

**Title:**

Tracking sea-ice extension in northern Alaska using Distributed Acoustic Sensing and Machine Learning

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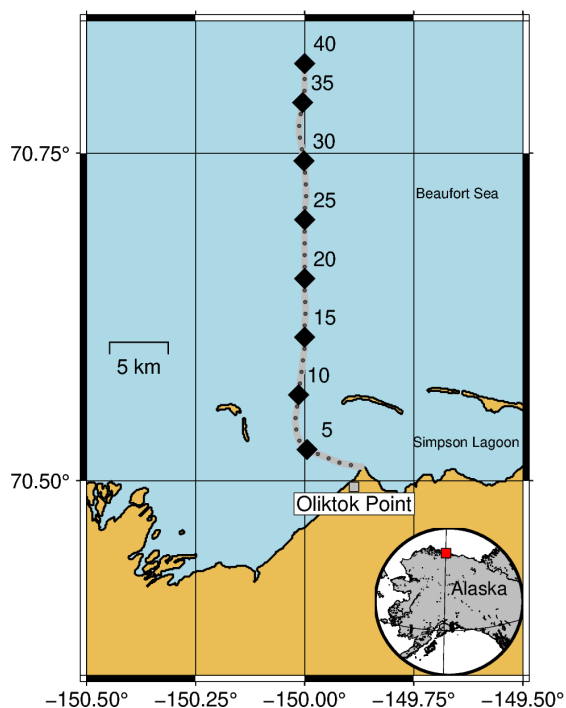
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**Abstract:**

Distributed Acoustic Sensing (DAS) is a new promising technology that records strain measurements along a fiber-optic cable with a high temporal and spatial resolution. We collect data from a submarine DAS system extending from the North Slope of Alaska (Oliktok Point) into the Beaufort Sea to test monitoring of ice-water interactions. DAS data were acquired up to ~37 km offshore, with a sampling rate of 1 kHz, and a spatial resolution of 2 m. We focus on two one-week deployments during July and November of 2021, where sea ice was in a transitional state. This DAS dataset has an approximate size of ~ 45 TB. We analyse this large dataset by using a Convolutional Neural Network and an unsupervised clustering algorithm to identify different types of seismic noises. We find that there are two major types of seismic noise (or clusters) in our dataset which correspond to the presence (open water system) or absence (sea ice) of gravity waves. Our results highlight the boundary between a coastal polynya and sea ice during the July deployment while during the November deployment we observe a rapid refreezing (~ 12 hours) of coastal waters. We observe a general agreement between the daily satellite-based estimates of sea-ice coverage and our clustering classification for the deployment during July but not during November. We show that DAS has the potential to be used as a sea-ice tracker in polar or glacier regions at higher temporal and spatial resolution than satellite imagery. *SNL is managed and operated*

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*Figure: Map of Oliktok Point and layout of the submarine fiber optic cable (Gray Line). Distributed acoustic sensing recorded data for the first 37.4 km of the cable. Black diamonds and gray circles represent intervals of 5 km and 1 km, respectively, along the cable. Inset shows the location of Oliktok (red square) with respect to Alaska (USA).*