

List of supplements

Supplement A: 16S reads (xlsx file)

Spreadsheet of the taxonomic affiliation for phylum, class, family, genus and species level of the 16S rRNA reads. The values are given as number of sequences and as percentages. An overview of the most dominant taxa is given by stacked barplots and different plots can be created for different views on the data.

Supplement B: Tables and figures (Pdf file)

Table S1 previously described tardigrade and rotifer species or genus from cryoconites. Dominant species are marked in bold and planctonic or predatory species are shown in brackets.

Table S2 species and genus of microalgae, including cyanobacteria in Arctic cryoconites. study 1: Kastovska et al. (2005), study 2: Mueller et al. (2001), study 3: Stibal et al. (2006), study 4: Uetake et al. (2010). Dominant species are marked in bold.

Table S3 description of the abbreviations used for the sampling sites and their geographical location in gps coordinates and altitude (error 25m). Each ID represents one cryoconite, if a cryoconite is sampled several times the number is added (eg. NC1.1, NC1.2...), the main sites (eg. Horbye main) are the sites with repeated sampling over the season. The moraine is located in front of Nordenskiöldbreen. Horbye transect are additional samples on Hørbyebreen in order to get variation in the altitudes. All samples of Hørbyebreen are summarized as HC for the analysis in the paper.

Table S4 environmental impacts on each sampling site. Remarks give special properties of the sample: a normal hole is considered as a cylindrical cryoconite between 10 and 40 cm long in diameter with cryoconite granules on the bottom, bigger holes are considered as ponds, precipitate is mainly iron precipitation on the granules, crevasse formed holes are within crevasses and formed by different processes, segmented holes are multiple holes connected by a shared water surface, V-shaped holes were typical for the supraglacial lake, proglacial ponds are either fed by glacier melt or moraine melt. Bird impacts are ranked between 0 (no impact) and 3 (high impact) depending on birds observed in the area, distances of bird colonies and the sea and observed resting places on the glacier. The observed animals are F: Northern fulmar (*Fulmarus glacialis*), G: Glaucous gull (*Larus hyperboreus*), I: ivory gull (*Pagophila eburnea*), K: black-legged kittiwake (*Rissa tridactyla*) and A: Arctic terns (*Sterna paradisaea*), the letters are sorted after their numbers of observations. Additionally, polar bears (*Ursus maritimus*) (P) were observed on one location (NR). The vegetation near the glacier is either moss (M), Nostoc mats (N) or the higher plant *Saxifrage oppositifolia* (S). The sediment cover is ranked between 0 (all sediments trapped in cryoconites) and 3 (high sediment cover on the glacier surface). The system is given as a code of the bigger hydrological system in the first three letters: Eba: Ebbabreen, Hor: Hørbyebreen, Nor: Nordenskiöldbreen, Ret: Retretøya, Lak: supraglacial lake on Nordenskiöldbreen and mor: proglacial moraine. The last letter indicates whether the holes are directly connected by meltwater flow. The closest sediment source (closest sed) indicates the closest source of locally borne, aeolian or meltwater transported sediments for the cryoconites. It is either moraines originating from nunataks (nunatak mor), moraines originating from adjacent slopes (slope mor), the glacier margin as moraine or peninsula (margin mor/penin), possible subglacial origin due to seasonal upwelling processes (subgl?) or from the proglacial

moraines (moraine). The distance to the closest slope as source of new input of sediments and biota and the distance to the sea as a source of nutrients and organisms is given in m (error 100 m).

Table S5 Abundances of the main invertebrates (ind. g⁻¹ dw.) and microalgae (cm³ g⁻¹ dw) x 10⁶. and the mean values and standard deviations for each site and for all cryoconites

Table S6 total organic carbon (TOC) and total inorganic carbon (TIC) analysis, using an elemental analyzer for Nordenskiöldbreen (NR) and Hørbyebreen (HC)

Figure S1. Organic and inorganic carbon analysis results for Nordenskiöldbreen (NR) and Hørbyebreen (HR). The error bars indicate the standard deviation of technical replicates.

Table S7. Results for nutrient analysis of sediments in mg/kg (top) and mmol/kg (bottom) and relevant ratios of particulate nutrients. P-PO₄: bioavailable phosphate, TP: total phosphate, TN: total nitrogen, TC: total Carbon, OM: organic matter.

Table S8. Water content and organic matter calculations by drying of sediments and combustion of dry sediments

Figure S2. Bird guano at the Retrettøya sampling site.

Figure S3. ARB phylogenetic tree based on full 16S sequences of published strains (NCBI). The tree is calculated, using the maximum likelihood (Phyml) algorithm. For alignments the implemented SINA alignment was used and the results were checked manually. Given are the ARB accession numbers and the genus and species name.

Supplement C: Cryoconite coverage (excel file)

Table of the data of cryoconite sediment coverage on Hørbyebreen and Nordenskiöldbreen by aerial pictures with a multicopter and manual pictures.

Supplement D: R code (folder)

R scripts (R file) and necessary data (txt files) for some statistics and creation of Figure3 and Figure5.

ANOVA ANOSim sites.R

Script for ANOVAs for the environmental differences between the sites. ANOSIM results are taken from the output of past and the p values are adapted after the false discovery rate in this script. The necessary txt file is envaverage2.txt.

Correlation grazer algae.R

Script for correlation analysis between grazer and microalgae densities. The necessary txt file is allspecies.txt

Median sizes_stats.R

Script for correlation analysis between grazer and microalgae densities. The necessary txt file is media_sizes.txt

Plotcreator3.R

Script for the creation of Figure3 and Figure5 and a summary of their source data as tables, which are shown if the script is running. The necessary txt file is envaverage2.txt.