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Retrieving Arctic Sea Fog Geometrical Thickness and Inversion Characteristics from Surface and Radiosonde Observations.

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Arctic sea fog hasn't been extensively studied despite its importance for environmental impact such as on traffic safety and on glacier ablation in coastal Arctic regions. Understanding fog processes can improve nowcasting of environmental impact in such remote regions where few observational data exist. To understand fog's physical, macrophysical and radiative properties, it is important to determine accurate Arctic fog climatology. Our previous study suggested that fog peaks in July over East Greenland and associates with sea ice break-up and a sea breeze with wind speeds between 1-4 m/s. The goal of this study is to understand Arctic coastal fog macrophysical properties and quantify its vertical extent. Radiosonde profiles were extracted from the Integrated Global Radiosonde Archive (IGRA) between 1980-2012, coincident with manual and automated fog observations at three synoptic weather stations along the coast of East Greenland. A new method using air mass saturation ratio and thermodynamic stability was developed to derive fog top height from IGRA radiosonde profiles. Soundings were classified into nine categories, based on surface and low-level saturation ratio, inversion type, and the fog top height relative to the inversion base. Results show that Arctic coastal fog mainly occurs under thermodynamically stable conditions characterized by deep and strong low-level inversions. Fog thickness is commonly about 100-400 m, often reaching the top of the boundary layer. Fog top height is greater at northern stations, where daily fog duration is also longer and often lasts throughout the day. Fog thickness is likely correlated to sea ice concentration density during sea ice break-up. Overall, it is hypothesized that our sounding classes represent development or dissipation stages of advection fog, or stratus lowering and fog lifting processes. With a new automated method, it is planned to retrieve fog height from IGRA data over Arctic terrain around the entire North Atlantic region. These results will serve as a basis for the incorporation of fog and temperature inversions into glacier surface energy balance models and can aid in improving the parameterization of fog for nowcasting methods for aviation applications.