ENA

CACTI

SGP

ARM

LASSO Breakout Session:
LASSO-ENA Update and Scenario Development for LASSO-BNF

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Goals for today's breakout session

► Have a forum to discuss LASSO usage and questions

► Provide a LASSO-ENA update to motivate researchers to start working with ENA model runs as they become available

► Start a public discussion to guide development of the next LASSO scenario for the Bankhead National Forest campaign

LASSO's high-resolution modeling library

▶ The **Large-Eddy Simulation (LES) ARM Symbiotic Simulation and Observation (LASSO)** activity supplements ARM observations with a library of high-resolution model simulations and forcing data

▶ LES modeling helps bridge the scale gap between ARM observations and coarse atmospheric models

▶ LASSO provides "scenarios" organized around selected locations and science drivers

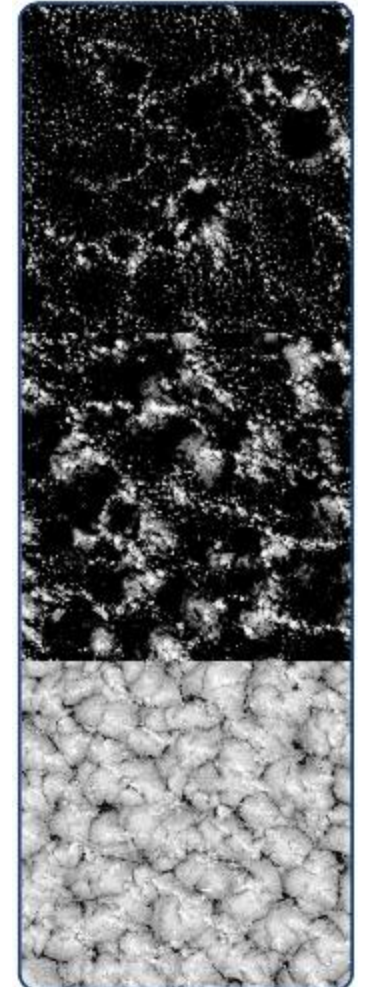**Continental shallow convection for Southern Great Plains (SGP) observatory**

Orographic deep convection for CACTI campaign

Maritime convection for Eastern North Atlantic (ENA) observatory

How does LASSO help?

► Foundational modeling in the context of observations
- ARM does the heavy lifting associated with getting modeling studies going
- Evaluating forcing data shows sensitivity of background conditions by day
- Simulations can be used as-is, or they can be used to build additional sensitivity studies

► Atmospheric studies struggle obtaining observations with sufficient resolution to answer all our questions
- LES provides this detail within the model's capabilities

► Models provide budgets and process rates unobtainable in the real world
- Connections between processes become quantifiable
- Ability to turn on/off different processes permits an experimental approach

► Detailed, high-resolution models serve as benchmarks for coarser models

► Remember we are in "model world" space—take it all with a grain of salt— observations are critical! Make sure to combine LASSO modeling with ARM's obs.

Simulated LWP from SAM at ENA

LASSO adapts the modeling approach to each scenario's objectives

SGP Shallow Convection

▶ **Science drivers:** processes associated with surface-flux-driven continental shallow convection

▶ **Modeling approach**
  ■ Periodic domain boundaries, 25 km wide
  ■ Column-based forcing from (re)analyses
  ■ Surface fluxes from observations

▶ Ensemble size: 8 members per case

▶ Cheap, so could afford 95 case dates

CACTI Deep Convection

▶ **Science drivers:** convective initiation and growth of large, orographic deep convection

▶ **Modeling approach**
  ■ Nested domains, inner domain ~250 km wide
  ■ Space-time dependent boundary conditions
  ■ Online land/surface model

▶ Ensemble size: 31 members for km-scales

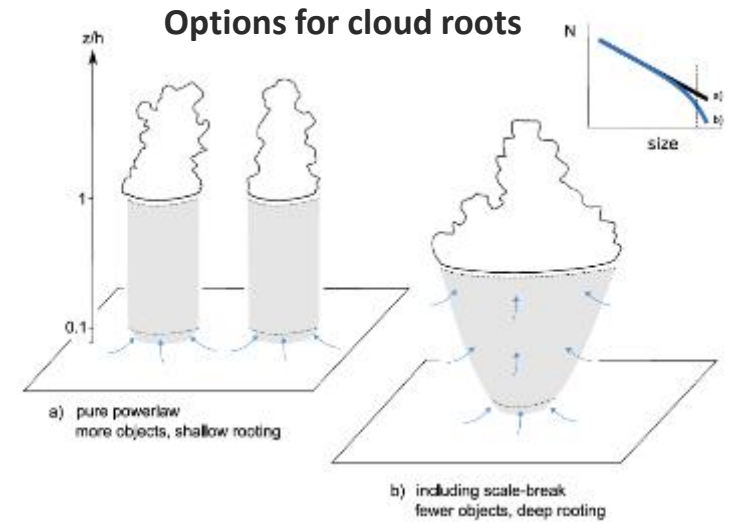▶ Expensive, so limited to 9 full-resolution case dates, supplemented with 21 days at km-scale

How have users applied LASSO?

**Some examples…**

Options for cloud roots

- ▶ Developing a theory and parameterization for subgrid cloud organization via clustering of thermals, Neggers & Griewank (2022)—used the DALES model with an embedded microgrid plume model called BiOMi-ED(MF)^n

Relative importance to convective initiation

- ▶ Analysis of cloud parcels to quantify entrainment and factors leading to convective initiation, Jo et al. (JAS, in review)—reran select hours of WRF to get 15-second output; strong focus on feature tracking
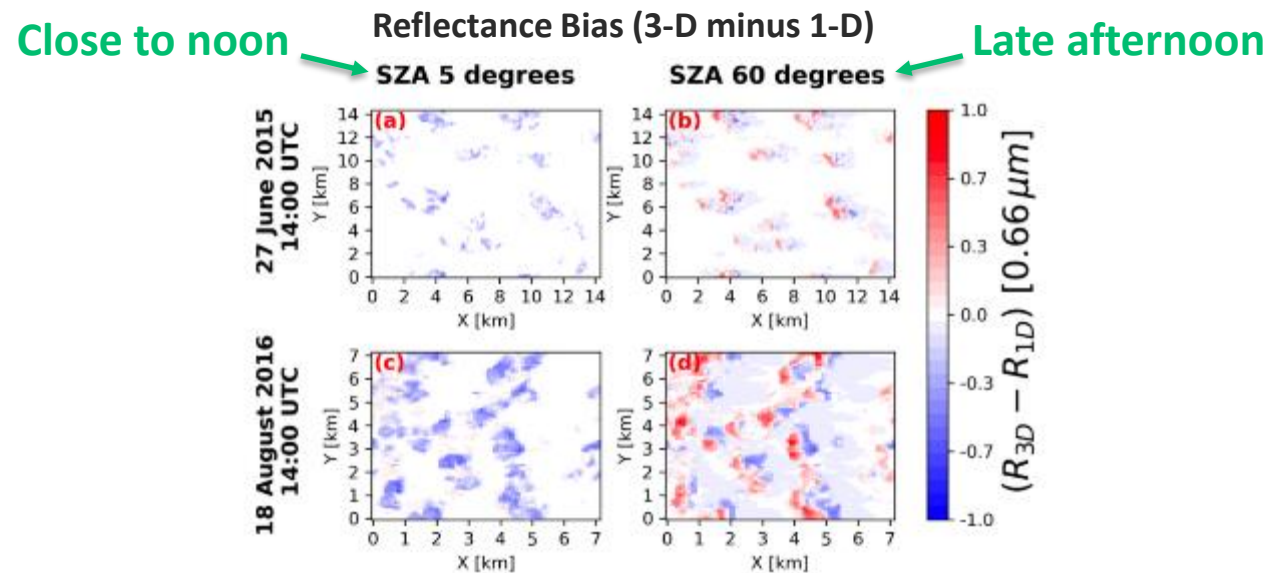
  Related posters:
  - Enoch Jo et al., Session 2 #59
  - Zhe Feng et al., Session 2, #75
  - Jim Marquis et al., Session 3 #46
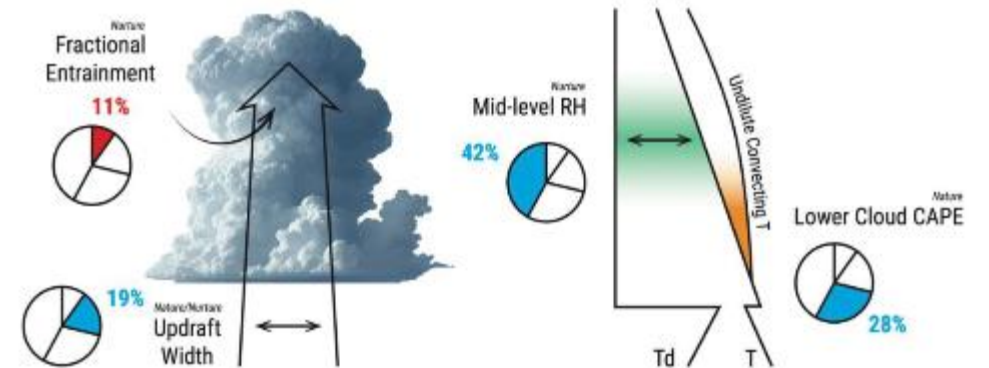
► Accuracy of calculating rCRE using 3-D vs. 1-D calculations, Ademakinwa et al. (2024)—fed LASSO cloud field into the spherical-harmonics discrete-ordinate method (SHDOM) radiative transfer model
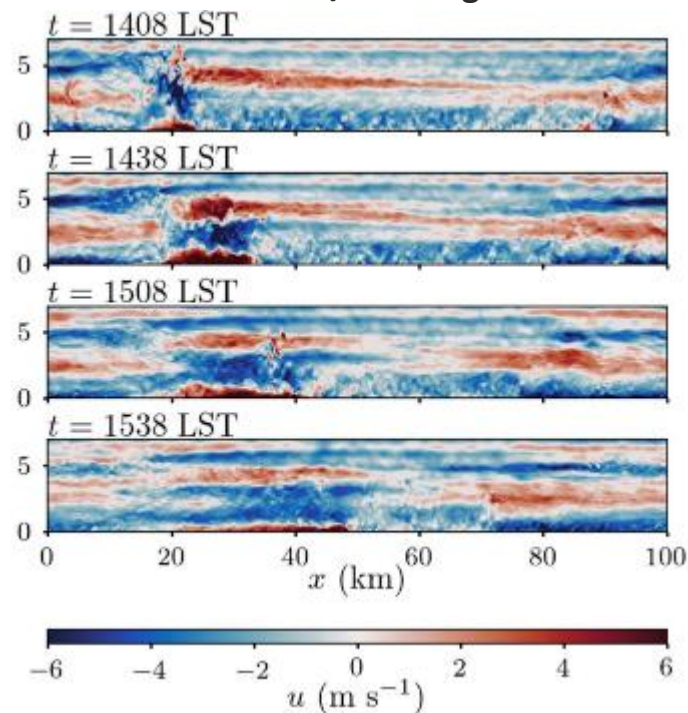
Reflectance Bias (3-D minus 1-D)

Close to noon   Late afternoon

► Impact of surface heterogeneity on secondary circulations, surface fluxes, & clouds, Simon et al. (2021 & 2024)—used HydroBlocks field-scale resolving land-surface model to calculate heterogeneous land-surface state to feed WRF-LES
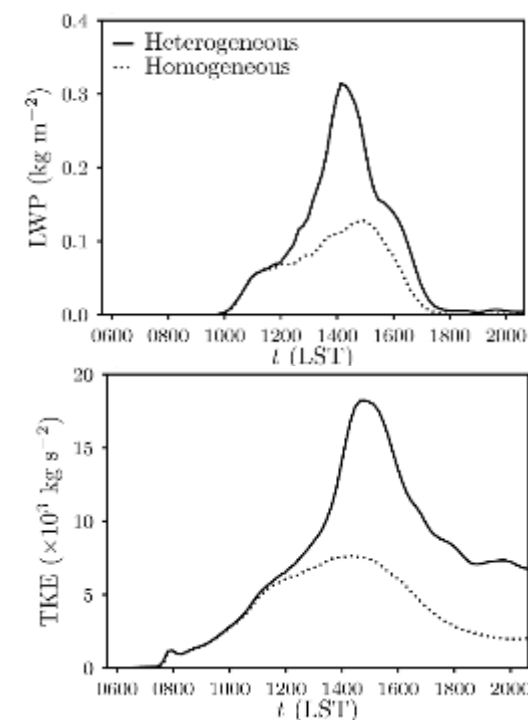
Related poster:

● Nathaniel Chaney et al., Session 1 #64

Wind Cross Sections w/ Heterogeneous Surface   **LWP & TKE**

Getting more information for LASSO

▶ Website: https://www.arm.gov/capabilities/modeling/lasso

▶ Technical documents
- LASSO-ShCu: https://www.arm.gov/publications/tech_reports/doe-sc-arm-tr-216.pdf
- LASSO-CACTI: https://lasso-cacti-doc.arm.gov/latest/index.html

▶ Bundle browsers for data downloading
- LASSO-ShCu: https://adc.arm.gov/lassobrowser
- LASSO-CACTI: https://adc.arm.gov/lasso/#/cacti

▶ Questions and help
- Discourse forum: https://discourse.arm.gov/c/lasso/
- Support email: lasso@arm.gov

Linking LASSO to the large-scale modeling community

► LASSO forcings can drive other LES and single-column models (SCM)

  ■ SCMs and periodic LES ingest forcings similarly

  ■ Permits fair comparisons between LASSO simulations and other models

  ■ Can use LASSO ensembles to pre-select input data for other modeling studies

► E3SM SCM, SCREAM, and NOAA/NCAR's Global Modeling Testbed (GMTB) include the ability to ingest LASSO-ShCu input data

Cloud fraction at SGP from ARSCL retrieval, LASSO LES (Δx=100 m), E3SM SCM, and DP-SCREAM (Δx=3.25 km)

E3SM simulations courtesy of Cheng Tao, Yunyan Zhang, and Peter Bogenschutz (LLNL)
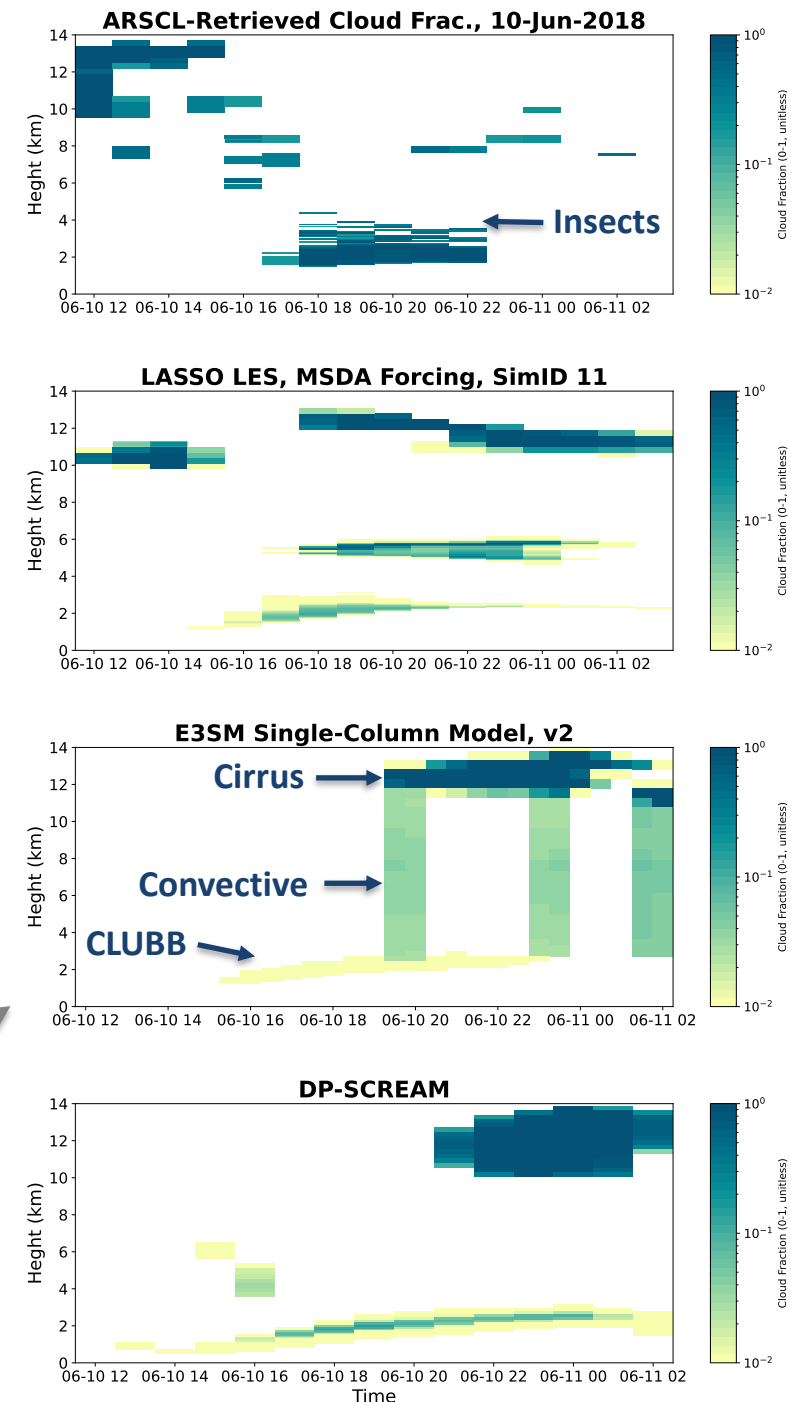
Perspective of hot topics to modelers

How can we blend ARM's observations and LASSO modeling to aid cloud and climate modelers?

1. What differentiates clouds that experience deep convection initiation? How can that be parameterized?

2. Mixing processes in clouds, e.g., entrainment/detrainment, hetero vs. homogeneous mixing

3. Fundamental details for ice processes, importance of the different ice processes, and how to incorporate them into models

4. Simulation of semi-resolved phenomena, such as MCSs

5. General issue of correcting biases in models, which commonly involves fixing clouds

CI?

No

Yes