Supplementary Material

1 RESOLUTION OF *COMPOSITE* AND *COMBINED* SIZE SPECTRA OF PHYTO- AND PROTOZOOPLANKTON

Composite size spectra of maximum resolution can be constructed when individual size spectra of every taxonomic group are added up, i.e. j represents all taxonomic groups present in the dataset. All taxon-specific KDEs can be assembled to a *composite* size spectrum, for example of all phytoplankton or zooplankton taxa:

$$\mathrm{KDE}^{\mathrm{composite}}_{\mathrm{phy/zoo}}(s) = \sum_{j=1}^{M_{\mathrm{phy/zoo}}} \overline{\mathrm{KDE}}_j(s, h_j) \tag{S1}$$

Here, the bandwidth parameter h_j is taxon-specific. The variability in size is typically smaller within taxa than in combined phytoplankton and microzooplankton subsets, which results in a smaller degree of smoothing (see equation 5), and thus a higher resolution in *composite* spectra, as compared to *combined* spectra.

The *composite* size spectra (Fig. S1, left panels) therefore exhibit details with the highest possible resolution of the communities' size structure. The high level of detail in the *composite* size spectra turned out to be associated with considerable uncertainties, with many narrow peaks, in particular for ESD $>$ 20 µm. The abundance of cells of ESD $<$ 20 µm seemed less variable among taxa. The highest abundance in phytoplankton appeared in the proximity of 5 µm and also around ESD = 7 µm. These were mainly diatoms and prymnesiophytes. Likewise, the highest abundance of heterotrophs fell into the same size range. It is noteworthy that the distinct peaks around ESD = 5 µm and ESD = 7 µm were also apparent in the spectra of heterotrophic cells, but with an additional distinct peak in the proximity of 10–11 µm. Furthermore, heterotrophic dinoflagellates lead to an additional peak at ESD = 200 µm.

Considering the confidence limits, it appeared difficult to unambiguously interpret ecological details of the *composite* size spectra. We found major characteristics of the *composite* size spectra to be well and consistently captured by the *combined* size spectra (Fig. S1, right panels). Similar to the *composite* size spectra, autotrophic and heterotrophic *combined* spectra overlapped between ESD $\approx$ 20 µm and ESD $\approx$ 50 µm. In size ranges ESD $>$ 50 µm, where cell abundance decreased significantly, *combined* and *composite* size spectra differed. The largest phytoplankton in the *composite* spectrum was larger than ESD = 200 µm, while the *combined spectrum* approximated 1 cell L^{-1} s^{-1} at ESD $\approx$ 180 µm. Furthermore, a symmetrical peak was centred around 110 µm in the *combined* spectrum and corresponded an trough in the *composite* spectrum, where in turn a peak followed around ESD $\approx$ 140 µm. Heterotrophic cells covered approximately the same size range in the *composite* and *combined* spectra.

Analogously, the analysis of *composite* seasonally separated size spectra (Fig.S2**A** and **B**) gave no clear advantage over the *combined* spectra (Fig. S2 **C** and **D**). Many details in the *composite* size spectra are subject to considerable uncertainty, which complicates the identification and interpretation of general trends, if compared to patterns derived with the *combined* spectra. For instance, the comparison between summer (left panels of Fig. S2) and autumn spectra (right panels) illustrates that the *combined* size spectra show only a few peaks and troughs, but total cell concentration are still in accordance with the *composite*

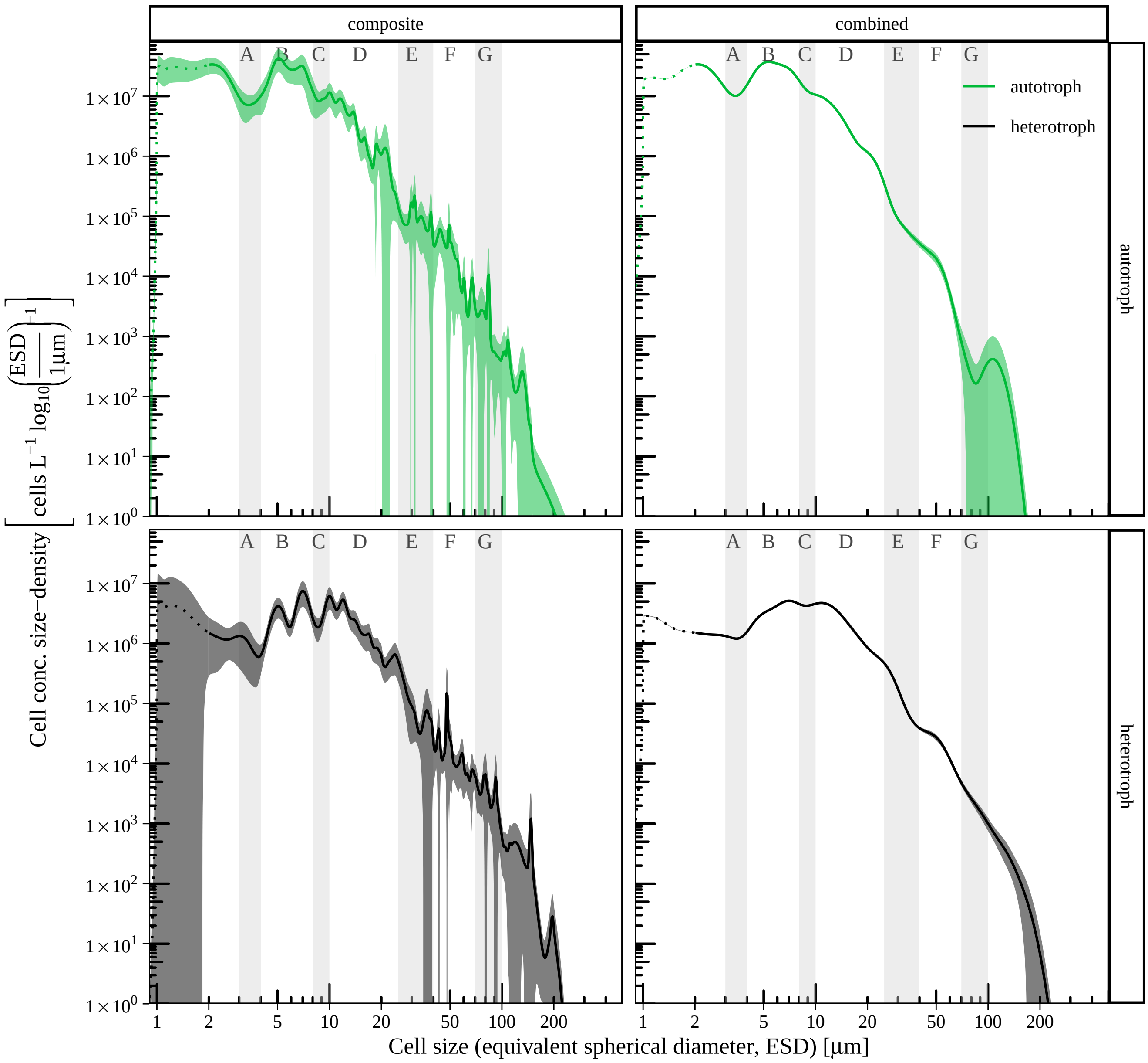

Figure S1. *Composite* (left) and *combined* (right) size spectra for autotrophic (upper) and heterotrophic (lower) microplankton.

spectra. Important and predominant features, e.g. the depression around 4 µm, the step-like drop around 30 µm, and the trough in summer and the peak in autumn of the autotrophic size spectra at 90 µm, remain well expressed in the *combined* size spectra, which also confirms the consistency and robustness of our approach.

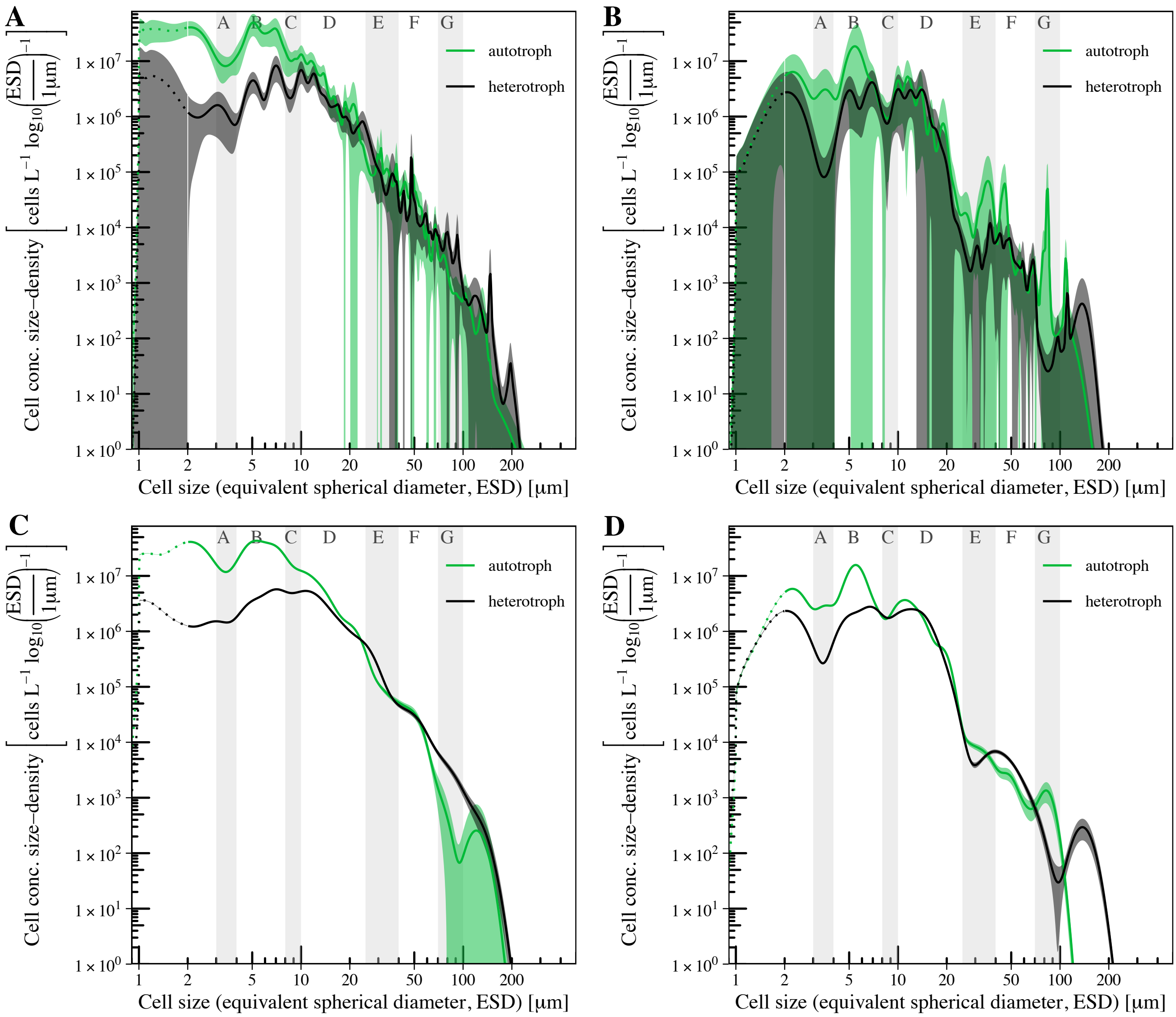

Figure S2. *Composite* size spectra for summer (**A**) and autumn (**B**). Species-specific size spectra were summed to autotrophic and heterotrophic spectra and averaged across samples; *Combined* size spectra for summer (**C**) and autumn (**D**), derived from a combined data-set of all available data. Shaded areas mark the confidence interval ($\overline{\text{KDE}}(s) \pm 1.96 \times \text{SE}(s)$).

2 SUPPLEMENTARY TABLES AND FIGURES

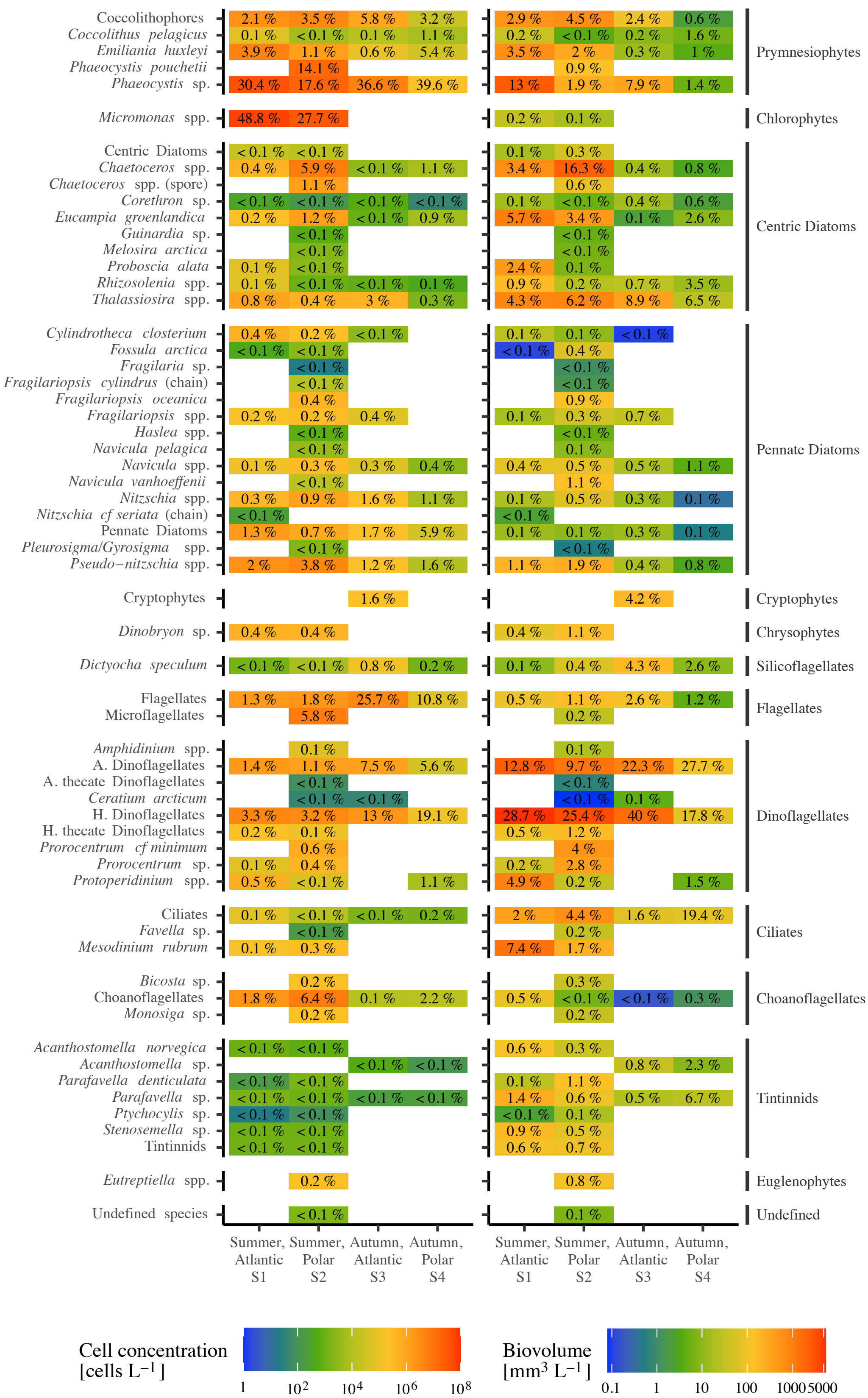

Figure S3. Mean total cell and biovolume concentration for each identifiable group. Individual samples were grouped by season and SST region distinguishing the bloom scenarios S1–S4. Numbers represent the relative shares of the averaged total cell concentration and biovolume concentration as percentages. Respective total abundance and biovolumina are listed in Table 4.

Table S1. Dates and locations of sample collections. SST cluster denotes whether a sample was classified as Atlantic (warm) or Polar (cold). PS99.1–PS114 were summer cruises, MSM77 was an autumn cruise. Event labels refer to the Pangaea database.

Cruise	Event label	HG Station	Depth [m]	Date	Latitude	Longitude	SST cluster
PS99.2	PS99/041-6	S-3	28	2016-06-25	78°36’28.08”N	5°2’48.48”E	warm
PS99.2	PS99/042-11	HG-4	28.4	2016-06-27	79°3’54.72”N	4°10’22.08”E	cold
PS99.2	PS99/048-11	EG-4	23.7	2016-06-30	78°48’57.6”N	2°43’43.68”W	cold
PS99.2	PS99/048-11	EG-4	9.7	2016-06-30	78°48’57.6”N	2°43’43.68”W	cold
PS99.2	PS99/051-2	EG-1	13.4	2016-07-02	78°59’26.88”N	5°24’33.48”W	cold
PS99.2	PS99/053-2	N-5	19	2016-07-03	79°55’16.32”N	3°3’43.2”E	cold
PS99.2	PS99/054-1	N-3	10	2016-07-04	79°35’12.12”N	5°10’12”E	warm
PS99.2	PS99/055-1	N-4	21.8	2016-07-05	79°44’29.4”N	4°30’12.6”E	cold
PS99.2	PS99/065-2	SV-1	18	2016-07-09	79°1’34.68”N	11°5’33”E	warm
PS99.2	PS99/066-2	HG-1	17.2	2016-07-09	79°8’21.12”N	6°5’18.6”E	warm
PS107	PS107_2-13	S-3	35	2017-07-26	78°36’31.291”N	5°3’16.33”E	cold
PS107	PS107_2-13	S-3	10	2017-07-26	78°36’31.291”N	5°3’16.33”E	cold
PS107	PS107_6-8	HG-4	10	2017-07-28	79°3’54.288”N	4°10’5.196”E	cold
PS107	PS107_7-1	HG-5	10	2017-07-28	79°3’11.844”N	3°44’58.812”E	cold
PS107	PS107_8-1	HG-6	10	2017-07-29	79°2’46.432”N	3°36’33.077”E	cold
PS107	PS107_10-4	FS 1	20	2017-07-29	78°58’36.588”N	2°29’39.48”E	cold
PS107	PS107_10-4	FS 1	10	2017-07-29	78°58’36.588”N	2°29’39.48”E	cold
PS107	PS107_12-3	FS 2	30	2017-07-30	78°56’41.316”N	2°42’6.12”E	cold
PS107	PS107_12-3	FS 2	10	2017-07-30	78°56’41.316”N	2°42’6.12”E	cold
PS107	PS107_14-1	FS 3	30	2017-07-30	78°55’37.308”N	2°51’0.972”E	cold
PS107	PS107_14-1	FS 3	10	2017-07-30	78°55’37.308”N	2°51’0.972”E	cold
PS107	PS107_18-3	FS 5	25	2017-07-31	78°59’9.168”N	2°45’20.808”E	cold
PS107	PS107_18-3	FS 5	10	2017-07-31	78°59’9.168”N	2°45’20.808”E	cold
PS107	PS107_19-1	HG-7	10	2017-07-31	79°3’33.66”N	3°28’55.056”E	cold
PS107	PS107_22-6	EG-4	22	2017-08-03	78°49’7.716”N	2°43’0.912”W	cold
PS107	PS107_22-6	EG-4	10	2017-08-03	78°49’7.716”N	2°43’0.912”W	cold
PS107	PS107_29-1	EG-1	35	2017-08-05	78°59’41.568”N	5°28’24.636”W	cold
PS107	PS107_33-6	N-4	25	2017-08-08	79°43’37.884”N	4°30’10.512”E	cold
PS107	PS107_33-6	N-4	10	2017-08-08	79°43’37.884”N	4°30’10.512”E	cold
PS107	PS107_34-5	N-5	40	2017-08-09	80°0’1.188”N	2°56’24.828”E	cold
PS107	PS107_34-5	N-5	20	2017-08-09	80°0’1.188”N	2°56’24.828”E	cold
PS107	PS107_43-1	HG-1	20	2017-08-12	79°9’9.9”N	6°6’54.864”E	warm
PS107	PS107_43-1	HG-1	10	2017-08-12	79°9’9.9”N	6°6’54.864”E	warm
PS107	PS107_48-1	SV-1	35	2017-08-14	79°1’45.3”N	11°6’6.084”E	warm
PS114	PS114_4-1	HG-4	10	2018-07-16	79°1’24.96”N	4°20’0.6”E	warm
PS114	PS114_4-1	HG-4	34.5	2018-07-16	79°1’24.96”N	4°20’0.6”E	warm
PS114	PS114_9-1	S-3	10.1	2018-07-17	78°36’24.12”N	5°2’28.68”E	warm
PS114	PS114_9-1	S-3	29.8	2018-07-17	78°36’24.12”N	5°2’28.68”E	warm
PS114	PS114_31-1	N-5	20.4	2018-07-22	79°56’42.36”N	3°11’55.32”E	cold
PS114	PS114_31-1	N-5	10.5	2018-07-22	79°56’42.36”N	3°11’55.32”E	cold
PS114	PS114_32-2	N-4	42.8	2018-07-22	79°44’22.2”N	4°31’32.52”E	cold
PS114	PS114_32-2	N-4	10.1	2018-07-22	79°44’22.2”N	4°31’32.52”E	cold
PS114	PS114_36-2	0°-N	29.6	2018-07-24	80°51’18.72”N	0°8’24.72”W	cold
PS114	PS114_36-2	0°-N	10	2018-07-24	80°51’18.72”N	0°8’24.72”W	cold
PS114	PS114_40-3	0°- S	11.7	2018-07-25	80°9’33.12”N	0°8’19.32”E	cold
PS114	PS114_43-4	EG-4	24.5	2018-07-26	78°49’3.36”N	2°46’9.12”W	cold
PS114	PS114_43-4	EG-4	4.7	2018-07-26	78°49’3.36”N	2°46’9.12”W	cold
PS114	PS114_46-8	EG-1	15.4	2018-07-27	79°0’44.64”N	5°17’6.36”W	cold
MSM77	MSM77_3-1	S-3	7	2018-09-16	78°36’59.292”N	5°4’4.836”E	warm
MSM77	MSM77_3-1	S-3	24	2018-09-16	78°36’59.292”N	5°4’4.836”E	warm
MSM77	MSM77_4-3	HG-4	7	2018-09-17	79°3’33.08”N	4°12’0.752”E	warm
MSM77	MSM77_4-3	HG-4	27	2018-09-17	79°3’33.08”N	4°12’0.752”E	warm
MSM77	MSM77_6-1	HG-6	13	2018-09-18	79°3’36.09”N	3°34’56.669”E	warm
MSM77	MSM77_13-1	HG-1	14	2018-09-20	79°8’0.139”N	6°5’32.773”E	warm
MSM77	MSM77_13-1	HG-1	22	2018-09-20	79°8’0.139”N	6°5’32.773”E	warm
MSM77	MSM77_24-1	SV-1	17	2018-09-24	79°1’42.312”N	11°5’10.295”E	warm
MSM77	MSM77_52-1	N-5	5	2018-10-03	79°56’17.7”N	3°10’59.941”E	cold
MSM77	MSM77_52-1	N-5	31	2018-10-03	79°56’17.7”N	3°10’59.941”E	cold
MSM77	MSM77_53-3	N-4	32	2018-10-04	79°44’11.062”N	4°29’6.58”E	warm
MSM77	MSM77_54-1	N-3	34	2018-10-04	79°36’13.82”N	5°10’22.264”E	warm