

Slowdown in landfalling tropical cyclone motion in south China

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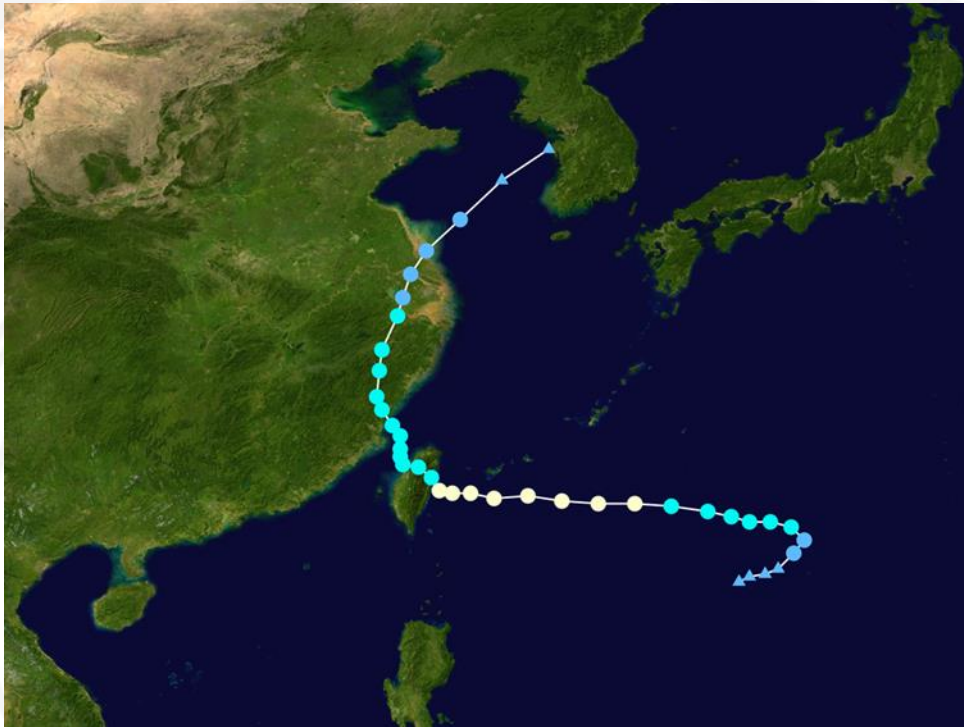
第五届全国中尺度气象论坛，宁夏银川

报告提纲

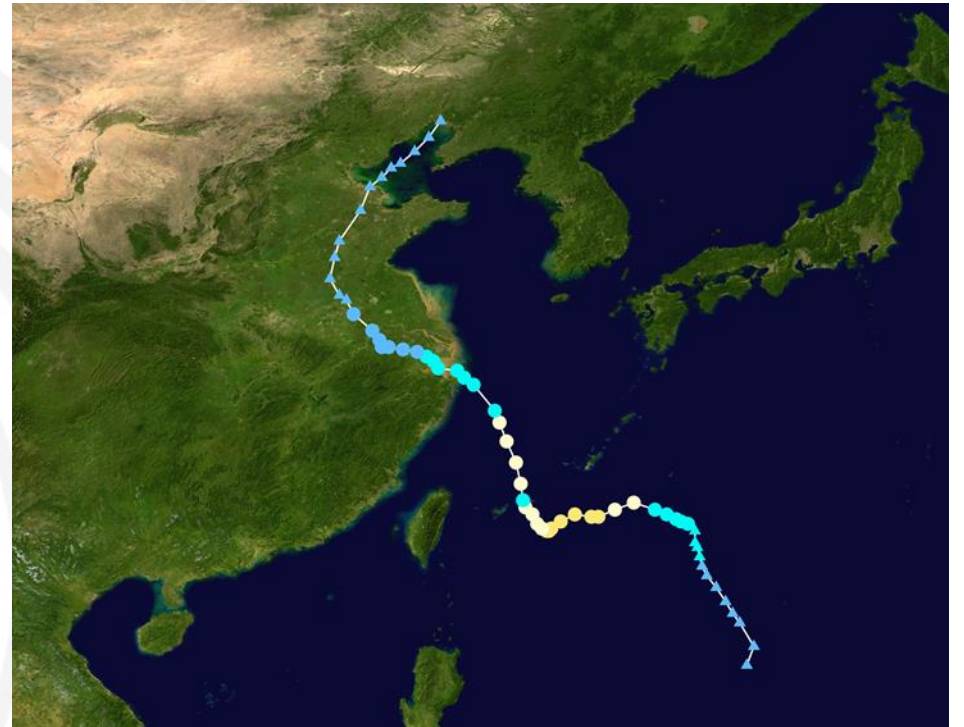
- ❖ 研究背景
- ❖ 资料和方法
- ❖ 登陆台风移速减慢及可能机理
- ❖ 结论

研究背景

➤ 台风移速是决定台风灾害的关键要素



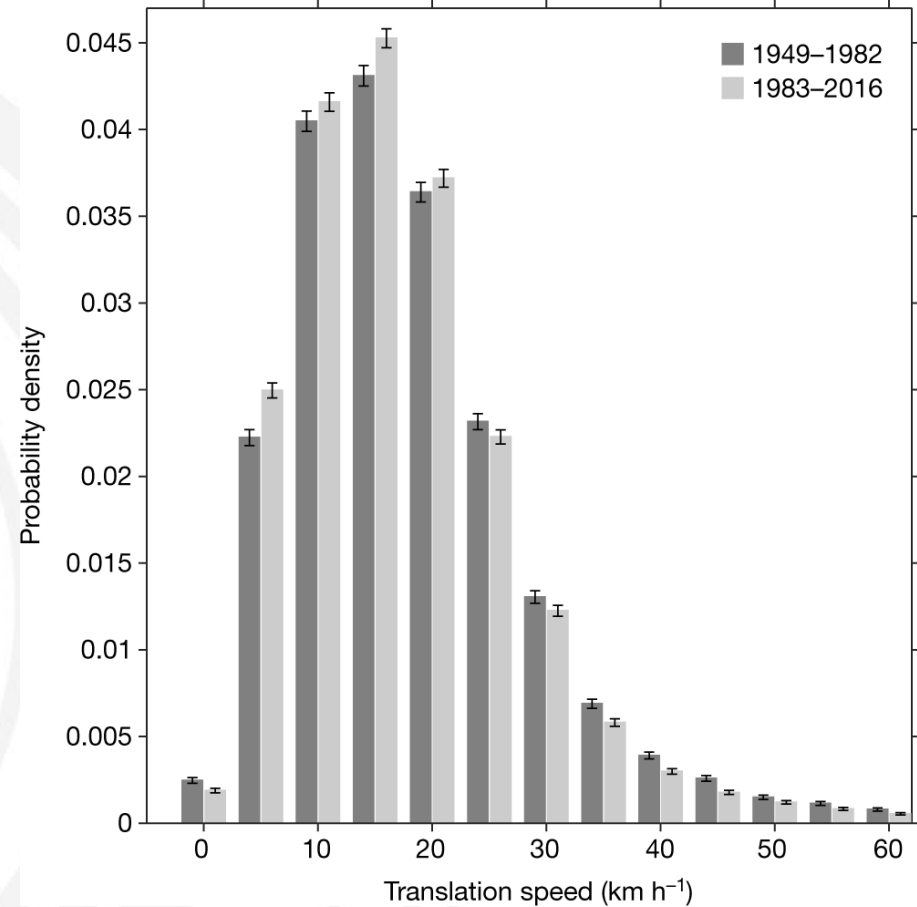
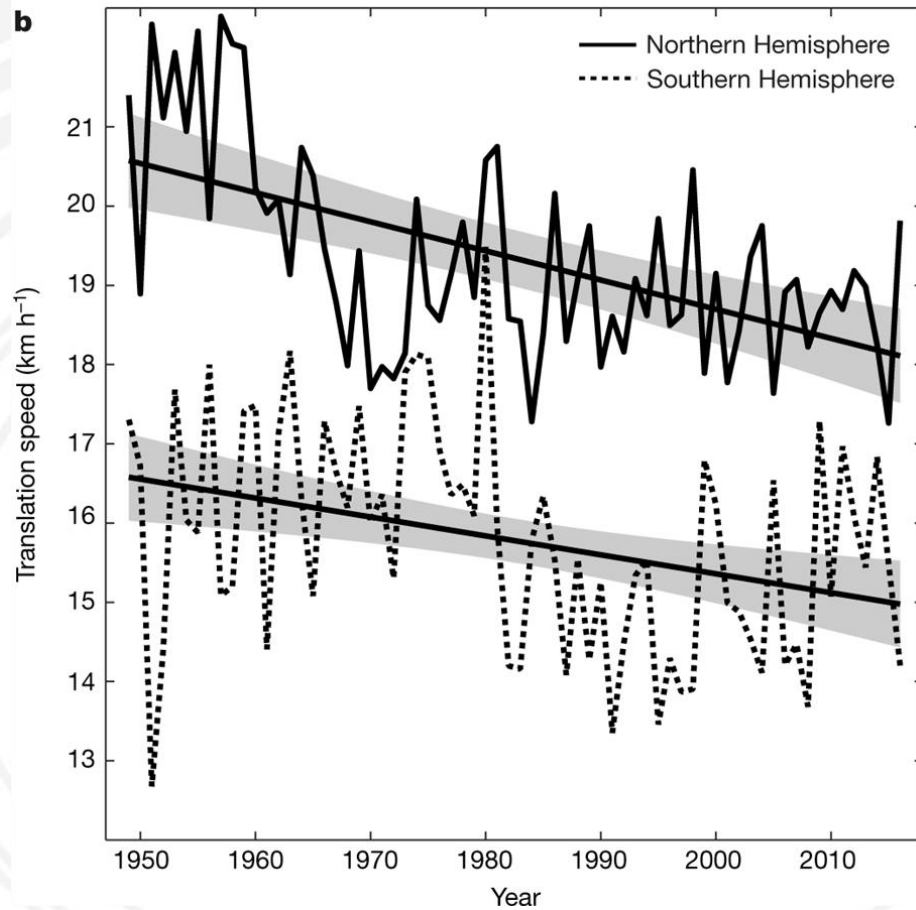
Typhoon Morakot (0908)



Typhoon In-fa (2106)

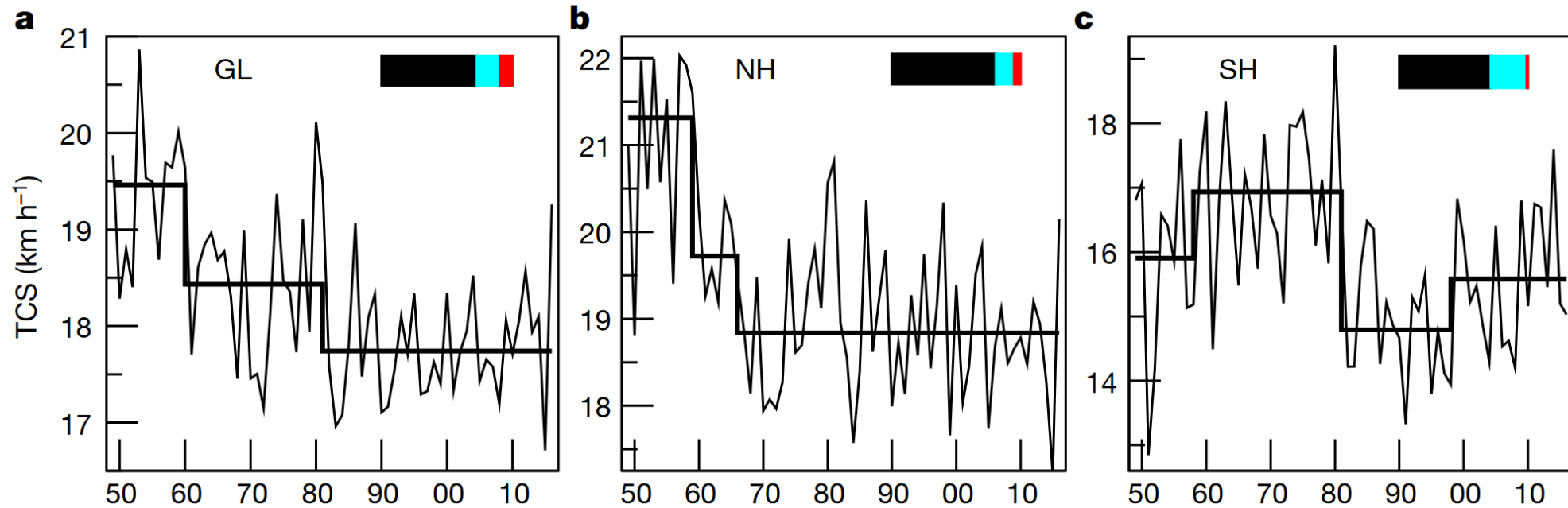
研究背景

➤ 全球台风移速在过去70年下降了10%



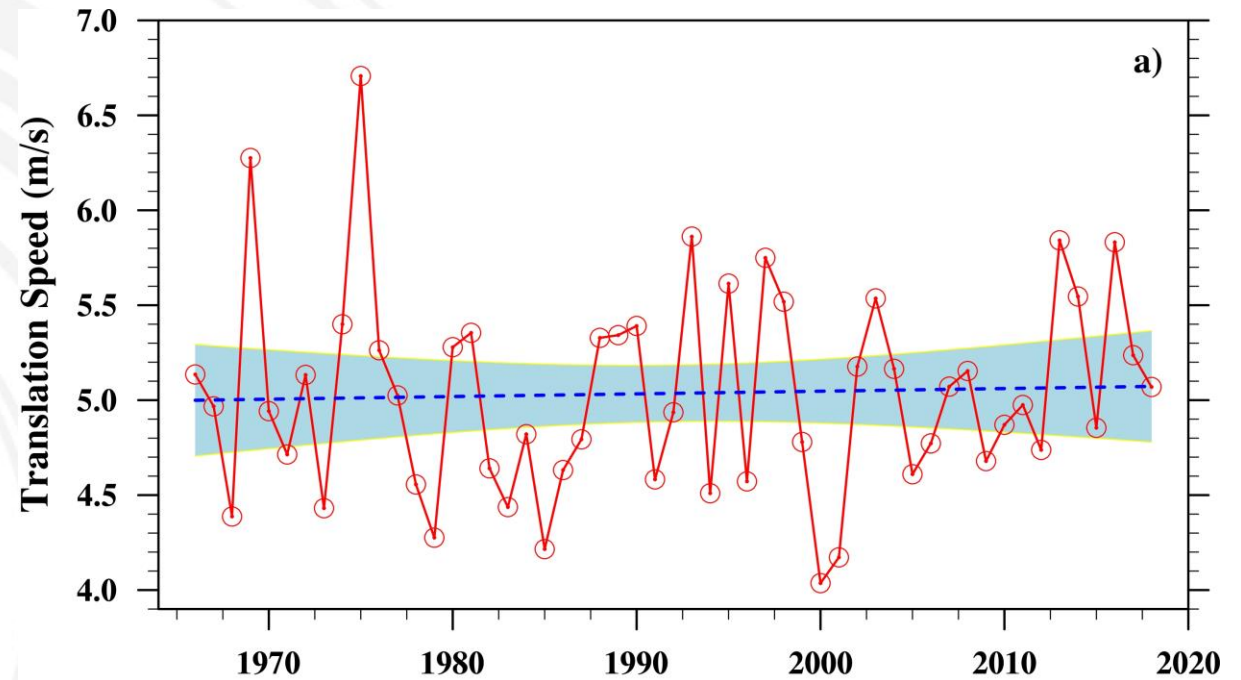
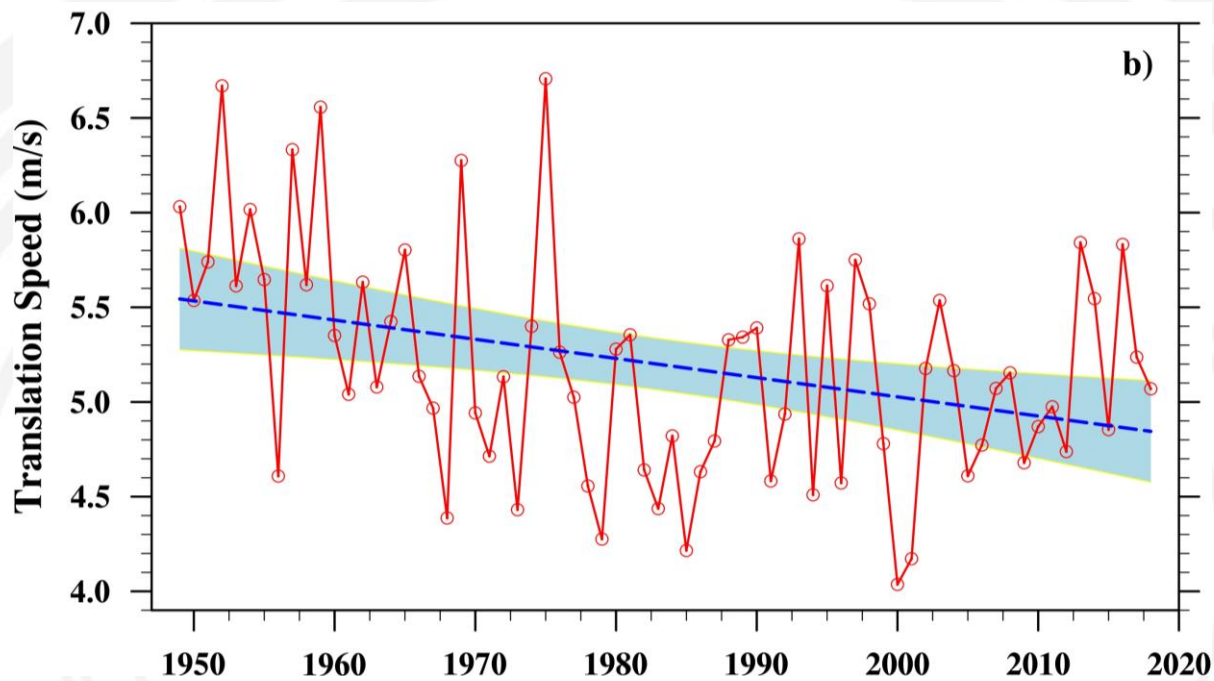
研究背景

► 台风移速变化的不确定性-观测手段的变迁



研究背景

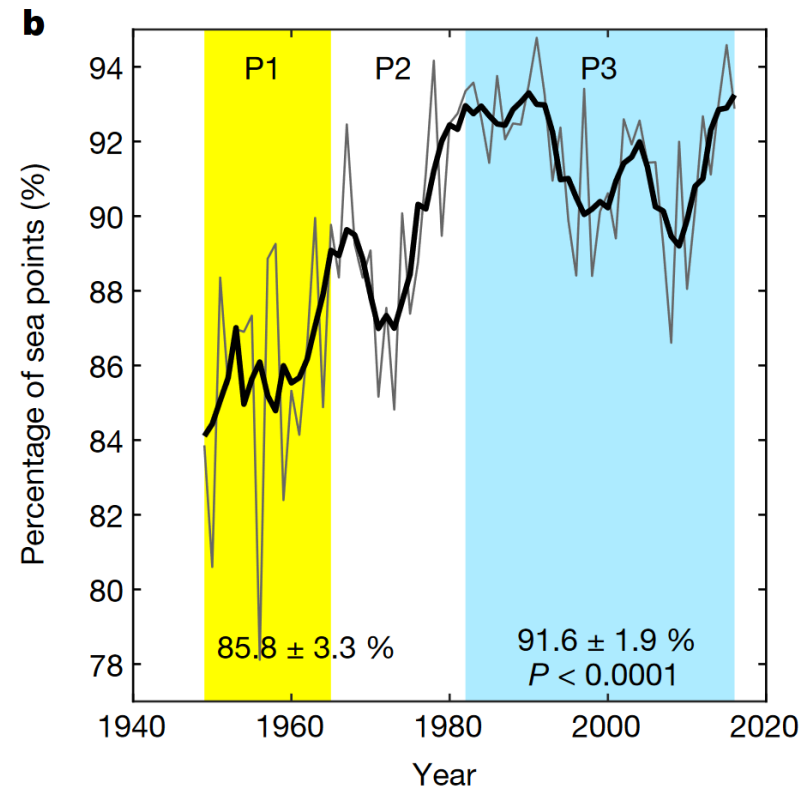
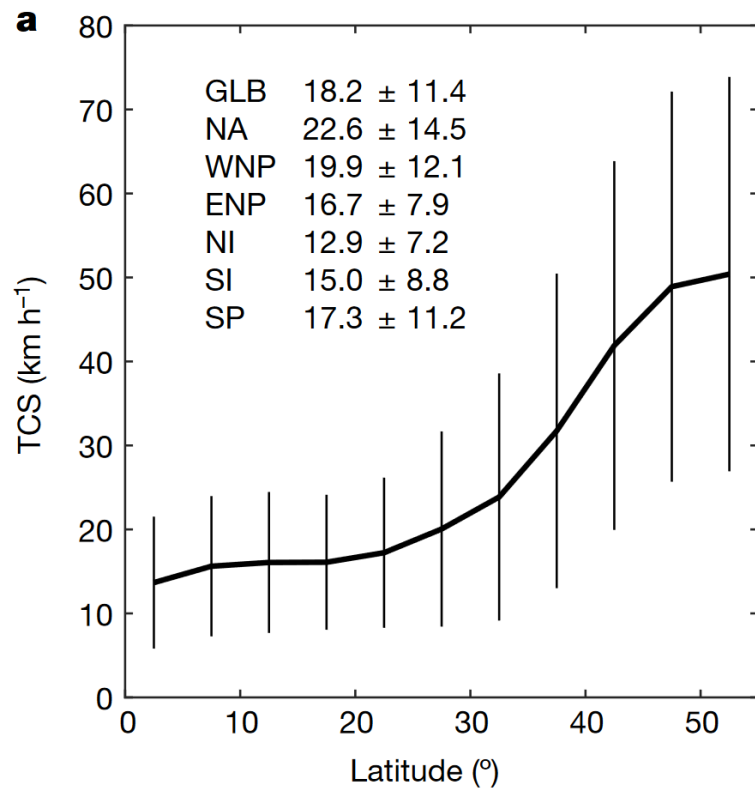
► 台风移速变化的不确定性-观测手段的变迁



Wang et al 2020; Guo et al. 2023

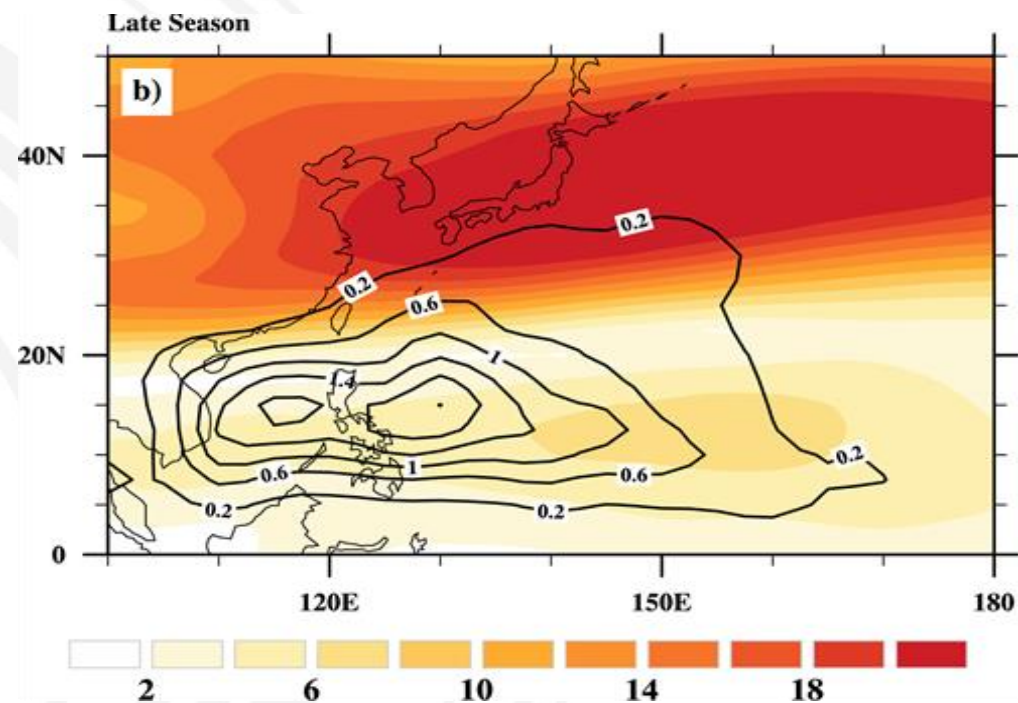
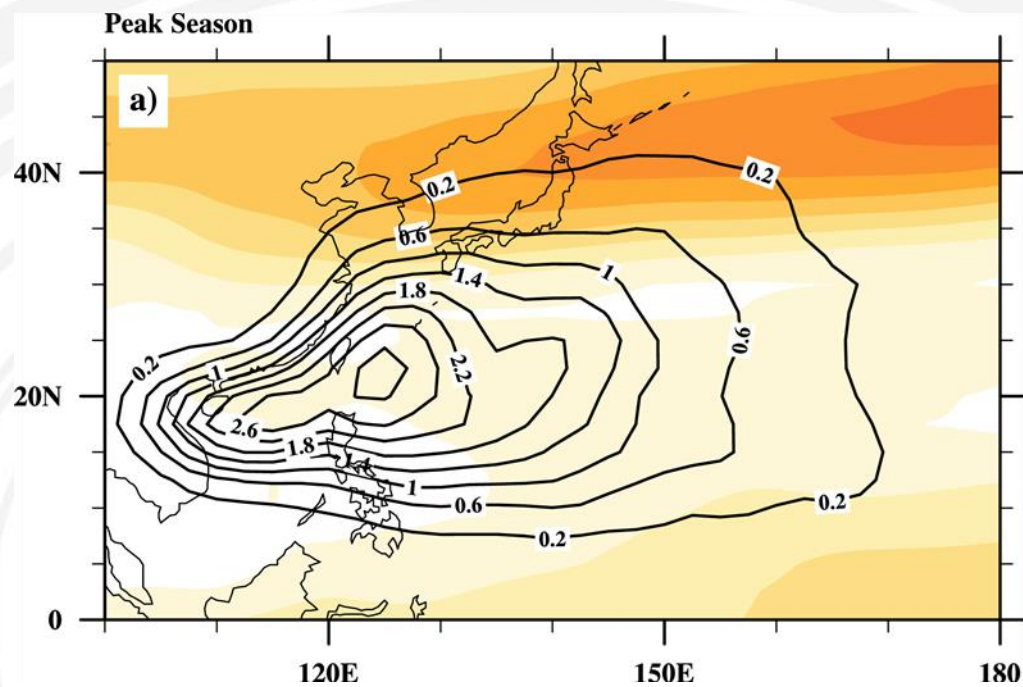
研究背景

► 台风移速变化的不确定性-移速随纬度增加



研究背景

► 台风移速控制因子的季节依赖性



研究背景

➤ 绝大部分灾害在台风登陆以后



科学问题

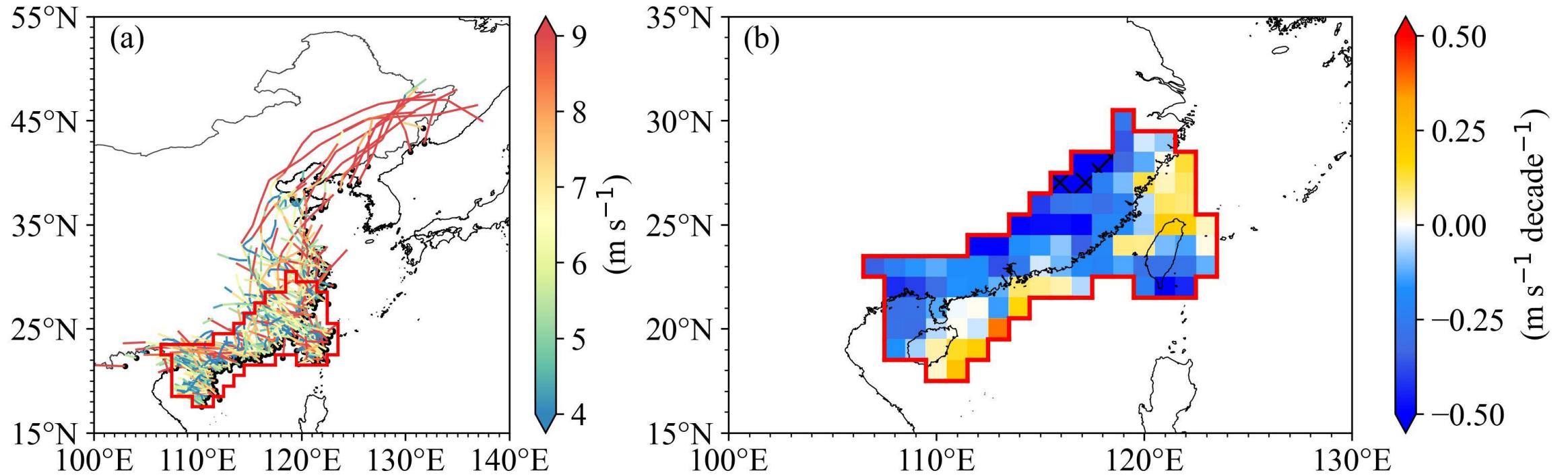
❖ 登陆中国的台风的移速如何变化？

资料和方法

- ❖ **CMA best track data (1979-2019)**
- ❖ **ERA5 daily and monthly reanalysis**
- ❖ **NOAA SST**
- ❖ **ECHAM5**

研究结果

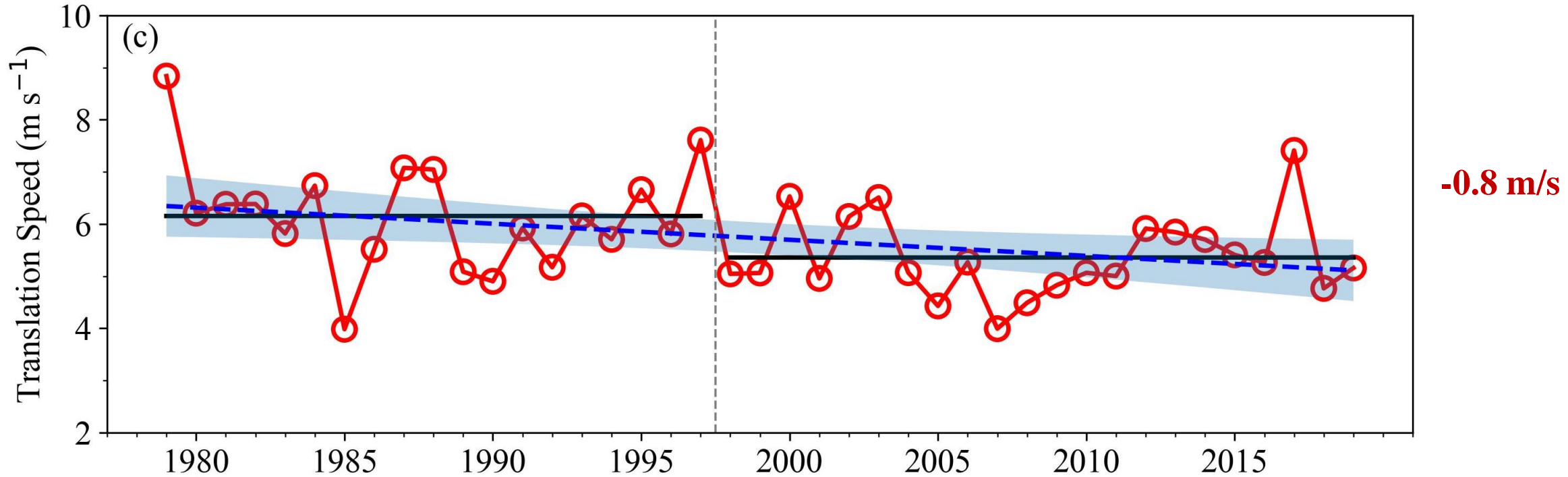
夏季登陆台风移速减慢



TC tracks (lines) landfalling in China and their translation speed (colors) during 1979-2019. (b) linear trend of TC translation speed during 1979-2019. The red lines in (a) and (b) outline south China.

研究结果

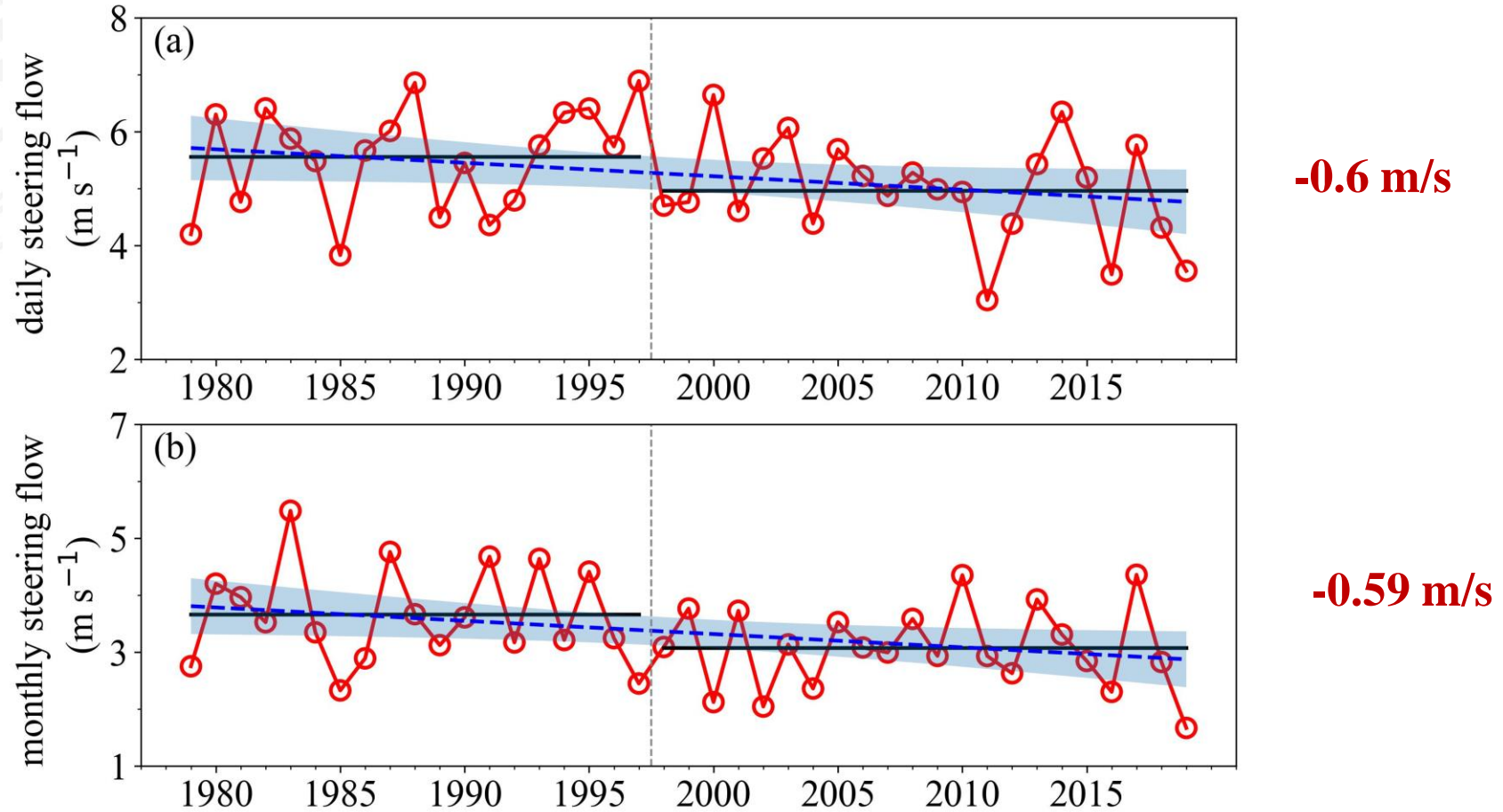
夏季登陆台风移速减慢



Time series of TC translation speed of landfalling TC in China (red dot line) during 1979-2019 and its linear trend (blue dash line) with their 95% two-sided confidence intervals (blue shading). The vertical gray dash line divides the years 1979–2019 into the high- and low-speed periods. The horizontal black dash lines denote the mean TC translation speed for the identified high- and low-speed periods.

研究结果

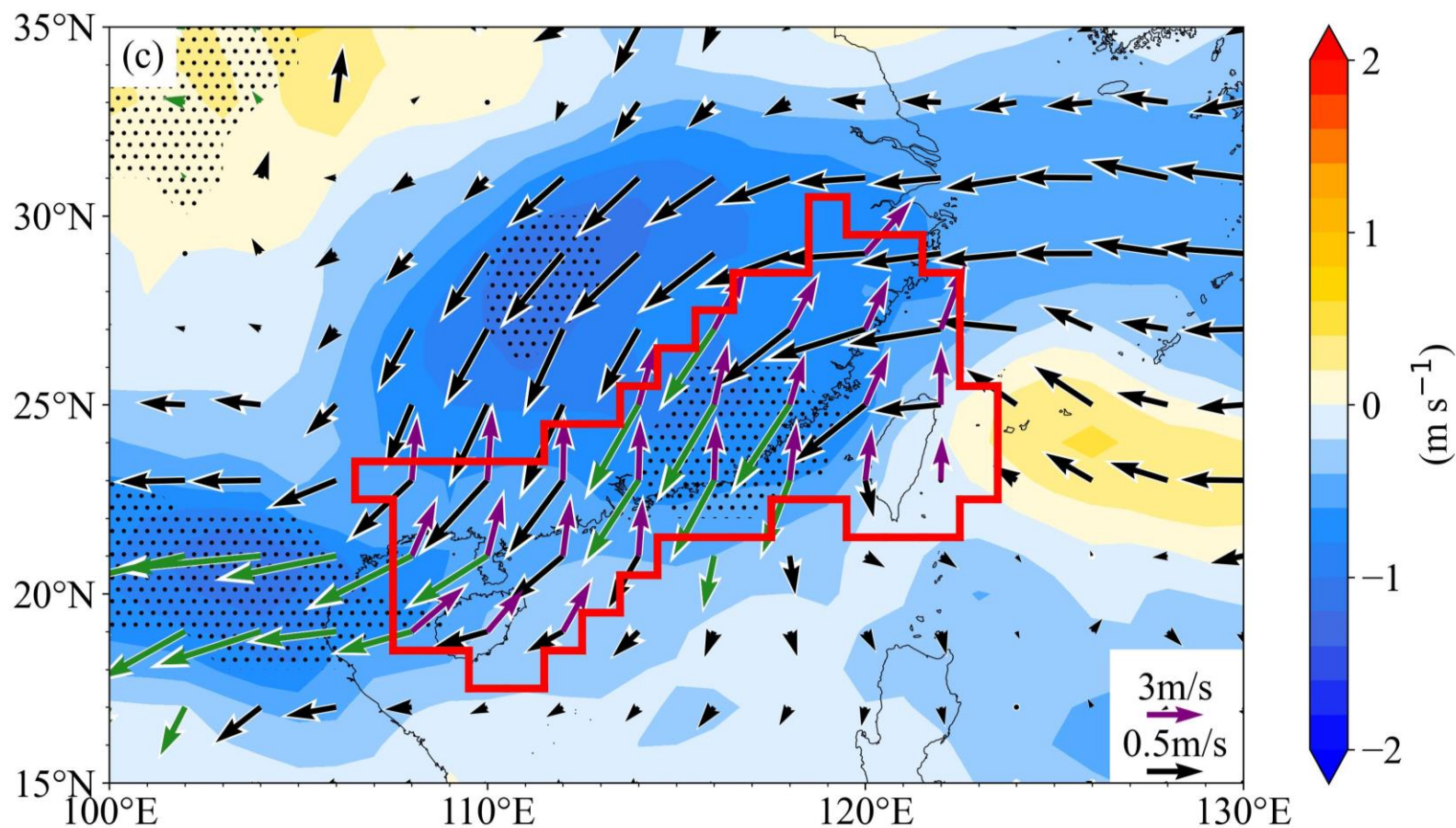
➤ 引导气流的年代际减速



Time series of steering flow (red dot line) derived from (a) daily (b) monthly wind field for the landfalling TC in south China and its linear trend (blue dash line) with their 95% two-sided confidence intervals (blue shading) during 1979-2019

研究结果

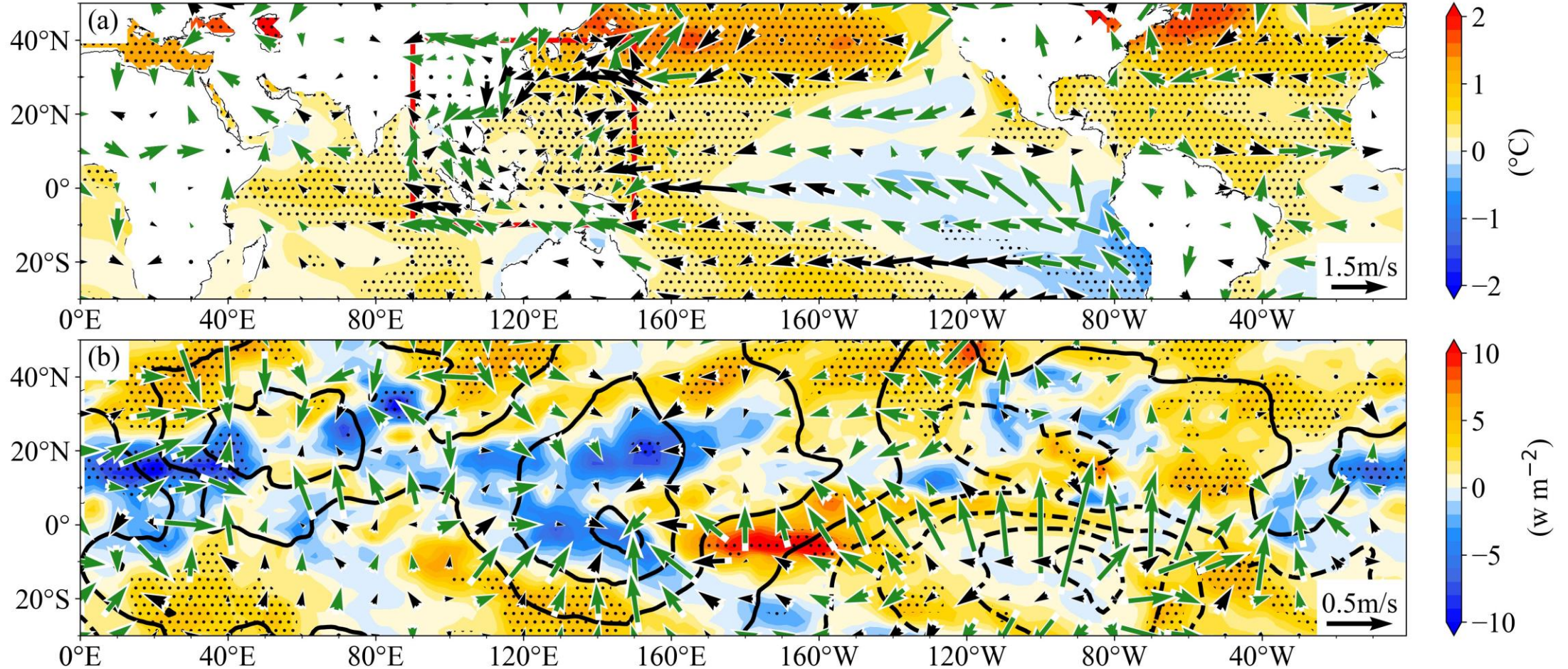
➤ 引导气流的年代际减速



Difference in large-scale steering flow (vectors, m s⁻¹) and speed (shadings, m s⁻¹) between 1998-2019 and 1979-1997.

研究结果

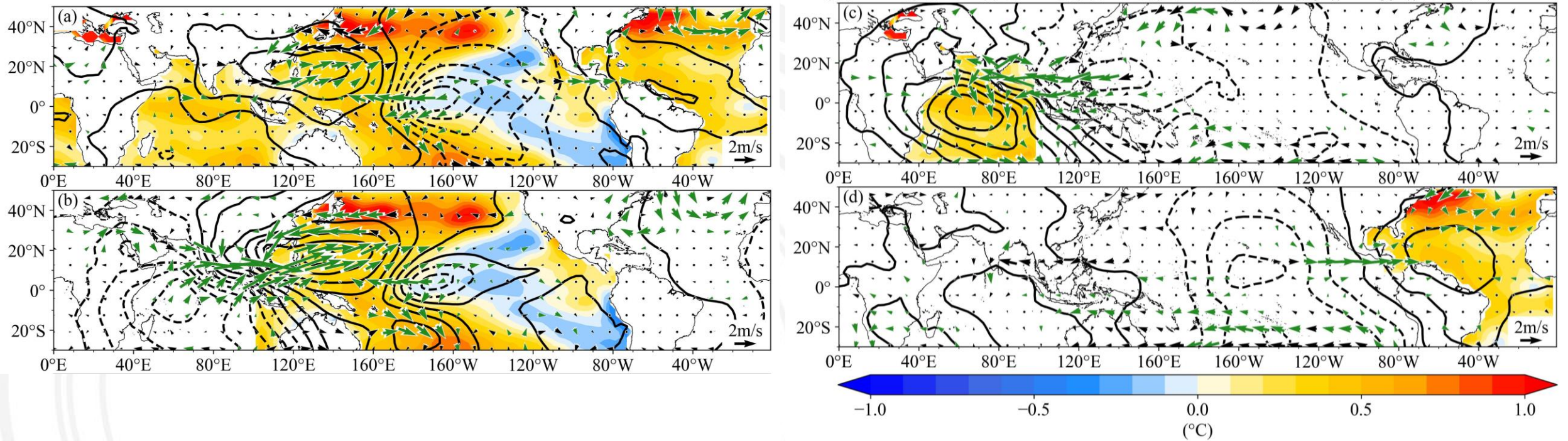
➤ 热带海海洋对引导气流的影响



Difference in (a) SST (shading, °C) and 850 hPa wind (vectors, m s⁻¹), (b) OLR (shading, w m⁻²), velocity potential (contours, 10⁶ m² s⁻¹) and divergent wind (vectors, m s⁻¹) at 850 hPa between 1998-2019 and 1979-1997. Dots and green vectors denote the differences that are significant at 90% confidence level.

研究结果

印度洋与太平洋的抵消作用



Simulated 850 hPa wind (vectors, m s^{-1}), and velocity potential (contours, $10^6 \text{ m}^2 \text{ s}^{-1}$) anomalies in response to the prescribed SST (shadings, $^{\circ}\text{C}$) over (a) the global ocean, (b) the Pacific Ocean (c) the Indian Ocean and (d) the Atlantic Ocean. Green vectors denote the differences that are significant at 90% confidence level.

结论

- ❖ 过去40年夏季登陆中国台风移速减慢了20%;
- ❖ 移速减慢是印度洋增暖和PDO负位相对台风移速的相反作用的相互抵消的结果;
- ❖ 外部强迫和自然变率对台风移速的影响可以相互抵消。

谢谢!

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Wu, Kun, Chao Wang, Liguang Wu, Haikun Zhao, and Jian Cao. Slowdown in Landfalling Tropical Cyclone Motion in South China. *Geophysical Research Letters* 49, <https://doi.org/10.1029/2022GL100428>.