



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:



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**

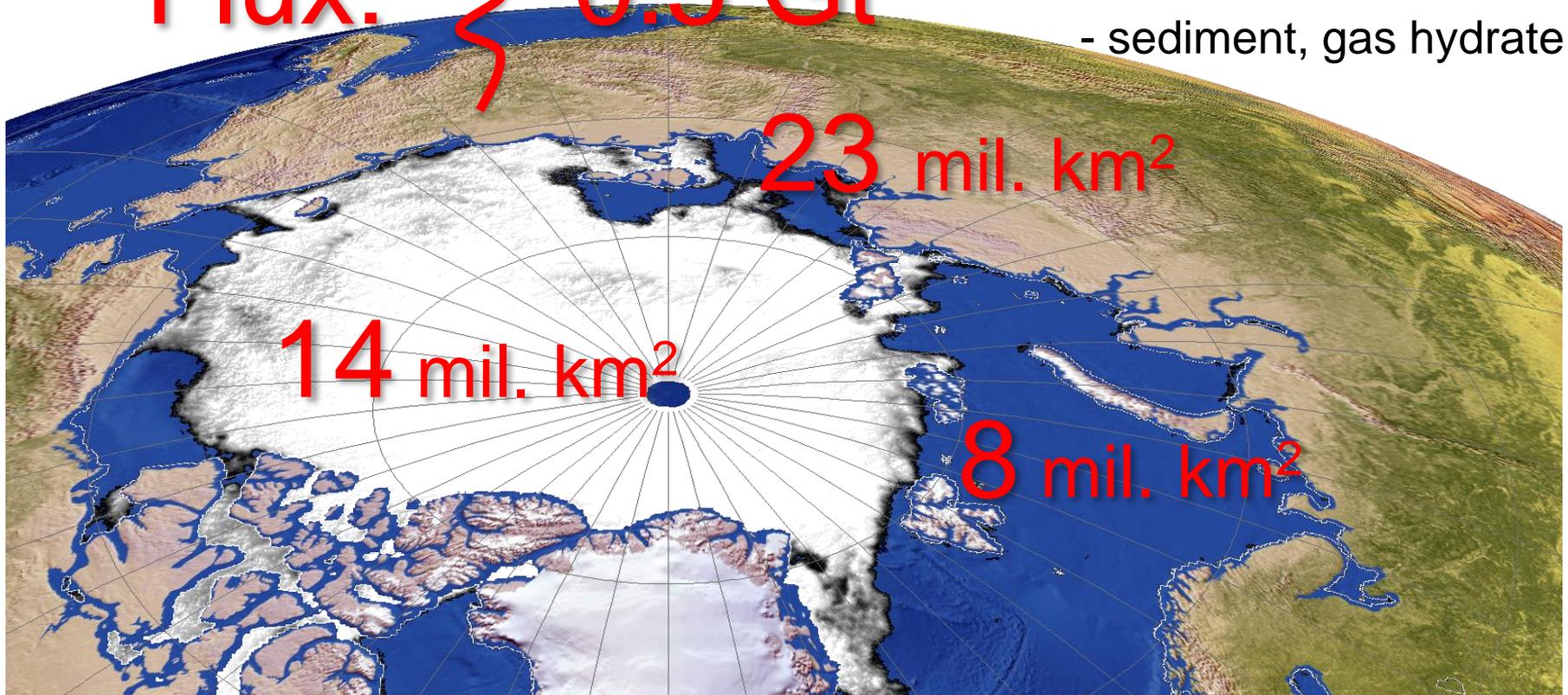
Methane pathways in the Arctic

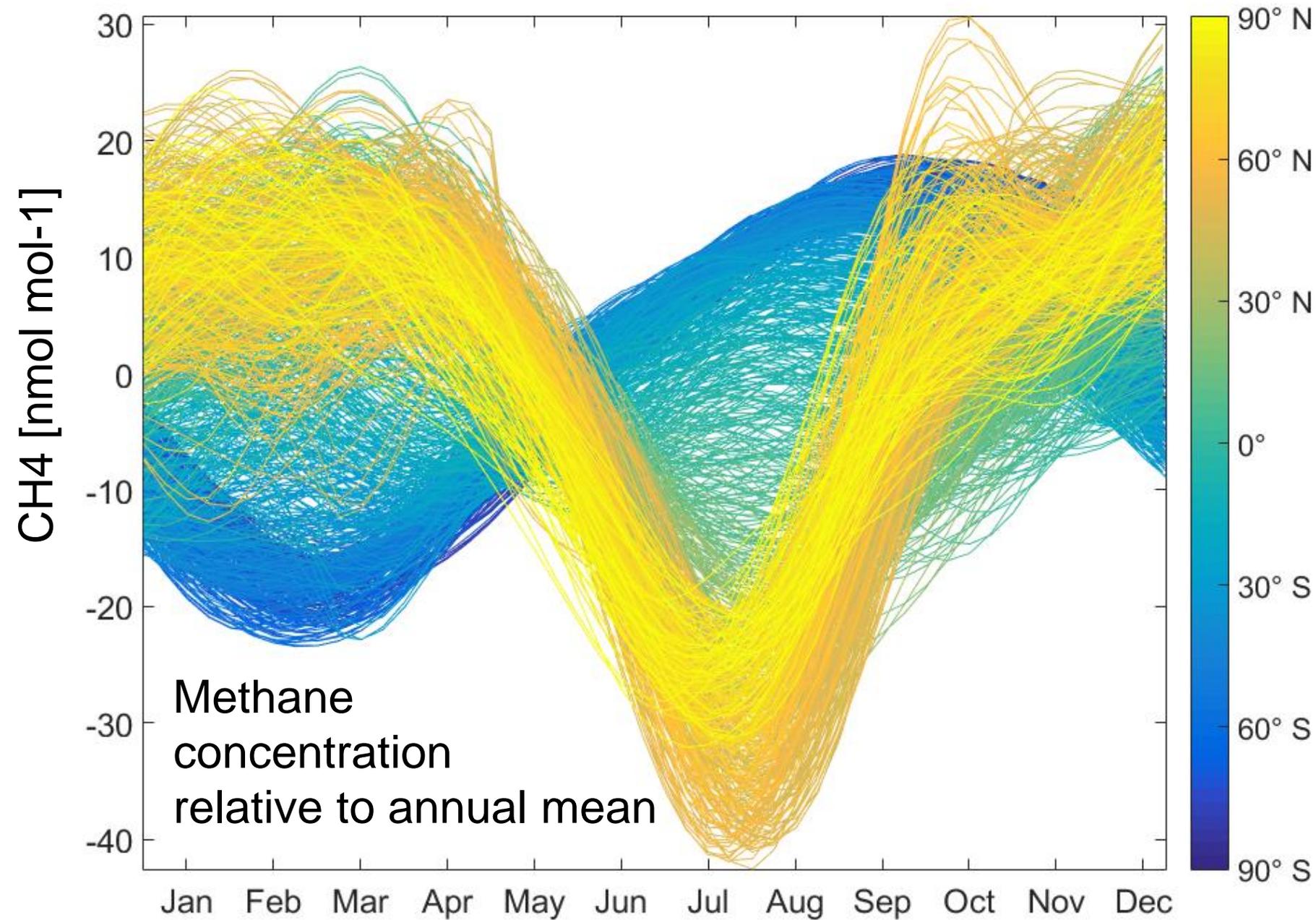
Atmosphere: 4 Gt

Flux:  0.5 Gt

Arctic Sources

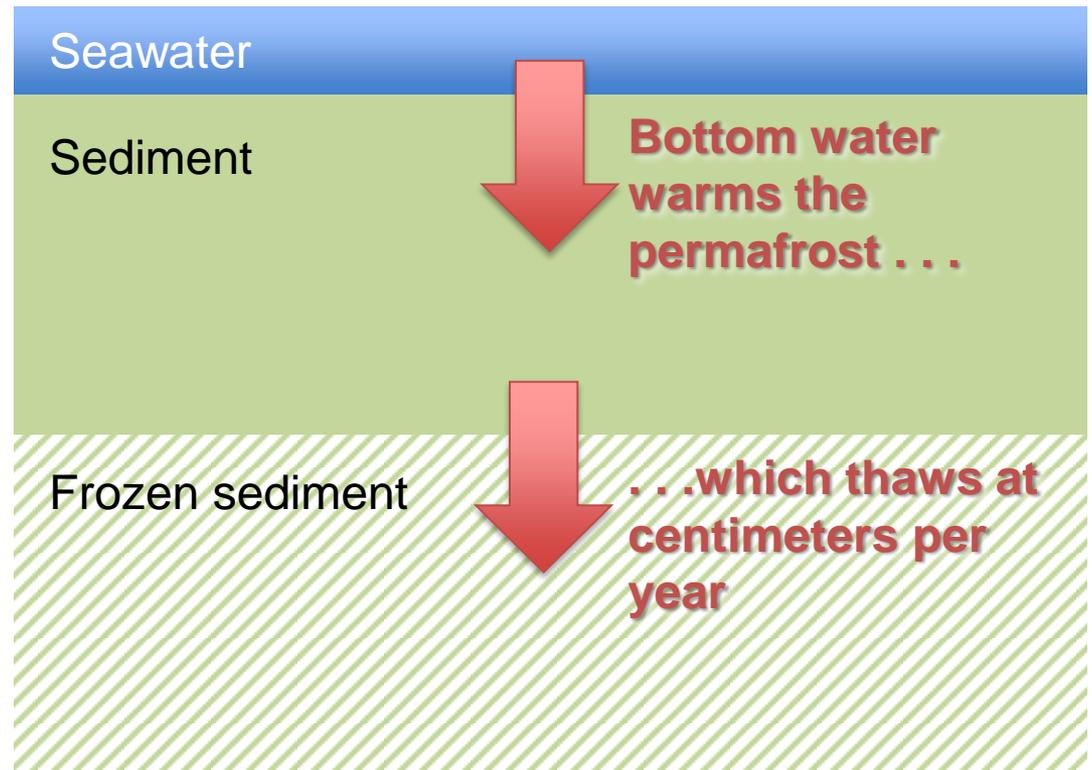
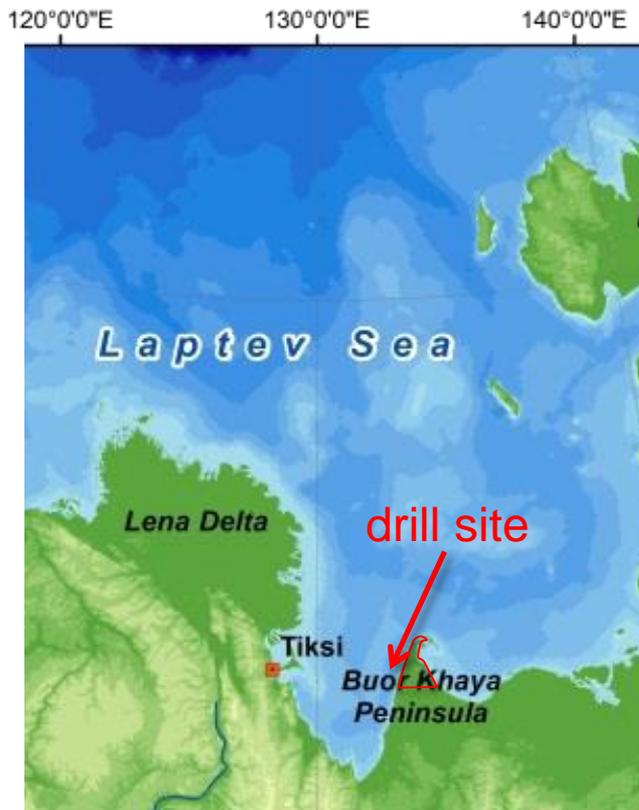
- anthropogenic
- permafrost, wetland
- river discharge
- sediment, gas hydrate





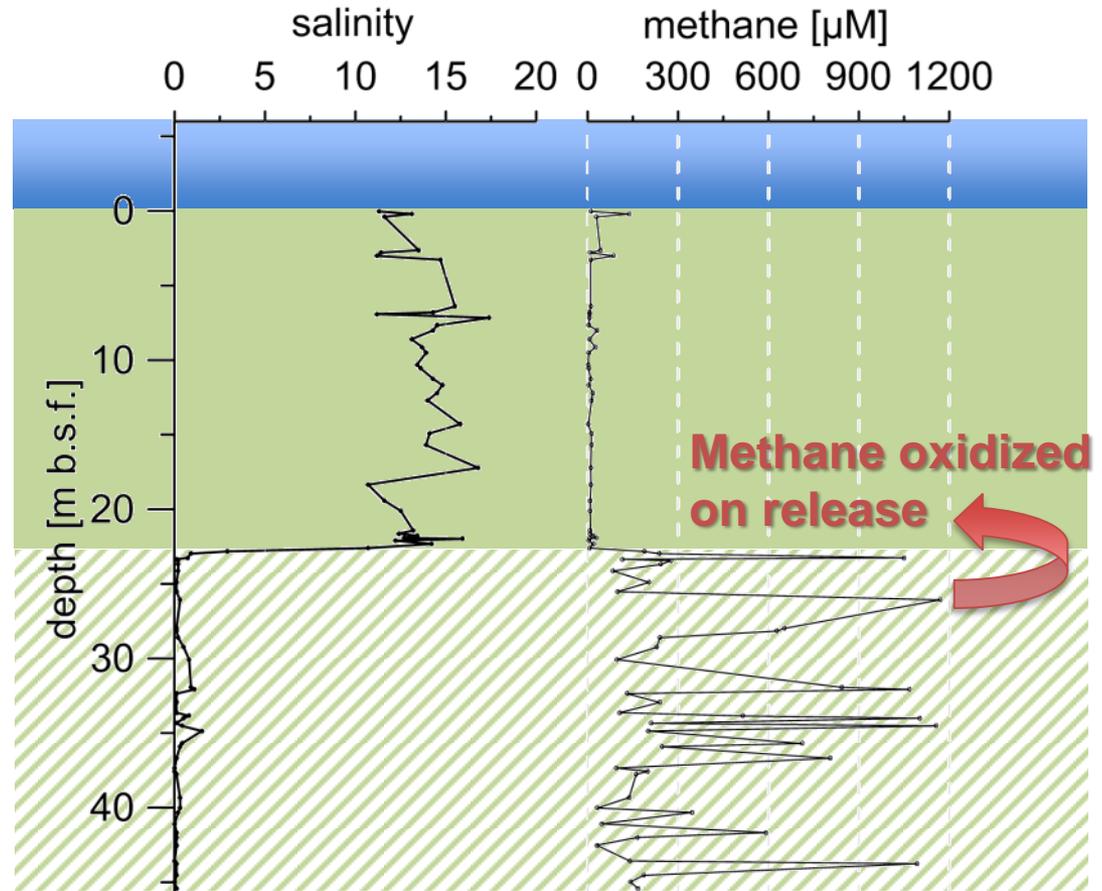
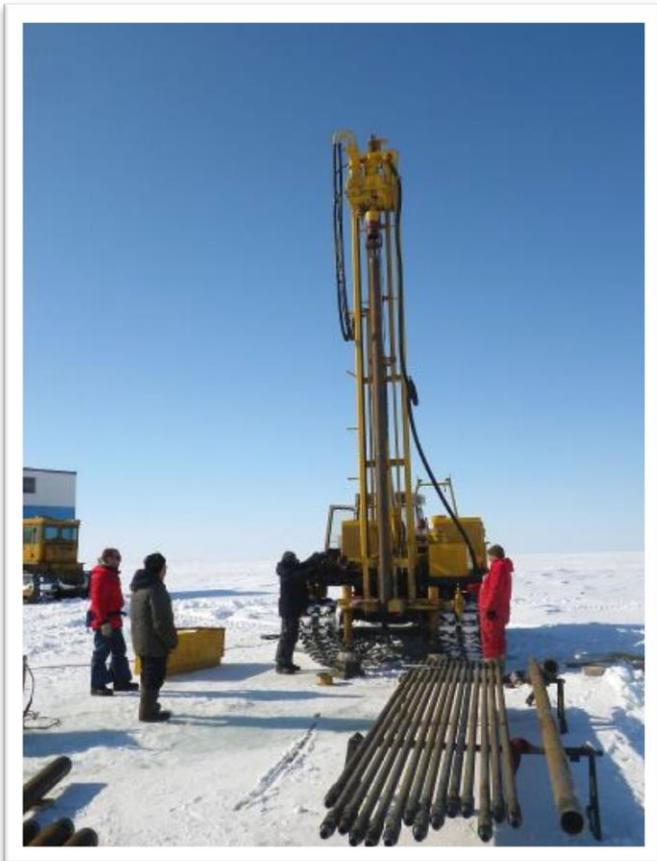
Subsea permafrost is thawing

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

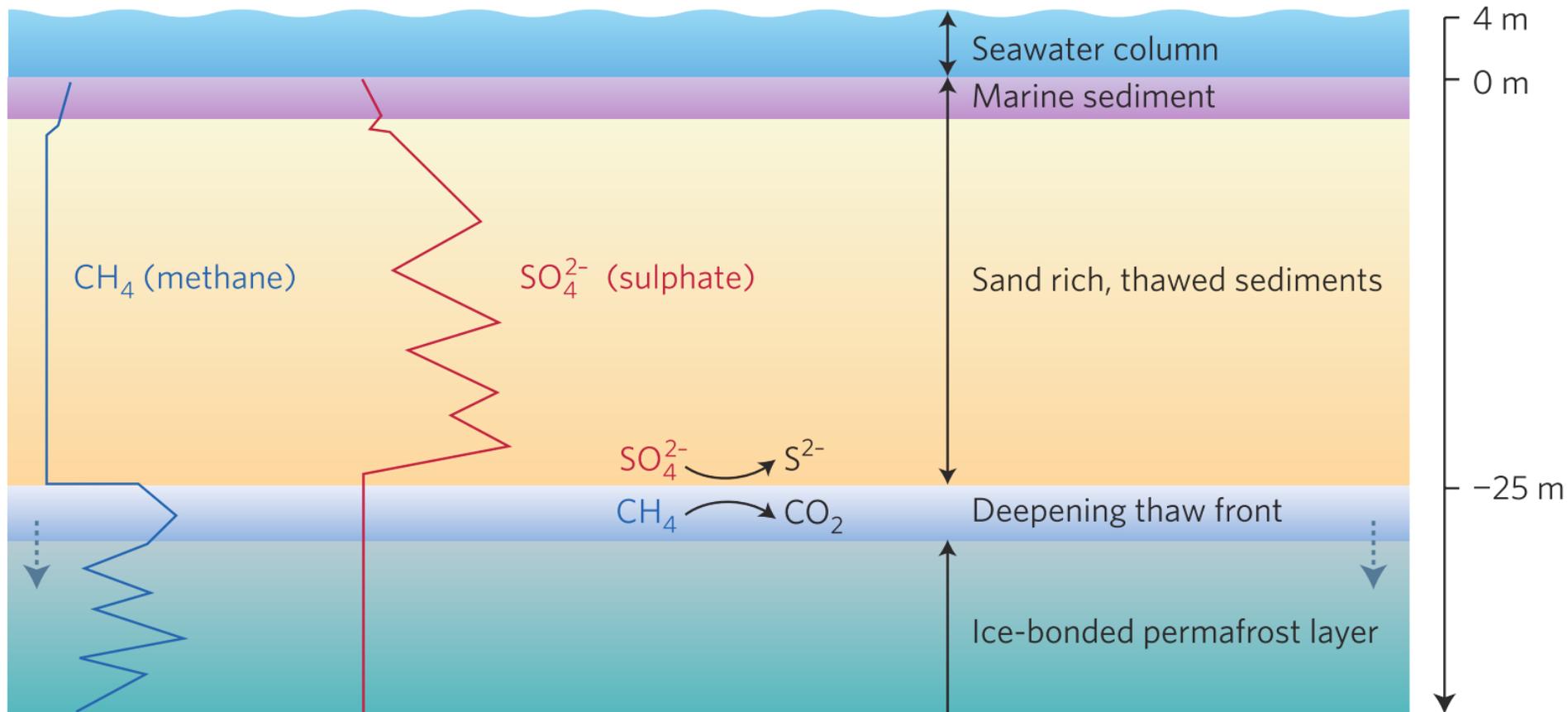


Methane is oxidized on release

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

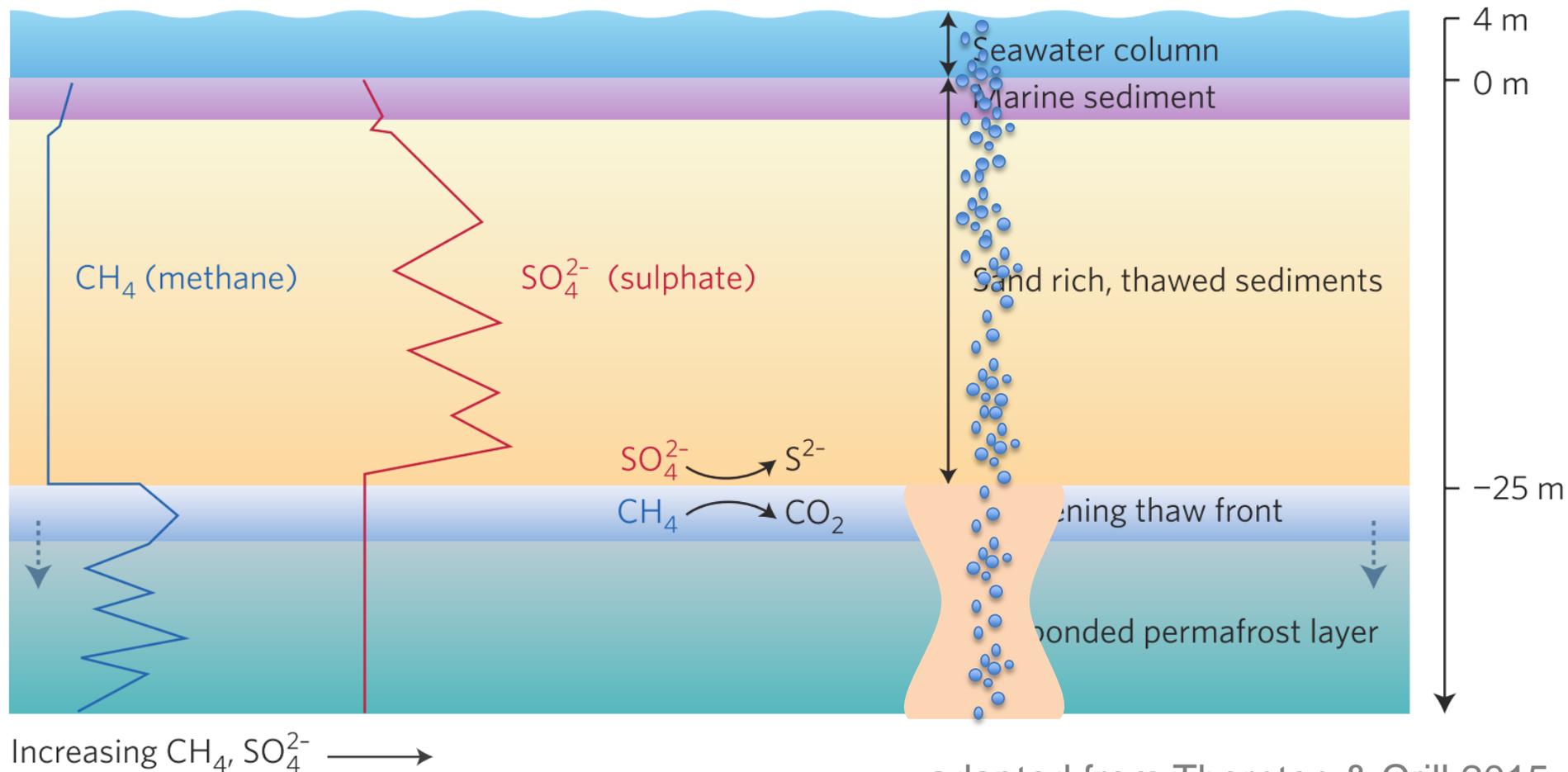


Unfrozen sediment acts as biofilter



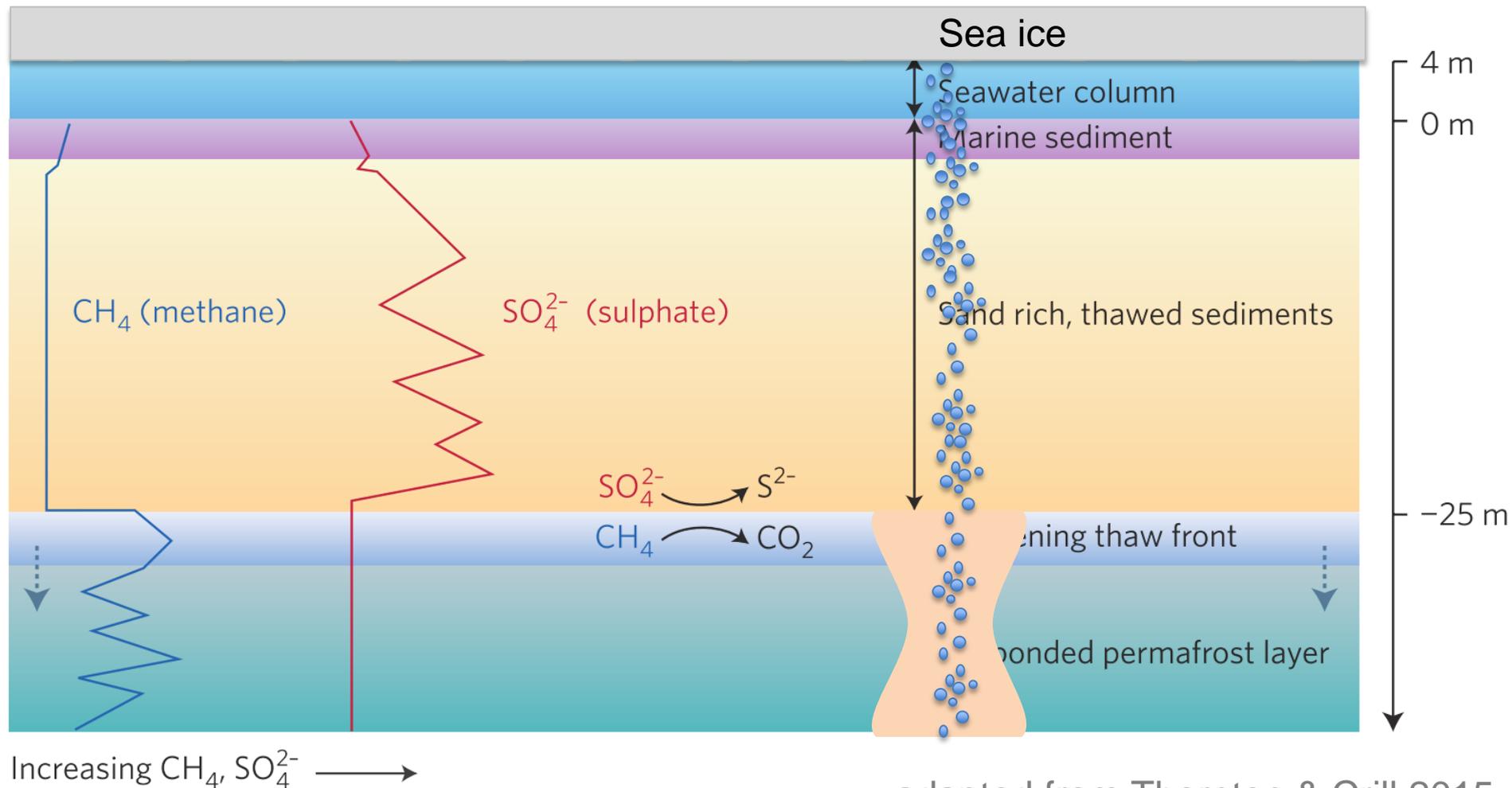
Increasing CH_4 , SO_4^{2-} →

Ebullition may bypass oxidation

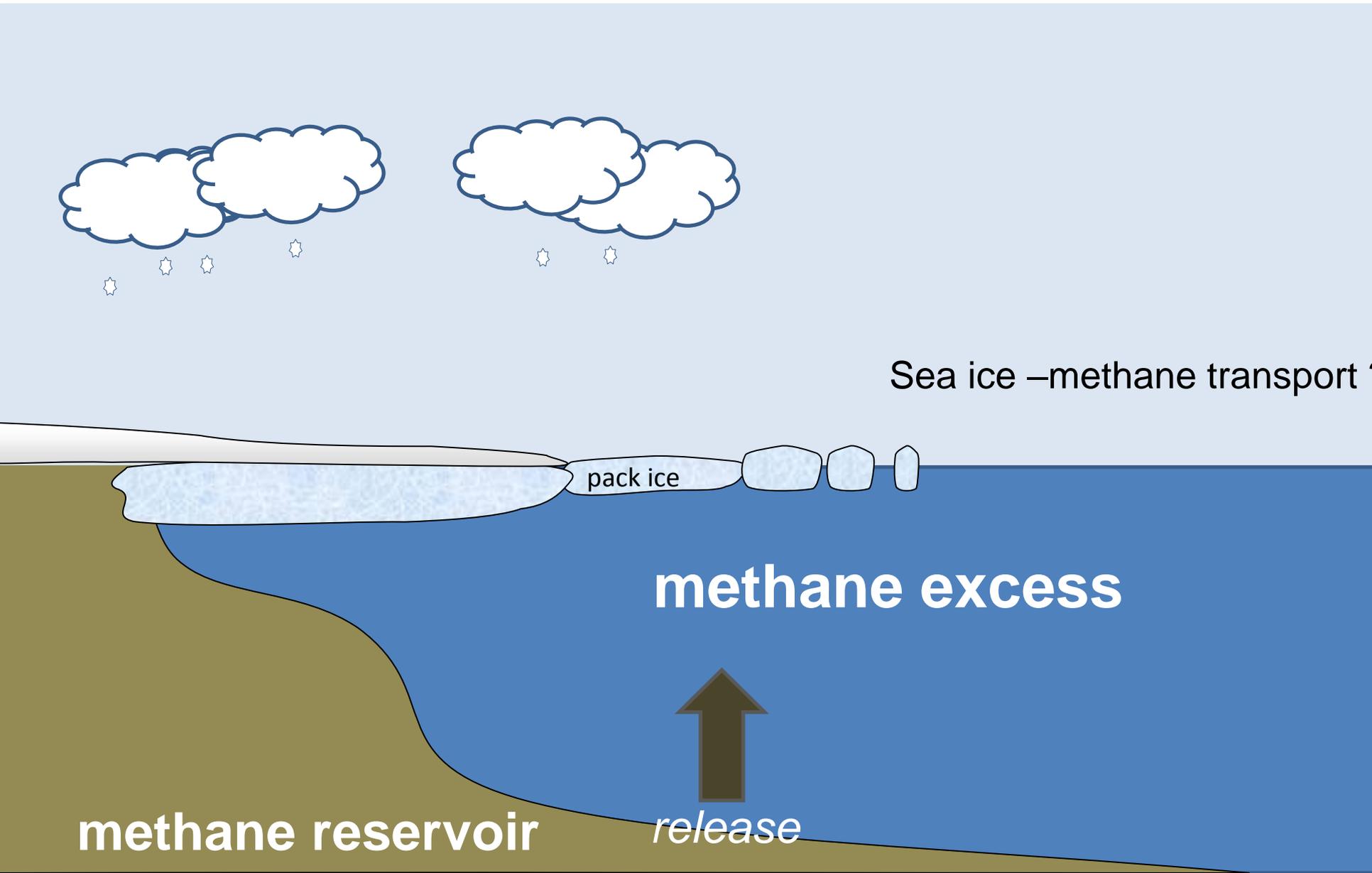


Ebullition may bypass oxidation

... but methane meets the ice cover.



Sediment-sea-ice-water-atmosphere



Sea ice –methane transport

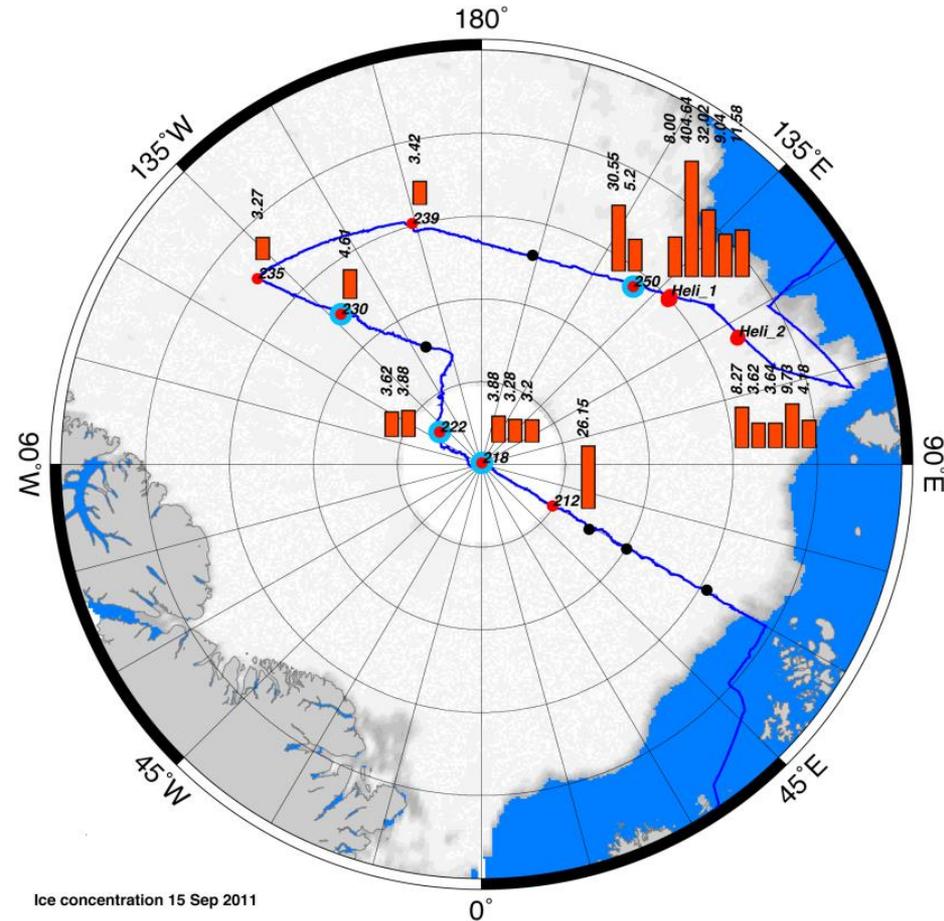
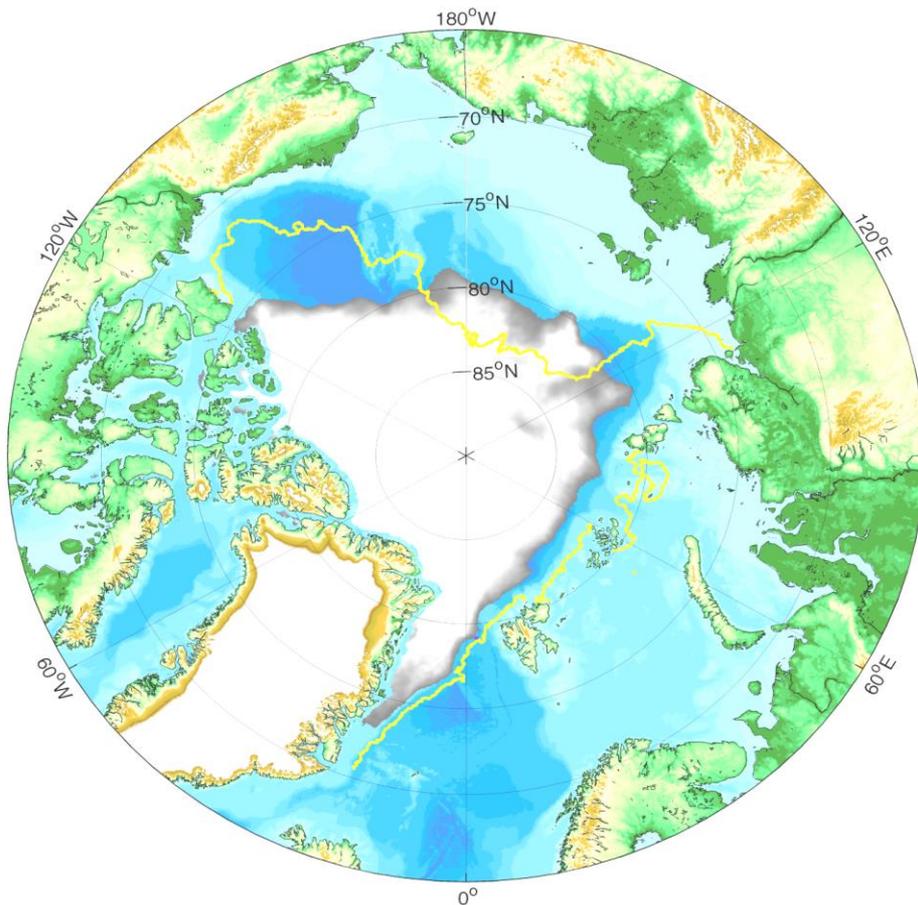
pack ice

methane excess

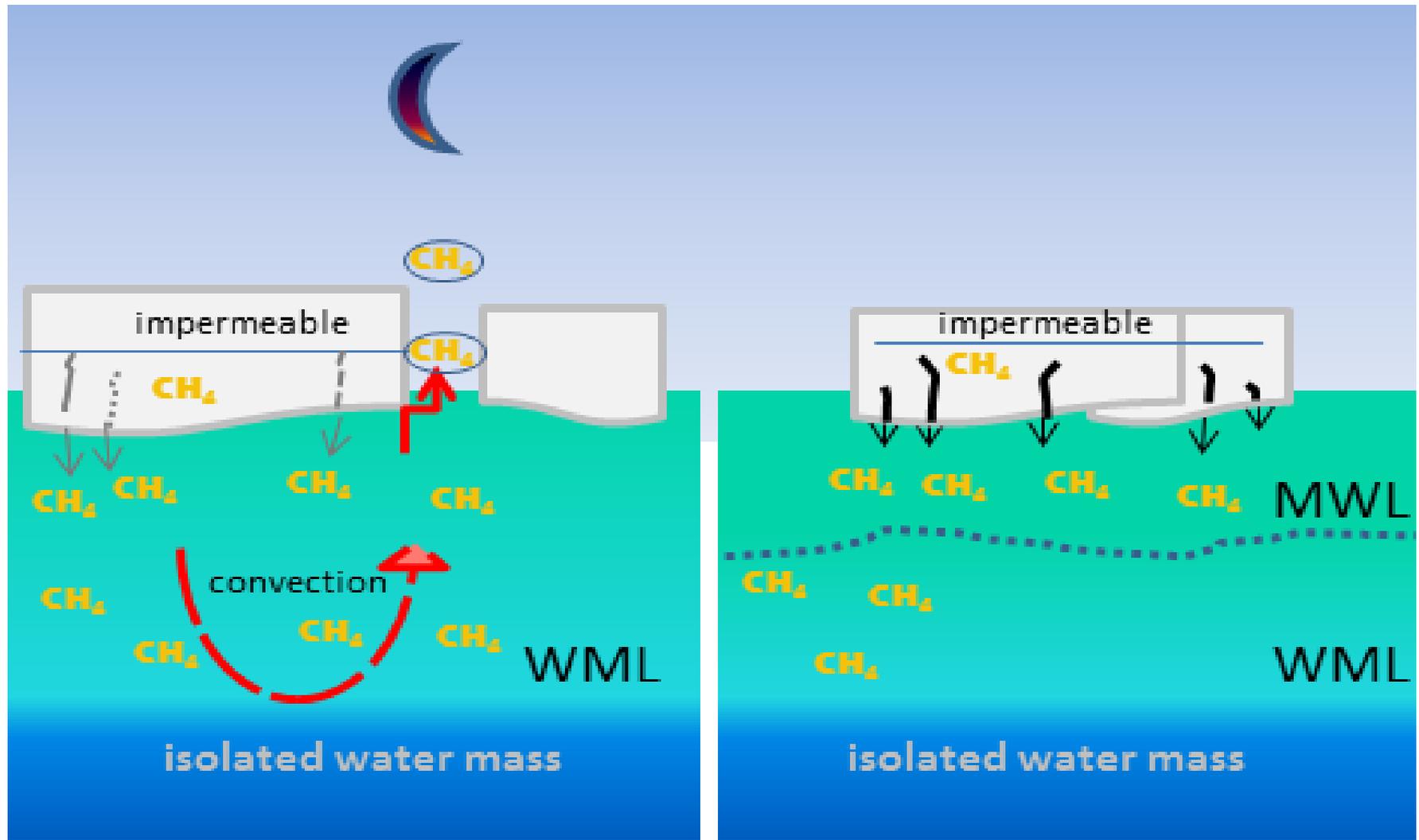
methane reservoir

release

Methane excess in sea ice



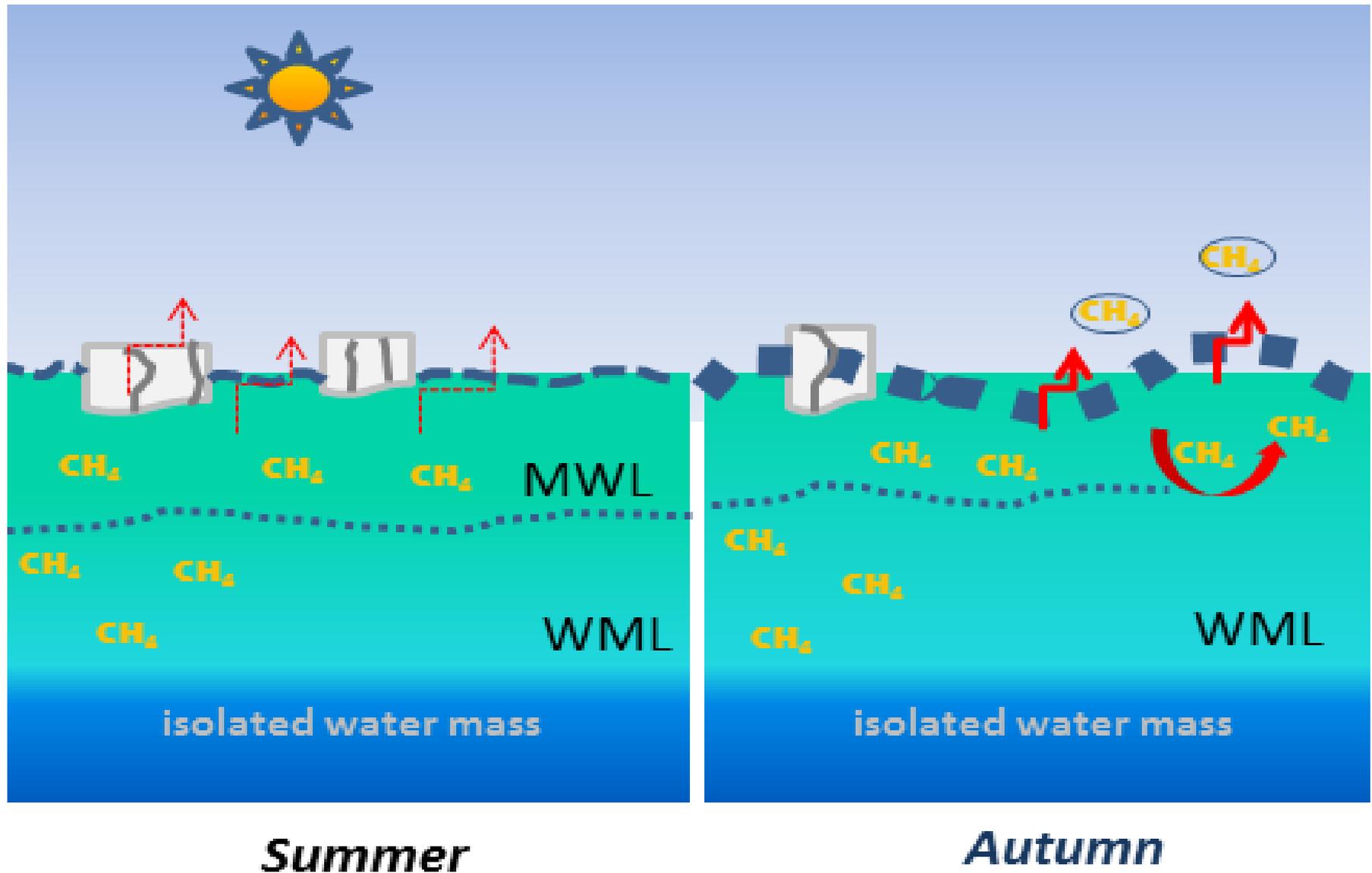
Sea ice, ocean and atmosphere



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**?