Influences of hydrology on peatland carbon cycling:

results from subtropical peat deposits

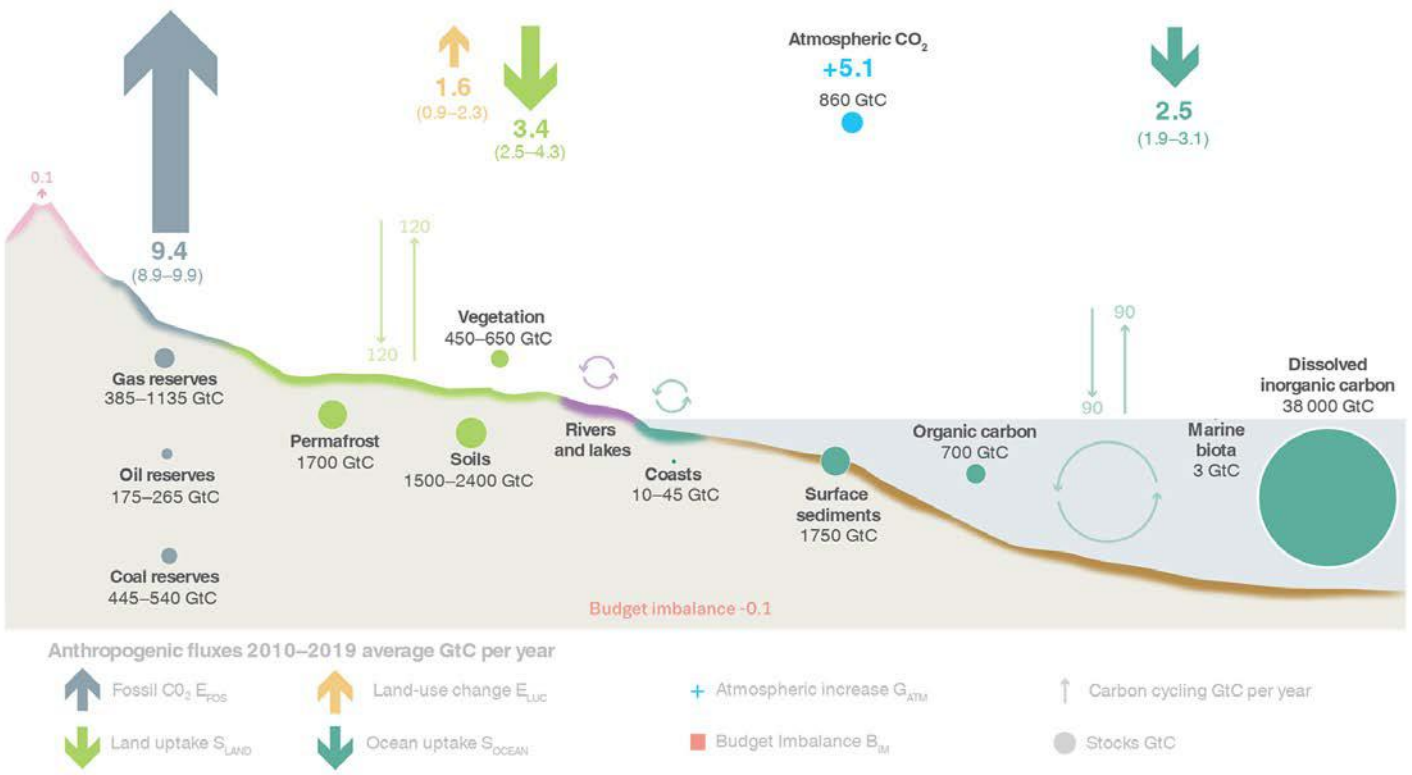
Xianyu Huang

State Key Laboratory of Biogeology and Environmental Geology

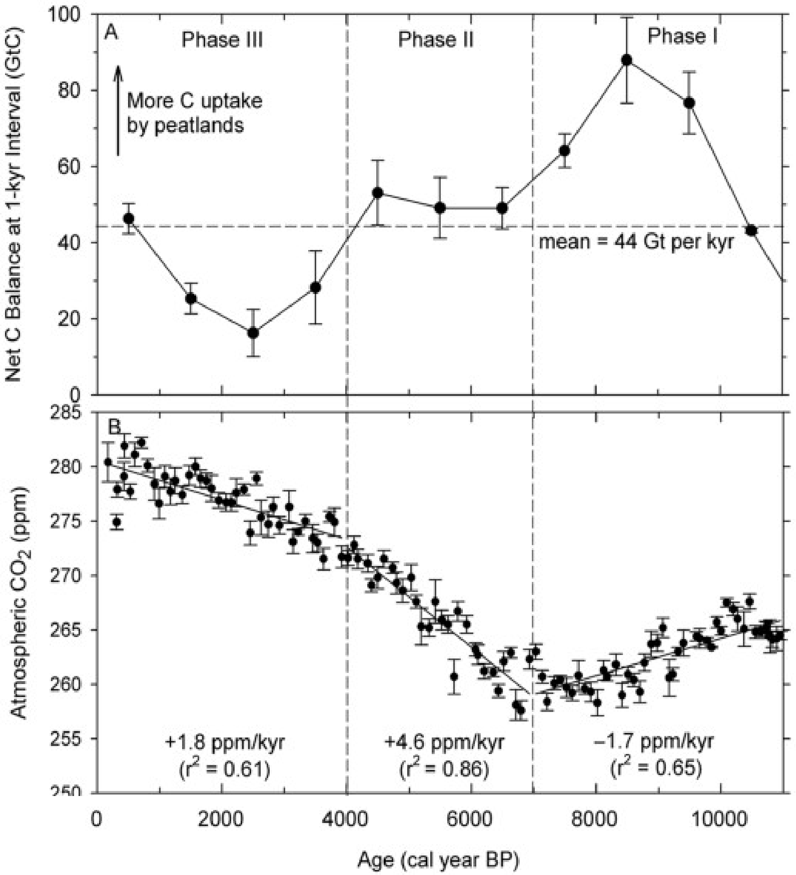
School of Geography and Information Engineering

China University of Geosciences, Wuhan

Global carbon cycling & peatlands



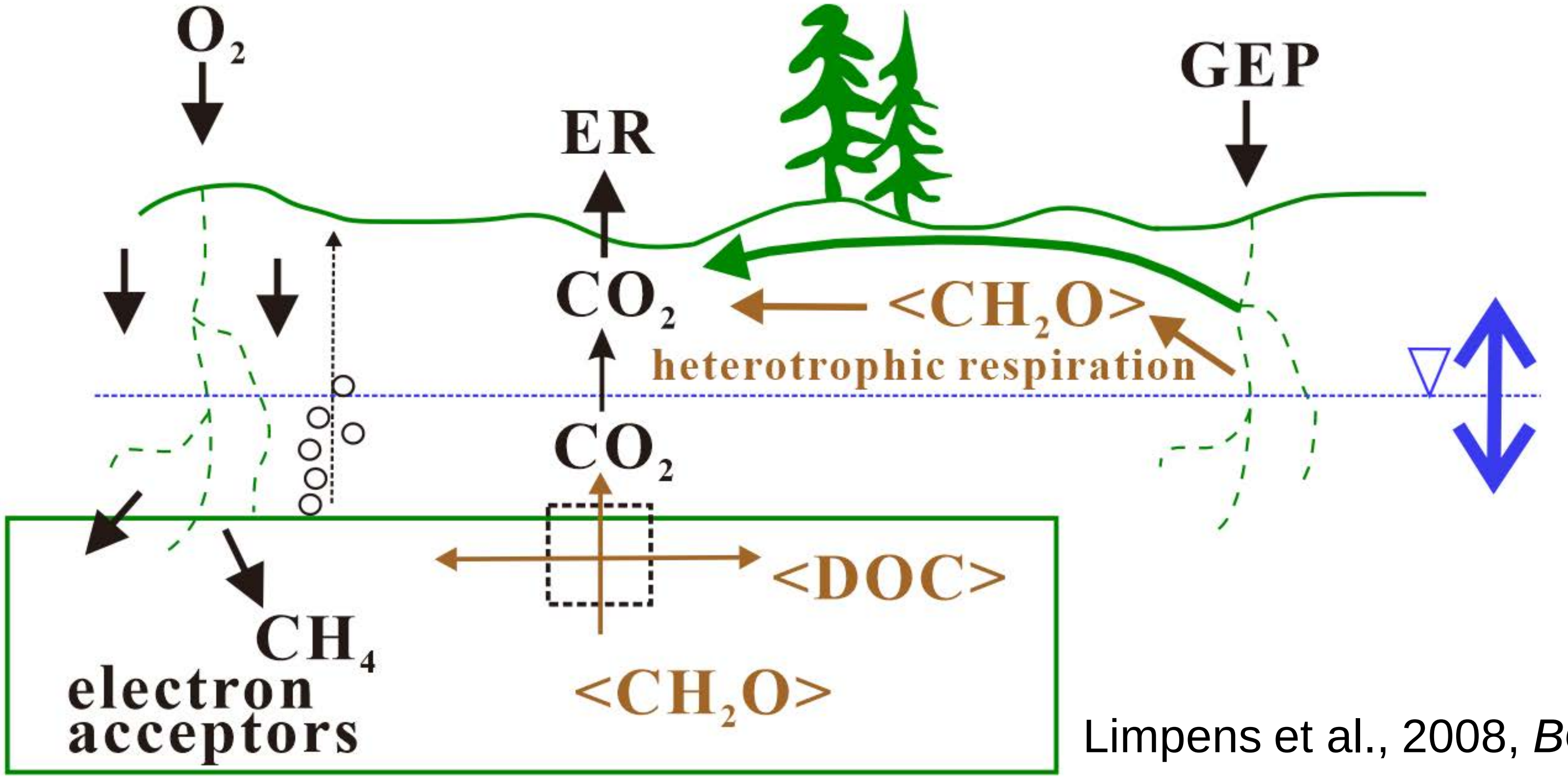
Friedlingstein et al., 2020 *ESSD*



Yu, 2011 *Holocene*

- Carbon-rich (TOC>30%), waterlogged, acidic, …
- Global peatlands store ca. 600 Pg C (Yu, 2012), the largest natural methane source

Water level vs peatland carbon cycling



water level
(below the surface)

Limpens et al., 2008, *BG*

- Water level ▸ redox ▸ carbon dynamic
- Understanding of influences of long-term water level fluctuations on carbon cycling is poor.

Objectives

- Hydroclimate changes in central China during the Holocene

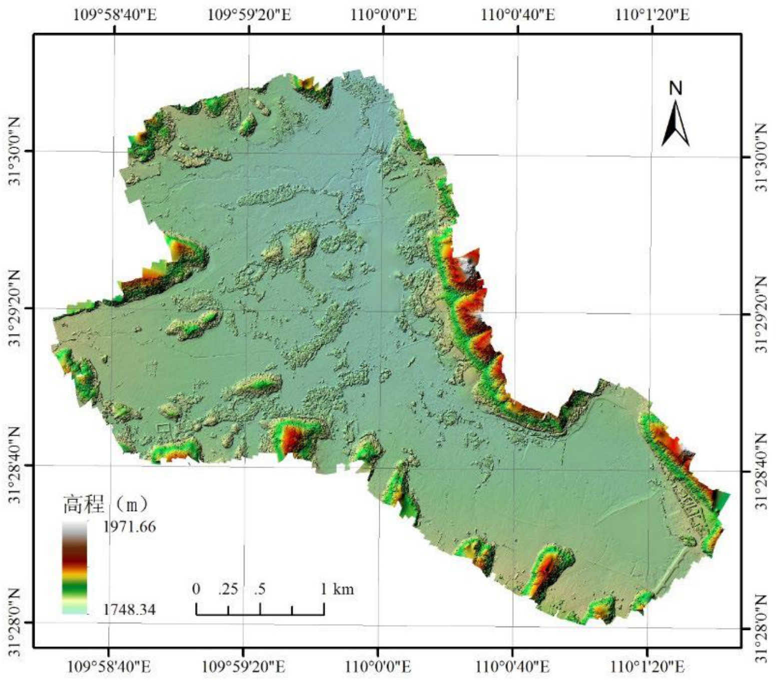
  - Wetlands are rich (rivers, lakes, peatlands, reservoirs, etc.)
  - Subtropical monsoon climate with dynamic hydroclimate
  - Knowledge of hydroclimate history is poor

- How hydroclimate affects the carbon dynamics in subtropical peat deposits

  - Climate conditions favoring peat initial
  - Drying influence on methane emission

Dajiuhu wetland

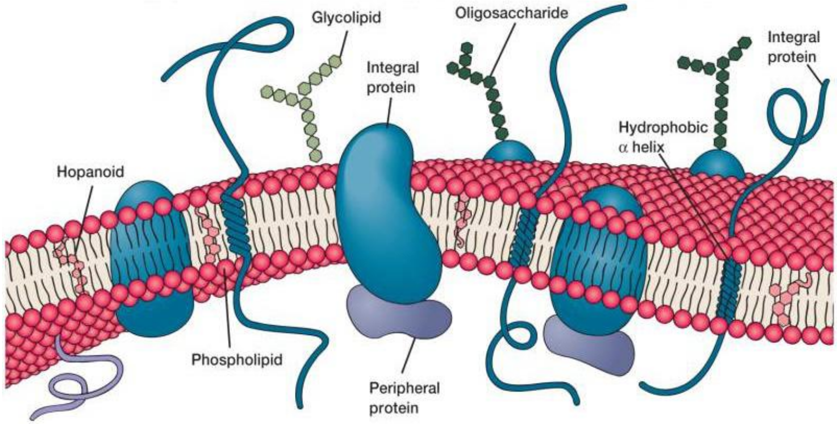
- Dominated by *Sphangum* and graminoid species, has been listed into the Ramsar Wetlands of International Importance in 2013
- Lacustrine and peat deposits span >200 ka



DEM map of Dajiuhu wetland

Peat core retrieved from Dajiuhu

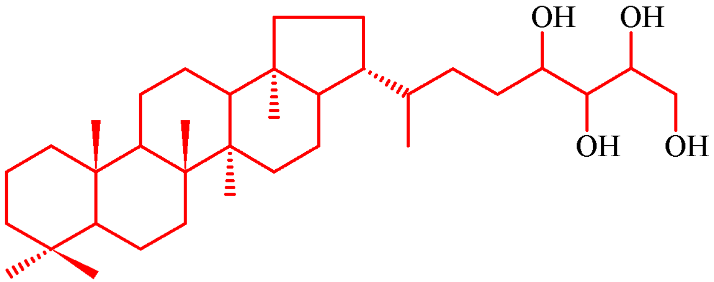
Lipids: molecules and C/H isotopes

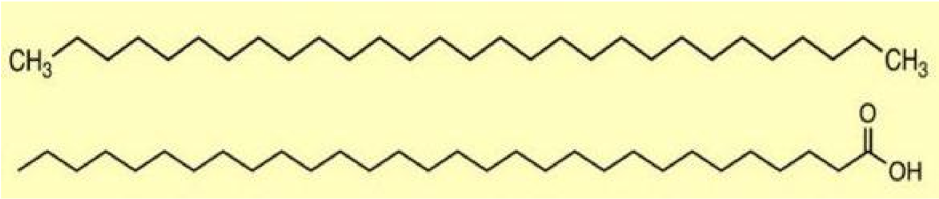


Madigan et al., 2010

Membrane lipids (e.g. hopanoids)

Leaf waxes (e.g. long-chain *n*-alkanes)

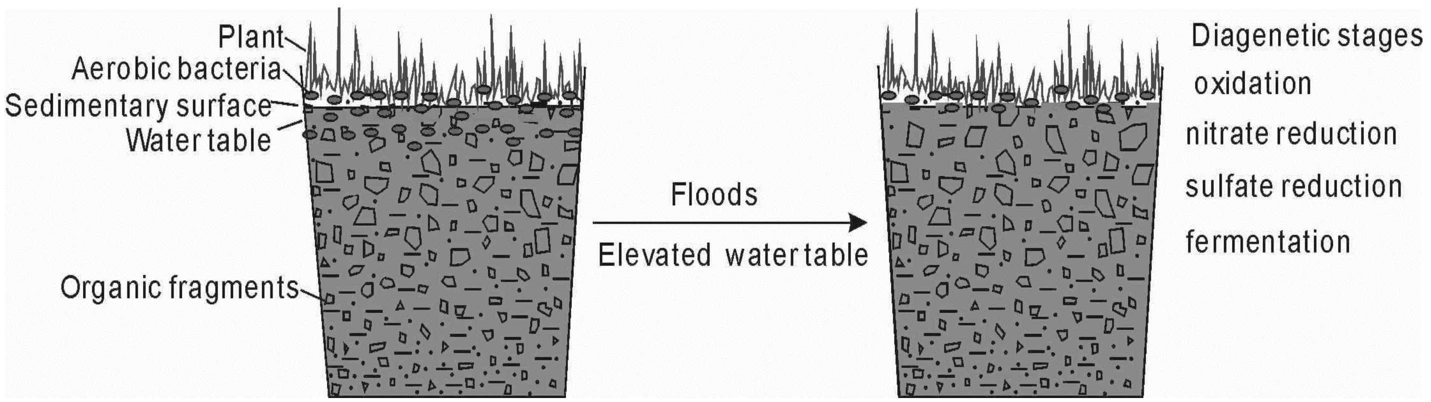


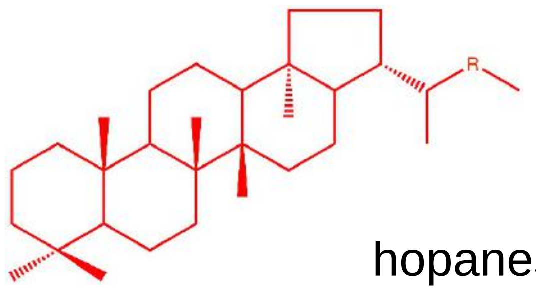


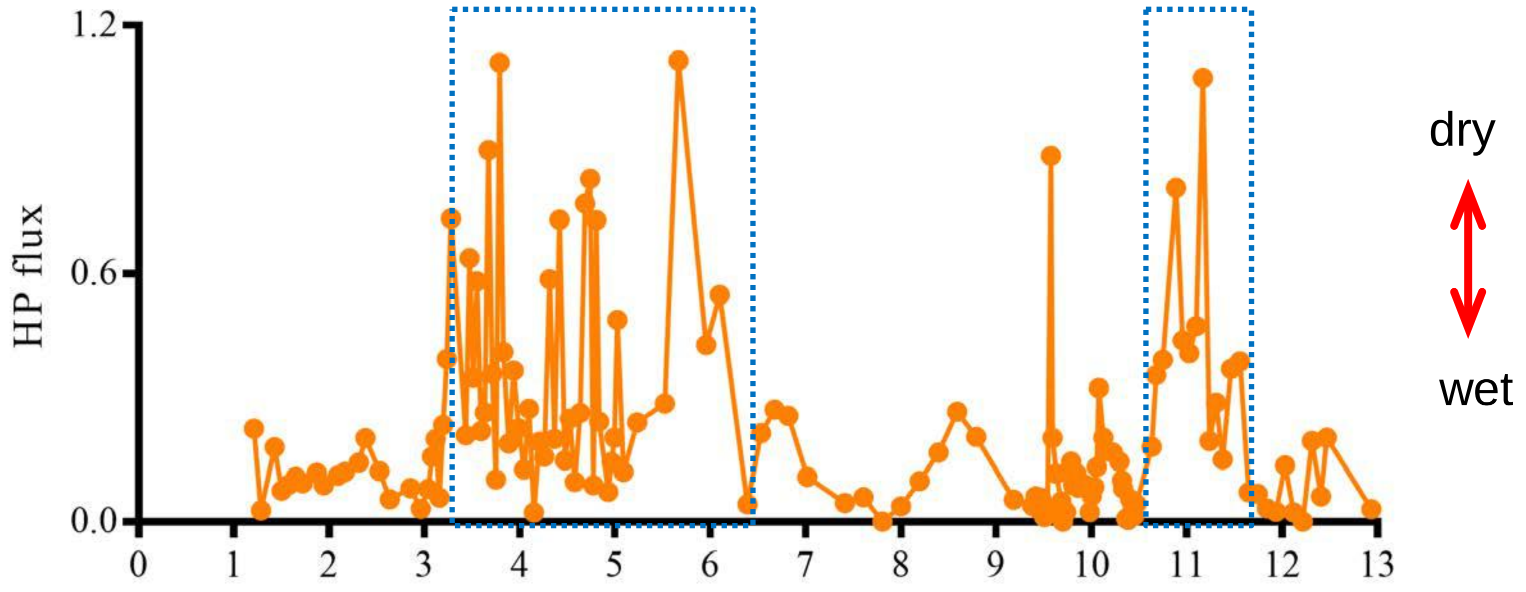
Molecular tools for illuminating past climate changes and ancient metabolism

Luo et al., 2019 *ESR*

Paleohydrological conditions over the past 13 ka





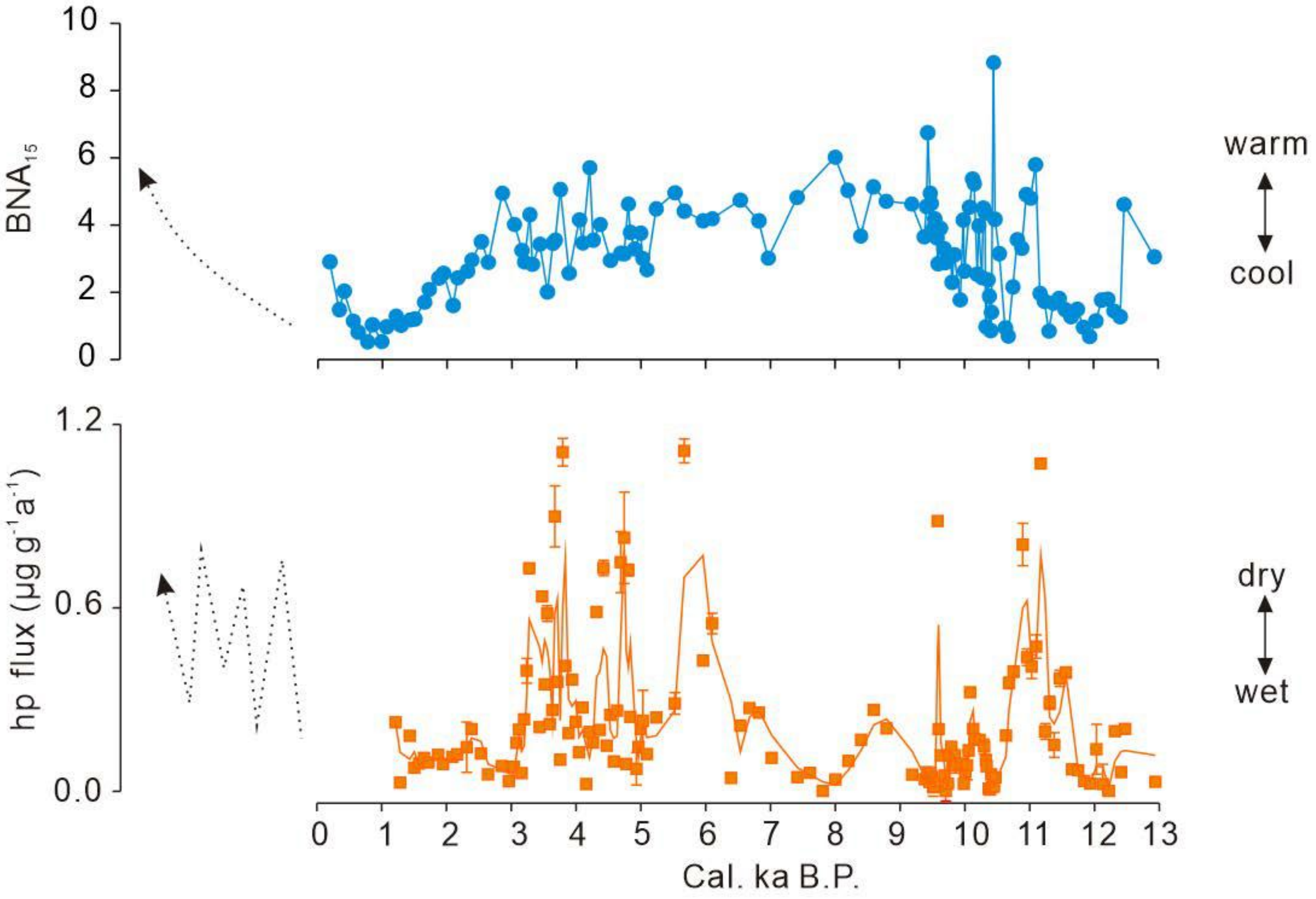


a novel paleohydrological proxy based on aerobic-derived lipids: hopanoid flux

two remarked drying intervals: ~7-3 ka BP, 11.6-10.6 ka

Xie et al., 2013, *Geology*; Huang et al., 2015 *GCA*; Gong et al., 2015 *Geomicrobiol J*

Implication for regional climate changes



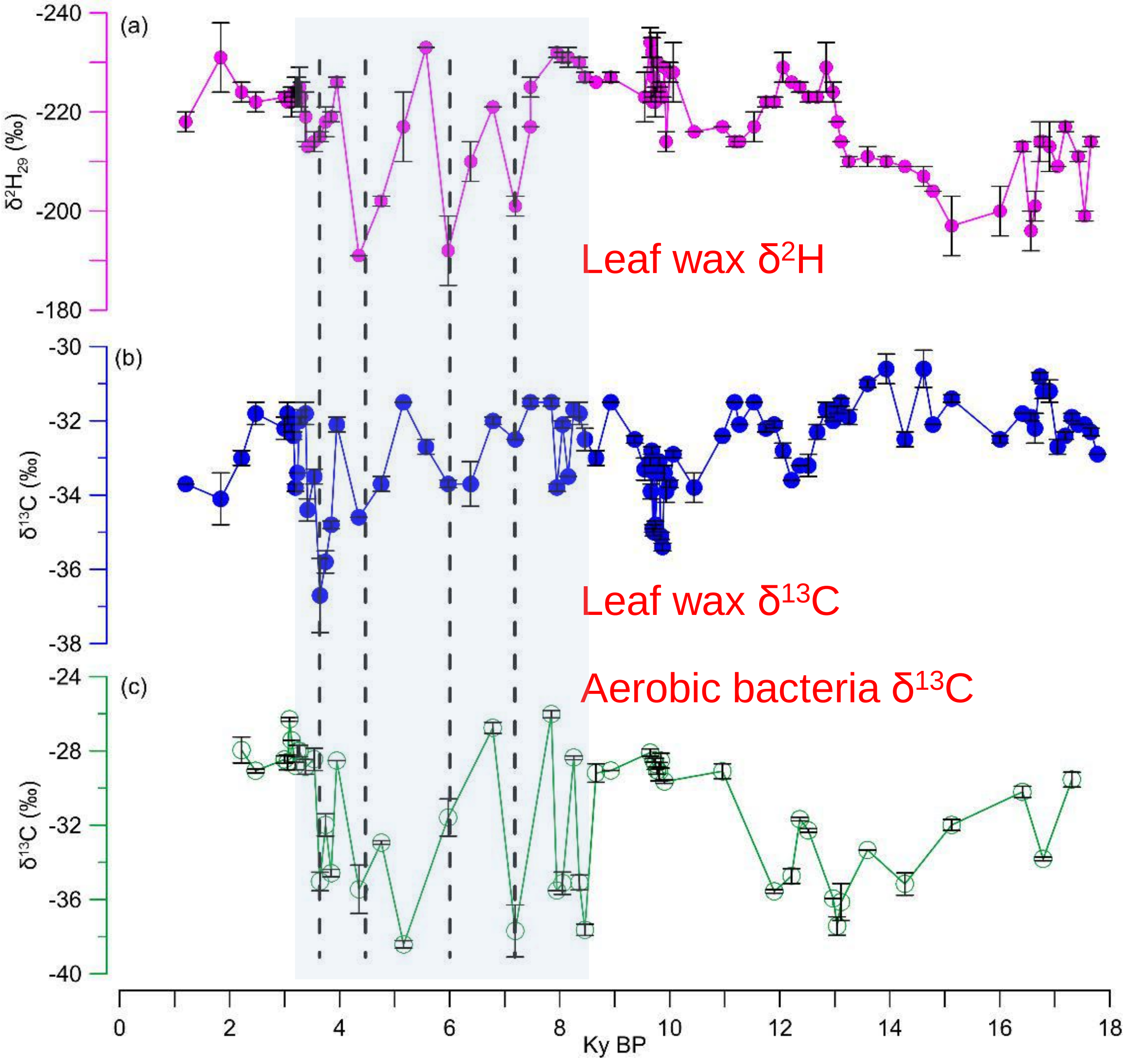
Third National Climate Assessment Report, 2015

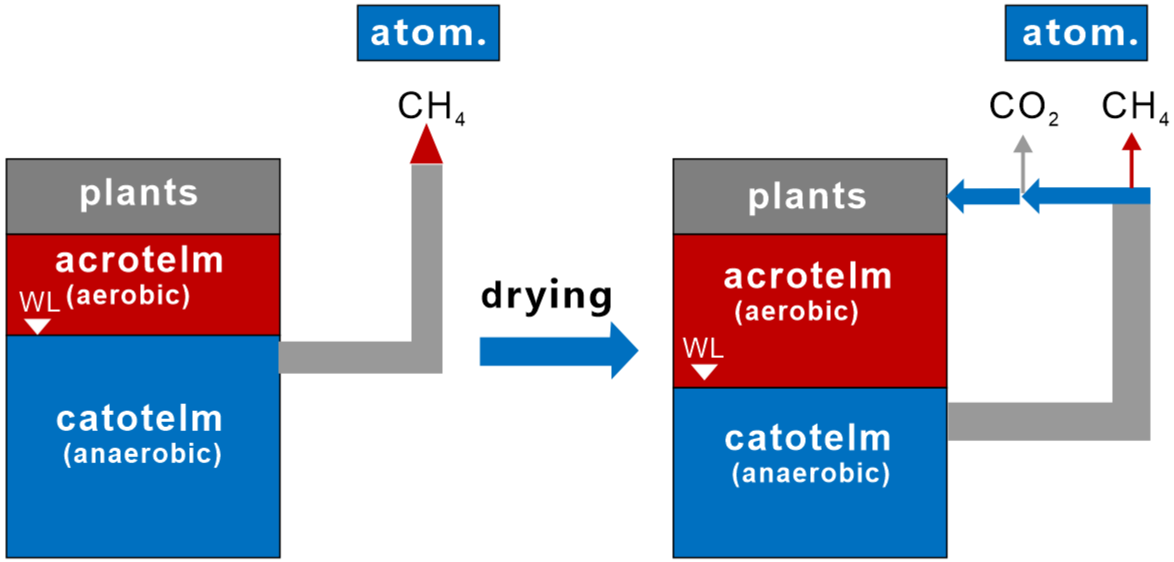
Paleotemperature
Huang et al., 2013
Holocene

Paleohydrological conditions
Xie et al., 2013 *Geology*

Stability of hydrological conditions decreased during the transitions

Influence of drying on methane dynamics during mid-Holocene

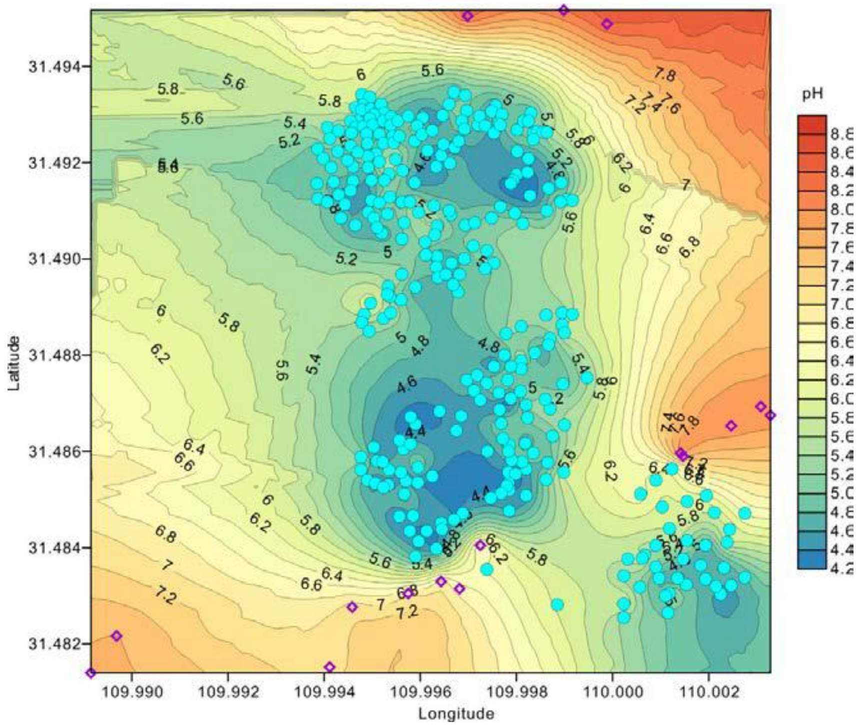




Methane feedback in peat deposits:
decrease of methane emission during drying intervals (recycled)

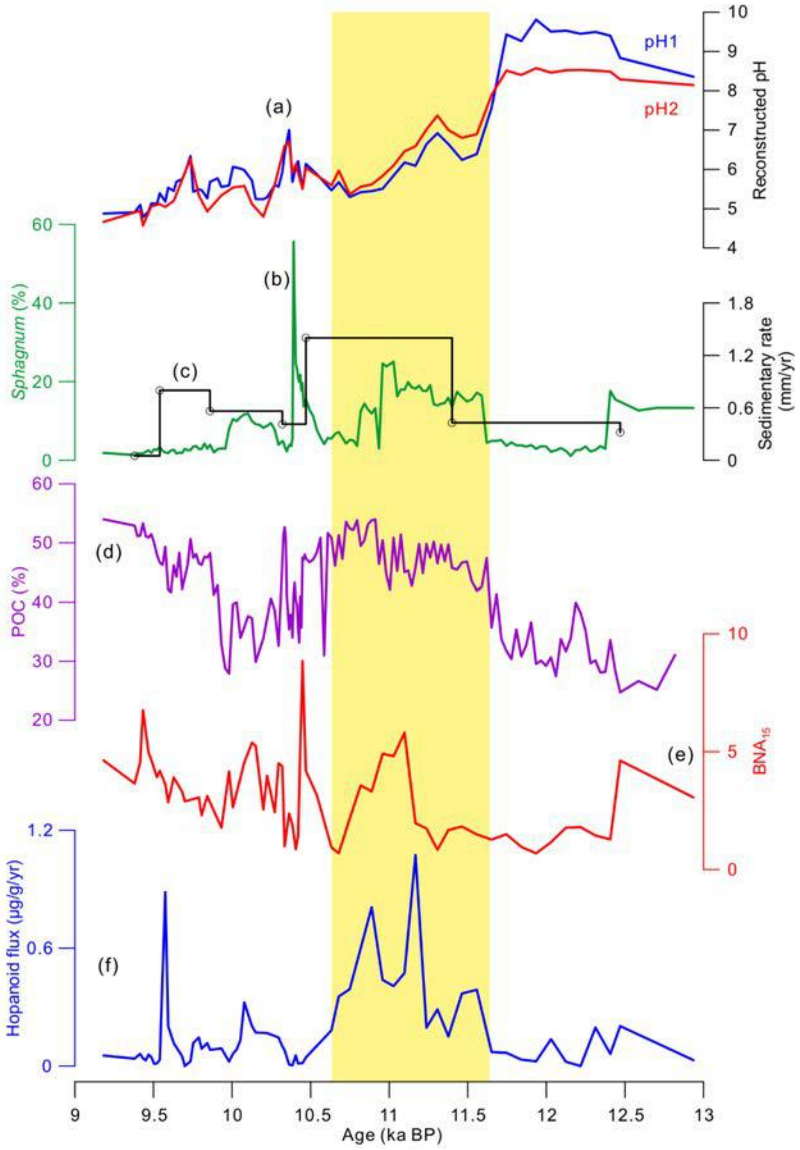
Huang et al., 2018 *Nat. Comm.*

Drying and acidification at the peatland initial



Dajiuhu wetland:
peatland (pH<6)
other water (pH 7~8)

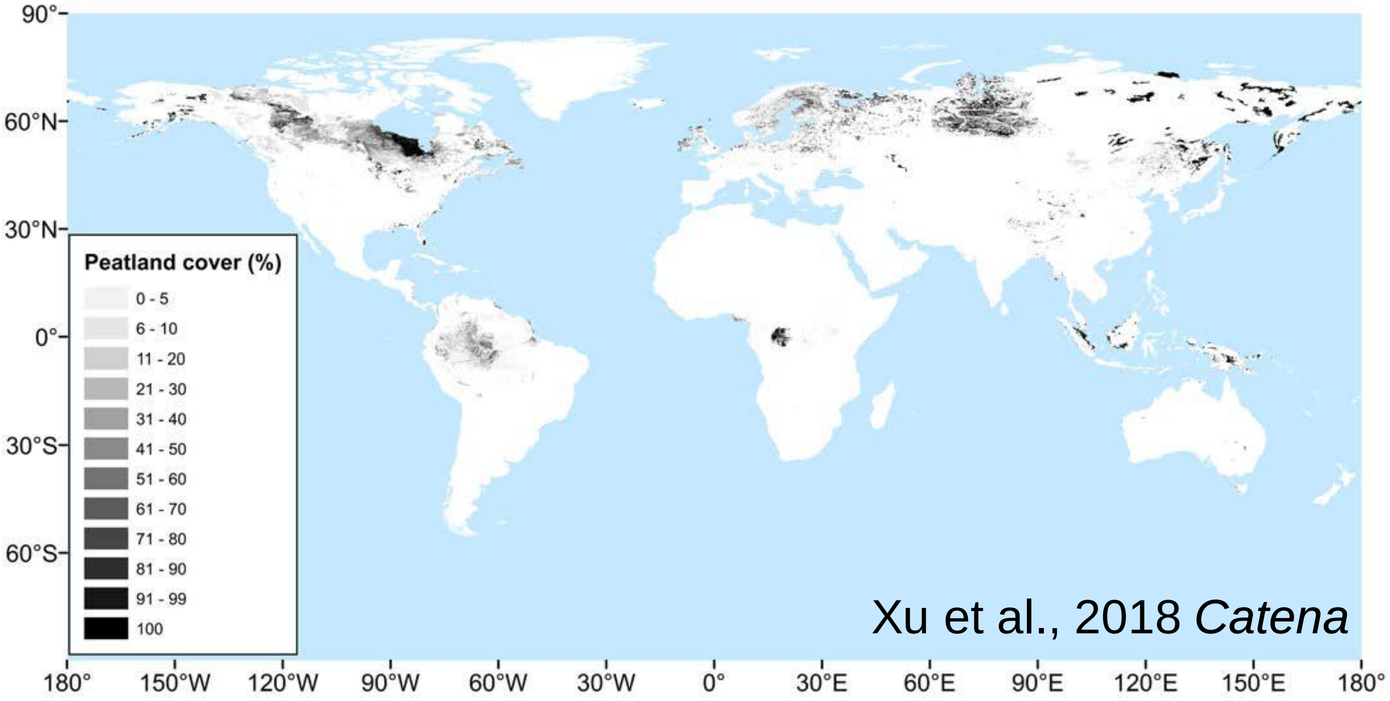
Zhang et al., 2020 *Chem. Geol.*



Peat initial context: drying, quick acidification, *Sphagnum* blossoming

Ongoing work: How does the methane dynamic changes?

Perspectives for the evolution of tropical peatlands



Xu et al., 2018 *Catena*

LETTER

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Age, extent and carbon storage of the central Congo Basin peatland complex

Greta C. Dargie[1,2*], Simon L. Lewis[1,2*], Ian T. Lawson[3], Edward T. A. Mitchard[4], Susan E. Page[5], Yannick E. Bocko[6] & Suspense A. Ifo[6]

Dargie et al., 2017 *Nature*

Carbon storage in tropical peatlands:

- **350 Pg C** (Gumbricht et al., 2017 *GCB*)
- **136 Pg C** (Müller & Joos, 2020 *BG*)
- **152–288 Pg C** (Ribeiro et al., 2021 *GCB*)

Key questions:

- Carbon accumulation history of tropical peatlands?
- Influences on atmospheric methane during the Holocene?

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