TIME SERIES ANALYSIS USING GRIDDED WIND-STRESS PRODUCT DERIVED FROM SATELLITE SCATTEROMETER DATA

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Abstract: Time series of gridded surface wind and wind-stress vectors over the world ocean have been constructed by satellite scatterometer data. The products are derived from the ERS-1,2 covering 9 years during 1992-2000 and the *SeaWinds* on board QuikSCAT (Qscat) which has been operating up to the present since June 1999, so they allows us to analyze variabilities with various time scales. In this study, we focus on interannual variability of the wind stress in the mid- and high-latitude region of North Pacific. These are compared with those by numerical weather prediction(NWP) ones (NCEP Reanalysis).

We also examine variability in the wind-stress curl field that is an important factor for ocean dynamics and focus its time and spatial characters in the northwestern Pacific around Japan. It is found that the vorticity field in the lower atmosphere tends to increase gradually with time, suggesting the enhancement of the North Pacific subtropical gyre.

Keywords:Wind-stress, scatterometer, time-series

1. Introduction

We have constructed gridded products of surface wind-stress vectors(WSV) over the world ocean using satellite scatterometer data(Kutsuwada, 1998; Kubota et al., 2002). These have been available for users on our web site (*http://dtsv.scc.u-tokai.ac.jp/j-ofuro/*), together with heat flux components, and used helpfully in many kinds of studies such as focusing on variabilities in the lower atmosphere and in numerical modeling studies as input parameters driving the Ocean Global Circulation Model (OGCM).

The products are basically derived from the European Remote-sensing Satellite (ERS-1,2) covering 9 years during 1992-2000, and from the *SeaWinds*, on board QuikSCAT(hereafter Qscat), which has been operating up to the present since its launch in June 1999. The ERS products are reconstructed by correction procedures for its slight difference in reliability from our Qscat's (Kasahara et al., 2003), and consequently our two products permit us to analyze WSV time series for a long period exceeding a decade. Recent studies have found that the surface heat flux in the northwestern Pacific region, corresponding to the Kuroshio Extension(KE), has a linear-increasing trend, and pointed out the possibility of interannually changing air-sea coupling (e.g. Tomita and Kubota, 2005). In this study, using our WSV product, we will examine long-term variabilities in the KE region.

2. Data and procedure

Using Level IIB data (individual wind speed and direction), provided by the NASA Physical Oceanography Distributed Active Archive Center (PO.DAAC) at the Jet Propulsion Laboratory, we calculate WSV on each 1°x 1° grid by the bulk formula using the drag coefficient depending only on wind speed based on Large and Pond (1981). Details of construction procedure for our products are described in Kutsuwada (1998) and Kubota et al., (2002).

3. Results

In the mean field of the zonal wind stress(not shown), the eastward wind stress covers area north of

about 25°N corresponding to the westerly wind region. Standard deviations(SD) for the zonal wind stress field (Fig.1a) have relatively large values in this region, meaning that the westerly wind changes with time in its strength and meridional position. We notice the wind-stress curl (curlτ) which is one of the essential forcing parameters for driving motions of the upper ocean. SD for the curlτ has also large values in the same region(Fig 1b).

We focus on time series of the zonal wind-stress and curlτ in the Kuroshio Extension(KE) region (Fig.2a and b), because the recent studies clarified the positive trend of latent heat flux in 1990's to 2000's. Even if there are not so clear signal in the zonal stress, we can find a gradually decreasing change in the time series of curlτ for the our satellite product but the NWP/NCEP one. This feature of linear trend means the increase of negative vorticity induced by the wind stress, and may be related to the enhancement of the North Pacific subtropical gyre.

Acknowledgements

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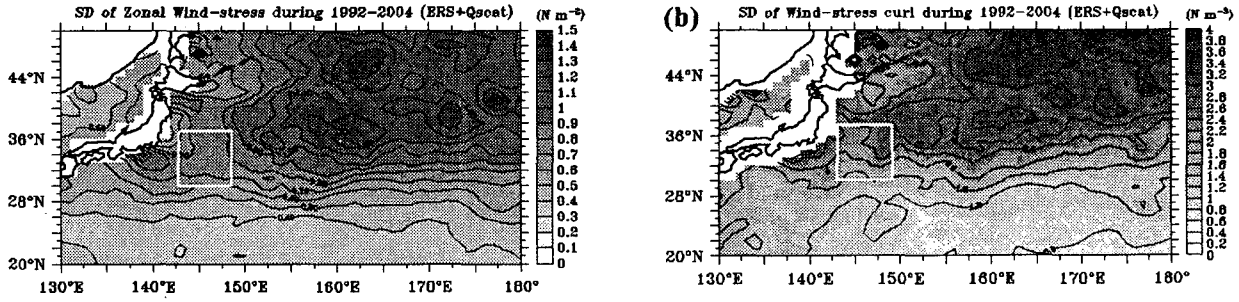

Fig. 1: Distributions of standard deviations for the zonal wind-stress(a) and wind-stress curl(b) for 13 years during 1992-2004 which are calculated from our ERS+ Qscat products. Quadrangle by white lines denotes areas in which time series are shown in Fig.2.

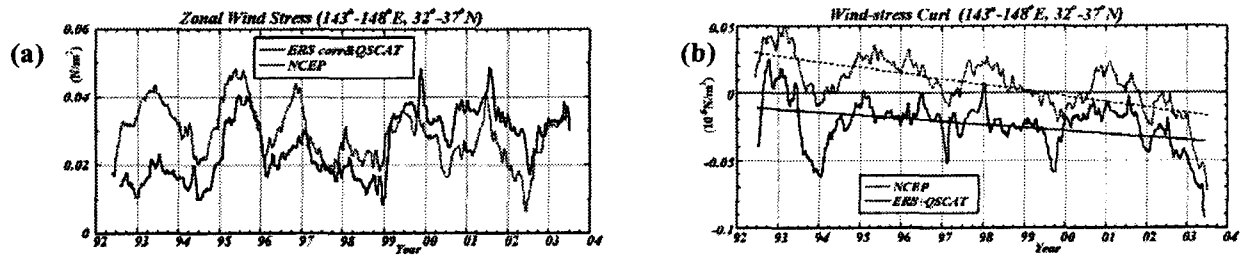

Fig. 2: Time series of zonal wind-stress (a) and wind-stress curl (b) in the Kuroshio Extension region (143°-148°E, 32°-37°N). Solid and broken lines depict values by our satellite and NCEP, respectively, products. Linear trends by the method of least square are also plotted in (b).