SVDS for SMAP RSS V5.3

and comparisons with SMAP RSS V5.0

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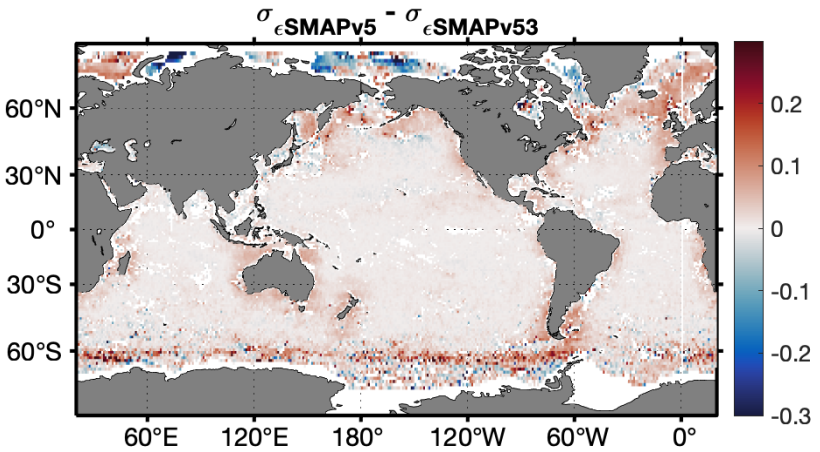
Earth and Space Research



Focus areas

Areas of focus for the preliminary evaluation of SMAP V5.3 are:

- Early Mission Biases
- Biases Depending on Look Direction
- High Latitudes

Analysis period: 4/1/2015-7/31/2023

Flags used for SMAP V5.0 and V5.3 L2 validation

For the L2 validation minimal flags (**bold**) are applied so that the most data can be evaluated

Flag #0: no valid radiometer observation in cell

Flag #1: Problem with OI

Flag #2: Strong land contamination (0.1)

Flag #3: Strong sea ice contamination (0.1)

Flag #4: MLE in SSS retrieval algorithm has not converged

Flag #5: sunglint

Flag #6: moonglint

Flag #7: high reflected galaxy

Flag #8: moderate land contamination (gland > 0.04 or fland > 0.001)

Flag #9: moderate sea ice contamination (gice > 0.003)

Flag #10: high residual of MLE in SSS retrieval algorithm

Flag #11: low SST (5ºC)

Flag #12: high wind speed (>15m/s)

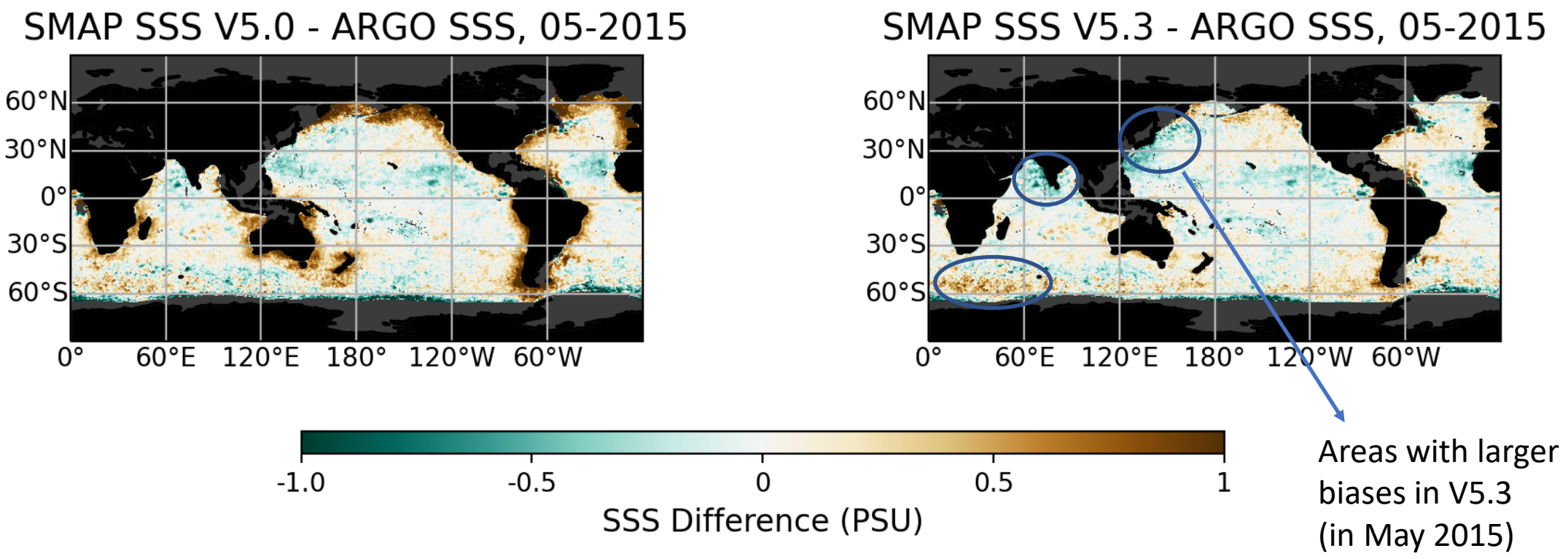
Flag #13: light land contamination (gland > 0.001)

Flag #14: light sea-ice contamination (gice > 0.001)

Flag #15: rain flag IMERG rain-rate exceeds 0.1 mm/h

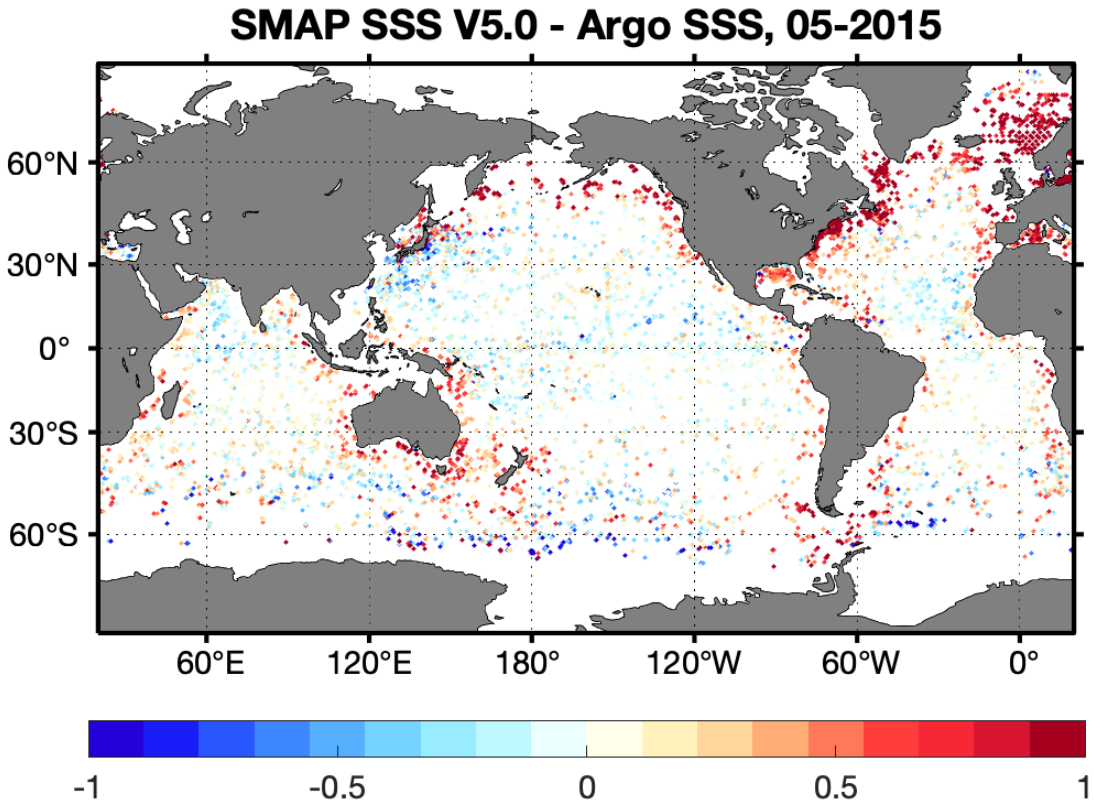
Flag #16: No sea-ice check possible (only available for V5.0)

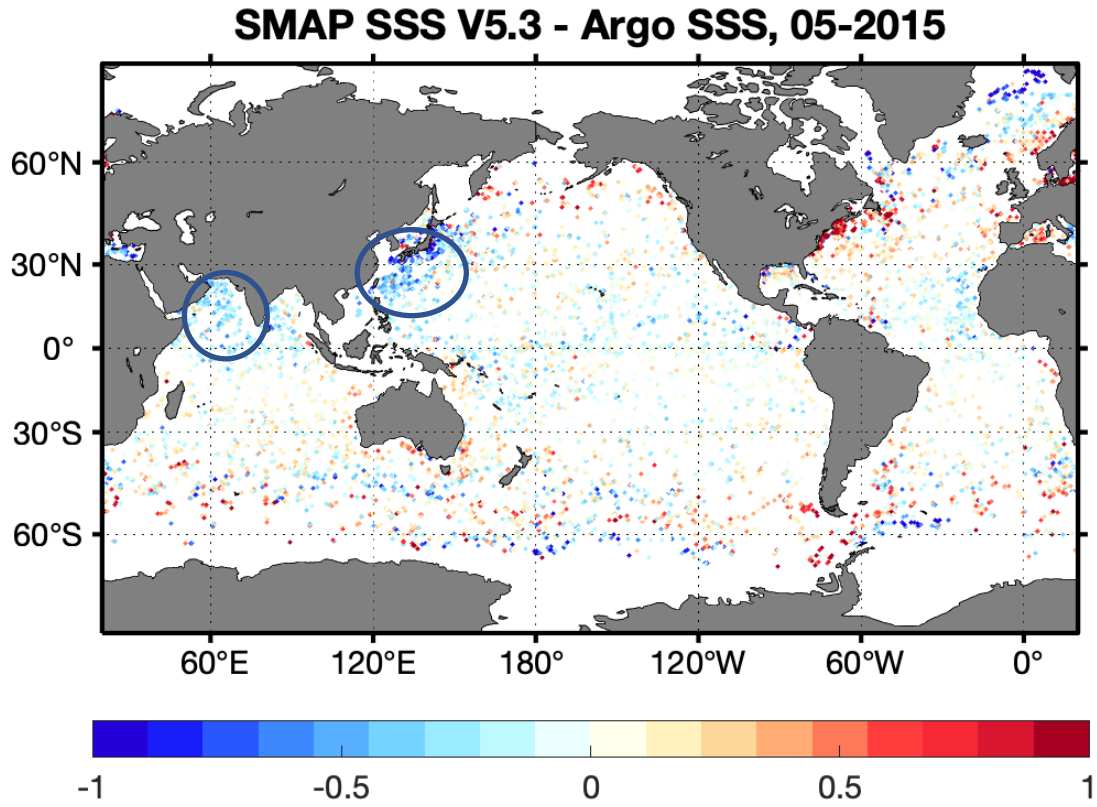
Early Mission Biases



RSS comparisons of SMAP - Argo show decreases in early mission biases in most regions after application of the LR TA offset. A few regions highlighted above show higher biases.

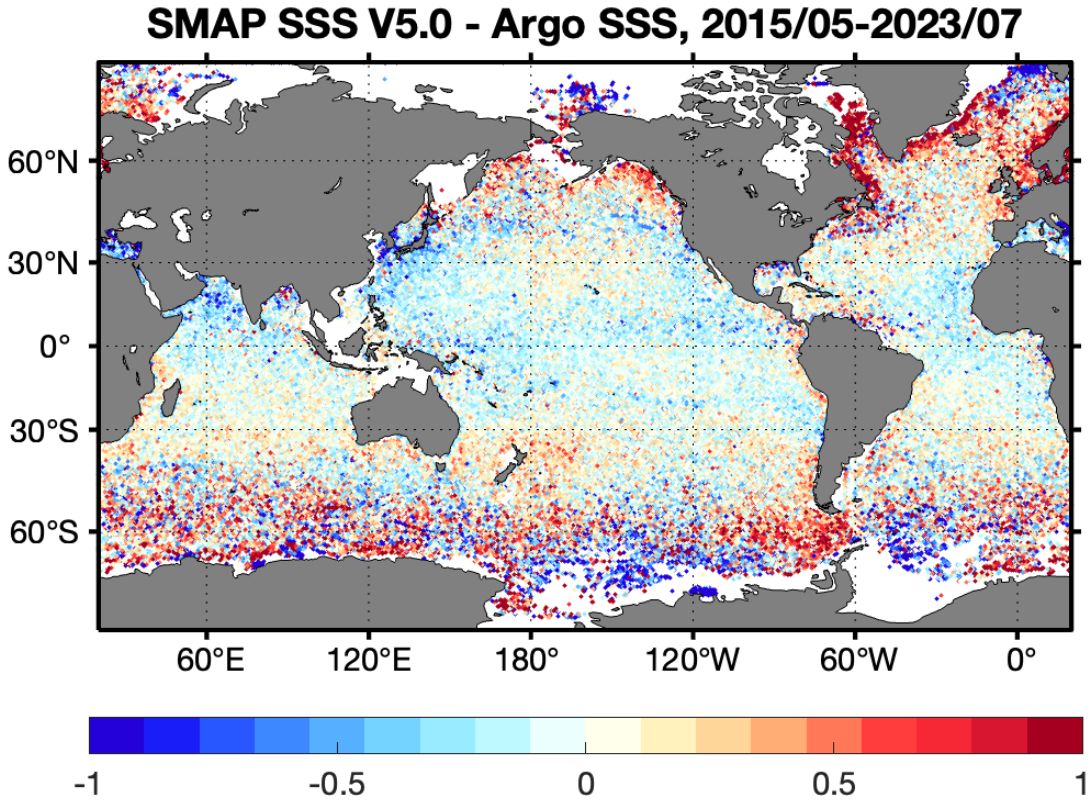
Comparison of L2 SMAP with individual Argo floats May 2015

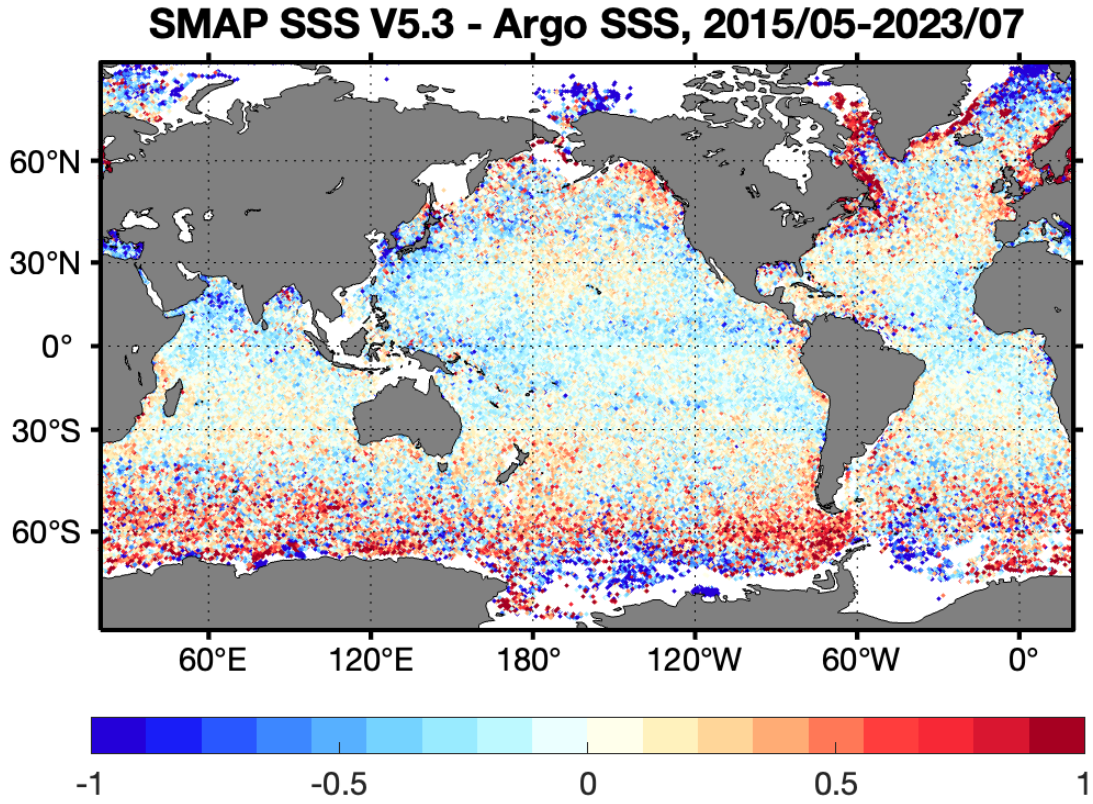




Most areas have lower biases (high latitude and coastal regions) except for near Japan and the Arabian Sea.

Comparison of L2 SMAP with individual Argo floats May 2015 – July 2023

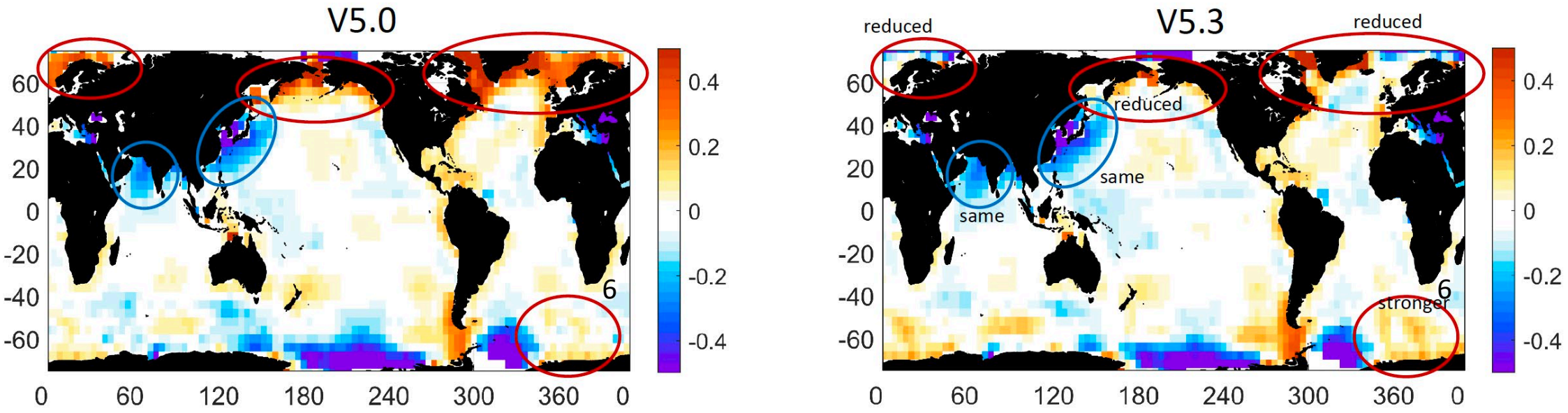




Negative biases near Japan and the Arabian Sea don't show large differences between the two versions when averaging over the whole time period.

Comparison of L3 SMAP

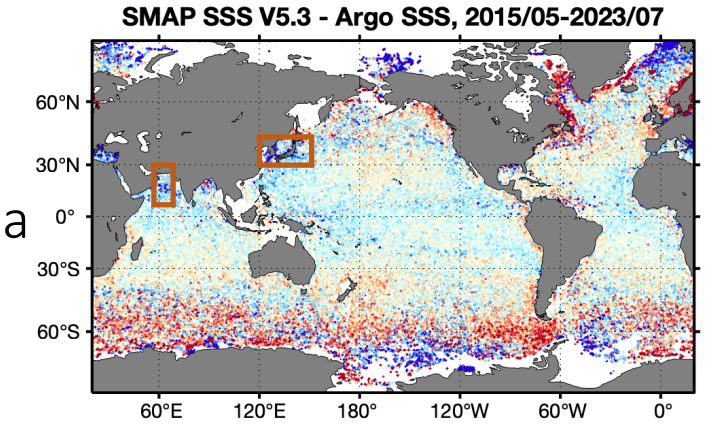
Mean spatial bias



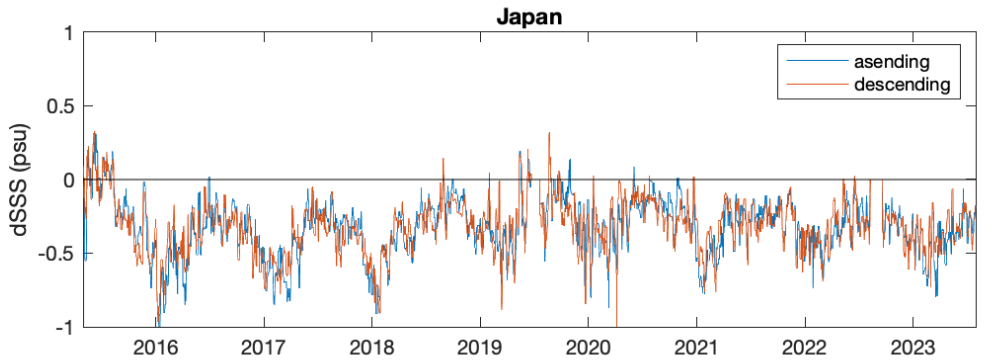
The error statistics are computed in 8-degree spatial bins by comparing Argo buoy measurements (Z<10m) for a given week with SSS values at the same locations obtained by interpolation of the corresponding L3 SSS maps

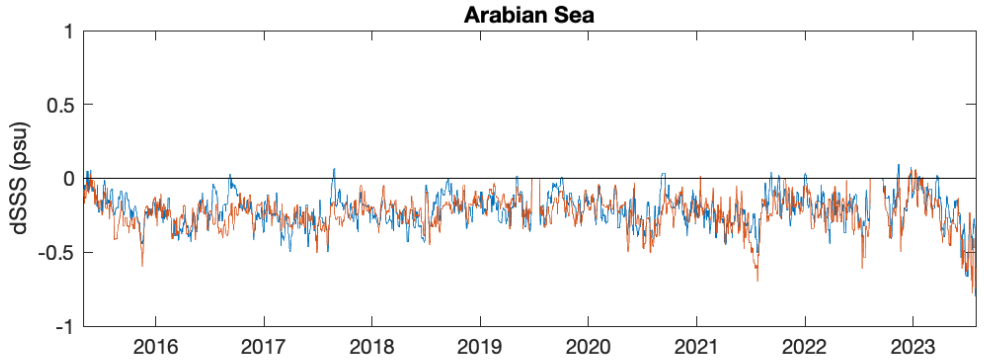
Credit: Oleg Melnichenko

Variations of daily salinity differences
SMAP L2 SSS – Argo SSS averaged over Japan and Arabian Sea

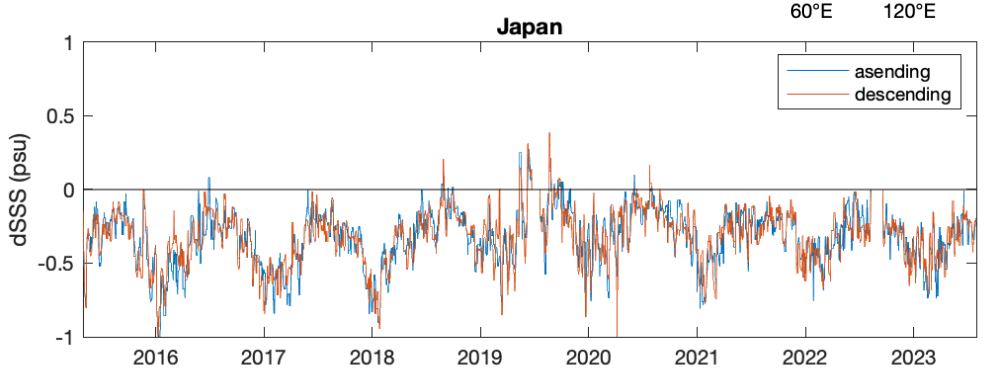


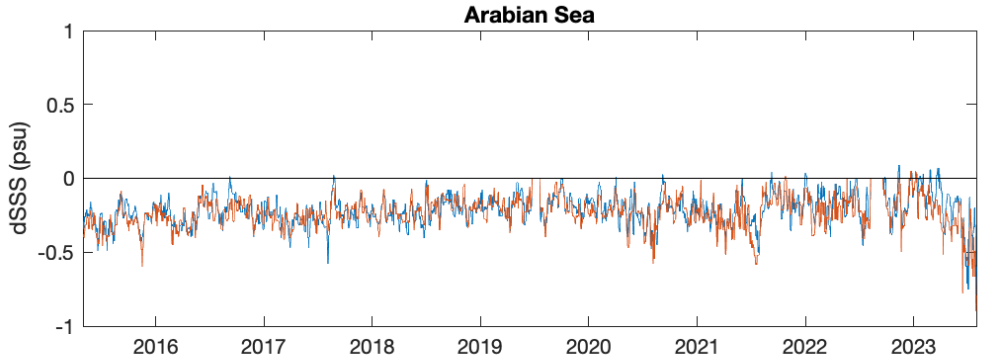
V5.0





V5.3





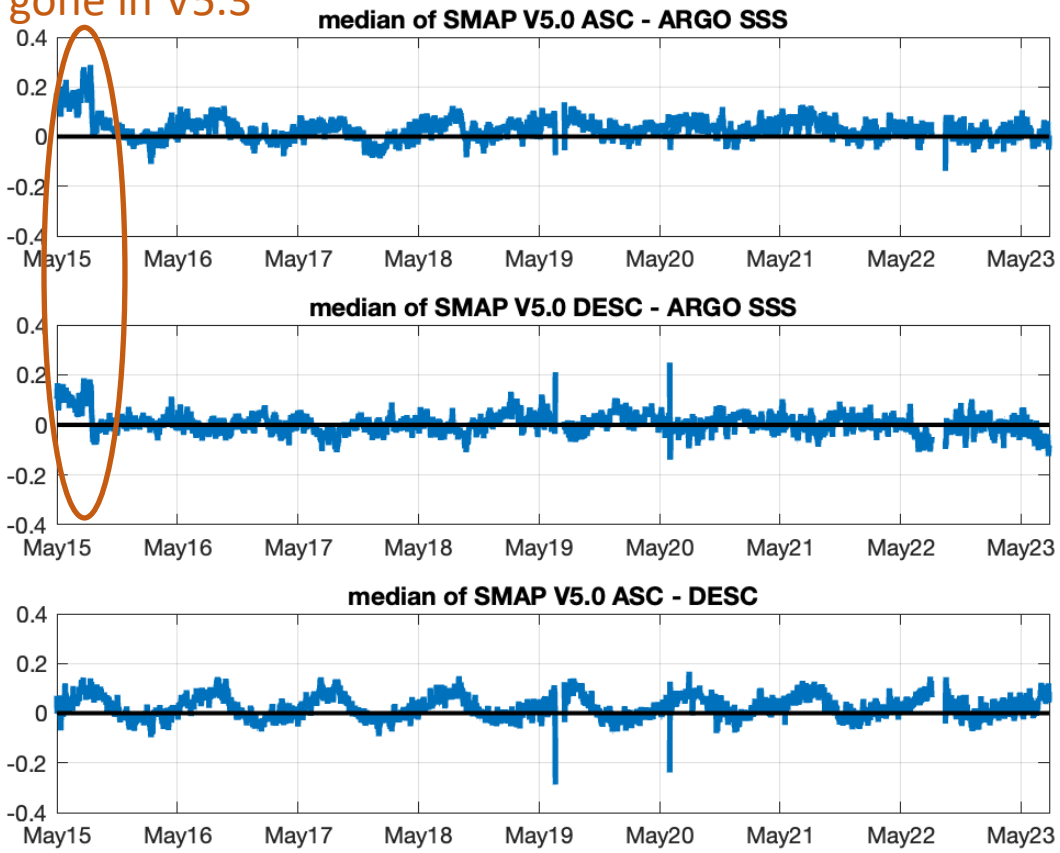
L2 salinity differences over Japan and the Arabian Sea show little difference between V5.0 and V5.3 with both having negative biases. Small biases in V5.0 during the beginning of the mission are likely a combination of biases from different sources.

Biases Depending on Look Direction

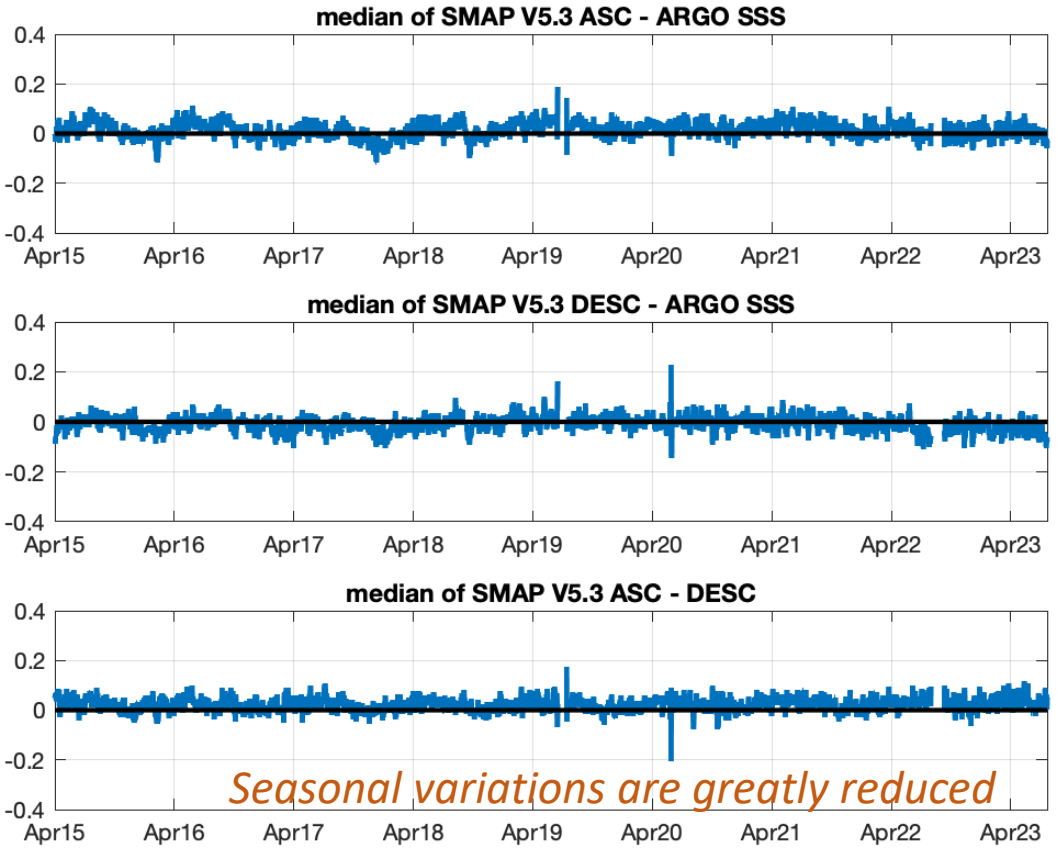
Time series of daily global mean dSSS (SMAP SSS – ARGO SSS)

Positive biases are gone in V5.3

V5.0



V5.3



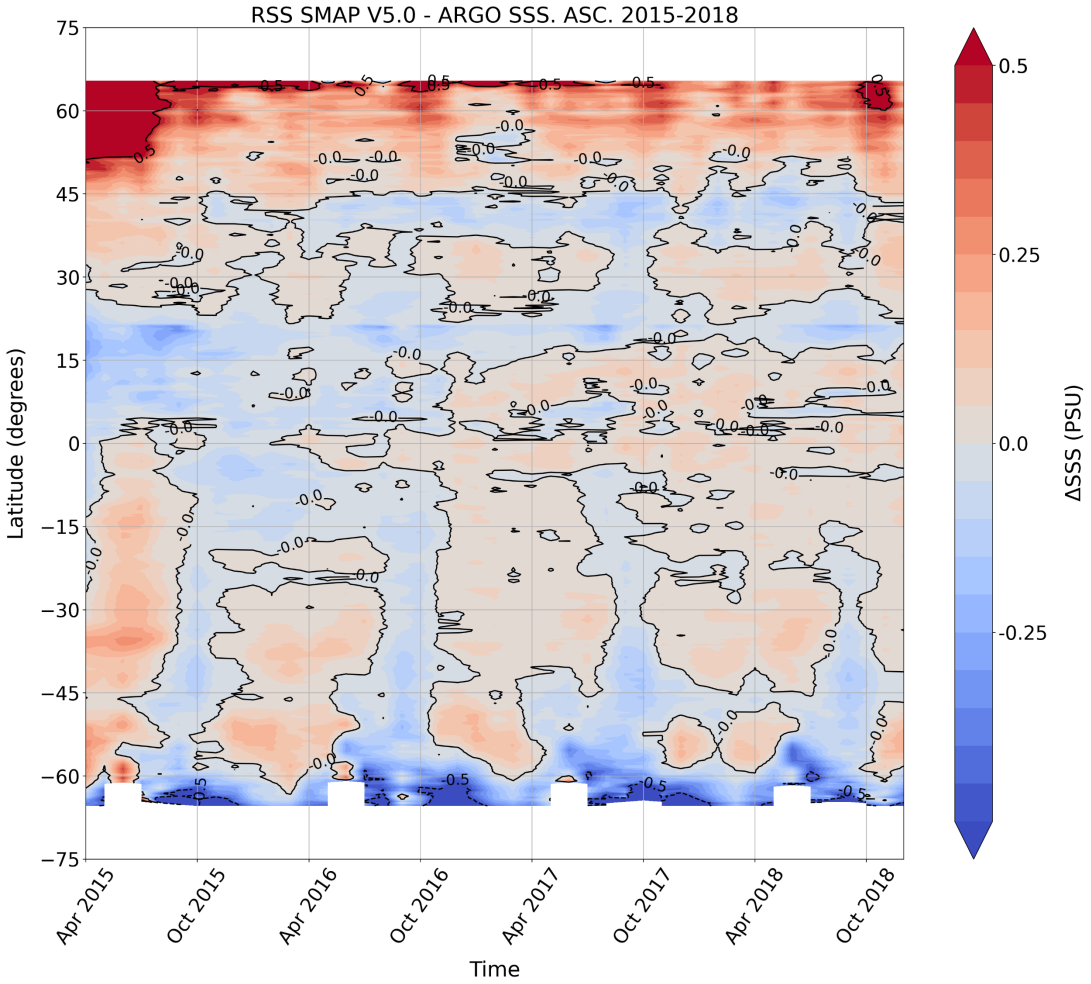
Positive salinity biases during the early mission are removed. The seasonal cycles between ascending and descending are also greatly reduced.

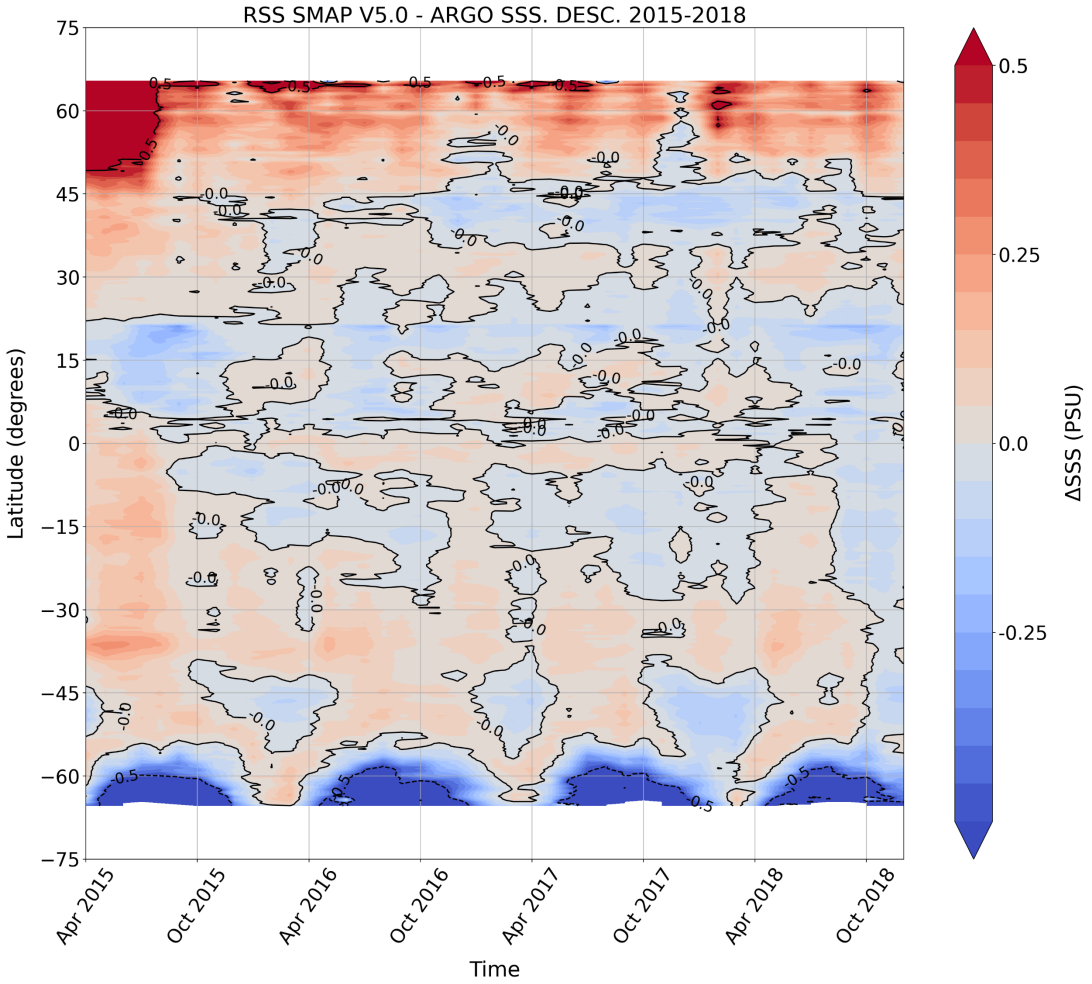
RSS remaining SSS biases 2015-2018 averaged over look direction

Remote Sensing Systems

ascending

descending

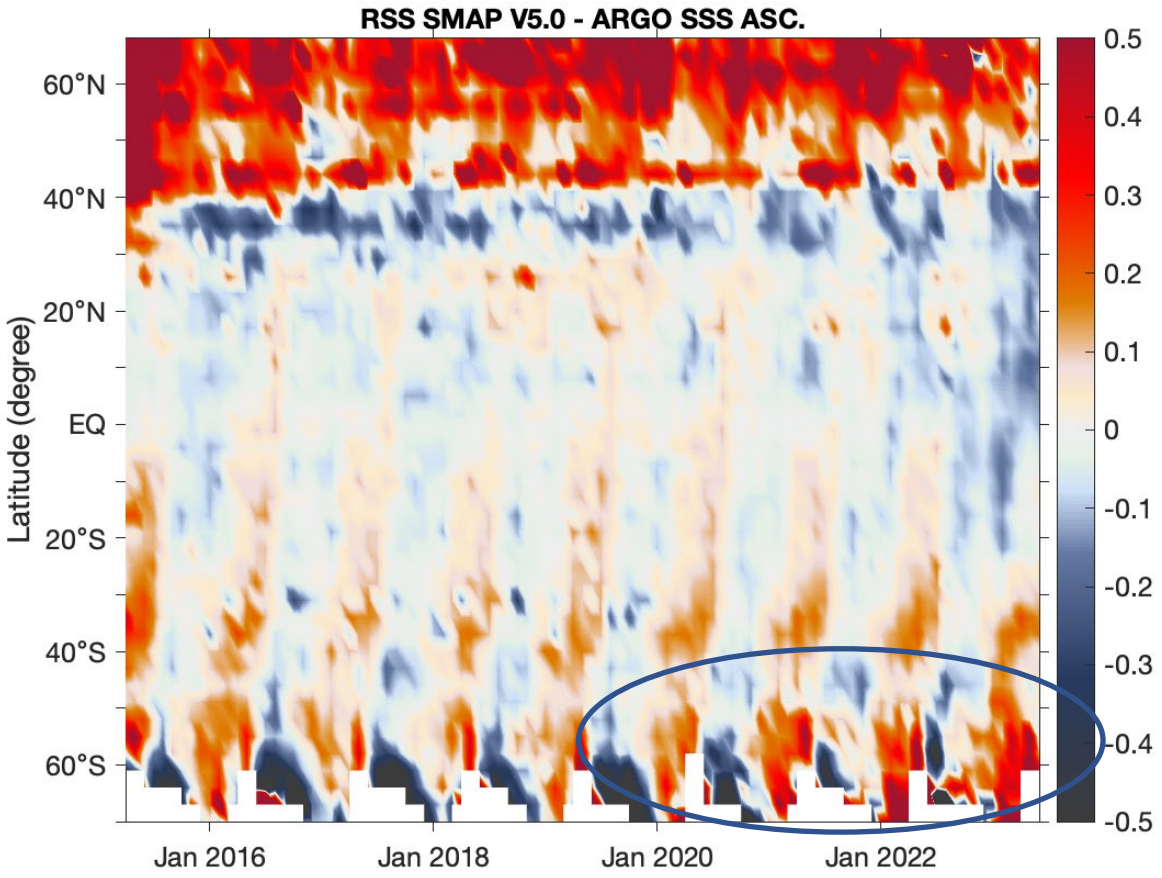


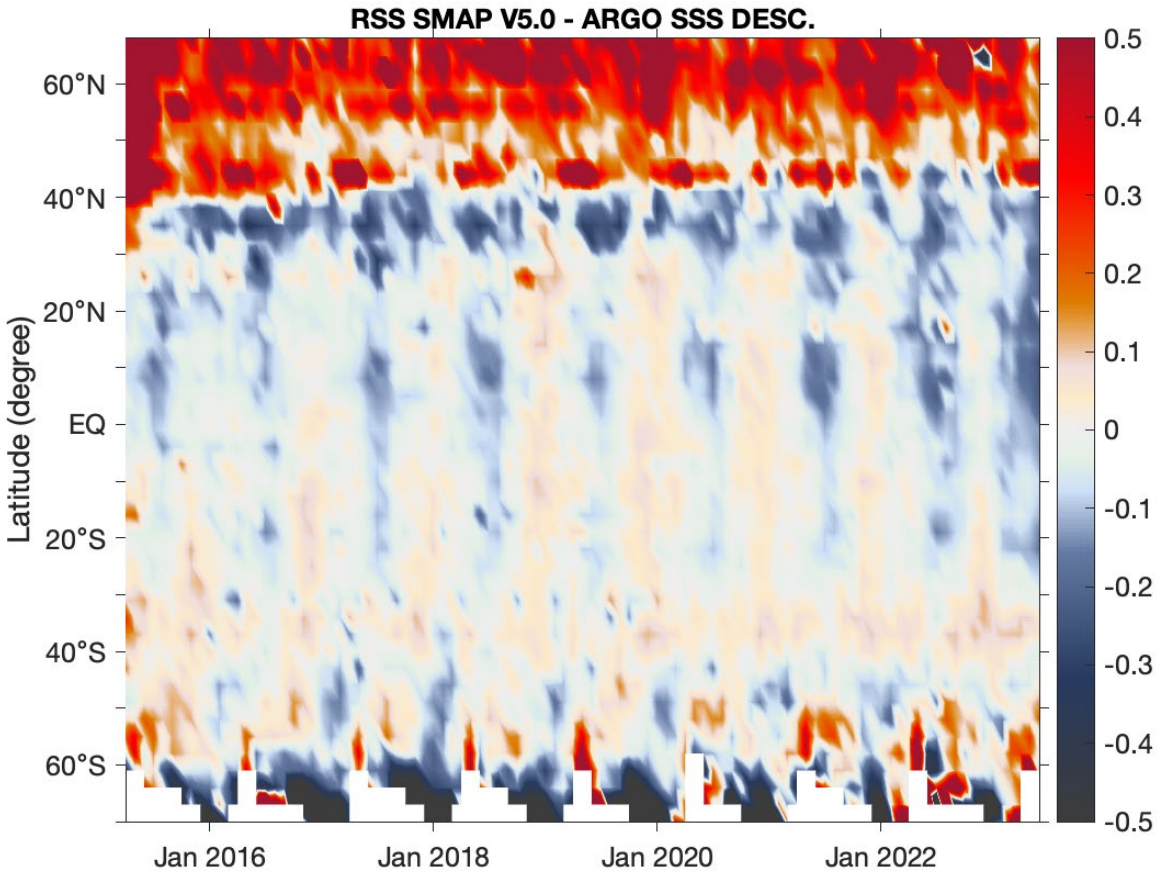


ESR remaining SSS biases
2015-2023 averaged over look direction

ascending

descending





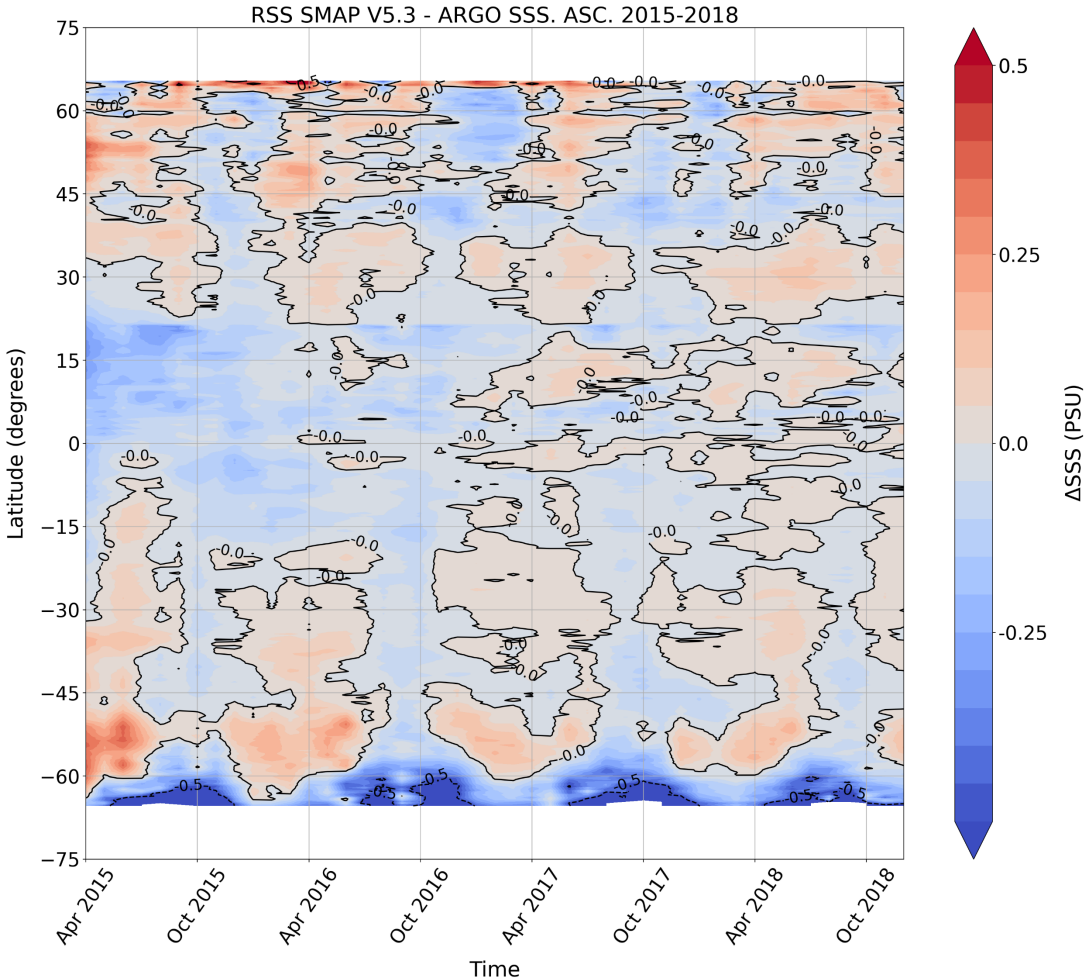
Positive biases increase in Southern Ocean (~60˚S) after 2020, especially along ascending orbits.

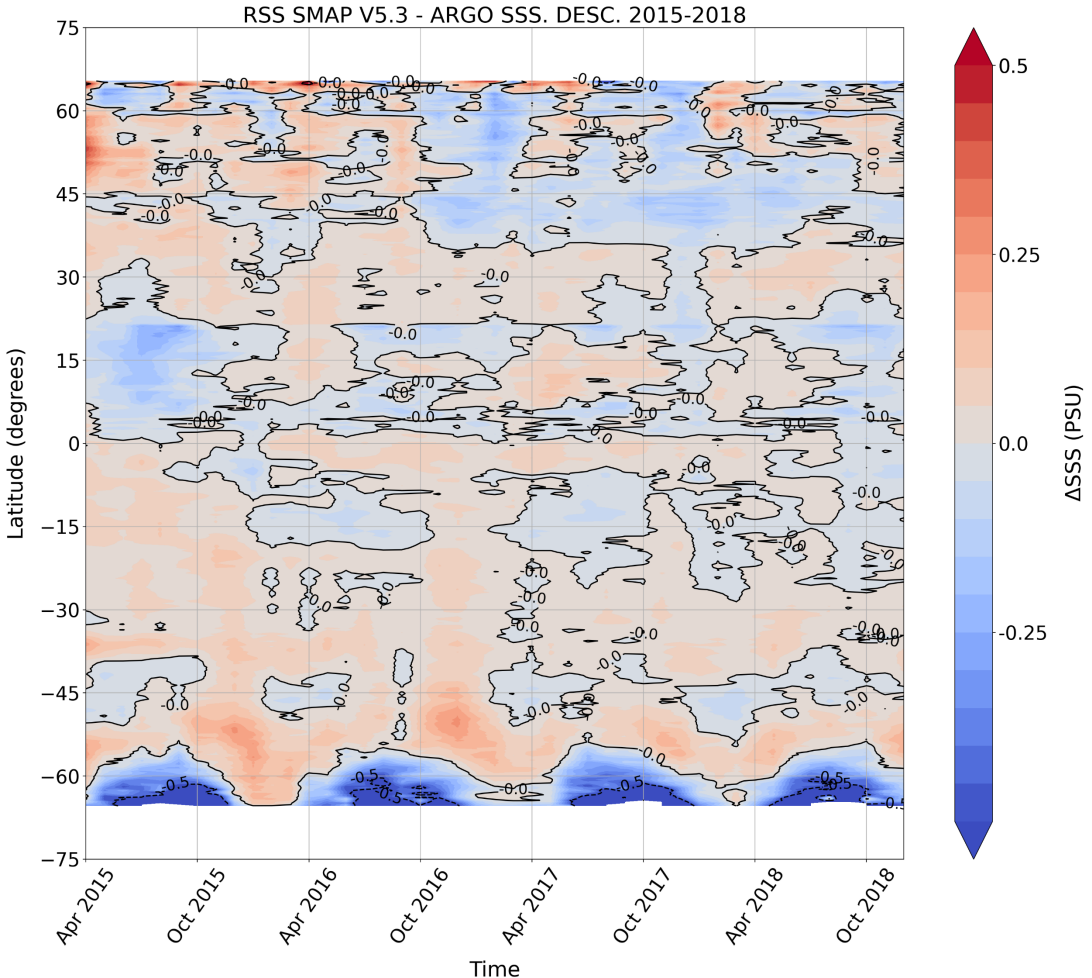
RSS remaining SSS biases after adjusting thermal model for reflector 2015-2018 averaged over look direction

Remote Sensing Systems

ascending

descending



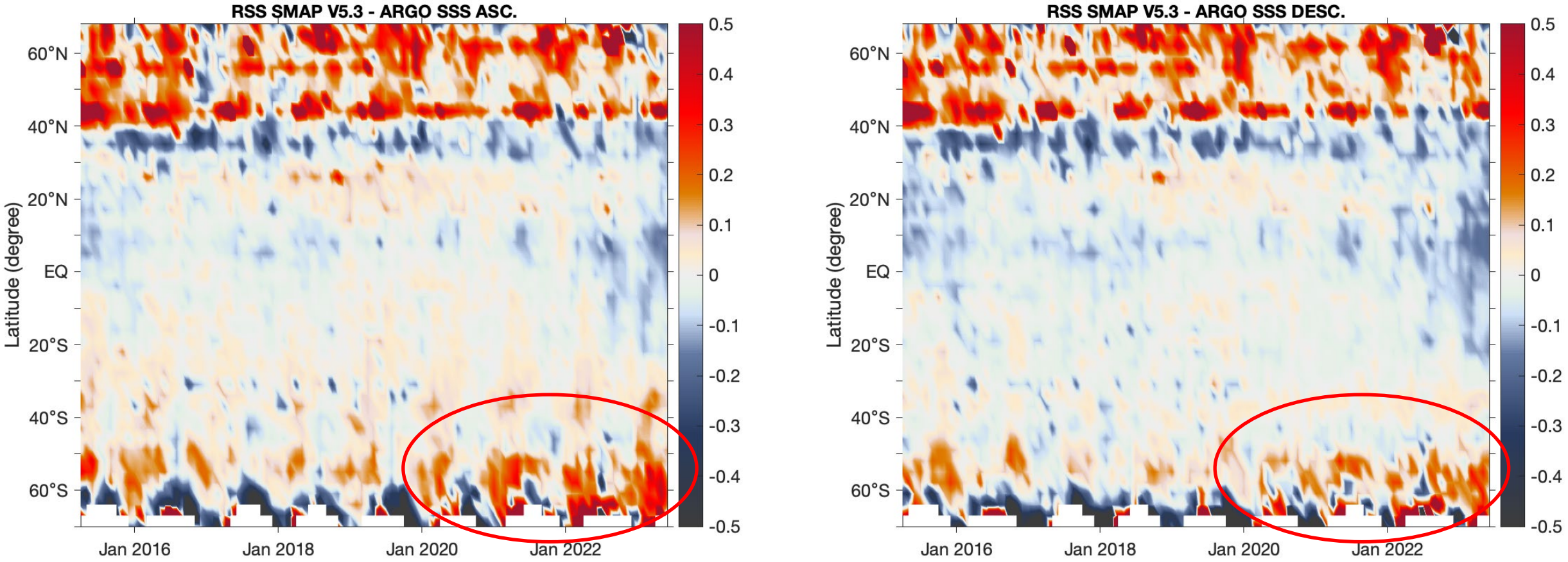


ESR remaining SSS biases V5.3

2015-2023 averaged over look direction

ascending

descending

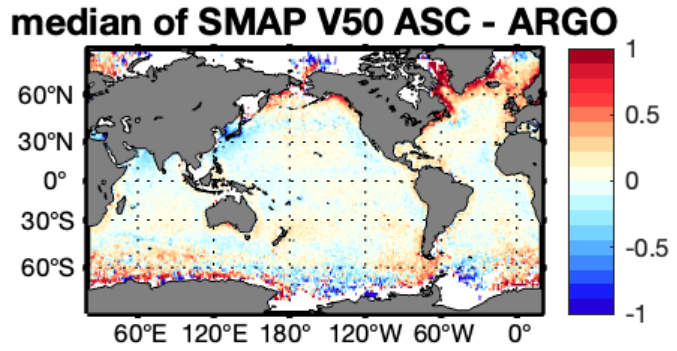


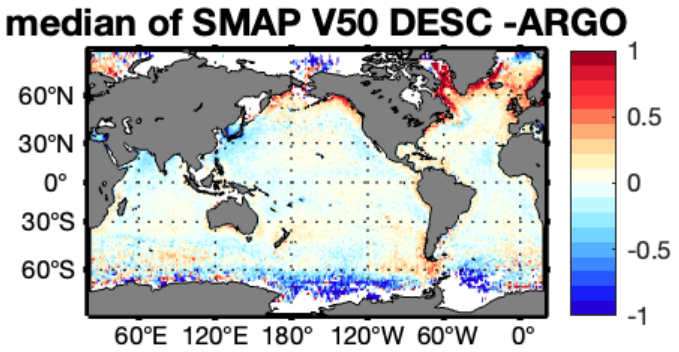
Biases at high latitude are greatly reduced, but positive biases are still observed in Southern Ocean (~60˚S) after 2020 and are larger in V5.3 along descending orbits.

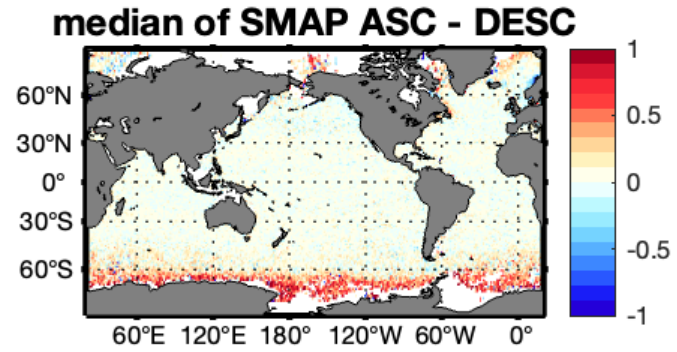
Salinity differences between SMAP SSS and Argo floats averaged near each grid cell

- Smaller ascending and descending differences in V5.3 higher than 60˚S
- Larger positive values around 60˚S along descending orbits.

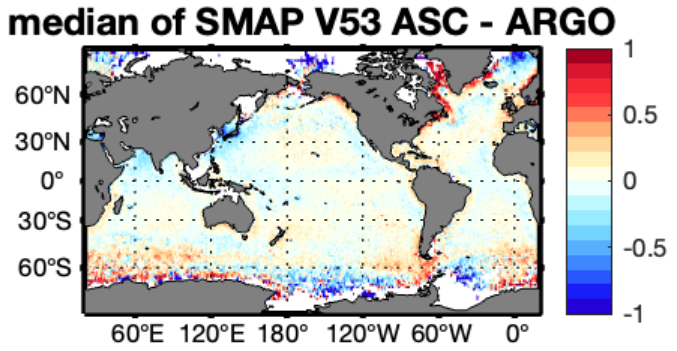
V5.0

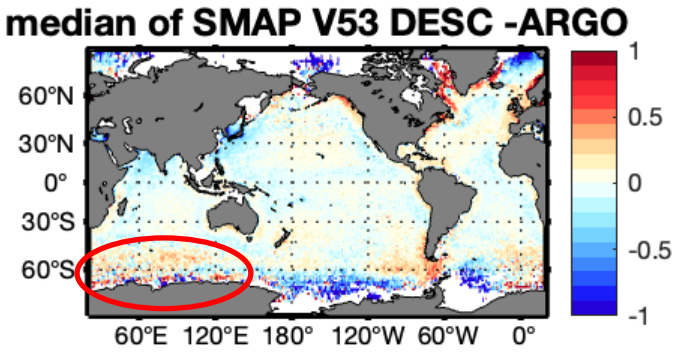


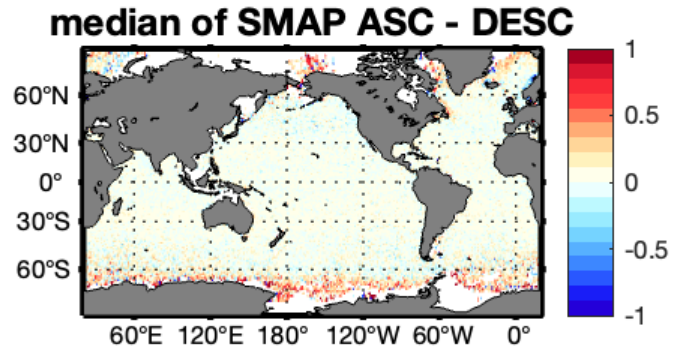




V5.3





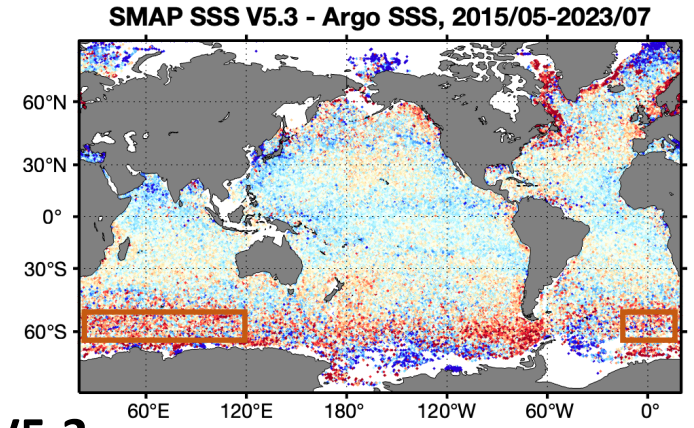


High Latitudes

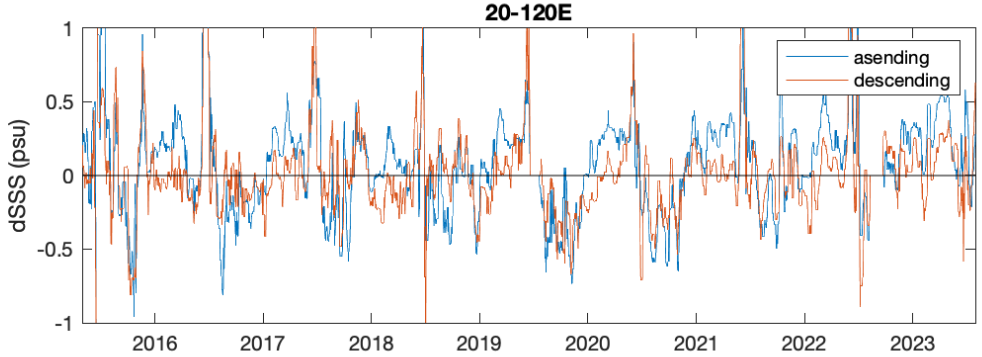
- Improvements in the Northern Hemisphere

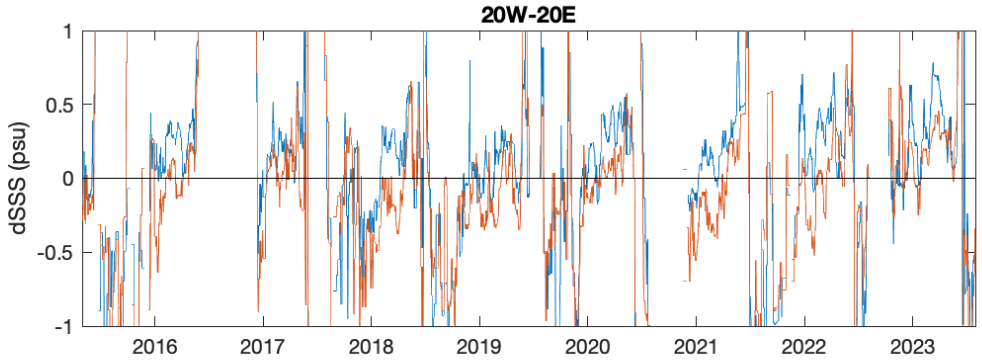
- Problems in the Southern Ocean (60˚S)
  - The look early mission and look direction bias analyses show that V5.3 has larger biases than V5.0 during certain periods at certain region in the Southern Ocean.
  - The positive biases in the Southern Ocean tend to increase after 2020.
  - Next slide shows the time variation of salinity differences in the Southern Ocean (averaged between 55˚S - 65˚S) in different basins.

Daily salinity difference variations (SMAP L2 SSS – Argo SSS) with two week running window averaged over Southern Ocean regions (20E-120E) and (20W-20E)

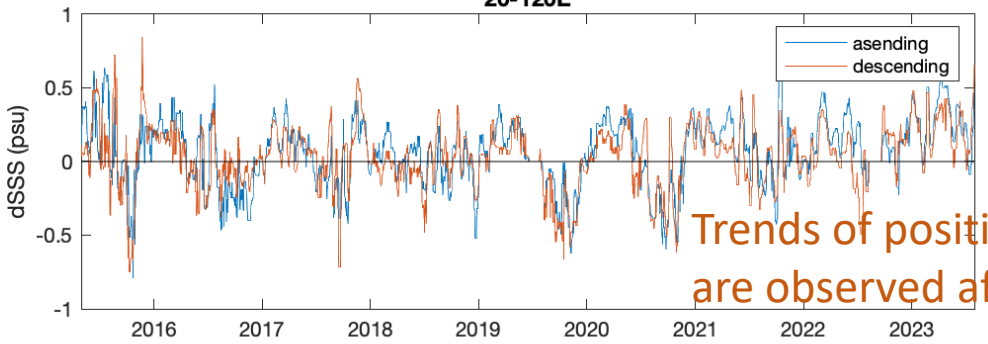


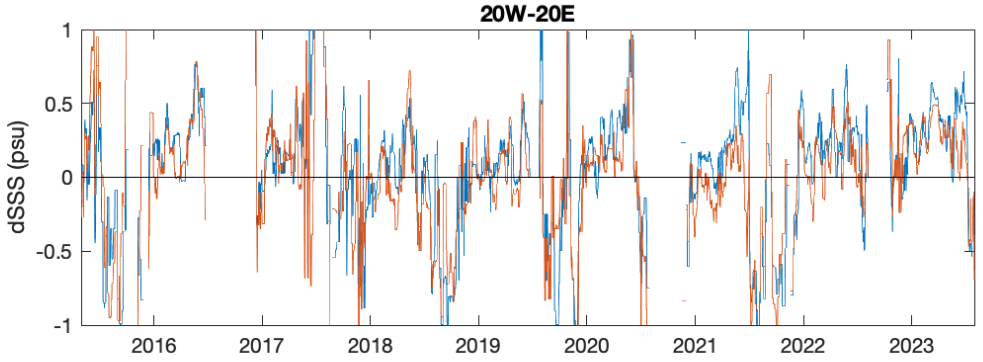
V5.0





V5.3



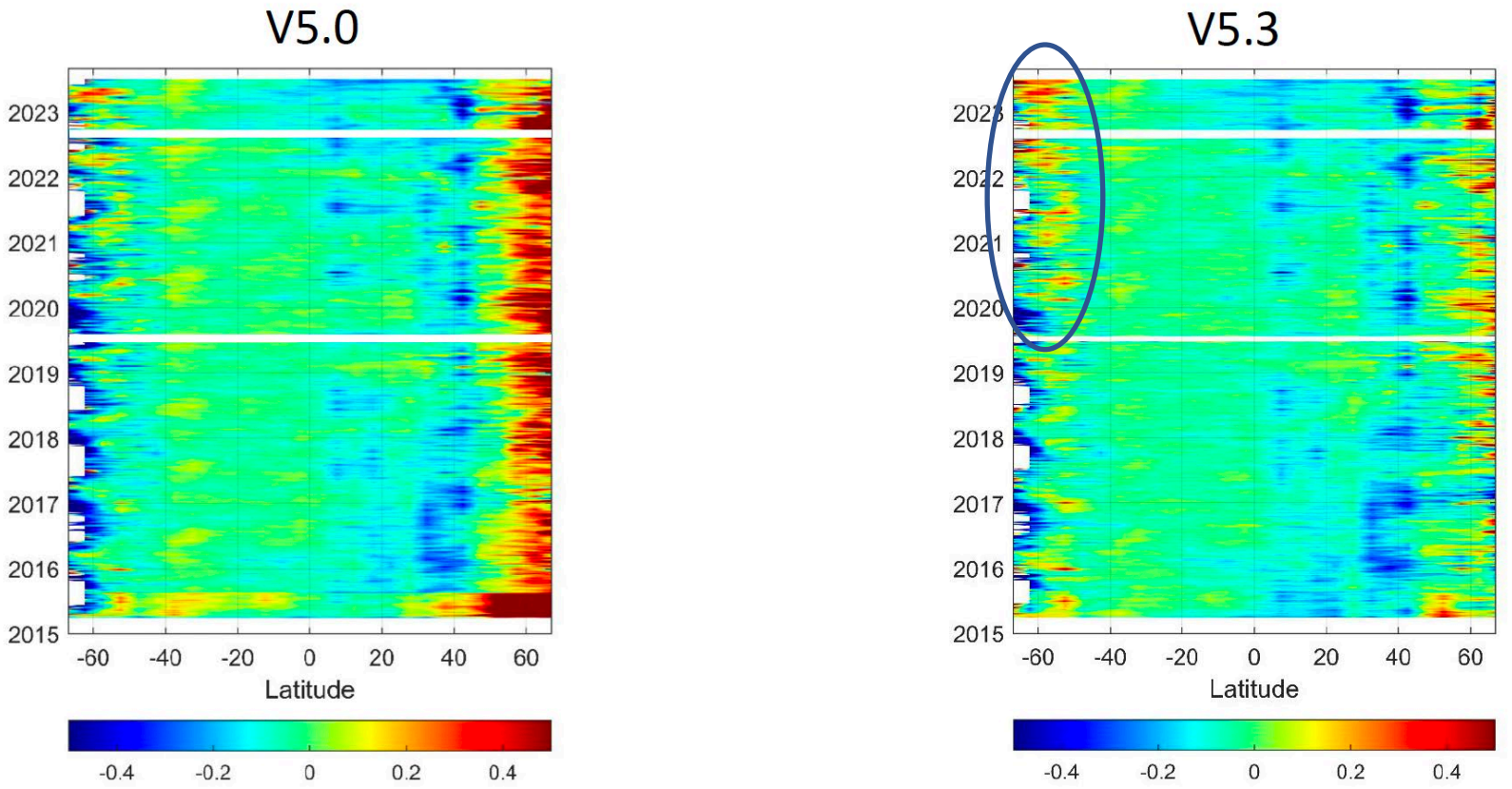


Trends of positive biases are observed after 2020

L2 validation shows that large noise is still observed in V5.3, but that overall anomalous values decrease in V5.3 over the Southern Ocean.

L3 SMAP

Zonally averaged biases



- L3 validation confirms positive biases that were seen in L2 look direction analysis.
- Biases increase after 2020 around 60˚S.

Latitude-time distribution of the zonally averaged differences between weekly L3 SSS maps and the corresponding Argo buoy data. The error statistics were computed by comparing Argo buoy observations for a given week with SSS values at the same locations obtained by interpolation of the corresponding SSS maps. The zonally averaged biases were computed by averaging these statistics over 5-degree latitude bands.

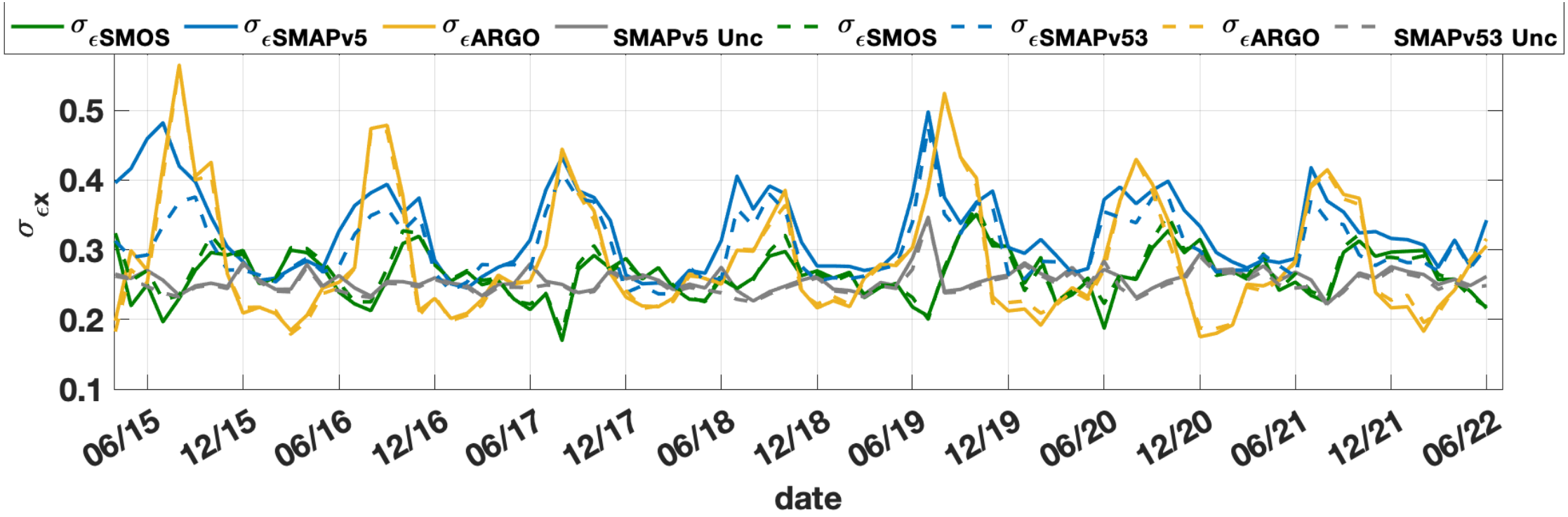
Credit: Oleg Melnichenko

L3 Triple Collocation Analysis

Monthly unscaled error variance

L3 triple collocation analysis

V5.0 (solid blue) and V5.3 (dashed blue)

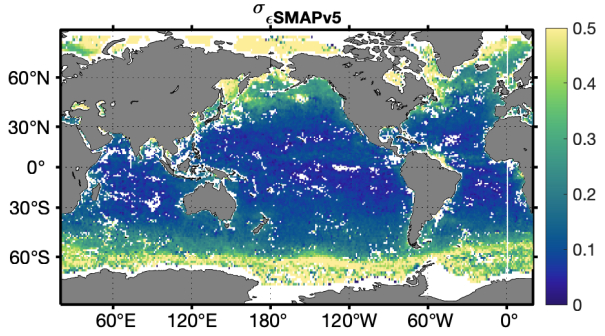


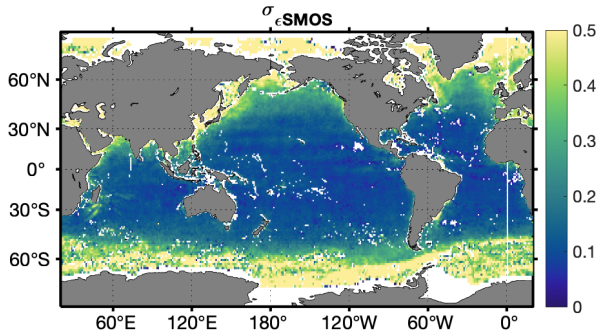
Positive bias at the beginning of the mission is removed and SMAP seasonal bias is reduced.

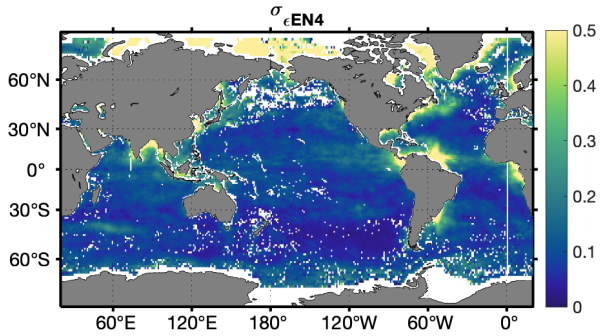
Temporally averaged monthly unscaled error variance

L3 triple collocation analysis

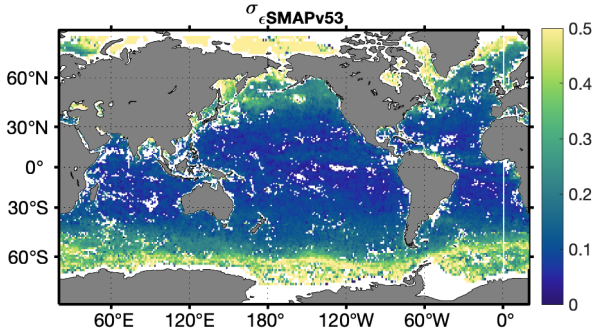
V5.0

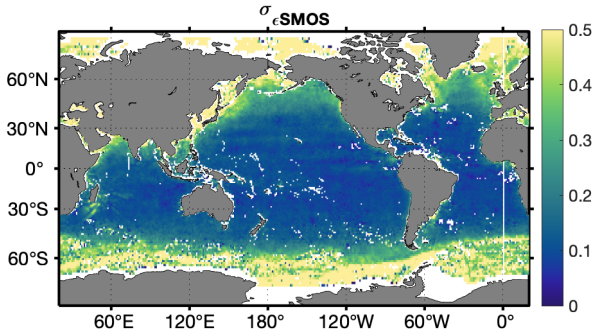


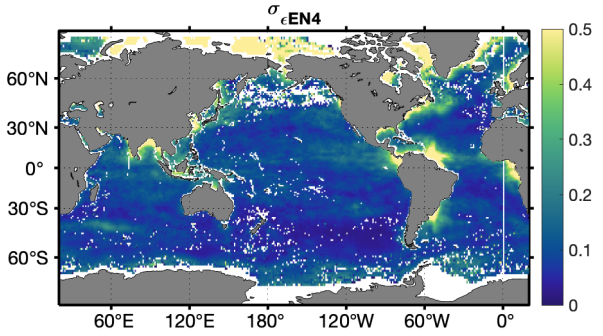




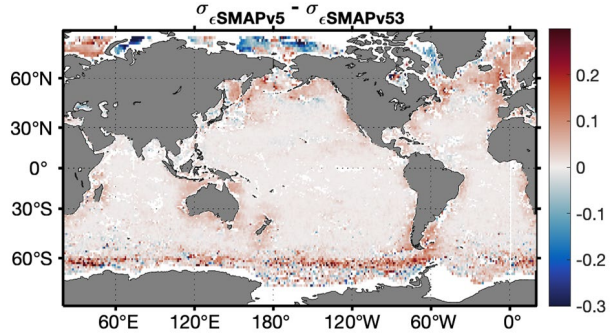
V5.3







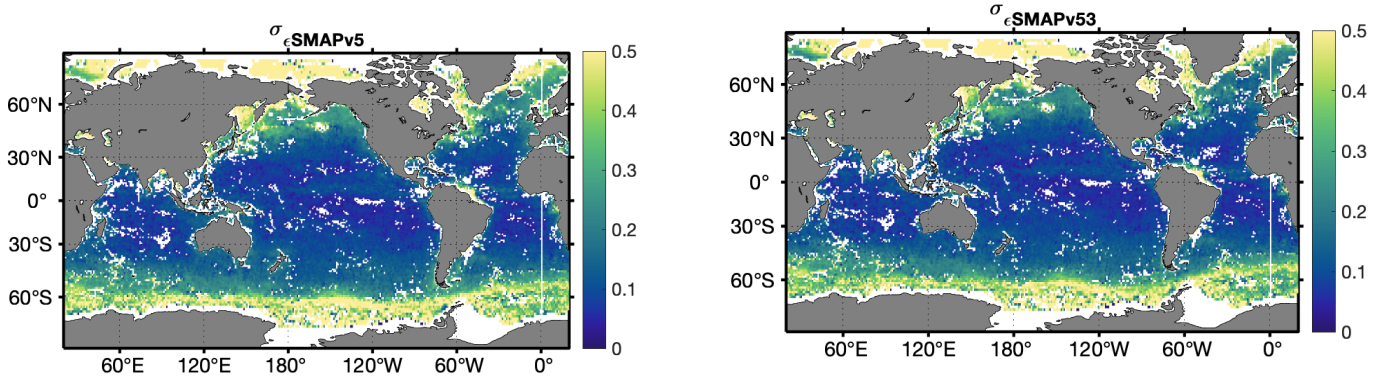
V5.0- V5.3



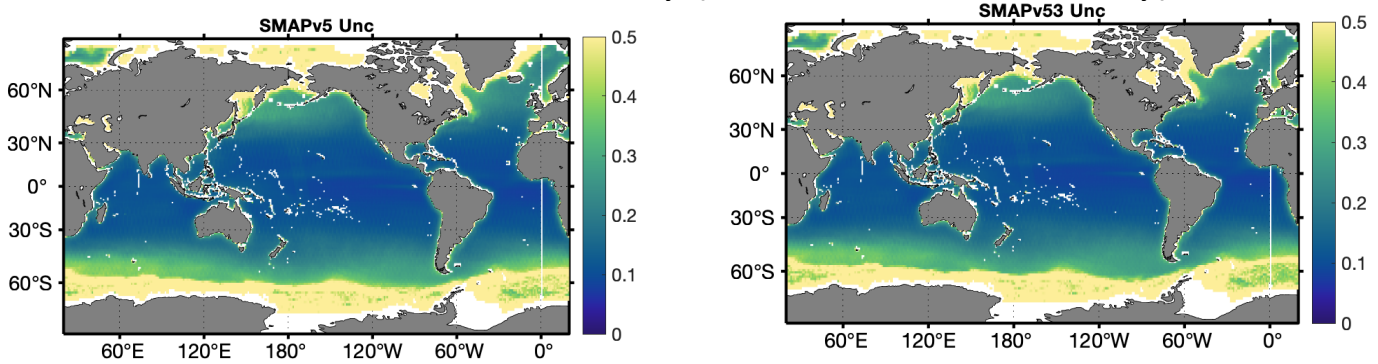
- Error variance is decreased near the coasts
- In the Northern Hemisphere high latitudes, error variance decreases in most locations, but increases slightly in the Lara Sea, Chukchi Sea, and Baffin Bay
- In the Southern Hemisphere high latitudes, the error variance decreases

L3 Error Sources

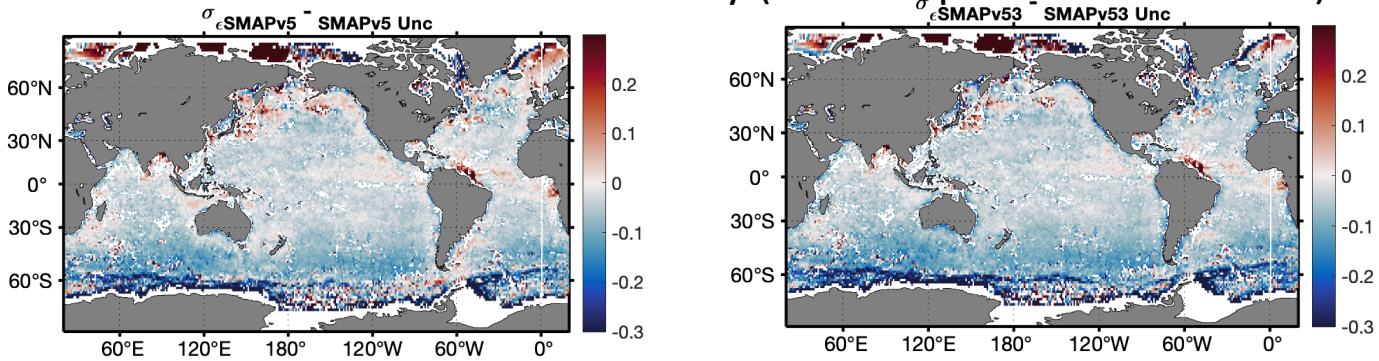
TCA monthly unscaled error variance



SMAP uncertainty (instrument uncertainty)



TCA error - SMAP uncertainty (SMAP representation errors)



L3 triple point collocation analysis

area weighted, globally averaged, unscaled error variance

Minimal Flags

	SMAP	SMOS	EN4
v5.0	0.100	0.121	0.078
v5.3	0.093	0.122	0.078

When minimal flags are applied, SMAP error is decreased by 0.007 in V5.3. SMOS error increases slightly, by 0.001 while Argo error remains unchanged.

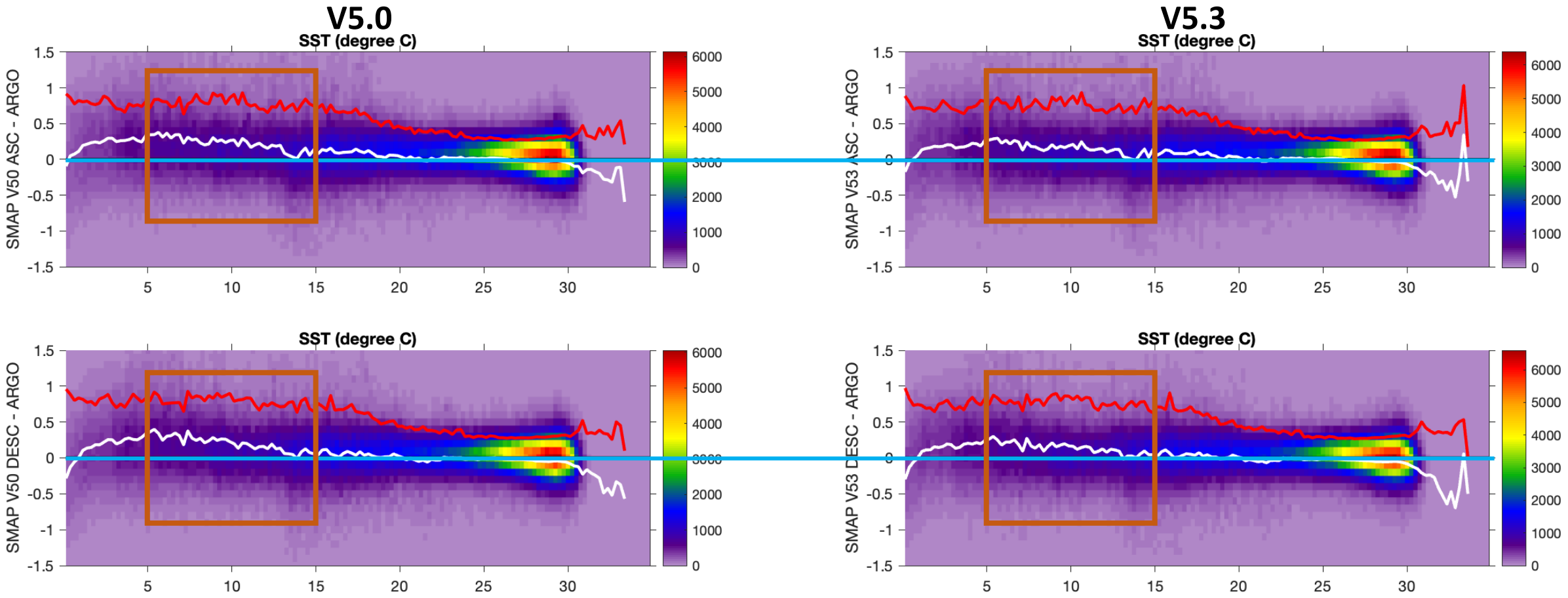
All Flags

	SMAP	SMOS	EN4
v5.0	0.044	0.057	0.043
v5.3	0.041	0.057	0.043

When all flags are applied, SMAP error is decreased by 0.003 in V5.3. SMOS and Argo error remain the same.

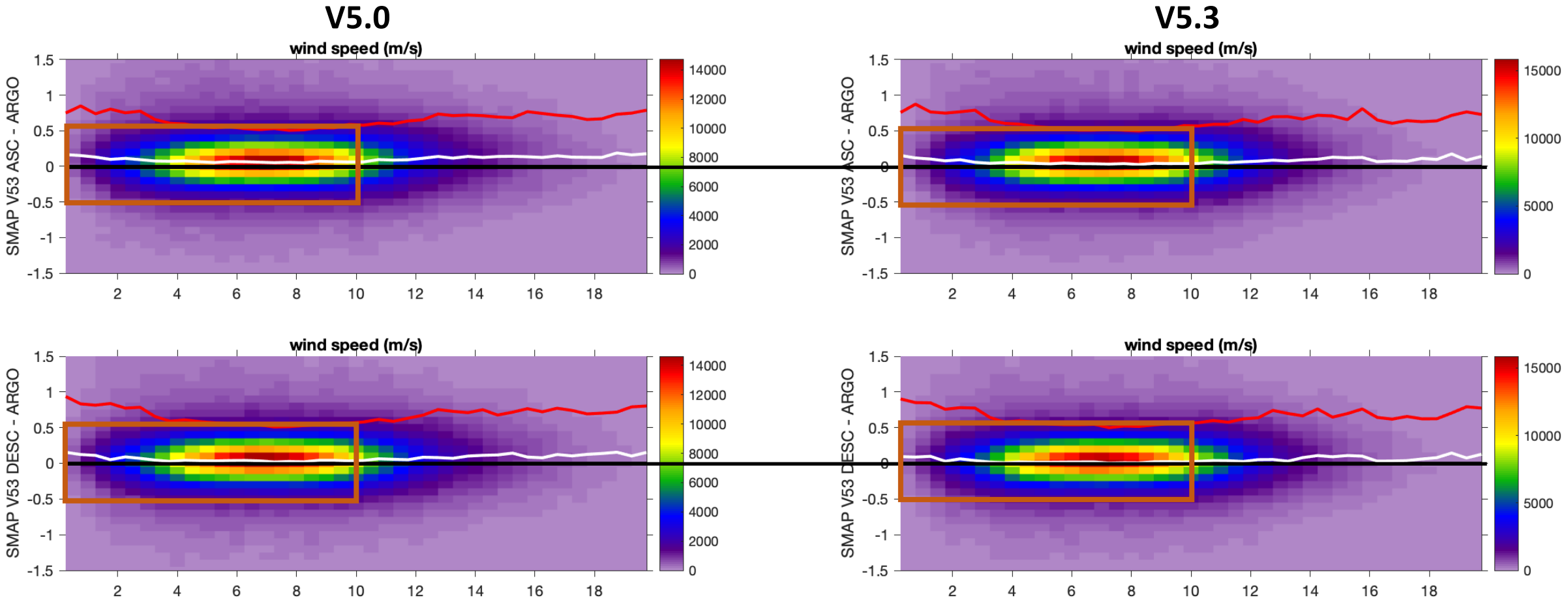
Sensitivity Tests

Sensitivity test with SST



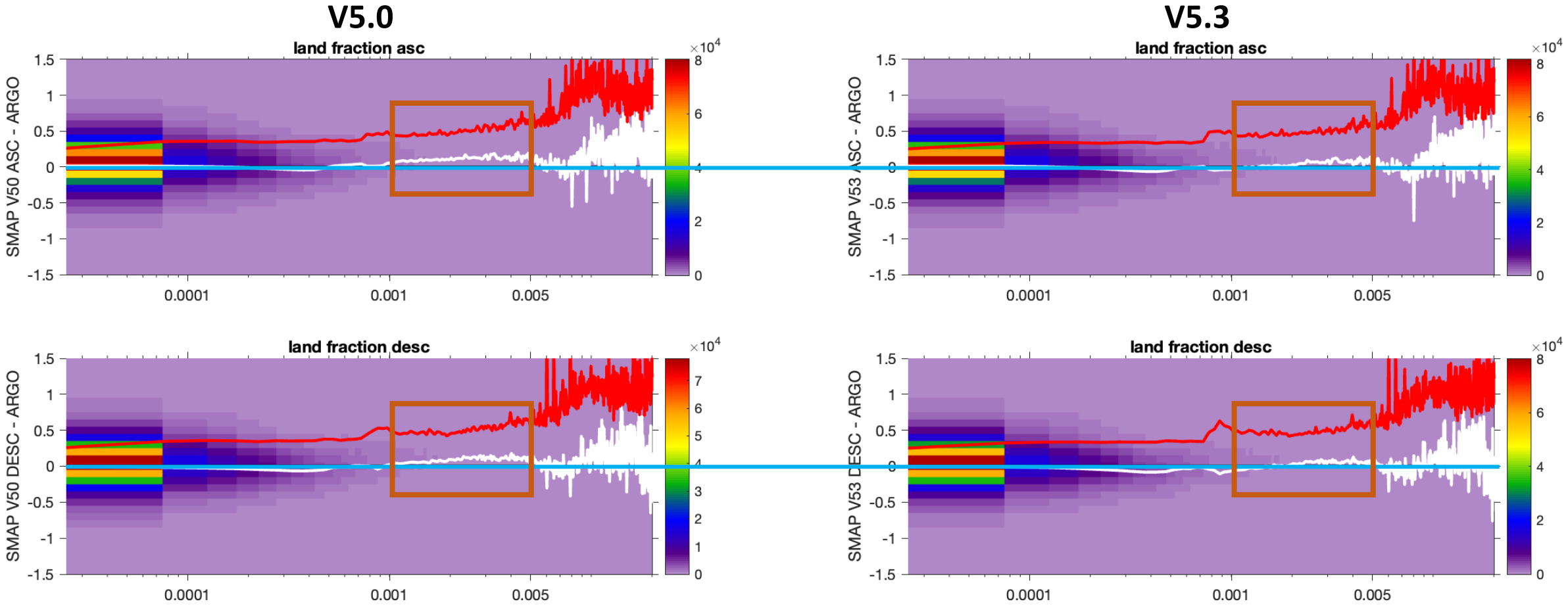
Salinity differences are slightly lower when SST is between 5-15˚C suggesting that V5.3 is an improvement in the high latitudes (cold water regions).

Sensitivity test with wind speed



Salinity differences are slightly lower when wind speed is between 0 and 10 m/s suggesting that V5.3 improve at low wind speed.

Sensitivity test with land fraction



Salinity differences are slightly lower when land fraction is between 0.001 and 0.005 suggesting that V5.3 improve near the coastal regions.

Summary

- Early Mission Biases
  - Biases in the early mission are reduced in V5.3
- Biases Depending on Look Direction
  - The seasonal cycles between ascending and descending are also greatly reduced
- High Latitudes
  - Biases are reduced in Northern Hemisphere in V5.3 except in a few regions of the Arctic
  - Positive biases in Southern Ocean increases after 2020