The CMCC contribution to CMIP-6

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WGCM + modelling groups' representatives meeting
9-10 October, 2014, Grainau, Germany

cmcc
Centro Euro-Mediterraneo
sui Cambiamenti Climatici

The new CMCC Climate Model

The new **CMCC ESM** is based on the NCAR Community Earth System Model (**CESM**) version 1.1.2 and on the **NEMO** ocean model version 3.4. (+ Marine Biogeochemistry CMCC model BFM5.1), which has been fully integrated into the NCAR CESM, replacing the default CESM ocean model (POP2).

River routing
River Tranport Model
RTM

Atmosphere
Community Atmosphere Model
CAM5.2

Coupler / Driver
CPL7

Land / Vegetation
Community Land Model
CLM4.0/CLM4.5

Sea Ice
Community
Ice Code
CICE4

Ocean
Nucleus for European
Modelling of the Ocean
NEMO 3.4

Marine Biogeochemistry
BFM5.1

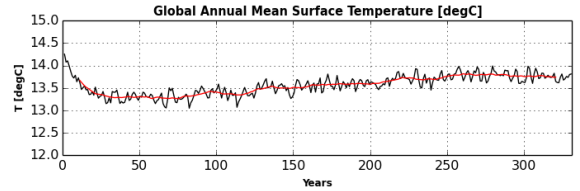
The new CMCC Climate Model

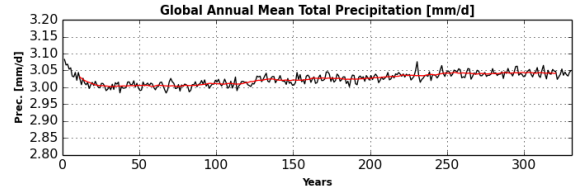
- **Atm: CAM-5.2**
  - ✓ Spectral Elements dynamical core (cubed sphere grid)
  - ✓ 1°x1° and 1/4°x1/4° horiz. resolution, 30 vertical levels (top at ~2 hPa)
- **Land: CLM-4.0**
  - ✓ C&N cycles
  - ✓ same atmosphere grid (cubed sphere grid)
- **River: RTM**
  - ✓ 0.5x0.5 deg horizontal resolution
- **Ocean: NEMO-3.4**
  - ✓ ORCA1 (1°x1°) horizontal resolution, 46 vertical levels
  - ✓ ORCA025 (1/4°x1/4°) horizontal resolution, 50 vertical levels
- **Sea-Ice: CICE-4.0** ✓ same ocean grid, 1 or 5 sea-ice categories
- **Marine Biogeochemistry: BFM-5.1** ✓ same ocean grid
- **Cpl: CPL-7**
  - ✓ coupling time-step: atm, land, sea ice = 0.5 hours
  - ✓ ORCA1 coupling time-step: ocn, rof = 1 hours (i.e. every 2 ocean model time-steps)
  - ✓ ORCA025 coupling time-step: ocean, rof = 1.5 hours (i.e. every 5 ocean model time steps)

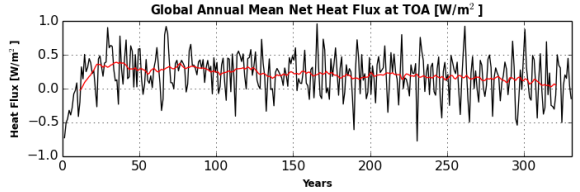
The new CMCC Climate Model

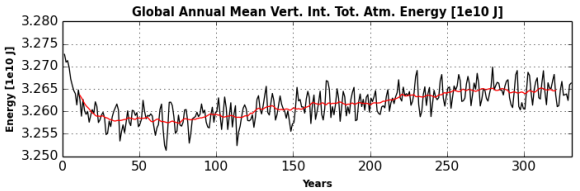
Now, we are in the model testing phase:

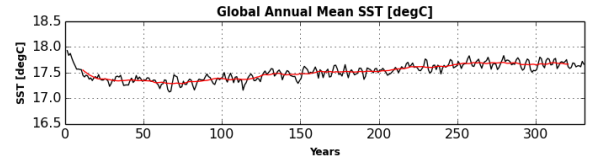
integrations of several hundreds of years already performed with different resolutions, e.g. Atm(1°x1°)-Oce(1°x1°) and Atm(1°x1°)-Oce(1/4°x1/4°)

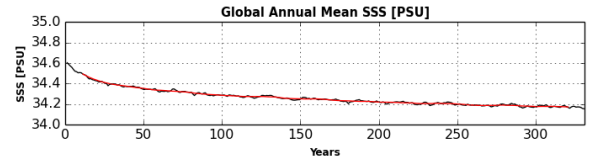


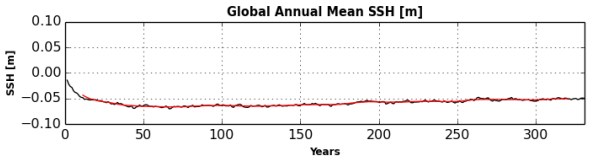


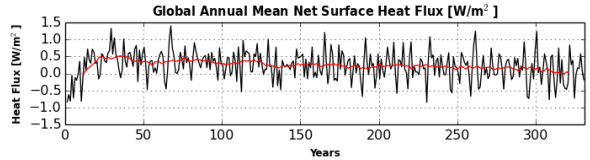


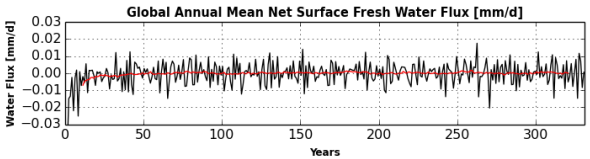


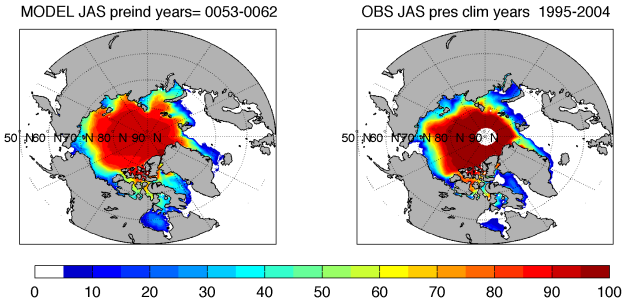


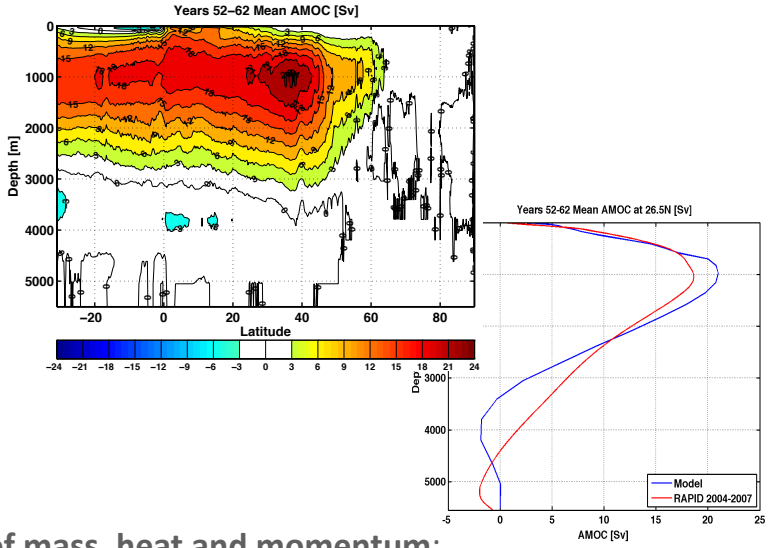












- The interface between NEMO and CESM was designed to ensure **conservation of mass, heat and momentum**:
  - conservation error on globally averaged T: 10^{-3} °C/century
  - conservation error on globally averaged S: 10^{-4} psu/century
- Validation of the coupling interface: CORE-II (Danabasoglu et al. 2014).

CMCC Contribution to MIPs

	NOTE:	0: if you do not plan to contribute simulations with your model to this MIP 1: if you plan to contribute simulations to this MIP 2: if you are not sure yet whether or not you will contribute simulations to this MIP	
			7
	Short name of MIP	**Long name of MIP**	CMCC Italy
1	**AerChemMIP**	Aerosols and Chemistry Model Intercomparison Project	0
2	**C4MIP**	Coupled Climate Carbon Cycle Model Intercomparison Project	1
3	**CFMIP**	Cloud Feedback Model Intercomparison Project	0
4	**DAMIP**	Detection and Attribution Model Intercomparison Project	0
5	**DCPP**	Decadal Climate Prediction Project	1
6	**FAFMIP**	Flux-Anomaly-Forced Model Intercomparison Project	0
7	**GDDEX**	Global Dynamical Downscaling Experiment	0
8	**GeoMIP**	Geoengineering Model Intercomparison Project	0
9	**GMMIP**	Global Monsoons Model Intercomparison Project	2
10	**HighResMIP**	High Resolution Model Intercomparison Project	1
11	**ISMIP6**	Ice Sheet Model Intercomparison Project for CMIP6	0
12	JCOMM*	Coordinated Ocean Wave Climate Project	0
13	**LS3MIP**	Land Surface, Snow and Soil Moisture	1
14	**LUMIP**	Land-Use Model Intercomparison Project	1
15	**nonlinMIP**	Non-linear Model Intercomparison Project	0
16	**OCMIP6**	Ocean Carbon Cycle Model Intercomparison Project, Phase 6	1
17	**PDRIP**	Precipitation Driver and Response Model Intercomparison Project	0
18	**PMIP**	Palaeoclimate Modelling Intercomparison Project	1
19	**RFMIP**	Radiative Forcing Model Intercomparison Project	0
20	**ScenarioMIP**	Scenario Model Intercomparison Project	1
21	**SensMIP**	Sensitivity Model Intercomparison Project	0
22	**VolMIP**	Volcanic Forcings Model Intercomparison Project	0

CMCC Contribution to CMIP-6

		ESM Atm(1° x 1°) + Oce(1° x 1°)	**ESM** Atm(1° x 1°) + Oce(1/4° x 1/4°)	**CM Standard Res.** Atm(1° x 1°) + Oce(1/4° x 1/4°)	**CM High Res.** Atm(1/4° x 1/4°) + Oce(1/4° x 1/4°)	**AMIP** (1° x 1°) (1/4° x 1/4°)
Deck		**~ 800 yrs**	**~ 800 yrs**	**~ 800 yrs**		
MIPs	HighResMIP			**~ 300 yrs**	**~ 100 yrs**	**~ 600 yrs**
	DCPP			**~ 3000 yrs**		
	C4MIP	**~ 300 yrs**				
	LS3MIP	**~ 500 yrs**				
	LUMIP	**~ 400 yrs**				
	OCMIP6		**~ 150 yrs**			
	PMIP	**~1500 yrs**				
	ScnarioMIP			**~ 200 yrs**		
	GMMIP	**~ 1300 yrs**				
Total		**~ 3500 yrs**	**~ 950 Yrs**	**~ 4300 yrs**	**~100 yrs**	**~ 600 yrs**

~ 10000

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Feedback on CMIP6 design

Which CMIP6 design do you prefer:

a) no further prioritization beyond the DECK. MIPs entirely based on groups' scientific interests
b) definition of a CMIP6 core: DECK plus a set of selected CMIP6-endorsed MIP experiments

We prefer option (a): it guarantees that also relatively small groups can contribute to the CMIP6 simulations; it allows modeling groups to concentrate their efforts on the MIPs closer to their research interests.

DECK simulations:

- AMIP simulation (~1979-2010); ✓
- a multi-hundred year pre-industrial control simulation; ✓
- a 1%/yr CO2 increase simulation to quadrupling to derive the transient climate response; ✓
- an instantaneous 4xCO2 run to derive the equilibrium climate sensitivity; ✓

Other issues

Things (among the others) we concern about:

- To have the inputs to run the DECK experiments (SST for the AMIPs, forcing for the pre-industrial) as soon as possible

- feedbacks (e.g., statistics on the downloaded data) on the use of the simulations (CMIP5): is it really necessary to post-process and archive the huge amount of data as it has been done for CMIP5?

Thanks