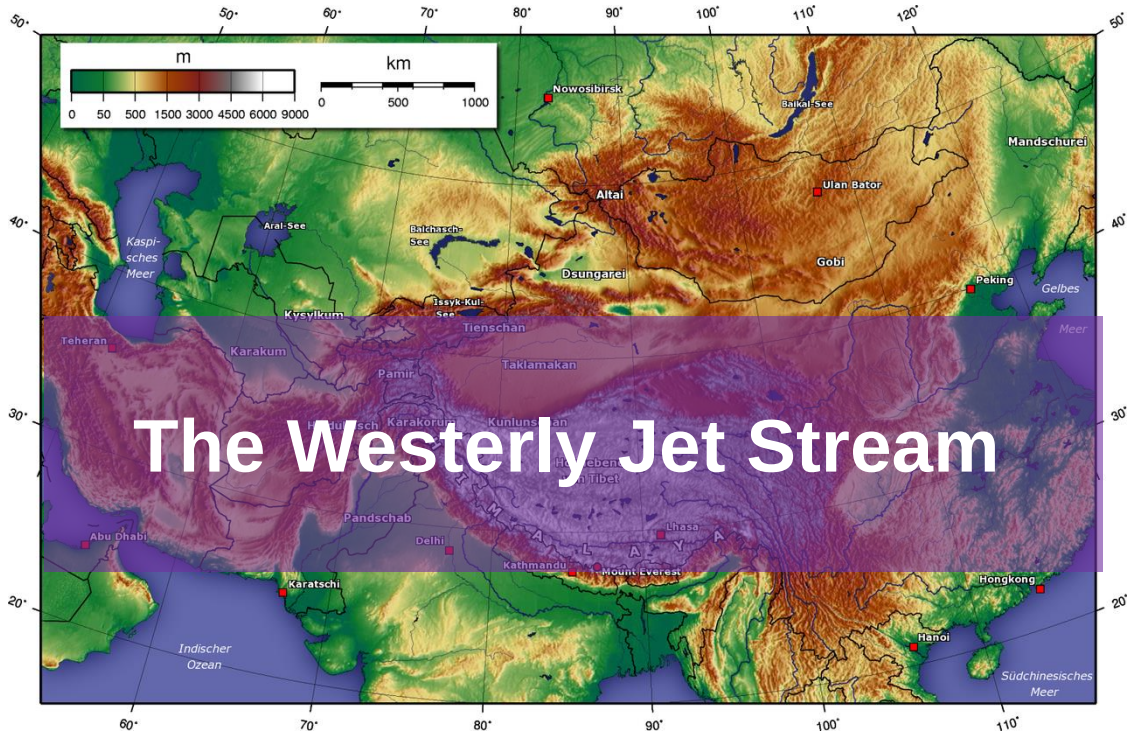
Behaviors of synoptic eddies around the Tibetan Plateau



Scientific questions：

- **How will the synoptic eddies develop when they encounter the Tibetan Plateau?** Passing? northward turning? Southward turning? Lysis at the intersection?
- **What effect will these eddies have on the surrounding weather?**

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2. Methodology

- The method of Hodges (1994, 1995, 1999) is used to objectively identify and track cyclones in **1980-2020 ERA5 hourly reanalysis data (0.7° horizontal resolution)**. This method uses **850-hPa, 500-hPa, and 250-hPa relative vorticity** for the feature tracking.

Spatial filtering:

- Be spectrally truncated to T63
- Remove all wavenumbers less than or equal to 5
- Eliminate the planetary scales and ensure that the synoptic scales are retained.

Identification:

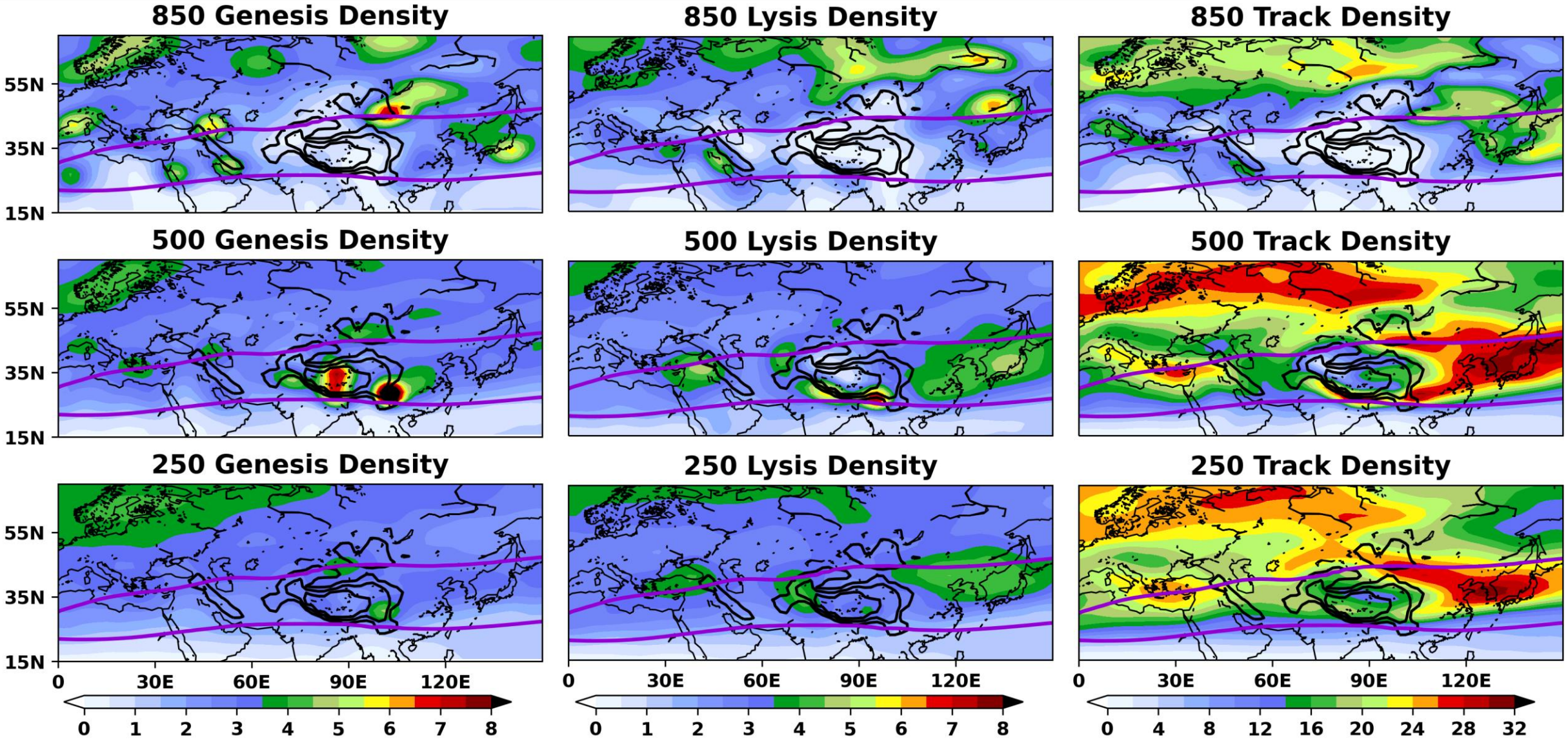
- Grid point extrema that exceed $1 \times 10^{-5}\ s^{-1}$
- Use a B-spline interpolation and steepest ascent maximization to refine

Tracking:

- 1-hourly time intervals
- a nearest neighbor approach
- Refined by the minimization of a cost function for track smoothness subject to adaptive constraints.

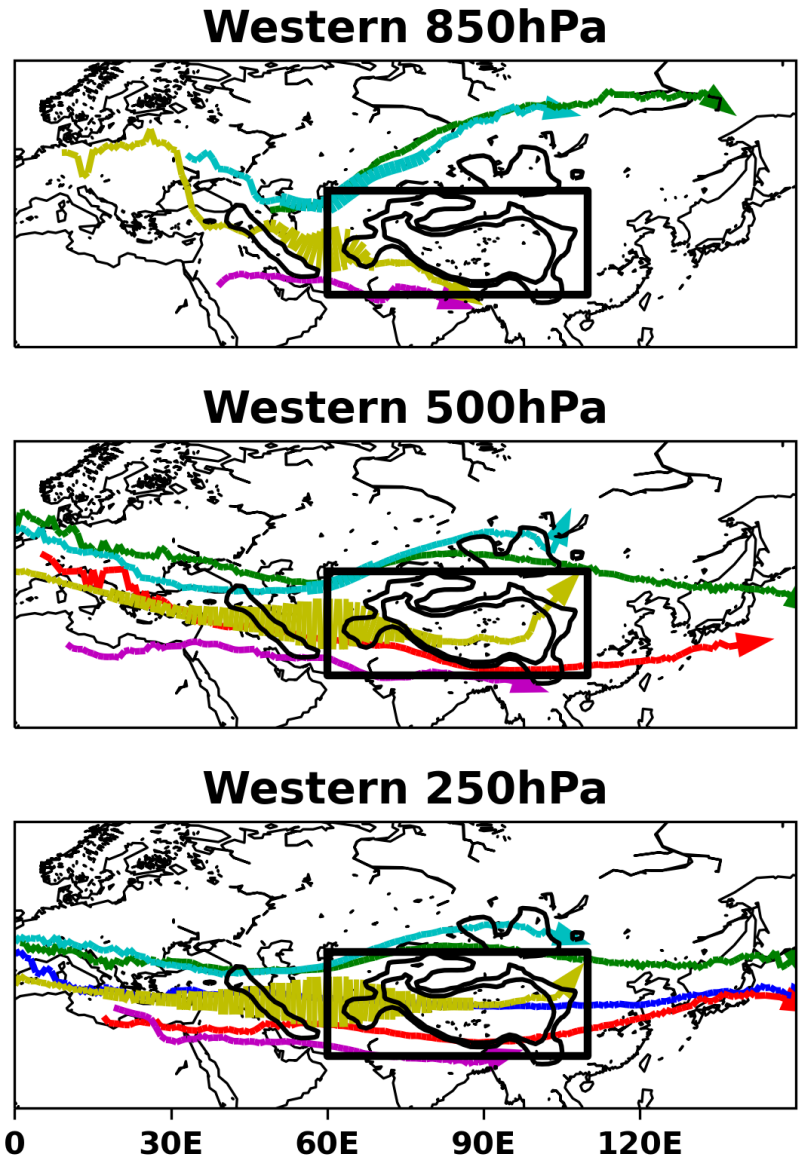
- Only retain those that **persist for at least 24h** and **travel more than 500km** to focus on long-lived, mobile storms.
- Storm track statistics are calculated from the individual cyclone tracks to produce cyclone **track, genesis, and lysis density** (Hodges 1996).

3. Results——Possible effects of the TP on synoptic eddies



Annual average genesis, lysis, and track densities (shading; number per month per unit area) of all synoptic eddies. The 200-hPa westerly jet stream is indicated using the 25m/s purple contour. Thick black contours represent the boundary of the TP (contour values: 1500, 3000, and 4500m).

3. Results——Tracks of synoptic eddies around the TP



Combined tracks of synoptic eddies coming from the western boundary of the black box. Thickness of each tracks indicates the percentage of this behavior's eddies to the total eddies in each level.

PAS: eddies that can directly pass through the TP

STP: southward turning eddies that can pass through the TP

STL: southward turning eddies that lysis to the south of the TP

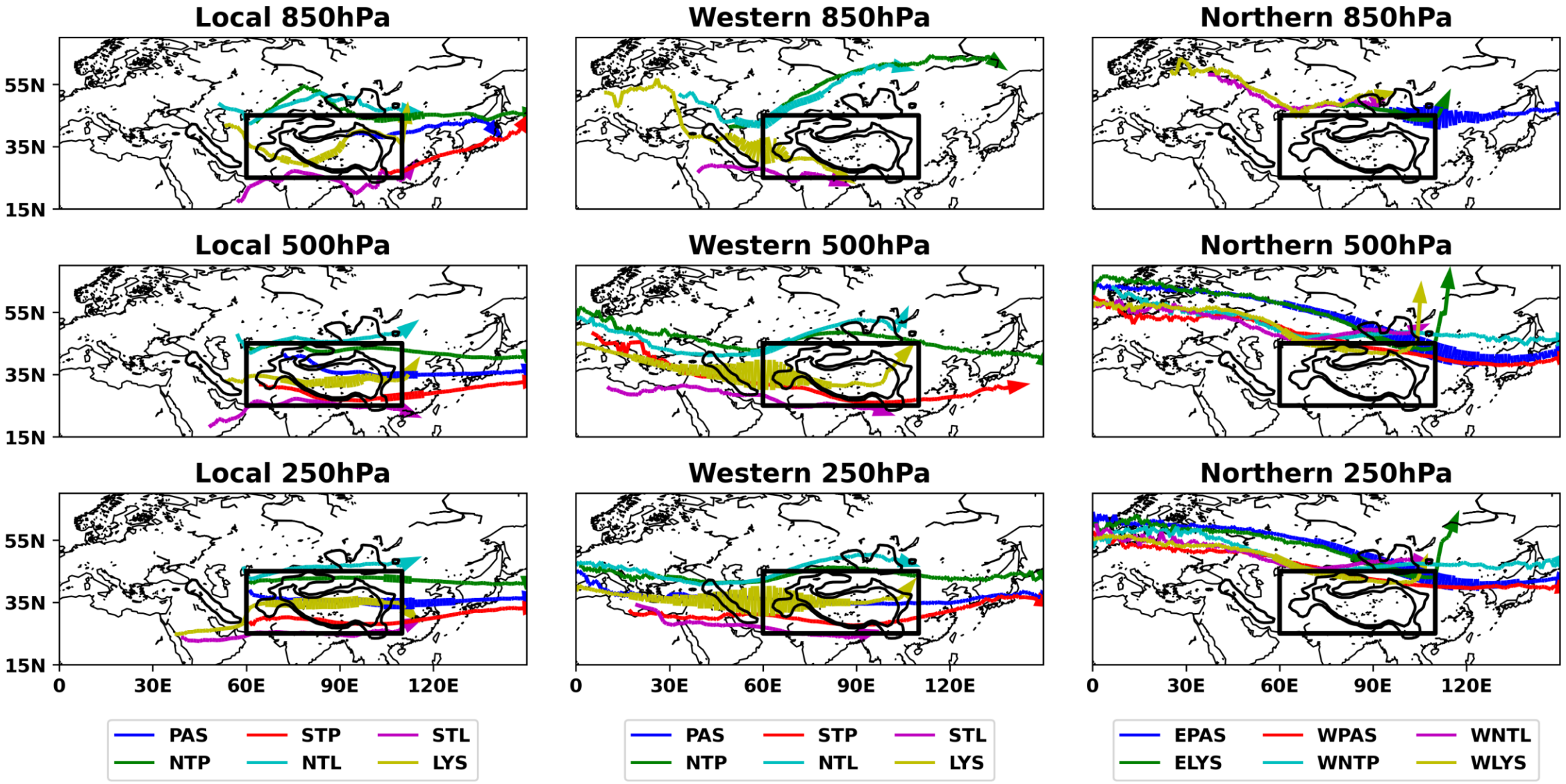
NTP: northward turning eddies that can pass through the TP

NTL: northward turning eddies that lysis to the north of the TP

LYS: eddies that lysis in the black box

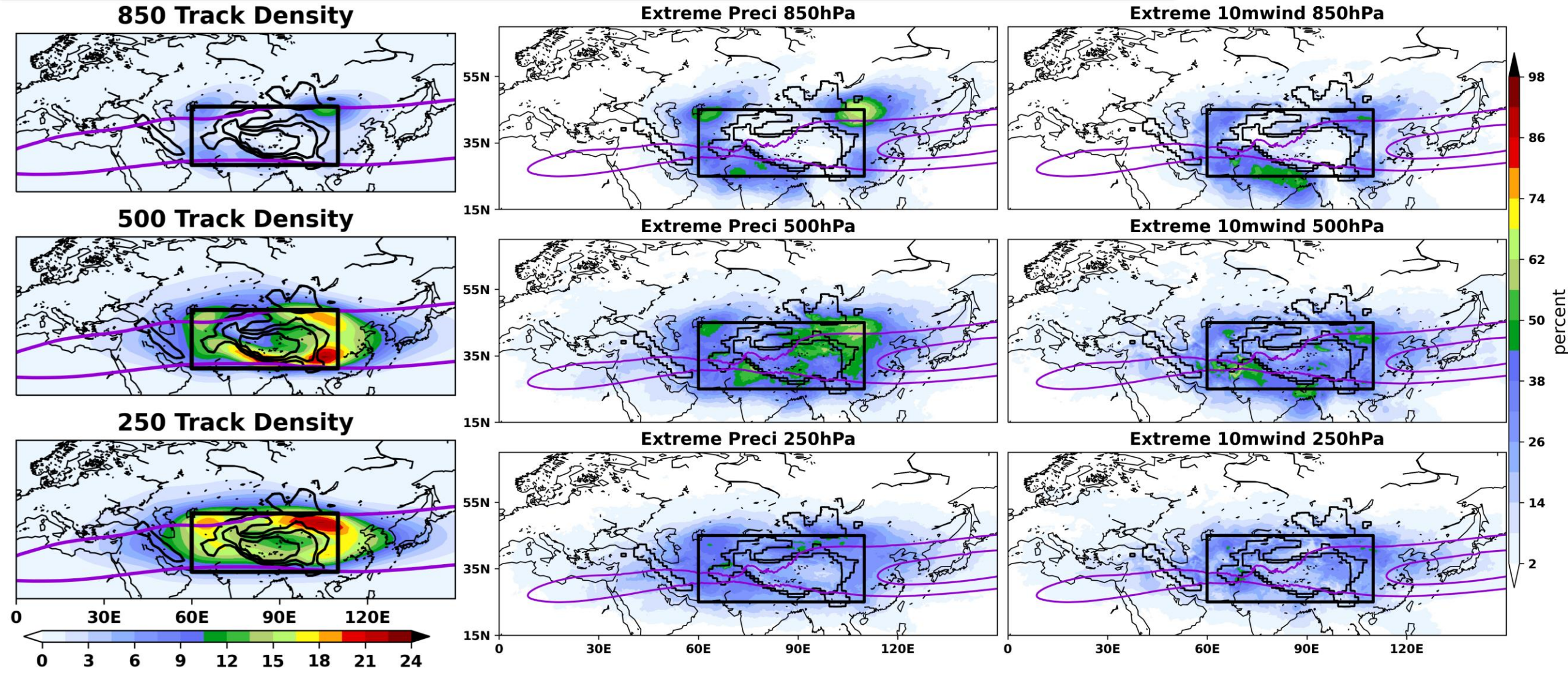
- Regardless of altitude, **more than half of the eddies** coming from outside **die out** when they encounter the TP .
- Eddies **do not generally directly pass** the TP region from west to east, except for a few cases at the upper level (250 hPa).
- Some 500-hPa and 250-hPa eddies can **reach East Asia** travelling around the TP **on its northern and southern sides**.

3. Results——Tracks of synoptic eddies around the TP



Combined tracks of synoptic eddies that locally generated over the TP (Left), come from the western (Middle) and northern boundary (Right). Thickness of each tracks indicates the percentage of this behavior's eddies to the total eddies in each level.

3. Results——Effects of eddies around the TP on the extreme weather



Annual average track densities (left column) of synoptic eddies passing through the box. Middle column is percent of hourly precipitation extremes (99th percentile threshold) associated with eddies to total extreme rainfall event. Similar for surface wind (right column).

4. Summary and discussion

- Regardless of altitude, more than half of the cyclones coming from outside die out when they encounter the TP, suggesting a suppression effect of the TP on external cyclones.

- Nearly half of the locally generated cyclones die out over the TP region, and more than a third move to East Asia.

- Cyclones that originate or pass through the TP region contribute 20%–40% of the regional extreme weather (precipitation and surface wind).

- This contribution increases to 50%-70% near the TP boundary, suggesting that the interaction between the TP and the cyclones can result in extreme weather.