Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AAS01-01 会場:101A 時間:5 月 24 日 09:00-09:15

セーシェルドーム域における海面水温の経年変動
Interannual variations of the sea surface temperature above the Seychelles Dome

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The interannual variations of the sea surface temperature (SST) above the Seychelles Dome (SD) are investigated using outputs from an ocean general circulation model. The SST becomes anomalously warm (cool) when the SD is weak (strong). In contrast to the seasonal variation, the vertical diffusion plays the most important role and causes anomalous warming (cooling). This warming (cooling) is due to the anomalously warm (cold) water below the mixed layer as a result of the deeper (shallower) thermocline in response to ocean dynamics. Also, the cooling by the vertical diffusion becomes less (more) efficient, because the mixed layer is anomalously thick (thin). The horizontal advection contributes to the anomalous warming (cooling) due to the anomalous southward (northward) Ekman heat transport. On the other hand, the anomalous surface heat flux tends to cool (warm) the mixed layer, because the warming of the mixed layer by the shortwave radiation becomes less (more) efficient due to the anomalously thick (thin) mixed layer.

キーワード: インド洋熱帯域, 湧昇ドーム現象, 経年変動, 海洋大循環モデル
Keywords: Tropical Indian Ocean, Oceanic upwelling dome, Interannual variation, Ocean general circulation model

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インド洋亜熱帯ダイポールの発生機構
On triggering mechanisms of the Indian Ocean subtropical dipole

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Based on experiments using a coupled general circulation model, triggering mechanisms on the Indian Ocean subtropical dipole (IOSD) are investigated. The IOSD is characterized by a dipole pattern of sea surface temperature (SST) anomalies in the northeastern and southwestern parts of the southern Indian Ocean, and generated by the variations in the Mascarene High during austral summer. In the experiment, where the SST outside the southern Indian Ocean is nudged toward the monthly climatology of the simulated SST, two types of the IOSDs occur owing to the anomalous Mascarene High. One type is associated with the zonal wavenumber four pattern of equivalently barotropic geopotential height anomalies in the midlatitudes, suggesting a potential link with the Antarctic Circumpolar Wave. Another type occurs when the geopotential height anomalies have opposite signs in the midlatitudes and the Antarctica, suggesting a possible relation with the Antarctic Oscillation. These results indicate that even without atmospheric teleconnections from air-sea coupled modes outside the southern Indian Ocean, the IOSD may develop owing to the variations in the Mascarene High. However, the IOSD occurs less frequently in this case. This suggests that atmospheric teleconnections from air-sea coupled modes such as El Nino/Southern Oscillation and Indian Ocean Dipole may also play a role in generating the IOSD.
Keywords: Indian Ocean subtropical dipole, Mascarene High, Antarctic Circumpolar wave, Antarctic Oscillation

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AAS01-03 会場:101A 時間:5月24日 09:30-09:45

CMIP3モデルに現れたインド洋亜熱帯ダイポールモードのメカニズムについて
On a mechanism of the Indian Ocean subtropical dipole mode simulated in the CMIP3 models

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Southern African rainfall with its maximum during austral summer (December-February) is influenced by the Indian Ocean subtropical dipole mode (IOSD) events in the southern Indian Ocean. Because this region is very vulnerable to abnormal weathers, an accurate prediction is needed for the socio-economic benefit there. However, a few studies have adopted coupled general circulation models (CGCMs) to study the IOSD together with its influence. Toward an accurate prediction of the IOSD and its associated impact, the ability of CGCMs to simulate the IOSD is investigated using observation data and outputs from the 'twentieth-century climate in coupled models' (20c3m) control runs of CGCMs submitted to the Coupled Model Intercomparison Project, phase 3 (CMIP3). Also, causes of the model biases as well as the generation mechanism are examined.

Many models simulate the IOSD, but the location and shape of the sea surface temperature (SST) anomaly vary among models. This model bias is closely linked to the bias in simulating the anomalous strengthening and southward shift of the subtropical high. Regarding its generation mechanism, it is shown for the first time using CGCMs that the anomalously thin (thick) mixed layer associated with the anomalous subtropical high enhances (suppresses) warming by climatological shortwave radiation and leads to positive (negative) SST anomaly.

キーワード: インド洋亜熱帯ダイポールモード, CMIP3モデル, 亜熱帯高気圧, 混合層厚
Keywords: Indian Ocean subtropical dipole, CMIP3 models, subtropical high, mixed-layer thickness

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Influence of La Nina on extreme rainfall over southern Africa associated with tropical temperate troughs

Influence of La Nina on extreme rainfall over southern Africa associated with tropical temperate troughs

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La Nina appears to have the greatest influence on rainfall in southern Africa and wet episodes tend to occur throughout the subcontinent. Extreme heavy rainfall events occurred over southern Africa due to synoptic disturbances during the austral summer and contributed to above normal seasonal rainfall in the case of La Nina events. Tropical temperate trough (TTT) is one such disturbance often associated with some of the severe floods of that region. The TTTs connect synoptic disturbances of the tropics and mid-latitudes, and bring heavy rainfall over southern Africa extended along the northwest-southeast direction. Based on a new objective method, 55 TTT events are identified using daily anomalies of outgoing longwave radiation and wind during the study period of 1980-2009. From the composite analyses of those 55 events, it is found that the TTTs evolve with suppressed convection over the southwest Indian Ocean adjacent to Madagascar region and enhanced convection over southern Africa. The suppressed convection found to be associated with the enhanced convection around Sumatra in southeast tropical Indian Ocean and this in turn associated with La Nina conditions in the Pacific. It is also found that, 11 TTT events evolved in 10 El Nino or El Nino Modoki years (average 1.1) but 18 TTT events evolved during 7 La Nina or La Nina Modoki years (average 2.6). Since the annual frequency of the TTT events is 1.8, it appears that more number of TTT events is associated with La Nina/ La Nina Modoki rather than El Nino/ El Nino Modoki. The La Nina and La Nina Modoki conditions seem to modify the Walker circulation, with upper level convergence over the equatorial Indian Ocean near the African continent and Madagascar region. This higher level convergence draws flow from the southern Africa landmass and this could induce anomalous low level convergence associated with the TTT over the landmass.

キーワード: tropical temperate trough, southern Africa, extreme rainfall, El Nino/La Nina
Keywords: tropical temperate trough, southern Africa, extreme rainfall, El Nino/La Nina

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南東熱帯インド洋におけるメソスケール渦の経年変調とその力学
Interannual moduation and its dynamics of the Mesoscale Eddy Variability in the South Eastern Tropical Indian Ocean

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Interannual modulation of the mesoscale eddy activity at the intraseasonal time-scale in the southeastern tropical Indian Ocean (SETIO) and a possible mechanism responsible for the modulation are investigated using the results from a high-resolution oceanic general circulation model (OGCM). The model reproduces reasonably well the observed intraseasonal variability in the SETIO and its interannual modulation. It is shown that the simulated intraseasonal eddies are generated by baroclinic instability. The magnitude of the eddy activity in the SETIO changes year by year. From a composite analysis classified into cases in which significant eddy activity co-occurred with/without Indian Ocean Dipole (SETIO cooling) events, the meridional gradient of the heat content anomaly in the region south of Java Island is enhanced in both cases. This meridional gradient is generated by the negative heat content anomaly off Sumatra and Java in the SETIO cooling case and the positive heat content anomaly along 14S, as well as the weak negative anomaly in the coastal region, in the No-SETIO cooling case. The anomalous positive heat content along 14S in the No-SETIO cooling case is originated from the western tropical Pacific and it takes about half a year to reach the SETIO. These interannual variations in the upper-ocean heat content anomaly modulate the meso-scale eddy activity in the SETIO through enhancement of the baroclinic energy conversion, with the lag of 3 months. The energy budget analysis and the simple stability analysis also confirm this result.
Keywords: Southeastern tropical Indian Ocean, Mesoscale eddy, Indian Ocean Dipole

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負のインド洋ダイポール現象に伴う東部インド洋の水温変動過程：2005・2010年の事例研究
Eastern Indian Ocean warming associated with negative Indian Ocean dipole: Case study on the 2005 and 2010 events

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Indian Ocean Dipole (IOD) is a short-term climate variation, the positive (negative) phase of which is characterized by low (high) sea surface temperature (SST) anomalies in the eastern equatorial Indian Ocean and high (low) SST anomalies in the western equatorial Indian Ocean. In 2005 and 2010, warm SST anomalies appeared in the eastern equatorial Indian Ocean and lasted more than three months from August to October, associated with the negative phase of IOD.

In this study, observation data from a long-term moored buoy were used together with satellite, in situ, and atmospheric reanalysis datasets to clarify the processes that produced the anomalous SST variation in 2005 and 2010. We focused on locations (5S, 95E) and (8S, 95E) where in situ measurements by RAMA (Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction) buoys were available. Temporal changes in the mixed layer temperature were obtained from the buoy data. Air-sea heat fluxes and horizontal heat advection were estimated from the buoy data, satellite-based data, and reanalysis products.

Heat balance analysis demonstrated that both air-sea heat fluxes and horizontal heat advection accounted for the temperature variation of the ocean mixed layer. Among surface heat fluxes, the variation of latent heat loss had a major role to produce the warm SST anomalies. The anomalous latent heat flux were associated with the weakening of wind speed in the fall season of 2005 and 2010: there was no strong south-easterly monsoon wind from August to October in these years, and the deceleration of wind speed leads to warm SST anomalies through suppressed evaporation. The positive horizontal heat advection due to the south-eastward surface current warmed the south-eastern tropical Indian Ocean. Compared with the case of the positive phase of IOD, in which the heat advection is the major factor to control SST, our analysis shows that air-sea heat exchanges play a more active role to produce the SST anomalies in the eastern Indian Ocean during the negative IOD.

キーワード: インド洋ダイポール現象, インド洋熱帯域, トライトンブイ
Keywords: Indian Ocean Dipole, Tropical Indian Ocean, TRITON buoy

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AAS01-07 会場:101A 時間:5 月 24 日 10:45-11:05

ユーラシア大陸南部の気候変動が受けるダイポールモード現象のインパクト
Impacts of the Indian Ocean Dipole on climate variations in the southern part of the Eurasian Continent

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Since the discovery of the Indian Ocean Dipole (IOD) in 1999, various regional climate variations have been identified as outcomes of IOD rather than El Nino/Southern Oscillation (ENSO). Here, based on recent studies, we show two typical examples in the southern part of the Eurasian Continent.

Using reanalysis data and snow cover data derived from satellite observations, respective influences of Indian Ocean Dipole (IOD) and El Nino/Southern Oscillation (ENSO) on the Tibetan snow cover in early winter are investigated. It is found that the snow cover shows a significant positive partial correlation with IOD. In the pure positive IOD years with no co-occurrences of El Nino, negative geopotential height anomalies north of India are associated with warm and humid southwesterlies to enter the plateau from the Bay of Bengal after rounding cyclonically and supply more moisture. This leads to more precipitation, more snow cover, and resultant lower surface temperature over the plateau. These negative geopotential height anomalies north of India are related to the equivalent barotropic stationary Rossby waves in the South Asian wave guide. The waves can be generated by the IOD-related convection anomalies over the western/central Indian Ocean.

Using monthly data during 1974-2005 from 183 meteorological stations in the southern part of Iran, the interannual variation of precipitation are examined. The precipitation in this region occurs during the rainy season from October to May. The interannual variation in fall and early winter during the first part of the rainy season shows a significant positive correlation with both IOD and ENSO. However, a partial correlation analysis used to extract the respective influence of IOD and ENSO shows a significant positive correlation only with the IOD and not with ENSO. The southeasterly moisture flux anomaly over the Arabian Sea turns anticyclonically and transport more moisture to the southern part of Iran from the Arabian Sea, the Red Sea, and the Persian Gulf during the positive IOD. During the latter part of the rainy season in late winter and spring, however, the interannual variation of precipitation is more strongly influenced by modes of variability over the Mediterranean Sea. The induced large-scale atmospheric circulation anomaly controls moisture supply from the Red Sea and the Persian Gulf.

Identification of the true cause of regional climate variations is very important for societal applications of climate forecast information.

Keywords: IOD, ENSO, partial correlation, Tibetan snow cover, Iran

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Indian Ocean capacitor effect for the past 140 years
Indian Ocean capacitor effect for the past 140 years

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The Indian Ocean responds to El Nino with a delayed basin-wide warming. This Indian Ocean basin mode and its effect on monsoons have intensified across the 1970s for the past six decades. These changes are consistent with those in response to global warming in a coupled GCM simulation. To investigate whether these changes are due to natural variability or global warming, a unique ocean-atmospheric dataset is constructed for the period of 1870-2007 using ship-board observations along a frequently travelled track across the North Indian Ocean (NIO) and the South China Sea. During the decades in the late 19th-early 20th century and in the late 20th century, the El Nino-induced NIO warming persists longer than during the 1910s-mid 1970s, well into the summer following the peak of El Nino. During the epochs of the prolonged NIO warming, rainfall drops and sea level pressure rises over the tropical Northwest Pacific in summer following El Nino. Conversely during the period when the NIO warming dissipates earlier, these atmospheric anomalies are not well developed.

The above centennial modulation of ENSO teleconnection to the Indo- Northwest Pacific region is correlated with the ENSO variance itself. The fact that enhanced ENSO teleconnections occurred 100 years ago during the late 19th-early 20th century indicates that the recent strengthening of ENSO correlation over the Indo-western Pacific may not owe entirely to global warming but reflect natural variability.

キーワード: Climate variability, Climate change
Keywords: Climate variability, Climate change

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115 年間のケニヤサンゴ年輪に記録された IOD と pre-ENSO シグナル
Footprints of IOD and ENSO in the 115year-Kenyan coral record

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The Pacific El Nino/Southern Oscillation (ENSO) and the Asian monsoon have been considered the major influences on the climate variability in the Indian Ocean [Charles et al., 1997; Torrence and Webster et al., 1999]. The East African Rainfall variability also has been explained by the effect of the ENSO teleconnection. However, the correlation between the ENSO and Indian Ocean climate variability is not particularly strong and is suggested to have become weak in recent decades [Kumar et al., 1999]. In 1999 the Indian Ocean Dipole (IOD) was identified as another dominant climate mode generating climate variability not only in the Indian Ocean but also in the world along with ENSO [Saji et al., 1999]. The IOD is a seasonally fixed phenomenon that peaks between September and November. Positive IOD is normally characterized by anomalous cooling (warming) of SST in the eastern (western) Indian Ocean together with severe droughts over the Indonesian region and heavy rainfall over East Africa. But their past variations are obscure due to a lack of reliable instrumental observations before 1958 [Saji et al., 1999], which has prevented the evaluation of IOD inter-annual shift and its corresponding relation to ENSO and monsoon.

We found Kenyan coral oxygen isotope ratio (delta Oxygen) reflected distinctly the East African Short Rain anomaly related to the IOD variability in January, a few months after the Short Rain peak due to oceanographic condition, and reconstructed the 115-year Short Rain anomaly as the coral IOD index. The coral IOD index demonstrates a dominantly decadal periodicity in the early part of 20th century. This low-frequency IOD occurred more frequently before 1924 with more quasi-biennial events since 1960. The mode shift has also coincided with an intensified coupling with Indian summer monsoon rainfall. We suggest that a warming of the western Indian Ocean, which has attenuated and replaced the El Nino Southern Oscillation effect over the Indian Ocean, has driven the observed shift.

On the other hand, a comparison of the monthly coral delta oxygen pattern corresponding to IOD and ENSO years shows that the ENSO-induced signals do not appear clearly as the positive sea surface temperature (SST) and rainfall anomalies in the Kenyan coral record. This result supports the suggestion that the IOD is the dominant climate mode rather than ENSO in the Kenyan coast. Moreover the coral records indicate that the negative IOD like- anomalously cold SST condition in the western Indian Ocean precedes the evolution of the Pacific El Nino by one year. The anomalously cold SST condition was prominent in the late 19th century, but weakened in the 20th century. This retreat of the cold SST condition due to warming of the western tropical Indian Ocean may influence the nature of the Pacific ENSO.

キーワード: インド洋ダイポールモード, エルニーニョ, 東アフリカ降水, ケニヤ, サンゴ記録
Keywords: IOD, ENSO, East African Rainfall, Kenya, coral record

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Role of the Indian Ocean in Climate Variations
Role of the Indian Ocean in Climate Variations

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The Indian Ocean gives rise to the well-known Indian Ocean Dipole (IOD) responsible for some of the extreme climate events in many parts of the world. For example, the extreme flooding events in East Africa and droughts in Australia are shown to be associated with the positive IODs. The impact was severe when in a rare turn of the history three positive dipole events evolved back to back during 2006, 2007 and 2008. However, after 2008, in the absence of positive IOD, several parts of East Africa suffered from severe draughts. In recent decades, the sea surface temperature of the tropical Indian Ocean has warmed leading to increased trade winds in the South Indian Ocean. Besides causing several changes in the southern and western Indian Ocean, the wind change has led to a warming in the Agulhas Current System. The stronger trade winds also have helped for the shoaling of the thermocline in the eastern tropical Indian Ocean. This has introduced favorable conditions for positive IOD formations. Considering these and their impacts on the regional climate, it has become an essential task to understand the characteristics of the Indian Ocean apparently related to changes in the background conditions under the global warming stress.

キーワード: Indian Ocean, Climate, IOD
Keywords: Indian Ocean, Climate, IOD

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AAS01-11 会場:101A 時間:5 月 24 日 12:00-12:15

PJ パターンとインド洋の相互作用
Interactions between the Pacific-Japan teleconnection pattern and the Indian Ocean

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A meridional teleconnection pattern called the Pacific-Japan (PJ) pattern is an important mode of variability that influences summer climate over the western North Pacific (WNP). The pattern features meridional dipoles of precipitation and lower-tropospheric circulation, whose lobes are located over the subtropical and midlatitude WNP. While El Nino-Southern Oscillation (ENSO) is effective in triggering the PJ pattern, it has become known that the pattern is an atmospheric internal mode. The present study examines a possibility that the PJ pattern interacts with oceanic anomalies other than ENSO.

We have conducted a coupled general circulation model experiment with GFDL CM2.1, where sea surface temperature (SST) is restored toward its climatology over the eastern equatorial Pacific to suppress ENSO (denoted as NoENSO experiment). Our empirical orthogonal function analysis reveals that the PJ pattern is a dominant mode over the summer WNP in the absence of ENSO. The PJ pattern in NoENSO is significantly stronger that that observed in an experiment with the atmospheric component of CM2.1 forced with climatological SST (CLIMO experiment), indicating an amplification of the pattern by coupling. The PJ pattern in NoENSO experiment is accompanied by SST anomalies over the northern Indian Ocean (IO) and an atmospheric equatorial Kelvin wave. This study proposes an IO-PJ coupled mode. In this mode, a reduction in precipitation over the subtropical WNP forces an atmospheric cold Rossby wave response that extends westward to the northern IO. The associated easterly anomaly weakens the surface monsoon westerlies and warms the northern IO. The warmer IO induces atmospheric warm Kelvin wave that penetrates into the equatorial western Pacific. Ekman convergence associated with this warm Kelvin wave causes anomalous surface divergence over the subtropical WNP, which suppresses the atmospheric convection locally and thereby closes a feedback loop.

キーワード: アジア夏季モンスーン, 大気海洋相互作用, 結合モード, 大循環モデル
Keywords: Asian summer monsoon, air-sea interactions, a coupled mode, GCM

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アジアモンスーン域における季節内変動
Intraseasonal variability in tropical Asian monsoon regions

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To understand and predict behavior of the intraseasonal variability (ISV) are central issues of Asian monsoon research, because of its severe impact on South and Southeast Asian countries. The ISV has time scales ranging from 30 to 60 days, and plays a crucial role in fluctuation of local rainfall amount. In particular, it contributes to interchange between monsoon active periods with abundant rainfall and break periods with almost no rainfall in each region. In this talk, I will describe spatiotemporal structure of atmospheric and oceanic anomaly fields associated with the ISV, with emphasis on its characteristic northward propagation from the equatorial Indian Ocean to the foot of the Himalayas. Although physical mechanism responsible for the northward propagation is still an open question, a number of studies have addressed this issue. Some proposed roles of seasonal-mean atmospheric circulation field characterizing the summer Asian monsoon, which is brought by heat contrast between the Indian Ocean and the Tibetan Plateau as well as spatial distribution of sea surface temperature. Some studies performing numerical experiments suggested the importance of air-sea interaction for the mechanism. I will briefly introduce these proposed mechanisms, and then try to discuss how observational studies over the Indian Ocean can contribute to this issue.

キーワード: アジアモンスーン, 季節内変動
Keywords: Asian monsoon, intraseasonal variability

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ジャカルタ周辺の降水経年変動に対する ENSO/IOD の影響
Effects of the ENSO/IOD on interannual rainfall variability in and around Jakarta

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Effects of the Indian Ocean Dipole (IOD) and El Nino Southern Oscillation (ENSO) on interannual rainfall variations over northwestern Jawa, Indonesia were investigated. IOD events clearly influence interannual rainfall variations from the dry season to the trainsition season (May-October) in northwestern Jawa. During positive (negative) IOD years, cooler (warmer) SST surrounds the maritime continent and large-scale divergence (convergenc) and lower (higher) atmospheric water vapor content are observed. These conditions tend to suppress (induce) rainfall in northwestern Jawa. Negative IOD years with warmer SST and higher water vapor content around Jawa brought greater rainfall in the dry season compared with La Nina years. On the other hand, interannual rainfall variation in the rainy season (November-April) is not closely related to ENSO/IOD, but rainfall tends to be abundant ”neutral” (non-ENSO/IOD) years.

キーワード: インド洋ダイポール, エルニーニョ南方振動, 海大陸, 降水変動
Keywords: IOD, ENSO, maritime continent, rainfall variability

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PREDICTION OF SEASONAL UPWELLING AT SOUTH SUMBAWA SEA, INDONESIA
PREDICTION OF SEASONAL UPWELLING AT SOUTH SUMBAWA SEA, INDONESIA

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Based on Ekman theory and Bakun upwelling index formula, prediction of upwelling occurrence at the south coast Sumbawa Island was carried out. Six hourly global wind data from the United State National Centers for Environmental Prediction (US-NCEP) were used for calculation of upwelling index. Furthermore, values of the indexes are correlated with thickness of thermocline layer. Depletion of thermocline layer occurs during upwelling occurrence because vertical movement of sea water mass brings cold water from deeper part of the sea to the surface. The thicknesses of thermocline layer at South Sumbawa Sea are obtained by analyzing ten years vertical profile of seawater temperature data. The data was observed by the team from PT. Newmont Nusa Tenggara from year of 1999 to 2009. Cross-correlation between upwelling index and thickness of thermocline layer shows that the index is inversely proportional to the thickness. It means that the positive index indicates occurrence of upwelling is correlate with the depletion of thermocline layer. This study concludes that upwelling index calculated using global wind data is able to represent occurrence of upwelling in South Sumbawa Sea and value of the index can also indicate the strength of upwelling.

キーワード: upwelling index, thermocline layer
Keywords: upwelling index, thermocline layer

AAS01-15 会場:101A 時間:5 月 24 日 14:35-14:50

風によって強制された赤道インド洋の季節内変動の力学
The dynamics of wind-driven intraseasonal variability in the equatorial Indian Ocean

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Variability in the equatorial Indian Ocean on intraseasonal time scales (defined as periods of 30-110 days) is investigated using satellite and in situ observations and a simple analytical linear long-wave equatorial beta-plane model. Despite the extreme simplicity of the model, which includes just the two gravest baroclinic mode Kelvin waves and first meridional mode Rossby waves, simulated surface zonal velocity and sea surface height compare very well with observations. Both observations and model are characterized by a red shift in the velocity spectrum relative to the wind forcing spectrum, which is attributable to a combination of factors, including (1) the near resonant excitation of Kelvin waves by eastward propagating winds, (2) constructive interference between wind-forced waves and Rossby waves reflected from the eastern boundary, and (3) the favored excitation of low-frequency waves whose zonal wavelengths are long compared to the zonal fetch of the wind. We decomposed variability in two broad period bands, namely, 30-70 days and 70-110 days, for detailed analysis. At periods of 30-70 days, zonal velocity tends to be stationary in the directly forced region along the equator owing to the competing contributions of Kelvin and Rossby waves. In contrast, at 70-110 day periods, zonal velocity propagates westward despite eastward propagation of zonal wind stress because of the combined influence of eastern boundary generated and wind-forced Rossby waves. Kelvin waves reflected from the western boundary are negligibly small, indicating that basin mode resonances are not prominent as has been previously suggested.

キーワード: 赤道インド洋, 季節内変動, 波動の力学, 共鳴
Keywords: Equatorial Indian Ocean, Intraseasonal Variability, Wave Dynamics, Resonance

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AAS01-16 会場:101A 時間:5 月 24 日 14:50-15:05

インド洋での季節内変動に関する国際集中観測”CINDY2011”
Cooperative Indian Ocean Experiment on Intraseasonal Variability in Year 2011 ”CINDY2011”

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This presentation is to introduce the outline and preliminary results of a international field experiment named ”Cooperative Indian Ocean Experiment on Intraseasonal Variability in Year 2011 (CINDY2011)”.

The principle target of CINDY is the Madden-Julian Oscillation (MJO) which is the dominant intraseasonal mode in the tropics to impact the global weather and climate. The MJO is usually characterized as an active cloud envelope which primarily initiates over the Indian Ocean and then propagates toward the western Pacific in slow speed (5 m/s). The insufficient observational data, however, make it difficult to clarify the mechanism of the MJO, or to reproduce the MJO by the numerical models.

To meet these scientific necessities, we designed an international project CINDY, with its U.S. component ”Dynamics of Madden-Julian Oscillation (DYNAMO)”, to have a field experiment. The four months from October 2011 to January 2012 was dedicated as the intensive observing period (IOP).

As the principle component, we set up the observation array in the central Indian Ocean. The array consists of island sites, research vessels, moorings, etc. To observe the atmospheric condition, radiosonde was launched 4 or 8 times per day at six sites. In particular, this network with frequent radiosonde observation is designed to accurately estimate adiabatic heating rate (a.k.a. Q1 and Q2 of Yanai et al. 1973). The three sites equipped various types of weather radars to retrieve the information on the precipitating / non-precipitating cloud systems over the array. The detailed oceanic profiles and surface meteorological parameters were captured by the vessels and buoys. Airplanes and floats were also deployed in the array to retrieve the atmospheric and oceanic status in detail.

During the IOP, we succeed to capture three convectively active phase of the MJO. The first one, which was identified as the MJO in the western Indian Ocean in the end of October,was characterized by weak westerly wind and active convection was observed only in the northern part of the array. The second one in the end of November also appeared in the western Indian Ocean but active convection appeared also southern part. The third one in the December appeared in the central Indian Ocean. In the all three events, the gradual growth of the moist layer toward the active period was captured. This was more clear in the northern and equatorial sites, while unclear in the southern sites. The organized cloud systems were captured frequently by the radars on the equator, while only in the second (November) event by the radar on R/V Mirai at the southern site. The oceanic observation at R/V Mirai captured clear diurnal variation in the oceanic mixing layer.

These observed dataset are now under the quality-control. After 12 months from the end of the field campaign, the quality-controlled dataset will be made available to the broader scientific community.

Keywords: Madden-Julian Oscillation (MJO), Intraseasonal Variation (ISV), Field Experiment

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AAS01-17 会場:101A 時間:5 月 24 日 15:08-15:15

Discussion: For future multidisciplinary research experiments in the Indian Ocean
Discussion: For future multidisciplinary research experiments in the Indian Ocean

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The accomplishment of RAMA array for whole basin is now around 70%, and the eastern part of RAMA array has accomplished already. Most of Argo array in the Indian ocean is already maintained. Therefore, it is the time to foster Indian Ocean researches by using existing system as well as by introducing new idea, and new technologies that can complement RAMA and other existing observing systems. Using this discussion time, we would like to discuss possible research themes for the Indian Ocean, utilizing RAMA array, introducing new scientific ideas and new technologies. Only considering from the point of view of RAMA data, there are already several possible research themes, which include air-sea interaction and upper ocean circulation in the Bay of Bengal, physical processes governed development and termination of eastern pole of IOD, ocean variations and air-sea interaction along Seychelles-Chagos Thermocline Ridge, and subduction processes and meridional circulation in the Indian Ocean. New ideas to be a seed for new research experiment are welcomes in this discussion.

Keywords: Indian ocean dipole, Monsoon, MJO, biogeochemical processes, air-sea interaction, ocean variation

AAS01-P01　　会場:コンベンションホール　　時間:5 月 24 日 15:30-17:00

Indian Ocean Observing System (IndOOS)
Indian Ocean Observing System (IndOOS)

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The Indian Ocean plays an important role for African-Asian-Australian monsoons, climate variability in regions surrounding the Indian Ocean, and its remote impacts at global scale through atmospheric teleconnections. However, a long-term, sustained observing system in the Indian Ocean had not been started as of about a decade ago, leaving the Indian Ocean as the least observed ocean among the three major basins. To fill this observation-gap, the Indian Ocean Observing System (IndOOS) has been developing in a recent decade. It is designed to provide high-frequency, near real-time climate-related observations, serving the needs of the intraseasonal, interannual and even decadal time-scale climate studies and services.

IndOOS is a multi-platform long-term observing system, which consists of Argo floats, surface drifting buoys, tide gauges, a surface mooring buoy array (RAMA), VOS based XBT/XCTD sections, and satellite measurements as a backbone observation for sea surface conditions. RAMA is the main platform for in situ observations in the tropical region, whose design was evaluated and supported by observing system simulation experiments. The first RAMA buoy was deployed in 2000 and, since then, a significant progress has been made in implementation of the observing system and also in scientific outcomes from the observed data. The proposed array for RAMA consists of 46 moorings, of which 27 locations are occupied as of Dec 2010. The Indian Ocean data thus collected is available through the data portal system maintained at INCOIS, India. This presentation summarizes recent progress in the observing systems in the Indian Ocean.

Keywords: Indian Ocean, Observing System

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AAS01-P02 会場:コンベンションホール 時間:5 月 24 日 15:30-17:00

Indian Ocean observation for ocean and climate variability in JAMSTEC
Indian Ocean observation for ocean and climate variability in JAMSTEC

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In the eastern Indian Ocean, two TRITON buoys deployed in October 2001 were the initiation of the current RAMA (Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction) buoys at 1.5S-90E and 5S-95E, and added one smaller size m-TRITON buoy at 8S-95E in November 2009. The TRITON buoys at 1.5S-90E and 5S-95E were replaced by smaller size m-TRITON buoys in 2006. We also maintain ADCP mooring site at 0-90E since 2000. The mooring provides quite precious information for ocean and climate variability and change. As an example of recent achievements in JAMSTEC, the time series analysis of the mooring buoy in the eastern equatorial Indian Ocean observed details of subsurface ocean conditions associated with Indian Ocean Dipole (IOD) events in 2006, 2007, and 2008. IOD is one of the inter-annual climate variability in the Indian Ocean, associated with the negative (positive) SST (Sea Surface Temperature) anomaly in the eastern (western) equatorial region developing during boreal summer/autumn seasons. In the 2006 IOD event, large-scale sea surface signals in the tropical Indian Ocean associated with the positive IOD started in August 2006, and the anomalous conditions continued until December 2006. Data from the mooring buoys, indeed, captured the first appearance of the negative temperature anomaly at the thermocline depth with strong westward current anomalies in May 2006, about three months earlier than the development of the surface signatures. Similar appearance of negative temperature anomalies in the subsurface were also observed in 2007 and 2008, while the amplitude, the timing, and the relation to the surface layer were different among the events. These subsurface evolutions within the ocean would be a key factor for better understanding of IOD mechanisms and its predictability.

Engineering developments in JAMSTEC are also essential to contribute sustaining and developing ocean observations. TRITON buoy, which has been used since 2000, is tough to severe oceanic and atmospheric conditions, and its data recovery rate from whole array in 2000-2005 was high (average of data recovery is more than 90%). Because of several disadvantages such as difficulties to deploy and recover by a smaller vessel etc., we have developed a new smaller and lower cost surface buoy system with flexibility in modifying electric system, named m-TRITON buoy system. The new m-TRITON buoys were already installed in Indian Ocean TRITON buoy sites at 1.5S-90E and 5S-95E, which are component of RAMA array.

キーワード: Indian Ocean, IOD, upper ocean dynamics, air-sea interaction, m-TRITON, RAMA buoy array
Keywords: Indian ocean, IOD, upper ocean dynamics, air-sea interaction, m-TRITON, RAMA buoy array

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AAS01-P03 会場:コンベンションホール 時間:5 月 24 日 15:30-17:00

インド洋ITCZ 上の熱帯波動擾乱に対する中緯度からの強制
Extratropical Foricng of Tropical Wave Disturbances along the Indian Ocean ITCZ

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The role of extratropical waves in the excitation of tropical waves along the Indian Ocean Intertropical convergence zone (ITCZ) during Austral summer is investigated using Japanese Reanalysis (JRA25-JCDAS) products and NOAA OLR data. The analysis period is December–February for the 29 years from 1979/80 through 2007/08. The ITCZ waves have zonal wavelengths of about 3000–5000 km and exhibit westward and southwestward phase propagation from the west of Sumatra into Madagascar, and eastward and northeastward wave energy dispersion from the southwestern to eastern Indian Ocean. Their timescales span submonthly (6–30 days) range. The horizontal structure of the wavetrain along the ITCZ may be interpreted as that of a mixture of equatorial Rossby waves and mixed Rossby-gravity wavelike gyres. The origin and initiation mechanism of the tropical wave train remain uncertain. The linkage between the tropical and extratropical waves which is responsible for the formation and strengthening of the tropical wave train is examined by performing an extended singular value decomposition (ESVD) analysis of daily meridional wind anomalies at 850 and 200 hPa and a composite analysis based on the ESVD result. Daily lagged composite analysis results show the progression of the mid- and high latitude Rossby wavetrain propagating eastward and northeastward from the South Atlantic into the subtropical Indian Ocean in the upper level. As troughs and ridges that are part of the extratropical wavetrain approach the southern Africa-Madagascar region, a low-level wavetrain originating from those subsequently extends toward the tropical eastern Indian Ocean. A southwest-northeast oriented wavetrain extending across the subtropical–tropical Indian Ocean is established and strengthened. Wave activity flux diagnostics indicate that wave energy dispersion from the extratropics toward the tropics occurs along this wavetrain. These results suggest that the extratropical–tropical interaction associated with the extratropical Rossby wave propagation plays an important role in the development of the tropical waves along the Indian Ocean ITCZ.

キーワード: インド洋, 中緯度-熱帯相互作用, 熱帯収束帯, 熱帯波動擾乱, 赤道波
Keywords: Indian Ocean, Extratropical-tropical interaction, ITCZ, Tropical wave disturbances, Equatorial waves

AAS01-P04 会場:コンベンションホール 時間:5 月 24 日 15:30-17:00

GPS signal delays in dust aerosols during Asian dust storm
GPS signal delays in dust aerosols during Asian dust storm

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The Asian dust storm (the so-called Yellow Sand Storm), which is a typical exampleof mineral aerosol, frequently originates in sand deserts. Absorption and scattering from dust particles during a storm is one of the possible causes of copolarization attenuation between the communication systems operating in the microwave and millimeter wavelength band during sand storms. The processes of emission, transport, dry and wet deposition of Asian dust storm are closely associated with atmospheric wet/dry conditions as well as air-pressure. In this study, the GPS tropospheric delays were calculated during a progress of Asian dust storm. The actual zenith wet delay changes are correlated with the changes in the PM 10 level. Based on these preliminary results, the increasing of the zenith wet delay, when the density of PM10 were increased, might be caused by the cloud effect which has occurred due to occuring of rainfall. And note that there is no rainfall record during the following days. However, the zenith hydrostatic delay does not seem to have any correlation with the PM10 variation. Consequently, the actual ZWD changes are correlated with the changes in the PM 10 level. The continuous tracking of tropospheric delay variations estimated by GPS with ground-based meteorological data would be useful to characterize the attributes of Asian dust storm in terms of the formation, emission, transport, deposition and dissipation. If there is a specific correlation between the dust storm density and the tropospheric conditions, as determined by GPS, this approach will also contribute a new observing technique to monitor the dust storm dynamics by providing continuous and reliable GPS observations.

キーワード: GPS, tropospheric delay, aerosol, Asian dust storm, PM10
Keywords: GPS, tropospheric delay, aerosol, Asian dust storm, PM10