Comparisons of Different WRF Configurations in a Severe Weather Forecasting Environment: The 2005 SPC/NSSL Spring Program

Jack Kain CIMMS/NSSL
Steve Weiss SPC
Greg Carbin SPC
Mike Baldwin CIMMS/NSSL
David Bright SPC
John Hart SPC
Jason Levit SPC

SPC/NSSL Spring Program: An annual program designed to investigate *problems of mutual interest to forecasters and research scientists.*

Spring Experiment 2005 Participating institutions:

NOAA Agencies:

- NCEP/EMC (4)
- NCEP/HPC
- NCEP/SPC (11)
- NWS/BIL
- NWS/DMX
- NWS/OUN (4)
- OAR/NSSL (9)
- OAR/FSL (3)
- NESDIS

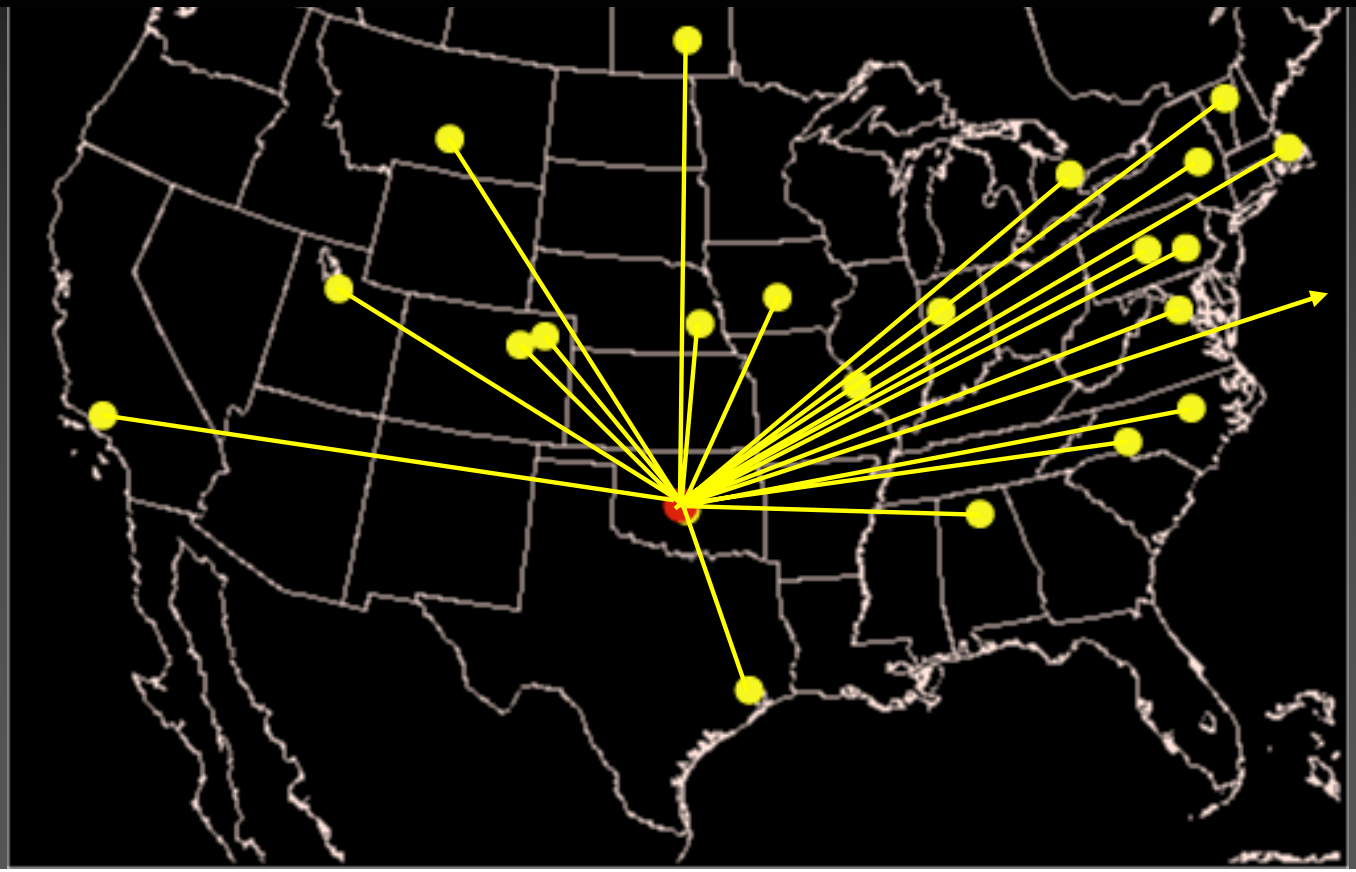
Universities

- Colo. St.
- Millersville
- NC State
- Purdue
- St. Louis U. (2)
- UCLA
- Lyndon St.
- Nebraska
- Oklahoma (2)
- Penn State
- SUNY-Albany(2)
- UNC-Charlotte
- Alabama-Huntsville

Government Agencies

- NCAR (4)
- NASA
- Met. Svice Canada (2)
- NAM - Romania

Private Meteorologists (4)



Spring Program 2005 in a nutshell…

Partnerships: *Hi-res WRF forecasts produced by **CAPS**, **EMC**, and **NCAR***

Science: *1) In what areas can these high resolution models help us advance the art and science of severe weather forecasting?*

2) How can operational forecasting exercises help model developers design a better product?

Daily Activities:

- During the first half of the day we all stepped into a forecasters' shoes and issued an experimental forecast for severe weather

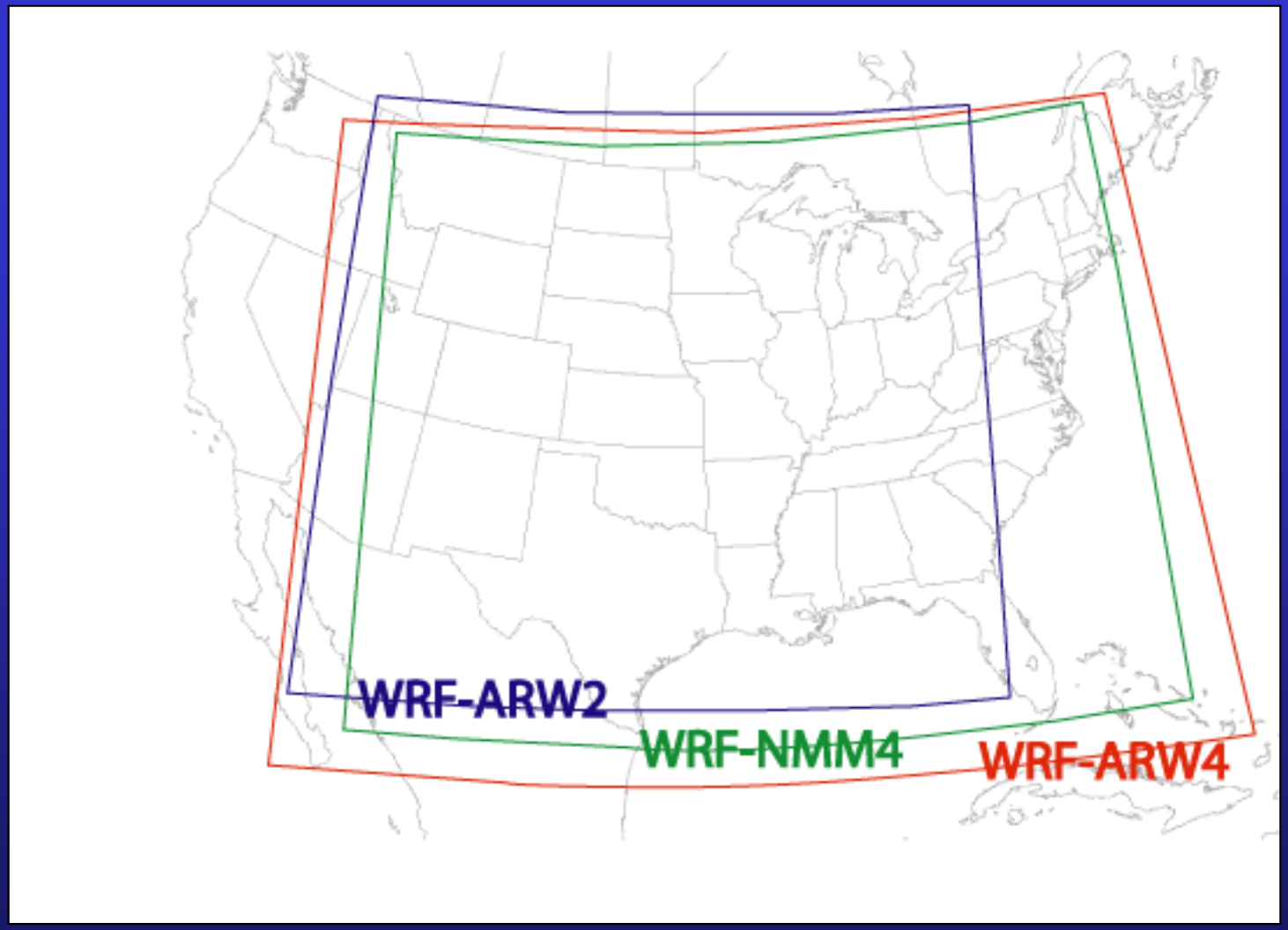
- After noon we all became researchers, focusing on interrogation and subjective verification of previous day's model output

**All results are very preliminary at this stage and mostly qualitative*

Model Configurations…

	WRF-NMM4 NCEP	**WRF-ARW4 NCAR**	**WRF-ARW2 CAPS**
Horiz. Grid Spacing (km)	4.5	4.0	2.0
Vertical Levels	35	35	51
PBL/Turb. Param.	MYJ	YSU	YSU
Microphysical Parameterization	Ferrier	WSM6	WSM6
Radiation Param. (SW/LW)	GFDL/GFDL	Dudhia/ RRTM	Dudhia/ RRTM
Initial Conditions	00Z 32 km Eta	00Z 40 km Eta	00Z 40 km Eta

Model Domains



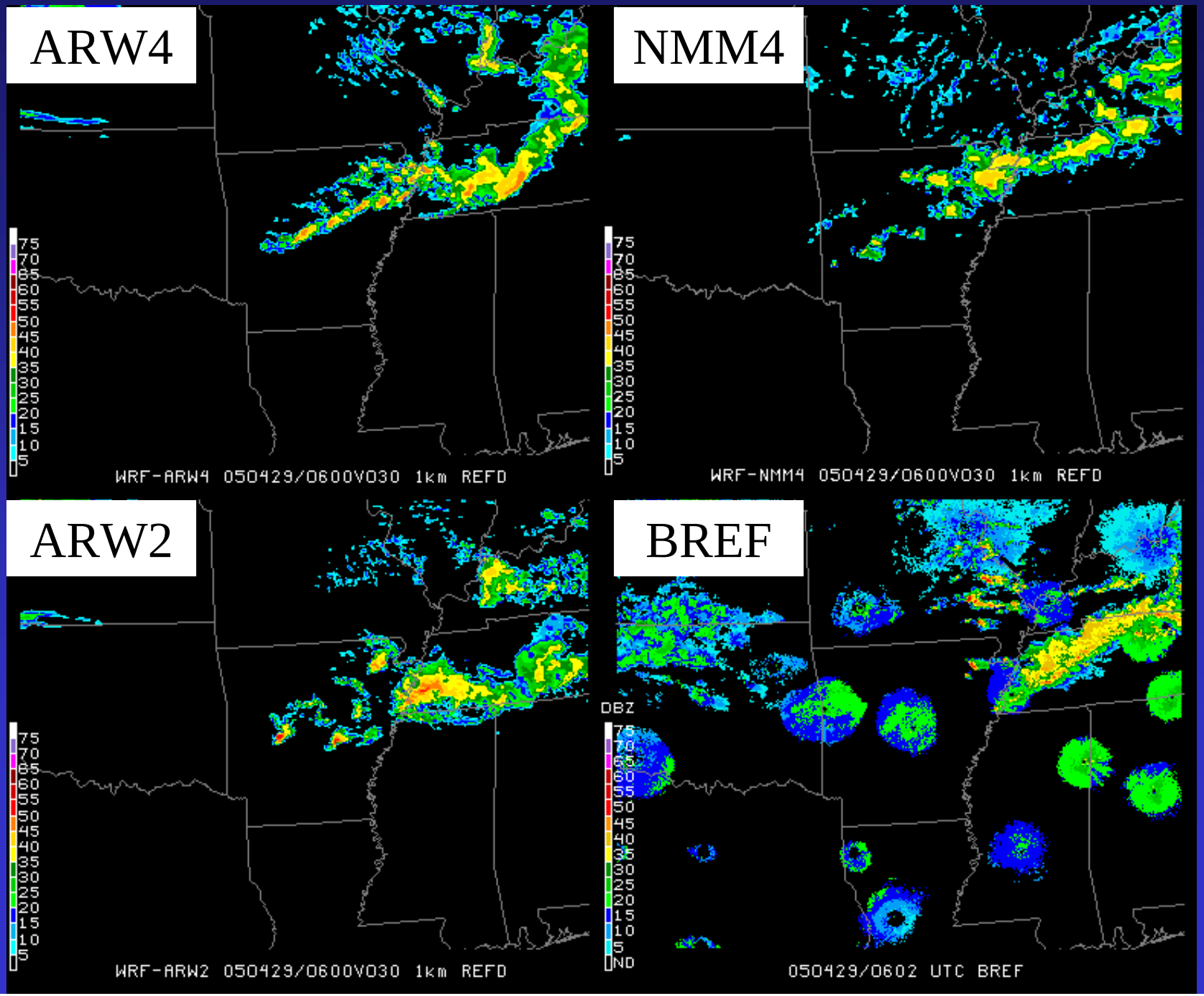

Our domain is much bigger than last year

The focus of our model evaluation efforts – Comparison/verification of…

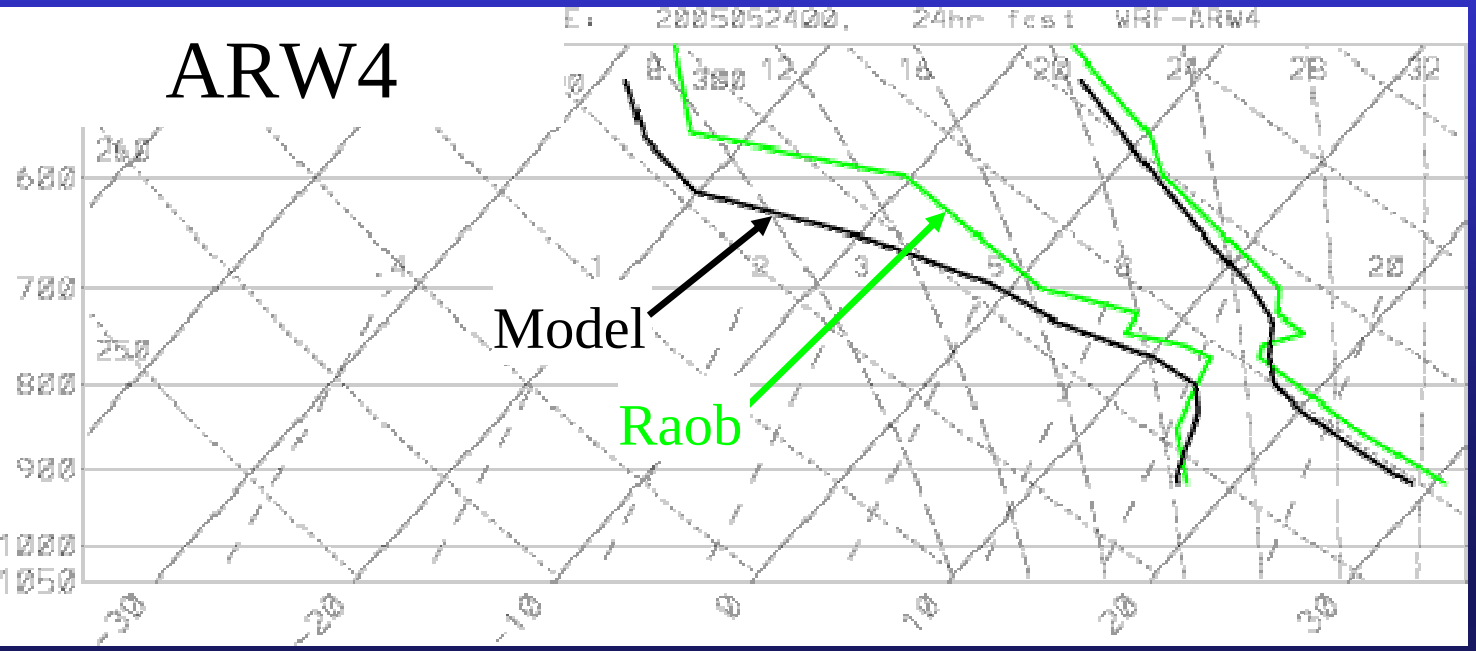
- sounding structures that impact convective initiation, evolution, and mode – mainly from runs using different physics (ARW4 and NMM4)*
- surface features such as frontal/dryline positions, uncontaminated T, Td, and CAPE.
- mesoscale aspects of convective initiation and evolution*
- explicit supercell forecasts*

A typical forecast/evaluation domain

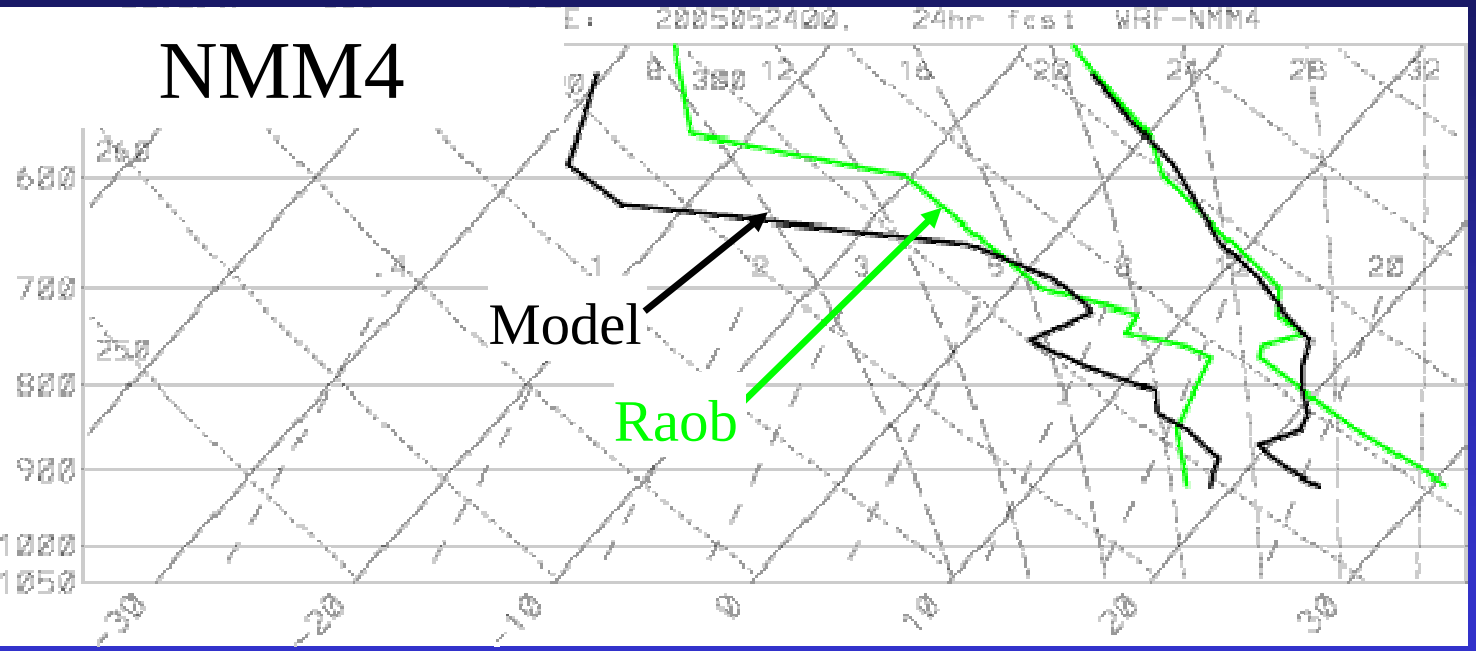
(see http://www.spc.noaa.gov/exper/Spring_2005/archive/20050428)



Sounding comparison: 24h forecast valid 00Z 24 May at DDC

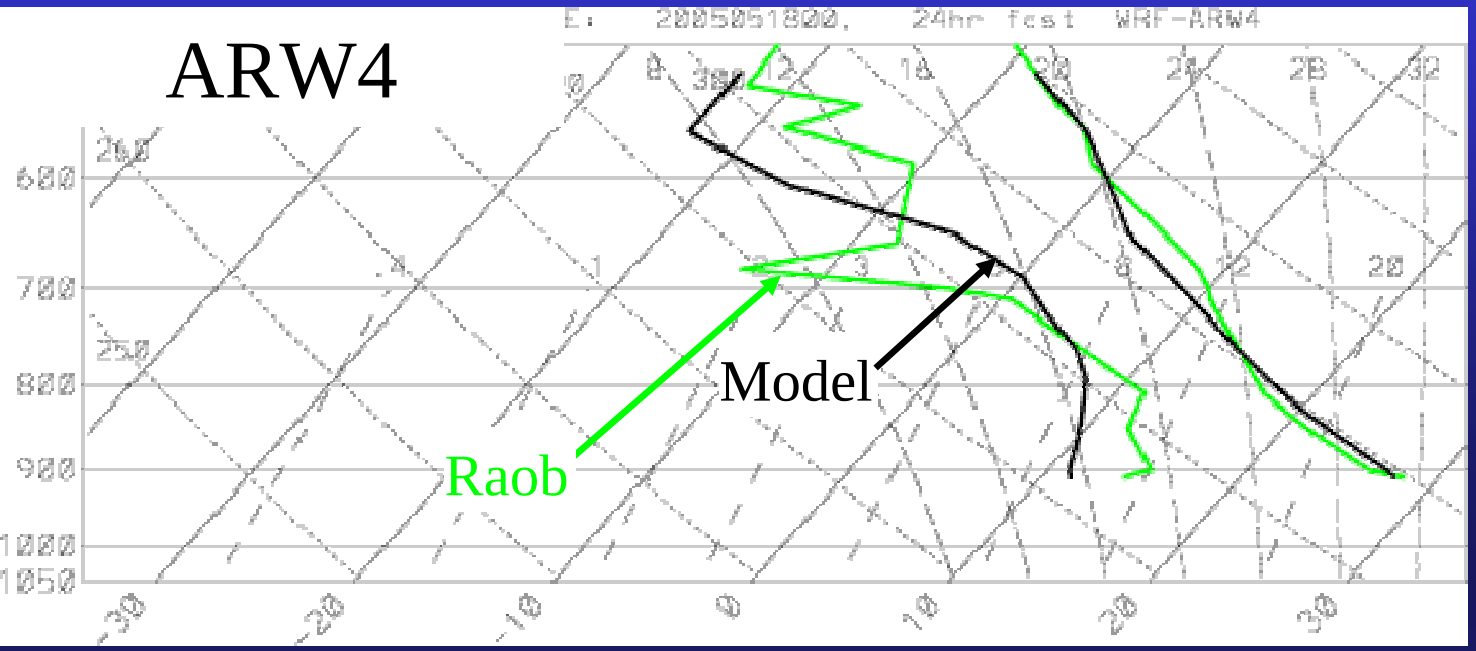


Good forecast…

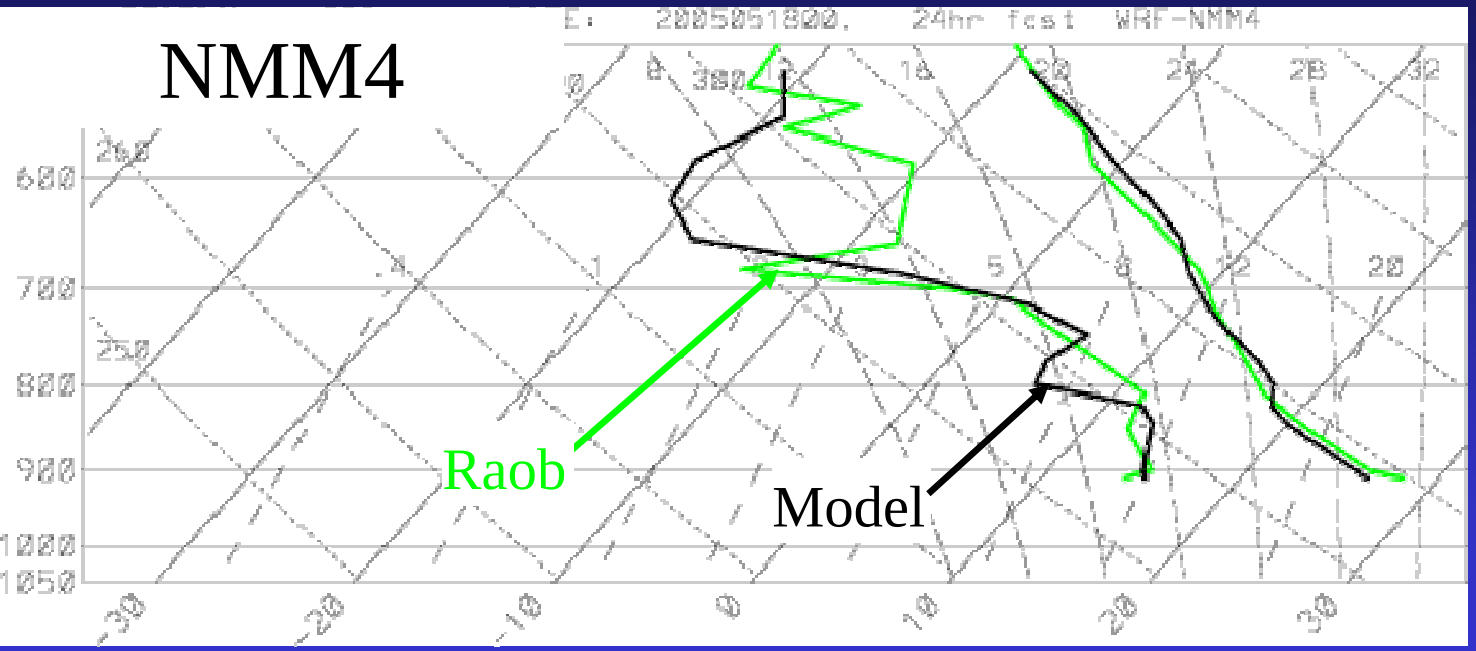


PBL too shallow, cold, & moist… clouds just broke up!

Sounding comparison: 24h forecast valid 00Z 18 May at DDC

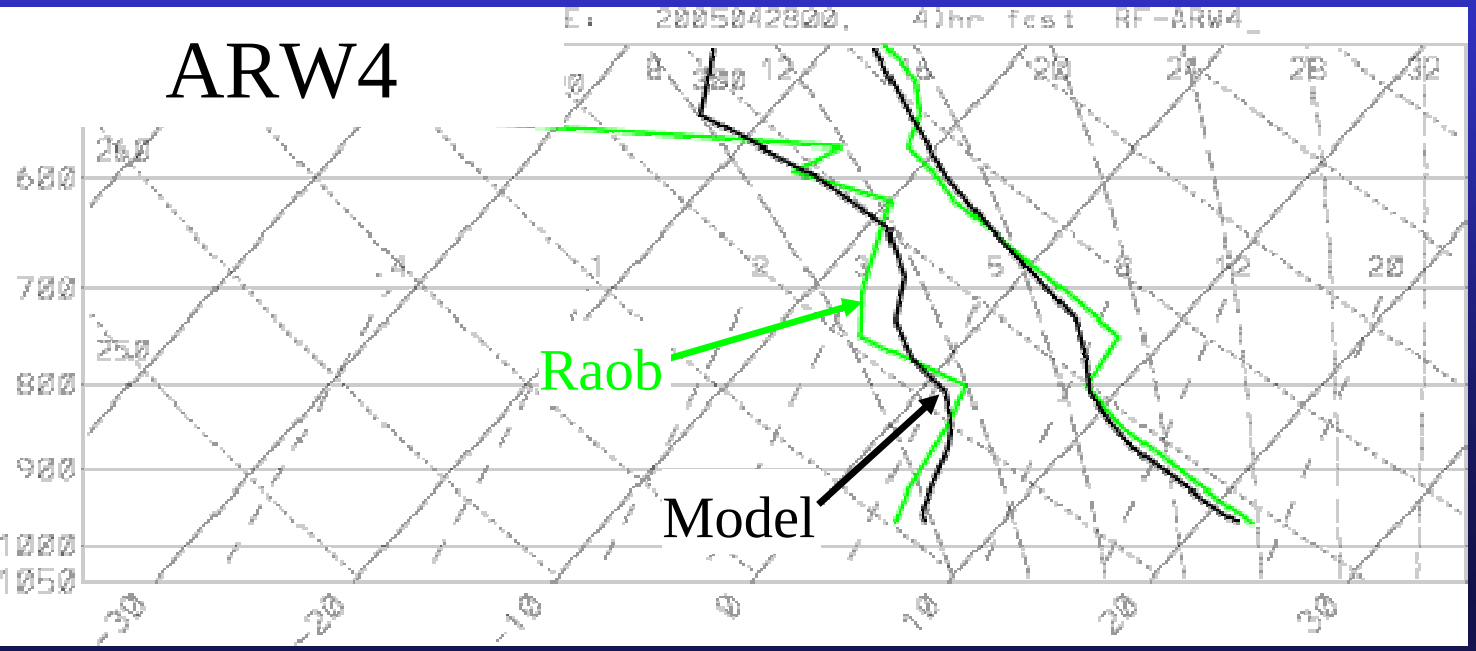


Too dry in PBL, too moist above; Where is the PBL top?

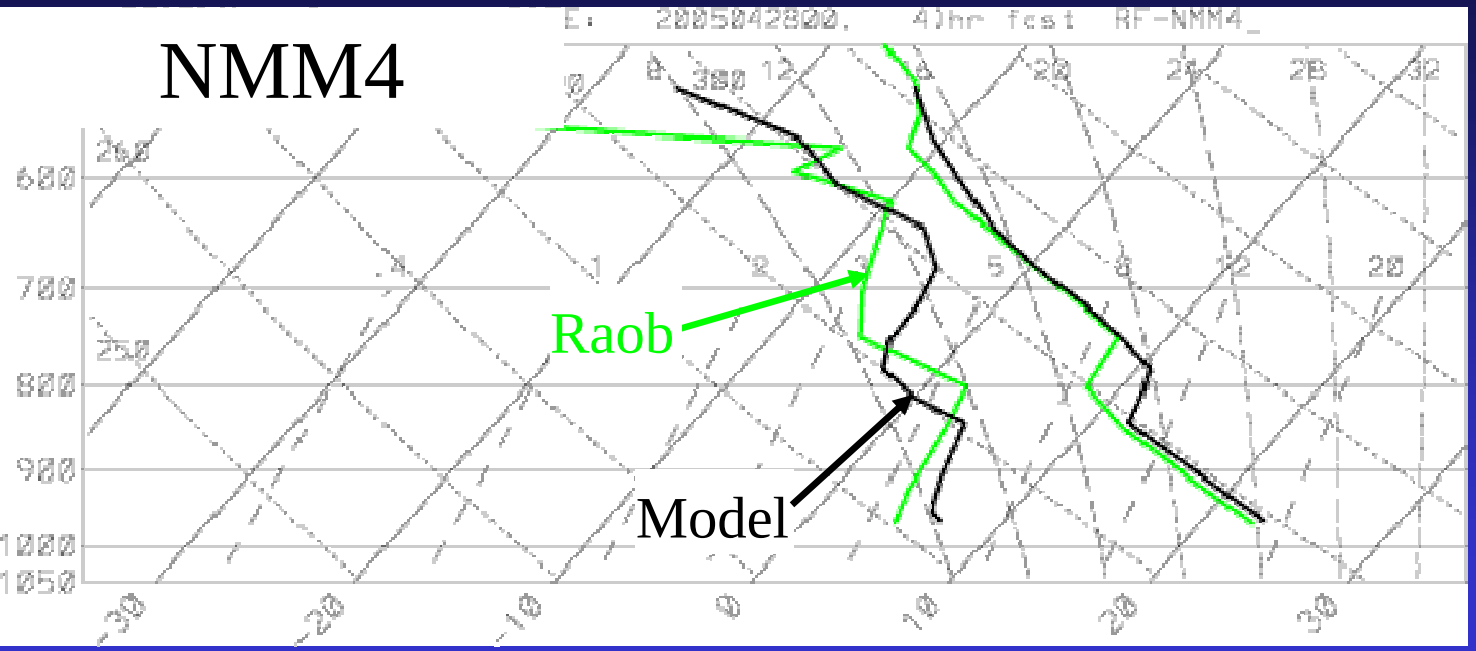


Good forecast…

Sounding comparison: 24h forecast valid 00Z 28 April at OUN

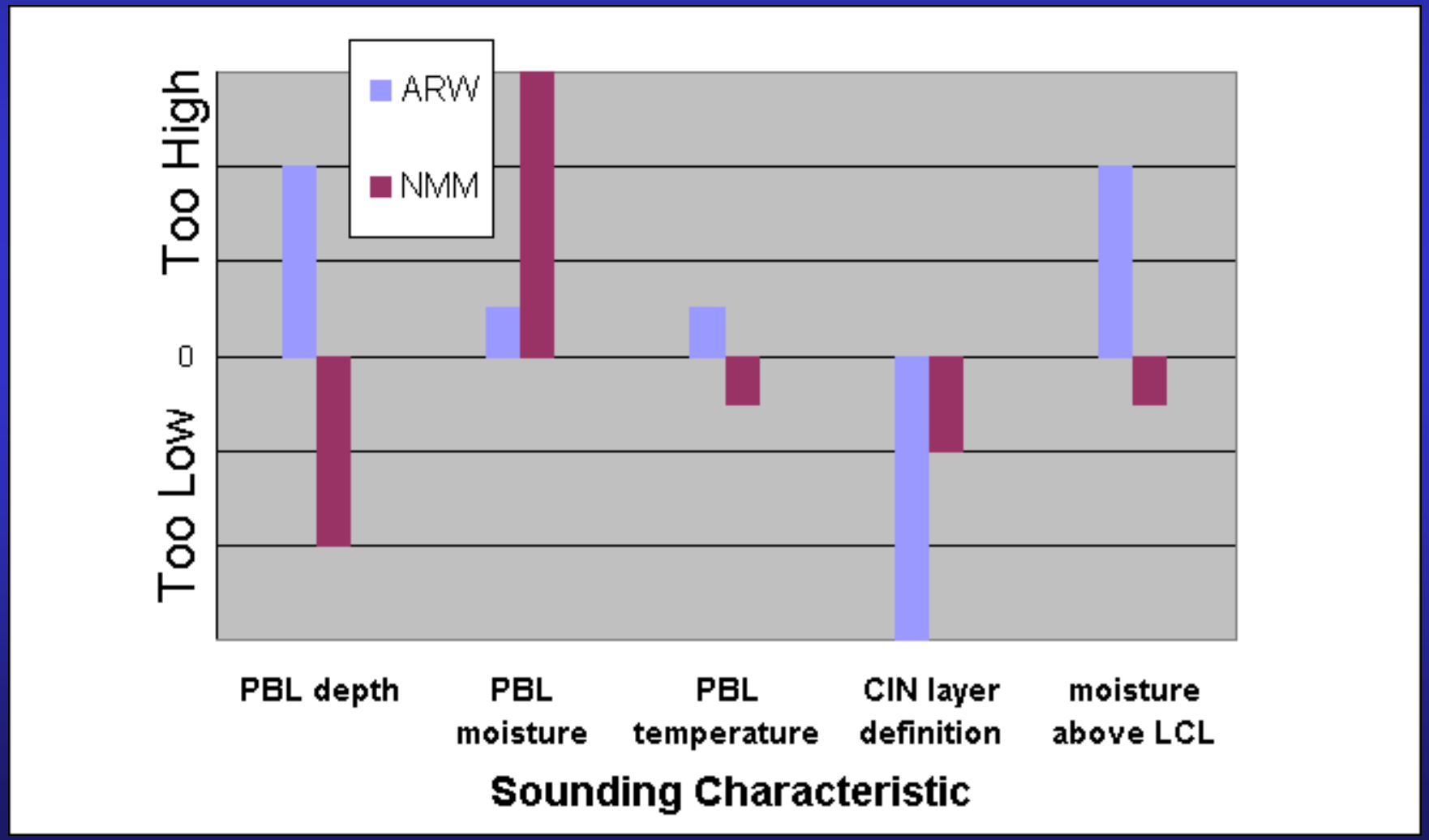


Good in PBL, but CIN layer is washed out



PBL too shallow and moist, but CIN layer looks good

Subjective perception of biases in sounding structure

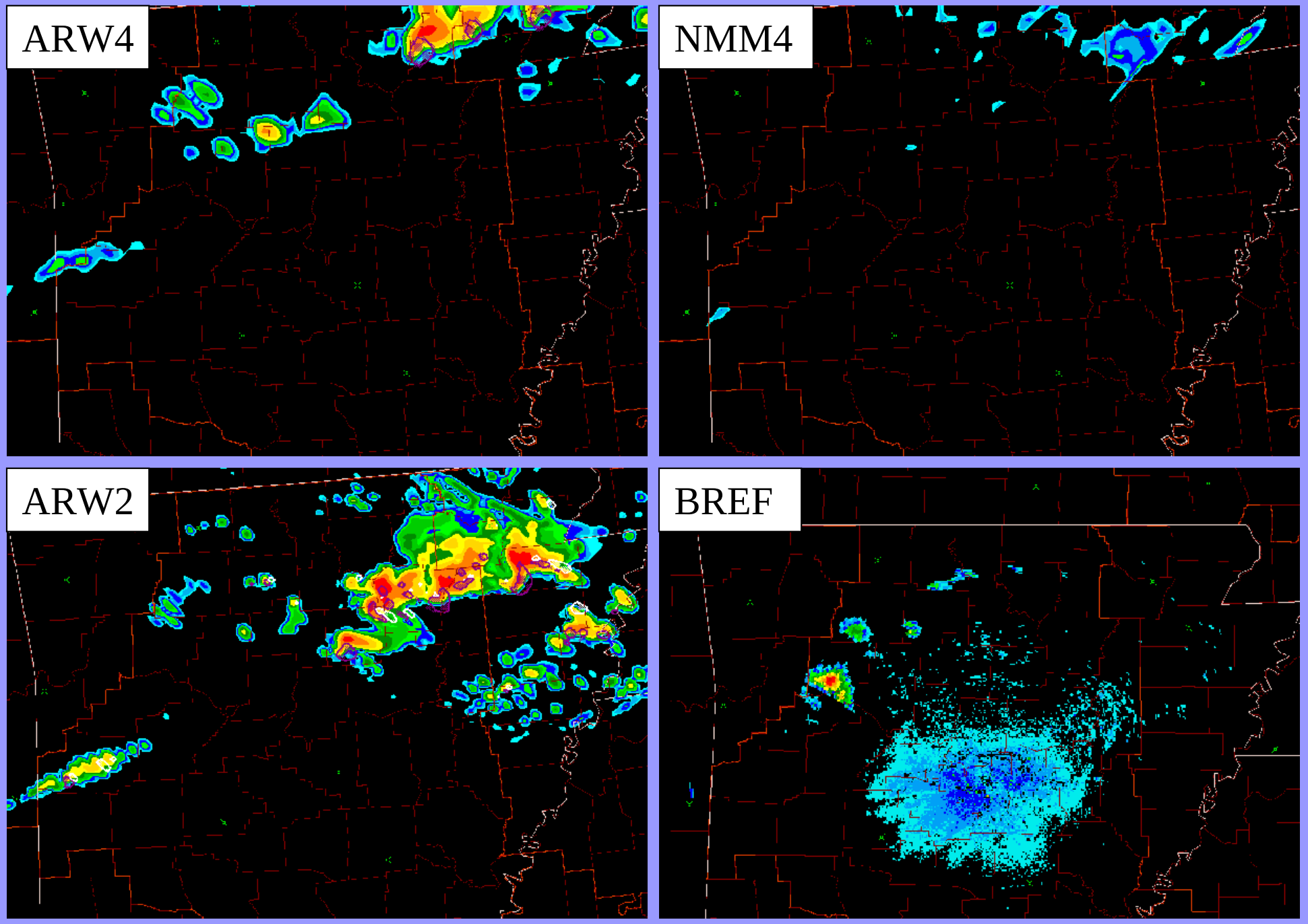


Preliminary comments on sounding structures observed in pre-convective environments

- YSU PBL yields smooth transitions between convective boundary layer and free atmosphere. It may help minimize absolute errors in sounding verification, but it makes it difficult to link sounding structures to distinct processes and phenomena (e.g., shallow convection); blurs the distinction between PBL, shallow convection layer, and free atmosphere.

- MYJ PBL produces relatively sharp transitions between convective boundary layer and free atmosphere, but appears to suffer from a lack of exchange between the two layers. Forecasted PBL depth is frequently too shallow; saturated layers at top of PBL can be problematic – they are very persistent and do not have a presentation like observed shallow-convection layers. Would parameterized shallow convection help?

0100 UTC 29 April 2005: 1 km model reflectivity, NEXRAD BREF



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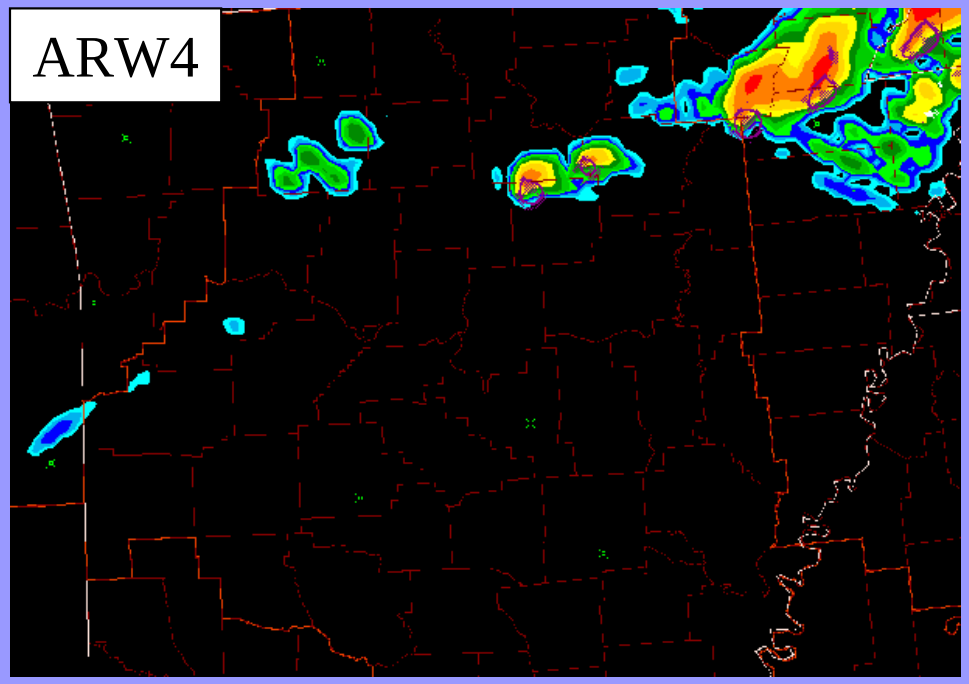

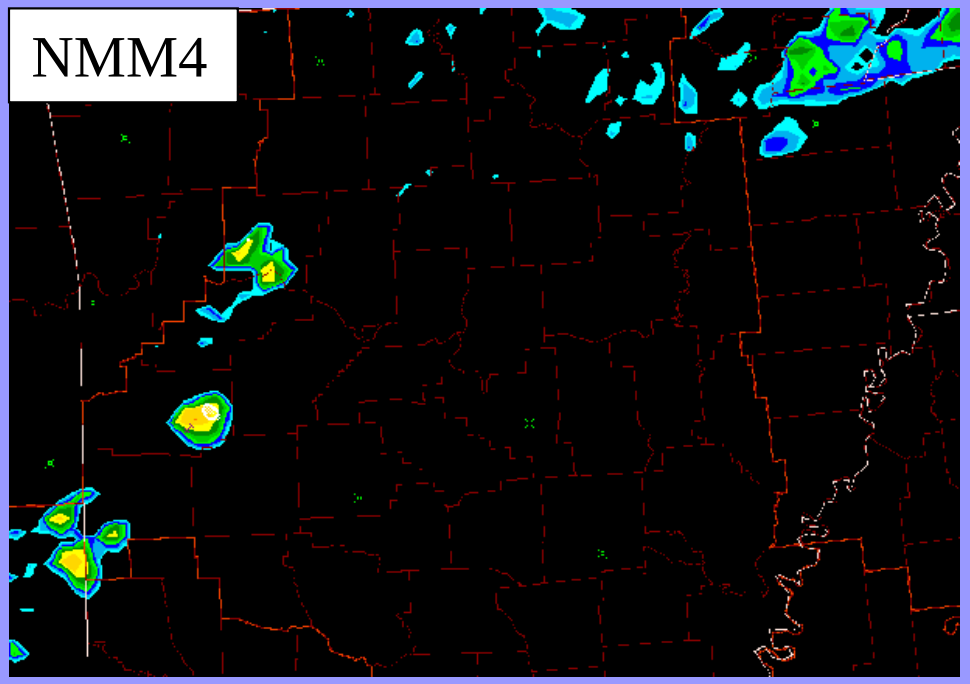

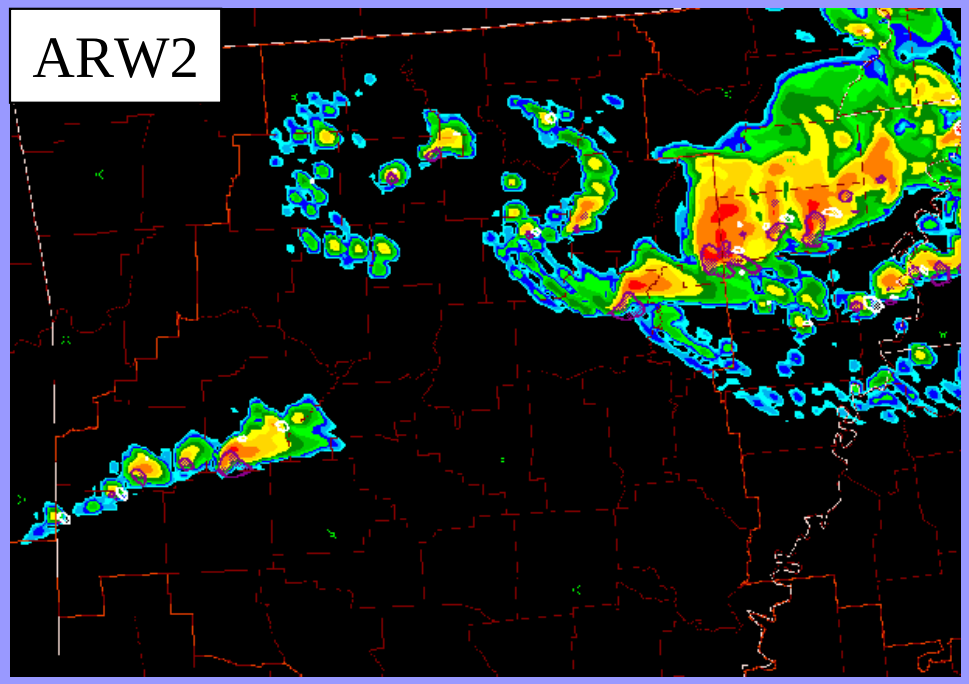

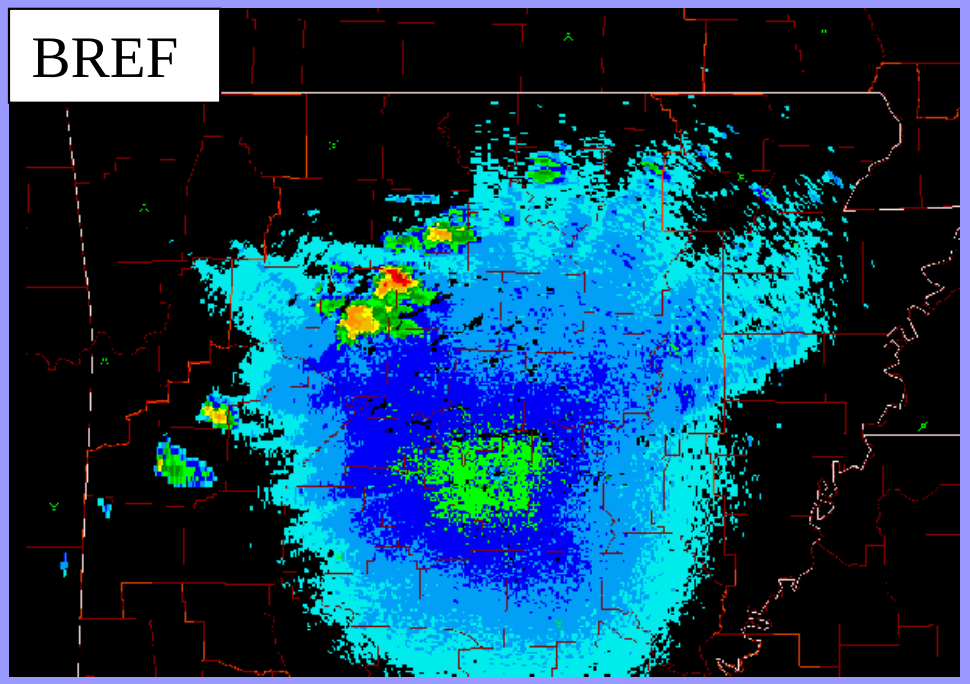

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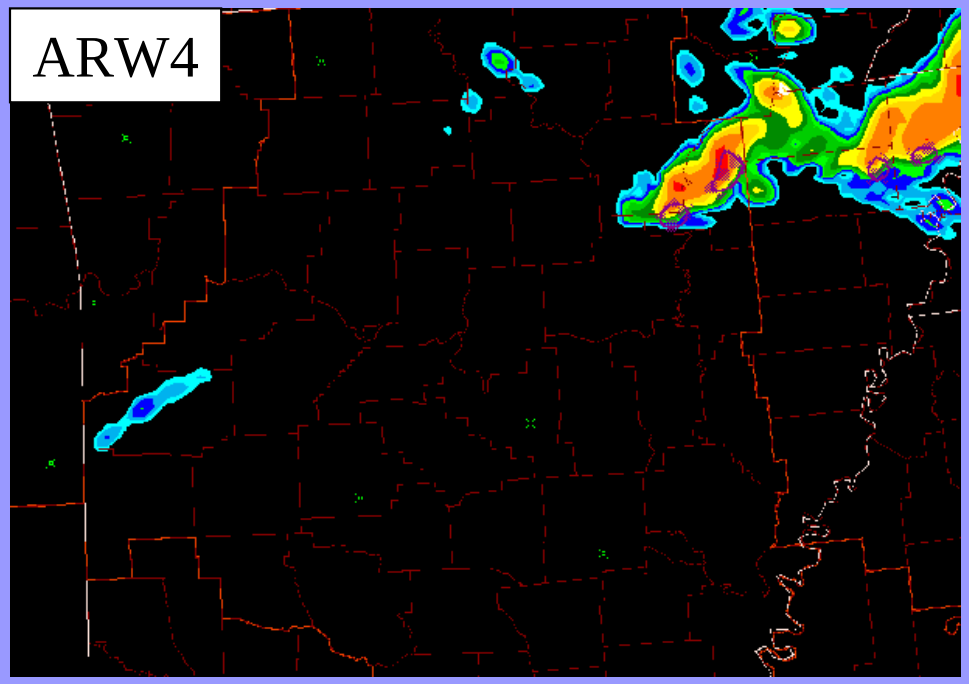

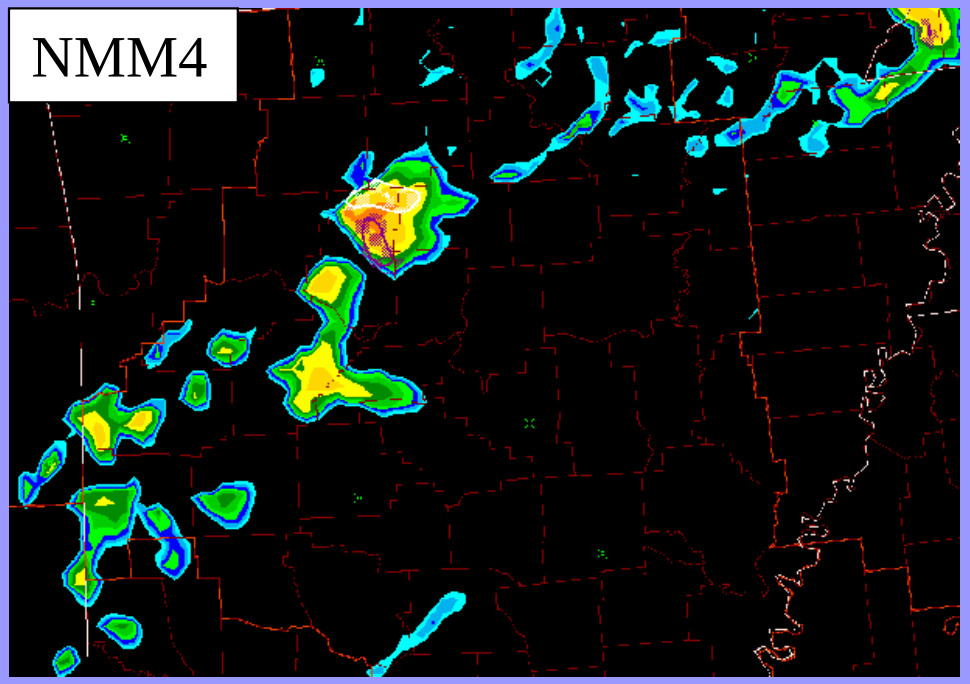

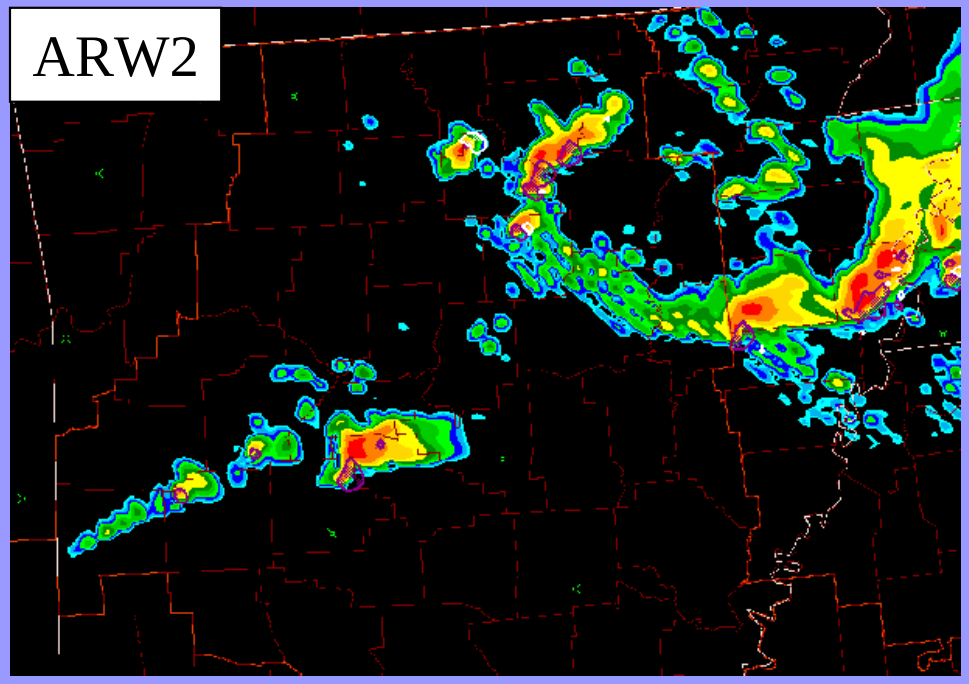

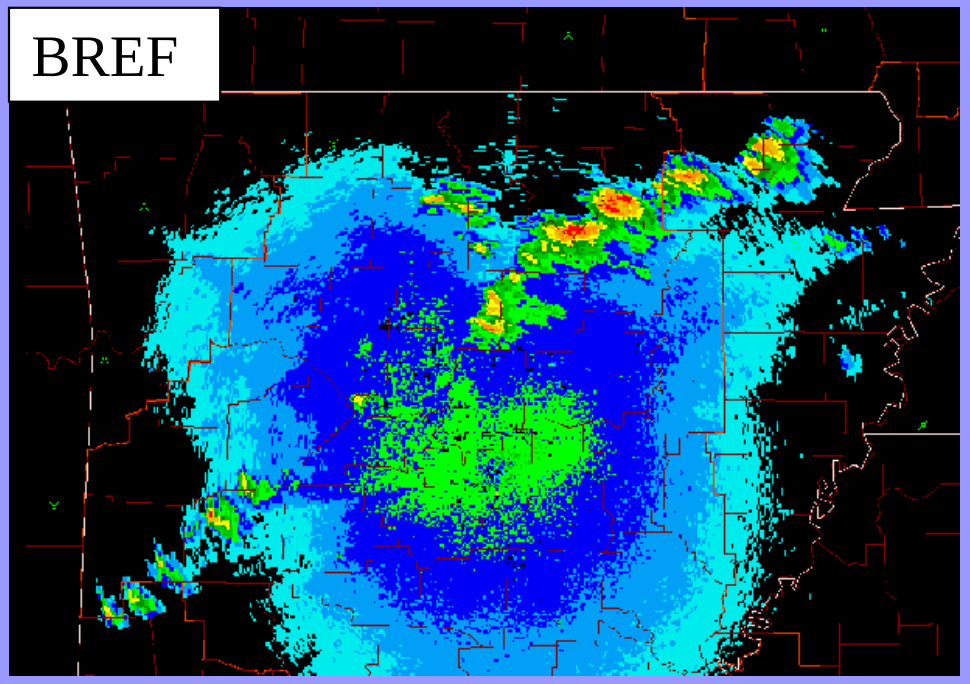

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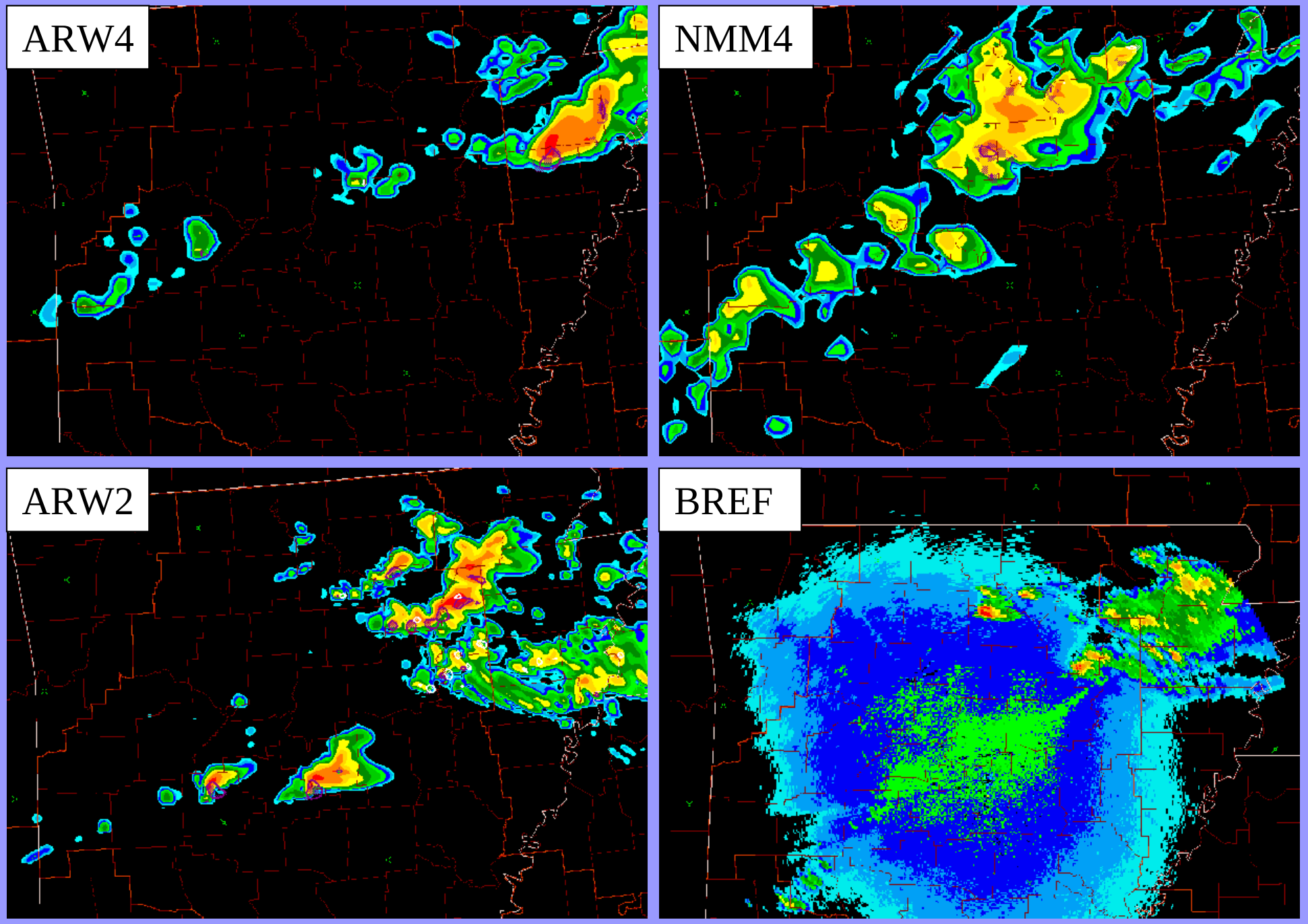

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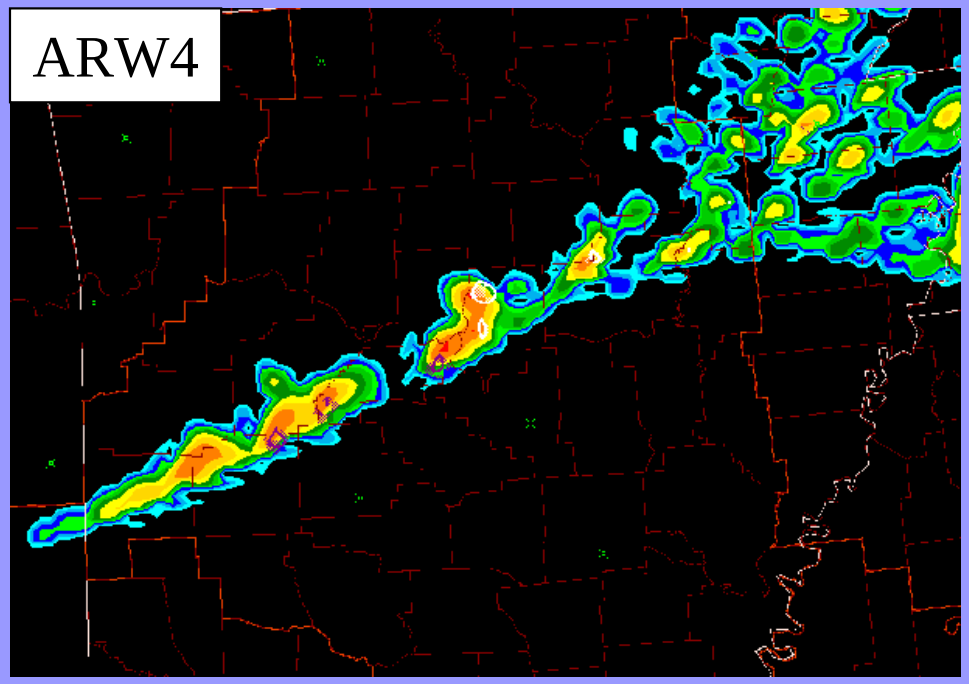
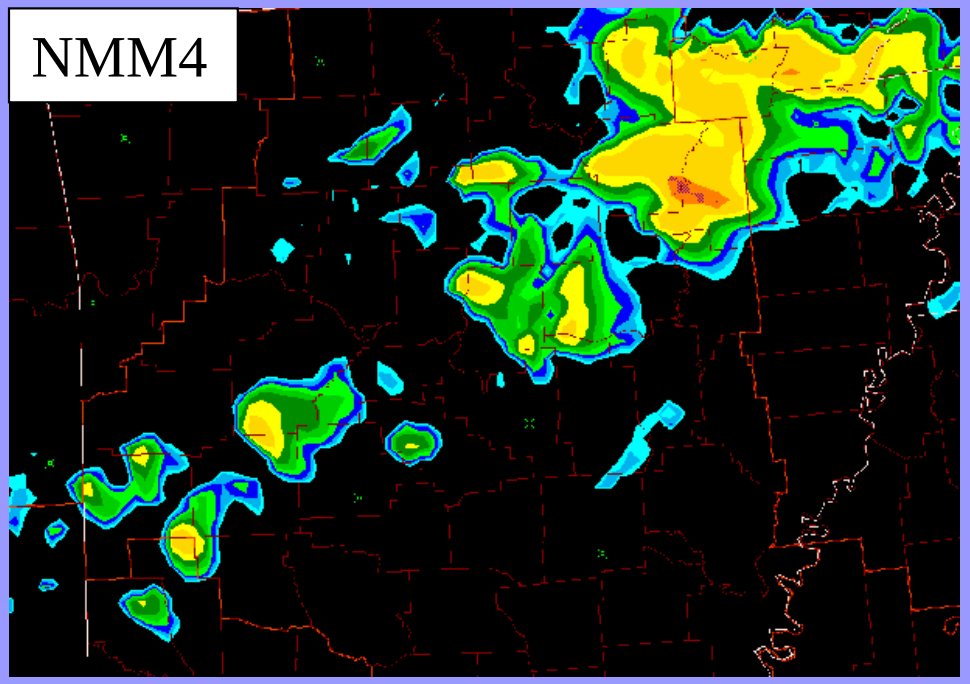
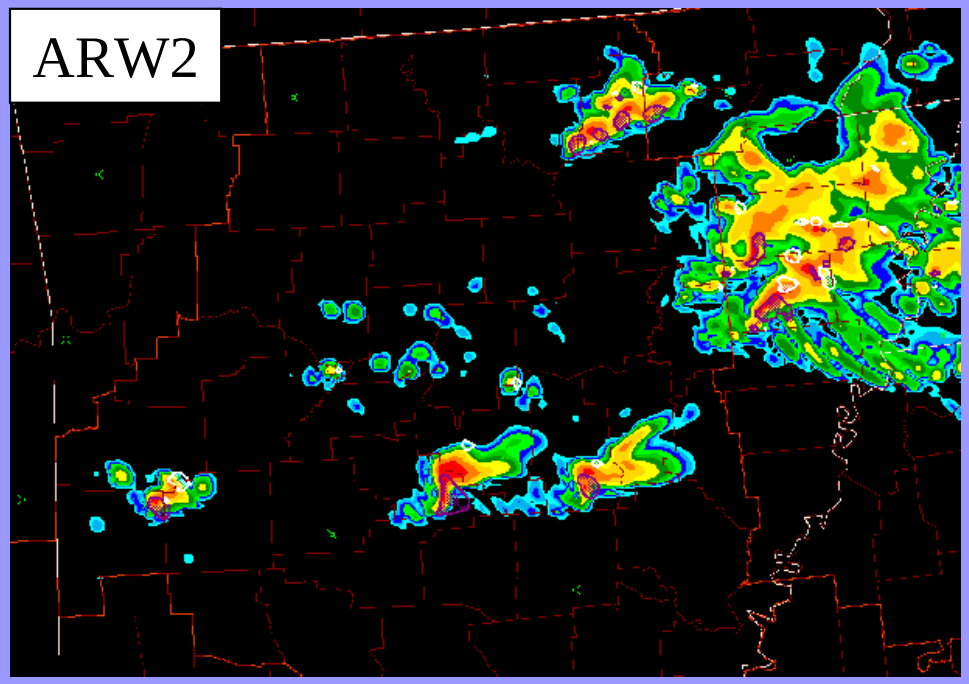
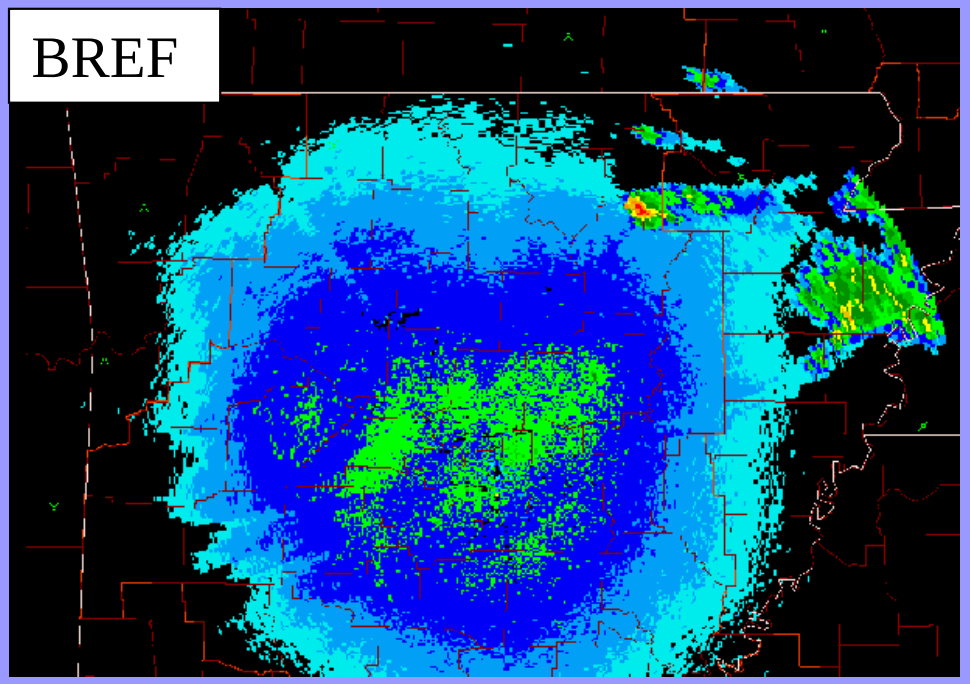
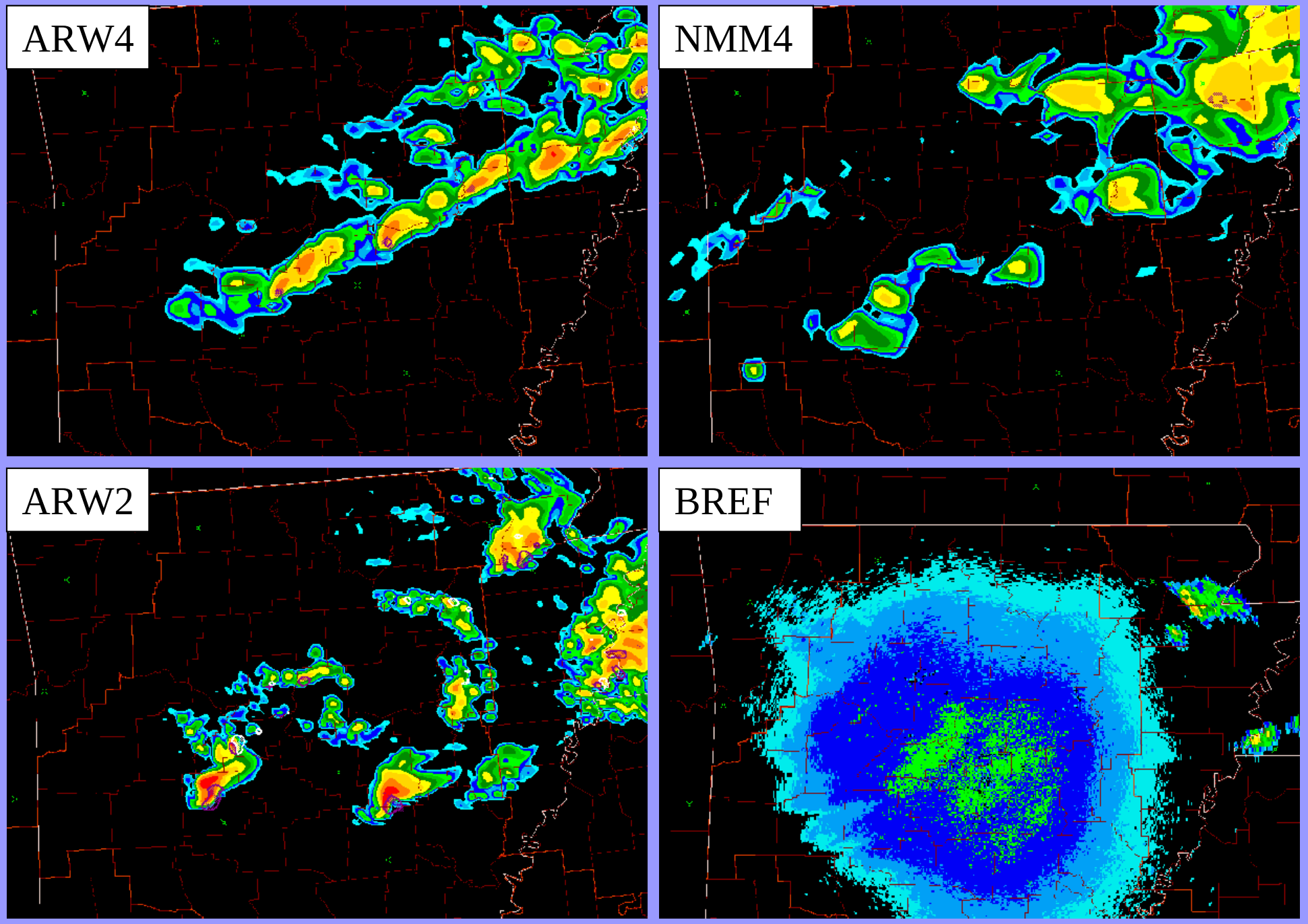






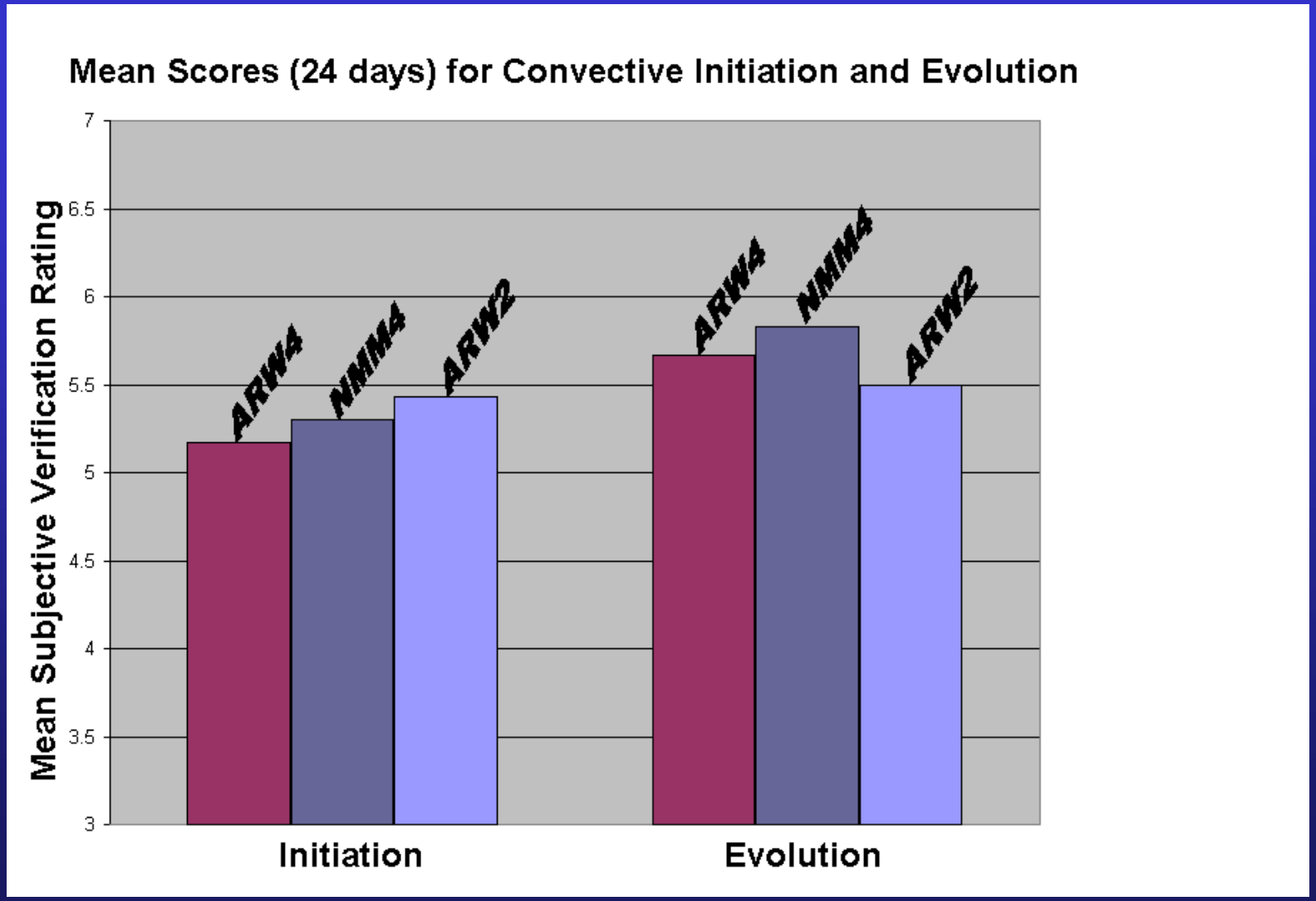


0600 UTC 29 April 2005: 1 km model reflectivity, NEXRAD BREF



Subjective verification (scaled from 1-10) of convective initiation and mesoscale aspects of evolution

Differences are not statistically significant!



Preliminary Conclusions

- Analysis of soundings in the pre-convective environment reveals numerous systematic differences between NMM and ARW forecasts, seemingly linked to MYJ and YSU PBL schemes

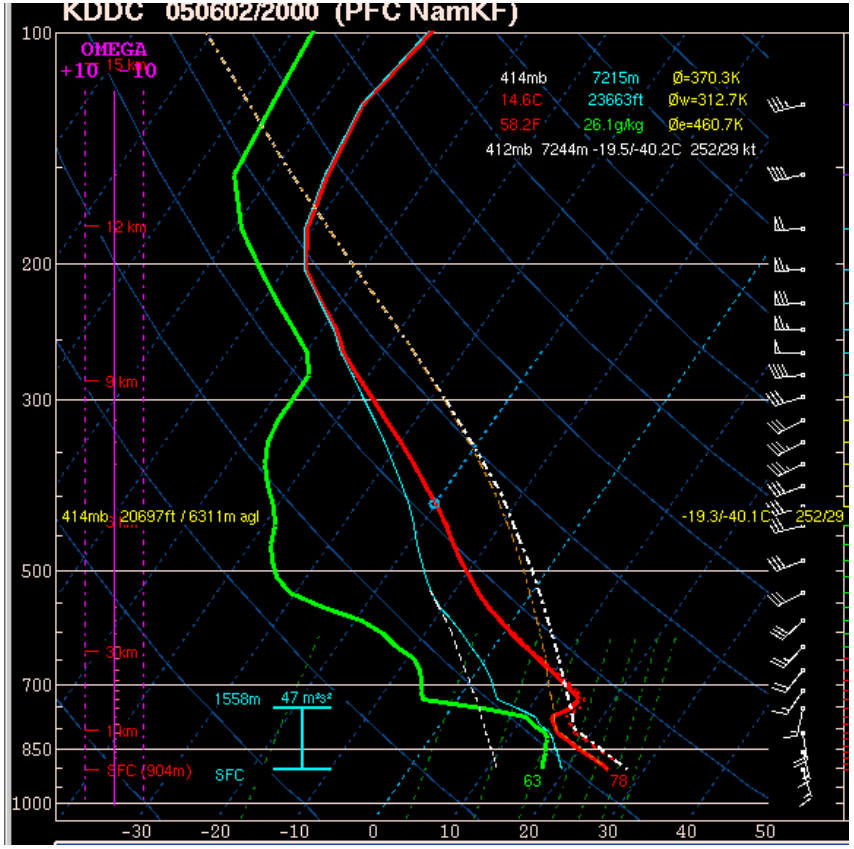
- Subjective comparisons of convective initiation and mesoscale evolution in severe storm environments suggest that current ARW and NMM convection-allowing resolutions produce equally good forecasts, on average

- Comparisons of 2 km and 4 km ARW forecasts suggest that mesoscale evolution and organization of convective systems is quite insensitive to this difference in resolution

- Explicit prediction of supercells shows promise when mesoscyclone detection algorithms are applied to hourly model output, especially with 2 km grid spacing.

Visit the web site: http://www.spc.noaa.gov/exper/Spring_2005/

NAM with KF shallow



4km NMM