Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG39-01 Room:301A Time:May 19 16:15-16:30

Long-term continuous observation of global water cycle by AMSR series

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In monitoring global environment and climate from space, the highest priority has been given to the continuity, frequency, and uniformity of the data records. These are also important to make satellite Earth observation an infrastructure in the society. The Global Change Observation Mission (GCOM) is designed to satisfy those needs. GCOM is a concept to perform global Earth observation from many perspectives, comprising of two polar-orbiting satellite series and spreading over three generations to achieve long-term and consistent data records. Two satellite series are GCOM-W (Water) and GCOM-C (Climate). The GCOM 1st ? Water (GCOM-W1) is the first satellite of the series and launched on May 18, 2012. The sole mission instrument on the satellite is the Advanced Microwave Scanning Radiometer-2 (AMSR2), which is a multi-frequency passive microwave radiometer system and serves as the major instrument to cover water-related geophysical parameters in the GCOM mission. AMSR2 is a successor instrument to the AMSR for the Earth Observing Systems (AMSR-E) and AMSR on the Advanced Earth Observing Satellite-II (ADEOS-II). Microwave radiometers have been playing an important role in measuring global water and energy cycles. Based on the accumulation of data records such as by the Scanning Multichannel Microwave Radiometer (SMMR) and the Special Sensor Microwave/Imager (SSM/I), the AMSR series made a significant progress in spatial resolution and frequency range. Although the characteristics of AMSR2 is similar to AMSR-E, the instrument had improved and enhanced in several important aspects such as calibration accuracy, spatial resolution, and reliability of instrument, as the latest instrument of the AMSR series. In addition to the basic product of brightness temperatures (Tbs), various water-related geophysical products are generated from Tbs obtained by AMSR2. They include integrated water vapor (total precipitable water), integrated cloud liquid water, precipitation, sea surface temperature, sea surface wind speed, sea ice concentration, soil moisture content, and snow depth. These products, as well as many geophysical parameters from the A-Train constellation and GCOM-C1, are expected to be utilized in many research areas covering water cycle and climate variability, and operational applications such as numerical weather forecast, drought monitoring, and fishery.

Keywords: satellite, remote sensing, water cycle, microwave radiometer

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ACG39-02 Room:301A Time:May 19 16:30-16:45

Observation of atmosphere-ocean interactions by AMSR2 on GCOM-W1

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The GCOM-W mission aims to establish the global and long-term observation system to collect data, which are needed to understand mechanisms of climate and water cycle variations, and demonstrate its utilization. We plan to obtain continuous and calibrated data over a period of 15 years with three GCOM-W satellites. The first generation of the GCOM-W satellite, GCOM-W1, was launched in May 2012. The GCOM-W1 satellite carries a multi-frequency, multi-polarization microwave radiometer, AMSR2, which continues Aqua/AMSR-E observations of integrated water vapor, cloud liquid water, precipitation, sea surface temperature, sea surface wind speed, sea ice concentration, snow depth, and soil moisture. In this paper, we will report validation of the sea surface temperature and wind speed observed by AMSR2 on GCOM-W1. Also we will discuss utilizations of the data from AMSR2 for studies of air-sea interactions and possibility of application to practical purposes.

Keywords: Remote sensing, Air-sea interaction, Atomosphere-ocean interaction, Microwave radimometer, GCOM-W1, AMSR2

ACG39-03 Room:301A Time:May 19 16:45-17:00

Sea ice algorithm improvement for AMSR2

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In recent years, the decline trend of the Arctic sea ice extent is becoming obvious. In May 2012, passive microwave sensor AMSR2 on-board satellite GCOM-W1 was launched by JAXA. On 16, September, 2012, AMSR2 recorded the minimum Arctic sea ice extent in the history of satellite observation. The passive microwave sensor on-board satellite can penetrate clouds and can monitor the global sea ice extent on daily basis. The authors have been working on sea ice monitoring from space, and now involved in improving sea ice algorithms for ASR2. The initial result of the study is presented at the conference.

Keywords: sea ice concentration, Sea of Okhotsk, GCOM-W1, remote sensing

ACG39-04 Room:301A Time:May 19 17:00-17:15

Scientific progresses from 15 years observation of TRMM and expectations to the GPM

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Tropical Rainfall Measuring Mission (TRMM) satellite, which was launched in November 1997, is a unique satellite equipped with a space-borne precipitation radar (PR). TRMM satellite has continued observation of precipitation from space for more than 15 years and has accumulated valuable data. Even one of the very early images obtained from TRMM PR surprised scientists with a discovery of precipitating particles at the level as high as 18km from the earth surface.

The primary advantage of the TRMM observation is its 3-dimensional measurements of precipitation with TRMM PR. Besides, its sun-unsynchronous orbit observation, multi-sensors (PR, TMI, VIRS, LIS, and CERES), as well as accumulation of 15 years continuous observation data provide us with very precious scientific data. They enabled us not only to improve the accuracy of precipitation estimates in the tropics and subtropics, but also to characterize the precipitation from region to region, thus revealed the mechanism and its variations of meteorological state associated with various types of precipitation. In such manner, 15 years of observation with TRMM brought us unprecedented opportunity for the progress of precipitation sciences.

On the other hand, TRMM data availability enabled us to estimate the diabatic heating of the atmosphere with moist convection, which is important to understand the large-scale circulation of the atmosphere on earth, and to evaluate the climate models. It is also utilized aiming to contribute to the infrastructure of flood alert systems as a flying precipitation gauge.

In this paper, we review the scientific achievements in Japan with TRMM, and discuss our expectations to the upcoming Global Precipitation Measurement (GPM) Mission; GPM will cover 65N-65S, with its primary satellite equipped with Dual-frequency Precipitation Radar (DPR), associated with a constellation of satellites equipped with Microwave Imagers to cover the globe in 3hourly temporal resolutions.

Acknowledgments: Scientific results reviewed in this paper are provided from members of the JAXA PMM Science Team, and are gratefully appreciated by the author.

Keywords: TRMM, GPM, Precipitation Radar, Precipiation Characteristics, Dual-frequency Precipitation Radar

ACG39-05 Room:301A Time:May 19 17:15-17:30

A developing precipitation retrieval algorithm for the GPM/DPR and the TRMM/PR

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The core satellite of the Global Precipitation Measurement (GPM) mission, which is scheduled to be launched in 2014, will carry the Dual-frequency Precipitation Radar (DPR). DPR is a successor of the single-frequency Precipitation Radar (PR) currently working on the Tropical Rainfall Measuring Mission (TRMM) satellite.

Precipitation radar measurement depends on drop size distribution (DSD) rather than precipitation rates. Generally, DSD is assumed to follow an exponential or a Gamma distribution with two unknown parameters. Here, DSD can be represented on a 2-dimensional plane. For a single-frequency radar measurement, as two parameters cannot be determined, an empirical power law between radar reflectivity factor Z and rain rate R (Z-R relationship) is used. Assuming Z-R relationship is equivalent to constraining DSD on a 1-dimenisonal curve. In the standard algorithm of PR, an empirical power law between specific attenuation k and Z (k-Z relationship) is given to correct attenuation (Hitschfeld-Bordan method; HB method). Assuming k-Z relationship is also equivalent to constraining DSD on another 1-dimensional curve. Fortunately, space-borne or air-borne radars such as PR can measure surface backscattering cross section and surface reference technique (SRT) is applied to estimate path integrated attenuation (PIA). By referring to PIA estimates, k-Z relationship can be adjusted. However, the adjustment depends on the accuracy of SRT, and is applied simultaneously for all range bins. Therefore, DSD cannot have 2-dimensional degrees of freedom. The accuracy of DSD estimation by PR depends on not only the accuracy of Z but the accuracy of constraints such as k-Z relationship.

In a developing algorithm for DPR, k-Z relation is assumed and the HB method is applied for each frequency. Once attenuation-corrected radar reflectivity factor Ze is given at both frequencies, the dual-frequency ratio (DFR) of Ze's is calculated, and DSD parameters are retrieved easily from the DFR (DFR method). However, the retrieved DSD generally does not agree with assumed k-Z relations. Then, k-Z relations are adjusted to fit the DSD. The HB method and DFR method can be applied again by using the adjusted k-Z relations. By iterating a combination of the HB method and the DFR method, k-Z relations are improved. This is termed HB-DFR method (Seto et al. 2013). Though k-Z relations are adjusted simultaneously for all range bins using SRT method, this method can adjust k-Z relation at a range bin independently of other range bins. Therefore, in this method, DSD is represented on a 2-dimensinal plane.

This method has no big differences from other dual-frequency retrieval methods in terms of the performance for dual-frequency measurement. But, this method can be smoothly applied to single-frequency measurement or the case that some range bins lack either of dual-frequency measurements, just by setting that DFR method and adjustment of k-Z relation are not applied for range bins without dual-frequency measurements. By the DPR, dual-frequency measurements are limited to inner swath of normal scans. In outer swath and in interleaved scans, single-frequency measurement by KuPR or KaPR is available. To have seamless 2-dimensional estimates of precipitation, this method is suitable. In the future, the DPR algorithm is applied to the PR measurements to produce long-term dataset with temporally constant quality.

Keywords: precipitation, radar, DSD, GPM, TRMM, DPR

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ACG39-06 Room:301A Time:May 19 17:30-17:45

NEW GSMAP MICROWAVE IMAGER OVER-LAND PRECIPITATION RETRIEVAL ALGORITHM

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1. Introduction

We have been developing precipitation retrieval algorithms for Microwave Imagers (MWI) under the Global Satellite Mapping of Precipitation (GSMaP) project to monitor global precipitation distribution. These algorithms have been adopted as Japan Aerospace Exploration Agency (JAXA) near-realtime precipitation retrieval system (http://sharaku.eorc.jaxa.jp/GSMaP/index.htm).

The basic idea of the MWI precipitation retrieval algorithm is to find surface precipitation rate that gives forward-calculated brightness temperatures (TBs) best-fit with the observed TBs. The conventional over-land precipitation retrieval algorithm (Aonashi et al. 2009) generally tends to underestimate Precipitation Radar (PR) surface rain (Rainsurf).

The objective of the present study is to develop new MWI over-land precipitation algorithm that alleviates the above retrieval bias. For this purpose, we derived the indices from MWI TBs that affected the relation between MWI TBs and the surface precipitation, using TRMM MWI (TMI) and PR data sets. Then, we corrected the forward calculation part of the algorithm with these indices.

We validated the performance of the new algorithm using TRMM data sets for 2004.

2. The conventional over-land algorithm

The conventional over-land algorithm for TMI consists of the forward calculation part and the retrieval part. In the forward calculation part , we derive look-up tables (LUTs) between high-frequency (37 and 85 GHz) polarization-corrected brightness temperature (PCT) depressions and the surface precipitation using the radiative transfer model (RTM) (Liu, 1998). The retrieval part finds surface precipitation rates that give forward-calculated PCT at 37 GHz (PCT37) and 85 GHz (PCT85) best fit with the TMI TBs.

3. The new over-land algorithm

We derived the indices from MWI TBs that affected the relation between MWI TBs and the surface precipitation. Then, we corrected the forward calculation part of the algorithm with these indices.

For this purpose, first, we performed forward calculation experiments to examine the dependency of PCT depressions to the variations in the precipitation-related variables. The results showed that PCT37 depression was sensitive to freezing level height (FLH) and depth of frozen precipitation (DFP) while it had little sensitivity against other frozen precipitation properties. It was also found that PCT85 was much sensitive to the DFP and other frozen precipitation properties than PCT37.

As the MWI index for DFP, we introduced the ratio of PCT85 depressions to PCT37 depressions (R8537) as the index of the frozen precipitation depth. We expressed R8537 in terms of ratio of precipitation retrieved from PCT85 depression (rain85) to those from PCT37 (rain37) using the conventional over-land algorithm. We also employed PCT37 in no rain areas (PCT37nr) for the indirect index of FLH, since PCT37nr can be regarded as a function of surface temperature.

Then, we checked the PCT depressions to the above MWI indices by comparing TMI retrievals and PR Rainsurf for 1998, for various R8537 and PCT37nr classes. The results show:

1) Relationship between Rain85 and Rainsurf is very sensitive to R8537.

2) Relationship between Rain37 and Rainsurf mainly depends on PCT37nr. Rain37 underestimates Rainsurf for low PCT37nr cases

Then, we derived linear fitting coefficients between Rain37, Rain85 and Rainsurf for each R8537 and PCT37nr class for 1998. The new algorithm used these fitting coefficients for the statistical correction of the LUTs.

4. Validation results

We validated the performance of the new algorithm using TRMM TMI and PR data sets over land for 2004. The results indicate that the new algorithm with statistical LUT correction using R8537 and PCT37nr alleviated negative bias of the TMI precipitation retrievals compared to the conventional algorithm. The new algorithm also reduced the zonal mean retrieval differences between the over-land TMI retrievals and PR Rainsurf.

Keywords: GSMaP, Microwave Imager, Precipitation retrieval, TRMM, GCOMW1, AMSR2

ACG39-07 Room:301A Time:May 19 17:45-18:00

Performance of the GSMaP data over Vietnam and a case study of its correction by using artificial neutral networks

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The performance of the Global Satellite Mapping of Precipitation data (GSMaP - MVK version 5.222.1) is examined by comparing with the rainfall gauged at 57 meteorological stations of Vietnam and the gridded Asian Precipitation - Highly-Resolved Observational Data Integration Towards Evaluation of Water Resources data (APHRODITE - V1003R1). Results show that correlation coefficients between GSMaP and rain-gauge observations for the period of 2001-2007 are commonly in the [-0.3,0.6] range, which are significantly lower compared to the [0.7,0.99] range of the APHRODITE data. The lowest correlated regions for GSMaP are located mainly in the coastal zone of Central Vietnam. An EOF analysis of the datasets shows that GSMaP well represents the first two principal rainfall regimes for Vietnam consisting of the May-October regime in North Vietnam and in the west side of the TruongSon mountain range; and the September-November rainfall regime in Central Vietnam. The first and the second eigenmodes of GSMaP respectively explained 83.95% and 11.12% of rainfall variances, which are in good agreement with APHRODITE. Both GSMaP and APHRODITE show topographic effects, which result in more precipitation in the windward side of the TruongSon mountain range during both summer and winter monsoon seasons. However, GSMaP largely underestimates the topographic effects on winter monsoon rainfall, particularly in the coastal zone of Central Vietnam. A case study of GSMaP correction by using artificial neutral networks (ANN) is implemented over the ThuBon-VuGia basin in Central Vietnam. Validation results through spatial correlation, amplitude and Nash?Sutcliffe efficiency coefficient show that the ANN correction method significantly improves the GSMaP rainfall quality over the basin for both the dependent and independent periods of 2001-2005 and 2006-2007, respectively.

Keywords: GSMaP, satellite rainfall, artificial neutral network, winter monsoon

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ACG39-08 Room:301A Time:May 20 09:00-09:15

LAND VALIDATION for GCOM-C1/SGLI (VNR) using UAV

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Japan Aerospace Exploration Agency (JAXA) is going to launch new Earth observation satellite GCOM-C1 in near future. The core sensor of GCOM-C1, Second Generation Global Imager (SGLI) has a set of along track slant viewing Visible and Near Infrared Radiometer (VNR). These multi-angular views aim to detect the structural information from vegetation canopy, especially forest canopy, for estimating productivity of the vegetation. SGLI Land science team has been developing the algorithm for above ground biomass, canopy roughness index, shadow index, etc.

In this paper, we introduce the ground observation method developed by using Unmanned Aerial Vehicle (UAV) in order to contribute the algorithm development and its validation. Mainly, multi-angular spectral observation method and simple BRF model have been developed for estimating slant view response of forest canopy. The BRF model developed by using multi-angular measurement has been able to obtain structural information from vegetation canopy. In addition, we have conducted some observation campaigns on typical forest in Japan in collaboration with other science team experienced with vegetation phenology and carbon flux measurement. Primary results of these observations are also be demonstrated.

Keywords: UAV, Second Generation Global Imager (SGLI), Multi-angular observation, Forest canopy, Vegetation productivity

ACG39-09 Room:301A Time:May 20 09:15-09:30

GCOM-C1 ocean product development

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Global Change Observation Mission for Climate (GCOM-C) is planned to be launched in FY2015. JAXA is designing, developing, and characterizing the satellite and sensor intensively in these years. Data product development has been conducted by JAXA and GCOM-C Principal Investigators (PIs) which has been organized in summer 2009 as the first research period (2009-2012). The first version of the algorithms are being examined by using in-situ data and simulation L1B data (HDF5 format) in EORC. The next research period will start from April 2013 (until March 2016), and it will more focus on development of the standard algorithm (operational processing codes) and validation preparation for the first version of the standard products which will be released to the public one year after the launch.

The GCOM-C1 standard ocean products includes sea-surface temperature, ocean color (normalized water-leaving radiance, chlorophyll-a concentration, suspended solid concentration, colored dissolved organic matter absorption, and photosynthetically available radiation). In addition to the above, we defined the research products, inherent optical properties, euphotic zone depth, net primary productivity, phytoplankton functional type, and redtide detection.

SGLI has 250m spatial resolution with 1050-km swath, which is expected to improve the coastal monitoring. Although the offshore ocean-color products show good accuracy showing seasonal and interannual changes properly, we still have some problems about the ocean color retrievals in the coastal area where the water has complex composition and the atmosphere is affected by the terrestrial aerosols.

We have started characterization study of coastal in-water optical properties (spectral absorption and back scattering) and aerosol characteristics in some coasts mainly around Japan, e.g, Mutsu, Tokyo, and Ariake Bays and so on. The obtained optical properties will be analysed by a consistent way, and the characterization results will be used in the satellite data retrievals (atmospheric correction and inversion of in-water optical properties) in each area. The analysis needs to make measurements in the variety of (typical) coastal areas. The observations will be conducted in collaboration with our GCOM-C1 science team, other collaborative research organizations, and international partners.

Keywords: GCOM-C, SGLI, ocean color, satellite

ACG39-10 Room:301A Time:May 20 09:30-09:45

Global snow and ice cover observations using GCOM-C1/SGLI

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The "Global Change Observation Mission-Climate" (GCOM-C) is a project of Japan Aerospace Exploration Agency (JAXA) for the global and long-term observation of the Earth environment. The GCOM-C is a part of the JAXA's GCOM mission which consists of two satellite series, GCOM-C and GCOM-W (Water), spanning three generations in order to perform uniform and stable global observations for 13 years. The first generation of GCOM-C (GCOM-C1) carries a multi-spectral optical radiometer named Second Generation Global Imager (SGLI), which will have special features of wide spectral coverage from 380 nm to 12 micrometer, a high spatial resolution of 250m, a field of view exceeding 1000km, two-direction simultaneous observation, and polarization observation. The GCOM-C mission aims to improve our knowledge on the global carbon cycle and radiation budget through high-accuracy observation of global vegetation, ocean color, temperature, cloud, aerosol, and snow and ice. As for the cryosphere observation, not only snow and ice cover extent but also snow physical parameters are retrieved from SGLI data such as snow grain sizes at shallow layers, temperature, and mass fraction of impurity mixed in snow layer and so on. These snow physical parameters are important factors that determine spectral albedo and radiation budget at the snow surface. Thus it is essential to monitor those parameters from space in order to better understand snow metamorphosis and melting process and also to study the response of snow and sea-ice cover extent in the Polar Regions to a climate forcing such as global warming. This presentation will summarize the SGLI cryospheric products and validation plans.

Keywords: Snow Cover, Snow Grain Size, Snow Impurity, Surface Temperature, Remote Sensing, GCOM

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ACG39-11 Room:301A Time:May 20 09:45-10:00

Expectations for the GCOMC satellite mission on long-term climate observation and clouds science study

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Clouds are key observation target for calculating earth energy budget and climate change study. Satellite remote sensing can observe the earth surface and the atmosphere with wide range and frequently, it is an efficient way for monitoring change of cloud properties and cloud spatial distributions. The Global Change Observation Mission (GCOMC)/Second Generation Global Imager (SGLI) is an passive optical radiometer for monitoring climate change, which is scheduled to launch in around 2014 by the Japan Aerospace eXploration Agency (JAXA).

The GCOM-C mission measures essential geophysical parameters on the Earth surface and in the atmosphere to facilitate understanding of the global radiation budget. There are 19 channels, including two polarized VNR channels in SGLI. The SGLI sensor is an optical sensor capable of multi-channel observation at wavelengths from near-UV to thermal infrared. The SGLI consists of two radiometer instruments, the Visible and Near Infrared Radiometer (VNR) and the Infrared Scanner (IRS). SGLI-VNR is capable of observing polarized, non-polarized radiance and multi-angle scanning. Sensor characteristics of polarized and multi-angle scanning are very important for determining the ice cloud shapes and aerosol studies. In the GCOMC satellite mission, cloud properties such as the cloud optical thickness, the effective particle radii, and the cloud top temperature will be retrieved from SGLI-VNR data. The International Satellite Cloud Climatology Project (ISCCP) cloud product will be produce and cloud inhomogeneity of the warm water cloud will be discussed. This is one of the new sciences of the GCOM-C satellite mission in terms of cloud sciences. Furthermore, ice crystal scattering database will be developed for ice cloud remote sensing.

Long-term cloud remote sensing data is important on improving the accuracy of the climate model and climate change study. There was a 40 year time-series cloud remote sensing data observed by the satellite instruments such as NOAA/AVHRR, Terra-Aqua/MODIS, ADEOS-II/GLI, and NPP/VIIRS until now. GCOMC/SGLI will continue the current satellite mission to observe the cloud property and contribute to the long-term climate change study.

Keywords: GCOMC/SGLI, Cloud science, Climate change, Ice cloud shapes

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ACG39-12 Room:301A Time:May 20 10:00-10:15

Food security packaging with utilization of numerical modeling and satellites observations

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We are plan to packaging process (called "food security package") for the estimation of global yield by a coupling model of hydrological and crop-growth modules. Driving forces of crop-growth such as precipitation, solar radiation, soil moisure will be given by satellite drived-products. In addition, initial and several condition such as crop calender, land-use map and so on also needs to assist satellite-based products. In this presentation, we will explain the overview of food security package, and the requirements of satellite-based products.

Keywords: yield estimation, hydrological modeling, satellite observation

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ACG39-13 Room:301A Time:May 20 10:15-10:30

Status of Next Generation Japanese Geostationary Meteorological Satellites Himawari-8/9 and Their Products

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The Japan Meteorological Agency (JMA) plans to launch and operate Himawari-8 and Himawari-9, which are the next generation Japanese geostationary meteorological satellites following the currently operational satellite MTSAT-2 (Himawari-7). JMA plans to launch Himawari-8 in 2014 and commence its operation in 2015, when MTSAT-2 is scheduled to complete its designed period of operation. JMA also plans to launch Himawari-9 in 2016.

Himawari-8 and -9 carry the Advanced Himawari Imager (AHI) units, comparable to the Advanced Baseline Imager (ABI) on board GOES-R, which is also the next generation satellite planned to be launched by 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 will be enhanced from those of MTSAT-2 as follows:
- Multi-channel capacity (16 channels)
- High spatial resolution (0.5 -1.0km for visible and 2km for infrared)
- Fast imaging (a full disk scan within 10 minutes)
- Rapid scanning with flexible area selection and scheduling

Observation images of AHI are expected to contribute to improvement of weather watch, tropical cyclone analysis, numerical weather prediction and climate/environment monitoring. Development for the utilization of the AHI images is ongoing. JMA makes a strong effort, in particular, to upgrade Atmospheric Motion Vector (AMV) products and develop new products of volcanic ash and yellow sand analysis.

JMA has set up a web page with information on Himawari-8 and -9 at http://mscweb.kishou.go.jp/himawari89/index.html. This page provides information on the schedule, specifications of the spacecraft and AHI, including estimated spectral response functions (SRF) and simulated AHI proxy data.

Keywords: Himawari-8, geostationary meteorological satellite, AHI

ACG39-14 Room:301A Time:May 20 10:30-10:45

Use of earth observing satellite data at Japan Meteorological Agency

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Earth observing satellites have been used for diverse operations and researches at Japan Meteorological Agency (JMA): They include numerical weather prediction (NWP), environmental and disaster monitoring, and verification of models and products.

Operational geostationary satellites such as MTSAT are inevitable because of their capability of frequent, long-term measurements and real-time data dissemination. However, due to their measurement limitation to visible (VIS) and infrared (IR) band, we face the difficulty to obtain information below thick clouds or vertical information about the temperature, humidity, cloud and precipitation. In contrast, they are provided by low earth orbiting (LEO) satellites carrying microwave (MW) sensors, IR multi-channel sounders, and cloud- and precipitation-radars. Thus, it is essential to take comprehensive advantage of both operational geostationary and LEO satellites.

For example, MW imagers have been used for analysis of sea surface temperature, sea-ice and snow depth, NWP and reanalysis even in cloudy regions. In the typhoon analysis, while IR/VIS cloud imagery of MTSAT is usually used to estimate the central position and pressure, MW imagers can help to identify the center, and the development of deriving maximum wind speed in typhoon region with TRMM/TMI is underway.

For NWP, satellite data are essential to data assimilation that creates initial state analysis, providing model boundary dataset, and verification of model and analysis. Increasing accuracy and variety of satellite data and advancement in data assimilation system have significantly improved the NWP accuracy for the past 20 years. For example, cloud and precipitation vertical information from TRMM/PR and Cloudsat/CPR contributes to model verification. Assimilation of radiances of MW sounders and imagers and hyperspectral IR sounders, radio propagation refractive data from the global navigation satellite system (GNSS) occultation, sea surface winds of MW scatterometers generates accurate analysis of the information of temperature, humidity and wind. In the current assimilation system, however, the accuracy of analysis related to cloud and precipitation is not sufficient. The important challenge is the effective assimilation of cloud- and precipitation-affected radiances and cloud- and precipitation-radars.

Keywords: satellite, typhoon analysis, data assimilation, JMA

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ACG39-15 Room:301A Time:May 20 11:00-11:15

Current status and future plan of the JAXA/EarthCARE algorithm development and production model

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EarthCARE (Earth Clouds, Aerosols, and Radiation Explorer) is a joint Japanese-European mission, and the mission is designed to produce the maximum synergetic collaboration of European and Japanese science teams. For Level 2 and higher data products, Japan originally develops the algorithms to release as Japanese products from JAXA, although continuous exchanges of information will be conducted between Japan and Europe through the Joint Algorithm Development Endeavor (JADE). The JAXA/EarthCARE algorithm development team as Prof. T. Nakajima (University of Tokyo) as the lead scientist consists of Prof. H. Okamoto (Kyushu University) and Mr. Y. Ohno (NICT) for CPR; Dr. T. Nishizawa (National Institute for Environmental Studies) for ATLID; Prof. T.Y. Nakajima (Tokai University) for MSI; Prof. H. Okamoto for CPR-ATLID synergy and CPR-ATLID-MSI synergy; Prof. M. Satoh (University of Tokyo) for model simulation; and Prof. T. Nakajima (University of Tokyo) for Four-Sensor Synergy Algorithm. The EarthCARE team in JAXA determined a list of products that will be processed and released from Japan on July 2011. JAXA L2 products are divided between standard products and research products. JAXA standard products will be processed and released from JAXA Mission Operations System Office (MOS). Agreed with ESA in Operation Interface Agreement (OIA), L2a standard products will be provided by 24 hours after observation, and L2b standard products will be provided by 48 hours after observation. On the other hand, research products are defined to be more challenging variables, and they are further divided between ER products and LR products. The ER (an abbreviation for "EORC Research") products will be processed and released from JAXA Earth Observation Research Center (EORC). The timeline is not defined in JAXA, but will be done on best-effort basis. The LR (an abbreviation for "Laboratory Research") products will be processed and released from the cooperation with Japanese Laboratories (including universities and research institutes), which are also on best-effort basis.

Keywords: Cloud, Aerosol, Radiation, Satellite, Cloud Profiling Radar

ACG39-16 Room:301A Time:May 20 11:15-11:30

Development of cloud algorithm for EarthCARE/MSI: Interpretation of retrievals using cloud simulation and active sensors

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Clouds exert an important influence on the earth water and energy balances and processes that relate to clouds underpin key climate feedbacks. Cloud remote sensing using the spaceborne instruments has been providing useful information about spatial distribution and time series of cloud microphysical properties, and contributing to better understanding of climate study. The satellite-base passive sensors that measure radiation in multi-spectral bands from the visible through the thermal infrared such as Aqua/MODIS and ADEOS-II/GLI are ones of the most commonly used instruments for cloud remote sensing. From the measurements of the passive sensors, cloud droplet effective radius (CDER), cloud optical thickness (COT) and cloud top temperature (CTT) of clouds can be retrieved. These are most important cloud microphysical properties that relate to radiation characteristic of clouds. Moreover, they are also indicators of the droplet growth such as condensational growth and collection processes. However, it is complex to interpret the retrieved CDERs and COTs in term of cloud structure and droplet growth, because clouds are usually vertical inhomogeneous and horizontal inhomogeneous.

In this presentation, we will introduce recent progresses in the interpretation of CDER and COT in term of vertical and horizontal inhomogeneity by using numerical cloud models and active instruments. First, based on the results of remote sensing simulation by using numerical cloud model, we attempt to illustrate how the values of retrieved CDER, COT and CTT are determined from in-cloud vertical structure and horizontal inhomogeneity at sub-pixel scale. Second, we attempt to seek the linkages of CDER, COT to droplet growth in nature based on synergistic use of the spaceborne active and passive sensors (CloudSat and Aqua/MODIS). Finally, we will mention about our research strategy using next coming EarthCARE mission.

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG39-17 Room:301A Time:May 20 11:30-11:45

Greenhouse Gases Observing Satellite (GOSAT) for observing global CO_2 & CH_4 and for estimating carbon fluxes

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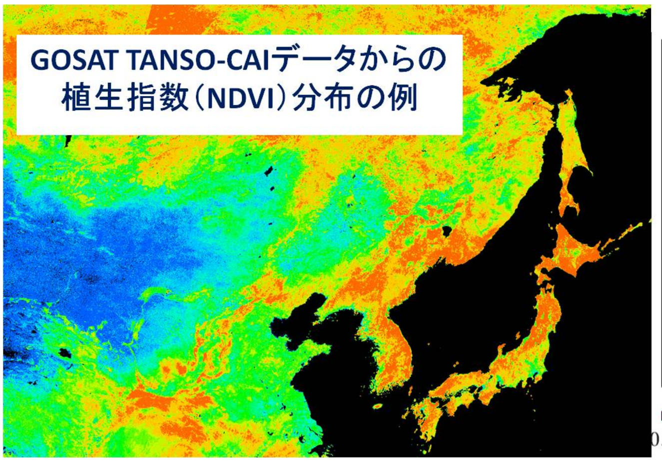
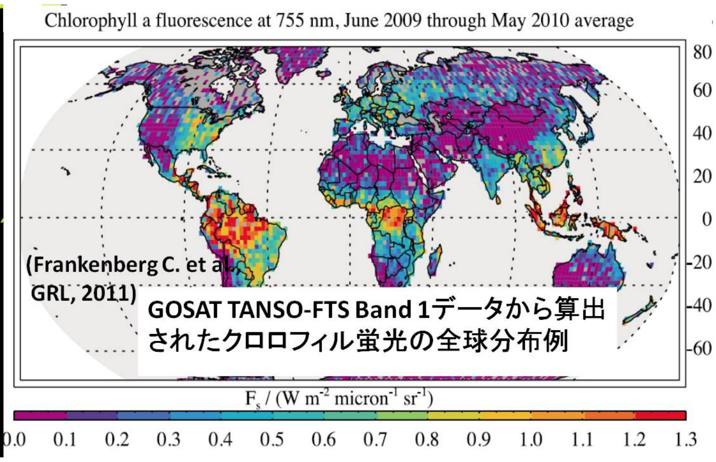
Please refer to the Japanese abstract.

Keywords: greenhouse gases, carbon dioxide, methane, global distribution, transport model, sources and sinks





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Middle atmospheric sciences using data from the Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES)

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The Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) aboard the Japanese Experiment Module (JEM) of the International Space Station (ISS) made atmospheric measurements of minor species in the stratosphere and mesosphere for about six months from October 2009 to April 2010. High-sensitivity measurements of SMILES had been performed by a receiver using superconductor-insulator-superconductor (SIS) mixers, cooled to 4.5 K by a compact mechanical cryocooler. Mission objectives are: i) Space demonstration of 4-K mechanical cooler and super-conductive mixer for the submillimeter limb-emission sounding in the frequency bands of 624.32- 627.32 GHz and 649.12- 650.32 GHz, and ii) global measurements with its high sensitivity for atmospheric minor constituents in the middle atmosphere (O3, HCl, ClO, HO2, HOCl, BrO, O3 isotopes, HNO3, CH3CN, etc), contributing to the atmospheric sciences. Thus global and vertical distributions of about ten atmospheric minor constituents related to the ozone chemistry are derived. See Kikuchi et al. (2010) in more detail about the SMILES mission.

In this talk, we will introduce an overview of the SMILES measurements and show some observational results in association with middle atmospheric chemistry and dynamics. To support the SMILES observational results, we also used outputs from nudged chemistry-climate models (MIROC3.2-CTM and SD-WACCM) in a complementary way. One of the most unique characteristics of the SMILES measurements is that the data from SMILES can be used to capture the diurnal variation of atmospheric minor constituents such as O3, ClO, HO2 and BrO, since the ISS took the non-sun-synchronous orbit. In particular we will give some detailed view on the global pattern of diurnal ozone variations throughout the stratosphere as reported by Sakazaki et al. (2013). These results demonstrate that the SMILES high sensitivity measurements are expected to provide further insights into atmospheric chemistry and dynamics.

References

Kikuchi, K., et al. (2010), Overview and early results of the Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES), J. Geophys. Res., 115, D23306, doi:10.1029/2010JD014379.

Sakazaki, T., et al. (2013), Diurnal ozone variations in the stratosphere revealed in observations from the Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) onboard the International Space Station (ISS), J. Geophys. Res., in press.

Keywords: middle atmosphere, satellite measurements, atmospheric dynamics, atmospheric chemistry