Bridging The Divide Between Bin And Bulk Microphysics

What prognostic variables are best for simulating warm rain with bulk microphysics schemes?

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The BOSS Framework: Microphysics With No Assumed Drop Size Distribution

BOSS: The Bayesian Observationally constrained Statistical-physical Scheme

- BOSS schemes with three cloud moments perform much better than those with two cloud moments (Fig. 1).
- Although rain moments are useful for diagnosing the autoconversion rate “offline”, they do not benefit the model in a time-evolving context (Fig. 2).
- We are developing a “single category” version of BOSS with no artificial rain/cloud distinction.

AMP: A Bulk Scheme With Bin Physics

AMP: An Arbitrary Moment Predictor

- The Hebrew University bin model was used to produce a bulk reconstruct-evolve-average collision-coalescence scheme.
- Using separate rain and cloud categories, defined by a 40 micron size cutoff, (schemes c03-r03 and c038-r038 in Fig. 4) is less accurate than using moments of the full hydrometeor size spectrum (scheme f0349).
- Two-category schemes perform much better with a 25 micron cutoff, though the two-moment scheme struggles with rain reflectivity (not shown).
- More details in Igel et al., 2022.

JEFE: Measuring Predictability

JEFE: Jacobian Evaluation of Functional Error

- Two-moment schemes with separate rain and cloud categories are generally unable to emulate bin model precipitation.
- Box model studies (AMP and JEFE) show that four-moment single-category schemes are more accurate. We are working on corroborating this with BOSS.
- All studies agree that using three or more cloud moments substantially improves two-category autoconversion rates.
- Lowering the threshold size separating cloud from rain may also help based on AMP results.

Conclusions

References


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