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—Full Length Articles—

Seasonal and long term evolution of oceanographic conditions based on year-around observation in Kongsfjorden, Arctic Ocean

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Recently measured oceanographic data (Temperature, Salinity and Current) from July 2014–July 2015 in the Kongsfjorden marine environment has been used for studying the seasonal hydrographic variation. Seasonal fluctuation in salinity and temperature for the entire period of observation in different seasons matches with the previous year records. Overall trend of the surface zonal current pattern is towards west compared to eastward flowing bottom current. In order to study stratification and mixing during different seasons (summer and winter), density and buoyancy frequency were derived from temperature and salinity. The observed range difference in the buoyancy frequency clearly supports stratification in summer and mixing during winter seasons. The energy level variation in spectral analysis of temperature also indicates the seasonal variation in stratification. The comparison of temperature with previous year records since 1969 clearly shows a warming trend, which indicates the impact of climate change in Kongsfjorden. Present study confirms the requirement of year around observation in Kongsfjorden, for seasonal as well as long term climate change monitoring studies.

Morpho-physiological response of *Colobanthus quitensis* and *Juncus bufonius* under different simulations of climate change

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Global warming has caused an increase in ambient temperature in Antarctica, which has led to changes in water availability due to increases of precipitation and the melting of permafrost. This scenario of climate change is shown to improve growth conditions, as well as increase populations and local expansion of native and non-native species in the Maritime Antarctic. We hypothesize that the combined effect of the increase in temperature and water availability will enhance the eco-physiological performance in *Colobanthus quitensis* (Kunth) Bartl. and *Juncus bufonius* L., being more evident in the non-native species. To test this, a combined effect of temperatures and water availability (4°C H₂O (field capacity), 4°C + H₂O (40% more than field capacity), 15°C H₂O, 15°C + H₂O, 20°C H₂O and 20°C + H₂O) on morphological and physiological variables on both species were assessed. Temperatures and water availability increased significantly, which enhanced variables such as plant length, number of inflorescences, Fv/Fm and chlorophyll content for both species. When evaluating both species separately, we determined that the most crucial climate factor

for the growth and development of *C. quitensis* was water availability, while the main determinate factor for the growth and development of *J. bufonius* was temperature. Also, through the simulated temperature rise and increased water availability, *J. bufonius* reached higher growth rates compared to *C. quitensis*.

Quantitative ecological risk assessment of inhabitants exposed to polycyclic aromatic hydrocarbons in terrestrial soils of King George Island, Antarctica

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This study aims to conduct a quantitative ecological risk assessment of human exposure to polycyclic aromatic hydrocarbons (PAHs) in terrestrial soils of King George Island, Antarctica. Generally, the average PAH concentrations detected in King George Terrestrial Soils (KGS) were appreciably lower than those of World Marine Sediments (WMS) and World Terrestrial Soils (WTS), highlighting the fact that Antarctica is one of the most pristine continents in the world. The total concentrations of twelve probably carcinogenic PAHs (Σ PAHs: a sum of Phe, An, Fluo, Pyr, B[a]A, Chry, B[b]F, B[k]F, B[a]P, Ind, D[a,h]A and B[g,h,i]P) were $3.21 \pm 1.62 \text{ ng g}^{-1}$, $5749 \pm 4576 \text{ ng g}^{-1}$, and $257,496 \pm 291,268 \text{ ng g}^{-1}$, for KGS, WMS and WTS, respectively. In spite of the fact that KGS has extremely low Σ PAHs in comparison with others, the percentage contribution of Phe is exceedingly high with the value of 50%. By assuming that incidental ingestion and dermal contact are two major exposure pathways responsible for the adverse human health effects, the cancer and non-cancer risks from environmental exposure to PAHs were carefully evaluated based on the “Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions” memorandum provided by US-EPA. The logarithms of cancer risk levels of PAH contents in KGS varied from -11.1 to -7.18 with an average of -7.96 ± 7.73 , which is 1790 times and 80,176 times lower than that of WMS and WTS, respectively. All cancer risk levels of PAH concentrations observed in KGS are significantly ($p < 0.001$) lower than those of WMS and WTS. Despite the Comandante Ferraz Antarctic Station fire occurred in February 25th, 2012, both the cancer and non-cancer risks of environmental exposure to PAHs were found in “acceptable level”.

—Research Notes—

Recent variability in the Atlantic water intrusion and water masses in Kongsfjorden, an Arctic fjord

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The present study reports high inter-annual variability in the water masses and in the intrusion of Atlantic origin waters in Kongsfjorden from 2000 to 2013 using both the historical (2000–2010 summers) and recent CTD measurements (2011–2013 summer/fall). An earlier intrusion of Atlantic Water (AW) into Kongsfjorden was observed in the contemporary years. An overall summertime subsurface warming is evident from the maximum September AW temperature in 2011 (4.8°C), 2012 (5.8°C) and 2013 (7°C). The combination of a compensating surface flow to the subsurface intrusion of AW and the strong southeasterly surface winds during the peak summer, resulted in a corresponding net outflow of the surface fresh water layer from Kongsfjorden. This led to the decreased freshwater volume inside the fjord during 2013 (1 km³) compared to 2011 (3.1 km³) and 2012 (2.3 km³).

Lithostratigraphy and paleoceanography in the Chukchi Rise of the western Arctic Ocean since the last glacial period

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Paleoceanographic multi-proxies were investigated from two piston cores PC01 and PC04, along with two pilot cores PL01 and PL04, collected from the Chukchi Rise in the western Arctic Ocean during the R/V Mirai Cruise MR09-03. Both cores were composed of three lithologic units (Unit I:

the Holocene brownish sandy mud, Unit II: the deglacial IRD layer, and Unit III: the glacial and gray thick mud with intervened IRD layers). The age estimate of the core units were decided by AMS ^{14}C dates and confirmed by the correlation of the geochemical properties and ice-rafted debris (IRD) pattern with the well-dated core (P2) in the study area. The geochemical, isotopic, and mineralogical properties indicate different paleoceanographic conditions of three lithologic units in the Chukchi Rise: low primary production during the glacial period (Unit III), high terrigenous contribution during the deglacial period (Unit II), and increase in diatom productivity during the late Holocene (Unit I). In particular, most IRDs were specified as detrital carbonates (calcites and dolomites) by SEM-EDS examination. The sediment source from the northern North America and the transport pathway by the Beaufort Gyre were confirmed by the isotopic signature of bulk IRDs and high kaolinite content of fine-grained particles.

From supernova to Solar System: Few years only; first Solar System components apatite and spinel determined

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We show data for the very first years of our Solar System development after an interaction between undisturbed, cold interstellar dust and supernova type II explosion gases. All manual work was done in 1976–1982 as part of 3 theses works but fundamentally new data interpretation was reached within the last three years. From the CI1 meteorite Orgueil, we are able to separate 1.4 per mill of material containing supernova related noble gases He, Ne and Ar as well as P. We separate minerals using essentially density gradient centrifugation followed by stepwise heating noble gas analysis. Our procedure loses nearly no material and is in sharp contrast to the otherwise used dissolution of >99% of material to obtain single presolar grains (Anders and Zinner, 1993). Our method safeguards minerals considerably more fragile than SiC or TiC presolar grains, such as apatite, Mg-Al-spinel, graphite clusters and even apatite coated graphite clusters. We find graphite, apatite and Mg-Al-spinel containing highly anomalous noble gases. For the first time, apatite, containing anomalous Ar with an isotope ratio for $^{38}\text{Ar}/^{36}\text{Ar}$ of 0.35, twice the normal ratio, is reported. Such a ratio is produced by a 20 solar mass type II supernova in the C-O-Ne-burning shell. Unmatched pure Ne-E from ^{22}Na measured in the same samples sets the timeframe for this interaction to a maximum of only a few years.

Plankton assembly in an ultra-oligotrophic Antarctic lake over the summer transition from the ice-cover to ice-free period: A size spectra approach

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Lakes from the Antarctic maritime region experience climate change as a main stressor capable of modifying their plankton community structure and function, essentially because summer temperatures are commonly over the freezing point and the lake's ice cap thaws. This study was conducted in such seasonally ice-covered lake (Lake Limnopolar, Byers Peninsula, Livingston Is., Antarctica), which exhibits a microbial dominated pelagic food web. An important feature is also the occurrence of benthic mosses (*Drepanocladus longifolius*) covering the lake bottom. Plankton dynamics were investigated during the ice-thawing transition to the summer maximum. Both bacterioplankton and viral-like particles were higher near the lake's bottom, suggesting a benthic support. When the lake was under dim conditions because of the snow-and-ice cover, autotrophic picoplankters dominated at deep layers. The taxa-specific photopigments indicated dominance of picocyanobacteria among them when the light availability was lower. By contrast, larger and less edible phytoplankton dominated at the onset of the ice melting. The plankton size spectra were fitted to the continuous model of Pareto distribution. Spectra evolved similarly at two sampled depths, in surface and near the bottom, with slopes increasing until mid-January. However, slopes were less steep (i.e., size classes more uniformly distributed) at the bottom, thus denoting a more efficient utilization of resources. These findings suggest that microbial loop pathways in the lake are efficiently channelized during some periods to the metazoan production (mainly the copepod *Boeckella poppei*). Our results point to that trophic interactions may still occur in these lakes despite

environmental harshness. This results of interest in a framework of increasing temperatures that may reduce the climatic restrictions and therefore stimulate biotic interactions.

The morphology of peat bog surfaces on Hermansenøya, NW Svalbard

Tomasz Jaworski

This article analyses the surface morphology of the arctic peat bogs occurring on Hermansenøya, a small island in the Forlandsundet, NW Svalbard. Six small, shallow peat bogs on the island show different microrelief features formed by ice-segregation as well as thermokarst and thermo-erosion processes. On the peat bogs the following forms have been identified: aggradational, associated with the growth of different types of ground ice (frost peat mounds, peat plateaus, polygonal peat plateaus, networks of ice-wedge polygons); and degradational, associated with thermokarst (symmetrically developed residual peat mounds and the furrows in between) and thermo-erosion (channels of niveo-fluvial streams). Some importance can also be attributed to aeolian processes, i.e. snow drifting from the tops of convex relief features for aggradational forms. Lack of insulating snow cover significantly increases frost penetration depth, promoting cryosuction and/or ice growth at the base of a frozen core. The oldest preserved forms and structures, frost peat mounds with an ice-peat core and ice-wedge polygons, developed during climatic cooling at the turn of the Subboreal and Subatlantic (c. 3.0–2.5 ka BP). Thermokarst mounds are younger, associated with warmer periods after the Little Ice Age (the warmer 1920s). Channels of niveo-fluvial streams are being shaped today.

Evaluating the relationship between wildfire extent and nitrogen dry deposition in a boreal forest in interior Alaska

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Alaska wildfires may play an important role in nitrogen (N) dry deposition in Alaskan boreal forests. Here we used annual N dry deposition data measured by CASTNET at Denali National Park (DEN417) during 1999–2013, to evaluate the relationships between wildfire extent and N dry deposition in Alaska. We established six potential factors for multiple regression analysis, including burned area within 100 km of DEN417 ($BA_{100\text{km}}$) and in other distant parts of Alaska (BA_{AK}), the sum of indexes of North Atlantic Oscillation and Arctic Oscillation (OI), number of days with negative OI (OI_{day}), precipitation (PRCP), and number of days with PRCP (PRCP_{day}). Multiple regression analysis was conducted for both time scales, annual (using only annual values of factors) and six-month (using annual values of BA_{AK} and $BA_{100\text{km}}$, and fire and non-fire seasons' values of other four factors) time scales. Together, BA_{AK} , $BA_{100\text{km}}$, and OI_{day} , along with PRCP_{day} in the case of the six-month scale, explained more than 92% of the interannual variation in N dry deposition. The influence of $BA_{100\text{km}}$ on N dry deposition was ten-fold greater than from BA_{AK} ; the qualitative contribution was almost zero, however, due to the small $BA_{100\text{km}}$. BA_{AK} was the leading explanatory factor, with a $15 \pm 14\%$ contribution. We further calculated N dry deposition during 1950–2013 using the obtained regression equation and long-term records for the factors. The N dry deposition calculated for 1950–2013 revealed that an increased occurrence of wildfires during the 2000s led to the maximum N dry deposition exhibited during this decade. As a result, the effect of BA_{AK} on N dry deposition remains sufficiently large, even when large possible uncertainties (>40%) in the measurement of N dry deposition are taken into account for the multiple regression analysis.