IN-FLIGHT RAPID OBSERVATION & SURVEYING TOOL (IFROST) FOR EMI MAPPING PERMAFROST

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Permafrost is ground that remains completely froze for at least two years, occupies approximately 24% of the terrestrial surface of the Northern Hemisphere, and accounts for approximately half of all organic carbon stored within the planet's surface. A direct impact of climate change, specifically global warming, is the accelerating thawing of the permafrost. About 65% of Russa's land mass and nearly 85% of Alaskan soil is permafrost meaning permafrost is the foundation to most of the roads, houses, and infrastructure in these areas. As this permafrost melts, the soils become unstable and subside causing roads, bridges, and buildings to collapse. Rapid and accurate mapping of permafrost subsurface composition at scales relevant to the design and maintenance of horizontal and vertical infrastructure has been a long-standing challenge. Of utmost utility would be the development of standoff measurement techniques that could discern at the meter to submeter spatial scale and up to 10 m into the subsurface the presence or absence of ice features. Ground-based geophysical measurement techniques, including ground penetrating radar, borehole logging, and electrical resistivity, have been used to interrogate the subsurface in permafrost terrains at the meter to kilometers scales. Airborne measurement techniques have broad applicability at the larger, kilometers to tens of kilometers scale and could support linear infrastructure development and terrain mapping. However, there is a broad need for cost effective airborne geophysical techniques to obtain high-resolution measurements of specific areas of interest. We present a multifrequency broadband, electromagnetic induction sensor that operates between 40kHz and 432kHz which is lightweight and deployable on a UAS. As a preliminary investigation, we will present ground-based data collected in a cued mode. Normalization techniques are implemented to scale the data in such a way that the amplitude of the data can be used to assist in the extraction of conductivity of layered media and differentiate between permafrost and non-permafrost layers.