# Sea Ice and Filling Data (and Research) Gaps for S2S Prediction

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NOAA Pacific Marine Environmental Laboratory

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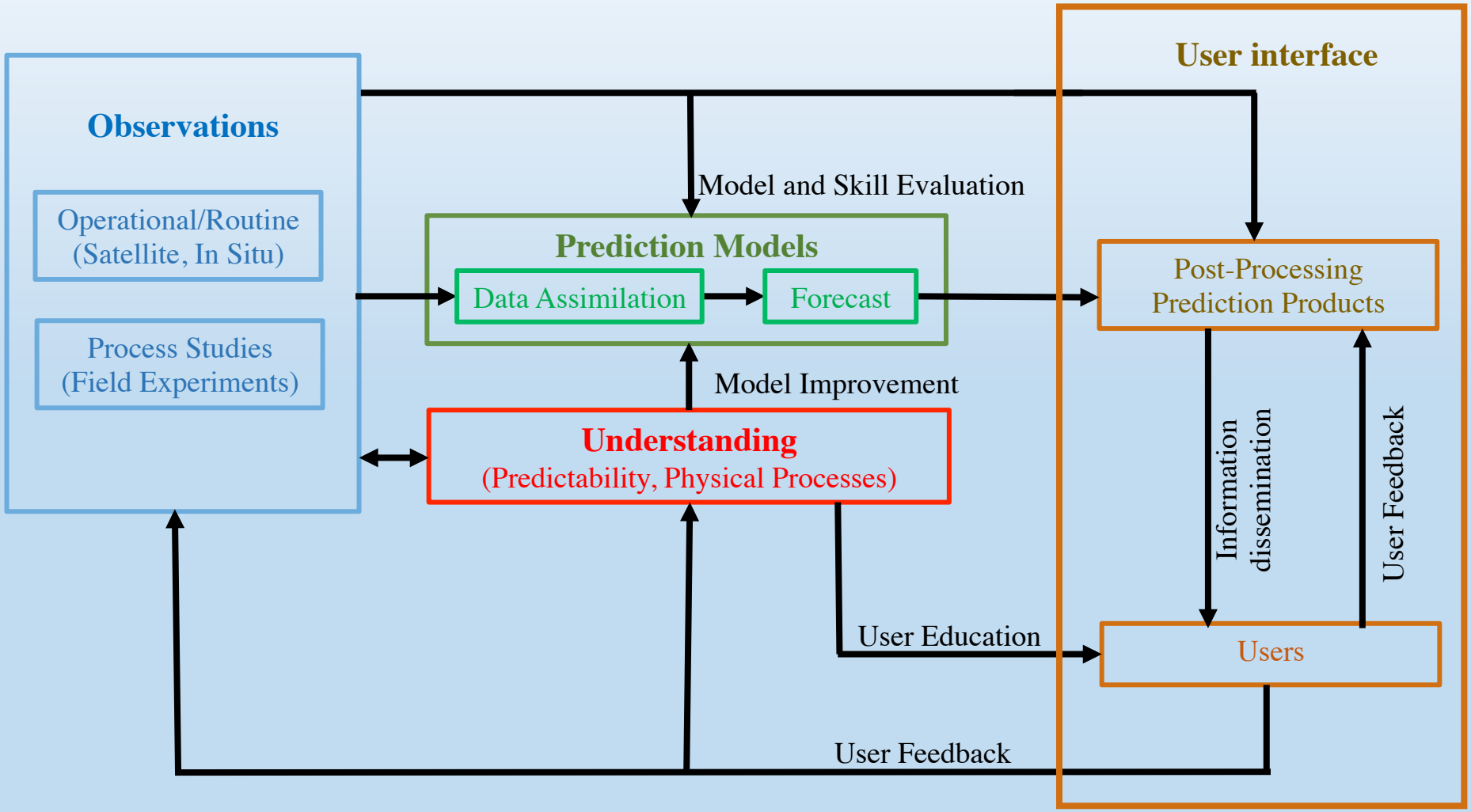
# S2S Prediction System and Information Flow



# S2S Prediction System and Information Flow

**Observations**

↓

**Data Assimilation**

↓

**Numerical Models**

↓

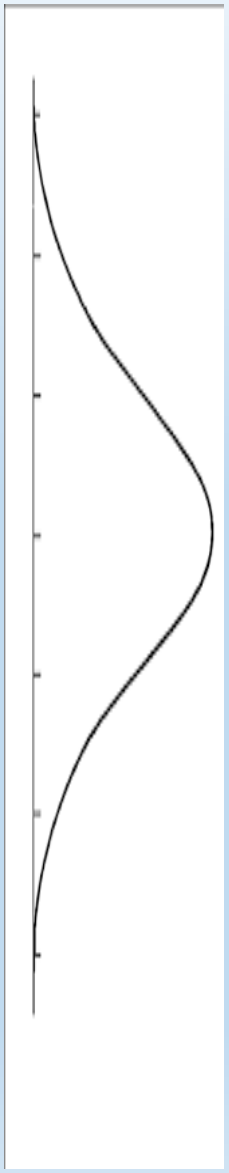
**Forecast Products**

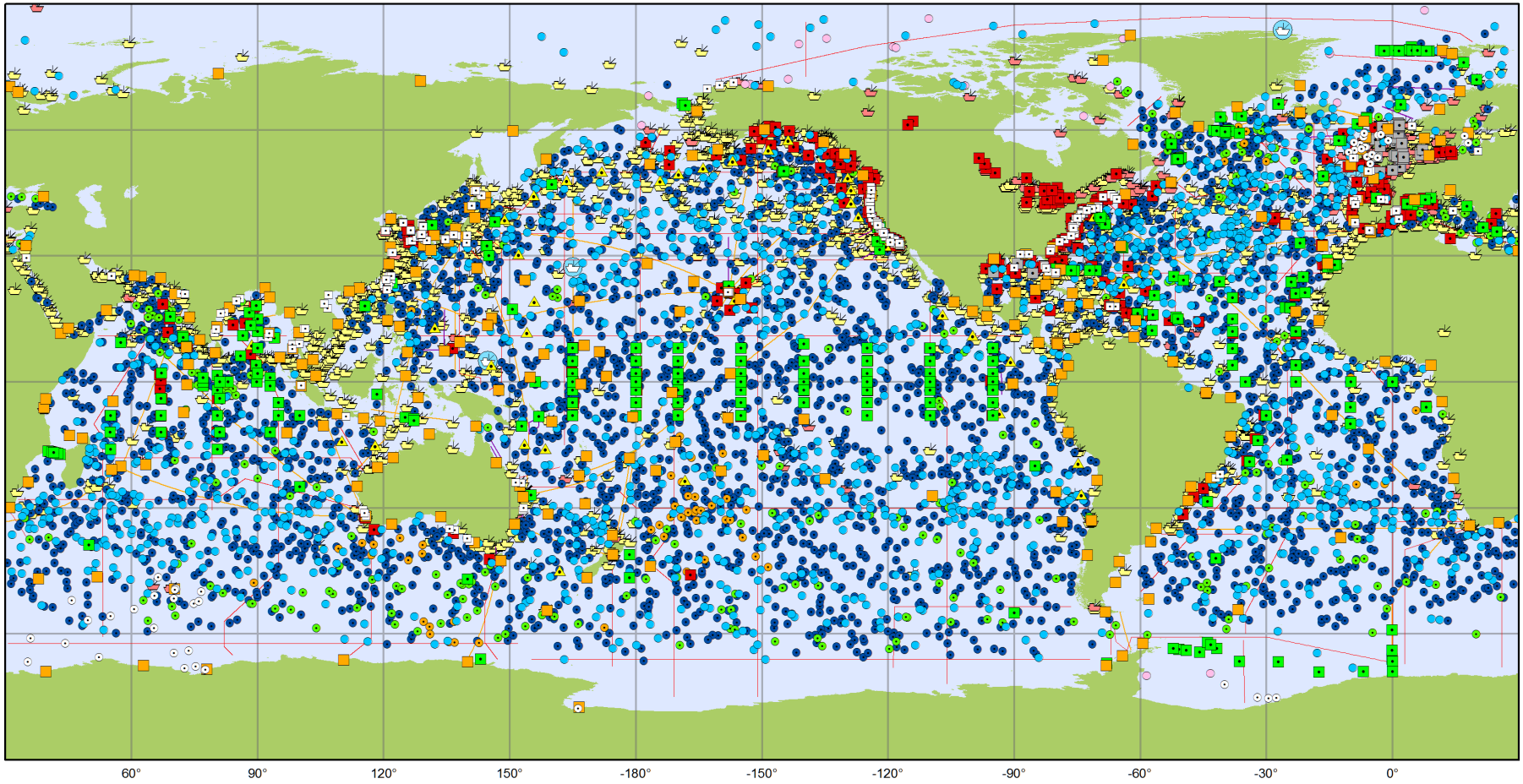
↓

**Information Dissemination**

↓

**Users**






## Main in situ Elements of the Global Ocean Observing System

July 2018

**Profiling Floats (Argo)**
- Core (3757)
- Deep (66)
- BioGeoChemical (286)

**Data Buoys (DBCP)**
- Surface Drifters (1394)
- Offshore Platforms (97)
- Ice Buoys (20)
- Moored Buoys (394)
- Tsunameters (37)

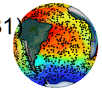
**Timeseries (OceanSITES)**
- Interdisciplinary Moorings (438)

**Repeated Hydrography (GO-SHIP)**
- Research Vessel Lines (61)

**Sea Level (GLOSS)**
- Tide Gauges (252)

**Ship based Measurements (SOT)**
- Automated Weather Stations (251)
- Manned Weather Stations (1787)
- Radiosondes (7)
- eXpendable BathyThermographs (37)

**Other Networks**
- HF Radars (270)
- Animal Borne Sensors (53)
- Ocean Gliders (31)



*Generated by www.jcommops.org, 20/08/2018*

# **Sources of S2S Predictability**:

Natural modes of variability: MJO, ENSO, QBO, IOD, extratropical modes (PNA, NAO/NAM, SAM) …

Slowing varying processes: Upper-ocean heat content, soil moisture and vegetation, terrestrial snow, ***sea ice***, sudden stratospheric warmings,

External forcing: volcano eruption, solar activities, anthropogenic influences

**Arctic Sea Ice**

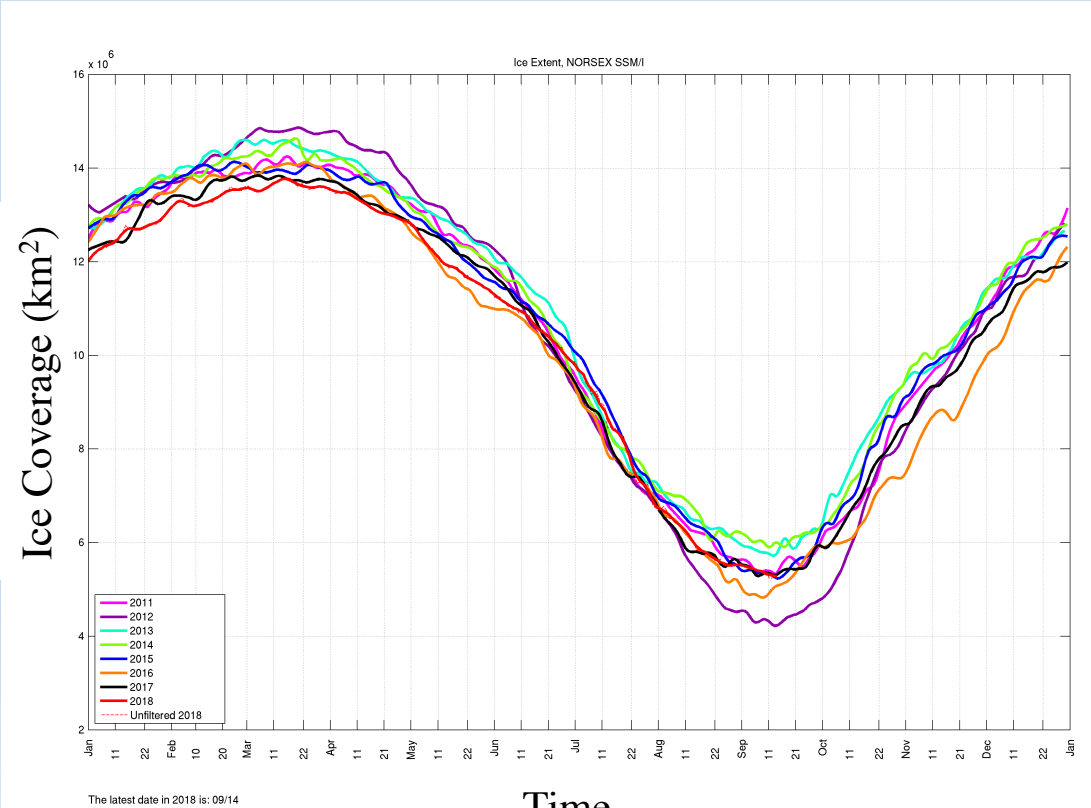
➔NAO

➔midlatitude zonal wind

➔snow cover in Eurasia

➔summer precipitation in Europe, the Mediterranean, and East Asia

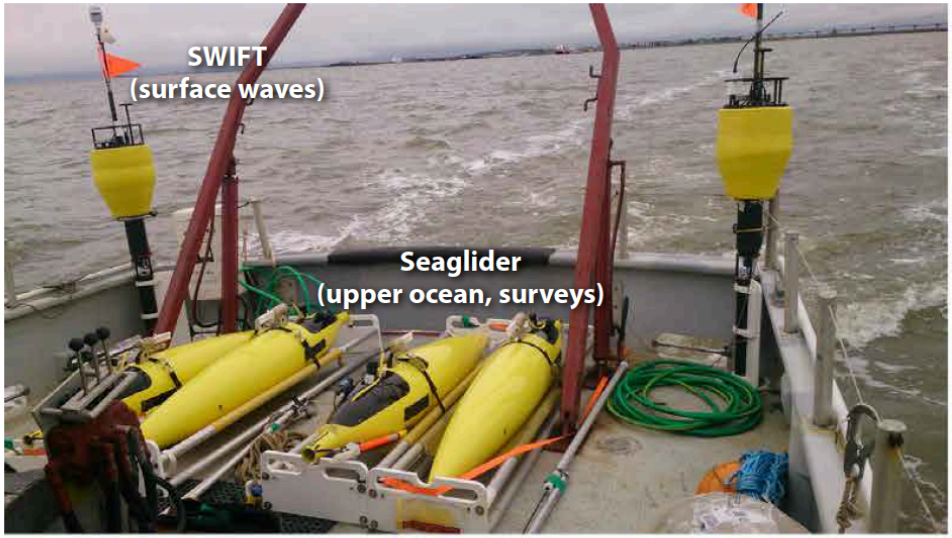
➔tornadoes in the US



**Issues related to sea ice as a source of S2S predictability**:

- Does sea ice play an important role in S2S variability?
- To what degree S2S prediction depends on model reproduction of sea ice?
- How much are model errors in sea ice prediction from model deficiency and uncertainties in initial conditions?

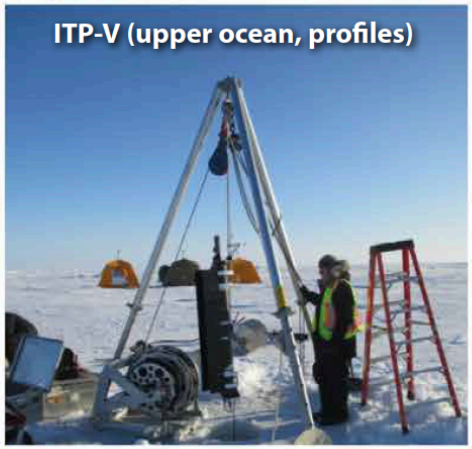
=> Sea ice being a source of S2S predictability remains as an unproven assumption.

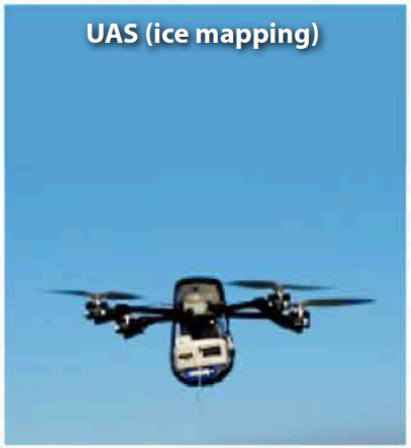

SWIFT
(surface waves)
Seaglider
(upper ocean, surveys)


IMB
(snow and ice)


Wave Buoy (waves in ice)


AWS
(meteorological)


ITP-V (upper ocean, profiles)


UAS (ice mapping)


AOFB (upper ocean, mixing)


Wave Buoy (waves in ice)


AUV (under ice)


Acoustic Navigation Buoy
(underwater geolocation)


Time
12/30/2021
SOP NH-1
SOP NH-2
SOP SH
MOSAiC
2018 Feb
2018 Mar
2018 Jul
2018 Aug
2018 Sep
2018 Nov
2018 Dec
2019 Jan
2019 Feb
YOPP
YEAR OF POLAR PREDICTION
Automated Weather Stations (AWS)
Radiosondes
Buoys
Airborne activities
activity planned and scheduled
activity under consideration
continuous activity
YOPP supersite
All placemarks are based on information provided to the Polar Prediction Project Coordination Office and may contain errors. For any changes or amendments contact office@polarprediction.net.
Symbols: Martin Künsting/Alfred Wegener Institute
US Dept of State Geographer
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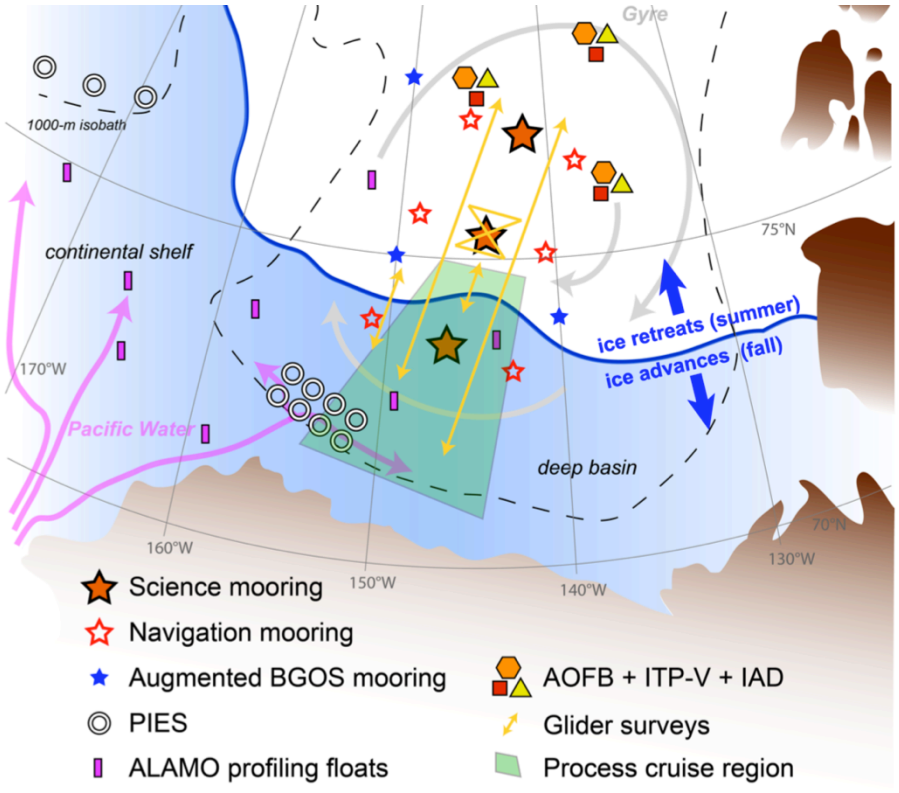
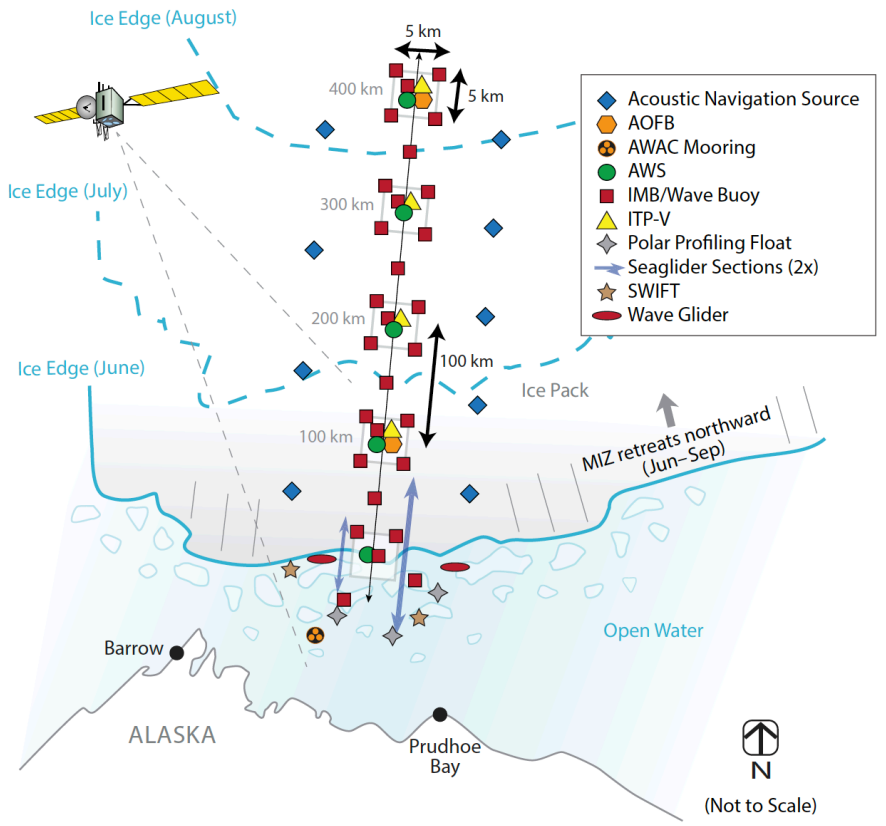
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Google Earth

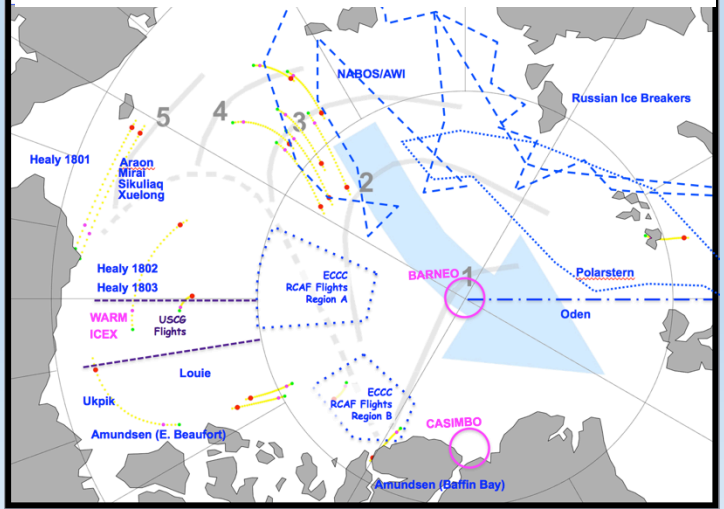
## Stratified Ocean Dynamics of the Arctic (2018-19)

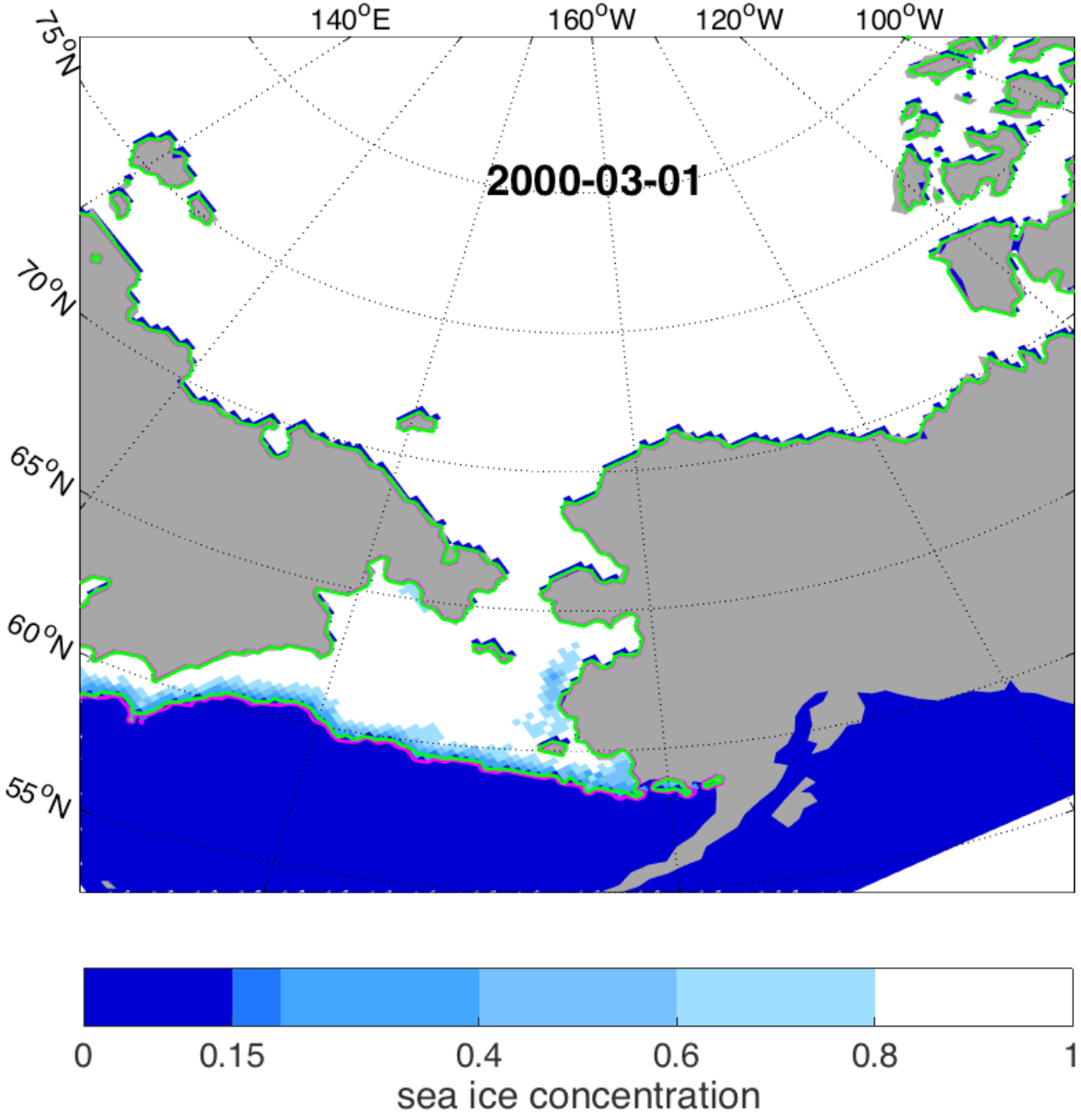


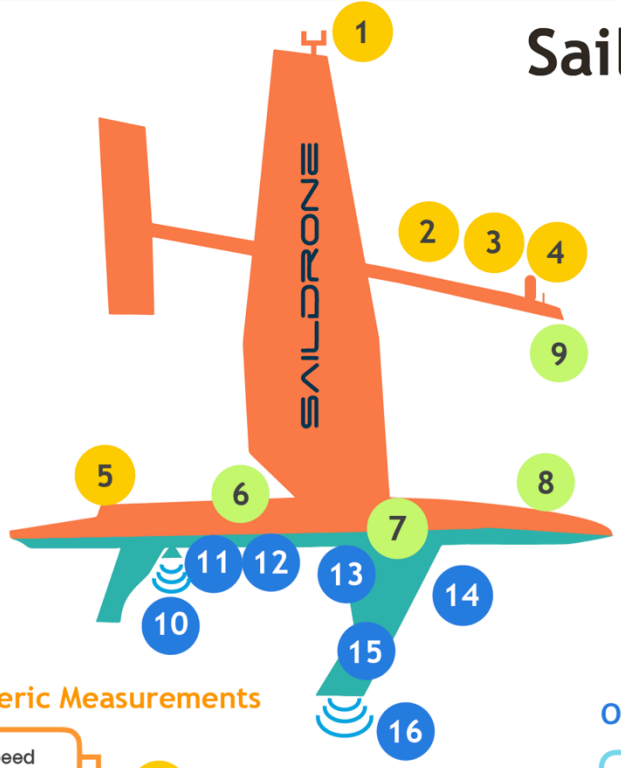

**International Arctic Science Committee**
**Artic Council**
**Sustaining Arctic Observing Networks**
**Years of Polar Prediction**
**Sea Ice Outlook**
**Sea Ice Prediction Network**

## International Arctic Buoy Program (2018)




140°E
160°W
120°W
100°W
75°N
70°N
65°N
60°N
55°N
2000-03-01
0
0.15
0.4
0.6
0.8
1
sea ice concentration

# Saildrone Sensor Suite




## Specifications

Leng
Heig
Draf
Weig
Spee
Payl
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Max
Long

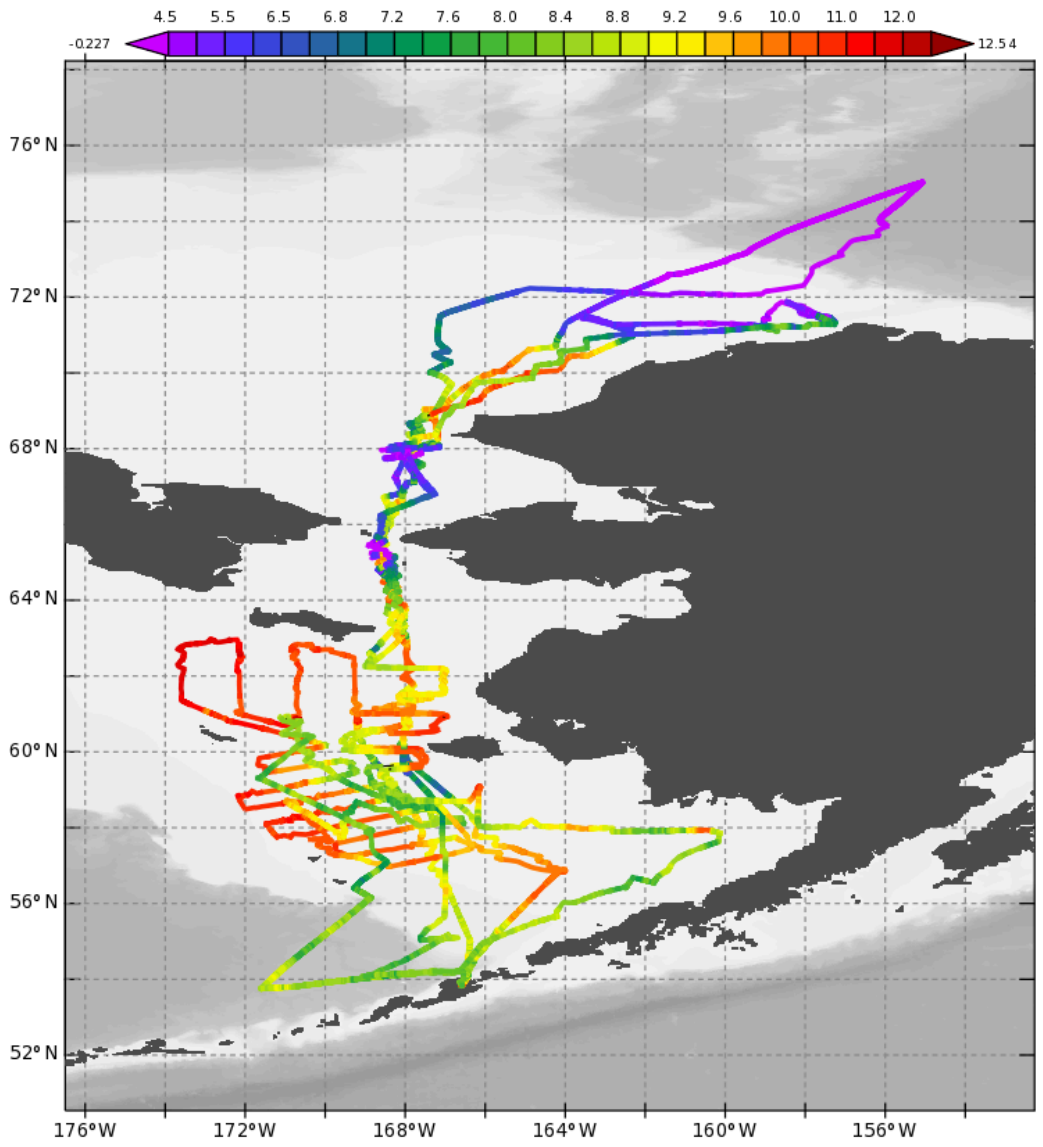
## Atmospheric Measurements

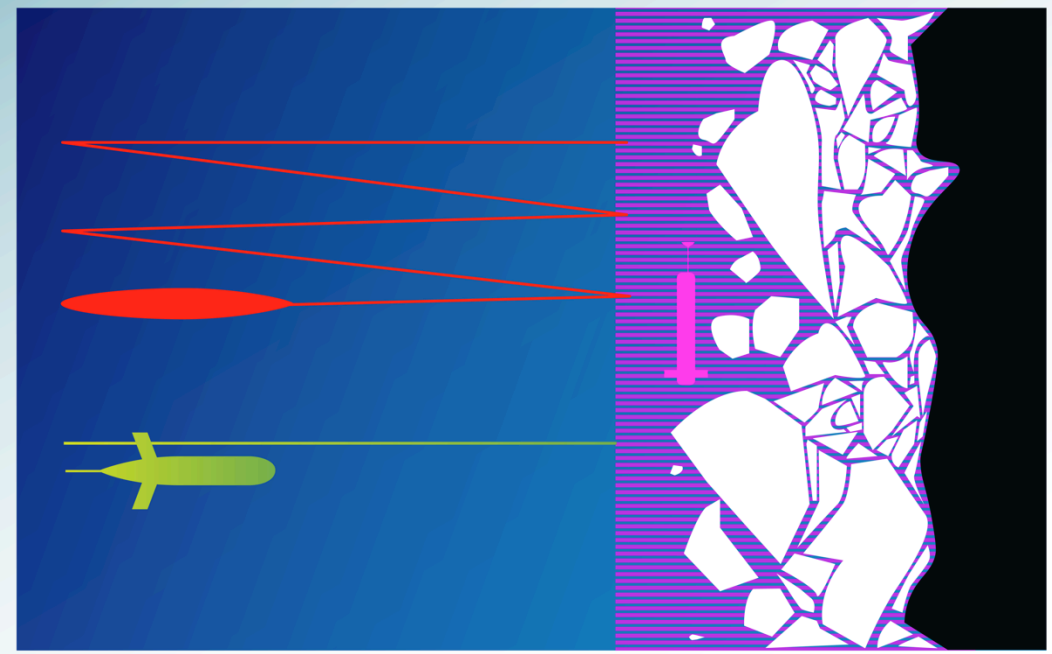
Wind Speed

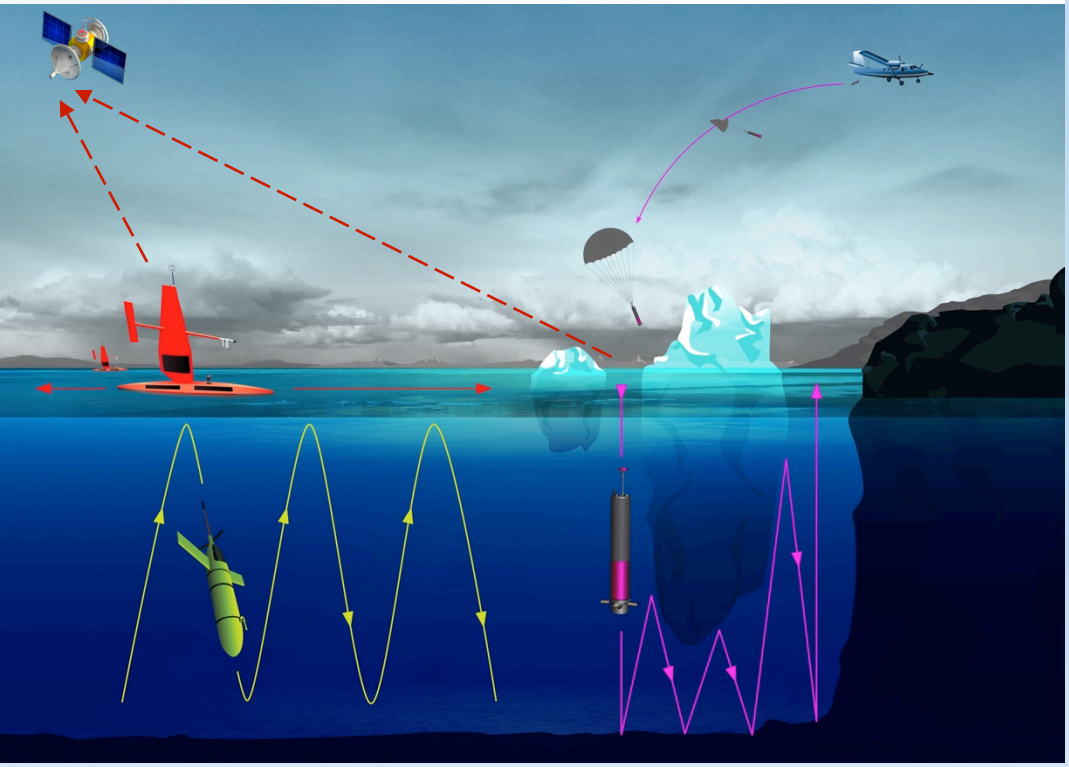
1 Anemometer @ +4.5m
Gill WindMaster 3D Ultrasonic 20Hz

## Oceanic S

Ocean Cur





# PMEL 2019 Saildrone Arctic Mission

Key variables:

SST, SSS
Air surface T, q, **V**, $F_L$, $F_S$
Upper ocean profiles of **u**, T, S

## Take home messages:

1. The possible role of sea ice as a source of S2S predictability need research attention;
2. There is an active sea ice research community with innovative sea ice observation and modeling capabilities (to predict sea ice), which should be engaged with the S2S research (to predict sea ice and its broader impact).

## Suggestions for Phase 2 of the S2S Prediction Project:

1. Extends beyond diagnostics of model skills and begin to address the need of observations. Arctic sea ice is only a case in point. (TPOS2020 is another one.)
2. Form a sub-project on Arctic sea ice.
3. Establish a close connection with the sea ice research community.