

Reply to all reviewers regarding comments on the isotopic fractionation model (section 4.1.1)

We thank all three reviewers for their judicious comments and suggestions on this section as we believe it has helped bring clarity to this section and improve the manuscript overall.

Following comments from Reviewers #2 and #3, PSW and AW datasets are now divided into separate models to reflect the different nutrient sources for initial conditions. Building on the comments raised by Reviewer #1, the colour code of the fractionation model now clearly highlights which samples are from within the mixed layer for clarity of interpretation of data at low nutrient concentrations. Updated Figure 6 is included below for reference.

Initial conditions prior to utilization were chosen from the subsurface water nutrient concentrations from the water mass (Table 2) as data on winter nutrient concentrations in Fram Strait is limited, particularly for PSW. The study from Randelhoff et al. (2018) shows that summer nutrient concentrations below the mixed layer depth are a good approximation of winter concentrations. The authors found using these conditions preferable to finding horizontal conditions instead due to the large uncertainty arising from the spatial and temporal variability expected for these conditions. This is further discussed in the edited manuscript. Adjusted initial conditions address the issue of AW d_{30Si} measurements artificially falling below the predicted compositions raised by Reviewers #1 and #3, now reflecting the lower DSi nature of AW. PSW does not fit either model of fractionation, which we attribute to the lateral transport of DSi signal instead. The updated model has not majorly changed observed trends but greatly improved fit of d_{30Si} data and has provided clarity for interpretation. The discussion of all trends relating to Figure 6 have been updated accordingly.

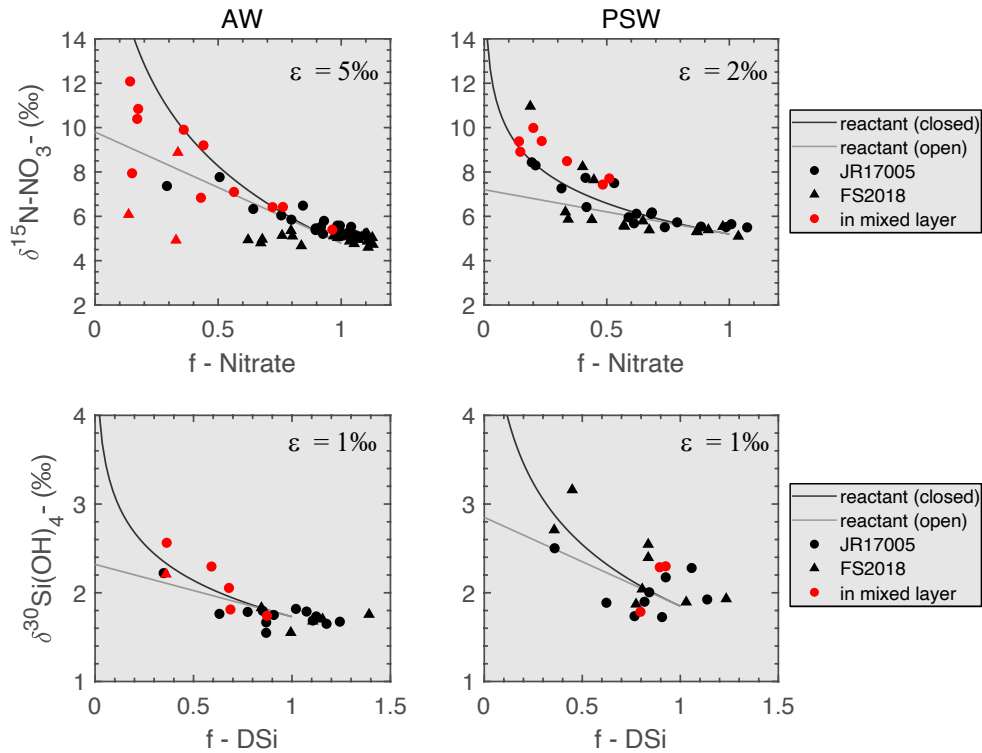


Figure 1: Top panels: nitrate utilisation vs $\delta^{15}\text{N-NO}_3^-$ for AW (left) and PSW (right). Bottom panels: DSi utilisation vs $\delta^{30}\text{Si(OH)}_4$ for AW (left) and PSW (right). Circles denote measurements from JR17005 (spring) and triangles from FS2018 (summer). Red symbols show measurements within the mixed layer. Black line follows the closed fractionation model and grey line an open fractionation model.

References

Randelhoff, A., Reigstad, M., Chierici, M., Sundfjord, A., Ivanov, V., Cape, M., Vernet, M., Tremblay, J.-É., Bratbak, G. and Kristiansen, S.: Seasonality of the Physical and Biogeochemical Hydrography in the Inflow to the Arctic Ocean Through Fram Strait, *Front. Mar. Sci.*, 5(June), 1–16, doi:10.3389/fmars.2018.00224, 2018.