Geophysical Research Abstracts
Vol. 19, EGU2017-15651, 2017
EGU General Assembly 2017

Algal communities in cryoconite holes on the Russell glacier, Southwest Greenland

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The surface of the Greenland Ice Sheet in ablation zone has considerably darkened in the last decades, thus absorbing more solar radiation and accelerating ice melting. Darkening of glacier is made of different impurities that reduce surface albedo. These impurities are represented as cryoconite – combination of dust, soot and microorganisms. While mineral dust composes the greatest part of cryoconite, the black carbon is the most solar radiation absorbing constituent. Microorganisms on the ice are concentrated in cryoconite holes, which have long been of scientific interest, but still remain poorly understood.
In order to investigate the microbial communities in cryoconite holes, we collected 12 samples from cryoconite holes at 6 sites located on a 2.5 km long transect line on Russell glacier, Southwest Greenland. The first sampling site was set 3 km from glacier margin at 552 m a.s.l. and the last sampling site was 500 m from the glacier margin at 423 m a.s.l. Depth and diameter of each cryoconite hole, as well as pH, temperature and electrical conductivity was measured in situ on July 29, 2017. During microscopic analysis all microcharcoal (10–100 μm), spheroidal carbonaceous particles (soot), pollen, spores and algae were recorded.
Principal Component Analysis reveal two clusters of cryoconite holes (located at 423–465 m a.s.l. and 465–552 m a.s.l.) indicating altitudinal differences. Further, our results show that the biomass of green algae Mesotaeniaceae is correlated with temperature. Meanwhile green algae Chlamydomonadaceae correlates with temperature, microcharcoal and soot particle abundance. Our results show that green algae are dominant type of microorganisms inhabiting cryconite holes on the Russell's glacier at least up to distance of 3 km from ice margin. It is contrary to the previous study of Uetake et al. (2010), who found that cyanobacterial (Oscillatoriaceae) community dominated at 510–635 m altitude of the ablation area of Russell glacier in 2007 (July 24). This turnover in algae composition over the last decade indicates apparent microbiological changes in Southwestern Greenland, which can enhance melting of the ice.

References

Uetake, J., Naganuma, T., Hebsgaard, M. B., Kanda, H., Kohshima, S. 2010. Communities of algae and cyanobacteria on glaciers in west Greenland. Polar Science, 4(1), 71–80.