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The spatial and seasonal distributions of air–transport origins to the Antarctic based on 5–day backward trajectory analysis

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Transport of moisture–bearing air to the Antarctic is one of the important factors that control the mass balance of the ice sheet. Here, we investigate the distribution of air–parcel transport using a backward trajectory analysis over the entire Antarctic ice sheet, based on whether the air parcel was located inside or outside of Antarctica at 5 days before arrival. At this time, we considered the air from outside Antarctica to be moisture rich. Oceanic air was found to dominate in West Antarctica throughout the year, whereas air from inland was more prominently distributed around East Antarctica, especially in summer. In East Antarctica, there was a significant seasonal variation: air from inland dominated in summer, while air of oceanic origin dominated in winter. The distribution of air parcels that came from oceanic/inland sources was similar to the accumulation map (based on satellite data), which indicates that oceanic air parcels could be a substitute for moisture transport to the Antarctic. To determine the future impacts of climate change (e.g., sea level rise), more precise predictions of the variations in the surface mass balance will be required. Our results contribute towards the improved understanding of the spatial distributions of accumulation and aerosols found in Antarctic snow and ice cores.

Seasonal climatologies of oxygen and phosphates in the Bering Sea reconstructed by variational data assimilation approach

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Climatological fields of dissolved oxygen and phosphates in the Bering Sea during the spring, summer, and fall seasons were generated on the basis of an extensive dataset of hydrochemical observations (16,356 stations, beginning in 1928) and a novel 3D variational algorithm for interpolation of a passive ocean tracer. The resulting patterns comply with maps produced earlier using an optimal interpolation method, though they also provide more detail and contain no ″missing data″ regions. Vertical, spatial, and temporal variability of both parameters follow large–scale patterns of circulation, upper mixed layer depth, and phytoplankton productivity in

the Bering Sea.

Long-term variability in Arctic sea surface temperatures

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In this study, we used 30 years of an operational sea surface temperature (SST) product, the NOAA Optimum Interpolation (OI) SST Version 2 dataset, to examine variations in Arctic SSTs during the period December 1981–October 2011. We computed annual SST anomalies and interannual trends in SST variations for the period 1982–2010; during this period, marginal (though statistically significant) increases in SSTs were observed in oceanic regions poleward of 60° N. A warming trend is evident over most of the Arctic region, the Beaufort Sea, the Chuckchi Sea, Hudson Bay, the Labrador Sea, the Iceland Sea, the Norwegian Sea, Bering Strait, etc.; Labrador Sea experienced higher temperature anomalies than those observed in other regions. However, cooling trends were observed in the central Arctic, some parts of Baffin Bay, the Kara Sea (south of Novaya Zemlya), the Laptev Sea, the Siberian Sea, and Fram Strait. The central Arctic region experienced a cooling trend only during 1992–2001; warming trends were observed during 1982–1991 and 2002–2010. We also examined a 30-yr (1982–2011) record of summer season (June–July–August) SST variations and a 29-yr (1982–2010) record of September SST variations, the results of which are discussed.

Geochemistry and mineralogy of a feldspathic lunar meteorite (regolith breccia), Northwest Africa 2200

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The lunar meteorite Northwest Africa (NWA) 2200 is a regolith breccia with a ferroan feldspathic bulk composition (Al_2O_3 = 30.1 wt.%; Mg# = molar 100 × Mg/(Mg + Fe) = 59.2) and low Th content (0.42 μg/g). Lithologically, NWA 2200 is a diverse mixture of lithic and glassy clasts, mineral fragments, and impact glass spherules, all embedded in a dark glassy matrix. NWA 2200 contains some feldspathic brecciated rock components (ferroan anorthositic granulitic breccia, poikiloblastic granulitic breccia, and glassy melt breccia with an intersertal texture). The bulk compositions of these brecciated components indicate they are derived from ferroan troctolitic or noritic anorthosite lithologies (bulk Al_2O_3 = 26–30 wt.%; bulk FeO/MgO > 1.0). The bulk composition of NWA 2200 is more ferroan and feldspathic than the Apollo feldspathic regolith samples and feldspathic lunar regolith meteorites, and is also more depleted in incompatible elements (e.g., rare earth elements) than Apollo 16 feldspathic regolith samples. We conclude that NWA 2200 originated from a location different to the Apollo landing sites, and may have been sourced from the ferroan KREEP-poor highlands, "KREEP" materials are enriched in such elements as potassium (K), rare earth elements (REE), phosphorus (P).

Gravity measurements with a portable absolute gravimeter A10 in Syowa Station and Langhovde, East Antarctica

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Absolute gravity values were measured with a portable absolute gravimeter A10 in East Antarctica, for the first time by the Japanese Antarctic Research Expedition. This study aims to investigate regional spatiotemporal variations of ice mass distributions and associated crustal deformations around Syowa Station by means of repeated absolute gravity measurements, and we obtained the first absolute gravity value in Southern Langhovde on the Antarctic Continent. The average absolute gravity value at the newly installed benchmark AGS01 in Langhovde (obtained on 3 February 2012) was 982535584.2 ± 0.7 μgal (1 [μgal] = 1 × 10−8 [m/s2]), which was in agreement with the gravity values obtained by the past relative gravity measurements within 1 mgal. In addition, the average absolute gravity value obtained at AGSaux in Syowa Station was consistent with both previous absolute gravity values and those obtained by simultaneous measurements using an FG5 gravimeter, owing to adequate data corrections associated with tidal effects and time variations in atomic clock frequencies. In order to detect the gravity changes associated with the ice mass changes and other tectonic phenomena, we plan to conduct absolute gravity measurements at AGS01 again and at other campaign sites around Syowa Station as well in the near future, with careful attention paid to the impacts of severe environmental conditions in Antarctica on gravity data collection.

Non-stochastic colonization by pioneer plants after deglaciation in a polar oasis of the Canadian High Arctic

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Initial plant colonization is critical in determining subsequent ecosystem development. In a High-Arctic oasis showing atypical "directional primary succession", we quantified the microhabitat characteristics associated with colonization by pioneer vascular plants of a bare moraine. The study moraine, formed during the Little Ice Age, is located within the proglacial area at the southern front of Arklio Glacier, Ellesmere Island, Canada. We established two line-transects on this moraine to quantify microhabitats for vascular species. Microsites favorable for plants were concave depressions, probably increasing the likelihood of colonization. At microsites distant from stable boulders, which probably protect seeds/seedlings from wind desiccation, plant colonization was less likely. Furthermore, favorable microhabitat properties differed depending on topographical location within the moraine, suggesting that, even within a single moraine, microhabitats favorable for plant colonization are heterogeneously-distributed. This moraine was characterized by two major pioneer species, Epilobium latifolium and Salix arctica. Their species-specific microhabitat requirements highlight the importance of biotic factors in

colonization processes. Favorable sites for plants are generally distributed at random in harsh environments. However, we showed that initial plant colonization is a deterministic process rather than random, indicating the possibility of non-stochastic processes even during the early phase of ecosystem development in High-Arctic ecosystems.