グリーンランド氷床上 SIGMA-A における積雪不純物とアルベド変化

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Variations of snow impurities and albedo at site SIGMA-A on Greenland ice sheet

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To clarify the contributions of light absorbing snow impurities and glacial microbes to recent abrupt melting of snow/ice in Greenland intensive observations of meteorological and snow parameters have carried out at the site SIGMA-A (78°03'N, 67°38'W, 1,490 m a.s.l.) on northwestern Greenland ice sheet during the period from June 28 – July 15, 2012. Figure 1 depicts the time seris variations of meteorological elements measured with automatic weather station (AWS) and mass concentration of snow impurities measured from snow samples of a 0-2 cm layer. Air temeprature varied around 0ºC during the first half of the observation period and snow surface level gradually decreased (Fig. 1a). After that a large amount of rainfall was observed from July 10 to 13 and the snow surface level decreased by 14 cm. At this time it was reported from NASA that a melting event of surface snow/ice over 97% of Greenland ice sheet happened between July 8 and 12. During the observation period broadband albedos represent cyclic dirnal variations under clear skies and irreguar variations under cloudy skies (Fig. 1b). Since the visible albedo is sensitive to the snow impurity concentrations, somewhat decreaseing trend of the visible albedo throughout the period could be due to increases of snow impurity concentrations. Figure 1c represents mass concentrations of snow impurities where elemental carbon (EC) concentration gradually increased. Since there was no precipitation except on 12 July and EC particles are generally too small to fall on snow surface by dry deposition, condensation process associated with snow melting and sublimation at surface possibly increases the EC concentration. Theoretically calculated albedo reduction by the maximum EC concentration 4.9 ppbw measured on 12 July is approximately 0.01. After the rainfall event high concentration of dust particles (1327 ppbw) on nuclepore filter with the pore size of 5 micrometers was observed on 12 July. This indicates a possible transport of even large particles to ice sheet surface at the elevation 1,490 m. This is important for nutrient supply to glacial microbes in ablation area.

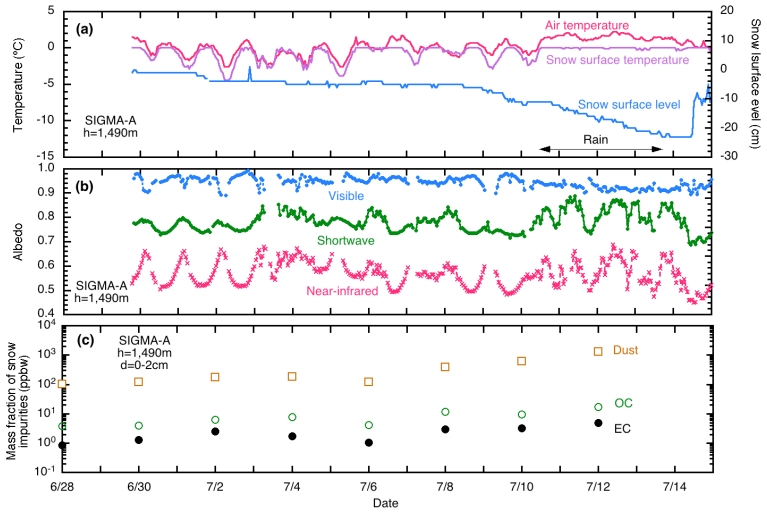

Fig. 1 Time series variations of (a) air and snow surface temperatures and snow surface level, (b) broadband albedos, (c) mass concentrations of mineral dust, organic carbon (OC), and elemental carbon (EC) measured at SIGMA-A on Greenland ice sheet during intensive observations. An abrupt rise of snow surface level on 14 July was artificially made to keep the AWS mast.