ISIMIP Biome Meeting

1. Quick paper presentations (5min each)
    1. Hao Shi
    2. Thomas Hickler
2. Main biome model developments WRT: Land-use/NBP: Wood harvest? Crop Yield/ harvest, fire, permafrost carbon; N Deposition, (3min each Model)
    ⓅCARAIB / CLM / DLEM / LPJmL / LPJ-GUESS / ORCHIDEE-MICT / VEGAS / VISIT / JULES / …
3. Status update 3a/3b runs
    1. Who is planning which runs?
    2. Paper plans for AR6
    3. Key issues: Forest harvesting data (input from iliusi) // PFT specific output
    4. Evaluation with ilamb

Recent Papers

IOP Publishing Environ. Res. Lett. 15 (2020) 044006 https://doi.org/10.1088/1748-9326/ab702b

Environmental Research Letters

LETTER

Pronounced and unavoidable impacts of low-end global warming on northern high-latitude land ecosystems

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Keywords: biome sector, ISIMIP2b, northern high latitudes, Paris agreement, climatic impacts

Supplementary material for this article is available online

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RESEARCH ARTICLE
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Climate Extreme Versus Carbon Extreme: Responses of Terrestrial Carbon Fluxes to Temperature and Precipitation

Shufen Pan and Jia Yang, equal contribution

Shufen Pan[1], Jia Yang[1,2], Hanqin Tian[1], Hao Shi[1,3], Jinfeng Chang[4], Philippe Ciais[4], Louis Francois[5], Katja Frieler[6], Bojie Fu[3], Thomas Hickler[7,8], Akihiko Ito[9], Kazuya Nishina[9], Sebastian Ostberg[6], Christopher P.O. Reyer[6], Sibyll Schaphoff[6], Jörg Steinkamp[7,10], and Fang Zhao[6]

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Key Points:

- Impacts of temperature or precipitation extremes on carbon fluxes could be amplified due to their interactive effects
- Hot extremes lead to a larger carbon loss in tropics while ecosystems in the arid and semi-arid zones show the largest sensitivity to precipitation
- Models simulated larger sensitivity of ecosystem productivity to precipitation than satellite product, particularly in tropics

Submitted papers / advanced drafts

1. Hao Shi
2. Thomas Hickler

Model		LPJ-GUESS	LPJmL	VISIT	ORCHIDEE-MICT	DLEM
Number of PFTs		11	24	32	17	15
DGVM activated		Yes	Yes	No	No	No
Permafrost included [b]		No	Yes	No	Yes	Yes
Land use change implementation	Crop harvest	No	Yes	Yes	Yes	Yes
	Crop harvest rule	--	Harvested carbon is added to a "harvest flux" at the time of harvest	Residual harvested carbon return to the field as little	A fixed fraction of NPP was harvested	Grain was harvested at the end of growing season
	Grass harvest	No	Yes [a]	No	No	No
	Wood harvest	No	No	No	No	No
	Cropland management	No	No	No	No	No
	Shifting cultivation	No	No	No	No	No
	Tillage	No	No	No	Yes [c]	No
	Biofuels NPP	C3grass-agriculture C4grass-agriculture	Bionergy tree Bionergy grass	No	C3-crop C4-crop	No
	Biofuels harvest	No	Yes	No	Yes, same as crops	No
	Separate SOC in pasture from natural grass	No	Yes	No	Yes	No
Reference		Smith et al., (2014)	Bondeau et al., (2007)	Ito and Inatomi, (2012)	Guimberteau et al., (2018)	Tian et al., (2015a)

- More categories for table needed?
- Add to model experiment documentation

Main biome model developments WRT: Land-use/NBP: Wood harvest? Crop Yield/ harvest, fire, permafrost carbon; N Deposition, (3min each Model)

- CARAIB: high resolution simulation, test, trait acclimation, model very similar to model version for ISIMIP2
- CLM: CLM5 new version, many more crop types, without irrigation and fertilizer, irrigation and land-use change no longer mutually exclusive, wood harvesting using LUH2, long-term inclusion of FATES model Ⓟecosystem demography for ISIMIP4, http://www.cesm.ucar.edu/models/cesm2/land/whatsnew_CLM5.png; https://escomp.github.io/ctsm-docs/versions/release-clm5.0/html/tech_note/Introduction/CLM50_Tech_Note_Introduction.html#clm5-0
- DLEM: very detailed agricultural model, not in biomes but in agmip/isimip agriculture, include anymoal foodchain, land-use components Ⓟmixed of linear and rule based- formulations, fertilizer timing, phosphorous maybe not for isimip 3, wood harvest, grazing now included
- JULES: have concluded 2b, include 3b data etc… nitrogen, land-ue, include river routing, agricultural yields, uses TRIFFID DGVM, no fire included yet, isimip2 ouputs not yet uploaded, include one simulation with JULES land-climate, light, fire and permafrost with new version, include ilamb Ⓟ
- JSBACH: possibly contribute
- LPJmL: 2b version now with new phenology, nitrogen cycle now included in LPJmL5 to be used in isimip 3 but not all problems wrt carbon sinks and vegetation Distribution , 1 lpjml for agriculture and 1 for biomes,permafrost-water, maybe somehow harmonized in isimip3
- LPJ-GUESS: no crop version, forest harvesting not included, different fire models for fire sector, simple fire model for biomes, maybe Lund ot join permafrost sector? Smith et al. 2014 version used in biomes! Maybe internal discussion in LPJ-GUESS team if models need further harmonized,
- MC2: possibly contribute
- ORCHIDEE-MICT: same version as isimip2b in 3a and 3b, fire permafrost, crop harvest, no nitrogen cycle, unclear how forest harvest included, pft-specific output
- VEGAS: many updates, VEGAS needs subdaily climate, subdaily photosynthesis improves simulation results for boreal region, netcdf-read module to pre-process all finles
- VISIT: no big changes to isimip3a/b but more advanced agriculture and permafrost models to be included after 3a/3b, wants to include LUH2 wood harvet, under development

Ⓟ All these models consider contributing simulations to ISIMIP3

Paper plans

- **Almut Arneth:** Paper idea / need for IPCC AR6 WG2Ⓟ simulated biome shift with state-of-the-art DGVMs / CMIP6, Ⓟdifficult from ISIMIP runs with land-use change Ⓟ Use “Nat” runs
  - what outputs are needed?
  - From protocol: definition of Nat = No direct human influences (naturalized run). “*Please only label your model run nat if it does not at all account for any direct human forcings, including e.g. human land use*”

Key issues / To Dos

- Forest harvesting data Ⓟ Iliusi to provide documentation
- Pft-specific output / right variables
- https://protocol.isimip.org/protocol/ISIMIP3a/biomes.html#output-variables

Follow-up email clarfying:

- Land-cover-class in variable Ⓟpft1 in pasture and in rangeland
- Averaged over whole grid cell or not? Ⓟwhat area is variable refering to? Ⓟ
- Make list of isimip and trendy variables, what is missing

Carbon Mass Flux out of Atmosphere due to Gross Primary Production on Land	**gpp-<pft/total>**	kg m-2 s-1		• 0.5° grid • daily, monthly	
Carbon Mass Flux into Atmosphere due to Autotrophic (Plant) Respiration on Land	**ra-<pft/total>**	kg m-2 s-1		• 0.5° grid • daily, monthly	
Carbon Mass Flux out of Atmosphere due to Net Primary Production on Land	**npp-<pft/total>**	kg m-2 s-1		• 0.5° grid • daily, monthly	
Carbon Mass Flux into Atmosphere due to Heterotrophic Respiration on Land	**rh-<pft/total>**	kg m-2 s-1		• 0.5° grid • daily, monthly	
Carbon Mass Flux into Atmosphere due to CO_2 Emission from Fire	**fireint-<pft/total>**	kg m-2 s-1		• 0.5° grid • daily, monthly	
Carbon Mass Flux out of Atmosphere due to Net Biospheric Production on Land	**ecoatmflux-<pft/total>**	kg m-2 s-1		• 0.5° grid • 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, carbonfluxes from fire, harvest, grazing and land use change. Positive flux is into the land.
Root autotrophic respiration	**rr-<pft/total>**	kg m-2 s-1		• 0.5° grid • daily, monthly	
Carbon in Products of Land Use Change	**cproduct-<pft/total>**	kg m-2		• 0.5° grid • annual	Products generated during Land-use change. Removed carbon should not go into the soil but into the product pool. Grid cell total and PFT information is essential.
Carbon in biomass harvested from natural vegetation	**charv-<pft/total>**	kg m-2		• 0.5° grid • annual	Refers to Carbon not going into soil. Grid cell total and PFT information is essential.

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CO2 Flux to Atmosphere from Grazing

CO2 Flux to Atmosphere from Crop Harvesting

Key issues

- why we need a 2015soc (LUC and management kept at 2015 level) in addition to nat (all at 1850? level)? I guess 2015soc is mainly for the water sector that using contemporary dam/water extraction, but not useful for biome sector (do I misunderstand it?).

Ⓟ Reply: 2015soc is a crucial –cross-sectoral setting. For the biomes ector it is useful for keeping LU constant as a kind of counterfactural to the future runs with changing LU pattern (once we have them).

- why the sensitivity scenario on CO2 uses 1901 CO2 rather than 1850/1860 one that usually used for attribution studies?
- Ⓟ The forcing for the ISIMIP3a studies only starts 1901, that is why we kept it at 1901 levels.

Evaluation

- do we enforce a quick evaluation on basic performance (gpp, nbp at least) for 3a outputs before starting 3b (e.g. run the Ilamb benchmark used for Trendy)?
- Ⓟ Reply: Would be great if we could do that for the biomes sector keeping in mind the overall ISIMIP policy that all simulations that follow the protocol can be uploaded to the ISIMIP archive, so no formal evaluation at that point but of course before papers are being written the ensemble could be run through ilamb. This is at the discretion of the authors/modellers and not centrally organised/enforced by ISIMIP.