
Data now available via ESGF data portals

- All available CMIP6 data obtainable from:
  - IPSL (France) https://esgf-node.ipsl.upmc.fr/search/cmip6-ipsl/
  - PCMDI/LLNL (USA) https://esgf-node.llnl.gov/search/cmip6/
- 4 models and 12 experiments
- Download options:
  - Point and click (http)
  - WGET script (http)
  - Globus (grid ftp)

Data now available via ESGF data portals

Show Citation

1. **CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2.r1i1p1f1.CFmon.albisccp.gr**
   Data Node: vesg.ipsl.upmc.fr
   Version: 20180605
   Total Number of Files (for all variables): 1
   Full Dataset Services: [Show Metadata] [List Files] [THREDDS Catalog] [WGET Script] [LAS] [Show Citation] [PID] [Globus Download] [Further Info]
   Add to Data Cart



Citation page

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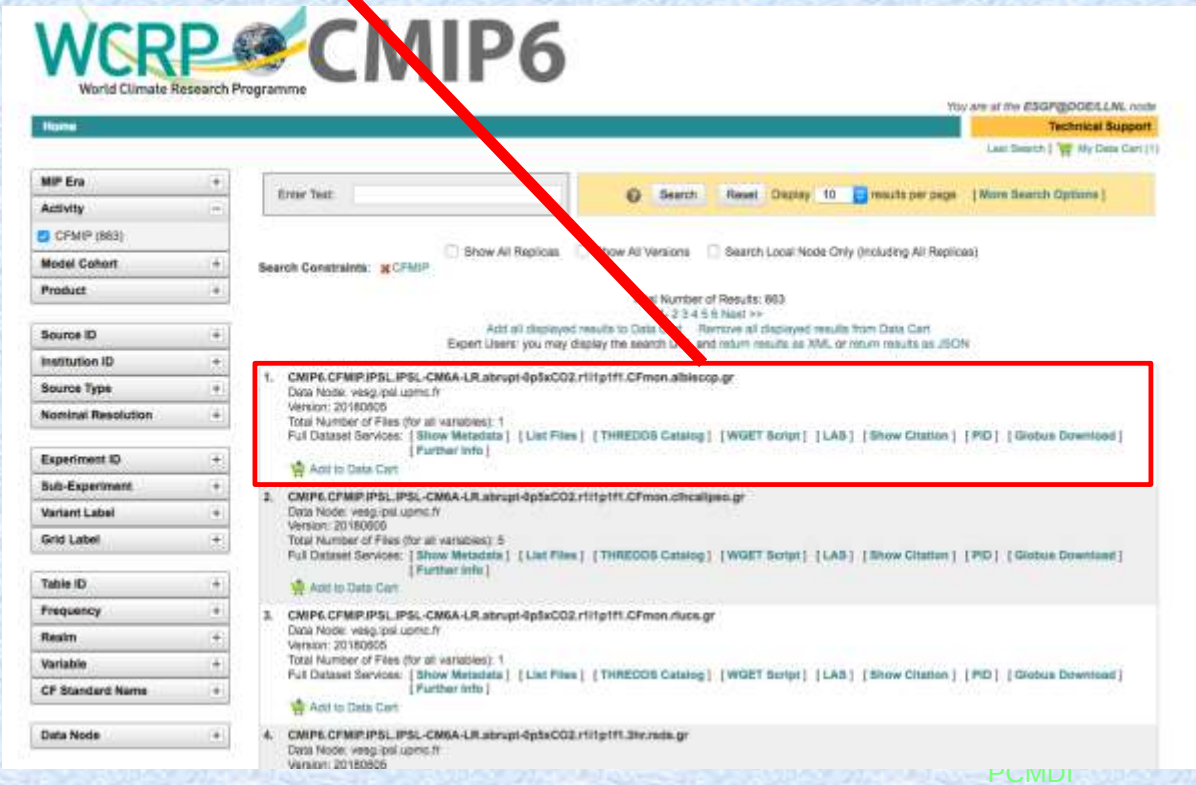
Further Info



Model and experiment documentation by es-doc

es-doc
Earth System Documentation

CMIP6 Further Information v0.5.0.0 Support Help

Further Info URL: https://furtherinfo.es-doc.org/CMIP6.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2.none.r1i1p1f1

ES-DOC Documentation

MIP Era	CMIP6
Institution	IPSL
Model	IPSL-CM6A-LR
Experiment	abrupt-0p5xCO2
Ensemble Description	N/A
Machine Performance	N/A

Dataset Documentation

Dataset ESGF Search	N/A
Dataset Errata	N/A
Dataset Citation(s)	https://cera-www.dkrz.de/WDCC/meta/CMIP6/CMIP6.CFMIP.IPSL.IPSL-CM6A-LR.abrupt-0p5xCO2

Other Documentation

WCRP CMIP6 Homepage	https://www.wcrp-climate.org/wgcm-cmip/wgcm-cmip6
ES-DOC CMIP6 Homepage	https://es-doc.org/cmip6

Obs4MIPs status

- Data specifications are now more closely aligned with CMIP6
- CMOR software has been adapted for use with obs4MIPs
- Existing data is being rewritten to conform
- Many new datasets expected soon.
- New obs4MIPs site: https://esgf-node.llnl.gov/projects/obs4mips/

First workshop to share preliminary CMIP6 results

- Acceptable to report on CMIP6 results from a single model
- Submit abstracts October 15– November 30

CMIP6 Model Analysis Workshop

Barcelona, Spain

25-28 March 2019

(https://www.wcrp-climate.org/news/wcrp-news/1360-cmip6-ma-workshop)

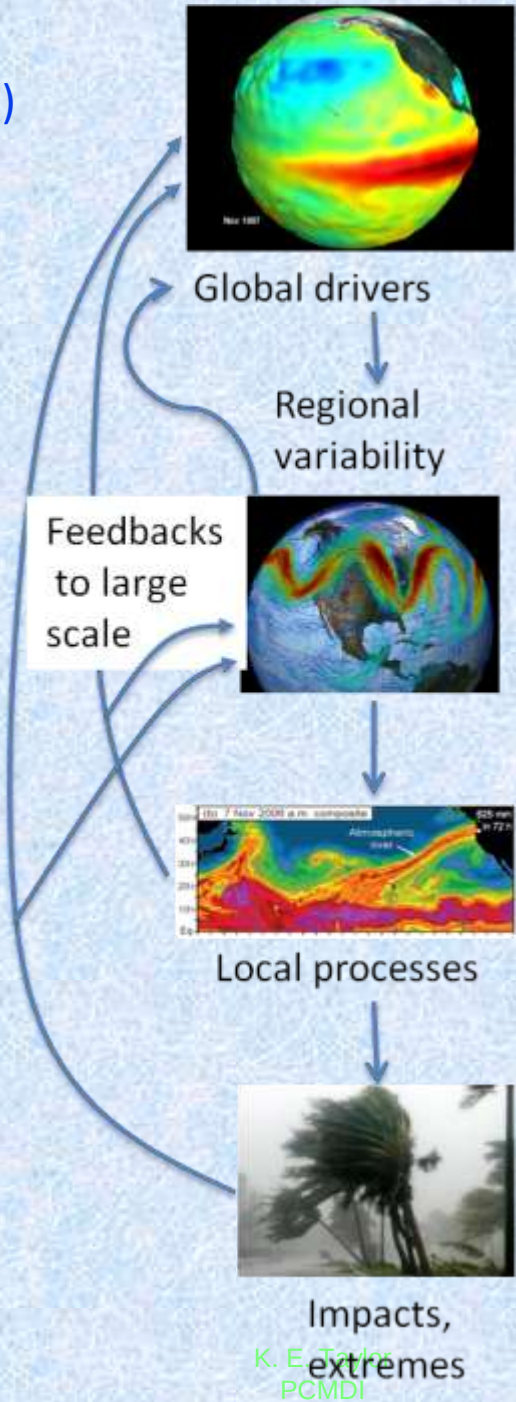
HighResMIP

Rein Haarsma KNMI (co-lead)
Malcolm Roberts Met Office (co-lead)

Goal of HighResMIP:

- to investigate the robustness across a multi-model ensemble of changes to the representation of climate processes as model horizontal resolution is increased
- To find out if there is any convergence with resolution across models
- Use coordinated, simple experimental protocol, each simulation using at least two model resolutions - Haarsma et al 2016
  - Tier 1: atmosphere-only, 1950-2014
  - Tier 2: 30-50 year spin-up, then pairs of coupled simulations, constant 1950's forcing and transient 1950-2014
  - Tier 3: 2015-2050 future forced simulations with both atmosphere-only and coupled models

CMIP6 main science question: What are the origins and consequences of systematic model biases



HighResMIP modelling groups (1)

Model name	Contact Institute	Tier	Atmos resolution (STD/HI) mid-latitude (km)	Ocean resolution (HI)
AWI-CM	Alfred Wegener Institute (Germany)	2,3	T63 (~200 km) T127 (~100 km) T255 (~50 km)	50 km (variable) 25 km (variable) 10 km (variable)
BCC-CSM2-HR	Beijing Climate Center (China)	1,2	TBD	
BESM	CPTEC/INPE (Brazil)	1	TBD	
CAM6-CSM1.0	NCAR/UCAR (USA)	1	100 km 28 km	
CAMS-CSM1.0	Chinese Academy of Meteorological Sciences (China)	1	T106 (~120 km) T255 (~50 km)	1 degree
CAS-ESM	IAP, CAS (China)	1	1.4x1.4 degree 0.5x0.5 degree	
CIESM	Tsinghua University (China)	1,3	100 km 25 km	
CMCC-CM2	Centro Euro-Mediterraneo sui Cambiamenti Climatici (Italy)	1,2,3	100 km 25 km	 0.25 degree
CNRM-CM6	CNRM-CERFACS (France)	1,2,3	T127 (~100 km) T359 (~35 km)	1 degree 0.25 degree
EC-Earth3	SMHI, KNMI, BSC and 26 other institutes (Europe)	1,2,3	T255 (~50 km) T511 (~25 km)	1 degree 0.25 degree
ECMWF-IFS	ECMWF (Europe)	1,2	Tco199 (~50 km) Tco399 (~25 km)	1 degree 0.25 degree
FGOALS-f3-H (L)	LASG, IAP, CAS (China)	1,2	1 degree 0.25 degree	 10 km

HighResMIP modelling groups (2)

Model name	Contact Institute	Tier	Atmos resolution (STD/HI) mid-latitude (km)	Ocean resolution (HI)
GFDL AM4	GFDL (USA)	1,2	50 km	
HadGEM3-GC3.1	Met Office Hadley Centre (UK)	1,2,3	130 km 60 km 25 km	1 degree 0.25 degree 1/12 degree
HiRAM-SIT	RCEC, Academia Sinica, (Taiwan, China)	2	50 km 25 km	25 km
INMCM5H	Institute of Numerical Mathematics (Russia)	1,2,3	1.5 x 2 degree 0.5 x 0.66 degree	0.25 x 0.5 degree 1/8 x 1/6 degree
MIROC6-CGCM	AORI, Univ. Of Tokyo/JAMSTEC/National Institute for Environmental Studies (NIES) (Japan)	1,2	T213 (~60 km)	0.25 degree
MPAS-A	Pacific Northwest National Laboratory (USA)	1,3	120 km 30 km	18-6 km (variable)
MPI-ESM-1-2	Max Planck Institute for Meteorology (Germany)	1,2,3	T127 (~100 km) T255 (~50 km)	0.4 degree
MRI-AGCM3.xS	Meteorological Research Institute (Japan)	1	-- TL959 (~20 km)	
NICAM glevel-7/8/9	JAMSTEC, AORI, Univ. Of Tokyo//RIKEN AICS (Japan)	1	56 km 28 km 14km (short term)	
NorESM2-H	Norwegian Climate Service Centre (Norway)		-- 0.25 degree	0.25 degree
E3SM	DOE National Laboratories (USA)	1		

Simulation progress

- Tier 1 (atmosphere-only):
  - → 6 European groups have completed simulations as part of EU-PRIMAVERA project, and analysis ongoing
  - → Several other groups active (FGOALS-f3-H, NICAM, MPAS-A), GFDL finished (colours indicate known activity)
- Tier 2 (coupled control-1950 & hist-1950):
  - → 7 European groups have finished simulations
  - → GFDL also completed
- Tier 3 (future to 2050, atmos-only + coupled):
  - → Awaiting future scenario CMIP6 forcing datasets
  - → Hoping to start simulations Oct/Nov 2018

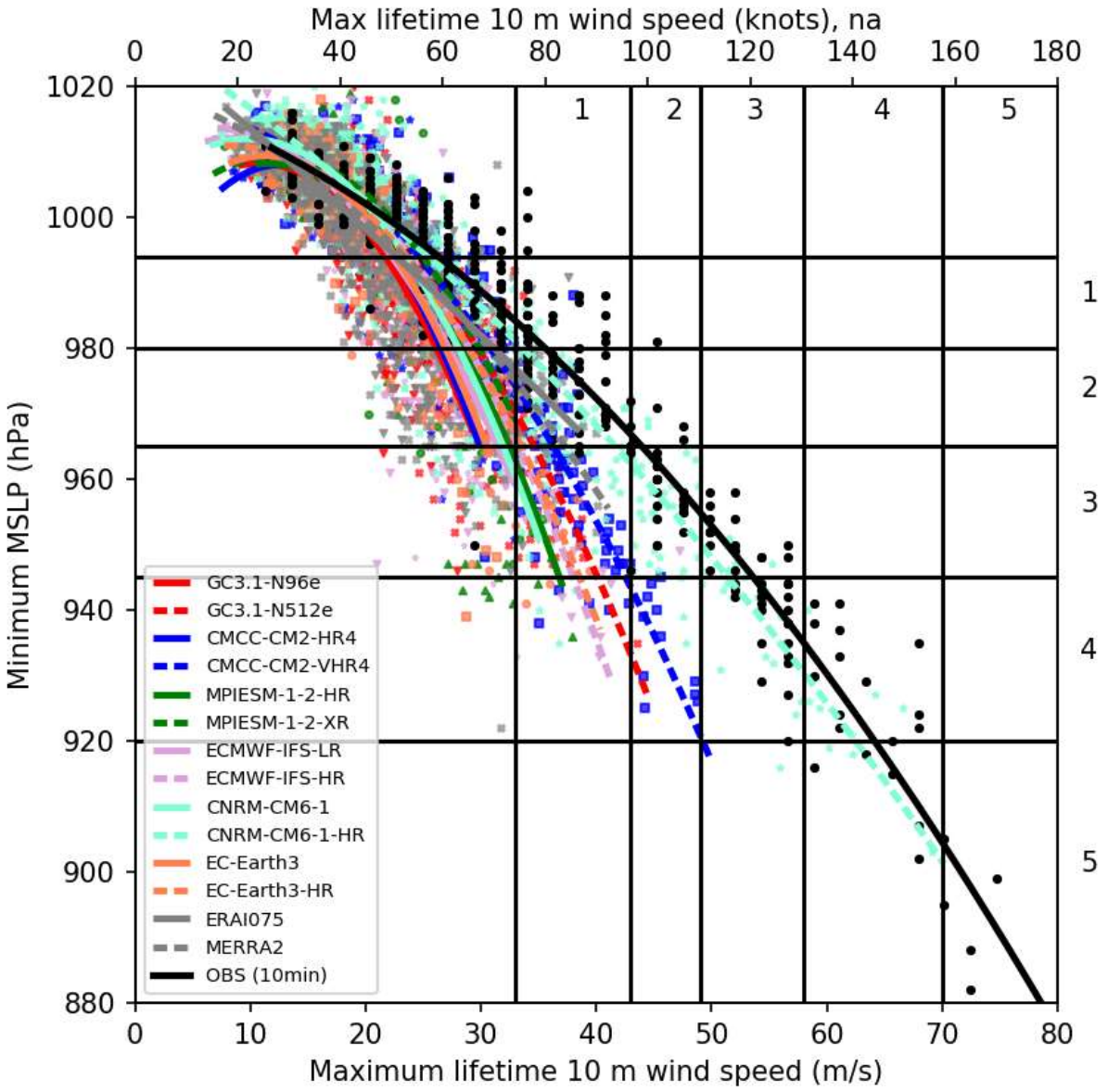
Results/analysis so far

- Initial analysis is being coordinated between EU-PRIMAVERA and other groups
  - → documented at collab.knmi.nl/project/highresmip
  - → CLIVAR panels (including Dynamics, Atlantic, Southern Ocean, etc)
  - → International Tropical Cyclone groups
  - → various other individual groups
- Model data available (~3PB) on single CEDA-JASMIN platform with analysis and processing tools and compute cluster
  - → This will enable coordinated analysis without need to download data elsewhere
  - → Suggest this is the way forward for other CMIP6 analyses

Data upload to ESGF and sharing

- Model data currently being validated on CEDA-JASMIN
- Hope to start upload to ESGF in ~2 months time
- Tropical cyclone tracks (using two algorithms) to be published to CEDA catalogue
  - → And hence available to the community
- Climate extremes indices
  - → Currently being calculated for all models, to be made available to community ASAP

Tropical cyclone intensities in North Atlantic



Tropical cyclones at peak intensity from highresSST-present simulations (atmos-only)

Solid lines – lower resolution
Dashed lines – higher resolution

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Coupled models - SST bias at end of 30/50 year spinup using 1950's forcing

Pairs of models – bias at higher resolution, and difference higher – lower resolution (atmosphere and/or ocean)