Arctic Cloud Response to Sea Ice Loss in Satellite Observations and a Global Climate Model

Over the next century, the Arctic Ocean is projected to become seasonally sea ice-free. Assessing feedbacks between clouds and sea ice as the Arctic loses sea ice cover is important because of clouds’ radiative impacts on the Arctic surface. Here, present and future Arctic cloud-sea ice relationships are assessed using spaceborne lidar observations and a fully-coupled global climate model forced by business-as-usual increases in greenhouse gases. Using a novel surface mask that restricts the analysis to where sea ice concentration varies, I isolate the influence of sea ice cover on Arctic Ocean clouds during summer and fall. Summer cloud structure and fraction are nearly identical over sea ice and over open water, but more clouds are observed over open water than over sea ice in the fall. Next, I use a global climate model with a lidar simulator to assess how observed cloud-sea ice relationships may change as the Arctic warms. With future sea ice loss, modeled summer cloud fraction, vertical structure, and optical depth barely change. Future sea ice loss does not influence summer clouds, but summer sea ice loss drives fall cloud changes by increasing the amount of sunlight absorbed by the summertime ocean and the heat released into the cooling fall atmosphere. The future fall boundary layer deepens and clouds become more opaque over newly open water. In summary, there is little evidence for a summer cloud-sea ice feedback but strong evidence for a positive cloud-sea ice feedback that emerges during non-summer months as the Arctic warms and sea ice disappears.

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Monday, January 28, 2019, at 3:15pm  
295 FASB  
Refreshments and Meet the Speaker at 3:00pm