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Executive Summary

Introduction

2008 was the second year of operation of the fully implemented Nuuk Basic programme (including both a terrestrial and a marine component), and it was expected to be the first year with complete annual time series for all sub-programmes. However, due to severe technical failures on different equipment belonging to especially the ClimateBasis and the GeoBasis programmes, many of the expected continuous time series for 2008 were broken.

Danish Polar Center closed down by the end of 2008 and as a consequence the secretariats of Nuuk Ecological Research Operations, Nuuk Basic, Zackenberg Ecological Research Operations and Zackenberg Basic were gathered in an organisation called Greenland Ecosystem Monitoring (GEM) with its own secretariat that was placed at National Environmental Research Institute at Aarhus University.

Summary from the ClimateBasis monitoring programme 2008

The ClimateBasic programme gathers and accumulates data describing the climatological and hydrological conditions in Kobbefjord. Data are measured by two automatic climate stations (C1 and C2), two automatic hydrometric stations (H1 and H2) and three diver stations (H3, H4 and H5).

The two climate stations are placed next to each other to ensure data continuity. After a few corrections during 2008 all the stations are working correctly now monitoring a total of 16 climate parameters.

In Kobbefjord measurement of the water level and manual discharge measurements at H1 started in 2006 and at H2, H3 and H4 in 2007. Manual measurements of discharge were continued at H1, H3 and H4 in 2008. In 2008 measurement of the water level and manual discharge measurements at H5 were added to the programme. H1 and H2 are measuring throughout the year, while measurements at H3, H4 and H5 starts up in early spring when the rivers are free of snow and ice, and ends in late fall before the rivers freezes.

The stage-discharge relation (Q/h relation) established for H1 after season 2007 has been re-evaluated on the basis of measurements made in 2008, although there still is a lack of measurements at high water level. For H2, H3, H4 and H5 there still is a lack of discharge measurements to establish reliable Q/h-relations. For H1, which is placed at the main river in Kobbefjord, the total discharge during the hydrological year from 1 October 2007 to 30 September 2008 was 30.1 million m3. The peak discharge in 2008 was recorded on 14 June caused by a combination of spring snow melt and precipitation.

Summary from the GeoBasis monitoring programme 2008

2008 is the first full season for the GeoBasis programme with a field season running from May to late September. However, due to cooperation with other research projects, the programme continued until late October. The programme has during 2008 unfortunately run into unforeseen problems (e.g. catabatic winds destroyed several installations, build up of snow drift in front of cameras prevented photo monitoring, high levels of melt water in the snow pack flooded the data loggers etc.). Although this has caused loss of data most of the experienced problems have now been solved or will be solved during the 2009 season. Installation of some stations had to be postponed in 2007 and they have therefore been installed during 2008.

The melting of snow and ice started in the second half of April and took speed in May. By 12 June all snow on the east side of the main river outlet had melted. The ice cover on the lakes in the area broke up during late May/beginning of June. As part of the snow monitoring three snow surveys were carried out during spring in cooperation with the ClimateBasis programme.

The micrometeorological station at 1000 m a.s.l., M1000, was installed on 4 September 2008. This installation completes installation of climate stations and we now collect climate data along the entire altitudinal gradient within the research area. Unfortunately, the SoilFen data logger was flooded and data between 18 March and late August was lost.

Three automatic soil stations are installed in the area; SoilFen, SoilEmp and SoilEmpSa. In 2008, soil water samplers (suction cup lysimeters) were installed at the same three sites. However, to allow for the soil to settle after the installation, sampling and analysis of soil water will first begin in 2009.

The methane (CH4) flux pattern reflected a dome-shaped peak with maximum about a month after snow melt and a decline to about half of the maximum towards the end of the summer season (around 1 September). In the autumn the methane flux continued to decline and it decreased consistently during September and October. The peak summer emissions reached about 5 mg CH4 m-2 h-1.

The measurements of temporal variation in daily net exchange of CO2 were initiated on 10 June and continued until 29 October. The estimated net uptake period was approximately 83 days and the maximum daily uptake reached 2.31 g C m-2 d-1 on 13 July.

Summary from the BioBasis monitoring programme 2008

2008 was the first year, in which BioBasis carried through the entire programme after the establishment of the programme in 2007.

We monitored reproductive phenology in three plant species: Silene acaulis, Salix glauca and Loiseleuria procumbens, each with four replicates separated into four sections. For L. procumbens, there was a large variation between plots in timing of flowering as the date of 50 % flowers in a plot ranged from 6 June to 2 July. In S. acaulis flowering peaked around 24 June in all four plots, indicating a longer period of maturing in the early snow free plots compared to the later snow free plots. In S. glauca budding peaked 4 June. Both female and male plants started to flower 17 June and kept having flowers for several weeks until 1 September. The timing of 50 % of female flowers with hair ranged over plots and sections from 26 August to 20 September.

For the four plant species Silene acaulis, Salix glauca, Loiseleuria procumbens and Empetrum nigrum we recorded total flowering at the time of peak flowering.

The vegetation greenness was monitored several times during the season by measurements of the NDVI in phenology plots as well as along the NERO line. In general, the vegetation greenness peaked around 1 August.

We have monitored the CO2 flux between the soil/vegetation and the atmosphere in ‘natural’ as well as in ‘manipulated’ plots. Data has not yet been processed.

The study of potential effects of UV-B radiation on plant health showed that the ambient UV-B did not induce any differences in maximum quantum yield (Fv/Fm) for Vaccinium and Betula. However, screening off a major proportion of the ambient UV-B radiation increased the Performance Index (PI) in both species in the August measurements. These initial results indicate that the experimental setup works.

The basis for preparing a vegetation map for the study area was improved by classifying additional 115 points.

Four pitfall arthropod trap stations each consisting of 8 sub-plots were sampled. All samples are stored at the Greenland Institute of Natural Resources. The material is kept in 70 % ethanol. Microarthropods were sampled in three different habitat types with two replicates of each. Unfortunately, all samples from 2008 were unsuccessfully extracted at the Greenland Institute of Natural Resources due to insufficient quality of the apparatus and lack of practice. The results cannot give a precise estimate of population abundance.

The bird study consisted of three sub-programmes, i.e. an ornithological survey which provided an overview of birds in the study area, observations of breeding phenology of Lapland bunting Calcarius lapponicus, and censuses from census points.

Mammals are seen only rarely in the study area. Arctic fox was seen occasionally and two caribou were observed only once.

Lake monitoring is carried out in two lakes, Badesø, with arctic char Salvelinus alpinus, located at low altitude and Qassi-sø, without arctic char, at a higher altitude. The nutrient levels recorded in Badesø and Qassi-sø are comparable to those in other low arctic Greenland lakes. In general, Badesø is warmer than Qassi-sø. Conductivity and pH were almost similar in the two studied lakes and comparable to other Greenland lakes. The results indicate that very few ions are washed into the freshwaters in Kobbefjord. In Badesø Secchi depth was high, particularly in early summer following the ice melt. Qassi-sø receives its inflowing water from the nearby glaciers reducing the Secchi depth compared to that in Badesø. For both lakes, Secchi depth decreased over time. Chlorophyll levels were very low in the two lakes. No fish have been caught in Qassi-sø, while both arctic char and threespined stickleback are found in Badesø. Submerged vegetation was dominated by mosses and real macrophytes Callitriche hamulata in both 2007 and 2008. In Qassi-sø submerged vegetation was sparse compared to Badesø.
In 2008 zooplankton was sampled monthly together with the other parameters. The samples have not been analysed yet, however.

Summary from the MarineBasis monitoring programme 2008
The programme was initiated in 2005 and comprises a consecutive monthly dataset of pelagic physical, chemical and biological parameters along with seasonal recordings of sea ice, benthic flux, fauna and flora, marine mammals and seabirds in Godthåbsfjord. The programme aims to link physiochemical conditions, marine production, re-mineralization, benthic-pelagic exchange and species abundance and composition with climatic forcing in Godthåbsfjord in a long-term perspective.

Satellite monitoring of sea ice conditions showed a prolonged maximum sea ice extent in Baffin Bay and a more extensive sea ice cover in parts of Godthåbsfjord during winter 2007/2008, compared to the two previous years. Nevertheless, minimum sea ice cover was as previously still observed in July/August in 2008 throughout the region. The ice cover in Baffin Bay is influenced by the West Greenland Current, which conveys warm water masses northwards.

Monthly monitoring of hydrographical conditions, at the main station near the entrance to Godthåbsfjord, showed a stratification of the water column lasting until May. Moreover, the annual monitoring at the length section conducted in May showed an inflow of coastal waters protruding as a sub-surface layer towards the inner parts of the fjord. Similar to the two previous years, release of melt water and heating of surface waters during the summer produced a fresher and warmer surface layer, thus reflecting a seaward export of freshwater along the northern coastline (Akia). This surface layer also sustains the highest phytoplankton biomass recorded throughout the year. Seasonally the phytoplankton biomass show two distinctive peaks occurring in May and July-September, which generally coincide with two separate bloom events in pelagic primary production. The pelagic primary production in summer depletes the different nutrients in the surface layer to varying degrees.

The complete dataset since 2005 of surface water pCO2 shows levels consistently below the atmospheric content, indicating that Godthåbsfjord is a strong CO2 sink. Moreover, surface pCO2 levels declines towards the head of the fjord, reflecting a potentially increasing CO2 uptake in surface waters along the fjord.

Vertical sinking flux of particulate material, measured monthly, showed a low organic material content dominated by lithogenic material. Although sinking fluxes of total particulate material show no clear seasonal patterns, sinking of phytoplankton based material coincided with the two distinctive peaks in phytoplankton biomass. Re-mineralization of organic matter in the sediment can be estimated by the oxygen flux, with the lowest rates generally observed in winter and highest rates in late summer/early autumn.

The phytoplankton community was dominated by diatoms throughout the year, except during the spring bloom in May/June when Phaeocystis sp. (Haptophyceae) dominated. The most abundant phytoplankton species observed throughout the year are typical species of arctic coastal waters.

Similar to the previous years, the zooplankton community showed a seasonal succession seemingly following the life cycle of copepods, with the abundance of eggs, nauplii and copepods peaking in that order. Microsetella sp. remained the most abundant copepod species throughout the year, except in June when Calanus spp. and Oithona spp. dominated.

The highest abundance of ichthyoplankton (fish larvae) was observed in March, with sand eel dominating from March to July followed by capelin in July/August. Cod larvae were only present in low numbers throughout the year, and at all stations along the length sections of the fjord. Furthermore, the species composition of ichthyoplankton along the fjord changed between the length sections conducted in May and July/August.

Monitoring of crab and shrimp larvae was included in the MarineBasis programme for the first time in 2008, although data was obtained from ichthyoplankton samples collected in 2006-2008. In 2006 and 2007, the highest abundance of crab and shrimp larvae occurred in May, while only low numbers were found in 2008. Shrimp larvae dominated from March to July, followed by snow crab in August and sand crab in September/October during 2008. Along the length sections sampled in May 2006-2008, shrimp larvae dominated on the shelf slope, sand crab on Fyllas Banke, while both sand crab and snow crab were more abundant than shrimp larvae at the entrance to the fjord.

The physiological status of the two dominant benthic fauna species sea urchin Chlamys islandica and scallop Strongolycentros droebachiensis were studied in May 2007 and 2008. Indices of both species reflected a general reduction in their physiological fitness from 2007 to 2008.

The annual monitoring of the macroalgal community distribution showed that brown macroalga Agarum clathratum is the most widely distributed macroalgal species in the fjord, although other species are abundant. The annual monitoring of the macroalgal species Laminaria longicruris showed a similar annual blade production in 2007 and 2008.

Seabirds are annually monitored at different locations in and around Godthåbsfjord. Qeqertannguit showed a decrease in the number of breeding kittiwake and arctic tern from 2006 and 2007 to 2008. In parallel, Nunngarussuit showed a lower number of guillemots in 2008 than in 2006 and 2007.

Observations of humpback whales were conducted from May to October overlooking a cross-section of the entrance to Godthåbsfjord. Fewer whales were observed in 2008 than in 2007, although most were sighted between June and August in both years. Photo-ID indicates that the humpback whales are moving in and out of Godthåbsfjord during the season, thus representing an ‘open population’.

Research projects

In 2008, eleven different research projects were carried out in cooperation with Nuuk Ecological Research Operations. The research projects all focussed on different biological topics in the marine compartment of the ecosystem.