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From: The Earth Institute, Columbia University
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Greenland's Ice is Getting Darker, Increasing Risk of Melting

Greenland's snowy surface has been getting darker over the past two decades, absorbing more heat from the sun and increasing snow melt, a new study of satellite data shows. That trend is likely to continue, with the surface's reflectivity, or albedo, decreasing by as much as 10 percent by the end of the century, the study says.

While soot blowing in from wildfires contributes to the problem, it hasn't been driving the change, the study finds. The real culprits are two feedback loops created by the melting itself. One of those processes isn't visible to the human eye, but it is having a profound effect.

The results, published in the European Geosciences Union journal *The Cryosphere*, have global implications. Fresh meltwater pouring into the ocean from Greenland raises sea level and could affect ocean ecology and circulation.

"You don't necessarily have to have a 'dirtier' snowpack to make it dark," said lead author Marco Tedesco, a research professor at Columbia University's Lamont-Doherty Earth Observatory and adjunct scientist at NASA Goddard Institute of Space Studies. "A snowpack that might look 'clean' to our eyes can be more effective in absorbing solar radiation than a dirty one. Overall, what matters, it is the total amount of solar energy that the surface absorbs. This is the real driver of melting."

The feedback loops work like this: During a warm summer with clear skies and lots of solar radiation pouring in, the surface starts to melt. As the top layers of fresh snow disappear, old impurities, like dust from erosion or soot that blew in years before, begin to appear, darkening the surface. A warm summer can remove enough snow to allow several years of impurities to concentrate at the surface as surrounding snow layers disappear. At the same time, as the snow melts and refreezes, the grains of snow get larger. This is because the meltwater acts like glue, sticking grains together when the surface refreezes. The larger grains create a less reflective surface that allows more solar radiation to be absorbed. The impact of grain size on albedo – the ratio between reflected and incoming solar radiation – is strong in the infrared range, where humans can't see, but satellite instruments can detect the change.

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