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Biogeochemical connectivity between freshwater ecosystems beneath the West Antarctic Ice Sheet and the sub-ice marine coastal environment

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Introduction

This file contains supplementary information regarding the analysis of dissolved organic matter fluorescence data and a table containing information about the parameters sampled at different depths of the sediment porewater profile.

S1. DOM fluorescence

Our 4-component parallel factor analysis (PARAFAC) model (Supplementary Figures 1 & 2) explained 99.7% of the variability in the sediment porewater EEMS dataset and had a core consistency of 58.3%. Our relatively small number of available samples (19, of which 7 water column samples were excluded from the model as outliers) may have limited our ability to validate models with more components, however, the low residuals (99.7% variability explained), along with manual analysis of the corrected EEMS profiles indicated that 4 fluorescent components is reasonable. The four component model also minimized the sum of squares error ($SSE=0.15$) and converged after 62 iterations with random starts and non-negativity constraints. The model was successfully split-half validated using alternating splits of 6 samples per split. We were unable to include water column samples in our model, as their fluorescence characteristics made them outliers relative to the porewaters (determined through visual examination of the spectra and preprocessing with the drEEM toolbox) and the small number of water column samples precluded the construction of a water column only PARAFAC

model. However, manual “peak picking” (i.e. Coble 1996) revealed the presence of a single peak, indicative of protein-like fluorescence (ex/em 240/310; Supplementary Figure 3).

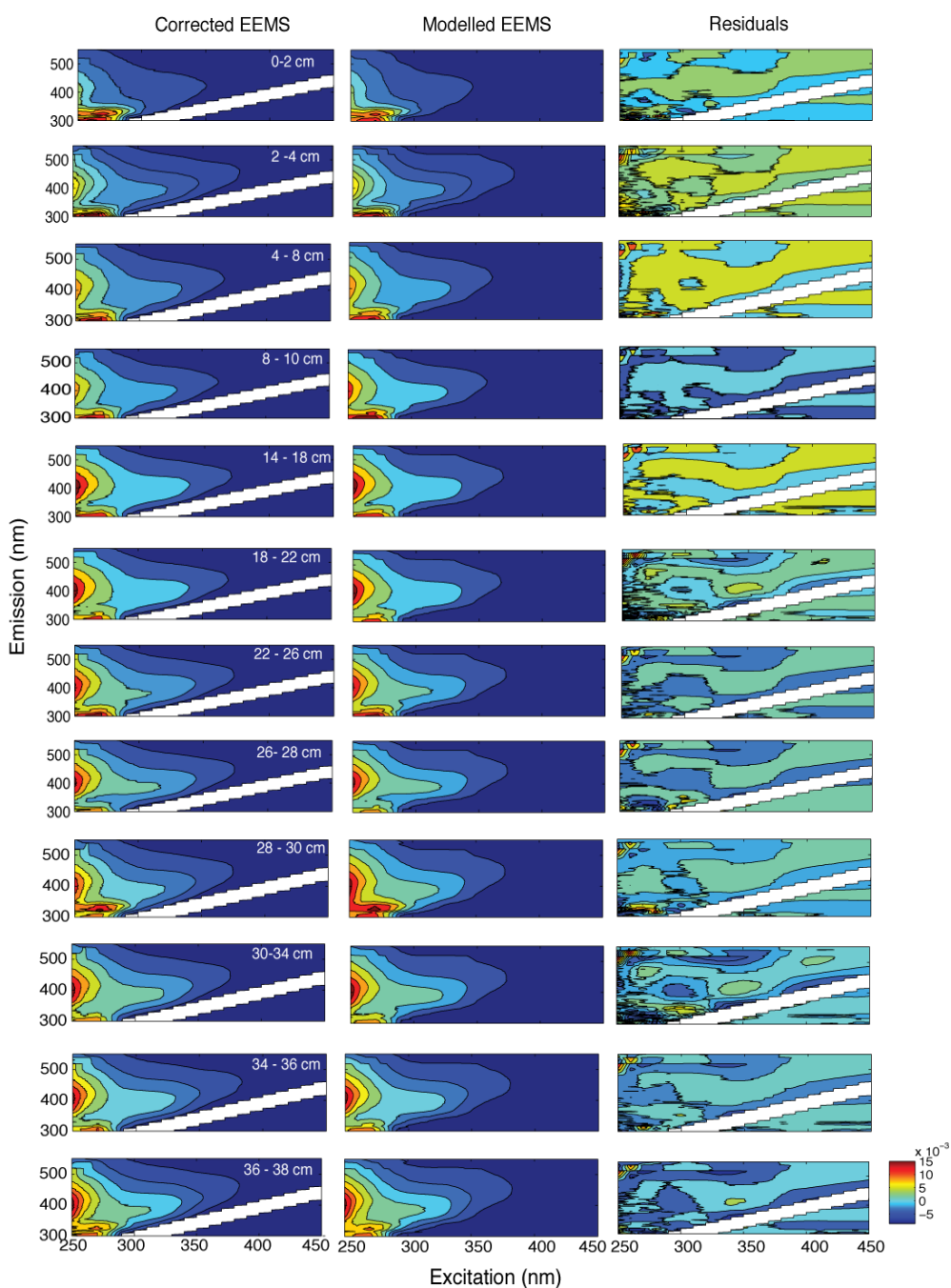


Figure S1. Fluorescence matrices for sediment porewater samples. The EEMS matrix (corrected as described in Methods), the modeled matrix (PARAFAC) and the residuals from the PARAFAC model are shown from left to right. Randomly distributed residuals, in combination with a high proportion of variability explained (99.7%) indicated a good model fit. The color scale in the lower right corner indicates the intensity of relative fluorescence units. The white band results from the removal of Rayleigh scatter. Samples are labeled by 2 to 4 cm increments, beginning at the sediment-water interface.

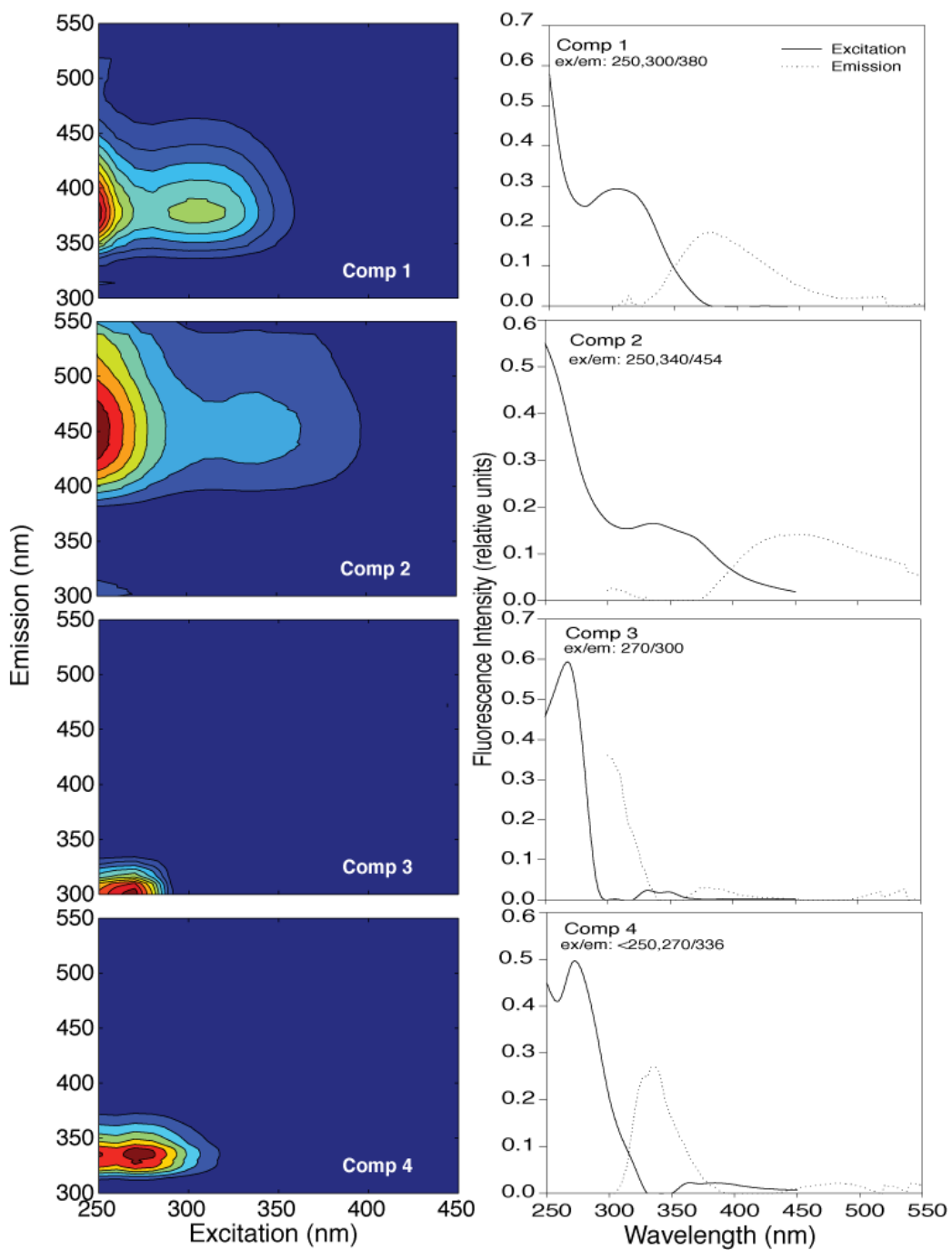


Figure S2. PARAFAC fingerprints and excitation and emission spectra. Comp 1, 2, 3, and 4 are C1, 2, 3, and 4 in the main text. Red indicates higher signal intensity of relative fluorescence units, while blue indicates lower intensity.

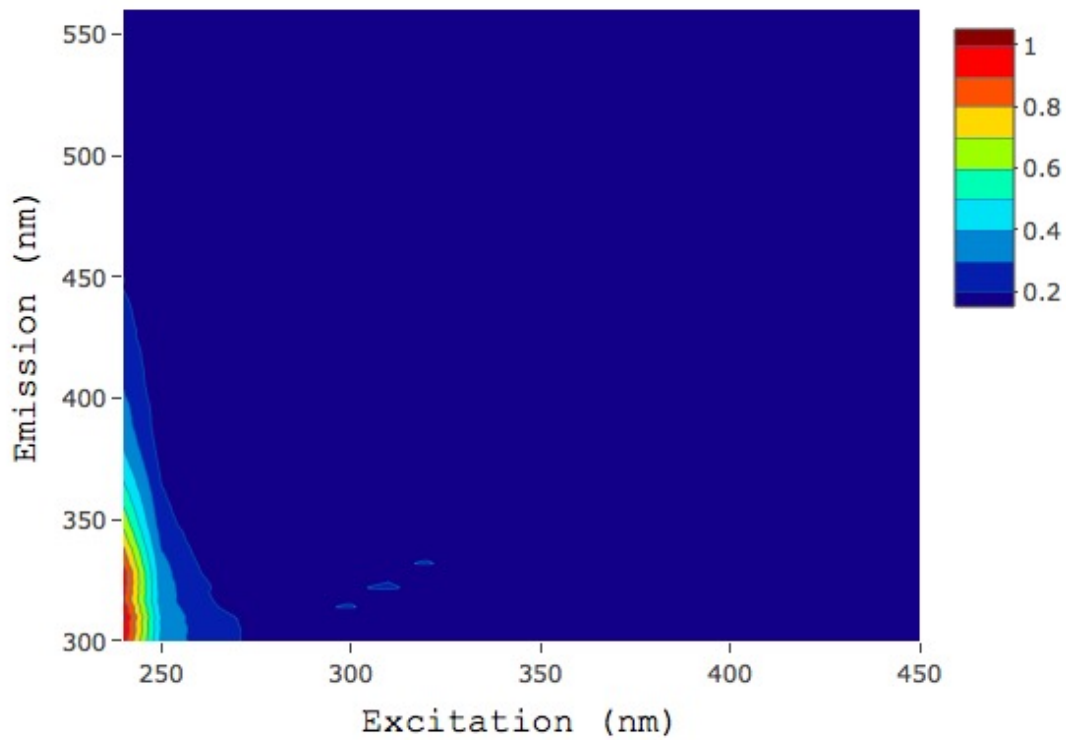


Figure S3. Representative water column EEM showing the maximum ex/em at 240/310. The color bar indicates intensity in relative fluorescence units.

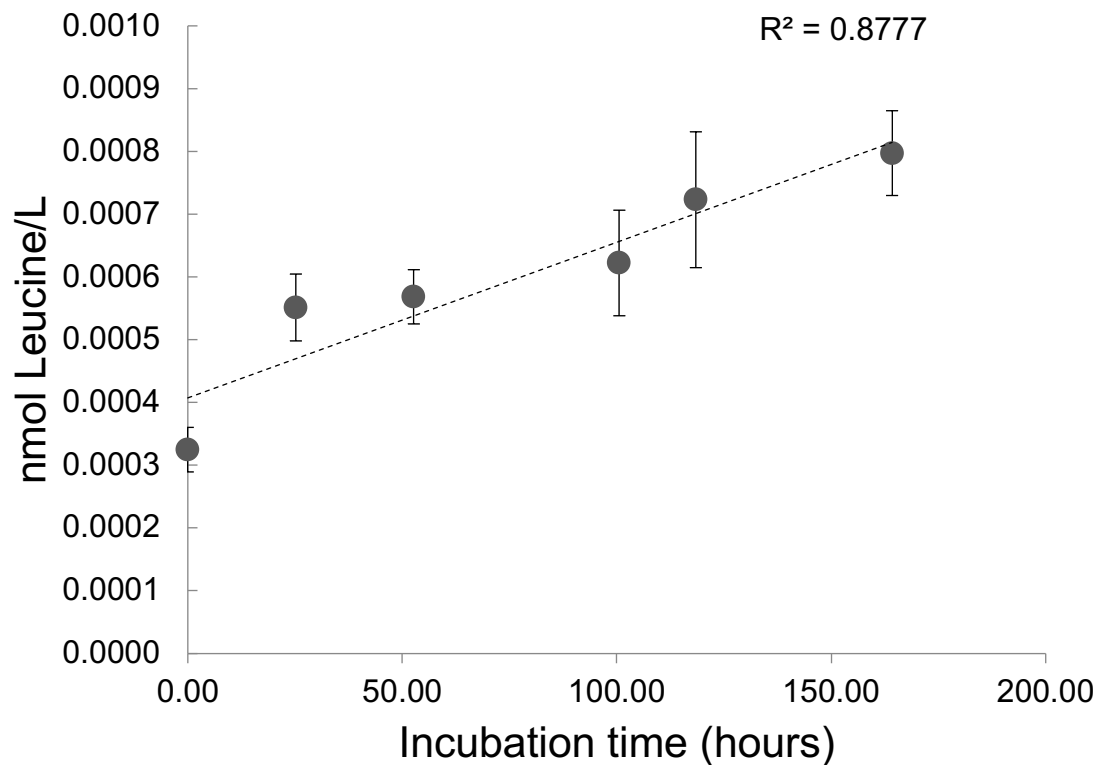


Figure S4. Relationship between the quantity of leucine incorporated and incubation time. Rate of incorporation was linear beyond the course of the experiment (117 h) used to determine rates at the GZ. Error bars show standard deviation of three replicates, except for the time point at 25 h, which is based on two replicates.

Sediment depth horizon (cm)	Analyte				
	DOC/FDOM	DON	NH ₄ ⁺	NO ₃ ⁻	PO ₄ ³⁻
0-2	X	X	X	X	X
2-4	X			X	X
4-6				X	X
6-8	X	X	X	X	X
8-10	X			X	X
10-12				X	X
12-14				X	X
14-16				X	X
16-18	X	X	X	X	X
18-20				X	X
20-22	X	X	X	X	X
22-24		X	X	X	X
24-26	X	X	X	X	X
26-28	X	N.D.	X	X	X
28-30	X			X	X
30-32				X	X
32-34	X			X	X
34-36	X	X	X	X	X
36-38	X			X	X

Table S1. Sediment porewater sampling increments. X's indicate analysis was completed and results are reported in the main manuscript. Grey boxes indicate depths where an analysis was not conducted. "N.D." indicates analyte was not detected. DOC = dissolved organic carbon and FDOM. DON = dissolved organic nitrogen.