



# Methane in the Arctic

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# Take-home message:

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1. Shelf: methane released from subsea permafrost is oxidized before reaching atmosphere



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1. Shelf: methane released from subsea permafrost is oxidized before reaching atmosphere
2. Ocean: sea ice key to methane flux to atmosphere



# Take-home message II:

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1. Methane Box topic in PACES II is **active**
2. Publications in 2015 demonstrate results and suggest tantalizing hypotheses:
  - on methane release from subsea permafrost
  - on the importance of sea ice in methane transport to atmosphere
3. There is great potential for surprising results in future cross-department work on **Arctic methane**

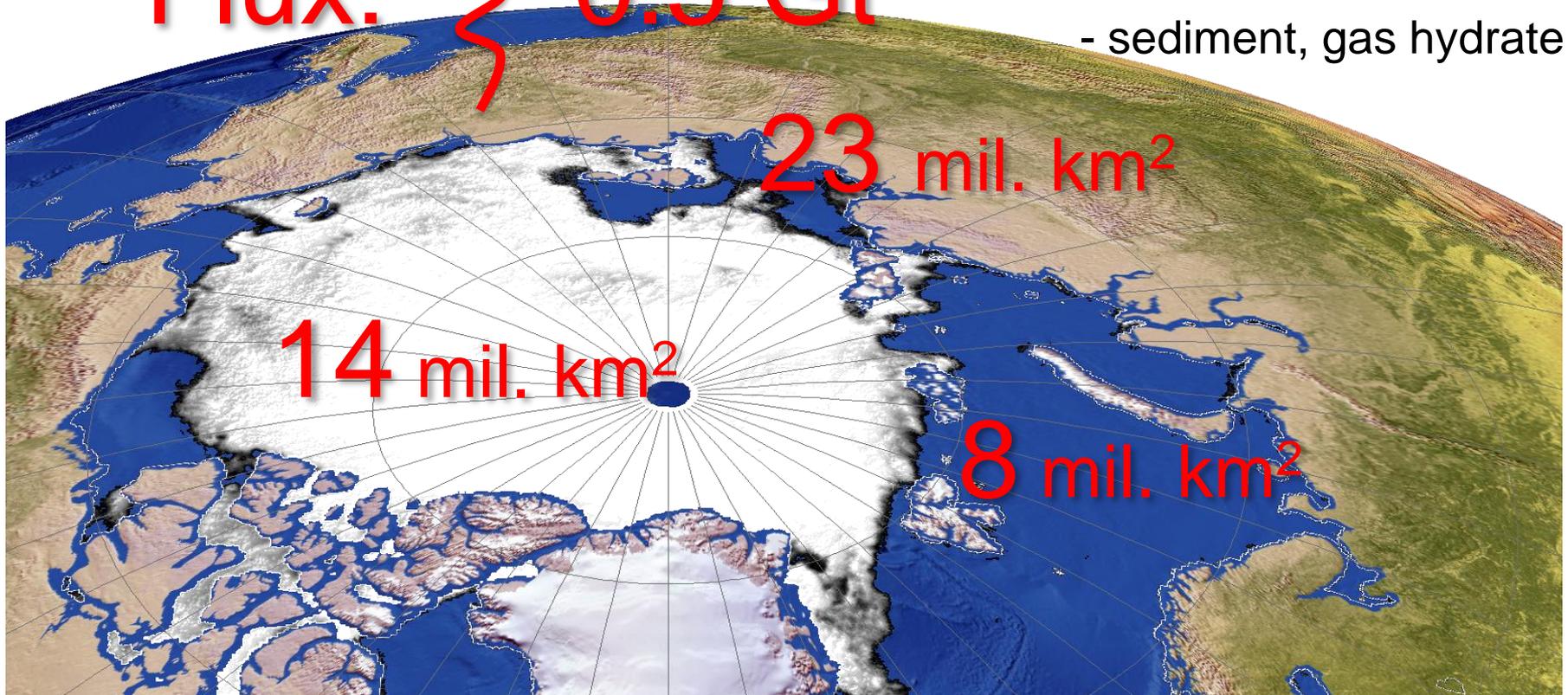
# Methane pathways in the Arctic

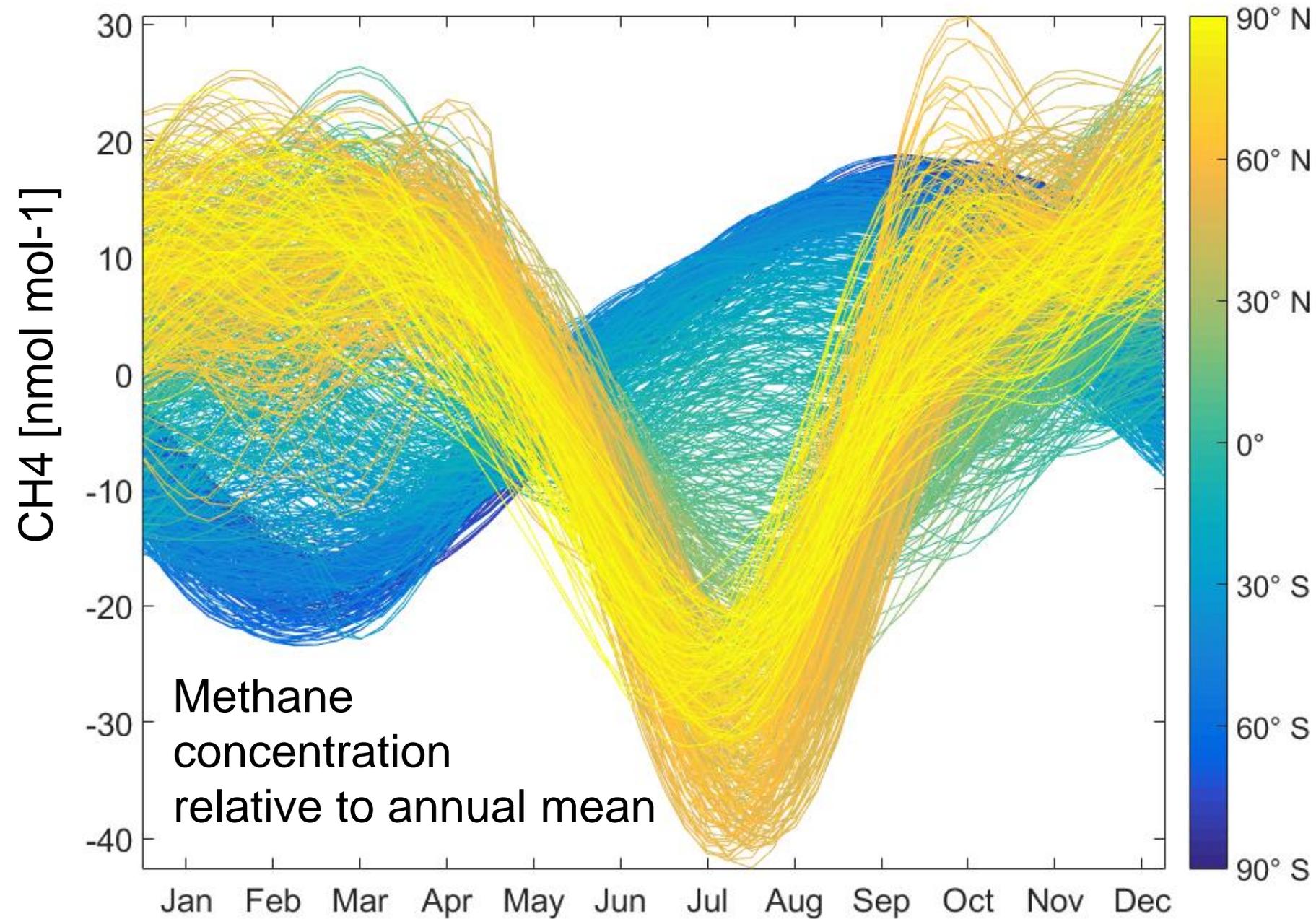
Atmosphere: 4 Gt

Flux:  0.5 Gt

## Arctic Sources

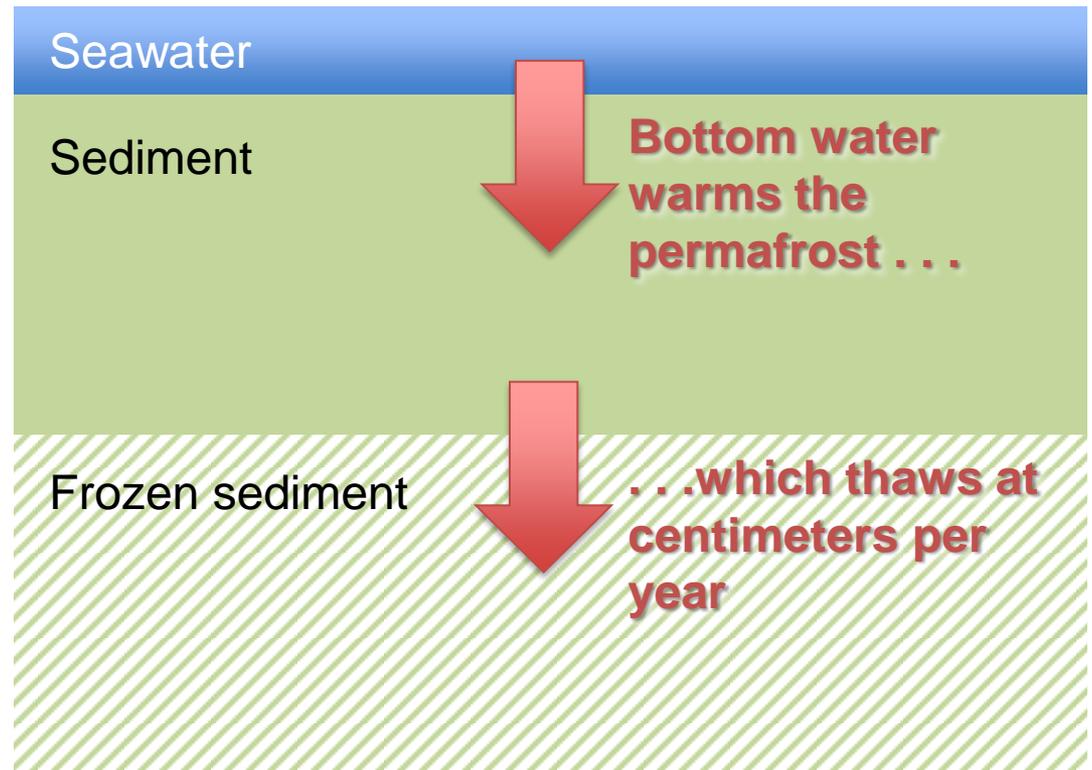
- anthropogenic
- permafrost, wetland
- river discharge
- sediment, gas hydrate





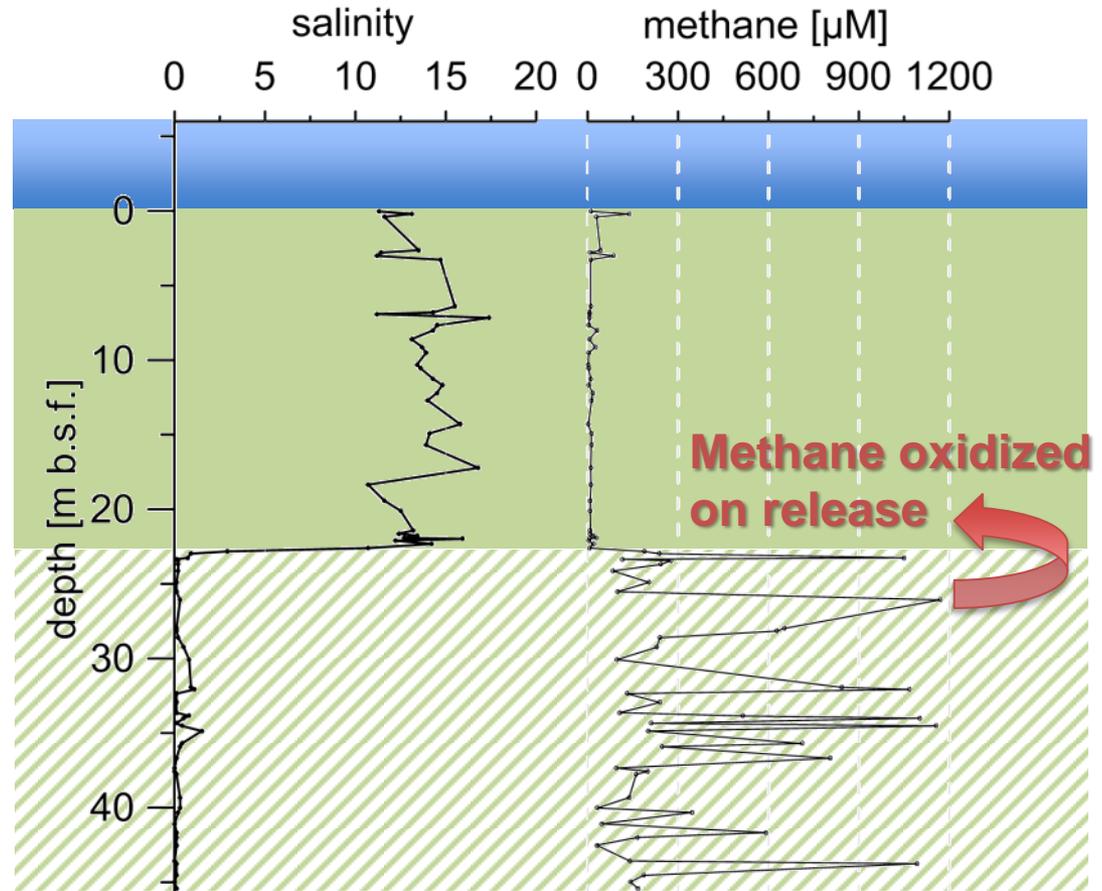
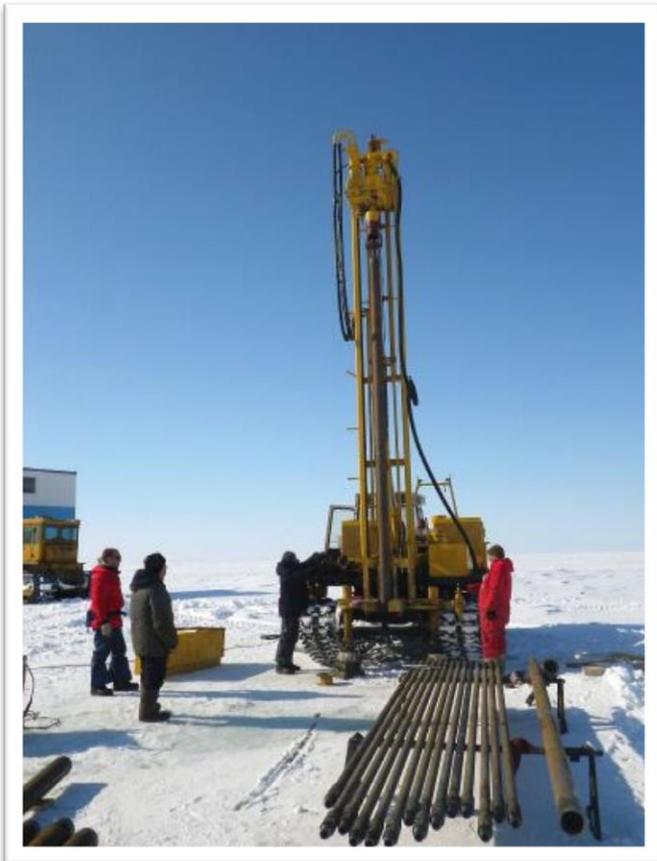
# Subsea permafrost is thawing

... and we can quantify how much methane could be released.

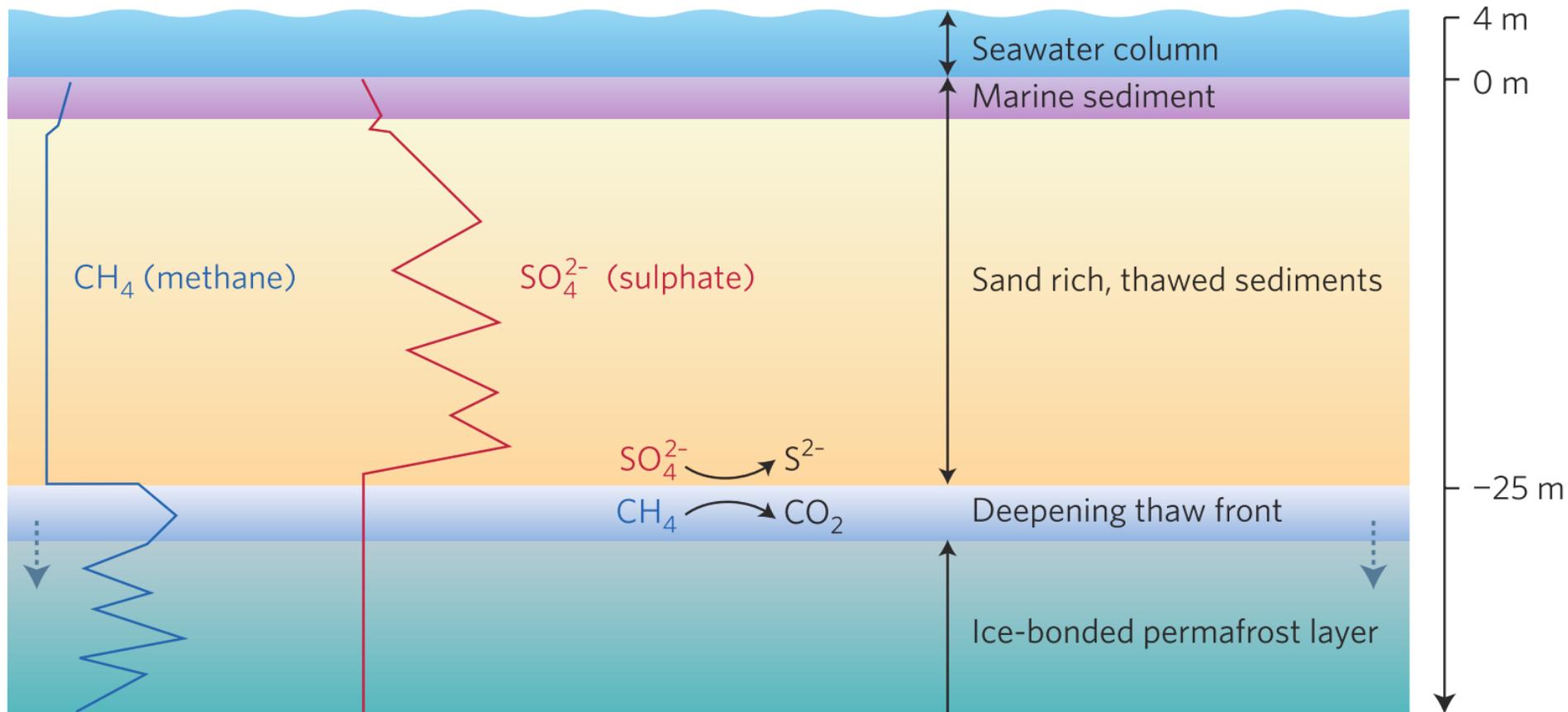


# Methane is oxidized on release

... and does not reach the sea bed or atmosphere.

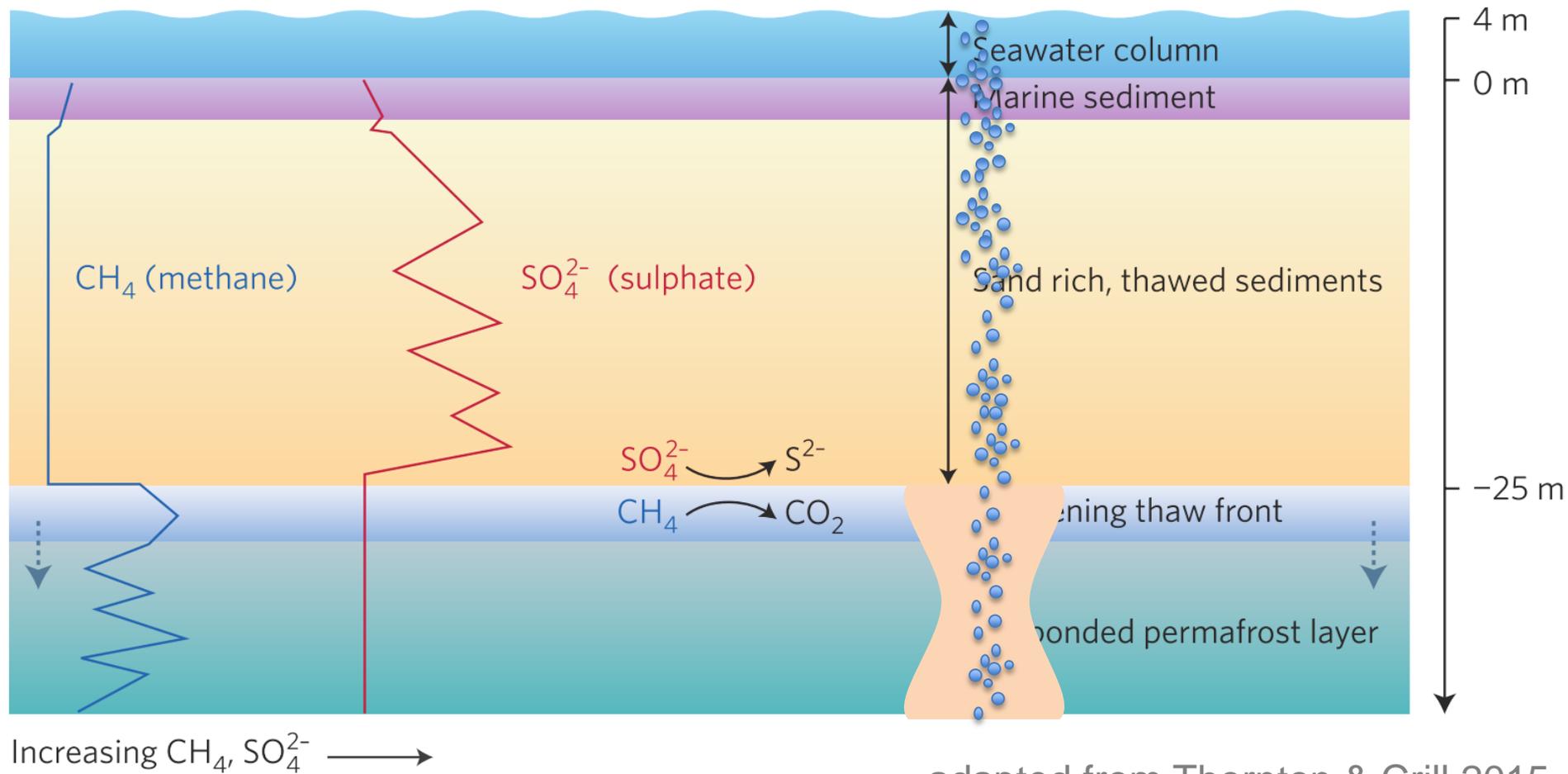


# Unfrozen sediment acts as biofilter



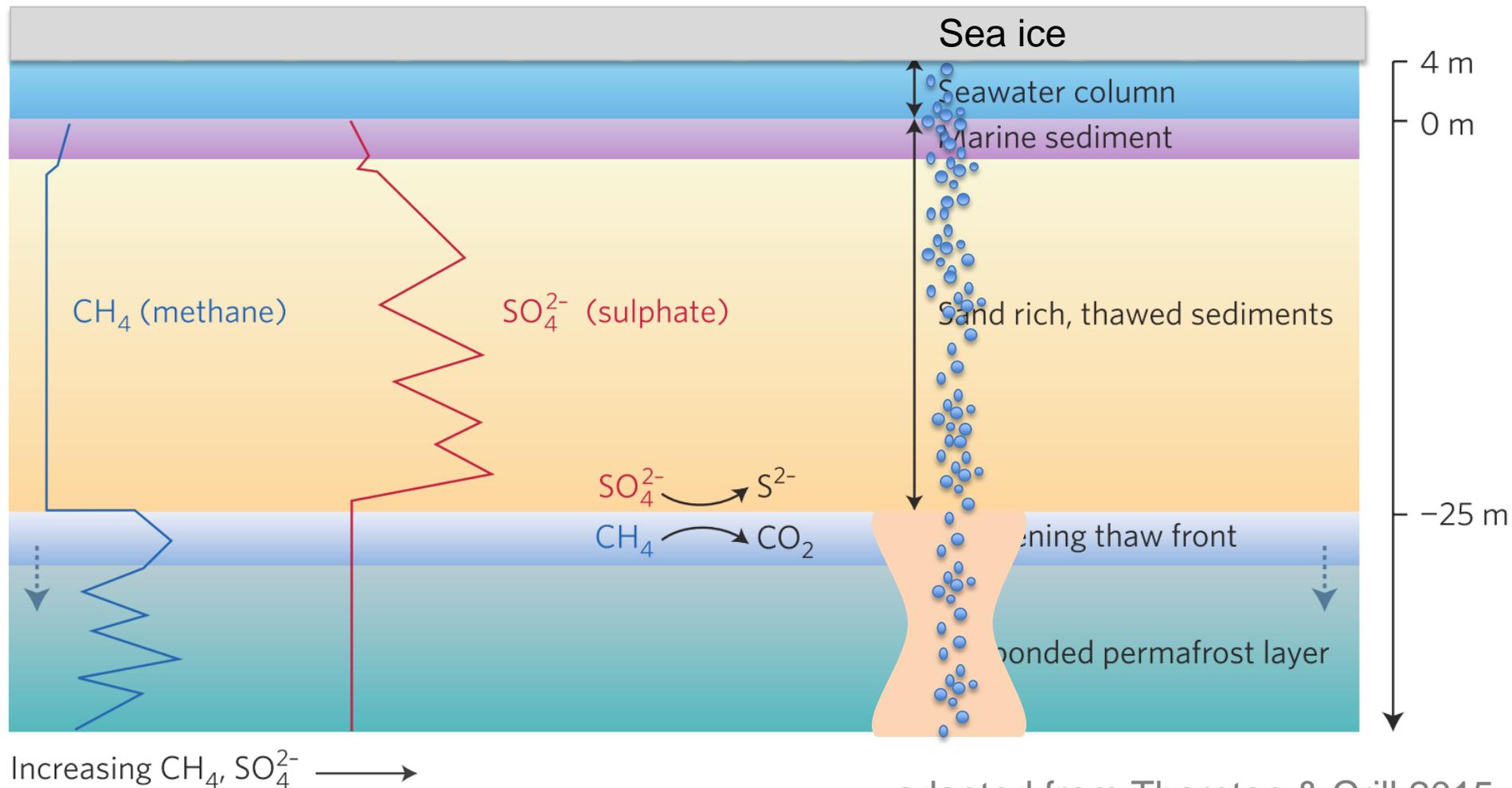
Increasing CH<sub>4</sub>, SO<sub>4</sub><sup>2-</sup> →

# Ebullition may bypass oxidation

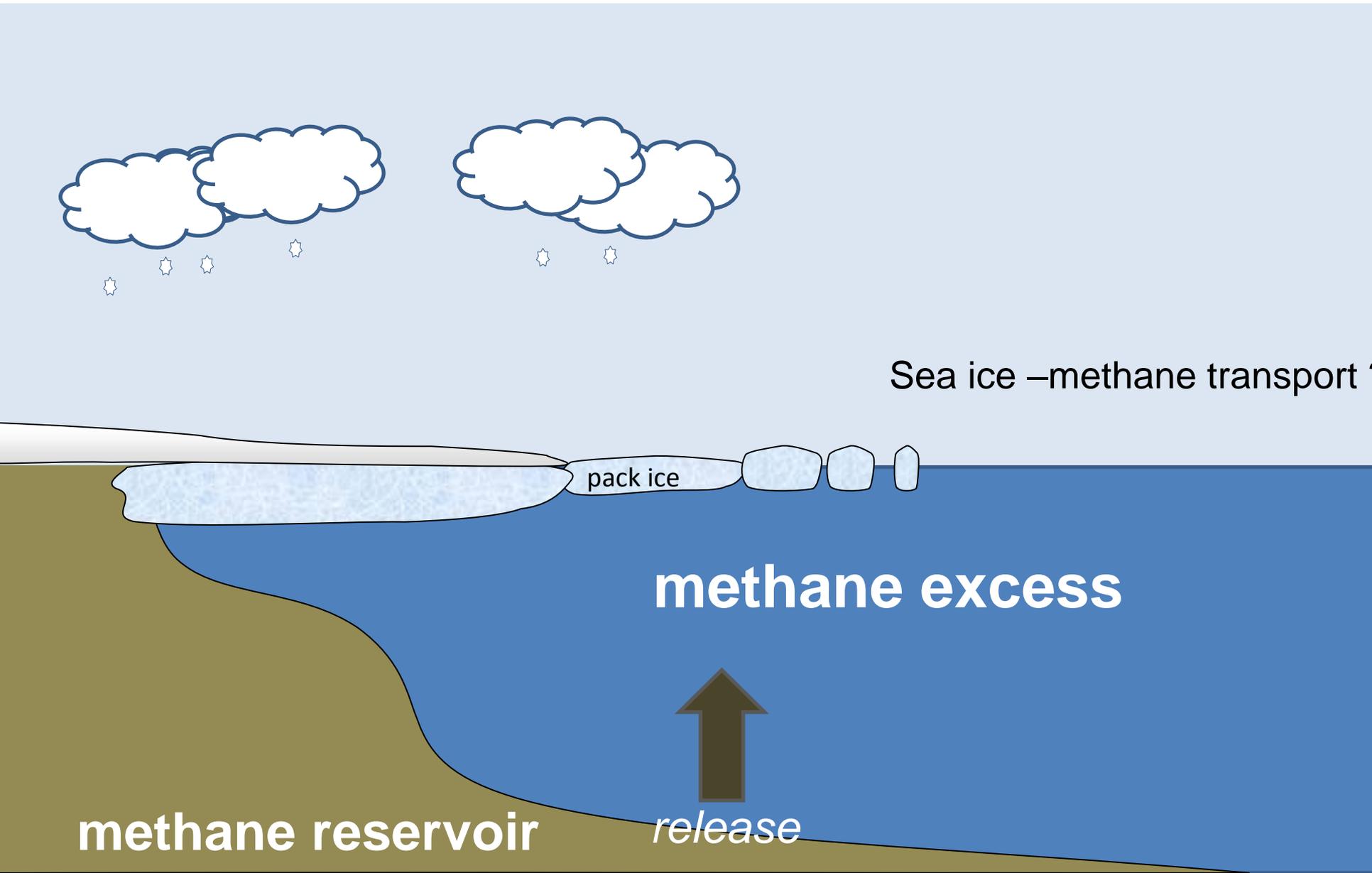


# Ebullition may bypass oxidation

... but methane meets the ice cover.



# Sediment-sea-ice-water-atmosphere



Sea ice –methane transport

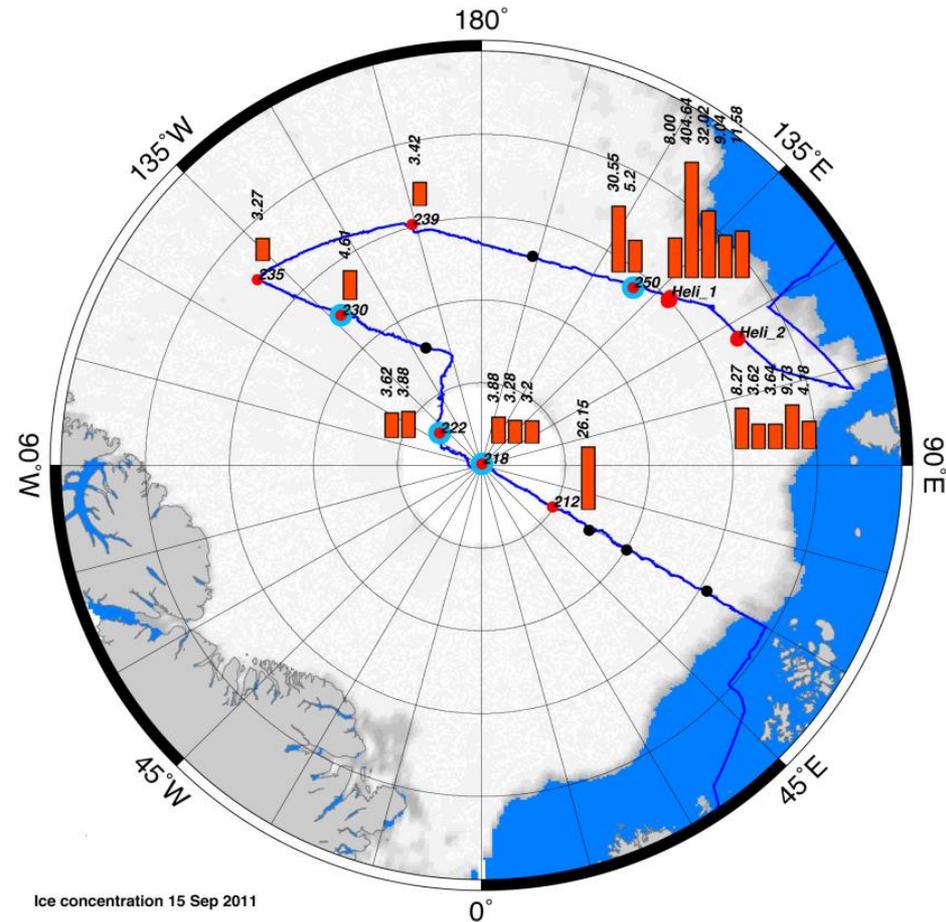
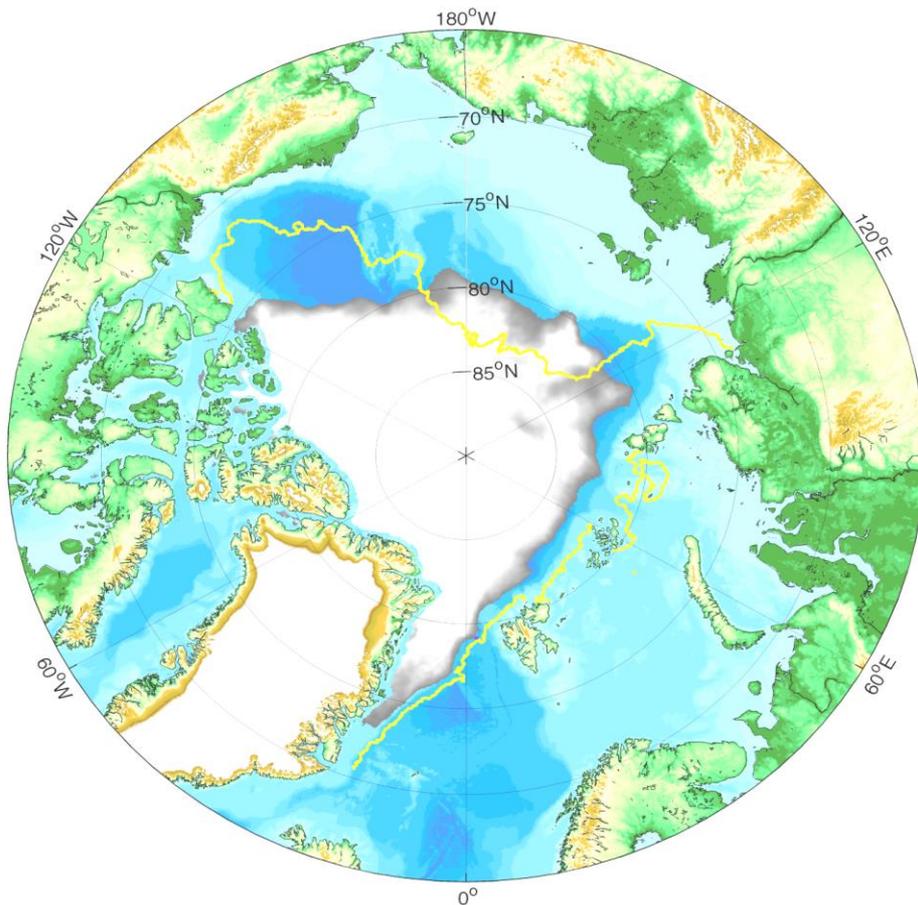
pack ice

methane excess

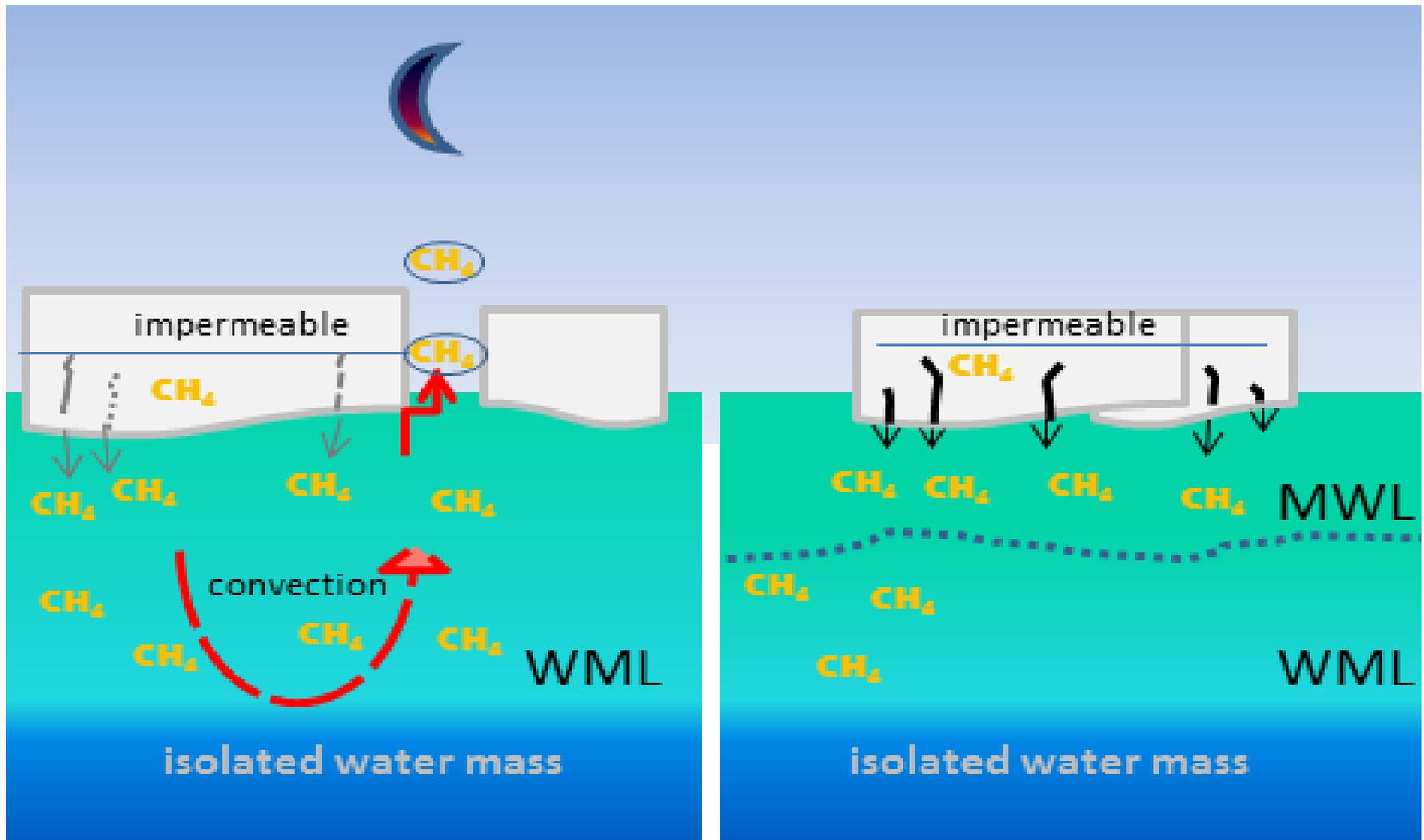
methane reservoir

release

# Methane excess in sea ice



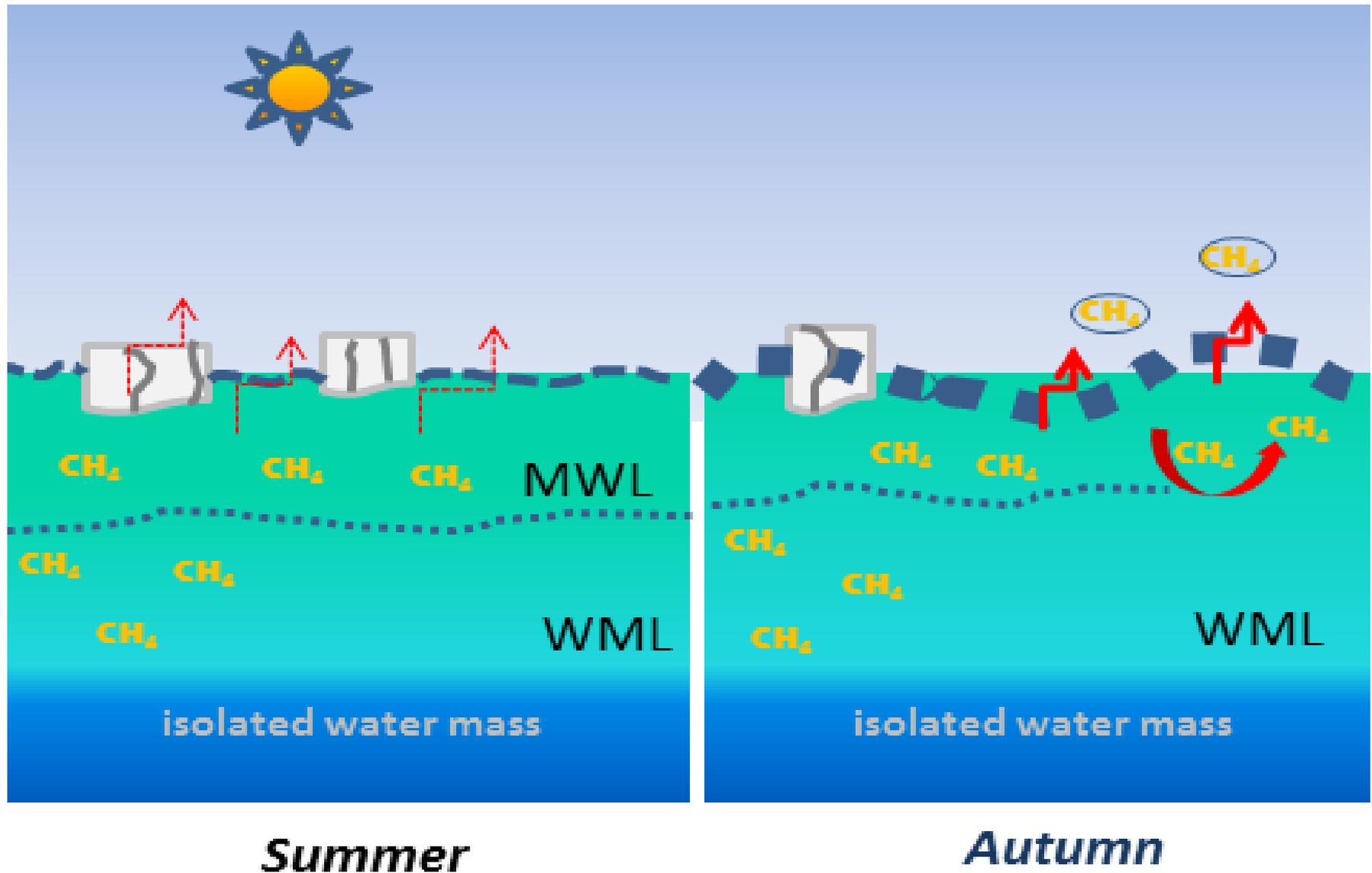
# Sea ice, ocean and atmosphere



*Winter*

*Spring*

# Sea ice, ocean and atmosphere



- How large are methane **stocks** in sediment and sea ice?
- What is oxidizing capacity in sediment, water column and sea ice?
- What are **pathways** from shelf sediments into sea ice?
- How do they change seasonally, especially during **freezing** and **thawing**?
- Need: Interdisciplinary group to *trace the sources and pathways using isotopic signature and fractionation*
- How will **decreasing sea ice** amount and transport, **warming sea water** change methane pathways and fate?
- How do **shelf-sea ice methane** dynamics influence arctic atmospheric methane?