Supertyphoon Boosters in the Western North Pacific Ocean

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Abstract

The role ocean features played in the intensification of 30 western North Pacific category-5 typhoons in the past 13 years is studied. We found that passing over the commonly-emphasized warm ocean features for intensification to category-5 is not always necessary. In a background with an existing thick, warm upper ocean layer, for example in the lower-latitude (10-20° N) gyre region where the depth of the 26° C isotherm (D26) ~ 110m, typhoons can intensify without encountering any features or even on cold features. However, in a shallower background, for example in the higher-latitude (20-26° N) South Eddy Zone region where D26 is around 50m, it becomes necessary to pass over warm features to boost up the intensity to category-5 because the background can not sufficiently suppress the self-induced cooling negative feedback. The observed shallowest warm layer (in D26) which a typhoon could intensify to category-5 is 70m, but over such shallow water typhoons need to move fast (≧ 6m/s). Over thicker layer (D26~110-150m), typhoon is allowed to transverse as slow as 1-2 m/s. Strong geographical dependence is found that all 90 category-5 typhoons occurred in the typhoon season since 1960 intensified only in a well-confined region covering the South Eddy Zone and the gyre. We suggest that the chance for occurring outside this region is very slim because even if other conditions (e.g., atmospheric or typhoon structure) are met, it is hard to meet the necessary ocean condition in limiting self-cooling in the thin (D26~30m) outside water.

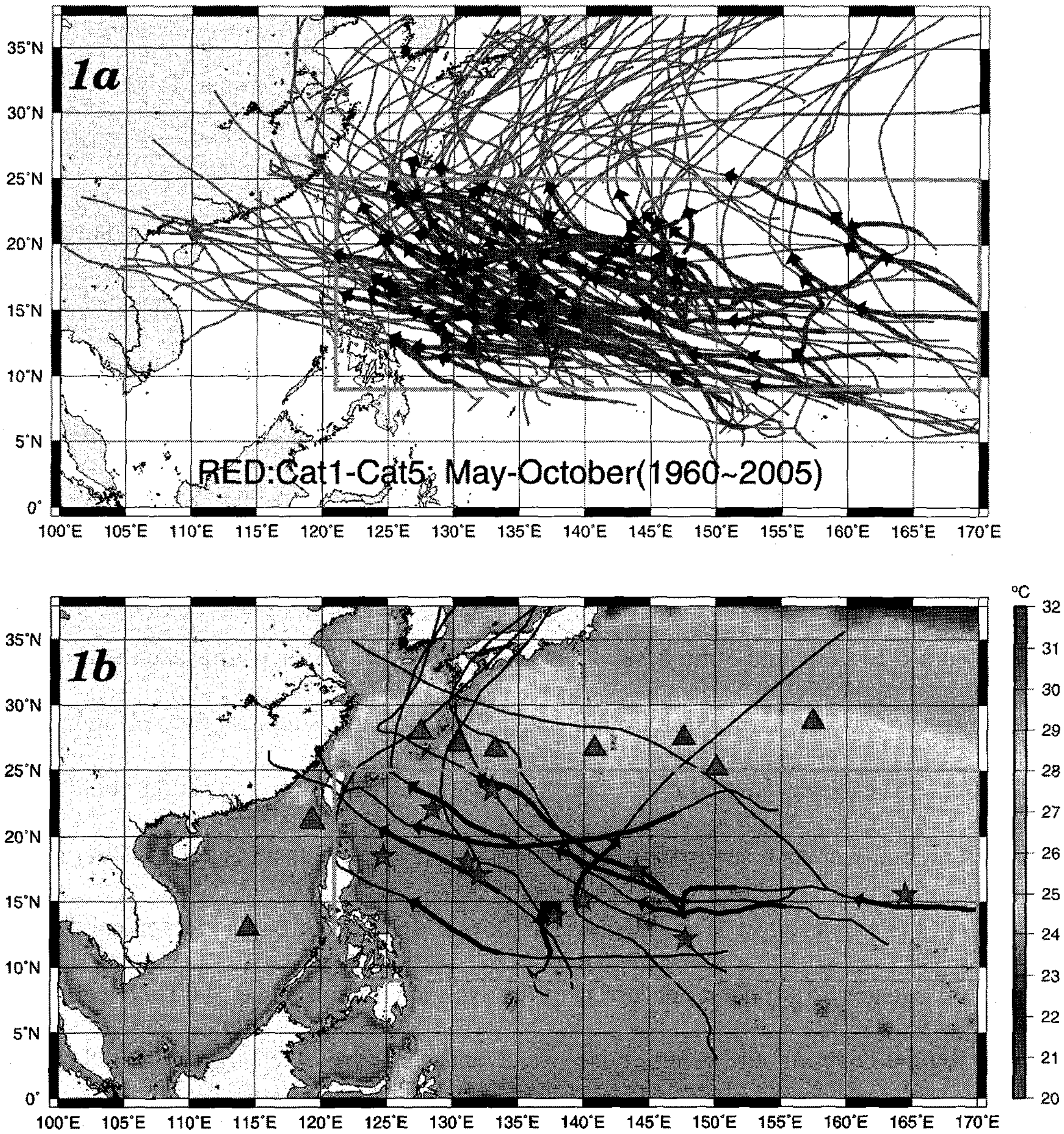

Figure 1: (a): The location of intensification (from category-1 to 5, shown in red segment with arrow) for the 90 super cyclones occurring in the Northwest Pacific Ocean during the May-October typhoon season in 1960-2005. The rest of the tracks are depicted in blue while the green box defines the intensification zone (121-170° E, 9-25° N). (b): Same as in (a), showing the full tracks (in grey) and intensification track segments (in black with arrows) of the 10 cases (1998-2005) studied; the base map is the July/August averaged TRMM sea surface temperature map of the same period; locations of the pre-cyclone Argo *in situ* profiles taken inside and outside of the intensification zone are depicted as stars and triangles, respectively. The location of the *in situ* profile found within 24h from Supertyphoon Dianmu's passage is depicted as square.

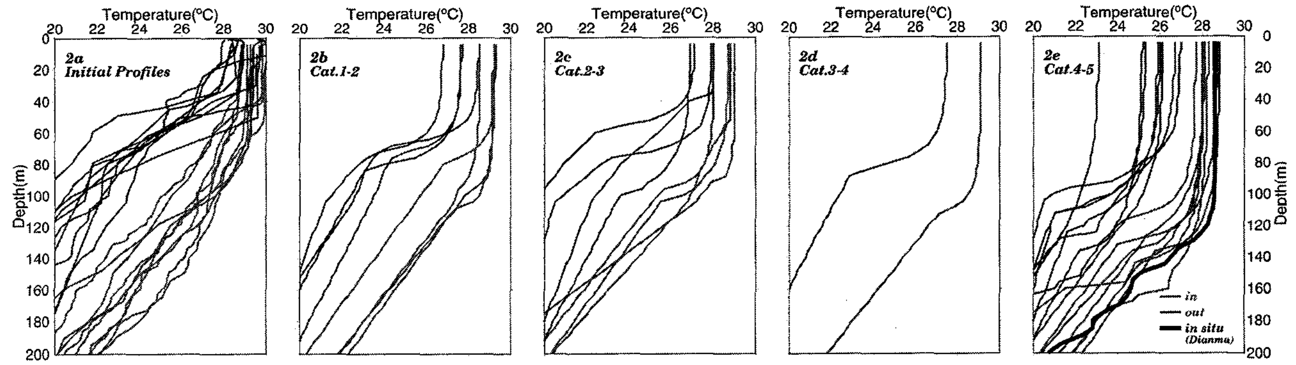

Figure 2: (a) Pre-cyclone ARGO *in situ* ocean depth-temperature profiles of the 10 super cyclone cases, profiles inside and outside of the intensification zone are depicted in red and blue, respectively. (b)-(e) Mixed-layer model simulated depth-temperature profiles under subsequent intensification stages[4]. The *in situ* profile found within 24h from Supertyphoon Dianmu's passage is depicted in black in (e); its location is depicted as square in Figs. 1b and 3.

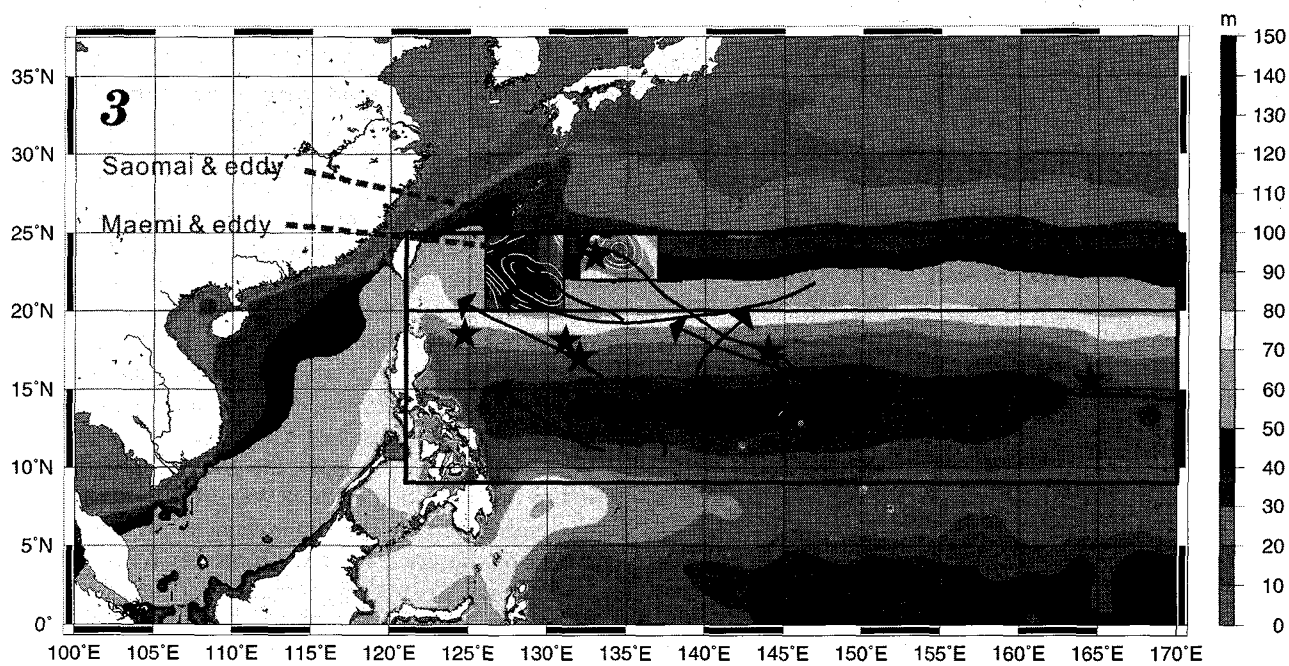

Figure 3: The May-October averaged climatological map (Stephens *et al.*, 2002) of the 26° C isotherm in the Northwest Pacific Ocean with the regenerated (using satellite sea surface height anomaly data, as in Shay *et al.*, 2000) 26° C isotherm at the 2 warm ocean eddy regions. Note the intensification zone is delimited as the southern (121-170° E, 9-20° N) and northern parts (121-170° E, 20-25° N).