Evaluation of GCOM-W1 standard products

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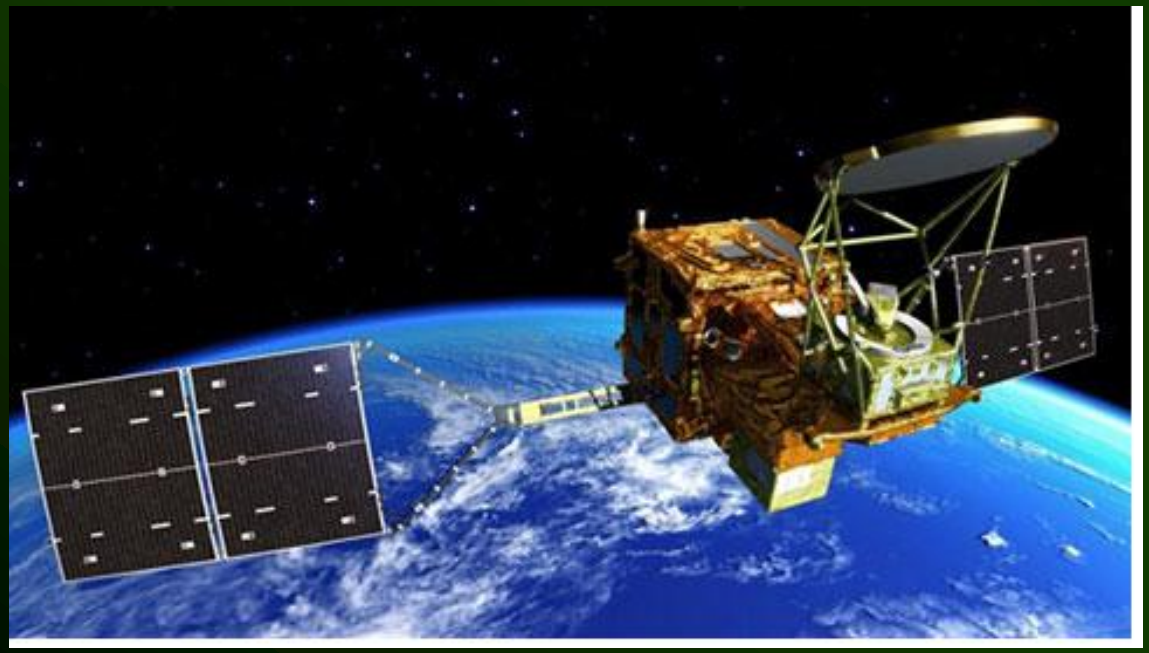
Outline:

1. Background
2. Data
3. Comparison with buoy data
4. Intercomparison with other products
5. Summary

Background

Global Change Observation Mission(GCOM) mission is a two series of satellites, GCOM-W for observing water circulation changes and GCOM-C for climate changes. The GCOM-W1, Japanese name is SHIZUKU, is the first satellite for the GCOM-W series and was launched on May 18, 2012.



http://www.jaxa.jp/press/2013/01/20130125_shizuku_e.html

Background

The Advanced Microwave Scanning Radiometer 2 (AMSR2) was loaded onto the GCOM-W1. Sea surface temperature(SST), sea surface wind(SSW) speed and precipitable water are derived from brightness temperature data observed by AMSR2.

http://www.jaxa.jp/press/2013/01/20130125_shizuku_e.html

Objectives:

Evaluation of GCOM-W1 SST and SSW products

1. Comparison of standard products with in situ data

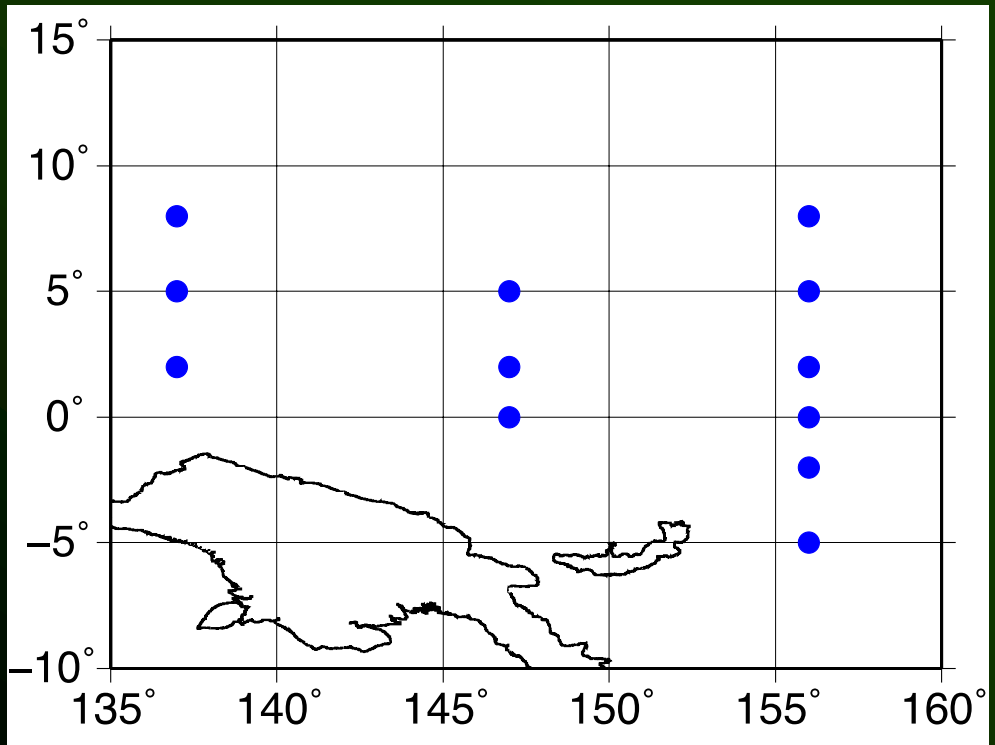
2. Global intercomparison of standard products with other products

1. Comparison of standard SST and SSW products with in situ data

TRITON buoy data

	Temporal resolution	Height (depth)	Accuracy	Period
SSW	Hourly average	3.5 m	0.3 m/s	Jul. 2012– Jan. 2013
SST		-1.5 m	0.002℃	

Location of TRITON buoy



Height correction by COARE 3.0 from 3.5 to 10.0 m

Since the hourly value is estimated by averaging every 10 minutes value, we assume the hourly value to be a value at 35 minutes.

Satellite data

Satellite SSW data

Sensor	Level	Version	提供
AMSR2	2	0.0	JAXA
AMSR-E	2	700	JAXA
SSM/I F16	3	7	RSS
SSM/I F17	3	7	RSS
TMI11GHz	3	4	RSS
TMI37GHz	3	4	RSS
WindSat LF	3	7	RSS
WindSat MF	3	7	RSS
WindSat AW	3	7	RSS
AMSR-E LF	3	7	RSS
AMSR-E MF	3	7	RSS

Satellite SST data

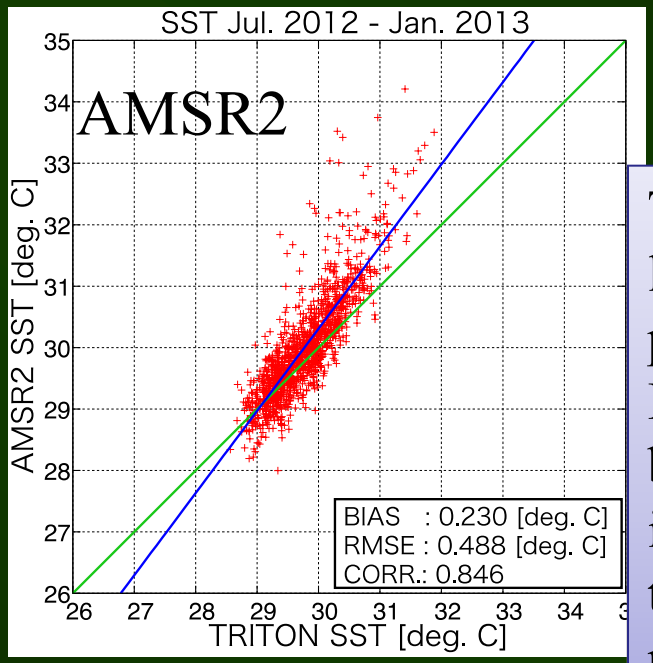
センサー	Level	Version	提供
AMSR2	2	0.0	JAXA
AMSR-E	2	700	JAXA
TMI	3	4	RSS
WindSat	3	7	RSS
AMSR-E	3	7	RSS

Data period: 2012/7-2013/1
(AMSR-E 2010/7-2011/1)
Level 3 data means near-real time data with a 0.25° grid.
2013/12/12 download

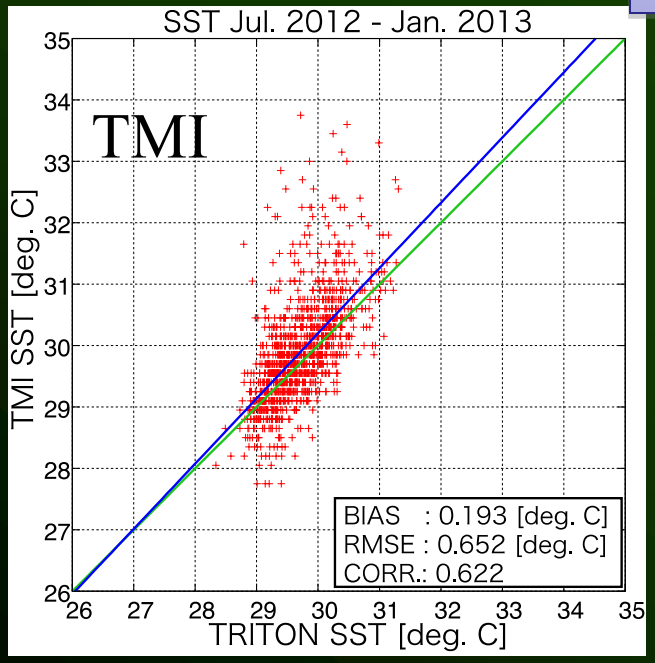
* JAXA : Japan Aerospace Exploration Agency
* RSS : Remote Sensing Systems

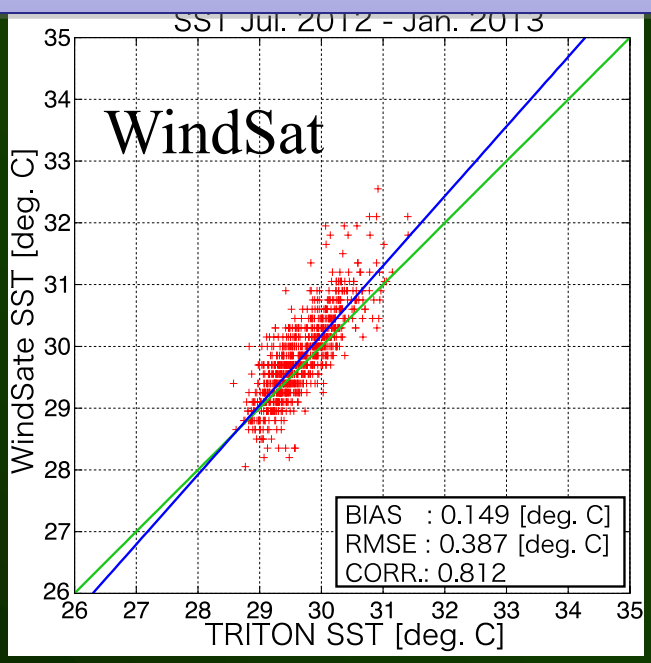
SST Data

SST data



The correlation coefficient of TMI SST data is quite low compared with other two products. Generally all products show overestimation for larger SST values. In particular the feature is clear for AMSR2. This may be due to diurnal heating effect, because the buoy SST is bulk temperature and satellite SSTs are sub-skin temperatures. The overestimation by AMSR2 is more remarkable than that by WindSat.

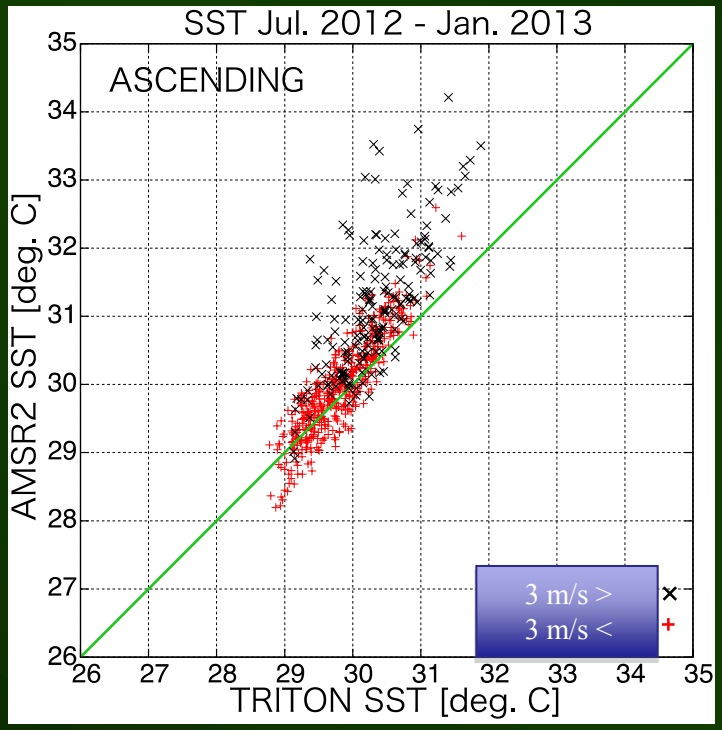


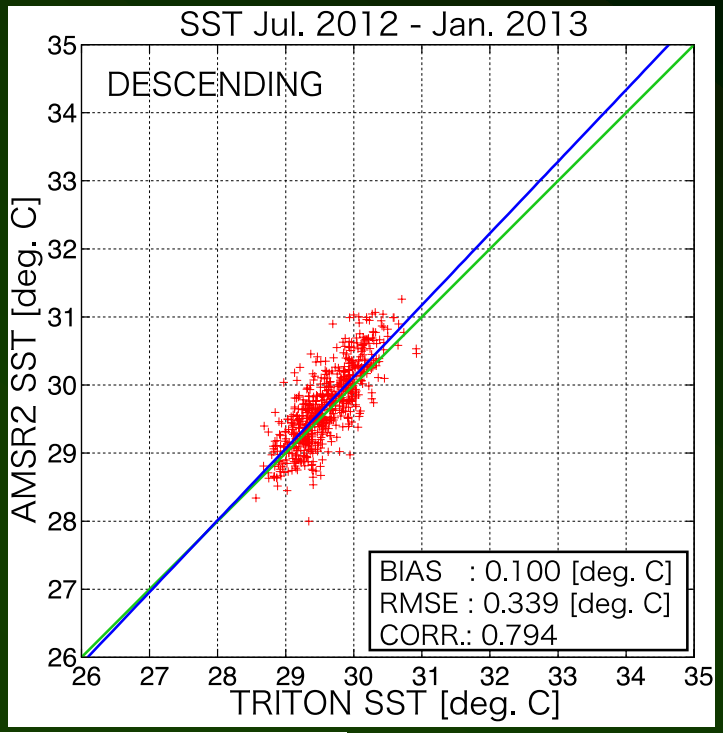


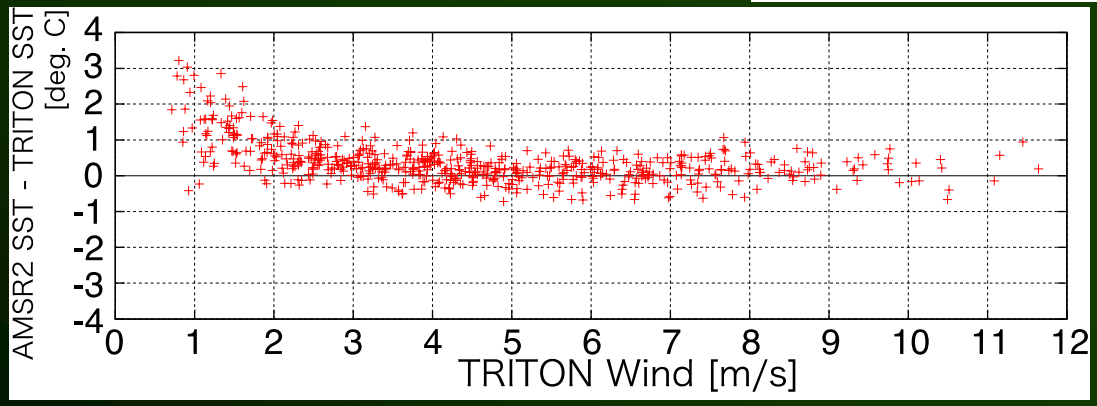
Equatorial Crossing Times

Satellite/Sensor	Ascending	Descending
GCOM-W1/AMSR2	13:30	01:30
Aqua/AMSR-E	13:30	01:30
DMSP F16/SSMI	17:32	05:32
DMSP F17/SSMI	17:47	05:47
TRMM/TMI	variable	
Coriolis/WindSat	18:01	06:01

We cannot see diurnal heating effect in WindSat data, because the observation time is 6:00 and 18:00.





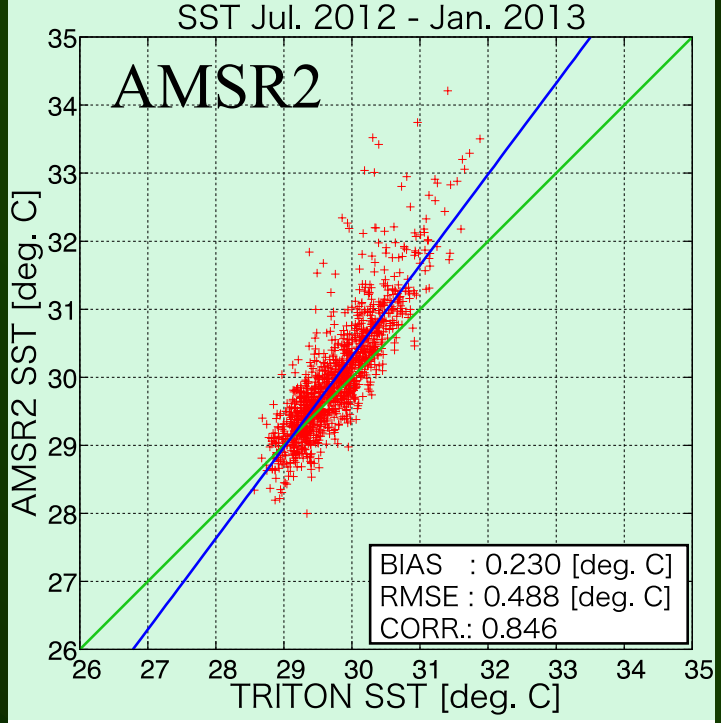


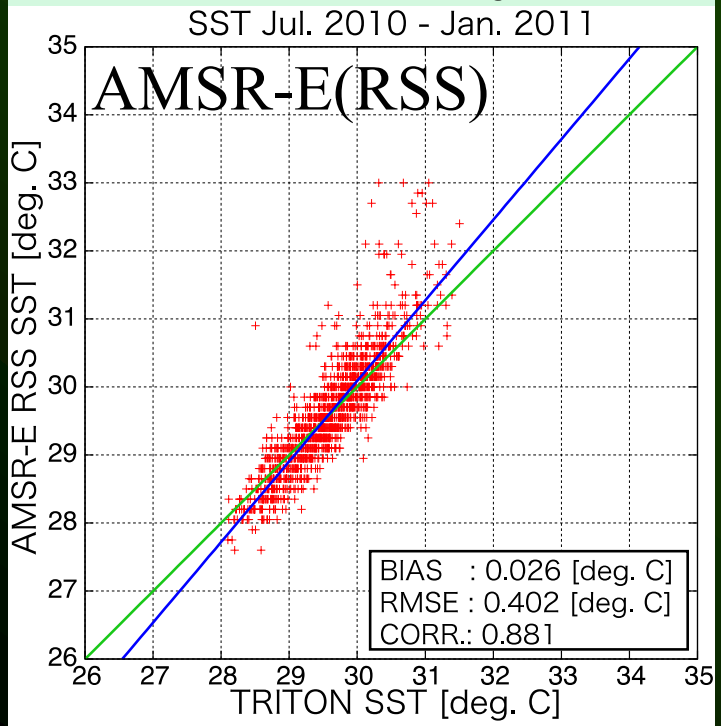
We can easily find most large overestimation values in ascending mode

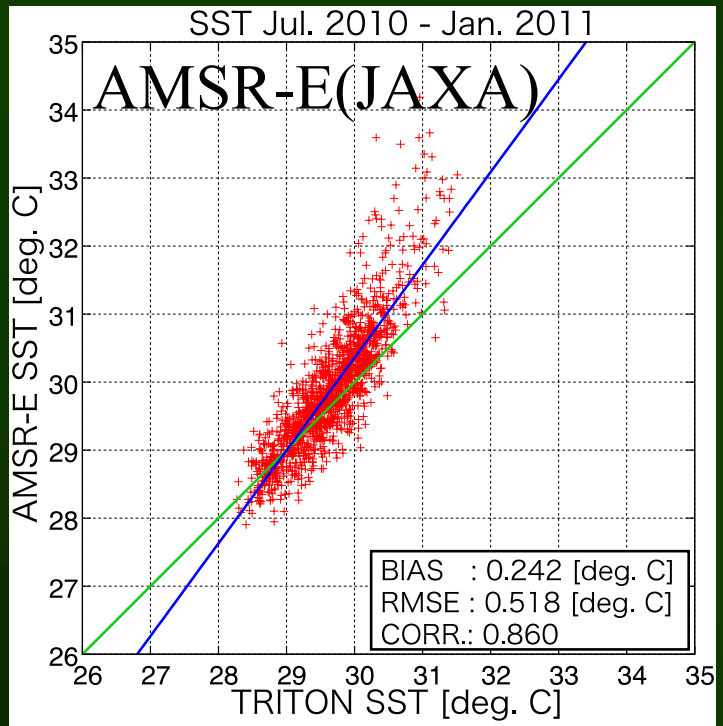
We can see large overestimation in the data corresponding to wind speeds under 3m/sec. From these figures we can understand the overestimation is strongly related to diurnal heating.

SST data

We can see a similar feature of overestimation to AMSR2. However, this feature for AMSR-E is not so remarkable in RSS data. This result suggest that JAXA AMSR-E is more affected by diurnal heating compared with RSS AMSR-E data and the feature can be found for AMSR2 SST data.





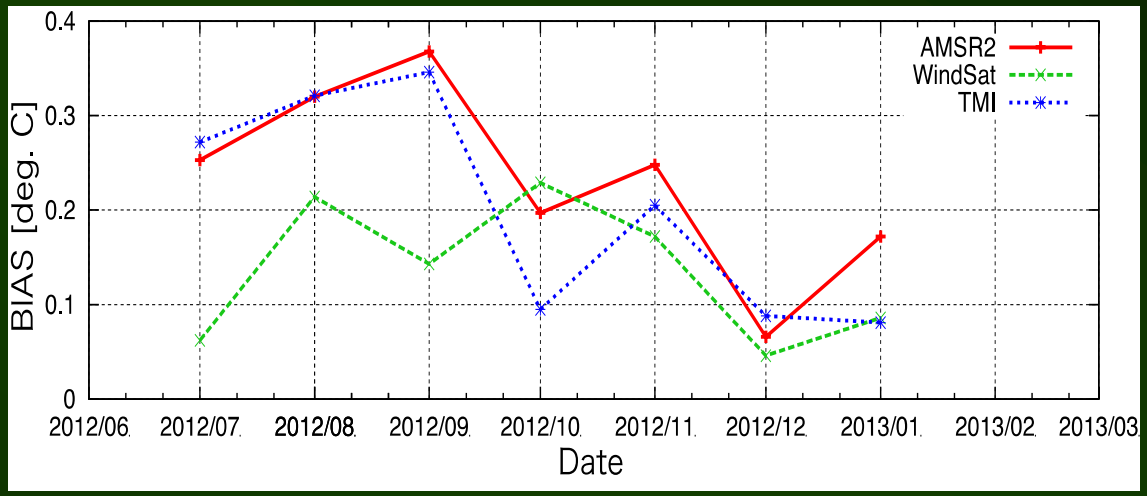


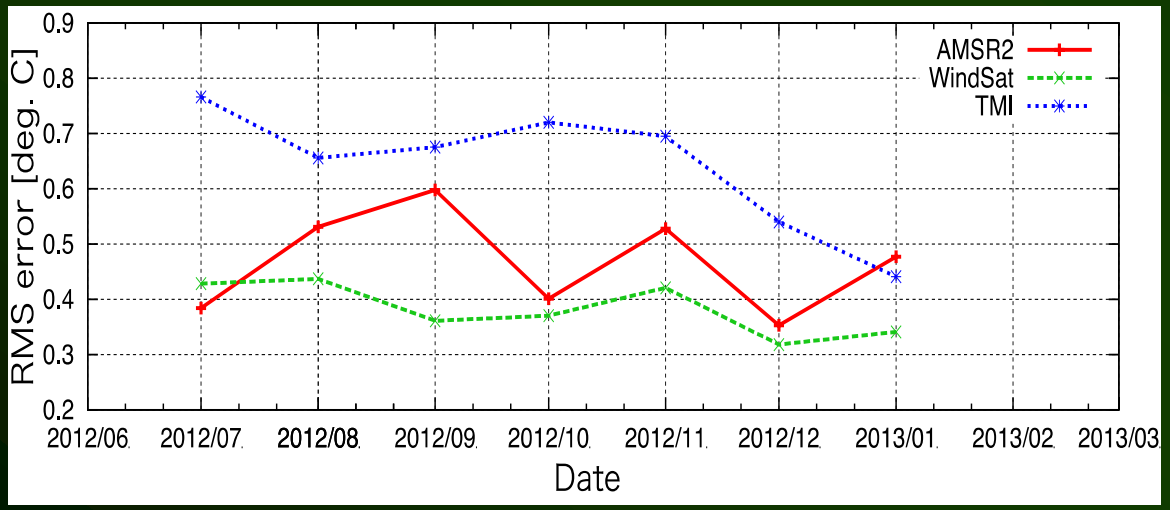
SST Comparison

センサー	BIAS [m/s]	RMSE [m/s]	Correlation	number
AMSR2	0.230	0.488	0.846	1263
TMI	0.193	0.652	0.622	1217
WindSat	0.149	0.387	0.812	884

センサー	BIAS [m/s]	RMSE [m/s]	Correlation	number
AMSR-E JAXA	0.242	0.518	0.860	1381
AMSR-E RSS	0.026	0.402	0.881	1395

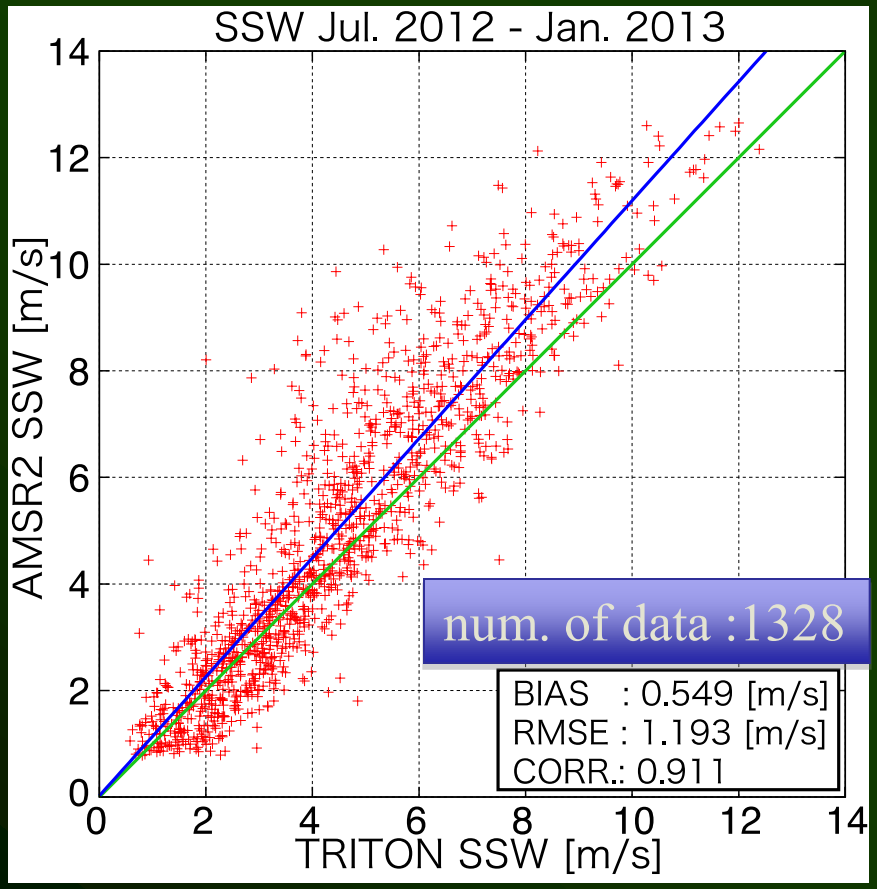
Time variation of Bias and RMS error for each SST product (2012_7-2013_1)



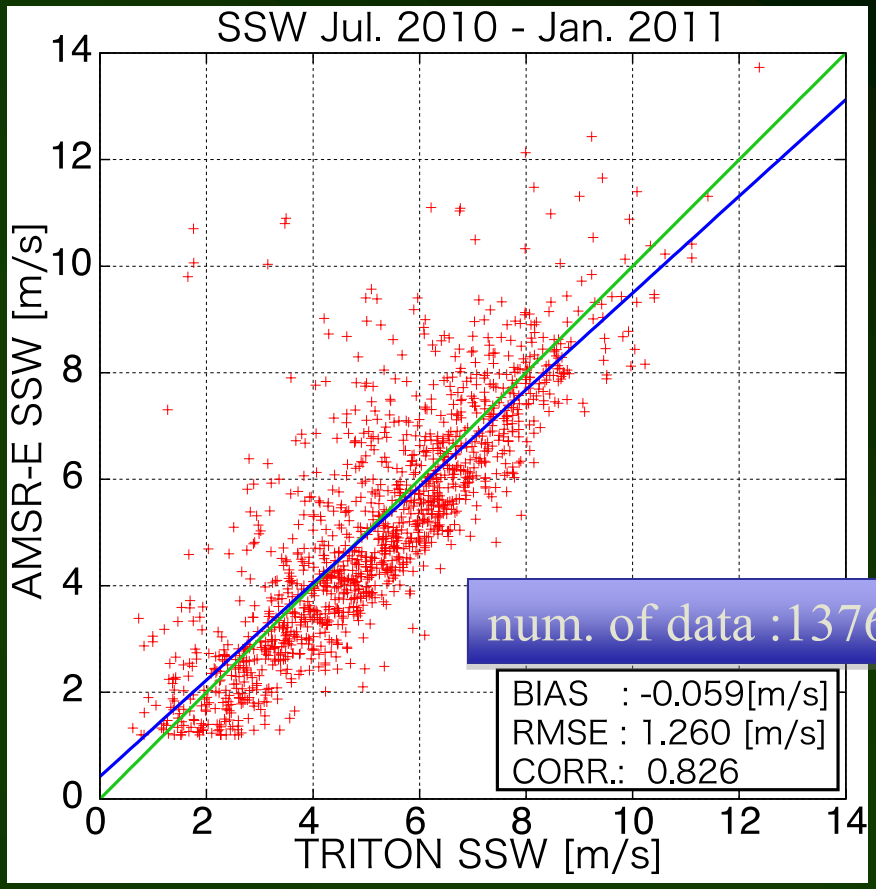


SSW Data

AMSR2 vs TRITON



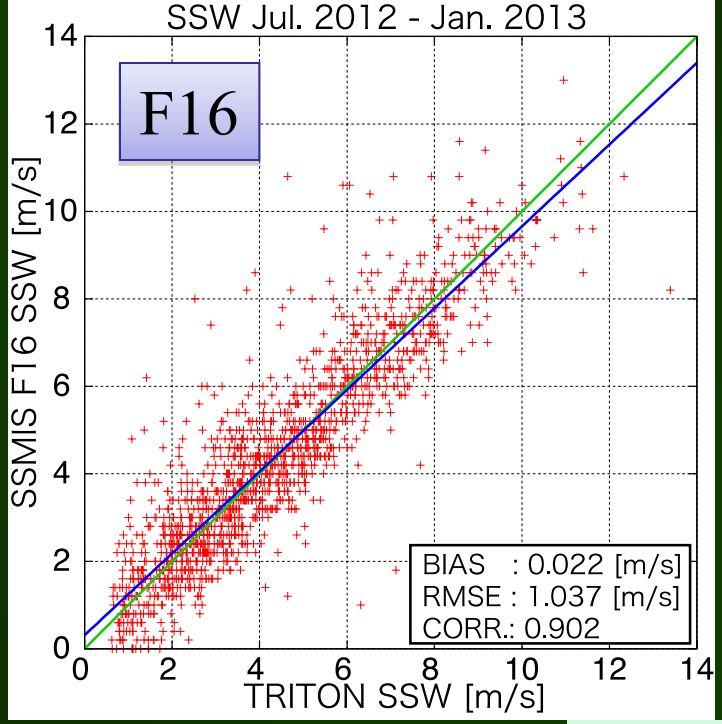
AMSR-E vs TRITON

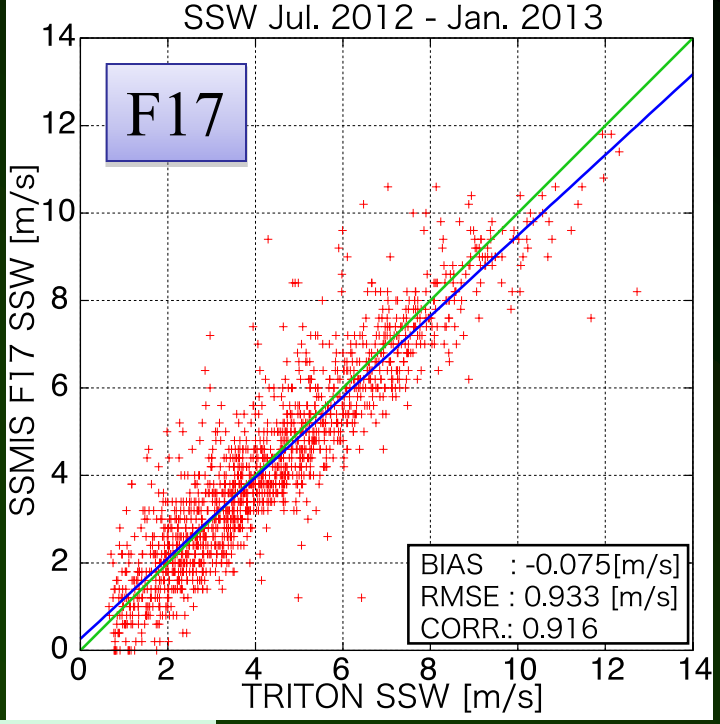


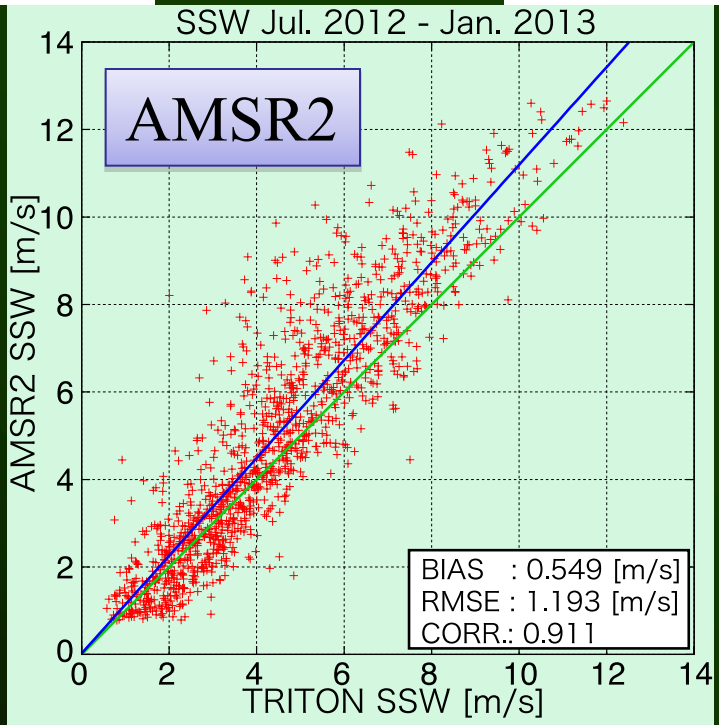
Overestimation of AMSR2 SSW

＊BIAS = Satellite ave. – Buoy ave.

SSM/I


SSW Jul. 2012 - Jan. 2013
F16
SSMIS F16 SSW [m/s]
TRITON SSW [m/s]
BIAS : 0.022 [m/s]
RMSE : 1.037 [m/s]
CORR.: 0.902

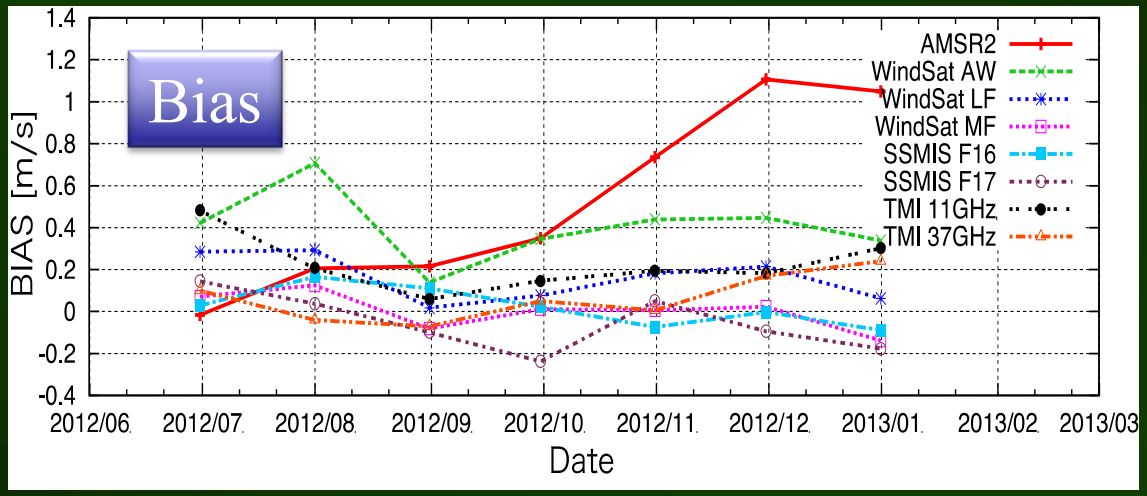

SSW Jul. 2012 - Jan. 2013
F17
SSMIS F17 SSW [m/s]
TRITON SSW [m/s]
BIAS : -0.075[m/s]
RMSE : 0.933 [m/s]
CORR.: 0.916

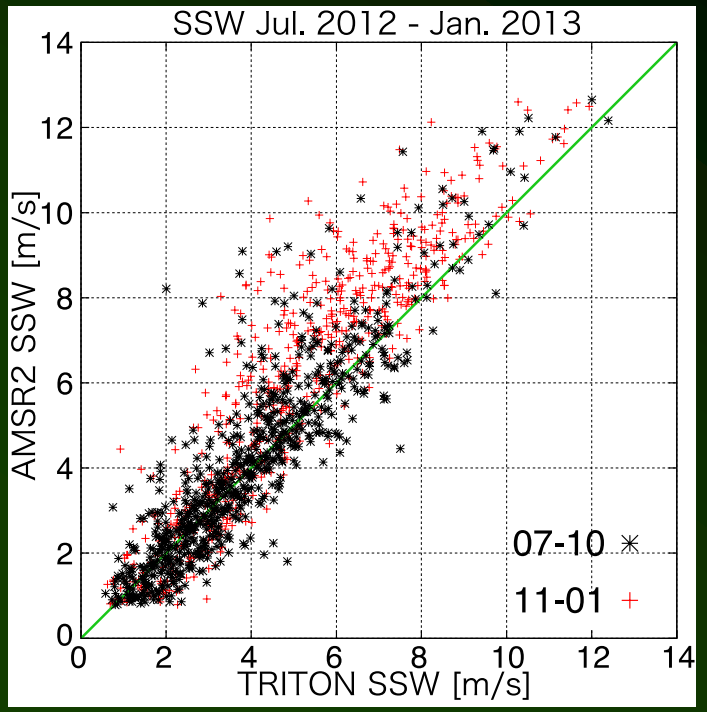

SSW Jul. 2012 - Jan. 2013
AMSR2
AMSR2 SSW [m/s]
TRITON SSW [m/s]
BIAS : 0.549 [m/s]
RMSE : 1.193 [m/s]
CORR.: 0.911

Sensor	BIAS [m/s]	RMSE [m/s]	Correlation	number
AMSR2	0.549	1.193	0.911	1328
SSM/I F16	0.022	1.037	0.902	1560
SSM/I F17	-0.075	0.933	0.916	1552
TMI11GHz	0.203	1.164	0.897	1220
TMI37GHz	0.062	0.923	0.932	1239
WindSat LF	0.144	0.829	0.936	1035
WindSat MF	-0.004	0.825	0.935	1067
Windsat AW	0.398	1.290	0.859	1510
AMSR-E LF	-0.154	0.867	0.919	1421
AMSR-E MF	-0.293	0.886	0.915	1423

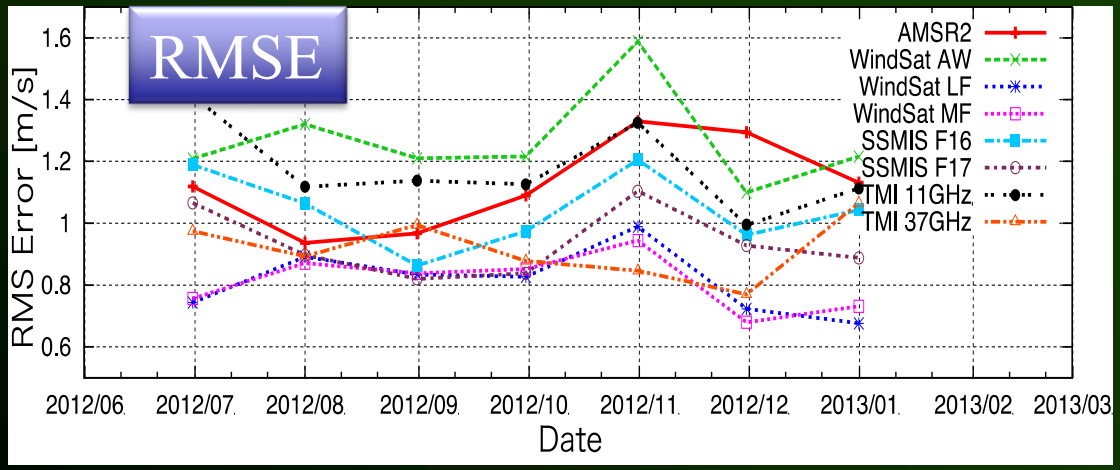
AMSR2: 36 GHz, WindSat LF:10.7GHz, WindSat MF: 18.7 GHz,
Windsat AW: all channels,
AMSR-E LF: 10 GHz, AMSR-E MF : 18 GHz

Time variation of Bias and RMS error for each SSW product (2012_7-2013_1)





The bias remarkably increases after October.



We can clearly find remarkable overestimation by a lot of red points. Probably there are some problems in the algorithm for estimation of SSW using AMSR2 data.

Sensor	BIAS [m/s]	RMSE [m/s]	Correlation	number
AMSR2	0.549 (0.162)	1.193 (0.993)	0.911 (0.910)	1328 (498)
SSM/I F16	0.022	1.037	0.902	1560
SSM/I F17	-0.075	0.933	0.916	1552
TMI11GHz	0.203	1.164	0.897	1220
TMI37GHz	0.062	0.923	0.932	1239
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AMSR-E MF	-0.293	0.886	0.915	1423

AMSR2: 36 GHz, WindSat LF:10.7GHz, WindSat MF: 18.7 GHz,
Windsat AW: all channels,
AMSR-E LF: 10 GHz, AMSR-E MF : 18 GHz

Summary

- We evaluated AMSR2 SST and SSW data by TRITON buoy SST and SSW data. Basically the accuracy is comparable with other products. Also AMSR2 SST is considerably affected by diurnal heating compared with other products depending on the observation time. The bias for AMSR2 SSW remarkably increases after October 2012. Probably there are some problems in the algorithm for estimation of SSW using AMSR2 data.

Thank you!

Backup slides

Global intercomparison with other products

SSW Products (daily, 0.25° grid)

Name (Abbr.)	Spatial Res.	Sensor	Period	Input data	Organization
AMSR2	0.25°	radiometer	2-Jul-2012 to present	AMSR2	JAXA
SSMIS Ocean Products	0.25°	radiometer	1-Dec-2003 to present	SSMIS F16	RSS
			1-Oct-2003 to present	SSMIS F17	
ASCAT L3 data	0.25°	scatterometer	21-Mar-2007 to present	ASCAT	IFREMER
WindSat (*all-weather surface wind)	0.25°	radiometer	5-Feb-2003 to present	WindSat	RSS

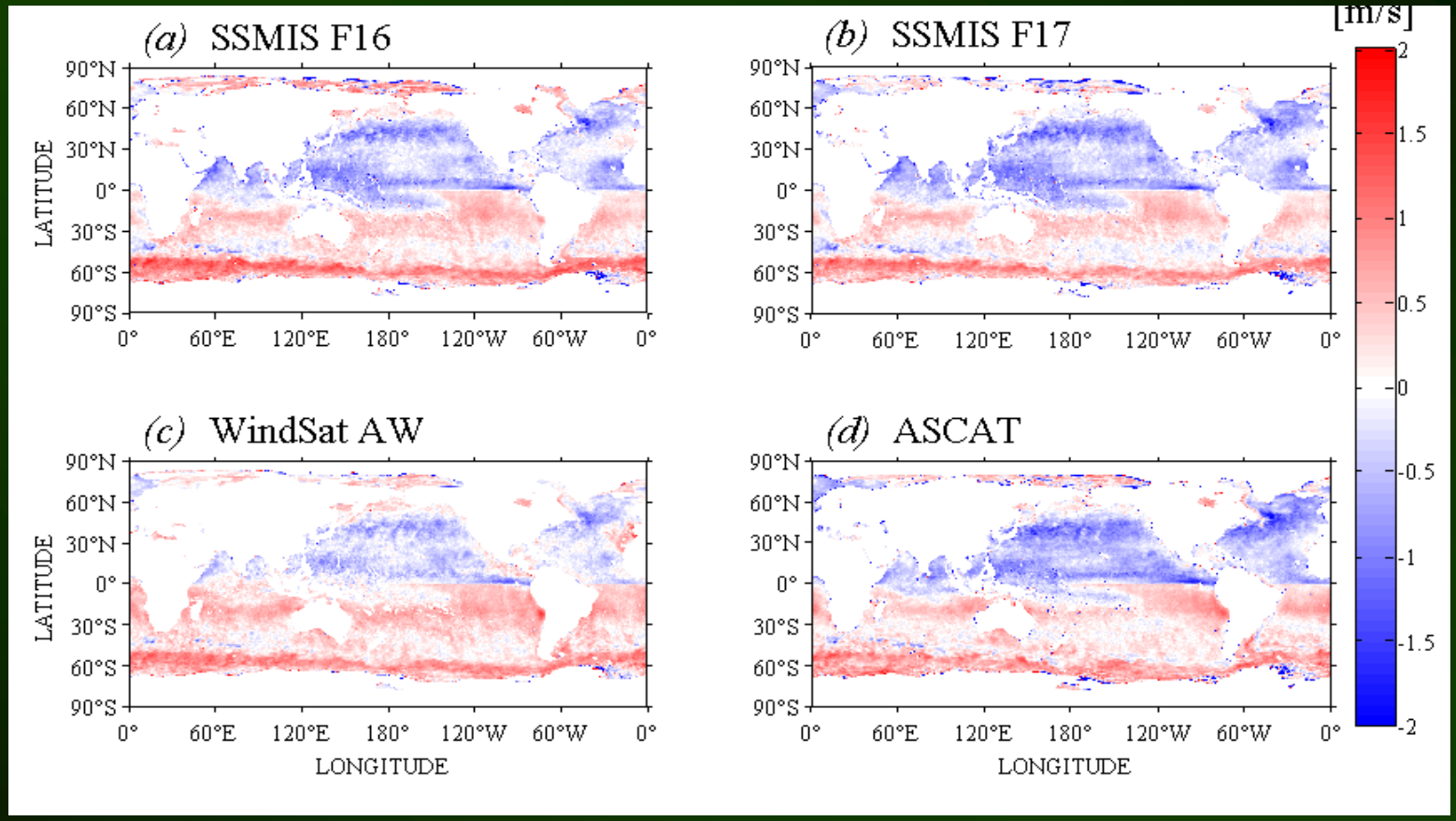
* **WSPD_AW: 6.8 10.7 18.7 23.8 37.0 GHz (polarization: VH)**

cf. WSPD_LF: 10.7 18.7 23.8 37.0 GHz , WSPD_MF: 18.7 23.8 37.0 GHz

[Note] Description of WindSat Data Products

http://www.ssmi.com/windsat/windsat_data_description.html

Daily SSW - mean differences(2012_7-2013_1) each product-AMSR2



From this panel, AMSR2 wind speeds are considerable weaker than other products in the southern hemisphere and stronger in the northern hemisphere. Also AMSR2 wind speeds are stronger than other products over the Arabian Sea and western North Pacific.

Statistics (each product VS AMSR2) (2012_7-2013_1) SSW

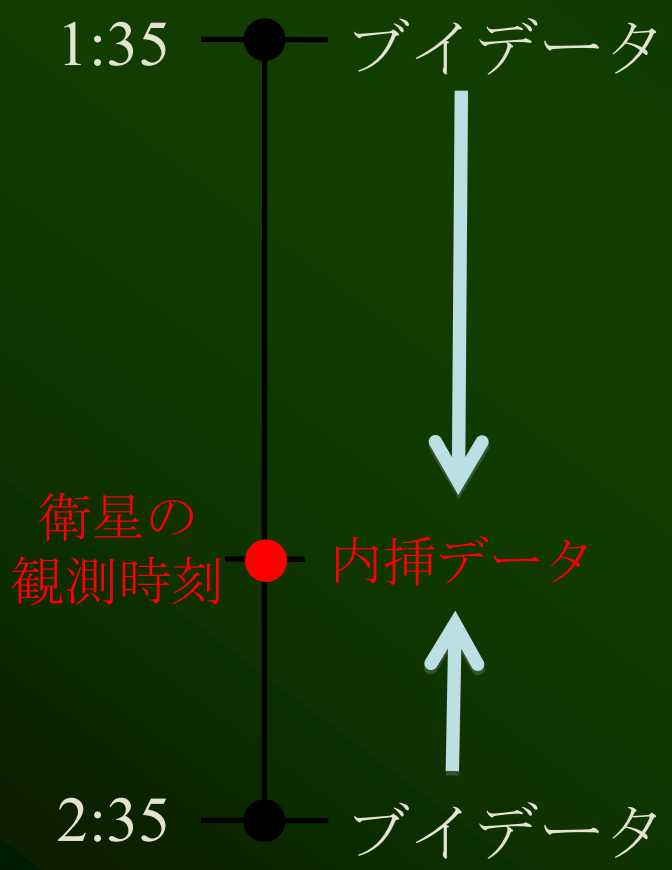
The mean difference between AMSR2 and other SSW products is less than 0.2 m/sec and the RMS difference is about 2.0 m/sec.

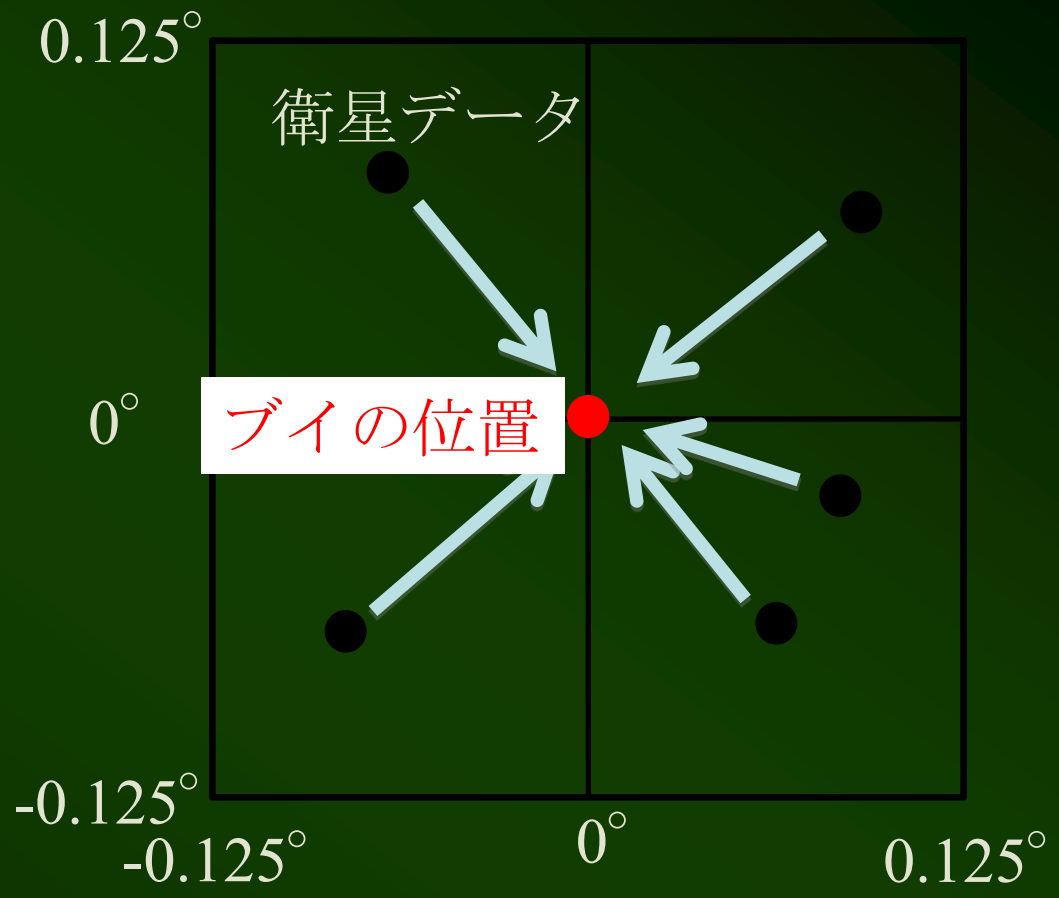
Wind speed	Mean diff.	RMSD	Corr.	Number
SSMIS F16	+0.093	1.979	0.850	78112729
SSMIS F17	-0.026	1.980	0.851	77810398
WindSatAW	+0.185	2.088	0.836	67978453
ASCAT	-0.003	1.941	0.848	85916857

(W order) Mean diff. : -0.1 - +0.1 RMSD : 2.0

マッチアップデータの作成

AMSR2、AMSR-E（Level 2）





ブイのデータを人工衛星データの観測時刻に線形に内挿

ブイの係留位置を中心とする0.25度格子以内の衛星観測値を距離の逆数の重み付き平均で内