Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

ACG32-01 Room:202 Time:May 26 14:15-14:40

A study on the meteorological condition associated with very deep rainfall in an open ocean at the fringe of the SPCZ

TAKAYABU, Yukari[1*] ; ITAGAKI, Yota[1] ; HAMADA, Atsushi[1]

[1]AORI, the University of Tokyo

Very deep rainfall events, not quite usual over the ocean, has been observed over some parts of open oceans such as at the southern fringe of the South Pacific Convergence Zone, with accumulation of three dimensional observation of rainfall with the TRMM PR (Takayabu, 2006). In order to clarify why such deep rainfall are observed over such an open ocean, we focused on a small region near Fiji and picked up all ″ deep rainfall events ″ defined with a ratio of precipitation with precipitation top height above 8km, and analyzed the meteorological condition around the events. As a result, 35% of the events were associated with tropical cyclones, while 56% of events were occurring under weather condition when the region is covered by surface high pressures. We named the latter ones as ″ high pressure type deep precipitation ″ , and analyzed their environmental meteorological conditions. Although we have focused on a very small limited region over the ocean, we could obtain as large as 3000 km scale tri-pole structure of precipitable water anomaly in the atmosphere associated with the ″ deep type rainfall events ″ . With further detailed analyses, statistically significant occurrences of a coincidence of a deep barotropic anticyclonic circulation in the troposphere in intraseasonal frequency, with approaching transient high pressure systems were observed to make up the large-scale tri-pole structure of precipitable water anomaly. In addition, there was found a simultaneous extension of upper level trough which is associated with low temperature anomaly to the mid-level troposphere to make the atmosphere more unstable. The analysis region at the southern fringe of the SPCZ is a region with relatively high sea surface temperature and unstable atmospheric stratification. In such region, it is suggested that additional dynamical forcing preferable to convection realized the occurrences of deep rainfall similar to those over land, even over an open ocean.

Keywords: TRMM, deep rainfall, meteorological condition, SPCZ, midlatitude transient disturbance, upper tropospheric trough

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ACG32-02 Room:202 Time:May 26 14:40-14:55

Cold surge and sea surface temperature cooling over the north part of the Pacific warm pool

HASEGAWA, Takuya[1*] ; OGINO, Shin-ya[1] ; MOTEKI, Qoosaku[1] ; HATTORI, Miki[1] ; KUBOTA, Hisayuki[1] ; INOUE, Tomoshige[1]

[1]JAMSTEC

In this study, cold surge over Philippine Sea is investigated using 10-years satellite, and re-analysis data. It is shown that anomalous cold sea surface air temperature from Asia reaches near 15N in the Philippine Sea. This cold event accompanies north-easterly surface wind centered high sea level pressure south of Japan. At that time, sea surface temperature shows also cooling tendency in this region. In previous studies pointed out that cold surge occurs in the South China Sea. In this study, similar cold surge also appear in the Philippine Sea. It is also shown that cold surge in Philippine Sea appears two days after cold surge in the South China Sea, which is related to eastward propagation of high sea level pressure. The present results newly show that the cold surge in Philippine Sea is related to sea surface temperature cooling in this region.

Keywords: Pacific warm pool, Cold surge, sea surface temperature cooling, air-sea interaction

Japan Geoscience Union Meeting 2015
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ACG32-03 Room:202 Time:May 26 14:55-15:10

Turbulent mixing and its impact on lower tropospheric moisture over tropical ocean

BELLENGER, Hugo[1*] ; KATSUMATA, Masaki[1] ; YONEYAMA, Kunio[1]

[1]Turbulent mixing and its impact on lower tropospheric 1 moisture over tropical ocean

The variability of lower-tropospheric water vapor is a critical feature of the tropical climate. Among the processes that impact moisture budget, the vertical transport by turbulent mixing is generally overlooked. Using observations from CINDY/DYNAMO campaign, this is a first attempt to quantify it over the tropical ocean. Turbulent patches of size of O(100 m) are observed in relation with large vertical gradients of specific humidity. Intense mixing is diagnosed within these intermittent patches. Three approaches are used in order to diagnose the effect of this intermittent turbulence and reveal large uncertainties on the corresponding eddy diffusivity coefficient. The observed dry conditions are associated with steep moisture vertical gradients above the boundary layers. These steep gradients are potentially associated with moisture tendencies on the order of 0.5-1 g kg^{-1} day^{-1} that could play a role in the recovery phase following a dry intrusion or during the preconditioning stage of an MJO.

Keywords: turbulent mixing, lower-tropospheric moisture, CINDY/DYNAMO, tropical oceanic region

Japan Geoscience Union Meeting 2015
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ACG32-04 Room:202 Time:May 26 15:10-15:25

Seasonality of the subtropical high over the South Indian Ocean and its influence on the low-level clouds

MIYAMOTO, Ayumu[1*] ; NAKAMURA, Hisashi[1] ; MIYASAKA, Takafumi[1]

[1]Research Center for Advanced Science and Technology, University of Tokyo

Over the South Indian Ocean, there is notable seasonality in the subtropical high. In summer the high resides over the eastern portion of the basin, while it strengthens in winter and shifts westward toward the seasonally-enhanced Agulhas storm-track core. As revealed from our analysis, low-level thermal contrast between the Australian Continent and southeastern Indian Ocean is important for the formation of the high in summer, while eddy-feedback forcing due to the enhanced Agulhas storm-track activity maintained by the strong SST gradient along the Agulhas Return Current is effective for the maintenance of the high in winter. In winter a Rossby wave activity flux is convergent into the upper-tropospheric high from lower and higher latitudes.

The present study also investigates how the seasonality of the high can influence the formation of low-level clouds, which are important for the Earth's radiation budget. The MODIS satellite data reveal that stratocumulus clouds are dominant in summer off the west coast of Australia, where near-surface cold advection and descending motion are enhanced in summer with the development of the subtropical high. In winter, low-level clouds form more extensively over the subtropical ocean than in summer. To the north of the subtropical SST frontal zone, however, cumulus clouds rather than stratocumulus clouds are prevalent, owing to enhanced latent heat flux from the warm ocean under the trade winds, which is likely to induce "decoupling". Our analysis highlights the importance of the combined effect among the subtropical high, SST and its gradient in determining the local properties of low-level clouds and their seasonality.

Keywords: Mascarene High, Low-level clouds

Japan Geoscience Union Meeting 2015
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ACG32-05 Room:202 Time:May 26 15:25-15:40

Seasonal onset of the Madden-Julian Oscillation and its relation to the southeastern Indian Ocean cooling

SEIKI, Ayako[1*] ; NAGURA, Motoki[1] ; HASEGAWA, Takuya[1] ; YONEYAMA, Kunio[1]

[1]Japan Agency for Marine-Earth Science and Technology

The relation among sea surface temperature (SST) cooling in the southeastern Indian Ocean (SEIO), oceanic Rossby waves, and the seasonal onset of the Madden-Julian Oscillation (MJO) is examined for the period 1993-2012. A westward propagation of the annual downwelling Rossby waves occurs in the southern Indian Ocean for most of the years. However, its amplitude and phase speed vary every year. Positive SST anomalies migrate concurrently with the Rossby waves but are followed by a wide-spread cold pool in the SEIO from boreal summer to fall. Whereas the cold pool tends to persist for a longer period until November during positive Indian Ocean Dipole (IOD) and/or El Nino years, it occurs irrespective of the IOD. Convection related to the MJO events during boreal winter propagates from the Indian Ocean to the Pacific only after the cold pool is terminated. A correlation analysis indicates that the SST cold pool is confined to the Southern Hemisphere, but its influence on convection reaches north of the equator via excitation of the local circulations over the eastern Indian Ocean and the tropical western Pacific. The resulting southerly surface-wind anomalies may advect dry air south of the equator to the north and suppress atmospheric convection around the equator. Thus, the SEIO cold pool tends to prevent intraseasonal convection from propagating eastward to the Pacific. Briefly analyzing the process of the cold pool formation shows that SST variability in the SEIO during boreal summer to fall correlates well with zonal advection and surface heat flux. In turn, zonal advection is connected to the strength of westward currents associated with the Rossby waves. Clarifying the SEIO upper-ocean processes can contribute in predicting the seasonal onset of an MJO sequence.

Keywords: Madedn-Julian Oscillation, oceanic Rossby wave, the southeasern Indian Ocean

Japan Geoscience Union Meeting 2015
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ACG32-06 Room:202 Time:May 26 15:40-15:55

A Wake due to the Maldives in the eastward Wyrtki jet

NAGURA, Motoki[1*] ; MASUMOTO, Yukio[2]

[1]JAMSTEC, [2]University of Tokyo

A wake due to islands in background zonal flow has been observed in the equatorial Pacific Ocean. This study detects a wake due to the Maldives in the eastward Wyrtki jets in the Indian Ocean using in-situ observations and examines its dynamics with numerical models. Observations by acoustic Doppler current profilers deployed east of the Maldives show semiannual variability in cross equatorial velocity, which cannot be explained by prevailing annual wind forcing related to monsoons. Output from a high-resolution ocean general circulation model (OGCM), OFES, shows that the semiannual current variability is a part of a wavelike structure that appears east of the Maldives in concurrent with the eastward Wyrtki jets. Most of the Maldives are atolls. Their top heights are mostly lower than the sea surface, but higher than mean thermocline depth, and they can be a block against the Wyrtki jet. An experiment is conducted using a 1.5-layer model, in which islands that are similar to the Maldives in shape are imposed, and an equatorial eastward zonal jet is driven by idealized wind forcing. Results show that the 1.5-layer model is able to reproduce the wake with a similar spatial structure to the OGCM results. Temporal variability in the zonal jet is not essential in the dynamics of the wake, because an experiment in which a steady zonal flow is given at the eastern end of the model domain reproduces a similar wake. Experiments with the 1.5-layer model show that the zonal wavelength of the wake becomes larger as the speed of the eastward zonal jet increases.

Keywords: Equatorial Ocean, Indian Ocean, Maldives, Wake, Dynamics

Japan Geoscience Union Meeting 2015
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ACG32-07 Room:202 Time:May 26 16:15-16:40

2014 aborted El Nino and its predictability

DOI, Takeshi[1*] ; BEHERA, Swadhin[1] ; YAMAGATA, Toshio[1]

[1]JAMSTEC/APL

El Nino occurrence is known to be predictable a few seasons ahead using a climate model. However, the El Nino of 2014 was quite unusual. It started quite well from the boreal winter to the boreal spring with some strong westerly wind bursts. This condition was very similar to the pre-condition in the 1997/1998 El Nino, which is the strongest event in the 20th century. Therefore, many climate scientists worried about the strong El Nino occurrence in the boreal summer and its societal impacts. Actually, many seasonal forecast systems in the world predicted that El Nino would occur in the boreal summer. The SINTEX-F seasonal prediction system was also predicting a moderate El Nino right from November 2013 initializations though some of the other prediction models were predicting a very strong El Nino similar to that of 1997 event. The El Nino was evolving well until June and the Indian summer monsoon rainfall, which is usually less than normal during El Nino events was actually 60% less than normal for that month. However, the El Nino did not progress well thereafter and was considerably weakened during August and September (aborted El Nino event). This was not captured well by model predictions, including SINTEX-F. In this research, we explore why the 2014 El Nino was killed. Although there are several hypotheses related to the decadal variability in the tropical Pacific and the Indian Ocean impact, we focus on the interaction between intraseasonal and seasonal variations. The intraseasonal upwelling Kelvin wave in the July could be one of key factors to explain 2014 aborted El Nino.

Keywords: El Nino, Seasonal Prediction

Japan Geoscience Union Meeting 2015
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ACG32-08 Room:202 Time:May 26 16:40-16:55

Interannual variability of SEC bifurcation and western boundary currents along the Madagascar and the relation with ENSO

YAMAGAMI, Yoko[1*] ; TOZUKA, Tomoki[1]

[1]Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo

The South Equatorial Current (SEC) in the Indian Ocean bifurcates at the east coast of Madagascar into Northeast and Southeast Madagascar Currents (NEMC and SEMC). In this study, the dynamical mechanism of the SEC bifurcation latitude (SBL), NEMC, and SEMC variations associated with the basin-scale wind variation are investigated using observational data, reanalysis data and the outputs from an atmospheric general circulation model (AGCM). It is found that the interannual NEMC and SEMC variations are dominated by the SEC variations rather than the SBL. Based on the Time-dependent Island Rule calculations, it is also found that the interannual anomalies of the SBL and the NEMC and SEMC transports are the responses to the meridional interior transport, which in turn is a result of westward popagating Rossby waves from 70^{o}E-90^{o}E.

The SBL, NEMC, and SEMC have correlation with Niño 3.4 index with 5-15 month lags, and the wind stress curl fields around 80^{o}E-110^{o}E, 20^{o}S-10^{o}S have positive correlation with the Niño 3.4 index from the late 1990s to the 2000s. From an analysis of AGCM sensitivity experiment, the wind stress curl anomalies around 60^{o}E-90^{o}E, 25^{o}S-15^{o}S may be because of the Matsuno-Gill response to diabatic heating anomalies in the western Pacific, whereas those around 80^{o}E-110^{o}E, 20^{o}S-10^{o}S may be due to the sea surface temperature anomalies off the west coast of the Australia that tend to appear during ENSO events.

Keywords: Indian Ocean, South Equatorial Current, western boundary current, Island Rule, ENSO

Japan Geoscience Union Meeting 2015
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ACG32-09 Room:202 Time:May 26 16:55-17:10

Wintertime meridional teleconnection associated with convective activity over the tropical Northwestern Pacific

SEKIZAWA, Shion[1*] ; KOSAKA, Yu[1] ; NAKAMURA, Hisashi[1] ; NISHII, Kazuaki[1] ; MIYASAKA, Takahumi[1]

[1]Research Center for Advanced Science and Technology, University of Tokyo

Tropical climate variability and associated meridional teleconnections are major origins of seasonal predictability. Statistically, it has been known that El Nino (La Nina) brings warmer (colder) winter to Japan, providing a basis for winter seasonal predictions. However, few studies examined structure and mechanisms for that tropical-extratropical teleconnection. In this study, we investigate the remote influence of wintertime convective activity over the tropical Northwestern Pacific on the atmospheric circulation in the extratropical Northern Hemisphere, by analyzing monthly observational data sets and an ensemble AMIP experiment for 1979-2012.

Convective activity over the tropical Northwestern Pacific is significantly correlated with El Nino-Southern Oscillation (ENSO), and our regression analysis shows that enhanced (suppressed) convection around the Philippines is associated with cold (warm) winter around Japan, which is consistent with the empirical relationship of ENSO. However, ENSO explains only half of the variance of the total convective activity around the Philippines, suggestive of a large contribution from atmospheric internal variability. We isolate the latter component by subtracting linear regression against an ENSO index from the observed anomalies and as inter-member variability in the ensemble AMIP experiment. Circulation anomaly patterns differ considerably between the ENSO-forced and internal components both in the observations and model, and the internal variability is more influential on the wintertime East Asian weather. Our analysis thus suggests that the atmospheric internal variability around the Philippines significantly limits the wintertime seasonal predictability in East Asia that arises from ENSO.

Keywords: ENSO, East Asian winter monsoon, seasonal predictability

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ACG32-10 Room:202 Time:May 26 17:10-17:25

An AGCM study on precipitation anomalies associated with Ningaloo Nino

TOZUKA, Tomoki[1*] ; KATAOKA, Takahito[1] ; YAMAGATA, Toshio[2]

[1]The University of Tokyo, [2]Application Laboratory, JAMSTEC

Ningaloo Nino (Nina) is a recently identified climate mode associated with positive (negative) sea surface temperature (SST) anomalies off the west coast of Australia and wet (dry) anomalies in the northwestern part of Australia. However, previous studies could not isolate its influences based on statistical analyses of observational precipitation data, because the precipitation over Australia is also influenced by tropical climate modes such as El Nino/Southern Oscillation and the Indian Ocean Dipole. Based on a series of experiments with an atmospheric general circulation model, we have examined whether Ningaloo Nino/Nina alone can induce precipitation anomalies. It is shown that even when SST is allowed to vary interannually only in the eastern South Indian Ocean and the monthly climatology of SST is imposed elsewhere, Ningaloo Nino (Nina) induces wet (dry) anomalies in the northwestern part of Australia.

Keywords: Ningaloo Nino, Precipitation, Atmospheric General Circulation Model, El Nino/Southern Oscillation

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ACG32-11 Room:202 Time:May 26 17:25-17:40

Ningaloo Nino simulated in the CMIP5 models

KIDO, Shoichiro[1*] ; KATAOKA, Takahito[1] ; TOZUKA, Tomoki[1]

[1]The University of Tokyo

Ningaloo Nino (Nina) is a recently identified climate mode characterized by anomalously warm (cool) sea surface temperature (SST) off the west coast of Australia and has strong impacts on precipitation over Western Australia and marine lives in the coastal area. Using outputs from 12 coupled general circulation models (CGCMs), which participate in the Coupled Model Intercomparison Project, phase 5 (CMIP5), ability of the models in simulating Ningaloo Nino/Nina is evaluated and causes of their differences are examined. Although many models can successfully simulate the spatial pattern and seasonality of Ningaloo Nino/Nina realistically, its amplitude varies among the models. This inter-model difference is mainly explained by varying strength of remote influences from El Nino/Southern Oscillation via oceanic wave propagation and atmospheric teleconnection. Differences in the strength of local air-sea interaction called the coastal Bjerknes feedback also contribute to the inter-model difference. This study may provide new insight into understanding processes that determine the strength of Ningaloo Nino/Nina.

Keywords: Ningaloo Nino, Coupled general circulation model, Southern Indian Ocean, El Nino/Southern Oscillation, Coastal Bjerknes feedback

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ACG32-12 Room:202 Time:May 26 17:40-17:55

On the role of internal atmospheric processes in interannual equatorial variability

RICHTER, Ingo[1*]

[1]JAMSTEC, APL

Major modes of tropical variability, such as El Nino-Southern Oscillation (ENSO), the Indian Ocean Dipole (IOD), or the Atlantic zonal mode, have been found to arise from coupled air-sea interaction. An often invoked mechanism in this context is the Bjerknes feedback, in which equatorial zonal winds respond to sea-surface temperature (SST) anomalies in such a way as to reinforce the original anomaly. Recent studies, however, have reexamined the role of coupled feedbacks and found that they might be less important than previously thought. Here we examine the issue by focusing on equatorial surface winds, which undoubtedly play an important role in driving oceanic variability in the equatorial region. We compare fully coupled general circulation models (GCMs) from the Coupled Model Intercomparison Project Phase 5 (CMIP5) with an experiment in which the atmospheric component is forced with the climatological seasonal cycle of SST. For the equatorial Atlantic, the analysis reveals that surface wind variability decreases by only about 25% when climatological SSTs are prescribed. This suggests that a large portion of equatorial Atlantic surface wind variability is due to internal atmospheric processes. In the equatorial Pacific and Indian Ocean, on the other hand, surface wind variability reduces substantially when climatological SSTs are prescribed, indicating the importance of coupled feedbacks. Even there, however, the intrinsic atmospheric component can be quite large depending on the season and is subject to a large inter-model spread. Potential reasons for the model spread will be discussed.

Keywords: equatorial variability, ENSO, IOD, Atlantic Nino, predictability, surface winds

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ACG32-13 Room:202 Time:May 27 09:00-09:15

What interrupted the 2014 El Nino? - A possible cause in the South Pacific Ocean

IMADA, Yukiko[1*] ; TATEBE, Hiroaki[3] ; WATANABE, Masahiro[2] ; ISHII, Masayoshi[1] ; KIMOTO, Masahide[2]

[1]Meteorological Research Institute, Japan Meteorological Agency, [2]Japan Agency for Marine-Earth Science and Technology, [3]Atmosphere and Ocean Research Institute, The University of Tokyo

At the beginning of 2014, westerly wind bursts and large downwelling Kelvin waves were observed. There was a consensus among state-of-the-art forecasting models on the development of a large El Nino in the following summer and autumn. From June 2014, however, cold sea surface temperature anomalies developed unexpectedly in the cold tongue region and prevented development of an El Nino. Interestingly, our experimental seasonal prediction system based on the coupled general circulation model MIROC5 successfully predicted this event. Using this prediction and additional sensitivity experiments, we found an important role of the oceanic circulation in the South Pacific Ocean in the interruption of the El Nino in 2014.

Keywords: ENSO, Seasonal Prediction, Pacific Decadal Oscillation (PDO)

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ACG32-14 Room:202 Time:May 27 09:15-09:30

Impact of super tropical volcanic eruptions on ENSO

OHBA, Masamichi[1*] ; SHIOGAMA, Hideo[2] ; YOKOHATA, Tokuta[2] ; WATANABE, Masahiro[3]

[1]Central Research Institute of Electric Power Industry (CRIEPI), [2]Center for Global Environmental Research, National Institute for Environmental Studies, [3]Atmosphere and Ocean Research Institute (AORI) The University of Tokyo

El Nino and La Nina exhibit significant asymmetry in their duration. El Nino tends to turn rapidly into La Nina after the mature, while La Nina tends to persist for up to 2 years. Reconstructed historical sea surface temperatures (SST) show a significantly increase in the intensity of El Nino-Southern Oscillation (ENSO) asymmetry, particularly El Nino transitivity, during the last six decades. Atmospheric observational data have shown that the relationship between El Nino and surface zonal wind anomalies over the equatorial Western Pacific (WP) has strengthened, and anomalous WP easterlies have appeared after the 1970s climate regime shift. To investigate the dependency of ENSO transitivity on its amplitude, a suite of idealized experiments using an atmospheric general circulation model (AGCM) is performed by imposing historical SST and 12 different ENSO-related SST anomalies exhibiting equal spatiotemporal distribution but different amplitude. Our AGCM experiments show strong nonlinearity in the WP zonal wind against the amplitude of the warm phase.

Keywords: Super Volcanic Eruption, Sea surface temperature, Pacific Ocean, El Nino/Southern Oscillation

Japan Geoscience Union Meeting 2015
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ACG32-15 Room:202 Time:May 27 09:30-09:45

Hiatus and accelerated global warming due to tropical Pacific natural variability

KOSAKA, Yu[1*] ; XIE, Shang-ping[2]

[1]RCAST, University of Tokyo, [2]Scripps Institution of Oceanography, UCSD

Annual global-mean surface temperature (GMT) has been flat since the beginning of this century. Mechanisms have been proposed for this hiatus of global warming. In our former study, we performed a climate model experiment called Pacific Ocean-Global Atmosphere (POGA), which forces tropical Pacific sea surface temperature anomalies to follow the observed history. When forced by the historical radiative forcing, POGA reproduced the observed annual-mean GMT variability strikingly well with a correlation coefficient R = 0.97 for 1970-2012, including the current hiatus period. POGA showed that GMT decrease by the recent tropical Pacific decadal cooling opposed the radiatively forced warming, mostly explaining the current hiatus.

When we look back to the past, GMT has risen since the mid-19th century with notable interannual and interdecadal variability. In this study, we perform a long POGA experiment dating back to the late 19th century with GFDL CM2.1, and examine the role of tropical Pacific variability on the observed history of global climate. POGA reproduces annual-mean GMT variability with R = 0.96 and 15-year running GMT trend with R = 0.80 since 1870. We quantify relative contributions from the radiative forcing and tropical Pacific variability by comparing POGA with another experiment forced solely by the radiative forcing. The tropical Pacific variability was a major cause of global cooling from the late 1890s to around 1910, accelerated the first warming from the 1910s to 40s, advanced the beginning and delayed the end of the big hiatus for the mid-1940s to mid-70s, and accelerated the first half of the second warming for the mid-1970s to late 90s. POGA also captures observed regional trend of surface temperature for these periods with strong tropical Pacific influence, especially over the tropical Indian Ocean, Indian subcontinent, North and South Pacific and North America. Rate of the recent GMT decrease due to the tropical Pacific cooling is comparable with that occurred in the beginning of the 20th century, but the recent one is the longest for the past 150 years. The strengthening of the Pacific trade wind since the 1990s is at the fastest rate. In these regards, the recent hiatus is unprecedented in the instrumental records.

Keywords: tropical PDO, ENSO, trade winds, global climate, teleconnections

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ACG32-16 Room:202 Time:May 27 09:45-10:00

Recent slowdown of upper tropospheric warming associated with the tropical SST variability

KAMAE, Youichi[1*] ; SHIOGAMA, Hideo[1] ; WATANABE, Masahiro[2] ; ISHII, Masayoshi[3] ; UEDA, Hiroaki[4] ; KIMOTO, Masahide[2]

[1]Nat. Inst. for Environ. Studies, [2]AORI, Univ. Tokyo, [3]Meteor. Res. Inst., [4]Life and Environ. Sciences, Univ. Tsukuba

In future climate projections by using atmosphere-ocean coupled general circulation models (AOGCMs), simulated zonal-mean warming have two major peaks in (1) upper troposphere over the tropics and (2) near-surface in the polar regions. AOGCMs tend to simulate larger increase in tropical upper-tropospheric temperature (TTUT) during these 15 years relative to radiosonde observations. Projected increase in TTUT is important for climate feedbacks, changes in tropical atmospheric circulation, and tropical cyclone activity in a warming climate. The recent observation-model discord in TTUT is an underlying issue regarding the reliability of future climate projections based on AOGCMs.

To examine reasons for this observation-model discord, we conducted ensemble simulations using an atmospheric general circulation model (AGCM) forced by sea surface temperature (SST) both with and without anthropogenic influences [1].

The recent TTUT increase is significantly overestimated in the CMIP5 AOGCMs but simulated accurately in the AGCM run. The largest discrepancy in the upper-tropospheric warming is found over the central Pacific (CP), which can be attributed to recent SST variability over the tropical Pacific associated with the ENSO cycle; however, the CMIP5 AOGCM ensemble is not intended to simulate this cycle. The effect of recent tropical SST variability can explain the spatial pattern, interannual variability, and about half of the bias in the warming trend in the CMIP5 AOGCMs. These results suggest that a large part of the recent slowdown in tropical upper-tropospheric warming can be ascribed to natural variability, refuting the suggestion of low reliability of climate change projections by CMIP-based AOGCM simulations.

Reference

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Keywords: tropospheric temperature, decadal variability, CMIP, radiosonde, MSU, sea surface temperature

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ACG32-17 Room:202 Time:May 27 10:00-10:15

1920s tropical Pacific climate shift revisited

TOKINAGA, Hiroki[1*]

[1]DPRI, Kyoto University

This study revisits the mid-1920s Pacific climate shift using a wide variety of historical climate data sets including sea surface temperature (SST), nighttime marine air temperature, sea level pressure, and cloudiness. Overall the 1920s Pacific climate shift is similar to the 1976/77 Pacific Decadal Oscillation shift from cold-to-warm phase, characterized by SST cooling over the North Pacific and deepening of the Aleutian Low. On the other hand, patterns of the tropical Pacific SST change during the 1920s largely depend on SST data sets. HadISST1 shows no significant SST change in the equatorial Pacific. In contrast, COBE-SST2 exhibits a local maximum of SST warming in the central-to-eastern equatorial Pacific, resulting in a weakening of zonal SST gradient. The latter pattern of SST change is more consistent with an observed weakening of the Walker circulation obtained from SLP observations. This result suggests that the 1920s climate shift actually happened not only over the North Pacific but also over the tropical Pacific, a feature not captured by conventional SST data sets. Simulated patterns of surface air temperature and SLP changes from AGCM experiments forced with COBE-SST2 and HadISST1 will also be discussed.

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ACG32-18 Room:202 Time:May 27 10:15-10:30

Possible influence of the Indian Ocean on decadal changes of the Pacific climate

MOCHIZUKI, Takashi[1*] ; CHIKAMOTO, Yoshimitsu[2]

[1]Japan Agency for Marine-Earth Science and Technology, [2]University of Hawaii

We have explored possible influence of the Indian Ocean on decadal changes of the Pacific climate, by performing ensembles of the so-called partial data assimilation experiments during the recent two decades. In these experiments, using an atmosphere-ocean coupled climate model, we have assimilated anomalies of ocean temperature and salinity only in a specific area (e.g., the Indian Ocean, the equatorial Pacific Ocean, and so on) rather than in the global ocean. On decadal timescales, since the sea surface temperature (SST) in the equatorial Pacific largely controls the zonal winds over the maritime continent, the SST variations in the Indian Ocean can be well reproduced even when assimilating the anomalies only in the Pacific Ocean. On the other hand, the assimilation using a gridded analysis of the Indian Ocean hardly shows significant impacts on the equatorial Pacific SST variation probably due to the internal decadal fluctuation with large amplitudes. We have also performed a partial data assimilation experiment using the detrended anomalies in the Indian Ocean, toward discussion focusing on decadal trends (i.e., trends in ten years) which show a decadal-scale modulation rather than steady warming. The changes in the zonal winds over the maritime continent associated with the Indian Ocean SST trends can modify the equatorial Pacific SST trends and these impacts of the Indian Ocean are significantly large in some periods of the recent two decades.

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ACG32-19 Room:202 Time:May 27 10:30-10:45

The role of the western Pacific SSH and associated changes in horizontal gyre circulation for the decadal phase shift

YAMANAKA, Goro[1*] ; NAKANO, Hideyuki[1] ; TSUJINO, Hiroyuki[1] ; URAKAWA, Shogo[1] ; SAKAMOTO, Kei[1]

[1]Meteorological Research Institute

Decadal variability of the Pacific Subtropical Cells (STCs) and associated sea surface height (SSH) in the western tropical Pacific during recent decades are examined by using a CMIP-class OGCM simulation (1965-2006). Since the long-term STC variations include not only decadal variations but also the long-term weakening trends, we deal with the former separately from the latter in order to focus on the decadal variability. The model exhibits decadal variations of the STCs concurrent with tropical Pacific thermal anomalies, which is similar to observations. The eastern tropical Pacific is warmer when the STCs are weaker and cooler when they are stronger. The spatial patterns of the SSH in the western tropical Pacific show different features, depending on events associated with decadal variability. During the warm phase (1977-1987), the SSH anomalies exhibit deviations from a meridionally symmetric distribution, with weakly positive (strongly negative) anomalies in the western tropical North (South) Pacific. Analysis of the heat budget in the upper 500 m of the tropical Pacific indicates that the termination of the warm phase around 1985 results from a poleward heat transport anomaly that is induced by a horizontal gyre associated with the SSH anomalies. During the cold phase (1996-2006), in contrast, the SSH anomalies are nearly meridionally symmetric, with positive anomalies in both hemispheres. Enhanced easterly wind anomalies contribute to the development of the cold phase after the late 1990s. A sensitivity of the results to OGCMs of different horizontal resolutions is also discussed.

Keywords: tropical Pacific decadal variability, Pacific Subtropical Cells, phase shift, sea surface height variations, ocean general circulation model, meridional heat transport