

Transformation of methylmercury at the beginning of the Arctic spring bloom

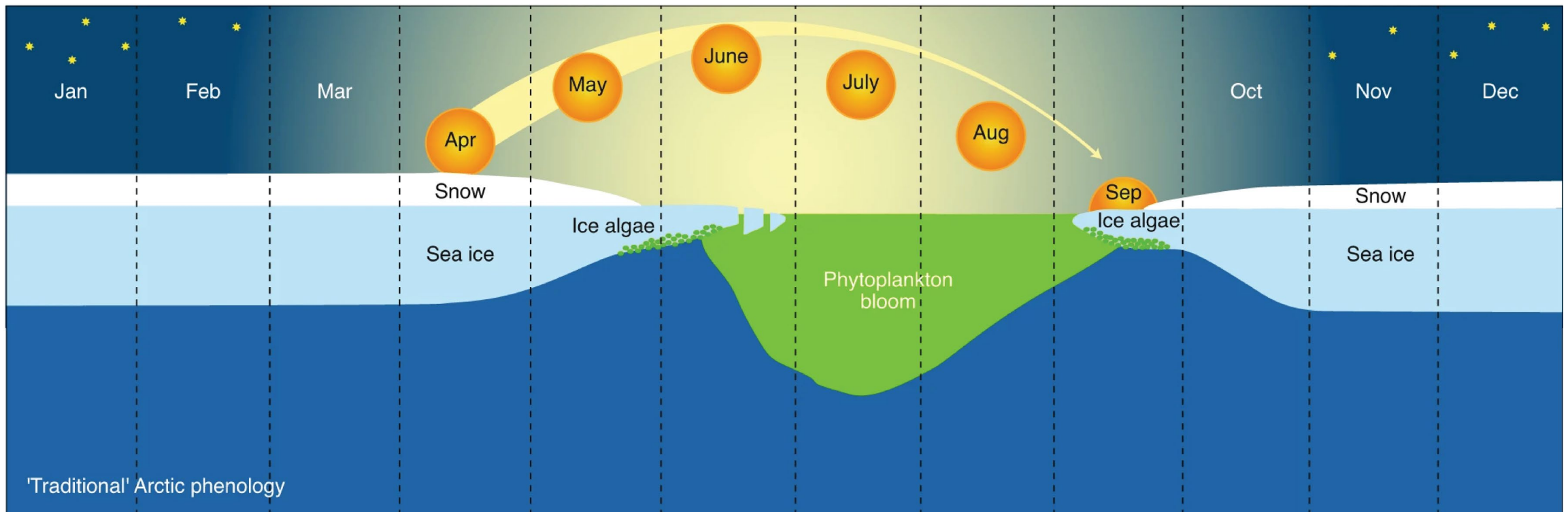
Presented by: Stephen G. Kohler

Contributors

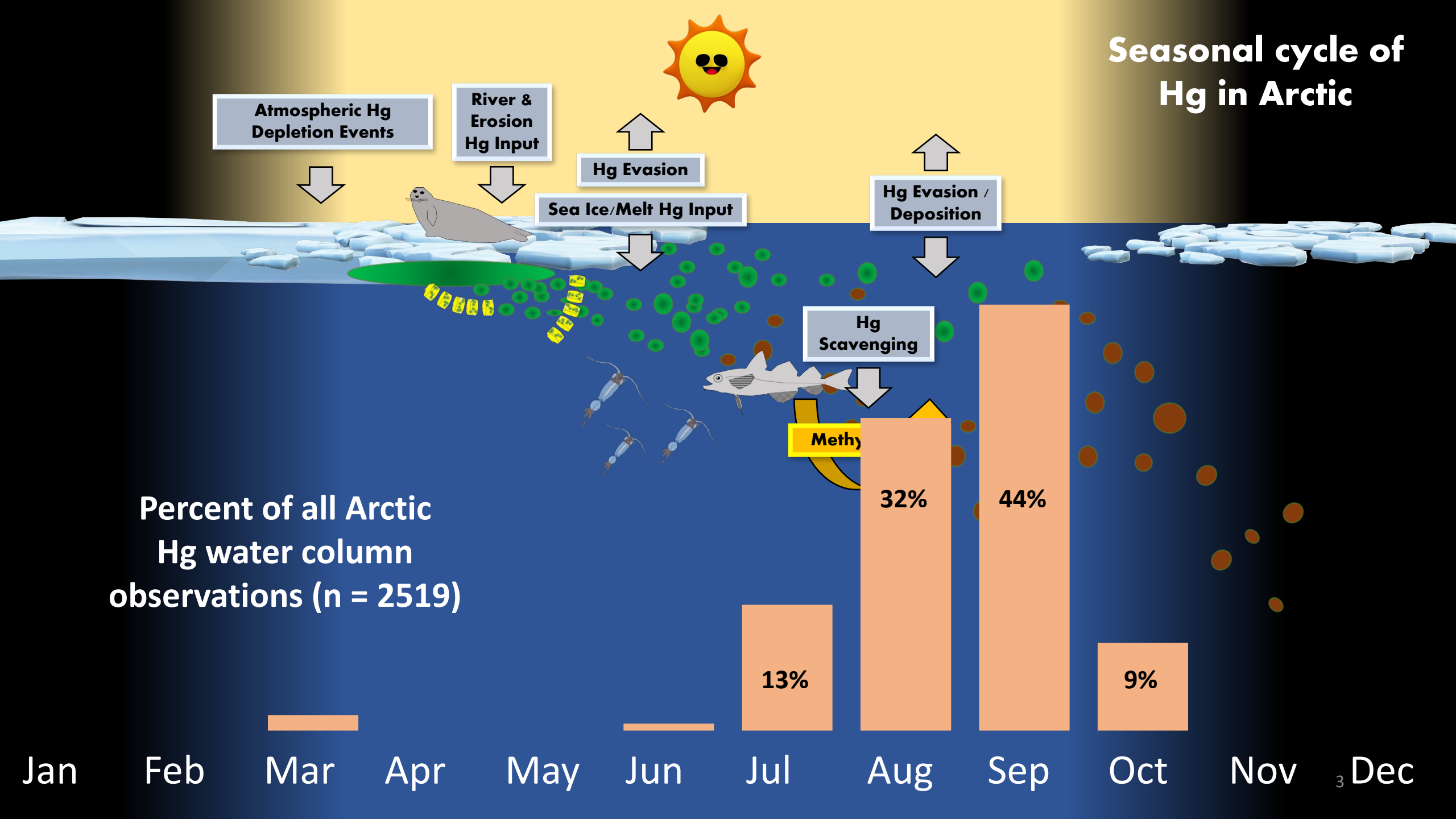
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Arctic Ocean Seasonality

- Polar day & polar night
- Seasonal biological productivity
- Heterogenous sea ice coverage & extent



Seasonal cycle of Hg in Arctic

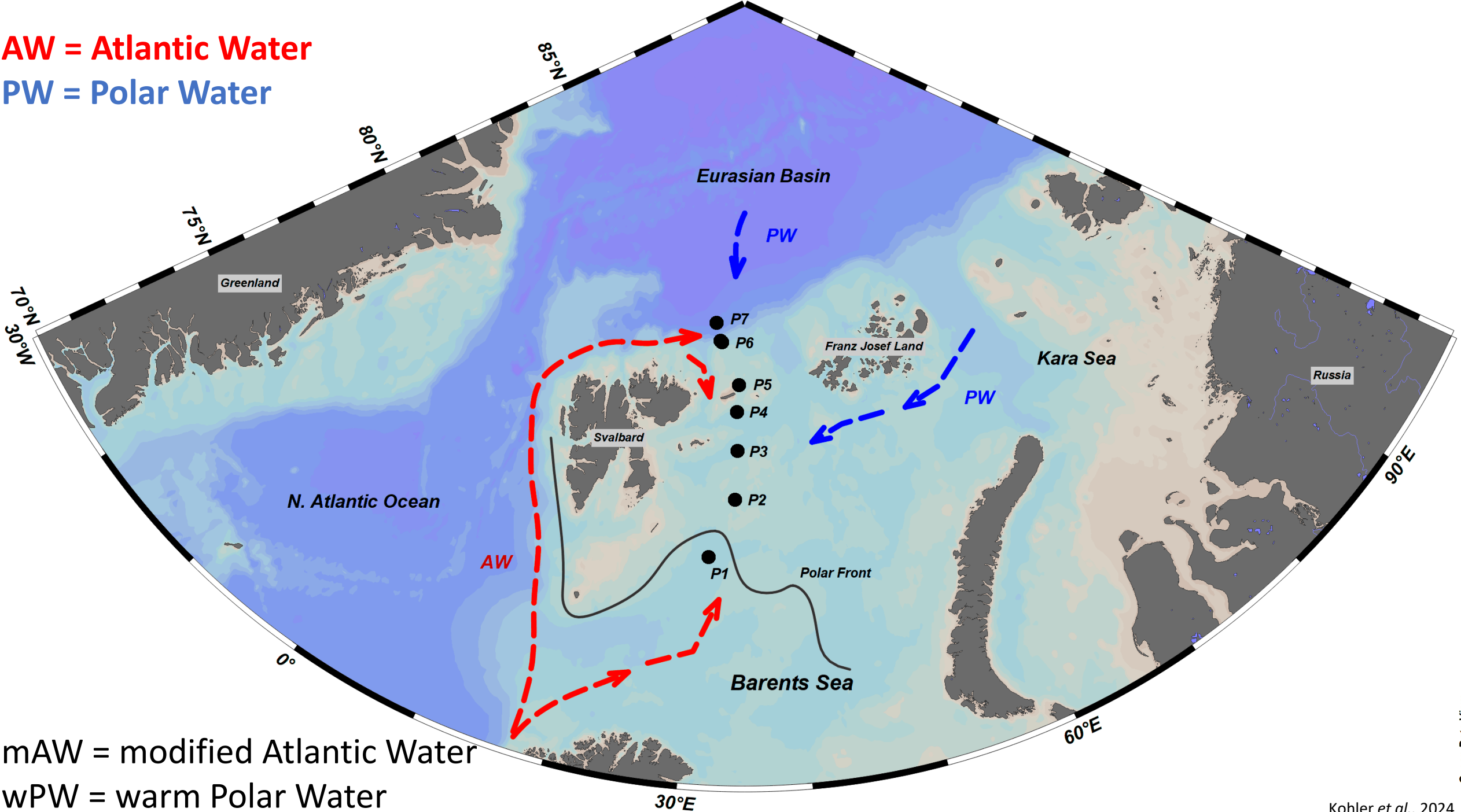


Investigation of the seasonal Hg cycle in the northern Barents Sea

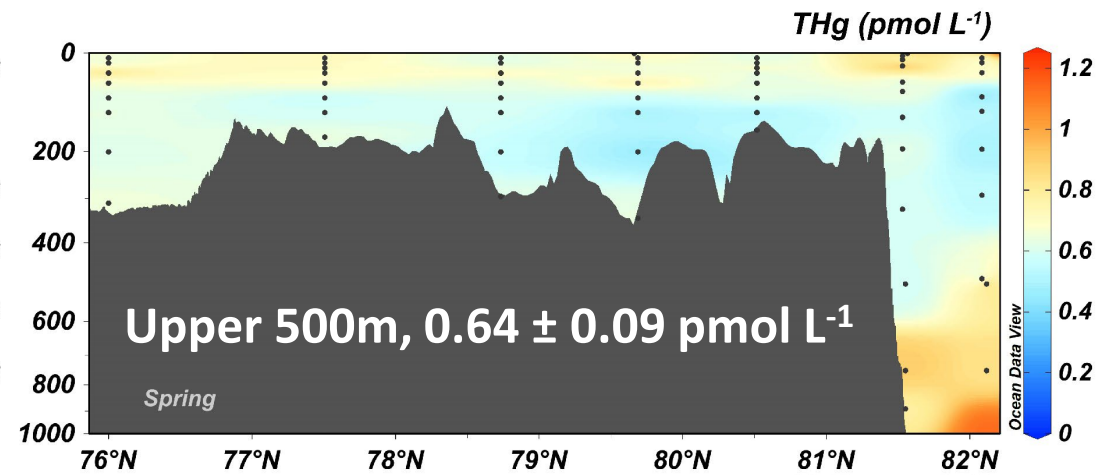
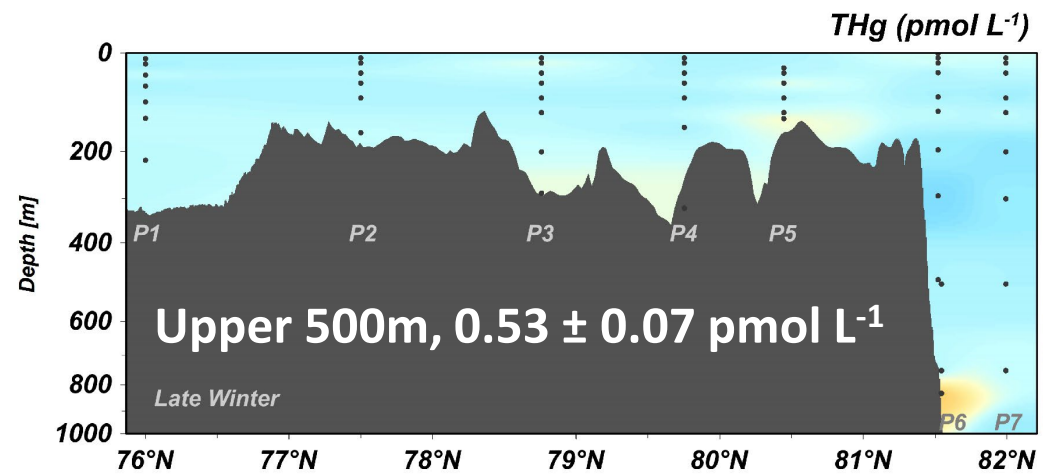
- Onboard RV *Kronprins Haakon*
 - March 2021 **Late winter (LW)**
 - May 2021 **Spring (SP)**
 - August 2019 **Summer (SU)**
 - December 2019 **Winter (W)**
- Samples collected
 - Unfiltered seawater total Hg (THg)
 - Unfiltered seawater methylated Hg (MeHg)
 - Sea ice, snow, frost flowers



AW = Atlantic Water
PW = Polar Water

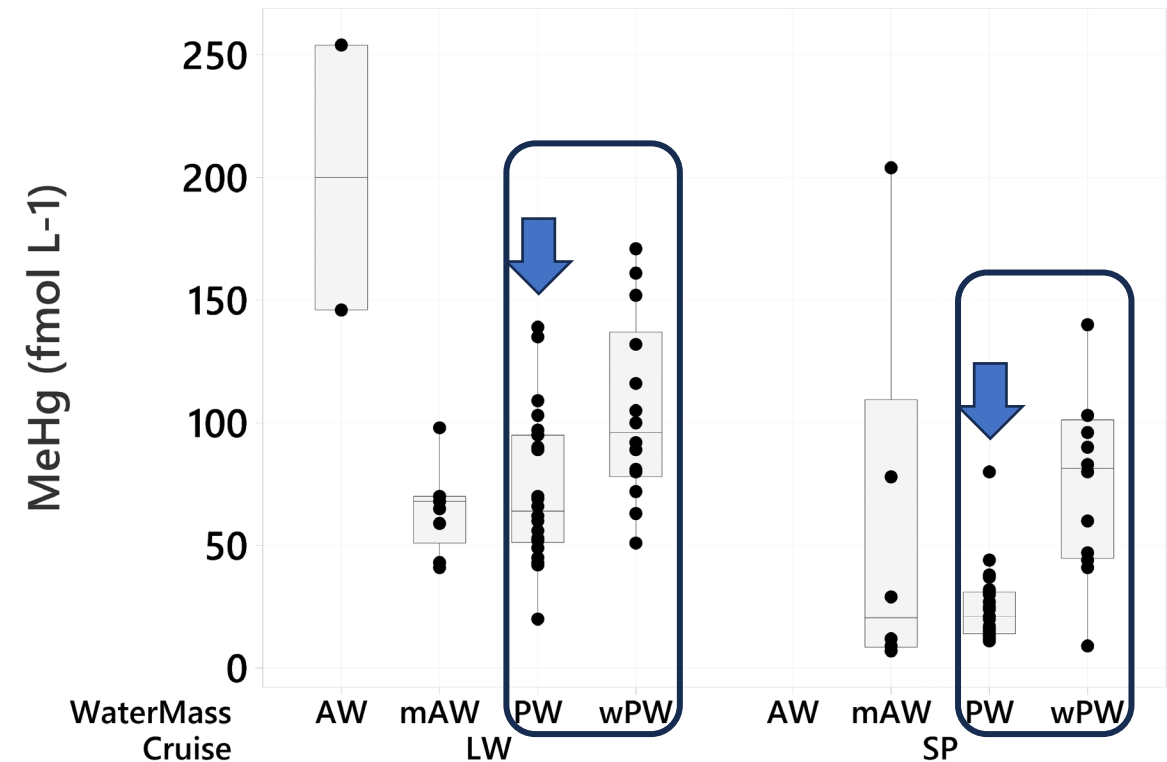
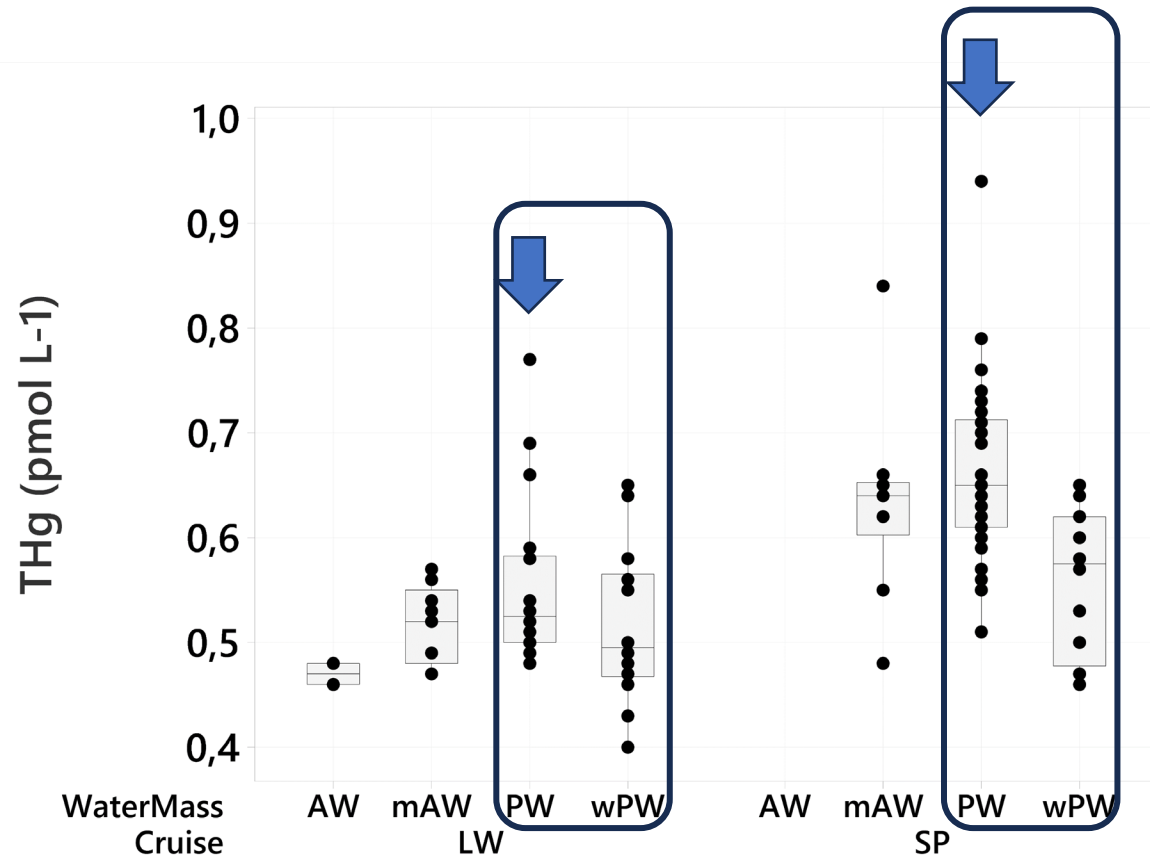


mAW = modified Atlantic Water
wPW = warm Polar Water



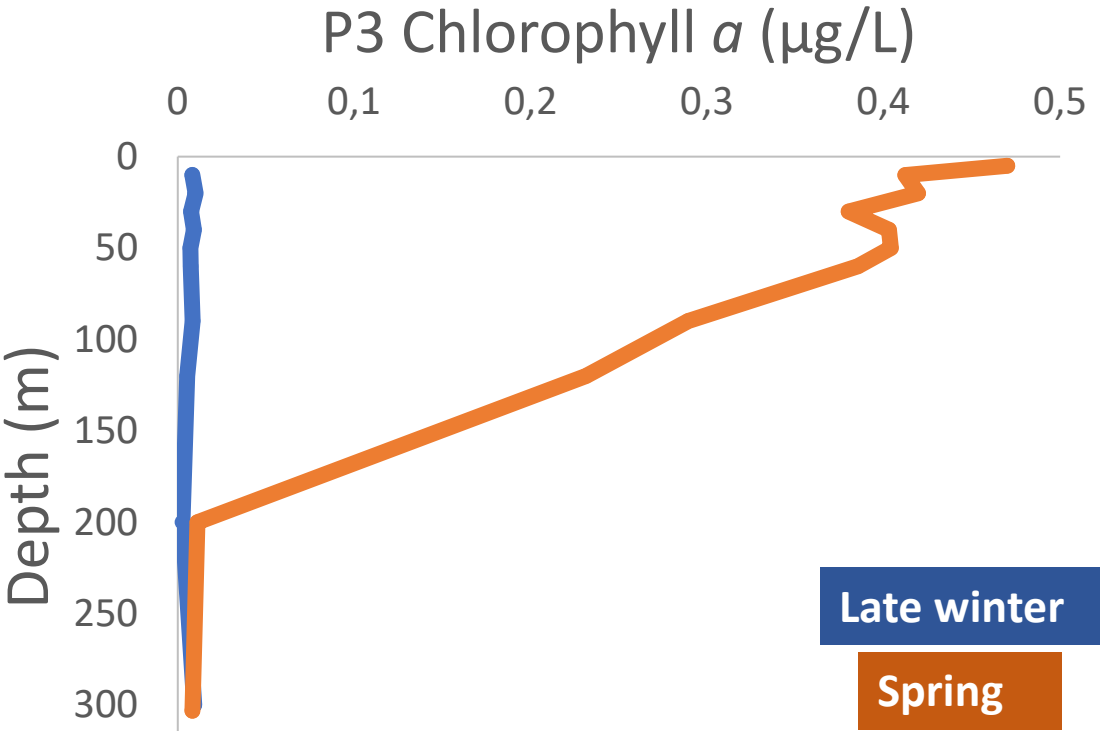
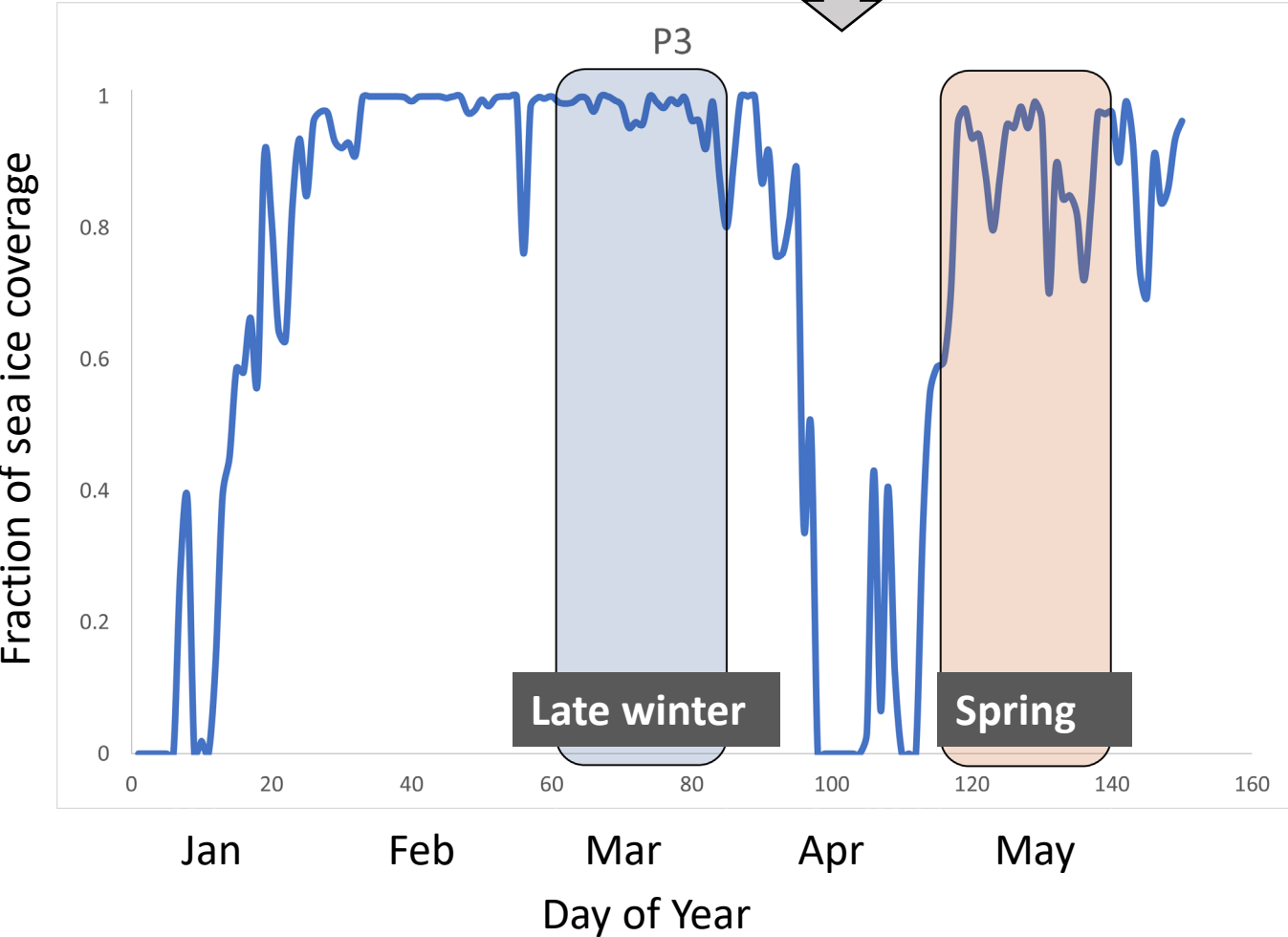
Shelf and surface waters consist entirely of **Polar Water (PW)**, $\Theta \leq 0.0^{\circ}\text{C}$, $\sigma_0 \leq 27.97 \text{ kg m}^{-3}$) with some influence from **warm Polar Water (wPW)**, $\Theta > 0.0^{\circ}\text{C}$, $S_A < 35.06 \text{ g kg}^{-1}$) in both late winter (LW) and spring (SP) in upper 500m

- THg average concentrations significantly different in **PW** in LW and SP ($p < 0.05$)
- MeHg average concentrations significantly different in **PW** in LW and SP ($p < 0.05$)

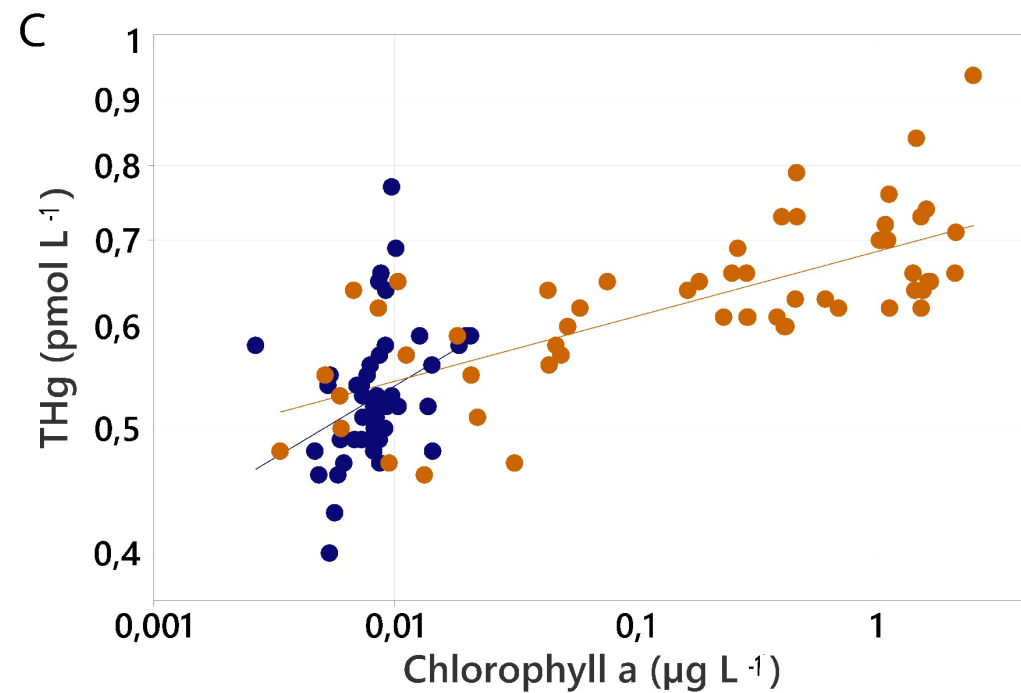
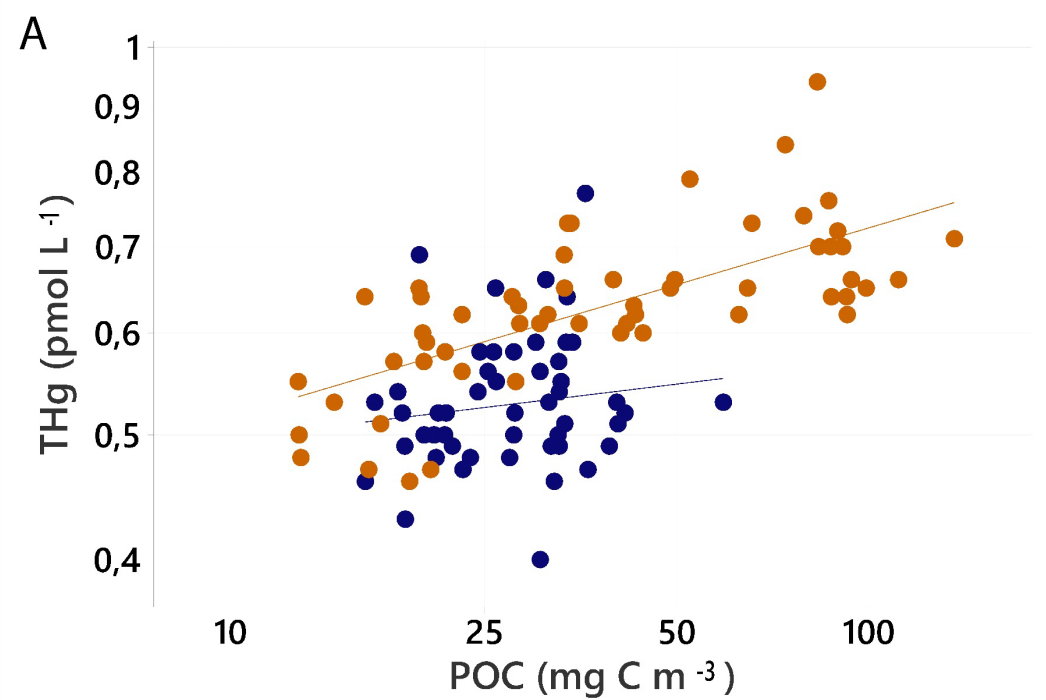


Environmental conditions

AMDEs,
Sea Ice Melt

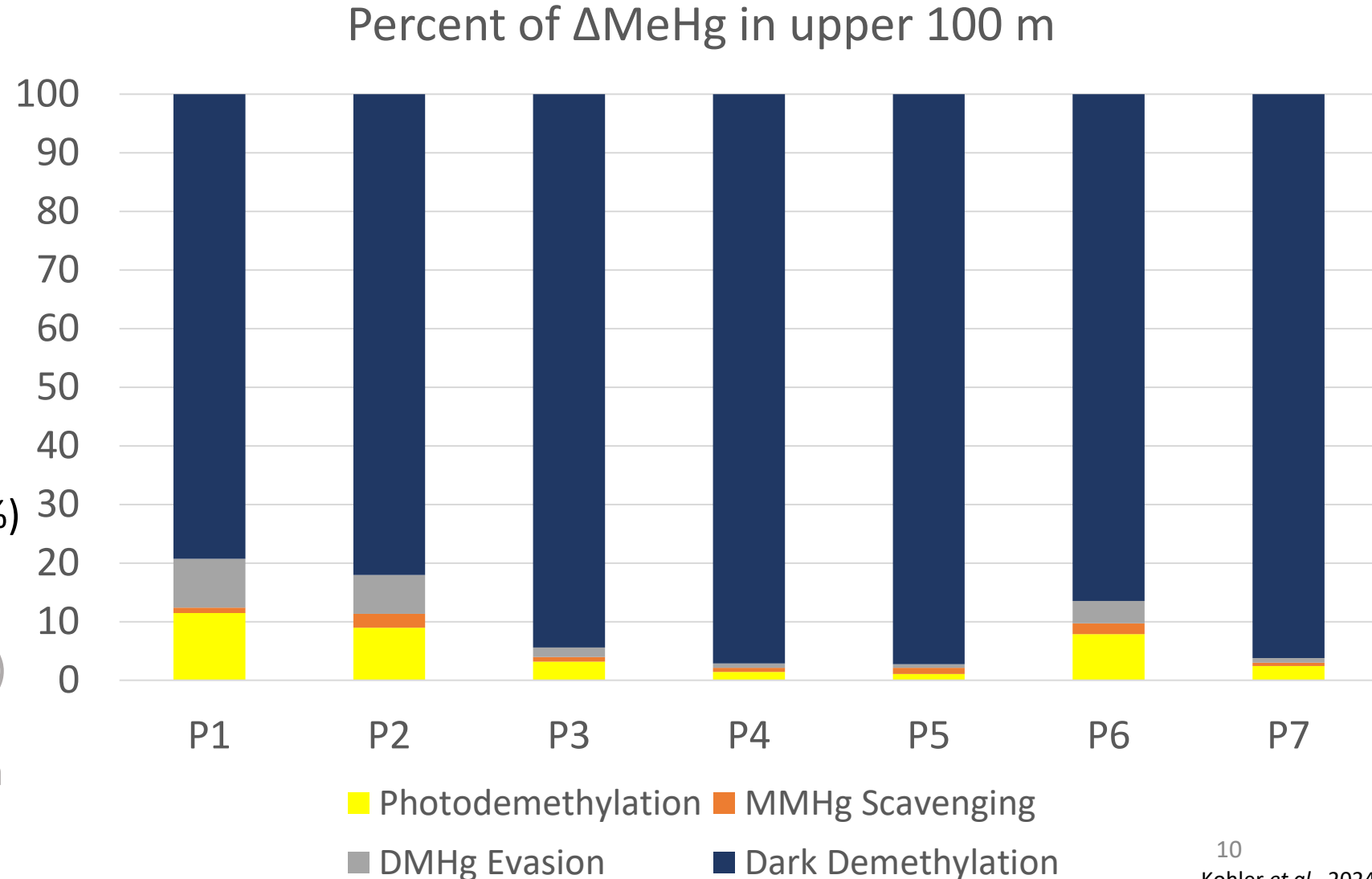


**Blue = Late
winter
(LW)**
**Orange =
Spring (SP)**



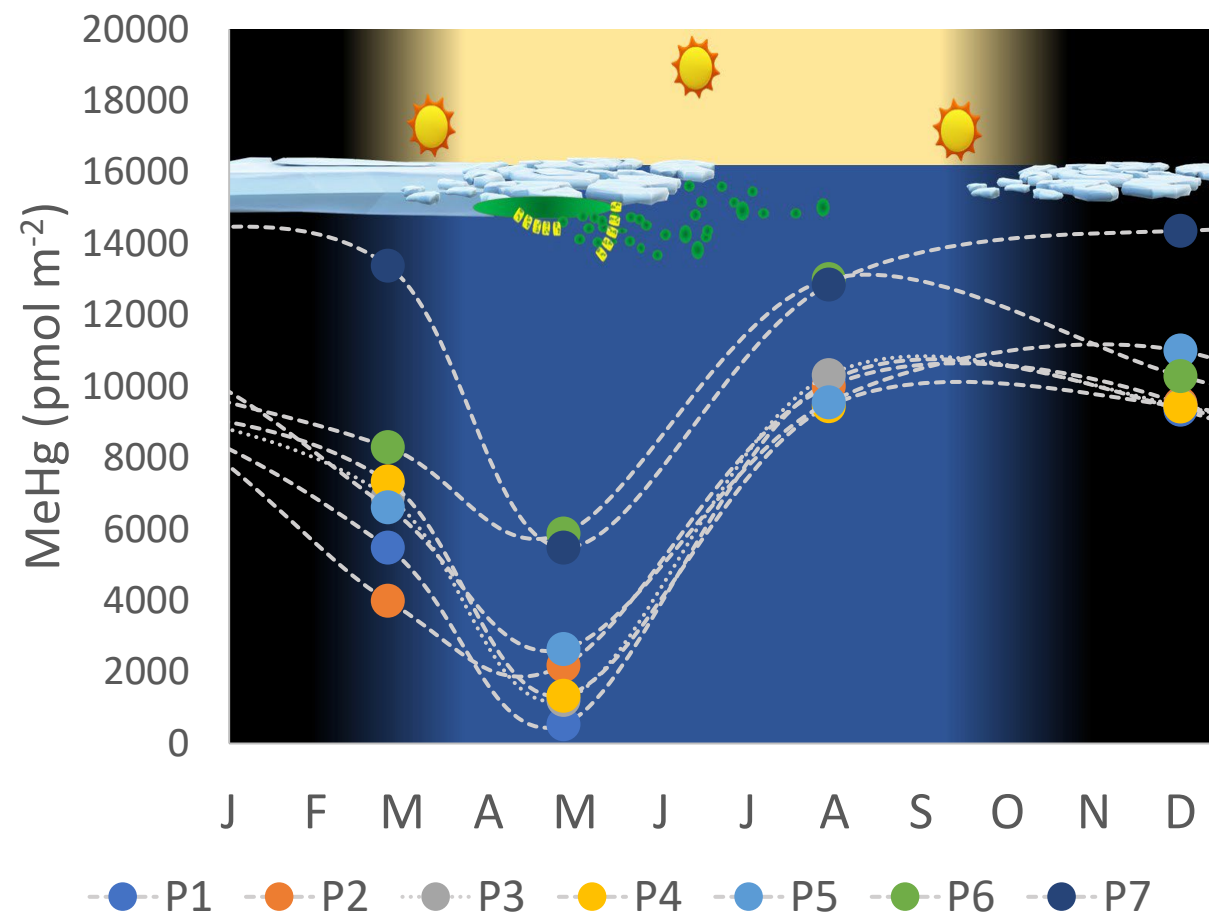
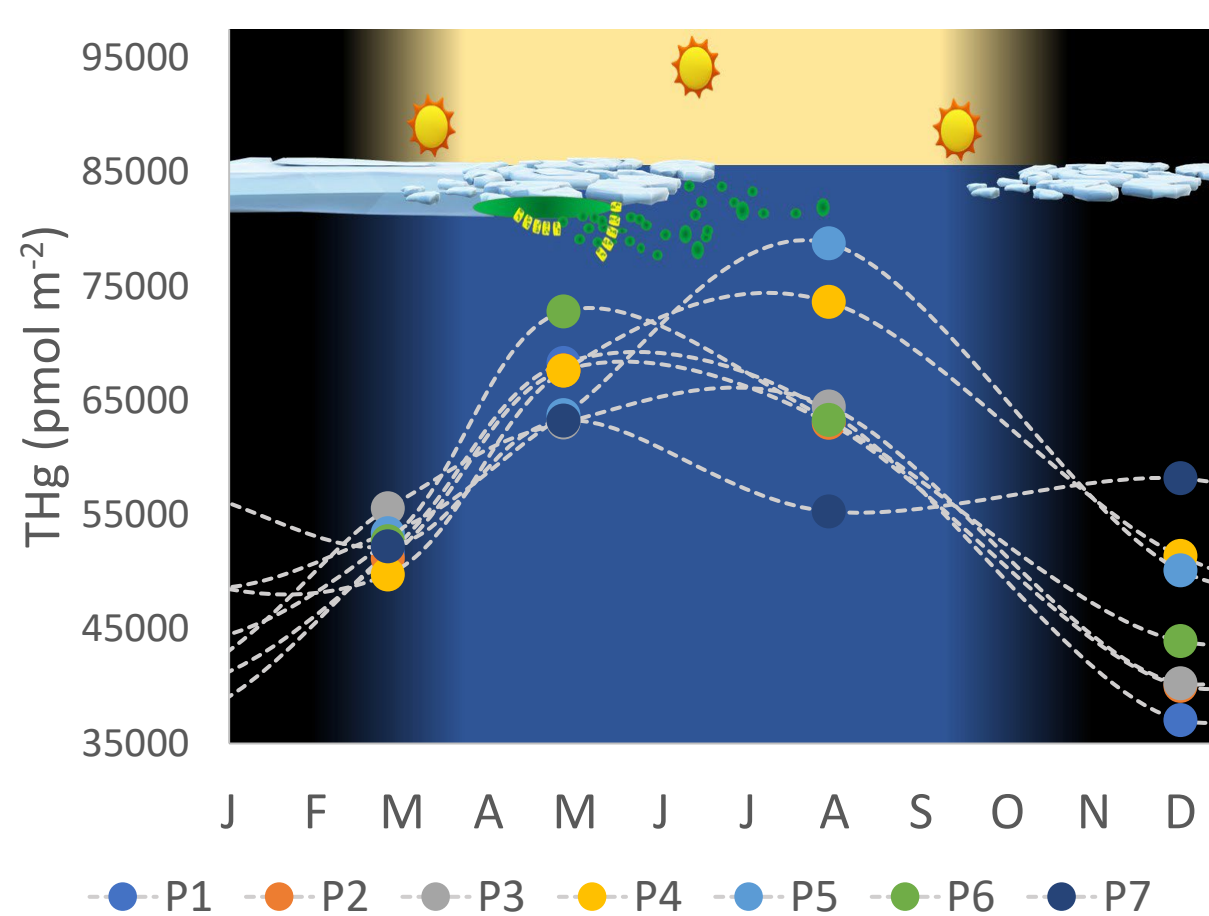
Evaluation of MeHg sinks

- Integrated pool of MeHg in upper 100 m for each cruise, Difference in pools between cruises = net loss of ΔMeHg
 - Photodemethylation
 - $5 \pm 4\%$ (range: 1 – 11 %)
 - MMHg scavenging
 - $2 \pm 1\%$ (range: < 1 – 3 %)
 - DMHg evasion
 - $3 \pm 3\%$ (range: < 1 – 8 %)
 - Dark demethylation (biotic & abiotic)
 - Remaining
 - $90 \pm 8\%$ (range: 79 – 97 %)
- Phytoplankton or bacterial demethylation
- Intracellular ROS (Liang et al 2023)
- Dissolved organic matter interactions (Li et al 2022, Jonsson et al 2016)

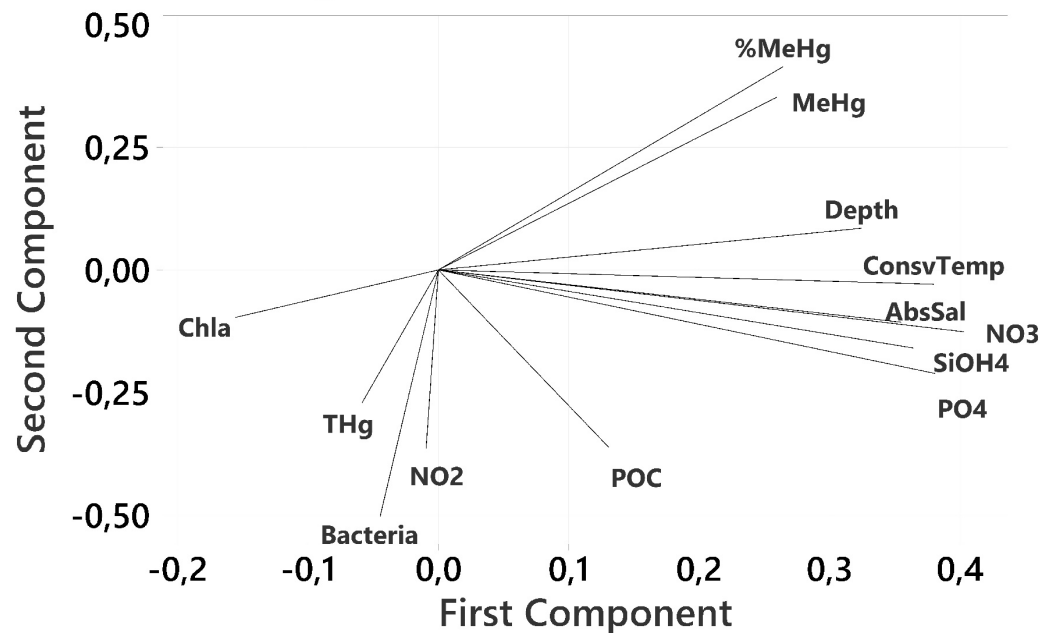


Seasonal cycle of Hg in water column of northern Barents Sea

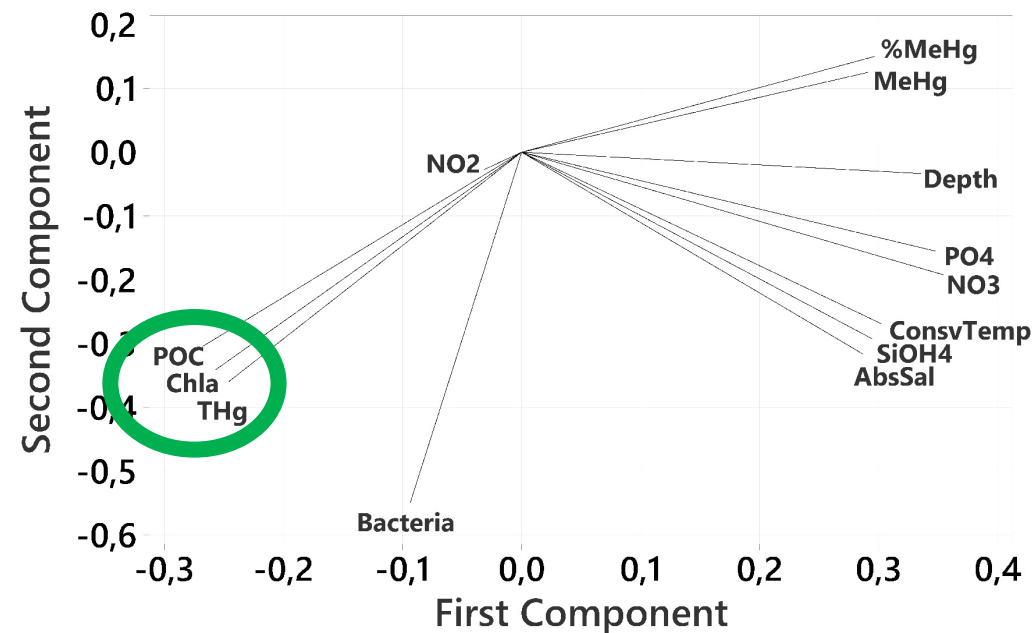
- Combination of Summer, Winter (Kohler et al., 2022), Late winter, Spring
- Plotted seasonal integrated pools of both THg and MeHg for all stations – upper 100 m
- Seasonal patterns emerge for THg and MeHg



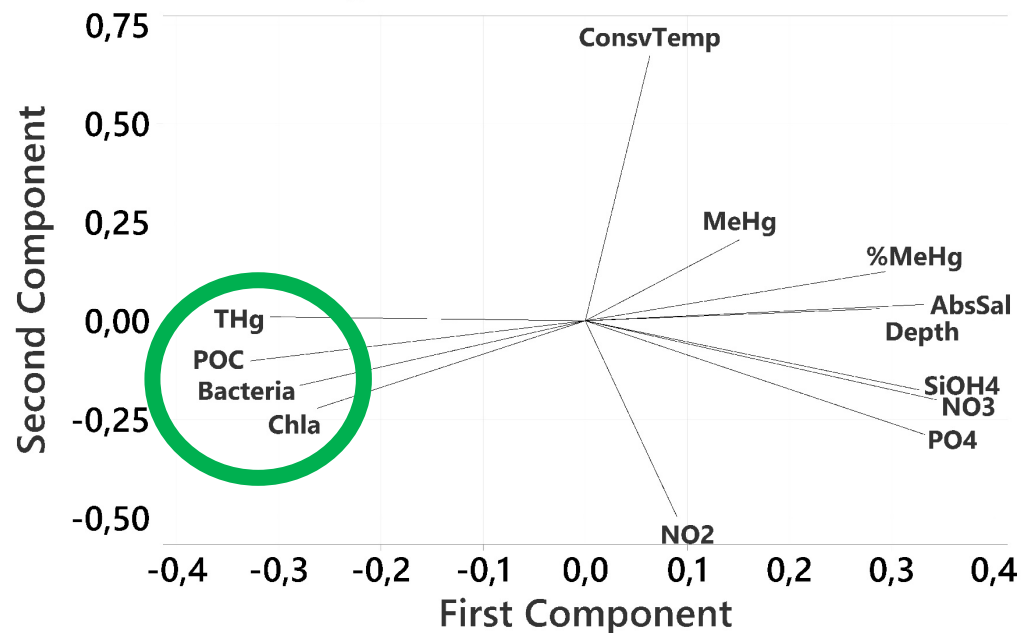
Loading Plot of Late Winter Cruise



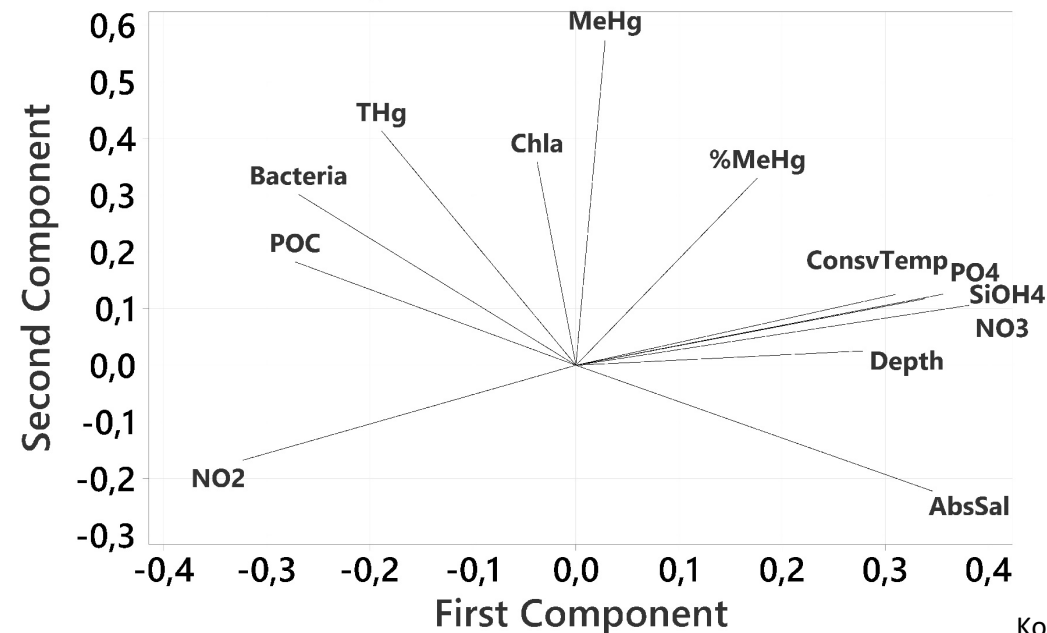
Loading Plot of Spring Cruise



Loading Plot of Summer Cruise



Loading Plot of Winter Cruise



Seasonal cycle of mercury (Hg)

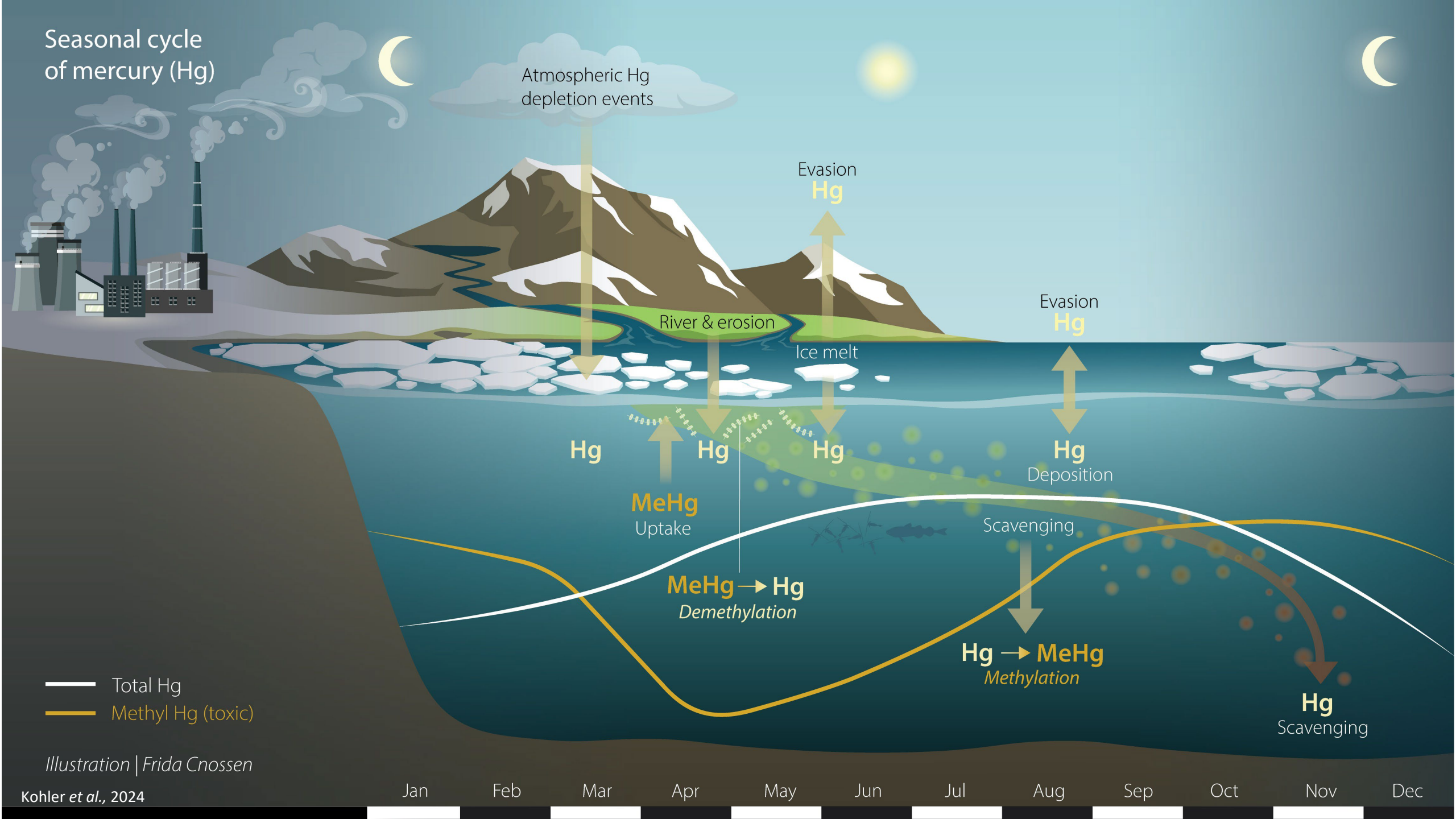


Illustration | Frida Cnossen

Kohler et al., 2024

Take home messages

- Increased THg concentrations in surface Arctic waters in spring hypothesized due to seasonal Hg inputs and sea ice dynamics
- Decreased MeHg concentrations and pools in spring hypothesized due to biotic dark demethylation in association with the spring bloom development
- Apparent seasonal cycle for both THg and MeHg in northern Barents Sea surface waters
- Seasonal cycling potentially driven by temporal Hg inputs, Hg's association to the particulate phase and seasonal biological activity



Thank you for your attention!!

For more information, please see:

<https://doi.org/10.1016/j.pocean.2024.103224>

