2019 Arctic Saildrone Field Campaign: Measurements of Sea Surface Salinity and Temperature for Validation of Satellite Retrievals

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NASA Physical Oceanography Program

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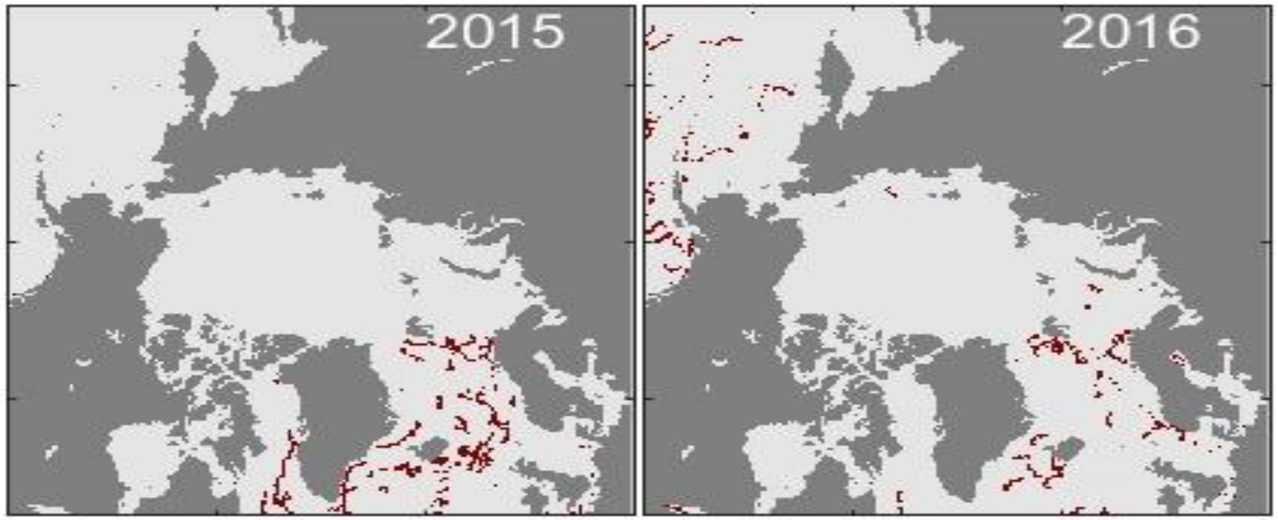
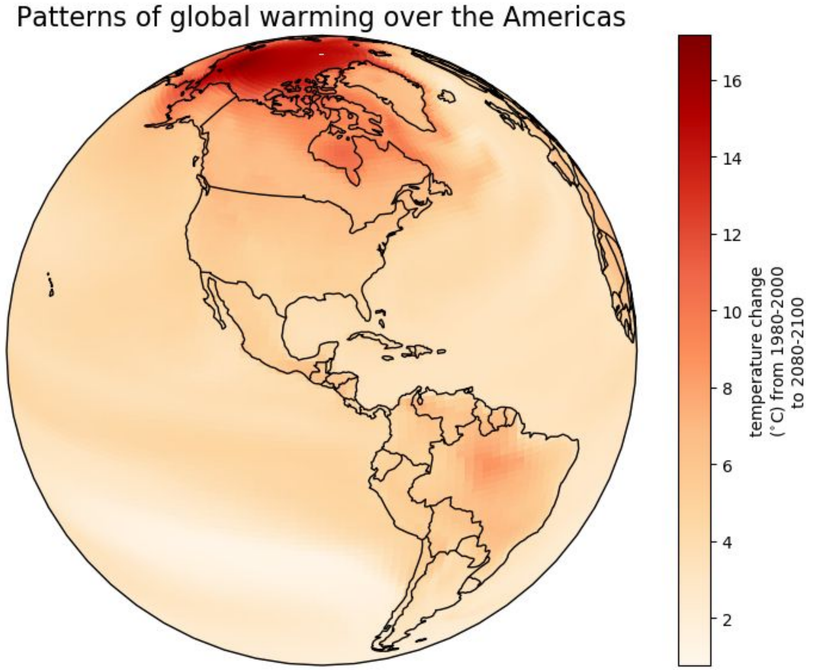




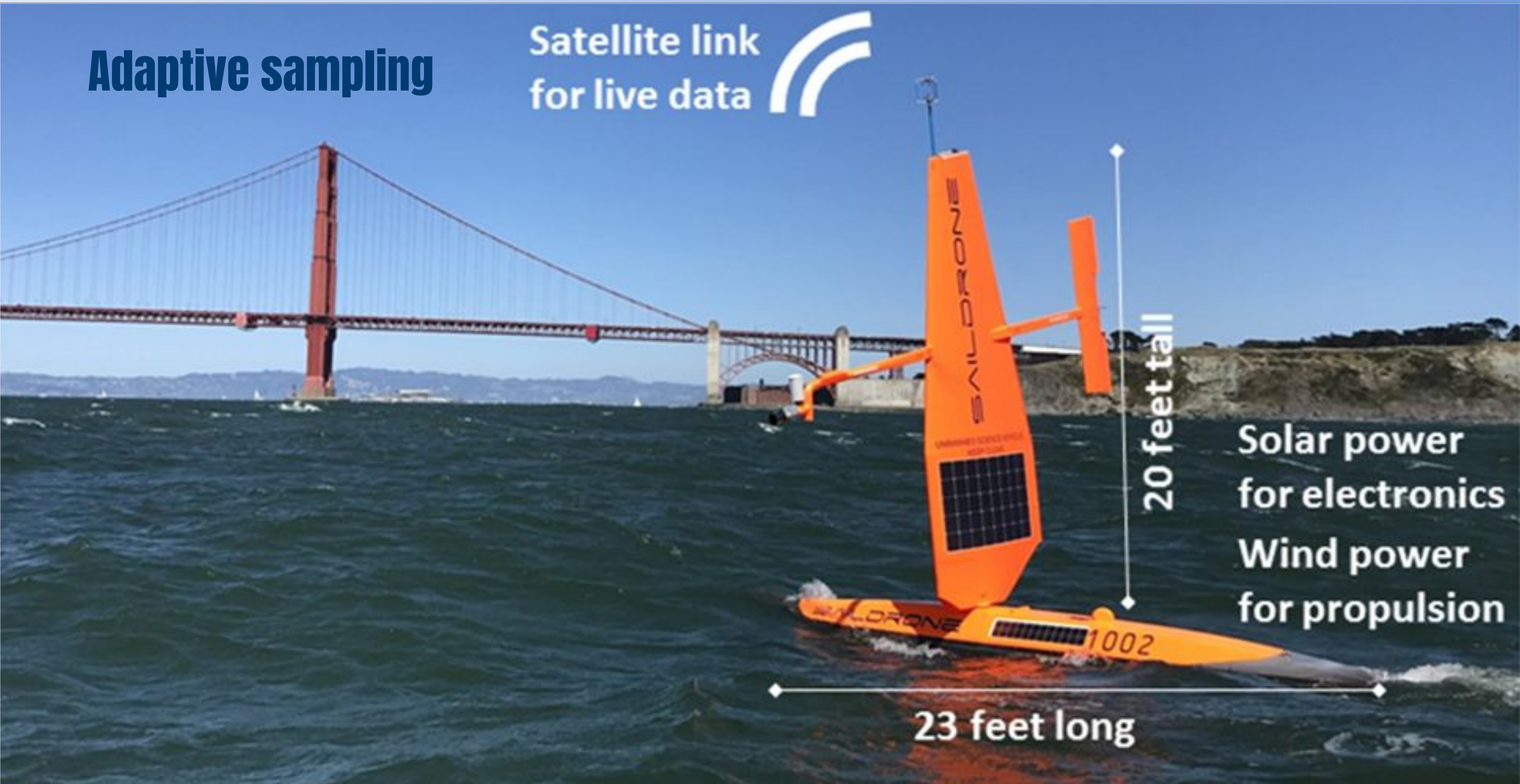
We need <u>global</u> data to develop <u>global</u> satellite algorithms.

In situ data from the Arctic is difficult to acquire

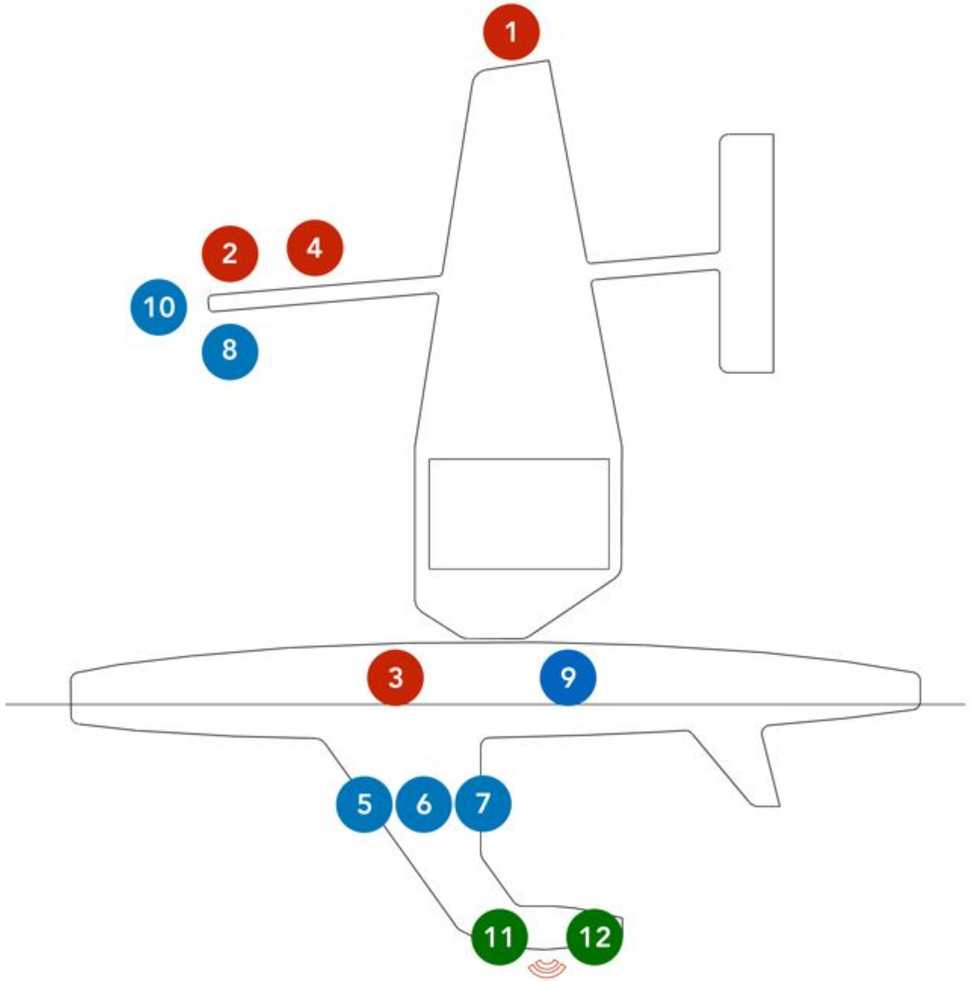
The Arctic Ocean is changing rapidly

Many research vessels don't report any additional salinity and ocean temperature observations over the GTS, so the data don't make it into the global databases used for satellite algorithm development or for other scientific research

Figure recreated from Henri Drake notebook


Adaptive sampling
Satellite link
for live data
20 feet tall
Solar power
for electronics
Wind power
for propulsion
1002
23 feet long

Saildrone Vehicles



Atmospheric Measurements

1	WIND	Gill Windmaster 3D 20Hz @ + 5.0 m
2	ATRH	Rotronic HC2 - S3 @ + 2.2 m
3	PRESSURE	Vaisala BAROCAP PTB210 @ + 0.2 m
4	RADIATION	LICOR LI-192SA @ + 2.2 m

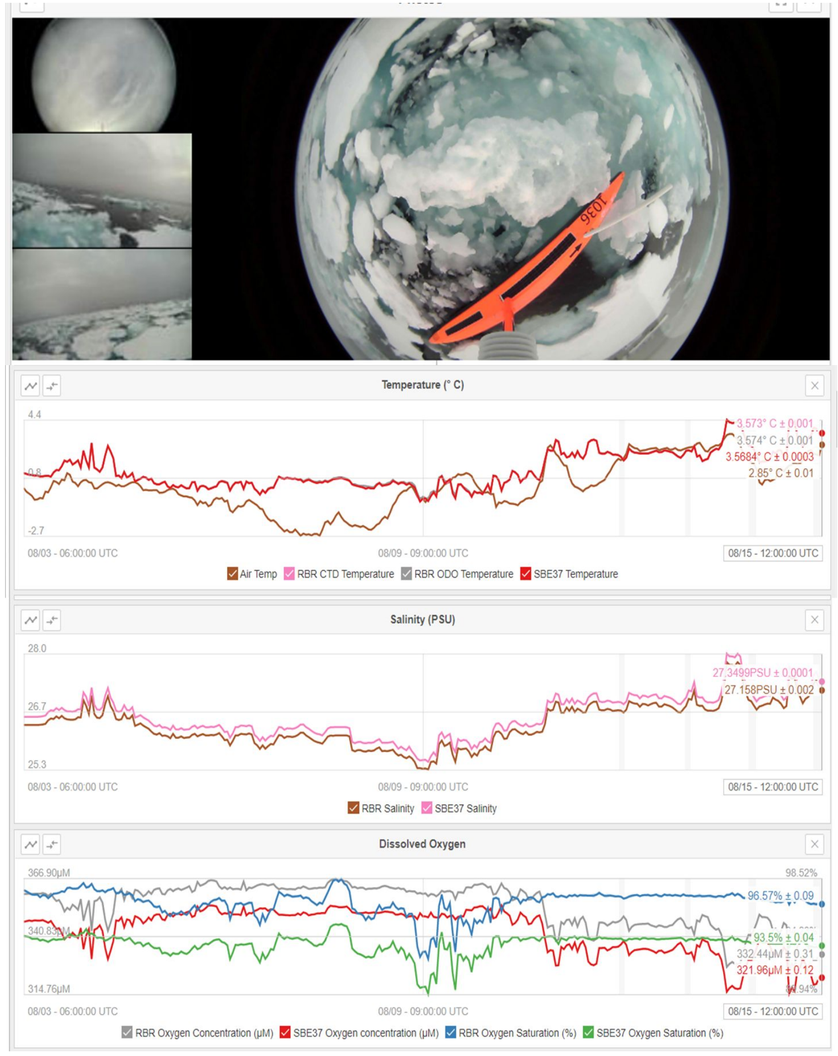
Ocean Measurements

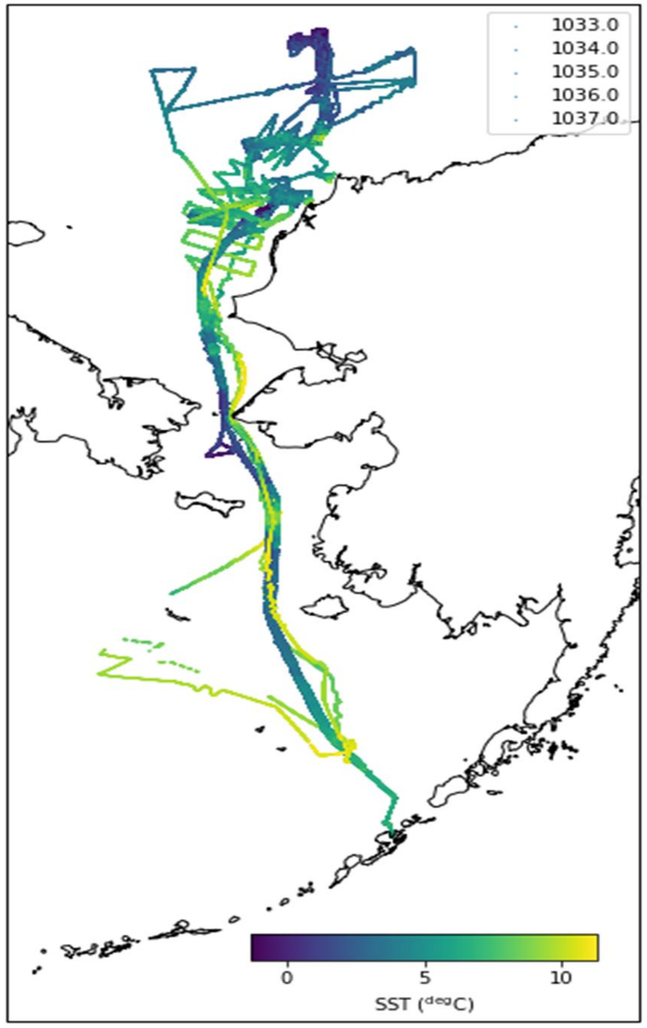
5	CTD	SBE 37 & RBR Conductivity @ -0.5 m
6	DO & TEMP	RBR Coda ODO & SBE 37 ODO @ -0.5m
7	CHL-A	Wetlabs ECO-FL-S G4 & Turner Cyclops-7F
8	SKIN SST	Heitronics CT15.2 @ +2.2 m
9	WAVES	Dual GPS aided IMU - VN 300
10	CAMERAS	Sky, Sea and Horizon Cameras

Options

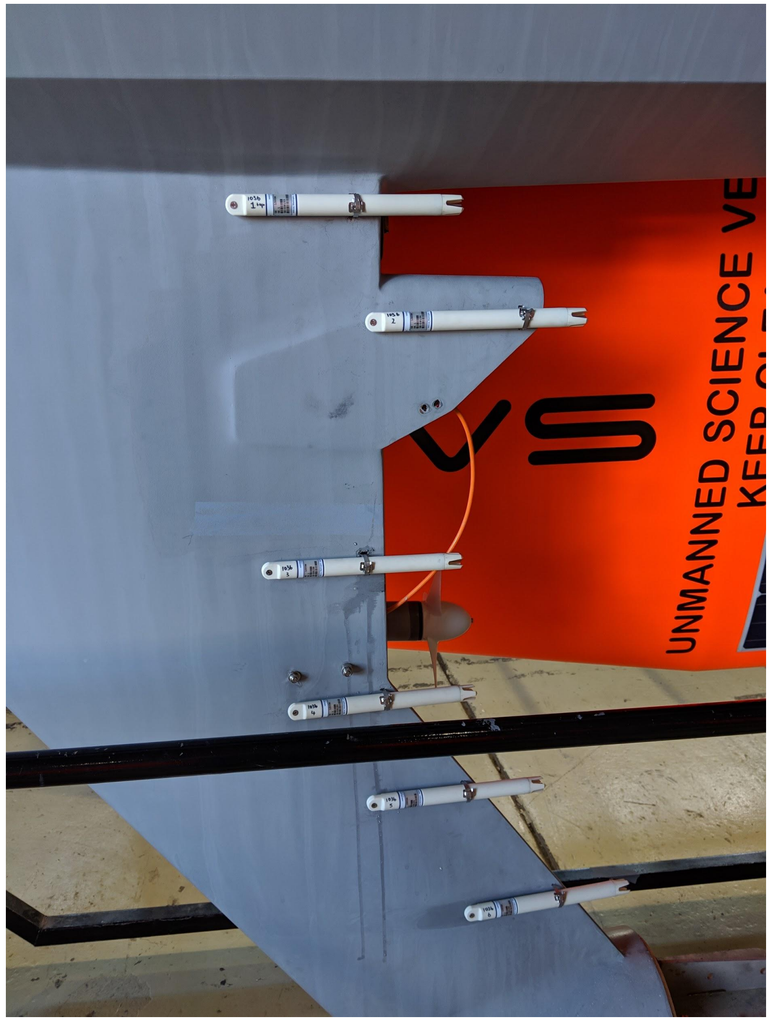
11	ADCP	Teledyne RDI Workhorse 300 kHz - 2.0 m
	OR	
12	ECHO-SOUNDER	SIMRAD WBT Mini (EK80) @ -2.0 m

2019: 5 Saildrones, 150 days, 3 NOAA, 2 NASA





Both NASA vehicles had additional temperature loggers along keel for upper ocean stratification measurments



NASA Saildrone data at NASA's PO.DAAC

Jet Propulsion Laboratory
California Institute of Technology

podaac
Physical Oceanography Distributed Active Archive Center

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Saildrone

Saildrone

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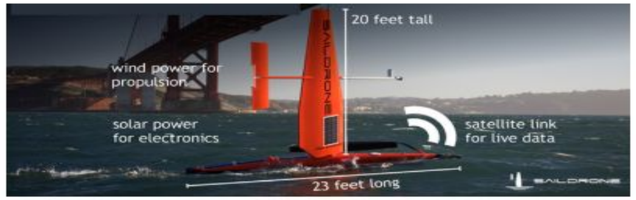


Saildrone is a state-of-the-art, wind and solar powered unmanned surface vehicle (USV) capable of long distance deployments lasting up to 12 months. The drone is autonomous in that it may be guided remotely from land while being completely wind driven. This novel sampling platform is equipped with a suite of instruments and sensors providing high quality, georeferenced, near real-time, multi-parameter surface ocean and atmospheric observations while transiting at typical speeds of 3-5 knots. Instruments are customizable depending on the mission, but typically include anemometer, barometer, thermosalinograph, CTD, IR pyrometer, fluorometer, and CO2/dissolved oxygen sensors. Saildrones have additionally been deployed with Acoustic Doppler Current Profilers (ADCP), passive acoustic sensors and echo sounders to measure along-track 3D current velocities and biological acoustic backscatter. Saildrone adopts a service model approach to the design and implementation of missions and the delivery of datasets to customers. Current deployments include the Tropical and North Pacific, with a focus on future deployments in the Arctic. Data from Saildrone are providing information being used to support NASA satellite cal/val and ocean science studies, including the improvement of salinity and SST retrievals at high latitudes and closer to the coast.

Data Links

- Browse Datasets for Saildrone Data

Saildrone in PO.DAAC Tools & Services

- PO.DAAC Drive
- OPeNDAP
- PO.DAAC Web Services

Documentation

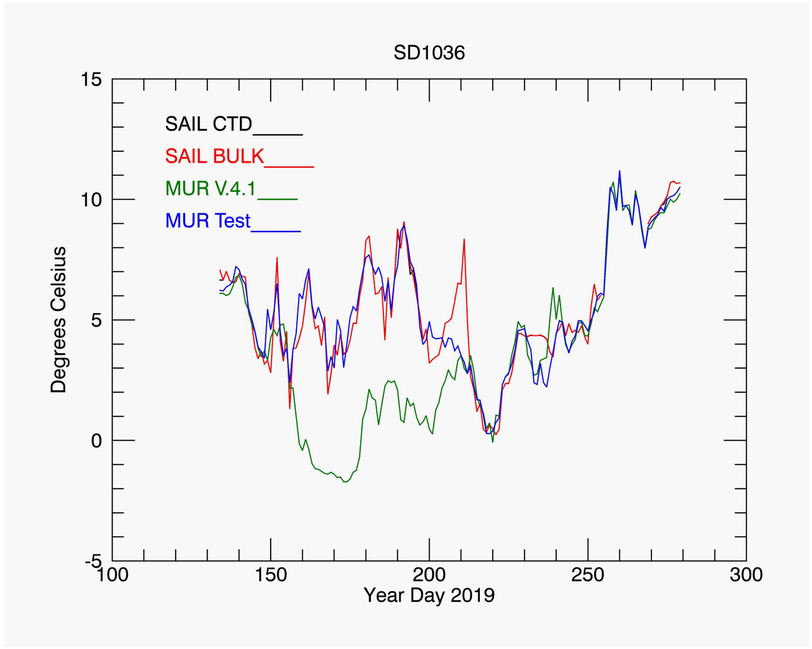
- Saildrone Baja Cruise & Instrument Reports

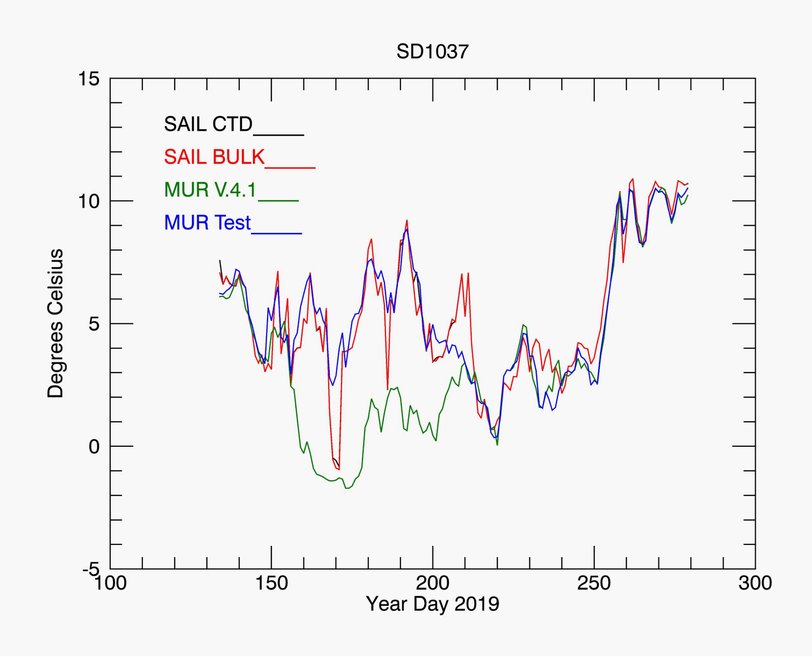
Related Links

- Saildrone Inc. Website
- Saildrone Inc Website - Baja Campaign page
- NOAA/PMEL Saildrone Project Website

Discovering issues with L4 products

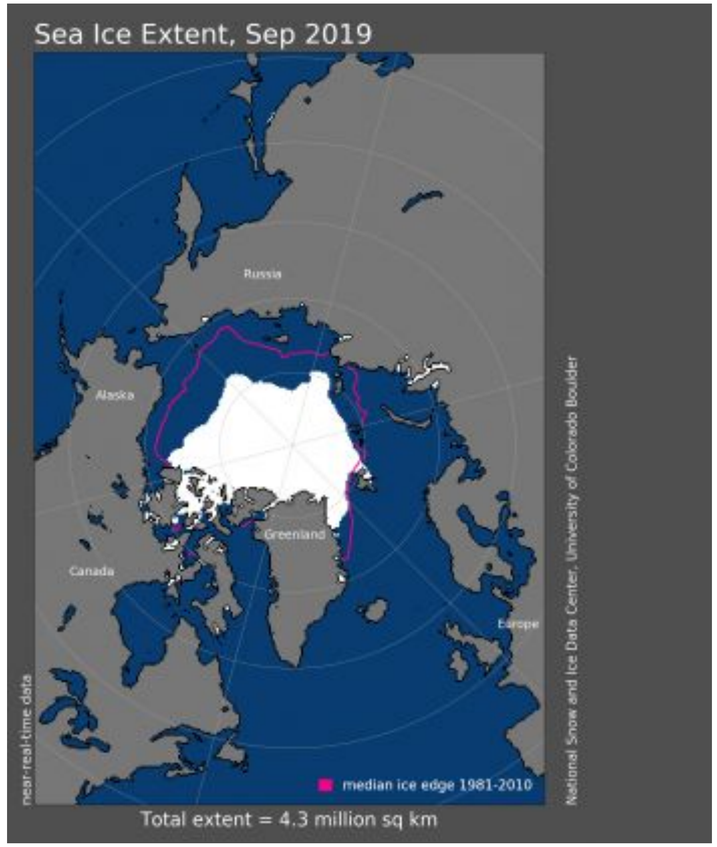
JPL's MUR SST was compared to Arctic Saildrone SSTs during the 2019 cruise. Version 4.1 of the data had large biases which were determined to be due to the definition of 'daytime' in the data. The new version of MUR (to be released soon) fixes this problem.

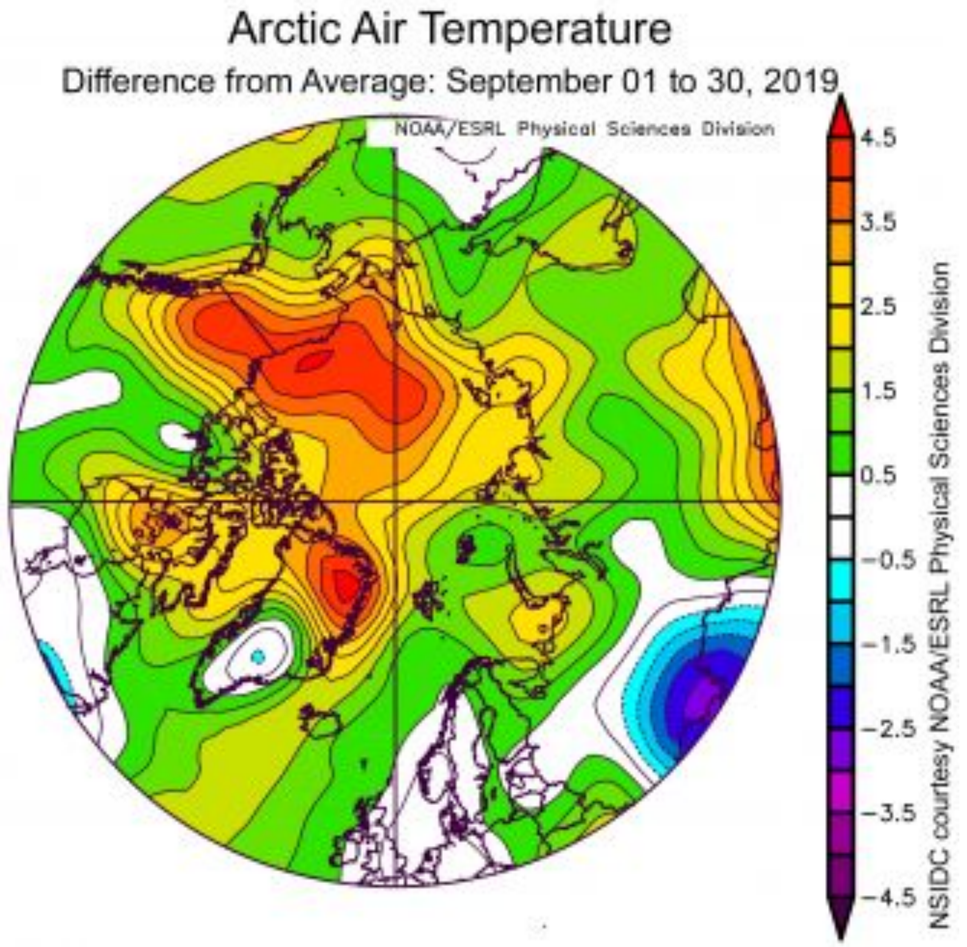




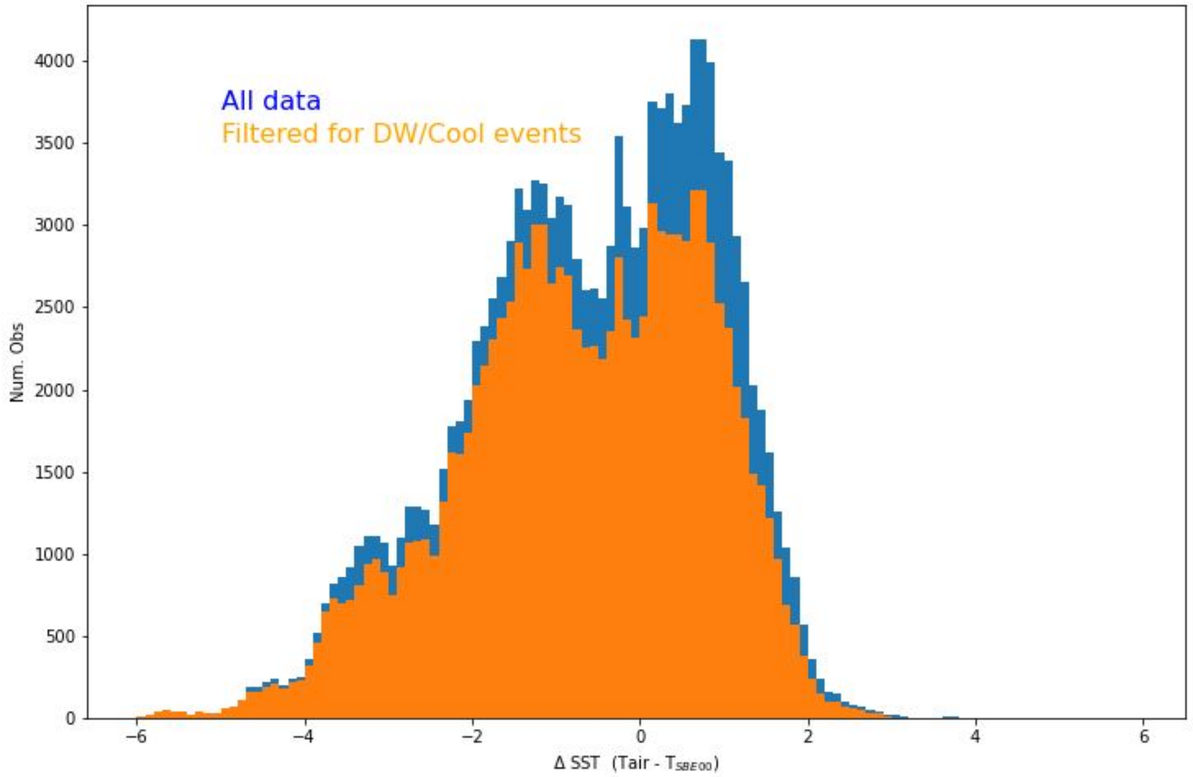
Endless Summer……

3rd lowest ice extent on record



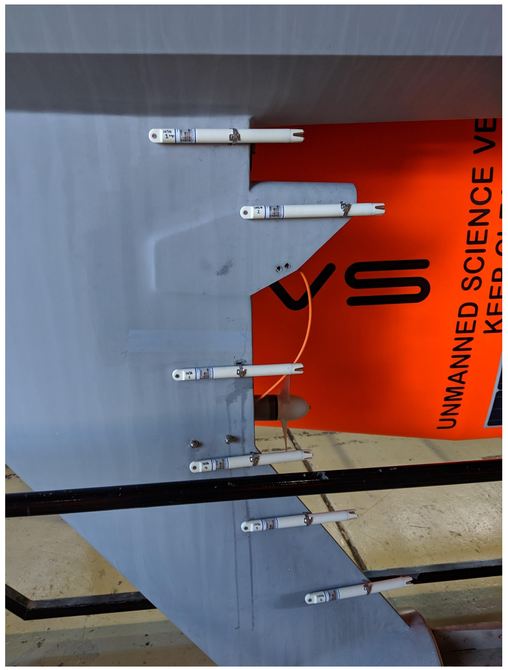


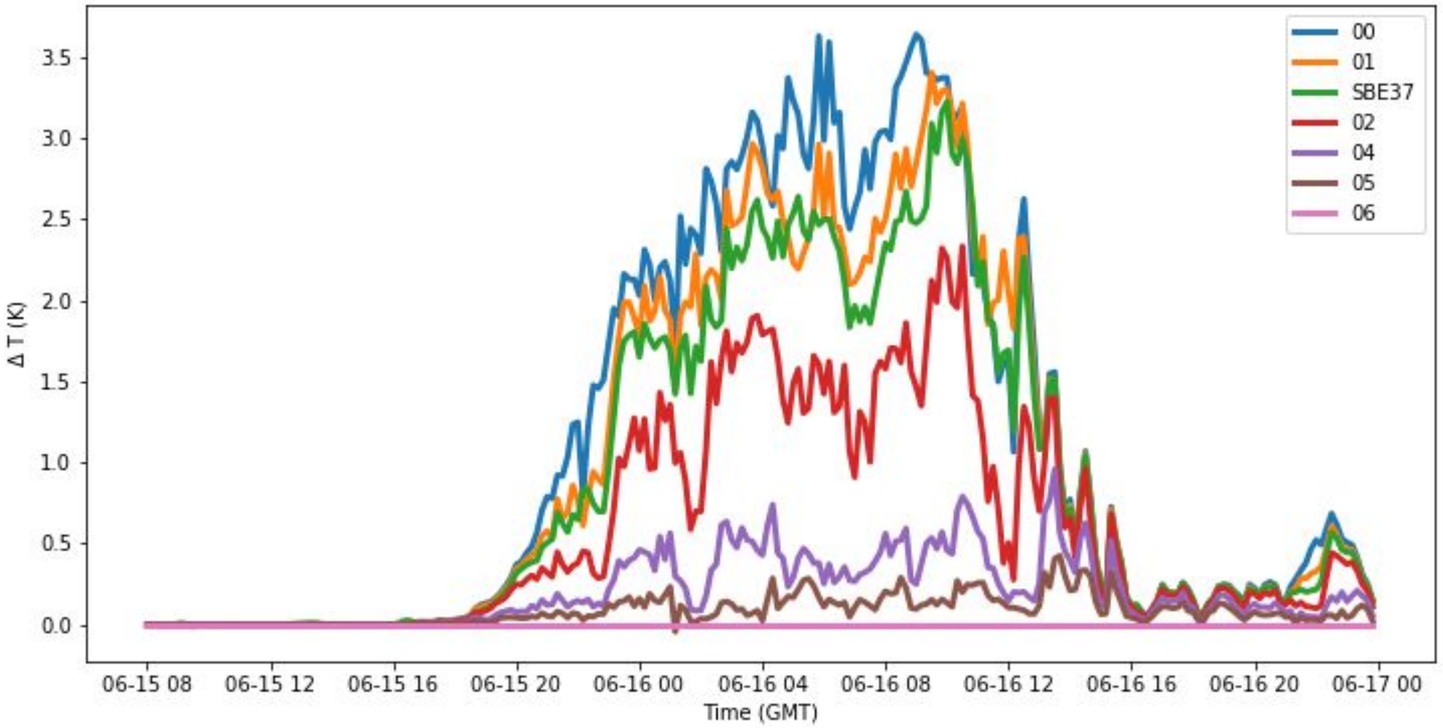
Unusual air-sea temperature differences



Bimodal, frequent occurances where near surface air temperature warmer than ocean temperature

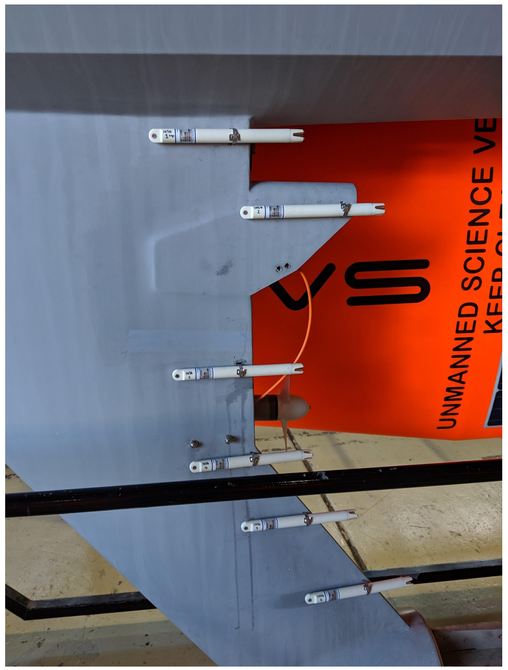
Upper Ocean Warming

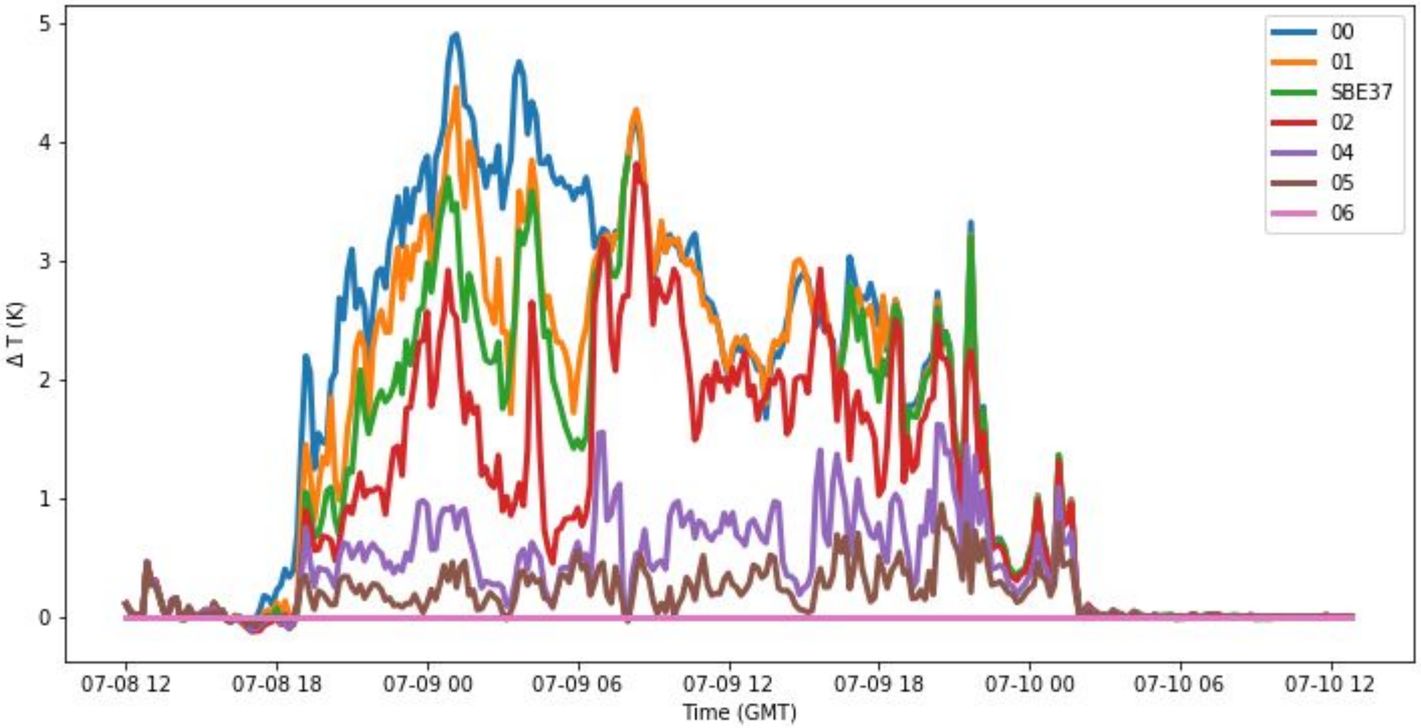




Warming of 3.5 K in upper 1.7 m.

Upper Ocean Warming



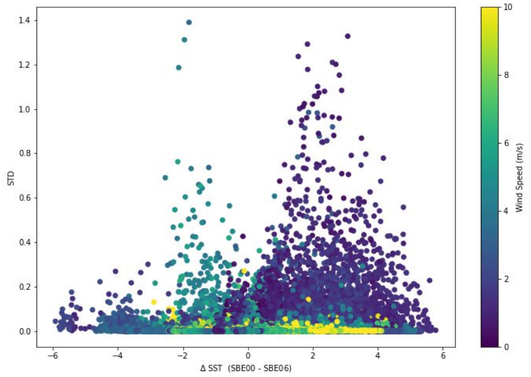


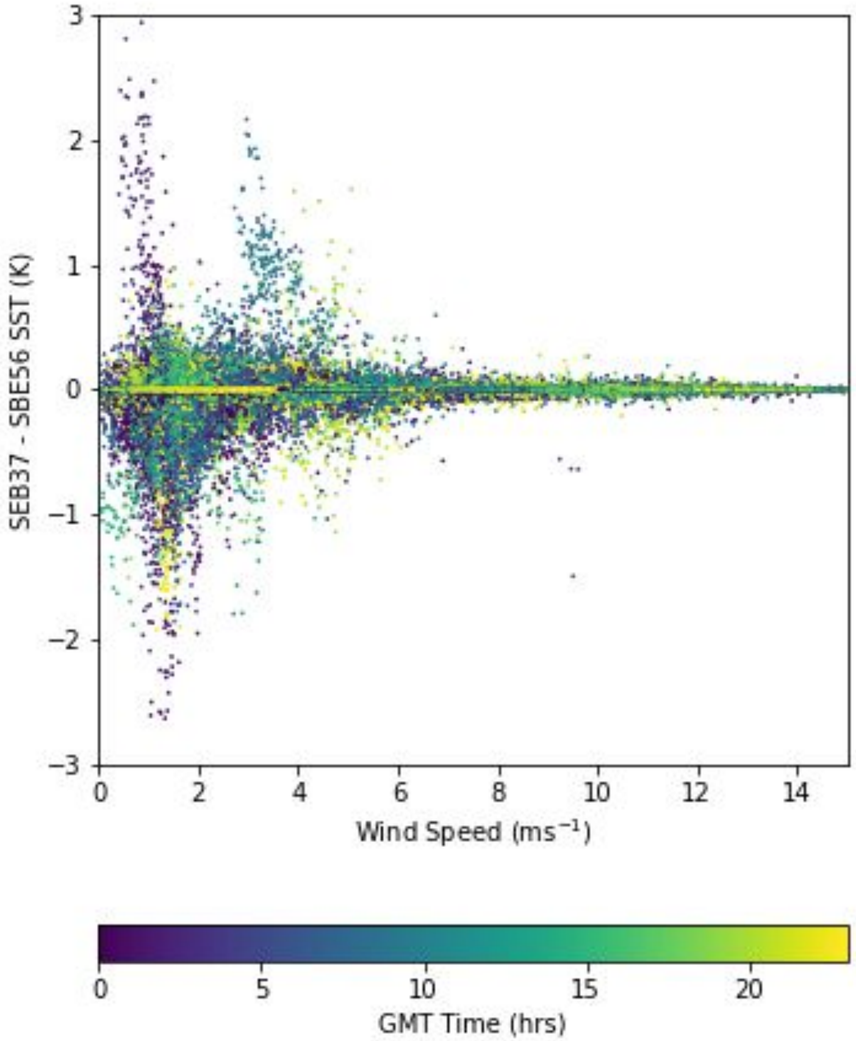
Warming of 5 K in the upper 1.7 m.

Data Quality

Other NOAA Saildrone cruises, Baja cruise, all reported increase STD at low winds. There was concern that this was related to vehicular or sensor heating.

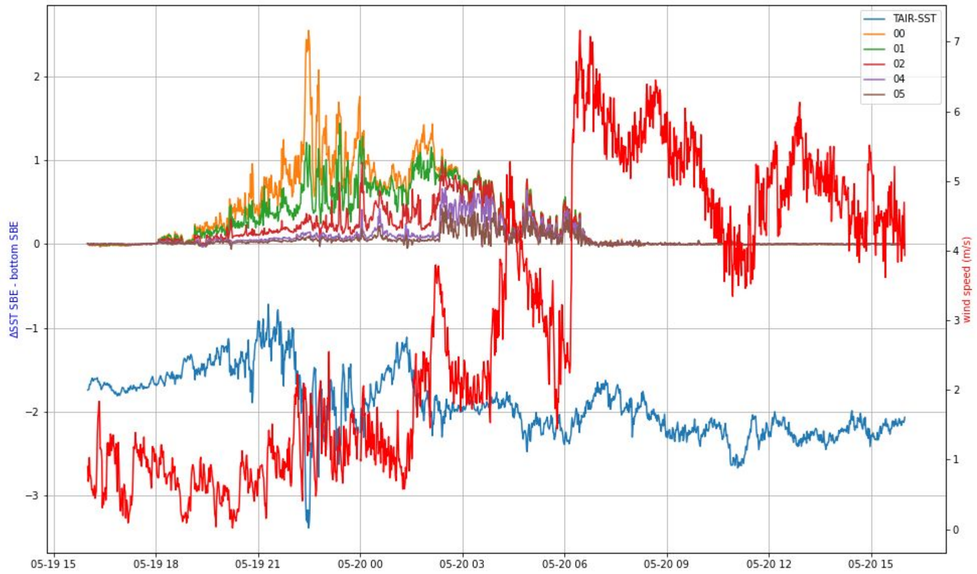
Is there something wrong with the observations below 6 m/s?





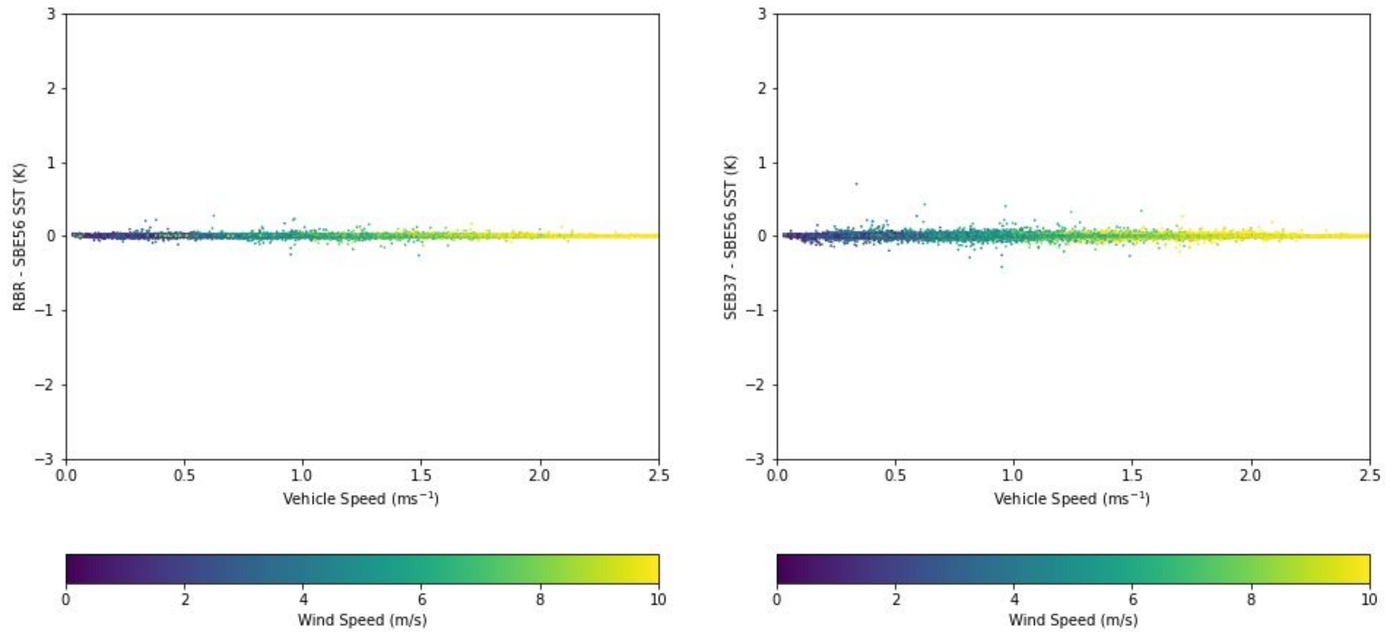
Use SBE56 to filter DW/cool events

Developed automated code to identify portions of the cruise where the SBE56 diverged from the CTDs onboard, indicating either diurnal warming or surface cooling events (likely related to nearby ice melt).

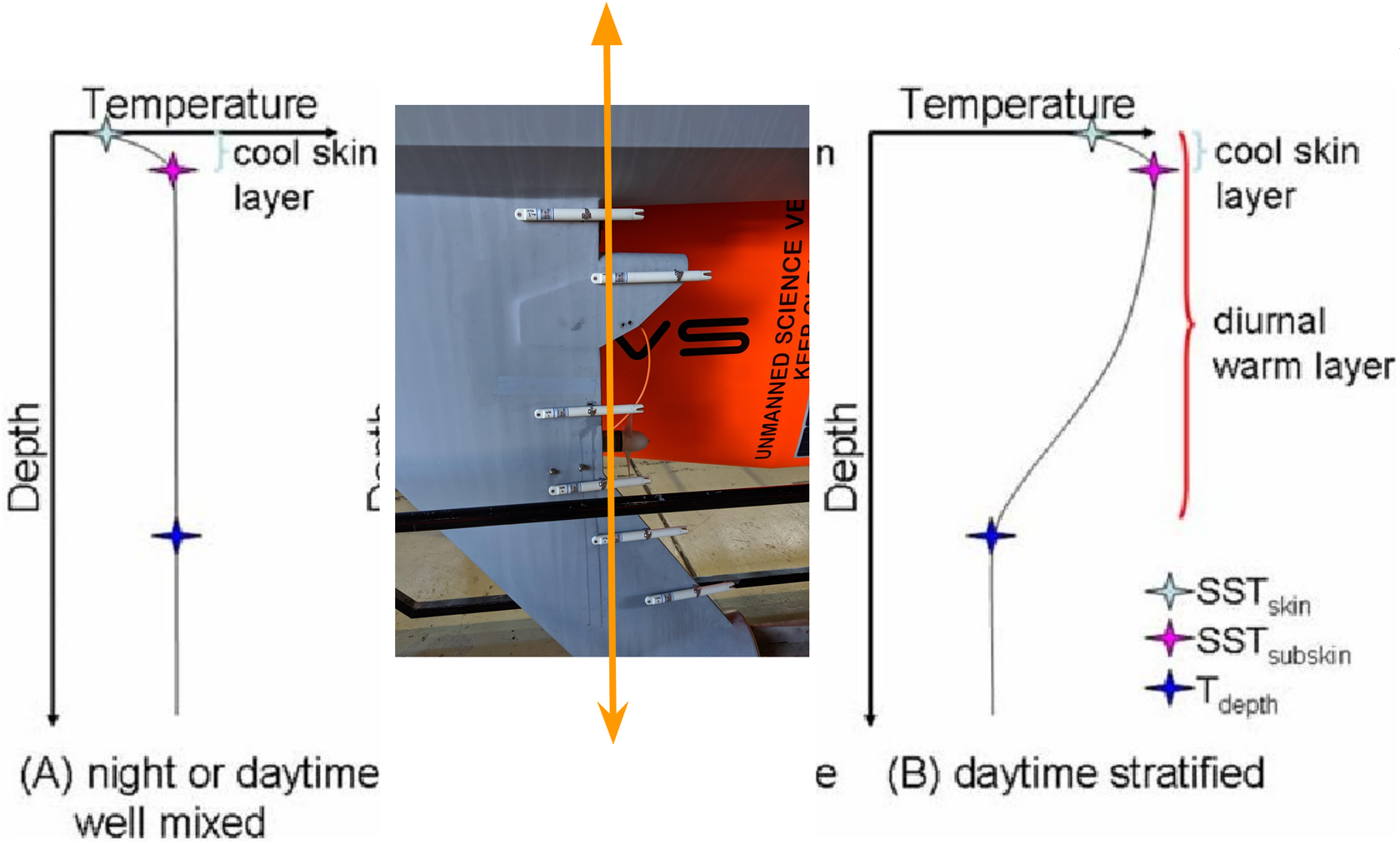


Unexpected result

The scatter goes away for both the RBR and the SBE37 comparisons when the data is filtered for periods when the SBE56 indicate thermal stratification.



Hypothesis: stratification



As the vehicle rides on the surface, sensors move up and down. In a well-mixed upper layer, at winds >6 m/s, all sensors measure the same temperature. In a stratified upper layer, at winds <6 m/s, small movements in vehicle motion change the depth of observation and increase the STD

Cruise data quality

PO.DAAC has the ADCP and temperature logger data as well as Saildrone vehicle dataset.

Quality appears to be good, but users should be careful of data that may be affected when the vehicle was stuck in ice

Strong fronts and diurnal warming. We will provide the cool/warm data mask to PO.DAAC in the future, for now email cgentemann@faralloninsitute.org

Other interesting features

Strong salinity fronts

Strong temperature fronts

Upper ocean diurnal warming measurements

What are the heat and moisture fluxes close to the ice?

What can these observations tell us about accuracy of L2, L3, and L4 products?

What can we understand about spatial variability from the coordinated sampling?

Future data….

2020: No Arctic cruise, 3 Saildrones deployed 45 days in Brazil Current Ring region, data to be available soon

2021: 2 NASA Arctic

2022: 1 NASA Arctic