# LASSO† Update: Current Products and Expansion Planning

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†Large-Eddy Simulation (LES) Atmospheric Radiation Measurement (ARM) Symbiotic Simulation and Observation; ‡Corresponding author: vogelmann@bnl.gov

## Summary

- LASSO generates observationally constrained, routine large-eddy simulations (LES) of shallow convection over the Southern Great Plains (SGP) region to augment routine observations.
- LASSO data bundles are provided to the community for their research, which include model inputs and outputs, observation-based diagnostics, and skill scores.
- Approximately 50 cases are available over three summer seasons (2015-2017) with another 30 cases for 2018 to be released this summer.
- Planning is underway to expand LASSO to the other weather regimes.

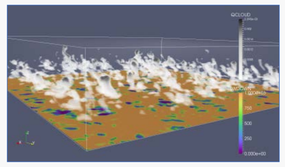
## 1. What is LASSO?

LASSO supports ARM research with high-resolution modeling

- Facilitates basic research and helps link ARM observations with global-scale models.

Key LASSO features:

- LES is constrained and evaluated using ARM observations,
- Routinely run to build a library of case data for statistical studies,
- Data bundles provide model input and output, ARM observations, diagnostics and skill scores to enable research.



## 2. Data Availability

SGP Shallow Convection Cases:

- 5 days, May–July 2015
- 12 days, May–August 2016
- 30 days, April–September 2017
- 30 days, May–October 2018 (soon)

The LASSO Bundle Browser (https://adc.arm.gov/lassobrowser) eases querying and queuing the data for download. The web interface enables intercomparing simulations using diagnostic plots and simulation skill scores.


### LASSO Ensemble Simulations

8 Forcings are used for recently run cases

- ARM Variational Analysis (300 km scale)
- ECMWF Analyses (16, 114, and 413 km)
- Multi-Scale Data Assimilation (75, 150, and 300 km)
- None (static background)

Different grid spacings and domain sizes available for select 2015 and 2016 cases

**LASSO data bundles** are designed for use by a range of researchers, from those unfamiliar with modeling to aficionados.

**LES Inputs & Diagnostics:** *lassodiagconfobsmodSIMID.m1*

- Model Inputs, for reproducing simulations: Large-scale forcings, surface fluxes, initial conditions, WRF namelist
  → *Contains information needed to run an SCM*
- Observation and model diagnostic fields, skill scores, and plots

**Raw WRF Model Output:** *lassodiagrasSIMID.m1*

- WRFout 10-min 3-D output fields
- WRFstat for statistics

**High Frequency Observations:** *lassohighfreqobs.c1*

- LWP, Mid-boundary layer temperature & moisture, ShCu cloud-base height from Doppler lidar

**← See Toto et al. LASSO-O Poster #1**

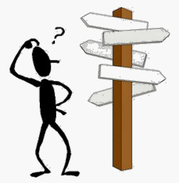
## 4. Expanding LASSO to Other Weather Regimes

LASSO will continue to run SGP shallow convection cases for another couple of years.

Meanwhile, planning is underway to expand LASSO to other weather regimes, with work to start on the next regime in FY20.

Whitepapers were solicited for candidate scenarios and a workshop was held to assess each.

### Scenario Criteria



1. Must be science driven, aligned with ARM's mission and broad community need.
2. Must effectively integrate observations and simulations.
3. Should clearly add value via running the simulations.
4. Scenario timing cannot precede necessary observational data sets.
5. Computational cost must be within constraints, but is not the primary criterion.

All scenarios considered are viable, but with different timeline constraints that may affect the order in which they could be addressed. Considerations are summarized below. **A survey is coming!**

## Scenarios Under Consideration

### Clear-Air Turbulence

*Writing Team:* William Gustafson Jr (Chair), and Larry Berg

**Key Science Drivers**

- Boundary layer turbulence basic to weather & climate
- Boundary layer transitions
- Wind energy

**Locations**

- SGP, or possibly the Arctic

**Proposed Model Configuration**

- Much higher resolution than ShCu (e.g., dx=25 m, dz=2-5 m near sfc.)
- Nesting may be needed for moisture gradients and topography
- Domain size ~12 km if periodic, larger if nested

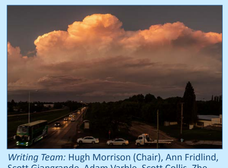
**Critical Measurements/Products**

- Doppler lidar turbulence products
- Develop turbulent moisture and temperature fluxes (combined Doppler and Raman lidar data)

**Timing Considerations**

- Doubly-periodic domains simple; Nesting will take more thought/work
- Using a faster model would help with the higher resolutions needed
- Data are available; time needed for product development and to interface with the model diagnostics

### Deep Convection



*Writing Team:* Hugh Morrison (Chair), Ann Fridlind, Scott Giangrande, Adam Varble, Scott Collis, Zhe Feng, Daniel Hernandez-Deckers, Matthew Kumjian, Sonia Lasher-Trapp, Toshi Matsui, Mariko Oue, Glen Romine, Greg Thompson, Marcus van Lier-Walqui, and Guang Zhang

**Key Science Drivers**

- Convective cloud dynamics
- Microphysics-dynamics interactions

**Locations**

- CACTI, TRACER, SGP

**Proposed Model Configuration**

- Nested simulations: Run ensemble with dx=2.5 km, Pick best cases, then run with dz=100 m for inner domain (150 x 150 km)
- Estimate simulating ~10 cases in a year (~1–5 LES per case)

**Critical Measurements/Products**

- Scanning radar, especially C-band for sampling storm cores
- Basic radar-related products: convective fraction area, domain-averaged precipitation and PDF, echo top heights, and first echo heights.

**Timing Considerations**

- WRF readily adaptable to needed configuration; Data storage/sampling requires thought/work
- Ensemble methodology requires thought/work
- Need of C-band restricts options primarily to CACTI and TRACER
- CACTI data products underway; time needed to interface with model diagnostics

### Marine Shallow Clouds

*Writing Team:* Robert Wood (Chair), Richard Forbes, Graham Feingold, and Pavlos Kollias

**Key Science Drivers**

- Low-cloud feedbacks
- Cloud sensitivity to aerosol loading

**Locations**

- Eastern North Atlantic (ENA)

**Proposed Model Configuration**

- Doubly periodic only over ocean (island not treated)
- Aerosol-aware microphysics
- Resolution dx=~50-100 m, dz=~10-20 m, over ~20-60 km domain

**Critical Measurements/Products**

- Development of lidar-based CCN profile retrieval
- XSAPR2 needed for drizzle products
- Surface fluxes from buoy, ERA5 SST, or ECMWF IFS (needs study)

**Timing Considerations**

- WRF readily adaptable
- ENA Science Team cloud and precipitation products available; need time for vetting and interfacing with model diagnostics
- Development and testing of CCN retrieval
- Can start with ACE-ENA, but need XSAPR2 data for later periods

### Central Arctic Clouds

*Writing Team:* Gijs de Boer (Chair), Mikhail Ovchinnikov, Michael Tjernström, Roel Neggers, Matthew Shupe, Joseph Sedlar, Steve Krueger, Erika Roesler, Jerry Harrington, Amy Solomon, Maximilian Maahn, Hailong Wang, David Turner, and Allison McComiskey

**Key Science Drivers**

- Mixed-phase lifecycle, aerosol-cloud and surface-atmosphere interactions in a region seeing rapid change

**Locations**

- MOSAiC, Utqiaġvik

**Proposed Model Configuration**

- Uncertain whether doubly periodic suitable or nesting is needed
- Aerosol-aware cloud microphysics ensemble
- Resolution dz=~20–40 m, dz <~10m, over ~30 km domain

**Critical Measurements/Products**

- Aerosol profiles including ice nuclei
- Surface fluxes; distribution of leads needed esp. if springtime simulated
- Cloud boundaries, and LWP and IWP (esp. for low values)

**Timing Considerations**

- Model configuration (doubly periodic or nesting) needs assessment
- Development of aerosol profile
- MOSAiC ARM data available starting early 2020 with VAPS in 2021
- Will need measurements from other groups.

Sign up for the LASSO e-mail list to get updates at
http://eepurl.com/bCS8s5

### For More Information

lasso@arm.gov
https://www.arm.gov/capabilities/modeling/lasso/

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