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Continuous measurement of CO2 flux through the snowpack in a dwarf bamboo ecosystem on Rishiri Island, Hokkaido, Japan

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To investigate the dynamics and environmental drivers of CO2 flux through the winter snowpack in a dwarf bamboo ecosystem (Hokkaido, northeast Japan), we constructed an automated sampling system to measured CO2 concentrations at five different levels in the snowpack, from the base to the upper snow surface. Using a gas diffusion approach, we estimated an average apparent soil CO2 flux of 0.26 μmol m−2 s−1 during the snow season (December–April); temporally, the CO2 flux increased until mid-snow season, but showed no clear trend thereafter; late-season snow-melting events resulted in rapid decreases in apparent CO2 flux values. Air temperature and subnivean CO2 flux exhibited a positive linear relationship. After eliminating the effects of wind pumping, we estimated the actual soil CO2 flux (0.41 μmol m−2 s−1) to be 54% larger than the apparent flux. This study provides new constraints on snow-season carbon emissions in a dwarf bamboo ecosystem in northeast Asia.

Heat flux calculations for Mackenzie and Yukon Rivers

Daqing Yang, Philip Marsh, Shaoqing Ge

This study analyzes long-term (40–60 years) discharge and water temperature records collected near the basin outlets of the Yukon and Mackenzie Rivers. It defines seasonal cycles of discharge, water temperature (WT), and heat flux (HF) for the basins, and compares their main features to understand their similarity and difference. Both rivers have similar hydrographs, i.e. low flows in winter and high discharge in summer, with the peak flood in June due to snowmelt runoff. Mackenzie River has many large lakes and they sustain the higher base flows over the fall/winter season. Mackenzie basin is large with high precipitation, thus producing 50% more discharge than the Yukon River to the Arctic Ocean. The WT regimes are also similar between the two rivers. Yukon River WT is about 2–3 ° C warmer than the Mackenzie over the open water months. Both rivers have the highest WT in the mid summer and they transport large amount of heat to the polar ocean system. Yukon River monthly HF is lower by 10–60% than the Mackenzie mainly due to

smaller discharge. Mackenzie River heat transport peaks in July, while the Yukon HF reaches the maximum in June and July. These results provide critical knowledge of river thermal condition and energy transport to the northern seas. They are useful for large-scale climate and ocean model development and validation, and climate/hydrology change research in the northern regions.

Investigation of Arctic and Antarctic spatial and depth patterns of sea water in CTD profiles using chemometric data analysis

Ewelina Kotwa, Silvia Lacorte, Carlos Duarte, Roma Tauler

In this paper we examine 2- and 3-way chemometric methods for analysis of Arctic and Antarctic water samples. Standard CTD (conductivity-temperature-depth) sensor devices were used during two oceanographic expeditions (July 2007 in the Arctic; February 2009 in the Antarctic) covering a total of 174 locations. The output from these devices can be arranged in a 3-way data structure (according to sea water depth, measured variables, and geographical location). We used and compared 2- and 3-way statistical tools including PCA, PARAFAC, PLS, and N-PLS for exploratory analysis, spatial patterns discovery and calibration. Particular importance was given to the correlation and possible prediction of fluorescence from other physical variables. MATLAB's mapping toolbox was used for geo-referencing and visualization of the results. We conclude that: 1) PCA and PARAFAC models were able to describe data in a satisfactory way, but PARAFAC results were easier to interpret; 2) applying a 2-way model to 3-way data raises the risk of flattening the covariance structure of the data and losing information; 3) the distinction between Arctic and Antarctic seas was revealed mostly by PC1, relating to the physico-chemical properties of the water samples; and 4) we confirm the ability to predict fluorescence values from physical measurements when the 3-way data structure is used in N-way PLS regression.

The effects of parent-body hydrothermal heating on amino acid abundances in CI-like chondrites

Aaron S. Burton, Sarah Grunsfeld, Jamie E. Elsila, Daniel P. Glavin, Jason P. Dworkin

We determined the amino acid abundances and enantiomeric compositions of the Antarctic CI1 carbonaceous chondrites Yamato (Y)-86029 and Y-980115, as well as the Ivuna and Orgueil CI1 carbonaceous chondrites by liquid chromatography with fluorescence detection and time-of-flight mass spectrometry. Y-86029 and Y-980115 both show evidence of parent-body heating (500-600 ° C) in addition to aqueous alteration, while Ivuna and Orgueil only show evidence for aqueous alteration. In contrast to Ivuna and Orgueil, which each contain ~70 nmol/g of amino acids in acid-hydrolyzed, water extracts, both heated Yamato CI meteorites contain only low levels of amino acids that were primarily L-enantiomers of proteinogenic amino acids, indicating that they are likely to be terrestrial in origin. Because

indigenous amino acids have been found in meteorites that have experienced metamorphic temperatures of >1000 ° C with only minimal aqueous alteration, heating alone is not sufficient to explain the lack of amino acids in Y-86029 and Y-980115. Rather, our data suggest that the combination of heating and aqueous alteration has a profound destructive effect on amino acids in meteorites. This finding has implications for the origins of amino acids and other molecules in the early evolution of our solar system.

The sediment properties of glacial diamicts from the Jutulsessen area of Gjelsvikfjella, East Antarctica: A reflection of source materials and regional climate

Prakash K. Shrivastava, Amit Dharwadkar, Rajesh Asthana, Sandip K. Roy, Ashit K. Swain, M. Javed Beg

The glacial diamicts deposited in the Jutulsessen area of Gjelsvikfjella, Dronning Maud Land, East Antarctica show the effects of localized meltwater channels and wind processes, as well as of the dominant glacial processes. These glacial sediments are characterized by poor sorting and a variable mean particle size, and the localized meltwater channels have removed silt- and clay-sized sediments, resulting in the relative enrichment of coarser sediments. The X-ray diffraction (XRD) patterns of clay minerals in samples collected across the study area show very similar characteristics. Biotite is the dominant mica mineral in the clay together with chlorite and K-feldspar. The presence of illite, and small amounts of smectite, demonstrates the limited extent of chemical weathering due to the cold and arid conditions. The samples from the glacial fan area contain mixed-layer clays, suggesting the effects of localized meltwater and limited chemical activity which has altered the crystal structure of biotite at lower topographic level. Scanning electron microscopy (SEM) analysis of surface microtextures from representative quartz grains suggest the dominance of glacial and glaciofluvial processes. The low rates of biogenic activity in this area are indicated by the low total organic carbon (TOC) content of the sediments.

Seasonal variability of phytoplankton biomass and composition in the major water masses of the Indian Ocean sector of the Southern Ocean

Takahiro Iida, Tsuneo Odate

Long-term changes in phytoplankton biomass and community composition are important in the ecosystem and biogeochemical cycle in the Southern Ocean. We aim to ultimately evaluate changes in phytoplankton assemblages in this region on a decadal scale. However, yearly continuous data are lacking, and long-term datasets often include seasonal variability. We evaluated the seasonal changes in phytoplankton abundance/composition across latitudes in the Indian Ocean sector of the Southern Ocean via multi-ship observations along the 110° E meridian from 2011 to 2013. The chlorophyll a concentration was 0.3-0.5 mg m—3 in the Subantarctic Zone (40-50° S) and 0.4-0.6 mg m—3 in the Polar Frontal Zone (50-

60° S); pico-sized phytoplankton (10 μm), mainly diatoms, dominated. Chlorophyll a concentrations and phytoplankton community compositions were the same within a latitudinal zone at different times, except during a small but distinct spring bloom that occurred north of 45° S and south of 60° S. This small seasonal variation means that this part of the Southern Ocean is an ideal site to monitor the long-term effects of climate change.

Egg production rates of two common copepods in the Barents Sea in summer

Vladimir G. Dvoretsky, Alexander G. Dvoretsky

Small copepod species play important roles in the pelagic food webs of the Arctic Ocean, linking primary producers to higher trophic levels. The egg production rates (EPs) and weight-specific egg production rates (SEPs) of two common copepods, Acartia longiremis and Temora longicornis, were studied under experimental conditions in Dalnezelenetskaya Bay (southern Barents Sea) during summer. The average EP and SEP at 5-10 ° C were 4.7 ± 0.4 eggs female−1 day−1 and 0.025 ± 0.002 day−1, respectively, for A. longiremis and 13.1 ± 0.9 eggs female−1 day−1 and 0.075 ± 0.006 day−1, respectively, for T. longicornis. EP and SEP were significantly higher at 10° C than at 5° C for both species. The mean egg diameter correlated positively and significantly with female prosome length (PL) in each species. SEP of T. longicorniscorrelated negatively and significantly with PL. Daily EP and SEP were similar to rates recorded for otherAcartia and Temora species in temperate and warm regions. The influence of environmental factors (temperature, salinity, and phytoplankton concentration) on EP of both species is discussed. We conclude that temperature is the main factor determining the reproduction rate and timing in A. longiremis and T. longicornis in the Barents Sea.

Variation of dimethylsulfide mixing ratio over the Southern Ocean from 36° S to 70° S

Seizi Koga, Daiki Nomura, Makoto Wada

Atmospheric dimethylsulfide (DMS) was measured to investigate the variation in its concentration over sea ice free oceans and sea ice regions of the Southern Ocean, using a proton transfer reaction-mass spectrometer (PTR-MS) on board the icebreaker Shirase from 1 December 2009 to 16 March 2010. In general, DMS concentrations over sea ice regions were very low compared with those over the sea ice free ocean. However, abrupt increases in DMS concentrations occurred over sea ice regions while the ship was moving and crushing the sea ice. Undoubtedly, the elevated DMS concentrations were caused by large DMS emissions from gaps in the ice made by the ship. During the period when Shirase had anchored off Syowa Station (69° 00.4′ S, 39° 35.3′ E), Antarctica, DMS concentrations were not detected. At this time, the surrounding sea of East Ongul island, on which Syowa Station is located, was completely covered with multi-year fast ice. Sea ice probably inhibits DMS emission from the ocean to the atmosphere. In addition, there was no

evidence that chlorophyll a concentration in the sea water or wind speed above the sea surface affect atmospheric DMS concentrations over the sea ice free ocean regions.