The ocean-atmosphere interaction over a summer upwelling system in the South China Sea

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The ocean-atmosphere interaction over a summer upwelling system is investigated in the South China Sea (SCS). A strong positive correlation between sea surface temperature (SST) and wind stress is observed near the southeast of Vietnam, where strong SST fronts occur during summertime. This air-sea coupling relationship indicates that the ocean is forcing the atmosphere at oceanic mesoscales, which is the opposite of the negative correlation at large scales. Our results reveal that the SST-induced wind stress curl anomalies have a feedback effect on SST itself. A regression analysis suggests that the wind stress curl anomalies can alter the SST magnitude by as much as 0.5˚C. The coupled system in the southeast of Vietnam is initiated by wind-induced Ekman transport. The Ekman pumping induced by the wind stress curl is subsequently developed over frontal regions, which is approximately half of the Ekman transport. Then the upwelling can enhance the strength of SST fronts. The factors influencing strength and interannual variability in air-sea interaction are also explored in the present study. The wind stress directional steadiness (WSDS) plays an important role in air-sea interaction over the SST frontal regions. The coupling between the wind stress and SST can fully develop, which is consistent with highly stable WSDS. Furthermore, our results suggest that interannual variabilities of air-sea interaction are largely impacted by the El Niño events through influencing the regional winds. The influence of a strong El Niño event on the summer upwelling system is characterized by SST warming and declining winds, which were associated with weakened SST gradients and mesoscale air-sea coupling during the 2010 summer. Current study offers a comprehensive description for the ocean-atmosphere interaction in a typical upwelling system and can be further applied in other global coastal regions.

Keywords: Ocean-atmosphere interaction, Sea surface temperature fronts, El Niño

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