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Integrating tropical peatland hydrology into a global land surface model (PEATCLSM)

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DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
KU Leuven - BELGIUM

HS10.6 - Peatland Hydrology
Thursday, 7 May 2020, 14:00-15:45

Hydrological modeling of peatlands in a global land surface model

Rationale

- Hydrological variables exert a first-order control on carbon cycle
- Unique peatland characteristics and processes result in a peat-specific hydrology

Poor representation of peatland hydrology in **global** land surface models (LSMs) with traditional (mineral) schemes

Development of peat-specific modules

Northern peatlands

Canadian Land Surface Scheme (Wu et al., 2016)
Lund-Potsdam-Jena model (Wania et al., 2009)
Community Land Model (Shi et al., 2015)
ORCHIDEE (Largeron et al., 2018)
Catchment Land Surface Model (Bechtold et al. 2019)

PEATCLSM$_{N,Natural}$

Tropical peatlands

No tropical module

Tropical PEATCLSM

- PEATCLSM$_{T,\mathbf{Natural}}$
- PEATCLSM$_{T,\mathbf{Drained}}$

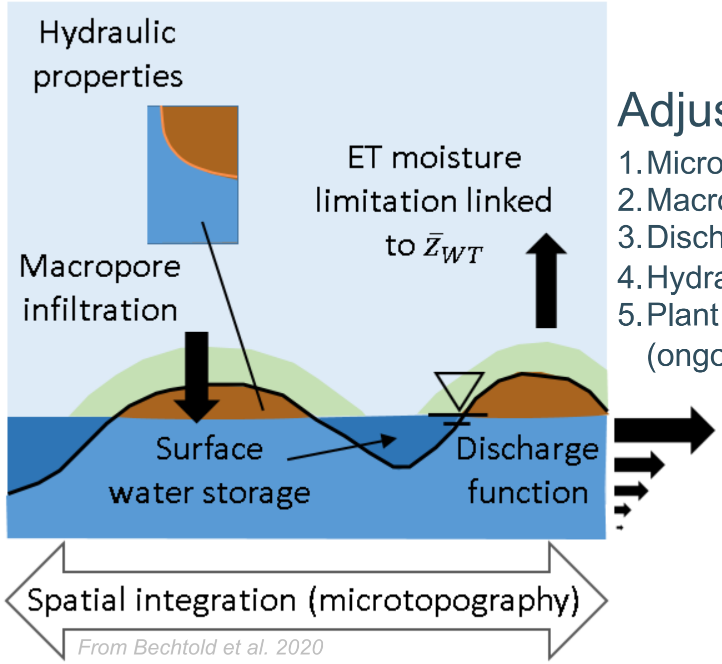
Hydrology of tropical peatlands in PEATCLSM

PEATCLSM

Why (PEAT)CLSM? Koster et al. 2000

- ✓ Simulates water table depth (WTD)
- ✓ Operational LSM of the SMAP Level 4 Soil Moisture product (assimilation of SMAP observations into $PEATCLSM_T$ is planned) Reichle et al. 2017
- Here: computation time step 7.5 min at 9-km resolution

PEATCLSM adaptations Bechtold et al. 2019

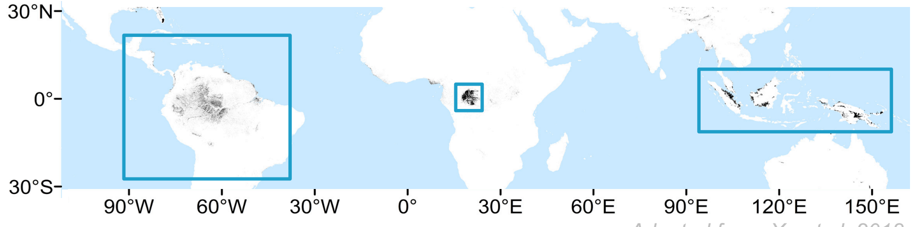


Adjusted for tropics:

1. Microtopography
2. Macropore infiltration
3. Discharge function
4. Hydraulic properties
5. Plant stress functions (ongoing work)

Tropical peatlands

Which regions?



Adapted from: Xu et al. 2018

What tropical modules?

$PEATCLSM_{T,Natural}$ and $PEATCLSM_{T,Drained}$

Literature-based parameters, <u>no regional tuning</u>

Drainage level set at -0.4 m

Which evaluation data?

Extensive, self-compiled evaluation dataset

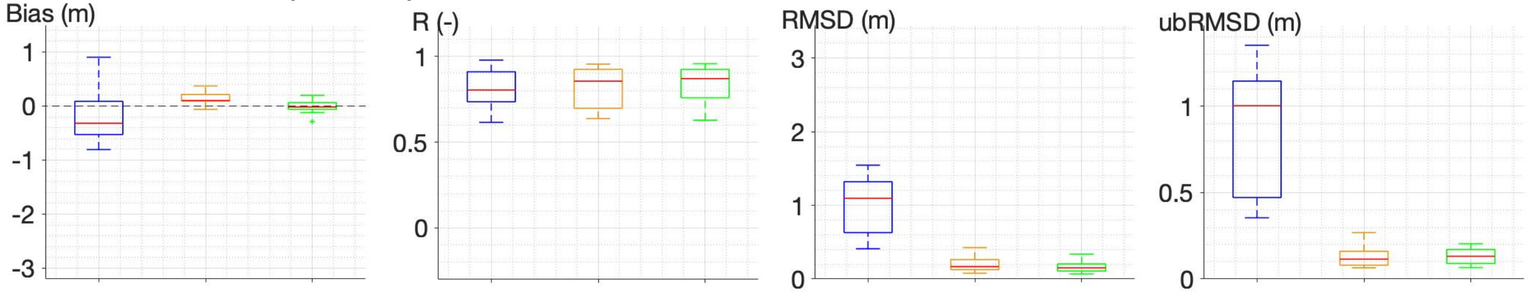
Time series of variable duration (months/years)

# of evaluation sites		WTD	ET
Natural	Indonesia	20	2 (1)
	Cuvette Centrale	13	-
	Central and South America	13	(1)
Drained	Indonesia	42	1
	Cuvette Centrale	-	-
	Central South America	-	-

Preliminary results – model comparison

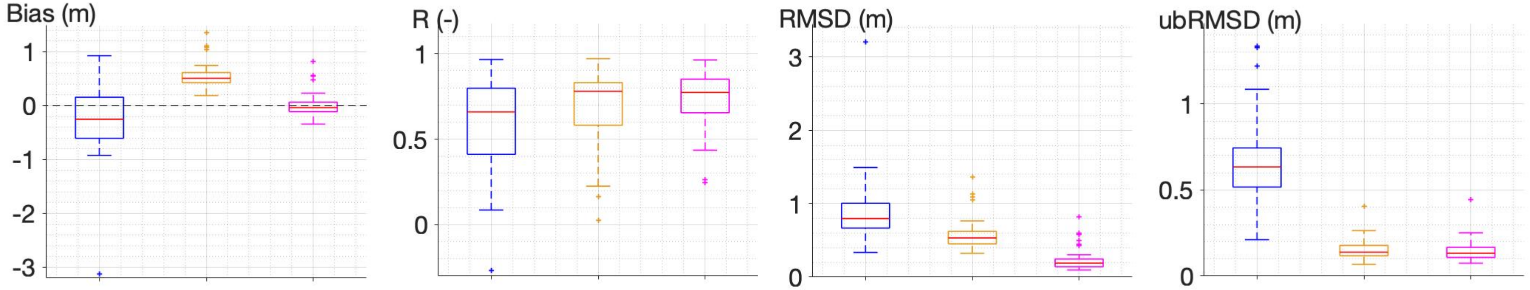
Water table depth (WTD)

Natural sites (n=20)

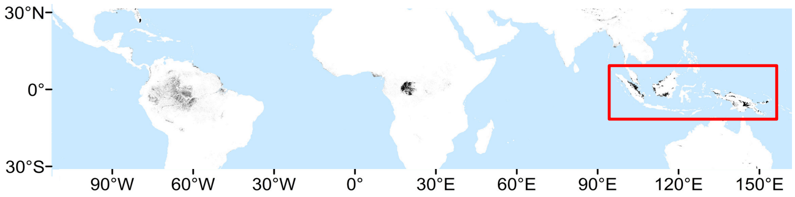


CLSM PEATCLSM$_N$ PEATCLSM$_{T,Natural}$

Drained sites (n=42)



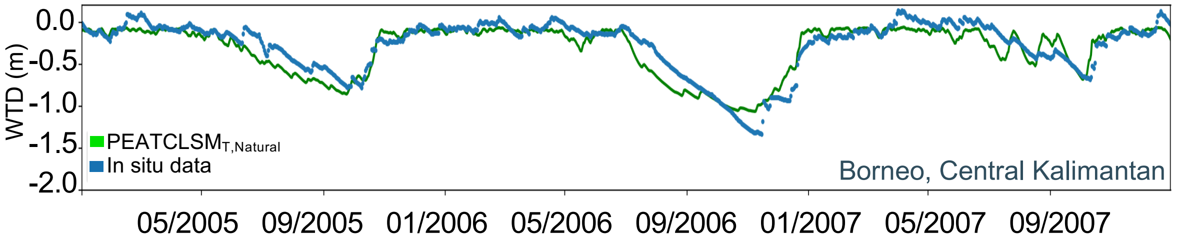
CLSM PEATCLSM$_N$ PEATCLSM$_{T,Drained}$



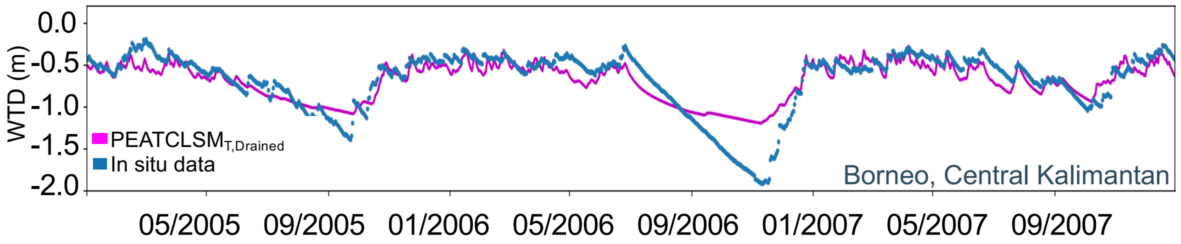
Key observations:

- Larger spread in bias of PEATCLSM$_{T,Drained}$ compared to PEATCLSM$_{T,Natural}$ is due to variability in drainage level (land use, design, management)
- PEATCLSM$_{T,Natural}$ time series have model cut-off around -0.05 m, in situ data goes above ground surface level
- Extreme drought in 2006 (El Niño year) is less well captured in PEATCLSM$_{T,Drained}$

Natural time series

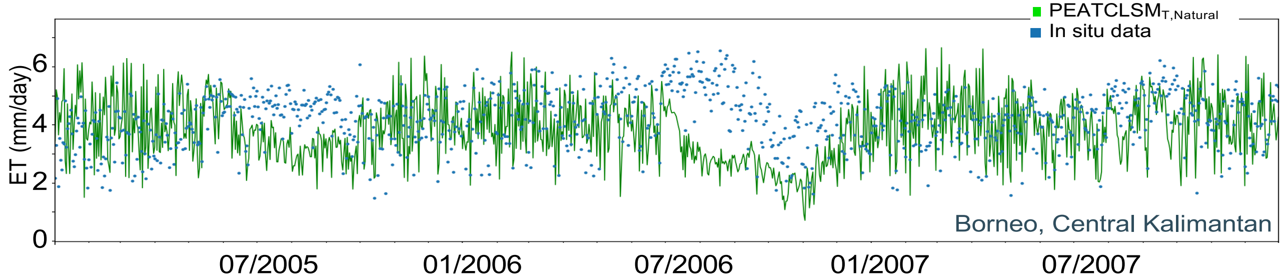


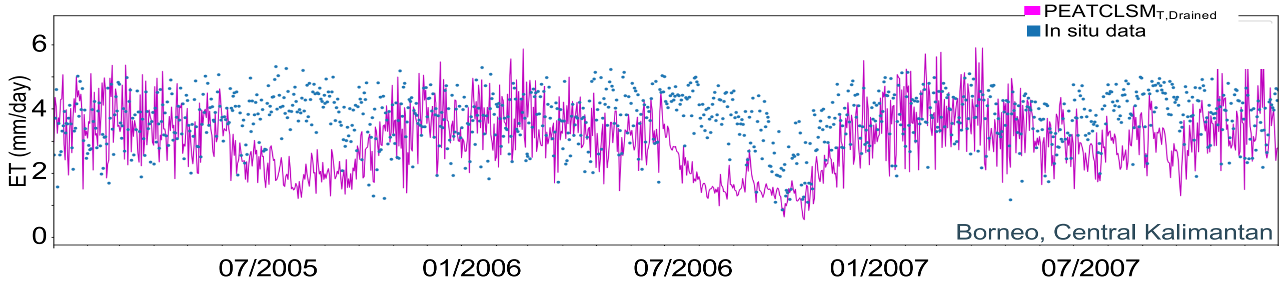
Drained time series



More preliminary results and next steps

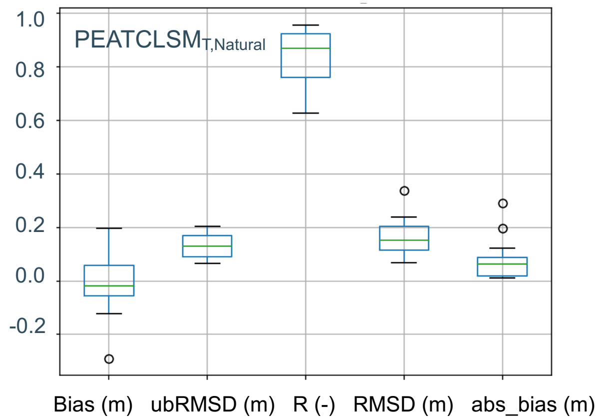
Evapotranspiration



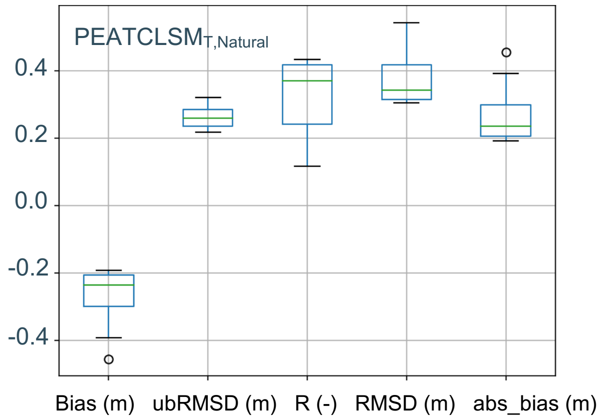


Regional skill differences (WTD)

Indonesia (n=20)

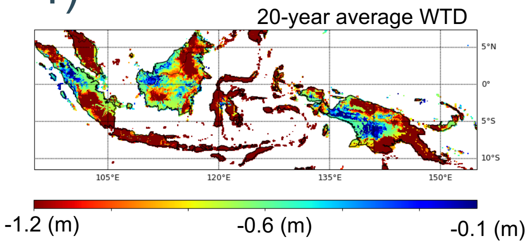


Cuvette Centrale, Congo (n=8)

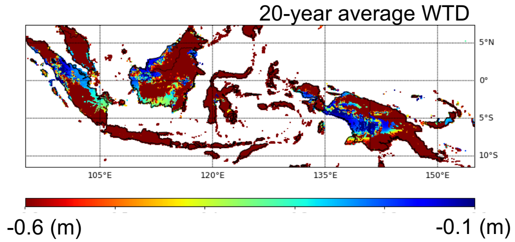


Next major steps …

1)



Drained map



Natural map

Land cover map

Hydrological estimates over all tropical peatlands

2) **Soil moisture data assimilation** to improve model hydrology further

For further questions/discussion or data sharing/collaboration:
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