

THE DECLINING ARCTIC SEA ICE COVER AND ICE-ALBEDO FEEDBACK EFFECTS

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ABSTRACT:

One of the most visible signals of our changing planet as observed from space is the rapid decline in the Arctic sea ice cover. Thirty years of continuous coverage by satellite passive microwave sensors have revealed that the sea ice cover in the Northern Hemisphere has been declining at the rate of -4% per decade. The decline rate is relatively moderate in winter and spring but much larger in summer and autumn. This is primarily because of the dramatic reduction of the area of the perennial sea ice cover in the recent decade. The perennial ice cover, which is the ice that survives the summer and consists mainly of the thick multiyear ice floes that has been the mainstay of the Arctic sea ice cover, has been declining quite rapidly. The average area of the perennial ice during the last 3 years was observed to be about 35% lower than the 30-year average and the overall decline rate has been about -13% per decade. Furthermore, the thick component, which is the 3-year and older ice types as observed in winter, is declining at an even greater rate of about -15% per decade. It is postulated that the rapid decline is associated with ice-albedo feedback that causes the amplification of global warming signal in the Arctic region because of the high albedo of the sea ice and snow cover. This leads to a conditioning of the mixed layer of the Arctic Ocean that causes the sea ice cover to be generally thinner and more vulnerable to total melt during the summer. Satellite measurements of sea surface temperature indeed show abnormally high values in the last few years. Modeling studies also show consistency of the observed retreat of the summer ice cover with ice-albedo feedback effects. Meanwhile, recent observations show significant decreases in the winter sea ice cover suggesting that increases in the Arctic surface temperature may be affecting the winter sea ice cover as well.