

Comparison of Aquarius sea surface salinity with Argo near-surface salinity

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Collocation of Aquarius level-2 SSS and Argo near-surface salinity

- 26,605 delayed mode profiles in 15 months

10,823 of these were inside one of the three beam footprints within +/-24h of acquisition.

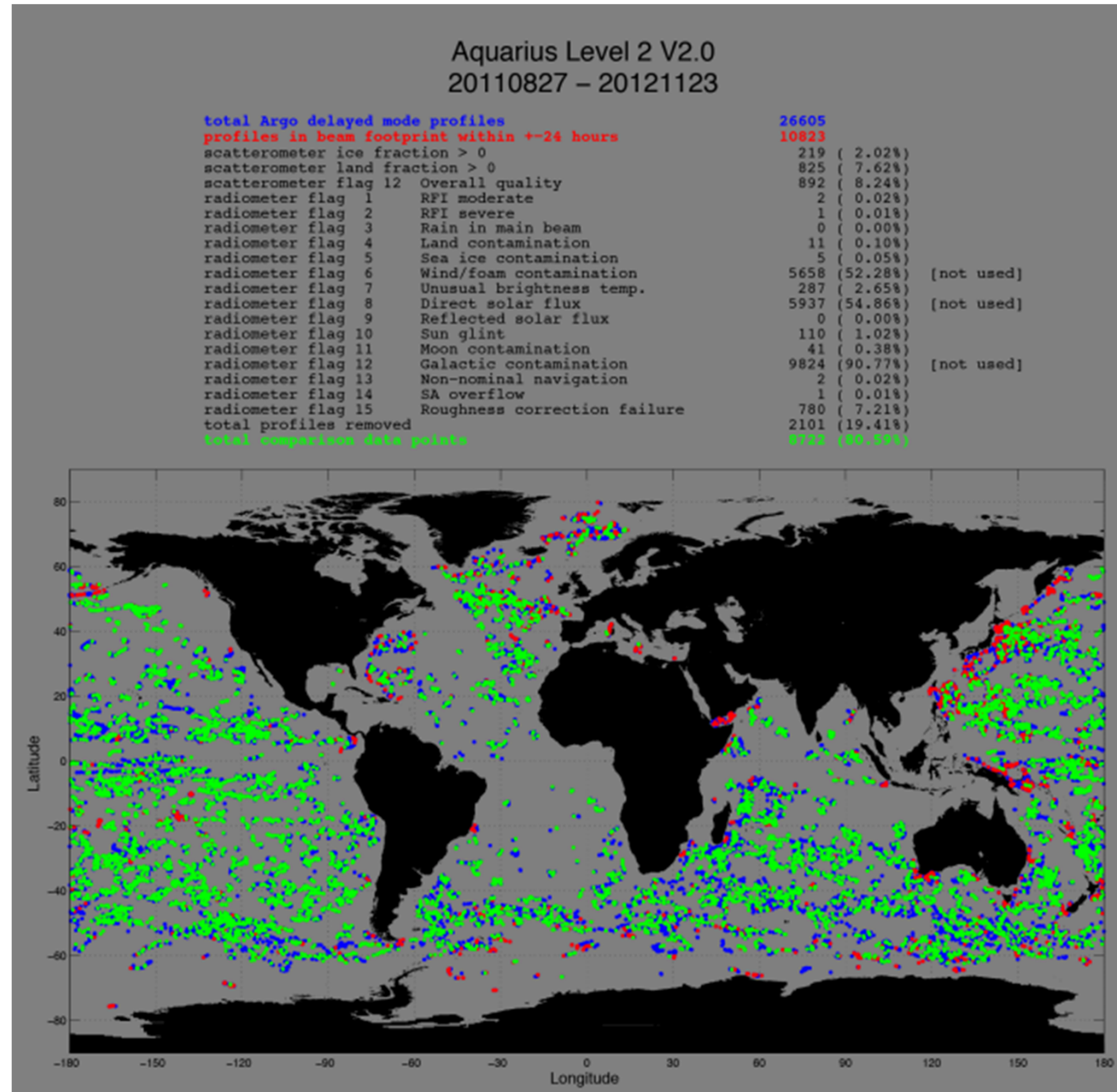
About 20% of these removed for flags, leaving 8722 collocated data pairs for analysis.

- Only delayed mode data with no QC flags used.

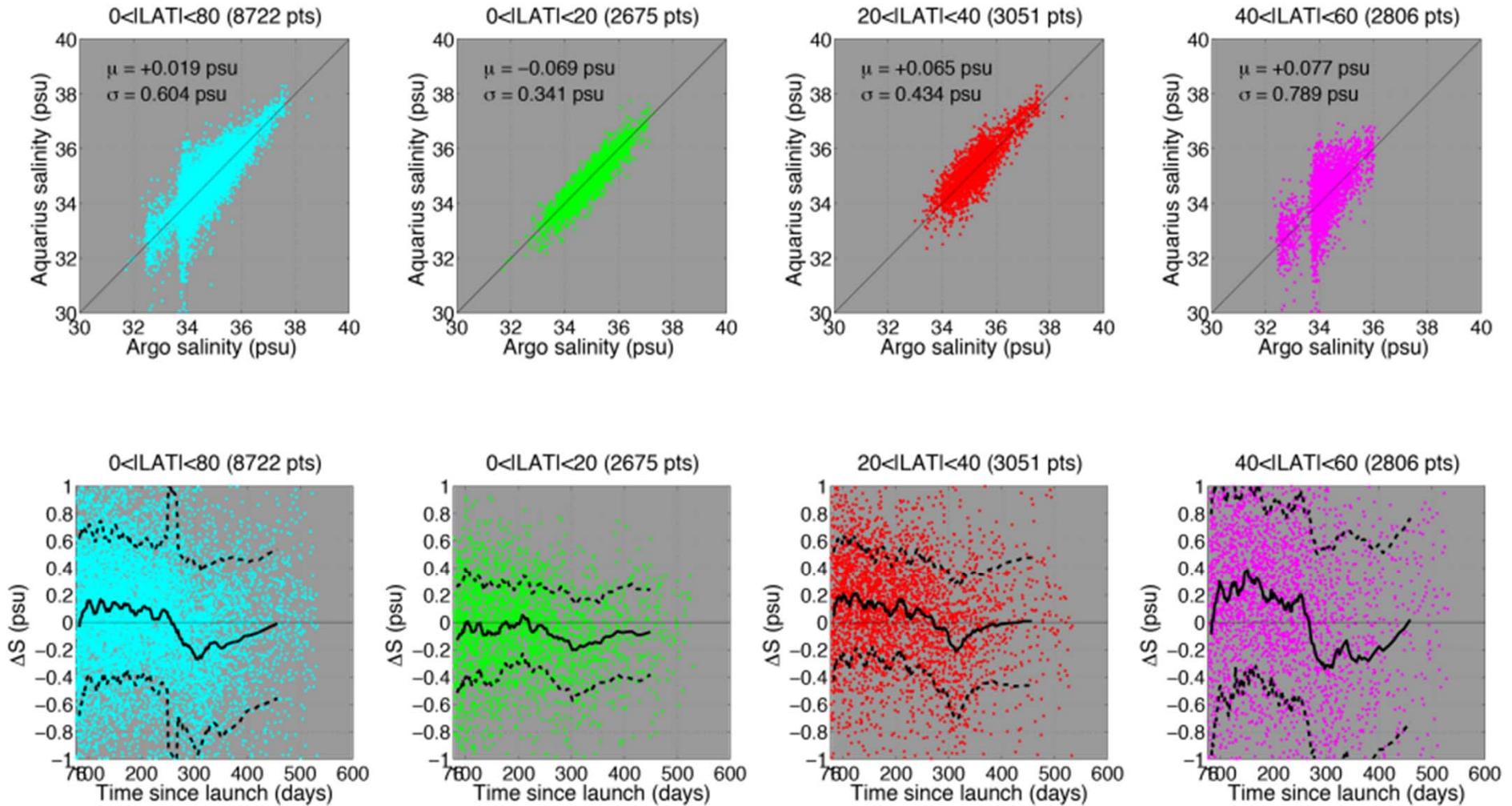
Accuracy better than 0.01 PSU

Nominal depth of 5m.

- $\Delta S = SSS_{\text{Aquarius}} - S_{\text{Argo}}$

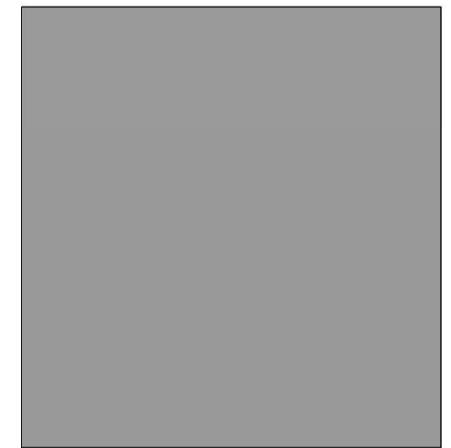
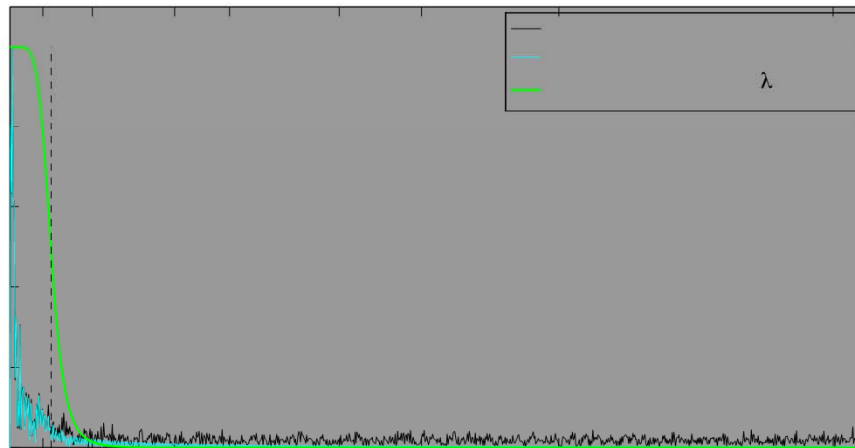
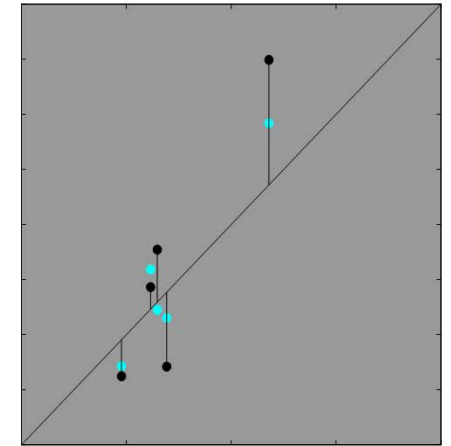
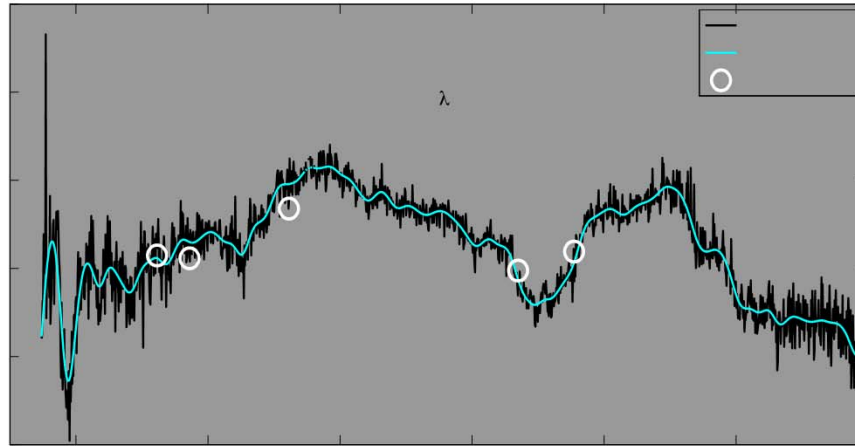
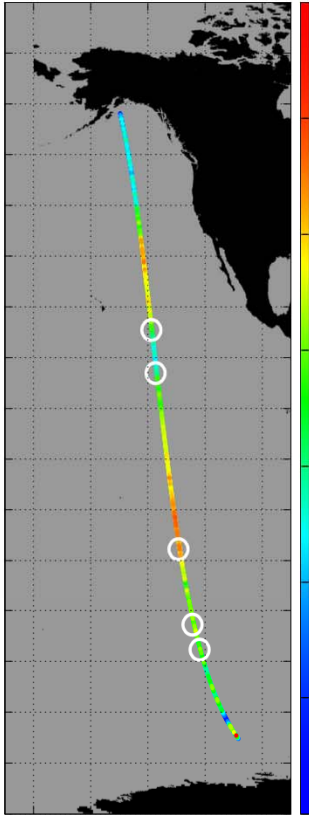


Overall $\mu < 0.1$ PSU for all latitudes up to 60, but σ is large.



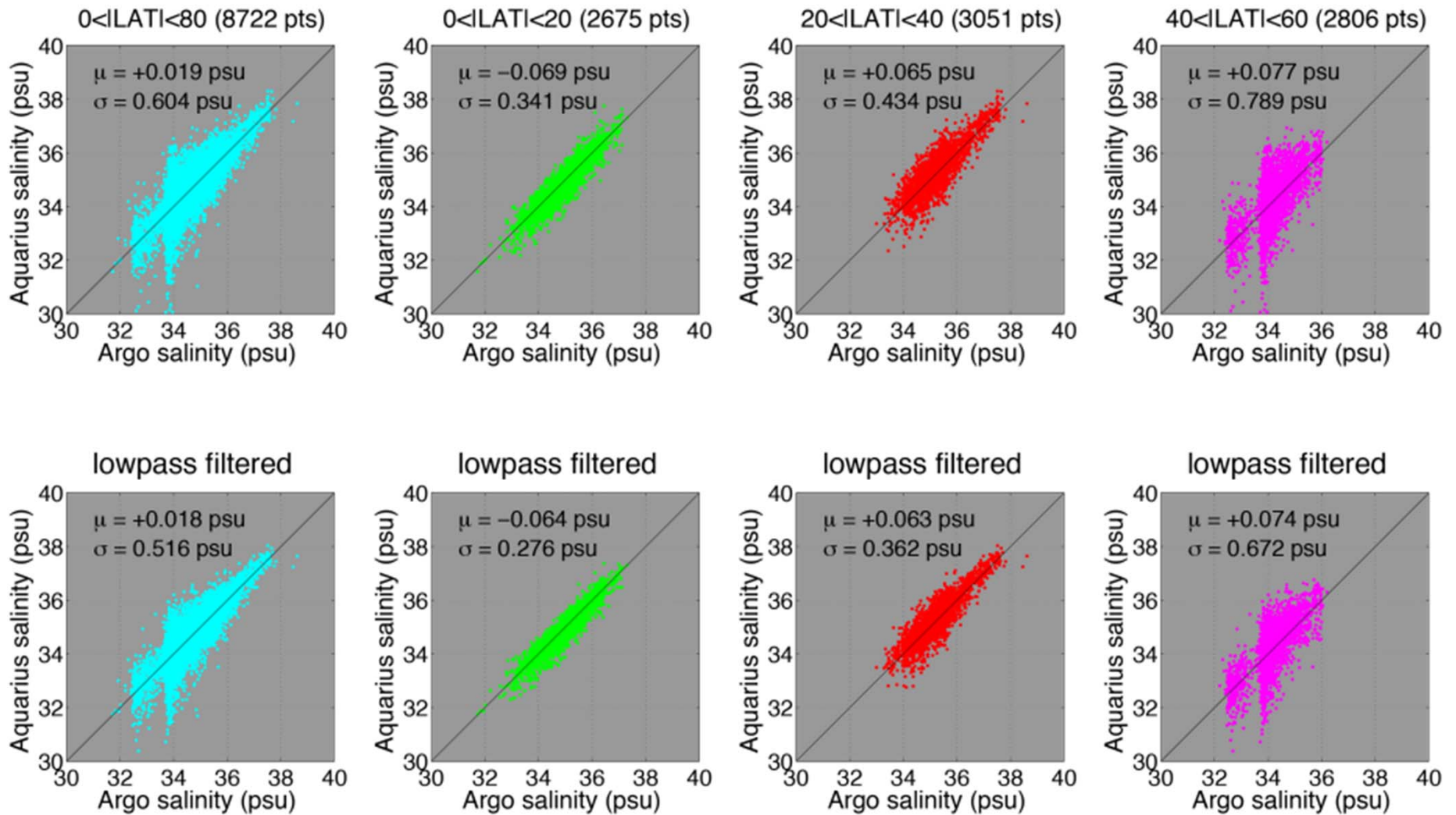
Also, μ has seasonal drift of $\pm 0.1 - 0.3$ PSU

Single (ascending) orbit



λ

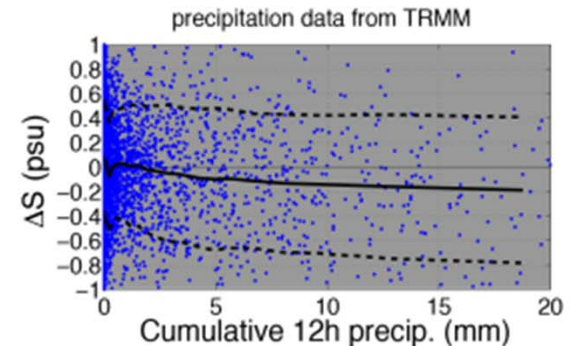
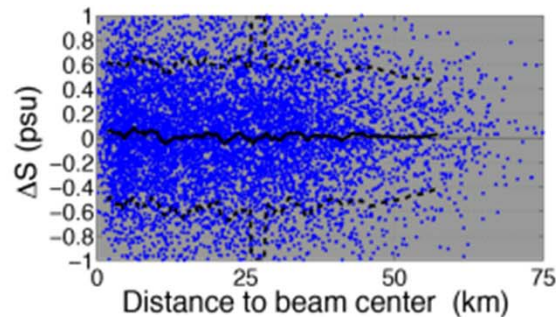
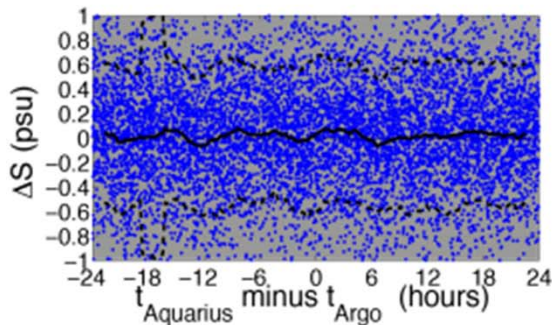
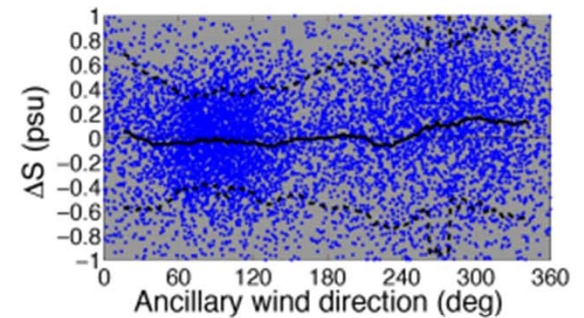
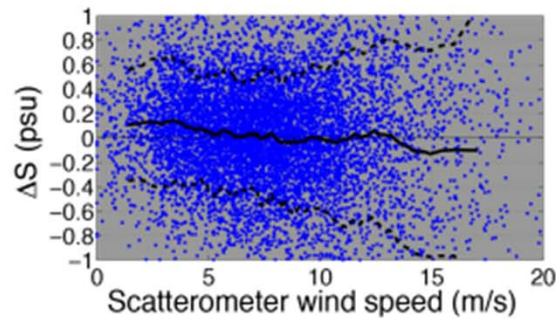
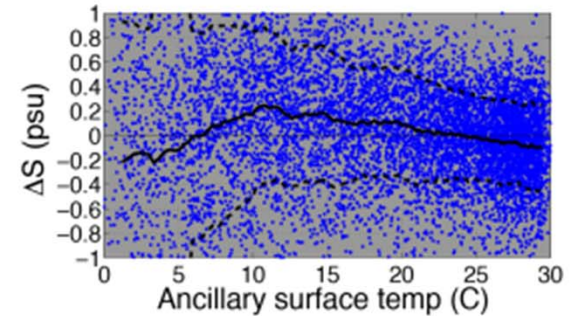
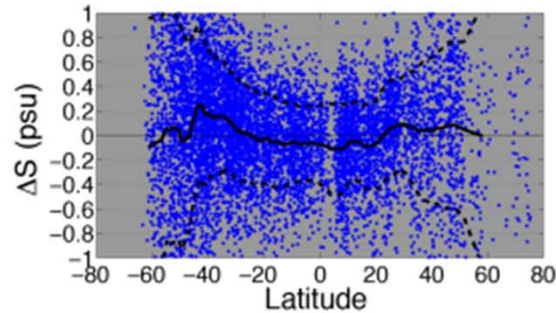
Lowpass filtering of Aquarius SSS signal reduces σ about 15-20%.



Dependence of ΔS on geophysical variables

Aquarius Level 2 V2.0
20110827 - 20121123
All latitudes

- Mean and variance depend on latitude, surface temperature, wind speed, and rain.
- No dependence on spatial or temporal proximity of Argo and Aquarius samples.
- Near-linear dependence on precipitation (TRMM)

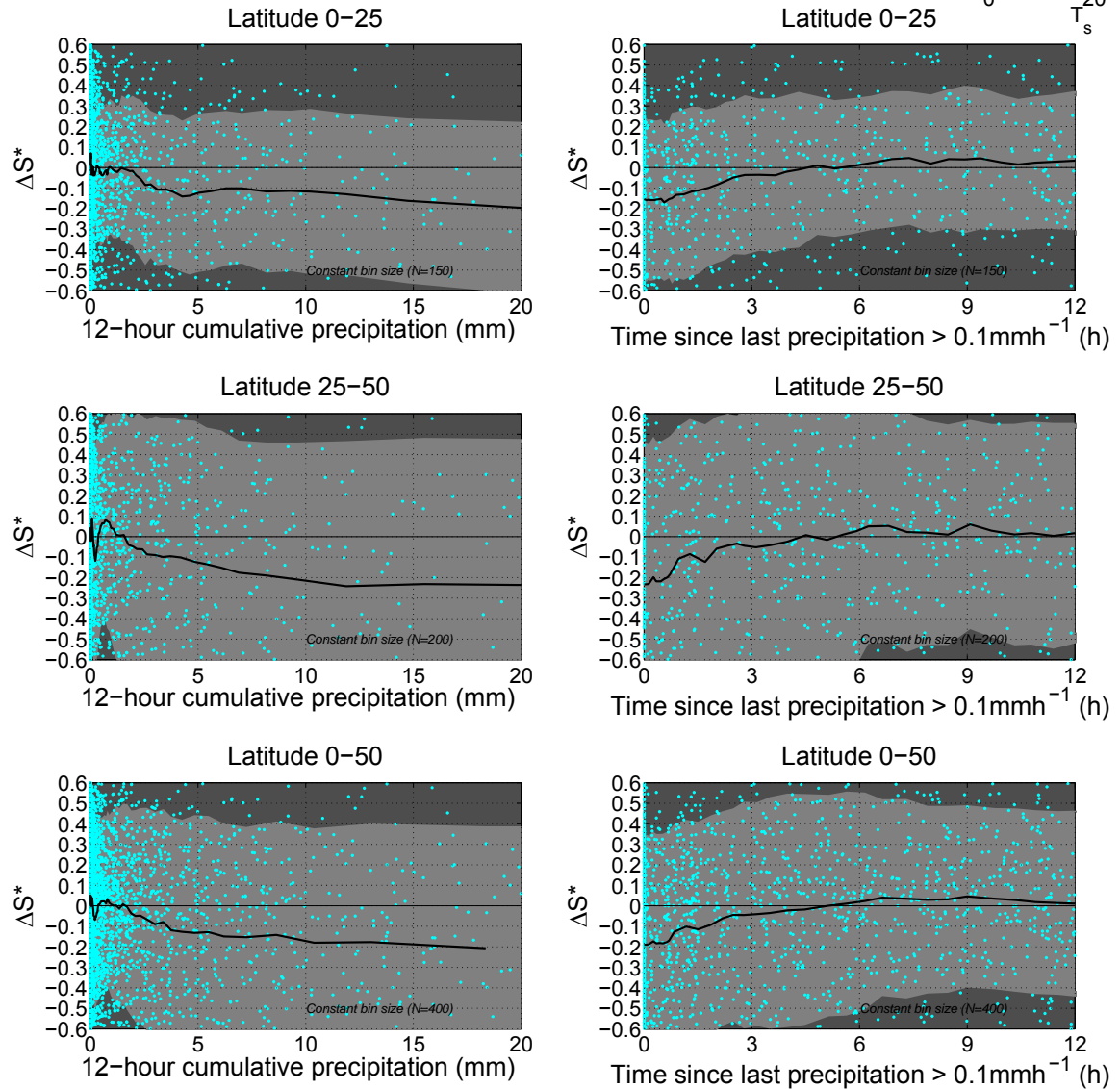
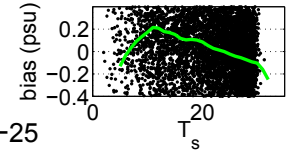


Dependence on precipitation

- $\Delta S^* = \Delta S - \mu(T_s)$
- Surface freshening trend with precipitation: ΔS decreases by about 0.2 psu for $P_{12h} > 10\text{mm}$**
- Freshening dissipates rapidly with time: bias disappears within ~ 6 hours.**
- No dependence on Argo/Aquarius Δt strongly suggests salinity stratification due to surface freshening.**

$$\Delta S^* = \text{Aquarius SSS} - \text{Argo 5m salinity} - \text{bias}(T_s)$$

Precipitation from Tropical Rainfall Measuring Mission (TRMM) 3B42 3-hourly 0.25° 50N-50S

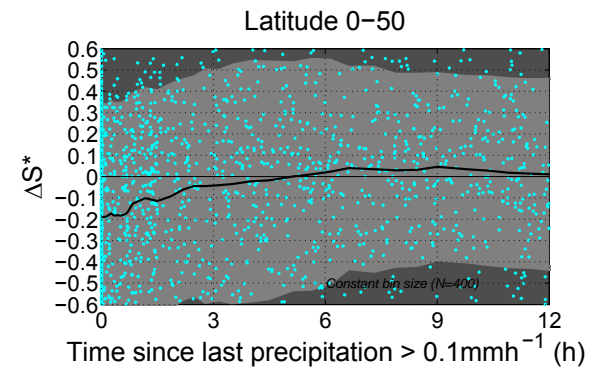
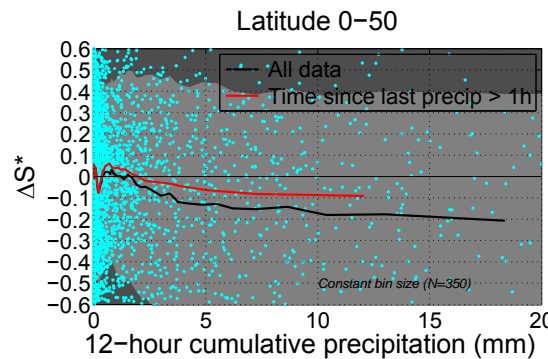
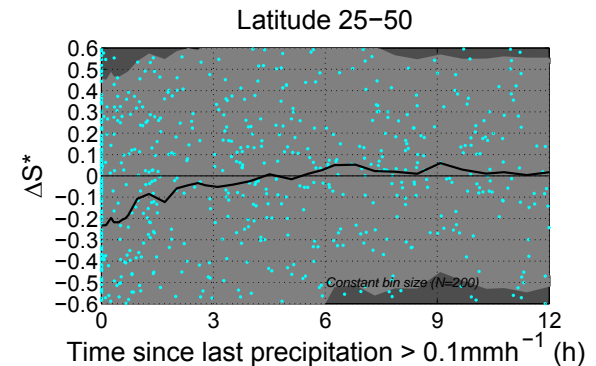
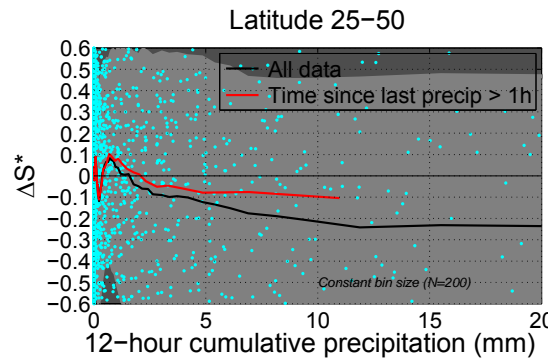
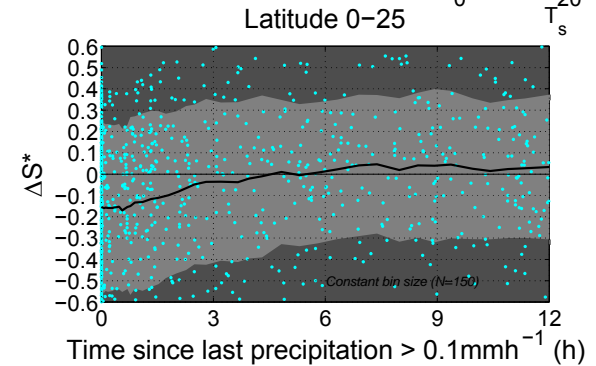
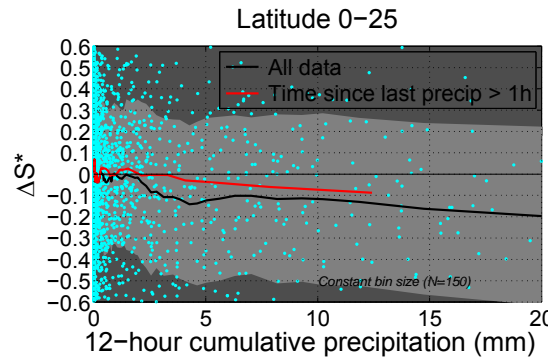
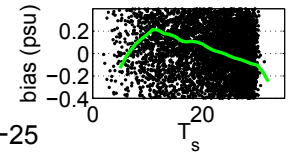


Dependence on precipitation

- $\Delta S^* = \Delta S - \mu(T_s)$
- Surface freshening trend with precipitation: ΔS decreases by about 0.2 psu for $P_{12h} > 10\text{mm}$**
- Freshening dissipates rapidly with time: bias disappears within ~6 hours.**
- No dependence on Argo/Aquarius Δt strongly suggests salinity stratification due to surface freshening.**
- Removal of $t_{\text{last}} < 1\text{h}$ reduces bias by about half. Possible effects of rain in the beam (eg, atmospheric or surface roughening)**

$$\Delta S^* = \text{Aquarius SSS} - \text{Argo 5m salinity} - \text{bias}(T_s)$$

Precipitation from Tropical Rainfall Measuring Mission (TRMM) 3B42 3-hourly 0.25° 50N-50S



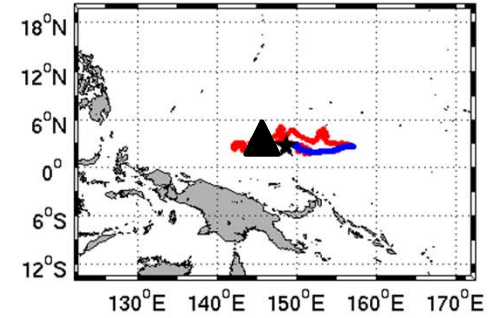
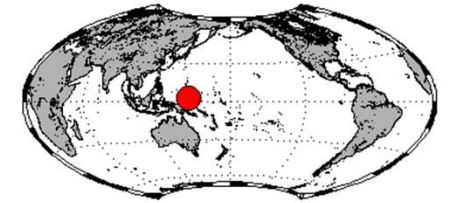
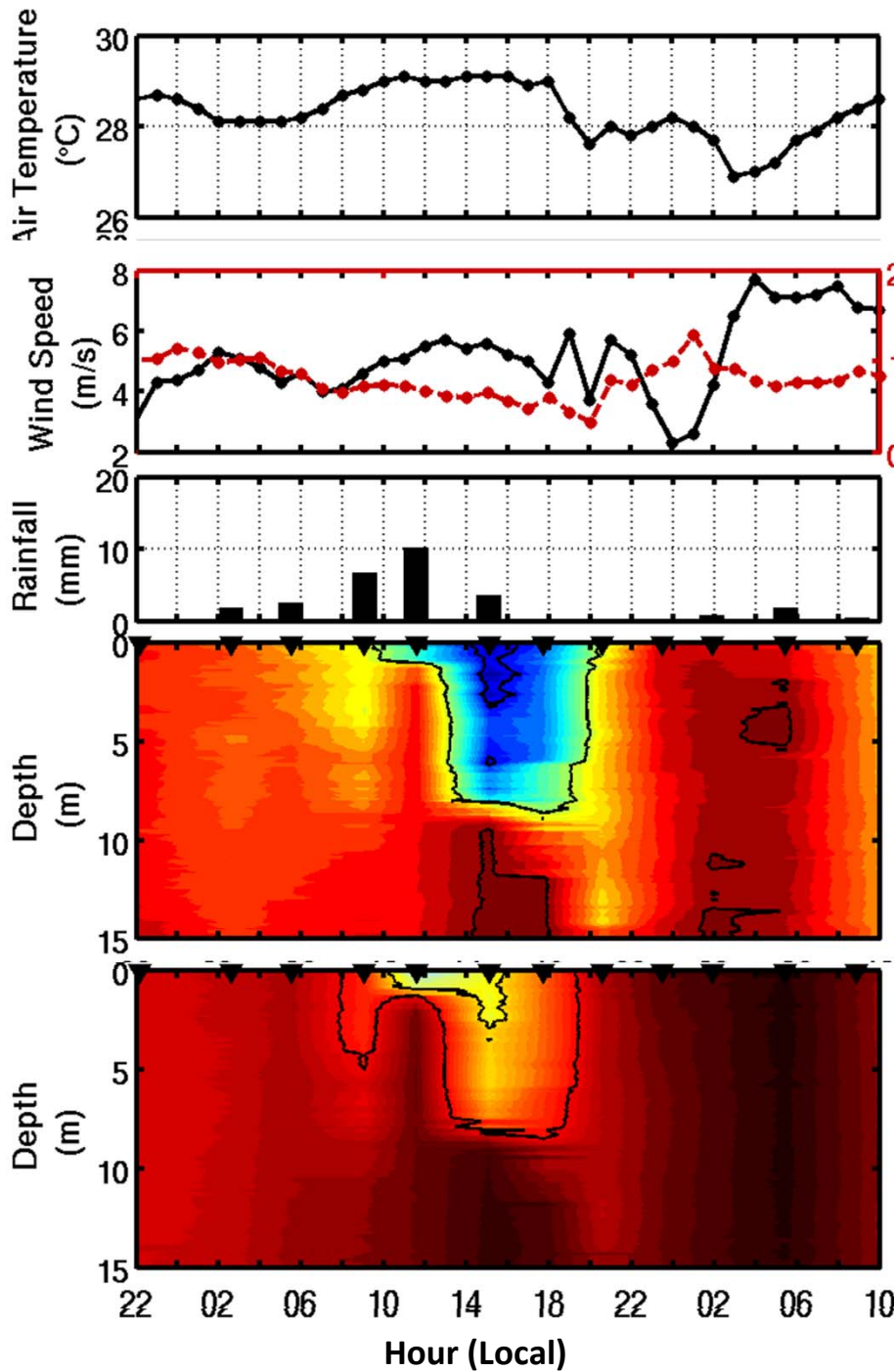
Float 6117

TAO mooring
2°N, 147°E

TRMM
(3 hourly)

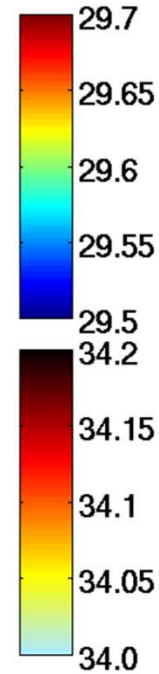
STS
Temperature

STS
Salinity

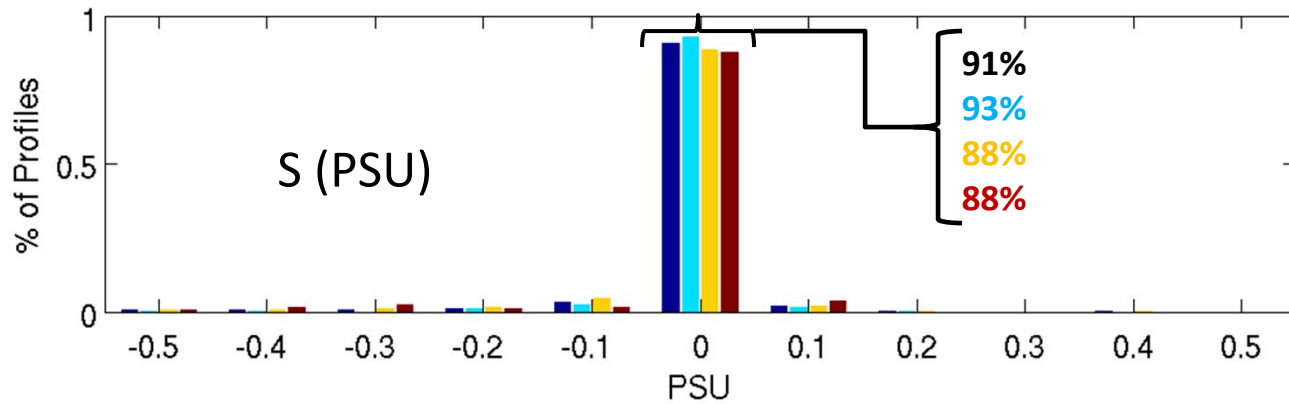
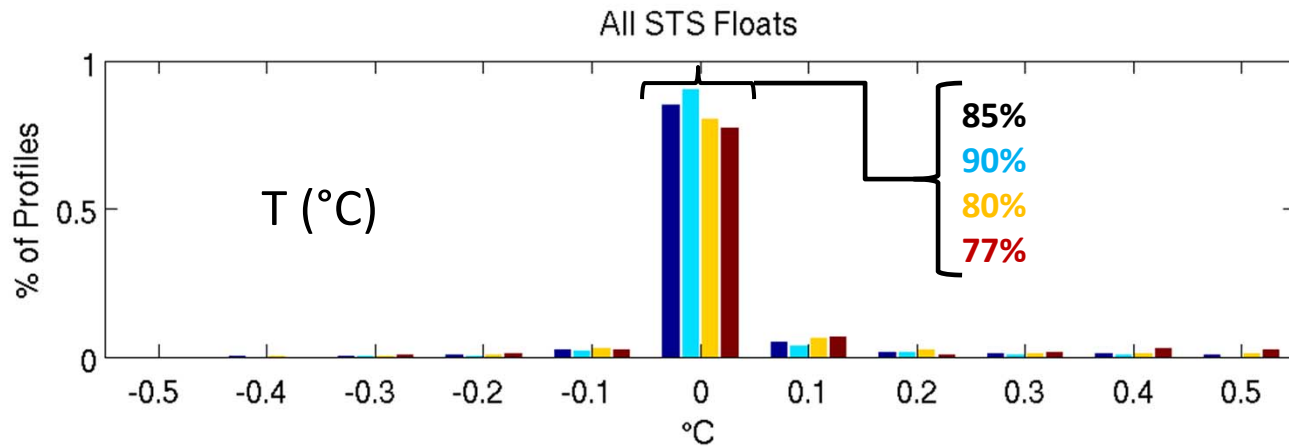
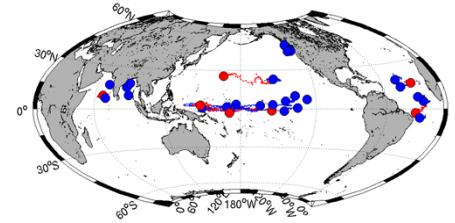


7/3/2009

Rainfall: 25mm
 ΔS : 0.15 PSU
 ΔT : 0.18 °C



Regional Variations



All Floats (31)

Atlantic

Pacific

Indian

STS(surface) – STS(depth of 4 m)

Conclusions

- Mean difference of Level-2 SSS and Argo near-surface salinity is about ± 0.07 PSU for all latitudes less than 60, varying with latitude.
- Seasonal variation $\pm 0.1-0.4$ PSU
- $\sigma \approx 0.4$ to 0.8 PSU (increasing with latitude.) Low-pass filtering reduces σ by 15-20%.
- Variables related to bias and variance include surface temperature, wind, and rain.
- For collocations of 0-70km and ± 24 h, neither bias nor variance depend on spatial/temporal proximity of Argo and Aquarius.
- Moderate to heavy rain causes a differential freshening of about -0.2 PSU. This is short-lived (< 6 h) and reduced by about half when current precipitation ($t < 1$ h) is excluded.
- STS floats show 5cm and 4m salinity agree to within .05 PSU in $> 85\%$ of profiles.

Further Work

- **Better understanding of salinity stratification in the upper 5m is needed to link Aquarius to the global Argo array (as well as scientific need.)**
- **In-situ data from STS floats and other in-situ instruments will fill this gap.**
- **Better collocated precipitation data needed: STS floats with PAL acoustic sensors, improved satellite rain measurement.**
- **High-frequency profiling to study small scale temporal and spatial salinity variability.**

Acknowledgements

- **NASA/JPL and NASA/GSFC for Aquarius and TRMM data.**
- **Ifremer for Argo data archive, and this conference.**