**‘Category-6’ typhoon Haiyan, Ocean Subsurface Warming, and**

**Ocean Coupling Potential Intensity Index**

**I.-I. Lin***(**iilin@as.ntu.edu.tw**;* [*http://homepage.ntu.edu.tw/~iilin/)***\***](http://homepage.ntu.edu.tw/~iilin/%29%2A) **and Iam-Fei Pun**

*Department of Atmospheric Sciences, National Taiwan University, Taipei, Taiwan*

**Abstract**

With intensity peaked at 170kts, i.e., 35 kts above the 135 kts threshold for category-5 intensity, supertyphoon Haiyan devastated the Philippines in November 2013. Using satellite altimetry, *in situ* upper ocean thermal structure observation from Argo floats and numerical modeling, we diagnose the upper ocean thermal condition for Haiyan. It is found that Haiyan intensified over the southern part of the typhoon main development region (MDR) over the western North Pacific (WNP). This region is a well-known favorable region for tropical cyclone intensification, due to both warm Sea Surface Temperature (SST) and warm subsurface ocean. Typically, the SST over this region is above 29 ∘C in typhoon season and the subsurface warm layer thickness (as characterized by depth of the 26 ∘C isotherm, D26) is 100m. Correspondently, the upper ocean heat content (UOHC) is also high, typically ~ 110 kj/cm2, since UOHC is the integration heat content from SST down to D26.

More interestingly, recent study from Pun et al. (2013) discovered that this MDR region is currently undergoing decadal variability with rapid warming in the subsurface ocean. As compared to the early 1990s, D26 and UOHC have both increased by ~ 12%. In this study, we showed that due to this further deepening of the ocean subsurface warm layer thickness (i.e. increase in D26 and UOHC), the enthalpy flux supply for Haiyan’s intensification has increased by around 15 % and contributed to the observed extra-ordinary intensity for Haiyan. This work also uses the recently-proposed new ocean coupling potential intensity (OCPI) index (Lin et al. 2013) to explore the associate change in the intensity upper bound. The use of OCPI instead of the traditional PI (or SST\_PI, i.e. Emanuel 1988) is because the traditional PI does not consider the subsurface ocean condition but OCPI include ocean subsurface condition in the intensity upper bound estimation. Finally, we discuss the possible need to add another category in the Saffir-Simpson tropical cyclone scale, i.e. category-6, to characterize tropical cyclones like Haiyan.

**Reference**

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