On 'Sub-Center' in CMA Tropical Cyclone Best Track Data

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The sub-center in CMA Tropical Cyclone Best Track Data is defined to be a circulation center split from or induced by its parent tropical cyclone (TC) circulation. Generally, sub-centers form when the TC circulation is affected significantly by topography, including the Philippines Archipelago, the Japanese Archipelago, the Taiwan island, the Hainan island, and mountains lying in south or east China, and so on. When such situation occurs, one to three sub-centers may be triggered (Figure 1). Some sub-centers exist only several hours and very close to the parent storm (for example, the sub-center marked with "5(1)" near Hainan island in Figure 1), but some can escape further away and have a lifespan of one or more days (for example, one of the sub-centers marked with "12(1)" in Figure 1). When the environmental condition is favorable, the escaped sub-center sometimes develops into a typhoon, for example, the sub-center of Faye (1971) (marked with "40(1)" in Figure 2). Some sub-centers appear when the parent storm decay over land and can live one or more days after the parent storm disappears, for example the sub-center of Winne (1997) (Figure 3). It looks like the storm jumping from one place to another place.

In CMA TC best track data, the sub-center is marked by "(-)n" (n=1, 2, 3) following the name of the parent storm. The sub-center always has the same Chinese number ID and name with the parent storm.

CMA experts try the best to record these phenomena associated with TCs as much as possible in post-season analyses, which imply a special mechanism for the high impact weather associated with TCs. These phenomena sometimes are recorded by other agencies in different form and sometimes are ignored by other agencies. A typical example for the first situation is Winne (1997) (Figure 3). The sub-center of the storm in CMA dataset is recorded as a TD stage as a part of Winne (1997)'s track, which finally enters ET both in JTWC and JMA dataset, while only a very short TD stage is recorded in HKO dataset. Andy (1982) is a similar case (Figure 4). The super typhoon Wendy (1963) is a typical case for the latter situation (Figure 5). In CMA dataset, two sub-centers are recorded, which brought about very heavy precipitation to higher latitudes (Figure 6). However, the 'sub-center' stage of the storm is ignored by other centers. Trix (1960) (Figure 7) is another example of this situation.

Concerning the application of the 'sub-center' information in climate research, we found that the differences in annual TS numbers among different agencies are not significant statistically (Ying et al., 2011). More significant differences may be introduced in the intensity-weighted variables such as ACE and PDI, which are closely related to the intensity estimation. It is recommended that experts using CMA best track data may define reasonable rules to include/exclude the sub-centers.

P. S.

We would like to recommend that experts do not convert the sustained wind speed in different average periods (1-min, 2-min, 10-min and so on) simply. We don't think that the intensity of tropical storm is designated objectively and obey the unique statistical relationships between different wind averaging periods. As we found, it is better to designate TS category according to the original data from different agencies (Ying et al. 2011).

Reference:

Ying, M., E.J. Cha, and H.-J. Kwon, 2011: Comparison of three western North Pacific tropical cyclone best track datasets in a seasonal context. J. Meteor. Sco. Japan. Doi: 10.2151/jmsj.2011-303. [Available from http://wwwsoc.nii.ac.jp/msj/JMSJ/JMSJ2011-03.html]

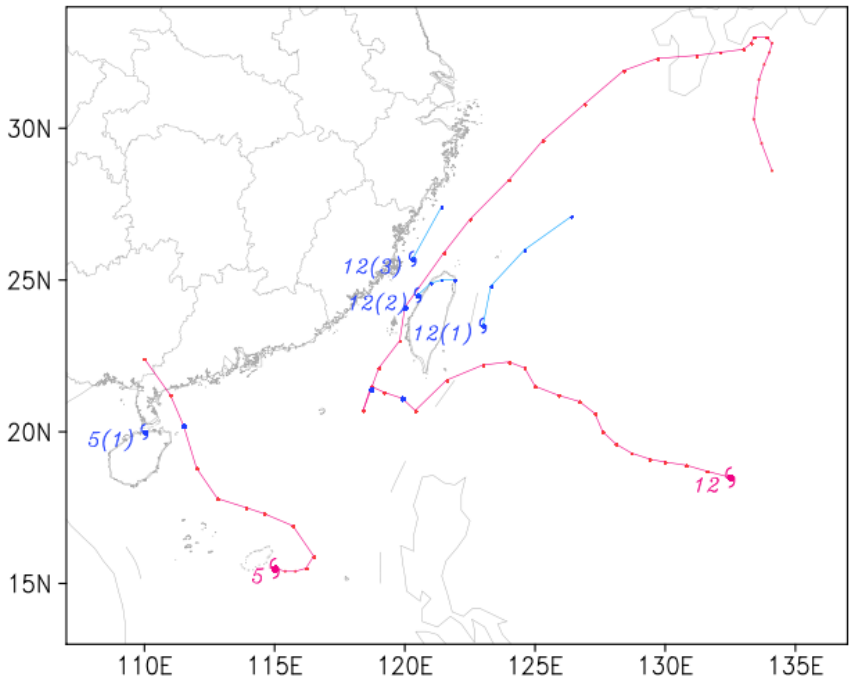

Fig. 1 Sub-center cases occurred in 1977. The numbers are the "TC number IDs" in CMA TC best track data. The parent storm (red) and its sub-center (blue) have same "TC number ID". The " ❟ " marks the start location and the blue dot on the track of the parent storm marks the time when its sub-center generates.

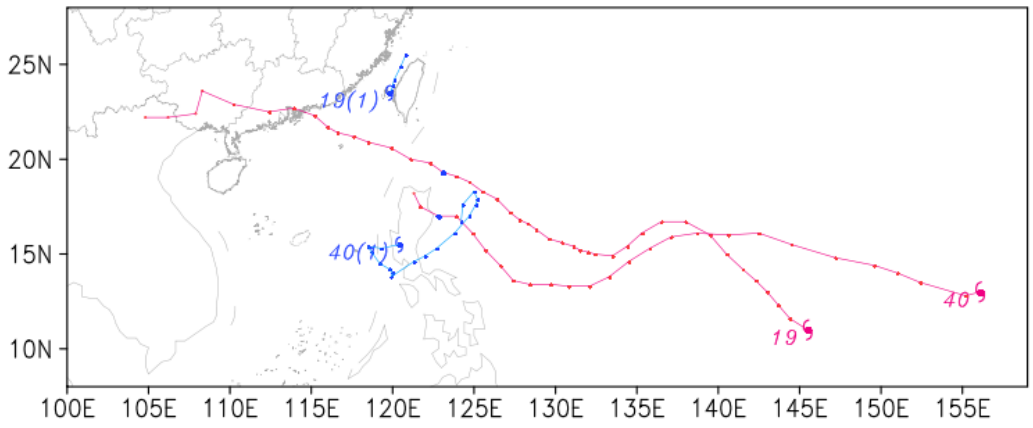

Fig. 2 Same as Figure 1 but for cases occurred during 1971.

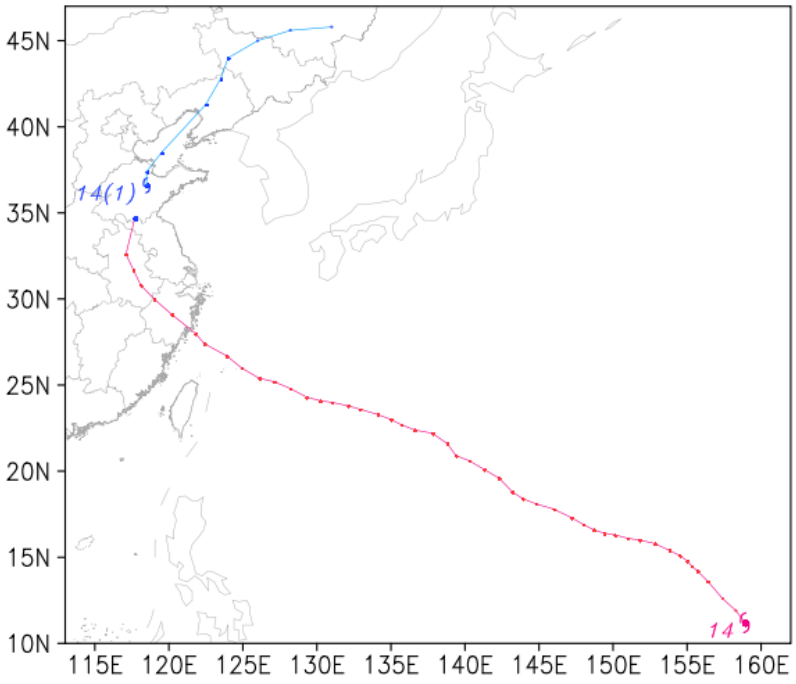

Fig. 1 Same as Figure 1 but for Winne (1997).

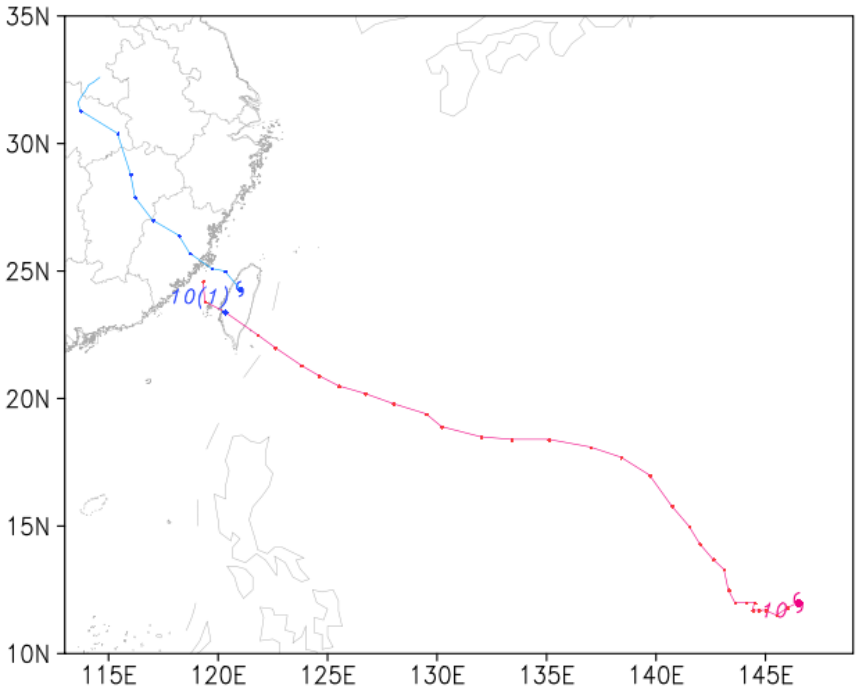

Fig.4 Same as Figure 1 but for Andy (1982).

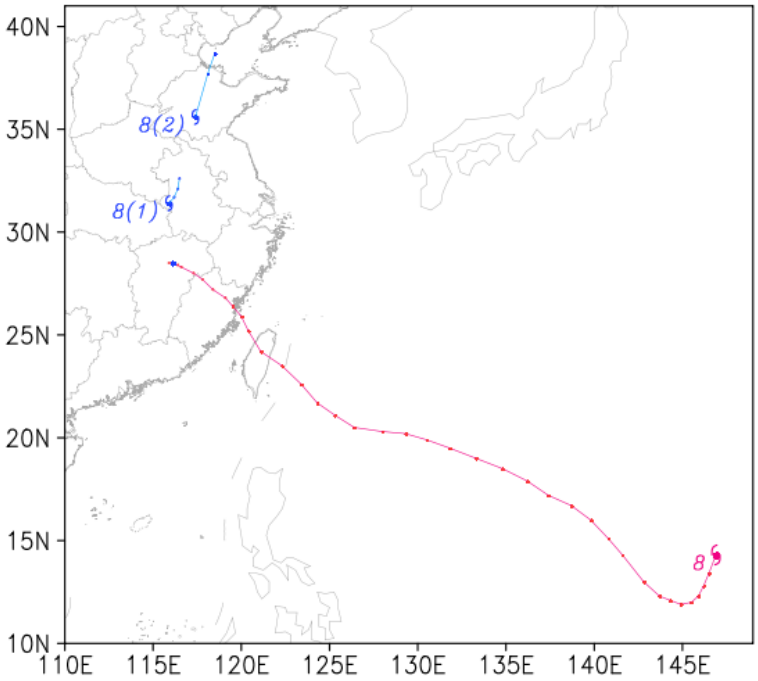

Fig.5 Same as Figure 1 but for Wendy (1963).

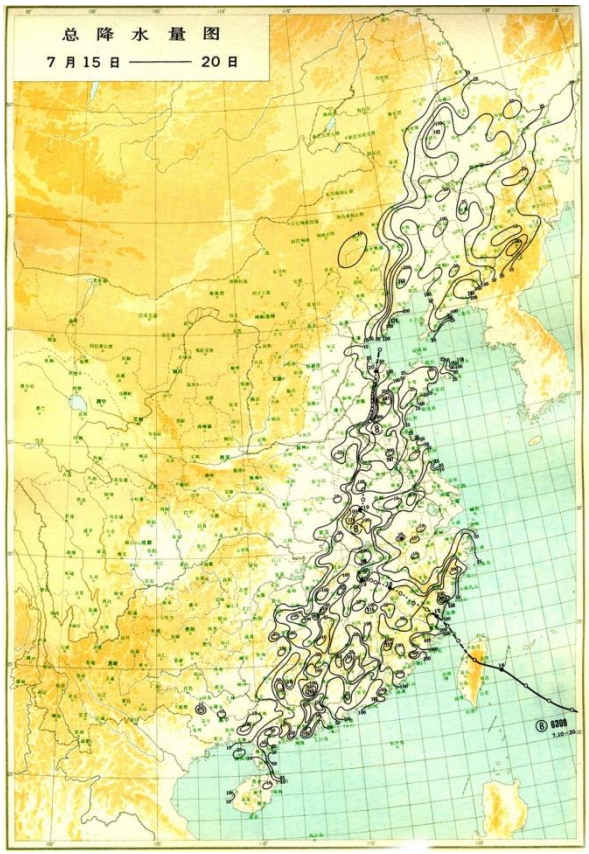

Fig.6 Total precipitation caused by Wendy (1963) in China Mainland.

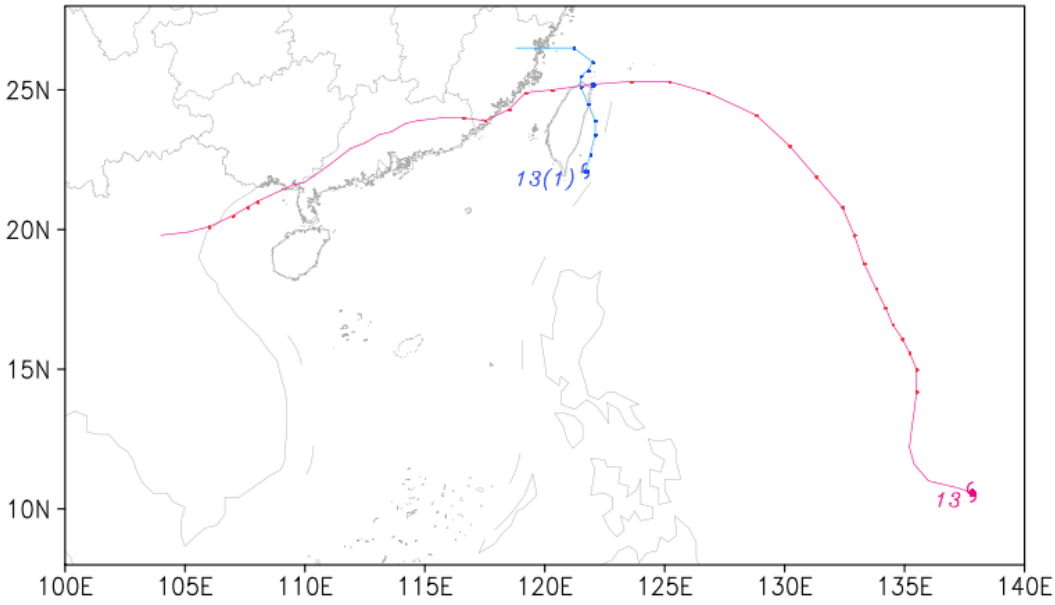

Fig.7 Same as Figure 1 but for Trix (1960).