#21875 INTRASEASONAL VARIABILITY IN TROPICAL SURFACE WIND FIELD USING SATELLITE SCATTEROMETER DATA

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1. Introduction

Surface wind stress is one of the essential factors for driving motions in the upper ocean. Recent studies have pointed out that the ship-measured winds involve questionable reliability such as uncertain anemometer height (e.g. Cardone et al, 1990). Instead, satellite microwave scatterometer supplies wind data with high temporal and spatial resolution. In this study, using scatterometer data by European Remote-sensing Satellite(ERS)-1/2, we construct a data set of gridded surface wind/wind-stress vectors and examine their variability in the tropical area. This data set covers about 9 years since 1992, and allows us to examine variabilities on multiple time scales.

We also use another scatterometer sensor data: SeaWinds on board Quikscat which was launched on June 1999 and have much higher data density than ERS-1/2.

In this study, we focus on intraseasonal variability in the tropical region. This is based upon much interest for the wind variability relating to the occurrence/development of El Niño event. A major event occurred in 1997-98 in which sea surface temperature(SST) anomaly in the eastern Pacific exceed 4 degrees. Observational studies have suggested that air-sea interaction on intraseasonal time scales plays an important role for the onset(McPhaden and Yu, 1999; Boulanger and Menkes, 1999). Thus, we attempt to describe spatial character of intraseasonal signal in detail.

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2. Data

The main data set is level 2.0 ERS-1 and 2 data involving the wind speed and direction, which have been supplied by the Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER).

For the scatterometer data having inhomogeneous spatial distribution due to satellite orbital motion, we perform vector-averaging method using a weighting function varying with time and space, and construct wind/wind-stress vector on each 1°x 1° grid in space in the tropical region(30°E-70°W, 30°S-30°N). This procedure is similar to that by Kutsuwada(1998) who constructed a similar data set from ADEOS/NSCAT data in 1996-97. Products of monthly and 10-day averages by ERS-1/2 are parts of a data set by the Japanese scientific group, together with heat flux components, called the Japanese Ocean Flux data sets with Use of Remote sensing Observations (J-OFURO). The data are available for any users on a web site (*http://dtsv.scc.u-tokai.ac.jp/*).

3. Validation of products

Reliability of our products is made by inter-comparison with TAO buoys in the equatorial Pacific. An example for time series of the monthly zonal wind in the central Pacific(Fig.1) shows a good similarity between them. Comparisons at other stations reveal that the RMS difference is larger in the western Pacific than in the central-eastern ones. Comparison is also made using the numerical product by ECMWF. In a zonal profile of annual average in 1997 along the equator, our product tends to be a bit larger in magnitude than ECMWF's and closer to TAO buoy's. Thus, our products have better reliability than ECMWF's.

4. Intraseasonal variability of zonal wind

Time-longitude diagram of the zonal wind along the equator exhibits that strong westerly wind burst(WWB) frequently covered the western equatorial Pacific and Indian Oceans in 1996-97, namely the onset of 1997-98 El Niño event. Spectral features reveal that there are high energies in the intraseasonal period band between 30 and 80 days, suggesting that the WWB is related to enhancement of intraseasonal signal.

Visual inspection of band-passed field(20-100 days) suggests that there are different zonally-migrating features in the equatorial band. So, we perform the Complex Empirical Orthogonal Function(CEOF) approach. Result reveals that the first and second modes on the equator have contribution of 42 and 20%, respectively, of total variance and contrastive spatial phase relations with each other(Fig.2). This means that two modes have characters of eastward and westward, respectively, phase lags.

A similar approach is made also for the wind product by the Qscat/SeaWinds data in August 1999 to September 2000. It is suggested that the two types of intraseasonal signals having different zonal structures are prominent in the equatorial band (Fig. 3).

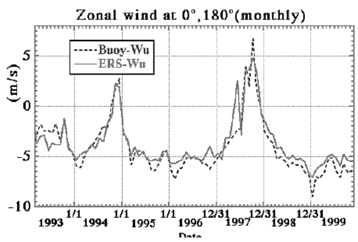

Fig. 1: Time series of monthly zonal wind at 0°, 180°. Solid and broken lines depict ERS-1/2 and TAO buoy data, respectively.

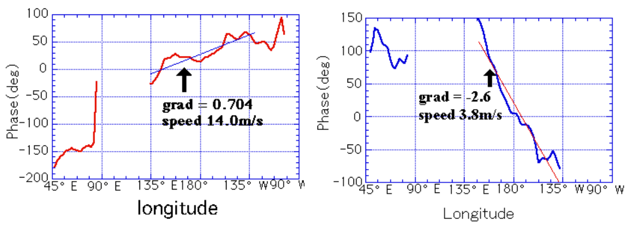

Fig.2: Spatial phase of first(left) and second(right) CEOF modes which are calculated from band-passed time series of zonal wind on the equator.

We have an evidence that the intraseasonal signal in the upper ocean was triggered in the western equatorial Pacific and propagated to the east, probably due to the effect of internal equatorial Kelvin wave (Kutsuwada and McPhaden, 2000). Thus, it should be considered that the intensified intraseasonal signal in the western equatorial Pacific played an important role for the onset of the 1997-98 El Niño event.

Reference

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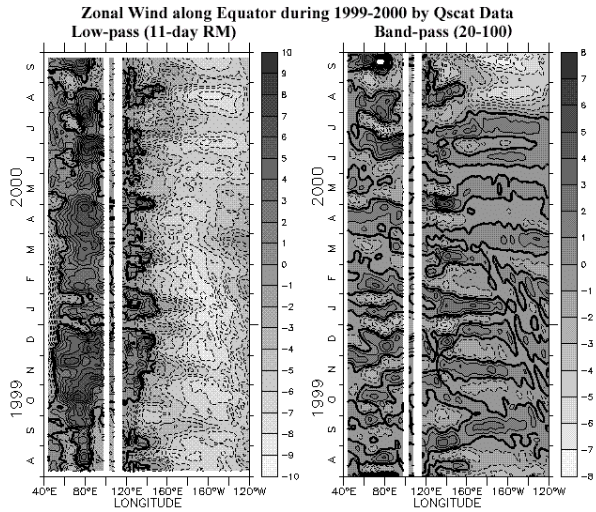

Fig.3: Time-longitude diagram of zonal wind along the equator by Qscat/SeaWinds data in Aug.1999-Sep.2000. Left: low-pass(>11-day) and Right: band-passed(20-100 days)