



水循環変動観測衛星「しずく」

Global Change Observation Mission-Water "SHIZUKU"

Update of AMSR2 SST, 10GHz and Multiband SST to Ver4.1

JAXA/EORC

July. 27, 2022

【Standard】 Sea Surface Temperature

- Algorithm PI
 - Dr. Akira Shibata (RESTEC)
- Major improvement :
 - Change in QC flag due to expansion of estimation area
 - Removal of the descending trend observed in the low latitudes of the northern hemisphere

(Details of the changes are on the next page)
- Validation
 - For Standard Accuracy: Matchup nearest AMSR2 and buoy data included in NOAA iQuam Ver.2.1 buoy dataset with time difference within 2 hour and distance less than 30 km.
 - For Target Accuracy: Calculate monthly mean biases versus buoys for each latitude of 10-degree intervals.
 - Period: from July 2, 2012 to December 31, 2021
- Reprocessing of previous observation data
We not reprocessed previous SST observation data. Reprocessing of SST observation data will be conducted in the next major version update.



【Standard】 Sea Surface Temperature

Improvement of the new SST algorithm

- 1. Calculation of sea surface temperature in high wind areas :**
A nonlinear term was added to the brightness temperature correction for V polarization.
- 2. Change in atmospheric correction :**
In addition to the 36 GHz V TB/23 GHz V TB, a correction method for 18 GHz V TB/23 GHz V TB, which is slightly more sensitive to rainfall, has been added.
- 3. Changing the correction of the brightness temperature trend :**
Since the trend of brightness temperature has recently calmed down, it is assumed that there is no TB trend after June 2021.
- 4. Refining calculations of land surface radiation effect :**
 - Changed the elevation angle from 0.2-degree increments to 0.05-degree increments.
 - The number of calculations was fixed for the azimuth direction, but the number of calculations will be changed depending on the elevation angle so that the sampling interval on the ground will be about 1 km.
 - Changed sea and land data from 2-minute mesh to 1-minute mesh.
- 5. Change of the judgment criteria of RFI :**
The current RFI removal process also removes many natural phenomena, so the judgment criteria is relaxed. (However, there is still a possibility that real RFI signal will be mixed in.)

【Standard】 Sea Surface Temperature

Sea Surface Temperature (SST:6G)

Ver.4

Ver.4.1

No	Status	<i>JAXA L2 V4.0 Pixel Data Quality</i>	<i>JAXA L2 V4.1 PixelData Quality</i>
01	Normal	0	0
02	strong wind (13-27 m/s)	-	1
03	light rain (below several mm/h)	-	2
04	satellite attitude out (incident angle : below 54 or over 56 degrees) (roll angle : above 0.01 degrees)	16	16
05	land area (above 2 %)	32	32
06	sea ice	48	48
07	sun glitter (less than 25 degrees)	64	64
08	rain (above several mm/h)	80	80
09	abnormal SST (Sea Surface Temperature) or RFI (Radio Frequency Interference)	96	96
10	strong wind (above 27 m/s)	112	112
11	cold SST (Sea Surface Temperature) (below minus 2 degC)	128	128

Notice: The Accuracy of No.2, and No.3 is worse than No.1.

- ✓ The new algorithm allows estimation of SST in strong winds and light rain region. However, in these regions, the accuracy is slightly reduced, so QC flags were assigned. (See Appendix)
- ✓ The gridded averaging process for Level 3 products also includes pixels in these regions (as described in the format description).

06G

(QC=0)

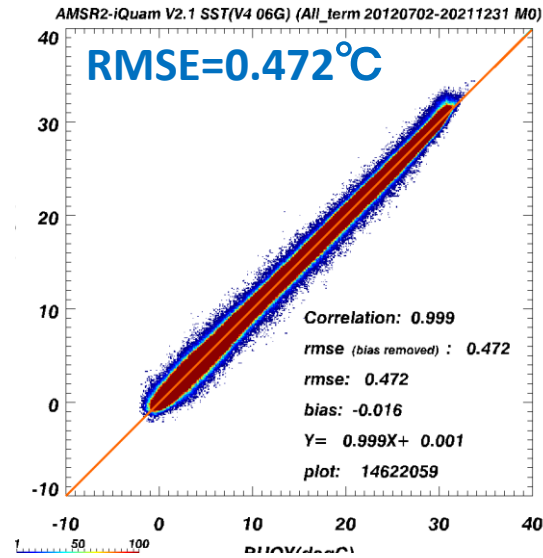
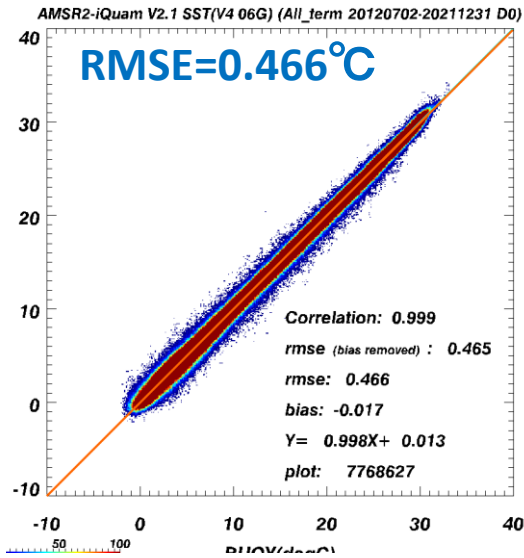
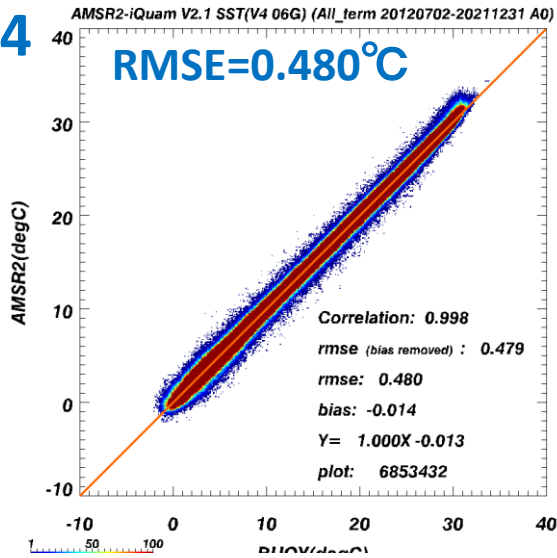
【Standard】 Sea Surface Temperature

Ver.4

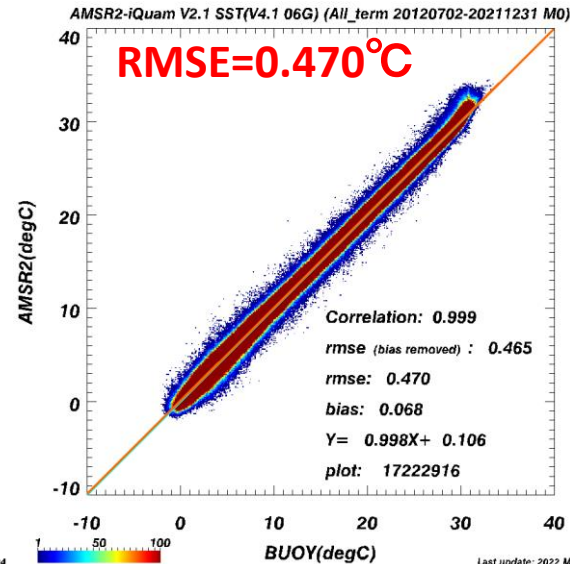
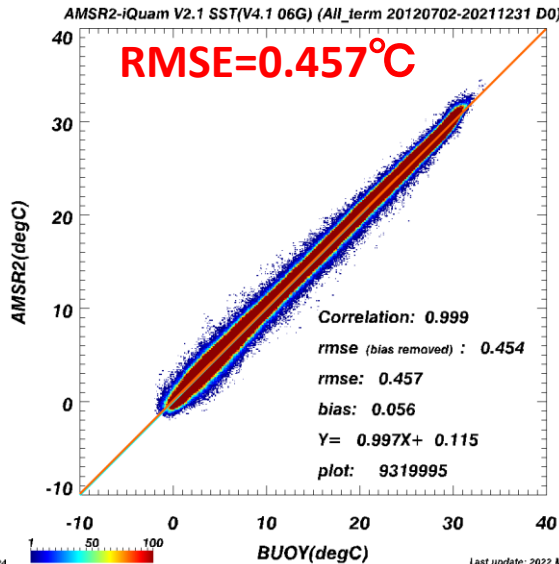
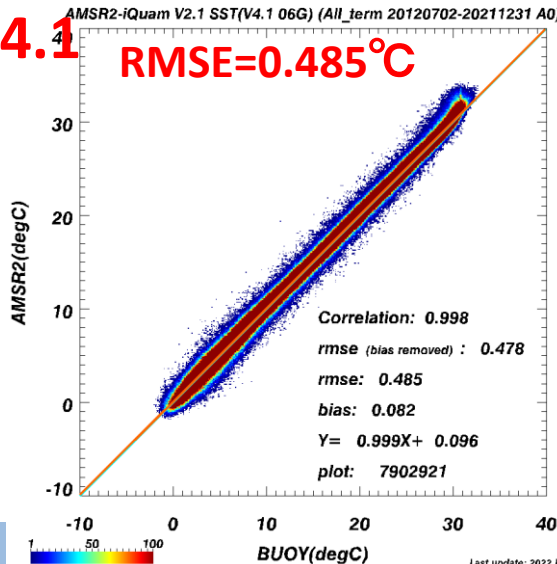
Ascending

Descending

A+D



Ver.4.1

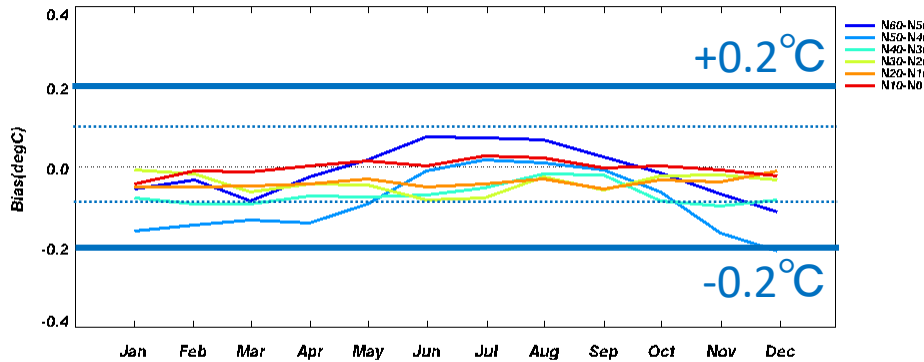


【Standard】 Sea Surface Temperature

- Target accuracy is defined as a zonal mean, so the bias variations from buoy are calculated each month, separated by 10 degrees of latitude.
- Ver. 4.1 also has a bias variation within $\pm 0.2^{\circ}$ C.

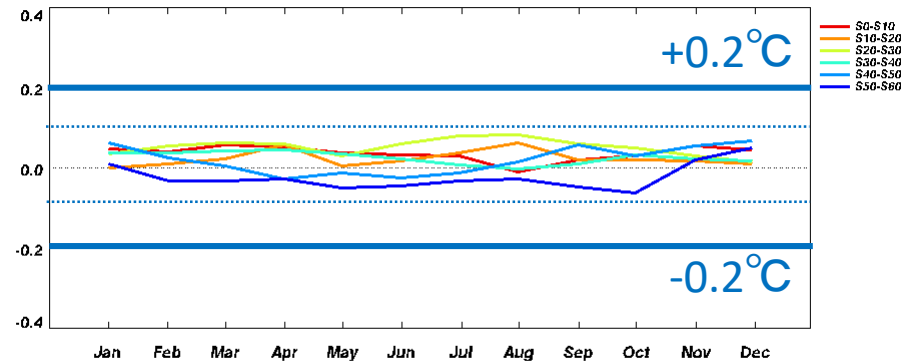
Ver.4 Northern Hemisphere A+D

AMSR2V4.0 -iQuamV2.1 SST Bias NHM (M)



Southern Hemisphere A+D

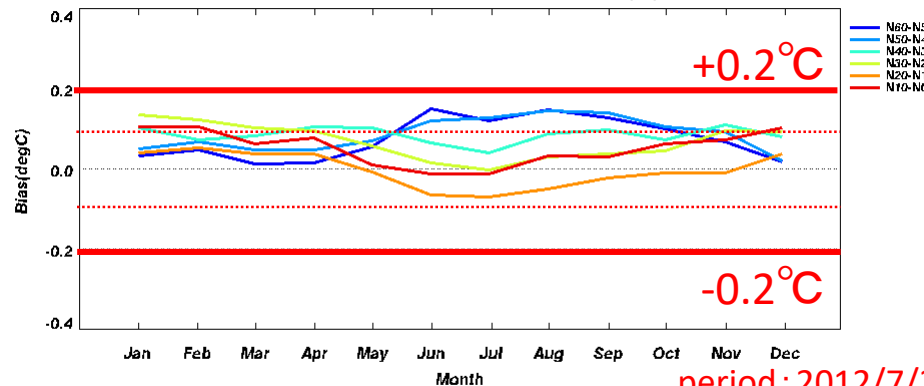
AMSR2V4.0 -iQuamV2.1 SST Bias SHM (M)



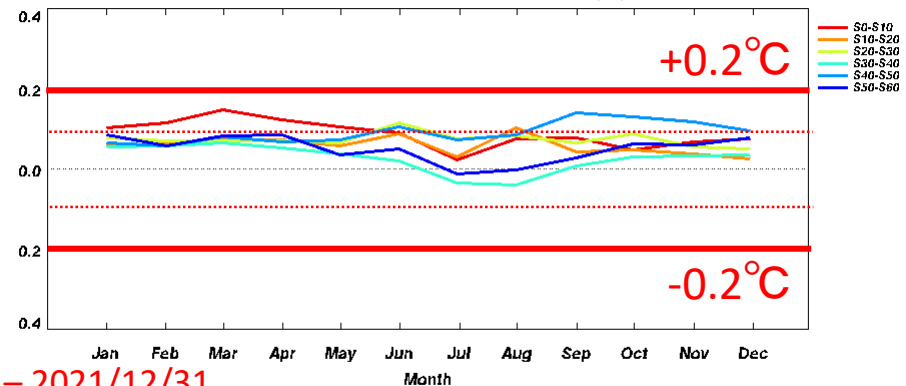
period : 2012/7/2 – 2021/12/31

Ver.4.1

AMSR2V4.1 -iQuamV2.1 SST Bias NHM (M)

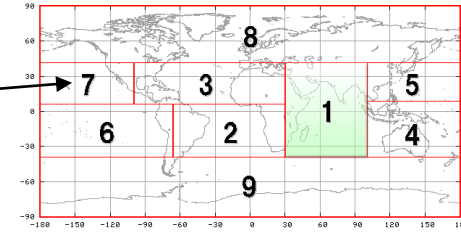


AMSR2V4.1 -iQuamV2.1 SST Bias SHM (M)



period : 2012/7/2 – 2021/12/31

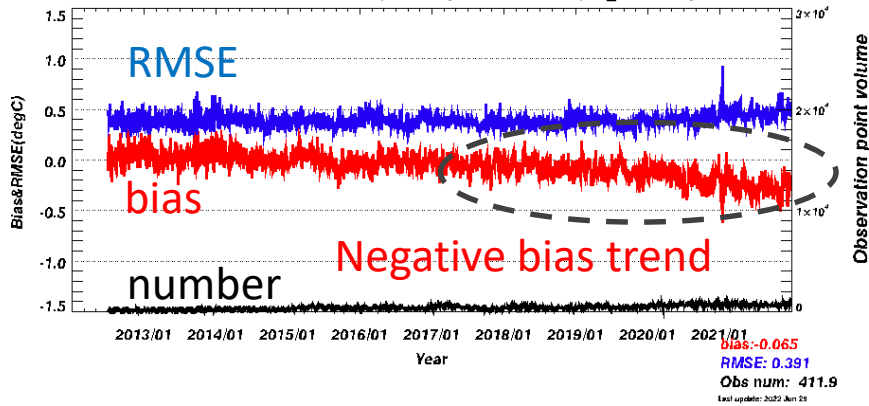
【Standard】 Sea Surface Temperature



Ver.4 A+D

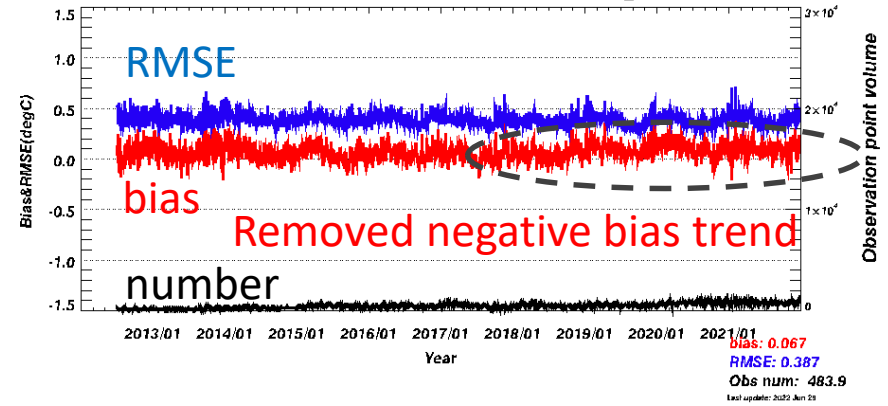
Example of 7 (region with large negative bias)

AMSR2-iQuam V2.1 SST(V4.06G) Bias & RMSE(All_term M7)



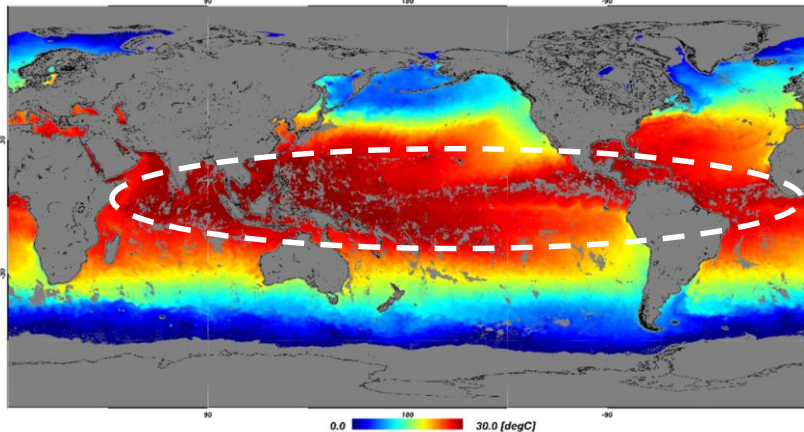
Ver.4.1 A+D

AMSR2-iQuam V2.1 SST(V4.1.06G) Bias & RMSE(All_term M7)



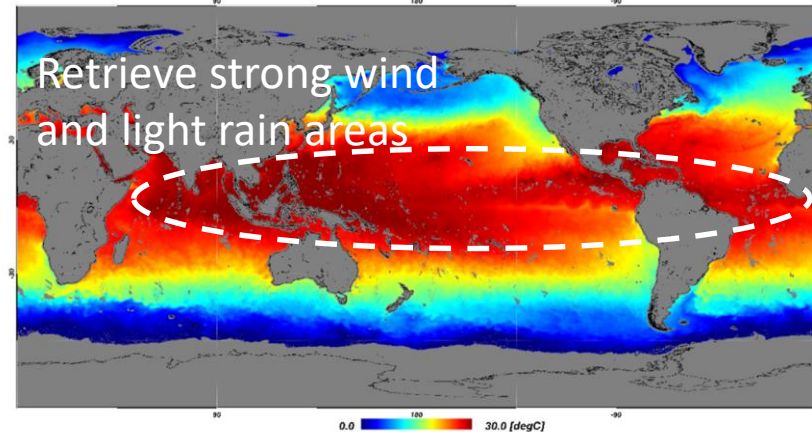
Ver.4 A+D 2day-mean

AMSR2 SST (2021/07/01 A+D) QC:all 2day 0.1deg v4.0



Ver.4.1 A+D 2day-mean

AMSR2 SST (2021/07/01 A+D) QC:all 2day 0.1deg v4.1



【 Research 】 10GHz SST



- Algorithm PI
 - Dr. Akira Shibata (RESTEC)
- Major improvement:
(same as 6 GHz, but atmospheric correction is not improved)
- Validation
 - For Standard Accuracy: Matchup nearest AMSR2 and buoy data included in NOAA iQuam Ver.2.1 buoy dataset with time difference within 2 hour and distance less than 30 km.
 - Period: from July 2, 2012 to December 31, 2021

【 Research 】 10GHz SST

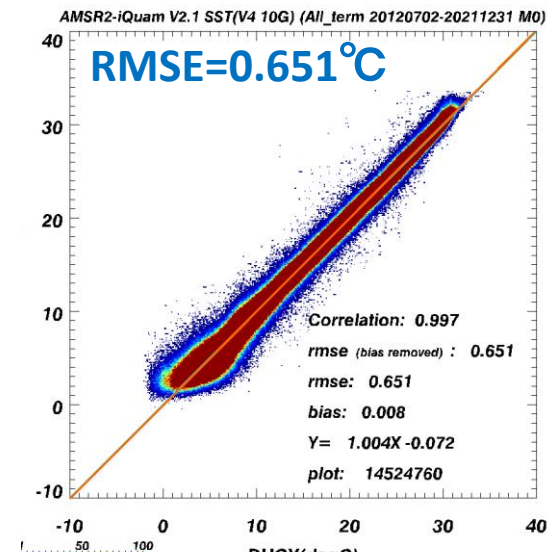
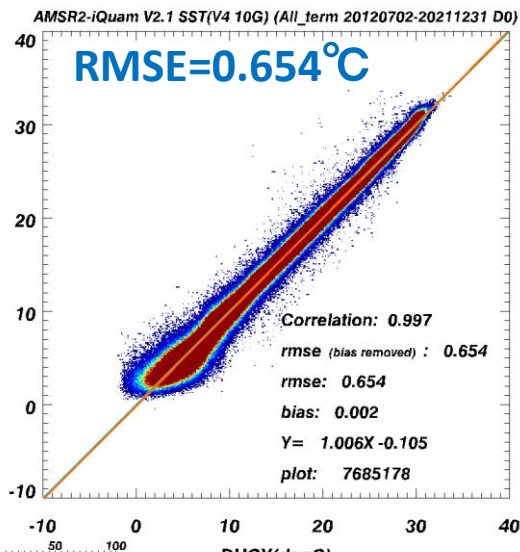
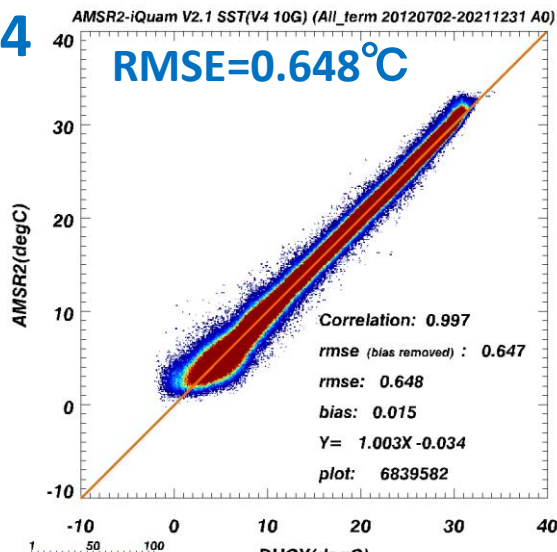
10G

(all temperature) Ascending

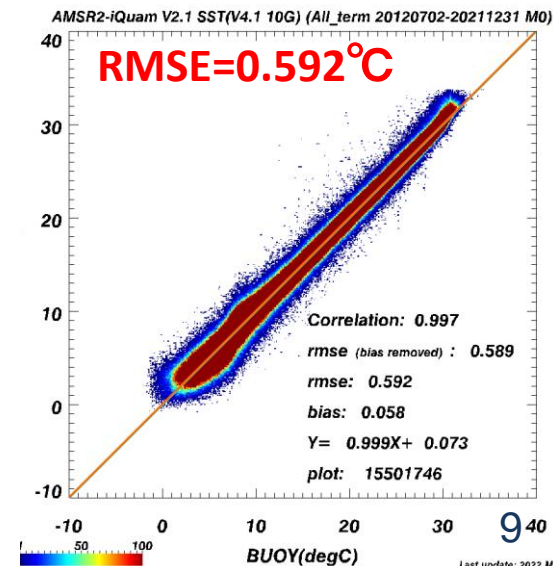
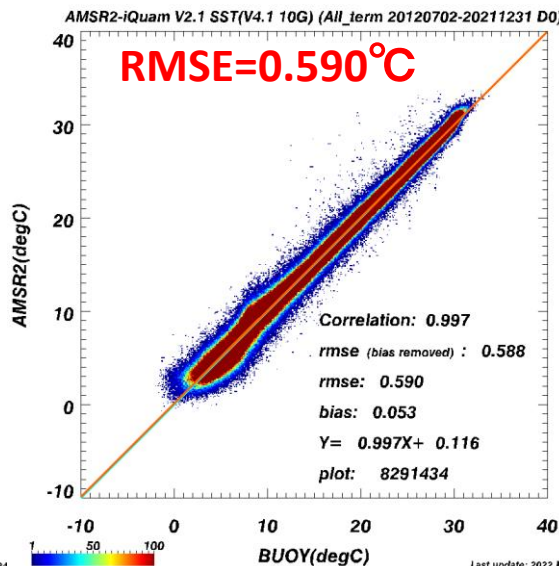
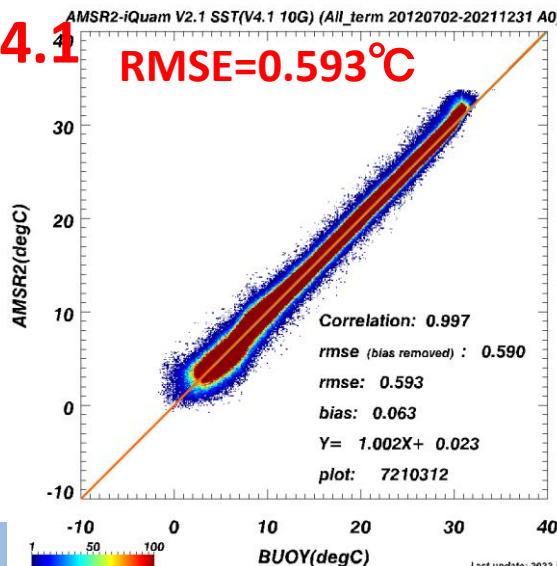
Descending

A+D

Ver.4



Ver.4.1



Standard accuracy: $\pm 0.8\text{ }^{\circ}\text{C}$



【 Research 】 10GHz SST

10G

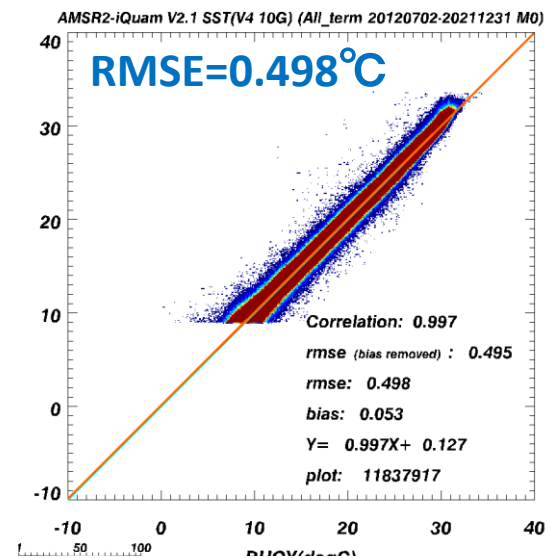
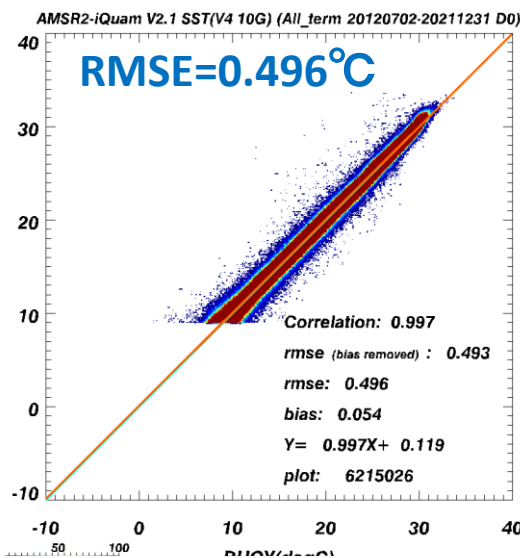
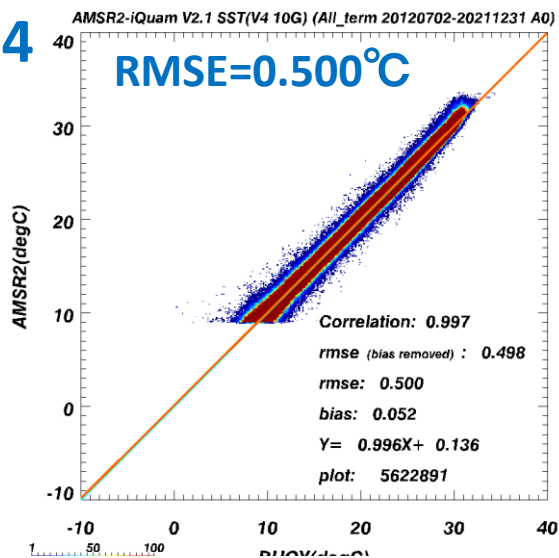
(above $9\text{ }^{\circ}\text{C}$)

Ascending

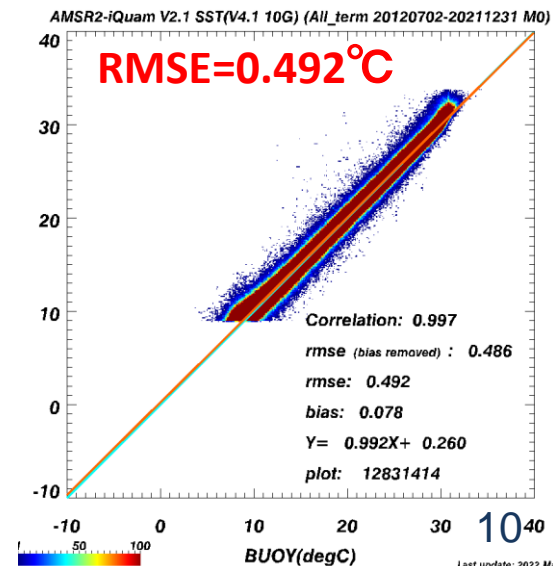
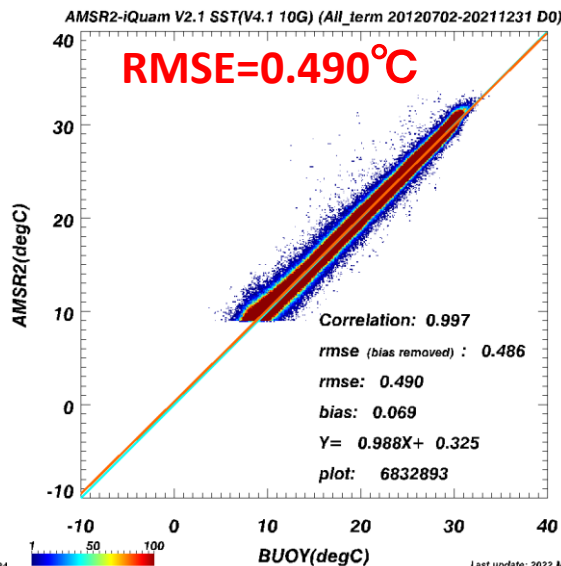
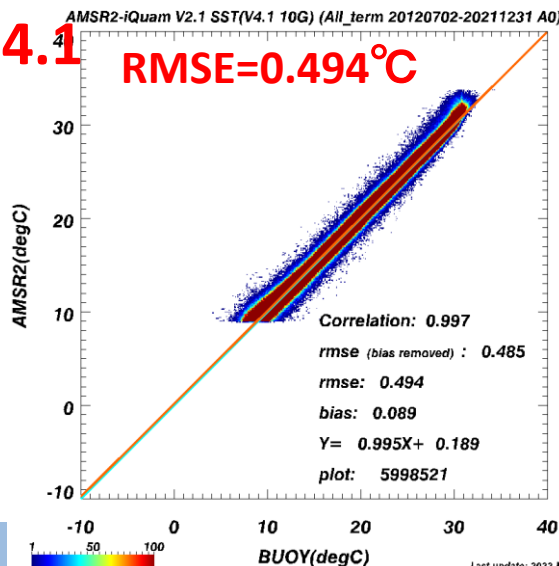
Descending

A+D

Ver.4



Ver.4.1



【Research】 Multi-band SST

- Algorithm PI
 - Dr. Akira Shibata (RESTEC)
- Major improvement :
(same as 6 GHz)
- Validation
 - For Standard Accuracy: Matchup nearest AMSR2 and buoy data included in NOAA iQuam Ver.2.1 buoy dataset with time difference within 2 hour and distance less than 30 km.
 - Period: from July 2, 2012 to December 31, 2021

Standard accuracy: ± 0.8 °C

Multi-band SST **[Research]** Multi-band SST

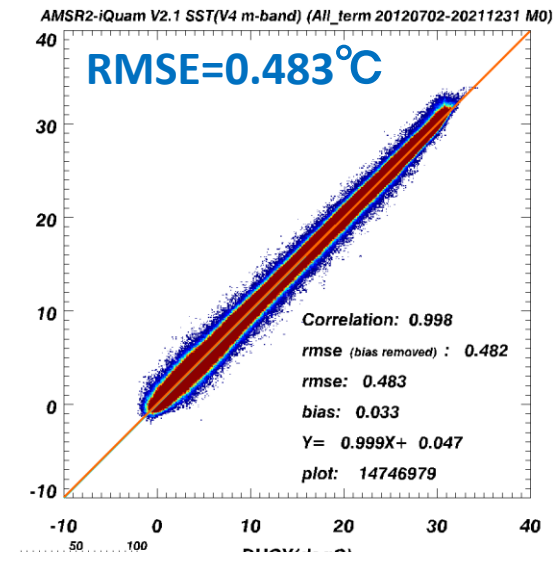
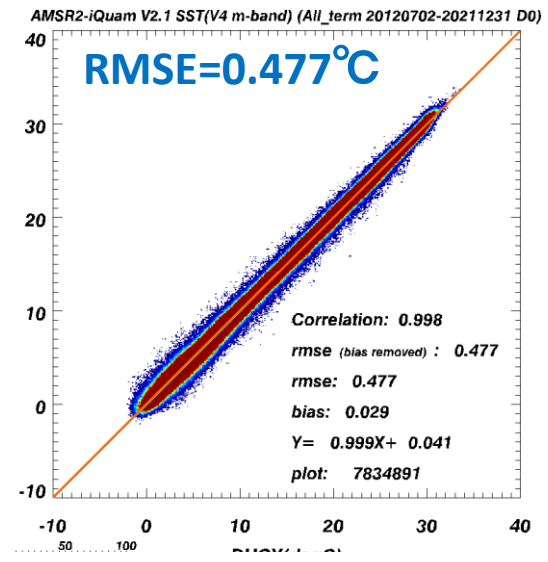
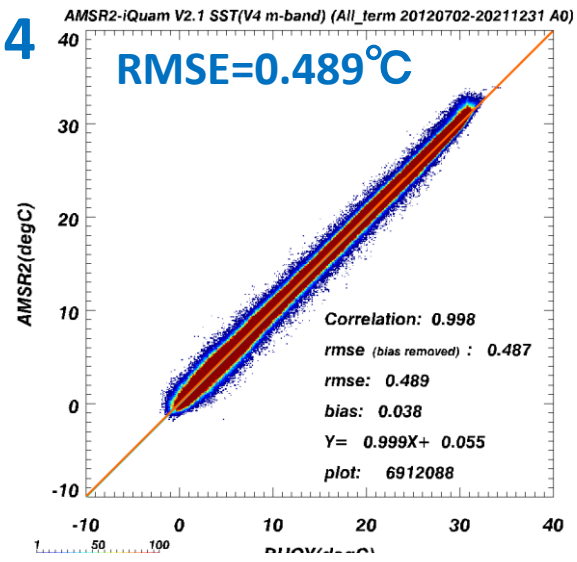
(QC=0)

Ver.4

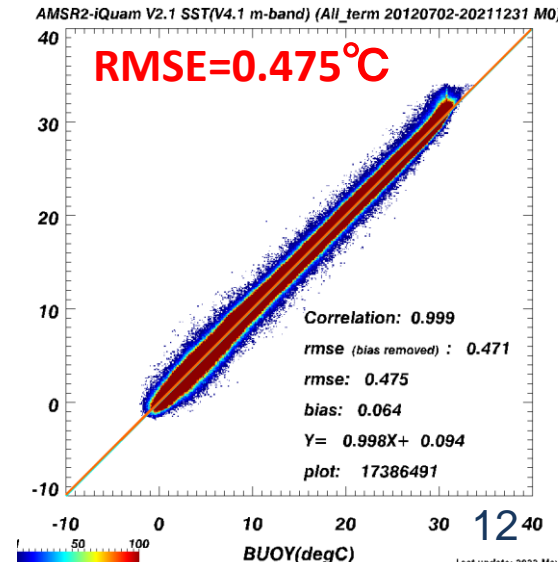
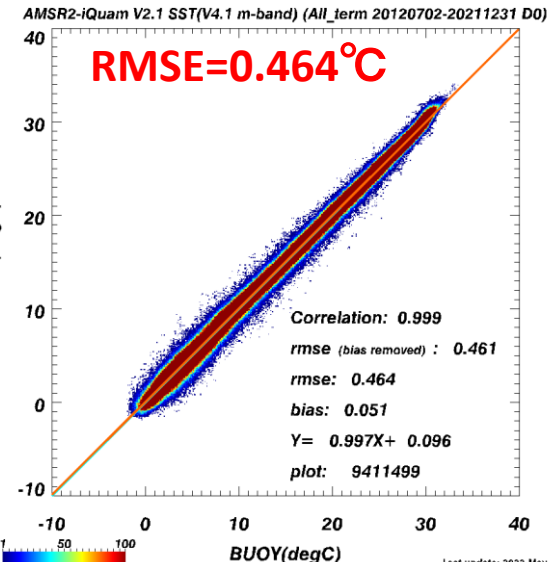
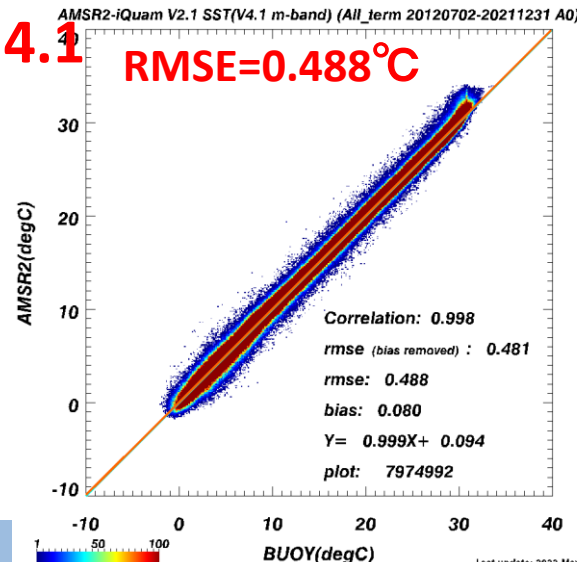
Ascending

Descending

A+D



Ver.4.1



Standard product list

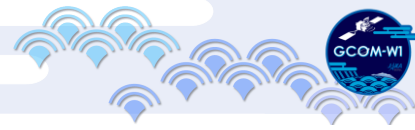
Summary

Updated

Geophysical Parameter (Version)	Release Accuracy	Standard Accuracy	Target Accuracy	Latest Validation Results
Integrated water vapor (V2.2)	$\pm 3.5 \text{ kg/m}^2$	$\pm 3.5 \text{ kg/m}^2$	$\pm 2.0 \text{ kg/m}^2$	RAOB: $\pm 2.5 \text{ kg/m}^2$ GPS: $\pm 1.5 \text{ kg/m}^2$
Integrated cloud liquid water (V2.2)	$\pm 0.10 \text{ kg/m}^2$	$\pm 0.05 \text{ kg/m}^2$	$\pm 0.02 \text{ kg/m}^2$	$\pm 0.04 \text{ kg/m}^2$
Precipitation (V3)	Ocean $\pm 50 \%$ Land $\pm 120 \%$	Ocean $\pm 50 \%$ Land $\pm 120 \%$	Ocean $\pm 20 \%$ Land $\pm 80 \%$	Ocean $\pm 37 \%$ Land $\pm 62 \%$
Sea Surface temperature (V4.1)	$\pm 0.8 \text{ }^\circ\text{C}$	$\pm 0.5 \text{ }^\circ\text{C}$	$\pm 0.2 \text{ }^\circ\text{C}$ (as zonal mean)	$\pm 0.47 \text{ }^\circ\text{C}$ (RMSE) $\pm 0.2 \text{ }^\circ\text{C}$ (as zonal mean)
Sea surface wind speed (V4)	$\pm 1.5 \text{ m/s}$	$\pm 1.0 \text{ m/s}$	$\pm 1.0 \text{ m/s}$	$\pm 0.96 \text{ m/s}$
Sea ice concentration (V3)	$\pm 10 \%$	$\pm 10 \%$	$\pm 5 \%$	$\pm 9 \%$
Soil moisture (V3)	$\pm 10 \%$	$\pm 10 \%$	$\pm 5 \%$	$\pm 4 \%$
Snow depth (V2)	$\pm 20 \text{ cm}$	$\pm 20 \text{ cm}$	$\pm 10 \text{ cm}$	$\pm 18 \text{ cm}$

Achieved standard accuracy

Achieved target accuracy



Summary

Updated

Released	Not released
----------	--------------

Geophysical Parameters	Target (Release) Accuracy	Latest Validation Results	Product Status
All-weather sea surface wind speed (V3)	± 7 m/s (high winds)	± 3.95 m/s (>= 16 m/s)	Released
10GHz sea surface temperature (V4.1)	± 0.8 °C	± 0.49°C (>= 9°C) ± 0.59°C (all temp.)	Released
Land surface temperature (V1)	Forest: ± 3 °C Nondense vegetation : ± 4 °C	Forest : ± 3 °C Nondense vegetation: ± 4 °C	Released
Vegetation water content	± 1 kg/m ²		Validating
High-resolution sea ice concentration (V1)	± 15 %	± 15 %	Released
Thin ice detection (V1)	80 % (correct answer rate)	> 88 % (Okhotsk · Bering sea · Hudson bay)	Released
Sea ice motion vector (V1)	± 6 cm/s (x & y component)	SIM(Y): x 3.16, y 2.91 cm/s SIM(R): x 4.09, y 3.64 cm/s	Released
Soil moisture & vegetation water content by land assimilation model	Soil moisture : ± 8% Vegetation water : ± 1 kg/m ²		Developing
Integrated water vapor over land (V1)	± 6.5 kg/m ² (except ice & vegetation area)	RAOB: ± 3.5 kg/m ² GPS: ± 2.6 kg/m ²	Released
Sea ice thickness (< 20cm)	Thin solid ice: ± 10 cm Active frazil: ± 3 cm		Developing
Sea ice thickness (>=20cm)	± 20 cm		Developing
Multi-band sea surface temperature (V4.1)	± 0.8 °C	± 0.48°C	Released

Appendix

- Accuracy of SST in strong wind and light rain area
- Difference of time series of SST

Accuracy of SST in strong wind and light rain area

06G

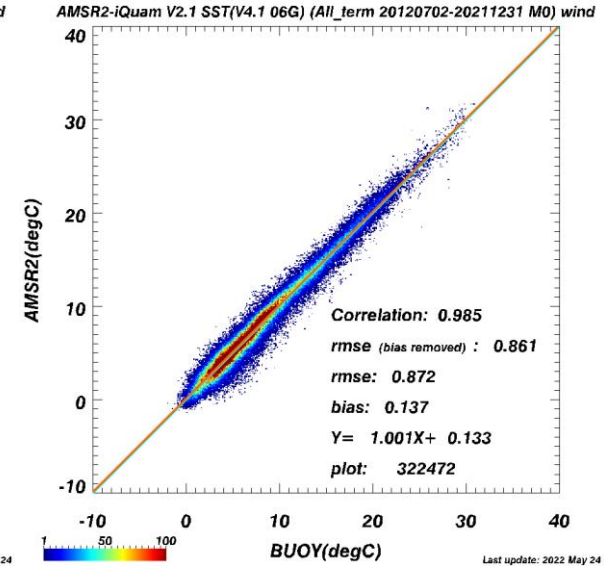
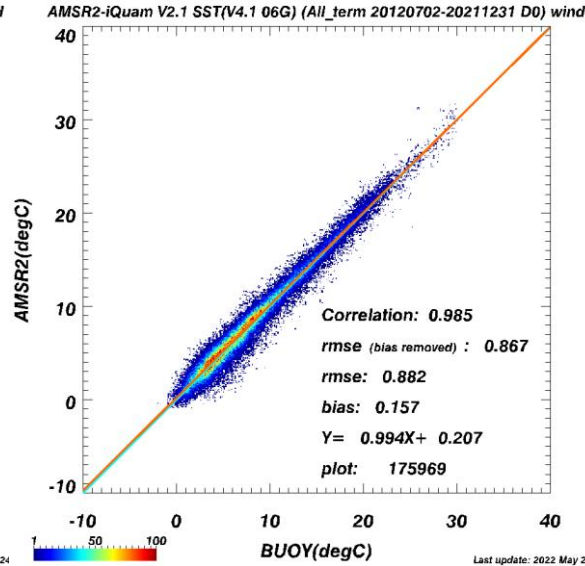
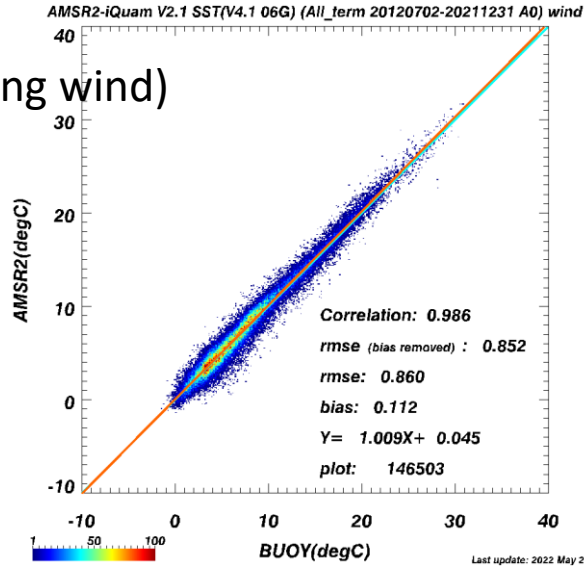
Ascending

Descending

A+D

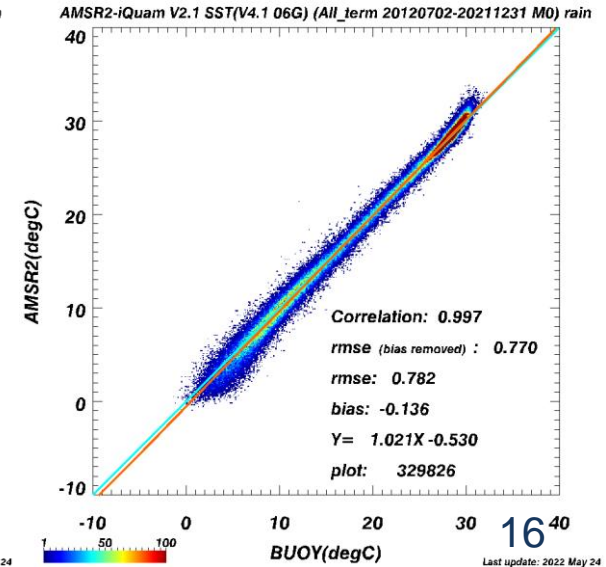
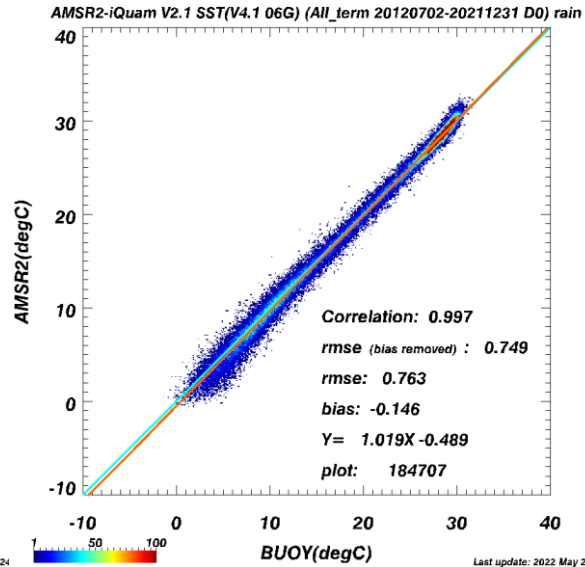
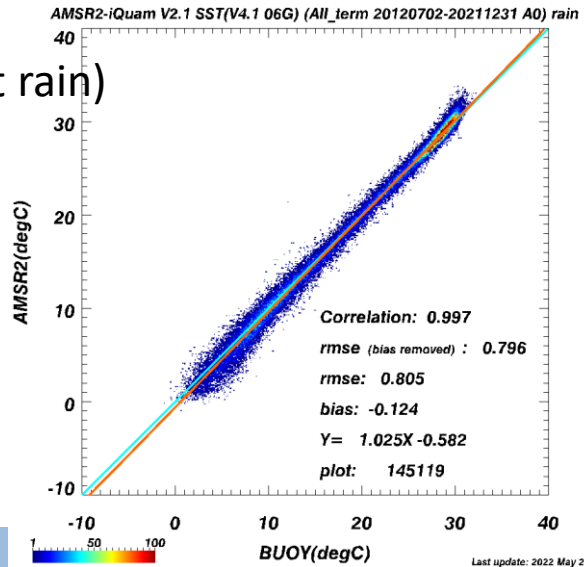
V4.1

(Strong wind)



V4.1

(light rain)

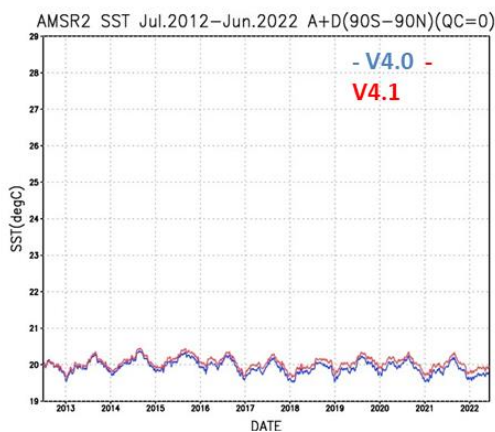


Difference of time series of SST

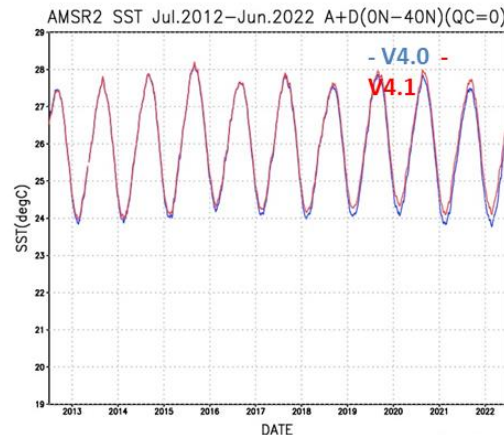
- The reprocessing will not be performed for this minor version updates. Therefore, the impact of the difference in the time series of global or zonal mean were investigated.
- This minor upgrade is expected to result in a gap of 0.15 K globally and a gap of about 0.4 K in the ocean areas where the downward trend was pronounced, but reprocessing will be performed at the time of the next major upgrade.

Average

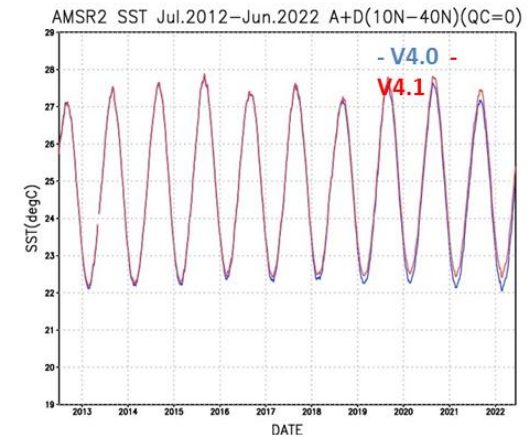
90S-90N



0N-40N



10N-40N



Difference(V4.0-V4.1)

