

# In Situ Observations of the Interplay Between Sea Ice and the Atmosphere and Ocean

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## Abstract

The International Arctic Buoy Programme (IABP) maintains fundamental in situ components of the Arctic Observing Network. Automated Drifting Stations (ADS) consisting of sea ice, meteorological, and oceanographic buoys are collectively deployed at many sites with webcams to help understand the intricate and complex interactions between sea ice, the atmosphere, and the ocean.

While passive microwave satellites provide substantial information about the Arctic, remote sensing still has resolution limitations despite broad spatial coverage. Climate modeling and atmospheric reanalysis help surmount these limitations, but traditional observational methods of in situ data collection still have many advantages. Buoys and webcams can monitor Arctic sea ice changes above and below, allowing for more direct observations of localized ice floes when deployed in close proximity.

Using data from webcams in the Arctic, we have stitched together images into time-lapse animations that provide insight into physical sea ice processes. Coupled with buoy data, we compare physical measurements (like temperature) with webcam observations (like cloud cover) to explain trends and anomalies. For example, isothermal periods in the buoy temperature data match time-lapse images with cloudy skies, while the opposite is also true: high variability correlates with sunny skies. Hence, these instruments allow for the verification of Arctic observations both visually and statistically.

Although significant challenges like camera lifetimes and temporal resolution still persist, we argue that buoys and time-lapse videos can help validate satellite data and offer cheaper solutions to collecting vital information that increases our understanding of geophysical processes. We've compiled these datasets and present case studies showing the use of time-lapse videos to help monitor and understand the interplay and processes of the Arctic environment.

[Link to the time lapse from the presentation](#)

[References \(+ other fun stuff on my website!\)](#)

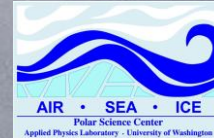
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2022-05-10 16:03:15

- Sea ice
  - Atmosphere-ocean interactions
- The Arctic
  - 2022
    - Low extent, age and thickness
- Monitoring is crucial
  - Environmental and social impact



# Observing Physical Sea Ice Processes

## Problem

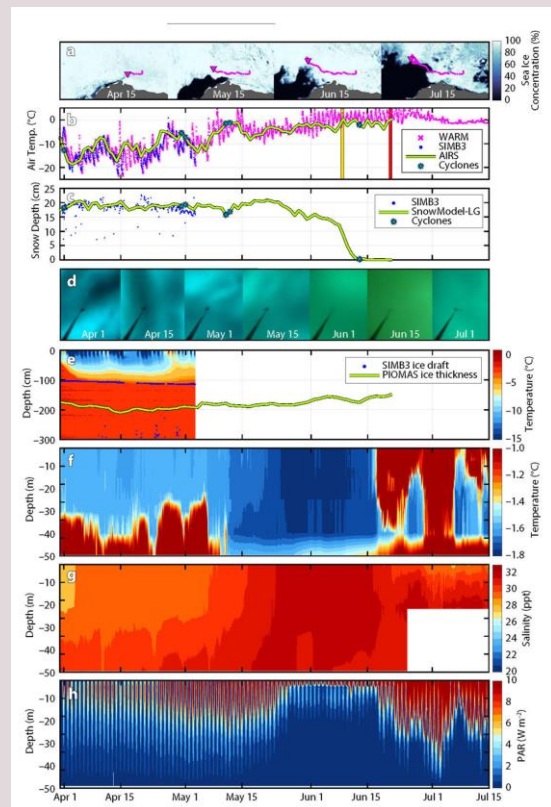
- Monitoring is difficult
- Satellites, modeling, reanalysis
  - Limitations -> expensive

## Solution?

- In situ methods
  - Advantages -> local, cheaper

## International Arctic Buoy Programme (IABP)

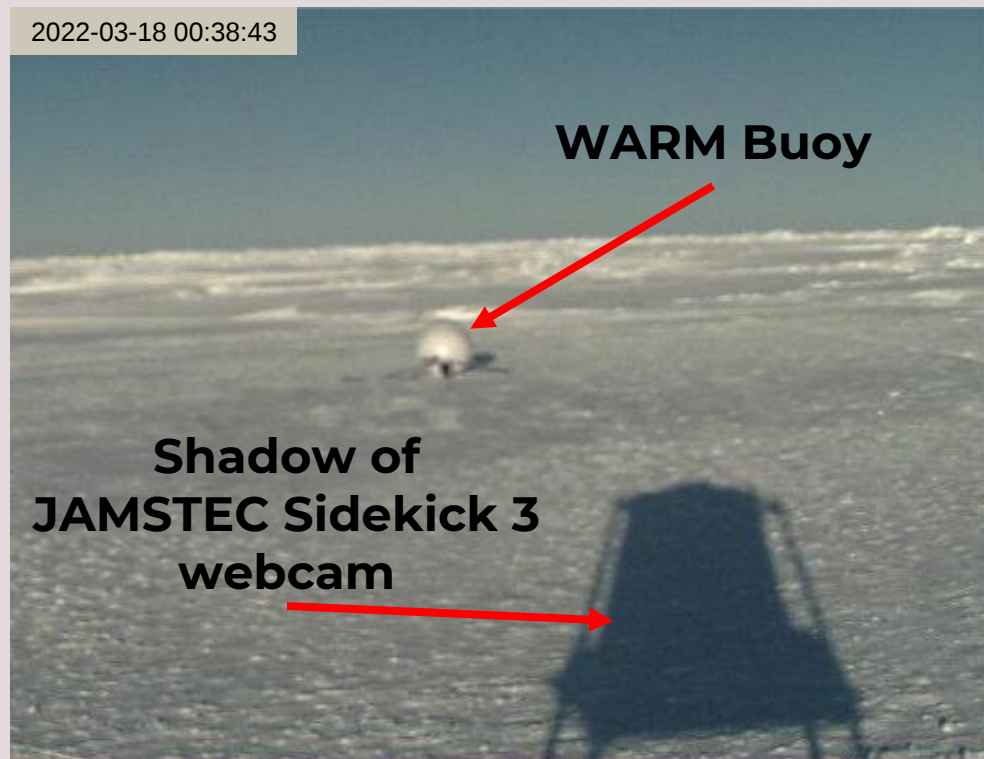
- Buoys
  - Temperature + etc.
- Web Cameras
  - Images of sky + ground (sea ice)



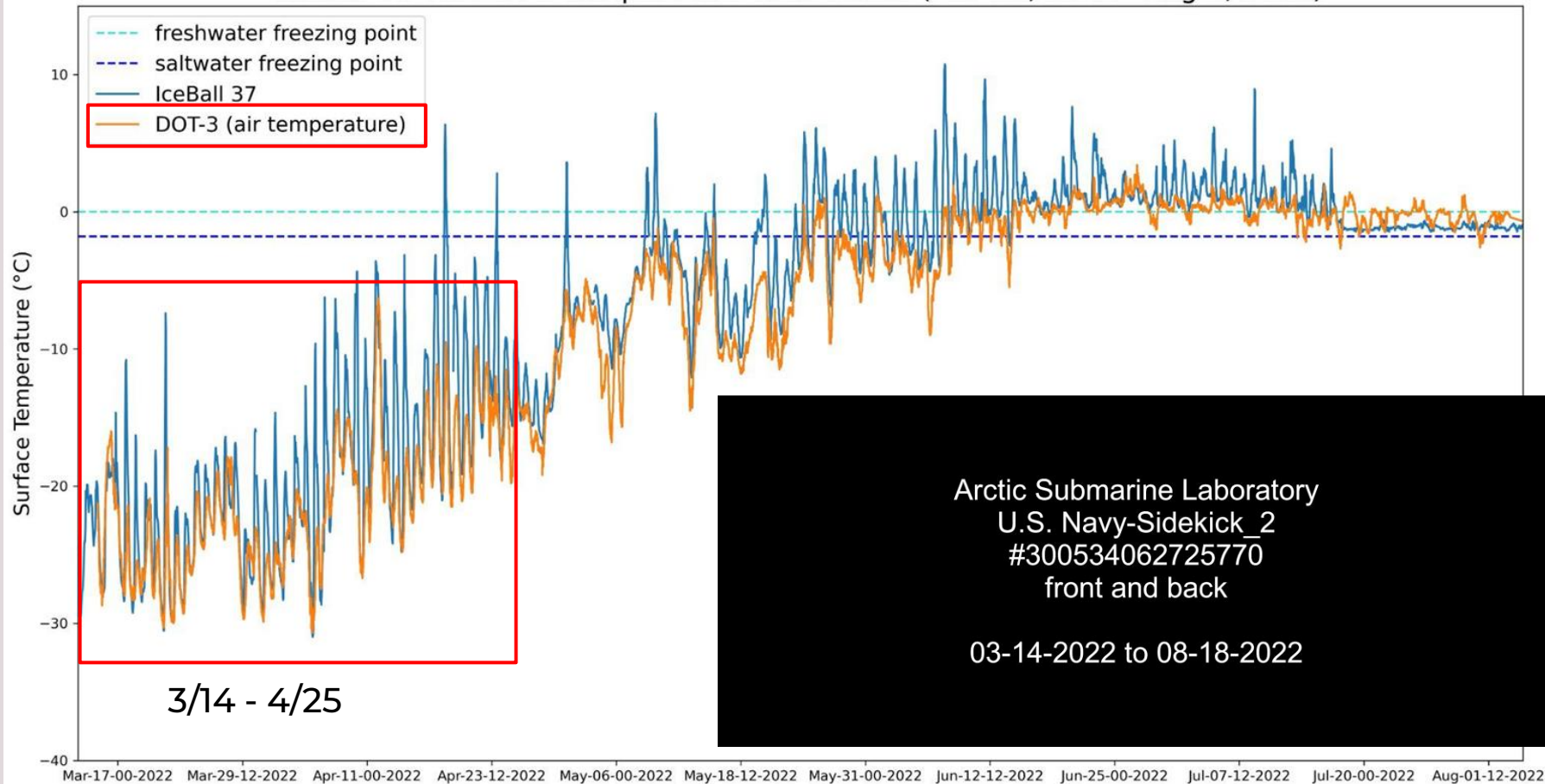
Wealth of information from buoys and webcams from a deployment site (2018 Arctic Ice Exercise (ICEX 2018)) (Webster et al., 2022).

# Objectives and Methods

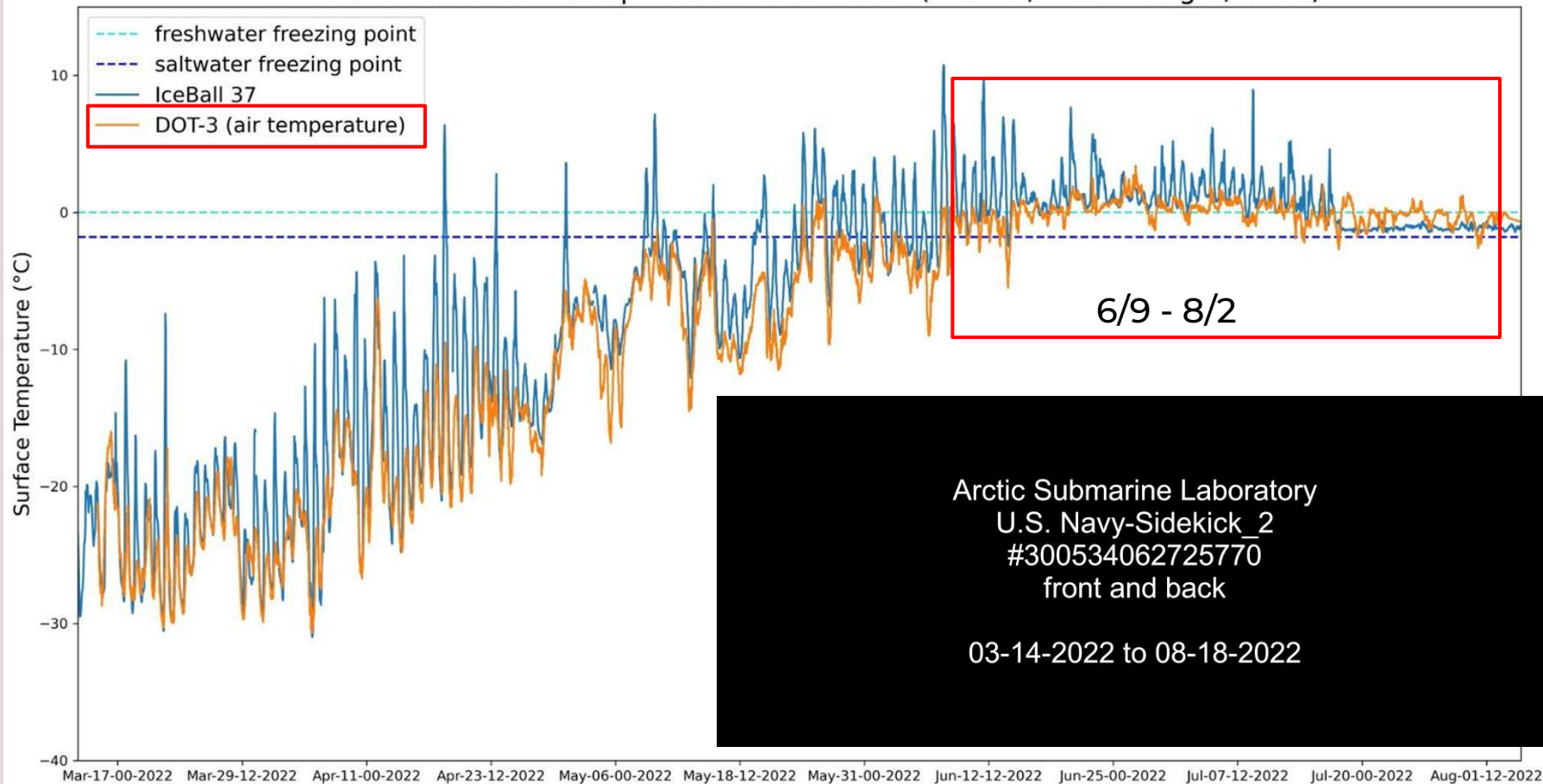
- **Validation of buoy data measurements with in situ observations**
  - Visual inspection
  - Stitching of images to create time lapse videos -> dataset of case studies
  - Temperature + sky
- **Validation and comparison of buoys**
  - Do buoy measurements make sense?
  - Temperature



IceBall 37 vs. DOT-3 Temperature Time Series (Mar 13, 2022 - Aug 3, 2022)



IceBall 37 vs. DOT-3 Temperature Time Series (Mar 13, 2022 - Aug 3, 2022)



# Objective #2: Buoy Comparisons



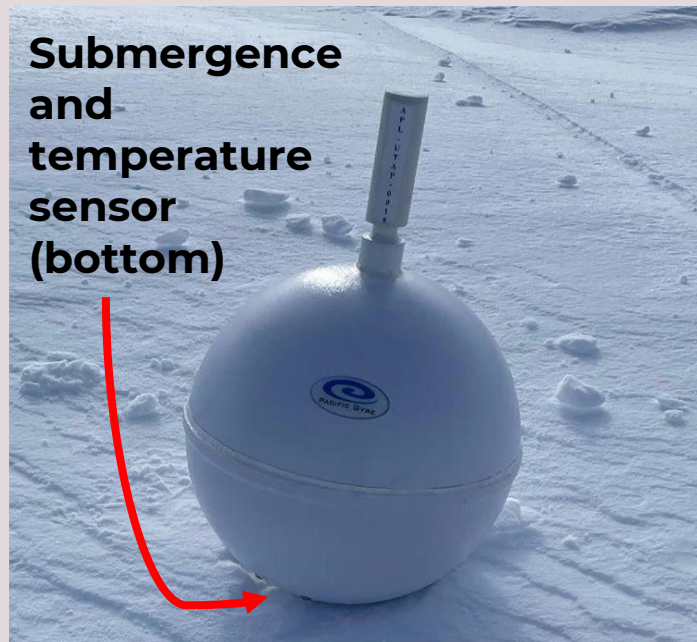
**DOT-3 Buoy deployed during the 2022 Arctic Ice Exercise (ICEX 2022).**

Photo credit: Ann Hill, ASL

**air  
temperature  
sensor**

**IceBall Buoy (this particular buoy wasn't deployed at ICEX 2022).**

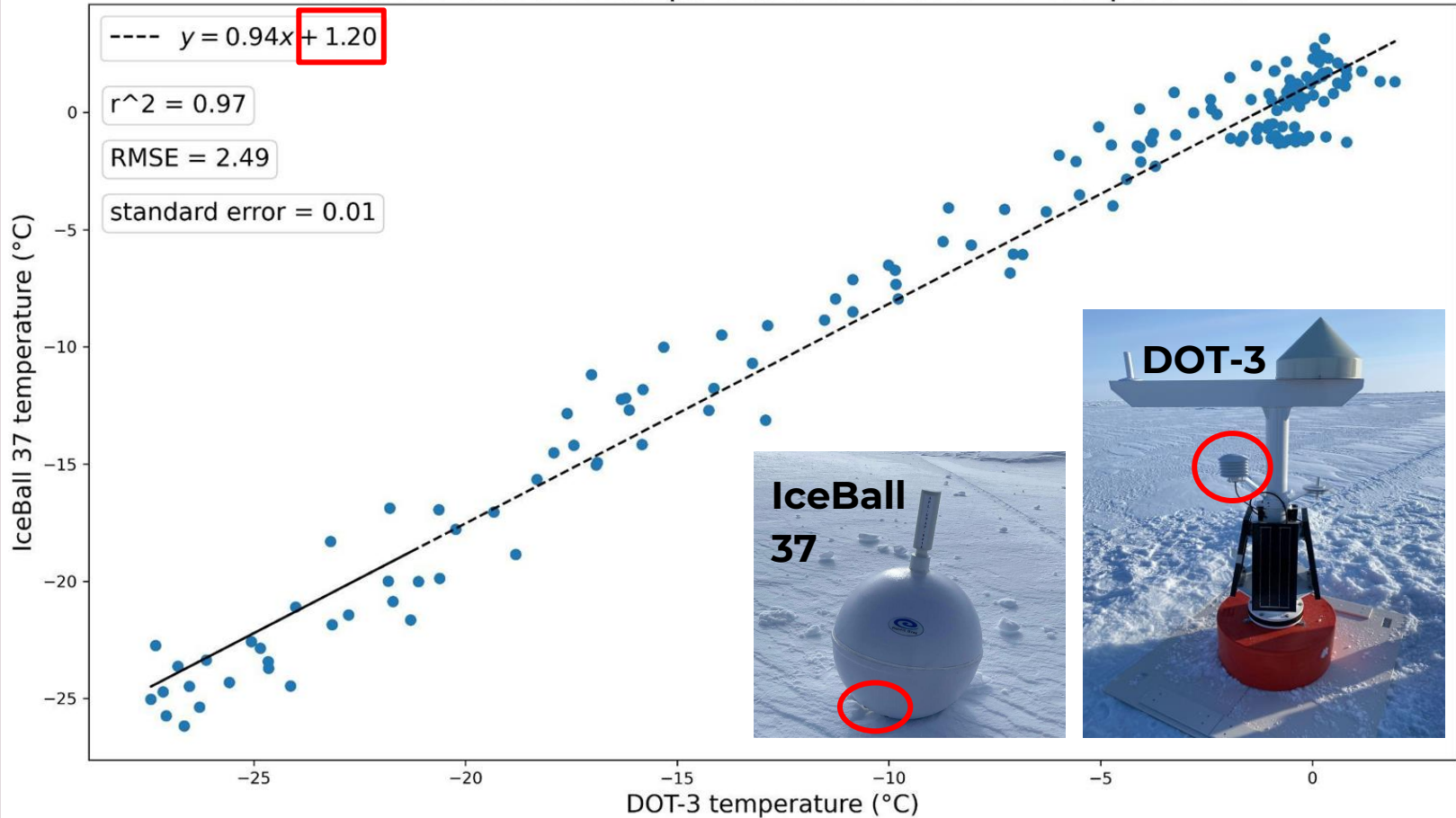
Photo credit: Ignatius Rigor, APL



**Submergence  
and  
temperature  
sensor  
(bottom)**

Images from the following organizations/buoys appear in the time-lapse videos: Applied Physics Laboratory (**APL**), U.S. Navy Arctic Submarine Laboratory (**ASL**), Japan Agency for Marine-Earth Science and Technology (**JAMSTEC**), **O-Buoy**, International Arctic Buoy Programme (**USIABP**), and Warming and Irradiance Measurement (**WARM**) Buoy

## IceBall 37 Surface Temperature vs. DOT-3 Air Temperature



# Discussion and Limitations

**Time lapses can visually verify the data received from buoys**

- Cloud cover observations and temperature measurements

**Instrument comparisons validate buoy measurements**

- IceBall Buoy and DOT-3 Buoy scatter plot differences reflect instrument sensor locations

## Limitations

- Data/information loss
  - Cameras lifetimes, pixels
- Temporal resolution difference between different cameras
  - Front vs. back images



# Conclusions

## Problem

- Current Arctic sea ice monitoring methods have limitations + expensive

## Solution?

- **Buoys + webcams as a viable complement to other monitoring methods**
- Webcam cloud cover observations and temperature measurements match
- Comparison of two buoys show that they work correctly -> specificity
- *Cheaper + robust data + visual inspection*



**Scan Me!**

More time lapses  
from other Arctic  
deployments

**Contact Me:**

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