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Abstracts Brochure

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Group on Earth Observations (GEO)

World Meteorological Organization (WMO)

Opening

James F.W. Purdom, Chair, International Conference Steering Committee

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Information from Local Organizing Committee

Session 1: Current and future meteorological satellite programs

S01-1

Prospects and expectation towards the era when the next generation geostationary meteorological satellites' global array will be in operation

S01-2

NOAA Satellite Programs

S01-3

Status of the EUMETSAT Satellite Programmes

S01-4

Current Status of Satellite Activities in the Australian Bureau of Meteorology

S01-5

Updates on Chinese Meteorological Satellite Programs

S01-6

Overview of Japanese new generation geostationary meteorological satellite, Himawari-8

S01-7

Current Status and Future Plan of KMA Satellite Program

S01-8

Roshydromet space-based observation system: current status and development perspectives

S01-9

The WMO Space Program, anticipated evolution and a picture of 2040

Session 2: Himawari-8, related status and application

S02-1

Advanced Himawari Imager (AHI) Design and Operational Flexibility

S02-2

Preliminary validation of Himawari-8/AHI navigation and calibration

S02-3

Status of development for assimilation of Himawari-8 Atmospheric Motion Vectors into the Numerical Weather Prediction Systems of Japan Meteorological Agency

S02-4

Multispectral Application Development for Himawari-8 AHI

Session 3: JAXA's coordinated efforts for the earth's environmental monitoring

S03-1

Real-time Global Satellite Mapping of Precipitation (GSMaP) product

S03-2

Aerosol retrieval using Himawari-8 visible data

S03-3

Utilization of IR imagery including MTSAT and Himawari datasets for wildfire management.

S03-4

Estimation of Solar radiation using HIMAWARI-8 with analysis of renewable energy

S03-5

Japan-Australia Collaboration on Non-Meteorological Applications from Geostationary Satellite Data

Session 4: Program plans, data access and utilization

S04-1

Overview of NOAA's Joint Polar Satellite System (JPSS) Program

S04-2

The Contribution of Operational and Research Applications from the Joint Polar Satellite System to Societal Benefits

S04-3

Towards GOES-R Launch: An Update on GOES-R Algorithm and Proving Ground Activities

S04-4

The Advancement of Community Based LEO and GEO Satellite Processing and Applications Packages

S04-5

Introducing a web-based system for hyperspectral instrument status and data quality assessment to meteorological users

S04-6

Interim Report of the COMS INR Performance Enhancement through the 1st four years of Normal Operation

Session 5: Atmospheric parameters derived from satellite observations

S05-1

Retrieval of multilayer cloud physical and optical properties from infrared measurements

S05-2

Cloud Products From CSPP-CLAVR-x

S05-3

Status of activities and plans for Geo-KOMPSAT-2A Meteorological Products

S05-4

Status of the GeoKompsat-2A AMI rainfall rate algorithm

S05-5

Application of Himawari-8 AHI to the GOES-R Rainfall Rate Algorithm

Session 6: Application of satellite data to weather analysis and disaster monitoring

S06-1

Extending the Operational Benefit of the NOAA Integrated Calibration and Validation System

S06-2

Detection of convective overshooting tops using MSG SEVIRI, Himawari-8 AHI, and CloudSat CPR data

S06-4

Application and validation of an artificial neural network approach for the fast estimation of the Total Precipitable Water (TPW) from AHI data

S06-5

Icing detection from geostationary satellite data over Korea and Japan using machine learning approaches

S06-6

Use of Microwave Imagery and Scatterometer Data as an Aid to the Dvorak Analysis

S06-7

A method to distinguish the hail and rainstorm cloud using Microwave Sounder data

S06-8

A new era: three-dimensional observation and service with fully high resolutions on FY-4 platform are coming next year

Session 7: Application of satellite data to numerical weather prediction

S07-1

Assimilation of AHI Infrared Radiance Measurements for Improved Tropical Cyclone Forecasts Using HWRF

S07-2

Assimilation experiments of Himawari rapid-scan atmospheric motion vectors

S07-3

The use of satellite data in the Met Office for Numerical Weather Prediction and other forecasting applications

S07-4

Next Generation LEO Hyperspectral Sensor IFOV Size Impact on the High-Resolution NWP Model Forecast Performance – An OSSE Study

Session 8: Application of satellite data to climate and environmental monitoring

S08-1

Building the High-Quality Sensor Data Records from NOAA Operational Satellites for Climate and Weather Applications

S08-3

Occurrence of extreme rainfall events associated with the Madden-Julian Oscillation

S08-4

GOCI Yonsei aerosol retrievals during 2012 DRAGON-NE Asia and 2015 MAPS-Seoul campaigns

Session 9: Land surface and ocean parameters derived from satellite observations

S09-1

Comparison between TRMM-TMI microwave land surface emissivity maps derived from JRA-25 and ERA-Interim

S09-2

Operational Utilization of Ocean Surface Vector Winds from RapidScat Scatterometer

S09-3

NOAA GCOM-W1/AMSR2 Oceanic Environmental Products: Operational Utilization and User Impacts

S09-5

A comparative study on the creation of multi-satellite SST ensemble using OI and BMA.

Session 10: Capacity development and training activities

S10-1

A Review of the Australian VLab Centre of Excellence National Himawari-8 Training Campaign

S10-2

The Himawari training program for NWS Pacific Region meteorologists

S10-3

Asia-Oceania Online Users Forum: Himawari-8 Real-time Web Application

Poster Presentations

P01

JPSS DATA PRODUCTS CALIBRATION/VALIDATION UPDATES

P02

Post-GPM rain retrieval and 3-D wind retrieval: the DYCECT mission

P03

Status of the GeoKompsat-2A AMI rainfall potential algorithm

P04

The Cyclone Global Navigation Satellite System (CYGNSS) – Mission Overview and Wind Product Assessment

P05

GOES-R Proving Ground Activities at CIRA

P06

Using Himawari-8 to Prepare Algorithms for GOES-R

P07

Diurnal and seasonal variations of inter-calibration for COMS Infrared channels

P08

Visible channel calibration of JMA's geostationary satellites using the Moon images

P09

An Introduction to Himawari-8 Cloud Products

P10

Convective Cloud Monitoring of Himawari-8 Satellite Data in NMSC/KMA

P11

Atmospheric Motion Vectors derived from Himawari-8

P12

Research to Operations: The STAR Enterprise Winds Algorithm on Himawari-8 for Algorithm Continuity in Operations

P13

Use of upper-tropospheric Atmospheric Motion Vectors (AMV) for diagnosing tropical cyclone intensity

P14

Current and Future Korean Geostationary Satellite AMV Quality Control Method

P15

Analysis of atmospheric motion vector tracking process

P16

Study of sulfur dioxide detection over East-Asian.

P17

Frequency change of Asian dust events depending on surface conditions

P18

Aerosol monitoring over South Korea using COMS MI measurement for MAPS 2015 and DRAGON-Asia 2012

P19

AERUS-GEO: A new aerosol product based on MSG geostationary satellite observations

P20

Aerosol Optical Depth Retrieval over the snow from GOCI in winter season.

P21

GOSAT thermal infrared data for meteorological use towards GOSAT-2

P22

Creating a high spatial resolution CO_2 sensitive 13.3 μm channel for AVHRR and VIIRS

P23

Correction of cloud effect in total column ozone measurement from PANDORA by using Kalman Filter

P24

A New Technique for Nighttime Sea Fog Detection from Satellite of Applying Unsupervised Learning.

P25

Development of fog detection technique using COMS and GIS information in the Korean Peninsula

P26

The applications of FENGYUN satellite data in Marine Meteorology

P27

VALIDATING CI2 AND DU2 MONSOON INDICES FOR THE PHILIPPINES USING RAINFALL AND WIND DATA

P28

Study of Tropopause Folding Turbulence Detection(TFTD) Algorithm for the future Korean geostationary satellite

P29

Inferring cumulus updraft strength using geostationary satellite rapid-scan measurements

P30

Machine learning approaches to detect convective initiation using geostationary satellites and weather radar

P31

A Quick Evaluation of GPM/DPR Reflectivity over Korea

P32

Rain retrieval using the SAPHIR water vapor sounder on Megha-Tropiques

P33

Effect of AMSU-A observation and adjusted AMSU-A observation error covariance on numerical weather predictions

P34

Optimal Assimilation of Hyperspectral IR and MW Soundings for Regional Numerical Weather Prediction

P37

Preliminary assessment of socio-economic benefits from CMA Meteorological Satellite Programmes

P38

Using satellite data for hydrometeorology and environmental monitoring in the Far Eastern Region of Russia

P39

Fire monitoring from Himawari-8

Session 1

Current and future meteorological satellite programs

S01-1

Prospects and expectation towards the era when the next generation geostationary meteorological satellites' global array will be in operation

James F.W. Purdom

Chair, International Conference Steering Committee

Within the next few years a new generation of geostationary satellites will ring the globe, some with lightning mappers, some with sounders, and most with 15 or 16 very similar high spatial resolution spectral channels: this constellation provides our community with tremendous opportunities as well as some great challenges.   This talk will address some of those challenges and opportunities.

16 channel imagers, as with Himiwari-8, offer the possibility of 65,535 ways to combine those channels (number includes using each independently)!, at least every 10 minutes (full disc) and at times as frequently as every one to two minutes (special events).   As we strive to take full advantage of the new generation of meteorological geostationary satellites, marked challenges face us in the ways we approach data handling, science, product development, training and utilization.   Aside from the well thought out uses of the various channels based on past experience with research satellite data (mainly polar orbiting), with the frequency of this new geostationary satellite imagery we must now think in terms of new multi-channel products, derived from mathematical analysis, at frequent intervals to be used in specific application areas.   Numerous product areas, such as precipitation estimation, cloud motion vector derivation, feature tracking, severe storm identification and nowcasting in general will benefit from the generation of satellite data, but only with a strong emphasis on advanced product development to take advantage of using the various channels in multi-channel product formats.

As we improve our current capabilities to meet user needs, other sciences and technologies that have major impacts on humanity will also progress over ensuing decades (computers, food production, water and power management, greenhouse gas monitoring, transportation, etc.).   All of this will occur as the world's population soars toward nine billion people during the next 35 years, placing increasing stress on our planet that includes human migrations to coastal areas occurring at a time of rising sea levels.   These factors will all place demands for advanced, and in many cases unanticipated product streams from our meteorological

and environmental satellite systems!   The challenge of keeping a vibrant and up-to-date product stream will require new ways of approaching all aspects of the data – science – product – user interfaces.   We are up to meeting the challenge, but we must meet it as a community.

S01-3

Status of the EUMETSAT Satellite Programmes

K. Holmlund, R. Stuhlmann, P. Schlüssel, S. Rota and M. Cohen

EUMETSAT

EUMETSAT has recently received approval from its Member States for the full EUMETSAT Polar System – Second generation (EPS-SG) Programme. This system will take over the operational monitoring of atmosphere, ocean and land surface from the current Metop-satellites in the early part of the next decade. EUMETSAT currently also developing its next generation geostationary satellites, the Meteosat Third Generation satellites, with a first launch in 2019. In addition with the launch of the first Sentinel-3 satellites, EUMETSAT will provide services for the marine community from a new series of satellites developed by the European Space Agency on behalf of the European Commission. And finally, as part of international collaboration with the French Space Agency (CNES), NOAA and NASA EUMETSAT provides data and products from the Jason-satellite series.

This presentation will give an overview of the status of the current EUMETSAT satellite systems and the anticipated improvements with the new satellites to be launched in a not so distant future.

S01-4

Current Status of Satellite Activities in the Australian Bureau of Meteorology

Anthony Rea, Agnes Lane, Prof John Le Marshall, Leon Majewski,
Denis Margetic, Chris Tingwell

BoM

The Bureau of meteorology treats space-based observations as a core capability within its composite observing system. Although Australia does not fly its own meteorological or environmental satellites, its geographical position and its large geographical area, mean that satellites are critical in measuring and understanding the environment.

These same factors mean that Australia can play a supporting role in the missions of other countries, providing ground station support, calibration and validation sites, and contributing its expertise to international efforts.

Satellites provide regular observations over large areas where in situ data is expensive or difficult to obtain. For Australia, with a large geographic area and relatively small population, satellite observations provide a basic level of coverage to those areas that do not have radars or other meteorological observing infrastructure.

This talk will cover the current use of satellites in the Bureau, and outline where Australia is making a significant contribution to international some key international partnerships with satellite operators.

S01-5

Updates on Chinese Meteorological Satellite Programs

Caiying Wei

CMA/NSMC

In this article, three main parts about the satellite issues in China are included and updated to provide the latest information. Firstly, the current satellite (Fengyun-2 and Fengyun-3) status, i.e. the observation, product and data service conditions, are briefly presented. Secondly, the future satellite program, for example Fengyun-4 operational satellite series and Fengyun-3 early-morning orbit satellite as well as rainfall measurement (RM) satellite, has been updated and some new considerations, e.g. mission requirement, key specifications and launch schedule are also offered. Finally, the latest progress of Fengyun polar and geostationary satellite series, including navigation and calibration, new products and applications, data assimilation are introduced in detail to show the primary positive promotions of CMA on the Fengyun data in recent years.

S01-6

Overview of Japanese new generation geostationary meteorological satellite, Himawari-8

Hitomi Miyamoto

JMA/MSC

Japanese new geostationary meteorological satellite of Himawari-8 was successfully launched from Tanegashima Space Center in Japan using an H-IIA rocket on 7 October 2014. Japan Meteorological Agency (JMA) has started its operation from 7 July 2015. Himawari-8 is located at 140.7 degrees east, and will observe the East Asia and Western Pacific regions as a successor to the MTSAT-2. Advanced Himawari Imager (AHI) boarding on the Himawari-8 has rich observation function comparing with MTSAT-2/Imager. AHI has 16 observation bands. The spatial resolution for AHI visible and infrared bands are twice of those of MTSAT-2/Imager. Himawari-8/AHI takes full disk scan every 10 minutes, and regional scans such as Japan area and targeting area every 2.5 minutes. All Himawari-8 imagery level-1b data in Himawari Standard Format (HSF) is distributed to National Meteorological and Hydrological Services (NMHSs) via the HimawariCloud service using Internet cloud, and subset imagery in MTSAT HRIT compatible format is also disseminated via the HimawariCast service using a communication satellite.

S01-7

Current Status and Future Plan of KMA Satellite Program

Sang Jin Lyu

KMA/NMSC

The KMA has been operating the first Korea meteorological satellite, COMS since 2010, disseminating its data via COMS itself and internet in real time. The 16 products were originally developed from COMS data and some of them have been improved for the purpose of operational weather forecast. The product of cloud amount from COMS shows a high correlation with the measurements of visual observation. The cloud amount and the cloud type are recently shown very useful in eliminating the false radar echo and improving the radar-derived precipitation. The Asian dust detection has been improved by correction of effect of humidity resulting in more continuous distribution of Asian dust without discontinuity between land and sea. The sea surface wind has been derived from the low frequency microwave imager data from AMSR2/GCOM-W1 and GMI/GPM using the relationship between the sea surface wind and the sea surface roughness which can be calculate from the microwave polarized data. This sea surface wind is very valuable in analyzing the tropical cyclone structure and intensity.

The KMA has been developing the follow-on geostationary meteorological satellite(GEO-KOMPSAT-2A, GK-2A) by 2018, which will have higher spatial and temporal resolution with 16 channels than COMS. The KMA will install KSEM(Korean Space Environmental Monitor) as well for the space weather monitoring. The 23 baseline meteorological products have been developed with 29 auxiliary products. Along with these products the integrated analysis and application facilities will be also developed to maximize the utilization and application of GK-2A data for daily weather forecast and environmental monitoring. The KMA is preparing a feasibility study for development of LEO satellite from 2017 to 2022 to complement GK-2A observation and contribute to international meteorological society.

S01-8

Roshydromet space-based observation system: current status and development perspectives

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The report presents an overview of Russian current and future weather and Earth observation satellite systems. According to the Russian Federal Space Program 2006-2016 the efforts are focused on the development and manufacturing the next generation of polar-orbiting (METEOR-M series) and geostationary (ELECTRO-L series) meteorological satellites. The space observation system will consist of three polar-orbiting meteorological and one oceanographic satellites, and three geostationary meteorological satellites. Currently, two spacecrafts of METEOR-M series (Meteor-M №1-2009 and Meteor-M №2-July,2014) and one spacecraft of ELECTRO-L series (Electro-L №1-2011) are already launched.Meteor-M №1 and Electro-L №1 are now considered as experimental. Meteor-M №2 is now in commissioning phase. Along with this two series of environmental satellites is planned to be designed and launched. The first one named Kanopus-V and already launched (2012) is intended for Earth surface monitoring. The series of Resurs-P satellites is being developed to provide detailed Earth surface observations. The Resurs-P №1 satellite was successfully launched in 2013. Basic payload of Meteor-M series satellites consists of: MSU-MR Scanning Radiometer (1 km spatial resolution, 6 channels, VIS/IR); KMSS VIS Scanning Imager (6 channels implemented by 3 cameras, 50 m and 100 m spatial resolution); Severjanin X-band Side-Looking Radar (500 m and 1000 m resolution);MTVZA-GY Imaging/Sounding Microwave Radiometer (26 channels, 10.6-183 GHz); IKFS-2 Infra-Red Fourier-transform Spectrometer (hyperspectral atmospheric sounder, spectral range 5-15 mm, spectral resolution ~ 0.5 cm-1 -on board Meteor-M №2 and succeeding satellites); Data collection system (DCS). Meteor-M №1 has three downlink radio lines including L-band radio link (1.7 GHz) with 665.4 Kbps data transmission rate (HRPT data transmission); VHF-band radio link (137 MHz) with 80 Kbps data transmission

rate (LRPT data transmission). The direct broadcast is operational in L-band in HRPT format. The detailed format description is published at SRC Planeta and WMO websites. Future Meteor-M series of polar-orbiting satellites and their payload, including oceanographic satellite Meteor-M №3 (scheduled for launch in 2020), and forthcoming Meteor-MP series satellites are provided. The geostationary meteorological satellite Electro-L №1 is located at 76E. Along with standard meteorological communication package (DCS and re-transmitters) the key payload consists of MSU-GS imager that provides data in three visible and seven IR channels. The spatial resolution at sub-satellite point is 1 km for visible and 4 km for IR channels. The period between scanning sessions for all channels is 30 min and in the more frequent mode is 15 min. The meteorological data in HRIT format is distributed to some users via SRC Planeta FTP server every 3 hours (standard synoptic hours).According to the Russian Federal Space Program future Electro-L constellation should consist of three similar satellites. Electro-L №2 is scheduled to be placed at 77.8E in the end of 2014. The launch of Electro-L №3 is scheduled in 2015. The payload of Electro-L constellation is similar to Electro-L №1 spacecraft but with improved MSU-GS instrument performance. Arctica-M project of two highly elliptical orbit satellites is outlined. It will provide observations similar to geostationary satellites but over the Arctic region. The payload of Arctica-M satellites will be similar to Electro-L series. The launch of the first Arctica satellite is scheduled for 2015. Roshydromet ground segment consists of three SRC Planeta regional centers, responsible for receiving, processing, disseminating and archiving satellite data: European (Moscow-Obninsk-Dolgoprudny), Siberian (Novosibirsk) and Far-Eastern (Khabarovsk). These centers together give full coverage of the Russia and neighboring territories. It also includes the network of DCP, LRIT and HRIT stations. The main purpose of the segment is to provide data and products for use inoperational meteorology, NWP, hydrology, agrometeorology, climate studies and environmental monitoring.

Session 2

Himawari-8, related status and application

S02-1

Advanced Himawari Imager (AHI) Design and Operational Flexibility

Paul C. Griffith

Harris

The Advanced Himawari Imager (AHI) payload is a revolutionary new design for geostationary imaging, not just an evolutionary update to the MTSAT-2 imager. In addition to providing many more bands at higher spatial resolution, it offers a unique ability to provide user-commanded rapid scan collections automatically interleaved with Full Disk and regional observations within a single instrument. In addition, AHI was designed to deliver unparalleled calibration. Not only does it have both reflective and emissive on-board targets, its scan control flexibility supports all of the traditional vicarious calibration approaches and provides the opportunity for brand new approaches. Even though AHI's north-south field-of-view is more than 60x that of the MTSAT-2 imager and has nearly 500x the number of detector elements, it can easily be calibrated using the same vicarious calibration sources. It also offers the unique ability to collect calibration data in parallel with routine weather image collections instead of interrupting these collections, which should greatly increase the opportunities for collecting calibration data.

This presentation will explain the AHI design and discuss its unique operational capabilities.

S02-2

Preliminary validation of Himawari-8/AHI navigation and calibration

Arata Okuyama(1), Akiyoshi Andou(1), Kenji Date(1), Nobutaka Mori(1), Hidehiko Murata(1), Tasuku Tabata(1), Masaya Takahashi(1), Ryoko Yoshino(2), Kotaro Bessho(1)

(1) JMA/MSC, (2) JAXA

Himawari-8 features the new 16-band Advanced Himawari Imager (AHI), whose spatial resolution and observation frequency are improved over those of its predecessor MTSAT-series satellites. These improvements will bring unprecedented levels of performance in nowcasting services and short-range weather forecasting systems. In view of the essential nature of navigation and radiometric calibration in fully leveraging the imager's potential, this presentation reports on the current status of navigation and calibration for the AHI. Image navigation is accurate to within 1 km, and band-to-band co-registration has also been validated. Infrared-band calibration is accurate to within 0.2 K with no significant diurnal variation, and is being validated using an approach developed under the GSICS project. Validation approaches are currently being tested for the visible and near-infrared bands. In this study, two of such approaches were compared and found to produce largely consistent results.

S02-3

Status of development for assimilation of Himawari-8 Atmospheric Motion Vectors into the Numerical Weather Prediction Systems of Japan Meteorological Agency

Koji Yamashita

JMA/NPD

The Meteorological Satellite Center of Japan Meteorological Agency (JMA) has produced operational Himawari-8 Atmospheric Motion Vectors (AMVs) from three sequential satellite images with time interval of 10 minutes since July 7th, 2015.

Then, the pre-processing system for assimilation of Himawari-8 AMVs into Numerical Weather Prediction (NWP) Systems is being developed at the Numerical Prediction Division of JMA. Three main procedures are being revised. Firstly, the quality indicator (QI, Holmlund 1998) thresholds for rejecting AMVs with the low QI will be improved. Secondly, a process to average AMVs in time and space will be introduced to produce super-observation over Japan. Thirdly, the climatological check is improved.

To check the impacts of these revised procedures compared with the current NWP pre-processing system for MTSAT-2 AMVs, observing system experiments (OSEs) using the JMA's operational global NWP system were performed for two typhoon cases (NOUL and DOLPHIN) in May 2015.

The OSEs revealed that wind forecast errors over the Himawari-8 observation area, especially around Japan, were reduced and mean positional error for typhoon NOUL was reduced after 18-hour forecast lead time. Its reduction rate was about 18 % from 24-hour to 42-hour forecast lead time. (Such reduction of typhoon position error was not observed for typhoon DOLPHIN.) These impacts are expected by introducing the revised NWP pre-processing system. It is planned to refine and introduce this revised NWP pre-processing system for Himawari-8 AMVs by March 2016.

I will give a presentation and discuss about these details at the Conference.

S02-4

Multispectral Application Development for Himawari-8 AHI

Steve Miller, Curtis Seaman, Dan Lindsey, Tim Schmit, Matt Gunshor,
Don Hillger, and Yasuhiko Sumida

Colorado State University; Cooperative Institute for Research in the Atmosphere

The Advanced Himawari Imager (AHI) on Japan's Himawari-8 represents the first of the next-generation of advanced geostationary imaging sensors. With its 16 spectral bands, 10-minute full disk imagery, and spatial resolution on par with many low-earth orbiting observing systems, AHI shifts the paradigm of weather observation and represents a boon to both the research and forecasting communities alike. This talk will focus on advanced imagery applications made possible for the first time on the geostationary platform—leveraging algorithms established for MODIS (on the NASA Terra and Aqua satellites) and VIIRS (on the NOAA/NASA Suomi NPP and forthcoming JPSS series). We will present various examples highlighting the benefits of AHI's spatial/spectral/temporal attributes as they apply to various meteorological phenomena. In particular, we demonstrate the first geostationary-based true color imaging capability since ATS-3, using atmospheric corrections and a hybrid green band. AHI provides important ancillary information for NOAA's GOES-R Advanced Baseline Imager (ABI), which lacks a native green band and will instead rely on a synthetic green. In addition, we will present progress on multi-spectral dust storm detection based on a Dynamic Enhancement Background Reduction Algorithm (DEBRA) developed initially for Meteosat Second Generation (MSG). Additional visible bands available to AHI, and in particular the 0.47 micron blue band, provides opportunities to improve the detection of lofted. The information is useful either as value-added imagery or as a confidence factor mask parameter. These examples represent the "tip of the iceberg" in terms of value-added applications available to AHI, as we transition algorithms that were traditionally relegated to the polar-orbiting satellites.

Session 3

JAXA's coordinated efforts for the earth's environmental monitoring

S03-1

Real-time Global Satellite Mapping of Precipitation (GSMaP) product

Riko Oki, Misako Kachi, Takuji Kubota

JAXA

The Global Satellite Mapping of Precipitation (GSMaP) product is a global rainfall map using a number of microwave radiometer observation data through the development of rain rate retrieval algorithms based on reliable precipitation physical models. Output product of GSMaP algorithm is 0.1-degree grid for horizontal resolution and 1-hour for temporal resolution. The GSMaP product is one of the Japan Aerospace Exploration Agency (JAXA) products in the Global Precipitation Measurement (GPM). GSMaP Near-Real-Time (NRT) product has been provided in a latency of four hours after observation. Moreover, in order to reduce the latency from 4-hr to "now", we have developed GSMaP just now version (GSMaP_NOW) in the GEO Himawari region. At first, the GSMaP at 0.5-hr before is produced using data that is available within 0.5-hour (GMI, AMSR2 direct receiving data, AMSU direct receiving data and Himawari-IR). And then the GSMaP at current hour (just now) is produced by applying 0.5-hour forward extrapolation by cloud motion vector. Such faster latency product can be more useful for meteorological and hydrological users.

S03-2

Aerosol retrieval using Himawari-8 visible data

Makiko Hashimoto (1), Akiko Higurashi (2), Hideaki Takenaka (1), Teruyuki Nakajima (1)

(1) JAXA, (2) NIES

We derive an aerosol product from visible observation data of Himawari-8. Himawari-8 provides us with data at every 10 minute intervals, so that it becomes possible to monitor atmospheric aerosol properties, e.g. aerosol amount, size or absorbing information, at the time interval. In the present study, we apply two-channel method (Higurashi and Nakajima., 1999) and MWP (Hashimoto PhD thesis, 2014) for the aerosol retrieval over land and ocean, respectively. MWP method is an optimal method using multi-wavelength and multi-pixel information of satellite imagery, and we can simultaneously retrieve the parameters that characterize multiple pixels in each of horizontal sub-domains consisting the target area. One of important target areas with the MWP method is the heterogeneous surface area like an urban area. Using above algorithms, we retrieve aerosol optical thickness (AOT) and Angstrom exponent (AE) over land and ocean areas.

S03-3

Utilization of IR imagery including MTSAT and Himawari datasets for wildfire management.

Koji Nakau

JAXA

Wildfire is one of common issues among asian countries. For example, we are suffering from much wildfires and its dense smoke plume in South East Asia currentry, under srong El Nino event. To monitor wildfires in Asian countries, JAXA is utilizing MTSAT and Himawari as well as low orbital satellites including CIRCs(Compact InfraRed cameras) and GCOM-C (Global Change Observation Mission - Climate) in future.

For promoting utilization of those results, JAXA is providing hotspots, cumlative cloud and other results of satellite observations on web GIS on Sentinel Asia system, as well as disaster emergency observation as a international collaboration program.

S03-4

Estimation of Solar radiation using HIMAWARI-8 with analysis of renewable energy

Hideaki Takenaka(1), T. Nakajima(1), T. Y. Nakajima(2), A. Higurashi(3), M. Hashimoto(1), K. Suzuki(4), T. Inoue(4), and T. Kurino(5)

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Clouds can cool the Earth by reflecting solar radiation and also can keep the Earth warm by absorbing and emitting terrestrial radiation. They are important in the energy balance at the Earth surface and the Top of the Atmosphere (TOA) and are connected complicatedly into the Earth system as well as other climate feedback processes. Thus it is important to estimate Earth's radiation budget for better understanding of the climate and environmental change. Third generation Japanese geostationary satellite HIMAWARI-8 is launched on 2014 October 07. Advanced Himawari Imager (AHI) has sixteen channels that has four visible channels, two near-infrared channels and ten thermal infrared channels. AHI will provides the detailed information of clouds and aerosols. We develop high-speed algorithm for estimate the Solar radiation using HIMAWARI-8/AHI data. It traces the high temporal resolution of satellite scan (10min wide area observation and 2.5min regional rapid scan) with quasi-realtime. Similarly renewable energy analysis (direct solar) is provided with by radiation analysis. We try to quasi-real-time monitoring of Photovoltaic power generation by Solar radiation analysis. It is new-innovative collaboration of Renewable energy and Climate study.

S03-5

Japan-Australia Collaboration on Non-Meteorological Applications from Geostationary Satellite Data

Agnes Lane(1), Michihiro Koide(2), Nobuyoshi Fujimoto(2), Stephen Ward(3)

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Himawari - 8 is already providing access to unprecedented EO data from space. When combined with the capabilities of Low Earth Orbit satellites, this opens up possibilities for a wide range of new applications and information services, to support highly dynamic monitoring of land, ocean, and atmosphere processes and disasters, and integrated applications of GEO and LEO Satellite Observations in the Asia - Pacific Region.

In August 2015, satellite users from Japan and Australian gathered to discuss the development of new algorithms and applications in the land, ocean and atmosphere areas. This presentation will discuss the outcomes of that workshop and plans for the future.

Session 4

Program plans, data access and utilization

S04-1

Overview of NOAA's Joint Polar Satellite System (JPSS) Program

Harry Arthur Cikanek（Presenter: Mitchell David Goldberg）

NOAA JPSS

The United States Joint Polar Satellite System (JPSS) is the new generation of Polar Operational Environmental Satellites in the early afternoon sun-synchronous orbit. The Joint NOAA/NASA Suomi National Polar Partnership (S-NPP) mission is the first of the JPSS missions. It has achieved nearly four years of successful on-orbit observations and was declared primary satellite for weather in May of 2014. Many advances have been made in data product maturity and utilization; development of succeeding missions - JPSS-1 and JPSS-2; and planning for future missions so as to provide global observations into the 2030's. This planning includes cooperation with EUMETSAT in the context of their planning for the EUMETSAT Polar System - Second Generation to provide global coverage from two orbits. This paper provides a summary of experience to date with the S-NPP mission and its four primary JPSS instruments; the status and results of data product maturity and calibration/validation efforts; status of preparations for JPSS-1 and JPSS-2 missions; and NOAA plans for additional missions providing coverage into the 2030's. It will also outline updates to the space and ground segments which are important to users; provide international partnership status and developments; and convey the strategy to assure continuity. The paper will conclude with a summary of how the observations are increasingly critical to ability of the world's weather services to support public safety, infrastructure protection, and mitigate societal impacts from weather and related environmental phenomena

S04-2

The Contribution of Operational and Research Applications from the Joint Polar Satellite System to Societal Benefits

Mitchell David Goldberg

NOAA JPSS

Applications of satellite data are paramount to transform science and technology to product and services which are used in critical decision making. For the satellite community, good representations of technology are the satellite sensors, while science provides the instrument calibration and derived geophysical parameters. Weather forecasting is an application of the science and technology provided by remote sensing satellites. The Joint Polar Satellite System, which includes the Suomi National Polar-orbiting Partnership (S-NPP) provides formidable science and technology to support many applications and includes support to 1) weather forecasting – data from the JPSS Cross-track Infrared Sounder (CrIS) and the Advanced Technology Microwave Sounder (ATMS) are used to forecast weather events out to 7 days - nearly 85% of all data used in weather forecasting are from polar orbiting satellites; 2) environmental monitoring -data from the JPSS Visible Infrared Imager Radiometer Suite (VIIRS) are used to monitor the environment including the health of coastal ecosystems, drought conditions, fire, smoke, dust, snow and ice, and the state of oceans, including sea surface temperature and ocean color; and 3) climate monitoring – data from JPSS instruments, including OMPS and CERES will provide continuity to climate data records established using NOAA POES and NASA Earth Observing System (EOS) satellite observations. To bridge the gap between products and applications, the JPSS Program has established a proving ground program to optimize the use of JPSS data with other data sources to improve key products and services. A number of operational and research applications will be presented along with how the data and applications support a large number of societal benefit areas of the Global Earth Observation Systems of Systems (GEOSS).

S04-3

Towards GOES-R Launch: An Update on GOES-R Algorithm and Proving Ground Activities

Jaime Daniels and Steve Goodman

NOAA/NESDIS Center for Satellite Applications and Research

This talk will highlight many of the ongoing algorithm, calibration/ validation, and proving ground activities that are underway in anticipation of the GOES-R launch in 2016. The GOES-R Algorithm Working Group continues to exercise the baseline Level-2 algorithms on the best available GOES-R proxy data as well as the calibration/validation tools it has developed. The availability of the data from JMA's Himawari-8/Advanced Himawari Imager (AHI) together with the fruitful collaboration between JMA and NOAA to analyze and understand the performance of the AHI has been of tremendous benefit to the AWG algorithm teams as they are now actively leveraging these data to more fully test and validate their baseline algorithms developed for GOES-R. While preparatory activities involving the GOES-R baseline algorithms are in full swing, the GOES-R Program Science Office is championing and coordinating the planning, development, and demonstration of products and applications beyond the baseline that are expected to bring benefits to field forecasters, numerical weather prediction, and decision makers. The latest status on these activities will be highlighted in this talk.

S04-4

The Advancement of Community Based LEO and GEO Satellite Processing and Applications Packages

Allen Huang, Liam Gumley and Kathy Strabala

SSEC/CIMSS, University of Wisconsin-Madison

In cooperation with the NOAA Suomi NPP/JPSS, NASA EOS Terra/Aqua, and NOAA GOES-R program, SSEC/CIMSS continues to leverage and expand International MODIS/AIRS Processing Package (IMAPP) effort, and to facilitate the use of international Low Earth Orbit (LEO) and Geostationary Earth Orbit (GEO) satellite data through the development of a unified Community Satellite Processing Package (CSPP) to support the Suomi NPP, JPSS, METOP series, and the GOES-R geostationary meteorological and environmental satellites for the global weather and environmental user community.

Main emphasis of this presentation is to report several ongoing projects, such as 1) status of CSPP LEO for VIIRS, CrIS/ATMS SDR/EDR, 2) status of CSPP GEO for GOES GVAR and GOES-R GRB, 3) Innovative Satellite Enhancement Exploration (ISEE), and 4) high performance computing for accelerated NWP forecasts, to advance CSPP towards facilitating enhanced LEO/GEO satellite processing and applications.

S04-5

Introducing a web-based system for hyperspectral instrument status and data quality assessment to meteorological users

Xin Jin(1), Ninghai Sun(1), Fuzhong Weng(2)

(1) Earth Resource Technologies, Inc.
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The Cross-track Infrared Sounder (CrIS) onboard the Suomi NPP satellite is a hyperspectral infrared interferometer, covering thousands of channels over three bands: longwave, mid-wave and shortwave. It has been in operational use for more than three years. Each day, it sends out more than 24 Gb science telemetry data (RDR) and produces about 50 Gb infrared radiance record (SDR). These data are not only widely assimilated in weather forecast model, but also applied in many areas related to environment/climate science. Therefore the CrIS instrument status and data quality are critical information for any user.

Timely monitoring the CrIS data quality is a challenging task, considering the huge data rate, sophisticated ground processing system and complicated calibration algorithm. The NOAA Center for Satellite Applications and Research (STAR) developed a long-term calibration/validation system (ICVS) to do this job.

The CrIS ICVS system covers three areas: instrument housekeeping information, RDR data quality, and SDR product quality. More than 400 parameters are monitored as figures through the internet on each day. Meanwhile, a processing log is archived in the back end, recording any anomaly down to the pixel level.

In the past three years, we have reported a bunch of anomalies through this system and accumulated an intact historical processing record. This system has helped many people: instrument vender uses it to assess instrument status; ground processing team uses it to debug software bugs; algorithm team uses it to evaluate calibration algorithm; end users use it to evaluate data reliability. After three years of development and optimization, this system has become a robust and reliable tool for operational use. It has been recently transplanted to the Office of Satellite and Product Operations (OSPO) as an official operational system.

S04-6

Interim Report of the COMS INR Performance Enhancement through the 1st four years of Normal Operation

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(1) KARI (Korea Aerospace Research Institute)
(2) KMA/NMSC

Communication, Ocean and Meteorological Satellite (COMS) of Korea has been in orbit since its launch on June 26, 2010 and now has completed up the first 4 years of its normal operational service. During this time, it has experienced many monumental accomplishments not only in terms of user service and end product utilization but also in the aspect of the technology enhancement, among which the INR (Image Navigation and Registration) performance improvement is believed to be probably the one unnoticeable but inherently meaningful feat.

This paper addresses the technical ground of this performance improvement and reports its consequential benefits in the end image products and its implied impact towards INR and geostationary remote sensing community.

Session 5

Atmospheric parameters derived from satellite

observations

S05-1

Retrieval of multilayer cloud physical and optical properties
from infrared measurements

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Shuichiro Katagiri(1), Miho Sekiguchi(2)

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An algorithm using several thermal infrared (TIR) bands to detect multilayer cloud and retrieve cloud physical and optical properties including cloud thermodynamic phase is developed. This significantly extends applicability of passive remote sensing and possibly improves accuracy of cloud property retrieval. The method uses the split window bands as well as the carbon dioxide and water vapor absorption bands. Errors in modeled and measured brightness temperatures are evaluated by model-to-model and model-to-measurement comparisons. Top pressure of lower cloud in multi-layer cloud column can be retrieved if the upper cloud optical thickness is less than 6. The optimal estimation method is used to simultaneously infer cloud water path, effective particle radius, and cloud-top pressure. The method is first applied to the Moderate Resolution Imaging Spectroradiometer (MODIS) using 10 TIR bands and compared to MODIS operational product and active remote sensing measurements, showing promising results. Particularly, cloud-top of optically thin cloud is estimated well. The algorithm will be applied to a study of cloud system evolution using frequent observation data by the Advanced Himawari Imager (AHI) onboard the Himawari-8.

S05-2

Cloud Products From CSPP-CLAVR-x

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The Clouds from AVHRR Extended System (CLAVR-x) is a processing system developed at NOAA/NESDIS and UW/CIMSS for generating quantitative cloud products in near real-time from AVHRR, MODIS, VIIRS, and other sensors. It is NOAA's operational cloud processing system for the AVHRR, and its cloud algorithms are scheduled to migrate to the operational processing system for NOAA JPSS. CLAVR-x was successfully packaged and released as part of the Community Satellite Processing Package (CSPP) suite in 2014, and has a 2015 new release coming soon. We report on the CLAVR-x cloud properties algorithms availability, and describe the ease of CSPP-CLAVR-x usage. CLAVR-x also supports geostationary satellite sensors such as SEVIRI, AHI, ABI, etc. Some examples of CLAVR-x product from AHI would also be presented.

S05-3

Status of activities and plans for Geo-KOMPSAT-2A Meteorological Products

Sung-Rae Chung, Byung-il Lee, Tae-Myung Kim, Eun-Bin Park,
Jae-Gwan Kim, Jae-Gwang Won

National Meteorological Satellite Center, Korea Meteorological Administration

KMA has developing COMS follow-on geostationary meteorological satellite (Geo-KOMPSAT-2A, GK-2A) by 2018, which will has an Himawari-8/AHI-like sensor, named advanced meteorological imager (AMI). GK-2A/AMI will provide huge observational data through 16 channels with high spatial and temporal resolution. In order to use this data for various applications such as hazardous weather and climate monitoring and numerical weather prediction, KMA has started to develop scientific algorithms of fifty-two meteorological products which are 23 baseline and 29 auxiliary products. These products consist of four groups, which are scene analysis and surface information, cloud and precipitation, aerosol and radiation, and atmospheric information. KMA is working on the algorithm development in close collaboration with academia and research institute.

S05-4

Status of the GeoKompsat-2A AMI rainfall rate algorithm

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Dept. of Atmospheric Science, Yonsei University

A rainfall rate algorithm has been developed for the Advanced Meteorological Imager (AMI) onboard the GeoKompsat-2A (GK-2A), the second Korea's geostationary satellite. The AMI rainfall rate algorithm uses the a-priori information including the microwave rainfall data from the low-earth orbiting satellites and infrared (IR) brightness temperatures from geostationary satellites. The algorithm may better perform with a variety of a-priori information describing all possible precipitating systems. In addition, separation of physically different precipitating systems likely to improve the accuracy of retrieval process. However, it has been well known that such the separation can be hardly achieved based on the measurements of cloud top temperatures. This algorithm tries to utilize the radiative characteristics observed differently for different wavelengths in IR spectral regions. The characteristics include the different emissivity as a function of wavelength and cloud thickness. Using the brightness temperature difference (BTD) between IR channels the algorithm determines the thresholds of the BTDs discriminating two types of precipitating clouds: shallow and not shallow types. In general, shallow precipitating clouds have the temperature similar to the surface temperature so that the temperature is not well connected with the surface rainfall. As such, the separation of two types of precipitating clouds may help the accuracy of rainfall estimates for each type of clouds. In addition to the separation of cloud types in the databases, the algorithm also uses databases classified by latitudinal bands. The bands are separated with four latitudinal zones. The separation of database based on latitudes may have an effect of distinguishing the cloud types that can occur regionally. The a-priori databases are thus classified with 8 different categories.

Once the a-priori databases are constructed, the algorithm inverts the AMI IR brightness temperatures to the surface rainfall rate based on a Bayesian approach. The Bayesian approach has advantages on using multi-channel brightness temperatures simultaneously and utilizing the probability of rainfall reserved in the a-priori databases. As a proxy for the

AMI this algorithm first tests the SEVIRI and then AHI data. The sample retrieval results and the status and plan of the algorithm development will be introduced.

S05-5

Application of Himawari-8 AHI to the GOES-R Rainfall Rate Algorithm

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The Japan Meteorological Agency (JMA) successfully launched its Himawari-8 satellite on 7 October 2014 and it started operations on 7 July 2015. The Advanced Himawari Imager (AHI) instrument on Himawari-8 is very similar to the upcoming Advanced Baseline Imager (ABI) instrument on the next generation Geostationary Operational Environmental Satellite (GOES-R).

The GOES-R Rainfall Rate algorithm is an effort to combine the rapid refresh and high spatial resolution of infrared (IR) data and the accuracy of microwave (MW) estimates of precipitation. Rain rates are derived from the ABI IR bands and calibrated against rain rates from MW. The algorithm estimates instantaneous rain rate every 15 minutes on the ABI full disk at the IR pixel resolution (~2 km) with a latency of < 5 minutes from image time.

Since the AHI is the best proxy data available for the upcoming ABI on GOES-R, the AHI data is being applied to the GOES-R Rainfall Rate Algorithm to evaluate the algorithm in real time prior to GOES-R launch in 2016, and the findings will motivate improvements to the algorithm.

This presentation will introduce the basic GOES-R Rainfall Rate algorithm and recent improvements to the algorithm, describe the application of the AHI data to the algorithm, and show the results and findings from the application of the AHI data.

Session 6

Application of satellite data to weather analysis and

disaster monitoring

S06-1

Extending the Operational Benefit of the NOAA Integrated Calibration and Validation System

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(1)ERT and NOAA/NESDIS/STAR,
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The quality of satellite radiances is essential for direct radiance assimilation in numerical weather prediction, for retrievals of various geophysical parameters, for climate trending studies, and, ultimately, the quality of weather forecasts. It is also a measure of the success of the engineering and science efforts of our operational satellite system. However, past efforts in post launch calibration/validation took a piecemeal approach, focusing on onboard calibration, with much less attention paid to the quality of radiance data of earth observations. Many instrument related artifacts were left to the users to discover, and evaluate the impacts. The lack of on-orbit calibration standard and methodology for radiance verification also aggravated the problem. In order to meet the challenge of the increasing demand for better satellite data quality, an integrated system that incorporates prelaunch, postlaunch onboard and vicarious, and long-term monitoring, as well as forward calculation of radiance, was needed.

An Integrated Calibration and Validation System (ICVS), developed by NOAA's Center for Satellite Application and Research (STAR), first and foremost, provides real time environmental satellite health status/Instrument performance and data product quality monitoring. It also provides support and reference for NOAA environmental satellite anomaly trouble shooting, satellite long term trending monitoring, and satellite products visualization. This has resulted in satellite observations that are intercomparable and tied to international standards for weather, climate, ocean and other environmental applications.

In 2015 NOAA STAR started exploring use of advanced image processing software and techniques to provide an event-based new capability, building on the successful ICVS developed for the satellite research and operational communities, which would enable a suitable prototype of environmental products to be tested in research and operational environments. These blended and fused satellite-derived products would help forecasters by providing information and imagery for significant weather events (e.g., hurricane tracking

and monitoring; snow and ice cover detection); delivering accurate products for weather forecasts (e.g., convective and severe weather and lightning potential using thicker vs thinner clouds) and environmental monitoring (e.g., using the day-night band to detect snow from clouds); and maintaining the integrity of the climate data records from broader satellite instruments. This presentation will provide an assessment of progress and future plans.

S06-2

Detection of convective overshooting tops using MSG SEVIRI, Himawari-8 AHI, and CloudSat CPR data

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The clouds that penetrate into the tropopause and grow to the bottom of stratosphere at the top layer of cumulonimbus with very strong updraft are referred to as Overshooting Tops (OTs). The cumulonimbus clouds with OTs can cause severe weather conditions such as ground lightning, large hail, strong winds, and heavy rainfall. Turbulence and lightning occur very frequently in the area near OTs. Thus, OTs are a very important risk factor for aviation operations. Especially, Federal Aviation Administration reported that 509 cases out of 4326 cases of weather-related events were caused by turbulences from 1992 to 2001. Therefore, detecting OTs is very crucial to predict the degree and location of severe weather conditions such as turbulence and lightning. There are two widely used methods to detect OTs using multispectral images. One is a Water Vapor-InfraRed window channel Brightness Temperature Difference (WV-IRW BTD) approach, which uses the differences in brightness temperatures at an infrared channel (about 11 μm). The other is an InfraRed Window texture (IRW-texture) method based on the characteristics of OTs that appear a group of pixels with low temperatures. In this study, an improvement to the IRW-texture algorithm was evaluated. While the typical IRW-texture approach uses simple thresholds to detect OTs, we tested machine learning approaches with various variables from geostationary satellite data such as MSG SEVIRI (over Africa) and Himawari AHI (over East Asia) to improve OT detection. Reference OT samples were extracted using CloudSat cloud profiling radar data. The results from the machine learning approaches were compared with those from the original IRW-texture algorithm as well as WV-IRW BTD. CloudSat and available lightning data were used for quantitative assessment of detected OTs.

S06-4

Application and validation of an artificial neural network approach for the fast estimation of the Total Precipitable Water (TPW) from AHI data

Yeonjin Lee, M. H. Ahn, Su Jeong Lee

Ewha Womans University, South Korea

The next generation geostationary satellite of Korea equipped with a high performance imaging instrument, Advanced Meteorological Imager (AMI) which has the pseudo-sounding channels, is under development to be launched in 2018. For the retrieval of total precipitable water (TPW) from the AMI data, a statistical approach, Artificial Neural Network (ANN) based on the multi-layer perceptron model with the feed-forward and back-propagation training, has been developed. To prepare the training dataset consisting of the input data (brightness temperatres, observation geometry, spatio-temporal information of measurement, etc.) and the output data (the corresponding TPW) are prepared using a set of atmospheric profiles of temperature (T) and humidity (q). For a comprehensive representation of the TPW within the interested area, the vertical profiles of T & q retrieved from the hyperspectral Infrared Atmospheric Sounding Interferometer (IASI) onboard the Metop satellite for two years are used. With the T & q profiles, the theoretical radiances are prepared using MODTRAN 5.2.2 with the spectral response function of the Advanced Himawari Imager (AHI), quite a similar instrument to AMI, onboard Himawari-8 for the band-averaged radiance.

For the algorithm training, the whole dataset is resampled to include similar number of training data based on the different values of TPW (0-10, 10-20, 20-30, 30-40, 40-50, 50-60, 60 and higher). The used dependent variables are day, hour, satellite zenith angle, latitude, longitude and the 9 simulated brightness temperatures (6.2, 6.9, 7.3, 8.6, 9.6, 10.4, difference(11.2-12.4), 12.4 and 13.3 µm) and the corresponding TPW values obtained from the T & q profile. An extensive performance tests for different sets of the ANN parameters including number of epochs, learning rate, and number of hidden neurons has been conducted to find the best combination of the parameters (hidden neuron: 11, epoch: 1400 and learning rate: 0.45). The algorithm performance has been assessed using the actual AHI observation data and the preliminarily results are going to be introduced during the conference.

S06-5

Icing detection from geostationary satellite data over Korea and Japan using machine learning approaches

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Icing has a significant impact on aviation safety. When an aircraft flies in clouds, supercooled water drops on the aircraft produce a thin film which is called 'icing'. This is a factor that can cause an accident when the aircraft is taking off and landing. Icing detection studies have been commonly carried out using geostationary weather satellite data. There are several existing icing detection algorithms specific to satellite sensors. In this study, we proposed a flight icing detection approach based on the GOES-R algorithm with COMS MI and Himawari-8 AHI satellite data. The proposed approach uses machine learning algorithms such as decision trees, random forest, and support vector machines. Pilot Reports (PIREPs) were used as reference data, which cover South Korea and Japan. Various atmospheric variables were used for icing detection, including cloud height, optical and physical properties of clouds. While the existing icing detection algorithms use simple thresholds to generate an icing mask, we used machine learning approaches to produce a more accurate icing mask. The improved icing detection method optimizes the thresholds associated with the atmospheric variables by empirically considering data characteristics, when compared to the existing algorithms whose thresholds are determined based on theoretical and physical properties of icing. Quantitative assessment of the proposed approach and the existing ones was conducted using PIREPs data. The proposed icing detection algorithm is expected to help prevent aviation accidents from icing.

S06-6

Use of Microwave Imagery and Scatterometer Data as an Aid to the Dvorak Analysis

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The Dvorak tropical cyclone intensity estimation technique remains the primary method used by tropical cyclone analysts and forecasters to determine intensity, as well as an estimation of positioning as part of the process, for tropical systems occurring in most of the global ocean basins.   This satellite-based approach which allows an analyst to determine initial intensity, development, peaking and weakening stages of the tropical cyclone life cycle has been very successful since its inception in the 1970s.   Even in the Atlantic Basin where aircraft reconnaissance is routinely used, the Dvorak technique has shown its value as a supplement to the aircraft data; and conveniently as a way to compare this indirect technique with the in situ measurements taken from aircraft. The results are quite good; however, these comparisons also reveal some of the strengths and weaknesses that have been suspected by Dvorak users in the other basins without verification for quite a long time. Some of these results have been summarized in publications such as Velden et al, 2006 (BAMS); and Brown and Franklin, AMS 26th Conference on Hurricanes and Tropical Meteorology, 2004; and Knaff et al, 2010 (Weather and Forecasting).

The data used exclusively to conduct the Dvorak intensity technique are the visual and infrared satellite imagery. Although the technique originated from available visual polar orbiting data, the continuous and readily available global coverage of the infrared imagery from the geostationary satellite is now the primary source used to conduct this analysis. With the availability of the Himawari-8 satellite over the western Pacific Ocean, even greater availability with higher resolution data, especially in the infrared, will soon be available. Scientist and forecasters, alike, are eagerly anticipating a plethora of new information and capabilities that will be soon available with this new unprecedented data source.   And yet, a basic physical fact remains: In the absence of a well-defined eye or an exposed low level circulation, both visual and infrared imagery often have difficulties in seeing through the thick cirrus canopy to locate the requisite surface circulation or to reveal the underlying convective structure, knowledge that is necessary to properly perform the Dvorak technique.

This paper addresses this basic issue and demonstrates several existing and new techniques that use microwave imagery and scatterometer data to supplement the infrared data to more accurately conduct the Dvorak analysis. Existing methods will be recapped and shown using 85GHz and 37GHz microwave imagery to help position potential unseen surface circulation center(s). In addition, uses of microwave data to help indicate potential intensity change, including rapid intensification and peaking will also be demonstrated. Furthermore, this paper will show how scatterometer data from the European ASCAT A and B instruments and from the RapidSCAT instrument on the International Space Station can be used to supplement the Dvorak analysis. In particular it will be shown how the directional ambiguities and the two very high resolution data and the normalized radar cross-section (NRCS) displays developed at Brigham Young University (Williams and Long, IEEE Geoscience and Remote Sensing Letters, 2008) can help clarify confusing wind vectors in the wind retrieval process and how these may become important tools in the tropical cyclone analysis. Examples will be presented that illustrate how these additional microwave data can complement the new higher resolution geostationary data to help make a better Dvorak analysis; and thus a better tropical cyclone evaluation and forecast.

S06-7

A method to distinguish the hail and rainstorm cloud using Microwave Sounder data

Xiang Fang and Xin Wang

CMA/NSMC

Hail and rainstorm are two kinds of important disasters caused by severe convective storms, and the effective monitoring and warning of them is the key point to weather forecasting. There are many differences between them, including weather generating conditions and the microphysical parameters. So it is important to study the relationship and to reveal the generation and development of these mesoscale storms for improving the diagnosis and forecasting.

Due to the similar feature of the convection cloud could cause by hail or rainstorm, the typical observation using visible and infrared channels is difficult to distinguish them. The microwave sounders carried by NOAA and FY-3 can penetrate high level cloud and get the convection internal characteristics. The AMSU-B (NOAA) and MWHS (FY-3) with 5 channels and a frequency range between 89 and 183GHz are usually used to retrieval humidity profile. The observation results of these channels have high sensitivity with ice water concentration and altitude variation, so it is suitable and beneficial using these data to detect differences in the hail and rainstorm.

This study integrates the microwave satellites data to discuss the different features between the hail and rainstorm, basing on the understanding the channels response for the ice and water. With the simulation results of the radiation transmission model, each channel brightness temperature response with hail and rainstorm are separately identified, this is the main basis for the method to distinguish the hail and rainstorm cloud. The main conclusions are as follows.

1) Hail and rainstorm clouds have great differences in characteristics of environmental field. Contrasting with rainstorm cloud, hail cloud has the larger rising velocity and vertical wind shear, lower 0℃ level, higher lifting condensation level, thinner warm cloud level, less low level water vapor convergence, and high convective instability.

2) Compared with rainstorm, there is less liquid water in hail, and ice particles concentrate on the top of 8km. Besides, the higher brightness temperature reduce rate in the water vapor channel than in window channel shows in hail system.

3) This method is developed with markedly brightness temperature difference between the 183.3±3GHz and 150GHz. In the convective region, hail cloud can be judged when the two channels brightness temperature difference is less than zero, while the area more than 70%. On the contrary, the cloud is considered rainstorm.

S06-8

A new era: three-dimensional observation and service with fully high resolutions on FY-4 platform are coming next year

Qiang Guo, Feng Lu, Zhiqing Zhang, Caiying Wei and Jun Yang

CMA/NSMC

Fengyun-4 (FY-4) is the secondary generation geostationary satellite series in China, whose first experimental member (FY-4A) is scheduled to be launched at the end of 2016. As an outstanding feature, the complete three-dimensional observations with high temporal (1 minute for region with its size at the 103 Km2 order), spatial (500m for visible band at nadir) and spectral (0.8cm-1 for long-wave infrared band) resolutions between visible and thermal infrared spectrums are coming into reality next year, which is widely believed to be the new era of GEO observation at least for CMA. In this presentation, the main recently progresses of the space- and ground-segments of FY-4A are introduced briefly and some new capabilities, e.g. new spectral bands compared with FY-2 VISSR, new measurement results from lightning imager as well as interfering sounding, are also discussed in detail. Meanwhile, the latest data and product service plans, for example data broadcasting and sharing, product distributing and emergency observation support, are presented to benefit the user community especially for the East Asia area as expectations.

Session 7

Application of satellite data to numerical weather prediction

S07-1

Assimilation of AHI Infrared Radiance Measurements for Improved Tropical Cyclone Forecasts Using HWRF

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Observations of tropical cyclones had to rely mostly on airborne and meteorological satellite data over oceans. Direct assimilation of radiance observations from various remote-sensing instruments on board Polar-orbiting Operational Environmental Satellites (POES) made a significant positive impact on forecast skills of global numerical weather prediction (NWP) models. Direct assimilation of radiance observations from GOES imagers on board Geostationary Operational Environmental Satellites (GOES) lagged behind the assimilation of radiances from POES for several reasons. However, GOES imager instruments provide nearly continuous, high horizontal resolution observations at visible and infrared channels within and around tropical cyclones. Thus, the GOES data are unique for capturing fast evolving weather systems such as tropical cyclones. In this study, the radiance data from the Advanced Himawari Imager (AHI) channels 7-16 were assimilated into the Hurricane Weather Research and Forecasting (HWRF) system through the National Centers for Environmental Prediction (NCEP) Gridpoint Statistical Interpolation (GSI) system. Improvements were made to bias correction (BC) and quality control (QC) of AHI data, especially AHI channel 7 (3.9 μ m) for which residual sun glint effects are found in O-B fields for those data already pass the GSI QC. Numerical results showed positive impacts of AHI radiance assimilation on hurricane track and intensity forecasts as well as the importance of satellite QC and BC algorithms on direct assimilation of AHI imager radiances for tropical cyclone forecasts using HWRF. Further developments are needed for the quality control of AHI data in HWRF system.

S07-2

Assimilation experiments of Himawari rapid-scan atmospheric motion vectors

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(1) JMA/MRI, (2) JMA/MSC

Atmospheric motion vectors (AMV) derived from 5-minute rapid scan imagery are expected to capture small-scale distributions of airflows better than typical AMVs because the observation interval is shorter. Shimoji (2014) developed new schemes for height assignment and target tracking in the AMV algorithm in order to make the best use of higher temporal and spatial observations by the newly launched Himawari-8. The impact of these high-density data on numerical forecasting of heavy rainfall events was investigated by conducting data assimilation experiments using NHM-LETKF (Kunii 2014). We are seeking an optimal assimilation strategy for AMVs derived from the Himawari-8 datasets to better forecast severe mesoscale phenomena such as local heavy rainfalls.

S07-3

The use of satellite data in the Met Office for Numerical Weather Prediction and other forecasting applications

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UK Met Office

The Met Office provides 24/7 weather and climate services to the UK and international community. The basis for these services is good quality, timely observations from a range of in situ and remote sensing platforms. These observations are assimilated into a range of global and regional models. They are also used to generate a variety of imagery products that enable meteorologists to gain situational awareness. This presentation aims to describe:-

• Recent advances in the use of satellite data for Numerical Weather Prediction

• The use of simulated and real satellite imagery for evaluating forecast quality

• Recent advances in the use of satellite data and imagery for other environmental forecasting applications

• Future plans and challenges ahead for the use of data from new satellites

S07-4

Next Generation LEO Hyperspectral Sensor IFOV Size Impact on the High-Resolution NWP Model Forecast Performance – An OSSE Study

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Major operational Numerical Weather Prediction (NWP) centers throughout the world are moving in the direction of high spatial resolution forecasts. Spatial resolution of satellite observations needs to increase to maintain its positive influence on forecast improvements. Impact of IFOV size for CrIS on NWP will be assessed through satellite data assimilation using the NCEP Global Forecast System (GFS) in the presence of existing observing network. As CrIS with a smaller IFOV is not yet available, impact assessment will be performed in a simulated environment, also known as an Observing System Simulation Experiment (OSSE). CrIS observations at both the current and increased resolution are simulated from a known state of the atmosphere or the Nature Run. The control run assimilates CrIS observations at the current resolution (14km @ nadir) and the experiment run assimilates CrIS observations that have a smaller IFOV. The quantitative assessment of the smaller IFOV of the next generation CrIS impact on forecasts will be presented to support NOAA JPSS program in the optimization of sensor specification.

Session 8

Application of satellite data to climate and environment monitoring

S08-1

Building the High-Quality Sensor Data Records from NOAA Operational Satellites for Climate and Weather Applications

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Long-term climate data records can be developed from the observations of the operational satellite systems. The operational weather satellites are designed primarily to provide measurements for short-term weather and environmental prediction. Instrument calibrations lack traceability to International Standards (SI) units, sensors and onboard calibration sources degrade in orbit, long term data sets must be stitched together from a series of overlapping satellite observations, orbital drift—leading to a changing time of satellite observing time during the satellite's lifetime—introduces artifacts into long term time series, and, most importantly, insufficient attention is paid to pre- and post-launch instrument characterization and calibration. This study presents a series of efforts conducted in NOAA to reduce inter-satellite measurement biases to help meet climate monitoring and NWP data assimilation applications. In the past decades, we have developed advanced algorithms for cross-calibration of microwave and infrared measurements to their respective reference instruments. For example, microwave sounding instruments from MSU, AMSU and ATMS are spatially re-sampled prior to simultaneous nadir overpassing (SNO) collocations. The resulted climate data records after cross-calibration display continuity and reasonable trends. Recently, an effort was also made to develop an atmospheric temperature profile from MSU/AMSU using 1dvar retrieval system. It is found that the temperature near tropopause shows much stronger warming than that previously derived from radiosondes and MSU radiances. This new temperature data set can be used for directly validating the climate model results. It is also demonstrated that the emission and scattering from precipitating clouds have significant influence on the temperature trends from microwave sounding instruments and the impacts and implications of their presence in the MSU radiance set and the 1dvar retrievals on the tropospheric trend are assessed

S08-3

Occurrence of extreme rainfall events associated with the Madden-Julian Oscillation

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The relation between intraseasonal rainfall variability over Indonesia and the Madden-Julian Oscillation (MJO) is investigated as well as its relationship with large-scale atmospheric circulation, by using pentad-mean TRMM (Tropical Rainfall Measurement Mission) precipitation data. The focus is placed on the boreal winter when most of the country experiences rainy season. The frequency of occurrence of extreme rainfall in Indonesian region is examined for each phase of the MJO. To begin with, extreme rainfall events are defined by using a threshold value of 20 mm/day, which is determined based on detail examination of the rainfall histogram at various places. By assessing the frequency distribution of rainfall at each MJO phase at six selected areas (three from over the seas and three from over the land), it is found that frequency of extreme rainfall is significantly larger during the wet phase than the dry phase of the MJO over both the seas and the land. Thirteen and twenty extreme rainfall events are identified in central part of Sumatra and Java Sea, respectively, and the lagged composite of TRMM precipitation and OLR anomalies are made for each case. A spatially-coherent pattern of rainfall and OLR anomalies are observed as well as their eastward propagation in both cases, suggesting that the extreme rainfall in those regions is preferably induced during the MJO wet phase. A typical extreme event during November through December 2002 is further examined. By investigating rainfall anomalies and evolution of OLR and circulation anomalies, it is again shown that the frequency of occurrence of extreme rainfall is affected by eastward-propagating large-scale convective system of the MJO.

S08-4

GOCI Yonsei aerosol retrievals during 2012 DRAGON-NE Asia and 2015 MAPS-Seoul campaigns

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The Geostationary Ocean Color Imager (GOCI) onboard Communication, Ocean, and Meteorological Satellite (COMS) started to operate in March 2011, and data have been archived more than 5 years. GOCI Yonsei aerosol retrieval (YAER) algorithm was developed and has been improved continuously so that it can provide hourly aerosol optical properties (AOPs), mainly aerosol optical depth (AOD) over East Asia. During that period, meanwhile, there were two field campaigns to obtain characteristics of AOPs over East Asia. One is DRAGON-NE Asia 2012 campaign (March-May), and another is 2015 MAPS-Seoul campaign (May-June), which is a pre-campaign for KORUS-AQ in 2016. Those field campaigns are very effective to evaluate algorithm performance. Especially, one of main purposes of those campaigns is to understand AOPs over megacities such as Seoul and Osaka. In this study, retrieved GOCI YAER AOPs are analyzed with those retrieved from ground-based AERONET sunphotometer measurements and other satellite data during two field campaigns. Several analyses such as cases study of dust and haze long-range transport, diurnal variation detection, algorithm evaluation, and application to air quality simulations are carried out. Collaboration between ground-based and geostationary satellite measurements and air-quality modeling can provide more intensive understandings about aerosol monitoring.

Session 9

Land surface and ocean parameters derived from

satellite observations

S09-1

Comparison between TRMM-TMI microwave land surface emissivity maps derived from JRA-25 and ERA-Interim

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Microwave land surface emissivity maps have been made from a brightness temperature of Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI), and land surface temperature (T) and atmospheric profile data of reanalysis data for rain-free scenes that the TRMM Precipitation Radar (PR) identify. As reanalysis data, Japanese 25-year Reanalysis Project (JRA-25) and the European Center for Medium Range Weather Forecast (ECMWF) Interim Re-Analysis (ERA-interim) are used. The emissivity maps estimated from both reanalysis data are similar but not the same. Estimated emissivity depends on used T. The cause of some 19 GHz vertical emissivity overestimations implies that their Ts are underestimated at each some region. Moreover, emissivity times T is compared. This is very similar with each other for all channels. It is confirmed that the difference of emissivities are mainly derived from the difference of surface temperatures between JRA-25 and ERA-Interim.

S09-2

Operational Utilization of Ocean Surface Vector Winds from RapidScat Scatterometer

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NASA launched RapidScat to the International Space Station (ISS) on September 21, 2014 on a two-year mission to support global monitoring of ocean winds for improved weather forecasting and climate studies. The JPL-developed space-based scatterometer is conically scanning and operates at ku-band (13.4 GHz) similar to QuikSCAT. The ISS-RapidScat's measurement swath is approximately 900 kilometers and covers the majority of the ocean between 51.6 degrees north and south latitude (approximately from north of Vancouver, Canada, to the southern tip of Patagonia) in 48 hours. RapidScat data are currently being posted at a spacing of 25 kilometers, but a version to be released in the near future will improve the postings to 12.5 kilometers. RapidScat ocean surface wind vector data are being provided in near real-time to NOAA, and other operational users such as the U.S. Navy, the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the Indian Space Research Organisation (ISRO) and the Royal Netherlands Meteorological Institute (KNMI).

Scatterometers have been impacting NOAA operations since the launch of QuikSCAT satellite in 1999. These winds revolutionized marine weather forecasting and warning functions at National Weather Service. Near real time utilization of RapidSCAT data in NOAA operations will be presented and impacts on weather data products will be discussed

S09-3

NOAA GCOM-W1/AMSR2 Oceanic Environmental Products: Operational Utilization and User Impacts

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Passive microwave radiometry is a special application of microwave communications technology for the purpose of collecting Earth's electromagnetic radiation. With the use of radiometers onboard earth orbiting satellites, scientists are able to monitor the Earth's environment and climate system on both short- and long-term temporal scales with near global coverage.

The Global Change Observation Mission (GCOM) is part of the Japanese Aerospace Exploration Agency (JAXA) broader commitment toward global and long-term observation of the Earth's environment. GCOM consists of two polar orbiting satellite series, GCOM-W (Water) and GCOM-C (Climate), with 1-year overlap between them for inter-calibration.

NOAA users routinely use AMSR2 data globally for monitoring ocean storms and for monitoring snow and ice over polar regions.   Every orbit of data is used in blended product analysis, including global precipitation and tropical rainfall potential, total precipitable water, and snow and ice cover.

The AMSR2 imagery is critical to National Weather Service for monitoring tropical cyclone development.   The much higher spatial resolution AMSR2 provides significant information on precipitation intensity and cyclone structure in the open waters, which is very important for assessing cyclone development.

NOAA produced AMSR2 ocean global products validation and its impact on near real time operations will be presented and discusse

S09-5

A comparative study on the creation of multi-satellite SST ensemble using OI and BMA.

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Sea surface temperature(SST) is an important parameter to understand global climate change and numerical weather prediction. So, to retrieve accurate SST have been very important issue. SST is detected with various satellite-born instruments. SST delivered from satellite have an advantage that is to provide a spatially continuous and consistent dataset. However the satellite products have uncertainty. Also the amount of the uncertainties is different due to difference in sensor and retrieval algorithms. To reduce the inherent uncertainties, statistical methods such as data assimilation and ensemble have been used. In this study, multi-SST product will be created using Bayesian model averaging(BMA) and optimal interpolation(OI) of the statistical methods, and be compared each other. The BMA is weighted averaging using the posterior probability as weight. BMA can consider difference in amount of uncertainty. OI is statistical methods to minimize error variance to reference data for data synthesis and gaps interpolation. In this study, the Moderate Resolution Imaging Spectroradiometer(MODIS) and Advanced Microwave Scanning Radiometer-EOS(AMSR-E) of Aqua and Advanced Very High Resolution Radiometer(AVHRR) of NOAA are used as ensemble members. And Advanced Along-Track Scanning Radiometer(AATSR) of Environmental Satellite(EnviSat) is used as reference data. The match-up data set consist of SST product for 3 years from 2006 to 2008. And 36,000 random sample data were extracted for 36 months(i.e., 1,000 samples per month). And then The posterior probability and covariance are calculated through analysis with reference data. The leave-one-out method was employed for the training and validation of a 36-month dataset. Finally, the two ensemble SST will be compared in various aspects such as RMSE and the cost of calculation.

Session 10

Capacity development and training activities

S10-1

A Review of the Australian VLab Centre of Excellence National Himawari-8 Training Campaign

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Bureau of Meteorology Training Centre (BMTC), Australian Bureau of Meteorology (BOM)

The Australian VLab Centre of Excellence National Himawari-8 Training Campaign was launched on the 23rd January 2015 by the VLab Manager Mr. Roger Deslandes. The Campaign's objective is to assist Australian Bureau of Meteorology, WMO Region V and other stakeholders in preparing for the effective use of Himawari-8 data. During this presentation the Campaign will be discussed in the context of the following:

• Planning the Campaign, including mapping the familiarisation and training activities to appropriate WMO-1083 capabilities and the BMTC/EUMETSAT Satellite Enabling Skills document.

• How existing satellite resources were utilised to simulate Himawari-8 data prior to the availability of this data.

• Collaboration with and gaining stakeholder engagement

• Sourcing, utilising, compiling and disseminating satellite meteorology training resources to stakeholders within the context of the WMO Global Campus concept.

• A summary of the achievements of the Campaign to date, and plans for the future.

S10-2

The Himawari training program for NWS Pacific Region meteorologists

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Weather forecast operations at the National Weather Service (NWS) in Guam are heavily dependent on the Japan Meteorological Agency (JMA) geostationary satellite, since the Geostationary Operational Environmental Satellites (GOES) do not observe the western Pacific basin, and Guam is otherwise in a geographical region lacking extensive in-situ observations. Fortunately, the imagers on the JMA satellite and GOES have historically been similar, so special training for Guam has been unnecessary in the past. While the Advanced Himawari Imager (AHI) is very similar to the Advanced Baseline Imager (ABI) on GOES-R, forecasters in Guam will be exposed to the improved spatial, spectral, and temporal resolution of the AHI imagery well before forecasters in the rest of the United States have access to ABI imagery.

In order to prepare operational meteorologists at NWS Guam for the capabilities of AHI, the NWS is investing in a new prototype training method where trainers are dispatched to the field office to lead forecasters in several four-hour sessions over two to three days. Some of the sessions are tailored with examples from the common meteorological challenges and scenarios in the tropics. In each session, participants will hear a short presentation from a subject-matter expert (SME) and then, in small groups, investigate real imagery using a software application specifically designed for the training environment, with oversight from the SME. The intent of the immersive environment is for forecasters to obtain the necessary background knowledge about the satellite instrument and imagery, and then learn more about the relevant applications to operational meteorology and their local area through viewing and interrogating the imagery in a guided lab setting.

This presentation will outline the curriculum for the NWS Guam Himawari training, highlight certain course materials, discuss the training software application, and propose future uses for this training delivery method in the context of the broader NWS training initiatives that are underway to assure United States meteorologists are well prepared for the GOES-R ABI.

With continued success and funding, this course could be tailored for other NWS field offices and potentially international users.

S10-3

Asia-Oceania Online Users Forum: Himawari-8 Real-time Web Application

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(1) National Institute of Information and Communications Technology,
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The Asia and Oceania area is frequently damaged by natural phenomena such as tropical cyclones, torrential monsoons, volcanic eruptions, yellow sand storms, floods, sea ice and wildfires. Roles of real-time monitoring of the climate and environment is thus getting important. In this area, meteorological satellite, Himawari-8, provides us with observational information for disaster prevention and climate monitoring.

Against these background, JMA (Japan Meteorological Agency) launched a new satellite, Himawari-8. in 2014. The big-data yielded by the satellite are processed almost in real-time and gets open through 4 facilities in Japan. The NICT (National Institute of Information and Communications Technology) is one of the four facilities; The NICT Science Cloud (http://sc-web.nict.go.jp) plays a central role of crawling, transfer, processing, visualizing and operating visualized data through an web application (Himawari-8 real-time web application; http://himawari8.nict.go.jp). This web application works not only on PC (Windows or Macintosh), but on smart-phone or slate PC (Android or iOS). The basic concept of this application is "get real-time climate view anywhere and anytime." For available uses of this web application for Asia-Oceania people, we need many helps from countries in this area. Multi-language design, data and information exchange, demonstration and auto-reaching, and research works are crucial. We kicked off "The Asia-Oceania Online Users Forum: Himawari-8 Real-time Web Application" to collaborate each other to develop this web application. In the present talk, we first demonstrate our Himawari-8 real-time web application. One may understand that everyone in his/her country can take a real-time view of the Himawari data on his/her PC and mobile-phone anytime and anywhere. Next we solicit all of the attending countries to join the Asia-Oceania Online Users Forum for the Himawari-8 Real-time Web Application. What is expected to members is to translate our application (messages showing up on the terminal) into your native language.

Poster Presentations

P01

JPSS DATA PRODUCTS CALIBRATION/VALIDATION UPDATES

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The Joint Polar Satellite System (JPSS) is the National Oceanic and Atmospheric Administration's (NOAA) next-generation operational Earth observation program that acquires and distributes global environmental data primarily from multiple polar-orbiting satellites. The first JPSS satellite mission, the Suomi National Polar-orbiting Partnership (S-NPP) satellite, was successfully launched in October 2011. S-NPP, along with the legacy NOAA Polar Operational Environmental Satellites (POES), provides continuous environmental observations. Two JPSS satellites will follow S-NPP: JPSS-1, planned for launch in fiscal year (FY) 2017, with JPSS-2 to follow in FY 2022.

NOAA/NESDIS/STAR established JPSS-STAR (JSTAR) Program to provide managerial and technical expertise for the JPSS Sensor Data Record (SDR) and Environmental Data Record (EDR) algorithms. JSTAR SDR and EDR science teams have been formed to conduct detailed work on calibration/validation/evaluation, updating, and maintaining of the algorithms for the SDR and EDR products.

To assure that the quality of the products and the performance of the algorithms meet the requirements, Beta, Provisional, and Validated maturity levels have been defined to track the algorithm calibration/validation maturity status. The maturity status is measured by comparing the performance of the algorithm against the requirements as well as the level of validation accomplished. Declaring SDR/EDR product maturity is the result of a readiness review that documents whether the products meet a series of criteria defined for each maturity stage. Thus far, all the S-NPP SDR products and most of the EDRs have reached the validated maturity level. With the approach of JPSS-1 launch, JSTAR SDR and EDR teams are working on the JPSS-1 Calibration/Validation Plan based on the lessons learned from S-NPP. The schedule for the maturity of the JPSS-1 data products is expected to be accelerated compared to that of S-NPP.

This presentation presents an overview of the JPSS Algorithm Calibration/Validation updates as part of JSTAR quality assurance (QA) management. Detailed S-NPP product maturity status, JPSS-1 Cal/Val timeline, Cal/Val methodology/strategy, test data sets, and Cal/Val schedules/milestones are described in this presentation.

P02

Post-GPM rain retrieval and 3-D wind retrieval: the DYCECT mission

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LATMOS-IPSL, CNRS-UVSQ-UPMC

GPM-core (Global Precipitation Mission) was launched in the spring 2014 and the post-GPM era is already in the decision/design phase. This is why it is time to investigate future possible missions to be launched. We propose here to study the feasibility of a mission that would carry a scanning polarimetric Doppler radar: DYCECT. This mission would not only be able to measure rain but also to build instantaneous wind fields and statistics of dynamics in convection and to retrieve the microphysical properties of precipitating ice.

Indeed, the critical variables that have not been measured so far by satellite-borne instruments are the three components of the wind field in the convection. Scanning radars with Doppler capability could allow us to retrieve dynamic information along with the rain estimates. This dynamic information would not only be a breakthrough in terms of our knowledge of convective properties (specifically over deep ocean) but also, dynamics can be a help to improve retrieval of rain because of the strong connection between the latter and microphysics.

In 2018, the EarthCare ESA-JAXA mission will see the first Doppler cloud radar (nadir pointing). In parallel ESA's ADM-AEOLUS with a Doppler lidar will provide some hints about the global dynamics. DYCECT will come to complement these missions, benefiting of these first results and going one step further.

P03

Status of the GeoKompsat-2A AMI rainfall potential algorithm

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A statistical algorithm to predict the accumulated rainfall for short lead times of 0-3 hours has been developed for the Advanced Meteorological Imager (AMI) onboard the GeoKompsat-2A (GK-2A). The GK-2A is the second geostationary satellite that uses 16 channels at the finer resolutions compared to the first generation. The AMI rainfall potential algorithm is designed for nowcasting of rainfall accumulations during 0 to 3 hours based on the extrapolation and image segmentation of the outputs from the AMI rainfall rate algorithm. The algorithm is divided into two processes: the identification of rainfall feature and the tracking of rainfall feature. The rainfall features have been identified by three procedures including smoothing, thresholding, and developing region discrimination. Tracking the motion vector of the rainfall feature is then implemented by using the coefficient of variation, the mean absolute error, and the weight function. Once the motion vector is measured, the rainfall potential is advected forward by one time step (15 min for the AMI). The preliminary results of the algorithm and ongoing works will be discussed.

P04

The Cyclone Global Navigation Satellite System (CYGNSS) – Mission Overview and Wind Product Assessment

Zorana Jelenak(1), Paul S. Chang(2), Seubson Soisuvarn(1), Faozi Said(3)

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The Cyclone Global Navigation Satellite System (CYGNSS) is a new NASA Earth science mission scheduled to be launched in 2016 that focuses on tropical cyclones (TC) and tropical convection. The mission's two primary objectives are the measurement of ocean surface wind speed with sufficient temporal resolution to resolve short time scale processes such as the rapid intensification phase of TC development, and the ability of its surface observations to penetrate through the extremely high precipitation rates typically encountered in the TC inner core. The mission's goal is to support significant improvements in our ability to forecast TC track, intensity and storm surge through better observations and, ultimately, better understanding of inner core processes. CYGNSS meets its temporal sampling objective by deploying a constellation of eight satellites. Its ability to see through heavy precipitation is enabled by its operation as a bistatic radar using low frequency GPS signals. The mission will deploy an eight spacecraft constellation in a low inclination (35°) circular orbit to maximize coverage and sampling in the tropics.

Sensitivities of reflected GPS signals to ocean wind based on TechDemoSat-1 GNSS receiver as it applies to CYGNSS mission will be discussed and presented.

P05

GOES-R Proving Ground Activities at CIRA

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The next generation Geostationary Operational Environmental Satellites (GOES) environmental satellite systems, beginning with GOES-R, will contain a number of advanced instruments including the Advanced Baseline Imager (ABI). GOES-R ABI will provide much higher spatial and temporal resolution imagery than the current GOES.

The GOES-R Proving Ground provides for an opportunity for National Weather Service (NWS) forecasters and other operational users of satellite data to be introduced to and trained on the new GOES-R capabilities. It also provides for operational forecasters to have an impact on the products they will see after GOES-R has been launched. The key to accomplishing this task is to emulate potential GOES-R products so that forecasters can provide feedback to developers before the satellite is launched. An additional benefit to the operational community is training on products and more familiarity with new capabilities and products so that they can be utilized fully as soon as they become operationally available.

CIRA has been involved in GOES-R product development and has been interacting closely on GOES-R product evaluations with NWS Weather Service Offices and NWS National Centers for many years. In this talk we will give an update on CIRA's current Proving Ground efforts, including a discussion of the latest products being tested and the feedback we have received.

P06

Using Himawari-8 to Prepare Algorithms for GOES-R

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The Algorithm Scientific Software Integration and System Transition Team (ASSISTT) at STAR maintain and update the STAR Algorithm Processing Framework (SAPF), a data processing framework initially used for the GOES-R Algorithm Working Group's (AWG) data processing.   This system provides an environment for algorithm development and testing along with the ability to process multiple algorithms in sequence with product precedence. Most of the GOES-R AWG algorithms have already been modified to process different satellite datasets as well as simulated data. The data from the Advanced Himawari Imager (AHI) on board the Himawari-8 satellite has been added to SAPF since it is a close proxy of the GOES-R Advanced Baseline Imager (ABI) instrument.   This presentation describes the efforts to enable the AWG cloud and aerosol algorithms in SAPF for AHI data, including both the GOES-R baseline version algorithms developed by the AWG and the updated version used to create Visible Infrared Imaging Radiometer Suite (VIIRS) products. Updates to SAPF and the AWG algorithms along with sample results will be shown. Testing these algorithms with AHI data will provide a preview of the science data products that can be anticipated from the ABI itself.

P07

Diurnal and seasonal variations of inter-calibration for COMS Infrared channels

Minju Gu and Dohyeong Kim

KMA/NMSC

COMS (Communication, Ocean, and Meteorological Satellite) Meteorological Imager (MI) has been monitored following Global Space-based Inter-Calibration System (GSICS) since April 2011. KMA use four well-calibrated hyper-spectral instrument on Low Earth Orbit (LEO) satellites, Atmospheric Infrared Sounder(AIRS) onboard Aqua, Infrared Atmospheric Sounding Interferometer(IASI) onboard MetOp-A /B and Cross-track Infrared Sounder (CrIS) onboard Suomi NPP (SNPP), as references for inter-calibration of four infrared (IR) channels of COMS. Mean brightness temperature(TB) biases of MI-IASI/A inter-comparison are 0.29K for IR1 (10.8 μm), 0.22K for IR2 (12.0 μm), -0.75K for IR3 (6.7 μm), and 0.04K for IR4 (3.7 μm) from April 2011 to December 2014. Mean TB bias of MI-IASI/B are 0.33K, 0.28K, -0.77K, and 0.05K, reapectively from August 2013 to December 2014. Mean TB bias of MI- AIRS are 0.22K, 0.22K, -1.00K and 0.18K, respectively, from April 2011 to December 2014. Mean biases of MI-CrIS are 0.14K, 0.17K , -0.91K and -1.44K, respectively, from January 2014 to December 2014. The mean biases of MetOp-B shows slightly larger than those of MetOp-A through the all four channels.

In addition, seasonal variation of inter-calibration for COMS-LEO is examined for 4 years accumulated observation data. Mean TB biases of MI-AIRS and MI-IASI show the different pattern that is, MI-AIRS has two peaks around March and September-October while MI-IASI has one peak around August-September. The difference between minimum and maximum values are 0K~0.4K for IR1 and IR2, -1.1K~0.3K for IR3 and -0.2K~1.5K for IR4 while 0.1K~0.5K for IR1 and IR2, -0.9K~-0.6K for IR3 and -0.35K~0.25K for IR4.

With the different equatorial crossing time with mid-morning orbit (MetOp-A and MetOp-B) and afternoon orbit (Aqua and SNPP), the diurnal variation of mean bias of COMS/MI IR channels could be examined in spite of time-gap between two orbits. In result, inter-calibration coefficients of IR1 and IR2 such as slope or bias seem to be relatively stable with respect to observation time in a day. But for IR3, the negative bias increases from around -0.9K at daytime to -1.2K at the local midnight. Both AIRS and CrIS show the same diurnal pattern, although the negative biases of MI-AIRS are slightly larger than those of

MI-CrIS. The further investigation is needed for the diurnal variation of COMS WV channel. IR4 shows relatively large variation which may be caused by stray light contamination including lunar radiance and/or by midnight effect due to the extra heating of scan mirror for three-axis body-stabilized geosynchronous satellite. The impacts of temporal variations of inter-calibration results need to be investigated before utilization of the GSICS correction products.

P08

Visible channel calibration of JMA's geostationary satellites using the Moon images

Masaya Takahashi and Arata Okuyama

JMA/MSC

The Moon is one of the invariant calibration targets without atmosphere and has been captured by historical geostationary meteorological satellites such as GMS-5 and MTSAT-2 by chance. A new generation geostationary meteorological satellite, Himawari-8 can observe the Moon as much as possible using super rapid-scanning mode performed every 30 seconds. Radiometric calibration system using lunar observation is based on the GSICS Implementation of the ROLO model (GIRO), which provides reference lunar irradiances. These lunar observation data are very useful for estimating long term instrument degradation due to its small uncertainty. A total of 62 and 2979 lunar images derived from MTSAT-2/Imager and Himawari-8/AHI observation are used in this study. A 2.71% annual drift of MTSAT-2/Imager visible channel with a 0.15% uncertainty shows good agreements with other post-launch calibration using deep convective clouds and radiative transfer simulation. Frequent lunar observations by AHI are expected be of help not only to enhance its calibration capability but also to improve the reference model. A preliminary result of Himawari-8/AHI visible and near-infrared bands will also be presented.

P09

An Introduction to Himawari-8 Cloud Products

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JMA/MSC

The Himawari-8 is the next generation geostationary meteorological satellite of Japan Meteorological Agency (JMA), and it has entered operations on 7 July 2015. The satellite carries the Advanced Himawari Imager (AHI), which is greatly improved than past ones in terms of the number of observation bands and temporal/spatial resolution.

The Meteorological Satellite Center (MSC) has developed the AHI Cloud Product (ACP), which consists of cloud mask, type, phase and top height. The cloud mask, type and phase are detected using threshold tests, and the cloud top height is retrieved by 3 methods (e.g., radiance fitting, radiance rationing and intercept method) depending on the cloud type. These techniques are based on NWC-SAF and NOAA/NESDIS cloud algorithm. The ACP is used for the AHI level 2 products (e.g., CSR and SST) in MSC. Spatial resolution of the ACP is the same with the Himawari Standard Data of infrared bands (i.e., 2km at sub satellite point), and it created every one hour. The ACP was evaluated by comparison with the MODIS cloud product (MYD06, 35 C6) during 2 weeks in Sep. 2015. As a result, the cloud mask hit rate was above 80%, and the cloud phase captured some 90% for ice and some 70% for water. The cloud top height was compared with the CALIPSO product (L2 1km V3.30). Although bias errors of low and middle level cloud were within some +1000m (positive means the ACP is higher), that of high level cloud reached -4000m.

The High-resolution Cloud Analysis Information (HCAI) is created from the ACP. The HCAI is the successor product of the Satellite Cloud Grid Information Data (SCGID) in MSC. The HCAI is composed cloud mask, type, top height, dust mask, snow ice mask and quality control information. Spatial resolution of the HCAI is 0.02° in both latitude and longitude, and it is higher than that of the SCGID whose resolution was 0.20° in latitude and 0.25° in longitude. Due to high resolution, the HCAI can capture local cumulonimbus that cannot be captured by the SCGID. In addition, it is possible to detect cloud top surface clearly. Thus, misclassifications of stratocumulus around stratus or fog are reduced. The HCAI has been operational since Himawari-8 began, and it has been disseminated to Myanmar and Indonesia with modified spatial resolution and limited region.

P11

Atmospheric Motion Vectors derived from Himawari-8

Kazuki Shimoji

JMA/MSC

The Japan Meteorological Agency (JMA) launched Himawari8 satellite in 2014 and started its operation in July 2015. It is the next generation Japanese geostationary meteorological satellites following to previous operational satellite MTSAT2 (Himawari7).

The agency also plans to launch Himawari9 in 2016 as a backup for Himawari8.

Himawari8 and 9 carry Advanced Himawari Imager (AHI) units comparable to the Advanced Baseline Imager (ABI) on board GOESR of the National Ocean and Atmosphere Administration / the National Environmental Satellite, Data, and Information Service (NOAA/NESDIS) in the United States. The observing functions of AHI were significantly enhanced from those of MTSAT2: multispectral capacity (16 bands), high spatial resolution (0.5 – 1.0 km for visible and 1 – 2 km for infrared), fast imaging (within 10 minutes for full disk), and rapid scanning with flexible area selection and scheduling. These upgrades of imager enable to retrieve more Atmospheric Motion Vectors (AMVs) with more accuracy than before. AMVs are satellitederived wind vectors obtained from consecutive satellites images by tracing cloud features and estimating its clouds height.

AMVs are computed and disseminated by satellite operation centers and assimilated by numerical weather prediction centers for computing analysis field. JMA have started to dissemination of Himawari8 AMVs since 7th July 2015 via Global Telecommunication System (GTS). In this presentation, Himawari8 AMV tracking algorithm using three or more consecutive images for finding timely consistent motion vector, cloud height estimation technique using multiple bands simultaneously for one targeted cloud and statistical validation result will be shown.

P12

Research to Operations: The STAR Enterprise Winds Algorithm on Himawari-8 for Algorithm Continuity in Operations

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The Enterprise Derived Motion Winds (DMW) is an algorithm developed by NOAA/NESDIS/STAR to retrieve environmental variables such as wind speed and wind direction. This algorithm has been implemented within the STAR Algorithm Processing Framework (SAPF) originally designed for GOES-R and has been adapted to run on Suomi-NPP Data Exploitation (NDE) and Consolidated High-throughput Operational Products System (CHOPS) operational processing systems. Data from the Advanced Himawari Imager (AHI) on board the Himawari-8 satellite has been added to SAPF since it is a close proxy of the GOES-R Advanced Baseline Imager (ABI) instrument. The Enterprise DMW products have been requested by the National Weather Service (NWS) Field Offices and will be produced from the SAPF.

The Algorithm Scientific Software Integration and System Transition Team (ASSISTT) at STAR has developed Near Real-Time (NRT) processing systems for product generation by using SAPF. The NRT system helps ASSISTT prepare for algorithm transition from research to operations (R2O). Because of the successful role the NRT processing has played in previous R2O projects, ASSISTT will run the Enterprise DMW algorithm pseudo-operationally to meet the NWS Field Office need until operations is ready for the transition. Updates to SAPF to produce the Enterprise DMW products along with the pseudo-operational methodology will be discussed.

P13

Use of upper-tropospheric Atmospheric Motion Vectors (AMV) for diagnosing tropical cyclone intensity

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Geostationary satellite imagery at intervals less than about 10 minutes, which is called rapid-scan imagery, enable to derive high-density Atmospheric Motion Vectors (AMV) even in tropical cyclone (TC) where the direction of cloud motion abruptly changes. This study derived upper-tropospheric AMVs over TC areas from MTSAT imagery at 15 minutes intervals by the JMA/MSC algorithm, and investigated the relationship between TC upper-tropospheric cyclonic vortex intensity from the AMVs (referred to as UMaxWind) and TC maximum sustained wind (MSW) of JMA best-track data. The research for 27 TCs in 2011-2014 showed that the correlation between UMaxWind and MSW was 0.74～0.77. It was also found that possible bias and root mean square error of estimated MSW from UMaxWind were -0.05～-1.32 m/s and 6.66～7.66 m/s, respectively. These results suggest that the diagnosis of MSW by using the upper-tropospheric AMVs is promising. We have another interest on how UMaxWind is related to the upper-tropospheric outflow and convection near TC center which possibly reflect the vertical transportation of absolute angular momentum from the surface. Investigations for this interest will be also presented using MTSAT and Himawari-8 AMVs.

P14

Current and Future Korean Geostationary Satellite AMV Quality Control Method

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Atmospheric Motion Vector (AMV) is very important data for numerical weather prediction (NWP) models as that provides valuable wind information. To get quality information of each vector, Quality Control (QC) is needed. There are two popular QC schemes are used which is Quality Indicator and (QI) (Holmund, 1998) Expected Error (EE) (Le Marshall, 2004) scheme. The QI is simple scheme that consists of five vector consistency tests. The EE is essentially an extension of the QI, but provides an output in the form of expected root-mean square error for each vector. For EE calculation, the five QI tests results and AMV's speed, pressure, NWP model vertical temperature gradient, and wind shear are needed. These values are used to extract linearly regression coefficients for EE calculation.

  We will present AMV QC (only QI) characteristics of Current Korean geostationary satellite (COMS) as well as its improvements, and AMV QC plans (QI + EE) for the next Korean geostationary satellite Geo-Kompsat-2A (GK-2A).

P15

Analysis of atmospheric motion vector tracking process

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A study of tracking process for developing the atmospheric motion vector (AMV) algorithm for COMS (Communication, Ocean, and Meteorological Satellite) MI (Meteorological Imager) is described. The typical way of AMV displacement is derived by tracking clouds or water vapor features in consecutive geostationary satellite images by assuming that cloud moves at a constant level and does change shape over time interval of an image sequence. To analyze and improve traditional tracking process, we have tested the coldest cluster within a reference target because features are appeared to be less deformed in a short-term image sequence. In this study, we have adapted Gaussian Mixture Model to extract the coldest cluster, adjusted target size and transformed target image. In selecting target image, we have performed image filtering based on that cloud pixels of highest cloud layer, which is assumed to be core, provide higher weight than cloud edge and clear pixels. The filtered target image in reference time is then used for the tracking. The comparison shows some improvement of our filter method over the operational COMS AMV. This approach may improve the current problems in tracking AMV.

P16

Study of sulfur dioxide detection over East-Asian.

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Sulfur dioxide (SO_2) is the primary gas constituting the background atmosphere and is a colorless and pungent gas. SO_2 is a direct effect on the health as the pollutant and affects also the climate impact. According to SO_2 absorption on the mid-infrared spectrum from 6.25-9.09 μm, geostationary satellite is difficult in SO_2 detection because geostationary has insufficient number of channels. Recently, it is possible to detect the SO_2 using geostationary satellite due to an increase of number of channels. In this study, we apply the Brightness Temperature Differences (BTD) method and effective absorption optical depth ratios to Moderate Resolution Imaging Spectroradiometer (MODIS) satellite which has similar channels with Geo-KOMPSAT-2A (GK2A). And then, we evaluate the possibility of SO_2 detection using geostationary satellite, GK2A over East-Asian. This study will provide the sulfur dioxide detection algorithm using GK2A scheduled in 2018.

P17

Frequency change of Asian dust events depending on surface conditions

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Asian dust outbreaks are known to be related to soil cohesion that is reinforced when surface condition is wet. This study is to investigate the frequency change of Asian dust events depending on surface conditions. The variables that explained the frequency change of Asian dust are tried to be found, and the thresholds for the index of the Asian dust occurrence depending on surface and hydrologic variables are determined. The data used in this study are surface synoptic observations (SYNOP), satellite-derived soil moisture, normalized difference vegetation index (NDVI), land surface temperature (LST), evapotranspiration (ET), precipitation, and snow cover fraction (SCF) over East Asia (30°N to 50°N and 90°E to 125°E) from January 2000 to April 2015. The present weather codes 7, 8 and 9 from SYNOP are assumed to be an indication of dust outbreak on the observation station. About 90% of Asian dust occurs on condition that soil moisture is below 9.5%; NDVI, below 0.259; LST, above 275.2 K; ET, below 25.9 mm/month; precipitation, below 30.3 mm/month; and SCF, below 4.3%. In order to analyze the effect of surface condition on dust outbreak, the normalized indices are introduced for each variable. Especially, the ratio for actual ET and potential ET (AET/PET) is considered and the AET/PET is found to be the variable to explain the frequency change of Asian dust events best among surface and hydrologic variables. Around 68.41% of Asian dust occurs in case the normalized ratio of AET/PET has negative value. When the normalized index for each variable is negative, Asian dust is more likely to occur as well and the occurrence percentage shows as follows: soil moisture, 55.75%; NDVI, 55.52%; evapotranspiration, 61.54%; and precipitation, 67.71%. On the other hand, when the normalized LST index has positive value, Asian dust happened about 58.00%. This study shows that surface conditions are important to diagnose Asian dust generation. The variables explained the frequency change of Asian dust events can help researcher to study Asian dust and to improve dust model.

P18

Aerosol monitoring over South Korea using COMS MI measurement for MAPS 2015 and DRAGON-Asia 2012

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Diverse efforts utilizing ground and satellite-based measurements have been applied to understand atmospheric environment over North East Asia (NEA). A geostationary satellite, COMS has been in operation since 2010 to monitor ocean and atmospheric condition for North East Pacific region. To capture aerosol variability in NEA, NASA science team and NIER of Korea conducted DRAGON-Asia campaign by deploying over 40 sun/sky-radiometers over South Korea and Japan from March to May, 2012. Subsequently, MAPS-Seoul campaign was performed from May to June, 2015 to assess the current status of air quality in the Seoul Metropolitan Area (SMA). For the MAPS-Seoul campaign, 8 sun/sky-radiometers were operated in South Korea together with other ground-based and airborne chemistry measurements.

While the campaign detected detail of aerosol characteristics at each local point, and AOD retrieval algorithm (Kim et al., 2014) using visible reflectance measured form a payload of the COMS, the MI, was in operation. The algorithm provides AOD distribution over an extensive area with high temporal resolution of up to 15 minutes, though it has limitation in detecting particle size or radiative absorptivity (SSA).

In this study, variability of aerosol characteristics in NEA during spring was analyzed by using the MI and those concentrated measurements in ground. Furthermore, the accuracy of the AOD retrieval algorithm was assessed by comparing the results with AERONET AODs, and the effects of the field campaigns on the improvement of satellite-based algorithm was discussed.

P19

AERUS-GEO: A new aerosol product based on MSG geostationary satellite observations

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The major difficulty in detecting the aerosol signal from visible and near-infrared remote sensing observations is to reach the proper separation of the components related to the atmosphere and the surface. This issue becomes especially challenging over bright targets such as deserts. A method is proposed to circumvent this issue by exploiting the directional and temporal dimensions of the satellite signal through the use of a semi-empirical kernel-driven model for the surface/atmosphere coupled system. As a result, simultaneous retrieval of surface albedo and aerosol properties is made possible. The proposed method proves to be capable of detecting and tracking the presence of anthropogenic aerosols, volcanic ash emissions and dust events over deserts.

The proposed method referred to as AERUS-GEO (Aerosol and surface albEdo Retrieval Using a directional Splitting method - application to GEO data) is applied to three spectral bands (0.6 mm, 0.8 mm, and 1.6 mm) of MSG (Meteosat Second Generation) observations, which scan Europe, Africa, and the Eastern part of South America every 15 minutes. The AERUS-GEO AOD estimates compare favorably with measurements of several AERONET stations, MODIS-derived (Moderate Resolution Imaging Spectro-radiometer), and MISR-derived (Multi-angle Imaging Spectro-Radiometer) products within a 20% of accuracy. Also, results reveal the capability of AERUS-GEO to detect more aerosol events within a given time period compared to products derived from low Earth orbit satellites. This higher availability of AOD products thanks to AERUS-GEO may benefit the accurate monitoring of the aerosol radiative forcing. The AERUS-GEO algorithm was recently implemented by the ICARE Data Center (http://www.icare.univ-lille1.fr), which operationally disseminates a daily AOD product at 670 nm over the MSG disk since 2014. Also, application of this method could be carried out with Himawari-8 data in the next years.

P20

Aerosol Optical Depth Retrieval over the snow from GOCI in winter season.

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Geostationary Ocean Color Imager(GOCI) sensor has provided real-time, hourly monitoring of aerosol properties the East Asian region. However, aerosol retrieval of aerosol properties over bright surface in the winter has been very difficult thus have not performed. So this study attempted the retrieval of aerosol properties over the snow cover from GOCI. Surface reflectance is obtained be taking second-maximum reflectance of the Rayleigh corrected reflectance using 11 day searching window. In addition, aerosol type is classified base on the AERONET as in Lee et al.(2010). However, snow surface has a high surface reflectance, it is very difficult to classify the aerosol type.

As a result, we can see a part which is not retrieved using the Yonsei aerosol retrieval(YAER) algorithm from the retrieved AOD in this study. These are looks like a smooth, but retrieved AOD show discontinuous. Because the snow reflectivity uncertain problems. It is difficult to assume the reflectance of snow, because snow removal work of the urban area, and polluted over the snow surface.

As no other data of the aerosol optical depth are available over snow surface from other satellites or AERONET, thus results were compared with the AOD using the DAI(Hsu et al., 2004) retrieved from GOCI.

P21

GOSAT thermal infrared data for meteorological use towards GOSAT-2

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The Greenhouse Gases Observing Satellite (GOSAT) is a Japanese mission to monitor greenhouse gases such as CO_2 and CH_4 from space. The GOSAT was launched on 23 January 2009 and obtains normal operation data over 6 years. The FTS covers wide wavelength range from SWIR 3 bands to TIR band from 5.5 to 14.3 microns by simultaneous observations with high spectral resolution.

The TIR band covers not only CO_2 and CH_4 absorption bands, but also skin temperature and water vapor channels. The sea surface temperature is estimated mainly from window channel after correction of water vapor. It is also useful for investigating the sensor stability for long time. Water vapor is an important atmospheric parameter by estimating from TIR band. Water vapor is validated by comparing with ground-based FTS, radiosonde and ground-based GPS receiver.

We will present the GOSAT TIR activity for meteorological use. These efforts will contribute to the next TIR mission such as GOSAT-2.

P22

Creating a high spatial resolution CO2 sensitive 13.3 µm channel for AVHRR and VIIRS

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The lack of any CO_2 absorption channel on AVHRR and VIIRS degrades the accuracy of the volcanic ash and cloud top pressure/height determinations as well as products related to thermodynamic phase. However, a high spatial resolution 13.3-µm CO_2 channel can be synthesized for AVHRR and VIIRS from a combination of imager and sounder radiances. The creation of a 13.3-µm "pseudo-channel" at the imager spatial resolution is a unique opportunity, possible because the top-of-atmosphere radiances at this wavelength have a contribution from both the surface (about 1/3 of the signal) and the atmosphere, primarily from CO_2 (about 2/3 of the signal). The atmospheric contribution from CO_2 is uniform enough so that sounder measurements (HIRS or IASI or CrIS) at coarser spatial resolution (~20 or 14 km) can be combined with the imager (AVHRR or VIIRS) window channel measurements to synthesize a 13.3-µm channel at imager spatial resolution (1 km or 750 m). The method is being developed and tested using MODIS and AIRS, since MODIS has measured 13.3-µm radiances for assessing the pseudo-channel radainces. Thereafter, the same approach can be applied to NOAA, S-NPP, and Metop.

P23

Correction of cloud effect in total column ozone measurement from PANDORA by using Kalman Filter

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Korea has a plan to launch the Geostationary Environment Monitoring Spectrometer (GEMS) into geostationary orbit in 2018 to monitor tropospheric air pollutant on hourly basis over East Asia. Because ground based measurements are required to validate ozone products from GEMS, we consider to use PANDORA instrument based on the DOAS method, which can provide hourly total column ozone (TCO) measurements even in the presence of aerosols and clouds. This study is to examine the performance of TCO from PANDORA, which was installed in Busan and Seoul, by comparing with TCO from Brewer, and OMI from March 2012 to December 2013. PANDORA TCO showed a high correlation of 0.99 with a negative bias of 2-3% relative to Brewer TCO. However, the correlation between PANDORA and OMI TCO was lower than that between Brewer and OMI TCO. We found that Brewer didn't provide TCO in the presence of clouds. However, even though PANDORA measurements were filtered out during thick cloudy condition, the PANDORA still showed unusual high ozone during thin cloudy condition. In order to have continuous PANDORA measurements for comparison with hourly GEMS measurements, the PANDORA measurements under thin cloudy condition are required to be corrected. We have performed the correction of PANDORA observations using Kalman filter which is a set of mathematical equations that provides an efficient computational solution of the least-squares method. When we applied this approach, the result showed the improvement in correlation between PANDORA and OMI TCO as much as that between Brewer and OMI TCO

P24

A New Technique for Nighttime Sea Fog Detection from Satellite of Applying Unsupervised Learning

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Satellite remote sensing has advantages in identifying sea fog area rather than ground measurements. At nighttime, dual channel difference (DCD) method using IR and shortwave IR channel have been mainly used to detect sea fog, because the visible channel is unavailable. However, it has some problems in identifying fog by containing a number of other clouds and clear pixels. To improve sea fog detection in nighttime, we have developed a new method of applying unsupervised learning, based on sea surface temperature and cloud top temperature difference (STD) along with brightness temperature difference (BTD). In the perspective of machine learning, DCD method can be classified into supervised learning, which utilizes predetermined threshold value. Our technique uses EM algorithm in conjunction with Gaussian mixture model without any predetermined thresholds. This makes apply the daily variable thresholds, including the atmospheric characteristics of the day. It showed reasonable results from CALIPSO data, and proposed a new direction for improving fog detection at further studies.

P25

Development of fog detection technique using COMS and GIS information in the Korean Peninsula

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In this study, we developed a fog detection algorithm based on the radiometric and textural properties of fog using Communication, Ocean, and Meteorological Satellite (COMS) data provided by National Meteorological Satellite Centre (NMSC) in Republic of Korea. As in many studies, we used the emissivity difference (DCD: Dual Channel Difference) between 3.9 μm and 11 μm channels for night time.

And high reflectance of visible channel is also used for the detection of fog during day time. In addition to that, smoothness of fog surface is used for the separation of fog form low stratus. In this study, we used the normalized LSD (localized standard deviation) of visible channel to minimize the effect of solar zenith angle along with the LSD of brightness temperature. The thresholds values used in this algorithm are derived empirically from COMS satellite data. The preliminary results of fog detection for the thick sea fog cases (e.g., April 14, 2012) and scattered land/sea fog case (e.g., February 11, 2015) will be presented.

P26

The applications of FENGYUN satellite data in Marine Meteorology

Xiang Fang and Xin Wang

CMA/NSMC

Meteorological satellite is the most important measure to monitor the ocean weather. Based on FENGYUN meteorological satellite data, NSMC/CMA has developed a series of marine remote sensing products, such as sea fog, sea convection, ocean precipitation, sea surface wind, sea surface temperature and Upper Tropospheric Wind Field Analysis etc.

In order to adapt to the demands of analyzing marine weather system and improve the accuracy of remote sensing products, NSMC made more improvement on the product algorithms. For example, for the sea fog remote sensing application, the detection results of day and night sea fog are more coincident by the dynamic threshold method. For the precipitation retrieval, it is very effective to promote the accuracy of sea surface precipitation using FY-3/MWRI precipitation product to correct the FY-2 precipitation result. For the sea surface wind retrieval, depending on multi-channel fusion method, it was solved that retrieved wind velocity of the strong wind area around tropical cyclones was lower. All of these improved algorithms of marine remote sensing application have been operationalized and applied by meteorological divisions in the coastal areas through the platform of SWAP. In this paper, the basic algorithms, accuracy and application of FENGYUN marine remote sensing products are introduced and future improving plan is also proposed.

P27

VALIDATING CI2 AND DU2 MONSOON INDICES FOR THE PHILIPPINES USING RAINFALL AND WIND DATA

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There are two kinds of monsoon that occur in the Philippines – southwest monsoon during June to September and northeast monsoon during November to February. In these months, intense rainfall and strong prevailing winds are experienced by most provinces in the archipelago. This study aims to measure the strength of the southwest and northeast monsoon episodes in a 31-year period (January 1983 to December 2013) with the use of existing monsoon indices. Specifically, the study intends to validate the CI2 (convection) and DU2 (differential zonal wind) monsoon indices for the Philippines using rainfall and wind station data for the 31-year period. Monthly mean outgoing longwave radiation (OLR) data averaged over the vicinity of the Philippines (10°-20°N, 115°-140°E) from NOAA and monthly mean differential zonal winds at 850-hPa pressure level averaged over (5°-15°N, 90°-130°E) and (22.5°-32.5°N, 110°-140°E) from NCEP are used in the study to infer the strength of the monsoon. Rainfall and wind indices derived from station data are used to validate these datasets. The relationship between the monsoon indices and the rainfall and wind indices are used to identify the strong and weak monsoon episodes in the 31-yr period. Moreover, a monsoon index for the Philippines is constructed based on the CI2 and DU2 monsoon indices and rainfall and wind cluster analyses. Furthermore, a risk index corresponding to the result of the effect of the monsoon is constructed, which can be contributed to disaster risk management and reduction.

P28

Study of Tropopause Folding Turbulence Detection(TFTD) Algorithm for the future Korean geostationary satellite

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The tropopause folding turbulence as one of the Clear-Air Turbulence (CAT) is a severe aviation turbulence. Because of its small time and spatial resolution, detection and forecasting have difficulties. It occurs unexpectedly at a cruising altitude of commercial aircraft, and could be possible to meet dangerous aviation accident. On the other hand, since Northeast Asia including Korea has the strongest jet-stream in the world, and the air transport industry becomes more active, the turbulence forecasting in this area seems more important.

In spite of this importance, the development of the turbulence detection algorithm using geostationary satellite data is at an early stage. The Tropopause Folding Turbulence Product (TFTP) algorithm of the U.S. future geostationary satellite, GOES-R, calculates the upper tropospheric specific humidity using a water vapor channel to compute spatial gradient as possible areas with the risk for turbulence by using image processing method. This study describes Tropopause Folding Turbulence Detection (TFTD) algorithm building on the GOES-R TFTP for the future Korean geostationary meteorological satellite, Geo-KOMPSAT-2A.

P29

Inferring cumulus updraft strength using geostationary satellite rapid-scan measurements

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A statistical analysis is conducted to infer updraft strength (w) of growing convective clouds, using 4-yrs of MTSAT-1R rapid scan observation during summer time over the Far East region. The updraft strength is estimated from depression rate of infrared brightness temperature by comparing successive images with five minute interval.

Estimated w at each height has a statistical distribution similar to log-normal distribution, which the updraft strength observed from direct aircraft measurements follows, demonstrating the efficacy of rapid scan observation for inferring the updraft strength.

P30

Machine learning approaches to detect convective initiation using geostationary satellites and weather radar

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Convective rainfall can cause flash flooding and thus significant human and economic loss. In order to prevent such damage, observation and prediction of convective rainfall have started with Automatic Weather System station (AWS) and ground based weather radar data. However, these measurements cannot cover vast areas limiting spatial continuity. Geostationary satellite sensors observe clouds and storms over vast areas at very high temporal resolution. Convective rainfall can cause flash flooding and thus significant human and economic loss. In order to prevent such damage, observation and prediction of convective rainfall have started with Automatic Weather System station (AWS) and ground based weather radar data. However, these measurements cannot cover vast areas limiting spatial continuity. Geostationary satellite sensors observe clouds and storms over vast areas at very high temporal resolution. Thus, geostationary satellite remote sensing is an ideal way to predict and monitor convective rainfall. In general, interest fields such as the brightness temperature of a specific channel or the difference of brightness temperature between two channels are considered important to identify convective initiation. Existing convective initiation algorithms use simple interest fields and associated thresholds. However, such simple thresholding might not be ideal to identify complicated characteristics of convective clouds. Thus, in this study, machine learning approaches such as decision trees, random forest, and support vector machines were evaluated for determination of key interest fields and associated rules to identify various characteristics of convective clouds. Communication, Ocean, and Meteorological Satellite (COMS) Meteorological Imager (MI), Meteosat Second Generation (MSG) Spinning Enhanced Visible and Infrared Imager (SEVIRI), and HIMAWARI-8 Advanced Himawari Imager (AHI) data were used to detect convective initiation with machine learning approaches. Reference samples to calibrate and validate machine learning approaches were extracted using ground based weather radar and lightning data. Among three approaches, random forest produced the best performance

for detecting convective initiation. Probability of detection (POD) and overall accuracy were up to 94.7 % and 97.8 %, respectively.

P31

A Quick Evaluation of GPM/DPR Reflectivity over Korea

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The Global Precipitation Measurement (GPM) mission is an international network of satellites that provides the next-generation global observations of rain and snow. Since 2009, the Korea Meteorological Administration (KMA) has participated in the ground validation (GV) projects through international partnerships within the framework of the GPM Mission. In this study, quick assessment of GPM/DPR (Dual-frequency Precipitation Radar) using the ground radar (GR) over the Korean Peninsula was performed. Data were collected from March 8th to August 17th in 2014 (163 days). In order to validate the GPM/DPR with GR, time series of GR data were also collected separately from above, within, and below the bright band (BB) in the stratiform and convective rains. Jindo, Gosan, Seongsan, and Oseong sites show a high correlation such as 0.80, 0.82, 0.81, and 0.83 respectively. However, the rest sites show relatively low correlation ranging from 0.58 to 0.75, because they have only a few rain cases of matching dataset for the GV. We also observed that DPR reflectivity at all the GR sites except Jindo was systematically overestimated. Thus the further investigation is needed along with collecting enough rain cases for GV. The mean reflectivity differences between DPR and GR demonstrate unstable at this stage due to the lack of match-up data, but it is expected to improve the accuracy as increasing cases.

P32

Rain retrieval using the SAPHIR water vapor sounder on Megha-Tropiques

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Megha-Tropiques is an Indo-French satellite launched in 2011 to study the water and energy cycle in the tropical belt. The satellite carries on board three passive instruments: MADRAS, an microwave imager, SAPHIR a microwave water vapor sounder, and ScaraB a broadband VIRS to compute TOA radiative budget. Unfortunately, MADRAS worked nominally only for about 14 month before failing. This was a dramatic loss for the rain retrieval objectives of the Megha-Tropiques mission. As an alternative solution an algorithm was developed to retrieve rain from SAPHIR using a combination of the 183 GHz channels. The latter are nominally designed to retrieve water vapor profiles but are also sensitive to scattering by ice. Bennartz and Bauer (2005) showed some preliminary results on the scattering regimes of such sounding instruments. We pushed further on and showed that the sounding properties remain true even in the scattering regime. By co-locating SAPHIR and three space-borne radars: CPR on CloudSat, PR on TRMM and DPR on GPM, we were able to test extensively the information content of the microwave brightness temperatures in scattering regime using the RTTOV-scatt radiative transfer model. This allows us to gather information on the vertical structure of the precipitating ice on the upper part of the cloud. The vertical structure of ice is in turn related to the properties of the convection: deep or shallow and intense or weak. Using these last properties, a rain retrieval algorithm was designed. The presentation will detail how the algorithm works, evaluate its performances and compare the results with the retrieval from MADRAS over the fourteen-month when the two instruments were functioning together.

P33

Effect of AMSU-A observation and adjusted AMSU-A observation error covariance on numerical weather predictions

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In this study, the effect of individual observations on numerical weather predictions was evaluated using the adjoint-based forecast sensitivity to observation (FSO) method. The effect of individual observations on 24 hour forecasts in the Korea Meteorological Ministration (KMA) Unified Model (UM) showed that the observation impact of Advanced Television and Infrared Observational Satellite Operational Vertical Sounder (ATOVS) AMSU-A on the forecasts was largest, followed by the SONDE, AIRCRAFT, and IASI. Especially, ATOVS AMSU-A radiance data were most helpful to improve temperature forecasts over the Northern Pacific. The effect of AMSU-A radiance data was varied with channels: the effect of channel number 5-8 which retrieve tropospheric temperatures was largest. Horizontally, the observation impact of AMSU-A on the forecasts was aggregated near mid-latitude troughs in the Northern and Southern Hemisphere for winter and summer months, respectively. In East Asia, the observation impact of AMSU-A installed in METOP-A was largest at 00 and 12 UTC, whereas that of AMSU-A installed in NOAA 18 and 19 was largest at 06 and 18 UTC, which is associated with the scanning track passing through the East Asia.

Using the FSO, the forecast sensitivity to error covariance (FSR) was calculated for July 2012. The FSR indicates that reducing observation error covariance and increasing background error covariance help to reduce the forecast error. The observation error covariances were adjusted using the multiple linear regression method of the FSO data of July 2012, and then applied to the forecasts for August 2012. Consistent with the previous results, the multiple linear regression method based on FSR suggested that the background error covariance needs to be inflated by 30%, whereas most of the observation error covariances need to be deflated. Because both FSO and FSR for AMSU-A data were largest, the observation error covariance of AMSU-A was reduced and the forecasts using the reduced AMSU-A observation error covariance show better results compared to the operational forecasts in KMA UM.

P34

Optimal Assimilation of Hyperspectral IR and MW Soundings for Regional Numerical Weather Prediction

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Regional numerical weather prediction (NWP) model can handle high spatial and temporal resolution forecast when the initial fields are in a reliable state nowadays. The meteorological satellite could provide critical data when convectional observation is coarse. The advanced infrared (hyperspectral) infrared (IR) and microwave (MW) sounders, such as AIRS and AMSU onboard NASA's Aqua satellite, could retrieve the best estimation of atmospheric thermodynamic sate, which will help to improve the initial fields through data assimilation technique. However, the soundings from these two sensors have some limitations when use both of them. The AIRS could provide find spatial resolution data than AMSU. It is anticipated the spatial gradient could retain in AIRS. However, AMSU could provide atmospheric profiles in cloudy sky, In this presentation, we would like to discuss the optimal assimilation of both of them for improving the NWP. It demonstrates a better handling of both sensors' data could provide positive impact over than use either sensor alone.

P37

Preliminary assessment of socio-economic benefits from CMA Meteorological Satellite Programmes

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CMA/NSMC

China is one of the countries suffering heavily from meteorological disasters, and the occurrence of disaster is widely distributed and highly frequent. It is estimated that meteorological disasters count for 71% natural disasters; Meteorological disasters bring huge influence to china. Statistic shows that more than 384 million people and 45.187 million hectares of crops are affected by meteorological disasters on annual average from 1991 to 2012, and the direct economic losses counts for total of approx. 5,000 billion CNY (830 billion USD) in 1991-2012. Although the total amount of losses keeps huge and even larger, the losses to GDP ratio obviously trends to decrease, the annual average of losses to GDP ratio comes down from 3.3% GDP in 1990s to 1.0% in recent 12 years; It believed that the improvement of meteorological service contributes much for relative reduction of the losses of life and property.

Satellite data plays important role in improving meteorological service. The satellites are not only used in meteorology, but also extensively used in many fields such as oceanography hydrology, agriculture, forestry, transportation, environment protection, space weather, key construction projects, scientific research and so on. With rapid development of remote sensing satellite, evaluation of socio-economic benefits of satellite observing has become an interesting topic for global satellite operators in recent years. In this presentation, several case studies are presented to estimate meteorological service benefit, and a preliminary cost-benefit analysis on FengYun Meteorological Satellite Programmes is also given.

P38

Using satellite data for hydrometeorology and environmental monitoring in the Far Eastern Region of Russia

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Far Eastern region of Russia is not a simple one in terms of environmental, geographic and meteorological conditions. In the last few years it has been confirmed that there exist many natural phenomena, such as floods or forest fires, that should be monitored using remote sensing data. Typhoons have become more devastating, the Kamchatka volcanoes eruptions have become more frequent and intensive, which makes additional difficulties for the air traffic. All these conditions substantiate the increasing necessity of remote sensing data which enables both fast monitoring and deep analysis of a situation.

Development of state-of-the-art remote sensing technologies, and their introduction into the Center's everyday practice enables cheaper and more efficient collection of the required information about the nature. In lack of measured hydrometeorological data, a lot of attention is paid to the possibility of merging ground based, aircraft and satellite observations in different geographic information systems.

State-of-the-art satellite data processing algorithms used in the Center enable usage of remote sensing data in a variety of thematic projects and applications of regional, national and international level. Reconstruction of the atmosphere's vertical structure, monitoring the natural and anthropogenic emissions spread, distribution of satellite products by means of WEB and GIS-technology are just a few examples out of many.

The most important and promising projects used for solving problems of hydrometeorology and environmental monitoring in the Far East region of Russia are presented in the report.

P39

Fire monitoring from Himawari-8

Adam Lewis

Geoscience Australia

The Sentinel Hotspots Monitoring system was originally developed in 2002 through a collaborative effort between agencies within the Australian government. The Sentinel Hotspots Monitoring System has been providing an important and consistent overview for management of fires across Australia, particularly in vast and remote areas where other fire information is not easily available. The new Himawari-8 weather satellite from Japan is a transformational capability as it images Australia every 10 minutes. Hotspots every 10 minutes would provide fire mangers with an immensely powerful new source of information for controlled burning and bushfire response.