Characterization of SMAP Salinity Dataset Biases and Errors

Jesse Anderson[1], Julian J. Schanze[1], and Oleg Melnichenko[1]
[1]Earth & Space Research, Seattle, WA USA

Salinity Validation Data System

The Salinity Validation Data System (SVDS) was developed with the goal of providing systematic estimation and assessment of satellite sea surface salinity over the global ocean. Using dataset matchups and techniques such as triple point collocation, we evaluate global, latitudinal, and regional biases and errors in L2 and L3 satellite salinity data.

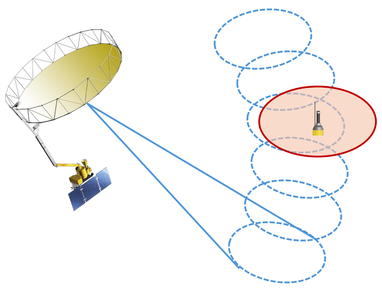
Here, we document improvements to and performance of the NASA's Soil Moisture Active Passive (SMAP) data products by comparing V5.0 with V6.0 and evaluation version V6.3.

Matchup Methods

Prior to comparing satellite and in situ salinity data, datasets with different spatiotemporal sampling (swath versus point) or spatial grids must be matched up.

For validation purposes of L2 satellite data, an in situ centered matchup with "all-in-box" averaging over a 50km search radius and a ± 3.5-day time are used (see Schanze et al., 2020 for a comparison of methods).

For L3 data, gridded data are regridded to the coarsest common grid. Matchups are then further quality controlled by applying data flags to the satellite observations.



for each in situ observation, search:

x = 50 km
t = ± 3.5 days

then average "all-in-box"

Data

Level 2 (swath) data
- SMAP RSS V5.0, V6.0, & V6.3 ~70km
- EN.4.2.2 profile data
- SMOS v700 30-80km

Level 3 (grided) data
- SMAP RSS V5.0 & V 0.25°x 0.25° monthly
- EN.4.2.2 gridded data 1°x 1° monthly
- SMOS CATDS-CPDC (RE07 & OPER) 50km x 50km monthly

References

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Contact

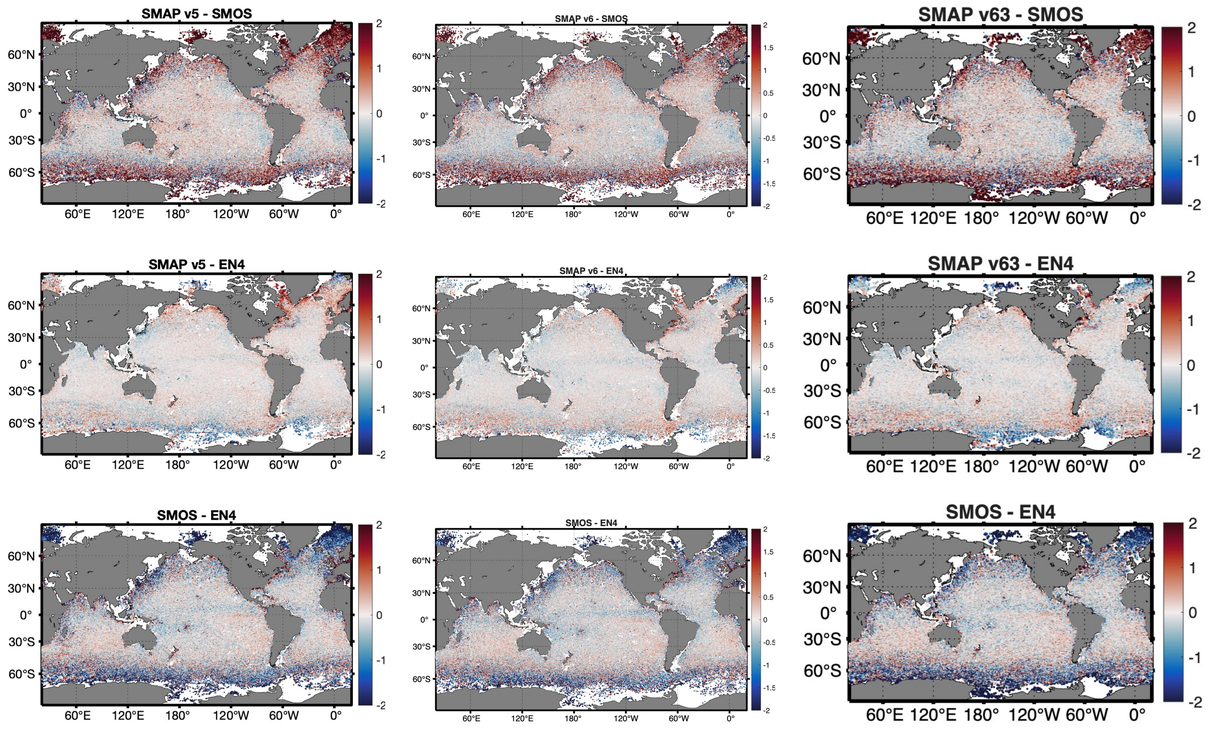
GitHub

janderson@esr.org

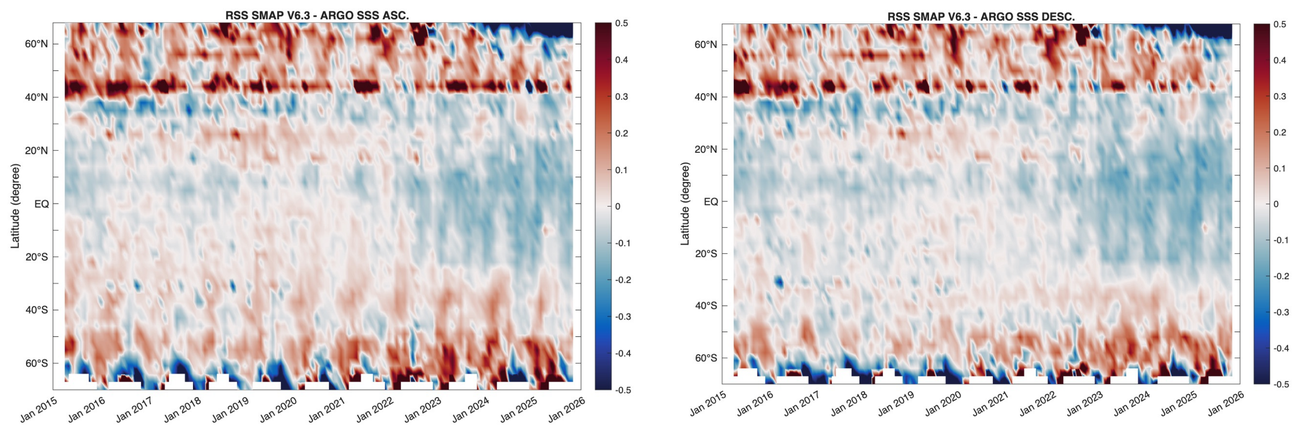
Matchup Validation Analysis

Biases getting larger since ~2021.
Positive biases observed in the Southern Ocean
Negative biases in the Arctic
Negative Bias in the Tropics

L2 Matchup differences, Minimal flags



Latitudinal Biases, Averaged over look direction



Triple Collocation Analysis

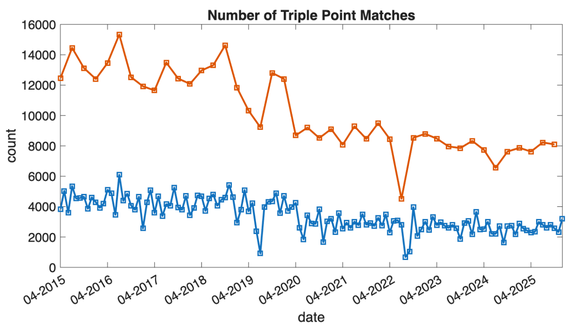
Here, we use the unscaled covariance notation described in Stoffelen (1998) and Gruber et al. (2016). The unscaled error variance (σ_ε^2) for each dataset is:

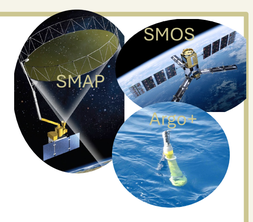
$$\sigma_{\varepsilon_X}^2 = \sigma_X^2 - \frac{\sigma_{XY}\sigma_{XZ}}{\sigma_{YZ}}$$

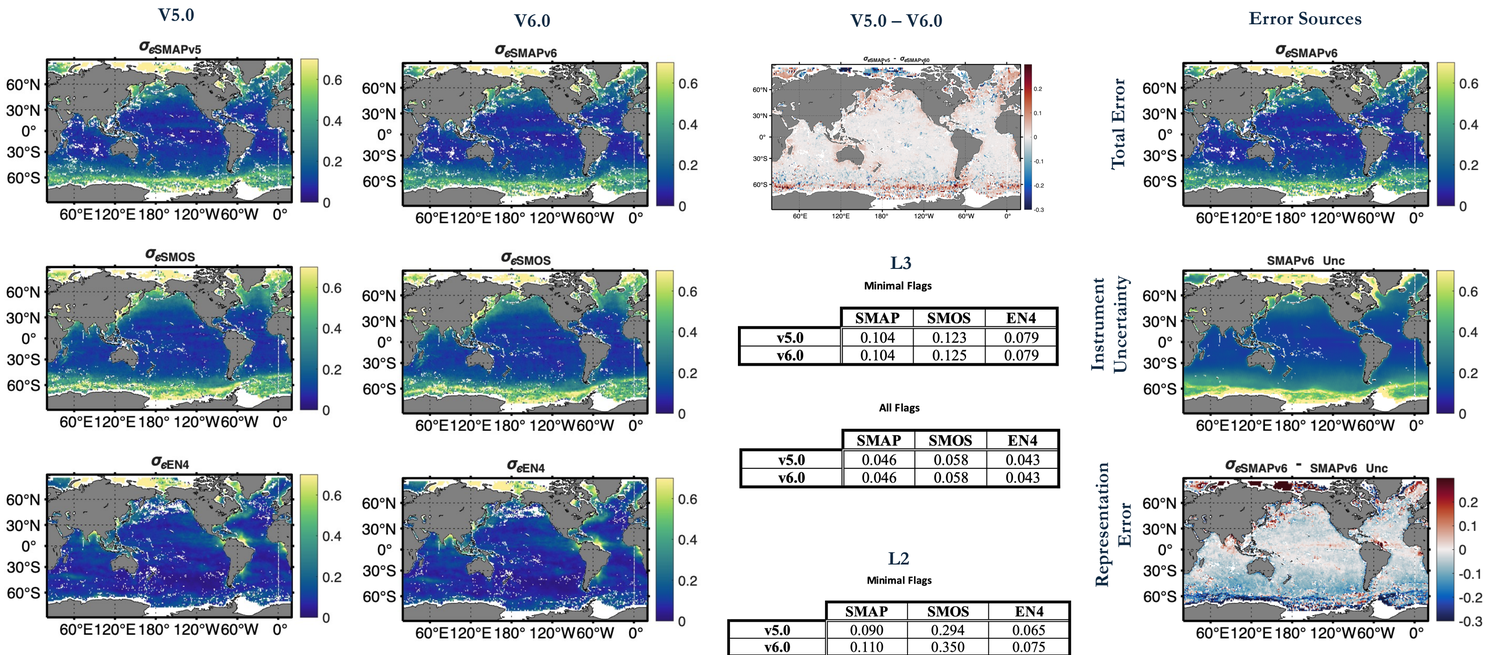
$$\sigma_{\varepsilon_Y}^2 = \sigma_Y^2 - \frac{\sigma_{YX}\sigma_{YZ}}{\sigma_{XZ}}$$

$$\sigma_{\varepsilon_Z}^2 = \sigma_Z^2 - \frac{\sigma_{ZX}\sigma_{ZY}}{\sigma_{XY}}$$

where, σ_i^2 is the dataset variance and σ_{ij} are the dataset covariances







L3

Minimal Flags

	SMAP	SMOS	EN4
v5.0	0.104	0.123	0.079
v6.0	0.104	0.125	0.079

All Flags

	SMAP	SMOS	EN4
v5.0	0.046	0.058	0.043
v6.0	0.046	0.058	0.043

L2

Minimal Flags

	SMAP	SMOS	EN4
v5.0	0.090	0.294	0.065
v6.0	0.110	0.350	0.075
v6.3	0.078	0.242	0.050

All Flags

	SMAP	SMOS	EN4
v5.0	0.053	0.160	0.043
v6.0	0.049	0.147	0.038
v6.3	0.049	0.142	0.035

Triple point matches decreased

Error variance is decreased near the coasts and in most locations in high latitudes

L2 SMAP error for the minimal flag case increases between V5.0-V6.0, then decreases from V6.0-V6.3 likely due to RFI near land.

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