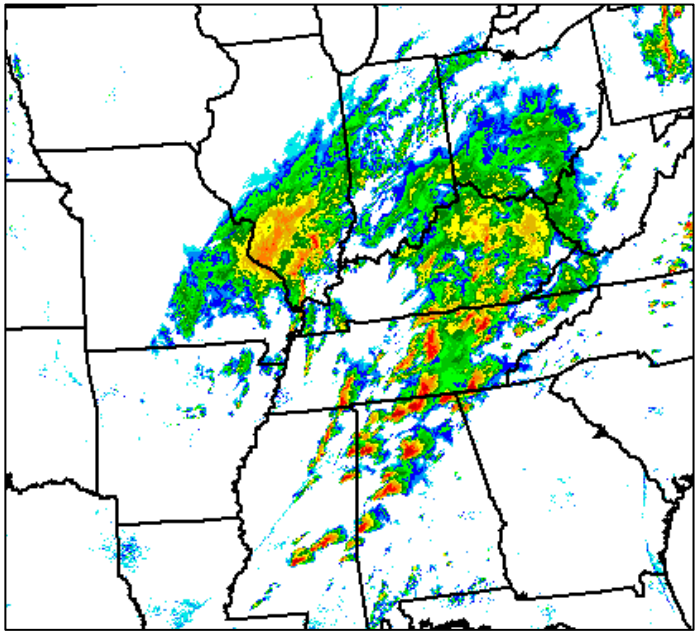
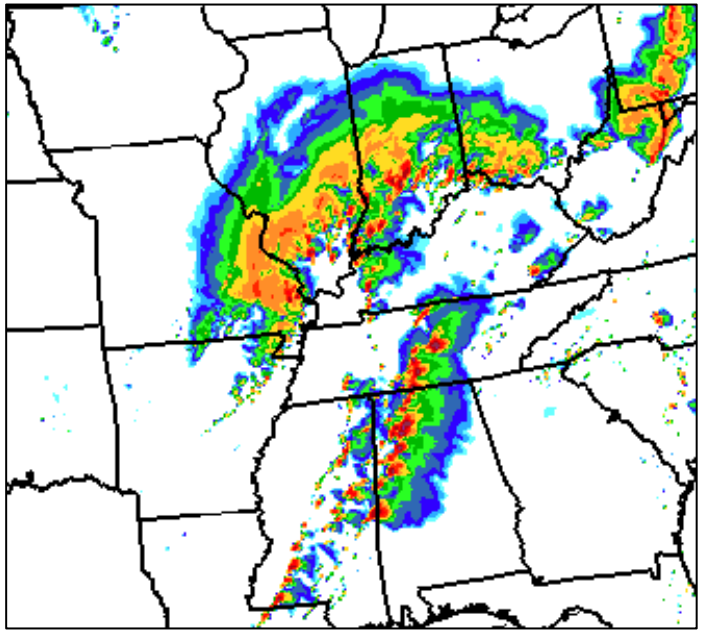
The Impact of WRF-DART Analyses on 3 km Explicit Convective Forecasts During the 2011 Spring Season

M. Weisman, W. Wang, K. Manning, G. Romine; NCAR/MMM

(12th WRF Workshop: June 20-24 2011)



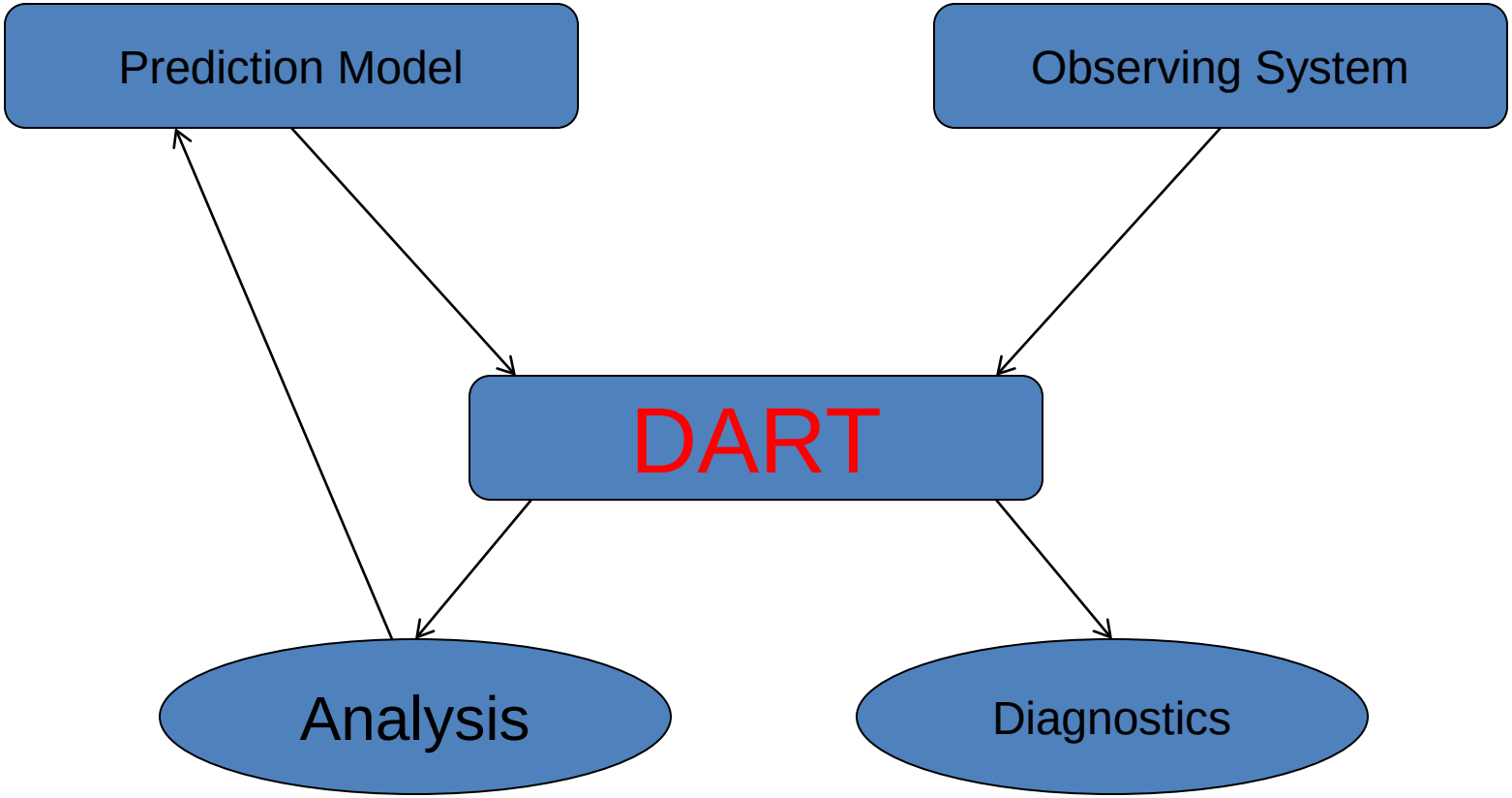
Radar 22 UTC



3 km ARW 4 h Forecast

Tornado Outbreak: 04/27/11

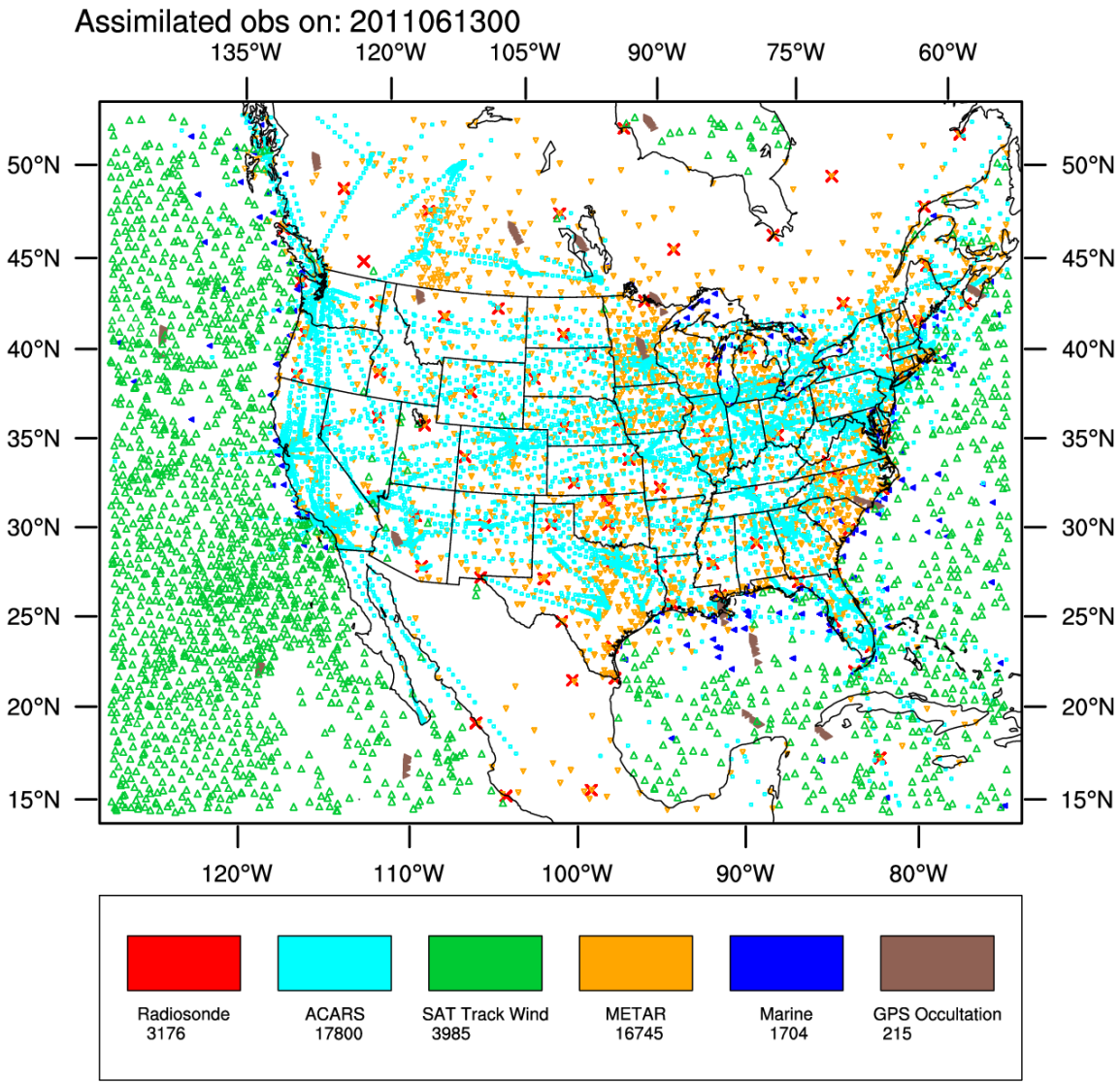
Data Assimilation Research Testbed (DART)



DART is a community ensemble assimilation facility

NESL

Assimilated Observation Types



<u>MADIS sourced:</u>
Radiosonde U,V,T,Td,Alt.
METAR U,V,T,Td,Alt.
MARINE U,V,T,Td,Alt.
ACARS U,V,T,Td

<u>SSEC sourced:</u>
SAT cloud track winds: U,V

<u>COSMIC sourced:</u>
GPS occultation

~ 40k obs, 4x daily

Mesoscale cycling period: 12Z 27 April-13 June 00Z 2011

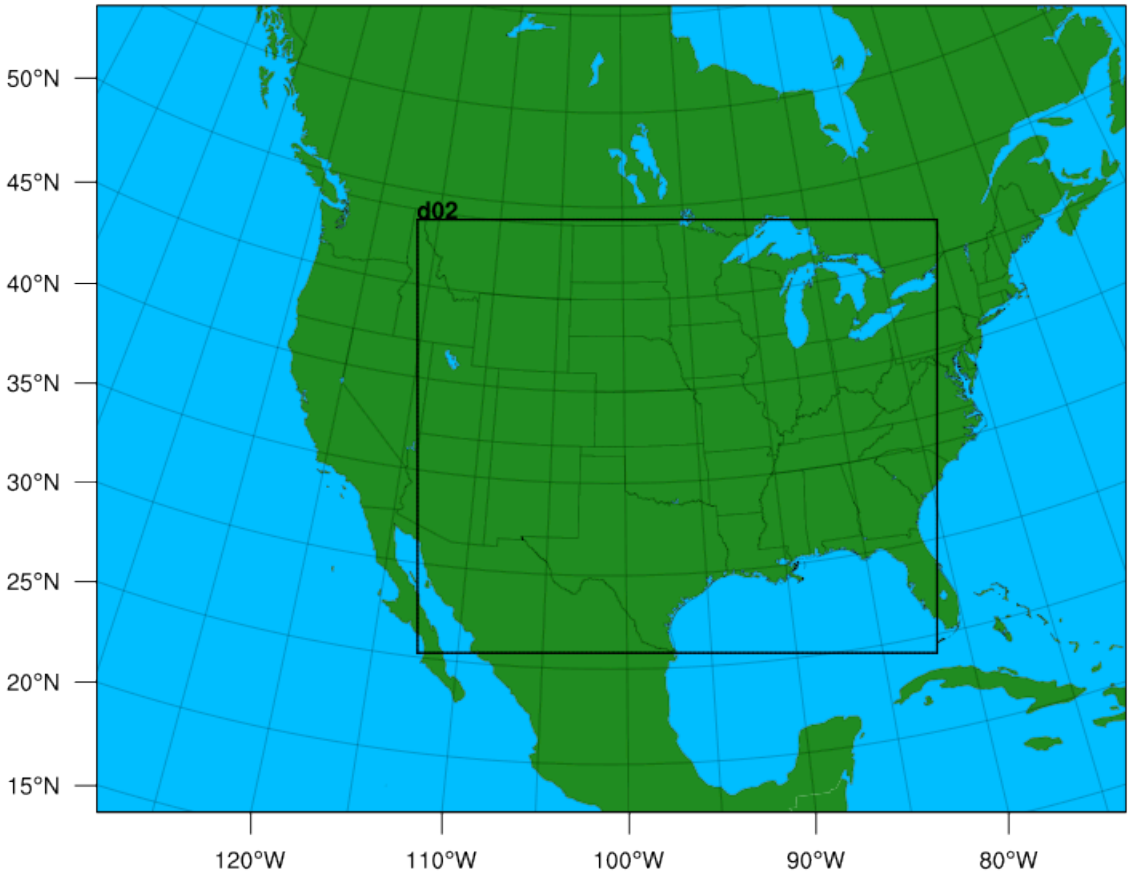
*50 members at 15 km grid resolution

*Member with closest normalized fit to ensemble mean selected for IC/BC for 3 km forecast

*GFS forecast BC for outer domain

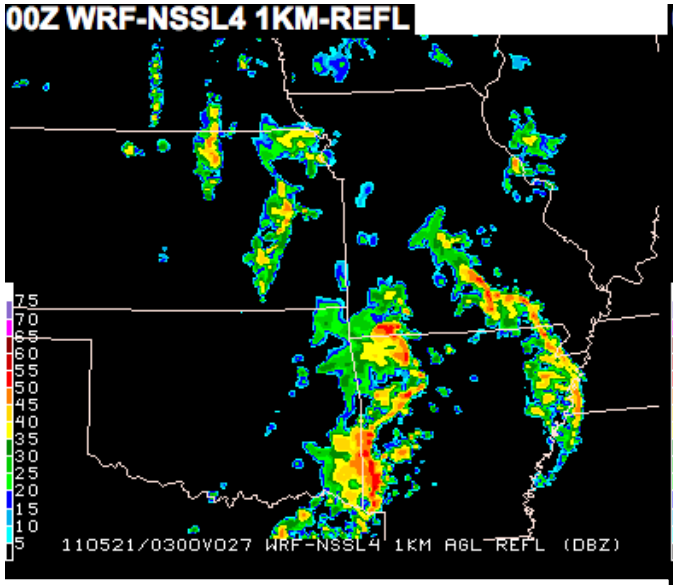
*MYJ PBL, Thompson Micro.

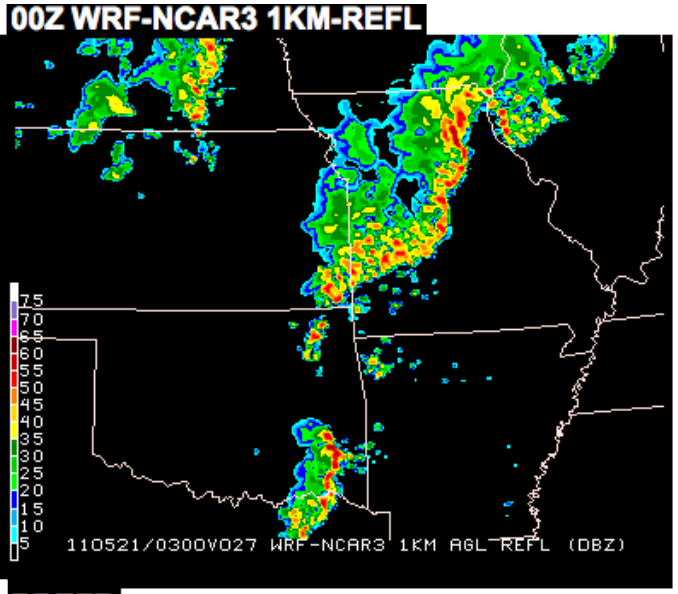
18Z anal. 27 APR-12 May
00Z anal. 13 May-12 Jun



05/21/11 0300 UTC

NSSL
4 km
NAM
WSM6

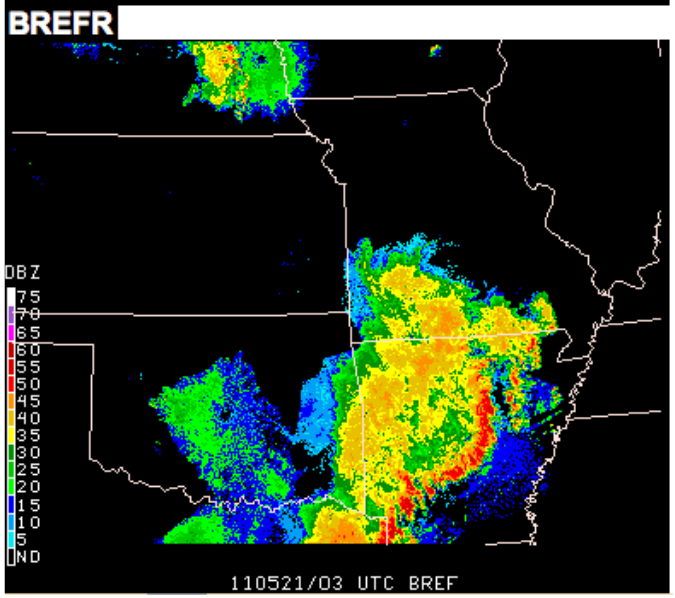




NCAR
3 km
DART
Thomp

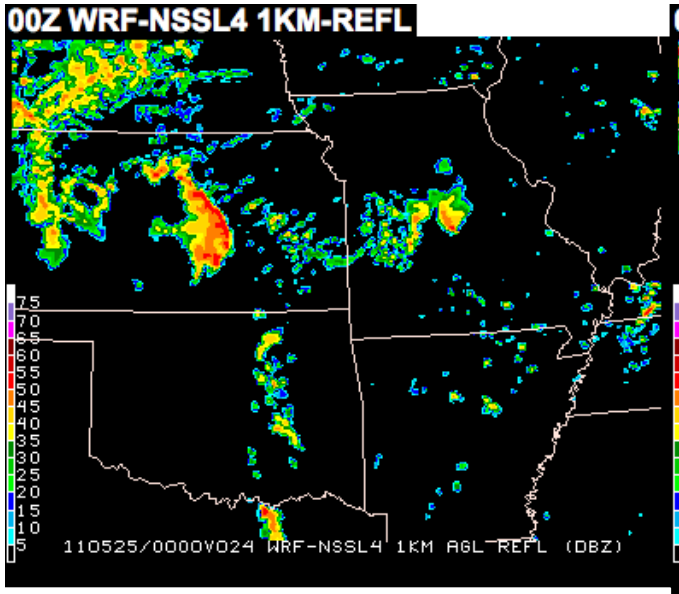
27 h Forecasts

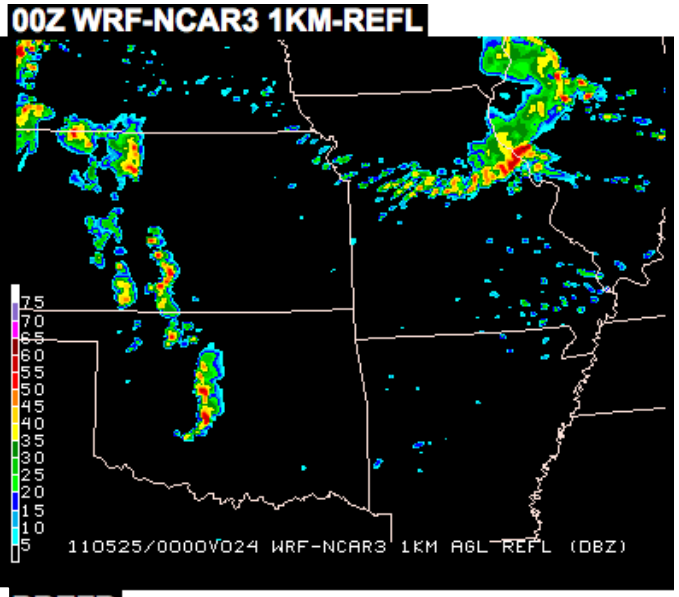
1 km Observed
Reflectivity



05/25/11 0000 UTC

NSSL
4 km
NAM
WSM6

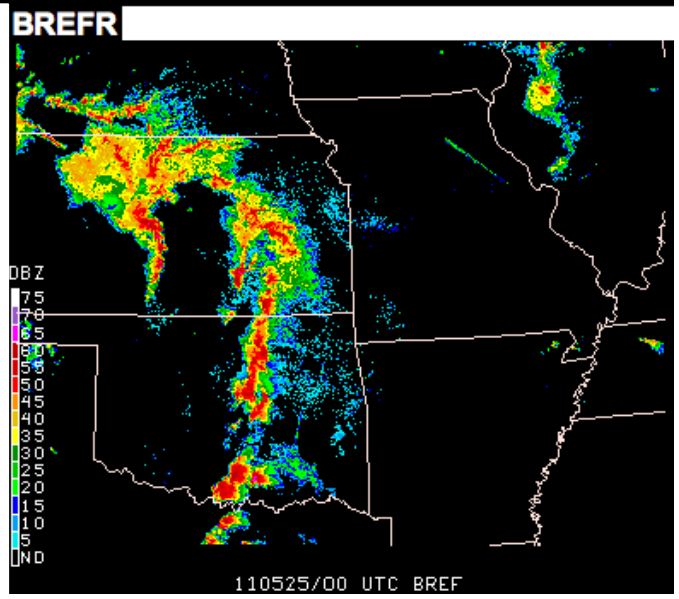




NCAR
3 km
DART
Thomp

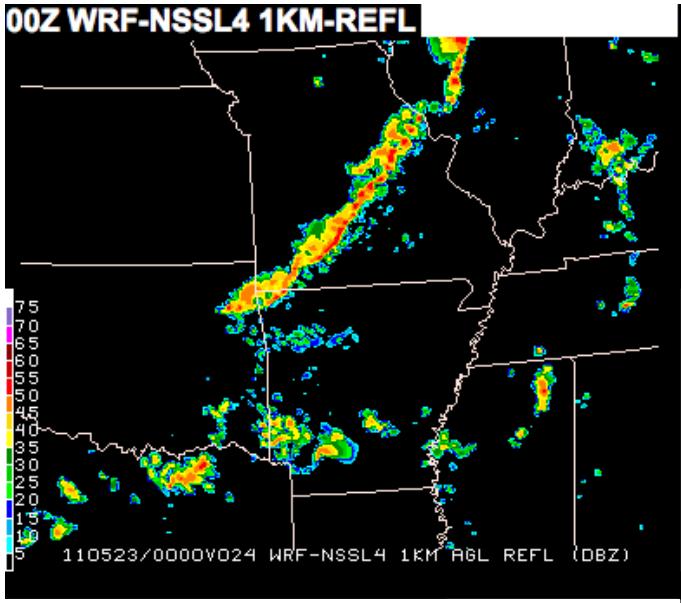
24 h Forecasts

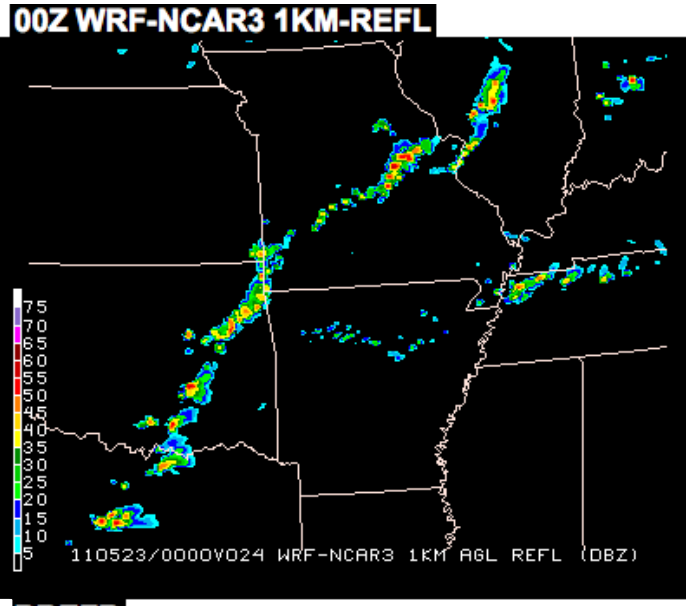
1 km Observed
Reflectivity



05/23/11 0000 UTC

NSSL
4 km
NAM
WSM6

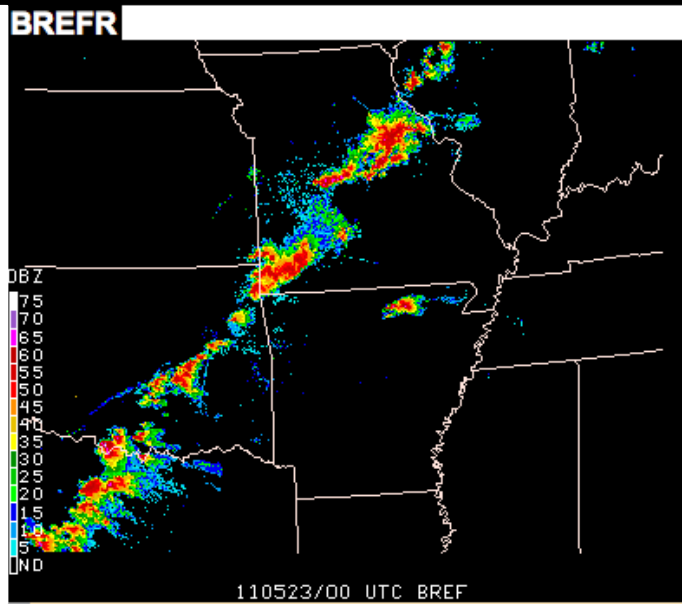




NCAR
3 km
DART
Thomp

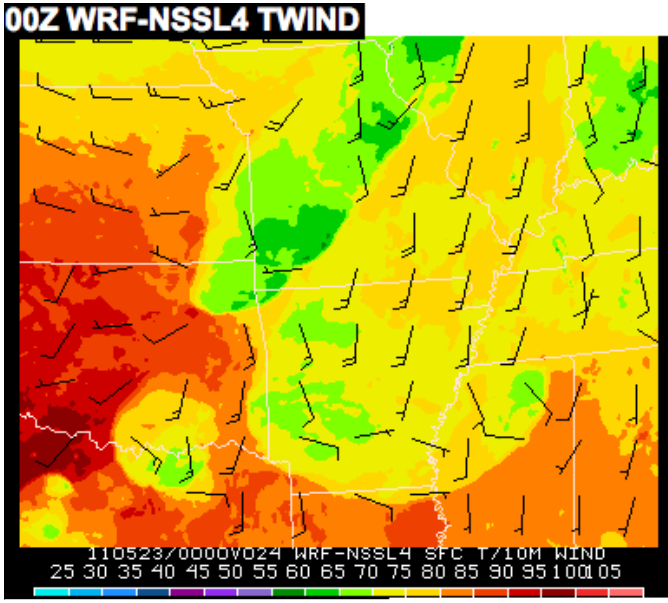
24 h Forecasts

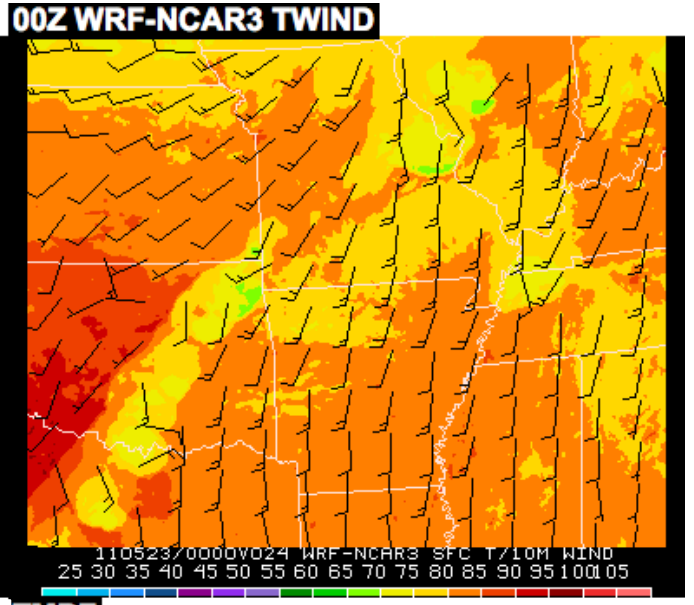
1 km Observed
Reflectivity



05/23/11 0000 UTC Surface Temp

NSSL
4 km
NAM
WSM6

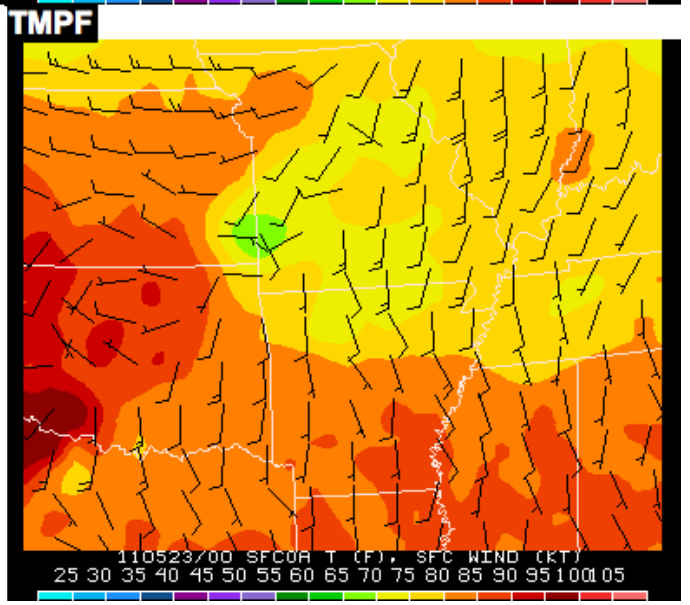




NCAR
3 km
DART
Thomp

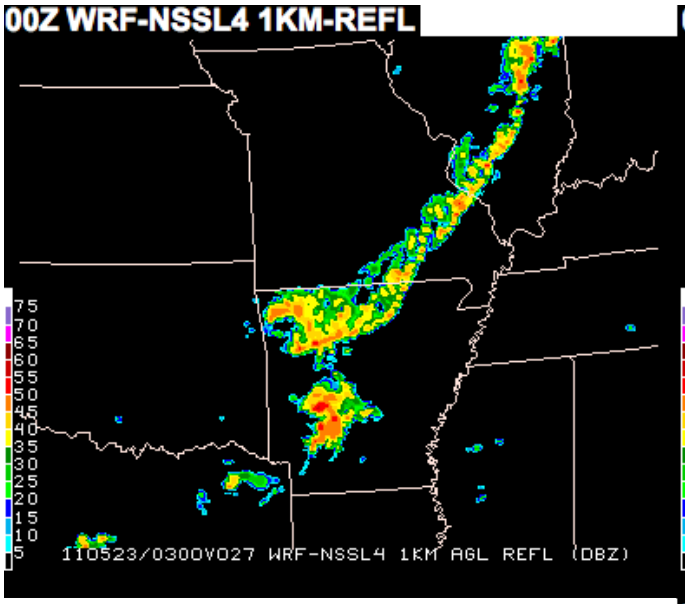
24 h Forecasts

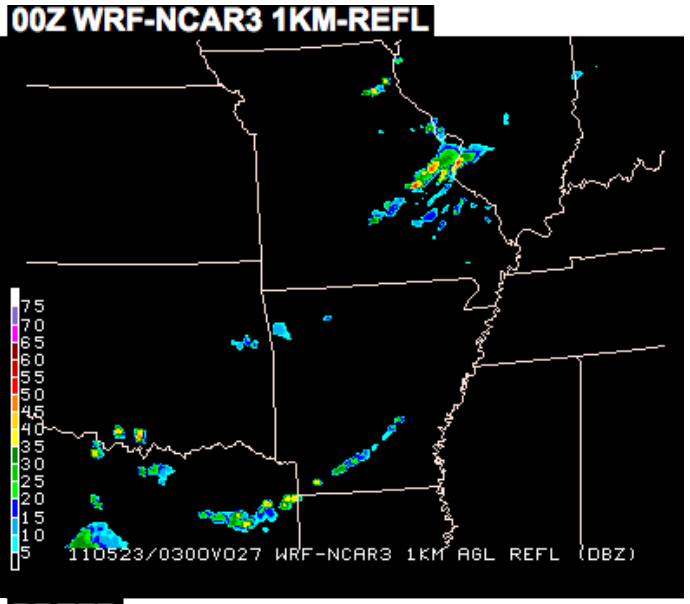
Surface Temp
Analysis:



05/23/11 0300 UTC

NSSL
4 km
NAM
WSM6

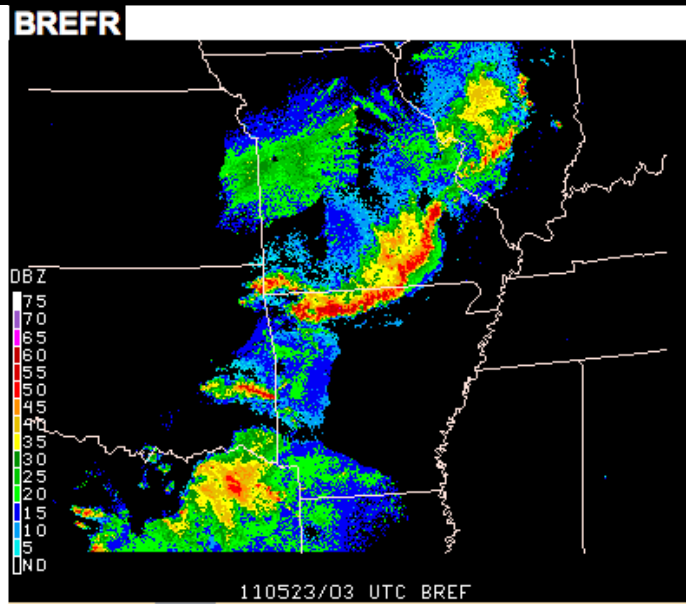




NCAR
3 km
DART
Thomp

27 h Forecasts

1 km Observed
Reflectivity



Basic Issues:

*Representativeness of single-member analysis…

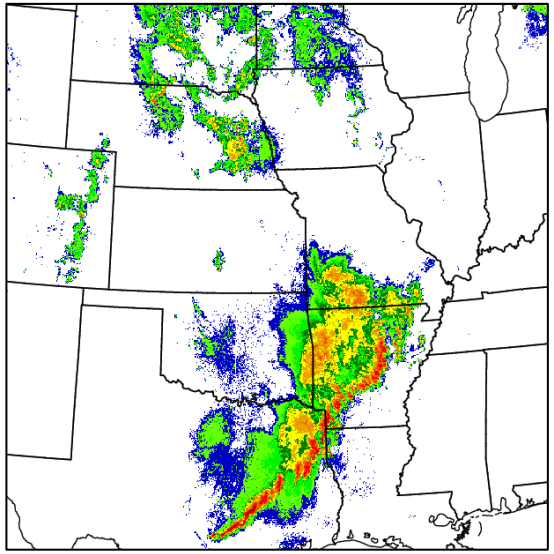
*Model biases….

*Observational biases/network issues

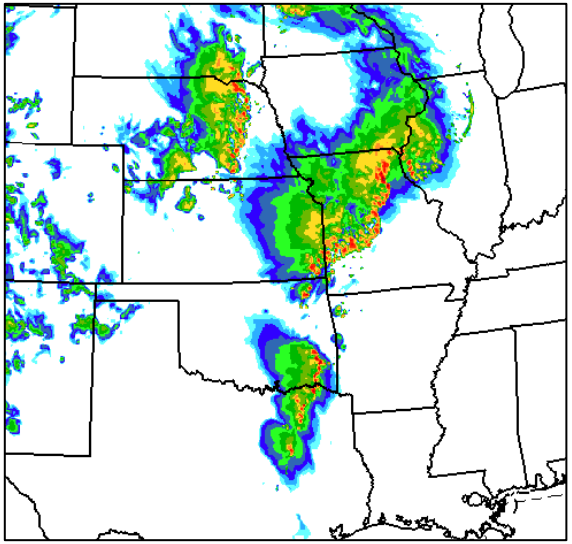
*Physics sensitivities…..

Micro. Sensitivities: 05/21/11 0300 UTC

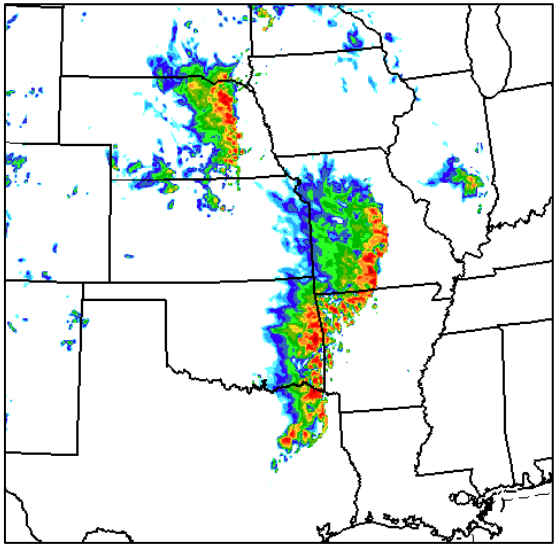
Observed Radar



ARW-Thompson

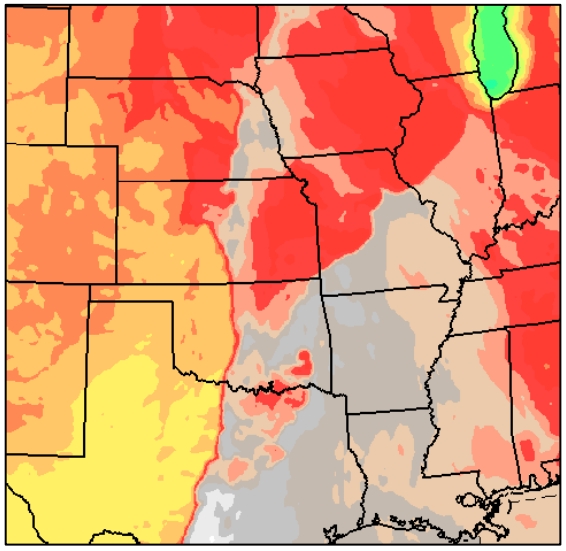


ARW-WSM6

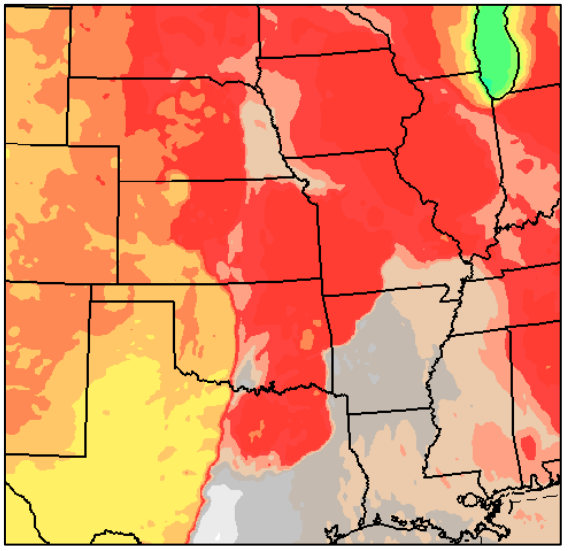


27 h Forecasts

Surface Theta-E

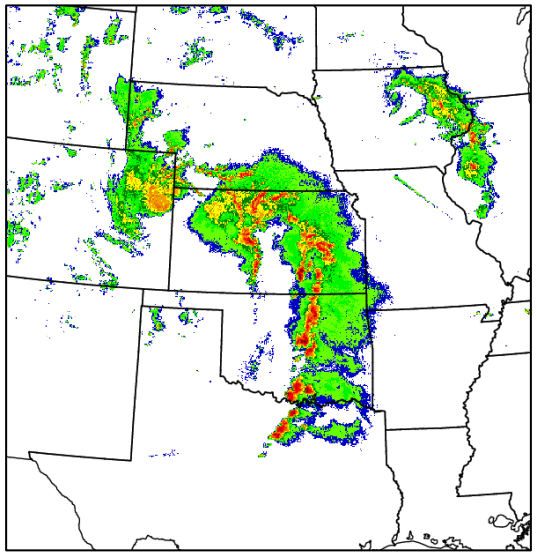


Surface Theta-E

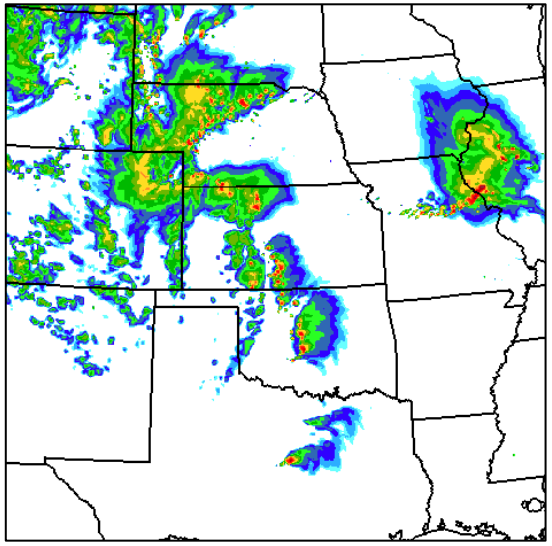


Micro. Sensitivities: 05/25/11 0000 UTC

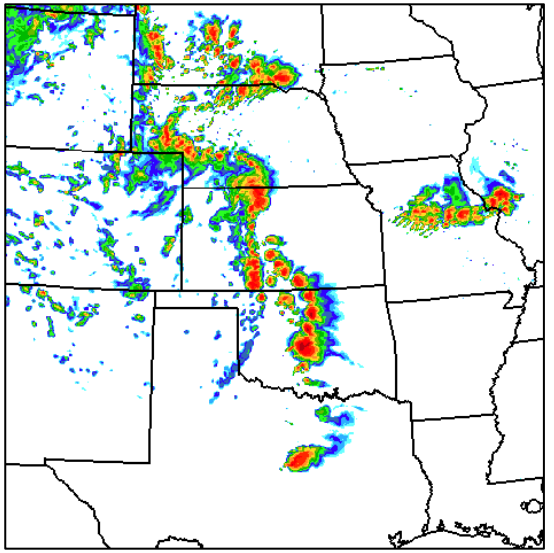
Observed Radar



ARW-Thompson

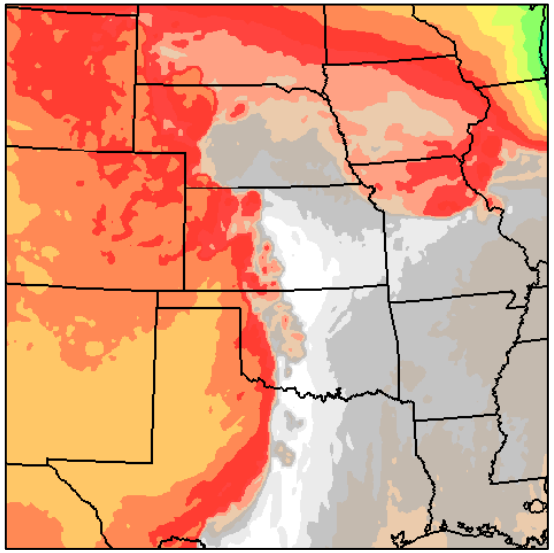


ARW-WSM6

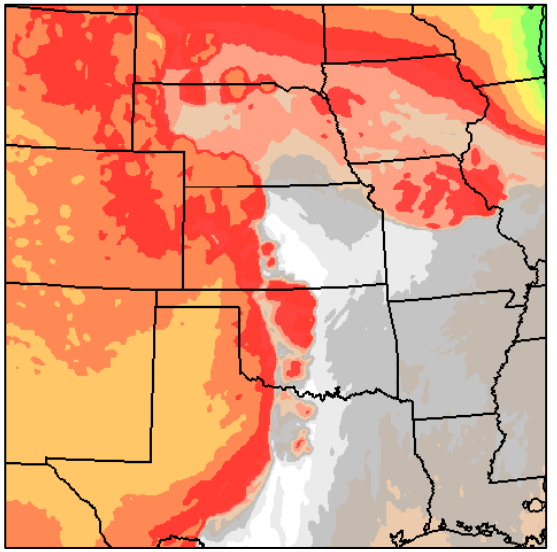


24 h Forecasts

Surface Theta-E

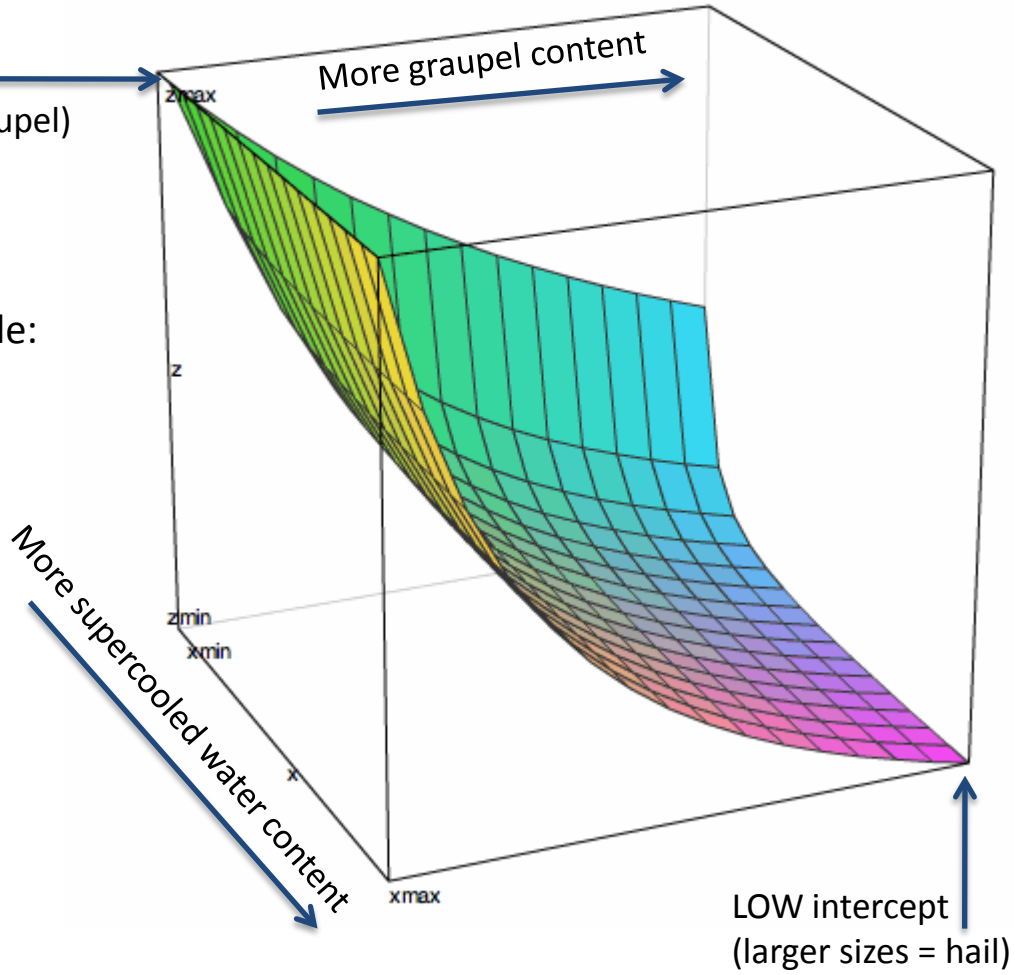


Surface Theta-E



Evolution of y-intercept param

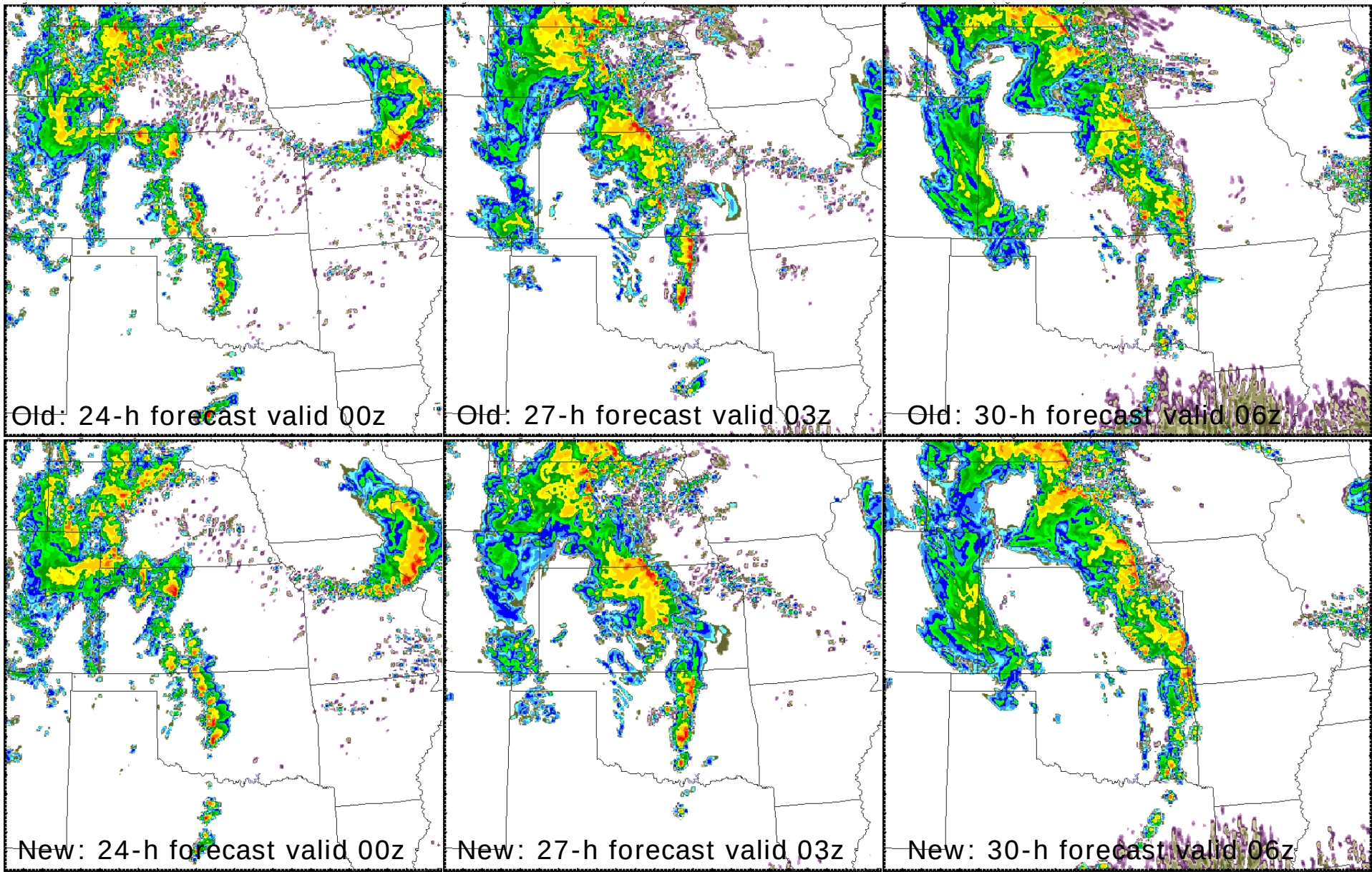
Version 3.1.1 and earlier: N_0 function of q_g
Version 3.2 and 3.2.1: N_0 function of $q_r + q_c$ *(however introduced a bug in a source term)*
Version 3.3 uses both graupel and supercooled liquid water components



Each axis represents 2 orders of magnitude:
Graupel/hail from 0.1 to 10 g kg^{-1}
N_0 from 10^6 to 10^4

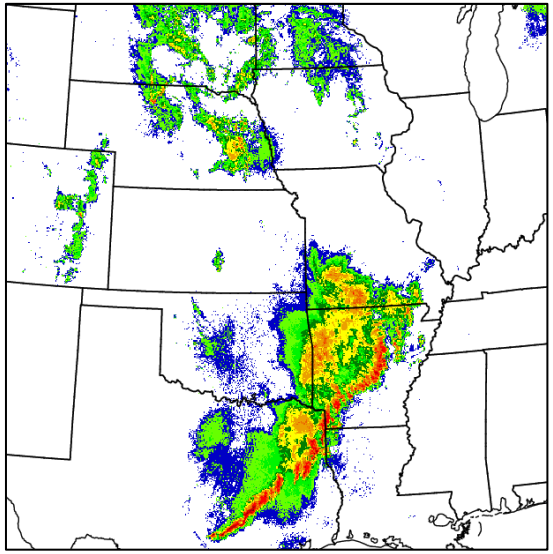
NEW… June 2011:
Adjusted the range of graupel values

Case study: 25 May 2011

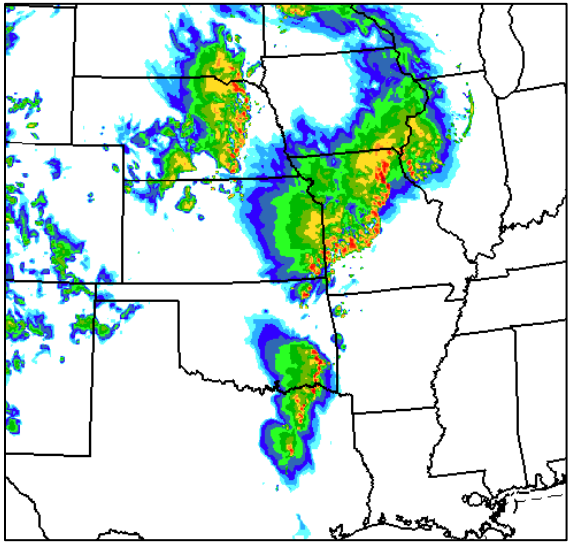


PBL Sensitivities: 05/21/11 0300 UTC

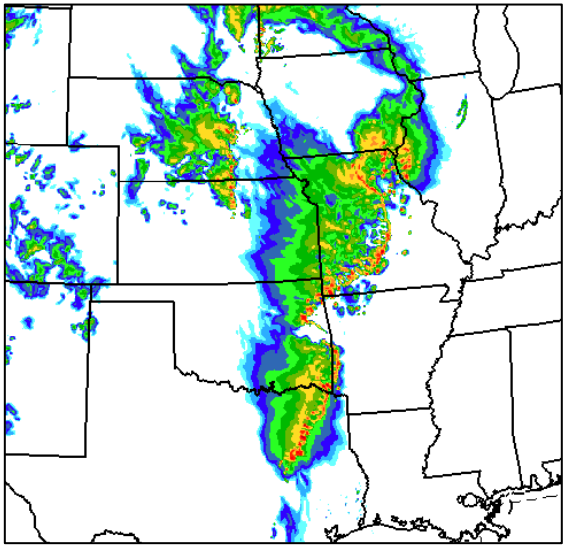
Observed Radar



ARW-Thompson-MYJ

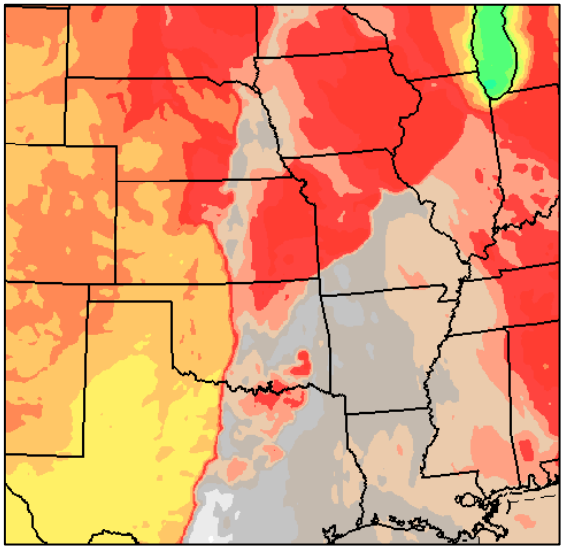


ARW-Thompson-YSU

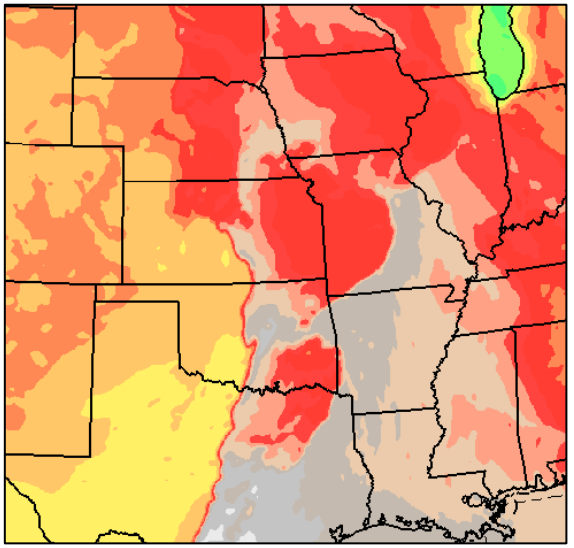


27 h Forecasts

Surface Theta-E

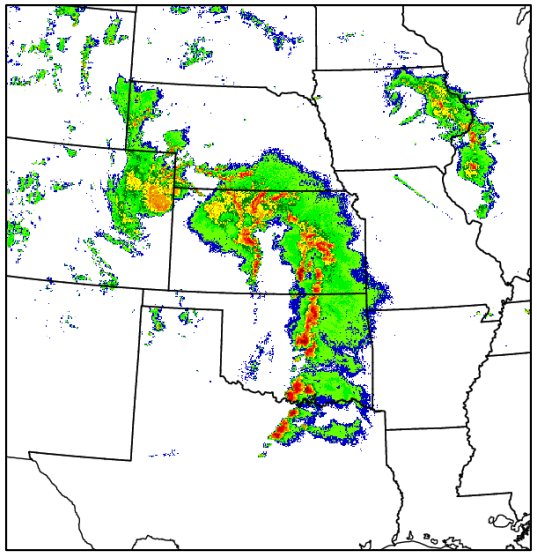


Surface Theta-E

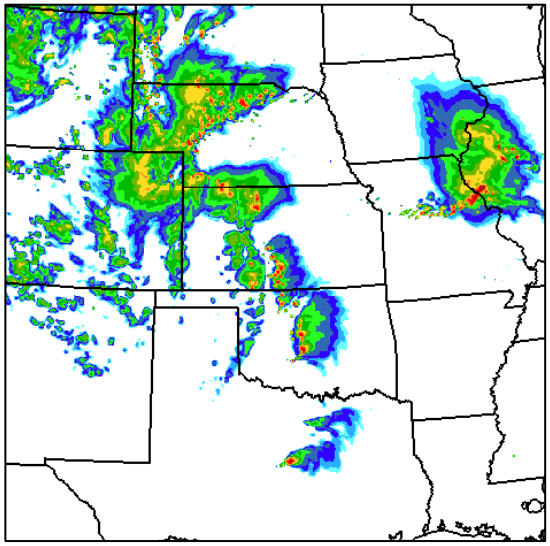


PBL Sensitivities: 05/25/11 0000 UTC

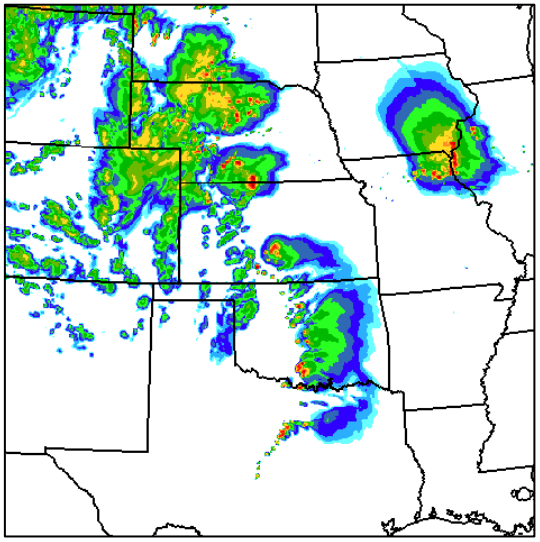
Observed Radar



ARW-Thompson-MYJ

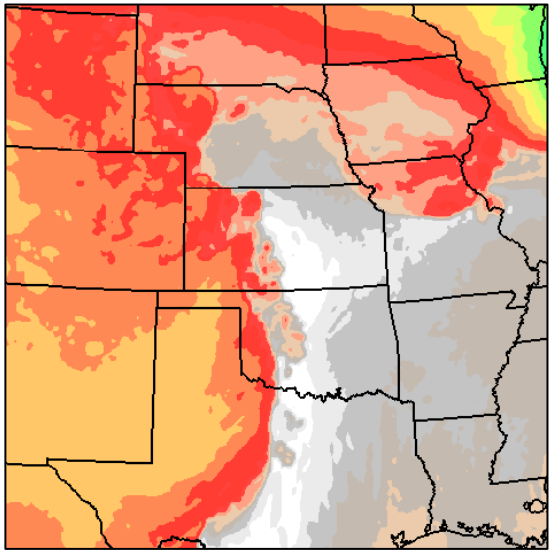


ARW-Thompson-YSU

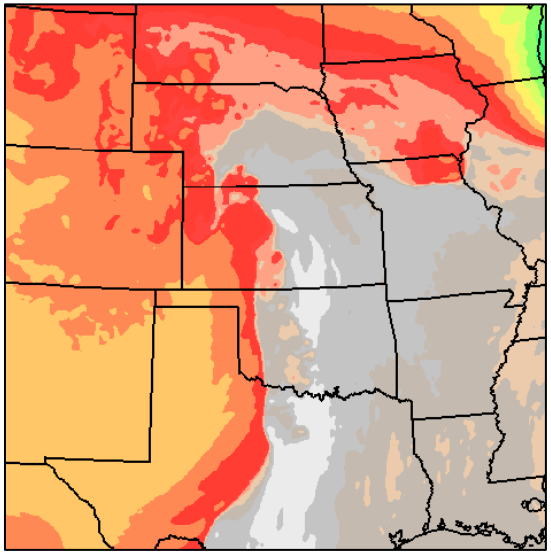


24 h Forecasts

Surface Theta-E



Surface Theta-E



Summary:

*DART was “successfully” implemented for convective applications:

however…

*This year’s forecasts offer much opportunity for improvement.
(Glen will try to explain)

also…..

* Thompson microphysics scheme is a bit light on convection
(cold pools and subsequent upscale convective growth).
(Greg is in the process of making adjustments…..)

*Microphysics and PBL sensitivities insufficient to explain
larger forecast errors