A New Aerosol Lidar Simulator

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Objective

- Develop an novel simulator for aerosols
- Create a new CALIPSO data product for evaluating GCM
- Use cloud and aerosol simulators and the corresponding observational data products to evaluate/constrain the model aerosol-cloud interactions

Approach

- ACME aerosol optics
  - Mie calculation → Internal mixing → Backscatter ($\beta$) and extinction ($\alpha$) parameterization
- Aerosol Lidar Simulator
  - ACME simulation → Cloud-screening → Measured $ATB(z)$, SR($z$), $ATB_{aer}(z)$, $ATB_{perp}(z)$ → Aerosol-typing
  - $ATB(z) = (\beta_{max}(z) + \beta_{max}(z)) \cdot e^{-2a \int_{z_{top}}^{z_{min}} \alpha_{max}(z)dz}$
  - $SR(z) = ATB(z) / ATB_{aer}(z)$
  - $ATB_{aer}(z)$, $SR_{aer}(z)$ → Aerosol-typing
- GCM-Oriented CALIPSO Aerosol Product (GOCAP)
  - Measured $ATB(z)$, SR($z$), $ATB_{aer}(z)$, $ATB_{perp}(z)$ → Aerosol-typing

Next Steps

- Produce nudged ACME simulations with the aerosol simulator for one year (2008), and evaluate/constrain the model against GOCAP
- Produce a multi-year GOCAP dataset to evaluate/constrain multi-year model simulations
- Produce a new collocated dataset consisting of aerosol, cloud, and precipitation, and use simulators to re-evaluate the aerosol-cloud-precipitation interactions.
- Relate the “true” aerosol types from the model with the simulator typing algorithm
- Implement the simulator for the 1064nm backscatter to evaluate/constrain model size and composition
- Coordinate with CMIP for model intercomparison
- Use ARM ground-based lidar observations and CRM/LES simulations to evaluate/constrain GCM’s satellite-oriented simulator results

Figure 1. Time series of (a) $ATB(z)$, (b) SR($z$), and (c) $Y(z)$, and histograms of raw (d) SR, (e) $Y$, and of noise-eliminated (f) SR, and (g) $Y$. 