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Mesoscale Modeling Branch: Where We Are and Where We're Going

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11 December 2007

Where the Nation's climate and weather services begin

WHAT – i.e. T O P I C S

- Who We Are
- Recent Changes in Operations
  - Observation Processing - continuous
  - SREF: 11 December 2007 & Plans
  - HiResWindow Upgrade
  - NAM: December & June Updates & Plans
  - Real-Time Mesoscale Analysis (RTMA)
  - SMARTINIT downscaling of NAM
  - Ozone & Smoke Guidance
  - DTRA ensemble & Extratropical Storm Tracks

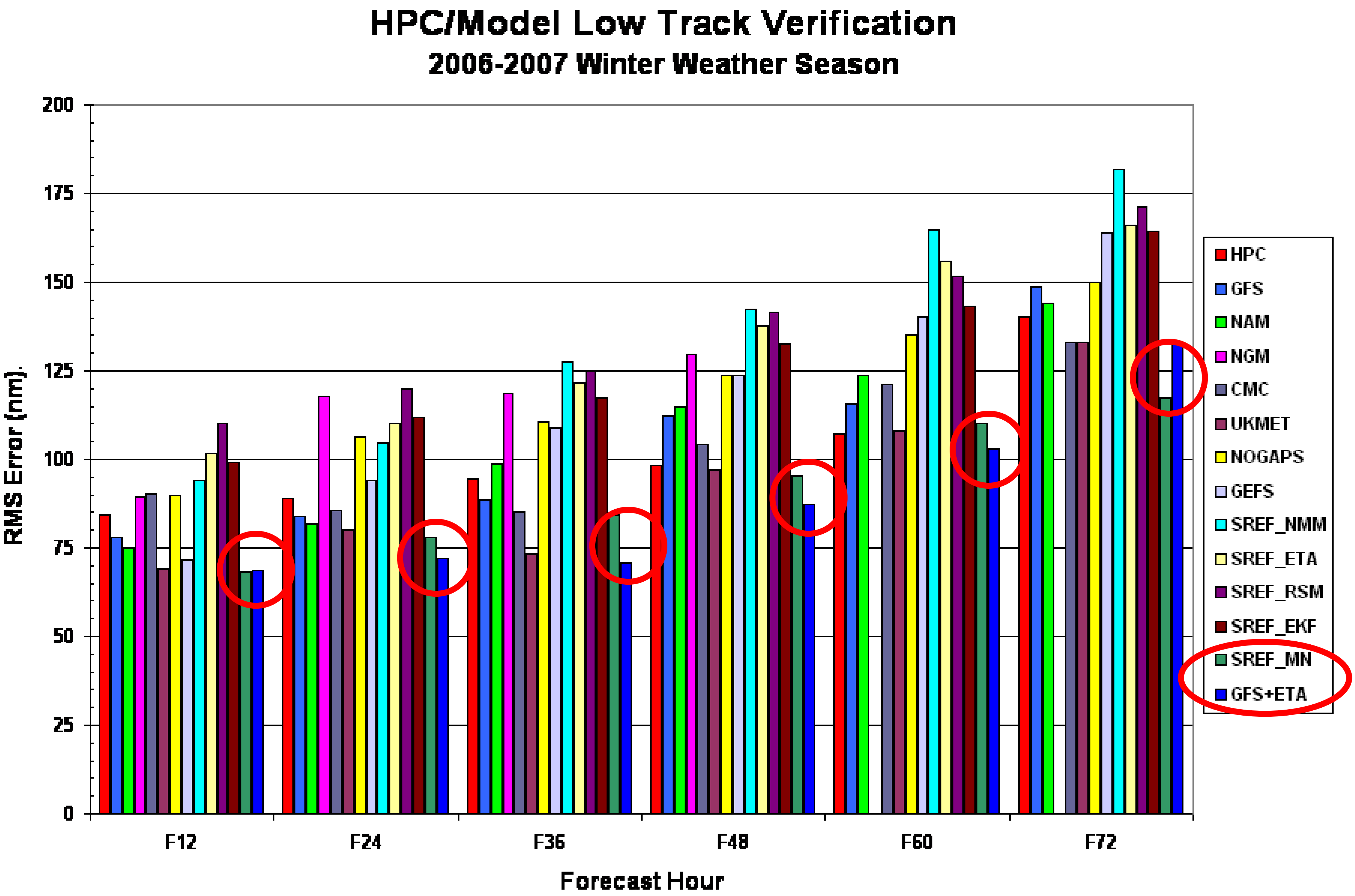
Who We Are

- Government Scientists
  - Tom Black
  - Hui-Ya Chuang*
  - Dennis Keyser
  - Ying Lin
  - Geoff Manikin
  - Ken Mitchell – LSM Ldr
  - Jeff McQueen
  - Dave Parrish
  - Matt Pyle
  - Eric Rogers
  - Wan-Shu Wu
- Visiting Scientists
  - Mike Ek
  - Zavisa Janjic
  - Shun Liu
  - Fedor Mesinger
  - Yoshiaki Sato - JMA
  - Duk-Jin Won - KMA
- Contractor Scientists
  - Stacie Bender*
  - Ed Colon
  - Jun Du
  - Brad Ferrier
  - George Gayno
  - Dusan Jovic
  - Sajal Kar
  - Pius Lee
  - Guang-Ping Lou
  - Manuel Pondeca
  - Jim Purser
  - Perry Shafran
  - Marina Tsidulko
  - Ratko Vasic
  - Jeff Whiting
  - Vince Wong
  - Binbin Zhou
  - Julia Zhu
  - Yanqiu Zhu

Observation Processing

- Prepared for observation subtype (e.g. airframe or mesonet provider)
- Adapted NRL aircraft QC package
  - Includes improved track-checking
- Ascent/descent reports generated as profiles
  - Associated with nearest METAR for sfc baseline
  - For use in grid-to-obs verification
  - For use in validating boundary layer etc
- NSSL merged Level II Radar QC package combining separate modules for radial wind (used reflectivity) and for reflectivity (used winds)

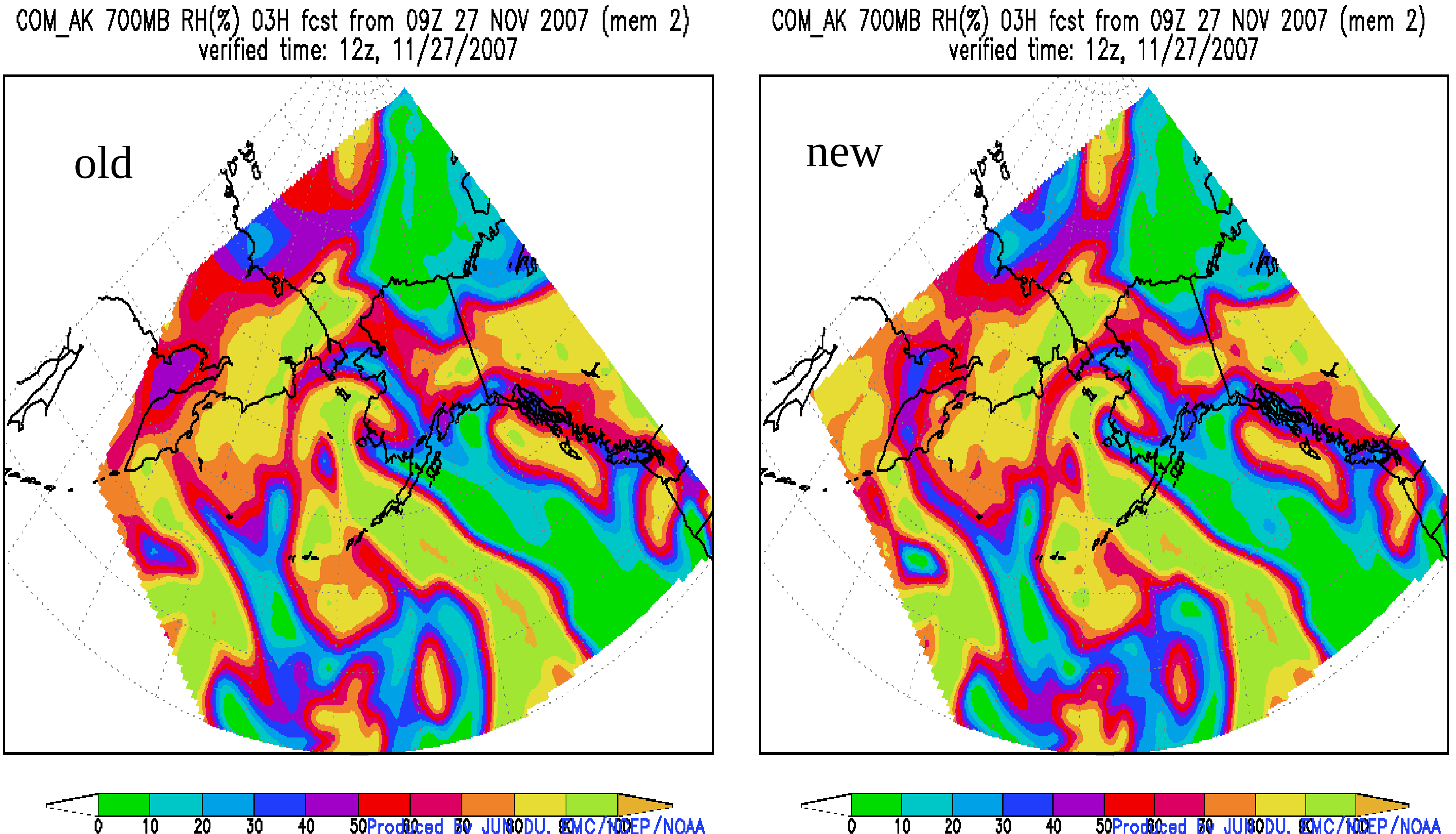
SREF Mean Still in Top Two



11 December 2007
SREF Implementation Package

- **Bias Correction**
- **RSM domain expanded to cover missing part of the AWIPS Alaska 216 grid**
- **BUFR output from 6 WRF members**
- **Aviation products** (icing, turbulence, ceiling and flight restriction) **added**
- **Alaskan Aviation website added**

RSM domain expansion to cover the missing part of Alaska 216 grid



Alaskan Aviation Guidance Added to SREF Web Page

http://wwwt.emc.ncep.noaa.gov/mmb/SREF/SREF.html

SHORT-RANGE ENSEMBLE FORECASTING (SREF)

Take free "Ensemble Forecasting" online course by clicking here

General Weather Forecasting for CONUS, Alaska, and Hawaii regions
A subset of selected fields for Winter Weather (CONUS, Alaska, and Hawaii)
Specific Applications (Aviation(CONUS), Aviation(Alaska), Convection, and Energy)
SREF-based other products: .Bright's plumes (under testing), Manikin's Meteograms, Marchok's Cyclone Tracks
Beijing 2008 Olympic Mesoscale Ensemble Project Testing Page
NCEP/NCO's SREF Guidance Page, Manousos's Winter Weather Impact
online available SREF datasets:NOMADSand NCEP ftp server

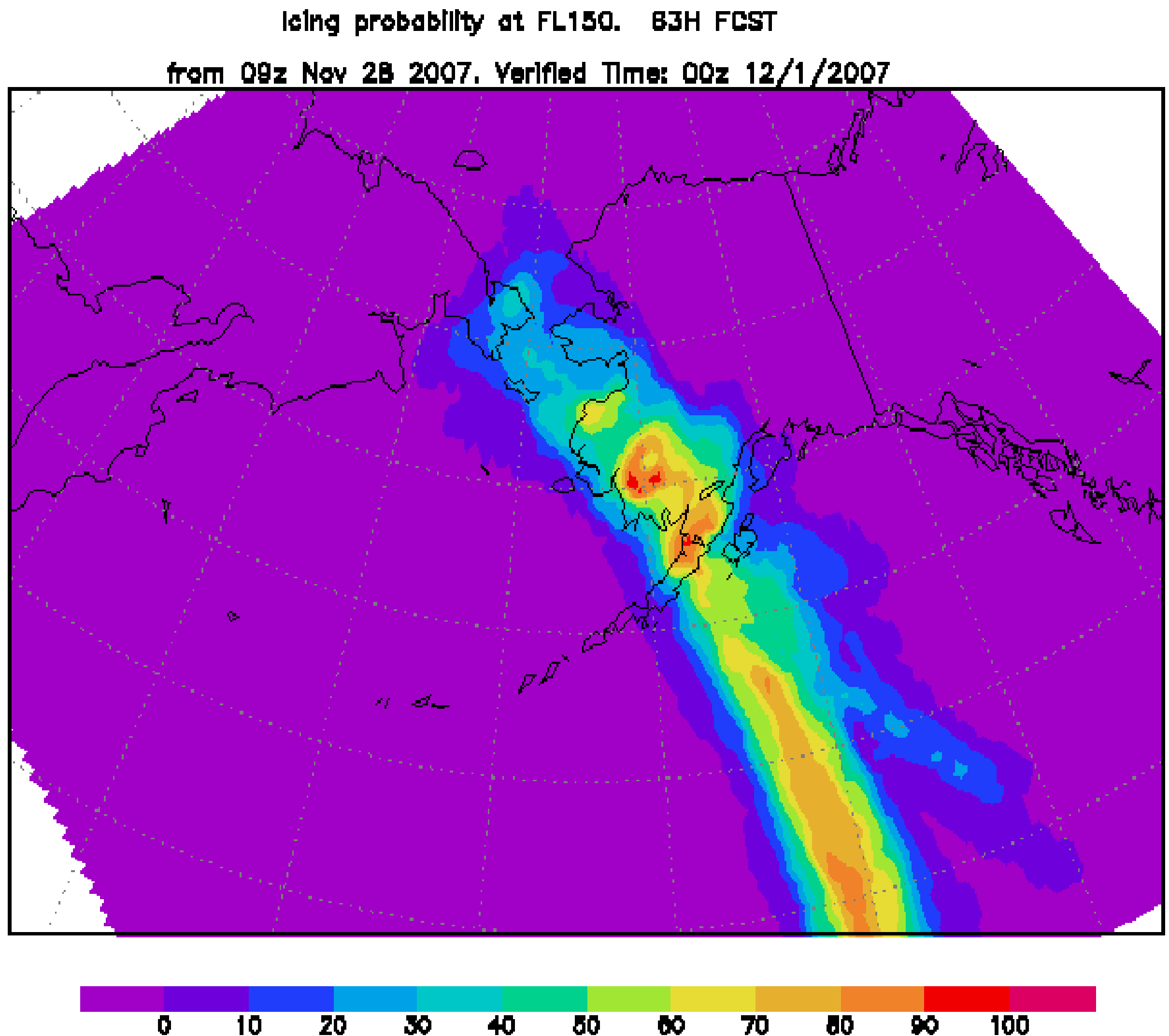
Sample Icing Product

NCEP SREF Aviation Products (Experimental)

Fcst-cycle
CONUS

Mean/spread or prob

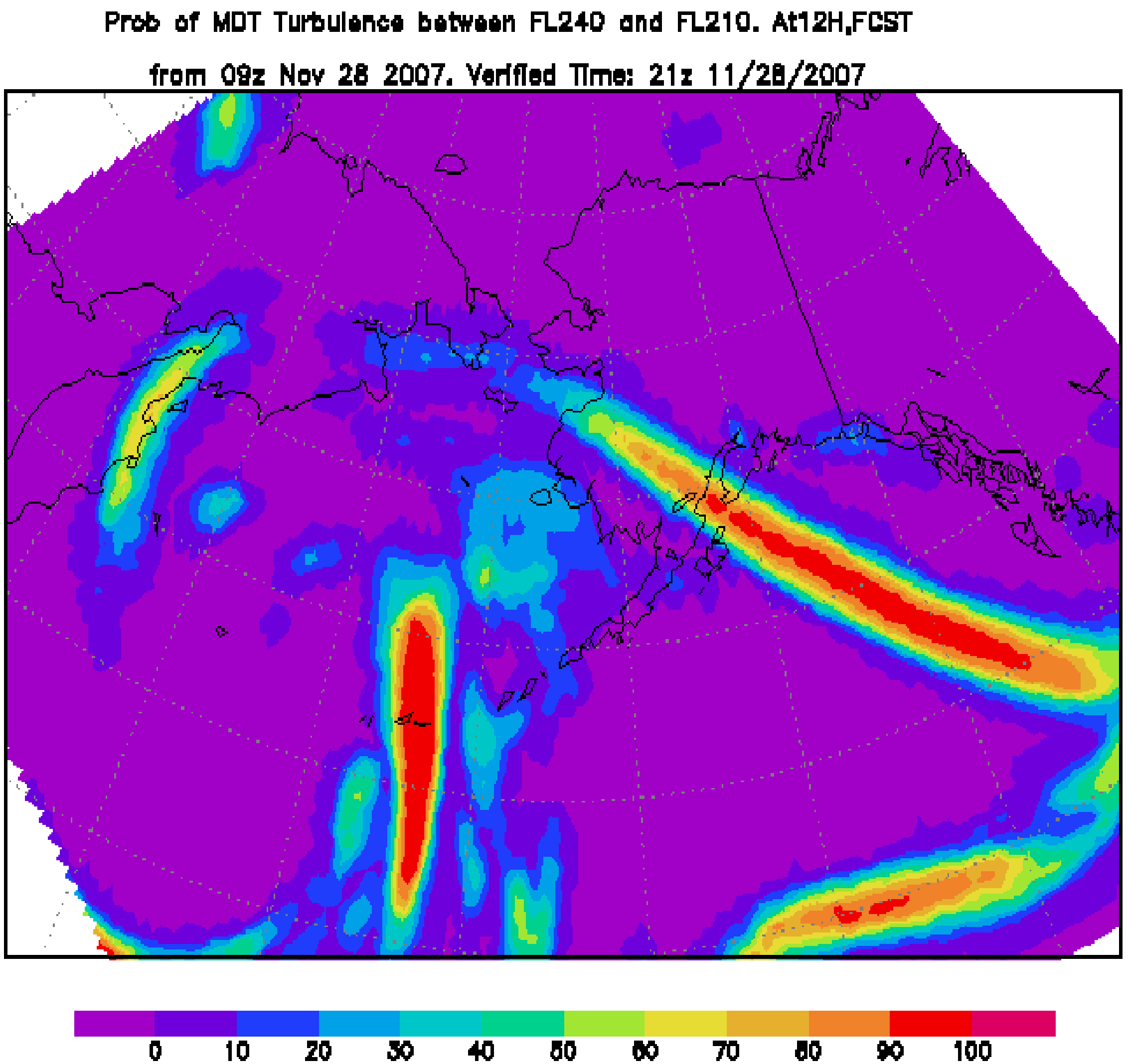
- NEW — Flight Restriction Prob
- NEW — Visbility&Ceiling
- Cloud amount
- 10m Wind
- Lower level wind shear
- Convection cloud
- Jet stream probability
- NEW — Icing probability
- Turbulence probability
- NEW — Tropopause
- Frozen height
- Precipitation type prob
- Fog (new)



Sample Turbulence Product

NCEP SREF Aviation Products (Experimental)

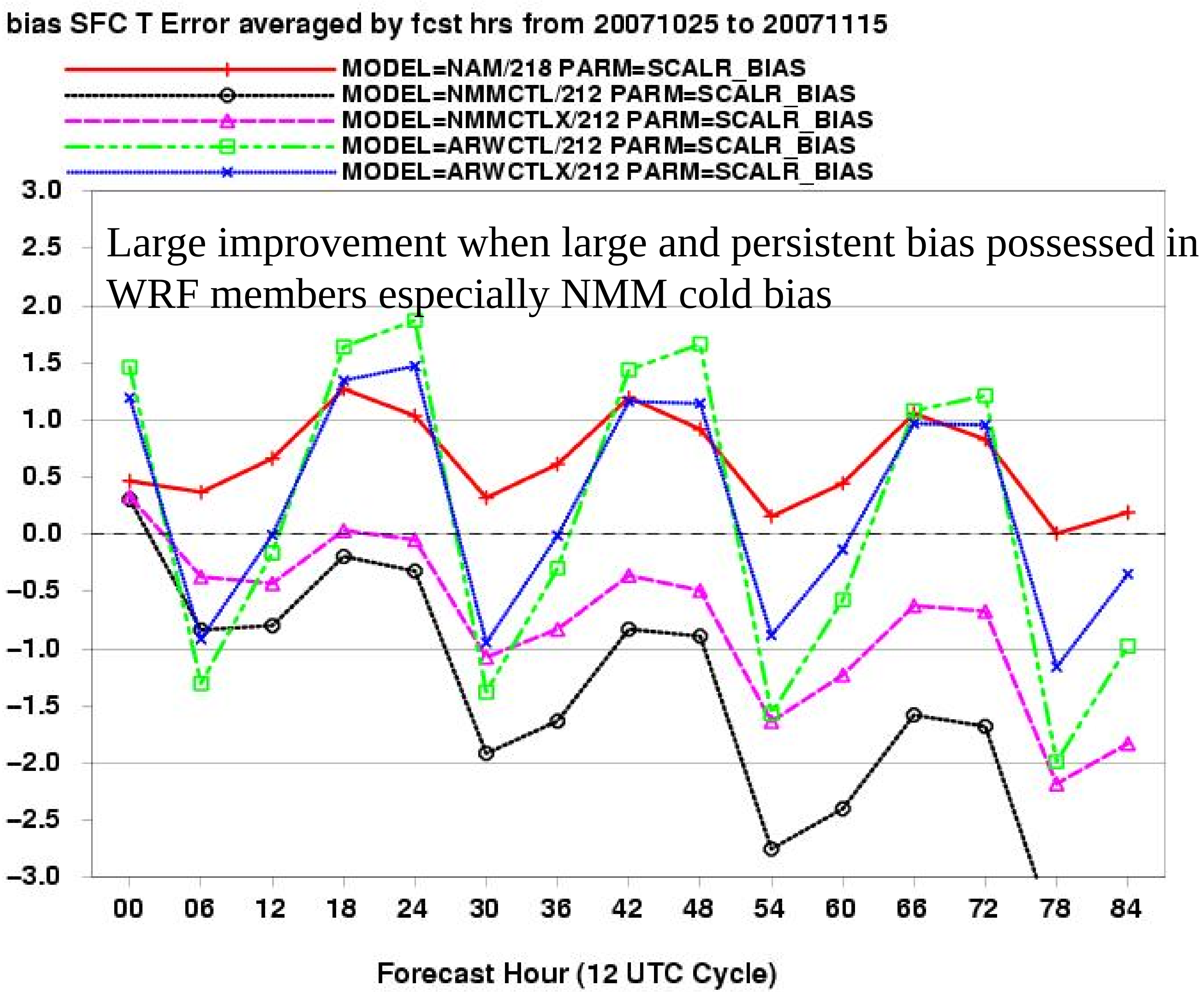
Fcst-cycle
CONUS
Mean/spread or prob
Flight Restriction Prob
Visbility&Ceiling
Cloud amount
10m Wind
Lower level wind shear
Convection cloud
Jet stream probability
Icing probability
Turbulence probability
Tropopause
Frozen height
Precipitation type prob
Fog (new)



Bias Correction Method

- Idea: Decaying average method which “weights” more the most recent past data.
- Technique: Bias = (1-a)*(accumulated bias from past) + a*(most recent past error), where a=5% or 0.05 for this implementation (note: 0.02 for GEFS).
- Each model has its own bias estimation based on the corresponding sub-ensemble mean: Eta, RSM, NMM and ARW yielding 4 independent components.
- Each cycle (03z, 09z, 15z, 21z) is bias corrected separately.
- Each forecast hour is bias corrected separately within the same cycle.

Acknowledgement: Bo Cui & Zoltan Toth


bias SFC T Error averaged by fcst hrs from 20071025 to 20071115
MODEL=NAM/218 PARM=SCALR_BIAS
MODEL=NMMCTL/212 PARM=SCALR_BIAS
MODEL=NMMCTLX/212 PARM=SCALR_BIAS
MODEL=ARWCTL/212 PARM=SCALR_BIAS
MODEL=ARWCTLX/212 PARM=SCALR_BIAS
Large improvement when large and persistent bias possessed in WRF members especially NMM cold bias
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
00 06 12 18 24 30 36 42 48 54 60 66 72 78 84
Forecast Hour (12 UTC Cycle)

Conclusions on Bias Correction

- **Bias Correction overall a positive impact**
  - **Big improvement for low-level temperature and humidity where bias is big and persistent**
  - **Small or no impact on upper-level variables (flow dependent), not good for wind (very flow dependent), not good when regime changes, and not good when bias is small**
- **A good first step but regime-dependent approach is probably needed such as Du (2004) which needs further testing.**
- **Bias corrected fields not to be distributed via AWIPS SBN due to insufficient lead-time for notice.**

SREF Plans for 2008

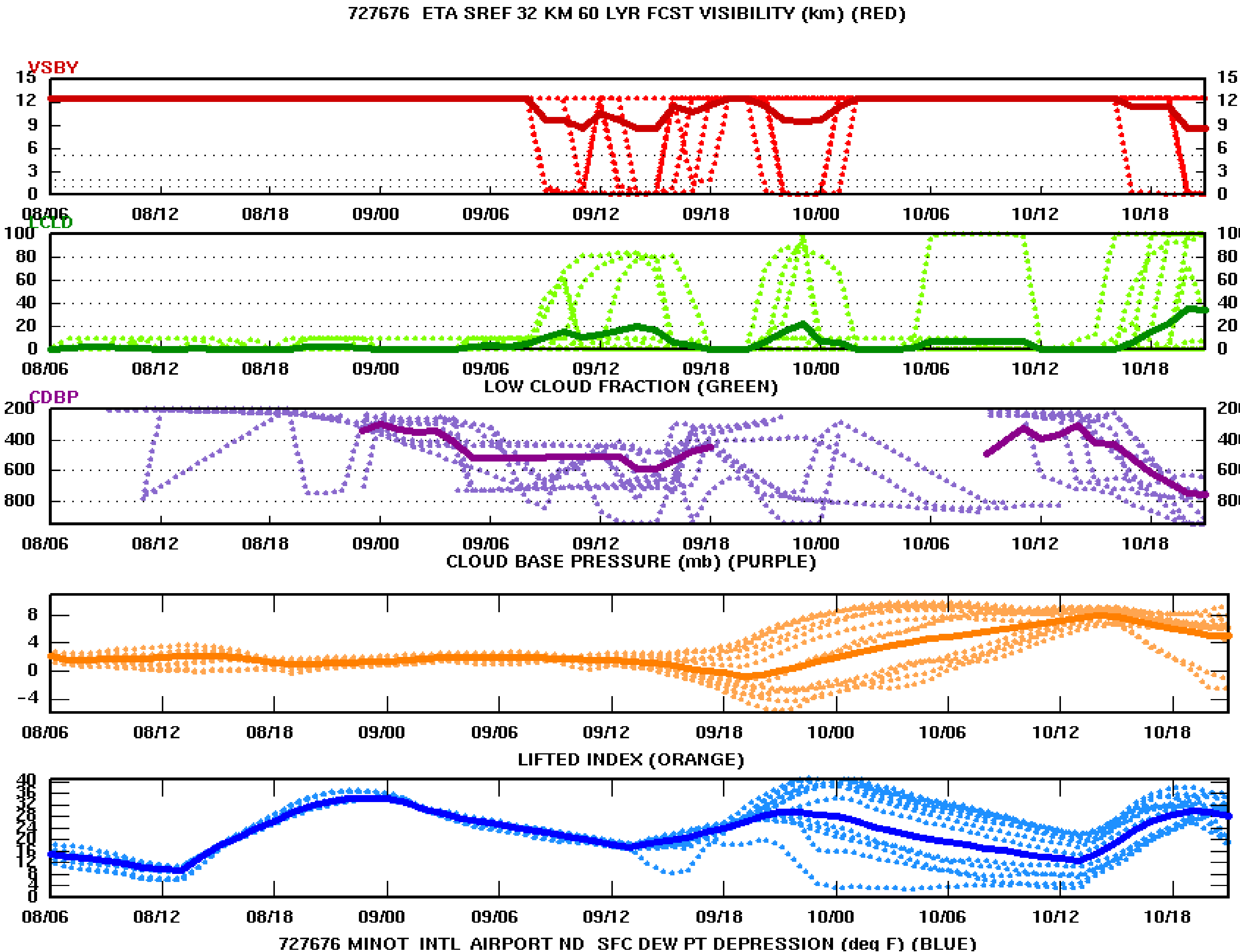
- WRF model upgrade (both NMM and ARW cores) from v2.0 to v2.2.1 (or higher)
- Move coarse resolution members → 32km
- Reconfigure 21 members from

  5 EtaBMJ + 5 EtaKF + 5 RSM + 3 NMM + 3 ARW

  to

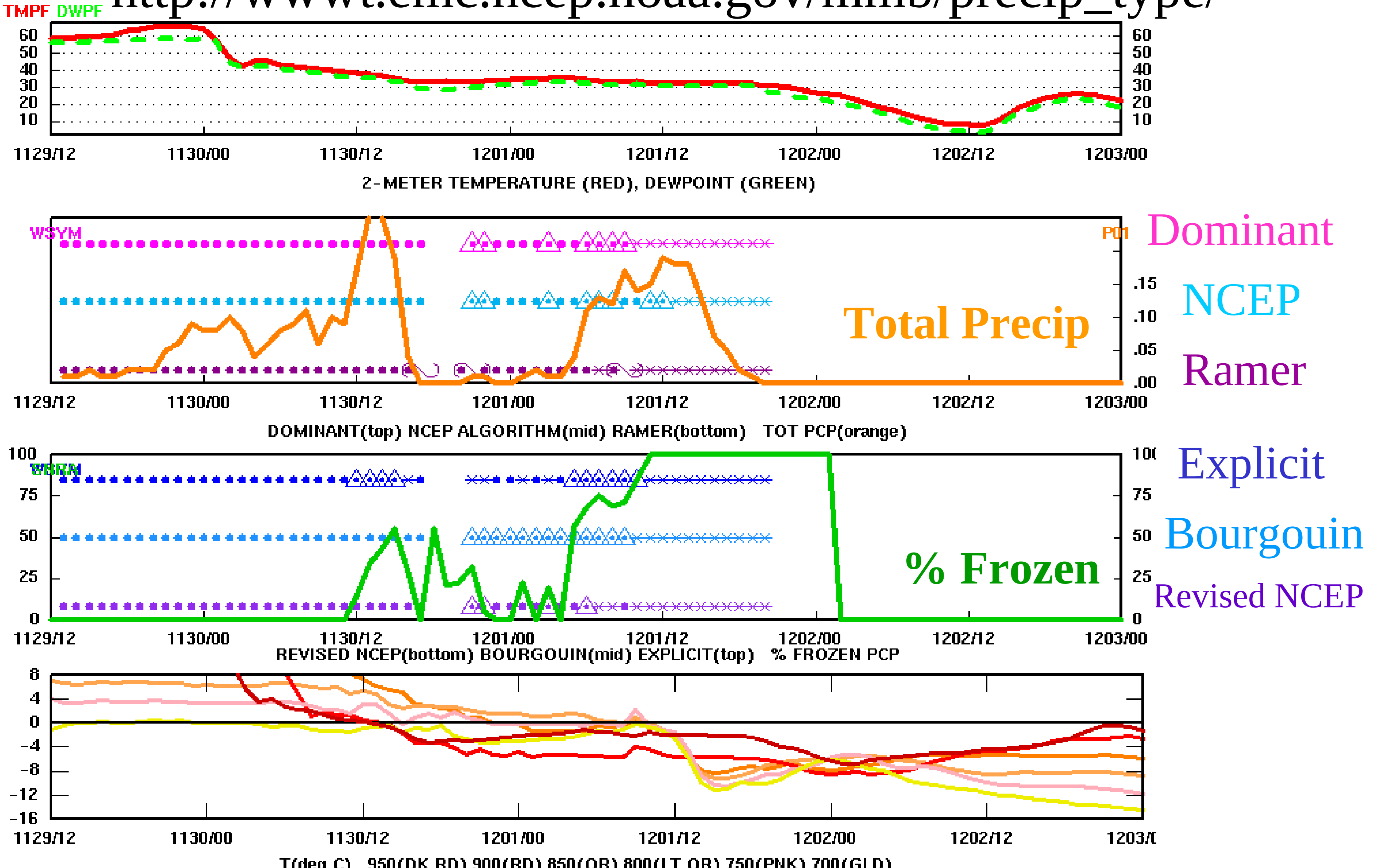
  3 EtaBMJ + 3 EtaKF + 5 RSM + 5 NMM + 5 ARW
- BUFR output product from 21 members
- Downscale all members to ~12km (5km with RTMA if human resource permits)
- Bias correct precipitation

Example of SREF Meteogram from BUFR



Sample Manikin's New Precipitation Type Webpage – Gary, Indiana

http://wwwt.emc.ncep.noaa.gov/mmb/precip_type/



SPC Requirements to Elevate the offline 4 km“Matt Pyle Run” to Ops: HiResWindow Upgrade

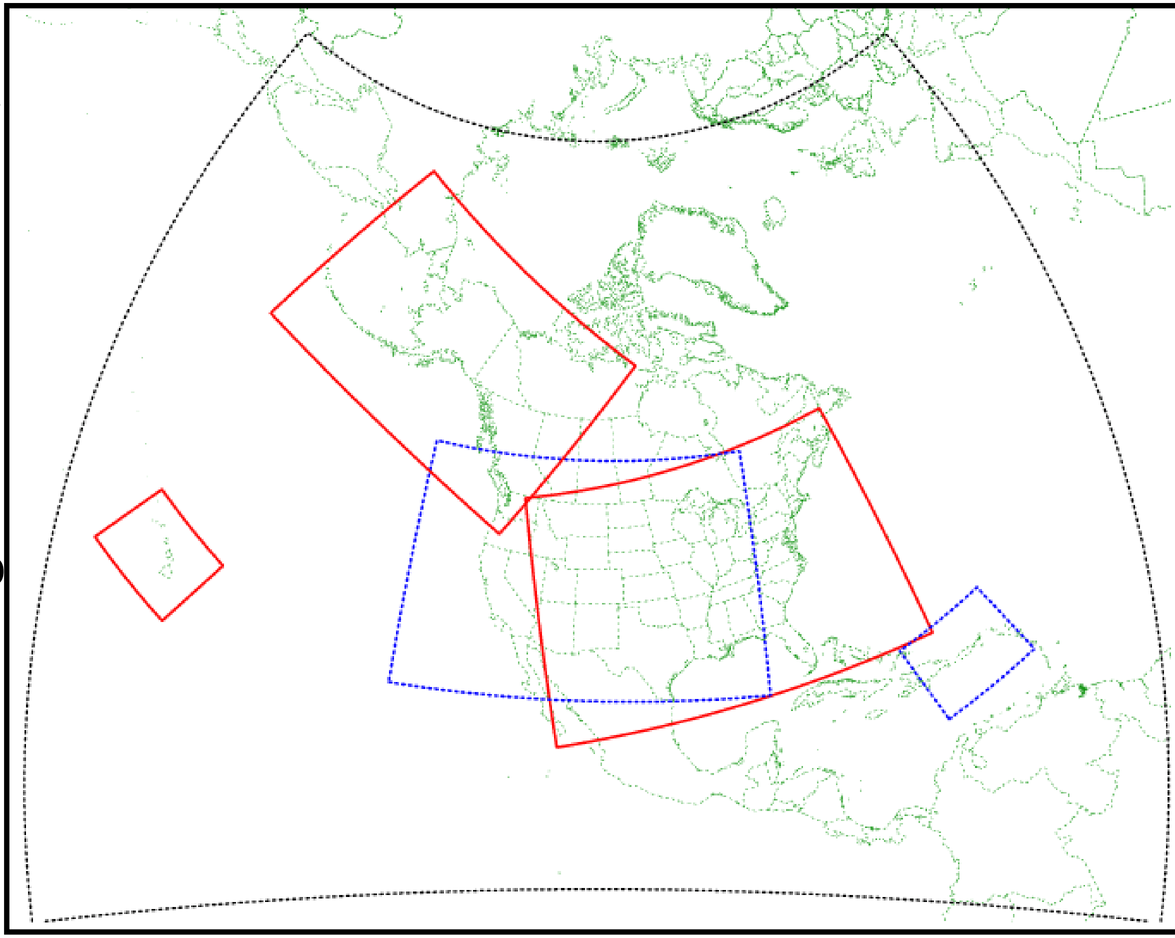
- Twice per day runs at 00z & 12z
- Expanded (East-Central) domain
- 4 km resolution WRF-NMM

HiResWindow Upgrade 2007

- **Model Upgrades**
  - Upgrade WRF-NMM from version 1.3 to 2.2 with IJK and new WPS and increase resolution from 5.1 km to 4.0 km ;
  - Upgrade WRF-ARW from version 1.3 to 2.2 with new WPS and Increase resolution from 5.8 km to 5.1 km;
  - Expand large domains – collapsing CONUS nests from 3 to 2 overlapping (West-Central & East Central)
  - Run SPC’s preferred domain (East-Central CONUS) at both 00z and 12z
- **Post-Processing and New Products**
  - Add simulated reflectivity
  - All output on 5 km grid

HiResWindow Fixed-Domain Nested Runs
4 km run Configuration

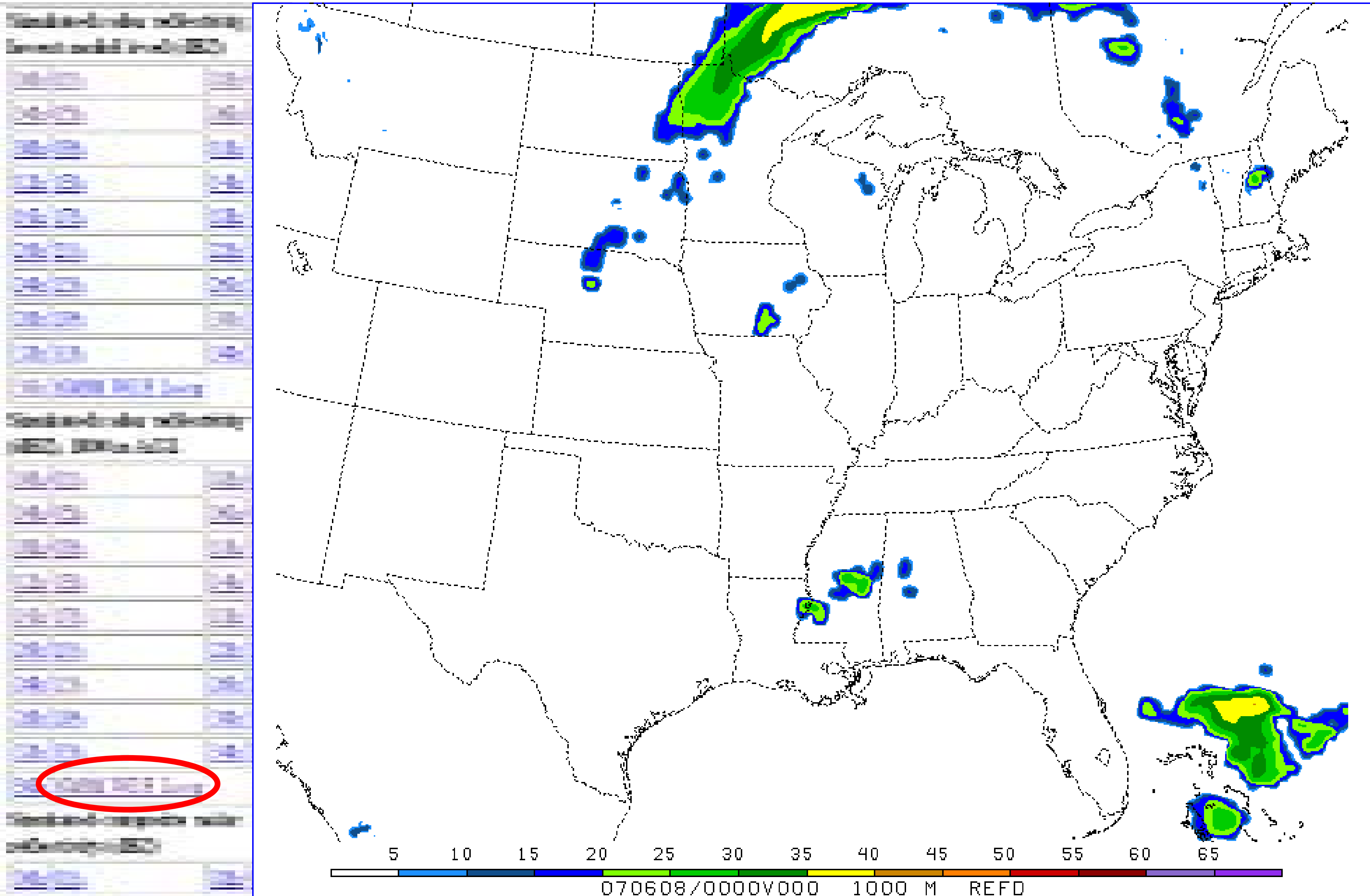
- FOUR routine runs made at the same time every day
- 00Z : ECentral & Hawaii
- 06Z : WCentral & Puerto Rico
- 12Z : ECentral & Hawaii
- 18Z : Alaska & Puerto Rico
- Everyone gets daily high resolution runs ***if & only if*** hurricane runs are not needed



Approved through OSIP Gate 3, to be included in OB8.3 … then OB9 … then dropped – but I'm not bitter.

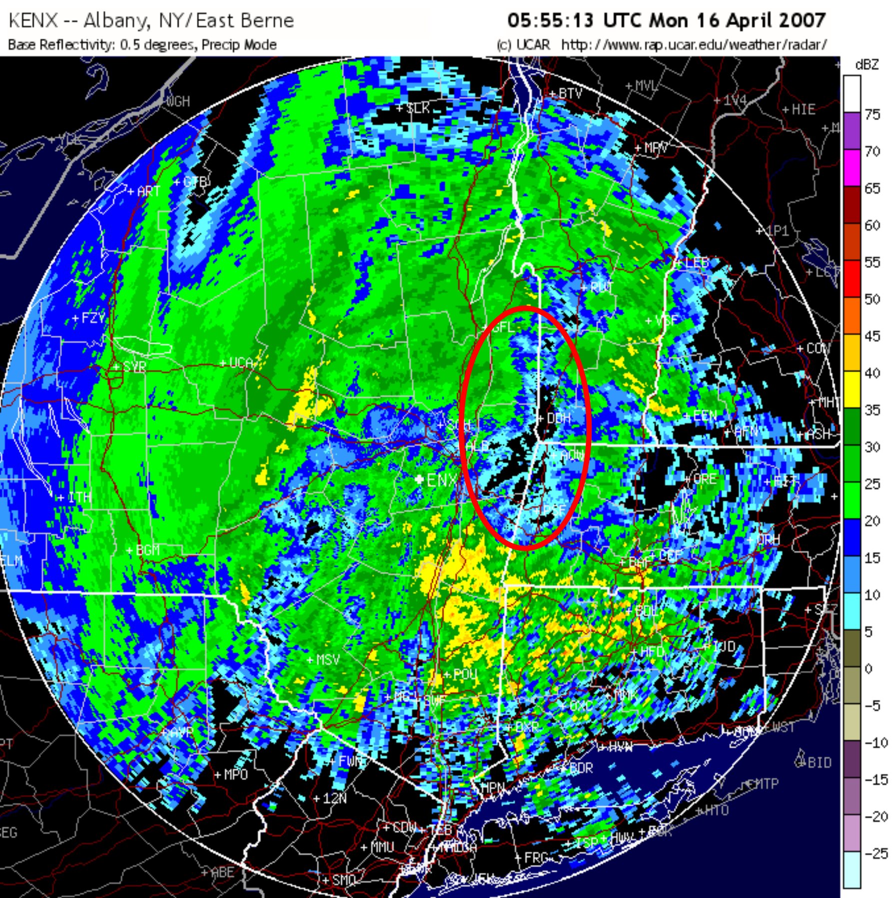
Pyle Webpage Now Displaying Simulated Reflectivity

http://www.emc.ncep.noaa.gov/mmb/mmbpll/cent4km/v2/

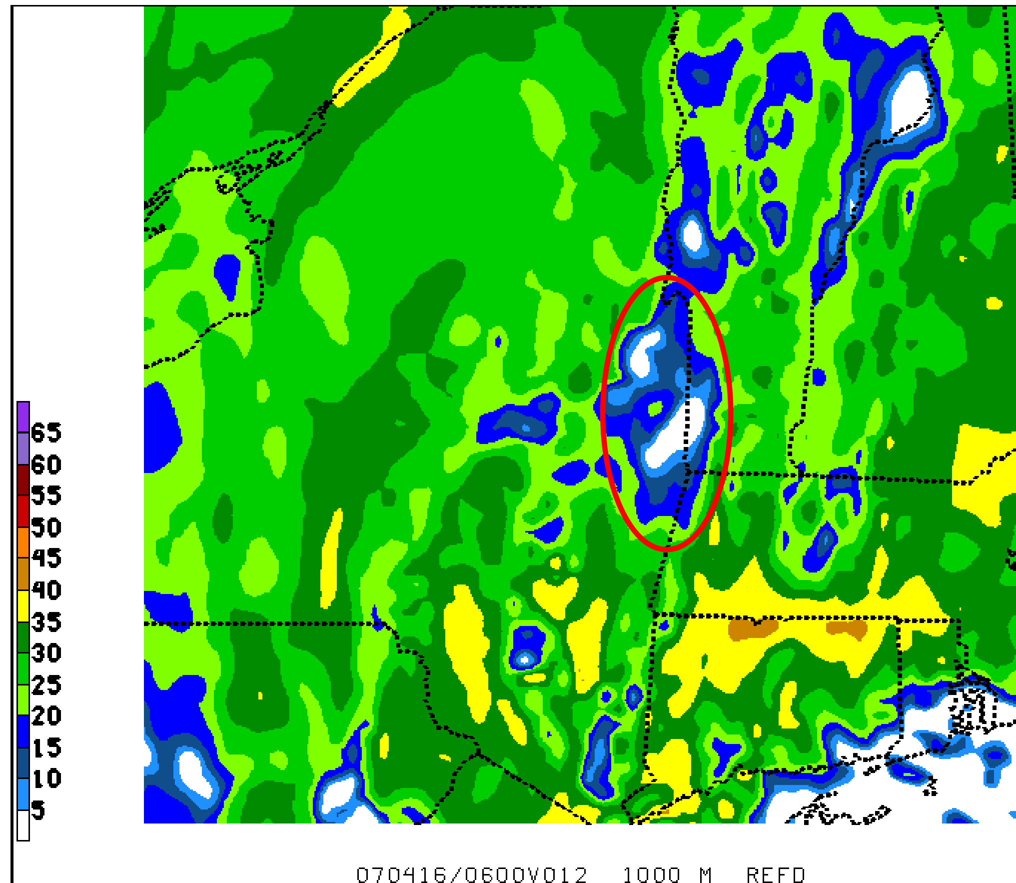


Mesoscale Detail – this 12 h forecast captures the reflectivity minimum in eastern NY in the lee of the Berkshires/Green Mountains, and some of the enhanced reflectivites in northern CT and extending into SE New York.

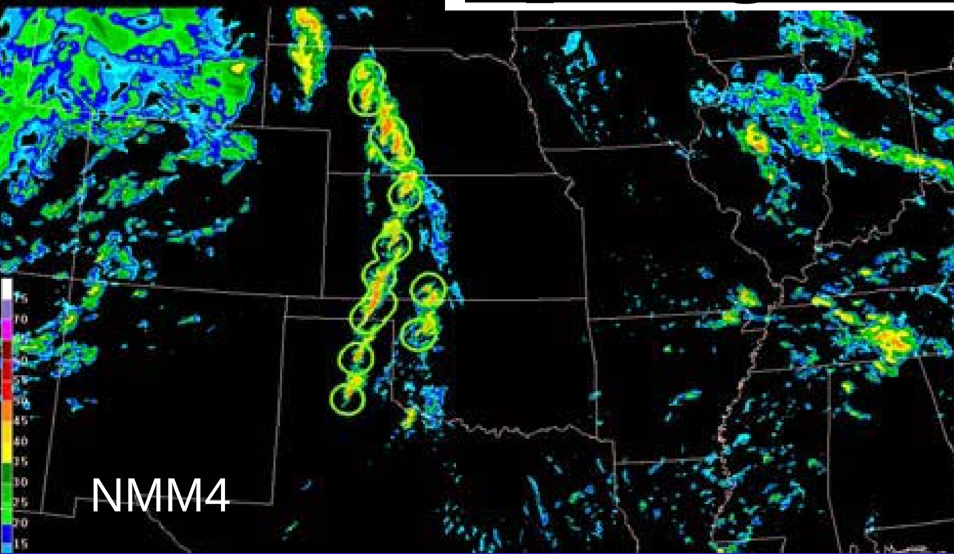
Albany, NY Radar Image

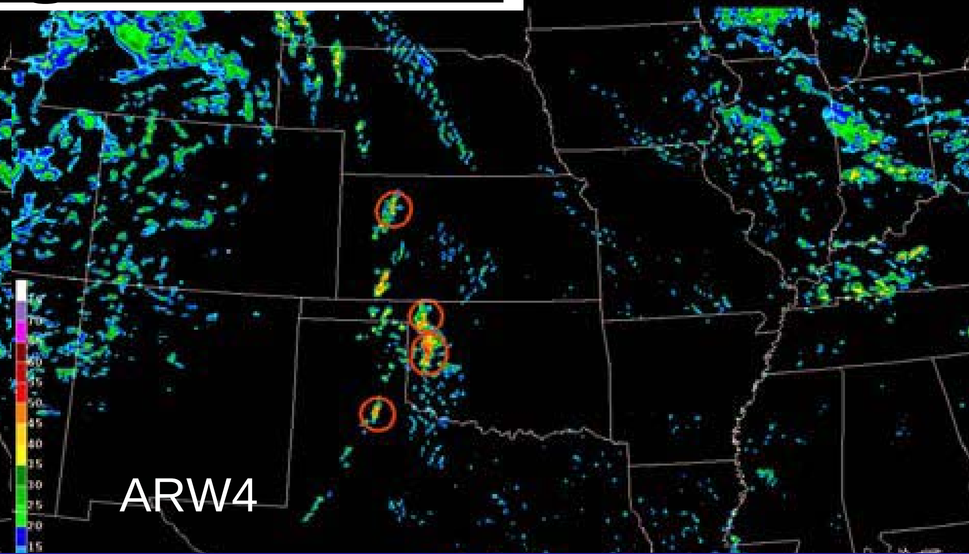


HRW Simulated Radar Reflectivity

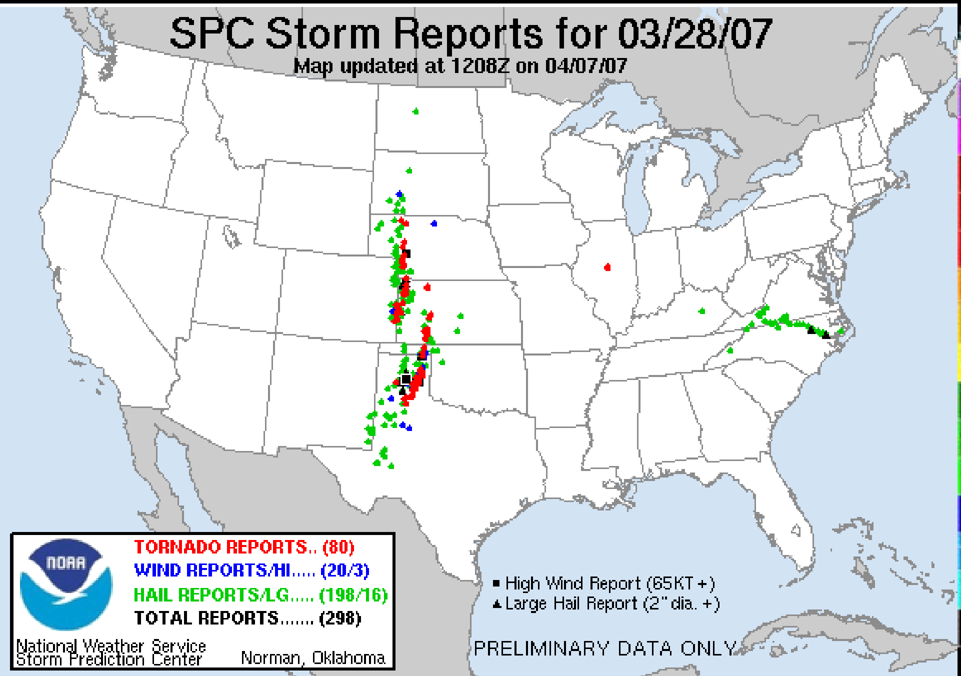


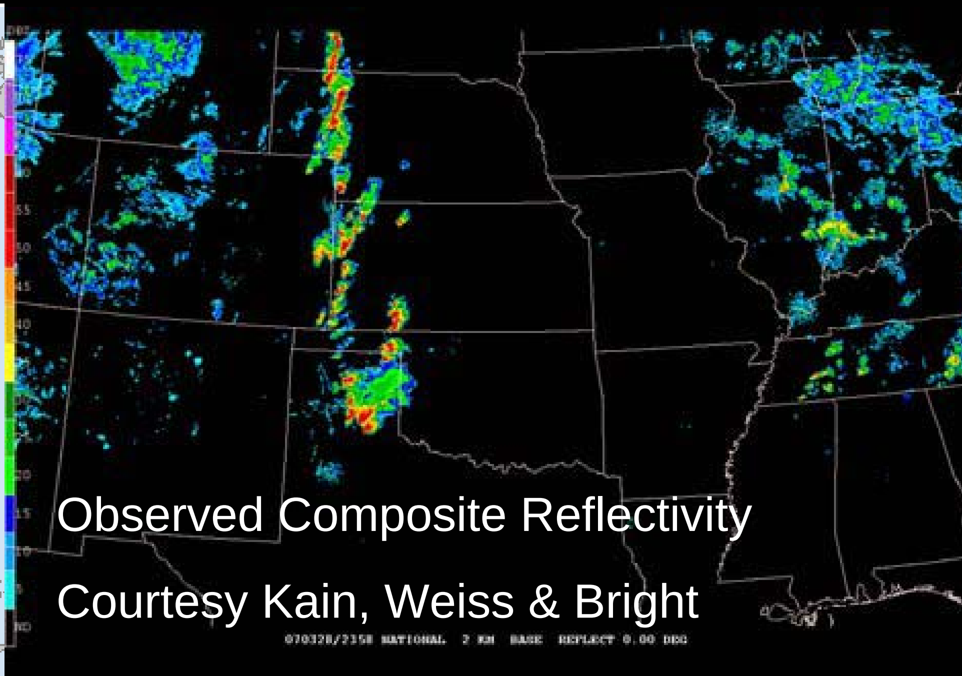
Spring Program 2007





Circles denote locations of rotating updrafts where updraft helicity is at least 50 m^2s^{-2}





NAM-MOS & FWIS

- Application of current MOS (derived from Eta forecasts) to WRF-NAM produced degraded quality
- NCEP runs an "*interim*" Eta-32
  - In a portion of unused Fire Weather/IMET Support runslot
  - Using SREF 32 km control member code with NAM initial and lateral boundary conditions
- NAM-MOS has same availability as today
- MOS only product distributed (no grids or graphics)
- Will continue running through 2008 (and beyond?)
- Reinstatement of FWIS run with upgraded computer power of dew/mist was being worked through OSIP, but it **too** fell off the list for OB9!

Three Minor NAM Upgrades

- December 2006 Crisis Change
  - In data assimilation: new divergence damper with extra damping of the external mode, applied (5x) more heavily in NDAS
  - Tuning convection and microphysics
  - http://www.emc.ncep.noaa.gov/mmb/namchanges_dec2006/NAM_Upgrades.Nov2006.html
- June 2007 Urgent Change
  - Decreased canopy resistance over evergreen & mixed-evergreen forests
    - Reduces latent heat fluxes & lowers high 2-m dew points
  - Change in surface exchange coefficients in stable conditions
    - Function of bulk Richardson number
    - Reduce nighttime/early morning warm biases over mountain west
- December 2007
  - Simulated GOES brightness temperture
  - Alaskan high-resolution tiles
  - Added BUFR sites

sensitivity to low-level moisture

- Full CONUS plot : Composite Reflectivity & GOES brightness temperature
- Regional CONUS : 1 km AGL Reflectivity & GOES brightness temperature

	CH 2	CH 3	CH 4	CH 5
CONUS	X	X	X	X
Northeast CONUS	X	X	X	X
Southeast CONUS	X	X	X	X
North Central CONUS	X	X	X	X
South Central CONUS	X	X	X	X
Northwest CONUS	X	X	X	X
Southwest CONUS	X	X	X	X

Regional Sfc Fields

NE=Northeast CONUS
SE=Southeast CONUS
NC=North Central CONUS
SC=South Central CONUS
NW=Northwest CONUS
SW=Southwest CONUS
GF=Gulf of Mexico
AK=Alaska

	NE	SE	NC	SC	NW	SW	GF	AK

temperature

	CH 2	CH 3	CH 4	CH 5
CONUS	X	X	X	X
Northeast CONUS	X	X	X	X
Southeast CONUS	X	X	X	X
North Central CONUS	X	X	X	X
South Central CONUS	X	X	X	X
Northwest CONUS	X	X	X	X
Southwest CONUS	X	X	X	X

Regional Sfc Fields

NE=Northeast CONUS
SE=Southeast CONUS
NC=North Central CONUS
SC=South Central CONUS
NW=Northwest CONUS
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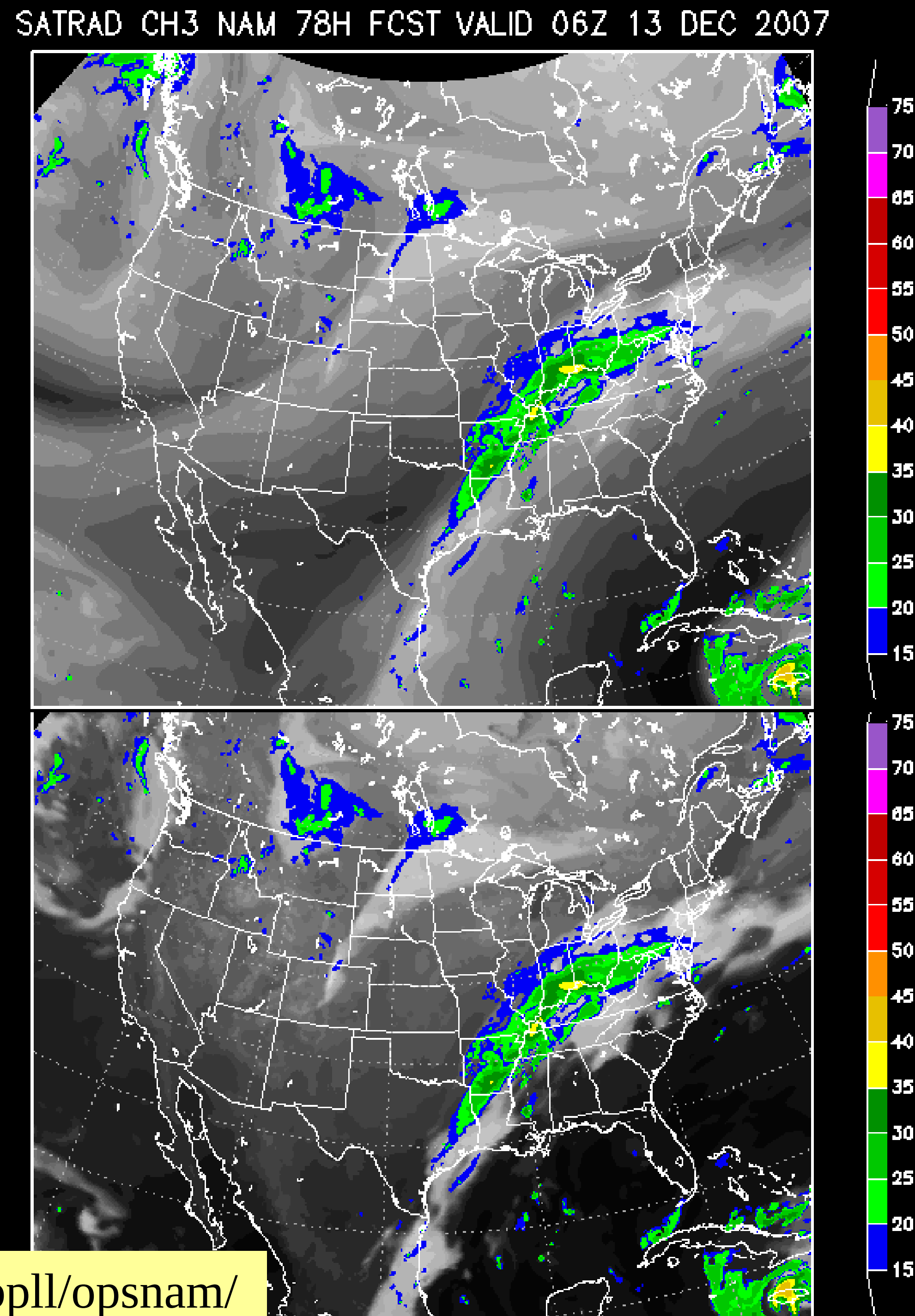
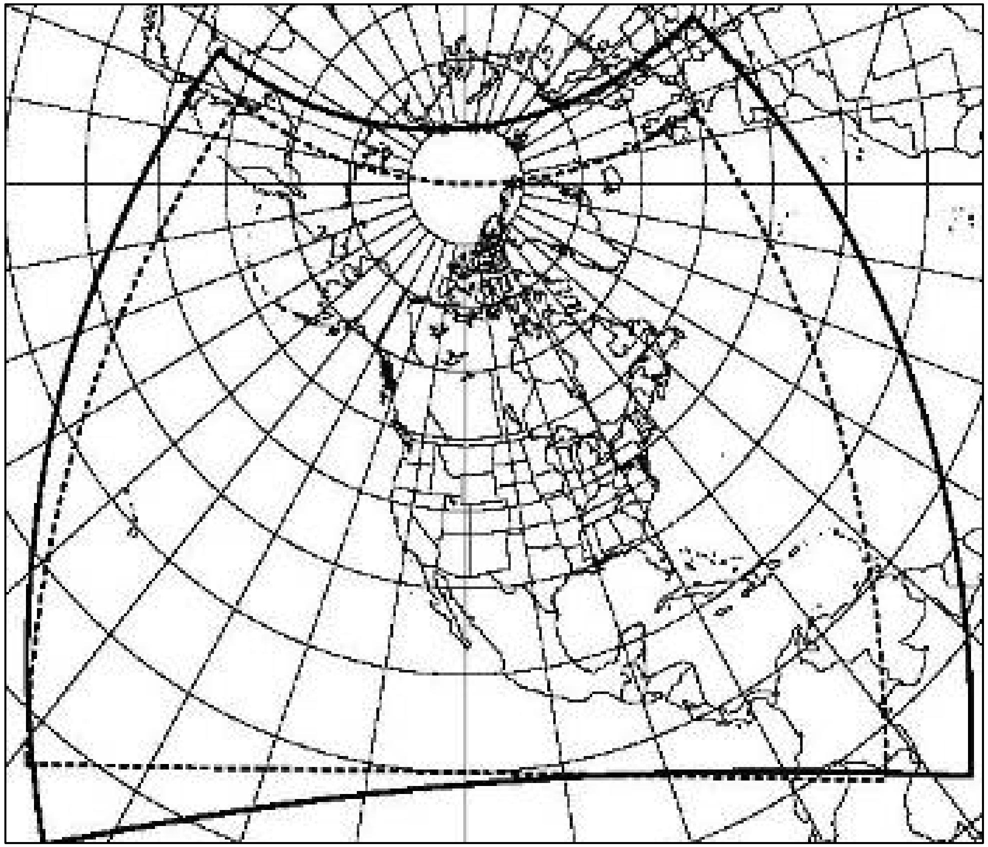
GF=Gulf of Mexico



http://www.emc.ncep.noaa.gov/mmb/mmbpll/opsnam/

The 2008 NAM Bundle

18% Increase in NAM domain



- Changes to the WRF-NMM model physics
  - GFS Gravity Wave Drag
  - Fix bug in ozone treatment
  - Improved computation of surface longwave radiation
  - **U**nified land-surface physics
- Enlarge the computational domain of the NAM by ~ 18%.
- Upgrade WRF-NMM code to IJK (12% faster) version and keep pace with changes to the public version distributed by DTC.
- New GSI code and recomputed NMM background error covariances
- Assimilation of new/better observation types (AIRS, MODIS wind, Mesonet obs, SFOV GOES).
- Use 12-36 h forecast precipitation from the 00Z operational NAM as driver for NDAS soil moisture in regions outside of the CONUS.
- New terrain after 3 passes of smooth-desmooth, fixed oversized GSL and waterfalls

The New GSI

- Recomputed NMM background errors
- New GSI code:
  - Data reported with height use height, not pressure in the forward mode
  - Change of analysis variable from Ln(ps) to ps
  - Use sensible temperature directly if no valid q obs
  - Ability to utilize multiple guess files; FGAT: first guess at appropriate time (i.e. the time of the ob)
  - Extend mpi-io capability to more data input

Lower Errors With New Background (NB) Error Covariances

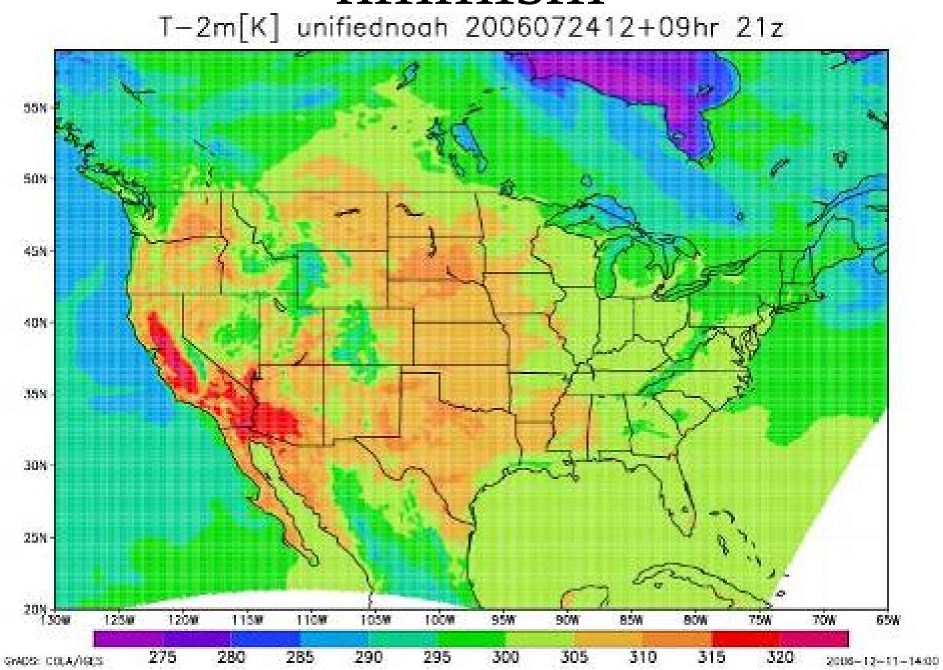
	Q	T	u/v	psfc
Ops	13.34	1.49	4.22	1.21
NB	13.23	1.46	4.03	1.13

WRF-NMM unification of "Noah" land-surface model with NCAR

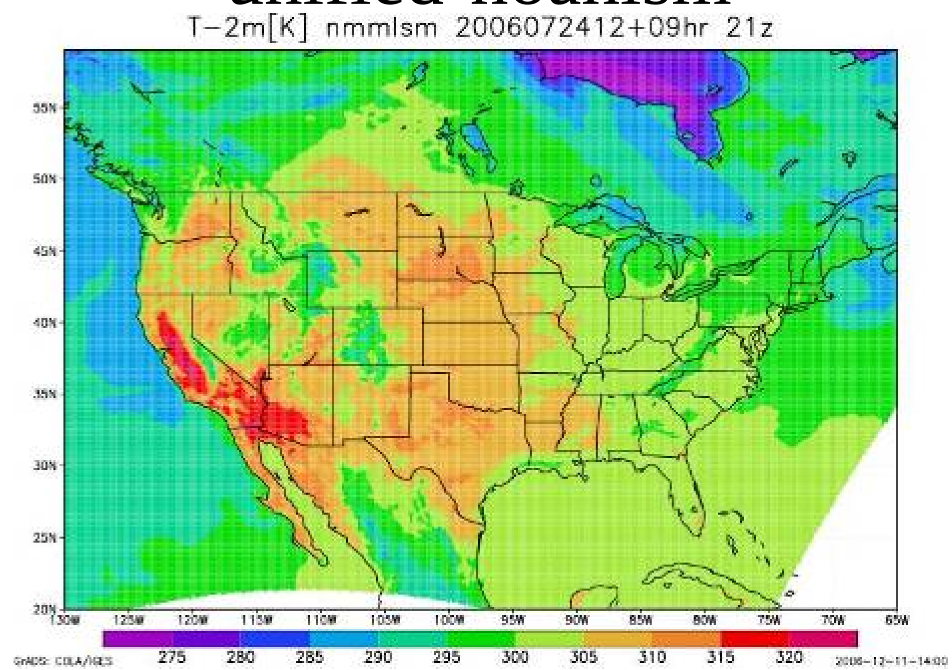
(single option: sf_surface_physics = 2)

- some changes to cold season physics, minor changes to other parameters, and passing total incoming/net radiation
- *mid-day 2-m air temperatures* ***nearly identical*** *for test case: 24-JULY-2006/21z (+09-hour forecast from 12z init)*

"nmmlsm"



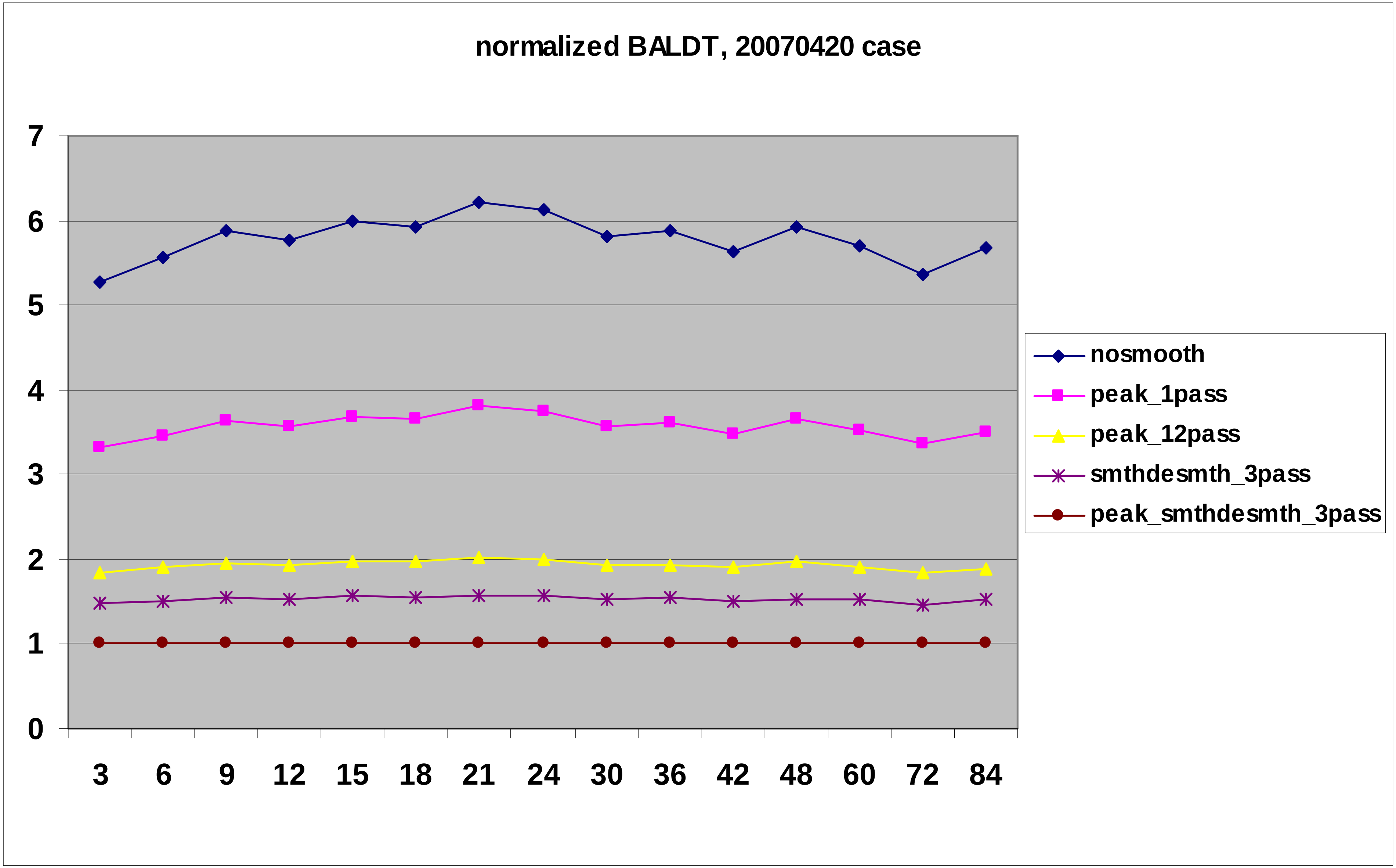
"unified-noahlsm"



GFS Gravity Wave Drag Package (Mountain Blocking and Form Drag)

- Mountain blocking of wind flow around sub-gridscale orography is a process that retards motion at various model vertical levels near or in the boundary layer – follows Lott & Miller (1997) with minor changes and including the dividing streamline.
- Gravity wave drag (Form Drag) scheme in the GFS follows the work of Alpert et al., (1988, 1996) and Kim and Arakawa (1995).

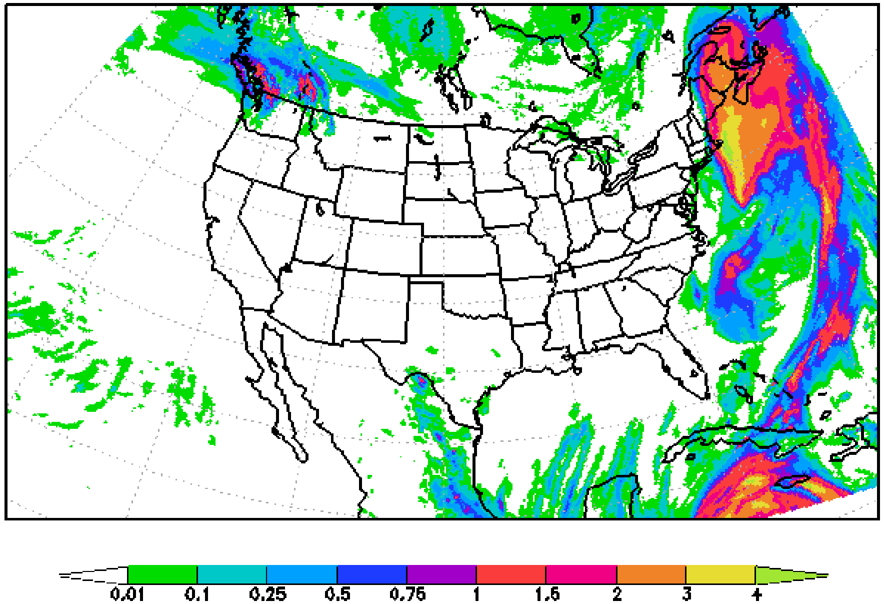
Noise Reduction with New Terrain



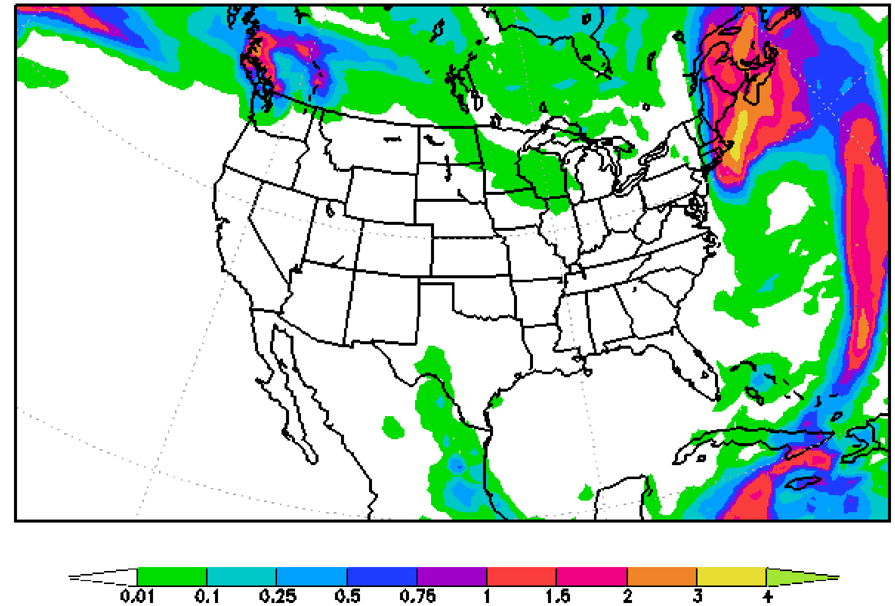
New NAM Parallels

	NAMEXP	*NAMY*	*NAMR*
Domain	Expanded	Operational	Operational
Orography	New terrain, w/3x3 smooth-de-smooth	Same as NAMEXP	Same as NAMEXP
Analysis	8/07 GSI with re-tuned background errors	Same as NAMEXP	Same as NAMEXP
Model	IJK new passive advection; unified LSM with hail fix (18z 10/24), GWD w/SIGFAC=0 (10/16)	Same as NAMEXP	Same as NAMEXP but with no GWD (18z 10/16)
Assimilation	OCONUS soil states adjusted with 00z NAMEXP 12-36 h precip	Same as NAMEXP, but with 00z ops NAM 12-36 h precip	Same as NAMY
Date of last restart	**18z 13 November from GDAS (atmo) and NAMEXP (sfc)**	**18z 13 November from GDAS (atmo) and NAMY (sfc)**	**Restarted from NDASY on 12z 14 November**

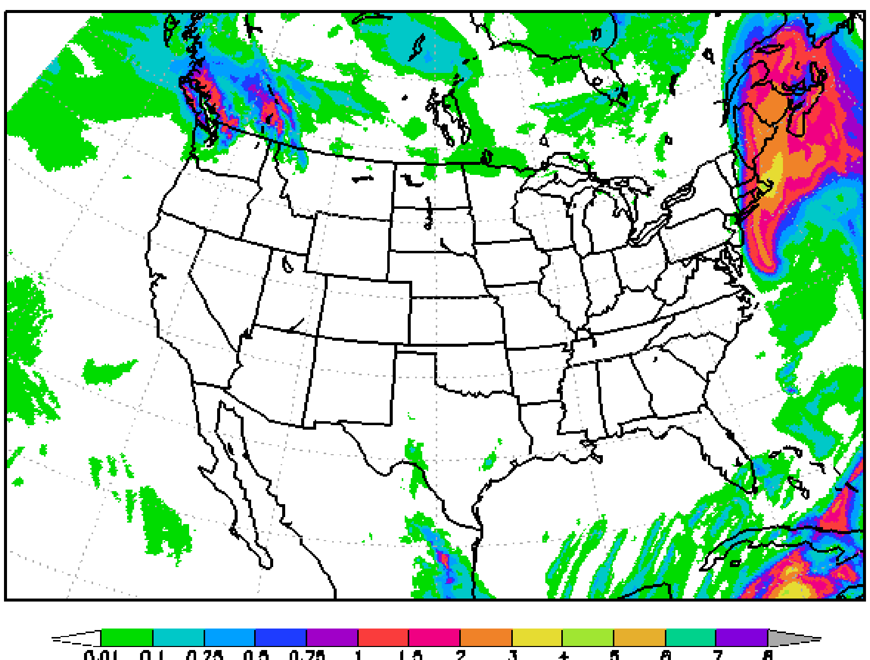
36-60 H APCP NAM 60H FCST VALID 12Z 04 NOV 2007

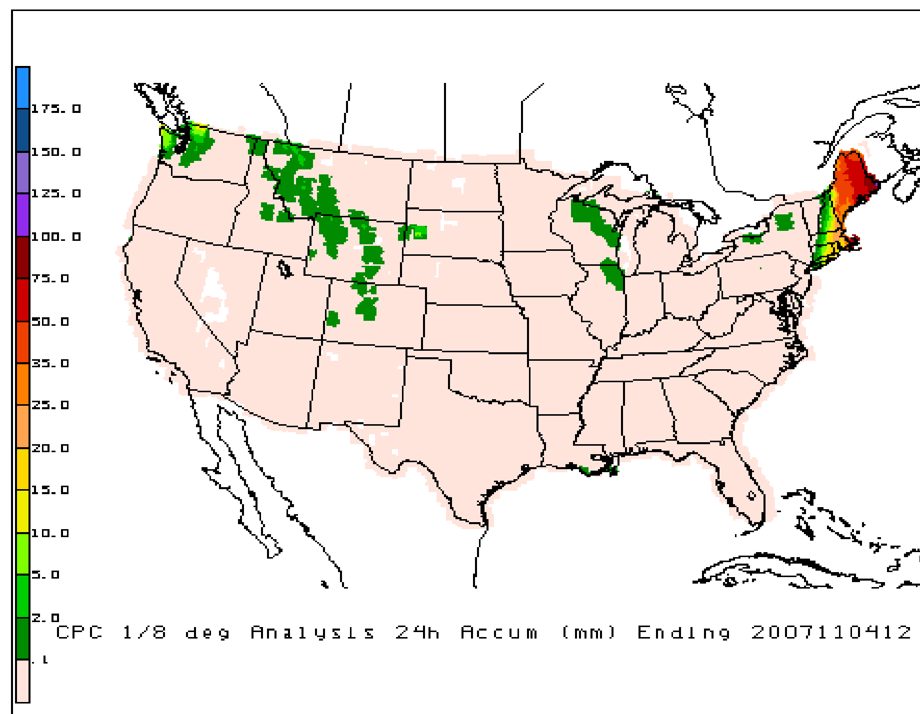


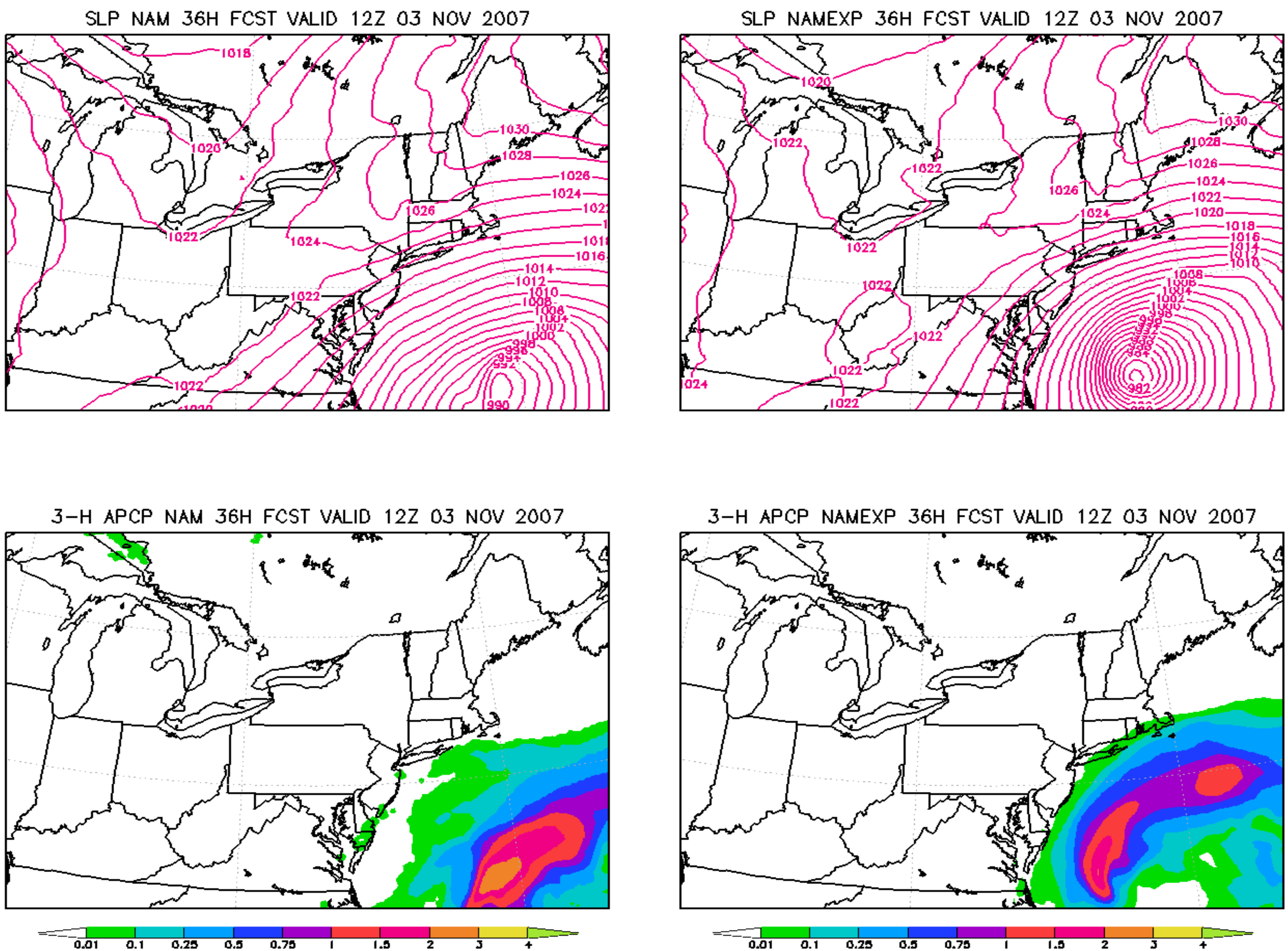
36-60 H APCP GFS 60H FCST VALID 12Z 04 NOV 2007

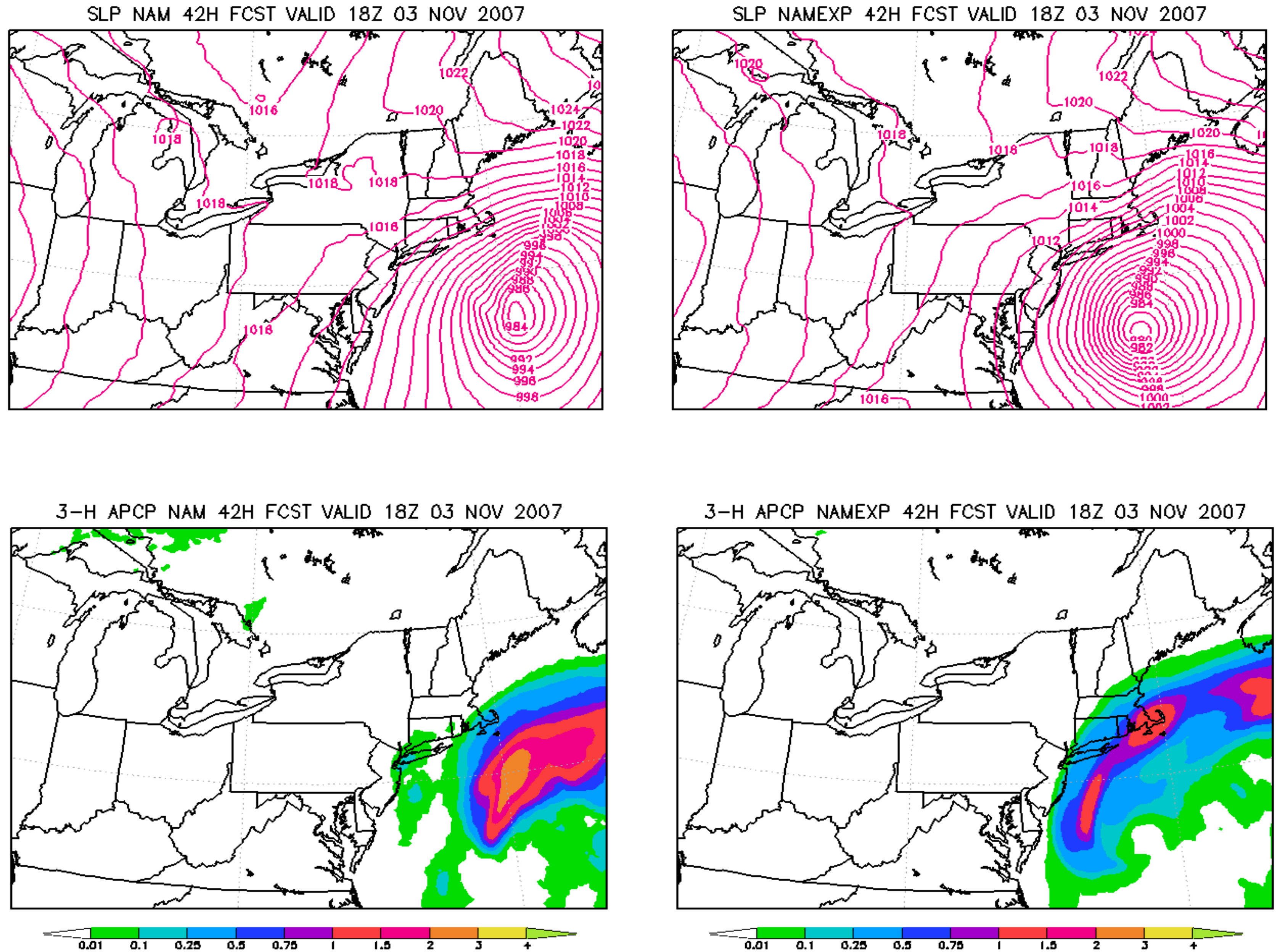


36-60 H APCP NAMEXP 60H FCST VALID 12Z 04 NOV 2007

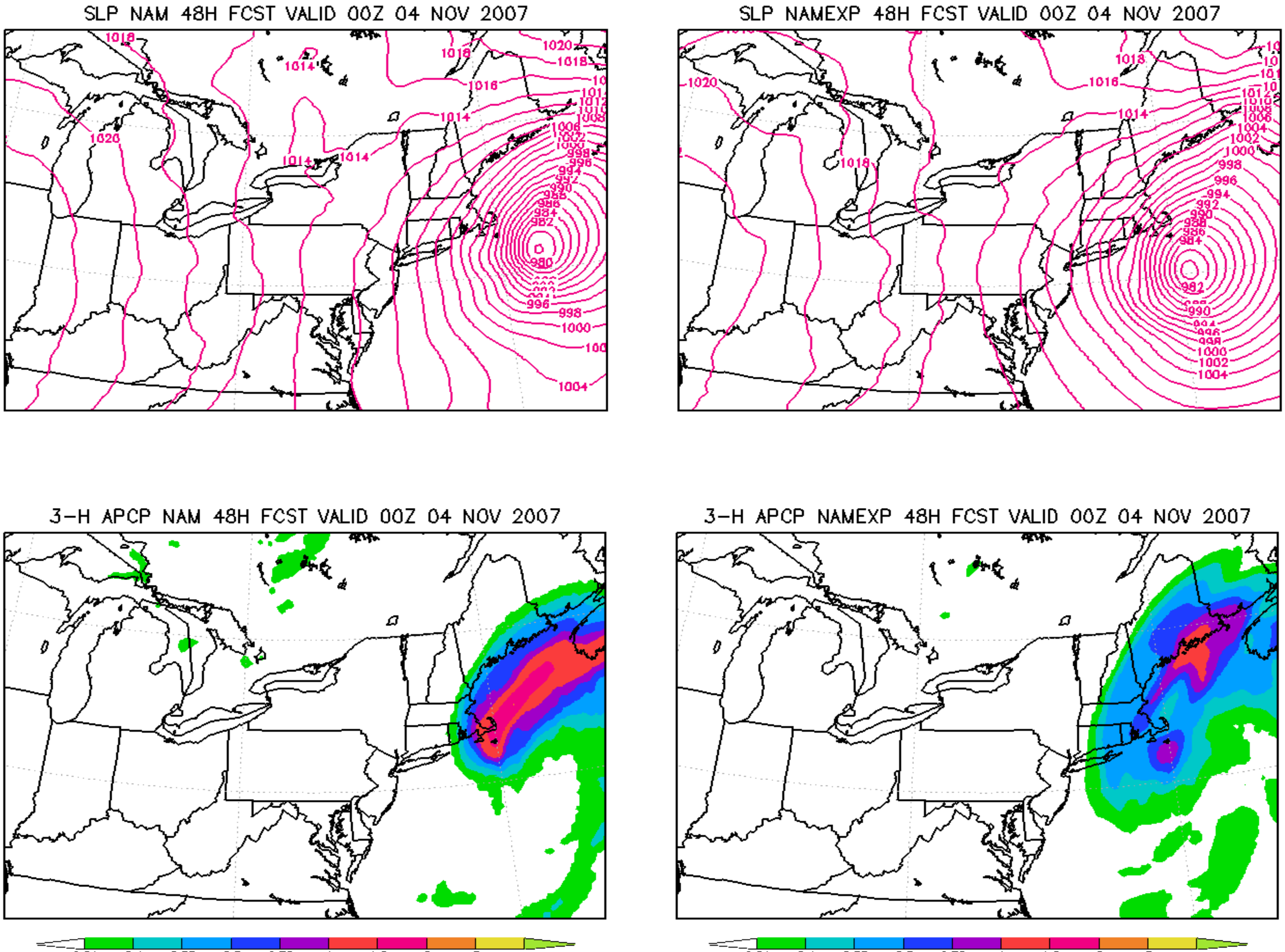





SLP NAM 36H FCST VALID 12Z 03 NOV 2007
SLP NAMEXP 36H FCST VALID 12Z 03 NOV 2007
3-H APCP NAM 36H FCST VALID 12Z 03 NOV 2007
3-H APCP NAMEXP 36H FCST VALID 12Z 03 NOV 2007
0.01 0.1 0.25 0.5 0.75 1 1.5 2 3 4
0.01 0.1 0.25 0.5 0.75 1 1.5 2 3 4

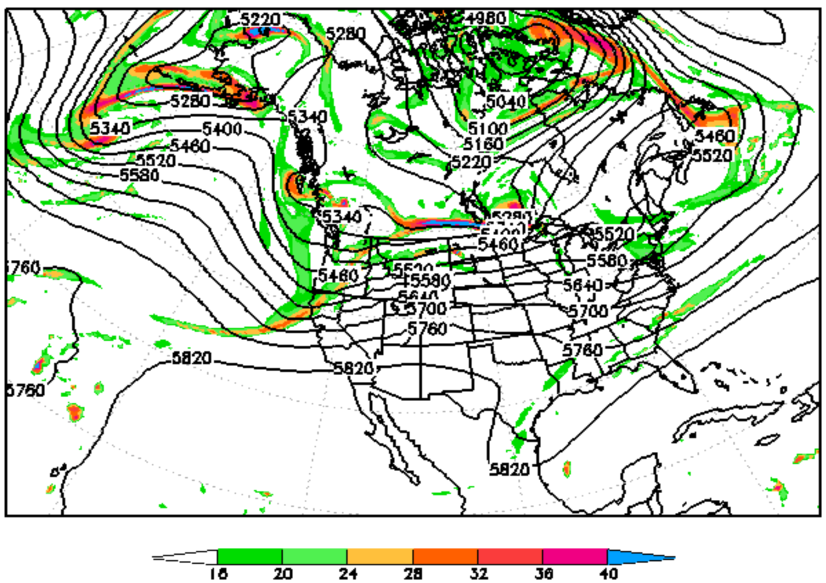


SLP NAM 42H FCST VALID 18Z 03 NOV 2007
SLP NAMEXP 42H FCST VALID 18Z 03 NOV 2007
3-H APCP NAM 42H FCST VALID 18Z 03 NOV 2007
3-H APCP NAMEXP 42H FCST VALID 18Z 03 NOV 2007
0.01 0.1 0.25 0.5 0.75 1 1.5 2 3 4
0.01 0.1 0.25 0.5 0.75 1 1.5 2 3 4

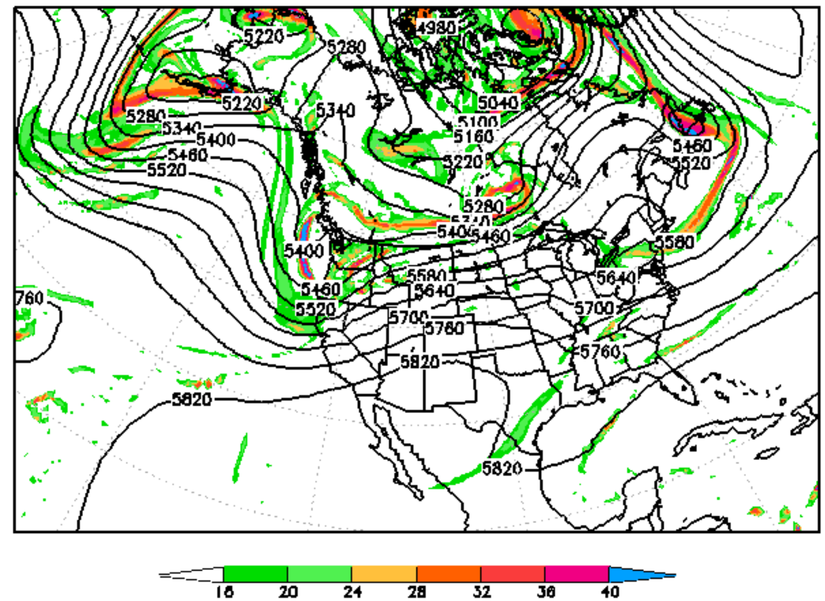

SLP NAM 48H FCST VALID 00Z 04 NOV 2007
SLP NAMEXP 48H FCST VALID 00Z 04 NOV 2007
3-H APCP NAM 48H FCST VALID 00Z 04 NOV 2007
3-H APCP NAMEXP 48H FCST VALID 00Z 04 NOV 2007
0.01 0.1 0.25 0.5 0.75 1 1.5 2 3 4
0.01 0.1 0.25 0.5 0.75 1 1.5 2 3 4

Another “NAMEXP looks more GFS-like” example

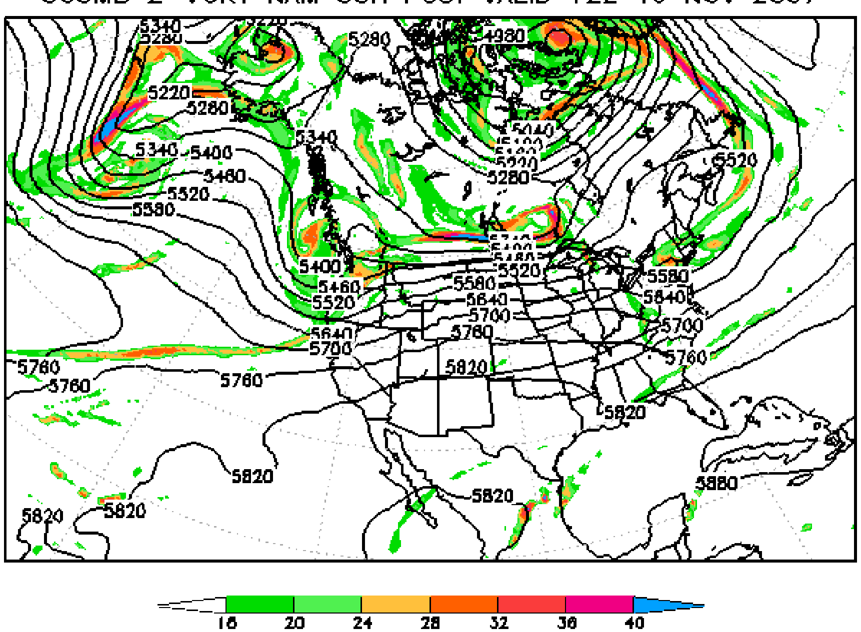
500MB Z-VORT NAM 84H FCST VALID 12Z 19 NOV 2007



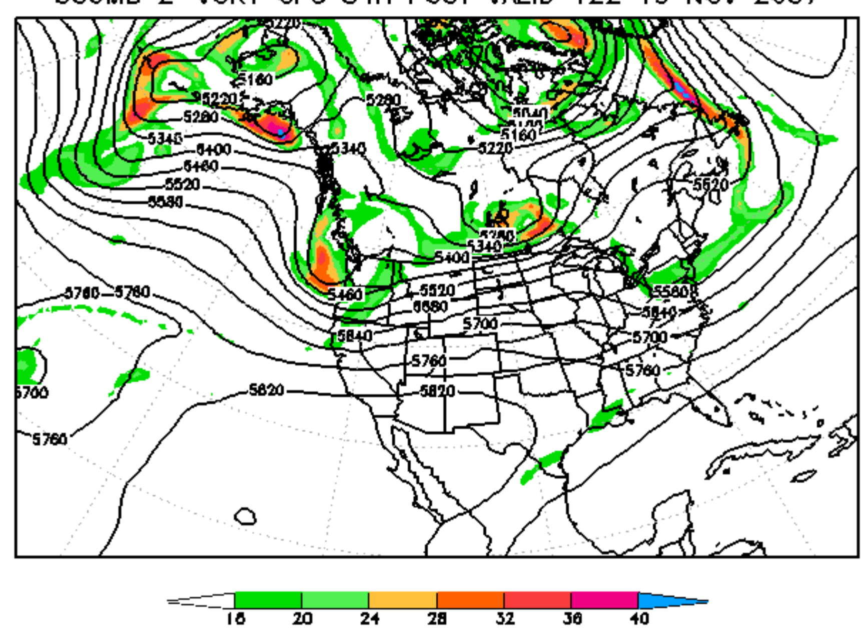
500MB Z-VORT NAMEXP 84H FCST VALID 12Z 19 NOV 2007



500MB Z-VORT NAM 00H FCST VALID 12Z 19 NOV 2007



500MB Z-VORT GFS 84H FCST VALID 12Z 19 NOV 2007



Recent Cumulative Stats

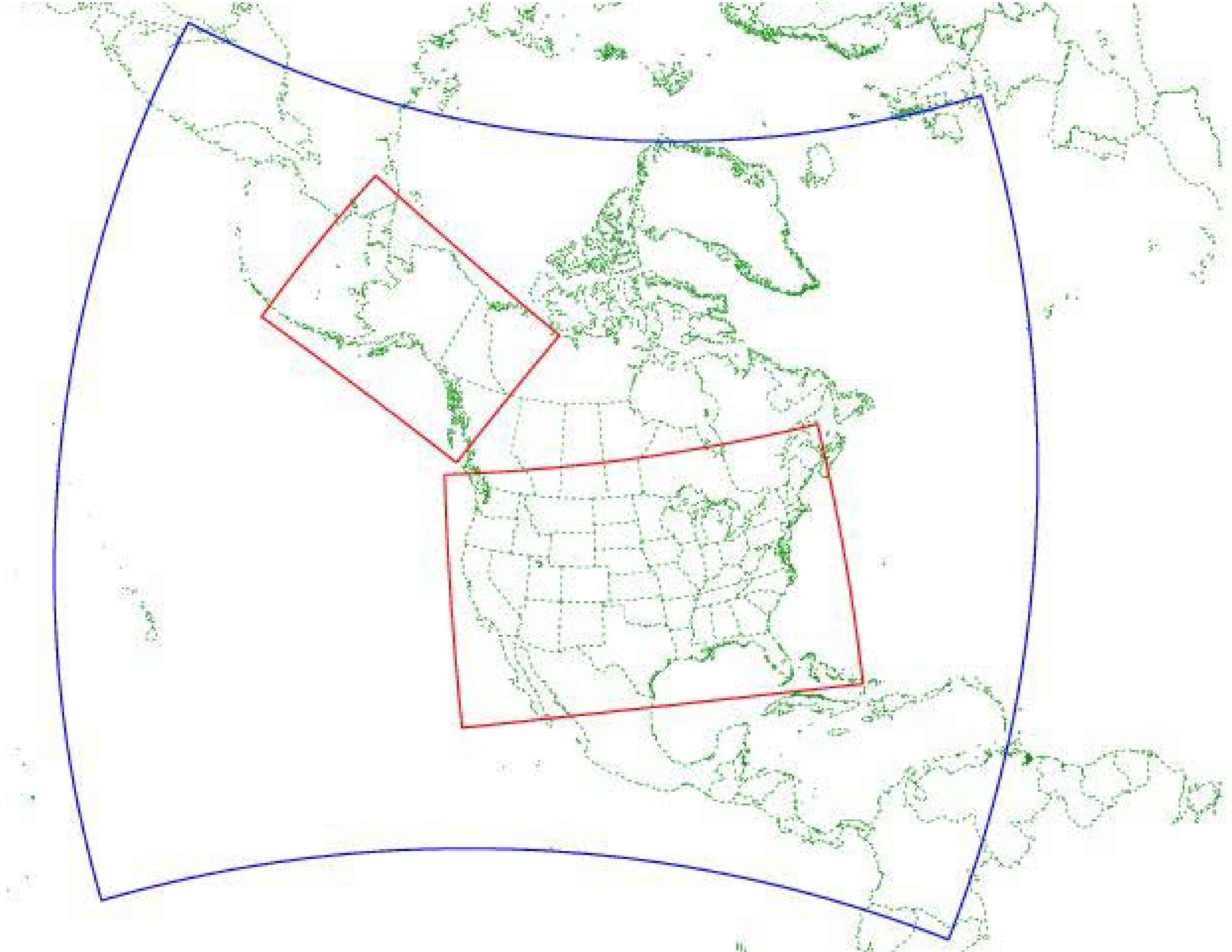
- NAMEXP vs Ops NAM (25 Oct – 18 Nov)
- NAMEXP vs NAMY vs ops NAM (24 Oct – 13 Nov) : NAMEXP, NAMY running the same model/analysis, both restarted at 18z 10/23; test of domain size
- NAMY vs NAMR vs Ops NAM (19 Oct – 12 Nov) : Clean test of GWD (not running in NAMR)

- Looking for a February 2008 implementation

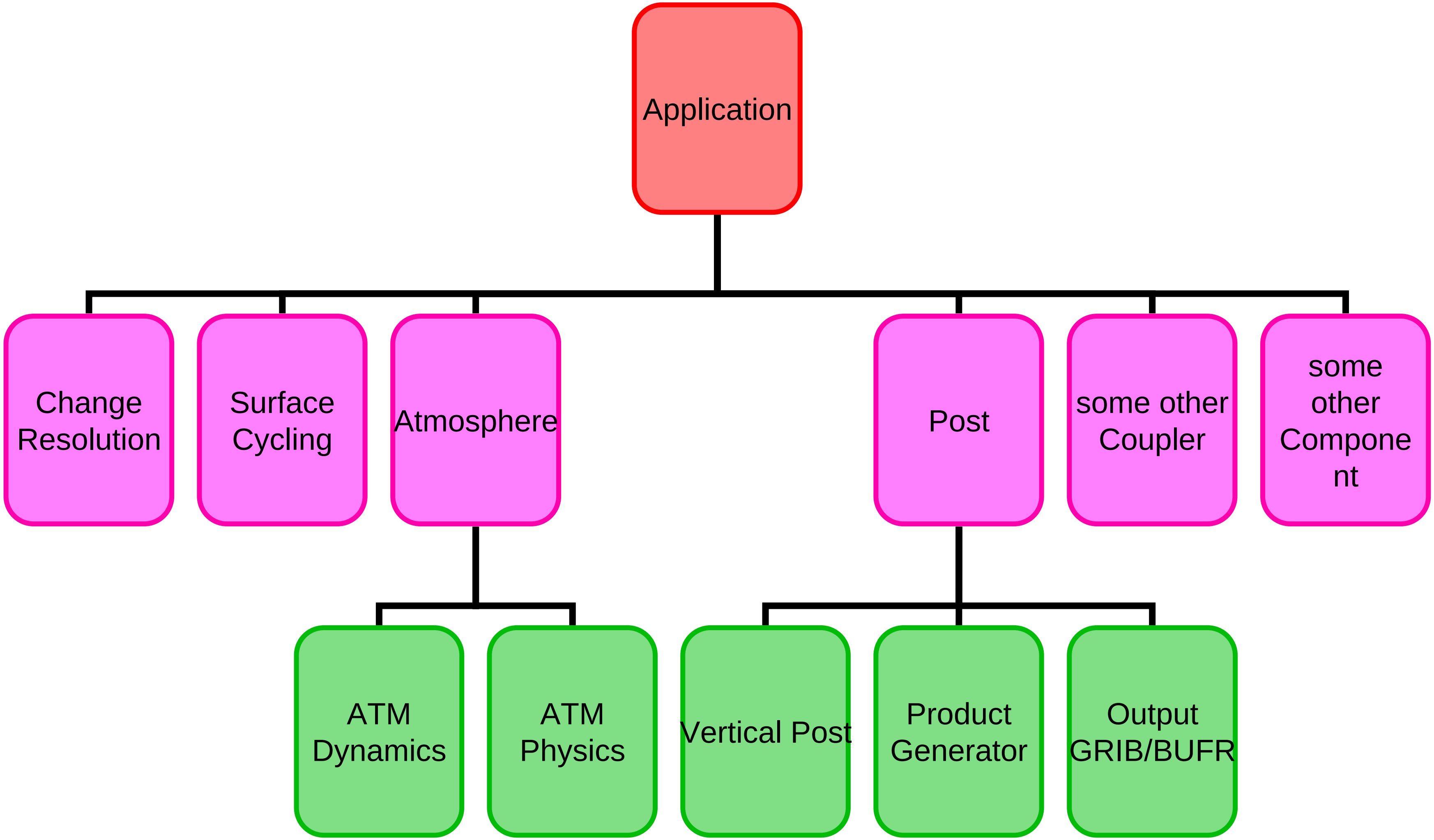
NAM Future Plans

- Current new machines (dew/mist) 2008-2009
  - Physics tuning (unification with GFS?)
  - Resolve GSI issues
    - Strong constraint, partial cycling, FGAT + FOTO, digital filter
    - Hourly cycling, radar assimilation, satellite channel bias correction
    - Non-linear quality control, dynamic reject lists
    - Test new sources of data: TAMDAR, COSMIC …
- Next machine (providing ~3x dew/mist) 2009-2010
  - Parent run is 12 km with all its normal NAM products out to 84 hr
  - Add 4 km nests over CONUS and Alaska run to 48 hours only
  - Nested fields available ~3 hours earlier than HiResWindow
  - 4 km output grids would be additional to existing NAM 12 km suite
- May not be many changes in 2009 update bundle due to
  - Move to new building (I hope I didn't just jinx it!)
  - Move to new ESMF-based NEMS (NCEP Environmental Modeling System)

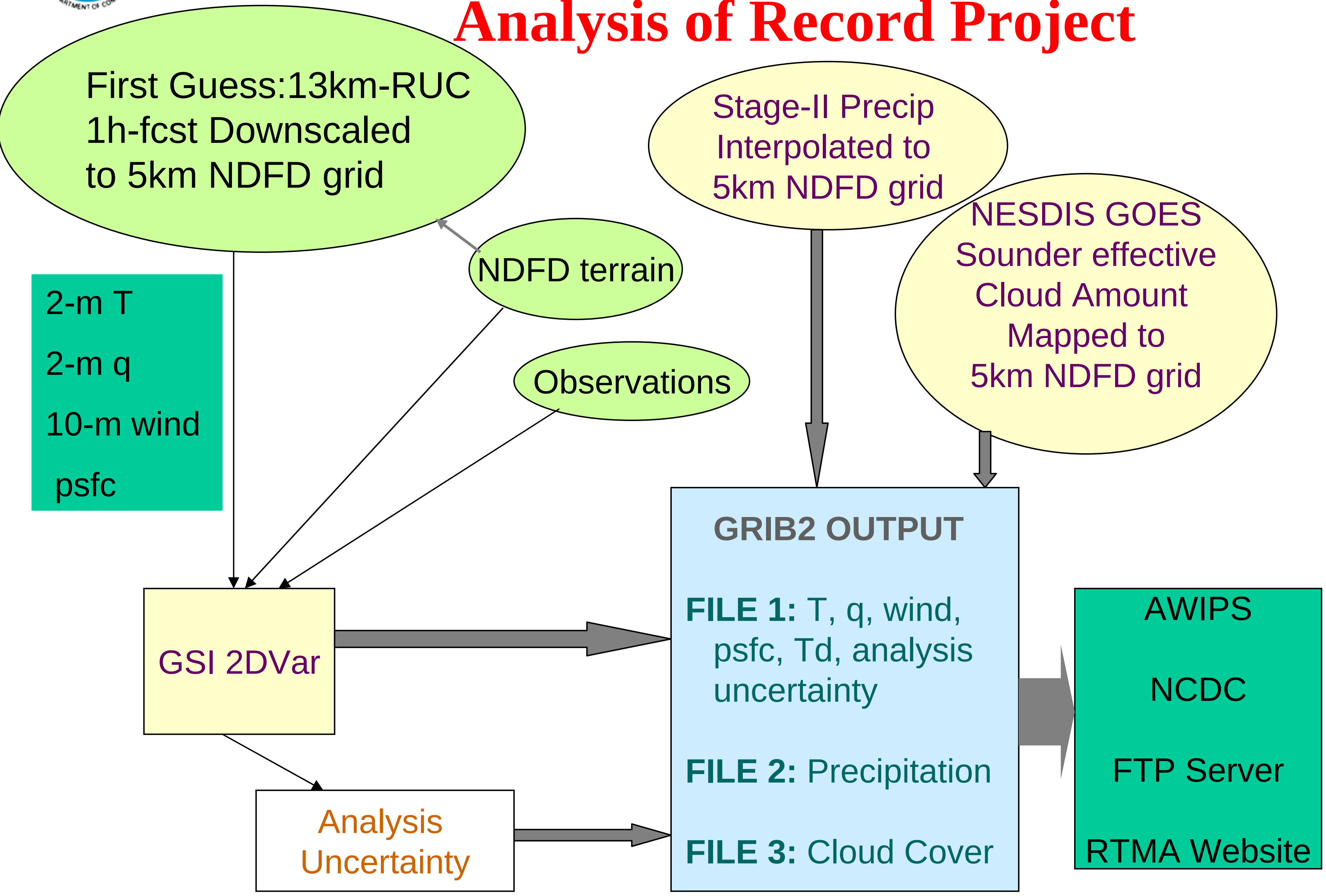
Future 4 km Nests Imbedded in 12 km NAM



NEMS Uses ESMF Component Framework



RTMA: First Phase of the Analysis of Record Project



RTMA Observations & Quality Control

- Surface Land (SYNOPTIC and METAR)
- Surface marine (Ship, Buoy, C-MAN)
- Surface Mesonets
- SSM/I Superobed wind speeds over ocean
- QuikSCAT winds over ocean

DATA FEED

- Conventional through TOC
- Mesonets through ESRL MADIS

Characteristics of the RTMA GSI -2DVar

- Background error covariances mapped to the NDFD topography to a controlled degree. Implemented with
  the help of spatial recursive filters.
  => Restrict ob influence based on elevation
  differences.

- Observation QC includes gross error checks, use of dynamic reject lists, WFOs reject lists, and
  mesonet wind 'uselists'.

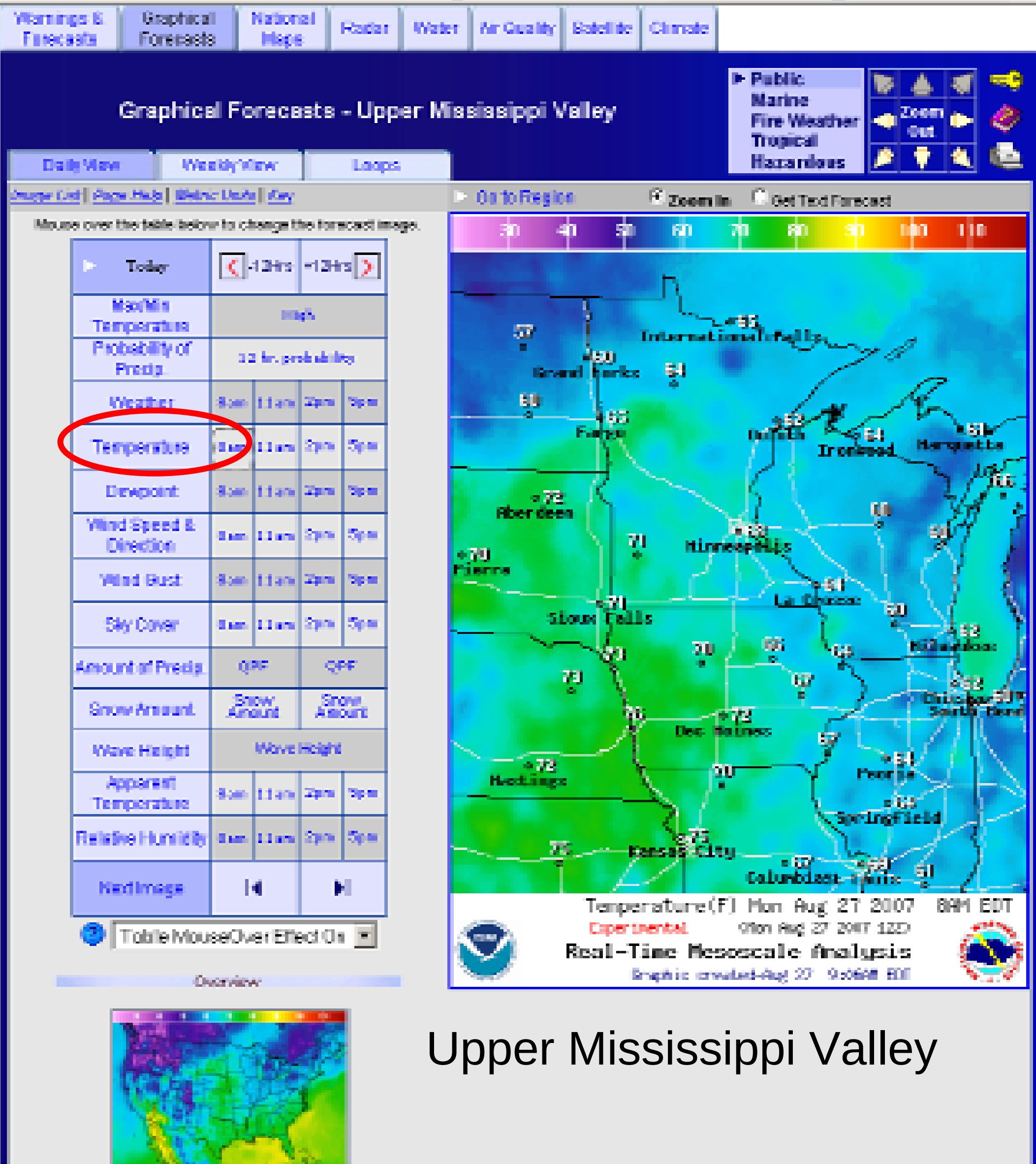
- Analysis error estimate via the Lanczos method for solving large scale eigenvalue problems in its connection with the pre-conditioned conjugate gradient method used in the GSI minimization.

RTMA Evaluation Website

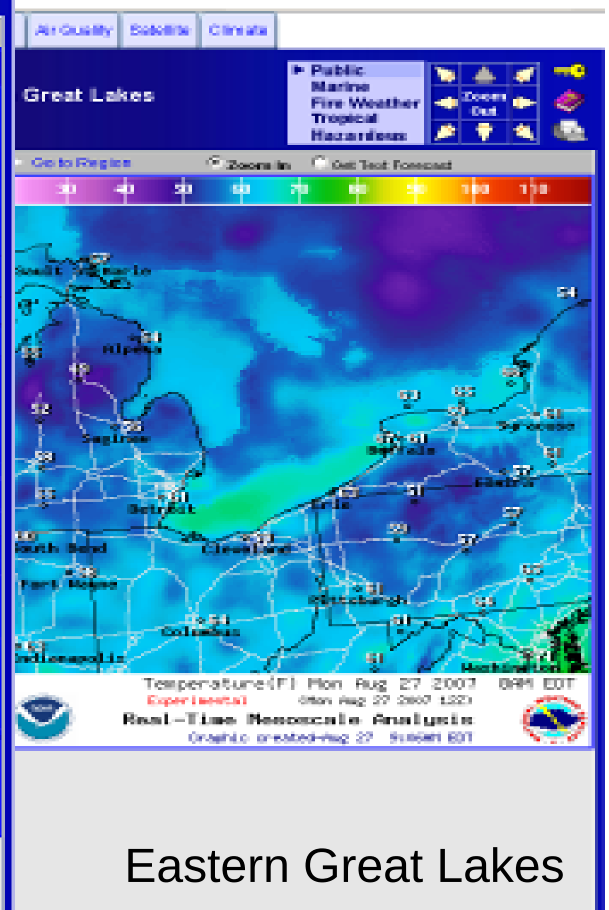
- http://www.emc.ncep.noaa.gov/mmb/rtma/
- Established 24 Jan. 2006 by Geoff Manikin
  - 7 geographical sub-regions displayed:
    NE, DC, FL, MW, TX, NW and SW
  - 3 analysis field displays: 2 m Temperature,
    2 m Dew Point and 10 m Wind
  - 4 analysis increment displays: 2 m Temp,
    2 m Dew Point, 10 m Wind Speed and
    10 m Vector Wind
- The IFPS Science Steering Team (ISST) has coordinated the distribution of the parallel datasets to the field and is conducting a field evaluation
- Western region site http://www.wrh.noaa.gov/wrh/rtma/

NDFD Fields at Times Prior to Current Now Populated with RTMA

http://www.weather.gov/forecasts/graphical/sectors/



Upper Mississippi Valley



Eastern Great Lakes

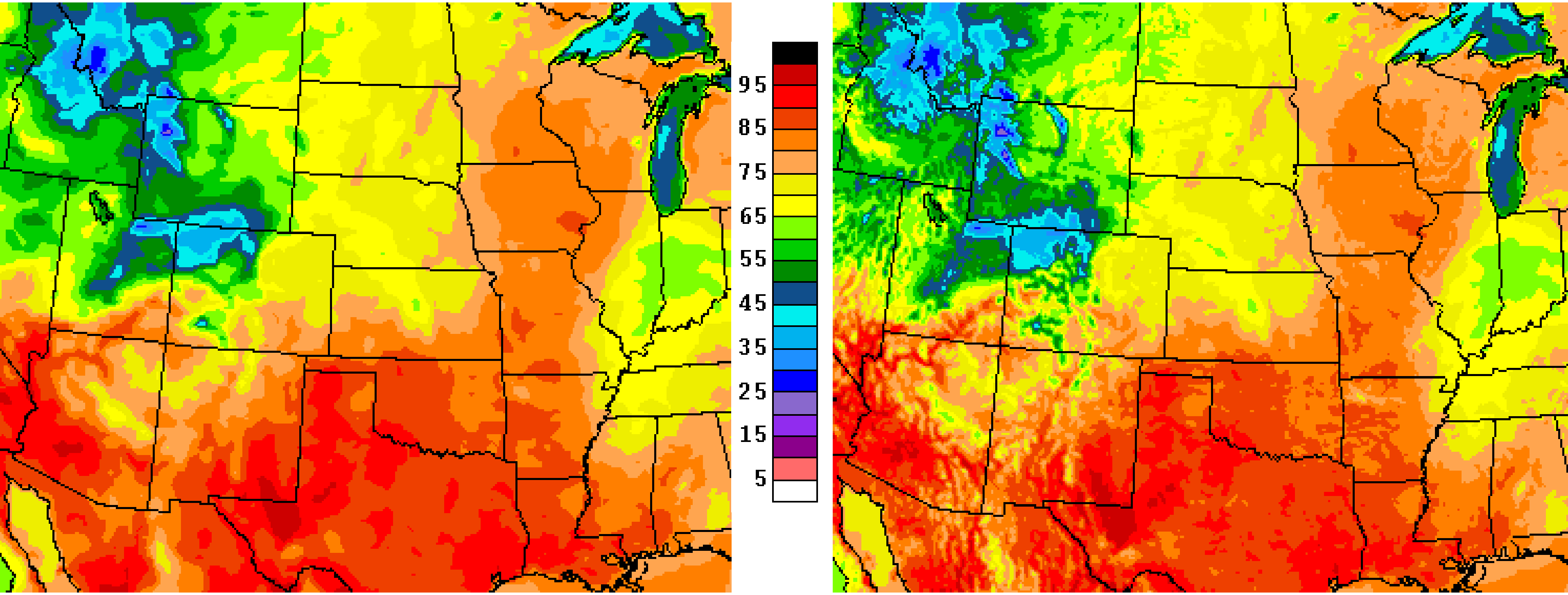
June/July 2007 RTMA Upgrades

- http://www.emc.ncep.noaa.gov/mmb/rtma/para
- Fine-tuned obs and background errors ➔ Analysis is now drawing much closer to the observations
- Reduced spatial scales of the anisotropic filter ➔ more fine scales resolved in the analysis
- **Improved handling of analysis near coasts: Elevation gradient made artificially large in order to obtain sharp background error covariances ➔ Reduced influence of coastal-land temperatures on over-water temperatures**
- Recalibrated observation gross error check
- Dynamic 'reject lists' of observations (especially mesonets) based on gross error checks from previous analyses
- Improved observation operators near coasts so that interpolation uses only grid points of one type (land or water)
- Run-time observation buddy check

RTMA First Guess / 2-m T

Original 13 km

Downscaled 5 km



- Contacts: Stan Benjamin, John Brown (NOAA/ESRL/GSD)
- Geoff Manikin (NOAA/EMC/NCEP)

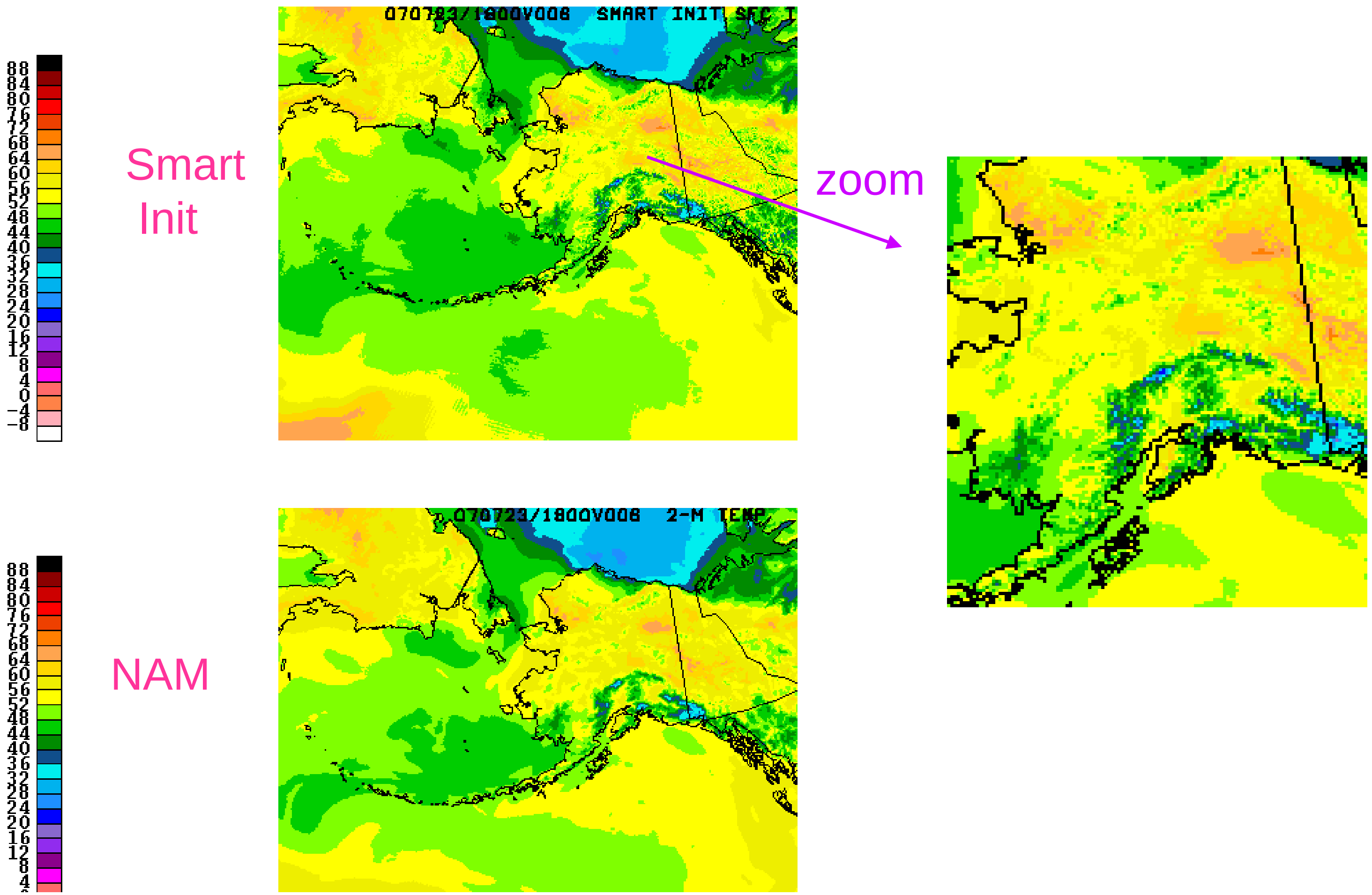
RTMA Plans

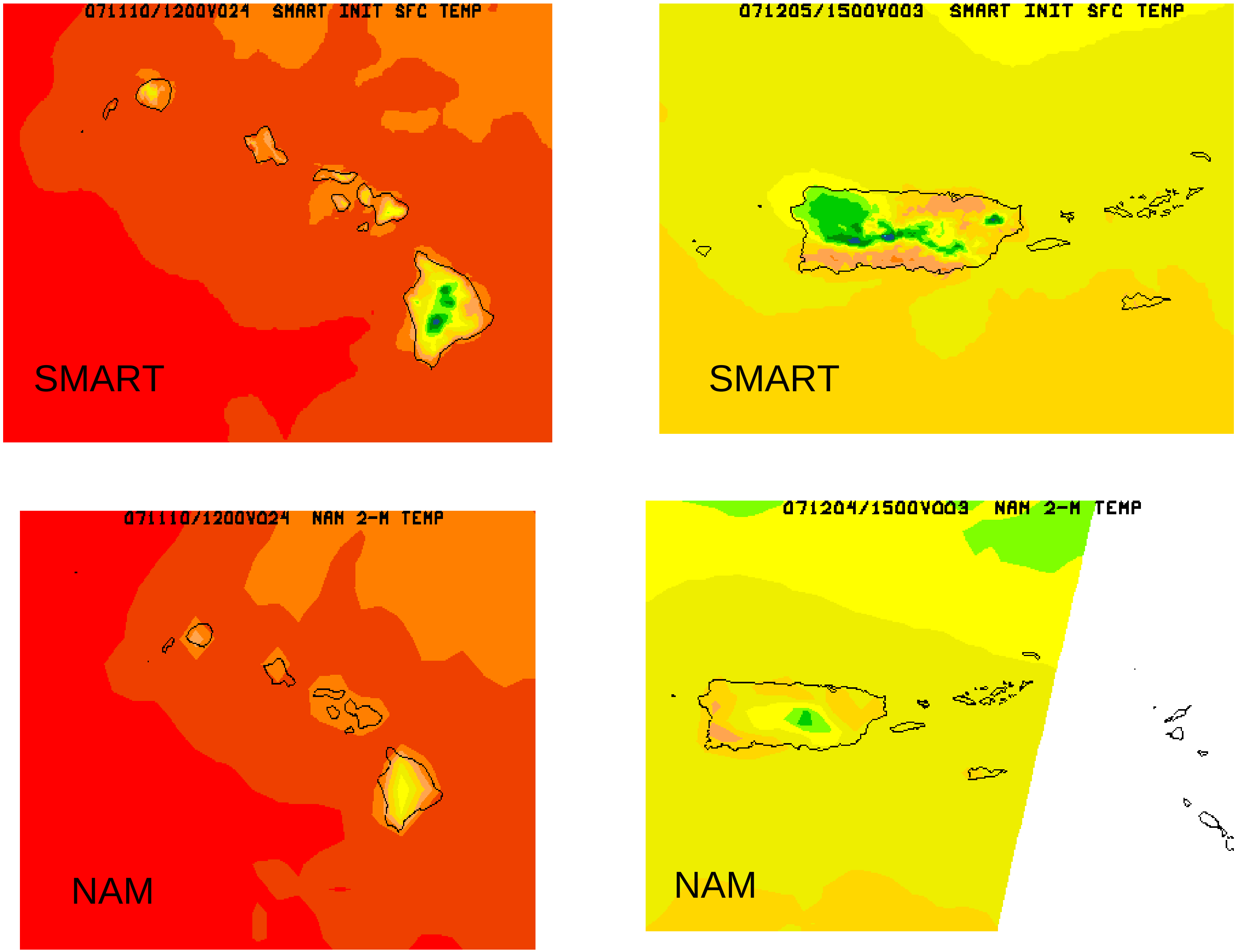
- Expand to Alaska – January 2008
- Expand to Hawaii, Puerto Rico
- Smartinit for GFS (requires FIRC funding!)
- Expand to Guam
- Expand variables

SmartInit / DNG

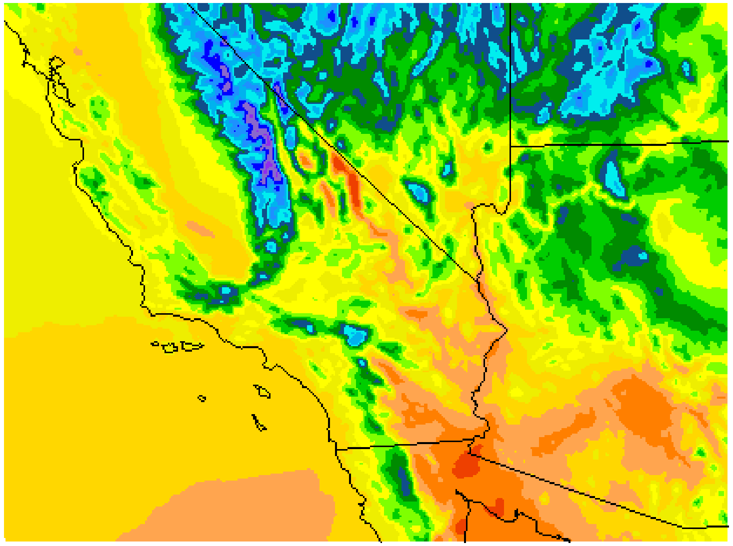
- Local NWS offices run “smartinit” code to populate 5 km NDFD grids, using 40 km NAM dataset with limited vertical resolution as starting point
- EMC now creating this data using 12 km native grids with full vertical resolution
- NCO now running parallels for CONUS, Alaska, and Hawaii;   EMC developing Puerto Rico
- Process involves interpolating fields to 5 (2.5 for HI/PR) km, computing elements like weather type and POP, and then downscaling temperatures, dew points, and winds to match hi-res terrain
- **Also serves as 1st guess for RTMA in AK/HI/PR**

Sample Alaska SmartInit Plot

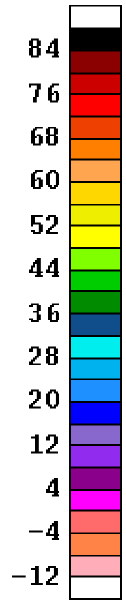


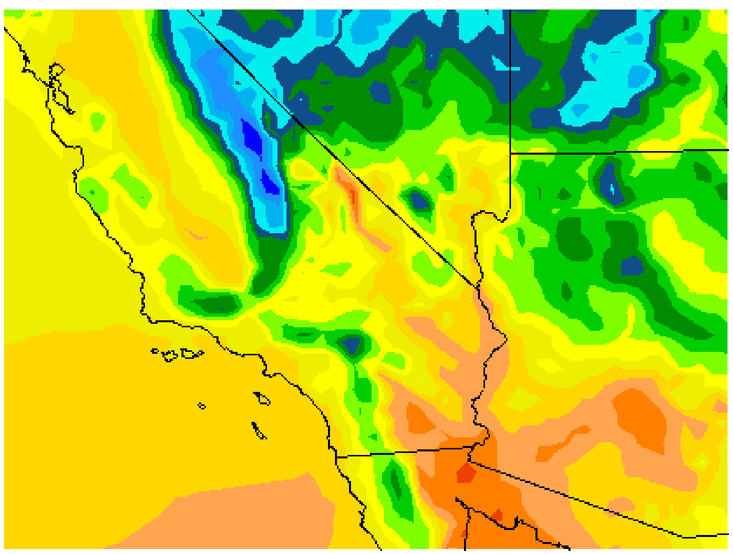

071110/1200V024 SMART INIT SFC TEMP
SMART
071205/1500V003 SMART INIT SFC TEMP
SMART
071110/1200V024 NAM 2-M TEMP
NAM
071204/1500V003 NAM 2-M TEMP
NAM

SMART INIT



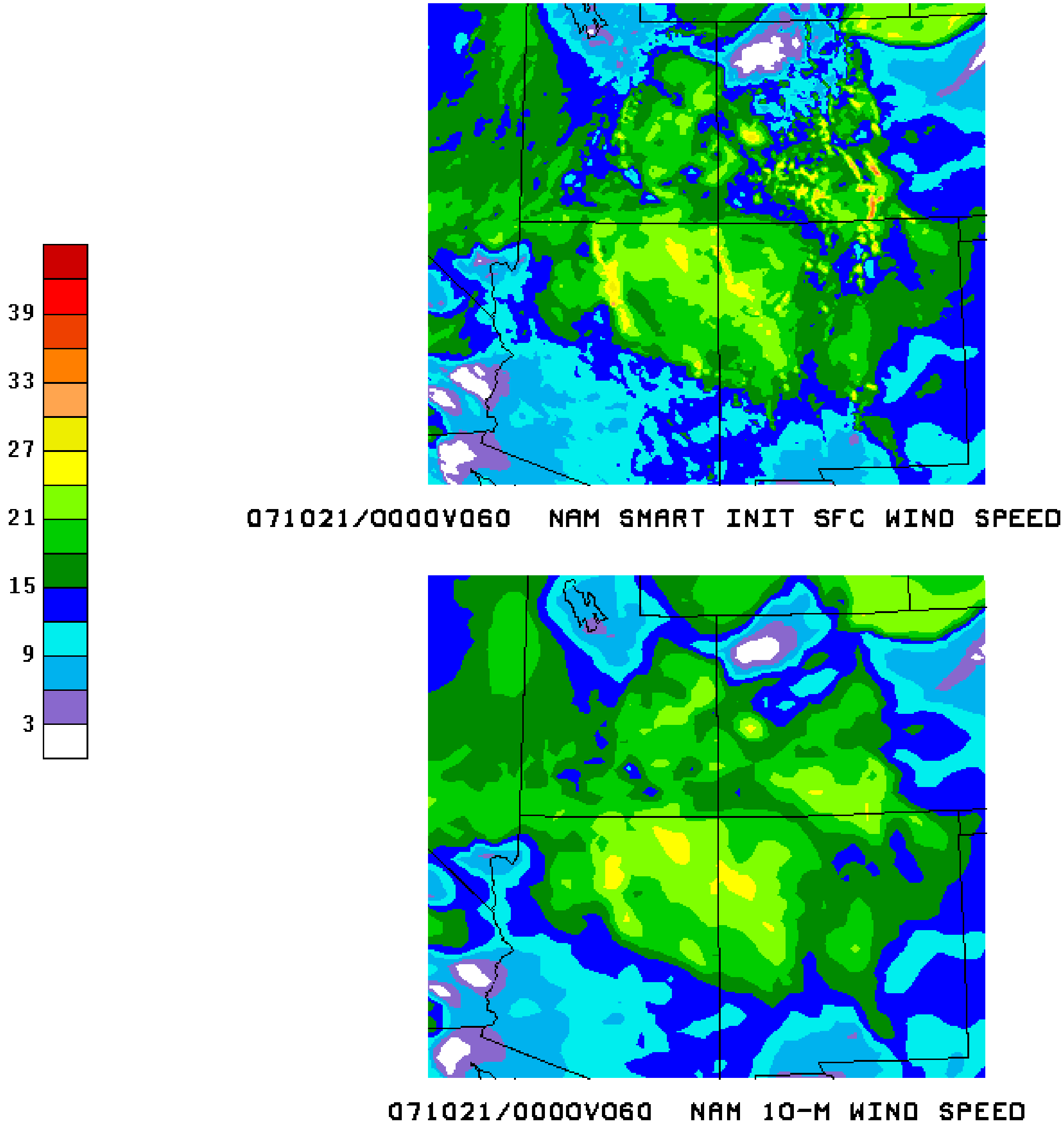
071208/0000V012 NAM SMART INIT SFC TEMPERA





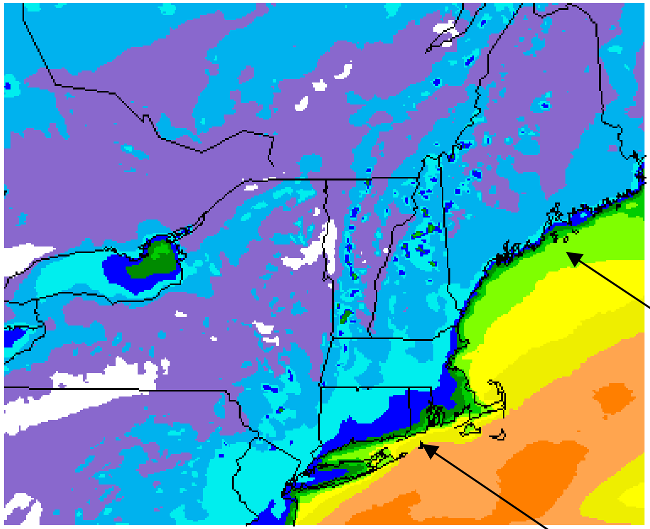
071208/0000V012 NAM 2-M TEMPERATURE

NAM

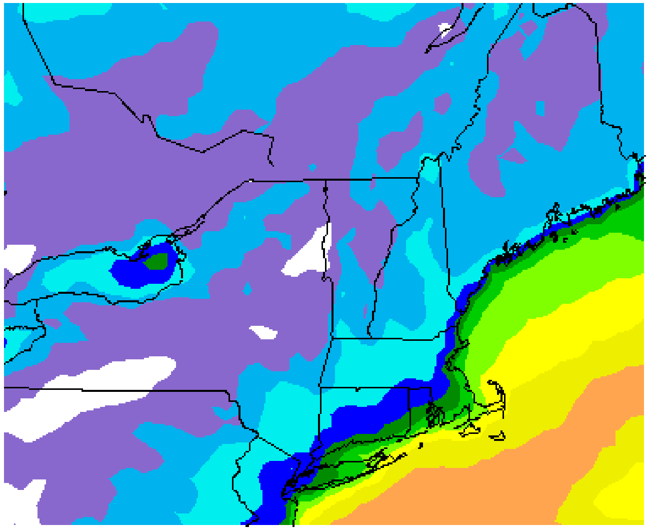


Downscaled
10-m winds

NAM “regular”
10-m winds



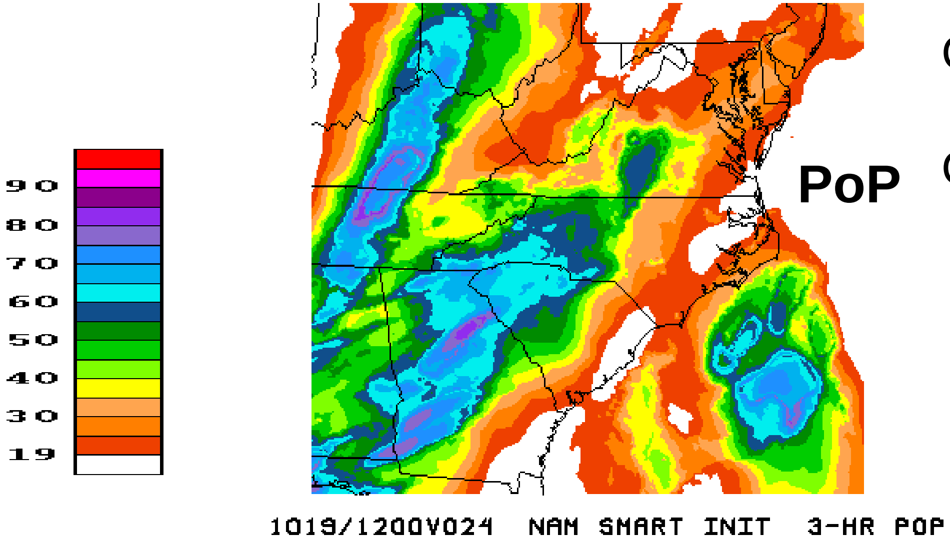
071103/1200V024 NAM SMART INIT SFC WIND SPEED



071103/1200V024 NAM 10-M WIND SPEED

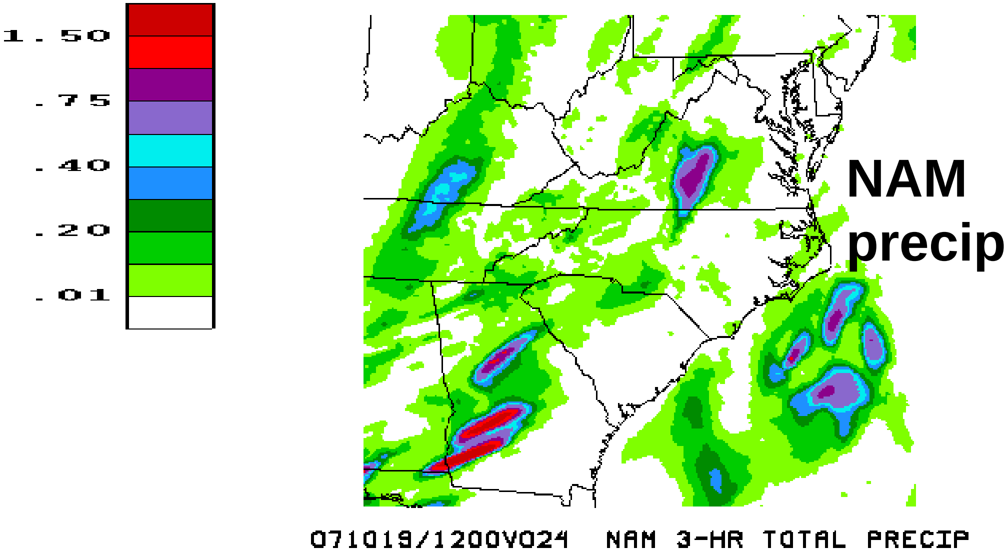
Downscaling technique also sharpens coastal gradients

Revised Smarinit PoPs



Old smartinit method
totally based on model
QPF and RH;
high model QPF=high PoP

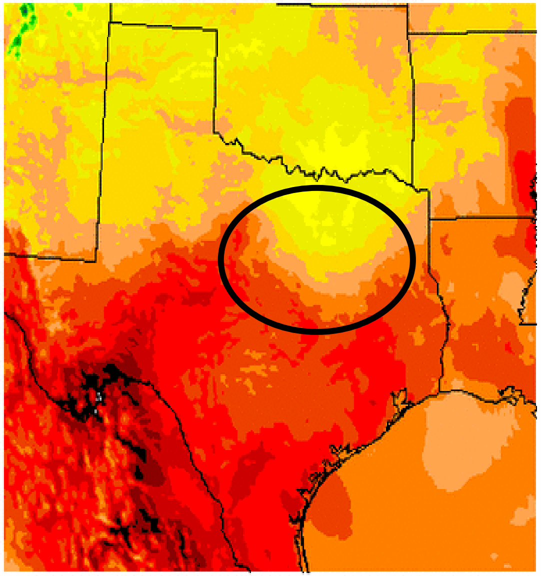
With higher resolution
we get mesoscale bands
which lead to narrow bands
of high PoP surrounded by
large areas of low or 0 PoP



New method combines
old method with SREF
pops

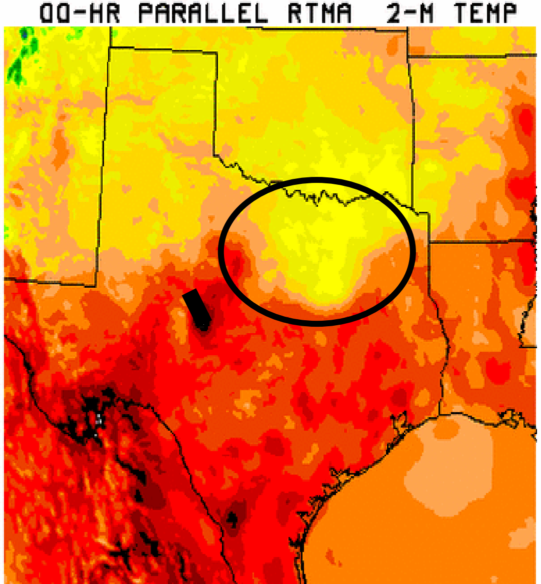
Parallel RTMA better captures this TX cold pool

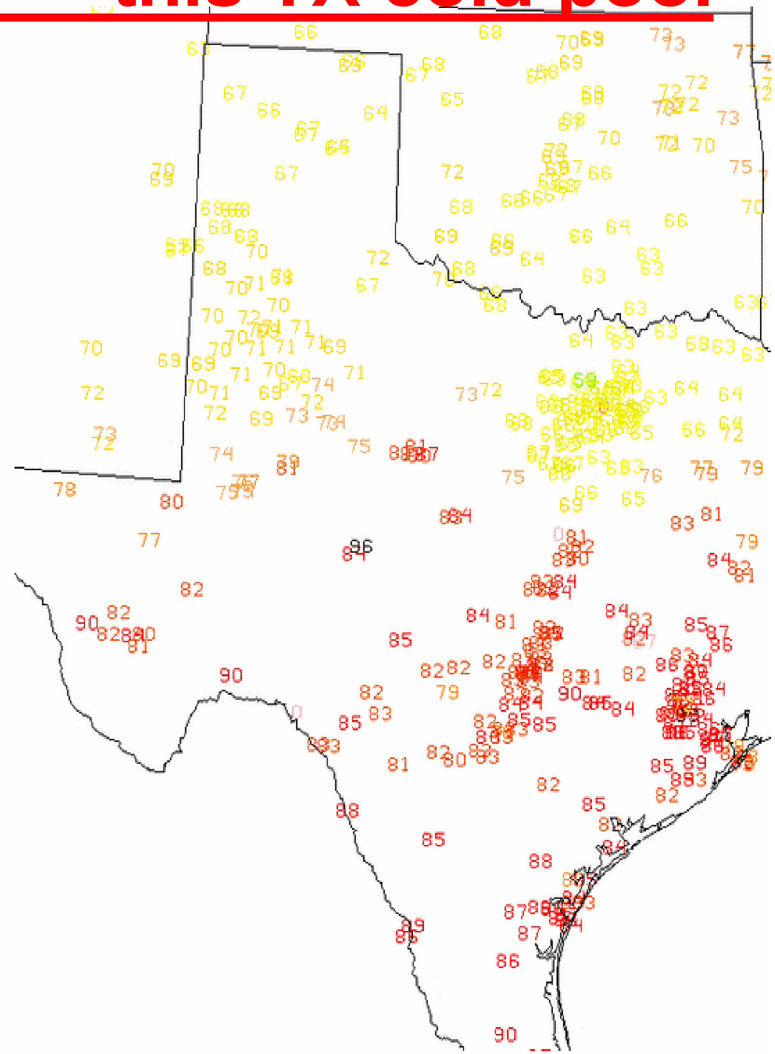
00-HR RTMA 2-M TEMP



ANALYSIS VALID 17Z 05/30

00-HR PARALLEL RTMA 2-M TEMP





070530/1700 TEMPERATURE OBSERVATIONS

2007 AQ Developments

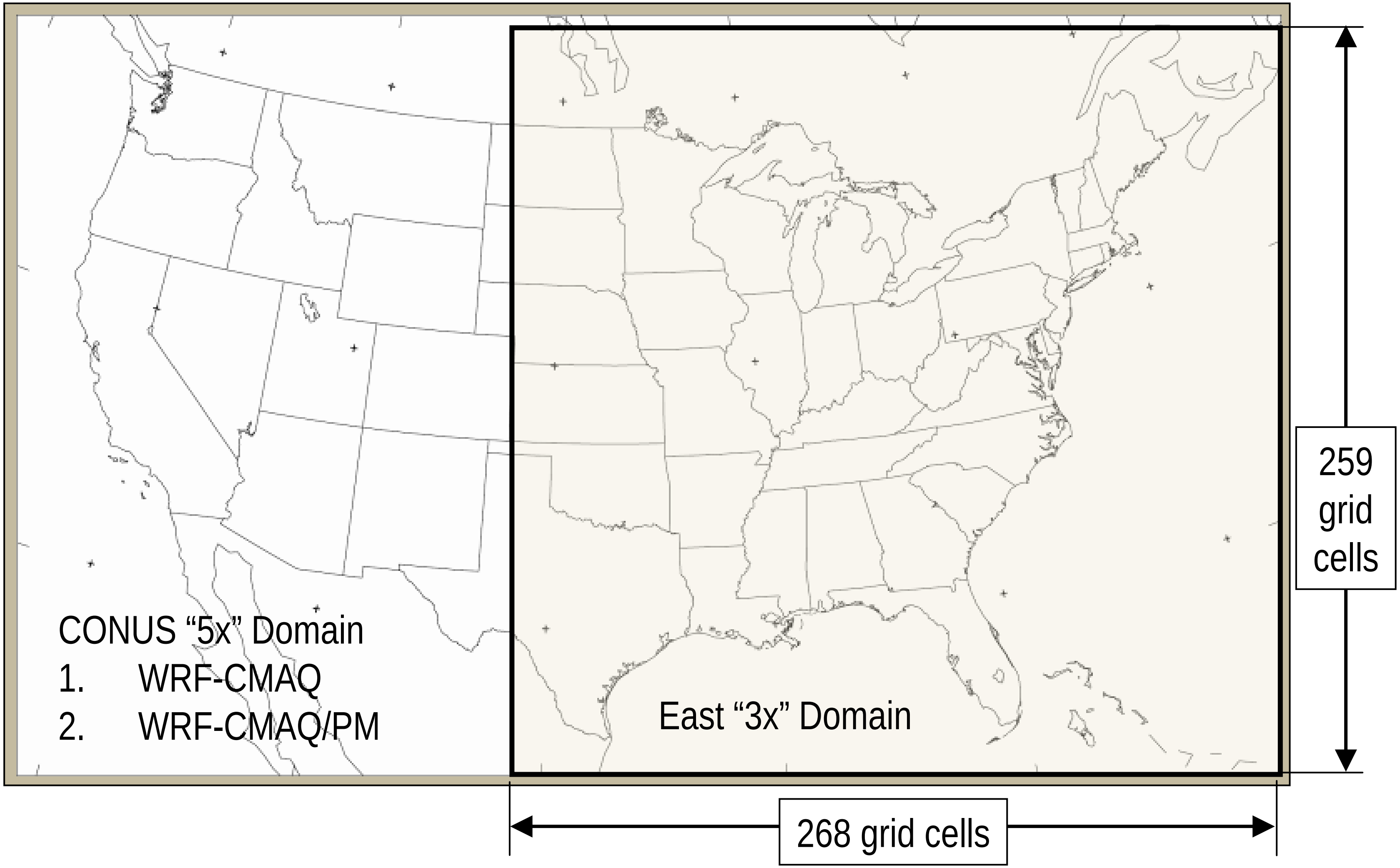
- WRF upgrades
  - Land use/Roughness length corrections: reduce NW high moisture bias
  - Enhanced horizontal diffusion on sloping terrain

- CMAQ Improvements
  - Common NMM vertical coordinate
  - Asymmetric Convective Model (ACM-2) PBL parameterizations
  - Area & Point emissions updated for 2007
    - California 2002 NEI emissions modified for biases
  - Corrections to deposition velocity & plume rise calculations
  - Once/day developmental Particulate Matter 48 hour forecasts

- AQF system retrospective & Real-time testing
  - July 22- Aug 5 2006 with experimental CONUS configuration

- Verification
  - Spatial map comparisons to observations (03 & PBL hgt)
  - Inclusion of NESDIS GASP AOD products
  - Focus group, TEXAQS06 & SHENAIR projects

AQ Forecast Domains (2005-2007)



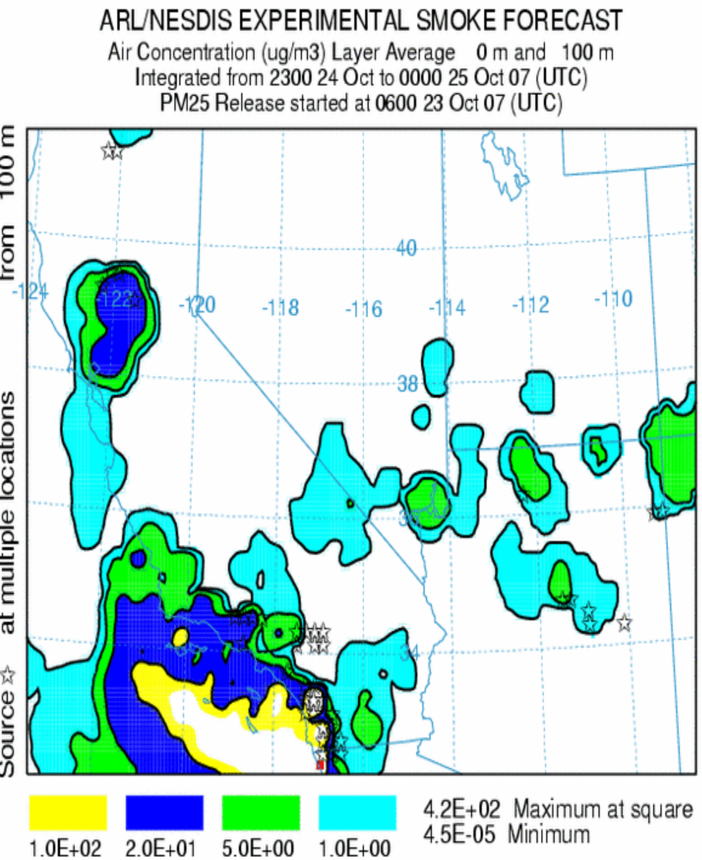
AQ Summary

- Overall results
  - Experimental biases are much improved
    - **NAM changes from 2006 to 2007 also have a positive impact (as Operational run biases improved)**
  - Skill scores are improved at lower levels and comparable at higher thresholds
  - Experimental run provides previously unavailable guidance to Western U.S.

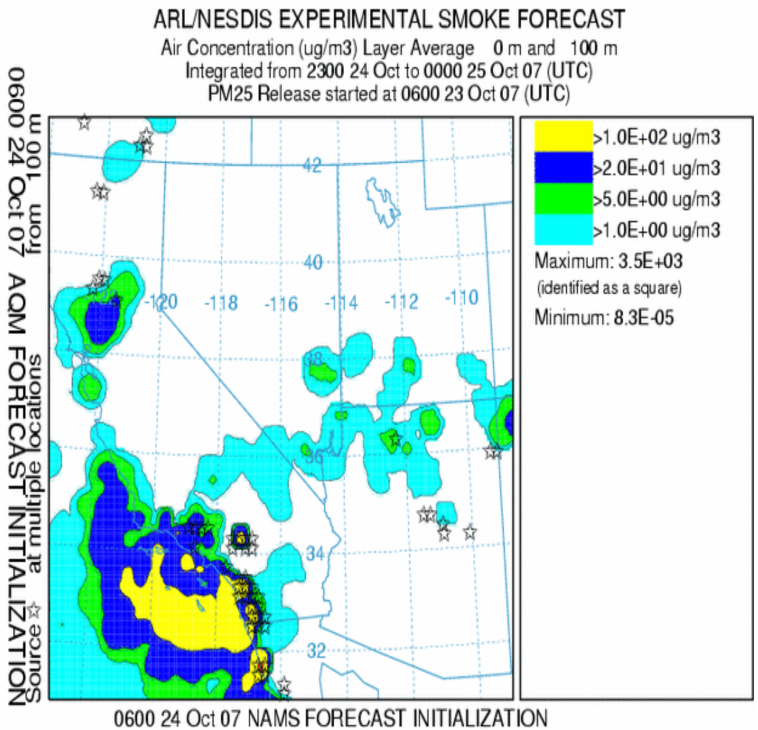
- California O3 forecasts improved
  - Better performance in San Joaquin Valley
  - Underprediction in LA urban area
  - Some Overprediction in Sacramento Valley & downwind of LA

– 5X overprediction along coastal urban areas
  - ACM-2 stable, marine PBL mixing may be too weak
    - **Produces pollutant reservoir off-shore that can impact coastal urban areas (Houston, Long Island Sound, Lake Michigan…)**

Smoke – 10/17 California wildfires



Old graphics



SMOKE UPGRADE (12/07)
w/ improved graphics

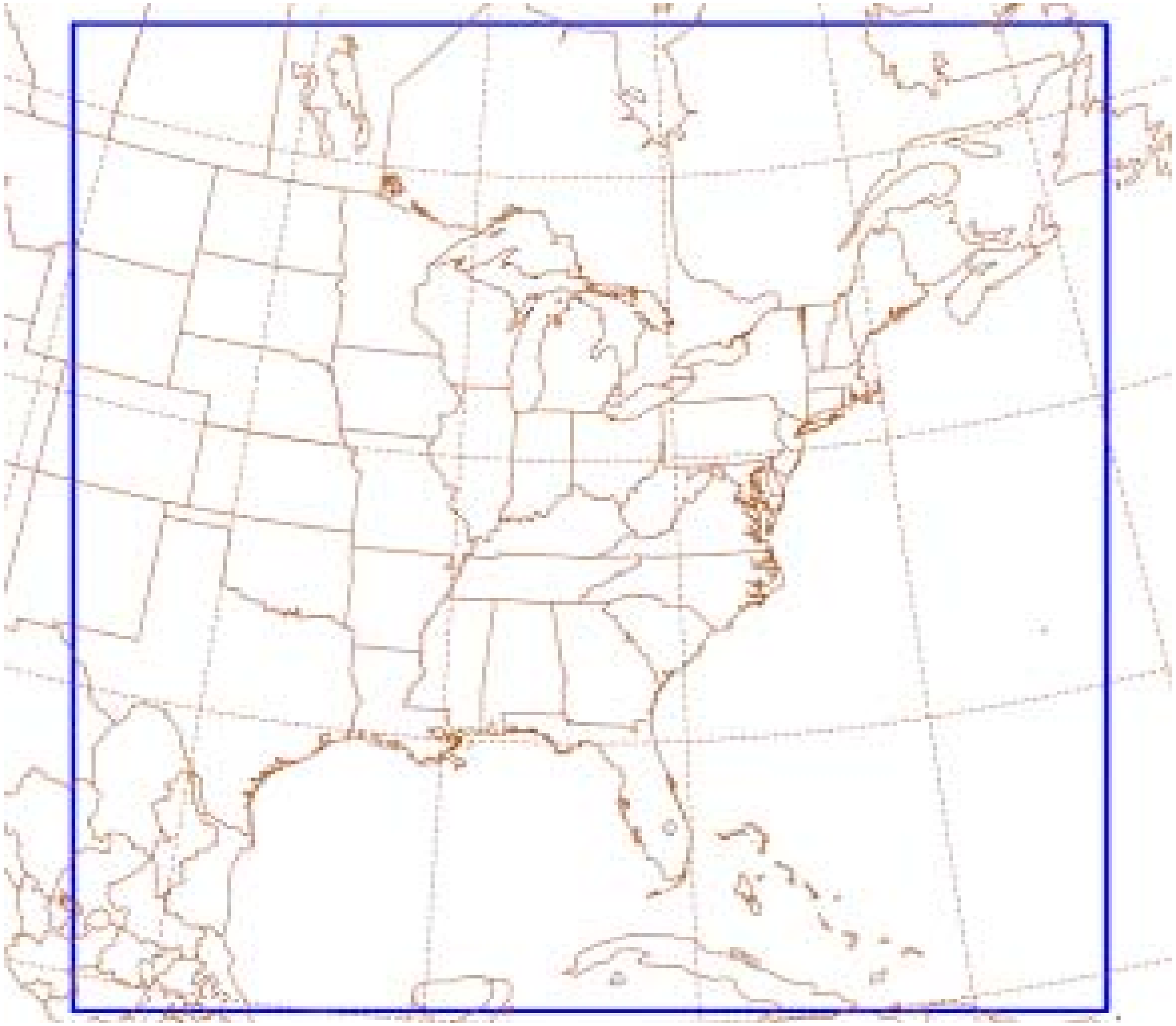
Other Projects

- DTRA / dispersion (McQueen)
- Verification implementation & unification

http://www.emc.ncep.noaa.gov/mmb/gplou/emchurr/nwprod/

- Aviation products for ICAO & Transition of FAA AWRP algorithms from AWC to NCEP's CCS.

Daily 9-member HREF for DTRA



NCEP/EMC Cyclogenesis Tracking Page

Alaska Region (Current DTG, NPS)	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	X	
U.S. East Coast (last 4 cycles, lat/lon)	X	✓	✓	✓	✓	✓	✓	✓	X	✓	X	
Eastern North America (last 4 cycles, NPS)	X	✓	✓	✓	✓	✓	✓	✓	X	✓	X	
NW Atlantic (last 4 cycles, lat/lon)	X	✓	✓	✓	✓	✓	✓	✓	X	✓	X	
NW Atlantic (last 4 cycles, NPS)	X	✓	✓	✓	✓	✓	✓	✓	X	✓	X	
Alaska Region (last 4 cycles, NPS)	X	✓	✓	✓	✓	✓	✓	✓	X	✓	X	
Text track file	✓	X	X	X	X	X	X	X	X	X	X	

North America: Analysis Tracks for Mid-Latitude Cyclones (past 10 days)

	Analysis Guidance											
Region	**Multi-Model**	**GFS**	**NAM**	**NCEP Ensemble**	**SREF Ensemble**	**Ukmet**	**NOGAPS**	**CMC**	**CMC Ensemble**	**ECMWF (Restricted)**	**ECMWF Ensemble (Restricted)**	**Mu w/I (Re**
U.S. East Coast (Current DTG, lat/lon)	✓	✓	✓	X	X	✓	✓	✓	X	✓	X	
Eastern North America (Current DTG, NPS)	✓	✓	✓	X	X	✓	✓	✓	X	✓	X	
NW Atlantic (Current DTG, lat/lon)	✓	✓	✓	X	X	✓	✓	✓	X	✓	X	
NW Atlantic (Current DTG, NPS)	✓	✓	✓	X	X	✓	✓	✓	X	✓	X	
Alaska Region (Current DTG, NPS)	✓	✓	✓	X	X	✓	✓	✓	X	✓	X	
Text track file	✓	X	X	X	X	X	X	X	X	X	X	