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Atmospheric gravity waves identified by ground-based observations of the intensity and rotational temperature of OH airglow

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Spectroscopic observations of OH airglow undertaken on May 2, 2006 at Uji, Japan reveal variations in intensity and rotational temperature related to the passage of an atmospheric gravity wave. The variations exhibit a period of approximately 1 h and magnitudes of 2–6% in intensity and 0.5–2% in rotational temperature. The vertical wavelength and intrinsic frequency of the atmospheric gravity wave were determined from the horizontal wavelength derived by an OH airglow imager, the background horizontal wind velocity obtained by the middle and upper atmosphere (MU) radar, and the dispersion relationship. The observed variations are consistent with the values calculated using the model of Liu, A.Z., Swenson, G.R. [2003. A modeling study of O_2 and OH airglow perturbations induced by atmospheric gravity waves. J. Geophys. Res. 108 (No. D4), 4151. doi:10.1029/2002JD002474].

On the response of the neutral temperature at 78° N and 90 km altitude to solar proton events

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We are able to determine neutral air temperatures by examining the fading times of meteor trail echoes in the upper mesosphere/lower thermosphere. It has been suggested that solar proton events may stimulate both dynamic and aeronomic changes in the middle atmosphere and we have endeavoured to investigate this. Despite a variety of approaches to determine the background temperature above which we might expect to see enhancements under conditions of strong proton precipitation, we are unable to detect any significant changes. We have repeated the search during selected seasons and also with various proton flux thresholds, similarly to no avail. We conclude, therefore, that at 90 km altitude, 78° N and 16° E, at least, we are unable to detect enhanced neutral temperatures due to solar proton events. At best, any enhancements, predicted to be of the order of a few K only, are likely to be completely masked by the day-to-day variability of the temperature field.

Laboratory experiments and thermal calculations for the development of a next-generation glacier-ice exploration system: Development of an electro-thermal drilling device

Yuko Suto, Sosuke Saito, Ken-ichi Osada, Hiroshi Takahashi, Hideaki Motoyama, Yoshiyuki Fujii, Yoichi Tanaka

A next-generation drilling system, equipped with a thermal drilling device, is proposed for glacier ice. The system is designed to penetrate glacier ice via melting of the ice and continuously analyze melt-water in a contamination-free sonde. This new type of drilling system is expected to provide analysis data in less time and at less cost than existing systems. Because of the limited number of parameters that can be measured, the proposed system will not take the place of conventional drilling systems that are used to obtain ice cores; however, it will provide a useful method for quickly and simply investigating glacier ice.

An electro-thermal drilling device is one of the most important elements needed to develop the proposed system. To estimate the thermal supply required to reach a target depth in a reasonable time, laboratory experiments were conducted using ice blocks and a small sonde equipped solely with heaters. Thermal calculations were then performed under a limited range of conditions. The experiments were undertaken to investigate the effects of the shape and material of the drill head and heater temperature on the rate of penetration into the ice. Additional thermal calculations were then performed based on the experimental results.

According to the simple thermal calculations, if the thermal loss that occurs while heat is transferred from the heater to ice (in melting the ice) is assumed to be 50%, the total thermal supply required for heaters in the sonde and cable is as follows: (i) 4.8 kW (sonde) plus 0 W (cable) to penetrate to 300 m depth over 10 days into temperate glacier ice for which the temperature is 0° C at all depths and to maintain a water layer along 300 m of cable; (ii) 10 kW (sonde) plus 19-32 kW (cable) to penetrate to 1000 m depth over 1 month into cold glacier ice for which the temperature is -25° C at the surface and 0° C at 1000 m depth and to maintain a water layer along 1000 m of cable; and (iii) 19 kW (sonde) plus 140-235 kW (cable) to penetrate to 3000 m depth over 2 months into an ice sheet for which the temperature is -55° C at the surface and 0° C at 3000 m depth and to maintain a water layer along 3000 m of cable. The thermal supply required for the cable is strongly affected by the thickness of the water layer, cable diameter, and the horizontal distance from the ice wall at which the ice temperature was maintained at its initial temperature. A large thermal supply is required to heat 3000 m of cable in an ice sheet (scenario (iii) above), but penetration into glacier ice (scenarios (i) and (ii) above) could be realistic with the use of a currently employed generator.

Resting cells of microorganisms in the 20-100 μm fraction of marine sediments in an Antarctic coastal area

Mutsuo Ichinomiya, Miwa Nakamachi, Mitsuo Fukuchi, Akira Taniguchi

We investigated the morphological features, vertical sinking fluxes, and number densities of the resting cells of ice-associated microorganisms in the 20–100 μm fraction of natural marine sediments collected from ice-covered and ice-free areas around Syowa Station, Lutzow-Holm Bay, East Antarctica. We identified the resting cells of various taxonomic groups, including the spores of a diatom, cysts of three dinoflagellates, cysts of five oligotrich ciliates, and the eggs of a mesozooplankton. This is the first report of oligotrich ciliate cysts from Antarctic waters. The resting spores of *Thalassiosira australis* (diatom), cysts of *Polarella glacialis* (dinoflagellate), and egg type 1 sink to the bottom sediment during summer. Our results suggest that some planktonic and ice-associated microorganisms in Antarctic coastal areas send their resting cells to the bottom sediments as seed populations for the following generation.

Temporal variations in the abundance and sinking flux of diatoms under fast ice in summer near Syowa Station, East Antarctica

Mutsuo Ichinomiya, Yasushi Gomi, Miwa Nakamachi, Masaki Honda, Mitsuo Fukuchi, Akira Taniguchi

To investigate the fate of ice algae released from sea ice, we investigated the abundance, species composition, and sinking flux of diatoms in the water column under fast ice near Syowa Station, Antarctica during the summer of 2005/2006. The diatom assemblage in the water column consisted of chain-forming planktonic species, in contrast to the under-ice assemblage dominated by pennate species reported from this site in the past; this dissimilarity suggests the presence of an unconsolidated platelet ice layer under the congelation ice, within which planktonic species can bloom. Among the dominant diatoms, *Porosira pseudodenticulata* and *Pseudo-nitzschia* cf. *turgiduloides* were dominant in the water column, and their water column stocks were higher than their mass sedimentation. These species apparently maintain their populations in the surface layer, as their production remains in the water column. In contrast, *Fragilariopsis kerguelensis* and *Thalassiosira australis* were scarce in the water column but rich in the flux, indicating active sinking and export of their production to the benthic ecosystem. This distinction in buoyancy control and sinking characteristics of the dominant diatoms on release from the fast ice influences the diatom species composition and carbon flow under the ice.

Vertical material flux under seasonal sea ice in the Okhotsk Sea north of Hokkaido, Japan

Takehiko Hiwatari, Kunio Shirasawa, Yasushi Fukamachi, Ryuichi Nagata, Tomoyoshi Koizumi, Hiroshi Koshikawa, Kunio Kohata

Downward material fluxes under seasonal sea ice were measured using a time-series sediment trap installed at an offshore site in the Okhotsk Sea north of Hokkaido, Japan, from 13 January to 23 March 2005. The maximum fluxes of lithogenic

material (753 mg m^{-2} day^{-1}) and organic matter (mainly detritus; 333 mg m^{-2} day^{-1}) were recorded during the period in which sea ice drifted ashore and increased in extent, from 13 January to 9 February. Organic matter as fecal pellets (81–93 mg m^{-2} day^{-1}) and opal as biosilica (51–67 mg m^{-2} day^{-1}), representing diatom fluxes, were abundant in sediment trap samples obtained during the period of full sea ice coverage from 10 February to 9 March. Microscopic observations revealed that fecal pellets were largely diatom frustules, suggesting that zooplankton actively grazed on ice algae during the period of full sea ice coverage. During the period of retreating sea ice, from 10 to 23 March, the phytoplankton flux showed a rapid increase (from 9.5 to 22.5 × 10^6 cells m^{-2} day^{-1}), reflecting their release into the water column as the sea ice melted. Our results demonstrate that the quantity and quality of sinking biogenic and lithogenic materials vary with the seasonal extent of sea ice in mid-winter.

The Tromso Dynasonde

M.T. Rietveld, J.W. Wright, N. Zabotin, M.L.V. Pitteway

A description, history and the capabilities of an ionospheric sounder in the auroral zone near Tromso, Norway are presented, together with some scientific applications. The sounder, which is of the dynasonde type, has provided a data set which has improved dramatically in quantity, quality and information content. A similar sounder is planned to be installed in the polar cap near Longyearbyen on Spitsbergen.