

Seasonal and decadal variability in bio-optical properties in the Northwest Atlantic

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2 ABSTRACT

3 TODO

4 **Keywords:** Phytoplankton, keyword, keyword, keyword, keyword, keyword, keyword, keyword

1 INTRODUCTION

5 A rich literature has established empirical relationships between water OACs (mostly chlorophyll-a and
6 associated pigments) and IOPs in the open oceans (Kirk, 1994; Morel and Gschwend, 1987; Bricaud et al.,
7 1995, 1998; Morel and Maritorena, 2001; Bricaud, 2004; Devred et al., 2006; Morel et al., 2007).

2 MATERIAL AND METHODS

8 2.1 Heading Levels

9 2.2 Level 2

10 2.2.1 Level 3

11 2.2.1.1 Level 4

12 2.2.1.1.1 Level 5

13 2.3 Equations

14 Equations should be inserted in editable format from the equation editor.

$$\text{PAAW} = \frac{\sum_{i=\lambda_1}^{\lambda_n} a_\phi(\lambda_i)}{\sum_{i=\lambda_1}^{\lambda_n} \frac{a_\phi(\lambda_i)}{\lambda_i}} \quad (1)$$

FIGURES

15 Cite figures with subfigures as figure 2B.

CONFLICT OF INTEREST STATEMENT

16 The authors declare that the research was conducted in the absence of any commercial or financial
17 relationships that could be construed as a potential conflict of interest.

AUTHOR CONTRIBUTIONS

18 The Author Contributions section is mandatory for all articles, including articles by sole authors. If an
19 appropriate statement is not provided on submission, a standard one will be inserted during the production
20 process. The Author Contributions statement must describe the contributions of individual authors referred
21 to by their initials and, in doing so, all authors agree to be accountable for the content of the work. Please
22 see here for full authorship criteria.

FUNDING

23 Details of all funding sources should be provided, including grant numbers if applicable. Please ensure to
24 add all necessary funding information, as after publication this is no longer possible.

ACKNOWLEDGMENTS

25 TODO

SUPPLEMENTAL DATA

26 Supplementary Material should be uploaded separately on submission, if there are Supplementary Figures,
27 please include the caption in the same file as the figure. LaTeX Supplementary Material templates can be
28 found in the Frontiers LaTeX folder.

DATA AVAILABILITY STATEMENT

29 The datasets [GENERATED/ANALYZED] for this study can be found in the [NAME OF REPOSITORY]
30 [LINK].

REFERENCES

- 31 Bricaud, A. (2004). Natural variability of phytoplanktonic absorption in oceanic waters: Influence of
32 the size structure of algal populations. *Journal of Geophysical Research* 109, C11010. doi:10.1029/
33 2004JC002419
- 34 Bricaud, A., Babin, M., Morel, A., and Claustre, H. (1995). Variability in the chlorophyll-specific
35 absorption coefficients of natural phytoplankton: Analysis and parameterization. *Journal of Geophysical*
36 *Research* 100, 13321. doi:10.1029/95JC00463
- 37 Bricaud, A., Morel, A., Babin, M., Allali, K., and Claustre, H. (1998). Variations of light absorption
38 by suspended particles with chlorophyll a concentration in oceanic (case 1) waters: Analysis and
39 implications for bio-optical models. *Journal of Geophysical Research: Oceans* 103, 31033–31044.
40 doi:10.1029/98JC02712
- 41 Devred, E., Sathyendranath, S., Stuart, V., Maass, H., Ulloa, O., and Platt, T. (2006). A two-component
42 model of phytoplankton absorption in the open ocean: Theory and applications. *Journal of Geophysical*
43 *Research* 111, C03011. doi:10.1029/2005JC002880
- 44 Kirk, J. T. O. (1994). Light and photosynthesis in aquatic ecosystems. In *Light and Photosynthesis in*
45 *Aquatic Ecosystems, Third Edition* (Cambridge: Cambridge University Press), vol. 51. Second edn.,
46 237–245. doi:10.1017/CBO9780511623370
- 47 Morel, A., Gentili, B., Claustre, H., Babin, M., Bricaud, A., Ras, J., et al. (2007). Optical properties of the
48 “clearest” natural waters. *Limnology and Oceanography* 52, 217–229. doi:10.4319/lo.2007.52.1.0217
- 49 Morel, A. and Maritorena, S. (2001). Bio-optical properties of oceanic waters: A reappraisal. *Journal of*
50 *Geophysical Research: Oceans* 106, 7163–7180. doi:10.1029/2000JC000319
- 51 Morel, F. and Gschwend, P. (1987). The role of colloids in the partitioning of solutes in natural water. In
52 *Aquatic Surface Chemistry*, ed. W. Stumm (New York). Wiley edn., 405–422

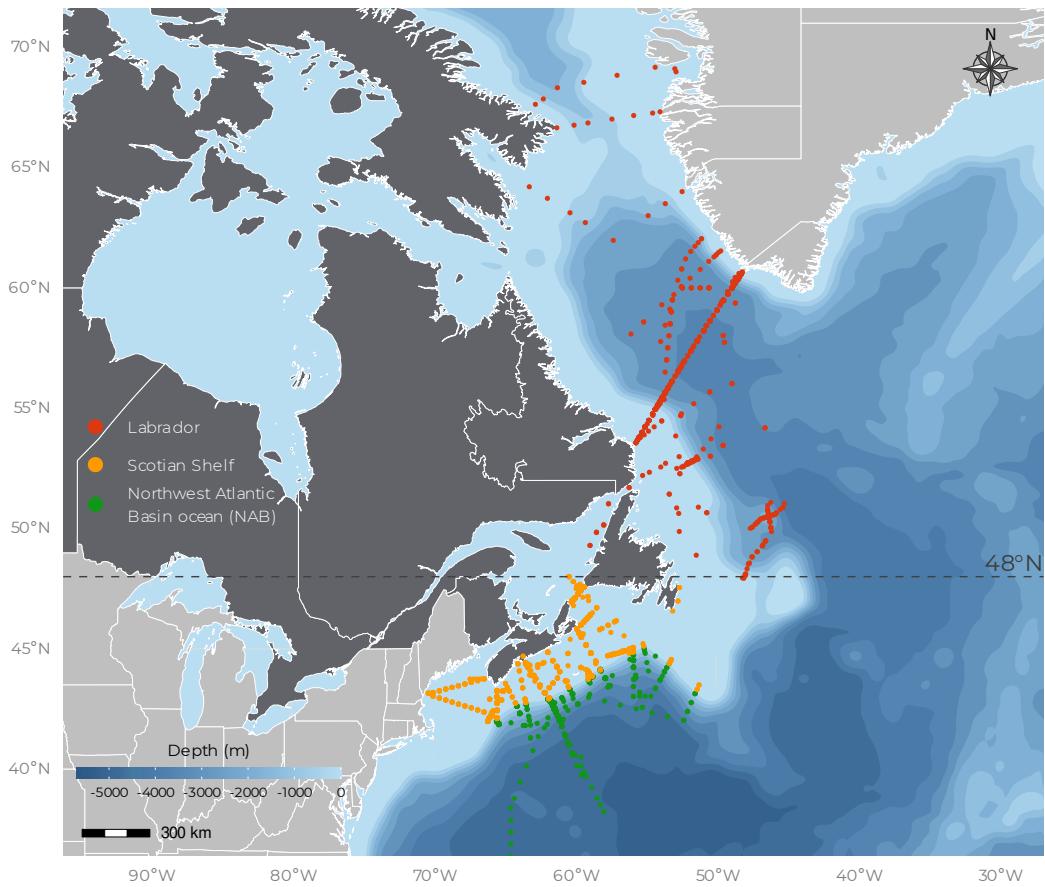
FIGURE CAPTIONS

Figure 1. This is a figure with sub figures, **(A)** is one logo, **(B)** is a different logo.

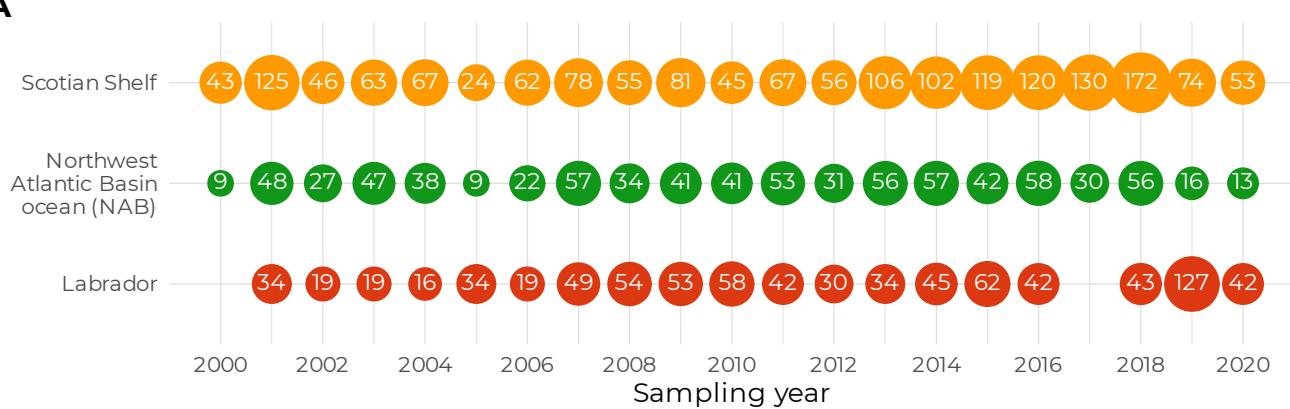
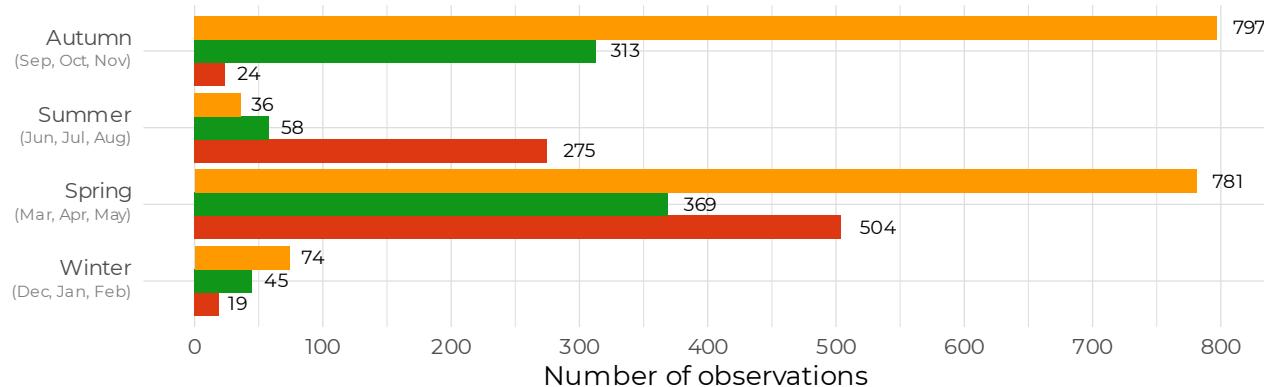
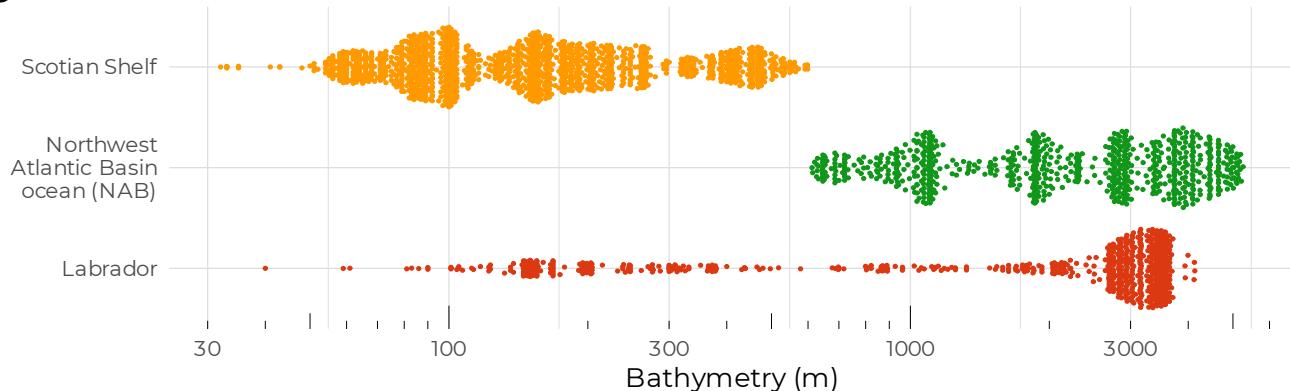
A**B****C**

Figure 2. This is a figure with sub figures, **(A)** is one logo, **(B)** is a different logo.

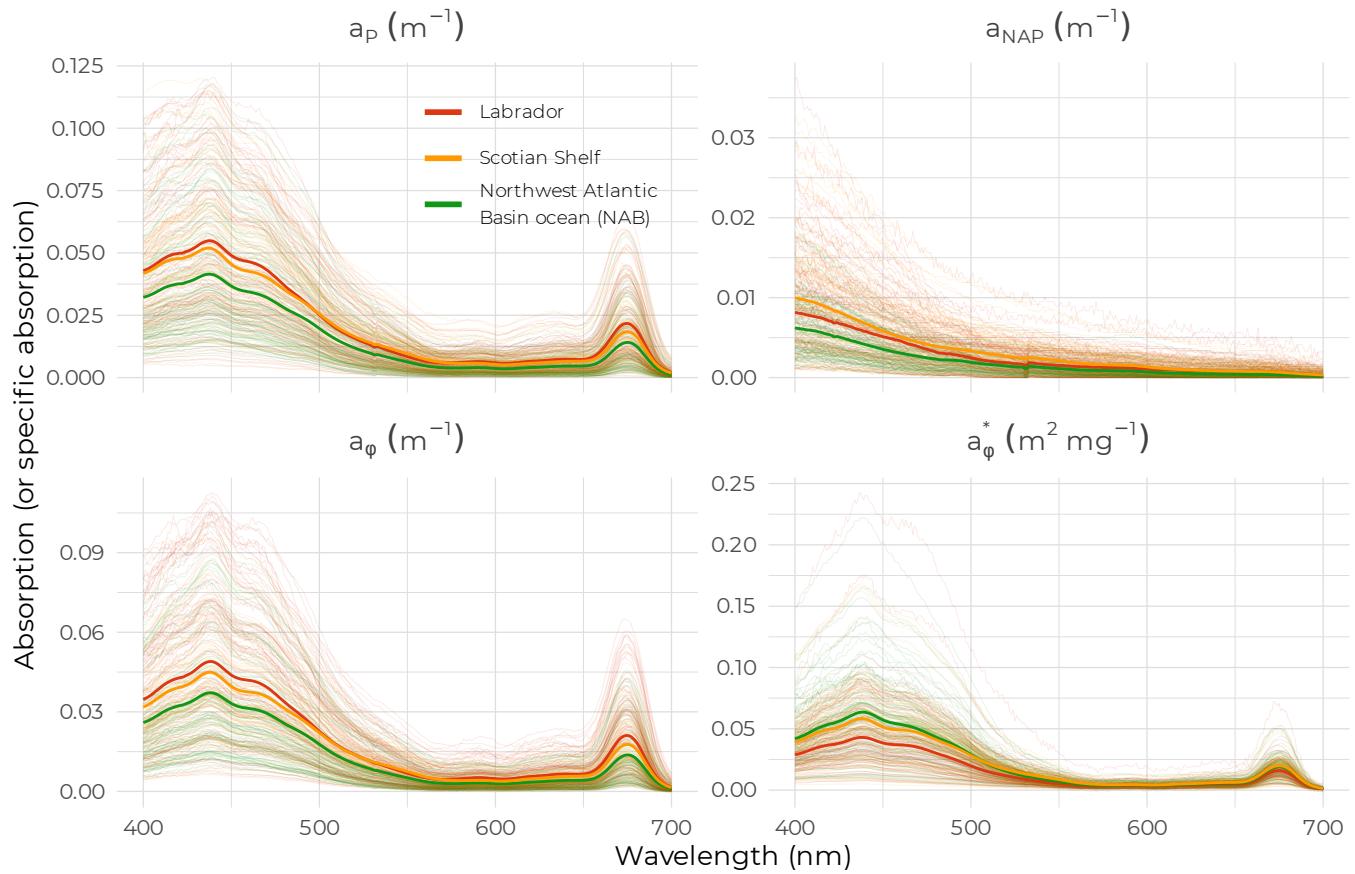


Figure 3. This is a figure with sub figures, **(A)** is one logo, **(B)** is a different logo.

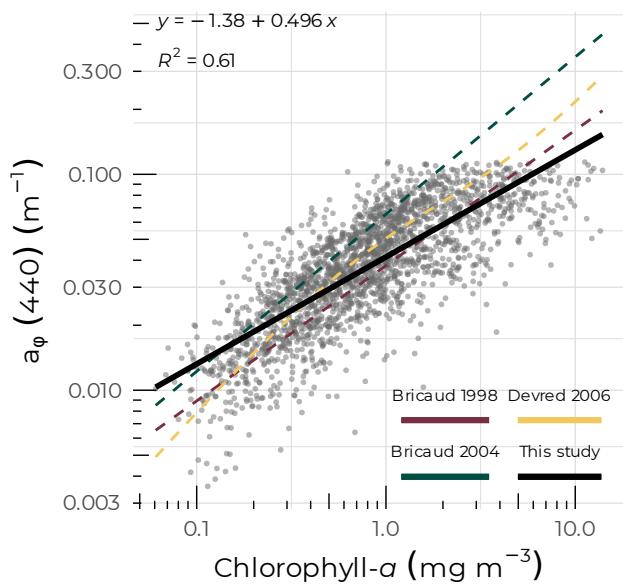


Figure 4. This is a figure with sub figures, **(A)** is one logo, **(B)** is a different logo.

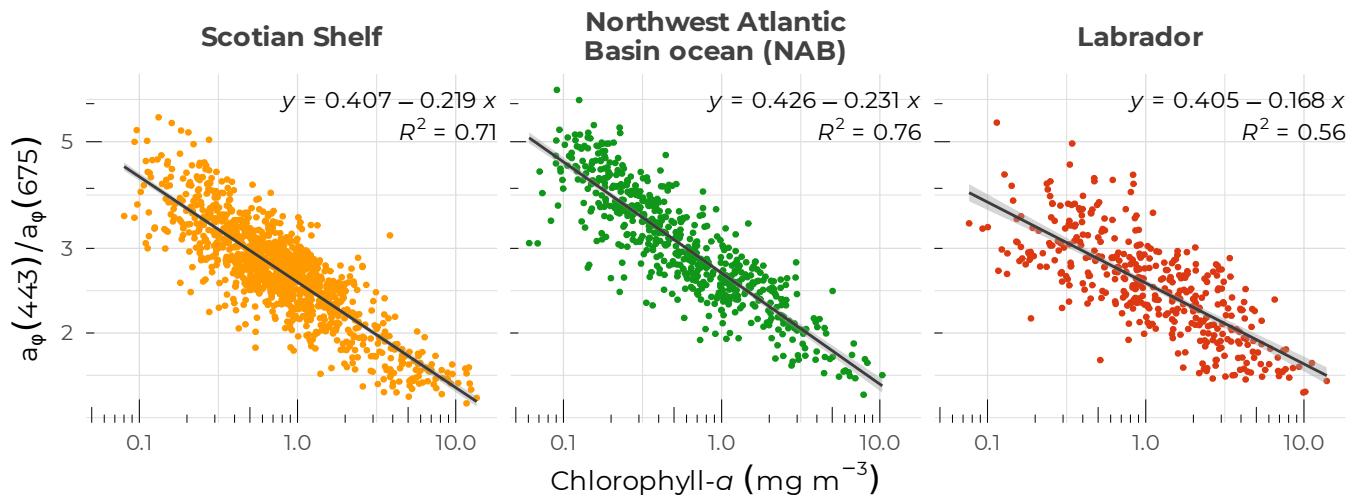


Figure 5. This is a figure with sub figures, (A) is one logo, (B) is a different logo.

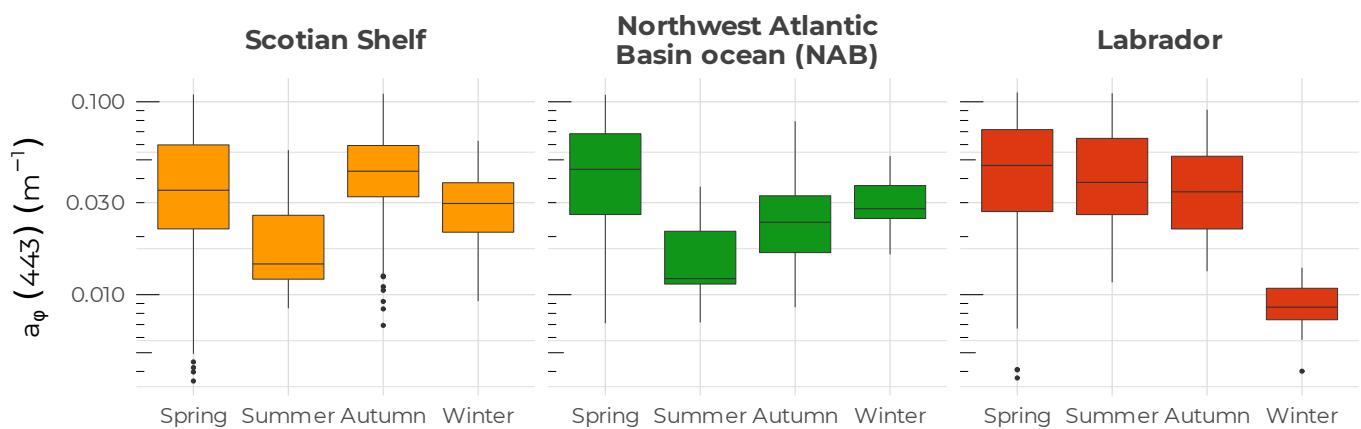
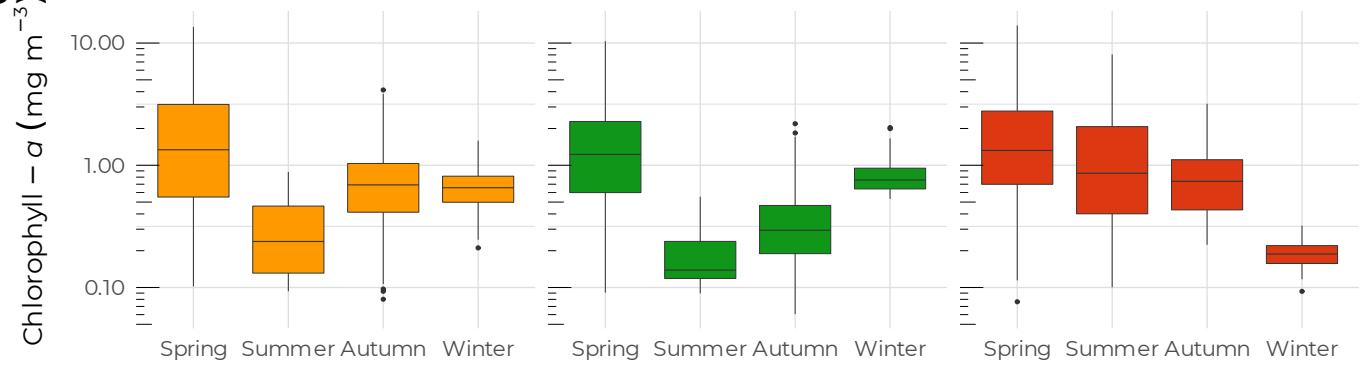
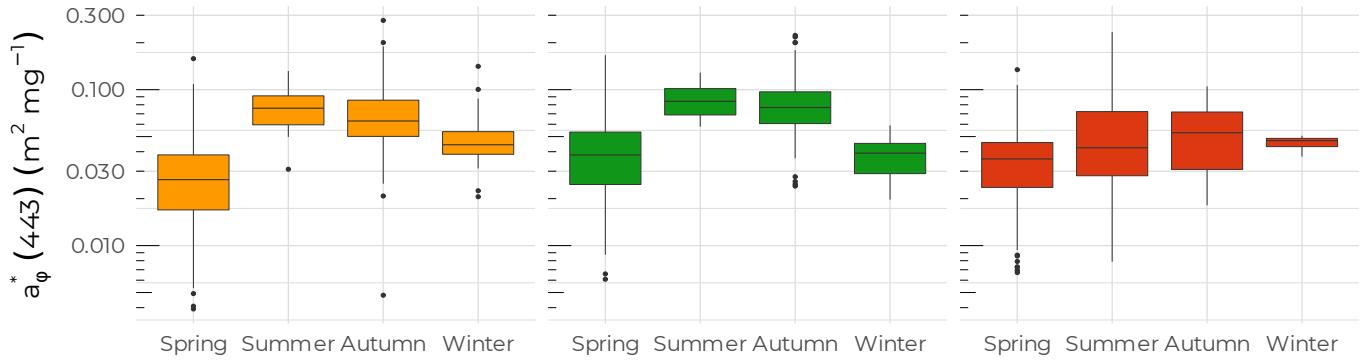
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Figure 6. This is a figure with sub figures, **(A)** is one logo, **(B)** is a different logo.

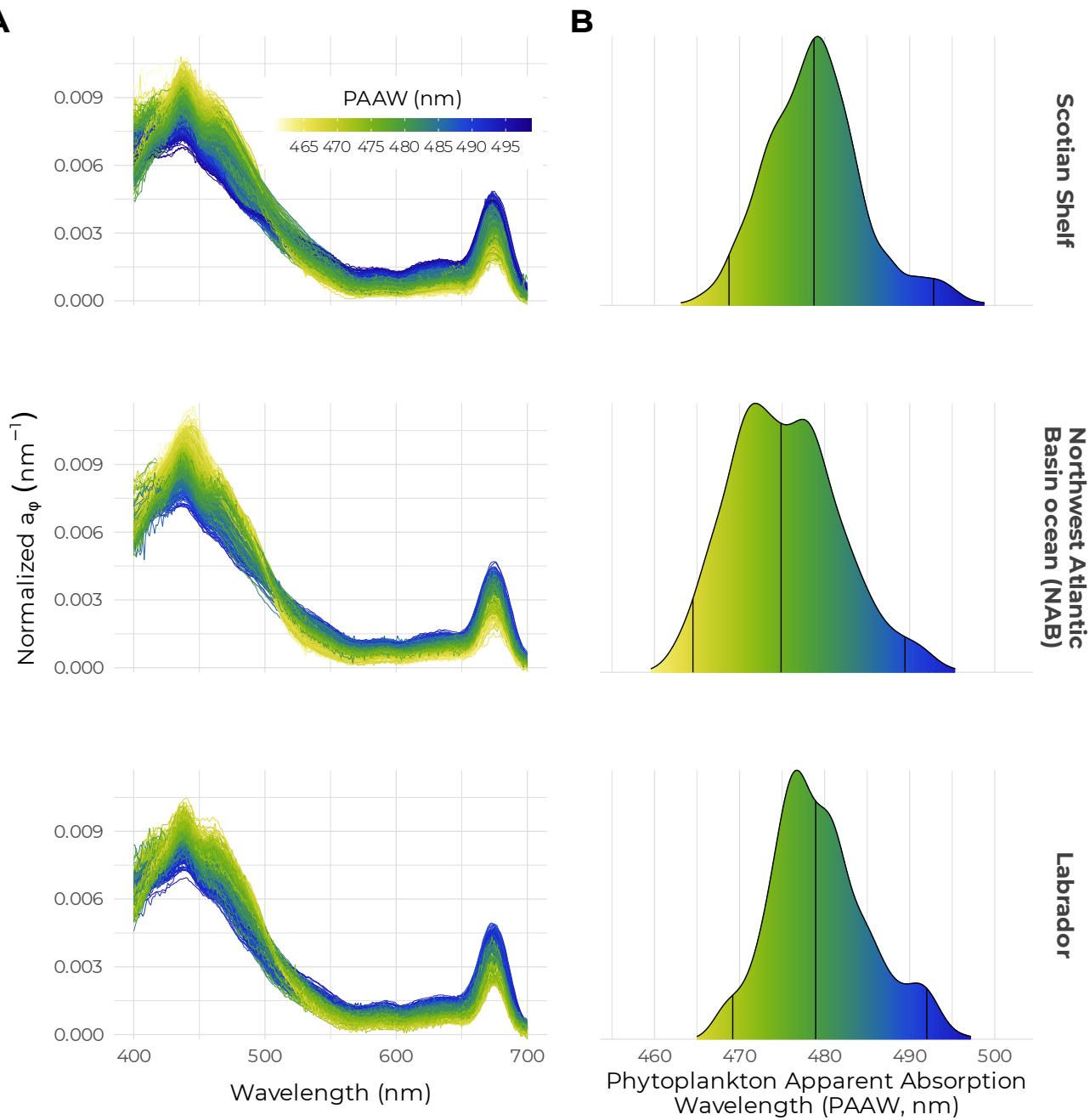


Figure 7. This is a figure with sub figures, **(A)** is one logo, **(B)** is a different logo.

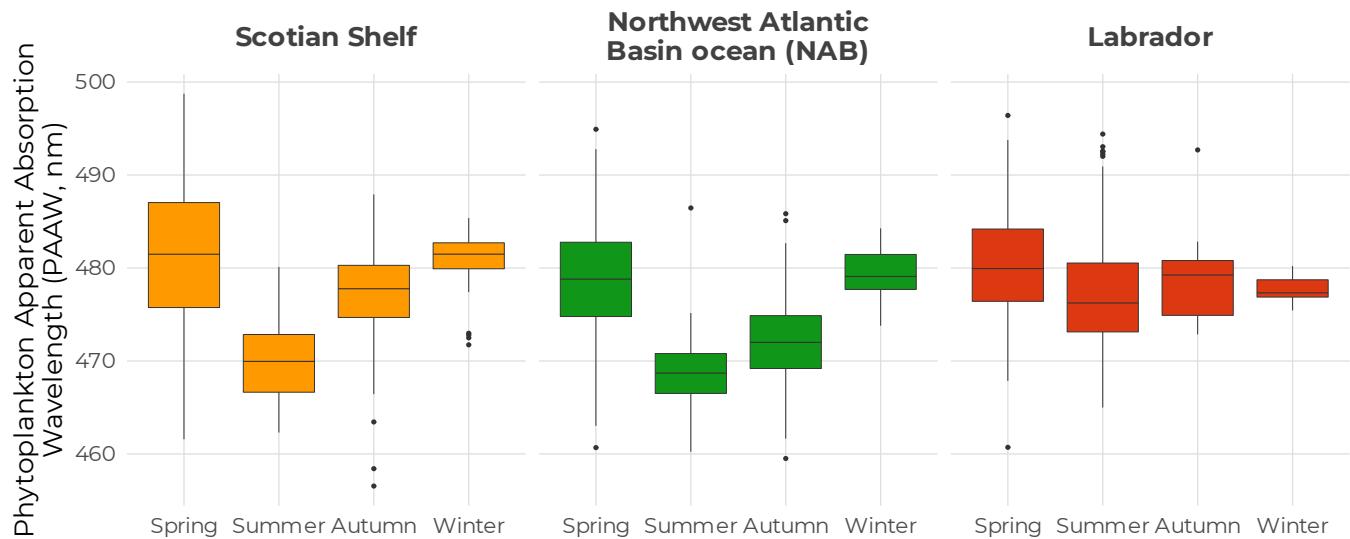


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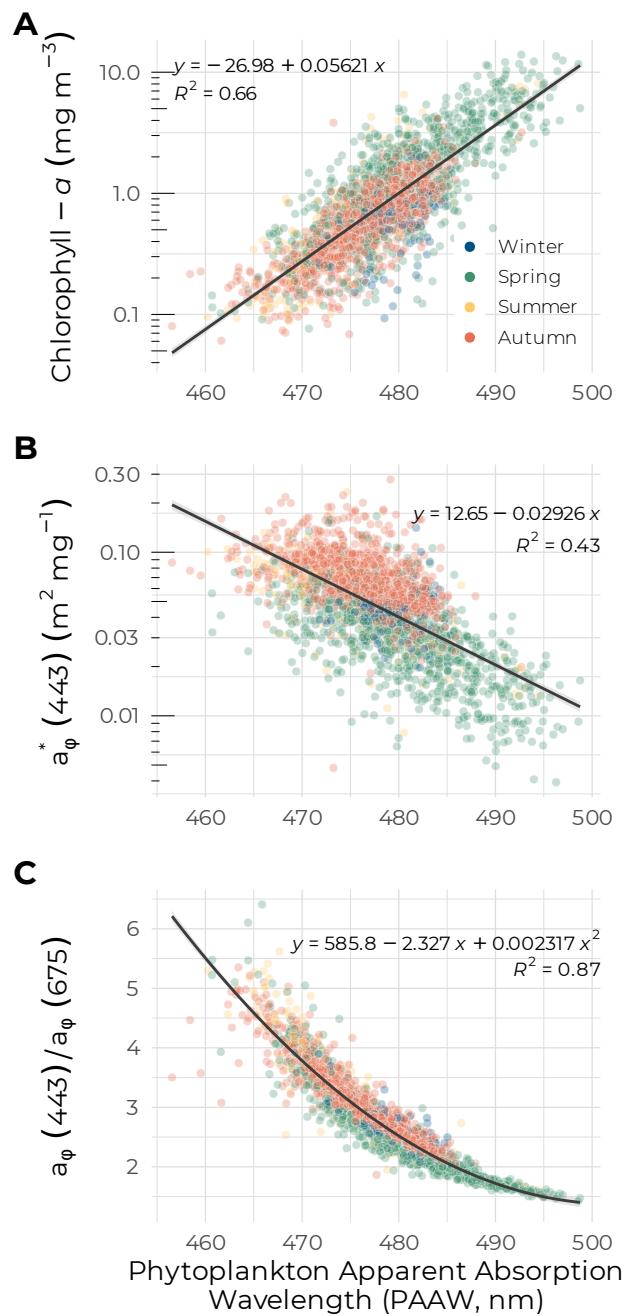


Figure 9. This is a figure with sub figures, **(A)** is one logo, **(B)** is a different logo.

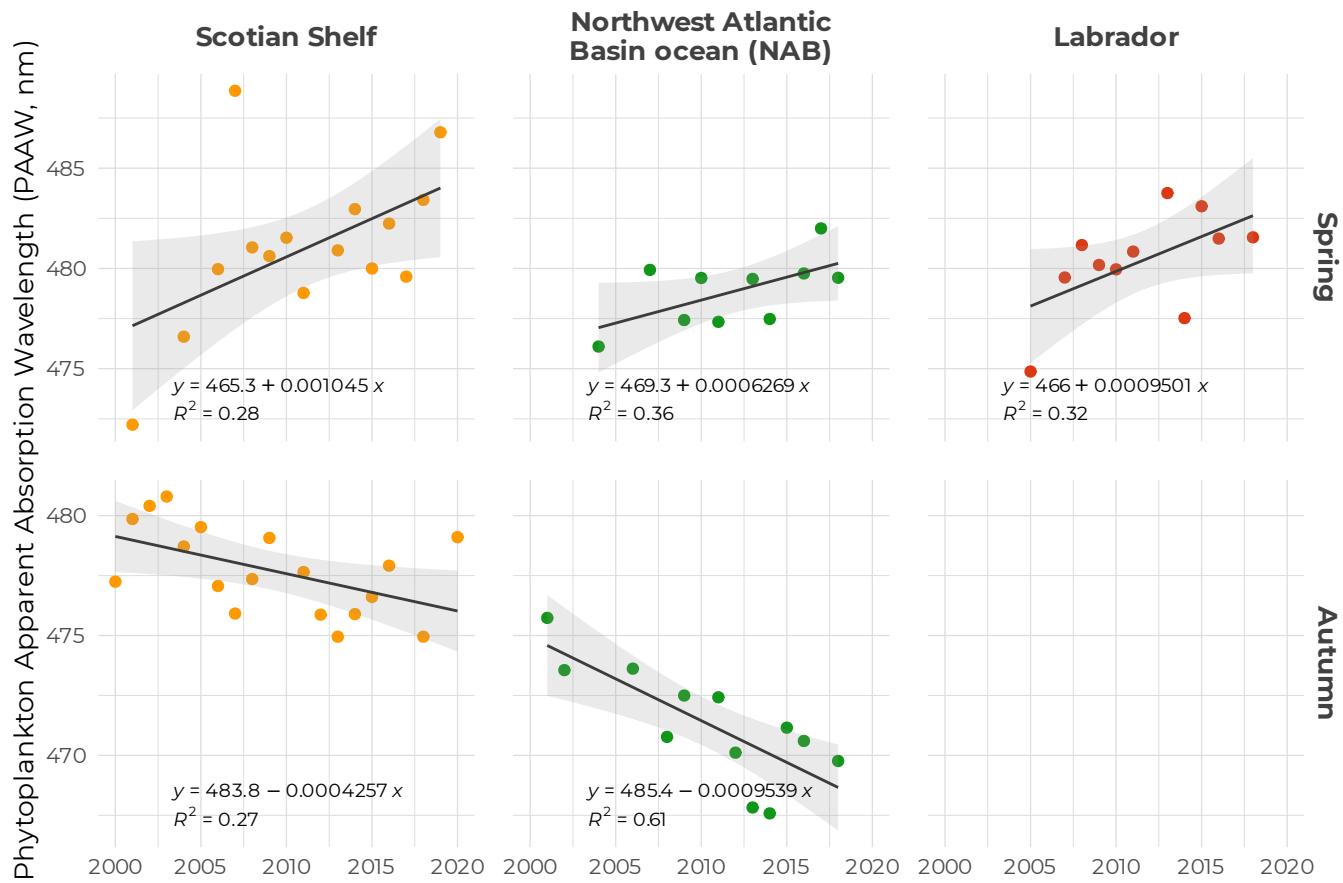


Figure 10. This is a figure with sub figures, (A) is one logo, (B) is a different logo.