NCEP FY04 Energy Project

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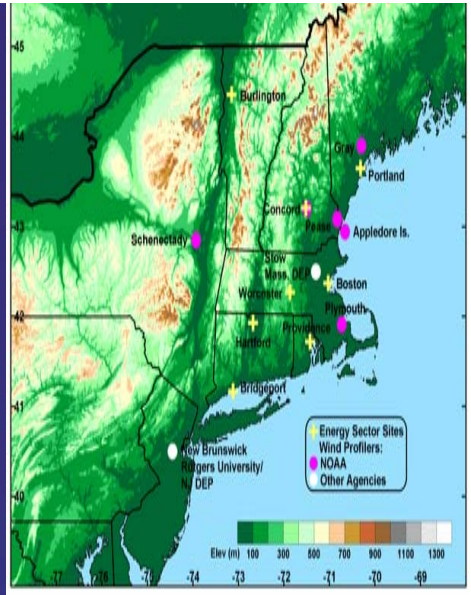
where the nation's climate and weather services begin

NE High Res Temperature

Physics diversity SREF tested for NEHRT

- **Evaluate and implement improved SREF with more physics diversity and more spread**
  - ***Improvements in system diversity based on FY03 results***
  - ***Improved Products for Energy Sector***
  - ***Coordinate NCEP model availability with OAR (e.g.: BUFR, GRIB files)***
- **Increased spread without substantial reduction of skill with physics-based ensemble systems:**
  - ***Evaluate with ranked histogram, Talagrand diagrams***
  - ***Deterministic FVS, ETL evaluation & analysis***
- **Increased accuracy using NCEP and OAR ensemble members**
- **Improved post-processing of Ensemble outputs**
  - ***NSSL bias-corrected temperature analysis.***
  - ***NCEP Grid Based Bias Correction***
- **Improved use of Surface observations in NCEP assimilation**



Short Range Ensemble Forecast (SREF) System

Current Configuration

- **Current: 48 km**
  - **15members:**
    - **5 Eta-Betts-Miller-Janic Convection,**
    - **5 Eta: Kain-Fritsch**
    - **5 RSM: Simple Arakawa Shubert**

    - 1 control + 2 breeding pairs (p1,n1,p2,n2)

    - Full North American Domain

    - Eta Version: from June 2002

  - **09 and 21 Z runs to 63 hours**

    - GFS Ensemble boundary conditions

  - **Products: Non-standard Grib on NCEP ftp**

    - AWIPS 212 Conus Mean, spreads, probabilities

    - Thinned" Grids for Each Member

SREF

Grib Mean/Spread Products

Grid 212: Lambert Conformal 40 km, 185x129

Mean and spread Parameters	*Units*	*Level*	*(*= not in Spread files)*
2m Temperature	[K]	Sfc	
10m U, Vwind	[m/s]	10 m	
Total precipitation(3,6,12,24hr)	[kg/m2]	Sfc	
Convective Avail. Pot. Energy	[J/kg]		
Convective inhibition (CIN)	[J/kg]		
Storm RElative Helicity (SREH)	[m2/s2]	0-3000 m	
Lifted Index	[K]	0-30 mb abv grnd	
Sea Level Pressure	[Pa]	Sfc	
Pressure	[Pa]	1000-50 mb (every 50 mb) ?	
*Categorical rain **	*[y/n]*	*Sfc*	
*Dominant precip type (over 3hr)**	*[1-7]*	*Sfc*	
*12hrly Large scale Snow Fall**	*[kg/m2]*	*Sfc*	
*12hrly Snow Depth**	*[kg/m2]*	*Sfc*	
12hrly Accumulated Snow Fall	[kg/m2]	Sfc	
*Absolute vorticity**	*[/s]*	*1000-50 mb (every 50 mb)?*	
Geopotential height	[gpm]	1000-50 mb (every 50 mb)?	
Relative humidity	[%]	1000-50 mb (every 50mb)?	
U, V- wind	[m/s]	1000-50 mb (every 50 mb)	
Temperature	[K]	1000-50 mb (every 50 mb)?	
Thickness	[gpm]	1000-850, 1000-500, 850-700mb	

SREF Parallel
Physics Members
Since 13 April 2004

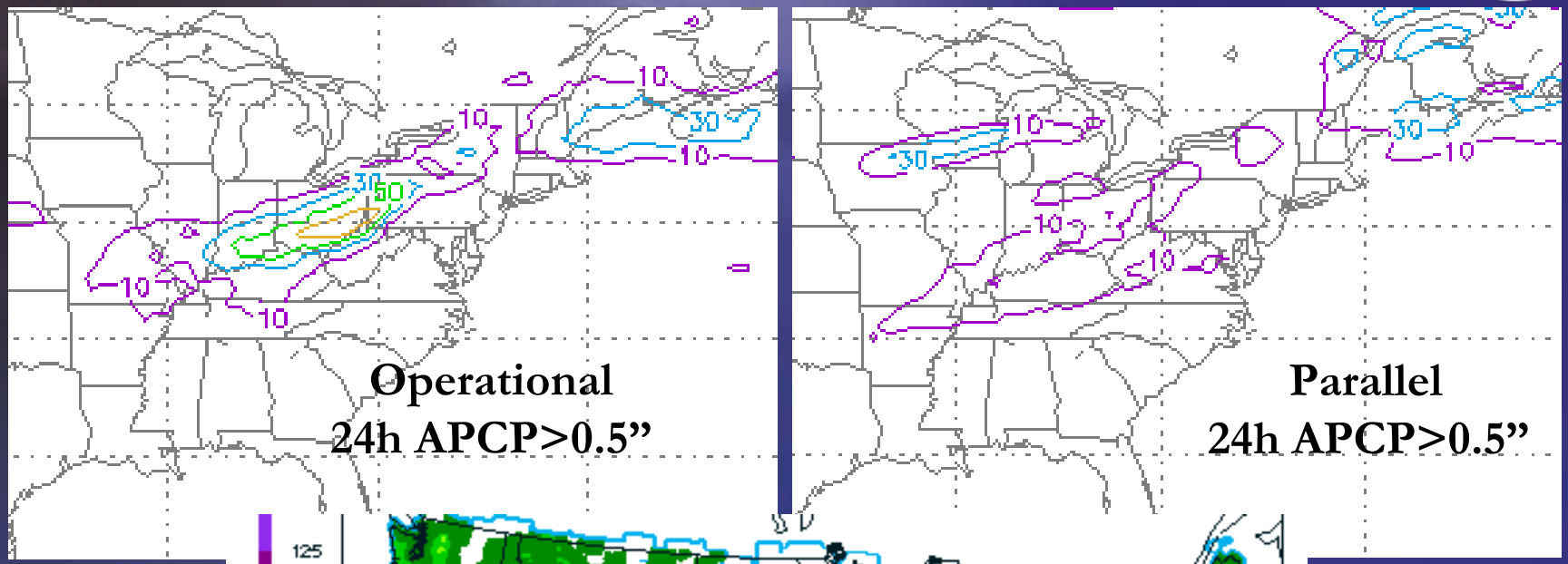
Model	*Res (km)*	*Levels*	*Members*	*Cloud Physics*	*Convection*
RSM SAS	32	28	Ctl,n1,p1	GFS physics	Simple Arakawa-Schubert
RSM RAS	32	28	n1,p1	GFS physics	Relaxed Arakawa-Schubert
Eta-BMJ	32	60	Ctl,n1,p1	Op Ferrier	Betts-Miller-Janic
Eta-SAT	32	60	n1,p1	Op Ferrier	BMJ moistened profiles (water/ice, mod triggers)
Eta-KF	32	60	Ctl,n1,p1	Op Ferrier	Kain-Fritsch
Eta-KFD	32	60	n1,p1	Op Ferrier	Kain-Fritsch w/ half detrainment

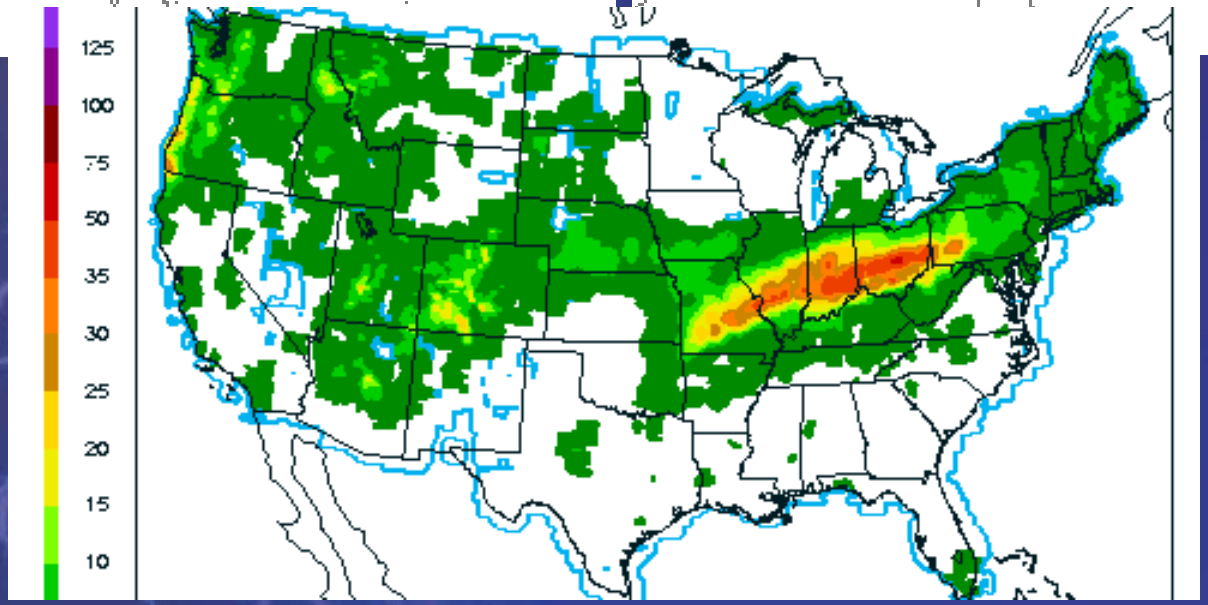
Similar to Summer 2003 parallel system, but removed poorest performing models (for QPF) and now using scaled breeding

Physics diversity evaluation

- **Some members of the SREF physics diversity system performed poorly for cold season convective outbreak (January 2-4, 2004).**
- **Evaluated Jan. 2-4 and Jan. 25-27 strong storms**
  - **Combination of breeding & increased convective diversity members produced too much spread**
  - **Initial condition (IC) breeding amplitudes were too high for some members**

51 h SREF probability forecast valid 12Z 4 Jan 2004



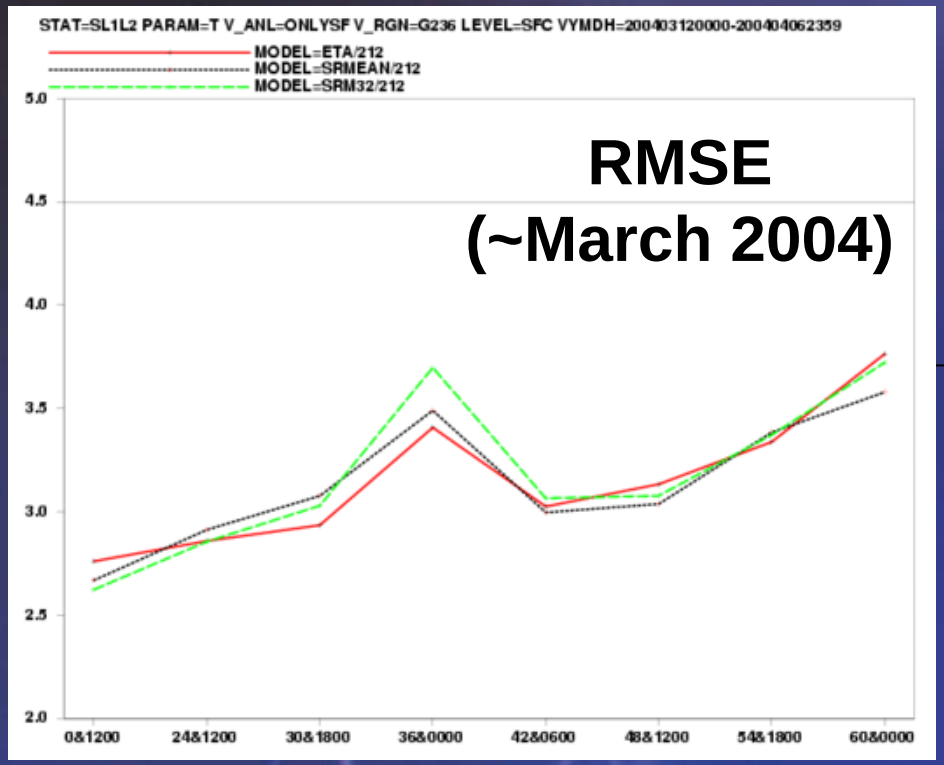


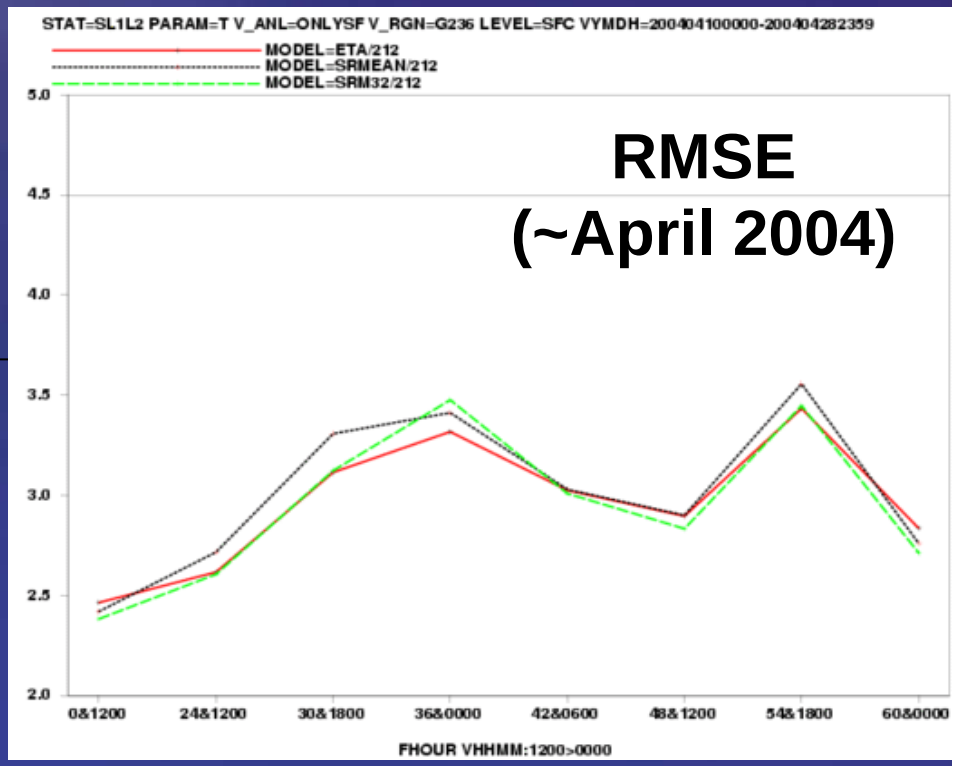
March, April corrections to SREF

- **Several experimental configurations in Jan & Feb '04**
- **Established several web pages for tracking progress of:**
  - **QPF and MSLP from individual members, member averages, and full ensemble ; QPF maps compared with CPC gauge analysis (B. Zhou, Y. Lin)**
  - **Operational vs. parallel mean, spread of QPF, MSLP**
- **Reduced physics diversity (removed Eta RAS)**
- **Developed & tested scaled IC breeding code**
  - ***Breeding using GFS & WRF scaled perturbations***
  - ***Scaled avg standard deviation of perturbed T_{850} to 0.5 C***
  - ***IC perturbation scale = 0.5/ Δ, $\Delta = F_{neg} - F_{pos}$ of the 12-h domain-avg 850-mb T forecast***
- **In April increased frequency of Eta physics calls, modified BMJ_sat to "BMJ_moist", KF full detrainment to "half detrainment", properly rotated RSM winds**

2-m Temperature

(See Deterministic Verification at http://wwwt.emc.ncep.noaa.gov/mmb/SREF-Docs/verif/)





(09Z cycle only)

2-m Temperature

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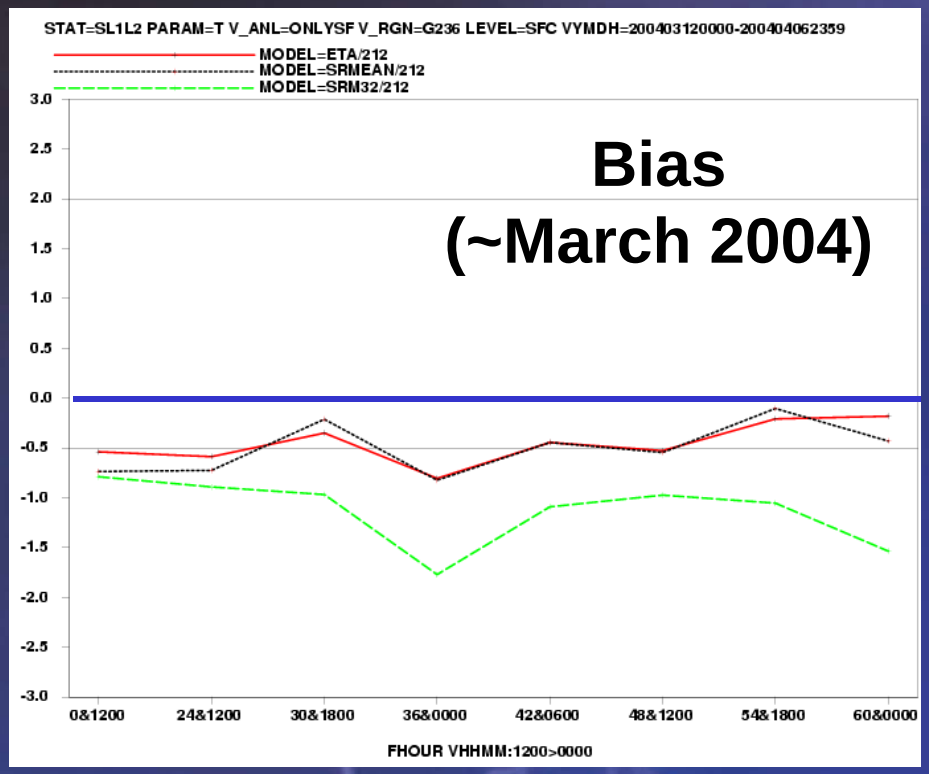
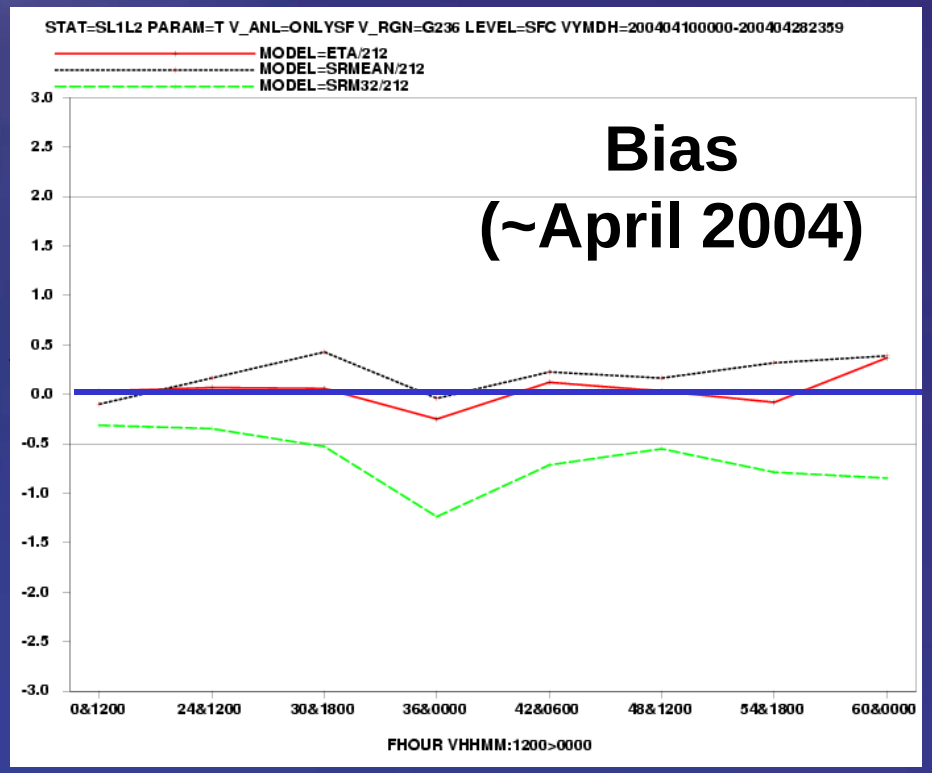
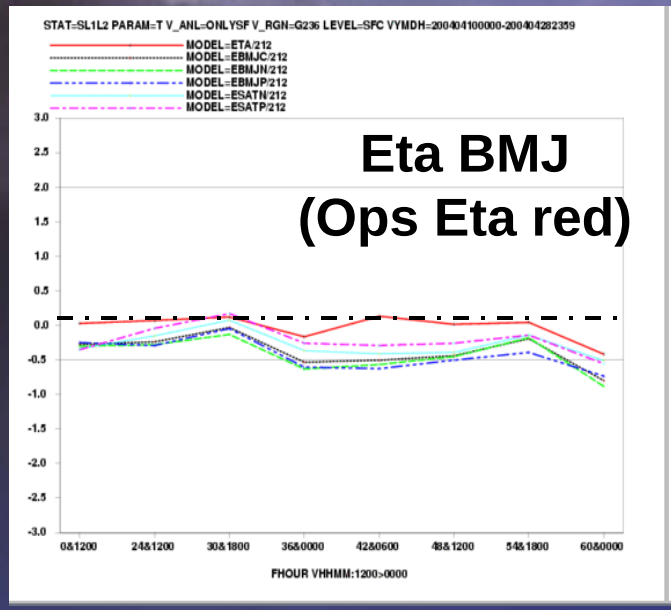
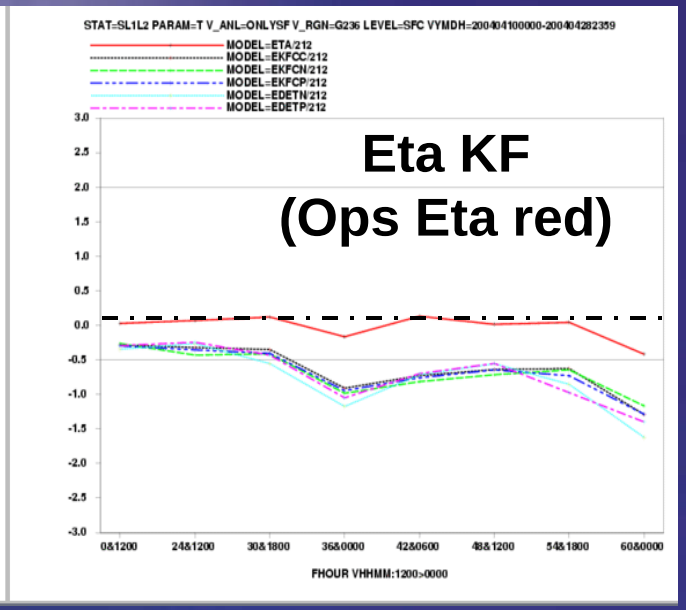


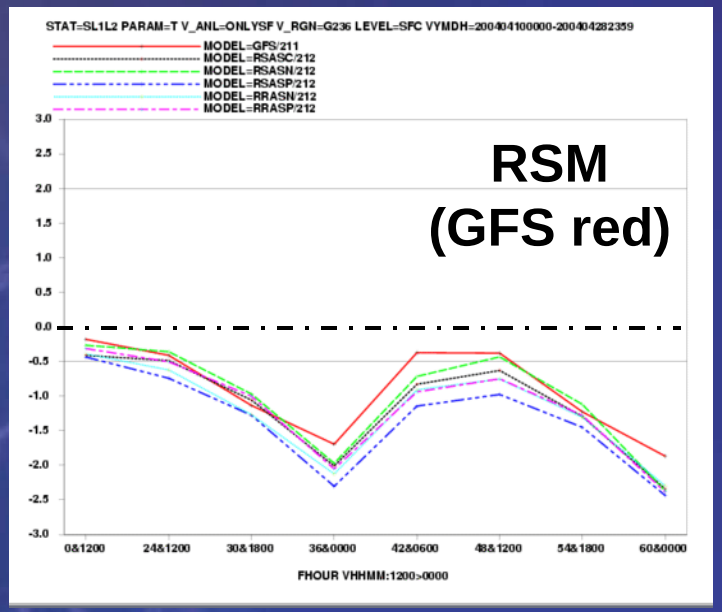


(09Z cycle only)

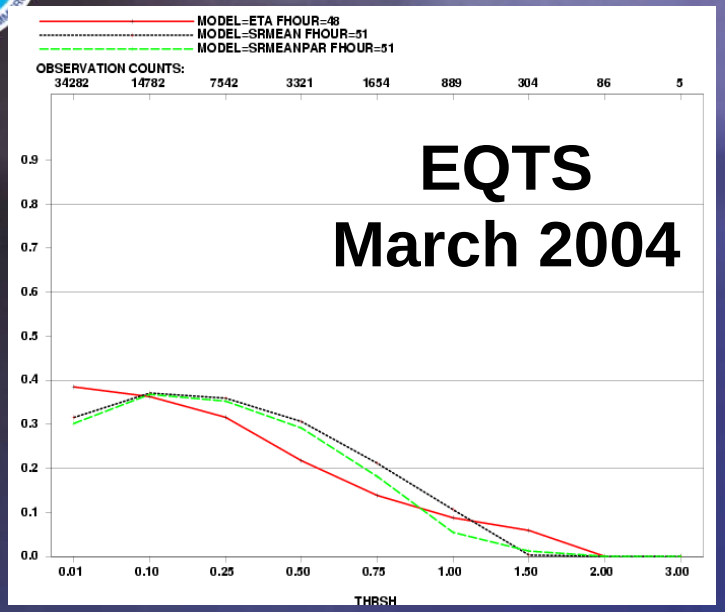
2-m Temperature Biases (April 2004)

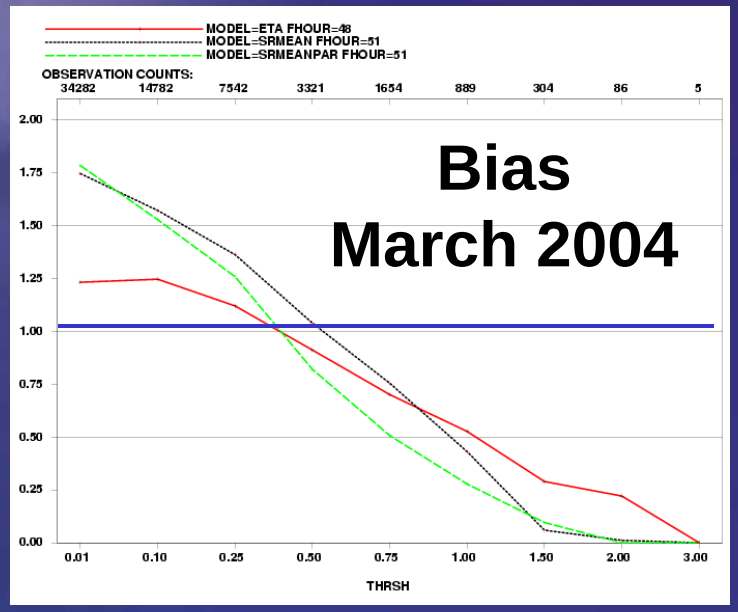


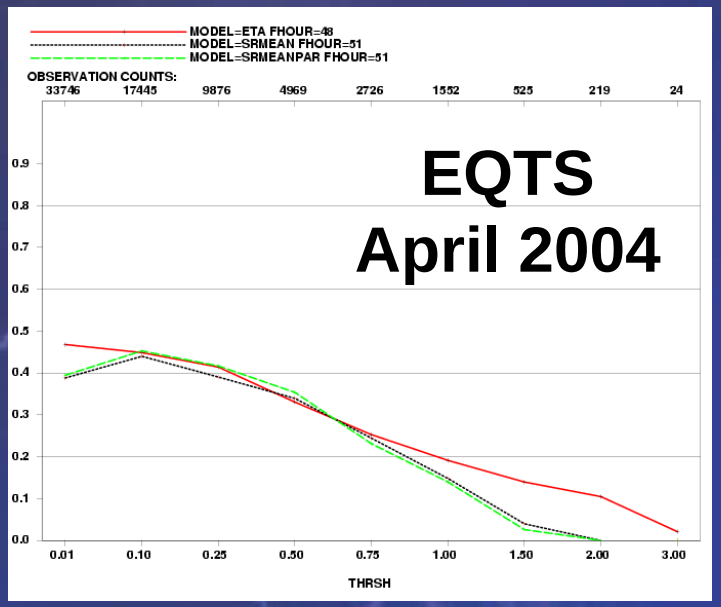


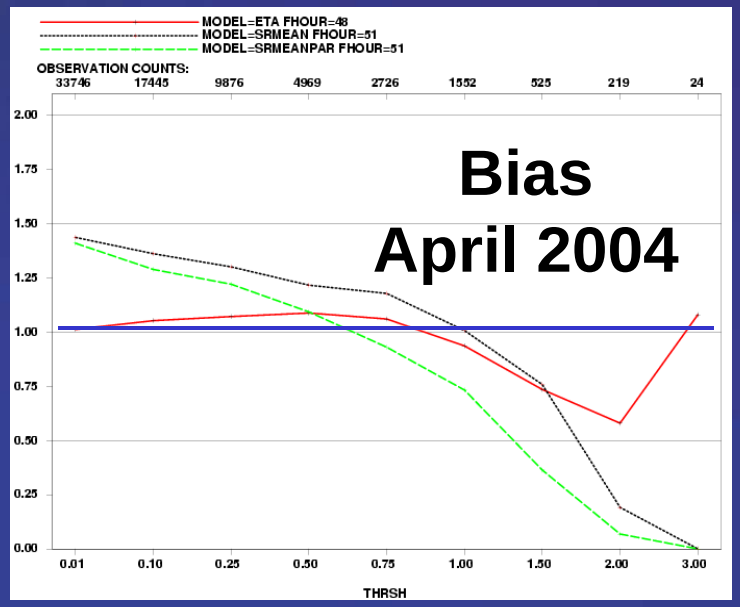


"Day 2" (27-51 h) Precip Verification



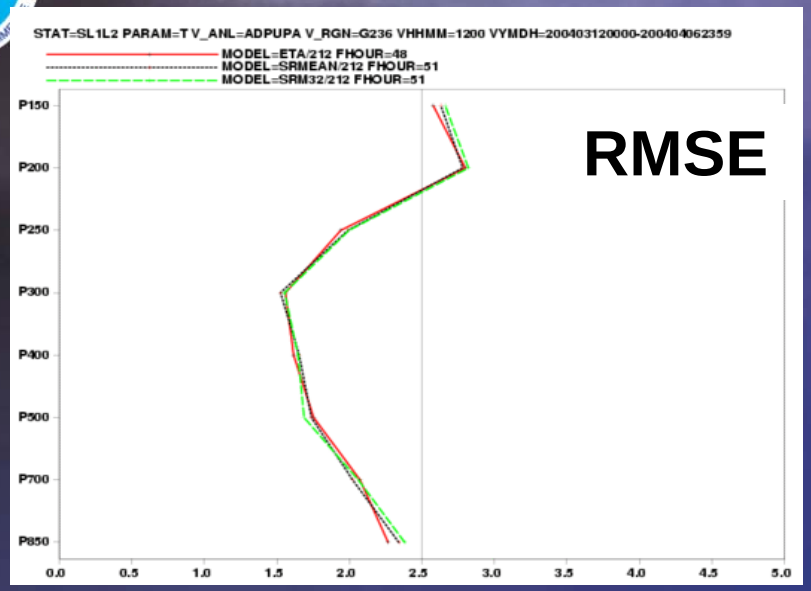


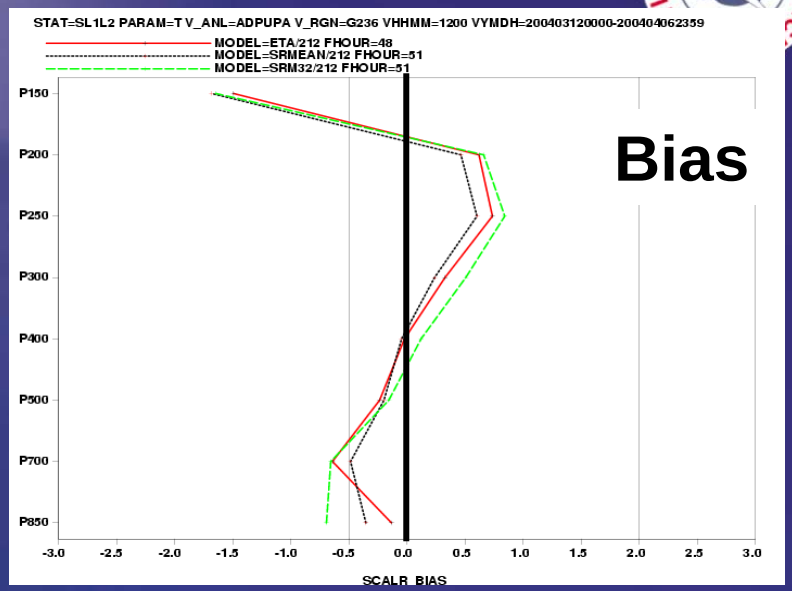




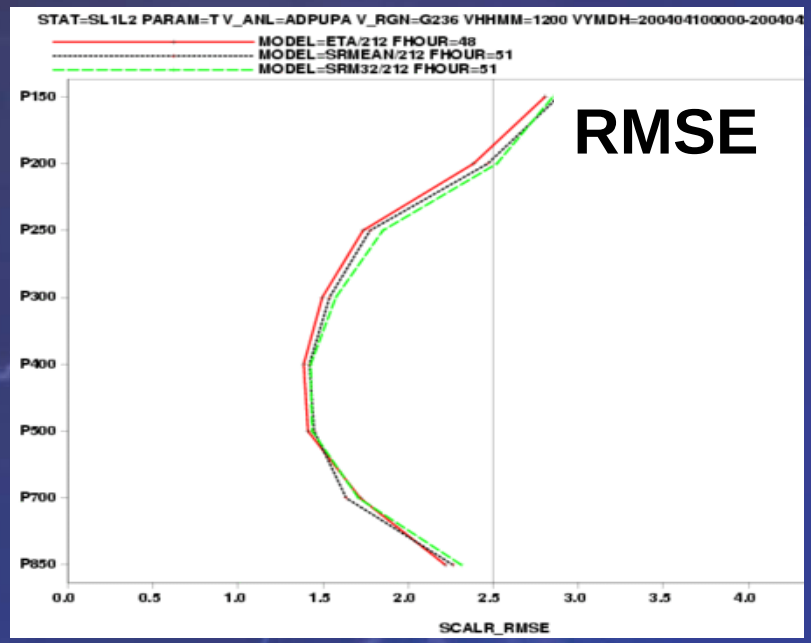
Upper-level Temperature

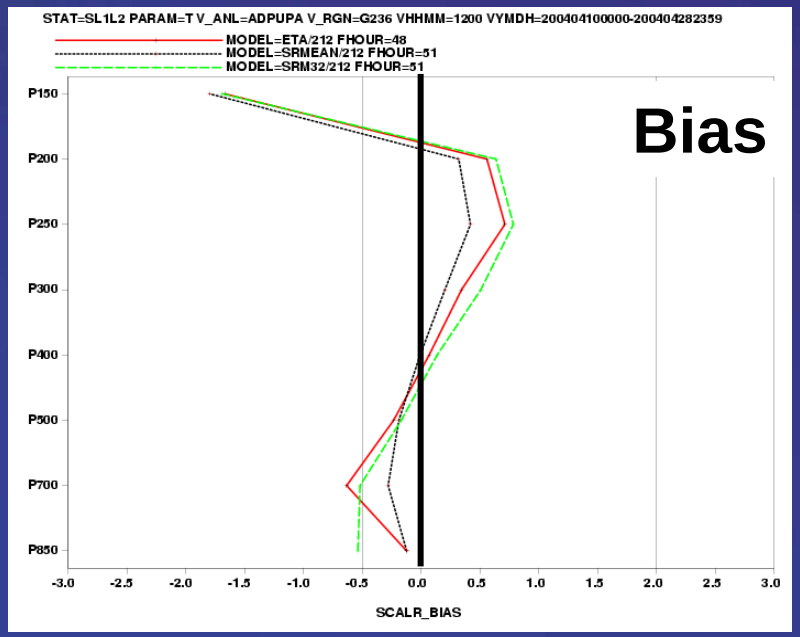
March 2004





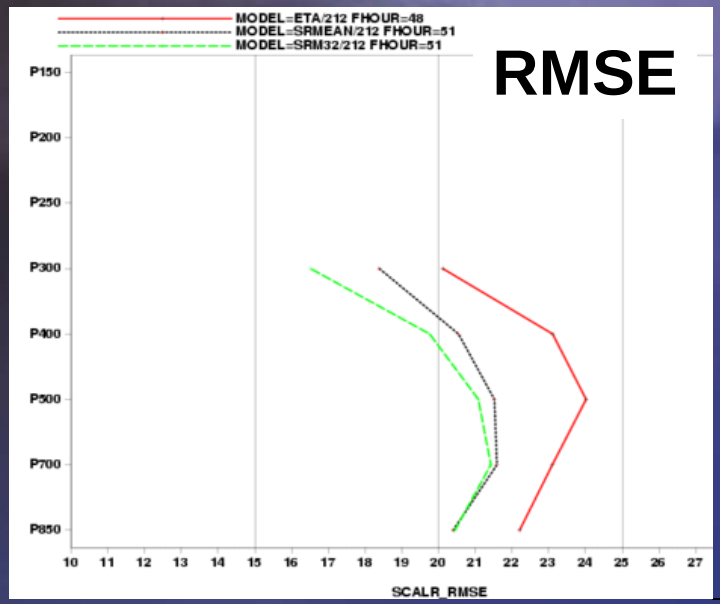
April 2004

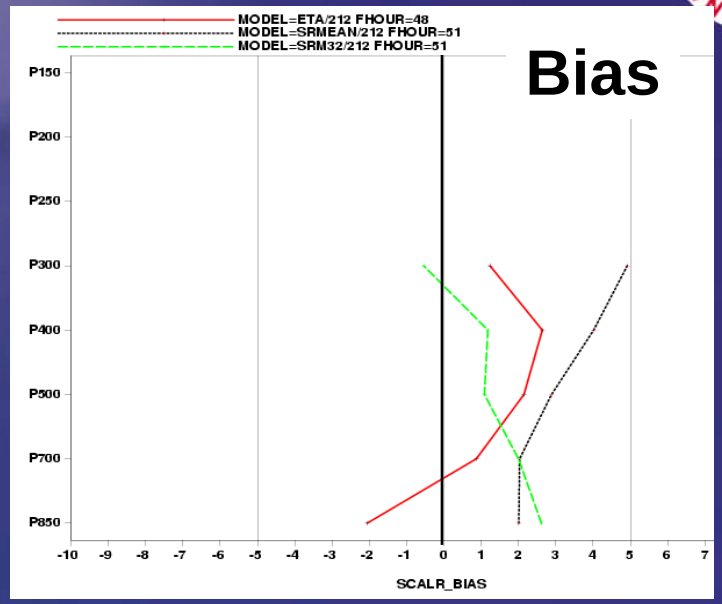




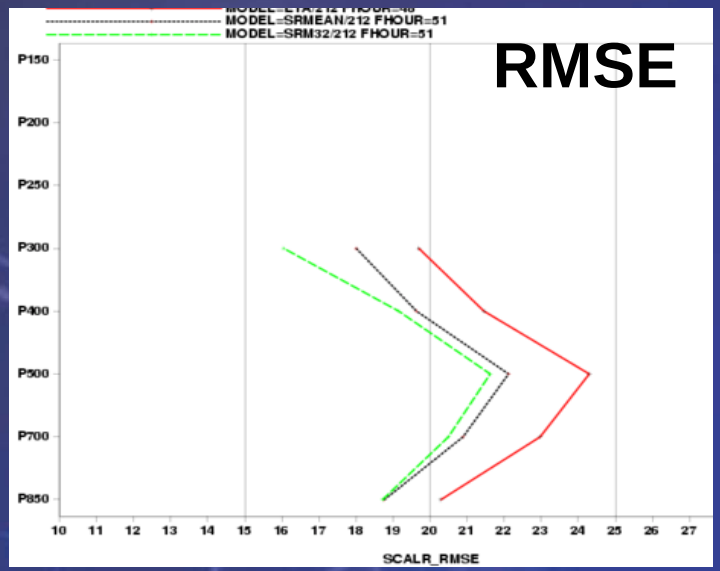
Upper-Level Relative Humidity

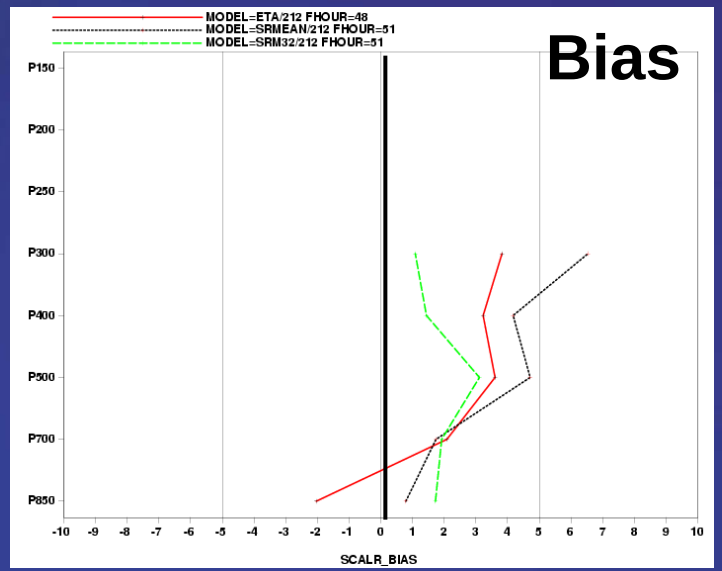
March 2004





April 2004



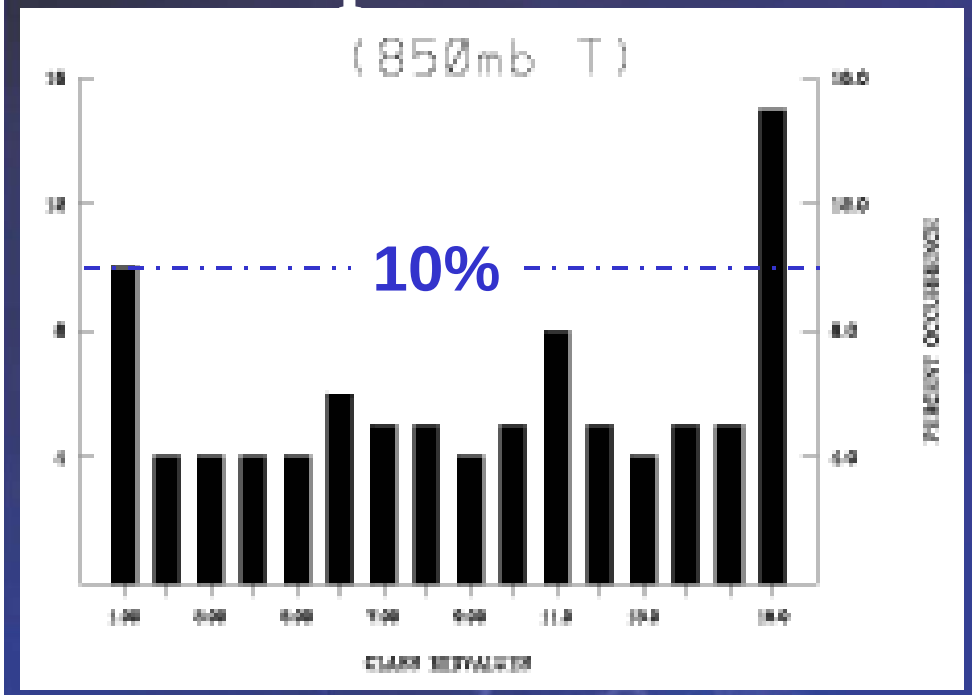


SREF ensemble performance

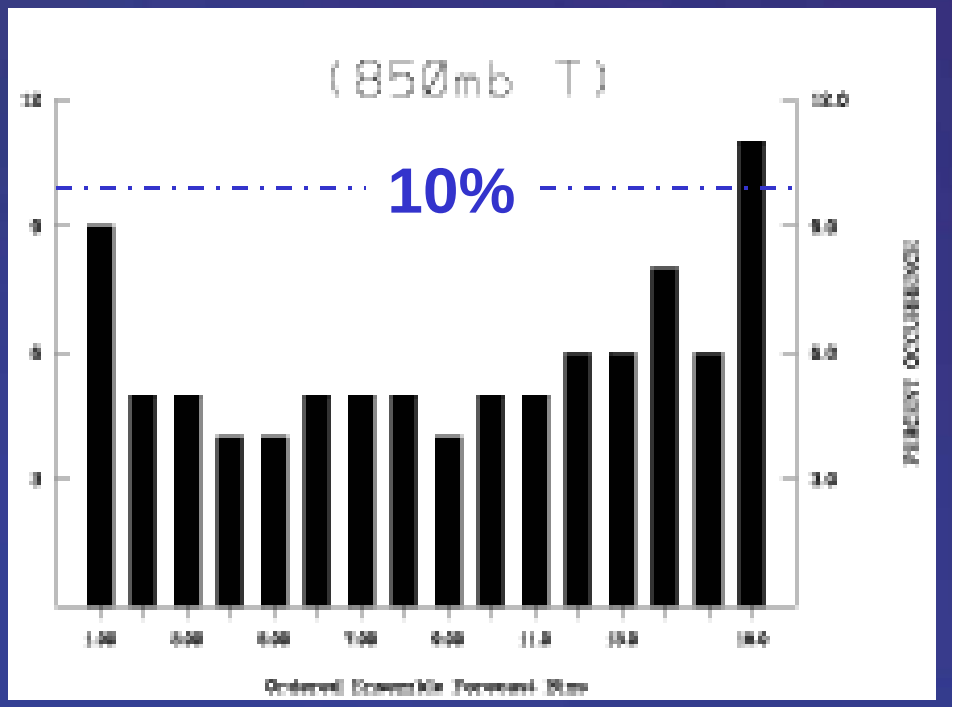
Ranked Histograms

Increased system spread for experimental physics based ensemble-→ fewer outlier forecasts

Operational



Parallel



Summary

- **Increased physics diversity improves system spread**
- **Scaled breeding controls system spread**
- **Deterministic results are mixed**
  - ***Some degradation of T, QPF***
- **Need for bias correction to improve probabilistic performance & statistical consistency**
  - ***MSE ~ Variance***
- **Issues:**
  - ***How to disseminate products (NDGD ?)***
  - ***Methods for grid-based bias correction***
  - ***Improved ensemble member configuration for low-level temperature forecasting***

SREF *Future Upgrades*

- Upgrade RSM to current GFS physics
- Upgrade RSM with new parallelization
- Add RSM BUFR files
- Common post-processor
- Implement ensemble mean BUFR files
- Improved and new products
- Grid Based Bias Correction
- Improved FVS verification
- Confidence information

BACKUPS FOLLOW

SREF System Goals

- **Improved system probabilistic and spread Information**
- **Improved or similar skill as determined from ensemble mean and probabilistic skill scores (RPSS, ROC) of :**
  - ***Sfc QPF***
  - ***Upper-level heights, winds***
  - ***2 m Temperature, MSLP***
- **Add more physics diversity to accomplish goals**

Possible Future Implement
32 km, WRF scaled breeding

<u>Add or Replace some current members</u>:

- 3 WRF-MASS-NCAR
- 2 WRF-MASS-NCEP
- 3 WRF-NMM-NCEP
- 2 WRF-NMM-NCAR
- LSM/PBL perturbations
- GDAS-ETA/WRF members

Short Range Ensemble Forecast (SREF) System

Energy Project

Domain and resolution

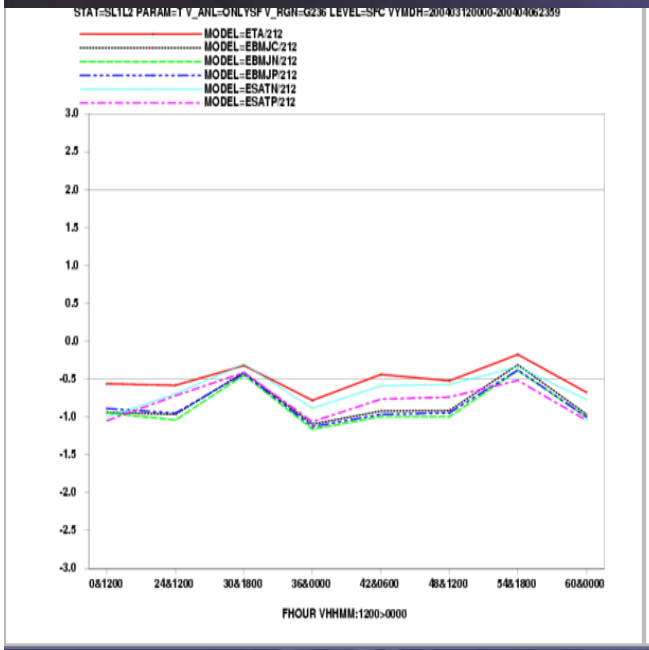
- *Domain is full North American continent*
- *Horizontal Resolution is 32 km*
- *Eta Vertical resolution increased to 60*
- *Forecast range was 63 hours at 6 and 18 Z*
- *Lateral boundary conditions from 6-hr old medium range ensemble system*
- *July 1-Sept. 1, 2003*

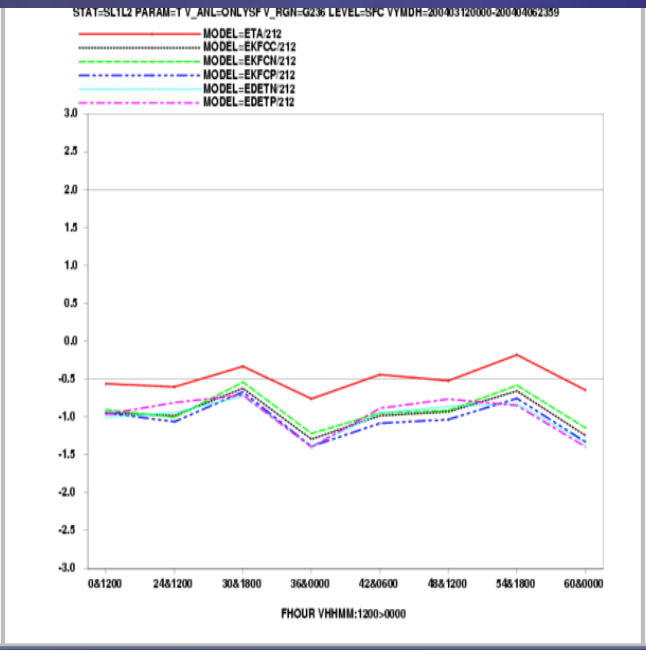
Transition to WRF

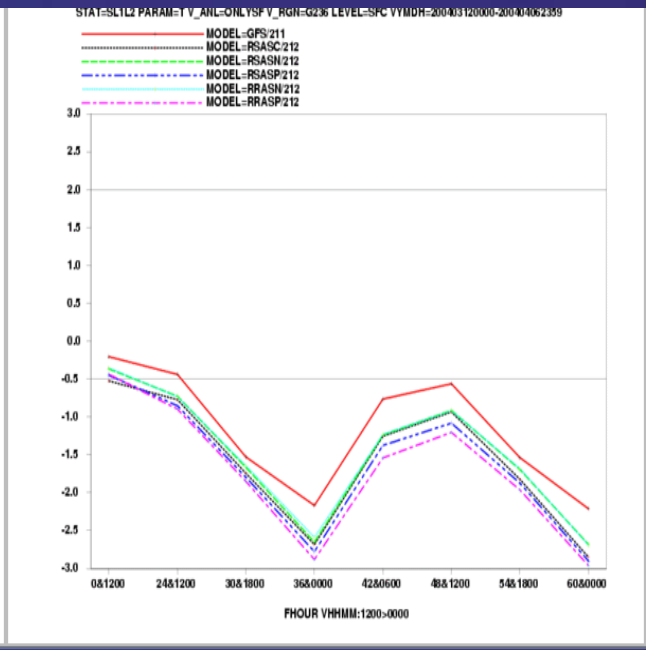
- **FY04 :** two member HRW-WRF-8
- **FY06:** North American WRF Run
- **FY07:**
  - Multi-member North American Run (~ 7 km)
  - Coarser resolution (~20 km) multi-core, physics, initialization SREF run

Individual Members

2 m Temperature







Eta-BMJ grp **Eta-KF grp** **RSM grp**

BIAS