

## 8 Permafrost

### 8.1 Scenarios

- 5 The simulation scenarios for models only participating as permafrost models are described below. Assuming that for the relevant regions “other human influences” only play a minor role, i.e. the regional simulations can be done as “naturalized” runs (**nosoc**). Results from permafrost modules embedded in global biomes models should be reported for the biomes model simulations specified in Section 6 and the extension beyond 2299 described below.

Climate & CO <sub>2</sub> scenarios	
<b>picontrol</b>	Pre-industrial climate and 286ppm CO <sub>2</sub> concentration. The climate data for the entire period (1661-2299) are unique – no (or little) recycling of data has taken place.
<b>historical</b>	Historical climate and CO <sub>2</sub> concentration.
<b>rcp26</b>	Future climate and CO <sub>2</sub> concentration from RCP2.6
<b>rcp60</b>	Future climate and CO <sub>2</sub> concentration from RCP6.0
<b>2299rcp26</b>	Repeating climate between 2270 and 2299 for additional 200 years up to 2500 (or equilibrium if possible), CO <sub>2</sub> fixed at year 2299 levels
<b>2005co2</b>	Fixed year 2005 CO <sub>2</sub> concentration
Human influence & land-use scenarios	
<b>nosoc</b>	No human influences

**Table 17** ISIMIP2b scenario specification for the permafrost simulations.

Experiment		Input	Pre-industrial 1661-1860	Historical 1861-2005	Future 2006-2099	Extended future 2100-2299	Beyond 2299
<b>I</b>	no climate change, pre-industrial CO <sub>2</sub>	Climate & CO <sub>2</sub>	<b>picontrol</b>	not simulated	not simulated	not simulated	not simulated
	no other human influences	Human & LU	<b>nosoc</b>				
<b>II</b>	RCP2.6 climate & CO <sub>2</sub>	Climate & CO <sub>2</sub>	Experiment I	<b>historical</b>	<b>rcp26</b>	<b>rcp26</b>	<b>2299rcp26</b>
	no other human influences	Human & LU		<b>nosoc</b>	<b>nosoc</b>	<b>nosoc</b>	<b>nosoc</b>
<b>Ila</b>	RCP6.0 climate, CO <sub>2</sub> varying until 2005, then fixed at 2005 levels thereafter	Climate & CO <sub>2</sub>	Experiment I	Experiment II	<b>rcp26, 2005co2</b>	<b>rcp26, 2005co2</b>	<b>2299rcp26, 2005co2</b>
	no other human influences	Human & LU			<b>nosoc</b>	<b>nosoc</b>	<b>nosoc</b>
<b>III</b>	RCP2.6 climate & CO <sub>2</sub>	Climate & CO <sub>2</sub>	Experiment I	Experiment II	<b>rcp60</b>	not simulated	not simulated
	no other human influences	Human & LU			<b>nosoc</b>		

## 8.2 Output data

**Table 18** Variables to be reported by permafrost models.

Long name	Units		Output variable name	Resolution	Comment
<b>Essential outputs</b>					
Temperature of Soil	K	per gridcell	<b>tsl</b>	daily (monthly)	Temperature of each soil layer. Reported as "missing" for grid cells occupied entirely by "sea". <b>THIS IS THE MOST IMPORTANT VARIABLE.</b> Also need depths in meters. Daily would be great, but otherwise monthly would work.
<b>Pools (as Biomes output Table)</b>					
Carbon Mass in Vegetation biomass	kg m <sup>-2</sup>	per pft and gridcell total	<b>cveg_&lt;pft&gt;</b>	annual	Gridcell total cveg is essential. Per PFT information is desirable.
Carbon Mass in Litter Pool	kg m <sup>-2</sup>	per gridcell total	<b>clitter</b>	annual	Info for each individual pool.
Carbon Mass in Soil Pool	kg m <sup>-2</sup>	per gridcell total	<b>csoil</b>	annual	Info for each individual pool.
<b>Fluxes (as Biomes output Table)</b>					
Carbon Mass Flux out of atmosphere due to Gross Primary Production on Land	kg m <sup>-2</sup> s <sup>-1</sup>	gridcell total	<b>gpp</b>	monthly (daily)	
Carbon Mass Flux out of atmosphere due to Gross Primary Production on Land	kg m <sup>-2</sup> s <sup>-1</sup>	per pft	<b>gpp_&lt;pft&gt;</b>	annual	
Carbon Mass Flux into atmosphere	kg m <sup>-2</sup> s <sup>-1</sup>	gridcell	<b>ra</b>	monthly (daily)	

due to Autotrophic (Plant) Respiration on Land		total			
Carbon Mass Flux out of atmosphere due to Net Primary Production on Land	kg m <sup>-2</sup> s <sup>-1</sup>	gridcell total	<b>npp</b>	monthly (daily)	
Carbon Mass Flux out of atmosphere due to Net Primary Production on Land	kg m <sup>-2</sup> s <sup>-1</sup>	per pft	<b>npp_&lt;pft&gt;</b>	annual	
Carbon Mass Flux into atmosphere due to Heterotrophic Respiration on Land	kg m <sup>-2</sup> s <sup>-1</sup>	gridcell total	<b>rh</b>	monthly (daily)	
Carbon Mass Flux into atmosphere due to total Carbon emissions from Fire	kg m <sup>-2</sup> s <sup>-1</sup>	gridcell total	<b>fireint</b>	monthly (daily)	
Carbon Mass Flux out of Atmosphere due to Net biome Production on Land (NBP)	kg m <sup>-2</sup> s <sup>-1</sup>	gridcell total	<b>ecoatmflux</b>	monthly (daily)	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 [as Biomes output Table]					
Leaf Area Index	1	per pft	<b>lai_&lt;pft&gt;</b>	annual	
Leaf Area Index	1	gridcell average	<b>lai_&lt;pft&gt;</b>	monthly (daily)	
Plant Functional Type Grid Fraction	%	per gridcell	<b>pft_&lt;pft&gt;</b>	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.
Hydrological variables [as per Biomes output Table]					

Runoff	$\text{kg m}^{-2} \text{ s}^{-1}$	per gridcell	<b>qtot</b>	daily** (monthly)	total (surface + subsurface) runoff ( $q_{\text{tot}} = q_{\text{s}} + q_{\text{sb}}$ ). If daily resolution not possible, please provide monthly. If storage issues keep you from reporting daily data, please contact the ISI-MIP team to discuss potential solutions.  **For those models also participating in the water simulations
Soil moisture	$\text{kg m}^{-2}$	per grid cell	<b>soilmoist</b>	monthly	please provide soil moisture for all depth layers (i.e. 3D-field), and indicate depth in m.
Frozen soil moisture for each layer	$\text{kg m}^{-2}$	per gridcell	<b>soilmoistfroz</b>	monthly	Please provide frozen soil moisture for all depth levels and indicate depth in m.
Snow depth	m	per gridcell	<b>snd</b>	monthly	Grid cell mean depth of snowpack.
Snow water equivalent	$\text{kg m}^{-2}$	per gridcell	<b>swe</b>	monthly	Total water mass of the snowpack (liquid or frozen), averaged over a grid cell.
Annual maximum thaw depth	m	per gridcell	<b>thawdepth</b>	annual	calculated from daily thaw depths
<b>Other outputs</b>					
Burnt Area Fraction	%	per gridcell	<b>burntarea</b>	monthly (daily)	fraction of entire grid cell that is covered by burnt vegetation
N <sub>2</sub> O emissions into atmosphere	$\text{kg m}^{-2} \text{ s}^{-1}$	gridcell total	<b>n2o</b>	monthly	From land, not from industrial fossil fuel emissions and transport
CH <sub>4</sub> emissions into atmosphere	$\text{kg m}^{-2} \text{ s}^{-1}$	gridcell total	<b>ch4</b>	monthly	From land, not from industrial fossil fuel emissions and transport