Aquarius optimum interpolation analysis for global and regional studies

3 beams 390 km wide swath

84x120 km

96x156 km

76x94 km
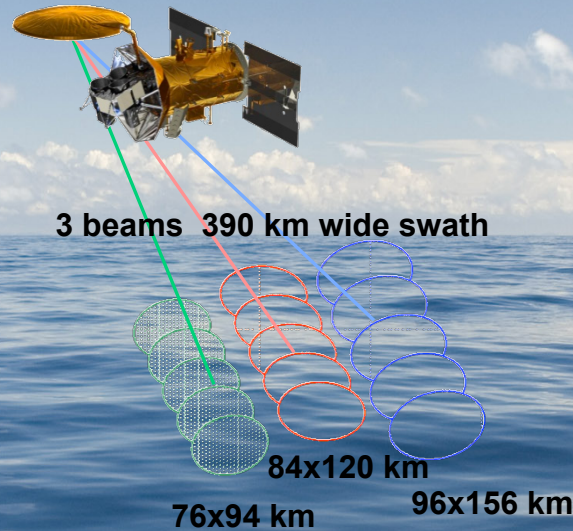
O. Melnichenko, P. Hacker, N. Maximenko, G. Lagerloef, and J. Potemra

Objectives: To develop gridded SSS analysis from Aquarius Level 2 (swath) data and improve the utility (reduce the noise) of the SSS fields:

1) Near-global coverage

2) From Sep 2011 - present

3) (O~150 km) spatial scales

4) Weekly temporal scales

5) Global RMS error < 0.2 psu

Challenges: satellite biases, high level of instrument noise; correlated errors

Approach: 1) correction for large-scale biases, 2) optimum interpolation (OI) that takes into account analyzed errors on the observations, specific to the Aquarius instrument
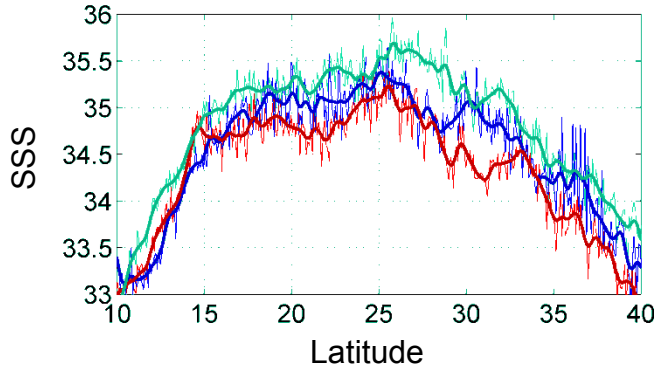
Correction for large-scale satellite biases: $S_{adj} = S_{obs} - \Delta S$
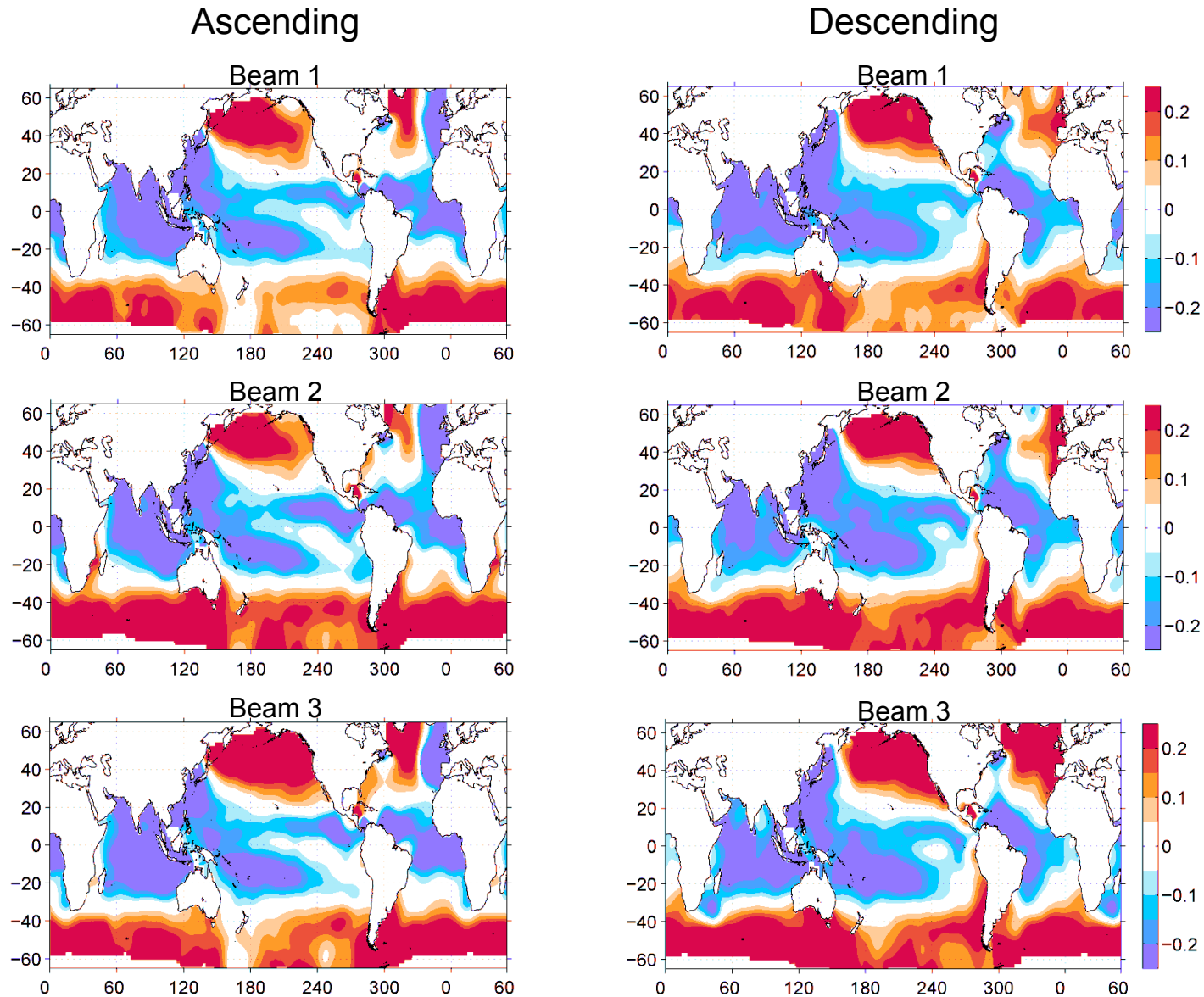
Mean spatial bias correction fields for Aquarius ascending (left) and descending (right) data and for each of the three beams.
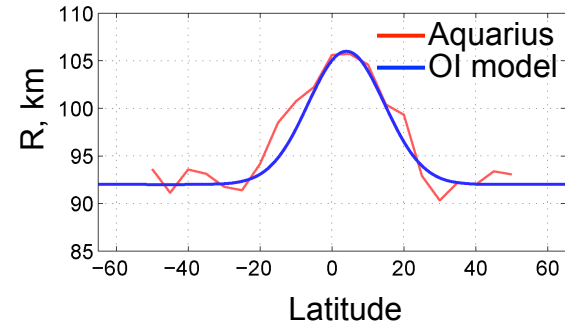
Input information for OI

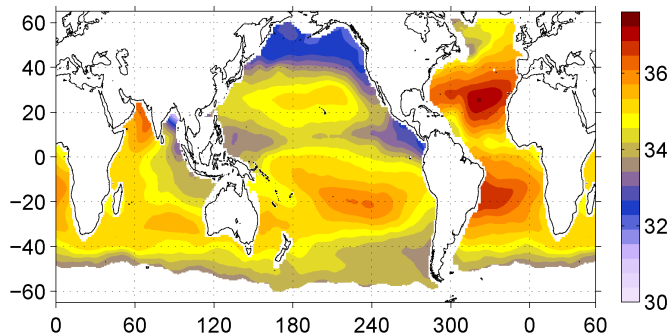## Input data: Aquarius along-track SSS smoothed with a running Hanning filter of half-width of ~60 km.

Signal covariance: from Aquarius L2 data

$$c(r) = \exp(-r^2 / R^2)$$

$92 < R < 106$ km

First guess: Argo-derived monthly SSS (IPRC product)

Example: September 2011

Long-wavelength error covariance:
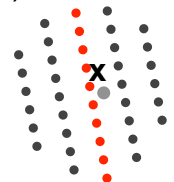
$$c_{long}(l) = \exp(-l / R_l)$$

$R_l = 500$ km

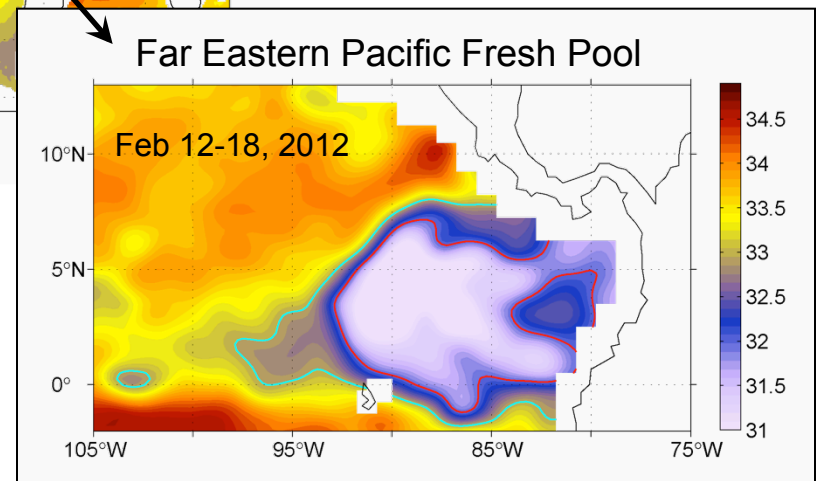Statistics of the inter-beam biases are inferred from Aquarius – HYCOM inter-comparison.

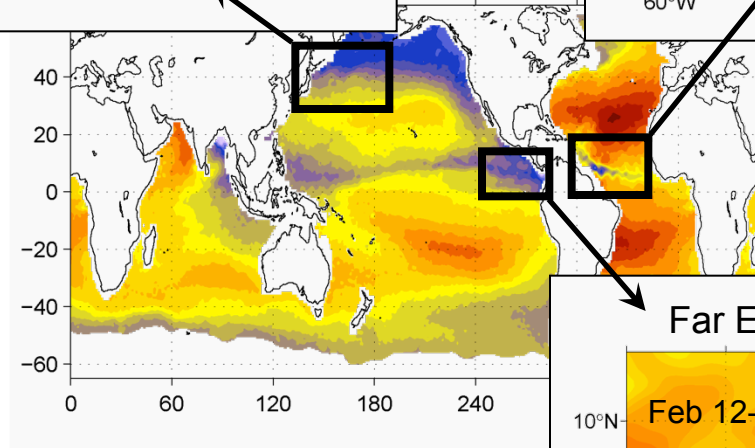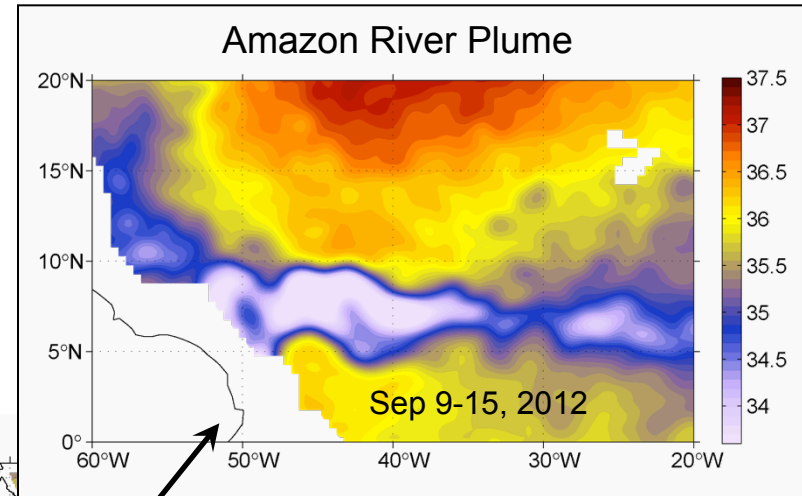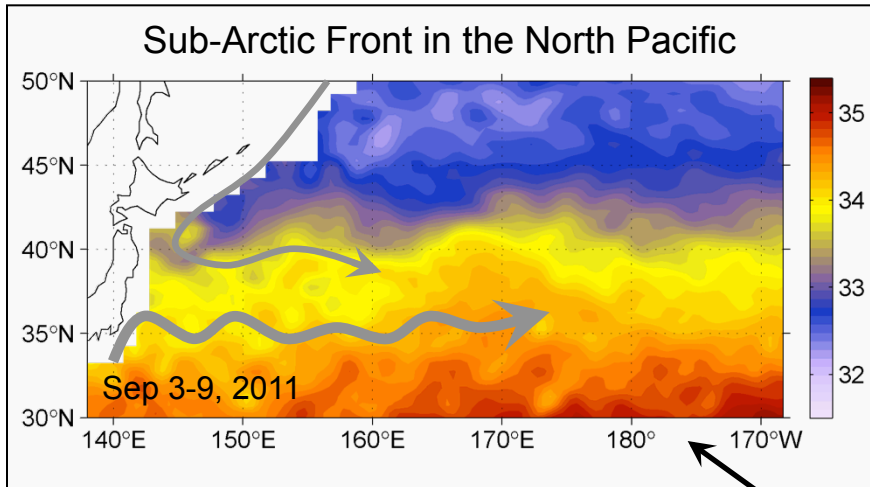Error covariance matrix (Le Traon et al., 1998):

$$< \varepsilon_i \varepsilon_j > = \delta_{ij} \sigma_w$$

$$< \varepsilon_i \varepsilon_j > = \delta_{ij} \sigma_w + \sigma_{long}$$

Melnichenko et al. [2014], JAOTec, 31, 1583-1600

A new gridded SSS product from Aquarius

Sub-Arctic Front in the North Pacific

Sep 3-9, 2011

Amazon River Plume

Sep 9-15, 2012

Far Eastern Pacific Fresh Pool

Feb 12-18, 2012

The Aquarius OI SSS dataset is open for free unrestricted use and can be accessed from the APDRC webpage:
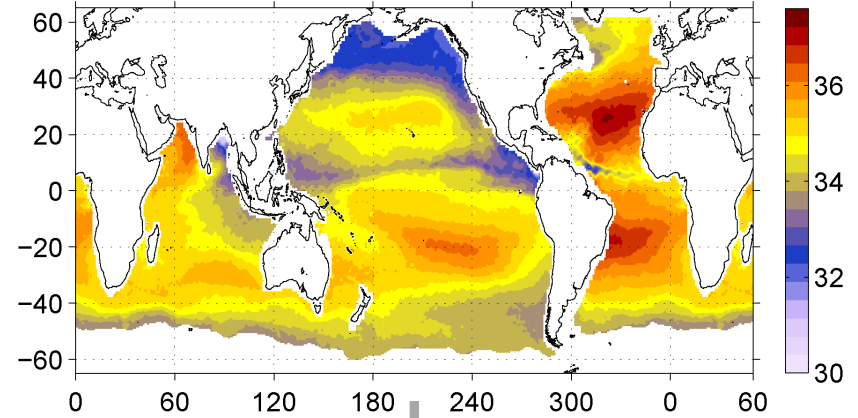
http://apdrc.soest.hawaii.edu/datadoc/oisss.php

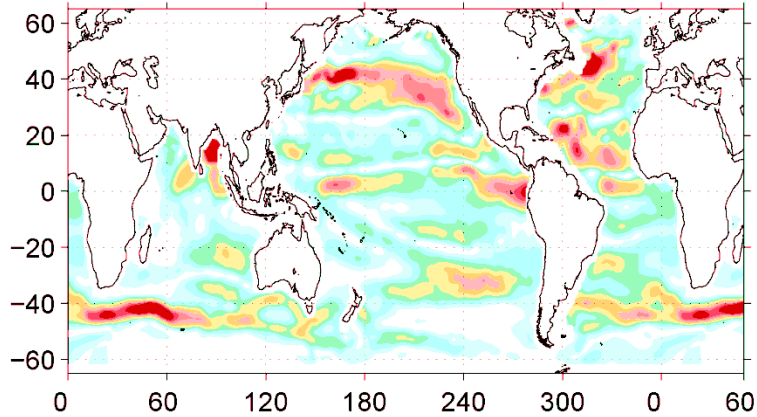# A new high-resolution SSS product from Aquarius

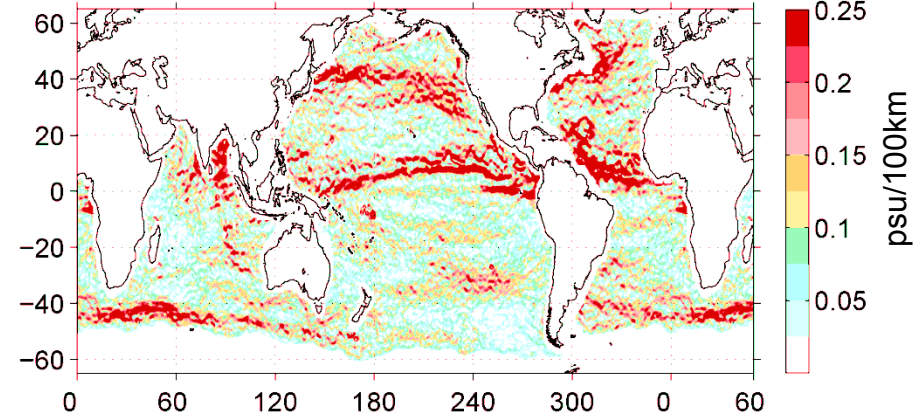

Argo SSS September 2011 (first guess)
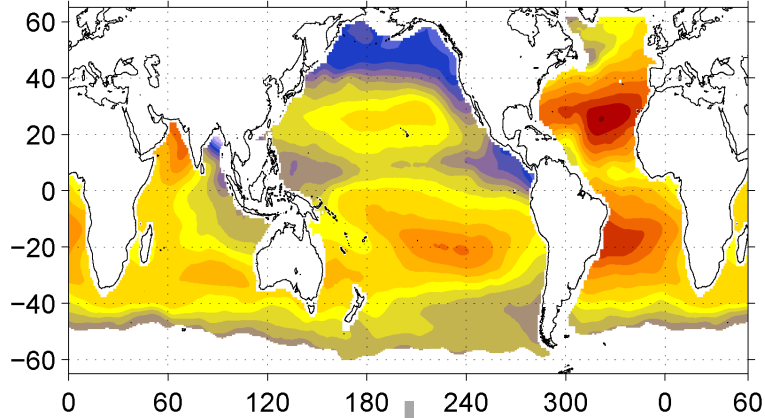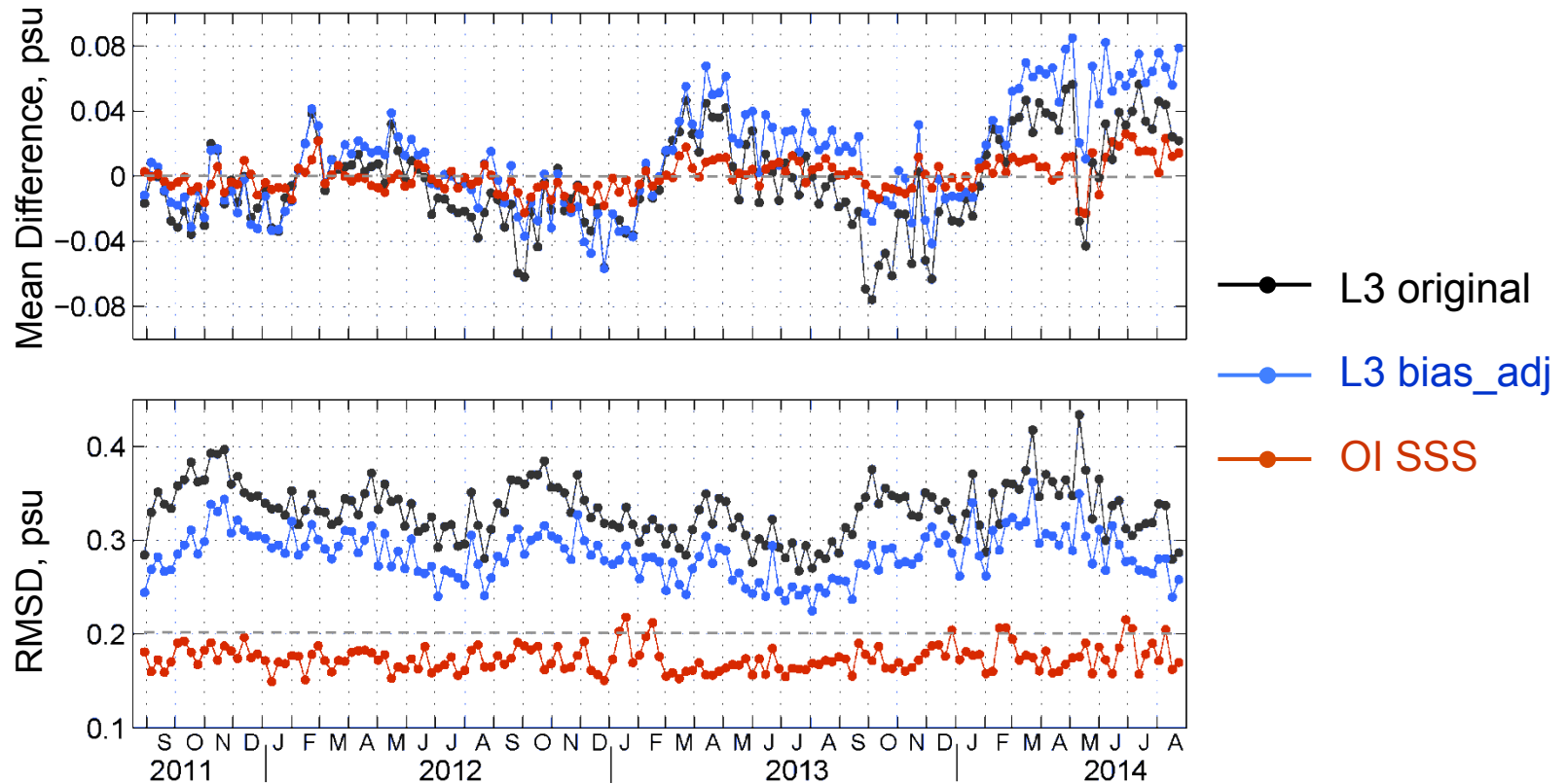
Aquarius OI SSS September 2011
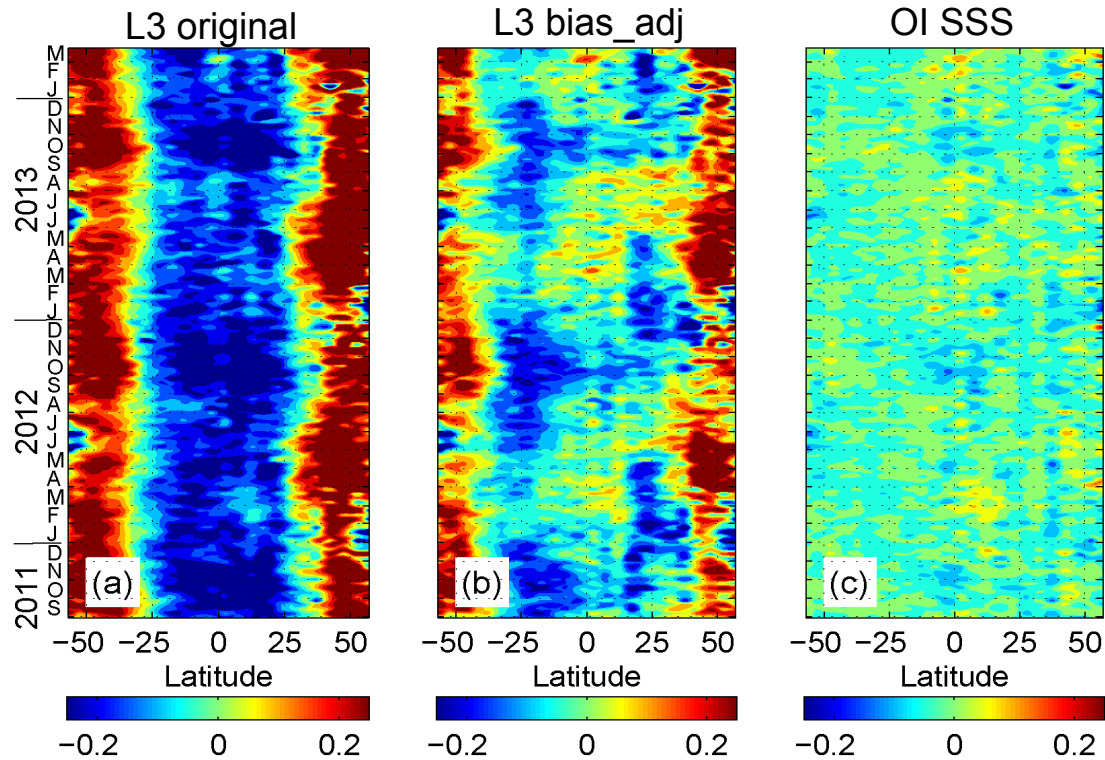
grad(SSS)

grad(SSS)

psu/100km

Statistics of the differences between Argo buoy data and Aquarius OI SSS analysis for the period from September 2011 through August 2014

The error statistics are calculated by comparing Argo buoy measurements for a given week (~1000, z < 6 m) with SSS values at the same locations obtained by interpolating the corresponding Aquarius-derived SSS maps.

Latitude-time distributions of the zonally averaged differences between weekly SSS maps and the corresponding Argo buoy data

(a) Standard Level-3 product without bias correction, (b) Standard Level-3 product with SST-dependent bias correction, and (c) OI SSS

Statistics of the differences between Argo buoy data and Aquarius OI SSS analysis for the period from September 2011 through August 2014
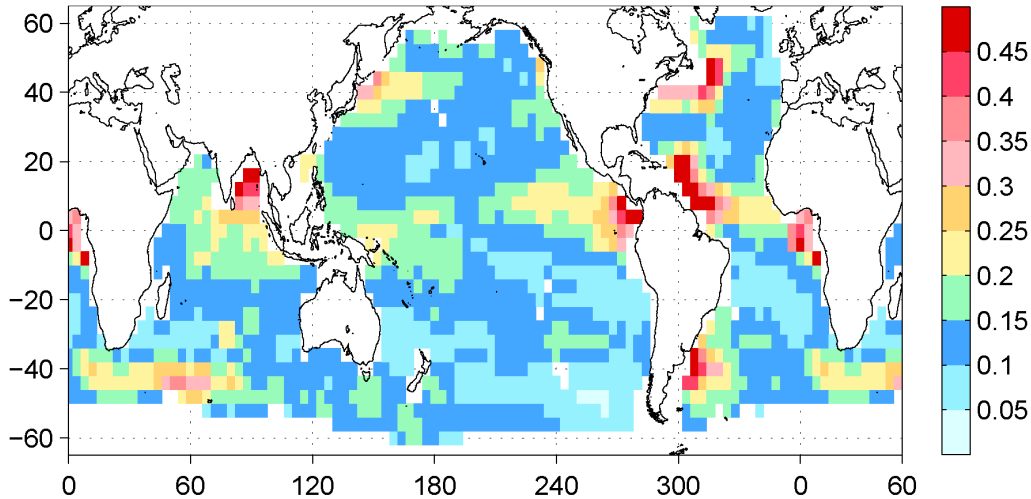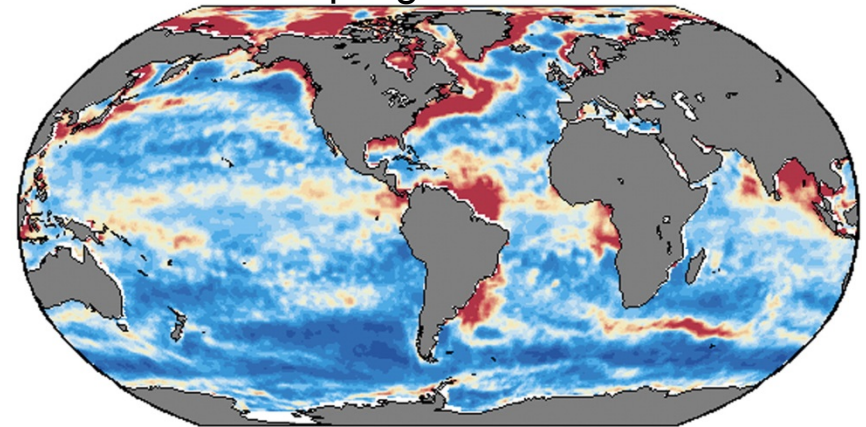

RMS Differences (psu) between weekly OI SSS maps and concurrent Argo buoy data

Differences can be due to

1. Misrepresentation of SSS by buoy measurements at 5 m depth

2. Unresolved small-scale variability

3. Unresolved temporal variability

4. Errors in the SSS maps

5. All of the above

Sampling RMS Error

Sampling RMS error due to unresolved small-scale variability from Vinogradova and Ponte [2013]

Conclusions

The Aquarius OI SSS analysis can be assessed from the APDRC webpage http://apdrc.soest.hawaii.edu/datadoc/oisss.php either through the Live Access Server or OPeNDAP.

The description of the mapping methodology as well as some results on statistical validation of the product against concurrent in-situ data can be found in the Technical Notes:
http://iprc.soest.hawaii.edu/users/oleg/oisss/glb/Technical_Notes.pdf

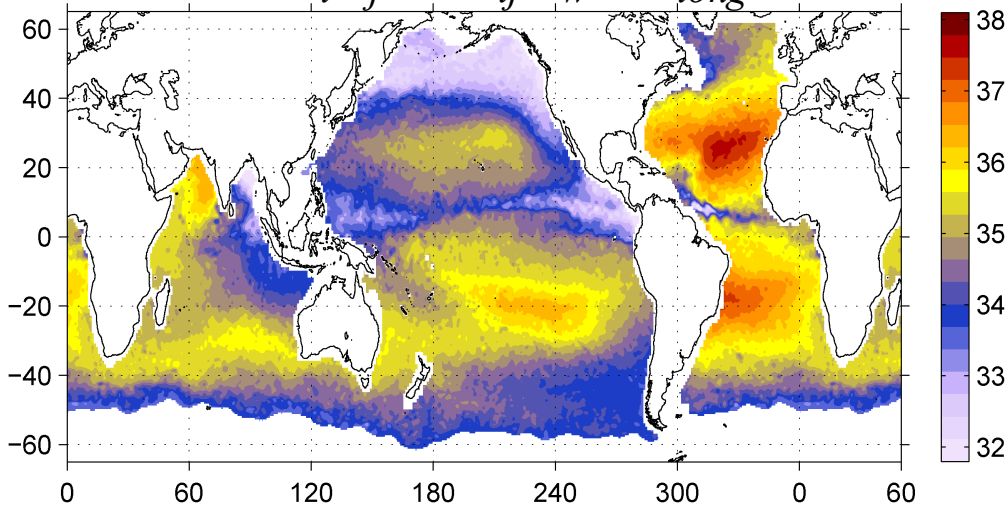We hope that you find the data useful. Please send comments/questions to oleg@hawaii.edu.

OI SSS analysis for the week September 10-16, 2011

$$< \varepsilon_i \varepsilon_j > = \delta_{ij} \sigma_w + \sigma_{long}$$
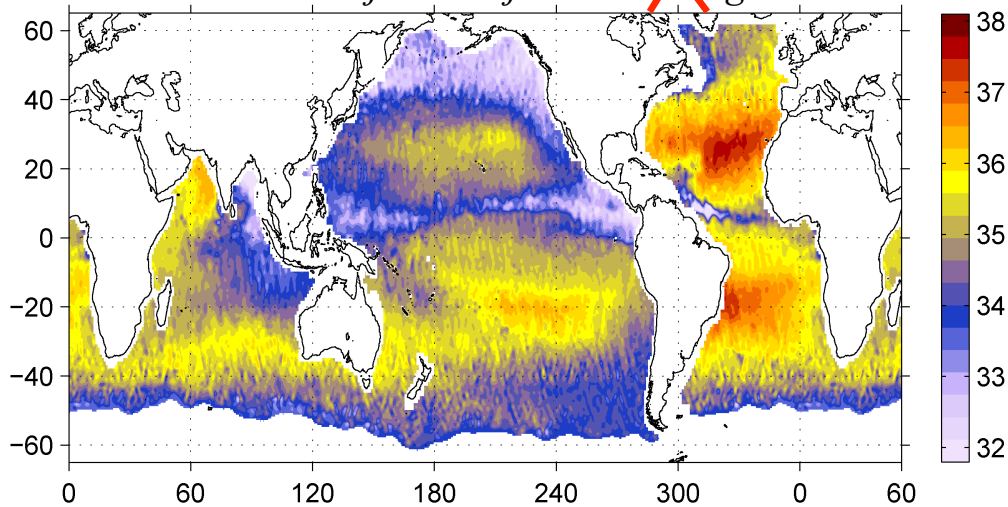
Long-wavelength error correction is switched off

$$< \varepsilon_i \varepsilon_j > = \delta_{ij} \sigma_w + \sigma_{long}$$

Long-wavelength error correction is switched on

Static bias (3-year mean)
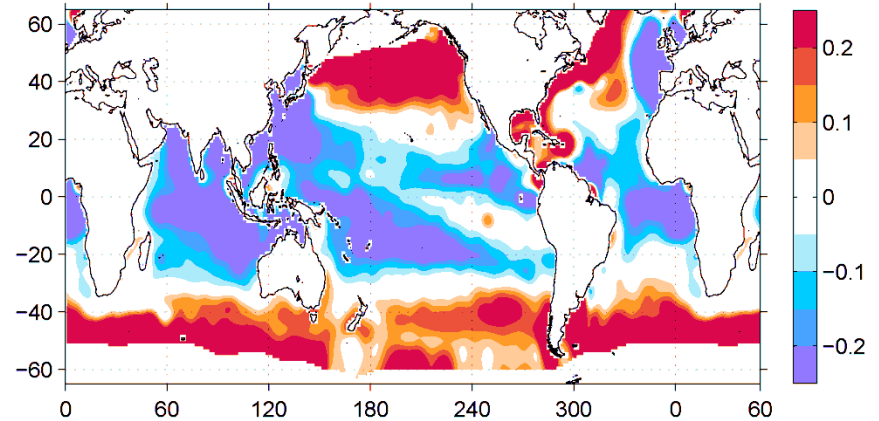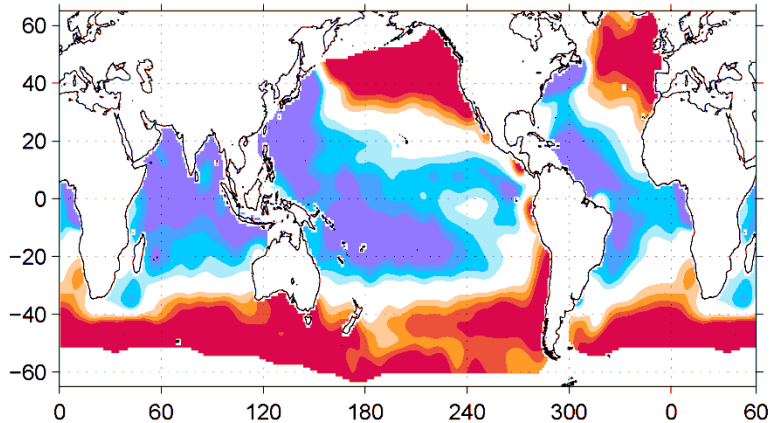
Ascending