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Classification of the tropical ocean based on time variation of surface parameters

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Because of a rapid decrease of observation buoys in the tropical ocean, continuity of the buoy observation became a big issue to be solved in Tropical Pacific Observing System 2020 (TPOS2020). Therefore, we need to examine optimum array of tropical observation buoys based on the scientific evidence. For this purpose, we need to investigate which buoy can monitor each physical phenomenon in the tropical ocean.

In this study, we use Merged satellite and in situ data Global Daily Sea Surface Temperatures (MGDSST) for sea surface temperature and The Modern-Era Retrospective Analysis for Research and Applications (MERRA) for wind speed and specific humidity. The temporal resolution of the data is daily. The horizontal grid size is 1(lat.)x2(log.). We focus on El Nino, Southern Oscillation and Madden-Julian Oscillation as target physical phenomena in this study. We extract the signal of each physical phenomenon from the data using a time filter. The tropical ocean (30N-30S) was classified by a cluster analysis. To investigate the relation between the time variations of each cluster and each physical phenomenon, we estimate the correlation coefficient between them. As indexes, we use NINO3 for El Nino, Southern oscillation index (SOI) for Southern oscillation and an all season real time multivariate MJO index (Matthew et al, 2004) for Madden-Julian oscillation.

The results of cluster analysis for sea surface temperature and wind speed are illustrated in Figure 1. The time variations of averaged data in clusters C and D located in the tropical Pacific show the high correlation with NINO3. Clusters C and D are also located in the Atlantic Ocean and in the Indian Ocean, respectively. On the other hand, for wind speeds, the correlation between the time variation of NINO3 and that of averaged data in cluster F, which extends from the tropical western Pacific to the tropical eastern Pacific, is higher than that in cluster B correspond to the NINO3 region. The result for specific humidity is similar to that for sea surface temperature. The results about SOI are similar to those about NINO3.

MJO index gives variability of enhanced convection at Maritime Continent and the tropical Pacific Ocean. As the results for wind speed and specific humidity, the correlation between the time variations of MJO indexes and that of averaged data in clusters at Maritime Continent and tropical central Pacific is high. For sea surface temperature, clusters in the Indian Ocean and the tropical western Pacific are high correlation with MJO indexes.

We classified the tropical ocean by using several ocean surface parameters and clarified the relation with remarkable tropical phenomena in this study. Our results give important information from the viewpoint of optimum array of tropical observing buoys. Also our results show the same cluster sometimes exists in the separate basin. It is suggested that the overlooked linkage between two separate regions exists concerning about the tropical phenomena. The results in this study will be important for considering about optimum array of tropical observing buoys and to understand mechanism of the physical phenomena in the tropical Pacific ocean

Keywords: Tropical Ocean, buoy observation, ENSO, Madden-Julian Oscillation

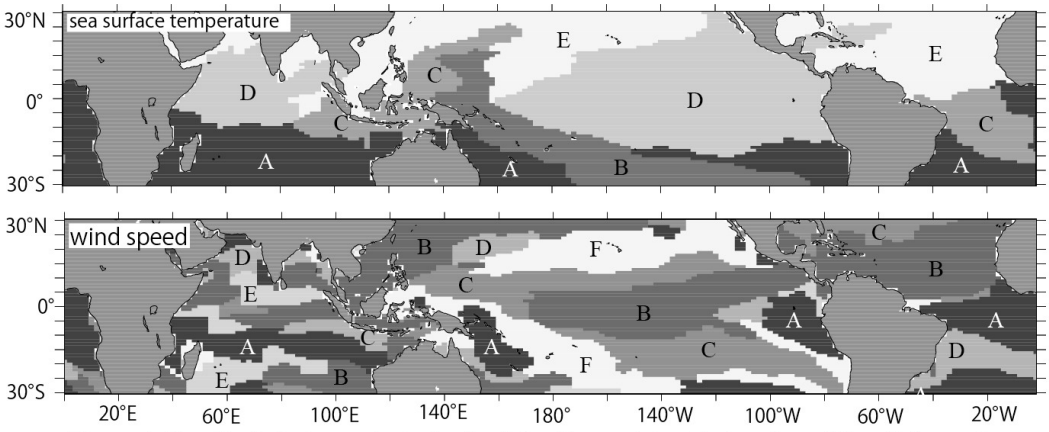

Figure 1. Result of cluster analysis for the data after applying the bandpass filter (3-5 years)