Supplement of Biogeosciences, 13, 4205–4218, 2016
http://www.biogeosciences.net/13/4205/2016/
doi:10.5194/bg-13-4205-2016-supplement

Biogeosciences Open Access EGU

Supplement of

Sedimentary response to sea ice and atmospheric variability over the instrumental period off Adélie Land, East Antarctica

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1 Supplementary Note S1

Several diatom species in polar and sub-polar marine environments exhibit a narrow range of environmental preferences, especially in terms of sea-ice conditions. Diatom assemblages are therefore commonly used in association with geochemical proxies to infer past sea-surface conditions. The distributions of these proxies have been studied and validated at synoptic scale throughout the Southern Ocean (e.g. Gersonde et Zielinksi, 2000; Crosta et al., 2005; Armand et al., 2005) but less is known about the Antarctic Coastal and Continental Shelf Zone (CCSZ). Off the Adélie-Georges V Land, it has been suggested that diatom communities primarily respond to water column stability and sea ice conditions and dynamics which in turn respond to atmospheric and oceanic forcing (e.g. Beans et al., 2008; Riaux Gobin et al., 2005; 2013). In Note S1 we refine the use of all diatoms and geochemical proxies off Adélie Land by statistically comparing their downcore abundances in DTCI2010. The Note S1 helps to discriminate the most relevant proxies, in terms of abundances and ecological preferences, which are described in Sections 4 & 5 of the article. Results are summarized in Table 1.

The PCA presented in Figure S2 includes all diatom species and geochemical proxies in order to observe their relationships and identify diatom clusters as groups of species having similar records in core DTCI2010. Cluster composition is based on significant coefficient correlation between the diatom species combined to their known ecological preferences in the literature. Clusters allow the use of low abundance species (<2%; represented in grey in the PCA; Table S1; Fig. S2) that may bear important ecological signatures but cannot be used alone as environmental indicators. Only significant Pearson correlation coefficients are detailed in the following sections. High level but non-significant Pearson coefficients are mentioned as strong relationships.

1.1 Sea ice related proxies

Antarctic sea-ice related diatom assemblages are largely represented by *Fragilariopsis* species with *F. curta* and *F. cylindrus* being the dominant taxa. Sediment trap studies indicate that relative abundances of the two species in the phytoplankton increase southward with increasing sea-ice cover and decreasing temperature (Gersonde and Zielinski, 2000) with highest occurrences in stratified, ice melt influenced waters (Kang and Fryxell, 1992). This distribution is reflected in surface sediments. Highest abundances of *F. curta* occur in locations that experience 9–11 months/yr of sea-ice cover, with highly consolidated ice conditions (65– 90%) during winter, while *F. cylindrus* optimum is at 8.5 months/yr and 70-90% of winter sea-ice concentration (Armand et al., 2005). In the study area, investigation of the sediment microstructure demonstrates highest abundances of *F. curta* and *F. cylindrus* at the beginning of the annual couplet indicating an early growth phase and subsequent deposition (Maddison et al., 2006; Denis et al. 2006). As such, *F. curta* and *F. cylindrus* along with *F. vanheurckii* were often considered as indicators of heavy sea-ice cover in several paleoclimate studies (Barcena et al., 2002; Barbara et al., 2010), notably in our region (Crosta et al., 2007; Denis et al., 2010). *Fragilariopsis cylindrus* and *F. curta* are among the most abundant species in DTCI2010, while *F. vanheurckii* is not significant in our dataset and is not discussed hereafter (Fig. S2; Table S3). *Fragilariopsis cylindrus* is located in the F1-&F2-quarter (Fig. S2), and displays a significant negative correlation with *F. kerguelensis* (-0.432; Table S3) and diatoms of clusters 4 and 6 (e.g. *T. lentiginosa*, -0.378; Table S3). However, *F. cylindrus* is also negatively and significantly correlated with *F. curta* (-0.306; Table S3). *Fragilariopsis curta* is located on F1+&F2- axes and is not significant (<0.25) neither on F1 nor F2 (Fig. S2), suggesting this species is poorly sensitive to changes in the main environmental parameters at that timescale. Large changes in environmental conditions are probably necessary to induce a sedimentary response of *F. curta*.

Few marine and freshwater diatoms belonging to *Haslea*, *Navicula*, *Pleurosigma* and *Rhizosolenia* genera were recently found to be synthesizing Highly Branched Isoprenoids (HBI) (Sinninghé et al., 2004; Massé et al., 2011). A di-unsaturated isomer [HBI:2] has been identified in Antarctic sea ice and isotopic analyses provide evidence for that this isomer is synthesized by sea ice dwelling diatoms, while a tri unsaturated isomer [HBI:3] is synthesized by phytoplankton diatoms (Collins et al., 2013). In Adélie Land, relatively high concentrations of [HBI:2] have been found to occur during the spring sea ice melt (Massé et al., 2011). Recent studies have proposed the use of [HBI:2] and/or [HBI:2]/[HBI:3] to reconstruct variations of Holocene Antarctic sea-ice duration as a complementary approach to diatom counts (Denis et al., 2010; Collins et al., 2013; Smik et al., 2016). More regionally, Campagne et al. (2015) built on the co-occurrence of [HBI:2] and *F. cylindrus* to infer periods of heavier sea-ice conditions over the last 250 years in Commonwealth Bay. [HBI:2] and [HBI:2]/[HBI:3] are both located in the F1+&F2+ quarter, opposite [HBI:3] (Fig. S2), which agrees with the literature. However, [HBI:2] is significantly correlated with Ti (0.372; Table S3) and *T. antarctica* (0.218; Table S3), and does not show any relationships with the

Banquisia gp or *F. cylindrus*, unlike observations at longer timescales (e.g. Denis et al., 2010; Etourneau et al., 2013; Collins et al., 2013; Campagne et al., 2015). These results may suggest that [HBI:2] respond to different sea ice conditions than sea-ice related diatoms at the seasonal-annual scale, possibly because of different origin of production. However, differential export towards the sediment may also account for the observed differences (Collins et al., 2013).

Thalassiosira antarctica is mainly present in stratified Antarctic inshore waters (Johansen and Fryxell, 1985). In the Weddell Sea, *T. antarctica* blooms are observed in newly formed platelet ice in polynyas and in crack pools formed by disintegrating sea ice during summer (Gleitz et al., 1996). *Thalassiosira antarctica* is closely related to sea-ice formation and/or breakup, as it blooms in open waters during summer-autumn, and produces resting spores (RS) at the end of the growing season when sea ice returns (Cunningham and Leventer, 1998; 1999). Taylor (1999) suggests that the formation of *T. antarctica* spores could be triggered by the low light intensities that occur beneath developing pack and platelet ice. Reduced wind mixing below the sea ice may also induce spore formation (Taylor et al., 2001). *Thalassiosira antarctica* RS, the main form encountered in sediments, is most abundant in regions where sea ice is present for at least 6 months/year, and is believed to be induced under nutrient-stressed conditions or low light intensities (Armand et al., 2005). To note that the lower threshold of 6 months/yr is attributable to the warm variety thriving in the northern Antarctic Peninsula (Taylor and McMinn, 2001), whereas the cold variety occurs mainly in southern Antarctic Peninsula and coastal Antarctic zones where sea-ice duration is above 8 months per year (Denis et al., 2006; Maddison et al., 2012). In DTCI2010, most valves were thus *T. antarctica* RS variety T1. In the Holocene sediment in the region, *T. antarctica* RS were found to co-occur with several large centric diatom species and *F. kerguelensis* (e.g. Denis et al., 2006). *Thalassiosira antarctica* were found to share globally similar sea-surface temperature, sea surface salinity, sea-ice proximity preferences and similar seasonal occurrences with *Porosira glacialis* (Pike et al., 2009). On the PCA, *T. antarctica* (here as RS of the cold form) is located in the F1+&F2+ axes (Fig. S2). The species shows significant positive correlation with large centric diatoms (e.g. *Thalassiosira lentiginosa*: 0.266; *Thalassiosira oliverana*: 0.280; Table S3) and higher correlation with *P. glacialis* (0.356; Table S3), in line with previous studies.

The *Porosira* group is composed of *P. glacialis* and *P. pseudodenticulata*. *Porosira glacialis* is associated to cold coastal waters adjacent to sea ice (Taylor et al., 1997; Zielinski and Gersonde, 1997). It has been observed in waters with high concentrations of slush and wave-exposed shore ice (Krebs et al., 1987). *Porosira pseudodenticulata* is commonly observed in pack ice and fast ice. *Porosira* spp are known to survive environmental stress (nutrient depletion, prolonged periods of darkness) by forming resting spores (RS) at the end of the ice-free season (Taylor and McMinn, 2001; Cremer et al., 2003; Pike et al., 2009). These spores can be incorporated into waxing sea ice. As such, *Porosira* spp can be directly seeded from the sea ice during spring of the following year (Gleitz et al., 1996). *Porosira glacialis* is abundant in regions that experience at least 7.5 months per year of sea-ice cover (slightly longer than *T. antarctica*), with 30% of summer sea-ice concentration and highly compacted winter sea ice (65–85% concentration) (Armand et al., 2005). As for *T. antarctica*, *P. glacialis* RS sublaminae have been interpreted in Holocene laminated sediments in Adélie Land, indicating a late summer/autumn rapid deposition that is linked to early sea-ice return (Maddison et al., 2006). *Porosira glacialis* and *P. pseudodenticulata* are respectively situated on the F1+&F2+ and F1+&F2- axes (Fig. S2). Pearson coefficient correlation between these two species is significant (0,252; Table S3), arguing that both species can be grouped together in our study and confirming previous observations.

The *Banquisia* gp is composed by sea-ice dwelling diatoms such as *Navicula directa*, *N. glaciei*, *Synedropsis* spp and *Ephemera* spp (Annett et al., 2010; Torstensson et al., 2012). These species are all localized in the F2- area (Fig. S2). *Navicula directa* is positively correlated to *Ephemera* spp (0,181; Table S3), and *N. glaciei* is positively correlated to *Synedropsis recta* (0,265). Only *Entomoneis* spp and *S. fragilis*, known to be sea ice related, are located at the opposite in the F2+ axis and are not correlated to other species. We nonetheless chose to include them in the *Banquisia* gp as their low abundances may bias the PCA results. Combined relative abundances of the species included in the *Banquisia* gp are less than 2% of the total diatom assemblages (species noted in grey in Fig. S2), they were not compared with meteorological parameters.

Fragilariopsis obliquecostata has been associated with surface melt pools and with the water column under sea ice (Garrison, 1991; Armand et al., 2005). *Fragilariopsis obliquecostata* is often associated to other cold water *Fragilariopsis* species such as *F. ritscheri* and *F. sublinearis* in the literature, and they were found to present similar Holocene records as *F.*

curta in the region (Crosta et al., 2008). On the PCA, *F. obliquecostata* is localized in the F1+/F2- quarter (Fig. S2) and displays its highest significant correlation with *F. rhombica* (0.454; Table S3) and *Eucampia antarctica* (0.378) for example. *Fragilariopsis obliquecostata* is however not significantly related to *F. ritscheri* and *F. sublinearis* in our study area, conversely to what is presented in the literature.

The *Fragilariopsis* summer group combines *F. ritscheri* and *F. sublinearis*. Highest abundance of *F. ritscheri* is observed with SST ranging 0-3°C and can support a wide range of an annual sea-ice duration from 2 to 10.5 months, with a peak around 9 month/yr (Armand et al., 2005). Although *F. ritscheri* has been observed in surface melt pools, land-fast and pack-ice samples (Tanimura et al., 1990), it has been found in higher abundances in the adjacent water column than in sea ice samples (Gersonde, 1984), suggesting that this species potentially prefers melt water conditions (Armand et al., 2005). From its surface sediment occurrence, *F. sublinearis* have been related close to and at the summer sea-ice edge in areas characterized by year-round sea ice influence and summer surface water temperatures <-1°C (Zielinski and Gersonde, 1997). Both species have found to co-occur with other *Fragilariopsis* spp in the sea ice assemblage in Antarctic Peninsula and in Adélie Land (Crosta et al., 2008; Pike et al., 2008). *Fragilariopsis ritscheri* and *F. sublinearis* are both significantly located in the F1+/F2+ and in the F1+/F2- axes respectively (Fig. S2). Pearson correlation coefficient reveals that both species are highly positively correlated (0,501; Table S3) in agreement with previous studies. *Fragilariopsis sublinearis* is significantly correlated to *F. curta* (0.234), along with summer and autumn associated species (e.g. *T. antarctica*: 0.234; *E. antarctica*: 0.223). However, unlike in paleoclimate studies (Crosta et al., 2008), *F. sublinearis* and *F. ritscheri* display negative and significant correlation with *F. cylindrus* (-0.359 and 0.346, respectively) and show no relationship with *F. obliquecostata*.

Distribution pattern of *E. antarctica* in surface sediments, along with Holocene sediment, indicates that the species is ubiquist and that its spatial distribution shows no clear relationship with the distribution of sea ice (Crosta et al., 1998; Zielinski and Gersonde, 1997; Crosta et al., 2008) probably because previous studies lumped together the two varieties *E. antarctica* var *antarctica* (“warm” variety) and *E. antarctica* var *recta* (“cold” variety). In core DTCI2010, only specimens of *E. antarctica* var *recta* were encountered. *Eucampia antarctica* is located on the F1+/F2- (Fig. S2), and presents significant positive correlation with several large centric diatoms (e.g. *Porosira glacialis*: 0.234; *Thalassiosira lentiginosa*:

0.260; Table S3) and with *F. rhombica* (0.373; Table S3). These results agree with the literature as the seasonal progression of diatom assemblages in surface waters over the Antarctic Peninsula suggests a concomitant occurrence of *E. antarctica* and large centric diatoms (e.g. genera *Porosira*, *Stellarima* and *Thalassiosira*), which increases through the ice-free season (Annett et al., 2010).

1.2 Open ocean proxies

Fragilariopsis kerguelensis dominates phytoplankton assemblages of the open ocean zone south of the Polar Front where sea ice is absent during summer (Halse et al., 1969; Froneman et al., 1995) and thus characterizes open water conditions during summer. *Fragilariopsis kerguelensis* is observed in recent sediments of areas experiencing up to 8 months/yr of sea-ice cover (Crosta et al., 2005). In several paleoclimate studies (e.g. Crosta et al., 2008), notably from the area, *F. kerguelensis*, present an inverse relationship to sea-ice and cold-water species. Summer-autumn laminae were found to present high occurrences of *F. kerguelensis*, along with *T. antarctica* and large centric species (Denis et al., 2006; Maddison et al., 2006). On the PCA, *F. kerguelensis* is located on the F1+&F2- (Fig. S2), and displays a significant positive correlation with several large centric diatoms (e.g. *T. lentiginosa*, 0.507; *T. antarctica*: 0.184; *P. glacialis*: 0.235; Table S3), and a strong negative correlation with *F. cylindrus* (-0.432; Table S3) and *Chaetoceros* RS (-0.248; Table S3), in agreement with previous studies.

The Open Water group is composed of large centric diatoms. In general, species belonging to the genus *Thalassiosira* are most commonly found in areas experiencing open water conditions during the growing season (Johanssen and Fryxell, 1985). *Thalassiosira lentiginosa* and *T. oliverana* commonly occur in the Southern Ocean, south of the Polar Front, in areas characterized by permanent open ocean conditions (Johanssen and Fryxell, 1985; Rigual-Hernández et al., 2015). Relative abundances in sediment of *T. lentiginosa* show an inverse relationship with sea-ice cover with high occurrences in areas experiencing between 0 and 4 month/yr of sea-ice presence and a decline towards prolonged sea-ice duration (Crosta et al., 2005). *Thalassiosira oliverana* is clearly dominant in locations where open ocean conditions occur close to the sea-ice edge during summer (Crosta et al., 2005). For *Thalassiosira gracilis*, the distinction between the two varieties (*T. gracilis* var. *gracilis* and

T. gracilis var. *expecta)* has not been performed in this study as this species presents low abundances in Antarctic coastal areas (Armand et al., 2005). In summer, the species appears most highly associated with conditions related to open-ocean conditions and its population diminishes in regions of unconsolidated sea ice (<40% concentration, SST below 2°C) (Crosta et al., 2005). *Actinocyclus actinochilus* has been observed with abundances over 2% (which is not the case in our study area) in regions where sea-ice cover persists more than 7 month/yr (Armand et al., 2005). *Actinocyclus actinochilus* can be considered as a cold-water Antarctic species, and increasing sedimentary abundances of this species are in line with an ice-free region during summer (<40% concentration) and a strongly compact sea ice covered region in winter (70–90% concentration) (Armand et al., 2005). *Coscinodiscus* is generally considered as an open water genus (Garrison and Buck, 1989; Moisan and Fryxell, 1993). High abundances of *Coscinodiscus* spp over the shelf were related to a southward influx of warm surface water (Taylor and Sjunneskog, 2002). *Stellarima microtrias* is reported as restricted to the Antarctic Zone south of the Polar Front (Zielinski and Gersonde, 1997). The species has been observed attached to sea ice in waters influenced by the ice (Hasle, 1988). *Stellarima microtrias* is rarely used in paleoenvironmental studies as its ecology is poorly documented, its ecological affinity is uncertain and its abundances are generally low (Taylor et al., 2001). *Thalassiosira tumida* has maximum occurrences south of the Polar Frontal Zone, and is most abundant during the austral summer (Cunningham and Leventer, 1998; Armand et al., 2005). Armand et al. (2005) indicate that maximum abundances of *T. tumida* occur in regions with low sea-ice cover during summer (open water conditions). Finally, Armand et al. (1997) have suggested that *Thalassiosira trifulta* thrives in the coldest waters amongst the *Thalassiosira spp*. However, its overall low abundance precluded any use downcore alone.

Thalassiosira lentiginosa, *T. oliverana, A. actinochilus* and *S. microtrias* are localized on F1+&F2+, and *T. trifulta*, *T. gracilis*, *Coscinodiscus* spp, *T. gracilis* and *T. tumida* are localized on F1+&F2- (Fig. S2). *Thalassiosira lentiginosa* exhibits significant positive correlation with *Coscinodiscus spp* (0,190; Table S3), *T. oliverana* (0.251; Table S3), *S. microtrias* (0.186; Table S3), *A. actinochilus* (0.330; Table S3) and *T. gracilis* (0.266; Table S3). *Thalassiosira oliverana* also displays significant positive correlation with *A. actinochilus* (0.166; Table S3), *T. trifulta* is significantly correlated with *Coscinodiscus* spp (0.174; Table S3) and *T. gracilis* is correlated with *A. actinochilus* (0.218; Table S3). *Coscinodiscus* spp exhibits a significant coefficient correlation with *A. actinochilus* (0.244; Table S3) and *S. microtrias* (0.211; Table S3). Strangely, *T. tumida* does not display a significant correlation with the species mentioned above despite being close to them in the PCA (Fig. S2). This species was therefore not included in the Open water group despite its distribution on the PCA and its documented ecological preferences. Our results show a significant positive correlation between *T. gracilis* (0.485; Table S3) and *T. lentiginosa* (0.507; Table S3) with *F. kerguelensis*, confirming grouping in previous studies (e.g. Crosta et al., 2008). As with other clusters cited above (e.g. cluster 4 & 5), it seems that the Open Water gp is also closely linked to the F1+ area in our analyses. We thereby decided to not include *Asteromphalus hookeri* in the group despite the few correlations (Table S3), as it seems to rather depend on F2 (Fig. S2). Additionally, *T. ritscheri*, *Actinocyclus curvatulus* and *Asteromphalus hyalinus* are insignificant in the F1+ area (Fig. S2) and, since they do not present any significant positive correlation with the other species (Table S3), we decided to remove them from the Open Water gp. *Thalassiosira gravida* also does not appear in this cluster as it is uncorrelated and positioned on the F1- area (Fig. S2). The Open Water group in our data is therefore composed by the following species: *T. lentiginosa*, *T. oliverana*, *T. trifulta*, *T. gracilis*, *Coscinodiscus* spp, *A. actinochilus* and *S. microtrias*. *Eucampia antarctica*, which is significantly correlated to species of the Open Water gp, was separated given its high abundance.

[HBI:3] is positioned in the F1-&F2- axes, opposite to [HBI:2] and [HBI:2]/[HBI:3] (Fig. S2). This suggests that the [HBI:2] and [HBI:3] are produced in contrasting environments, in agreement with previous studies that proposed the use of [HBI:2] and [HBI:3] to reconstruct variations of past sea-ice cover as complementary sea-ice proxy to diatom counts (Denis et al., 2010; Collins et al., 2013; Smik et al., 2016). Strangely, the Pearson correlation between [HBI:3] and [HBI:2] does not show any relationships in our PCA, (Table S3). This could be caused by the variability of the sea-ice seasonality in our study area whereby Collins et al. (2013) suggested that [HBI:3] and [HBI:2] correlate most positively and, consequently, co-occurred during a period of low seasonal sea ice change, and are less positively correlated during a period characterized by high seasonal change. Therefore, it seems that both biomarkers have to be considered carefully when they are taken separately. PCA show [HBI:3] is significantly correlated with *Rhizosolenia* spp and *Proboscia inermis* (0.491 and 0.635 respectively; Table S3), in agreement with Sinninghé et al. (2004) that found the [HBI:3] to be synthesized by the Rhizosolenoids. While the analysis of the hydrocarbon content of several temperate species belonging to the genus *Proboscia* did not reveal the presence of HBIs, the polar species *P. inermis* may be able to synthesize these compounds.

Titanium (Ti) is considered as an indicator of terrigenous inputs (Denis et al., 2006; Presti et al., 2011). In Antarctic coastal areas, delivery of terrigenous particles is possible via several processes such as meltwater discharge, ice rafting, runoff from outlet glaciers, and although, considered negligible in coastal East Antarctic regions, eolian transport (Presti et al., 2003; Escutia et al., 2003; Denis et al., 2006). In the literature, Ti content is used to infer past changes in terrigenous supply to the ocean and associated to open conditions (Denis et al., 2006; Campagne et al., 2015). Therefore, Ti is an indicator of enhanced melting period over the ice-free season. In our data, Ti is located in the F1+&F2+ area (Fig. S2), and displays high significant positive correlation with some open water taxa, e.g. *F. kerguelensis* (0.248; Table S3), *P. glacialis* (0.228; Table S3) and *T. antarctica* (0.238; Table S3), in line with previous studies. In the same way, Ti presents significant negative correlations with *F. cylindrus* (-0.283; Table S3). Unexpectedly, Ti also shows significant negative correlations with [HBI:3] (-0.218; Table S3) and positive correlations with the [HBI:2] (0.372; Table S3).

The *Rhizosolenia* gp is composed of *Rhizosolenia* spp and *Proboscia* spp (Fig. S2). Both genera belong to the same family (*Rhizosoleniaceae*). *Rhizosolenia* spp and *Proboscia* spp are generally associated to late summer season production, long diatom productivity season, linked with open ocean conditions (Armand et al. 2005; Crosta et al. 2005; Maddison et al. 2006; Willmott et al., 2010). Undetermined *Rhizosolenia* spp were observed around the Astrolabe Glacier, closely linked to mixed waters with higher surface densities and nutrient levels (Beans et al., 2008). *Rhizosolenia* spp thrive better in mixed waters than the smaller pennate diatoms due to drag-inducing adaptations that reduce their sinking rate compared to needle-like morphology. They can also regulate buoyancy to move between shallow high-light and deeper high-nutrient areas of the water column (Kemp et al., 2000; Annett et al., 2010). Stickley et al. (2005) connected the occurrence of *Proboscia* spp in Iceberg Alley, East Antarctica, with an open ocean provenance and, thus, an increasing influence of offshore waters in this area. Similarly, Maddison et al. (2006) suggested that the presence of *P. inermis* in sediments in our study area constitutes a signal for warmer oligotrophic waters onto the shelf. As such, it is possible that the *Rhizosolenia* gp can survive in stable, nutrient-poor surface waters associated to a strong seasonal thermocline and nutricline. The mass sinking of those diatoms (the ‘‘fall dump’’) is triggered by the breakdown of the water column stratification, therefore implying that the *Rhizosolenia* gp may also track rapid deposition events (Kemp et al. 2000). *Proboscia inermis* and *Rhizosolenia* spp (here strongly dominated by *R. antennata* var *semispina*) are significantly located on the F1-/F2- area, while *P. truncata* is situated in the F1+/F2- area (Fig. S2). Pearson coefficient correlation confirms their positive relationship by indicating significant positive correlation between *P. truncata* and *P. inermis* (0,250; Table S3) and between *Rhizosolenia* spp and *P. inermis* (0,639). Although *P. alata* is in the F1+/F2- axes (Fig. S2), Pearson coefficient correlation points a significant positive correlation between *P. truncata* and *P. alata* (0,261). From this and from the known similar ecologial preferences (see above), we decide to include all these species in the *Rhizosolenia* gp.

The *Thalassiothrix* gp is composed by *Thalassiothrix antarctica* and *Trichotoxon reinboldii*. Both species are found in low abundance in Holocene Antarctic shelf sediments (Crosta et al., 2008). Similarly to the *Rhizosolenia* gp, species from the *Thalassiothrix* gp are likely linked to a long diatom productivity season, and are an indicator for rapid deposition and good preservation in sediment, as its needle-like frustules generally do not preserve well (Leventer et al., 1996). However, due to their ubiquitous distributions in sediment, these species are not considered as good environmental indicators (Zielinski and Gersonde, 1997). *Thalassiothrix antarctica* and *T. reinboldii* are respectively located in the F1+/F2- and in the F1+/F2+ axes (Fig. S2). The Pearson correlation between both species indicates significant positive value (0,303), arguing for their combination, as suggested in the literature.

In surface sediment samples, highest abundances were of *F. rhombica* are related to ice free conditions in February and generally highly consolidated sea ice conditions in September (between 65 and 90% concentration), in regions where sea ice cover persisted for 7-9 month/yr (Armand et al., 2005). In Holocene sediment, Denis et al. (2006) suggests that *F. rhombica* replaced the *F. curta* during the warmer mid-Holocene relative to the colder Late Holocene, and many chains of *F. rhombica* were found in situ in the spring laminae during the Hypsithermal against few single cells during the Neoglacial. It is therefore believed that *F. rhombica* would replace *F. cylindrus* and *F. curta* in the spring assemblage when sea ice is less present during the spring/summer season (Armand et al., 2005). On the PCA, *F. rhombica* is situated in F1+/F2- (Fig. S2). PCA indicate *F. rhombica* does not displays any relationship with *F. curta*, but the species is significantly and negatively correlated with *F. cylindrus* (-0,239; Table S3).

1.3 Surface water stratification and wind conditions related proxies

Vegetative cells of *Chaetoceros Hyalochaete* are often observed in high abundances within the surrounding pack ice waters (Gleitz et al., 1998) and are abundant in Adélie Land surface waters (Beans et al., 2008). High nutrient content in surface waters, surface water stratification by sea-ice meltwater and stabilization by low wind intensity appear to be the most important factors for the development of *C. Hyalochaete* blooms (Leventer, 1991). It has been suggested that resting spore formation occurs when the bloom begins to decline as a response to decreasing nutrient levels, low light levels during vertical mixing of the water column or as a result of reduced seasonal insolation during the autumn (Hollibaugh et al., 1981). Nutrient depletion in highly stratified surface waters, as a result of both meltwater input and thermal warming (Leventer, 1991), is probably the main trigger for spore formation. Highest sedimentary abundances of CRS (>80%) occur in the Antarctic Peninsula with ~7 months/year sea ice cover (Armand et al., 2005). In Holocene sediment, high relative abundances of CRS are commonly used to track high productivity events and strongly stratified surface waters at the receding sea-ice edge (Leventer et al., 1996; Denis et al., 2006; Leventer et al., 2006). *Chaetoceros Hyalochaete* vegetative cells were here counted with CRS, as they are generally present in low abundance in Antarctic sediments. CRS is significantly located on the F1-&F2+ area in our PCA, strongly separated from other diatom species (Fig. S2). CRS display numerous negative significant correlation with both sea ice associated and open ocean associated species (e.g. *F. curta*, *F. cylindrus, F. rhombica*, *F. kerguelensis*, *Chaetoceros cryophilum;* Table S3).

Variations in the relative abundances of Zirconium (Zr) and Rubidium (Rb) content provide an estimate of the variations in sediment grain size, where Zr represents the coarsest sediment fraction and Rb the finest (Dypvik et al., 2001). In the Weddell Sea and in the Mertz Depression, recent studies have proposed the Zr/Rb ratio as an indicator for enhanced bottom water formation and increased (coarser) sediment transport due and intensification of convective current during periods of intense sea ice formation and brine rejection under strong katabatic winds (Sprenk et al., 2014; Campagne et al., 2015). Zr/Rb is located on F1-&F2+ axes (Fig. S2), and displays highly significant negative correlations with some open water taxa, e.g. *P. glacialis* (-0.193; Table S3), *T. antarctica* (-0,188; Table S3) and *F. kerguelensis* (-0,176; Table S3), coherent with the use of the ratio.

The *Chaetoceros* subgenus *Phaeoceros* is common in open water environment (Kang and Fryxell, 1993). *Chaetoceros dichaeta* and *C. cryophilum* were found in water samples to be the most abundant species of the *C. Phaeoceros* sub-genus in the study area (Beans et al., 2008). In Holocene sediment in Antarctic Peninsula, presence of *Phaeoceros* vegetative cells suggests an oceanic influence (Maddison et al., 2005) and, in the region, *Phaeoceros* spp with *F. rhombica* and CRS in light laminae (Denis et al., 2006) possibly indicate a late spring bloom when sea ice retreated. Wherever possible, *Chaetoceros* cells were counted at the species level. Undetermined species of *Phaeoceros* (referred as *Phaeoceros* spp) along with *C. atlantica* and *C. dichaeta* are positioned in the F1-/F2+ axes while *C. cryophilum* is situated at the opposite in the F1+/F2- area and *C. bulbosum* is located on the F1-/F2- area (Fig. S2). Pearson coefficient correlations indicate that *C. atlantica* and *C. dichaeta* are significantly linked (0,424; Table S3) as well as *Phaeoceros* spp and *C. dichaeta* (0,336). However no clear relationship occurs for *C. cryophilum* and *C. bulbosum*. Based on PCA and Pearson analyses, *Phaeoceros* gp in our study is composed by *C. Phaeoceros* spp, *C. atlantica* and *C. dichaeta*. *Phaeoceros* species are generally considered having similar ecological preferences and are grouped all together (Denis et al., 2006) or are not identified at the species level in most studies (Riaux-Gobin et al., 2013). However, our observations highlight that differences exist between species in term of seasonal to interannual behaviour, which should be investigated in more details in future studies. *Chaetoceros atlantica* and *C. dichaeta* present high significant correlations with *T. antarctica* and some large centric diatoms, while *C. cryophilum* displays significant correlation with the *Thalassiothrix* gp and *F. kerguelensis* suggesting a summer production and/or open ocean origin.

Benthic diatoms were extremely rare in our samples. *Cocconeis* spp, *Grammatophora* spp, *Trachyneis* spp, *Licmophora* spp, *Melosira sol*, *M. adelia*, *Achnantes brevipes*, *Amphora* spp, *Diploneis* spp, *Pseudogomphonema* spp and *O. weissflogii* are benthic to epiphitic species (Al-Handal and Wulff, 2008). The benthic taxa are not commonly used use in paleoenvironmental studies as they constitute the less well-documented taxa (Taylor et al., 1999). However, *Cocconeis* spp occur in water depths >10 m (Whitehead and McMinn, 1997) and form spring/summer blooms and diatom mats in the coastal subtidal zone. The mats disintegrate by late spring as wind strength increases and sea ice breaks up. In sediment traps from the northern Antarctic Peninsula, Leventer (1991) recorded an autumn diatom assemblage with increasing benthic and ice-related species as being the coastal flora resuspended by autumn storms. Therefore the benthic group may be taken as an indicator for storm frequency and intensity and/or wave action implying strong turbulences in the water column (Barbara et al., 2013) during the ice-free season (Heil et al., 2006). *Achnantes* spp is positively correlated to *Cocconeis fasciolata* (0,233; Table S3) and to *Diploneis* spp (0,289), *Amphora* spp and *Odontella weissflogii* are also positively correlated (0,281), same for *M. adelia* and *Pseudogomphonema* spp (0,171). All these species are located in the F1+ (Fig. S2). Although not been significantly correlated to the species cited above, *Grammatophora* spp, *Trachyneis* spp, *Cocconeis costata*, *Licmophora* spp and *Melosira sol* are also present in the F1+ area and were thus added into the Benthic gp along with the other species mentioned. *Cocconeis fasciolata* is one of the most abundant species of this group despite relative abundances less than 1% of the total diatom assemblage. *Cocconeis fasciolata* presents significant positive correlation with several open water related taxa (e.g. *F. kerguelensis, T. antarctica and T. lentiginosa*) supporting a summer deposition of this group as suggested in the literature.

Corethron spp is typically associated with open ocean conditions (Armand et al., 2005; Crosta et al., 2005). As such, *C. criophilum* occurs in open water with little sea ice (Fryxell and Hasle, 1971). Beans et al. (2008) also observed that *C. pennatum* in the region showed a positive relationship with surface mixed waters as it would thrive better in this environment than the smaller pennate diatoms due to drag-inducing adaptations that reduce their sinking rate. This species is part of the shade flora (Kemp et al., 2000). In Holocene sediment, *Corethron* spp has been used to indicate disruption of the pycnocline associated to return of atmospheric perturbations during summer/autumn (Denis et al., 2006). Given the difficulties to identify them properly (low preservation of long appendices), we have grouped both species during the counting process. On the PCA, *Corethron* spp is positioned in the F1+/F2- quarter (Fig. S2). *Corethron* spp displays significant positive correlation with *F. rhombica* and the *Thalassiothrix* gp along with some species of the Open Water gp, and negative significant correlation with e.g. CRS and [HBI: 2] supporting a summer production as suggested in the literature.

2 Supplementary Note S2

Sea-ice cover in the area is subject to a strong interannual variability in terms of formation and retreat (Massom et al., 2009; Smith et al., 2011). Recent studies suggest the sea-ice conditions to be closely linked to fast-ice dynamics over the DDUT, which is largely depending to synoptic scale wind fields (Adolph and Wendler, 1995; Massom et al., 2003; 2009). Few studies have focused on the impacts of atmospheric and oceanic conditions on the regional sea ice. Most of these studies are either limited in time (Adolph and Wendler, 1995; Massom et al., 2009; Wang et al., 2014) or are too low in resolution to appropriately cover the Adélie Land region (Massom et al., 2013). In order to refine the relationships and response of sea-surface conditions to atmospheric forcing, PCA were performed between seasonal meteorological parameters (Fig. S3), recorded from AWS in the vicinity of DDU and satellite data over the core site (Fig. S1). Studying the seasonal lagged response between meteorological parameters is beyond the scope of this study, and would necessitate higher frequency analyses. In Note S2.1, we therefore restricted our investigations to the statistical relationships between parameters at the intra-seasonal scale. Secondly in Note S2.2, we established three scenario based on our statistical analyses and the little regional literature.

PCA between meteorological parameters were performed at the seasonal scale, spring (September to November), summer (December to February), autumn (March to May) and winter (June to August). The four seasons are considered independently and we decided to not take in consideration the seasonal lagged response that may exist between atmospheric forcings and sea-ice conditions, as this is beyond the scope of this study. Only significant correlation are shown, but high level non significant relationship (>± 0,200) between parameters are also discussed here.

In spring (September to November, SON), wind direction displays positive relationship with the sea-ice retreat date (Table S2), indicating that more easterly (westerly) winds tend to promote early (late) sea-ice melting, as observed for the summer period (see below). Spring sea-ice concentrations (SIC) are positively linked with the sea-ice retreat date and negatively related to the ice-free season (Table S2). Finally, wind speed is positively associated with spring temperatures (Table S2), indicating that weak winds are cooler than strong ones for the season.

In summer (December to February, DJF), wind speed is significantly negatively correlated to wind direction (-0,601; Table S2) indicating that more easterly winds are stronger than southerly to westerly ones in the area. Katabatic winds extend only to a limited distance over the open ocean during the summer season, due to less gravitational flow, whereas in winter with the sea-ice cover, katabatic winds are not constrained and blow further offshore (Pettré et al., 1993). Therefore, the opposite relationship we observed between wind speed and direction might reflect the increasing contribution of the more along shore wind pattern through the East Wind Drift, due to soften (meridional) katabatic winds in summer (Wendler et al., 1997). Additionally, a strong relationship exists between the summer wind direction and the sea-ice retreat date while the wind speed displays an opposite relationship with the timing of sea-ice retreat. The wind direction in summer is further negatively linked to temperatures and the length of the ice-free season, suggesting that more easterly (westerly) winds would tend to be associated with higher (lower) temperatures and longer (shorter) ice-free season. Additionally, wind speed displays opposite relationships with timing of sea-ice advance, which in turn appears positively linked to summer temperature. These results suggest that a stronger easterly (weaker westerly) winds in spring-summer promote earlier (later) sea-ice retreat in our study area. Results regarding the sea-ice advance date and atmospheric parameters appear contradictory (see above), but looking at their relationships is question able as sea-ice waxing conditions are attributable to the autumn and not summer period (see below). Unsurprisingly, summer SIC is significantly negatively correlated to the length of the ice-free season (-0,868) and significantly positively correlated to the sea-ice retreat date (0,930).

For the autumn period, wind speed is positively linked to wind direction, and displays a significant negative correlation with SIC (-0,472; Table S2) and a significant positive correlation with the closing date (0,360). These results would suggest that easterly (westerly) winds are weaker (stronger) over the March to May period. In autumn, the katabatic phase becomes stronger due to the strengthening of the surface inversion, which results in a more downslope (increasing) wind direction (Wendler et al., 1997), likely explaining the opposite relationship between wind direction and speed we found in summer (see above). Additionally, our results show that years characterized by weaker easterly (stronger south to westerly) winds in autumn would be associated by increasing (decreasing) sea-ice conditions and subsequently advanced (delayed) sea-ice closing. Such sea-ice conditions are further associated to low (high) temperatures in our study area, as this latter exerts negative relationship with SIC and positive link with the wind speed along with the closing time period. However, satellite data of SIC does not allow to discriminate if increasing SIC in autumn is due to increasing sea-ice presence or sea-ice formation in the area, whose characteristics may have large impacts on water column stratification through the dense water formation process. Unsurprisingly, for the autumn period SIC are significantly negatively correlated with the sea-ice advance date (-0,917) and the length of the ice-free season (-0,425).

During the winter season, the wind speed displays a positive correlation with the temperature (0.542; Table S2), indicating that strong (weak) winds are associated to warmer (cooler) temperature. Interestingly, although the winter wind direction is not significantly correlated to winter wind speed and temperature, it displays high positive relationship with both, implying that easterly winds are weaker and cooler in winter than westerly winds in the region. This might reflects the contribution of storms crossing the Adélie Land coastal area and bringing moist warmer air under a more westerly regime (Wang et al., 2014). SIC during winter are negatively linked with wind speed and temperature (Table S2), suggesting that weak cold winds would promote increase of SIC.

Seasonal responses of sea-ice conditions to atmospheric forcing highlight that summer and autumn display the highest correlations/relationships with weather forecast/satellite data, likely because both seasons at high latitude experience much of the environmental variability through sea-ice melting and regrowth. Compared to temperature variability, it appears the wind pattern has a greater influence at that scale on sea-ice dynamics, as suggested previously by Adolph and Wendler (1995) and Massom et al. (2003; 2009). Indeed, opposite response of sea surface conditions occurs between summer and autumn in our PCA, as stronger easterly (weak westerly) winds would reduce (increase) sea ice conditions in summer at the core site but increase (reduce) sea ice conditions during autumn. Our results allowed us to draw hereafter different scenario based on wind directional pattern variability.

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Supplementary figure captions

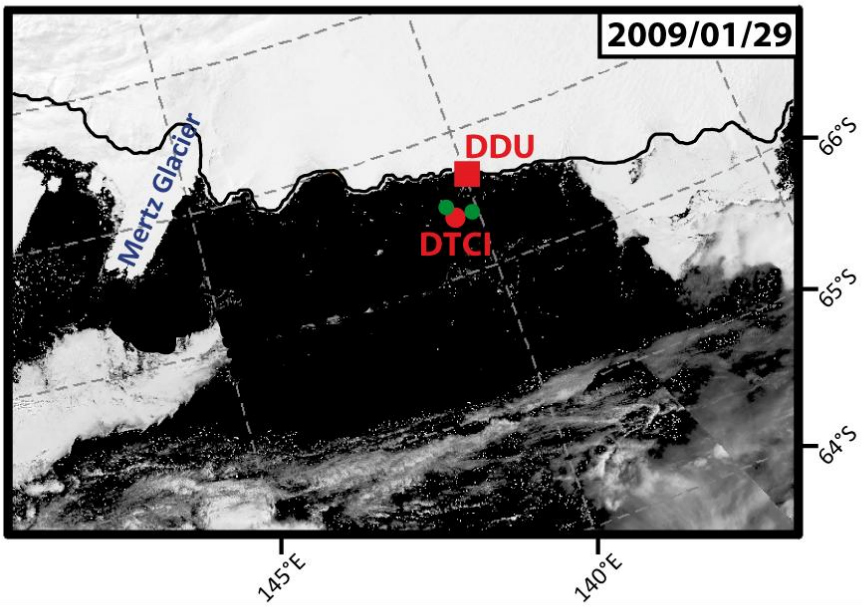

Figure S1. Location of satellite data pixels. MODIS satellite image (2009/01/29) of the Georges V Land indicating the grid points (green spots; -66,5481; 140,5149 and -66,4065; 140,0883) used for the extraction of the daily sea ice concentration values. The red spot indicates the DTCI core location, and the red square marks the Dumont D'Urville french station.

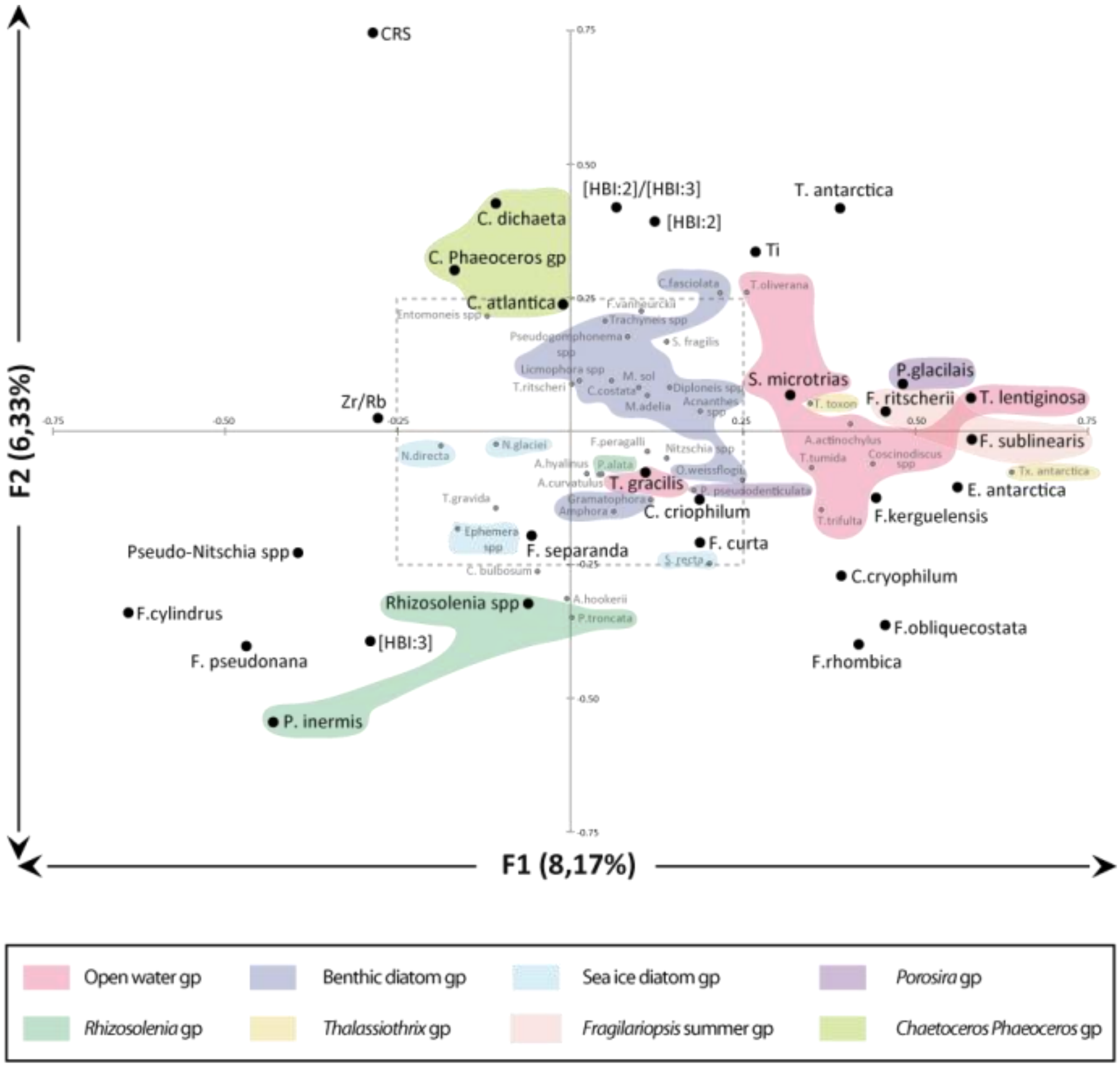

Figure S2. PCA applied to sedimentary raw data from the DTCI 2010 core. Shaded areas represent diatom clusters, based on significant correlation between species (Table S3). Abundant species (relative abundance>2%) are written in black, unrepresentative species (relative abundance<2%) are written in grey.

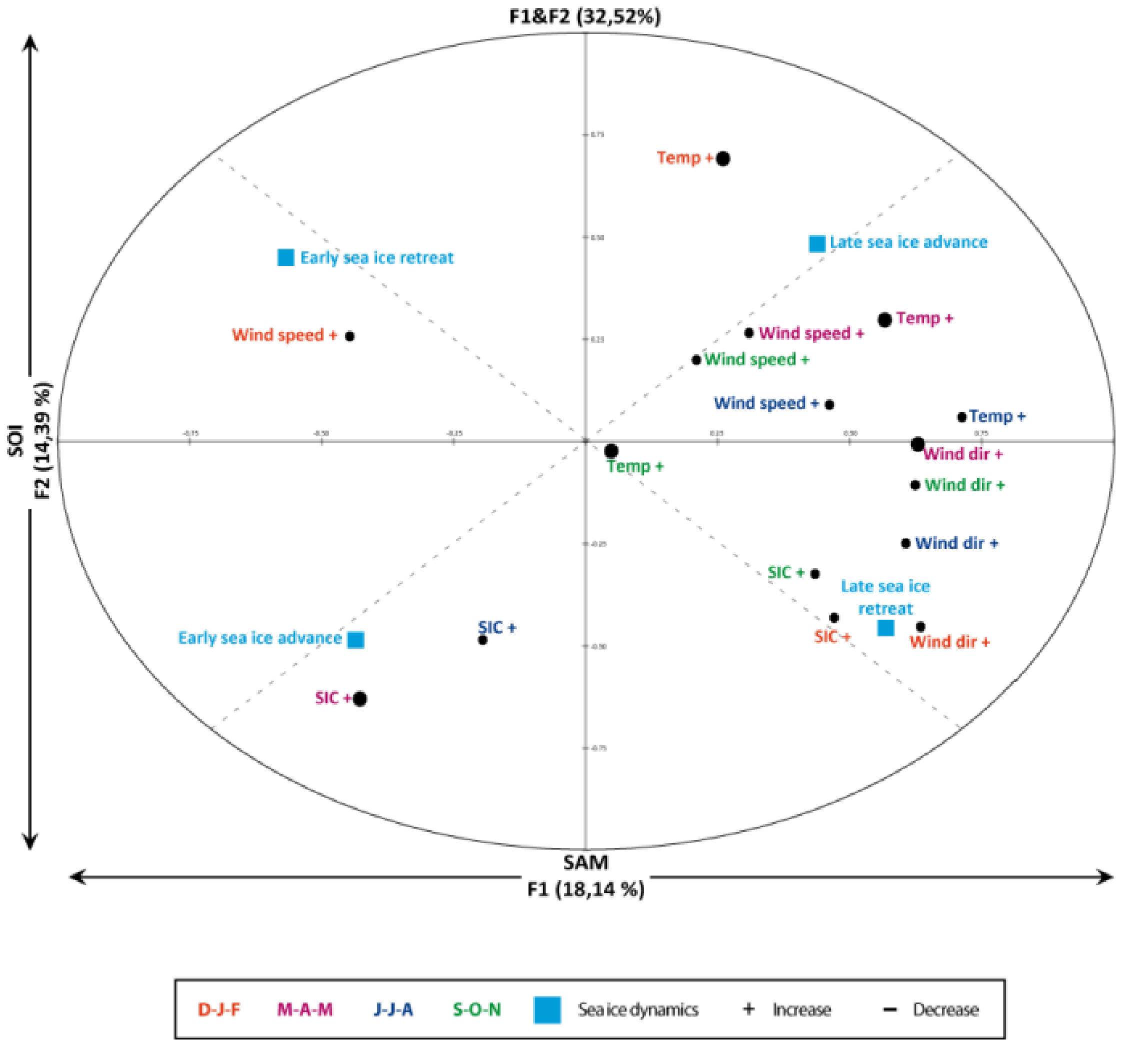

Figure S3. PCA seasonal data of weather forecast parameters. PCA applied to weather forecast and satellite data, that were previously seasonally averaged over the spring period (September to November-SON), the summer period (December to February-DJF), the autumn period (March to May-MAM) and over the winter period (June to August-JJA).

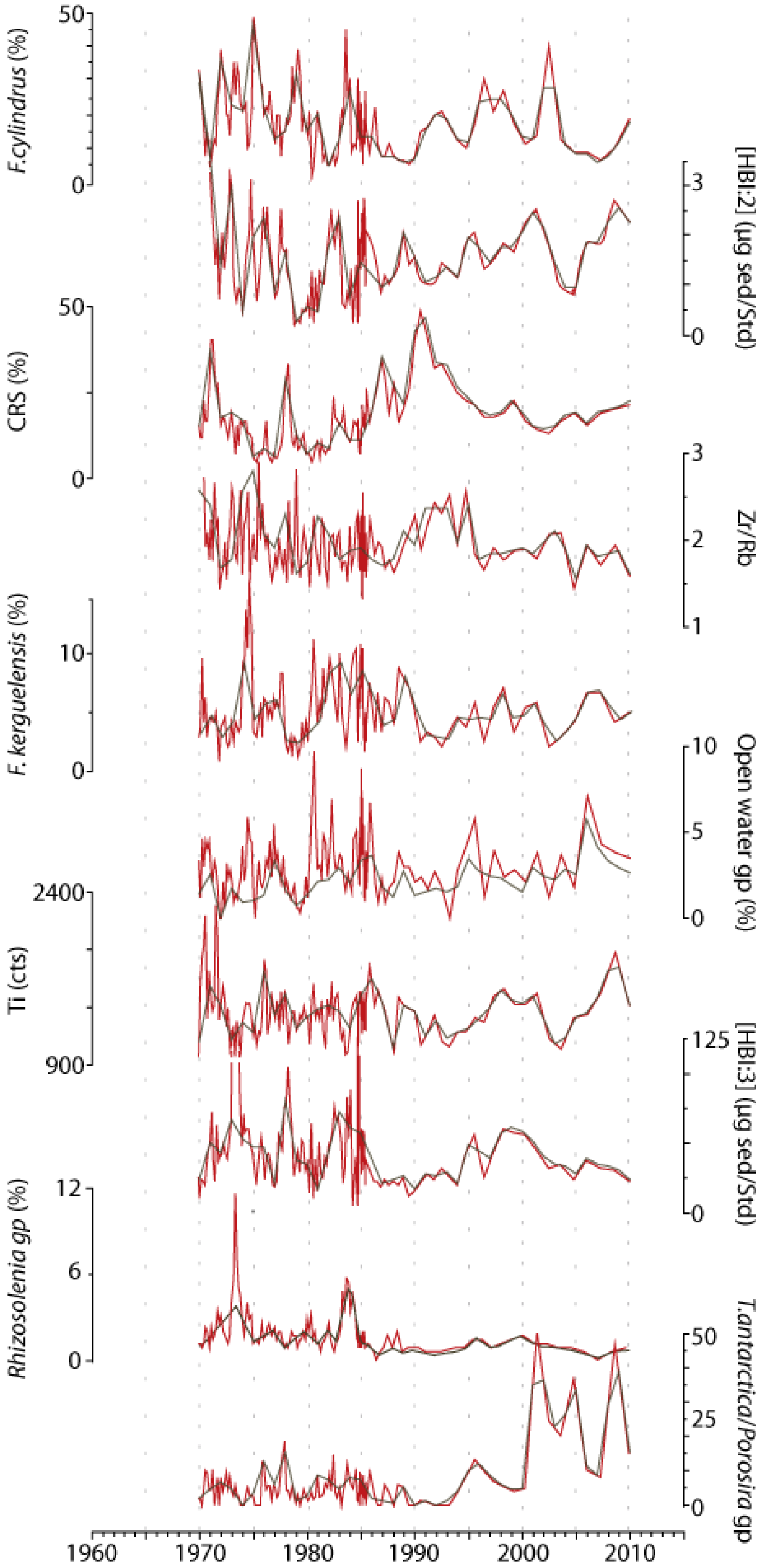

Figure S4. Raw versus standardised data. Raw data (red) and standardised data (grey) from the sediment core DTCI 2010.

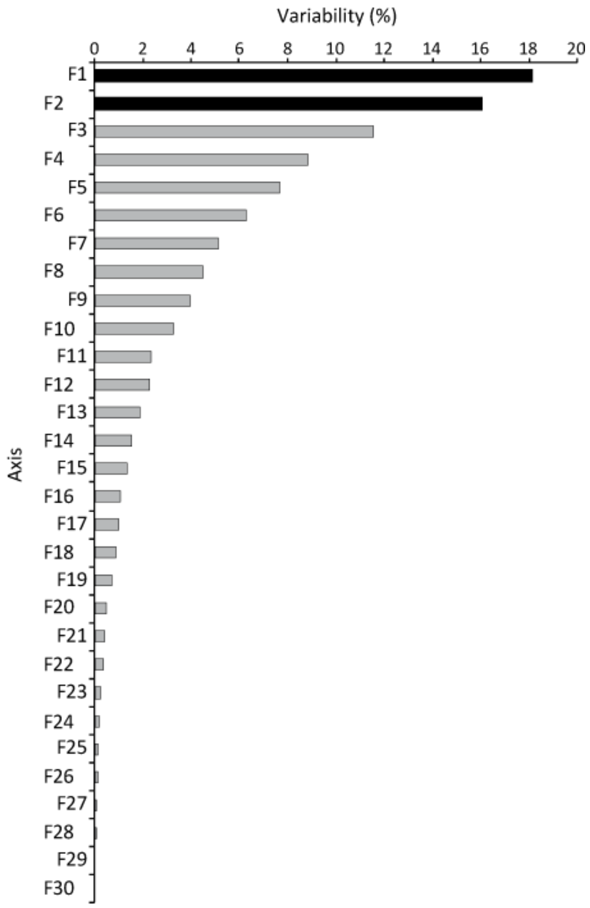

Figure S5. Axis contribution to the total variability, from PCA applied to standardized sedimentary and meteorological parameters. Selected axes for PCA are in black.

Supplementary Tables

Table S1. List of the diatom species identified in the core DTCI2010. Diatom species that are mentioned in bold have a maximum relative abundance greater than 2% in our samples.

Variable	Mean	Maximum
A. actinochylus	0,28	1,20
A. curvatulus	0,05	0,80
A. hookerii	0,32	1,60
A. hyalinus	0,10	1,00
Acnanthes spp	0,02	0,50
Amphora	0,01	0,30
C. atlantica	**0,28**	**3,00**
C. bulbosum	0,11	1,10
C. costata	0,06	0,50
C. criophilum	**0,84**	**3,80**
C. cryophilum	**1,12**	**4,60**
C. dichaeta	**0,64**	**4,10**
C. fasciolata	0,07	0,60
C. Phaeoceros gp	**3,61**	**14,70**
Cocconeis gp	0,03	0,50
Coscinodiscus spp	0,07	0,60
CRS	**17,19**	**52,50**
Diploneis spp	0,01	0,50
E. antarctica	**0,61**	**2,90**
Entomoneis spp	0,01	0,30
Ephemera spp	0,14	0,80
F. curta	**23,52**	**39,00**
F. cylindrus	**17,92**	**48,80**
F. kerguelensis	**5,26**	**16,60**
F. obliquecostata	**2,50**	**8,10**
F. peragalli	0,00	0,60
F. pseudonana	**0,47**	**3,80**
F. rhombica	**9,30**	**27,80**
F. ritscherii	**0,94**	**3,90**
F. separanda	**0,21**	**2,10**
F. sublinearis	**1,34**	**4,30**
F. vanheurckii	0,18	1,10
Gramatophora	0,00	0,30
Licmophora spp	0,01	0,30
M. adelia	0,13	1,10
M. sol	0,04	0,30
N. directa	0,22	1,10
N. glaciei	0,09	1,10
Nitzschia spp	0,06	0,60

Variable	Mean	Maximum
O. Weissflogii	0,02	0,60
P. alata	0,04	0,30
P. glacialis	**0,43**	**2,00**
P. inermis	**0,84**	**7,50**
². pseudodenticulat	0,16	1,20
P. troncata	0,07	0,60
Pseudo Nitschia sp	**2,03**	**5,60**
udogomphonema	0,06	0,90
Rhizosolenia spp	**0,76**	**3,90**
S. fragilis	0,04	0,60
S. microtrias	**0,25**	**3,20**
S. recta	0,04	0,60
T. antarctica	**3,37**	**15,10**
T. gracilis	**0,88**	**4,00**
T. gravida	0,14	0,90
T. lentiginosa	**1,22**	**6,10**
T. oliverana	0,08	0,60
T. ritscheri	0,21	0,90
T. toxon	0,35	1,20
T. trifulta	0,11	0,80
T. tumida	0,16	0,80
Trachyneis spp	0,01	0,80
Tx. antarctica	0,49	1,80

Table S2. Pearson matrix of coefficient correlation, from the PCA between sedimentary raw data/proxies from the DTCI2010.

Variables	[HBI:2]	[HBI:2]/[HBI:3]	[HBI:3]	A. actinochylus	A. Curvatulus	A. hookerii	A. hyalinus	Acnanthes spp	Amphora spp	C. atlantica	C. bulbosum	C. costata	C. cryophilum	C. dichaeta
[HBI:2]	**1**	**0,797**	-0,043	**0,170**	0,142	-0,145	0,047	0,037	-0,011	-0,040	0,013	0,124	**-0,190**	0,080
[HBI:2]/[HBI:3]	**0,797**	**1**	**-0,336**	0,146	**0,190**	**-0,188**	-0,021	-0,054	-0,042	0,016	-0,016	0,078	**-0,169**	0,085
[HBI:3]	-0,043	**-0,336**	**1**	-0,003	-0,056	**0,192**	0,005	0,064	-0,006	-0,109	0,096	0,086	-0,118	-0,140
A. actinochylus	**0,170**	0,146	-0,003	**1**	0,024	0,083	-0,033	0,095	-0,076	-0,078	-0,014	**0,226**	0,144	-0,068
A. Curvatulus	0,142	**0,190**	-0,056	0,024	**1**	-0,060	-0,030	-0,091	-0,002	-0,082	0,015	0,034	0,128	-0,033
A. hookerii	-0,145	**-0,188**	**0,192**	0,083	-0,060	**1**	0,072	0,119	-0,060	0,028	**0,232**	-0,078	-0,018	**-0,190**
A. hyalinus	0,047	-0,021	0,005	-0,033	-0,030	0,072	**1**	0,091	-0,069	0,113	**0,190**	-0,104	-0,045	0,002
Acnanthes spp	0,037	-0,054	0,064	0,095	-0,091	0,119	0,091	**1**	-0,036	0,075	**0,212**	-0,129	0,074	0,033
Amphora spp	-0,011	-0,042	-0,006	-0,076	-0,002	-0,060	-0,069	-0,036	**1**	-0,045	0,098	-0,074	-0,022	-0,039
C. atlantica	-0,040	0,016	-0,109	-0,078	-0,082	0,028	0,113	0,075	-0,045	**1**	0,145	0,110	-0,118	**0,424**
C. bulbosum	0,013	-0,016	0,096	-0,014	0,015	**0,232**	**0,190**	**0,212**	0,098	0,145	**1**	0,021	-0,028	-0,113
C. costata	0,124	0,078	0,086	**0,226**	0,034	-0,078	-0,104	-0,129	-0,074	0,110	0,021	**1**	-0,019	-0,100
C. cryophilum	**-0,190**	**-0,169**	-0,118	0,144	0,128	-0,018	-0,045	0,074	-0,022	-0,118	-0,028	-0,019	**1**	-0,061
C. dichaeta	0,080	0,085	-0,140	-0,068	-0,033	**-0,190**	0,002	0,033	-0,039	**0,424**	-0,113	-0,100	-0,061	**1**
C. fasciolata	0,161	0,068	-0,032	0,122	-0,027	0,084	0,059	**0,233**	-0,067	0,082	0,075	-0,053	**-0,172**	**0,179**
C. hyalochaete R	0,104	0,123	**-0,167**	-0,144	-0,119	**-0,201**	-0,146	-0,012	-0,088	0,082	**-0,235**	0,007	**-0,277**	0,156
C. Phaeoceros gr	0,122	0,110	-0,073	-0,044	0,013	-0,017	-0,035	-0,049	-0,071	0,032	-0,077	-0,107	-0,124	**0,336**
Ch. cryophilus	0,149	**0,213**	-0,105	0,039	0,041	0,062	0,021	-0,071	-0,015	0,061	0,094	-0,093	0,094	0,112
Cocconeis spp	0,022	-0,042	0,047	0,151	0,065	-0,057	0,063	-0,074	**0,248**	-0,009	-0,083	0,047	0,085	-0,154
Coscinodiscus sp	0,084	0,021	0,020	**0,244**	0,013	-0,046	-0,009	0,035	0,103	-0,103	0,030	0,129	**0,228**	-0,160
Diploneis spp	-0,035	0,042	-0,101	0,034	-0,067	-0,006	0,040	**0,289**	-0,027	-0,038	0,083	-0,095	0,016	0,011
E. antarctica	0,057	0,022	-0,155	0,156	-0,007	-0,031	-0,016	0,032	0,010	0,037	0,094	**0,166**	**0,363**	-0,054
Entomoneis spp	0,004	-0,041	0,014	**-0,167**	**0,194**	-0,045	-0,090	-0,048	-0,027	-0,062	-0,050	-0,007	-0,005	0,088
Ephemera spp	0,096	0,021	0,044	-0,119	0,095	0,066	**0,183**	0,008	-0,066	-0,048	0,155	-0,106	-0,090	-0,023
F. curta	0,018	-0,021	0,131	0,122	0,033	0,158	-0,017	0,038	-0,101	0,020	0,041	0,066	-0,140	-0,089
F. cylindrus	-0,124	-0,062	**0,189**	**-0,233**	0,007	-0,082	-0,015	-0,146	0,123	-0,061	0,155	-0,097	-0,051	-0,004
F. kerguelensis	0,128	0,046	-0,042	0,164	-0,031	**0,264**	**0,255**	**0,243**	-0,029	-0,049	**0,171**	-0,014	-0,094	**-0,227**
F. obliquecostata	-0,116	-0,090	-0,137	0,077	**0,216**	-0,113	-0,072	-0,099	0,152	-0,084	0,066	0,076	**0,377**	-0,077
F. peragalli	0,051	-0,021	0,056	-0,074	-0,030	-0,077	0,083	-0,021	-0,012	-0,048	-0,049	-0,043	0,029	-0,070
F. pseudonana	-0,043	-0,073	**0,256**	-0,121	0,027	0,151	**0,166**	-0,043	0,070	-0,062	**0,168**	-0,131	-0,039	-0,109
F. rhombica	**-0,245**	**-0,169**	-0,118	0,102	0,060	-0,013	-0,071	-0,013	-0,030	**-0,216**	-0,037	0,089	**0,442**	**-0,256**
F. ritscherii	-0,148	**-0,177**	-0,071	0,029	-0,099	-0,046	-0,049	**0,334**	0,102	-0,113	-0,045	0,017	**0,181**	**-0,193**
F. separanda	-0,054	-0,117	0,110	-0,081	-0,052	**0,386**	**0,281**	0,072	-0,063	0,067	0,136	-0,093	-0,123	-0,054
F. sublinearis	-0,063	-0,123	-0,037	0,153	0,014	-0,033	-0,089	0,056	-0,002	0,042	-0,102	0,026	**0,168**	-0,096
F. vanheurckii	-0,005	0,090	-0,144	0,013	-0,070	0,071	-0,081	0,081	0,027	-0,063	-0,148	-0,038	-0,027	-0,084
Gramatophora sp	-0,009	-0,031	-0,014	0,006	**0,204**	-0,058	-0,057	-0,030	-0,017	-0,068	-0,070	-0,061	0,041	-0,014
Licmophora spp	-0,053	0,022	-0,070	-0,037	-0,069	-0,109	0,133	-0,048	-0,027	0,041	-0,050	0,084	-0,046	0,014
M. adelia	**0,451**	**0,366**	-0,033	0,045	0,091	-0,137	-0,032	-0,038	-0,086	0,027	0,039	0,090	-0,033	-0,036
M. sol	**0,199**	**0,181**	-0,059	**0,195**	-0,021	0,093	0,073	0,064	-0,059	-0,083	-0,029	-0,014	0,007	-0,035

Variables	[HBI:2]	[HBI:2]/[HBI:3]	[HBI:3]	A. actinochylus	A. Curvatulus	A. hookerii	A. hyalinus	Acnanthes spp	Amphora spp	C. atlantica	C. bulbosum	C. costata	C. cryophilum	C. dichaeta
N. directa	0,056	0,124	-0,024	0,001	0,082	0,001	-0,001	-0,010	0,008	0,007	-0,089	0,019	-0,099	0,004
N. glaciei	0,108	0,121	-0,068	-0,139	0,055	**-0,184**	0,129	-0,075	0,064	-0,023	-0,045	0,031	-0,098	0,085
Nitzschia spp	-0,029	-0,044	0,030	0,110	-0,086	**0,194**	-0,077	-0,082	-0,007	0,089	0,009	0,011	0,086	-0,098
O. weissflogii	0,036	-0,040	0,107	-0,012	**0,193**	-0,051	0,011	0,104	**0,281**	0,035	-0,117	-0,102	0,112	-0,021
P. alata	**0,206**	0,154	0,001	0,060	-0,042	0,089	0,139	0,109	0,012	-0,072	0,052	0,087	-0,003	-0,066
P. glacialis	0,146	0,095	-0,097	**0,225**	0,026	0,004	0,149	0,007	0,121	0,050	0,043	0,105	0,076	-0,068
P. inermis	**-0,209**	**-0,244**	**0,635**	-0,032	-0,077	**0,241**	0,076	-0,074	0,054	-0,163	0,079	-0,014	-0,025	**-0,174**
pseudodenticula	-0,076	-0,144	0,104	-0,008	0,074	-0,026	-0,003	-0,032	-0,029	0,081	0,056	0,129	0,018	-0,078
P. tronca	0,010	0,124	0,103	0,092	0,137	0,142	0,046	-0,124	0,097	-0,077	-0,044	-0,072	-0,070	-0,061
dogomphonema	**0,266**	**0,262**	-0,009	0,132	0,105	-0,090	-0,001	-0,020	-0,054	0,046	-0,048	0,085	-0,113	0,028
seudo-nitschia sp	-0,010	0,087	-0,042	**-0,295**	0,097	0,128	0,016	-0,124	-0,052	0,028	0,102	**-0,190**	-0,104	-0,042
Rhizosolenia spp	-0,117	**-0,177**	**0,491**	0,097	-0,068	0,081	-0,031	-0,018	0,077	-0,112	0,031	-0,044	-0,022	-0,063
S. fragilis	**0,198**	0,152	-0,089	0,162	-0,135	0,027	0,104	-0,026	-0,054	-0,012	-0,134	0,101	-0,039	-0,077
S. microtrias	0,003	-0,020	-0,104	0,027	0,031	-0,082	-0,026	0,008	0,095	**0,214**	-0,074	0,041	0,094	0,014
S. recta	-0,092	-0,076	-0,050	-0,084	0,144	0,007	0,005	-0,087	0,164	-0,060	-0,106	-0,130	**0,191**	-0,042
T. antarctica	**0,218**	0,087	-0,101	**0,224**	0,058	-0,080	**0,237**	0,133	0,053	**0,299**	-0,061	0,098	0,001	**0,303**
T. frenguelli	-0,128	-0,082	0,091	0,075	-0,061	-0,047	**0,168**	-0,043	-0,024	0,026	0,036	-0,087	-0,088	0,023
T. gracilis	0,163	0,101	0,026	**0,218**	-0,064	**0,297**	0,096	0,116	-0,038	-0,080	0,047	0,008	**-0,180**	-0,143
T. gravida	-0,138	-0,102	0,127	-0,018	**-0,223**	**0,300**	0,040	**0,170**	-0,098	-0,054	**0,227**	-0,052	-0,148	**-0,167**
T. lentiginosa	0,110	0,042	**-0,195**	**0,330**	-0,140	**0,173**	0,087	0,149	0,060	-0,100	-0,039	-0,002	**0,187**	-0,088
T. oliverana	-0,037	0,002	-0,157	**0,166**	**-0,168**	-0,006	-0,092	-0,069	-0,067	0,071	-0,101	0,095	0,067	0,164
T. ritscheri	0,028	-0,009	0,123	0,142	0,033	0,100	-0,004	-0,018	-0,013	**0,165**	-0,119	0,055	-0,014	**0,230**
T. toxon	**0,178**	0,079	-0,053	-0,026	-0,139	0,033	0,051	0,077	-0,067	-0,072	-0,050	-0,148	0,130	-0,028
T. trifulta	0,002	-0,012	-0,070	0,152	0,039	-0,077	0,106	**0,197**	**0,191**	0,076	0,067	-0,103	0,074	0,078
T. tumida	0,147	0,044	-0,049	0,125	0,033	0,072	0,052	-0,135	0,004	0,017	-0,063	-0,015	0,139	0,043
Ti	**0,372**	**0,394**	**-0,218**	0,150	0,063	-0,130	0,044	0,071	-0,033	0,096	-0,013	**0,176**	0,027	0,125
Trachyneis spp	0,080	0,056	-0,040	0,044	0,001	-0,078	**0,219**	-0,038	-0,022	0,015	-0,003	-0,077	0,110	**0,226**
Tx. antarctica	0,000	-0,040	-0,162	**0,283**	-0,034	0,009	0,036	**0,183**	-0,012	-0,115	-0,043	-0,099	**0,298**	-0,083
Zr/Rb	0,060	0,063	0,081	0,023	0,024	-0,077	**-0,226**	-0,068	0,009	-0,096	0,003	0,112	-0,067	0,022

Variables	C. fasciolata	C. hyalochaete R	C. Phaeoceros gr	Ch. cryophilus	Cocconeis spp	Coscinodiscus sp	Diploneis spp	E. antarctica	Entomoneis spp	Ephemera spp	F. curta	F. cylindrus	F. kerguelensis	F. obliquecostata
[HBI:2]	0,161	0,104	0,122	0,149	0,022	0,084	-0,035	0,057	0,004	0,096	0,018	-0,124	0,128	-0,116
[HBI:2]/[HBI:3]	0,068	0,123	0,110	**0,213**	-0,042	0,021	0,042	0,022	-0,041	0,021	-0,021	-0,062	0,046	-0,090
[HBI:3]	-0,032	**-0,167**	-0,073	-0,105	0,047	0,020	-0,101	-0,155	0,014	0,044	0,131	**0,189**	-0,042	-0,137
A. actinochylus	0,122	-0,144	-0,044	0,039	0,151	**0,244**	0,034	0,156	**-0,167**	-0,119	0,122	**-0,233**	0,164	0,077
A. Curvatulus	-0,027	-0,119	0,013	0,041	0,065	0,013	-0,067	-0,007	**0,194**	0,095	0,033	0,007	-0,031	**0,216**
A. hookerii	0,084	**-0,201**	-0,017	0,062	-0,057	-0,046	-0,006	-0,031	-0,045	0,066	0,158	-0,082	**0,264**	-0,113
A. hyalinus	0,059	-0,146	-0,035	0,021	0,063	-0,009	0,040	-0,016	-0,090	**0,183**	-0,017	-0,015	**0,255**	-0,072
Acnanthes spp	**0,233**	-0,012	-0,049	-0,071	-0,074	0,035	**0,289**	0,032	-0,048	0,008	0,038	-0,146	**0,243**	-0,099
Amphora spp	-0,067	-0,088	-0,071	-0,015	**0,248**	0,103	-0,027	0,010	-0,027	-0,066	-0,101	0,123	-0,029	0,152
C. atlantica	0,082	0,082	0,032	0,061	-0,009	-0,103	-0,038	0,037	-0,062	-0,048	0,020	-0,061	-0,049	-0,084
C. bulbosum	0,075	**-0,235**	-0,077	0,094	-0,083	0,030	0,083	0,094	-0,050	0,155	0,041	0,155	**0,171**	0,066
C. costata	-0,053	0,007	-0,107	-0,093	0,047	0,129	-0,095	**0,166**	-0,007	-0,106	0,066	-0,097	-0,014	0,076
C. cryophilum	**-0,172**	**-0,277**	-0,124	0,094	0,085	**0,228**	0,016	**0,363**	-0,005	-0,090	-0,140	-0,051	-0,094	**0,377**
C. dichaeta	**0,179**	0,156	**0,336**	0,112	-0,154	-0,160	0,011	-0,054	0,088	-0,023	-0,089	-0,004	**-0,227**	-0,077
C. fasciolata	**1**	0,026	0,016	0,004	-0,004	-0,019	0,020	0,003	0,060	0,005	-0,073	**-0,165**	**0,261**	-0,097
C. hyalochaete R	0,026	**1**	0,108	**-0,333**	-0,160	-0,065	0,080	**-0,206**	**0,165**	-0,118	**-0,340**	**-0,271**	**-0,248**	**-0,384**
C. Phaeoceros gr	0,016	0,108	**1**	0,124	-0,080	**-0,180**	-0,055	-0,040	**0,325**	0,075	-0,138	-0,087	-0,033	-0,157
Ch. cryophilus	0,004	**-0,333**	0,124	**1**	-0,009	0,007	-0,036	**0,228**	-0,087	0,050	-0,011	0,026	**0,214**	**0,186**
Cocconeis spp	-0,004	-0,160	-0,080	-0,009	**1**	**0,236**	-0,054	0,129	-0,056	0,125	-0,045	-0,005	0,038	0,154
Coscinodiscus sp	-0,019	-0,065	**-0,180**	0,007	**0,236**	**1**	0,037	**0,305**	-0,089	-0,052	-0,008	**-0,203**	0,026	**0,186**
Diploneis spp	0,020	0,080	-0,055	-0,036	-0,054	0,037	**1**	0,022	-0,035	0,056	-0,045	-0,094	0,026	-0,031
E. antarctica	0,003	**-0,206**	-0,040	**0,228**	0,129	**0,305**	0,022	**1**	-0,004	-0,034	-0,054	**-0,252**	0,146	**0,378**
Entomoneis spp	0,060	**0,165**	**0,325**	-0,087	-0,056	-0,089	-0,035	-0,004	**1**	-0,077	-0,147	0,022	-0,133	-0,083
Ephemera spp	0,005	-0,118	0,075	0,050	0,125	-0,052	0,056	-0,034	-0,077	**1**	-0,075	**0,171**	0,075	-0,085
F. curta	-0,073	**-0,340**	-0,138	-0,011	-0,045	-0,008	-0,045	-0,054	-0,147	-0,075	**1**	**-0,306**	0,136	0,040
F. cylindrus	**-0,165**	**-0,271**	-0,087	0,026	-0,005	**-0,203**	-0,094	**-0,252**	0,022	**0,171**	**-0,306**	**1**	**-0,432**	-0,143
F. kerguelensis	**0,261**	**-0,248**	-0,033	**0,214**	0,038	0,026	0,026	0,146	-0,133	0,075	0,136	**-0,432**	**1**	0,077
F. obliquecostata	-0,097	**-0,384**	-0,157	**0,186**	0,154	**0,186**	-0,031	**0,378**	-0,083	-0,085	0,040	-0,143	0,077	**1**
F. peragalli	-0,039	-0,010	-0,050	-0,002	-0,025	-0,039	-0,016	0,029	-0,016	0,072	-0,048	-0,038	0,150	-0,028
F. pseudonana	-0,088	**-0,278**	-0,135	0,117	-0,016	**-0,193**	-0,137	**-0,180**	-0,069	**0,221**	**-0,183**	**0,535**	0,063	-0,132
F. rhombica	-0,080	**-0,351**	-0,146	0,026	0,119	**0,259**	0,013	**0,373**	-0,088	-0,082	-0,051	**-0,239**	0,027	**0,454**
F. ritscherii	0,105	0,036	**-0,212**	**-0,194**	-0,044	**0,215**	**0,278**	0,083	-0,026	**-0,219**	0,114	**-0,346**	0,090	0,117
F. separanda	0,000	**-0,173**	-0,067	0,065	0,069	-0,131	0,019	-0,110	-0,110	0,102	**0,225**	-0,068	**0,356**	-0,111
F. sublinearis	**0,250**	-0,148	**-0,207**	-0,045	0,073	**0,188**	0,054	**0,223**	-0,012	**-0,165**	**0,234**	**-0,349**	0,138	0,155
F. vanheurckii	0,025	**0,176**	0,095	0,012	-0,128	-0,033	**0,199**	-0,116	-0,012	-0,141	0,037	**-0,200**	0,057	**-0,189**
Gramatophora sp	-0,055	-0,101	0,015	0,067	-0,035	-0,056	-0,022	0,042	-0,023	0,102	0,063	-0,093	0,004	0,160
Licmophora spp	0,109	0,079	-0,036	0,098	-0,056	-0,017	0,143	-0,004	-0,036	0,043	-0,016	-0,085	-0,016	-0,036
M. adelia	0,097	-0,078	0,128	**0,235**	-0,010	0,054	-0,067	**0,264**	-0,029	**0,167**	-0,016	-0,003	0,083	0,083
M. sol	0,028	0,020	-0,039	-0,034	-0,120	-0,075	0,020	0,063	-0,078	0,090	-0,099	-0,020	0,133	-0,022

Variables	C. fasciolata	. hyalochaete R	C. Phaeoceros g	Ch. cryophilus	Cocconeis spp	oscinodiscus sp	Diploneis spp	E. antarctica	Entomoneis spp	Ephemera spp	F. curta	F. cylindrus	F. kerguelensis	F. obliquecostat
N. directa	-0,084	0,033	0,053	0,016	**0,178**	-0,158	-0,049	-0,082	-0,081	**0,181**	0,050	0,083	-0,033	-0,126
N. glaciei	-0,064	-0,027	0,036	0,081	0,028	-0,155	0,016	0,097	-0,029	0,135	-0,037	0,162	-0,117	0,114
Nitzschia spp	-0,074	-0,039	-0,062	0,032	-0,022	0,002	-0,081	0,151	0,006	-0,016	0,055	-0,097	0,098	-0,001
O. weissflogii	-0,015	-0,061	-0,044	-0,104	**0,311**	0,159	0,075	0,002	-0,038	-0,082	0,073	-0,162	0,088	0,141
P. alata	0,039	-0,073	-0,061	-0,019	0,080	-0,007	0,021	0,065	-0,077	0,069	0,045	-0,063	**0,293**	-0,070
P. glacialis	0,085	-0,051	-0,092	0,001	0,049	**0,210**	-0,059	**0,234**	0,062	-0,040	0,013	**-0,303**	**0,235**	0,141
P. inermis	-0,163	**-0,261**	-0,010	-0,078	0,041	-0,139	-0,078	**-0,237**	-0,074	0,128	0,010	**0,353**	-0,049	-0,097
pseudodenticula	0,054	-0,142	**-0,167**	-0,031	0,051	0,004	0,081	0,046	**0,263**	-0,136	0,100	-0,040	0,074	0,115
P. tronca	-0,081	**-0,311**	0,054	-0,014	**0,259**	-0,011	-0,091	-0,012	-0,093	0,155	0,130	-0,035	0,153	0,124
dogomphonema	0,009	0,073	0,074	-0,064	-0,067	0,019	-0,070	-0,045	-0,072	-0,150	0,144	**-0,178**	0,007	-0,018
eudo-nitschia sp	**-0,209**	-0,151	0,065	**0,195**	-0,032	**-0,247**	-0,007	**-0,208**	-0,103	**0,257**	-0,038	**0,337**	-0,145	-0,093
Rhizosolenia spp	0,075	**-0,180**	0,104	0,086	0,136	0,029	-0,066	0,058	-0,040	-0,011	-0,143	0,093	0,097	0,053
S. fragilis	-0,002	0,054	0,052	**0,170**	-0,053	-0,075	-0,069	0,004	-0,071	-0,011	0,048	**-0,196**	0,121	-0,060
S. microtrias	0,002	-0,032	0,026	0,012	0,107	**0,211**	0,024	0,155	-0,015	-0,138	0,120	**-0,246**	0,156	0,100
S. recta	-0,122	-0,132	-0,127	0,042	**0,289**	-0,028	0,036	0,147	-0,066	0,027	-0,045	-0,058	-0,023	**0,258**
T. antarctica	**0,381**	0,083	0,066	-0,010	0,081	0,100	-0,009	0,063	0,092	-0,118	-0,040	**-0,363**	**0,184**	0,029
T. frenguelli	0,004	-0,100	-0,121	0,005	-0,050	-0,079	-0,031	0,036	-0,032	0,079	0,099	0,049	-0,007	0,013
T. gracilis	0,063	-0,140	-0,046	0,069	-0,036	-0,080	-0,042	-0,038	-0,071	0,121	**0,249**	**-0,216**	**0,485**	**-0,206**
T. gravida	0,031	0,029	-0,162	-0,123	0,000	0,040	0,157	-0,137	-0,129	0,061	0,092	0,036	0,001	-0,084
T. lentiginosa	**0,234**	-0,072	-0,153	0,163	0,100	**0,190**	0,141	**0,260**	-0,137	0,068	-0,022	**-0,378**	**0,507**	0,056
T. oliverana	**0,184**	0,052	-0,007	0,089	-0,136	0,032	0,074	**0,234**	0,046	-0,101	-0,143	-0,143	0,053	0,087
T. ritscheri	0,049	0,052	0,050	0,051	0,053	-0,055	-0,093	0,079	0,055	-0,109	0,088	-0,111	-0,011	-0,019
T. toxon	0,100	-0,062	0,025	0,139	-0,147	0,100	0,040	0,160	-0,086	0,082	0,092	**-0,219**	**0,213**	0,055
T. trifulta	-0,043	**-0,210**	-0,072	0,042	0,032	**0,174**	0,106	0,130	0,015	-0,020	**0,183**	**-0,200**	0,136	**0,178**
T. tumida	0,095	-0,158	0,007	0,144	0,076	0,105	-0,128	**0,245**	-0,031	0,041	0,137	-0,150	0,051	**0,248**
Ti	0,086	0,087	0,147	**0,167**	-0,033	-0,038	0,046	**0,175**	0,006	-0,019	-0,051	**-0,283**	**0,248**	-0,001
Trachyneis spp	-0,018	0,077	0,021	-0,058	-0,044	0,114	-0,028	-0,092	-0,029	-0,025	0,033	-0,091	-0,035	-0,099
Tx. antarctica	0,112	-0,131	-0,040	**0,186**	0,101	**0,313**	**0,207**	**0,291**	-0,162	-0,001	-0,008	**-0,388**	**0,334**	**0,289**
Zr/Rb	**-0,218**	0,059	0,012	-0,060	-0,150	-0,025	0,024	-0,034	0,125	0,097	0,011	0,151	**-0,176**	-0,076

Variables	F. peragalli	F. pseudonana	F. rhombica	F. ritscherii	F. separanda	F. sublinearis	F. vanheurckii	ramatophora sp	Licmophora spp	M. adelia	M. sol	N. directa	N. glaciei	Nitzschia spp
[HBI:2]	0,051	-0,043	**-0,245**	-0,148	-0,054	-0,063	-0,005	-0,009	-0,053	**0,451**	**0,199**	0,056	0,108	-0,029
[HBI:2]/[HBI:3]	-0,021	-0,073	**-0,169**	**-0,177**	-0,117	-0,123	0,090	-0,031	0,022	**0,366**	**0,181**	0,124	0,121	-0,044
[HBI:3]	0,056	**0,256**	-0,118	-0,071	0,110	-0,037	-0,144	-0,014	-0,070	-0,033	-0,059	-0,024	-0,068	0,030
A. actinochylus	-0,074	-0,121	0,102	0,029	-0,081	0,153	0,013	0,006	-0,037	0,045	**0,195**	0,001	-0,139	0,110
A. Curvatulus	-0,030	0,027	0,060	-0,099	-0,052	0,014	-0,070	**0,204**	-0,069	0,091	-0,021	0,082	0,055	-0,086
A. hookerii	-0,077	0,151	-0,013	-0,046	**0,386**	-0,033	0,071	-0,058	-0,109	-0,137	0,093	0,001	**-0,184**	**0,194**
A. hyalinus	0,083	**0,166**	-0,071	-0,049	**0,281**	-0,089	-0,081	-0,057	0,133	-0,032	0,073	-0,001	0,129	-0,077
Acnanthes spp	-0,021	-0,043	-0,013	**0,334**	0,072	0,056	0,081	-0,030	-0,048	-0,038	0,064	-0,010	-0,075	-0,082
Amphora spp	-0,012	0,070	-0,030	0,102	-0,063	-0,002	0,027	-0,017	-0,027	-0,086	-0,059	0,008	0,064	-0,007
C. atlantica	-0,048	-0,062	**-0,216**	-0,113	0,067	0,042	-0,063	-0,068	0,041	0,027	-0,083	0,007	-0,023	0,089
C. bulbosum	-0,049	**0,168**	-0,037	-0,045	0,136	-0,102	-0,148	-0,070	-0,050	0,039	-0,029	-0,089	-0,045	0,009
C. costata	-0,043	-0,131	0,089	0,017	-0,093	0,026	-0,038	-0,061	0,084	0,090	-0,014	0,019	0,031	0,011
C. cryophilum	0,029	-0,039	**0,442**	**0,181**	-0,123	**0,168**	-0,027	0,041	-0,046	-0,033	0,007	-0,099	-0,098	0,086
C. dichaeta	-0,070	-0,109	**-0,256**	**-0,193**	-0,054	-0,096	-0,084	-0,014	0,014	-0,036	-0,035	0,004	0,085	-0,098
C. fasciolata	-0,039	-0,088	-0,080	0,105	0,000	**0,250**	0,025	-0,055	0,109	0,097	0,028	-0,084	-0,064	-0,074
C. hyalochaete R	-0,010	**-0,278**	**-0,351**	0,036	**-0,173**	-0,148	**0,176**	-0,101	0,079	-0,078	0,020	0,033	-0,027	-0,039
C. Phaeoceros gr	-0,050	-0,135	-0,146	**-0,212**	-0,067	**-0,207**	0,095	0,015	-0,036	0,128	-0,039	0,053	0,036	-0,062
Ch. cryophilus	-0,002	0,117	0,026	**-0,194**	0,065	-0,045	0,012	0,067	0,098	**0,235**	-0,034	0,016	0,081	0,032
Cocconeis spp	-0,025	-0,016	0,119	-0,044	0,069	0,073	-0,128	-0,035	-0,056	-0,010	-0,120	**0,178**	0,028	-0,022
Coscinodiscus sp	-0,039	**-0,193**	**0,259**	**0,215**	-0,131	**0,188**	-0,033	-0,056	-0,017	0,054	-0,075	-0,158	-0,155	0,002
Diploneis spp	-0,016	-0,137	0,013	**0,278**	0,019	0,054	**0,199**	-0,022	0,143	-0,067	0,020	-0,049	0,016	-0,081
E. antarctica	0,029	**-0,180**	**0,373**	0,083	-0,110	**0,223**	-0,116	0,042	-0,004	**0,264**	0,063	-0,082	0,097	0,151
Entomoneis spp	-0,016	-0,069	-0,088	-0,026	-0,110	-0,012	-0,012	-0,023	-0,036	-0,029	-0,078	-0,081	-0,029	0,006
Ephemera spp	0,072	**0,221**	-0,082	**-0,219**	0,102	**-0,165**	-0,141	0,102	0,043	**0,167**	0,090	**0,181**	0,135	-0,016
F. curta	-0,048	**-0,183**	-0,051	0,114	**0,225**	**0,234**	0,037	0,063	-0,016	-0,016	-0,099	0,050	-0,037	0,055
F. cylindrus	-0,038	**0,535**	**-0,239**	**-0,346**	-0,068	**-0,349**	**-0,200**	-0,093	-0,085	-0,003	-0,020	0,083	0,162	-0,097
F. kerguelensis	0,150	0,063	0,027	0,090	**0,356**	0,138	0,057	0,004	-0,016	0,083	0,133	-0,033	-0,117	0,098
F. obliquecostata	-0,028	-0,132	**0,454**	0,117	-0,111	0,155	**-0,189**	0,160	-0,036	0,083	-0,022	-0,126	0,114	-0,001
F. peragalli	**1**	-0,023	0,005	0,074	0,090	0,080	-0,056	-0,010	-0,016	-0,050	-0,035	-0,077	-0,039	-0,037
F. pseudonana	-0,023	**1**	-0,156	**-0,332**	0,093	**-0,319**	-0,130	0,042	-0,028	0,033	0,125	0,139	0,032	0,063
F. rhombica	0,005	-0,156	**1**	**0,248**	-0,123	**0,196**	-0,058	**0,168**	0,106	-0,052	-0,048	**-0,189**	-0,101	-0,040
F. ritscherii	0,074	**-0,332**	**0,248**	**1**	-0,112	**0,501**	**0,299**	0,009	0,027	-0,145	-0,087	**-0,200**	**-0,208**	0,048
F. separanda	0,090	0,093	-0,123	-0,112	**1**	-0,038	**-0,179**	-0,020	-0,047	-0,068	0,032	0,035	-0,047	0,066
F. sublinearis	0,080	**-0,319**	**0,196**	**0,501**	-0,038	**1**	**0,178**	0,138	0,007	-0,021	-0,053	-0,126	-0,121	0,073
F. vanheurckii	-0,056	-0,130	-0,058	**0,299**	**-0,179**	**0,178**	**1**	0,056	0,104	-0,077	-0,023	0,046	-0,115	-0,031
ramatophora sp	-0,010	0,042	**0,168**	0,009	-0,020	0,138	0,056	**1**	-0,023	0,089	-0,049	-0,036	-0,055	-0,052
Licmophora spp	-0,016	-0,028	0,106	0,027	-0,047	0,007	0,104	-0,023	**1**	-0,063	0,034	0,044	-0,029	-0,083
M. adelia	-0,050	0,033	-0,052	-0,145	-0,068	-0,021	-0,077	0,089	-0,063	**1**	0,073	0,007	0,037	0,027
M. sol	-0,035	0,125	-0,048	-0,087	0,032	-0,053	-0,023	-0,049	0,034	0,073	**1**	-0,046	-0,059	0,088

Variables	F. peragalli	F. pseudonana	F. rhombica	F. ritscherii	F. separanda	F. sublinearis	F. vanheurckii	ramatophora sp	Licmophora spp	M. adelia	M. sol	N. directa	N. glaciei	Nitzschia spp
N. directa	-0,077	0,139	**-0,189**	**-0,200**	0,035	-0,126	0,046	-0,036	0,044	0,007	-0,046	**1**	0,150	-0,040
N. glaciei	-0,039	0,032	-0,101	**-0,208**	-0,047	-0,121	-0,115	-0,055	-0,029	0,037	-0,059	0,150	**1**	-0,036
Nitzschia spp	-0,037	0,063	-0,040	0,048	0,066	0,073	-0,031	-0,052	-0,083	0,027	0,088	-0,040	-0,036	**1**
O. weissflogii	-0,017	-0,096	0,041	0,136	-0,063	0,104	-0,012	-0,024	-0,038	-0,088	-0,012	0,043	-0,056	0,063
P. alata	-0,034	0,142	-0,072	-0,137	**0,304**	0,028	-0,067	-0,048	-0,077	0,117	0,075	0,062	**0,202**	**0,165**
P. glacialis	0,143	-0,160	0,051	0,129	-0,034	**0,255**	0,004	0,081	-0,083	-0,134	0,072	-0,041	-0,004	0,159
P. inermis	-0,022	**0,412**	-0,090	**-0,224**	0,080	**-0,203**	-0,051	0,032	-0,049	-0,068	-0,020	0,118	0,001	-0,073
pseudodenticula	0,055	-0,147	0,101	0,063	0,038	**0,208**	**-0,202**	-0,004	0,020	-0,126	-0,097	**-0,197**	-0,052	0,128
P. tronca	-0,041	**0,173**	0,155	-0,112	**0,169**	0,021	-0,141	**0,197**	-0,093	0,090	0,063	**0,193**	0,011	0,106
dogomphonema	-0,032	-0,129	-0,009	0,107	-0,036	0,122	-0,086	-0,045	-0,072	**0,171**	0,127	-0,070	-0,035	-0,024
eudo-nitschia sp	-0,110	**0,198**	-0,007	**-0,230**	0,071	**-0,331**	-0,030	-0,048	-0,046	-0,007	-0,089	0,119	**0,169**	-0,067
Rhizosolenia spp	0,005	0,146	-0,026	-0,150	-0,042	0,046	-0,038	0,038	-0,020	0,037	0,022	0,059	0,021	-0,027
S. fragilis	-0,031	-0,005	-0,040	0,029	-0,037	0,011	0,122	-0,044	0,024	0,074	**0,177**	0,069	0,026	**0,250**
S. microtrias	0,010	**-0,194**	-0,008	0,065	-0,021	0,132	-0,007	-0,029	-0,015	0,001	-0,098	-0,060	-0,068	0,025
S. recta	**0,431**	0,035	**0,222**	0,006	-0,008	**0,165**	-0,073	0,122	-0,066	-0,155	-0,117	-0,005	**0,263**	0,024
T. antarctica	0,115	**-0,271**	**-0,212**	0,054	0,032	**0,234**	0,057	0,032	-0,028	-0,023	0,023	-0,083	-0,040	0,059
T. frenguelli	-0,014	0,033	0,039	-0,110	-0,063	0,052	-0,065	-0,020	**0,199**	0,012	0,055	**0,175**	0,031	-0,074
T. gracilis	-0,010	0,134	-0,068	-0,049	**0,269**	-0,013	0,012	-0,099	-0,044	0,131	0,055	0,022	-0,112	0,102
T. gravida	-0,057	-0,069	-0,035	0,037	0,164	-0,163	-0,048	-0,081	0,023	**-0,186**	-0,018	-0,013	-0,108	-0,040
T. lentiginosa	0,073	-0,157	0,079	0,155	0,035	0,092	0,101	-0,103	-0,005	0,035	**0,172**	-0,041	-0,111	**0,177**
T. oliverana	-0,039	**-0,189**	0,028	0,029	-0,136	**0,191**	-0,075	-0,055	-0,021	-0,035	0,135	**-0,167**	-0,100	0,095
T. ritscheri	0,031	-0,020	-0,140	-0,091	**0,171**	0,039	-0,066	-0,029	0,008	-0,076	0,080	0,143	0,056	-0,052
T. toxon	0,152	-0,106	-0,019	0,121	-0,017	0,149	0,051	0,095	0,021	**0,243**	0,104	-0,140	0,076	-0,033
T. trifulta	-0,048	**-0,177**	**0,201**	**0,205**	-0,104	**0,270**	0,007	0,125	-0,047	0,107	-0,064	0,070	0,023	0,022
T. tumida	**0,165**	-0,159	-0,016	-0,031	-0,061	**0,249**	0,004	-0,004	-0,048	**0,198**	0,079	-0,083	**0,200**	0,004
Ti	-0,017	-0,104	-0,047	-0,058	**0,166**	0,107	0,061	0,029	0,077	0,155	0,112	0,076	0,025	0,033
Trachyneis spp	-0,013	-0,086	-0,108	-0,059	**0,172**	0,105	-0,101	-0,018	-0,029	-0,054	0,016	-0,040	0,082	-0,066
Tx. antarctica	0,070	**-0,244**	**0,238**	**0,253**	-0,083	**0,209**	0,139	0,148	0,086	0,014	0,099	-0,068	-0,152	-0,009
Zr/Rb	-0,055	**0,236**	-0,042	-0,132	**-0,173**	**-0,226**	-0,018	0,000	0,060	-0,041	0,019	-0,073	0,025	-0,087

Variables	O. weissflogii	P. alata	P. glacialis	P. inermis	pseudodenticula	P. tronca	dogomphonema	eudo-nitschia s	Rhizosolenia spp	S. fragilis	S. microtrias	S. recta	T. antarctica	T. frenguelli
[HBI:2]	0,036	**0,206**	0,146	**-0,209**	-0,076	0,010	**0,266**	-0,010	-0,117	**0,198**	0,003	-0,092	**0,218**	-0,128
[HBI:2]/[HBI:3]	-0,040	0,154	0,095	**-0,244**	-0,144	0,124	**0,262**	0,087	**-0,177**	0,152	-0,020	-0,076	0,087	-0,082
[HBI:3]	0,107	0,001	-0,097	**0,635**	0,104	0,103	-0,009	-0,042	**0,491**	-0,089	-0,104	-0,050	-0,101	0,091
A. actinochylus	-0,012	0,060	**0,225**	-0,032	-0,008	0,092	0,132	**-0,295**	0,097	0,162	0,027	-0,084	**0,224**	0,075
A. Curvatulus	**0,193**	-0,042	0,026	-0,077	0,074	0,137	0,105	0,097	-0,068	-0,135	0,031	0,144	0,058	-0,061
A. hookerii	-0,051	0,089	0,004	**0,241**	-0,026	0,142	-0,090	0,128	0,081	0,027	-0,082	0,007	-0,080	-0,047
A. hyalinus	0,011	0,139	0,149	0,076	-0,003	0,046	-0,001	0,016	-0,031	0,104	-0,026	0,005	**0,237**	**0,168**
Acnanthes spp	0,104	0,109	0,007	-0,074	-0,032	-0,124	-0,020	-0,124	-0,018	-0,026	0,008	-0,087	0,133	-0,043
Amphora spp	**0,281**	0,012	0,121	0,054	-0,029	0,097	-0,054	-0,052	0,077	-0,054	0,095	0,164	0,053	-0,024
C. atlantica	0,035	-0,072	0,050	-0,163	0,081	-0,077	0,046	0,028	-0,112	-0,012	**0,214**	-0,060	**0,299**	0,026
C. bulbosum	-0,117	0,052	0,043	0,079	0,056	-0,044	-0,048	0,102	0,031	-0,134	-0,074	-0,106	-0,061	0,036
C. costata	-0,102	0,087	0,105	-0,014	0,129	-0,072	0,085	**-0,190**	-0,044	0,101	0,041	-0,130	0,098	-0,087
C. cryophilum	0,112	-0,003	0,076	-0,025	0,018	-0,070	-0,113	-0,104	-0,022	-0,039	0,094	**0,191**	0,001	-0,088
C. dichaeta	-0,021	-0,066	-0,068	**-0,174**	-0,078	-0,061	0,028	-0,042	-0,063	-0,077	0,014	-0,042	**0,303**	0,023
C. fasciolata	-0,015	0,039	0,085	-0,163	0,054	-0,081	0,009	**-0,209**	0,075	-0,002	0,002	-0,122	**0,381**	0,004
C. hyalochaete R	-0,061	-0,073	-0,051	**-0,261**	-0,142	**-0,311**	0,073	-0,151	**-0,180**	0,054	-0,032	-0,132	0,083	-0,100
C. Phaeoceros gr	-0,044	-0,061	-0,092	-0,010	**-0,167**	0,054	0,074	0,065	0,104	0,052	0,026	-0,127	0,066	-0,121
Ch. cryophilus	-0,104	-0,019	0,001	-0,078	-0,031	-0,014	-0,064	**0,195**	0,086	**0,170**	0,012	0,042	-0,010	0,005
Cocconeis spp	**0,311**	0,080	0,049	0,041	0,051	**0,259**	-0,067	-0,032	0,136	-0,053	0,107	**0,289**	0,081	-0,050
Coscinodiscus sp	0,159	-0,007	**0,210**	-0,139	0,004	-0,011	0,019	**-0,247**	0,029	-0,075	**0,211**	-0,028	0,100	-0,079
Diploneis spp	0,075	0,021	-0,059	-0,078	0,081	-0,091	-0,070	-0,007	-0,066	-0,069	0,024	0,036	-0,009	-0,031
E. antarctica	0,002	0,065	**0,234**	**-0,237**	0,046	-0,012	-0,045	**-0,208**	0,058	0,004	0,155	0,147	0,063	0,036
Entomoneis spp	-0,038	-0,077	0,062	-0,074	**0,263**	-0,093	-0,072	-0,103	-0,040	-0,071	-0,015	-0,066	0,092	-0,032
Ephemera spp	-0,082	0,069	-0,040	0,128	-0,136	0,155	-0,150	**0,257**	-0,011	-0,011	-0,138	0,027	-0,118	0,079
F. curta	0,073	0,045	0,013	0,010	0,100	0,130	0,144	-0,038	-0,143	0,048	0,120	-0,045	-0,040	0,099
F. cylindrus	-0,162	-0,063	**-0,303**	**0,353**	-0,040	-0,035	**-0,178**	**0,337**	0,093	**-0,196**	**-0,246**	-0,058	**-0,363**	0,049
F. kerguelensis	0,088	**0,293**	**0,235**	-0,049	0,074	0,153	0,007	-0,145	0,097	0,121	0,156	-0,023	**0,184**	-0,007
F. obliquecostata	0,141	-0,070	0,141	-0,097	0,115	0,124	-0,018	-0,093	0,053	-0,060	0,100	**0,258**	0,029	0,013
F. peragalli	-0,017	-0,034	0,143	-0,022	0,055	-0,041	-0,032	-0,110	0,005	-0,031	0,010	**0,431**	0,115	-0,014
F. pseudonana	-0,096	0,142	-0,160	**0,412**	-0,147	**0,173**	-0,129	**0,198**	0,146	-0,005	**-0,194**	0,035	**-0,271**	0,033
F. rhombica	0,041	-0,072	0,051	-0,090	0,101	0,155	-0,009	-0,007	-0,026	-0,040	-0,008	**0,222**	**-0,212**	0,039
F. ritscherii	0,136	-0,137	0,129	**-0,224**	0,063	-0,112	0,107	**-0,230**	-0,150	0,029	0,065	0,006	0,054	-0,110
F. separanda	-0,063	**0,304**	-0,034	0,080	0,038	**0,169**	-0,036	0,071	-0,042	-0,037	-0,021	-0,008	0,032	-0,063
F. sublinearis	0,104	0,028	**0,255**	**-0,203**	**0,208**	0,021	0,122	**-0,331**	0,046	0,011	0,132	**0,165**	**0,234**	0,052
F. vanheurckii	-0,012	-0,067	0,004	-0,051	**-0,202**	-0,141	-0,086	-0,030	-0,038	0,122	-0,007	-0,073	0,057	-0,065
Gramatophora sp	-0,024	-0,048	0,081	0,032	-0,004	**0,197**	-0,045	-0,048	0,038	-0,044	-0,029	0,122	0,032	-0,020
Licmophora spp	-0,038	-0,077	-0,083	-0,049	0,020	-0,093	-0,072	-0,046	-0,020	0,024	-0,015	-0,066	-0,028	**0,199**
M. adelia	-0,088	0,117	-0,134	-0,068	-0,126	0,090	**0,171**	-0,007	0,037	0,074	0,001	-0,155	-0,023	0,012
M. sol	-0,012	0,075	0,072	-0,020	-0,097	0,063	0,127	-0,089	0,022	**0,177**	-0,098	-0,117	0,023	0,055

Variables	O. weissflogii	P. alata	P. glacialis	P. inermis	pseudodenticula	P. tronca	dogomphonema	eudo-nitschia sp	Rhizosolenia spp	S. fragilis	S. microtrias	S. recta	T. antarctica	T. frenguelli
N. directa	0,043	0,062	-0,041	0,118	**-0,197**	**0,193**	-0,070	0,119	0,059	0,069	-0,060	-0,005	-0,083	**0,175**
N. glaciei	-0,056	**0,202**	-0,004	0,001	-0,052	0,011	-0,035	**0,169**	0,021	0,026	-0,068	**0,263**	-0,040	0,031
Nitzschia spp	0,063	**0,165**	0,159	-0,073	0,128	0,106	-0,024	-0,067	-0,027	**0,250**	0,025	0,024	0,059	-0,074
O. weissflogii	**1**	0,107	0,129	-0,044	0,010	0,091	0,017	-0,005	0,050	-0,075	0,113	**0,173**	0,162	-0,034
P. alata	0,107	**1**	-0,018	0,060	-0,035	**0,261**	-0,034	-0,074	0,086	0,054	-0,107	-0,002	0,023	-0,068
P. glacialis	0,129	-0,018	**1**	-0,154	**0,252**	0,047	0,089	**-0,234**	0,053	**0,190**	0,157	0,130	**0,356**	-0,068
P. inermis	-0,044	0,060	-0,154	**1**	-0,037	**0,250**	-0,094	0,096	**0,639**	-0,076	-0,118	0,014	**-0,308**	0,140
pseudodenticula	0,010	-0,035	**0,252**	-0,037	**1**	-0,028	0,093	-0,073	0,045	0,013	0,152	0,019	0,093	-0,005
P. tronca	0,091	**0,261**	0,047	**0,250**	-0,028	**1**	0,162	0,068	0,119	0,005	-0,114	0,137	-0,068	0,008
dogomphonema	0,017	-0,034	0,089	-0,094	0,093	0,162	**1**	-0,022	-0,028	-0,040	-0,010	-0,093	-0,007	0,018
eudo-nitschia sp	-0,005	-0,074	**-0,234**	0,096	-0,073	0,068	-0,022	**1**	-0,126	-0,040	-0,147	0,030	**-0,391**	0,058
Rhizosolenia spp	0,050	0,086	0,053	**0,639**	0,045	0,119	-0,028	-0,126	**1**	-0,054	-0,048	0,039	0,027	0,090
S. fragilis	-0,075	0,054	**0,190**	-0,076	0,013	0,005	-0,040	-0,040	-0,054	**1**	-0,044	-0,107	0,090	0,043
S. microtrias	0,113	-0,107	0,157	-0,118	0,152	-0,114	-0,010	-0,147	-0,048	-0,044	**1**	0,107	0,132	-0,073
S. recta	**0,173**	-0,002	0,130	0,014	0,019	0,137	-0,093	0,030	0,039	-0,107	0,107	**1**	0,010	-0,058
T. antarctica	0,162	0,023	**0,356**	**-0,308**	0,093	-0,068	-0,007	**-0,391**	0,027	0,090	0,132	0,010	**1**	-0,116
T. frenguelli	-0,034	-0,068	-0,068	0,140	-0,005	0,008	0,018	0,058	0,090	0,043	-0,073	-0,058	-0,116	**1**
T. gracilis	-0,019	0,145	0,042	0,016	-0,099	**0,208**	0,033	-0,004	-0,093	0,114	-0,011	-0,081	-0,050	**0,191**
T. gravida	-0,004	-0,038	-0,023	0,114	0,008	0,035	-0,105	0,002	-0,052	-0,078	0,084	-0,087	-0,131	0,076
T. lentiginosa	0,097	0,105	**0,304**	**-0,197**	0,038	-0,056	-0,028	**-0,288**	0,003	**0,233**	**0,186**	0,024	**0,266**	0,024
T. oliverana	-0,022	-0,114	**0,262**	**-0,174**	0,035	-0,095	-0,033	-0,159	0,003	0,001	-0,002	0,012	**0,280**	-0,079
T. ritscheri	0,035	0,049	-0,056	0,060	0,071	0,065	0,057	-0,105	0,108	-0,017	0,082	0,012	0,129	-0,042
T. toxon	0,139	0,091	0,066	-0,128	-0,052	-0,096	-0,011	-0,050	-0,025	**0,177**	0,129	0,095	0,097	0,015
T. trifulta	**0,307**	0,017	0,090	-0,139	0,080	**0,170**	0,006	-0,035	-0,017	-0,099	0,026	-0,007	0,102	**0,225**
T. tumida	0,095	-0,004	**0,215**	-0,045	-0,020	0,068	0,009	-0,054	0,020	0,048	0,059	**0,210**	0,130	-0,024
Ti	0,007	**0,200**	**0,228**	**-0,265**	0,049	-0,026	0,066	-0,085	-0,091	0,155	0,087	-0,009	**0,238**	0,016
Trachyneis spp	-0,030	0,017	0,004	-0,101	-0,071	-0,074	-0,006	-0,090	-0,076	0,010	0,084	0,021	**0,294**	-0,026
Tx. antarctica	**0,187**	-0,009	**0,264**	-0,118	-0,016	-0,040	-0,079	**-0,260**	0,117	0,073	**0,217**	0,065	0,161	0,072
Zr/Rb	-0,031	-0,043	**-0,193**	0,099	-0,004	0,092	-0,031	-0,020	-0,090	-0,072	-0,097	-0,061	**-0,188**	-0,158

Variables	T. gracilis	T. gravida	T. lentiginosa	T. oliverana	T. ritscheri	T. toxon	T. trifulta	T. tumida	Ti	Trachyneis spp	Tx. antarctica	Zr/Rb
[HBI:2]	0,163	-0,138	0,110	-0,037	0,028	**0,178**	0,002	0,147	**0,372**	0,080	0,000	0,060
[HBI:2]/[HBI:3]	0,101	-0,102	0,042	0,002	-0,009	0,079	-0,012	0,044	**0,394**	0,056	-0,040	0,063
[HBI:3]	0,026	0,127	**-0,195**	-0,157	0,123	-0,053	-0,070	-0,049	**-0,218**	-0,040	-0,162	0,081
A. actinochylus	**0,218**	-0,018	**0,330**	**0,166**	0,142	-0,026	0,152	0,125	0,150	0,044	**0,283**	0,023
A. Curvatulus	-0,064	**-0,223**	-0,140	**-0,168**	0,033	-0,139	0,039	0,033	0,063	0,001	-0,034	0,024
A. hookerii	**0,297**	**0,300**	**0,173**	-0,006	0,100	0,033	-0,077	0,072	-0,130	-0,078	0,009	-0,077
A. hyalinus	0,096	0,040	0,087	-0,092	-0,004	0,051	0,106	0,052	0,044	**0,219**	0,036	**-0,226**
Acnanthes spp	0,116	**0,170**	0,149	-0,069	-0,018	0,077	**0,197**	-0,135	0,071	-0,038	**0,183**	-0,068
Amphora spp	-0,038	-0,098	0,060	-0,067	-0,013	-0,067	**0,191**	0,004	-0,033	-0,022	-0,012	0,009
C. atlantica	-0,080	-0,054	-0,100	0,071	**0,165**	-0,072	0,076	0,017	0,096	0,015	-0,115	-0,096
C. bulbosum	0,047	**0,227**	-0,039	-0,101	-0,119	-0,050	0,067	-0,063	-0,013	-0,003	-0,043	0,003
C. costata	0,008	-0,052	-0,002	0,095	0,055	-0,148	-0,103	-0,015	**0,176**	-0,077	-0,099	0,112
C. cryophilum	**-0,180**	-0,148	**0,187**	0,067	-0,014	0,130	0,074	0,139	0,027	0,110	**0,298**	-0,067
C. dichaeta	-0,143	**-0,167**	-0,088	0,164	**0,230**	-0,028	0,078	0,043	0,125	**0,226**	-0,083	0,022
C. fasciolata	0,063	0,031	**0,234**	**0,184**	0,049	0,100	-0,043	0,095	0,086	-0,018	0,112	**-0,218**
C. hyalochaete R	-0,140	0,029	-0,072	0,052	0,052	-0,062	**-0,210**	-0,158	0,087	0,077	-0,131	0,059
C. Phaeoceros gr	-0,046	-0,162	-0,153	-0,007	0,050	0,025	-0,072	0,007	0,147	0,021	-0,040	0,012
Ch. cryophilus	0,069	-0,123	0,163	0,089	0,051	0,139	0,042	0,144	**0,167**	-0,058	**0,186**	-0,060
Cocconeis spp	-0,036	0,000	0,100	-0,136	0,053	-0,147	0,032	0,076	-0,033	-0,044	0,101	-0,150
Coscinodiscus sp	-0,080	0,040	**0,190**	0,032	-0,055	0,100	**0,174**	0,105	-0,038	0,114	**0,313**	-0,025
Diploneis spp	-0,042	0,157	0,141	0,074	-0,093	0,040	0,106	-0,128	0,046	-0,028	**0,207**	0,024
E. antarctica	-0,038	-0,137	**0,260**	**0,234**	0,079	0,160	0,130	**0,245**	**0,175**	-0,092	**0,291**	-0,034
Entomoneis spp	-0,071	-0,129	-0,137	0,046	0,055	-0,086	0,015	-0,031	0,006	-0,029	-0,162	0,125
Ephemera spp	0,121	0,061	0,068	-0,101	-0,109	0,082	-0,020	0,041	-0,019	-0,025	-0,001	0,097
F. curta	**0,249**	0,092	-0,022	-0,143	0,088	0,092	**0,183**	0,137	-0,051	0,033	-0,008	0,011
F. cylindrus	**-0,216**	0,036	**-0,378**	-0,143	-0,111	**-0,219**	**-0,200**	-0,150	**-0,283**	-0,091	**-0,388**	0,151
F. kerguelensis	**0,485**	0,001	**0,507**	0,053	-0,011	**0,213**	0,136	0,051	**0,248**	-0,035	**0,334**	**-0,176**
F. obliquecostata	**-0,206**	-0,084	0,056	0,087	-0,019	0,055	**0,178**	**0,248**	-0,001	-0,099	**0,289**	-0,076
F. peragalli	-0,010	-0,057	0,073	-0,039	0,031	0,152	-0,048	**0,165**	-0,017	-0,013	0,070	-0,055
F. pseudonana	0,134	-0,069	-0,157	**-0,189**	-0,020	-0,106	**-0,177**	-0,159	-0,104	-0,086	**-0,244**	**0,236**
F. rhombica	-0,068	-0,035	0,079	0,028	-0,140	-0,019	**0,201**	-0,016	-0,047	-0,108	**0,238**	-0,042
F. ritscherii	-0,049	0,037	0,155	0,029	-0,091	0,121	**0,205**	-0,031	-0,058	-0,059	**0,253**	-0,132
F. separanda	**0,269**	0,164	0,035	-0,136	**0,171**	-0,017	-0,104	-0,061	**0,166**	**0,172**	-0,083	**-0,173**
F. sublinearis	-0,013	-0,163	0,092	**0,191**	0,039	0,149	**0,270**	**0,249**	0,107	0,105	**0,209**	**-0,226**
F. vanheurckii	0,012	-0,048	0,101	-0,075	-0,066	0,051	0,007	0,004	0,061	-0,101	0,139	-0,018
Gramatophora sp	-0,099	-0,081	-0,103	-0,055	-0,029	0,095	0,125	-0,004	0,029	-0,018	0,148	0,000
Licmophora spp	-0,044	0,023	-0,005	-0,021	0,008	0,021	-0,047	-0,048	0,077	-0,029	0,086	0,060
M. adelia	0,131	**-0,186**	0,035	-0,035	-0,076	**0,243**	0,107	**0,198**	0,155	-0,054	0,014	-0,041
M. sol	0,055	-0,018	**0,172**	0,135	0,080	0,104	-0,064	0,079	0,112	0,016	0,099	0,019

Variables	T. gracilis	T. gravida	T. lentiginosa	T. oliverana	T. ritscheri	T. toxon	T. trifulta	T. tumida	Ti	Trachyneis spp	Tx. antarctica	Zr/Rb
N. directa	0,022	-0,013	-0,041	**-0,167**	0,143	-0,140	0,070	-0,083	0,076	-0,040	-0,068	-0,073
N. glaciei	-0,112	-0,108	-0,111	-0,100	0,056	0,076	0,023	**0,200**	0,025	0,082	-0,152	0,025
Nitzschia spp	0,102	-0,040	**0,177**	0,095	-0,052	-0,033	0,022	0,004	0,033	-0,066	-0,009	-0,087
O. weissflogii	-0,019	-0,004	0,097	-0,022	0,035	0,139	**0,307**	0,095	0,007	-0,030	**0,187**	-0,031
P. alata	0,145	-0,038	0,105	-0,114	0,049	0,091	0,017	-0,004	**0,200**	0,017	-0,009	-0,043
P. glacialis	0,042	-0,023	**0,304**	**0,262**	-0,056	0,066	0,090	**0,215**	**0,228**	0,004	**0,264**	**-0,193**
P. inermis	0,016	0,114	**-0,197**	**-0,174**	0,060	-0,128	-0,139	-0,045	**-0,265**	-0,101	-0,118	0,099
pseudodenticula	-0,099	0,008	0,038	0,035	0,071	-0,052	0,080	-0,020	0,049	-0,071	-0,016	-0,004
P. tronca	**0,208**	0,035	-0,056	-0,095	0,065	-0,096	**0,170**	0,068	-0,026	-0,074	-0,040	0,092
dogomphonema	0,033	-0,105	-0,028	-0,033	0,057	-0,011	0,006	0,009	0,066	-0,006	-0,079	-0,031
eudo-nitschia sp	-0,004	0,002	**-0,288**	-0,159	-0,105	-0,050	-0,035	-0,054	-0,085	-0,090	**-0,260**	-0,020
Rhizosolenia spp	-0,093	-0,052	0,003	0,003	0,108	-0,025	-0,017	0,020	-0,091	-0,076	0,117	-0,090
S. fragilis	0,114	-0,078	**0,233**	0,001	-0,017	**0,177**	-0,099	0,048	0,155	0,010	0,073	-0,072
S. microtrias	-0,011	0,084	**0,186**	-0,002	0,082	0,129	0,026	0,059	0,087	0,084	**0,217**	-0,097
S. recta	-0,081	-0,087	0,024	0,012	0,012	0,095	-0,007	**0,210**	-0,009	0,021	0,065	-0,061
T. antarctica	-0,050	-0,131	**0,266**	**0,280**	0,129	0,097	0,102	0,130	**0,238**	**0,294**	0,161	**-0,188**
T. frenguelli	**0,191**	0,076	0,024	-0,079	-0,042	0,015	**0,225**	-0,024	0,016	-0,026	0,072	-0,158
T. gracilis	**1**	0,141	**0,266**	0,064	-0,105	0,076	0,047	-0,027	0,148	-0,033	0,159	0,119
T. gravida	0,141	**1**	0,051	-0,097	-0,113	-0,057	-0,034	-0,134	**-0,164**	-0,062	0,081	-0,027
T. lentiginosa	**0,266**	0,051	**1**	**0,251**	-0,006	**0,233**	0,131	0,097	0,119	-0,018	**0,528**	-0,133
T. oliverana	0,064	-0,097	**0,251**	**1**	0,036	0,011	-0,083	0,045	0,089	0,055	0,054	0,106
T. ritscheri	-0,105	-0,113	-0,006	0,036	**1**	-0,075	-0,017	0,053	0,052	**0,170**	-0,050	0,097
T. toxon	0,076	-0,057	**0,233**	0,011	-0,075	**1**	0,062	**0,306**	0,075	0,090	**0,303**	-0,158
T. trifulta	0,047	-0,034	0,131	-0,083	-0,017	0,062	**1**	0,153	0,015	-0,043	0,151	-0,112
T. tumida	-0,027	-0,134	0,097	0,045	0,053	**0,306**	0,153	**1**	-0,045	-0,034	**0,254**	**-0,169**
Ti	0,148	**-0,164**	0,119	0,089	0,052	0,075	0,015	-0,045	**1**	**0,236**	0,026	-0,084
Trachyneis spp	-0,033	-0,062	-0,018	0,055	**0,170**	0,090	-0,043	-0,034	**0,236**	**1**	-0,043	-0,016
Tx. antarctica	0,159	0,081	**0,528**	0,054	-0,050	**0,303**	0,151	**0,254**	0,026	-0,043	**1**	-0,137
Zr/Rb	0,119	-0,027	-0,133	0,106	0,097	-0,158	-0,112	**-0,169**	-0,084	-0,016	-0,137	**1**

Table S3. Pearson matrix of coefficient correlation, from the PCA between seasonal meteorological parameters averaged over the spring period (September to November-SON), the summer period (December to February-DJF), the autumn period (March to May-MAM) and over the winter period (June to August-JJA). Acronyms of meteorological parameters: sea ice concentration (sic); wind direction (dir); wind speed (speed); temperature (temp).

Variables	Opening	Closing	MAM_sic	JJA_sic	SON_sic	DJF_sic	MAM_dir	JJA_dir	SON_dir	DJF_dir	MAM_speed	JJA_speed	SON_speed	DJF_speed
Opening	**1**	0,051	0,060	-0,036	0,306	**0,930**	0,155	0,261	0,229	0,299	-0,068	0,196	0,072	-0,208
Closing	0,051	**1**	**-0,917**	-0,251	-0,121	0,009	0,202	-0,012	0,135	0,126	**0,360**	0,154	0,219	-0,236
MAM_sic	0,060	**-0,917**	**1**	**0,398**	0,107	0,093	-0,307	0,023	-0,091	-0,074	**-0,472**	-0,105	-0,207	0,189
JJA_sic	-0,036	-0,251	**0,398**	**1**	0,246	-0,045	-0,049	-0,020	-0,018	0,223	-0,263	-0,295	-0,121	-0,100
SON_sic	0,306	-0,121	0,107	0,246	**1**	0,278	0,329	0,184	0,158	**0,374**	-0,101	0,254	-0,131	-0,086
DJF_sic	**0,930**	0,009	0,093	-0,045	0,278	**1**	0,019	0,192	0,182	0,140	0,009	0,211	0,003	-0,086
MAM_dir	0,155	0,202	-0,307	-0,049	0,329	0,019	**1**	**0,583**	**0,398**	**0,568**	0,250	0,172	0,046	-0,299
JJA_dir	0,261	-0,012	0,023	-0,020	0,184	0,192	**0,583**	**1**	**0,679**	**0,728**	0,268	0,304	0,162	-0,304
SON_dir	0,229	0,135	-0,091	-0,018	0,158	0,182	**0,398**	**0,679**	**1**	**0,586**	0,113	0,314	0,023	-0,230
DJF_dir	0,299	0,126	-0,074	0,223	**0,374**	0,140	**0,568**	**0,728**	**0,586**	**1**	0,136	0,157	0,091	**-0,601**
MAM_speed	-0,068	**0,360**	**-0,472**	-0,263	-0,101	0,009	0,250	0,268	0,113	0,136	**1**	0,118	0,315	0,116
JJA_speed	0,196	0,154	-0,105	-0,295	0,254	0,211	0,172	0,304	0,314	0,157	0,118	**1**	0,107	0,070
SON_speed	0,072	0,219	-0,207	-0,121	-0,131	0,003	0,046	0,162	0,023	0,091	0,315	0,107	**1**	0,092
DJF_speed	-0,208	-0,236	0,189	-0,100	-0,086	-0,086	-0,299	-0,304	-0,230	**-0,601**	0,116	0,070	0,092	**1**
MAM_temp	**0,369**	**0,419**	**-0,453**	-0,218	0,025	0,344	0,154	0,075	0,226	0,049	0,294	-0,018	0,258	-0,243
JJA_temp	0,340	0,283	-0,244	-0,271	0,274	0,246	0,319	0,220	0,350	**0,356**	-0,024	**0,542**	0,166	**-0,397**
SON_temp	0,101	0,292	-0,247	-0,154	-0,094	0,060	0,073	-0,187	-0,195	0,038	0,346	-0,187	0,263	-0,037
DJF_temp	-0,022	0,216	-0,296	-0,250	-0,057	-0,088	0,103	-0,078	0,125	-0,254	-0,106	0,168	0,004	0,044

Variables	MAM_temp	JJA_temp	SON_temp	DJF_temp
Opening	**0,369**	0,340	0,101	-0,022
Closing	**0,419**	0,283	0,292	0,216
MAM_sic	**-0,453**	-0,244	-0,247	-0,296
JJA_sic	-0,218	-0,271	-0,154	-0,250
SON_sic	0,025	0,274	-0,094	-0,057
DJF_sic	0,344	0,246	0,060	-0,088
MAM_dir	0,154	0,319	0,073	0,103
JJA_dir	0,075	0,220	-0,187	-0,078
SON_dir	0,226	0,350	-0,195	0,125
DJF_dir	0,049	**0,356**	0,038	-0,254
MAM_speed	0,294	-0,024	0,346	-0,106
JJA_speed	-0,018	**0,542**	-0,187	0,168
SON_speed	0,258	0,166	0,263	0,004
DJF_speed	-0,243	**-0,397**	-0,037	0,044
MAM_temp	**1**	**0,389**	0,030	**0,423**
JJA_temp	**0,389**	**1**	0,049	0,336
SON_temp	0,030	0,049	**1**	-0,159
DJF_temp	**0,423**	0,336	-0,159	**1**

Table S4. Pearson matrix of coefficient correlation, from the PCA between significant sedimentary data and meteorological parameters, averaged over the November to March period.

Variables	EAST	SOUTH	WEST	NORTH	Temperature	Wind direction	Wind speed	SIC	Opening	Closing	Ice free season	Open water gp	Benthic gp	Banquisia gp
EAST	**1**	**-0,949**	**-0,451**	-0,248	0,063	**-0,848**	0,220	-0,035	-0,221	**-0,385**	0,048	0,209	-0,051	-0,190
SOUTH	**-0,949**	**1**	0,207	0,039	0,026	**0,771**	-0,052	0,081	0,223	0,281	-0,093	-0,193	-0,012	0,188
WEST	**-0,451**	0,207	**1**	0,143	**-0,470**	**0,666**	**-0,456**	-0,130	0,062	**0,366**	0,093	-0,004	0,192	-0,065
NORTH	-0,248	0,039	0,143	**1**	0,151	-0,004	-0,355	-0,038	0,039	0,259	0,070	-0,201	0,088	0,213
Temperature	0,063	0,026	**-0,470**	0,151	**1**	-0,222	0,085	0,040	0,104	0,272	0,014	-0,062	**-0,362**	0,338
Wind direction	**-0,848**	**0,771**	**0,666**	-0,004	-0,222	**1**	-0,302	0,054	0,233	0,207	-0,130	-0,096	-0,025	-0,011
Wind speed	0,220	-0,052	**-0,456**	-0,355	0,085	-0,302	**1**	0,045	-0,060	-0,030	0,039	-0,283	-0,069	0,131
SIC	-0,035	0,081	-0,130	-0,038	0,040	0,054	0,045	**1**	**0,916**	-0,259	**-0,962**	-0,077	-0,341	-0,178
Opening	-0,221	0,223	0,062	0,039	0,104	0,233	-0,060	**0,916**	**1**	0,051	**-0,915**	-0,122	-0,288	-0,053
Closing	**-0,385**	0,281	**0,366**	0,259	0,272	0,207	-0,030	-0,259	0,051	**1**	**0,355**	-0,139	0,146	0,259
Ice free season	0,048	-0,093	0,093	0,070	0,014	-0,130	0,039	**-0,962**	**-0,915**	**0,355**	**1**	0,061	0,328	0,160
Open water gp	0,209	-0,193	-0,004	-0,201	-0,062	-0,096	-0,283	-0,077	-0,122	-0,139	0,061	**1**	**0,367**	-0,172
Benthic gp	-0,051	-0,012	0,192	0,088	**-0,362**	-0,025	-0,069	-0,341	-0,288	0,146	0,328	**0,367**	**1**	-0,144
Banquisia gp	-0,190	0,188	-0,065	0,213	0,338	-0,011	0,131	-0,178	-0,053	0,259	0,160	-0,172	-0,144	**1**
Thalassiothrix gp	0,239	-0,157	-0,352	-0,078	0,140	**-0,456**	0,191	-0,220	-0,220	0,243	0,303	0,145	0,016	0,154
C.phaeoceros	0,308	**-0,386**	**0,371**	-0,298	**-0,441**	0,021	-0,175	-0,158	-0,211	-0,114	0,156	0,183	0,123	-0,254
CRS	-0,251	0,289	0,090	-0,163	0,004	**0,396**	**0,364**	0,091	0,044	-0,066	-0,070	-0,237	-0,224	-0,252
ilariopsis summ	0,187	-0,155	-0,233	0,041	-0,271	**-0,377**	0,229	0,057	-0,040	-0,097	-0,005	0,193	**0,517**	-0,017
F.obliquecostata	-0,139	0,184	-0,053	-0,073	-0,089	-0,058	0,060	-0,092	0,005	0,145	0,056	0,155	0,340	0,345
F.kerguelensis	0,028	-0,017	-0,066	0,017	-0,121	-0,120	-0,073	-0,354	**-0,360**	-0,058	0,316	**0,560**	**0,594**	0,205
F.cylindrus	0,089	-0,143	-0,135	**0,399**	0,266	-0,240	-0,172	0,171	0,162	0,016	-0,148	**-0,418**	-0,324	0,152
C. cryophilum	-0,001	0,059	-0,043	-0,231	-0,085	0,052	-0,236	0,116	0,111	-0,264	-0,211	0,178	-0,220	-0,091
T. antarctica	**0,535**	**-0,624**	0,154	-0,086	-0,262	-0,211	-0,236	-0,223	-0,288	-0,272	0,162	**0,467**	0,083	-0,288
E. Antarctica	0,129	-0,195	-0,003	0,255	0,017	-0,247	-0,072	0,194	0,222	0,008	-0,202	0,161	0,291	0,303
P.glacialis	**0,453**	**-0,472**	-0,110	-0,031	-0,228	**-0,435**	0,081	-0,340	**-0,431**	-0,217	0,312	0,299	0,232	-0,003
Rhizosolenia gp	-0,112	0,065	-0,078	**0,411**	0,102	-0,159	-0,296	-0,038	-0,020	0,064	0,042	-0,226	0,231	0,308
F. rhombica	-0,208	0,288	-0,221	0,026	0,215	-0,100	0,073	0,170	0,318	0,334	-0,163	-0,214	0,092	0,278
Ti	0,011	-0,105	0,162	0,244	-0,045	0,068	-0,175	-0,227	-0,121	0,056	0,141	0,351	0,273	-0,077
Zr/Rb	-0,338	0,330	0,091	0,121	0,146	0,344	0,095	0,269	0,306	0,100	-0,243	0,062	-0,016	0,219
[HBI:3]	**0,361**	**-0,412**	-0,199	0,303	-0,039	**-0,482**	-0,206	-0,097	-0,206	-0,140	0,132	0,235	0,334	-0,008
[HBI:2]	0,158	-0,260	0,218	0,119	-0,305	0,025	-0,085	-0,180	-0,178	-0,011	0,163	**0,463**	0,329	-0,126
[HBI:2]/[HBI:3]	-0,283	0,220	**0,398**	-0,052	-0,270	**0,520**	0,022	-0,127	-0,026	0,082	0,061	0,155	0,064	-0,073

Variables	Thalassiothrix gp	C.phaeoceros gp	CRS	ilariopsis summ	F.obliquecostata	F.kerguelensis	F.cylindrus	C. cryophilum	T. antarctica	E. Antarctica	P.glacialis	Rhizosolenia gp	F. rhombica	Ti
EAST	0,239	0,308	-0,251	0,187	-0,139	0,028	0,089	-0,001	**0,535**	0,129	**0,453**	-0,112	-0,208	0,011
SOUTH	-0,157	**-0,386**	0,289	-0,155	0,184	-0,017	-0,143	0,059	**-0,624**	-0,195	**-0,472**	0,065	0,288	-0,105
WEST	-0,352	**0,371**	0,090	-0,233	-0,053	-0,066	-0,135	-0,043	0,154	-0,003	-0,110	-0,078	-0,221	0,162
NORTH	-0,078	-0,298	-0,163	0,041	-0,073	0,017	**0,399**	-0,231	-0,086	0,255	-0,031	**0,411**	0,026	0,244
Temperature	0,140	**-0,441**	0,004	-0,271	-0,089	-0,121	0,266	-0,085	-0,262	0,017	-0,228	0,102	0,215	-0,045
Wind direction	**-0,456**	0,021	**0,396**	**-0,377**	-0,058	-0,120	-0,240	0,052	-0,211	-0,247	**-0,435**	-0,159	-0,100	0,068
Wind speed	0,191	-0,175	**0,364**	0,229	0,060	-0,073	-0,172	-0,236	-0,236	-0,072	0,081	-0,296	0,073	-0,175
SIC	-0,220	-0,158	0,091	0,057	-0,092	-0,354	0,171	0,116	-0,223	0,194	-0,340	-0,038	0,170	-0,227
Opening	-0,220	-0,211	0,044	-0,040	0,005	**-0,360**	0,162	0,111	-0,288	0,222	**-0,431**	-0,020	0,318	-0,121
Closing	0,243	-0,114	-0,066	-0,097	0,145	-0,058	0,016	-0,264	-0,272	0,008	-0,217	0,064	0,334	0,056
Ice free season	0,303	0,156	-0,070	-0,005	0,056	0,316	-0,148	-0,211	0,162	-0,202	0,312	0,042	-0,163	0,141
Open water gp	0,145	0,183	-0,237	0,193	0,155	**0,560**	**-0,418**	0,178	**0,467**	0,161	0,299	-0,226	-0,214	0,351
Benthic gp	0,016	0,123	-0,224	**0,517**	0,340	**0,594**	-0,324	-0,220	0,083	0,291	0,232	0,231	0,092	0,273
Banquisia gp	0,154	-0,254	-0,252	-0,017	0,345	0,205	0,152	-0,091	-0,288	0,303	-0,003	0,308	0,278	-0,077
Thalassiothrix gp	**1**	-0,086	**-0,383**	0,350	0,338	0,283	-0,014	0,192	-0,036	0,103	0,234	0,060	0,285	0,191
C.phaeoceros	-0,086	**1**	-0,061	-0,209	-0,129	-0,108	-0,318	-0,132	**0,567**	-0,095	-0,017	-0,265	**-0,445**	-0,045
CRS	**-0,383**	-0,061	**1**	-0,277	**-0,539**	-0,341	-0,226	**-0,432**	-0,306	**-0,526**	-0,342	**-0,520**	**-0,476**	-0,178
ilariopsis summ	0,350	-0,209	-0,277	**1**	0,192	**0,621**	-0,233	-0,010	0,011	**0,404**	**0,480**	0,347	0,324	0,294
F.obliquecostata	0,338	-0,129	**-0,539**	0,192	**1**	0,331	-0,146	0,297	-0,063	0,286	0,235	0,245	**0,503**	0,005
F.kerguelensis	0,283	-0,108	-0,341	**0,621**	0,331	**1**	**-0,441**	0,067	0,192	0,295	**0,407**	0,230	0,111	**0,421**
F.cylindrus	-0,014	-0,318	-0,226	-0,233	-0,146	**-0,441**	**1**	-0,028	-0,273	0,171	-0,208	**0,376**	0,001	-0,258
C. cryophilum	0,192	-0,132	**-0,432**	-0,010	0,297	0,067	-0,028	**1**	0,222	0,019	0,265	0,041	**0,387**	0,218
T. antarctica	-0,036	**0,567**	-0,306	0,011	-0,063	0,192	-0,273	0,222	**1**	0,005	**0,506**	-0,233	**-0,391**	**0,442**
E. Antarctica	0,103	-0,095	**-0,526**	**0,404**	0,286	0,295	0,171	0,019	0,005	**1**	0,198	**0,403**	0,285	0,181
P.glacialis	0,234	-0,017	-0,342	**0,480**	0,235	**0,407**	-0,208	0,265	**0,506**	0,198	**1**	0,061	0,008	0,344
Rhizosolenia gp	0,060	-0,265	**-0,520**	0,347	0,245	0,230	**0,376**	0,041	-0,233	**0,403**	0,061	**1**	**0,395**	-0,117
F. rhombica	0,285	**-0,445**	**-0,476**	0,324	**0,503**	0,111	0,001	**0,387**	**-0,391**	0,285	0,008	**0,395**	**1**	-0,008
Ti	0,191	-0,045	-0,178	0,294	0,005	**0,421**	-0,258	0,218	**0,442**	0,181	0,344	-0,117	-0,008	**1**
Zr/Rb	**-0,484**	-0,105	0,345	-0,284	-0,023	-0,181	0,038	**-0,359**	-0,284	0,044	-0,269	-0,170	-0,194	-0,273
[HBI:3]	0,250	-0,173	**-0,467**	**0,594**	-0,001	**0,474**	0,256	-0,027	0,164	0,322	**0,530**	**0,547**	0,026	0,185
[HBI:2]	0,046	0,173	-0,027	**0,373**	-0,129	**0,449**	-0,288	-0,100	**0,586**	-0,006	**0,436**	-0,247	**-0,357**	**0,561**
[HBI:2]/[HBI:3]	-0,221	0,220	**0,459**	-0,100	-0,217	0,096	**-0,476**	-0,129	0,262	-0,296	-0,120	**-0,551**	**-0,375**	**0,363**

Variables	Zr/Rb	[HBI:3]	[HBI:2]	[HBI:2]/[HBI:3]
EAST	-0,338	**0,361**	0,158	-0,283
SOUTH	0,330	**-0,412**	-0,260	0,220
WEST	0,091	-0,199	0,218	**0,398**
NORTH	0,121	0,303	0,119	-0,052
Temperature	0,146	-0,039	-0,305	-0,270
Wind direction	0,344	**-0,482**	0,025	**0,520**
Wind speed	0,095	-0,206	-0,085	0,022
SIC	0,269	-0,097	-0,180	-0,127
Opening	0,306	-0,206	-0,178	-0,026
Closing	0,100	-0,140	-0,011	0,082
Ice free season	-0,243	0,132	0,163	0,061
Open water gp	0,062	0,235	**0,463**	0,155
Benthic gp	-0,016	0,334	0,329	0,064
Banquisia gp	0,219	-0,008	-0,126	-0,073
Thalassiothrix gp	**-0,484**	0,250	0,046	-0,221
C.phaeoceros	-0,105	-0,173	0,173	0,220
CRS	0,345	**-0,467**	-0,027	**0,459**
ilariopsis summ	-0,284	**0,594**	**0,373**	-0,100
F.obliquecostata	-0,023	-0,001	-0,129	-0,217
F.kerguelensis	-0,181	**0,474**	**0,449**	0,096
F.cylindrus	0,038	0,256	-0,288	**-0,476**
C. cryophilum	**-0,359**	-0,027	-0,100	-0,129
T. antarctica	-0,284	0,164	**0,586**	0,262
E. Antarctica	0,044	0,322	-0,006	-0,296
P.glacialis	-0,269	**0,530**	**0,436**	-0,120
Rhizosolenia gp	-0,170	**0,547**	-0,247	**-0,551**
F. rhombica	-0,194	0,026	**-0,357**	**-0,375**
Ti	-0,273	0,185	**0,561**	**0,363**
Zr/Rb	**1**	-0,193	0,024	0,141
[HBI:3]	-0,193	**1**	**0,364**	**-0,474**
[HBI:2]	0,024	**0,364**	**1**	**0,582**
[HBI:2]/[HBI:3]	0,141	**-0,474**	**0,582**	**1**