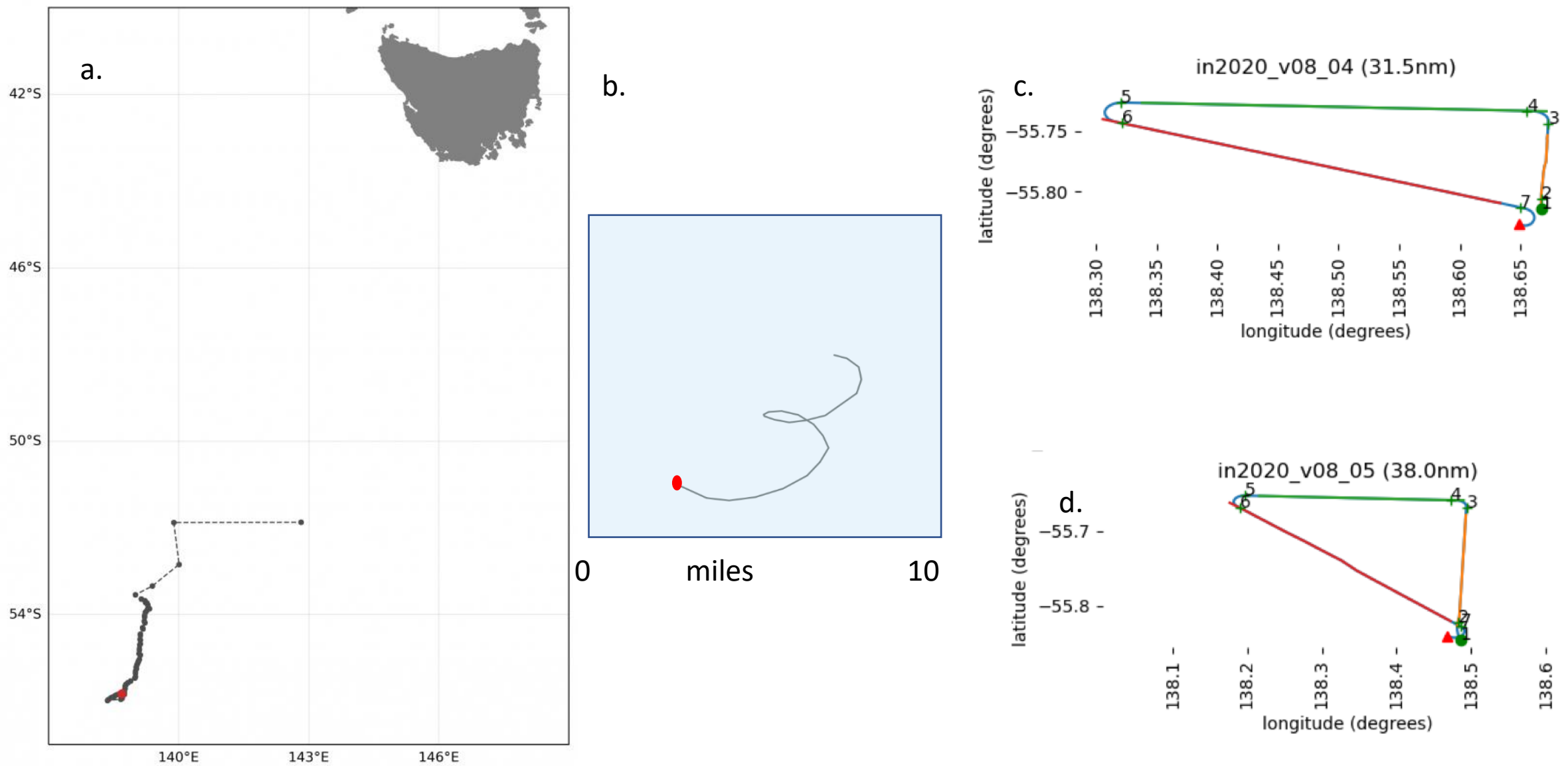
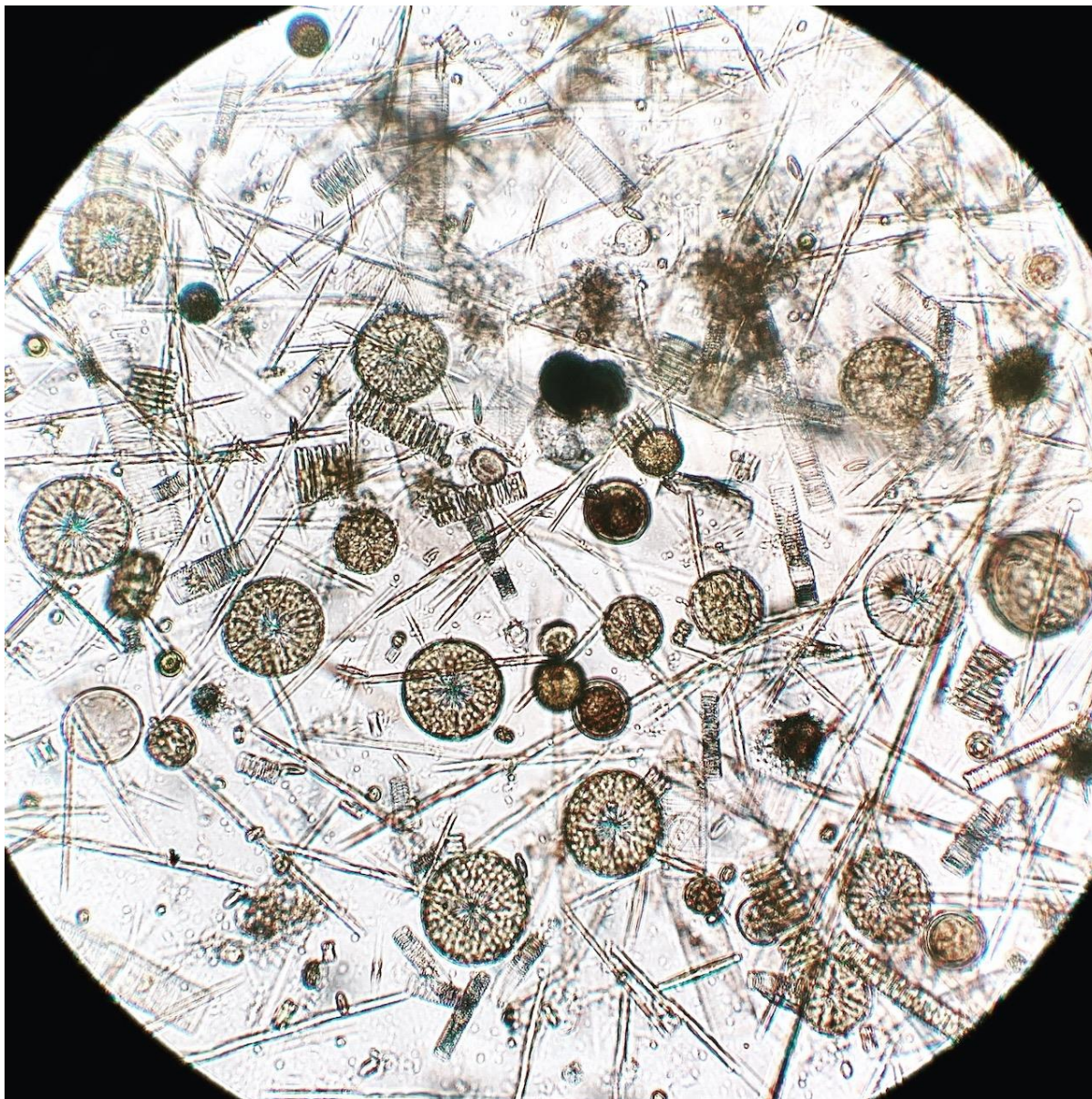


S-Figure 1 Locations of stations occupied during the 2020/21 SOLACE voyage (in2020\_v08) south of Tasmania, Australia. The left hand panel shows the locations of all three sites superimposed on the voyage track, and also showing the locations of the Triaxus undulating towbody tows. The right hand panel features only the polar 1 and 2 sites overlaid on a map of ocean color chlorophyll and SSH anomaly from early January 2021 (courtesy of Benoit Legresy, CSIRO, Australia). The two sites were located in low flow regions with intermediate chlorophyll Concentrations.

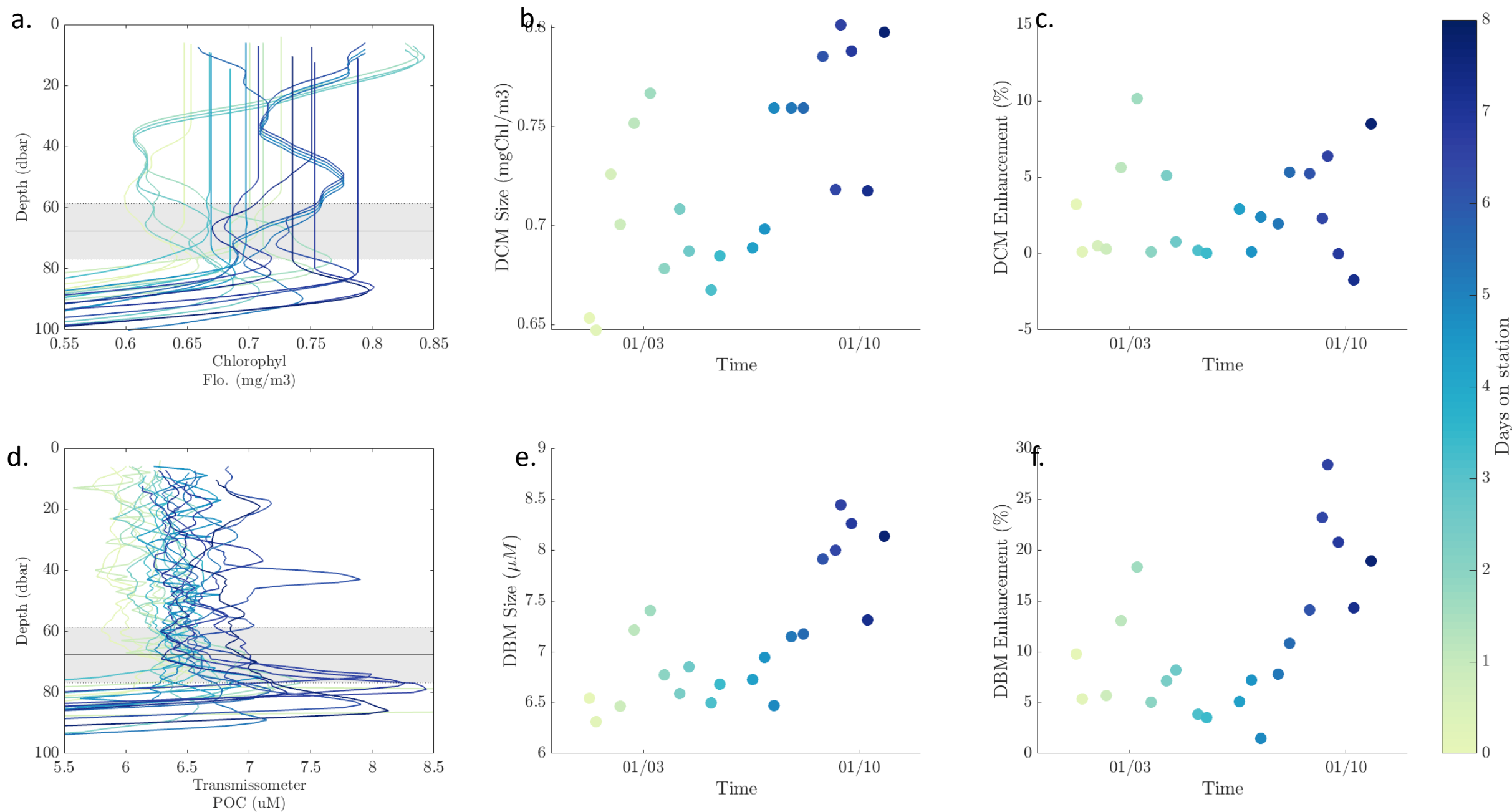


S-Figure 2 Location of a) the BGC-ARGO float relative to the 56S site (red circle) from its launch in Dec 2020 to June 2021 (just N of 54S, W of 140E). B) drift trajectory (miles) of holey-sock drogue at 56S polar site (denoted by red circle). Examples of Triaxus towbody routes at c) 56S and d) 58S.

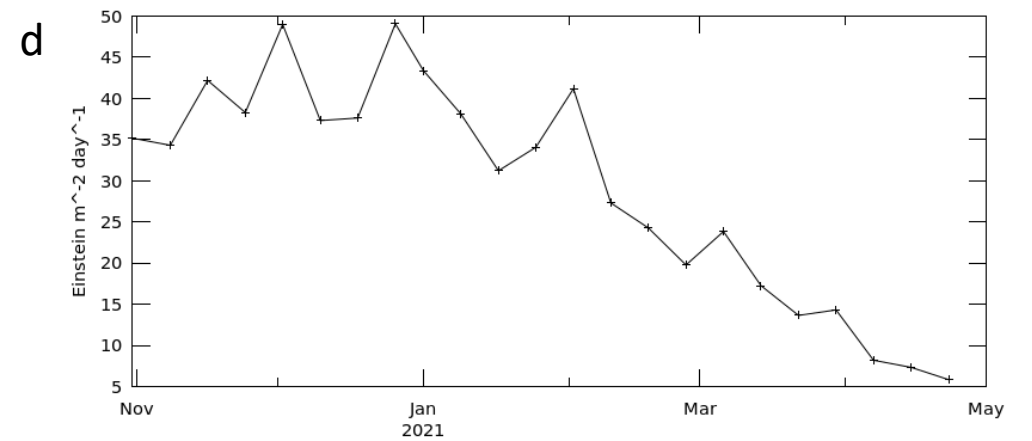
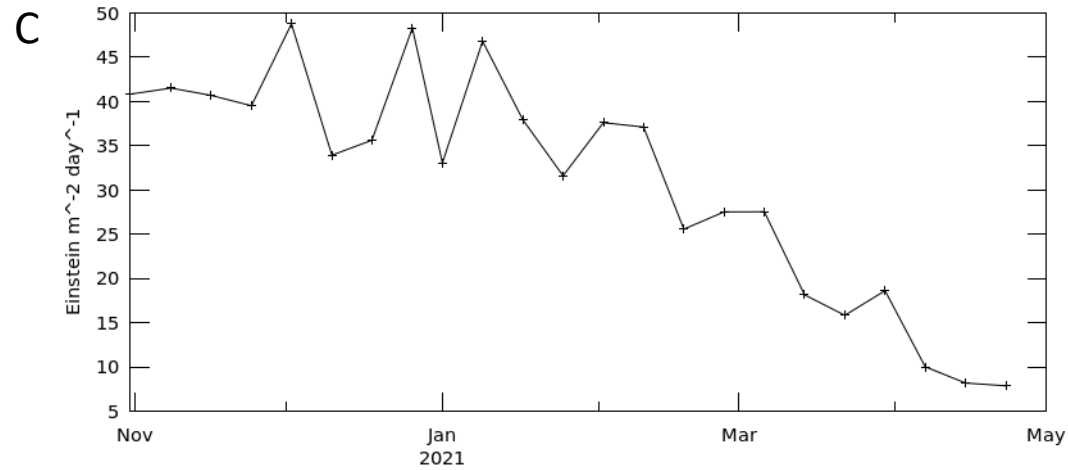
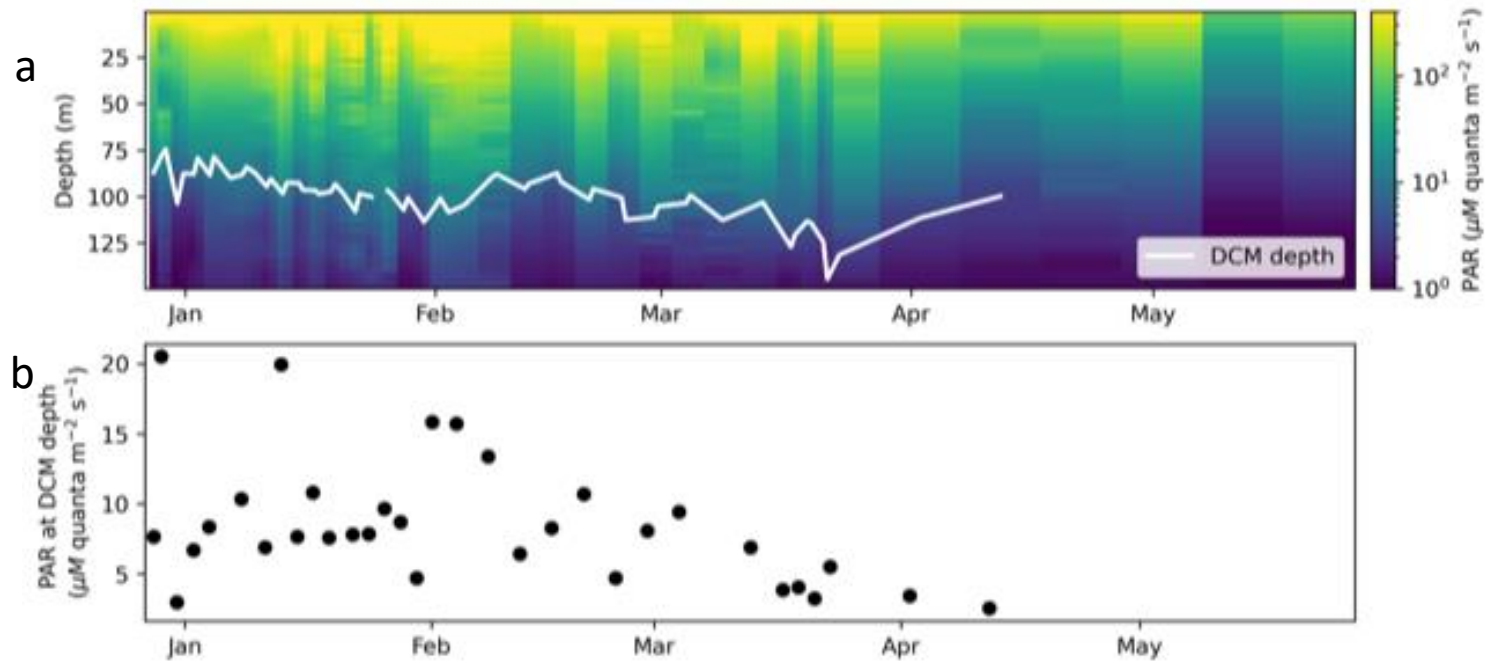




S-Figure 3 Overview of SOLACE DCM large diatom species based on a photomicrograph using a 20-fold concentrate from the DCM at the 56S site. Species include: *Fragilariopsis kerguelensis*, *Fragilariopsis* sp. (cylindrus/curta), *Pseudo-nitzschia* spp., *Proboscia* sp. (alata / inermis / truncate), *Dactyliosolen antarctica*, *Cylindrotheca* spp., *Corethron* spp., *Chaetoceros atlanticus*, *Asteromphalus hookeri*, *Thalassiosira oliverana* / *tumida*.

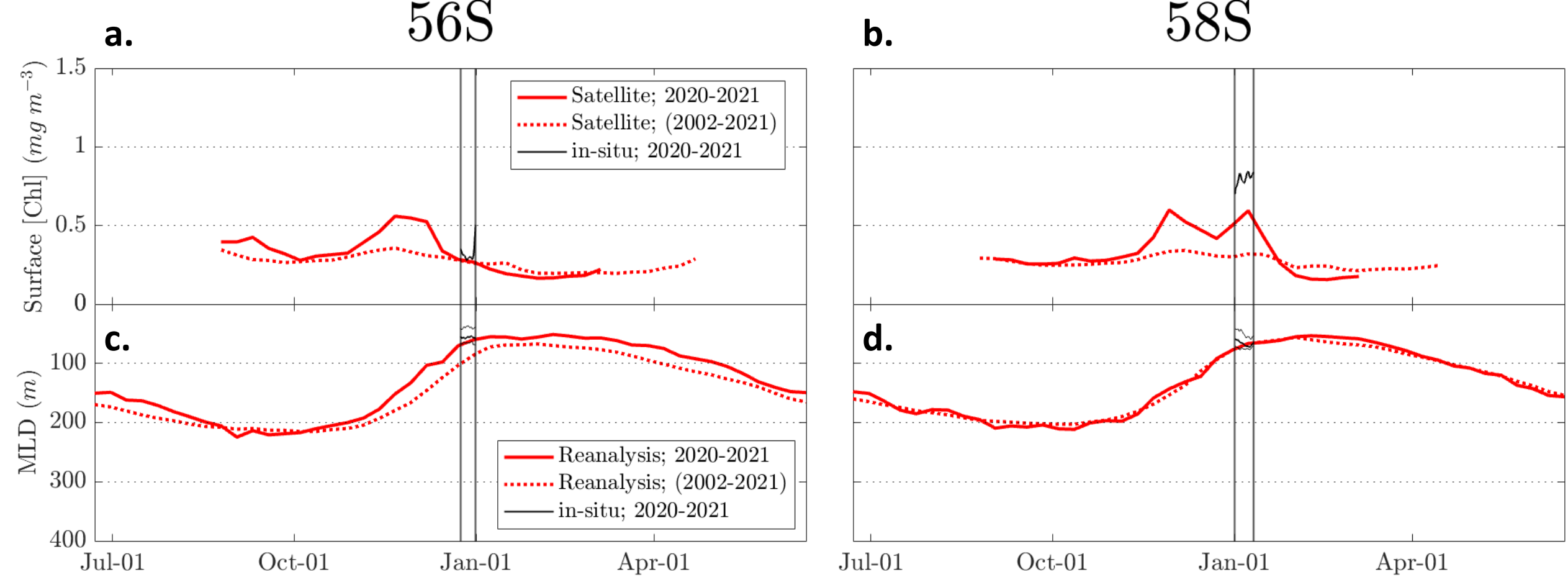


S-Figure 4 The temporal evolution of the DCM and DBM at the 58°S site. a) Chl and d) POC profiles from Fig 3d and 3e are shown, zoomed in on upper 100 m. The associated temporal evolution of the b, e) magnitude and c, f) enhancement relative to the mean MLD concentration for the b, c) DCM and e, f) DBM are plotted. Note, the ‘DBM/DCM’ magnitude and enhancement are shown even if they do not technically qualify as a ‘DBM/DCM’ based on our threshold criteria (See Methods).

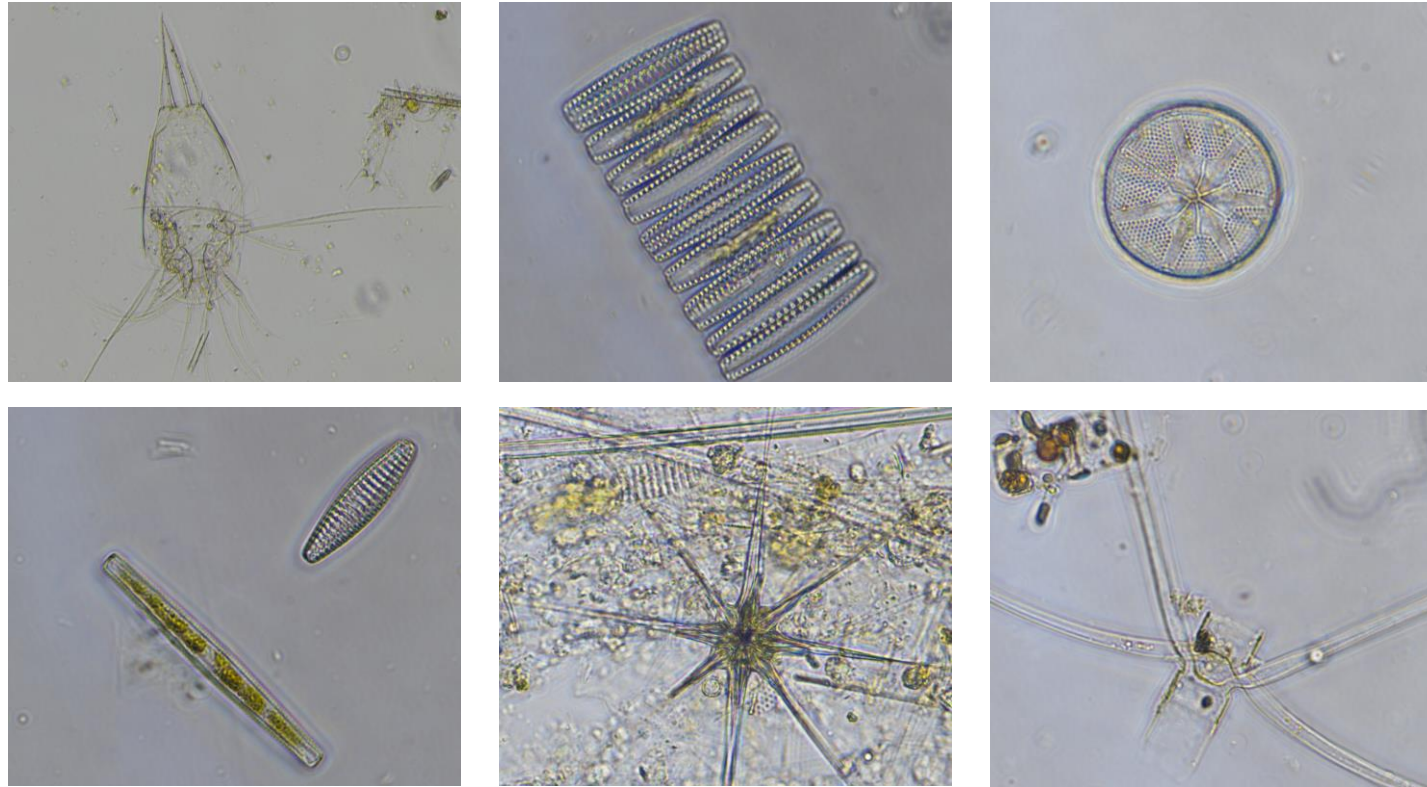


S-Figure 5 (a) Irradiance (PAR) from the BGC-ARGO float over the duration of the observed DCM/DBM. (b) time-series of PAR at the depth of the DCM from the profiling float. Time-series of areally-averaged PAR (4 km resolution, MODIS) over period Late 2020 and early 2021 for (c) 55.5S – 56.5S, 137.5E – 138.5 E, (d), 57.5S-58.5S, 140.5E to 141.8E.





**S-Figure 6** Seasonal cycle of phytoplankton accumulation at both sites. The seasonal development of **a, b**) surface Chlorophyll and **c, d**) the depth of the SML is shown for the **a, c**) 56S and **b, d**) 58S sites. For each, we plot shipboard measurements (black) atop the full seasonal cycle from the **a, b**) remote sensing or **c, d**) reanalysis record (red). For the latter we show the 2020-2021 cycle (solid) and the climatologic cycle (dashed). Remote sensing chlorophyll is from the MODIS-GSM ocean colour record and reanalysis SML depths are from HYCOM, both downloaded from the OSU ocean productivity page. Both are averaged over the same box encompassing 0.5 degrees of latitude and longitude around the mean position of the occupation. Remote sensing chlorophyll is correct by a factor of 1.73 per Johnson et al. (2013).



S-Figure 7 Photomicrographs of intact diatoms within the (dissected) gut of a salp at the 58S site suggests that diatoms are ingested but not consumed by herbivores.

Location	Feature	Depth Range (m)	NPP (mmol C m <sup>-3</sup> d <sup>-1</sup> )	Chlorophyll Fluorescence (mg m <sup>-3</sup> )	Phytoplankton Biomass (mmol m <sup>-3</sup> )	Cell-specific Division Rate (d <sup>-1</sup> )	Phytoplankton Biomass (mmol m <sup>-3</sup> )	Cell-specific Division Rate (d <sup>-1</sup> )
					Without Photoacclimation C:Chl =30 (g:g)		With Photoacclimation C:Chl = 30 g:g below SML C:Chl = 15 g:g below SML	
56 S	SML	14.2 – 57.3	.53	.26	.65	.82	.65	.82
	DBM	71.4 – 86.7	.27	.51	1.28	.21	.64	.44
	DCM	80.4 – 103.3	.23	.48	1.20	.19	.60	.38
58 S	SML	10.6 – 67.7	.98	.59	1.48	.66	1.48	.66
	‘Deep’	67.7 – 82.7	.21	.42	1.05	.20	.53	.40

**S-Table 1.** Phytoplankton specific growth rates in different features. Division rates are calculated by dividing NPP by phytoplankton biomass. Phytoplankton biomass is approximated with a C:Chl of 30 (g:g) in all cases except for below the SML under the ‘With Photoacclimation’ assume, where it is equal to 15 (g:g). NPP and Chlorophyll are averaged across the specified depth range for each feature, with the SML, DBM and DCM defined as in Figures 1-4. At 58S no DCM or DBM was identified so ‘Deep’ value were computed over the 15 m below the SML. NPP was averaged across all c-uptake incubation profiles (Fig. 5) and Chl was averaged across all profiles of extracted Chl (Figs. 2, 4)