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DEVELOPING A SENSOR TO MEASURE ICE THICKNESS VARIABILITY IN THE POLAR SEAS: THE ARCTIC SEA ICE LEVEL SENSOR (ARCTIC SEILS)

Abstract

The Arctic Ocean covers millions of kilometers, and studying its evolution can provide a clearer understanding of global warming mechanisms. The Arctic is an early indicator of climate changes, and investigating it is imperative for mitigating the climate crisis. Precise measurement of ocean ice thickness is one of the most valuable parameters for climate change models. However, due to the remote nature of the Arctic Ocean, obtaining in situ measurements can be perilous. Thus, there is a need for technology which can enable researchers to remotely determine sea ice thickness, especially over a large area. Different methods have been used in the past to measure ice thickness, and altimeters have been found to be especially useful in satellite operations. However, altimetry data presents many limitations: short data record, narrow field of view, and perturbations due to other variables. One of the most notable challenges is extracting accurate ice thickness measurements when the sheets are covered by external layers of snow, as current sensors cannot differentiate between the two. The objective of this investigation is to review current remote sensing techniques and evaluate their overall performance, present the advantages and limitations of these instruments, and design an alternative approach to measure ice thickness. This paper aims to propose a conceptual design that can provide a framework for the development of hardware and software for the Arctic Sea Ice Level Sensor (Arctic SeILS). The study presents a theoretical and science-based approach to measure sea ice thickness, with a solution that aims to be an improved tool for remote sensing that can be integrated within existing architecture. Arctic SeILS can measure sea ice thickness accurately and across different environments, including any time of day or year. While Arctic SeILS is being developed for the goal of Earth observation, we propose extended applications to measure sea ice on other planetary bodies, including icy moons, as an exploration tool. The development of a reliable technology to measure sea ice thickness can help researchers better understand the impact of global warming on the Arctic Ocean, and consequently, mitigate climate change.