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Modeling Skin-Layer Salinity with an Extended Salinity Layer

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ARGO and Models used extensively for comparing with Aquarius SSS

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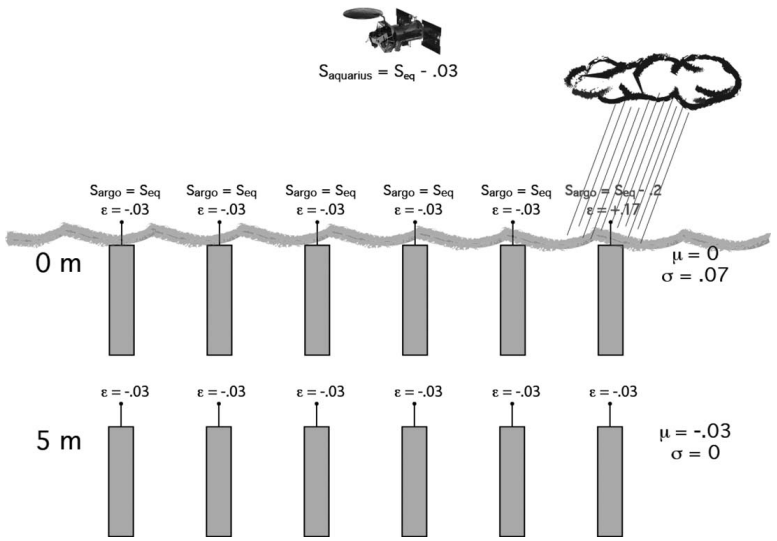
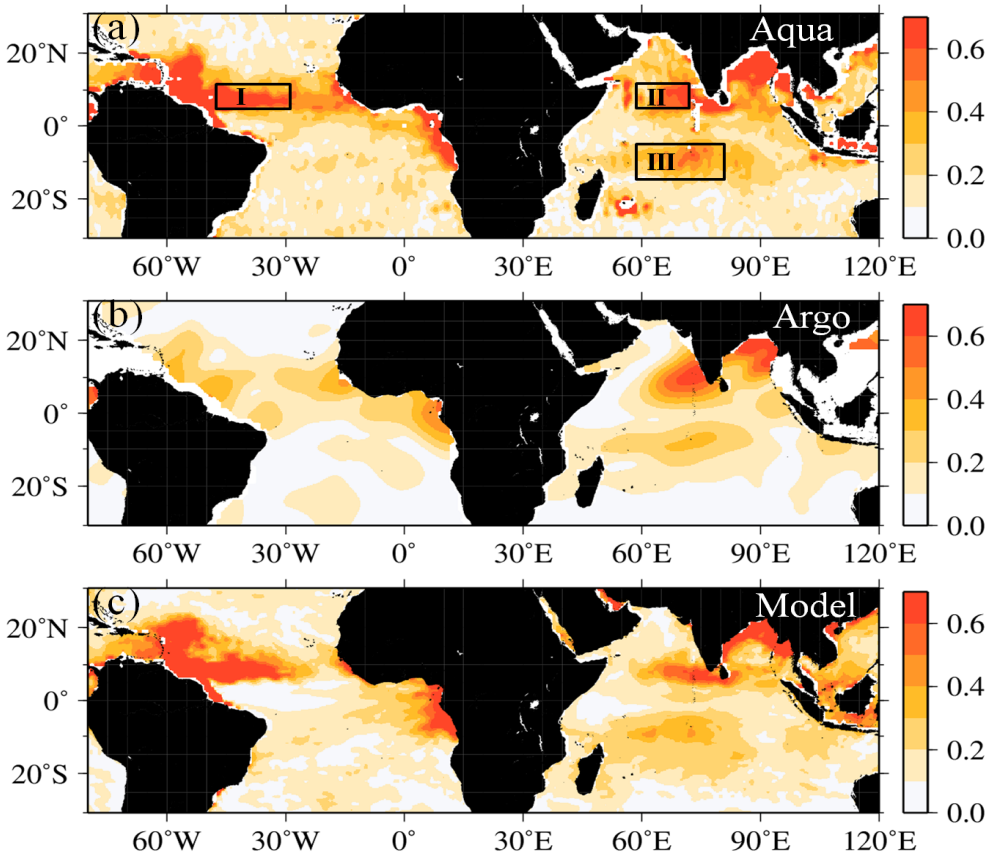


Figure B1. Error due to vertical salinity stratification for in situ references at the surface (top row) and at 5 m (bottom row). Stratification $q = -0.2$ PSU occurring with probability $p = .16$.



Drucker & Riser, *JGR-Oceans* 2014:

co-located comparison

Moon & Song, *JGR-Oceans* 2014:

gridded products comparison

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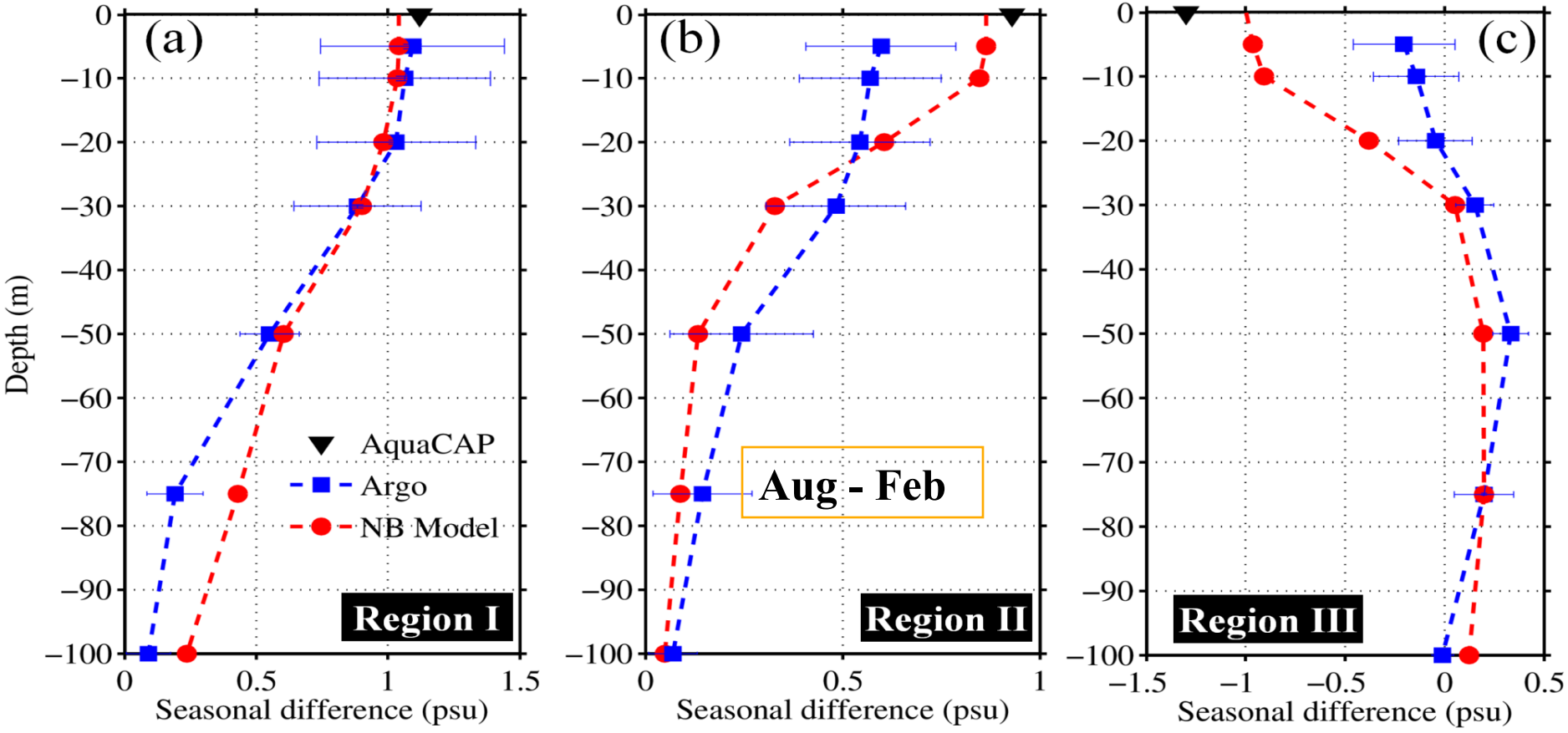
Discrepancies due to different physical mechanisms

a. well mixed **b. stratified by P** **c. stratified by P+R**



Moon & Song, *JGR-Oceans* 2014

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Aquarius, ARGO, Models
"Apples compare Oranges"

JPL

1. Aquarius senses the first few cm SSS.

2. ARGO measures the 5m SSS.

3. Model SSS represents the surface-layer averaged salinity:

$$dS/dt = S*(E - P - R)/H + O$$

H ---- thickness of the surface layer
S ---- surface layer salinity
E, P, R ---- Evaporation, Precipitation, River discharge
O ---- Ocean dynamics

Extended Surface Salinity Layer (ESSL)

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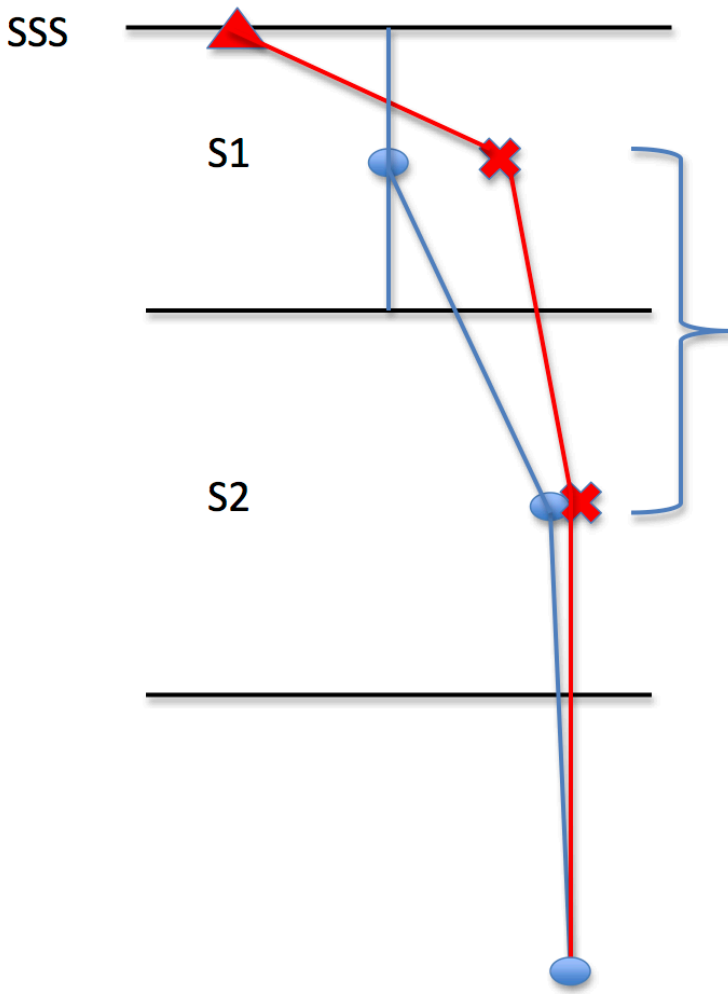

$$ESS = S1 + \Delta S \times CF \times c0$$

$$ES1 = S1 - \Delta S \times CF \times c1$$

$\sim 10m$

$$ES2 = S2 - \Delta S \times CF \times c2$$

- **CF = Correlation Function:** between S1 and E-P
- c0, c1, and c2: empirically and mathematically determined constants

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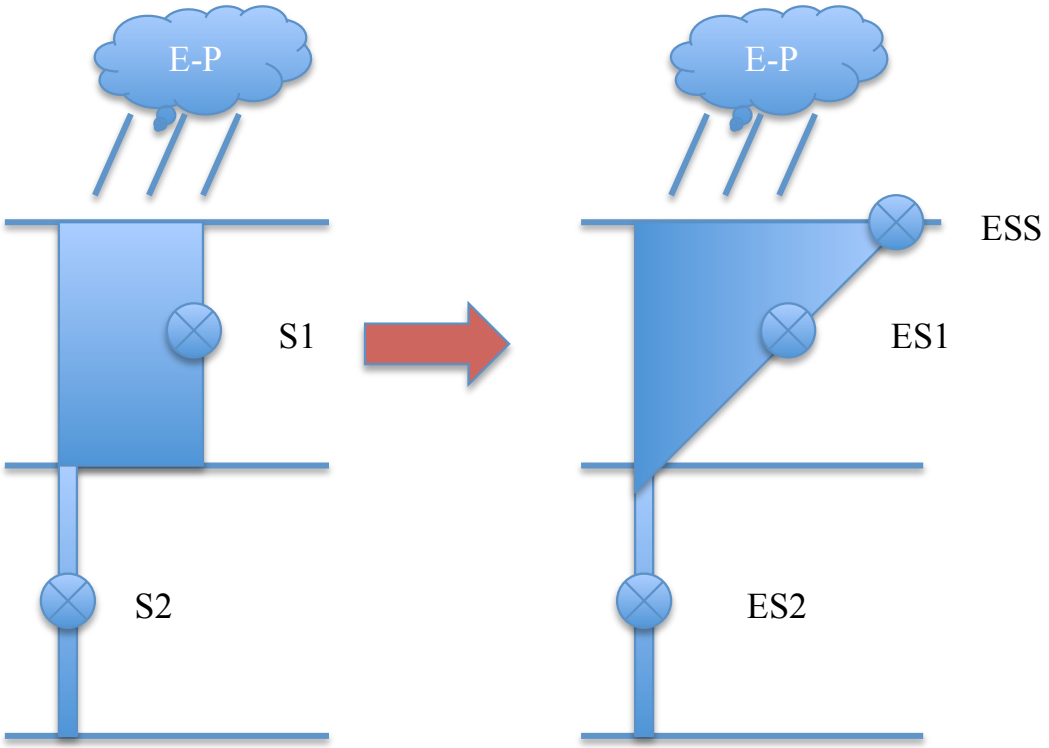
Cartoon of ESSL (e.g., rain effect)



$$ESS = S1 + \Delta S \times CF \times c0$$

$$ES1 = S1 - \Delta S \times CF \times c1$$

$$ES2 = S2 - \Delta S \times CF \times c2$$

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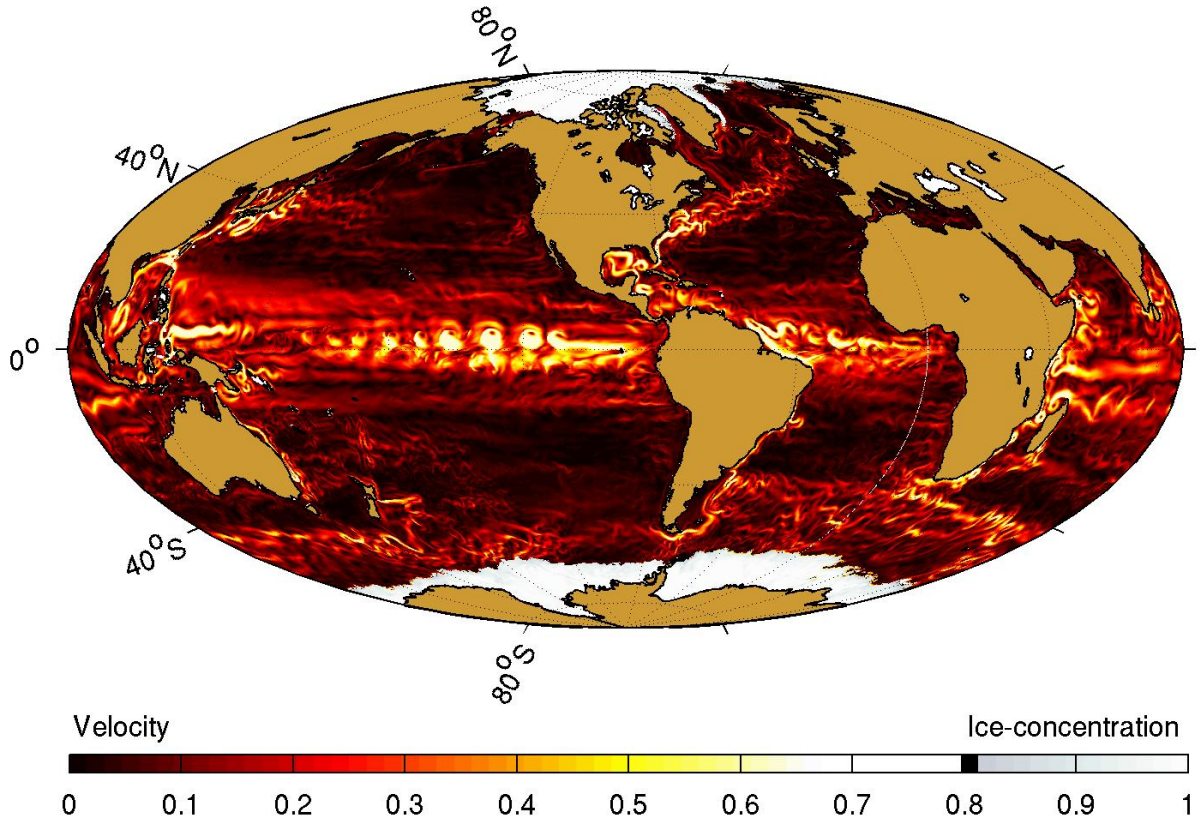
The Non-Boussinesq Global ROMS
(1/4-degree, sea-ice coupled)



Heat & momentum:

- NCEP SST & flux
- NCEP winds

Freshwater flux:

- -E+P+R==GRACE;
- Greenland melting
- River runoffs (256) since 2011

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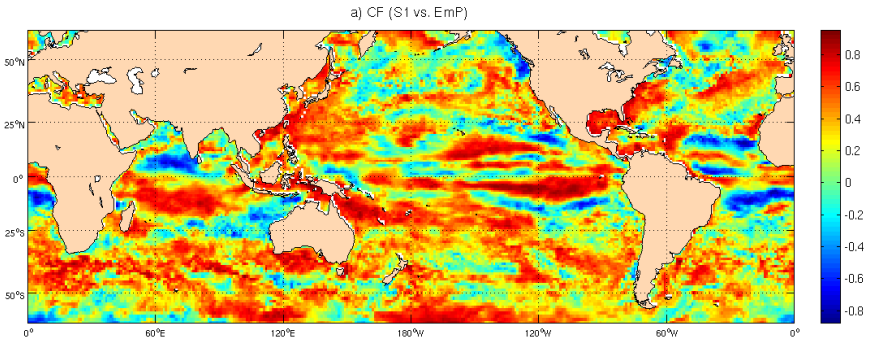
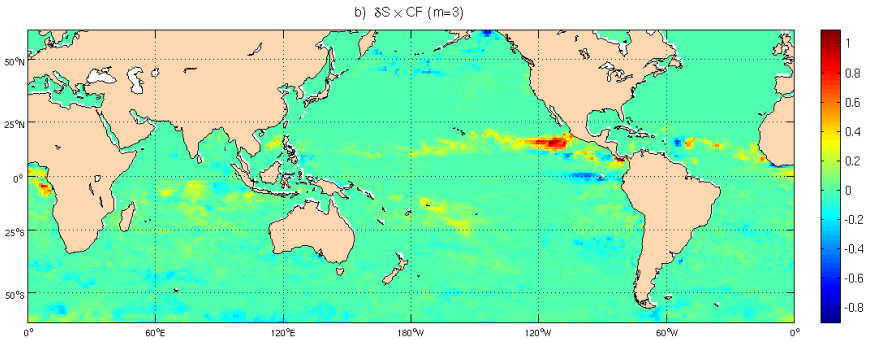
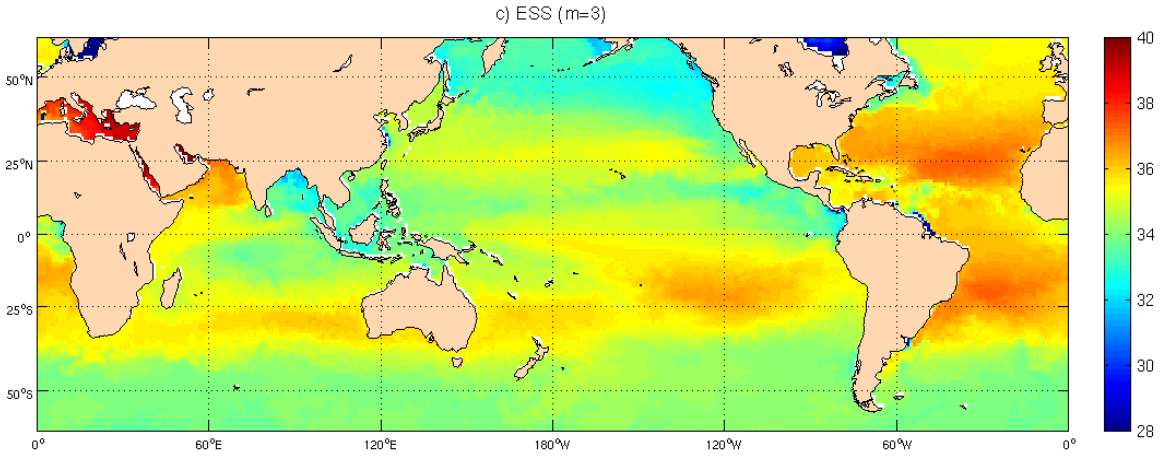
Correlation Function (CF)

$$ESS(t) = S1(t) + \Delta S(t) \times CF(x,y) \times c0$$







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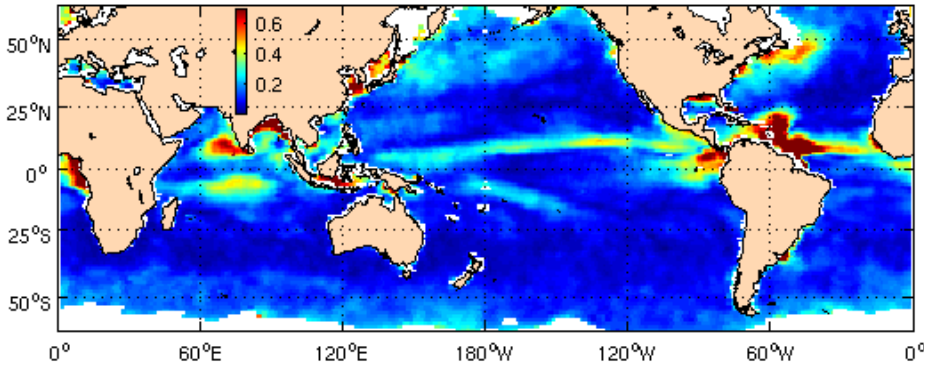
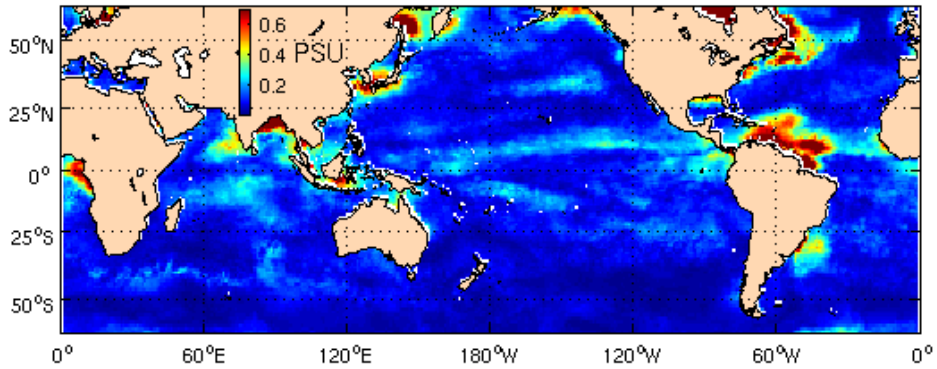
Annual Amplitude

a) Aquarius SSS (amplitude)

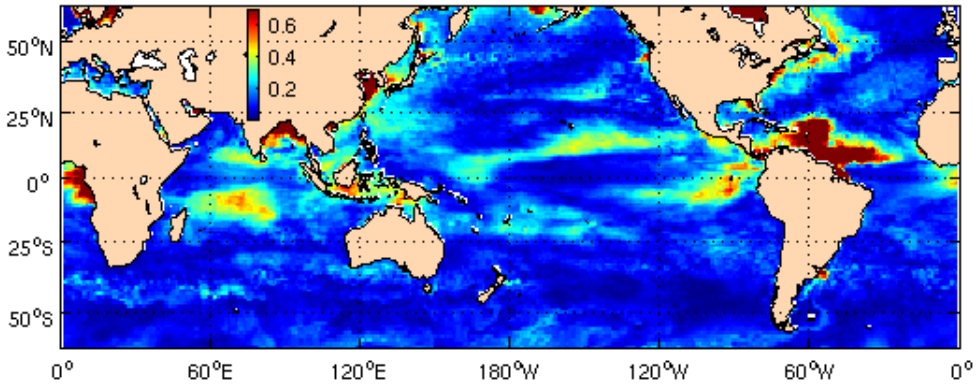


a) HYCOM SSS (amplitude)



$$V(t)=A * \sin(B * t + C)$$

e) NB-ROMS ESS (amplitude)



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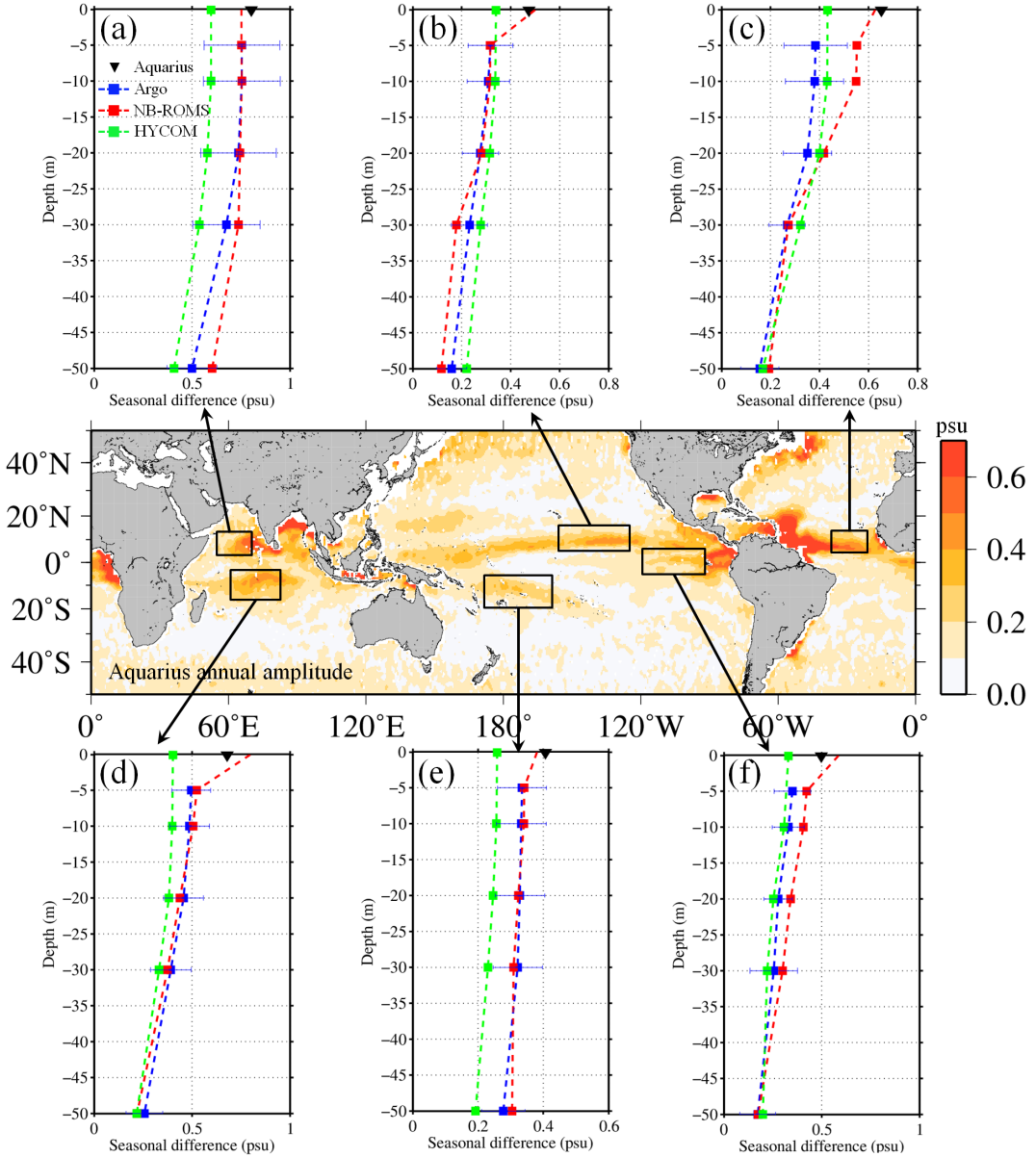
Comparisons in depths



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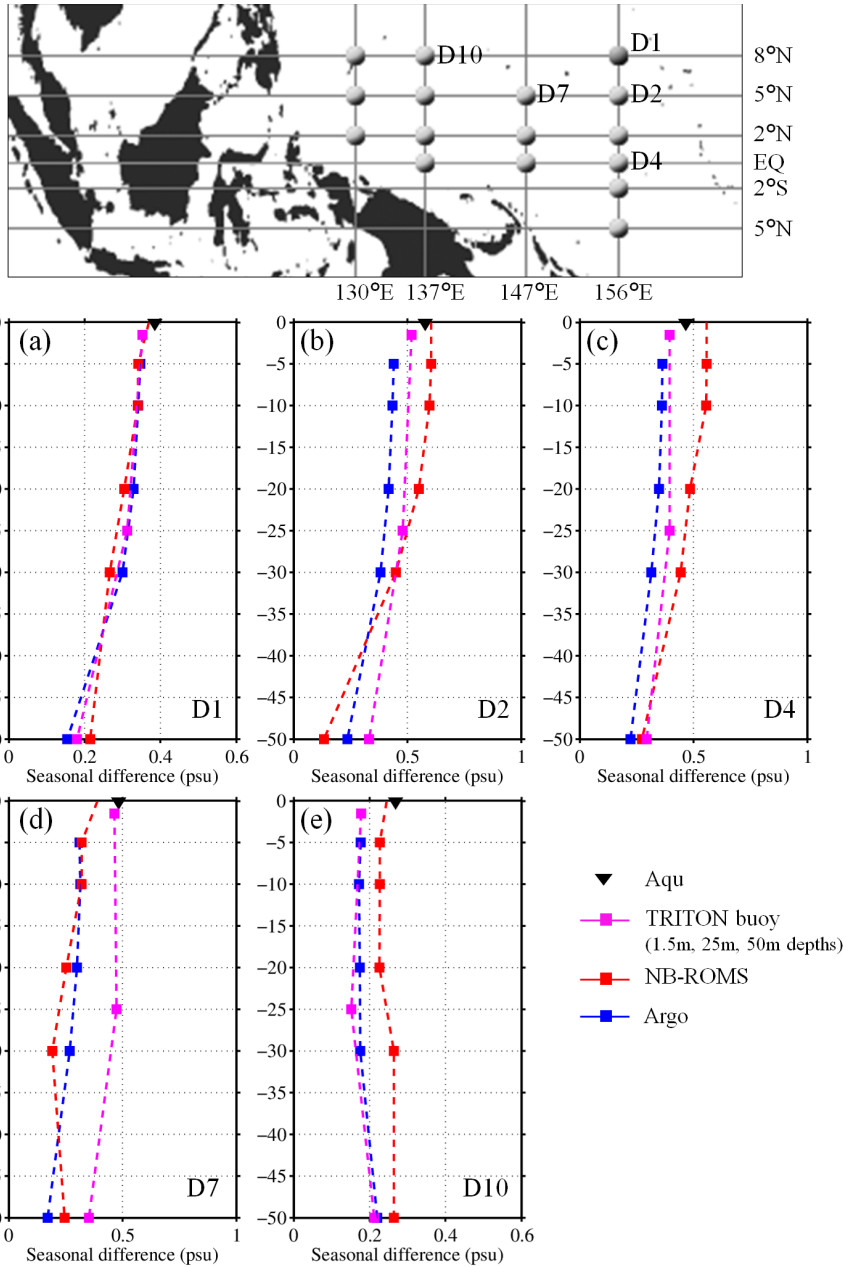
Comparisons by points



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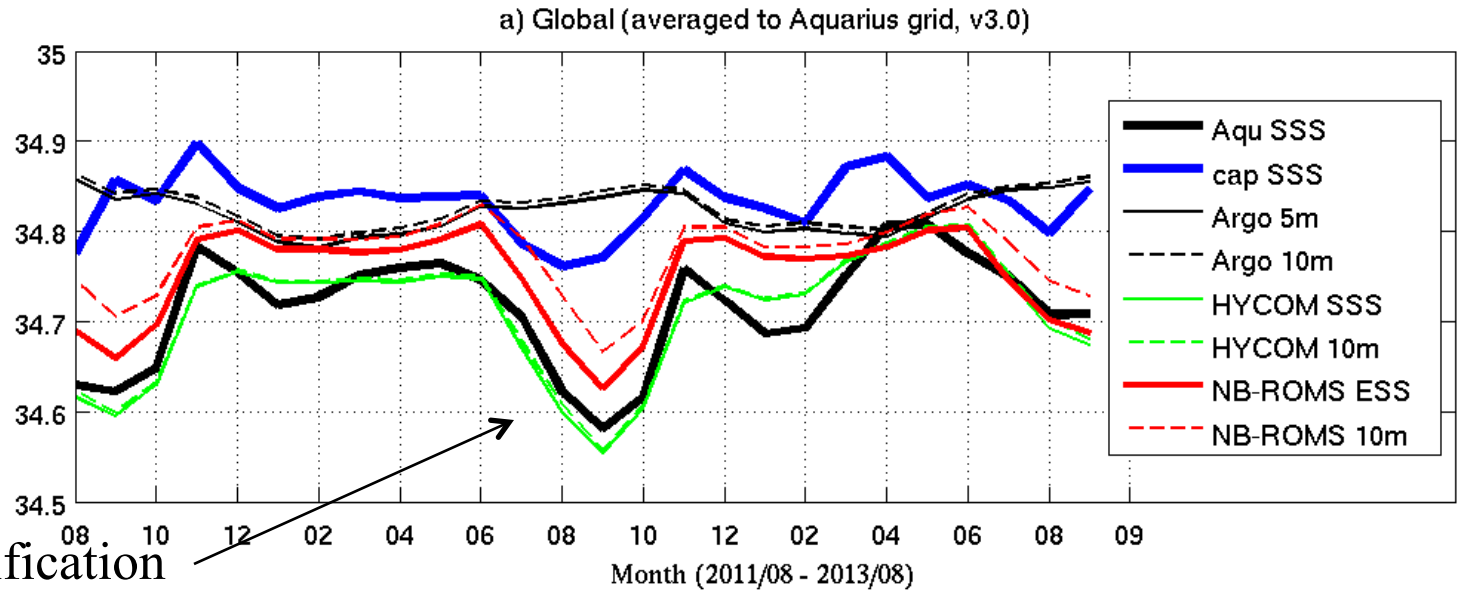
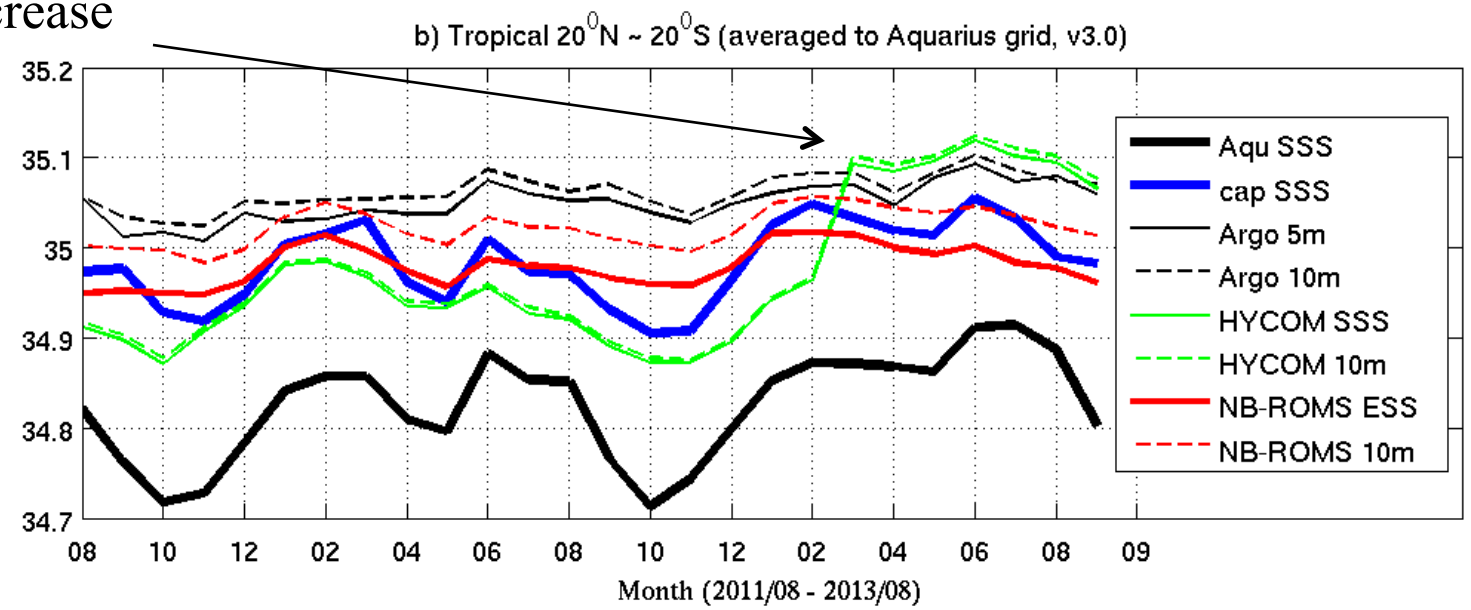
Comparisons in times (Global Means)



HYCOM:

- Little stratification
- Abrupt increase



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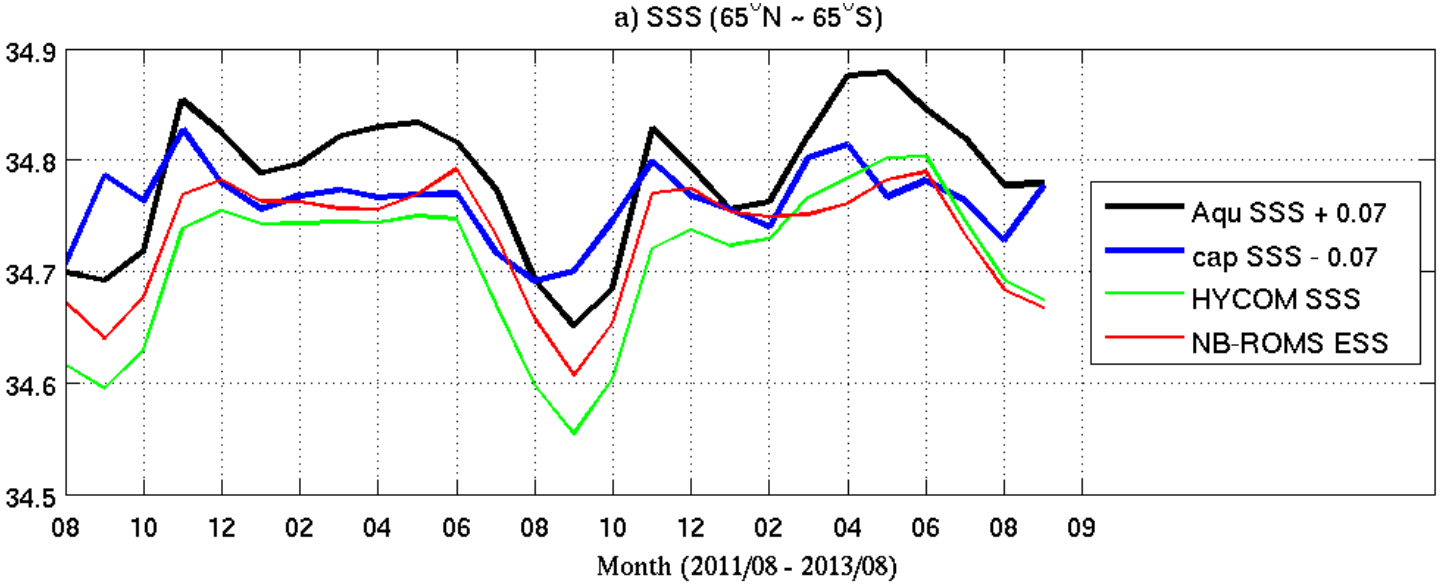
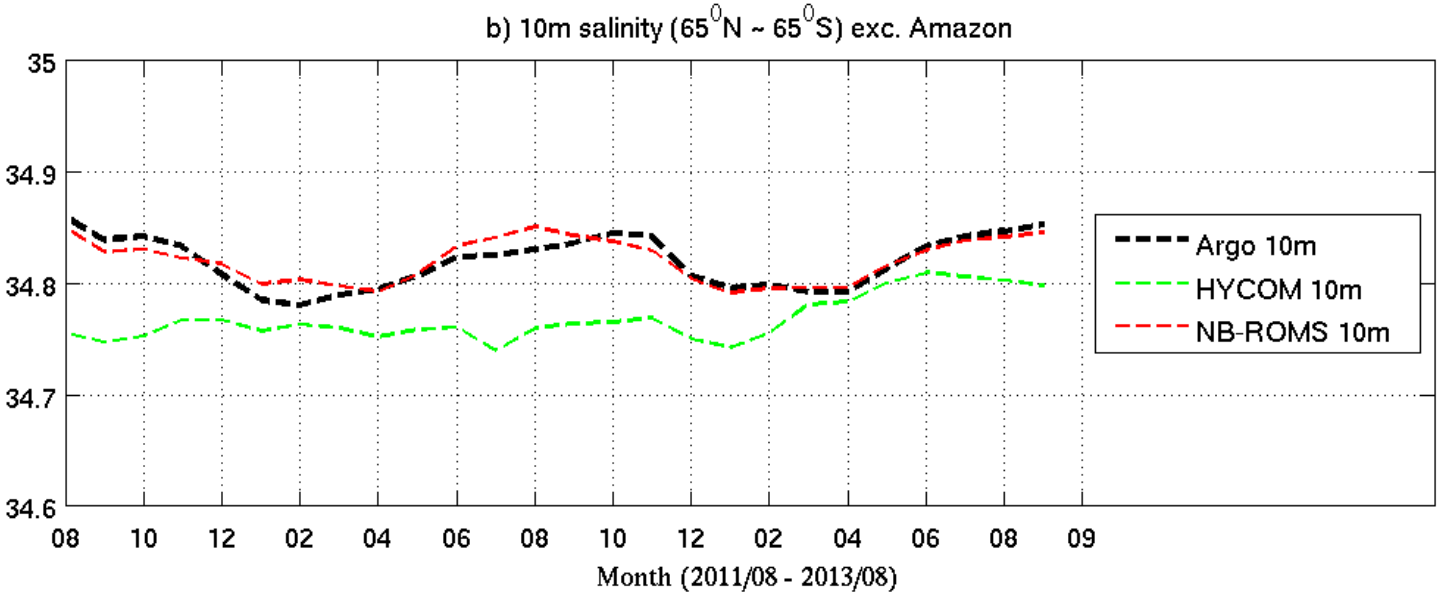
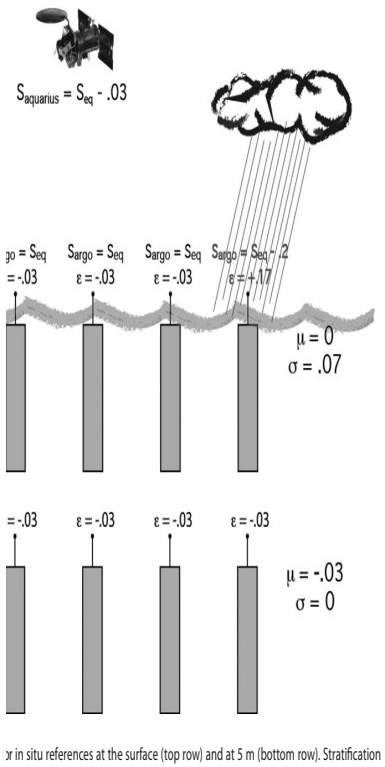
Comparisons in times

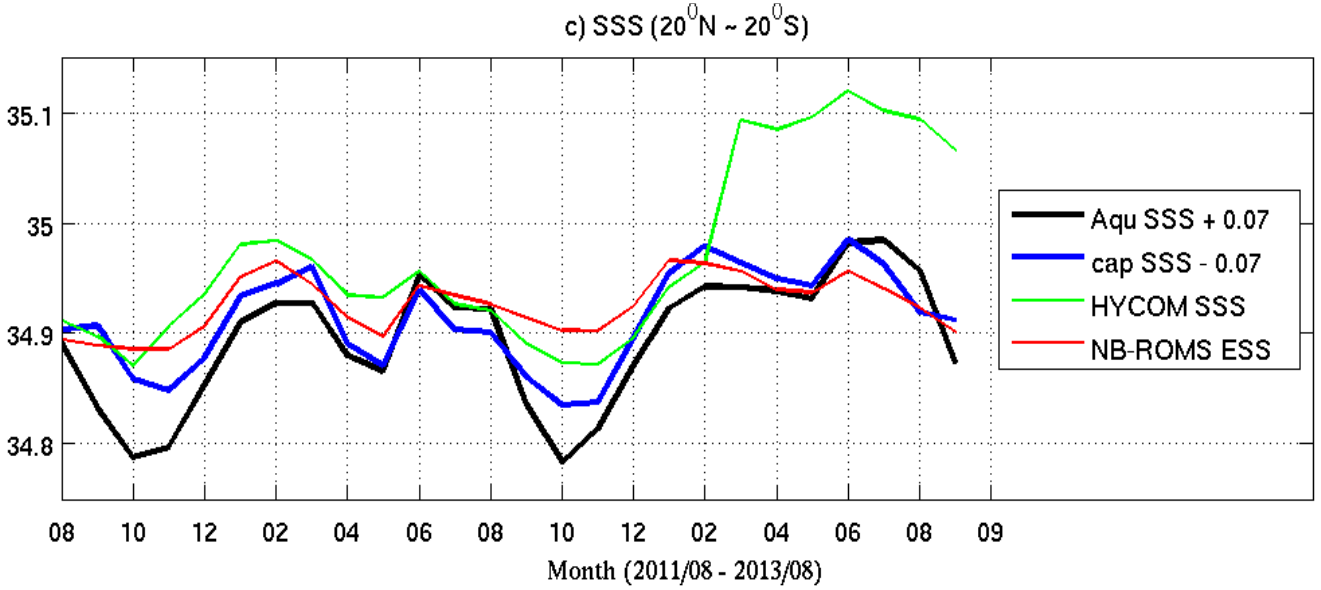


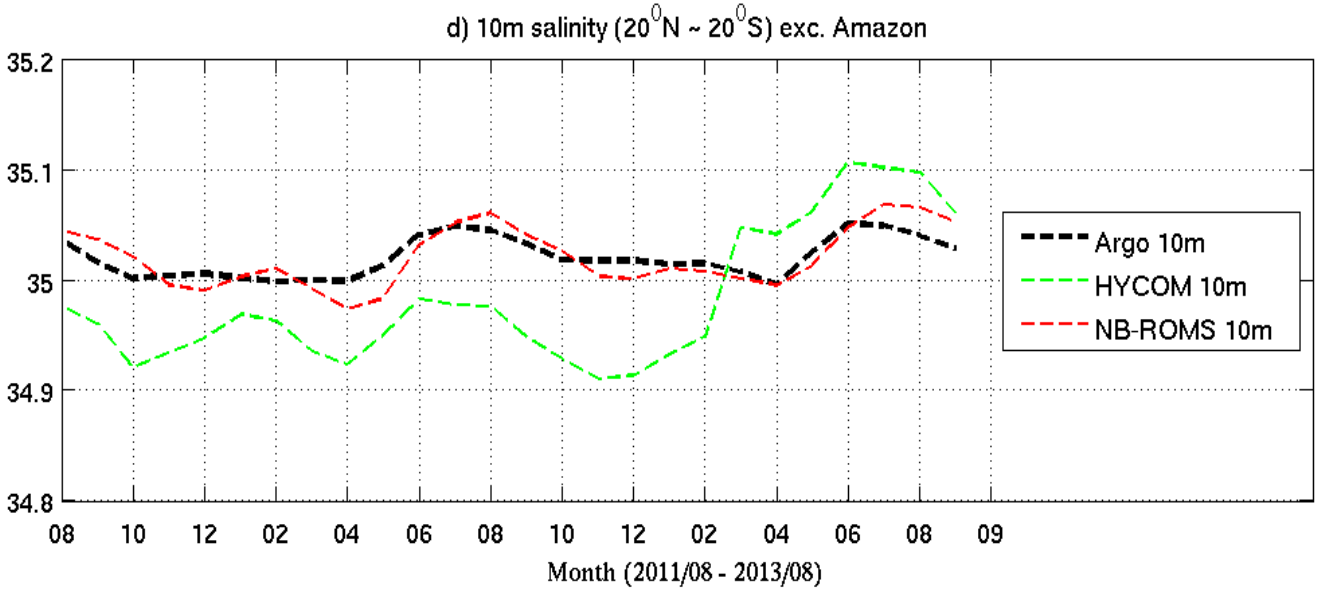


Comparisons in times



or in situ references at the surface (top row) and and at 5 m (bottom row). Stratification





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Summary

1. OGCM models need an ESSL scheme to compare with Aquarius and ARGO on an “Apples-to-Apples” basis.

2. The ESSL scheme allows extrapolating sub-surface ARGO salinity to the skin-layer for a “global mean salinity” reference.

3. The model skin-layer salinity can be used (an alternative to HYCOM) in processing Aquarius data.