格子間隔10数kmから1km未満の全球大気実験における湿潤対流の解像度依存性
Resolution dependence of deep convections in a global simulation from over 10-kilometer to sub-kilometer grid spacing

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The success of sub-kilometer global atmospheric simulation opens the door for resolving deep convections, which are essential elements of cloudy disturbances that drive global circulation. Previous study, Miyamoto et al. (2013), found that the essential change in simulated convection properties occurred at a grid spacing of about 2 km as a global mean. In grid-refinement experiments (14 km - 0.8 km) with a constant vertical resolution by using NICAM (Satoh et al., 2014), we conducted further comprehensive analysis of the global-mean state and the characteristics of deep convection, to clarify the difference of the essential change by location and environment. We found that the essential change in convection properties was different in location and environment for each cloudy disturbance. The convections over the tropics show larger resolution dependence than convections over mid-latitudes, whereas no significant difference was found in convection over land or ocean. Furthermore, convections over cloudy disturbances [(i.e., Madden Julian Oscillation (MJO), tropical cyclones (TC)] show essential change of convection properties at about 1-km grid spacing, suggesting resolution dependence. As a result, convections not categorized as cloudy disturbances make a large contribution to the global-mean convection properties. This implies that convections in disturbances largely affect organization processes, and hence have more horizontal resolution dependence. In contrast, other categorized convections that are not involved in major cloudy disturbances show the essential change at about 2-km grid spacing. This affects the latitude difference of the resolution dependence of convection properties, and hence the zonal mean outgoing long-range radiation (OLR). Despite the diversity of convection properties, most convection is resolved at less than 1-km grid spacing. In the future, longer integration of global atmosphere, to 0.87-km grid spacing, will stimulate significant discussion about the interaction between the convections and cloudy disturbances.

キーワード：湿潤対流、高解像度、全球大気実験、解像度依存性
Keywords: deep convection, high resolution, global simulation, resolution dependence

超高解像度全球大気シミュレーションにおける熱帯降水日変化の解像度依存性

Resolution dependence of diurnal cycle of tropical precipitation in a global
high-resolution simulation

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<!--?xml version="1.0" encoding="UTF-8" standalone="no"?-->We carried out the global
high-resolution atmospheric simulations with five horizontal resolution from 14km to 0.87km. The
Nonhydrostatic Icosahedral Atmospheric Model (NICAM; Satoh et al. 2014) was used for this study and
both simulations and anarysis are conducted on the K computer. In the tropical region (15S-15N),
the result shows clear resolution dependence of the diurnal precipitation cycle over the land.
Relatively weak precipitation peak appeared at late night in the result of the coarse resolution.
The peak becomes stronger and its time becomes faster with increasing the horizontal resolution.
Theresolution dependence of temporal changes in the averaged environmental variables over the
tropical land, such as CAPE, PBL height, cloud base height, and precipitable water, were analyzed.
The result shows that the activation of the convections become earlier, especially in the
simulations with grid spacing less than 2 km. This result suggests that the difference of
convection activity around the noon at the different horizontal resolution affects timing of the
peak of the daily precipitation.The early morning peak of tropical precipitation cycle over the
ocean was also well reproduced, with lesser resolution dependence.

キーワード：GCM、降水、高解像度シミュレーション
Keywords: GCM, precipitation, high resolution simulation

水平解像度100mの30秒毎アンサンブルカルマンフィルタを用いたフェーズドアレイ気象レーダの同化実験
Data assimilation experiments of phased array weather radar with 30-second-update ensemble Kalman filter with 100-m resolution

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For preventing and mitigating natural disasters caused by local severe rainstorms, precise numerical weather prediction with higher spatial and temporal resolution would be essential. In this study, we developed a 30-second-update data assimilation system based on an ensemble Kalman filter using JMA-NHM with 100-m resolution. In the present setting of the experiments, we assimilated radar reflectivity and radial velocity derived from the every 30-second volume scan of the phased array weather radar (PAWR) at the Osaka University.
The data assimilation experiments were performed to reproduce the local heavy rainfall that had occurred in Kyoto on 13 July 2013. During the data assimilation cycles, the reflectivity patterns in the model became closer to the observations, indicating that the PAWR data were appropriately assimilated. However, the extended forecast showed a rapid error growth in about 10 minutes. This very short limit of predictability would be related to the time scales of convective activities represented by 100-m resolution, and may also be caused by an imbalance in the initial conditions due to 30-second update cycles, or could be related to potential inconsistency with the lateral boundaries. This presentation will include an introduction to the experimental system and the results of the data assimilation experiments.

キーワード：データ同化、アンサンブルカルマンフィルタ、フェーズドアレイ気象レーダ
Keywords: data assimiilation, ensemble Kalman filter, phased array weather radar

全球雲解像モデルNICAMを用いた全球降水マップGSMaPのアンサンブルデータ
Ensemble Data Assimilation of GSMaP precipitation into the nonhydrostatic global atmospheric model NICAM

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It is generally difficult to assimilate precipitation data into numerical models mainly because of non-Gaussianity of precipitation variables and nonlinear precipitation processes. Lien et al. (2013, 2015) proposed to use an ensemble Kalman filter approach to avoid explicit linearization of models, and a Gaussian transformation (GT) method to deal with the non-Gaussianity of precipitation variables. Lien et al. pioneering results show that using an EnKF and GT helps improve the forecasts by assimilating global precipitation data, in both a simulated study using the SPEEDY model, and in a real-world study using the NCEP GFS and TRMM Multi-satellite Precipitation Analysis (TMPA) data.
This study extends the work of Lien et al. by assimilating the JAXA's Global Satellite Mapping of Precipitation (GSMaP) data into the Nonhydrostatic Icosahedral Atmospheric Model (NICAM) at 112-km horizontal resolution. It develops a new method to construct the two GTs (forward and inverse GTs) for observed and forecasted precipitation using the previous 30-day precipitation data. Using this new forward GT, precipitation variables are transformed to Gaussian variables, and assimilating the GSMaP precipitation results in improved forecasts. We also found that using the inverse GT allows to create realistic observation-like precipitation fields from the model forecasts transformed by the observation-based inverse GT. Moreover, we also explore online estimation of model parameters related to precipitation processes using precipitation data. This presentation will include the most recent progress up to the time of the meeting.

キーワード：データ同化、GSMaP、NICAM-LETKF、ガウス変換
Keywords: Data Assimilation, GSMaP, NICAM-LETKF, Gaussian Transformation

熱帯上の巻雲シミュレーションに必要な鉛直解像度の評価
Vertical grid spacing necessary for simulating tropical cirrus clouds

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The distribution of simulated cirrus clouds over the tropics is affected by the particular model's vertical grid spacing. To examine this effect, we use a high-resolution atmospheric general circulation model NICAM with 28-km and 14-km horizontal meshes. We show that a vertical grid spacing of at least 400 m is necessary to resolve the bulk structure of cirrus clouds. As one reduces the vertical grid spacing below about 1000 m, the visible cirrus cloud fraction decreases, the cloud thins (optically and geometrically), the cloud-top height lowers, and consequently, the OLR increases. These effects are stronger over the tropics. When using a vertical grid spacing of 400 m or less, the vertical profiles of effective radii and ice water content converge toward measurements (CloudSat satellite and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation).

キーワード：大気大循環モデル、気候、巻雲
Keywords: General Circulation Model, Climate, Cirrus

NICAMを用いた雲放射フィードバックの解析─温暖化応答の雲微物理依存性─
High Cloud Responses to Global Warming Simulated by Two Different Cloud Microphysics Schemes Implemented in the Nonhydrostatic Icosahedral Atmospheric Model (NICAM)

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This study examines cloud responses to global warming using a global nonhydrostatic model with two different cloud microphysics schemes. The cloud microphysics schemes tested here are the single- and double-moment schemes with six water categories: these schemes are referred to as NSW6 and NDW6, respectively. Simulations of one year for NSW6 and one boreal summer for NDW6 are performed using the nonhydrostatic icosahedral atmospheric model with a mesh size of approximately 14 km. NSW6 and NDW6 exhibit similar changes in the visible cloud fraction under conditions of global warming. The longwave (LW) cloud radiative feedbacks in NSW6 and NDW6 are larger than the average LW cloud radiative feedbacks in the Coupled Model Intercomparison Project Phase 5 (CMIP5)/Cloud Feedback Model Intercomparison Project 2 (CFMIP2). The LW cloud radiative feedbacks are mainly attributed to cirrus clouds, which prevail more in the tropics under global warming conditions. For NDW6, the LW cloud radiative feedbacks from cirrus clouds also extend to mid-latitudes. The changes in cirrus clouds and their effects on LW cloud radiative forcing (LWCRF) are assessed based on changes in the effective radii of ice hydrometeors (R_{ei}) and the cloud fraction. We determined that an increase in R_{ei} has a non-negligible impact on LWCRF compared with an increase in cloud fraction.

キーワード：雲フィードバック
Keywords: Cloud Feedback

Achievements and future subjects of the 'Ultra-high Precision Mesoscale Weather Prediction' in SPIRE Field 3

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A research project on super high-resolution mesoscale numerical weather prediction with the High Performance Computing using the K-computer was conducted from FY 2011 to FY 2015 (March 2016). This research was one of the five fields of the MEXT-funded national research project in Japan, the HPCI Strategic Programs for Innovative Research (SPIRE). Following three subjects were performed to show the feasibility of precise prediction of local high impact weather phenomena using the K-computer: 1) Development of cloud resolving 4-dimensional data assimilation systems, 2) Development and validation of a cloud resolving ensemble analysis and forecast system, and 3) Basic research with very high resolution atmospheric models.
In the presentation, achievements in the five year projects including development of advanced data assimilation methods, high-resolution data assimilation/ensemble experiments and super high resolution experiments for mesoscale high impact weathers (torrential rains, tropical cyclones, and tornados) are presented, and remaining subjects are addressed.

Keywords: High Performance Computing, K-computer, Mesoscale Numerical Weather Prediction

Mesoscale hybrid data assimilation system based on JMA nonhydrostatic model

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This presentation discusses the benefits of using a hybrid ensemble Kalman filter and four-dimensional variational (4D-Var) data assimilation (DA) system rather than a 4D-Var system employing the National Meteorological Center (NMC)-method to predict severe weather events. This hybrid system is an adjoint-based 4D-Var system that uses a background error covariance matrix $\mathbf{B}$ constructed from the NMC method and perturbations in a local ensemble transform Kalman filter (LETKF) system. To reduce the sampling noise, two types of implementation (the spatial localization and neighboring ensemble approaches) were tested. Both the 4D-Var and LETKF systems are based on the Japan Meteorological Agency's nonhydrostatic model. The assimilation of a pseudo-single-observation of sea-level pressure located at a tropical cyclone (TC) center yielded wind and potential temperature increments physically consistent with what is expected of a mature TC in both hybrid systems at the beginning of the assimilation window, whereas analogous experiments performed using the NMC-based $\mathbf{B}$ (4D-Var-Bnmc) were not. At the end of the assimilation window, the structures of the increments became similar to each other among 4D-Var-based methodologies, while the analysis increment by the 4D-Var-Bnmc system was broad in the horizontal direction. Realistic DA experiments showed that the hybrid systems provided initial conditions that yielded more accurate TC intensity and track forecasts than those achievable by the 4D-Var-Bnmc system. The hybrid systems also yielded some statistically significant improvements in forecasting a local heavy rainfall event in terms of fraction skill scores when a 160 km ×160 km window size was used.

Keywords: Data Assimilation, Tropical Cyclone, Heavy Rainfall Event

Inter-comparison of the hybrid variational-ensemble methods

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Variational (VAR) and ensemble Kalman filter (EnKF) methods are two dominant approaches in data assimilation for large-scale problems. VAR estimates the mode of the posterior distribution, leading to minimize a cost function. This cost function depends on the second moment of the prior distribution which cannot be produced by VAR itself. Therefore the climatological background covariance is used instead of the true "errors of the day". This second moment is available into EnKF by sampling the prior distribution with a number of ensemble members. However, with a limited number of ensemble members, only a subspace of the error space can be represented. This means partial "errors of the day" are considered in EnKF. To introduce "errors of the day" into assimilation as in EnKF but can still explore the full error space as in VAR, some hybrid methods have been proposed.

In a hybrid method a specific operator is taken as a linear combination from the corresponding operators in the variational part and the ensemble part. If this operator is the background covariance we have the hybrid covariance method (hybrid B). In case the Kalman gain is chosen we have the hybrid gain method (hybrid K). In some variants of the hybrid covariance method, the operators in the factor form of the background covariance can be used. That means we can take a linear combination between background variances (hybrid V) or background correlations.

In the Strategic Programs for Innovative Research (SPIRE) Field 3, besides the traditional methods like 4DVAR and EnKF, hybrid methods have been implemented in the K Computer under a unified hybrid assimilation system for the Japan Meteorological Agency (JMA) limited-area operational model NHM. The system consisted of two components: the variational one 4DVAR and the ensemble one 4D-LETKF. The variational part was adopted from the JNoVA system developed at JMA. The ensemble part was based on the NHM-LETKF system developed at JMA. There is a two-way interaction between two sub-systems.

Real observation experiments were carried out for the August in 2014. This month was characterized by abnormal rainfall over the western Japan with two tropical cyclones and several heavy rainfall events. To verify performance of three hybrid methods (Hybrid B, Hybrid V, and Hybrid K) the same 50-50 weights were used in all hybrid experiments. In addition to the hybrid experiments, JNoVA and NHM-LETKF were run over the same period. Verification shows that all hybrid methods and JNoVA outperformed NHM-LETKF. Using JNoVA as the control method, Hybrid B and Hybrid K were slightly better than JNoVA. Hybrid V can beat JNoVA at some pressure level but in general Hybrid V was slightly worse than JNoVA. Hybrid B and Hybrid K were comparable in predicting atmospheric variables. Further verification against rainfall analyses points out that Hybrid K was comparable to JNoVA, whereas Hybrid B was better than JNoVA significantly in predicting precipitation especially for rainfall thresholds greater than 20 mm.

Keywords: variational data assimilation, ensemble Kalman filter, hybrid covariance, hybrid gain

Issues regarding the high-performance computing associated with the rapid-update-cycle
ensemble data assimilation

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We have developed the SCALE-LETKF system, utilizing the Scalable Computing for Advanced Library and
Environment (SCALE)-LES model and the Local Ensemble Transform Kalman Filter (LETKF), aiming to
conduct ensemble data assimilation with very high resolution and rapid update cycle. The system has
been used for several different studies, including the assimilation of the phased array weather
radar (PAWR) and the Himawari-8 satellite radiance data. Although the peak computational speed of
the K computer is powerful enough to run a very large problem, but the early version of the
SCALE-LETKF system showed several issues to cause poor computational performance and low
parallelization efficiency, or even to inhibit us from running a big problem. These issues include
the memory overflow with huge observation files, heavy disk I/O and inter-process communication,
and the load imbalance among processes. Some issues have been solved by the improvement of the code
design, and the others are being investigated. We will discuss the issues and solutions up to the
time of the presentation.

Keywords: LETKF, SCALE, High-performance computing

10240メンバーのアンサンブルデータ同化実験に基づいた大気の非ガウス性の調査
Non-Gaussian statics and data assimilation in the global atmospheric dynamics with
10240-member ensemble Kalman filter

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In our previous work, impacts of removing covariance localization are investigated by increasing
the ensemble size up to 10240, with an intermediate AGCM known as the SPEEDY (T30/L7) model and an
ensemble Kalman filter (EnKF). The analysis accuracy without localization was greatly improved, and
we found that the long range covariance structures up to several thousand km helped to extract
information from distant observations. By contrast, the improvement in the tropical regions was
relatively small. In this study, we hypothesize that this little improvements be related to the
non-Gaussianity of the error statistics due to highly-nonlinear processes of convections. Actually,
we found that strong non-Gaussianity such as bimodal distributions frequently appears in the
tropical regions, and the spatial patterns of the occurrences of the non-Gaussian error statistics
correspond well to that of the analysis error. We test some ideas to partly account for
non-Gaussianity in the EnKF framework. We will present the results up to the time of the workshop.

キーワード：データ同化、数値予報、非ガウス性
Keywords: data assimilation, numerical weather prediction, non-Gaussianity

Hydro-Debris2&3Dモデルの改良と山岳地域土砂災害への応用

Improvement of Hydro-debris2D&3D model and It's application to Mountain Hazards and Sediment Disaster Prediction

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Hydro-debris2D model has been developed and improved for predicting occurrence of debris flow throughout hydrological regime changes. The model contains three components: (1) Shallow-water based surface flow modules, in order to calculate mountain zone torrential flow regimes, (2) rapid subsurface/interflow in weathered rock, and (3) debris flow components. The model has been applied into Izu Oshima Island's debris flow event in 2013 and to Hiroshima's debris flow disaster in 2014. As rainfall was input, we made a comprehensive comparison between observed rainfall station datasets from AMeDAS and High-resolution NHM calculation results. In the case of Izu Oshima, heavy rainfall and extensive surface flow occurred in the western part of the island, together with extreme interflow which may have caused the start of debris flow in the wall. In Hiroshima's case, observed rainfall reproduced occurrences of debris flow with better agreement of the disaster due to the slight changes in heavy-rainfall zone. Prediction using ensemble rainfall results may be needed in order to increase the accuracy of the occurrence.
Hydro-debris 3D has been developed in order to simulate flow-particle interaction in the debris flow using Euler-lagrangean coupling numerical simulation. By precisely routing particle segregation, the mechanism of "Inverse grading" in debris flow observed in steep slope channel experiment in large eddies of debris flow is being reproduced by the model.

キーワード：Hydro-debris2D、土石流、豪雨、Euler-lagrangean coupling model
Keywords: Hydro-debris2D, Debris Flow, Heavy Rain, Euler-lagrangean coupling model

局地的豪雨予測における高頻度・高密度地上観測データのインパクト：孤立積乱雲によるケースについて
Impacts of dense and frequent surface observations on a sudden severe rainstorm forecast: A case of an isolated convective system

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To investigate the predictability at 1-km resolution for a sudden severe rainstorm event occurred on September 11, 2014 around Kobe city, we perform a series of data assimilation (DA) experiments using the Local Ensemble Transform Kalman Filter (LETKF) with the JMA-NHM (NHM-LETKF). In this event, a cumulonimbus generated suddenly near the Kobe city center around 0800 JST. It developed rapidly within 10-minutes, and brought heavy rainfalls over 50 mm h^{-1} from 0830 JST to 0930 JST, affecting people's morning activities.

The control run (CTRL) was performed with only reflectivity and radial velocity data from the Phased Array Weather Radar (PAWR) in Osaka University. We installed the automated weather stations Meisei "POTEKA II" at 8 locations in Kobe city, and have been observing surface data every 30 seconds. We performed DA experiments with the additional temperature and relative humidity data from the surface stations. Since we found that the surface station data had significant biases, a bias correction method has been developed with the Kobe observatory data as the unbiased ground truth. Two DA experiments with the raw data (NOBC) and the bias corrected data (BC) have been performed.

CTRL showed strong echoes and surface rainfalls, although the rainfall intensity is smaller than the JMA analyzed precipitation based on the radar and gauge networks. NOBC showed a significant decrease in surface relative humidity because of the dry biases of the surface station data, and consequently, showed decreased surface rainfalls. By contrast, BC showed stronger rainfall intensity, better matching with the JMA analyzed precipitation. The results suggest that the dense and frequent surface DA have a potential to improve the forecast accuracy for sudden severe rainstorms.

キーワード：データ同化、局地的豪雨予測、孤立対流系
Keywords: Data assimilation, Sudden severe rainstorm forecast, An isolated convective system

ひまわり 8 号輝度温度観測のデータ同化研究:台風 Soudelor (2015)事例
Assimilating Himawari-8 Brightness Temperature: A Case Study on Typhoon Soudelor (2015)

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The Japan Meteorological Agency started full operations of the new geostationary meteorological satellite "Himawari-8" in July 2015. Himawari-8 is the first of a series of the third-generation geostationary meteorological satellites including NOAA's GOES-R (planned for launch in 2016), producing about 50 times more data with more channels and 3 times more observing frequency than the previous generation. In August 2015, Himawari-8 successfully captured rapid intensification of Typhoon Soudelor (2015), the strongest northwestern Pacific typhoon in the summer of 2015 with minimum central pressure of 900 hPa. In this study, we assimilate brightness temperature from Himawari-8 using our new ensemble data assimilation system called "SCALE-LETKF" and investigate its impact on the analyses and forecasts of Soudelor.

全球非静力学モデルによる地球温暖化に対する熱帯低気圧の活動と構造の応答
Response of tropical cyclone activity and structure to a global warming in a
high-resolution global nonhydrostatic model

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Recently, the present-day and global warming simulations are conducted by using Nonhydrostatic ICosahedral Atmospheric Model (NICAM) without cumulus convective scheme. These simulations span 30-years. Horizontal grid interval is 14-km. The authors investigate response of tropical cyclone (TC) activities to global warming by using those outputs. The model projects reduction in the global TC formation, and a rise in rate of intense TC formation to the total TC. These findings are consistent with the previous studies.
NICAM reproduces the TC primary and secondary circulations. In particular, updrafts along eyewall cloud exhibits outward slope with height, which was documented by observational studies. Horizontal size of TC modulates the scale of natural disaster by tropical cyclone as well as its genesis number and intensity. The authors investigate a future change in the radius of maximum wind at the same life time maximum intensity. The global warming simulation projects a decrease in sea-level pressure under eyewall cloud, and an increase in TC frequency with large radius of maximum wind for TC developing to deeper than 980 hPa.
This change is related to the elevation of tropopause due to global warming. The elevation of tropopause induces upward extension of eyewall cloud, and increase in diabatic heating related to the extension. The heating decreases sea level pressure underneath the heating area mainly from hydrostatic adjustment. The change in sea level pressure distribution enhances tangential wind under and outward of eyewall cloud. The Outward slope of updrafts with height plays a key role in this mechanism.

キーワード：熱帯低気圧、地球温暖化
Keywords: tropical cyclone, global warming

14kmメッシュ全球大気モデルにおける温帯低気圧の将来予測
Future projection of extratropical cyclone simulated by a 14 km mesh global atmospheric
model

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Changes in the extratropical cyclones due to global warming were investigated using 14 km mesh
global non-hydrostatic atmospheric model. Present and future climate runs were performed for 30
years each with cloud microphysics scheme instead of convection scheme. Detection and tracking
algorithms were applied to the model output as well as reanalysis data to obtain statistics of the
extratropical cyclones. Structural changes of the extratropical cyclones were analyzed by
compositing each variable at the cyclone center.
 The model simulates statistics and mean structure of the extratropical cyclones including
histograms of mean sea level pressure (MSLP), wind speed and precipitation and dynamical structure.
Geographical distribution of storm-track is captured, though significant positional bias exists,
especially over the north Pacific.
 The model projects poleward shift of the storm-track and slight reduction of the number of
extratropical cyclones. Though MSLP does not change significantly, precipitation and Southern
Hemispheric low-level wind speed around the extratropical cyclone are enhanced due to global
warming. The magnitudes of changes in precipitation and low-level wind speed tend to be greater for
the cyclones with lower synoptic-filtered MSLP. Both liquid and ice water paths are increased, and
it seems to be linked to the increased temperature and the enhanced upward motion around the
extratropical cyclones. Such thermodynamical and dynamical factors will be discussed in our talk.

キーワード：温帯低気圧、将来予測、高解像度全球大気モデル
Keywords: extratropical cyclone, future projection, high-resolution global atmospheric model

全球非静力学モデルを用いた北半球夏季の1か月予測計算
Month-long forecasts using a global non-hydrostatic model in boreal summer season

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Month-long forecasts using a global non-hydrostatic model (Nonhydrostatic Icosahedral Atmospheric Model, NICAM) have been routinely run (once a week) during boreal summer season in 2014 and 2015. The model was initialized using NCEP final analysis and free run was conducted with prescribed sea surface temperature. Horizontal mesh size of 14-km was globally used with explicit representation of moist convection. In both years, El Nino was developing and successive formation of tropical cyclones took place in the western North Pacific during the active periods of intraseasonal oscillation (ISO). The model generally captured the large-scale variability associated with the ISO, such as the eastward and northward extension of lower tropospheric equatorial westerlies and convective activity at the lead time of approximately two weeks. These results support the arguments of previous studies based on NICAM ensemble simulations using the K-computer. Some common biases were noted, such as northward displacement of monsoonal circulation and earlier growth of convectively coupled vorticity disturbances. By fixing these biases, extension of predictability is highly expected. The simulation results also suggest that better prediction of major convective systems, such as tropical cyclones, leads to better forecast skills in large-scale fields.

キーワード：全球非静力学モデル、台風発生、夏季季節内振動
Keywords: Global nonhydrostatic model, Tropical Cyclogenesis, Boreal Summer Intraseasonal
          Oscillation

NICAM海洋結合版(NICOCO)を用いた季節内実験の現状
Current status of subseasonal simulations using ocean coupled NICAM (NICOCO)

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NICAM has demonstrated its potential as an atmospheric model in producing realistic MJOs in terms of eastward propagation speed and spatial precipitation patterns (Miura et al. 2007, Miyakawa et al. 2014). Ocean-surface boundary conditions for NICAM had been either prescribed SSTs or mixed-layer 1D ocean model in these studies. Recently we developed a coupler that connects the Icosahedral grid-system of NICAM with a Tri-polar grid system applied in an ocean model COCO, which has been used extensively as the ocean component of MIROC. The ultimate target of the ocean coupling is to enable long-term climate predictions, which require additional effort for adjustment and verification along with a large amount of computational resource. However in the short term, we seek to utilize the ocean coupled NICAM (NICOCO) to improve sub-seasonal to seasonal predictions, and deepen our understandings in the interactions between MJO and ocean. The pilot study of NICOCO includes the evaluation of ocean coupling impacts on 1) interaction between MJO and ENSO, 2) interactions between MJO and oceanic waves and/or through flows in the Maritime continent warm pool regions, and 3) Australian monsoon onset. Model features and preliminary results will be introduced.
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キーワード：NICAM、海洋結合モデル、全球非静力モデル
Keywords: NICAM, Ocean coupled model, global nonhydrostatic model