Use of the NCEP Short Range Ensemble Forecast System

Eastern Region of the NWS

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With contributions from
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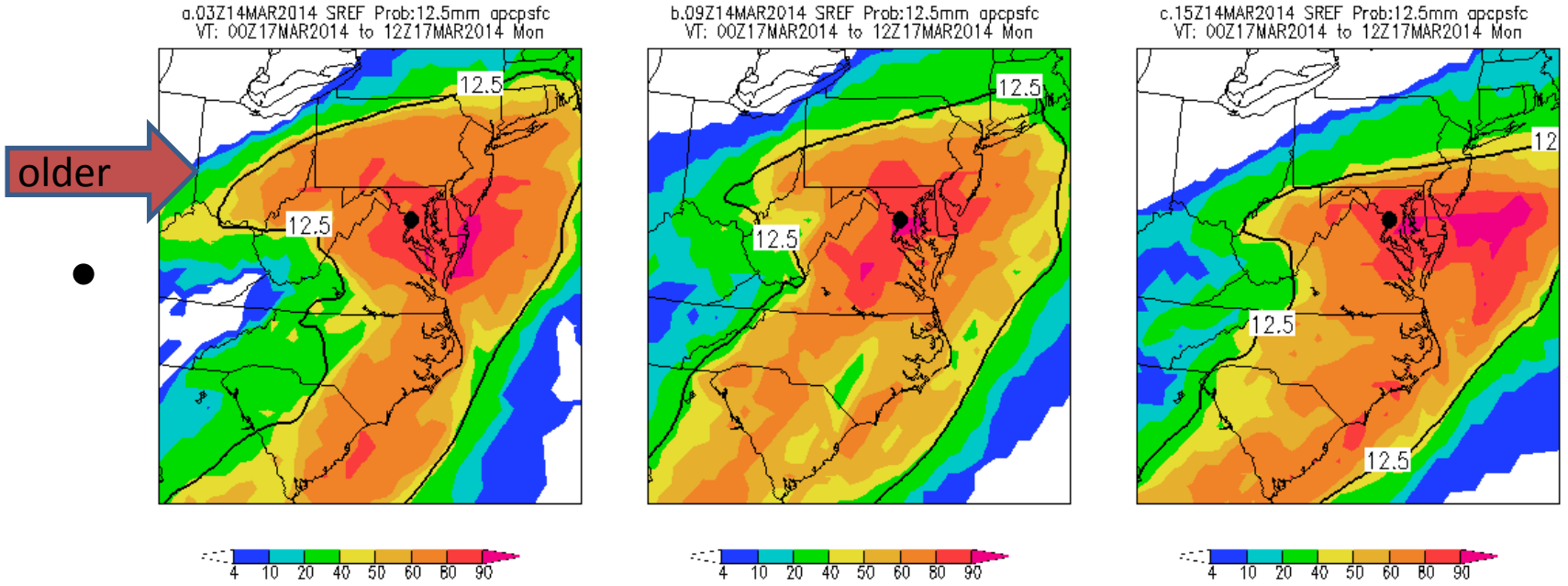
25 March 1230_1500

Overview

- **Over a decade experience using the SRE**F and **GEFS**
  - *Good access to SREF, GEFS, NAEFS and experimental versions*
  - *Main uses*
    - *Web site for mean/spread/anomalies*
    - *Case studies to use EFS data*
  - *Challenges → better systems and longer predictability horizons!*

- **Focus on recent examples**:
  - *Winter storms*
  - *Dealing with uncertainty and short predictability horizons*

- **Current work and future work**



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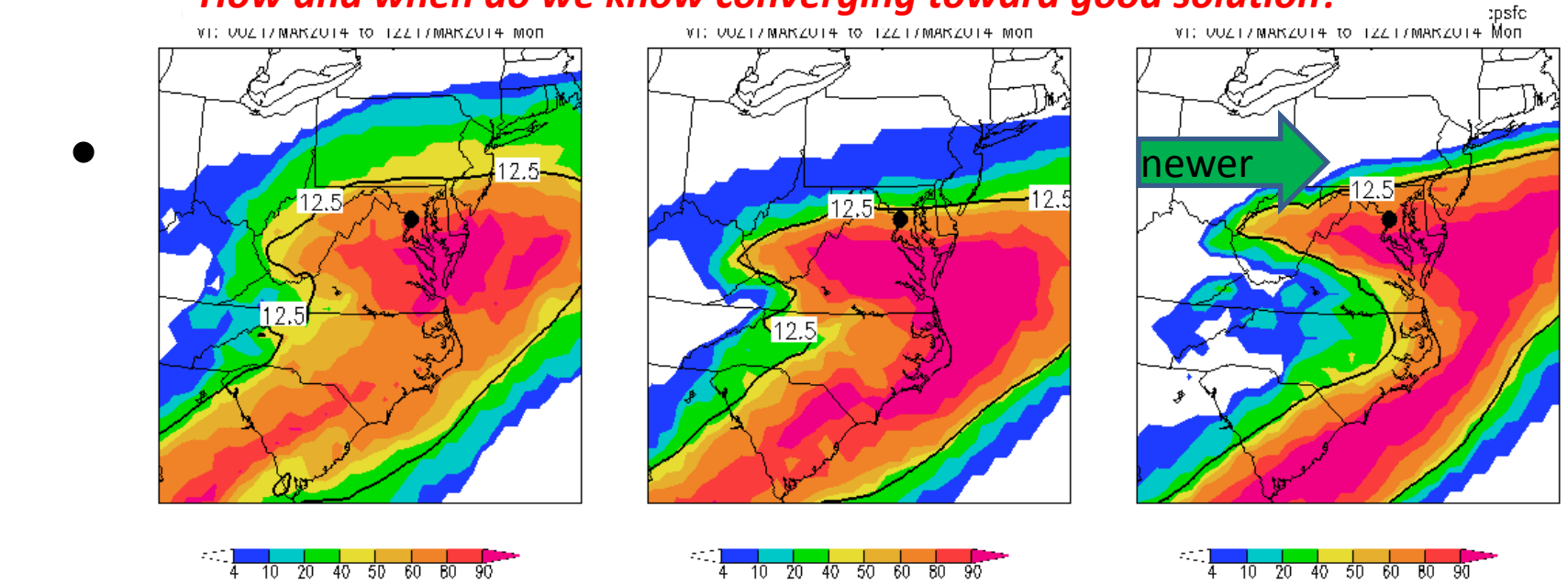
How and when do we know converging toward good solution?



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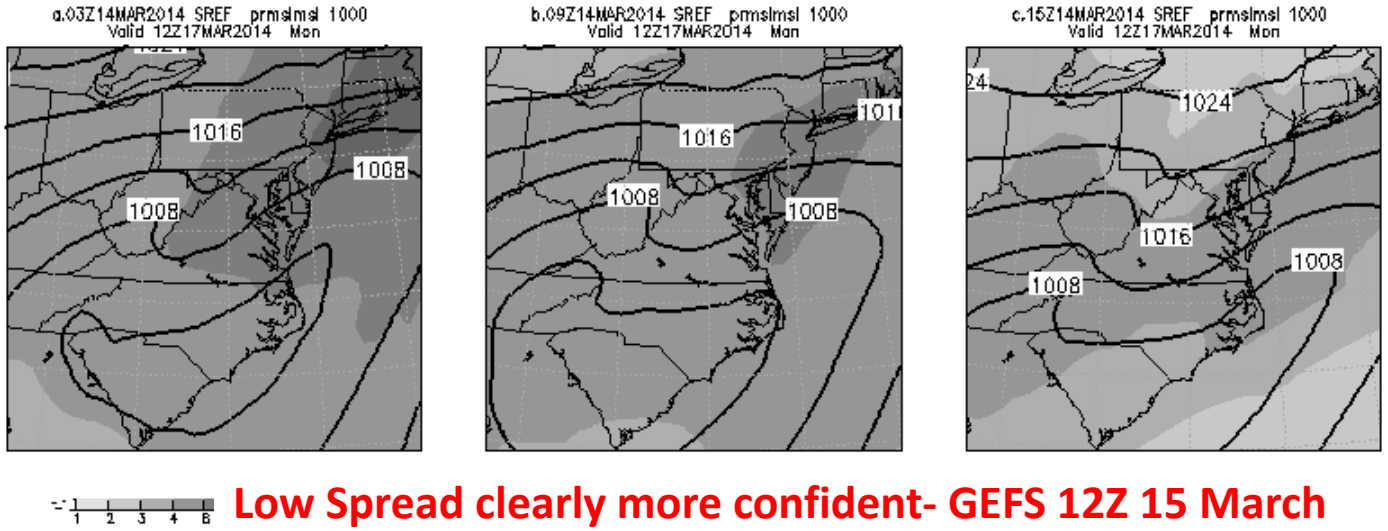
Focus on recent examples

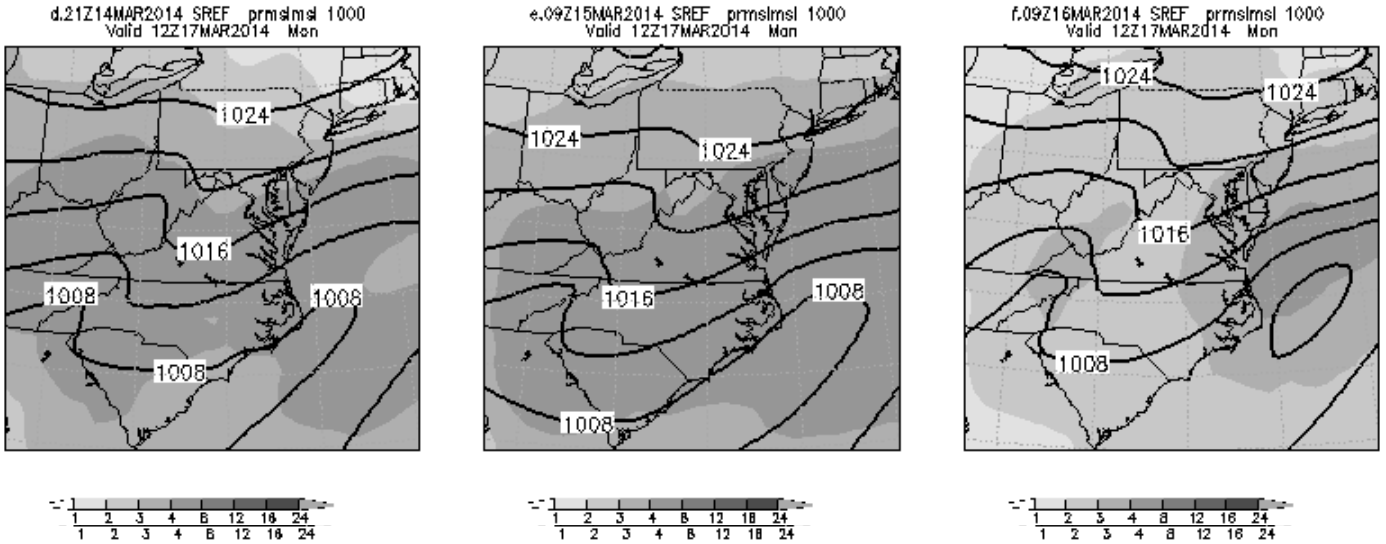
- Three Events→
  - 3 March and 17 March large anticyclone and weak low GEFS-SREF forecast too much QPF too far north→ *short predictability horizons*
  - 12 March deep cyclone tracked QPF and cyclone too far south and east
- **Calibration and Predictability horizons→**
  - ***Need some calibration and tools for this?***
  - 17 March DC snow case→

Large Spread→cyclone track shifted south

Note GEFS had same predictability horizon issues

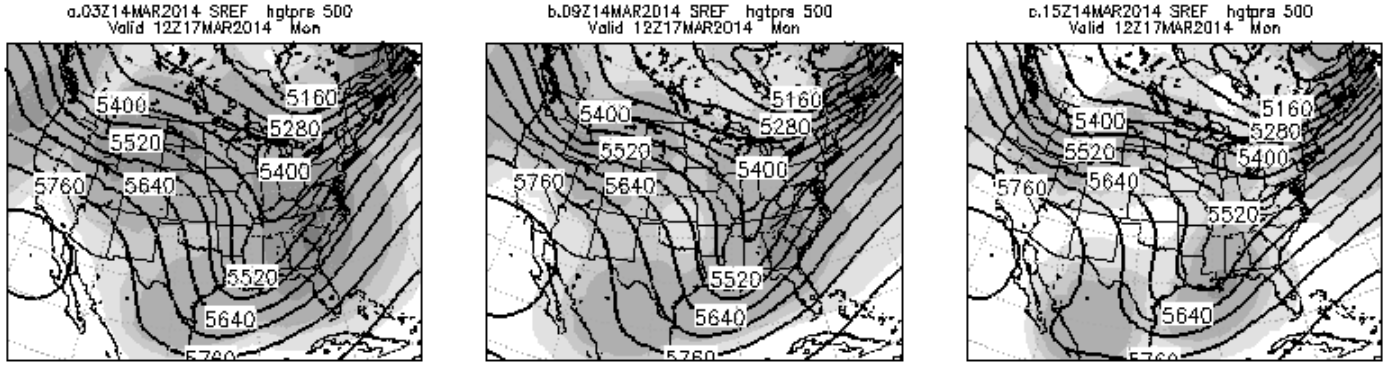


Low Spread clearly more confident- GEFS 12Z 15 March

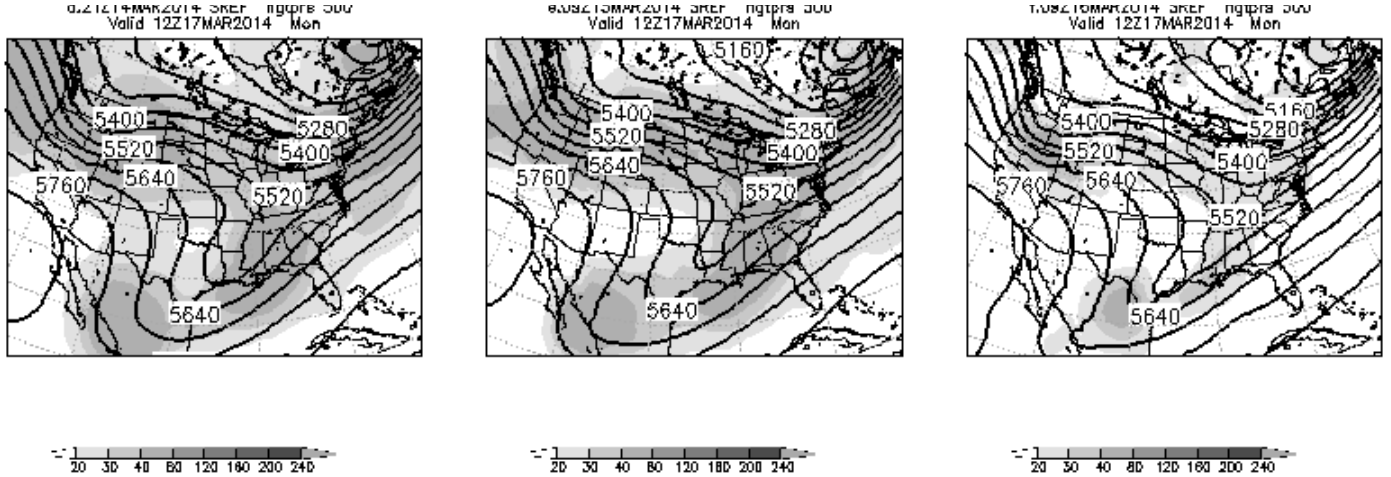


Same at 500 hPa

spread rapidly decreased on 14-15 March

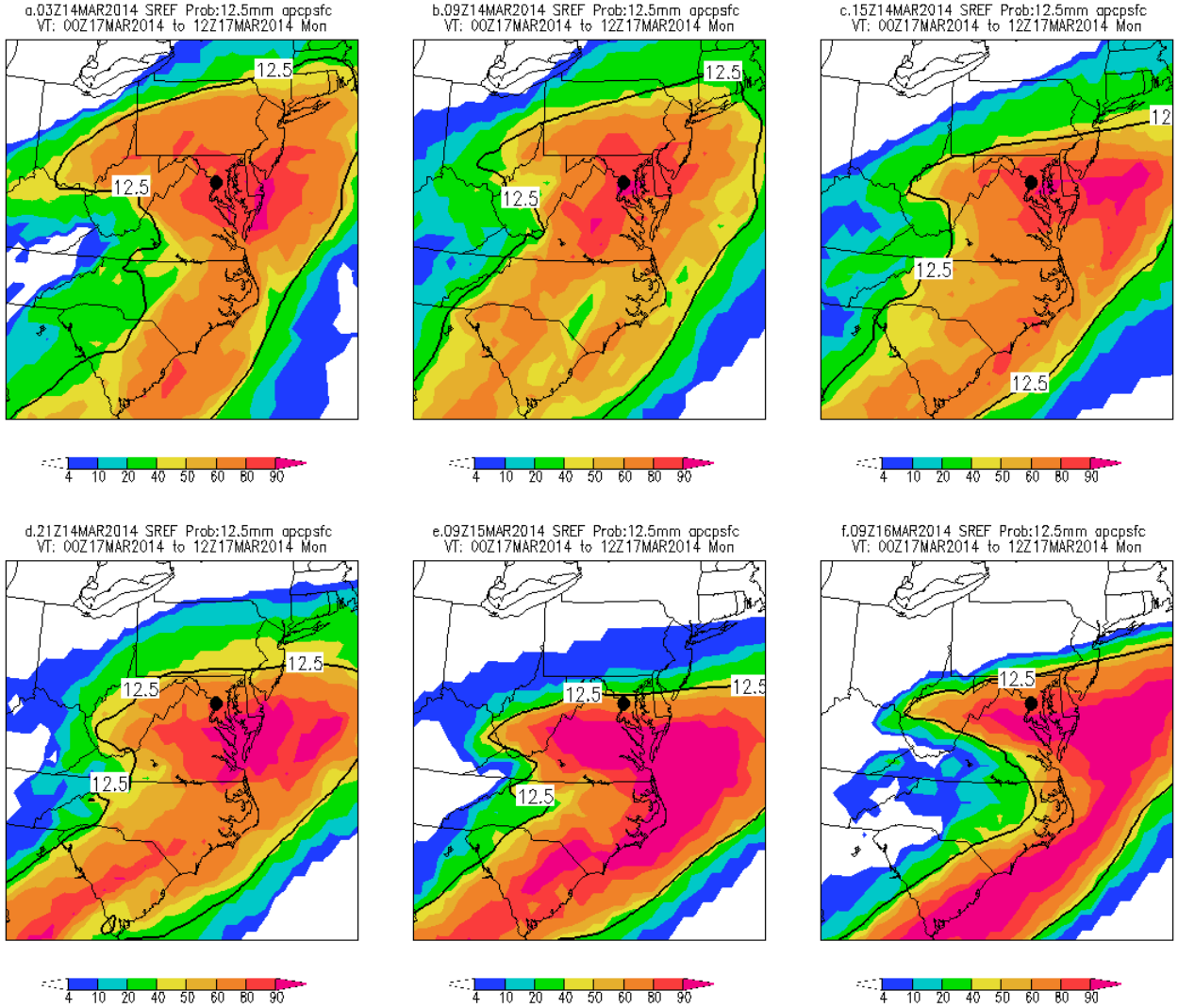


ARE WE LEVERAGING Uncertainty information→ not very well in some cases→ Many WSW products issued too early too far north!



Short Predictability horizon→ Dramatic Impact on QPF Shield

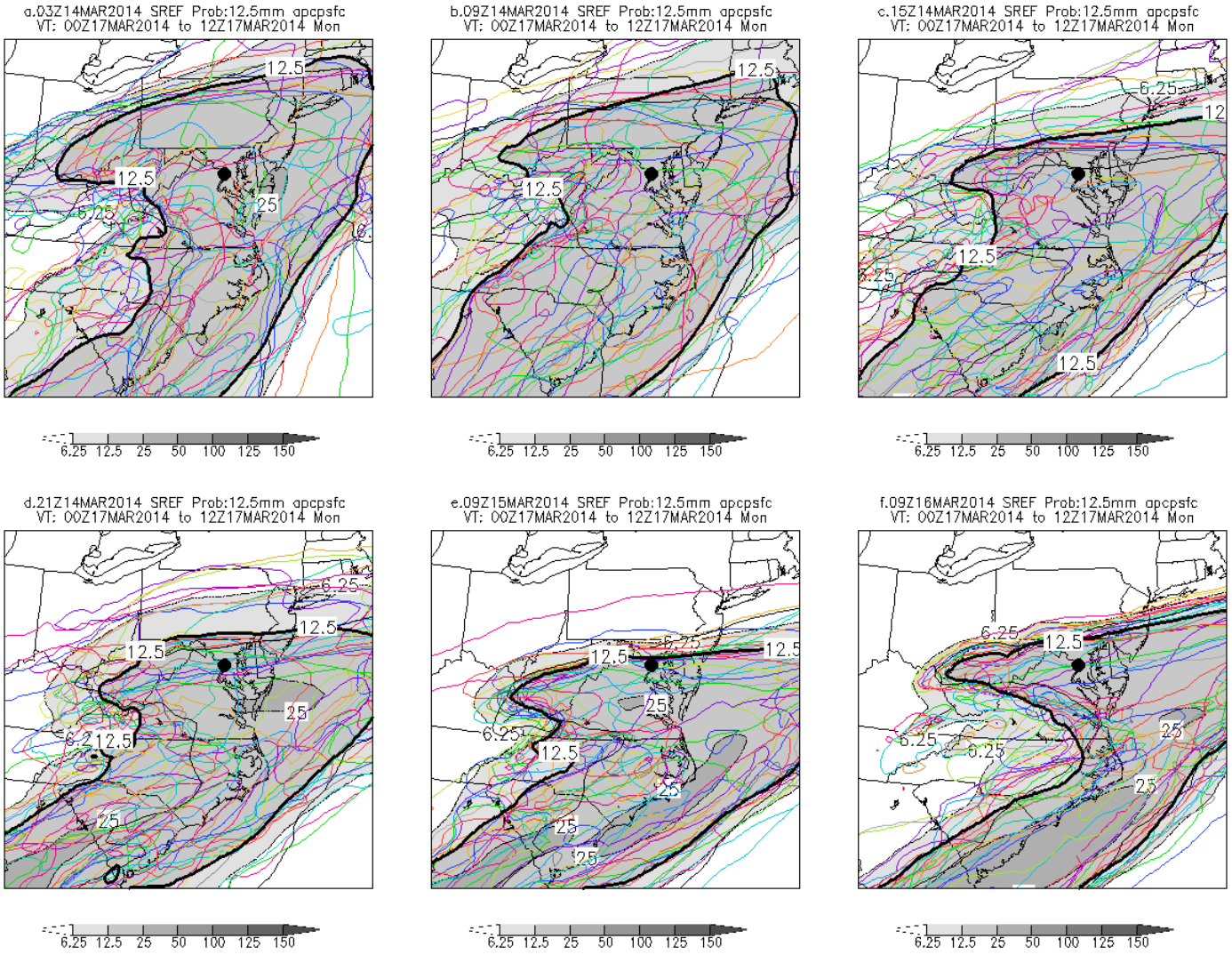
The high probability of QPF over PA panel a→ too high and not calibrated



General Issues

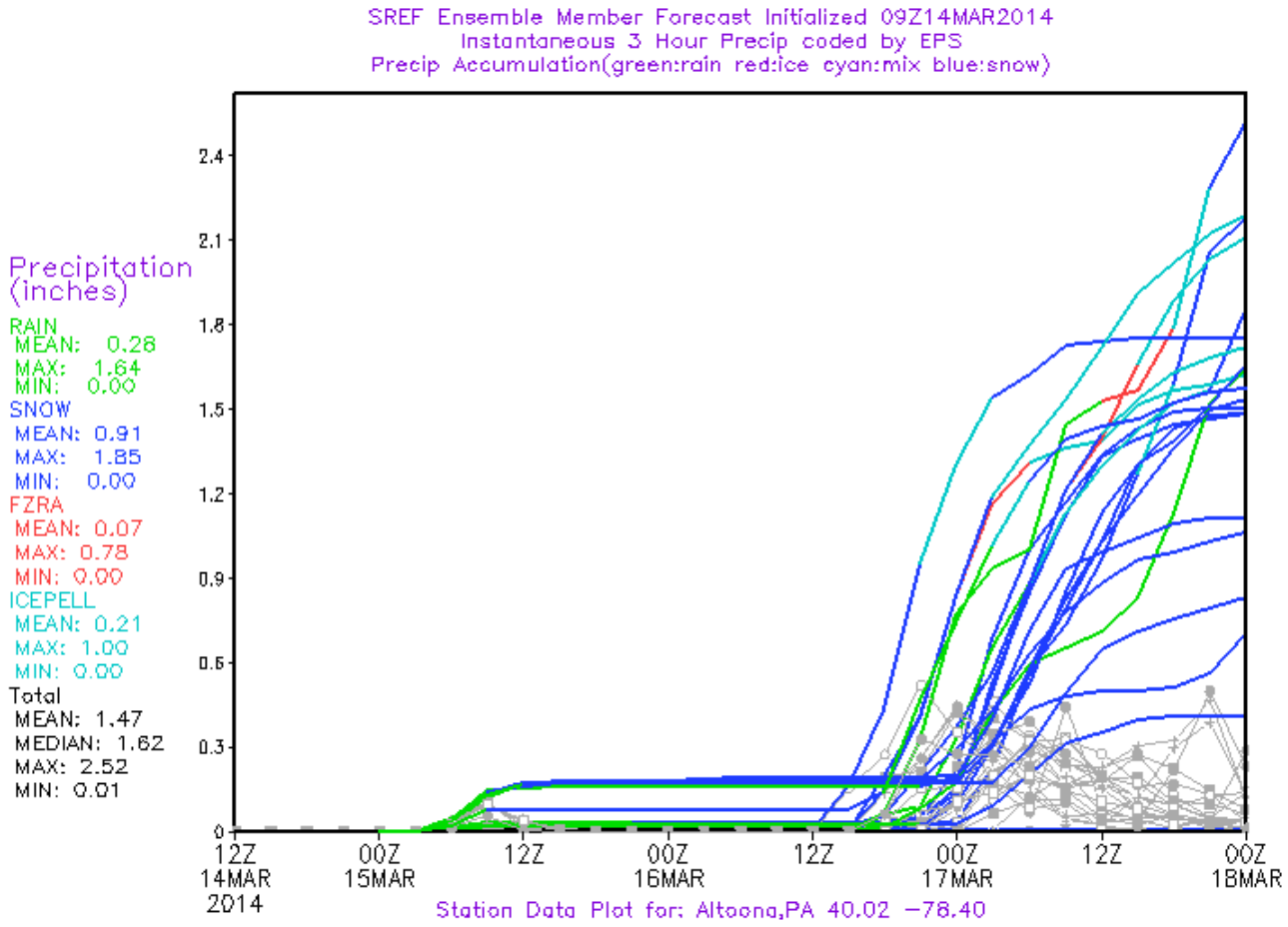
- **GEFS-SREF similar (3 March in Appendix)**
  - *QPF shields and areas of high spread*
  - *When **does one know when converging toward** solution?*
- **Predictability Horizons→ often short**
  - *High confidence is often in the 24-60 hour range*
  - *SREF/GEFS both tend to converge within a cycle or two→ sometimes the 3-hour cycle difference!*

Solutions converged fast 1500 UTC 15 March continued to improve



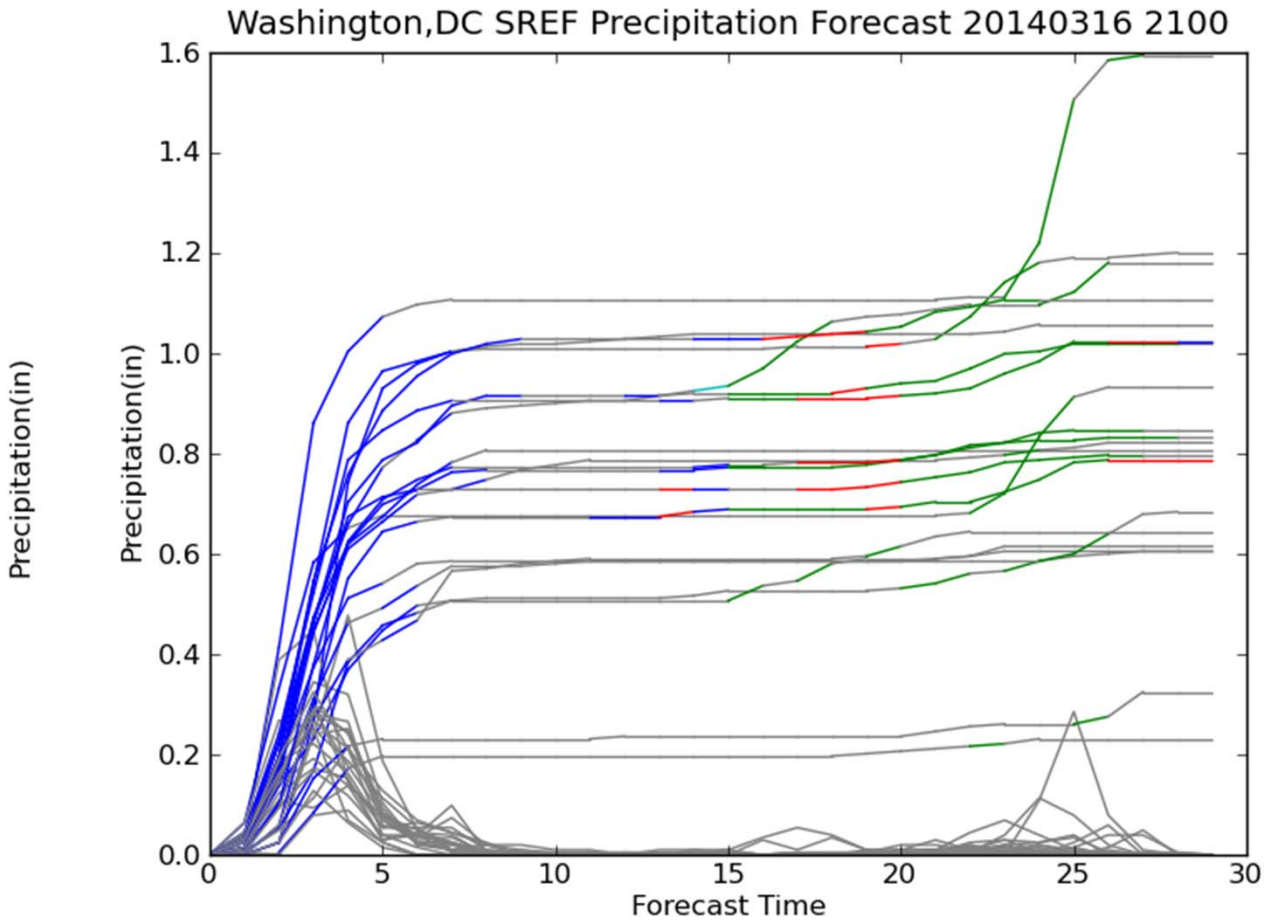
On the edge of a storm is really difficult

little snow fell in PA and now mixed!



DC area did better with SREF 17 March

experimental pygrib plumes

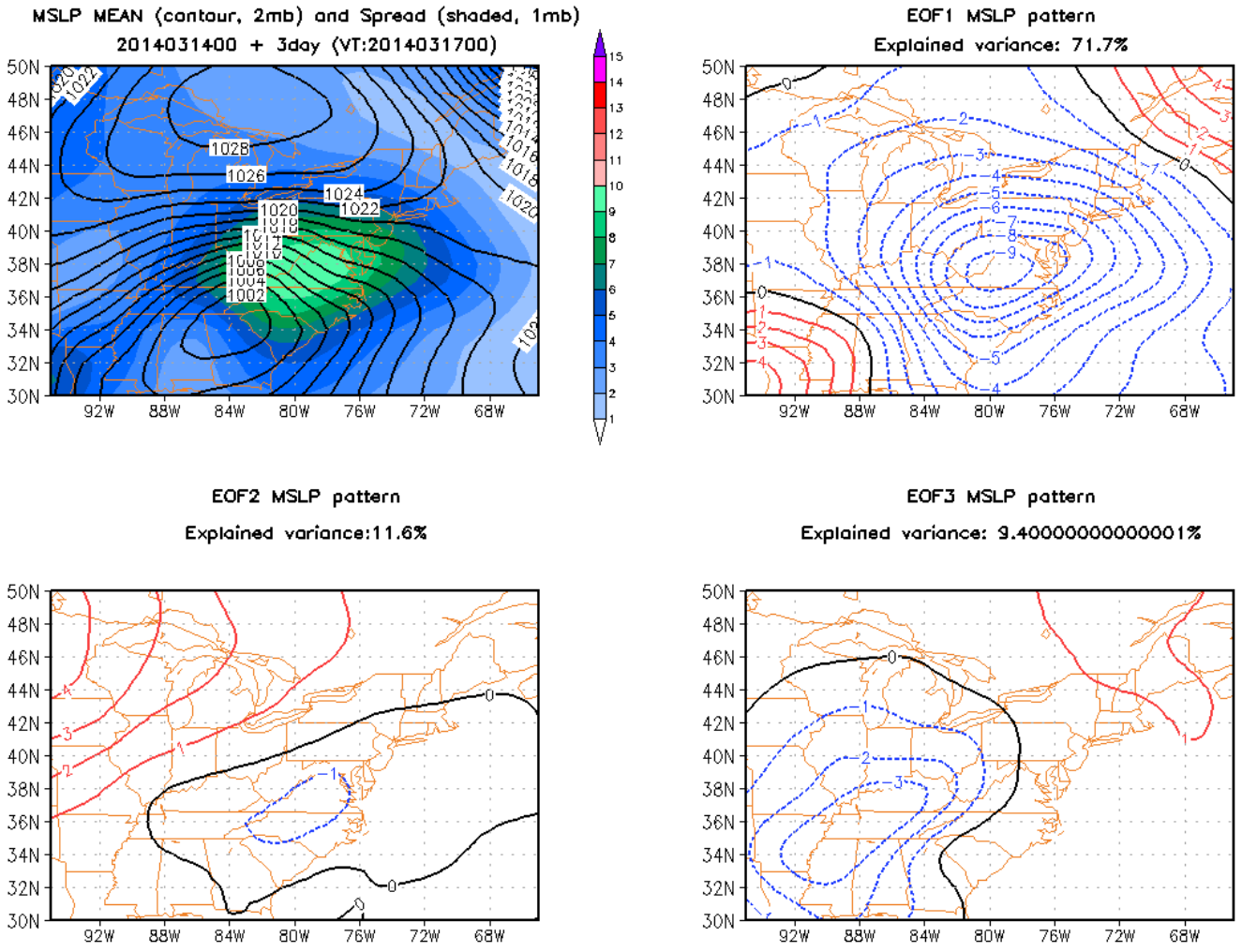


Uncertainty Products

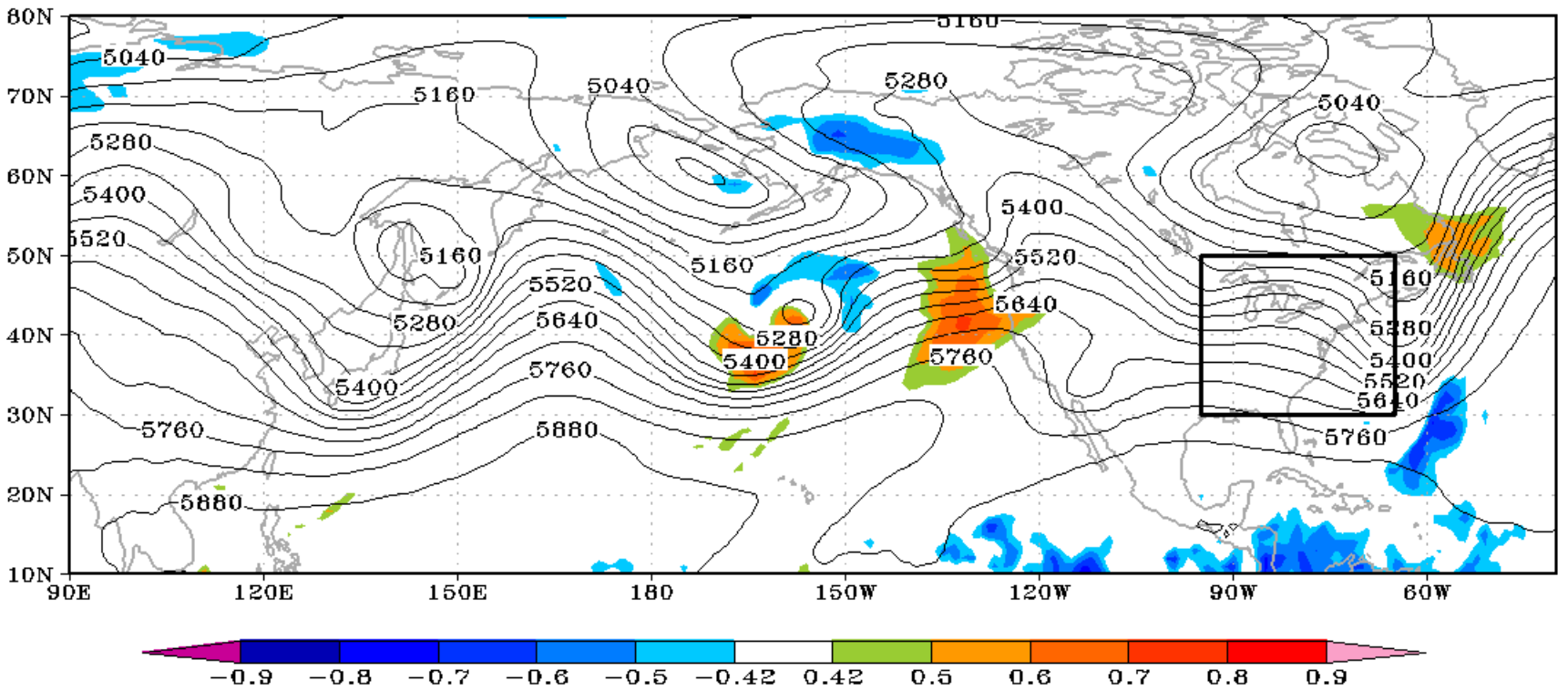
- **Basic products not well used or exploited**
  - Pretty simple stuff and should be used more
  - Mean/spread and of course probabilities
- **Ensemble sensitivity information**
  - Not easy stuff not well understood
  - Should we and how do we improve this?

Sensitivity

http://dendrite.somas.stonybrook.edu/CSTAR/Ensemble_Sensitivity/Plots/2014031400/region1/day3/EOF_4fig_NCEP.gif



Sensitivity of PC1 to Z500 at 2014031400 +0.5 day



Sensitivity of EOF PC1 to Z500 field (Shaded)
NCEP ensemble mean Z500 (Contour); unit(m); IT:2014031400
Valid area (box): LON from 95W to 65W, LAT from 30N to 50N; VT: 2014031700

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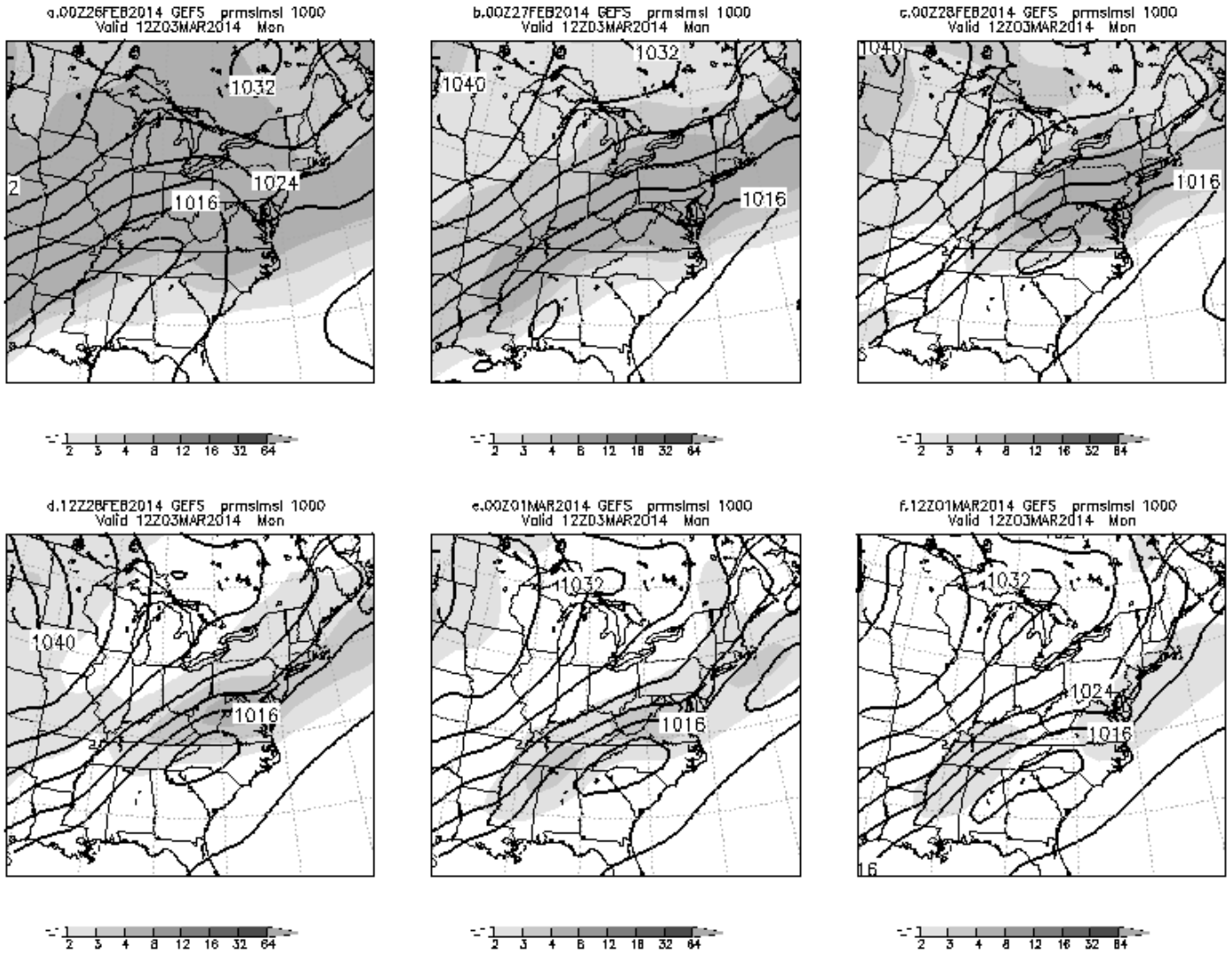
Predictability Horizons and Uncertainty

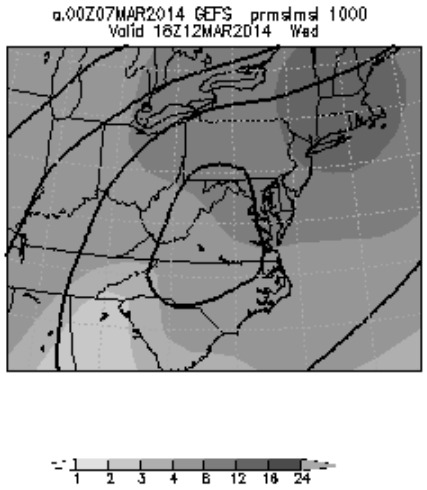
- Repeatedly impacts forecasts and forecaster
- Hard to deal with for range of reasons
  - *Disparate model/EFS solutions*
  - *3-4 day skill one event 1-2 day skill next*
- D(Prog/dt) in each event is unique!
  - *One storm tracks south next north*
  - *Can change run-to-run sometime*

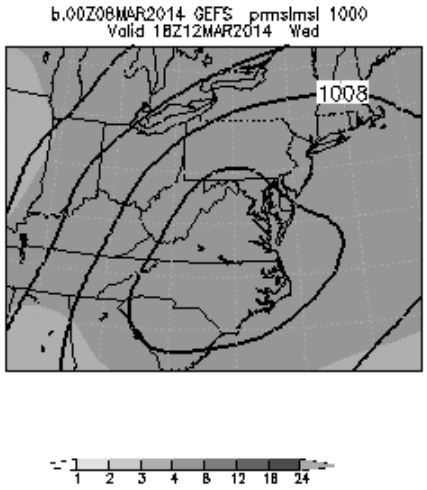
3 March Storm → trended south

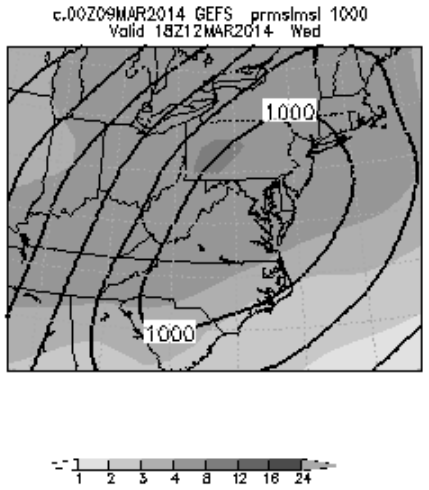
SREF example in appendix

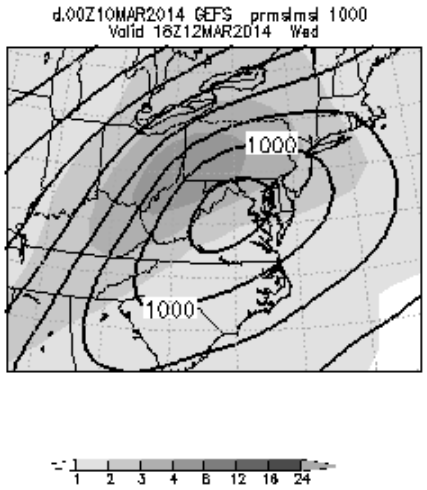


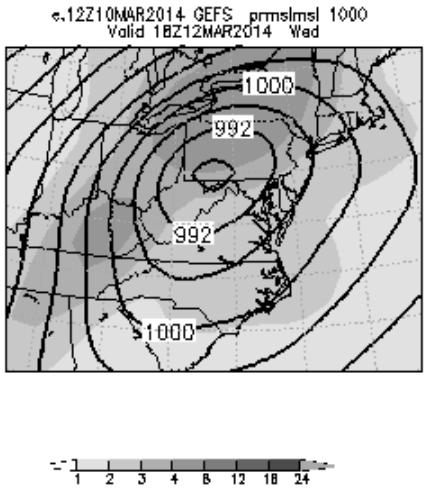
12 March Storm ended up farther north

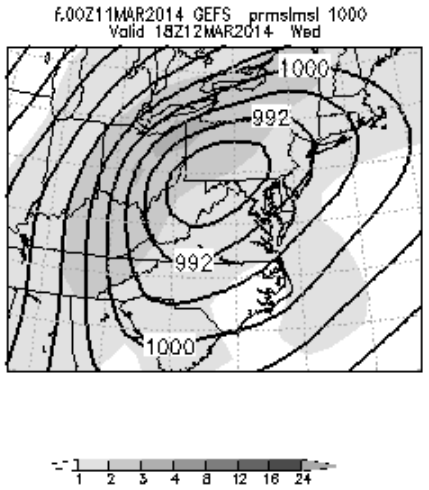




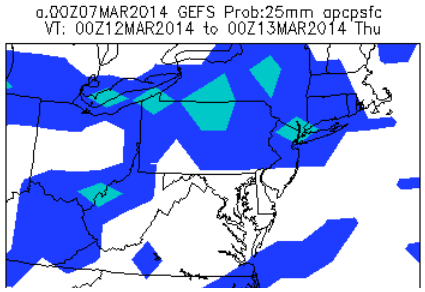


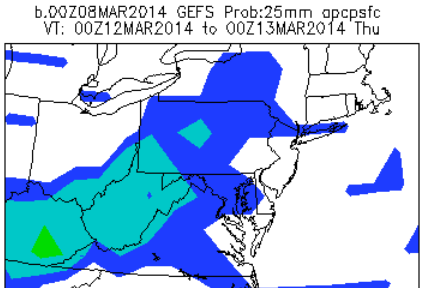


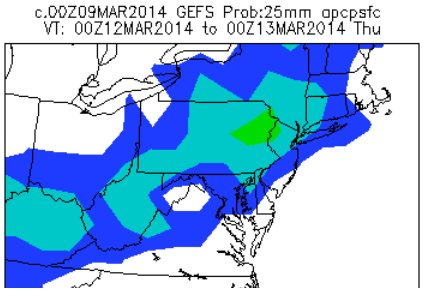




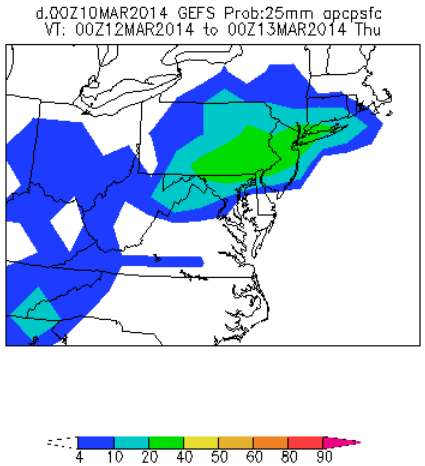
12 March→
QPF farther north and west

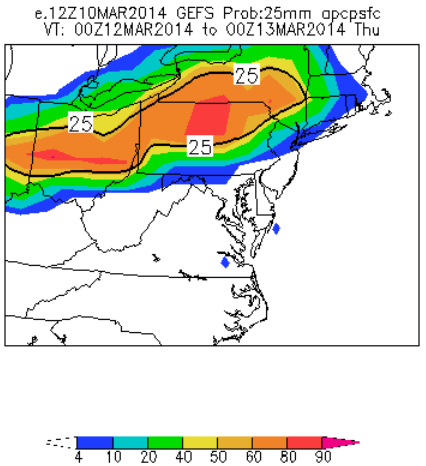


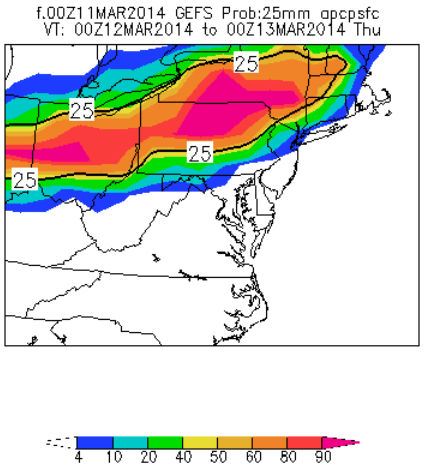




Forecasters viewed earlier forecast as "What will occur" over forecast snow south and east → Training issue?







SREF/GEFS Summary

- SREF and GEFS do well in 1-2 day range

- Uncertainty really impacts forecasts
  - *Need tools and calibrated products to deal with this?*
  - *Human Forecasts may not reflect diminished skill longer ranges*
- **Some of the things we are doing→**

WFO State College-PSU

- **Ensemble Products Research Team**
  - winter weather Dec 2013-March 2014—
    - Student Projects
    - PYGRIB and MATLAB → improve products
    - Steven Greybush leading group
  - Using climate data in forecast process
- **Improve training to use EFS better**
  - Uncertainty and high impact weather
  - Case based and GEFS-R based

NWS-Brookhaven-SUNY Stony Brook

- **CSTAR Effort on Ensembles:**
  - Ensemble Sensitivity and predictability
  - Web and AWIPS experimental products→ ALPS

- **Training on uncertainty**
  - *Will talk about Thursday but critical issue on effective use EFS data*

Current work and future work

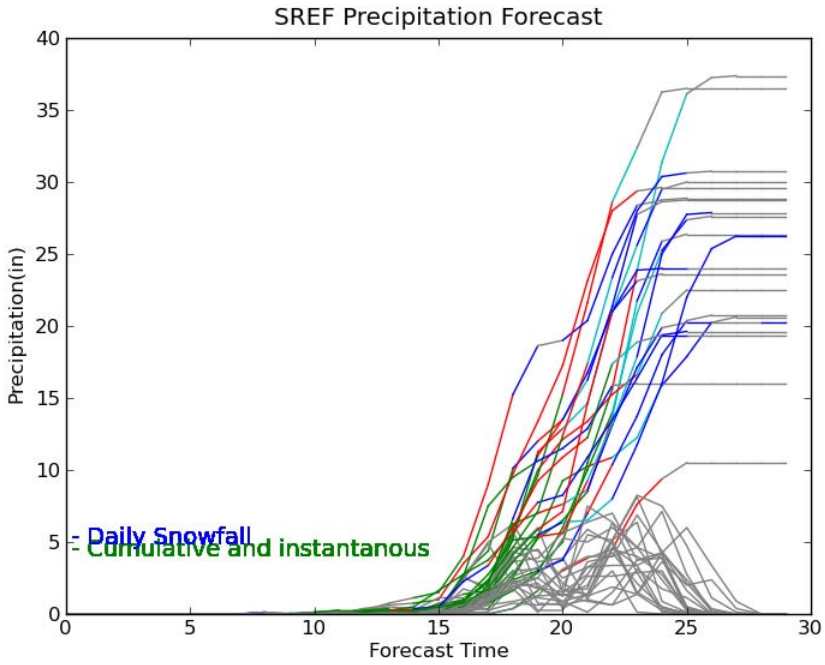
- **NWS-State College-PSU Ensemble Research**
  - winter weather Dec 2013-March 2014—
    - Student Projects
    - PYGRIB and MATLAB → improve products
    - Steven Greybush leading group

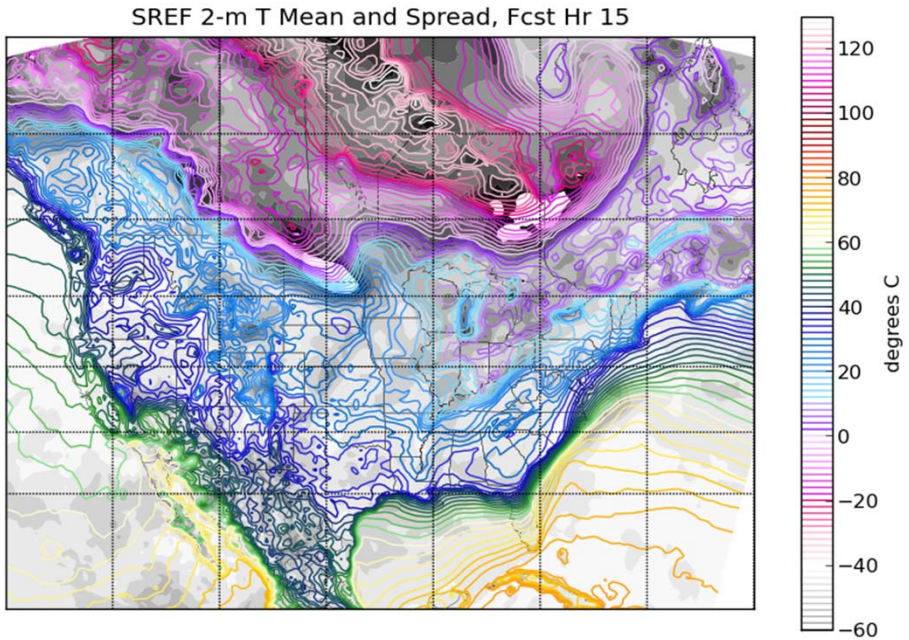
- **Improve training to use EFS better**
  - Uncertainty and high impact weather

- **NWS-Brookhaven**
  - Ensemble Sensitivity and predictability
  - Web and AWIPS experimental products
  - Wider training activities

Pygrib and netCDF Products

Student projects PSU → crowd sourcing





Summary

- Over a decade experience using the SREF/GEFS
  - *Main use most NWS is in AWIPS limited functionality*
    - *State College-PSU → Anomalies and Probabilities*
    - *Brookhaven-SUNY-SB Ensemble SENSI*
  - *Challenges →*
    - *Predictability horizons and forecast related issues*
    - *Better products and more efficient use of data*
- **SREF/GEFS Experience→ recent examples**
  - *High confidence often in 1-2 day range*
  - *Often huge uncertainty in 2-3.5 (SREF) and 2-16 (GEFS)*

Acknowledgements

- NCEP for support and access to data over the past 15 years
  - Yuejian Zhu and Jun Du
  - Christine Caruso-Magee experimental data
- PSU for all local support and collaboration
- WFO Brookhaven→ sensitivity data

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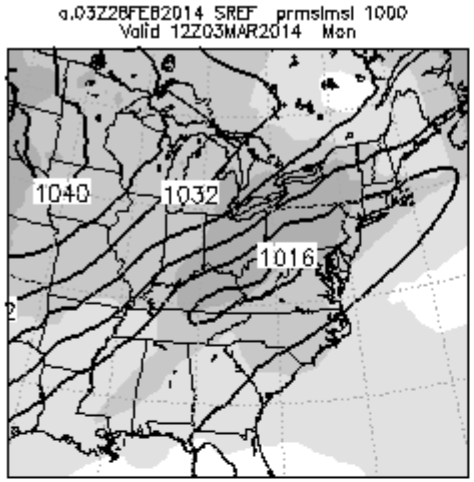
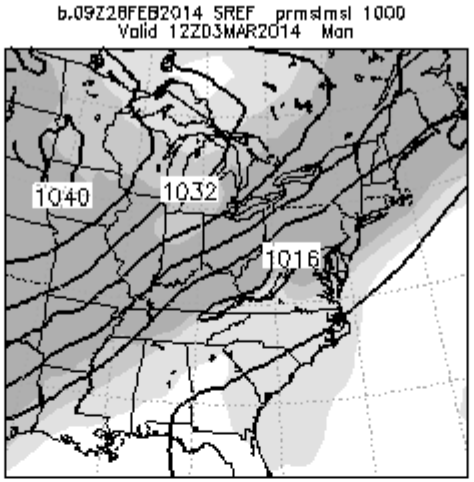
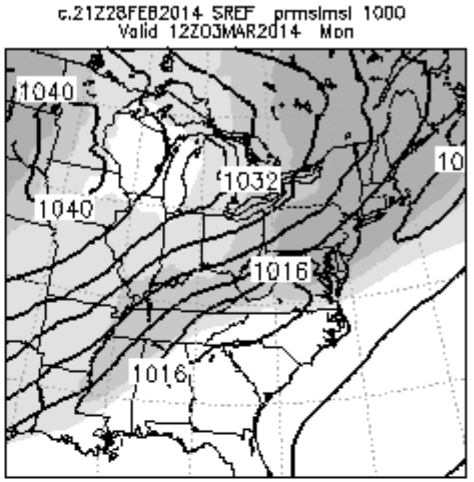
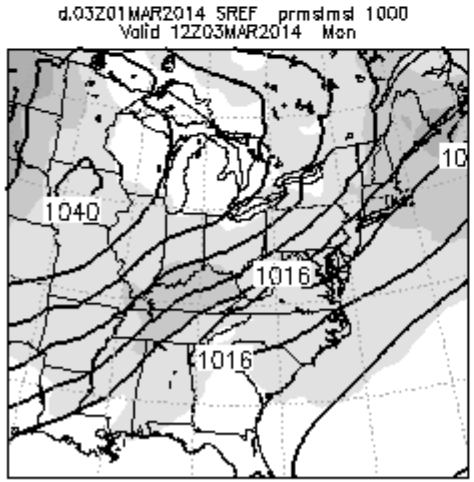
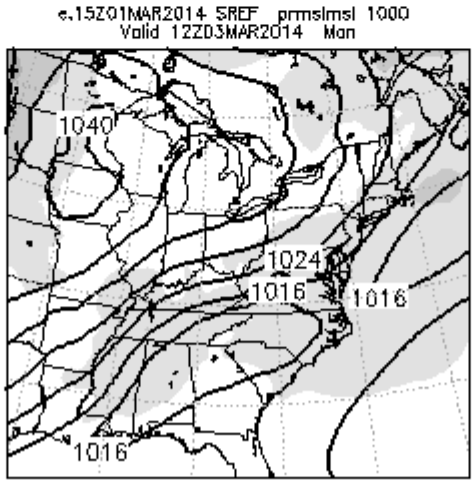
SREF 3 March example

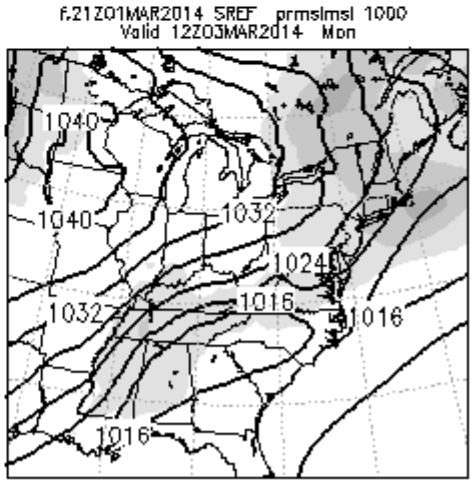




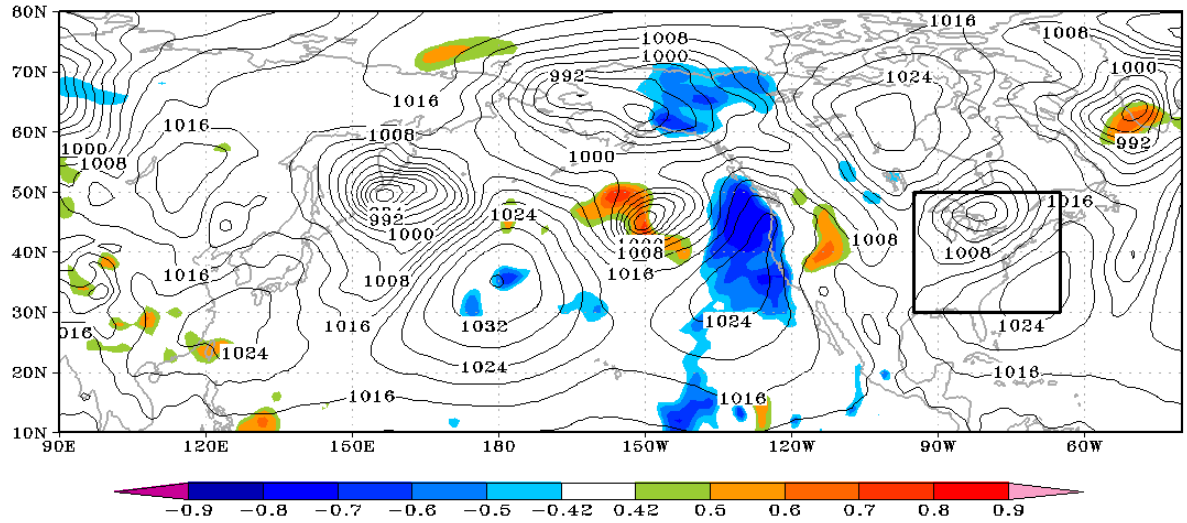








Sensitivity of PC1 to MSLP at 2014031400 +1.0 day



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−0.9 −0.8 −0.7 −0.6 −0.5 −0.42 0.42 0.5 0.6 0.7 0.8 0.9

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NCEP ensemble mean MSLP (Contour); unit(mb); IT:2014031400
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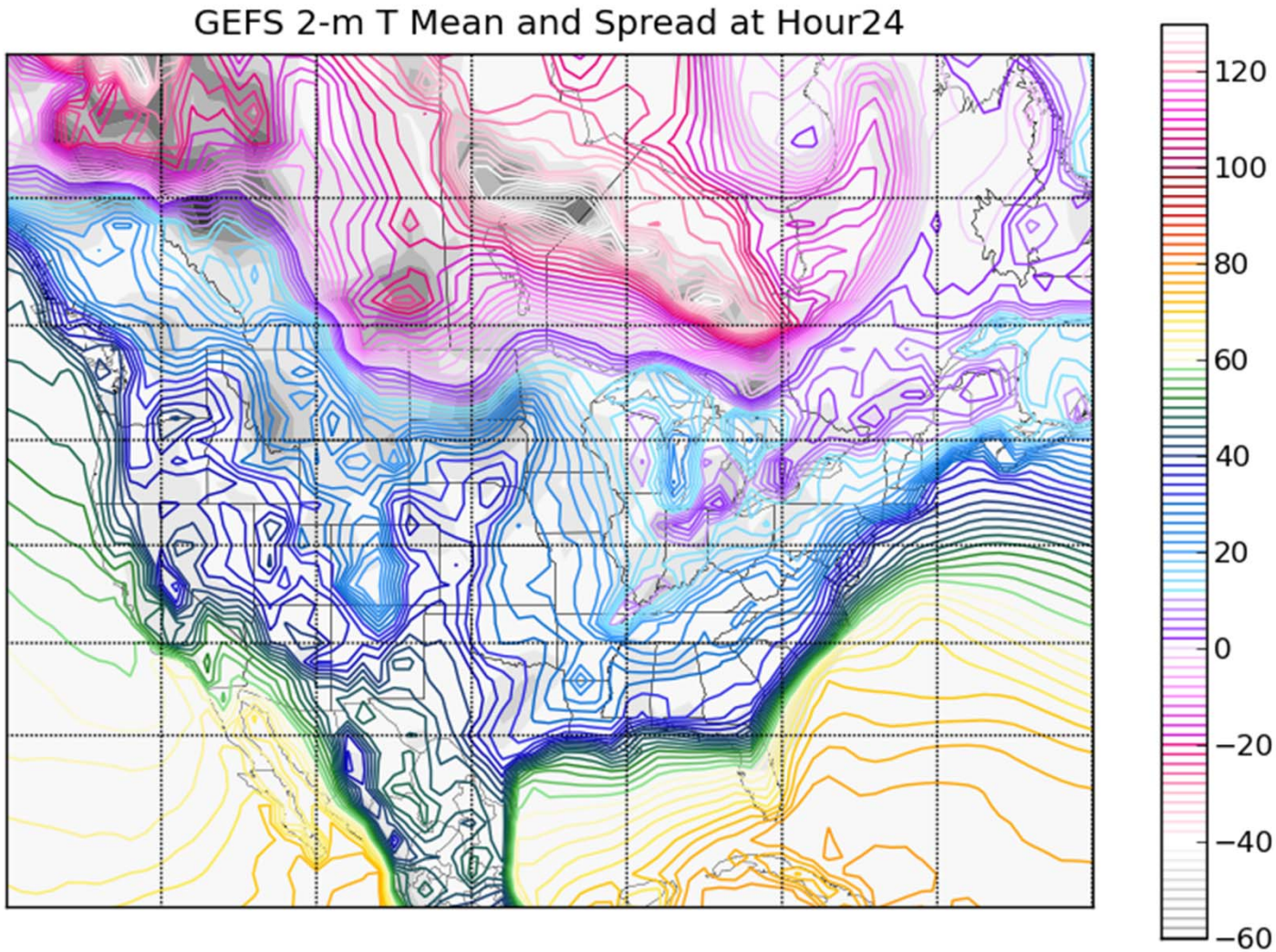
GEFS 2-m T Mean and Spread at Hour24
120
100
80
60
40
20
0
−20
−40
−60