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Development of a cloud detection method from whole-sky color images

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A method is proposed for detecting clouds from whole-sky color images obtained with an all-sky camera (ASC) system. In polar regions, cloud detection using whole-sky images usually suffers from large uncertainties in fractional cloud cover retrievals because of large solar zenith angles (SZAs) and high surface albedo, which cause "whitening" in the images. These problems are addressed by using differences between real images and virtual clear-sky images for a particular observation time with the same SZA. The method is applied to ASC images obtained at Ny-Ålesund, Svalbard in May of 2005-2007, and the results are compared with Micro-Pulse Lidar (MPL) measurements. When no clouds were detected by MPL, the false cloud detection rate from ASC classification was 2.1% in total hours. Conversely, when clouds were detected by MPL, the ASC classification underestimated the clouds by 11.6%. In most cases, this occurred when MPL detected very optically thin clouds. Furthermore, the variability of cloud fractions estimated by MPL and ASC was roughly constant regardless of the SZA. Thus, it is confirmed that the method developed in this study is valid for cloud detection from whole-sky color images.

Importance of soil moisture and N availability to larch growth and distribution in the Arctic taiga-tundra boundary ecosystem, northeastern Siberia

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To better understand the factors controlling the growth of larch trees in Arctic taiga-tundra boundary ecosystem, we conducted field measurements of photosynthesis, tree size, nitrogen (N) content, and isotopic ratios in larch needles and soil. In addition, we observed various environmental parameters, including topography and soil moisture at four sites in the Indigirka River Basin, near Chokurdakh, northeastern Siberia. Most living larch trees grow on mounds with relatively high elevations and dry soils, indicating intolerance of high soil moisture. We found that needle δ13C was positively correlated with needle N content and needle mass, and these parameters showed spatial patterns similar to that of tree

size. These results indicate that trees with high needle N content achieved higher rates of photosynthesis, which resulted in larger amounts of C assimilation and larger C allocation to needles and led to larger tree size than trees with lower needle N content. A positive correlation was also found between needle N content and soil NH4+ pool. Thus, soil inorganic N pool may indicate N availability, which is reflected in the needle N content of the larch trees. Microtopography plays a principal role in N availability, through a change in soil moisture. Relatively dryer soil of mounds with higher elevation and larger extent causes higher rates of soil N production, leading to increased N availability for plants, in addition to larger rooting space for trees to uptake more N.

Small unmanned aerial vehicles for aeromagnetic surveys and their flights in the South Shetland Islands, Antarctica

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We developed small computer-controlled unmanned aerial vehicles (UAVs, Ant-Plane) using parts and technology designed for model airplanes. These UAVs have a maximum flight range of 300–500 km. We planned aeromagnetic and aerial photographic surveys using the UAVs around Bransfield Basin, Antarctica, beginning from King George Island. However, we were unable to complete these flights due to unsuitable weather conditions and flight restrictions. Successful flights were subsequently conducted from Livingston Island to Deception Island in December 2011. This flight covered 302.4 km in 3:07:08, providing aeromagnetic and aerial photographic data from an altitude of 780 m over an area of 9 × 18 km around the northern region of Deception Island. The resulting magnetic anomaly map of Deception Island displayed higher resolution than the marine anomaly maps published already. The flight to South Bay in Livingston Island successfully captured aerial photographs that could be used for assessment of glacial and sea-ice conditions. It is unclear whether the cost-effectiveness of the airborne survey by UAV is superior to that of manned flight. Nonetheless, Ant-Plane 6-3 proved to be highly cost-effective for the Deception Island flight, considering the long downtime of the airplane in the Antarctic storm zone.

Holocene paleoclimatic variation in the Schirmacher Oasis, East Antarctica: A mineral magnetic approach

Binita Phartiyal

An analysis of remanent magnetism and radiocarbon ages in the dry lacustrine/sediment fills of the Schirmacher Oasis (SO) in East Antarctica was conducted to reconstruct past climatic condition. The statistically run mineral magnetic data on paleontological statistics software package (multivariate cluster analysis) placed on accelerator mass spectrometer radiocarbon chronology of the three sediment sections, trace 6 phases of climatic fluctuation between 13 and 3 ka,

(Phases 1, 3 and 5 represent cold periods while Phases 2, 4, and 6 represent warm periods). One short warm period (Phase 2, ca. 12.5 ka) occurred in the late Pleistocene, and two marked warm periods (Phase 4, 11–8.7 ka; Phase 6, 4.4–3 ka) occurred in the Holocene. High magnetic susceptibility (χ), saturation isothermal remanent magnetism (SIRM), and soft isothermal remanent magnetism (soft IRM) values correspond to colder periods and low values reflect comparatively warmer lacustrine phases. Holocene Optima (Phase 4) and Mid Holocene Hypsithermal (Phase 6) are distinguished by decreased values of concentrations dependent parameters. Remanence is preserved in the low-coercive minerals. Heavy metals in the sediments include, Fe, Rb, Zn, Mo, Co, Pb, Mn, Cu, and As in order of decreasing abundance.

The influence of air–sea–ice interactions on an anomalous phytoplankton bloom in the Indian Ocean sector of the Antarctic Zone of the Southern Ocean during the austral summer, 2011

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An anomalous phytoplankton bloom was recorded in the Indian Ocean sector of the Antarctic Zone (AZ) of the Southern Ocean (SO) during the austral summer, 2011. Possible mechanisms for the triggering of such a large bloom were analyzed with the help of in situ and satellite data. The bloom, which formed in January 2011, intensified during February and weakened by March. High surface chlorophyll (Chl) concentrations (0.76 mg m^<-3>) were observed in the area of the bloom (60° S, 47° E) with a Deep Chlorophyll Maximum (DCM) of 1.15 mg m^<-3> at a depth of 40–60 m. During 2011, both the concentration and spatial extent of sea ice were high on the western side of the bloom, between 0° E and 40° E, and enhanced freshwater influx was observed in the study area as a result of melting ice. A positive Southern Annular Mode (SAM) (with a resultant northward horizontal advection) and an intense La Niña during 2010–2011 are possible reasons for the high sea–ice concentrations. The enhanced Chl *a* observed in the study region, which can be attributed to the phytoplankton bloom, likely resulted from the influx of nutrient–laden freshwater derived from melting sea ice.

Photosynthetic characteristics of sinking microalgae under the sea ice

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The photosynthetic characteristics of sinking a microalgal community were studied to compare with the ice algal community in the sea ice and the phytoplankton community in the water column under the sea ice at the beginning of the light season in the first-year sea ice ecosystem on the Mackenzie Shelf, in the western Canadian Arctic. The phytoplankton community was collected using a water bottle, whereas the sinking algal community was collected using particle collectors, and the

ice algal community was obtained by using an ice-core sampler from the bottom portion of ice core. Photosynthesis versus irradiance (P-E) incubation experiments were conducted on deck to obtain the initial slope (α ^B) and the maximum photosynthetic rate (Pm^B) of the three algal communities. The α ^B and the Pm^B of the light saturation curve, and chlorophyll a (Chl a) specific absorption coefficient (ā_<ph>*) between the sinking microalgal community and the ice algal community were similar and were distinctly different from the phytoplankton community. The significant linear relationship between α ^B and Pm^B, which was obtained among the three groups, may suggest that a photo-acclimation strategy is common for all algal communities under the low light regime of the early season. Although the sinking algal community could be held for the entire duration of deployment at maximum, this community remained photosynthetically active once exposed to light. This response suggests that sinking algal communities can be the seed population, which results in a subsequent phytoplankton bloom under the sea ice or in a surface layer, as well as representing food for the higher trophic level consumers in the Arctic Ocean even before the receding of the sea ice.

Effects of substrate differences on water availability for Arctic lichens during the snow-free summers in the High Arctic glacier foreland

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We used observational and experimental analyses to investigate the photosynthetic activity and water relationships of five lichen species attached to different substrates in a glacier foreland in the High Arctic, Ny-Ålesund, Svalbard (79° N) during the snow-free season in 2009 and 2010. After the rains ceased, lichens and their attached substrates quickly dried, whereas photosynthetic activity in the lichens decreased gradually. The in situ photosynthetic activity was estimated based on the relative electron transportation rate (rETR) in four fruticose lichens: *Cetrariella delisei, Flavocetraria nivalis, Cladonia arbuscula* ssp. *mitis*, and *Cladonia pleurota*. The rETR approached zero around noon, although the *crustose* lichen *Ochrolechia frigida* grown on biological soil crust (BSC) could acquire water from the BSC and retain its WC to perform positive photosynthesis. The light-rETR relationship curves of the five well-watered lichens were characterized into two types: shade-adapted with photoinhibition for the fruticose lichens, and light-adapted with no photoinhibition for *O. frigida*. The maximum rETR was expected to occur when they could acquire water from the surrounding air or from substrates during the desiccation period. Our results suggest that different species of Arctic lichens have different water availabilities due to their substrates and/or morphological characteristics, which affect their photosynthetic active periods during the summer.