Bayley et al. provide a valuable introduction and description of the detailed parameterization choices and numerical methods for warm rain processes in their new SDM, “CLEO.” The included thorough description of numerics for condensation and other processes makes this manuscript valuable for future replication and comparison of CLEO-based results with other SDM methods in future work. I have some small objections to claims and language used to describe Eulerian microphysics in the introduction, as well as some suggestions to validate and/or demonstrate the more novel aspects of CLEO (ventilation, breakup) that would strengthen the impact of this paper. Once addressed, I believe this manuscript will be a valuable addition to the scientific model description literature.

Major Comments:

1. The abstract and introduction include strong and potentially misleading descriptions of traditional microphysics methods that would benefit from a more nuanced presentation. Specifically:
    - The abstract mentions “Eulerian models” but should be careful to distinguish microphysics parameterizations from the entire class of “Eulerian” models; all ESMs are Eulerian in their treatment of momentum, after all.
    - Bold claims like “their underlying assumptions are inconsistent with even the most basic kinematic processes” need elaboration or tempering
    - Claims that SDM converges toward the Smoluchowski equation while bulk or bin schemes do not are needs elaboration. Consider that linear sampling in the SDM would lead to slower than expected convergence, wherease bin schemes provide a direct finite element approximation to the Smoluchowski equation.
    - The introduction should recognize that the rationale for developing bulk and bin microphysics largely stems from computational limitations that necessitate approximations; the SDM is still infeasible for global simulation, thus we will continue to rely on bulk microphysics. In fact, many non-Lagrangian approaches are based on clever mathematical approximations and have enabled broad advances in atmospheric science based on necessary complexity tradeoffs. Lagrangian microphysics is itself not free of assumptions or limitations, nor differences between implementations (see Hill 2023) and these should be reasonably discussed in similar level of detail.
2. Some of the new additions to CLEO (ventilation, breakup) have not been rigorously validated in the included experiments.

- Ventilation was not validated for expected qualitative behavior (cooling, evaporation of rain) in any of the example cases. Please show an instance where the ventilation effect can be qualitatively observed.
- The choice to eschew fragment size distributions altogether is a break from the norm, and warrants further discussion and validation. I recommend including a comparison of the stationary PSD that results from this choice of fragment size with those of traditional implementations (Straub 2010, McFarquhar) to reveal any systematic biases that that your implementation may suffer, such as overproduction of cloud-size fragments.
- Figure 10: Including a plot of CLEO's predictions of precipitation rate and timing would further be extremely useful for comparison with other SDMs in the Hill 2023 study (and would back up the claim in L350-351).
- Seeing a verification example where the terminal velocity is included in addition to the passive tracer flow (Figure 9) would be interesting.

3. Please clarify and justify the choice of parameterizations, including when CLEO is designed to switch between different parameterizations, and when a single parameterization has been fixed. For instance, condensation and ventilation appear to have a single fixed option, whereas coalescence leaves room for multiple implementations. Please explain and justify the mixing of various implementation components, such as describing the probabilities of coalescence/breakup/rebound from Testik while utilizing the coalescence efficiency of Straub 2010. It would further be useful to understand where CLEO's chosen parameterizations differ from those adopted by other production-ready SDMs (LibCloud, SCALE, PySDM). Differences between PySDM and CLEO in collision implementation are well-documented, but understanding any differences in CLEO's default choice for other dynamics such as the collision kernel and sedimentation velocity would be helpful to the modeling community.
4. Please describe some implementation details that are relevant to coupling with LES or another dynamical model:
    - What are the parameterized source and sink terms to Eulerian tracers including latent heating, moisture/buoyancy sources, or any momentum feedbacks during transport?
    - At a minimum, it would be helpful to describe the prognostic variable sets that are natively compatible with the current implementation of CLEO, and which would require interpolation and/or additional coupling intricacies. For instance, many large scale models operate in pressure coordinates rather than z; others have different choices of moisture and thermodynamic prognostic variables. In my experience, converting between these native

prognostic variables and those required by the SGS scheme can result in qualitative differences simply due to small differences in a choice of thermodynamic constants, so it is helpful to understand the native variable set that is most compatible with CLEO.

Minor Comments:

- The CLEO acronym is never defined
- L92-93: “Droplets with a radius… same terminal velocity” needs a reference or proof.
- L129: “references in Morrison et al. 2020” is not an appropriate citation; select the appropriate supporting references and cite them directly
- Please clarify the rationale for terminating a simulation rather than removing an empty superdroplet (L207)
- I could not find the citation for Bayley 2025b; Bayley 2025a needs an updated URL with the relevant DOI
- L228: the result of collision is only deterministic in certain cases in CLEO, but is still probabilistic in that it uses the random number (Monte Carlo) in other cases
- Can you clarify for a non-computer scientist what a C++20 concept is?
- L358 and elsewhere: clarify that adaptive sub-time-stepping is only implemented in condensation, not in coalescence (whereas PySDM v2 includes a coalescence adaptive time step)
- The lightest yellow in Figure 7 is difficult to see and does not print well.
- A table of notation would be helpful for reference

Typos:

- L32: “effect” → affect
- L110: “upto”
- L147: “we prescribe for the collision probability” – a leftover/hanging phrase?
- L312: “was” → were