

# Extreme Typhoon Rainfall in Taiwan associated with monsoon

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## Outline

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- ▶ Introduction – 51 years of rainfall data
- ▶ Westward Typhoon extreme rainfall
- ▶ Typhoon rainfall and typhoon translation speed
- ▶ Ocean dominated Typhoon cases
- ▶ Typhoon extreme rainfall associated with monsoon and mesoscale convections
- ▶ Summary

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- ▶ 352 Typhoon cases affected Taiwan in 1960-2010(51years)
- ▶ 21 Central Weather Bureau (CWB) stations hourly rainfall data from 1960-2010
- ▶ The definition of typhoon strength is the maximum wind speed of typhoon within 1 degree of latitude when typhoon approach Taiwan

### CWB Observation Stations

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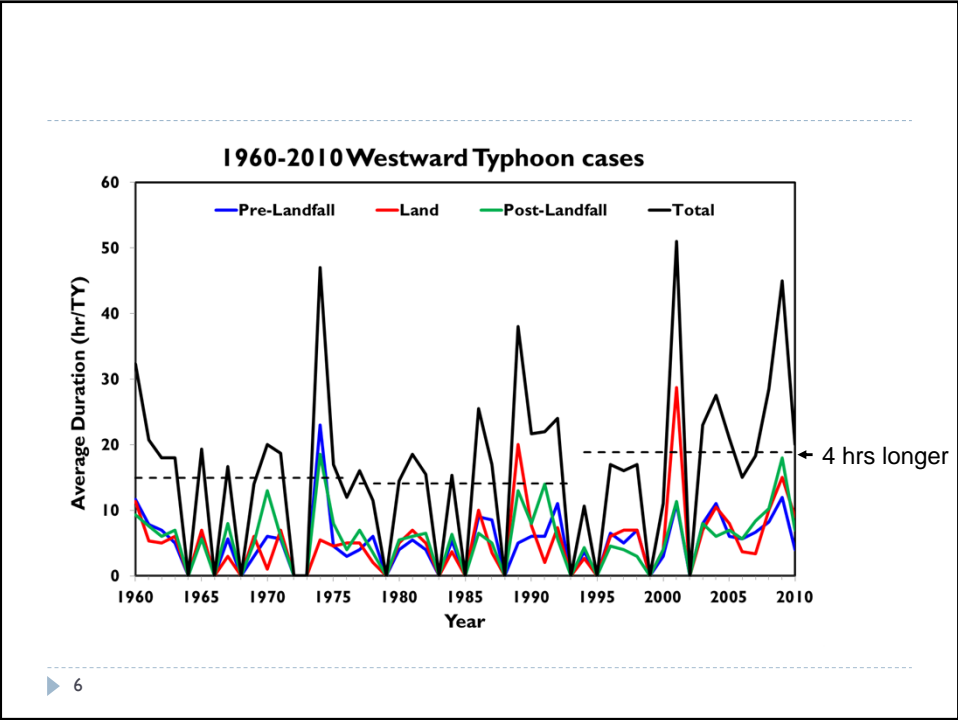
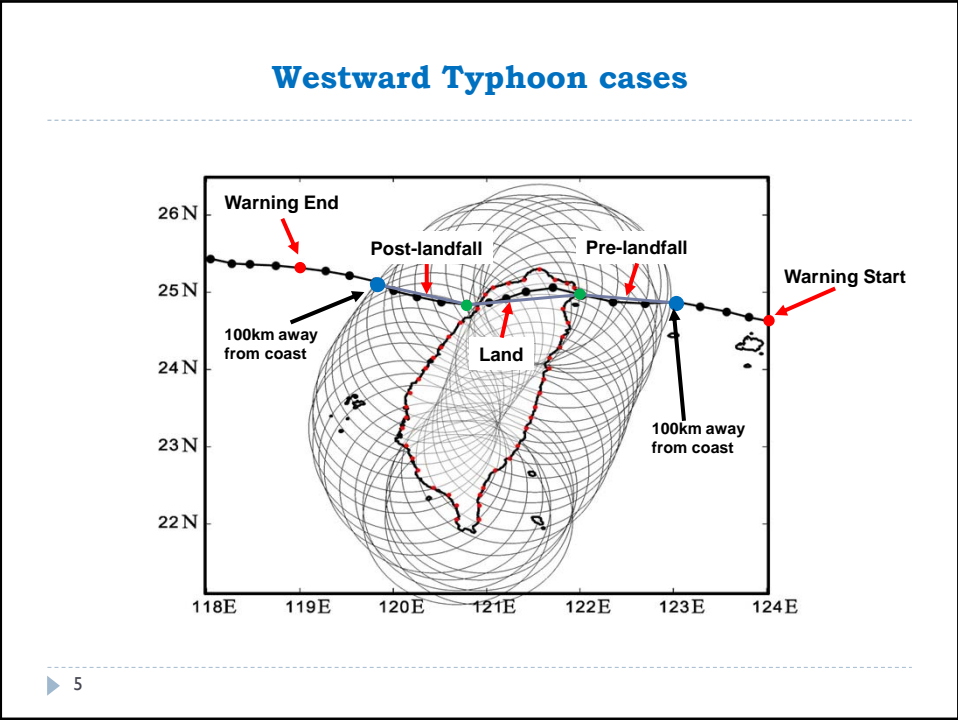
### 1960-2010 95% Extreme Rainfall

← Accumulated Rainfall

Accumulated Frequency →

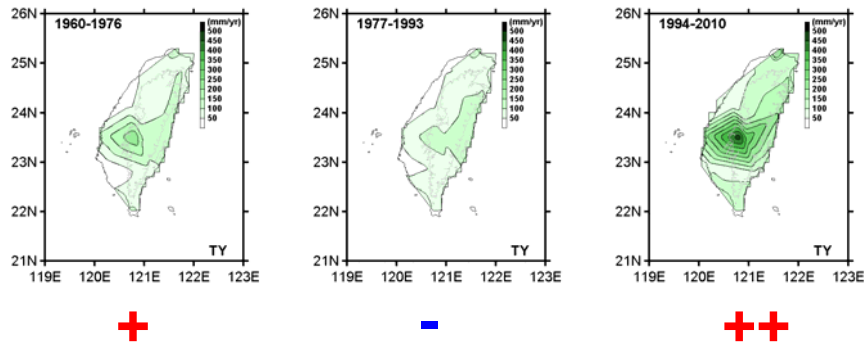
More TY number ?  
Longer TY duration?

4

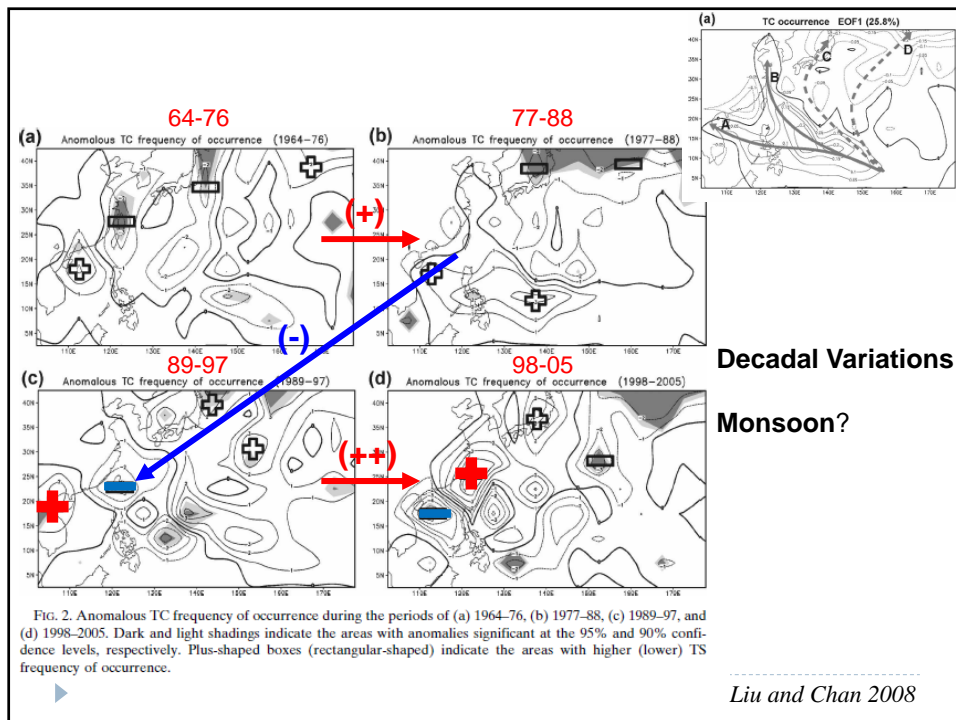


## Westward Typhoon

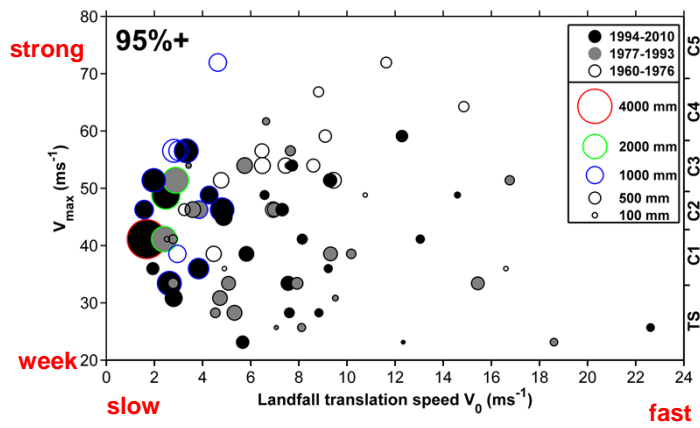
### 95% + Extreme Accumulated Rainfall Decadal



▶ 7



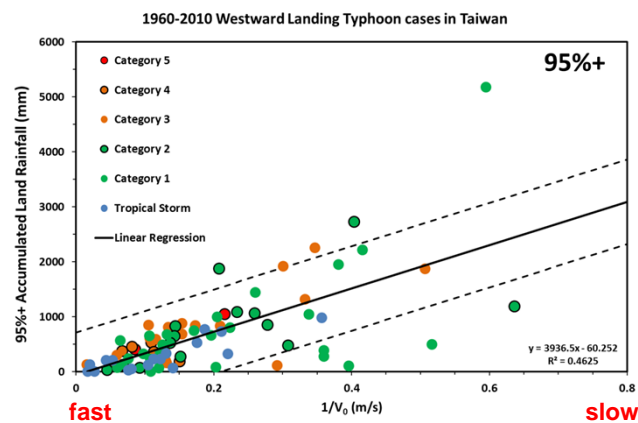
### 1960-2010 95%+ Extreme Rainfall Typhoon Accumulated Rainfall (Landfall Period)



- Strong TY is not cause more extreme typhoon rainfall
- Slow translation speed cases have more extreme typhoon rainfall
- Recent 17 years have more extreme rainfall

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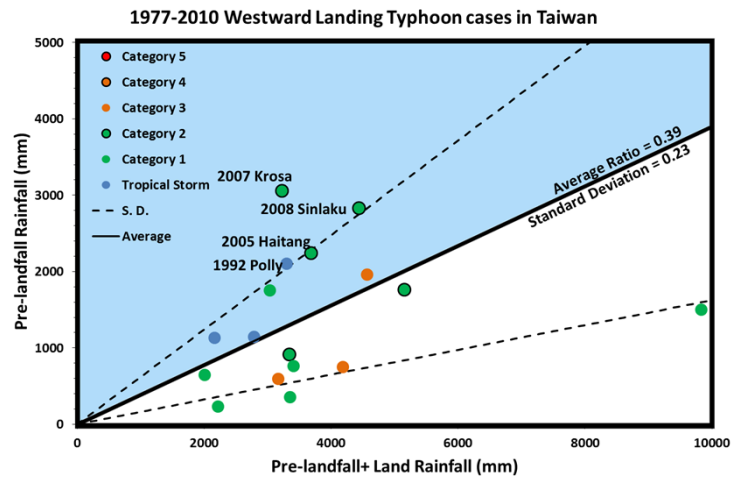
### 1960-2010 95%+ Extreme Rainfall Typhoon Accumulated Rainfall (Landfall Period)



- The linear regression shows the extreme rainfall amount is related with translation speed ( $R^2=0.46$ )

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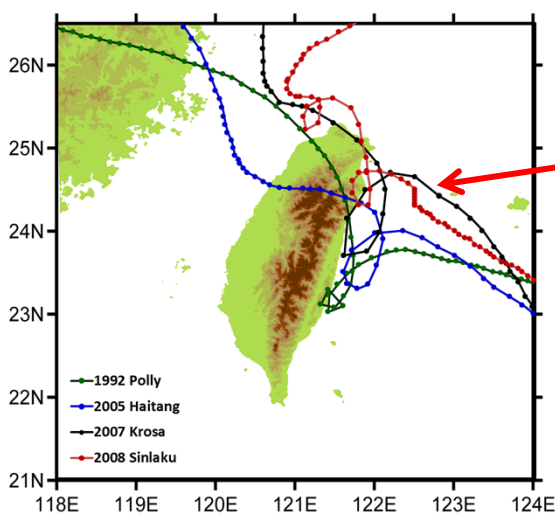
### Pre-landfall dominate



Pre-landfall + Land rainfall amount > 2000mm  
 Pre-landfall rainfall > 1.5 (Land rainfall)

▶ 11

### Pre-landfall dominate

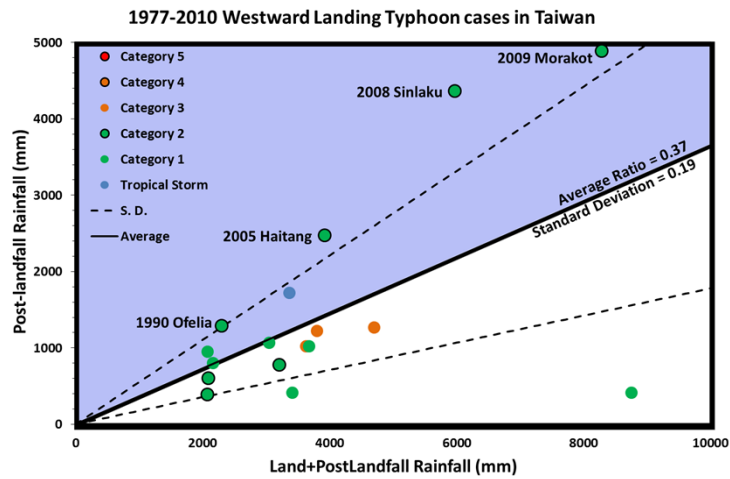


**Looping track before Typhoon landfall**

- Topographic Rossby effect (Kuo et al., 2001)
- Channel effect (Jian and Wu, 2007)
- 2<sup>nd</sup> vortex center (Yeh et al., 2011)

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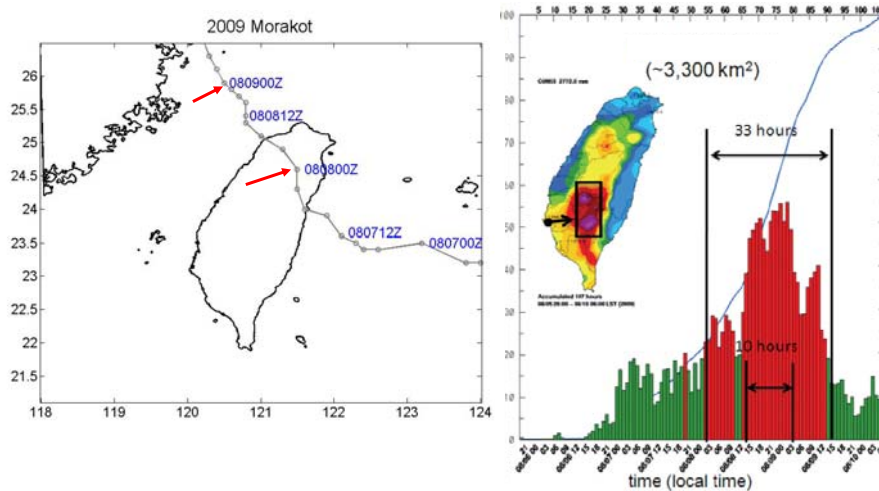
### Post-landfall dominate



Post-landfall + Land rainfall amount > 2000mm  
Post-landfall rainfall > 1.2 (Land rainfall)

▶ 13

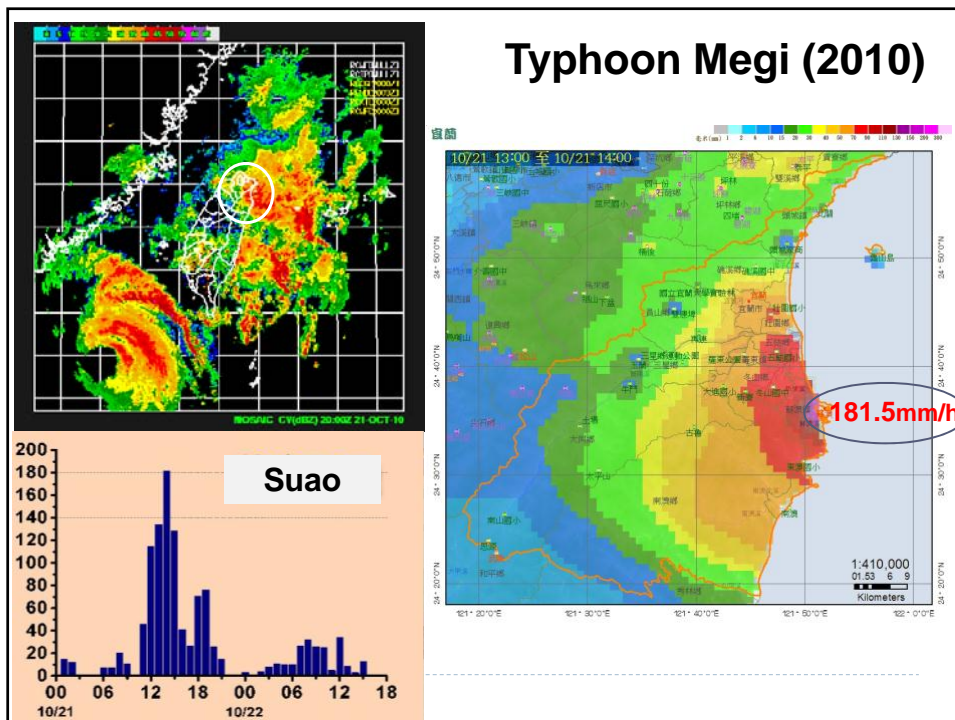
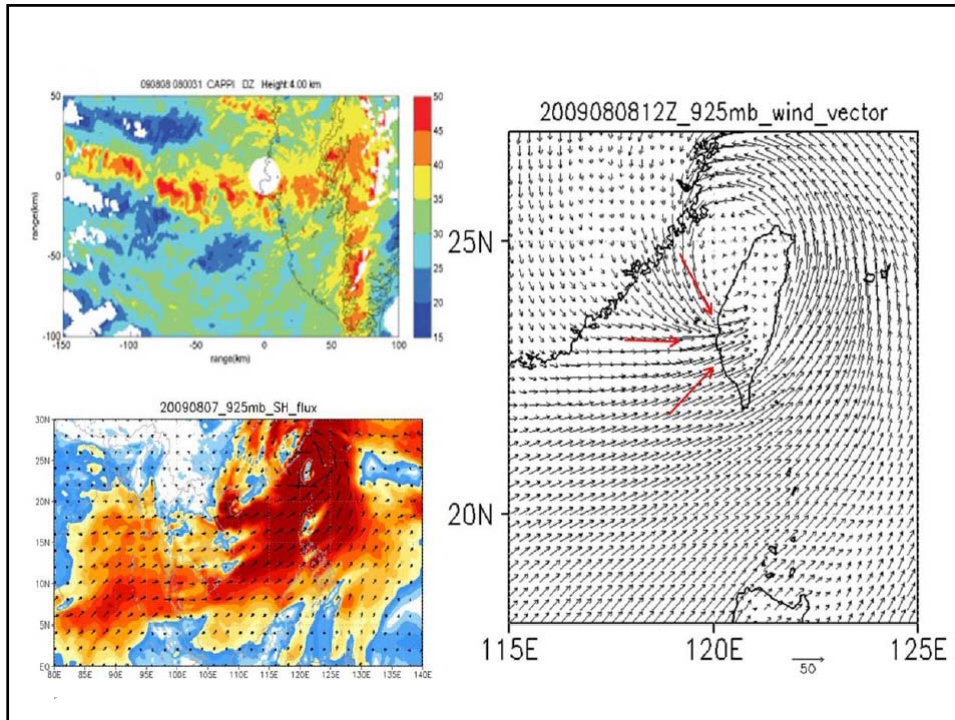
### Typhoon Morakot (2009)



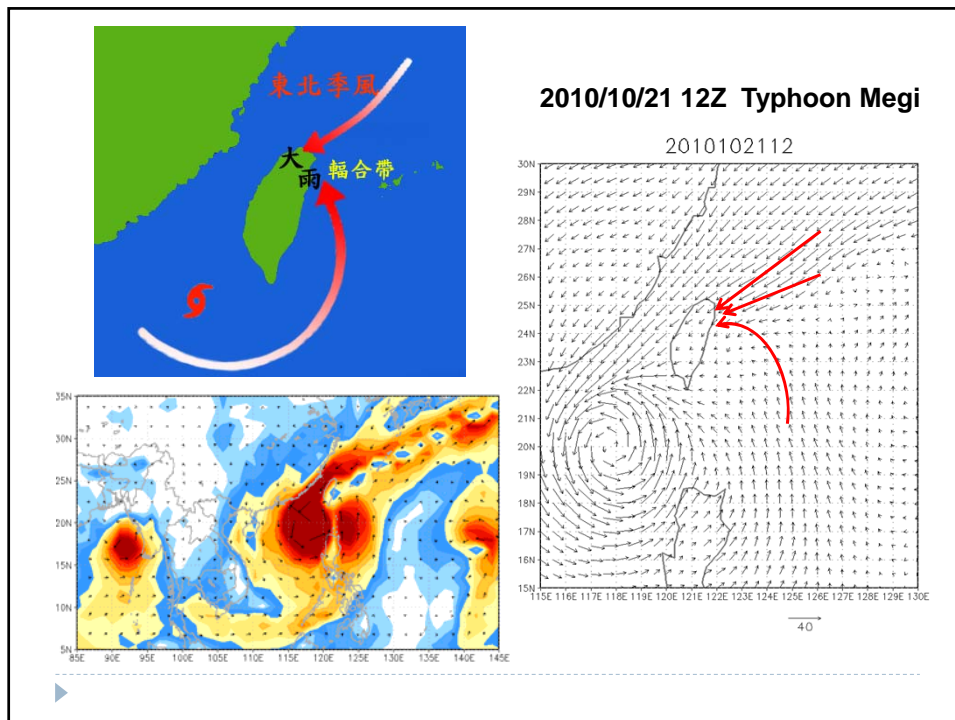
Chen et al. 2010

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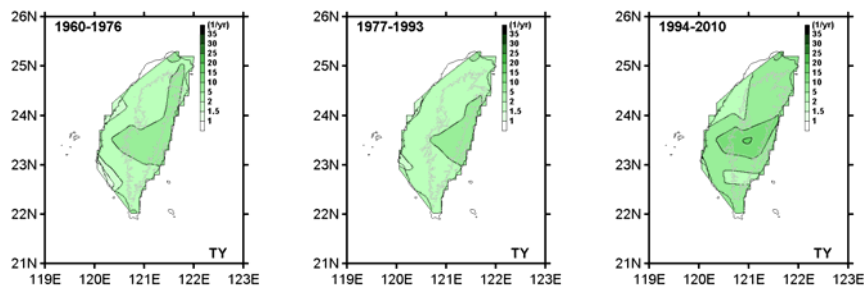
## Summary

- Extreme rainfall amount/frequency is increasing in past 17 years
- Most extreme rain comes from the typhoon
- Long duration time (slow movement of typhoon)
- Extreme typhoon rainfall amount related to typhoon translation speed
- Pre-landfall dominated typhoon – looping track
- Post-landfall dominated typhoon - southwest monsoon surge
- Asymmetry in convection (Mesoscale convection) , Terrain

**End**

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**95% + Extreme Rainfall  
Westward Typhoon Accumulated Frequency Decadal**



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