Improvements to CLUBB's subgrid PDF shape

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The current version of CLUBB's PDF ("ADG1") has the following problems:

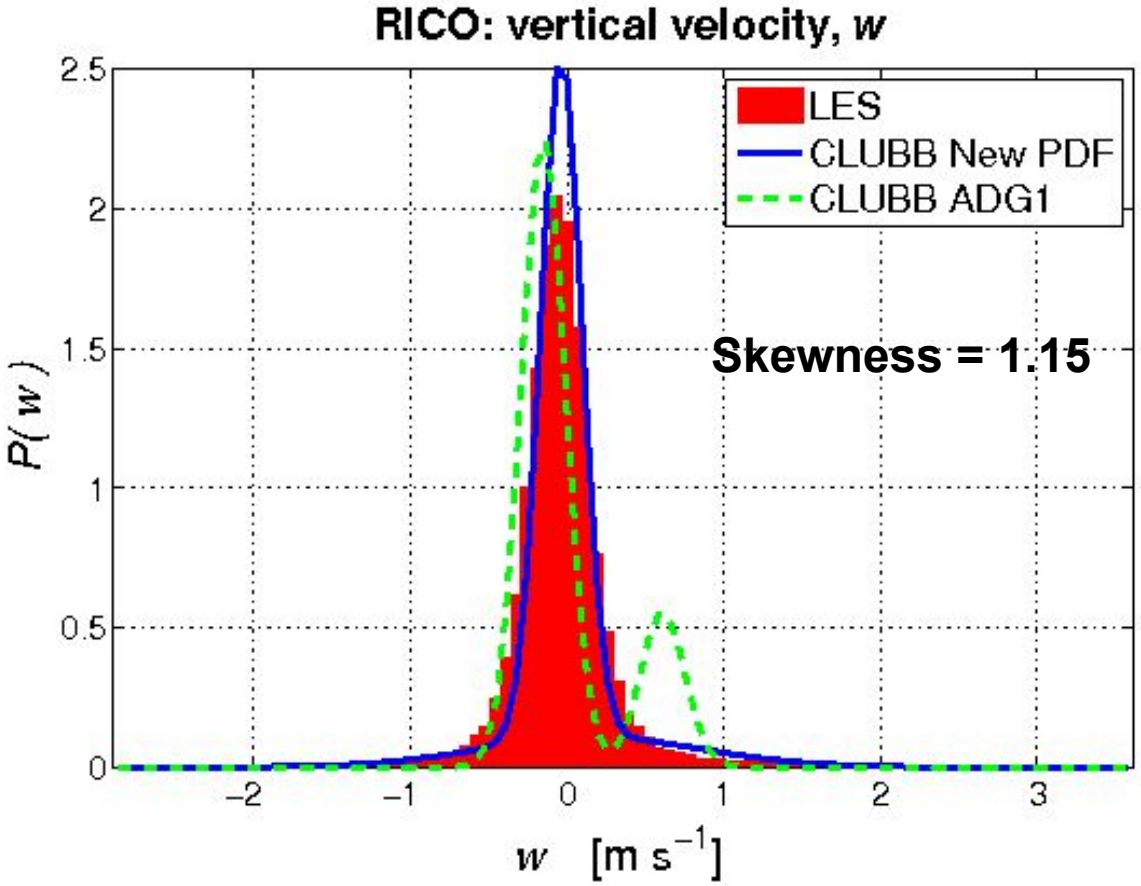
- Excessively bimodal PDF of vertical velocity, *w*.
- Excessive evaporation alongside cloud in precipitating cumulus cases.
- Underestimated turbulent advection of higher-order moments.

To circumvent these problems, we are developing a new analytic double Gaussian PDF that

1) approaches a single Gaussian in *w* in the limit of zero skewness; and
2) has non-zero within-component turbulent flux of heat and moisture.

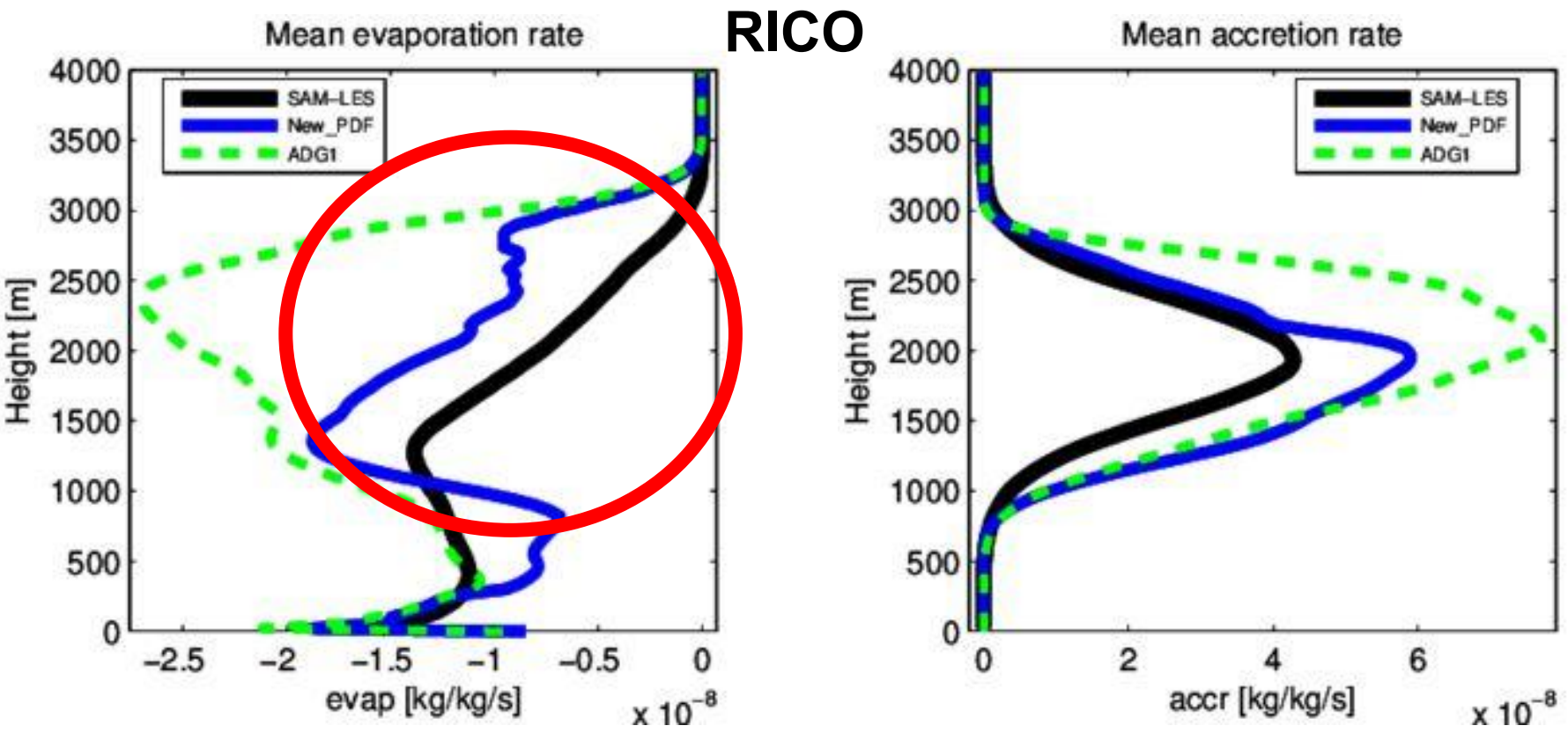
Next we'll evaluate the new PDF using non-interactive simulations of the RICO shallow cumulus case.

The new PDF of *w* is less bimodal (improved):



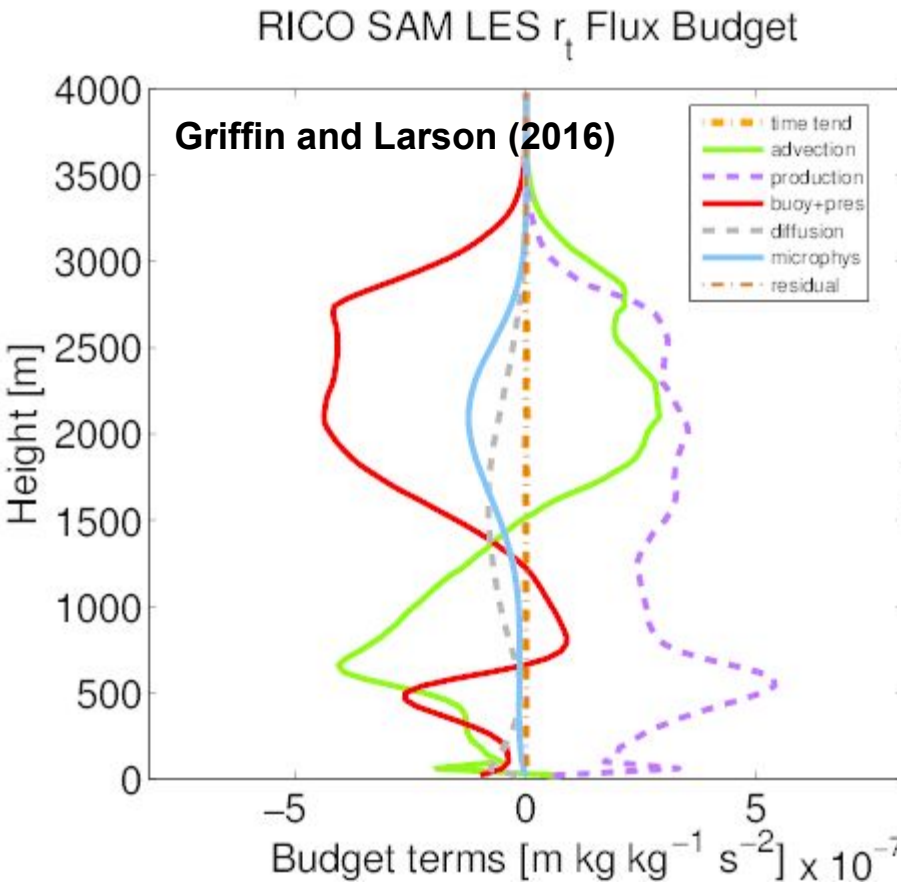
We hope that someday, the improved PDF of *w* will help with aerosol activation.

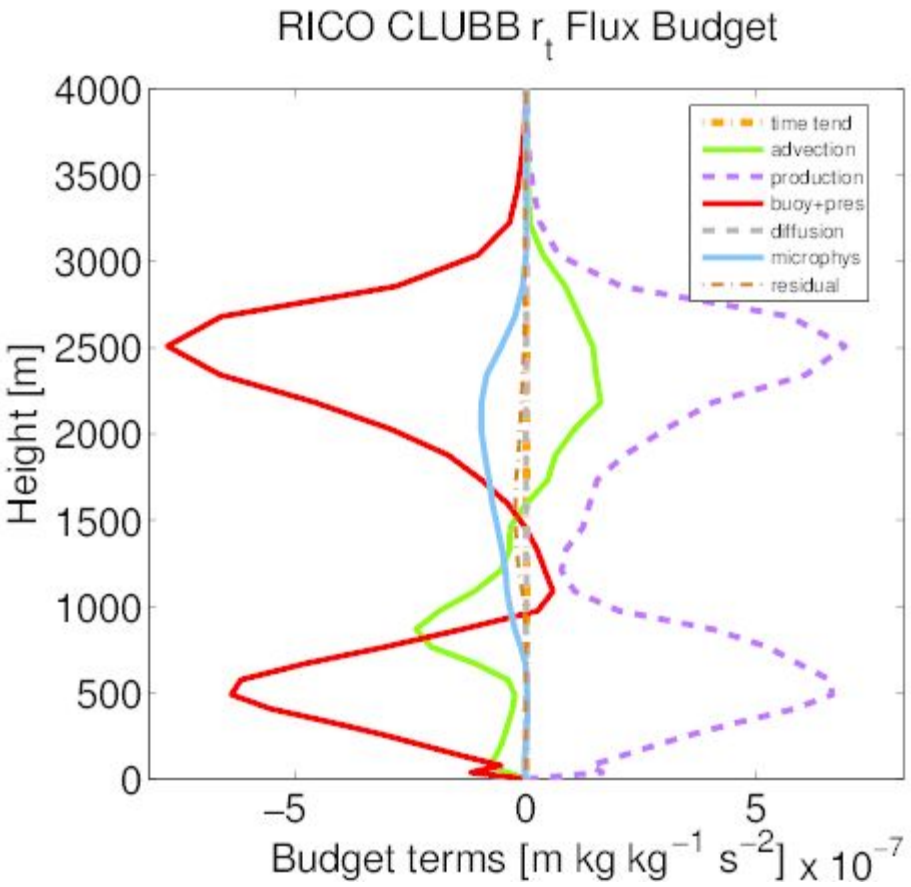
The new PDF reduces excessive evaporation aloft:



We hope that the reduced evaporation will reduce (improve) the precipitable water in global simulations using CLUBB-SILHS.

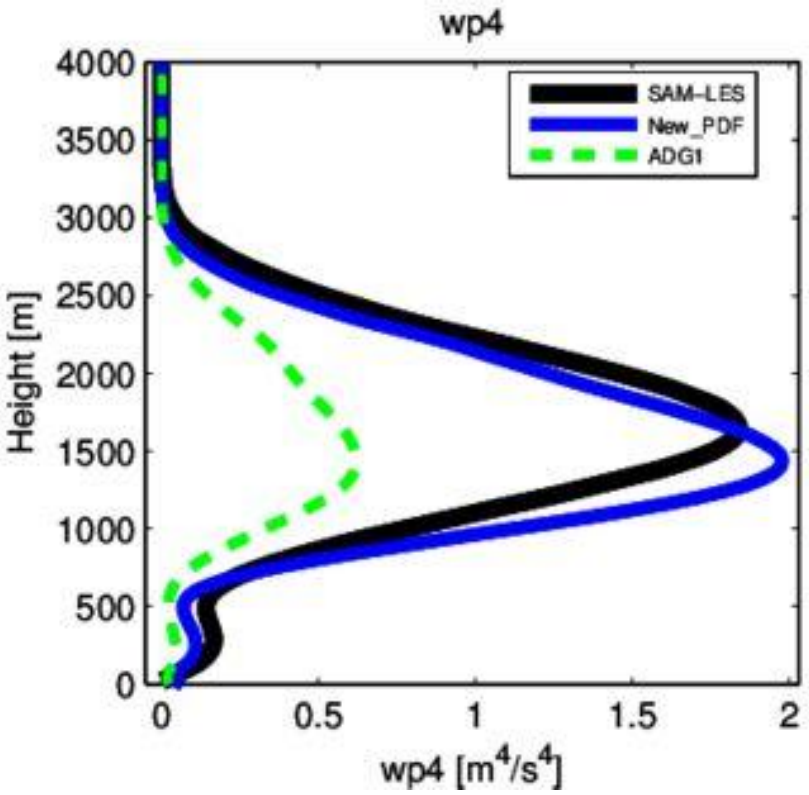
Problem . . . CLUBB's current PDF underpredicts turbulent advection:

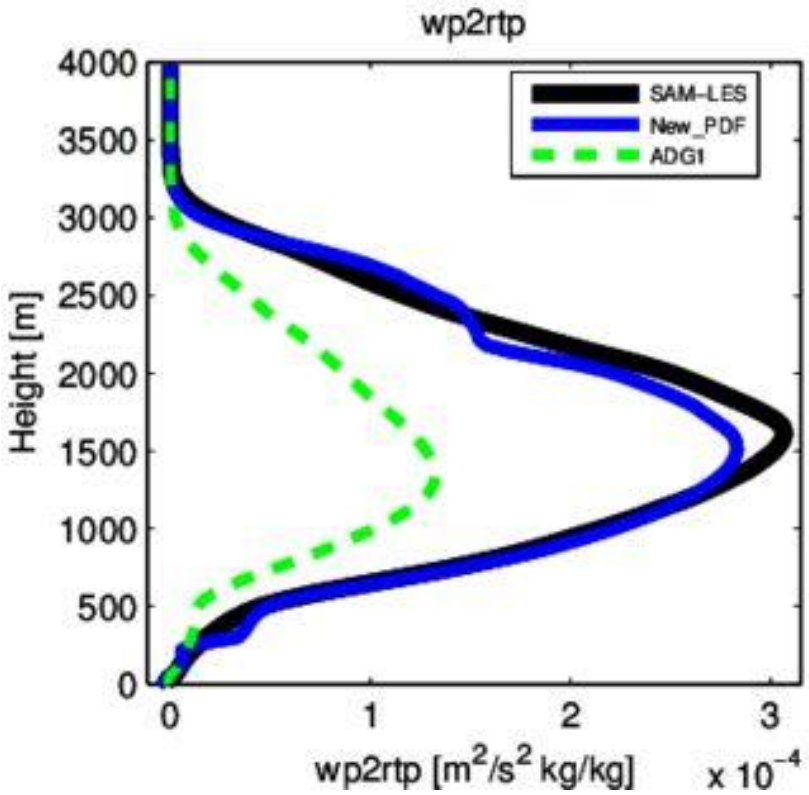




Turbulent advection helps a layer to deepen.

The new PDF increases the 3rd- and 4th-order moments because the PDF is less bimodal:





We hope that the improvement will help deepen Cu layers.