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RA II WIGOS Project Newsletter

DEVELOPING SUPPORT FOR NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES IN SATELLITE DATA, PRODUCTS AND TRAINING

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JMA's Himawari-8 successfully launched

Photo by MHI/JAXA

The next-generation geostationary meteorological satellite of the Japan Meteorological Agency (JMA), Himawari-8, was successfully launched using H-IIA Launch Vehicle No. 25 at 5:16 UTC on 7 October 2014 from the Tanegashima Space Center in Kagoshima, Japan.

The satellite successfully separated from the launch vehicle about 28 minutes after lift-off, and will fly unaided for around 10 days before settling into geostationary orbit.

The satellite is expected to start operation in July 2015 after the completion of in-orbit testing and checking of the overall system including related ground facilities.

Himawari-8 will be located at around 140 degrees east, and will observe the East Asia and Western Pacific regions as a successor to the current MTSAT-2 satellite. Himawari-8 will feature a new imager with 16 bands as opposed to the 5 bands of the MTSAT series. Full-disk imagery will be obtained every 10 minutes, and rapid scanning at 2.5-minute intervals will be conducted over several regions, one of which will be for targeted observation of tropical cyclones. The unit's horizontal resolution will also be double that of the MTSAT series. These significant improvements will bring unprecedented levels of performance in monitoring for tropical cyclones as well as rapidly developing cumulonimbus and volcanic ash clouds.

(Yukihiro Kumagai, JMA)

Migration from MTSAT to Himawari-8/9

Himawari-8, successfully launched on 7 October 2014, will provide significantly improved observation data. For every users who wants to get Himawari-8 data, it is necessary to ready data receiving environment preferably by the start of operation of Himawari-8 (expected to be in July 2015) to enjoy the benefit of the improvement, or, at the latest by November 2015.

In order to ensure continuity of, and for further betterment of, meteorological services in Asia and West Pacific region, JMA has operated and prepared a various kind of services that would be useful to obtain and use imagery of the next Himawari-series satellites. Especially important points are as follows:

1. Direct dissemination of current MTSAT-2 imagery will be discontinued around November 2015.

2. Current distribution service via the WIS/GISC Tokyo server will be continued. Although resolution of imagery remains the same as the current service, frequency of imagery distribution will be improved to every 10 minutes, reflecting enhancement in observation frequency. Users of SATAID Automatic Download Tool (available at http://www.wis-jma.go.jp/cms/sataid/) can continue using it operationally for Himawari-8/9 although it is recommended to download upgraded version of the tool to be available in due course.

3. Current distribution service via the JDDS server will also be continued, however, resolution and frequency of imagery remains the same as the current service.

4. As a new service for NMHSs, data distribution via Internet cloud will start in the second quarter of 2015. NMHSs who wish to utilize full resolution imagery of all bands have to use this service. High-speed Internet environment (at least about 25 Mbps if all data needed) will be required. Of course, NMHSs can select and download imagery of segments and bands of their choice.

5. Another new service, data dissemination service via a communication satellite will start (named HimawariCast). HimawariCast will disseminate not only HRIT files of five bands (one visible and four infrared), but also gridded numerical weather prediction products and other essential data such as SYNOP and TEMP in SATAID format, for superimposition by the SATAID software freely available. What will be required to receive the HimawariCast data is a dedicated receiving and processing system including an antenna.

The following website provides all information on Himawari-8/9 itself and other relevant information such as the said Internet cloud service, the HimawariCast and HimawariCast receiving equipment, and will be duly updated.

http://www.data.jma.go.jp/mscweb/en/himawari89/index.html

Any questions will be answered by contacting the following focal point.

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Typhoon Analysis Technique using Passive Microwave Sensors

Introduction

Tropical cyclones (TCs), especially Typhoon, are a major natural disaster to give huge damage to Korean Peninsula from a few days to weeks. The inner structure of TCs such as rain rates and surface wind speeds (WS) are indirectly estimated from the COMS (Communication, Ocean, and Meteorological Satellite) data because of the physical limitations of those bands. Thus, KMA/NMSC is developing an algorithm for retrieving sea surface wind speed under rain-free and rain conditions using passive microwave satellite observations (Hong and Seo wind algorithm).

This report is intended to introduce this wind algorithm, and its applications for analyzing the size and intensity of TCs.

Sea surface wind speed retrieval algorithm

Under rain conditions, the satellite observed TB is contributed from the atmospheric brightness temperatures because of the rainfall, and from the surface because of the wind speed. Under the non-raining condition at low microwave frequencies (<10 GHz), the atmospheric contributions to the brightness temperature in the satellite observations are negligible (Yan and Weng, 2008; Uhlhorn and Black, 2003). The atmospheric radiation effects at 6.9 GHz are much less than 0.2K for vertical (V)-polarization and 0.8K for horizontal (H)-polarization, respectively (Wentz, 2002).

In this investigation, we use the AMSR-2 data, which is operated and well calibrated at several frequencies: 6.9, 7.3, 10.65, 18.7, 23.8, 36.5, and 89.0 GHz at the constant incidence angle of 55.0°. The rain-contaminated observations are determined using AMSR-2 rain flag data to separate inside or outside TCs.

Relationships between the AMSR-2 TB observation and AMSR-2 TB simulation, between AMSR-2 TB simulation and rough sea surface reflectivities RR are estimated for V and H polarizations, in turn. For H polarization, the rough sea surface reflectivity is obtained from a radiative transfer calculation with RTTOV-9 using ECMWF surface and atmospheric profile data, and AMSR-2 sea surface temperature. The surface roughness TB is estimated as follows (Hong, 2009; Hong, 2010; Hong and Shin, 2013):

$$\sigma \approx \frac{\lambda}{4\pi \cos\theta}\sqrt{\ln\left(\frac{(R_{R,H})^{\cos^2\theta}}{R_{R,V}}\right)} \quad (1)$$

Specular surface reflectivities RS,V and RS,H can be determined with the Fresnel equations and known complex refractive index at a particular incidence angle. However, a priori complex refractive indexes are unknown for complex and heterogeneous surfaces in general cases. Hong (2009) developed and validated an approximate relationship between RS,V and RS,H (Hong approximation) irrespective of a priori information on surface refractive index using the generalized Fresnel equation (Tousey, 1939) and the first term in the Taylor series of the natural logarithm ratio ln RS,V /RS,H as follows:

$$R_{S,H} = (R_{S,V})^{\sec^2\theta} \quad (2)$$

In addition, microwave sensors onboard the satellites observe the Earth at the view angel near Brewster angles. The polarized surface reflectivities near the Brewster angle have the characteristics of RS,V > RR,V and RS,H ~ RR,H for specular surfaces (Hong, 2010). Therefore, Eq. (1) can be derived using Hong approximation (Eq. (2)) and the characteristics of the polarized surface reflectivities near the Brewster angle for specular surfaces. Figure 1 describes a procedure of this wind algorithm.

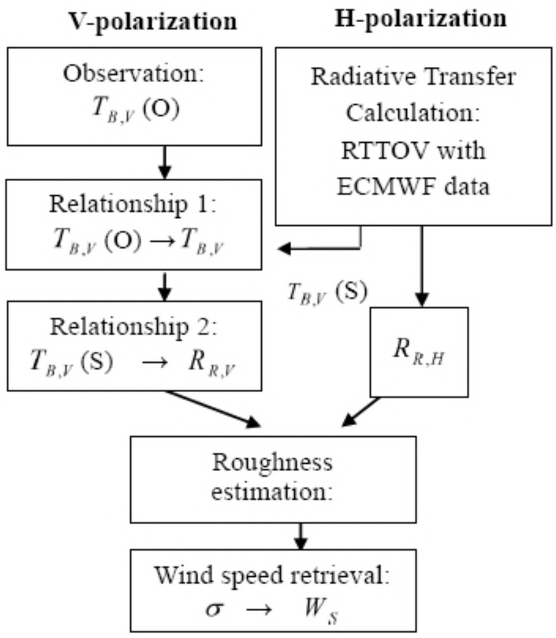

Figure 1: Diagram of the presented WS retrieval algorithm. V and H mean vertical and horizontal polarization, respectively. O and S indicate observation and simulation, respectively.

Figure 2 shows the validation results of the current AMSR-E WS and WS retrieved by the proposed wind algorithm. The Tropical Atmosphere Ocean (TAO) buoy observations during one month (August, 2011) were used for the validation. The bias and RMSE are 0.09 m/s and 1.13 m/s, while the bias and RMSE of the current AMSR-E WS are -0.71 m/s and 1.38 m/s, respectively. The current AMSR-E WS has a good agreement with the TAO buoy observation. The algorithm exhibits the improved results statistically for the bias, RMSE, and correlations.

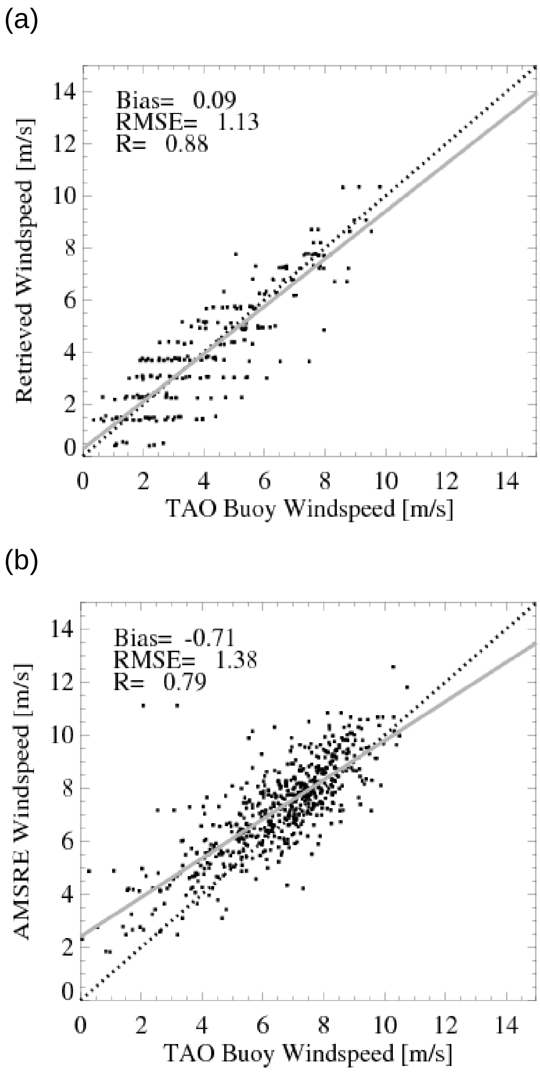

Figure 2: Scatterplot (a) between the TAO WS and the HS WS, (b) between the TAO WS and the WS provided by the current AMSR-E WS.

Analysis of TCs size and intensity

Figure 3 shows an example of TC size analysis. In this case, typhoon DANAS in 2013 was considered. From the ASCAT data, the radius of 15 m/s wind speed at 12:00 UTC 7 October, 2013 for typhoon DANAS was estimated approximately as 250 km. According to the proposed wind algorithm using AMSR-2 data on 17:10 UTC Oct. 7, 2013, the radius of 15 m/s wind speed can be estimated as 240 km for the same TC. Therefore, this wind algorithm is very useful to estimate the size of TCs, and an alternative when the ASCAT data are not available.

Figure 4 shows an example of TC intensity analysis for typhoon KONG-REY in 2013. In this case, the current intensity (CI) indexes from the Advanced Dvorak Technique (ADT) performed by KMA were 2.5, 2.7 and 2.5 on 03UTC 27 August, 03UTC 29 August, 18UTC 27 August, 2013. The CI indexes from the Subjective Dvorak Technique (SDT) by KMA were 2.5, 2.5 and 2.0. The Satellite Report (SAREP) described the CI index for this TC as 2.5, 3.0, and 3.0. When the algorithm was applied to the same cases, the CI indexes are analyzed as 2.4, 2.6, and 2.0. Therefore it is useful to estimate the TCs intensity.

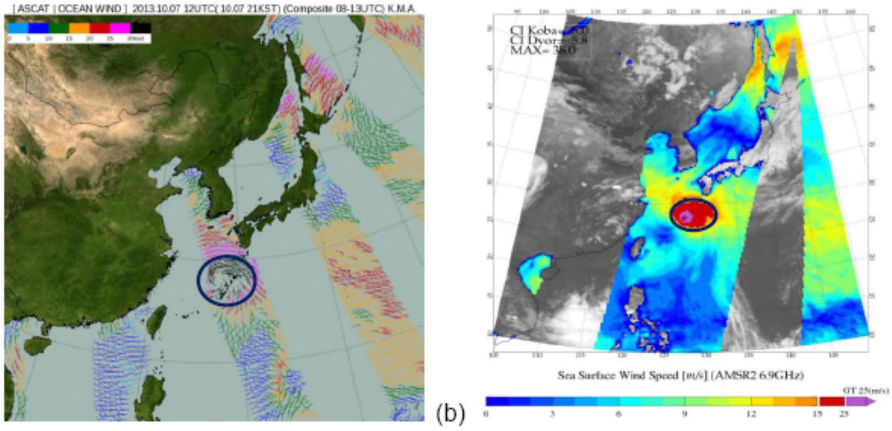

Figure 3: Sizes (radius of 15 m/s WS) of Typhoon DANAS in 2013 using (left) ASCAT data on 12UTC Oct. 7, 2013 and (right) the HS algorithm on 17:10 UTC Oct. 7, 2013.

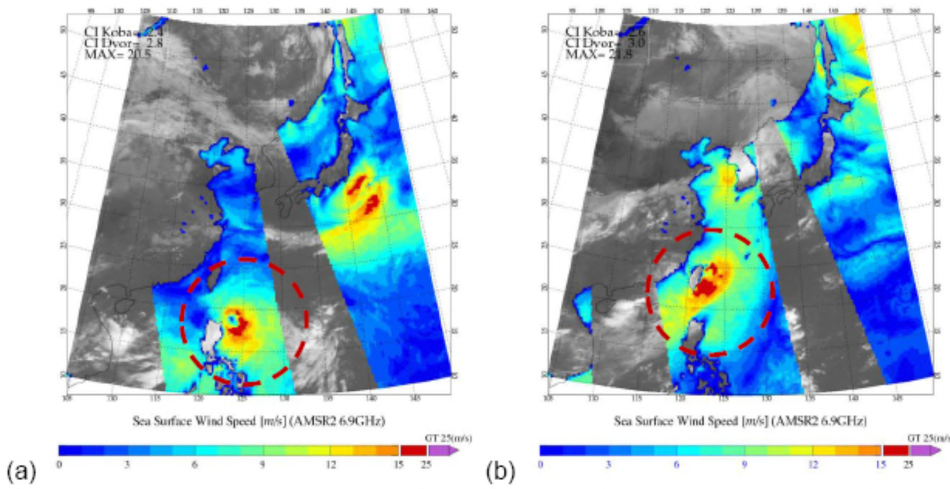

Figure 4: Intensity (CI index, maximum WS) of Typhoon KONG-REY on (a) 27 August, 2013 and (b) 29 August, 2013 using the presented algorithm. In this case, the conversion table provided by Koba et al. (1990) was applied.

The proposed algorithm will be used operationally in KMA/NMSC for analyzing the TCs. In addition to GCOM-W1/AMSR-2, TRMM/TMI and GPM/GMI observation data will be added in the near future to improve the temporal resolution for TC analysis.

(Sungwook Hong, NMSC/KMA)

COMS lunar calibration using GIRO method

As one of visible-calibration methods for COMS (Communication, Ocean, and Meteorological Satellite) MI (Meteorological Imager), NMSC has observed moon twice a month and used this data for monitoring COMS visible channel performance since April 2011. The observed moon data was processed by Moon Processing system in

IMPS (Image Processing Subsystem) of NMSC. In this Moon Processing system, the total irradiance of observed moon data is computed and compared with ROLO model value, which is Moon irradiance output model in USGS.

Also, NMSC/KMA has processed moon data using GIRO (GSICS Implementation of the ROLO model) that is initiated from GSICS Research Working Group (GRWG). GIRO is aimed at defining unified calibration references and will implement a lunar calibration tool that will be made available within the GSICS community. GIRO is a joint effort of different institutions, namely EUEMTSAT, USGS, CNES, NASA, JMA and KMA. Then it will be the lunar calibration workshop to discuss the results each agency on middle of December 2014.

(Tae-Hyeong Oh, NMSC/KMA)

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From the Co-editors

The co-editors invite contributions to the newsletter. Although it is assumed that the major contributors for the time being will be satellite operators, we also welcome articles (short contributions of less than a page are fine) from all RA II Members, regardless of whether they are registered with the WMO Secretariat as members of the WIGOS Project Coordinating Group. We look forward to receiving your contributions to the newsletter.
(*Dohyeong KIM, KMA, and Tomoo OHNO, JMA*)

RA II WIGOS Project Home Page

http://www.wmo.int/pages/prog/sat/ra2wigos project-intro_en.php

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