LASSO: LES for the Masses

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LASSO Webpage: https://www.arm.gov/capabilities/modeling
LASSO e-mail list sign up: http://eepurl.com/bCS8s5

Posters, Tues. 3:30–5:00 p.m.

#168, Oue et al., An ARSCL simulator: Generation and application to LASSO case studies
#171, Li et al., Multiscale Data Assimilation Forcing for LASSO
#172, Krishna et al., Large-Scale Data Analysis and Visualization Using NoSQL Technologies for LASSO, Radar Data, and Beyond
#173, Gustafson et al., LES for the Masses: LASSO's Going into Production
#174, Vogelmann et al., LASSO's Data Bundles for Consumption

Breakout agenda

4:00–4:10 Introduction and big picture overview of LASSO (W. Gustafson)

Example uses for discussion

4:10–4:25 Improving observations and retrieval methodologies (P. Kollias)

4:25–4:40 LES ensembles for understanding cloud-aerosol co-variability (G. Feingold)

4:40–4:55 Comparing LES output to cloud parameterizations (V. Larson)

LASSO development

4:55–5:20 Data bundle development and discovery (A. Vogelmann & B. Krishna)

5:20–5:35 Multiscale Data Assimilation (MSDA) with ARM observations (Z. Li)

5:35–5:45 What to expect going forward: LASSO timeline & further development (W. Gustafson)

5:45–6:00 Open discussion

The LASSO philosophy

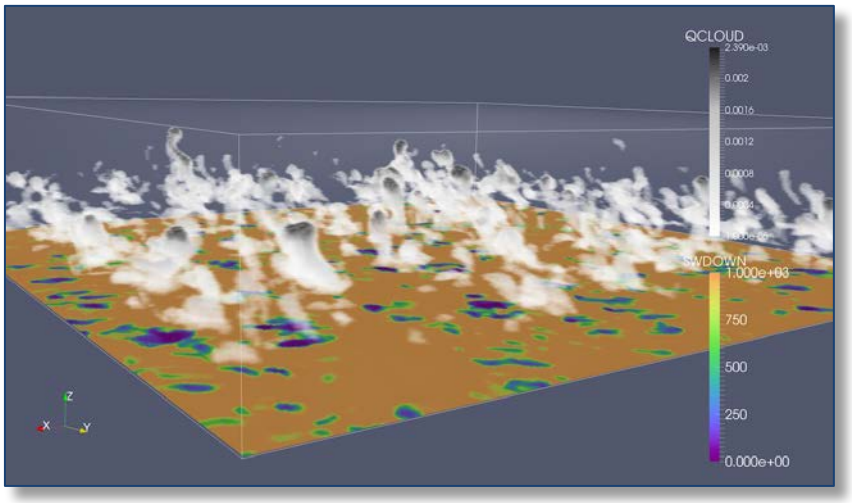
LASSO = LES ARM Symbiotic Simulation and Observation

Henry Scherren, 1909

LASSO aims to bridge the gap between observations and models to add value to both kinds of data.

The LASSO Pilot Project

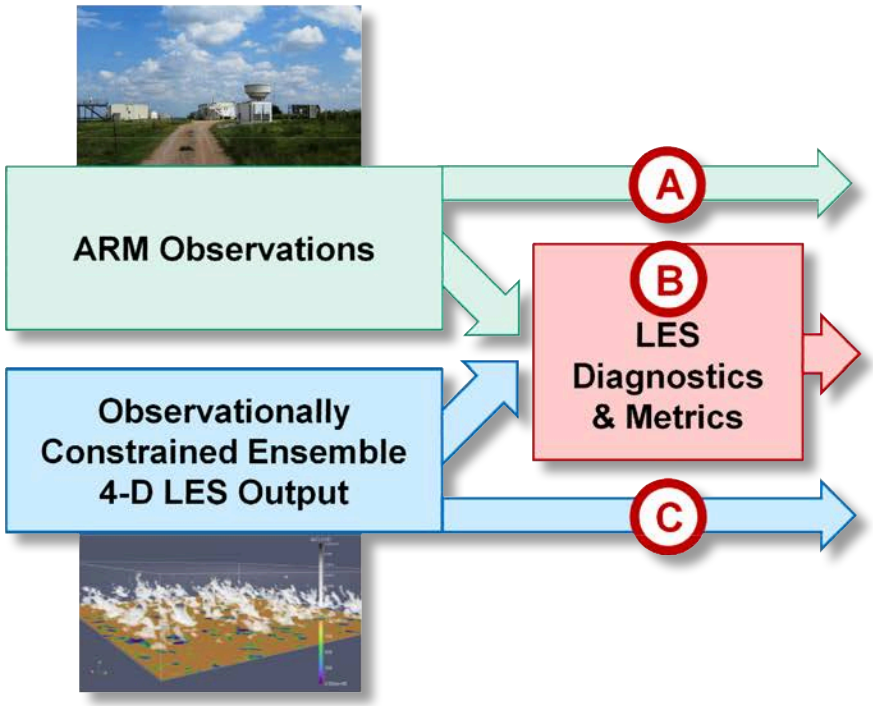
- Tasked with
  - Fleshing out a vision for LES modeling and how ARM can use it to add value to its extensive observations
  - Developing prototype workflows for implementing into ARM's infrastructure
- Initial target: shallow convection at the SGP site
- 2-year period ending this May



LASSO encompasses a chain of products

- Cloud classification product
- Daily ensemble of model forcings for driving LES, CRM, parameterizations, etc.
  - ARM Variational Analysis (VARANAL)—profile
  - ECMWF from IFS model—profile
  - Multiscale Data Assimilation with ARM obs.—profile and gridded
- Library of "data bundles" blending LES and observed information
  - 20–40 shallow convection days per year
  - Additional days as staffing and computing availability permits
- Discovery via Bundle Browser extension to Data Discovery website

Data bundles optimally package data to ease user consumption



Model-Observation Data Bundle

A. Case Descriptors

- Cloud type classification
- Atmospheric state descriptors (weather pattern, inversion strength. etc.)

B. LES Diagnostics and Metrics

- Co-registered observation & model evaluation data
- LES-observation diagnostics
- LES-observation performance metrics

C. LES Inputs and Outputs

- 3-D volumes and profile statistics
- Unobservable properties: budget terms, GCM parameterization terms, etc.
- Input forcings, atmospheric profiles, and surface fluxes

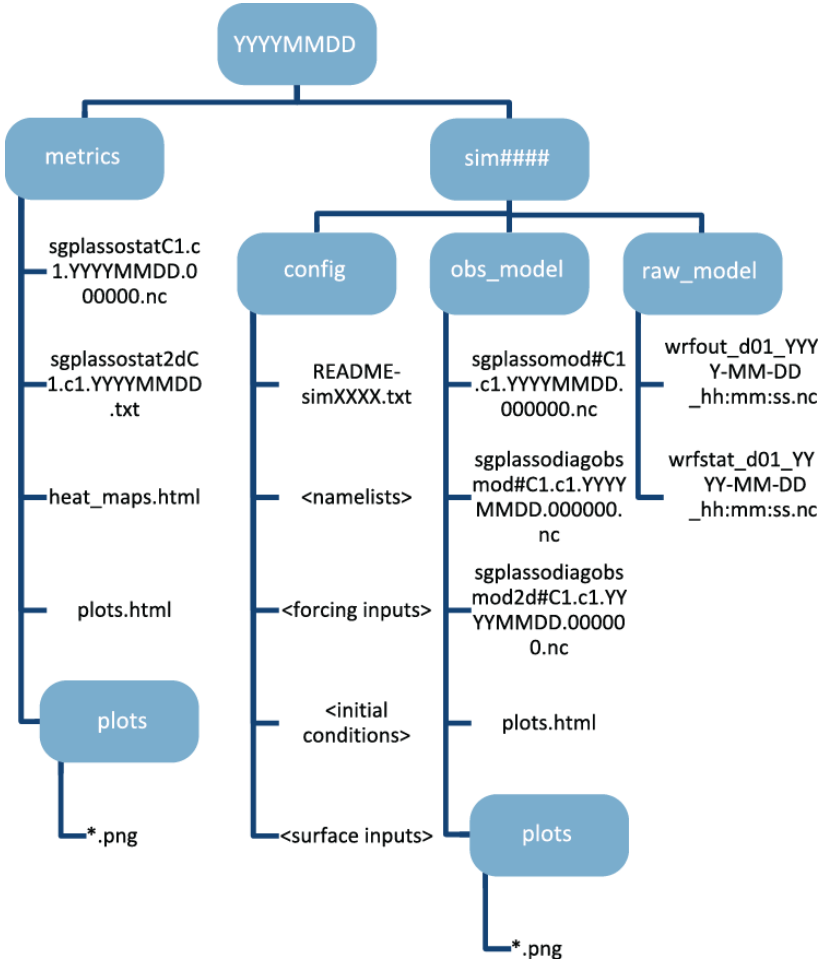
Data bundles designed to accommodate a wide range of sophistication

ARM CLIMATE RESEARCH FACILITY

BASIC USERS

ADVANCED USERS

- Diagnostics and metrics for discovery & model evaluation
- ARM observations in a form directly comparable to the LES output
- Domain-wide and time averaged profiles for LES statistics, e.g., meteorological state, cloud fraction, variances
- Instantaneous LES output fields at regular intervals
- LES initialization and forcing data based on an ensemble of forcing sources



LASSO designed to add value to ARM data and increase its usage

ARM CLIMATE RESEARCH FACILITY

- As an observationalist
  - Inform instrument remote sensing retrievals
  - Conduct Observation System Simulation Experiments (OSSEs)
  - Test implications of radar scan strategies or flight paths
- As a theoretician
  - Get estimates of fluxes & co-variability of values
  - Test relationships w/o having to run the model yourself
- As a modeler
  - Know ahead of time which days have good forcing
  - Have co-registered observations at high-resolution scales
  - Have inputs and corresponding outputs to test parameterizations

What to expect going forward:
LASSO timeline & further development

LASSO Webpage: https://www.arm.gov/capabilities/modeling

LASSO e-mail list sign up: http://eepurl.com/bCS8s5

We want your feedback!

- Once implementation begins, so does the sluggishness caused by bureaucracy and inertia
- The next several months are critical for receiving feedback
  - Directly to the LASSO team, e.g., William.Gustafson@pnnl.gov
  - Atmospheric Modeling Advisory Group


William Gustafson, Pacific Northwest National Laboratory


Andy Vogelmann, Brookhaven National Laboratory


Jim Mather, Pacific Northwest National Laboratory


Graham Feingold, National Oceanic and Atmospheric Administration Earth System Research Laboratory


Minghua Zhang, Stony Brook University


Chris Golaz, Lawrence Livermore National Laboratory


Maike Ahlgrimm, European Centre for Medium-Range Weather Forecasts


David Turner, National Oceanic and Atmospheric Administration National Severe Storms Laboratory


Chris Bretherton, University of Washington

LASSO timeline

April 2015	Started LASSO pilot project
March 2016	Formed Atmospheric Modeling Advisory Group
May 2016	Began collecting data from new boundary facility instruments
July 2016	Released Alpha 1 data bundles
May 2017	Planned release of Alpha 2 data bundles Make recommendations to ARM and transition from pilot phase to routine operations
Later 2017	Formally adopt and implement recommendations 2017 ShCu cases most likely manually processed

Our current focus: preparing Alpha 2

Alpha 1

- Demonstrates the overall vision with data available during year 1
- Aimed at getting community response
  - Model configuration and forcing techniques
  - Observation-LES coupling into data bundles
  - Approach to metrics for model evaluation
  - Encourage thinking about how to use LASSO to enable research

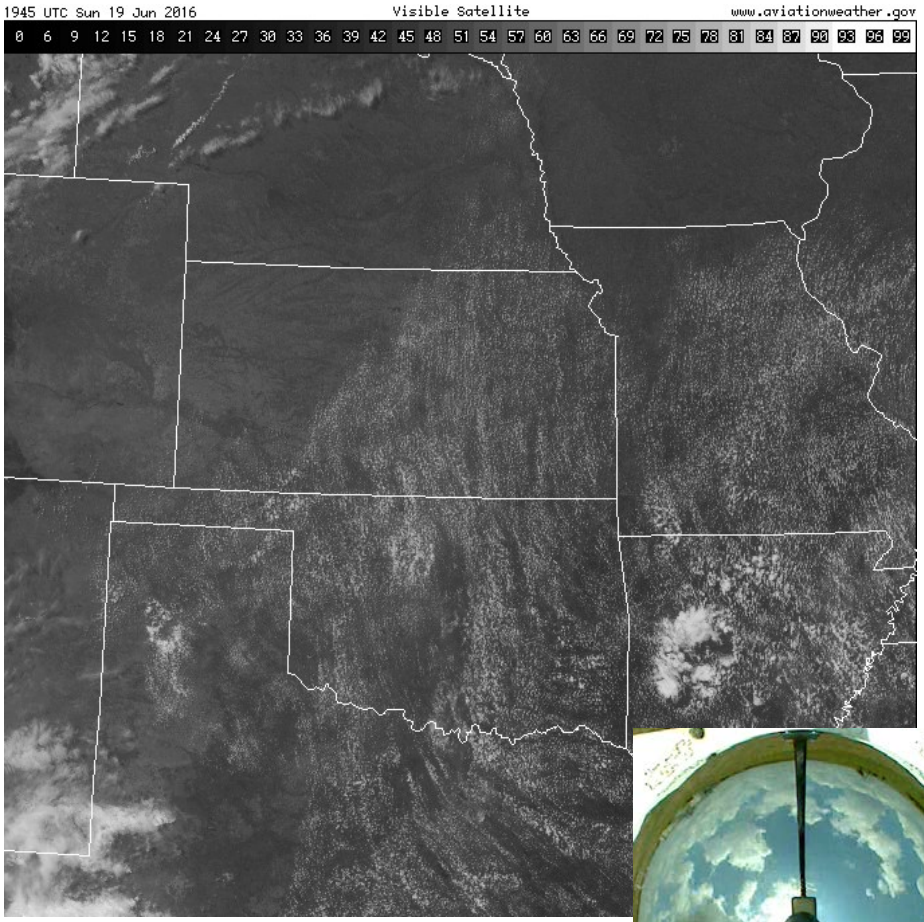
Alpha 2

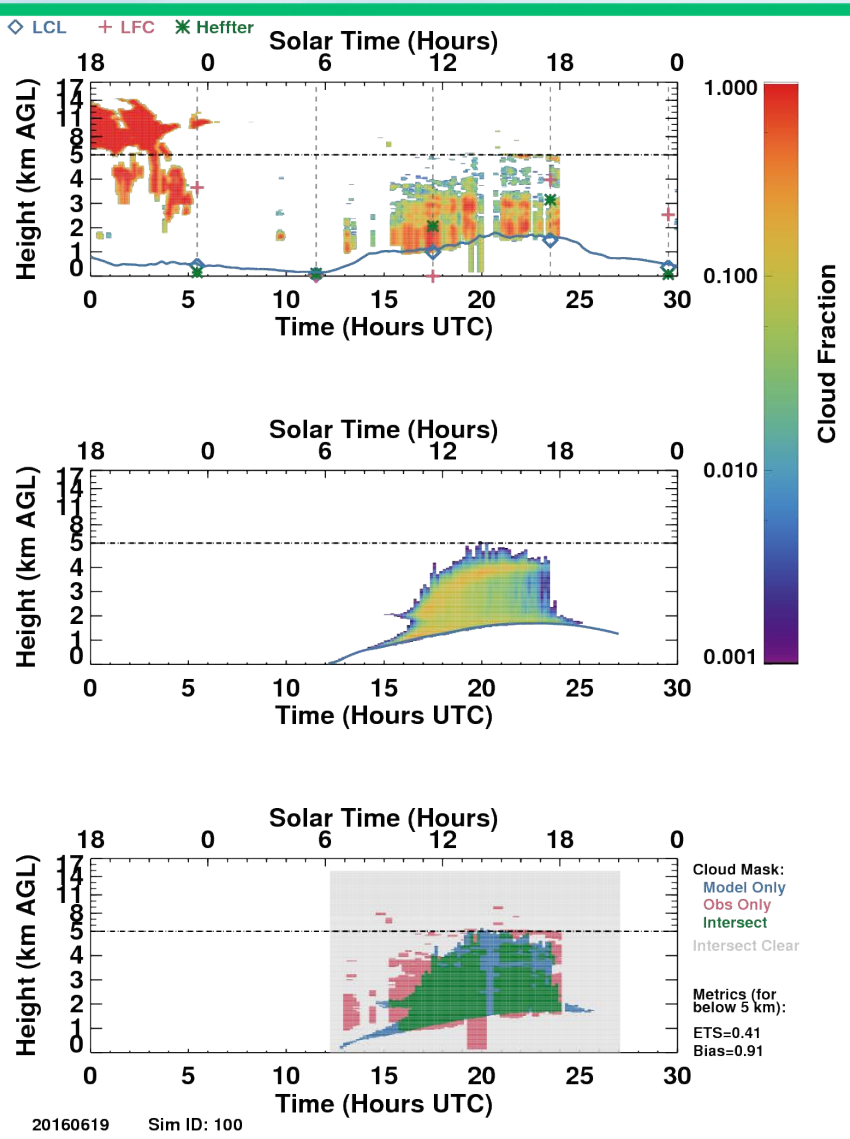
- Incorporates ARM profiles into data assimilation and metrics
- Expands evaluation from solely using Central Facility data to the broader SGP facility
- Begins exploring bounds of ShCu definition

Shallow convection, but what does that mean?

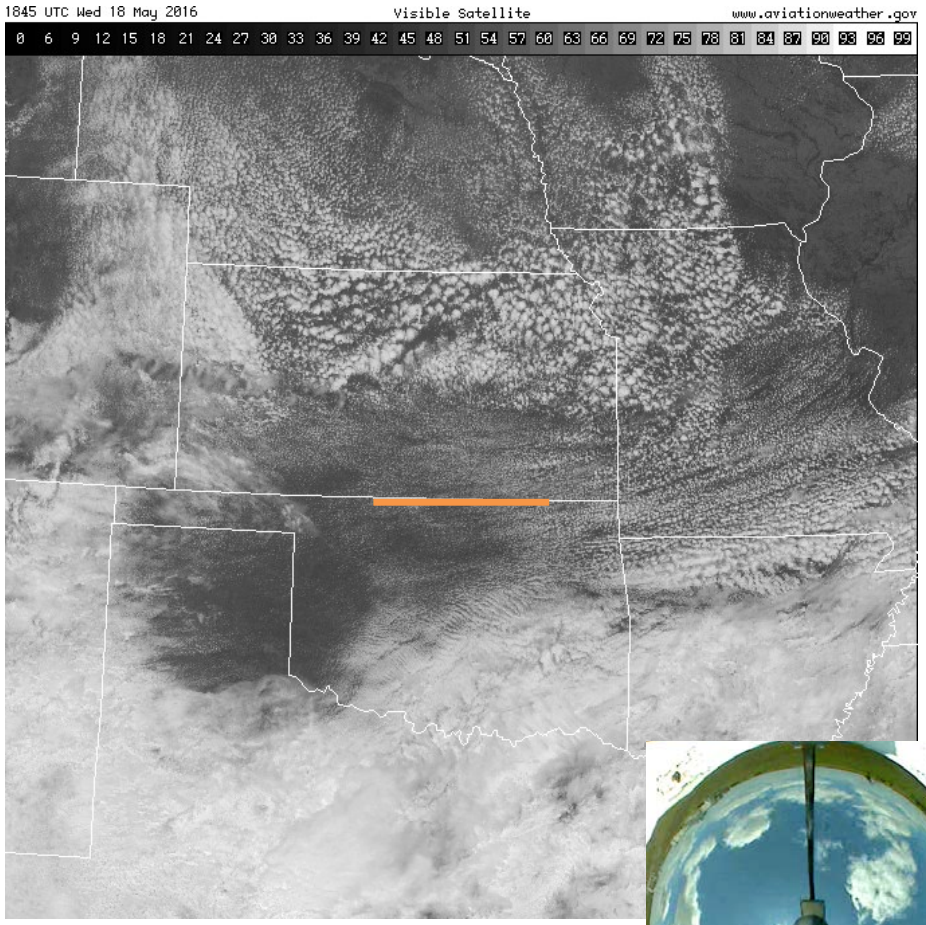
- We have tiered Alpha 2 into three categories of complexity
  - A = Classic / traditional shallow convection
  - B = Mixed shallow convection
  - C = Difficult shallow convection

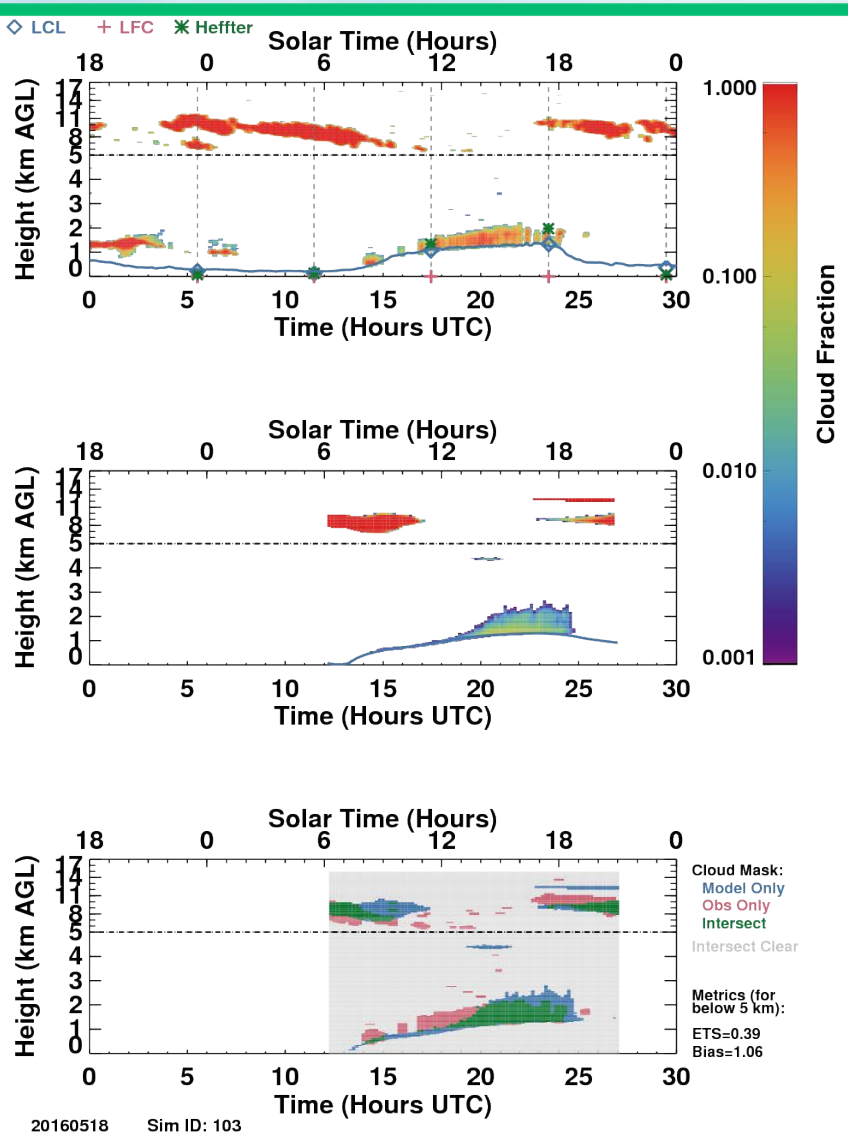
19-Jun-2016: classic ShCu



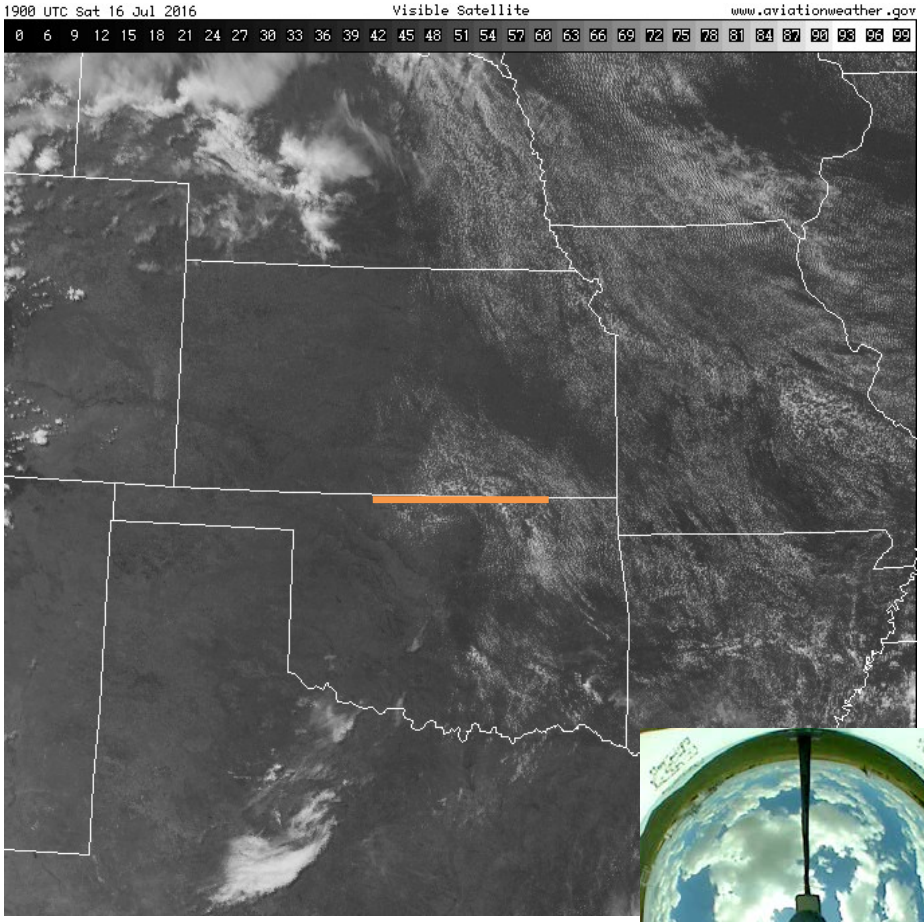


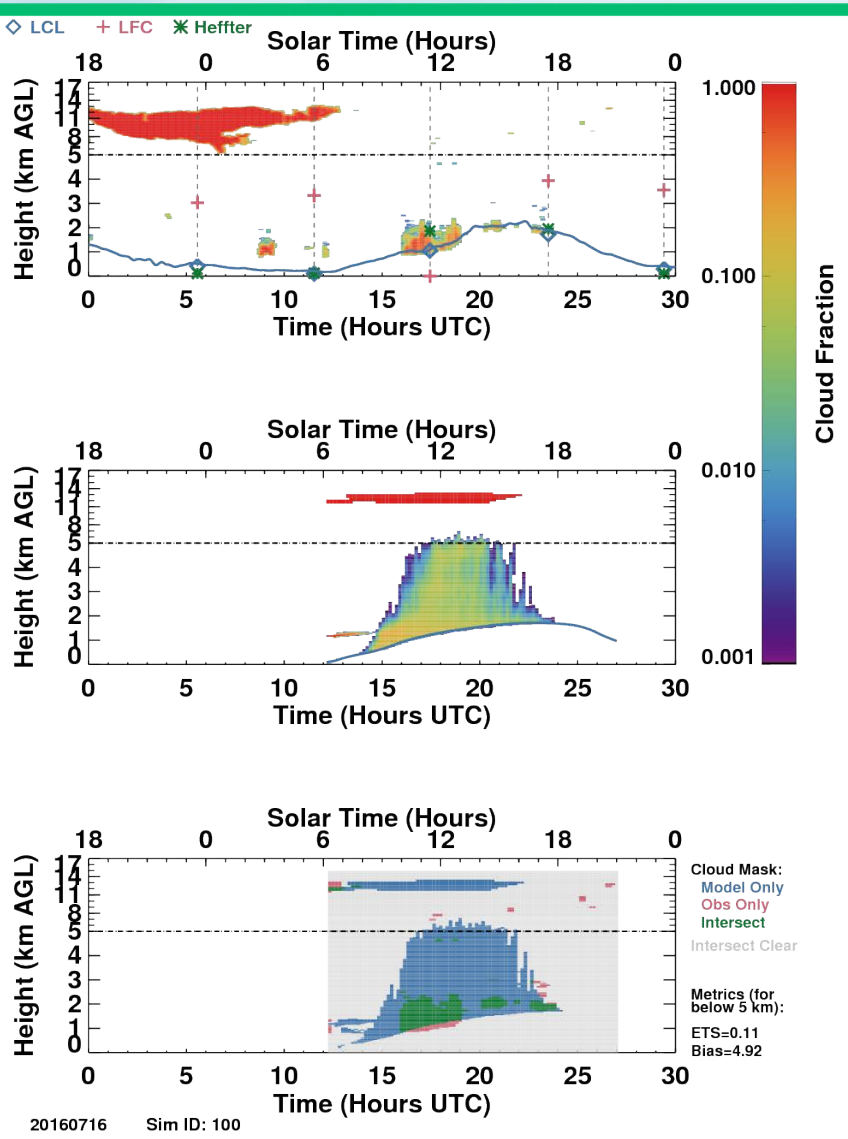
18-May-2016: Mixed ShCu





16-Jul-2016: Trouble?

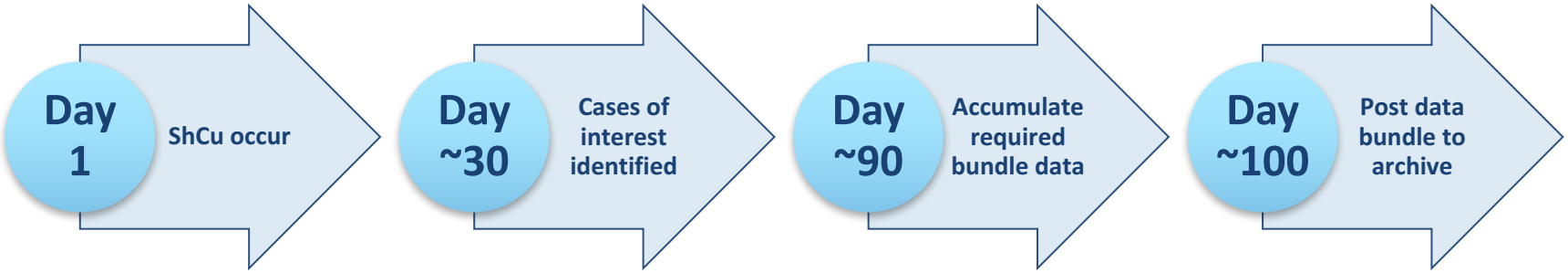




LASSO Operations

- Generate forcings every day
  - ARM will be in the weather hindcasting business
  - Time lagged to account for processing observations

- Hypothetical timeline for a given ShCu case



Discovering and accessing LASSO

- Discovery primarily through Bundle Browser http://archive.arm.gov/lassobrowser
  - Search by metadata
  - Search by value for pre-computed metrics
- Access via ARM's Archive
  - Grouping of data by "type" to ease download burden
  - Data Discovery / Bundle Browser links
  - Globus (online and API)
- Considering online analytics

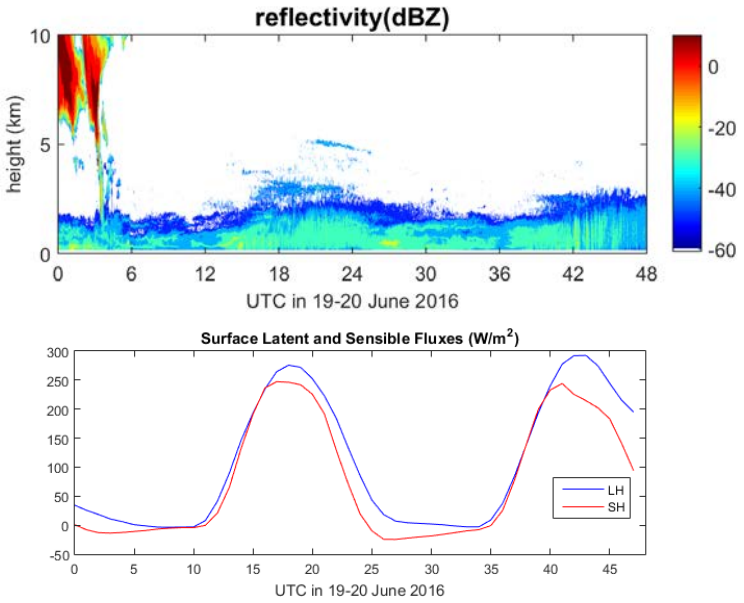
VARANAL with MSDA

Shaocheng Xie
Shuaiqi Tang

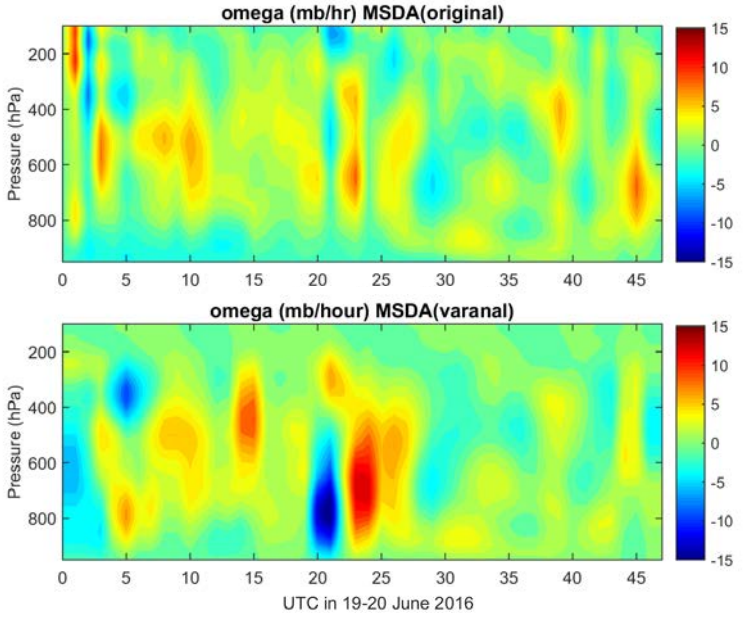
Optimally use available ARM observations

- Incorporate boundary layer profiles into MSDA and use it as the background data for VARANAL
- Add value to MSDA by applying constraints from ARM observations

LASSO shallow convection case, 19-20 June 2016



Forcing using original MSDA and VARANAL with MSDA



Discussion

What would make LASSO more valuable for your research?

- Does the modeling approach work for your needs?
  - What aspects help you most?
  - Is there anything you'd like added/changed?
- Does the data bundle approach work for your needs?
  - What part of the bundle would you use? (forcing, obs, LES output?)
  - Is there something you would like added/changed?
- What are desired discovery & access approaches?
  - What sort of discovery options are your highest priority?
  - What about "nice to haves" for discovery and online bundle interaction?
  - What data interfaces do you want for LASSO?

LASSO presence this week

Breakouts

Mon. 1:30–3:30 p.m.	ARM Data & Tools for Cloud Modeling and GCMs (Xie & Riihimaki)
Mon. 4–6 p.m.	LASSO (Gustafson)
Tues. 1:30–2:30 p.m.	Warm Boundary Layer Processes Working Group (Wood & Zhang)
Wed. 1:30–3:30 p.m.	Probing the Boundary Layer with ARM Lidar Systems: Implications for ASR Science and LASSO (Berg et al.)
Thurs. 1:45–3:45 p.m.	From Models to Virtual Observatories using Simulators (Kollias & Oue)

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