Following the water: The thawing and erosion of Permafrost increase input of reactive nitrogen to the coastal water at the Baldwin Peninsula, Alaska

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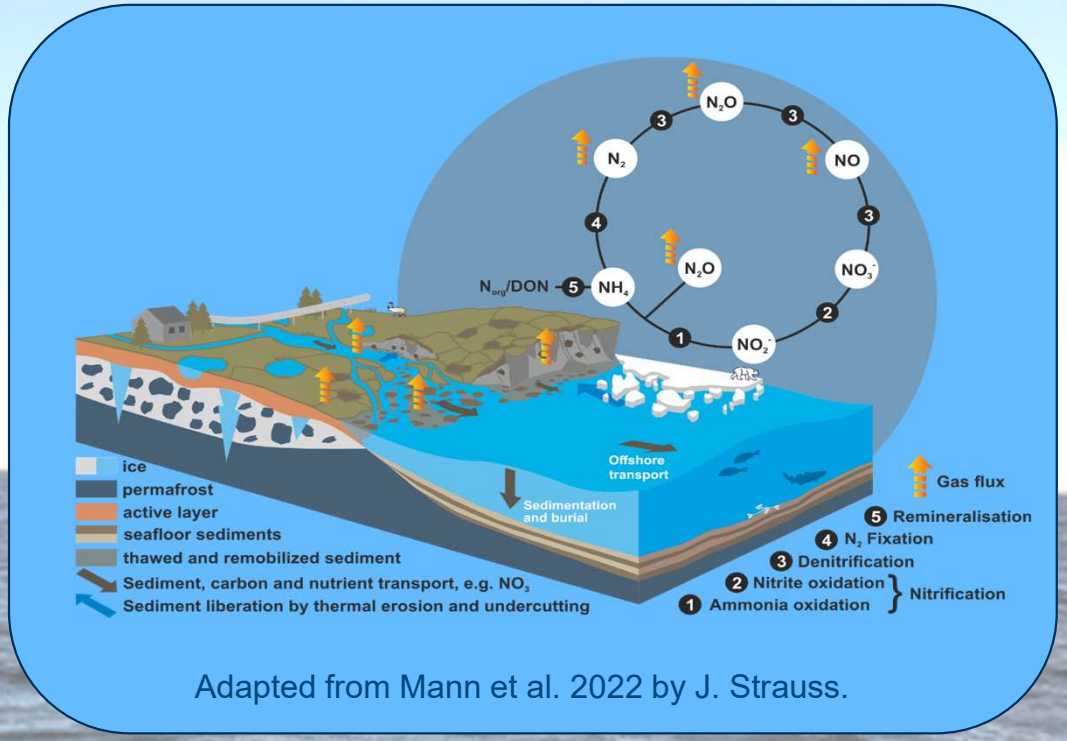
Introduction - General

- Permafrost-affected soils store high amount of organic matter including carbon and nitrogen
- Nitrogen mainly bound in organic matter, so that the ecosystems are characterised as nitrogen limited
- Global warming and degradation of permafrost release reactive nitrogen
- Huge input of fresh water and nutrients from the river into the Arctic Ocean
- Higher input may stimulate the primary production and further on the food web in the Arctic Ocean

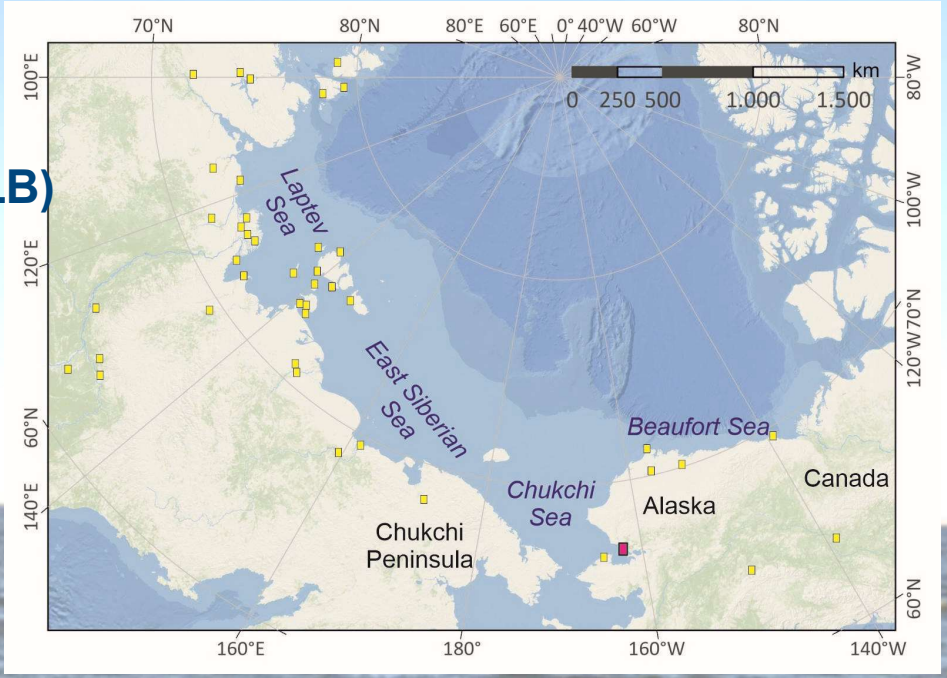


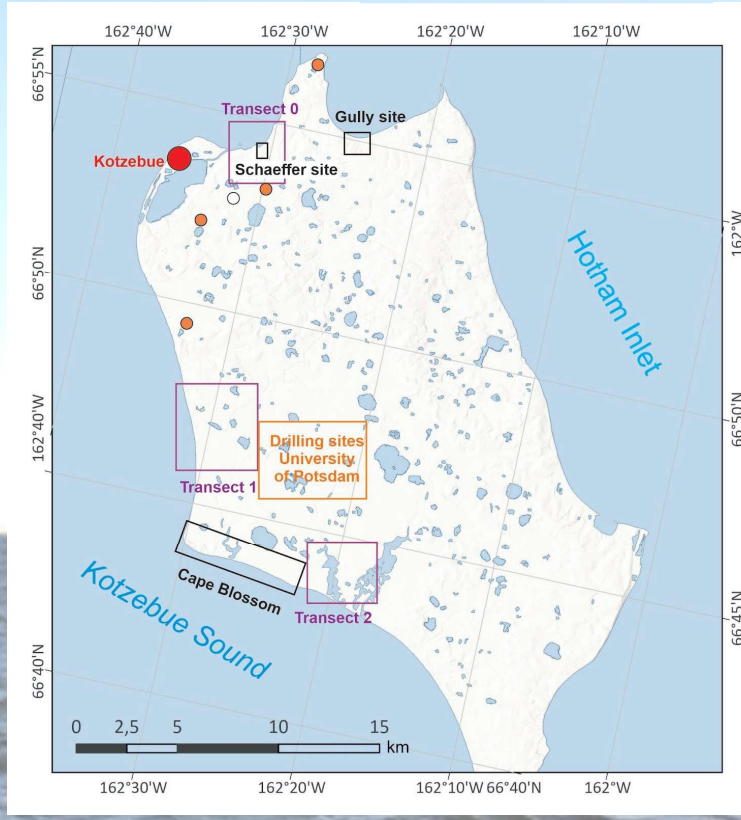
Adapted from Mann et al. 2022 by J. Strauss.

- Nitrogen stable isotopes can help to identify sources of the nitrogen inputs and unravel ongoing alteration in the soils, rivers and ocean

Introduction: Investigation Site, Alaska, Baldwin Peninsula

- Two different site:
- **The sheffers Lake (DLB)**
  Drained Lake Basin
- Cape Blossom
  Yedoma Cliff (CB)





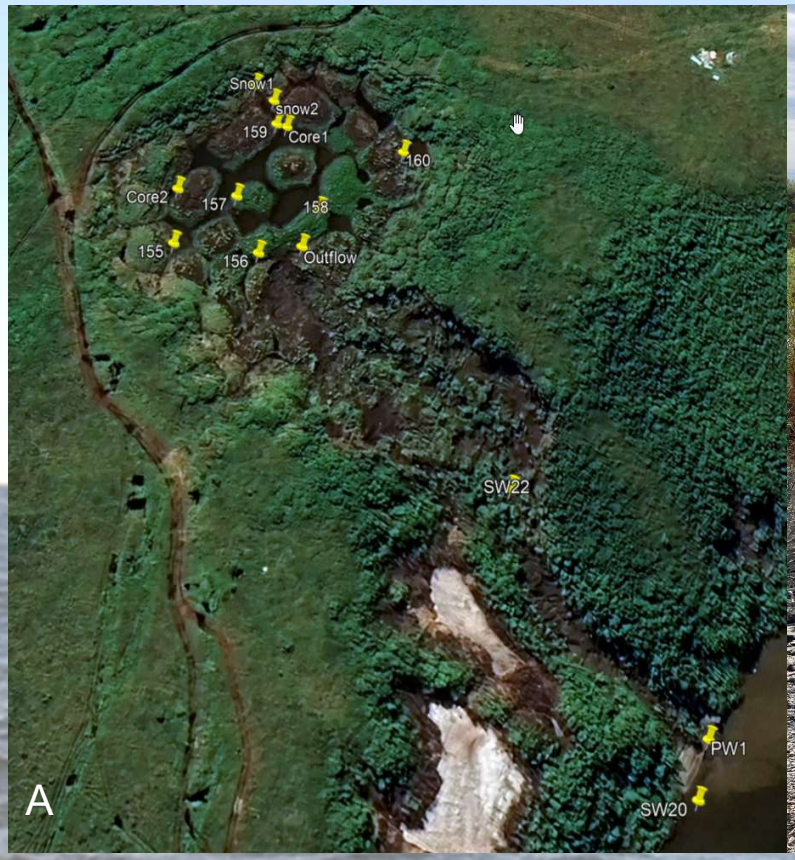
- What are water sources?
- How much reactive nitrogen is mobilizied?
- What are soures of the reactive nitrogen (nitrate and ammonium)?
- Can natural stable isotope identify ongoing processes?

Cape Blossom (Yedoma Cliff)

Samples
- Ice wedges
- Water
- Soil extraction

Parameter
- DIN (Nitrate, Ammonium)
- $\delta^{15}N/^{18}O$ Nitrate
- $\delta^{18}O/\ \delta D$ Water

Drained Lake Basin (Sheffers Lake)



Samples
- Rain water
- Snow
- Water
- Porewater
- Soil extraction

Parameter
- DIN (Nitrate, Ammonium)
- $\delta^{15}N/^{18}O$ Nitrate
- $\delta^{18}O/\ \delta D$ Water

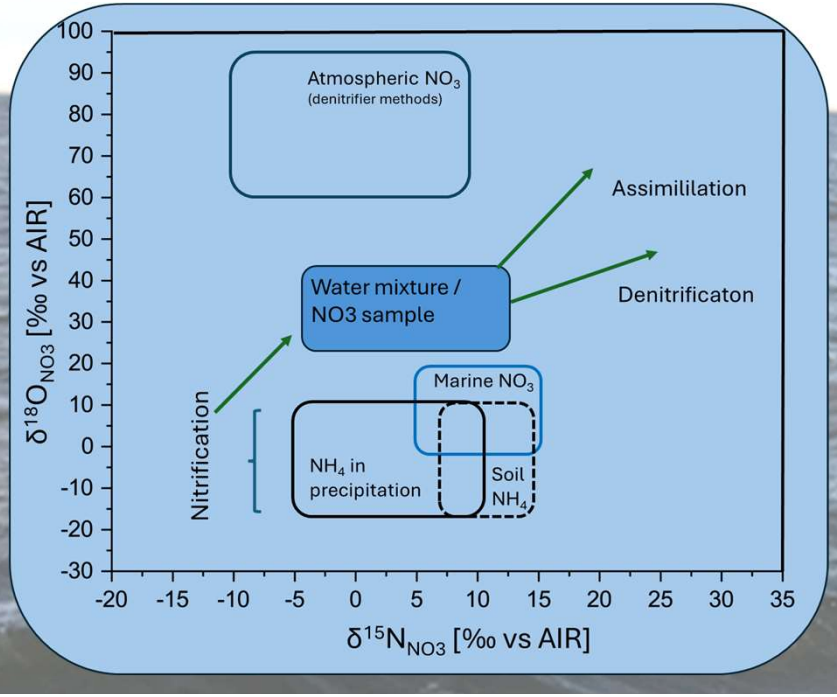
Background Nitrogen Stable Isotopes

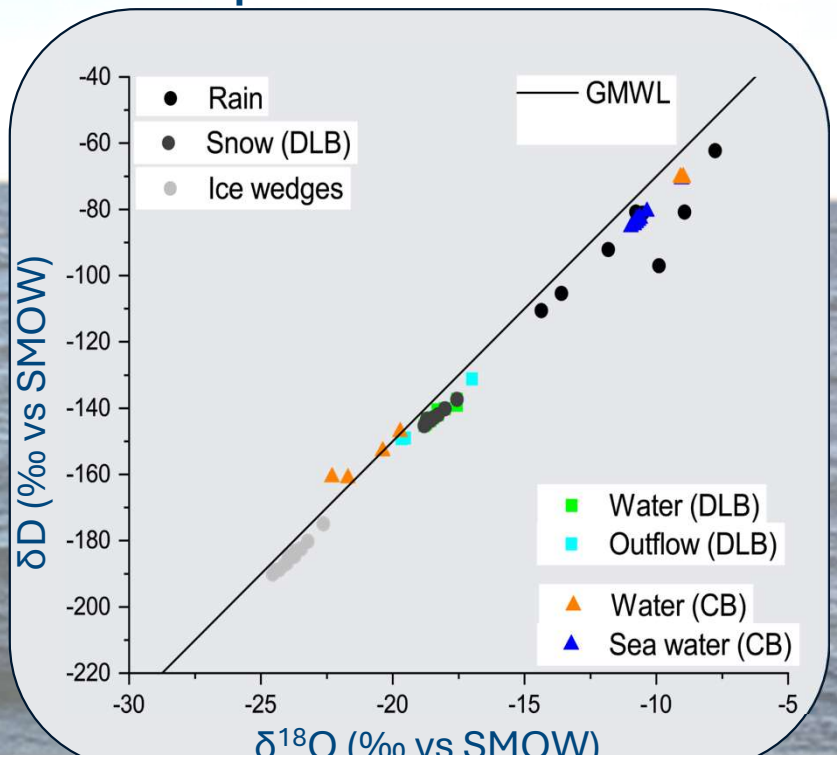
Isotope	Standard	R	δ (‰)
$^{15}N/^{14}N$	Air N2	0.003676	0.0
$^{18}O/^{16}O$	VSMOW	0.002005	0.0
	atm NOx		60.8
	atm O_2		23.5
	Water (arctic)		-18.0

δ ^{15}N and d^{18}O are source specific and are changed by biological processes

Based on this isotope signatures we can investigate biogeochemical cycles

- **…. If you know the isotope effects and sources signature**

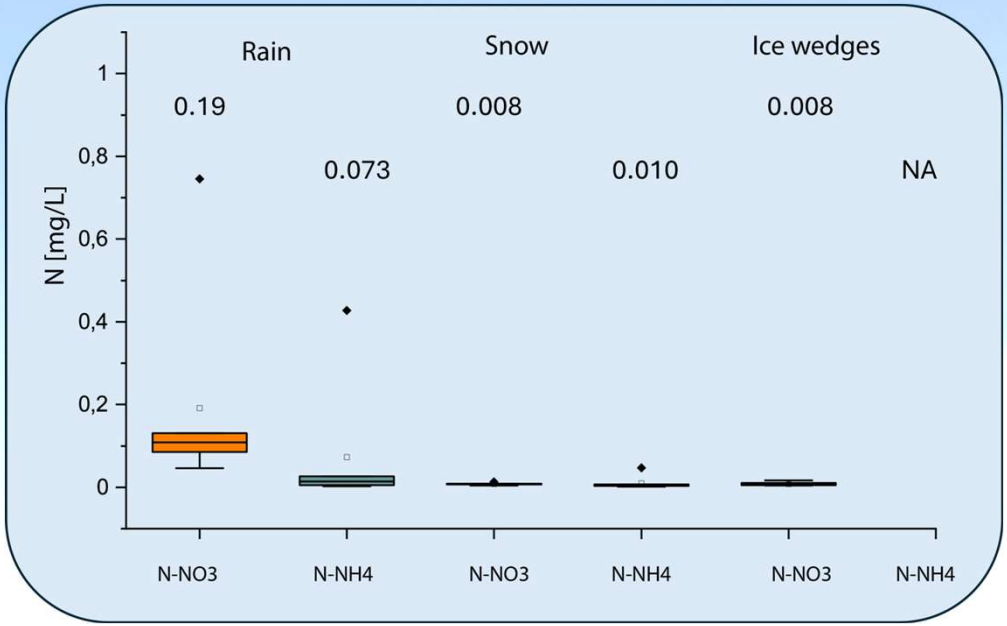




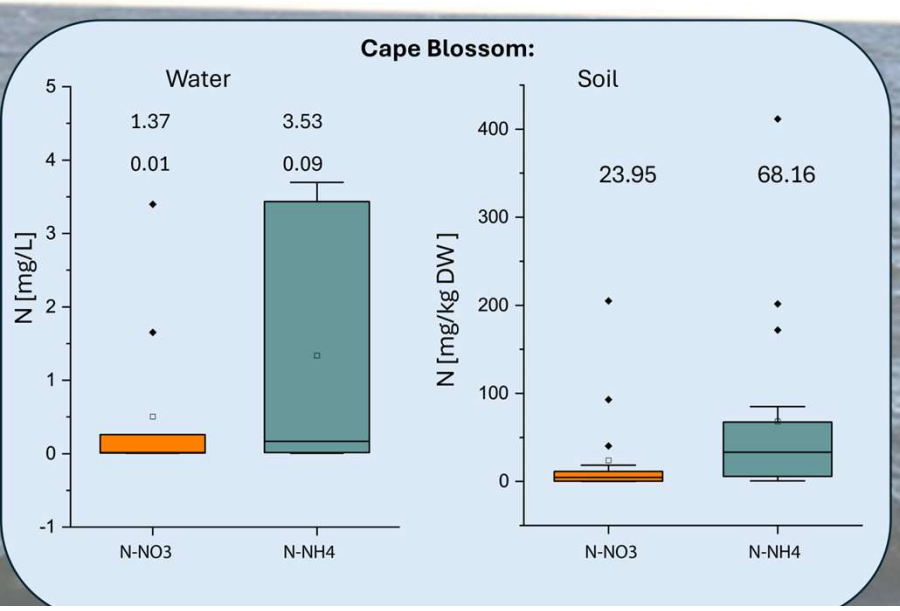
Results: Reactive Nitrogen

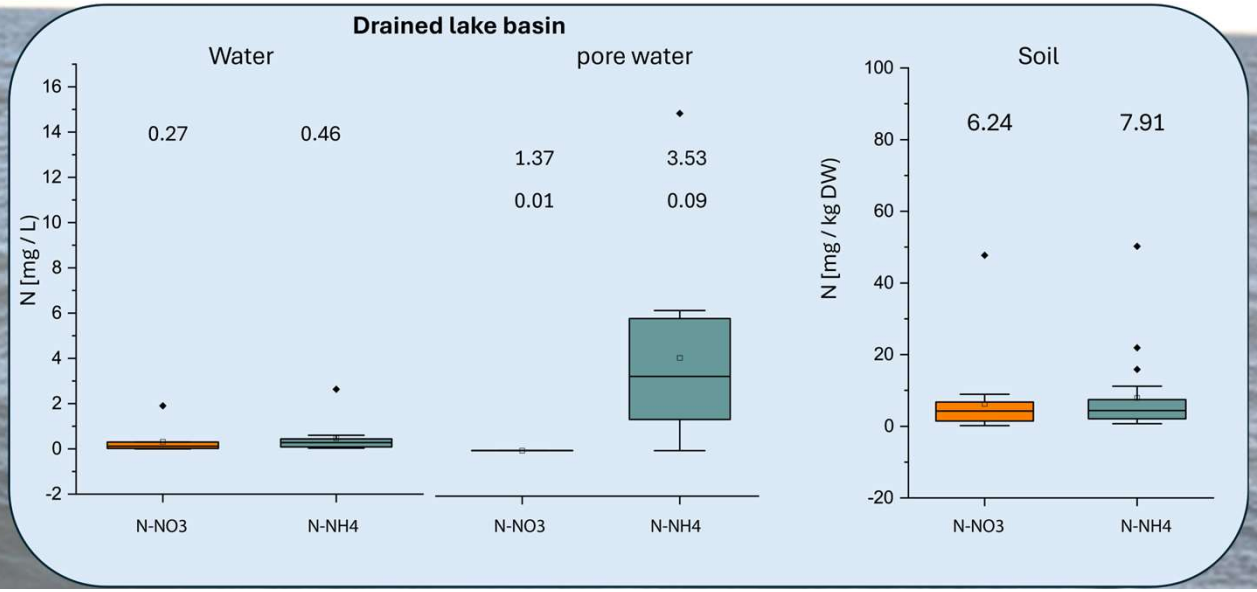
Cape Blossom:
Water:
Top: higher than at the outflow
Nitrate decrease during the drainage
Soil extraction:
Ammonium: High at the top and low at the bottom
Nitrate: Low at the top and high at the bottom

Rain, snow, Ice wedges:
souces of water
Rain: signifcant sources for nitrate



Sheffers Lake
Water: relatively low, pore water source for ammonium
Soil extration: lower than at CB



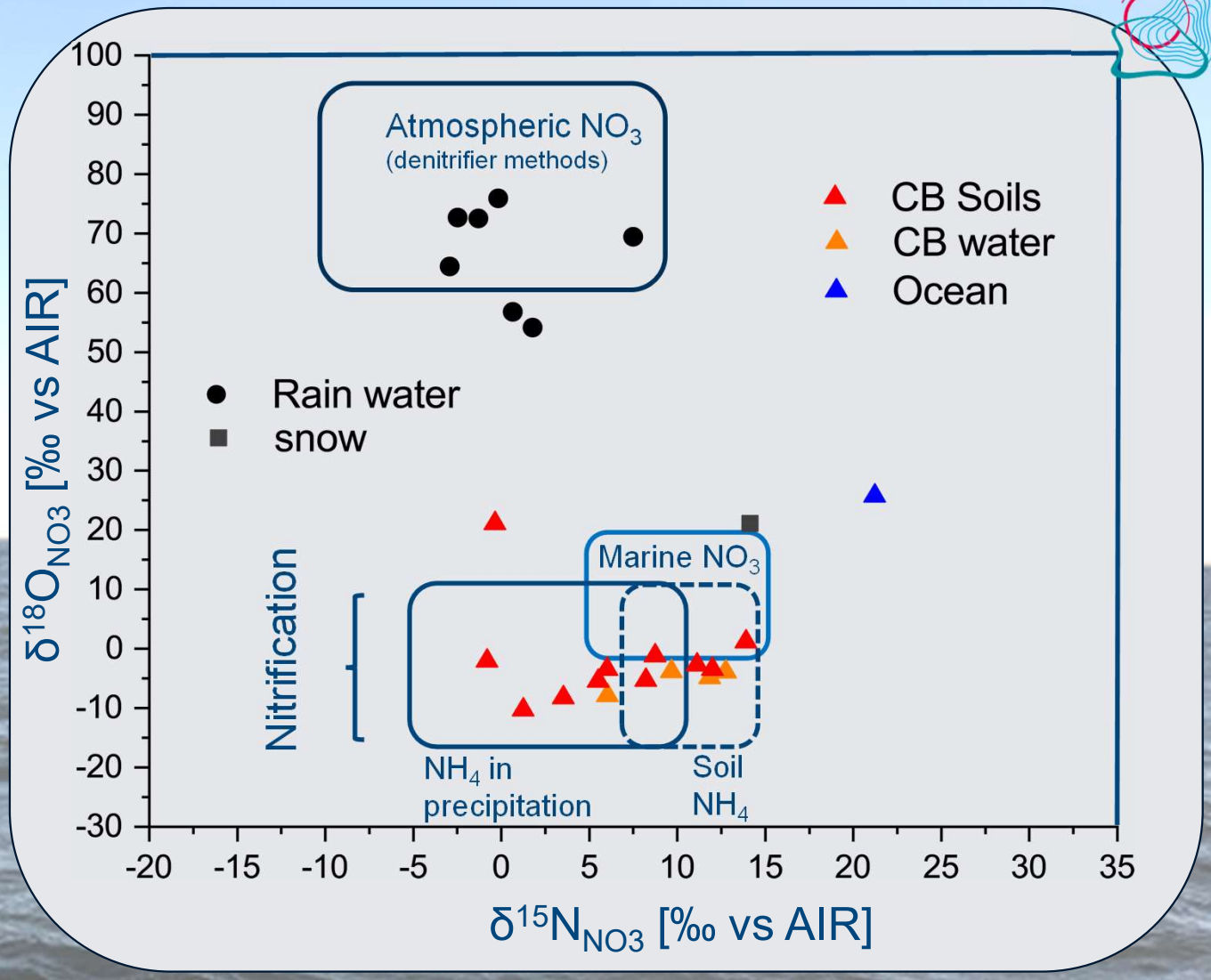


Isotope Signal Nitrate Cape Blossom

Rain: Highly enriched in $\delta^{18}O$

Source for the soil nitrate is mainly **nitrification:**
^{15}N from organic matter (2-5 ‰)
^{18}O from water (-23 to -18 ‰)

On the way from soil to Ocean
Enrichment in $^{15}N/^{18}O$:
Denitrification



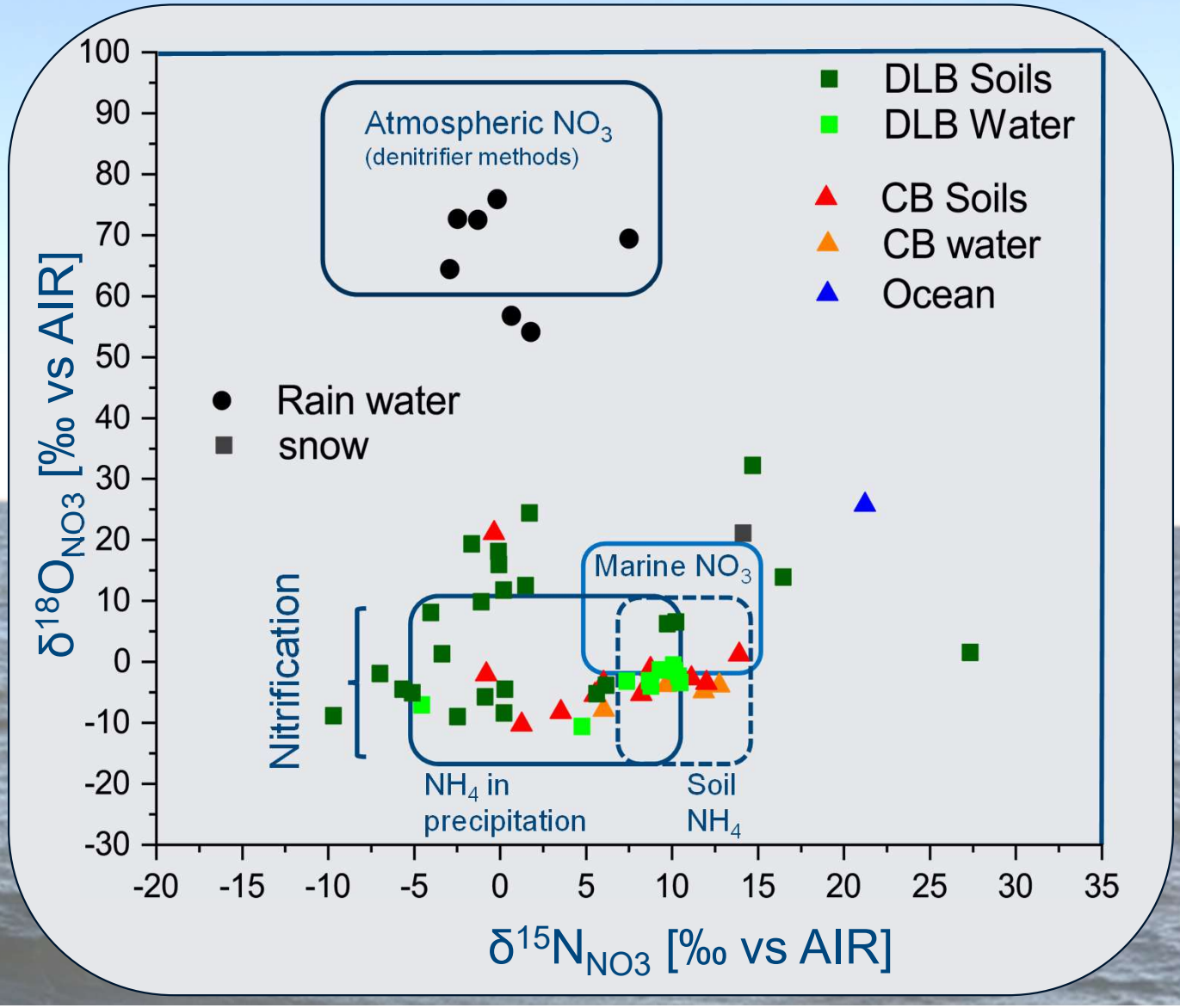
Isotope Signal Nitrate Cape Blossom Drained Lake Basin

Source for the soil nitrate is mainly **nitrification:**

^{15}N from organic matter (2-5 ‰) is depleded
^{18}O from water (-23 to -18 ‰)

Source: N-Fixation and Rain?!

Denitrification
and
Mixing



Conclusion

- The water is a good instrument to follow the mobilisation of reactive nitrogen
- The thawing Permafrost at Cape Blossom and the Drained Lake basin is a source of reactive nitrogen
- Especially Nitrification and Denitrification occur on the way to the ocean…

… a source of N2O

Thank you for your Attention…

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….and thanks the crew for one of the best expedition!

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