Why Greenland melts: A Geo-Bio-Interface Perspective

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Concerns are growing about how fast and how much the Greenland Ice Sheet (GrIS) is melting, how this contributes to sea level rise and to what extent the released solutes and particles change the biogeochemical cycles and coastal ecosystems in the N Atlantic. Changes in the surface energy- and mass balance of the GrIS are linked to albedo, which is a response to the GrIS surface darkening through changes in snow and ice properties and the presence of light absorbing impurities (LAI). This darkening of the GrIS snow and ice surfaces is an important feedback to global temperature changes. Although, traditionally LAI were assumed to be solely Aeolian delivered black carbon and mineral dust, recently bio-albedo factors have been recognized as important, yet not well quantified parameters that affect surface albedo. Biological processes highly dynamic particularly during the ever increasing summer melt seasons. Such summer melt associated blooms of pigmented snow and ice algae will, in contrast to black carbon and mineral dust, rapidly respond to changes in the timing and duration of the annual melt seasons. As the climate warms and melt seasons become longer, such biological habitats will expand and increasingly contribute to the darkening of the GrIS, yet these bio-albedo effects are currently not included in predictive numerical models.

These changes in summer melt season length and extent also dramatically affect the delivery of icebergs and meltwaters and their entrained particulates to the N-Atlantic Ocean. Such processes in turn regulate the fluxes of dissolved and particulate elements (e.g., Fe, Si, P etc.). Such processes affect not just local environments but are important on a global scale, especially in a warming climate scenario.