



# ARM

CLIMATE RESEARCH FACILITY

## Routine Large-Eddy Simulations of Continental Shallow Convection: Simulation Workflow Development and Megosite Observations

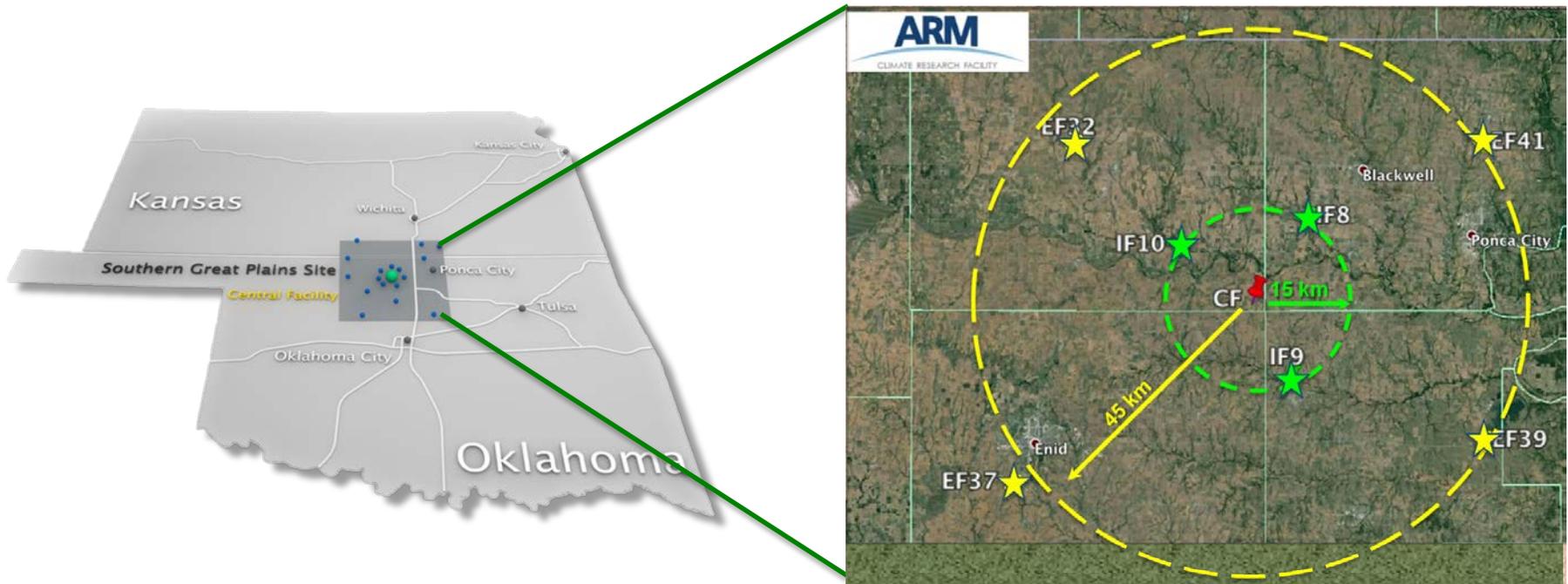
Andrew M. Vogelmann (Co-PI)<sup>1</sup>, William I. Gustafson Jr. (PI)<sup>2</sup>, Zhijin Li<sup>3,4</sup>,  
Xiaoping Cheng<sup>5</sup>, Satoshi Endo<sup>1</sup>, Bhargavi Krishna<sup>6</sup>, Tami Toto<sup>1</sup>, Heng Xiao<sup>2</sup>

<sup>1</sup>BNL, <sup>2</sup>PNNL, <sup>3</sup>UCLA, <sup>4</sup>JPL, <sup>5</sup>Nanjing University, <sup>6</sup>ORNL

### Summary

The LES ARM Symbiotic Simulation and Observation (LASSO) Workflow is designed to complement the ARM megasite observations with LES output to support community study of atmospheric processes & improved model parameterizations.

# DOE Atmospheric Radiation Measurement (ARM) Facility's Southern Great Plains (SGP) Megosite



- CF: Extensive meteorology, cloud, radiation, aerosol, & surface flux obs
- 15 km: Includes Radar Wind Profilers
- 45 km: Includes Doppler Lidar, Surface fluxes, IR Spectrometer, MWR

# LASSO Objectives

- Help bridge the scale gap between DOE ARM observations and models
- Use routine LES to add value to observations
  - Provide a dynamical context for the observations
  - Provide *unobservable* processes & properties
  - Self-consistent representation of the atmosphere
- Generate a simulation library for researchers
  - Enable *statistical* approaches beyond single-cases
  - Provide information needed by modelers to reproduce the LES

# What LASSO could do for YOU

## ■ Observationalists

- Aid development of instrument remote sensing retrievals
- Test implications of instrument scan strategies or flight paths

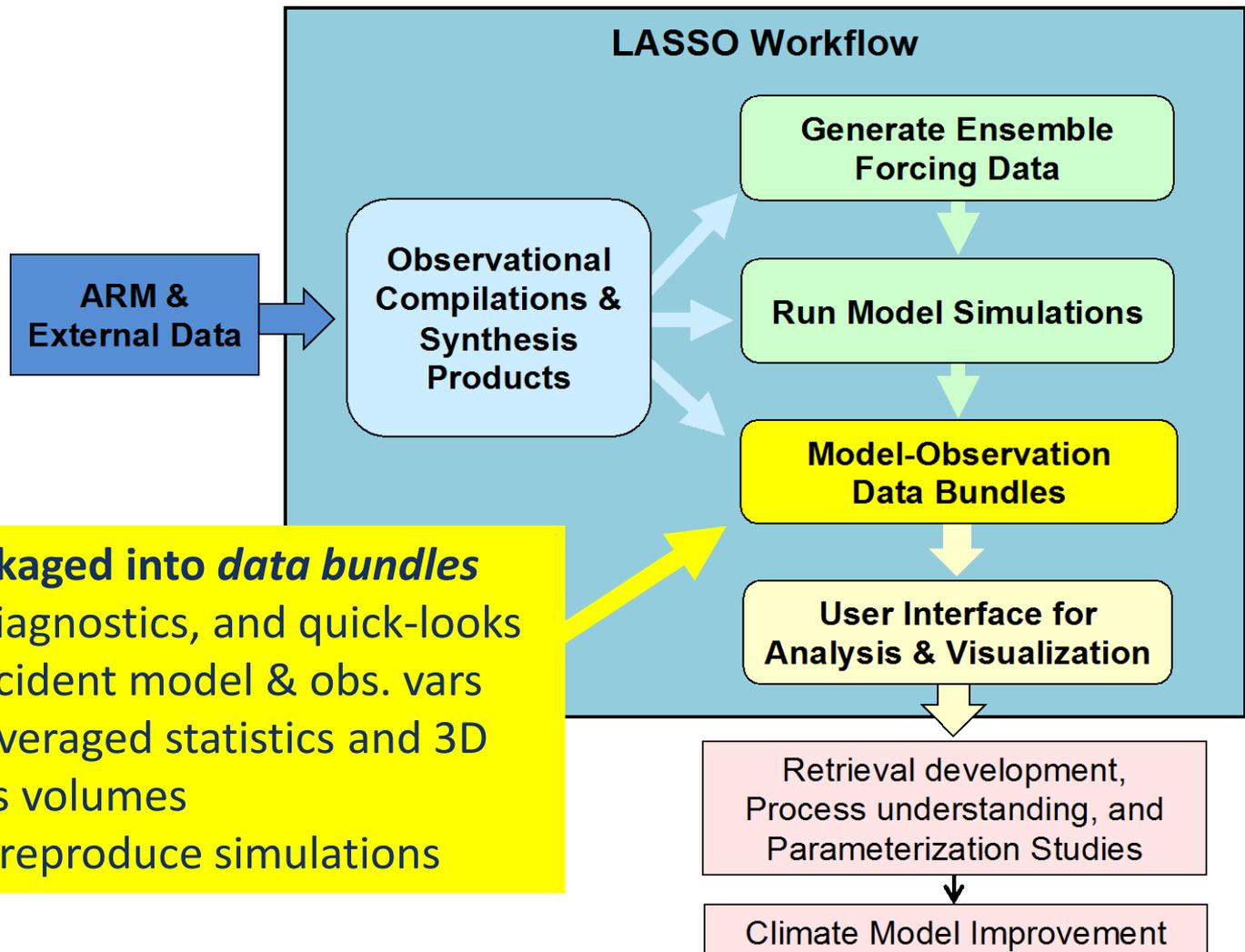
## ■ Theoreticians

- Get estimates of fluxes & co-variability of values
- Test relationships without having to run the model

## ■ Modelers

- Know which days have good forcing (atmospheric specifications)
- Have co-registered observations at high-resolution scales
- Have the inputs and outputs to test parameterizations

# LASSO Workflow to Support Research

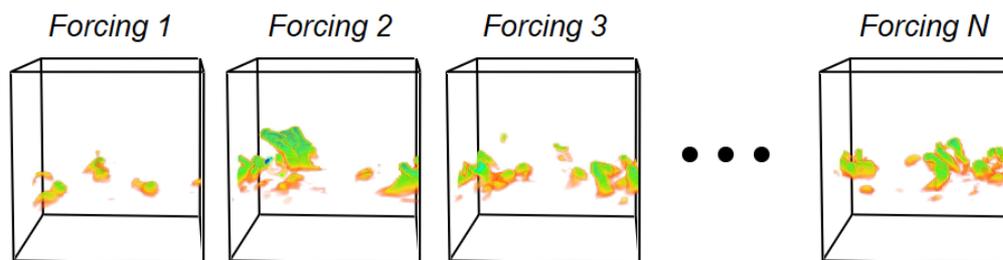
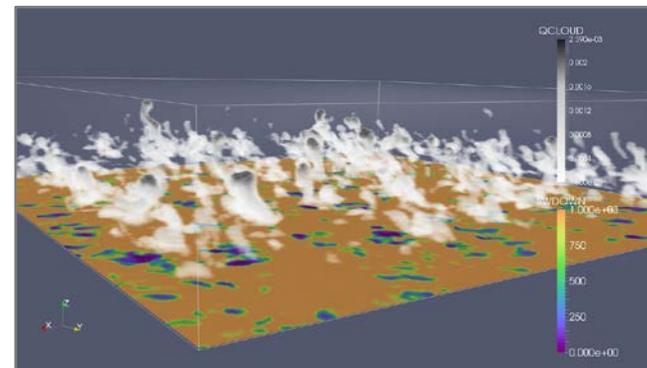


## Simulations packaged into *data bundles*

- Skill scores, diagnostics, and quick-looks
- Selected coincident model & obs. vars
- LES domain-averaged statistics and 3D instantaneous volumes
- Input data to reproduce simulations

# Model Configuration & Approach

- Evaluating SAM & WRF
- Configuration:
  - Doubly-periodic domains
  - $\Delta x=100$  m,  $\Delta z=30+$  m to tropopause
  - Environmental specifications
    - 12Z radiosonde, Surface fluxes from ARM Observations, Large-scale tendencies
- Models run in a hindcast mode using ensemble forcings
  - Forcing uncertainty determines model results to 0<sup>th</sup> order
  - Routine LES cannot afford to tune forcings as done for case studies
  - The ensemble aims to bound the realizations w/ metrics to evaluate



# Ensemble Forcings from 3 Sources

1. ARM constrained variational analysis (300 km scale)
2. ECMWF-analysis-based forcing (75, 150, 300 km)
3. Multi-scale data assimilation (MS-DA) (75, 150, 300 km)
  - WRF-based using Gridpoint Statistical Interpolation (GSI) system
  - Scale separation to combine observations at coarse & fine scales
  - Initially using GSI w/ 3D-Var DA and will test hybrid EnKF DA
  - Can directly incorporate ARM observations
    - ▣ Hybrid Raman Lidar+AERI-retrieved T profiles
    - ▣ Raman Lidar Qv profiles
    - ▣ RWP wind profiles
    - ▣ Surface meteorology network

# LASSO Bundle Browser

**ARM DATA DISCOVERY**  
LASSO BUNDLE BROWSER - VISUALIZATION & ACCESS

DATA DISCOVERY / LASSO HOME / ARM ARCHIVE / HELP / FEEDBACK

**Introduction**  
Welcome to the LASSO Bundle Browser that is designed to assist users with identifying LASSO large-eddy simulations (LES) of interest for their research. The plots and associated data table update dynamically based on user search criteria, and links within the table enable direct access to the data bundles of the displayed simulations. More information on LASSO and the data bundles can be found at the LASSO home page and on the Alpha 1 Release web page. Note that this is an initial evaluation version of the browser that specifically queries and displays observed and simulated cloud properties for the five days worth of simulations released in the LASSO Alpha 1 release. There are 187 simulations between the five days that differ in terms of the LES model, forcing dataset, domain size, and model physics.

**Date: June 27, 2015**

**Measurement: Liquid Water Path (LWP) (g/m<sup>3</sup>)**

**Select All**

**DATE**

- June 6, 2015
- June 9, 2015
- June 27, 2015
- August 1, 2015
- August 29, 2015

**MEASUREMENTS**

**MODEL TYPE**

**OUTPUT DOMAIN SIZE**

**NUMBER OF LEVELS**

**LARGE SCALE FORCING**

**LARGE SCALE FORCING SCALE**

**INITIAL CONDITION**

**SURFACE TREATMENT**

**MICROPHYSICS**

**Submit**

**Overview Plots**

- Heat Maps
- Metrics

**Taylor Diagrams**

△ - SAM ○ - WRF

Normalized Standard Deviation

Observed Std. Dev. color legend same as Skill score plot

Sim 19 (27 J 1 3) all

Sim 20 (27 J 1 3) all

Sim 21 (27 J 1 3) all

Sim 32 (27 J 1 3) all

Sim 33 (27 J 1 3) all

Composites

**Taylor Skill**

△ - SAM ○ - WRF

\*Points are color grouped by Forcing

Taylor Skill

Relative Mean Skill

MSCA

**Time Series**

17 - Obs △ - SAM ○ - WRF

Observation

Sim 19 SAM

Sim 20 SAM

Sim 21 SAM

Sim 31 WRF

Sim 32 WRF

Sim 33 WRF

Time (hours, solar)

**Model Data**

△ - SAM ○ - WRF

△ 19-SAM-MSDA

△ 20-SAM-MSDA

△ 21-SAM-MSDA

○ 31-WRF-MSDA

○ 32-WRF-MSDA

○ 33-WRF-MSDA

Model Data

Observation Data

**Skill Scores on June 27, 2015**

Copy CSV Print PDF

Search

Measurement Skill

1D Cloud Skill

2D Cloud Mask Skill

Total Cloud Skill

Slide orange sliders to adjust min and max skill ranges

Simulation ID	Measurement Skill (Liquid Water Path [LWP])	1D Cloud Skill	2D Cloud Mask Skill	Total Cloud Skill
19 (Diagnostic) (Data)	0.02	0.01	0.06	0.09
20 (Diagnostic) (Data)	0.12	0.19	0.23	0.21
21 (Diagnostic) (Data)	0.14	0.26	0.29	0.27
31 (Diagnostic) (Data)	0.8	0.68	0.23	0.44
32 (Diagnostic) (Data)	0.53	0.13	0.29	0.30
33 (Diagnostic) (Data)	0.12	0.19	0.13	0.19

Showing 1 of 0 entries

Print Full View

Privacy & Security Notice for rights request.

<http://archive.arm.gov/lassobrowser>

# LASSO Data Releases & Contact Information

## ■ Data Releases

- Alpha 1: 192 simulations from 5 ShCu days in 2015
- Alpha 2: To be released in July (13 ShCu cases from 2016)
- Summer 2017: Soft transition of LASSO to operations

## ■ Contact information

- **Leads:** Andrew Vogelmann: [vogelmann@bnl.gov](mailto:vogelmann@bnl.gov)  
Bill Gustafson: [William.Gustafson@pnnl.gov](mailto:William.Gustafson@pnnl.gov)
- **LASSO Webpage:** <https://www.arm.gov/capabilities/modeling/lasso>
- **LASSO e-mail list sign up:** <http://eepurl.com/bCS8s5>