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

AAS01-P01 Room:Convention Hall Time:May 24 15:30-17:00

Indian Ocean Observing System (IndOOS)

MASUMOTO, Yukio[1*], Weidong Yu[2], M. Ravichandran[3]

[1]Japan Agency for Marine-Earth Science and Technology, [2]First Institute of Oceanography, [3]Indian National Centre for Ocean Information Services

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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Indian Ocean observation for ocean and climate variability in JAMSTEC

ANDO, Kentaro[1*], MASUMOTO, Yukio[1], HORII, Takanori[1], Iwao Ueki[1], Yasuhisa Ishihara[1]

[1]JAMSTEC

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.

Keywords: Indian ocean, IOD, upper ocean dynamics, air-sea interaction, m-TRITON, RAMA buoy array

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Extratropical Foricng of Tropical Wave Disturbances along the Indian Ocean ITCZ

FUKUTOMI, Yoshiki[1*], YASUNARI, Tetsuzo[2]

[1]Research Institute for Global Change, JAMSTEC, [2]Hydrospheric and Atmospheric Research Center, Nagoya University

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.

Keywords: Indian Ocean, Extratropical-tropical interaction, ITCZ, Tropical wave disturbances, Equatorial waves

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GPS signal delays in dust aerosols during Asian dust storm

SONG, DongSeob[1*]

[1]Dept. of Ocean Construction Engineering, The Kangwon National University

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.

Keywords: GPS, tropospheric delay, aerosol, Asian dust storm, PM10