台風セミナー2016

日程：2016 年 8 月 4 日（木）～5 日（金）
場所：名古屋大学　ＥＳ総合館１階ＥＳ会議室
共催：名古屋大学宇宙地球環境研究所　日本気象学会台風研究連絡会

＜日程＞

【8/4】
・9:00-9:30 受付
・9:30-9:40 開会のあいさつ（伊藤耕介）
・9:40-12:40
　・Michael Bell 氏講演(1)（座長：山田広幸）
　　Aircraft Observations of Tropical Cyclones: Past, Present, and Future
　（休憩は適宜２回程度とる予定です）
・12:40-12:55 ノーマルポスター紹介（各 3 分紹介）
　・伊藤耕介（琉球大学）
　　Secondary eyewall formation fueled by outer convective instability
　・中野満寿男（ＪＡＭＳＴＥＣ）
　　サイクロン Pam(2015)の発生について
　・藤原圭太（九州大）
　　SST 改変実験にみられる台風と水蒸気コンベアベルトの相互作用の変化
　・藤田実季子（ＪＡＭＳＴＥＣ）
　　アンサンブル予報データを用いた低頻度事象の統計解析
　　-「平成 27 年 9 月関東・東北豪雨（鬼怒川）」を例に-
・12:55-13:00 写真撮影
・13:00-14:30 昼食・ポスター閲覧
・14:30-18:00 ロングポスター紹介（各１時間；休憩時間は各 10 分程度）（座長：辻宏樹）
　・辻野智紀（名大）
　　理想化した熱帯低気圧に伴う長寿命多重壁雲の維持メカニズム
　・藤田浩史（京大）
　　台風の眼周辺の詳細構造の解析
　・辻宏樹（九大）
　　衛星観測データを用いた台風の大きさの変化と降水分布の関係の考察

・19:00- 懇親会

魚菜市場　いごこ家　名駅店

http://www.hotpepper.jp/strJ001109893/

予算は 4,000～5,000 円の予定です.

【8/5】

・9:00-12:00

・Michael Bell 氏講演(2) （座長：山口宗彦）

Aircraft Observations of Tropical Cyclones: Past, Present, and Future

（休憩は適宜２回程度とる予定です）

・12:00-13:00 昼食・ポスター閲覧

・13:00-16:30 ロングポスター紹介（各 1 時間；休憩時間は各 10 分程度）

（座長：中野満寿男）

・金田幸恵（名大）

温暖化による非常に強い台風の将来変化：

４つの水平解像度 5km モデルを用いた相互比較研究

・嶋田宇大（気象研）

2015 年台風第 15 号の壁雲交換後の急発達に関する観測的研究

・村田憲人（気象庁台風センター）

台風強度予報モデル SHIPS の現業利用に向けた取り組み

・16:30-16:35 閉会のあいさつ（篠田太郎）

＜ポスター発表に関する補足＞

ポスター発表紹介において、１時間の説明をされる方は、

ポスター作成のもととなった ppt や Illustrator のファイルを

プロジェクタに映す形で説明を行っていただきます。

別途、ｐｐｔで口頭発表用の資料を作ることのないように

お願いいたします（補足資料として用意するのは可です）。

招待講演要旨

Michael Bell (University of Hawai‘i)

Aircraft Observations of Tropical Cyclones: Past, Present, and Future

Tropical cyclones (TCs) are a yearly threat to coastal populations around the world with heavy rainfall, strong winds, and powerful storm surge. While our ability to forecast TCs continues to improve on average, individual typhoons or hurricanes can present significant forecast challenges. Rapid formation and intensification prove especially difficult for numerical weather prediction models, producing large errors in track and intensity at longer lead times of three to five days. This talk will review recent advances in our scientific understanding of TCs, with a focus on the insights obtained from aircraft observations. Though satellites provide the most frequent observations of TCs and their environment around the globe, direct aircraft measurements are still a primary tool for revealing and understanding the structure, intensity, and track of these storms. A review of the history of operational aircraft reconnaissance and results from field experiments using research aircraft from 2005 - 2015 will be highlighted. Challenges to further improvements in forecast skill will be discussed, along with future directions for observations and research that will benefit Japan, Hawaii, and other coastal areas affected by typhoons and hurricanes.

ポスター発表要旨

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Kosuke Ito (Univ. of the Ryukyus)
伊藤耕介（琉球大学理学部）

Sensitivity analysis with a high-resolution nonhydrostatic atmospheric model and its adjoint model is conducted to elucidate the important process on the secondary eyewall formation (SEF) of TC Bolaven (2015). A response function is defined as the secondary maximum of azimuthal-mean tangential velocity. A notable sensitivity with respect to water vapor mixing ratio appears in the lower atmosphere around the SEF region. In addition, sensitivity around the SEF region significantly amplifies during several hours, exhibiting the large influence from this region. In contrast, the sensitivity near the primary eyewall region is relatively weak. The amplification of sensitivity around the SEF region large is presubmably associated with the convective instability. In the current framework, the outer convective instability plays the most significant role in the SEF. Additional experiment, in which the water vapor content is changed in the outer region, assured that the occurence of the SEF can be dependent on the outer humidity profile. The increase of humidity in the outer region helps to fuel the convection in the outside which lead to the SEF, while the tangential velocity decreases. In contrast, SEF did not form when the humidity is substantially decreased in the outer region.

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Nakano, Masuo (JAMSTEC)
中野満寿男（JAMSTEC）

Genesis of Super Cyclone Pam (2015): Sea Surface Temperature Anomalies and Modulation of Large-Scale Environmental Circulation and the Madden–Julian Oscillation
（サイクロン Pam(2015)の発生について）

Super cyclone Pam (2015) was generated in the tropical central Pacific under conditions that included a sea surface temperature anomaly (SSTA) of +2 K associated with a developing El Niño and passage of the Madden–Julian Oscillation (MJO), which traveled eastward in the western Pacific, and developed to a record-breaking amplitude. Objectives of this study are to investigate the influence of SSTAs on the MJO and the large-scale environmental circulation, and to establish how those modifications and the SSTA itself modulated the genesis of tropical cyclone Pam in March 2015. Two series of numerical experiments were conducted by using a nonhydrostatic global atmospheric model with observed (OBSSST) and no (CLMSST) SSTAs. Both the atmospheric reanalysis dataset

and the results of experiments showed that large-scale environmental westerly wind at 850 hPa (U850) intensified in the tropical central Pacific by SSTA. The amplitude of MJO simulated in OBSSST was larger than that in CLMSST. Especially in the experiments initialized during 26 February–3 March, the phase of MJO in OBSSST was ahead of that in CLMSST and the genesis location in OBSSST was 10° to the east of that in CLMSST. The analysis of the genesis potential index indicated that (1) the potential velocity enlarged by the SSTA itself, (2) an eastward shift of the MJO phase and its amplification, and (3) strengthening of U850 in the tropical central Pacific due to the SSTA placed the location of Pam's genesis 10° further east without affecting its genesis probability.

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Fujiwara, Keita (Kyushu Univ.)
藤原圭太（九州大学理学府地球惑星科学専攻）

Evidence for the significant role of moisture conveyor belt in tropical cyclone track, intensity and size
（SST 改変実験にみられる台風と水蒸気コンベアベルトの相互作用の変化）

Recent studies have pointed out that moisture conveyor belt (MCB), which is large-scale moisture transportation from the Indian Ocean and South China Sea into the vicinity of the tropical cyclone (TC) center, may affect the TC intensity and track (Kudo et al. 2014, Hegde et al. 2015). We examined the response of the MCB to surface sea temperature (SST) changes in the Indian Ocean and South China Sea, using in Cloud Resolving Storm Simulator (CReSS). The obtained results are consistent with those of Hedge et al. (2015). According to trajectory analysis, the number of air parcels that intrude into the TC inner system from the Indian Ocean and South China Sea in warm SST run is much smaller than that in cool SST run. This difference is intimately associated with enhancement or weakening of the MCB. Since the MCB is interrupted over the South China Sea in warm SST run, the amount of moisture import into the TC system is reduced, leading to weakening of the TC intensity. Another intriguing feature is that the simulated TC size in the cool run tends to be larger than that in the warm run. We are also conducting simulation with respect to other TCs that have similar tracks, such as typhoon Halong (2002).

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Fujita, Mikiko (JAMSTEC)
藤田実季子（JAMSTEC）

Dynamical downscaling for statistical analysis using ensemble forecast data during the Japan floods of September 2015
（アンサンブル予報データを用いた低頻度事象の統計解析-「平成27年9月関東・東北豪雨（鬼怒川）」を例に-）

The dynamical downscaling was performed for statistical analysis of heavy rainfall and floods event around Kanto region in Japan in September 2015. We used the global ensemble forecast data provided from NCEP, and the WRF model was used for the downscaling. The 1029 members of floods events were simulated by WRF in 16 km horizontal resolution. Comparing the result using FNL, which is corresponding to the observed results, the real rainfall in the target period was estimated as 95th percentile approximately. In the presentation, I will discuss the relationship between the reproducibility of heavy precipitation and forecast errors of typhoon tracks.

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Tsujino, Satoki (Nagoya Univ.)
辻野智紀 （名古屋大学宇宙地球環境研究所）

Maintenance mechanism of long-lived concentric eyewalls associated with an idealized tropical cyclone
（理想化した熱帯低気圧に伴う長寿命多重壁雲の維持メカニズム）

To clarify maintenance mechanism of long-lived concentric eyewalls (CEs) associated with an idealized tropical cyclone (TC), a numerical experiment is performed using a three-dimensional and non-hydrostatic model over a long period of 90 days. In this study, long-lived CEs are successfully represented. The outer eyewall has weak updraft with outward tilting structure, in contrast to the structure of the outer eyewall with the eyewall replacement cycle. The kinetic energy (KE) budget is employed to diagnose the contraction of the outer eyewall. In the long-lived CEs case, negative work due to radial pressure gradient force above the planetary boundary layer (PBL) in the outer eyewall prevents the outer eyewall from contracting. The negative KE tendency inside the outer eyewall due to the negative work is mainly produced by the outflow above the PBL in the inner eyewall. The outflow is caused by the super-gradient wind above the PBL in the inner eyewall.

Super-gradient wind in the case of the long-lived CEs is much stronger than that in the ERC case. Thus, it suggests that the strong super-gradient wind in the inner eyewall is an essential factor for the maintenance mechanism of the long-lived CEs.

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FUJITA Hiroshi (Kyoto Univ.)
藤田浩史（京都大学生存圏研究所）

Detailed structure within the Typhoon eye
（台風の眼周辺の詳細構造の解析）

The characteristics of the ""Eye"" and eyewall of a Tropical Cyclone (TC) are examined with a windprofiler and upper-soundings around a small island belonging to Japan. There are few observations of wind behavior in the eye of a TC with high time and height resolutions. In the eye of the TC, weak cyclonic wind and updraft formed like a cylinder centered on the TC. The updraft did not form clouds and precipitation because stable and relatively dry air existed in the middle troposphere. There were dry layers above the middle troposphere in the eye, especially in the lower layers on the front side of the TC. Therefore, the rainfall associated with the eyewall was strengthened and developed. This is the first time that the detailed wind behavior in the eye of the TC in the developing and mature stage has been observed.

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Tsuji Hiroki (Kyushu Univ.)
辻宏樹（九州大学大学院理学府地球惑星科学専攻）

Consideration of relationship between tropical cyclone size change and rainfall distribution using satellite observation data
（衛星観測データを用いた台風の大きさの変化と降水分布の関係の考察）

Size of tropical cyclones (TCs) is an important property of TCs, along with intensity of TCs. However, far fewer studies have examined TC size than have considered intensity, genesis, and development of TCs.　Tsuji et al. (2016, JMSJ) shows that thermal forcing applied in lower inertial stability region can increase the size of TC-like vortices　and that in higher inertial stability region hardly affects the size.　In this study, we try to reveal the difference of rainfall distribution in TC size increase period and TC size stationary period by using satellite

observation data. The size of TCs is defined by the radius of 15 m/s wind speed (R15).

We find that the precipitation is located from inside to outside R15 in the size increase period, whereas it is mostly concentrated near the TC center in the size stationary period. We also find that inertial stability near the center where the distribution of rainfall has statistically no difference between both periods is large enough to prevent the heat-induced circulation from extending to outside R15. This suggests that the rainfall in the outer region of TC contributes to increase TC size, being in consistent with the results of Tsuji et al. (2016).

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Kanada, Sachie (Nagoya Univ.)
金田幸恵（名古屋大学宇宙地球環境研究所）

Study on a Category-5 typhoon in future, warmer climates: a multi-model intercomparison by four 5-km models

（温暖化による非常に強い台風の将来変化：４つの水平解像度 5km モデルを用いた相互比較研究）

Typhoon Vera (1959) was an extremely intense tropical cyclone (TC) with a minimum central pressure of 895 hPa and caused huge disaster in Japan. To explore the impacts of future climate changes in intensity and structures of such an intense TC, we conducted numerical simulations on Typhoon Vera in a current climate and a global warming climate using four 5-km mesh non-hydrostatic models; CReSS, MM5, JMANHM, and WRF. Initial and boundary conditions for control simulations of typhoon Vera were provided by the Japan Meteorological Agency 55-year Reanalysis dataset. Future changes between the periods of 1979-2003 and 2085-2099 were calculated from climate runs using a 20-km mesh atmospheric general circulation models. These changes were then added to the initial and boundary conditions of the control simulations.

The results show that the maximum intensity of an intense TC increases in all the warmer climate simulations. The height and intensity of eyewall updrafts increase in all future TCs. However, the major structural changes appeared within a radius of 150 km from the storm center. Abundant water vapor supply from the warmer sea allows a future TC to form new updrafts inside a radius of the maximum wind speed (RMW). The formation leads the further intensification associated with a decrease in RMW.

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Shimada Udai (Meteorological Research Institute)
嶋田宇大（気象研究所台風研究部）

Observational study on rapid intensification of Typhoon Goni (2015) after eyewall replacement
（2015 年台風第 15 号の壁雲交換後の急発達に関する観測的研究）

This poster presents analysis results of a rapid intensification (RI) of Typhoon Goni (2015) immediately after an eyewall replacement by using radar reflectivity and wind field retrieved by the GBVTD technique. Around the onset of the RI, the radius of maximum reflectivity was located a few km inside the radius of maximum wind (RMW). The low-level RMW contracted rapidly, which resulted in large outward slope of the RMW. Relatively strong outflow was present in the lower troposphere above the boundary layer, which contributed to the contraction of tangential wind field and high inertial stability region. During the RI, satellite imagery showed the enhancement of convection in the eyewall and the low-level outflow suddenly changed into inflow just outside the RMW. Tangential wind field and high inertial stability region expanded radially outward, followed by the secondary eyewall formation twice outside the RMW. Mesovortices traveled cyclonically around the inside of the RMW with a period of an hour. A hypothesis was proposed that a feedback between the persistence of strong inflow and outflow in and above the boundary layer, and maintenance of low inertial stability outside the RMW, in the presence of diabatic heating inside the RMW, led to the RI onset after the eyewall replacement.

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Kento Murata (Japan Meteorological Agency RSMC Tokyo)
村田憲人（気象庁アジア太平洋気象防災センター）

Trial use of Statistical Hurricane Intensity Prediction Scheme (SHIPS) in JMA
（台風強度予報モデル SHIPS の現業利用に向けた取り組み）

While the accuracy of tropical cyclone (TC) track forecasts has been steadily improved over the last few decades due mainly to improvement in numerical weather prediction systems, forecasting TC intensity accurately is still a great challenge for both TC research and forecasting communities. Meanwhile DeMaria et al. (2014) showed the evidence that is contrary to a common expression that little or no progress has been made in TC intensity

forecasts. One of the skillful TC intensity forecast guidance is the Statistical Hurricane Intensity Prediction Scheme (SHIPS, DeMaria and Kaplan 1994) that has been operationally used in the US National Hurricane Center. SHIPS is a statistical-dynamical model based on a multiple regression technique. The Japan Meteorological Agency (JMA) plans to operationalize SHIPS for improving TC intensity forecasts as well as strengthening TC-related services as the Regional Specialized Meteorological Centre (RSMC). To achieve this, with great support of SHIPS developers in the US, the Meteorological Research Institute of JMA has transported the SHIPS codes so that they can run from the outputs of the JMA Global Spectral Model (JMA/GSM). This JMA/GSM-based SHIPS was then transported to the JMA's Forecast Division for its trial use in early 2016. In the presentation, the preliminary results of the SHIPS prediction for T1601 (Nepartak) will be shown.