Updates of AMSR2 Level 2 (Geophysical Parameters) to Ver.4 (Standard Product)

JAXA/EORC

Oct. 12, 2020

Ver.4 Updates

- Following standard products are updated to Version 4
  1. Sea Surface Temperature (SST)
  2. Sea Surface Wind Speed (SSW)

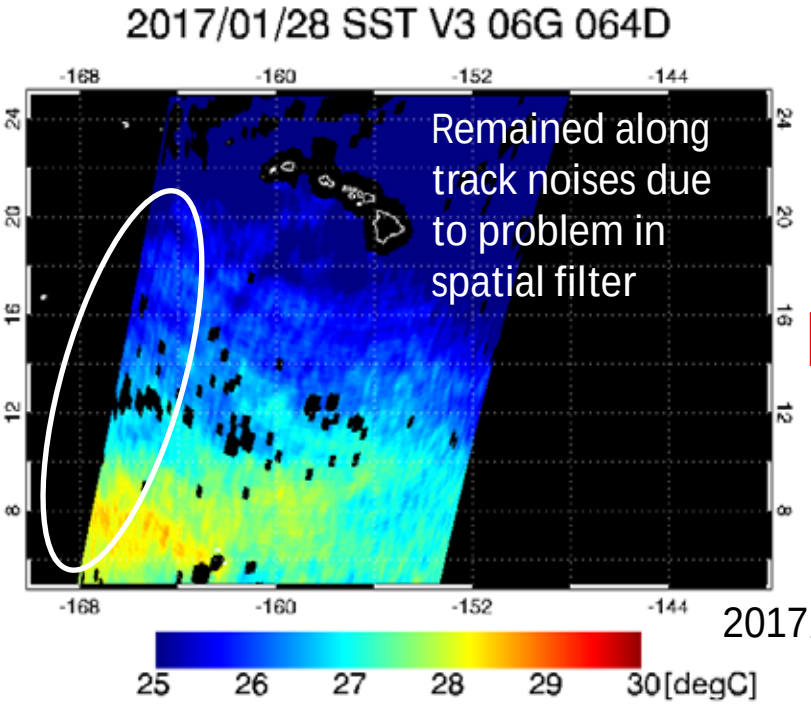
- In Ver.4 updates, following research products are also updated or newly added. Those products are stored in the second and third layers of “Geophysical Data” in the standard SST product file. See Reference for more details.
  1. 10GHz Sea Surface Temperature: 2nd layer
  2. Multi-band Sea Surface Temperature: 3rd layer (newly added)

1.1: Sea Surface Temperature

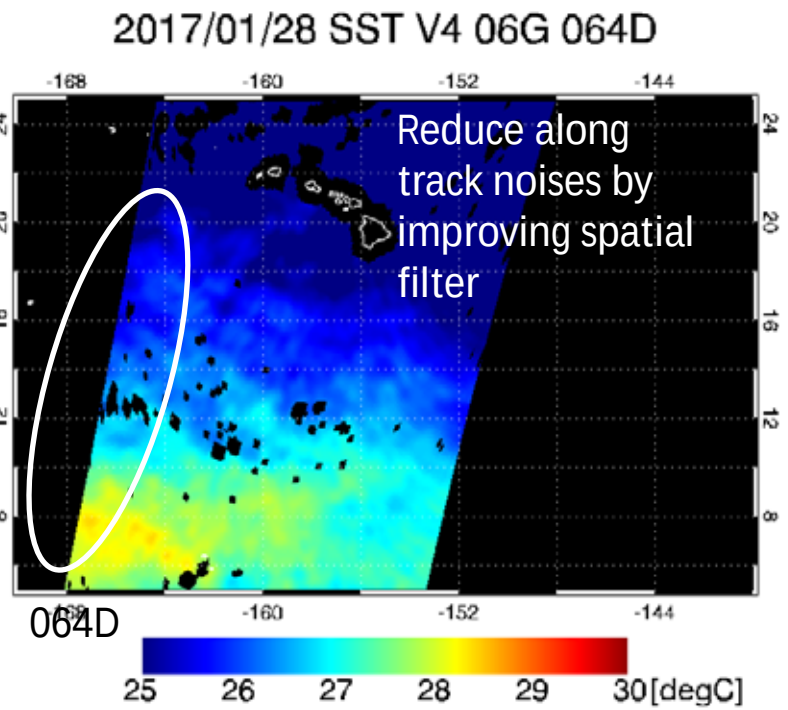
- Algorithm PI
  - Dr. Akira Shibata (RESTEC)
- Major improvements
  - Correction of positive trends since the late 2017, especially found in Ascending orbit
  - Improvements of spatial filter to reduce noises
  - Enable to estimate SST closer to the coast (about 50km off the coast)
- Validation
  - For Standard Accuracy: Matchup 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. AMSR2's 10 pixels near the buoy are averaged when SSTs are spatially homogeneous (differences of max and minimum SST is less than 3 degC).
  - For Target Accuracy: Calculate monthly mean biases versus buoys for each latitude of 10-degree intervals.
  - Period: from July 2, 2012 to December 31, 2018

1: Sea Surface Temperature

Ver.3

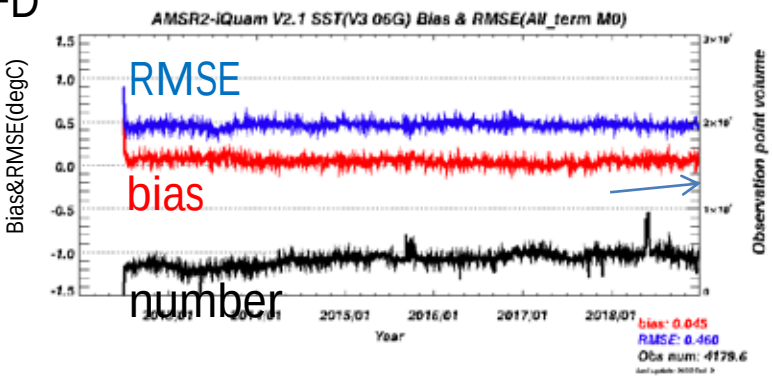


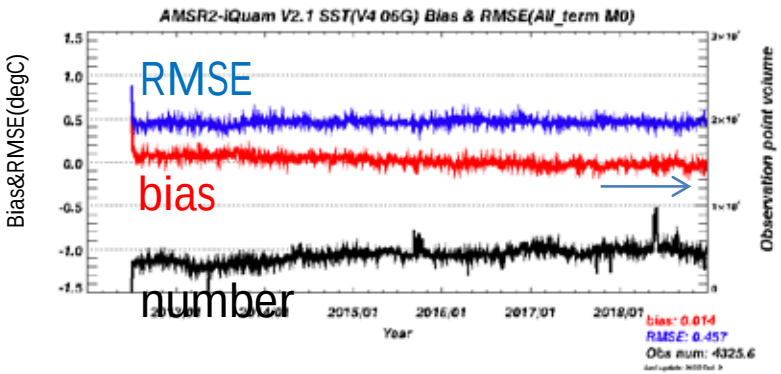
Ver.4



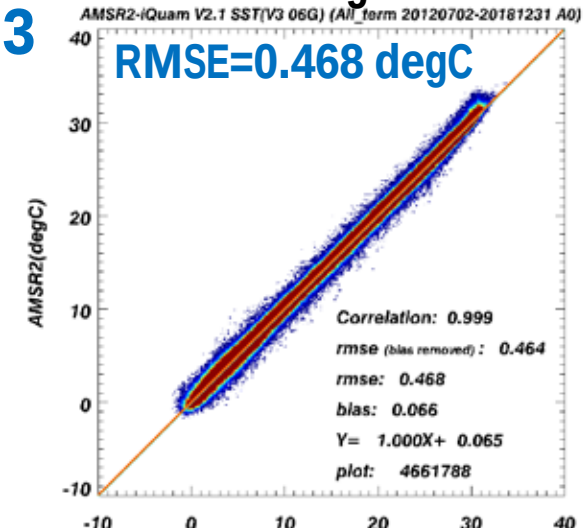
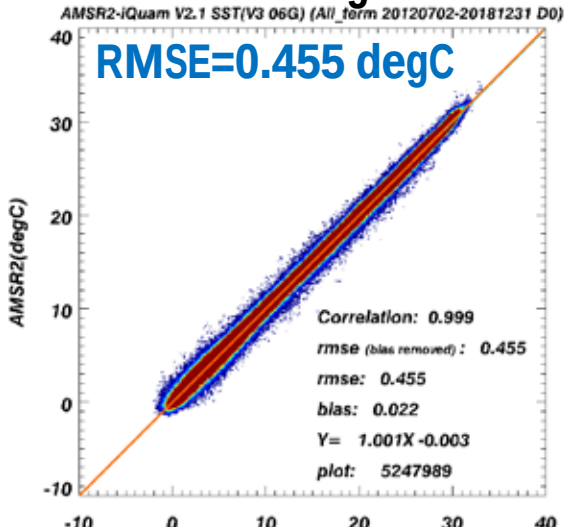
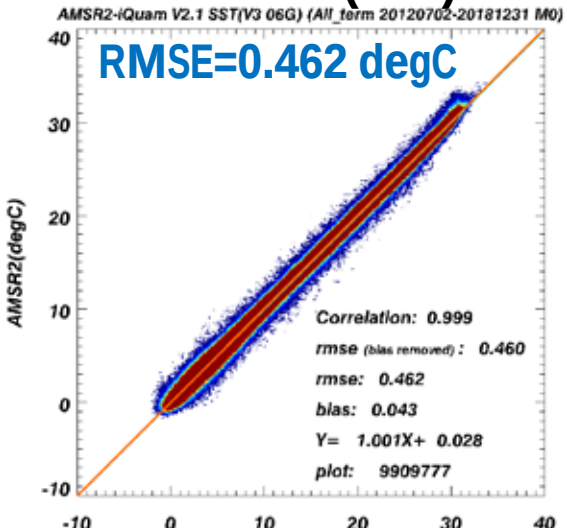
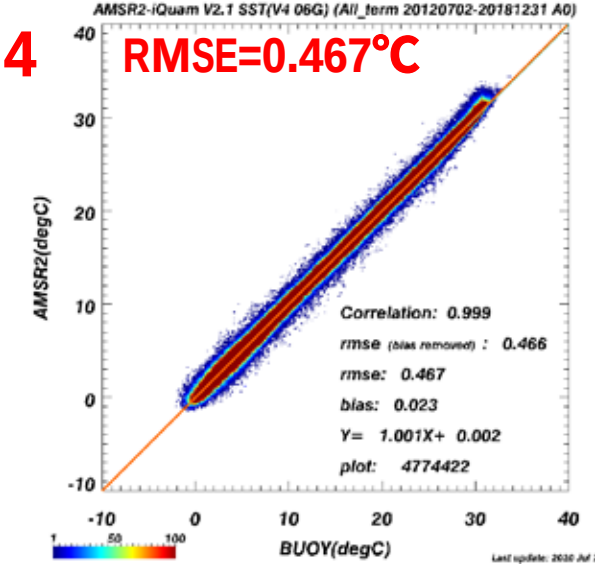
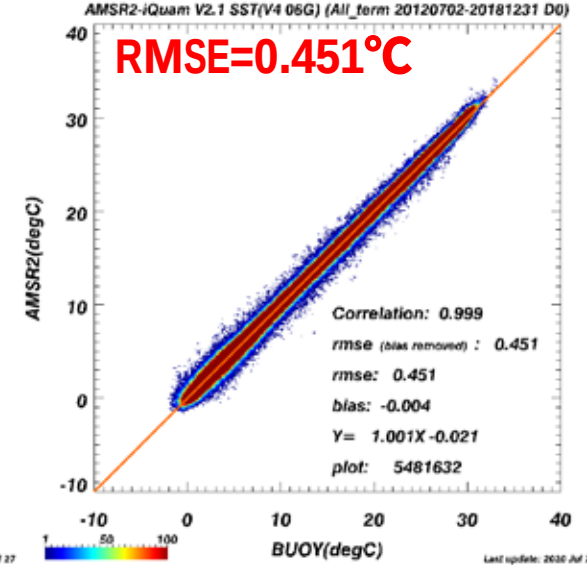
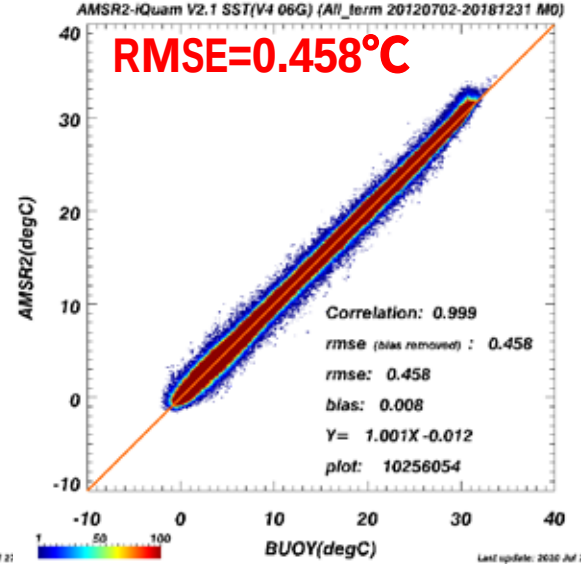
2017/1/28 064D

A+D





1: Sea Surface Temperature

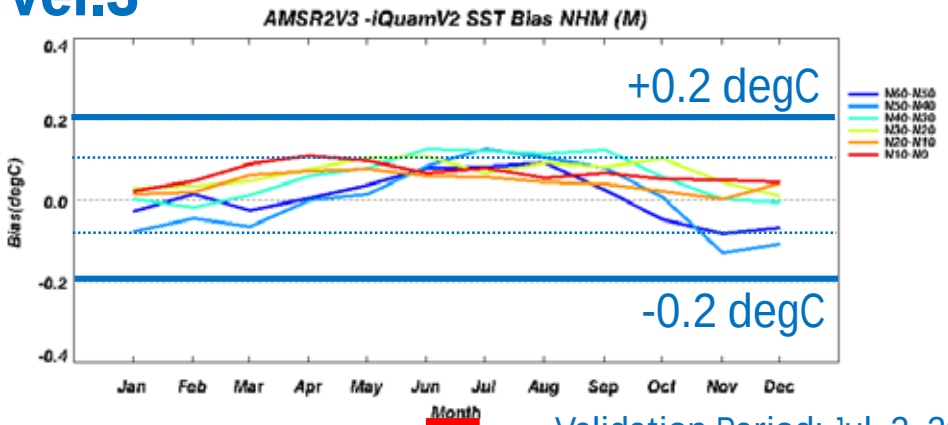
	Ascending Orbits	Descending Orbits	All Orbits (A+D)
Ver.3			
Ver.4			

1: Sea Surface Temperature

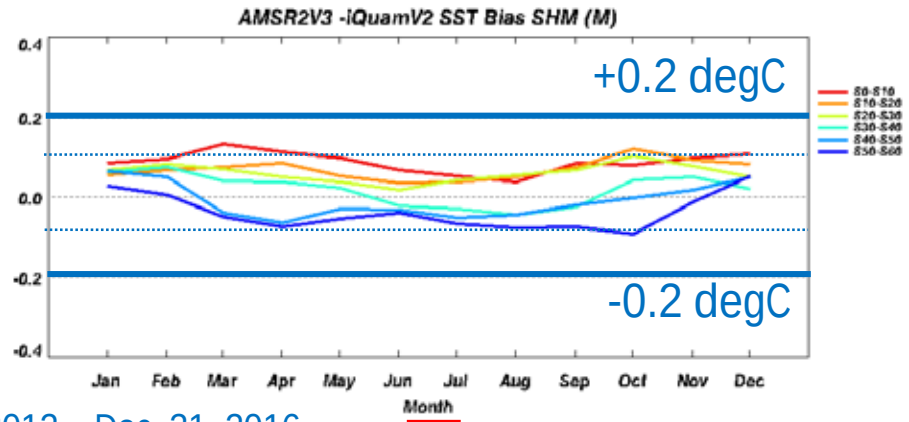
- Since Target Accuracy was defined as zonal mean, we calculate monthly mean bias variation versus buoys for each latitude of 10-degree intervals and evaluate each bias variation is within range of ±0.2 degC.
- Bias variation of Ver.4 is within range of ±0.2 degC, and monthly biases of each latitude of 10-degree intervals is within range of ±0.1 degC except latitudes of 40-50N.

Ver.3

Northern Hemisphere: All (A+D)

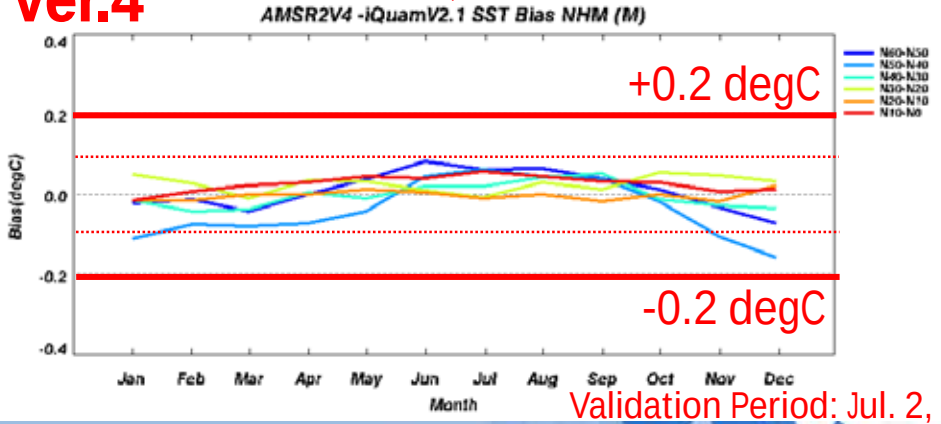


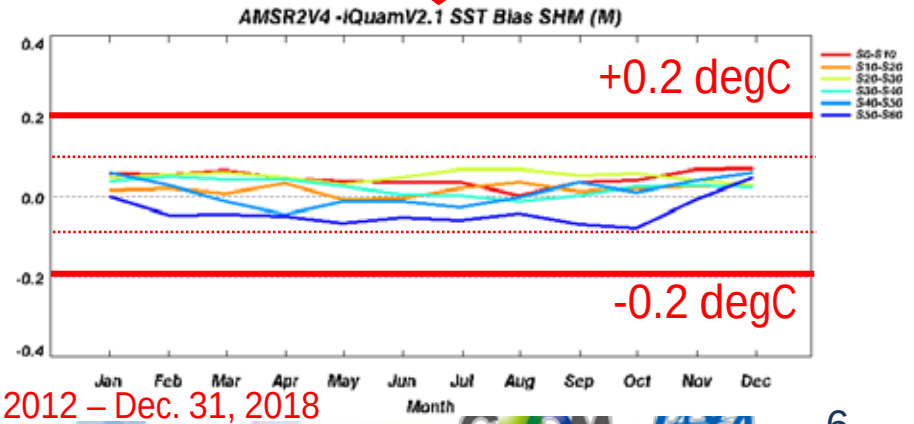
Southern Hemisphere: All (A+D)



Validation Period: Jul. 2, 2012 – Dec. 31, 2016

Ver.4





Validation Period: Jul. 2, 2012 – Dec. 31, 2018

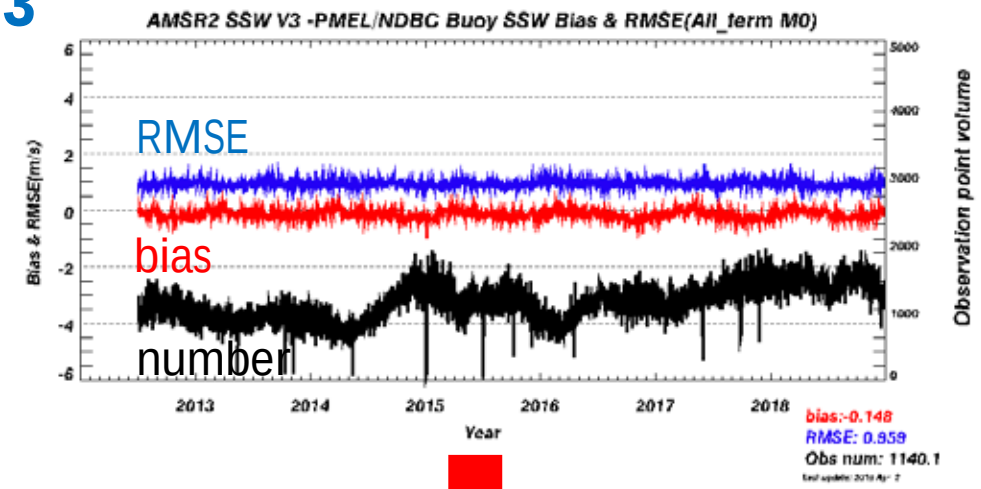
2: Sea Surface Wind Speed

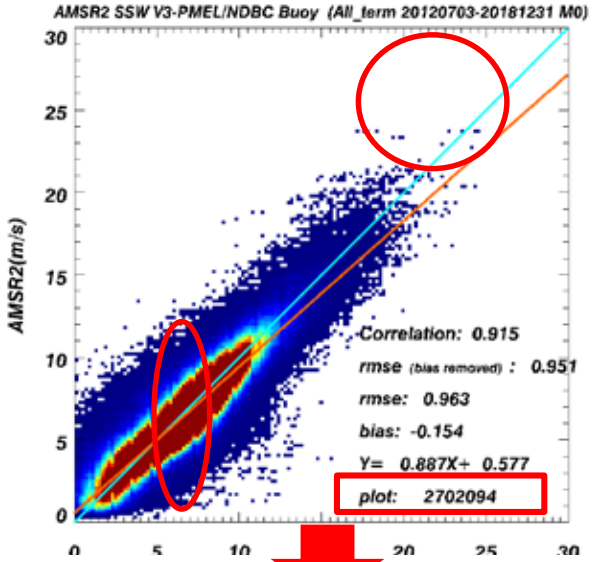
- Algorithm PI
  - Dr. Akira Shibata (RESTEC)
- Major improvements
  - Correction of known issues in Ver.3 products
    - Improve two forked biases (both over- and under-estimates) in windy condition found when compare with sea surface wind speeds of JMA's objective analysis and AMSR2's all-weather sea surface wind speed product.
    - This correction is already reflected to AMSR-E V8 products.
- Validation
  - Matchup AMSR2 and buoy data included in PMEL/NDBC buoys with time difference within 2 hour and distance less than 30 km.
  - Period: from July 2, 2012 to December 31, 2018

2: Sea Surface Wind Speed

Ver.3

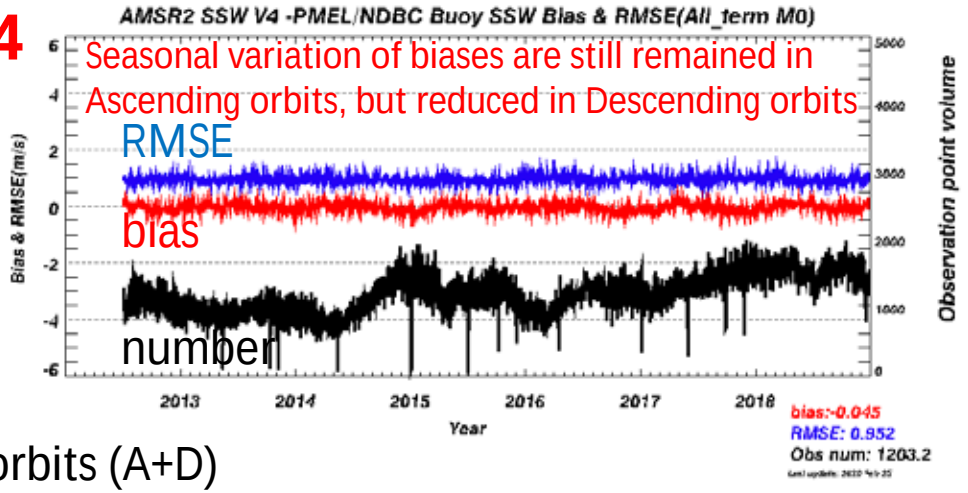
RMSE=0.963 m/s

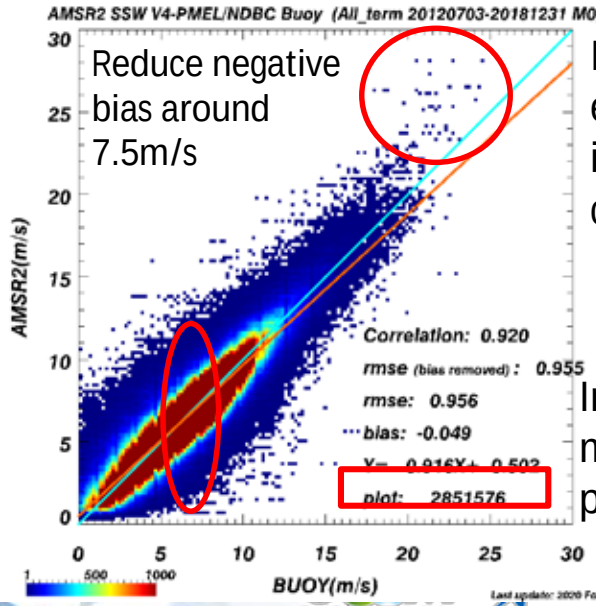




Ver.4

RMSE=0.956 m/s





Improve estimates in windy condition

Improve match-up points

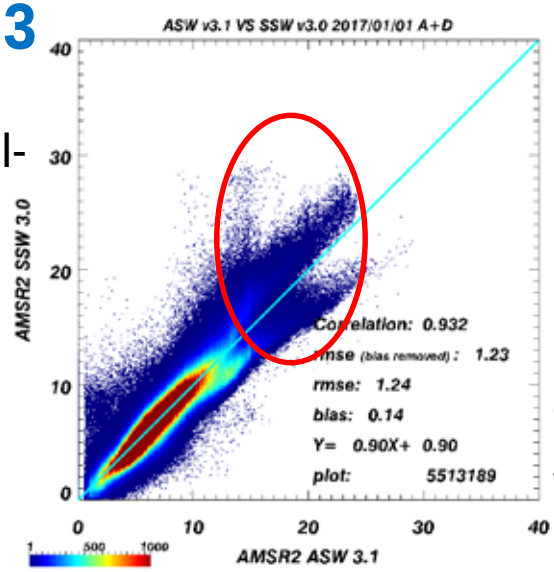
* All orbits (A+D)

2: Sea Surface Wind Speed

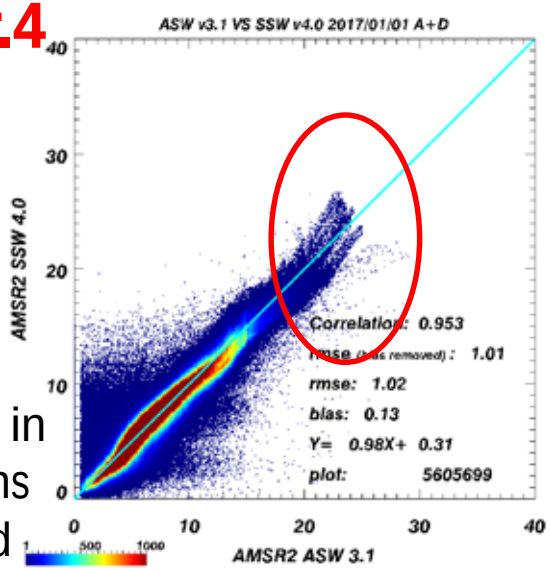
* All orbits (A+D)

Ver.3

Comparison with AMSR2 all-weather sea surface wind speed (X-axis)

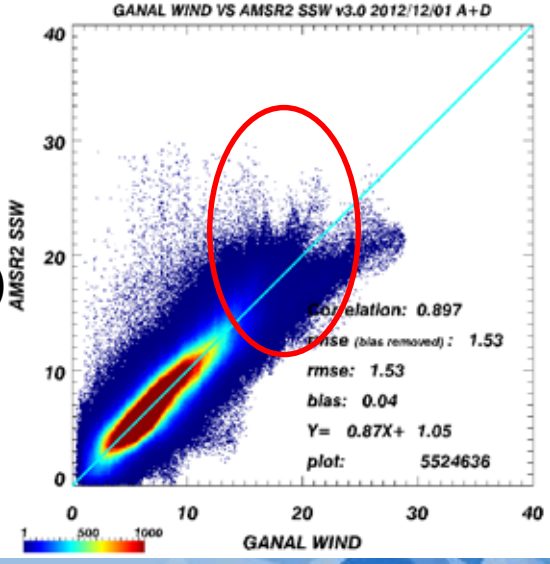


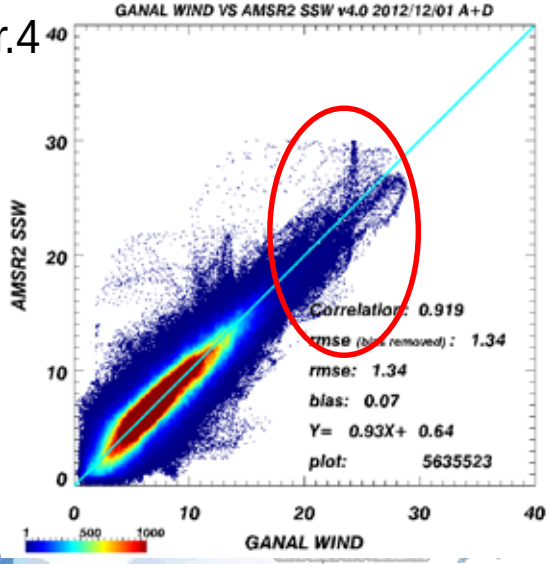
Ver.4



Two fork biases in windy conditions (> 20m/s) found in Ver.3 are improved in Ver.4

Comparison with JMA's GANAL wind speed at surface (X-axis)





Evaluation results of standard products

Updated

Geophysical Parameters (Version)	Release Accuracy	Standard Accuracy	Target Accuracy	**Latest Validation Results**
Integrated water vapor (V2)	±3.5 kg/m^2	±3.5 kg/m^2	±2.0 kg/m^2	**RAOB:±2.5 kg/m^2 GPS:±1.5 kg/m^2**
Integrated cloud liquid water (V2)	±0.10 kg/m^2	±0.05 kg/m^2	±0.02 kg/m^2	**±0.04 kg/m^2**
Precipitation (V2)	Ocean: ±50 % Land: ±120 %	Ocean: ±50 % Land: ±120 %	Ocean: ±20 % Land: ±80 %	**Ocean: ±48 % Land: ±86 %**
Sea surface temperature (V4)	**±0.8 ºC**	**±0.5 ºC**	**±0.2 ºC (as zonal mean)**	**±0.46 ºC (RMSE) ±0.2 ºC (as zonal mean)**
Sea surface wind speed (V4)	**±1.5 m/s**	**±1.0 m/s**	**±1.0 m/s**	**±0.96 m/s**
Sea ice concentration (V3)	±10 %	±10 %	±5%	**±9 %**
Soil moisture(V3)	±10 %	±10 %	±5 %	**±4 %**
Snow depth (V2)	±20 cm	±20 cm	±10 cm	**±18 cm**

Achieved standard accuracy | **Achieved target accuracy**

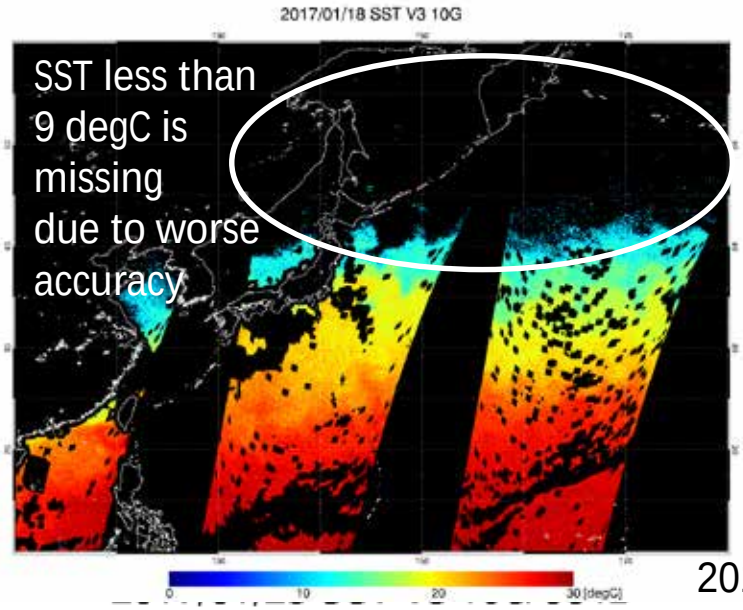
(Reference)
Updates of Research Products

1: 10GHz Sea Surface Temperature

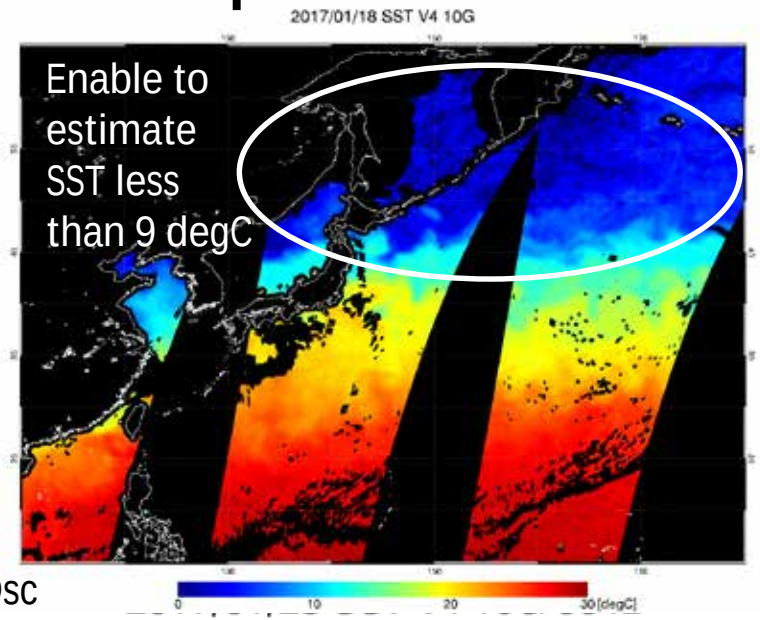
- Algorithm PI
  - Dr. Akira Shibata (RESTEC)
- Major improvements
  - Correction of positive trends since the late 2017, especially found in Ascending orbit
  - Apply spatial filter to reduce random noises
  - Enable to estimate SST under 9 degC by improving calibration of low brightness temperature
  - Enable to estimate SST closer to the coast (about 30km off the coast)
- Validation
  - Matchup 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. AMSR2's 10 pixels near the buoy are averaged when SSTs are spatially homogeneous (differences of max and minimum SST is less than 3 degC).
  - Period: from July 2, 2012 to December 31, 2018

1: 10GHz Sea Surface Temperature

Ver.3

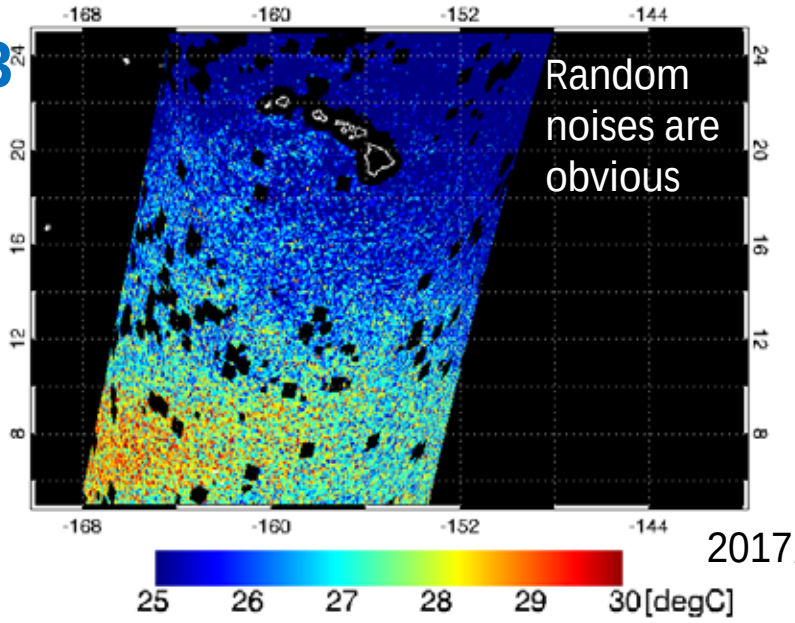


Ver.4

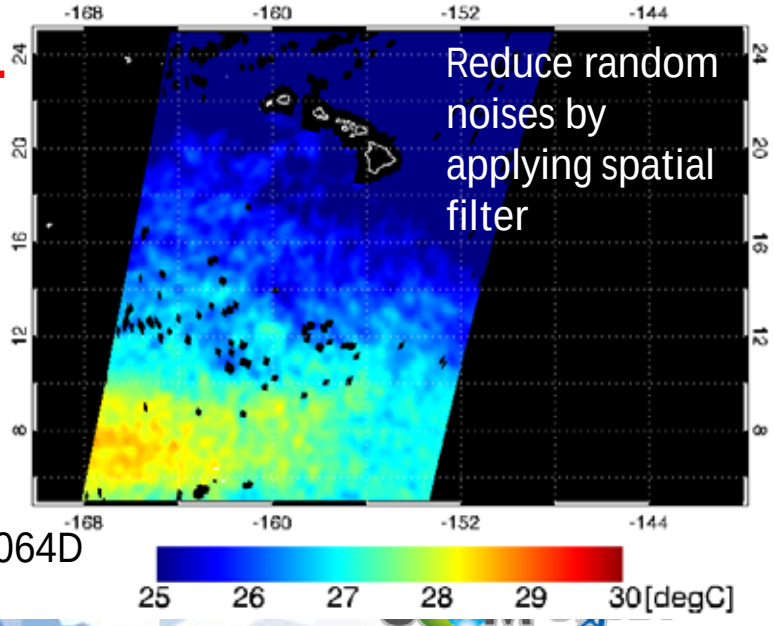


2017/1/18 Dsc

Ver.3



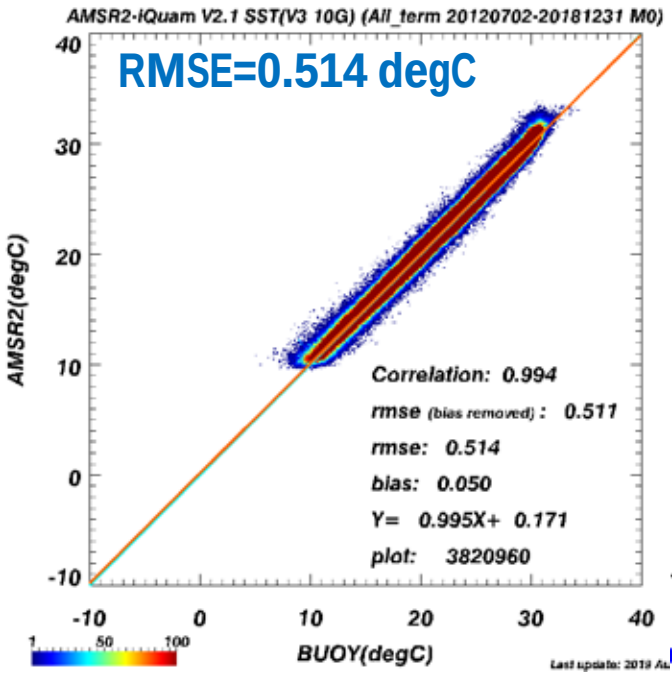
Ver.4



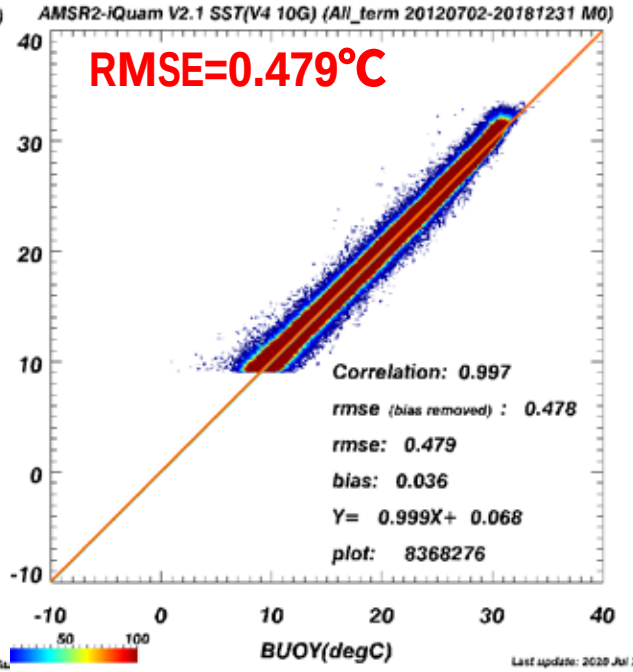
2017/1/28 064D

1: 10GHz Sea Surface Temperature

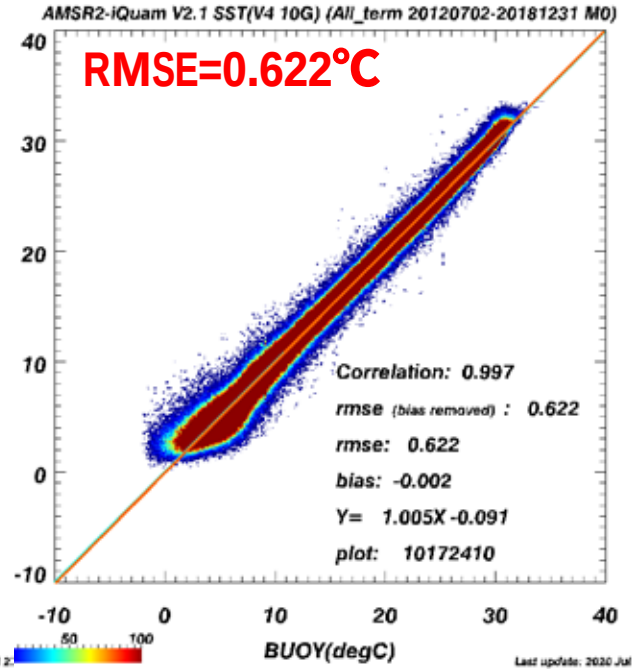
Ver.3 (>= 9 degC)



Ver.4 (>= 9 degC)



Ver.4 (all temp.)



* All orbits (A+D)

Ver.4 products provides all SST that achieved target accuracy (0.8 degC) although SST less than 9 degC has worse accuracy than higher SSTs.

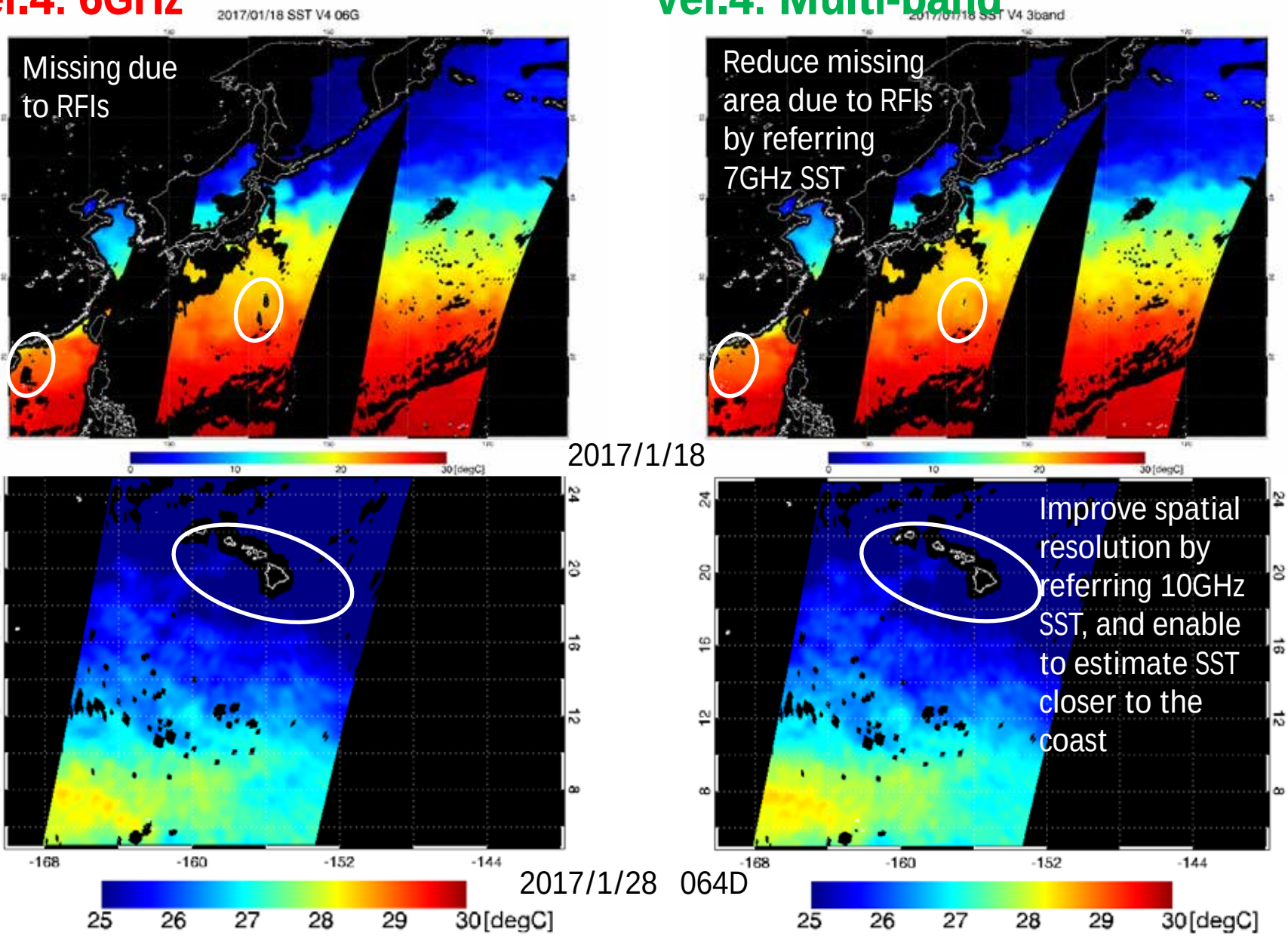
2: Multi-band Sea Surface Temperature (new)

- Algorithm PI
  - Dr. Akira Shibata (RESTEC)
- Target
  - To improve SST estimate near the coastal area and spatial resolution
- Characteristics
  - Stored in the third layer of the standard SST product to complement it
  - Produce SSTs using each 6.9, 7.3 and 10.65GHz brightness temperature to mitigate missing areas due to RFIs and rainfalls
  - Enables to estimate SST closer to the coast by determination of effects due to RFIs in each SST
  - Reduce noises found in current (Ver.3) 6 and 10GHz SSTs by applying improved spatial filter with less degradation of spatial resolution to expand areas where 10GHz SST with finer spatial resolution can be used
- Validation
  - Matchup 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. AMSR2's 10 pixels near the buoy are averaged when SSTs are spatially homogeneous (differences of max and minimum SST is less than 3 degC).
  - Period: from July 2, 2012 to December 31, 2018

2: Multi-band Sea Surface Temperature (new)

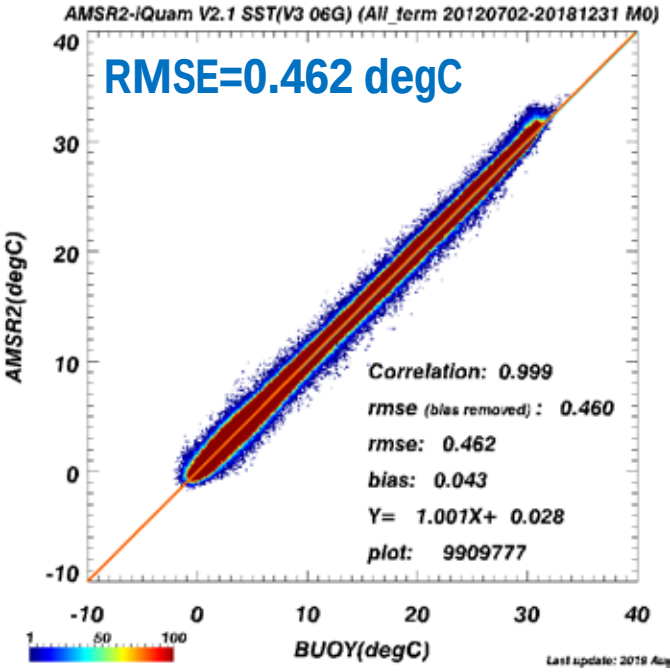
Ver.4: 6GHz

Ver.4: Multi-band

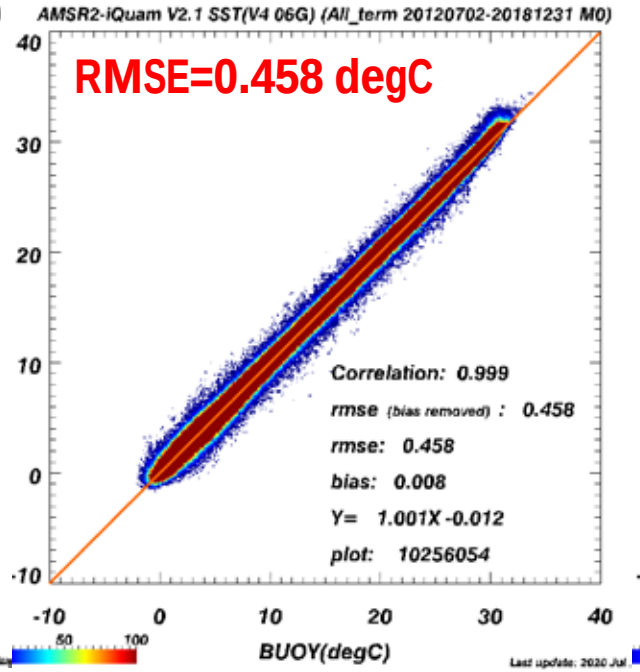


2: Multi-band Sea Surface Temperature (new)

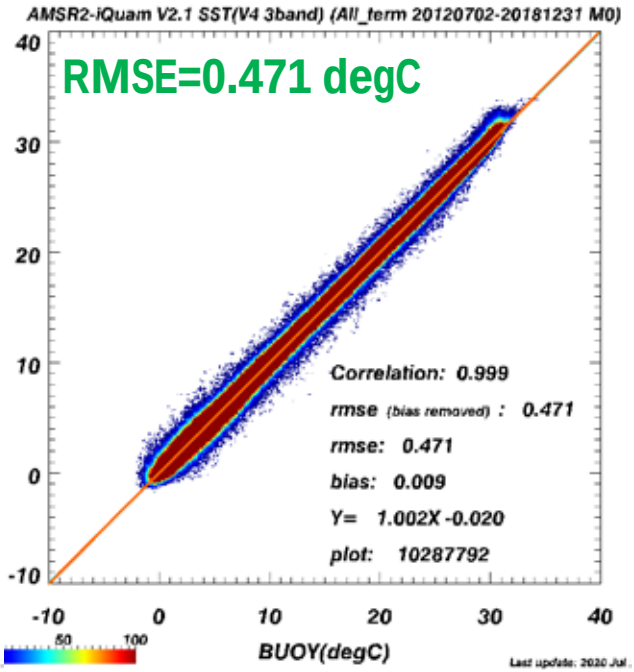
Ver.3: 6GHz



Ver.4: 6GHz



Ver.4: Multi-band



* All orbits (A+D)

Multi-band SST achieves not only target accuracy of research product (0.8 degC) but also standard accuracy of standard SST (0.5 degC).

AMSR2 Ver.4 SST & 10GHz SST Quality Flag

Sea Surface Temperature (SST:6G SST, 10G SST)

No	Status	bit7~bit4 Error				bit3~bit0 Normal				*Unsigned byte*	*Signed byte*
01	Normal	0	0	0	0	0	0	0	0	0	0
02	10GHz : strong wind (15-23m/s)	0	0	0	0	0	0	0	1	1	1
03	10GHz : SST (Sea Surface Temperature) below 9 degC	0	0	0	0	0	0	1	0	2	2
04	10GHz : strong wind (15-23m/s) and Sea Surface Temperature below 9 degC	0	0	0	0	0	0	1	1	3	3
03	incident angle error	0	0	0	1	0	0	0	0	16	16
04	land area	0	0	1	0	0	0	0	0	32	32
05	sea ice	0	0	1	1	0	0	0	0	48	48
06	sun glitter	0	1	0	0	0	0	0	0	64	64
07	rain、abnormal Brightness Temperature	0	1	0	1	0	0	0	0	80	80
08	abnormal SST (Sea Surface Temperature) or RFI (Radio Frequency Interference)	0	1	1	0	0	0	0	0	96	96
09	6GHz: strong wind 10GHz: strong wind (above 23m/s)	0	1	1	1	0	0	0	0	112	112
10	cold SST (Sea Surface Temperature) (below minus 2 degC)	1	0	0	0	0	0	0	0	128	-128

Notice: The Accuracy of the No.2, No.3 and No. 4 is worse than No.1.

AMSR2 Ver.4 Multi-band SST Quality Flag

Sea Surface Temperature (SST: Multi Band SST)

No	Status	bit7～bit4 Error				bit3～bit0 Normal				*Unsigned byte*	*Signed byte*
01	Normal	0	0	0	0	0	0	0	0	0	0
02	land area in 6GHz SST (Sea Surface Temperature)	0	0	0	0	0	1	0	0	4	4
03	incident angle error	0	0	0	1	0	0	0	0	16	16
04	land area	0	0	1	0	0	0	0	0	32	32
05	sea ice	0	0	1	1	0	0	0	0	48	48
06	sun glitter	0	1	0	0	0	0	0	0	64	64
07	rain, abnormal brightness temperature	0	1	0	1	0	0	0	0	80	80
08	abnormal SST (Sea Surface Temperature) or RFI (Radio Frequency Interference)	0	1	1	0	0	0	0	0	96	96
09	strong wind	0	1	1	1	0	0	0	0	112	112
10	cold SST (Sea Surface Temperature) (below minus 2 degC)	1	0	0	0	0	0	0	0	128	-128

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

Evaluation results of research products

Released	Not released

Updated

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)	**±0.8 degC**	**±0.48 degC (>= 9 degC) ±0.62 degC (all temp.)**	**Released**
Land surface temperature (V1)	Forest: ±3 degC Nondense vegetation: ±4 degC	**Forest: ±3 degC Nondense vegetation: ±4 degC**	Released
Vegetation water content	±1 kg/m^2		Validating
High-resolution sea ice concentration	±15 %		Validating
Thin ice detection (V1)	80 % (correct answer rate)	**> 88 % (Okhotsk, Bering sea, Hudson bay)**	Released
Sea ice motion vector	±3 cm/s (x & y components)		Validating
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 (< 20 cm)	Thin solid ice: ±10 cm Active frazil: ±3 cm		Developing
Sea ice thickness (>= 20 cm)	±20 cm		Developing
Multi-band sea surface temperature (V4)	**±0.8 degC**	**±0.47 degC**	**Newly released**