WORLD METEOROLOGICAL ORGANIZATION
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COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

INTER-PROGRAMME EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS

ITEM: INF.5.1

FOURTH SESSION

GENEVA, SWITZERLAND, 26 FEBRUARY – 1 MARCH 2018

Original: ENGLISH

Report on the 8th Asia/Oceania Meteorological Satellite Users' Conference

(Submitted by KMA)

Summary and Purpose of Document

This document reports the 8th Asia/Oceania Meteorological Satellite Users' Conference (AOMSUC-8).

ACTION PROPOSED

The second session is invited to:

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

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Appendices: A. AOMSUC-8 Short Summary
B. AOMSUC-8 Summary

The Eighth Asia/Oceania Meteorological Satellite Users' Conference

The eighth Asia/Oceania Meteorological Satellite Users' Conference (AOMSUC-8) was held in Vladivostok, Russia from 16–21 October 2017. AOMSUC-8 was hosted and sponsored by Roshydromet and Roscosmos of the Russian Federation, and was co-sponsored by the China Meteorological Administration (CMA), the Japan Meteorological Administration (JMA), the Korean Meteorological Agency (KMA), the Indonesian Agency for Meteorological, Climatological and Geophysics (BMKG), the Australian Bureau of Meteorology (BoM), the India Meteorological Department (IMD) and the India Space Research Organization (ISRO) of India, the World Meteorological Organization (WMO), and the Group on Earth Observations (GEO).

AOMSUC-8 began with a two-day training event, that brought together participants from WMO Regions II and V. Including lecturers and attendees, 114 people from 22 countries participated in the training event; summarized later in this document. The next three days of AOMSUC-8 were the Conference portion consisting of 68 oral and 51 poster presentations and was attended by over 170 people from 28 countries. On behalf of Roshydromet Prof. Vasily Asmus welcomed the participants, stressing the importance of this Conference as an opportunity for enhancing cooperation, exchanging information, and improving satellite data utilization.

The Conference portion of AOMSUC-8 was divided into eight oral sessions and one poster session; however, the term poster session is an understatement since posters were conveniently set up in the coffee break area, which allowed for their viewing during break times as well as during a dedicated poster session. The eight oral presentation sessions covered the following topical areas:

(a) Current and future meteorological satellite programs and user activities/plans within Asia/Oceania
(b) Facilitation of data access and utilization, including training activities
(c) Atmospheric parameters derived from satellite observations
(e) Application of satellite data to numerical weather prediction
(d) Application of satellite data to weather analysis and disaster monitoring
(f) Application of satellite data for climate and environmental monitoring
(g) Land surface and ocean parameters derived from satellite observations
(h) Global Spaced-based Inter-Calibration System (GSICS)

The training Event was conducted from the 16-17 October 2017, with some of the practical training conducted in the Practical Training Room during the second day. Including lecturers and attendees there were 114 participants to the Training Event. The audience was represented by participants from 22 countries.

The two days involved a blend of introductory lectures followed up by practical sessions. On the first day Meteorological Satellite related information sessions were presented by NOAA, EUMETSAT and CMA. EUMETSAT presented a very interactive session exploring Meteosat-8 data and data products utilizing the Socrative classroom App as an advanced means of audience participation.

The second day commenced with a presentation pertaining to Himawari-8 data and data application with emphasis on RGB Products by JMA. The following session as presented by BoM and EUMETSAT provided participants with practical insights into the effective use of these RGB products within the forecast process with emphasis on fog/low cloud and thunderstorm detection and nowcasting. Once again, audience interaction was facilitated through the use of the Socrative classroom app. JMA coordinated exercises in rendering appropriate RGB products for case studies in the Asia and Oceania region within the SATAID software. NOAA introduced the Community Satellite Processing Package (CSPP) as applied to LEO and GEO satellites. Exercises utilized the latest version of the HYDRA software in order to interrogate VIIRS Sensor Data Records (SDR) and science products. Informal feedback from attendees indicated that the activities were of high quality and permitted a good insight into the challenging topic of satellite RGB products and their applications. The many hands-on activities were appreciated and the good coordination of the staff supervising the training was noted. The online resources will be useful for future reference by participants.

AOMSUC-8 Summary

The eighth Asia/Oceania Meteorological Satellite Users' Conference (AOMSUC-8) was held in Vladivostok, Russia from 16 – 21 October 2017. AOMSUC-8 was hosted and sponsored by Roshydromet and Roscosmos of the Russian Federation, and was co-sponsored by the China Meteorological Administration (CMA), the Japan Meteorological Administration (JMA), the Korean Meteorological Agency (KMA), the Indonesian Agency for Meteorological, Climatological and Geophysics (BMKG), the Australian Bureau of Meteorology (AuBOM), the India Meteorological Department (IMD) and the India Space Research Organization (ISRO) of India, the World Meteorological Organization (WMO), and the Group on Earth Observations (GEO).

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The Conference portion of AOMSUC-8 was officially opened on October 18 by Dr. Krill Golokhvast, Vice President for Research for the Far Eastern Federal University (FEFU). He welcomed the participants to the University and wished success for the conference. The FEFU campus is located on Russky, Island, Vladivostok, Russia and served as a marvelous venue for the conference. Dr. James F.W. Purdom, Chair of the AOMSUC International Conference Steering Committee welcomed the participants and iterated the four main goals of AOMSUC: 1) promote the importance of satellite observations and promote their utility; 2) advance satellite remote sensing by fostering scientist to scientist interaction; 3) provide a means for satellite operators to interact directly with the user community; and, 4) engage young people entering the field. Next on behalf of Roshydromet Prof. Vasily Asmus welcomed the participants to AOMSUC-8. He stressed the importance of this Conference as an opportunity for enhancing cooperation, exchanging

information, and improving satellite data utilization. Then Dr. Mikhail Khailov, Deputy Director-General of Roscosmos wished the participants a successful conference and noted the importance of satellite data to environmental monitoring. In their welcoming remarks, Dr. Noer Nurhayati, Director of Center for Public Weather Services, BMKG, Dr. Agnes Lane, Manager User Requirements and Analysis Observing Strategy Section, AuBOM, and Dr. Virendra Singh, India Meteorological Department, as representatives of users across Oceania reflected on the importance of the AOMSUC in bringing together satellite operators and the user community. They noted the positive efforts to engage the user community and to offer training with AOMSUC in order to achieve improved satellite data utilization. They thanked the satellite data providers for their good efforts in sharing data and information across the region. Dr. Xinwen Yu, Deputy Administrator of CMA, Dr. Hiroshi Kunimatsu, Senior Supervisor for Satellite Operations of Satellite Program Division, JMA, and Dr. YongSang Kim, Director of Satellite Operation Division, NMSC/KMA, as representatives of the satellite operators across Asia/Oceania all spoke of the opportunities afforded to Asia/Oceania with the greatly improved observing capabilities presented by the new generation of geostationary and polar satellites being introduced recently and over the next few years. They recognized the importance of AOMSUCs in promoting the importance of satellite observations and improving their utility, as well as providing a means for them to interact directly with the user community, Dr. Fernando Belda, Director of Observing and Information Systems Department, WMO, representing the global user community praised the vibrancy of the Asia/Oceania meteorological satellite community and renewed the WMO commitment to support this and future AOMSUCs and stressed the importance of the Vision of the WIGOS to 2040 as a roadmap for cooperation across Asia/Oceania.

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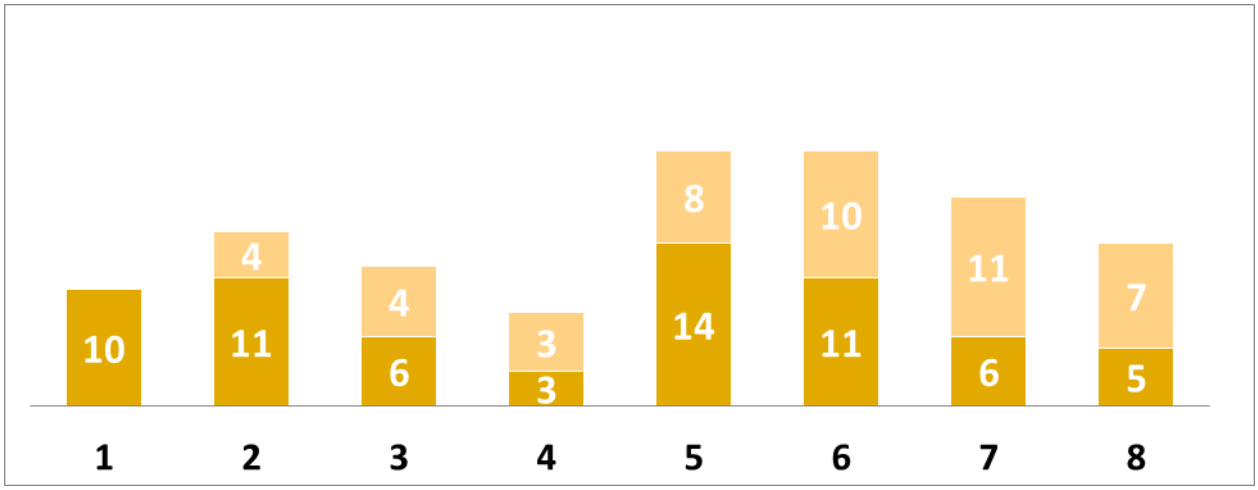
(f) Application of satellite data for climate and environmental monitoring

(g) Land surface and ocean parameters derived from satellite observations

(h) Global Spaced-based Inter-Calibration System (GSICS)



The above figure shows the number of oral presentations (bottom portion) and posters (top portion) associated with each of the eight sessions

The AOMSUC-8 venue was exceptionally well suited for a major international gathering; audio visual support was outstanding, and staff was always on hand when needed. It was evident to all that an exceptional effort had been put forth by the staffs of Roshydromet and Roscosmos in the planning and organizing of AOMSUC-8. Both oral and poster presentations were of the highest quality without exception. The conference was very successful in meeting the four major conference goals as set forth by Dr. Purdom in his welcoming remarks. It was evident throughout the conference that the new generation of geostationary and polar orbiting satellites have already had a major impact across the globe – great scientific adventures await us as we move forward with science and product development and new applications with these data: the satellite operators are meeting their commitment as we inaugurate this 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 foster the dream of "full utilization." These annual conferences of the Asia/Oceania satellite community are an important part of that effort. At the end of AOMSUC-8, Dr. Noer Nurhayati announced that BMKG looked forward to hosting AOMSUC-9 in Jakarta, Indonesia, from October 8-13, 2018, in a format like that used for AOMSUC-8.

Session co-chairs provided summaries of their sessions, below, while Mr. Bodo Zeschke, with input from Zoya Andreeva, Kathy Strabala, Ioka-san and Mark Higgins provided the summary of the training event, also below. The activity of the Coordination Group that met on the final day of AOMSUC-8 is an ongoing WIGOS activity, it is best addressed by going to the WMO WIGOS web site.

Presentations demonstrated at AOMSUC-8 (Vladivostok, FEFU, 16-21 October) may be downloaded via the following link: http://aomsuc8.ntsomz.ru/presentations/ Selected photos taken during AOMSUC-8 were added to the website of the Conference — http://aomsuc8.ntsomz.ru/photo /

SESSION SUMMARIES:

Session 1 "Current and future meteorological satellite programs and user activities/plans within Asia/Oceania" was co-chaired by Prof. Vasily Asmus, Director, SRC Planeta, Roshydromet, and Dr. James Purdom, Chair of the AOMSUC International Conference Steering Committee. The session opened with a key note by Dr. Purdom titled "Realization of a Dream: The New Generation of Meteorological Satellites." In his presentation he traced our growth as a scientific effort from the origins of the meteorological satellite era with the launch of TIROS-1 in 1960 to the complex multichannel multispectral satellite era of today. He pointed out that to get to where we are today required leadership, vision, research and utilization and that international cooperation played a major role in bringing to fruition the dream that has evolved over the last 55+ years: moving forward will require similar efforts. Further, he emphasized that the space agencies have met the challenge of providing vibrant polar and geostationary satellite systems; it is our challenge to help realize those data's potential.

The remainder of the session was composed of six satellite operator presentations and three user presentations. The satellite operators, NOAA, EUMETSAT, CMA, JMA, KMA and Roscosmos/Roshydromet presented current plans and anticipated improvements to satellite systems providing meteorological and other environmental satellite data and products across the Asia/Oceania region (and in some cases globally). The current operational capabilities are providing very well calibrated data that includes imagery and products from advanced multichannel imagery at very frequent intervals from geostationary meteorological satellites some which had pre-operational lightning mappers and hyperspectral sounders, and the hope of a Molniya orbit is on the near horizon. The advanced polar orbiting capabilities are equally impressive. The NOAA presentation showed a robust polar mission with Joint Polar Satellite System (JPSS) and with the recent launch of GOES-16 its commitment to an advanced global geostationary satellite constellation. The presentation by EUMETSAT supported the importance of JPSS and METEOSAT's importance to both Europe and Oceania. The presentation also emphasized the importance of Satellite Applications Facilities and the need for development of a variety of geostationary satellite applications from the new generation of geostationary satellites. The presentation by CMA emphasized the development of the new generation of FY-3 (polar orbit) satellites as well as the new FY-4 (geostationary) satellites whose instrumentation include a 14-channel high resolution imager, a lightning mapper and the first geostationary hyperspectral sounder. The JMA presentation show cased the Himawari-8 satellite's contribution to Asia/Oceania; after the launch and checkout of Himawari-9 has been placed into backup mode and will replace Himawari-8 as the primary satellite in due time. KMA pointed out that with the launch of GeoKomsat-2A, expected in November of 2018, 16 channel high resolution geostationary satellite imagers with the same spectral bands and performance characteristic in most channels would be operated by KMA, JMA and NOAA opening the pathway for joint algorithm development. The similarity of channels with other geostationary satellite operators would also benefit joint algorithm development relevant to Asia/Oceania. The presentation from Roscosmos showed the status of the current Russian polar and geostationary satellites. It pointed to the high-resolution sensors for land and ice observations from the polar series. In the geostationary satellite arena, the Electro series is on track with its advanced sensors, and in the highly-elliptical orbit the Arctica series is expected to be introduced in 2019; Arctica when realized as a two satellite configuration will provide the first "geostationary like" imaging of the North Polar region. Users of the data from these systems in Oceania, represented by AuBOM, BMKG and WMO, were excited about the advanced capabilities and services that they were now able to provide their using community. They recognized that as their capabilities were increasing, so was their need for training and new and sophisticated products to reflect their services menu. AuBOM pointed out that the new data and derived products from them were essential to NWP and accurate tropical cyclone forecast. BMKG emphasized the use of these new frequent interval

imagery and their importance for heavy rainfall estimation; however, to improve usefulness parallax correction was required to help place the rainfall at the proper location. WMO recognized the importance of these data to realizing the vision of the WMO Integrated Global Observing system (WIGOS). Indeed, these impressive satellites and the advanced services that they are providing were making possible represent the realization of a dream that many in the audience share.

Session 2 "Facilitation of Data Access and Utilization, including Training Activity" was co-chaired by Dr Jinho Shin (National Meteorological Satellite Center/Korea Meteorological Administration), Dr. Victor Savorsky (Institute of Radio-engineering and Electronics RAS) and Dr. Kenneth Holmlund (EUMETSAT Chief Scientist). In this session 12 oral presentation were given accompanied with many relevant posters presented in the poster session. The presentations were roughly evenly distributed across data access, tools for utilization and training.

The first two presentations in the session were given by WMO, introducing the WMO Space Programme, its activities in facilitating global data exchange and access as well as OSCAR, Observing Systems Capability Analysis and Review Database. The following three presentations presented infrastructures facilitating efficient data access with the Roscosmos Digital Earth project, the JAXA Monitor system as well as the ground processing systems for CMA FY-4 satellite. These systems provide not only a large variety of different types of traditional meteorological products like aerosol, SST, cloud properties, lightning from the latest meteorological satellites, but also like in the case of Digital Earth access to all types of satellite data, including high-resolution imagery. Later in the session the Space Research Institute of the Russian Academy of Sciences IKI-Monitoring system with similar capabilities as those above was introduced.

Today the new generation of geostationary satellites provide a huge potential for a multitude of applications and the next one to join this global fleet is the Korean Advanced Meteorological Imager (AMI) on GEO-KOMPSAT-2A, which was introduced in a dedicated presentation. AMI is with minor differences the same instrument as the GOES-R ABI and Himawari AHI that already have demonstrated the huge capabilities now being deployed in geostationary orbit. Furthermore, the Chinese Feng Yun 4 satellite provides in addition to high performance imagery data atmospheric hyperspectral sounding information and lightning observations.

To efficiently use all these different types and large volumes of data, interactive tools are necessary. The following three papers introduced various systems and software packages that indeed enable the efficient derivation and analysis of products. The SLIDER web application can be used not only by computers, but also by mobile phone, enabling a wide outreach to the general public. The CSPP LEO and GEO processing packages on the other hand support the derivation of science data for environmental decision makers.

The last two presentations in the session focused on training activities and introduced the Roshydromet and Australian Bureau of Meteorology Virtual Laboratory (VLab) Centers of Excellence. As an imperative part of an overall data exploitation system the activities done under the WMO and CGMS VLab provide a platform for training and training material to satellite data users leading to high quality satellite data services.

The posters relevant to this session introduced a broad range of tools, applications and activities, facilitating access to a wide variety of satellite based remote sensing data across the full spectrum from currently available instruments; active and passive, all spectral bands and full range of resolution. The posters also presented some practical considerations for provision of satellite data for downstream services and users and concrete examples on how efficient data access support educated decision making for ongoing activities and planning. Finally, it should be noted that

through the interactive approach the posters presented also an opportunity for learning even training and hence all being relevant to this session!

Session 3 "Atmospheric Parameters Derived from Satellite Observations" was co-chaired by Prof. Alexander Uspensky (Principal scientist, SRC Planeta) and Prof. Teruyuki Nakajima (Director, EORC, JAXA). In this session 6 oral and 4 poster presentations were made. Six speakers provided information about the progress achieved in the methods and techniques for derivation of atmospheric parameters from satellite data.

In the presentation of James Purdom (CIRA, Colorado State University) the needs of new tools for analyzing the new generation of geostationary satellite data are under discussion. It is noted, that numerous product areas, such as precipitation estimation, cloud motion vector derivation, feature tracking, severe storm identification and nowcasting in general will benefit from satellite data, but only with a strong emphasis on advanced analysis methods designed to take advantage of using the various channels in multi-channel product formats. Among the topics addressed are using feature relative motion and imaging averaging to extract meaningful information.

In the presentation of Fuzhong Weng (NOAA Center for Satellite Applications and Research) a new technique is described for cloud detection (optically thin or optically thick clouds) using the Cross-track Infrared Sounder (CrIS) hyperspectral radiances or observations from Microwave Temperature Sounder (MWTS) and Microwave Humidity Sounder (MWHS) onboard the Chinese FY-3C satellite. The significance of this work is twofold: global detection of cloud vertical distributions under all weather conditions and quality control of clouds-affected data when the infrared and microwave sounder radiances are assimilated.

The paper, presented by Teruyuki Nakajima (EORC, JAXA), focused on new retrieval studies on aerosol and surface solar energy from AHI (Advanced Himawari Imager) on board the Himawari-8 satellite and the GOSAT CAI imager. Adaptation of a new algorithm (Multi-Wavelength and Multi-Pixel Method) results in the successful retrievals of aerosols over land and ocean area. The authors also applied an improved neural network-based algorithm to the AHI data for surface solar energy and aerosol retrievals.

Alexander Eremenko (IACP) in his presentation discusses the results of usage of atmospheric temperature and humidity profile retrievals to derive the pressure drop in the tropical cyclones and are compared with the JMA best track analysis to find good agreement.

The paper presented by J. Solbrig (CIRA, CSU) contains an overview of the first two years of a Multi-University Research Initiative to observe, retrieve, model and understand aerosols in the Asia/Oceania littoral zone. The extension of current aerosol retrieval algorithm has been performed for coastal regions using AHI/Himawari, VIIRS/S-NPP and other data. It is found that dust plumes show different visible and IR radiance responses depending on their compositions.

The presentation of E. Zubko (FEFU) with coauthors focuses on a new technique for accurate estimation of the reflectance of aerosol particles using polarimetric measurements of sunlight scattered by aerosols. He proposed a scattering angle of 90 degrees for a useful polarization measurement.

Four presentations were made at poster session. Hwan-Woo Lee (NMSC/KMA) with coauthors enhanced COMS algorithm of fog detection using AHI/Himawari-8 data. A. Uspensky (SRC Planeta) with coauthor presented a new multi- spectral threshold technique developed for the assessment of cloud cover and precipitation parameters from polar-orbiting and geostationary meteorological satellite data. The poster presented by Leonid Mitnik (POI FEB RAS) with coauthors reported on post-launch calibration of MTVZA-GY microwave radiometer data from Meteor-M № 2 satellite.

Examples are considered showing application of the MTVZA-GY data and developed retrieval algorithms for the studying structure, parameters (sea surface temperature and wind speed, total water vapor content and total cloud liquid water content) and evolution of the various marine weather systems. The poster by H. Kunimatsu (JMA) introduced surface solar radiation remote sensing and modeling for various applications.

Session 4 "Application of satellite data to numerical weather prediction" was co-chaired by Prof. Alexander Uspensky (Principal scientist, SRC Planeta) and Dr. Allen Huang (SSEC/CIMSS, UW-Madison). In this session 4 oral and 3 poster presentations were made. The majority of presentations describe the progress achieved in the methods of satellite data processing for subsequent satellite data assimilation in the numerical weather prediction schemes.

In the presentation of Allen Huang (SSEC/CIMSS, UW-Madison) the converging of traditional 1-D satellite retrieval with modern-day 3D/4D data assimilation techniques is applied to provide the enhanced soundings with the greater vertical resolution required for the reliable severe weather forecasts. He concluded that working with NWP community, satellite agencies to invest on adopting/adapting the latest DA techniques to 1) Identify pros and cons of traditional retrieval and modern-day analysis techniques, and to 2) conduct comprehensive demonstration and validation of enhanced sounding products for various nowcasting & nearcasting operations.

The presentation by Ms. Wu on behalf of Qifeng LU (National Satellite Meteorological Center, China Meteorological Administration) covered the status of FY-3C and FY-4A data usage in NWP and the preparation of FY-3D data for NWP applications were discussed. Some initial evaluation to FY-4A data quality and the potential contributions to the NWP operational forecast were also reported.

The paper, presented by Ms. Dahye Bae (National Meteorological Satellite Center of Korea Meteorological Administration) focused on the current status and future plans of LEO satellite data processing to support meteorological data assimilation in NWP/KMA including the quality check activities. In specific, Ms. Bae has discussed the use of AAPP, IMAPP and CSPP in support of their preparation for timely NWP operation. She has also reported on the dissemination of locally acquired direct broadcast CrIS, ATMS, IASI, AMSU and other LEO data through GTS to DBNet.

Three presentations were made at poster session. Boran Kim (NMSC/KMA) with coauthors informed on quality analysis (bias correction) of the clear sky radiances measured by AHI/Himawari-8. Vladimir Krokhin (FERHRI) with coauthors studied the usage of satellite and radar data for verification of numerical forecasts in the Northwest Pacific Ocean. Alexander Uspensky (SRC Planeta) with coauthors described positive results of using microwave MTVZA-GY observations from Meteor-M N 2 in the data assimilation system of the Hydrometcentre of Russia.

Session 5 "Application of satellite data to weather analysis and disaster monitoring" was co-chaired by Alexander Vasilyev (Principal scientist of Hydrometcentre of Russia), Agnes Lane (AuBOM) and Peng Zhang (NSMC/CMA). 14 plenary presentations were made from the following countries and agencies: Australia (BOM), China (NSMC/CMA), Japan (MSC/IMA), India (IMD), Indonesia (BMKG, University of Indonesia, BIG), Russian Federation (SRC Planeta/Roshydromet, SRI RAS, POI FEB RAS), Thailand (TMD), USA (NOAA) and WMO.

The first paper was presented by Dr. S. Bojinski from the World Meteorological Organization on "WMO SCOPE-Nowcasting new-generation satellite data: Progress and Perspectives". He stressed

that the aim of SCOPE-Nowcasting initiative is to provide consistent satellite products for nowcasting and severe weather risk reduction with focus on developing countries and on the use of new-generation satellite data. It is aligned with a number of WMO initiatives and is supported by major satellite operators and user organizations. The paper took stock of progress made during the 2013-2016 pilot phase of SCOPE-Nowcasting, and highlighted results of existing pilot projects.

A number of papers focused on the observational capacity of new-generation satellites and existing data processing systems which permit users to apply satellite data to weather analysis, disaster monitoring and forecasting. The papers in this category included those by Kramareva L., Dedukh A. "Activities to address the Regional Challenges" (Far Eastern Department of SRC "Planeta/Roshidromet), Goodman S.J. "GLM Post launch testing, Performance, and product assessments" (NOAA/NESDIS GOES-R Program Office), Wang Xin, Xu Jianmin, Caj Zhigiang, Tang Shihao "Operational utilization of FY-4 satellite data for extreme weather monitoring" (NSMC/CMA), Elena Vertinskaya "International charter on space and major disasters – an active spatial data distribution mechanism for disasters management with regards to the Russian Federation activities" (ISC RSS), and Virendra Singh, Amit Kumar "Potential of RGB composite imageries of INSAT-3D/3DR and their analysis using RAPID tool in weather forecasting".

The paper presented by Andrey Dedukh on behalf of Mrs L. Kramareva discussed the goals of the SRC "Planeta" concerning receiving, processing and distribution of satellite-based data products in hydrometeorology, oceanography and environmental monitoring. Special attention was given to the development of algorithms for Meteor-M satellite data to produce cloud maps, SST, vegetation indexes, ice cover for the Russian Far Eastern Seas, forest fires monitoring and atmospheric sounding. Himawari-8 has created new opportunities for detection and monitoring of fires.

Laurence Flynn presented the work of Dr. S.J. Goodman, on the Geostationary Lightning Mapper (GLM) on board GOES-16, a new instrument that provides a capability for total lightning detection. The GLM will map total lightning continuously with near-uniform spatial resolution of 8 km over the Americas and adjacent oceanic regions. The total lightning detection is very useful for identifying hazardous and severe thunderstorms, monitoring storms and tracking their evolution

The third paper, presented by Dr. Wang Xin focused on results of in orbit tests of instruments onboard the Fengyn-4A (FY-4A) satellite, which was launched in December 2016. Data from AGRI, GIIRS and LMI were assessed for their application in operational monitoring of events such as typhoons and rain storms. It was found that GIIRS data used with AGRI data can be used to monitor the environment for convection genesis potential in extreme weather nowcasting.

The paper presented by Mrs. Elena Vertinskaya informed the conference that the state corporation ROSCOSMOS participates in the International Charter on Space and Major Disasters mitigation via its Operation-Research Center for Earth Operative Monitoring of JSC Russian Space systems. Currently ROSCOSMOS operates three remote sensing satellites that provide data for disaster response: Kanopus-V, Meteor-M and Resurs-P.

The paper presented by Mr. Virendra Singh described the technical characteristics of the INSAT-3DR satellite at 74°E. The satellite is designed for enhanced meteorological observations, monitoring of land and ocean, generating vertical profile of temperature and humidity. Information was also provided on the Real time Analysis of Products and Information Dissemination (RAPID) system which is web-based quick visualization and analysis tool for satellite data and products. RAPID is used for doing the analyses of RGB composite imageries for various weather phenomena.

Most of the papers in the remaining part of the session were devoted to analysis, monitoring and forecast of different weather phenomena. This relates to papers submitted by Yusuke Ioka,

Takumi Maruyama, Haruma Ishida and Koetsu Chubachi “Improvement of fog detection by adjustment of night microphysics RGB image and developing fog detection product” (MSC/JMA, MRI, HAEX CORPORATION), B. Zeschke, M. Willmott, A. Lane, A. Rea “How Himawari-8 data has revolutionized the work of Australian Bureau of meteorology forecasters” (Australian BOM), Mark Broomhall, Christopher Griffin, Leon Majewski “Towards 10 minute Australian satellite rainfall rate” (Australian BOM), Riris Adriyanto, Rokhmafuloh, Adhasena Sopaheluwaka, Aris Poniman Kertopermono, Sobirin, Eko Kusratmoko “Monitoring of volcanic ash distribution pattern of Mt. Kelud, Mt. Raung and Mt. Rinjani Eruptions using Himawari satellite data and HySPLITModel: 2014-2015 Eruption case study” (BMKG – Indonesia, University of Indonesia, Depok – Indonesia, Indonesia National agency for Geospatial intimation, Cibinong — Indonesia), Kamol P. N. Sakolnakhon, P. Longsomfum, S. Tantanee “Compaison the estimation rainfall from GSMaP-V6 to GSMaP-V7 over Thailand” (Thai Meteorological Department), A.V. Frolov, V.V. Asmus, S.V. Borshch, R.M. Vilfand, V.V. Zatyagalova, V.A. Krovotyntsev “System of Flood Monitoring, Forecasting, and Early Warming: GIS-Amur” (Roshidromet, SRC “Planeta”, Hydrometcentre of Russia), M.K. Pichugin, I.A. Gurvich, E.A. Zabolotskikh “Severe Weather System over the Eastern Part of the Eurasian Arctic Using Satellite Measurements and Reanalysis Data” (V.I. Ll’ichev Pacific Oceanological Institute FEB RAS, Russian State Hidrometeorological University).

Mr. Yasuke Ioke described the analysis of RGB composite imagery to detect fog from satellites. Results were found to vary depending on season and climatic zones. To mitigate the problem an adjusted Night Microphysics RGB image was developed by adjusting thresholds of each color. This results show little seasonal dependence. A fog detection product has also been developed by utilizing Himawari-8 and Numerical Weather Prediction (NWP) data. The fog detection depend on NWP quality, but fog areas can be detected without regional and seasonal dependence.

In the paper presented by Mr. Bodo Zeschke he described how the availability of increased temporal, spatial and spectral information from Himawari-8 satellite data has revolutionized the way forecasters at the Bureau of Meteorology do their work. The presentation summarizes the impact of this data utilizing feedback from 115 Bureau forecasting staff. The availability of Himawari-8 data has increased also the connectedness of satellite data to the nowcasting and short-term forecasting process as well as reinforcing good forecasting practices.

In the paper presented by Mr. Mark Broomhall methods to generate satellite rainfall estimates were discussed (from Himavari-8 and Meteosat Second Generation). These methods were validated against gauge and radar networks and compared against the validation metrics of a number of other satellite rainfall algorithms.

Mr. Riris Adriyanto presented the paper concerning methods of monitoring the distribution of volcanic ash in order to provide early warnings to the relevant stakeholders. The research of authors was conducted to obtain information about differences in the distribution of volcanic ash with three different detection methods and comparing the result of HYPSLIT model predictions of volcanic ash dispersion with observation from satellite. The results showed that there were differences between the distribution patterns of volcanic ash eruption depending on eruption types which were caused by several factors such as: height of the eruption column, the volume of volcanic material and wind speed and its direction at some altitude.

Authors of the paper presented by Mr. Kamol P.M. Sakolnakhon studied the verification statistics to the estimate rainfall from satellite over Thailand in year of 2017. The satellite data from Global Satellite Mapping (GSMaP)-V6 was compared with the Global Satellite Mapping (GSMaP)-7. The verification of the accuracy of precipitation estimates with rainfall observation at meteorological station showed that GSMaP-7 performs better in estimation of the probability of detection (POD) and the threat score (TS). The relationship GSMaP to observations of the correlation coefficient

(CC) is 0.65, the mean absolute error (MAE) is 4.40, to the root mean square error (RMSE) is 1.94. Therefore, GSMaP-V7 is a good performance to estimate in the area.

The paper concerning system of flood monitoring, forecasting, and early warming was presented by Mrs. Victoria Zatyagalova. This system (GIS system) was developed for the effective surveillance of hydrological conditions in the Amur River Basin. The system is based on the use of hydrometeorological, data from hydrological forecasts and data from satellites. The GIS-Amur system provides high reliability, safety and operational speed. The system provides new-real time access to all available hydrometeorological data in Amur River basin that favor correct and timely decision-making for flood risk reduction.

Mr. Mikhail Pichugin explained that that the main sources of weather information in the Eastern Part of the Eurasian Arctic are satellites due to sparse network of meteorological stations. Measurements from different kind of satellite are used to estimate sea surface wind, temperature, total atmospheric water vapor, sea ice conditions as well as cloud structure. Data from satellite together with reanalysis and observed data provides a quantitative data set of atmospheric and oceanic parameters.

The paper presented by Mrs. Liudmila Vanina-Dart (SRI RAS, The Seeingear LTD) described the "multi-hazard" effect of tropical cyclones in the SW Pacific and South Indian oceans. In some cases, severe damage in the area can caused by many geophysical processes, not only atmospheric ones. The author analyzed the multi-hazard effects in the region and satellite data will also may be useful in this respect.

There were a number of poster presentations on the theme of satellite products for weather monitoring and forecasting, including Alexander Uspensky's poster on cloud cover and precipitation products, Hwan-Woo Lee's poster on fog detection using Himawari-8, and Oksana Novikova's poster on flood monitoring.

Session 6 "Application of Satellite Data for Climate and Environmental Monitoring" was co-chaired by Prof. Sergey Gromov (Deputy director of Institute of Global Climate and Ecology, Roshydromet and RAS), and Dr. Fuzhong Weng, and Hiroshi Kunimatu. In this session, the new architecture for climate monitoring and for climate service from space are presented and the requirements for constructing the climate data records are proposed by WMO GCOS. High quality of climate services is based on the use of operational and robust strategies and the use of technologies delivered by last generation satellites. For users to have access to the climate observations, data records and information, GCOS specifies 55 Essential Climate Variables (ECVs) that are key for sustainable climate observations. Many of the ECVs can be defined from space-based instruments and provide in combination with ground based observations robust means to assess the state of the Earth's climate and climate change. As an example, re-calibration techniques are introduced for deriving the climate data record from historical HIRS data. The climate trends of three decades of global cloud and moisture properties from HIRS have been reprocessed and studied at CIMSS, Univ. of Wisconsin. The climate datasets are constructed by GlobColour project (ESA) to merge data from SeaWiFS, MODIS, MERIS, VIIRS scanners with some new improvements in cloud treatments for reducing the missing values and are used to monitor the glacier variation over former Soviet region. Satellite data for monitoring glacial changes are used in the territory of continental Russia but the difficulty remains from available satellite images with medium and low resolutions in detecting small glacier areas. The sea surface height derived from the Olga Satellite altimetry now has a two-decade length and shows an increasing mean sea level trend of 3.4 mm/yr in the global ocean but a much large magnitude of trend over the Sea of Japan. At Roshydromet, a suite of satellite products are also generated from Russian satellite

missions such as Electric-L, Meteor-M and Kanopus-L from weather, climate and environmental applications. Some of these products are shared through EUMETSAT data dissemination system. Solar radiation at surface is recognized as a basic meteorological element for variable applications including the renewable energy industry. JMA is now testing the new retrieval algorithm to retrieve the surface solar radiation. Initial validation with in-situ measurements shows the correction of aerosol scattering and ice cloud scattering tables are also critical for improving the the products. The South Korea government has established its second, third, and fourth basic plans for renewable energy use and suggested national supply targets. Surface radiation products from AHI will likely a key data source for renewable energy monitoring and forecasting. AHI data are also used for operational forecast fire monitoring. As a very important topic in this session, the atmospheric transboundary fluxes of SO2 in Siberia and Russian is first estimated through using the meteorological fields from the ERA re-analysis data, SO2 retrievals products from the Ozone Monitoring Instrument (OMI) and the EI-based transport data and the concomitant mixing ratios of SO2 in the PBL is then estimated.

Session 7, "Land surface and ocean parameters derived from satellite observations" was chaired by Anatoly Aleksanin (Institute of Automation and Control Processes FEB RAS) and Paul Menzel (Univeristy of Wisconsin-Madison). Six presentations focused on the remote sensing of sea ice, ocean surface currents, snow, and ore bearing regions. Progress was noted (S7.1) in passive microwave and infrared detection of sea ice in the Arctic Ocean and estimation of the areal extent; ASI (ARTIST Sea Ice) algorithm for SSM/I data was verified with in situ observations; CLAVR-X offers cloud detection uniformity for the infrared users, and microwave algorithm tuning has been achieved using shipborne observations. Nonetheless it is found that satellite data underestimate sea ice concentration with an average error of about 10% both in winter and summer. Satellite snow mapping (S7.6) is becoming more important in regional scale studies and characterization of the snow cover through the use of synergetic approaches which combine observations from different satellite platforms, data from different types of satellite sensors, and snow products derived with different retrieval techniques, e.g., interactive and automated. Estimation of sea surface currents and ice drift from satellite (S7.2) has improved with better pixel level geo-location and better screening of faulty velocity determinations (all must be within 5 cm/sec). A briefing (S7.3) was given on an information system called «See the Sea» which provides users access to long-term (over 20 years) archives of satellite data from a variety of sensors; this facilitates studies of anthropogenic (discharges from ships, oil) and biogenic pollution in the Baltic, Black, and the Caspian seas and mapping oil pollution of the sea surface. SAR detection of ships, ship wakes and oil spills along with various dynamic oceanic phenomena such as the internal waves, coastal fronts, eddies, upwellings, biogenic slicks, swell and river plumes were reported (S7.4) to be increasingly reliable. Finally, remote sensing has been used to focus prospecting in the most prominent ore bearing areas with positive impact on schedule and budget (S7.5).

Fifteen posters offered more information on this topic. Results of satellite monitoring the dryness in Kazakhstan using a terrestrial aridity index (hydrothermal coefficient HTC) was presented in poster (P27). Poster (P26) presented satellite monitoring of situations leading to water hypoxia formation in the Amur Bay and adjacent areas. GOCI (Geostationary Ocean Color Imager) mapping of phytoplankton and prediction of the ecology in Case II (near coastal) waters, which are usually subject to anthropogenic influences, was presented in poster (P28). A fourth poster (P29) showed infrared image analysis of frontal systems in the northwestern pacific and discussed a possible relationship of oenological formations to areas of successful fishing. The use of an SRTM (Shuttle radar topographic mission on the Endeavour shuttle, February 11-22, 2000) derived digital

elevation model to determine flood basin and snow cover was the focus of poster (P32). Poster (P36) extolled the utility of short wave radio waves for diagnosing a «rough» earth surface and dielectric subsurface structures for assessing seismic hazard, hazardous natural phenomena, changes in ecosystems, and also some extreme events of anthropogenic nature. Poster (P37) presented an overview of the evolution of remote sensing of sea ice cover in the far eastern region of Russia since 1983 with a side looking X-band radar. Application of dual-frequency precipitation radar to mapping ice cover over Lake Baikal was also presented in poster (P45). Another poster (P38) investigated the features of radio-thermal radiation of thin layered media that are comparable with the observation wavelength (ice cover, surface layer of dry or wet ground as compared to the bottom layer, etc.) that often reveal anomalous behavior of the radio brightness temperature. Satellite monitoring of ice islands in the Arctic Ocean was presented in poster (P46) with the goal of organizing a network of drifting ice stations. Global and regional sea surface temperature monitoring with METEOR-M was reported in poster (P39) to be within 1.0 K RMS of buoy data. Another poster (51) used the MSU-MR/METEOR-M2 radiometer to achieve results within 0.8 K. IMD presented (P49) a diurnal correction to the IR sensor calibration that eliminated false diurnal SST excursions. Soil moisture estimation from a combination of in situ and satellite (COMS, MODIS) was proposed in poster (P41). Application of AVHRR to assess inter-annual variability of the ice-thermal regime of Lake Baikal was presented in poster (P42).

Session 8 "Global Spaced-based Inter-Calibration System (GSICS)" was co-chaired by Dr. Alexey Rublev (Deputy Director, SRC Planeta) and Dr. Mitch Goldberg (GSICS EP Chair, NOAA). In this session 5 oral and 7 poster presentations were made.). Generally, the presentations described the progress achieved in the developing and implementing intercalibration methods to best characterize satellite observations and to adjust observations from different satellites to a common reference instrument. In the presentation of Mitchell Goldberg, the aim of GSICS is to organize the production of satellite inter-calibration information to enable improved and consistent accuracy among space-based observations worldwide for climate monitoring, weather forecasting, and environmental applications. GSICS has resulted in a shared expertise of calibration scientists from the satellite agencies which joined GSICS. Every CGMS agency is now a member of GSICS, and each agency now have scientists with expertise in calibration and intercalibration. Together that have developed consensus methods for instrument performance monitoring and intercalibration.

In the presentation of Manik Bali (NOAA) key aspects of GSICS activity were presented including its goals, membership, and organization as well as GSICS products, and the standards.

GSICS research and development activities were presented by Lawrence E Flynn (NOAA). His presentation was also devoted to the calibration comparisons methods, data sets and tools with examples of their use for creating GSICS products.

The methods and results of Himawari-8/-9 AHI intercalibration were described in the presentation of Ryo Yoshida (Japan Meteorological Agency). JMA validated Himawari-8 and -9 calibration performance jointly using the GEO-LEO and GEO-GEO approaches while Himawari-9's data were available (e.g. during its in-orbit testing). The results generally showed close correspondence with among the validation approaches.

The paper, presented by Alexey Rublev (State Research Center Planeta), focused on the different application of Russian Cal/Val system. Using this system, SRC Planeta provides an external calibration of Russian meteorological satellite instruments and validation of developed information products. In particular, the presentation describes the use of the Cal/Val system for GEO-GEO intercalibration of IR channels of MSU-GS scanner from the payload of Electro-L #2

satellite using SEVIRI/Metesat-10 as a reference instrument.

Seven presentations were made at poster session. Anderey Filey and Julia Kislova (SRC Planeta) with coauthors presented two posters devoted to intercalibration of all MSU-MR/ Meteor-M#2 channels. Virendra Singh with coauthors described the validation of the satellite-derived sea surface temperature from INSAT-3D Imager. Minju Gu and (NMSC/KMA) reported on diurnal and seasonal variation of COMS IR channels intercalibration. The calibration of COMS visible channel using different targets was presented by Tae-Hyeong Oh and Dohyeong Kim (NMSC/KMA). Sergey Dyakov (IACP FEB Russian Academy of Sciences) described intercalibration of IR channels of the MSU-MR/Meteor-M using AVHRR/NOAA as reference instrument. Ninghai Sun and Fuzhong Weng (NOAA) described the ATMS/AMSU cross-calibration monitoring for future SmallSat applications in NOAA integrated Cal/Val system.

AOMSUC-8 Training Event, 16-17 October 2017 report

The AOMSUC-8 Training Event was conducted at the Marine Conference Hall on the FEFU Campus from the 16-17 October 2017, with some of the practical training conducted in the Practical Training Room during the second day. Including lecturers and attendees there were 114 participants to the Training Event. The audience was represented by participants from 22 countries including the Russian Federation, Japan, Australia, the United States, China, the Republic of Korea, New Zealand, Bahrain, Germany, Switzerland, Hong Kong, India, Sultanate of Oman, United Arab Emirates, the Kyrgyz Republic, India, Malaysia, Myanmar, Republic of Kazakhstan, Thailand, Pakistan and Turkmenistan.

The two days involved a blend of introductory lectures followed up by practical sessions. On the first day this included the opening addresses to the Training Session by Roshydromet and Roscosmos Senior Management. This was followed by Meteorological Satellite related information sessions presented by United States, EUMETSAT, China Meteorological Administration (CMA and NASA). The EUMETSAT representative presented a very interactive session exploring Meteosat-8 data and data products utilizing the Socrative classroom App as an advanced means of audience participation.

The morning of the second day commenced with a presentation pertaining to Himawari-8 data and data application with emphasis on RGB Products by a representative from the Japan Meteorological Agency (JMA). The following session as presented by Australian Bureau of Meteorology and EUMETSAT representatives provided participants with practical insights into the effective use of these RGB products within the forecast process with emphasis on fog/low cloud and thunderstorm detection and nowcasting. Once again, audience interaction was facilitated through the use of the Socrative classroom app. Appropriate resources for further reference as archived on the Australian VLab Centre of Excellence web link were also provided.

(note the web link is at http://www.virtuallab.bom.gov.au/archive/regional-focus-group-recordings/).

The next session was conducted in the Practical Training Room involving Satellite Meteorology trainers, students and other interested attendees. The remaining conference attendees listened to the sessions remotely from the Marine Conference Hall. JMA representatives coordinated exercises in rendering appropriate RGB products for case studies in the Asia and Oceania region within the SATAID software. In this way participants were able to familiarise themselves and

experiment with a wide range of Himawari-8 RGB data products the context of appropriate regional case studies within this user-friendly display software as used by many WMO RAV and RAII NMHS.

(note the web link for the SATAID software is at

http://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.html#software and the web link for the VLab/Himawari RGB Training library is at

http://www.data.jma.go.jp/mscweb/en/VRL/VLab_RGB/RGBimage.html

After lunch presenters from the United States introduced the Community Satellite Processing Package (CSPP) as applied to LEO and GEO satellites. This was followed by practical sessions conducted in the Practical Training Room and also viewed remotely from the Marine Conference Room. Exercises utilized the latest version of the HYDRA software in order to interrogate VIIRS Sensor Data Records (SDR) and science products, demonstrating the characteristics of the numerous spectral bands, and demonstrating one example of how the data can be useful for environmental applications. Highlights included scatterplot analysis of relevant window channels and channel combinations to give distinguish a variety of clouds as well as clear land and ocean over Eastern Russia and offshore regions and to compare this to a Cloud Type scientific product. The potential of the Day/Night band was also investigated.

All lab materials, including data, labs and software are to be posted at the University of Wisconsin direct broadcast workshop website http://cimss.ssec.wisc.edu/dbs/

Informal feedback from attendees indicated that the activities were of high quality and permitted a good insight into the challenging topic of satellite RGB products and their applications. The many hands-on activities were appreciated and the good coordination of the staff supervising the training was noted. The online resources will be useful for future reference by participants.