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

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- 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

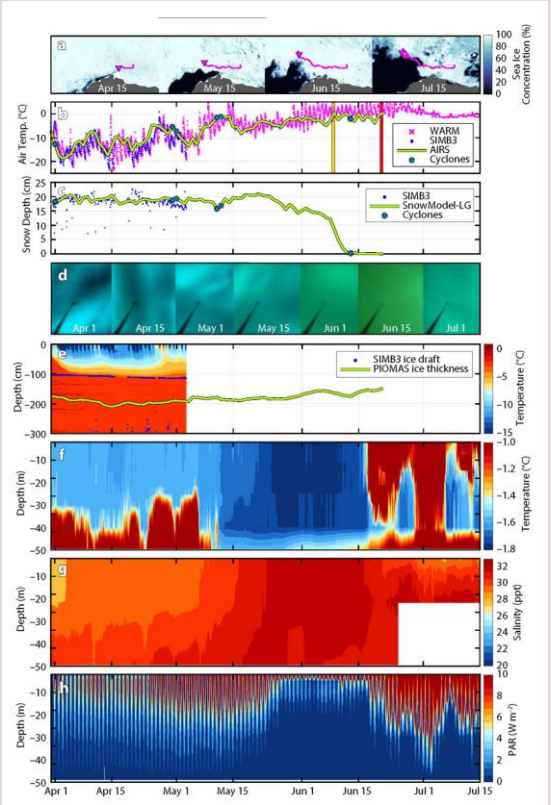
- **Monitoring is difficult**
- **Satellites, modeling, reanalysis**
  - Limitations -> expensive

Solution?

- **In situ methods**
  - Advantages -> local, cheaper

International Arctic Buoy Programme (IABP)

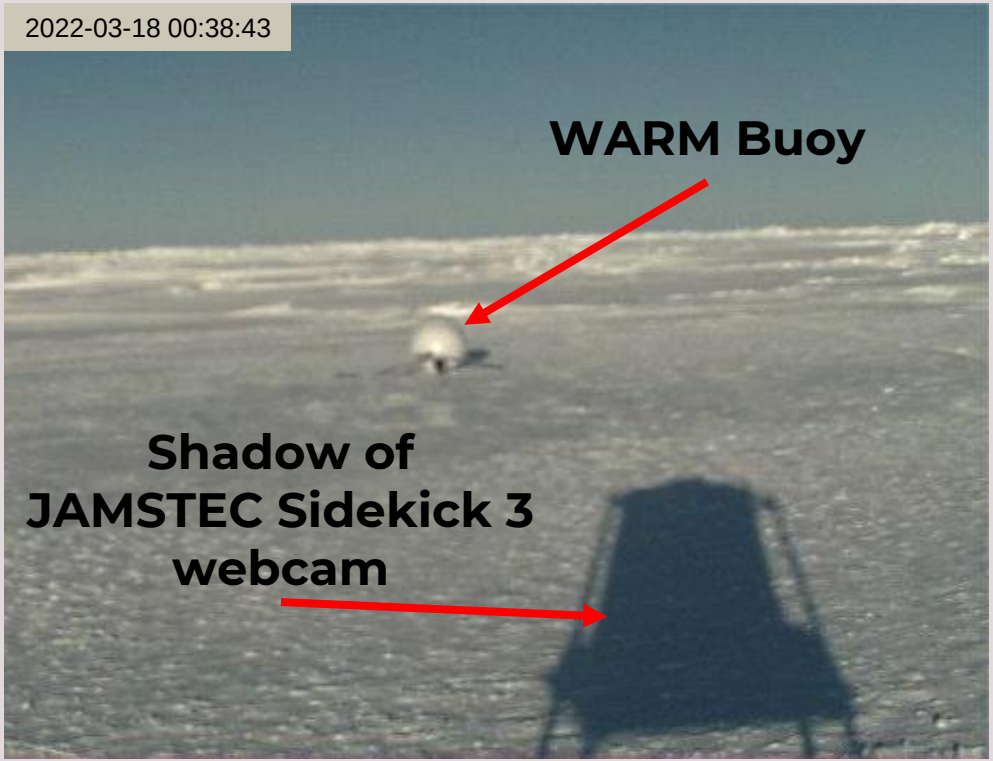
- **Buoys**
  - Temperature + etc.
- **Web Cameras**
  - Images of sky + ground (sea ice)

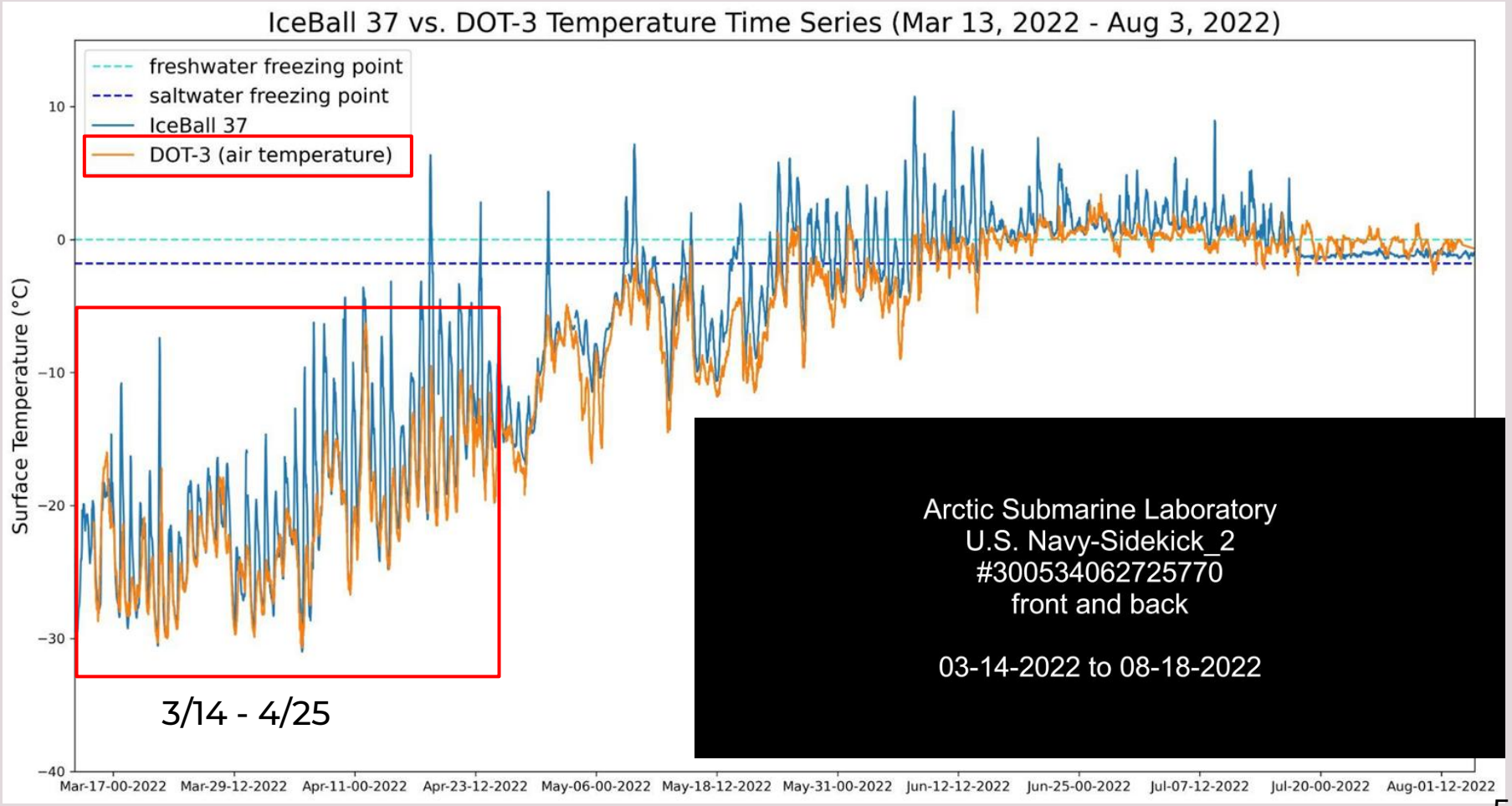


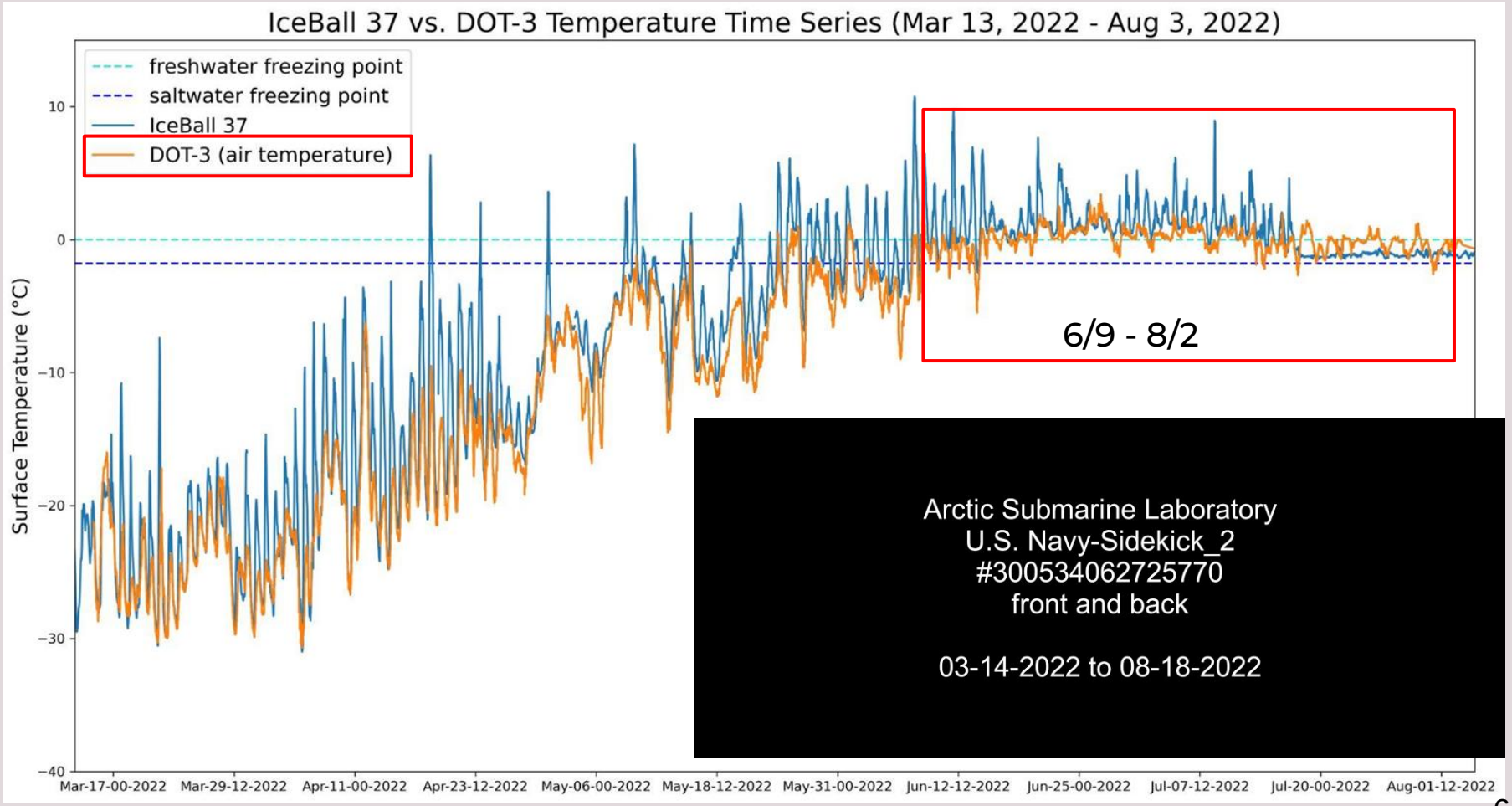
Wealth of information from buoys and webcams from a deployment site (2018 Arctic Ice Exercise (ICEX 2018)) (Webster et al., 2022).

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)
freshwater freezing point
saltwater freezing point
IceBall 37
DOT-3 (air temperature)
Surface Temperature (°C)
10
0
−10
−20
−30
−40
Mar-17-00-2022
Mar-29-12-2022
Apr-11-00-2022
Apr-23-12-2022
May-06-00-2022
May-18-12-2022
May-31-00-2022
Jun-12-12-2022
Jun-25-00-2022
Jul-07-12-2022
Jul-20-00-2022
Aug-01-12-2022
3/14 - 4/25
Arctic Submarine Laboratory
U.S. Navy-Sidekick_2
#300534062725770
front and back
03-14-2022 to 08-18-2022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Jul-20-00-2022
Aug-01-12-2022
6/9 - 8/2
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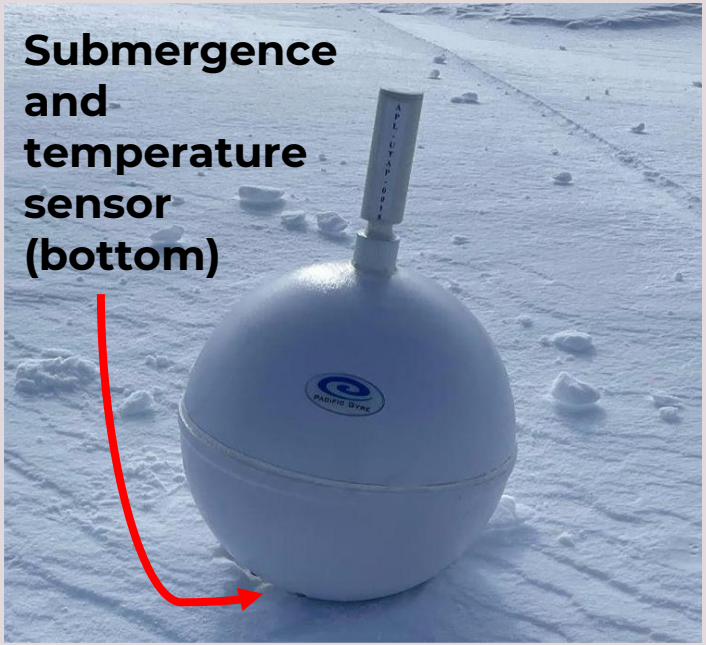
Objective #2: Buoy Comparisons

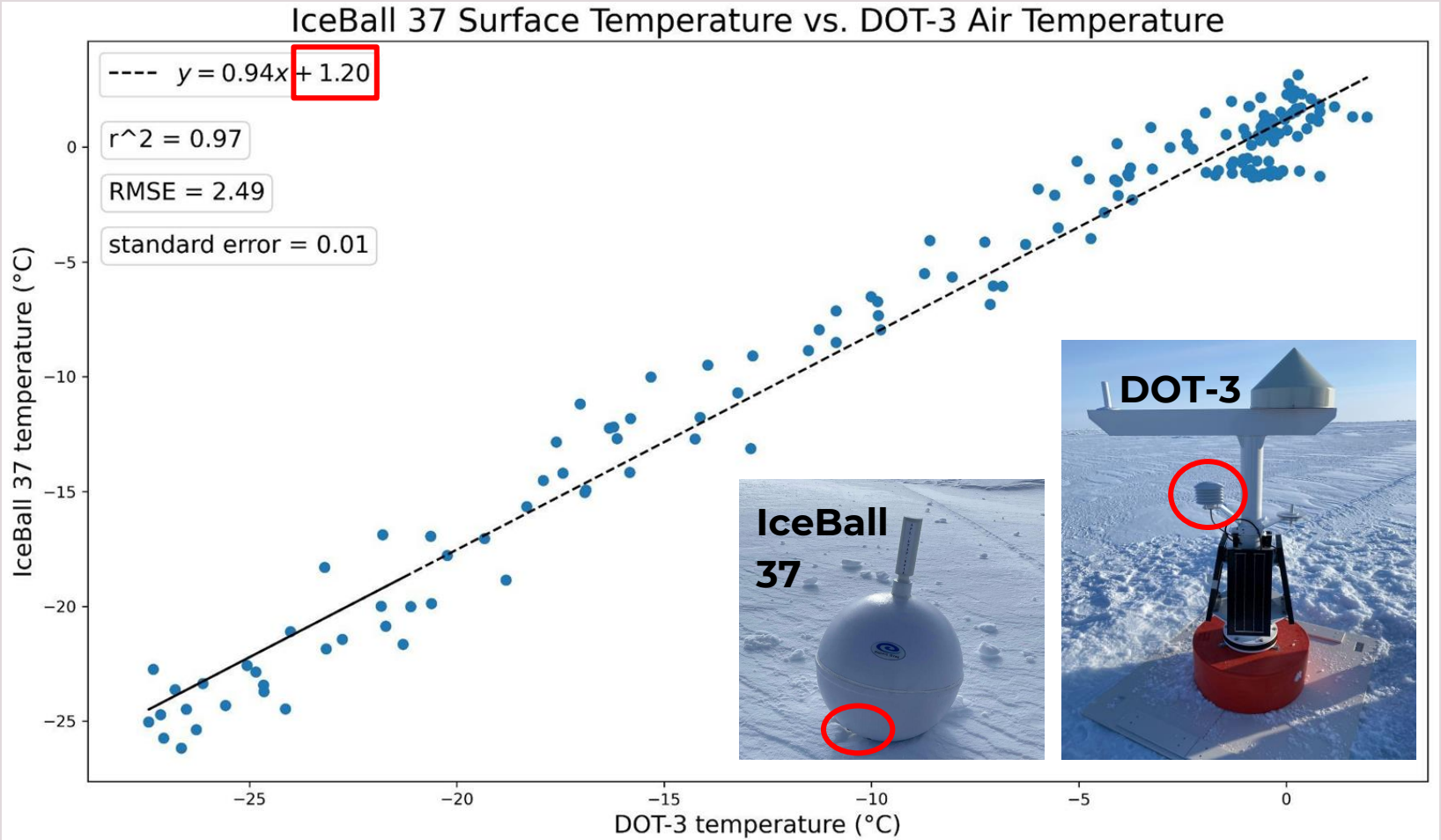
DOT-3 Buoy deployed during the 2022 Arctic Ice Exercise (ICEX 2022).
Photo credit: Ann Hill, ASL

air temperature sensor

IceBall Buoy (this particular buoy wasn't deployed at ICEX 2022). Photo credit: Ignatius Rigor, APL



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
---- y = 0.94x + 1.20
r^2 = 0.97
RMSE = 2.49
standard error = 0.01
IceBall 37 temperature (°C)
DOT-3 temperature (°C)
0
−5
−10
−15
−20
−25
−25
−20
−15
−10
−5
0
IceBall 37
DOT-3

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

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