LASSO Data Bundle Development and Discovery

Andrew Vogelmann[1], Bhargavi, Krishna[2], William Gustafson[3], Tami Toto[1], Zhijin Li[4,5], Xiaoping Cheng[5], Satoshi Endo[1], Jinwon Kim[4], & Heng Xiao[3]

[1]BNL, [2]ORNL, [3]PNNL, [3]UCLA, [4]JPL, [5]Nanjing U.

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

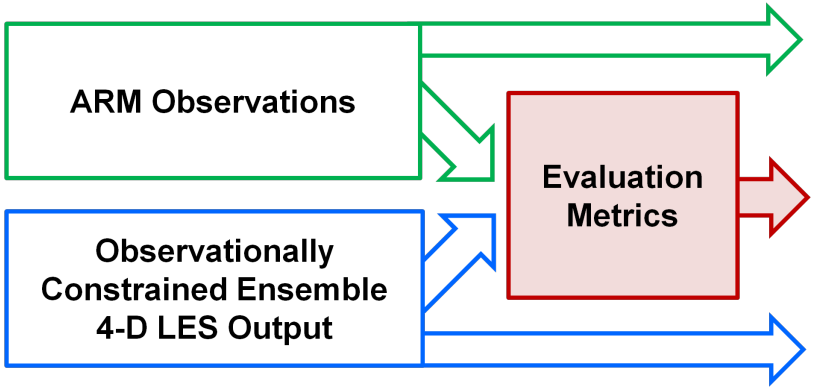
LASSO e-mail list sign up: http://eepurl.com/bCS8s5

What you need to know be a bundle pro

- What is a LASSO Data Bundle?
  - Model input vs. model evaluation
- Model evaluation
  - Diagnostics
  - Model skill scores
- Data Bundle Observations
  - Alpha 1 release
  - Alpha 2 release
- Interactive querying: The LASSO Bundle Browser (Bhargavi)

What is a LASSO Data Bundle?

Package of observations and simulations (aka, a "data structure") aimed at providing the best description of the atmosphere



Data Bundles

1. **Case descriptors**
2. **Observations & Evaluation metrics**
3. **Model input and output fields**

Navigate

1. **Case descriptors**
   - Cloud type, weather state, inversion strength, etc.
2. **Evaluation metrics**
   - Model-observation diagnostics
   - Model skill scores
   - The observations used
3. **Model input and output fields**
   - Includes 3-D model fields, profile statistics, and model-based budget terms
   - Forcings and initial conditions

Find

Model input vs. model evaluation

- Model initialization and forcing generation
  - Can assimilate meteorological variables
    - T, P, water vapor mixing ratio, winds (plus non-ARM other NCEP data)
    - Prefer observations that are as all-weather as possible
  - Cannot assimilate cloud variables or surface fluxes
    - These properties are either specified (fluxes) or used for evaluation (cloud)

Initialization and Forcing

Alpha 1

- Sonde profiles @6 h (T, P, wv, winds)
- Surface MET and Mesonet data @1 h (T, P, wv)

Alpha 2, the above plus:

- Hourly boundary layer profiles (T, P, wv, winds) (Raman lidar/AERIoe, Radar wind profiler)

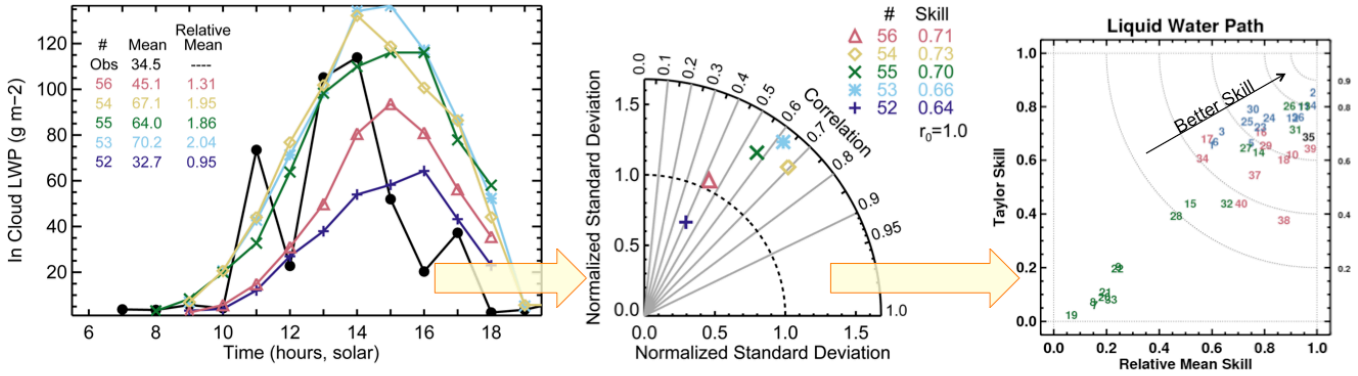
LASSO diagnostics

- Ensemble LES simulations are assessed using ARM observations of cloud and environmental variables
- A diagnostic plot compares model output to observations
  - "Like" processing of a quantity (e.g., LCL)
  - Use of instrument simulators to make the model output look like instrument observations [Breakout Session, Thursday, 1:45 pm – 3:45 pm: "From Models to Virtual Observatories using Simulators"]
- Diagnostics used
  - Time series
  - Taylor diagrams
  - Regression analyses
  - 2-D cloud masks
  - Heat maps
  - Phase space relationships

- Pre-computed plots in the data bundles
- Interactive (Bundle Browser)

LASSO model skill scores

- Skill scores, based on the diagnostic plots, assign a numerical value to the level of model-observation agreement
- Enables assessing the ensemble model simulations (e.g., Alpha 1 had ~30-40 simulations per case!)

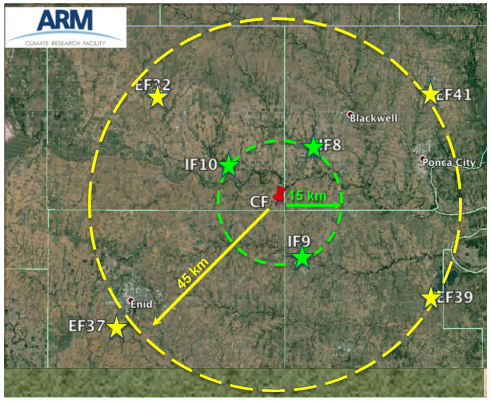


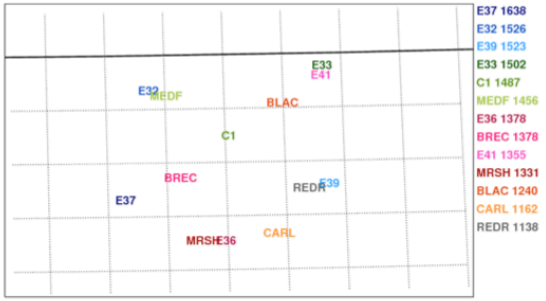
Alpha 1: Focus on Central Facility

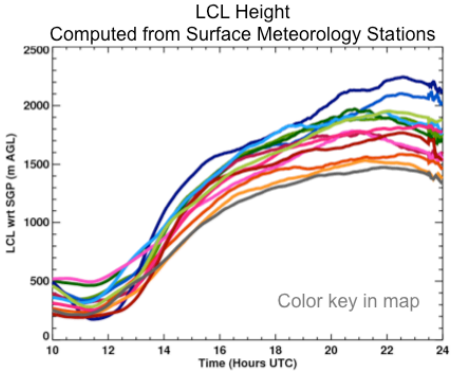
- 5 case days with model initialization and validation based on point measurements at the SGP central facility (CF).
- Observations include cloud and environmental variables at the CF:
  - Cloud:
    - Cloud fraction (TSI, ARSCL)
    - Liquid water path (AERIoe, MWR-2C)
    - 2-D time-height cloud location (ARSCL)
  - Environment:
    - Meteorological variables at the surface and aloft
      - Soundings (T, qv, RH, Θ, Θ_e) every 6 h
      - Hourly qv, RH, T at surface (MET) and at mid-BL (Raman Lidar)
    - LCL (computed from MET)

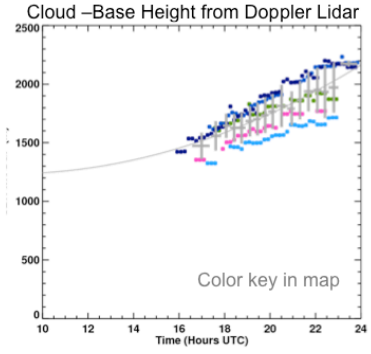
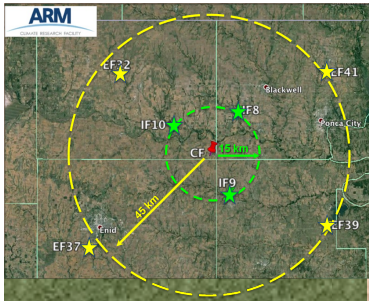
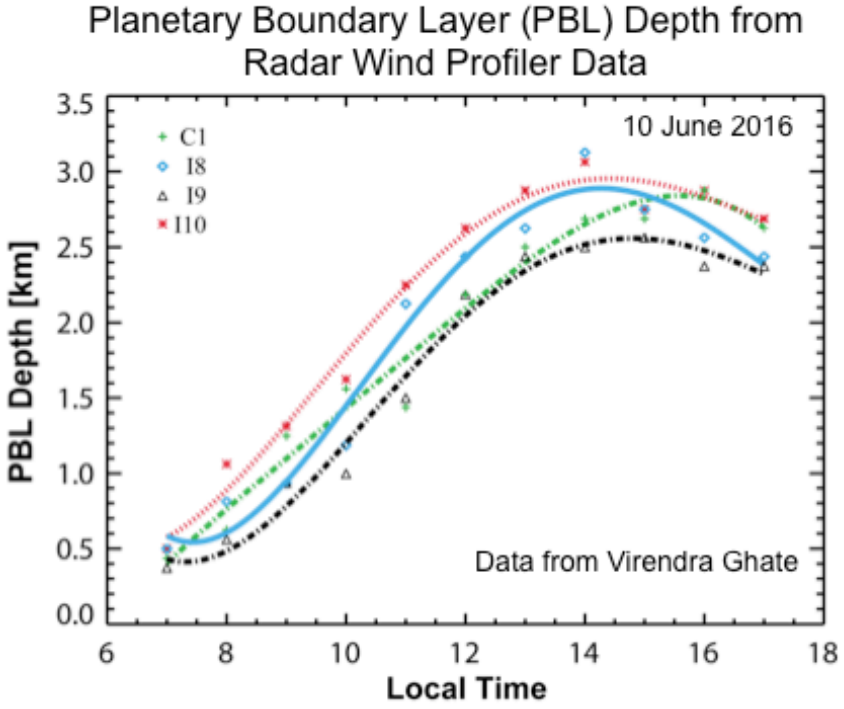
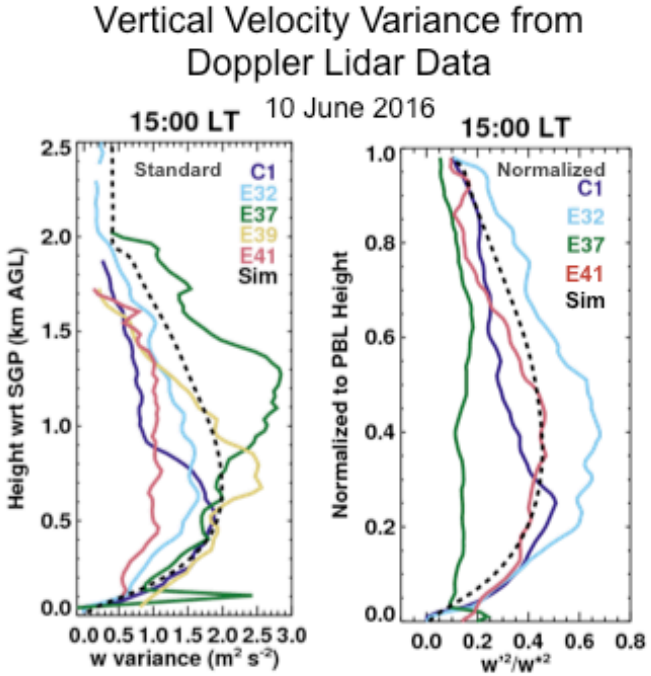
Alpha 2: Focus on Regional Observations

- 14 case days with model initialization and validation using measurements from the CF, Intermediate Facilities (IF), and Extended Facilities (EF).
- Include more observations, particularly focused on boundary layer properties. New to Alpha 2 are:
  - Cloud
    - Improved and regional liquid-water path (AERIoe v2.4)
    - Cloud-base height (Doppler Lidar)
  - Environment
    - Planetary boundary layer height (Radar Wind Profiler)
    - Vertical velocity variance (Doppler Lidar)









Alpha 2: More regional variation!