

Reviewer Comment 1

This manuscript presents interesting research on pathways of tracers ("biological aerosol particles") in atmospheric deep convection. However, section 3.2.1 has several obscure definitions starting from equation 1. Also, some terms, physical question answered and names in table 2 contradict each other. Could you please revise this whole section. I suggest that you first explain rigorously step by step how each physical quantity discussed in the paper was calculated in the model. Second, please make sure that the names and explanations are not misleading. The rest of the paper needs some editing accordingly.

Response:

We thank the reviewer for their comment and suggestions. In our response, we have sought to clarify our methodology and the calculations we perform using the model output. We have amended this section to add further description and mathematical expression of the quantities that are used to compute the metrics in Table 3 (previously Table 2), including the addition of another table (Table 2) describing our calculations. We could not identify the contradictory physical questions or names in Table 3 (previously Table 2). As specific examples or further explanation of the terms found to be contradictory or misleading were not provided, we have not been able to adjust them. However, we hope that the changes that have been made address any concerns that the reviewer may have in this regard.

Changes:

1. Lines 264-273 have been replaced with:

We first define quantities in Table 2 that are calculated directly from model output and which will be used in constructing metrics that describe the characteristics of each storm.

Quantity	Units	Method of calculation
In-updraft	N/A	$\left(\text{Vertical velocity} \geq 1 \frac{m}{s} \right) \text{ AND } \left(\text{condensate mixing ratio} \geq 0.1 \frac{g}{kg} \right)$
Updraft mass	kg	$\sum_{\text{In-updraft gridpoints}} \text{Air density} \left[\frac{kg}{m^3} \right] * \text{gridpoint volume} [m^3]$
Total fixed-source tracer entrained	#	$\sum_{\text{In-updraft gridpoints}} \text{Fixed-source tracer mixing ratio} \left[\frac{\#}{kg \text{ air}} \right] * \text{air density} \left[\frac{kg}{m^3} \right] * \text{gridpoint volume} [m^3]$

Total rain-sourced tracer entrained	#	$\sum_{\text{In-updraft gridpoints}} \text{Rain-sourced tracer mixing ratio} \left[\frac{\#}{\text{m}^3} \right]$ $* \text{ air density} \left[\frac{\text{kg}}{\text{m}^3} \right]$ $* \text{ gridpoint volume} [\text{m}^3]$
Total fixed-source tracer emitted	#	$\sum_{\text{Time}=0}^{\text{Present}} \sum_{\text{Surface gridpoints}} \text{Tracer emission rate} \left[\frac{\frac{\#}{\text{kg air}}}{\text{s}} \right]$ $* \text{ air density} \left[\frac{\text{kg}}{\text{m}^3} \right]$ $* \text{ gridpoint volume} [\text{m}^3]$ $* \text{ timestep} [\text{s}]$
Total rain-sourced tracer emitted	#	$\sum_{\text{Time}=0}^{\text{Present}} \sum_{\text{Surface gridpoints}} \text{Tracer emission rate} \left[\frac{\frac{\#}{\text{kg air}}}{\text{s}} \right]$ $* \text{ air density} \left[\frac{\text{kg}}{\text{m}^3} \right]$ $* \text{ gridpoint volume} [\text{m}^3]$ $* \text{ timestep} [\text{s}]$ $* \begin{cases} 0, & \text{Rainfall} < \text{threshold} \\ 1, & \text{Rainfall} > \text{threshold} \end{cases}$

Table 2 Quantities used in constructing analysis metrics, as calculated directly from model output.

The mixing ratio of a rain-sourced tracer in a given gridpoint represents the product of the mass of air in that gridpoint that has been in contact with the surface and the duration for which this contact occurred. Each rain-sourced tracer species captures this product of mass and time of surface contact for rainfall of a different intensity. *The mixing ratios of the rain-sourced tracers are therefore the most direct measure of the proportion of air in a storm that we would expect to contain biological particles aerosolized by rain.* These quantities reflect a combination of many different processes and characteristics of each storm, and some of the most salient questions we could ask to disentangle these factors are as follows: