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——Full Length Articles——

Multi-wavelength and multi-scale aurora observations at the Chinese Zhongshan Station in Antarctica

Ze-Jun Hu, Fang He, Jian-Jun Liu, De-Hong Huang, De-Sheng Han, Hong-Qiao Hu, Bei-Chen Zhang, Hui-Gen Yang, Zhuo-Tian Chen, Bin Li, Xiang-Cai Chen

The Chinese Antarctic Zhongshan Station (ZHS) is located in a unique geographical and geomagnetic site that is suitable for observations on the cusp and of the post-noon dayside aurora and the poleward boundary of the nightside auroral oval. Since 2010, a unique, advanced synthetically auroral observation system has been deployed at ZHS, composed of a multi-wavelength all-sky imager, a multi-scale imager, a spectrum imager, and a radio imager. This system can record auroral forms from large (~100 km) to small scales (~10 m), auroral spectral lines from 400 to 730 nm, and auroral characteristics in the radio spectrum. Using this system, we have investigated the visible characteristics of UV ‘bright spots,’ the variation characteristics of the dayside shock auroras and convection, and the methodology for the quiet-day curve (QDC), among others. These investigations have enhanced our understanding of the solar wind–magnetosphere–ionosphere coupling process.

Can preferred atmospheric circulation patterns over the North-Atlantic-Eurasian region be associated with arctic sea ice loss?

Berit Crasemann, Dörthe Handorf, Ralf Jaiser, Klaus Dethloff, Tetsu Nakamura, Jinro Ukita, Koji Yamazaki

In the framework of atmospheric circulation regimes, we study whether the recent Arctic sea ice loss and Arctic Amplification are associated with changes in the frequency of occurrence of preferred atmospheric circulation patterns during the extended winter season from December to March. To determine regimes we applied a cluster analysis to sea-level pressure fields from reanalysis data and output from an atmospheric general circulation model. The specific set up of the two analyzed model simulations for low and high ice conditions allows for attributing differences between the simulations to the prescribed sea ice changes only. The reanalysis data revealed two circulation patterns that occur more frequently for low Arctic sea ice conditions: a Scandinavian blocking in December and January and a negative North Atlantic Oscillation pattern in February and March. An analysis of related patterns of synoptic-scale activity and 2 m temperatures provides a synoptic interpretation of the corresponding large-scale regimes. The regimes that occur more frequently for low sea ice

conditions are resembled reasonably well by the model simulations. Based on those results we conclude that the detected changes in the frequency of occurrence of large-scale circulation patterns can be associated with changes in Arctic sea ice conditions.

Rapid ice drilling with continual air transport of cuttings and cores: General concept

Rusheng Wang, Liu An, Pinlu Cao, Baoyi Chen, Mikhail Sysoev, Dayou Fan, Pavel G. Talalay

This article describes the investigation of the feasibility of rapid drilling in ice sheets and glaciers to depths of up to 600 m, with cuttings and cores continually transported by air reverse circulation. The method employs dual wall drill rods. The inner tubes provide a continuous pathway for the chips and cores from the drill bit face to the surface. To modify air reverse circulation drilling technology according to the conditions of a specific glacier, original cutter drill bits and air processing devices (air-cooled aftercoolers, air receivers, coalescing filters, desiccant dryers) should be used. The airflow velocity for conveying a 60-mm diameter and 200-mm long ice core should not be lower than 22.5 m/s, and the minimal airflow rate for continual chip and cores transport is 6.8 m^3/min at 2.3–2.6 MPa. Drilling of a 600-m deep hole can be accomplished within 1.5 days in the case of 24 h drilling operations. However, to avoid sticking while drilling through ice, the drilling depth should to be limited to 540 m at a temperature of −20 °C and to 418 m at a temperature of −10 °C.

Generation of a high-accuracy regional DEM based on ALOS/PRISM imagery of East Antarctica

Kaoru Shiramizu, Koichiro Doi, Yuichi Aoyama

A digital elevation model (DEM) is used to estimate ice-flow velocities for an ice sheet and glaciers via Differential Interferometric Synthetic Aperture Radar (DInSAR) processing. The accuracy of DInSAR-derived displacement estimates depends upon the accuracy of the DEM. Therefore, we used stereo optical images, obtained with a panchromatic remote-sensing instrument for stereo mapping (PRISM) sensor mounted onboard the Advanced Land Observing Satellite (ALOS), to produce a new DEM (“PRISM-DEM”) of part of the coastal region of Lützow–Holm Bay in Dronning Maud Land, East Antarctica. We verified the accuracy of the PRISM-DEM by comparing ellipsoidal heights with those of existing DEMs and values obtained by satellite laser altimetry (ICESat/GLAS) and Global Navigation Satellite System surveying. The accuracy of the PRISM-DEM is estimated to be 2.80 m over ice sheet, 4.86 m over individual glaciers, and 6.63 m over rock outcrops. By comparison, the estimated accuracy of the ASTER-GDEM, widely used in polar regions, is 33.45 m over ice sheet, 14.61 m over glaciers, and 19.95 m over rock outcrops. For displacement measurements made along the radar line-of-sight by DInSAR, in conjunction with ALOS/PALSAR data, the accuracy of the PRISM-DEM and ASTER-GDEM correspond to estimation errors of <6.3 mm and <31.8 mm, respectively.

Time–space variations in infrasound sources related to environmental dynamics around Lützow–Holm Bay, east Antarctica

Takahiko Murayama, Masaki Kanao, Masa-YukiYamamoto, Yoshiaki Ishihara, Takeshi Matsushima, Yoshihiro Kakinami, Kazumi Okada, Hiroki Miyamachi, Manami Nakamoto, Yukari Takeuchi, Shigeru Toda

Characteristic features of infrasound waves observed in the Antarctic reflect the physical interaction between the surface environment along the continental margin and the surrounding Southern Ocean. The temporal–spatial variability of the source locations for infrasound excitation during the eight-month period between January and August 2015 was investigated using recordings made by two infrasound arrays deployed along a section of the coast of Lützow–Holm Bay (LHB), Antarctica. The infrasound arrays clearly detected temporal variations in frequency content and propagation direction during this period. A number of infrasound sources were identified, many located north of the arrays. Many of the events had a predominant frequency content of a few Hz, higher than microbaroms from the ocean. A comparison of the results with MODIS satellite images indicated that these infrasound sources were ice-quakes associated with the calving of glaciers, the breaking off of sea ice, and collisions between this sea ice and icebergs around the LHB. Continuous measurements of infrasound in the Antarctic may serve as a proxy for monitoring the regional surface environment in terms of climate change at high southern latitudes.

Multistage formation processes in the acapulcoite-lodranite parent body: Mineralogical study of anomalous lodranite, Yamato 983119

Masahiro Yasutake, AkiraYamaguchi

Y 983119 is a coarse-grained rock consisting mainly of orthopyroxene (44–71 vol%, $Wo_3En_{94}Fs_4$), olivine (4–30 vol%, Fo_{97}), Fe, Ni metal (4–14 vol%) and interstitial plagioclase (9–14 vol%, $Or_2Ab_{67}An_{29}$) and augite (2–5 vol%, $Wo_{46}En_{53}Fs_2$). The modal abundance of orthopyroxene is higher than known acapulcoites and lodranites. Olivine grains show chemical zoning with higher Fe/Mn values along rims and cracks. Orthopyroxene and olivine contain melt inclusions that mainly consist of augite, feldspar and glass. Hornblende, biotite, rutile and baddeleyite were also found in melt inclusions. Based on the compositions of melt inclusions, the parent melt is felsic, and contains a significant amount of Na, K, Ti, Zr, F and OH. The major mineral and oxygen isotopic compositions indicate that Y 983119 is a lodranite. However, the high abundance of orthopyroxene and the presence of melt inclusions indicate that Y 983119 is not a residue in contrast to other lodranites. We suggest that Y 983119 formed by more complex formation processes than the other lodranites.

Antimicrobial properties and the influence of temperature on secondary metabolite production in cold environment soil fungi

U.Yogabaanu, Jean-Frederic Faizal Weber, Peter Convey, Mohammed Rizman-Idid, Siti Aisyah Alias

The Arctic and Antarctic share environmental extremes. To survive in such environments, microbes such as soil fungi need to compete with or protect themselves effectively from other soil microbiota and to obtain the often scarce nutrients available, and many use secondary metabolites to facilitate this. We therefore (i) screened for antimicrobial properties of cold-environment Arctic and Antarctic soil fungi, and (ii) identified changes in the secreted secondary metabolite profiles of a subset of these strains in response to temperature variation. A total of 40 polar soil fungal strains from King George Island, maritime Antarctic and Hornsund, Svalbard, High Arctic, were obtained from the Malaysian National Antarctic Research Centre culture collections. The plug assay technique was used to screen for antimicrobial potential against Gram-positive and Gram-negative human pathogenic bacteria (*Bacillus subtilis*, *B. cereus*, *Pseudomonas aeruginosa*, *Enterococcus faecalis* and *Escherichia coli*). About 45% of the tested fungal strains showed antimicrobial activity against at least one tested microorganism. Three fungal isolates showed good bioactivity and were subjected to secondary metabolite profiling at different temperatures (4, 10, 15 and 28 °C). We observed a range of responses in fungal metabolite production when incubated at varying temperatures, confirming an influence of environmental conditions such as temperature on the production of secondary metabolites.

Selection of priority investment projects for the development of the Russian Arctic

A. Novoselov, I. Potravny, I. Novoselova, V. Gassiy

In the Russian Arctic, there is currently an active process of preparation and implementation of investment projects aiming to extract natural resources, with the aim of sustainable socioeconomic development of the region. These projects are associated with the development of key zones in the Arctic and involve the exploration for and production of minerals (diamonds, gold, rare-earth metals, oil, and gas) and the development of energy and infrastructure (e.g., the Northern Sea Route). Such projects, which are often carried out in territories of traditional nature management belonging to the indigenous peoples of the North, must consider their environmental and social responsibility and the preservation of the ethnic identity and culture of indigenous peoples. The extraction of mineral deposits in the Arctic and the Far North places new demands on subsoil users, related to the preservation and development of the socio-cultural environment of the indigenous peoples of the North and to the ecological rehabilitation of the area. This article presents economic and mathematical models for selecting the optimal development project options based on the pairwise comparison of investment projects and the evaluation of indigenous peoples' preferences. We investigated the investment projects' impact on traditional territories in the Arctic, including the Republic of Sakha (Yakutia), in terms of socioeconomic and ethnological development, and environmental change. The suggested system of models can be used to assess the priority of projects supporting and developing the region in the mining corporation's area of responsibility. The proposed models are based on fuzzy set theory, which provides an effective assessment of the population's preferences for projects. Data are processed using the hierarchy analysis method and multivariate optimization calculations to determine the project sets at different funding levels. The creation of information-linked processing models is innovative. Indigenous people's expert assessments of the

priority of projects are processed using the hierarchy analysis method to determine the coefficients of the optimization model that enables the calculation of the choice between the analyzed projects, given the allocated financial resources. This approach can be used to address issues of support for indigenous people in areas where mining and other economic development activities are taking place, especially in the Arctic region. The proposed decision-making mechanism, which includes public hearings, sociological surveys, ethnological expertise, and compensation payments to indigenous minorities of the North, facilitates the justification of optimal strategies for maintaining and developing the region, taking into account economic, ecological, social, and ethnological factors.

——*Research Notes*——

Observations and first reports of saprolegniosis in Aanaakłiq, broad whitefish (*Coregonus nasus*), from the Colville River near Nuiqsut, Alaska

Todd L. Sformo, Billy Adams, John C. Seigle, Jayde A. Ferguson, Maureen K. Purcell, Raphaela Stimmelmayr, Joseph H. Welch, Leah M. Ellis, Jason C. Leppi, John C. George

We report the first confirmed cases (2013–2016) of saprolegniosis caused by water mold from the genus *Saprolegnia* in Aanaakłiq, broad whitefish (*Coregonus nasus*), from the Colville River near Nuiqsut, Alaska. While this mold is known to be worldwide, these instances represent the first cases in Nuiqsut and only the second instance on a single fish on the North Slope, occurring in 1980. We describe the collaborative work on monitoring this emerging disease. Because fish constitute a critical component of the diet in Nuiqsut and fishing is an integral part of Inupiaq nutritional and cultural subsistence activities overall, individual subsistence fishers, local governmental entities, and Alaska Native organizations representing Nuiqsut requested an examination of affected fish and information on possible drivers of this emerging disease. The collaborative work described here ranges from recording fishermen observations, acquiring fish and mold specimens, histopathology, and molecular identification of the mold. This work, not currently grant-funded, begins with Native observation that incorporates western scientific methods and involves local, state, and federal departments as well as for-profit and non-profit organizations. Additionally, we report the more recent (2016) observation of this disease in a second species of whitefish, Pikuktuuq, humpback whitefish (*Coregonus pidschain*).

Large thermo-erosional tunnel for a river in northeast Greenland

Catherine L. Docherty, David M. Hannah, Tenna Riis, Simon Rosenhøj Leth, Alexander M. Milner

Thermo-erosional river bank undercutting is caused by the combined action of thermal and mechanical erosion of the permafrost by Arctic rivers whilst the overlying sediment withstands collapse temporarily. Here, we report the discovery of a large thermo-erosional tunnel that formed in

the banks of a meltwater-fed stream in northeast Greenland in summer 2015. The tunnel was observed over eight days (14–22 July), during which period the tunnel remained open but bank-side slumping increased. Stream solute load increased immediately downstream and remained high 800 m from the tunnel. Whilst this field observation was opportunistic and information somewhat limited, our study provides a rare insight into an extreme event impacting permafrost, local geomorphology and stream habitat. With accelerated climate change in Arctic regions, increased permafrost degradation and warmer stream water temperature are predicted thereby enhancing potential for thermo-erosional niche development and associated stream bank slumping. This change could have significant implications for stream physicochemical habitat and, in turn, stream benthic communities, through changes in aquatic habitat conditions.