Researchers suggest Greenland ice shelf melting faster due to embedded dust particles

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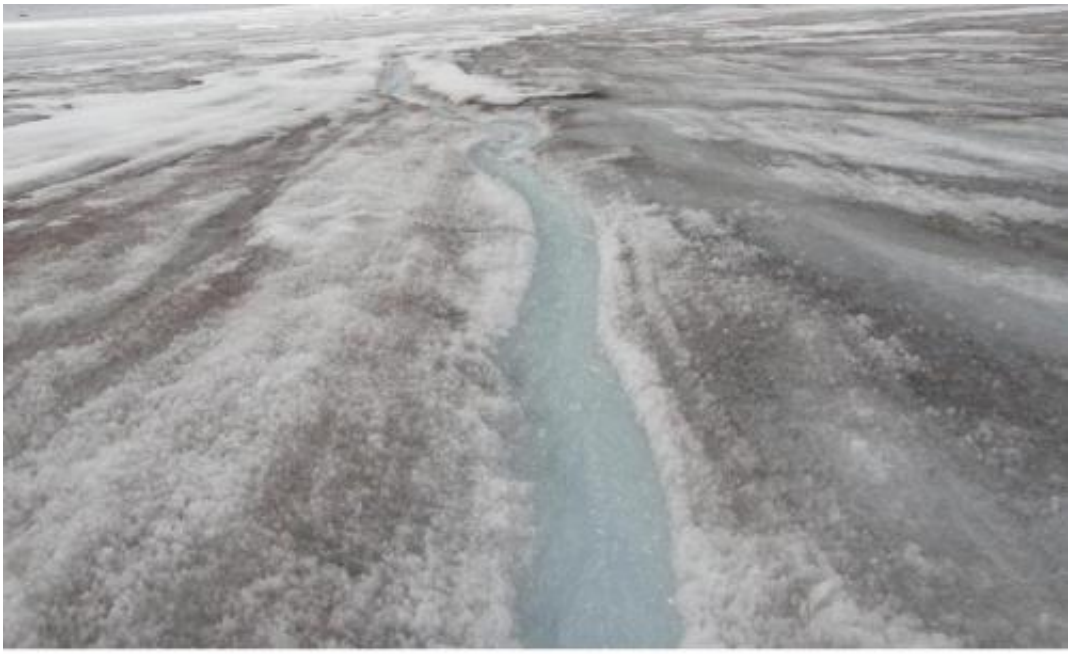

Melting snow containing light absorbing impurities. Credit: Florent Dominé

(Phys.org) —A team of planetary scientists with members from several research centers in France, has developed a theory that suggests that one of the reasons that Greenland's ice shelf is melting faster than models suggest, is because of embedded dust particles that hold more heat. In their paper published in the journal *Nature Geoscience*, the researchers describe how an analysis of satellite data over a several year period (2009-2013) convinced them that dust particles in the ice are responsible

for the accelerated loss of ice covering the island.

Scientists have known for some time that the edges of the Greenland's ice shelf are slowly melting due to global warming, but recently, they've begun to uncover evidence that suggests the interior of the shelf is melting too—a worrisome finding because it could mean higher ocean levels sooner than most models have predicted. Greenland's interior is both mountainous and is located at a high latitude, which means temperatures remain below freezing all year around. But, that's not enough apparently, to keep the ice from melting anyway. This, the researchers on this new effort, claim, is because dust from parts of the arctic that have seen ice disappear over the past decade blows onto the ice shelf and becomes embedded in the ice. When the sun shines on the ice, more of the heat is absorbed by the dust particles and held, causing some of the ice on top of the shelf to melt.

Prior to this new effort, scientists have attributed a darker looking Greenland, as seen from satellites, to an increase in ice crystal granule size, which they note, comes about due to slightly higher temperatures, as the atmosphere over the island, like the rest of the planet, slowly warms. This new research contradicts that theory and suggests Greenland's ice shelf is melting faster than anyone else has predicted. As the ice covering melts, sea levels rise—just how fast has been a matter of opinion, with different models offering different estimates. The researchers on this new effort suggest that as the arctic warms, and more ice near the edges melts, exposing bare ground, more dust will settle inland, causing more warming, and on and on creating a cycle that likely will only end when the entire shelf is bereft of ice. If that happens, sea levels would rise as much as 24 feet, inundating many coastal urban areas and completely covering many islands that are now inhabited by people.

Albedo measurement at Summit, Greenland. Credit: Florent Dominé

More information: Contribution of light-absorbing impurities in snow to Greenland's darkening since 2009, *Nature Geoscience* (2014) DOI: 10.1038/ngeo2180

Abstract

The surface energy balance and mass balance of the Greenland Ice Sheet depends on the albedo of snow, which governs the amount of solar energy that is absorbed. The observed decline of Greenland's albedo over the past decade1, 2, 3 has been attributed to an enhanced growth of snow grains as a result of atmospheric warming1, 2. Satellite observations show that, since 2009, albedo values even in springtime at high elevations have been lower than the 2003–2008 average. Here we show,

using a numerical snow model, that the decrease in albedo cannot be attributed solely to grain growth enhancement. Instead, our analysis of remote sensing data indicates that the springtime darkening since 2009 stems from a widespread increase in the amount of light-absorbing impurities in snow, as well as in the atmosphere. We suggest that the transport of dust from snow-free areas in the Arctic that are experiencing earlier melting of seasonal snow cover4 as the climate warms may be a contributing source of impurities. In our snow model simulations, a decrease in the albedo of fresh snow by 0.01 leads to a surface mass loss of 27 Gt yr−1, which could induce an acceleration of Greenland's mass loss twice as large as over the past two decades5. Future trends in light-absorbing impurities should therefore be considered in projections of Greenland mass loss.