

## Recent changes in physical, chemical, and biological conditions on the surface of Tyndall Glacier of the Patagonia

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Melting and shrinkage of glaciers have been recently reported in the many part of the world. The shrinkage is not caused only by global warming but also by surface albedo reduction due to surface dust on glaciers (cryoconite). In this study, we analyzed surface albedo, cryoconite amounts and snow and ice algae collected on Tyndall Glacier in 2012 and these results were compared with those from studies in 1999. Moreover, a satellite image was analyzed to estimate of recent variations in surface albedo in entire surface of the bare ice area.

The surface albedo and amounts of cryoconite were measured at the 3 site on the bare ice surface on Tyndall glacier in 2012, and then were compared with the result of same measurements in 1999. However, there was statistically no significant difference between the two years, indicating that surface albedo and the amounts of cryoconite did not significantly change in the last decade. The analysis of community structure of snow algae on glacier surface showed that there were various snow algae on the ice surface in 2012, however there were statistically no significant differences in their biomass and community structure between in 2012 and 1999. These results suggest that there was no significant physical and biological change on the ice surface of the glacier in the last decade. The analysis of Landsat-7/ETM+ satellite image of the Tyndall Glacier reveals that there was no significant change in surface albedo between 2001 and 2010. Thus, the entire bare ice surface of the Tyndall glacier did not significantly changed in the last decade.

Recent years, the bare ice surface of the Greenland ice sheet has been darkened probably due to increase of cryoconite on the surface, however, our studies showed that that of Patagonia Icefield has not changed significantly. The shrinking on Patagonia Icefield is unlikely due to surface darkening, but to calving effect of glacier margin by marine and lake water. The reason why the Patagonia Icefield is not darkened is uncertain, however, it is important to clarify the reason in order to understand the differences of glacial variations in the world.