ARM data-oriented metrics and diagnostics package (ARM-Diags)

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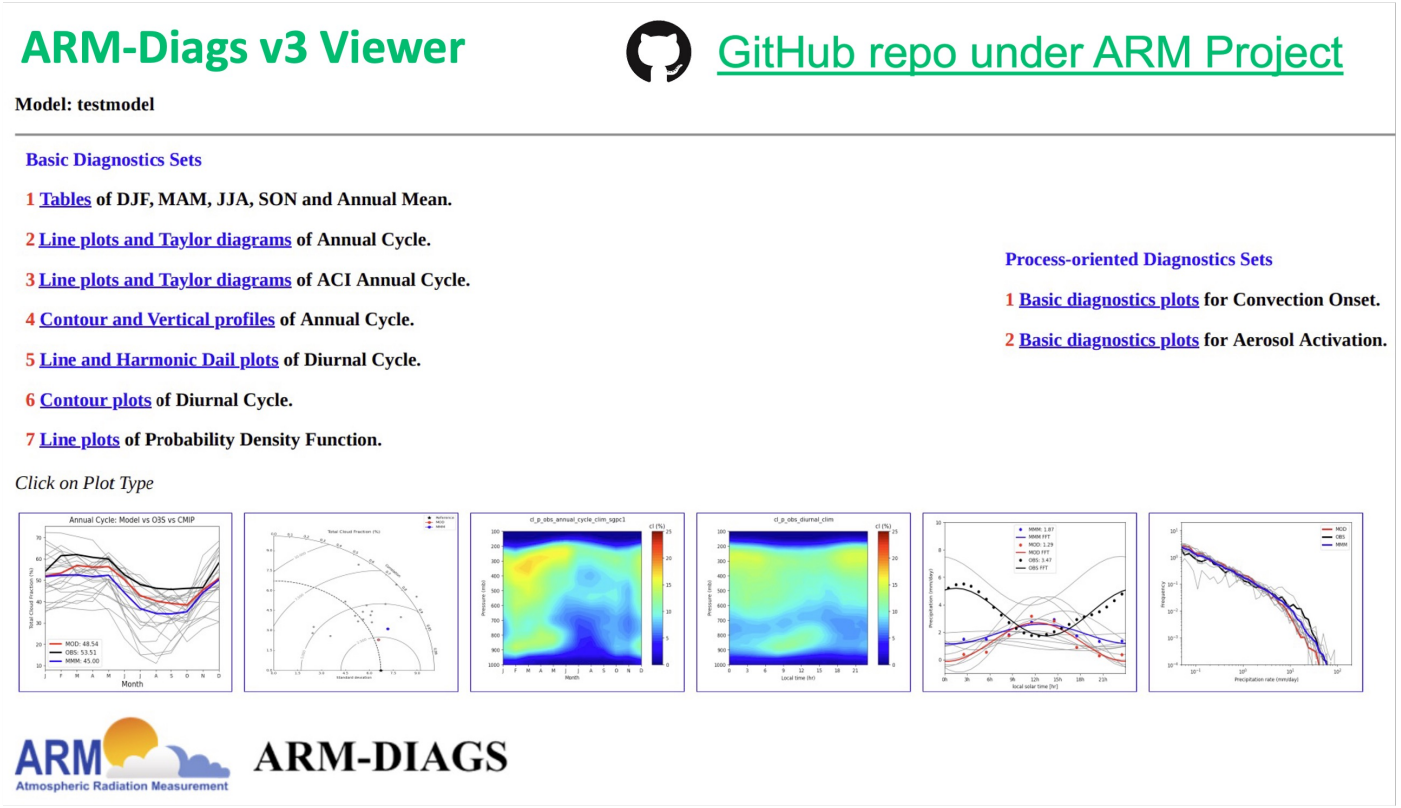
ARM-Diags: Overview

Objective: To facilitate the use of ARM ground-based in-situ measurements in climate model evaluation and model inter-comparison.

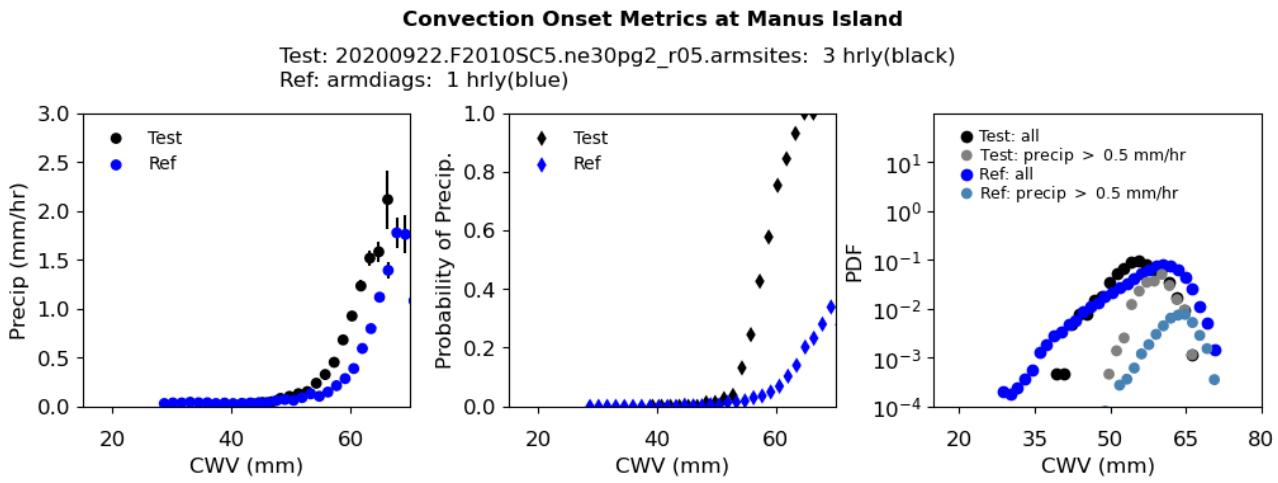
- Utilize ARM high-frequency long-term continuous measurements of clouds, aerosols, radiation, and precipitation.
- Provide process-oriented diagnostics to help understand model errors and improve physical parameterizations.
- Python package for file I/O, metrics calculation, graphics, generating viewer, available from GitHub ARM project space.



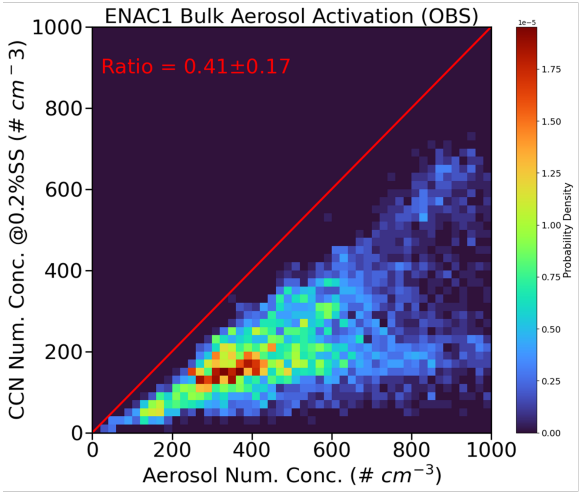
ARM-Diags: List of metrics and diagnostics

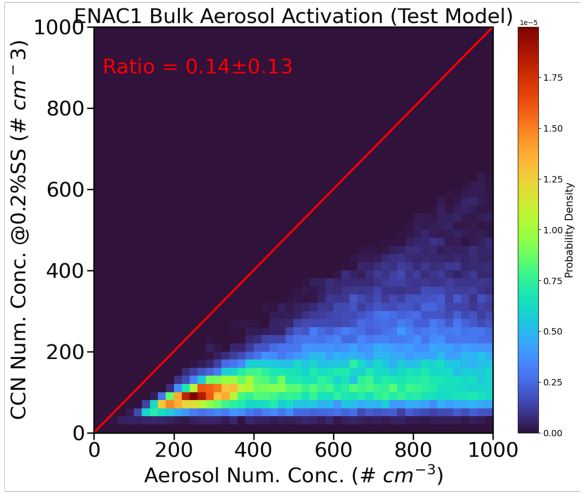
- Basic diagnostics sets: **line plots and Taylor diagrams** for annual cycle variability; **contour and vertical profiles** of annual cycle and diurnal cycle of cloud fraction; **line and Harmonic dial plots** of diurnal cycle of precipitation; **probability density function (PDF)** plots of precipitation rate;
- Process-oriented diagnostics sets**: convection onset metrics; aerosol-CCN activation metrics.**

Convection onset metrics (contributed by UCLA)



Aerosol-CCN activation metrics (contributed by U. of Arizona)



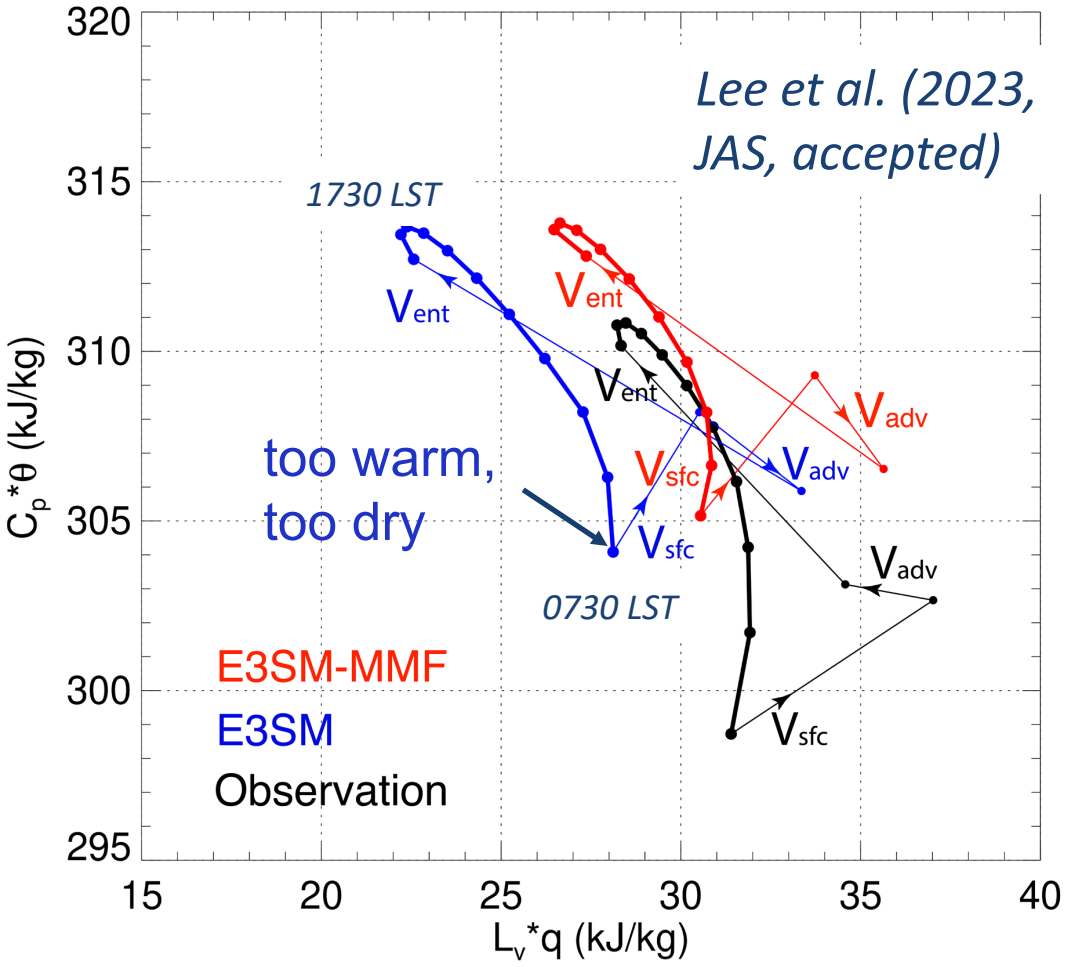


ARM-Diags: Current development

ARM-Diags Phase 4 (Ongoing):

- Implement the Local Land-Atmosphere Coupling (LoCo, Santanello et al. 2018) metrics in the current ARM-Diags.
- Include both basic metrics that focus on one single variable, and co-variability and integrative metrics like mixing diagrams.
- Emphasis on the local convective regimes (i.e., clear-sky days, shallow cumulus days, etc.).
- Apply composites for statistical analysis.

Mixing diagram (clear-sky days)



ARM-Diags: Future Plan

Extend the ARM-Diags for high-res model evaluation.

- **Expand analysis capability** by orchestrating diagnostics and metrics developed from the ARM/ASR and broader community (e.g., THREAD).
  - Collect existing and newly developed analysis and implement it into the ARM-Diags.
  - Regime-based metrics and diagnostics for regionally refined SCREAM hindcasts and double periodic SCREAM (CRM) simulations.
- Incorporate the **ARM radar/lidar simulator** as part of the ARM-Diags to provide support for high-res models.
  - Highly needed by E3SM-SCREAM.
  - Built-up a case library including more cases for various cloud systems.
  - Address observational and simulator uncertainties.