Review of egusphere-2026-4109

"Warm-Sector Heavy Rainfall over the Eastern China Plains: Identification, Characteristics, and Precursor Dynamic Signals“

<Summary>

This manuscript presents a five-year (2021-2025), station-based objective framework that separates warm-sector heavy rainfall (WSHR) from other heavy rainfall over the eastern China plains, using rain-gauge, ERA5, and radar wind profiler (RWP) observations. The identification scheme (automated front detection, warm-sector mask, station-specific 99th-percentile threshold) is methodologically sound and well documented, and the spatiotemporal characterization of WSHR (Section 3.1-3.2) is clear and well supported by the data. The RWP-based precursor analysis (Section 3.4) is, in my view, the most valuable contribution of the paper, as it extends the pre-convective picture beyond what ERA5 or radiosondes can resolve. The manuscript is well organized, the figures are clear, and the writing is precise. **I recommend minor revision, focusing on the points below.**

<Major Comments>

M1. Vertical thermodynamic structure vs. RWP kinematic structure (Section 3.3-3.4, 4.1)

The manuscript characterizes the pre-onset environment using two complementary but separate sources: ERA5-based thermodynamic composites (specific humidity, θe, VIMFD; Figs. 7-8) and RWP-based kinematic composites (wind, KE, shear, ascent; Figs. 9-12). The authors correctly note (L538-541, 4.1) that the RWP's 6-min resolution captures pre-convective flow evolution that hourly reanalyses and radiosondes cannot resolve — this justification is reasonable and **I do not ask the authors to substitute RWP with radiosonde data.**

However, because ERA5 has only hourly resolution, the thermodynamic evolution shown in Figs. 7-8 is comparatively coarse relative to the RWP kinematic evolution, which is resolved at 6-min steps down to the final 30 min before onset. This creates an asymmetry: the paper can show precisely when, kinematically, the pre-convective environment intensifies, but not precisely when the thermodynamic destabilization (e.g., a rapid increase in low-level moisture or a sharp decrease in stability) occurs relative to that kinematic evolution.

→ I would suggest **briefly discussing this resolution asymmetry as a limitation** (in addition to the limitations already listed in 4.1),

M2. Specificity and predictive skill of the precursor signals (Section 3.4, 4.1, 4.3)

The authors appropriately flag, in Section 4.1 (L548-551), that the current analysis has no non-heavy or non-warm-sector baseline, so the specificity of the RWP precursor signals to WSHR (rather than to warm-season rainfall in general, or to non-precipitating warm-sector conditions) remains untested. This is an important and honest limitation, but I believe it is central enough to the manuscript's main claim — that these signals "may serve as candidate reference indicators" for imminent WSHR (L514-516, L651-653) — that it merits at least a partial quantitative treatment rather than being deferred entirely to future work.

Specifically, I would encourage the authors to: compute the same RWP diagnostics (LLJ occurrence frequency, low-level KE, shear, ascent frequency) for a comparison sample — e.g., warm-sector non-heavy rainfall events, or non-raining warm-sector periods at the same RWP stations — over an equivalent pre-onset window.

<Minor / Specific Comments>

1, L37-38 (Abstract): "contributed 13.8% of the total heavy-rainfall accumulation, and locally 40-50%" — please clarify in the abstract (as is done in the text, Fig. 6e) that the 40-50% figure refers to station-level maxima rather than a regional mean, to avoid ambiguity for readers who read only the abstract.

2, L91-95 (Introduction): The rationale for extending the objective warm-sector scheme to the eastern China plains is clear; consider briefly stating up front (rather than only in 4.1) that the 200-400 km distance band and percentile thresholds are adopted from prior studies rather than independently tuned for this region, so readers are aware of this choice earlier.

3, Eq. (7), L289-293: Please confirm the sign convention and units are consistent with the axis labels in Fig. 10 (10^{-3} s^{-1}); a brief note on how bulk shear direction (not just magnitude) might relate to the veering profile discussed in Fig. 9b would help connect Section 3.4's shear results to the warm-air-advection interpretation given for the wind profile.

4. L429-430: "62 WSHR events across 48 stations" — please clarify whether events from the same station are treated as independent samples in the composite and bootstrap analyses (Sect. 3 of the Supplement), given potential spatial/temporal autocorrelation among nearby stations during the same synoptic episode.

5. Fig. 11b: "Num = 29" — please state explicitly in the caption or text what fraction of the 62 WSHR events contained an identifiable LLJ at any point in the 180-min window, versus the ~20% figure quoted for individual time steps (L465-473), to avoid reader confusion between event-level and time-step-level frequencies.

6. L546-547 (4.1): The point that "compositing 62 events smooths the large case-to-case variability... best read as robust mean tendencies, not event-level certainties" is well taken and should be echoed, even briefly, in the Conclusions (Section 5), since the conclusions currently state the precursor findings somewhat more categorically than the discussion does.

<Recommendation>

I recommend minor revision. The manuscript makes a solid and novel observational contribution, and my comments are intended to strengthen the causal/thermodynamic linkage (M1) and to move the precursor-signal claim from a plausible hypothesis toward a more quantitatively supported one (M2), which I believe is well within reach given the dataset already assembled.