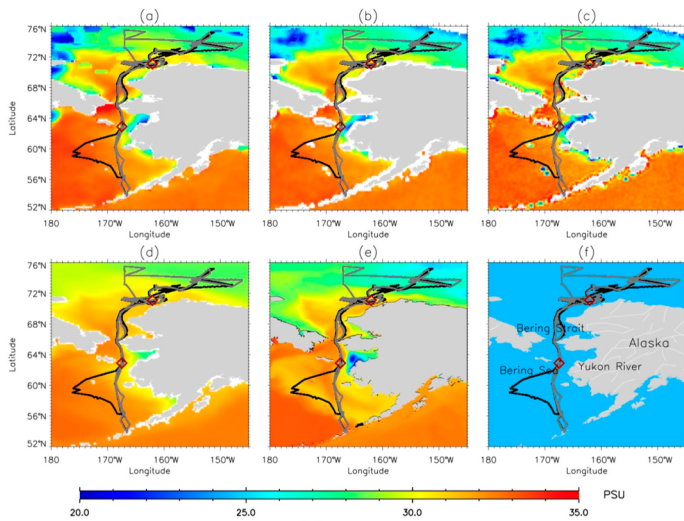
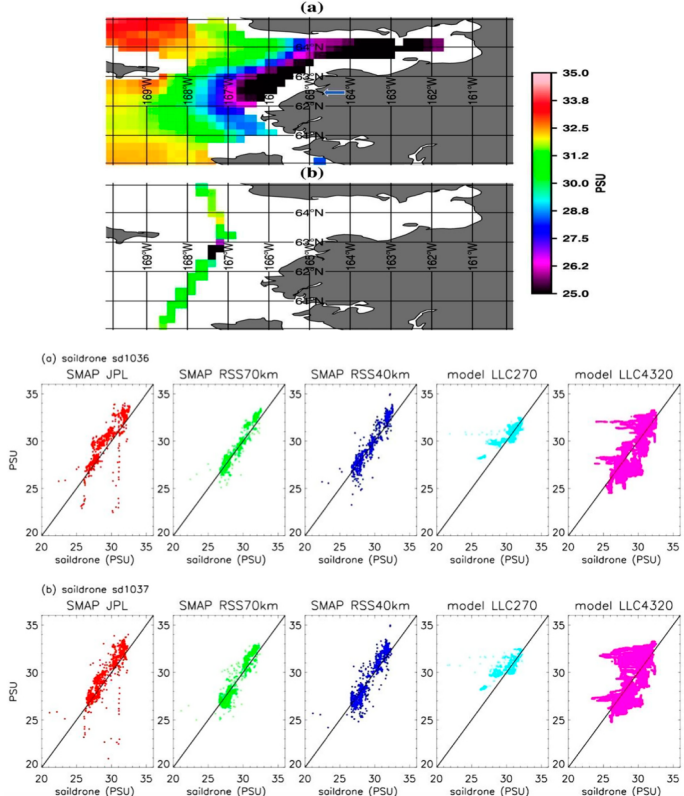


Using Saildrones to Validate Arctic Sea-Surface Salinity from the SMAP Satellite and Ocean Models



Top figure shows Maps of mean SSS time-averaged over the period of Saildrone deployment. (a) SMAP JPL V4.3, (b) SMAP RSS 70km, (c) SMAP RSS 40km, (d) LLC270, and (e) LLC4320. Blue values are indicative of low salinity. Overlaid are tracks of Saildrone 1036 (black) and 1037 (grey) deployments. White colors indicate satellite data that was masked due to land contamination. The locations of Saildrones when the two major freshening events occurred (see Figure 2) are indicated by red diamond symbols. (f) shows a map with the geographical locations of the study area, including the location of the Yukon River discharge (Y-K delta). **Middle figure shows** (a) Map of mean SSS derived from RSS70km product over the period of the Saildrone deployment. (b) Saildrone SSS from SD1036 along the deployment track. Blue arrow shows the location of Y-K Delta. **Bottom figure shows** the scatter plots between Saildrone and the SMAP and model products.



Technology Question:

Validation of remote sensing data sets in the Arctic presents one of the most challenging problems. Yet at the same time the Arctic is a critical area for understanding the impact of a warming planet on climate and ecosystems. In-situ data can be difficult to acquire for the Arctic. The uncrewed surface vehicle Saildrone provides a unique opportunity for validating remote sensing and models in the Arctic. Validation of models, in combination with observations, is critical for predicting future changes in the Arctic. The study should be considered as a testbed for future applications of Saildrones in challenging areas of the world's oceans. Deployments in 2019 in the Bering Strait off the Alaskan Coast provides an opportunity for the validation of salinity from both NASA's Soil Moisture Active Passive Mission (SMAP) and model output from the Estimating the Circulation and Climate of the Ocean (ECCO) model.

Data & Results:

Saildrone is an unmanned surface vehicle that has the capability for measuring multiple atmospheric and oceanographic parameters. This study focuses on the sea surface salinity. Overall, comparisons between the SMAP observations from three products, the 1) JPL Captive Active Passive (CAP) and 2) the Remote Sensing Systems 40km and 70km SMAP products indicate good agreement between observation and Saildrone. Correlations were approximately 0.90. Table 1 shows the summary of the statistics for the three SMAP products and the two models. Biases ranged from near zero to approximately 1 PSU. The high resolution version of the model indicates significant variability can exist at scales less than 100km. Thus improvements of the model and observations to increase feature resolution and nearness to land are critical. Spectral slopes all approximated the -2.0 slope associated with the mesoscale-submesoscale variability.

Significance:

Why is salinity important for monitoring in the Arctic. The paper presents one example showing how both SMAP observations and model show freshening associated with the Yukon river discharge delta. This is a significant finding in that it would allow the application of remote sensing to monitor changes in river discharge associated with possible changes in climate and changes in precipitation and ice melt. Additionally, the signal seen in the ECCO model associated with the freshening indicates applications of models in the Arctic could lead to better prediction of river discharge and coastal freshening. This has additional implications for monitoring of ecosystems in the Arctic.

The research was carried out at the Jet Propulsion Laboratory (JPL), California Institute of Technology. This work was supported by a NASA ROSES grant under the SMAP Salinity Announcement of Opportunity.

Reference

Vazquez-Cuervo, J.; Gentemann, C.; Tang, W.; Carroll, D.; Zhang, H.; Menemenlis, D.; Gomez-Valdes, J.; Bouali, M.; Steele, M. Using Saildrones to Validate Arctic Sea-Surface Salinity from the SMAP Satellite and from Ocean Models. *Remote Sens.* **2021**, *13*, 831. <https://doi.org/10.3390/rs13050831>



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Citation: Vazquez-Cuervo, J.; Gentemann, C.; Tang, W.; Carroll, D.; Zhang, H.; Menemenlis, D.; Gomez-Valdes, J.; Bouali, M.; Steele, M. Using Saildrones to Validate Arctic Sea-Surface Salinity from the SMAP Satellite and from Ocean Models. *Remote Sens.* **2021**, *13*, 831. <https://doi.org/10.3390/rs13050831>

Data Sources:

VOCALS: <http://podaac.jpl.nasa.gov/>

Technical Description of Figure:

The figures show comparisons between the salinity observed from the three SMAP products as derived from the JPLCAP and RSS products. Scatter plots show good overall relationship between the SMAP/Model derived salinity and Saildrone salinity.

Scientific significance, societal relevance, and relationships to future missions: Why is salinity important for monitoring in the Arctic. The paper presents one example showing how both SMAP observations and model show freshening associated with the Yukon river discharge delta. This is a significant finding in that it would allow the application of remote sensing to monitor changes in river discharge associated with possible changes in climate and changes in precipitation and ice melt. Additionally, the signal seen in the ECCO model associated with the freshening indicates applications of models in the arctic could lead to better prediction of river discharge and coastal freshening. This has additional implications for monitoring of ecosystems in the Arctic. The significance for future missions is that differences in SMAP products, especially with respect to a freshening even observed in the JPL product, need to be examined further. Further research needs to be done to improve the overall consistency of the products as well as possible ice and land contamination. Improvements in resolution with respect to resolving coastal dynamics are also needed based on the spectra which indicated energy exists at scales < 100km. These scales are important with respect to resolving coastal features associated with freshening and river discharge.