The impact of horizontal grid spacing on the development and evolution of a mixed-mode convective event in the UFS-SRW application

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Developmental Testbed Center

Who, what, where, when, why, and how?

- **Who?** The DTC…with collaboration from partners!
- **What?** Investigate the scalability of physics suites availa[illegible] the UFS-SRW application for a severe weather event
- **Where?** Severe weather occurred over the [illegible] west through the Ohio Valley and the Southern Great Pl[illegible]
- **When?** 15-16 June 2019
- **Why?** The UFS-SRW app[illegible]s to deliver accurate forecasts for a variety of phenomen[illegible] a range of spatial and temporal scales. As US weather model[illegible] toward a more unified approach, it is necessary to understan[illegible] performance over a range of scales.
- **How** [illegible]ions were run at 25-, 13-, and 3-km horizontal grid spacings for sev[illegible] GFS- and GSD-based physics suites to determine optimal grid spacing to best represent the convective event, from the synoptic environment down to the convective initiation and evolution.

Today's focus: Precipitation-based analysis!

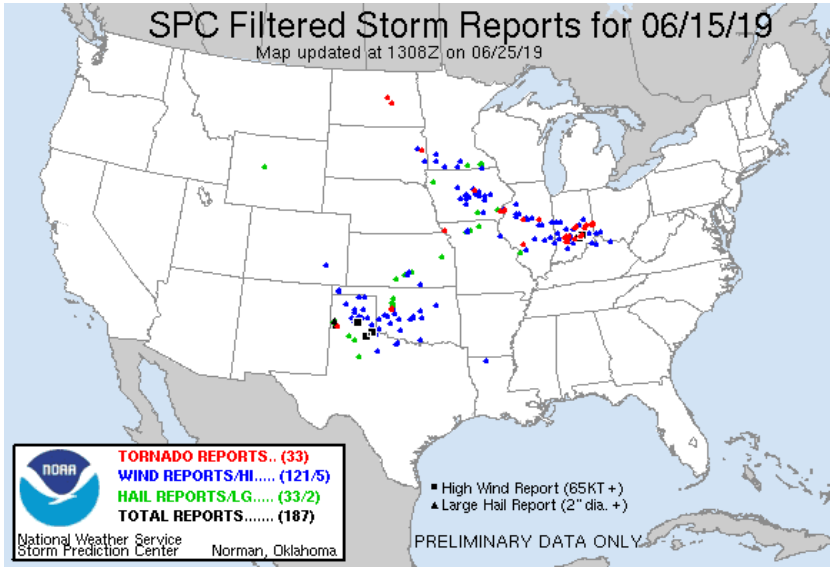
Physics Suite Configurations

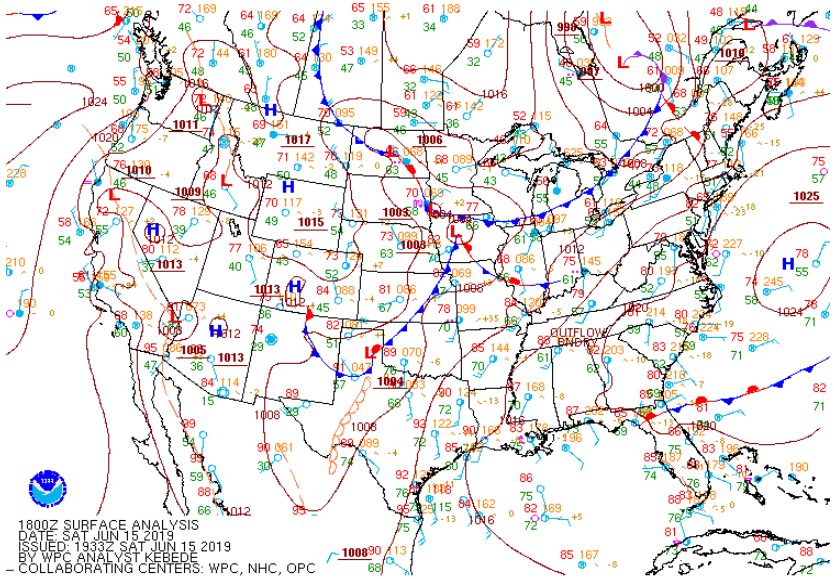
- Ran multiple versions of GFS and GSD suites for this test
  - All runs initialized with GFS IC/BCs
  - GFS suites
    - GFDL-MP (Like GFSv14 physics + GFDL MP)
    - GFSv15.2 (Current op GFS physics)
    - **GFSv16beta** (Proposed for GFSv16)
  - GSD suites
    - GSDv0 (Like RAP/HRRR + GFS surface layer)
    - **GSD_noah** (GSDv0 + Noah LSM)
  - Note: Suites are rapidly updating!

	GFSv16beta	GSD_noah
Cumulus	Scale-aware SAS	Grell-Freitas
Microphysics	GFDL	Thompson
Radiation LW	RRTMG	RRTMG
Radiation SW	RRTMG	RRTMG
PBL	GFS-TKE-EDMF	MYNN-EDMF
Surface Layer	GFS	GFS
Land Surface	NOAH	NOAH
Ozone	GFS (2015)	GFS (2015)
Strat. Water Vapor	GFS	GFS
Gravity Wave Drag	GFS	GFS

Case Background
15-16 June 2019

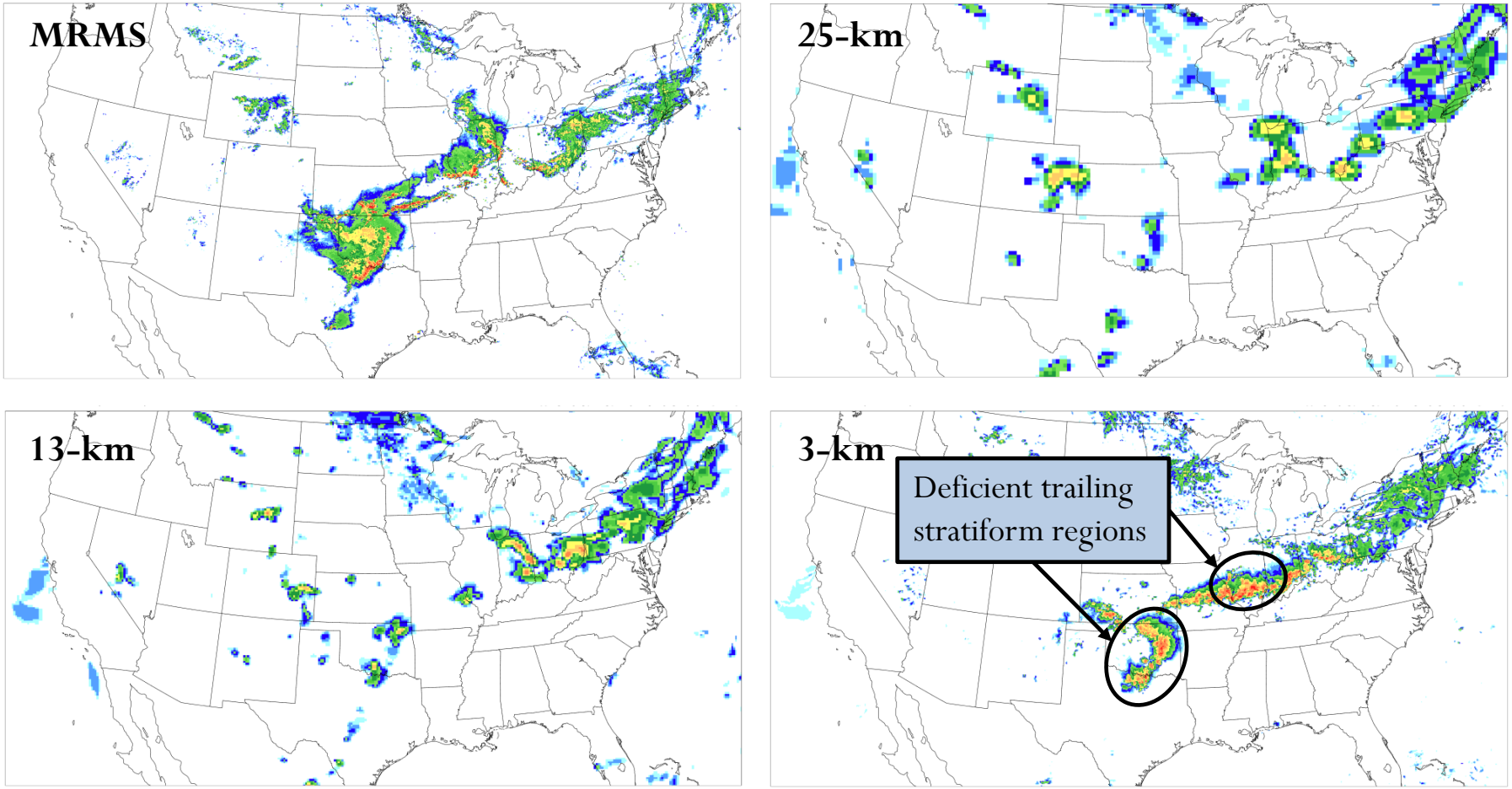
- Severe weather clustered into two major areas: the Upper Midwest through the Ohio Valley and the Southern Great Plains
- Northern and southern areas of convection had different forcing mechanisms
  - Northern → more strongly forced, some areas had higher CAPE/shear
  - Southern → weaker forcing, deeper and drier PBLs

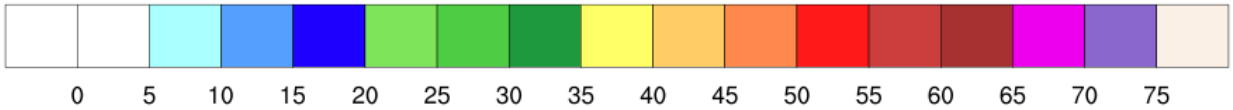




Composite Reflectivity (dBZ)

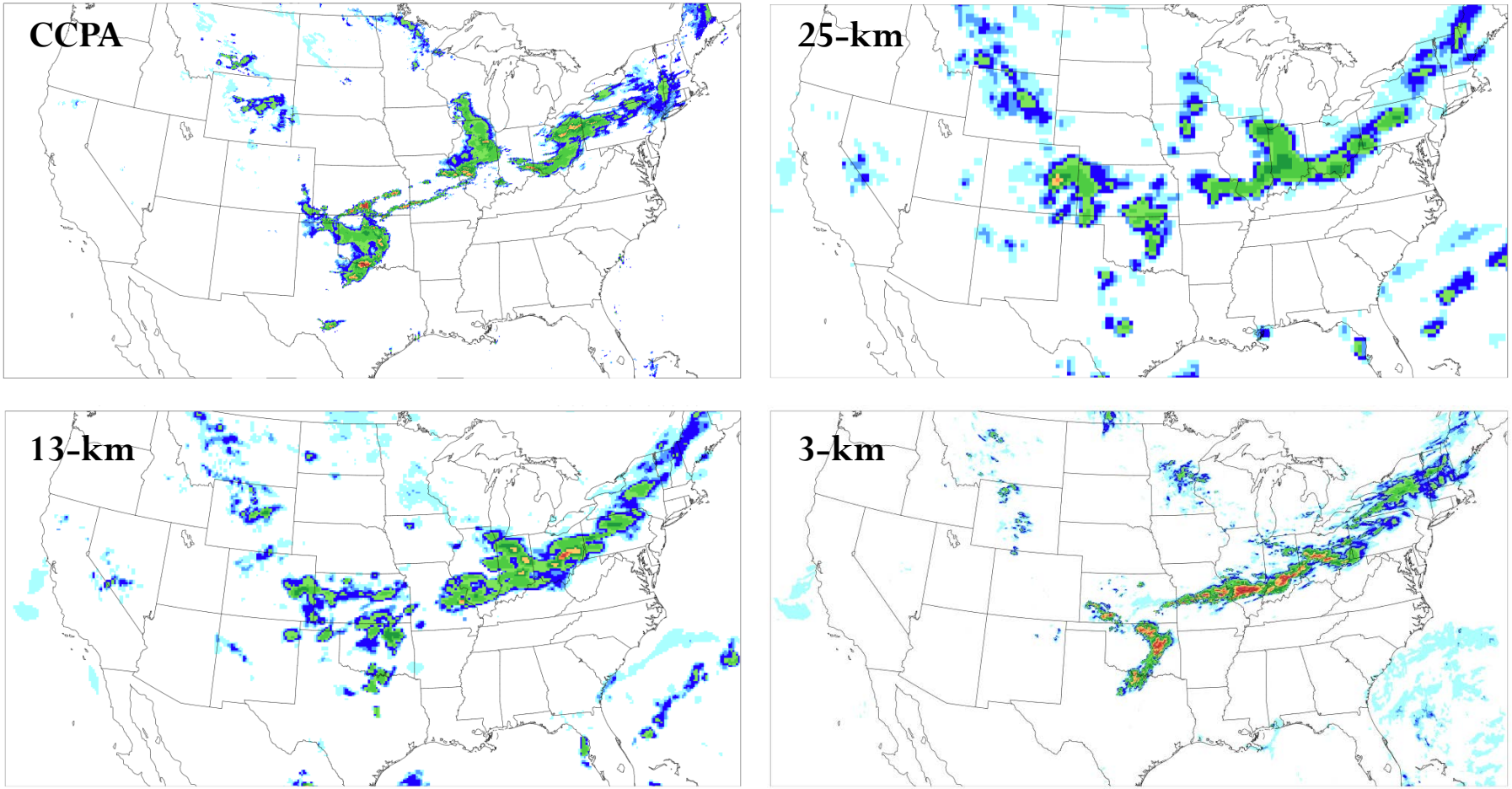
GFSv16beta – valid 20190616 06 UTC (f30)





1-h Accumulated Precipitation (in)

GFSv16beta – valid 20190616 06 UTC (f30)



Precipitation Partitions

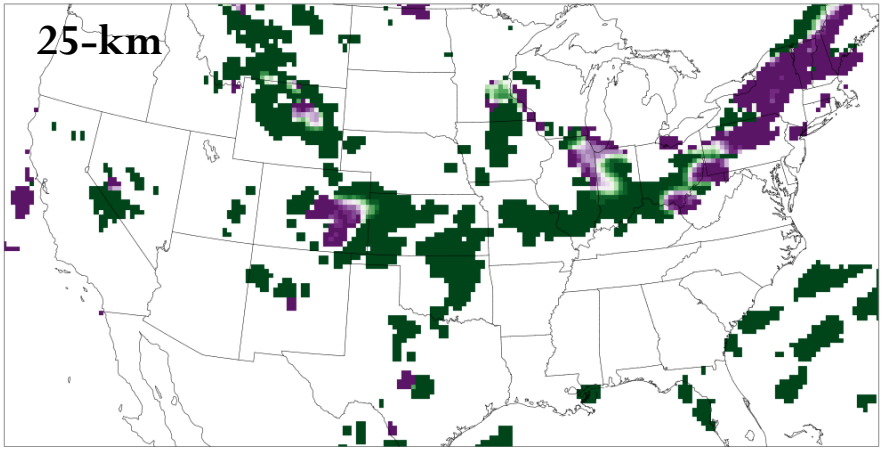
$$\frac{subgrid\ -resolved}{total} = \text{precip partition ratio}$$

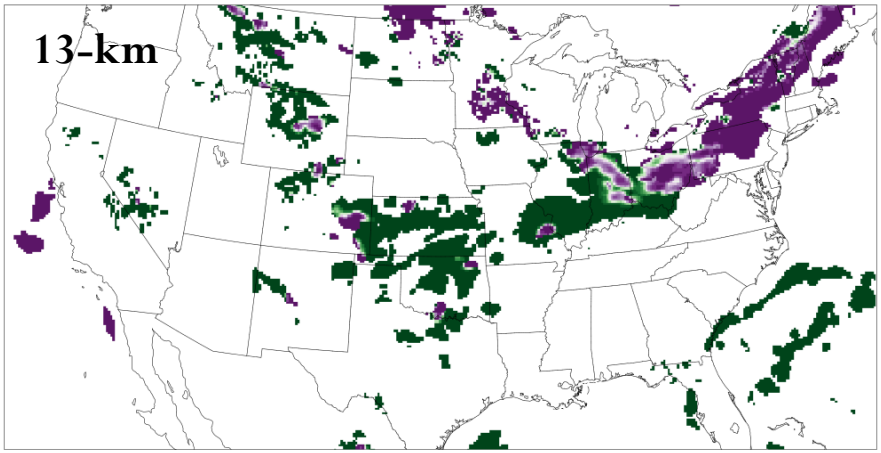
Method taken from Jeworrek et al. 2019

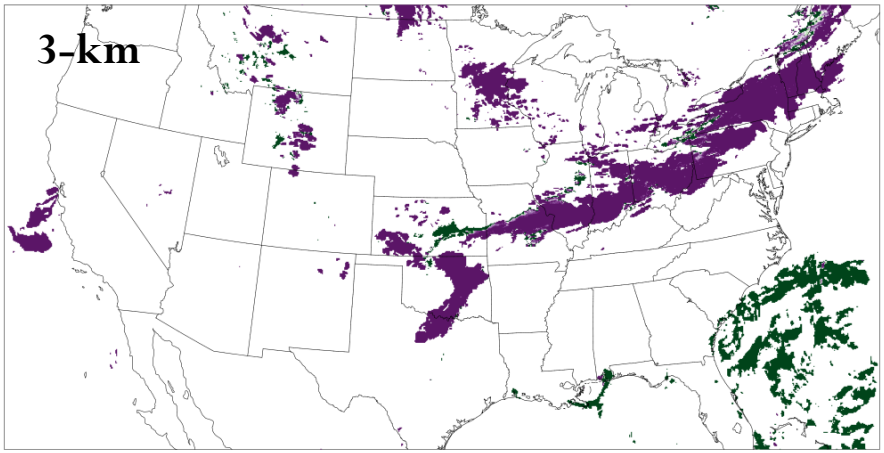
GFSv16beta – valid 20190616 06 UTC (f30)

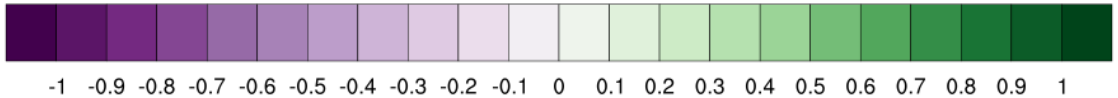
Precipitation Analysis

- At 25- and 13-km partitions are more similar in distribution, with more precip coming from the cumulus scheme; whereas, most of the precip at 3 km is resolved
- Typically, areas of active convection/areas of higher precip accums are dominated primarily by the microphysics scheme; areas of weaker convection/low precip accums are dominated by the cumulus scheme

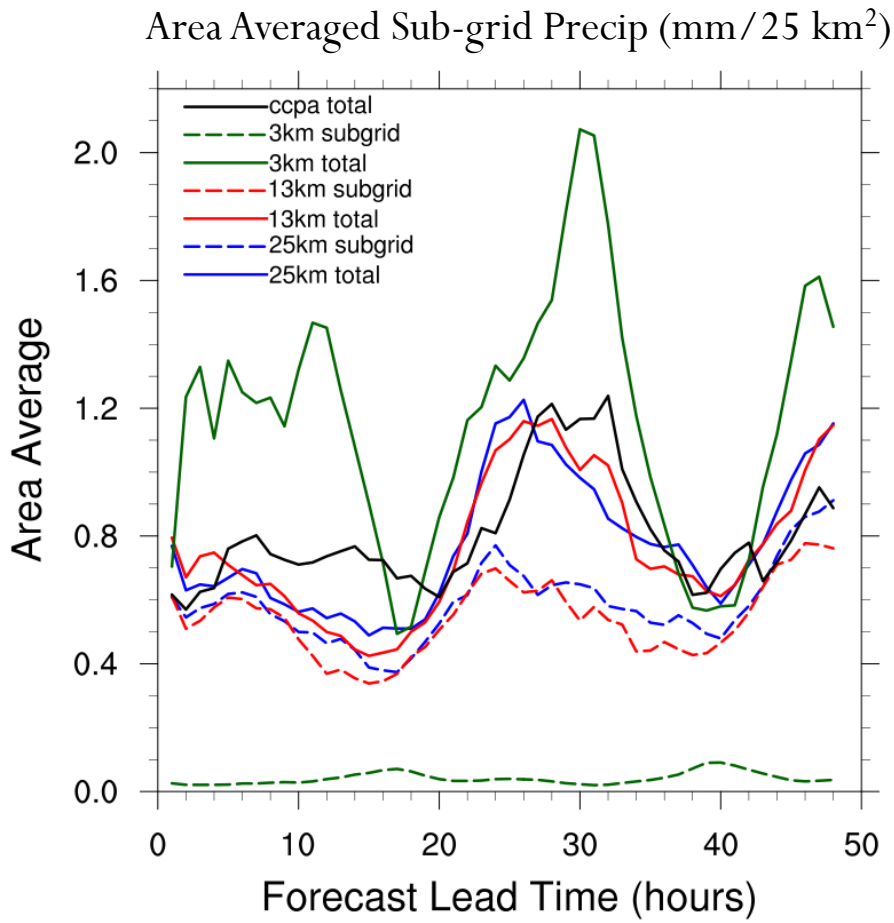


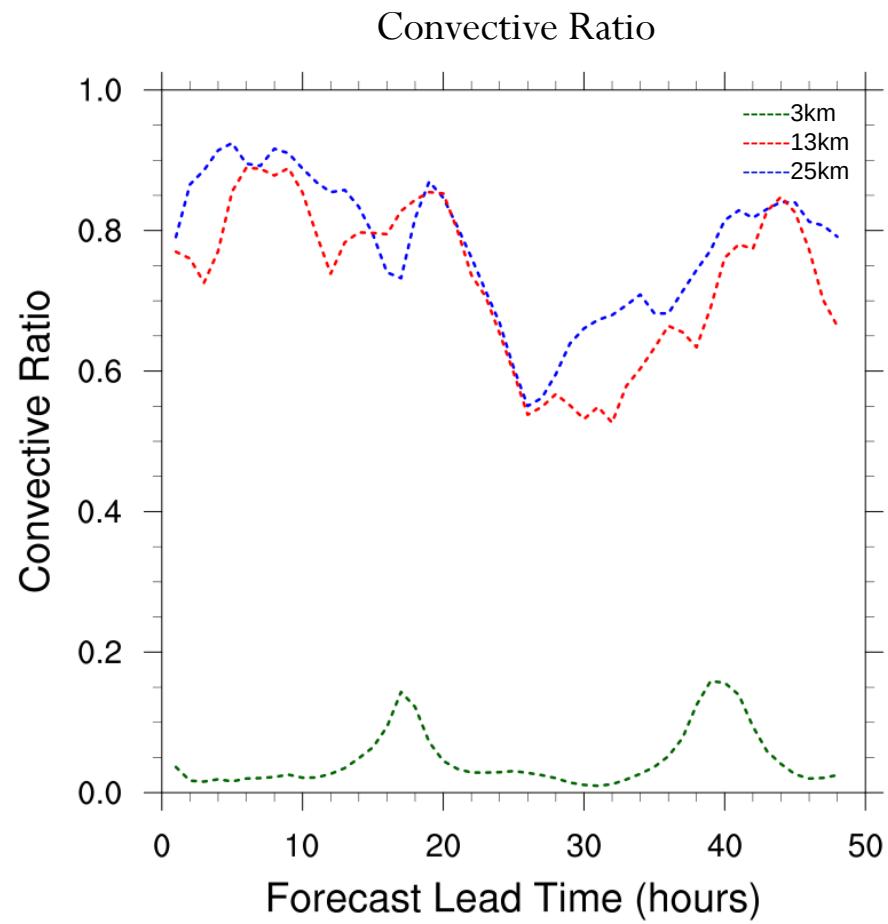






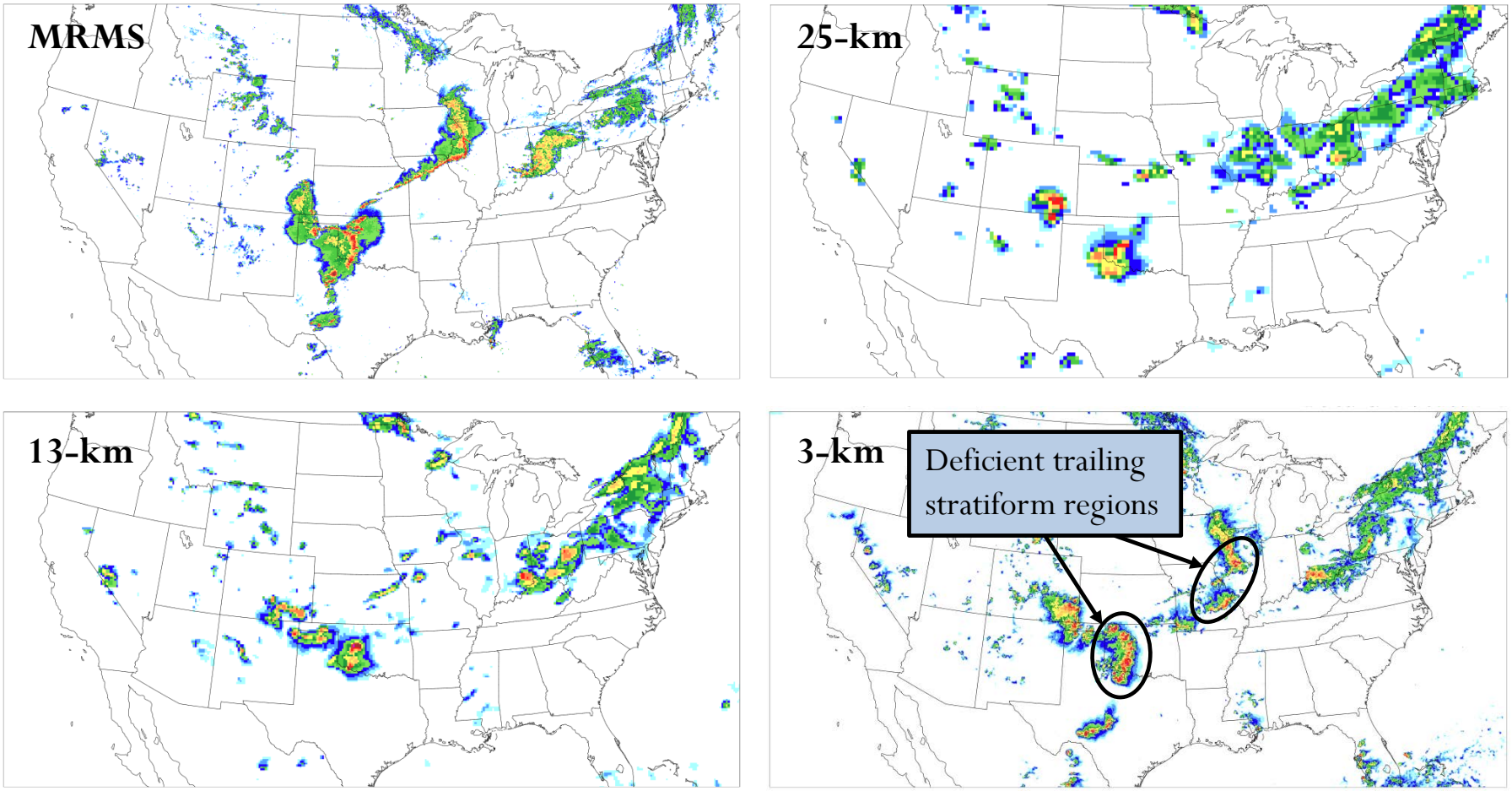
GFSv16beta Precipitation Partitions

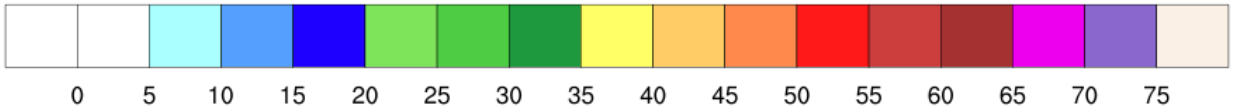




Composite Reflectivity (dBZ)

GSD_noah – valid 20190616 03 UTC (f27)





1-h Accumulated Precipitation (in)

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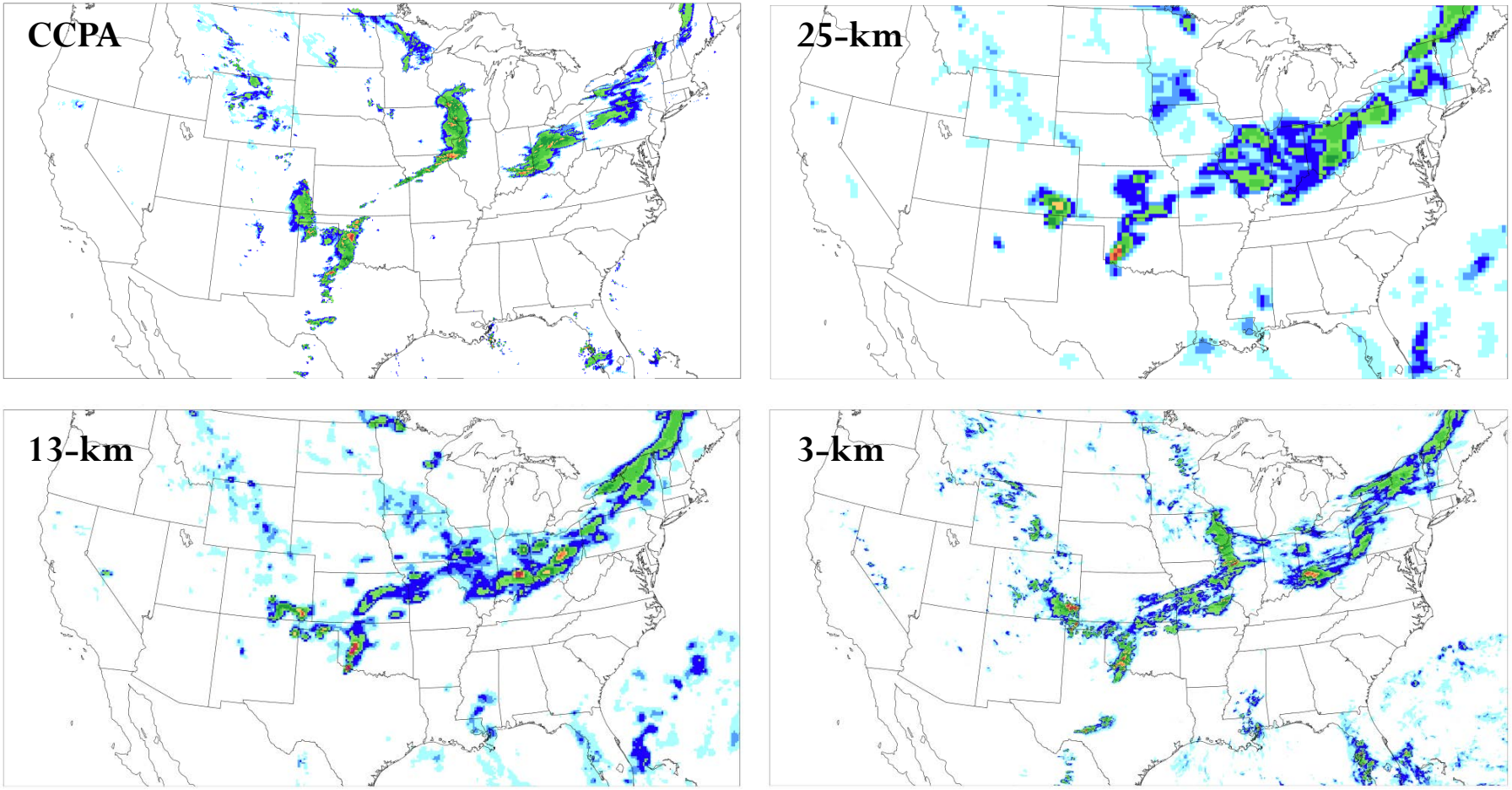
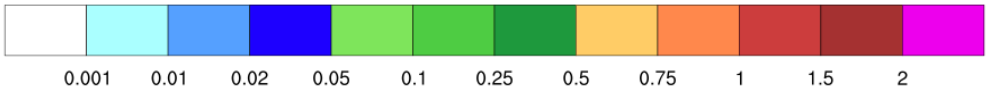


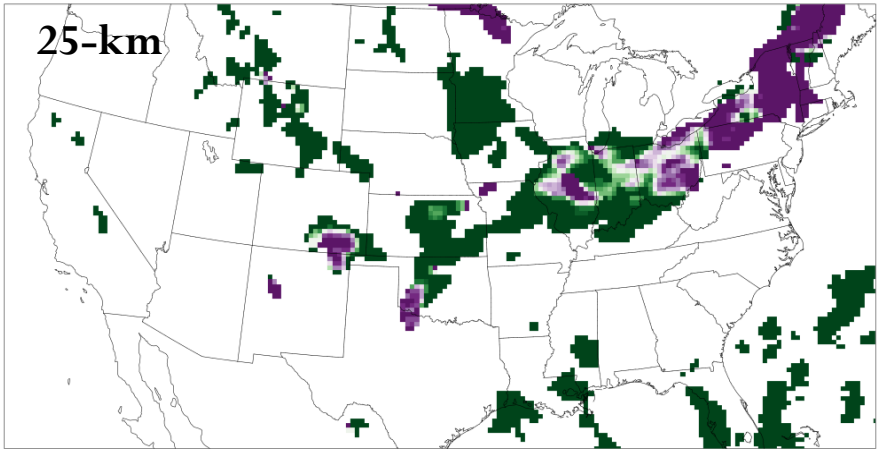


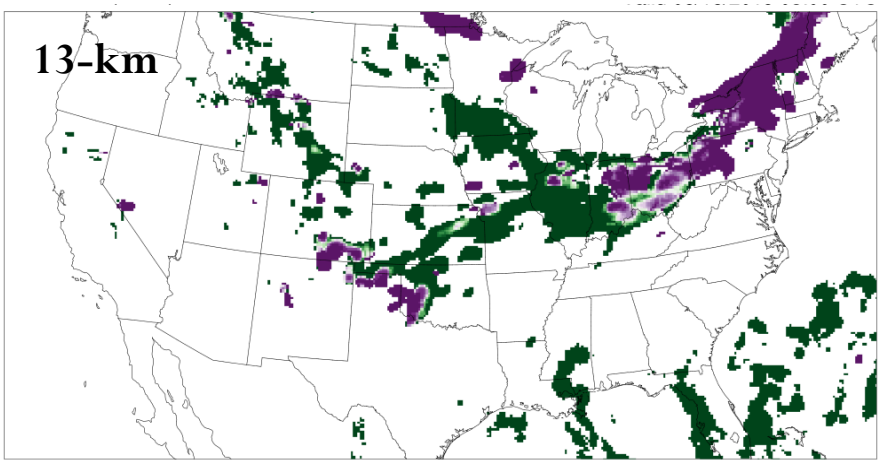
Precipitation Partitions

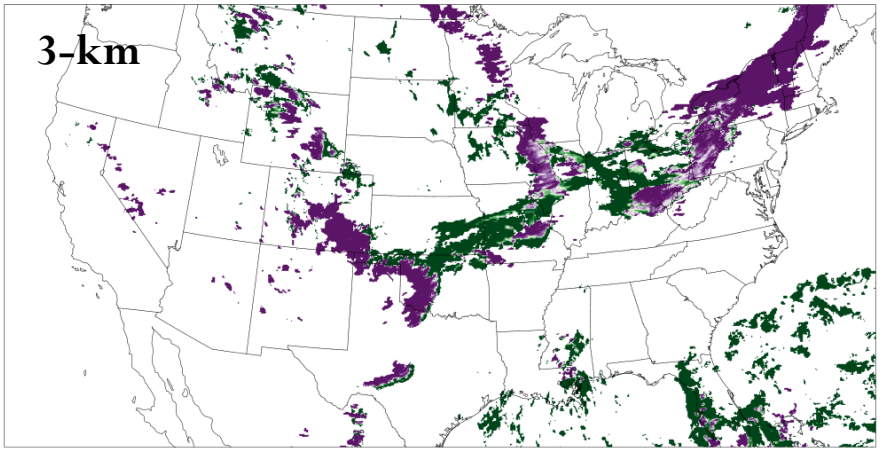
GSD_noah – valid 20190616 03 UTC (f27)

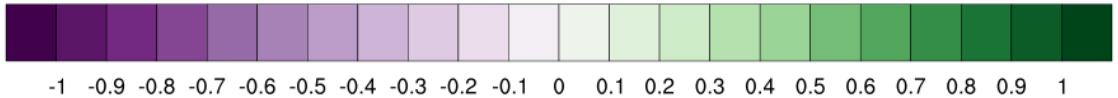
Precipitation Analysis

- General transition from sub-grid precip to more resolved precip from 25→13→3 km
- Areas of active convection/higher precip accumulations tend to be resolved by microphysics scheme, whereas regions exhibiting low accumulations tend to be dominated by the cumulus scheme.

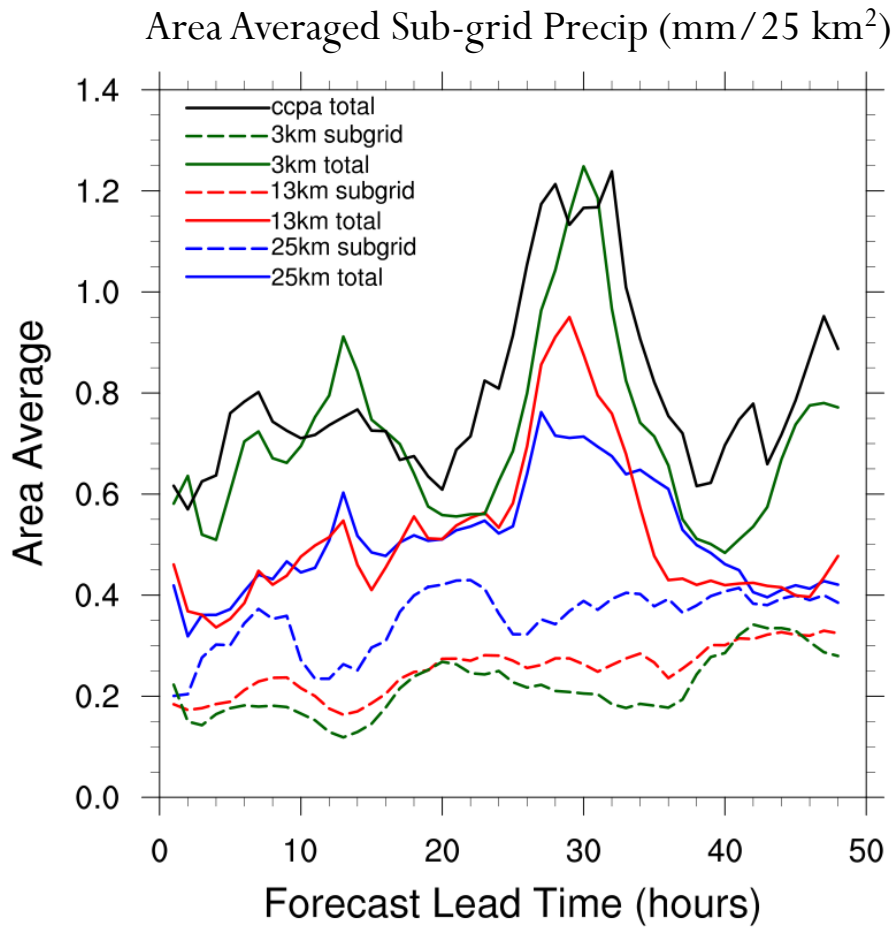


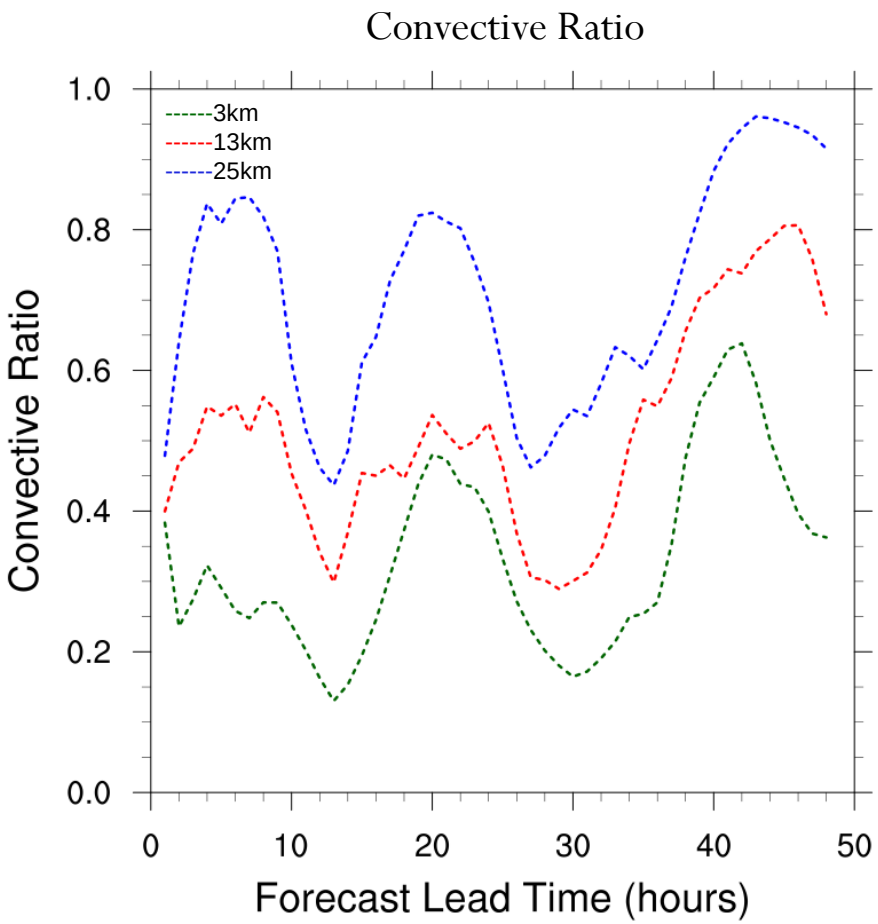






GSD_noah Precipitation Partitions

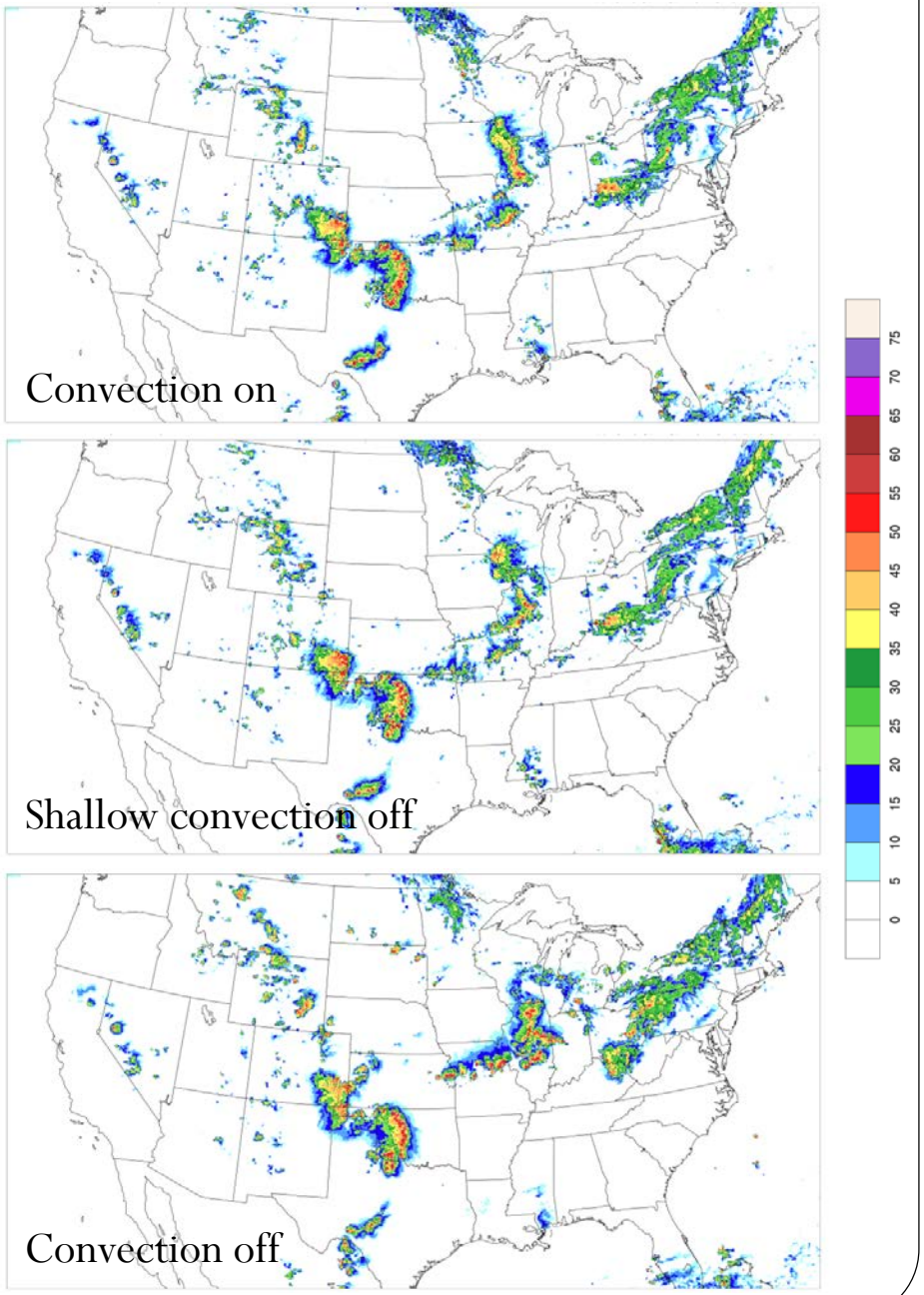




But wait! There's more!

- Additional runs were performed with deep and/or shallow convection turned off to test the sensitivity of the cumulus parameterization at convection-allowing grid spacing
- Re-runs will be conducted with updated versions of the code to include latest physics developments

3-km GSD_noah – Composite Reflectivity (dBZ)



Summary

- There is no clear "winner" in which quite/ combination performed hs and weakne
- All ru t well
- hat is ion
- Pl s than at 25- and 13-km
- Deficient tra are noted in several runs, suggesting deficiencies in the model microphysics

Interested in collaborating?
Check out the DTC Visitor Program!
https://dtcenter.org/visitor-program