Review of Ritman et al., submitted to EGUsphere

Title: Convective controls on anvil cloud evolution in the ICON km-scale global climate model

Manuscript no: egusphere-2026-580

General comments:

This manuscript investigates the relationship between deep convection and anvil cloud evolution using a novel 3D tracking methodology within the ICON global climate model. By implementing a distance-transform-based "erosion" technique, the authors successfully isolate convective cores from their surrounding debris—a necessary step for quantifying how core intensity and organization dictate anvil properties. The study finds that greater convective intensity or convective size both lead to larger anvils, albeit more reliably for convective size. It also finds a significant 4-fold increase in anvil extent associated with convective intensity when convective cores are large, providing valuable quantitative constraints for cloud-radiative feedback studies in high-resolution models. I generally support the study and recommend publication, as it addresses a critical source of uncertainty in climate projections. However, I have some comments regarding the justification of specific thresholds and several technical points that I encourage the authors to consider.

Specific comments:

1. **Threshold Justification:** The authors describe the 0.75 m s^-1 vertical velocity threshold and the 50% erosion fraction as "semi-arbitrary" or "experimentally determined." While I understand the practical necessity of these choices, the manuscript would benefit from a clearer demonstration of how sensitive the final results (e.g., the 4-fold increase in anvil area with intensity in large convective cores) are to these parameters.
2. **Model Bias Context:** Since the study acknowledges that ICON overestimates convective intensity and prefers smaller cloud structures, it would be helpful to include a brief discussion on whether these model-specific biases might artificially amplify the scaling relationships reported between core intensity and anvil size.
3. **3D Vertical Coherence:** The erosion algorithm treats vertical levels independently. I would appreciate a note on whether this leads to vertical "shredding" of tracked objects and how the tracking algorithm ensures that a single convective system remains vertically integrated.
4. **Convective Intensity Definition:** The authors used lifecycle-averaged intensity (wmax) to categorize objects into intensity quartiles. I wonder how final results would change if wmax were chosen at peak convective activity instead (peak wmax, or alternatively peak convective mass flux, which should occur in the first half of the lifecycle). I think the authors could possibly mention that the results (eg, 4-fold increase in anvil area) are likely

sensitive to the definition of convective intensity.

Technical corrections:

- **Abstract:** Correct the drafting error "associated assoc with".
- **Table 1:** In the vertical velocity row, replace "no applied" with "None" or "Not applied".
- **Line 131:** Use standard time formatting (14:00–18:00) rather than 1400-1800 for consistency with the figures.
- **Table 1:** Thresholds for specific ice water are written both as 1e-6 kg kg^{-1} (Line 139) and in decimal form like 0.000005 in Table 1. Standardizing these to a single format (e.g., 5 10^{-6} would improve readability
- **Figure 2:** The caption should more explicitly link the sub-steps 3a and 3b in the diagram to the corresponding text in Section 2.2.4.
- **Line 324:** Correct drafting error "the link between intense convection and".
- **Line 352:** Correct drafting error "excitation by gravity waves".
- **Line 389:** Please reformulate "and robust, and Lagrangian methods" to make the sentence clearer.
- **Line 401:** Correct the name: "Daniel Klocke".