Modeling methane ebullition from peat soils of the Florida Everglades
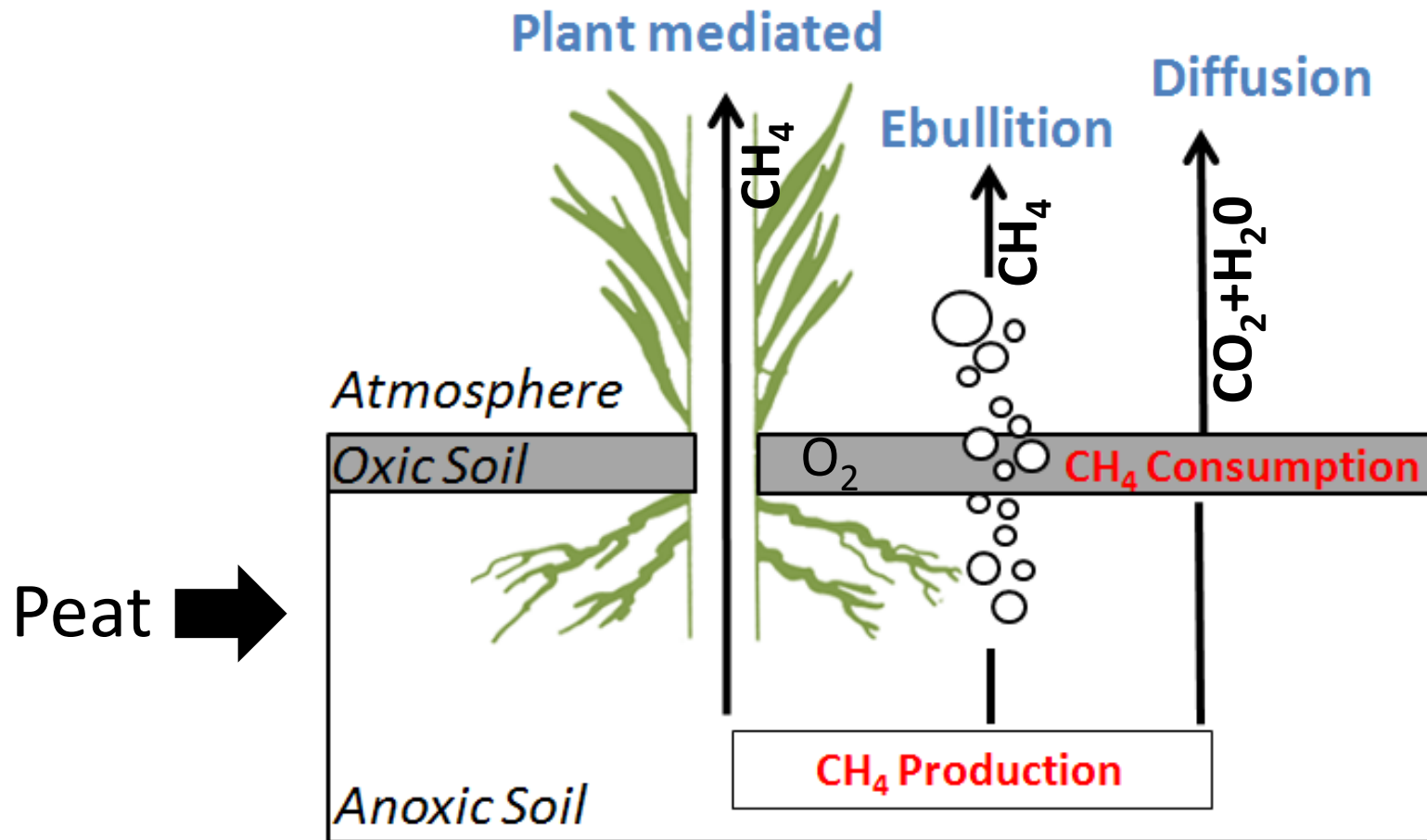
Jorge A Ramirez
William Wright
Xavier Comas

Methane transport to atmosphere
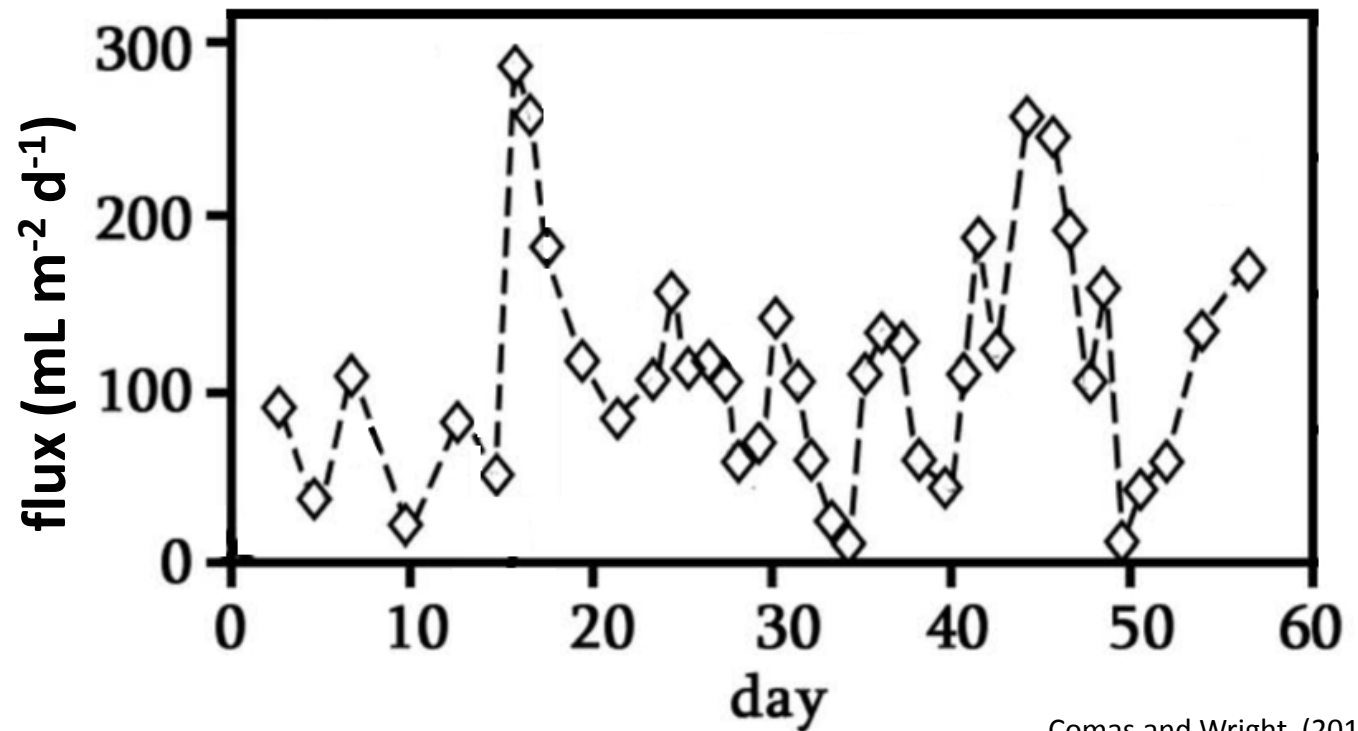

Redrawn from Conrad (1989)

Everglades methane ebullition

- Ebullition from Everglades peat can be <u>highly variable</u>
- How to replicate this behavior with a model

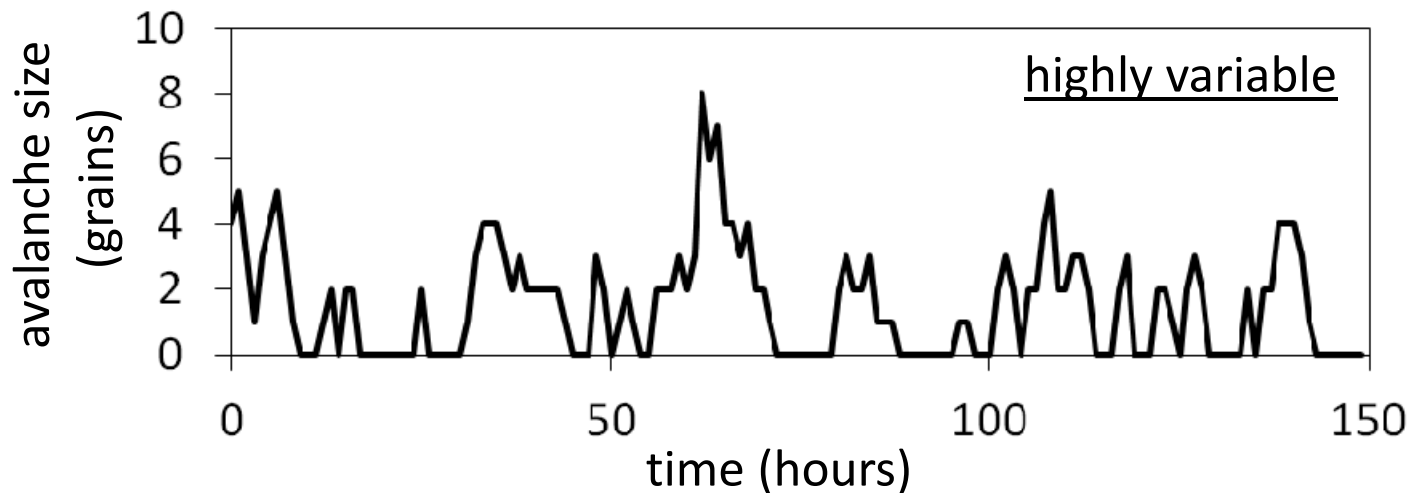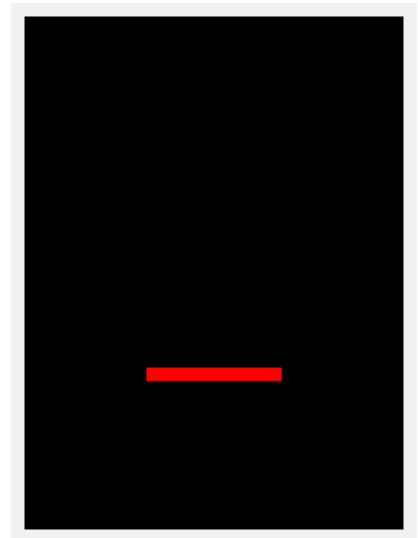**Daily gas flux from time-lapse cameras**

Comas and Wright (2012)

Inspiration from sand pile models

Simple model of avalanche dynamics:

- Sand **trapped**
- Sand **accumulates**
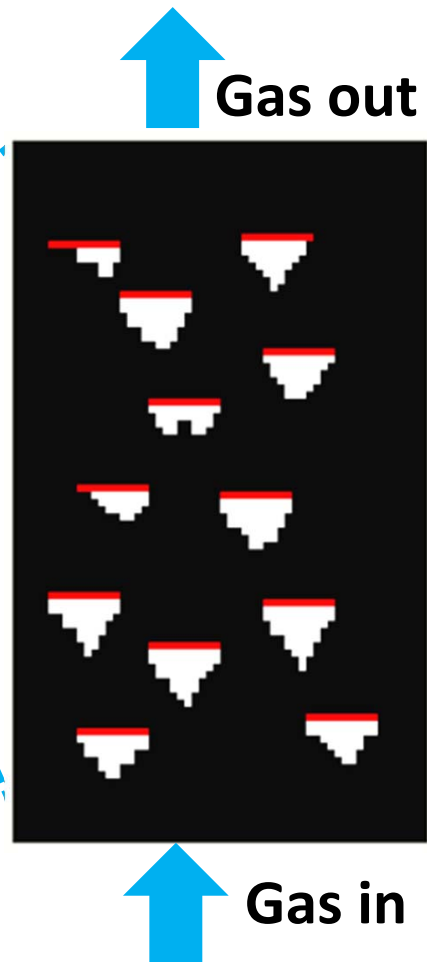- **Release** of sand as non steady avalanches

highly variable

Model of Ebullition and Gas storAge (MEGA)

Peat core in profile

Modeled peat
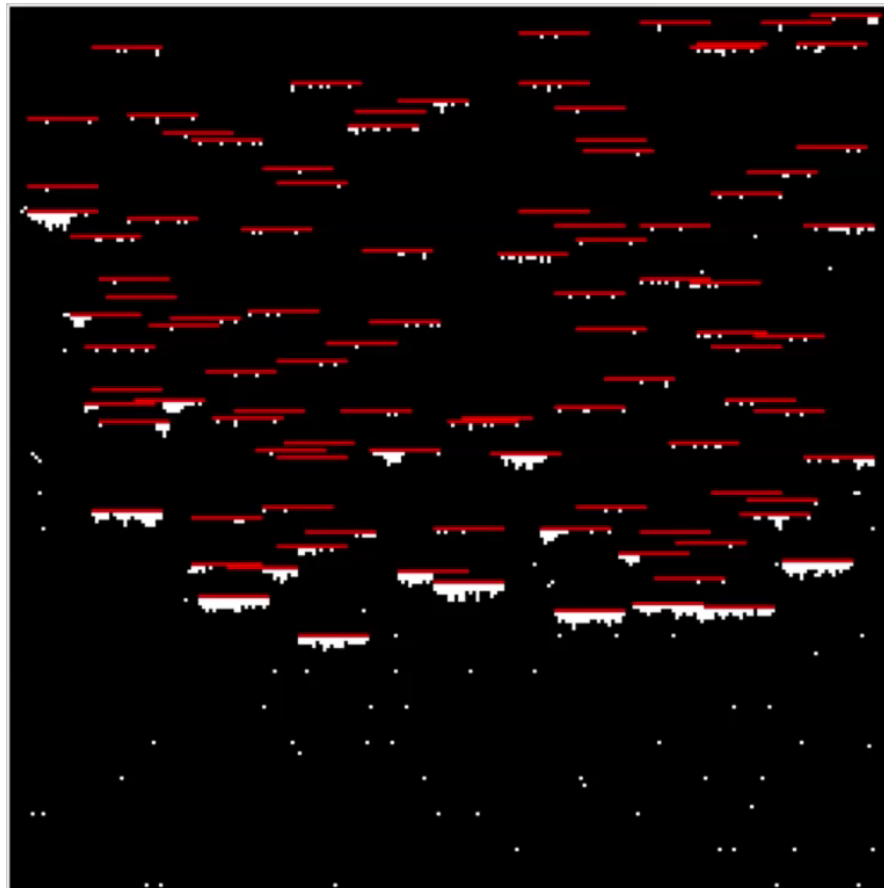
Gas out

Gas in

- gas
- water
- peat

- Peat is represented by a set of shelves
- Bubbles behave like inverted sand piles
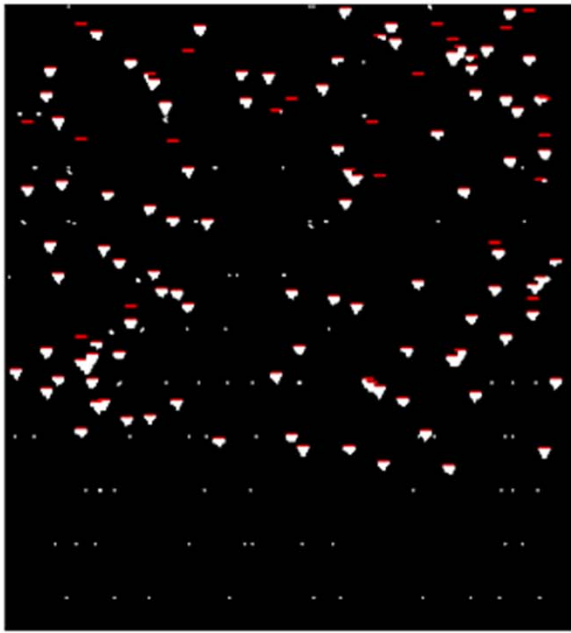- Gas movement = avalanches

Ramirez et al (2015)

MEGA

Gas out

MEGA replicates:
bubble **accumulation**,
storage, and release
within peat

☐ gas
■ water
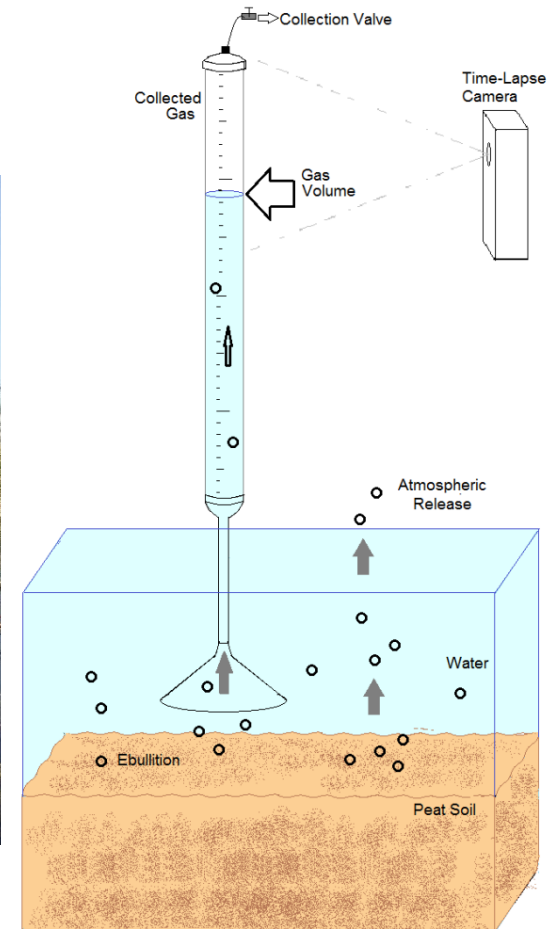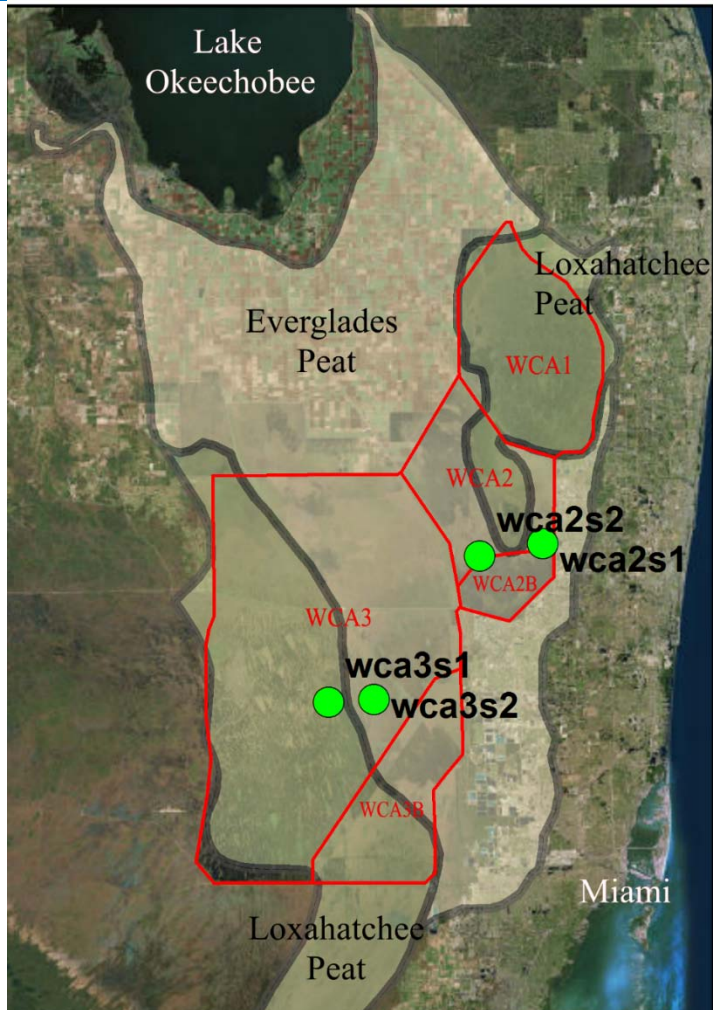■ peat

Gas in
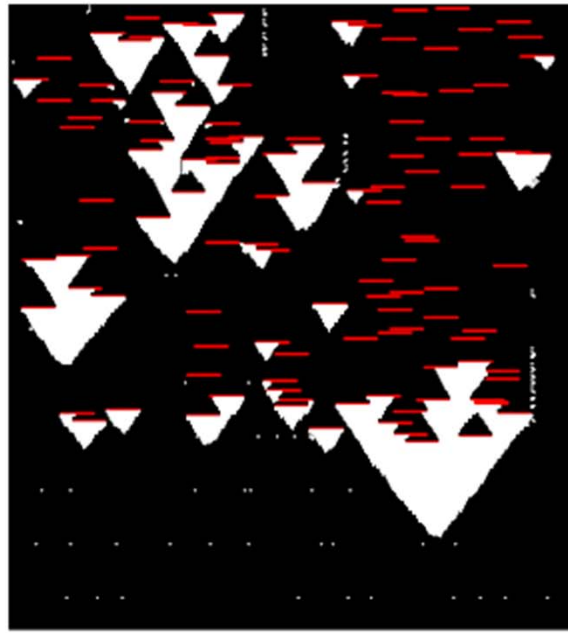
MEGA

Open peat **Dense peat**

MEGA can be used to investigate the affect
of **peat structure** on CH_4 ebullition

Study aim

- Replicate CH_4 ebullition from Everglades peat with MEGA by representing peat pore structure, and pore-level gas dynamics.

- Test MEGA against observed:
  - Gas content within Everglades peat
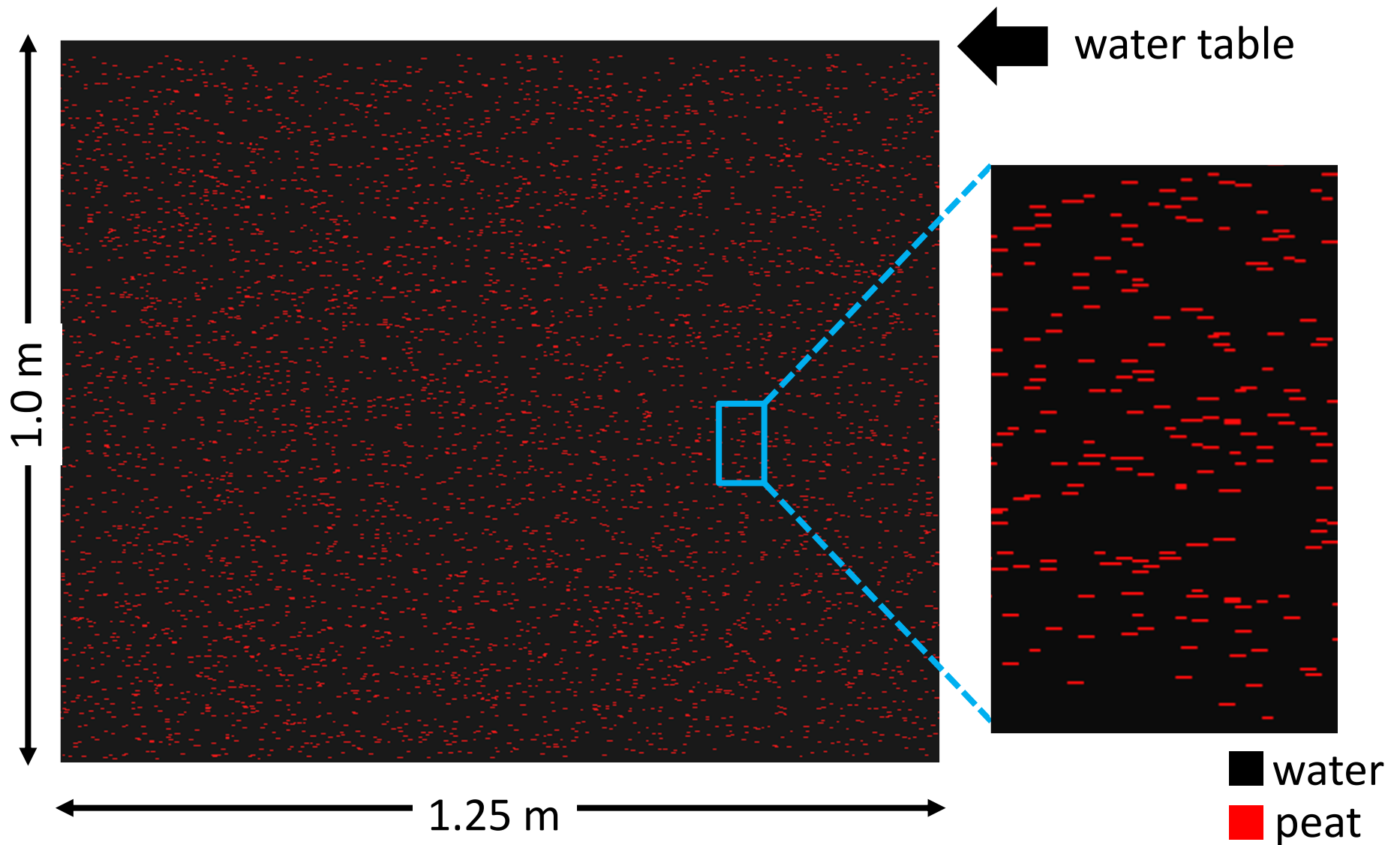 - Magnitude and frequency of ebullition from Everglades peat

Field sites

Gas trap

3 months of hourly ebullition records
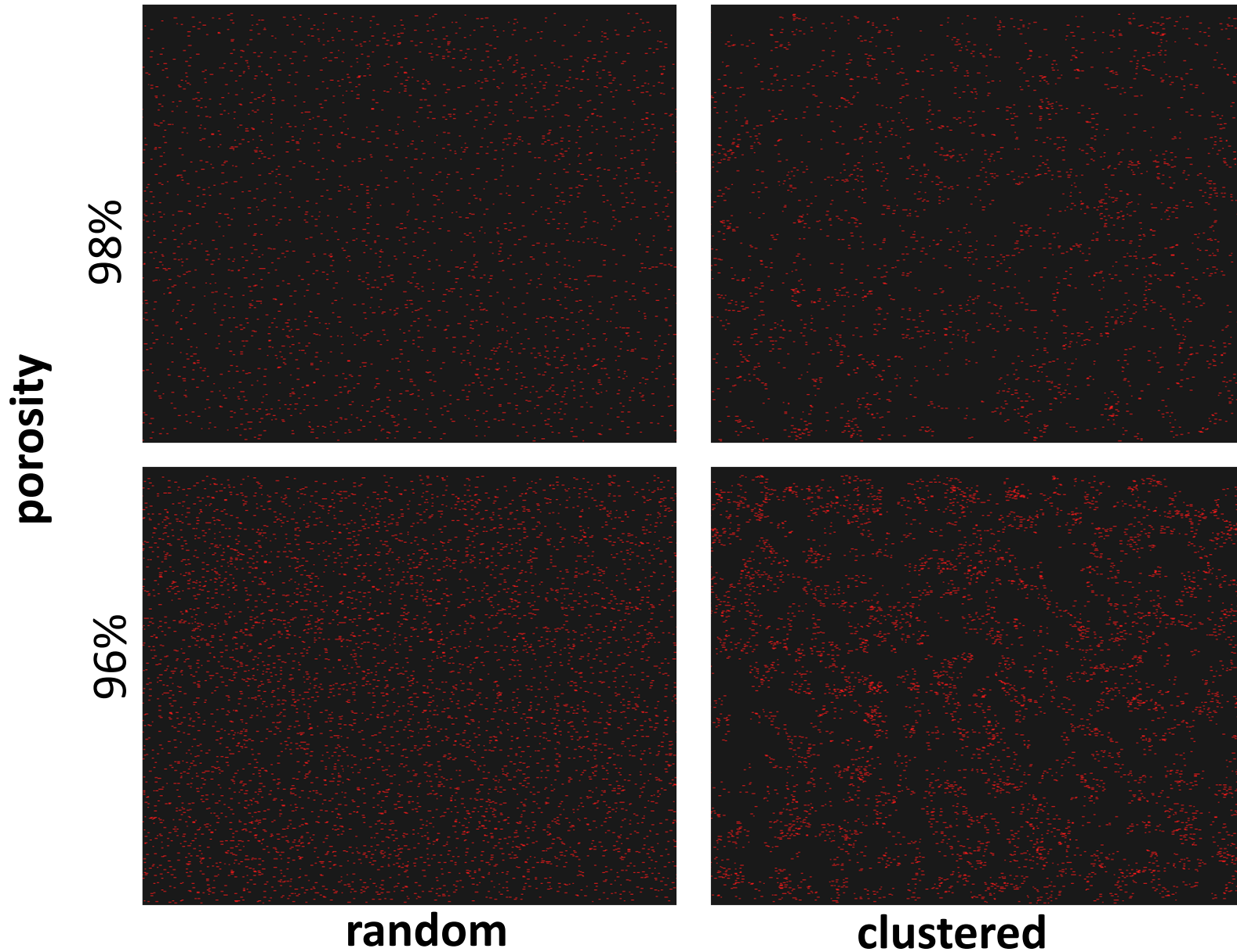Ground penetrating radar for gas content

Field sites

- Peat porosity: 96-98% (further investigate)

- Peat thickness: 0.5 – 1.31m

- CH_4 production values: 968 mL CH_4 m^{-2} day^{-1}

Model setup: Peat structure

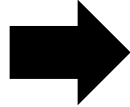water table

1.0 m

1.25 m

water
peat

Model setup: Peat structure
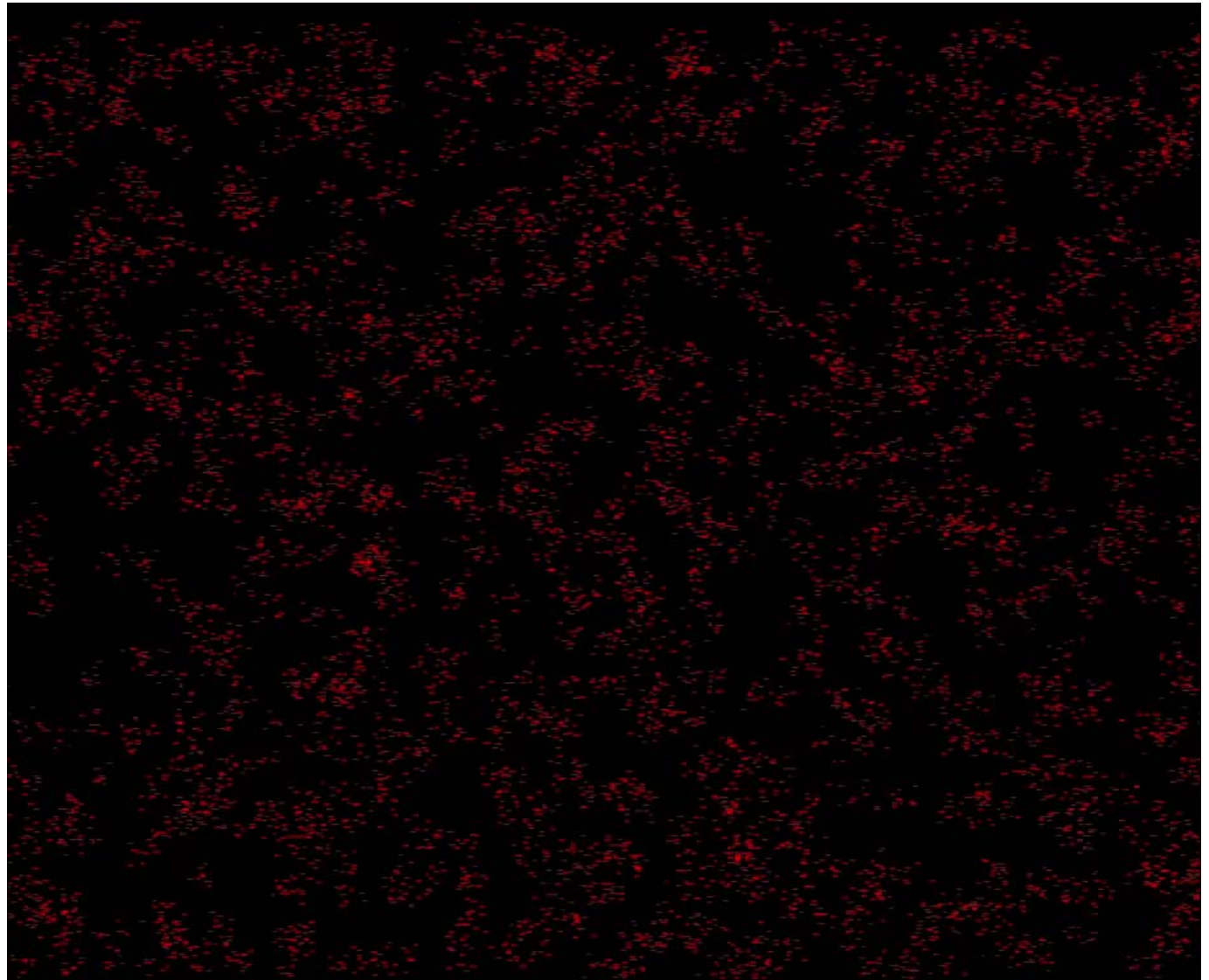
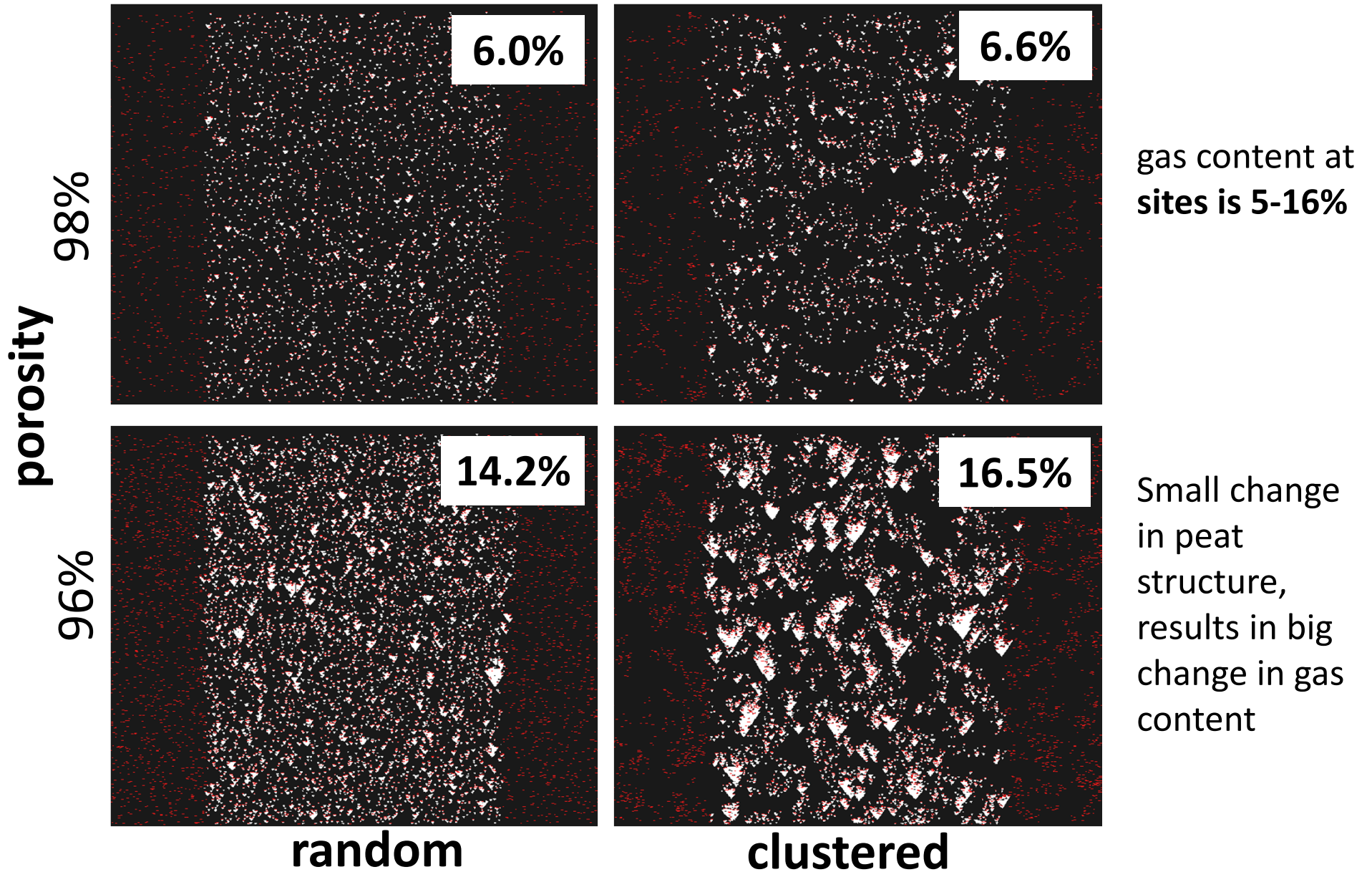# Initial conditions

water table →

Gas production is added at random locations per hour

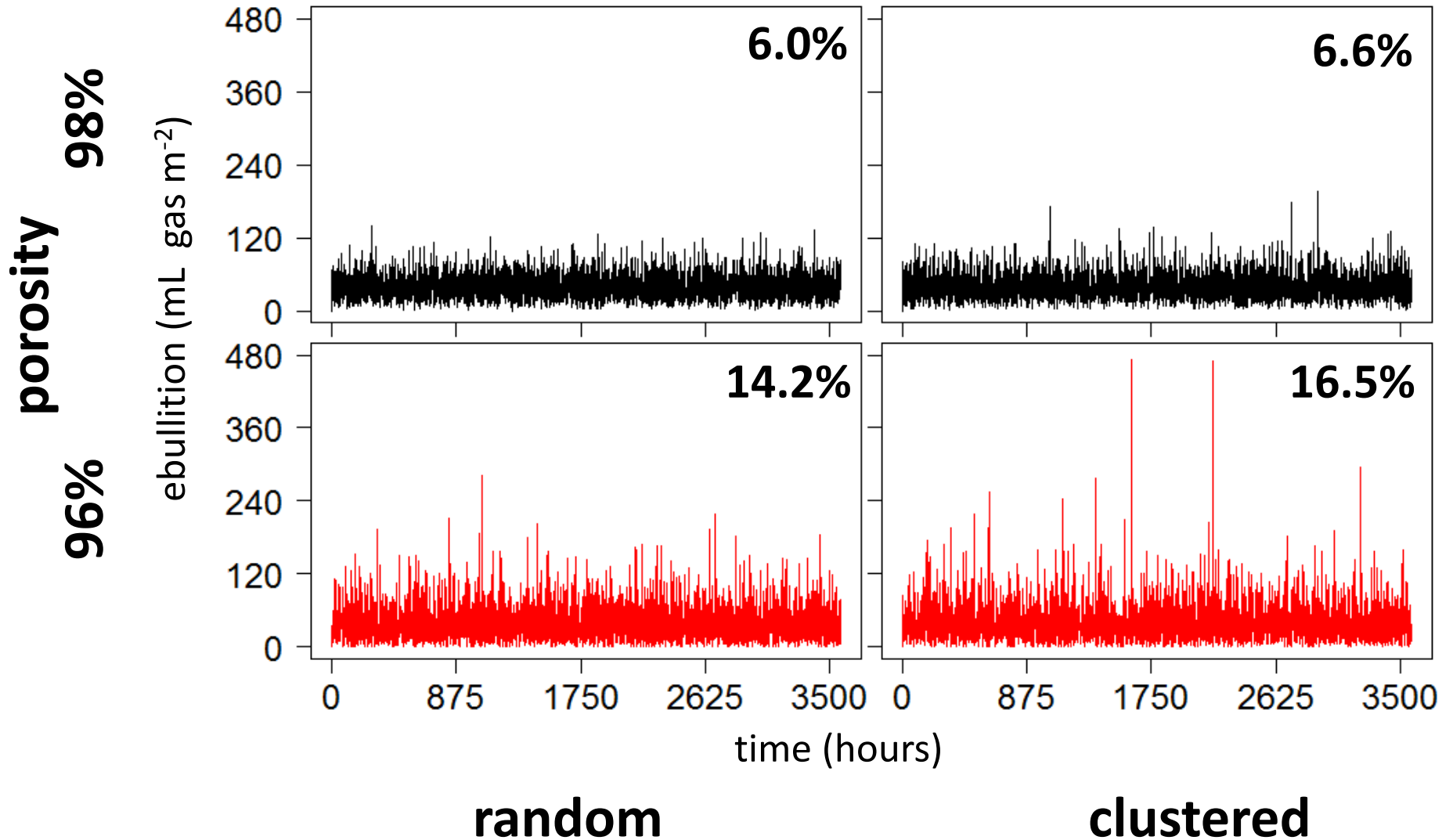1500 days of simulation until peat is saturated with gas

150 days of hourly gas flux at water table
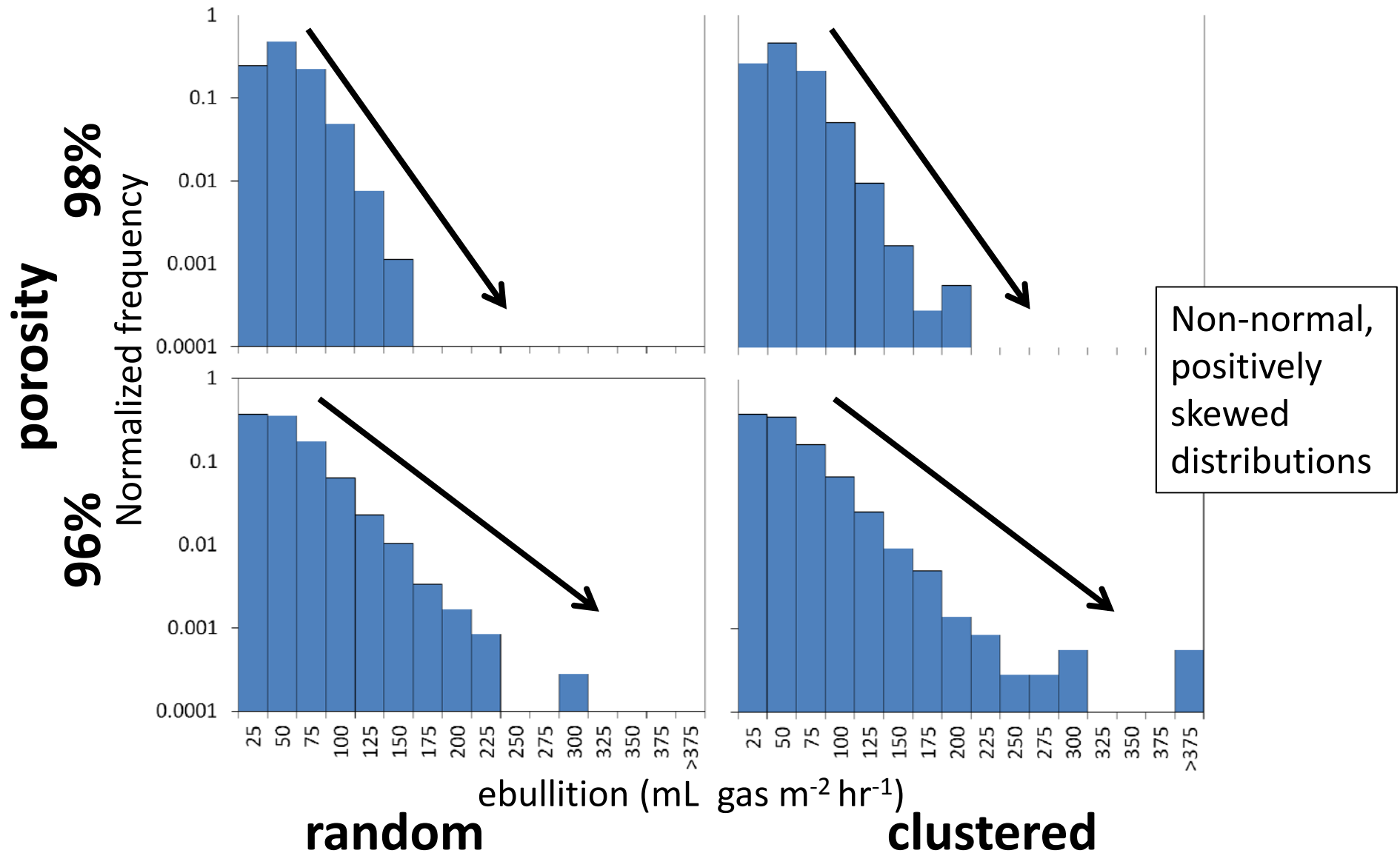
Gas content comparison

98%	6.0%	6.6%
96%	14.2%	16.5%
porosity	random	clustered

gas content at **sites is 5-16%**

Small change in peat structure, results in big change in gas content
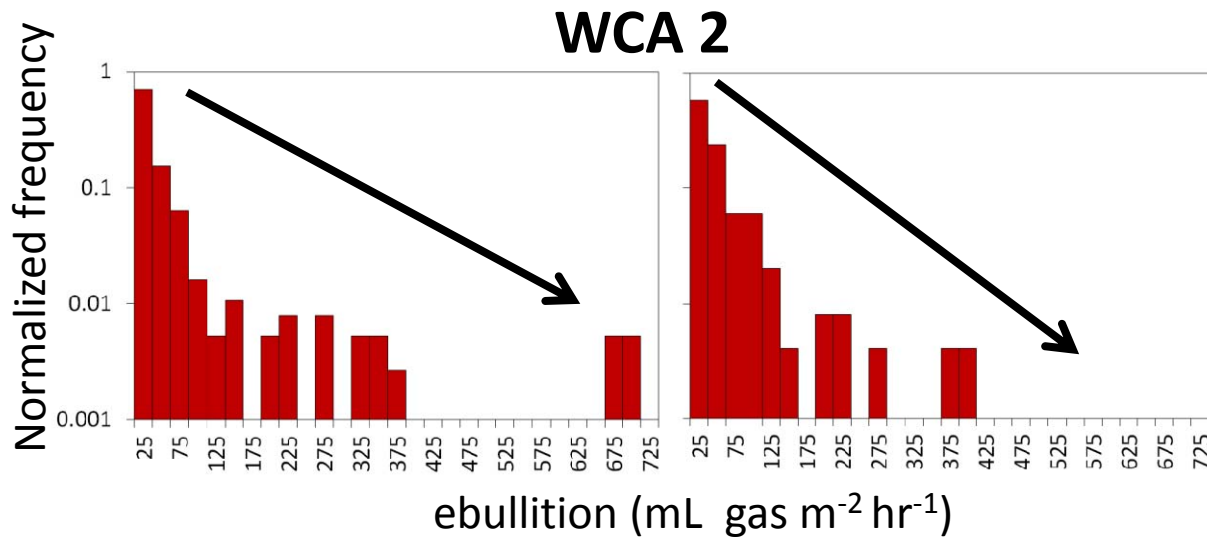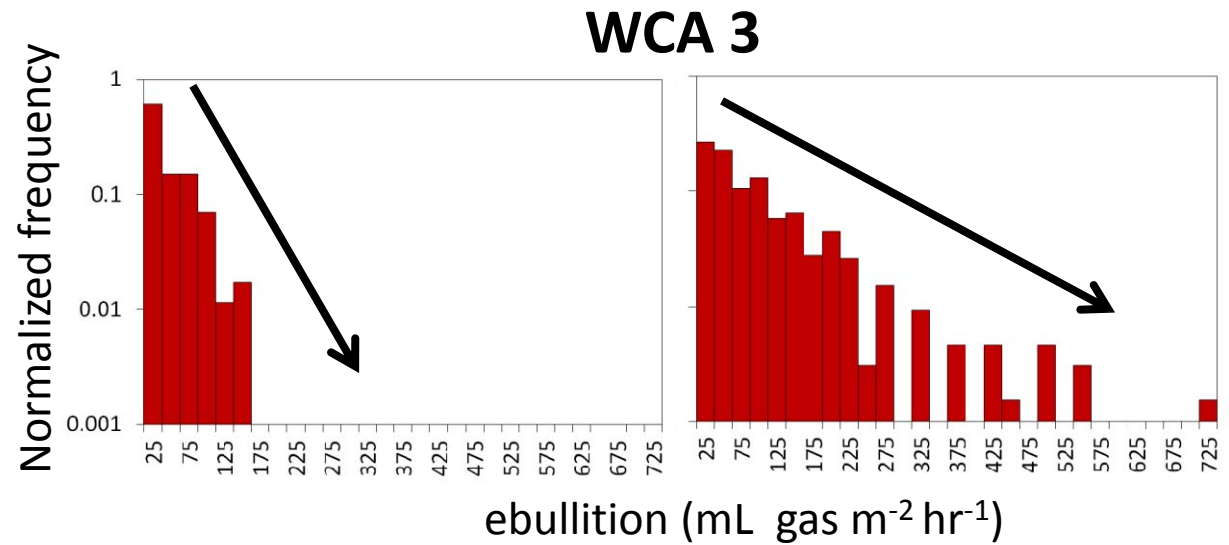
Modeled ebullition

Modeled ebullition

Observed ebullition

Non-normal, positively skewed distributions

Conclusions and future work

- MEGA can reproduce observed:
  - Gas content
  - Patterns magnitude and frequency of ebullition
- Model results suggest that <u>pore structure </u>may be an important control on ebullition <u>timing</u> and <u>quantity</u>
- More work is needed on characterizing the pore structure of the peats at each site
- Match site to model setup with similar peat structure