

6 Biomes

6.1 Scenarios

Since the pre-industrial simulations are an important part of the experiments, the spin-up has to finish before the pre-industrial simulations start. The spin-up should be using pre-industrial climate (**picontrol**) and year 1860 levels of “other human influences”. For this reason, the pre-industrial climate data should be replicated as often as required. The precise implementation of the spin up will be model specific, the description of which will be part of the reporting process.

Climate & CO ₂ scenarios	
picontrol	Pre-industrial climate and 286ppm CO ₂ concentration. The climate data for the entire period (1661-2299) are unique – no (or little) recycling of data has taken place.
historical	Historical climate and CO ₂ concentration.
rcp26	Future climate and CO ₂ concentration from RCP2.6.
rcp60	Future climate and CO ₂ concentration from RCP6.0.
rcp85	Future climate and CO ₂ concentration from RCP8.5.
2005co2	CO ₂ concentration fixed at 2005 levels at 378.81ppm.
Human influence and land-use scenarios	
1860soc	Constant pre-industrial (1860) land use, nitrogen deposition, and fertilizer input.
histsoc	Varying historical land use, nitrogen deposition and fertilizer input.
2005soc	Fixed year-2005 land use, nitrogen deposition and fertilizer input.
rcp26soc	Varying land use, water abstraction, nitrogen deposition and fertilizer input according to SSP2 and RCP2.6.
rcp60soc	Varying land use, water abstraction, nitrogen deposition and fertilizer input according to SSP2 and RCP6.0.

Table 13 ISIMIP2b scenarios for the global biomes simulations.

Experiment		Input	Pre-industrial 1661-1860	Historical 1861-2005	Future 2006-2099	Extended future 2100-2299
I	no climate change, pre-industrial CO ₂	Climate & CO ₂	picontrol	picontrol	picontrol	picontrol
	varying LU & human influences up to 2005, then fixed at 2005 levels thereafter	Human & LU	1860soc	histsoc	2005soc	2005soc
II	RCP2.6 climate & CO ₂	Climate & CO ₂	Experiment I	historical	rcp26	rcp26
	varying LU & human influences up to 2005, then fixed at 2005 levels thereafter	Human & LU		histsoc	2005soc	2005soc
Ila	RCP2.6 climate, CO ₂ after 2005 fixed at 2005 levels	Climate & CO ₂	Experiment I	Experiment II	rcp26, 2005co2	rcp26, 2005co2
	varying LU & human influences up to 2005, then fixed at 2005 levels thereafter	Human & LU			2005soc	2005soc
III	RCP6.0 climate & CO ₂	Climate & CO ₂	Experiment I	Experiment II	rcp60	not simulated
	varying LU & human influences up to 2005, then fixed at 2005 levels thereafter	Human & LU			2005soc	
IV	no climate change, pre-industrial CO ₂	Climate & CO ₂	Experiment I	Experiment I	picontrol	picontrol
	varying human influences & LU up to 2100 (RCP2.6), then fixed at 2100 levels thereafter	Human & LU			rcp26soc	2100rcp26soc

V	no climate change, pre-industrial CO ₂	Climate & CO ₂	Experiment I	Experiment I	picontrol	not simulated
	varying human influences & LU (RCP6.0)	Human & LU			rcp60soc	
VI	RCP2.6 climate & CO ₂	Climate & CO ₂	Experiment I	Experiment II	rcp26	rcp26
	varying human influences & LU up to 2100 (RCP2.6), then fixed at 2100 levels thereafter	Human & LU			rcp26soc	2100rcp26soc
VII	RCP6.0 climate & CO ₂	Climate & CO ₂	Experiment I	Experiment II	rcp60	not simulated
	varying human influences & LU (RCP6.0)	Human & LU			rcp60soc	
VIII	RCP8.5 climate & CO ₂	Climate & CO ₂	Experiment I	Experiment II	rcp85	not simulated
	varying LU & human influences up to 2005, then fixed at 2005 levels thereafter	Human & LU			2005soc	

Table 14 Additional sector-specific simulations for the biome sector.

Experiment		Input	Pre-industrial 1661-1860	Historical 1861-2005	Future 2006-2099	Extended future 2100-2299
Ia	no climate change, pre-industrial CO ₂	Climate & CO ₂	picontrol	picontrol	picontrol	picontrol
	LU & human influences fixed at 1860 levels	Human & LU	1860soc	1860soc	1860soc	1860soc
I Ib	RCP2.6 climate & CO ₂	Climate & CO ₂	Experiment I	historical	rcp26	rcp26
	LU & human influences fixed at 1860 levels	Human & LU		1860soc	1860soc	1860soc

IIIa	RCP6.0 climate, CO ₂ after 2005 fixed at 2005 levels	Climate & CO ₂	Experiment I	Experiment II	rcp60, 2005co2	not simulated
	varying LU & human influences up to 2005, then fixed at 2005 levels thereafter	Human & LU			2005soc	
IIIb	RCP6.0 climate & CO ₂	Climate & CO ₂	Experiment I	Experiment II	rcp60	not simulated
	LU & human influences fixed at 1860 levels	Human & LU			1860soc	
IIIc	RCP8.5 climate, CO ₂ after 2005 fixed at 2005 levels	Climate & CO ₂	Experiment I	Experiment II	rcp85, 2005co2	not simulated
	varying LU & human influences up to 2005, then fixed at 2005 levels thereafter	Human & LU			2005soc	

6.2 Output data

Table 15 Variables to be reported by biomes models. Variables marked by * are also relevant for the permafrost sector and also listed in **Table 21**. **Note:** If you cannot provide the data at the temporal or spatial resolution specified, please provide it the highest possible resolution of your model.

Variable (long name)	Variable name	Unit (NetCDF name)	Resolution	Comment
Essential outputs				
Pools				
*Carbon Mass in Vegetation biomass	cveg-<pft>	kg m-2	per pft and gridcell total annual	Gridcell total cveg is essential. Per PFT information is desirable.

*Carbon Mass in aboveground vegetation biomass	cvegag-<pft>	kg m-2	per pft and gridcell total	annual	Gridcell total cvegag is essential. Per PFT information is desirable.
*Carbon Mass in belowground vegetation biomass	cvegbg-<pft>	kg m-2	per pft and gridcell total	annual	Gridcell total cvegbg is essential. Per PFT information is desirable.
*Carbon Mass in Litter Pool	clitter	kg m-2	per gridcell total	annual	Info for each individual pool.
*Carbon Mass in Soil Pool	csoil	kg m-2	per gridcell total	annual	Info for each individual pool.
*Total Carbon Mass in Soil Pool	soilc	kg m-2	per gridcell total	annual	Integrated over the entire soil depth
Fluxes					
*Carbon Mass Flux out of atmosphere due to Gross Primary Production on Land	gpp	kg m-2 s-1	gridcell total	daily (monthly)	
*Carbon Mass Flux out of atmosphere due to Gross Primary Production on Land	gpp-<pft>	kg m-2 s-1	per pft	annual	
*Carbon Mass Flux into atmosphere due to Autotrophic (Plant) Respiration on Land	ra	kg m-2 s-1	gridcell total	daily (monthly)	
*Carbon Mass Flux out of atmosphere due to Net Primary Production on Land	npp	kg m-2 s-1	gridcell total	daily (monthly)	
*Carbon Mass Flux out of atmosphere due to Net Primary Production on Land	npp-<pft>	kg m-2 s-1	per pft	annual	
*Carbon Mass Flux into atmosphere due to Heterotrophic Respiration on Land	rh	kg m-2 s-1	gridcell total	daily (monthly)	
*Carbon Mass Flux into atmosphere due to total Carbon emissions from Fire	fireint	kg m-2 s-1	gridcell total	daily (monthly)	

*Carbon loss due to peat burning	somcfire	kg m ⁻² s ⁻¹	gridcell total	monthly	
*Carbon Mass Flux out of Atmosphere due to Net biome Production on Land (NBP)	ecoatmflux	kg m ⁻² s ⁻¹	gridcell total	daily (monthly)	This is the net mass flux of carbon between land and atmosphere calculated as photosynthesis MINUS the sum of plant and soil respiration, carbon fluxes from fire, harvest, grazing and land use change. Positive flux is into the land.
Structure					
*Leaf Area Index	lai-<pft>	1	per pft	annual	
*Leaf Area Index	lai	1	gridcell average	daily (monthly)	
*Plant Functional Type Grid Fraction	pft-<pft>	%	per gridcell	annual (or once if static)	The categories may differ from model to model, depending on their PFT definitions. This may include natural PFTs, anthropogenic PFTs, bare soil, lakes, urban areas, etc. Sum of all should equal the fraction of the grid-cell that is land. Value between 0 and 100.
Hydrological variables					
Total Evapo-Transpiration	evap	kg m ⁻² s ⁻¹	gridcell total	daily (monthly)	
Evaporation from Canopy (interception)	intercept-<pft>	kg m ⁻² s ⁻¹	gridcell total	daily (monthly)	the canopy evaporation+sublimation (if present in model). Provide at pft-level if available in the model
Water Evaporation from Soil	esoil-<pft>	kg m ⁻² s ⁻¹	per gridcell	daily (monthly)	includes sublimation. Provide at pft-level if available in the model
Transpiration	trans-<pft>	kg m ⁻² s ⁻¹	per gridcell	daily (monthly)	Provide at pft-level if available in the model

*Runoff	qtot	kg m ⁻² s ⁻¹	per gridcell	daily** (monthly)	total (surface + subsurface) runoff (qtot = qs + qsb). ** especially for models also participating in the water sector If daily resolution not possible, please provide monthly. If storage issues keep you from reporting daily data, please contact the ISIMIP team to discuss potential solutions.
*Soil Moisture	soilmoist	kg m ⁻²	per gridcell	daily (monthly)	If possible, please provide soil moisture for all depth layers (i.e. 3D-field), and indicate depth in m. Otherwise, provide soil moisture of entire column.
Surface Runoff	qs	kg m ⁻² s ⁻¹	per gridcell	daily (monthly)	Total surface runoff leaving the land portion of the grid cell.
*Frozen soil moisture for each layer	soilmoistfroz	kg m ⁻²	per gridcell	monthly	Please provide soil moisture for all depth levels and indicate depth in m.
*Snow depth	snd	m	per gridcell	monthly	Grid cell mean depth of snowpack.
*Snow water equivalent	swe	kg m ⁻²	per gridcell	monthly	Total water mass of the snowpack (liquid or frozen), averaged over a grid cell.
*Annual maximum thaw depth	thawdepth	m	per gridcell	annual	calculated from daily thaw depths Please provide for purposes of permafrost sector.
Other outputs					

*Temperature of Soil	tsl	K	per gridcell	daily (monthly)	Temperature of each soil layer. Reported as "missing" for grid cells occupied entirely by "sea". Also needs depths in meters. Daily would be great, but otherwise monthly would work.
Burnt Area Fraction	burntarea	%	per gridcell	daily (monthly)	Area percentage of grid cell that has burned at any time of the given day/month/year (for daily/monthly/annual resolution)
Albedo	albedo	1	per gridcell	monthly	average of pfts, snow cover, bare ground and water surfaces, range between 0-1
*N ₂ O emissions into atmosphere	n2o	kg m ⁻² s ⁻¹	gridcell total	monthly	From land, not from industrial fossil fuel emissions and transport
*CH ₄ emissions into atmosphere	ch4	kg m ⁻² s ⁻¹	gridcell total	monthly	From land, not from industrial fossil fuel emissions and transport