EC-Earth in CMIP6 – Status updates

Simulations are available or will soon be published on the ESGF

Model configuration	ATM Res.	Oce. Res.	CMIP6 activity	Total simulated years	Members published	Members not published	Total number of members	Remarks
EC-Earth3	80 km L91	1 deg L75	DECK	3008	1	2	3	3 of each experiment, 1 piControl of 1000 years
			historical	6375	73	2	75	50 members started from perturbed states of 1950
			ScenarioMIP	24636	72	3	75	75 members for 4 Tier1 scenarios + 52 members for SSP1-1.9
			AerChemMIP, C4MIP, CORDEX, DCPP, LS3MIP, OMIP, PAMIP, RFMIP, SIMIP	21937	x	x		Working on publishing data for CORDEX
EC-Earth3-Veg	80 km L91	1 deg L75	DECK	2680	1	1	2	1 member for each experiment
			historical	2145	8	5	13	
			ScenarioMIP	22130	3 - 8	x	10-12	10-12 members for Tier1 SSPs, 7 members for SSP1-1.9,
			LS3MIP, LUMIP	417	x			
EC-Earth3-LR	125 km L62	1 deg L75	DECK	1001	0.5	0.5	1	piControl has published
			historical	165	-	1	1	
			ScenarioMIP	344	-	1	1	
			PMIP	1600	1		1	1 member from 4 experiment
EC-Earth3-Veg-LR	125 km L62	1 deg L75	DECK	840	1	-	1	1 member from each experiment
			historical	495	3	-		
			ScenarioMIP	1290	-	3		3 members for 5 scenarios
			PMIP	450		1		1 member for 3 experiment
EC-Earth3-AerChem	125 km L62	1 deg L75	AerChemMIP, ScenarioMIP	2160	1	x		1-4 members for all Tier1 exp. + 1-2 members for some Tier2/3 ex
EC-Earth3-HR	40 km L91	0.25 deg L75	DCPP, HighResMIP	775	-	10		10 members for 15 startyears
EC-Earth3P	125 km L62	1 deg L75	HighResMIP	805	2-3	2-3	4-6	4-6 members for each exp.
EC-Earth3P-HR	40 km L91	0.25 deg L75	HighResMIP	805	2-3	2-3	4-6	4-6 members for each exp.

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			historical	2145	8	5	13	
			ScenarioMIP	22130	3 - 8	x	10-12	
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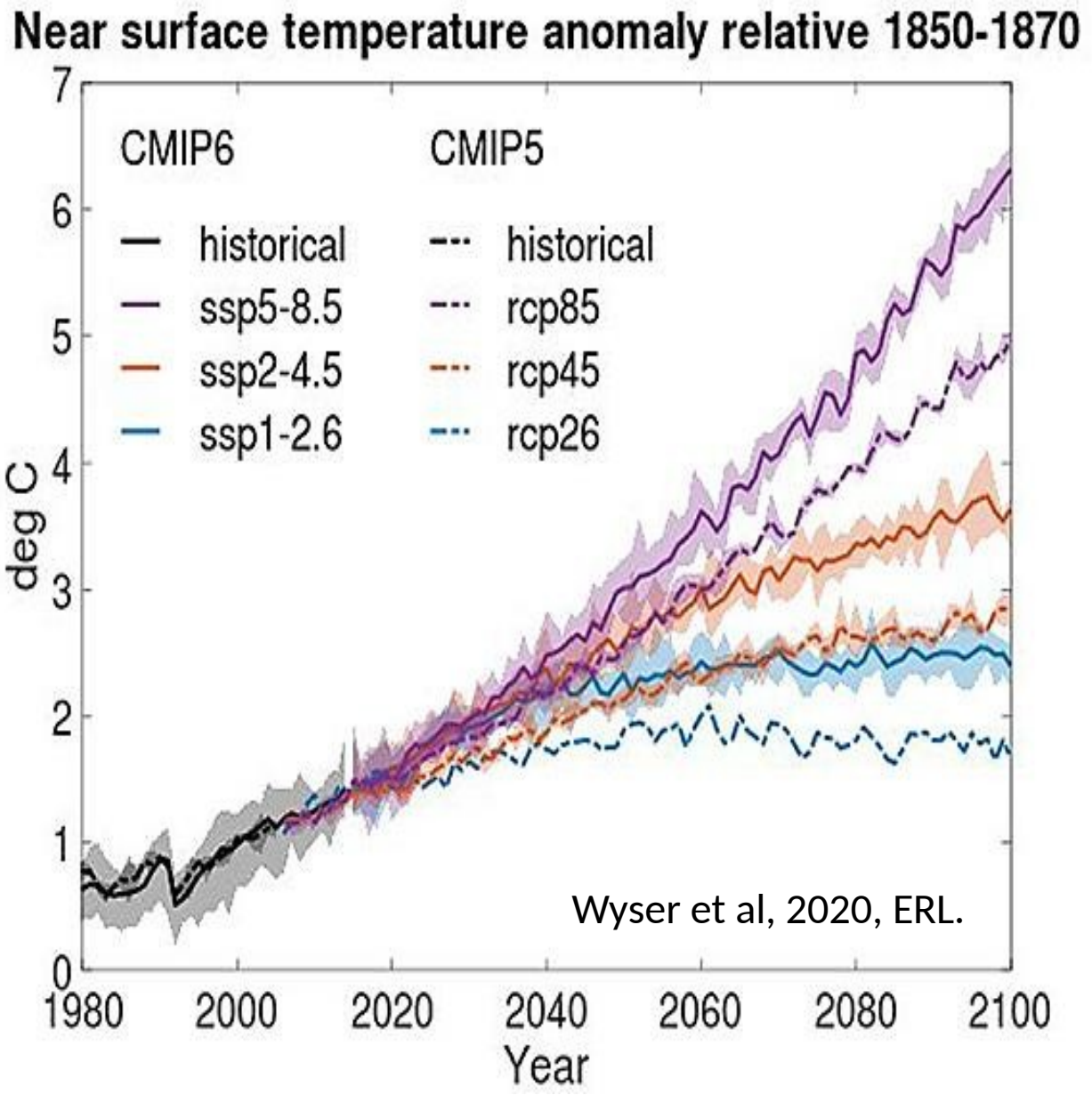
- 8 model configurations, with both GCMs and (light) ESMs, 3 resolutions
- Contribute to 14 MIPs
- Total simulations years more than 94000 years
- Many studies of the CMIP6 results using EC-Earth only/with other models jointly have been published/ submitted/in preparation

EC-Earth CMIP6 assessment of climate change

- EC-Earth **projected future climate changes slightly above the CMIP6 multi-model** ensembles
- L**ikely related to the (high) ECS** (~4.3 K)
- EC-Earth **projections for the are warmer than those for CMIP5**, as many ESMs
- **Due to higher ECS** (~4.3 K vs ~3.3 K) and **higher ERF in CMIP6**
- 50% or more of the temperature increase by 2100 for SSP5-8.5 and SSP2-4.5 is **due to differences in the prescribed GHG concentrations**
- **CMIP6 and CMIP5 scenarios are not directly comparable**; needs to be explained to stakeholders



Ongoing engagement with CMIP6

- **Two more ESM configuration**s are currently being finalized:
  - **EC-Earth3-CC: w**ith full carbon cycle

    Contribute to: CMIP, CDRMIP, C4MIP, DCPP, LUMIP, OMIP
  - **EC-Earth3-Veg-GrIS:** with interactive ice sheet model for Greenland

    Contribute to: CMIP, ISMIP6, PMIP
- **More simulations in progress** for contributions to

  ScenarioMIP, AerChemMIP, C4MIP, DCPP, DynVarMIP, HighResMIP, LUMIP, and Covid-MIP
- Documentation
  - A number of **papers** documenting model system/configurations, performance and climate change assessments under preparation/been sumitted
  - ES-DOC
  - Continue the efforts of **publishing** all simulations on the **ESGF**, including data for **CORDEX** which are on model vertical levels of high resolution
- Will use historical and scenario experiments for **dynamical downscaling** in CORDEX, including contributions to Euro-CORDEX, Polar-CORDEX, etc.
- **Analysis** of the CMIP6 and CMIP6-MIPs experiments **will continue**

Ongoing engagement with CMIP6

- EC-Earth's contributions to CMIP6 have been heavily relied on the supports of projects funded by EU H2020, Nordic research funds as well as partners national funding
- Analyses of CMIP6/CMIP6-MIPs has formed the bases in many research projects and foster new initiatives regarding process understanding of the climate variability and climate changes; for assessment, predictions and projections of climate changes with reduced uncertainty, globally and regionally such as in Europe, and in the Arctic at diverse temporal scales.

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Lessons learned from CMIP6

- **Forcing** data sets: Quality control, transparency, and keeping a timeline that can be handled by model teams
  - quality issues and quality control, eg.
    - The provided **stratospheric aerosol data** set is **only valid above the tropopause level,** but isn't filtered. So in case a model underestimates the actual tropopause height, it may see incorrect values.
    - the CMIP6 MACv2-SP data set is based on a pre-final version of the CEDS emissions (used for scaling of the aerosol optical depth in the plumes).
  - For **particulate emissions**, if possible give **recommendations on particle size distributions and vertical profile** shapes for the relevant sources.
  - Should be versioned and the **format of the forcings** (dimensions, names, units) **should not change** from one version to version.
  - More **transparency on the creation of forcing**s - What is the reason to select forcings from a specific group/institute and not from others?
  - **Earlier provision of forcing in CMIP7**, to avoid mismatch between model output availability and publication deadlines
- **Data request was too large, unclear priorities, and too many late changes.**
  - The CMIP DR should be concise and **cover only the most important variables**
  - The **number of variables in the DR from the MIPs could be reduced** after consultation with the MIPs.
  - **Changes** to the existing data request should be incremental, well justified and **clearly explained.**
  - **Backward compatibility of the DR** should be ensured whenever the DR is updated, no late changes that make already produced data noncompliant.
  - **For CMIP7, use the (reduced) CMIP6 DR as the basis**
- Better coordination between MIPs
  - Eg. **Land off-line simulations** in CMIP6 were of interest to several MIPs but each MIP (and external projects; e.g. TRENDY project) tended to diverge in the configurations/set-up; this reduced the potential to have comprehensive evaluations and inter-model comparisons of current state-of-the-art land models.
  - **Pursue an endorsed Land-MIP in CMIP7** able to coordinate an off-line land model intercomparison, or maybe **consider a set of Land simulations as part of core-set "DECK" simulations**.