**RF Propagation Characterization in the Arctic:
Measurements from JHU/APL participation in 2018 and 2019 SODA campaigns**

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This paper is a follow-on to work presented in the 2019 AP-S/URSI meeting in Atlanta detailing Johns Hopkins University Applied Physics Laboratory's (JHU/APL) participation in the Office of Naval Research's (ONR) 2018 and 2019 Stratified Ocean Dynamics of the Arctic (SODA) measurement campaign. These measurements focused on better characterizing the propagation of RF energy, in particular for low elevation angle paths, which is sensitive to vertical gradients in atmospheric temperature and humidity. Anomalous RF propagation can present challenges to designers and users of radar, communications, and navigation systems. These challenges, coupled with recent climatological changes, require a reassessment of the current state of the near-surface (up to ~1 km in altitude) atmospheric variability in the Arctic along with the accuracy of Numerical Weather Prediction (NWP) models to adequately capture these details.

Data were collected for the SODA campaign from two separate voyages of the USCGC Healy icebreaker in early Fall of 2018 and 2019 in the Beaufort and Chukchi Seas and consisted of meteorological measurements from various sensors along with data from radio receivers. Weather balloons (radiosondes) were launched during both years with additional measurements collected in 2019 using a customized quadrotor unmanned aerial vehicle (UAV) designed by JHU/APL to collect vertical profiles of air temperature, pressure and relative humidity data up to an altitude of 1 km. This paper will discuss the design of this new UAV and present its measured data in comparison to radiosondes and various weather models with a focus on the aspects of the profiles that most affect RF propagation. Indications of the presence of surface ducting, where RF energy is trapped in an atmospheric waveguide and can travel well beyond the horizon, occurred on several days of the 2018 underway, but were notable absent during the entirety of the 2019 underway. Subrefraction, where RF energy is bend up from the horizon, was also observed in the test data, which presents additional operating limitations. Seasonal variations of these conditions that remain uncharacterized to date will be discussed in the context of NWP forecast and reanalysis data.