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

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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.

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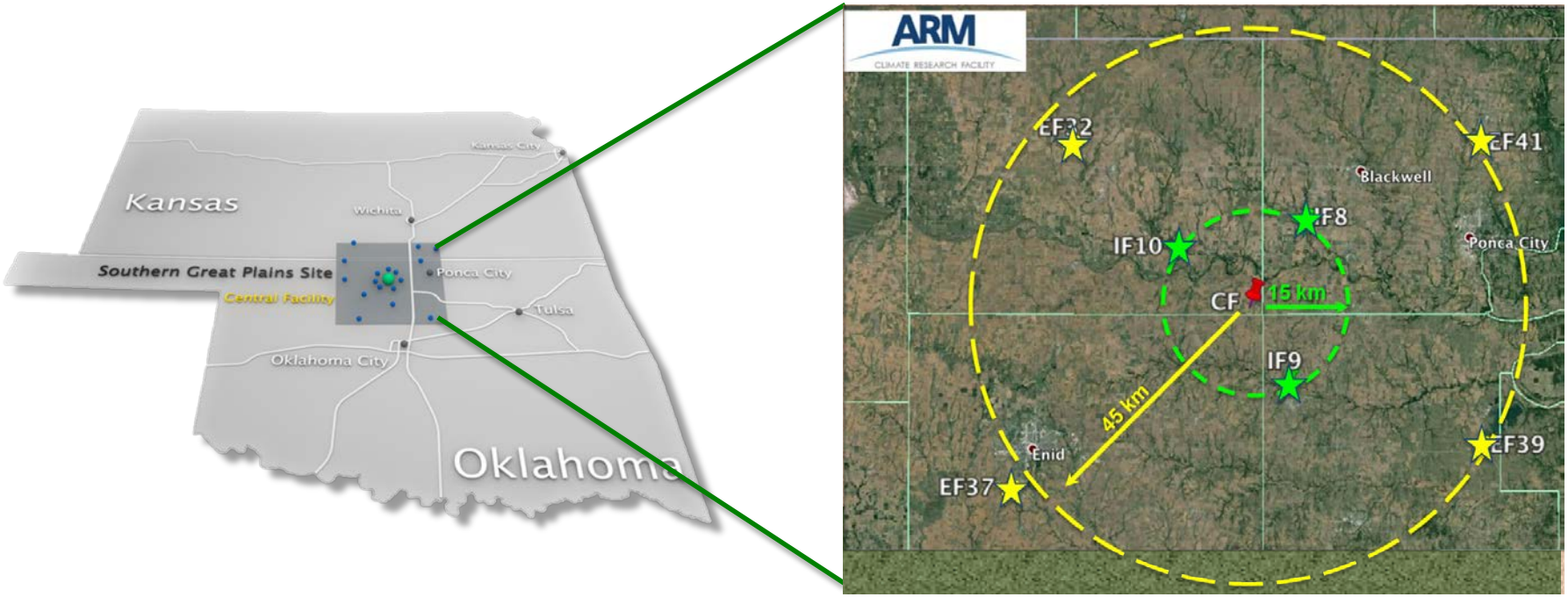
DOE Atmospheric Radiation Measurement (ARM) Facility's Southern Great Plains (SGP) Megasite



- 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

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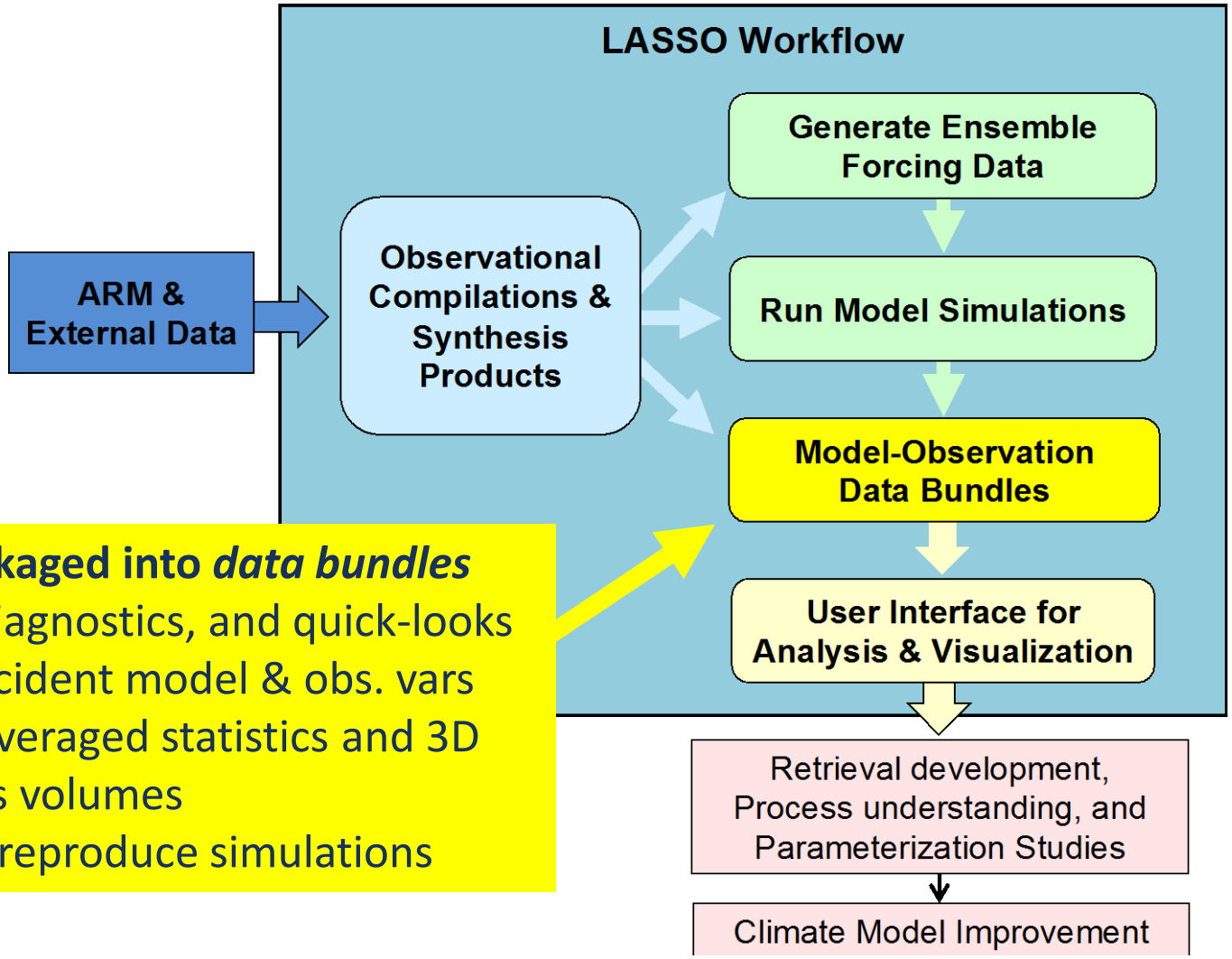
LASSO Objectives

- 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

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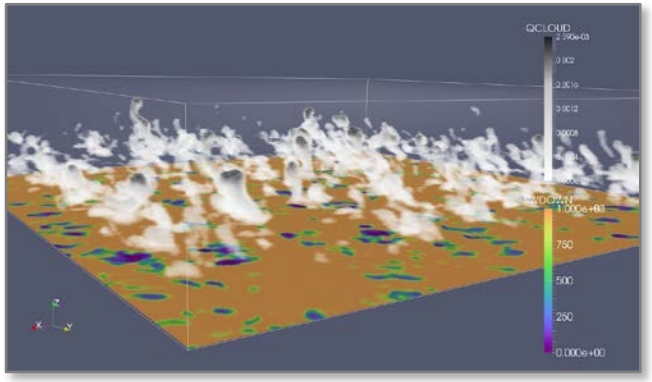
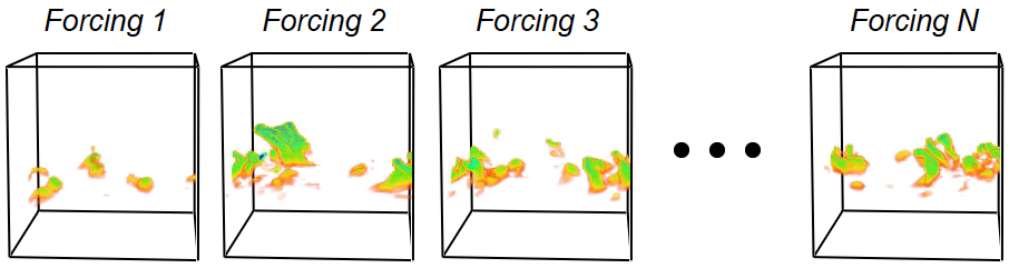
Model Configuration & Approach

- Evaluating SAM & WRF
- Configuration:
  - Doubly-periodic domains
  - Δx=100 m, Δz=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^{th} order
  - Routine LES cannot afford to tune forcings as done for case studies
  - The ensemble aims to bound the realizations w/ metrics to evaluate



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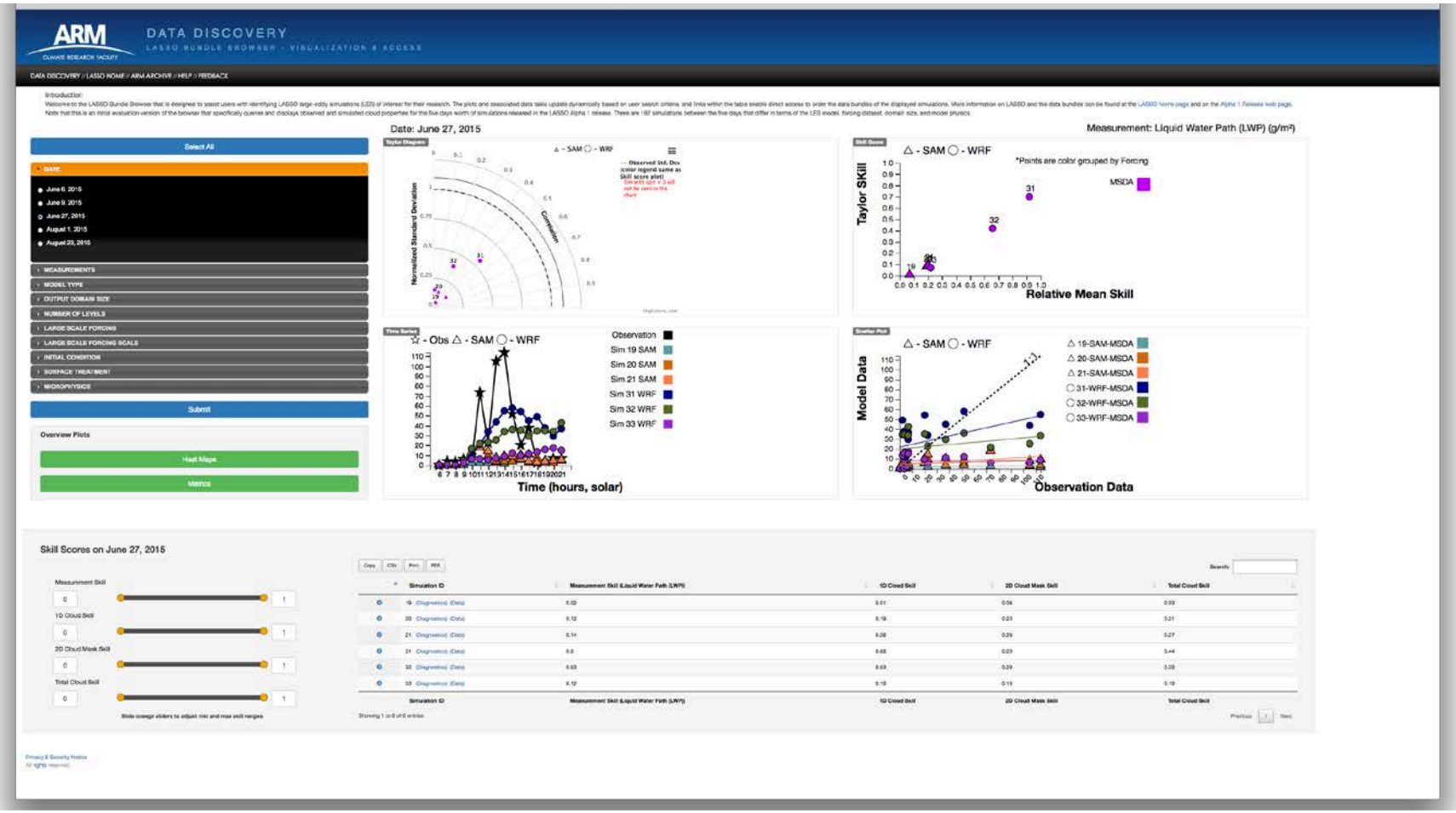
Ensemble Forcings from 3 Sources

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



http://archive.arm.gov/lassobrowser

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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
    Bill Gustafson: William.Gustafson@pnnl.gov
  - **LASSO Webpage:** https://www.arm.gov/capabilities/modeling/lasso
  - **LASSO e-mail list sign up:** http://eepurl.com/bCS8s5