

## Seasonal and decadal changes of the surface albedo of the sea ice over the Arctic Ocean

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Rapid decline of the entire cryosphere in recent years is generally considered to be caused by global warming. However, the sensible heat transfer from air to snow by the temperature rise by 1 K is estimated to be about 10 W/m<sup>2</sup>, while the reduction of surface albedo by 0.1 absorbs more solar energy of about 40 W/m<sup>2</sup> in the Arctic region in summer. It is therefore important to examine whether the snow/ice melting is indeed caused by global warming or by the reduction of surface albedo. Note that the change of snow-melting rate can be estimated from that of snow/ice surface albedo, because the albedo decreases with increasing water content.

In this paper we have analyzed the dataset of clear-sky surface albedo over the Arctic Ocean for the years 1982 ? 2003 (available from the National Snow and Ice Data Center), and examined the seasonal and decadal changes of surface albedo. The albedo values are estimated from satellite visible imageries with corrections for the effects of water vapor, cloud, and angles between the zenith and sun and satellite.

It has been found that the seasonal decrease in albedo is most significant in mid-June to mid-July when the sun is highest and sunshine duration is longest. On the other hand, the albedo begins to fall in August when the air temperature is still high. This fact suggests that the snow/ice melting is mainly caused not by warm air temperature but by the absorption of solar radiation. It has also been found that the decadal changes of ice albedo show the largest reduction rate for the periods during the middle of June and the middle of July. These facts imply that the snow-melting in the Arctic Ocean is caused by the interplay between the solar radiation and accumulated impurities on the ice surface rather than the warm air temperature.

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