Aquarius Satellite Salinity Measurement Mission
Status, and Science Results from the initial 3-Year
Prime Mission
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Three Main Measurement Objectives

How well are we doing?

1. Global Mean Sea Surface Salinity (SSS)

2. Seasonal Cycle

3. Interannual Variations
Aquarius V2.0 had significant *seasonal* ascending-descending biases caused primarily by the residual error of the galaxy reflection correction. This has been corrected by a symmetrization method developed by Thomas Meissner.

Here, the animation shows the difference in seasonal progression of the ascending-descending maps before and after the correction.
- Zonal mean bias is positive in mid latitudes and negative in tropics
- Magnitude ≤ 0.5
- Calibration vs HYCOM is global, so zonal differences average out.
- HYCOM differs substantially from Argo (ADPRC) and NODC in situ based analyses
- Extreme low bias near Antarctica likely is spurious.
The most distinct features resolved in Aquarius data are the Amazon Plume and Atlantic ITCZ.

The Animation shows the monthly SSS climatology (Left) based on 2 years of data (superimposed OSCAR currents), and the interannual SSS differences (Right).

The plume is minimal in the winter months (DJF), and spreads NNW toward the Caribbean in the spring, then spreads eastward with the ITCZ and eastward NECC in late summer/fall.

Inter-year differences show elevated SSS (reduced plume volume) in the second year.
Season Variability – Tropical Pacific

- The Animation shows the monthly SSS climatology (Top) based on 2 years of data (superimposed OSCAR currents), and the interannual SSS differences (Bottom).
- The minimum seasonal SSS under Pacific ITCZ is in November.
- A springtime low SSS anomaly in the east evolves southward of the equator; split ITCZ.
- Large scale inter-year differences evolve in the western half of the Tropical Pacific.
Sea surface salinity (SSS) maps from (a) Argo floats and (b) Aquarius satellite. (c) and (d) show the horizontal gradients of SSS (in psu/km) calculated from (a) and (b), respectively. The black contours indicate the 34.6 isohalines.

The black contours indicate the 100 mm/month isolines from CMORPH precipitation.
Large Scale Inter-Year Changes

YEAR 1  Sep 2011 to Aug 2012

YEAR 2  Sep 2012 to Aug 2013
Aquarius Inter-annual changes

YEAR 2 minus YEAR 1

Generally saltier across north and tropical Pacific

Large scale South Pacific freshening band

Saltier in the Amazon Plume and Panama Bight (SPURS-2)

Freshening across the eastern Atlantic

Aquarius Year2 - Year1
Similar SSS Changes in Other Analyses
Aquarius Features are More Distinct

Aquarius

APDRC Argo

HYCOM

NODC

2014 Aquarius/SACD/OSST Science Team Meeting
Seattle, WA, 11 November 2014
References:

Summary: Open Issues

- Aquarius is clearly resolving seasonal and strong inter-year variations with significant detail. (Session 1; Key Science Results)
  - Ironically, measuring the global mean field is turning out to be the greater challenge, as evidenced by large scale zonal differences with Argo fields in mid-latitudes vs tropics.
    - This may be due to near surface freshening by tropical rainfall skewing the global calibration, and is being investigated.
    - Alternate hypothesis is that a secondary SST correction is needed in the tropics due to bias in the emissivity model. An SST adjustment has been derived empirically and included in the data processing as an ancillary adjustment term. (Session 2; Aquarius Algorithm and Cal/Val)

- Long-term trend analyses should be a science component of the extended mission. This requires more dedicated effort to calibration stability and validation.
Understanding the Interaction Between Ocean Circulation, the Water Cycle, and Climate by Measuring Ocean Salinity