Comparison of variations in sea surface height with sea surface temperature and wind field in the Tropical Pacific Ocean

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Abstract: The purpose of this study is to contribute the development of an El Niño prediction model. The objectives of the study are to (1) extract sea surface height data from the TOPEX/Poseidon altimeter, and (2) compare the relations among the sea surface height, sea surface temperature and wind field. NOAA AVHRR Multi-channel data is used for sea surface temperature and wind data is derived from ERS 1,2 AMI wind scatterometer.

The results showed that sea surface height has increased significantly during the El Niño season. The sea surface height is positively related to sea surface temperature and negatively related to zonal wind.

1. Introduction

The current strong El Nino event provides good condition to assess it using satellite data, which will help to improve future predictions of climate events (NOAA 1997). Now we can predict this events using many method such as ship observing data, buoy data, and satellite data. However, the use of accurate information is vital because the prediction of El Niño is very complex and other information from a ship or buoy data pose difficulty in gathering and managing continuously.

The satellite data such as Scatterometer & Altimeter data can contribute to improve prediction and assessment of the El Niño, because many numerical prediction models are needed accurate information. Particularly, the condition of El Niño cannot be understood using only one climate parameter, Hence, investigation should consider other factors such as sea surface temperature, wind vector information and sea surface height. If these measurement are studied within same space and time, the results can be improved to understand and predict El Niño.

1. Methodology

NOAA AVHRR Multi-Channel Sea-Surface Temperature (MCSST) data, ERS AMI wind scatterometer data and TOPEX/Poseidon Altimeter data was used in the Pacific Ocean from 1991 to 1997. Fig. 1, shows the study area and the TOPEX/Poseidon repeat cycle over study area.

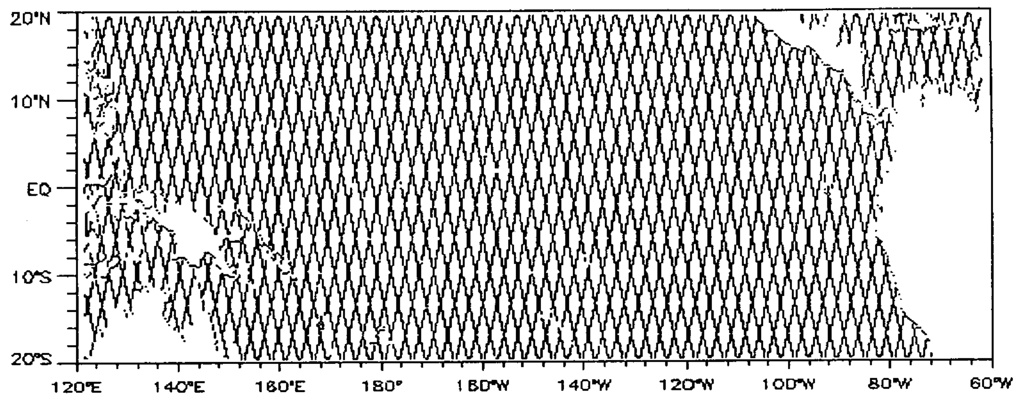


Figure 1. TOPEX/Poseidon 10day repeat cycle tracks over the study area

From the extracted altimeter data set, sea surface height data was calculated by substracting the corrected range that affect altitude. The environmentally corrected TOPEX/POSEIDON sea surface height relative to the reference ellipsoid is defined by:

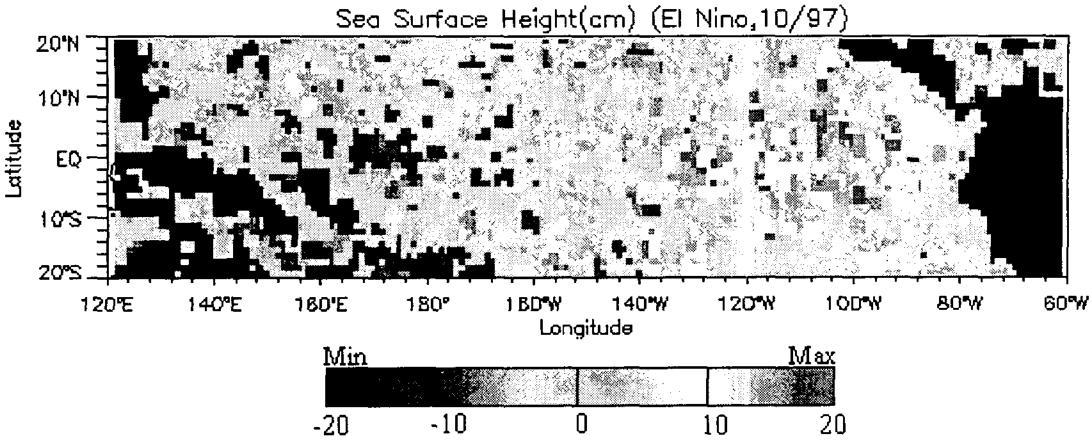
SSH = sat_height - (altimeter_range + delta_alt_range + altimeter_bias) - geoid_height - geocentric_body_tides - ocean_tides - atmospheric_loading

SST anomaly was calculated. which is useful technique when the data are subject to seasonal variations. For further assessment Empirical Orthogonal Function analysis(EOF) was conducted on anomaly data.

The first alias wind speed data was used from the wind scatterometer data. Each data put on 25 km x 25 km geographical data box and a monthly mean wind speed, zonal wind and wind vector data set were created. Finally time series analysis and statistical analysis was conducted on 3 data sets.

2. Results and Discussion

At the first step, all processed data are presented in the form of color-coded maps for the visual interpretation. Fig 2, shows sea surface height over the Tropical Pacific Ocean during the El Nino season, the Fig. 3, shows the sea surface height regional behavior during the 2 years which shows the sea surface height change among the Niño 1-4 regions. As you can see, the SSH on Niño 1,2,3 region was increased but, Niño 4 region was decreased during the El Niño season. Fig. 4 shows the time series evolution of SST anomaly, Zonal wind and Sea surface height on the Niño 3 region. The SST and SSH was relatively increased but the zonal wind was decreased during the El Niño season. The Fig. 5 shows the regression results.



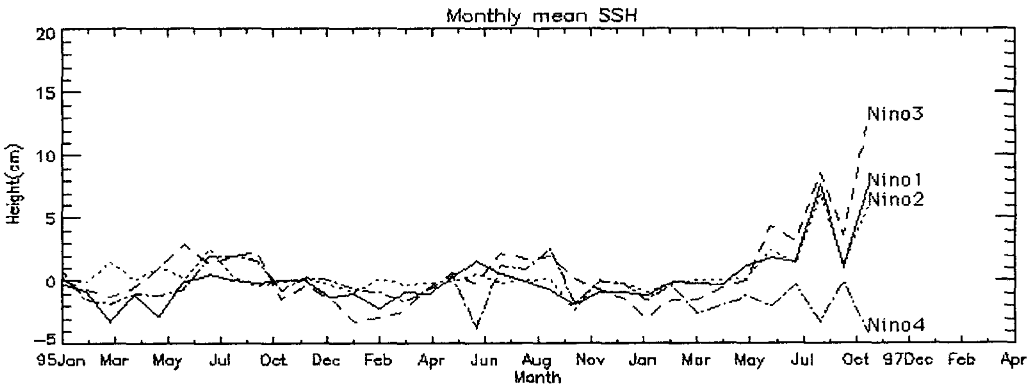


Fig.2. The Sea Surface Height behavior during the 2 years

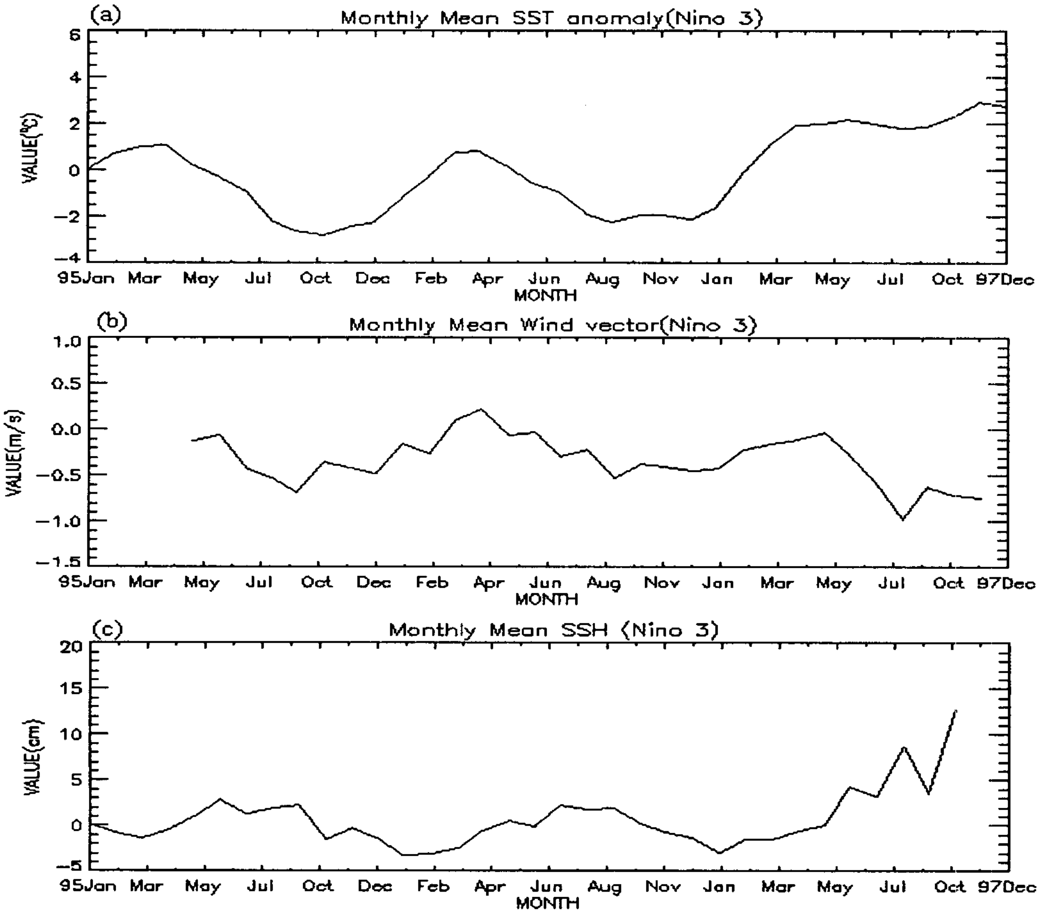


Fig.3. Time series of (a) SST anomaly, (b) Zonal wind, (c) SSH

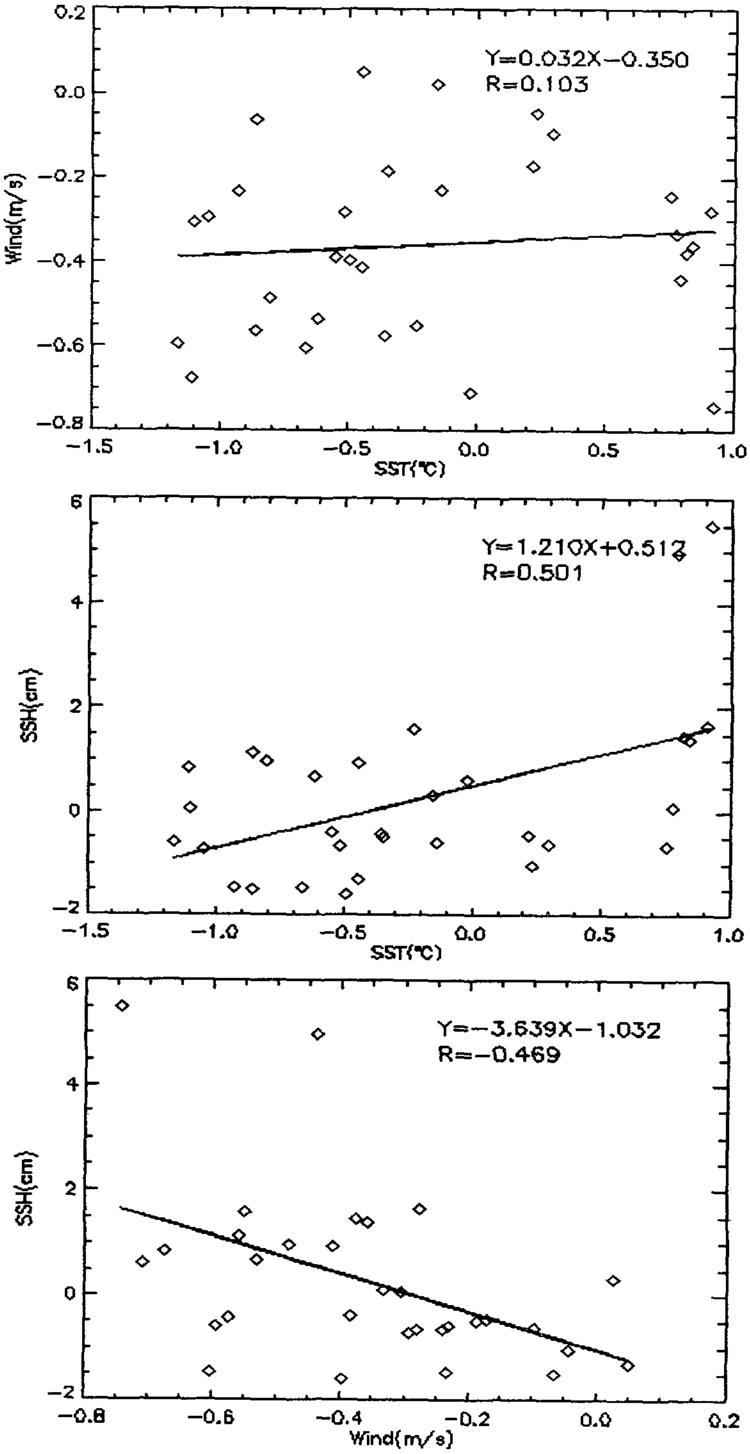


Fig. 4. Scatter plot and regression line for (a) SST–Wind, (b) SST -SSH, (c) Wind-SSH

3. Conclusion

During the El Niño season, the Eastern Pacific Ocean of sea surface temperature was increased and the sea surface height was increased significantly. The zonal wind over whole pacific ocean was disrupted, the trade wind direction was changed and the western pacific ocean wind speed was weakened.

The regression analysis shows that the sea surface height is positively related to sea surface temperature and negatively related to zonal wind.

Acknowledgments

The Asian Institute of Technology STAR program provided financial funding support and the European Space Agency provided ERS-1,2 AMI wind scatterometer data, the Physical Oceanography Distributed Active Archive Center(PO.DAAC) provided AVHRR MCSST data and TOPEX/Poseidon altimeter data.

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