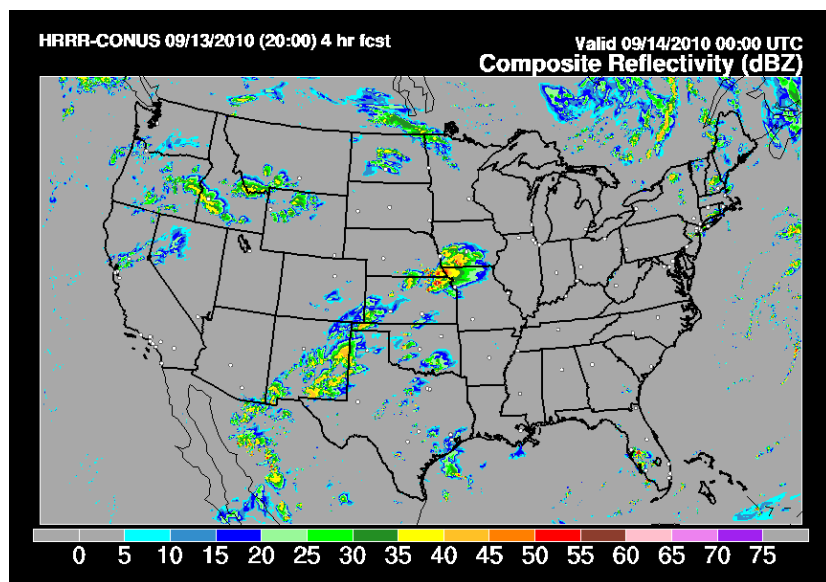# 2010 Improvements in wx guidance for aviation from hourly updated NOAA models: *HRRR, Rapid Refresh, RUC*

Key info

- Rapid Refresh – in testing at NCEP, planned implementation – July 2011
- HRRR – key component for CoSPA
    - 2011 – 3km radar assimilation, RR parent

HRRR-CONUS 09/13/2010 (20:00) 4 hr fcst   Valid 09/14/2010 00:00 UTC
Composite Reflectivity (dBZ)

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

NOAA Earth System Research Lab, Boulder, CO
Stan Benjamin
(+Steve Weygandt, Curtis Alexander,
Ming Hu, Tanya Smirnova, rest of ESRL team, NCAR,

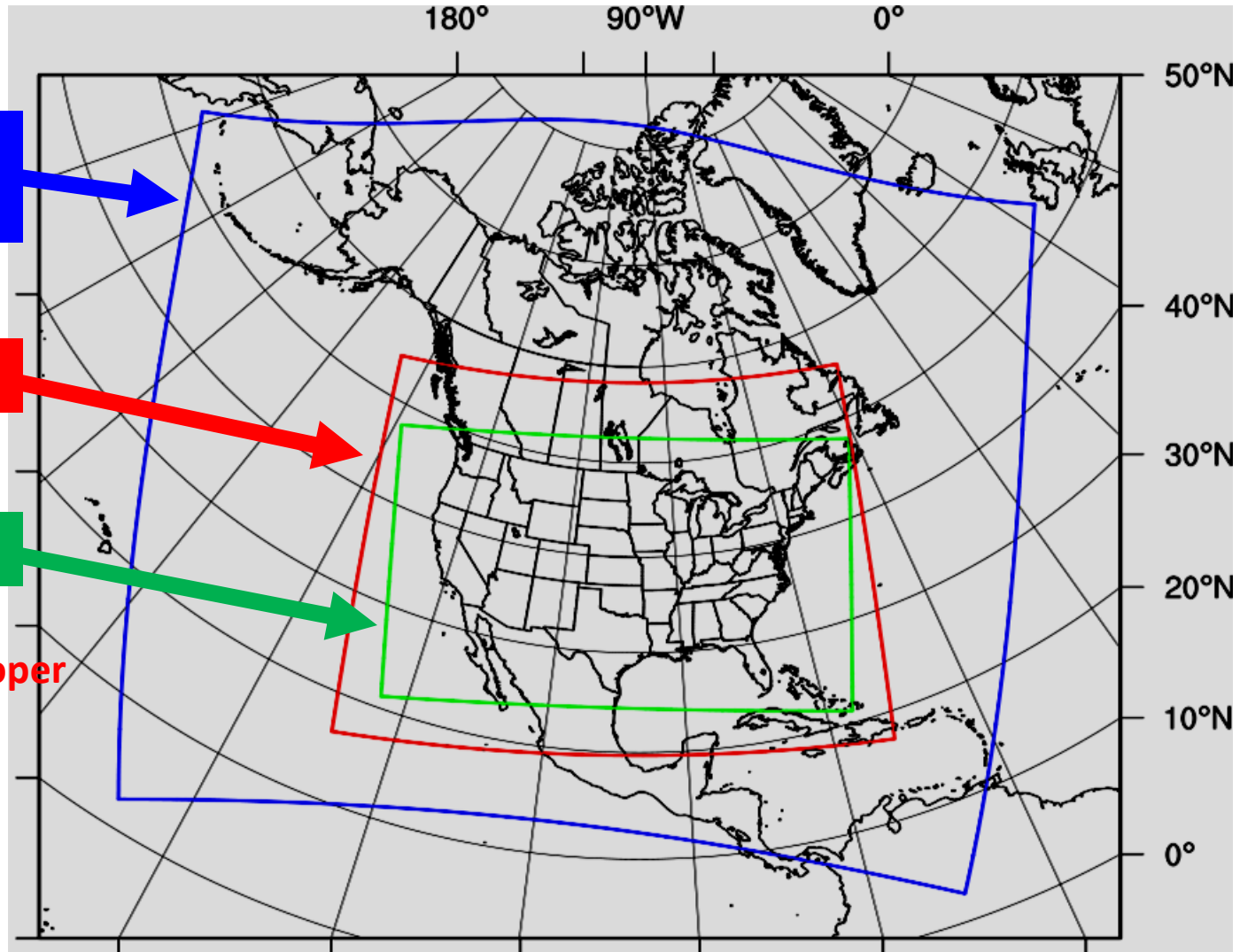Friends and Partners in Aviation Weather
21 October 2010 - Atlanta, GA - NBAA

Hourly Updated NOAA NWP Models

Rapid Refresh (RR) replaces RUC at NCEP planned for July 2011
- WRF/GSI, both with RUC-based enhancements

13km Rapid Refresh

13km RUC

3km HRRR

RUC — current NCEP-oper model, new 18h fcst every hour
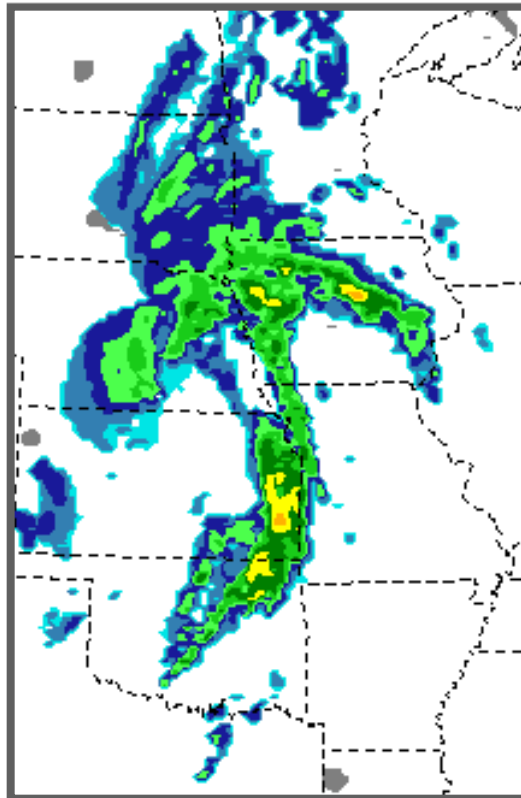
High-Resolution Rapid Refresh

Experimental 3km nest inside RUC or RR, new 15-h fcst every hour, *central to 2-8h CoSPA*

Radar reflectivity assimilation in RR and RUC
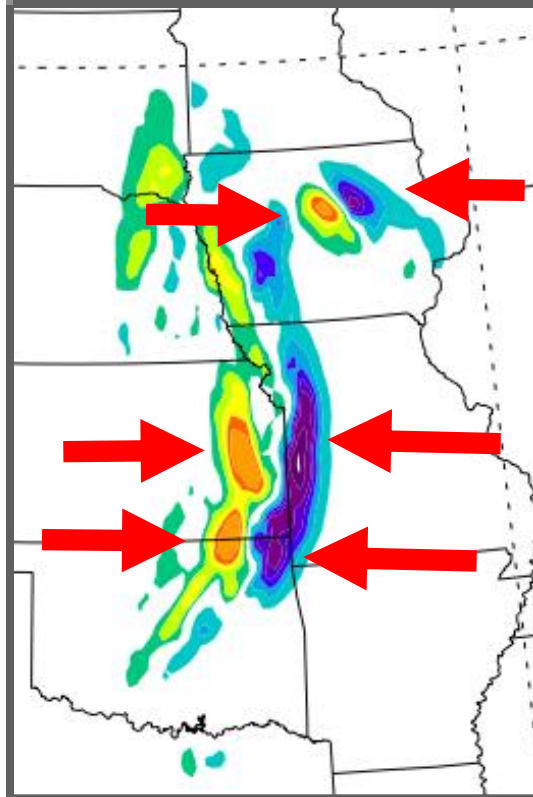## - "DFI-radar" technique – reason for HRRR success
reflectivity assimilation example below – from RR
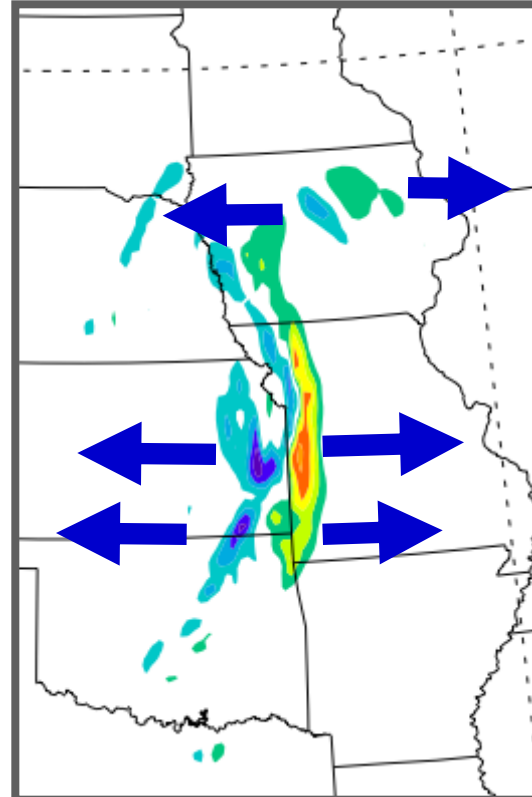
NSSL radar reflectivity (dBZ)

Low-level Convergence

Upper-level Divergence
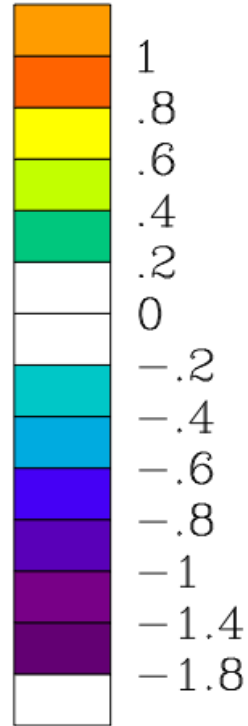

**14z 22 Oct 2008
Z = 3 km**

K=4 U-comp. diff
(radar - norad)

K=17 U-comp. diff
(radar - norad)

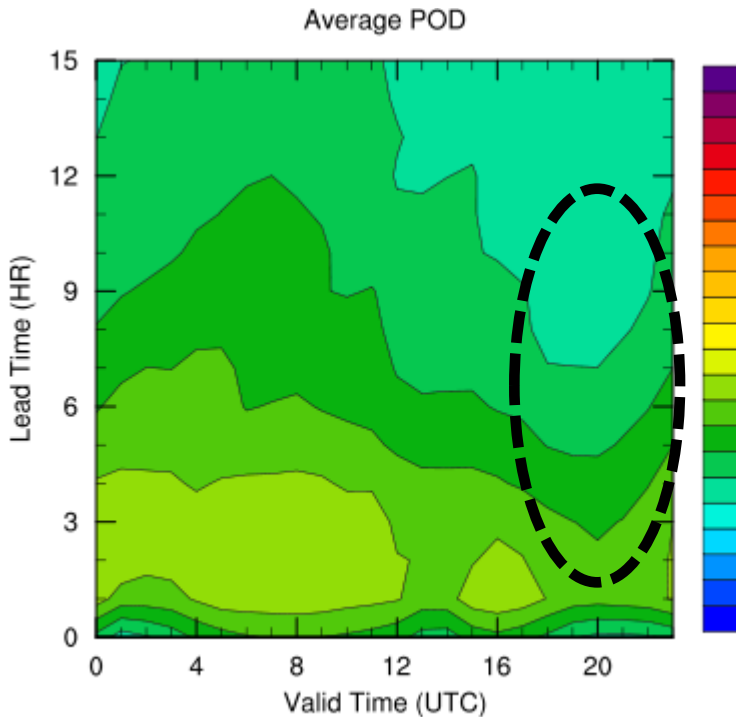# HRRR Multi-Scale Reflectivity Verification   10 June – 26 Sept 2010

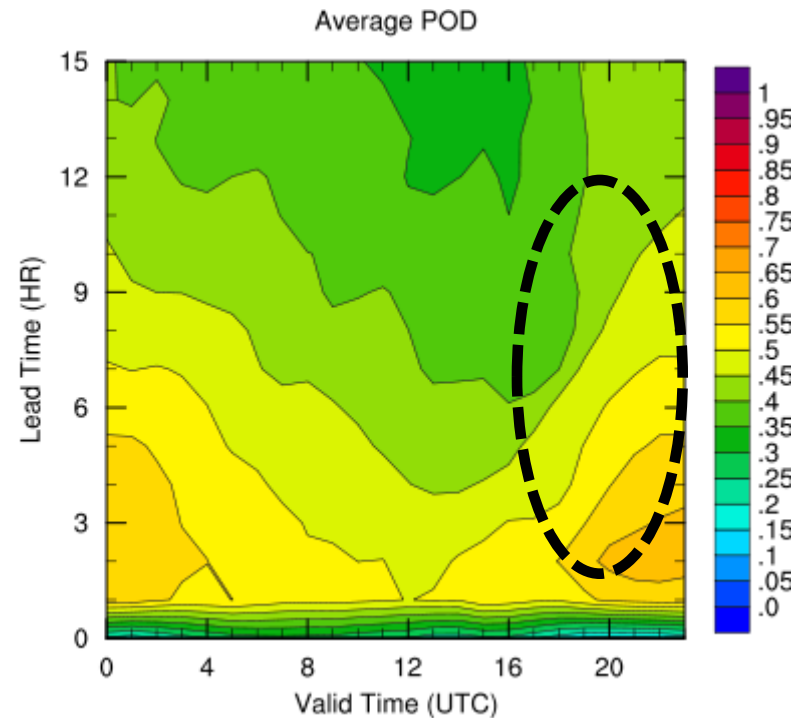20 dBZ threshold
NSSL refl. mosaic

Convective Initiation:
HRRR missing exact location of small-scale early thunder-storm development
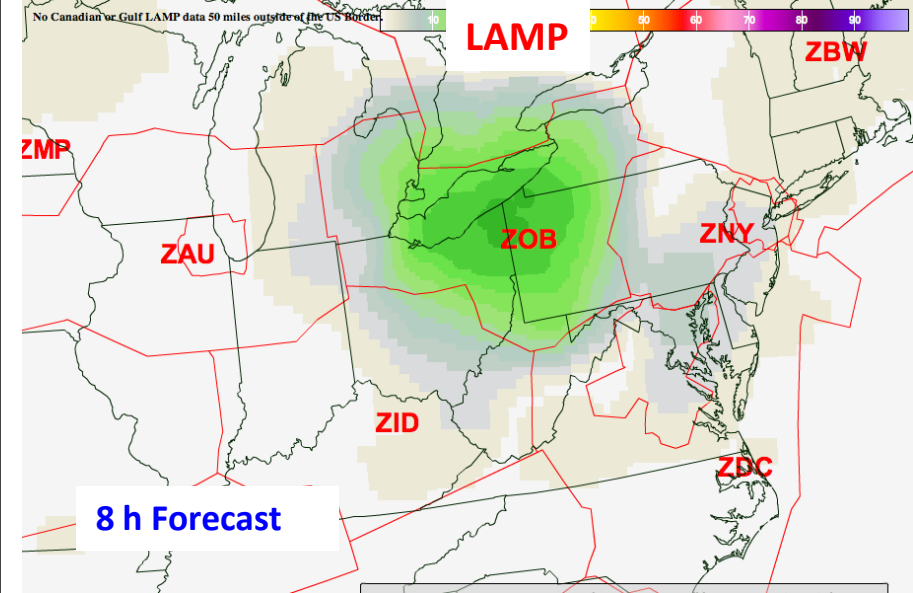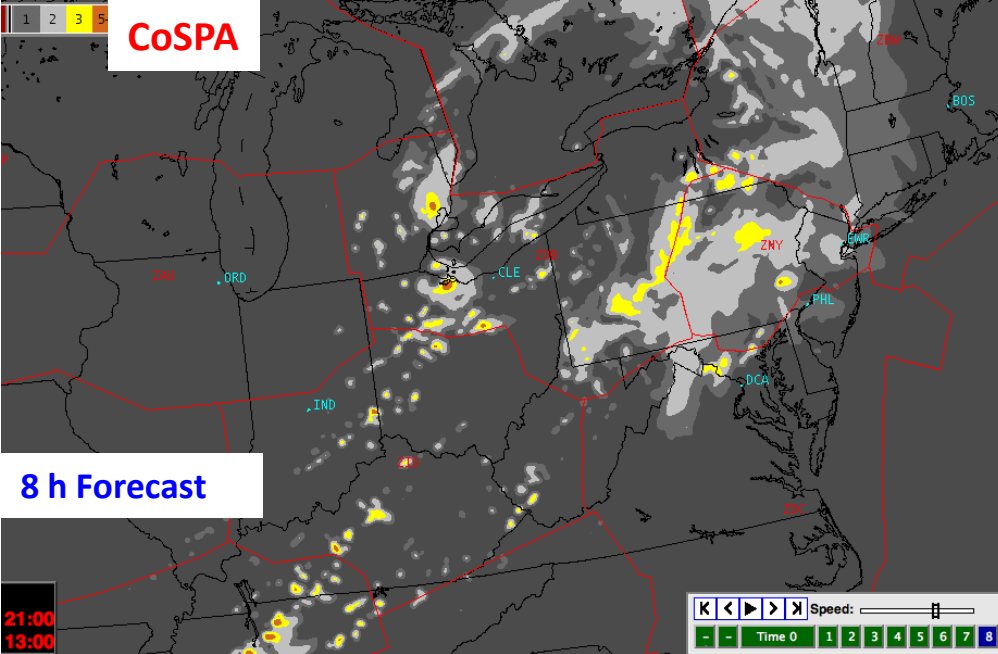
Convective Initiation:
"Neighborhood" verification shows HRRR capturing "regions" where thunderstorms are developing
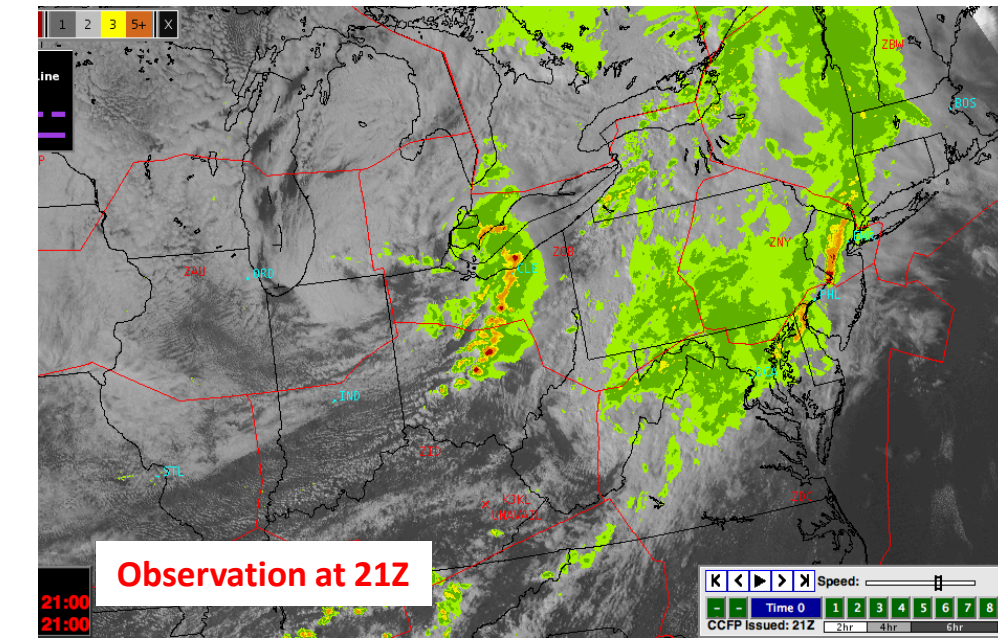

3 km scale

80 km scale

CoSPA

8 h Forecast

LAMP

8 h Forecast

16 September 2010

Observation at 21Z
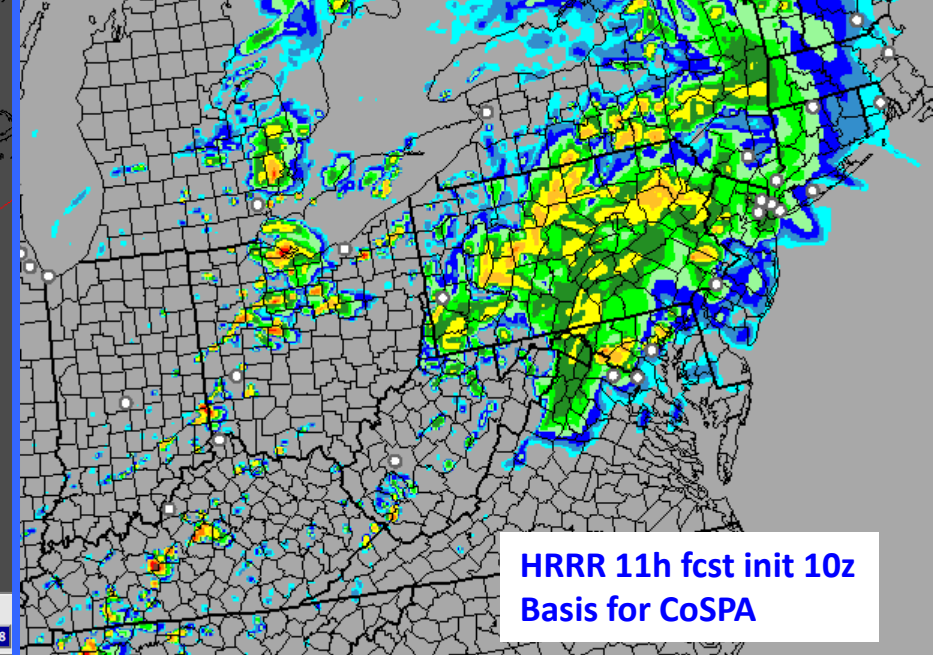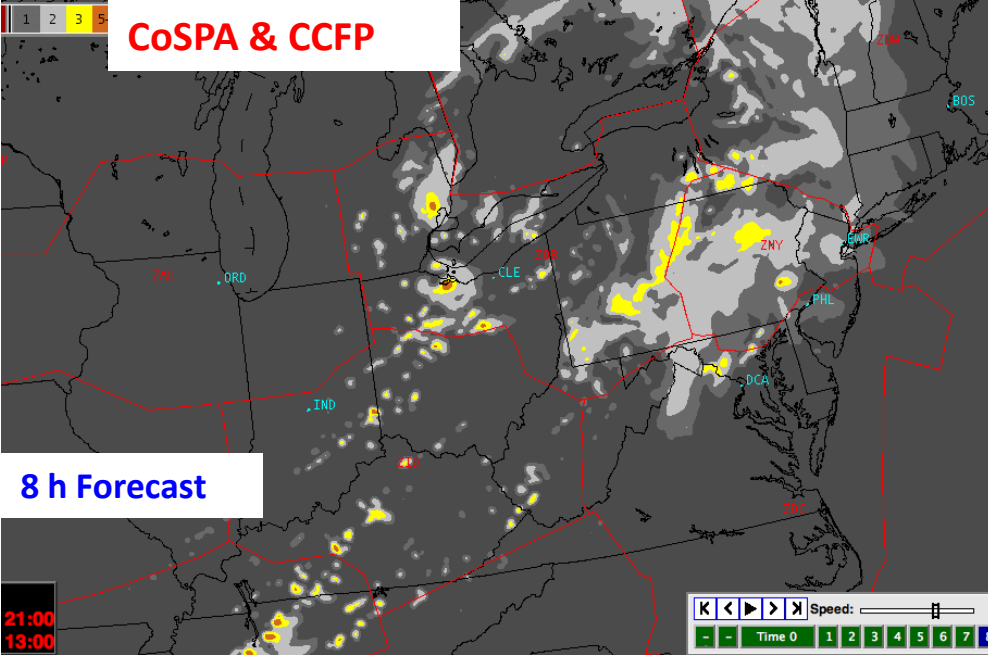
Last CoSPA-2010 Blitz day – 16 September NYC severe weather and tornado

Slides from Matthias Steiner - NCAR

CoSPA & CCFP

8 h Forecast

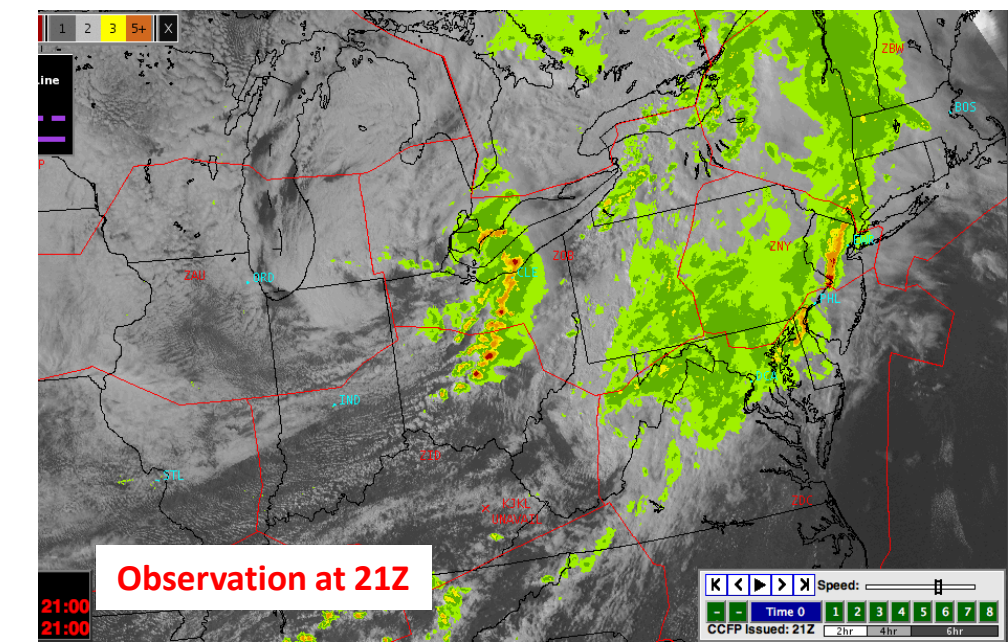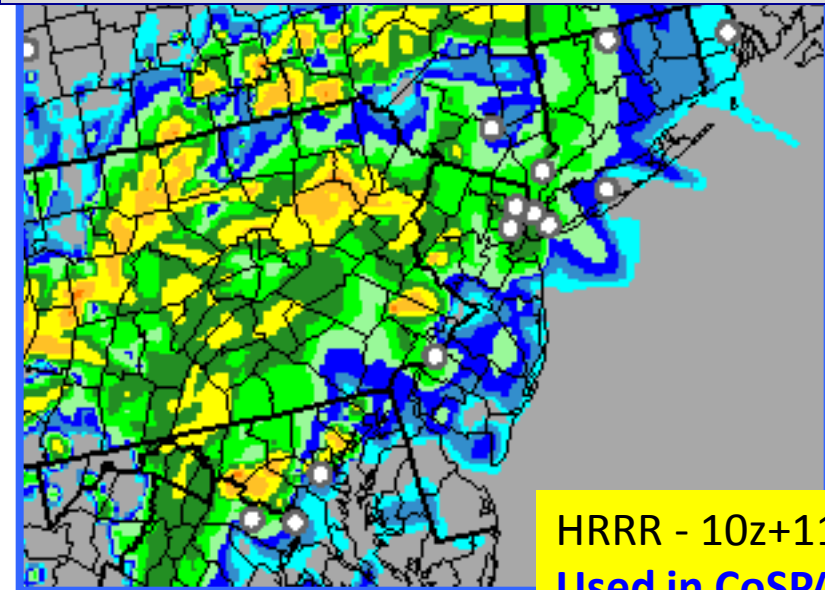**HRRR 11h fcst init 10z Basis for CoSPA**

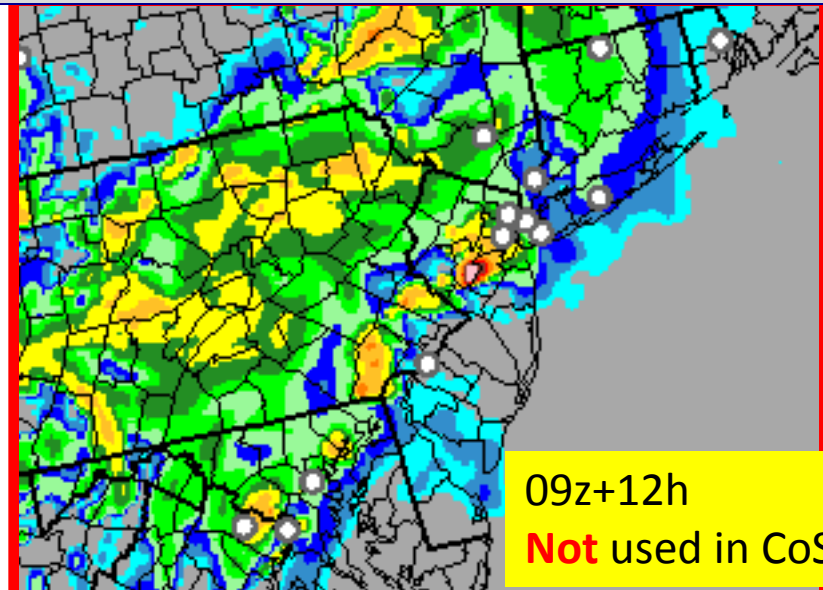**16 September 2010**

Observation at 21Z

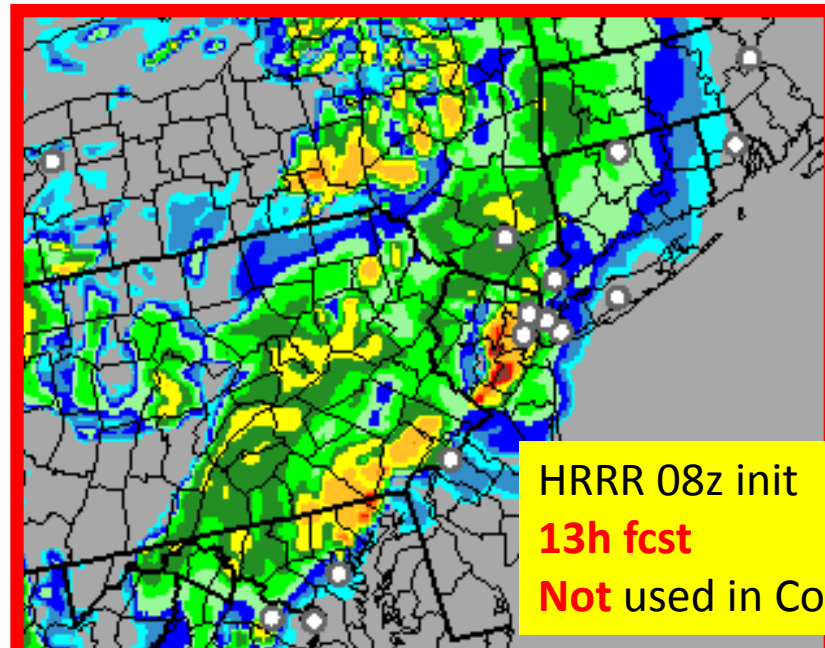**At longer lead times CoSPA based mostly on HRRR guidance**

Much better guidance from earlier HRRR runs for 16 Sept NYC case

HRRR - 10z+11h
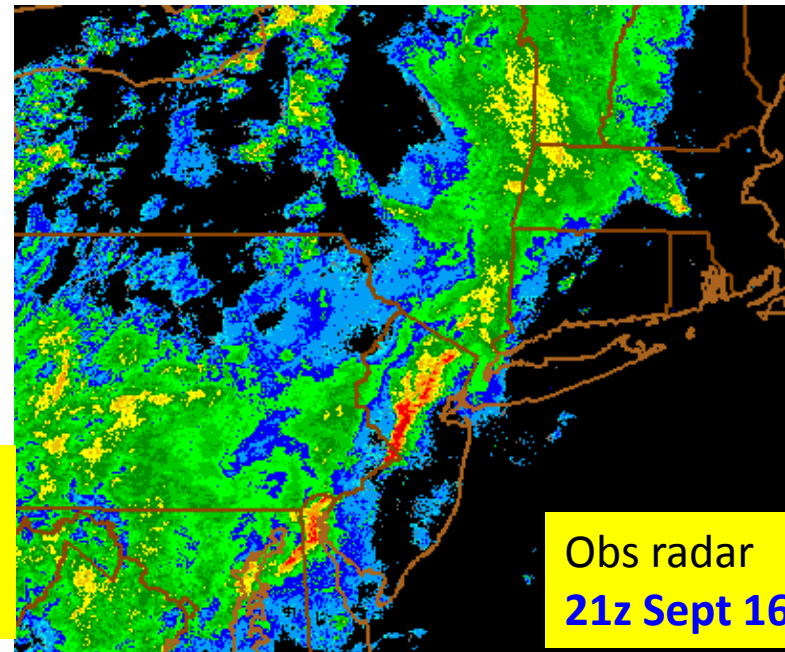**Used in CoSPA**

09z+12h
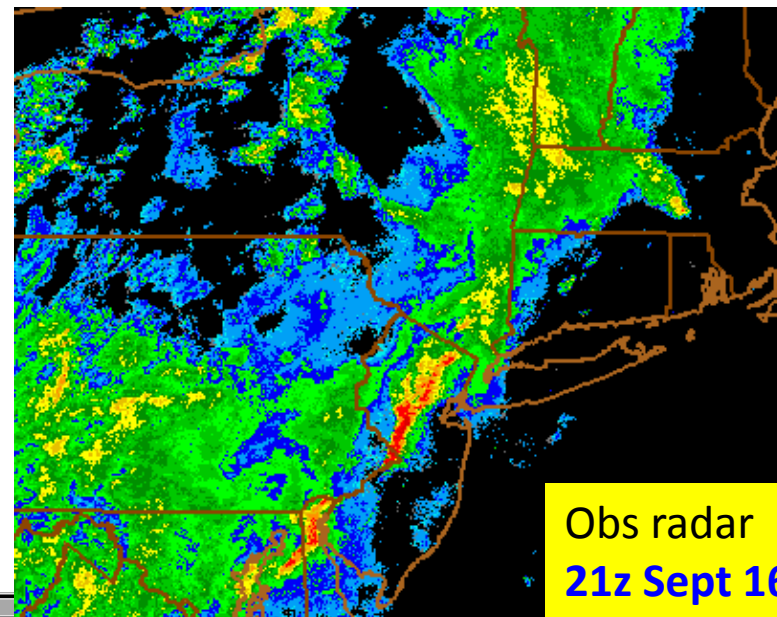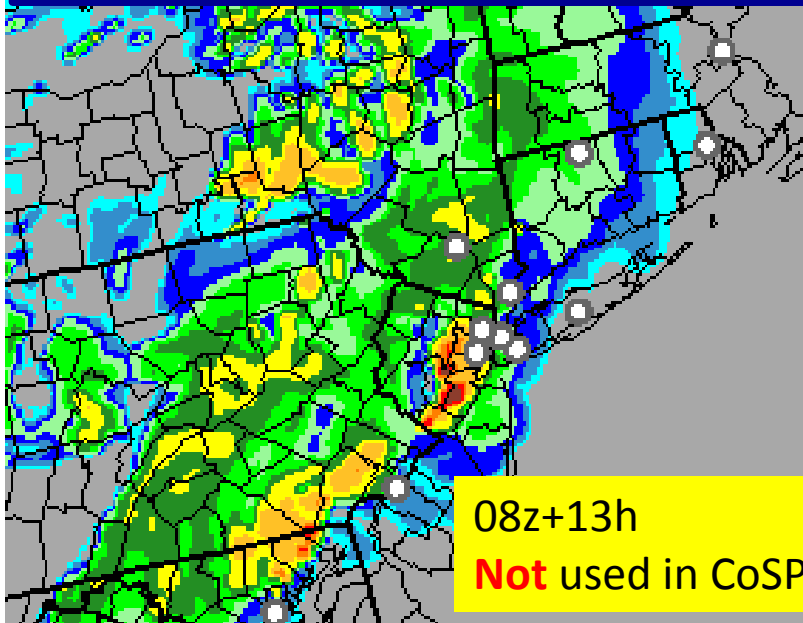**Not** used in CoSPA
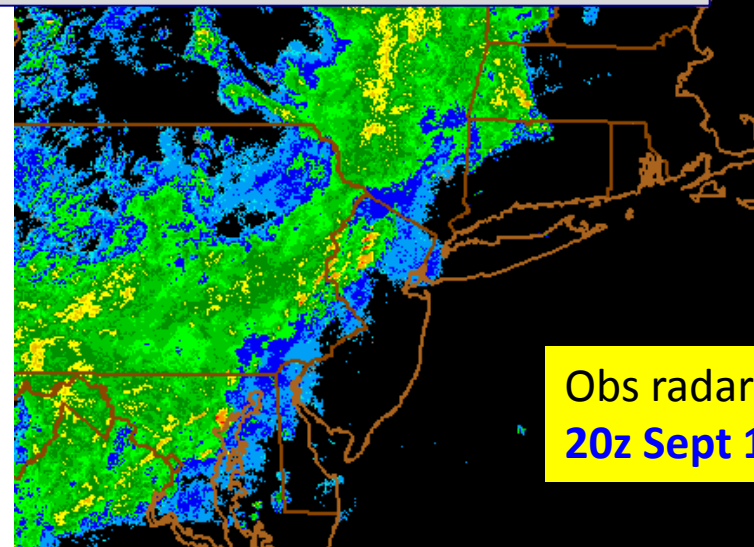
HRRR 08z init
13h fcst
Not used in CoSPA
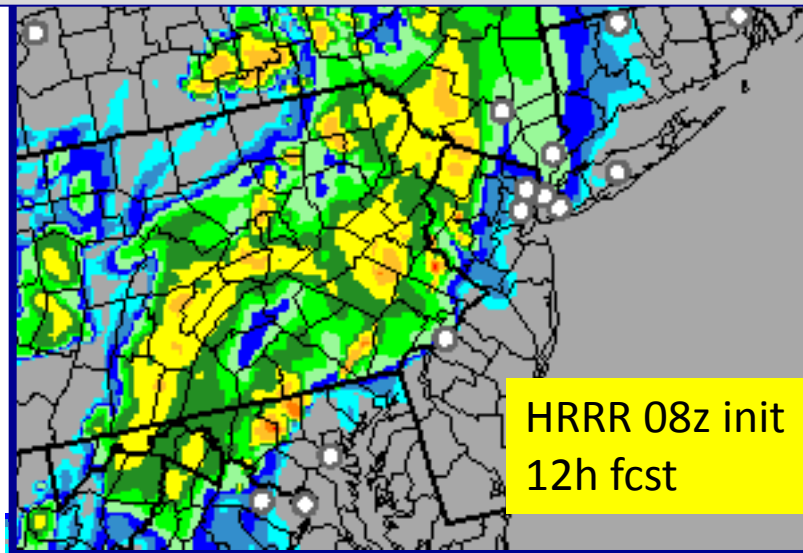
Obs radar
21z Sept 16

Rapid intensification w. of NYC from 20-21z for 16 Sept case
Also captured by 08z HRRR run (12h, 13h forecasts below)

HRRR 08z init
12h fcst

Obs radar
20z Sept 16

08z+13h
Not used in CoSPA

Obs radar
21z Sept 16

| 0 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 |

HCPF - Convective probability forecasts from HRRR time-lagged ensemble
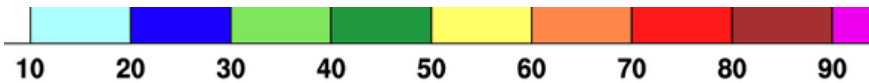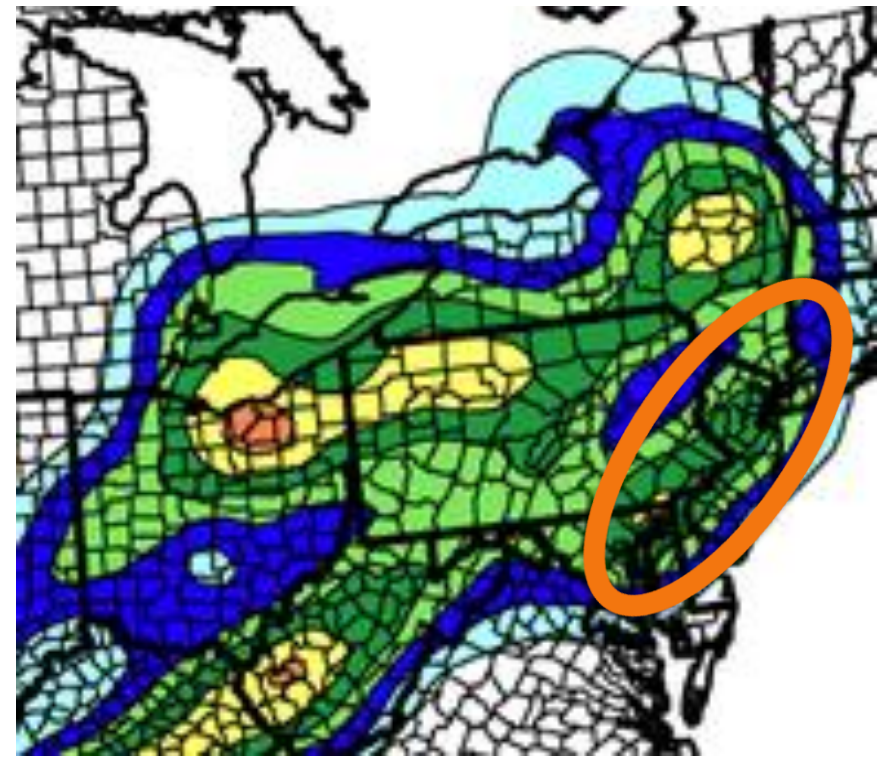
Probability (%)

09z + 13h HCPF valid 22z

Forecasts some risk for NYC development

22z 16 Sept '10 Verification

Upcoming HRRR Changes

Fall/Winter 2010

Improved mapping of radar reflectivity
   (no-echo area, latent heating magnitude)
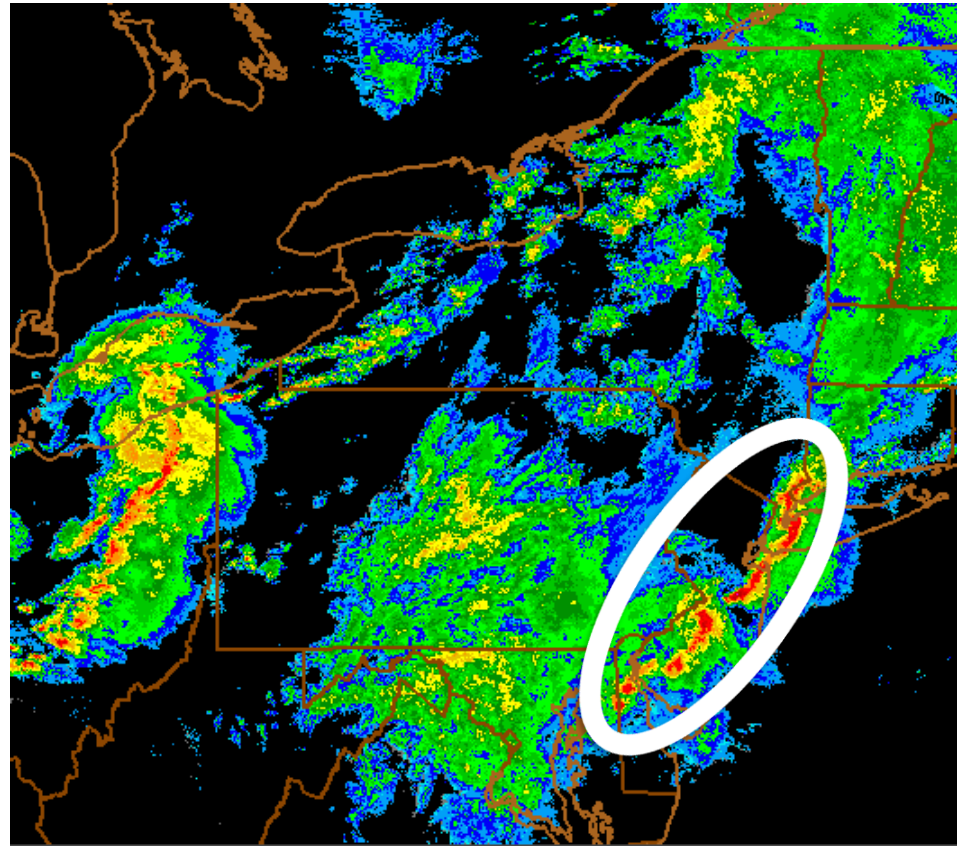
Modifications to WRF model physics (esp. cloud microphysics) to improve HRRR forecasts for MCSs (mesoscale convective systems)

Reduce HRRR model latency by ~30 min to attain ~2 hr latency

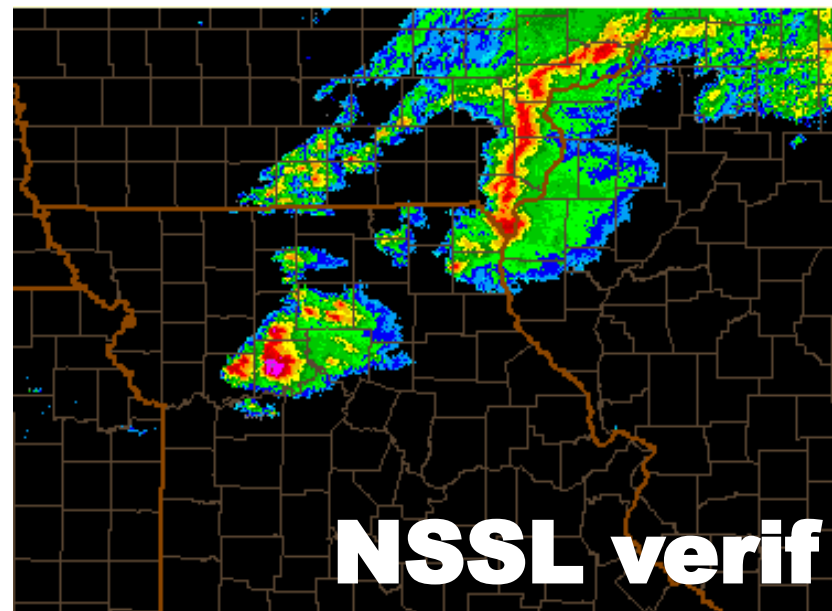Winter/Spring 2011
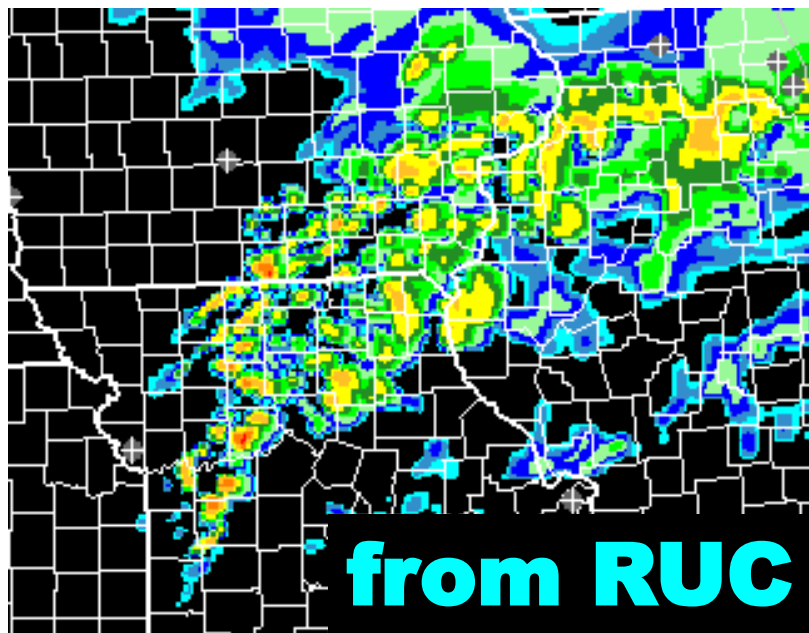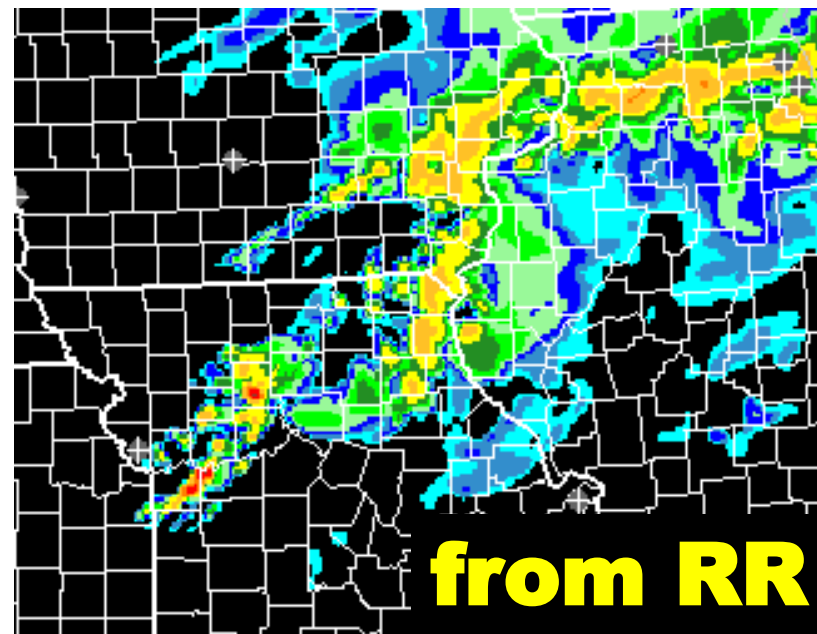
Switch parent model from RUC to RR

Assimilate 3-d radar radial wind data

Assimilate radar reflectivity at 3-km (hydrometeors, temperature tendency)

Test assimilation of SatCast as proxy radar, add to actual radar and lightning

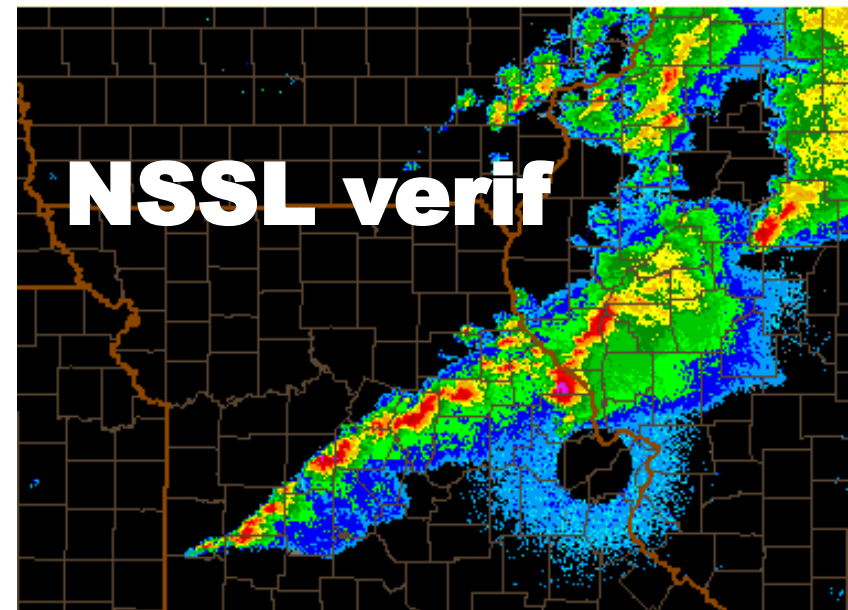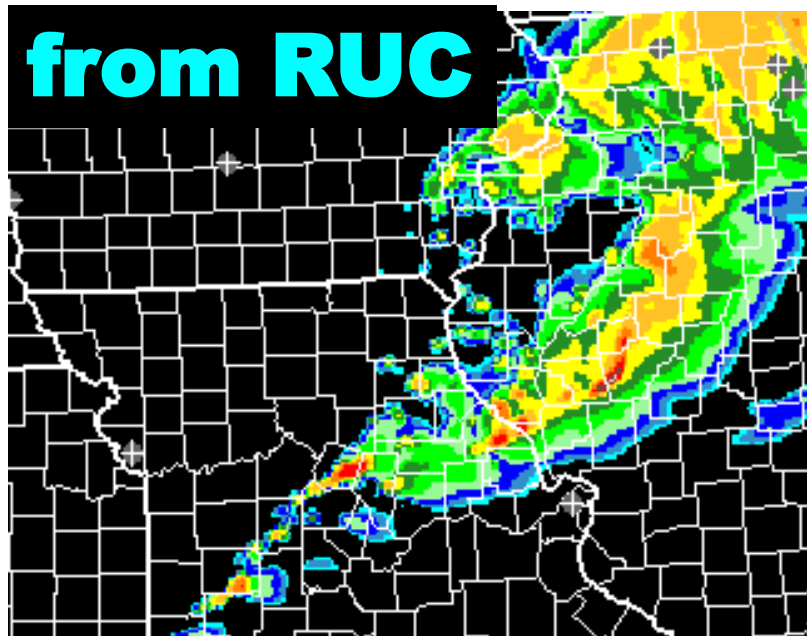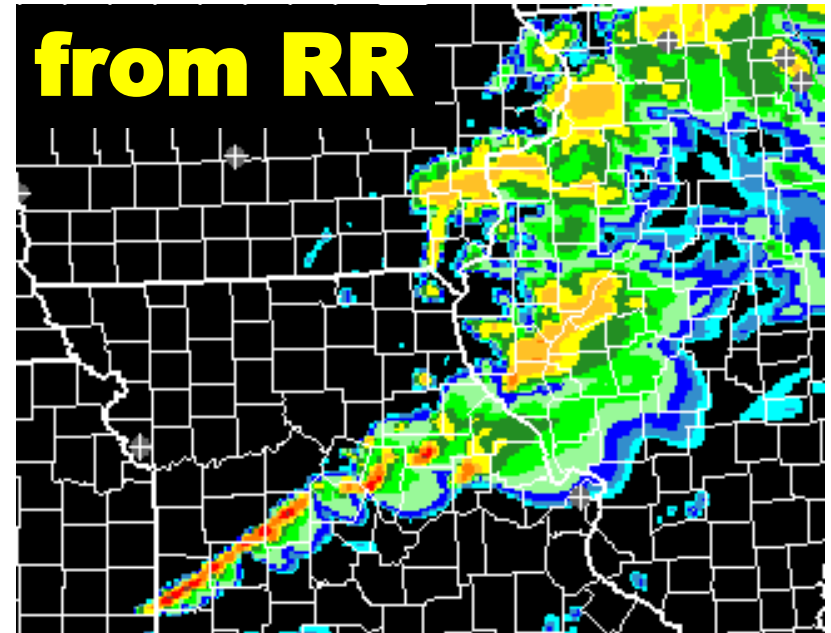# Switch from RUC to RR initial/boundary conditions

1-h HRRR
forecasts
Valid 23z
April 4, 2010

from RR

from RUC

NSSL verif

Switch from RUC to RR initial/boundary conditions

from RR

4-h HRRR
forecasts
Valid 02z
April 5, 2010

from RUC

NSSL verif

Summary

- Keys for HRRR success:
  - Accuracy in mesoscale environment from 13km RUC/RR parent assim/model
  - Effective radar reflectivity assimilation ("DFI-radar" technique)
- Improved HRRR in 2011
  - better radar reflectivity assimilation – radial wind assimilation
  - RR as parent model
  - applicable to winter weather, surface conditions, ceiling, turb, icing, etc.
  - NOAA/ESRL demo will continue until NCEP resources available (FY13?)

- Rapid Refresh –
  - In mature testing at NCEP, some changes being finalized @ESRL
  - Expected implementation date @NCEP – July 2011
  - Grids available via ftp from NCEP – starting Nov-Dec 2011

- HRRR can provide an estimate of the likelihood (probability), timing, and location of convection and other phenomena through a time-lagged "ensemble-of-opportunity" – HPCF (HRRR Convective Probabilistic Forecast)

- Testing of 1-km 2-way nests in HRRR already performed, will provide terminal-scale information for NextGen requirements and improve forecasts of convective evolution