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——Full Length Articles——

Arctic-midlatitude weather linkages in North America

James E. Overland, Muyin Wang

There is intense public interest in whether major Arctic changes can and will impact midlatitude weather such as cold air outbreaks on the central and east side of continents. Although there is progress in linkage research for eastern Asia, a clear gap is conformation for North America. We show two stationary temperature/geopotential height patterns where warmer Arctic temperatures have reinforced existing tropospheric jet stream wave amplitudes over North America: a Greenland/Baffin Block pattern during December 2010 and an Alaska Ridge pattern during December 2017. Even with continuing Arctic warming over the past decade, other recent eastern US winter months were less susceptible for an Arctic linkage: the jet stream was represented by either zonal flow, progressive weather systems, or unfavorable phasing of the long wave pattern. The present analysis lays the scientific controversy over the validity of linkages to the inherent intermittency of jet stream dynamics, which provides only an occasional bridge between Arctic thermodynamic forcing and extended midlatitude weather events.

Scavenging ratio of black carbon in the Arctic and the Antarctic

Mukunda M.Gogoi, S. Suresh Babu, Santosh K.Pandey, Vijayakumar S.Nair, Aditya Vaishya, I.A.Girach, N.Koushik

Long-term monitoring of atmospheric aerosols and their interaction with radiation, cloud, and cryosphere over the Arctic and the Antarctic are very important for the global climate change related issues. In this regard, for conducting aerosol measurements, India has extended the concerted efforts to the Svalbard region of the Norwegian Arctic (Himadri, 78°55′ N 11°56′ E, 8 m a.s.l.) in the northern hemisphere and the Larsemann Hills of coastal Antarctic (Bharati, 69°24.4′ S 76°11.7′ E, 40 m a.s.l.) in the southern hemisphere. In the present study, we have examined the role of black carbon (BC) deposition in darkening the polar snow in different sunlit seasons and estimated the scavenging ratio of BC over both the poles from simultaneous measurements of atmospheric and snow deposited BC concentrations. The study reveals distinct spatio-temporal variability of BC in polar snow, even though the concentrations are, in general, low (<12 ppbw, parts per billion by weight). During local summer seasons, the BC in snow at the Arctic (median ~ 7.98 ppbw) was higher than that at the Antarctica (median ~ 1.70 ppbw). Concurrent with this, the scavenging ratio (SR) also showed large variability over both the poles. Relatively higher values of SR over the Antarctica (mean ~ 119.54 ± 23.04; during southern hemispheric summer) in comparison to that over the Arctic (mean ~ 69.48 ± 4.79; during northern hemispheric spring) clearly indicate the difference in removal mechanisms (aerosol mixing, aging and size distribution) of BC from the atmosphere over distinct polar environments. Measurement of spectral incoming and reflected radiances over the Arctic snow during the early spring season of 2017 indicated the values of surface broadband albedo varying between 0.64 and 0.79. The Snow, Ice and Aerosol Radiative (SNICAR) model simulated values of spectral albedo correlated well with the measured ones and indicated the role of dust absorption, in addition to that of BC, in changing the snow albedo. This information needs to be accurately incorporated in the radiative transfer models for the accurate estimation of snow albedo forcing over the Polar Regions.

Regional geology mapping using satellite-based remote sensing approach in Northern Victoria Land, Antarctica

Amin Beiranvand Pour, Yongcheol Park, Tae-Yoon S. Park, Jong Kuk Hong, Mazlan Hashim, Jusun Woo, Iman Ayoobi

Satellite remote sensing imagery is especially useful for geological investigations in Antarctica because of its remoteness and extreme environmental conditions that constrain direct geological survey. The highest percentage of exposed rocks and soils in Antarctica occurs in Northern Victoria Land (NVL). Exposed Rocks in NVL were part of the paleo-Pacific margin of East Gondwana during the Paleozoic time. This investigation provides a satellite-based remote sensing approach for regional geological mapping in the NVL, Antarctica. Landsat-8 and the Advanced Spaceborne

Thermal Emission and Reflection Radiometer (ASTER) datasets were used to extract lithological-structural and mineralogical information. Several spectral-band ratio indices were developed using Landsat-8 and ASTER bands and proposed for Antarctic environments to map spectral signatures of snow/ice, iron oxide/hydroxide minerals, Al-OH-bearing and Fe, Mg-OH and CO3 mineral zones, and quartz-rich felsic and mafic-to-ultramafic lithological units. The spectral-band ratio indices were tested and implemented to Level 1 terrain-corrected (L1T) products of Landsat-8 and ASTER datasets covering the NVL. The surface distribution of the mineral assemblages was mapped using the spectral-band ratio indices and verified by geological expeditions and laboratory analysis. Resultant image maps derived from spectral-band ratio indices that developed in this study are fairly accurate and correspond well with existing geological maps of the NVL. The spectral-band ratio indices developed in this study are especially useful for geological investigations in inaccessible locations and poorly exposed lithological units in Antarctica environments.

Lithospheric structure of an incipient rift basin: Results from receiver function analysis of Bransfield Strait, NW Antarctic Peninsula

C. Berk Biryol, Stephen J. Lee, Jonathan M. Lees, Michael J. Shore

Bransfield Basin (BB), located northwest of the Antarctic Peninsula (AP) and southeast of the South Shetland Islands (SSI), is the most active section of the Antarctic continental margin. The region has long been (50 Ma) a convergent plate boundary where the Phoenix plate was subducting beneath the Antarctic Plate and is characterized by long-lived arc magmatism and accretion. However, the collision of the Antarctic-Phoenix spreading center with the subduction front near SSI (ca. 4 Ma) gave way to the opening of slab windows and dramatic decrease in the subduction rate of the Phoenix plate beneath AP and SSI. Consequently, the Phoenix slab began to rollback slowly along the South Shetland Trench (SST), giving way to slow extension in the back-arc region and rifting along the BB. Although there is consensus on the factors that control the current deformation and extension of the BB, the origin of the BB and the tectonic configuration of the basin are still unclear. Most of the controversy stems from uncertainties regarding the crustal thickness of the BB. Hence, we computed teleseismic receiver functions for 10 broadband stations in the region that belong to existing permanent and temporary deployments in order obtain robust constraints on the lithospheric structure and crustal thickness of the BB, as well as the AP and SSI. Our results indicate that the crust is thinning from 30 km to 26 km from the AP towards the South Shetland trench and Central BB showing the asymmetrical character of the rift basin. The crustal thickness and Vp/Vs variations are less pronounced along the AP but very significant across the SSB indicating the lithospheric scale segmentation of the South Shetland Block (SSB) and the incipient rift basin under the control of the opening of slab window and the roll-back of stalled Phoenix slab. High Vp/Vs ratios (~1.9) beneath BB and SSI, agree well with the nascent rift character of BB, the presence of a steep Phoenix slab

and consequently a wider mantle wedge characterized by the presence of underplating partial melts beneath SSI and BB.

Soil microbial succession along a chronosequence on a High Arctic glacier foreland, Ny-Ålesund, Svalbard: 10 years' change

Shinpei Yoshitake, Masaki Uchida, Yasuo Iimura, Toshiyuki Ohtsuka, Takayuki Nakatsubo

Rapid glacial retreat in the High Arctic causes the expansion of new habitats, but the successional trajectories of soil microbial communities are not fully understood. We examined microbial succession along a chronosequence twice with a 10-year interval in a High Arctic glacier foreland. Soil samples were collected from five study sites with different ages and phospholipid fatty acids analysis was conducted to investigate the microbial biomass and community structure. Microbial biomass did not differ significantly between the two sampling times but tended to increase with the chronosequence and showed a significant correlation with soil carbon (C) and nitrogen (N) content. Microbial community structure clearly differed along the chronosequence and was correlated with C and N content. The largest shift in community structure over 10 years was observed in the newly exposed sites after deglaciation. The accumulation of soil organic matter was regarded as an important determinant both of microbial biomass and community structure over the successional period. In contrast, the initial microbial community on the newly exposed soil changed rapidly even in the High Arctic, suggesting that some key soil processes such as C and N cycling can also shift within the relatively short period after rapid glacial retreat.

Hydrogeological characteristics of aquifer near Arctowski Polish Antarctic Station on King George Island (South Shetland Islands), Antarctica

Ewa Krogulec, Tomasz Krogulec, Jerzy Małecki, Paweł Pietrzykowski, Paweł Dobak

During the Antarctic summer season of 2015/2016, the groundwater studies were performed in the area of Henryk Arctowski Polish Antarctic Station on King George Island (South Shetland Islands) in Admiralty Bay of Antarctica. Rock and groundwater samples were collected from 14 research excavations down to a depth of 0.8–2.5 m b.g.l. Analyses of surface waters were performed on water samples from streams, mossland, and a drinking water reservoir. The scope of hydrochemical studies comprised analyses of temperature, pH, mineralization, phosphates, nitrates, macroelements and selected microelements. Using empirical formulas, granulometric analysis of rock samples from various depths, measurements of sample moisture, and calculations of the hydraulic conductivity were performed. The groundwater is poorly mineralized, representing chloride –sulfate –bicarbonate -sodium and chloride-bicarbonate-sodium-calcium types. Studies on hydrochemical indicators show a small range of the effect of animal ecosystems on the waters; no effects of organic matter have been identified in the study area. Results of hydrogeochemical studies of waters and observations of

groundwater levels in the summer season indicate groundwater recharge in a shallow groundwater circulation system, lateral inflow direction from land toward the seashore, and a low rate of rainwater infiltration. Groundwater drainage occurs through evapotranspiration and water runoff to the sea.

Research Notes

Potential influence of birds on soil testate amoebae in the Arctic

Yuri A. Mazei, Natalia V. Lebedeva, Anastasia A. Taskaeva, Alexander A. Ivanovsky, Viktor A. Chernyshov, Andrey N. Tsyganov, Richard J. Payne

Birds can be an important agent of environmental change in High Arctic ecosystems, particularly due to the role of seabirds as a vector transferring nutrients from the marine to terrestrial realms. The soils of bird nesting sites are known to host distinct plant communities but the consequences of bird modification for microorganisms are much less clear. Our focus here is testate amoebae: a widely-distributed group of protists with significant roles in many aspects of ecosystem functioning. We compared the testate amoeba assemblages of a site on Spitsbergen (Svalbard archipelago) affected by nesting birds, with nearby control sites. We found differences in assemblage between sites, typified by reduced relative abundance of *Phryganella acropodia* and Centropyxis aerophila in bird-modified soils. These changes may reflect a reduced availability of fungal food sources. We found no evidence for differences in assemblage diversity or test concentration between bird-modified and control soils. Our dataset is small but results provide the first evidence for the potential effect of bird modification of soils on testate amoebae in the Arctic. Results show only limited similarity to experimental studies of nutrient addition, implying that response mechanisms may be more complicated than simply additional nutrient supply.

First record of the larvae of tanner crab *Chionoecetes bairdi* in the Chukchi Sea: A future northward expansion in the Arctic?

Jose M. Landeira, Kohei Matsuno, Yuji Tanaka, Atsushi Yamaguchi

In the Bering Sea, warming and reduction of summer sea-ice cover are driving species ranges towards the Arctic. Tanner crab, *Chionoecetes bairdi*, is a commercially important species in the SE Bering Sea with a northerly range margin in 62ºN. In this paper, using plankton samples collected in the Pacific sub-Arctic/Arctic sector during summer, we report for the first time the presence of larval stages (zoea II) of *C. bairdi* far from its northern limit of the distribution, in the south of St. Lawrence Island during 1991, and even crossing the Bering Strait into the Chukchi Sea during 1992. We suggest that the long planktonic phase (3–5 months), in combination with the oceanographic circulation, may facilitate eventual long-distance transport.

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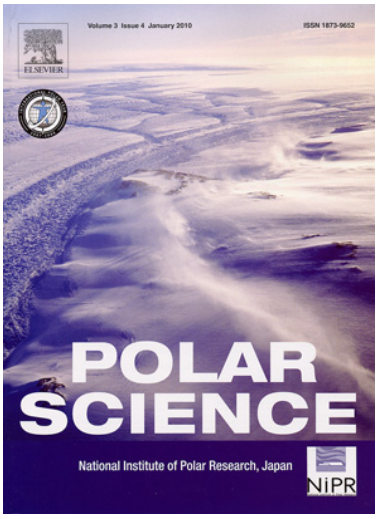

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