Multiscale Data Assimilation Forcing for LASSO

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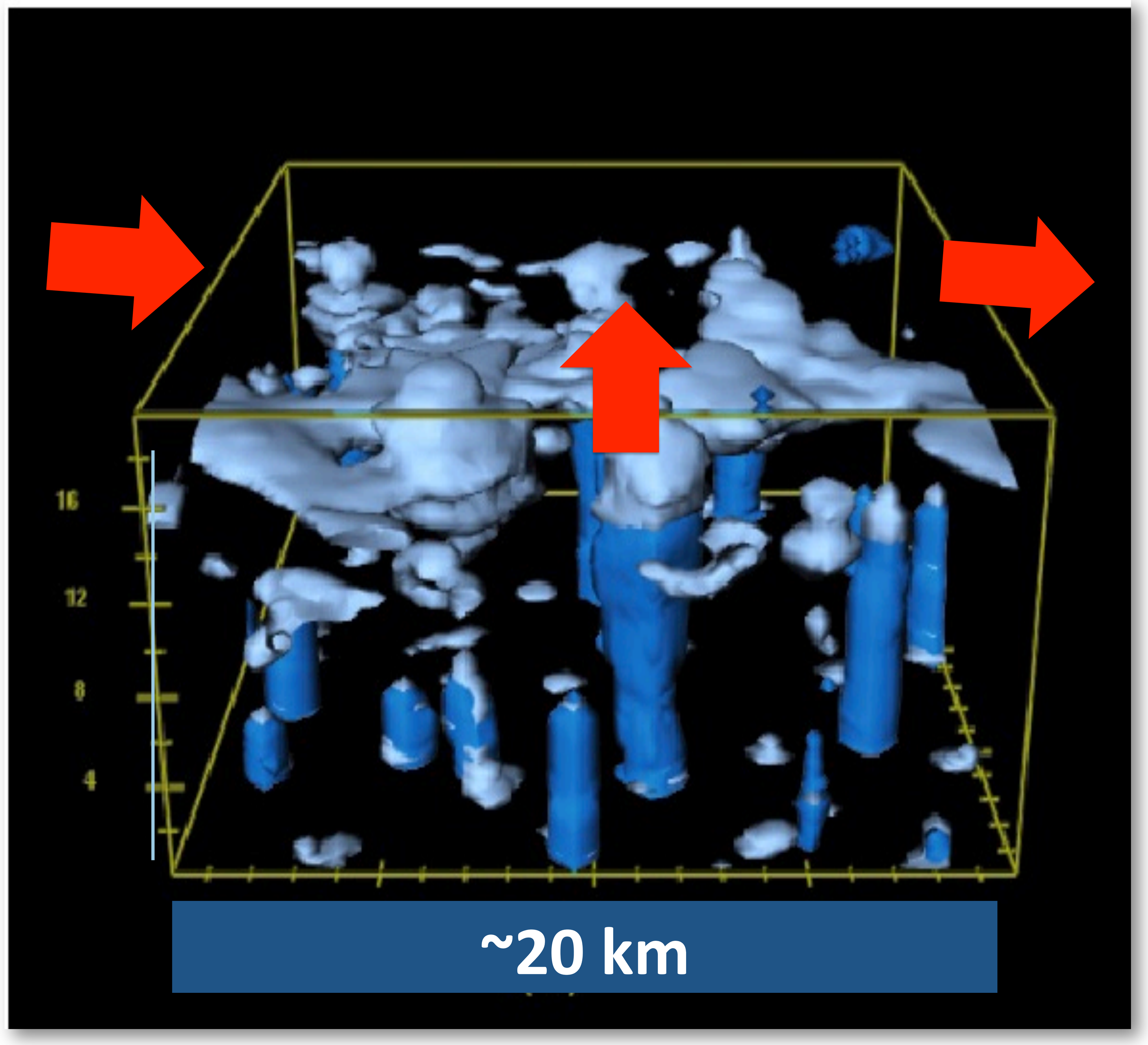
ARM CLIMATE RESEARCH FACILITY



LES is driven by

- Large scale horizontal and vertical advection
- Surface sensible heat flux, latent heat flux, albedo and skin temperature

MSDA: Decomposition of large and small scales

$$x = x_L + x_S$$

$$\min_x J(\delta x) = \frac{1}{2}\delta x^T (B_L + B_S)^{-1}\delta x + \frac{1}{2}(H\delta x - \delta y)^T R^{-1}(H\delta x - \delta y)$$

Existing analysis/reanalysis (FNL, NARR, etc)

$$\min_{\delta x_L} J(\delta x_L) = \frac{1}{2}\delta x_L^T B_L^{-1}\delta x_L + \frac{1}{2}(H\delta x_L - \delta y)^T (HB_S H^T + R)^{-1}(H\delta x_L - \delta y)$$

$$\min_{\delta x_S} J(\delta x_S) = \frac{1}{2}\delta x_S^T B_S^{-1}\delta x_S + \frac{1}{2}(H\delta x_S - \delta y)^T (HB_L H^T + R)^{-1}(H\delta x_S - \delta y)$$

Small scale data assimilation

U.S. DEPARTMENT OF ENERGY

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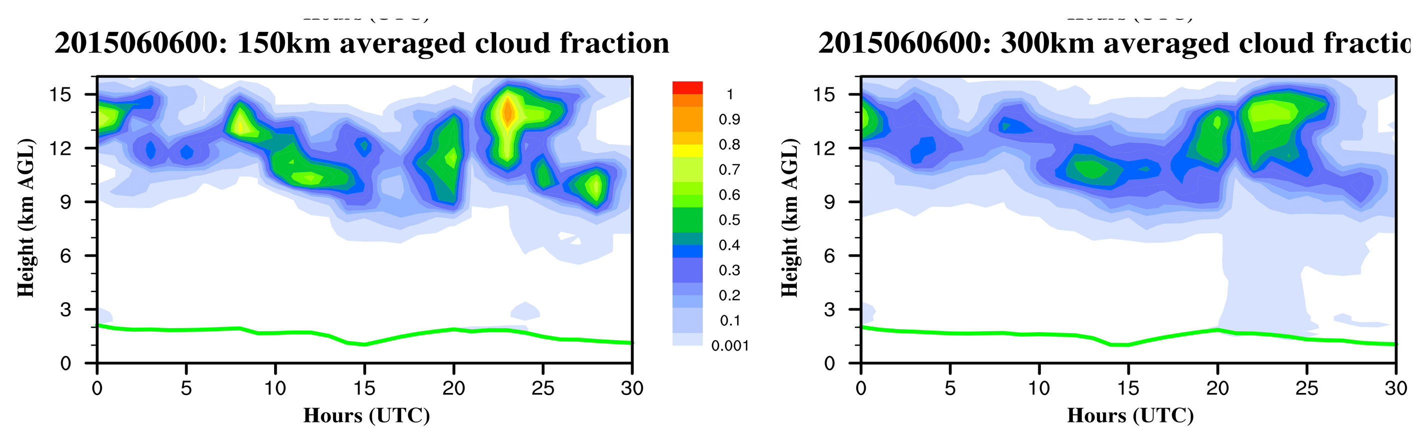
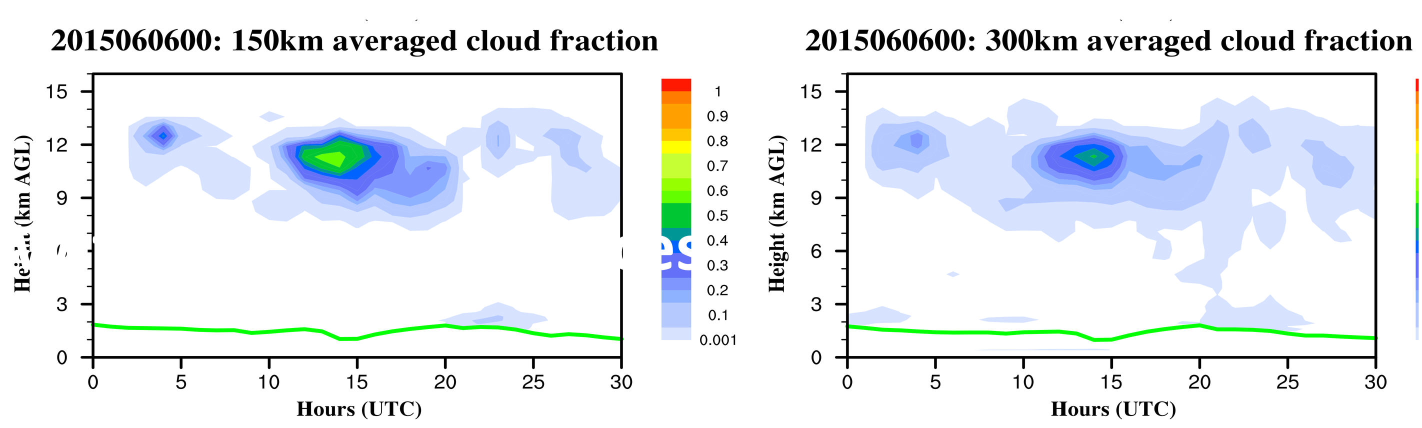
Objectives:

1. Develop optimal large-scale forcing
2. Produce an ensemble of forcing members for estimating uncertainty

W/O satellite infrared radiance



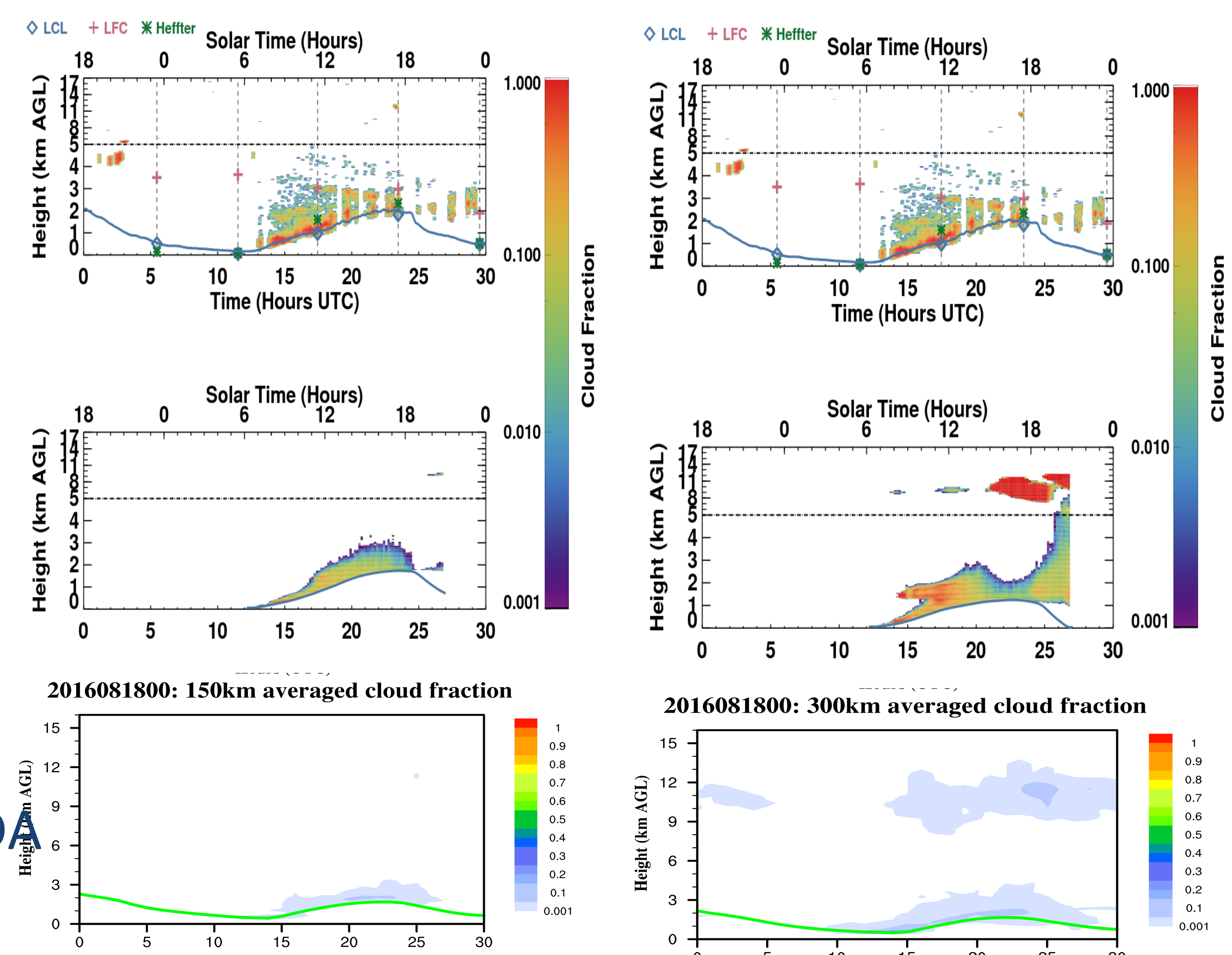
With satellite infrared radiance



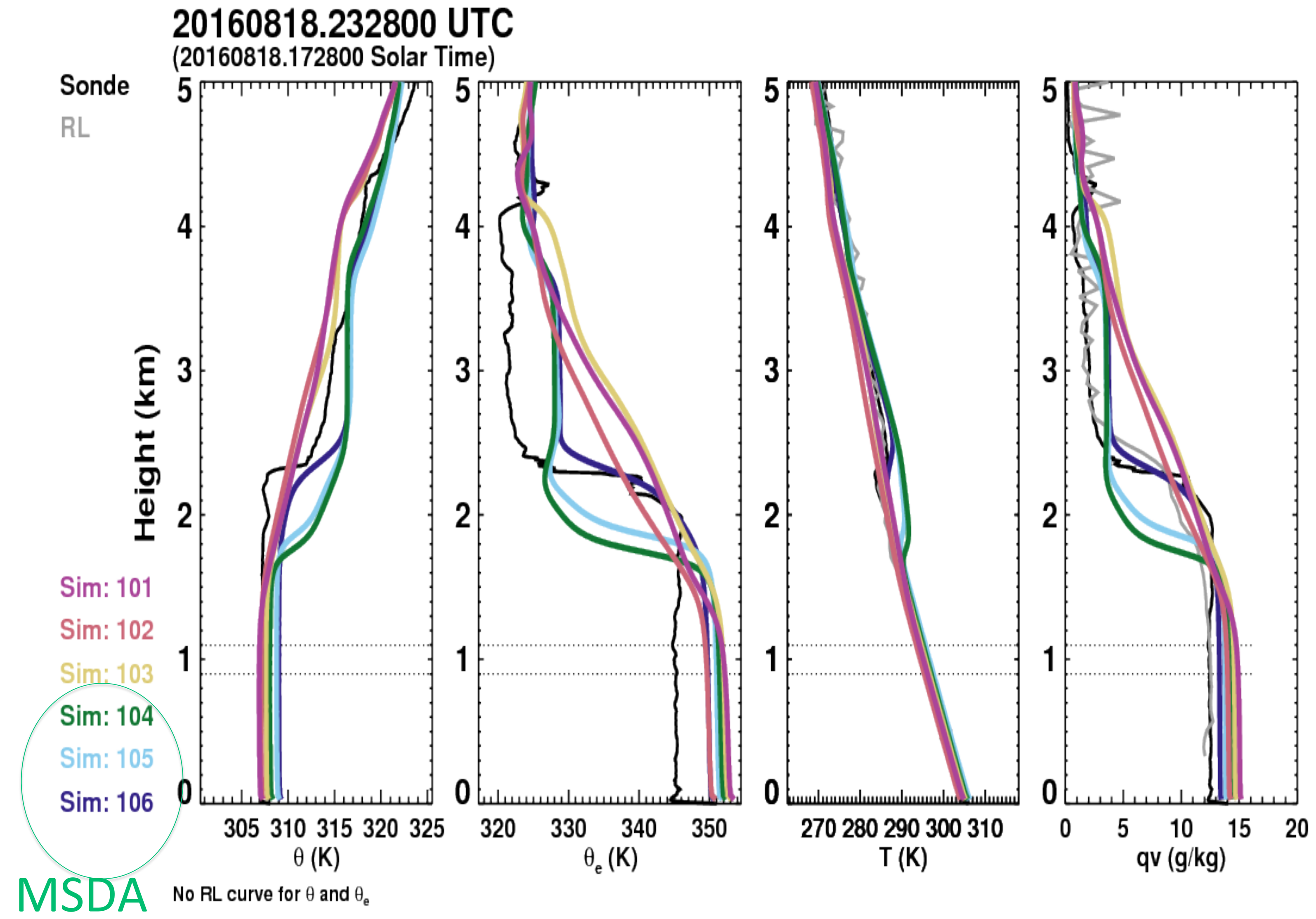
Obs

LES

MSDA



Clouds in MSDA have much similarity with those in LES



- MSDA helps LES represent the boundary layer
- Discrepancies from the Sonde profile significant
- Multiple vertical profiles needed to evaluate
- Ready to explore secondary discrepancies when more vertical profiles are available

On-going and Future Work

1. Preparation for being used as a quasi-realtime system
2. Observing system experiments (OSEs) to improve the impact of Raman lidar profile, wind profilers and others on LES.
3. Nesting LES to cloud-resolving WRF with MSDA
4. Optimization of forcing ensemble members: desirable spread of skill scores
5. Implementation of ensemble-MSDA