STATUS OF ALGORITHM DEVELOPMENT FOR SEA SURFACE TEMPERATURE RETRIEVAL OF GEO-KOMPSAT-2A/ADVANCED METEOROLOGICAL IMAGER

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Geo-KOMPSAT-2A (Geostationary Korea Multi-Purpose Satellite-2A, GK-2A), which was launched successfully on 5 December 2018, is a second geostationary satellite of Korea, following on the Communication, Ocean and Meteorological Satellite (COMS). Advanced Meteorological Imager (AMI) on the GK-2A, which is quite a similar to the ABI of GOES-16/17 and the AHI of Himawari-8/9, has sixteen channels and has an overall wavelength range from 0.4 to 13 μm. The spatial resolution is 0.5 km or 1 km for the visible channels and 2 km for the infrared channels. The temporal resolution is 10 minutes for the full disk images. In this study, for operational GK-2A/AMI sea surface temperature (SST) retrieval, we developed SST algorithm using 8.7, 10.5, 11.2, and 12.3 μm channel data of Himawari-8/AHI as proxy data. In addition to cloud mask using the cloud detection algorithm, a quality control process of the estimated SSTs using real-time radiative transfer model data and climatology data was also applied for stable and accurate SST retrieval. The estimated SST is compared with the quality controlled GTS buoy temperature observation data. The daily, 5-day and 10-day SST composite data were produced based on the simple average method. In addition, daily blended SST composite data are also produced using retrieved Himawari-8 SST data, NOAA/AVHRR local area coverage data, microwave SST data from AMSR2 and GMI, drifter temperature data, and in-situ moored-buoy temperature data. Preliminary results of SST estimation from GK-2A data are presented.

GK-2A/AMI

Geo-KOMPSAT-2 Program

	GK-2A	GK-2B	
Payload	AMI	GOCI-2	GEMS
Channels	16	13	1000
Wavelength Range	0.4–13 μm	375–860 nm	300–500 nm
Spatial Resolution	0.5/1 km (VIS) 2 km (IR)	250 m @ eq 1 km (FD)	7 x 8 km @ Seoul 3.5 x 8 km (aerosol)
Temporal Resolution	10 min(FD)	1 hour	1 hour

First image of GK-2A/AMI (26 Jan. 2019 0310 UTC)

Advanced Meteorological Imager

Channel	Band name	Wavelength (μm)	Resolution (km)	SNR	NEΔT(K) (240/300K)	Radiometric Accuracy	Wavelength (μm)	Resolution (km)
1	VIS 0.4	0.47	1	250		5 %		
2	VIS 0.5	0.51	1	250		5 %		
3	VIS 0.6	0.64	0.5	120		5 %	0.675	1
4	VIS 0.8	0.856	1	210		5 %		
5	NIR 1.3	1.378	2	300		5 %		
6	NIR 1.6	1.61	2	300		5 %		
7	IR 3.8	3.9	2		3 / 0.2	1 K	3.75	4
8	IR 6.3	6.185	2		0.4 / 0.1	1 K		
9	IR 6.9	6.95	2		0.37 / 0.1	1 K	6.75	4
10	IR 7.3	7.34	2		0.35 / 0.12	1 K		
11	IR 8.7	8.5	2		0.27 / 0.1	1 K		
12	IR 9.6	9.61	2		0.35 / 0.15	1 K		
13	IR 10.5	10.35	2		0.4 / 0.2	1 K	10.8	4
14	IR 11.2	11.2	2		0.19 / 0.1	1 K		
15	IR 12.3	12.3	2		0.35 / 0.2	1.1 K	12.0	4
16	IR 13.3	13.3	2		0.48 / 0.3	1.1 K		

- The AMI is a mission-critical payload on GK-2A. AMI is used for a wide range of qualitative and quantitative weather, oceanographic, climate, and environmental applications. Its nominal spatial resolution will be 2 km for the infrared bands and 0.5-1 km for the visible bands.
- The AMI has 16 spectral bands, and the characteristics of each band are very similar to AHI (Advanced Himawari Imager) and ABI (Advanced Baseline Imager) mounted on Himawari-8 and GOES-16 (Geostationary Operational Environmental Satellite-16), respectively.

Algorithm for Sea Surface Temperature Retrieval

Flowchart for GK-2A SST Retrieval

- **Hybrid Algorithm**
- **Multi-band Algorithm**

SST Quality Control

Fig. Flowchart of quality control procedure for sea surface temperature retrieval.

Matchup Procedure
- Temporal limitation : < 10 min
- Spatial limitation : < 2 km

In-situ SST   Ch13 BT   OSTIA SST

GK-2A/AMI SST Retrieval and Validation

GK2A/AMI SST Retrieval

GK-2A/AMI   Himawari-8/AHI   OSTIA

Fig. An example of spatial distribution of retrieved SST from GK-2A/AMI data at 00:30 UTC on 1 April 2019.

Comparison of GK-2A SST with other Products

(a) Bias = 0.0309 °C, RMSE = 0.5455 °C, SI = 0.0205, R = 0.9944

(b) Bias = 0.0040 °C, RMSE = 0.6407 °C, SI = 0.0317, R = 0.9873

Fig. Comparison between retrieved SST from GK-2A/AMI data and (a) SST from Himawari-8/AHI and (b) OSTIA SST. The color scale represent the percentage of the data.

Algorithm Assessment and Error Characteristics

Algorithm Assessment using Proxy Data (Himawari-8/AHI)

(a) Hybrid SST   (b) Multi-band SST

- **Period** 1st Aug 2016 ~ 31st July 2017
- **Hybrid SST** Positive bias (> 30°C)
- **Multi-band** Positive bias (< 10°C)

Fig. Comparison between (a) Hybrid SST and (b) Multi-band SST and in-situ measurements and distributions of (c) Hybrid SST and (d) Multi-band SST as a function of the in-situ SST. The color scale represent the percentage of the data.

Fig. Time series of RMSE and bias results of quality control coefficients from 1 August 2016 to 31 July 2017.

Error Characteristics

- **Hybrid SST** positive error (SZA <15°)
- **Multi-band SST** SST error increase at the high SZA

Fig. Spatial distribution of errors of (a) Hybrid SST and (b) Multi-band SST and distributions of (c) Hybrid SST and (d) Multi-band SST as a function of satellite zenith angle (SZA).

Summary and Conclusion

- The GK-2A/AMI SST is basically retrieved using the multi-band (4 band) SST retrieval algorithm by default, and can be retrieved using the empirical regression SST algorithm and the hybrid SST algorithm optionally, depending on user demand. The retrieved SST does not represent the skin temperature; instead, it represents the temperature at a depth of approximately 20 cm, because the drifter data are used as in situ data. Therefore, it is reasonable that this retrieved SST is considered as the temperature between the skin and subskin layer.
- At thermal infrared (IR) wavelengths, the SST can be retrieved only under clear sky. The accuracy of the satellite SST measurement is limited by the accuracy of sensor radiances, the quality of cloud screening, and correction for the effects of atmospheric absorption and scattering and surface reflection in the retrieval algorithms.