

Using Saildrone USVs to validate — OSCAR Surface Currents in the Western Arctic Marginal Seas

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Motivation

- Western Arctic marginal Seas undergo large seasonal variation and sensitive to the warming climate
- One of the most challenging but critical to observe in the world's ocean
 - Sea ice
 - Shallow depths
- Saildrones provide a unique opportunity to validate the OSCAR - satellite-derived surface currents

[Chiodi et al. 2021](#)



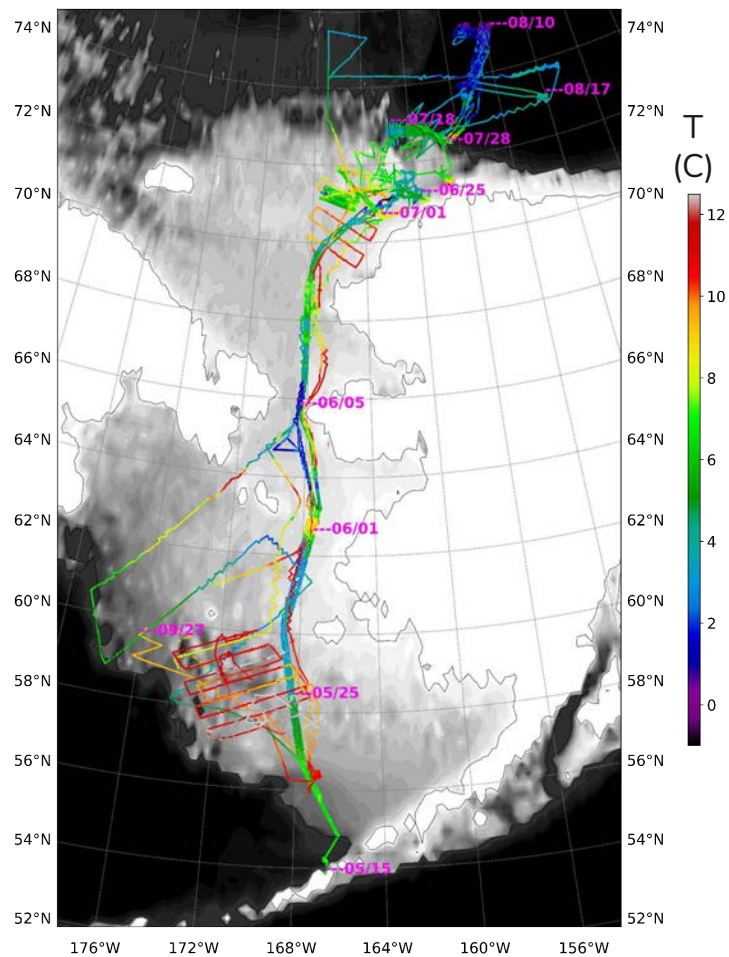
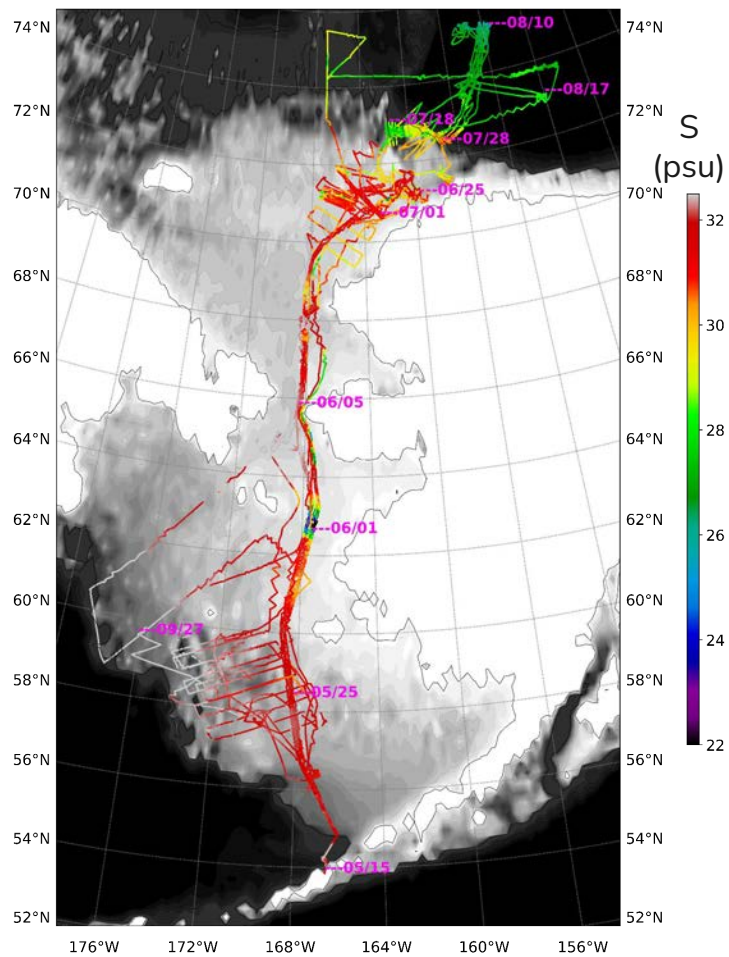
Data



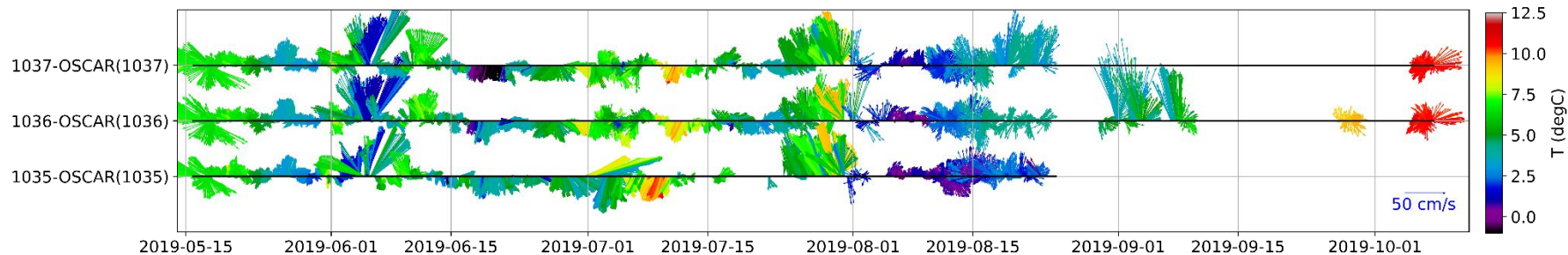
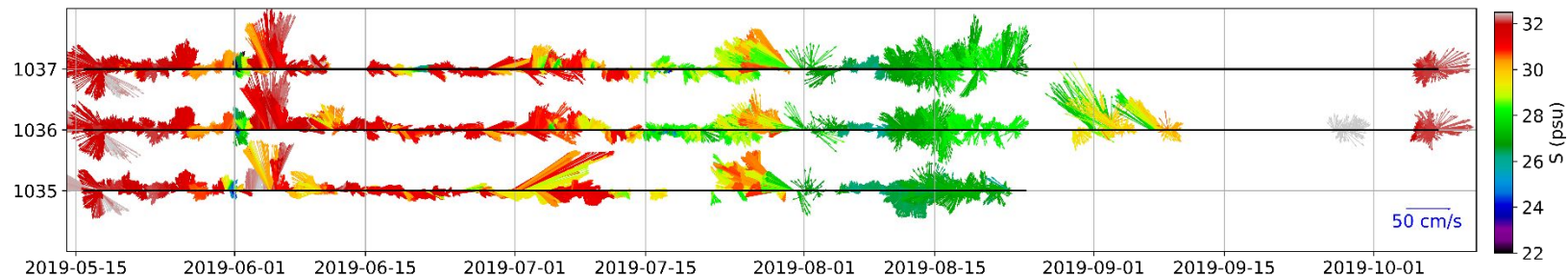
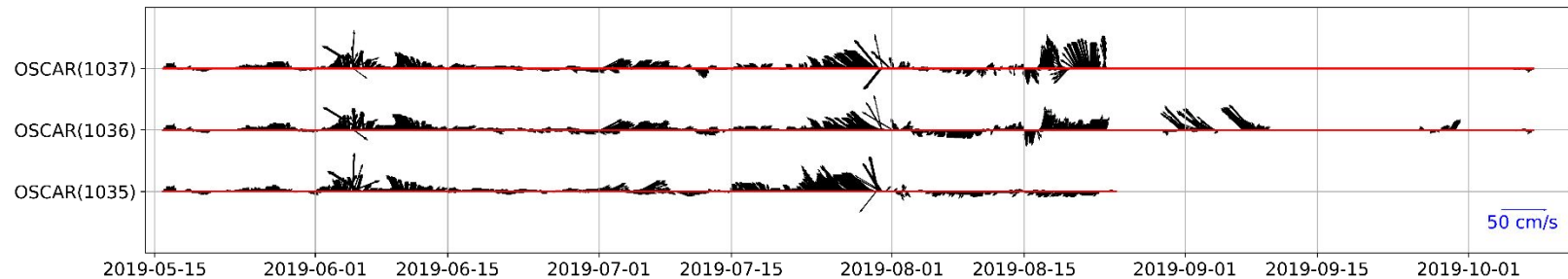
- OSCAR (Ocean Surface Currents Analyses Real-time) currents Dohan & Kathleen 2021
Bonjean & Lagerloef 2002
 - Final V2.0: $\frac{1}{4}$ degree, 1-day
 - Nominal depth: 15 m
 - Satellite-derived current product (SSH, surface vector wind and SST from the various satellites and in situ instruments)
 - Model formulation: combines geostrophic, Ekman and thermal wind dynamics
- Saildrone currents - 2018, 2019 Arctic Saildrone Mission Chiodi et al. 2021
 - 2018: July ~ Sept, 5-min
 - 2019: mid-May ~ Oct, 5-min → mean vehicle speed 0.96 m/s ~ 83 km/day
 - 4 m to the 100 m depth (depending on bathymetry, echo intensity,...)
 - QC & De-tide (AVISO FES 2014 tides database)

<https://www.aviso.altimetry.fr/>

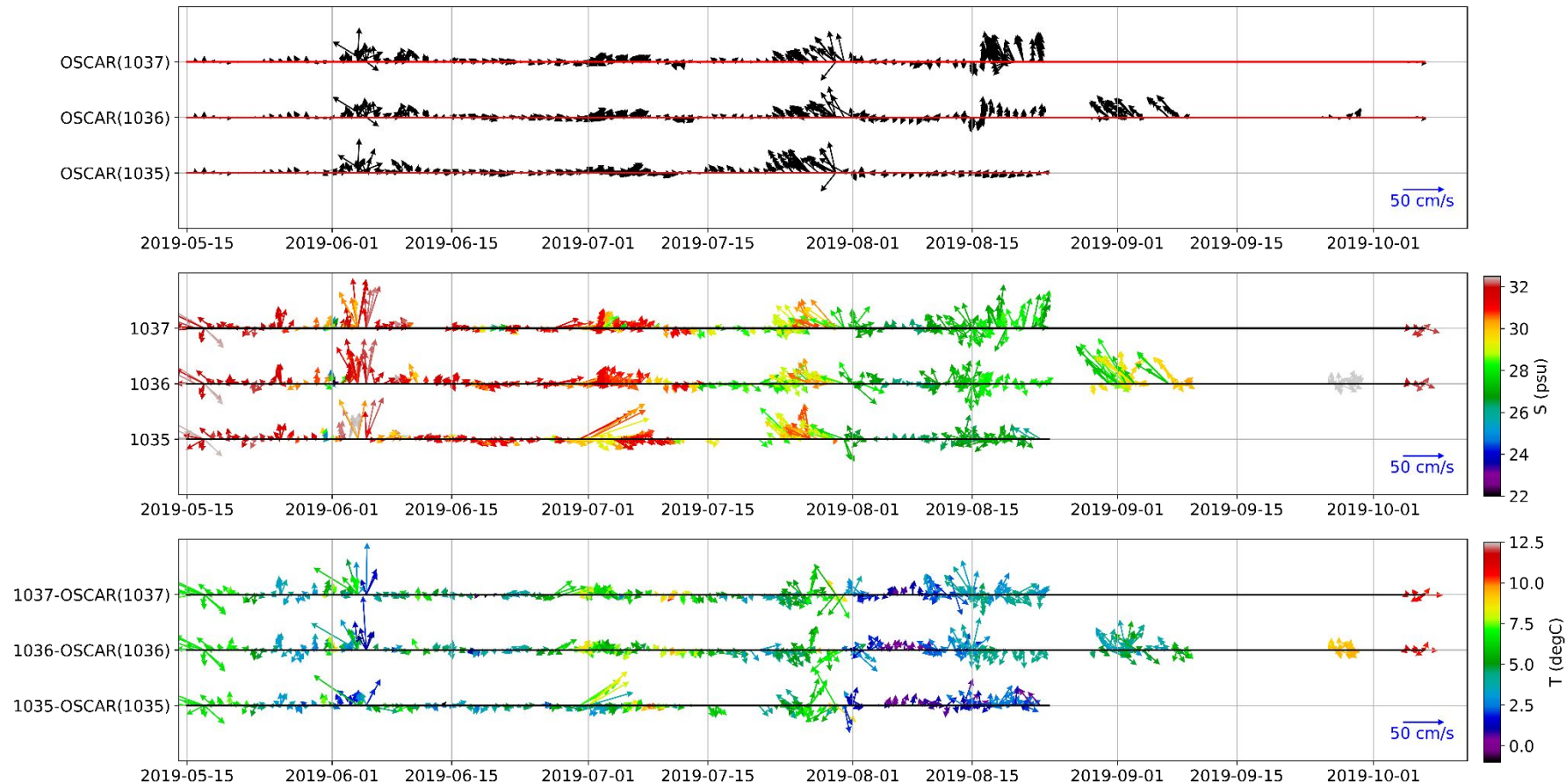
0.5-m T & S from 6 saildrone during 2019 Arctic Saildrone Mission



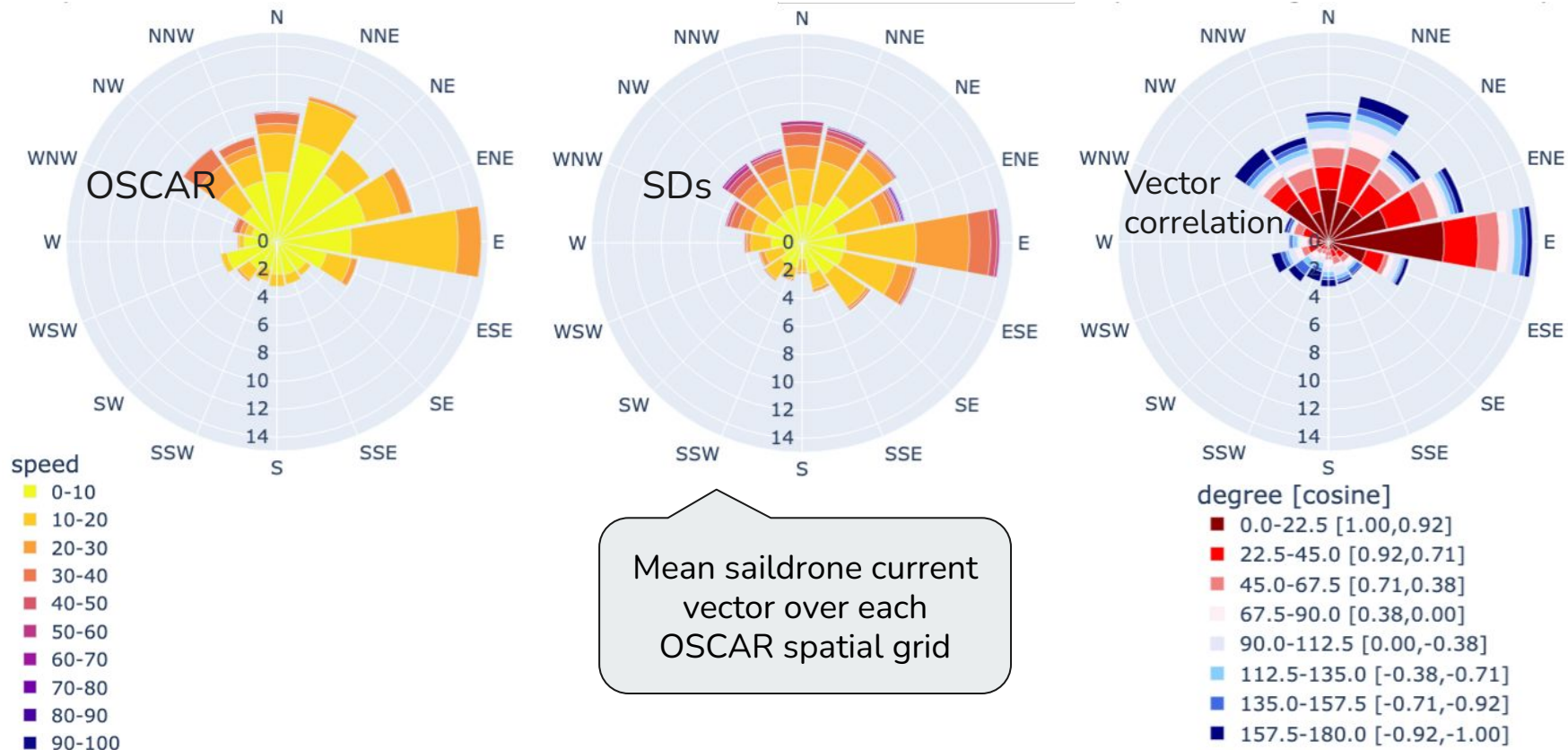
OSCAR ($\frac{1}{4}$ deg - 1 day) 15 m & saildrone (along track 5 min) 10-20 m mean currents



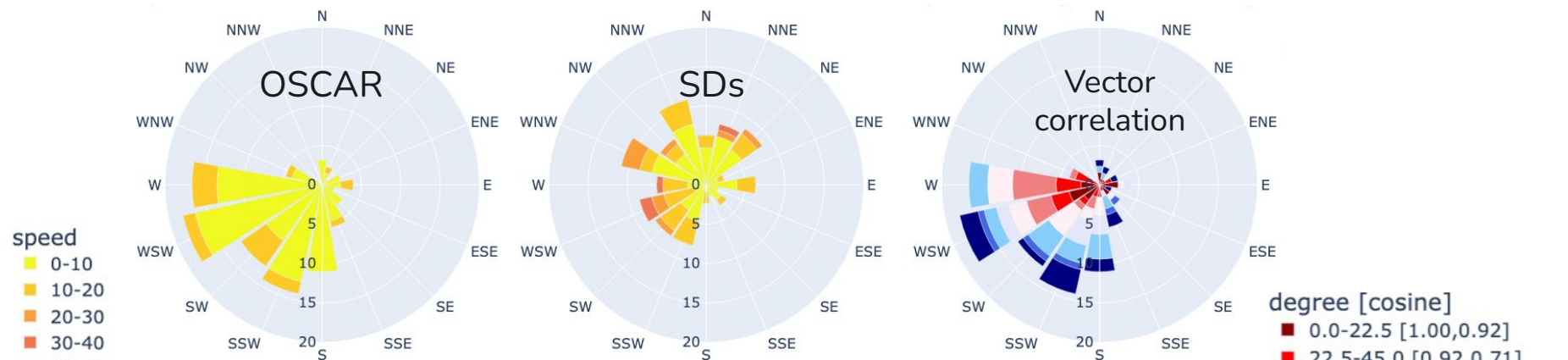
OSCAR ($\frac{1}{4}$ deg - 1 day) 15 m & saildrone (to OSCAR grid) 10-20 m mean currents



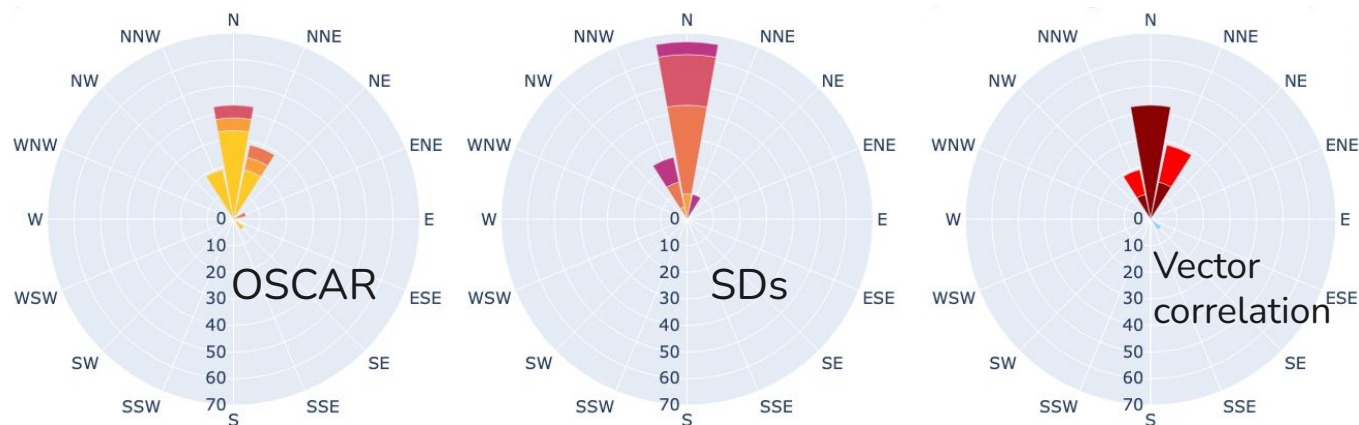
Wind rose plot for collocated vectors (OSCAR & saildrones (2267 pairs)) in 2018 (1020, 1021) & 2019 (1035, 1036, 1037)



Cold fresh surface waters (127)

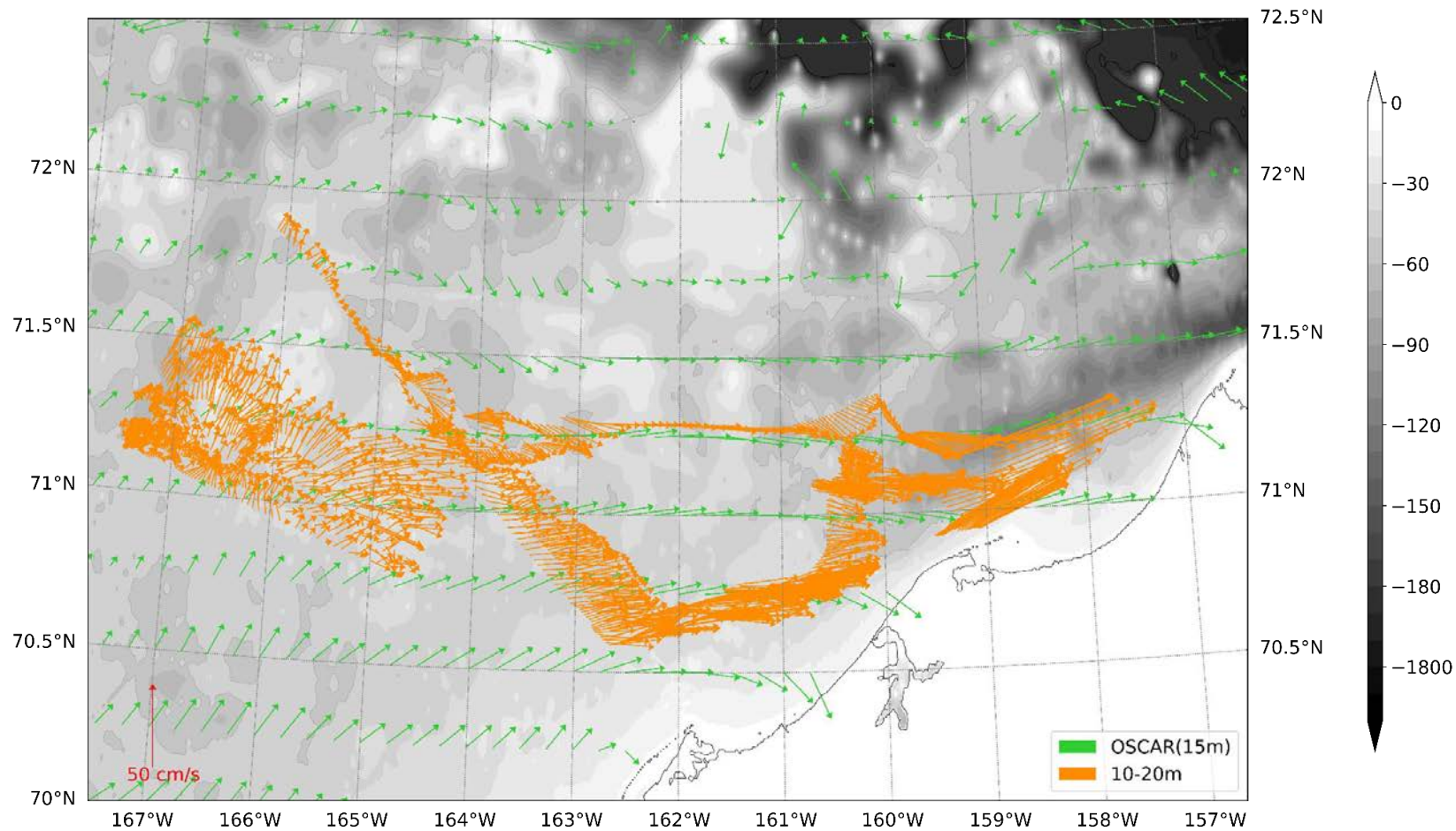


Bering Strait (21)



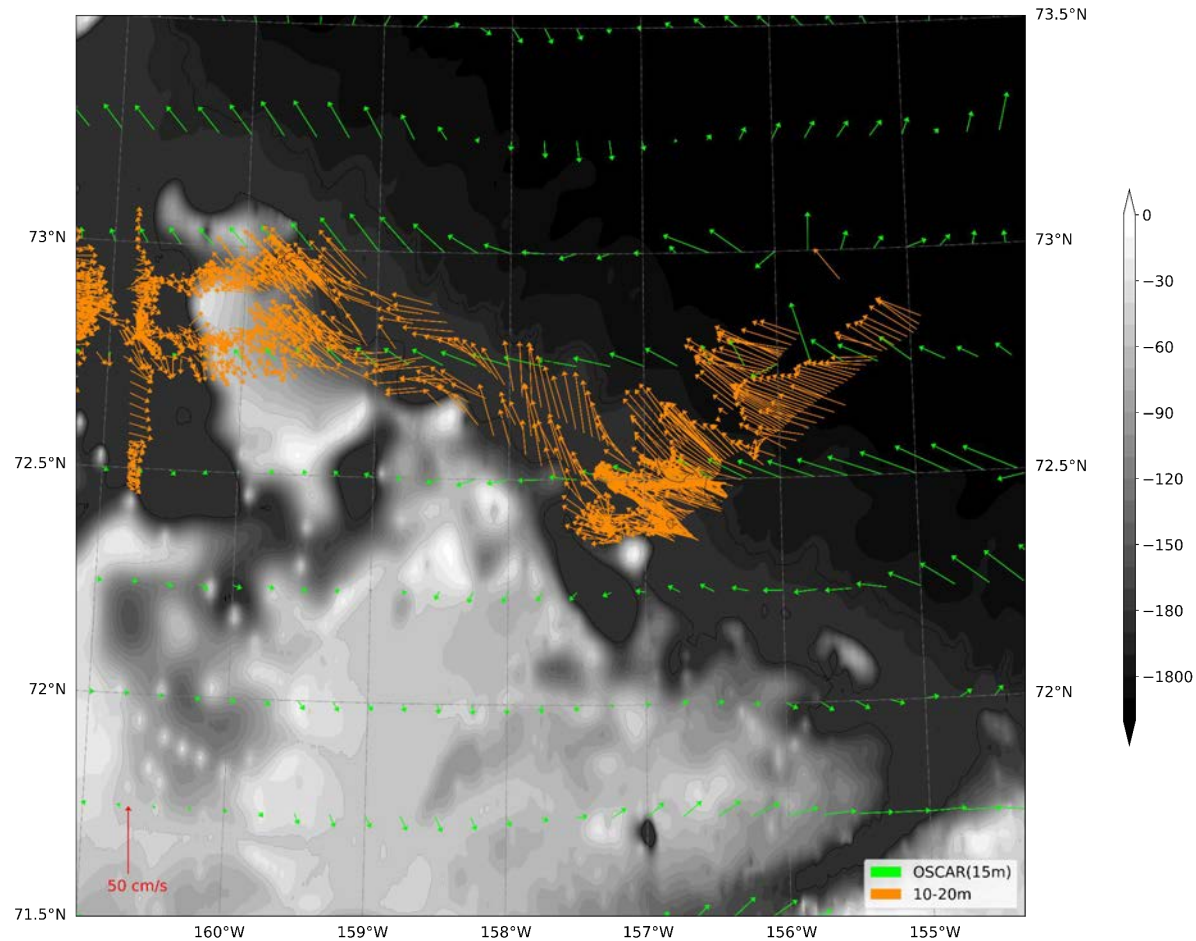
Upstream Barrow Canyon

OSCAR: 07/04
SDs: 06/27-07/09

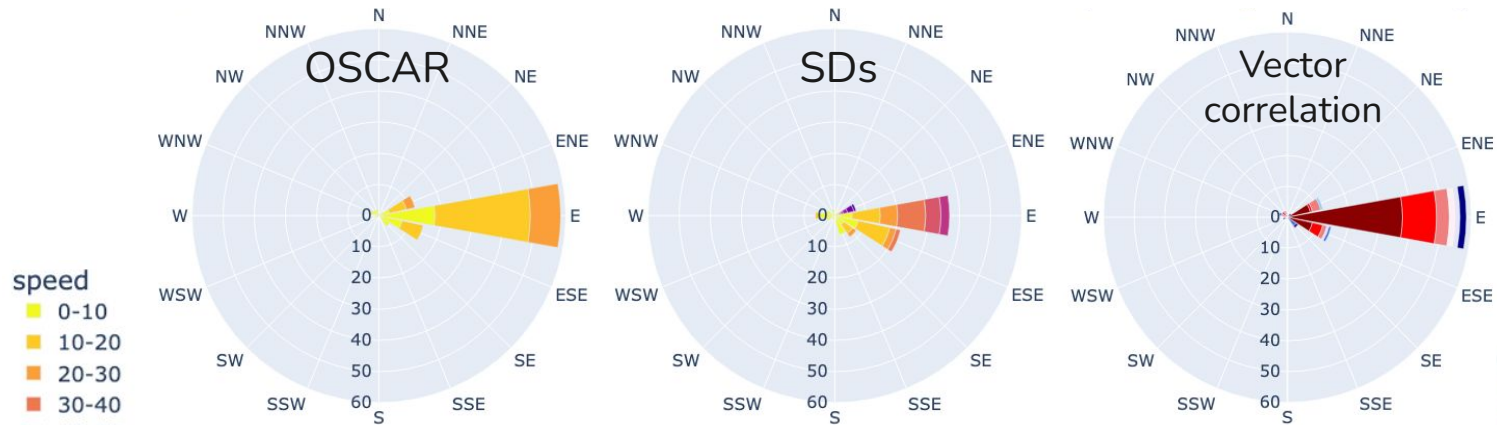


Chukchi Slope Current

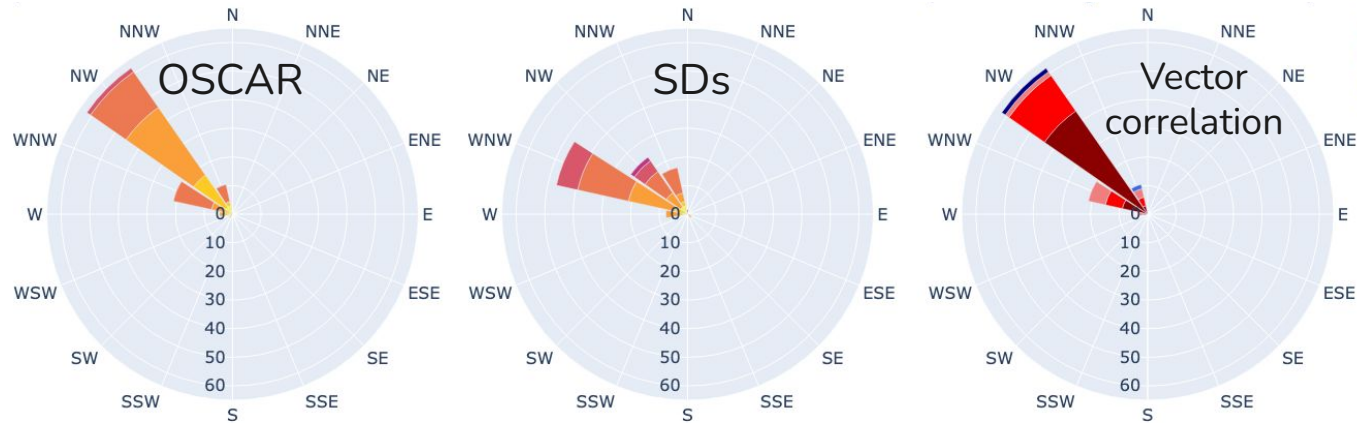
OSCAR: 07/25
SDs: 07/20-07/31



Upstream Barrow Canyon (144)



Chukchi Slope Current (66)



Stats between OSCAR ($\frac{1}{4}$ deg - 1 day) & saildrone (to OSCAR grid) in 2019

	Bias (OSCAR-SD) of current speed	RMSD of current speed	Current vector correlation
Overall	-5 cm/s	11 cm/s	R> 0.38: 71% R < 0.38: 13% R< -0.38: 16%
Strong current (> 30 cm/s)	-19 cm/s	23 cm/s	R> 0.38: 89% R < 0.38: 5% R< -0.38: 6%
Weak current (< 10 cm/s)	0.8 cm/s	5 cm/s	R> 0.38: 57% R < 0.38: 18% R< -0.38: 25%
Cold fresh surface waters (T< 2C, S< 27 psu)	-3.2 cm/s	8 cm/s	R> 0.38: 43% R < 0.38: 24% R< -0.38: 32%

Summary



- Present rarely measured upper ocean measurements from saildrone USVs in the Bering and Chukchi Sea shelf and Beaufort Sea.
- The overall speed differences for the collocated OSCAR vs. saildrones is notable: OSCAR < saildrones by $O(10 \text{ cm/s})$
- Large speed differences $O(20 \text{ cm/s})$ but high vector correlation often occurs for stronger currents.
- Low vector correlation is often observed for weak currents and at the cold fresh regimes.
- Future plans:
 - Explore the feasibility of combining OSCAR and satellite T/S to investigate surface Pacific water inflow. This preliminary study serve as a benchmark to understand the uncertainties of the future study.

Thank you

OSCAR ($\frac{1}{4}$ deg - 1 day) 15 m & saildrone (to OSCAR grid) 10-20 m mean currents

