Climate model overview

The Past4Future consortium exploits climate system models which are already in use (or will be in operation soon) by the project participants. A usage of these modeling tools reflects a current state-of-the-art in the climate model development. Because of our imperfect understanding of the climate system and current limitations of computing power, the permanent process of model improvement has not led to a selection of one (or few) “best” climate system model(s). Climate modeling community typically uses several models to get a range of model uncertainty. Two commonly used classes are Earth system models of full (GCMs) and intermediate (EMICs) complexity.

Table A5.1. Overview of climate (Earth) system models to be used in Past4Future

Partner	Model	Model class (GCM or EMIC), resolution	Components	Workpackage	Applications within Past4Future
2 (BCCR)	MITgcm -2D GISS	EMIC (3D ocean 4°x4°, zonally averaged atmosphere)	Atmosphere, ocean, sea ice, carbon cycle, hydrology, vegetation, $\delta^{13}C$, ocean sediments (to be coupled), adjoint of the ocean and chemistry components.	1.1, 1.2, 2.1, 2.2	Transient simulation of present and last interglacials. State estimate and sensitivity of mean Eemian climate using adjoint of the model.
2 (BCCR)	NorESM (CAM-CLM-MICOM-CSIM-HAMOCC)	GCM (coarse T31 version of the IPCC AR5 model, 3.75 deg resol., gx1v5 resol with 35 layers in ocean)	Atmosphere, ocean, sea ice, dynamic vegetation, carbon cycle, atmospheric chemistry	1.1, 1.2, 2.1, 2.2	Transient simulations of present and last interglacials driven by accelerated orbital forcings and GHG concentrations, “snapshot” simulations with freshwater and solar forcings

5 (UNIBE)	Bern3D-LPJ	EMIC (coarse resolution, 5°x10°, 32 levels, land: 3.75x2.5°	atmosphere (lat-long EBM), ocean incl. sediments (3D), sea ice, carbon cylce, food web model, 14C, 13C, Pa/Th, Nd, dynamic vegetation (LPJ), wetlands, CH4, marine N2O. Permafrost and land N2O to be developed	1.1, 3.1, 3.2	Holocene physical-biogeochemical changes, abrupt climate change during ice age, direct paloclimate simulations, Ensemble Kalman simulations
5 (UNIBE)	CSM1.4-carbon, CCSM3-carbon	GCM including comprehensive carbon cycle, T31	NCAR CSM, version 1.4 and CCSM, version 3 (ocean-atmosphere-land-sea ice-coupler) both with marine and terrestrial carbon cycle.	3.1, 3.2	carbon cycle response in ocean, atmosphere and land cover to abrupt climate change, north-south connections
5 (UNIBE)	CCSM3	GCM	NCAR CCSM, version 3	1.1	simulations of northern hemisphere climate modes to interpret high-resolution CFA measurements
9 (BRIS)	FAMOUS	GCM (coarse resolution version of HadCM3, 11.25° by 5° in atmos).	Atmosphere, ocean, sea ice, option for dynamic vegetation (under development), option for dynamic ice-sheets (under development)	1.1,1.2,2.1, 2.2,4.1	Transient runs of present and last interglacials with/without dynamic vegetation and sea ice.

9 (BRIS)	HadCM3	GCM, 3.75° by 2.5° in atmos. AR4 model.	Atmosphere, ocean, sea ice, option for dynamic vegetation	1.1,1.2,2.1, 2.2,4.1	Snapshot present and last interglacial runs with/without dynamic vegetation
9 (BRIS)	GENIE	EMIC	Atmosphere, ocean, sea ice, carbon cycle, carbonate sediments	3.1	Transient present and last interglacial runs with interactive carbon cycle
10 (UCL)	LOVECLIM	EMIC (T21 in the atmosphere and for land, 3° in the ocean)	Atmosphere, ocean, sea ice, dynamic vegetation, carbon cycle, ice sheets, Oxygen and hydrogen isotopes (under development)	1.1, 1.2, 1.3, 2.2, 2.3, 4.2, 4.3	Transient present and last interglacials runs, abrupt events (with and without data assimilation)
11 (UNI-HB)	CCSM3	GCM (T31 resolution version; identical setup as partner 5)	Atmosphere, ocean, sea ice, dynamic vegetation	1.1,1.3	Snapshot simulations of past interglacials driven by different orbital forcing and GHG concentrations (jointly with partner 5)
12 (MPG)	ECHAM5-MPIOM -JSBACH	GCM (coarse T31 version of the IPCC AR5 model, 3.75° resolution)	Atmosphere, ocean, sea ice, dynamic vegetation, non-interactive (diagnostic) carbon cycle	1.1,3.1	Transient simulations of present and last interglacials driven by orbital forcing and GHG concentrations. Snapshot simulations of the carbon cycle
12 (MPG)	CLIMBER- JSBACH	EMIC (zonally-averaged ocean, 0.5° to 3.75° resol. of the land biosphere module)	Atmosphere, ocean, sea ice, dynamic vegetation, carbon cycle incl. weathering, sedimentation, 13C. Wetlands, permafrost and CH4 emissions (under development)	3.1, 3.2	Transient present and last interglacial runs with interactive carbon cycle

13 (VUA)	LOVECLIM	EMIC	see description of the partner 10	1.1, 1.3, 2.1, 2.2	Transient present and last interglacials runs, abrupt events
13 (VUA)	LOVECLIM-GRISLI	EMIC	(see description of the partner 10), GRISLI: global dynamical ice sheets (see partner 14)	1.2	Transient runs of penultimate and last termination
14 (CEA)	CLIMBER-2+iso	EMIC (3 zonally averaged ocean basins, statistical-dynamical atmosphere with 7 longitudinal sectors and 18 latitude bands)	Atmosphere, ocean vegetation, with oxygen and carbon representation	1.1, 2.1, 2.2	Baseline transient simulations + fresh water forcing experiments + comparison to isotopic data
14 (CEA)	CLIMBER-2-GRISLI	Same as above, coupled to ice-sheet models (45 km resolution)	Same as above coupled to northern and southern hemisphere ice-sheet models	1.2, 4.1, 4.3	Transient experiments for deglaciations + interglacials, analyses of ice-sheet feedbacks
14 (CEA)	IPSL_CM5	GCM with 2 resolutions Atm 144x142L19 Oce 2°L30 Atm 96x71 Oce 2° L30	Atmosphere, ocean, sea-ice For some of the simulations: carbon cycle	1.1, 1.3, 2.1, 3.1, 4.1	Snapshot atmosphere-ocean experiments Snapshot simulations with fresh water forcing, including ^{18}O isotopes Snapshot simulations with interactive carbon cycle Snapshot experiments with interactive ice-sheets

Table A5.2. Overview of ice sheet models used in Past4Future

Partner	Ice sheet model	Components	Workpackage	Applications within Past4Future
1 (UCPH)	PISM	Ice sheet (incl. ice shelves and ice streams), lithosphere	4.1	Present and last interglacials changes to the Greenland ice sheet including the response to the preceding terminations
8 (NERC-BAS)	BASISM	Thermo-mechanical model, horizontal stress transmission in grounded ice, ice shelves, dynamic grounding line, sediment movement, resolution 10 km	4.1	Transient experiments for deglaciation and interglacials,
13 (VUE), 14 (CEA)	GRISLI	thermo-mechanical model, grounded ice, ice streams, ice shelves, dynamic grounding line, resolution 10 to 40 km	1.2, 4.1	Transient experiments for deglaciations and interglacials, analyses of ice-sheet feedbacks