

WORLD METEOROLOGICAL ORGANIZATION

IPET-SUP-2/Doc. INF.7.1
(08.II.2016)

COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

INTER-PROGRAMME EXPERT TEAM ON SATELLITE UTILIZATION AND
PRODUCTS

ITEM: INF.7.1

SECOND SESSION

Original: ENGLISH

GENEVA, SWITZERLAND, 23-26 FEBRUARY 2016

Report on the 6th Asia/Oceania Meteorological Satellite Users' Conference

(Submitted by JMA)

Summary and Purpose of Document

This document reports the 6th Asia/Oceania Meteorological Satellite Users' Conference (AOMSUC).

ACTION PROPOSED

The second session is invited to:

- (a) take note of the information provided in this report.

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- Appendices:** A. Sixth Asia/Oceania Meteorological Satellite Users' Conference Summary
B. Tokyo Statement of the 6th Asia Oceania Meteorological Satellite Users
Conference

The Sixth Asia/Oceania Meteorological Satellite Users' Conference

The Sixth Asia/Oceania Meteorological Satellite Users' Conference (AOMSUC-6) was held in Tokyo, Japan, from 9 to 13 November 2015. The event was hosted and sponsored by the Japan Meteorological Agency (JMA) and co-sponsored by the China Meteorological Administration (CMA), the Korea Meteorological Administration (KMA), the Russian Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET), the Australian Bureau of Meteorology (AuBoM), the World Meteorological Organization (WMO) and the Group on Earth Observations (GEO). The event was opened by JMA Director-General Noritake Nishide, and the co-sponsors also provided words of welcome. The start of Himawari-8's operations in 2015 marked the beginning of a new era in the history of geostationary meteorological satellites. Against such a background, all the opening speakers emphasized that the conference should facilitate the sharing of information on best practices among National Meteorological and Hydrological Services (NMHSs) and accelerate the advanced utilization of Himawari-8 and other new-generation satellites. To support the achievement of these ends, JMA hosted numerous experts from NMHSs in the Asia/Oceania regions for the conference in collaboration with WMO. The five-day gathering was attended by over 170 people from 37 countries, including students, scientists, users and satellite operators.

The conference involved three days of plenary sessions (10 - 12 November) and two days of training (9 and 13 November). The plenary sessions featured a mix of high-quality oral and poster presentations, and covered topics including current/future operational and research satellite observational capabilities relevant to the Asia/Oceania regions, data sharing and utilization, scientific activities and applications, and education/training opportunities. The content and clarity of the event's scientific presentations promoted fruitful discussions and furthered information exchanges based on the following ten sessions:

- Session 1: Current and future meteorological satellite programs
- Session 2: Himawari-8, related status and application
- Session 3: JAXA's coordinated efforts for the earth's environmental monitoring
- Session 4: Program plans, data access and utilization
- Session 5: Atmospheric parameters derived from satellite observations
- Session 6: Application of satellite data to weather analysis and disaster monitoring
- Session 7: Application of satellite data to numerical weather prediction
- Session 8: Application of satellite data to climate and environmental monitoring
- Session 9: Land surface and ocean parameters derived from satellite observations
- Session 10: Capacity development and training activities

The plenary sessions featured 26 country reports from NMHSs using meteorological satellite data for operations such as weather analysis, forecasting and issuance of warnings. This was the first opportunity for Asia/Oceania-region users to provide feedback. The reports detailed the current status of satellite data utilization in NMHSs, their expectations for new-series satellites in hazard monitoring, and needs for their derivation of desired benefits. The satellite operators, researchers and others present recognized the importance of satellite data utilization for mitigating the effects of disasters in developing/least-developed countries and elsewhere, and welcomed the willingness of Asia/Oceania-region users to develop their own products based on such data.

The training sessions were intended to enhance capacity for satellite data usage. Presentations given on the first day highlighted the new generation of geostationary meteorological satellites such as Himawari-8 and applications for RGB satellite imagery. RGB products are easy to composite, and their further use in weather analysis is expected. Hands-on training provided on the second day focused on visualization/analysis software such as JMA's SATAID product. Trainees installed SATAID on PCs and interpreted actual Himawari-8 observation data using the software with the assistance of presenters and JMA staff.

At the end of the plenary session, KMA announced a plan to host the Seventh Asia/Oceania Meteorological Satellite Users' Conference in the fall of 2016 in conjunction with the 22nd AMS Satellite Conference and the 2nd KMA International Meteorological Satellite Conference.

Sixth Asia/Oceania Meteorological Satellite Users' Conference Summary

The sixth Asia/Oceania Meteorological Satellite Users' Conference (AOMSUC-6) was held in Tokyo, Japan from 10 - 12 November 2015. The conference was hosted and sponsored by the Japan Meteorological Agency (JMA), and was co-sponsored by the China Meteorological Administration (CMA), the Korea Meteorological Administration (KMA), the Australian Bureau of Meteorology (AuBOM), the Roshydromet of the Russian Federation, the World Meteorological Organization (WMO), and the Group on Earth Observations (GEO). A training event was conducted prior to and following the conference (summarized in the conclusions) that brought together participants from WMO Regions II and V. Over 170 scientists, users, and satellite operators representing 37 countries participated in the AOMSUC-6. All attendees expressed their great appreciation of the outstanding efforts of JMA in its planning and hosting of the conference as well as the support of the co-sponsors and the work of the International Conference Steering Committee (ICSC).

Noting that the successful launch and operation of Himawari-8 in 2014 inaugurated a new era in the Space Based Component of the WMO Integrated Global Observing System (WIGOS), the participants welcomed the efforts being undertaken to introduce and utilize an unprecedented stream of new data; it was agreed that this early coordination in the generation of new products and services and the preparation for their utilization by the worldwide user community must be energetically sustained. It will be a significant undertaking for the operational space agencies in the coming years and these annual conferences of the Asia/Oceania satellite community are an important part of that effort.

The conference was opened by Mr Noritake Nishide, Director-General of JMA. Director-General Nishide welcomed the participants and noted that this conference was building on the past success of the last five conferences and was pleased that the success of Himawari-8 gave the conference a new focus in training. He stressed the importance of this conference as an opportunity for enhancing cooperation, exchanging information, and improving satellite data utilization. In their welcoming remarks, Ms Caiying Wei, Deputy Director General, National Satellite Meteorological Center, CMA, Dr Sang Jin Lyu, Director, Satellite Analysis Division, KMA, Dr Anthony Rea, Assistant Director, Observing Strategy and Operations, AuBoM, Ms Liubov Kramareva, Director of the Far Eastern Center of SRC Planeta, Roshydromet, all reflected on the importance of the AOMSUC's in bringing together satellite operators and the user community. All noted the increasing efforts to engage the user community and to offer training on site and remotely in order to achieve improved satellite data utilization. Dr Barbara Ryan, representing

GEO via a video presentation, noted that AOMSUC continues as an important mechanism for enhancing scientific understanding through international cooperation and collaboration. Dr Wenjian Zhang, Director of the WMO Observation Department, lauded the vibrancy of the Asia/Oceania meteorological satellite community, complimented them for their good efforts in sharing data and information across the region, and renewed the WMO commitment to support this and future AOMSUCs. He reiterated that the increase in satellite data quality, volume, and information content presents a challenge to the community to realize the opportunity for improved weather and climate services.

Session 1, “Current and future meteorological satellite programs,” was chaired by Dr Wenjian Zhang (WMO) and Mr Toshiyuki Kurino (JMA). Six speakers provided information about the plans of the operational space agencies (EUMETSAT, JMA, KMA, NOAA/NESDIS, NSMC/CMA and ROSHYDROMET), preparations for use, and anticipated impact on the WMO Global Observing System (GOS). All agencies are working towards continuity and improvement of satellite data services (calibration, demonstration of new applications, access to data and products, and training). Japan’s first of the new generation of geostationary satellite imagers, the Advanced Himawari Imager, is providing unprecedented new and exciting multispectral measurements. NSMC/CMA is planning launch of the FY-3 and FY-4 series (FY-4A in 2016 will introduce geostationary satellite high spectral resolution infrared (IR) measurements along with a geo test of microwave technology). Additional plans for the rest of this decade include MTG and EPS-SG by EUMETSAT; Himawari-9 by JMA, GEO-KOMPSAT-2A and B by KMA; GOES-R and JPSS by NOAA/NESDIS; ELECTRO-L and -M geostationary-series (the latter will include a geo FTS) and Meteor-MN3, Meteor-MP LEO-series and Arctica in a Molniya orbit by Roshydromet. CMA is proceeding with plans to cover the early morning polar orbit with FY-3; this has been noted to be of significant benefit to the WIGOS and NWP in particular. Global imaging from geostationary orbit will be enhanced with five more high quality imagers. Addressing the challenge of making use of the new data, AuBOM is introducing new product utilization opportunities to the Asia/Oceania community using VLab and other mechanisms. From the WMO perspective, it was noted that these satellite plans bring to fruition many of the recommendations from the Expert Team on the Evolution of the GOS. In his session opening presentation, ICSC Chair Dr James Purdom noted the frequent multispectral high spatial resolution data presents a challenge for image analysts and offered examples of the effectiveness of Principal Component de-construction.

Session 2, “Himawari-8, related status and application,” was chaired by Dr Ken Holmlund (EUMETSAT) and Mr Toshiyuki Kurino (JMA). The Advanced Himawari Imager on board Himawari-8 (AHI-8), its performance, and specific applications were presented. AHI, the first of a series of same instruments with minor differences in channel selection, was deployed in 2014; additional satellites with comparable imagers include Japan’s Himawari-9, the US GOES-R, and

Korea's GEO-KOMPSAT-2 satellites. The innovative design allows for flexible scan strategies e.g. full disk with a 10 minute repeat cycle and two dedicated rapid scan sectors. Its in-orbit performance is excellent with an image navigation accuracy of 1 km and calibration accuracy of 0.2 K. This enables the derivation of Atmospheric Motion Vector (AMV) with improved quality over the predecessor satellite MTSAT-2 with an associated strengthened positive impact of AMVs on the JMA Numerical Weather Prediction model. Furthermore the increase in resolution and number of channels presents new opportunities for multi-spectral analysis of weather phenomena. The impressive results shown in the session unequivocally demonstrate the great advances that can be made with the new generation geostationary satellites that will be launched in the coming years by several satellite operators.

Session 3, "JAXA's coordinated efforts for the earth's environmental monitoring," was chaired Dr Teruyuki Nakajima (JAXA) and Mr Toshiyuki Kurino (JMA). Presentations were given on Global Satellite Mapping of Precipitation and aerosol retrieval and wildfire detection improvements with Himawari-8. It was noted that these research data sets were now available to the general public. Finally a report on the close cooperation of Australia and Japan toward maximizing the applications and benefits from Himawari data was given.

Three sessions on Country Reports from Southeast Asia, Oceania, South Asia, Middle east, and Central Asia were chaired Bodo Zeschke (AuBOM), Anthony Rea (AuBOM), Agnes Lane (AuBOM), Joachim Saalmueller (EUMETSAT), and Kenneth Holmlund (EUMETSAT). Twenty six countries presented their major weather challenges; tropical storms, typhoons, excessive rainfall, flooding, and landslide were repeatedly mentioned.

Country reports from Southeast Asia were received from the Kingdom of Cambodia, Hong Kong, Republic of Indonesia, Lao People's Democratic Republic, Malaysia, Republic of the Union of Myanmar, Republic of the Philippines, Republic of Singapore, Kingdom of Thailand, and Socialist Republic of Viet Nam. Satellite data is very important in many of the countries for the detection and monitoring of high impact weather and atmospheric phenomena such as Typhoons, thunderstorms, dust, volcanic ash etc. due to the paucity of other observations. For many of the countries there are issues in the access of the data due to limited reception facilities, limited bandwidth and a lack of knowledge of the online resources. In response a number of online resources were presented by some satellite providers and attendees in the audience. Users were encouraged to be more proactive in asking satellite providers for the required data. In addition the importance of collaboration with the RAV Task Team on Satellite User Requirements was mentioned. The countries want to have the freedom to modify the products for their own local conditions. Conference attendees recognised that there could be a problem in developing different data products for the planned overlapping geostationary satellites over the Asia/Pacific region. In this context reference was made to the WMO SCOPE-

Nowcasting initiative. Finally, the importance of training courses that "Train the Trainer" was emphasized by some of the presenters.

Country reports from Oceania were received from the Democratic Republic of Timor-Leste, Fiji Meteorological Service, Federated States of Micronesia, Meteorological Service of New Zealand, Papua New Guinea National Weather Service, Solomon Islands Meteorological Service, Tonga Meteorological Service, and Tuvalu Meteorological Service. For a number of the countries in Oceania, the lack of in situ observing systems means that satellites are often the primary tool for nowcasting and warning services. Key themes emerging from the discussion were the urgent need for training in satellite products, particularly new products emerging from Himawari-8. Participants also highlighted the need for easy-to-use products. Lack of sufficient internet bandwidth to access satellite products remains an issue for some countries. The contribution of Japan in terms of HimawariCast was recognized as a very significant contribution to the Region. In addition to geostationary data, scatterometer data is an important input to forecasting and warning services for most countries in the region.

Country reports from South Asia included the People's Republic of Bangladesh, Kingdom of Bhutan, Republic of Maldives, Islamic Republic of Pakistan, Democratic Socialist Republic of Sri Lanka; from the Middle East and Central Asia reports were heard from the Kyrgyz Republic, Sultanate of Oman, and Republic of Uzbekistan. Many countries share the same top hazards, typically being tropical storms, severe thunderstorms and monsoon with related impact through torrential rain, flash floods and land-slides. For Island Nations and coastal regions a particular challenge is the sea-level rise induced by climate change. However, some challenges are quite diverse due to the geographical situation like avalanches and glacier lake outburst floods for Kyrgyzstan and Uzbekistan in their high mountain areas, drought in Pakistan and Uzbekistan and dust storms affecting Oman.

Discussion after the presentations concluded that joint challenges include infrastructure, overall level of resources, and for some sustained operations through critical weather events. Whilst satellite observations are a key for monitoring, prediction and analysis of the top hazards, severe limitations exist due to lack of sufficient bandwidth for data access, available computing power for data analysis and in particular lack trained experts in satellite meteorology. The training needs are highly diverse as well, including: (1) basic training in developing a resilient reception, processing and visualization infrastructure, (2) training on generation and applications of specific products derived from the multispectral imagers available from the new generation GEO imagers in conjunction with Nowcasting and short-range NWP. Hence it is felt that training is and will be one of the major challenges, particularly noting some of the diverse needs, and education on availability of data and tools on the internet, is highly important. The

VLab Centers of Excellence offer a variety of training opportunities and gather training requirements on a regular basis e.g. in form of regional focus group meetings. A continued challenge will be to devise organizational mechanisms for developing skills for a smaller sub-regional set of NMHSs with similar training needs. Models for such cooperation exist. Furthermore training should be active, not reactive; it should be strongly founded on the physical properties of the observations and should increasingly use polar orbiting data too. Finally, several countries are deploying new systems for improving on the above limitations, however the advent of the new generation of meteorological satellites make the technical challenges more severe, if these satellites were to be efficiently exploited. The most frequently used tools are multi-spectral images (RGBs) and image animations, where available rapid scanning.

Session 4, "Program plans, data access and utilization," was chaired by Drs Paul Menzel (UW/CIMSS) and James Purdom (CIRA). NOAA's Joint Polar Satellite System (JPSS) was briefed and societal benefits being realized from Suomi NPP were presented. These include volcanic ash detection, monitoring drought conditions, tracking dust and smoke, detecting ice flows and blockages in Arctic regions, monitoring the health of coral reefs, and many more. The GOES-R Proving Ground was noted to have prepared users of the Advanced Baseline Imager by demonstrating the new applications with data from Himawari-8; utilization of the geo lightning mapper has also been advanced. The LEO and GEO components of the Community Satellite Processing Package (CSPP is a freeware package) were presented with emphasis on their utility for direct broadcast users. A web site summarizing the CrIS instrument data quality and associated issues was introduced. And an improved INR system developed for COMS was offered as an opportunity for regional collaboration on improving image navigation and registration performance with regard to accuracy and timeliness.

Session 5, "Atmospheric parameters derived from satellite observations," was chaired by Drs Mitch Goldberg (NOAA/NESDIS) and Myoung-Hwan Ahn (Ewha Womans University). The focus was on the derivation of cloud and precipitation from geostationary and polar orbiting satellites. Multiband, frequent observations by the Himawari-8/AHI, GEO-KOMPSAT-2A/AMI and other geostationary satellites will enable to study diurnal cycle of cloud system and cloud evolution during their lifetime. A multiband infrared and visible cloud retrieval based on the optimal estimation method was discussed to provide consistent cloud-property retrievals, which fits physics-based model simulations to the observation signals. A suite of cloud, aerosols, surface, and radiation products derived using the Clouds from AVHRR Extended Processing System (CLAVRX) was discussed. CLAVRX currently operates on AVHRR, MODIS and AVHRR and is part of the Community Satellite Processing Package (CSPP) and will be extended to CSPP geostationary package. CLAVRX will provide consistent products from a suite of imagers and is

available to the entire community. The community is encouraged to use CLAVRX as a possible reference in comparing the accuracy of cloud, surface, and aerosol algorithms. KMA has started the development of GK-2A meteorological products for applying weather forecast, NWP, climate monitoring in July 2014. Significant work is underway in preparation for the 2018 launch of the AMI. Finally two papers on geostationary rainfall rates were presented. Both papers acknowledge the importance of the more accurate polar-orbiting microwave rain rates to calibrate the geostationary infrared-based rainfall products especially for warm and shallow precipitating clouds.

Session 6, “Application of satellite data to weather analysis and disaster monitoring,” was chaired by Mr Ken Carey (Earth Resources Technology, Inc.). In seven presentations the following highlights emerged. An Integrated Calibration and Validation System (ICVS), developed by NOAA, provides real time status of environmental satellite health/instrument performance/data product quality; the system also delivers long term trending of NOAA instruments and automated warning messages when anomalies are detected. Detection of overshooting tops (OTs) was presented as a useful indicator of severe weather conditions such as lightning, large hail, high winds, heavy rainfall, and severe turbulence and icing; detection methods include a Water Vapor-InfraRed window channel Brightness Temperature Difference (WV-IRW BTD) approach and an InfraRed Window texture (IRW-texture) method. Machine learning approaches with various variables from geostationary satellite data such as MSG/SEVIRI (over Africa) and Himawari/AHI (over East Asia) have been used to improve OT detection. CloudSat and lightning data demonstrated promise in predicting the spatial and temporal extent of OTs. Retrieval of total precipitable water (TPW) from the Advanced Microwave Imager data using a statistical approach, an Artificial Neural Network (ANN), was presented; using AHI data demonstrated potential in assessing the areal, intensity, and extent of TPW. Inflight icing detection with machine learning techniques applied to COMS/MI and Himawari-8/AHI satellite data showed improvement when icing thresholds were adjusted empirically. The Dvorak tropical cyclone intensity adjusted for Himawari-8 data was presented; when supplemented with microwave imagery and scatterometer data, better tropical cyclone evaluation and forecasts were realized. Positive results for hail and rainstorm detection were demonstrated when adding data from microwave sounders carried by NOAA and FY-3 to that from VIS/IR imagers. Fengyun-4 (FY-4) will soon feature complete three-dimensional observations with high temporal, spatial and spectral resolutions; progress of the space- and ground segments of FY-4A was also discussed. New data and product service plans include data broadcasting and sharing, product distributing and emergency observation support, which will benefit the user community.

Session 7, "Application of satellite data to numerical weather prediction," was chaired by Drs Fuzhong Weng (NESDIS/STAR) and Kozo Okamoto (JMA). Presentations covered various data assimilation topics. A report on assimilation of current GEO radiances in Hurricane Weather Research and Forecast (HWRF) featured the vetting of AHI thermal channels for direct radiance assimilation. Positive impacts of assimilation of AHI motion vectors in JMA regional NWP on precipitation and typhoon forecasts were demonstrated. Activities of satellite data assimilation in UK global, in both regional and ocean data assimilation systems, were also highlighted. A plan for conducting an Observing System Simulation Experiment (OSSE) was briefed; the ECMWF nature run will be used for truth and the impacts of smaller CrIS FOV size on NWP forecast skills will be studied.

Session 8, "Application of satellite data to climate and environmental monitoring," was chaired Ms Caiying Wei (CMA). Presentations noted improved efforts within NOAA to build high quality sensor data records; cross calibration of sensors has been carefully performed to good effect for long term time series of measurements. Extreme rainfall characterized with TRMM precipitation data was linked to the wet phase of the Madden-Julian Oscillation; evolution of OLR and circulation anomalies was also found to be associated. Five years of GOCI aerosol retrievals have been re-calibrated via two field campaigns; understanding of the AOPs over major cities has been increased by intercomparison with ground based sun photometer measurements. It was noted that useful data sets for climate and environmental monitoring are emerging through efforts like those presented here.

Session 9, "Land surface and ocean parameters derived from satellite observations," was chaired by Drs Anthony Rea (AuBOM) and Adam Lewis (Geoscience Australia). Four interesting presentations covered land and ocean applications of polar orbiting satellites offering globally consistent data. Noted was the use of TRMM to determine surface emissivity, use of AMSR-2 for ocean products, the operational use of Rapidsat (recently deployed on the International Space Station), and a multi-sensor approach the sea surface temperature analysis. The talks in this session demonstrated the complementary nature of geostationary and polar orbiting data and, in particular, the additional VIS/NIR/IR detail available from polar orbiting sensors and cloud penetrating microwave data. The data from these instruments, whilst less frequent than geostationary images, provide additional information on storm structures and other phenomena. The ability of AMSR-2 to fill in the gaps in infrared SST products arising from persistently cloudy areas was noted. Issues associated with the introduction of new products into operations were discussed; easy data access and display, training of users and trainers, and collocating product developers and researchers with the users of products are very important.

Session 10, "Capacity building and training activities," was chaired by Dr Sang Jin Lyu (KMA/NMSC) and Mr Bodo Zeschke (AuBoM). Three presentations focused on training program and application to ensure user readiness for the new generation satellites. AuBoM has launched "Himawari-8 Training Campaign" in January 2015 as a VLab Center of Excellence to assist Australian Bureau of Meteorology, WMO Region V and other regions in preparation for the effective use of Himawari-8 data. AuBoM has been providing valuable training courses timely for RA II and V. The US NWS invested in a new prototype training method where trainers are dispatched to the field office to lead forecasters in several four-hour sessions over two or three days. The NWS Guam Himawari training was outlined with the training software (SIFT) application and future uses of this training delivery method for the GOES-R/ABI. The National Institute of Information and Communications Technology of Japan (NICT) introduced "The Asia-Oceania online Users Forum for the Himawari-8 Real-time Web Application" to transfer, process and visualize data through a web application (<http://himawari8.nict.go.jp/>) with a concept of "get real-time climate view anywhere and anytime." Many volunteers are anticipated to come up to make this application available in multiple languages. It was also pointed out that many CoEs in different regions need to cooperate more closely to meet the users' requirements more effectively. These excellent efforts in the direction of capacity development were lauded but it was realized that the energy level must be sustained.

In the poster session, 34 posters detailed new developments in sensor calibration, cloud detection and characterization, wind retrievals, dust detection, fire monitoring, nighttime sea fog detection, convective initiation characterization, rainfall estimation, NWP improvements resulting from satellite data usage, and several other topics. The session produced spirited discussion, initiated new collaborations, and provided further opportunity for useful information exchange.

AOMSUC-6 featured high quality presentations in 10 oral sessions, 26 country reports, a poster session with 34 posters, and a concluding panel to summarize the highlights. Each of the co-sponsors expressed appreciation of the conference accomplishments and stressed the importance of continuing the AOMSUC as a future venue. Further, it was announced that India and Indonesia had expressed interest in joining as an AOMSUC co-sponsor, thus expanding the reach of these conferences. Toward continuation, KMA announced that they are making arrangement to host the next AOMSUC at the end of October or early November 2016 and invited prospective attendees to Seoul. Dr James Purdom, Chair of the ICSC, reviewed a statement of resolve from AOMSUC-6 to continue the AOMSUCs, the mechanisms for continuation, and terms of reference of the hosting institute, co-sponsors, the ICSC and a AOMSUC supporting secretariat.

As noted earlier in this summary, in conjunction with AOMSUC-6, a Training event was hosted by JMA on 9 and 13 November 2015. The objectives of the workshop were a) to provide details on the next generation of satellites to assist with user preparedness, b) to give users an appreciation of the various applications of meteorological satellite data and products, and c) to provide participants with the skills to apply meteorological satellite observations to weather analysis, climate monitoring, and environment and disaster management. On the 9th the workshop was attended by 78 participants from 36 countries, while on the 13th there were 54 participants from 32 countries. The workshop lecturers provided information on current and future satellite data, as well as the application of this data for weather and climate analysis, land and ocean monitoring, and disaster mitigation. Presenters also provided information on how to access to data and products, such as via HimawariCast, and tools to interrogate the data, such as via HYDRA2. Another common theme of the workshop was user preparedness for the next generation of satellite systems, and related to this, information was provided on the activities of the WMO Task Teams on Satellite Utilization.

The annual AOMSUC continues to be an excellent forum for members within the Asia/Oceania community to meet and enhance their joint efforts in the utilization of satellite data and products for improved weather and climate services. The current activities and plans presented by the satellite operators in Asia/Oceania continue to be most impressive featuring cutting edge geostationary satellite imagers from JMA, KMA, and CMA that will be capable of multispectral measurements at high temporal and spatial resolution with rapid scan as a routine part of their operation. In addition CMA is introducing the first hyperspectral infrared geostationary satellite sounder. The operational and research satellite communities and users within Asia/Oceania are continuing their close cooperation with great benefit of all.

In summary AOMSUC-6 was very successful in meeting the four goals of these conferences; (1) to promote the importance of satellite observations and highlight their utility, (2) to advance satellite remote sensing science by enabling scientist to scientist information exchanges focused on Asia/Oceania, (3) to provide a means for satellite operators to interact directly with the user community concerning current and future satellite related activities and plans, and (4) to engage young people entering into the field.

**Statement of
Sixth Asia/Oceania Meteorological Satellite Users' Conference**

November 12 2015

--Maximizing the benefit of meteorological satellite observations to sustain social-economic development

We, the participants assembled at the Sixth Session of Asia-Oceania Meteorological Satellite Users' Conference (AOMSUC-6) in Tokyo, Japan from 9-13, November, 2015:

Recalling the overwhelming success of the Asia Oceania Meteorological Satellite Users Conferences held so far, with the first conference in Beijing, China in November, 2010, followed by the second in Tokyo, Japan (2011), the third in Jeju Island, Korea (2012), the fourth in Melbourne, Australia (2013), the fifth in Shanghai, China (2014) and the sixth in Tokyo, Japan (2015).

Recalling further that the AOMSUCs provide an excellent forum for members within the Asia/Oceania community to meet and improve their joint efforts in the utilization of satellite data and products for enhanced weather, climate, and disaster mitigation services. The conferences feature high quality oral and poster presentations, as well as panel discussions that address topical issues such as utilization of satellite data in Weather Analysis and Forecasting, Climate and Environmental Monitoring, Numerical Weather Prediction and Disaster Monitoring. The conferences have proven very effective in:

- (1) Promoting the importance of satellite observations and highlighting their utility;
- (2) Advancing satellite remote sensing science by enabling information exchange between scientists from the Asia/Oceania region and focusing on regional issues;
- (3) Providing a means for satellite operators to interact directly with the user community respect to current and future satellite related activities and plans and respond to the requirements of those users; and
- (4) Engaging young scientists entering the field.

Recognizing that the Asia/Oceania is a weather disaster-prone region, particularly affected by tropical cyclones, severe weather events, etc. The super typhoon Haiyan in 2013 was one of the strongest tropical cyclones ever recorded, that devastated portions of Southeast Asia, particularly the Philippines, causing significant casualties and disruption to socio-economic activities in the region. Most observations of the typhoon were taken from space, and satellite

data played an important role in determining Haiyan's position and strength and in forecasting its movement as well as its intensity. The Haiyan case demonstrated importance of satellite data and coordination at global and regional levels including the reception of data and products from meteorological and environmental satellites for meeting future needs.

Recognizing that the Pacific Ocean is surrounded by the Ring of Fire, inducing significant hazards related to volcanic eruptions and ash clouds, with satellite data being one of the primary tools for the monitoring, assessment and prediction of volcanic ash and SO₂ cloud movement and dispersion.

Recognizing that the Global Framework for Climate Services (GFCS), a United Nations led initiative spearheaded by the World Meteorological Organization (WMO) to guide the development and application of science-based climate information and services in support of decision-making particularly noting the vulnerability of the Pacific region and the Island Nations to sea-level rise. Regional Climate Outlook Forums now exist all over the world, including in the Asia-Oceania region. They are providing meteorological expertise to agriculture, food, disaster and health managers that will lead to huge potential socio-economic development benefits. The development of an Architecture for Climate Monitoring from Space needs unprecedented collaboration and support among the Asia/Oceania space agencies and among the users to help ensure that climate records derived from satellite observations will play an important role in the provision of climate services.

Noting the important roles played by the International Conference Steering Committee (ICSC) of the AOMSUCs, composed of both scientists and satellite operators from China (CMA/NSMC), Japan (JMA), Korea (KMA), Russia (Roshydromet) and India (ISRO), as well as from Australia (AuBOM) representing Oceania, and other internationally renowned scientists, together with the sponsoring organizations WMO and Group on Earth Observations (GEO). The ICSC was very successful in helping formulate the roles of the key co-sponsors, in setting up the program of the conferences, in helping to attract strong science participation from across the globe, and in setting the pathway for future conferences.

Noting with appreciation that India (IMD) and Indonesia (BMKG) joined the ICSC and became co-sponsors of the AOMSUC on the occasion of the World Meteorological Congress in 2015.

Noting the expectation of the participants that the AOMSUCs will continue to contribute to building an effective platform and a long-term cooperative mechanism that engages meteorological satellite operators and users in the Asia/Oceania region and in the rest of the world at large, and in this aspect, the participants reached further the following consensuses:

1. **Note with satisfaction** that the AOMSUCs have provided a forum that facilitated improved collaboration among the space agencies and with the broader user communities of the Asia/Oceania region, that provided an unique atmosphere where users and satellite operators could communicate positively to address the challenges that ranged from utilization to future satellite systems and requirements, and that attached great importance to the cooperation and exchange of Earth observations from space.
2. **Recommend continuing** the AOMSUCs as an annual satellite user conferences with focus areas that reflect the needs of Asia/Oceania, and with the hosts coming from one of the regional satellite operators and some major users representative countries of the Asia/Oceania region, and to expand invitation to more satellite operators of the region, and to encourage more active participation from all the Asia/Oceania countries to benefit by utilizing the new generation of meteorological satellites.
3. **Recommend further** to retain the current mandate of the International Conference Steering Committee (ICSC) of AOMSUC in line with the opportunities and challenges provided by new generation of meteorological and environmental satellites and new emerging services requirements.
4. **Recommend further** to proceed with an ICSC that is composed of a Chair that is chosen by the ICSC and serves for three years, two Co-chairs, one from the host country and the other from the former host country, preferably the permanent representative of WMO Members, or his/her high level representative, with members composed of high level representatives from satellite operators and major user countries of the region, as well as internationally renowned scientists recommended by the co-sponsors.
5. **Recommend further** to establish a permanent secretariat function to sustain the AOMSUC mechanism by facilitating the organization and coordination of future AOMSUCs, supporting the ICSC meetings, liaising with EUMETSAT and NOAA conference secretariats. Provide support to AOMSUC co-sponsors and others in Asia/Oceania to strengthen existing, and foster the future collaboration on utilization and exploitation of satellite data and help coordinate their activities.
6. **Recommend further** the Permanent Representatives of WMO Members sponsoring and endorsing the AOMSUC to bring this statement and these recommendations to the attention of the WMO Secretary-General with the aim of encouraging Asia/Oceania Members to participate in future AOMSUCs; and, further continue to support AOMSUC related training events and workshops through financial support to ensure participation of people from

developing and least developed countries.

7. **Extend** deep appreciation to all the host countries for graciously hosting the AOMSUCs; and acknowledge and value the contributions of WMO and GEO as the co-sponsoring organizations to the success of the AOMSUCs, and special gratitude to the ICSC Chair and members, as well as the local organization committee members for dedicating their time, efforts and resources to the success of AOMSUCs.

Annex: Terms of Reference of Host, Co-sponsors, ICSC and Secretariat of AOMSUCs

Asia Oceania Meteorological Satellite Users' Conference Structure

Introduction

Meteorological and earth observation satellites provide frequent and extensive observational information for use in disaster prevention and climate monitoring/diagnostics, and are indispensable in today's world. Today satellites have evolved into a powerful space based observing system with China, EUMETSAT, India, Japan, the Republic of Korea, the Russian Federation and the United States providing high quality observations over the Asia/Oceania region. Those satellites are a part of the Global Observing System (GOS) promoted by the World Meteorological Organization (WMO) and contribute to the Global Earth Observing System of Systems.

Beginning in 2010, CMA, JMA, KMA, AuBOM, WMO and GEO joined forces to put on the first Asia/Oceania Meteorological Satellite Users' Conference in Beijing, China. Since that first conference, conferences have been held annually in Japan, Korea, Australia and again in China and Japan in 2014 and 2015. The purpose of these annual conferences was to further enhance the exchange of application techniques among satellite data users in Asia/Oceania, to foster cooperation among satellite operators and users in Asia/Oceania with the goal to improve regional capacity in exploiting satellite data in a cost-effective, collaborative manner, building upon and concentrating existing skills and infrastructure, as well as to advance satellite observation technologies and to promote synergetic development related to meteorological satellites in this region. This conference is the eminent scientific event in the Asia-Pacific for those working in satellite remote sensing with applications in weather forecasting, climatology, oceanography and related fields. Attendees have included world leaders in the field of satellite meteorology, satellite operators and leading scientists from around the world.

Topical areas that have been covered at these conferences 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

In order to place the conference on a self-perpetuating basis it is necessary to define the roles

and responsibilities of the various parties engaged in formulating the annual AOMSUC. The sections below define the structure of the conference and the roles of the host, co-sponsors, the International Conference Steering Committee (ICSC) and a secretariat. At the end of those sections is a list of those ICSC members present at AOMSUC-6 who approved those structures.

Asia/Oceania Meteorological Satellite Users' Conference Structure

November 12, 2015

The AOMSUC shall be composed of a primary sponsor (that year's host) and co-sponsors (cohost) to include meteorological satellite operators from RA II and RA V, a country or countries representing Asia/Oceania who are not meteorological satellite operators, as well as other organizations with a vested interest – as a whole they are referred to as major sponsors. At the time of this document the major sponsors include satellite operators CMA, ISRO, JMA, KMA and Roshydromet; countries representing Asia/Oceania, AuBOM and BMKG; and the organizations WMO and GEO. An International Conference Steering Committee (ICSC) and a secretariat will support the AOMSUC and associated activities. Responsibilities of the secretariat, host, co-host and ICSC are presented below:

SECRETARIAT

A permanent secretariat function operating under the auspices of the host exists to sustain the AOMSUC mechanism and facilitate the organization and coordination of the AOMSUCs. During the period leading up to and for some time after the AOMSUC, the host will have primary responsibility for assuring the tasks of the secretariat are brought to fruition. This may be accomplished by the host assuming those duties or through secondment or funding to the WMO Space Programme (WMOSP). The secretariat will have a major support role in its interaction with the major sponsors and the ICSC. The secretariat will work in close coordination with the WMOSP, the ICSC through its Chair and Co-chairs, and the host and co-sponsors to ease their workload and ensure requirements are met in a timely fashion. It should further:

- 1) Ensure the smooth transition between one AOMSUC to the next AOMSUC and provide management support during the inter-sessional period;
- 2) Aid in the formulation and distribution of the final report of the AOMSUC;
- 3) Work with the incoming host to select a best possible date for the conference through inspection of other relevant organization's and working group's calendars and list of upcoming events;
- 4) Aid the host in the timely development of the contents of a web site for the upcoming AOMSUC;
- 5) Have primary coordination of responsibilities with appropriate parties for conference associated scientific activities such as user focused training events and workshops of the WMO regional groups for identifying requirements for satellite data;

- 6) Foster the establishment of joint regional satellite research and applications related activities based on recommendations of the conference that further the goals of the AOMSUC;
- 7) Liaise with other major satellite conference secretariats such as EUMETSAT and NOAA conference secretariats, and other major organizations as appropriate.

HOST

The host has primary responsibility for the AOMSUC arrangements spelled out below and co-chairing of the ICSC. The host will have primary responsibility for assuring the tasks of the secretariat are brought to fruition.

- 1) At the final session of the AOMSUC announce the venue and timeframe for the next AOMSUC.
- 2) Within a month of the last AOMSUC begin reformulation of the ICSC by;
 - a. Appointing its co-chair whose term will be two years;
 - b. Appointing one or two scientists from their country to participate on the ICSC;
 - c. In coordination with the ICSC Chair and Co-chairs seek ICSC membership from the global science community.
- 3) Develop a local organizing committee to do the following:
 - a. Handle local arrangements such as venue, hotels, transportation, meals, events, visits, etc.;
 - b. Formulate the initial conference program structure (main topical areas) with support from the secretariat and ICSC Chair and Co-chairs for review by the ICSC. The conference program should reflect strategic and programmatic priorities of the major sponsors;
 - c. Collect and review abstracts and work with the ICSC Chair and Co-Chairs in the formulation of the final conference program.
- 4) With the aid of the secretariat develop the contents of a website for the upcoming AOMSUC;
 - a. the website should contains information such as relevance of the AOMSUC, venue, dates of the AOMSUC, call for abstracts, and other pertinent information;
 - b. the website's posting should be announced to the ICSC Chair as well as AOMSUC co-sponsors
 - c. this website should be updated as appropriate;
- 5) Interact with the secretariat and WMOSP toward the goal of developing a training event to immediately precede, follow or be integrated as part of the AOMSUC;

- 6) As appropriate in the timeframe of the AOMSUC, interact with the secretariat and WMOSP to help organize a workshop of the WMO regional groups for identifying requirements for satellite data (i.e., the Coordinating Group for the WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training (in RA II), and the Regional Task Team on Satellite Utilization (in RA V)), to be held in association with the AOMSUC.
- 7) Work with a secretariat to ensure coordination is being carried out in a timely fashion between co-sponsors and other interested parties as well as activities mentioned above.
- 8) To the extent possible support the participation of people from developing and least developed countries in the AOMSUC.
- 9) Functionally carry out all needed arrangements for organizing an AOMSUC and its associated events.

CO-HOST (co-sponsors):

At the end of an AOMSUC, the incoming co-sponsors should proceed with the following activities:

- 1) Within a month appoint a member from their organization to be their representative on the ICSC as well as one or two members from the scientific community from within their country to participate on the ICSC - in the case of international organizations their representative(s) on the ICSC would be representative of their involvement in the AOMSUC;
- 2) Notify the ICSC Chair and incoming host of their appointments to the ICSC;
- 3) Constitute a presence on their website that reflects the information on the upcoming AOMSUC and provide a link to the host's website;
- 4) Support people within their agency and country to participate in the AOMSUC - in the case of international organizations this would be from within their realm of activities and not necessarily from within their organization;
- 5) As possible support the participation of people from developing and least developed countries in the AOMSUC;
- 6) As appropriate participate in the training events and workshops associated with the AOMSUC.

INTERNATIONAL CONFERENCE STEERING COMMITTEE

There will be an International Conference Steering Committee that helps guide the direction

and of the Asia Oceania Meteorological Satellite Users' Conference. Members of the ICSC are expected to be renowned experts in their field and well recognized as such within their country as well as internationally. The ICSC will have a chair person that serves a term of three years. The incoming Chair should be an internationally recognized scientist. He/she will be nominated and appointed by the ICSC at the end of the term of the incumbent Chair. ICSC membership will be by invitation of the major sponsors, with the ICSC Co-chair residing within the host country. The major sponsors are invited to coordinate their appointments to the ICSC with the ICSC Chair and Co-chairs. The ICSC is expected to be fully formed within two months of the end of the previous ICSC.

ICSC members are expected to take a leadership role in the conference by helping formulate the conference agenda and its associated program in conjunction with the appropriate host's local organizing committee. ICSC members are expected to actively support the conference in one or more of the following ways:

- 1) co-chair one of the conference sessions and provide a brief written summary of that session to the ICSC Chair and Co-chairs in a timely manner so that the summary can be included in the conference final report;
- 2) present a lecture during the conference;
- 3) serve as a panel or round table discussion chair, co-chair or member;
- 4) provide closing thoughts in the final session;
- 5) foster attendance by contacting colleagues and encouraging them to participate in the AOMSUC;
- 6) aid in the development of a user focused training event and/or a workshop of the WMO regional groups for identifying requirements for satellite data that are attached to the AOMSUC.
- 7) make consideration for, and a decision on, accepting a new co-sponsor when a new satellite operator, a country to represent Asia/Oceania and an organization asks to be a new co-sponsor.

ICSC Members at 6th AOMSUC

Below are the names of the members of the International Conference Steering Committee (ICSC), with affiliation, that participated in AOMSUC-6 and in the development of the "Statement" and "Roles and Responsibilities" papers; surnames in capital letters and presented in English format (surname last).

James PURDOM (CHAIR of the ICSC)

Paul MENZEL (CIMSS, University of Wisconsin)

Wenjian ZHANG(WMO)
Sang Jin LYU(KMA/NMSC)
Myoung-Hwan AHN (Ewha Womans University)
Caiying WEI (CMA/NSMC)
Jiashen ZHANG (CMA/NSMC)
Liubov S. KRAMAREVA ... (Roshydromet/SRC Planeta)
Kenneth F. CAREY (AMS)
Teruyuki NAKAJIMA (JAXA/EORC)
Toshiyuki KURINO (JMA)
Tatsuya KIMURA (JMA)
Mitch GOLDBERG (NOAA/NESDIS)
Fuzhong WENG(NOAA/NESDIS)
Anthony REA(AuBOM)
Kenneth HOLMLUND (EUMETSAT)