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Effect of Typhoon-Generated Cold Wake on the Subsequent Typhoon Tembin and Its Sensitivity to Horizontal Resolutions

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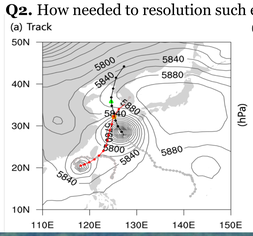
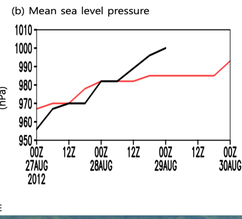
1. Motivation

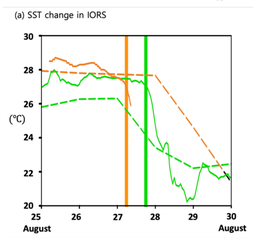
Q1. How does a cold wake caused by a typhoon affect subsequent typhoon intensity and precipitation?
Q2. How needed to resolution such effect?

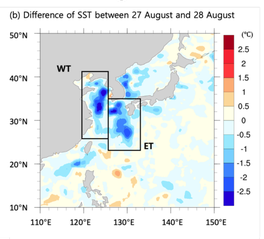




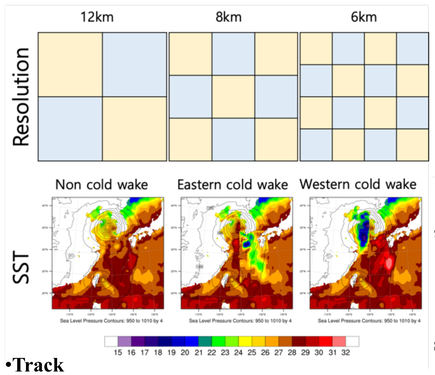
- **Interaction** between typhoons occurs during periods of high typhoons in western-north Pacific. Especially, direct interaction is called “Fujiwhara effect” and many studies have been done. Direct interaction as well as **indirect effects** are also important. The most **important phenomenon** is the **typhoon generated cold wake.**

2.Observation and Experimental design



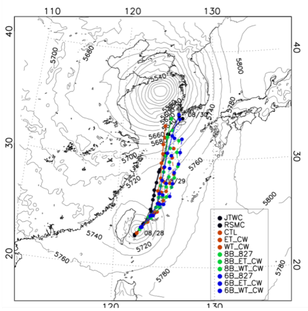


-**Ieodo Ocean Research Station data (Ha et al. 2019) : rapidly decrease (observations were missing)**
-**Yellow Sea buoy: -7.5 ℃ cooling and recovered 2 ℃**
-**OISST.v2: gradually decrease at 28th and 29th(doesn’t shows cooling and recover)**
-**FNL 6hr data, JTWC best track data**
- **Model: Weather research and forecasting (WRF) v3.2 model**

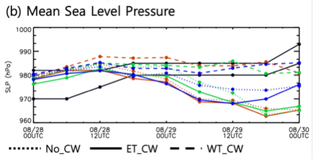


Horizontal resolutions
(**12km**, **8km**, **6km**)
SST condition
-**Non cold wake**
-**Eastern cold wake**
-**Western cold wake**)

(a) Track



(b) Mean Sea Level Pressure

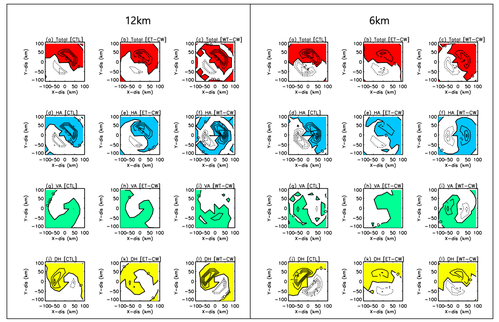


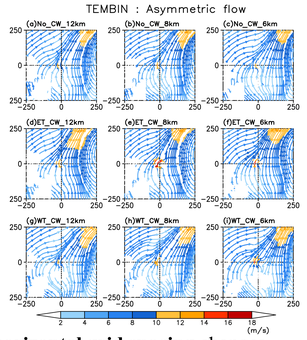
•**Track**
Western cold wake : East deflection compared with other SST conditions
As the horizontal resolutions, TCs move faster in higher resolution experiment

•**Intensity**
Eastern cold wake : Stronger than non cold wake
Western cold wake : Weaker than non cold wake
8km : weaker than 12kkm in non cold wake condition
6km : weaker than 12 km in non cold wake and eastern cold wake condition

3. Effect of the Location of the Cold Wake on the Simulated Tembin

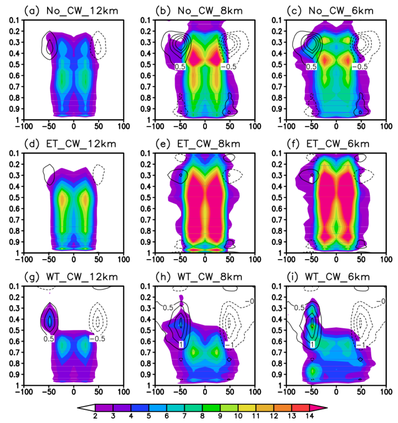
▪ Track

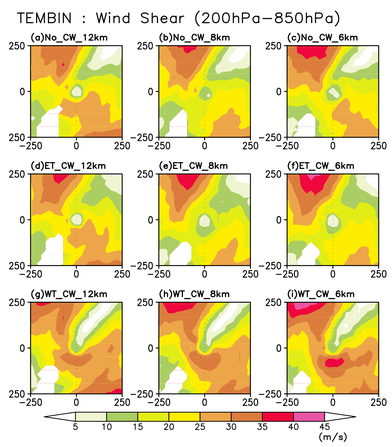




- **SST gradient** changes **the direction of the TC** and **the horizontal grid spacing** changes the **translating speed** of the TC.
- **Cold wake**
  - **Eastern cold wake** : **The direction of the horizontal advection of PVT related to asymmetric flow is similar to a non cold wake.**
  - **Western cold wake** : **The direction of the horizontal advection of PVT related to asymmetric flow faces east compared to the non cold wake.**
- **Horizontal resolutions**
  - **8km** : **Stronger** Asymmetric flow compared with **12km**
  - **6km** : **Stronger** Asymmetric flow compared with **12km**

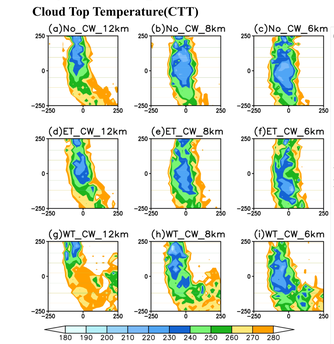
▪ Intensity

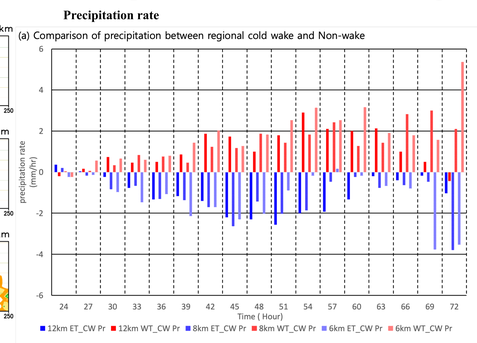


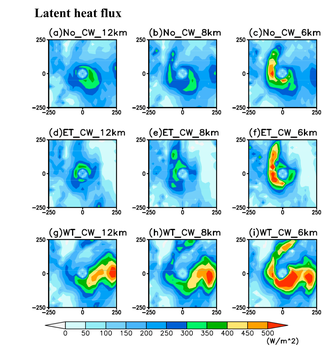


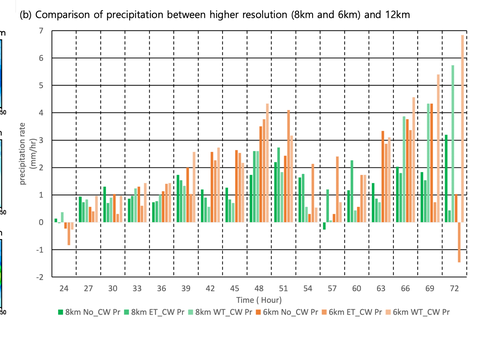
- **The intensity of TC** is **greatly influenced** by **the SST gradient and horizontal resolutions.**
- **Cold wake**
  - **Eastern cold wake** : **Stronger vertical PV** than **non cold wake**
  - **Western cold wake** : **Weaker and lower vertical PV** than **non cold wake**
- **Horizontal resolutions**
  - **8km** : **Stronger vertical PV** compared with **12km**
  - **6km** : **Stronger vertical PV** and stronger vertical wind shear compared with **12km**

4. Physical response in the surface and the top of TC as SST and horizontal grid









- **Cold wake**
  - **Eastern cold wake** : **Lower** CTT, **less** latent heat flux, and **Less** precipitation than **non cold wake**
  - **Western cold wake** : **Higher** CTT, **stronger** latent heat flux, **More** precipitation than **non cold wake**
- **Horizontal resolutions**
  - **8km** : **Lower** CTT, **stronger** latent heat flux, and **More** precipitation compared with **12km**
  - **6km** : **Lower** CTT, **stronger** latent heat flux, and **More** precipitation compared with **12km**

5. Summary

- In the aspect of **intensity** of TC, the **vertical structure** of **PV** at the center of TC shows more various for SST conditions.
- In the aspect of **precipitation** of TC, the **locations of SST** makes different amount of **precipitation** and the **higher horizontal resolution** makes **strong precipitation rate**.

Reference

Moon, M.; Ha, K.-J. Effect of Typhoon-Generated Cold Wake on the Subsequent Typhoon Tembin and Its Sensitivity to Horizontal Resolutions. *Atmosphere* **2019**, *10*, 644.

Acknowledgment

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