

Reply and discussion to comments from Patrick Neale.

We would like to thank for the positive and constructive comments from Patrick Neale. Below we address his comments and suggestions:

Yes, weather conditions in the North Sea during the period where the incubations were made (transect 2-5) were relatively calm (with typical wind speeds between 5 - 10 m/s, or less), with only a single short period with wind speeds approaching 13-15 m/s (station 117-118). Thus, a few stations may have been impacted by relatively strong vertical motion in the upper 5-10 m, that may have affected the degree of photoinhibition. We have added information on this in section 3.1 on Timeseries observations in the North Sea: "Surface winds were relatively calm ($\sim 5 - 10 \text{ m s}^{-1}$) during the low-light incubations in the North Sea and they varied between 3 - 10 m s^{-1} during the timeseries station (average and SD: $6.2 \pm 1.9 \text{ m s}^{-1}$).

We acknowledge the suggestion of modifying the title to reflect that the majority of data is from the North Sea, so we change the title to: "Impact of light, turbulent mixing, and nutrients on phytoplankton photoinhibition in the North Sea and selected regions of the subtropical to subpolar North Atlantic". We have kept the reference to "nutrients" because they are considered in the PCA-analysis that shows that nutrients and other environmental variables are of less importance for PI.

Minor comments:

1. Section 2.2:

Turbulence was also measured in the Irminger Sea. We have added this information in section 2.2: "Micro-scale turbulence in the North Sea and in the Irminger Sea was measured with a loose-tethered free-fall Rockland Scientific International (RSI) VMP-250 microstructure vertical profiler equipped with two shear probes."

We specify that the discussion on turbulence is related to the North Sea in Discussion Section 4: "The vertical turbulent diffusion coefficient near the surface **in the North Sea** was **typically** estimated to be in the range $\sim 10^{-2}$ - $10^{-3} \text{ m}^2 \text{ s}^{-1}$ (Fig. 2b), so vertical displacements of $\sim 5 \text{ m}$ in this layer then correspond to turbulent diffusive timescales of 0.7-7 hours."

Turbulence measurements in the Irminger Sea showed the same general distribution, however, with a deeper impact of surface turbulence, and this may have made a larger impact on PI. We have added the following comment on this in the revised manuscript in the Discussion section:

"Turbulence measurements from the Irminger Sea (not shown) were in general accordance with this distribution, although a weaker stratification and a larger wind forcing caused a deeper impact from turbulence. Turbulence at 10 m depth ranged between 10^{-3} - $10^{-2} \text{ m}^2 \text{ s}^{-1}$ at some stations, and values of $\sim 10^{-3} \text{ m}^2 \text{ s}^{-1}$ were found at 30 m depth at a single station. Otherwise k_v -values were below $10^{-4} \text{ m}^2 \text{ s}^{-1}$ in the euphotic zone. Elevated mixing in the Irminger Sea could therefore have made a larger impact on PI and may explain some of the generally higher PI-values for low light levels there (Fig. 8)."

2. Section 2.4:

We agree that albedo vary during the day and this will modify the surface PAR. However, we consider this to be a second order effect on the regression analysis of the time history of SPAR compared to the large daily variation due to changes of the solar angle and clouds, and also the relatively strong attenuation with depth. We explain that we assume a constant albedo in the end of the section.

Section 2.5:

We did not give the sample a short exposure to light before the measurement, so this potential effect was not considered in this study.

The bottle correction applied in From et al. (2014) was not included in this study, because of the difference in temperature and also spatial variability of the phytoplankton composition between the samples.

l. 146: The typo has been corrected to 10^{-3} .

Supplemental information:

The complete data for the Irminger Sea and the Sargasso Sea are already included in the supplementary excel-sheet. The "Information" sheet describes the 3 cruises, the "Stations" include a station description with location and time, and "FvFm" includes the low-light incubations. Data from the Irminger Sea (ROCS 2021) and the Sargasso Sea (2014) are listed below the North Sea data (VERMIX 2016).