Response of upper ocean cooling off northeastern Taiwan to typhoon passages

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In this study, all upper ocean responses to typhoons striking Taiwan from 2005 to 2013 were simulated based on Regional Oceanic Modeling System to provide a comprehensive investigation on the process of typhoons induced upper ocean responses off northeastern Taiwan. Previous study indicates that the strong northeast wind, accompanied by a typhoon, could trigger a Kuroshio intrusion (KI) event that would promote the upwelling of the Kuroshio's subsurface water onto the shelf and thus causing cooling off northeastern Taiwan. In addition to this scenario, this study indicates another mechanism of wind-current resonance (WCR) over the continental shelf of East China Sea that can also trigger a distinct cooling (through entrainment mixing) within this region. Besides, statistic results based on 17 typhoon cases indicate that the processes of typhoon passage leading to distinct cooling NET are not as common as expected. Actually, they are conditional phenomena. By executing a series of sensitivity experiments and systematic analysis on the behaviors and background conditions (in both atmospheric and oceanic frames) of 17 typhoon cases, key criteria determining the occurrences of cooling NET through both mechanisms (KI and WCR) were elucidated individually. Once the rotation rate of local sensed wind forcing (depending mainly on moving track, translation speed, and RMWs of typhoons) off northeast Taiwan over the continental shelf of ECS is comparable to the turning rate of wind-driven local inertial motions (it is about 27.4 hours off northeast Taiwan), TCNET will be triggered through WCR. Occurrence of TCNET through the mechanism of KI is determined mainly by intensity/strength of northeast wind within local NET. Both processes are dominated by wind forcing rather than oceanic conditions. Finally, according to the possible dynamic linkage between local SST off NET and regional weather system raised in recent studies, the results elucidated in this study are believed to provide a possible advancement on improving regional weather prediction surrounding NET.

Keywords: air-sea interaction, typhoons, modeling, remote sensing

