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—Full Length Articles—

An assessment of historical Antarctic precipitation and temperature trend using CMIP5 models and reanalysis datasets

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The study of Antarctic precipitation has attracted a lot of attention recently. The reliability of climate models in simulating Antarctic precipitation, however, is still debatable. This work assesses the precipitation and surface air temperature (SAT) of Antarctica (90 °S to 60 °S) using 49 Coupled Model Intercomparison Project phase 5 (CMIP5) global climate models and the European Centre for Medium-range Weather Forecasts “Interim” reanalysis (ERA-Interim); the National Centers for Environmental Prediction Climate Forecast System Reanalysis (CFSR); the Japan Meteorological Agency 55-year Reanalysis (JRA-55); and the Modern Era Retrospective-analysis for Research and Applications (MERRA) datasets for 1979–2005 (27 years). For precipitation, the time series show that the MERRA and JRA-55 have significantly increased from 1979 to 2005, while the ERA-Int and CFSR have insignificant changes. The reanalyses also have low correlation with one another (generally less than +0.69). 37 CMIP5 models show increasing trend, 18 of which are significant. The resulting CMIP5 MMM also has a significant increasing trend of $0.29 \pm 0.06 \text{ mm year}^{-1}$. For SAT, the reanalyses show insignificant changes and have high correlation with one another, while the CMIP5 MMM shows a significant increasing trend. Nonetheless, the variability of precipitation and SAT of MMM could affect the significance of its trend. One of the many reasons for the large differences of precipitation is the CMIP5 models' resolution.

Predictability of the 2012 Great Arctic Cyclone on medium-range timescales

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Arctic Cyclones (ACs) can have a significant impact on the Arctic region. Therefore, the accurate prediction of ACs is important in anticipating their associated environmental and societal costs. This study investigates the predictability of the 2012 Great Arctic Cyclone (AC12) that exhibited a minimum central pressure of 964 hPa on 6 August 2012, using five medium-range ensemble forecasts. We show that the development and position of AC12 were better predicted in forecasts initialized on and after 4 August 2012. In addition, the position of AC12 was more predictable than

its development. A comparison of ensemble members, classified by the error in predictability of the development and position of AC12, revealed that an accurate prediction of upper-level fields, particularly temperature, was important for the prediction of this event. The predicted position of AC12 was influenced mainly by the prediction of the polar vortex, whereas the predicted development of AC12 was dependent primarily on the prediction of the merging of upper-level warm cores. Consequently, an accurate prediction of the polar vortex position and the development of the warm core through merging resulted in better prediction of AC12.

Bulk chemical compositions of Antarctic meteorites in the NIPR collection

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Bulk chemical compositions of meteorites were traditionally analyzed by wet chemical analysis, and NIPR has data for 1162 meteorites as of September 2017. We discuss the classification of meteorites on the basis of these data. Chondrite data are distributed in an anomalously wide range of compositions on the Urey-Craig diagram. One of the reasons for such wide distribution is terrestrial weathering producing Fe₂O₃-bearing phases from Fe-Ni metal and sulfides. Another important factor affecting the bulk compositional data is brecciation. Our observations indicate that many brecciated chondrites contain anomalously abundant opaque minerals, or are depleted in them, resulting in unusual compositions. In case of enstatite and some carbonaceous chondrites, the bulk compositions are distributed in wider ranges than reported before. The bulk compositions of HED meteorites are consistent with their mineralogy and classification. Our study suggests that wet chemical data are still significant for the meteorite classification. However, petrographic observation is indispensable for evaluating the bulk chemistry and classification of meteorites.

Oxygen isotope reservoirs in the outer asteroid belt inferred from oxygen isotope systematics of chondrule olivines and isolated forsterite and olivine grains in Tagish Lake-type carbonaceous chondrites, WIS 91600 and MET 00432

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To understand oxygen isotope ratios and redox conditions of the chondrule formation environments of the outer regions of the asteroid belt, we analyzed major element concentrations and oxygen isotope ratios of olivine grains in chondrules, isolated forsterite, and isolated olivine from the WIS 91600 and MET 00432 carbonaceous chondrites, which are thought to have originated from D-type asteroids located in the outer asteroid belt. The oxygen isotope ratios of individual chondrules and isolated grains show a wide variation in $\delta^{18}\text{O}$ from -9.9‰ to $+9.1\text{‰}$ along the carbonaceous chondrite anhydrous mineral (CCAM) and primitive chondrule mineral (PCM) lines. The $\Delta^{17}\text{O}$ ($= \delta^{17}\text{O} - 0.52 \times \delta^{18}\text{O}$) values of the measured objects increase with decreasing Mg#; i.e., FeO-poor objects (Mg# > 90; type I chondrules and isolated forsterites) mainly have $\Delta^{17}\text{O}$ values of ca. -6‰ , and FeO-rich objects (Mg# < 90; type II chondrules and isolated olivines) have $\Delta^{17}\text{O}$ values ranging from -3‰ to $+2\text{‰}$. Similar trends are observed for ferromagnesian silicate particles from comet

Wild2 and CR chondrite chondrules, particularly in terms of FeO-rich objects with $\Delta^{17}\text{O}$ values ranging from -3‰ to $+2\text{‰}$. It is suggested that FeO-rich objects formed in the outer regions of the asteroid belt and were transported to the outer solar nebular regions where comet Wild2 formed.

Benthic diatoms from Potter Cove, 25 de Mayo (King George) Island, Antarctica: Mucilage and glucan storage as a C-source for limpets

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Biofilms were allowed to develop on ceramic tiles placed in closed containers on the shore of Potter Cove, 25 de Mayo (King George) Island. Water pumping from the cove inside the containers extended for 25 days. Diatoms were the dominant microalgae in these biofilms, which were removed from a set of tiles to a) characterize the extracellular mucilage, b) carry out floristic determination and c) perform grazing experiments with the limpet *Nacella concinna*. Biofilms mucilaginous matrix consisted of proteins and carbohydrates. Room temperature aqueous extraction of the freeze-dried material rendered a fraction enriched in the storage glucan chrysolaminarin, its identity confirmed by methylation structural analyses. Hot water extracted products showed greater heterogeneity in monosaccharide composition, including glucose, mannose, galactose, fucose, xylose and rhamnose. Diatom identification revealed that *Pseudogomphonema kamtschaticum* was the dominant species followed by several *Navicula* species, *Nitzschia pellucida* and *Synedra kerguelensis*. Photographical survey of colonized tiles placed in glass flasks together with a specimen of *Nacella concinna* exhibited between 5 and 30% removal of the biofilms coverage after 24 h of exposure to the limpet, suggesting that EPS and chrysolaminarin constitute a C-source for the gastropod.

New application of two Antarctic macroalgae *Palmaria decipiens* and *Desmarestia menziesii* in the synthesis of gold and silver nanoparticles

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In this study, two Antarctic macroalgae (Rhodophyta *Palmaria decipiens* and Phaeophyta *Desmarestia menziesii*) were selected in order to report their use for the biosynthesis of nanomaterials. Two aqueous extracts of the macroalgae were prepared and their reducing activity, total phenolic content and DPPH scavenging activity were determined, showing that brown seaweed has higher antioxidant activity than red seaweed. Aqueous extracts were used as an eco-friendly, one-pot synthetic route to obtain gold and silver nanoparticles acting both as reducing and stabilizing agents. The nanoparticles obtained were characterized by UV–Vis spectroscopy and Transmission electron microscopy (TEM), demonstrating the formation of gold and silver nanoparticles with mean diameters of 36.8 ± 5.3 and 11.5 ± 3.3 nm for Au@PD and Au@DM and 7.0 ± 1.2 nm and 17.8 ± 2.6 nm in the case of Ag@PD and Ag@DM. Lastly, functional groups of the biomolecules present in the extracts were characterized by Fourier transform infrared spectra (FTIR) prior to, and after, the synthesis of the nanoparticles, in order to obtain information about the biomolecules involved in the reducing and stabilization process.

Vertical distribution of the sound-scattering layer in the Amundsen Sea, Antarctica

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Mid-trophic level at high-latitude coastal water in the Southern Ocean reside unique geographical condition with sea ice, coastal polynya, and ice shelf. To investigate the regional differences in their vertical distribution during summer, we examined acoustic backscatter data from scientific echo sounder, collected in the three representative regions in the Amundsen Sea: pack ice zone, coastal polynya zone, and ice shelf zone. The weighted mean depths (WMDs) representing zooplankton were calculated with the high resolution acoustic backscatter (1-m depth) to identify the vertical variability of the sound-scattering layer (SSL). WMDs were mainly distributed between 50 and 130 m exhibiting clear regional differences. The WMDs were detected in the shallow depth ranged between 48 and 84 m within the pack ice and coastal polynya, whereas they were observed at deeper depths around near ice shelf ranged between 117 and 126 m. WMDs varied with changing the stratification of water column structure representing strong linear relationship with the mixed layer depth ($r = 0.69$). This finding implies that understanding the essential forcing of zooplankton behavior will improve our ability to assess the coastal ecosystem in the Southern Ocean facing dramatic change.

Comparison of the seasonal variability in abundance of the copepod *Pseudocalanus newmani* in Lagoon Notoro-ko and a coastal area of the southwestern Okhotsk Sea

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Replacement of the warm water of the Soya Warm Current (SWC) and the cold water of the East Sakhalin Current (ESC) occurs seasonally along the coast of the southwestern Okhotsk Sea, and sea ice covers the surface during winter. *Pseudocalanus newmani* is one of the dominant copepods in coastal waters of the northern hemisphere. To better understand the population dynamics of the copepod *P. newmani* in coastal areas of the southwestern Okhotsk Sea, this study compared the seasonal variation in *P. newmani* abundance in Lagoon Notoro-ko and a coastal area of the Okhotsk Sea with regard to developmental stage. We sampled *P. newmani* in the lagoon, including during the ice cover season, and the coastal waters. *Pseudocalanus newmani* was abundant at both sites in spring. During summer–fall, adults disappeared from the populations at both sites, whereas the early developmental stages were abundant and dominated the population. Total length of adult females decreased toward summer at both sites. *Pseudocalanus newmani* abundance in the lagoon increased in early winter, and larger females were found in the populations at both sites. These phenomena at both sites corresponded with seasonal variation in water temperature caused by seasonal water-mass replacement and sea ice.

Assessment of topsoil contamination near the Stanislaw Siedlecki Polish Polar Station in Hornsund, Svalbard, using magnetic methods

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Topsoil contamination near the Stanisław Siedlecki Polish Polar Station (PPS), Hornsund, Svalbard, has been assessed using magnetic methods supplemented by chemical analyses and microscopic observations. Analysis of magnetic parameters has enabled to evaluate the concentration, magnetic mineralogy, and grain-size distribution of anthropogenic magnetic particles. Heavy-metal contamination near the PPS originates primarily from local sources. Anthropogenic spherical, magnetite-like particles were found near the station, whereas uncontaminated topsoil is devoid of such particles. Magnetic studies indicate that magnetite and goethite are the primary magnetic phases, with magnetite levels being higher in polluted area. Magnetic fraction of contaminated topsoil includes a mixture of single-domain and multi-domain grains, while uncontaminated topsoil contains smaller grains. Results show a clear correspondence between Pollution Load Index and magnetic susceptibility anomalies, and that the areal extent of PPS impact on the environment has not expanded significantly since 2004 (although a new contamination source, the scrap yard, is now present). A comparison of magnetic susceptibility measurements with metal analyses indicates that magnetic methods can be used as a rapid, inexpensive, non-invasive, and sensitive tool for the evaluation of topsoil contamination.

—*Research Notes*—

Sedimentological and geochemical investigations to understand source of sediments and processes of recent past in Schirmacher Oasis, East Antarctica

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Three sediment cores collected from GL-1, V-1 (Vetehiya) and L-6 lakes of Schirmacher Oasis, East Antarctica were studied for sediment components (sand, silt, clay, total organic carbon, total nitrogen, TOC/TN ratio and biogenic silica), major elements (Aluminium, Iron and Manganese) and trace metals (Chromium, Zinc, Lead, Cobalt, Cadmium and Nickel). High sand content in all the three cores revealed the release of coarser sediments through mechanical weathering in fluvio-glacial environment. Relatively, high biogenic silica along with high total organic carbon associated with high clay in some sections indicated high primary productivity due to the warming and exposure of the lakes to the ice-melt water influx. TOC/TN ratio for all the cores was found to be < 10 which indicated that the major source of organic matter was autochthonous. Metals were found to be strongly associated with clay and organic carbon in core V-1, with sand and clay in core L-6 while, with silt and organic matter in core GL-1 indicating their role in regulating the distribution of metals. Cadmium in lake GL-1 was found to be associated with total organic carbon and showed largely biogenic origin, while, Cd and Pb in lakes L-6 and V-1 were found to be of anthropogenic origin. All the other metals showed signatures of lithogenic origin.

The response of tundra springtails (Collembola, Hexapoda) to human activity on the Murman coast of the Kola Peninsula, Russia

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This study was carried out in the Dalne Zelentsy settlement (69°07'N, 36°03'E) on the Barents Sea of the Kola Peninsula in Russia. Three transects were established: the 'new garden transect' ; the 'old garden transect'; and the 'settlement transect'. Overall, the number of springtails increased with distance from the 'settlement' and decreased from the 'old garden' towards the tundra. However, in the case of the 'new garden transect' there were no clear trends in springtail abundance. Eleven species of springtail were found, with *Parisotoma notabilis* being found at each of the studied areas along the transects. Trends in the species diversity of the springtail communities were not clear, and the values of H' ranged from 1.36 to 2.08. The springtail communities located 10 m from the 'new garden' and the 'old garden' were characterized by low species diversity compared with the other sites along the transects (H' values of 1.36 and 1.67, respectively). There were no differences in species diversity among the springtail communities along the 'settlement transect'.