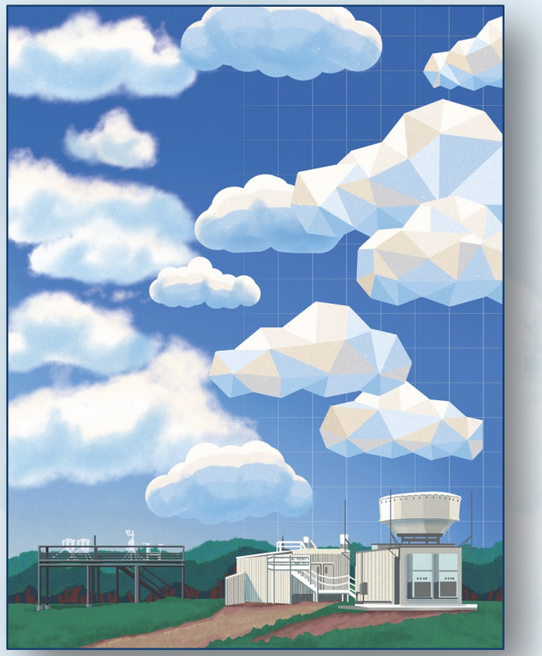
Update: The LASSO-CACTI Scenario for Deep-Convection with Large-Eddy Simulation



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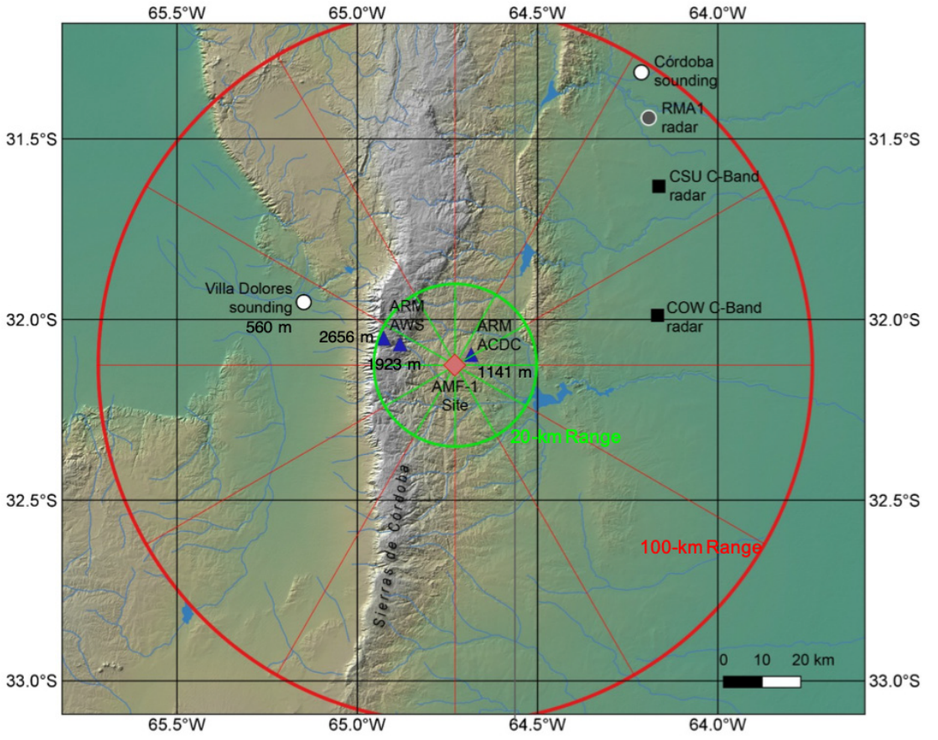
What is LASSO & LASSO-CACTI?

- LASSO = LES ARM Symbiotic Simulation and Observation
- LASSO seeks to add value to ARM observations by using high-resolution modeling to bridge scale gaps and add context to observations
- The original scenario for shallow convection is now on hiatus to enable development of the new LASSO-CACTI scenario focusing on deep convection
- The CACTI field campaign occurred in 2018–2019 in Argentina with a focus on large-scale convection and its upscale growth
- LASSO will use large-eddy simulation (LES) to simulate ~10 CACTI cases with results released in 2022

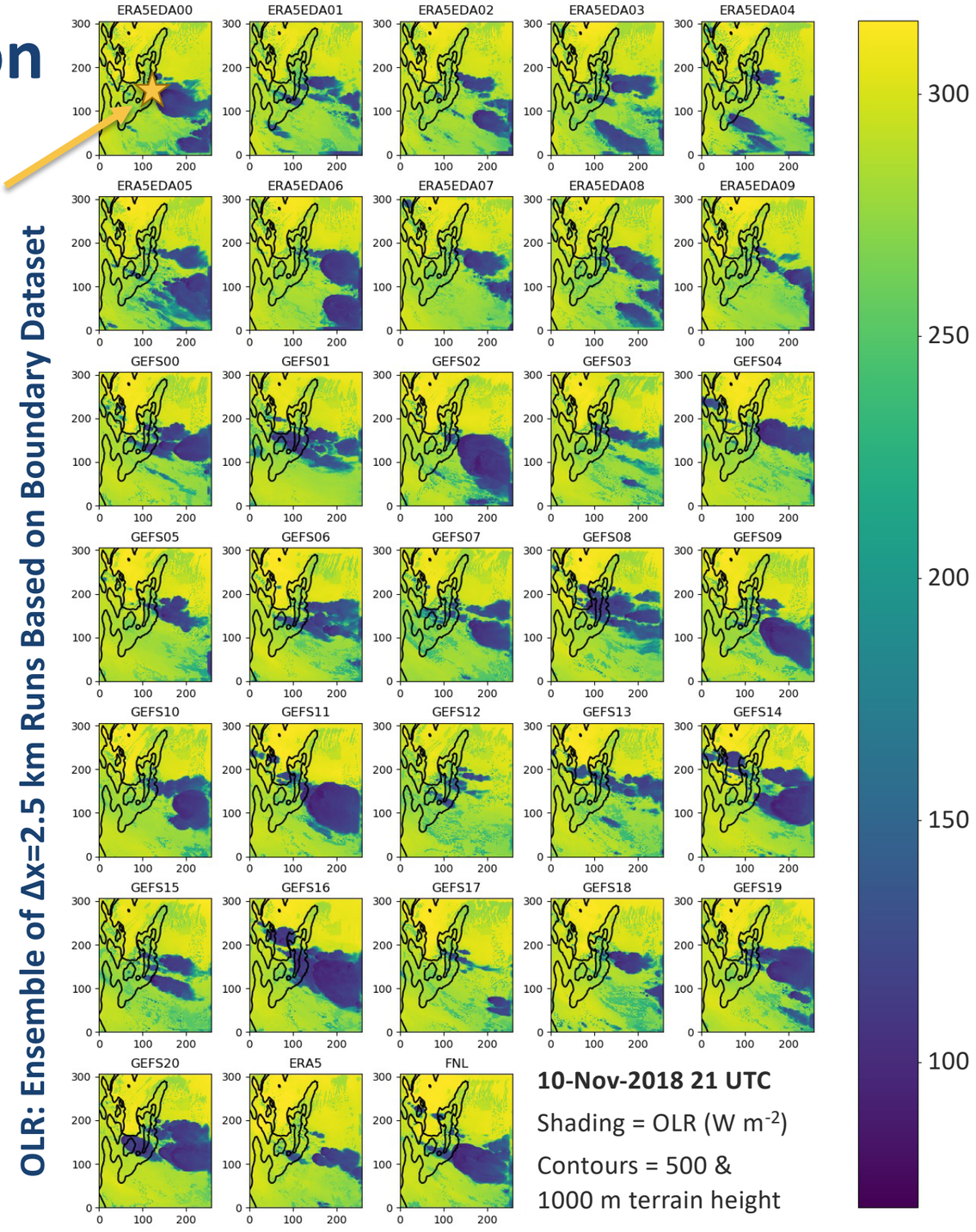
Map of CACTI Deployment in Argentina



Mesoscale ensembles for case selection and LES boundary condition choices

- Selecting LASSO-CACTI cases
  - We aim to release LES for about 10 case dates
  - Selection of dates driven by convective initiation near the AMF site
  - Down-selection involves using mesoscale ensembles to test boundary condition data

- Ran mesoscale ensembles for 20 candidate case dates—example for 10-Nov-2018 at right
  - 33 ensemble members based on ERA5, ERA5 Ensemble, FNL, and GFS Ensemble
  - Nested down to 2.5 km grid spacing
  - Best performing ensemble members identified based on cloud comparison to GOES-16 IR data

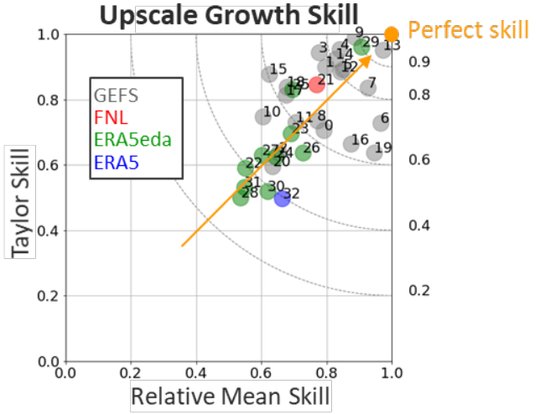


Mesoscale ensemble comparison against GOES-16 IR data

Time series of convective core area (T_B < 225 K) is assessed during *upscale* growth (15–24 Z) and *pre-upscale* growth (3–15 Z)

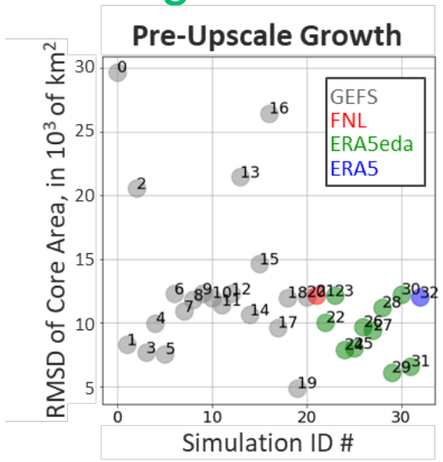
Upscale Growth Assessed Using a Taylor-based skill score

- Taylor skill is *f*(R,σ) for shape
- Relative mean for bias
- Range [0,1], 1 is perfect

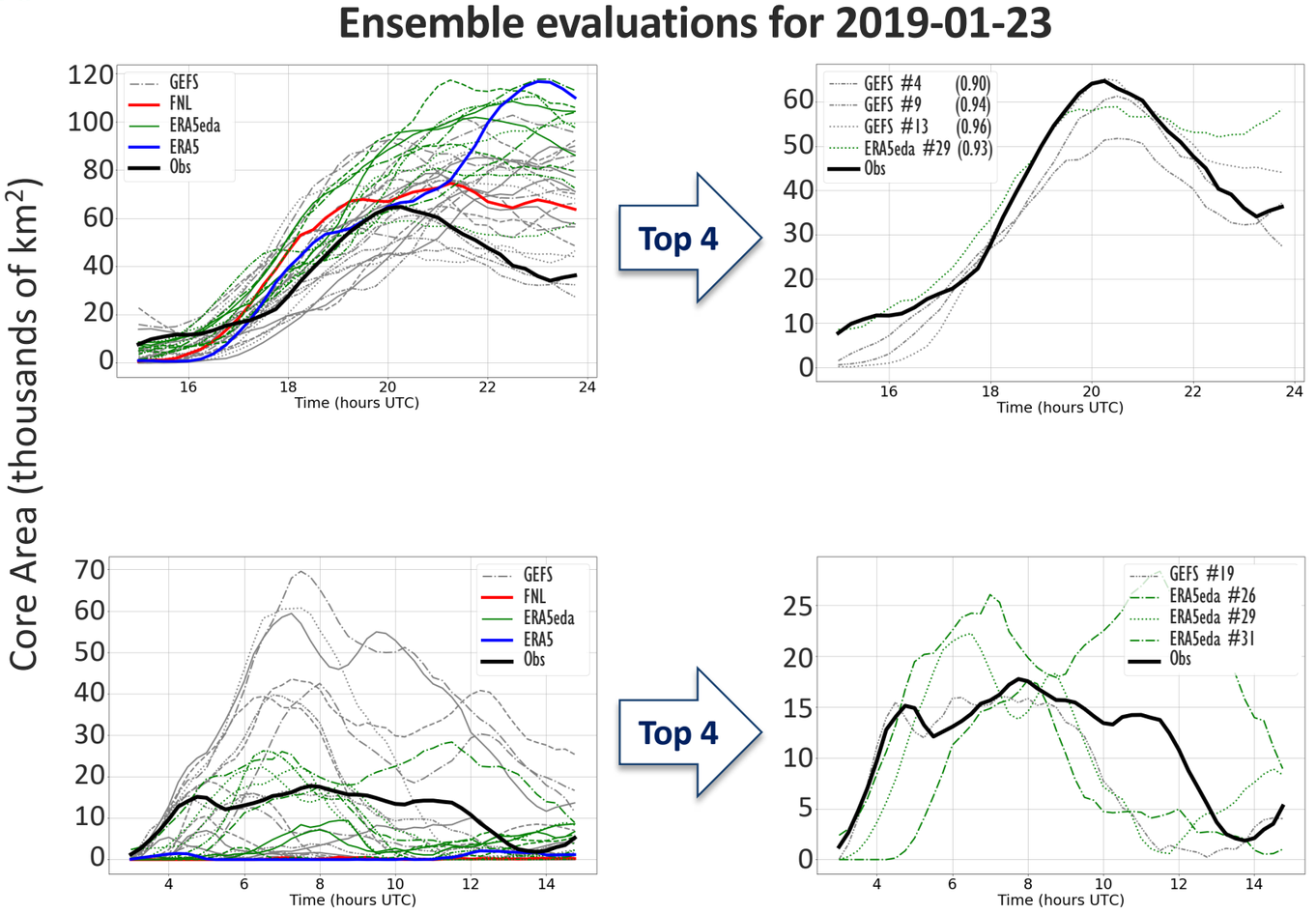


Pre-Upscale Growth Assessed Using RMSD

- Lowest values are best

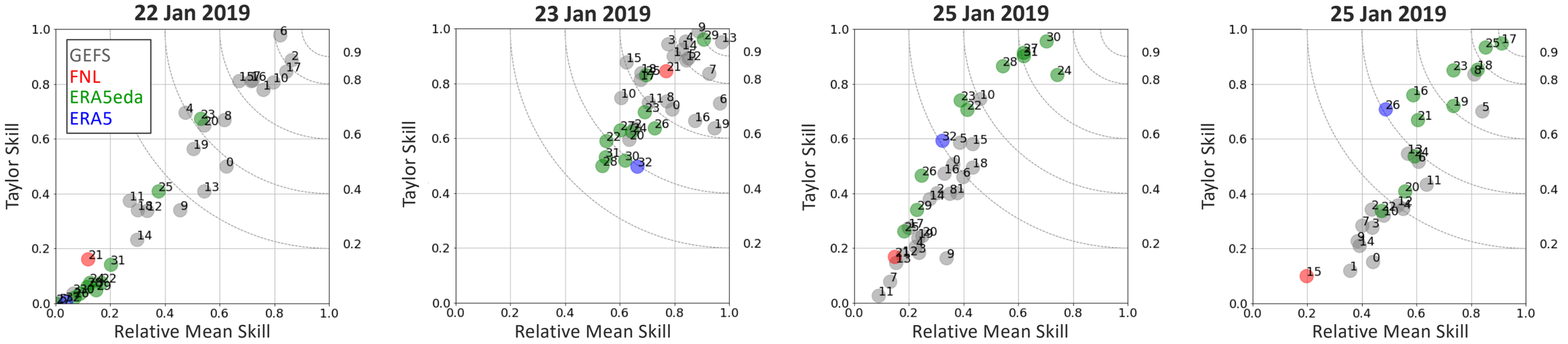


Ensemble evaluations for 2019-01-23

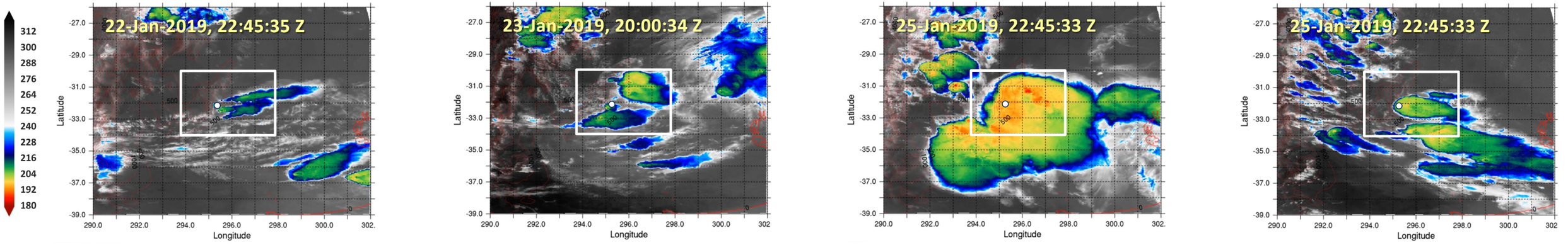


Example ensemble comparison for upscale growth periods

Taylor Skill



Peak Area-IR-T_B @ 11.2 µm [K]

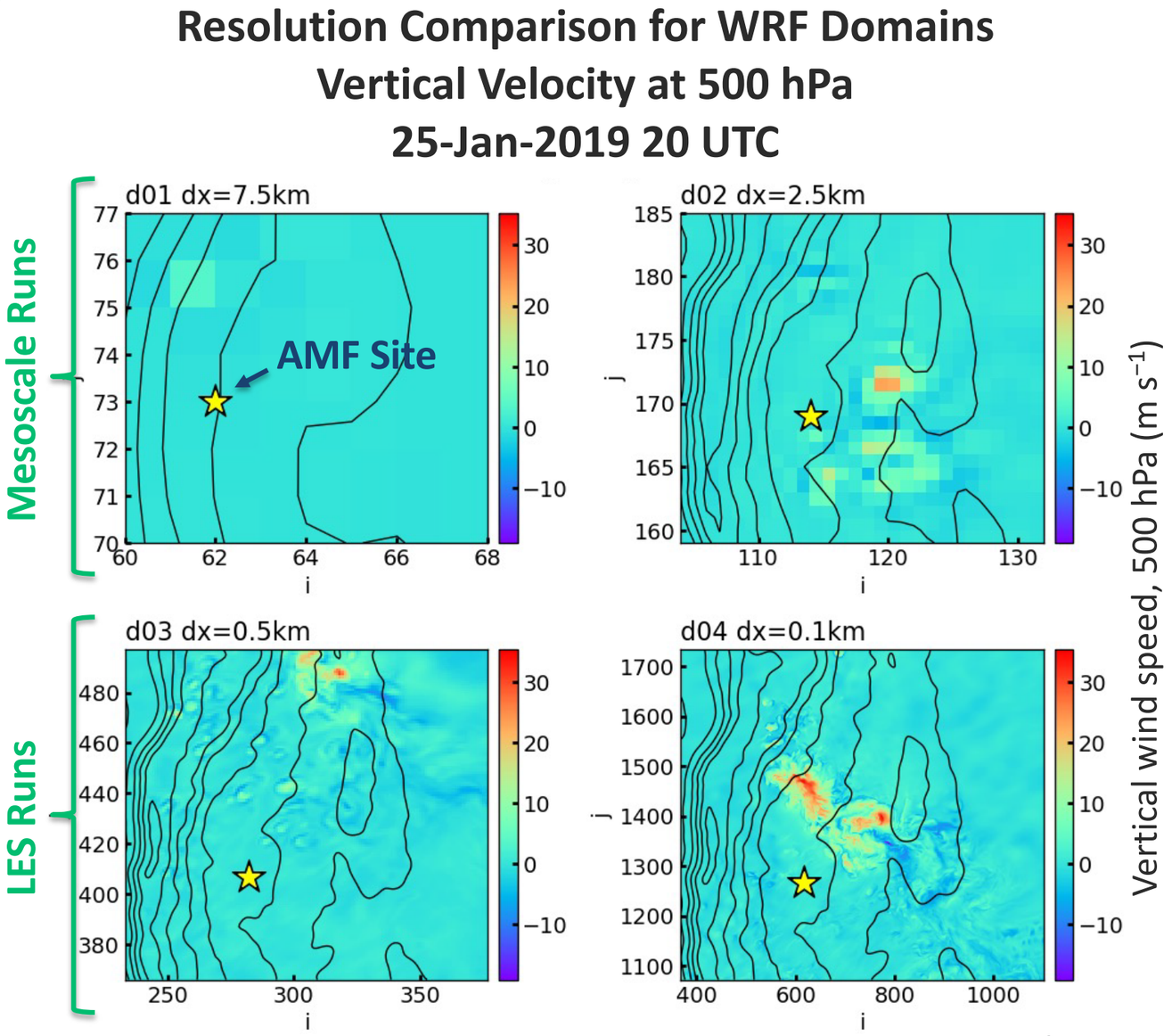


Large-eddy simulations for CACTI

- WRF permits nested LES driven by reanalysis
- Using a 4-nest configuration

  Δx=7.5 km + 2.5 km, Ndown to 500 m + 100 m

- Panels at right demonstrate increased detail available in up/down-drafts gained at dx=100 m
  - Topographic ridge & slope captured more accurately in terrain dataset at high resolution
  - Note ringing of downdrafts more prominently seen at dx=500 m (d03)
  - Getting more natural, turbulent looking drafts at dx=100 m (d04)



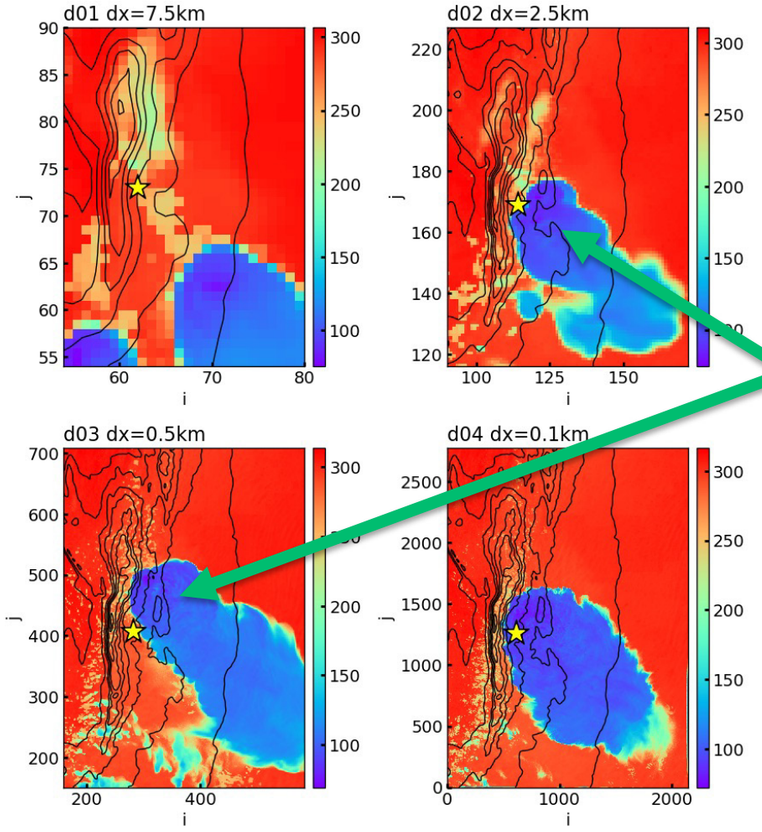
Contours = Terrain height, 300 m interval

Mesoscale vs. large-eddy simulations

Finding that mesoscale simulations are only semi-predictive of cloud development within LES

WRF's OLR, 25-Jan-2019 20 UTC

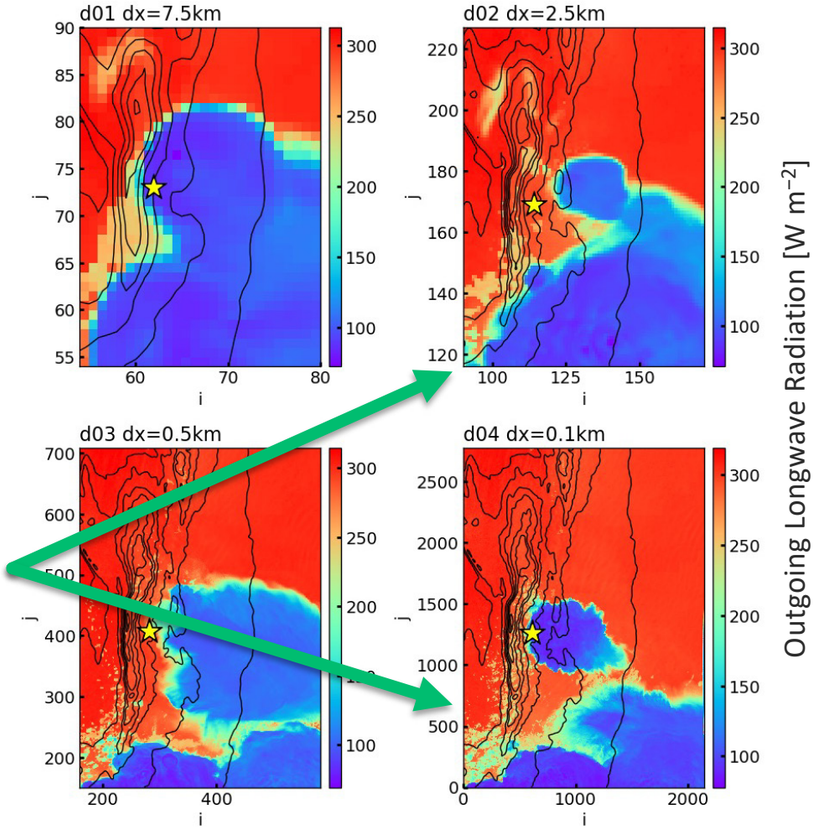
Forcing = GEFS Member #1



- Substantial variability between ensemble members with mesoscale grid spacings (d01 & d02) necessitates careful choice of boundary conditions
- Location of convective development shifts along ridge between grid spacings
- Size of cloud system varies between grid spacings

WRF's OLR, 25-Jan-2019 20 UTC

Forcing = GEFS Member #2



Contours = Terrain height, 300 m interval

Current status of LES runs

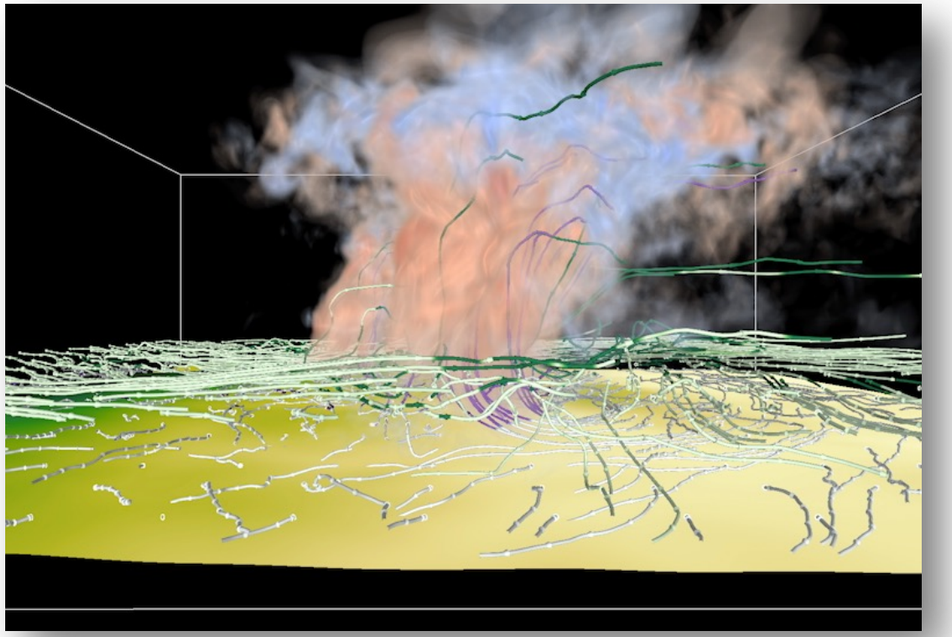
- Using 25-Jan-2019 for initial tests
  - Have run 3 GEFS ensemble members to examine predictability between scales
  - In process of starting a second date
- Worked through various technical difficulties
  - Broke the netCDF file conventions with our large domains – need to switch to CDF5 from the CDF2 format available in default WRF
  - Increased terrain dataset resolution and balanced with smoothing to get stable runs
- Still have some details and issues to work through
  - In process of using WRF-Hydro to generate improved soil initial conditions
  - Having issues with high cell count of ERA5 inputs on large domain—anybody else seen “ptop” error messages and knows how to get around them?
- Awaiting new nodes for Cumulus cluster, which will enable multiple, simultaneous LES runs

What outputs should be provided?

- Beyond typical WRF output, what variables do you want to see from the LES?
  - Basic microphysical process rates
  - Variables necessary for running CR-SIM
  - Converted WRF nuances, e.g., destaggered winds, P+PB

- How frequently should output be provided for each scale?
  - Δx = 7.5 km and 2.5 km domains → 15 min.
  - Δx = 500 m → 15 min.
  - Δx = 100 m → 5 or 15 min. for full run
    1 min. for several hours around initiation
    10 sec. for short period (how long?)

WRF, Δx = 100 m
Vertical Velocity of Cloud Core Region and Streamlines, 25-Jan-2021 20 UTC

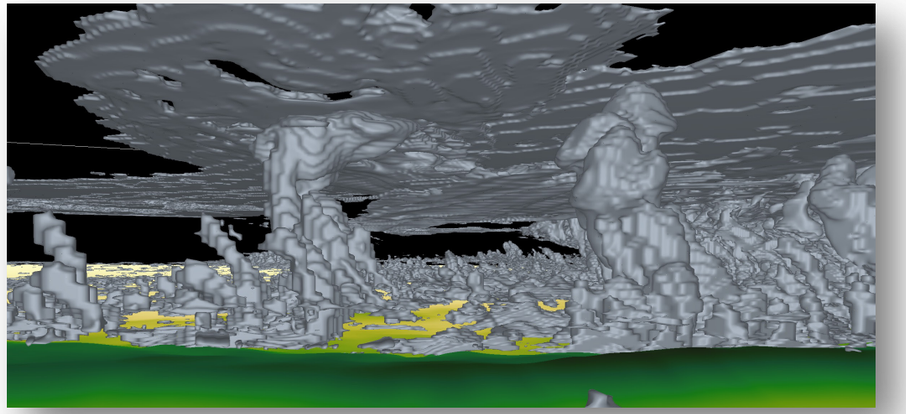


Shading: Red=W Up; Blue=W Down
Streamlines: Seeds at 2 km AMSL (white-to-purple) and 5 km AMSL (light to dark green)

Join us for a LASSO-CACTI session this summer!

- Join us for an online session to discuss finalizing LASSO-CACTI details
  - Which variables to output and their frequency
  - Case date selection
  - Options for working with the large dataset
  - Discuss your usage desires
- Date and time to be determined; will likely happen this summer
- We will advertise via the LASSO email list and the ARM newsletter
  - Sign up link for the LASSO email list

WRF Cloud Fraction
25-Jan-2019 20 UTC, Δx=500 m



Viewed from west of AMF Site

Join the community! New online forum for LASSO

- Check out the new online forum for LASSO: https://discourse.adc.arm.gov/
- Use it for user support, discussing scenario development, and related topics around LASSO and ARM
- Aiming for it to become an online resource for LASSO information and support
- Other ARM topics besides LASSO are also possible—ask us if you would like a category added, e.g., for a field campaign or value-added product