CAL/VAL Status of the GCOM-W1/AMSR2

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Status of AMSR2 and GCOM-W1

- **May 18, 2012** GCOM-W1 (SHIZUKU) was launched
- **Jun. 29, 2012** Join A-Train orbit
- **Jul. 3, 2012** Start AMSR2 observation from A-Train orbit
- **Jul. 4, 2012** Release of AMSR2 observation images
- **Aug. 10, 2012** Initial functional verification completed
- **Aug. 31, 2012** Preliminary L1 delivery (PI and related agencies)
- **Oct. 19, 2012** Preliminary L2 delivery
- **Jan. 24, 2013** L1 (and L3TB) public release
  from **https://gcom-w1.jaxa.jp/**
  L1 product information available at
  http://suzaku.eorc.jaxa.jp/GCOM_W/
- **May 17, 2013** L2 (and L3GEO) public release
  L2 product information coming soon.

AMSR2 Standard Products

Products		Areas	Res.	Accuracy			Range
				Release	Standard	Goal	
Brightness Temperature		Global	5-50km	±1.5K	±1.5K	±1.0K (systematic) ±0.3K (random)	2.7-340K
GEO	Integrated water vapor	Global, over ocean	15km	±3.5kg/m^2	±3.5kg/m^2	±2.0 kg/m^2	0-70kg/m^2
	Integrated cloud liquid water	Global, over ocean	15km	±0.10kg/m^2	±0.05kg/m^2	±0.02kg/m^2	0-1.0kg/m^2
	Precipitation	Global, except cold latitude	15km	Ocean ±50% Land ±120%	Ocean ±50% Land ±120%	Ocean ±20% Land ±80%	0-20mm/h
	Sea surface temperature	Global, over ocean	50km	±0.8℃	±0.5℃	±0.2℃	-2-35℃
	Sea surface wind speed	Global, over ocean	15km	±1.5m/s	±1.0m/s	±1.0m/s	0-30m/s
	Sea ice concentration	Polar region, over ocean	15km	±10%	±10%	±5%	0-100%
	Snow depth	Land	30km	±20cm	±20cm	±10cm	0-100cm
	Soil moisture	Land	50km	±10%	±10%	±5%	0-40%

Inter-calibration of AMSR2 Tb

- Brightness temperatures (Tbs) of AMSR2 (Version 1.1) were inter-calibrated with those of TMI and AMSR-E.
- Differences were found between the calibration of AMSR2 and TMI/AMSR-E. The differences seem to be Tb-dependent.
- Inter-calibration coefficients (slope and intercept) were derived to compensate the calibration differences.
  - Note that these coefficients are just to cancel out calibration differences. Differences originated from instrument's characteristics (e.g., center frequency and incidence angle) should be handled by users.
- Investigation of the causes of the calibration differences are underway.
- Further inter-calibrations are in progress, including comparison with polar orbiting radiometers through TMI or by polar region match-ups, and direct comparison with AMSR-E Tbs obtained by slow rotation observation (from December 2012).
- Calibration result is available at GCOM web site. **http://suzaku.eroc.jaxa.jp/GCOM_W/**
  - Go to Publication → Product Information

Summary of TMI Inter-calibration

- Inter-calibration coefficients (slope/intercept) were derived by linear regression (no physical meaning of straight-line approximation). Calibration differences at typical Tbs are also shown in table below based on the inter-calibration coefficients.
- Characteristics of the difference sometimes differ for ocean/land and ascending/descending. Coefficients below were determined by using both ocean and rainforests values, and averaged over ascending and descending. Separated coefficients for ascending and descending are also provided.

Asc+Dsc	slope	intercept	TB@ocean	ΔT@ocean	TB@land	ΔT@land
10V	-0.01662	6.99952	179	+4.0	285	+2.3
10H	-0.00975	5.61573	91	+4.7	283	+2.9
18V	-0.05124	13.80014	205	+3.3	286	-0.8
18H	-0.01944	4.62348	131	+2.1	284	-0.9
23V	-0.03970	13.47956	237	+4.1	288	+2.0
23H	-	-	-	-	-	-
36V	-0.02711	9.66059	224	+3.6	285	+1.9
36H	-0.02108	7.84445	160	+4.5	284	+1.9
89AV	-0.00141	1.75392	270	+1.4	287	+1.3
89AH	-0.00975	4.97772	242	+2.6	287	+2.2
89BV	-0.00618	3.37024	269	+1.7	287	+1.6
89BH	-0.00545	3.80564	241	+2.5	287	+2.2

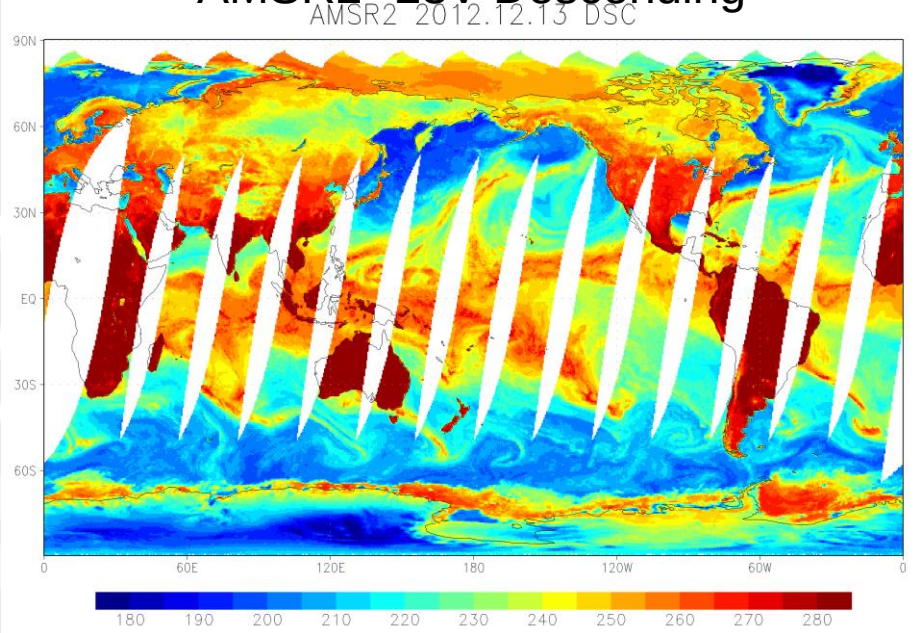
$$\Delta Cal_{AMSR2-TMI}[K] = Tb_{AMSR2}[K] * slope + intercept$$

$$\Delta Cal_{TMI-AMSR2}[K] = -(Tb_{AMSR2}[K] * slope + intercept)$$

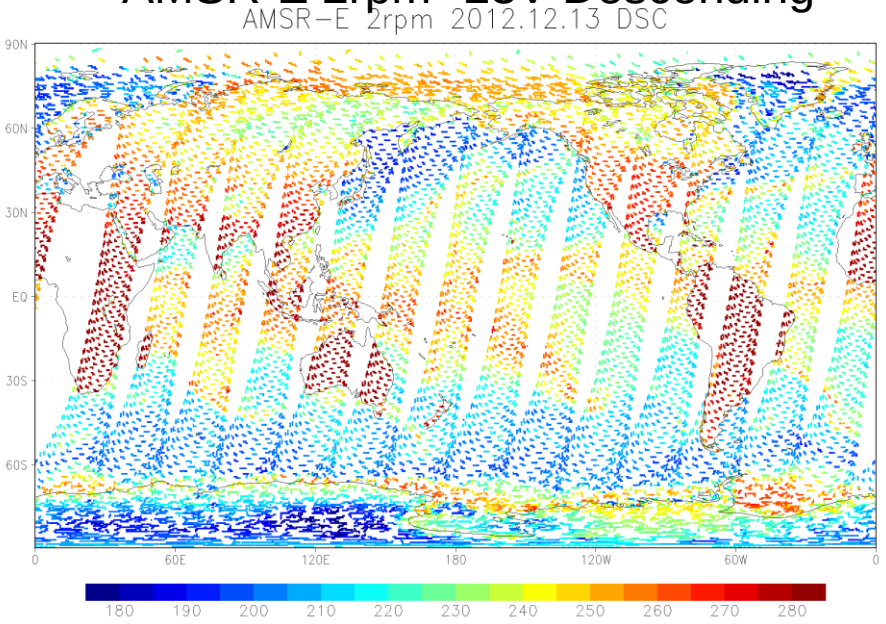
Direct Comparison with AMSR-E

- Orbits and frequency channel sets are almost identical: no corrections are needed for center frequency, incidence angle, and observing local time. It enables cross calibration in wide range of Tbs over land, ice, and ocean.
- AMSR-E observations resumed from December 4, 2012 with 2rpm rotation speed. Geolocation and Tbs are computed by modified software.
- Observation is sparse, but reasonable for global-scale comparison.
- Calibration improvement of 2rpm mode data is underway.

AMSR2 23V Descending



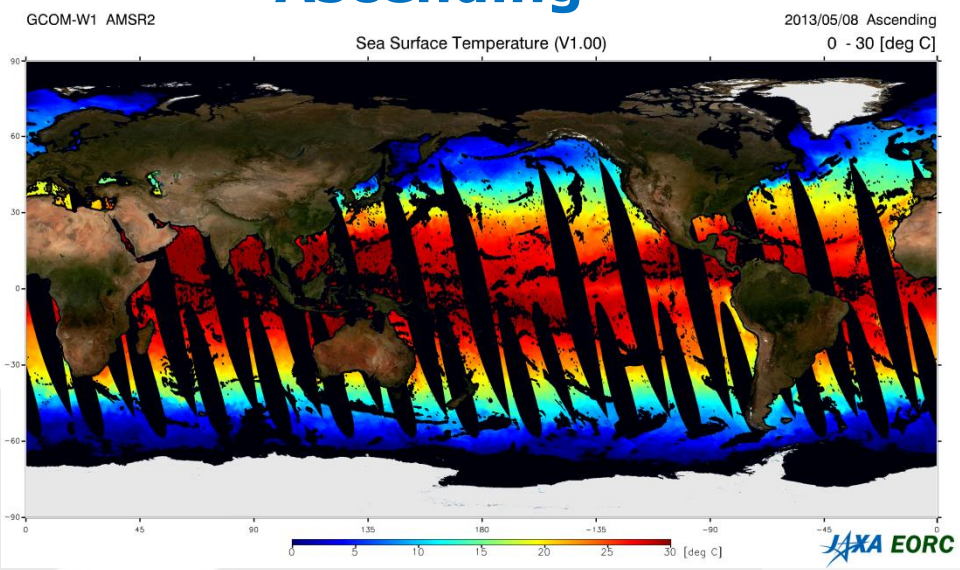
AMSR-E 2rpm 23V Descending



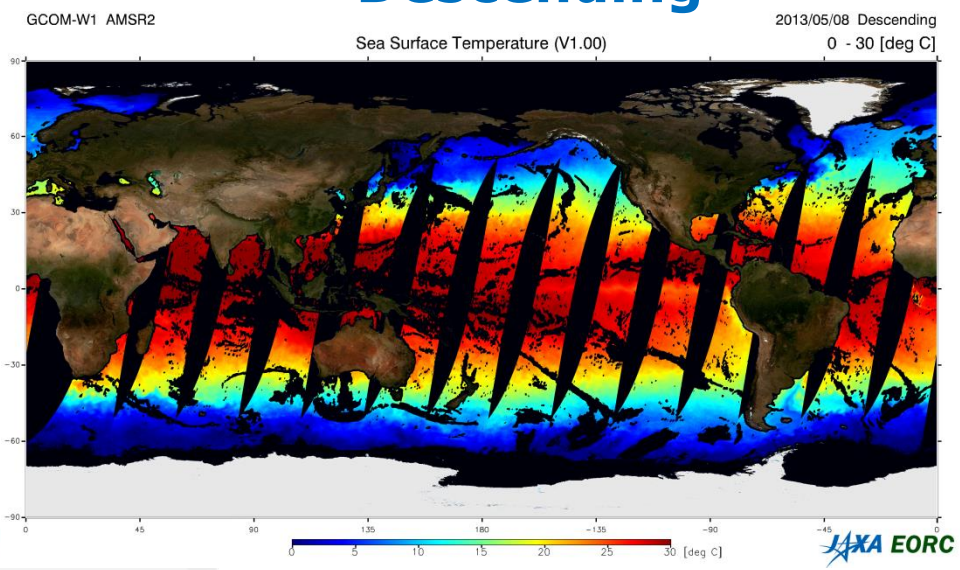
Sea Surface Temperature

May 8, 2013

Ascending



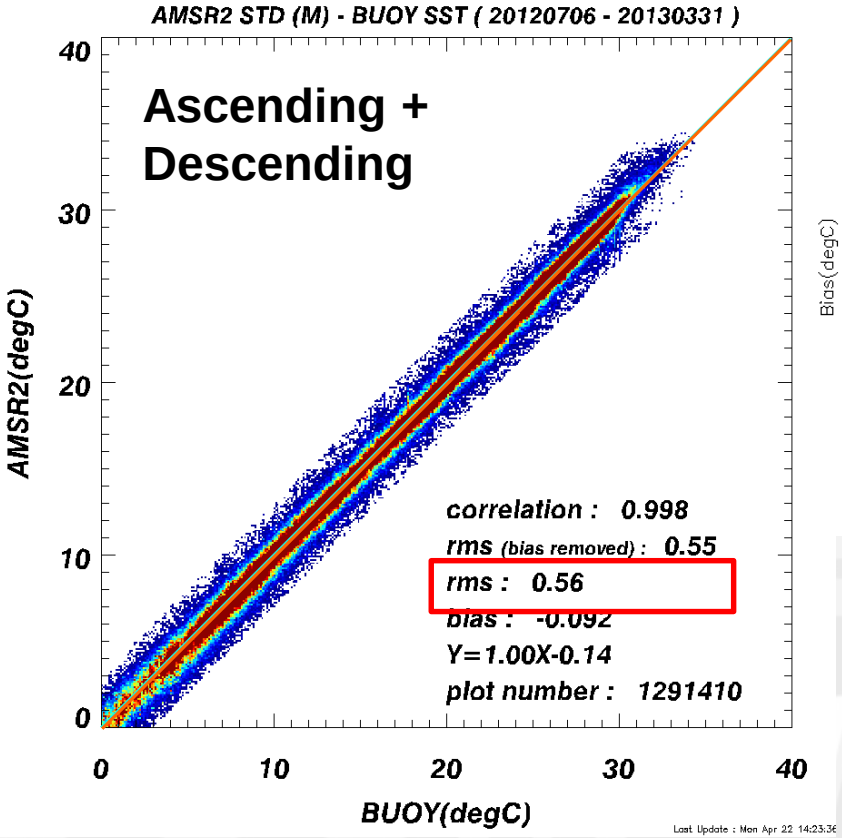
Descending

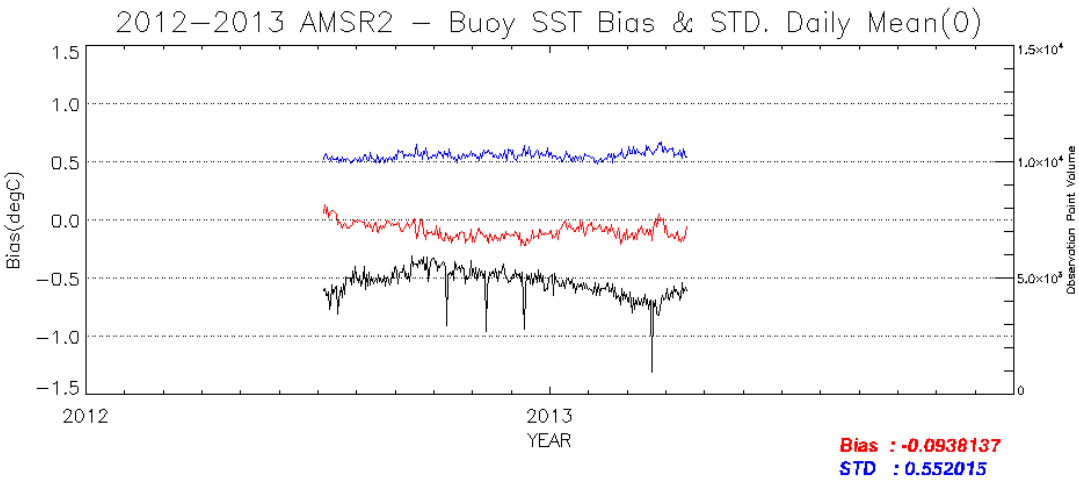


- Validation period: from July 6, 2012 to March 31, 2013.
- Compare with buoy SST derived from GTS within 2-hr in time and 30km in distance, 10-points average of AMSR2 SST (QC of buoy measurement is based on AMSR-E experience. Validation method should be re-considered in future validation).

Sea Surface Temperature

with buoys





Black: Number of observation

Red: Bias

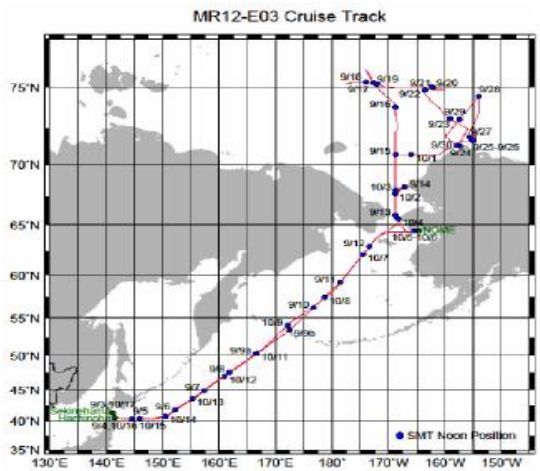
Blue: STD

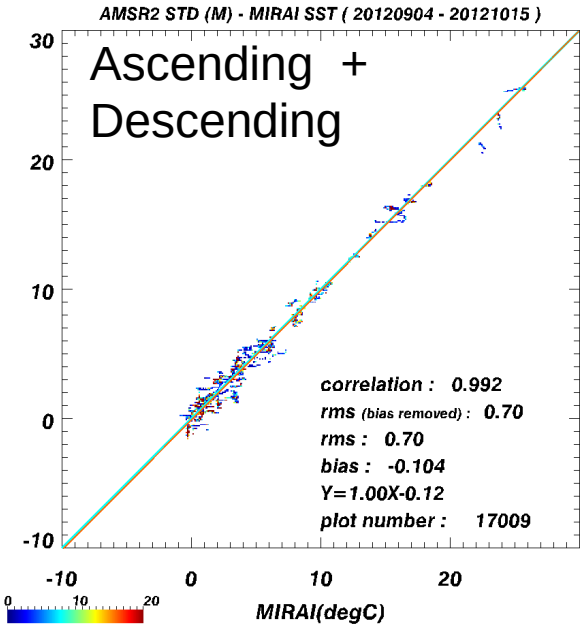
Validation result	Required (Release)
0.6 ℃	0.8 ℃

(RMSE)

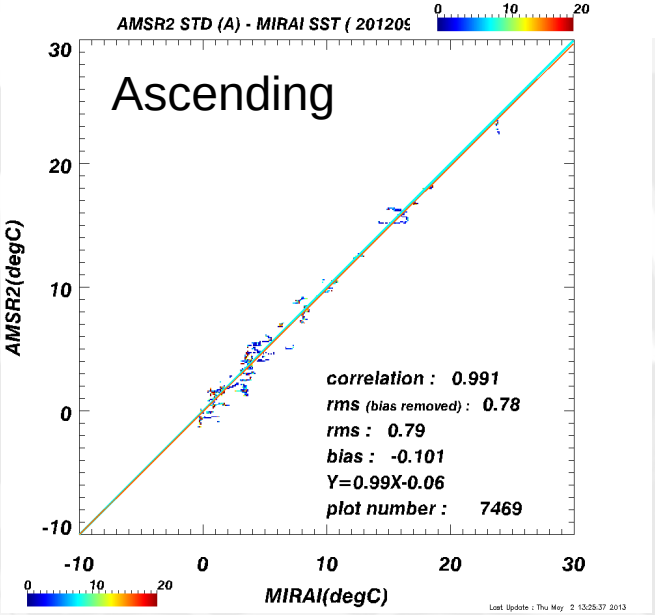
SST by R/V Mirai around Arctic

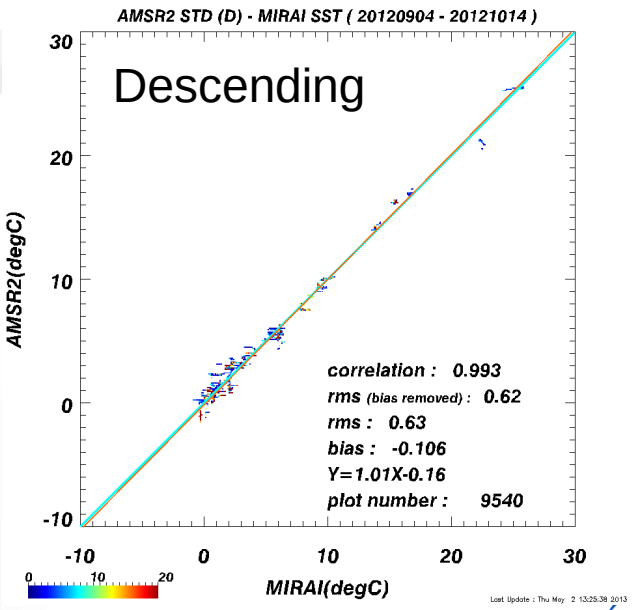
Courtesy of JAMSTEC





- Observation at ship bottom (7m depth). Use points where mixing layer assumed to be more than 10m depth.
- RMSE of Ascending orbit is greater than that of Descending orbit.
- RMSE is 0.70 degC for Ascending & Descending orbits, and lower than release accuracy.

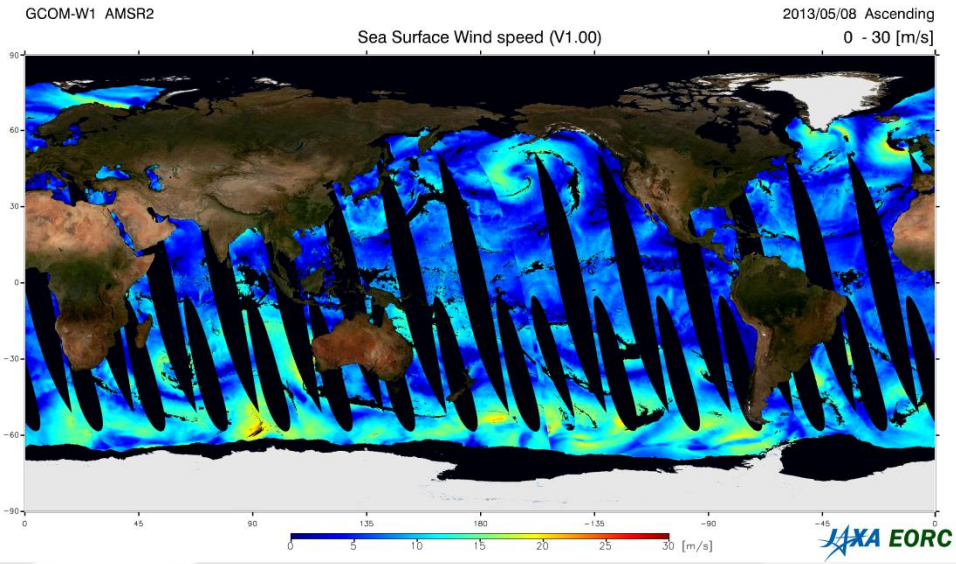




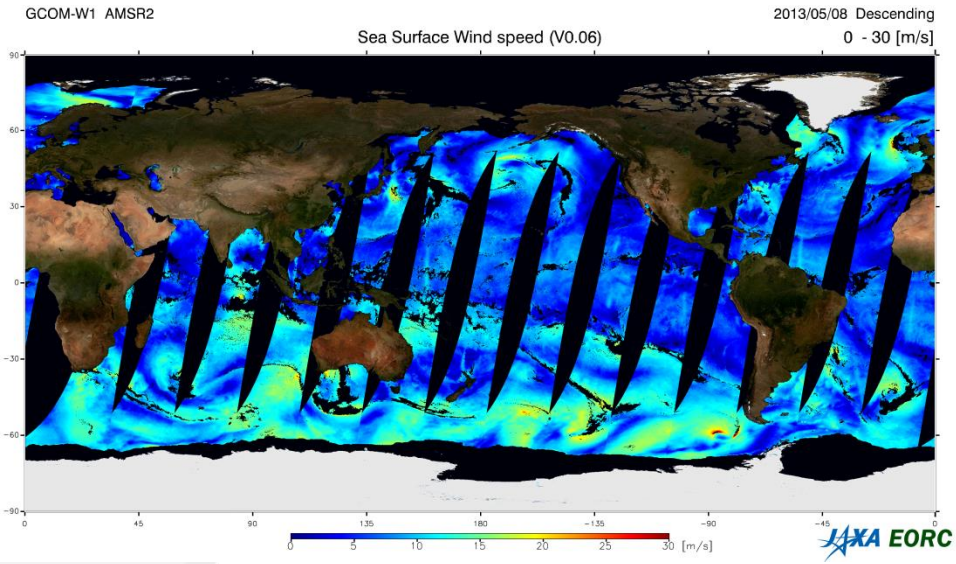
Sea Surface Wind Speed

May 8, 2013

Ascending



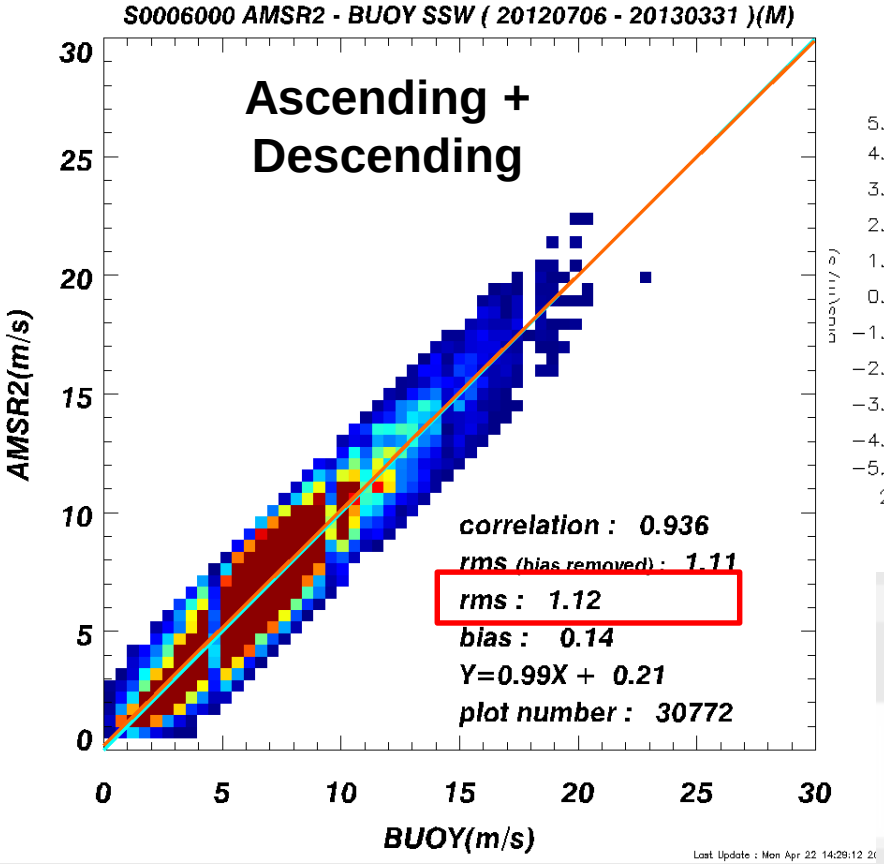
Descending

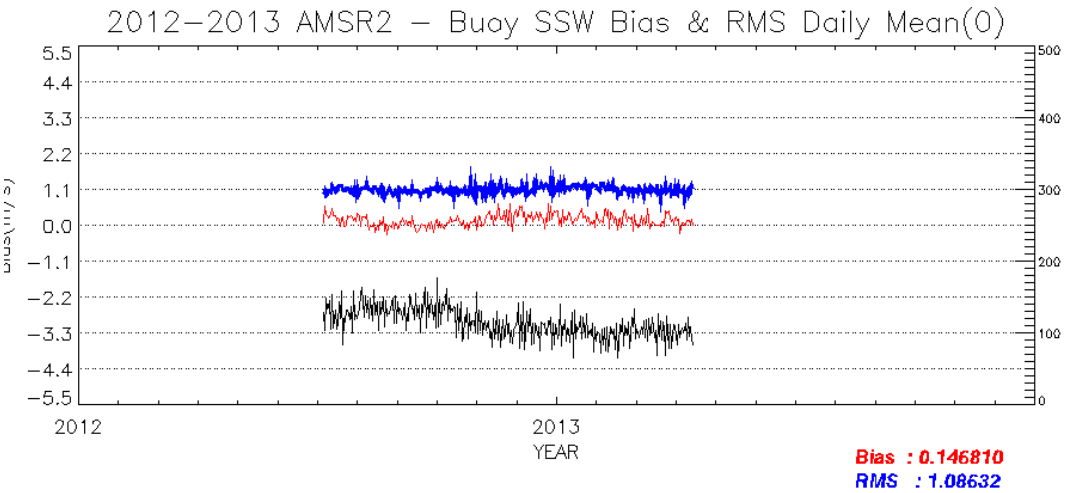


- Period of comparison: from July 6, 2012 to March 31, 2013.
- Compare with buoy SSW derived from GTS within 2-hr in time and 30km in distance, 10-points average of AMSR2 SSW (QC of buoy measurement is based on AMSR-E experience. Validation method should be re-considered in future validation).

Sea Surface Wind Speed

with buoys





Black: Number of observation

Red: Bias

Blue: STD

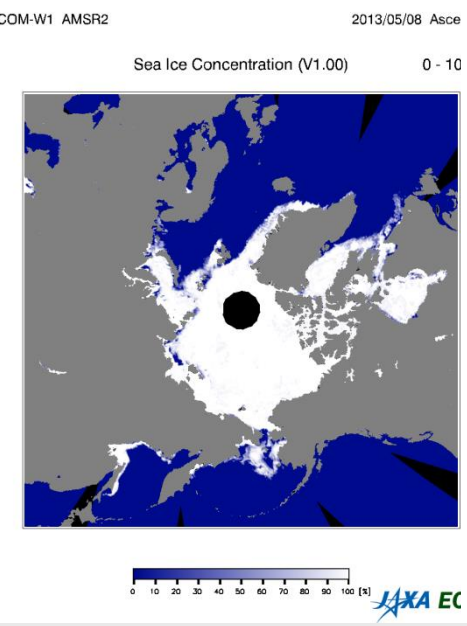
Validation Result	Required (Release)
1.1 m/s	1.5 m/s

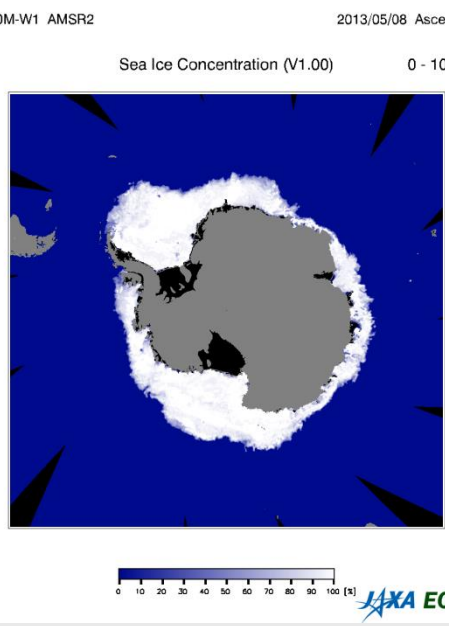
(RMSE)

Sea Ice Concentration

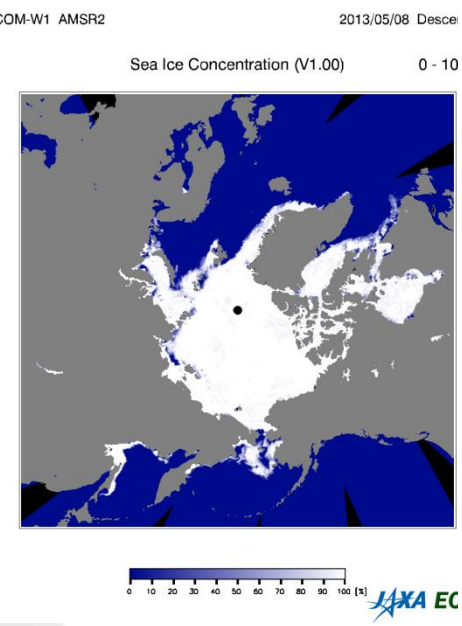
May 8, 2013

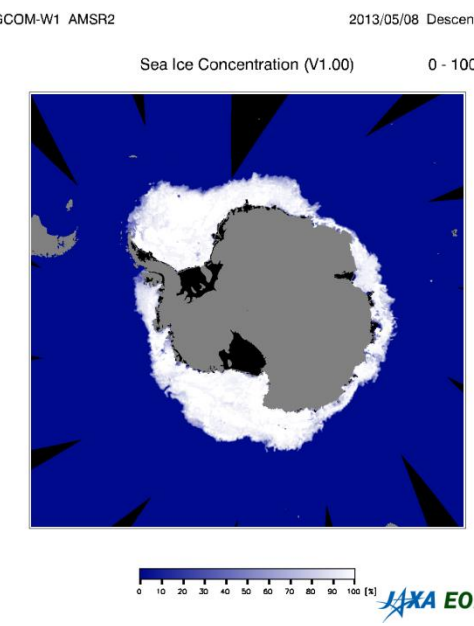
Ascending





Descending

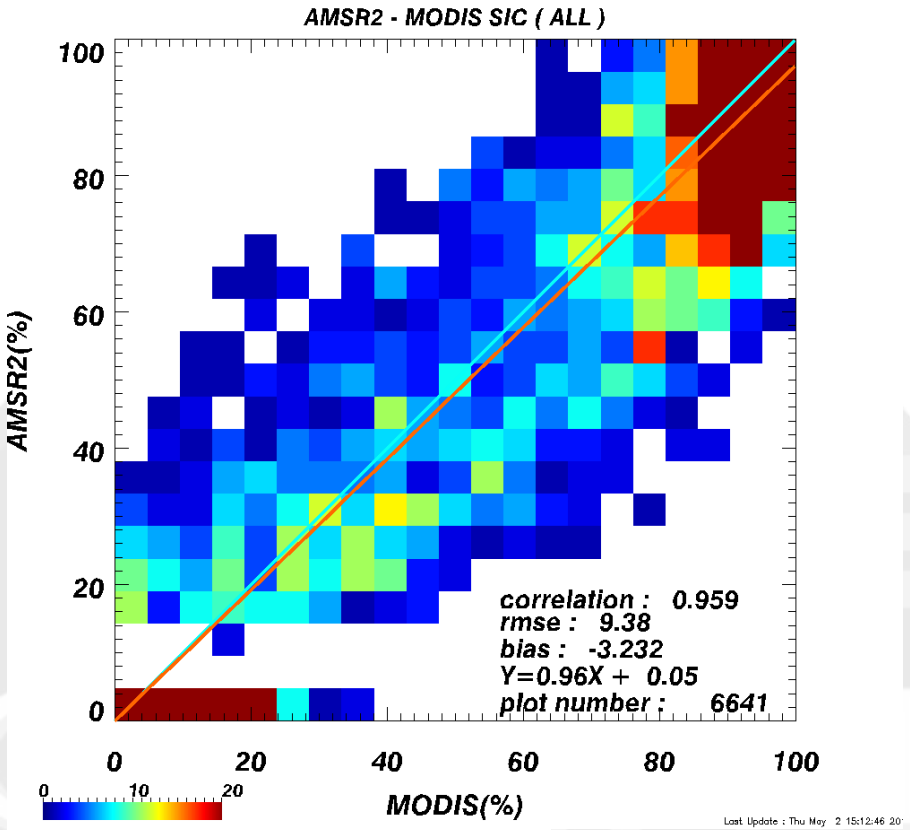




- Validation period:
  - October 31, 2012: Bellingshausen-Amundsen Sea
  - July 28, 2012: Arctic Sea – Greenland Sea
  - November 30, 2012: Bering Sea
  - March 5, 2013: Okhotsk Sea
- Compare with sea ice observation by Aqua/MODIS over clear-sky regions.

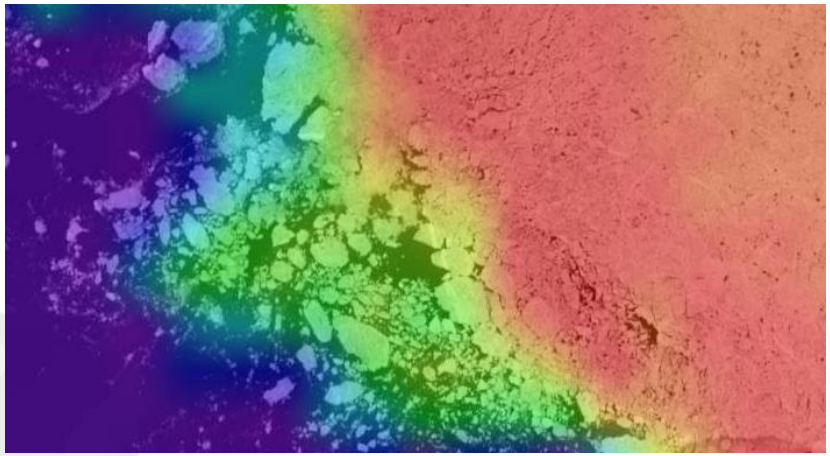
Sea Ice Concentration

with Aqua/MODIS



correlation : 0.959
rmse : 9.38
bias : -3.232
Y=0.96X + 0.05
plot number : 6641

Sea Ice Concentration(IC) vs. MODIS band1
(Jul 28, 2012)



The IC give close agreement with MODIS image in high concentration area.

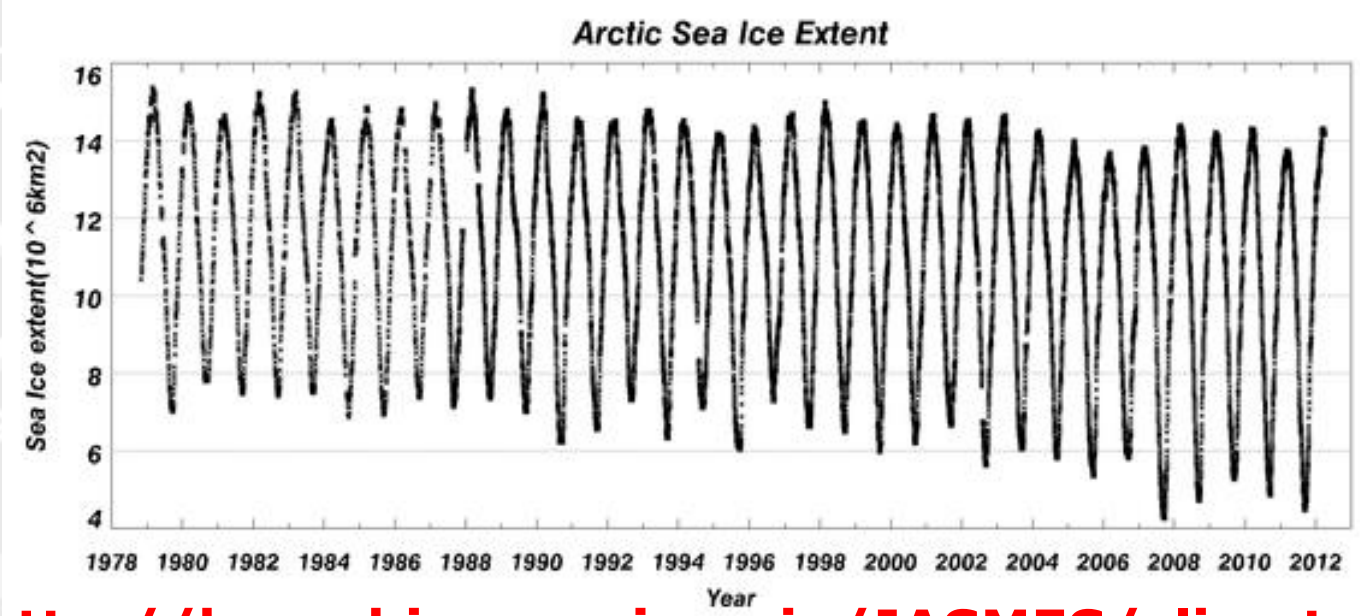
The ice edge roughly in accordance with MODIS image.

Validation Result	Required (Release)
9 %	10 %

(RMSE)

Long-term Sea Ice Dataset

- Sea Ice Concentration (binary) and Sea Ice Extent (text)
- Period: Nov. 1, 1978 - Mar. 31, 2012
  - SMMR: Jan. 1980 - Jul. 1987
  - SSM/I: Aug. 1987 - May 2002
  - AMSR-E: Jun. 2002 - Oct. 2011
  - Windsat: Oct. 2011 - present
- Will be extended by using AMSR2 data.



http://kuroshio.eorc.jaxa.jp/JASMES/climate/

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Summary

- All AMSR2 standard products have been released to public from GCOM-W1 Data Providing Service System (**https://gcom-w1.jaxa.jp/**)
  - Level 1 TB and Level 3 TB products have been released to public since Jan. 24, 2013. Version-up (Ver.1.1) products was released in Mar. 1, 2013.
  - All Level 2 GEO products satisfied release accuracy required. Level 2 and L3 GEO products have been released to public since May 17, 2013.
- AMSR2 Sea Ice Concentration will be integrated to JAXA long-term Sea Ice dataset (from 1978-present).
- AMSR2 SST in GDS 2.0 format is now available both NRT and past period.
  http://suzaku.eorc.jaxa.jp/GHRSST/
- Further calibration and validation activities will be continued toward future algorithm improvements. Latest Cal/Val results are available at GCOM-W1 web site (L2 Val status is coming soon).
- Please check our GCOM-W1 web site for more details.
  http://suzaku.eroc.jaxa.jp/GCOM_W/

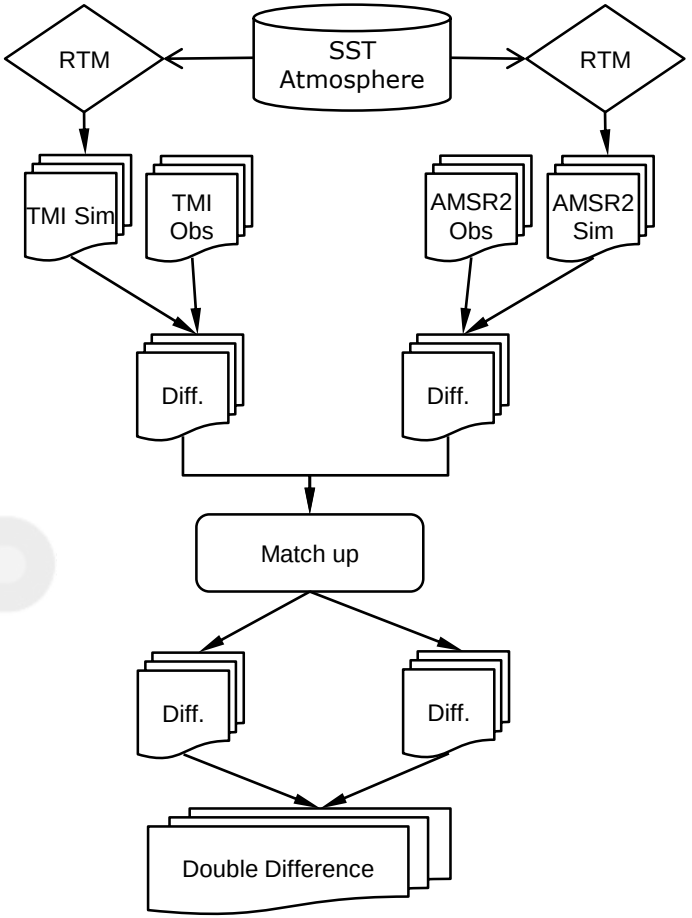
Future Plan

- Toolkit, sample program, and guidance how to use AMSR2 standard products in English will be available at GCOM-W1 web site. Now, translation is going on … **http://suzaku.eroc.jaxa.jp/GCOM_W/**
- Upon requests from Japan Coast Guard, we're planning to process AMSR2 10GHz SST (available only higher SST than ~12 degC) along with 6GHz SST (standard product) to get finer resolution and retrieve SST near the coast as far as possible.
- **Next GCOM research announcement (5th)** for GCOM-W will be announced in this summer for the research period from Apr. 2014 to Mar. 2017, which will include algorithm development, validation, amndproposals for research products such as;
  - all-weather sea surface wind speed
  - sea ice moving vector, sea ice thickness, etc

backups

Methodology

- TMI intercalibration
  - Create collocation dataset from AMSR2 and TMI (15 minutes and 0.1 degrees grid).
  - Compute differences between observed- and calculated-Tb (O-C) for both AMSR2 and TMI, over rainforest and cloud-free/calm ocean areas. Global analysis data and RTM are used to derive calculated-Tbs.
  - Further create "double difference" to cancel out the differences in frequency and incidence angle: AMSR2(O-C) – TMI(O-C).



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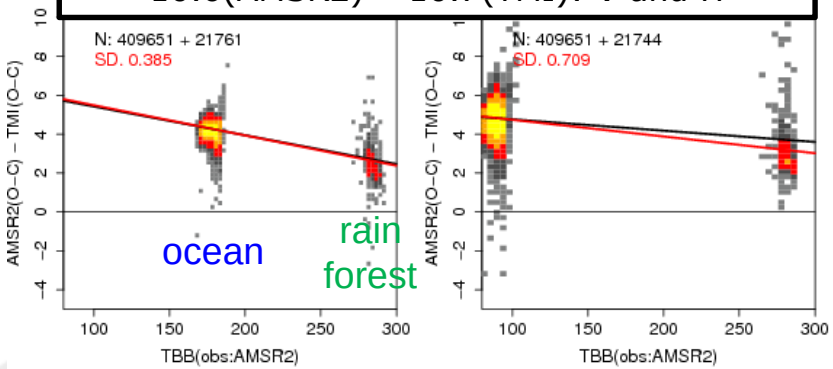
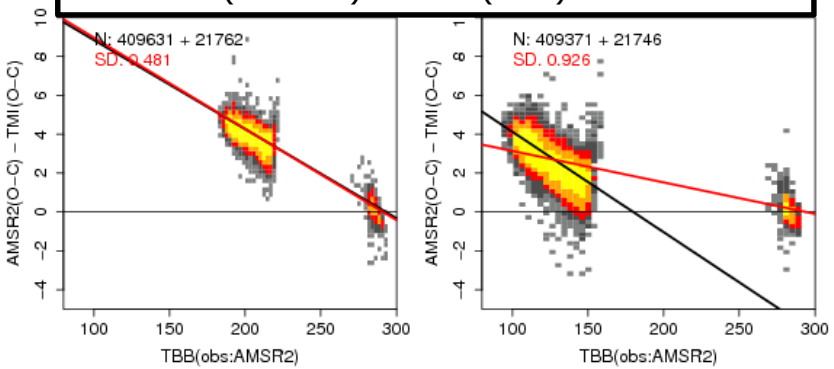
Tb-dependent Calibration Differences

AMSR2 Ascending Passes

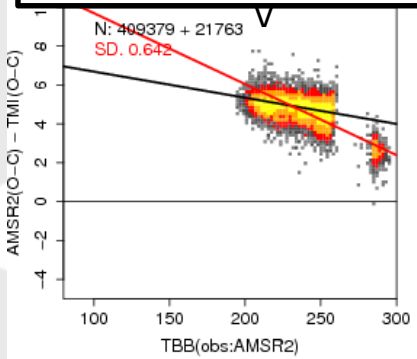
10.6(AMSR2) – 10.7(TMI): V and H



18.7(AMSR2) – 19.4(TMI): V and H

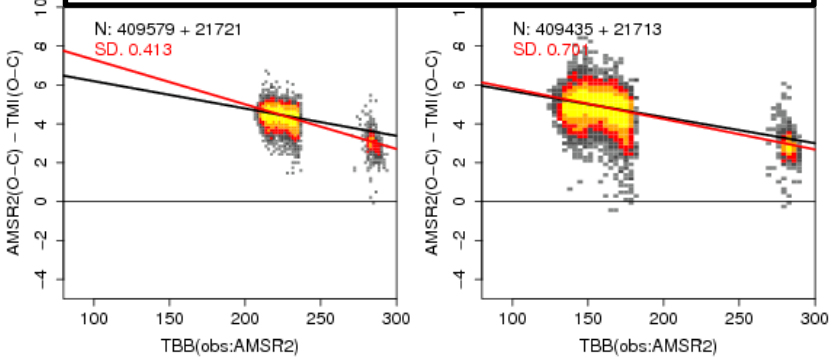


23.8(AMSR2) – 19.4(TMI): V

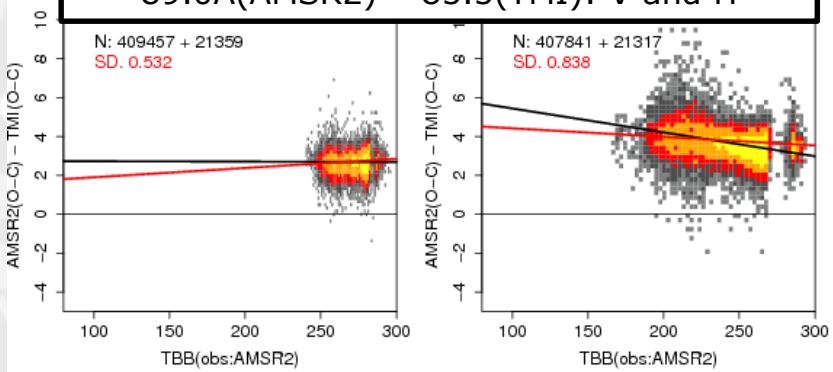


Black: regression line for Tb differences over ocean
Red: regression line for Tb differences over both ocean and rainforests.

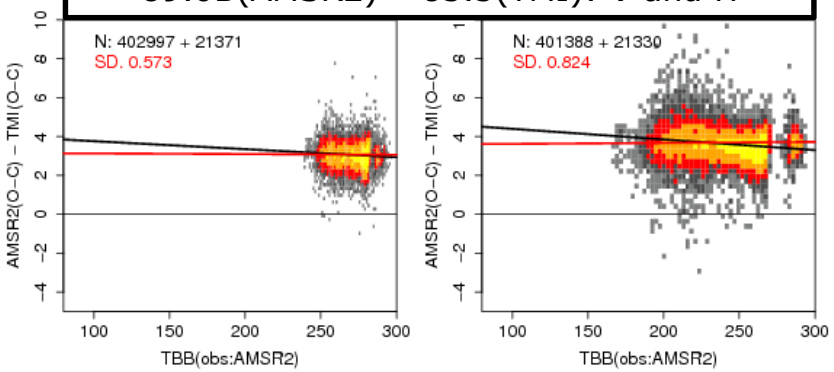
36.5(AMSR2) – 37.0(TMI): V and H



89.0A(AMSR2) – 85.5(TMI): V and H

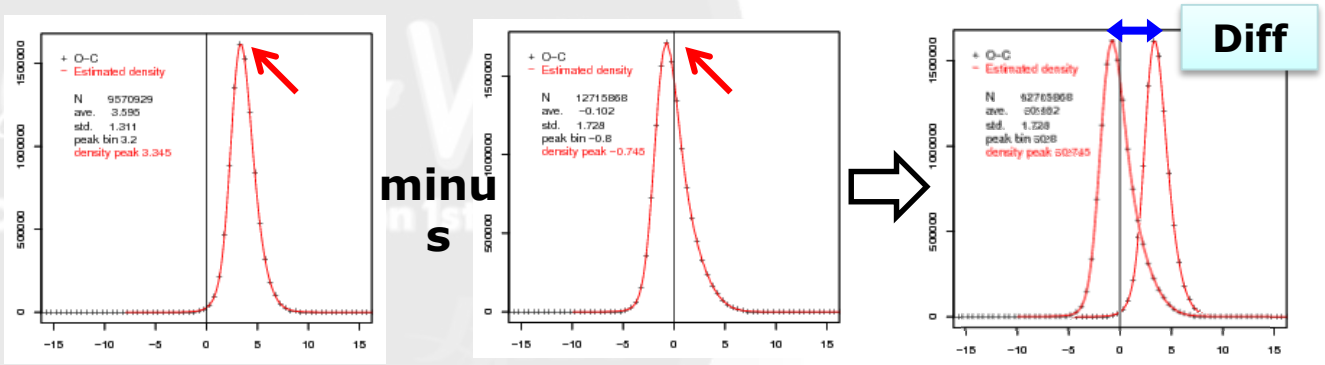


89.0B(AMSR2) – 85.5(TMI): V and H



Methodology

- AMSR-E intercalibration
  - Calculate differences between observed- and simulated-Tb (O-C) over rainforest and cloud-free/calm ocean areas for 2012 AMSR2 Tbs, by using global analysis data and RTM. Data period is from July to September in this report.
  - Obtain peak values from O-C histogram.
  - Follow the same steps for 2011 AMSR-E data in the same period.
  - Differences between O-Cs indicate calibration differences within the limits of accuracy of global analysis.



AMSR2 (2012)
O(obs) – C(RTTOV)

AMSR-E (2011)
O(obs) – C(RTTOV)

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Summary of AMSR-E Inter-calibration

- Inter-calibration coefficients (slope and intercept) provided below are those of lines passing through two O-C values over ocean and rainforest (no physical meaning for straight-line approximation). Calibration differences at typical Tbs are shown based on the coefficients.
- Averaged over ascending and descending passes. Separated coefficients for ascending and descending orbits are provided in Appendix.

Asc+Dsc	AMSR-E(O-C)		AMSR-2(O-C)		AMSR(2-E)		Ocean		Land	
	Ocean	Land	Ocean	Land	Slope	Intercept	TB	ΔT	TB	ΔT
06V	-1.8	-2.6	-0.3	-2.7	-0.01412	3.89494	167	+1.5	282	-0.1
06H	+0.3	-3.3	+2.3	-3.3	-0.00982	2.83897	82	+2.0	281	+0.1
07V	NA	NA	-0.1	-1.1	-0.00203	2.08485	168	+1.7	284	+1.5
07H	NA	NA	+2.8	-2.3	-0.00805	3.30649	83	+2.6	282	+1.0
10V	-1.6	-3.9	+2.6	-1.1	-0.01351	6.70216	175	+4.3	284	+2.9
10H	+0.3	-4.0	+3.4	-1.5	-0.00293	3.42724	87	+3.2	282	+2.6
18V	+0.7	-1.5	+4.4	-2.1	-0.04960	13.49461	195	+3.8	284	-0.6
18H	+3.1	-1.5	+3.8	-2.3	-0.00945	1.82686	113	+0.8	283	-0.8
23V	+1.5	-1.6	+4.0	+0.1	-0.01237	5.29143	217	+2.6	287	+1.7
23H	+3.9	-1.6	+6.5	-0.4	-0.01114	4.49098	155	+2.8	286	+1.3
36V	-0.5	-1.5	+2.9	+1.1	-0.01103	5.78519	216	+3.4	283	+2.7
36H	+2.1	-1.2	+5.1	+1.3	-0.00440	3.78759	144	+3.2	283	+2.5
89AV	NA	NA	+3.1	+0.2	-0.01578	5.71765	257	+1.7	286	+1.2
89AH	NA	NA	+7.1	+0.2	-0.01738	5.61016	213	+1.9	286	+0.6
89BV	+1.6	-0.9	+3.4	+0.6	-0.01304	5.33198	257	+2.0	286	+1.6
89BH	+5.4	-0.4	+6.9	+0.3	-0.01133	4.04361	213	+1.6	286	+0.8

$$\Delta Cal_{AMSR2-AMSRE}[K] = Tb_{AMSR2}[K] * slope + intercept$$

$$\Delta Cal_{AMSRE-AMSR2}[K] = -(Tb_{AMSR2}[K] * slope + intercept)$$

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