GSMaP Gauge NRTの検証
Validation of the GSMaP Gauge NRT

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Information of real time precipitation is important for water disaster management. However real-time observation does not cover the whole world. Satellite observes global precipitation, although a satellite observation is limited overpass time. Global Satellite Mapping of Precipitation (GSMaP) is hourly rainfall map using combined passive microwave and infrared radiometric data from multi satellite. GSMaP in near-real-time (NRT) is providing data 4-hour after observation. Precipitation retrieval from the passive microwave radiometer underestimate over land. Gauge adjusted GSMaP (GSMaP Gauge) achived to compensate GSMaP MVK precipitation by gauge data. The method is not applied to GSMaP NRT, because we do not get global rain gauge data in 4 hour. We developed new GSMaP Gauge adjusted GSMaP NRT (GSMaP Gauge NRT). The new method estimate adjustment parameters for GSMaP NRT using previous GSMaP Gauge and GSMaP MVK. The method modify precipitation of the GSMaP NRT with these parameters. Distribution of monthly precipitation of GSMaP Gauge NRT is close to that of GSMaP Gauge. We will introduce GSMaP Gauge NRT algorithm and present validation of the GSMaP Gauge NRT.

キーワード：降水、マイクロ波放射計、GSMaP
Keywords: precipitation, microwave radiometer, GSMaP

地上レーダデータを用いたGPM/DPRの降水強度の評価

Evaluation of the rain rate estimates of GPM/DPR using ground radar data

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１．はじめに

2014年3月より，全球降水観測計画(Global Precipitation Measurement)のGPM主衛星の運用が行われている．GPM主衛星は二周波降水レーダ(DPR)を搭載しており，DPRは比較的強い雨の観測に優れるKuPRと，比較的弱い雨や雪などの固体降水の観測に優れるKaPRの2つのレーダから構成されている．DPRを搭載した人工衛星による降水観測は初の試みであり，観測結果については十分な評価が必要である．そこで本研究では，地上レーダによる観測結果として国土交通省の運用するXRAINに着目し，DPRの観測結果との比較を行う．また，両者の観測結果の違いについて評価を行う．

２．比較方法

XRAINは国土交通省の運用している地上降水レーダである．従来の広域レーダと比較して高頻度(１分間隔)，高解像度(250mメッシュ)の観測が可能であり，2016年2月現在で日本の14箇所にて運用が行われている．この研究では，九州北部にて運用が行われているレーダに着目し，DPRの観測結果との比較を行う．DPRとXRAINは解像度が異なっているため，DPRのフットプリント内のXRAINの降水強度の平均を算出し，DPRの降水強度と比較を行う．なお，DPRの降水強度は，地表面のクラッターの影響を受けない高さのものを用い，プロダクトのバージョンはV03Bを用いた．

３．降水強度の比較

DPRとXRAINの降水強度観測結果について比較を行う．DPRとXRAINの観測範囲が重なっており，なおかつ降水の観測された事例は，2014/6～2016/1の間で現在46ケース見つかっている．この章では，2015/07/07 03:27(JST)(DPR orbit:7703)に観測された事例について示す．図１にXRAINとDPRの降水強度を示す．全体的にXRAINのほうが降水強度は強くなっており，降水の観測された範囲にも違いが見られる．また，XRAINの降水強度は放射状に広がる線状の分布が見られる．図２はXRAINとDPRの降水強度の散布図である．X軸に内挿したXRAINの降水強度，Y軸にDPRの降水強度を示している．また，赤いプロットが層状性降雨，青いプロットが対流性降雨を示している．図より，全体的にXRAINのほうにプロットが集中しており，バイアスの値もマイナスの値となった．

４．全マッチアップ事例の比較

この章では，全マッチアップ事例を使った比較結果について示す．図３にXRAINとDPRの降水強度の散布図を示す．灰色のコンターは各観測点の結果，赤いラインはXRAINの降水強度に対するDPRの降水強度の平均値を示している．図より，全体的に降水強度はXRAIN側に過大評価となっており，平均値のラインもXRAIN>DPRとなっている．要因としては，着目している高さが異なる点，XRAINがレーダ中心から離れるほど推定精度が減少する点が挙げられる．DPRは降水の３次元データを取得できるため，今後は着目高さを合わせた比較を行う予定である．

５．結論

GPM主衛星は2014年2月より運用されている．DPRによる観測は初めての試みであり，観測結果の評価が必要である．そこで，地上レーダXRAINの観測結果に着目し，DPRとXRAINの降水強度について比較を行った．結果，XRAINの降水強度が過大評価される結果となった．要因としては，着目高さと地上レーダからの距離が挙げられる．今後は，着目高さを統一した比較を行う予定である．

キーワード：全球降水観測計画、二周波降水レーダ、XバンドMPレーダ
Keywords: Global Precipitation Measurement (GPM), Dual-Frequency Precipitation Radar (DPR), MLIT X-Band MP Radar Network (XRAIN)

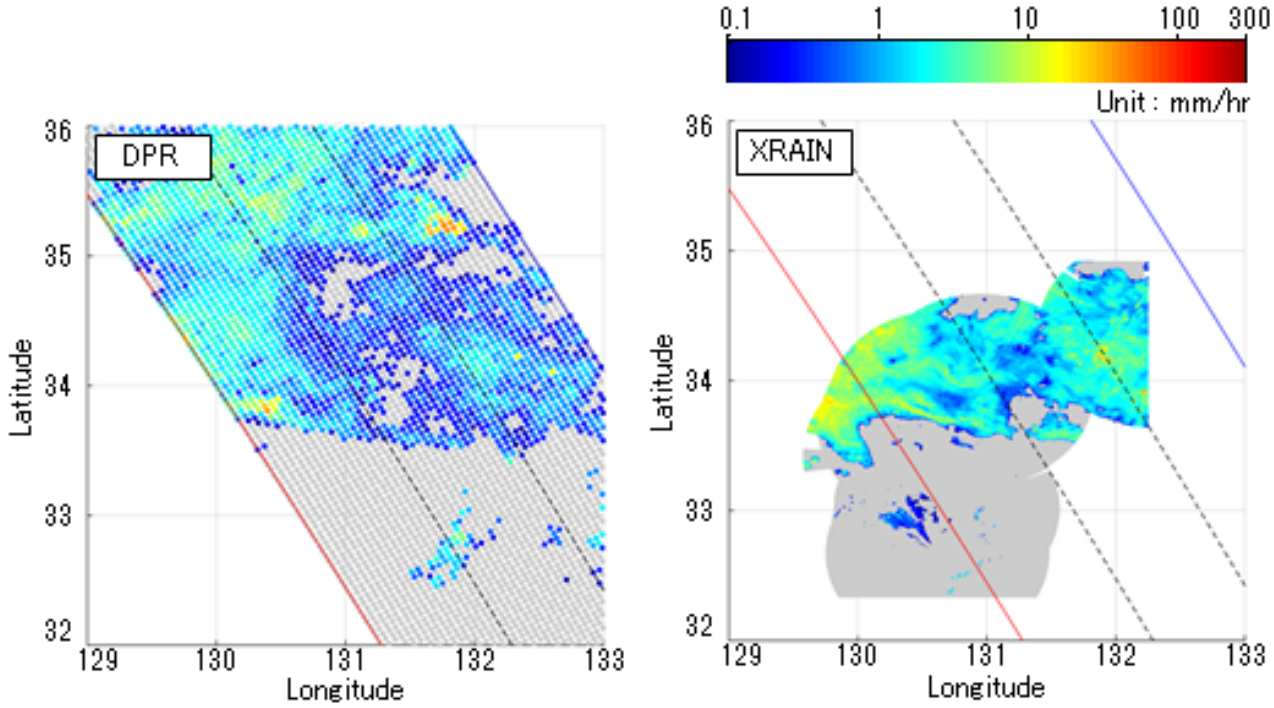

Fig.1 The rain rate estimates

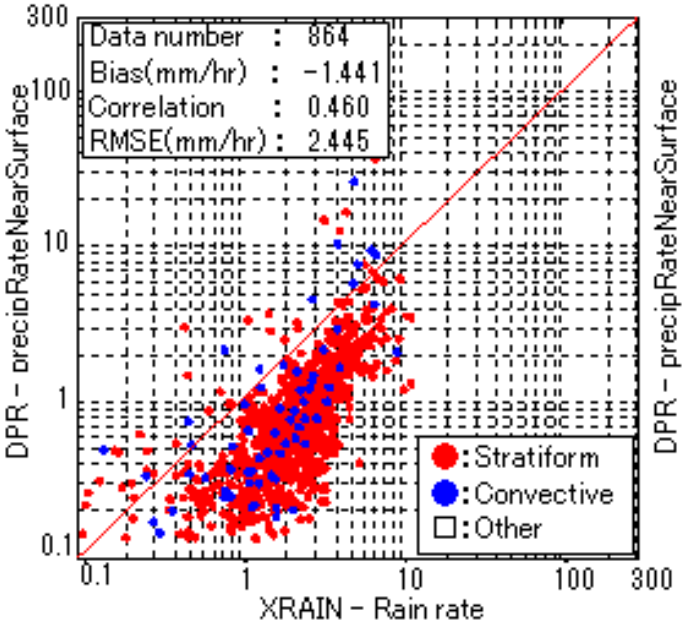

Fig.2 Scatterplot of the rain rate

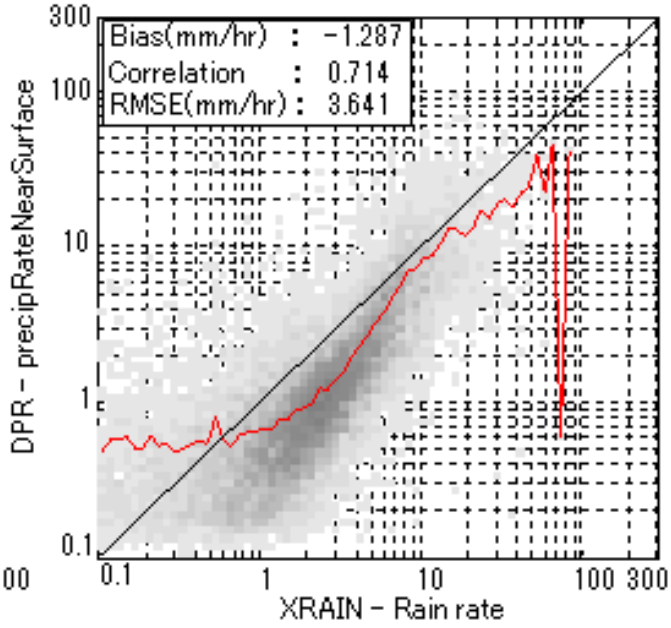

Fig.3 2-D histogram of the rain rate

PRとTMIの降水経年変動の違い
A difference in the interannual variability of precipitation between PR and TMI

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Precipitation has an important role in maintaining the hydrological cycle on the earth's climate, so that understanding the long-term variability of precipitation is essential to provide for the future such as the decadal climate variability or the climate change. It is, however, well known that the interannual variability of precipitation associated with El Nino Southern Oscillation (ENSO) is different between the Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (PR) and the TRMM Microwave Imager (TMI) estimates (Robertson et al. 2003; Wang et al. 2008; Lau and Wu 2011). The current study is aimed to explore the origin of the difference of the interannual variability of precipitation between PR and TMI.
The current study focuses on the differences in the precipitation type (convective and stratiform types) and its interannual variability. The precipitation estimates derived from PR (2A25; Iguchi et al. 2009) and TMI (2A12; Kummerow et al. 2011) products are individually divided into stratiform and convective precipitation estimates. The PR product contains results of the precipitation type in each pixel, but the TMI product contains together in same pixel. These data are projected onto a common 0.5 degrees gridded instantaneous data with ascending and descending orbits and sampled only where PR and TMI observations are available. Data are analyzed in the El Nino season (December 1997 to May 19998) and the La Nina season (December 1999 to May 2000) and compared between PR and TMI. Differences in unconditional precipitation average of convective and stratiform types over semi-global (35S-35N) oceans are overall same between PR and TMI in the La Nina season, because the database for the TMI retrieval was generated by means of the PR observation in this period. On the other hand, the difference in the convective precipitation between PR and TMI (TMI is generally higher than PR) are obviously found in the El Nino season, while the stratiform precipitation is similar between PR and TMI. The regions where the difference in convective precipitation between PR and TMI are large are found in warm sea surface temperatures (SSTs) for 300 to 303 K and moist column water vapors (CWVs) for 66 to 75 mm and frequently located over the central Pacific in the El Nino season. In the El Nino event, the ratio of stratiform precipitation against total precipitation central Pacific was increased (Schumacher and Houze 2003), which implies that the TMI does not follows the interannual nature-variability of the precipitation characteristics observed by the PR.

キーワード：降水レーダ、マイクロ波放射計、経年変動
Keywords: Precipitation Radar, Microwave radiometer, Interannual variability

ひまわり8号降雨推定プロダクト精度向上のための降水雲の時間変化情報の取り込み
Additional information of precipitating cloud life stages for Improvement of rain rate data estimated from Himawari-8

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広域・高時間分解能の降水観測データを得るために，マイクロ波放射計搭載衛星による高精度降雨観測は非常に重要である．しかしマイクロ波衛星は台数が限られているため短時間で全球をカバーすることはできない．そのようなマイクロ波観測の利用できない場所では，静止気象衛星から得られた高時間分解能の降水関連情報を用いることで降雨推定精度の向上が期待できる．Kühnlein et al.（2014）はMETEOSAT第二世代の静止気象衛星（MSG-2）に搭載されている１０チャンネルの観測輝度情報を，Random Forest（RF）と呼ばれる統計的手法によって地上レーダの降雨観測と関連付けることで，静止気象衛星と同様の高時間分解能で降雨推定が可能になるとしている．この手法はまず静止気象衛星観測からランダムにいくつかのチャンネルを抽出し，降雨・非降雨を分類するための場合分けのツリーを作成する．このツリーを量産し，最終的に各ツリーの判定結果の多数決によって降雨域が決定される．また特筆すべきは降雨域だけでなく降雨タイプの判別や降雨強度の推定も可能であるという点である．本研究ではこのRF手法を現在世界唯一の第３世代静止気象衛星ひまわり８号の１０分毎全球マルチチャンネル観測に適用することによって，マイクロ波降雨観測網を補うことのできる高時間分解能の降雨推定プロダクトを作成した．さらにRF手法の機械学習に用いる降雨の真値を，先行研究で用いられていた地上観測からGPMの衛星降雨観測に置き換えることによって，ひまわり8号の観測域全体での降雨推定を可能にした．
ひまわり8号降雨プロダクトの精度検証のために，推定降雨域のスレットスコアを気象庁合成レーダの降雨観測を真値として計算した結果，可視チャンネルの使える日中では0.5以上と非常に高く夜間でも0.42以上でマイクロ波観測に匹敵する精度が得られた．またひまわり８号から新たに追加されたチャンネルが降雨推定に対してどの程度有効であるのかを調べたところ，降雨判定に関しては 観測波長0.46μmの青色可視チャンネルが最も貢献しており，降雨タイプの判別には雲相判別のための1.6μmの近赤外チャンネルが最も寄与率が高いことがわかった．また降雨強度の二乗平均誤差は1.3 mm/hour であったが，8.0 mm/hourを超えるような強い雨に対しては過小評価傾向がみられた．これはRF手法によって推定された降雨強度がひまわり8号輝度温度観測から得られた雲頂温度（高度）情報に強く依存するため，降雨を伴わない薄い巻雲と降雨を伴う厚い対流雲を十分に分離できていないことが原因であると考えられる．この問題に対処するため，ひまわり8号の高時間分解能観測から得られた降水雲の時間変化情報を取り込むことで，対流性降雨の推定精度をさらに向上させる試みを行った．まずひまわり8号の全球10分毎観測から降水雲の移動ベクトルを計算する．次にこの移動ベクトルを元に降水雲の軌道を追跡し，そこから得られた過去1時間の間の降水雲の輝度温度変化の情報をRFに取り込むことで，降水雲の発達段階の情報を含むより精度の高い降雨推定プロダクトを作成する．当日は改良後のひまわり8号降雨プロダクトによる日本付近での事例解析結果についても発表する．
本研究で使用したひまわり８号観測データは全て文部科学省特別教育研究経費プロジェクト「地球気候系の診断に関わるバーチャルラボラトリーの形成」の一環として作成され，千葉大学環境リモートセンシング研究センターが公開するものである．降雨観測の真値として気象庁合成レーダの換算降雨強度とGPM主衛星のKuバンド降雨レーダによる地上降水強度を用いた．

キーワード：ひまわり8号、GPM、降水、GSMaP
Keywords: Himawari-8, GPM, precipitation, GSMaP

静止気象衛星赤外スプリットウィンドウ観測を用いた雲気候データベースの作製
Climatological Cloud Database Estimated by Geostationary Satellite Split-Window Measurements

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We extended our cloud-top database spatially to the midlatitude and temporally to new satellite Himawari-8. We have already released a database of cloud top height and visible optical thickness (CTOP) with one-hour resolution over the tropical western Pacific and Maritime Continent, using infrared split-window data of the geostationary satellites (MTSAT-1R and MTSAT2) (http://database.rish.kyoto-u.ac.jp/arch/ctop/). By comparing MT-SAT IR observation and the direct observation of the cloud top height by CloudSat radar, we can construct a lookup table (LUT) with which the cloud top height is estimated by using only MTSAT data. Unfortunately, now in the age of Himawari-8 that has been available since July 2015, the CloudSat observations are limited in the daytime and the precise direct comparison with the data cannot be conducted to construct LUT. Therefore, we proceeded an alternative way by constructing a calibration table based on the comparison between MTSAT-2 and Himawari-8 observations during July 2015 when both geostationary satellites were in operation. By using the similar approach repeatedly, it will be possible to construct LUT for the past geostationary satellites that had been in operation before the launch of CloudSat in 2006.
We also tried to extend the targeted region to the mid-latitude. In our present scheme applicable for only tropics, the vertical profile of temperature is assumed to be almost constant in whole tropics and all the year. However, since the temperature variability is much larger in mid latitude, it is not plausible to assume that the same IR radiance comes from the clouds with a certain top height. Therefore, we proposed a new method to use temperature data of the global analysis together. The temperature of the cloud top is estimated through the altitude of the cloud top observed by CloudSat as well as the temperature profile deduced from the global analysis data. Then we constructed LUT of cloud top temperature (not height) by the regression of the MTSAT IR radiance with respect to cloud top temperature. We can get the cloud top height at any point at any time by converting the cloud top temperature to cloud top height, with using global analysis data. A preliminary estimate using this method indicated that the cloud top height is estimated within allowable error even in the mid latitude.

キーワード：静止衛星、雲、データベース
Keywords: geostationary satellite, cloud, database

Simultaneous retrieval of aerosol optical thickness and chlorophyll concentration using multi-wavelength and multi-pixel method

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This study proposes an algorithm for the simultaneous retrieval of aerosol optical thickness(AOT) and chlorophyll concentration using multi-wavelength and multi-pixel method over ocean. In our algorithm, the forward radiation calculation is performed by a coupled atmosphere-ocean model(Ota et al., 2010; Nakajima and Tanaka, 1986) with an improved bio-optical ocean module(Shi et al., 2015) for CASE 1 water, which is different to the traditional ocean color algorithms which decouple the atmosphere and ocean surface(Gordon and Wang, 1994) using atmospheric correction procedures; then the Maximum a posterior method(Rodger, 2000) but considering the spatial constrain incorporated with the multi-pixel optimization algorithm(Hashimoto, 2014) is used to retrieval aerosol optical thickness and chlorophyll concentration. For the AOT retrieval, a global aerosol transport-radiation model named SPRINTARS(Takemura et al,. 2000) is used as the priori constrain; Finally, the inversion results are achieved from HIMAWARI-8 and GOSAT-TCAI satellite observation data through comparison to AERONET products and other aerosol retrieval algorithm which is widely used in satellite remote sensing.

Keywords: Aerosol, Ocean color, Remote sensing, Radiative transfer

GOSATによる太陽光誘導クロロフィル蛍光と大気CO_2濃度の同時観測

Simultaneous observations of solar-induced chlorophyll fluorescence by vegetation and atmospheric CO_2 dynamics by GOSAT

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In these decades, global warming has progressed owing to increase of greenhouse gases (GHGs) such as CO_2. To deal effectively with this issue by mitigation and adaptation, it is necessary to monitor emission and sequestration of GHGs with their underlying mechanisms including biogeochemical processes and human activities. Terrestrial ecosystem, which is the large carbon sink, absorbs 123 Pg carbon per year through plant photosynthesis (IPCC 2014). Satellite remote sensing has been used to monitor the spatial and temporal dynamics of terrestrial ecosystems that are responsible for such photosynthetic CO2 absorption. Such observation provides us with geographical information on the potential distribution of carbon sequestration by the aid of ecosystem models. However, as the photosynthesis of a given vegetation is quite sensitive to meteorological changes such as radiation, temperature and precipitation, we need to observe the photosynthetic ‘activity’ in a physiological sense, together with the atmospheric CO2 concentration over continental and global scales. Joiner et al. (2011) and Frankenberg et al. (2011) have suggested that TANSO FTS on Greenhouse Gases Observing Satellite (GOSAT) could detect overlapping part of solar-induced chlorophyll fluorescence (SIF) emitted by terrestrial vegetation and Fraunhofer line. The chlorophyll fluorescence is photons of red and far-red light that emitted by chlorophylls, and in plant ecophysiology it has been a biophysical index to examine the photosynthetic responses to environmental stresses such as extreme temperatures and drought. Thus SIF remote sensing is drawn considerable attention as a new technique to observe the photosynthetic activity of the vegetation. This paper will present our on-going and future challenges by GOSAT and GOSAT-2 to observe such photosynthetic activity of terrestrial ecosystems and its possible consequences with the atmospheric CO2 concentration from national, continental to global scales under climate change.

キーワード：陸域炭素循環、光合成生産
Keywords: carbon cycle of terrestrial ecosystem, photosynthetic production

GOSAT-2 FTS SWIR 設計結果に基づく感度解析初期結果

Preliminary sensitivity study of the GOSAT-2 FTS SWIR retrievals based on the designed specifications

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The Greenhouse gases Observing SATellite (GOSAT) was launched in January 2009 and observed global distribution of the column-averaged dry air mole fractions of carbon dioxide and methane (XCO_2 and XCH_4) for about seven years. As a successor mission to the GOSAT, GOSAT-2 is planned to be launched in early 2018, and its critical design review (CDR) was completed. GOSAT-2 also has a Fourier transform spectrometer (FTS) like GOSAT to obtain short-wavelength infrared (SWIR) light reflected from the earth's surface and thermal infrared (TIR) radiation emitted from the ground and atmosphere. According to the current design of the FTS-2 (FTS onboard the GOSAT-2), its SNR is higher than or almost equal to that onboard the GOSAT, and it covers the 2.3 μm carbon monoxide (CO) band as well as the 1.6 and 2.0 μm CO_2 bands and 1.67 μm CH_4 band. Our preliminary sensitivity test shows that the SNR improvement in SWIR bands reduces the retrieval random error (precision) about 15% for XCO_2 and 35% for XCH_4 than those of GOSAT.

キーワード：温室効果ガス観測技術衛星2型、二酸化炭素カラム平均濃度、メタンカラム平均濃度
Keywords: GOSAT-2, XCO2, XCH4

Applied FORMOSAT-3/COSMIC on observing atmospheric temperature changes caused by volcanic eruptions

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Volcanic eruptions are often along with fiery magma, hot dense gases and powerful explosive energy. Those materials injected into atmosphere might cool tropospheric temperature and warm the temperature of bottom of stratosphere but sometimes the phenomenon was exactly opposite or mixture. This study focused on 8 volcanic eruptions, the explosive indexes of which were 4 during 2008 to 2011 and analyzed the temperature-related data from radio occultation observations of FORMOSAT-3/COSMIC (F3/C). It individually investigated the temporal latitude-altitude and longitude-altitude variances atmospheric temperatures from northeastern, northwestern, southeastern and southwestern of volcanos before and after the eruptions. This study also observed the image from Moderate resolution Imaging Spectroradiometer (MODIS) on NASA terra satellite to see where the volcanic plum extended. Results apparently show that 3 events had cooling troposphere and warming bottom of stratosphere and 2 events were just the opposite. One of the rest events was mixture case and the other one of the rest was without apparent variances in temperature. Cooling troposphere and warming bottom of stratosphere caused by stratospheric aerosols that reduced sunlight reaching troposphere and absorbed radiation at the bottom of stratosphere. The consequence opposite to above was caused by that volcanos erupted hot and high density gases into troposphere and adiabatic expansion happened during the top of troposphere and bottom of stratosphere. Moreover, in mixture case, area with more volcanic ash showed decreasing temperature in the troposphere and increasing temperature at the bottom of stratosphere. Area with less volcanic ash showed increasing temperature in the troposphere and decreasing temperature at the bottom of stratosphere.

Keywords: FORMOSAT-3/COSMIC, volcano

EarthCARE/MSI観測データを用いた雲特性解析
Cloud properties analysis based on EarthCARE/MSI observation

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雲・エアロゾルは地球の放射収支や気候変動に重要な影響を与えることが知られている。しかしIPCC第四次評価報告書によれば、雲・エアロゾル及びそれらの相互作用に関する知見不足は、気候変動予測に不確実性が生じる一因と認識されている。
EarthCARE (Earth Clouds, Aerosols and Radiation Explorer) は、ESA・JAXAが共同で開発を進める地球観測衛星である。搭載される4つのセンサ(雲プロファイリングレーダ(CPR)、大気ライダー(ATLID)、多波長イメージャ(MSI)、広帯域放射収支計(BBR))は、これまで十分な観測が行われてこなかった雲・エアロゾルを全球的に観測し、両者の地球大気中における役割の理解に有用なデータを取得する。EarthCAREは雲・エアロゾルに関する知見不足を解消し、気候変動予測の精度向上に貢献する重要な観測である。
搭載される多波長イメージャMSIは、可視(0.67 um)から熱赤外(12.00 um)までの複数波長において観測を行い、雲・エアロゾルの3次元的理解を目指す。本研究では、CLAUDIA [Ishida and Nakajima, 2009]・CAPCOM [Nakajima and Nakajima, 1995; Kawamoto et al., 2001]・MWP法[橋本真喜子氏 博士論文2015]を元に開発を進めたアルゴリズムを用いて、MSI観測データから雲特性を導出する。本発表では、各アルゴリズム開発の現状とMODIS観測データを用いた雲特性解析結果を報告する。

キーワード：EarthCARE、雲
Keywords: EarthCARE, cloud

衛星エアロゾルリトリーバル手法の開発と事例解析の紹介

Development of remote sensing algorithm to retrieve aerosol optical properties and introduction of the results of case studies

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We have developed a satellite remote sensing algorithm to retrieve the aerosol optical properties using multi-wavelength and multi-pixel information of satellite imagers (MWP). We simultaneously retrieve several parameters that characterize pixels, such as aerosol optical thickness (AOT) of fine and coarse mode particles, single scattering albedo (SSA), and ground surface albedo of each observed wavelength, in each of horizontal sub-domains consisting the target area.
We applied the algorithm to GOSAT/TANSO-CAI and Himawari-8/AHI data. We will show the retrieval results of aerosol characteristics over the urban and forest fire regions such as the Kanto area in Japan and Beijing in China. We also tried to retrieve aerosol properties at a forest fire case, so we would like to introduce the retrieval results over the forest fire regions in Indonesia.
From the results, AOT over the urban or high population areas is larger than that around rural or the low population areas. Furthermore, the SSA is lower in the urban region. For the forest fire case, the AOT and SSA along the plume are higher and lower than that of the other region, respectively. Although the AOT of fine mode totally looks dominant, the Angstrom exponent around the hot spot is lower than that of the leeward side, and increase with the increasing distance from the hot spot.

キーワード：リモートセンシング、エアロゾル、衛星
Keywords: Remote sensing, Aerosol, Satellite

Eddy Effect on the Kuroshio East of Taiwan from Satellite Altimetry

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Kuroshio is a western boundary current in the North Pacific Ocean. It flows northward along the east coast of Taiwan. Previous studies have shown that there is an eddy-rich zone located at 18°-26°N, 122°-160°E. The westward propagating eddies may affect the axis of Kuroshio when they impinge the Kuroshio east of Taiwan. To more understand the phenomenon, satellite altimeter data are used to investigate effects of oceanic mesoscale eddy on the Kuroshio from 18°N to 26°N. The Kuroshio axis is defined as a line with the maximum surface velocity along the Kuroshio path. The velocity of Kuroshio is calculated from the absolute dynamic topography data derived from satellite altimetry with the geostrophic relations. The results show that the Kuroshio meander occurred 13 times from 1993 to 2013 which were caused by westward or northward moving cold eddies when they propagated to the east of Taiwan. The average duration of the meanderings was 27 ±20 days, and the maximum duration was 80 days. The farthest position of the Kuroshio axis meandering was approximately 270 km from the average Kuroshio axis. It is affected by the size of the cold eddy. Under the circumstances of a cold eddy, the mean speed of the Kuroshio axis drops to 0.63 m/s, which is approximately 84% of the seasonal average.

Keywords: Kuroshio, meander, eddy, satellite altimetry

The Central-Pacific type of ENSO and its connection to Pacific Meridional Mode

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In this study, we examine the simulation of the Pacific meridional mode in pre-industrial experiments of the Coupled Model Intercomparison Projects Phase (CMIP5) and link the Pacific meridional mode simulations to the simulation of the Central-Pacific (CP) and Eastern-Pacific (EP) types of El Niño Southern Oscillation (ENSO). Objective criteria are developed to evaluate the model performance in Pacific meridional mode simulations, which gauge the intensity, spatial pattern, air-sea coupling strength, and persistence strength of the coupling of the model meridional mode. Our analyses indicate that most of the CMIP5 model overestimate the air-sea coupling strength in the subtropical where the Pacific meridional mode model occurs, but underestimate the persistence of the coupling. Based on our criteria, ten CMIP5 models are found capable of realistically simulating the Pacific meridional mode. Further analyses reveal that CMIP5 model simulations of the CP ENSO is linked to the model performance in simulating the Pacific meridional mode; the models that are more capable of simulating the Pacific meridional mode also produce stronger CP ENSO. This study demonstrates that the subtropical dynamics and coupling affect the ability of CMIP5 models in simulating the different flavors of ENSO, which should be considered as one of the importance matrices for CMIP5 model evaluation.

Keywords: Central-Pacific types of ENSO, Eastern-Pacific types of ENSO, Pacific meridional mode

AMSR2海洋圏プロダクトの検証 –検証システムの構築–
Validation of AMSR2 ocean products –Construction of validation system–

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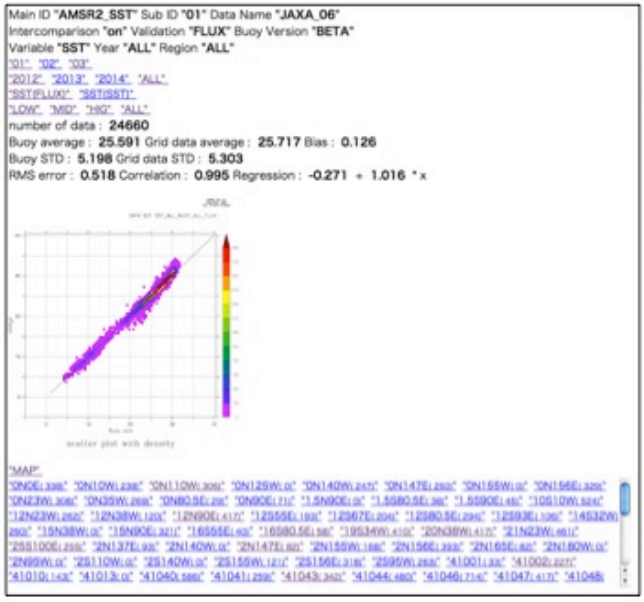
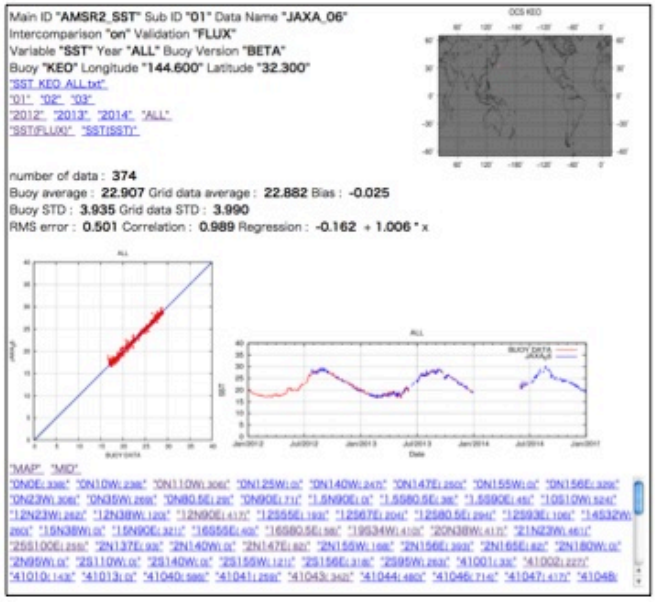
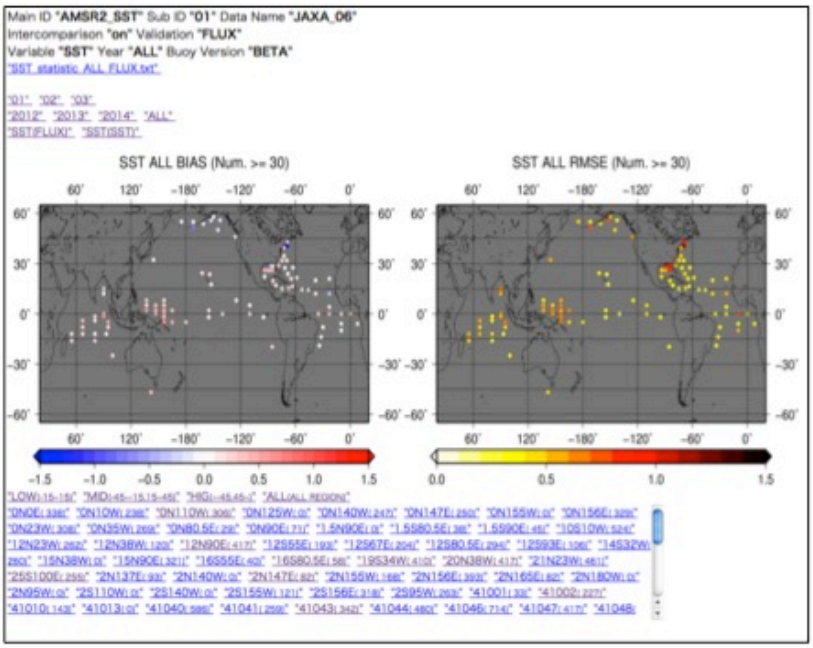
地球環境変動観測ミッション（GCOM）では、全球規模の気候変動や水循環変動メカニズムの理解に必要不可欠な地球物理パラメータを長期継続的に観測するために、2012年に高性能マイクロ波放射計2（AMSR2）を搭載した水循環観測衛星GCOM-Wを打ち上げている。宇宙航空研究開発機構（JAXA）は、AMSR2によって観測された輝度温度から、海洋圏プロダクトとして、海面水温データと海上風速データを作成し、2013年5月に一般提供を開始している。通常、衛星データは、一般提供が開始された以降も精度検証とアルゴリズム改善が繰り返えしによって、比較的頻繁にアップデートされる。AMSR2の海洋圏プロダクトにおいても、これまでに１度のアップデートが行われており、今後もアップデートされることが予想される。そこで、本研究では、長期的、統一的な視点で、AMSR2海洋圏プロダクトの精度や信頼性を検証し、校正に有効な情報を迅速的かつ継続的に提供するシステム（Validation System; VS）の開発を行っている。
VSは、主に、「複数の格子データ間の相互比較」と「現場観測データとの比較」の２つの評価コンポーネントによって構成されている。前者の評価コンポーネントでは、格子データごとの平均場、標準偏差場、領域平均値の時間変化や、予め用意されたリファレンスデータとの平均差、RMS差などが計算される。後者の評価コンポーネントでは、品質管理を徹底して行った係留ブイや船舶データとの比較が行われる。比較項目は、バイアス、RMS誤差、相関係数などの基本的な統計量および、散布図と時間変化図である。我々は、これらの評価結果を、VSによって自動生成されるhtmlファイルによって、ウェブブラウザからグラフィカルに確認できるように設計している。
VSの実行例として、添付図に、ブイデータとAMSR2海面水温データの評価結果のスクリーンショットを示す。この例では、2012年から2014年までの3年間において、97基のブイによって観測された24660個の日平均値データを用いて、AMSR2海面水温データを評価している。出力される統計値および、図は、全てのブイによる結果だけではなく、年ごと、緯度帯ごと、個々のブイごとの結果も参照することが出来る。

キーワード：GCOM-W、AMSR2、係留ブイデータ、海上気象、海面水温
Keywords: GCOM-W, AMSR2, mooring buoy data, marine meteorology, sea surface temperature







Applying Big Data Analysis Method to Improvement Sea Surface Temperature of Geostationary Satellite.

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Big Data is the amount of data involved enormous and cannot be the information within a reasonable period of time to query, retrieve, manage, and analyze. The Big Data are three qualities: Volume, Velocity, and Variety, which information in many fields have brought progress and a breakthrough opportunity. Recent studies sea surface temperature mostly as a reference material Moderate Resolution Imaging Spectroradiometer (MODIS). Sun-synchronous satellites significantly better than geostationary satellites at a time resolution. The equatorial region of the tropical Pacific SST bias main factors are wind speed and air temperature in past studies. In this study, used big data commonly algorithms to provide sea surface temperature (SST) image hourly data. We apply and compare data mining techniques to improve the quality of GOES SST product. By a logistic regression approach, the GOES SST can be determined with an accuracy of 0.4°K and an improvement of the correction to 95%.

Keywords: Big Data, Sea Surface Temperature, Tropical Pacific

The Evolution of internal wave from mode-one to mode-two

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Internal waves (IWs) are observed in the ocean all over the world. In the northern South China Sea, internal waves are frequently monitored between the Luzon Strait and Hainan Island by several satellites, such as optical or radar satellites. The wave crest can be as long as 200 km. It's amplitude is larger than 170 m. The huge amplitude maybe the largest than that ever observed in the world's oceans. The huge IW is usually observed in the deep sea area between the Luzon Strait and Hainan Island. Then a small mode-two wave was observed following a huge mode-one IW on the shelf near Dong-Sha Atoll. Due to the different wave speeds, mode-one and mode-two waves would separate into two waves after decomposition on the shelf. Thus we though the huge model-one IW in deep sea area could be deposited into more modes of IW on the shelf.
In this study, the objective is to observe the generation and evolution of mode-one IWs in the deep sea area, and then the mode-one IW deposit into more modes of IWs on the shelf break. The generation of mode-two waves on the shelf by disintegration of mode-one IWs in the deep ocean is proposed and analyzed based on the theory of modal-decomposition. In this study, some historical measurement data and satellite image are used to detect IWs. Then , the environmental condition is from a mooring near Dong-Sha Island. For comparison, the characteristics of mode-one and mode-two waves from environmental parameters have been estimated. For the test case, water depth increases to 450 m the mode-two wave energy is decreasing to 14%, while it is increasing to 25% when water depth decreases to 350 m. So, the mode-two waves can be generated under favorable condition, especially for multiple layer stratification in the shallow water on shelf.

Keywords: internal wave, south china sea, mode-two

