11 Permafrost

11.1 Experiments

The permafrost sector in ISIMIP2a will not require any additional runs. The runs developed for the biomes sector and the water sector can also be assessed by the permafrost sector (see Section 4.7 Scenario design for the scenario setup). Finnland (region 12) and the Lena catchment (region 11) are the two regions affected by permafrost. Therefore, any runs over these regions can be assessed for permafrost. Permafrost will require additional output data. Models which do not include a carbon cycle should still submit the requested hydrological variables as these can be used to assess permafrost extent and thaw.

11.2 Sector-specific input

None

11.3 Output data

Table 28 below is very similar to **Table** 18 in the Biomes sector, but with some hydrological variables added. **Soil temperature at each model level is the most important variable – if that is all you can deliver then please do so, it will be useful.**

Table 28: Variables to be reported for the permafrost sector.

Variable (long name)	Variable name	Unit (NetCDF format)		Resolution	Comment
Essential outputs					
Temperature of Soil	**tsl**	K	per gridcell	Day (mon)	Temperature of each soil layer. Reported as "missing" for grid cells occupied entirely by "sea". **THIS IS THE MOST IMPORTANT VARIABLE.** Also need depths in meters. Daily would be great, but otherwise monthly would work.

Pools (as Biomes output Table)					
Carbon Mass in Vegetation	**cveg-<pft>**	kg m-2	per pft and gridcell total	year	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	year	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	year	Gridcell total cvegbg is essential. Per PFT information is desirable.
Carbon Mass in Litter Pool	**clitter**	kg m-2	per gridcell	year	Total of all pools. Info for each individual pool is desirable.
Carbon Mass in Soil Pool	**csoil**	kg m-2	per gridcell	year	Total of all pools. Info for each individual pool is desirable.
Fluxes (as Biomes output Table)					
Carbon Mass Flux out of Atmosphere due to Gross Primary Production on Land	**gpp**	kg m-2 s-1	per gridcell	mon (day)	
Carbon Mass Flux into Atmosphere due to Autotrophic (Plant) Respiration on Land	**ra**	kg m-2 s-1	per gridcell	mon (day)	
Carbon Mass Flux out of Atmosphere due to Net Primary Production on Land	**npp**	kg m-2 s-1	per gridcell	mon (day)	
Carbon Mass Flux into Atmosphere due to Heterotrophic Respiration on Land	**rh**	kg m-2 s-1	per gridcell	mon (day)	
Carbon Mass Flux into Atmosphere due to	**fireint**	kg m-2 s-1	per gridcell	mon (day)	

CO2 Emission from Fire					
Fraction of cell burnt by fire	**firefrac**	Fractional	per gridcell		Burnt area fraction: single value for each scenario corresponding to year 2100
Carbon Mass Flux out of Atmosphere due to Net Biospheric Production on Land	**ecoatmfluxc**	kg m-2 s-1	per gridcell	mon (day)	This is the net mass flux of carbon between land and atmosphere calculated as photosynthesis MINUS the sum of plant and soil respiration, carbonfluxes from fire, harvest, grazing and land use change. Positive flux is into the land.
Structure (as Biomes output Table)					
Fraction of absorbed photosynthetically active radiation	**fapar-<pft>**	%	per pft and gridcell average	mon (day)	
Leaf Area Index	**lai-<pft>**	1	per pft and gridcell average	mon (day)	
Plant Functional Type Grid Fraction	**pft-<pft>**	%	per gridcell	year (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.
Soil moisture for each layer	**soilmoist**	kg m-2	per gridcell	mon	Please provide soil moisture for all depth levels and indicate depth in m. (As for Water sector)
Frozen soil moisture for each layer	**soilmoistfroz**	kg m-2	per gridcell	mon	Please provide soil moisture for all depth levels and indicate depth in m. **This is a new variable.**
Snow depth	**snd**	m	per gridcell	Day	Grid cell mean depth of snowpack. **This is a new variable.**
Annual maximum thaw depth	**thawdepth**	m	per gridcell	year	Calculated from daily thaw depths
Snow water equivalent	**swe**	kg m-2	per gridcell	mon	Total water mass of the snowpack (liquid or frozen) averaged over grid cell (As for Water sector)
Runoff	**qtot**	kg m-2 s-1	per gridcell	mon (day)	Total runoff leaving the land portion of the grid cell (this

					is in both Biomes and Water Tables)
Optional outputs					
Burnt Area Fraction	**burntarea**	%	per gridcell	mon (day)	fraction of entire grid cell that is covered by burnt vegetation

Note: If you cannot provide the data at the temporal or spatial resolution specified, please provide the highest possible resolution of your model. Please contact the coordination team (Info@isimip.org) to for any further clarification, or to discuss the equivalent variable in your model.

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