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RA II WIGOS Project Newsletter

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

Contents of this issue

The 41st meeting of the Coordination Group for Meteorological Satellites (CGMS-41), in Tsukuba, Japan, 8-12 July 2013

Background

CGMS provides an international forum for the exchange of technical information on geostationary and polar orbiting meteorological satellite systems.

The 41st CGMS meeting was jointly organised by Japan Meteorological Agency (JMA) and Japan Aerospace Exploration Agency (JAXA) in Tsukuba, Japan, and co-chaired by Masanori Obayashi, JMA and Alain Ratier, EUMETSAT

Mitsuhiko Hatori, Director-General of JMA, welcomed participants to Japan, and to the town of Tsukuba. He reflected on the achievements of CGMS since its conception, the progress in the development of meteorological satellites and the use of meteorological satellite data. Kiyoshi Higuchi, Vice-President, JAXA also welcomed participants and wished them a successful meeting. He underlined the importance of exchanging ideas and information within the CGMS as well as outside of the group through various outreach activities.

Objectives of CGMS

The main objectives of CGMS are:

- To have a clear focus on coordination of long-term and sustainable satellite systems relevant to weather and climate to which both operational and R&D agencies contribute;

- To give a *technical* focus to the discussions handled by the group; and
- Through a close interaction with WMO, to respond as far as possible to requirements from WMO and related programmes (e.g. WIGOS, IOC, GCOS).

Working Groups

The EUMETSAT holds the CGMS Secretariat since it joined the group in 1987. The CGMS Secretariat is responsible for organising the annual CGMS Plenary meeting with the support of a local host, which is a CGMS Member designated on a rotating basis. During the Plenary meeting, the CGMS plenary Working Groups also come together.

Working Group I (Telecommunications)

The WGI provided a report on the outcome related to frequency management and protection, direct broadcast services, international data collection and distribution, coordination and global standards and optimisation of data collection systems, and contributions to the WIS.

One point brought to the attention of the CGMS plenary was the proposed update to the Global Specification for HRPT (CGMS Global Spec 04). The update has been technically agreed inside WGI but needed to be endorsed at plenary level. Following consultation, the CGMS plenary agreed on the proposed update of the CGMS Global Spec-04.

Working Group II (Satellite Products)

The WGII presented the outcome covered agency reports on GSICS, SCOPE-CM and SCOPE-Nowcasting; in-depth discussions on intercomparing and improving volcanic ash, atmospheric motion vector, and cloud products; ocean matters for which the ocean community is looking for guidance from CGMS on data formats and real-time access; GPM Constellation and precipitation sampling matters; updates on radio-occultation activities from the IROWG including the concerns about the decline of the radio occultation constellation and access to existing radio occultation data; updates on ESA and NASA programmes and validation activities; very encouraging Cal/Val results from CNSA on HY-2A instruments; the importance of orbital parameters for optimising the observing system for ocean colour; and suggestions for support from CGMS members to the ISWGs and VLab.

Working Group III (Contingency Planning)

The WGIII provided a summary report on the coordination of observing systems, advancing the architecture for climate monitoring from space, and the impact and benefit of Earth observation satellite missions.

Working Group IV (Global data dissemination)

The WGIV provided a report on Global DVB satellite services, coordinated dissemination services for disaster mitigation purposes, transition to new direct-readout systems, RARS, contribution to the WIS infrastructure, coordination of metadata for satellites and instruments, Internet-based services, user dialogue and interface, and long-term data preservation.

Space Weather

The Ad-hoc Meeting on Space Weather reported on the outcome covering cross-cutting issues and challenges, guiding principles, setting up a team to develop the Terms of Reference for CGMS space weather activities, and collecting information on spacecraft anomalies resulting from space weather.

The Tiger Team on LEO optimisation

WMO has convened a Tiger Team to coordinate the technical evaluation of the global and regional impact of flying an FY-3 satellite in early morning orbit, in order to support CMA in the assessment process of such a potential redeployment.

There is a consensus among international experts to acknowledge that a satellite mission in an early morning orbit (around 6:00 Equatorial Crossing Time) would bring significant benefits through improved accuracy of weather forecasts, thanks to the optimum temporal distribution of sounding radiances assimilated into NWP models.

Further benefits are expected from the direct use of imagery and derived products in a number of applications including tropical cyclone monitoring, fog and fire detection, air quality monitoring, climate monitoring, and solar monitoring of space weather. Moreover, early morning/late afternoon satellite observations are well timed to support the daily operational briefings held by weather services (e.g. at 8:00/20:00 local time).

The FY-3 programme offers a unique opportunity for China to play this important role as one of the three major components of the global constellation besides the European programme in the mid-morning orbit and the US programme in the afternoon orbit, while complementary missions would provide the necessary redundancy for operational robustness.

Climate Monitoring Architecture

The space architecture is now a key component of the GFCS Observations and Monitoring pillar. As a contribution to the architecture, WMO provided a mapping of the satellite missions to the essential climate variables (ECVs) product inventory. Moreover, these missions had the potential to provide Fundamental Climate Data Records (FCDRs) that were important for climate monitoring but were not properly captured in the ECV product inventory.

Regarding the architecture, ongoing implementation activity is focused on the development of the ECV inventory. There is an ongoing effort to add input to this ECV inventory and CGMS members were encouraged to contribute further.

EDUCATION AND TRAINING

The WMO-CGMS highlighted major achievements of the VLab over the past year, and future plans and directions. Since October 2012, VLab Training Centres of Excellence have continued offering an array of regional training opportunities and, most importantly, strengthening the global network of trainers by coordinating training delivery in various languages.

JMA and KMA updated the progress with the WMO RA II WIGOS Project to develop support for NMHSs in satellite data, products, and training. The project, jointly coordinated by JMA and KMA, aims to improve the dissemination and utilisation of satellite data with WMO members in RA II, with a focus on developing countries. Since it started in 2008 as a pilot project, it has undertaken user surveys, prepared quarterly newsletters, maintained a web site, supported the Asia/Oceania Meteorological Satellites Users Conferences, and organised training events jointly with the conferences. The Project Coordination Group currently has a membership of 13 countries and EUMETSAT (as an observer) and holds meetings on an annual basis.

Regarding training, KMA reported that activities in the framework of the project are aligned with the VLab. In October 2012, KMA hosted, along with the 3rd Asia/Oceania Conference, a high-profile training event with over 30 participants from the region.

CGMS HIGH LEVEL PRIORITY PLAN (HLPP)

The first HLPP was agreed at CGMS-40 capturing the priorities of CGMS for the period 2013-2017. The HLPP is a rolling five-year plan and therefore a living document reviewed and revised by CGMS on an annual basis. The HLPP targets are to be specific, measurable and timely for the HLPP to be the basis for demonstrating and reviewing the progress of CGMS.

The CGMS Secretariat highlighted the early morning orbit Tiger Team conclusions on forecast impact and other benefits from the three-orbit LEO baseline configuration and the agreement on new global direct read-out specifications, endorsed by the CGMS-41 plenary.

It was also suggested that the WGs should review relevant areas of the HLPP, and in particular assess whether all targets stated are specific and timely enough to drive the CGMS work-plan over the five-year period.

Preparation of operational users for new generation of geostationary meteorological satellites was endorsed by the plenary, and the CGMS Secretariat will issue a new version of the HLPP following CGMS-41, reflecting the new cross-cutting area.

Closing of the meeting

The Chairperson thanked all participants for their hard work and active participation in CGMS-41, adding that there had been many interesting discussions and important developments during the Working Groups and Plenary sessions.

All participants warmly thanked JMA and JAXA for the excellent hosting and organisation of the meeting in Tsukuba, Japan.

(Dohyeong Kim, NMSC/KMA)

Successful launch of KOMPSAT-5 (Arirang-5)

The goal of the **KOMPSat 5** (**Korean Multi-purpose Satellite 5**) or **Arirang 5** project is to lead the development of the first Korean SAR Satellite using manpower and facilities from the KOMPSAT-3 program. The project is being developed and managed by KARI (Korea Aerospace Research Institute). The primary mission objective is to develop, launch and operate an Earth observation SAR(Synthetic Aperture Radar) satellite system to provide imagery for geographic information applications and to monitor environmental disasters. KOMPSAT-5, which was developed since in the middle of 2005, was launched in 2014 and its payload is a X-band SAR a, which operates at Dawn-Dusk orbit between an altitude of 500 km to 600 km.

Figure1: KOMPSAT-5 (Arirang-5)

KOMPSAT-5 is also referred to as the **GOLDEN** mission:

- **G**IS: Acquisition of independent high resolution SAR images
- **O**cean & **L**and Management: Survey of natural resources
- **D**isaster & **EN**vironment Monitoring: Surveillance of large scale disasters and its countermeasure.

It executes all weather and all day observations of the Korean peninsula during its five year mission using the SAR payload, unlike the optical KOMPSAT-1, -2 and -3 satellites. And in order to meet the urgent national needs for various SAR images information, the KOMPSAT-5 GOLDEN

Mission will provide GIS (Geographical Information Systems), Ocean monitoring, Land management, Disaster monitoring, and Environment monitoring.

The primary mission of the KOMPSAT-5 system is to provide high resolution SAR images in various modes at incidence angle of 45 degrees.

- High resolution SAR mode imagery: 1 m (also known as spot SAR mode)
- Standard SAR mode imagery: 3 m (stripmap mode)
- Wide swath SAR mode imagery: 20 m (ScanSAR mode).

The COSI payload consists of the SSS (SAR Sensor Subsystem) and the DLS (Data Link Subsystem). The SSS operates in X-band and is equipped with an active phased array antenna with electronic scanning capabilities in the azimuth and elevation planes. The DLS is in charge of source data storage (and ancillary data) and transmission to the ground segment.

Table 1: Performance parameters of the COSI assembly

Parameter	Value	Remark
Design life	5 years	
Instrument mass	520 kg	Without the payload module structure
Peak power consumption	1.7 kW	
Average power consumption	600 W	2 minutes operation and downlink
Center frequency	9.66 GHz (X-band) or 3.2 cm wavelength	
Standard mode imagery	3 m GSD, 30 km swath width	At nominal incidence angle of 45º
High resolution mode imagery	1 m GSD, 5 km swath width	
Wide swath mode imagery	20 m GSD, 100 km swath width	
Image acquisition time	2 continuous minutes per orbit	
Polarization	Selectable among: HH,HV, VH, VV	
Incidence angle range (look angle)	20º-45º (nominal) 45º-55º (extended)	Providing a potential nominal coverage region of 185-490 km from nadir
NESZ (Noise Equivalent Sigma Zero)	≤ -17 dB	
On-board data memory	256 Gbit	EOL (End of Life)
Downlink data rate	310 Mbit/s	

Table 2: Observation mode and resolution

Observation mode	Resolution (GR) @ 45º incidence angle	Swath width @ 45º incidence angle	No of beams (Nominal: 20~45º)	No of beams (Nominal: 45~55º)
High Resolution (HR)	1 m	5 km	21 (HR01~21)	10 (HR22~31)
Standard (ST)	3 m	30 km	12 (ST01~12)	7 (ST13~19)
Wide swath (WS)	20 m	100 km	12 (WS01~12)	7 (WS13~19)

The secondary mission of KOMPSAT-5 is to generate the atmospheric sounding profile and support radio occultation science using AOPOD (atmospheric occultation and precision orbit determination) secondary payload which is composed of a dual frequency GPS receiver and a laser retro reflector array (LRRA).

(Dohyeong Kim, NMSC/KMA)

COMS visible channel calibration using moon

Introduction

COMS MI has no on-board calibration target for visible channel like blackbody for Infrared channel, thus KMA used vicarious calibration methods for VI calibration which uses model simulation. As one of a visible calibration, NMSC has observed moon twice a month and used to monitor COMS visible channel degradation trend since Feb 2011. The observed moon data has been processed by Moon Processing system in NMSC's IMPS (Image Processing Subsystem). 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. The trend from this compared data shows nearly 3.12% (1.44%/year) of visible channel degradation from Feb. 2011 to Apr. 2013.

Data

In Moon calibration, to compute the annual degradation of the COMS MI visible channel, it is assumed that several Moon views (typically once per month) are available, which fulfill the following geometric and radiometric conditions in order to integrate the full signal produced by the Moon: the Moon view used in this method is a global Moon image. KMA obtains the moon images by using LA (Local Area) observation mode which is Korean peninsula observation mode, one of the three COMS MI observation modes.

To remove the effect of stray light from Earth in the image (left panel of Figure 2), there should be added the process of taking off the only moon-mask (only moon part of the image) in the right panel of Figure 2. The Sun must be far enough, i.e. the phase angle as seen from the Imager shall be less than 90 deg.

KMA used the Moon data from Feb. 2011 to Apr. 2013.

Figure 2: The process of taking a moon-mask

Method

The method is based on the lunar database provided by the RObotic Lunar Observatory (ROLO) of USGS that describes an empirical model of the lunar disk reflectance as a function of its phase angle (the angle between the Moon-Sun direction and Moon-Earth direction), and irrespective of the librations and the properties of the Moon surface. It will compare the global signal measured by between the instrument and the model provided by ROLO.

Even though ROLO measurements have very good relative performances, i.e. from one measurement condition to another, the absolute accuracy is not as good. Thus the best use of ROLO model is its application in a multi-temporal approach. With a long-term set of observations, relative visible response trending of the Imager has residuals about 0.1%. Then we define a quantity which depends only of the instrument response to monitor the behaviour of the instrument. The instrument state at a given time is used as a reference point; the Moon image is then used to monitor the instrument evolution with respect to this reference.

$$P = \frac{I_{instrument}}{I_{ref}}$$

Where, $I_{instrument}$ is the Moon irradiance as measured by the Imager and I_{ref} is the Moon irradiance computed from the

ROLO model, under the same conditions.

All Imager responses are linearly trended over the various Moon images with the ratio $k = \frac{P(t)}{P(t_0)}$ expressed in percentage.

Results

Figure 3 shows that the instrument irradiance is degraded to about maximum 6% compared with ROLO values. The degradation trend from Feb. 2011 to Apr. 2013 can be clearly seen. But, in the results from Jun 2012 to Aug 2012, visible channel performance looks like improved. These phenomena are found in two terms, about Jun to Dec in 2011 and Jun to Nov in 2012. So, we assume that there is some seasonal effect in this period. In advance, we have a plan to research whether this phenomena is truly related with seasonal effect. KMA will investigate whether any other problems with our methods and calculations on the way of applying these methods.

The regression line from image responses is shown in Figure 3. From this regression line, there is about 3.12% (1.44%/year) visible channel degradation in total period of observing moon (Feb. 2011 ~ Apr. 2013). Even though some data are contrary to overall trend in Jun. to Dec. on 2011 and Jun. to Nov. in 2012, visible channel has some degradation patterns in total period. Since the number of moon observation is normally twice a month, total number of data is only 54. Therefore, for obtaining more precise result and confirming the accuracy of data, more data and long term observation are needed.

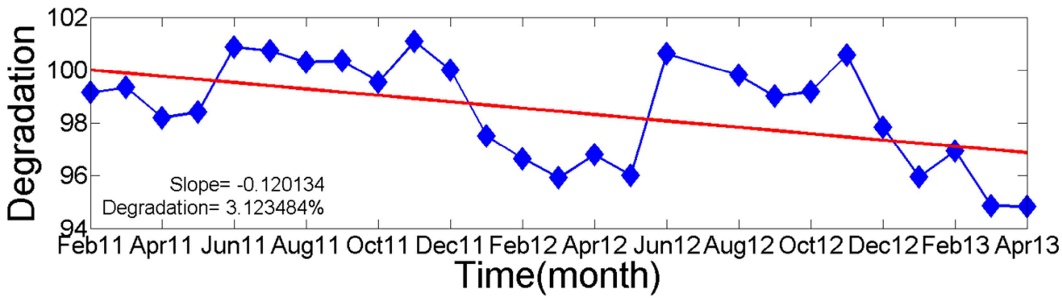

Figure 3: Image responses (blue) and trend (red) from Sep. 2011 to Apr. 2013

REFERENCES

Hugh H. K. and Thomas C. S., 2005: The spectral irradiance of the moon, the astronomical journal, **129**, 2887-2901.

(Ho-Seung Lee, NMSC/KMA)

Release of geophysical products of GCOM-W1 "SHIZUKU"

After the initial calibration and validation period, the Japan Aerospace Exploration Agency (JAXA) had started distributing standard geophysical products of the Advanced Microwave Scanning Radiometer-2 (AMSR2) onboard the Global Change Observation Mission 1st – Water "SHIZUKU" (GCOM-W1) from May 17, 2013. Since the brightness temperature products were already released in January 2013, all the AMSR2 standard products are now available to the public. The geophysical products of AMSR2, which are mostly related to the Earth's water, include integrated water vapor (or total precipitable water, TPW), integrated cloud liquid water, precipitation, sea surface temperature (SST), sea surface wind speed, sea ice concentration, soil moisture content, and snow depth. These products will contribute to capture environmental changes on a global scale such as decreasing sea ice extent in the Arctic Ocean as well as phenomena related to large scale air-sea interaction including El Nino and La Nina events. The products can also be utilized for various fields including numerical weather forecasts by meteorological agencies in the world, compiling fishing and oceanographic conditions for efficient fisheries, and enhancing measures against floods in Asian countries that engage in a cooperative project with the Asian Development Bank. Figure 4 shows three-day averages of SST (upper) and TPW (lower) centered around March 31, 2013. Because of the advantage of using microwave frequency, that provides nearly all-weather SST observation through non-precipitating clouds, global SST distribution is well captured even by three-day mean.

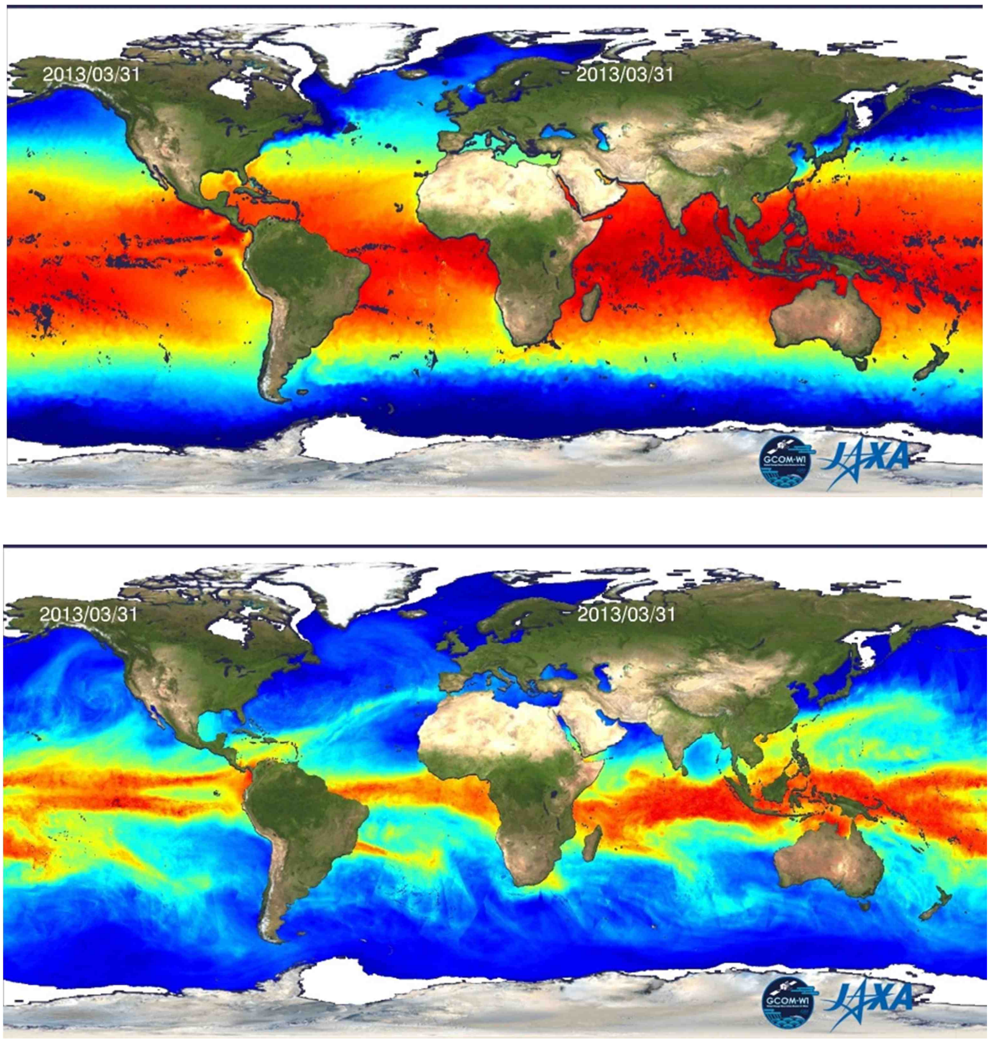

Figure 4: Three-day averages of SST (upper) and TPW (lower) centered around March 31, 2013

The geophysical products are summarized in Table 3 in terms of observable area, accuracy, and range of geophysical parameter. Three-step accuracies were defined including release threshold, standard, and goal (not shown in Table). The release threshold accuracy is the minimum level for the first data release one year after launch. By the initial validation activities, we have confirmed this release threshold accuracy for all geophysical products. Our validation activities are categorized into two ways. One is to fully utilize the existing in-situ observation network such as of oceanic buoy and radiosonde, and the other is to conduct dedicated field campaigns or continuous point monitoring for some geophysical parameters such as soil moisture, of which global in-situ observations are difficult to obtain. For example, data from global radiosonde network, which are provided by the Japan Meteorological Agency under the agreement with JAXA, have been used in validating TPW product. Figure 5 shows an example of validation results of TPW. In this case, the root-mean-square error is about 2.9 kg m^{-2}, which meets the release threshold accuracy of 3.5 kg m^{-2}. Further validations are ongoing by using ground-based GPS estimates of TPW.

Table 3: GCOM-W1 geophysical products

Geophysical Product	Area	Accuracy		Range
		Release threshold	Standard	
Integrated water vapor	Global, over ocean	3.5kg m^{-2}	3.5kg m^{-2}	0–70kg m^{-2}
Integrated cloud liquid water	Global, over ocean	0.10kg m^{-2}	0.05kg m^{-2}	0–1.0kg m^{-2}
Precipitation	Global, except cold latitudes	Ocean 50% Land 120%	Ocean 50% Land 120%	0–20mm h^{-1}
Sea surface temperature	Global, over ocean	0.8℃	0.5℃	-2–35℃
Sea surface wind speed	Global, over ocean	1.5m s^{-1}	1.0m s^{-1}	0–30m s^{-1}
Sea ice concentration	Polar region, over ocean	10%	10%	0–100%
Soil moisture	Land	10%	10%	0–40%
Snow depth	Land	20cm	20cm	0–100cm

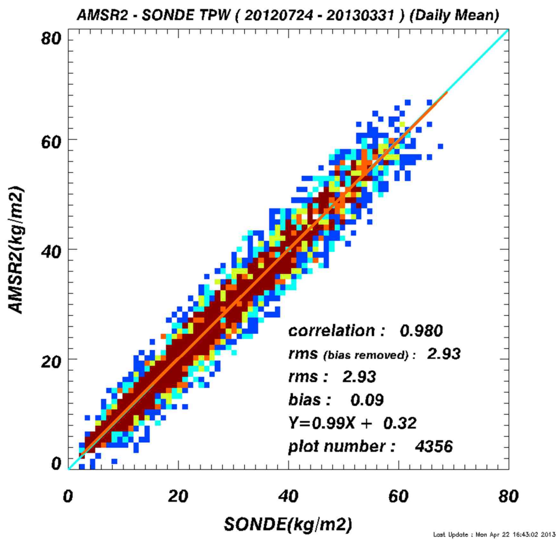

Figure 5: An example of validation results of TPW

All the AMSR2 standard products can be obtained from the GCOM-W1 data providing service, with one-time registration at the first visit to the website. Global daily browse images of AMSR2 and some climate dataset by compiling AMSR2 and historical data records can be found on the JAXA Satellite Monitoring for Environmental Studies (JASMES) site. For more information such as the updated calibration and validation results, please visit the GCOM-W1 website of the Earth Observation Research Center (EORC).

- **GCOM-W1 Data Providing Service**
  https://gcom-w1.jaxa.jp
- **JASMES**
  [JASMES Top]
  http://kuroshio.eorc.jaxa.jp/JASMES/index.html
  [JASMES for Water Cycle]
  http://kuroshio.eorc.jaxa.jp/JASMES/WC.html
  [JASMES for Climate]
  http://kuroshio.eorc.jaxa.jp/JASMES/climate/index.html
- **GCOM-W1 website at EORC**
  http://suzaku.eorc.jaxa.jp/GCOM_W/index.html

(Keiji IMAOKA, JAXA)

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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 Mailing Lists

Two mailing lists for discussion on the WIGOS project will soon be set up using the Google Groups service, and will be implemented either through the Google Groups web interface or by e-mail.

One list is for WIGOS Project Coordinating Group members who are already registered with the WMO's Regional Office for Asia and the South-West Pacific.

Group name: ra2pp_sat_cg
Group home page:
http://groups.google.com/group/ra2pp_sat_cg
Group email address:
ra2pp_sat_cg@googlegroups.com

The other list is for RA II Members in general.

Group name: ra2pp_sat
Group home page:
http://groups.google.com/group/ra2pp_sat
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ra2pp_sat@googlegroups.com

RA II WIGOS Project Home Page

http://www.wmo.int/pages/prog/sat/ra2pilot project-intro_en.php
(To be updated)

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