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ATMOSPHERE-ICE-OCEAN INTERACTIONS DURING SUMMER MELT AND EARLY AUTUMN FREEZE-UP: OBSERVATIONS FROM THE ACSE FIELD PROGRAM

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Surface energy fluxes are key to the annual summer melt and autumn freeze-up of Arctic sea ice, but are strongly modulated by interactions between atmospheric, ocean, and sea-ice processes. This paper will examine direct observations of energy fluxes during summer melt and the onset of autumn freeze-up from the Arctic Clouds in Summer Experiment (ACSE), and place them in context of those from other observational campaigns. The ACSE field program obtained measurements of surface energy fluxes, boundary-layer structure, cloud macro- and microphysical structure, and upper-ocean thermal and salinity structure from pack-ice and open-water regions in the eastern Arctic from early July to early October 2014. Summer measurements showed energy flux surpluses leading to significant surface melt, while late August and September measurements showed deficits, leading to freeze-up of sea ice and the ocean surface. The surface albedo and processes impacting the energy content of the upper ocean appear key to producing a temporal difference between the freeze-up of the sea ice and adjacent open water. While synoptic conditions, atmospheric advection, and the annual solar cycle have primary influence determining when energy fluxes are conducive for melt or freeze, mesoscale atmospheric phenomena unique to the ice edge region appear to also play a role.

These observations suggest a scenario of key processes important for the annual evolution of melt and freeze-up. The presentation will therefore also examine some of these processes as documented by other field programs, such as SHEBA, which had some sea-ice and ocean measurements not available for ACSE. The presentation will conclude with speculations of positive and negative feedbacks on these various processes involved in the melt and freeze as the Arctic moves towards a seasonally ice-free state.