Meltwater lenses over the Chukchi and the Beaufort seas during summer 2019: from in-situ to synoptic view.

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Introduction

Salinity of the Arctic Ocean :

- A **tracer** of ocean freshwater cycle : river plumes and sea ice melting/growth.
- An **actor** driving density and vertical stratification : influencing ocean circulation, air/sea and ice/sea interaction.

Sea ice freeze up onset (*Crews et al., 2022*)

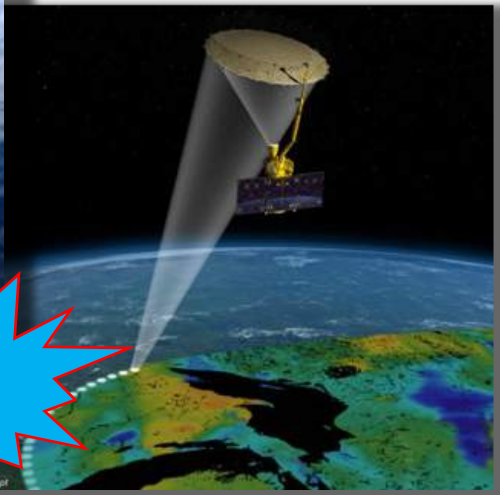
Heat storage (*Jackson et al., 2010; Steele et al., 2012*)

- How freshwater lenses evolve after sea ice retreat ?
- Is it possible to observe freshwater lenses from space ?

New tools → New challenges

Spatial resolution : ~ **50 km**

2010-present



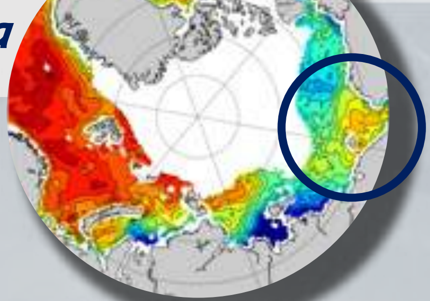
2015-present

1st cm

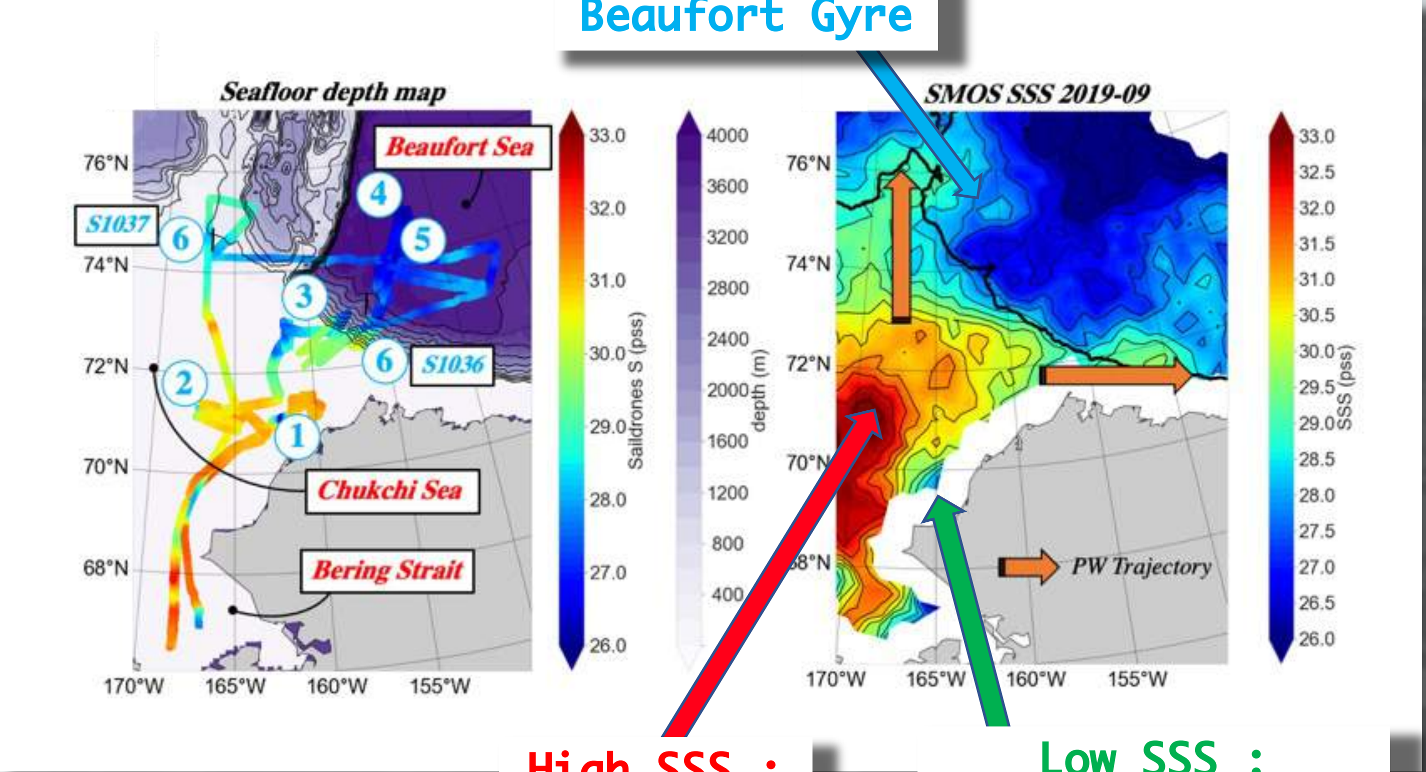
- Low sensitivity of L-Band T_B at low SST and sea ice contamination.
- Accurate SST is key to decrease uncertainty of SSS estimates.
- Low number of in-situ measurements in rapidly changing Arctic Ocean.

Introduction

Chukchi/Beaufort Sea



Low SSS : Beaufort Gyre



High SSS : Pacific Water

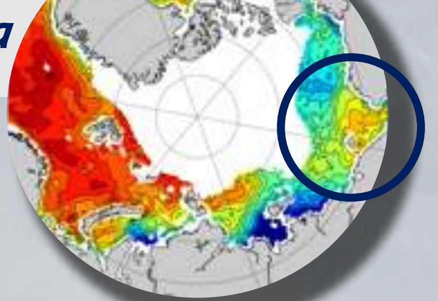
Low SSS : coastal riverine water & river plumes

- Salinity measurement at 50 cm depth during summer 2019 with 2 saildrones (*Gentemann et al., 2019*).
- Saildrones salinity used to validate SMAP SSS (*Vazquez-Cuervo et al., 2021*)
- **In this study:**

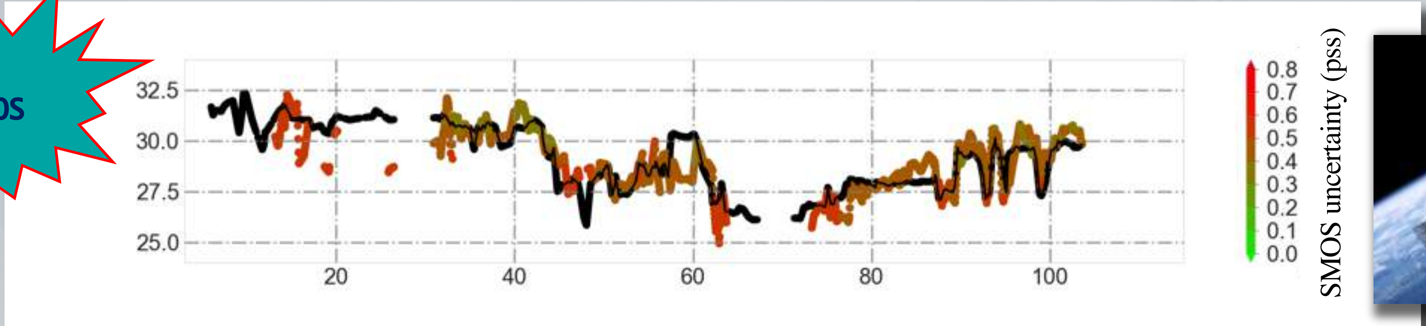
We use SMOS+SMAP and focus on sea ice edge and Meltwater Lenses (MWL).

SMOS+SMAP validation

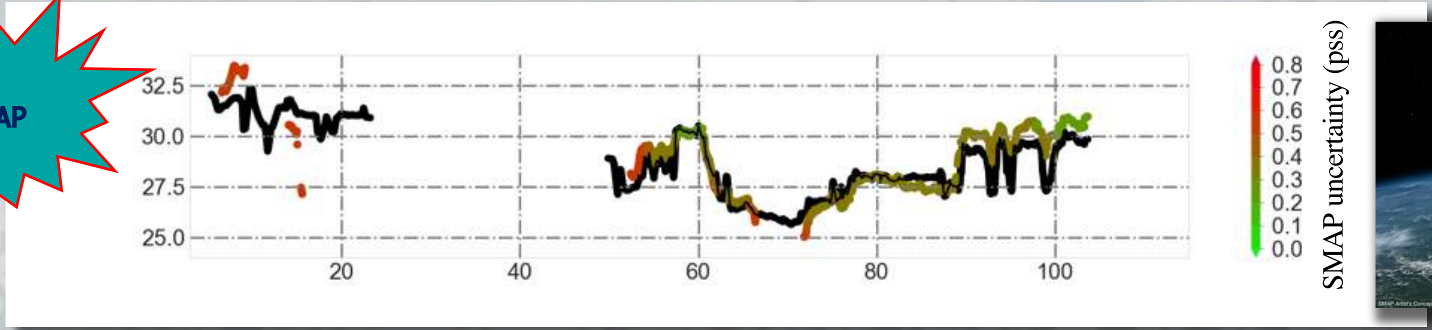
Chukchi/Beaufort Sea

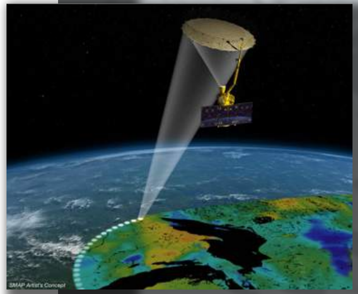


SMOS

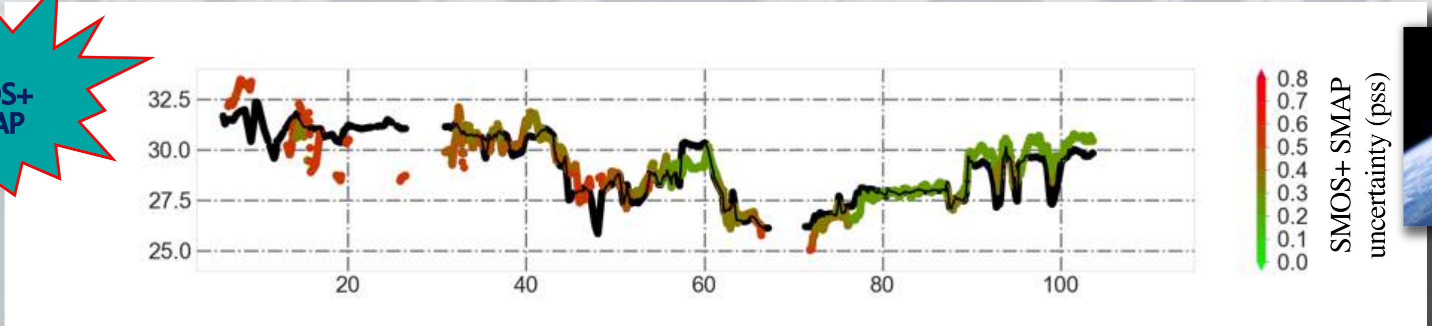


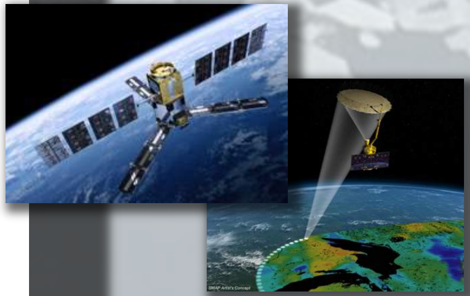
SMAP





SMOS+ SMAP





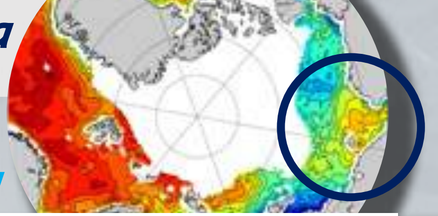
Strong consistency between SMOS and SMAP.

SMOS and SMAP intercalibrated using saildrones

SMOS+SMAP validation - SSS/SST diagrams

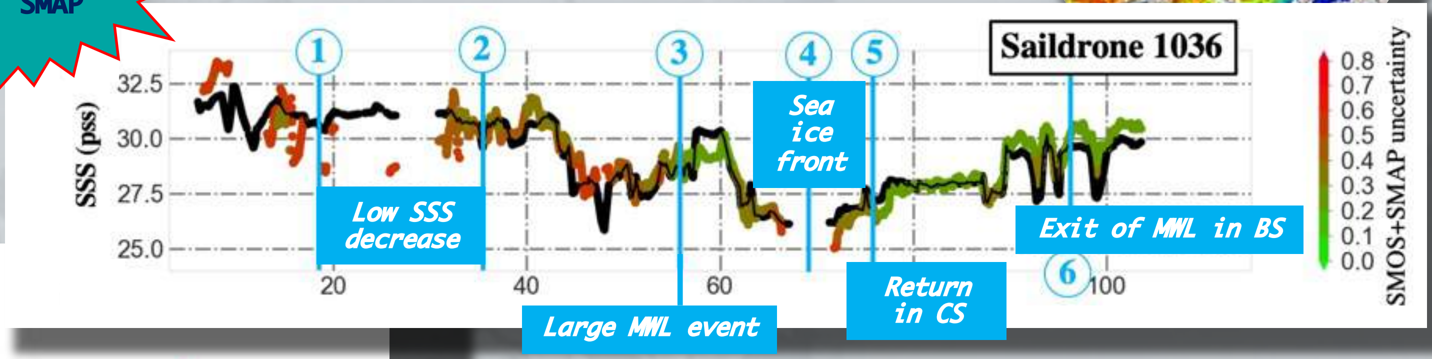
SMOS+ SMAP

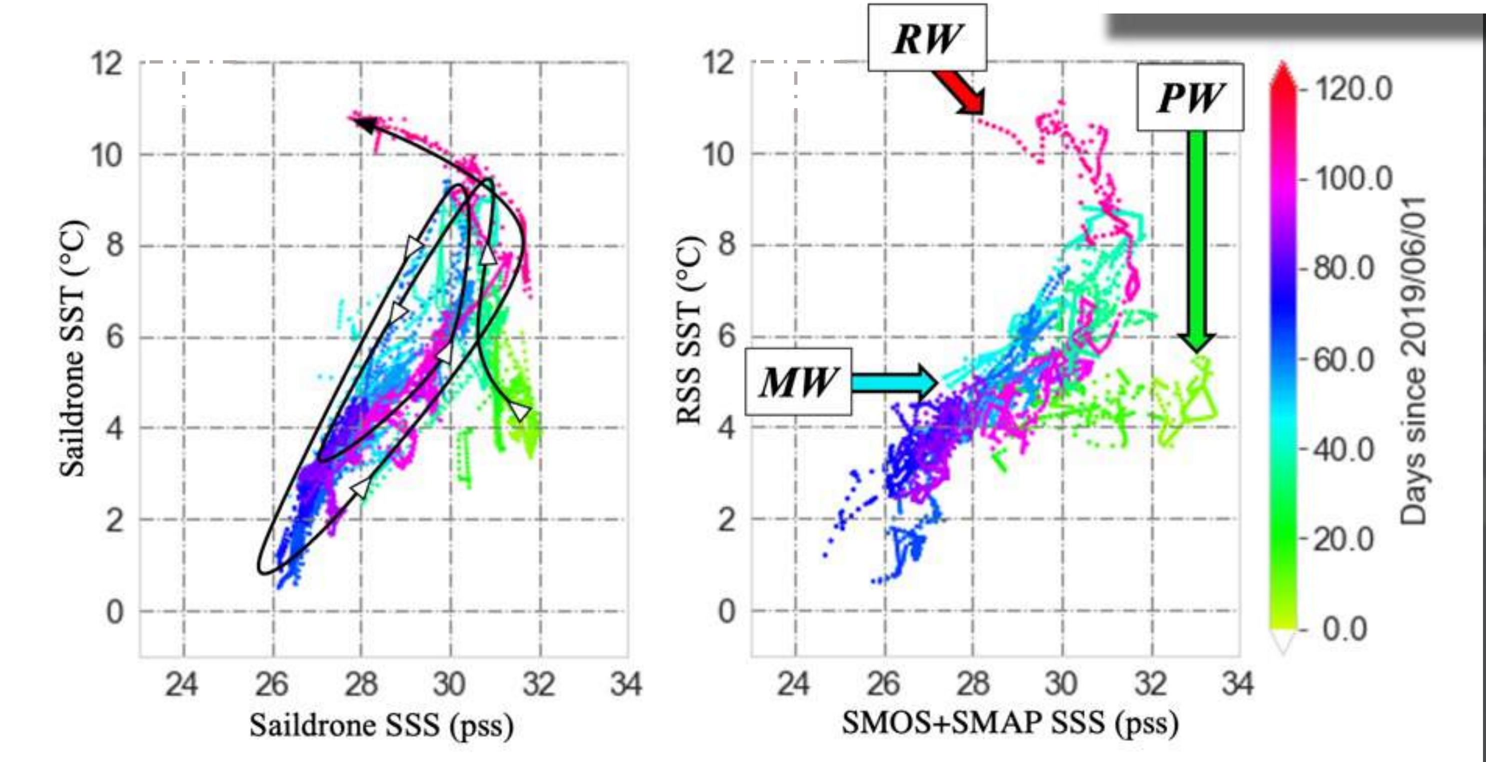
Chukchi/Beaufort Sea



**BS=Beaufort Sea; CS=Chukchi Sea*

RW = Riverine Water
PW = Pacific Water
MW = MeltWater

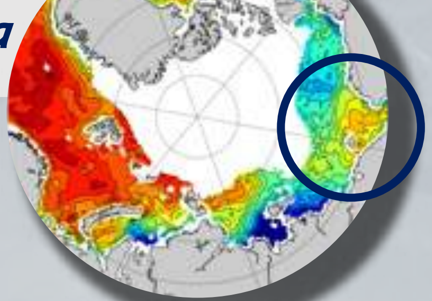


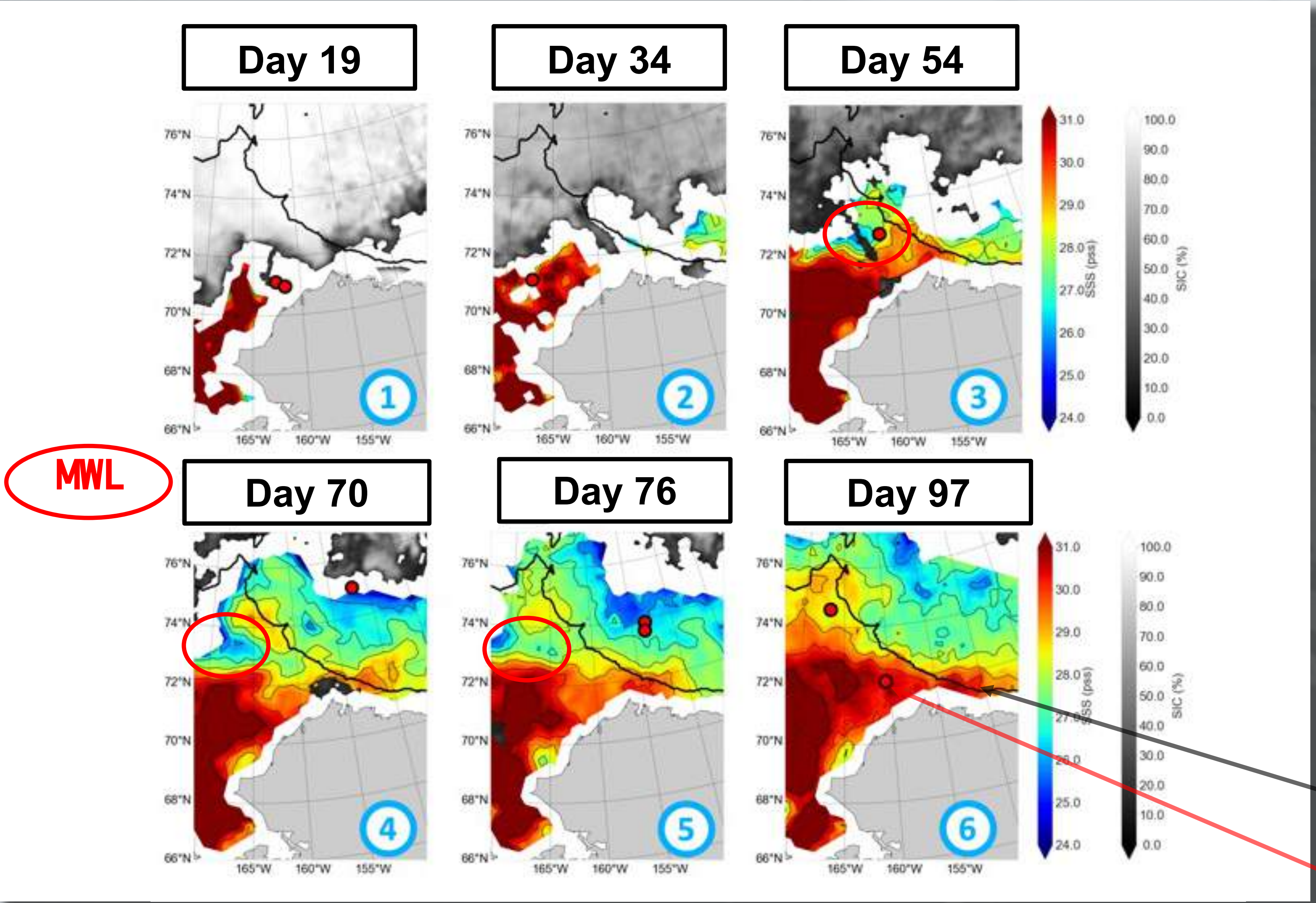


- Good performances of SMOS+SMAP SSS compared to saildrones 1036 and 1037:
  - **MoD = 0.02 pss**
  - **STDD = 0.70 pss**
  - **r = 0.91**
- Detection of different water masses with satellites SSS/SST consistent with saildrones SSS/SST.

MWL persistence

Chukchi/Beaufort Sea



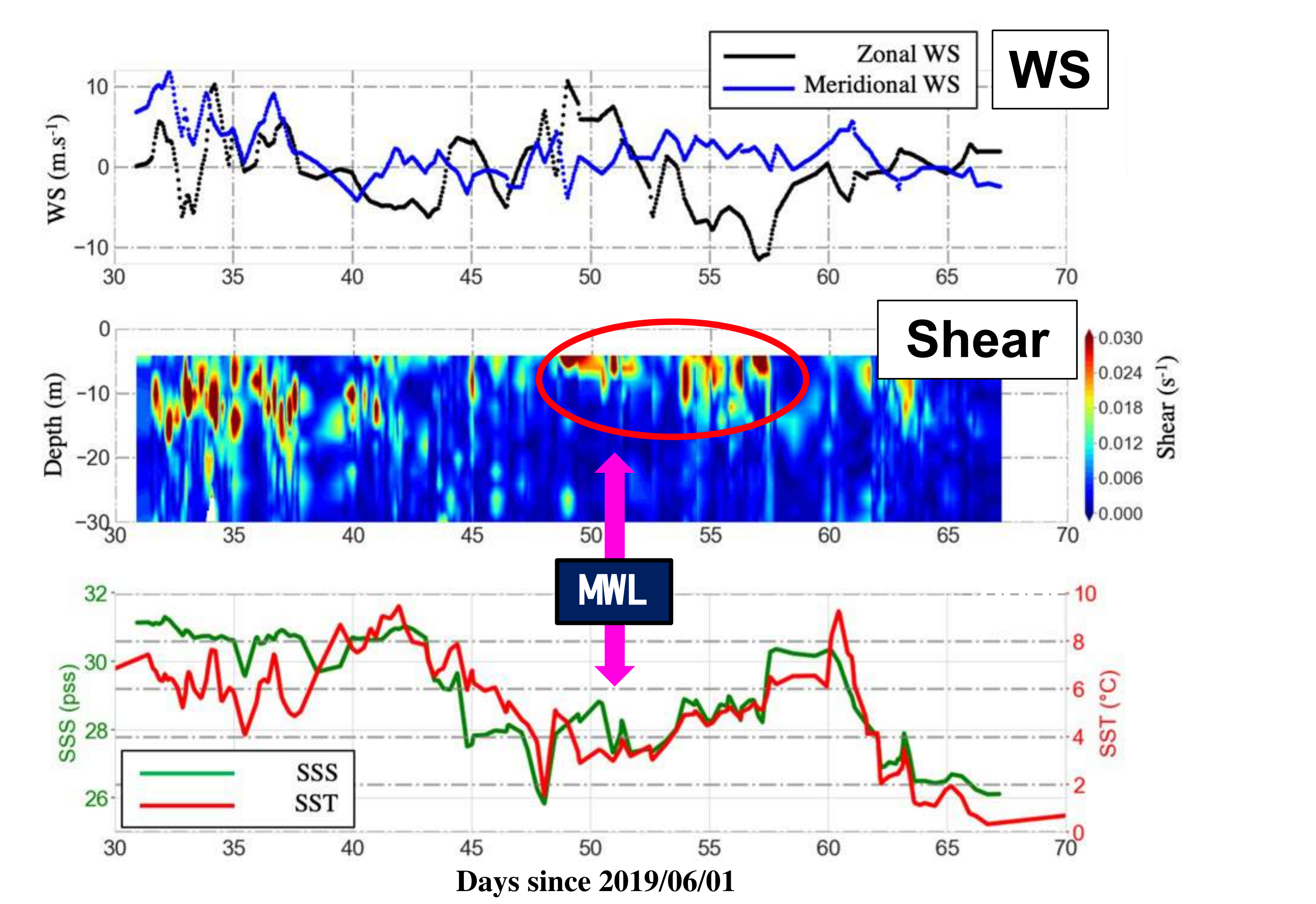


- Freshwater lenses due to sea ice melting crossed by both saildrones.
- Freshwater lenses detected by SMOS and SMAP.
- The persistence time of the freshwater lenses may be longer than one month.

Isobath 500m

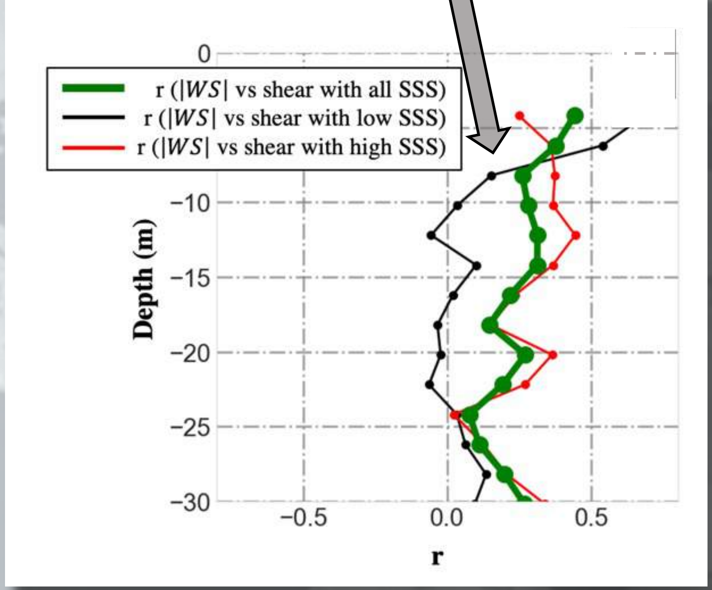
Saildrones

SSS, WS and shear



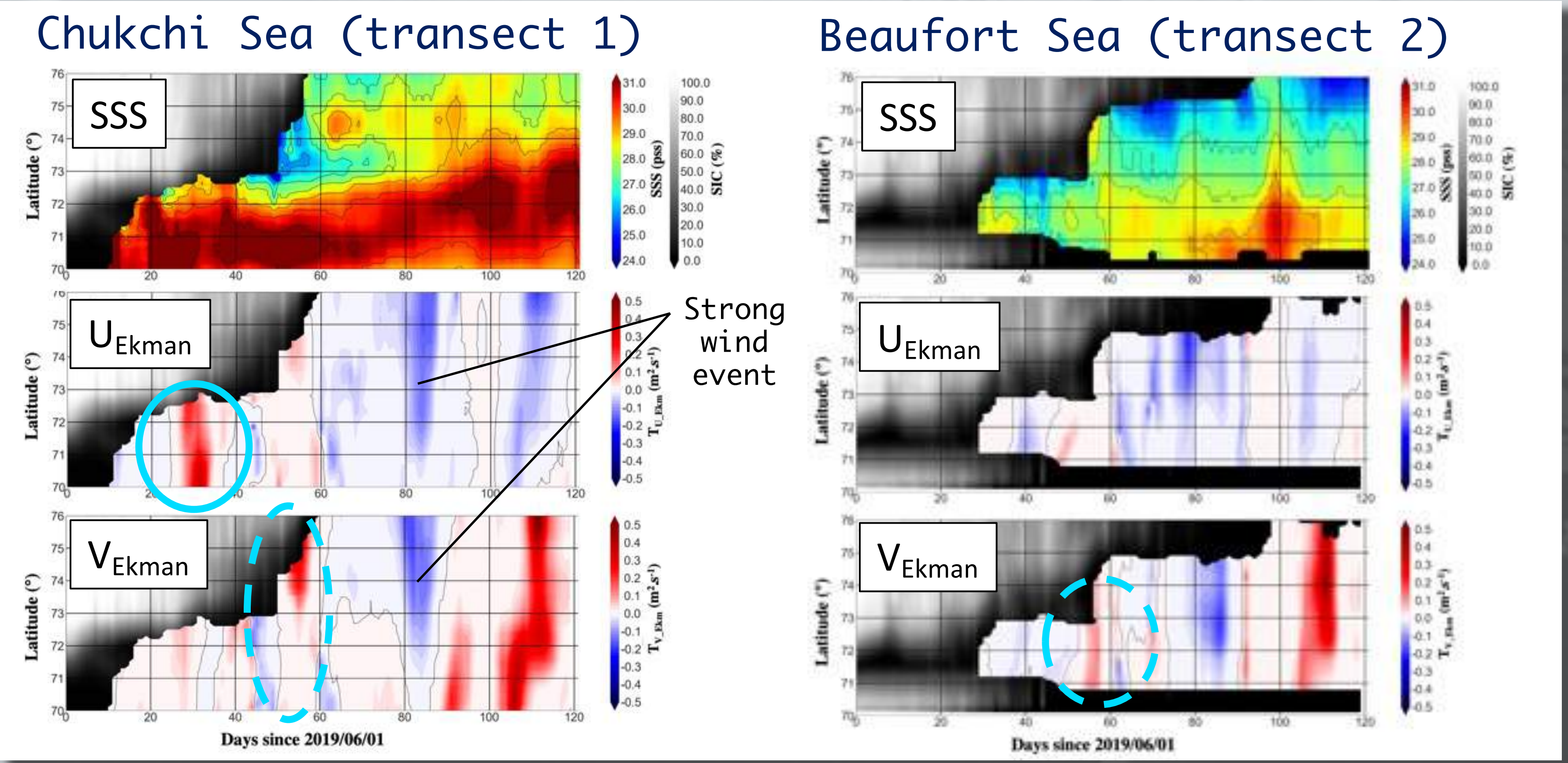
Presence of MWL has the potential to modulate the ocean response to the winds, and the air-sea momentum transfer.

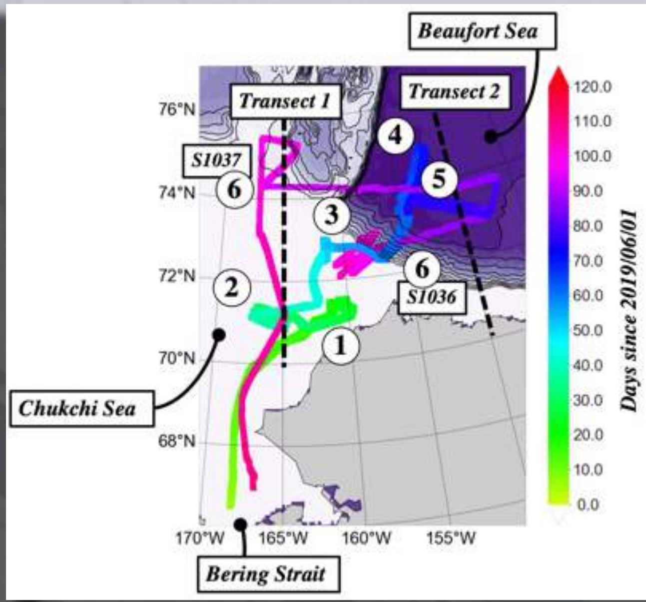
Low SSS : wind-influenced layer is restrained at first 10 meters.



MWL evolution and Ekman transport

- Two different types of dynamics for MWL:
  - large persisting MWL is generated by the advection of a sea ice filament (Chukchi Sea).
  - MWL evolution follows the meridional sea ice retreat (Beaufort Sea).



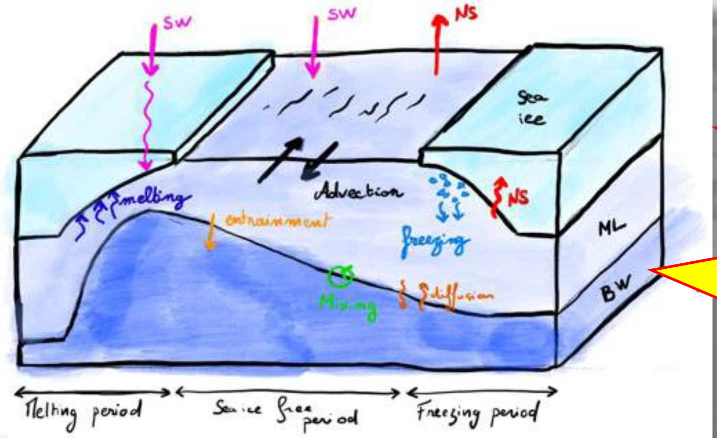


Ekman transport derived from ERA5 wind and air density, SMOS SSS and REMSS SST

Conclusion

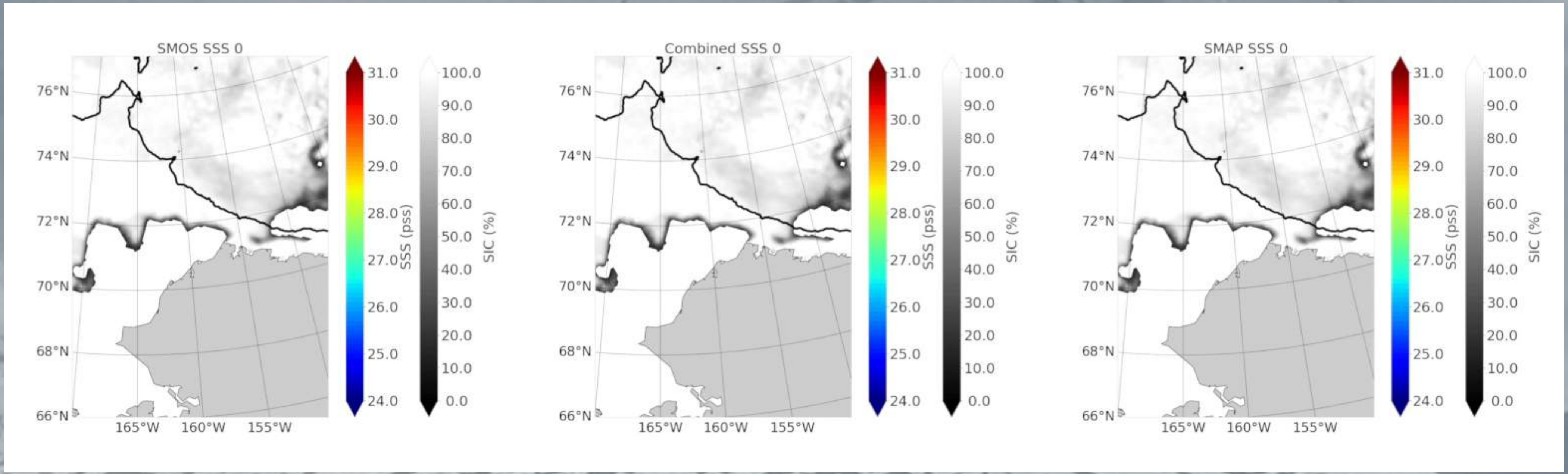
- Saildrones and L-Band radiometers detect sea ice induced large SSS variability over the Chukchi and the Beaufort Sea.
- Low SSS patterns formed by sea ice melting influence the vertical extent of momentum transfer induced by wind stress.
- Despite their limited precision and spatial resolution, L-Band radiometric measurements can monitor meltwater lenses with a persistence time of one month or more reaching 5 pss SSS decrease.

Perspectives: better understand the processes driving the mixed layer seasonal variability in the SIZ and the Sea Ice Edge.
(see poster session : Arctic Ocean mixed layer seasonal variability in an ice-ocean model)



For SASSIE:
New SMOS SSS Arctic science close-NRT (1 day lag)

SIZ = Seasonal Ice Zone



Young sea ice in the Chukchi Sea. Operation IceBridge March 2017. ***Credits: NASA***