WRF-DART 2011 Real-time mesoscale analysis spring experiment

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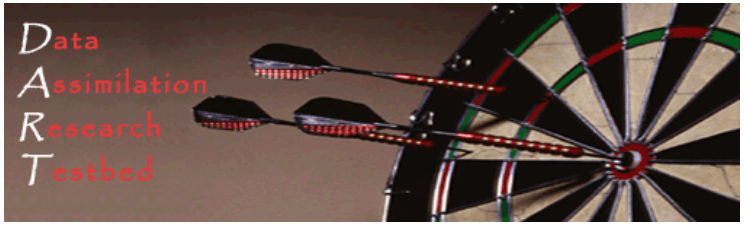
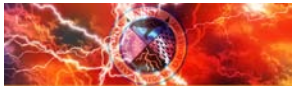
Also contributions from Ryan Torn, Steven Cavallo, Craig Schwartz, Kevin Manning, Wei Wang, Ming Chen



DART is used at:

43 UCAR member universities
More than 100 other sites

- Public domain software for Data Assimilation
  - Well-tested, portable, extensible, free!
- Models
  - Toy to HUGE, includes WRF
- Observations
  - Real, synthetic, novel
- An extensive tutorial
  - With examples, exercises, explanations
- People: The DAReS Team



UNIVERSITY OF WASHINGTON

CIRES

THE UNIVERSITY OF UTAH

Central Weather Bureau

GFDL Geophysical Fluid Dynamics Laboratory Princeton, NJ

NOAA

PENNSTATE

CALIFORNIA INSTITUTE OF TECHNOLOGY 1891

JPL
Jet Propulsion Laboratory
California Institute of Technology

NESL

Overview of Data Assimilation

Prediction Model

NESL

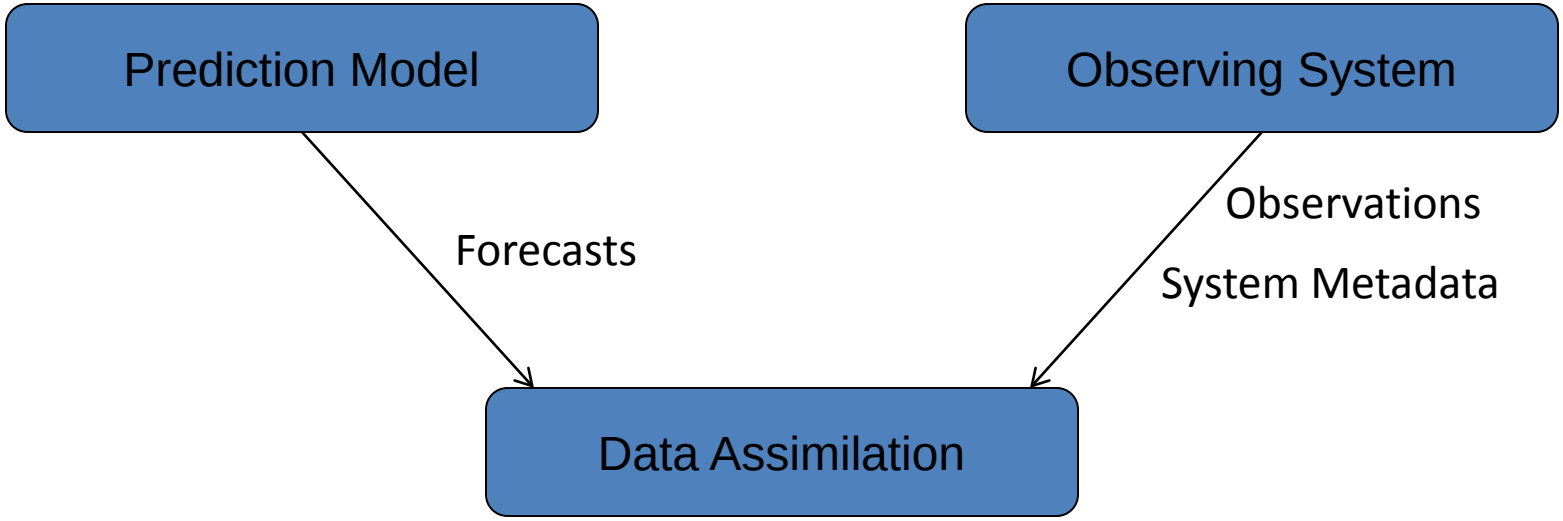
Overview of Data Assimilation

Prediction Model

Observing System

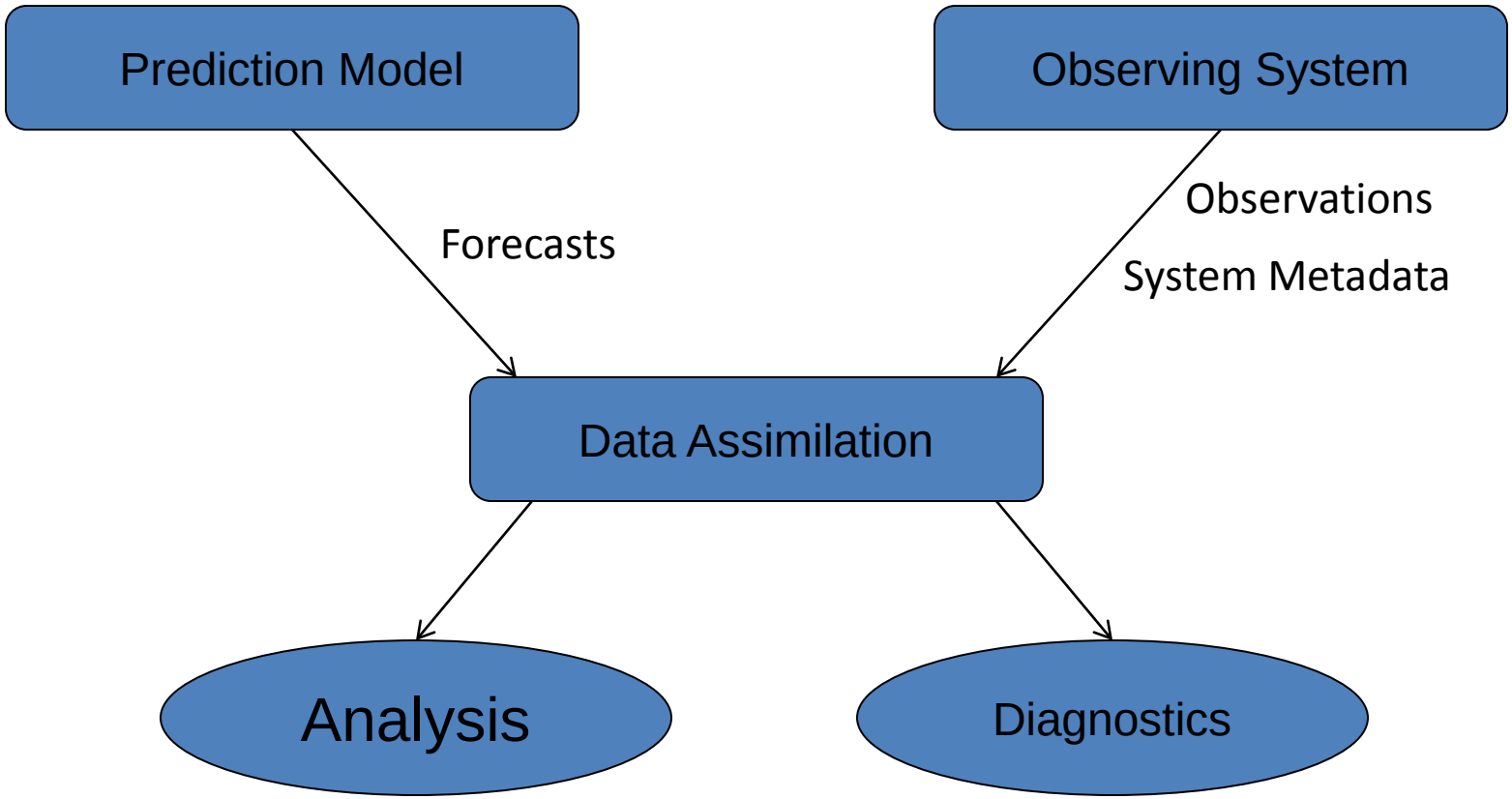
NESL

Overview of Data Assimilation



NESL

Overview of Data Assimilation



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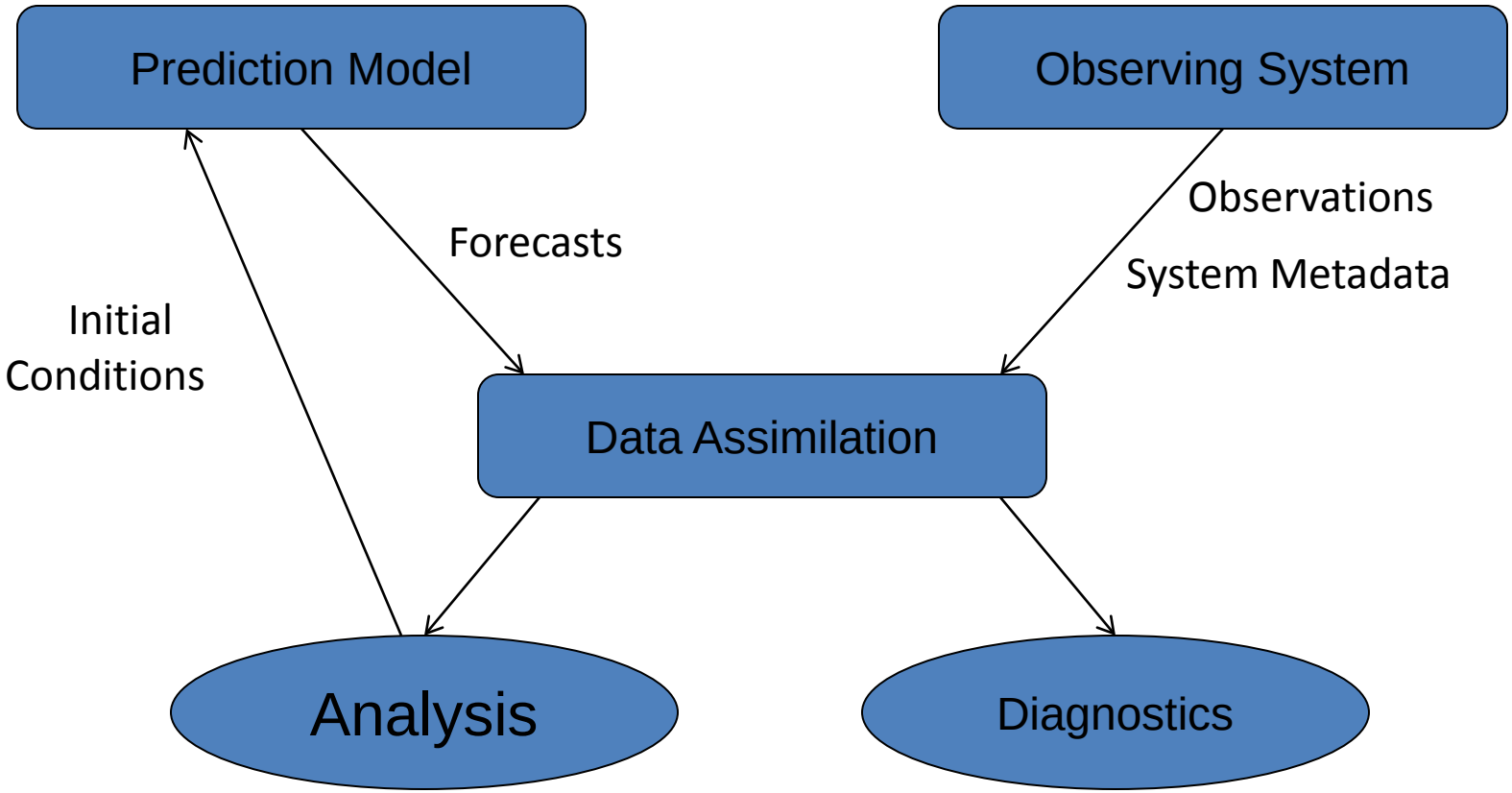

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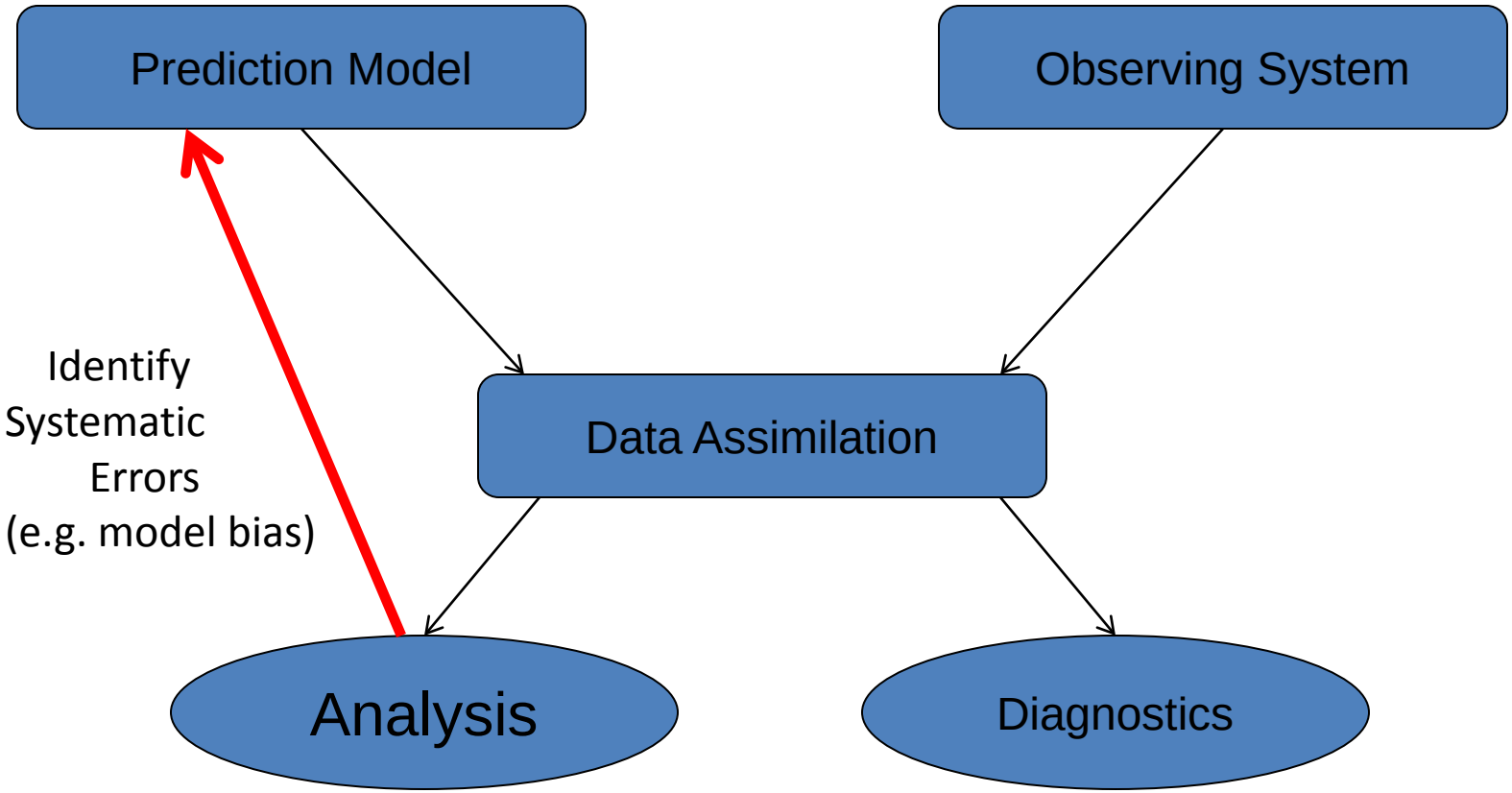

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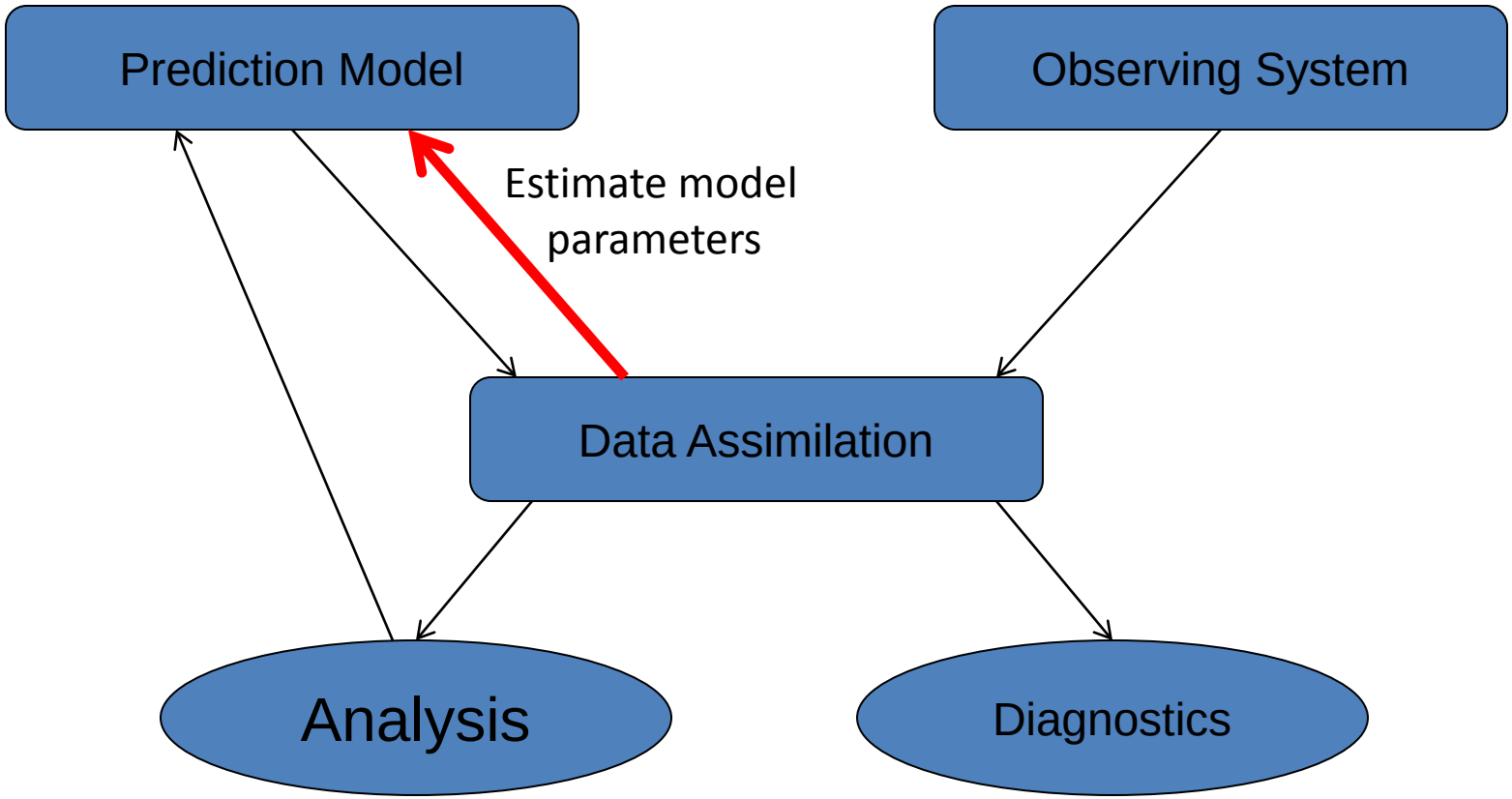

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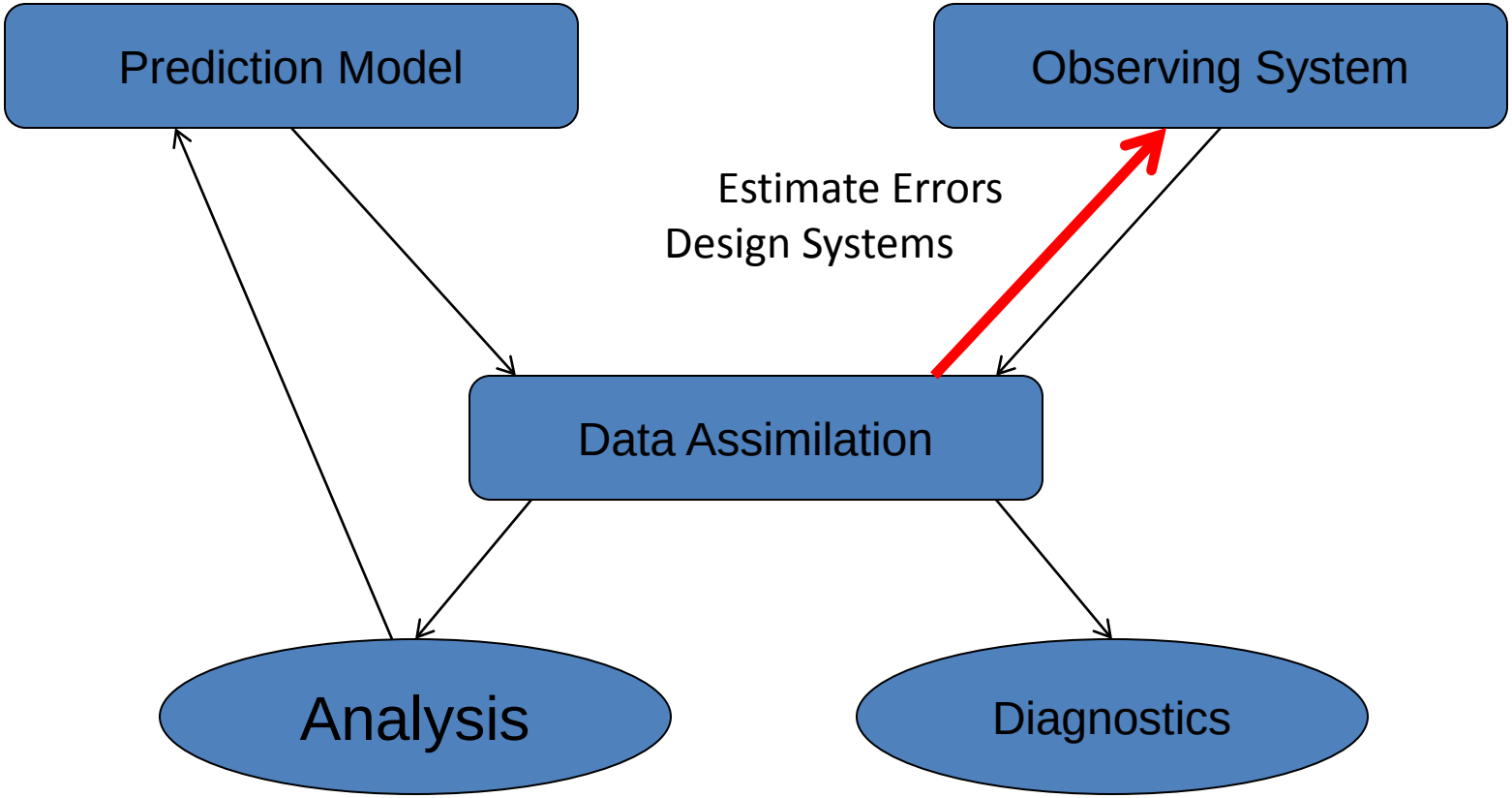

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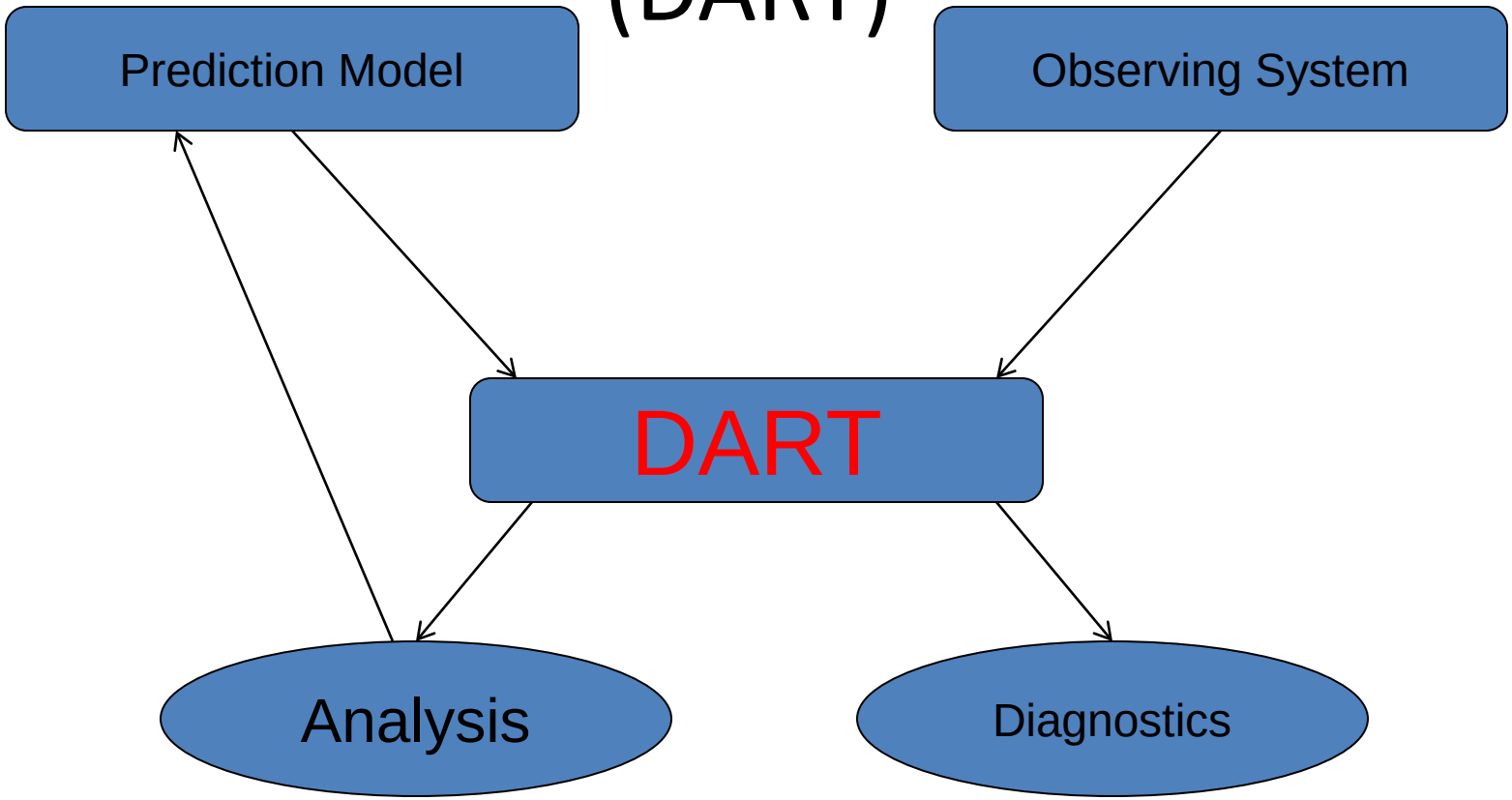
Data Assimilation Research Testbed (DART)



DART is a community ensemble assimilation facility

NESL

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

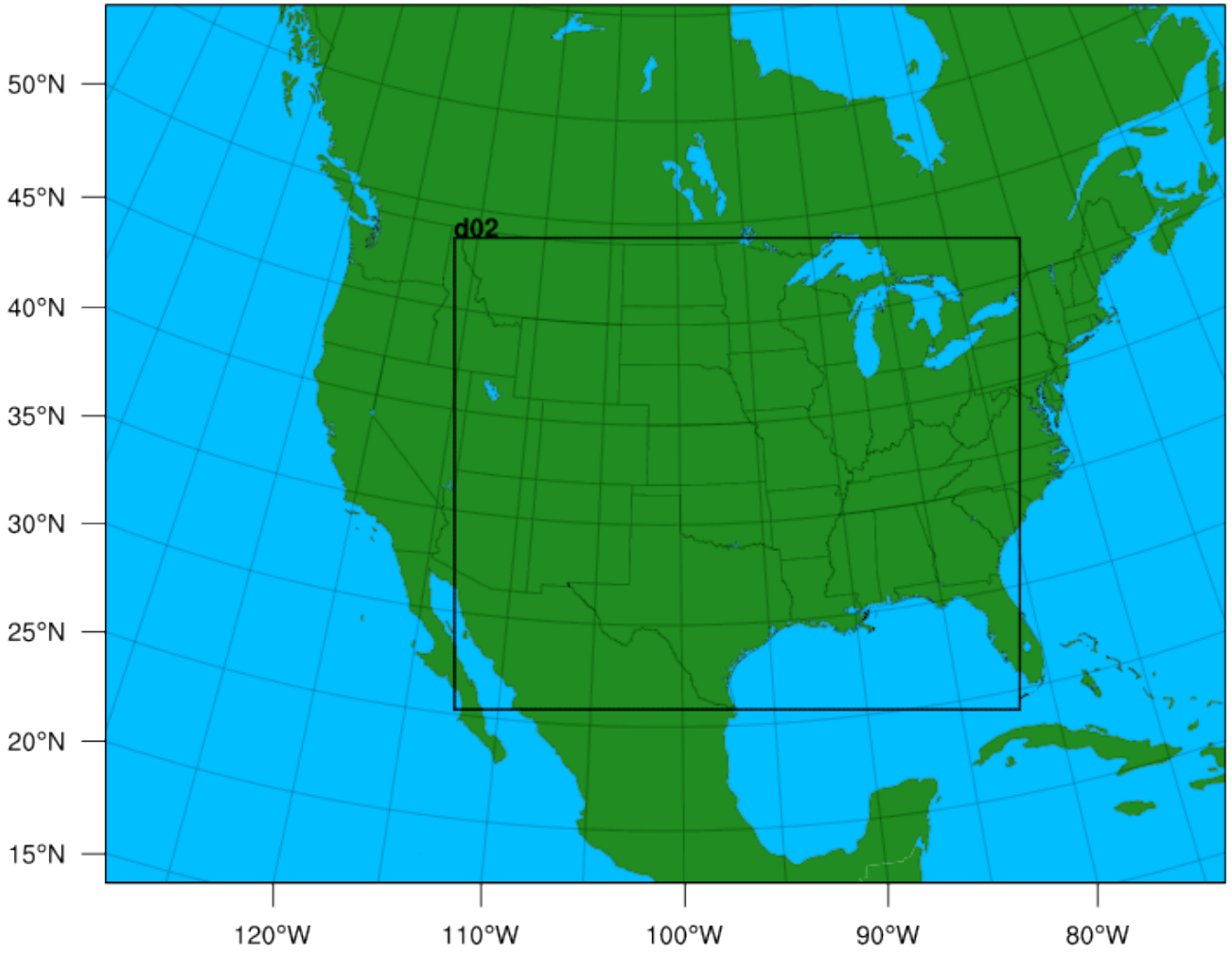
50 member ensemble

15 km resolution on cycled outer domain

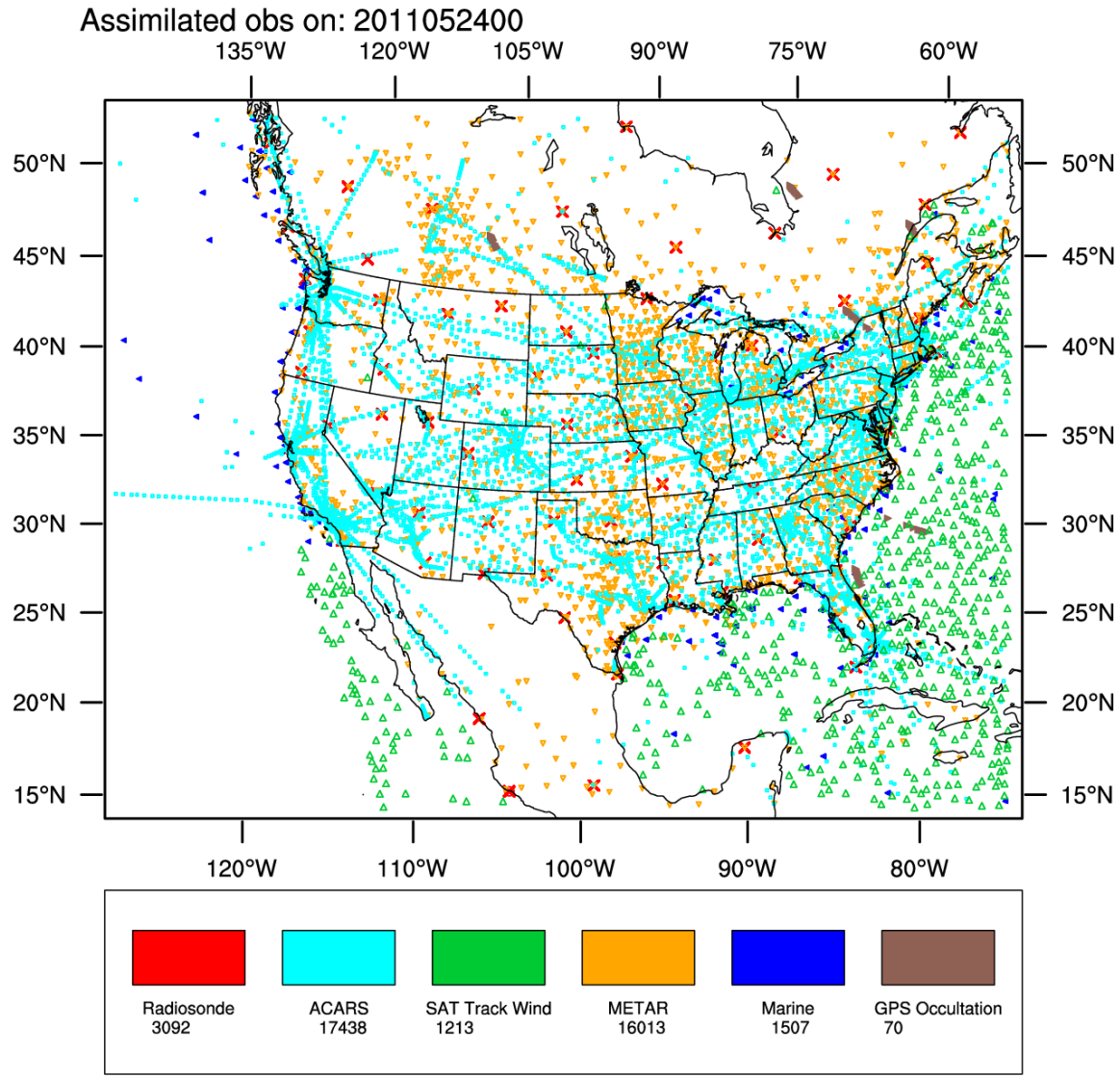
Member with closest normalized fit to ensemble mean selected for IC/BC for hi-res forecast

GFS forecast BC for outer domain

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



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

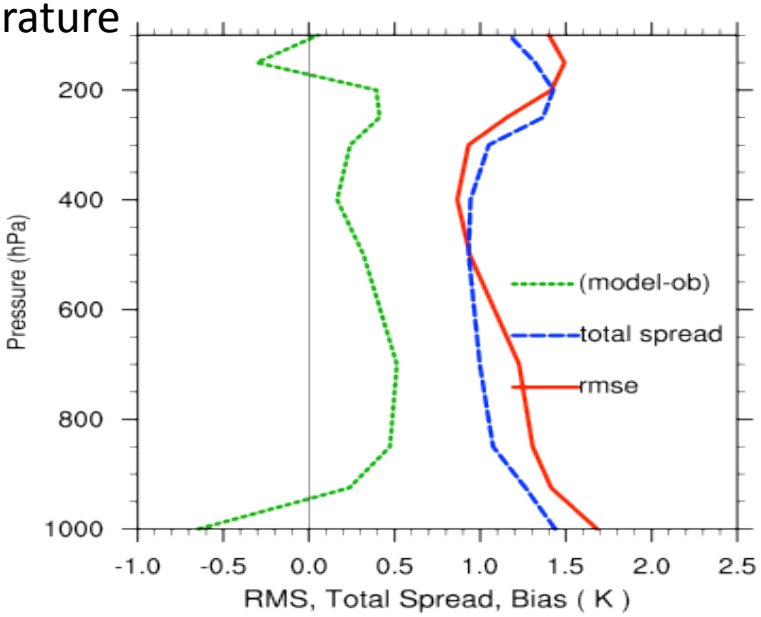
<u>SSEC sourced:</u>
SAT cloud track winds: U,V

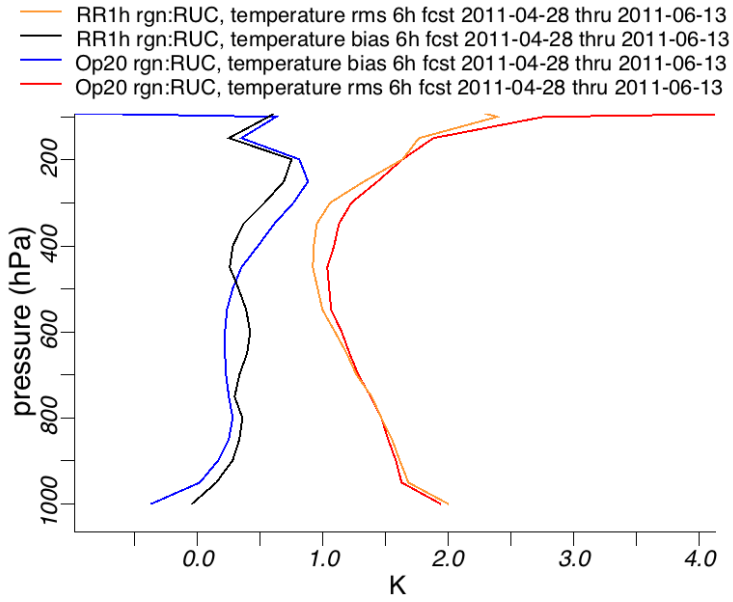
<u>COSMIC sourced:</u>
GPS occultation

~ 40k obs, 4x daily

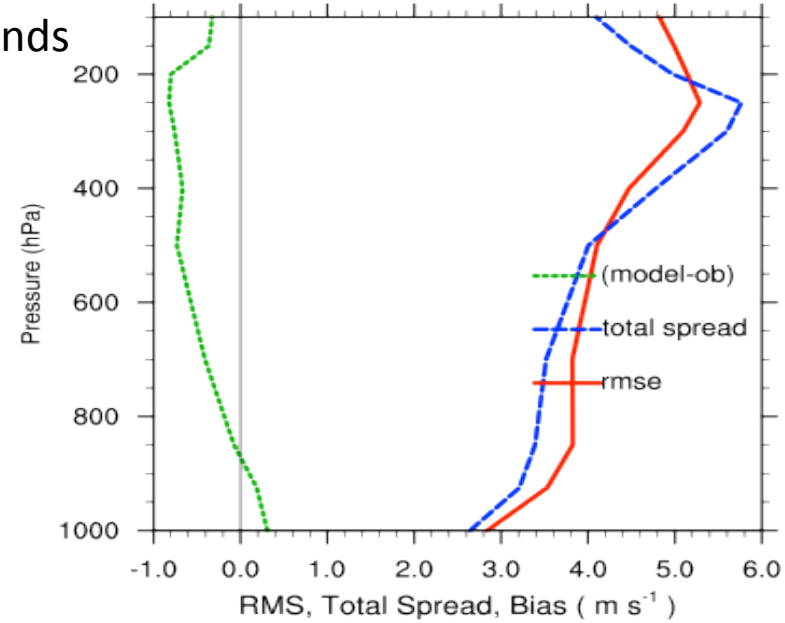
Sometimes obs are missing during real-time…. (Pacific atmospheric motion vectors)

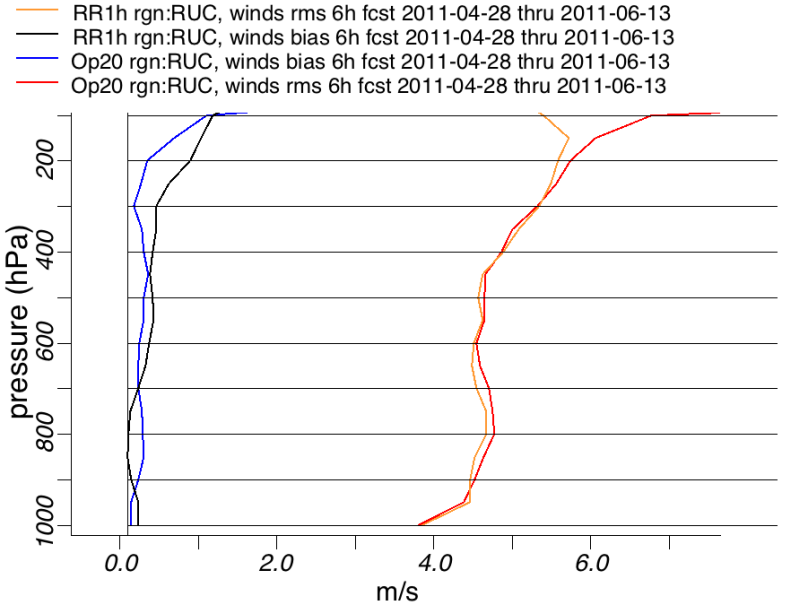
Temperature





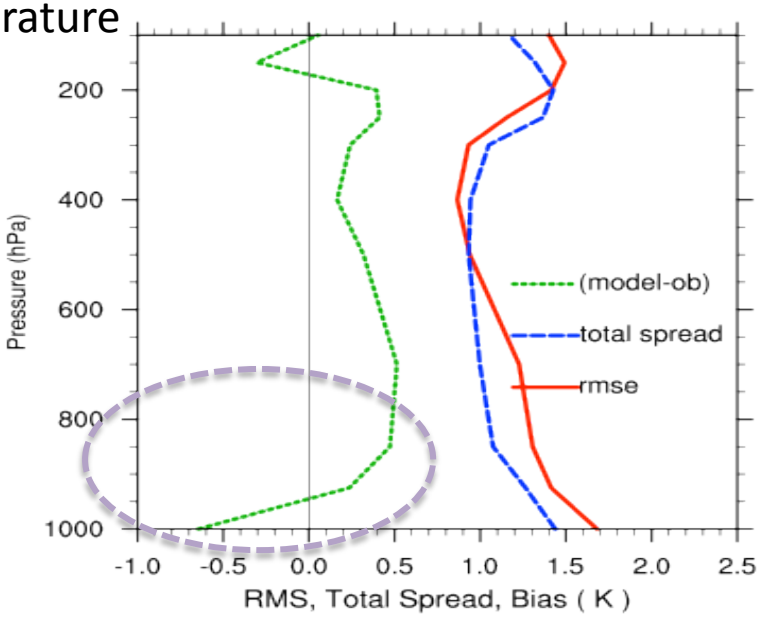
H. Winds

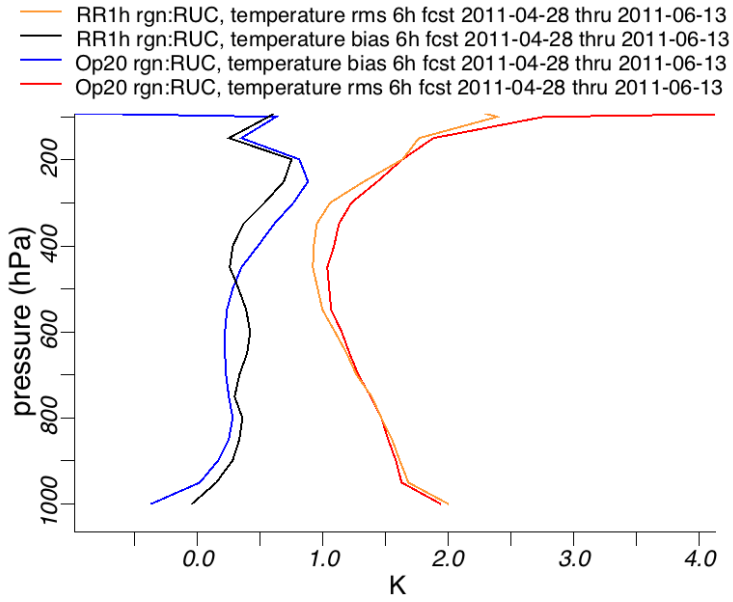




Ens. mean 6 hr forecast fit to radiosonde observations – avg over 47 days

Temperature





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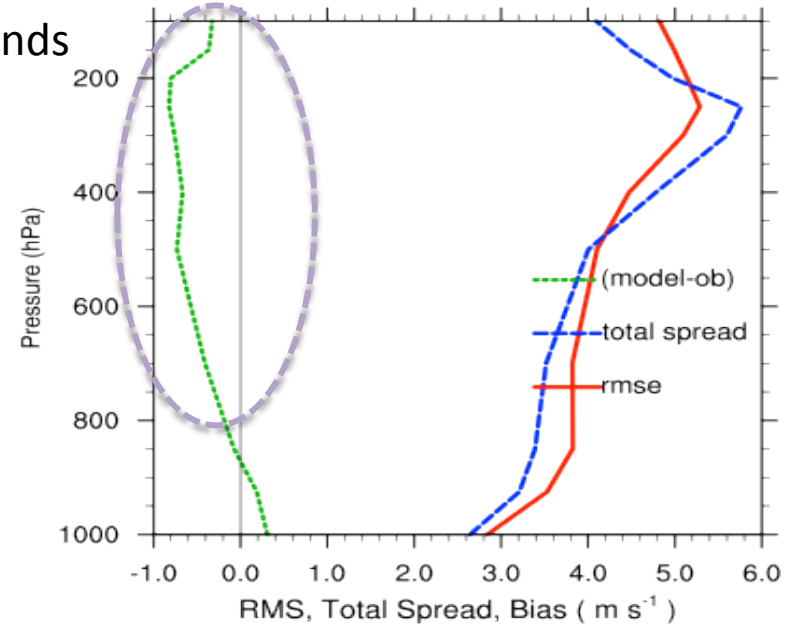

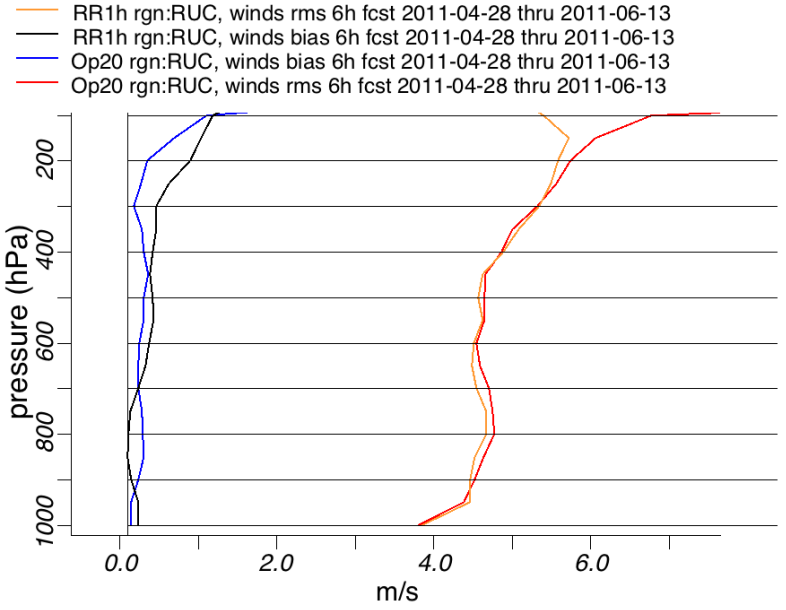

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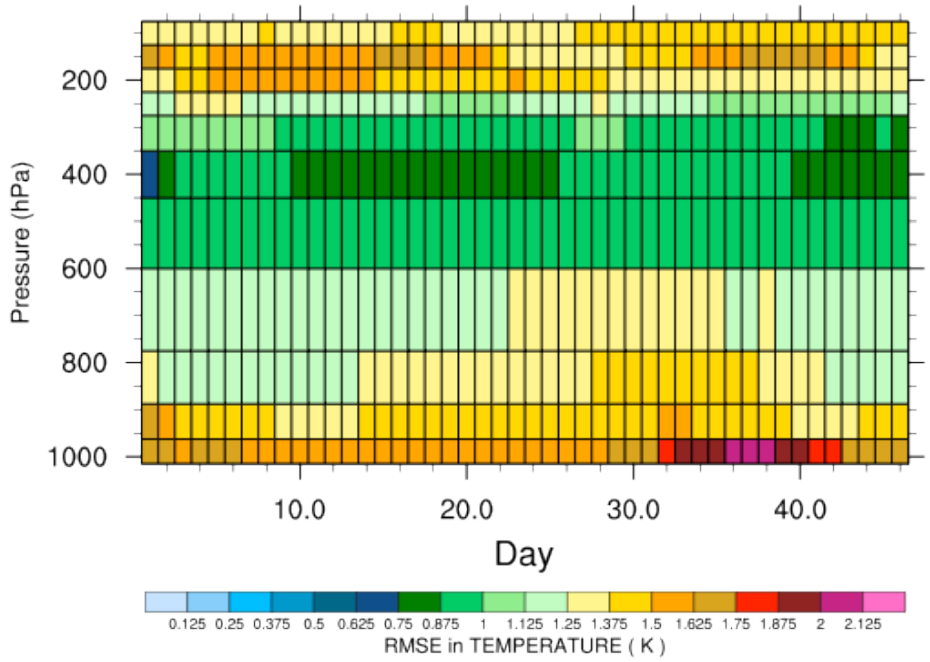
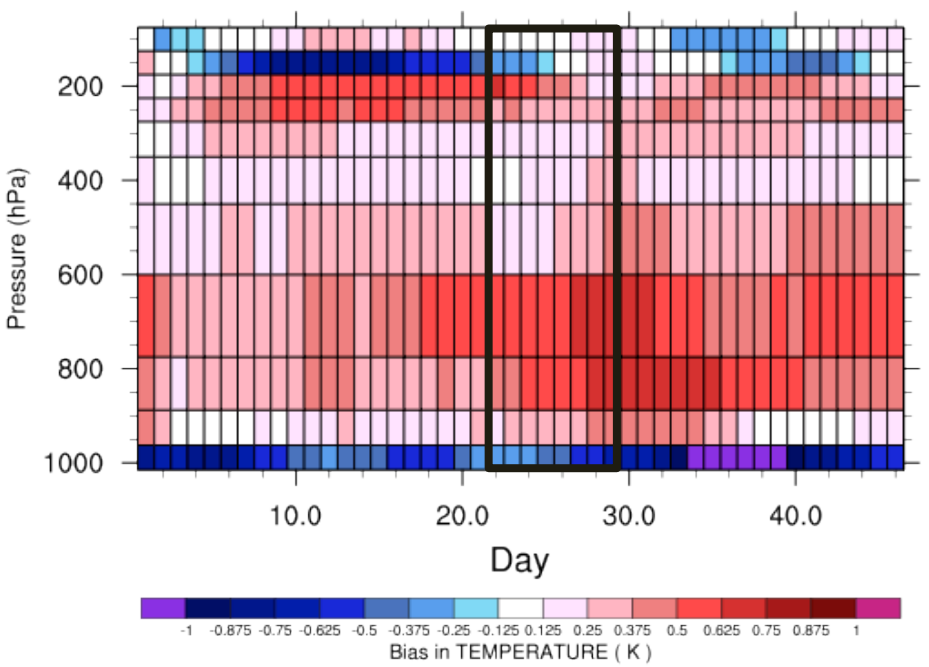
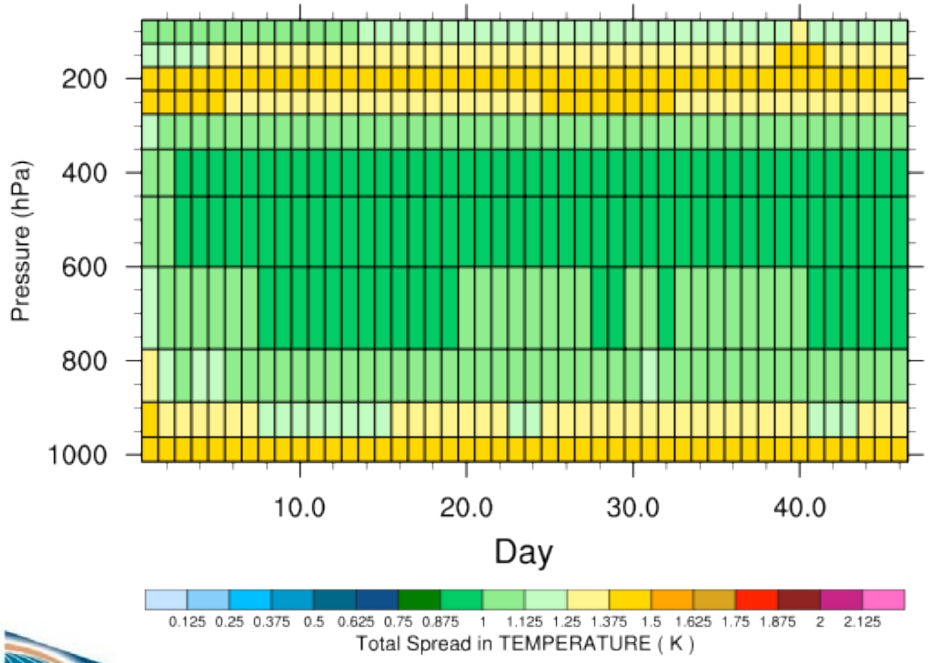






Time Series Radiosonde Temperature:

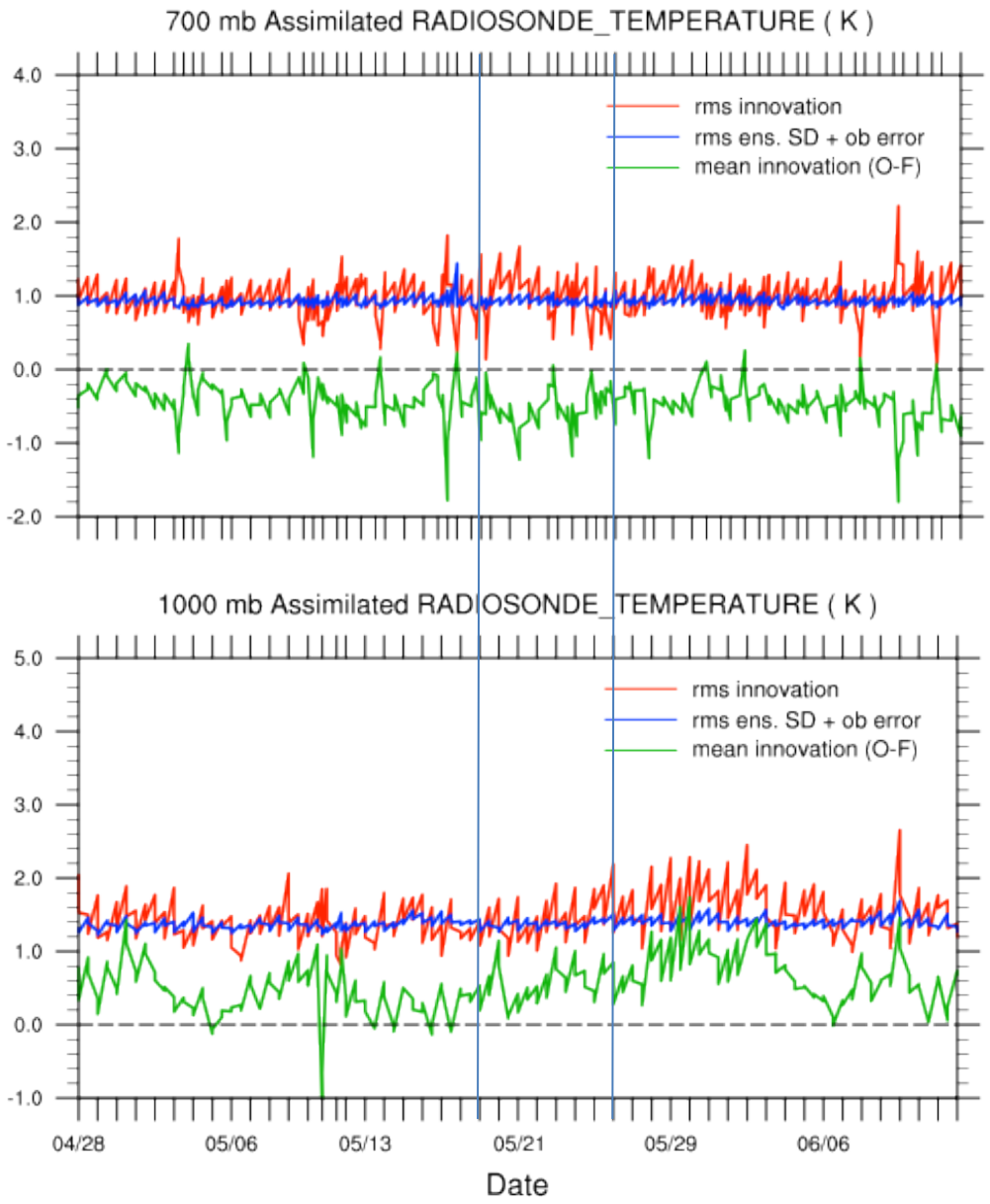
Increasing lower tropospheric stability begins during “challenged” period

Radiosonde temperature 6 hr forecast fits – trends in increasing stability

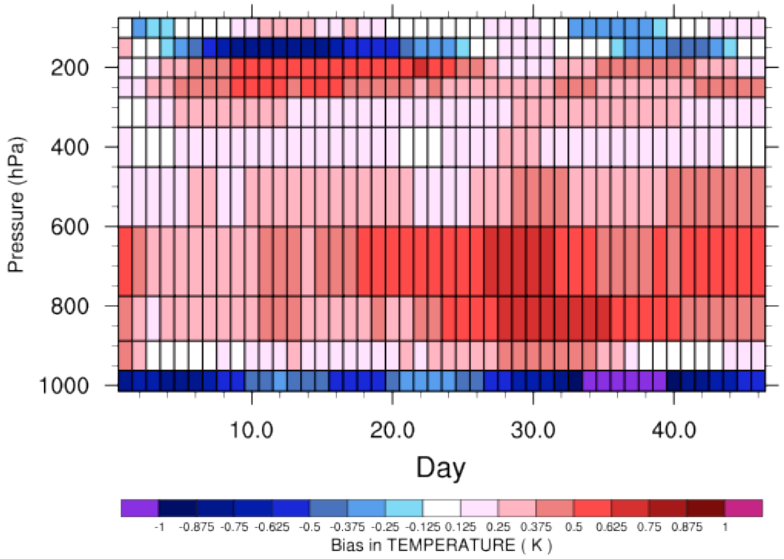
Time series for 700 (1000) mb level shows general trend toward warmer (cooler) bias and increasing RMSE, while total spread remains fairly constant.

1000 mb sample size small, spatially biased to East Coast region.

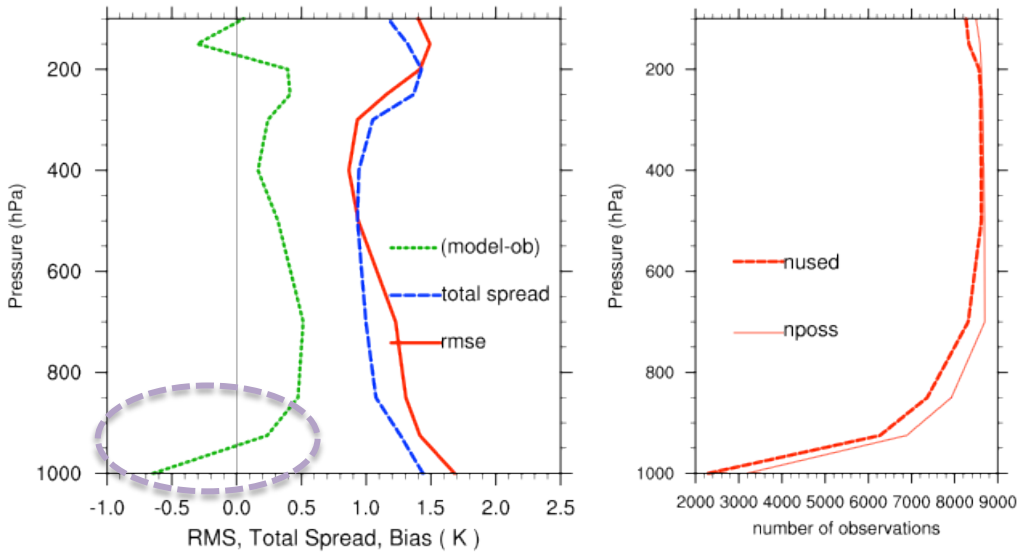
No significant trends during The “challenged” forecast period.



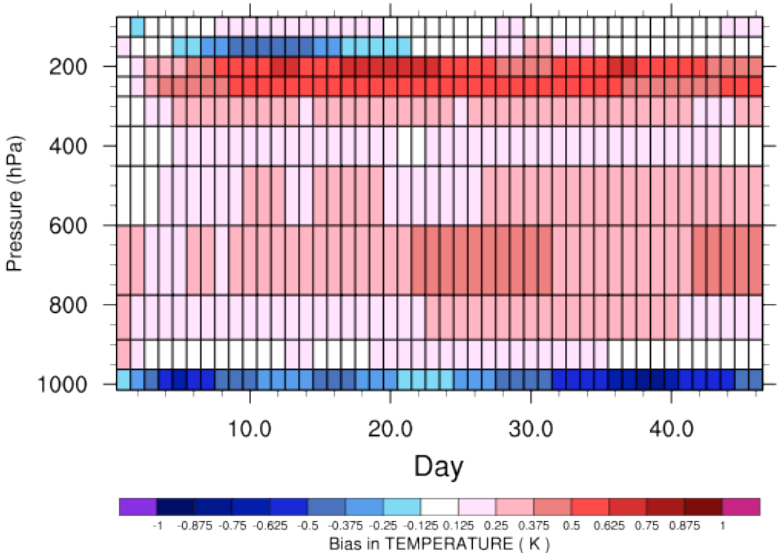
6 hr forecast bias



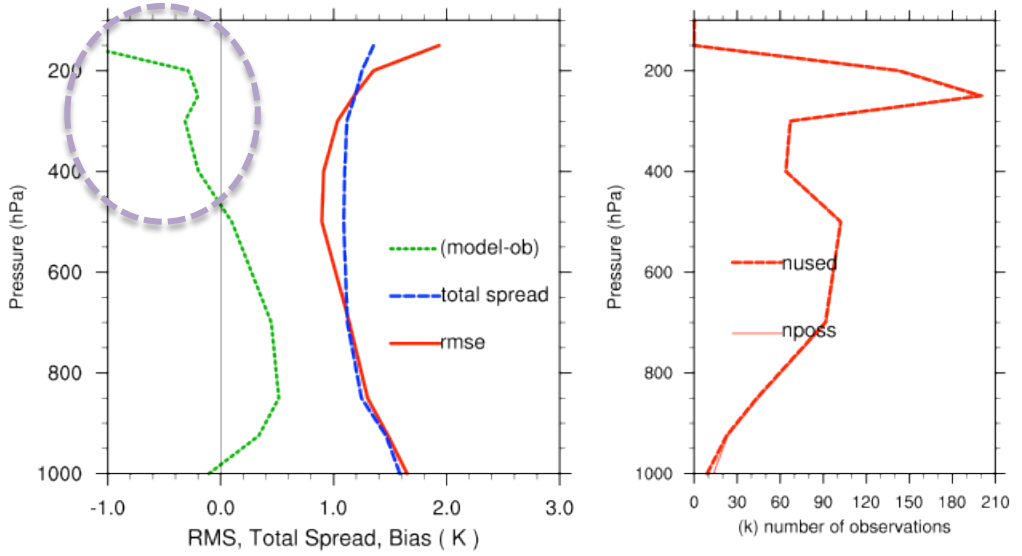
Radiosonde Temperature

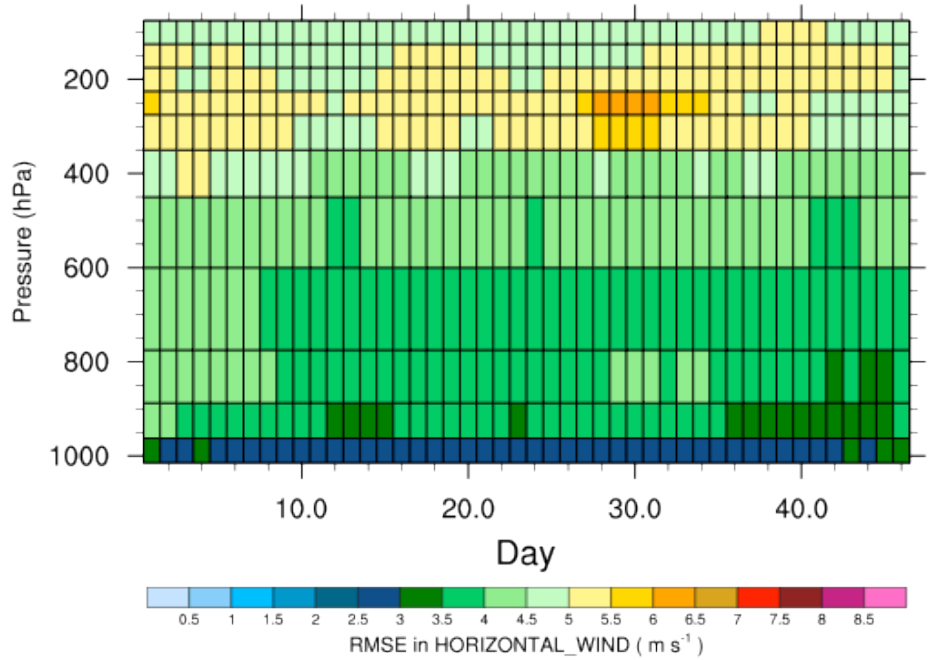


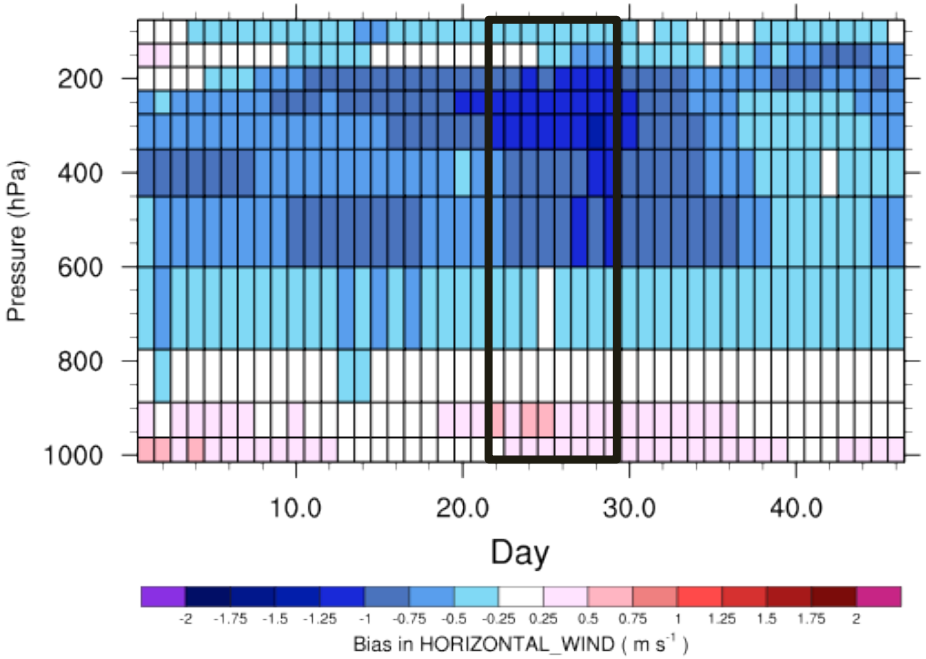
analysis bias

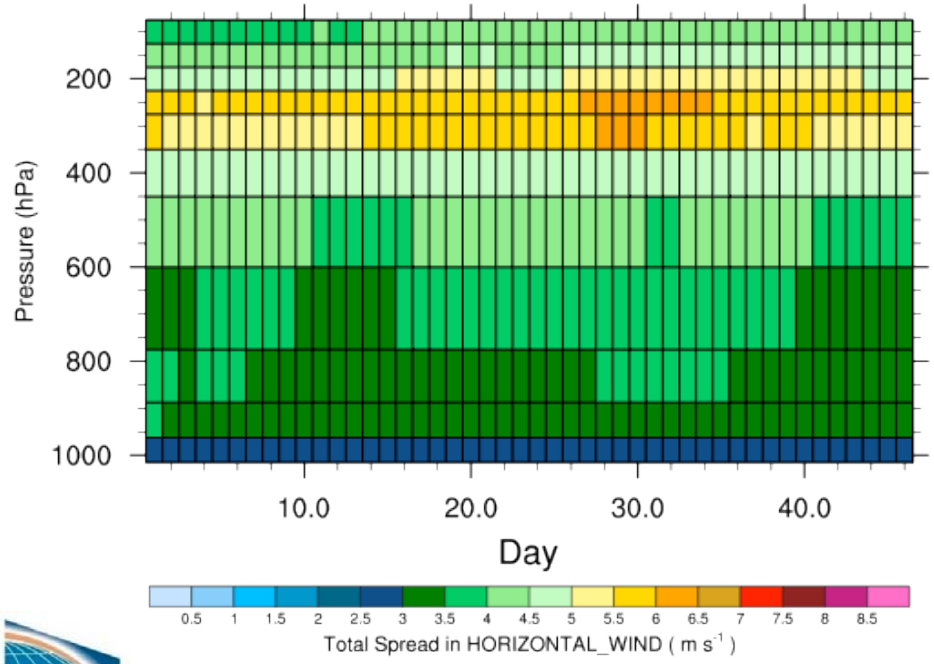


ACARS Temperature



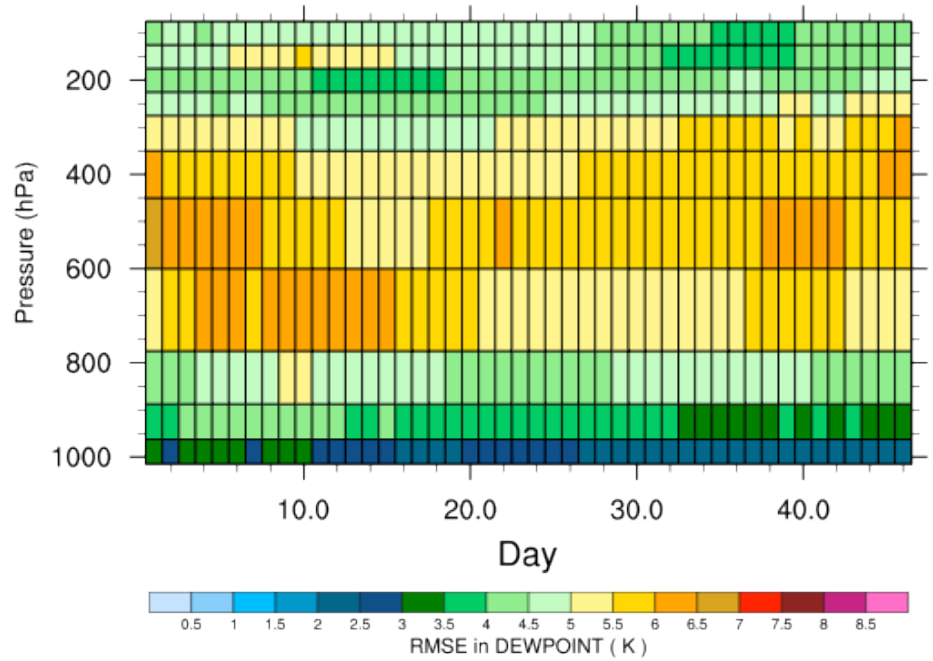


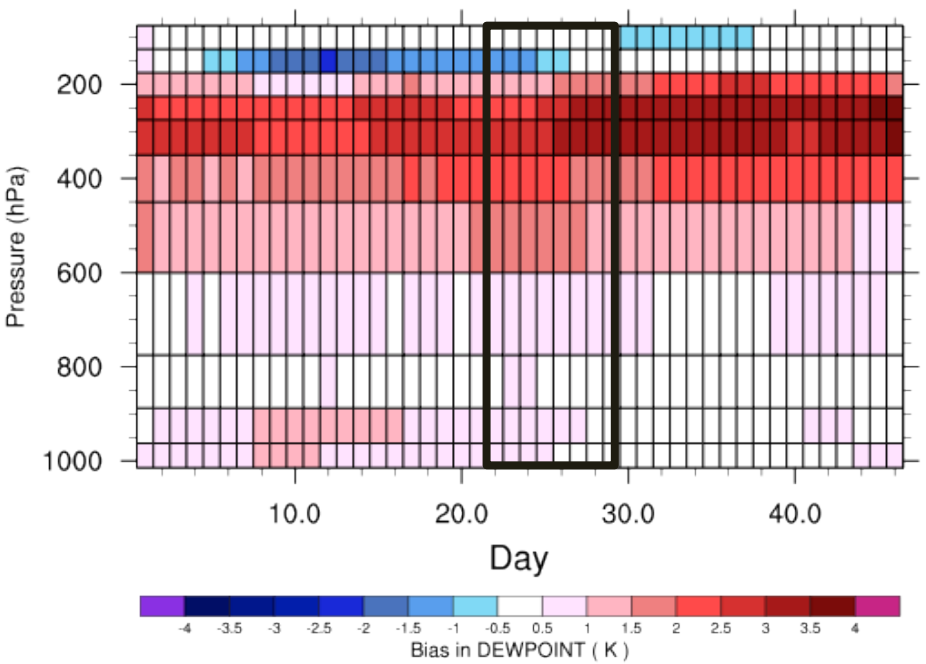


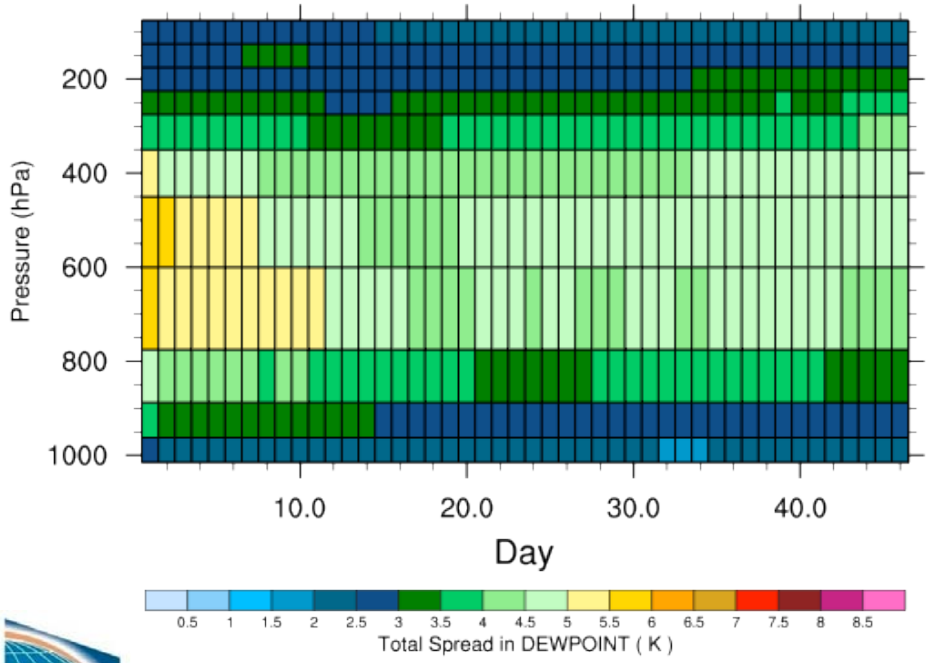


Time Series Rsonde Horizontal Wind Speed:

Increasing trend in mid-upper tropospheric bias, spread and RMSE during "challenged" period





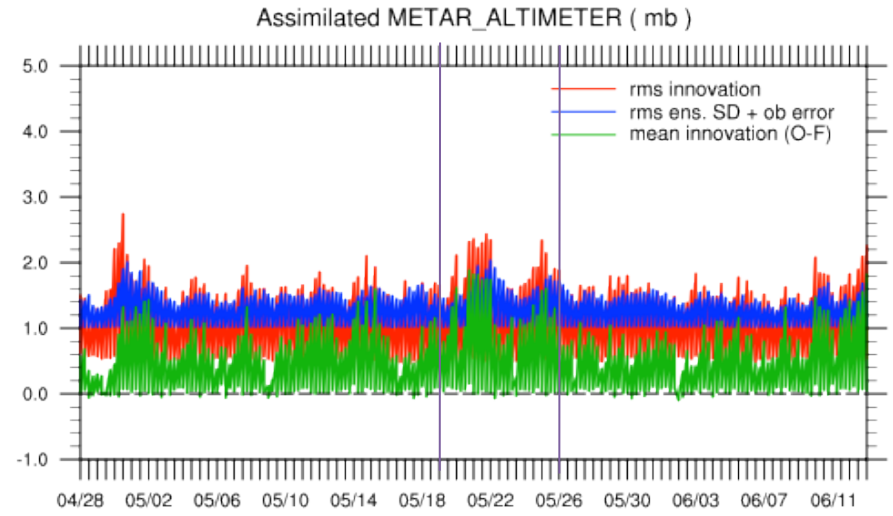


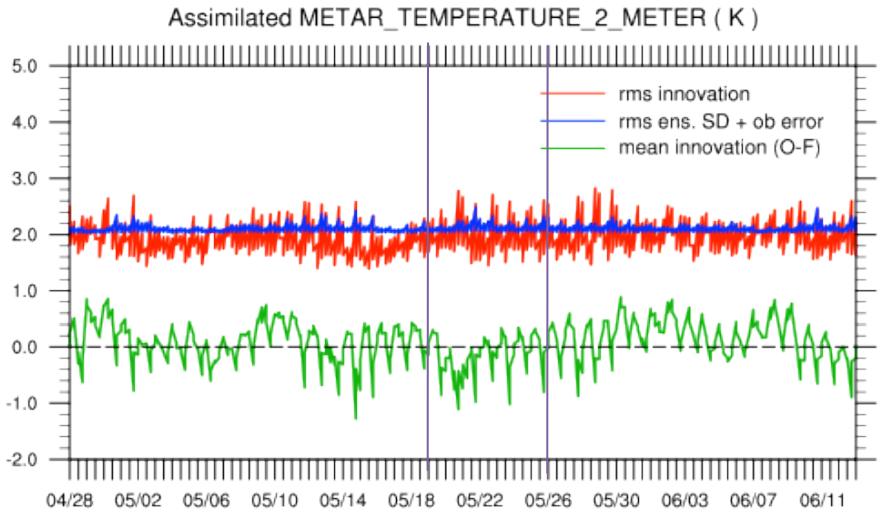
Time Series Rsonde Dewpoint:

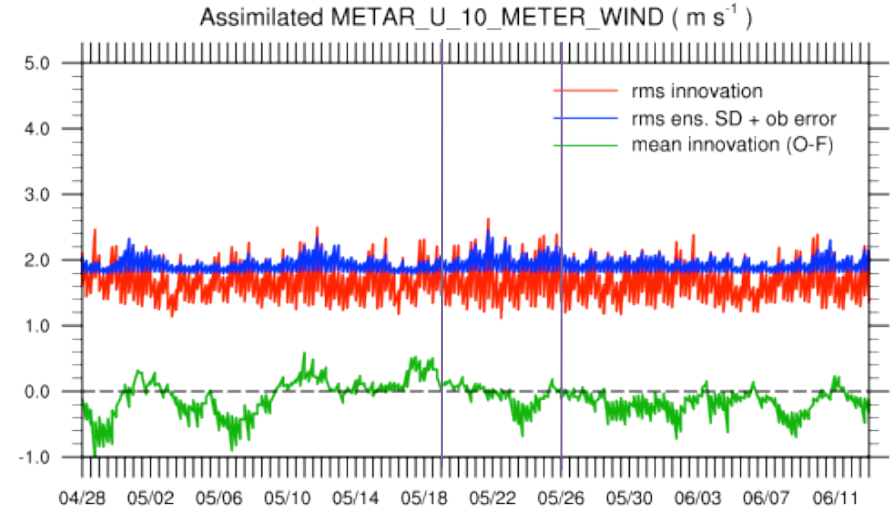
Increasing positive bias trend in upper troposphere

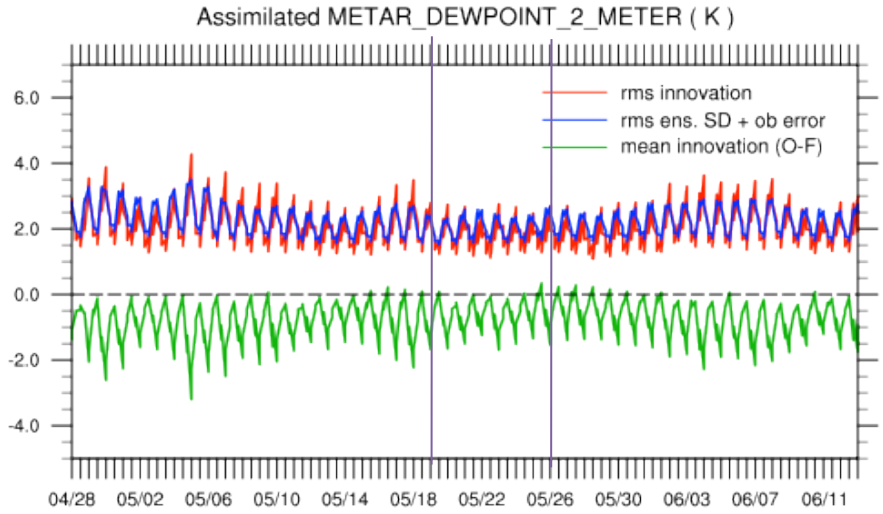
Spread decrease ~ day 10 from change in observation error assignment (tuning) to correct ‘wet’ bias during early forecast period

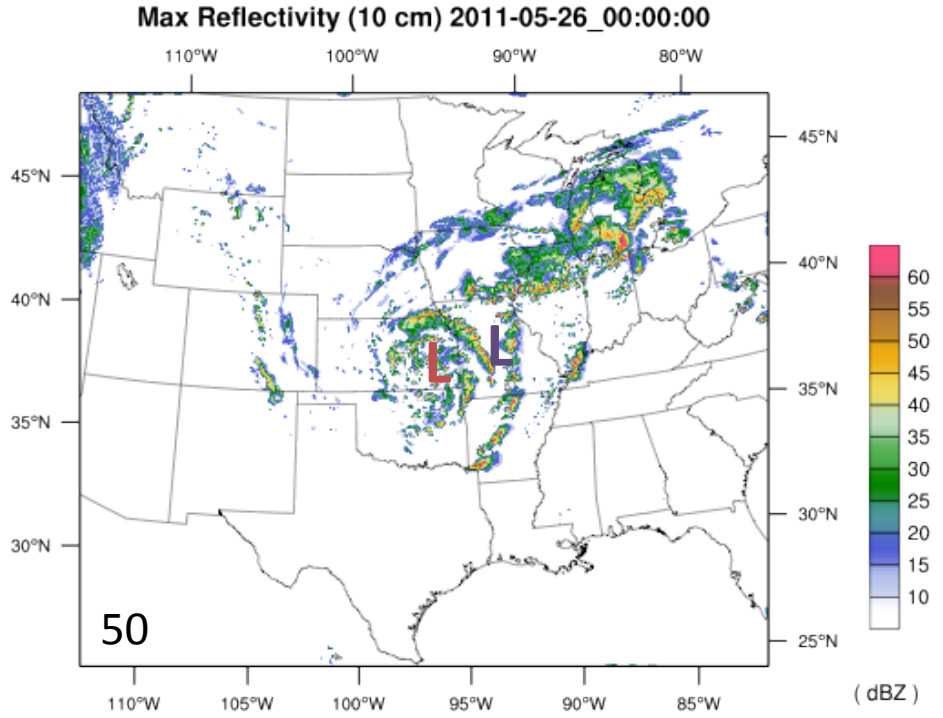
Prior fit to METAR observations

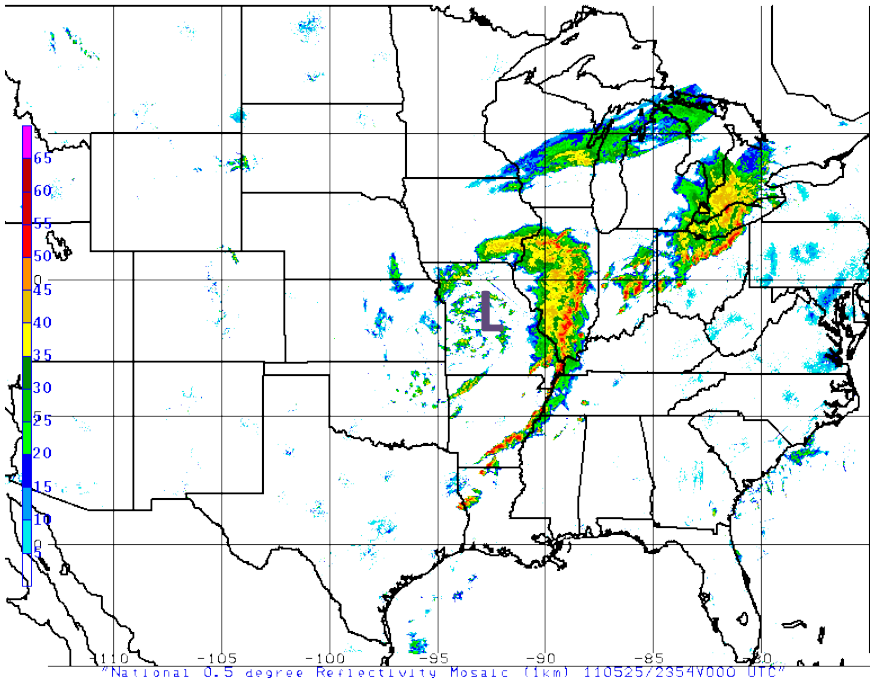


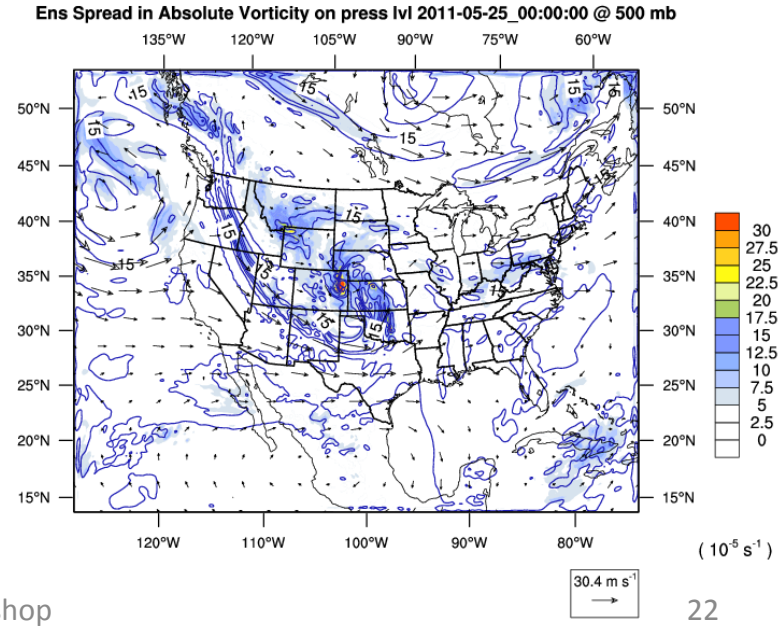






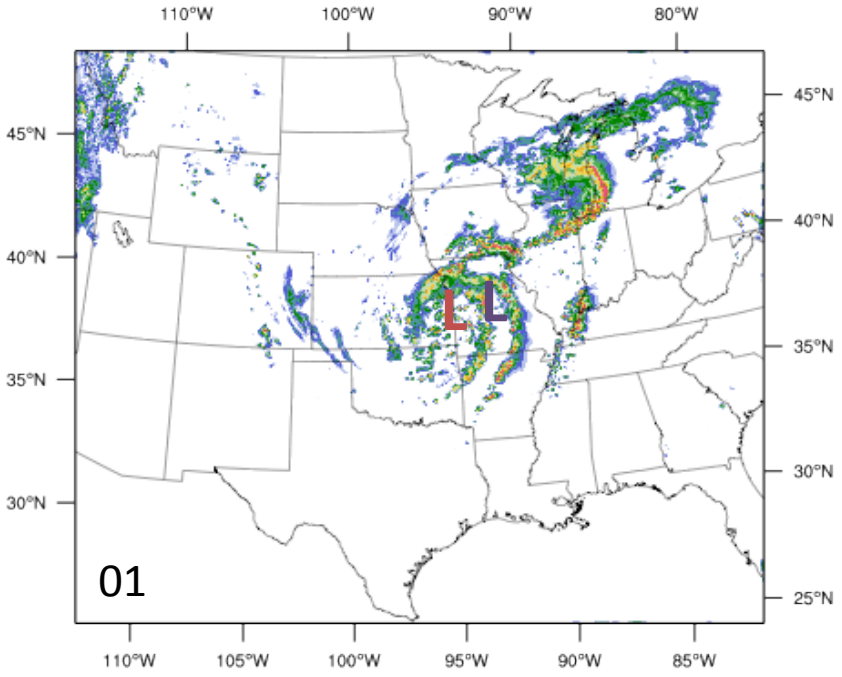






Yet another bad forecast – slow emergence of an upper low. Is this forecast member an outlier?

Enhanced uncertainty in mid-trop features within negative tilt trough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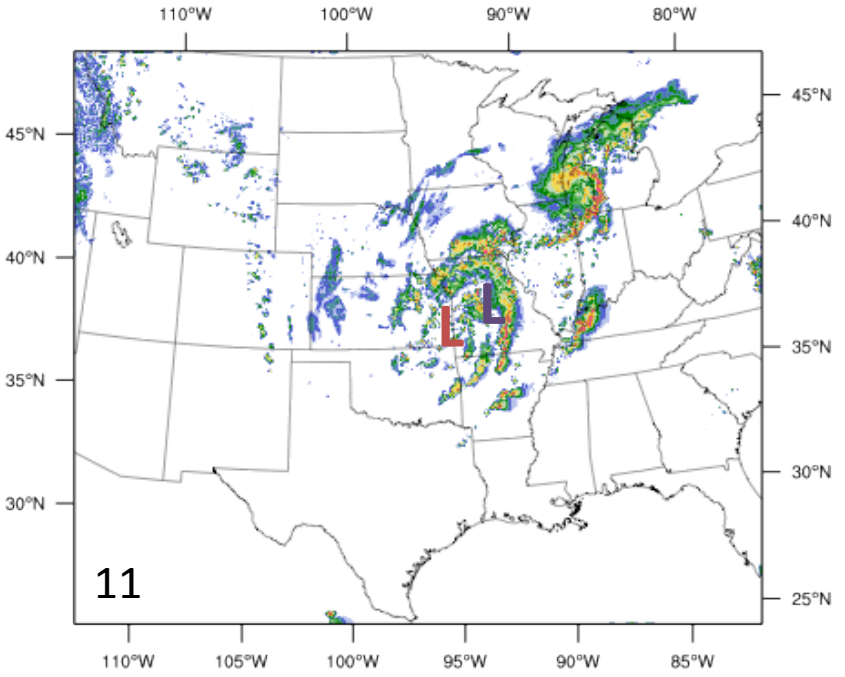
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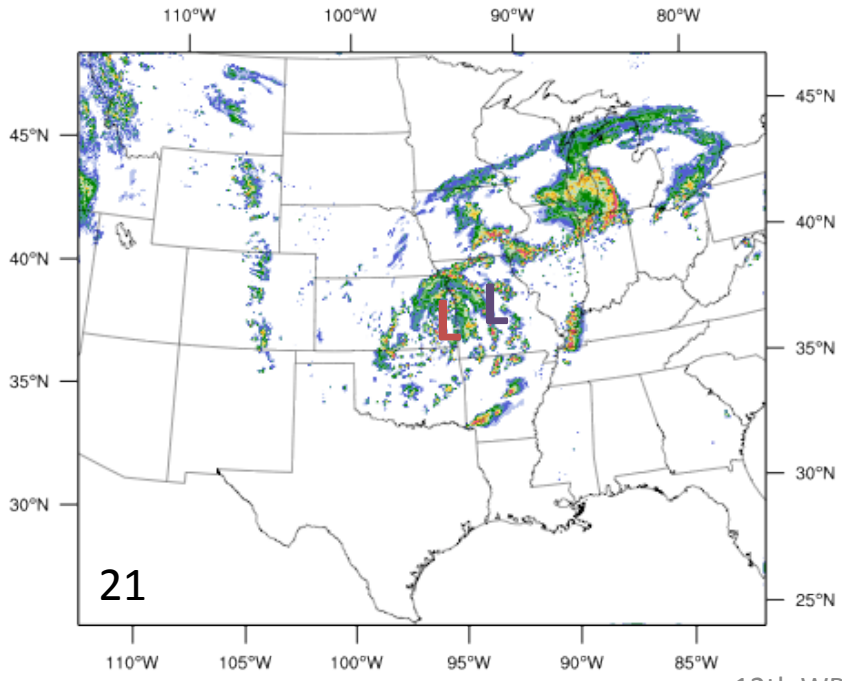
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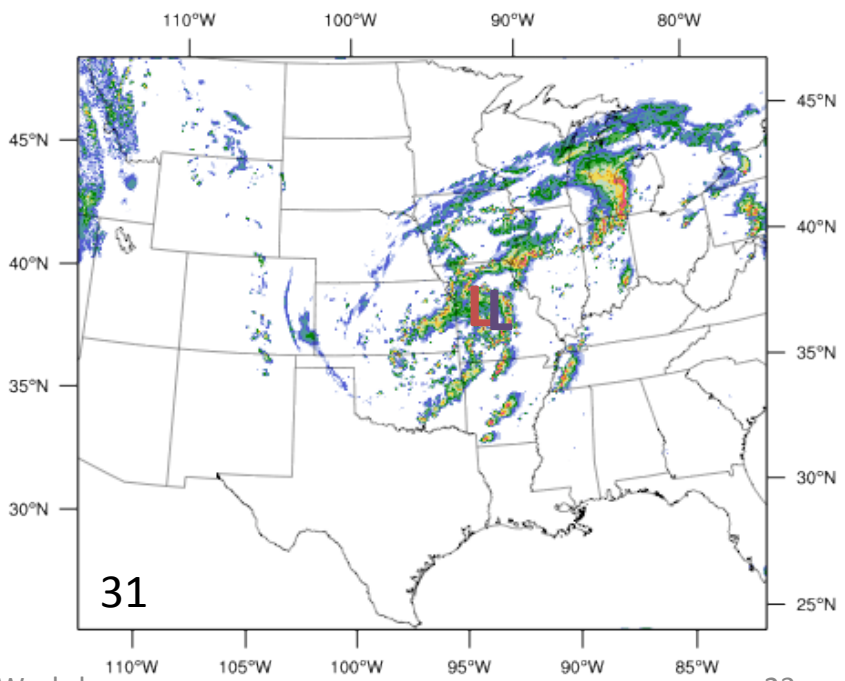
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Current Plans

- Relating high resolution forecast performance to analysis system fit trends
- Aim to identify model bias sources, seek potential remedies
- Observations to include (exclude) or increase (decrease) impact on analysis
- Ensemble sensitivity analysis
- Initial condition diversity between WRF_DART ensemble, NAM, rapid refresh, GFS analysis (convective forecast sensitivity)
- 2012 real-time exercise