SMOS & Aquarius
science workshop
(April 17, 2013)

Evaluation of sea surface salinity observed by Aquarius and SMOS

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Introduction (1/1)

- Aquarius V2.0 has been opened to the public.
- Other SSS products also have been produced, based on different algorisms (e.g. Combined-Active-Passive (NASA/JPL)) and different measurement (SMOS).
- Evaluations of these products based on in situ observations are needed to reveal their accuracies and error structures.

Objective of this study

Evaluate SSS observed by Aquarius and SMOS including their error structures.

Data (1/1) - Level 2 -

- Satellite salinity

  Aquarius SSS (beam1)

  1) V2.0 : NASA/JPL PO.DAAC

  2) CAP V2.0 : NASA/JPL Dr. Simon Yueh

  3) RSS testbed : Remote Sensing Systems
  (galaxy correction done)

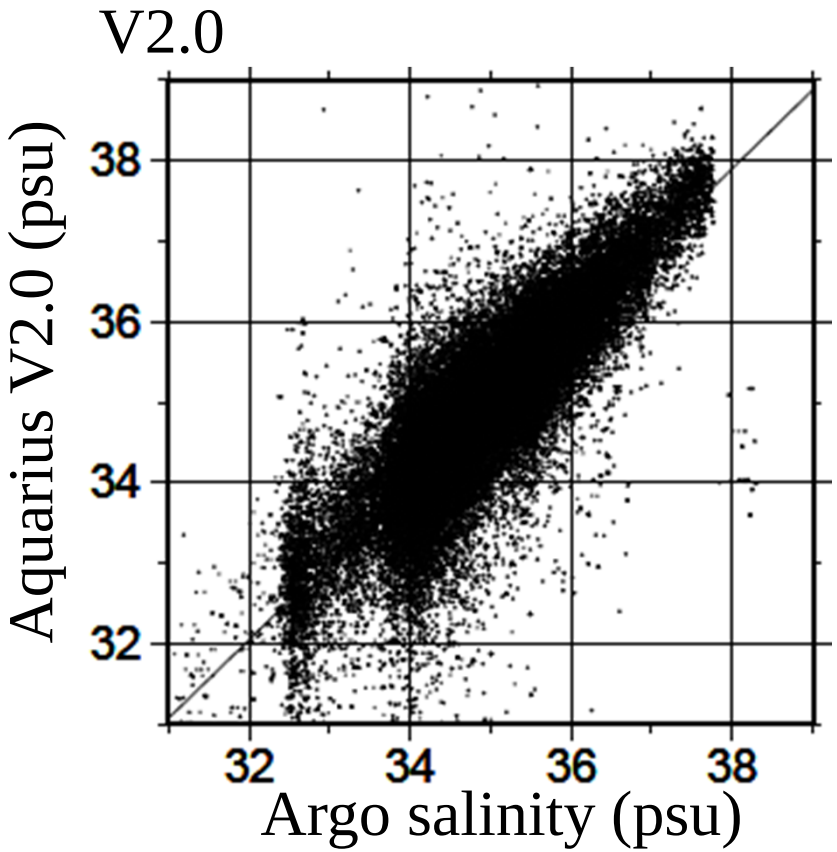
- In situ salinity

  1) Argo salinity : Global Data Assembly Center,
  realtime mode data

  2) TAO/TRITON, PIRATA, RAMA buoys

Comparison to in situ data (1/3)

Argo vs AQ V2.0



Scatter plot of collocated data

Period : 25 Aug 2011 – 31 Dec 2012
Matchup condition : 200 km, 12 h

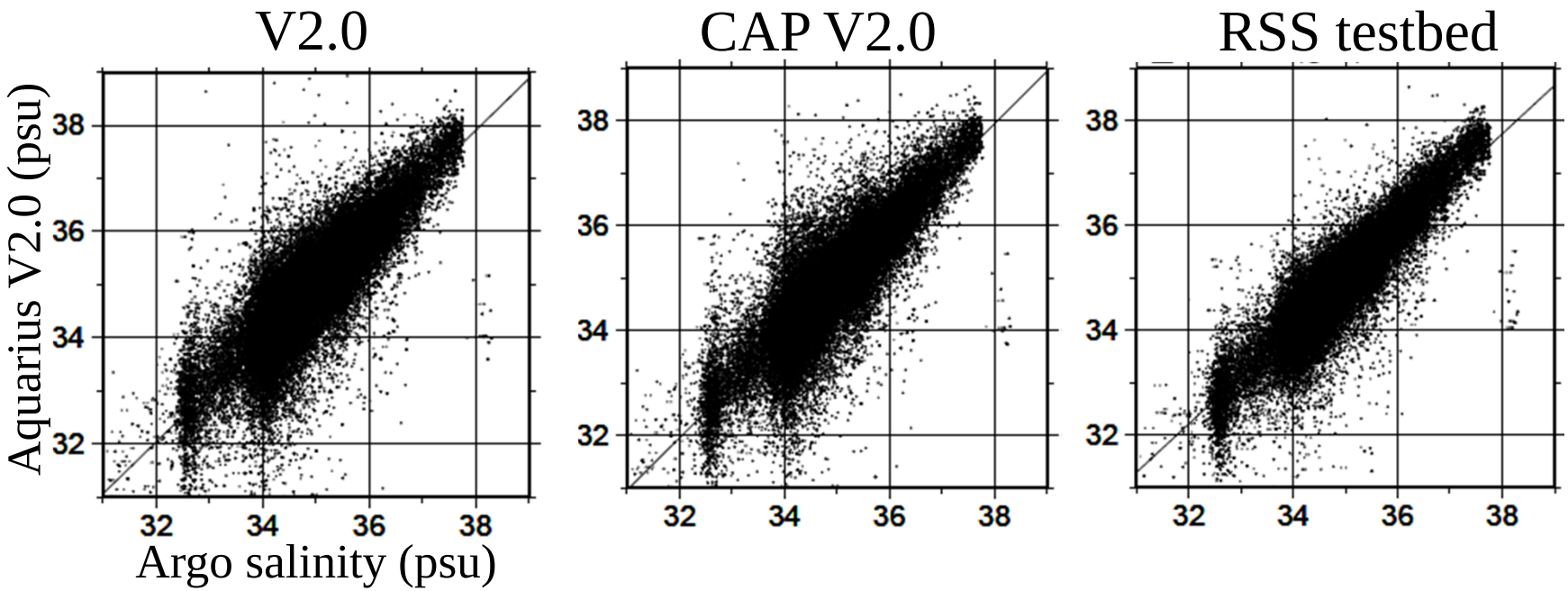
1) wind speed < 15m/s
2) Argo temperature > 5C
3) Argo depth < 12.5 dbar
4) rad_land_frac < 0.0005
5) rad_ice_frac < 0.0005

bias : -0.02 psu
Standard deviation (stddev)
: 0.58 psu

Comparison to in situ data (2/3)

Argo vs AQ

Scatter plot of collocated data



	V2.0	CAP V2.0	RSS testbed
bias :	-0.02 psu	-0.06	0.00
stddev :	0.58	0.57	0.44

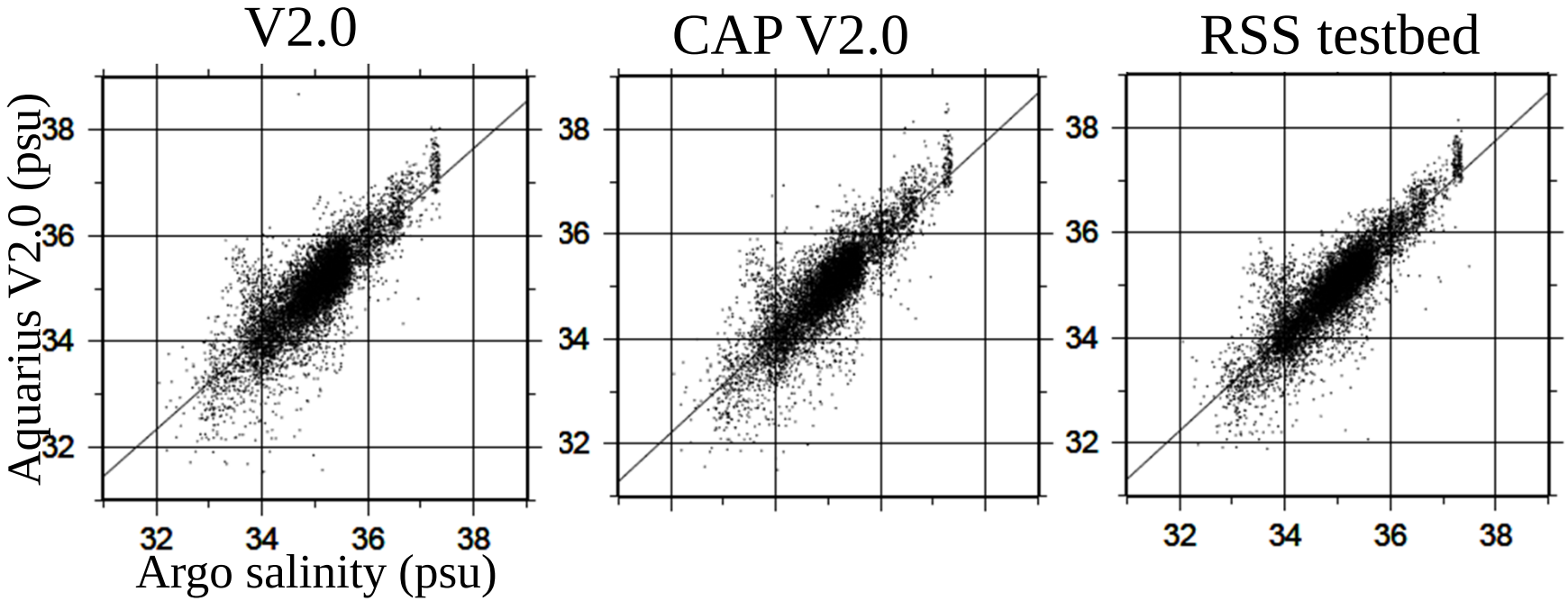
Standard deviation is large in this order

V2.0 > CAP 2.0 > RSS testbed

Comparison to in situ data (3/3)

Mooring buoy (1 dbar) vs AQ

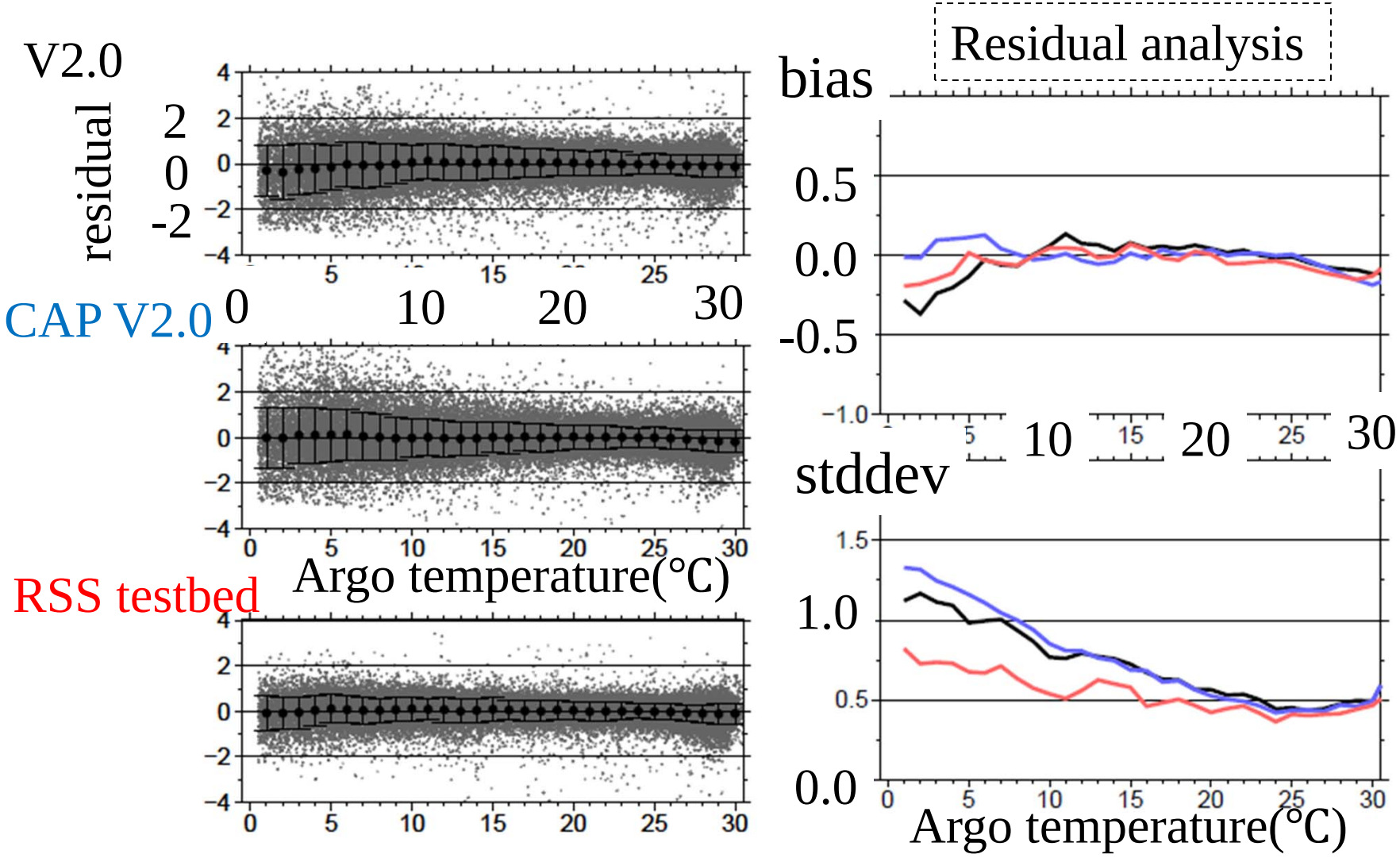
Scatter plot of collocated data



	V2.0	CAP V2.0	RSS testbed
bias:	-0.01 psu	-0.02	0.00
stddev:	0.48	0.47	0.41

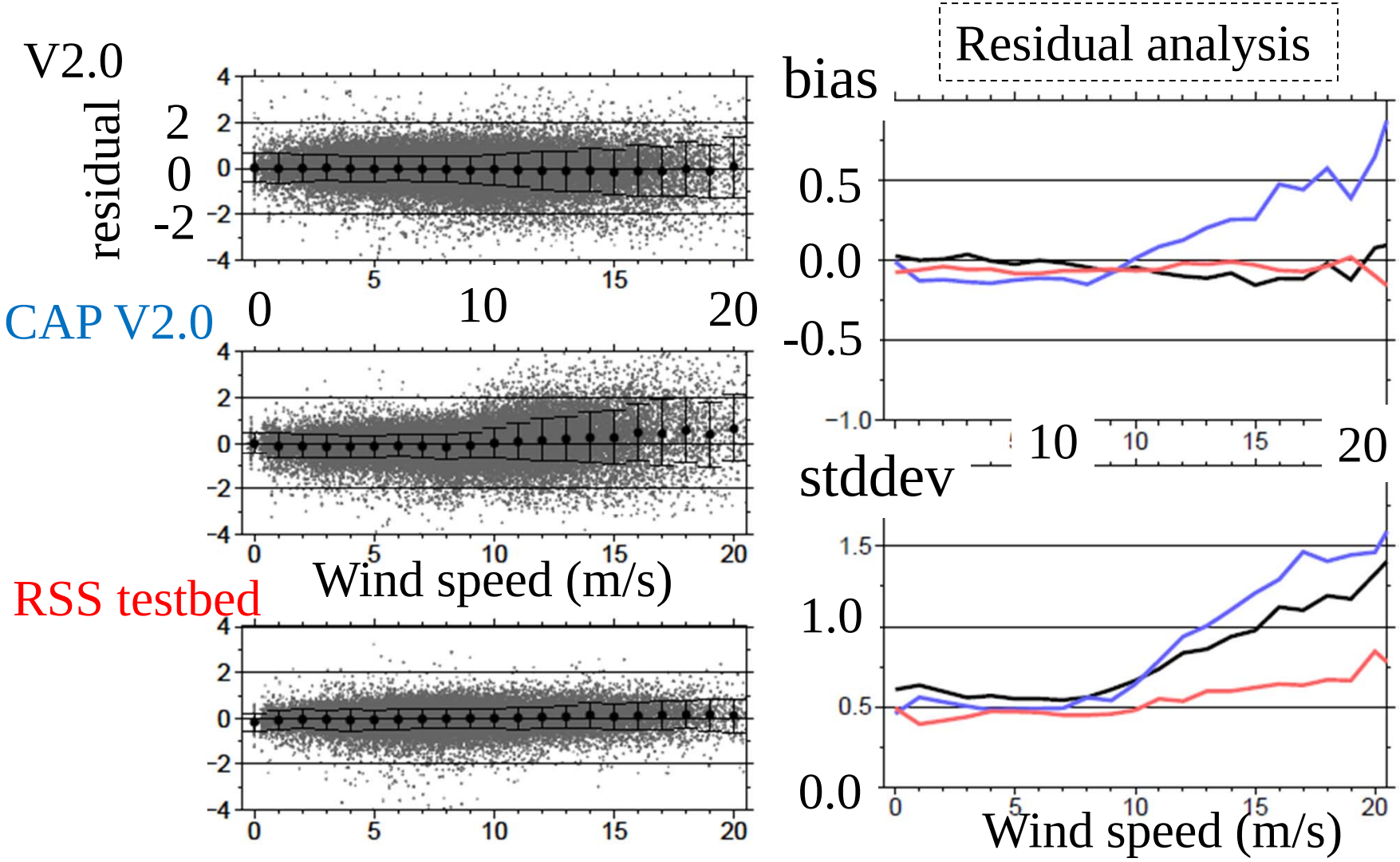
The order does not change

Error structure (1/3) ~SST~



The smallest stddev is found in RSS testbed.

Error structure (2/3) ～wind speed～

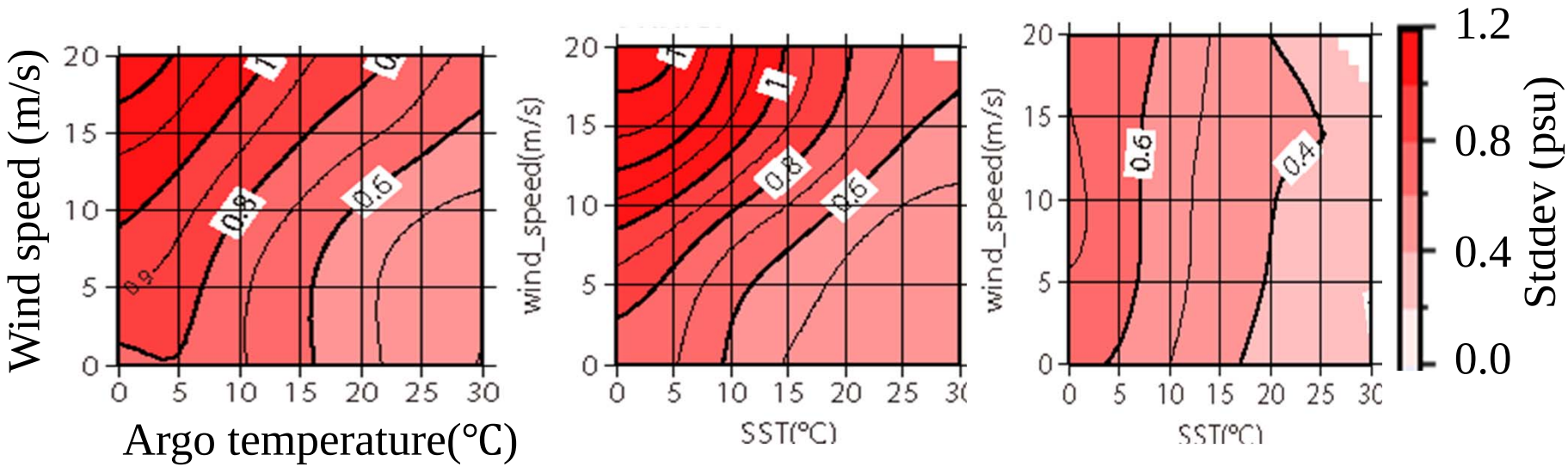


The stddev in RSS testbed is the smallest.

Error structure (3/3)　～SST and wind speed～

stddev

V2.0　　CAP V2.0　　RSS testbed

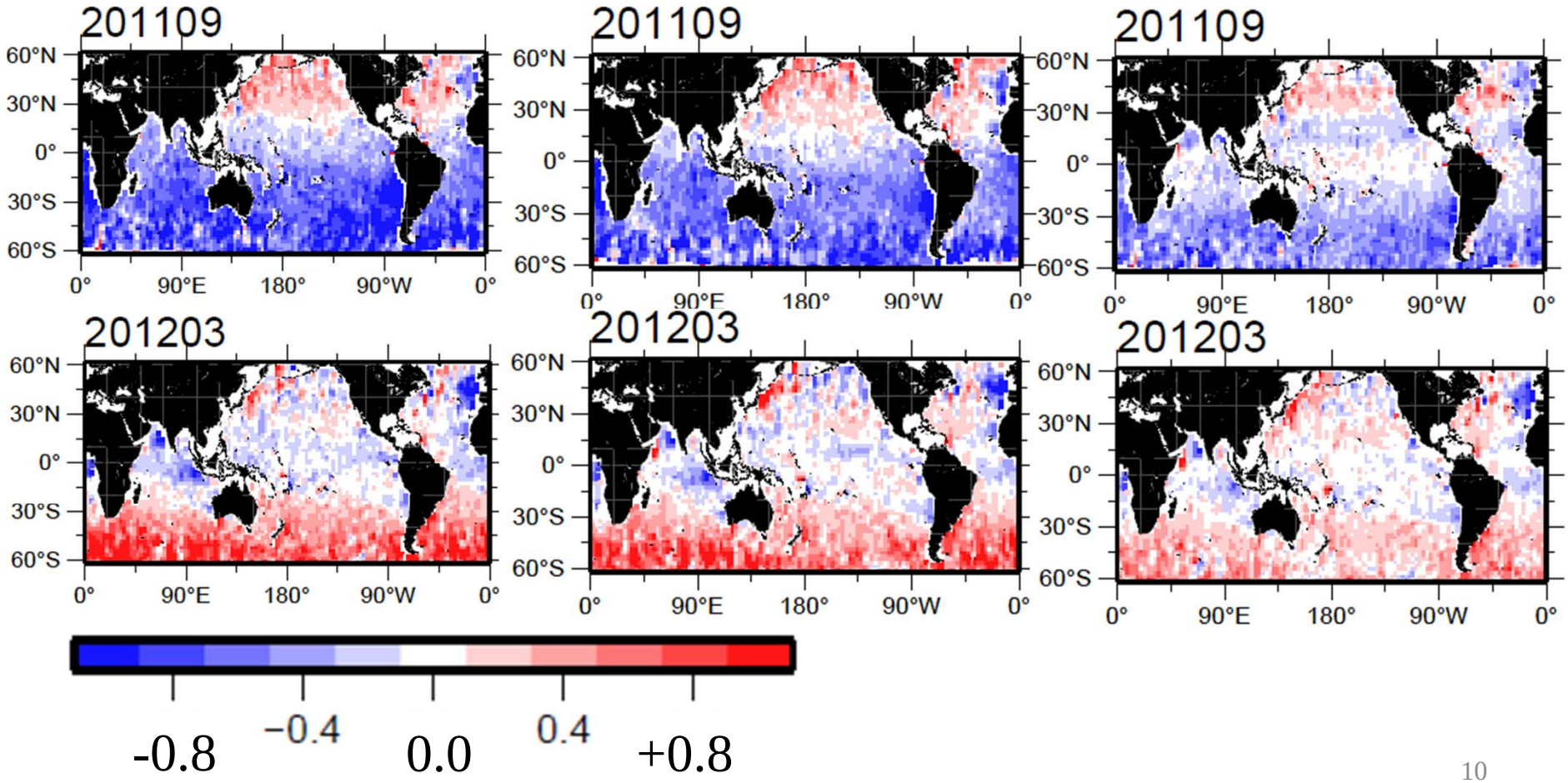


1) V2.0 has large stddev under low SST and high wind speed conditions.
2) The contrast is strong for stddev in CAP V2.0.
3) Wind speed dependency is weak for stddev in RSS testbed.

Ascending minus descending seasonality (1/2)

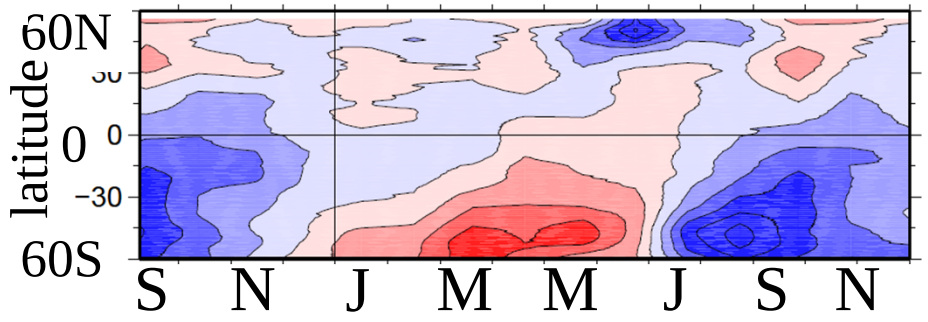
Ascending – descending

V2.0 CAP V2.0 RSS testbed



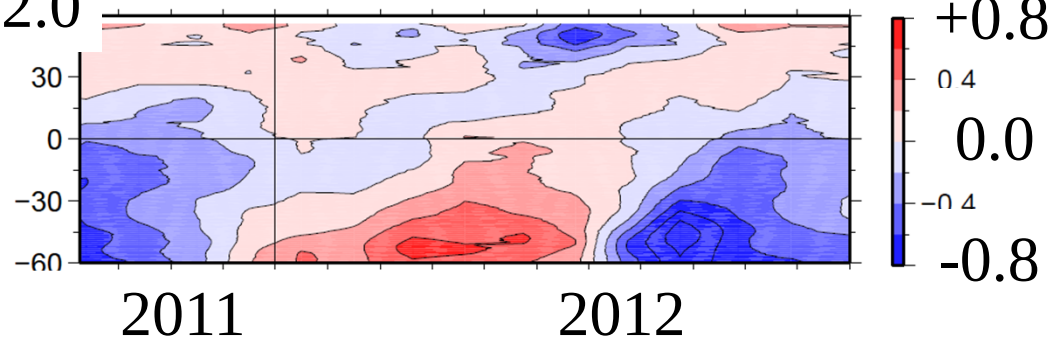
Ascending minus descending seasonality (2/2)

V2.0

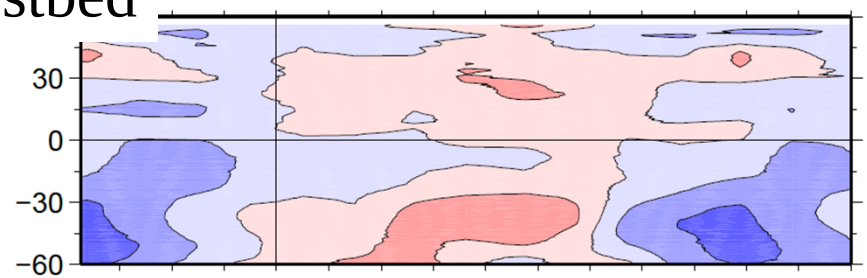


Ascending – descending
(latitude-time diagram)

CAP V2.0



RSS testbed



SSS bias between ascending and descending is improved for RSS testbed.

However, it still remains.

Data (1/1) - Level 3 -

○Satellite salinity

1) Aquarius Level 3 V2.0 SSS : NASA/JPL PO.DAAC

2) SMOS Level 3 reprocessed SSS : CATDS, CNES

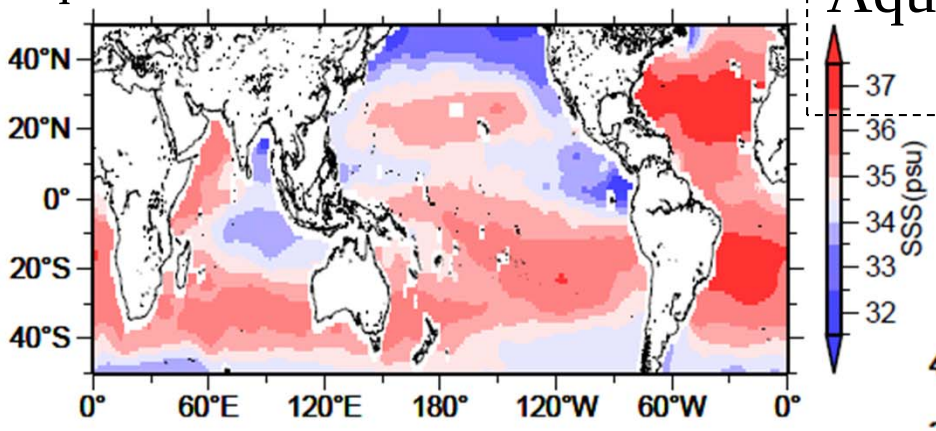
○Salinity data

1) Argo optimal interpolation : JAMSTEC (MOAA GPV)
(Argo salinities are interpolated based on World Ocean Atlas 2001 as the first guess)

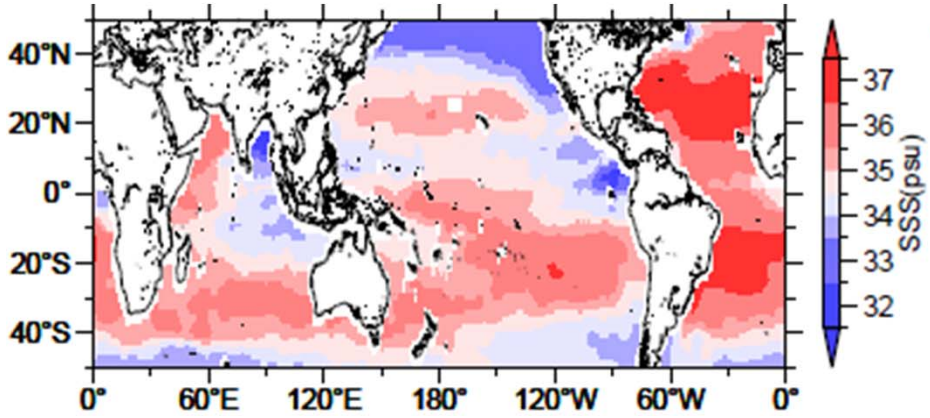
2) Assimilation data system : Japan Meteorological Research Institute (MRI)
(In-situ and satellite altimeter data are assimilated. Combination of OGCM and EOF)

Comparison to monthly JAMSTEC Argo OI (1/3)

Aquarius V2.0

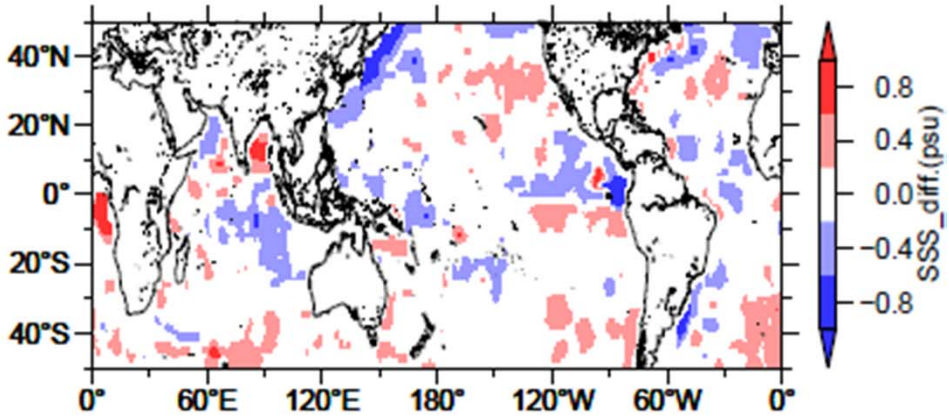


JAMSTEC Argo OI (10m)



Aquarius V2.0 v.s. JAMSTEC Argo OI (March 2012)

Aquarius V2.0 – JAMSTEC Argo OI



Stddev is 0.38 psu (>0.2 psu)

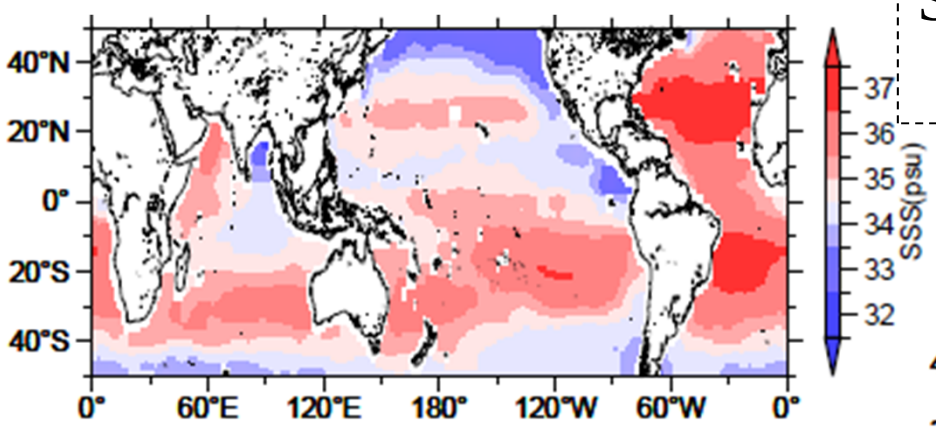
Residual SSS are negative

1) low latitude

2) Kuroshio and Gulf stream

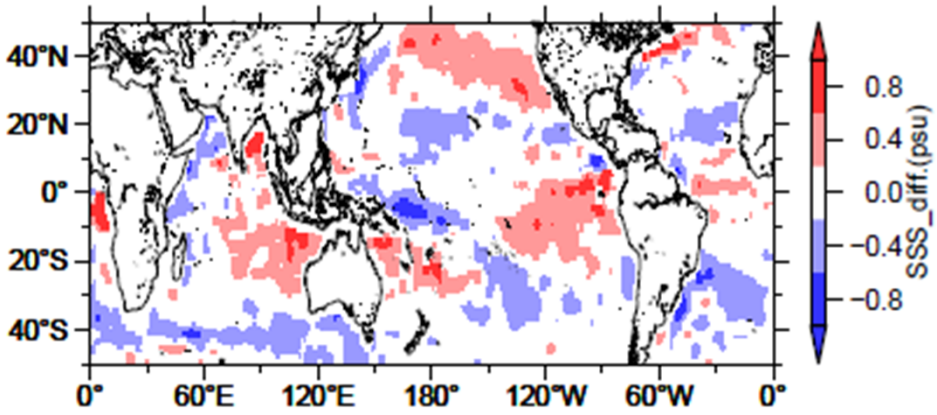
Comparison to monthly JAMSTEC Argo OI (2/3)

SMOS

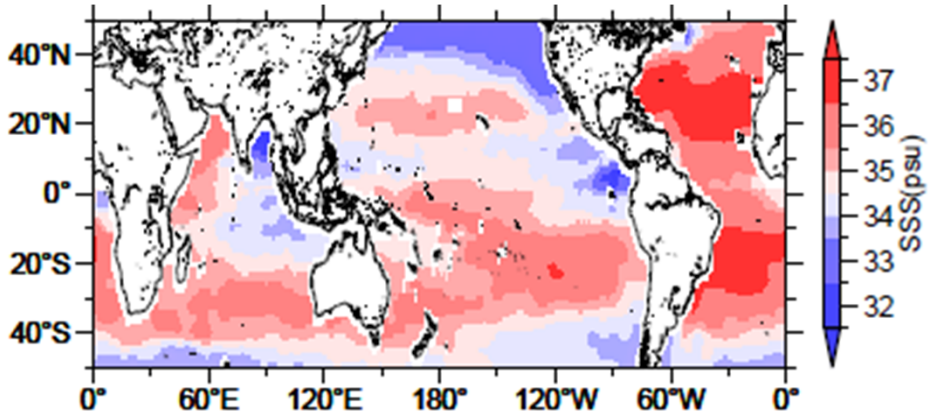


SMOS v.s. JAMSTEC Argo OI (March 2012)

SMOS – JAMSTEC Argo OI

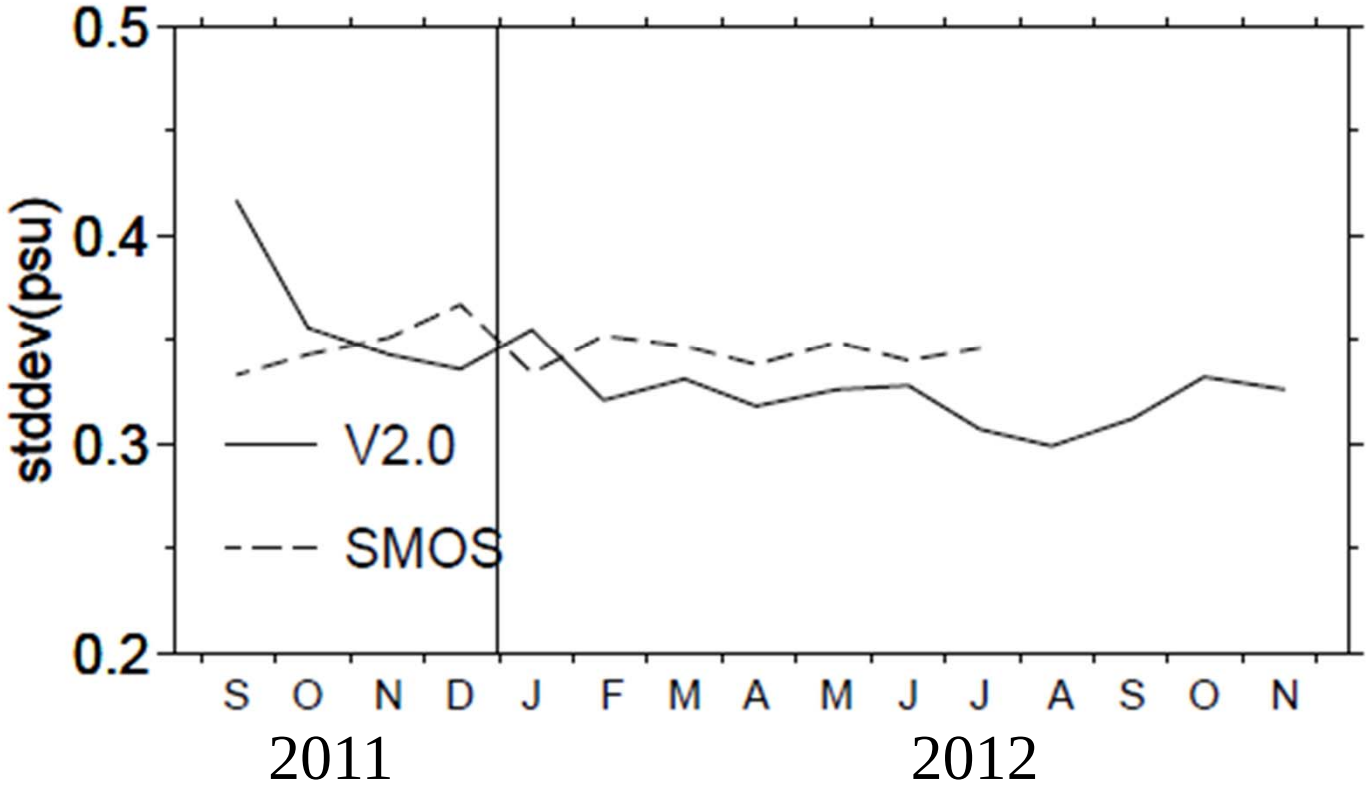


JAMSTEC Argo OI (10m)



Comparison to monthly JAMSTEC Argo OI (3/3)

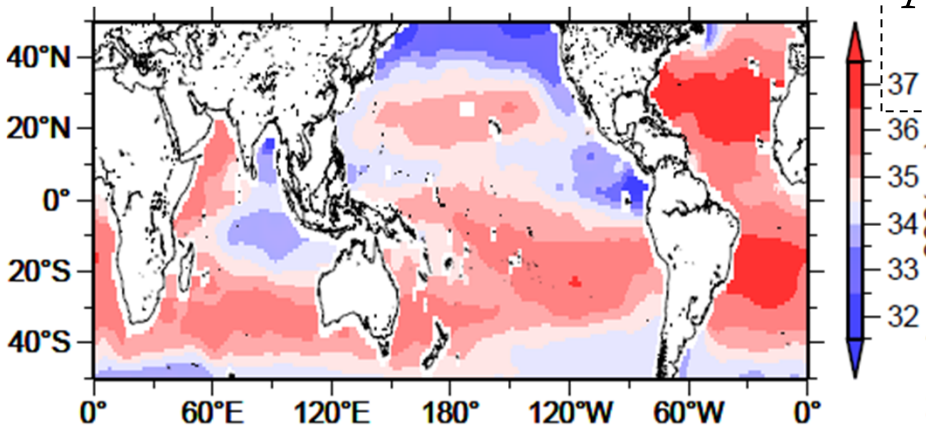
Stddev of residual SSS (psu)
(40S-40N)



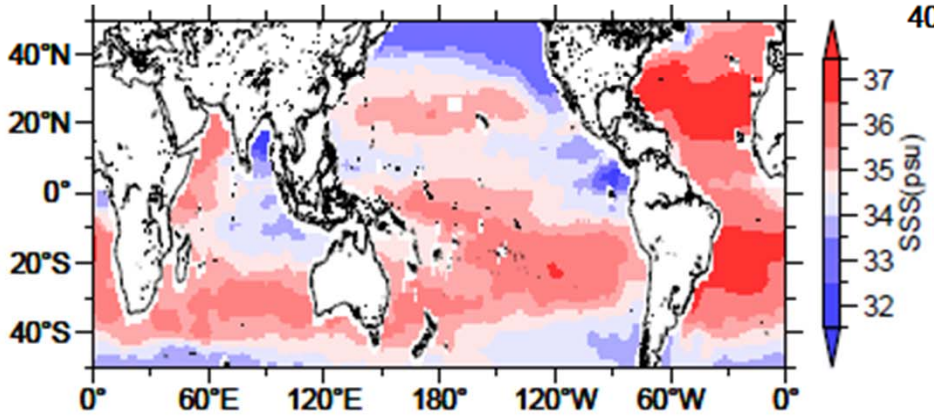
Aquarius 0.33 psu < SMOS 0.35 psu

Comparison to J-MRI assimilation system (1/3)

Aquarius V2.0

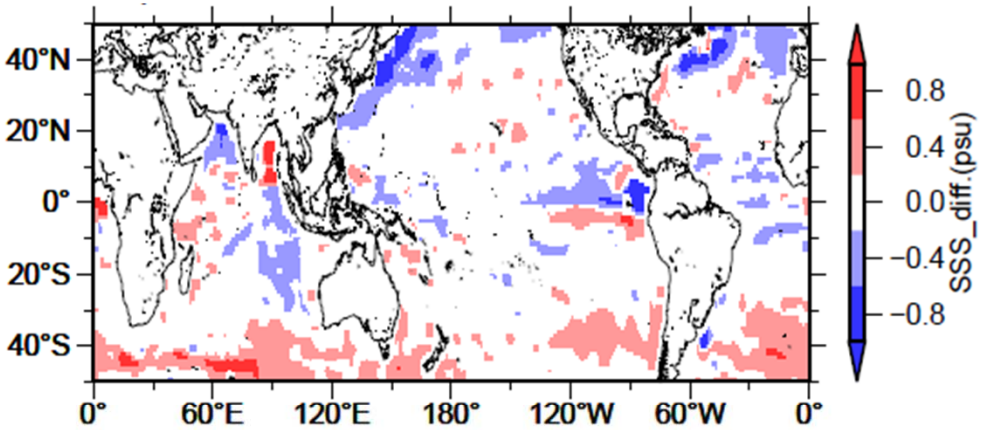


MRI assimilation SSS (1m)



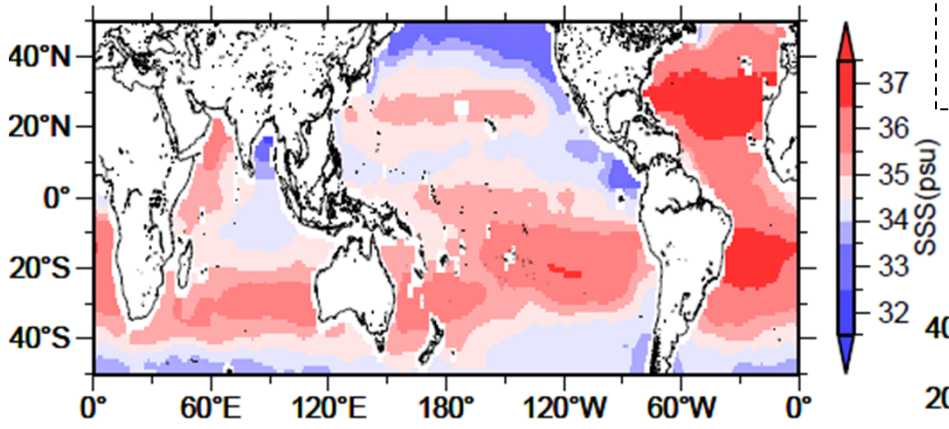
Aquarius V2.0 v.s. J-MRI assimilation (March 2012)

Aquarius V2.0 – MRI assimilation SSS



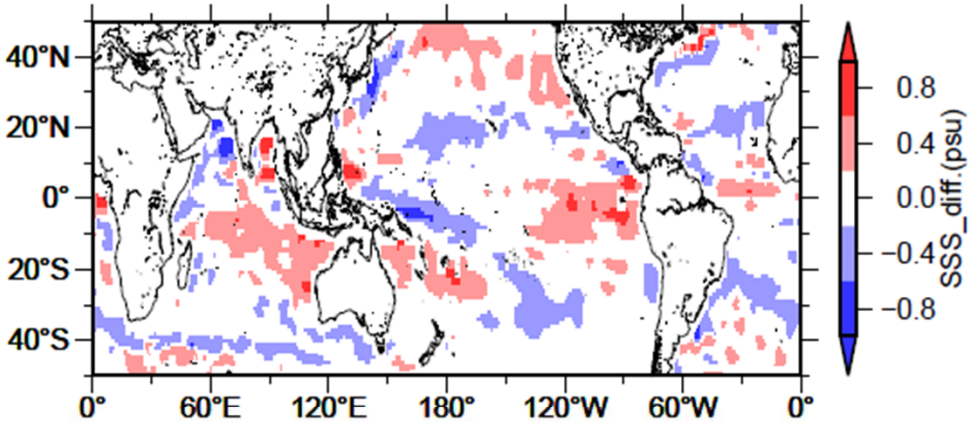
Comparison to J-MRI assimilation system (2/3)

SMOS

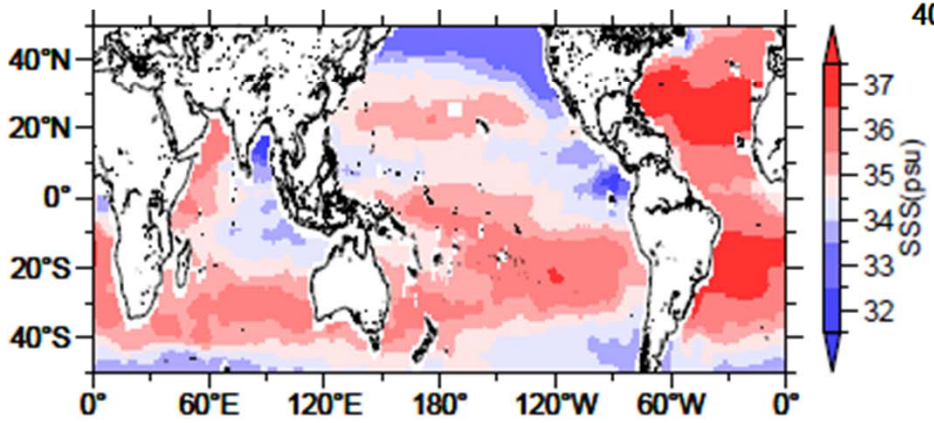


SMOS v.s. J-MRI assimilation (March 2012)

SMOS – MRI assimilation SSS

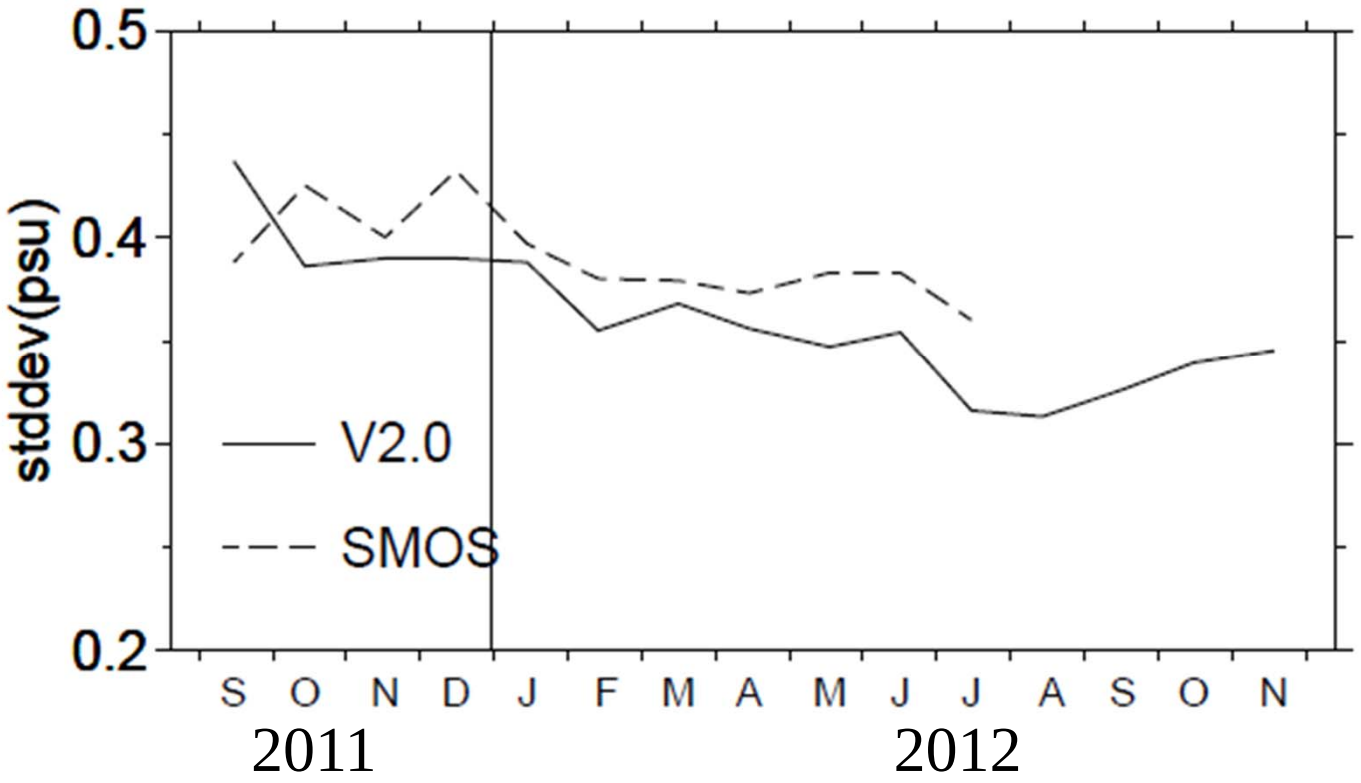


MRI assimilation SSS (1m)



Comparison to J-MRI assimilation system (3/3)

Stddev of residual SSS (psu)
(40S-40N)



Aquarius 0.36 psu < SMOS 0.39 psu

Summary (1/2)

○Aquarius and SMOS SSSs were evaluated.

Level 2 (Aquarius)

- Stddev of residual SSS using Argo ranged from 0.44 - 0.58 psu.
- Stddev in RSS testbed was the smallest
- The stddev showed different error structures.
  1) V2.0 : large stddev under low SST and high wind speed.
  2) CAP V2.0 : the contrast was strong.
  3) RSS testbed : weak dependency for wind speed.
- Ascending and descending bias was improved for RSS testbed. However it was not removed completely.

Summary (2/2)

Level 3 (Aquarius and SMOS)

- Stddev of the residual for the Aquarius SSS was smaller than that of SMOS.
  - JAMSTEC Argo OI : 0.33 psu (AQ) and 0.35 psu (SMOS)
  - J-MRI assimilation : 0.36 psu (AQ) and 0.39 psu (SMOS)

Acknowledgment

We would like to thank all the data provider!