Spatial distribution of snow specific surface area along the traverse route from the coast to Dome Fuji, Antarctica: multiple in-situ observations

Ryo Inoue[1], Teruo Aoki[2], Shuji Fujita[2,1], Shun Tsutaki[2,1], Hideaki Motoyama[2,1], Fumio Nakazawa[2,1] and Kenji Kawamura[2,1,3]

[1] *The Graduate University for Advanced Studies, SOKENDAI, Japan*

[2] *National Institute of Polar Research, Japan*

[3] *Japan Agency for Marine-Earth Science and Technology*

The specific surface area (SSA, the ratio of surface area to mass or volume and an indicator of grain size) of snow grains at the surface is a dominant factor of surface albedo for the Antarctic ice sheet. Thus, it is important to observe the spatial and temporal distribution of the snow SSA and understand how depositional environments such as snow temperature, accumulation rate and wind control the SSA in the near-surface snow. However, only a few field observations for wide-area distribution of snow SSA have been performed in Antarctica. For example, SSA on a pit wall was measured at 21 sites between Dumont D'Urville (near the coast) and Dome C (inland) using the IceCube (A2 photonics, France) instrument (Gallet et al., 2011). In this study, we observed the surface snow SSA along two round-trip traverse routes between S16 and Dome Fuji from November 2021 to February 2022 within the 63rd Japanese Antarctic Research Expedition to reveal the spatial distribution of snow SSA at higher measurement intervals. We used a newly developed Handheld Integrating Sphere Snow Grain Sizer (HISSGraS), which has the same measurement principle as the IceCube and has the advantage of rapid measurements and fewer calibrations. These improvements greatly shortened the time spent for the measurements at each observation site and allowed us to collect an unprecedented amount of in-situ data from Antarctica. We performed measurements at a total of ~200 sites along the traverse routes, with 20-30 km intervals on each way of two round trips (Fig. 1). At each site, we measured ten surfaces at intervals of ~2 m. Thus, a total of ~2000 snow surfaces were measured. We found that the surface snow SSA gradually increases from S16 to Dome Fuji as elevation increases and air temperature decreases. We observed some cases where strong winds (> ~20 m/s) caused erosion, exposing older snow and decreasing the SSA at the surface, even when it was snowing. In the katabatic wind region, on steep slopes where snow was blown away by strong winds (resulting in lower accumulation rate), glazed surfaces with low SSA developed. Our data provide crucial information for studying surface albedo.

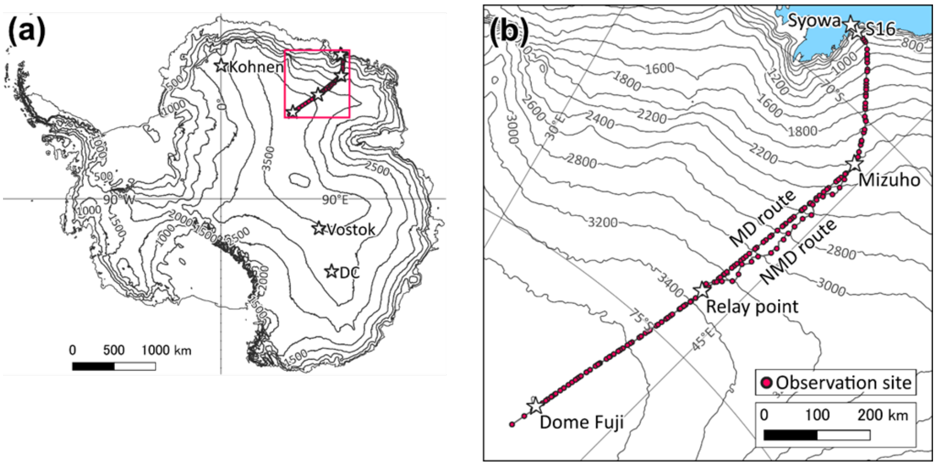

Figure 1. (a) Topographic map of Antarctica. (b) Enlarged view of red rectangle in (a), showing the traverse route from S16 to Dome Fuji.

References

Gallet, J.-C., Domine, F., Arnaud, L., Picard, G., and Savarino, J., Vertical profile of the specific surface area and density of the snow at Dome C and on a transect to Dumont D'Urville, Antarctica – albedo calculations and comparison to remote sensing products, The Cryosphere, 5, 631–649, 2011.