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Combined use of InSAR and GLAS data to produce an accurate DEM of the Antarctic ice sheet: Example from the BreivikaeAsuka station area

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Surface elevation data for the BreivikaeAsuka Station area, East Dronning Maud Land, Antarctica, obtained during ground surveys undertaken in 1987 were compared with elevation data measured by the Geoscience Laser Altimeter System (GLAS) onboard the Ice, Cloud, and land Elevation Satellite (ICESat) in 2003. The two sets of measurements were consistent within ±12.4 m for an elevation range from 300 to 1000 m. We produced an interferometric synthetic aperture radar (InSAR) digital elevation model (DEM) with 50 m grid spacing and InSAR DEM heights were corrected using GLAS heights as ground-truth data. The height differences are assumed to have a quadratic function of rectangular polar stereographic coordinates with six coefficients, and the most probable estimate of the correction parameter set was calculated using a least squares method. Before correction, the root-mean-square (rms) height error was ±284 m; after correction, the associated error was reduced to ±22.3 m, where the absolute error in the horizontal coordinates (grids) was ±230 m. The resultant InSAR DEM height error is twice as large as the GLAS DEM height error; however, the accuracy of the resultant InSAR DEM is reasonable when we consider the limitations of single baseline InSAR and the steep slopes (range in elevation: 1000 m) within the ice sheet region. An InSAR DEM with high spatial resolution and 2 m relative accuracy in terms of yearly change is useful for monitoring ice volume (mass) change by a superconducting gravimeter.

Spatio-temporal changes in surface air temperature in the region of the northern Antarctic Peninsula and south Shetland islands during 1950-2003

Viktorie Stastna

Time series of surface air temperature recorded at eight stations upon the northern Antarctic Peninsula and South Shetland Islands were analyzed for the period 1971-2000 (longer time series were analyzed for some of the stations). Erroneous values and inhomogeneities were searched for. After homogenization, missing data were replaced by interpolated values. Monthly, seasonal, and annual trends in surface air

temperature were analyzed, and their statistical significance calculated. Spatial variability in surface air-temperature trends was determined and three distinct regions identified: a southern region (Vernadsky, Rothera), eastern region (Esperanza, Marambio), and northern region (Bellingshausen, Prat, Frei, O'Higgins).Different trends in temperature were obtained for the eastern and western coasts of the Antarctic Peninsula, despite the close vicinity of the stations. The surface air temperature on the northern coast (O'Higgins) and in the northern region shows the smallest changes in temperature. The lowest surface air temperature and greatest warming trends during 1971-2000 were recorded on the eastern coast (Marambio and Esperanza) in autumn. The analyses confirm a warming trend (except for spring) at some stations. The most pronounced increasing seasonal trend was found in winter (five stations), followed by autumn (three stations). This warming is probably related to changes in atmospheric circulation, the extent of sea ice, and ocean processes.

Seiches in Lützow-Holm Bay, Antarctica

Akira Nagano, Yutaka Michida, Minoru Odamaki, Kazunori Suzuki, Jun Ogata

Sea-level oscillations induced by Sumatran earthquakes on 26 December 2004 and 28 March 2005 were analyzed using tide gauge data recorded in L□tzow-Holm Bay, Antarctica. The oscillations continued for more than 2 days, with principal periods of about 1 and 3 h. The 3-h component was repeatedly excited by the 1-h component, resulting in alternations of the dominant period of oscillation. The dynamical modes of sea-level oscillations were calculated based on topographic data for Lützow-Holm Bay. The predominant periods of the long-lived sea-level oscillations were found to be similar to those of the waves of topographically constrained modes. The alternations in the dominant period of the oscillations may be interpreted as disturbances that were initially localized in a shallow region of the basin and subsequently expanded to the entire basin.

Glaciation history of Queen Maud Land (Antarctica) reconstructed from in-situ produced cosmogenic ^{10}Be, ^{26}Al and ^{21}Ne

Marcus Altmaier, Ulrich Herpers, Georg Delisle, Silke Merchel, Ulrich Ott

We present for the first time rock exposure ages primarily for the Wohlthat Massiv/Queen Maud Land, Antarctica, determined from 54 quartz rich samples via in-situ produced ^{10}Be ($T_{1/2}$ = 1.51 Ma) and ^{26}Al ($T_{1/2}$ = 0.7 Ma) using accelerator mass spectrometry (AMS). Measured radionuclide concentrations vary from extremely low values up to saturation. For a scenario with extremely low erosion and minimal tectonic uplift ^{10}Be and ^{26}Al surface exposure ages are generally in good agreement. Long exposure ages up to >8 Ma were confirmed by measurement of stable ^{21}Ne using noble gas mass spectrometry.

Our data suggest that the regional highest mountain peaks had risen above the ice surface at least 1–4 Ma ago. Notwithstanding a 200–400 m higher ice sheet elevation persisted in the Wohlthat Massiv/Queen Maud Land until about 0.5 Ma ago. In our interpretation, the successive thinning of the ice sheet was probably in response to global cooling and less annual precipitation since the Pliocene. Our results are in line with published ice sheet modelling results predicting only modest changes in ice thickness in Queen Maud Land during the □warmer" Pliocene and during the transition to the "cooler□ present. Low-level changes occurred during the last glacial maximum, but only affected the region located close to the present shelf ice. As the extremely low erosion rates (<5 cm Ma^{-1}) inferred for several samples can only exist under extremely cold and hyperarid conditions, we exclude a scenario featuring a prolonged period with warm and humid climatic conditions within the last 8 Ma. Our data do not support the notion of a temporary large scale retreat of the East Antarctic ice sheet during a suspected warming episode in the Pliocene.

Reproductive mode of *Polygonum* 1 *viviparum* depends on environment

Miki Tomita, Takehiro Masuzawa

We investigated the effects of microenvironmental conditions on the reproductive characteristics of Polygonum viviparum in the Southern Alps of Japan. We examined environmental differences and the distribution of P. viviparum at four study sites on the southeast-facing cirque of Mt Maedake. P. viviparum was found at two sites, where the humic loam layer was well developed on the soil surface. The timing of snowmelt differed considerably between these two sites. On average, the ratio of flowers to bulbils per inflorescence was low and the production of bulbils was high in the population experiencing later snowmelt. The mean maximum leaf area, number of flowers per inflorescence, and fresh weight of bulbils decreased with decreasing length of the growing season. In contrast, the number of individuals without inflorescences increased with decreasing length of the growing season. The starch content of the rhizomes of each individual was similar, regardless of the presence of flowers in the inflorescence. Within rhizomes, the starch content in the old rhizome was lower than that in the new and central portions of the rhizome. The starch content of the old rhizome was higher in individuals without inflorescences; starch appeared to be consumed for inflorescence production.

Communities of algae and cyanobacteria on glaciers in west Greenland

Jun Uetake, Takeshi Naganuma, Martin Bay Hebsgaard, Hiroshi Kanda, Shiro Kohshima

Communities of algae and cyanobacteria on two glaciers in west Greenland (the Qaanaaq and Russel glaciers) were analyzed and compared with the aim of explaining why the Qaanaaq Glacier (in northwestern Greenland) has a dark-colored surface in

satellite images whereas the Russel Glacier (in western central Greenland) has a light-colored surface. We found that algal and cyanobacterial communities differed between the glaciers and that the amount of biomass was higher on the colder glacier (Qaanaaq Glacier). The community on the Qaanaaq Glacier was composed mainly of green algae, whereas that on the Russel Glacier was dominated by cyanobacteria. Despite the shorter melting period (due to colder air temperature) for the Qaanaaq Glacier, the biovolume of algae and cyanobacteria was 2.35 times higher than that on the Russel Glacier at a similar altitude, suggesting greater primary production on the Qaanaaq Glacier. We discuss the possible effects of temperature, nutrient concentrations, and cryoconite holes (melt-holes in the glacier) on the community structure and productivity of algae and cyanobacteria on each glacier, and consider the influence of the identified differences in algal and cyanobacterial communities on the amount of surface melt.

Microbial diversity across a Canadian sub-Arctic, isostatically rebounding, soil transect

J. T. Trevors, P. G. Kevan, L. Tam

Seacoast to inland soil transects of 1 and 2 km were researched over 2 years to understand the microbial diversity in a post ice age, isostatically, rebounding, soil environment. Community level substrate utilization analysis and 16S rDNA eubacterial diversity were employed. The community level substrate analysis demonstrated that regardless of the location along the transect from seacoast to forest, sandy or peat soil, the microbial diversity (Shannon diversity index about 3) was virtually the same. Shannon diversity indexes based on PCR-DGGE analysis yielded values between about 0.6 and about 2 depending on the sand or peat soil type and the year the samples were collected and analyzed (2002 and 2003). Regardless of the genetic diversity, the soils exhibited similar metabolic capabilities. This is a good example of redundant, functional, physiology regardless of the species present at each location along the transects.