

Preliminary study of multi-year ocean salinity trends with merged Aquarius and SMOS data.

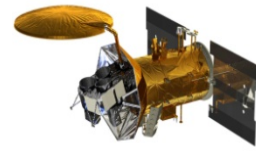
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Understanding
the Interaction
Between Ocean
Circulation, the
Water Cycle,
and Climate by
Measuring
Ocean Salinity

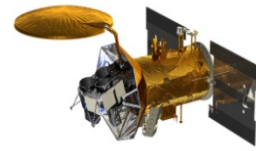


Aquarius/SAC-D

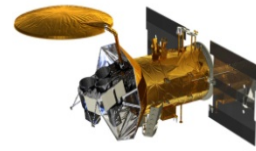




- A major science objective is to build a long term satellite salinity climate data record (CDR) to measure climatic trends in ocean salinity and marine water cycle.
 - Requires decadal measurement records; long-term calibration stability.
 - Stretches the present data to its limits.
- What trends are observable with our present satellite record ?



- Analyse for trends in current satellite SSS data records.
- Very preliminary results are presented here.
- Question: What trends are detectable in the current data sets?
- A null result is meaningful.



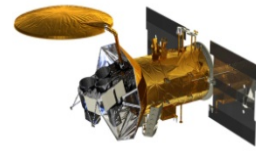
1. Aquarius V3.4 test run for V4.0; Standard monthly L3 fields
2. Aquarius OISSS from U. Hawaii; large-scale biased adjusted with Argo fields (Melnichenko et al 2015, submitted JGR).
<http://apdrc.soest.hawaii.edu/datadoc/oisss.php>
3. SMOS CATDS CEC-LOCEAN v2013 L3 product

All fields are interpolated to $1^{\circ} \times 1^{\circ}$ monthly grid

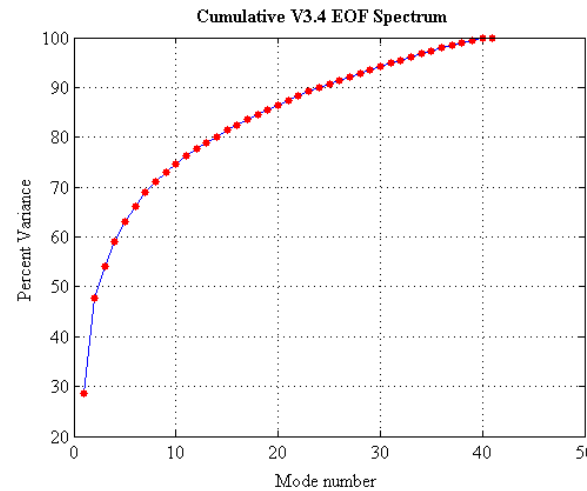
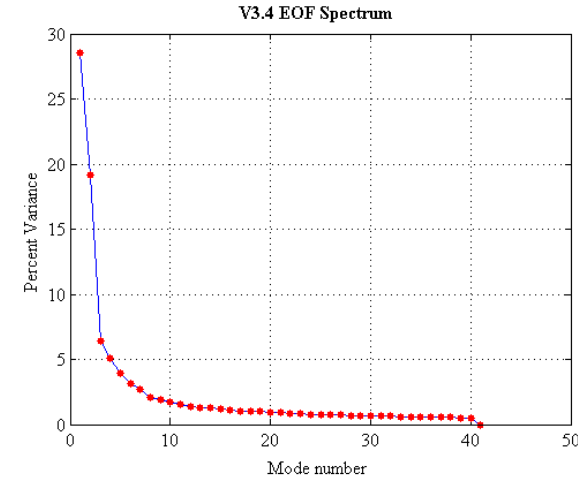
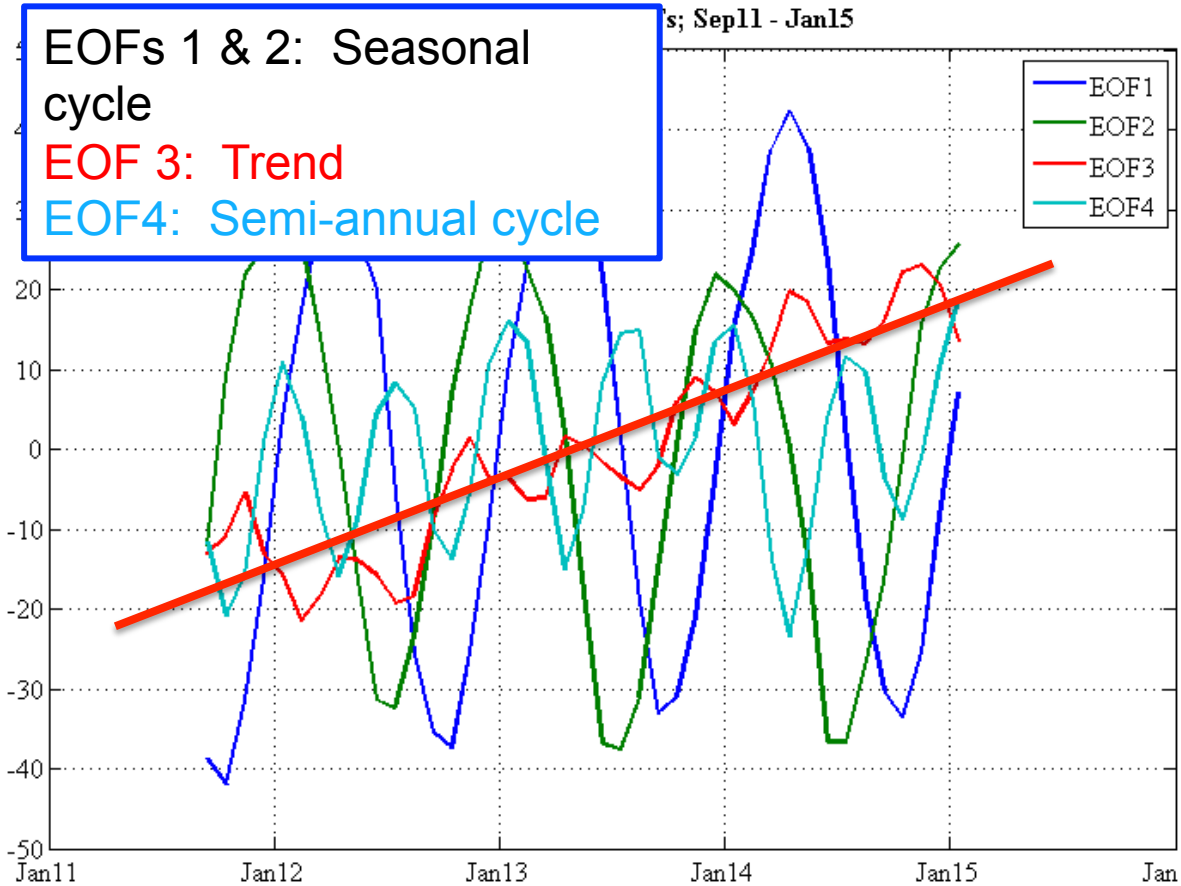
Time Intervals:

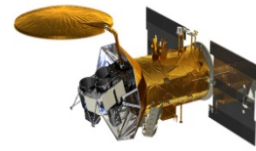
Sep 2011 – Jan 2015; Aquarius/SMOS overlap

Jan 2010 – Jan 2015; SMOS

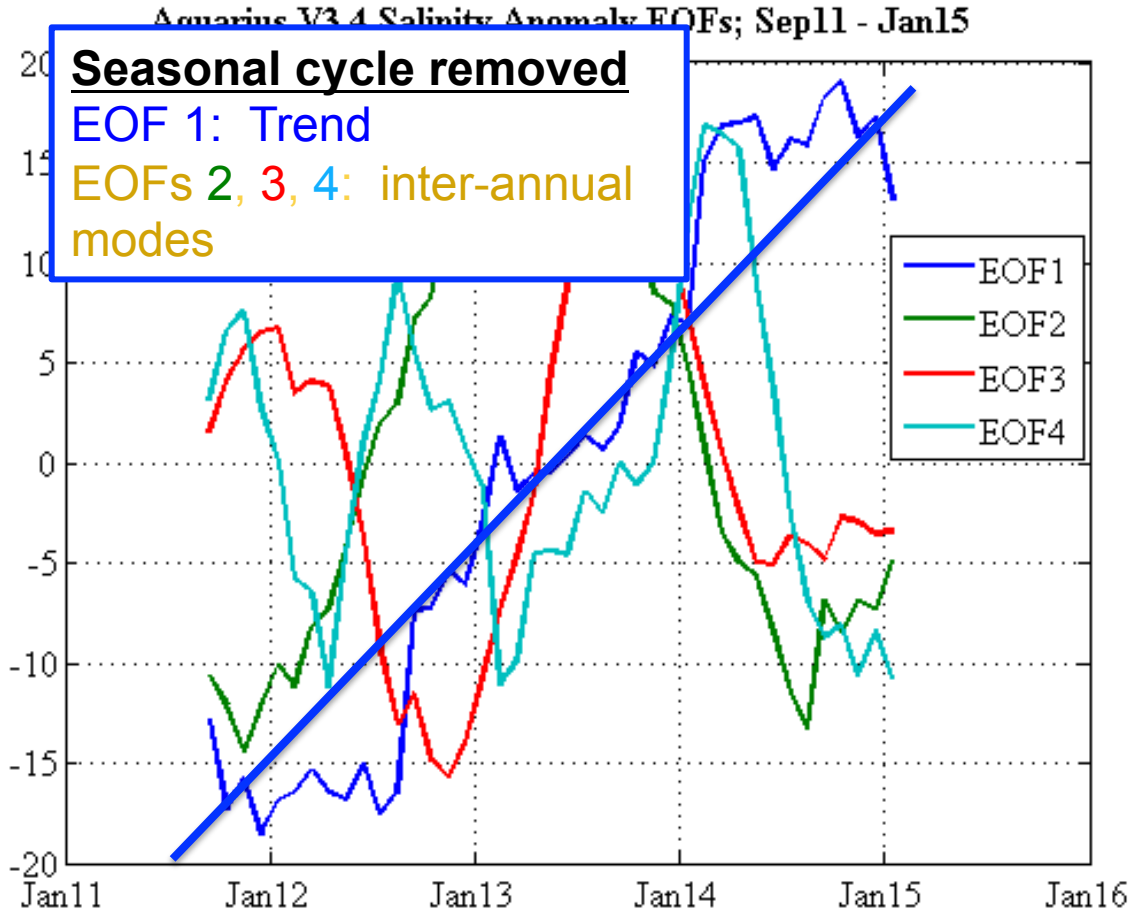


Aquarius V3.4 test run for V4.0



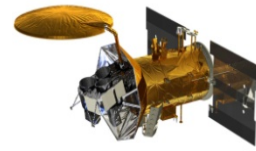


Aquarius V3.4 test run for V4.0



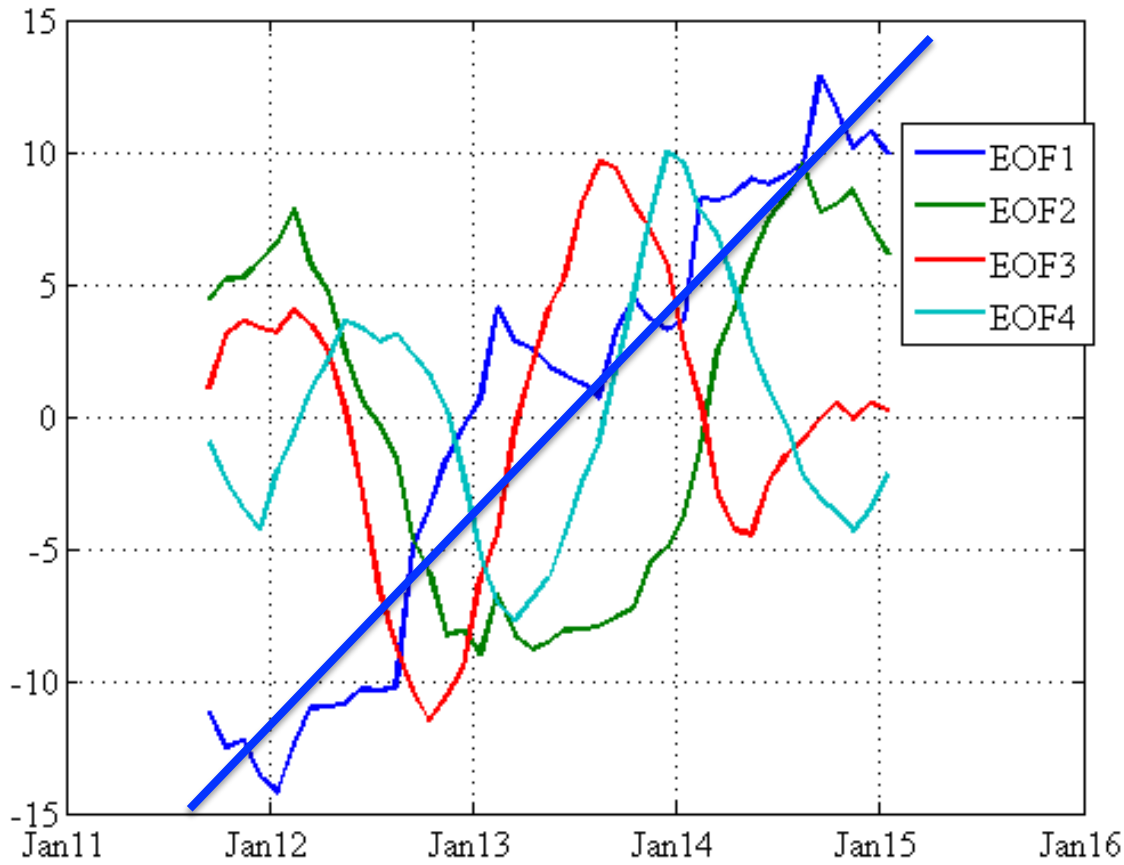
The trend becomes the dominant mode, after removing the seasonal climatology.

6



Aquarius OISSS; Bias Adjusted with Argo

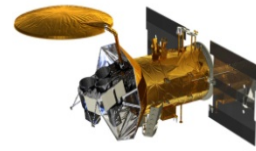
Aquarius OISSS Salinity Anomaly EOFs; Sep11 - Jan15



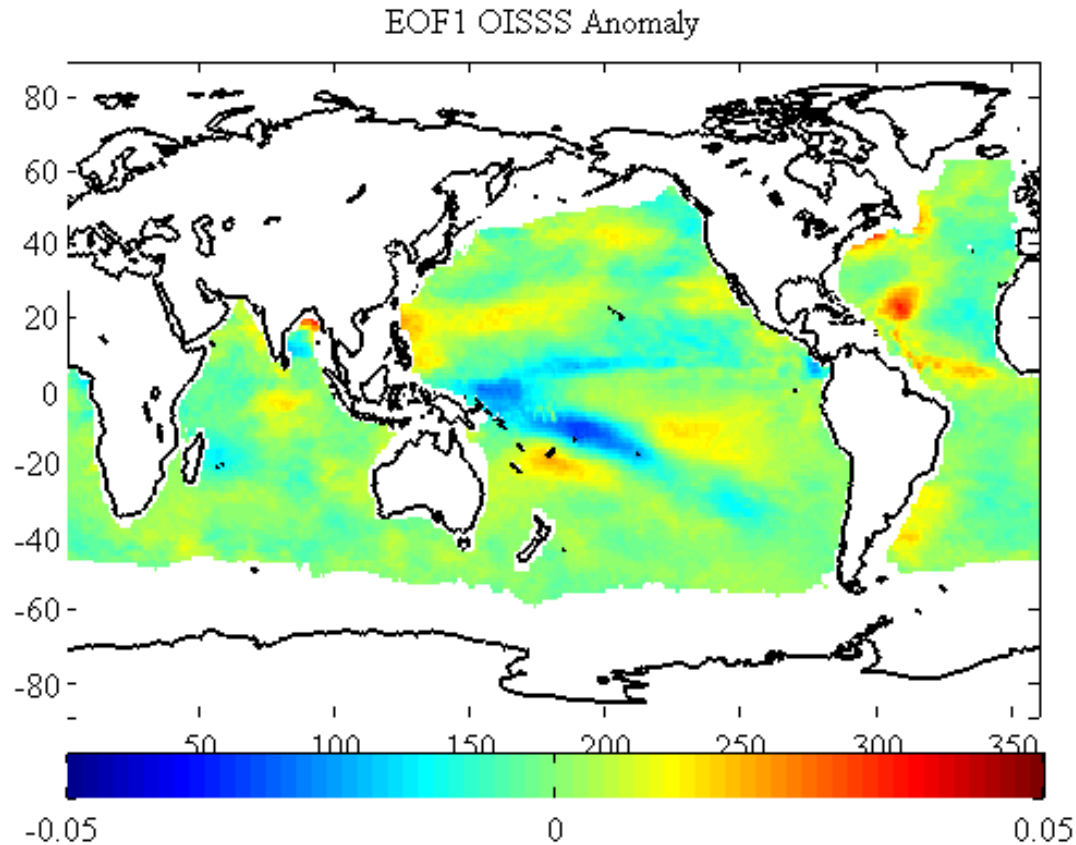
Similar result with the Aquarius OISSS data.

The trend remains the dominant anomaly EOF mode.

The OISSS bias adjustment does not alter this dominant pattern.

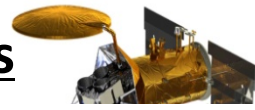


Aquarius OISSS



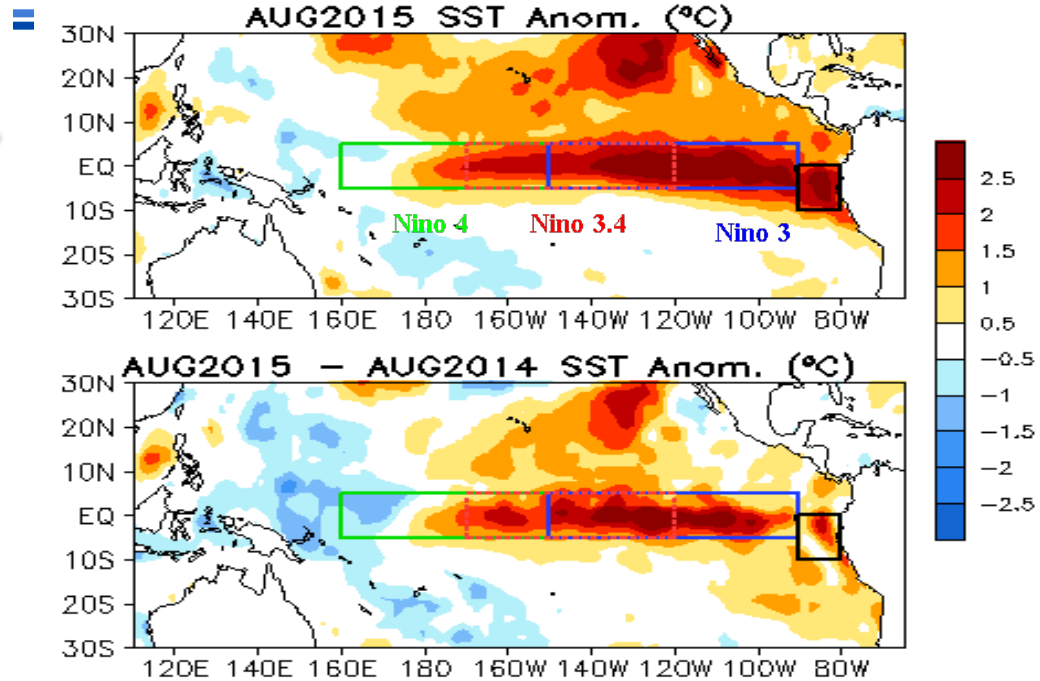
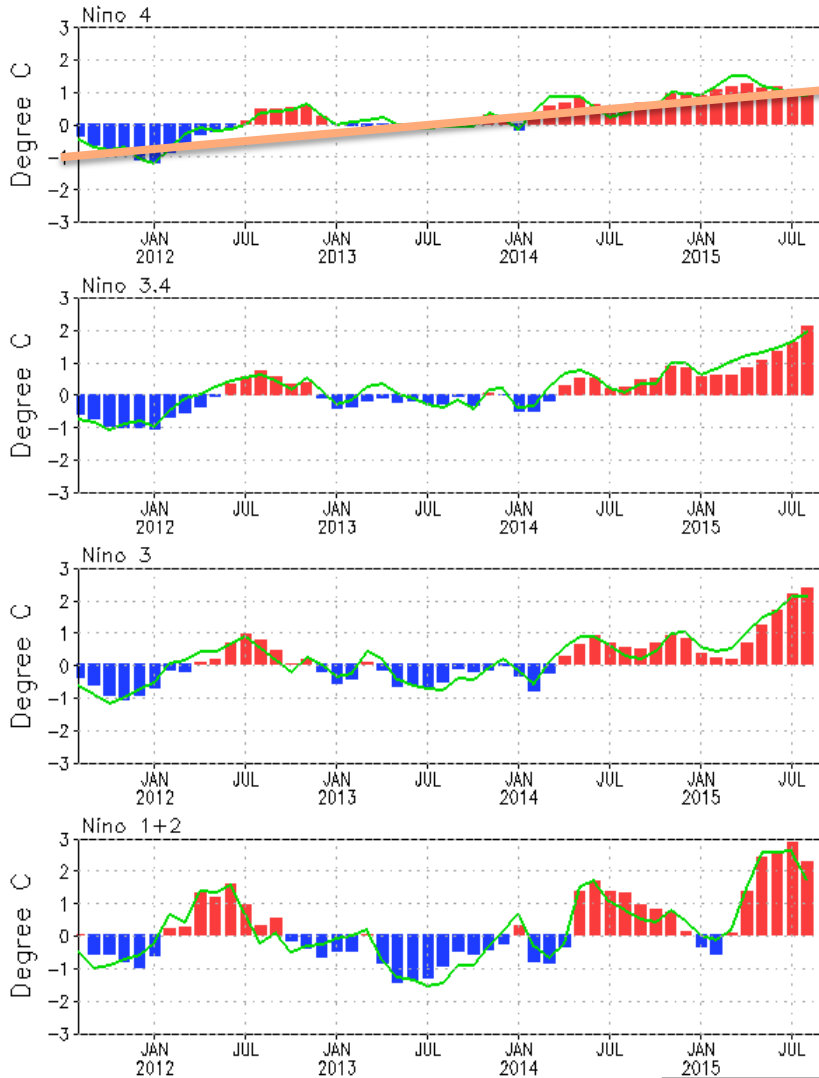
The dominant trend pattern is freshening along a band in the SW Tropical Pacific.

It reveals the ENSO-related SSS evolution between late 2011 and the present.



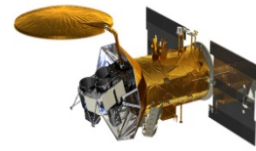
Monthly Tropical Pacific SST Anomaly

(Bar: 1981–2010 Climatology; Curve: Last 10 YR Climatology)



- Nino 3.4, Nino 3 and Nino 1+2 indices exceeded 2.°C in Aug. 2015.
- Nino3.4 = 2 °C in Aug. 2015 and ranks the warmest August since 1982.
- Compared with last August, the central-eastern equatorial Pacific and the central and southern American coast were warmer in August 2015.

<http://www.cpc.ncep.noaa.gov/products/GODAS/> 10 September 2015

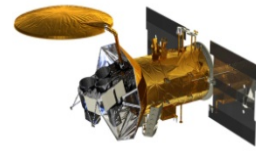


1. The analyses above apply the two Aquarius monthly SSS fields.
2. Now, we introduce SMOS CATDS CEC-LOCEAN v2013.

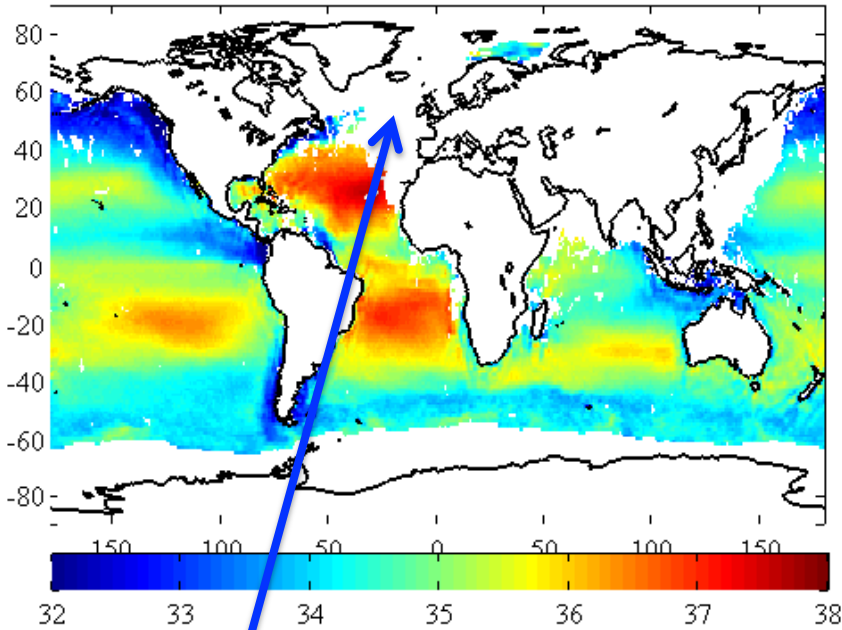
Time Intervals:

Sep 2011 – Jan 2015; Aquarius/SMOS overlap

Jan 2010 – Jan 2015; SMOS

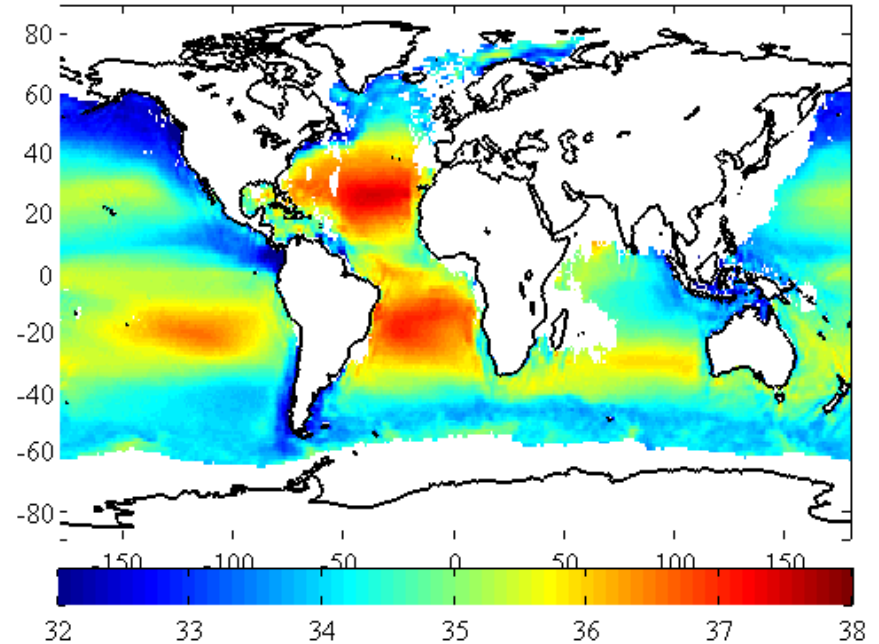


Mean SMOS/CATDS SSS; Pre-Aquarius; Jan2010 - Aug2011



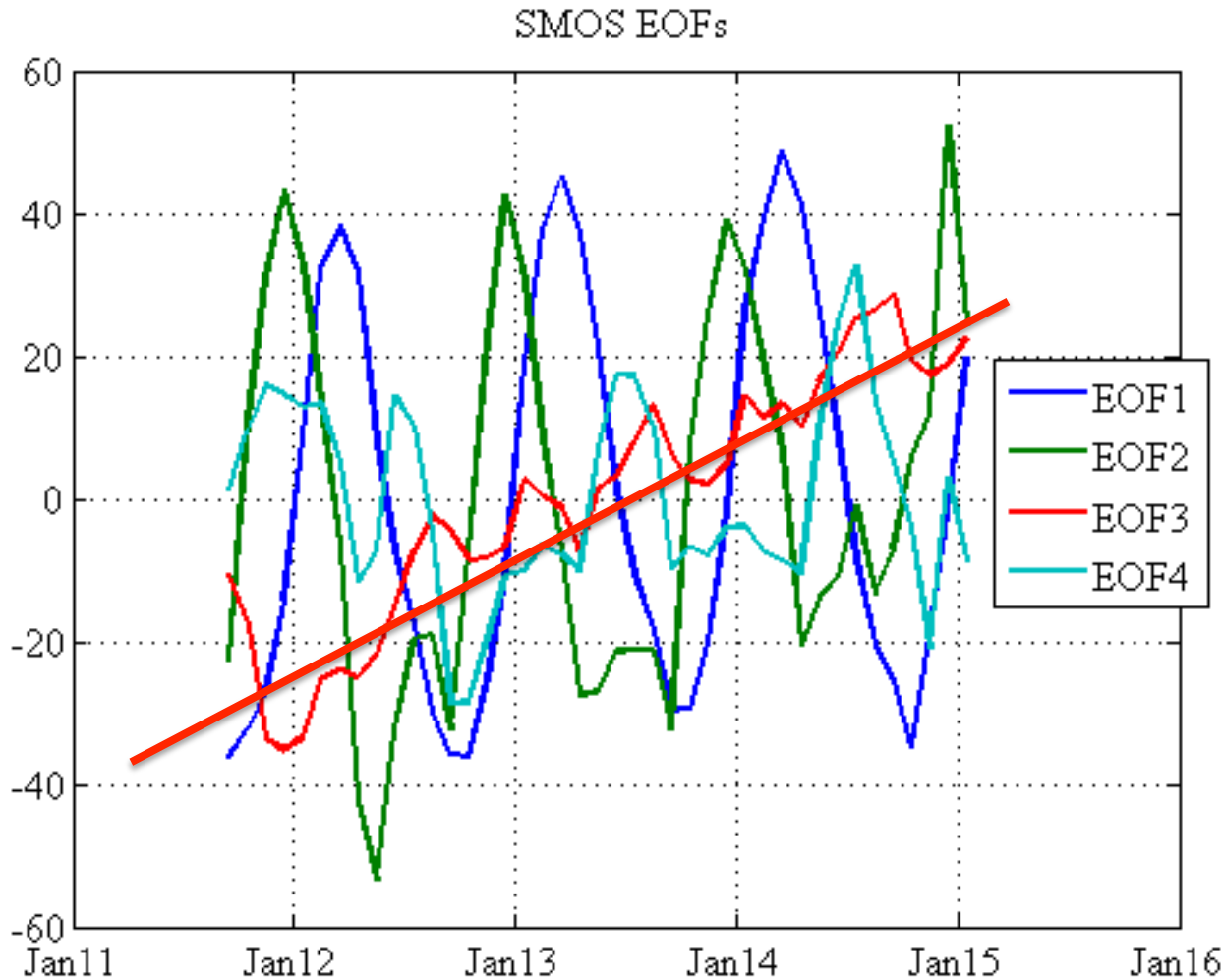
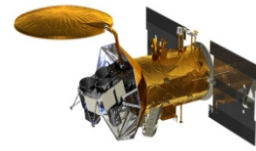
Pre Aquarius
Note gap in NE Atlantic

Mean SMOS/CATDS SSS; Aq Overlap Period Sep2010 - Jan2015



SMOS Aquarius
Overlap

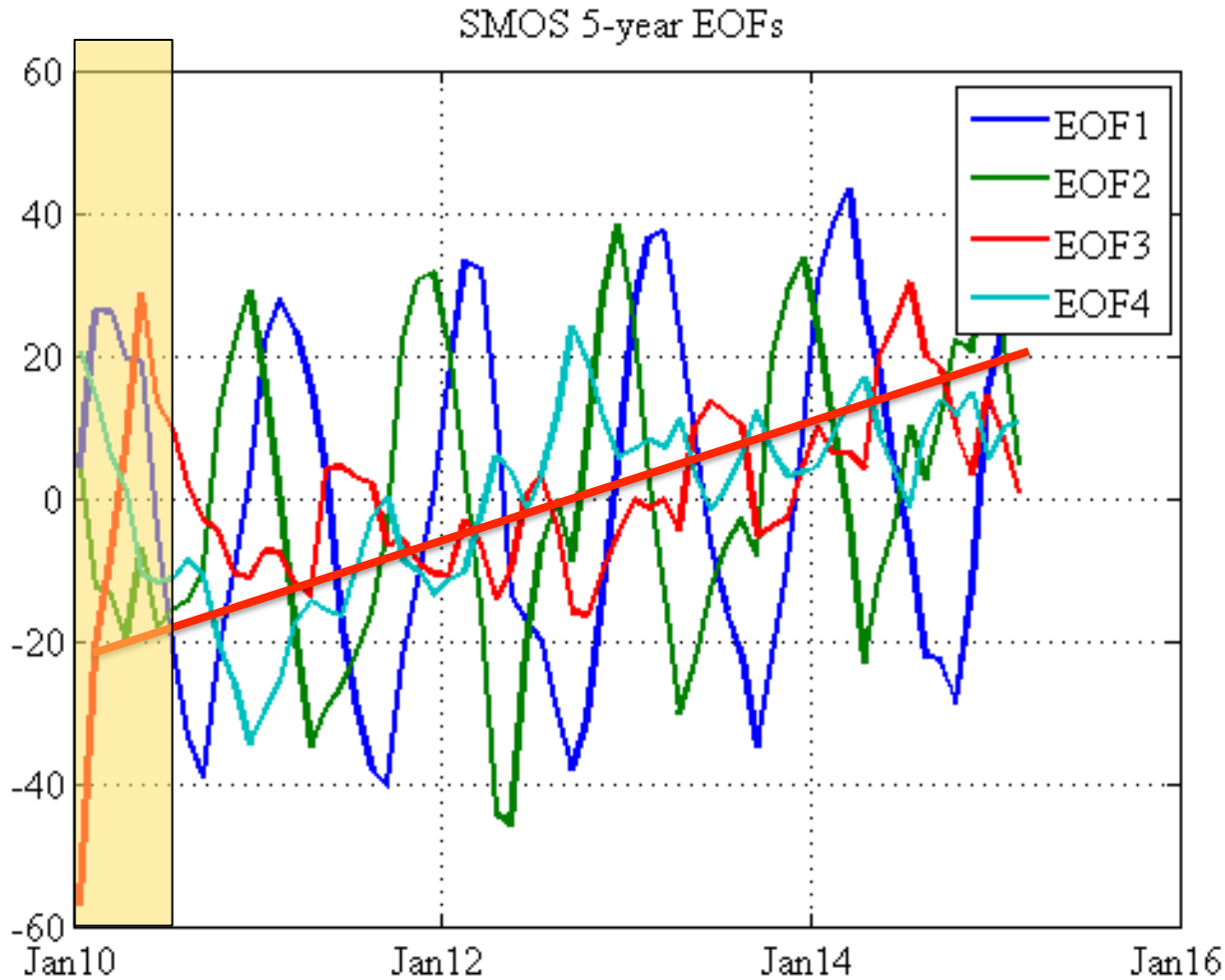
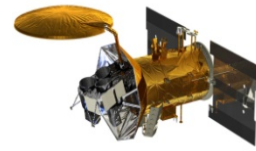
Ignore SMOS prior to July 2010
(advice of J. Boutin and N. Reul)



Very similar to the Aquarius results during the overlap time period.

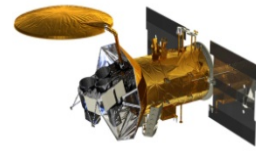
Annual cycle dominates.

The trend is in EOF3

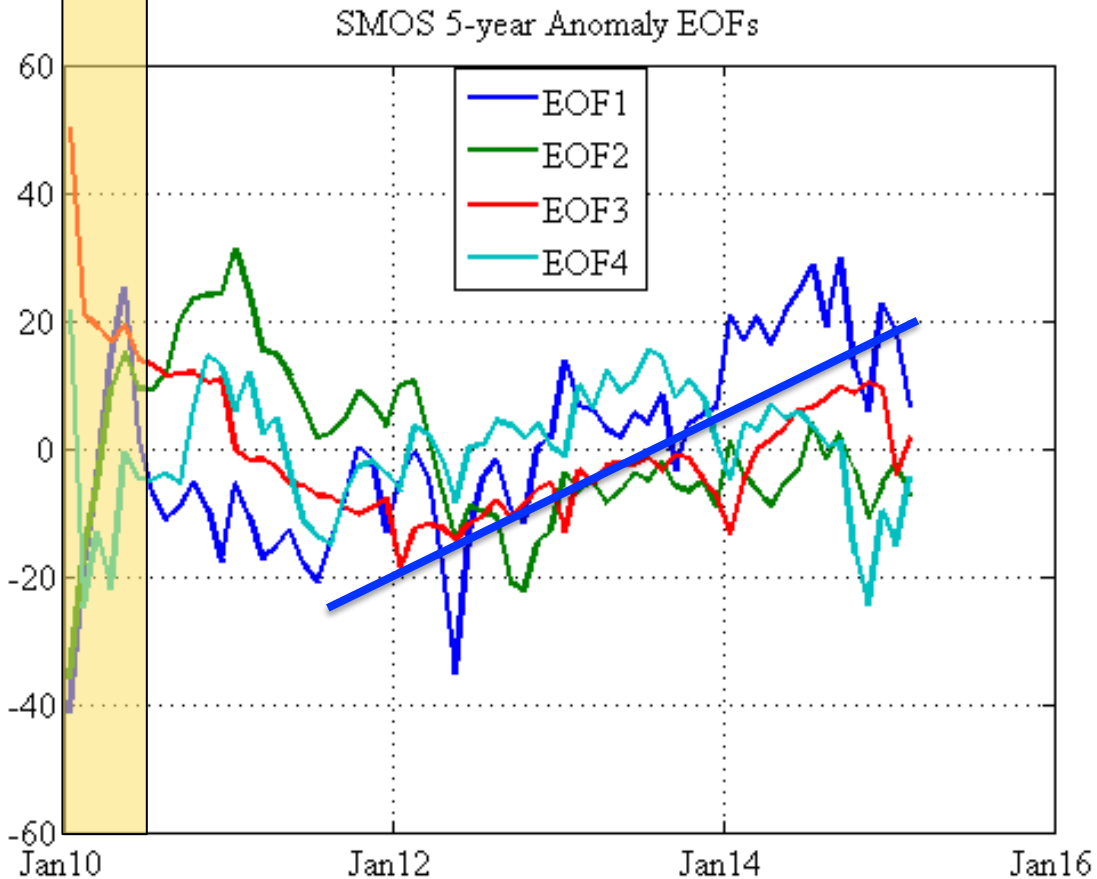


The trend is still evident in EOF3, but there is anomalous spike in 2010.

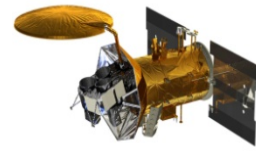
Annual cycle still dominates EOFs 1 & 2.



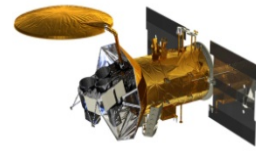
SMOS 5-year Record



The anomaly trend is still dominant in EOF1 in later years, while there was more anomalous activity in 2010, indicating the trend was part of a cycle [ENSO].

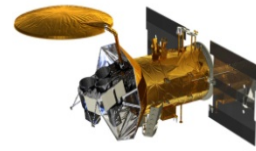


- A secular SSS trend is resolved in the EOF analyses of satellite data during recent years.
- The pattern appears to be linked ENSO variability in the western tropical Pacific.
- Extended observations will be needed to filter seasonal and inter-annual climate variability and resolve long-term climate changes in the ocean; at least a few ENSO cycles.
- Decadal variability will appear as trends in such analyses.



- Update this analysis with latest SMOS and Aquarius data versions; add preliminary SMAP-SSS retrievals (April 2015 and onward).
- Regression analysis with ENSO indices to filter ENSO-scale variability in the western tropical Pacific.
- Evaluate methods to seamlessly merge the different satellite data sets into a common, extended, time series.
- Advocate for follow-on satellite observations; expand the measurement parameter baseline [sea ice, terrestrial hydrology, river input, etc.]

Thank You



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