Snow and Ice in the Earth System Viewed by Space Scatterometer Observatory

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Abstract

Snow and ice have an important role in the Earth climate system due to their interactions with land, ocean, and atmosphere in complex feedback processes. This paper presents recent results from satellite scatterometer, which serves as a space observatory to study the role of snow and ice from aggregation to hemispheric and global scales. Hemispheric snow cover is mapped on the daily basis by the QuikSCAT/SeaWinds scatterometer. The timing and duration of snowmelt process can be determined accurately to address snow impacts in both radiative and hydrologic balances. Extreme events such rapid snowmelt causing spring floods in cold land regions can be monitored leading to possible early detection or prediction of flooding conditions. Anomalous melt zones over the Greenland ice sheet and extreme warming events at McMurdo, Antarctica, have been detected and monitored with the space scatterometer observatory. Sea ice mapping by the scatterometer uncovers the mystery of the Svalbard sea-ice barrier, a rapid growth (1 day) of an elongated sea ice feature (100's km) that blocks off the sea route and traps fishing ship. Sea ice together with ocean wind mapping results show strong interactions among ice cover, atmosphere, and ocean currents that are related to ocean bottom bathymetry. In cold winter conditions, areas of seasonal and perennial sea ice are obtained to study the distribution and balance of new sea ice production and old sea ice export in different regions of the Arctic ocean. During seasonal transitions, the timing of sea ice surface albedo changes is determined. The albedo transition timing is important to accurately estimate solar radiation input into sea ice. In warm summer conditions, areas of positive and negative integrated energy absorption can be identified and mapped. Results present a clear impact of clouds as evident from cyclonic patterns of sea ice surface melt around an Arctic low pressure center. The space scatterometer observatory results affirm that snow and ice should be observed and studied together within the integral of the Earth system, and not as separated parts.