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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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Himawari-8 satellite "Big Data Assimilation" for typhoon and heavy-rainfall prediction

"Big Data Assimilation" (BDA) is the idea proposed by Miyoshi et al. (2016a,b) exploring where numerical weather prediction (NWP) should go in the era of so-called "Big Data" and Internet of Things (IoT). Miyoshi's BDA project has been showing promising results for severe weather prediction by fortunate combinations of next-generation sensing and computing technologies, namely, the phased array weather radar (PAWR, Yoshikawa et al. 2013), geostationary satellite Himawari-8 (Bessho et al. 2016), and the Japanese flagship supercomputer "K" [1]. Most recently, the BDA project had a major achievement using Himawari-8 satellite "Big Data" and the "K" supercomputer (Honda et al. 2018a,b) [2]. The large supercomputer allows running many exploratory experiments in a limited time. This is beneficial when exploring something new, so that we can learn from many trials. Here, researchers in RIKEN and collaborators explored how to use "Big Data" from Himawari-8 effectively in NWP.

Typhoons and heavy rainfalls cause severe disasters. To mitigate the damage, geostationary satellite observations play an important role in monitoring the atmosphere and improving NWP through data assimilation (DA). In July 2015, the Japan Meteorological Agency (JMA) started full operations of a new generation geostationary satellite "Himawari-8", which provides "Big Data" of high spatiotemporal resolution visible, near-infrared, and infrared (IR) radiances. These observation Big Data are beneficial to capture rapidly evolving convective clouds associated with severe weather conditions. In most operational NWP systems, IR radiances are assimilated only in the clear sky conditions.

Using an advanced ensemble DA system (SCALE-LETKF, Lien et al. 2017), researchers in RIKEN and collaborators succeeded in assimilating all-sky Himawari-8 IR radiances every 10 minutes (Honda et al. 2018a,b). They used a high-resolution NWP model called the Scalable Computing for Advanced Library and Environment (SCALE, Nishizawa et al. 2015; Sato et al. 2015) and an advanced data assimilation method known as the local ensemble transform Kalman filter (LETKF, Hunt et al. 2007; Miyoshi and Yamane 2007). With the default LETKF settings, assimilating cloud-affected radiance data did not update the deep atmosphere. Honda et al. (2018b) modified settings of the LETKF to address this issue.

Super Typhoon Soudelor (2015) was chosen for the first case study (Honda et al. 2018b). By assimilating a single moisture sensitive band of Himawrai-8 every 10 minutes, the cloud patterns associated with Soudelor were dramatically improved (Figure 1). The Himawari-8 DA also modulated the inner-core structure of Soudelor and contributed to improve the predictability of rapid intensification, which is known to be generally hard to predict (Figure 2). Honda et al. (2018b) demonstrated that the enhanced observing frequency of Himawari-8 was essential to obtain these benefits.

The second case was chosen to be a heavy rainfall event that caused a severe disaster in September 2015 in Japan (Honda et al. 2018a). In this case, a stationary precipitation band caused a record-breaking rainfall and resulted in severe flooding. All-sky Himawari-8 DA modulated moisture transport and improved precipitation forecasts significantly (Figure 3). With every-10-minute Himawari-8 DA, we can refresh precipitation and river discharge forecasts every 10 minutes, i.e., 36 times in 6 hours (Figure 4). The every-10-minute refresh can provide warning information at an earlier time; having a longer lead time by even 10 minutes may save lives.

These results would be a milestone of future development of operational weather and flood prediction systems making use of new generation geostationary satellites including Himawari-8 and GOES-16 (Schmit et al. 2017).

[1] RIKEN Press Release: http://www.riken.jp/en/pr/press/2016/20160809_1/

[2] RIKEN Press Release: http://www.riken.jp/en/pr/press/2018/20180118_1/

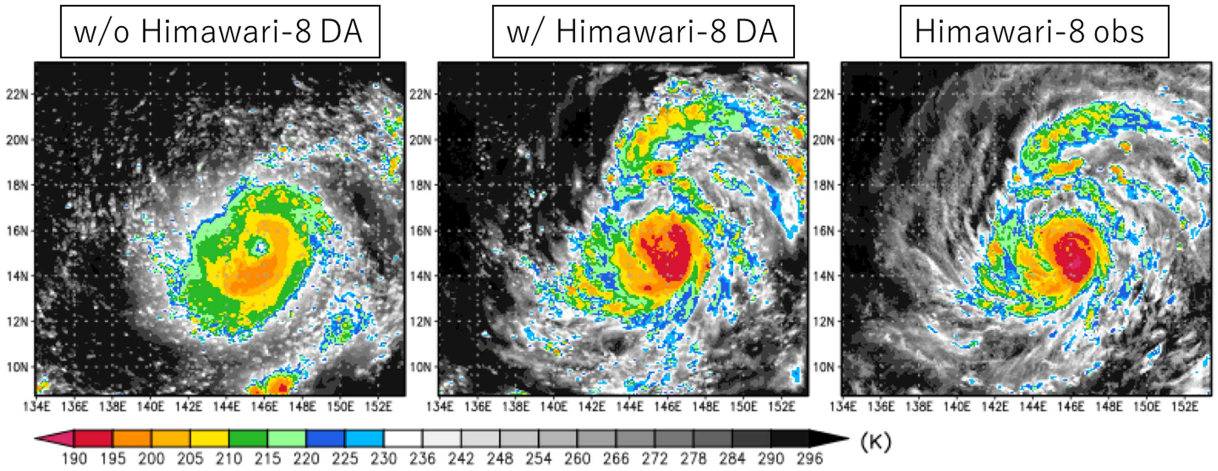

Figure 1: Himawari-8 band 13 (10.4 μm) brightness temperature analyses (K) for DA experiments (left) without and (middle) with Himawari-8, and (right) corresponding Himawari-8 observation.

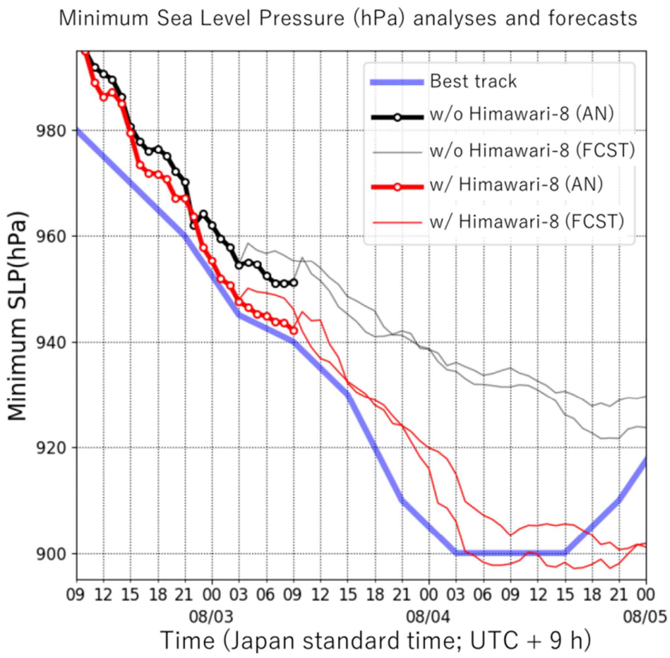

Figure 2: Analyses (thick) and forecasts (thin) of minimum sea level pressure of Typhoon Soudelor. Red and black curves correspond to the experiments with and without Himawari-8 DA, respectively. Blue curve shows the JMA best track analysis.

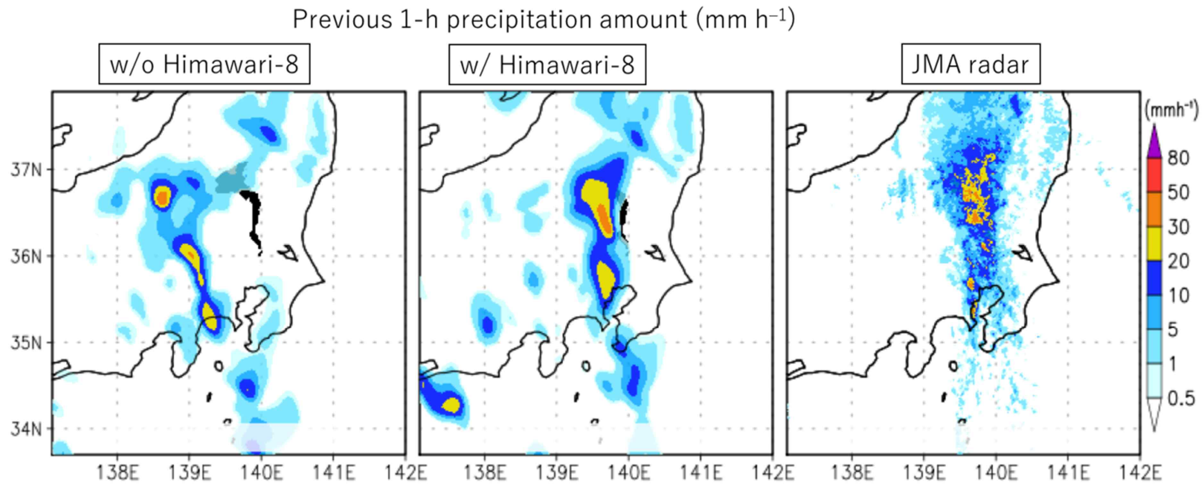

Figure 3: Horizontal maps of 12-hour forecast precipitation (mm h^{-1}, previous 1-hour accumulation) for the experiments (left) without and (middle) with Himawari-8 DA, and (c) corresponding JMA radar estimate.

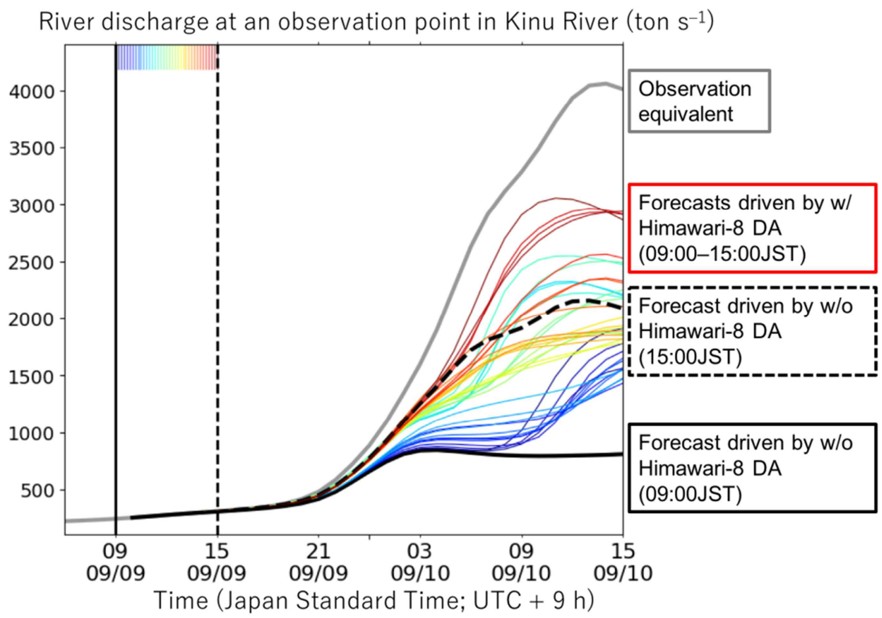

Figure 4: River discharge forecasts driven by the rainfall inputs from the experiments with and without Himawari-8 DA. Black curves show the forecasts without Himawari-8 DA, initiated at 0900 JST (solid) and 1500 JST (dashed). Colored curves show the forecasts with Himawari-8 DA, where warmer colors indicate a later initial time corresponding the colors shown at the top between 0900 JST and 1500 JST. Gray curve corresponds to the observed river discharge.

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(Takemasa Miyoshi and Takumi Honda, RIKEN Center for Computational Science)

The Fourth Session of the Inter-Programme Expert Team on Satellite Utilization and Product

The fourth session of the Inter-Programme Expert Team on Satellite Utilization and Products (IPET-SUP) was convened in Geneva, Switzerland from 26 February – 1 March 2018.

The primary objective of the session was to advance the work programme defined by the World Meteorological Organization (WMO) Commission for Basic Systems (CBS) as concerns in particular the promotion of access and use of satellite data by WMO Members in support of all WMO programmes and WMO co-sponsored programmes.

The session focused on user preparation for the new-generation meteorological satellites GOES-16 and FY-4A, as well as NOAA-20 and FY-3D. In this context, participants discussed early availability of instrument characteristics to users, such as on the SATURN portal, continuity of product lines, and exchange, dissemination and monitoring of datasets at global and regional levels. The session discussed ways to monitor global satellite data availability and quality in support of the WIGOS Data Quality and Monitoring System (WDQMS).

Advancing the use of WMO metadata standards (WIGOS and WIS) by satellite operators, and interfacing these with the OSCAR/Space resource were further items of consideration by the Team. Coordinated and where appropriate standardized product development for nowcasting and climate monitoring was subject of discussions, as well as progress with education and training in the WMO-CGMS Virtual Laboratory (VLab).

The Team strives to reach out to satellite data user communities in climate, oceanography and marine meteorology, hydrology, and in the area of land surface modelling for NWP, and fosters community building, the definition of user requirements, and linkage to satellite operators in CGMS.

A major item for discussion was finalization of a position paper on critical satellite data for WMO applications, and implications of a possible revision of WMO Resolution 40 Annex 1.

The Team furthermore reviewed its communication strategy with the various stakeholders within and outside WMO, and gave guidance on the development of WMO Space Programme online resources, such as SATURN and OSCAR/Space.

All documents, presentation material and final report are available on the WMO web page: “IPET-SUP-4”, http://www.wmo.int/pages/prog/sat/meetings/IPET-SUP-4.php.

Report of CGMS Working Group III Workshop for CGMS baseline and contingency plan

CGMS baseline

In CGMS-45, Working Group III agreed to hold a review of the CGMS Baseline to be synchronized with the development of the WMO Vision for WIGOS in 2040. The Working Group III Co-Chair developed a draft to be shared with all members of Working Group III. Following these initial drafts, WMO hosted a CGMS Baseline and Contingency Plan Meeting with representatives from the CGMS Secretariat, CMA, EUMETSAT, KMA, JMA, JAXA, NOAA, and the WMO from 30 April to 2 May 2018 in WMO HQ. Significant progress was made at the workshop that resulted in this working paper.

The CGMS Baseline enumerates the observations, measurements, and services that form the CGMS contribution to the space-based Global Observing System and is responding to end-user requirements expressed in WMO’s Rolling Review of Requirements (RRR). The CGMS Baseline will strive to support the WMO Integrated Global Observing System (WIGOS) 2040 vision and serves as CGMS’s response to the WIGOS 2040 Vision to document what missions are currently being, or planned on being flown.

The CGMS Baseline included missions that are comprised of the following key principles:

- Commitment: The CGMS Members are providing, or have firm plans to provide, the observations, measurements, and services enumerated in the Baseline.
- Sustained: The observations, measurements, and services are provided on a sustained basis.
- Available: The observations, measurements, and services are available on a free and unrestricted basis.
- Operational: The data and products can be utilized in operational applications.

The observations and measurements that constitute the CGMS Baseline are enumerated in a table that describes the Sensor Type, the

Orbit, the Observation/Measurement (or geophysical parameter), and any specific orbital attributes. The table was designed to facilitate the linkage with the OSCAR/Space Database, future risk assessments, and gap analyses.

The CGMS Baseline discusses the importance of services and steps CGMS will take to ensure the quality and continuity of data and products.

CGMS Contingency Plan

CGMS Contingency Plan serves as a reference for CGMS satellite operators in the planning and implementation of satellite missions; outline a process for risk assessment against the CGMS Baseline; and a process for mitigating and coping with capability degradation or loss against the baseline.

The CGMS Contingency Plan provides guidance and processes for identifying, mitigating, and coping with capability loss against the CGMS Baseline. This plan provides guidance to Members to ensure continuity of their missions, discusses steps Members can take to coordinate continuity among themselves, and steps CGMS can take to monitor and respond to losses.

The CGMS Contingency Plan defines the key terms as follows:

- Contingency: Within the context of the CGMS, a contingency arises when CGMS is no longer in a position to provide certain satellite-based observations, measurements, and services that are part of the CGMS Baseline or when the group anticipates that such a situation is likely to occur in the near future.
- Contingency Planning: The development of strategy, analysis, planning, development of capabilities, and processes necessary to assure continuity of established baseline observations, measurements, and services in the event of unforeseen circumstances.
- Mitigation: Proactive attempt by a Member or CGMS to ensure continuity of observations, measurements, and services in support of the CGMS Baseline; an effort to anticipate and thereby reduce or eliminate the probability of a risk materializing or risk avoidance.
- Coping: Steps taken by a Member or by CGMS to reduce the impact of a materialized risk or capability loss against the CGMS Baseline.

Overall, The CGMS level contingency planning follows a traditional risk management framework in order to avoid degradation or loss of service, and to minimize the impacts of any potential losses. The progress can be seen in the Figure.

(Dohyeong Kim, KMA)

The 9th Asia/Oceania Meteorological Satellite Users' Conference in Jakarta, Indonesia, 6-11 October 2018

BMKG is pleased to announce that the ninth Asia/Oceania Meteorological Satellite Users' Conference will be held in Jakarta, Indonesia from 6-11 October 2018.

Asia/Oceania has a rich history in satellite meteorology, and with the recent introduction of the next generation of geostationary and polar orbiting satellites exciting new products and their potential for improved services are becoming available to the user community. The Asia and Oceania regions are frequently affected by severe natural phenomena such as tropical cyclones, torrential monsoons, volcanic eruptions, yellow sand storms, floods, sea ice and wildfires. The importance of monitoring the climate and the environment is also increasing, which has prompted enhanced global interest in the field. In this area, the new generation of meteorological and earth observation satellites provide frequent and extensive observational information for use in disaster prevention and climate monitoring/diagnostics; they are indispensable in today's world. The Asia/Oceania Meteorological Satellite Users' Conferences provide an excellent forum for satellite operators and users within the Asia/Oceania community to meet and enhance their joint efforts in the utilization of satellite data and products for better weather, climate and disaster mitigation services.

AOMSUC Conferences have proven to be very effective in: promoting satellite observations and advancing application areas, with a focus on regional issues; informing on recent advances in remote sensing science; fostering the dialogue between satellite operators and the user community on current and future satellites; and engaging young scientists. This conference is the eminent scientific and technical event in the Asia-Pacific for those working in satellite remote sensing with applications in meteorology, climatology, oceanography and related fields. The attendees will include world leaders in the field of satellite meteorology, satellite operators, leading scientists from around the world, and major users in the Asia/Oceania region. The conference is designed to further enhance the information exchange on various application techniques among satellite data users, to advance satellite observation technologies and to further prepare the Asia-Oceania region for taking full advantage of the new generation satellites.

Topical areas to be covered at the conference include:

- Current and future meteorological satellite programs
- Facilitation of data access and utilisation
- Atmospheric parameters derived from satellite observations
- Application of satellite data to weather analysis and disaster monitoring
- Application of satellite data to numerical weather prediction
- Application of satellite data to climate and environmental monitoring
- Land surface and ocean parameters derived from satellite observations
- Capacity building and training activities

As with past AOMSUCs, AOMSUC-9 will have three parts:

1. October 6 and 7 will be a training event focused on satellite data and products;
2. October 8-10 will be the plenary session of AOMSUC-9; and,
3. October 11 will be the Joint Meeting of RA II WIGOS Project and RA V TT-SU for RA II and RA V NMHSs (shortly, “RA II / RA V Joint Meeting”).

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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 Hiroshi KUNIMATSU, JMA)

RA II WIGOS Project Home Page

http://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/ra2wigosproject-intro_en_jma.html

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