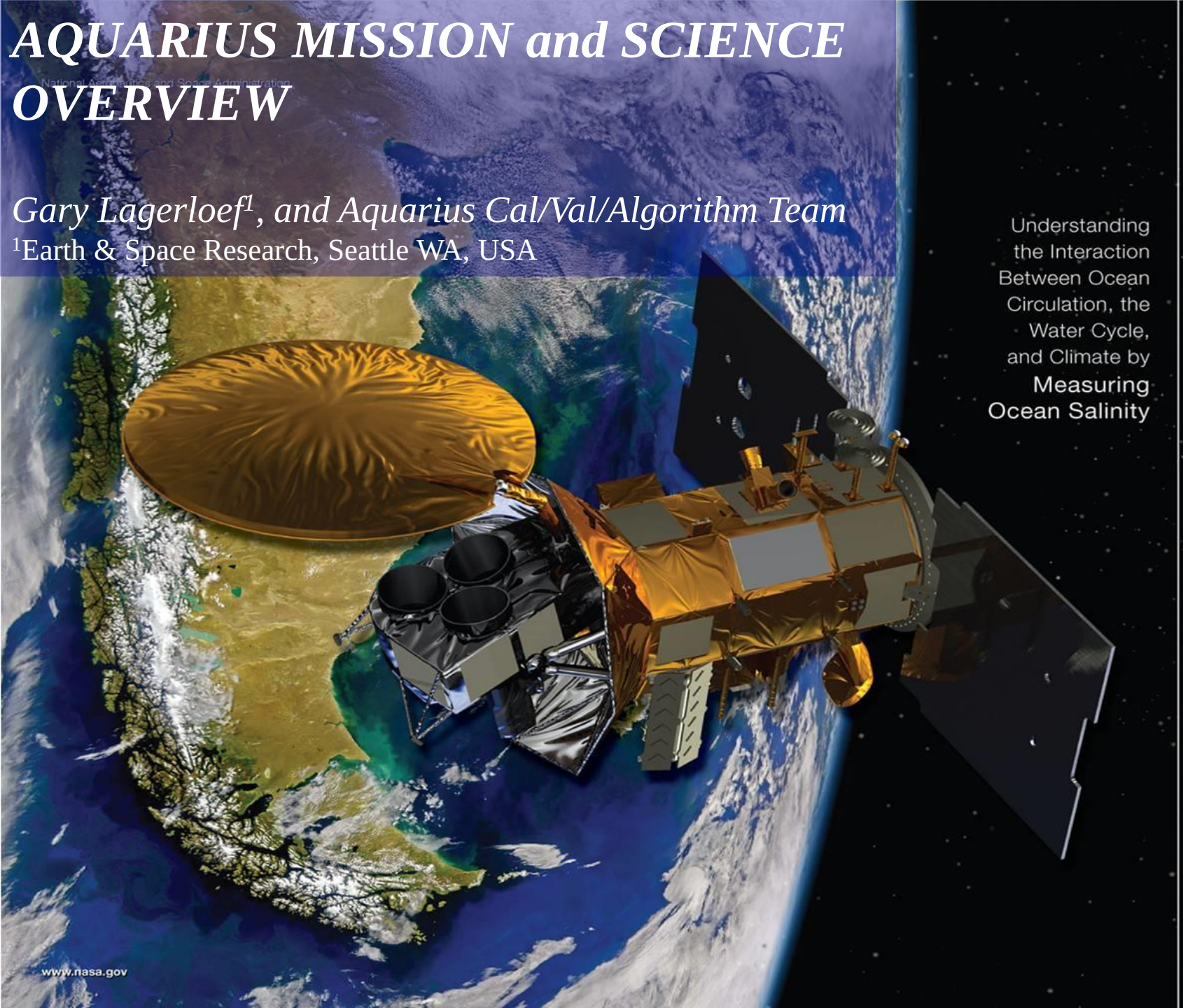
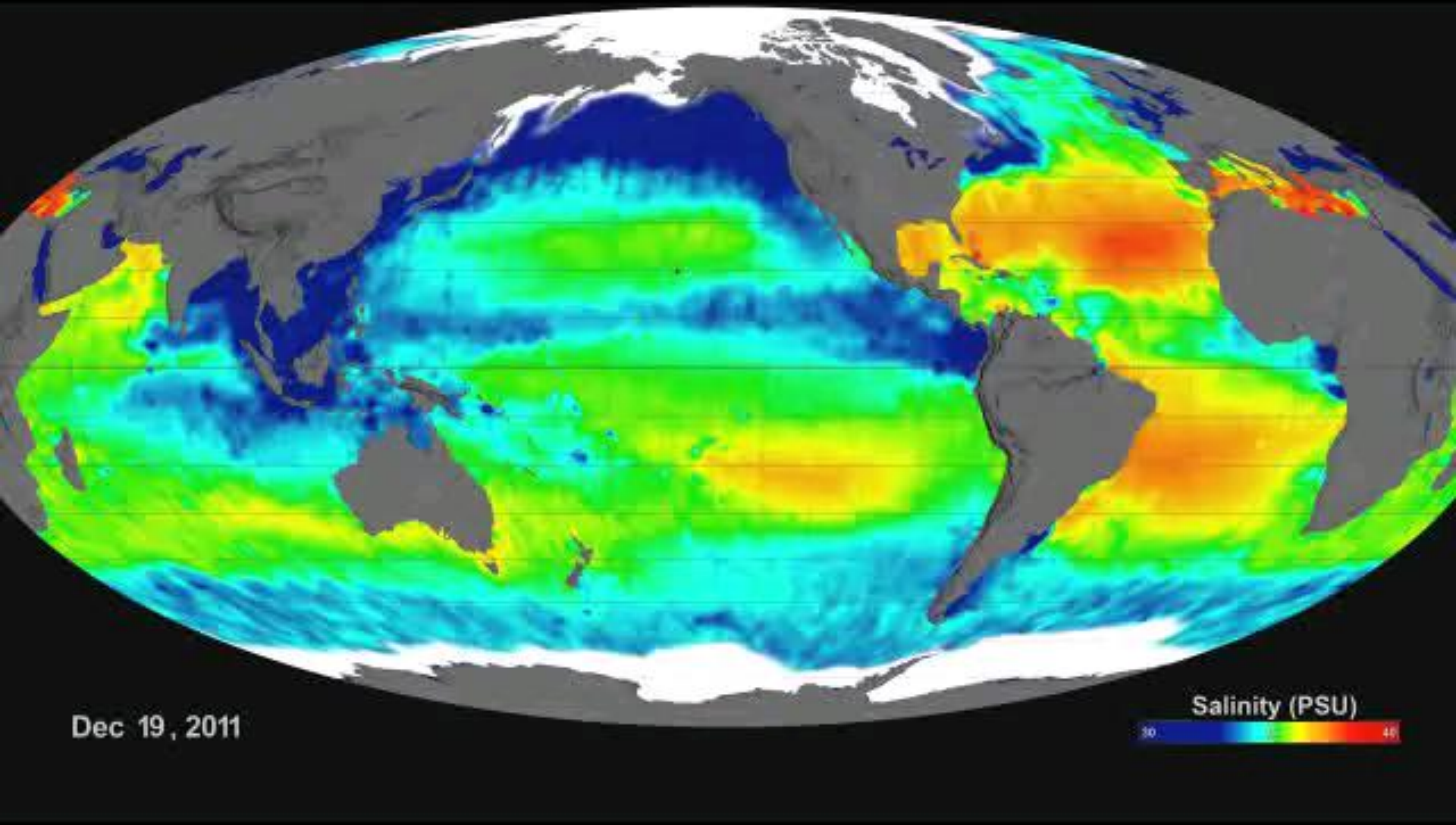
AQUARIUS MISSION and SCIENCE OVERVIEW

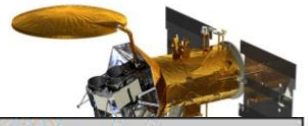
Gary Lagerloef[1], and Aquarius Cal/Val/Algorithm Team
[1]Earth & Space Research, Seattle WA, USA

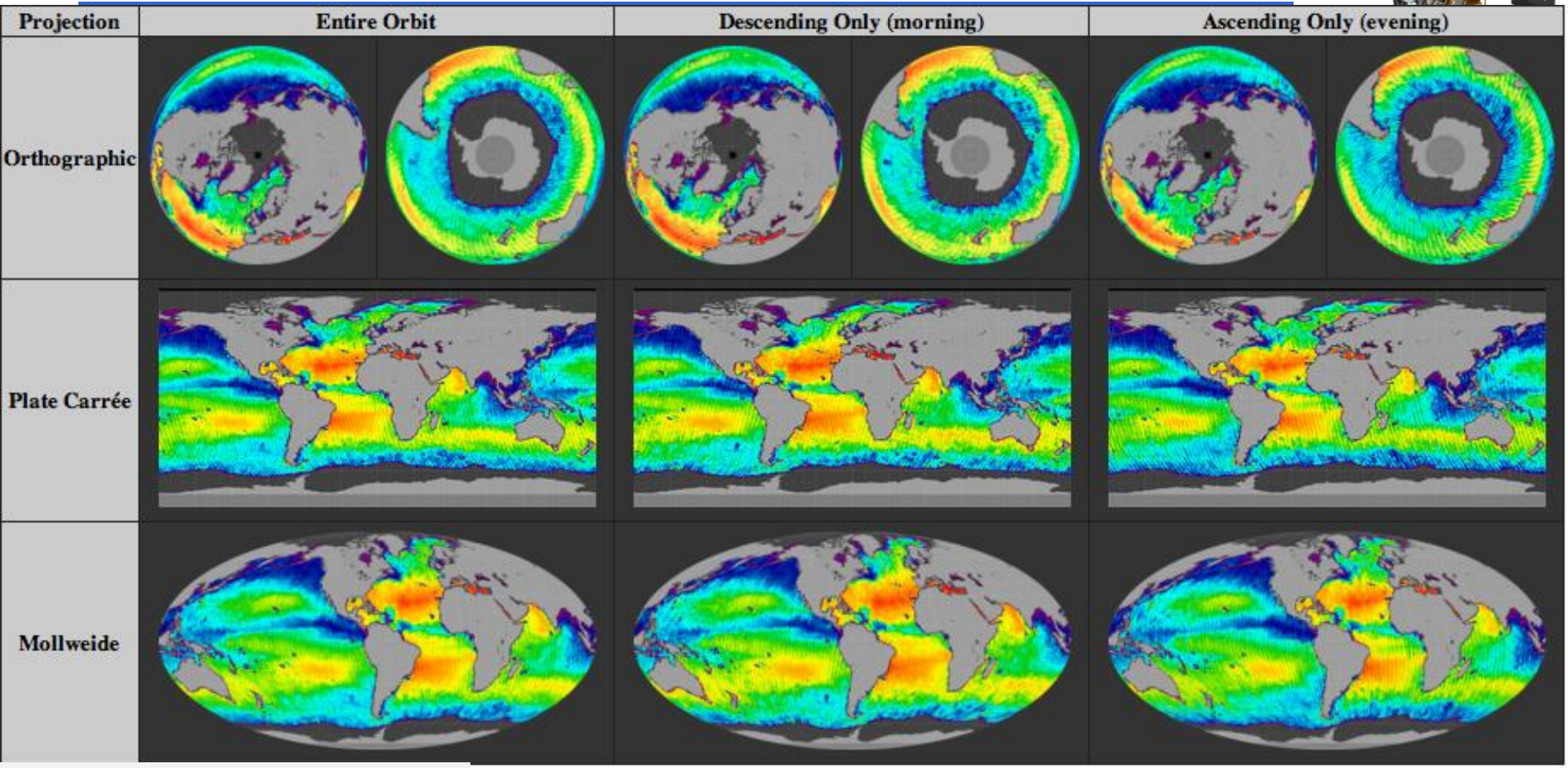


Calendar Year 2012 Animation; Data Version 2.0

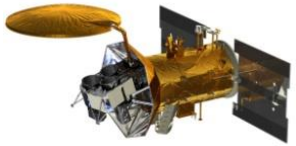


Latest Monthly Average (V2.0)





Norman Kuring
NASA/GSFC



SAC-D Service Platform is presently in good health an operating normally

Issues to report briefly

- Star Tracker and Attitude Control – Resolved
  - Frequent safe-hold anomalies in 2012; some data loss
  - Usually quarter moon disruption of star tracker performance
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- Cold Sky Calibrations

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  - Spontaneously powered off 12 Sep 2013; not responding
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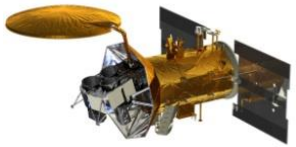
Spacecraft Planned Operations and Anomaly Tracking

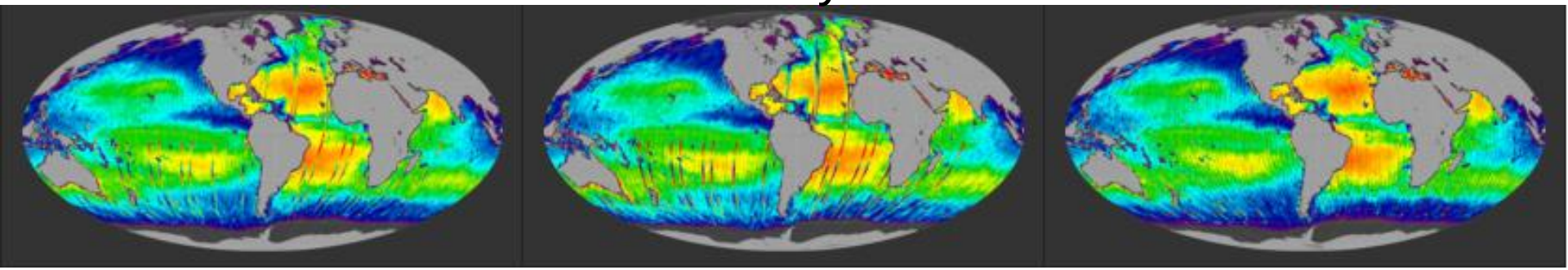
Month	Time Spent in Planned Operations			Time Spent in Pointing Anomalies		
	days	hh:mm:ss	%	days	hh:mm:ss	%
Dec 2011		00: 21:11	0.047		01: 08:16	0.153
Jan 2012		00: 00:00	0		01: 15:28	0.169
Feb 2012		00: 22:08	0.053		00: 08:56	0.021
Mar 2012		04: 46:05	0.641		08: 06:33	1.09
Apr 2012		00: 52:16	0.121		07: 43:43	1.073
May 2012		00: 44:26	0.1		02: 43:13	0.366
Jun 2012		00: 52:16	0.121		01: 11:12	0.165
Jul 2012		00: 52:16	0.117	1	22: 58:09	6.313
Aug 2012		06: 41:36	0.9		00: 59:43	0.134
Sep 2012		04: 12:11	0.584	1	12: 59:04	5.137
Oct 2012		14: 59:19	2.015		23: 09:57	3.114
Nov 2012	1	01: 22:29	3.524	1	20: 45:57	6.217
Dec 2012	1	11: 34:46	4.782		03: 52:01	0.52
Jan 2013	1	11: 15:49	4.74		01: 46:09	0.238
Feb 2013	1	10: 45:05	5.171		00: 29:43	0.074
Mar 2013	1	03: 51:04	3.743		02: 19:21	0.312
Apr 2013		22: 38:31	3.145		02: 22:46	0.33
May 2013		11: 44:47	1.579		02: 14:30	0.301
Jun 2013		08: 18:40	1.154		02: 11:33	0.305
Jul 2013		02: 37:30	0.353		00: 00:00	0
Aug 2013		00: 52:16	0.117		00: 00:00	0
Sep 2013		01: 35:50	0.222		00: 00:00	0
Oct 2013		00: 52:16	0.117		00: 00:00	0
Nov 2013		00: 00:00	0		00: 00:00	0
Mission to Date 708 days 17:28:30	10	02: 12:47	1.424	7	22: 26:14	1.12

No science data lost to pointing anomalies since July.

Worst-case Months

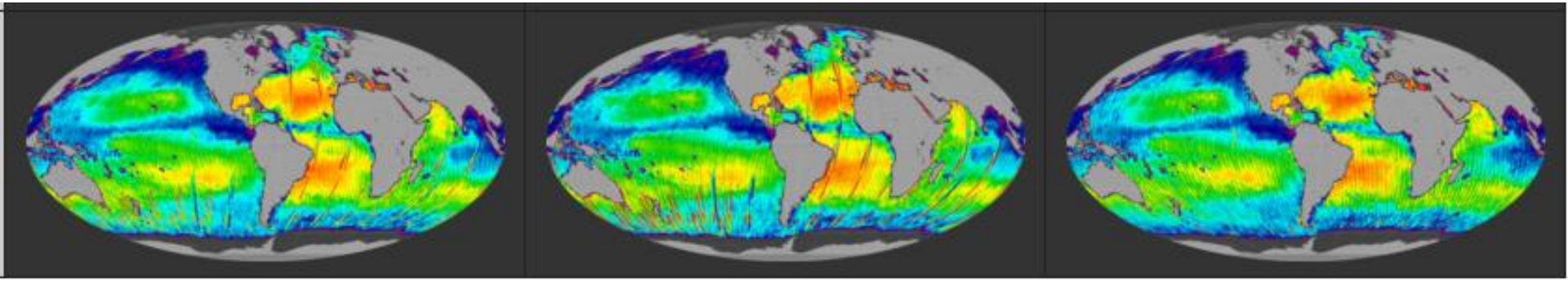


July 2012



Entire Orbit	Descending Only (morning)	Ascending Only (evening)

November 2012



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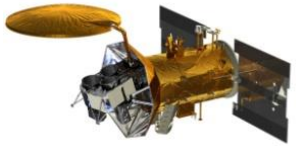

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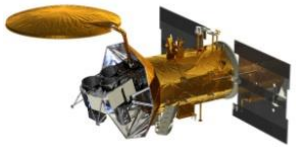
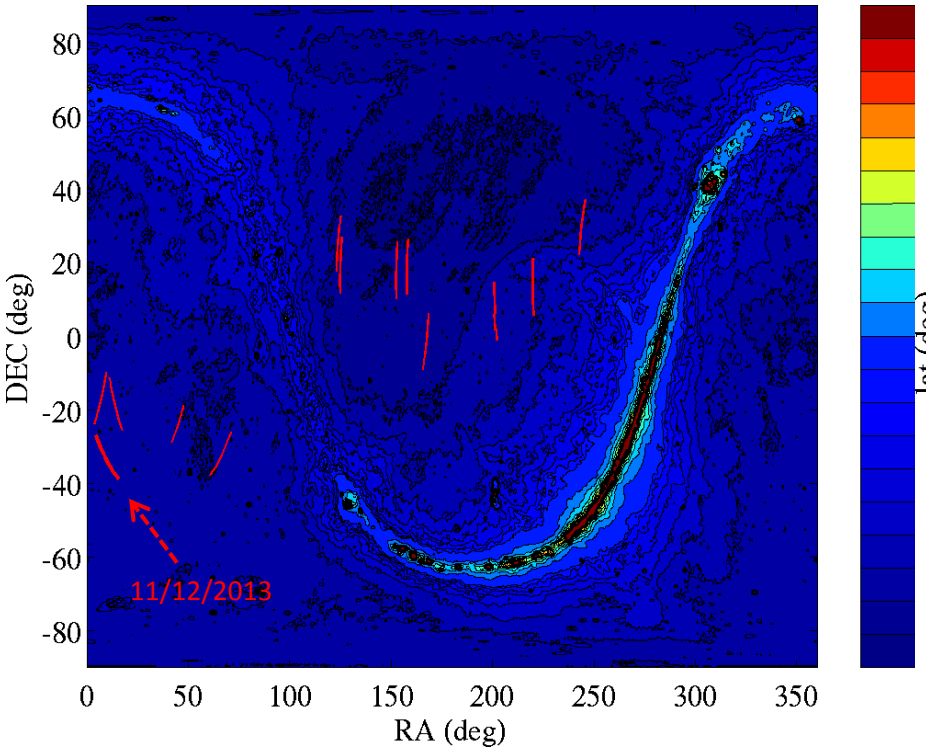
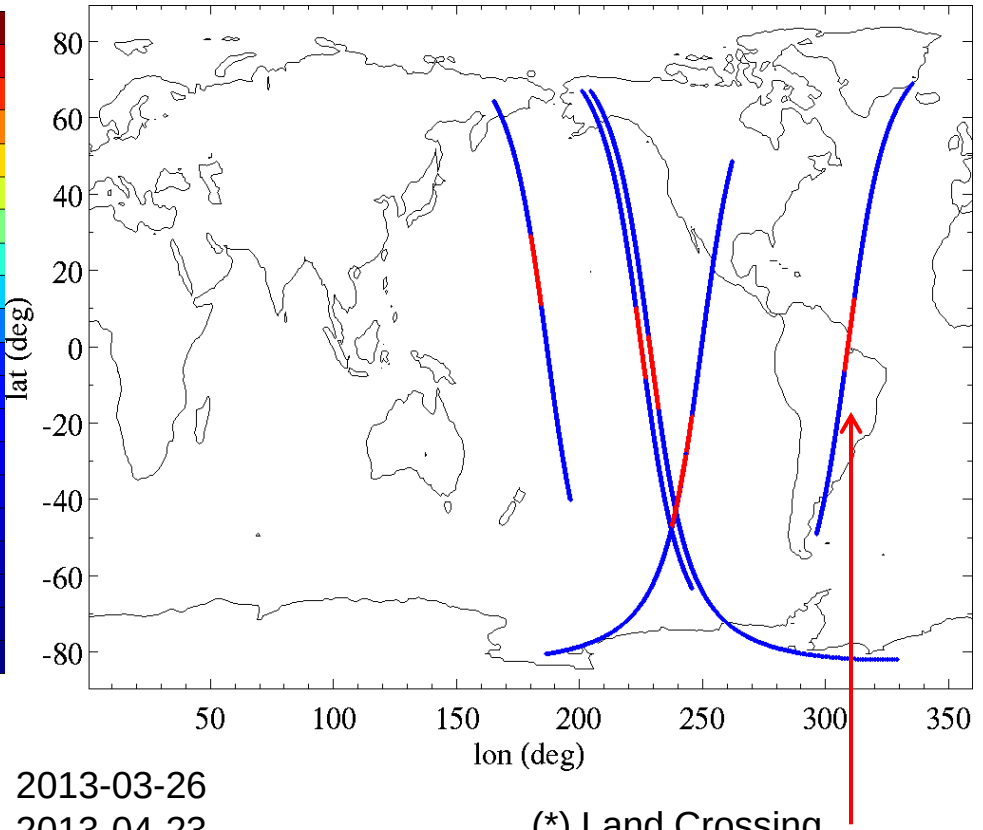
Cold Sky Calibrations





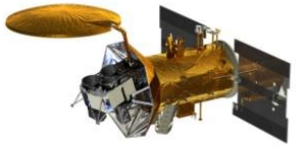


Dates:

2012-03-24	2013-03-26
2012-04-28	2013-04-23
2012-06-30	2013-06-11
2012-07-23	2013-08-06
2012-11-27	2013-09-17
2013-01-10 (*)	2013-10-15
	2013-11-12

(*) Land Crossing

Emmanuel Dinnat; GSFC



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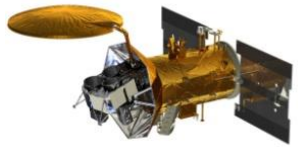
NASA Science Mission Timeline



Launch 10 June 2011

Aquarius on 25 Aug 2011

First Image 22 Sep 2011

NASA PLAR 10 Nov 2011

NASA Begin Prime Mission 1 Dec 2011

7th Aquarius/SAC-D Science Meeting 11-13 April 2012

Aquarius V1.3 Data Apr 2012

Aquarius 1 Year of Data 25 Aug 2012

Webinar 29-30 Jan 2013

Aquarius V2.0 Validated Data 25 Feb 2013

Joint SMOS-Aquarius Workshop, Brest 15-17 April 2013

Aquarius 2 Years of Data 25 Aug 2013

8th Aquarius/SAC-D Science Meeting 12-14 Nov 2013

2011 | 2012 | 2013

10 Month Interim Extension

2014 | 2015 | 2016

2-Year Extended Mission …

Aquarius V3.0 Validated Data January 2014

Aquarius V4.0 Validated Data TBD 2014

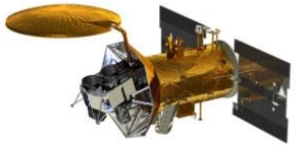
Science Meeting, Seattle September 2014(TBC)

NASA End of Prime Mission 30 Nov 2014

NASA Extended Mission Senior Review Proposal Spring 2015

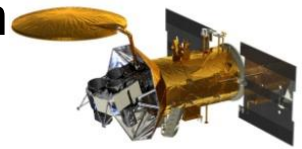
NASA 2-Year Extended Mission Begins 1 Oct 2015

Data Versions Update



- **Version 1:** (Sep 2011) Initial calibration, but showed a calibration drift in the following months
- **Version 1.3:** (Apr 2012) Deflection Ratio (DR) calibration algorithm corrected drift and some variations, but left residual quasi-monthly oscillations.
- **Version 2.0:** (Feb 2013) Current operational version. Pointing correction applied. Empirical calibration method corrected quasi monthly oscillations. SSS errors are primarily seasonal residuals of the galaxy correction.
- **Version 3.0:** (Jan 2014) Corrects galaxy residual error. Improved wind roughness correction. Updated data quality flags. Reduced warm and cold end calibration biases. Next key problem is RFI.
- **Version 4.0** (TBD 2014) Add MWR rain correction. Address RFI (somehow). Improve L3 gridding algorithms (resolution, de-biasing, …), other updates.

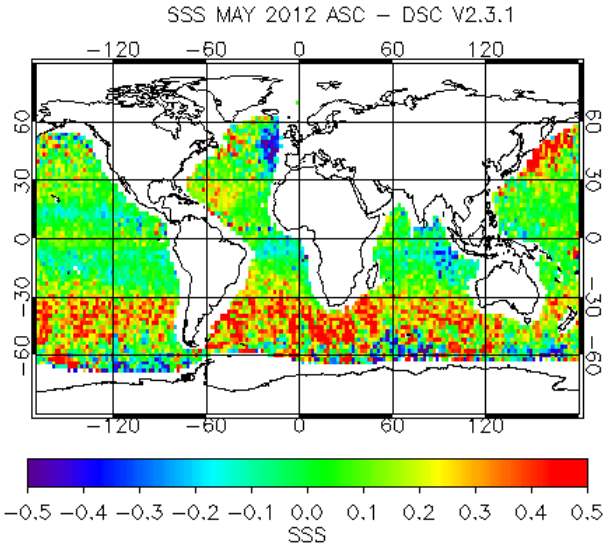
Improved Corrections for the Galaxy term in the next data version, January 2014

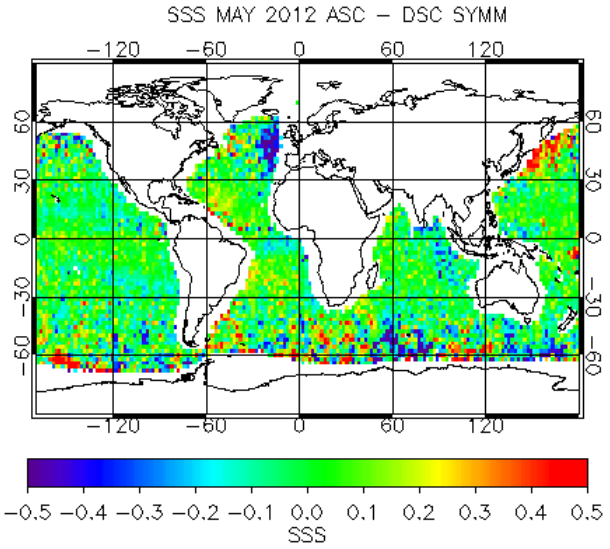


Old: V2.0

New: V3.0

2012

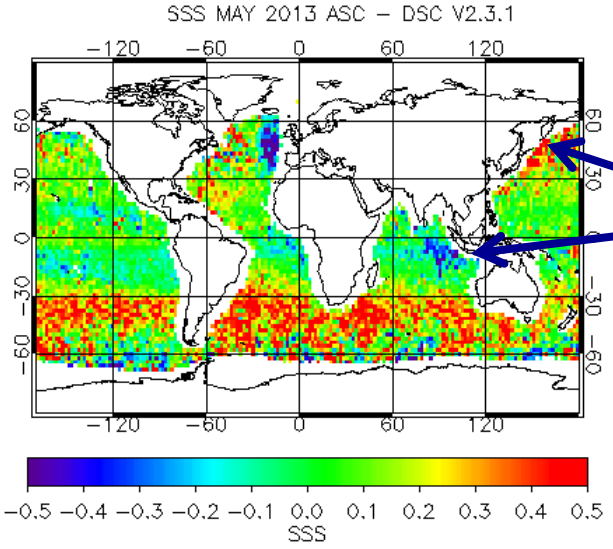


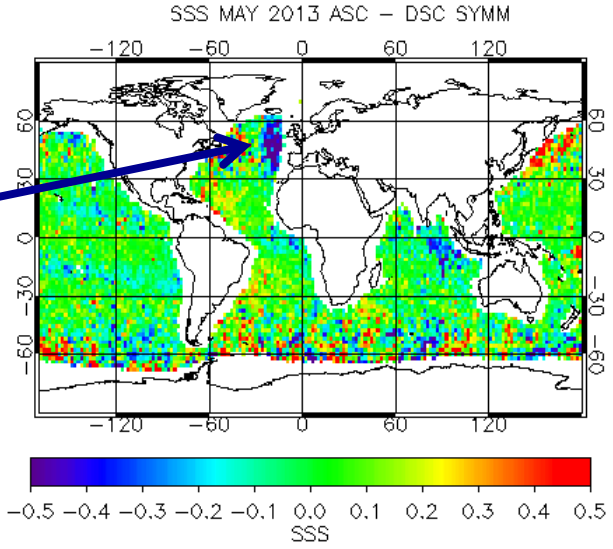


May

Asc-Dsc Maps:

2013

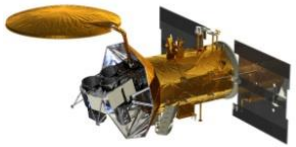




RFI

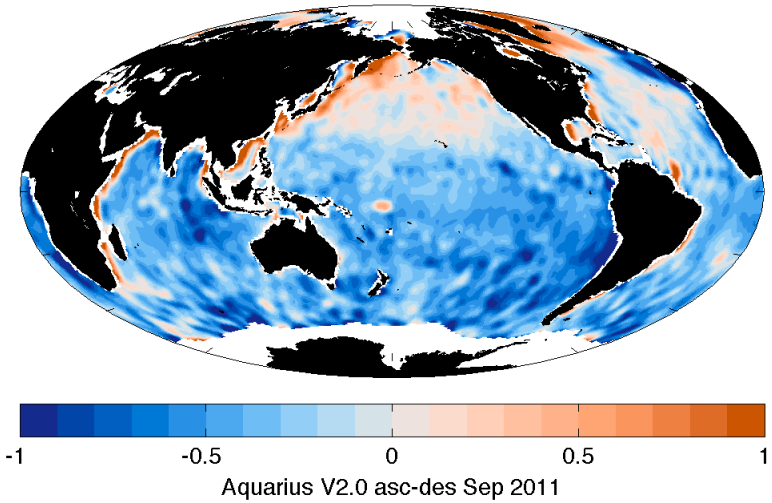
T. Meissner, Remote Sensing Systems

Aquarius ascending - descending

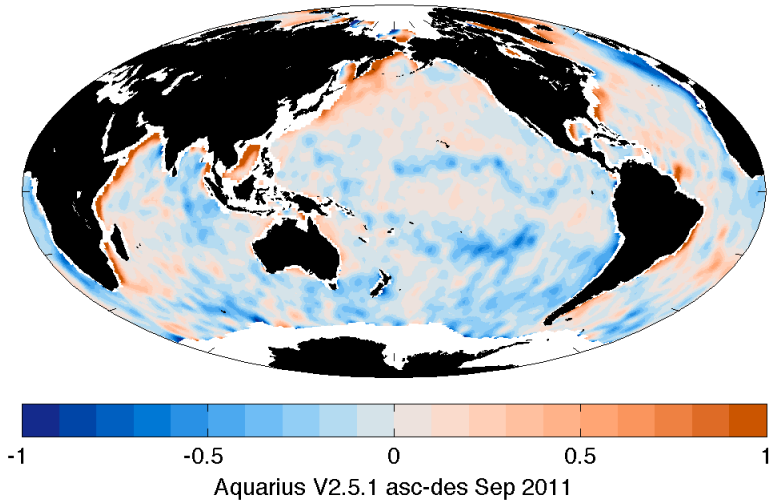


Hsun-Ying Kao, ESR

V2.0



V2.5.1

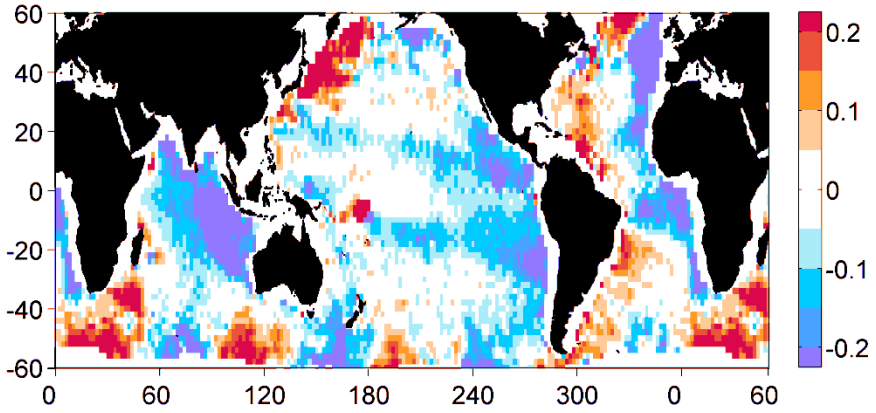


Ascending-Descending Differences

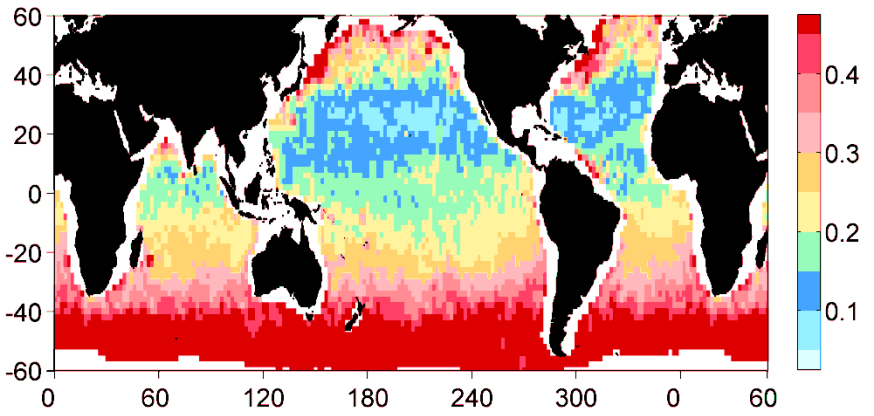
Oleg Melnichenko, U. Hawaii

V2.0

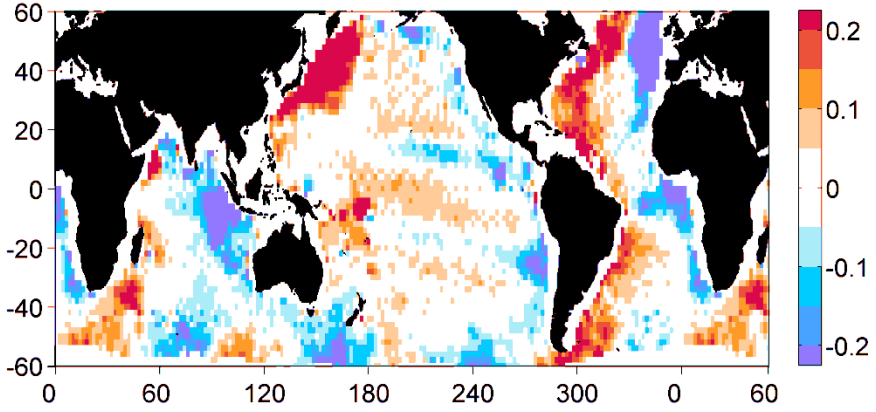
24-month average (Sep 2011-Aug 2013), psu

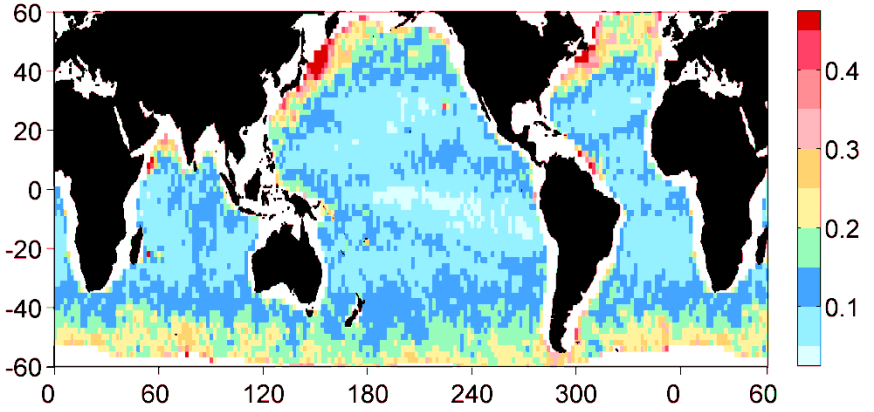


standard deviation, psu



V2.5.1





Over most of the ocean STD is less than 0.1 psu

Bin-averaging of Aquarius data within 4º x 4º bins centered on a global grid with the grid spacing of 2º.

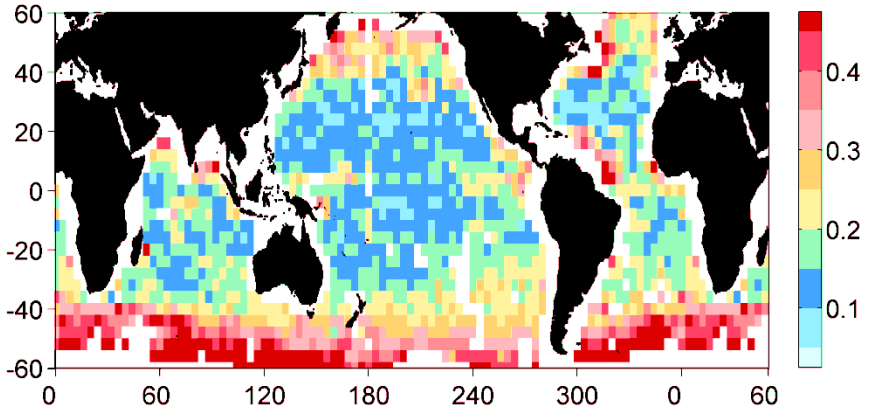
Aquarius-Argo Differences

Oleg Melnichenko, U. Hawaii

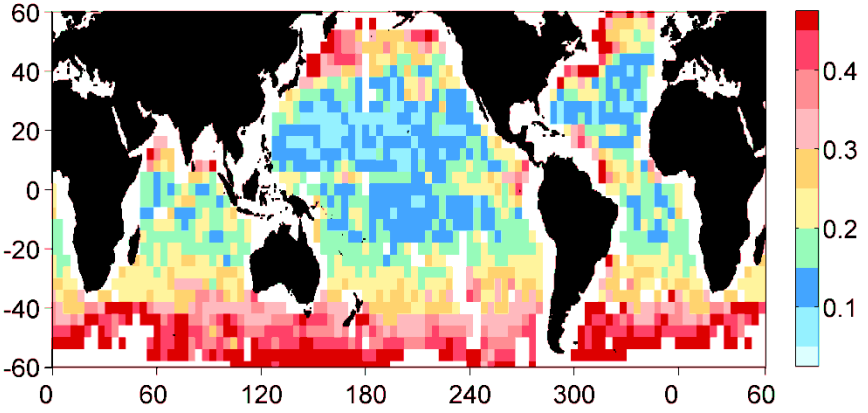
standard deviation, psu

V2.0

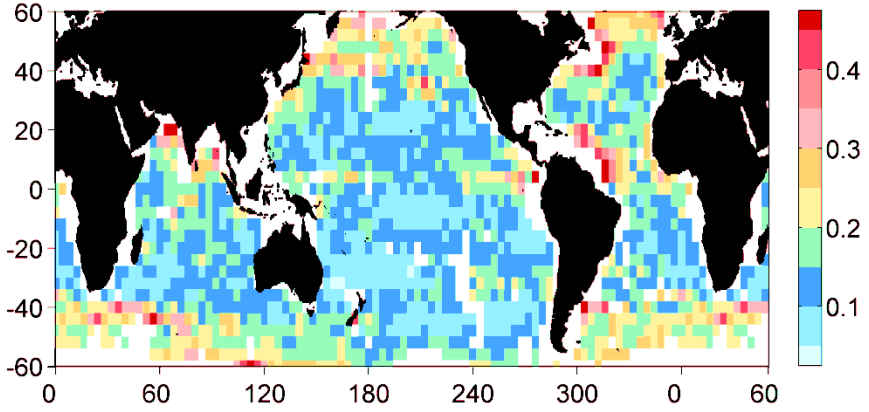
Ascending

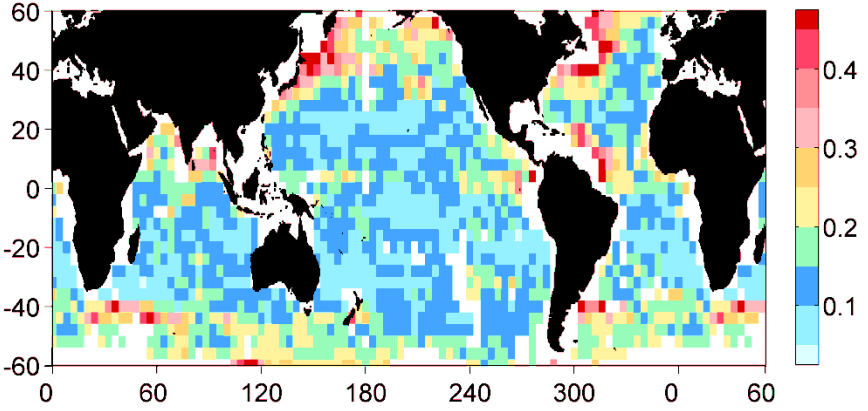


Descending



V2.5.1





Over most of the ocean STD is less than 0.2 psu

Bin-averaging of Aquarius and Argo data within 8º x 8º bins centered on a global grid with the grid spacing of 4º.

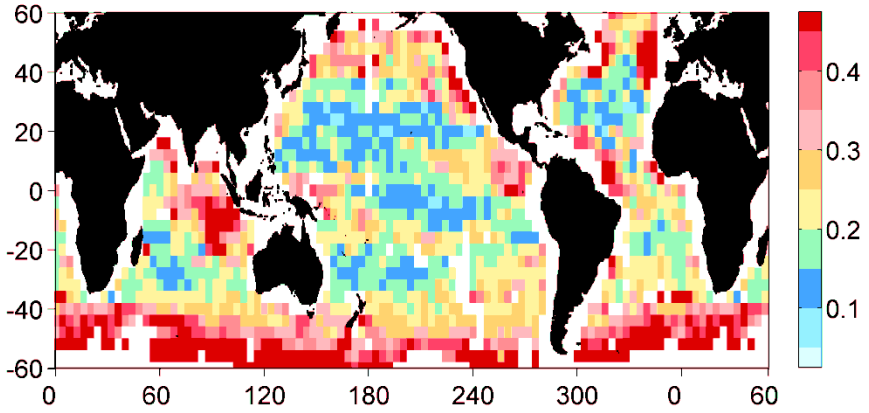
Aquarius-Argo Differences

Oleg Melnichenko, U. Hawaii

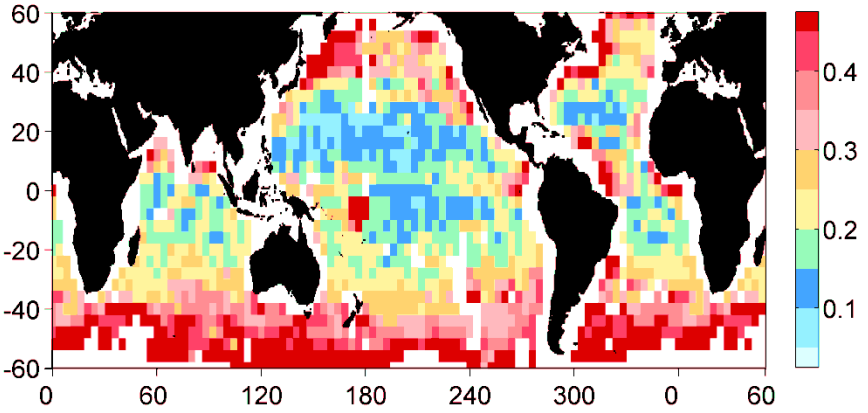
RMSD (sqrt(mean^2+std^2)) , psu

V2.0

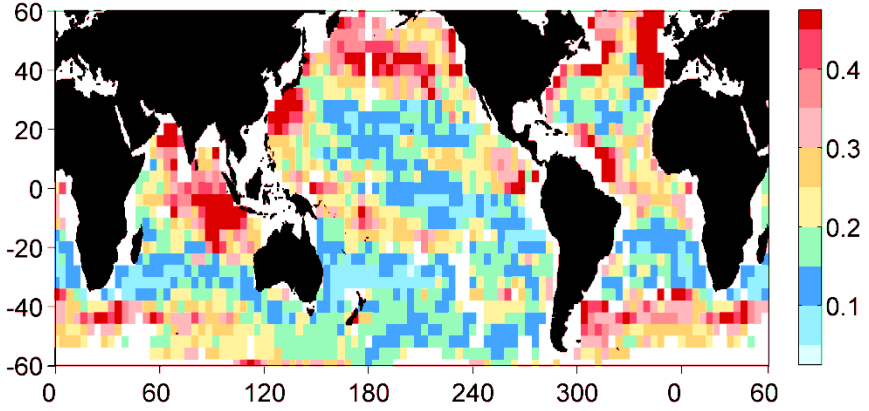
Ascending

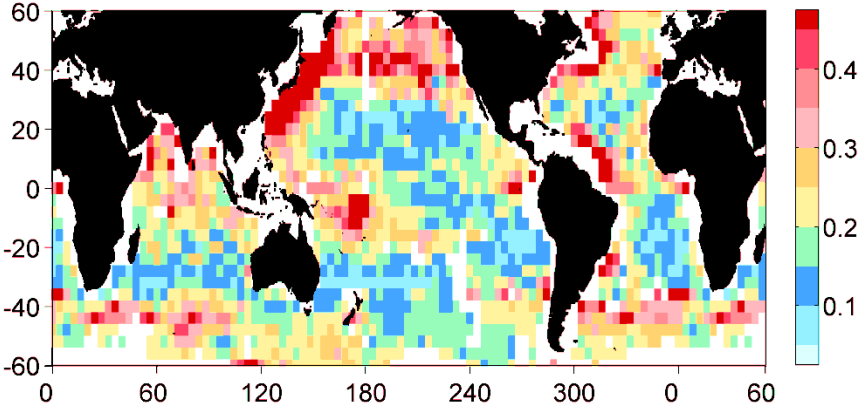


Descending



V2.5.1





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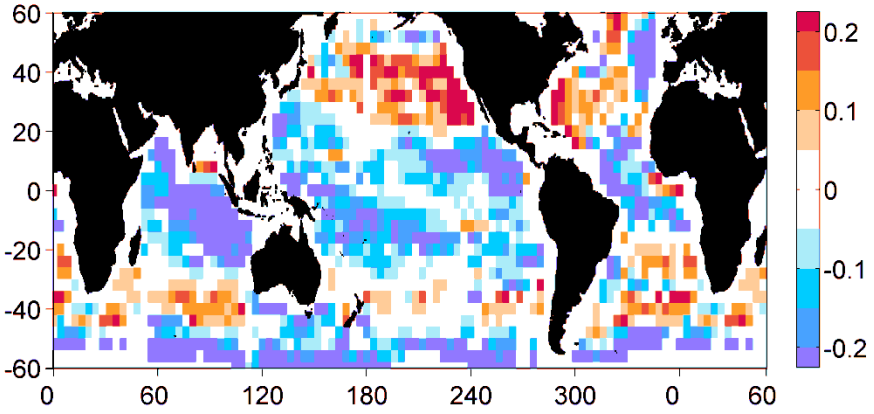
Aquarius-Argo Differences

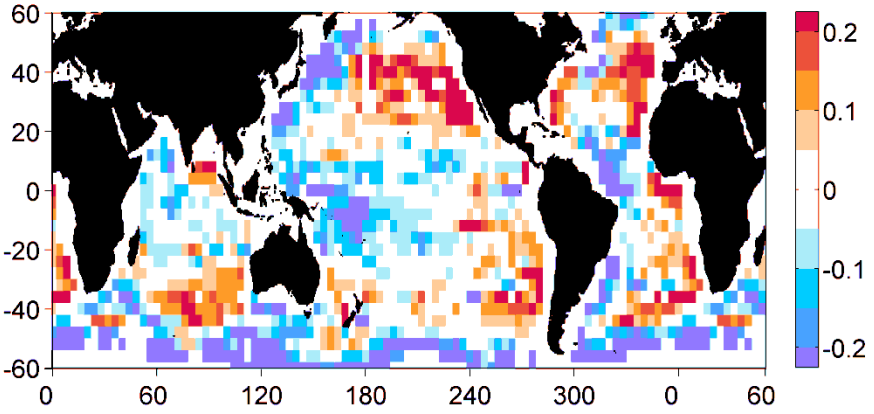
Oleg Melnichenko, U. Hawaii 24-month average (Sep 2011-Aug 2013), psu

V2.0

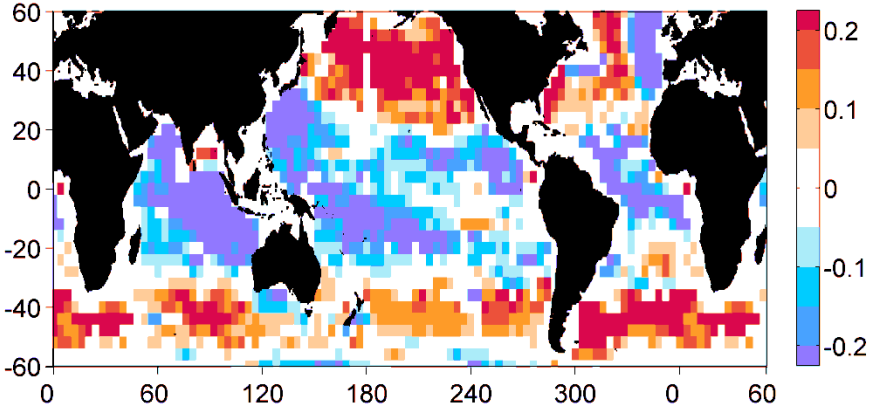
Ascending



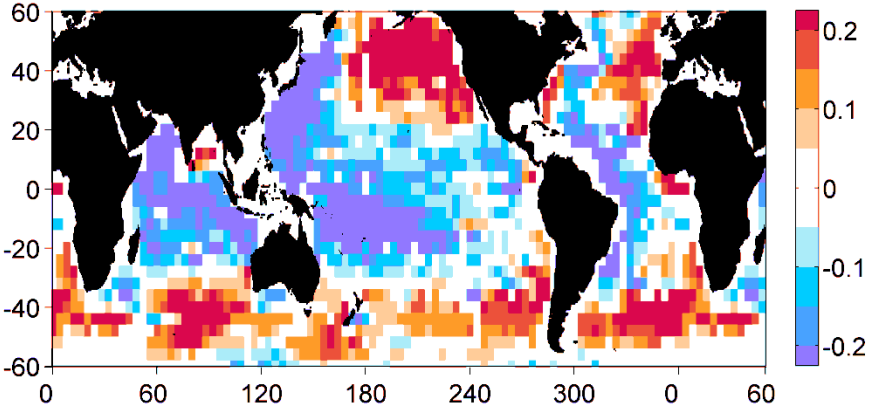
Descending



V2.5.1



Median=-0.01 psu



Median=-0.02 psu

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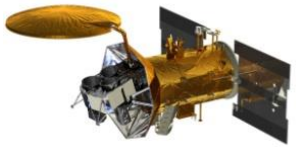
BAMS State of Climate 2012



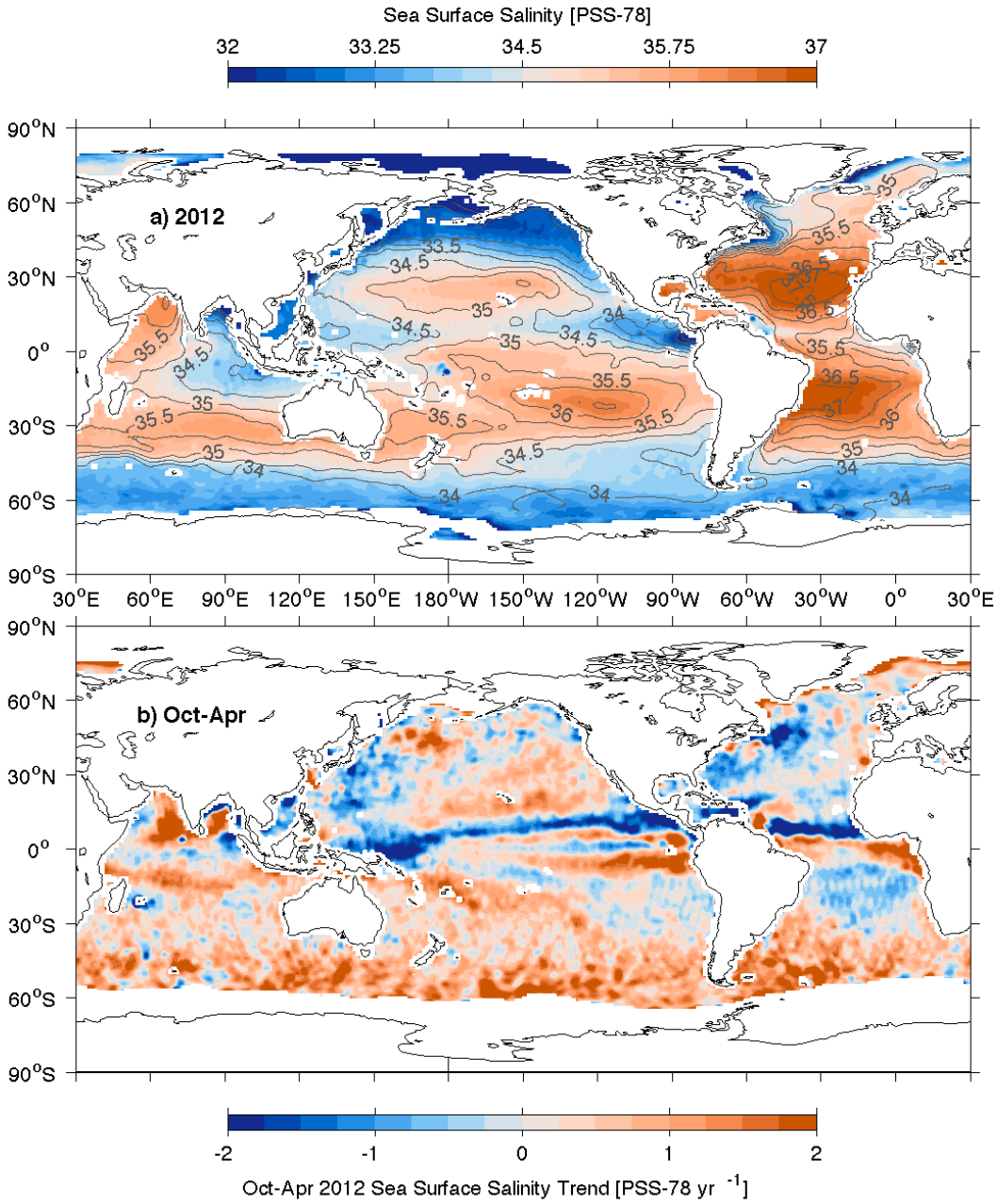
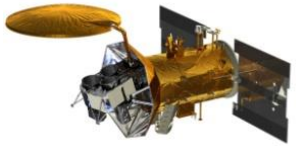


Fig. SSS3. **a) Aquarius V2.0 mean 2012 SSS** from average of monthly maps [colors in PSS-78] with the Argo mean 2012 values overlaid [grey contours at 0.5 PSS-78 intervals]. **b) The difference of Oct. and Apr. 2012 Aquarius maps** [colors in PSS-78 yr^{-1} to allow direct comparison with Fig. SSS1b and Fig. SSS2a]. White ocean areas have excessive land or ice contamination in the Aquarius field of view.

Johnson, Lyman, Lagerloef, Kao, 2013, BAMS, in press.

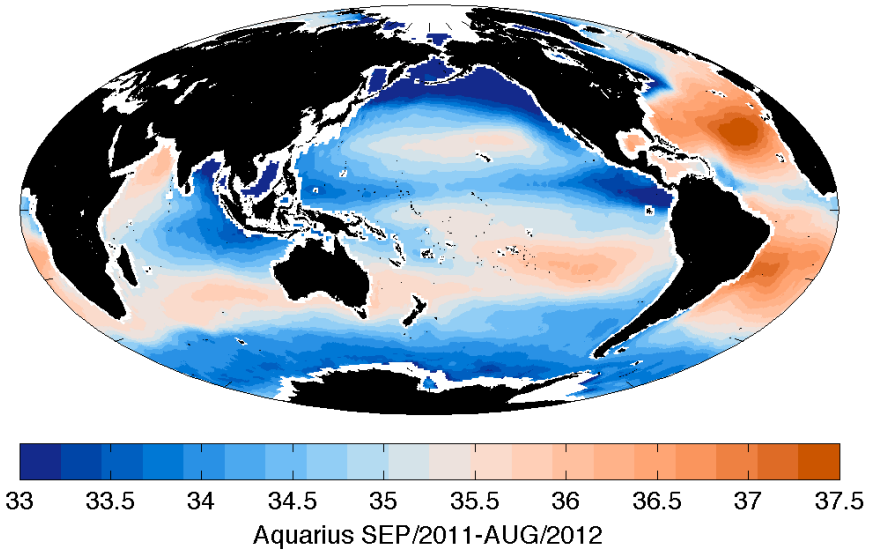
Aquarius year 1 & year 2



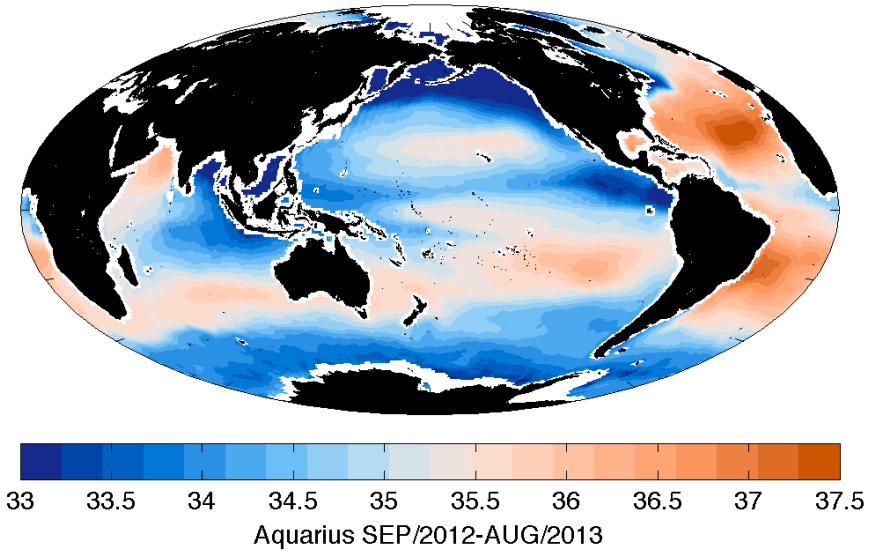
YEAR 1 Sep 2011 to Aug 2012

YEAR 2 Sep 2012 to Aug 2013

YEAR 1

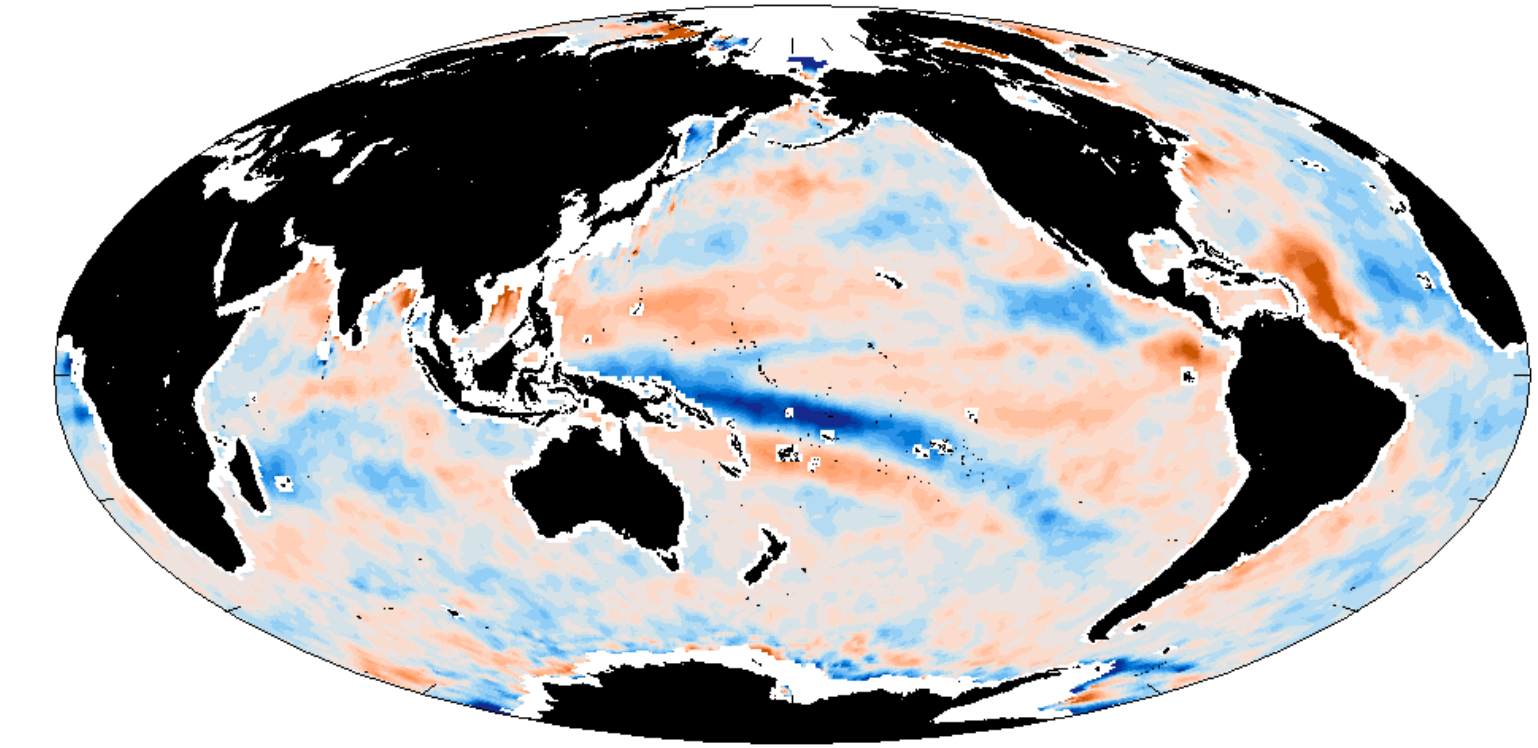


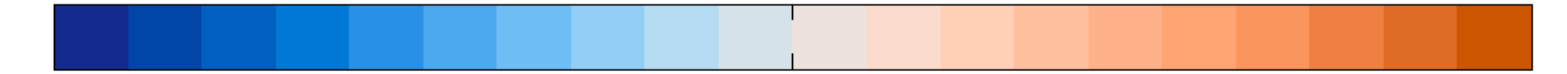
YEAR 2



Aquarius Inter-annual changes

YEAR 1 Sep 2011 to Aug 2012 YEAR 2 Sep 2012 to Aug 2013





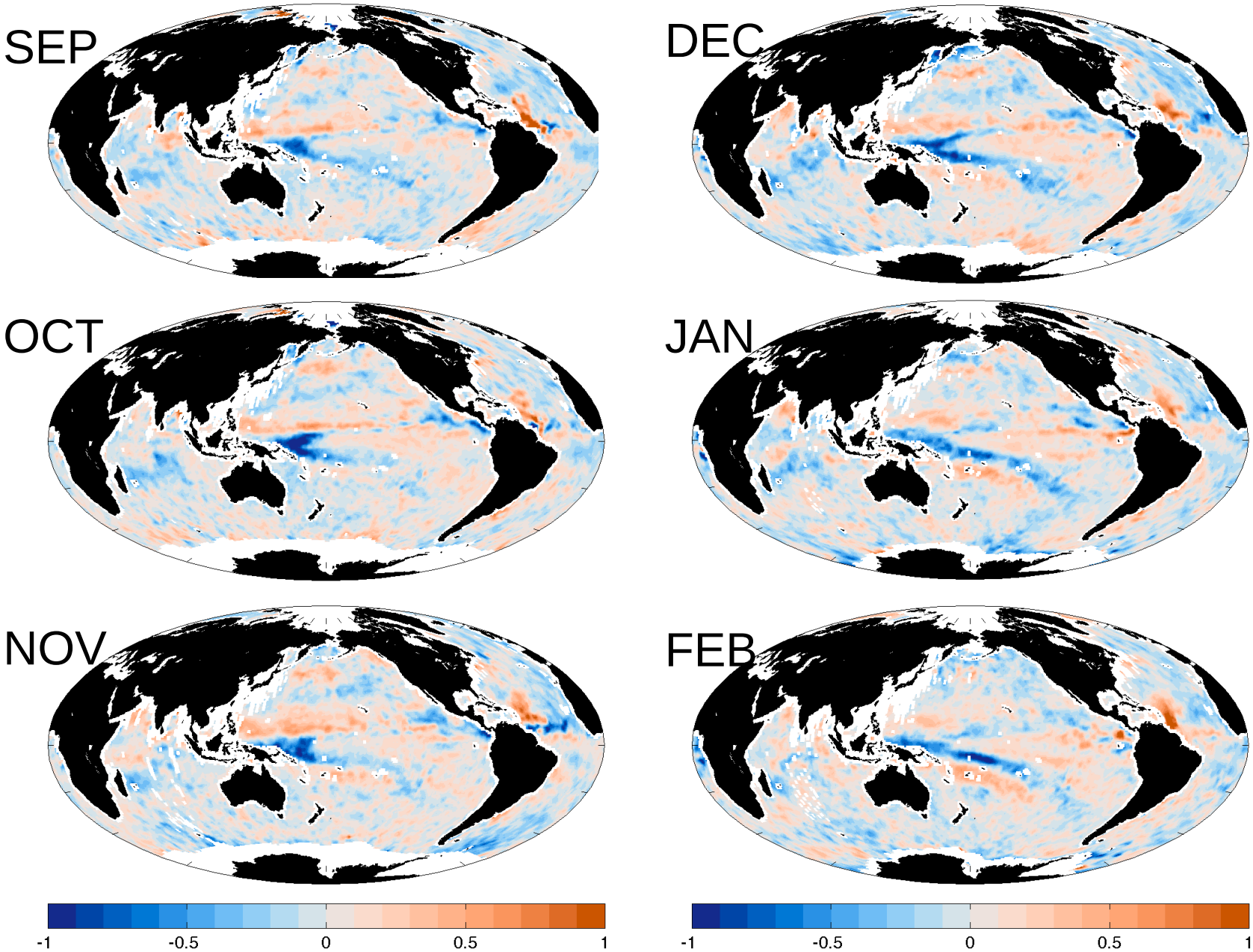
Aquarius Year2 - Year1

Hsun-Ying Kao, ESR

AQUARIUS/SAC-D

Monthly Differences Year 2 – Year 1

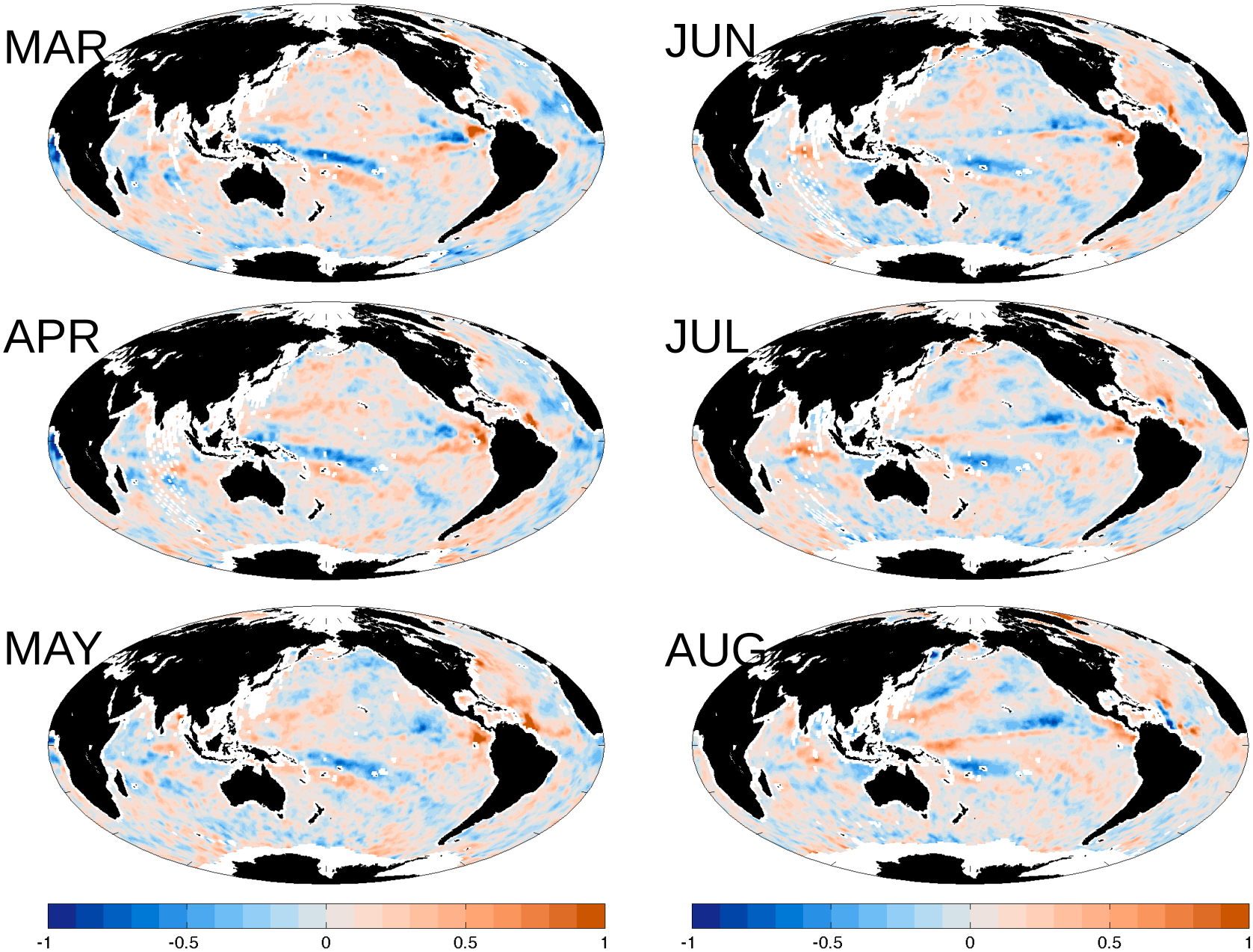
Hsun-Ying Kao, ESR

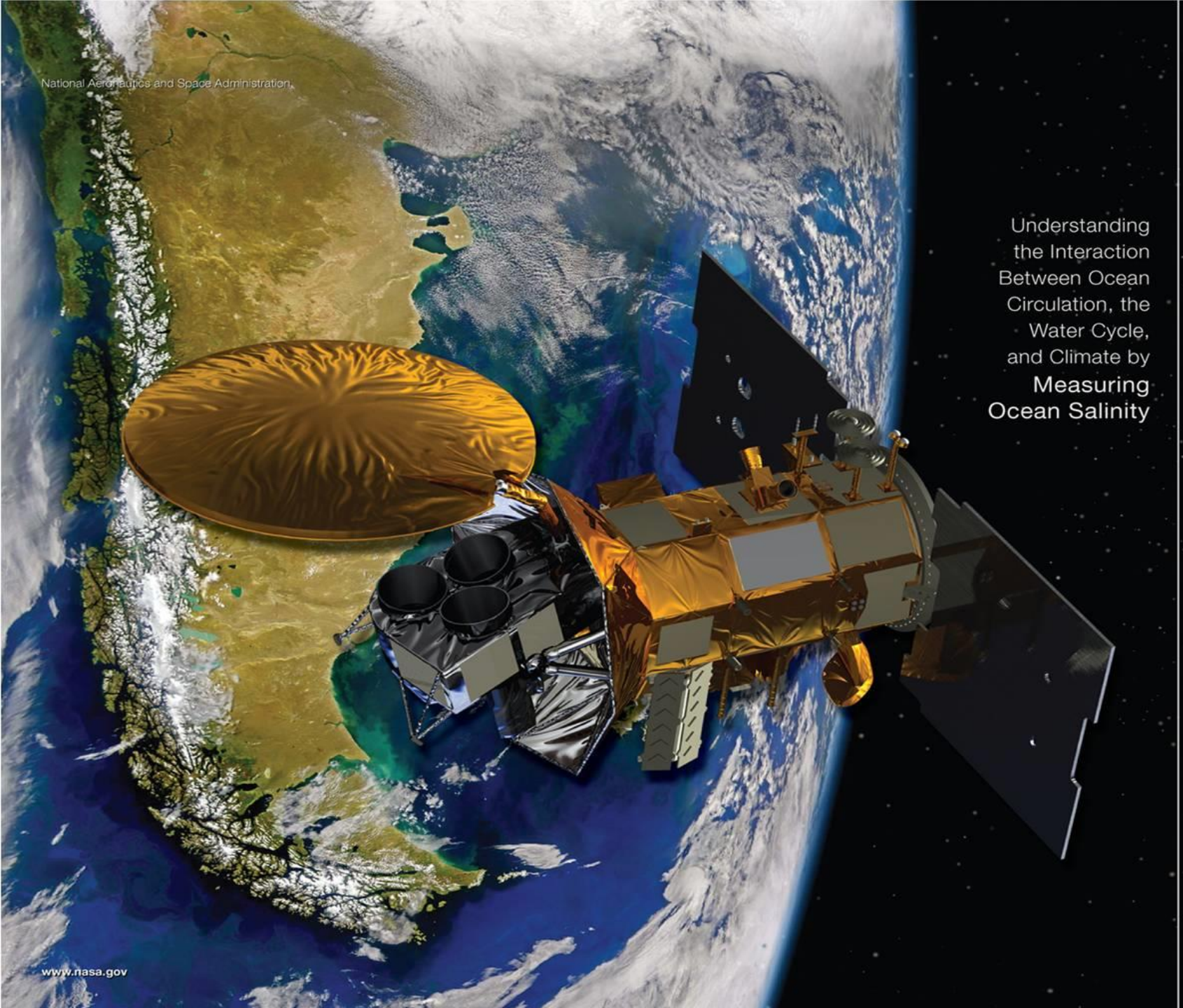


AQUARIUS/SAC-D

Monthly Differences Year 2 – Year 1

Hsun-Ying Kao, ESR





Aquarius/SAC-D

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

www.nasa.gov

AQUARIUS/SAC-D

Launch 10 June 2011
Aquarius on 25 Aug 2011
First Image 22 Sep 2011
NASA PLAR 10 Nov 2011
NASA BOPM 1 Dec 2011
7th Aquarius/SAC-D Science Meeting 11-13 April 2012
Aquarius V1.3 Data Apr 2012
Aquarius 1 Year of Data 25 Aug 2012
Webinar 29-30 Jan 2013
Aquarius V2.0 Validated Data 25 Feb 2013
Joint SMOS-Aquarius Workshop, Brest 15-17 April 2013
Aquarius 2 Years of Data 25 Aug 2013
8th Aquarius/SAC-D Science Meeting 12-14 Nov 2013

2011 | 2012 | 2013

10 Month Interim Extension

2014 | 2015 | 2016

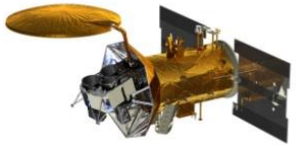
2-Year Extended Mission …

Aquarius V3.0 Validated Data January 2014
Aquarius V4.0 Validated Data TBD 2014
Science Meeting, Seattle September 2014(TBC)
NASA EOPM 30 Nov 2014
NASA Extended Mission Senior Review Proposal Spring 2015
NASA 2-Year Extended Mission Begins 1 Oct 2015

Timeline bar-graph (Launch, Aq-on, 1st-light, PLAR, BOPM, 1yr, 2yr, now, 3yr, EOPM, 10-month Ext, Sr Rev Proposal, Start 2yr Ext Mission.

Issues and plans: next Science Team; EOPM assessment; Ext Mission proposal in Mar-Apr 2015.

Outline (30 min)



- Animation
- Project status (2) from Gene
  - Month, week & day most recent Kuring maps
  - Kuring mapes Jul & Nov 2012
  - Highlight data loss stats
  - AOCS issues solved
- Timeline bar-graph (Launch, Aq-on, 1st-light, PLAR, BOPM, 1yr, 2yr, now, 3yr, EOPM, 10-month Ext, Sr Rev Proposal, Start 2yr Ext Mission.
  - Issues and plans: next Science Team; EOPM assessment; Ext Mission proposal in Mar-Apr 2015.
- Cold-Sky Cals
- Timeline: Algorithm versions
  - Key improvements V1.3, V2.0, V3.0
  - V2 solved Qusai monthly oscillations
  - V3 solves (mostly) seasonal errorsdue to galaxy; some residual
- Analyses of V2.5.1 (V3.0 presursor) – 4-5 slides from Oleg &HsunYing
- 2-years of data; some science highlights
  - TIWs; Hurricane Ivan; GOM(gierach, refer to later talk)
  - BAMS SOC 2012
  - Prelims from V2 & V2.5.1: yr2-1, spit itcz, amazon-orinoco outflow; Atl spit ITCZ?
  - Advances in gridding (Olegs paper for SPURS)
  - Gordon Giulivi SPURS analyses
  - EOFs V2 vs V2.5.1
- Wrap-up_ some key issues for meeting to be discussed at end of day.