Preliminary analysis result of the Handheld Integrating Sphere Snow Grain Sizer (HISSGraS)

*Teruo Aoki[1,2,3], Masashi Niwano[2], Satoru Yamaguchi[4], Sumito Matoba[5], Tomonori Tanikawa[2], Masahiro Hori[6], Rigen Shimada[6], Akihiro Hachikubo[7]

1. The Graduate School of Natural Science and Technology, Okayama University, 2. Meteorological Research Institute, Japan Meteorological Agency, 3. National Institute of Polar Research, 4. National Research Institute for Earth Science and Disaster Resilience, 5. Institute of Low Temperature Sciences, Hokkaido University, 6. Earth Observation Research Center, Japan Aerospace Exploration Agency, 7. Kitami Institute of Technology

Snow grain size is one of the most important factors as a snow physical parameter expressing the snow metamorphism as well as controlling the albedo. As snow grains are generally non-spherical and complicated shapes, the optically-equivalent grain size is not a common glaciological grain size[1)]. Thus, various techniques to measure the specific surface area (SSA) as an optically-equivalent grain size have been developed[2-5)]. It is known from intercomparisons of those techniques so far that one of the most accurate field instruments is IceCube (A2 Photonics Sensor, France)[2)]. The IceCube measures a reflectance of snow sample at the wavelength of 1,310 nm using an integrating sphere and a laser light source. The value of SSA is transformed from the reflectance. A weight of the IceCube is as much as about 20 kg and the snow sampling into a sampling case is needed. These impose not only a workload to the observer but also a certain observation time. We therefore developed a small and light-weight (1/10) instrument, the Handheld Integrating Sphere Snow Grain Sizer (HISSGraS), which operates on the same principle as the IceCube and can measure snow pit face or snow surface directly. This direct measurement enables us to measure the SSA of snow of natural condition in a short time. We measured the SSAs with HISSGraS and IceCube for several snow samples in a cold laboratory and for natural snow pit face in Japan and Greenland. When the SSAs were measured for the same snow samples with both HISSGraS and IceCube, the those SSAs agreed well with each other. When HISSGraS measured snow pit face directly and IceCube measured snow samples collected from the same snow pit, the SSAs by HISSGraS were somewhat larger than those by IceCube. This is because the snow crystals in a sampling case would be compressed at the sampling and the snow grain size could differ from that under natural snow condition.

References

1) Aoki et al. (2007): Remote Sens. Environ., 111, 320–336.
2) Gallet et al. (2009): The Cryosphere, 3, 167-182.
3) Legagneux et al. (2002): J. Geophys. Res., 107(D17), 4335.
4) Hachikubo et al. (2012): Seppyo in Hokkaido, 31, 45–48.
5) Matzl and Schneebeli (2010): Cold Reg. Sci. Tech., 64, 1-8.

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