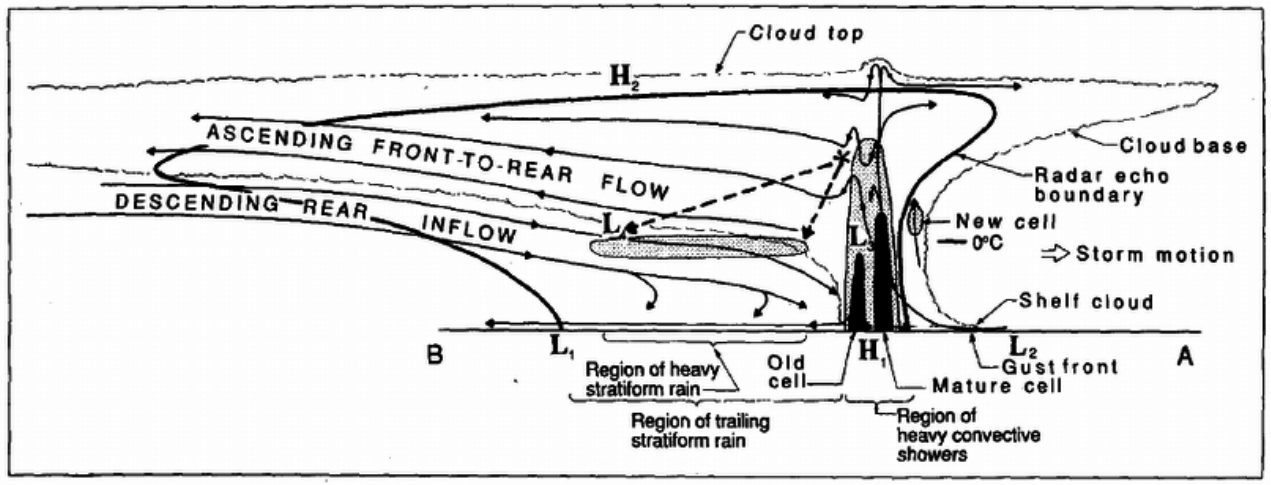
Observational Data and Skill Scores for the CACTI Scenario

Andrew M. Vogelmann (BNL), William I. Gustafson Jr. (PNNL)
Satoshi Endo, Tami Fairless, Karen Johnson (BNL)
Heng Xiao (PNNL)

Helpful discussions with Adam Varble, Joe Hardin, Zhe Feng, and Jiwen Fan (PNNL)

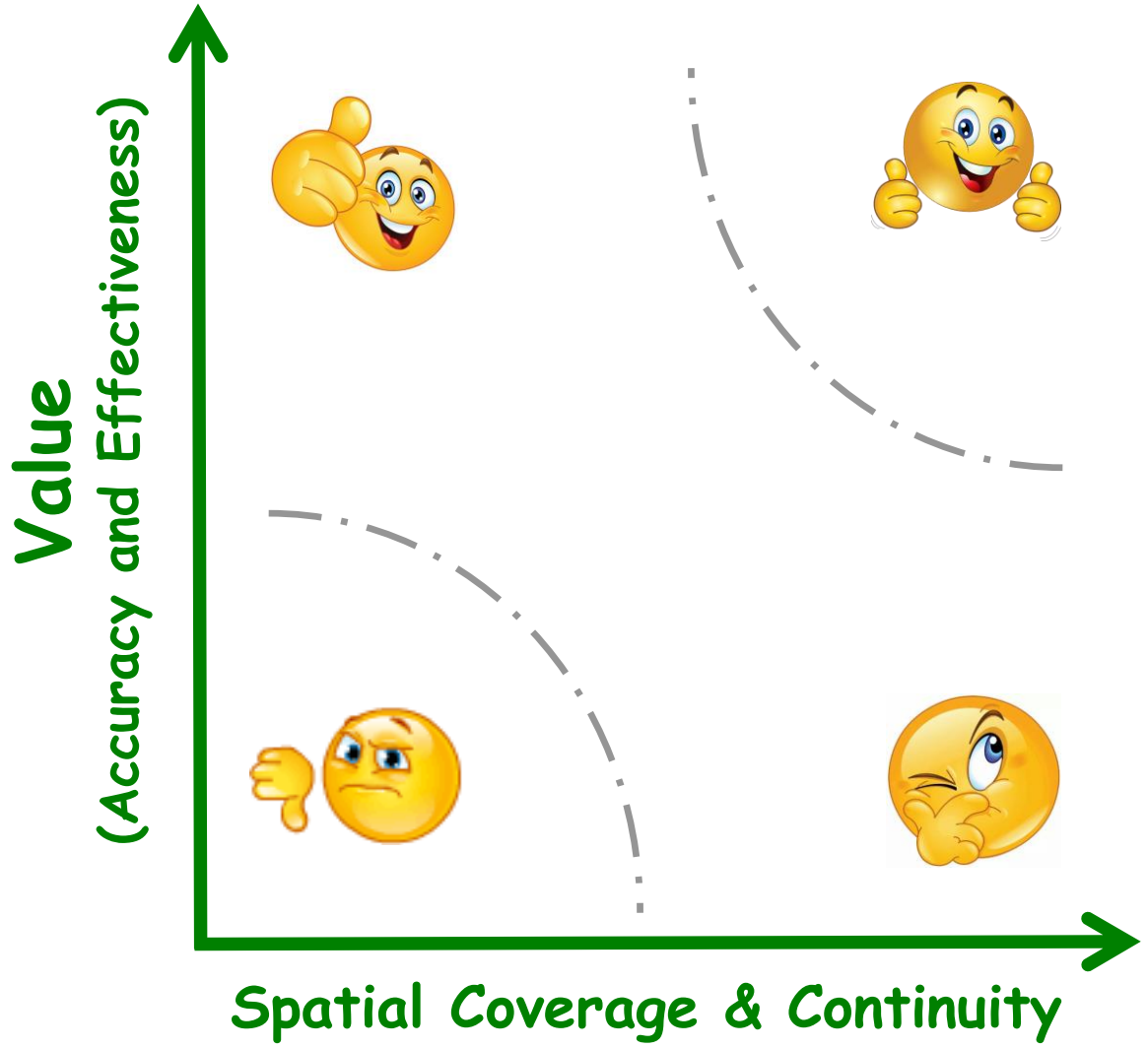
The Task at Hand

- Need approach to quantitatively evaluate model output with CACTI observations
  - Assess model setup/configuration from sensitivity tests
  - In operations, identify promising ensemble members for further use
  - Communicate quality through simulation skill scores



Houze et al. (*BAMS*, 1989)

Data Priorities

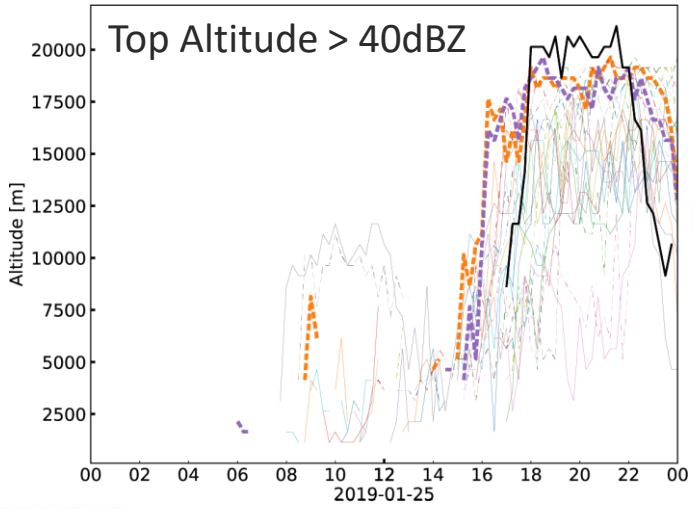


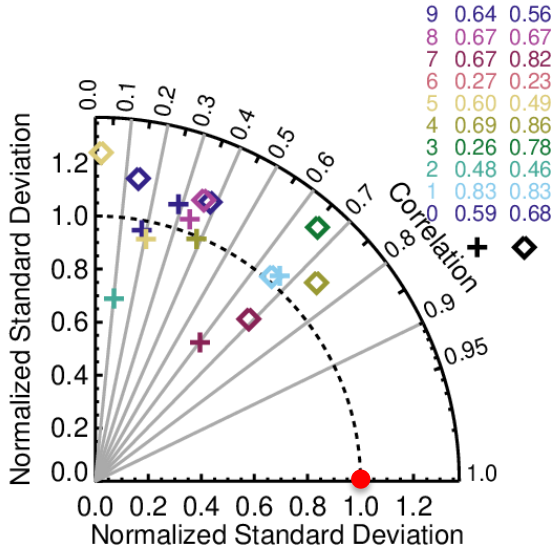
Multiscale Observational Datasets

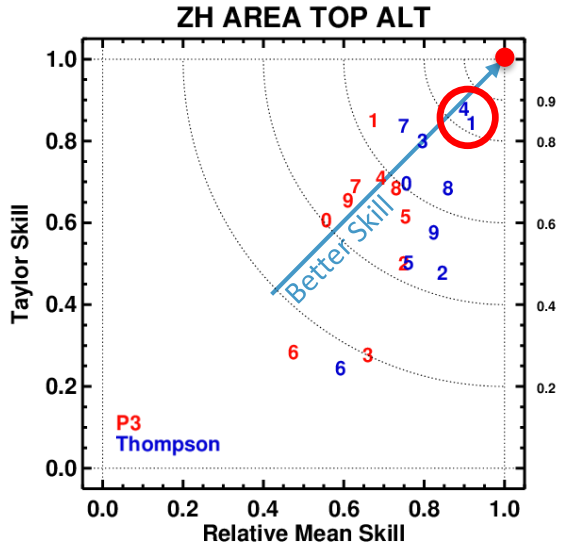
- Regional: Satellite-based
  - Sources
    - VISST: Pixel and gridded radiation and cloud property retrievals
    - Bedka: Detections of deep convective storm anvils and anvil penetrating convective updrafts
  - Application
    - Time-dependent convective area coverage of the anvil and colder cores
- Local: Scanning Radar-based
  - Sources
    - CSAPR-2, **X**/Ka-Band SACR, RELAMPAGO (?)
  - Applications
    - Time-dependent radar reflectivity, CFADs, Surface rain rates, Hor & Vert Winds (?)
- Point Measurements
  - Radar Wind Profiler (vertical velocity, winds), Sondes (thermo), G-1 (thermo, cloud prop)

Simulation Diagnostics and Skill Scores

- Diagnostic plots to assess CACTI simulations with observations
  - Time series
  - Taylor diagrams: standard deviation and correlation phase space
  - Phase space relationships for relative relationships between a set of variables (e.g., CFADs)
- Simulation skill scores
  - Based on the Taylor diagram skill and relative mean
  - A skill score per variable or based on their combination

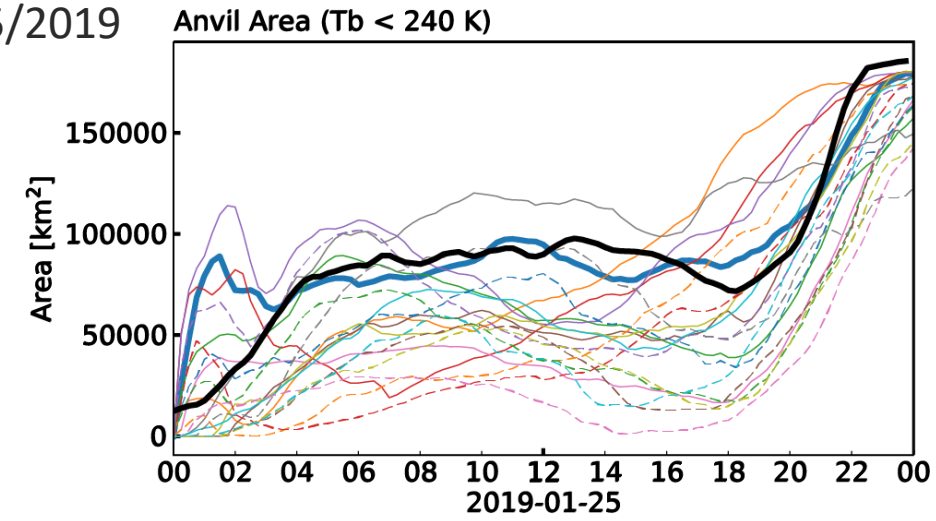


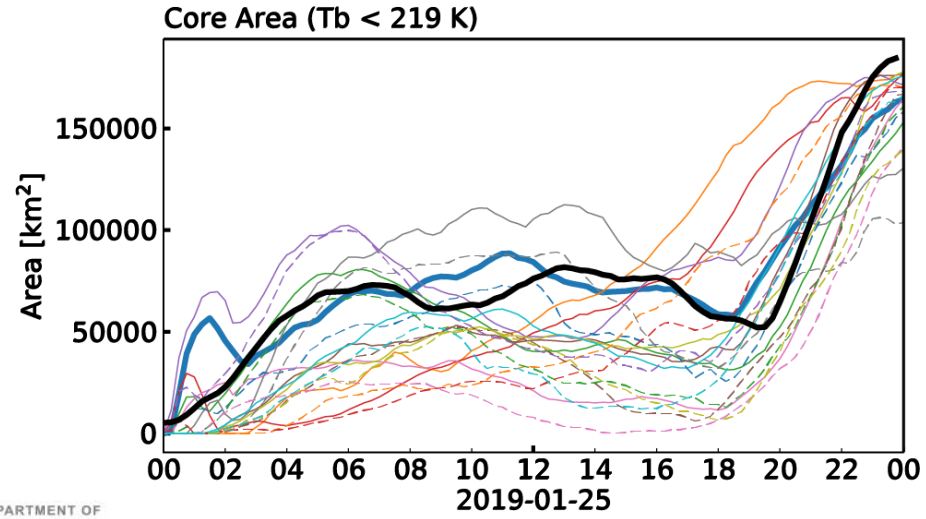




Satellite Brightness Temperature Example

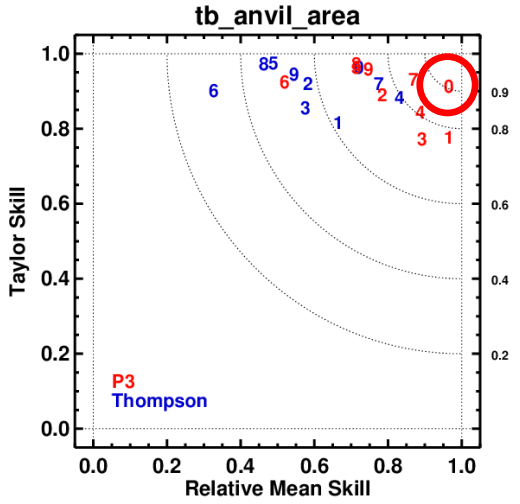
1/25/2019

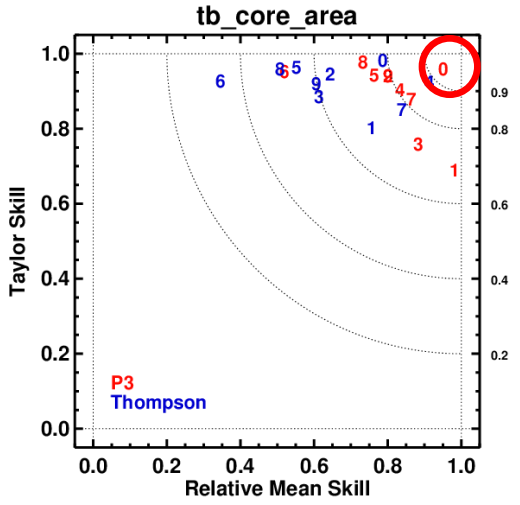




Model cloud temperature at τ_a=1

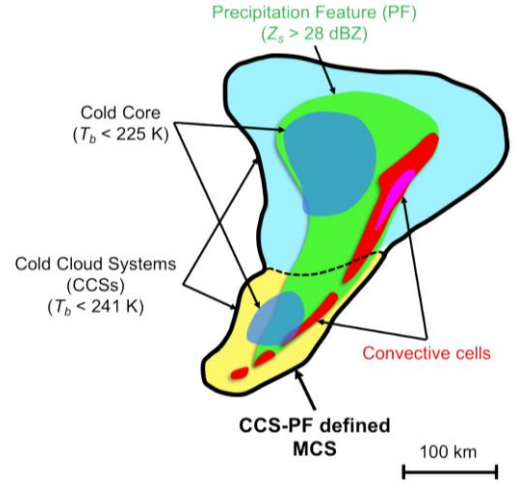
- GOES16
- era5eda_en00_p3i2_k180
- era5eda_en01_p3i2_k180
- era5eda_en02_p3i2_k180
- era5eda_en03_p3i2_k180
- era5eda_en04_p3i2_k180
- era5eda_en05_p3i2_k180
- era5eda_en06_p3i2_k180
- era5eda_en07_p3i2_k180
- era5eda_en08_p3i2_k180
- era5eda_en09_p3i2_k180
- era5eda_en00_thom_k180
- era5eda_en01_thom_k180
- era5eda_en02_thom_k180
- era5eda_en03_thom_k180
- era5eda_en04_thom_k180
- era5eda_en05_thom_k180
- era5eda_en06_thom_k180
- era5eda_en07_thom_k180
- era5eda_en08_thom_k180
- era5eda_en09_thom_k180





Location, Location, Location

- Requires object-based location of the AMF within the model domain
  - Even the best simulation will not locate the storm genesis in the same relative AMF model location
  - Propose minor shifts in the model's AMF grid location based on relative distances to observed features
- Satellite anvil/core analyses
  - Use 'reverse tracking' of brightness temperatures from the developed storm to locate its genesis point
- Radar analyses
  - Start with the location from the satellite analysis
  - Locate the final model position of the AMF relative to radar reflectivity 'objects/clusters'



Feng et al. (2019)

Observations and Skill Score Discussion Items

- Comments and questions can be posted via the Q&A feature
- Longer questions: Raise your hand to speak and we will call on you – We will unmute you, and you must too
- Or, feel free to contact Andy and Bill at lasso@arm.gov at any time

- Additional suggestions for useful observations or analyses for model diagnostics/metrics?
- Feedback on the object-oriented 'reverse tracking' to shift the location of the virtual AMF?
  - Should other things be considered? And, how much of a "minor shift" is minor?
- How important is characterizing the shcu properties prior to the sh→ deep onset?
- Other thoughts or suggestions?