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Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

1. Assessing the Seasonal Variability of the Global Sea Surface Salinity from Aquarius

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2. Near Surface Salinity Variations observed by Aquarius —A case study

Jae-Hong Moon & Y. Tony Song (JPL)

Special Thanks to:
Wendy Tang
Akiko Hayashi
Gary Lagerloef

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Motivations

1. There are some studies in assessing SMOS/Aquarius SSS with ARGO data (e.g., Boutin et al. 2013).

2. However, there are difficulties in explaining their differences.

1. This study focuses on investigating why they are similar at some regions, but different at others.

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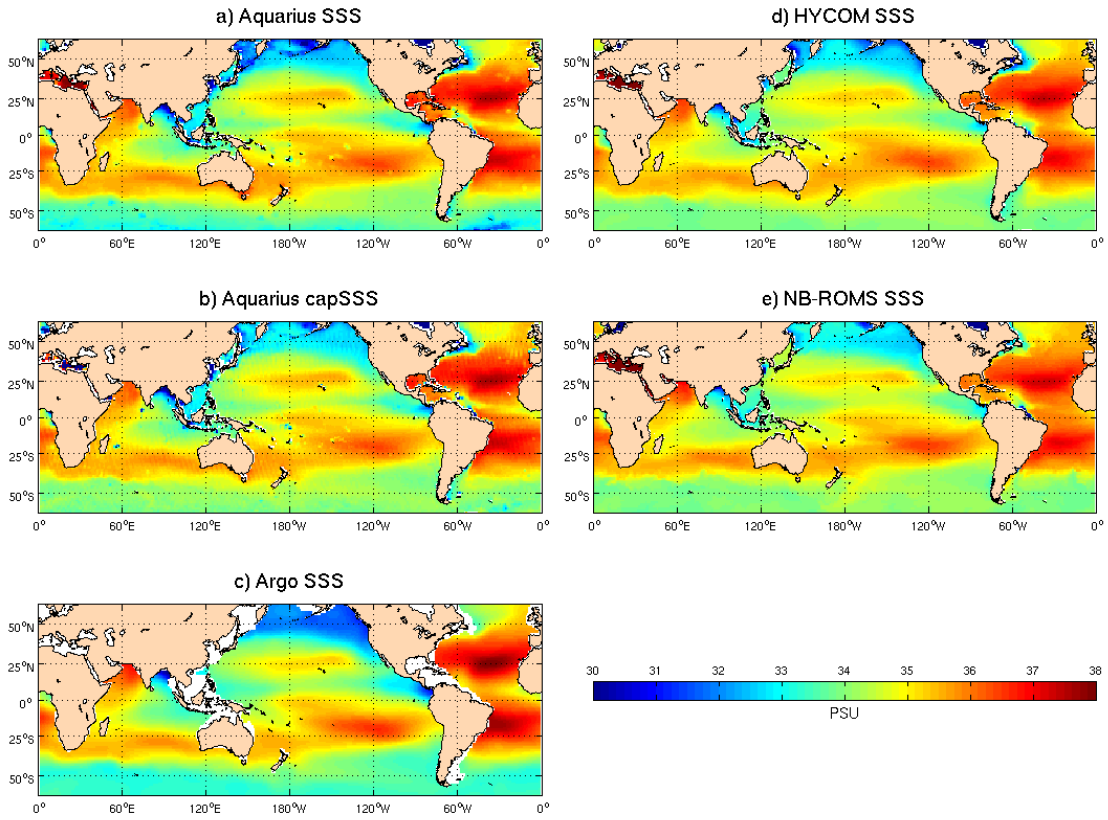
Three datasets & two models



1. Aquarius released v2.0 SSS (08/11-05/2013), using NCEP winds
2. Aquarius released CAP SSS (08/11-05/2013), using Aquarius winds
3. Argo SSS (Univ. Hawaii)

1. HYCOM output (NRL)
1. NB-ROMS output (JPL)

All monthly

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Justification
Three different platforms
(satellite, *in-situ*, and model)

1. Aquarius senses the first few cm of SSS.

2. ARGO measures the 5m SSS.

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

$$dS/dt = S_0 (E - P - R)/H + O$$

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

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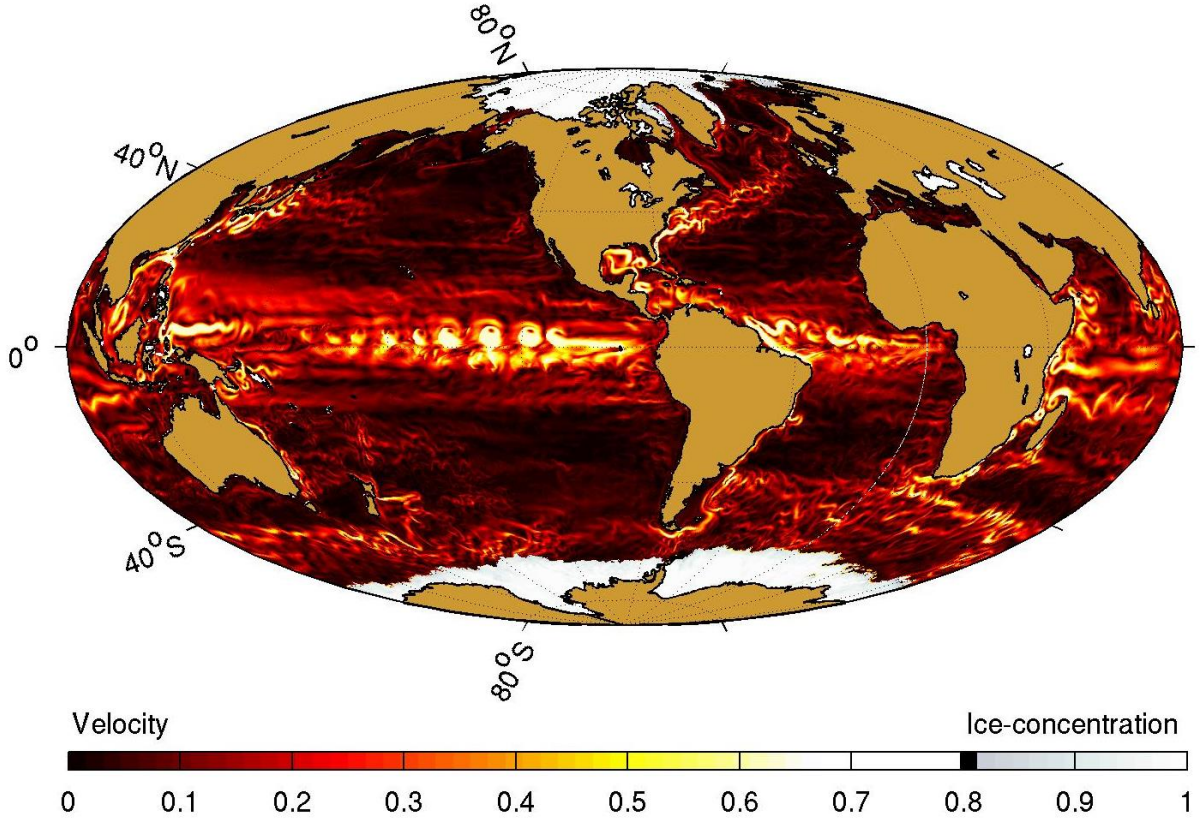
The Non-Boussinesq ROMS
(1/4-degree, sea-ice coupled)

Song & Hou, *Ocean Modell*. 2006
Song et al, *AdGeo*. 2011
http://www-radar.jpl.nasa.gov/ocan-data



Heat & momentum:

- NCEP SST & flux
- NCEP winds

Freshwater flux:

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

Focusing on Annual Amplitude

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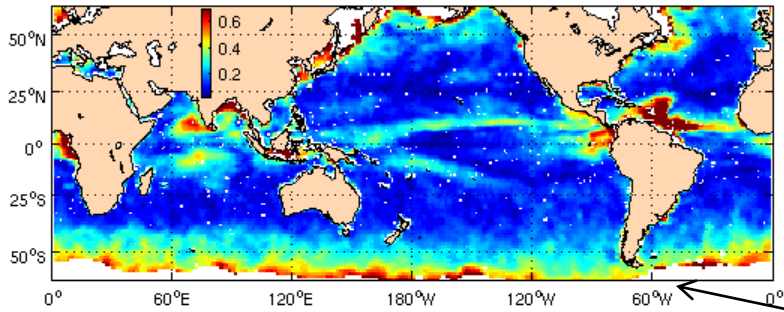
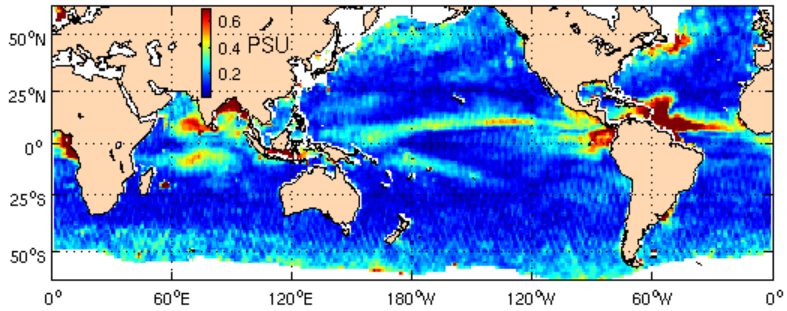
$$V(t)=A * sin\,(B * t + C)$$

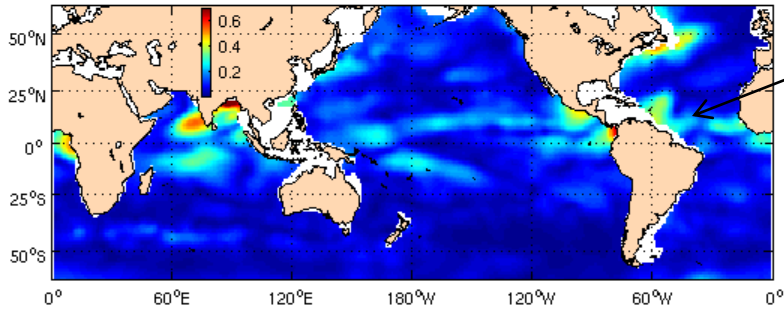
a) Aquarius SSS (amplitude)



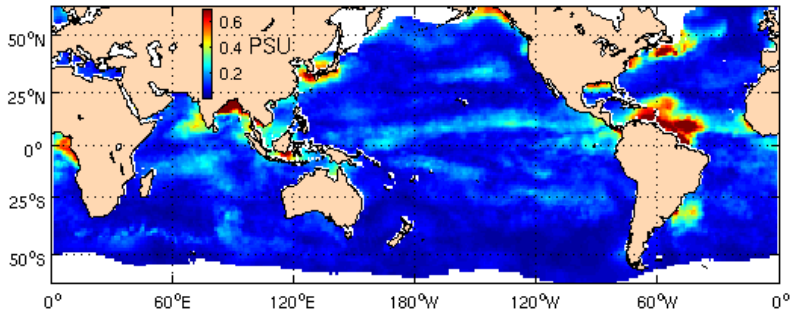
c) Aquarius capSSS (amplitude)



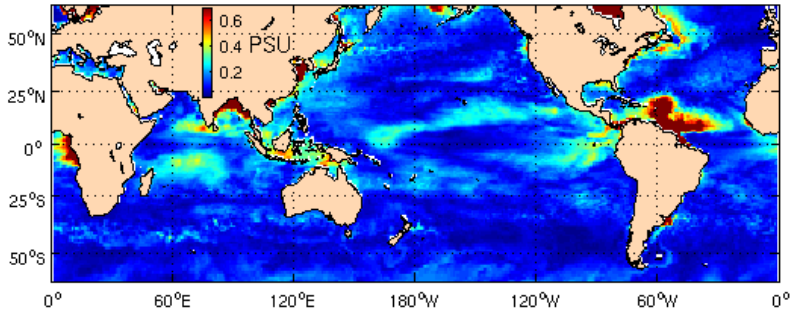
e) Argo SSS (amplitude)



g) HYCOM SSS (amplitude)



i) NB-ROMS SSS (amplitude)



- Missing River discharge in ARGO
- High latitude noise in aqSSS

Focusing on Annual Phase

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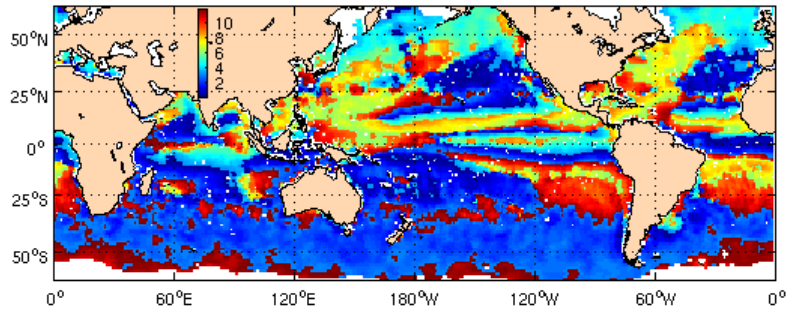
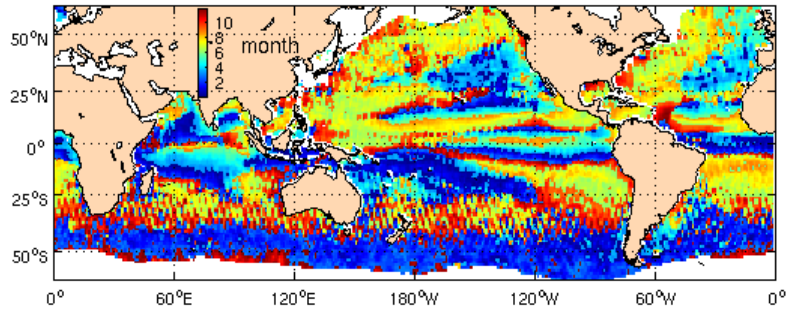
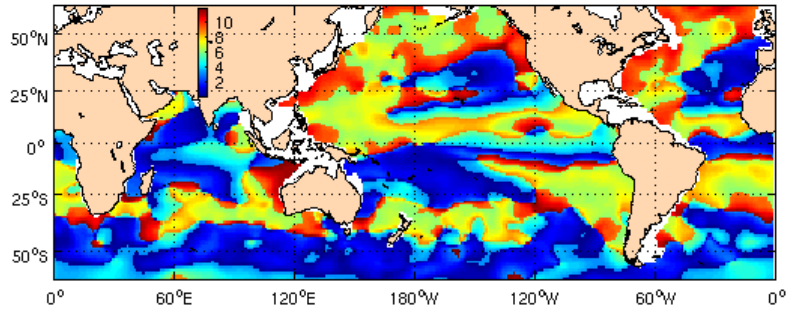
b) Aquarius SSS (phase)



d) Aquarius capSSS (phase)

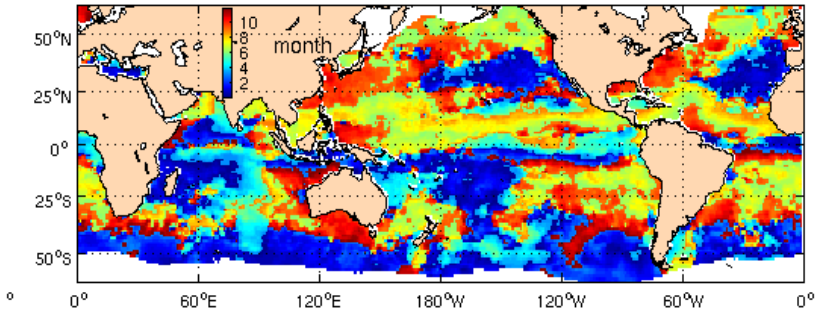


f) Argo SSS (phase)

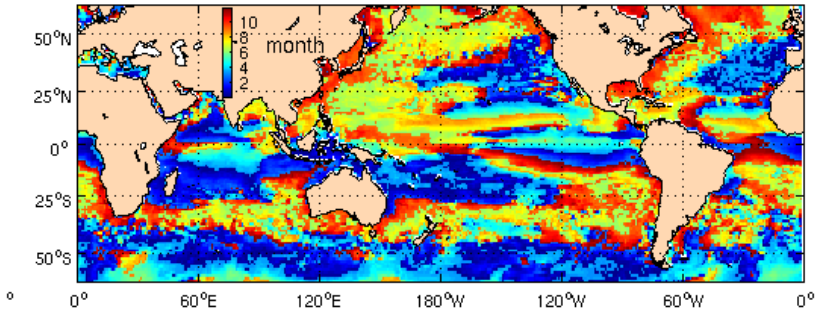


$$V(t)=A * sin\,(B * t + C)$$

h) HYCOM SSS (phase)



j) NB-ROMS SSS (phase)



- Along track noise in capSSS
- High latitude issues in aqSSS

Focusing on River Discharges

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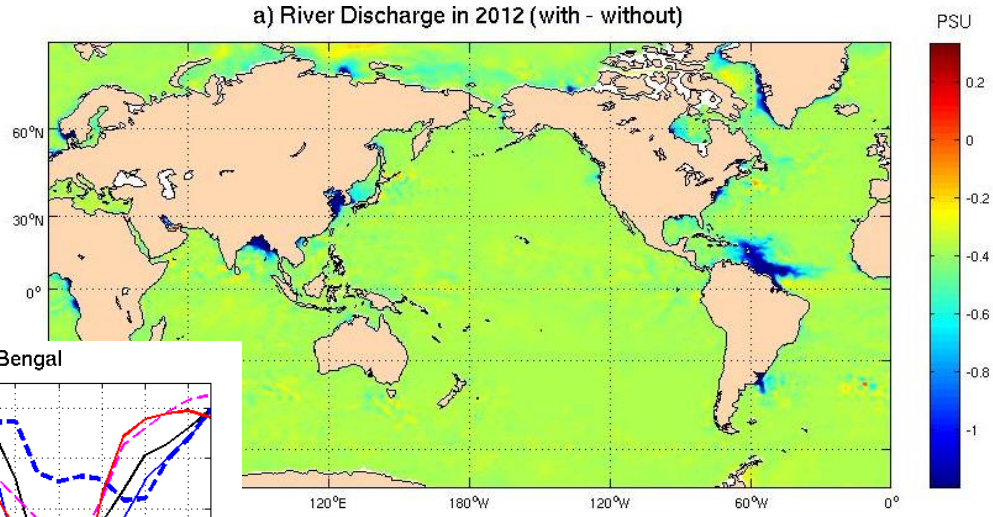

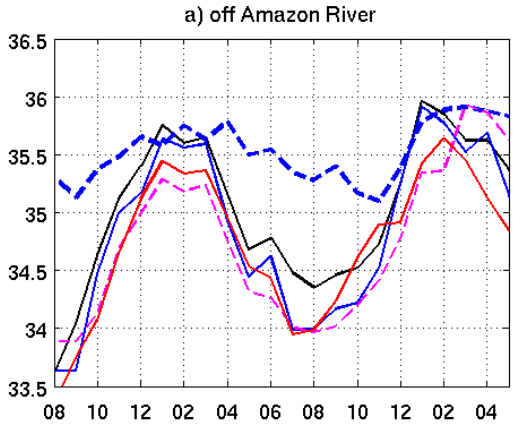

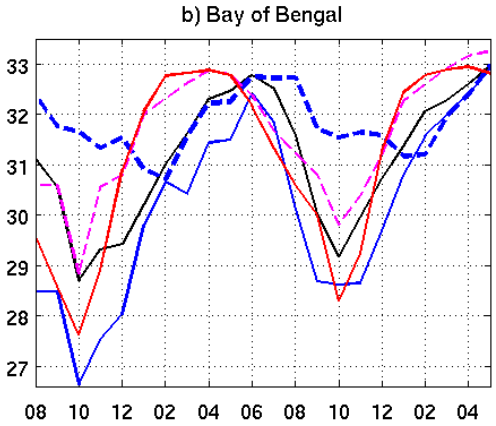

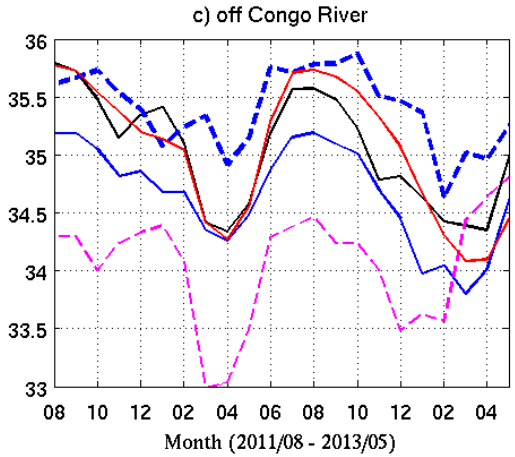

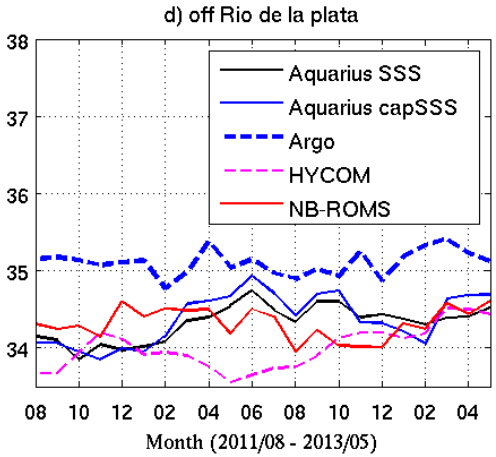

- ARGO is incapable of resolving R.
- Aquarius and ROMS are more closer.

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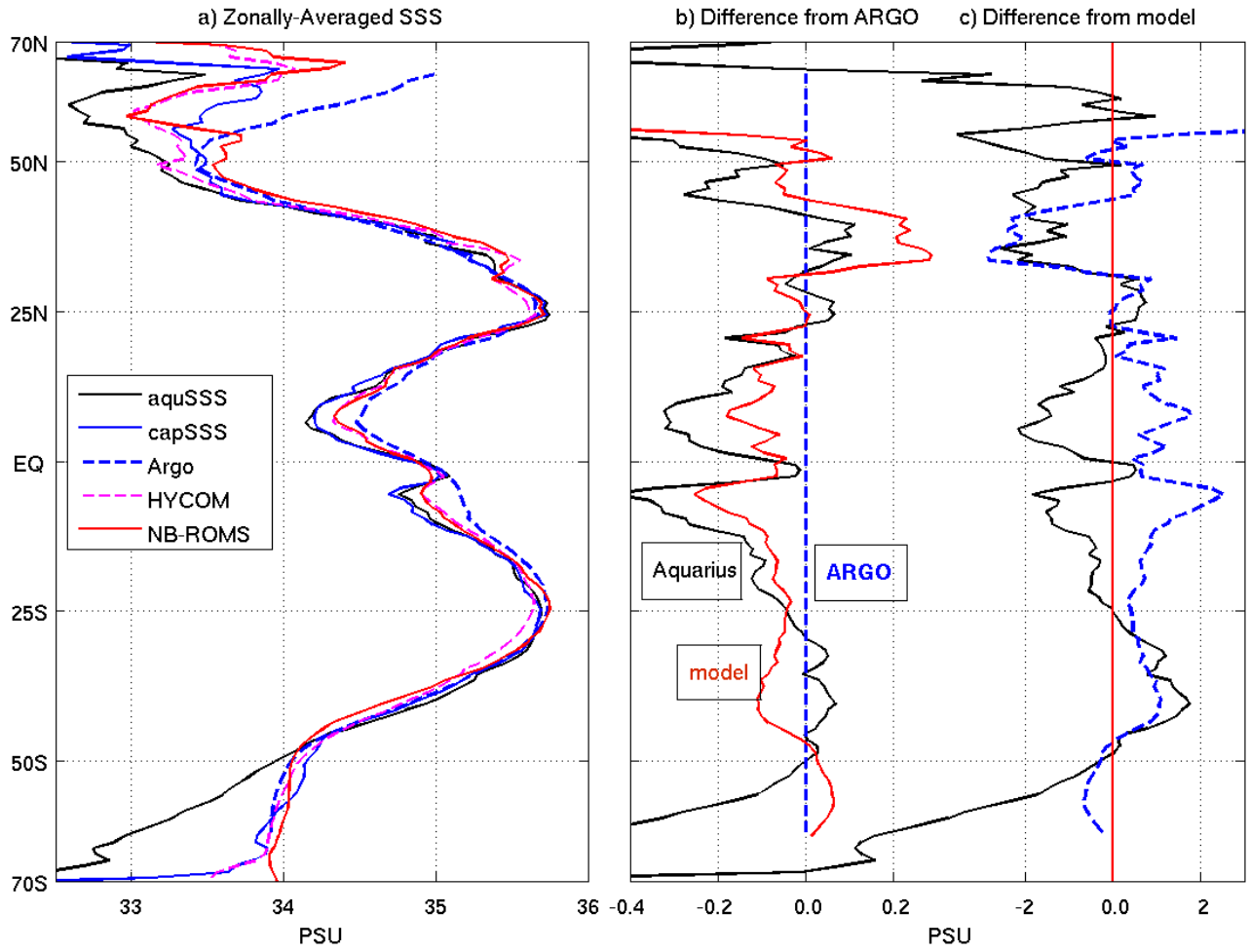
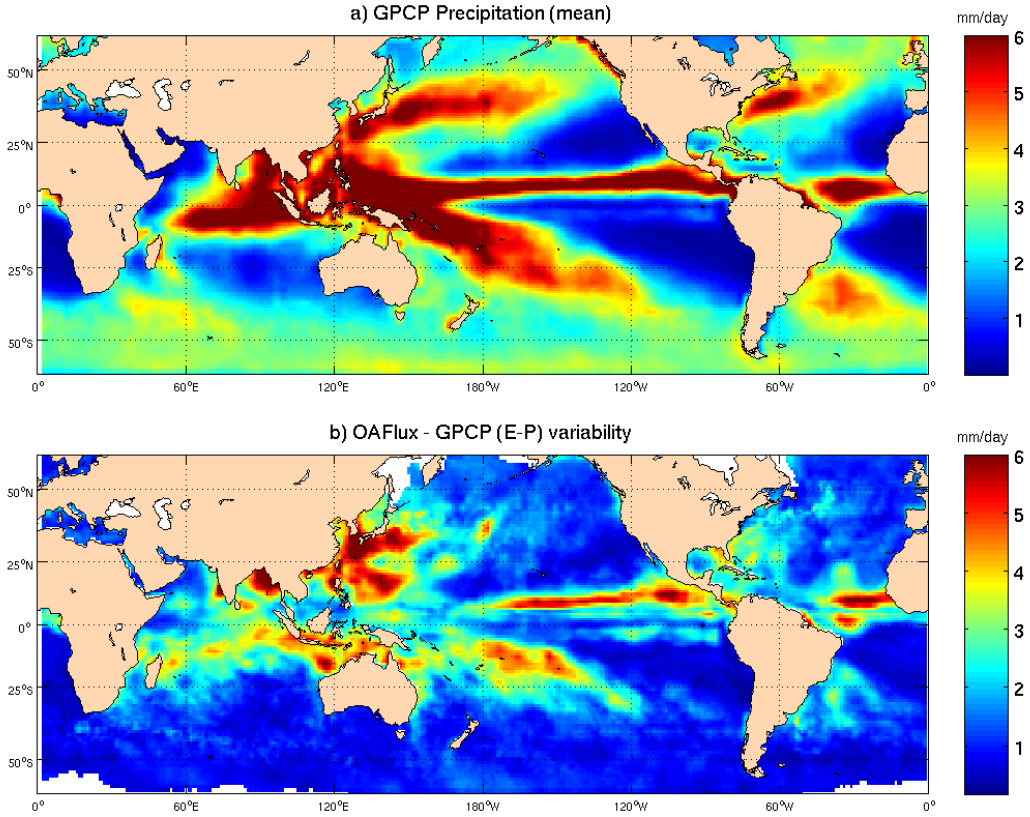
Focusing on Zonal Averages

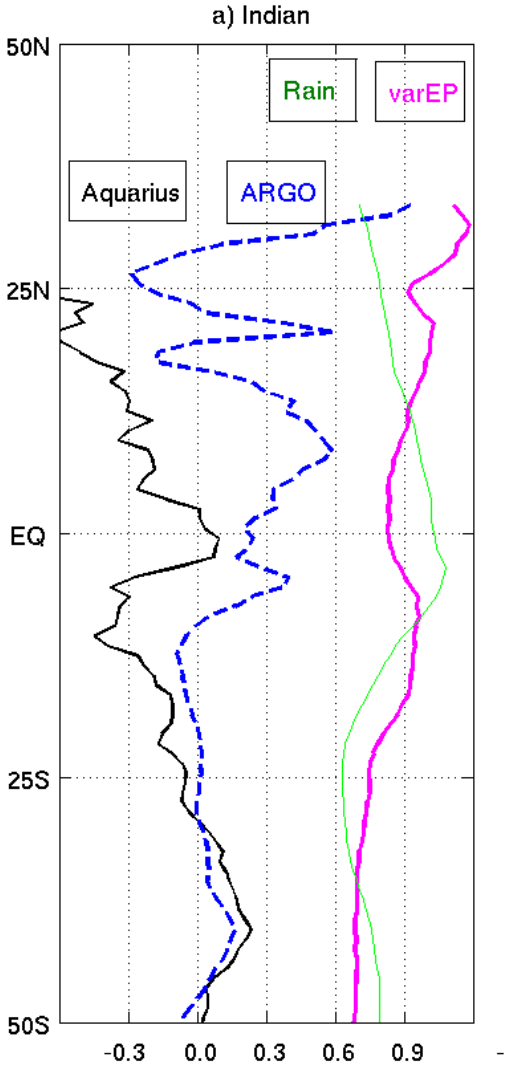


Key points:

- The five data agree well in 50S-50N;
- Aquarius and ARGO differ off equator
- Model in the middle

Focusing on P & E-P variability

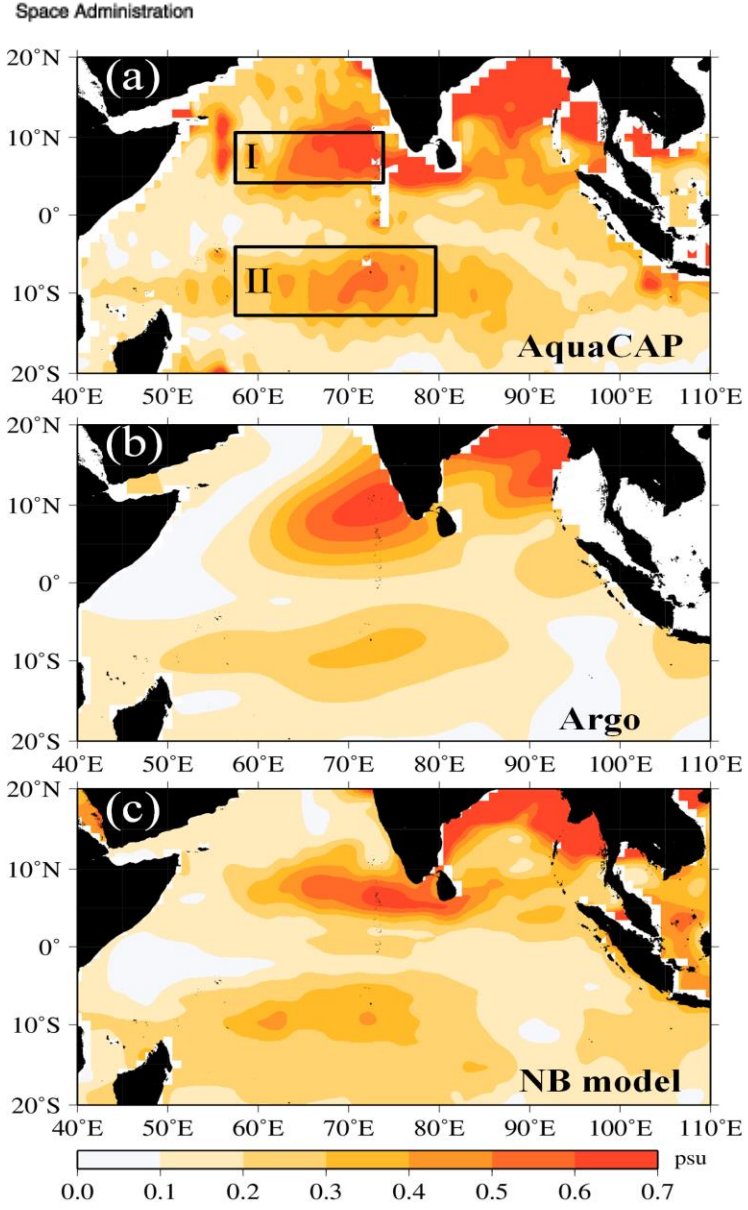


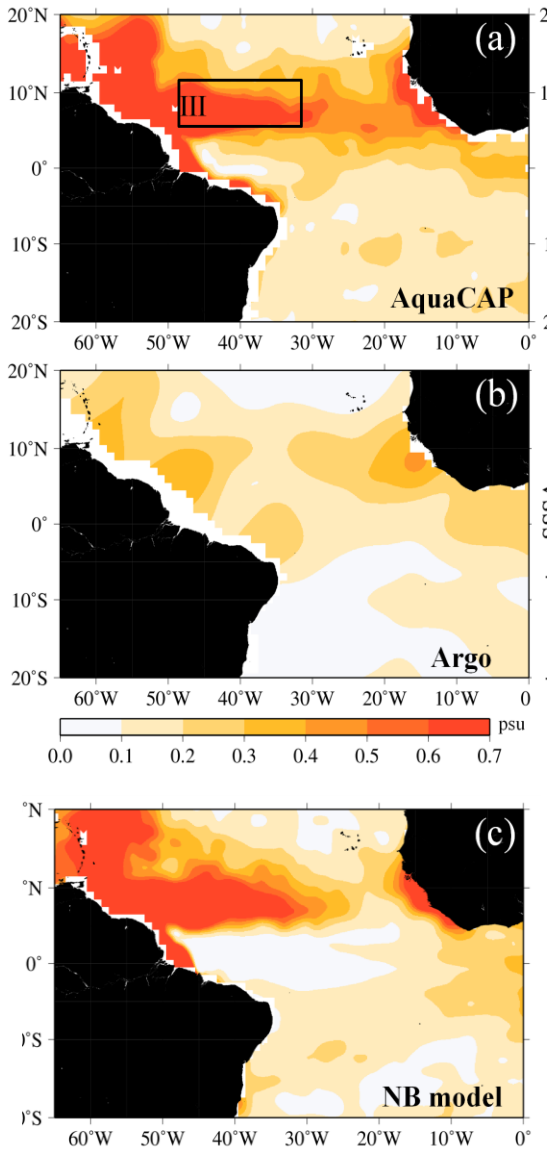


Key points:

- Rainy and E-P variability regions are different,
- Particularly, off equator.

Case Study (A)





Comparison:

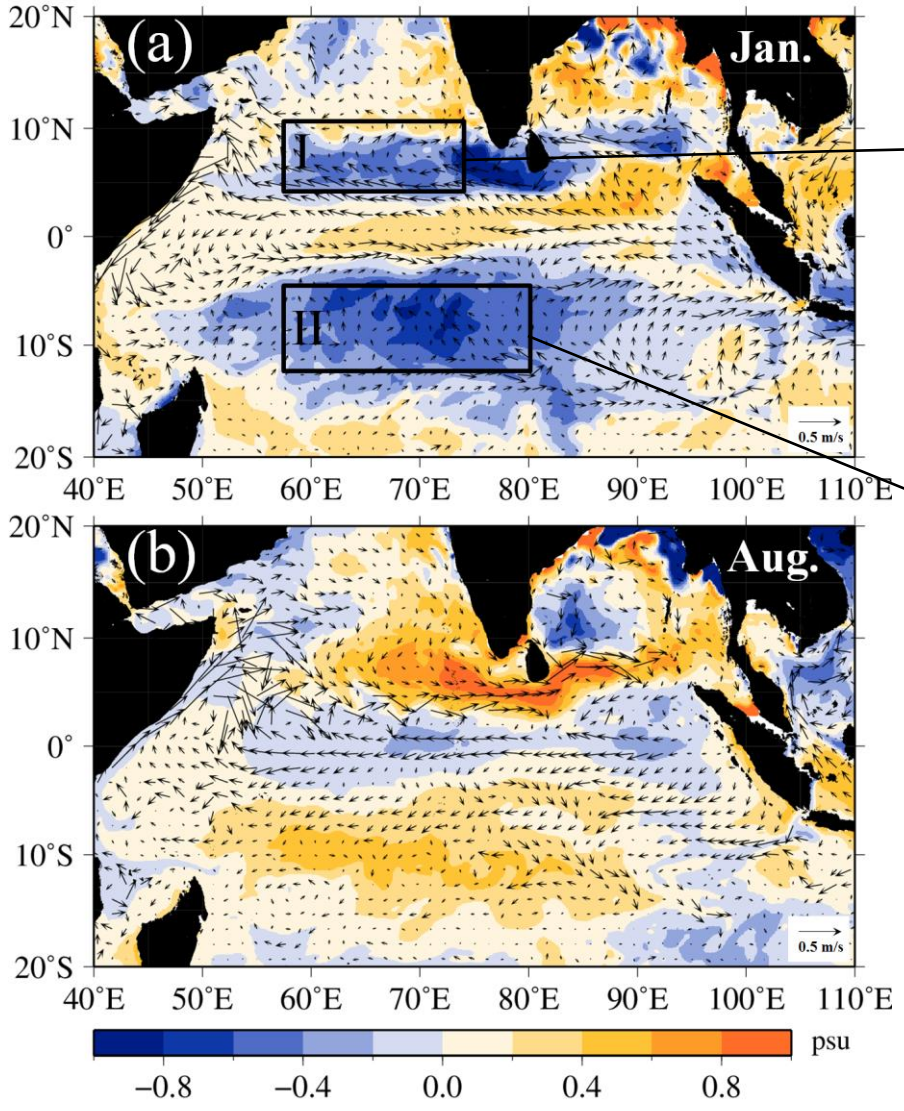
I – Arabian See

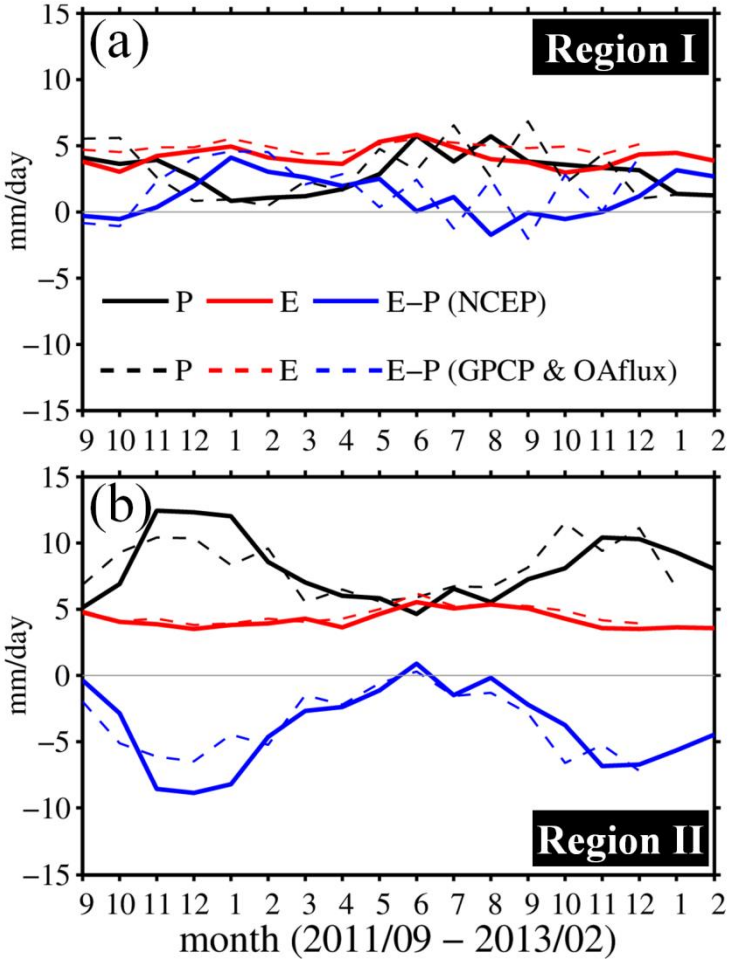
II – Tropical Indian

III – Off Amazon

Aquarius and ARGO are similar in region I, but differ in II and III.

Case Study (B)





Explanation for I & II:

Strong mixing vs. Strong E-P variability

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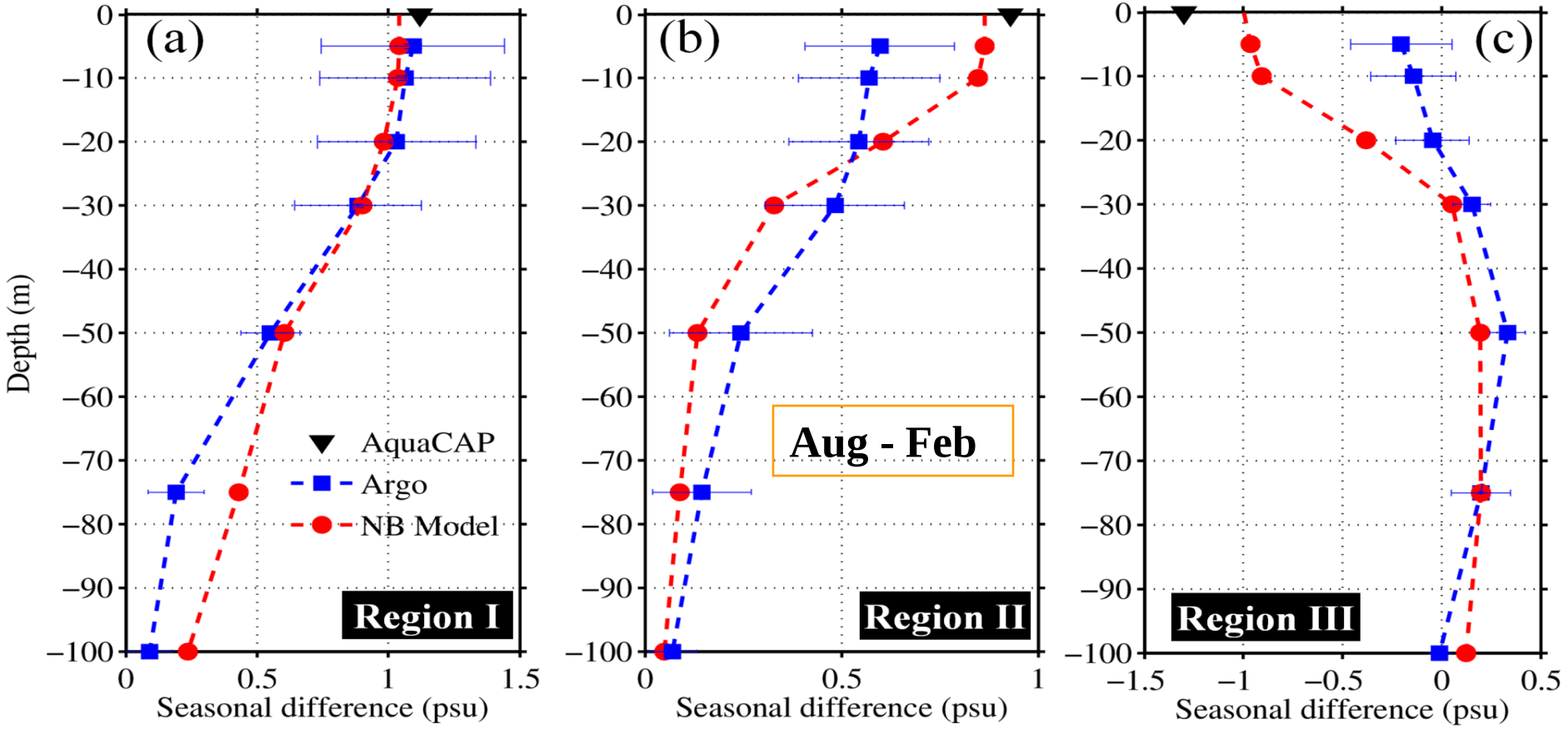
Different Physical Mechanisms

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



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Summary

We have assessed SSS variability using three SSS datasets, two ocean models, and (GPCP, OAflux, River discharge) data. They complement each other.

Main conclusions:

1. The regional differences between Aquarius and ARGO can be explained by high E-P and R variability.
2. Aquarius shows a clear advantage over ARGO in river discharge regions.

Aquarius likely make break through over coastal oceans because of the relationship between SSS and freshwater cycle.

Challenges are issues of resolution and land boundary effect.

Focusing on Regional Averages

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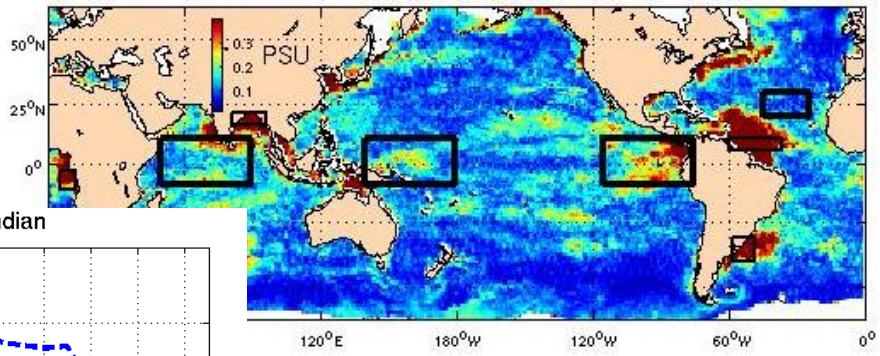

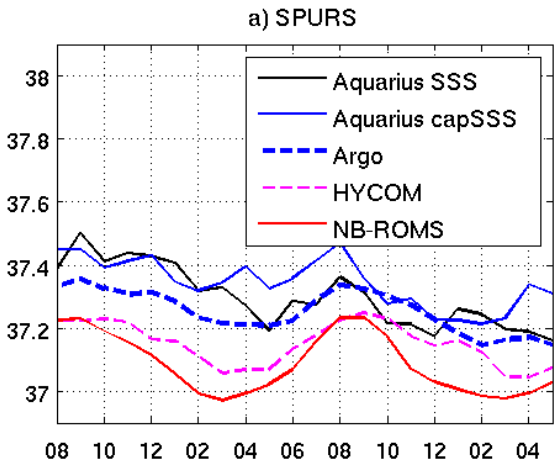

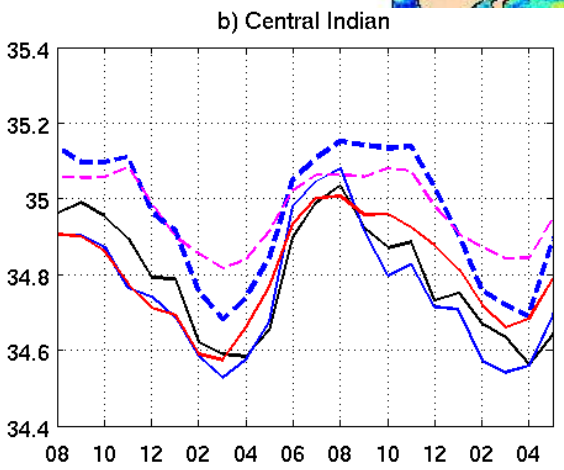

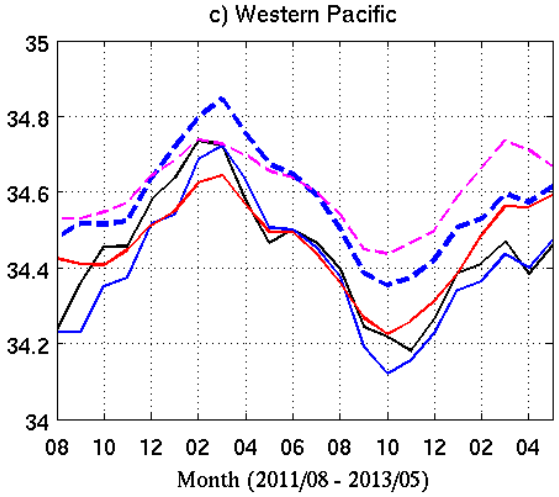

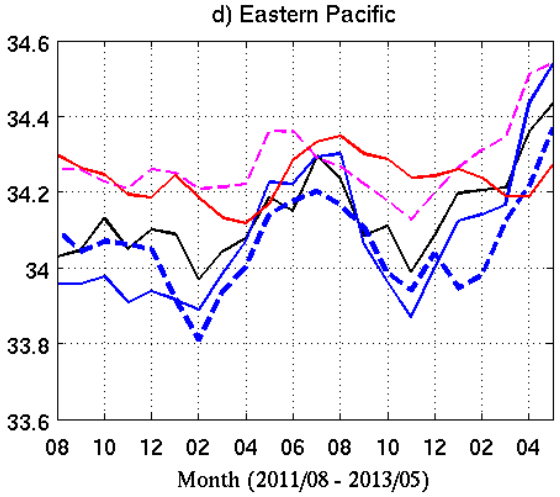

- Aquarius & ARGO within 0.2 PSU
- Models have bias