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EMC CCB: Q3FY2011 NAM & NAQFC Upgrade Bundle

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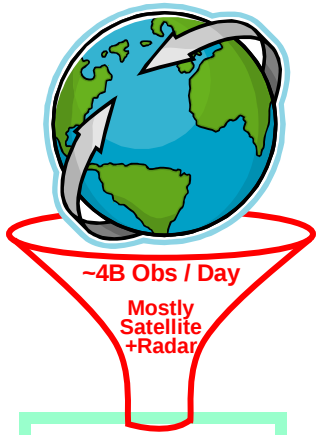
T O P I C S courtesy Chad Cary

- Standardized EMC CCB Presentation Outline:
  - Scope of changes (high level summary from Charter)
  - Description of scientific changes/enhancements
  - Description of added code or significant code updates
  - Resource utilization
    - Changes to disk, HPSS, compute nodes
    - Data contributed to HPSS for these experiments. Length of time this data is planned to be retained.
  - Testing conducted (IT, downstream, regression, etc)
    - Results (mechanical and scientific)
  - Potential degradations to operational output
  - Preliminary recommendations
- Discussion/approval

The Q3FY2011 NAM-AQ Bundle

- Big Picture(s)
- Modeling Infrastructure - NEMS
- Prediction Model NMMB dynamic core & Nesting
- GSI analysis & NDAS
- Physics Development and Testing
- Testing,Verification Results & Example Cases
- Post-Processing & Product Generation
- FWIS Cases, Smoke, Resources & Distribution
- Contingency/IT & Downstream Testing
- NAQFC - CMAQ
- Discussion/approval

The NCEP Operational Model Suite
Items in RED are Meso Branch Concerns

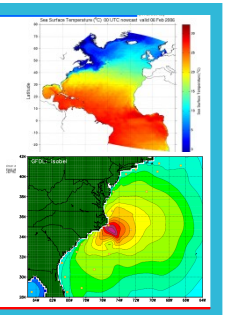


Climate CFS
MOM3

Hurricane
GFDL
HWRF (NMM)

Coupled

Oceans
HYCOM
WaveWatch III

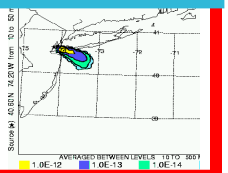


Global Data Assimilation

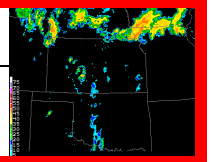
Global Forecast System

North American Mesoscale
NMMB

Dispersion, Ash, Smoke & Dust
ARL's HYSPLIT



Severe Weather
NMMB + NMM + ARW



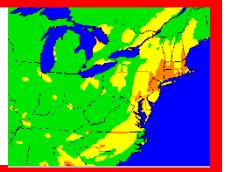
Regional Data Assimilation

DGEX
NMM

Short-Range Ensemble Forecast
NMM + ARW + ETA + RSM

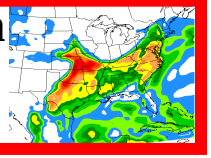
Fire Weather : NMMB

Air Quality
NAM [NMMB]
+ EPA's CMAQ



North American Ensemble Forecast System
GFS, Canadian Global Model, FNMOC +

Rapid Refresh for Aviation
GSD's RUC/RR

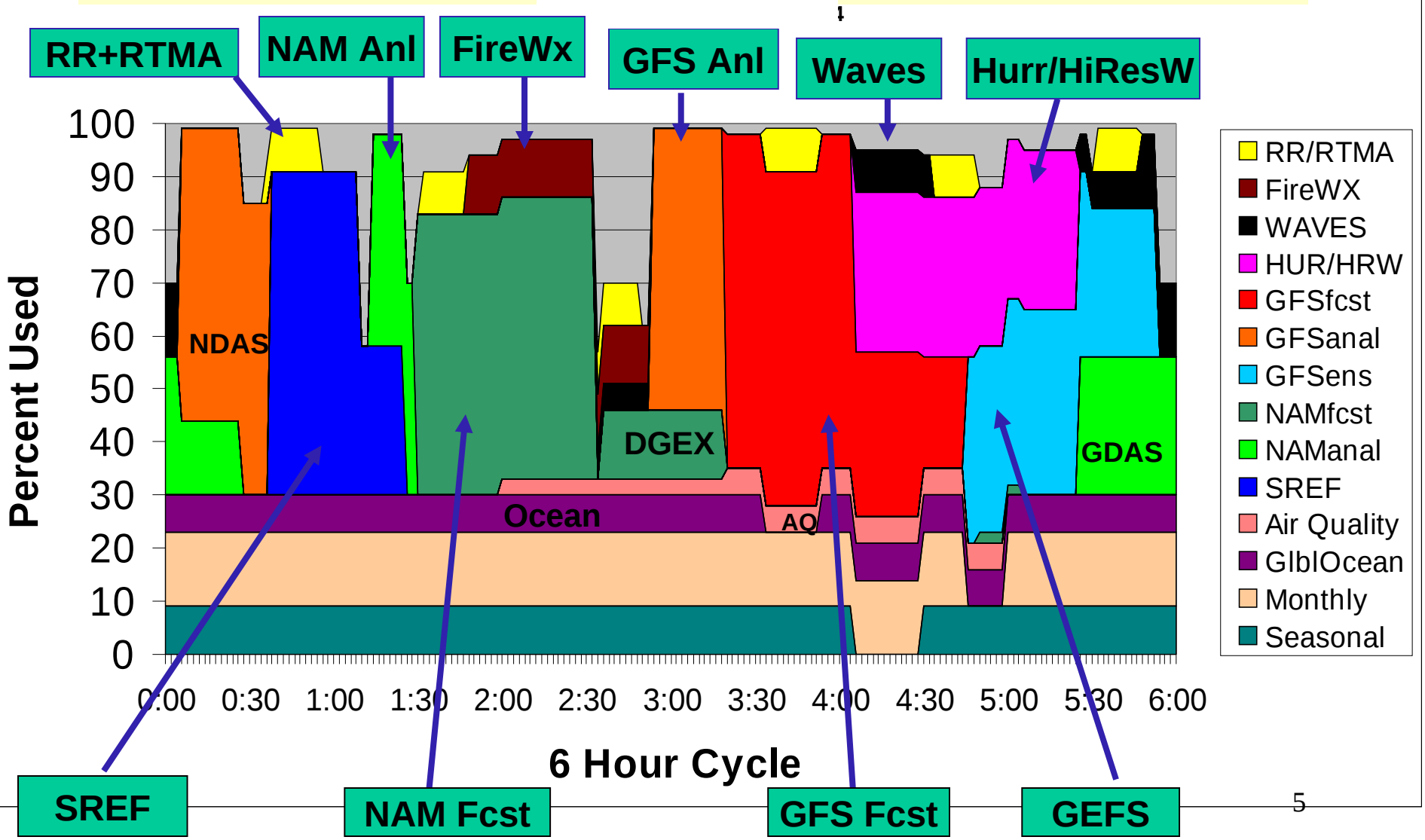


VSREF/NARRE
RUC/RR + NAM

R T M A

NOAH Land Surface Model

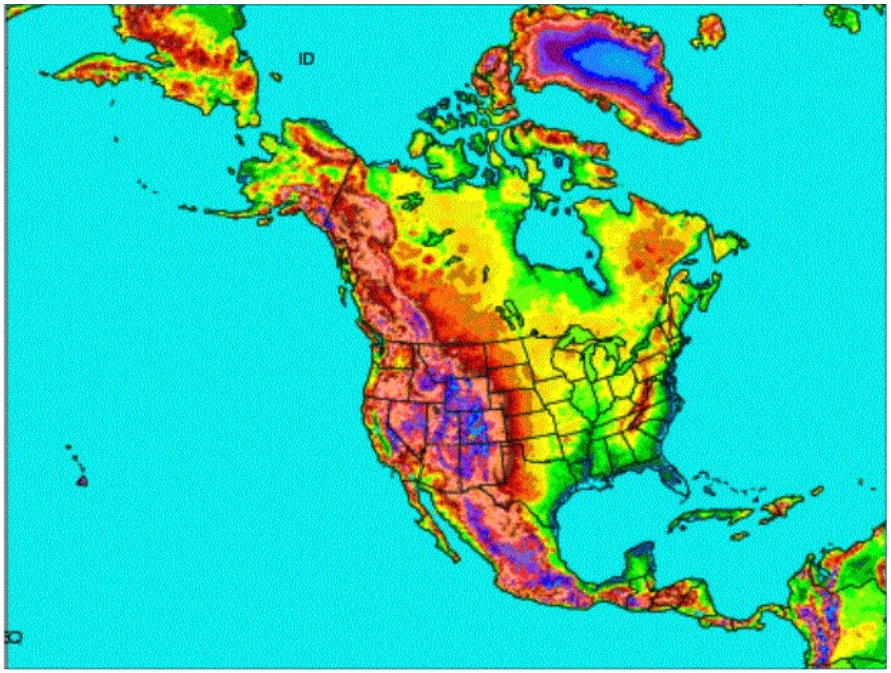
NCEP Production Suite Jigsaw Puzzle
NAM & FireWx allocated 63% of CCS



~July 2011 NAM Upgrade

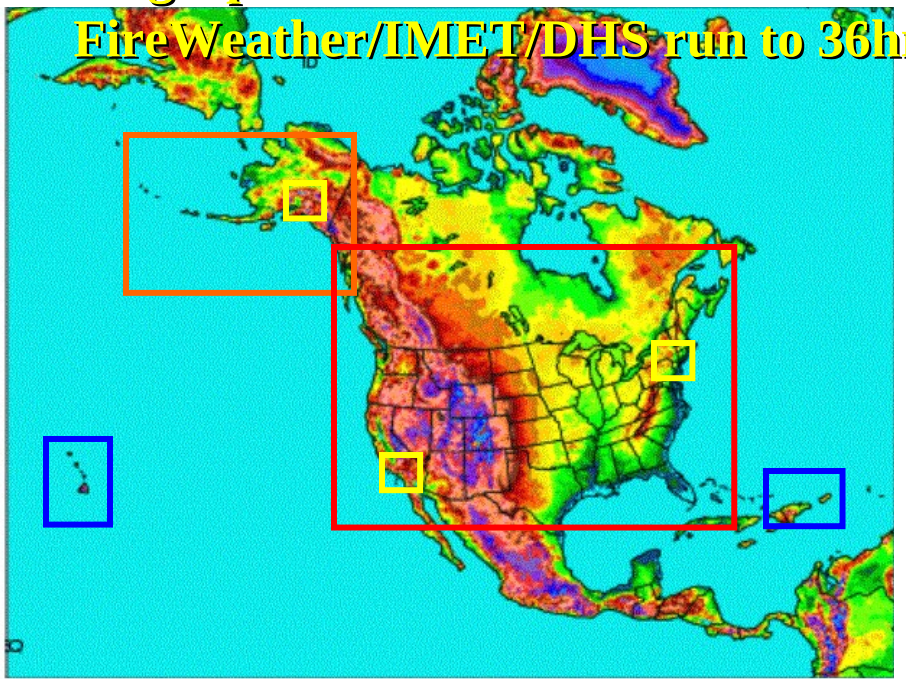
Current NAM

- WRF-NMM (E-grid)
- 4/Day = 6 hr update
- Forecasts to 84 hours
- 12 km horizontal grid spacing



New NAM

- NEMS based NMMB
- B-grid replaces E-grid
- Parent remains 12 km to 84 hr
- Four Fixed Nests Run to 60 hr
  - **4 km CONUS nest**
  - **6 km Alaska nest**
  - **3 km HI & PR nests**
- **Single placeable 1.33km or 1.5 km FireWeather/IMET/DHS run to 36hr**



ESMF

Earth System Modeling Framework

NSF NCAR

Tim Killeen, PI
Byron Boville
Cecelia DeLuca
Roberta Johnson
John Michalakes
Al Kellie

MIT

John Marshall, PI
Chris Hill

NASA GMAO

Arlindo da Silva, PI
Leonid Zaslavsky
Will Sawyer
Max Suarez
Michele Rienecker
Christian Keppenne
Christa Peters-Lidard

NOAA GFDL

Ants Leetmaa
V. Balaji
Robert Hallberg
Jeff Anderson

NOAA NCEP

Stephen Lord
Mark Iredell
Mike Young
John Derber

DOE Los Alamos Nat'l Lab

Phil Jones

DOE Argonne Nat'l Lab

Jay Larson
Barry Smith

University of Michigan

Quentin Stout

There is Agreement & Commitment on a 'One NOAA' Modeling Framework

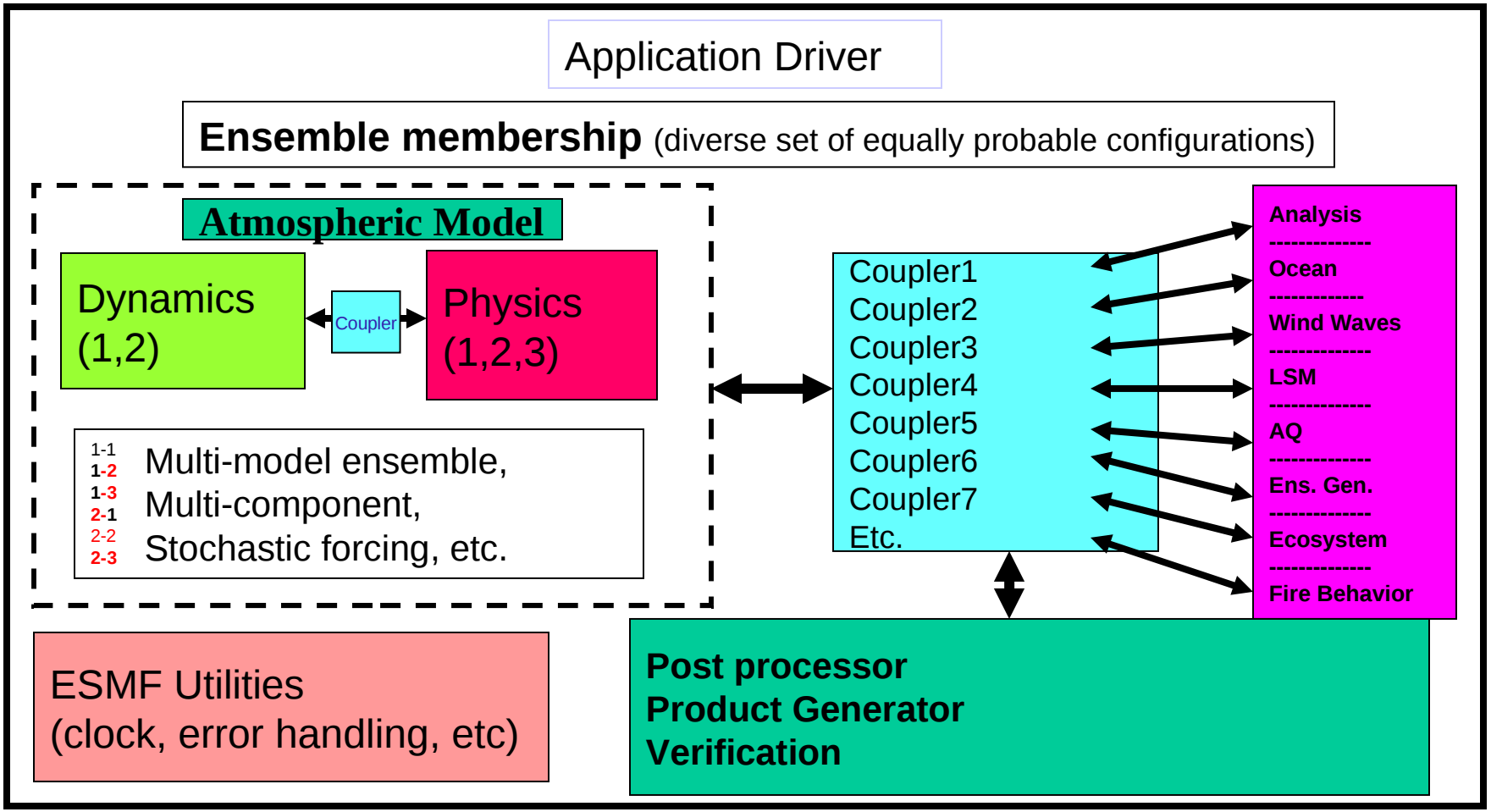
- This goes back to the first days of Admiral L.
- The ultimate target is a completed NOAA framework of ESMF components within which NOAA scientists can work efficiently
- Consistency with NUOPC is expected as well
- NCEP has been building NEMS for this purpose
- Community involvement is expected and encouraged
- Support for ESMF has moved permanently from NCAR/SCD to NOAA/ESRL

NEMS = NOAA Environmental Modeling System

- NEMS has been built with only highest levels of ESMF
  - To keep dependence on ESMF to a minimum
  - To keep transparency of code at a maximum
- Physics options will include those of WRF and GFS
- All major modeling systems in NCEP Production suite to run in NEMS:
  - **GFS, CFS** version coupled to ocean (**HYCOM**) & **NOAH LSM** & **NMMB**
  - **NMMB**: global and regional [for NAM], run NAM concurrent with GFS within single executable, run nested within GFS or itself, couple to Chem (**WRF-CHEM or CMAQ or GOCART** etc) to LSM and/or to ocean/wave, contribute to NARRE/HRRRE
  - **Rapid Refresh**: GSD will adapt WRF-ARW to NEMS, couple to Chem, contribute to NARRE/HRRRE
  - **FIM**: GSD will adapt FIM to NEMS, couple to its Chem, contribute to global ensemble suite
  - **HYCOM**, Hurricane, Ensemble, Data Assimilation …
  - Fire Behavior models from USFS, ESRL/GSD, NCAR, NIST
  - Ecological, Space Weather, Tsunami, Bay & Estuary, Surge etc
  - Building couplers between/among components is a key activity
- In their Operations-to-Research role, the DTC will support NEMS to the community. First version to be based on 2011 NAM upgrade.

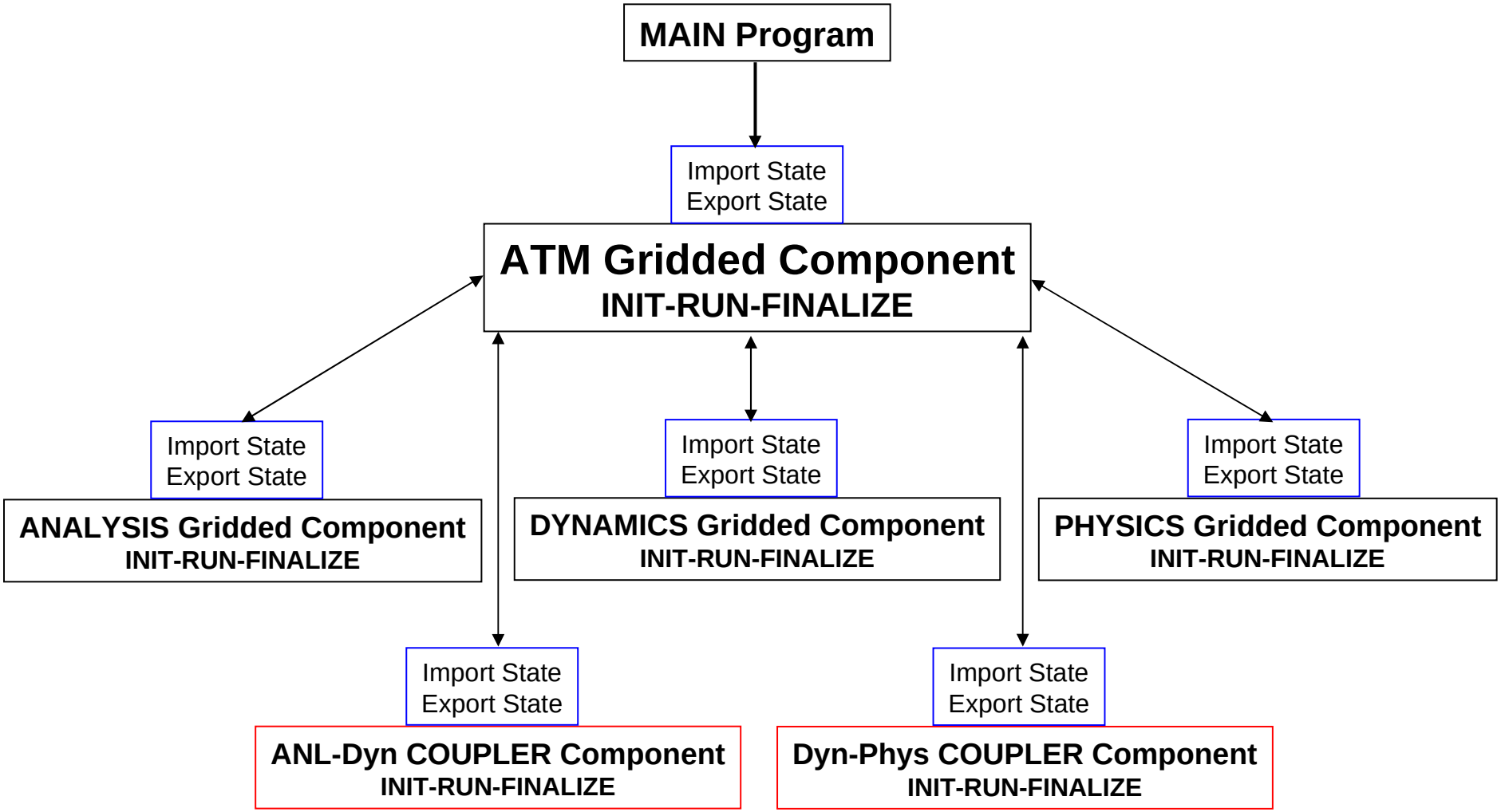
National Environmental Modeling System (NEMS)
(uses standard ESMF* compliant software) courtesy of Steve Lord

ESMF Infrastructure [INIT-RUN-FINALIZE, import & export states etc.] and ESMF Superstructure [component definitions, "mpi" communications, etc.]

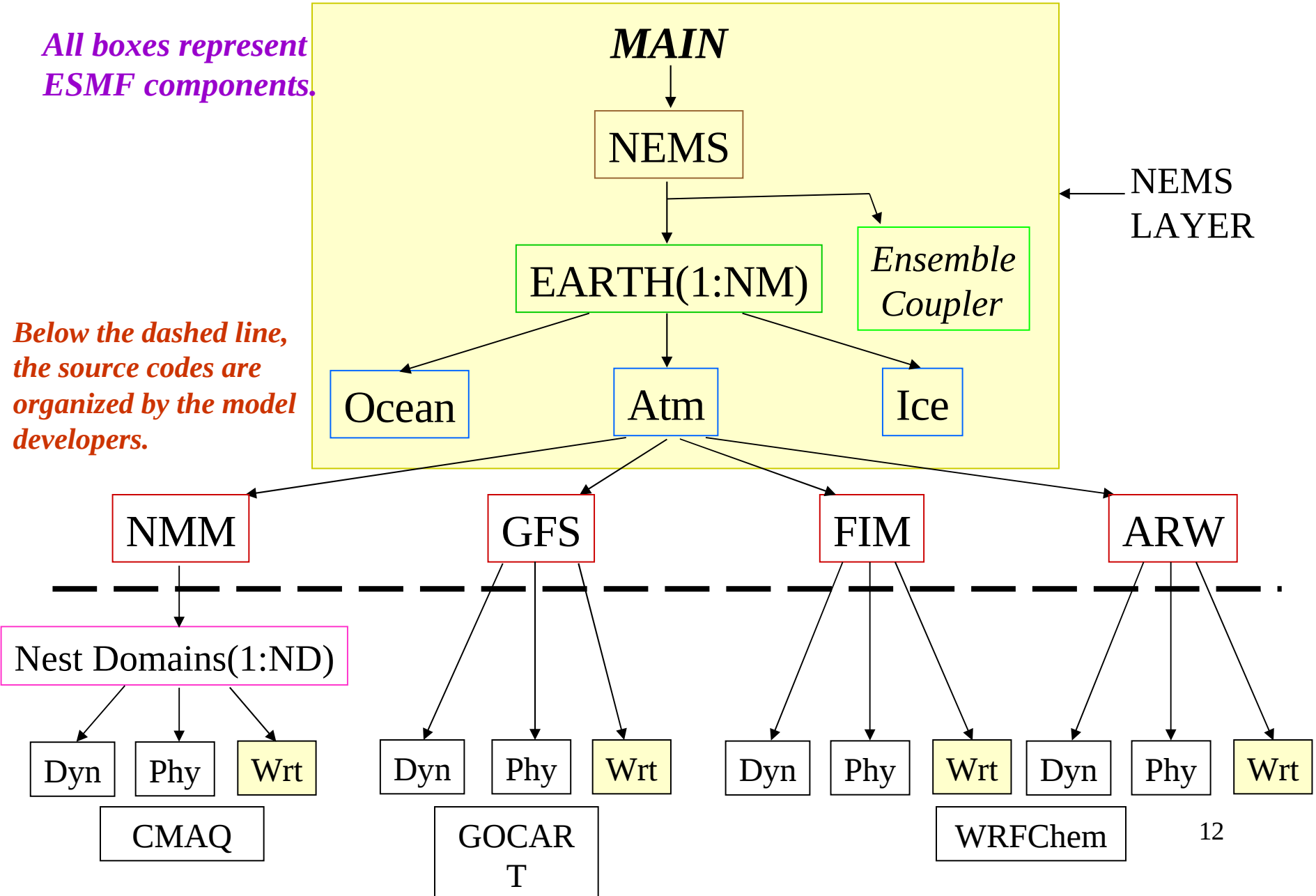


*Earth System Modeling Framework - NCAR/CISL, NASA/GMAO, NCEP/EMC, NOAA/GFDL, Navy/NRL, MIT

A Possible Coupled NAM / 0-Hr Analysis



NEMS Component Structure



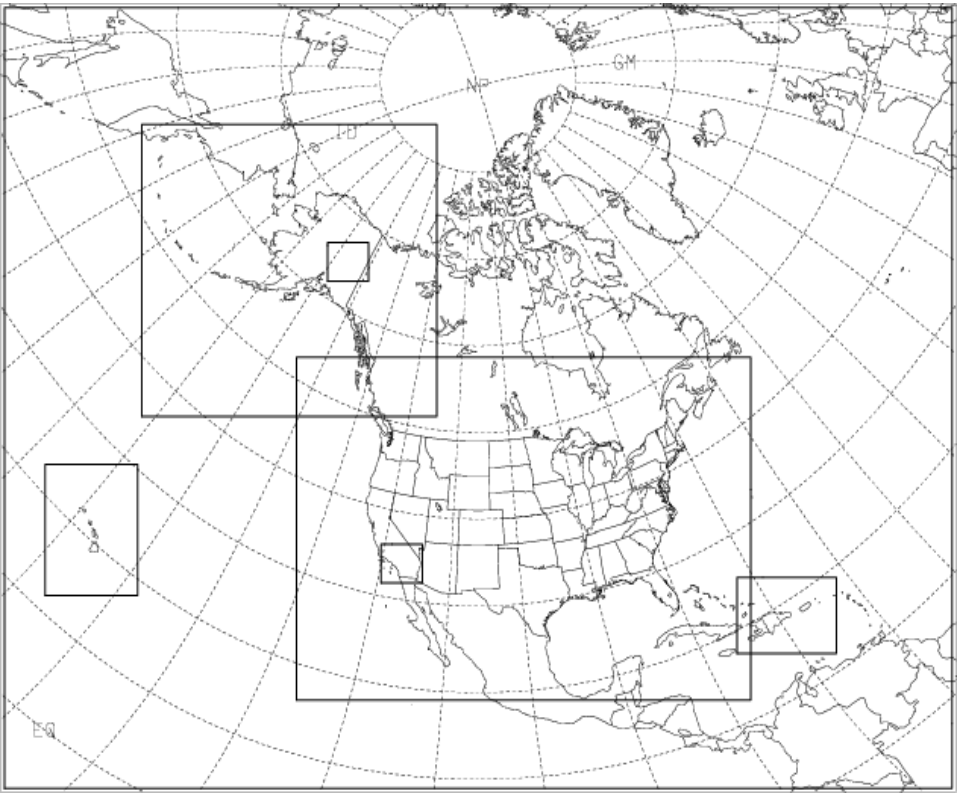
NOAA Environmental Modeling System (NEMS)

Nesting in NMMB (courtesy Tom Black)

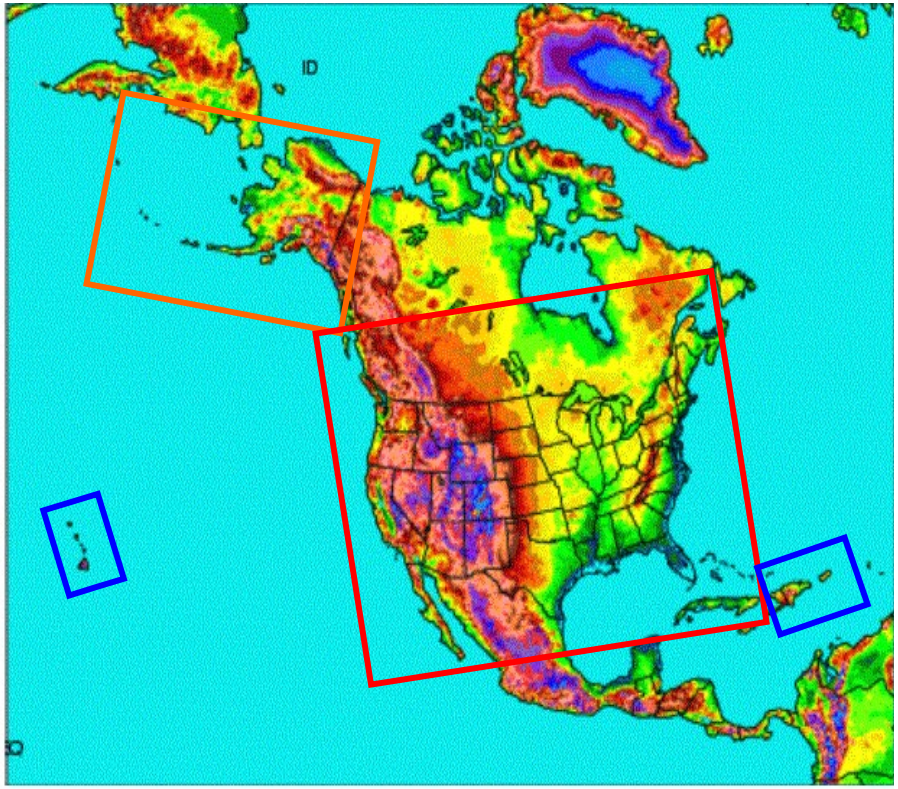
- Static, 1-way interaction
- Boundaries fed by the parent every parent time step during the integration
- Unique sets of processors are assigned to each domain to optimize the balance of work and minimize the clock time required to run (not possible in WRF)
- Nests are all ‘grid-associated’ with their parent
- Any parent-nest ratio (integer) can be used

Grid Association Revealed

Nests **<u>Are</u>** Grid Associated



Nests are **<u>Not</u>** Grid Associated

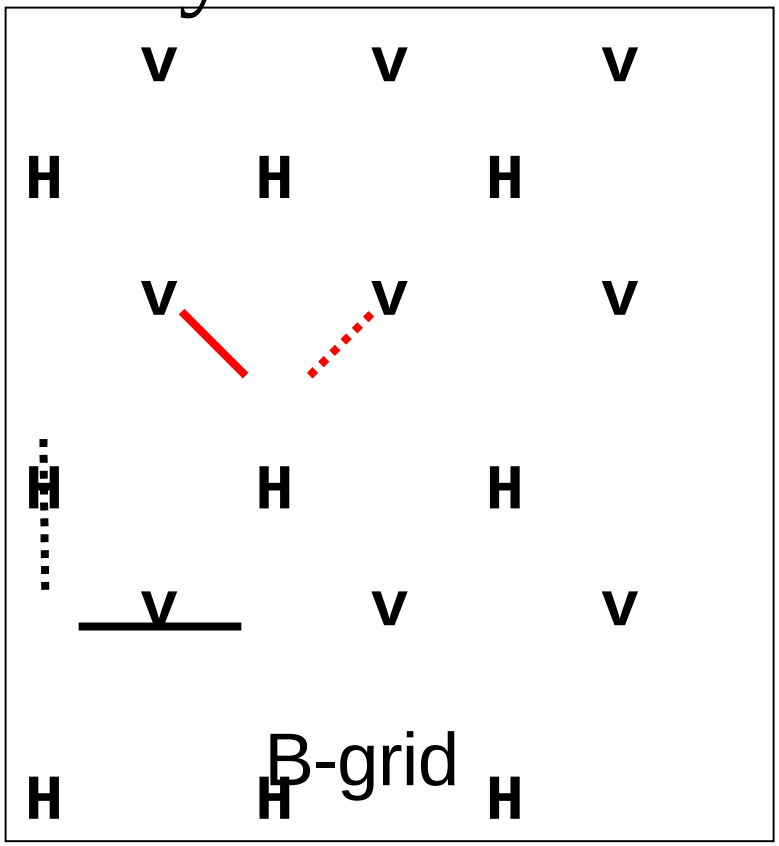


Highlights of NEMS Preprocessing System (NPS) for NMMB (courtesy Matt Pyle)

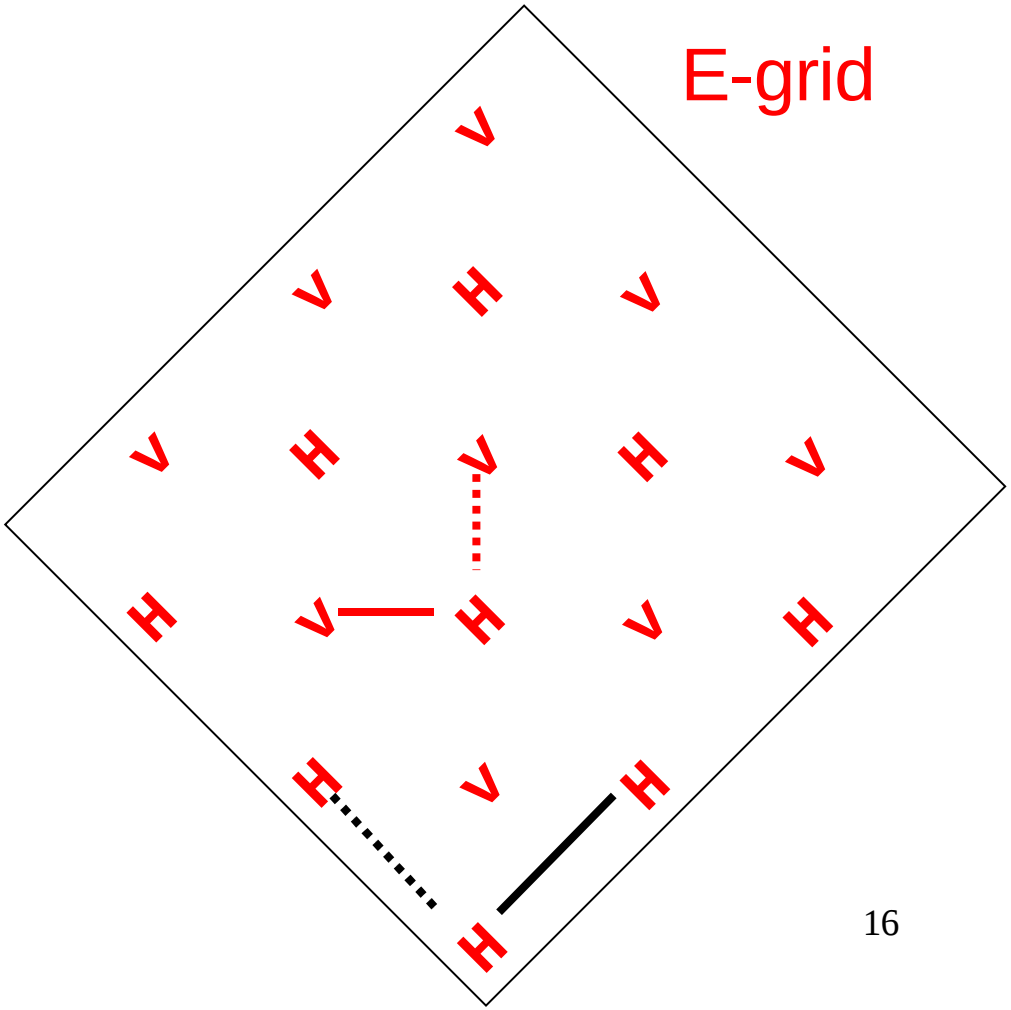
- To create the first guess at the start of the NDAS (at time T-12hr), NPS uses GFS spectral coefficients rather than post-processed pressure level fields on a 1 deg lat/lon grid as has to be done with WRF Preprocessing System (WPS)

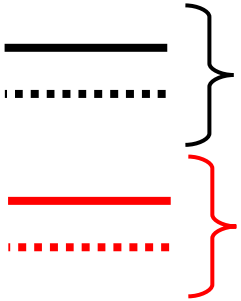
- Lateral boundary conditions also based on GFS spectral coefficients (as is done in current NAM but not in WRF REAL)

NMMB stands for
Nonhydrostatic Multiscale Model on B-grid



B-grid is just an E-grid rotated 45 degrees (and vice-versa)





B-grid dx and dy

E-grid dx and dy

Zavisa Janjic's NMMB

- NMMB = Nonhydrostatic Multiscale Model on B-grid, but no fundamental differences in the dynamics versus current NMM
- These are the main B grid advantages:
  - The B-grid requires narrower halos, i.e. less communications;
  - On the global scale, the polar filtering on the B-grid is more effective and the polar boundary condition is more straightforward;
  - E-grid code is more complex , indirect addressing (slower too) and is more difficult for debugging and maintenance;
  - The B-grid is better for application of the model in idealized 2D studies, e.g. in the x-z plane;
  - NEMS physics interface streamlined compared to WRF infrastructure, facilitating development, debugging and maintenance.
- Other NMMB differences / enhancements
  - New Eulerian passive advection
  - New generalized hybrid vertical coordinate embodies:
    - Sangster 1960; Arakawa and Lamb 1977; "SAL"
    - Simmons and Burridge (1981) "SA" + Eckerman (2008)
    - Hybrid used by GFS
  - WRF & GFS physics options available

NMM-B Dynamical Core - 1

(Janjic, 2005; Janjic and Black, 2007)

- Nonhydrostatic *Multiscale* Model on B grid (NMM-B)
  - Further evolution of WRF NMM (Nonhydrostatic *Mesoscale* Model)
  - Intended for wide range of spatial and temporal scales, from meso to global, and from weather to climate
  - Evolutionary approach, built on NWP and regional climate study experience by relaxing hydrostatic approximation (instead of extending cloud models to large scales; Janjic et al., 2001, MWR; Janjic, 2003, MAP)
    - Applicability of the model extended to nonhydrostatic motions
    - Favorable features of the hydrostatic formulation preserved
  - The nonhydrostatic option as an add–on nonhydrostatic module
    - Reduced cost at lower resolutions
    - Easy comparison of hydrostatic and nonhydrostatic solutions
  - Pressure based vertical coordinate
    - Nondivergent flow on coordinate surfaces (often forgotten)
    - No problems with weak static stability on meso scales

NMM-B Dynamical Core - 2

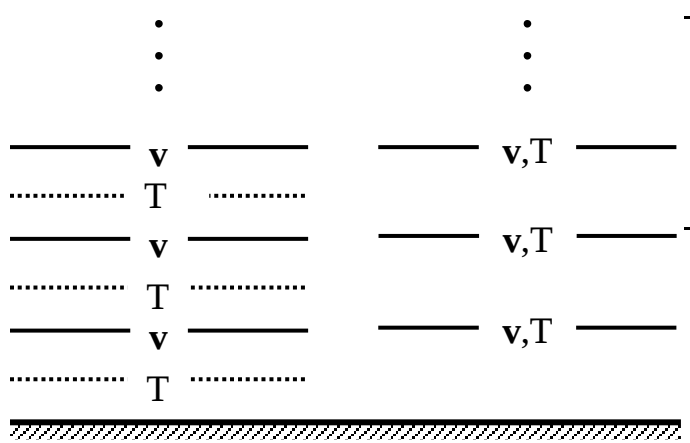
- Conservation of important properties of a continuous system (Arakawa, 1966, 1972, …; Janjic, 1977, …; Sadourny, 1968, … ; … aka “mimetic” approach in Comp. Math)
  - Nonlinear energy cascade controlled through energy and enstrophy conservation
  - “Finite volume”
  - A number of first order and quadratic quantities conserved
  - A number of properties of differential operators preserved
  - Omega-alpha term, consistent transformations between KE and PE
  - Errors associated with representation of orography minimized

NMM-B Dynamical Core - 3

- Horizontal coordinate system and grid
  - Global lat-lon,
  - Regional rotated lat-lon, more uniform grid size
  - Arakawa B grid staggering (versus WRF-NMM E grid)

```
h     h     h
    v     v
h     h     h
    v     v
h     h     h
```

- Lorenz vertical staggering



Charney-Phillips Lorenz

- Pressure-sigma hybrid (Sangster 1960; Arakawa and Lamb 1977; Simmons and Burridge 1981)
  - Flat coordinate surfaces at high altitudes where sigma problems worst (e.g. Simmons and Burridge, 1981)
  - Higher vertical resolution over elevated terrain
  - No discontinuities and internal boundary conditions

NMM-B Dynamical Core - 4

- Lateral boundaries for limited area domains
  - Upstream advection in rows next to the boundary
    - No computational outflow boundary condition for advection
    - Enhanced damping along boundaries
  - Narrow blending zone along boundaries
- Time stepping explicit, except for vertical advection and vertically propagating sound waves
- NCEP's WRF NMM "standard" physical package (more options will be available)

NMM-B Dynamical Core - 5

- Polar boundary conditions
  - "Across the pole" with wind sign changes
- Polar filter configuration
  - "Decelerator"
  - Tendencies of T, u, v, Eulerian tracers, divergence, dw/dt, deformation
  - Physics not filtered
- Polar filter formulation
  - Waves in the zonal direction faster than waves with the same wavelength in the latitudinal direction slowed down
  - Filter response function quasi 1-2-1 (on filtered part of spectrum)

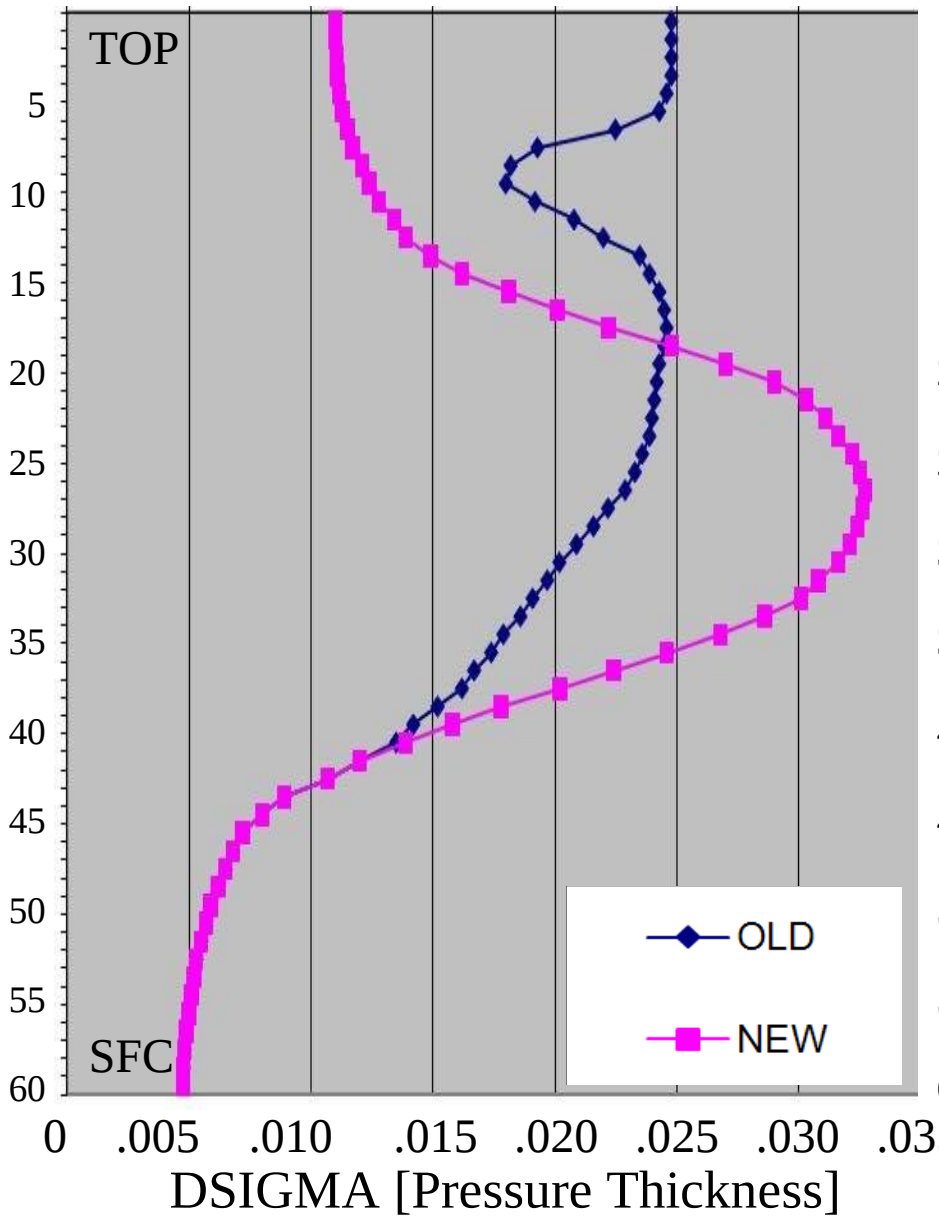
NMMB Upgrades Since 2009

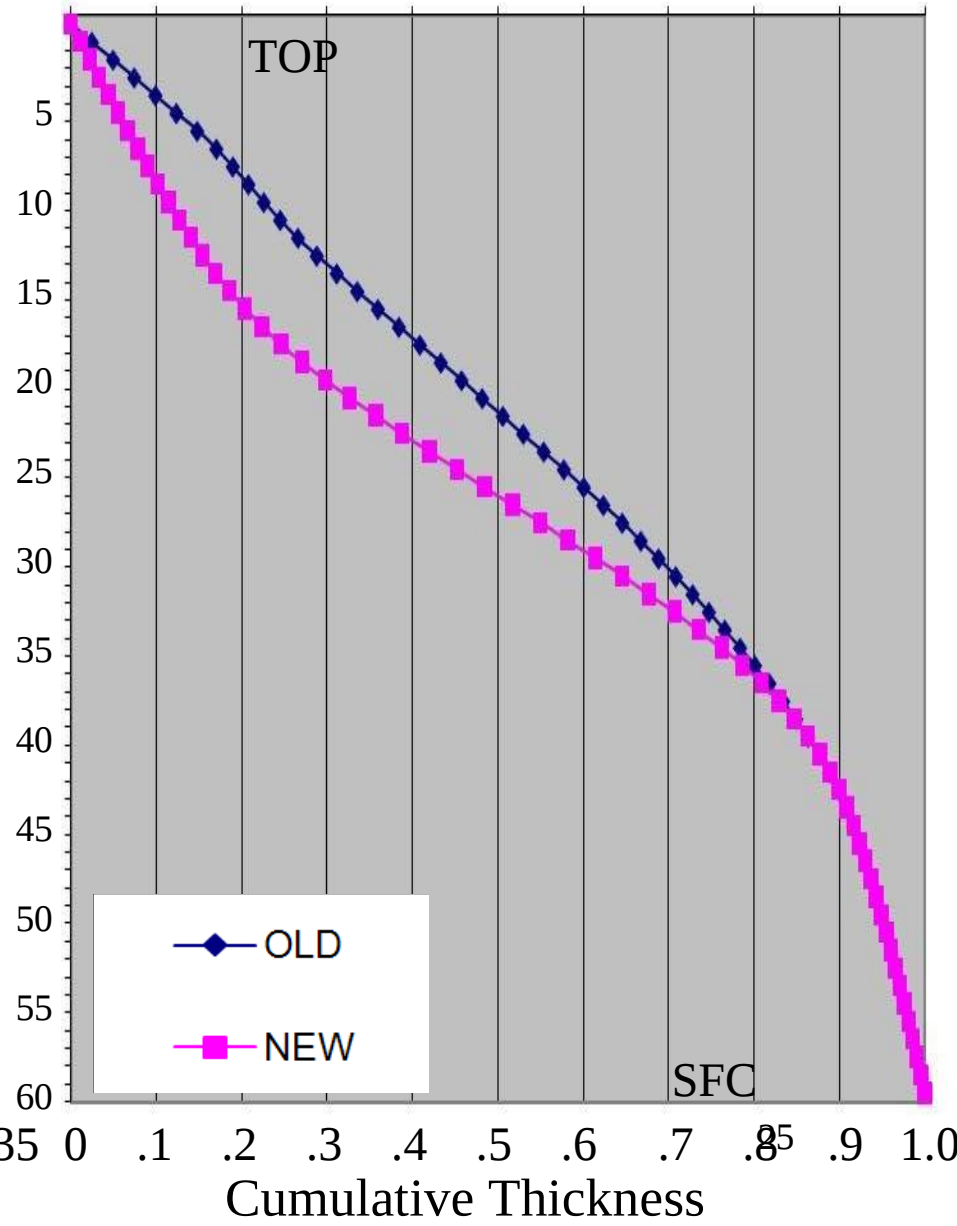
- New generalized hybrid vertical coordinate
- Rearranged vertical layer thicknesses, more layers in stratosphere
- Tested RRTM radiation (Mlawer et al. 1997)
- New affordable Eulerian conservative, positive definite, monotone tracer advection scheme
- Option for enhanced divergence damping along lateral boundaries
- Widened lateral boundary blending zone
- Gravity wave drag (Kim & Arakawa 1995; Lott & Miller 1997; Alpert, 2004)
- Debugging and retuning GFDL radiation
- Retuning and optimization of Ferrier microphysics
- BMJ convection scheme for high (single digit) resolutions
- MODIS_IGBP land use definitions and LSM retuning
- High-resolution (1/12th degree) RTG_SST analysis
- Retuning dissipative processes

Vertical Coordinate & RRTM Tests

- Results of tests of the 12z 2/28/09 case with RRTM and modified vertical level distribution
  - http://www.emc.ncep.noaa.gov/mmb/mmbpll/radlevtests.html
  - RRTM too expensive for little improvement
  - 70 levels too little improvement for expense
  - <u>Redistributed 60 levels</u> almost as much improvement as 70 levels, so this is solution of choice

Redistributed 60 Levels





Eulerian Tracer Advection Scheme - 1

- Transport of “passive” scalars
  - Conservative (for cyclic boundary conditions, closed domain or rigid wall boundary conditions in combination with continuity Eq.)
  - Positive definite
  - Monotone
  - Affordable
- Lagrangian, problems with ?
  - Strict conservation
  - Open boundary conditions
- Eulerian, problems with ?
  - Positive definitness
  - Monotonicity

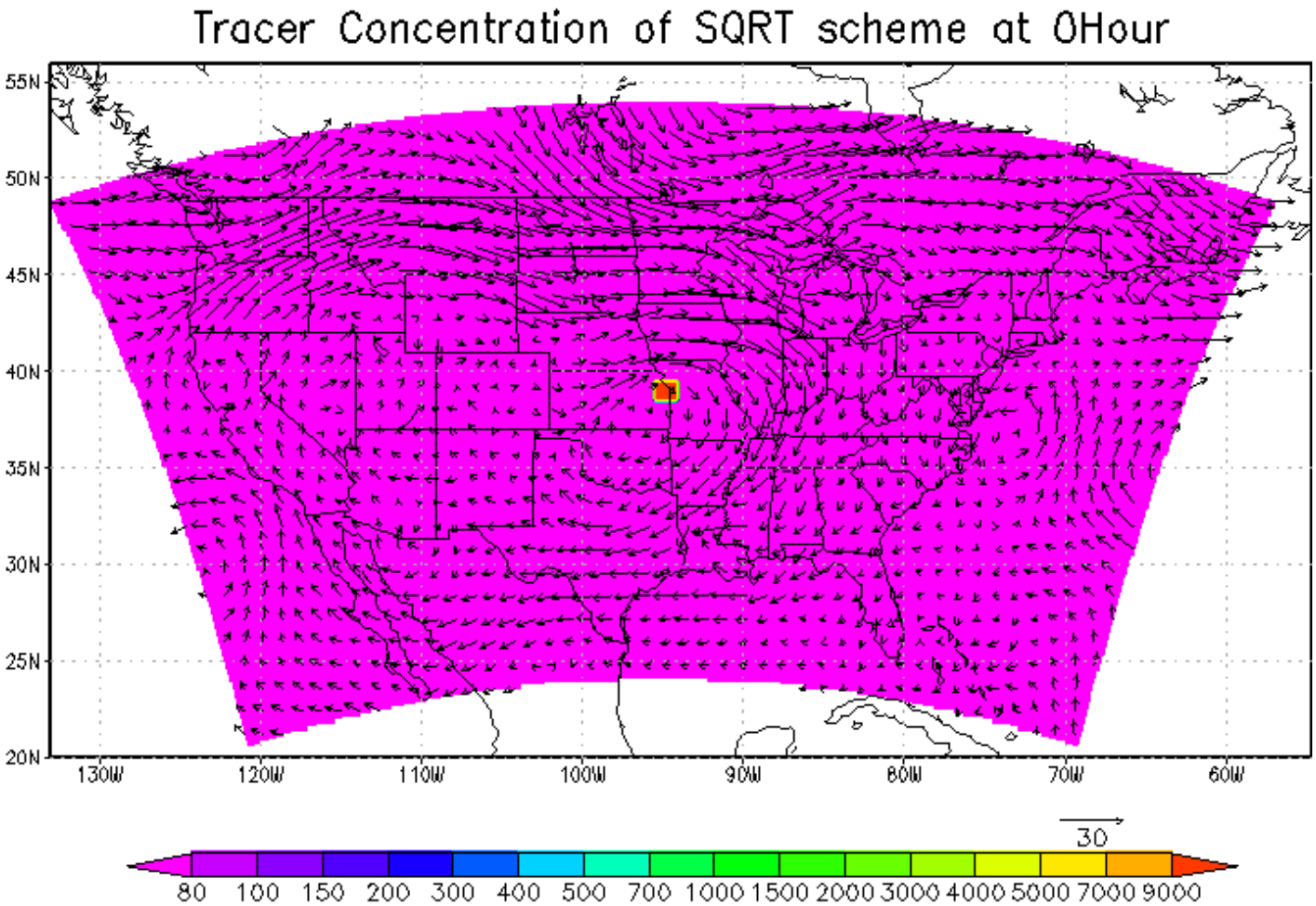
Eulerian Tracer Advection Scheme - 2

- The Eulerian Alternative
  - Conservation through flux cancelations, *not* forced *a posteriori*
  - Quadratic conservative advection scheme coupled with continuity Eq
    - Crank-Nicholson for vertical advection
    - Modified Adams-Bashforth for horizontal advection
  - Advection of square roots of tracers (c.f. Schneider, MWR 1984) provides positive definitness
  - Quadratic conservation provides tracer mass conservation
  - *Monotonization* with *a posteriori* forced conservation to correct oversteepening

Eulerian Tracer Advection Scheme - 3

- Implemented and tested in global & regional NMM-B and WRF-NMM (HiResWindow & SREF)
- Performance
  - Satisfactory mass conservation considering other uncertainties
  - Satisfactory shape and extremes preservation
- Cost
  - Faster than the Lagrangian scheme per time step, BUT
  - Overall slower than the Lagrangian scheme due to shorter advection step
  - Stable with longer time steps (2 times), appears safe for standard model tracers

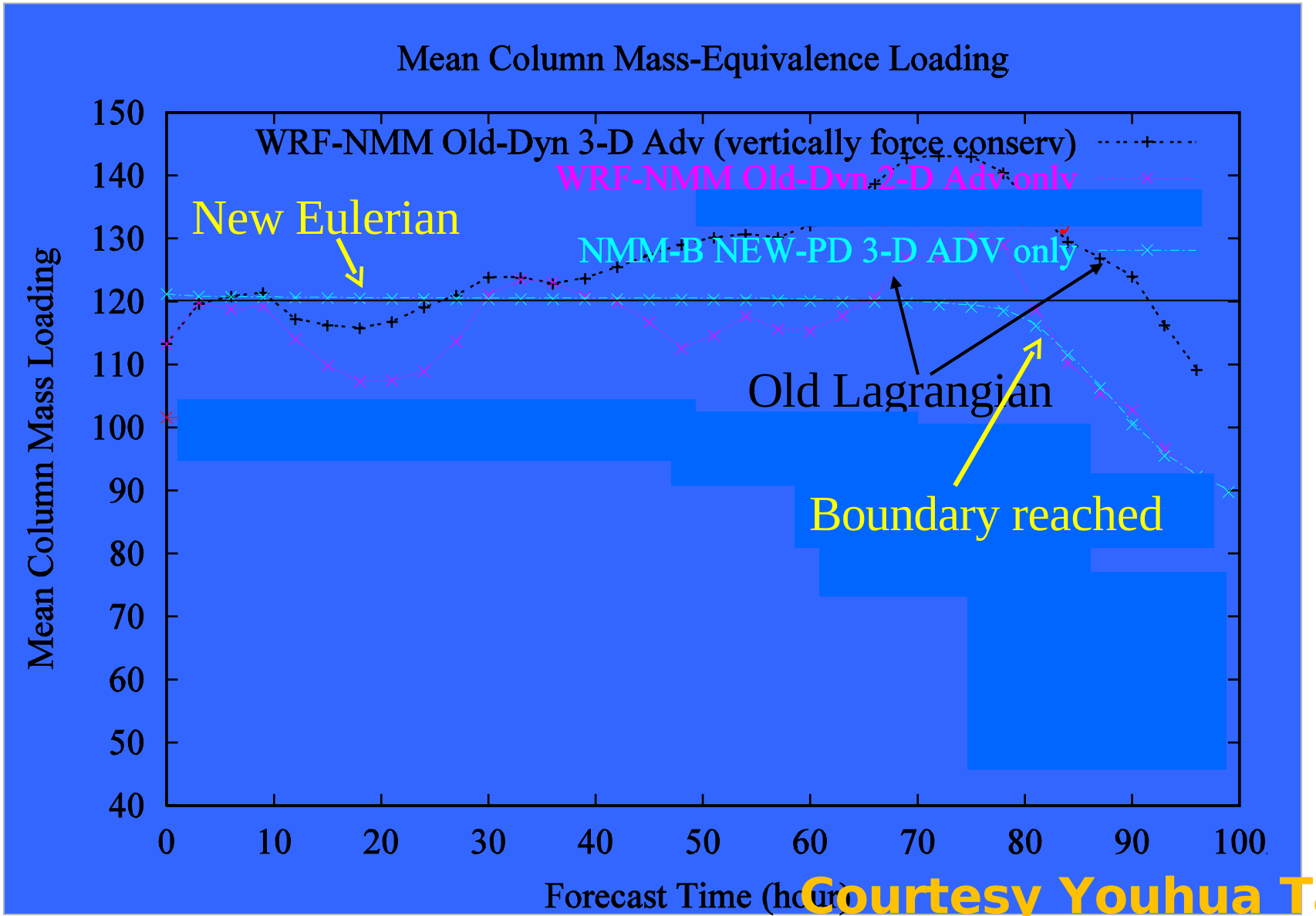
Tracer Concentration Test courtesy of Youhua Tang



- Regional NMM-B with 3-D tracer advection (no tracer physics & diffusion)
- Tracer initialized at center of the domain from bottom to top (cuboid form)
- Zero lateral boundary conditions
- 500 hPa field shown

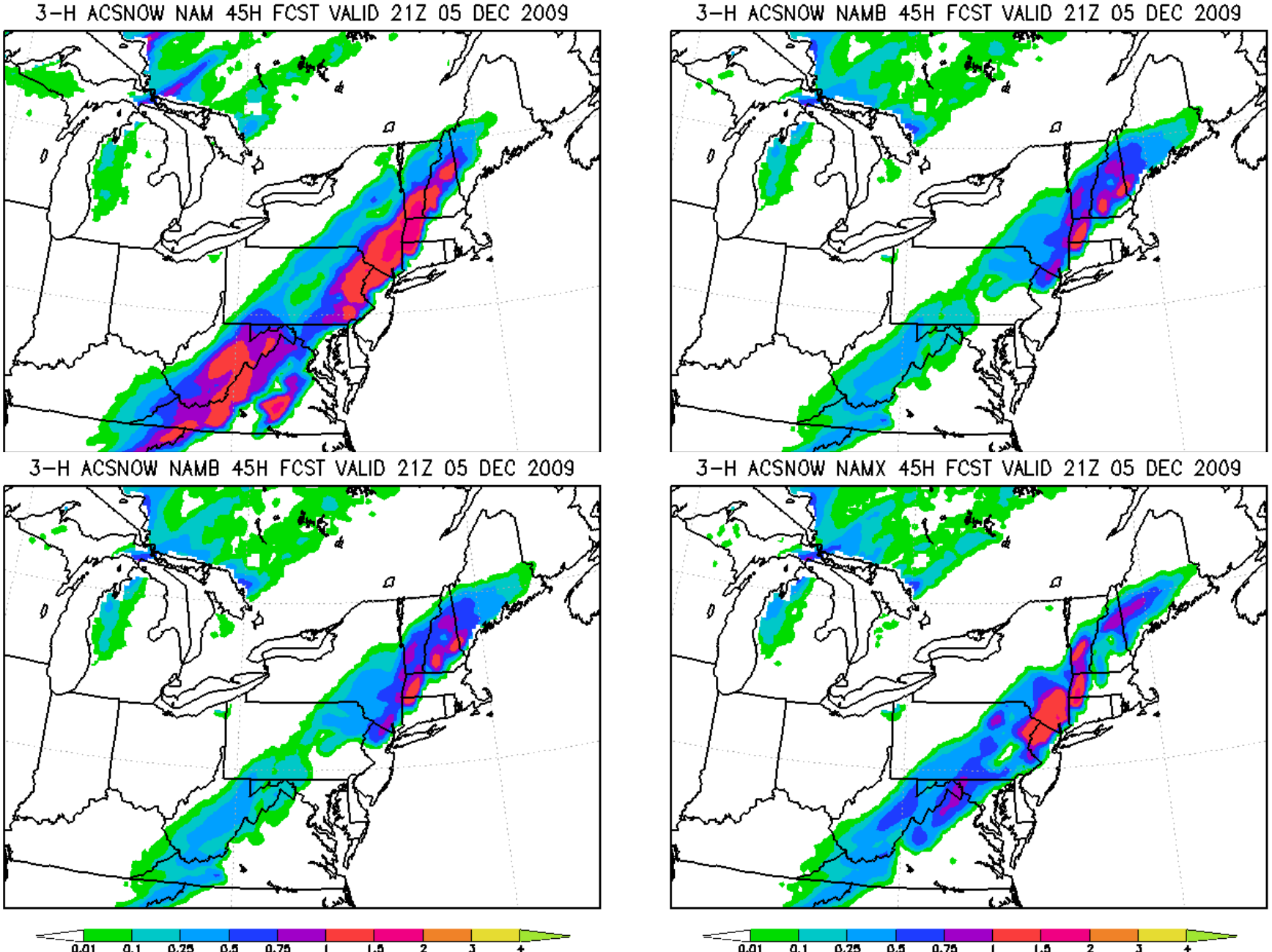
NMM-B tracer run with initial cuboid-shaped field

Shows nearly perfect conservation properties of new "Eulerian" passive advection scheme in NMMB

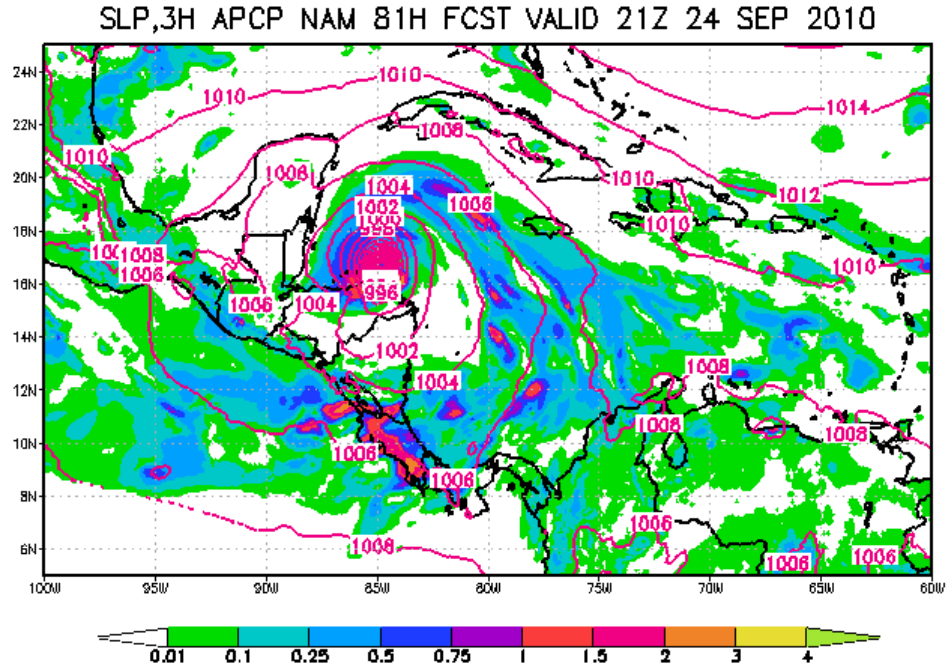


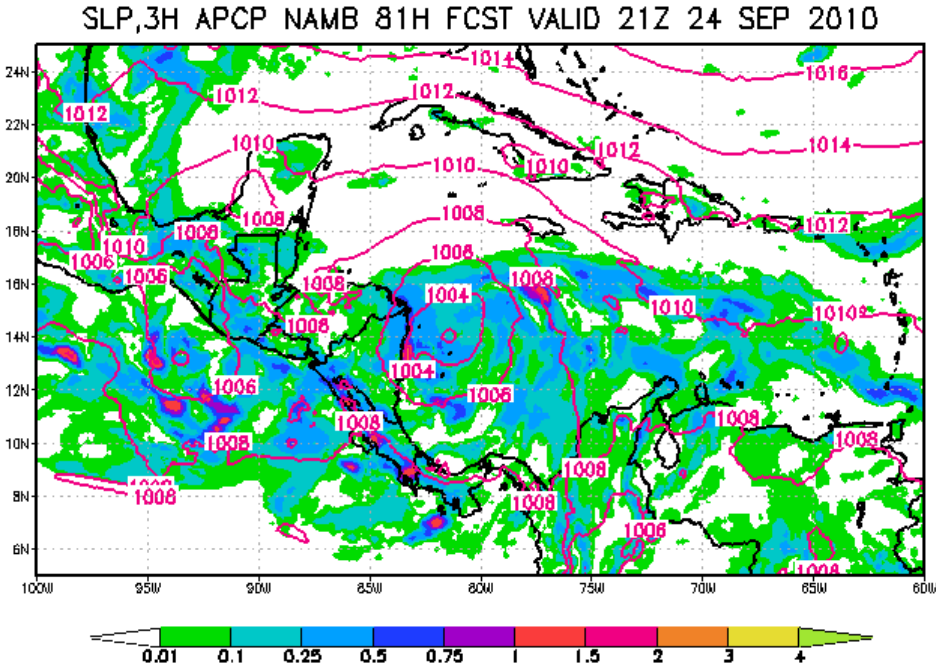
Courtesy Youhua Tan

Initial Test of New Advection

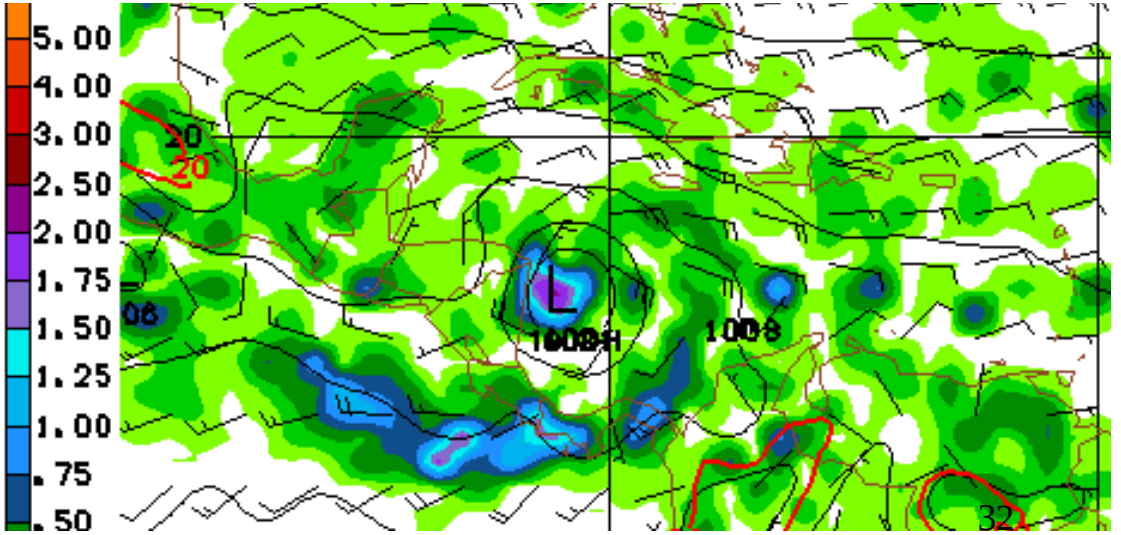


Case of NAM Boguscane

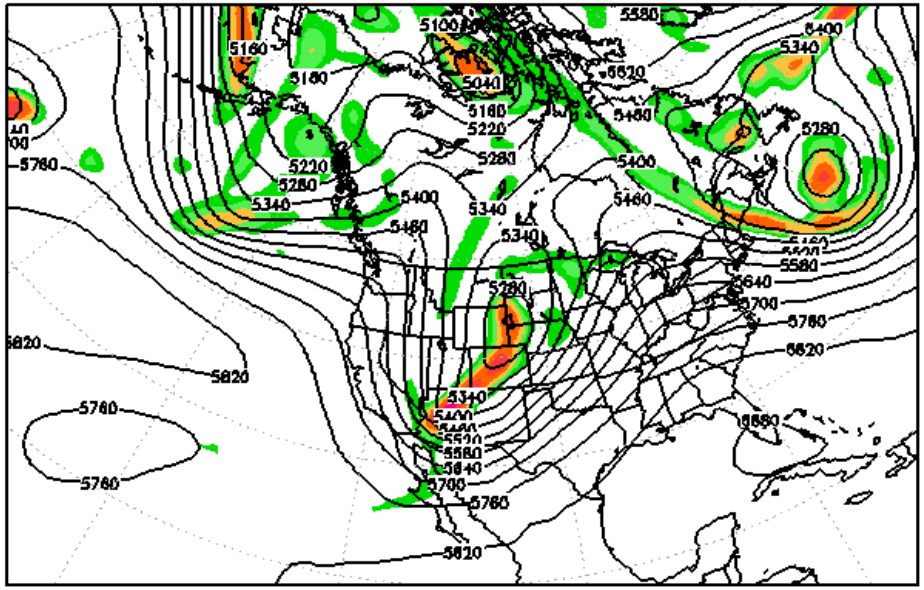




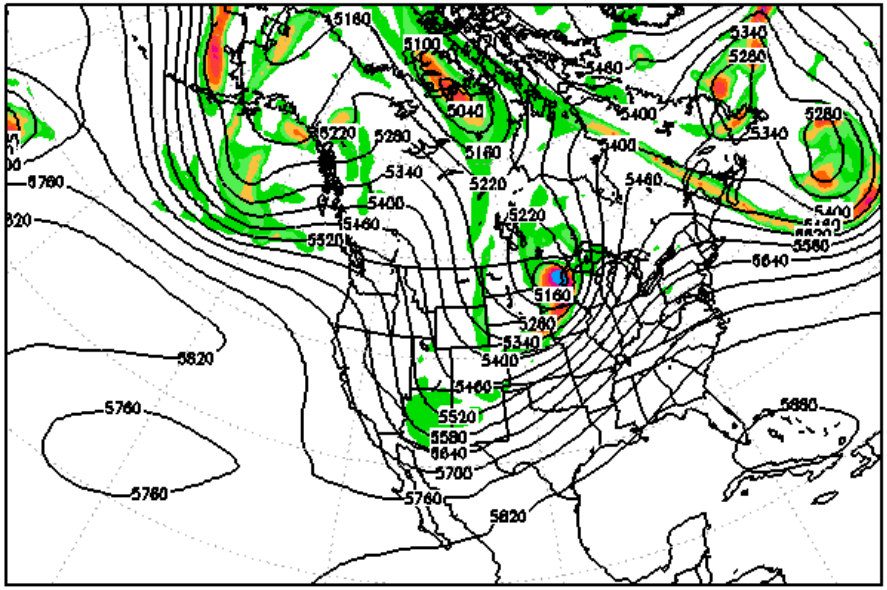
GFS 84 hr forecast



500MB Z-VORT NAM 84H FCST VALID 12Z 25 NOV 2010



500MB Z-VORT GFS 84H FCST VALID 12Z 25 NOV 2010



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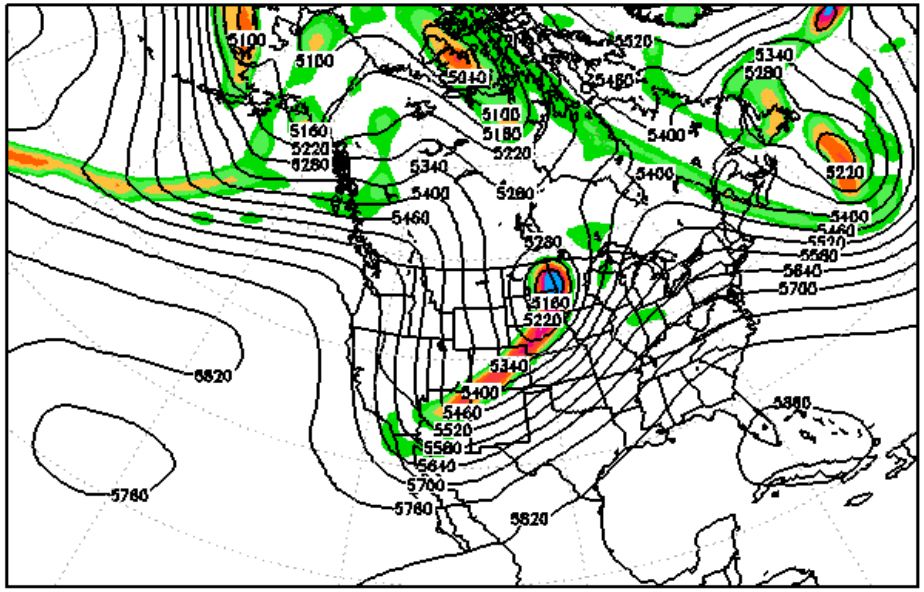
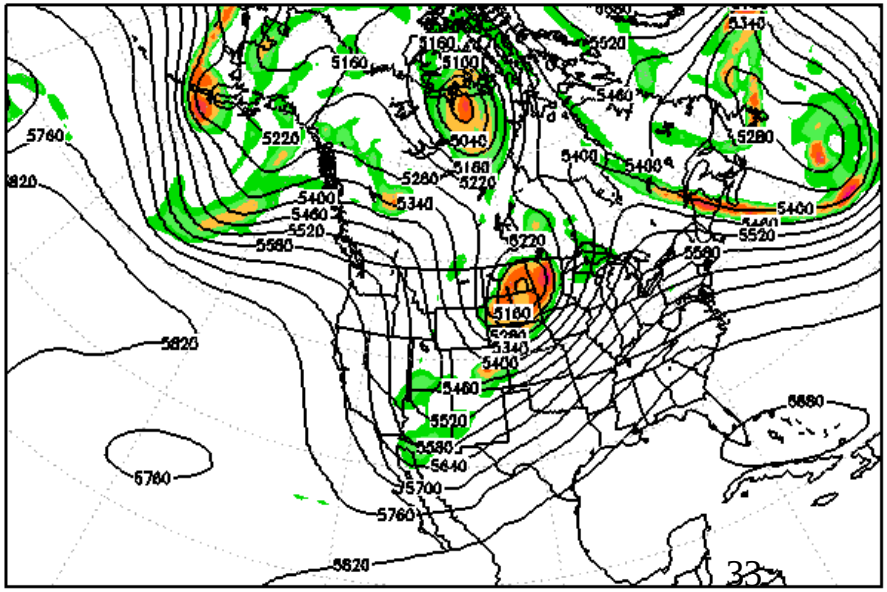
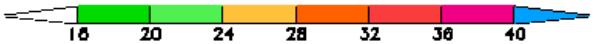
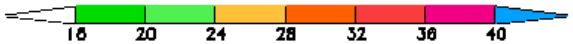


500MB Z-VORT GFS 00H FCST VALID 12Z 25 NOV 2010



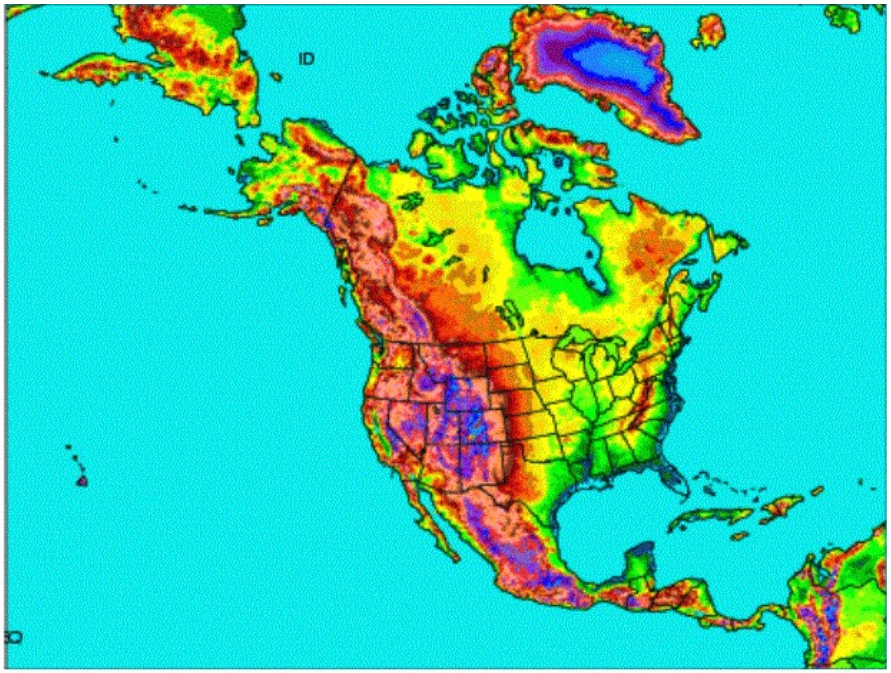




~July 2011 NAM Upgrade

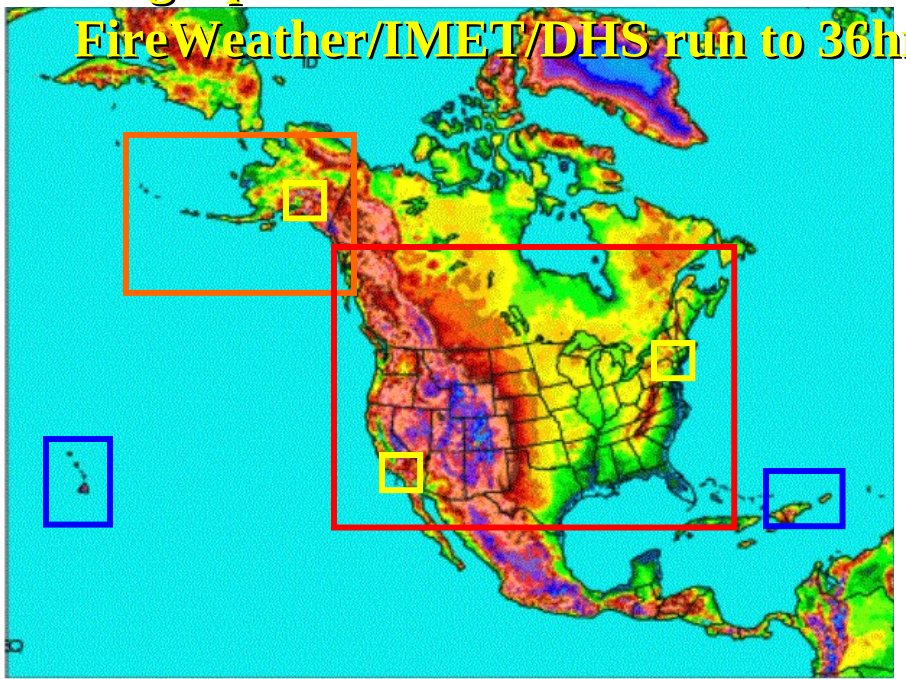
Current NAM

- WRF-NMM (E-grid)
- 4/Day = 6 hr update
- Forecasts to 84 hours
- 12 km horizontal grid spacing



New NAM

- NEMS based NMMB
- B-grid replaces E-grid
- Parent remains 12 km to 84 hr
- Four Fixed Nests Run to 60 hr
  - **4 km CONUS nest**
  - **6 km Alaska nest**
  - **3 km HI & PR nests**
- **Single placeable 1.33km or 1.5 km FireWeather/IMET/DHS run to 36hr**



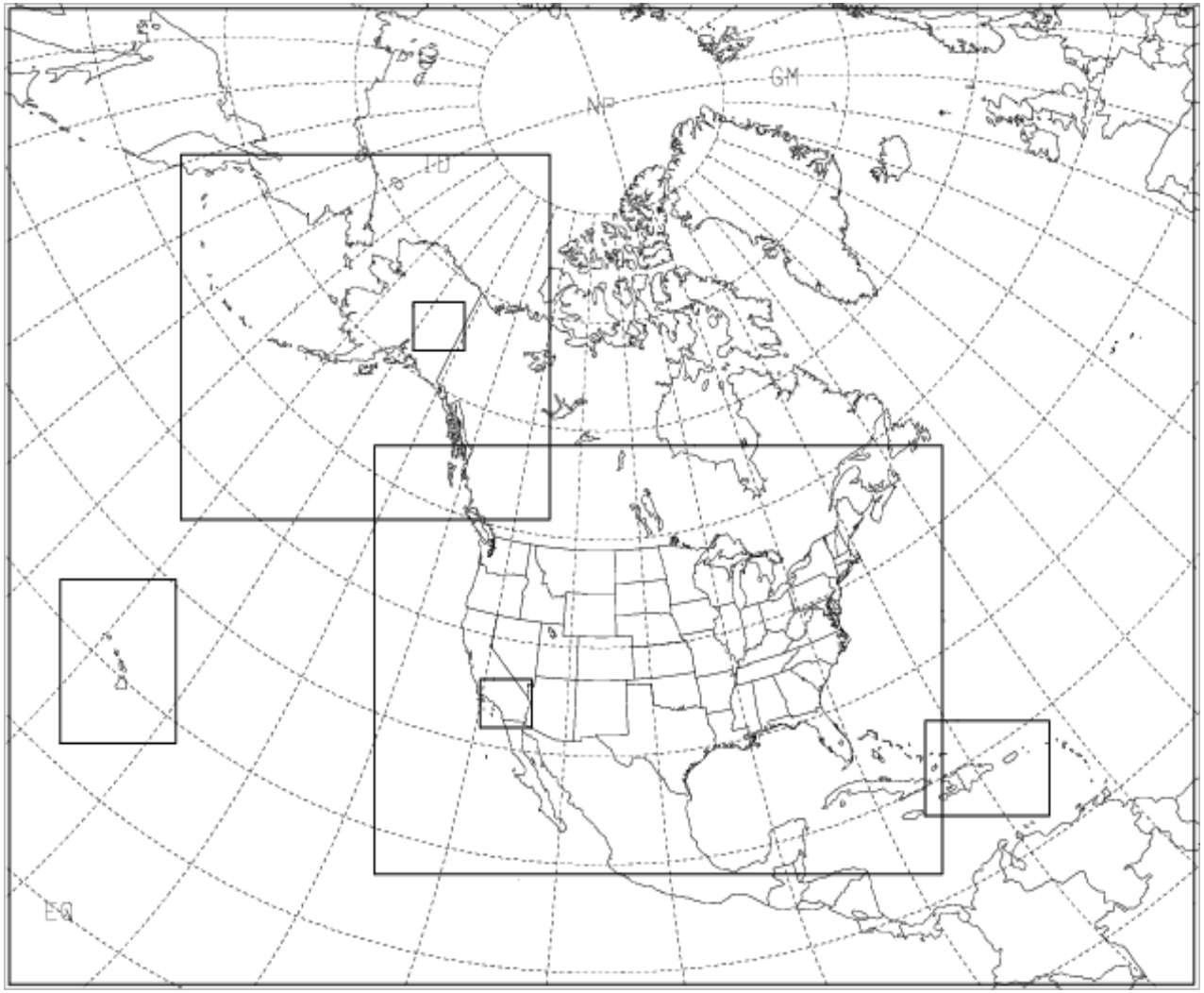
- **12 km NAM will still run to 84 hr, with current output**
- **Fixed domain nests run to 60 hr**
  - **4 km CONUS**
  - **6 km Alaska**
  - **3 km HI & PR**
- **Single locatable 1.33 km (CONUS) or 1.5 km (Alaska) Fire Weather / IMET / DHS run to 36hr**

CONUS mapped to GRIB grid 227

Alaska mapped to GRIB grid 198

Hawaii mapped to GRIB grid 196

Puerto Rico mapped to GRIB grid 194

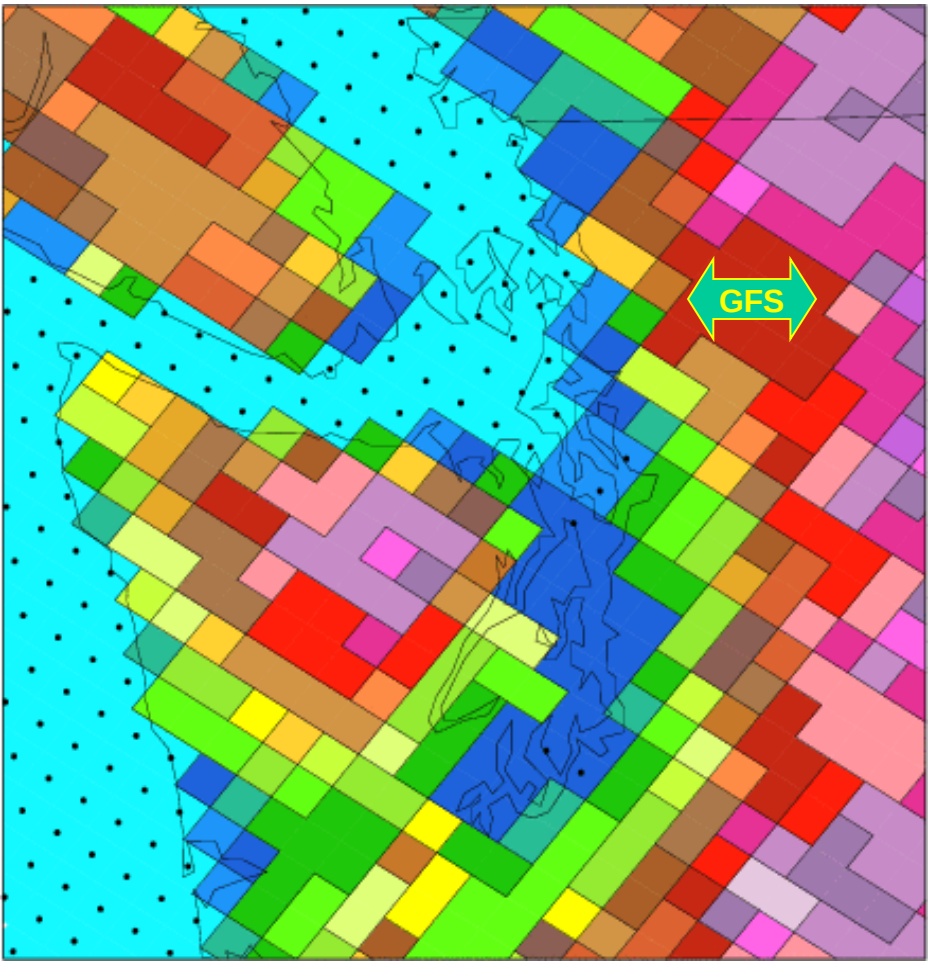


FWIS CONUS mapped to GRIB grid 90

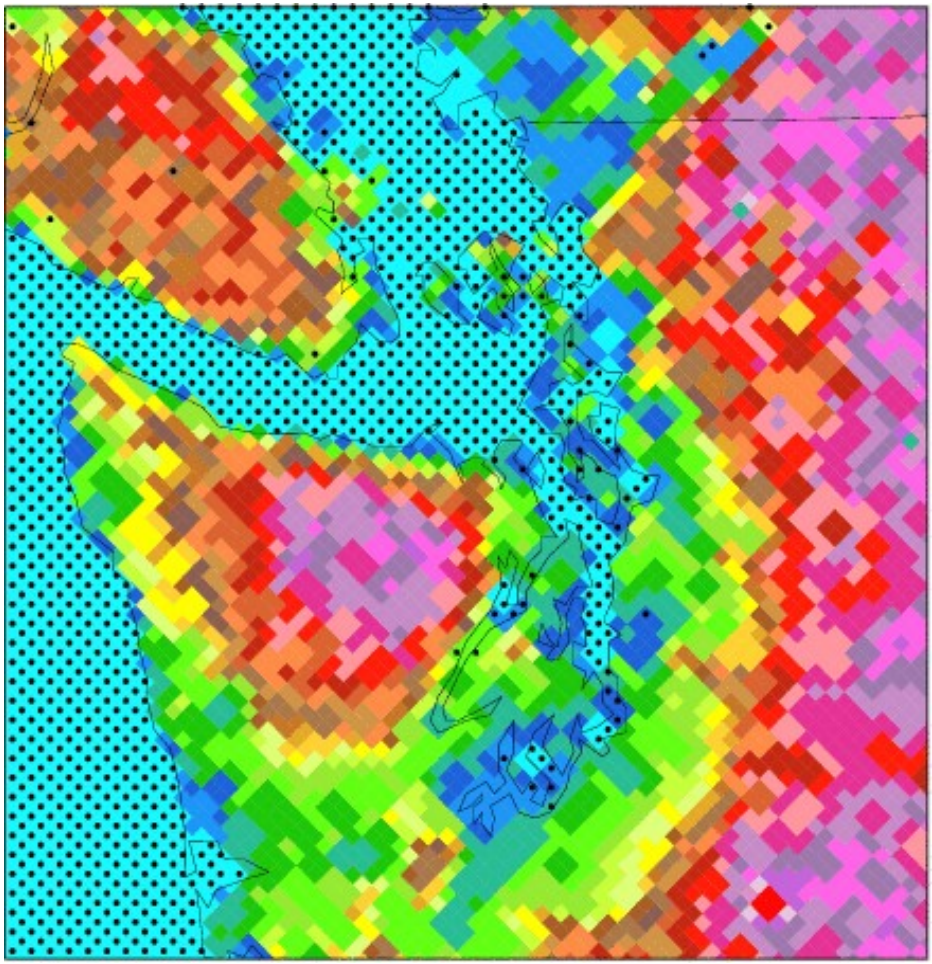
FWIS Alaska mapped to GRIB grid 92

Dots represent water points Domain is Puget Sound

12 km Terrain

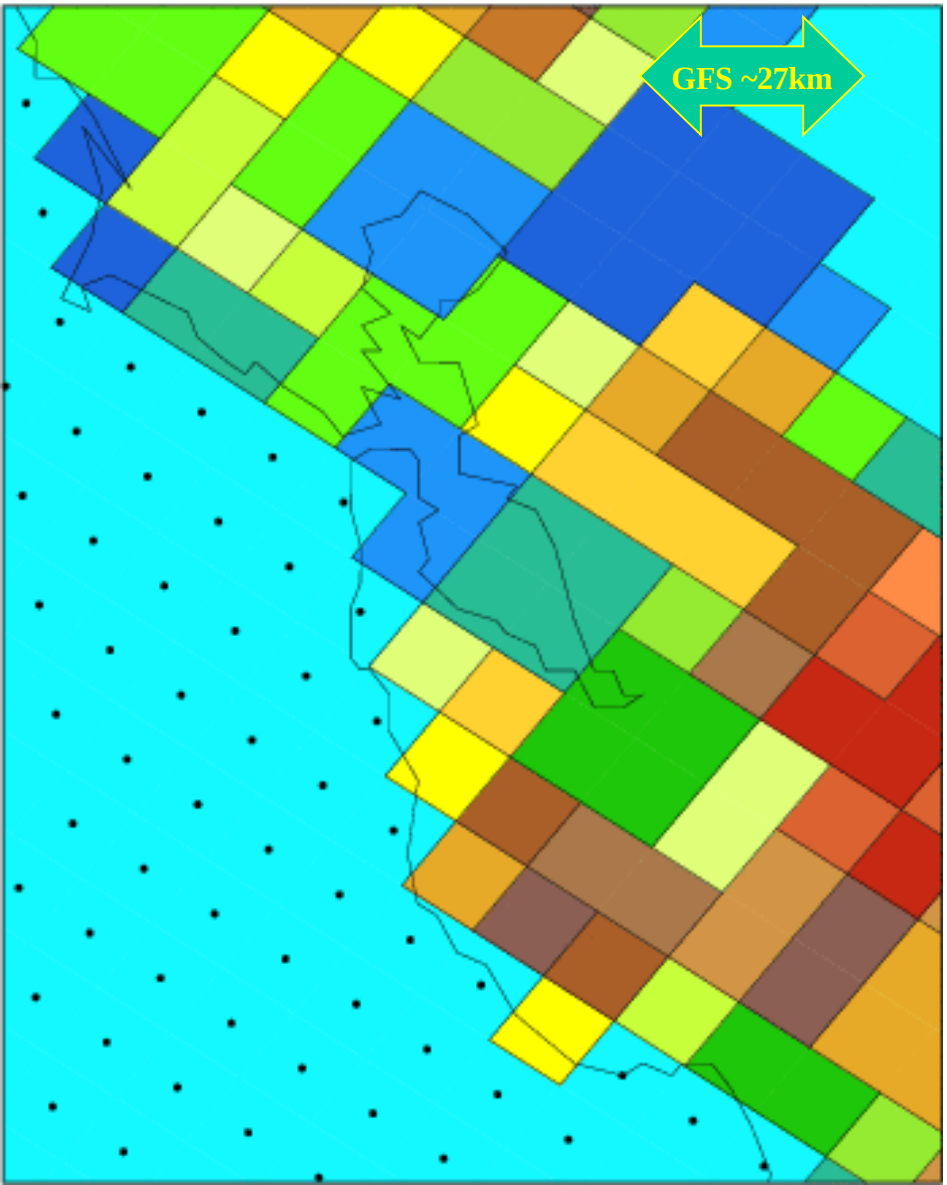


4 km Terrain

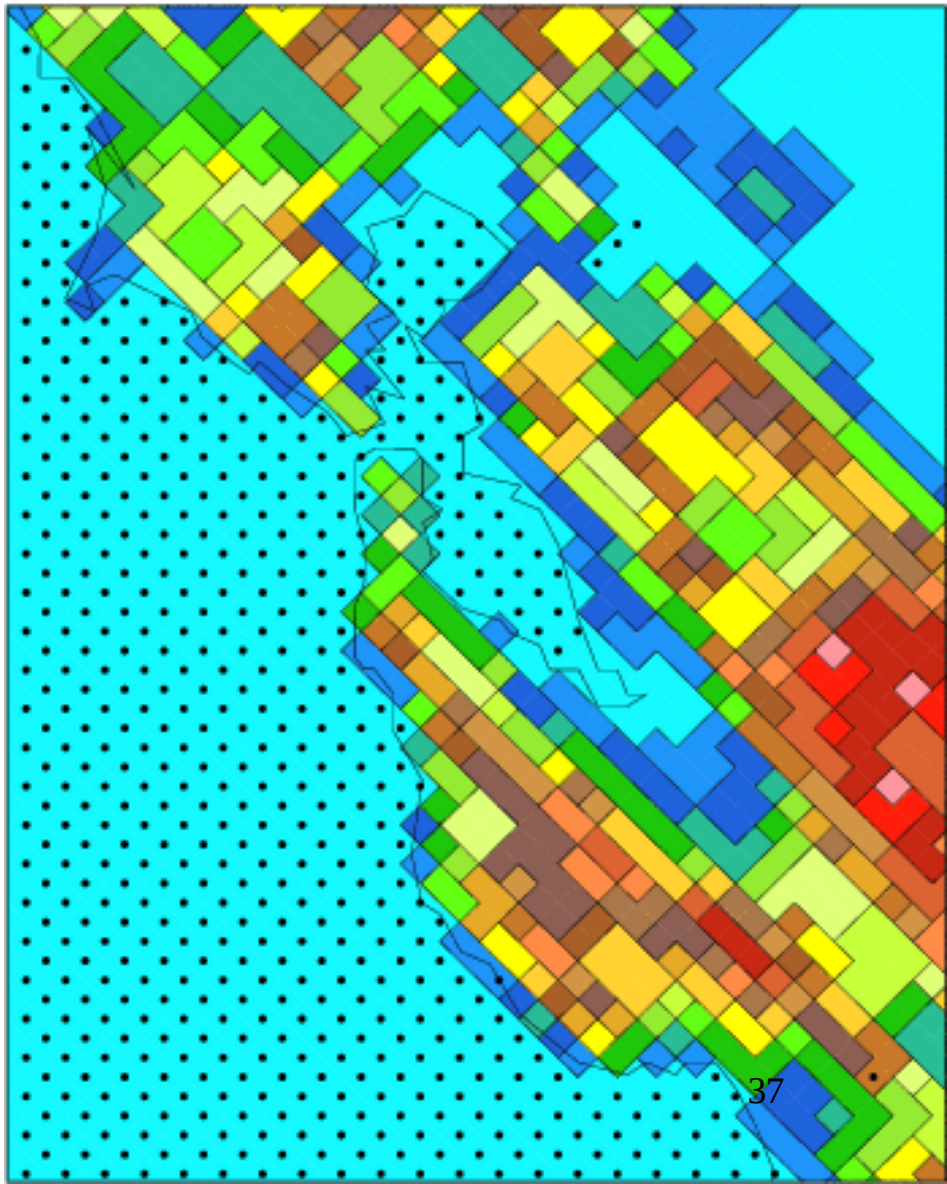


Dots represent water points Domain is San Francisco Bay

12 km Terrain

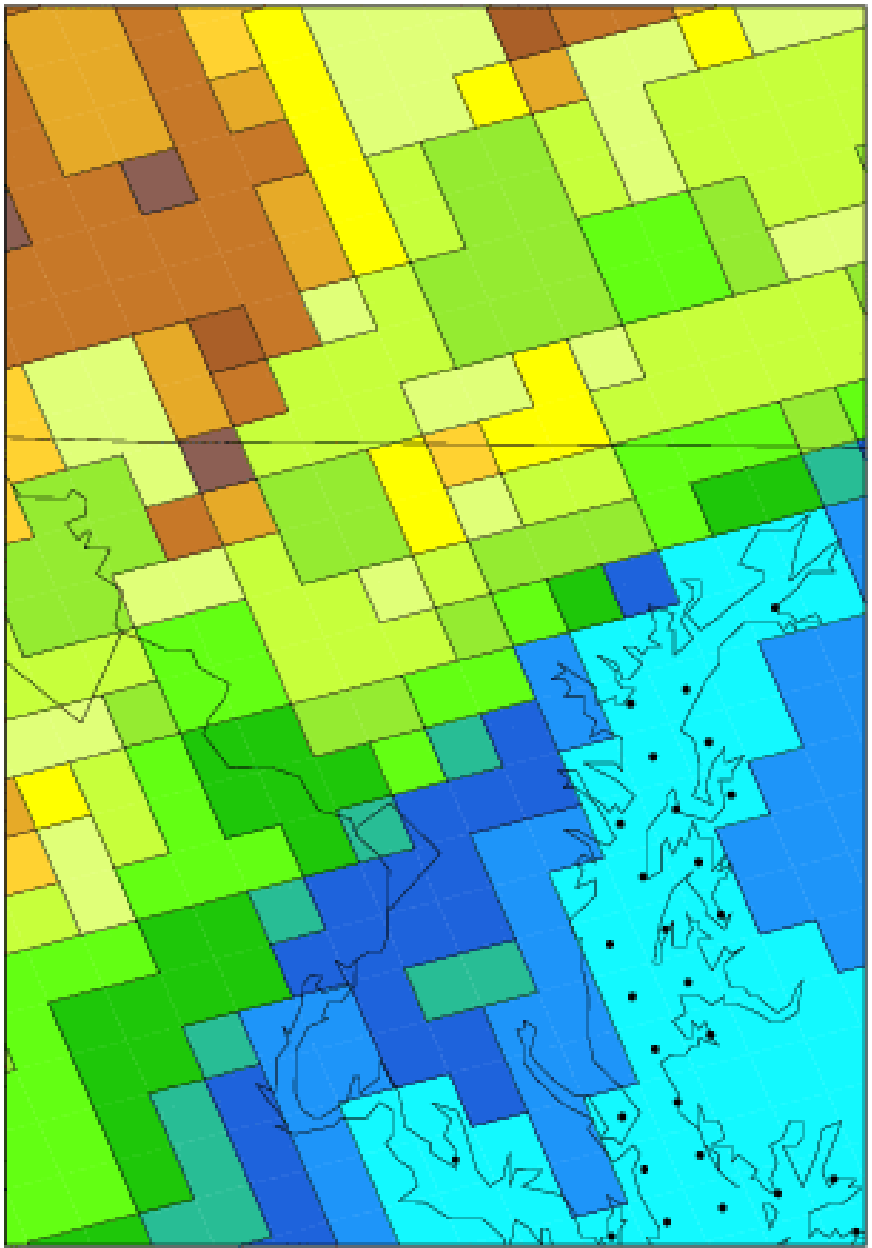


4 km Terrain

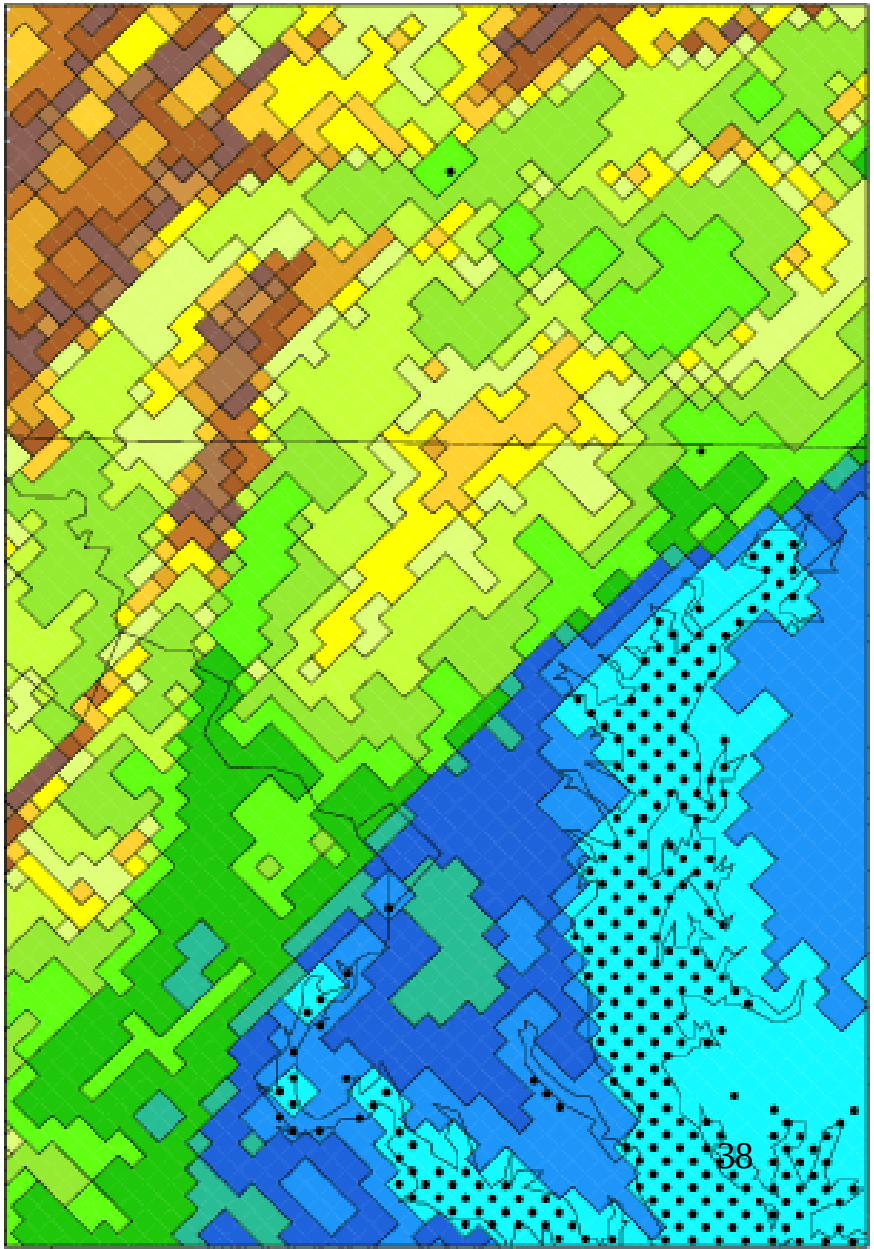


Dots represent water points Domain is Chesapeake Bay

12 km Terrain

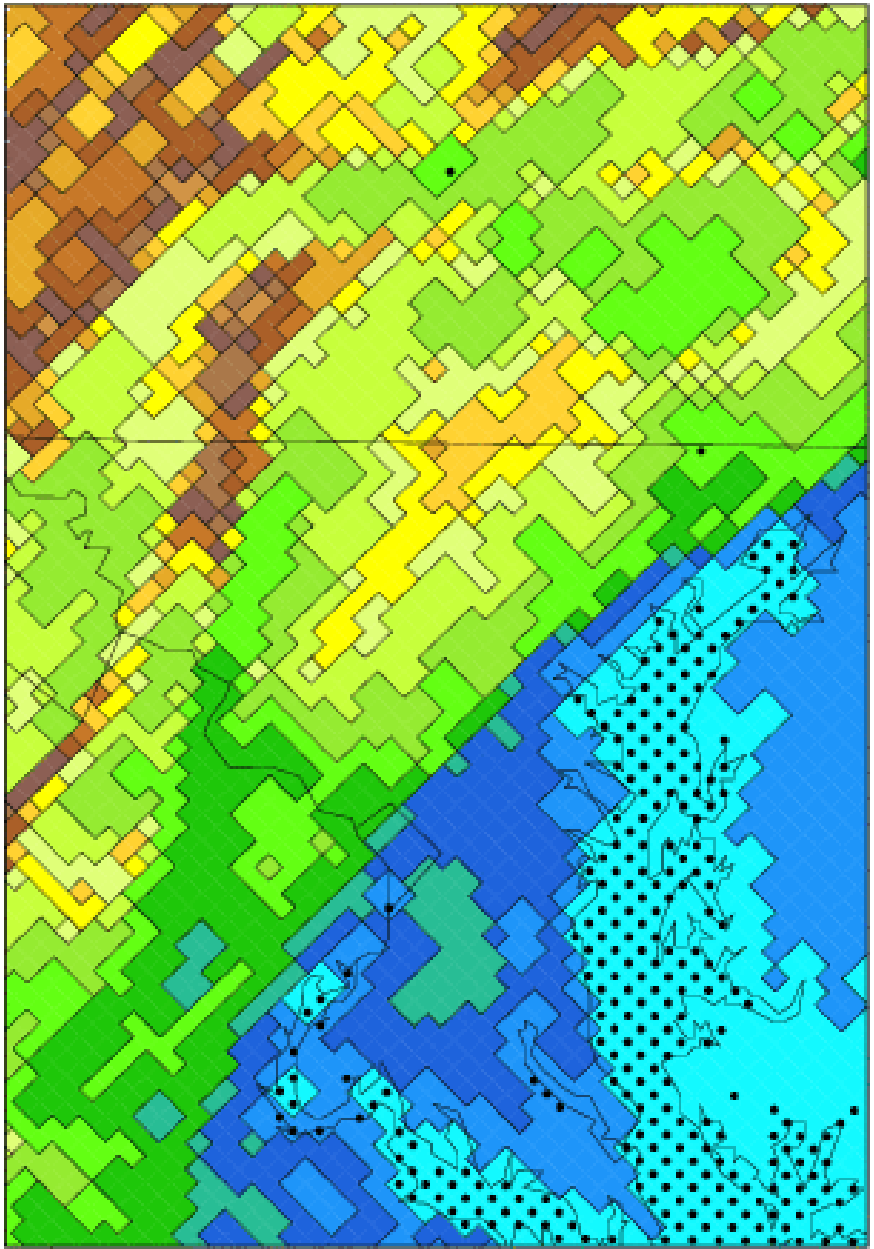


4 km Terrain

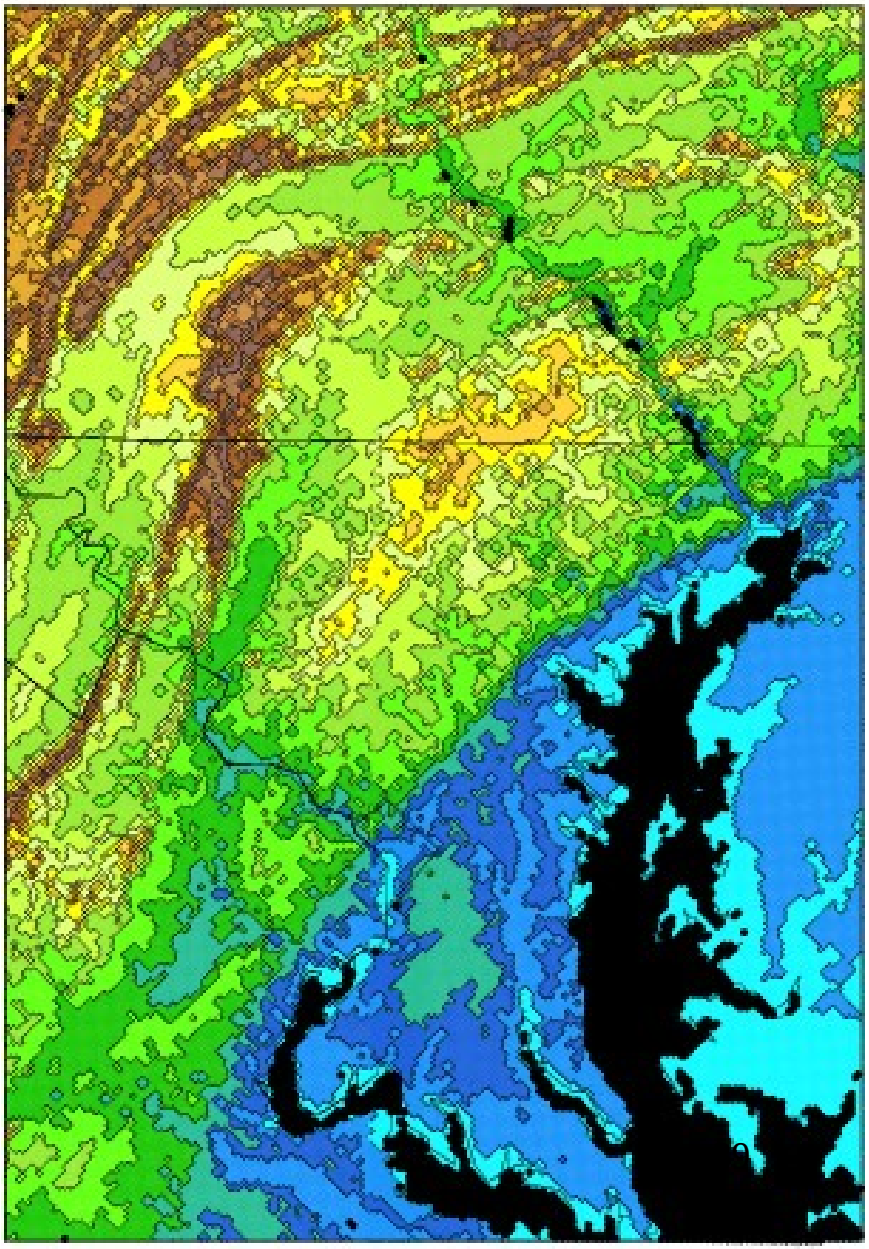


Dots represent water points Domain is Chesapeake Bay

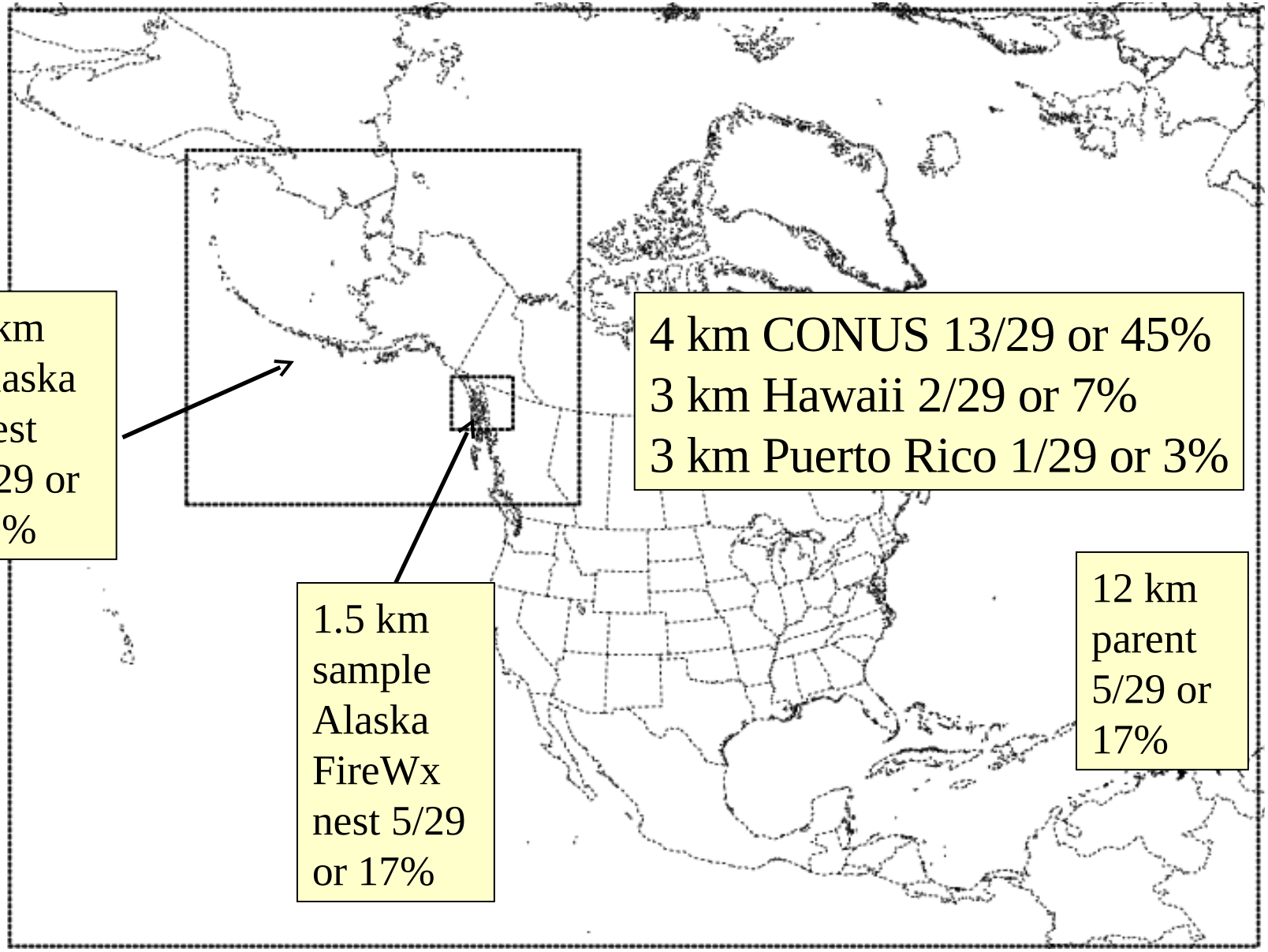
4 km Terrain



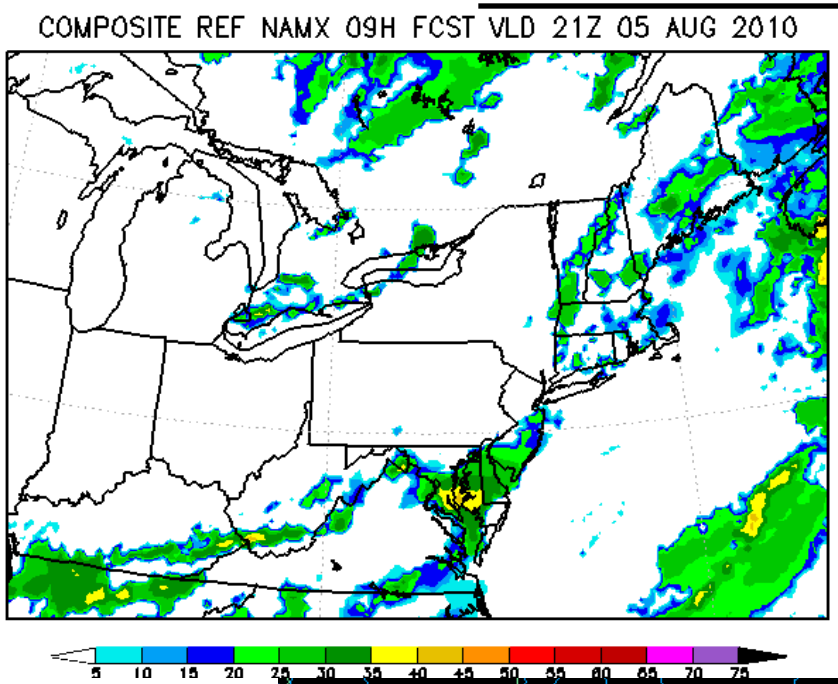
1 km Terrain

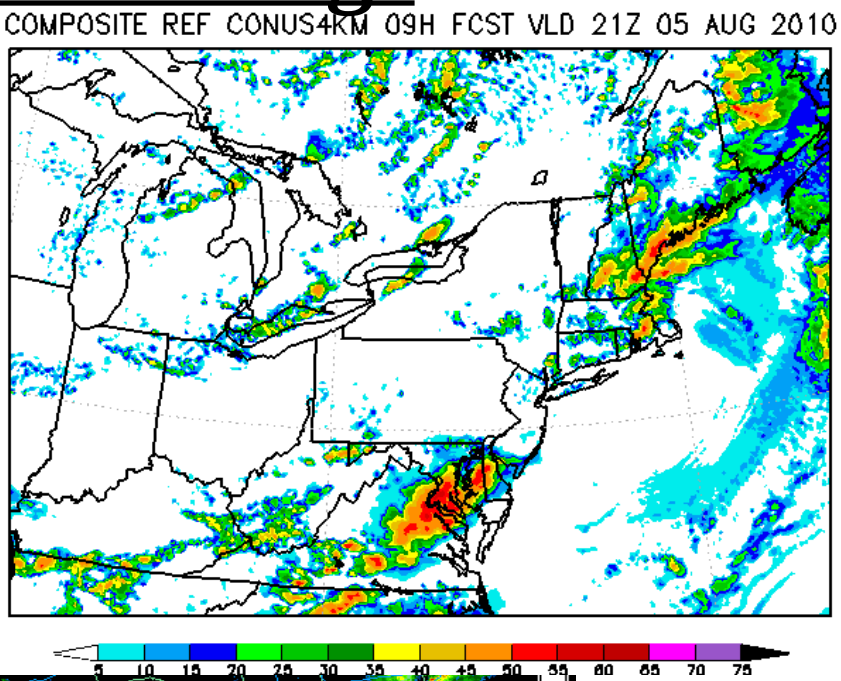


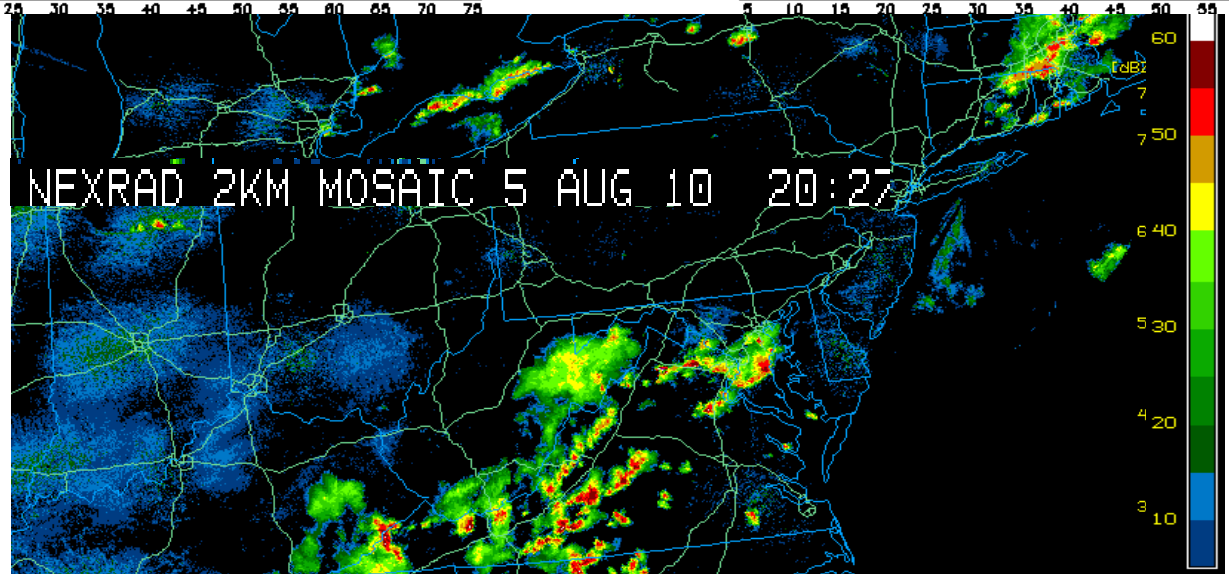
Proportional expense of high-resolution nesting in NAM



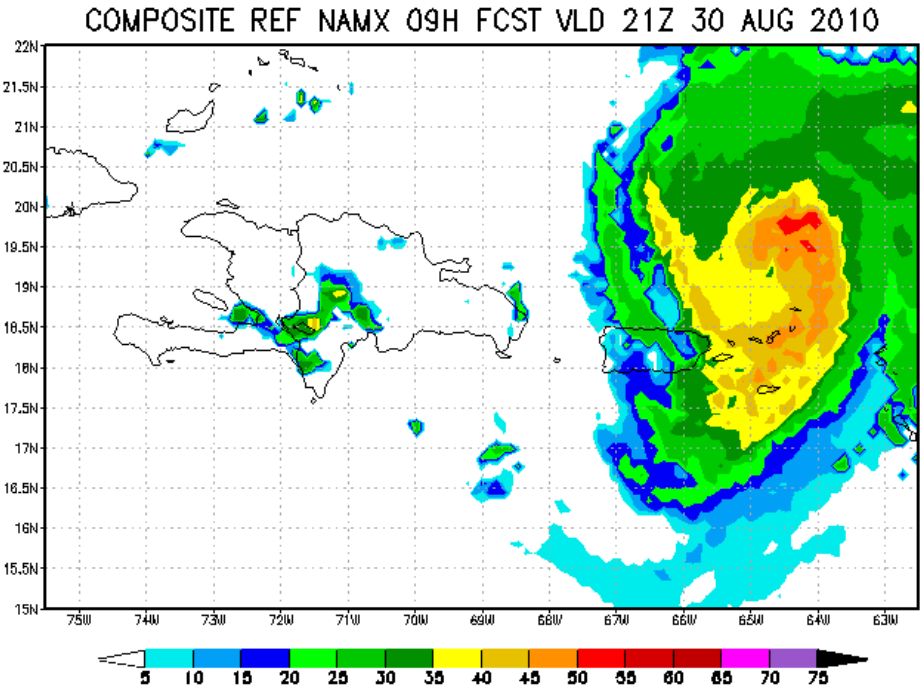
August 5th DC Severe Weather: NCEP Power Outage



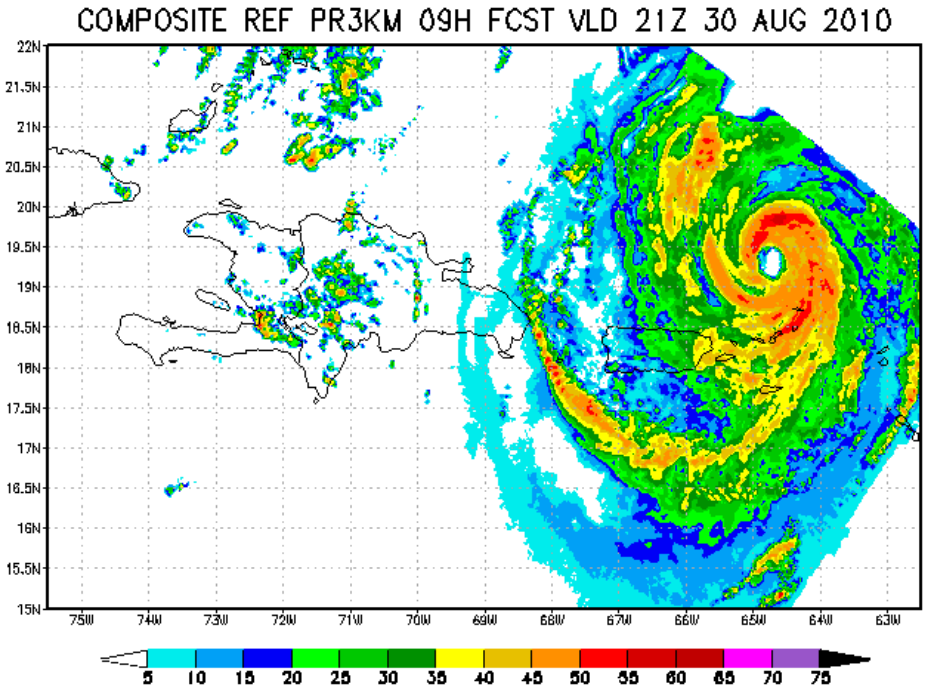




Hurricane Earl near Puerto Rico



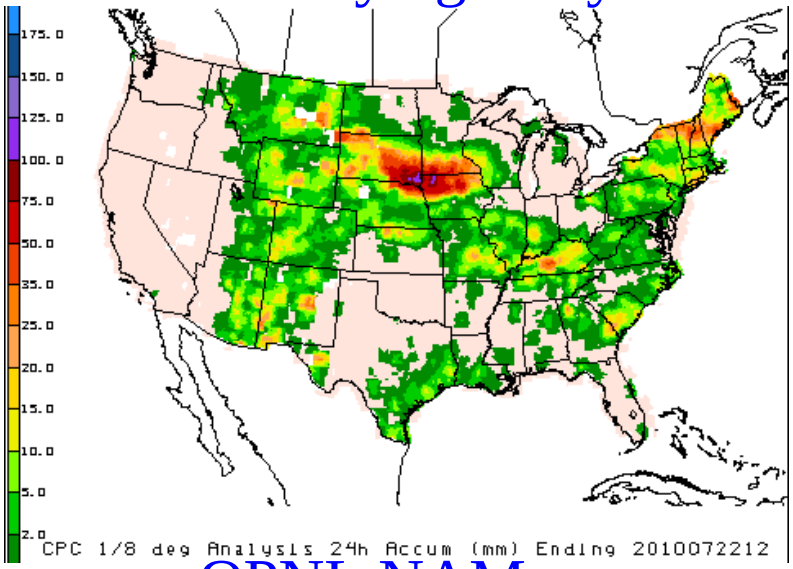
12 km NMMB parent



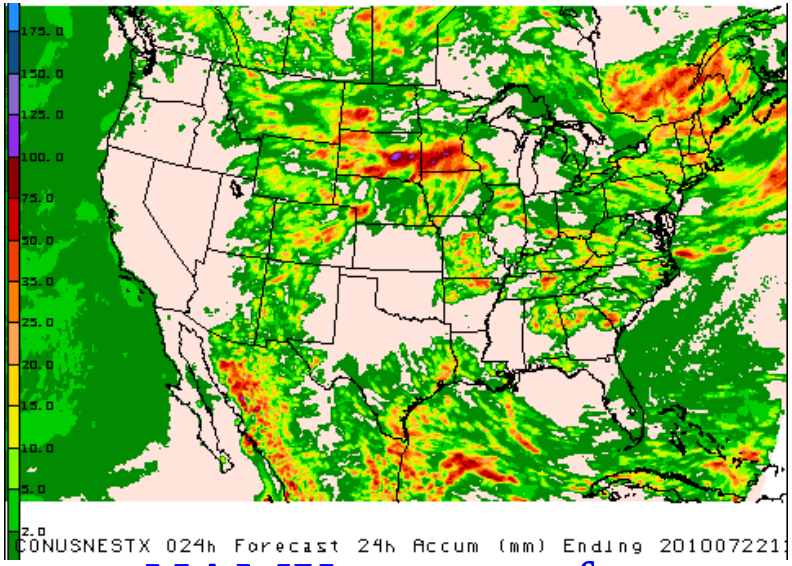
3 km Puerto Rico nest

Performance of 4 km ConUS nest: ex. 1 of 3

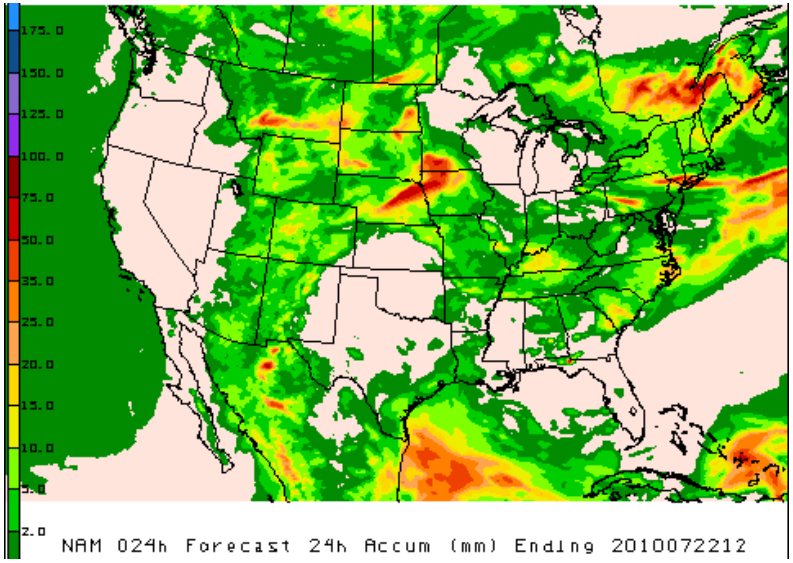
Verifying analysis



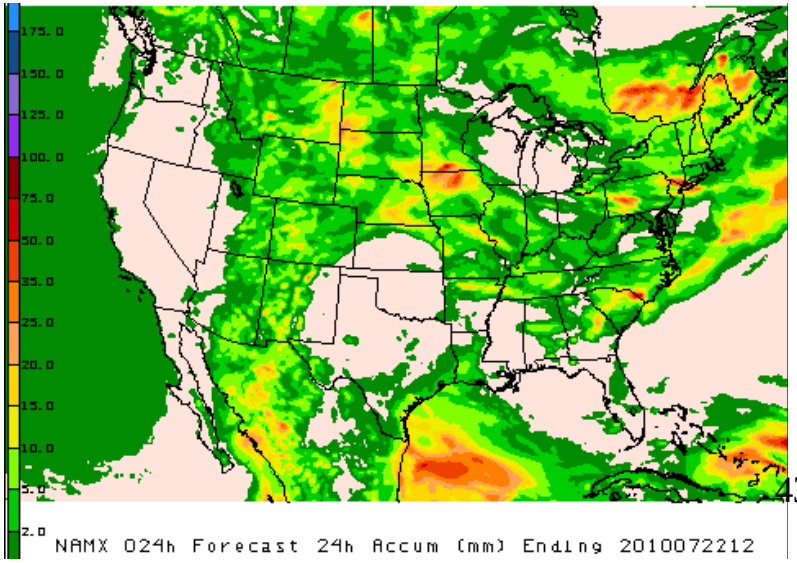
4km ConUS nest



OPNL NAM

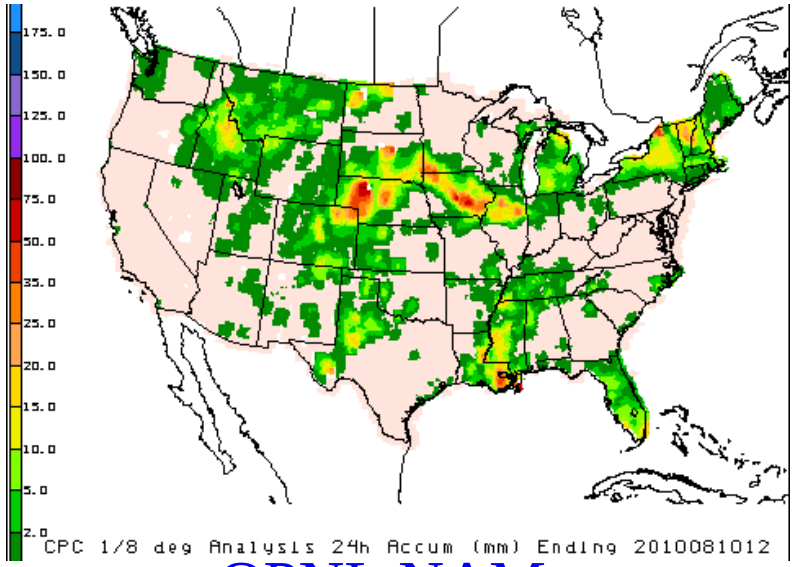


NAMX: parent of nest

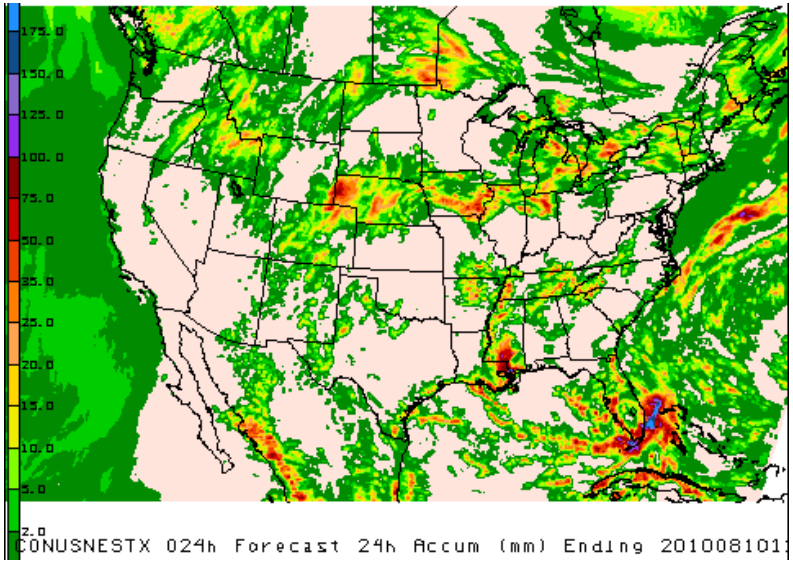


Performance of 4 km ConUS nest: ex. 2 of 3

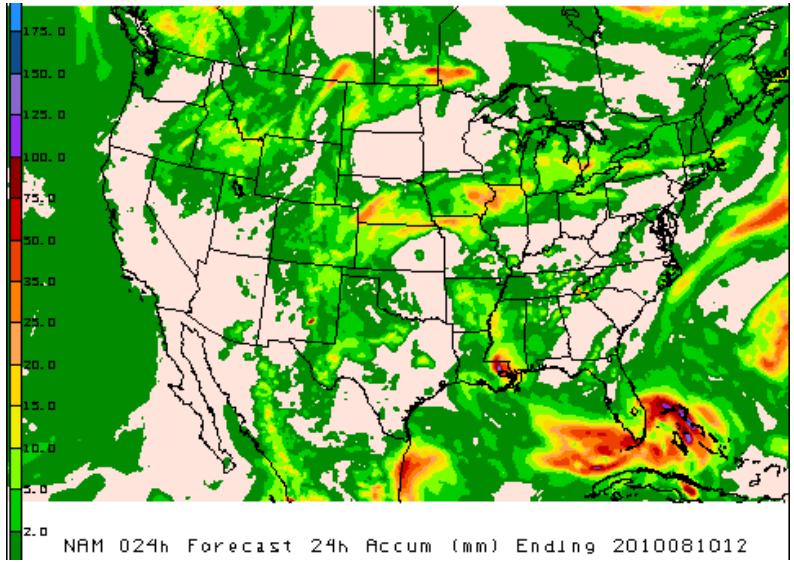
Verifying analysis



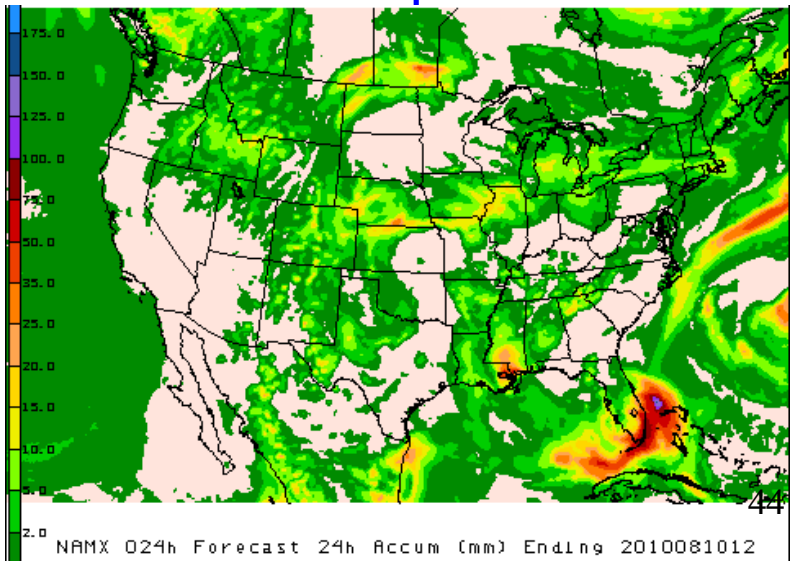
4km ConUS nest



OPNL NAM

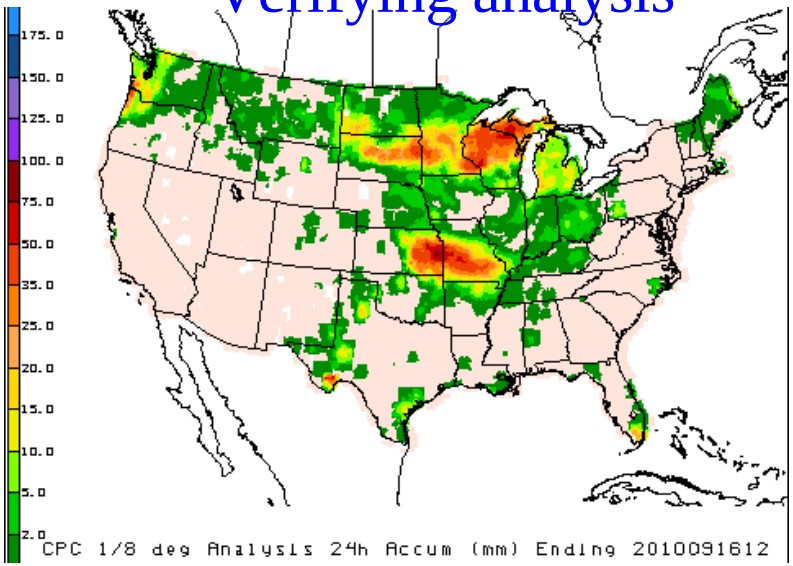


NAMX: parent of nest

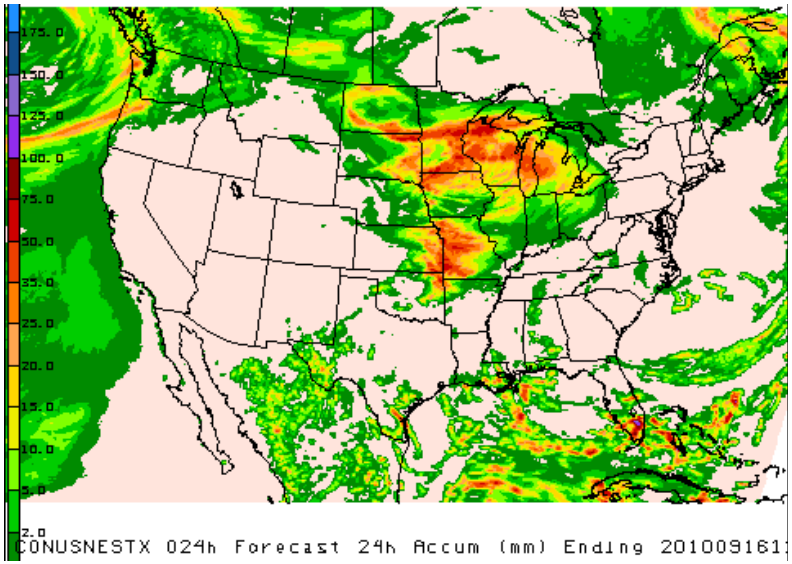


Performance of 4 km ConUS nest: ex. 3 of 3

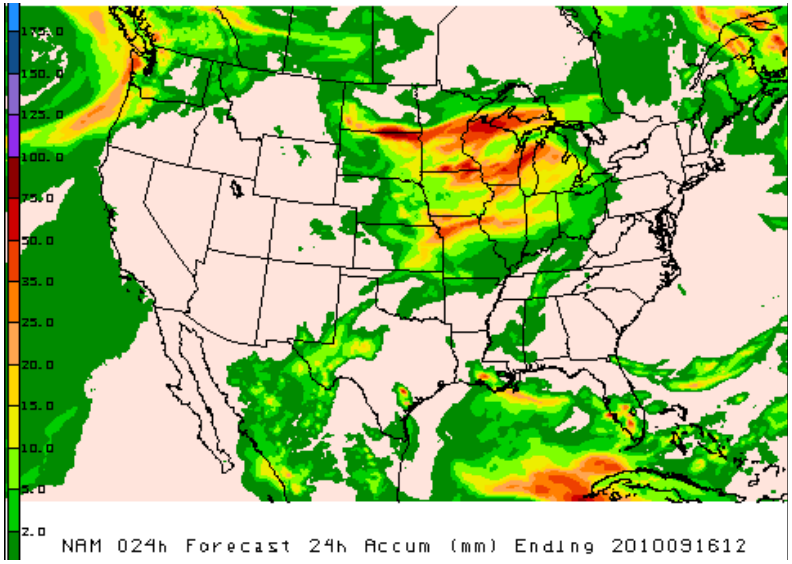
Verifying analysis



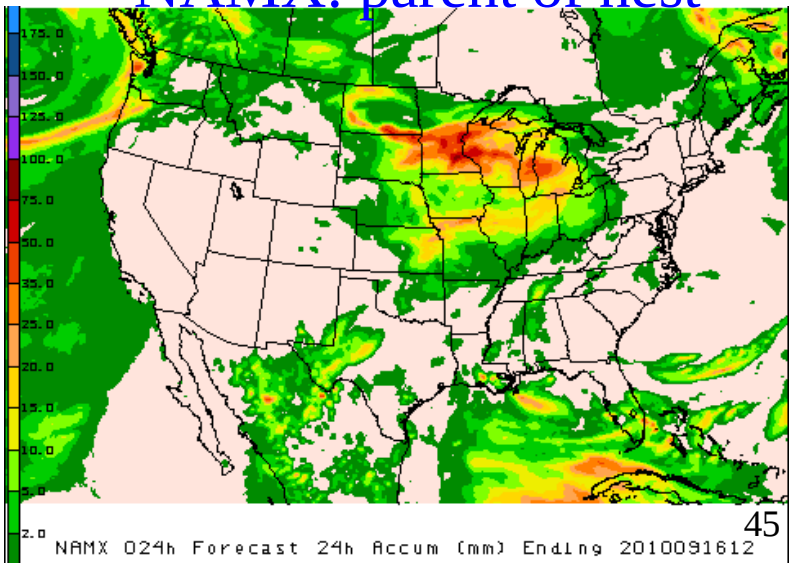
4km ConUS nest



OPNL NAM



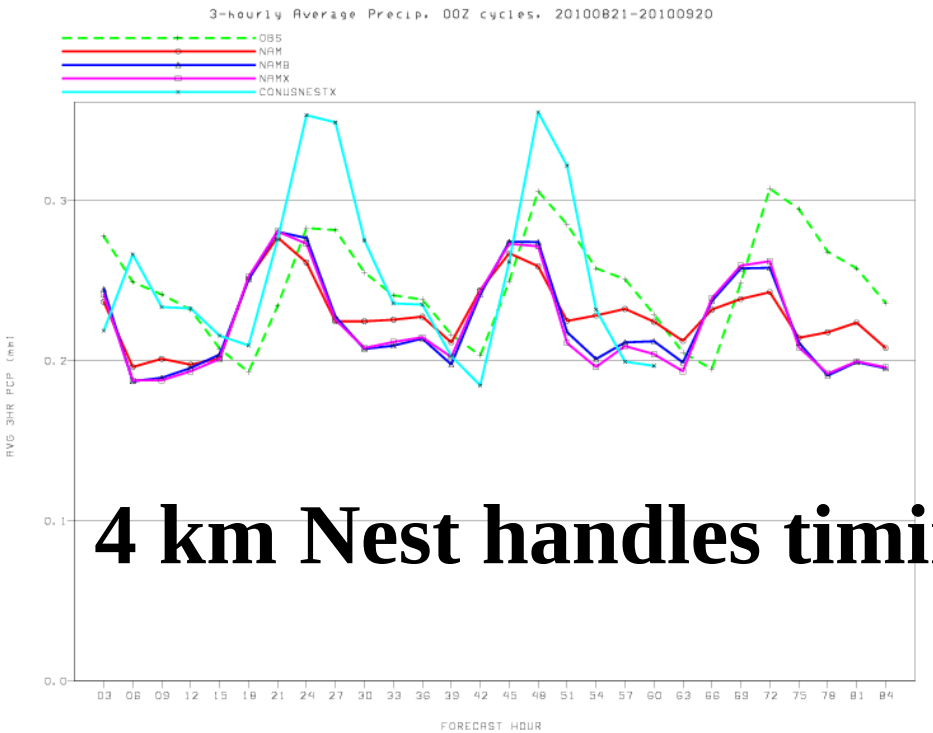
NAMX: parent of nest

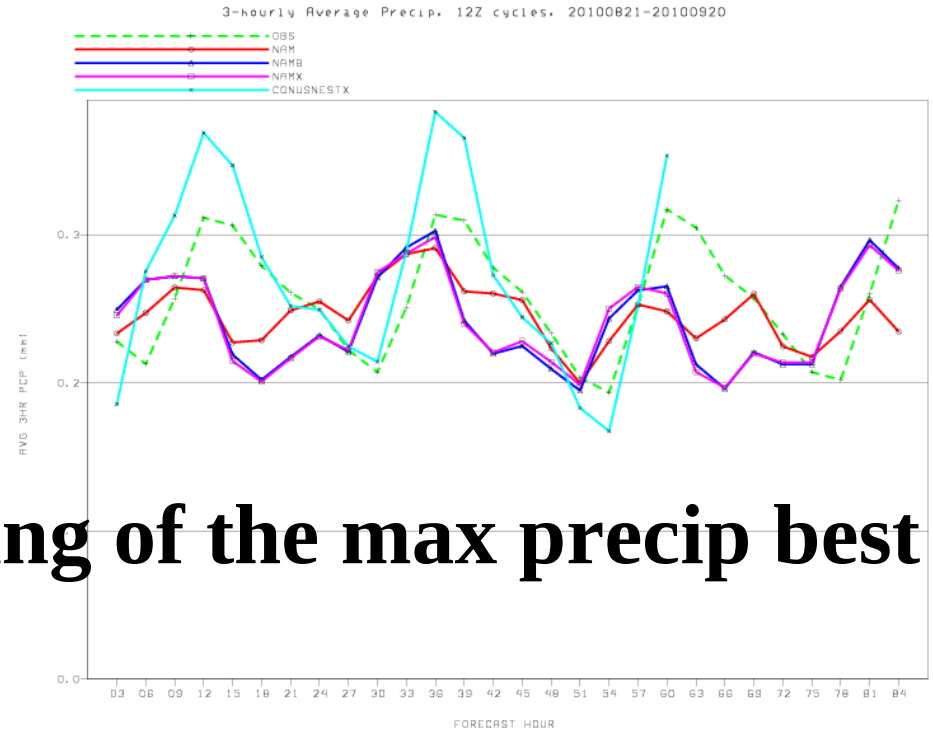


NAM, NAMB, NAMX, CONUSNESTX

Diurnal Cycles

3-hourly ConUS avg, 21 Aug – 20 Sept 2010 (verifying: Stage II)





4 km Nest handles timing of the max precip best

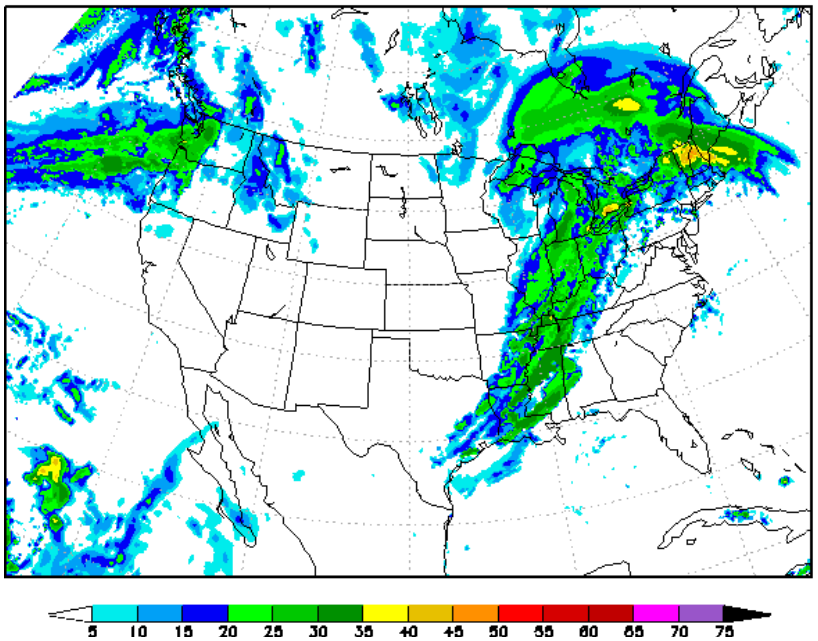
00Z cycles

12Z cycles

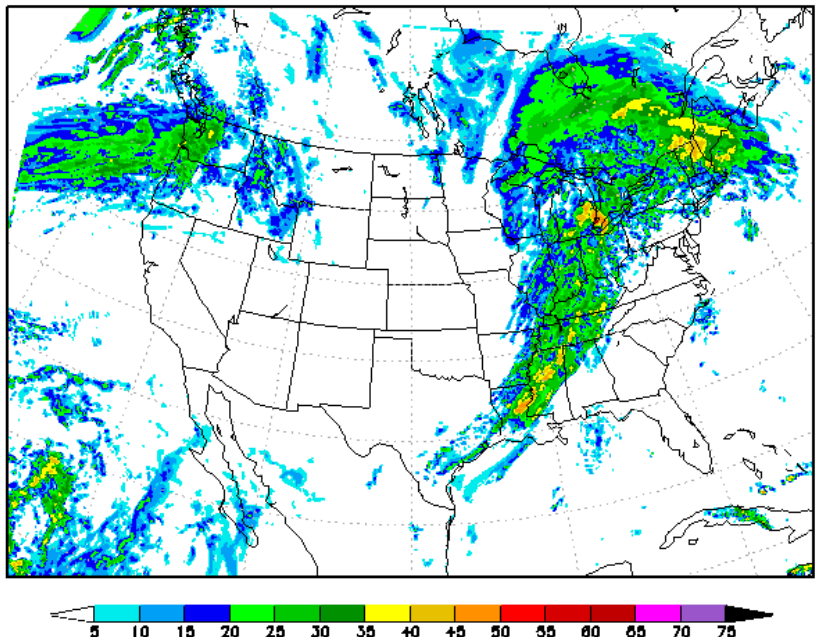
(CONUSNESTX forecast goes to 60h; the other models go to 84h)

Composite Reflectivity NAMX12 vs CONUS4

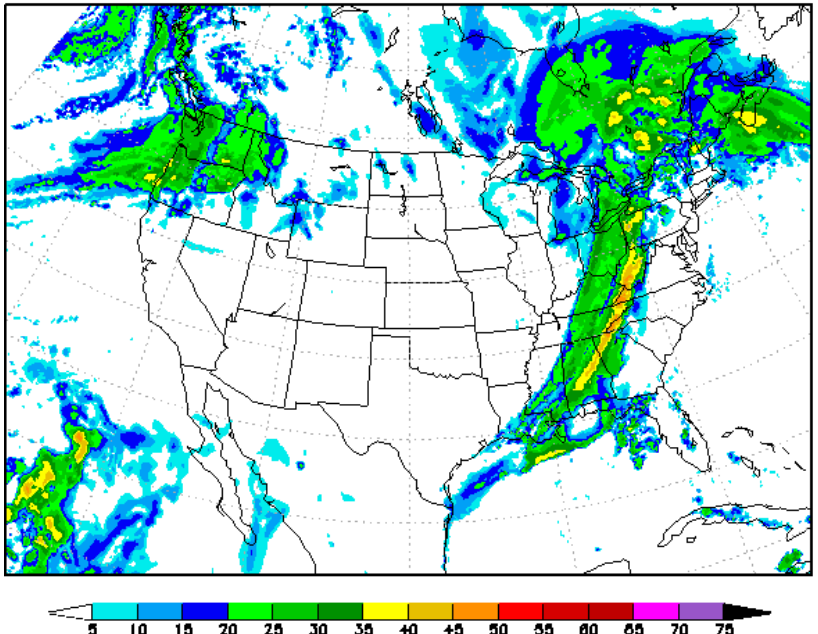
COMPOSITE REF NAMX 42H FCST VLD 18Z 04 APR 2011



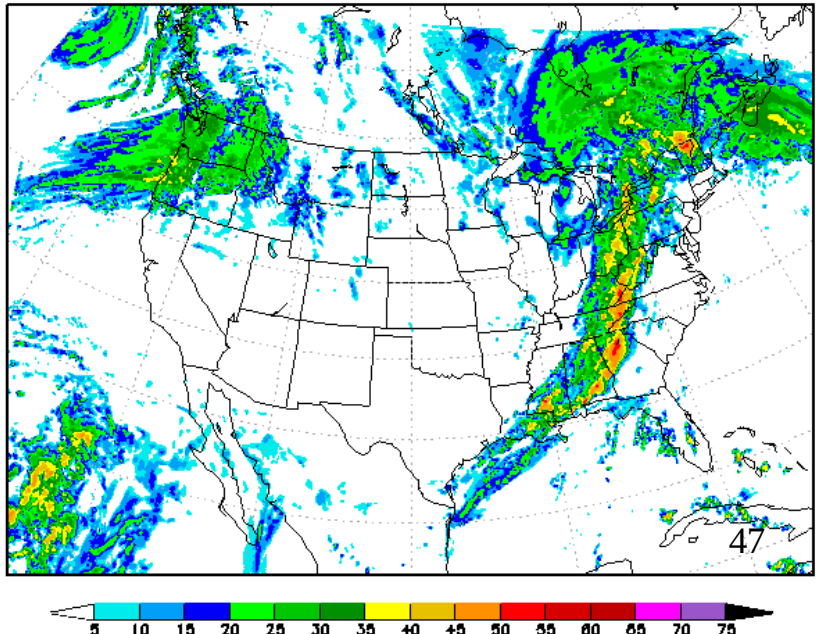
COMPOSITE REF CONUS4KM 42H FCST VLD 18Z 04 APR 2011



COMPOSITE REF NAMX 48H FCST VLD 00Z 05 APR 2011



COMPOSITE REF CONUS4KM 48H FCST VLD 00Z 05 APR 2011



GSI Upgrades from Prior Global upgrades

FY2009 & FY2010

- Adding new observation data sources.
  - Assimilate tropical storm pseudo sea-level pressure obs
  - NOAA19 hirs/4,AMSU-A, & MHS brightness temp obs
  - NOAA18 sbuv/2. Monitor N19 GOME, and OMI ozone (no assimilation)
  - RARS (currently only EARS) 1B data
  - EUMETSAT-9 atm motion vectors
- Implementing improved techniques in GSI analysis.
  - Use uniform thinning mesh for brightness temp data
  - Improvements to assimilation of GPS RO data (QC, retune ob errors, improved forward operator)
  - Add dry mass pressure constraint
  - Merge GMAO & EMC codes
  - Update background error covariance
  - Proper use of different spectral truncation between background and analysis
  - Give more weight to profile data in upper troposphere / lower stratosphere
  - Extensions to allow global_gsi to run from T878L91 spectral coefficient files

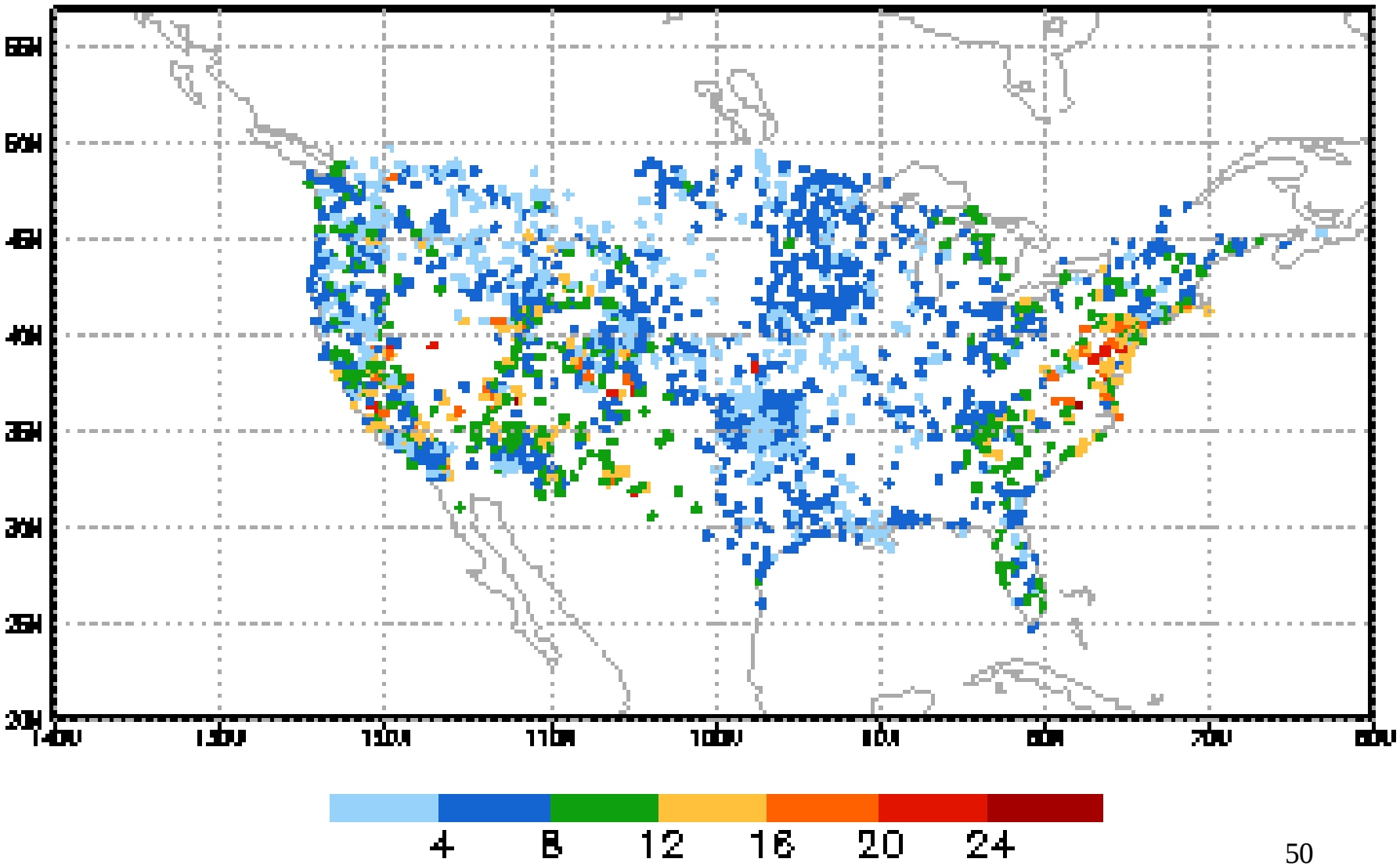
~May 2011

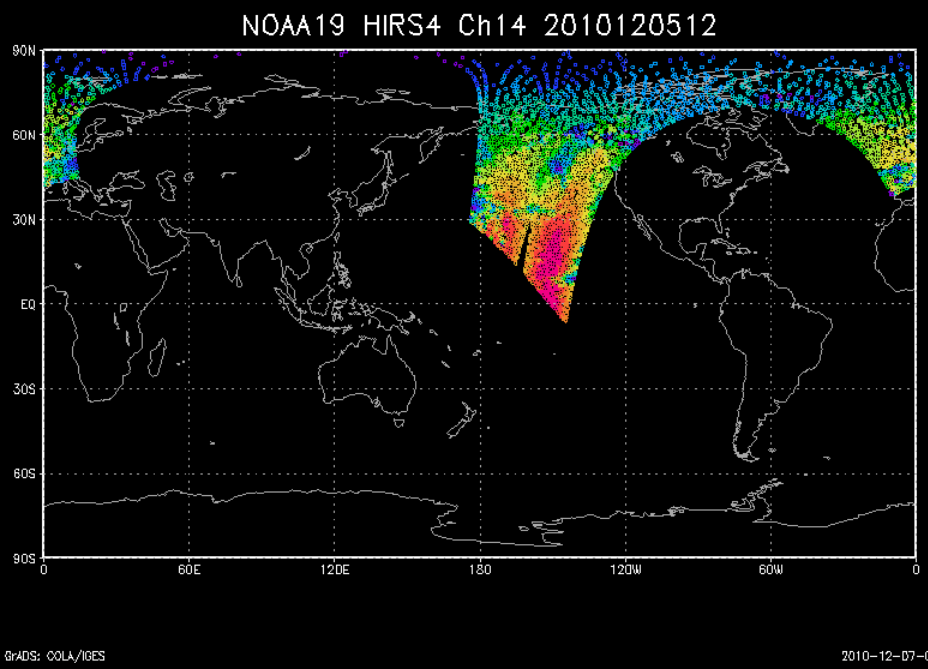
- Faster code (~9%), threaded, improved optimization and additional options
- Recomputed background errors
- Limit moisture to be >= 1.e-10 in each outer iteration and at the end of analysis
- Locate buoys at 10 m (down from 20 m)
- Ambiguous vector qc for ASCAT winds
- Satellite radiance related changes
  - Update to radiative transfer - CRTM 2.0.2
  - Inclusion of Field of View Size/Shape/Power for radiative transfer
  - Relax AMSU-A Channel 5 QC
  - Remove down weighting collocated radiances
  - Inclusion of uniform (higher resolution) thinning for satellite radiances
- Stratospheric satellite
  - Improved OMI QC
  - Removal of redundant SBUV/2 total ozone
  - Retune SBUV/2 ozone ob errors
  - Inclusion of SBUV from NOAA-19

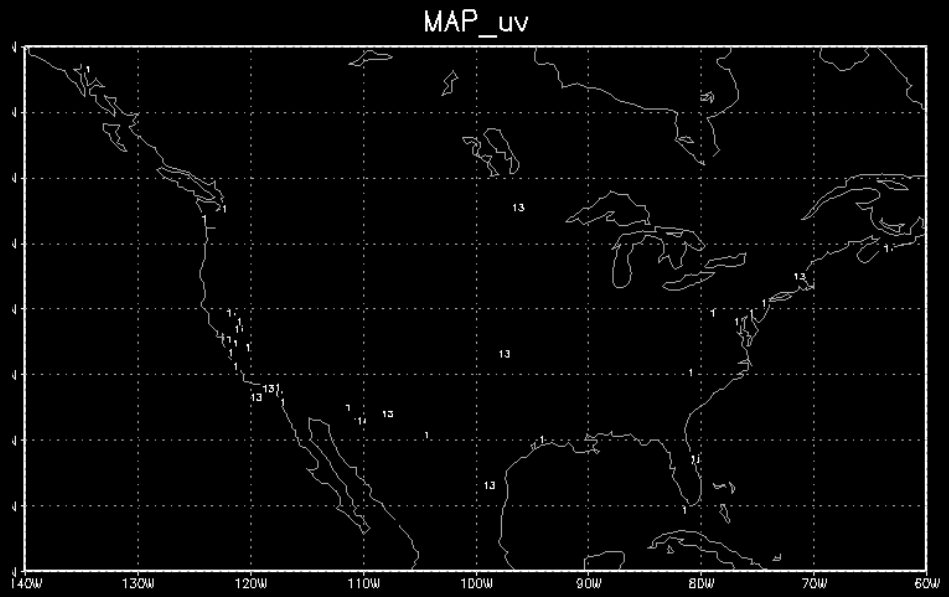
Regional GSI Obs Changes in NAM

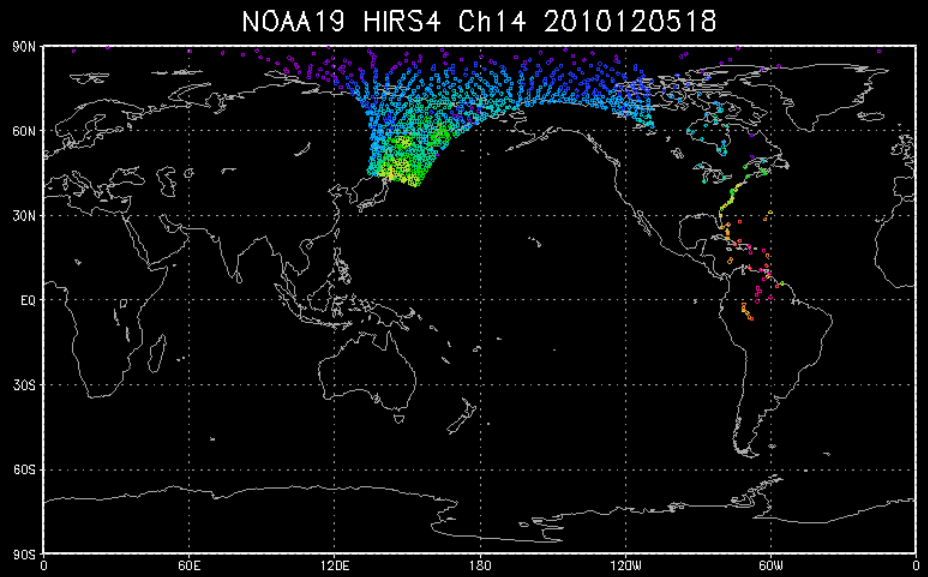
- Add new conventional obs
  - MESONET p_s, T, q with RTMA's dynamic reject list (mesonet winds already used in NAM with both reject & use lists)
  - ACARS moisture (WVSS-II)
  - MAP Profiler winds (below 400 mb)
  - RASS Profiler T_v (virtual temp)
  - WINDSAT & ASCAT ocean winds (from scatterometer)
- Add new satellite obs
  - Satellite Radiances
    - AMSUA from aqua & NOAA19 (exCh8)
    - HIRS4 from NOAA19
    - IASI from METOP-A
  - Refractivity
    - GPS radio-occultation (e.g. COSMIC)
- Turn off NOAA15 AMSUB
- Increase ob error of Level 3 88D winds
- Turn off use of Level 2.5 88D winds except over Alaska
- Use retuned ob errors (via Derozier et al.)

Example Mesonet Observations at 20Z Feb. 25, 2011




NOAA19 HIRS4 Ch14 2010120512
90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
120W
60W
0
GrADS: COLA/IGES
2010-12-07-09:18


MAP_uv
140W
130W
120W
110W
100W
90W
80W
70W
60W


NOAA19 HIRS4 Ch14 2010120518
90N
60N
30N
EQ
30S
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0
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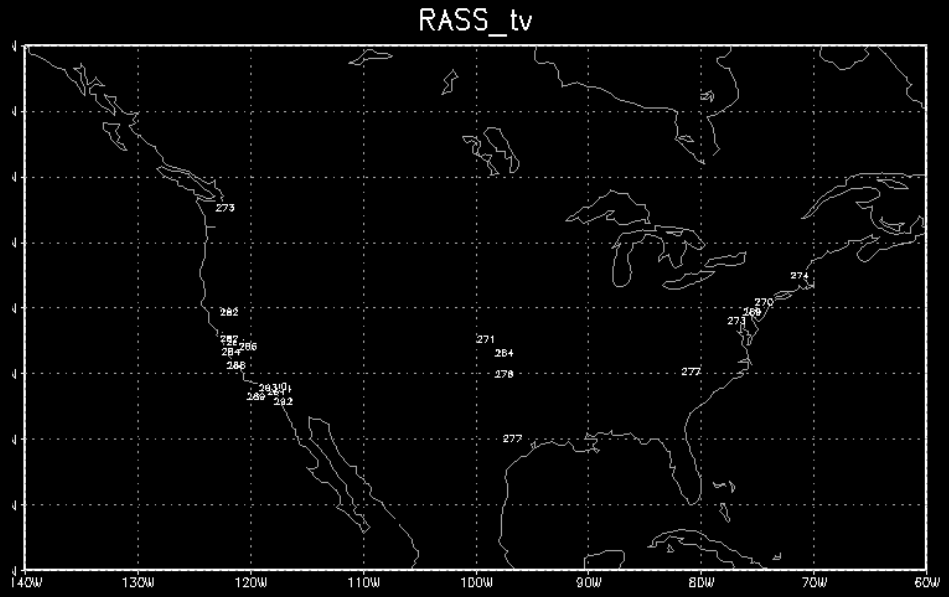
2010-12-07-09:20 S: COLA/IGES


RASS_tv
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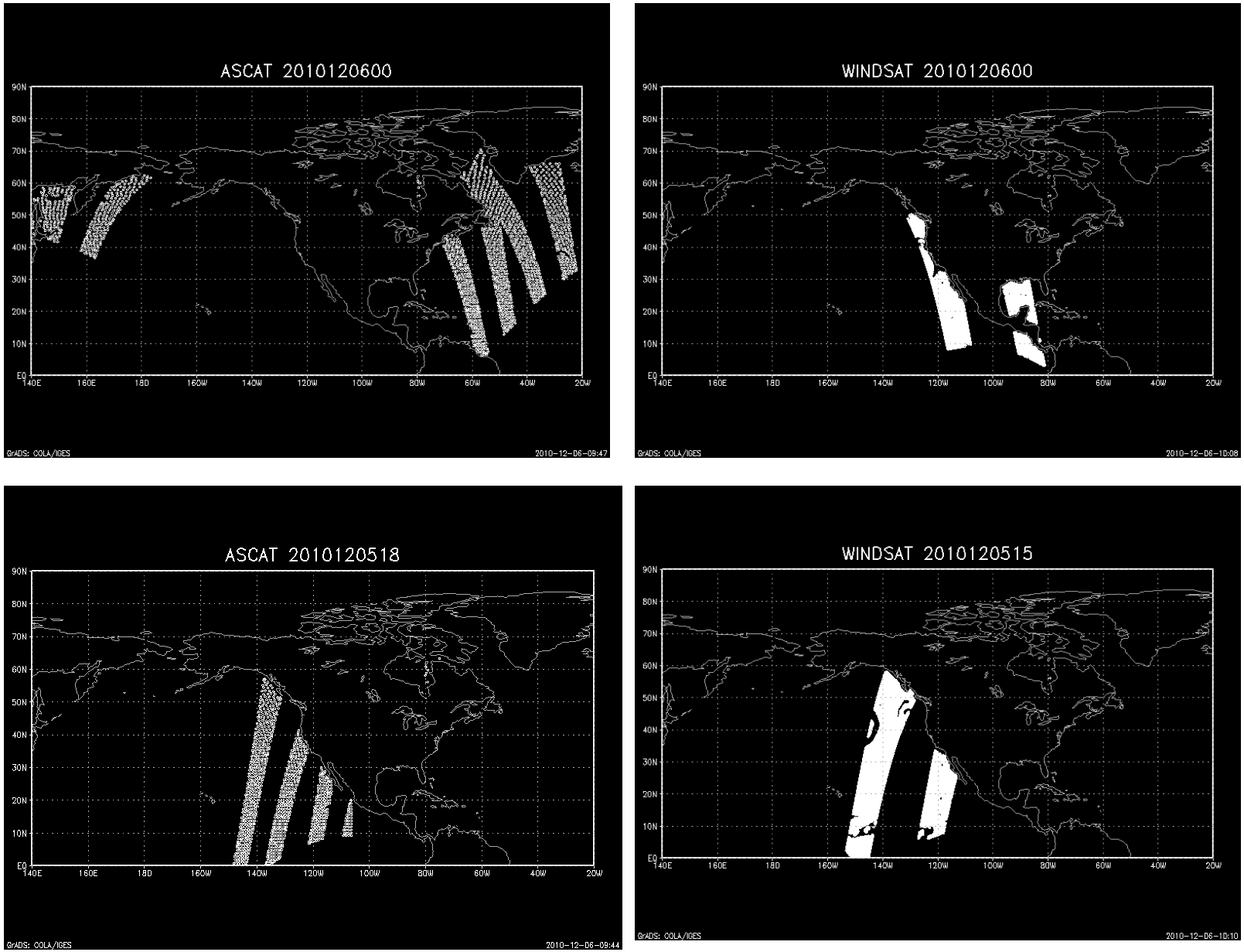
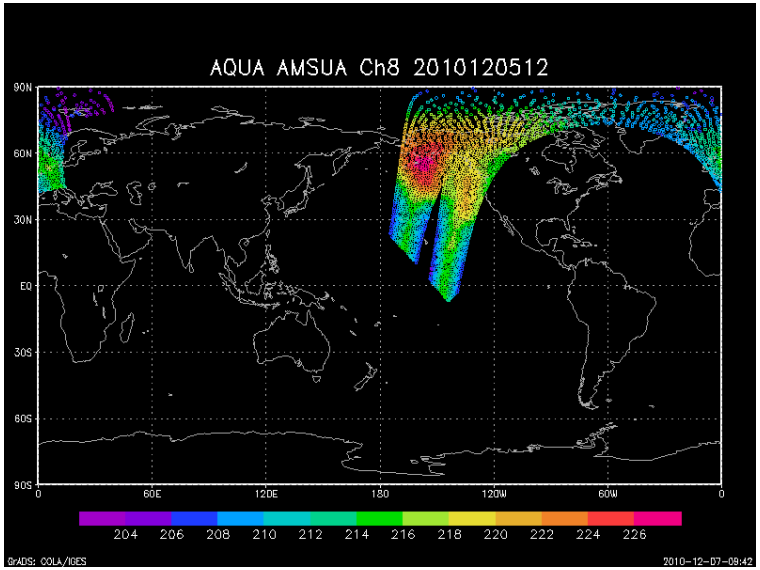
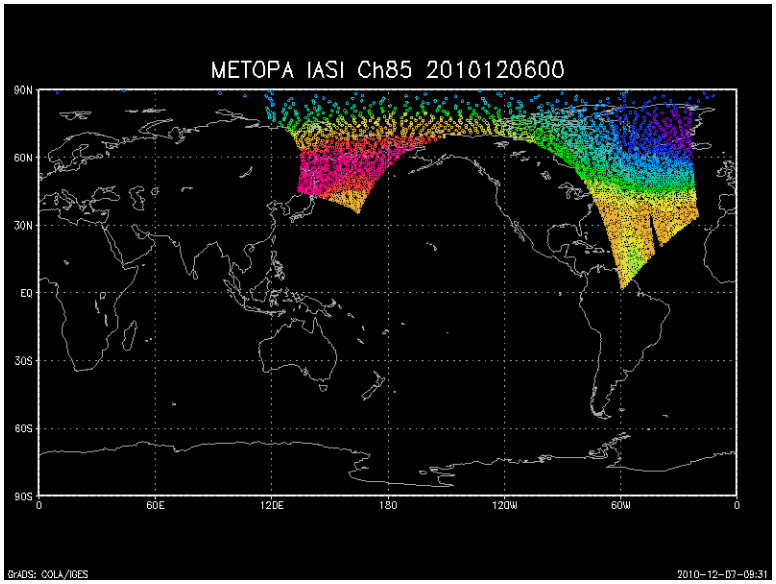
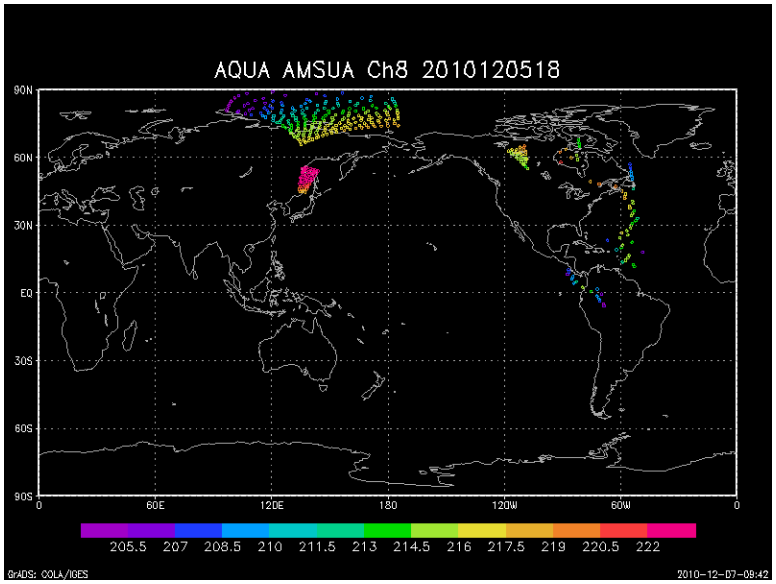
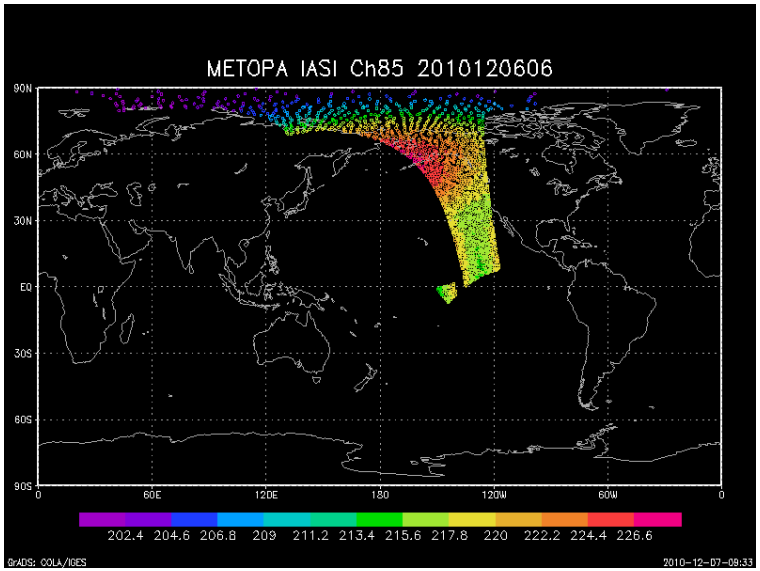


Time of the day Variation of data coverage
8 cycles/day, but only 2 each are shown







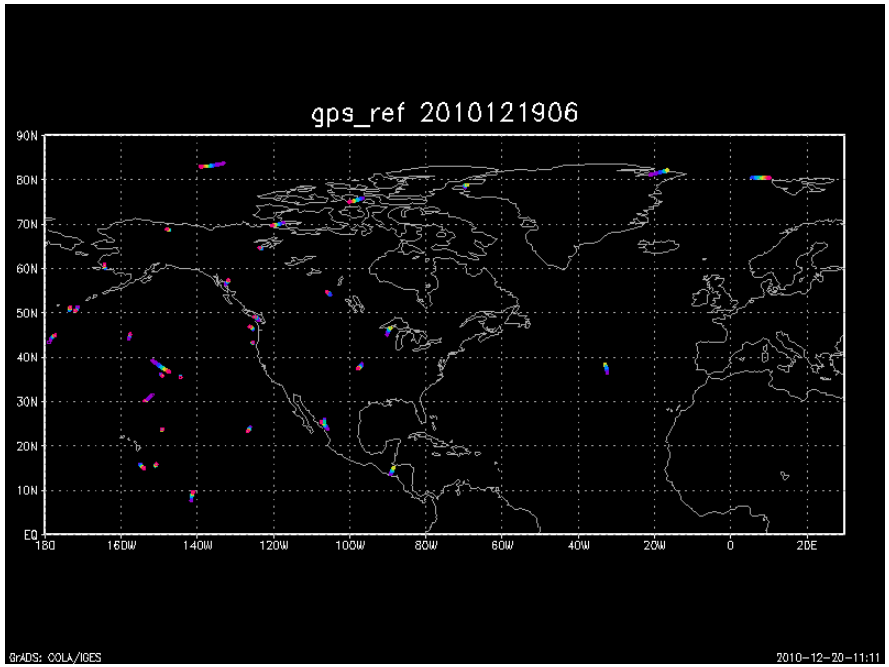


Time of the day Variation of data coverage
8 cycles/day, but only 2 each are shown

GPS_REF data distribution

	Obs	/	sounding
06	9192	/	655
12	11143	/	660
18	18057	/	672
00	20138	/	676

* tm12 used for maximum amount of data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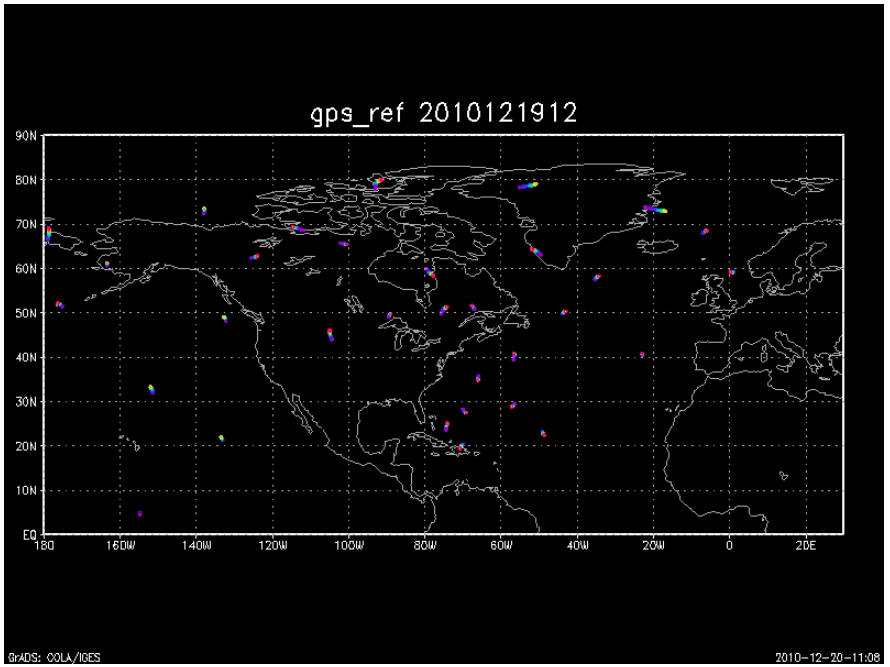
80N
70N
60N
50N
40N
30N
20N
10N
EQ
180
160W
140W
120W
100W
80W
60W
40W
20W
0
20E
GrADS: COLA/IGES
2010-12-20-11:11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80N
70N
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50N
40N
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20N
10N
EQ
180
160W
140W
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100W
80W
60W
40W
20W
0
20E
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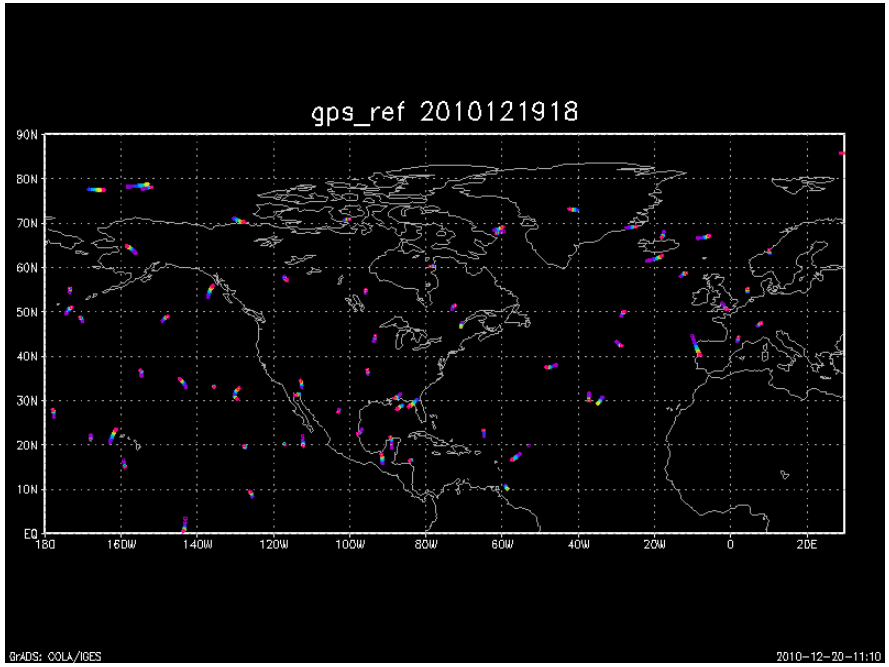
2010-12-20-11:08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80N
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10N
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100W
80W
60W
40W
20W
0
20E
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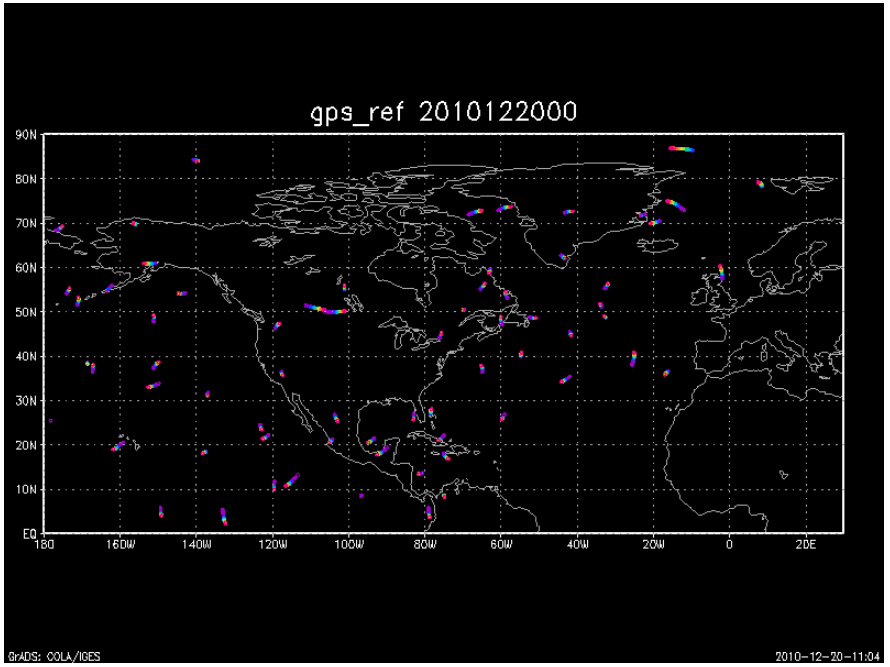
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180
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20W
0
20E
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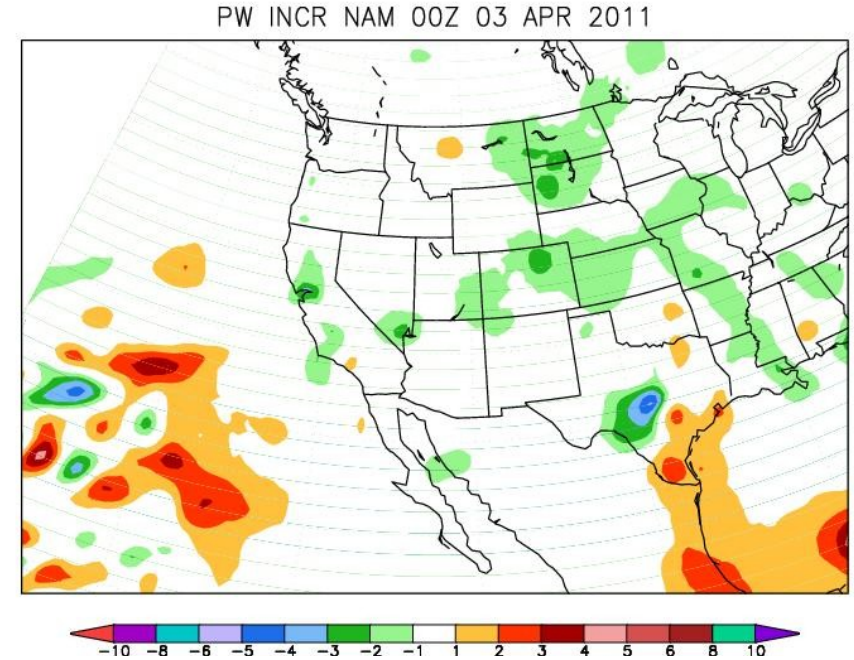
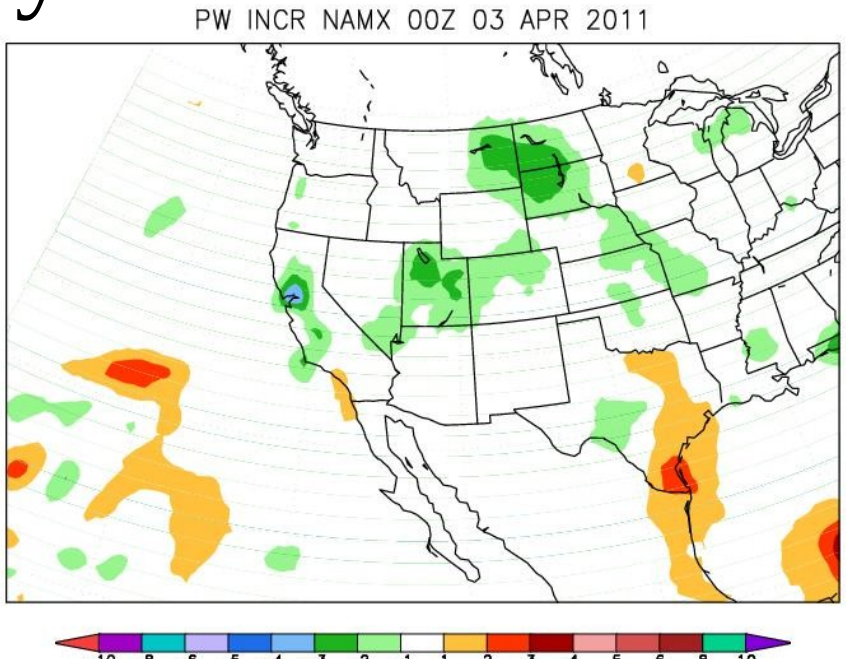
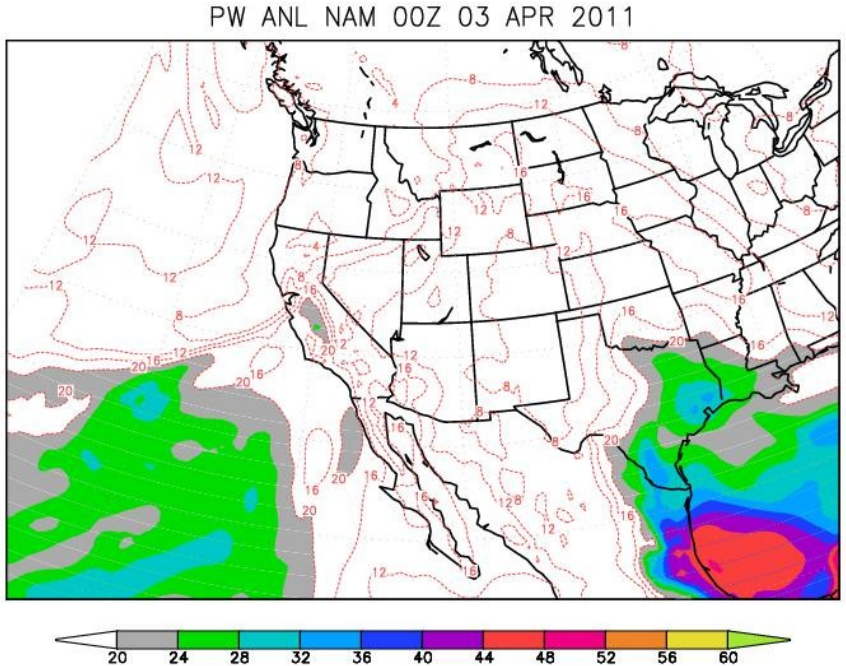
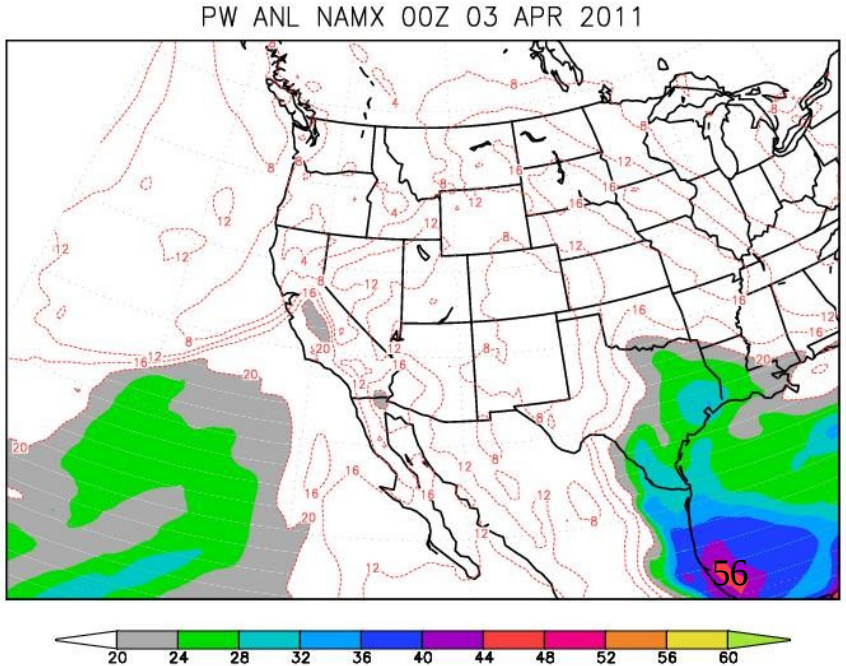
Reduced PW Analysis Increments





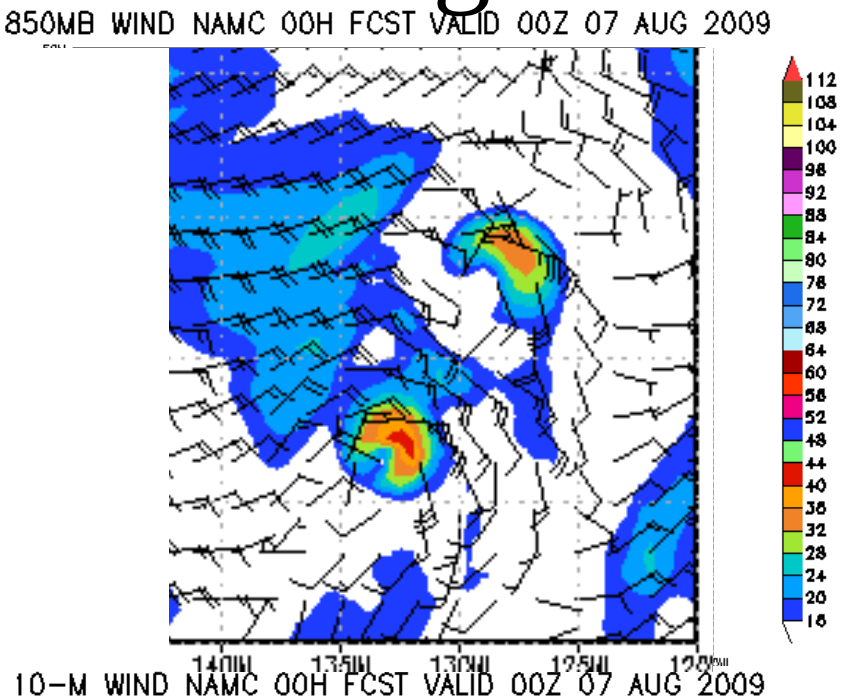


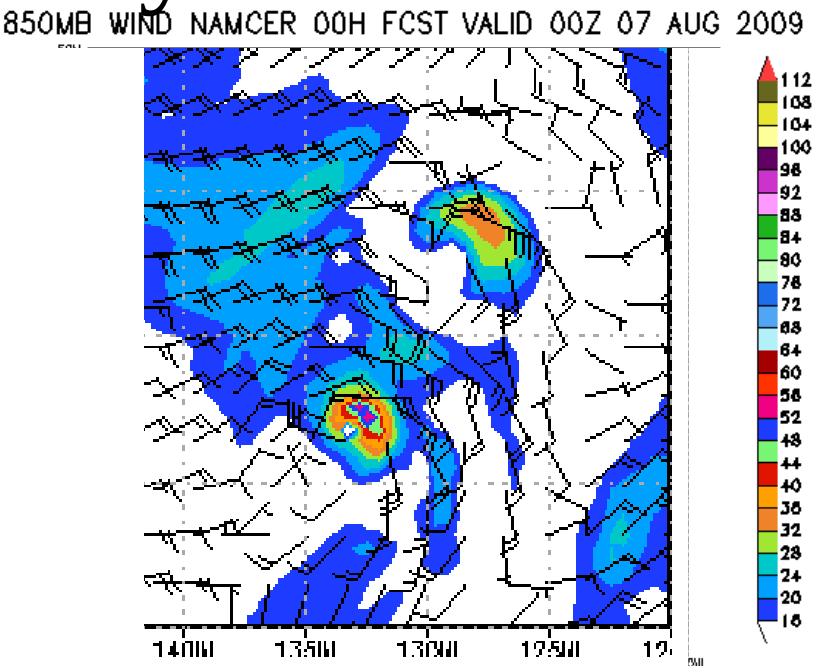


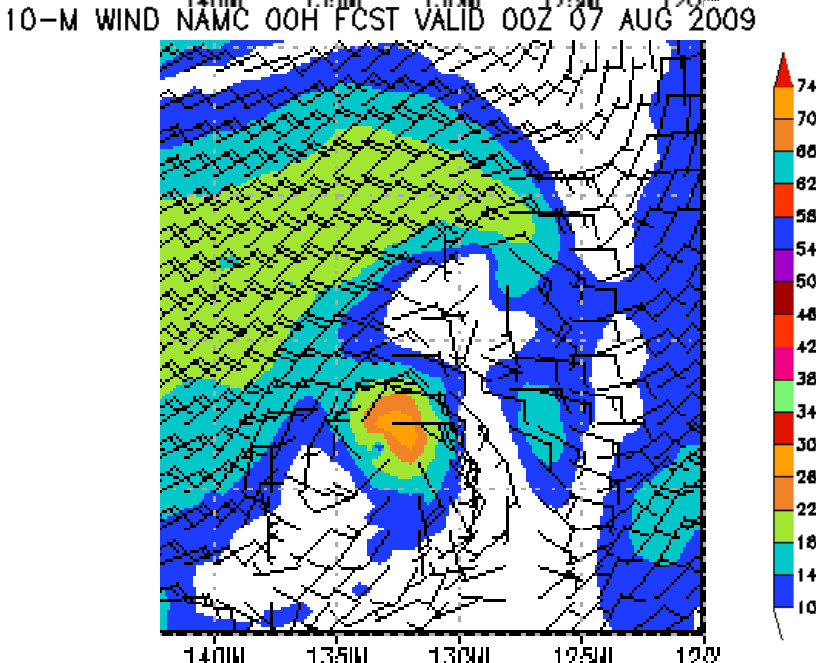
Changes to the NAM Data Assimilation System (NDAS)

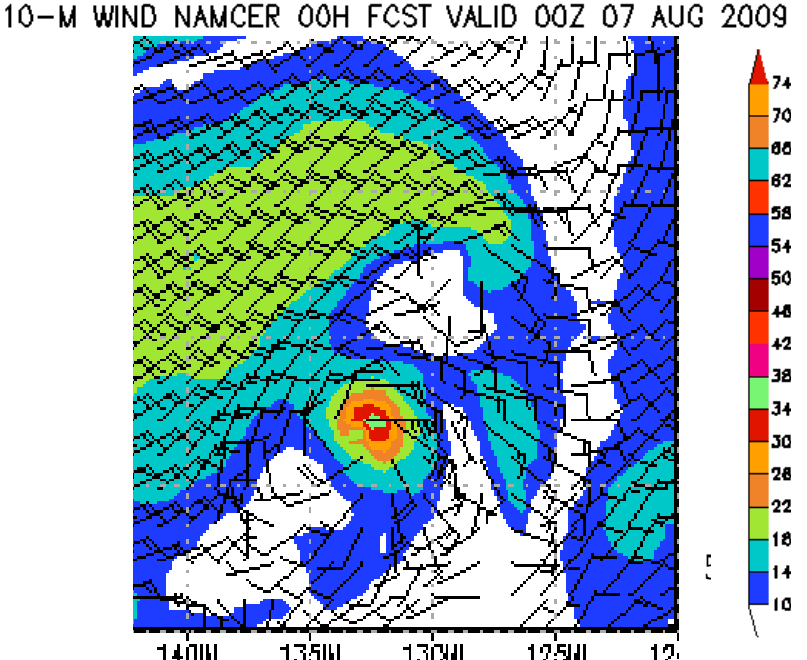
- First guess at T-12 reflects relocation of tropical cyclones
- Use of 1/12th deg SST (RTG_SST_HR) in place of ½ deg
- GSI updates 2 m temperature & moisture and 10 m winds with portion of 1st layer correction
- Updated background errors for NMMB
- 5X divergence damping in NMMB in NDAS only

Use of guess with t.cyc relocation

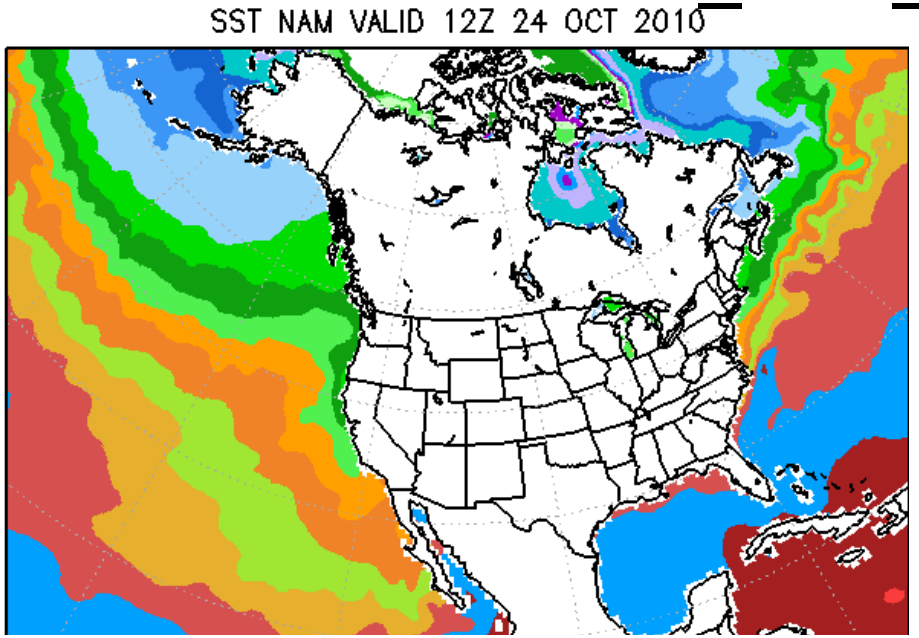


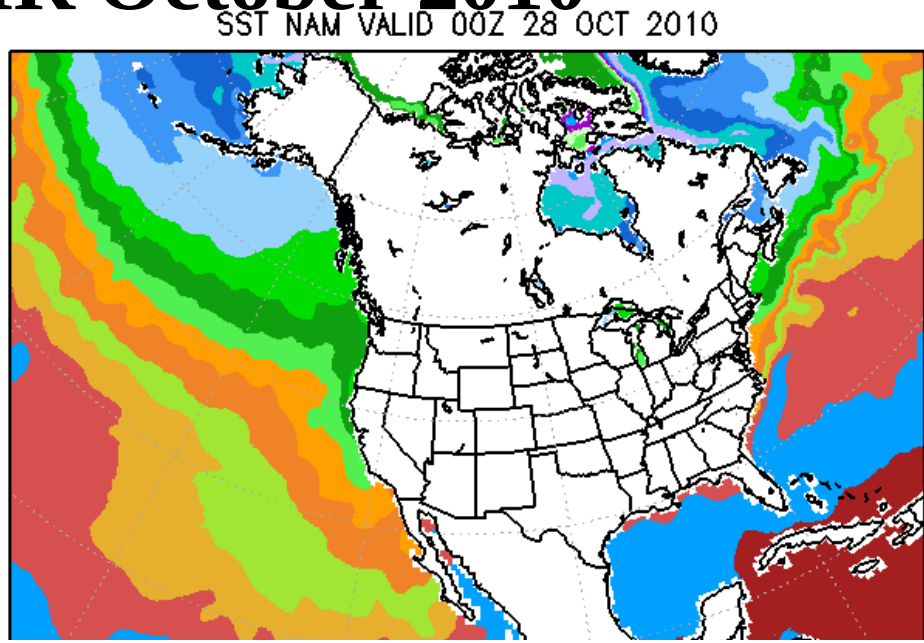


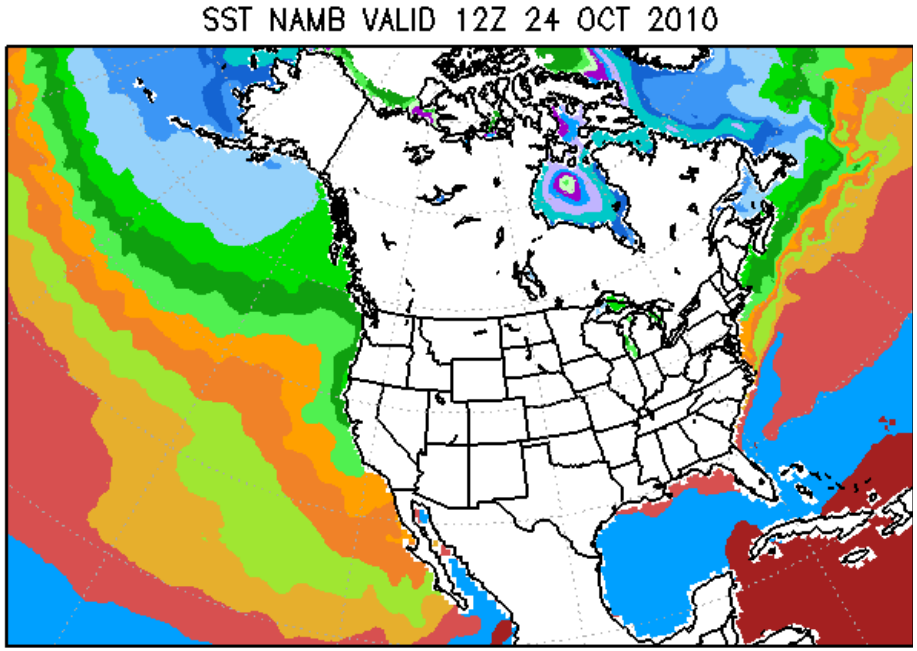


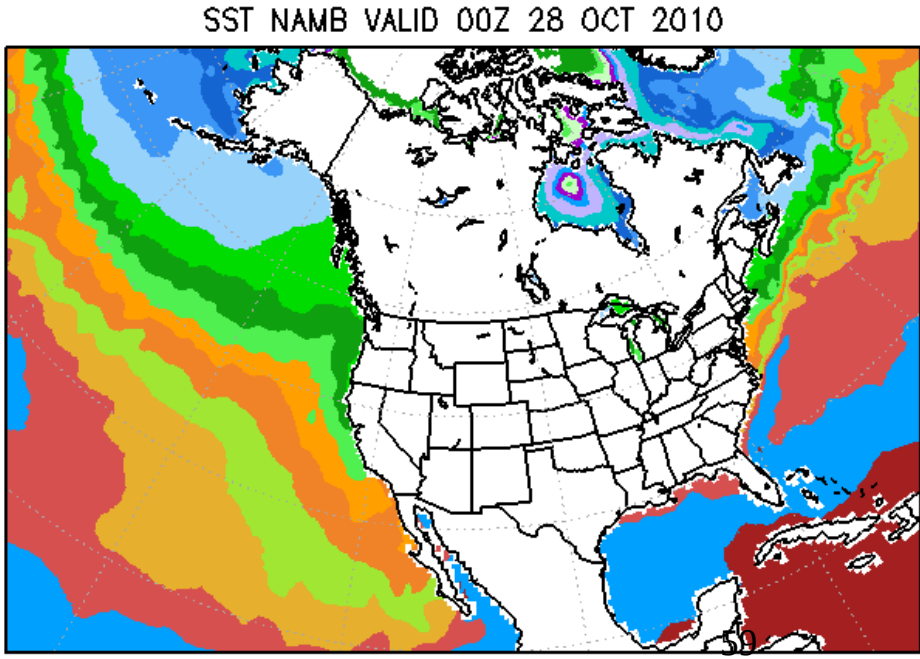


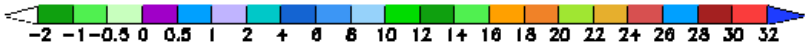
New RTG_SST_HR October 2010

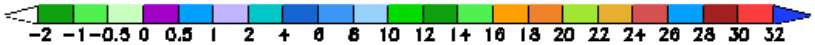




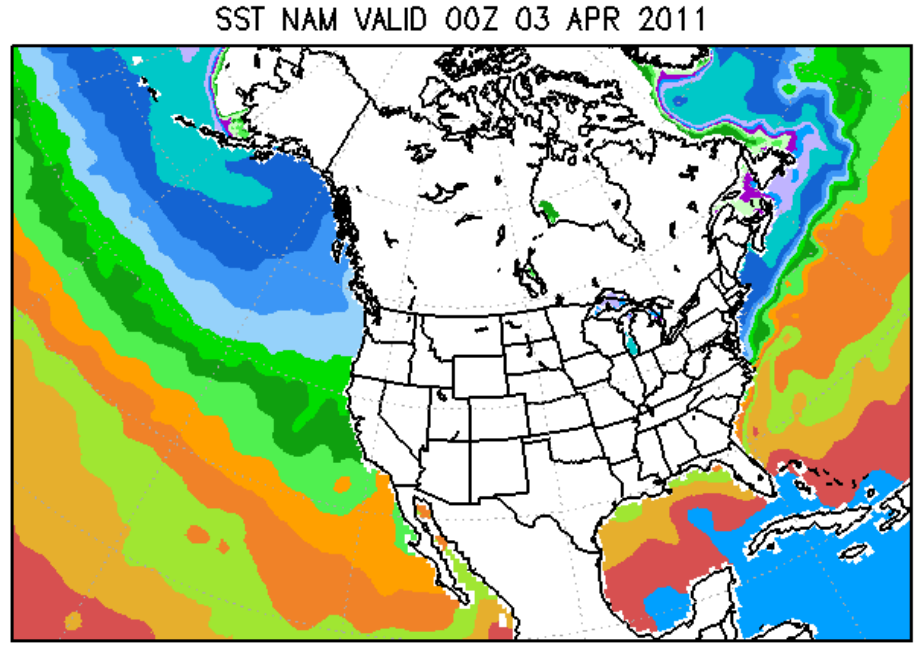


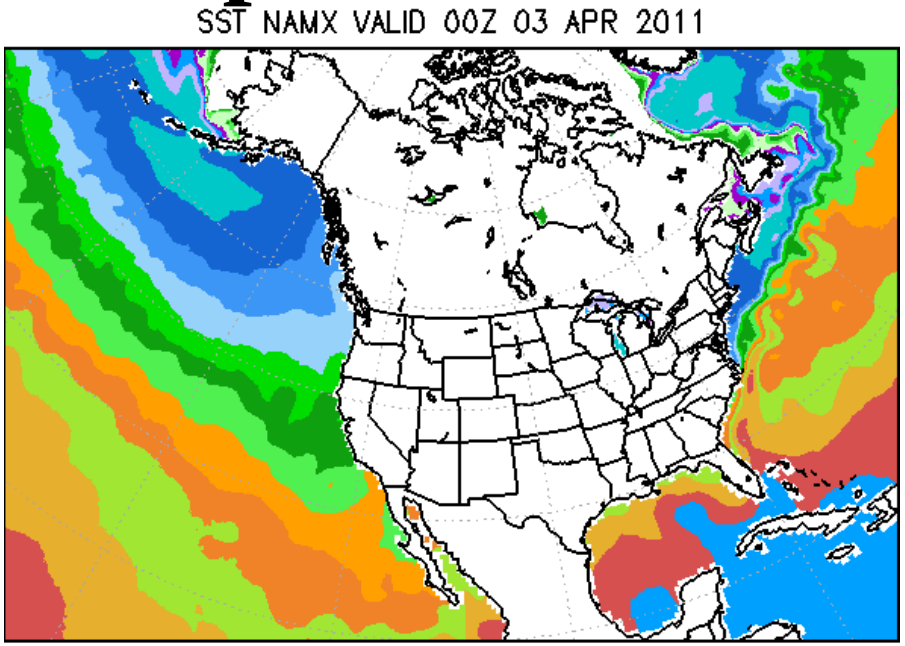


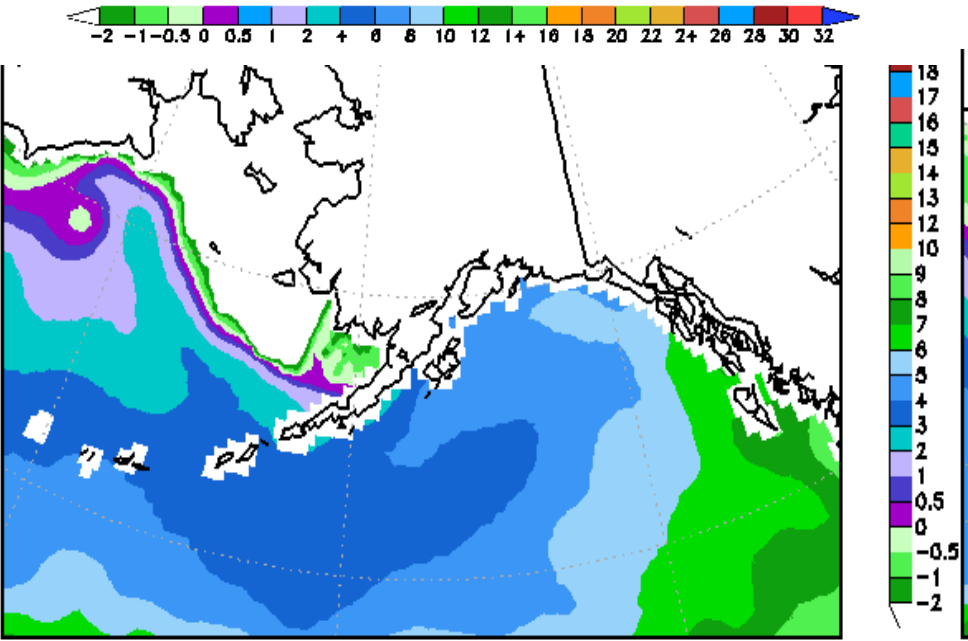


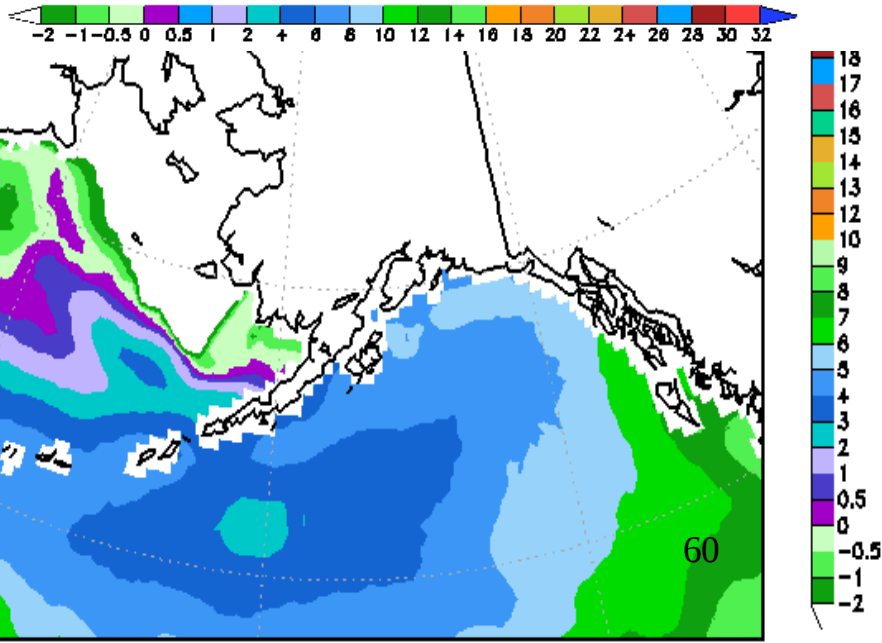


New RTG_SST_HR April 2011

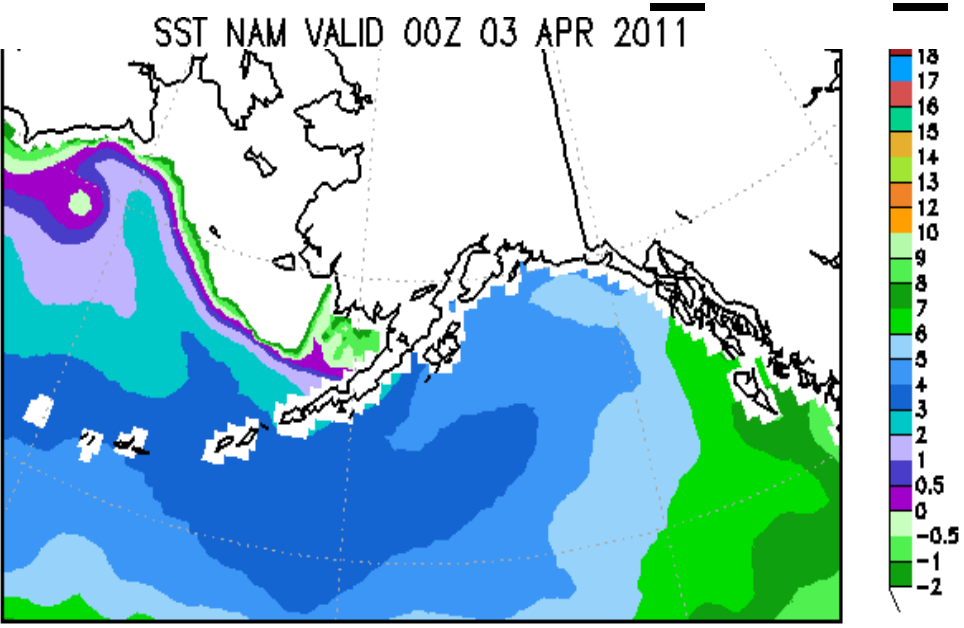


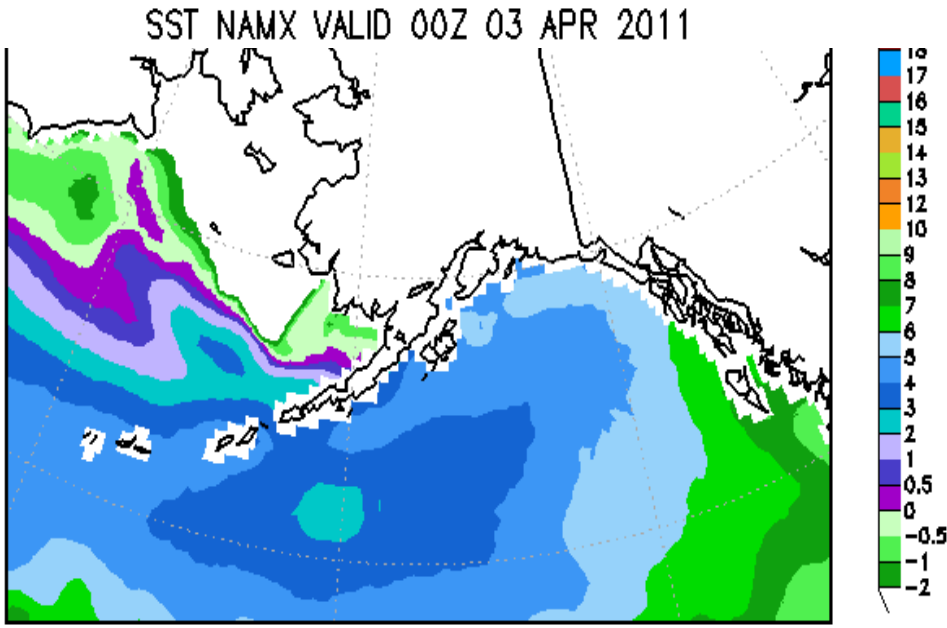


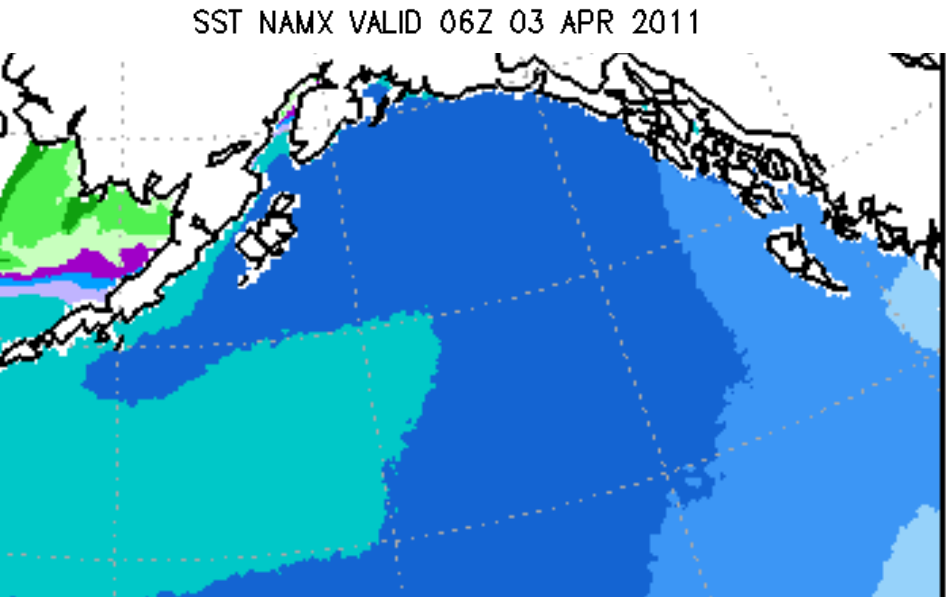


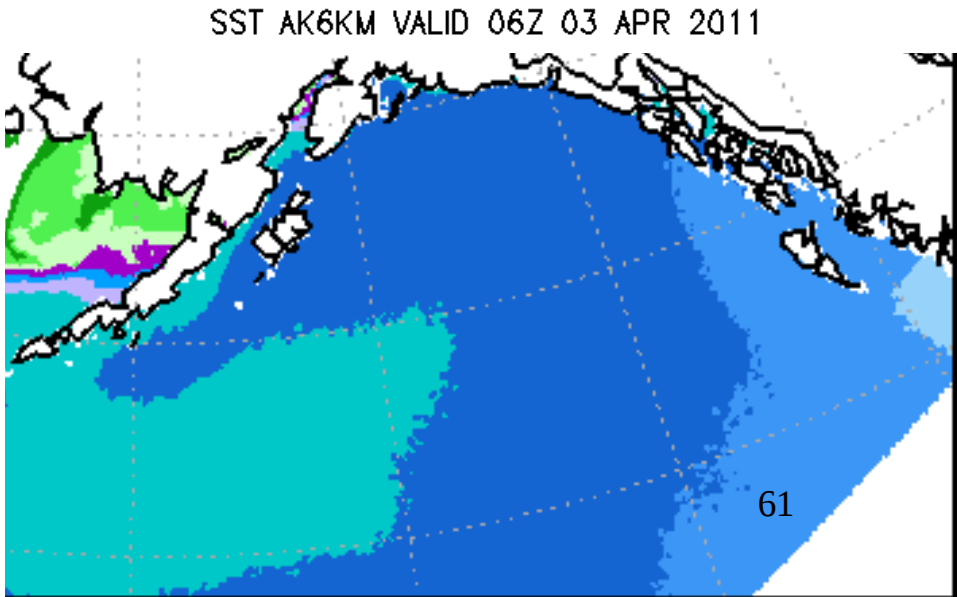


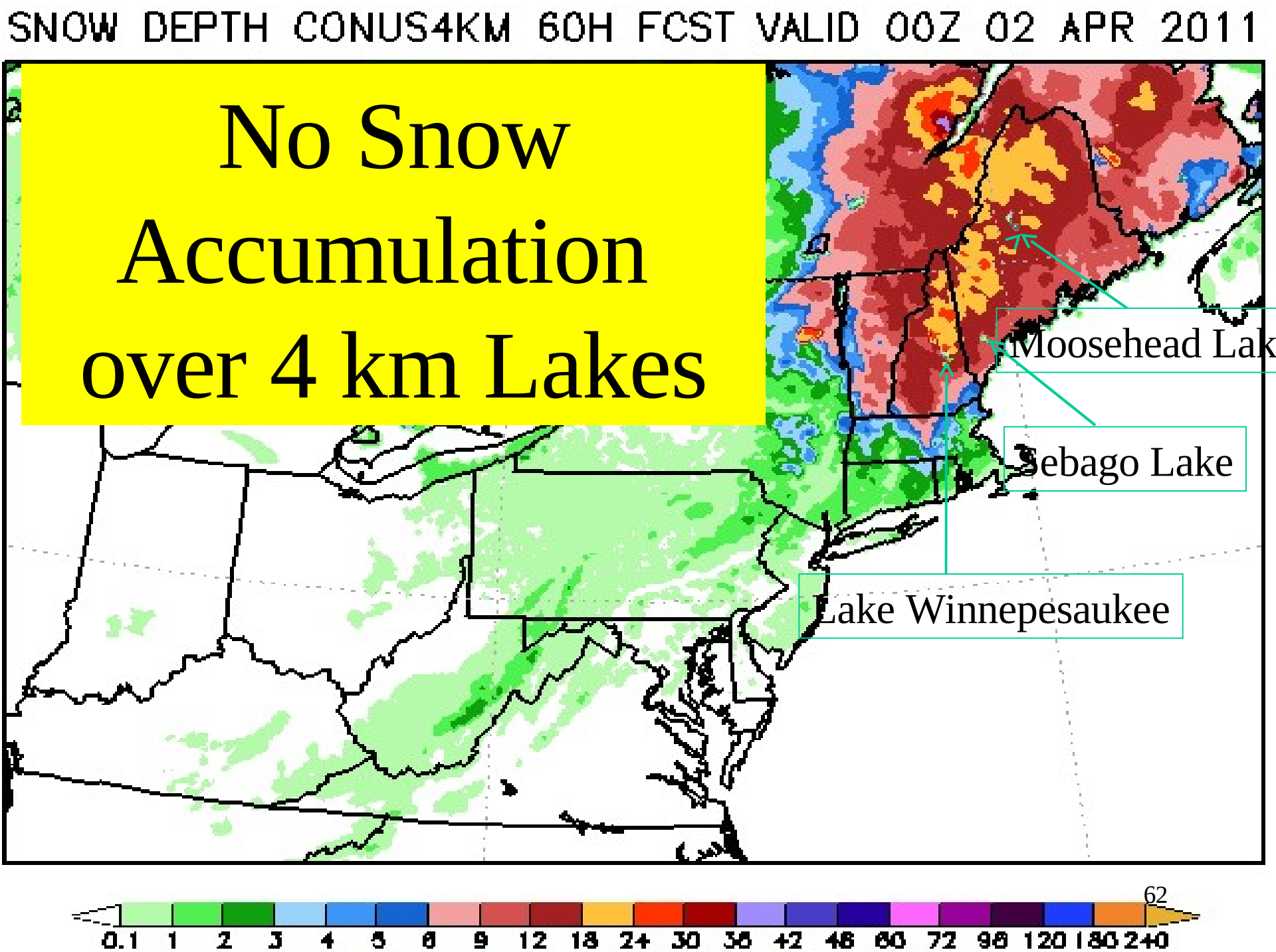
New RTG_SST_HR April 2011





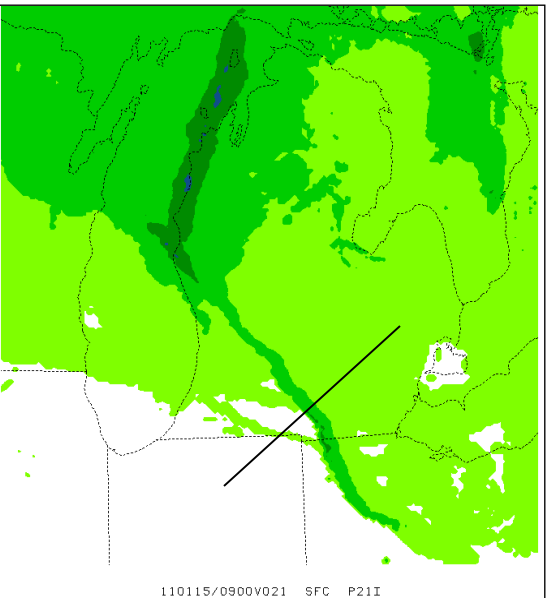


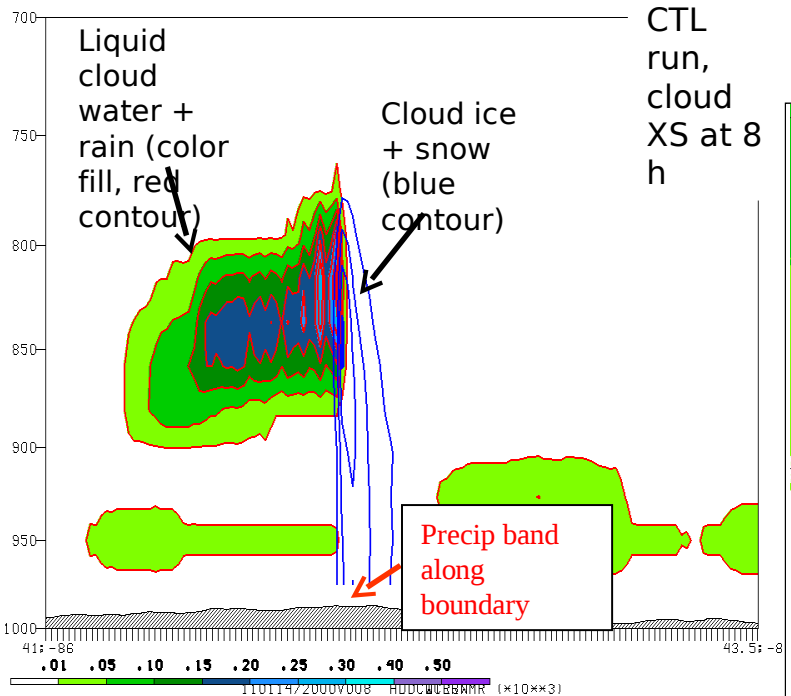


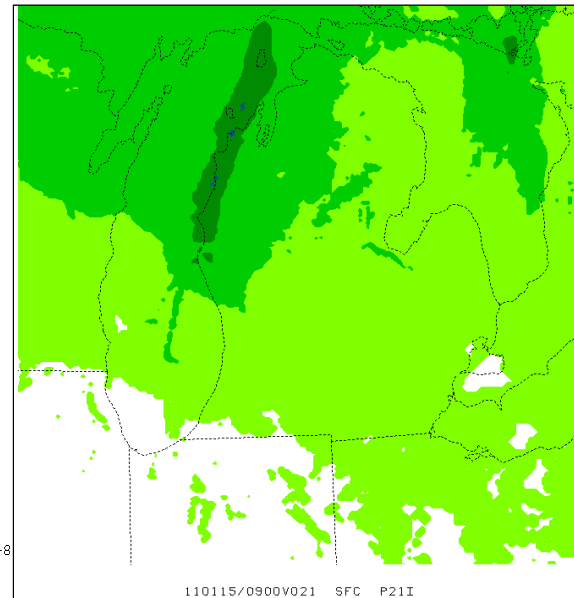

SNOW DEPTH CONUS4KM 60H FCST VALID 00Z 02 APR 2011
No Snow Accumulation over 4 km Lakes
Moosehead Lak
Sebago Lake
Lake Winnepesaukee
0.1 1 2 3 4 5 6 9 12 18 24 30 36 42 48 60 72 96 120 180 240

HRW Microphysics Code Change Already in NMMB

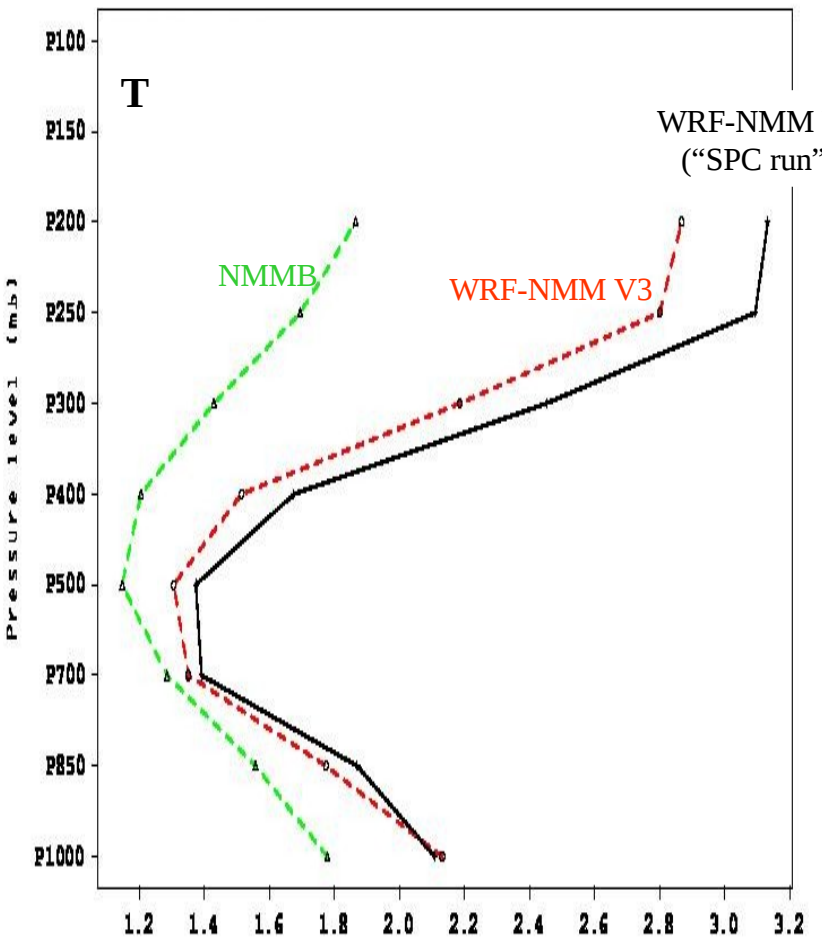
- Microphysics code change – background
- HPC noticed a persistent (and bogus) precipitation band
- The band was in **both** the opnl and parallel NMM runs
- Quick insight from Brad Ferrier led to a test modification of the cloud microphysics allowing ice nucleation to begin at warmer temperatures: T_ice_init changed from -15 C to -5 C
- This change worked perfectly, eliminating the specific pathology, and had very small forecast impact on other cases.



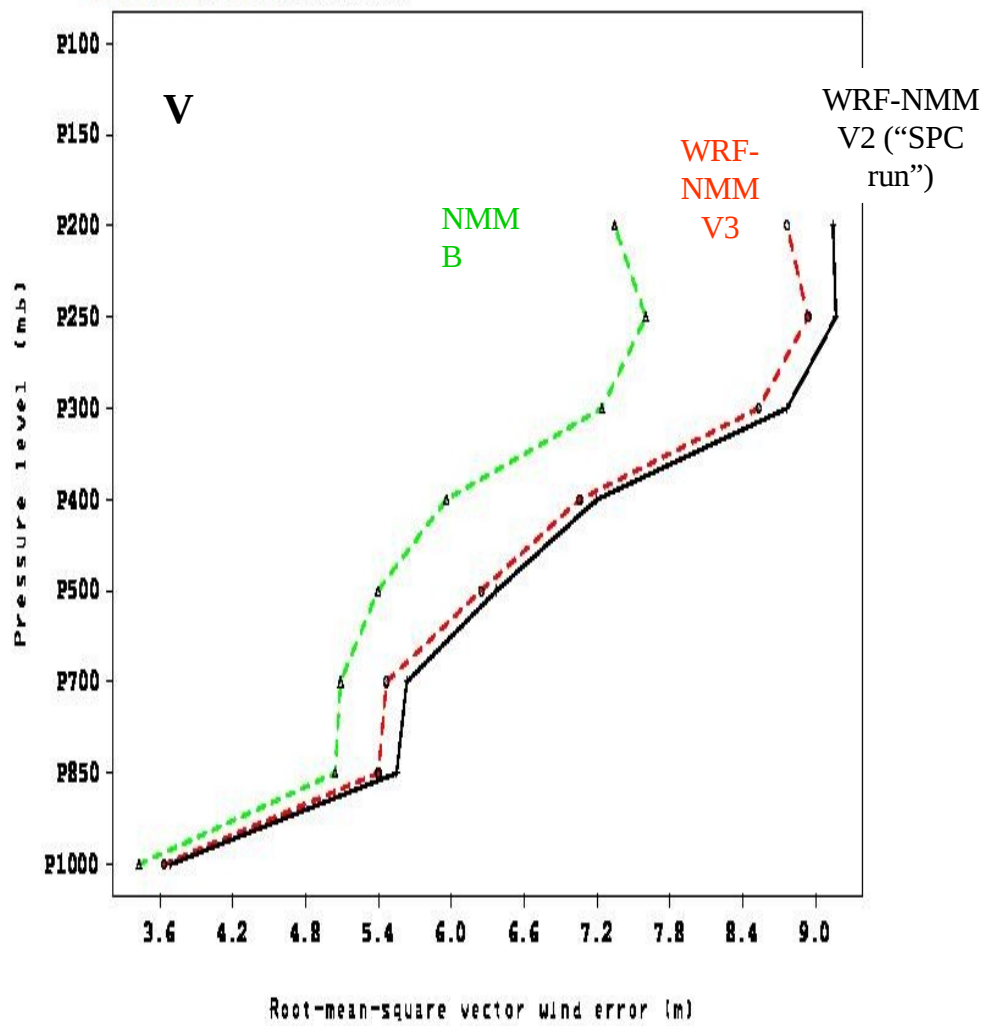




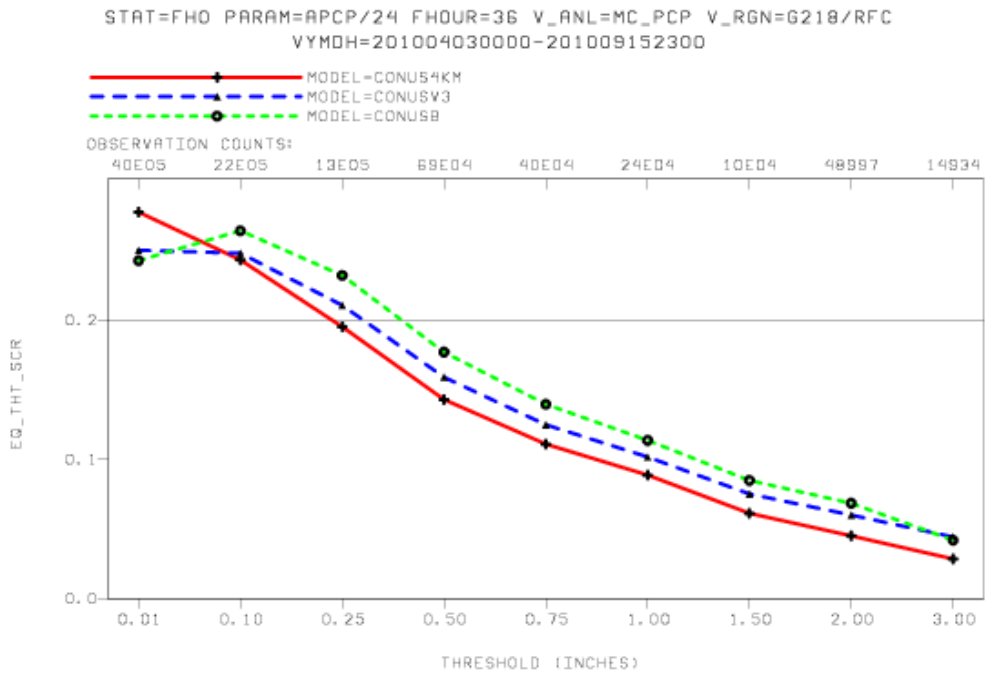
Development CONUS 4 km runs (Pyle) 04/03-09/27: 36 h forecast T & V rms



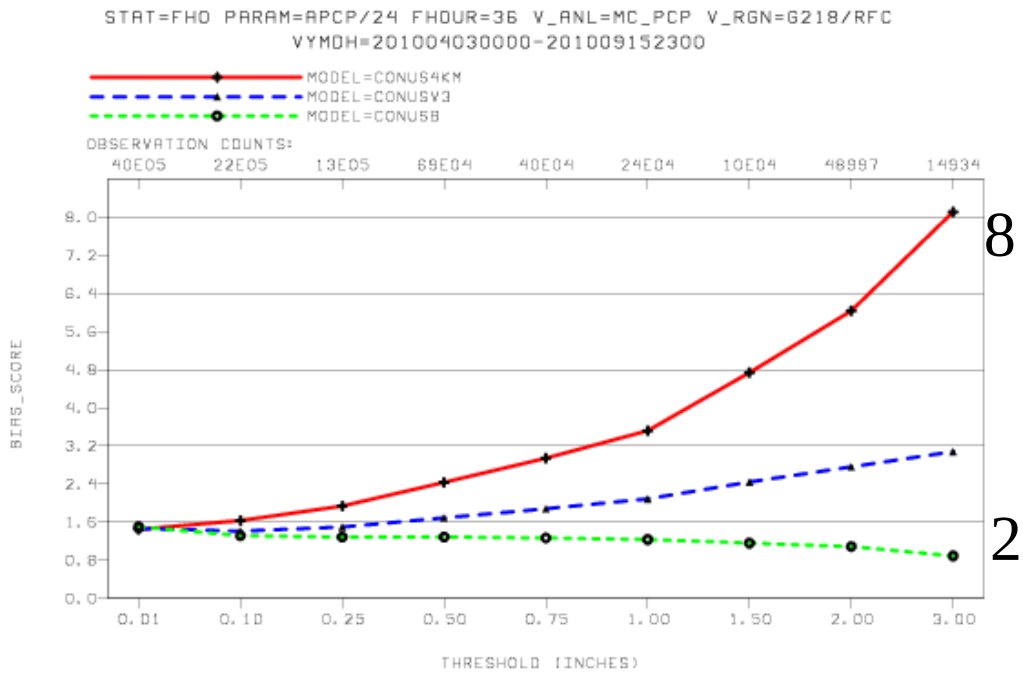
Root-mean-square temperature error (K)



Equitable Threat Score



Bias



0403 - 0915 CONUS 4 km runs, 12-36 h precip

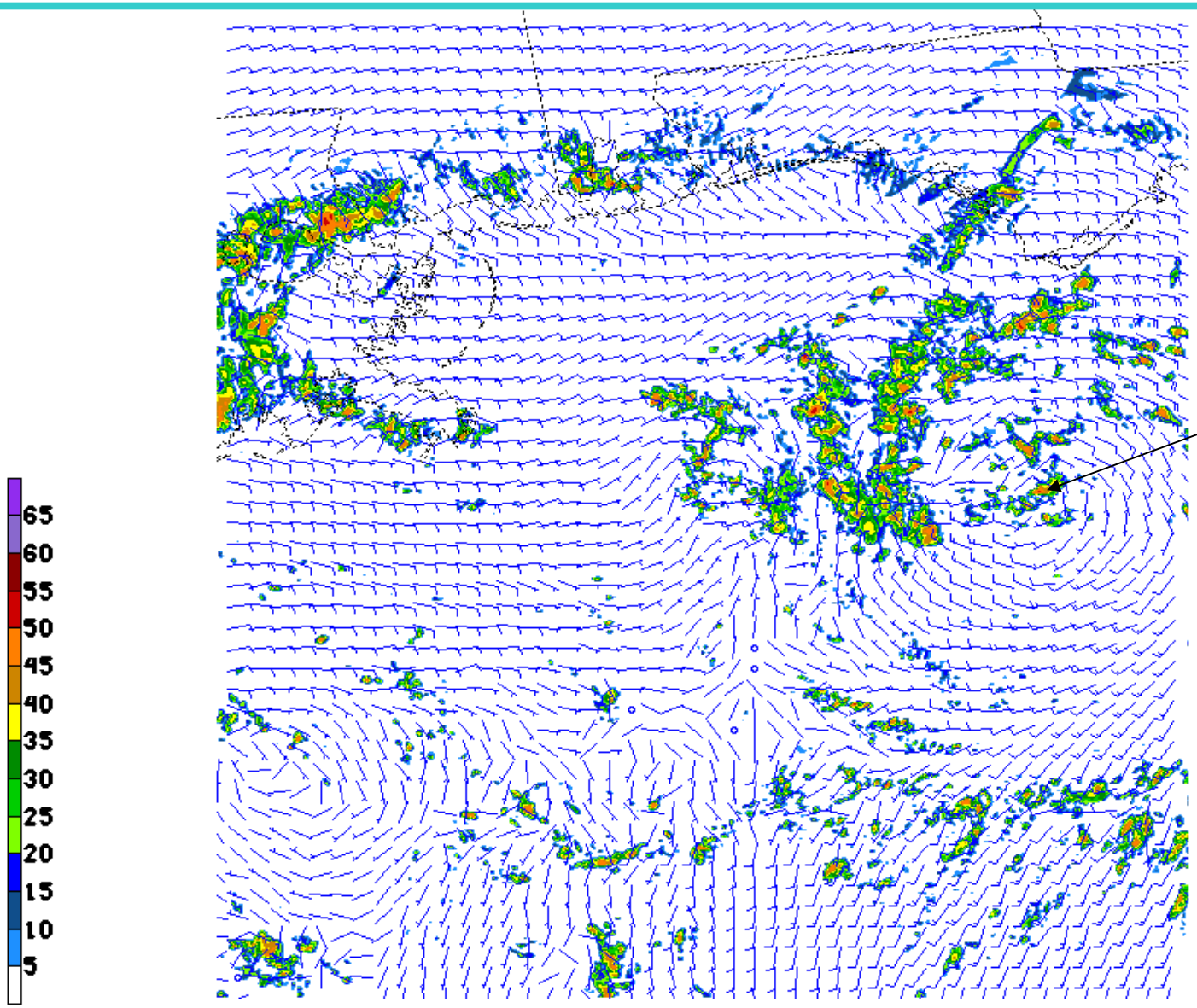
old WRF

new WRF

NMMB

NOTE: color change from previous two slides

Pyle's Test of Fire Wx Nest Capability
Gulf Spill 1.33 km NEMS/NMMB nest



Tropical Depression 5

19Z 11 August

1000 m REFD, 10 m winds

Real-Time Parallel Testing

- Two NMMB/NDAS parallels
  - Control running since 7/29/2009
  - Experimental running since 12/1/2009
  - 4 fixed domain nests running <u>only</u> in Experimental running since 7/12/2010
    No resources to run nests in both parallels
  - 1 placeable FWIS nest running in either CONUS (1.33km) or Alaska (1.5km) nest running since 12/8/2010

Mesoscale Parallel Experiment Log: NAMB

Start date of parallel experiment
18Z 2009/07/29
End date of parallel experiment
00Z 2011/03/23
Experiment changes log
Background links
Evaluation of parallel results

- Forecast maps vs ops NAM
- Daily forecast stats
- Ops NAM vs NAMB Cyclone tracks (NAMB is called NAMY on this web page)
- NAM Parallel and ops NAM 500 mb Height Forecasts vs GDAS analysis
- NDAS soil states : Parallel vs Ops
- Ops NAM, NAMB, NAMX vs Ops NDAS vs RTMA Analysis
- NAMB, NAMX, CONUSNESTX vs Ops NDAS vs RTMA Analysis
- Analysis increments : Parallel vs Ops
- Ops/Parallel NDAS/NAM Surface Radiation Budget Verification
- Ops NAM vs NAMB Verification of precipitation and against rawinsondes / surface data (09/30/09-10/28/09)
- Ops NAM vs NAMB Verification of precipitation and against rawinsondes / surface data (11/11/09-12/13/09)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (12/01/09-01/23/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (01/27/10-02/21/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (03/01/10-03/06/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (03/09/10-03/27/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (03/31/10-05/09/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (05/19/10-07/20/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (08/04/10-09/13/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (09/22/10-10/26/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (11/10/10-11/22/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (11/11/10-12/09/10)
- Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (12/09/10-12/26/10)

Seasonal cumulative statistics

- **Ops NAM vs Pll NAM Verification of precipitation and against rawinsondes / surface data (06/01/10-08/31/10)**
- **Ops NAM vs Pll NAM Verification of precipitation and against rawinsondes / surface data (09/01/10-11/30/10)**
- **Ops NAM vs Pll NAM Verification of precipitation and against rawinsondes / surface data (12/01/10-02/28/11)**

Mesoscale Parallel Experiment Log: NAMX

Forecast maps vs ops NAM
Forecast maps of NAMX parent run vs 6 km Alaska nested run
Forecast maps of NAMX parent run vs 4 km CONUS nested run
Forecast maps of NAMX parent run vs 3 km Hawaii nested run
Forecast maps of NAMX parent run vs 3 km Puerto Rico nested run
Daily forecast stats
NAM Parallel and ops NAM 500 mb Height Forecasts vs GDAS analysis
NDAS soil states : Parallel vs Ops
Ops NAM, NAMX vs Ops NDAS vs RTMA Analysis
Ops NAM, NAMX, CONUSNESTX vs Ops NDAS vs RTMA Analysis
Analysis increments : Parallel vs Ops
Ops/Parallel NDAS/NAM Surface Radiation Budget Verification
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (12/01/09-01/23/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (01/27/10-02/21/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (03/01/10-03/06/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (03/09/10-03/27/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (03/31/10-05/09/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (05/19/10-07/20/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (08/04/10-09/13/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (09/22/10-10/26/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (11/10/10-11/22/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (11/11/10-12/09/10)
Ops NAM vs NAMB vs NAMX Verification of precipitation and against rawinsondes / surface data (12/09/10-12/26/10)
Ops NAM vs NAMX vs Alaska/CONUS nests (both run 00z and 12z cycles) verification of precipitation and against rawinsondes / surface data (07/12/10-07/25/10)
Ops NAM vs NAMX vs Alaska/CONUS nests (both run 00z and 12z cycles) verification of precipitation and against rawinsondes / surface data (08/04/10-08/29/10)
Ops NAM vs NAMX vs Alaska/CONUS nests (both run 00z and 12z cycles) verification of precipitation and against rawinsondes / surface data (08/30/10-10/31/10)
Ops NAM vs NAMX vs Alaska/CONUS nests (both run 00z and 12z cycles) verification of precipitation and against rawinsondes / surface data (09/24/10-10/30/10)
Ops NAM vs NAMX vs Alaska/CONUS nests (both run 00z and 12z cycles) verification of precipitation and against rawinsondes / surface data (11/10/10-11/22/10)

Seasonal cumulative statistics

Ops NAM vs Pll NAM Verification of precipitation and against rawinsondes / surface data (06/01/10-08/31/10)
Ops NAM vs Pll NAM Verification of precipitation and against rawinsondes / surface data (09/01/10-11/30/10)
Ops NAM vs Pll NAM Verification of precipitation and against rawinsondes / surface data (12/01/10-02/28/11)
Ops NAM vs Pll NAM Verification of precipitation and against rawinsondes / surface data (03/01/11-03/27/11)
Ops NAM vs Pll NAM (12 km) vs Alaska/CONUS nests verification of precipitation and against rawinsondes / surface data (07/12/10-08/30/10)
Ops NAM vs Pll NAM (12 km) vs Alaska/CONUS nests verification of precipitation and against rawinsondes / surface data (09/01/10-11/30/10)
Ops NAM vs Pll NAM (12 km) vs Alaska/CONUS nests verification of precipitation and against rawinsondes / surface data (12/01/10-02/28/11)
Ops NAM vs Pll NAM (12 km) vs Alaska/CONUS nests verification of precipitation and against rawinsondes / surface data (03/01/11-03/29/11)

Chronological Summary of Changes

- A condensed list of all major changes to the NMMB parallels, including all GSI-related changes and nest-related changes, to make it easier than having to slog through all the parallel logs.

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

Major changes in parallel NMMB (NAMB) run since 1/1/2010

- 12z 1/27/2010: Turned on Eulerian passive tracer advection of scalars.
- 12z 3/30/2010: In the radiation parameterization, the absorbtion coefficients for water and ice have been halved to 800 and 500, respectively.
- 06z 5/17/2010: Boundary condition treatment changed to specify 5 boundary rows (LNSH, LNSV=5) instead of one row in the control run.
- 12z 7/29/2010: Modified vertical level distribution with more layers in the stratosphere (14 layers above 200 mb instead of 7).
- 12z 9/14/2010: "July 14 2010" microphysics changes; produces thicker upper-level ice clouds and lower peak reflectivities above freezing level.
- 00z 10/09/2010: Begin use of 1/12th deg RTG_SST_HR.
- 12z 11/04/2010: Change from USGS to MODIS_IGBP land-use definitions.
- 18z 11/09/2010: Put Crank-Nicholson off-centering in time back into model code (was originally done at 12z 4/29/2010 but was inadvertently removed sometime in June 2010)/
- 18z 11/10/2010: Adjustments to IGBP z0 for forests/grassland/croplands.
- 18z 11/22/2010: Enhance diffusion for specific humidity and cloud water by 4x (equivalent to setting smag2=0.8).
- 00z 11/27/2010: Put ops monthly greenness fraction climatology back into parallels, instead of weekly greenness which was inadvertently turned on with the IGBP land-use definitions.
- 12z 12/09/2010: Microphysics changes to improve cloud fractions.
- 00z 1/06/2011: NDAS forecast now running with a digital filter with a +/- 40 minute window.

Major Obs/GSI changes in parallel NMMB (NAMB) run since 1/1/2010

- 18z 11/25/2009: Turn on new obs:
  - ACARS humidity
  - WDSATR : superob'ed Scatterometer winds over oceans ,
  - HIRS and AMSU-A radiances from NOAA-19,
  - IASI radiances from METOP
  - AMSU-A radiances from AQUA
- 18z 4/05/2010: Update to new GSI version (r7244), update the 2-m temperature, 2-m specific humidity and 10-m wind and turn on:
  - assimilation of GPS radio occultation (COSMIC) data
- 00z 7/14/2010: Begin use of dynamic reject list (from RTMA) for mesonet data in the GSI analysis.
- 18z 10/20/2010: Update to new GSI version (r9527), new observation errors and retuned background errors, use of new data types:
  - RASS virtual temperature
  - MAP winds
  - ASCAT winds

Major changes exclusive to <u>nested</u> runs in parallel NMMB (NAMB) run since 1/1/2010

- 12z 7/12/2010: Begin running all 4 nested domains (Alaska, CONUS, Hawaii, Puerto Rico) in the NAMX parallel for both 00z and 12z cycles, run to 60-h w/explicit convection.
- 12z 8/06/2010: 3 km Puerto Rico nested domain enlarged to cover all of Hispanola.
- 00z 8/30/2010: Begin using the BMJ_DEV convection option in the nested runs with settings:
  - fres=0.25 (resolution factor for dsp's)
  - fr=1.00 (land factor for dsp's)
  - fsl=0.75 (reduction factor for "slow" dsp's over land)
  - fss=0.75 (reduction factor for "slow" dsp's over water)
- 00z 9/03/2010: Initial conditions for each nest are now created by a GSI analysis on the nest domain using the NDAS first guess, instead of interpolating the 12 km NAM analysis to each nest domain (which actually takes longer because parts of it can’t be run in parallel).
- 00z 9/24/2010: Turned on gravity wave drag/mounatin blocking in the 6 km Alaska nest.
- 12z 11/04/2010: Increase Smagorinsky constant for 2nd order diffusion (smag2) from 0.2 to 0.4 for all nested runs.
- 12z 11/19/2010: The number of boundary blending rows for the Alaska nest was reduced from 5 to 3 to prevent code hangs.
- 00z 12/17/2010: Modified the land-sea masks for the CONUS/Alaska nests to resolve all lakes that are resolved by the MMAB 1/12th degree RTG_SST.

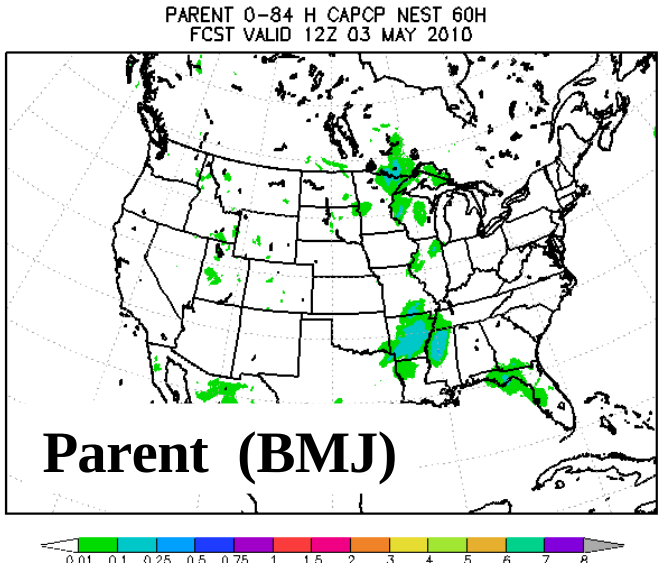
Summary of Physics Development

- A compilation of what we've done during 2010+ is available online here http://www.emc.ncep.noaa.gov/mmb/bf/presentations/Ferrier_
- There's a lot of grinding work that went into what's been prepared for the NAM bundle, best exemplified by this link to Eric's NAMX change log http://www.emc.ncep.noaa.gov/mmb/mmbpll/paralog/parachl.

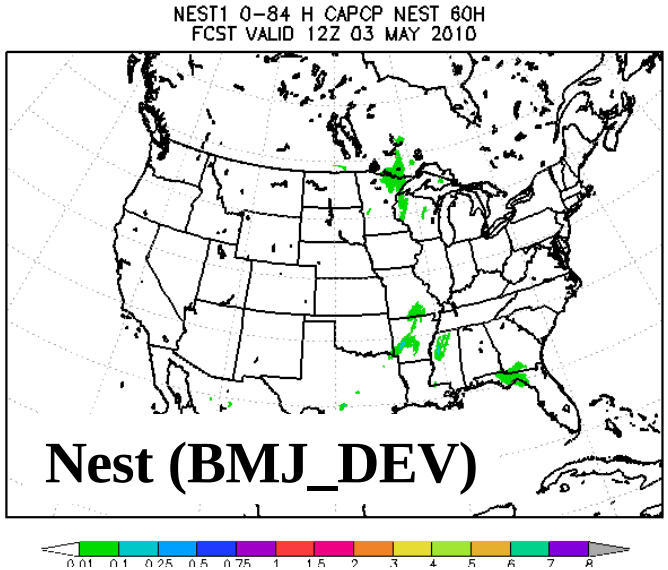
Microphysics Development

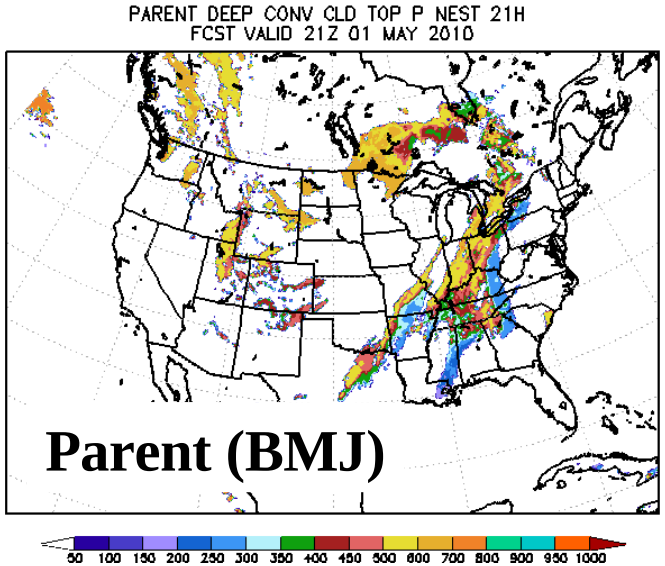
- Added WRF's WSM6 microphysics (W. Wang)
  - Tests over 4-km CONUS (conus4) and 4-km CONUS in 12-km AQ domain runs (nest)
  - Similar skill in both runs, WSM6 ~30% slower
- Advection of condensate (W. Wang)
  - Added "spec_adv" flag to NMMB
    - Advect total condensate only (false)
    - Advect individual hydrometeors (true)
  - Works for *wsm6* & *fer* microphysics
  - Similar skill seen for either advection option
- Concluded no benefit to compensate for greater expense

Physics Testing: Reduced Convective Triggering in 4 km CONUS nest vs 12 km Parent

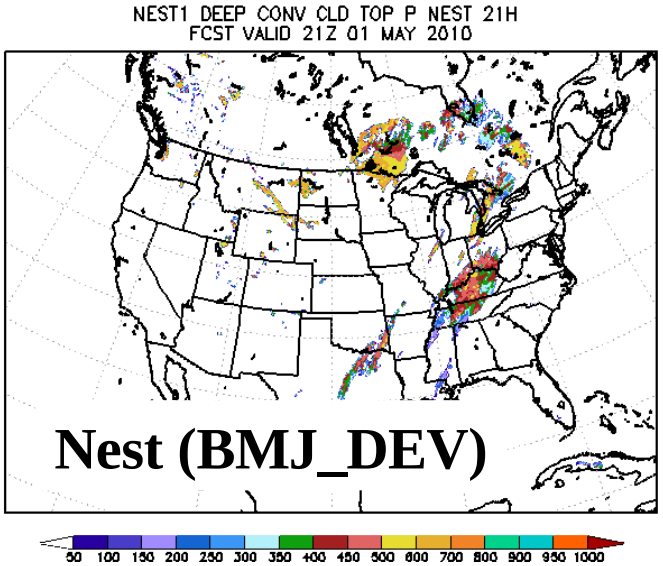


0-60 h Cu QPF





Deep Cu Cloud Top Pressure (hPa)

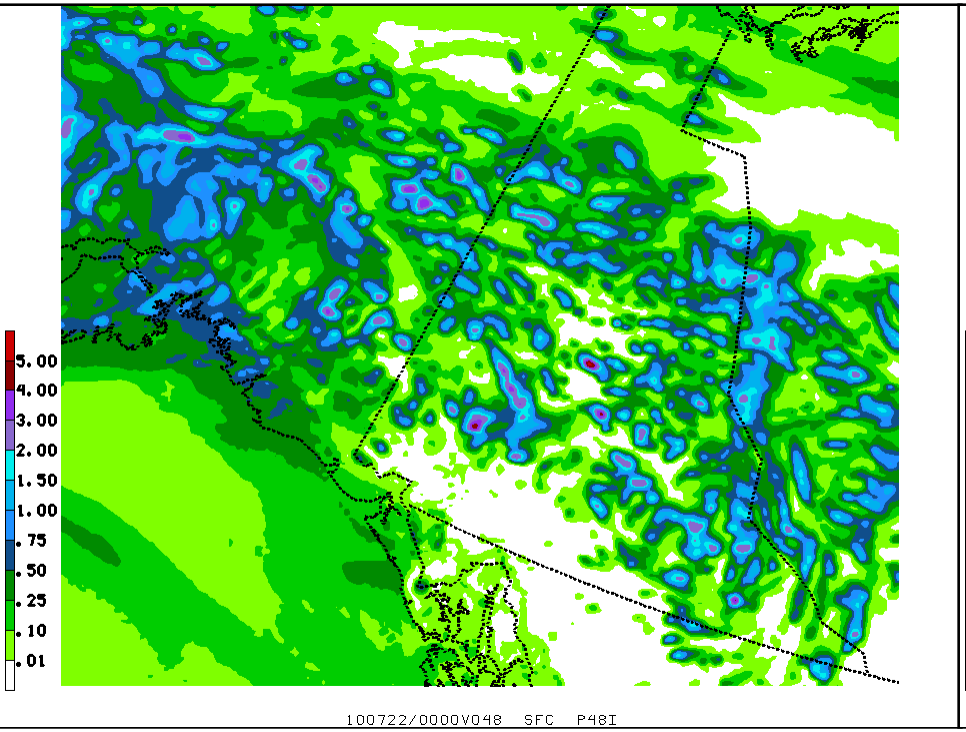


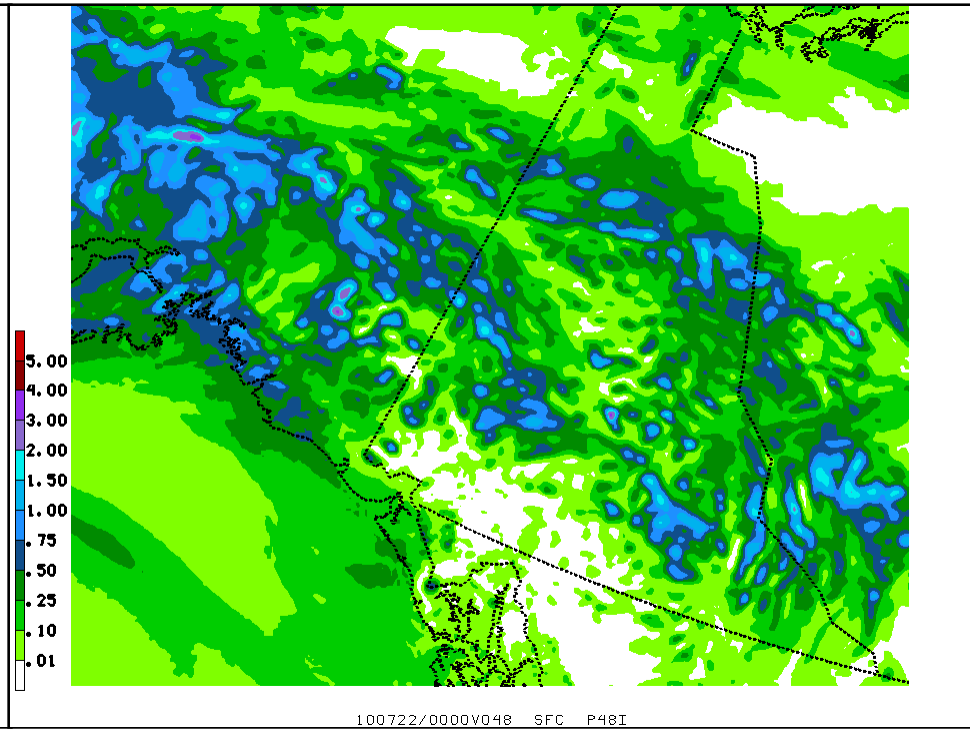
Scaled down BMJ convection for NMMB nests

(Matt Pyle for AK)

- Different model forecast customers interpret high-resolution guidance differently (literal vs. qualitative)
- With the NMMB implementation in NAM, an efffort is being made to partially satisfy both camps.
- New scaling factor in the BMJ allows for relaxation toward moister profiles in finer grid-spacing runs:
  - Smaller modification of thermodynamic profiles
  - Goal is to improve QPF performance in nests without destroying fine-scale forecast structure

6 km NMMB nest
48 h total precip ending 20100722/00Z



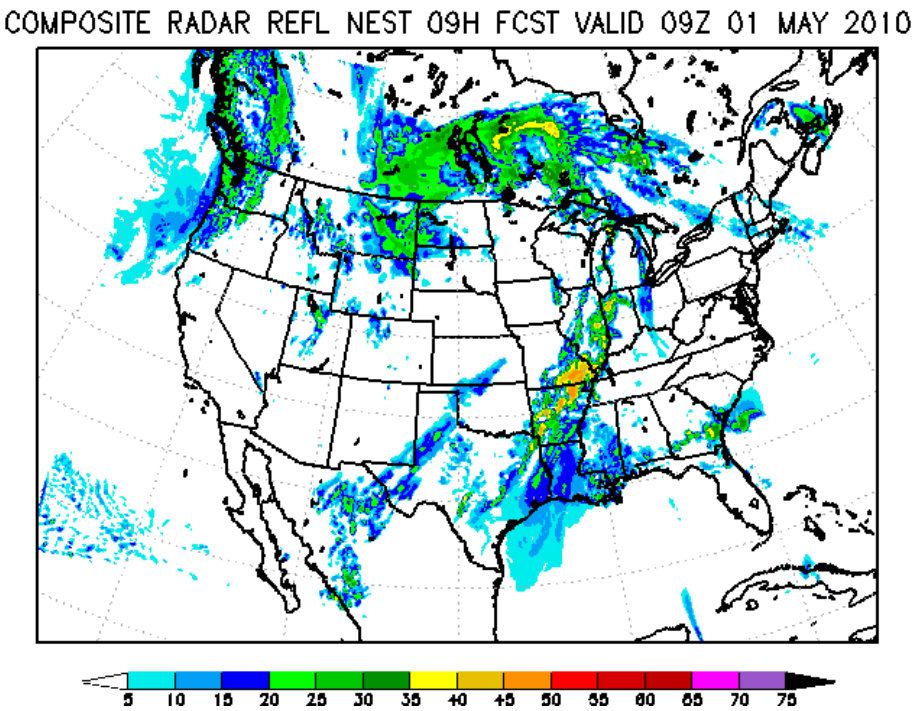


w/o parameterized convection
Max precip = 4.91”

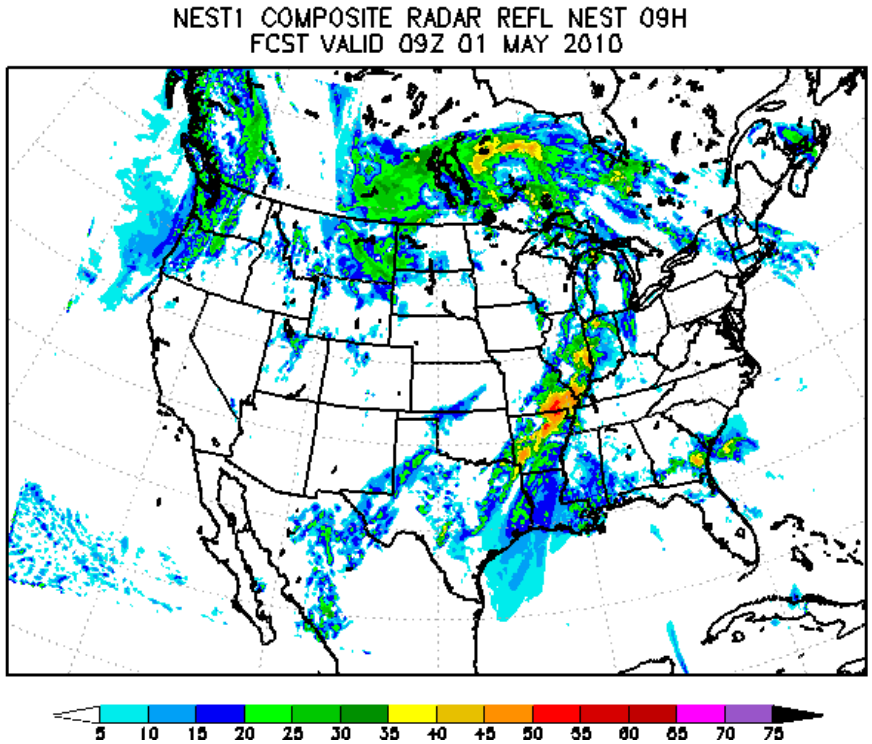
w/ scaled down BMJ convectio
Max precip = 3.39”

Microphysics Changes Impacts the Simulated Radar Reflectivities

Ops ferrier

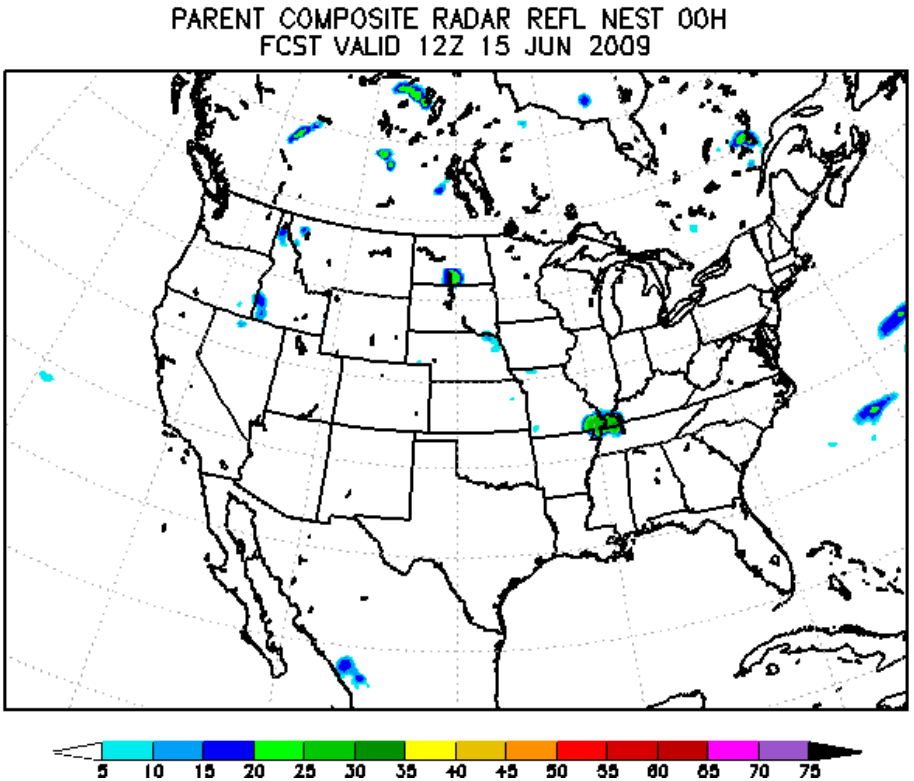


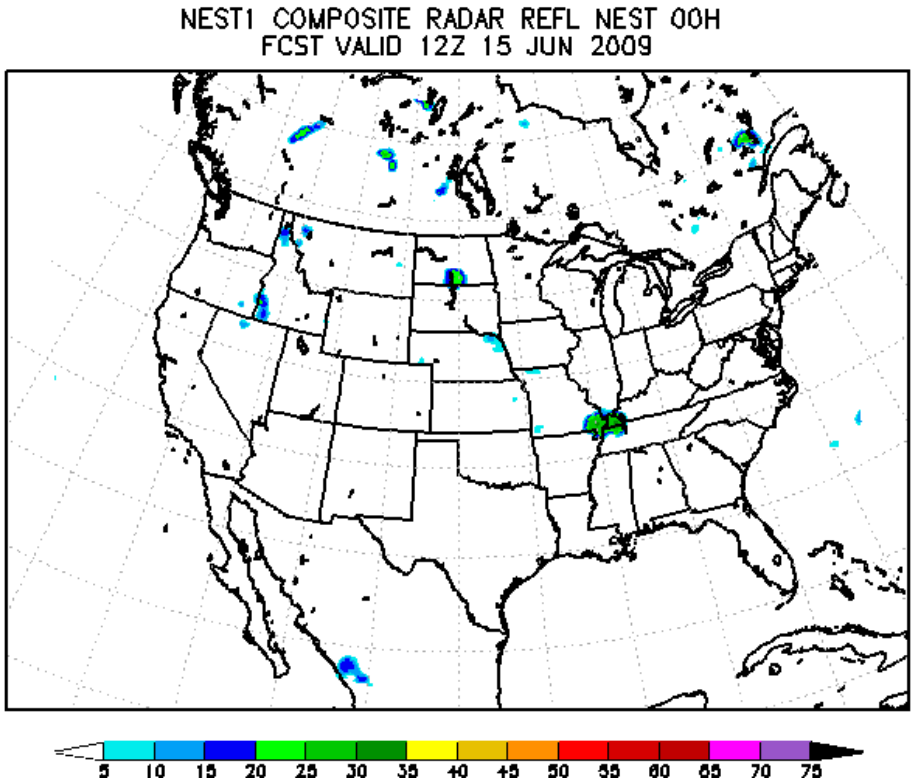
New ferrier



- **Higher composite dBZ in new vs. ops fer**
- **Output is from 4-km CONUS nest runs but interpolated to 12-km grid 218.**

Parent & Nest Reflectivity Loop

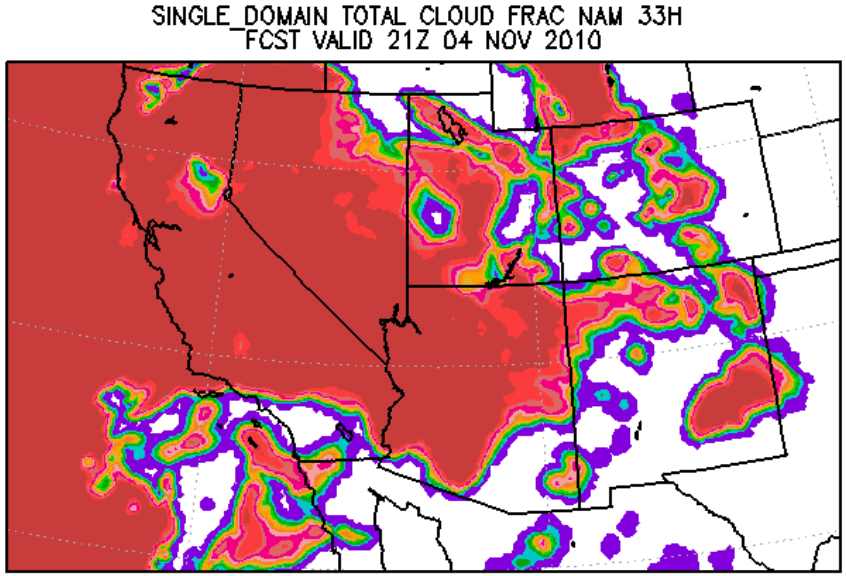




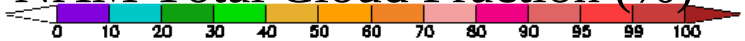
Left: 12-km PARENT (Launcher Domain ~1/2 size of NAM)
- Control BMJ convection (same as in NAM)
- Modified Ferrier microphysics

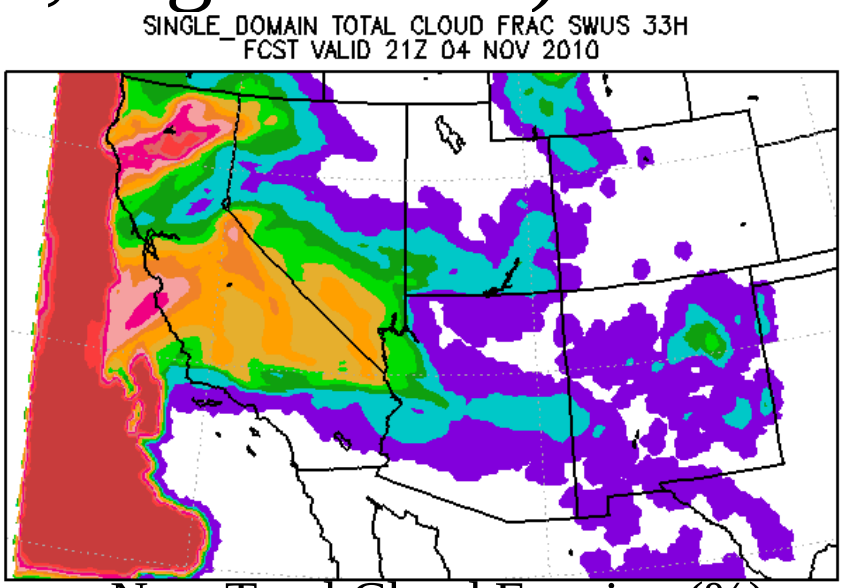
Right: 4-km CONUS “NEST” domain (inside parent)
- BMJ_DEV convection (reduced triggering)
- Modified Ferrier microphysics

New Cloud Fraction
(reduced for cold, high clouds)

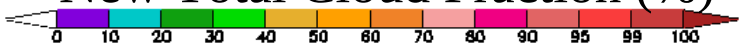


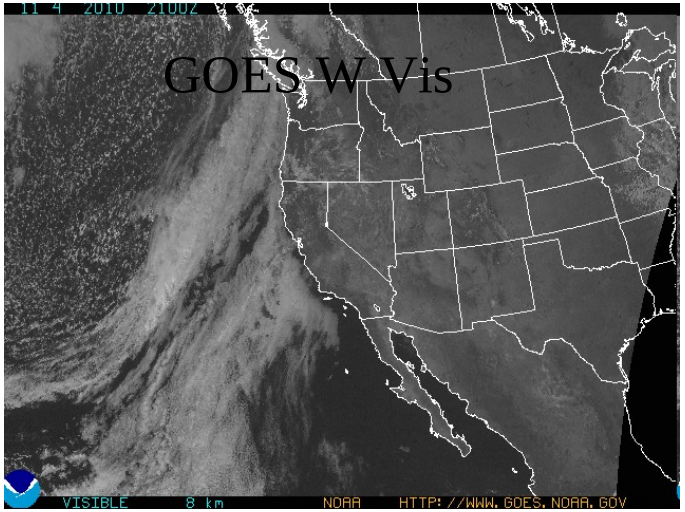
NAM Total Cloud Fraction (%)

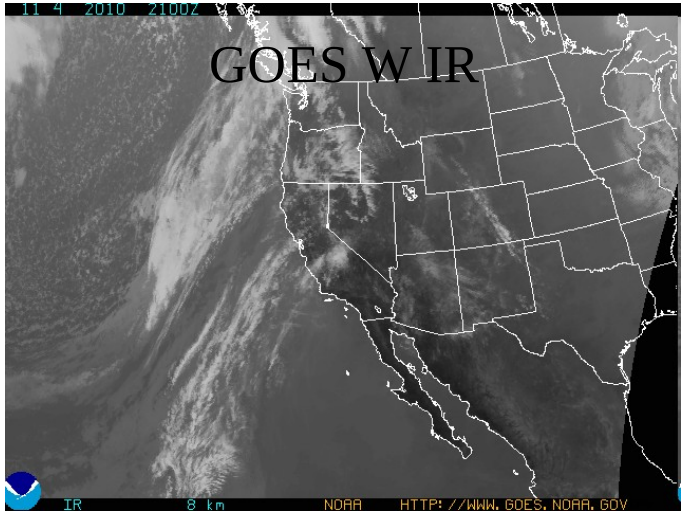




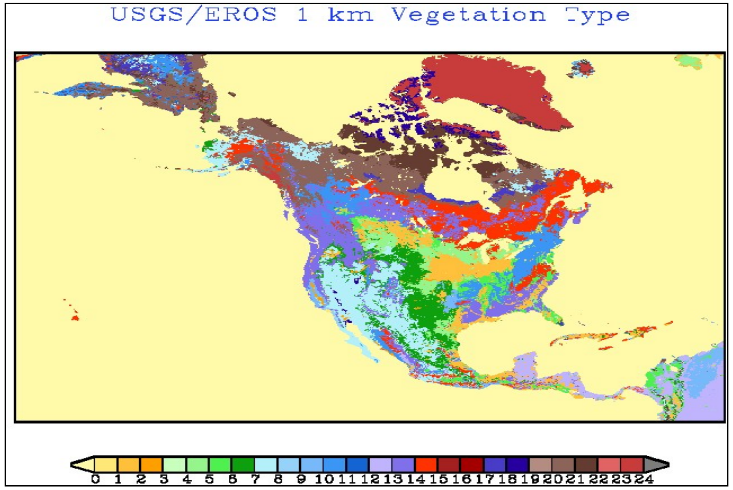
New Total Cloud Fraction (%)



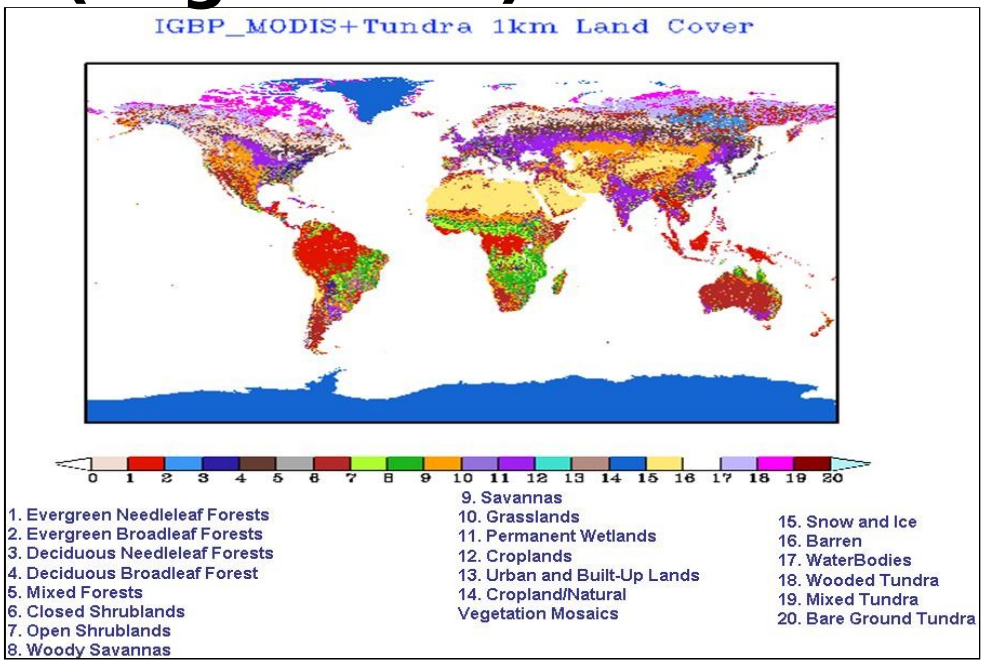




Latest NAMX test started 9/21; MODIS IGBP land-use (vegetation)

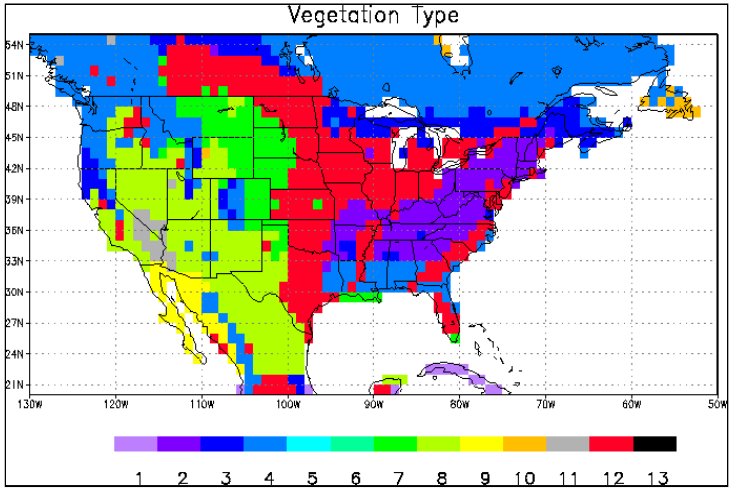


24-class 1-km USGS (NAM, NLDAS)

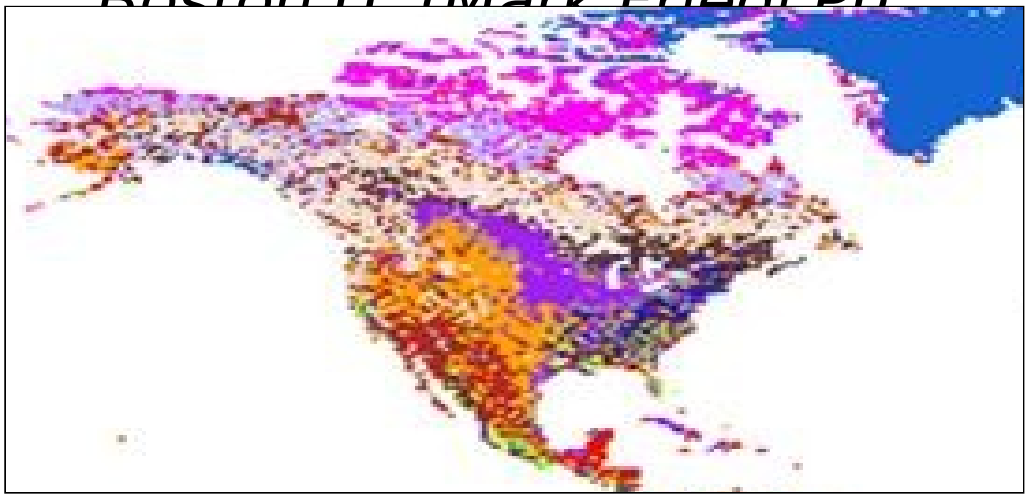


NEW 20-class 1-km extended-IGBP-MODIS

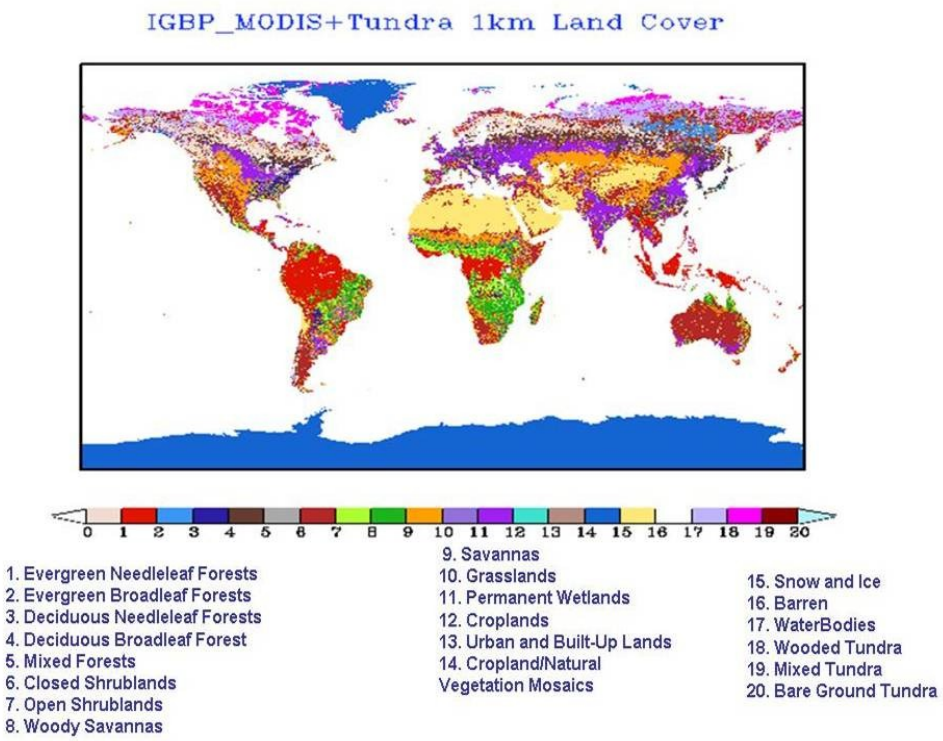
Boston U. (Mark Friedl PI)



13-class 1-deg SiB (GFS, CFS)



MODIS-IGBP land-use specifications will replace USGS (Wong and Ek, Conference on Hydrology)

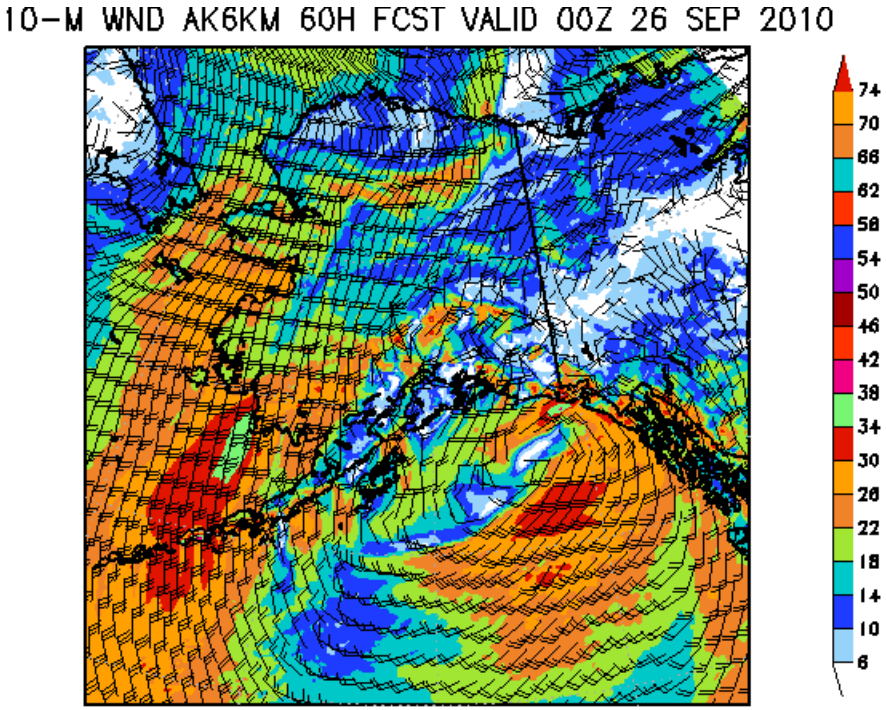


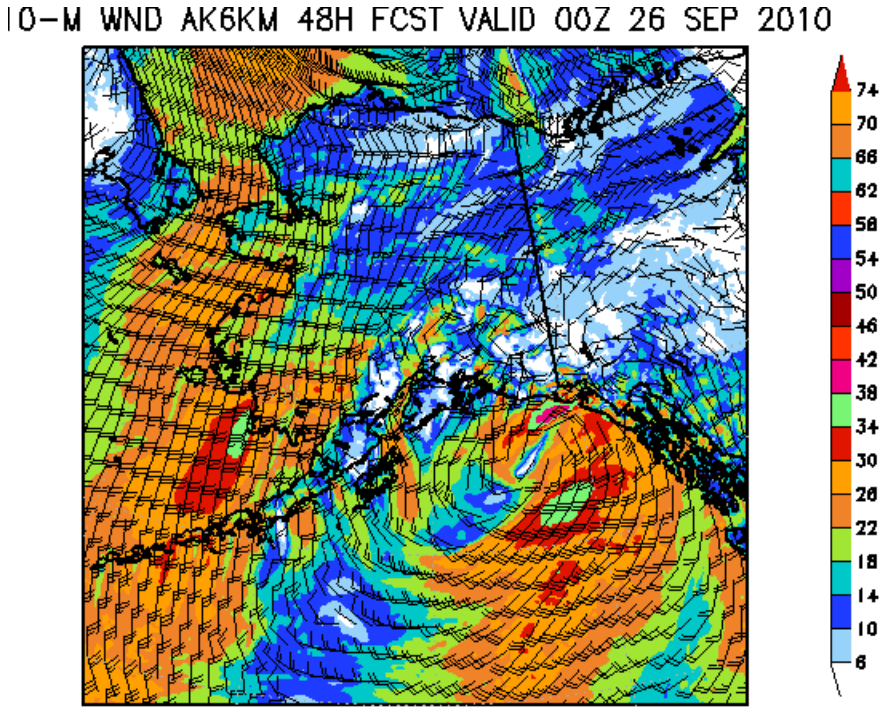
Classification Scheme	IGBP	USGS
Satellite Instr.	MODIS 2001-2006	AVHRR 1992-1993
Coastline	More Details	
Urban	More	
Evergreen	More in Alaska	More in SE of US
Deciduous Broadleaf	More in SE of US	
Savanna		More in Oklahoma

Little difference in near-sfc T, Td between NMMB runs w/ IGBP & USGS land-use (based on many tests run for all seasons)

Alaska Nest with Gravity Wave Drag

1) 60-h forecast valid at 00z 9/26 from 12z 9/23 initial conditions (last run without GWD)
2) 48-h forecast valid at 00z 9/26 from 00z 9/24 initial conditions (first run w/GWD)





There are some synoptic differences (see next slide) but the pressure gradient over land is similar, and you can see a significant reduction in the 10-m wind speed in the run with GWD. Please also note the differences over the elevated terrain east of Juneau. That region and the coastal mountains of British Columbia east of the Queen Charlotte Islands was where I would first see the most dramatic differences when we started looking at GWD in the NAM. That area was also the epicenter for mountain blocking

Alaska Nest with Gravity Wave Drag

1) 60-h forecast valid at 00z 9/26 from 12z 9/23 initial conditions (last run without GWD)
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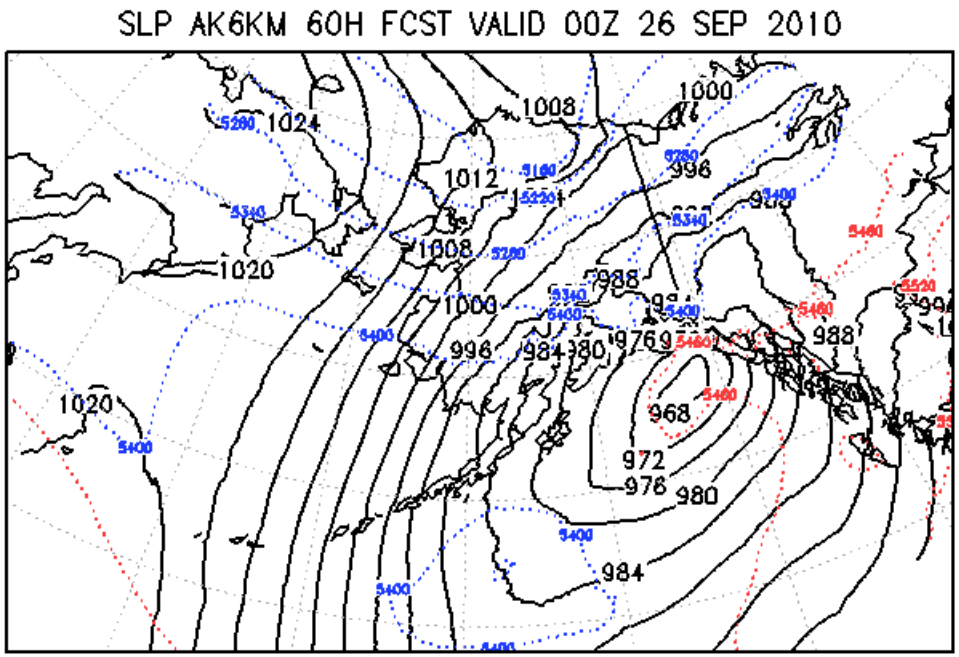
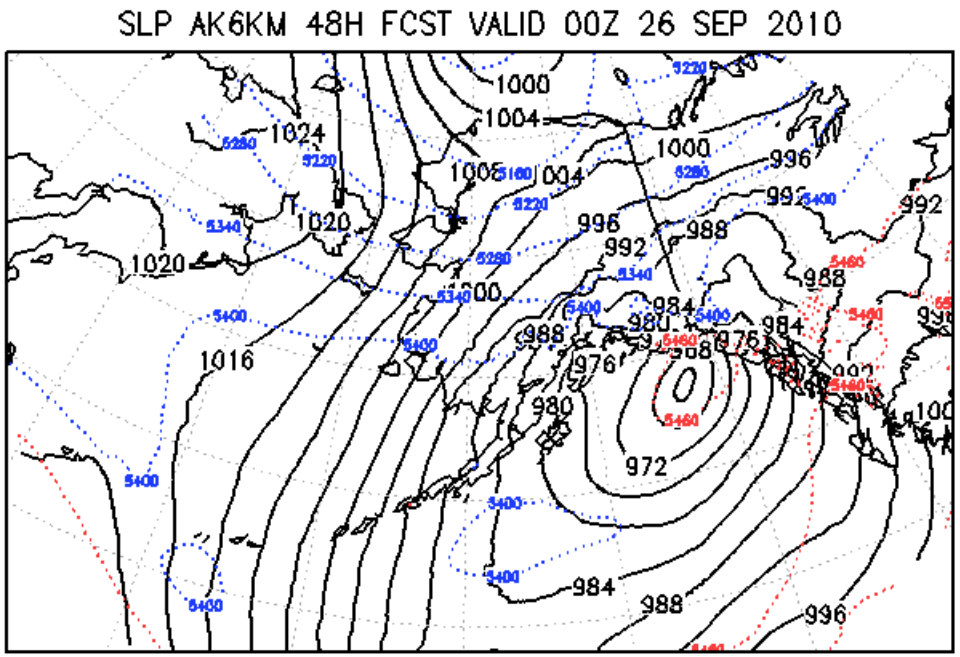
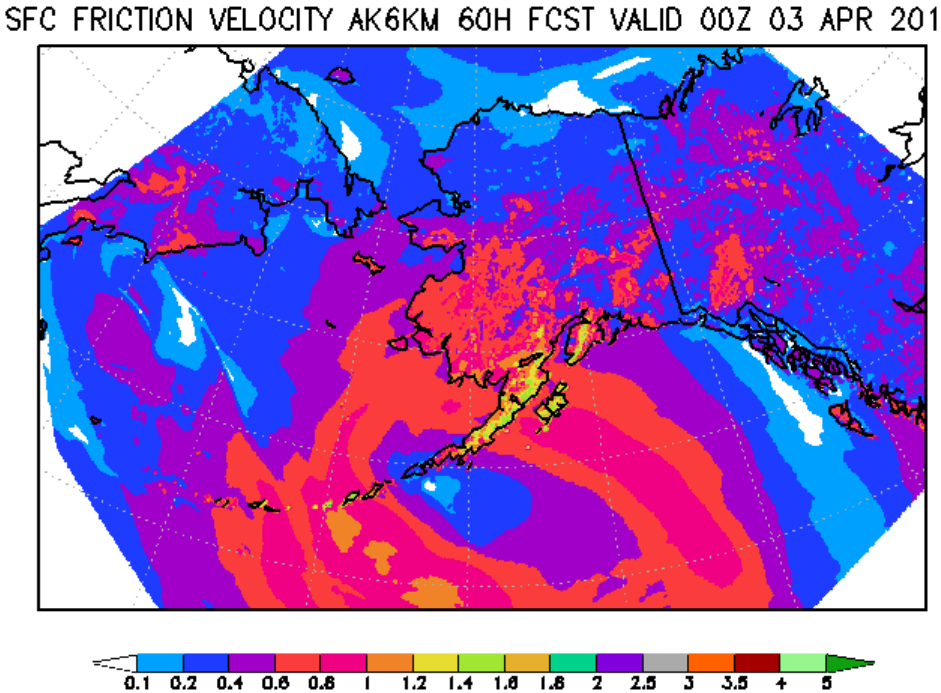


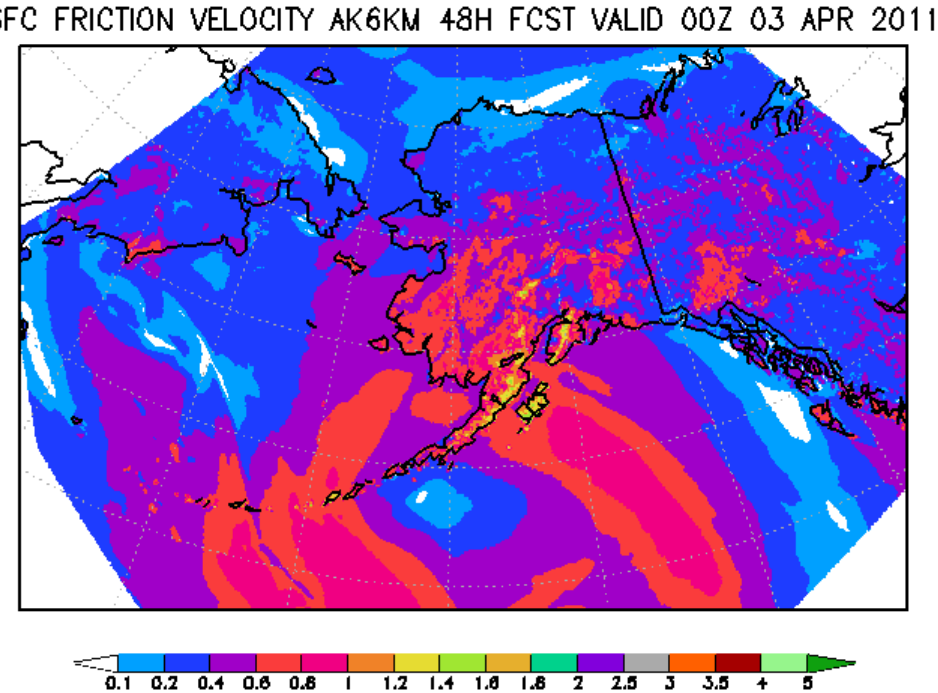


There are some synoptic differences as you can see from the SLP forecast plots especially with the position of the cyclone in the Arctic Ocean.

Alaska Nest with Gravity Wave Drag

1) 60-h forecast valid at 00z 9/26 from 12z 9/23 initial conditions (last run without GWD)
2) 48-h forecast valid at 00z 9/26 from 00z 9/24 initial conditions (first run w/GWD)

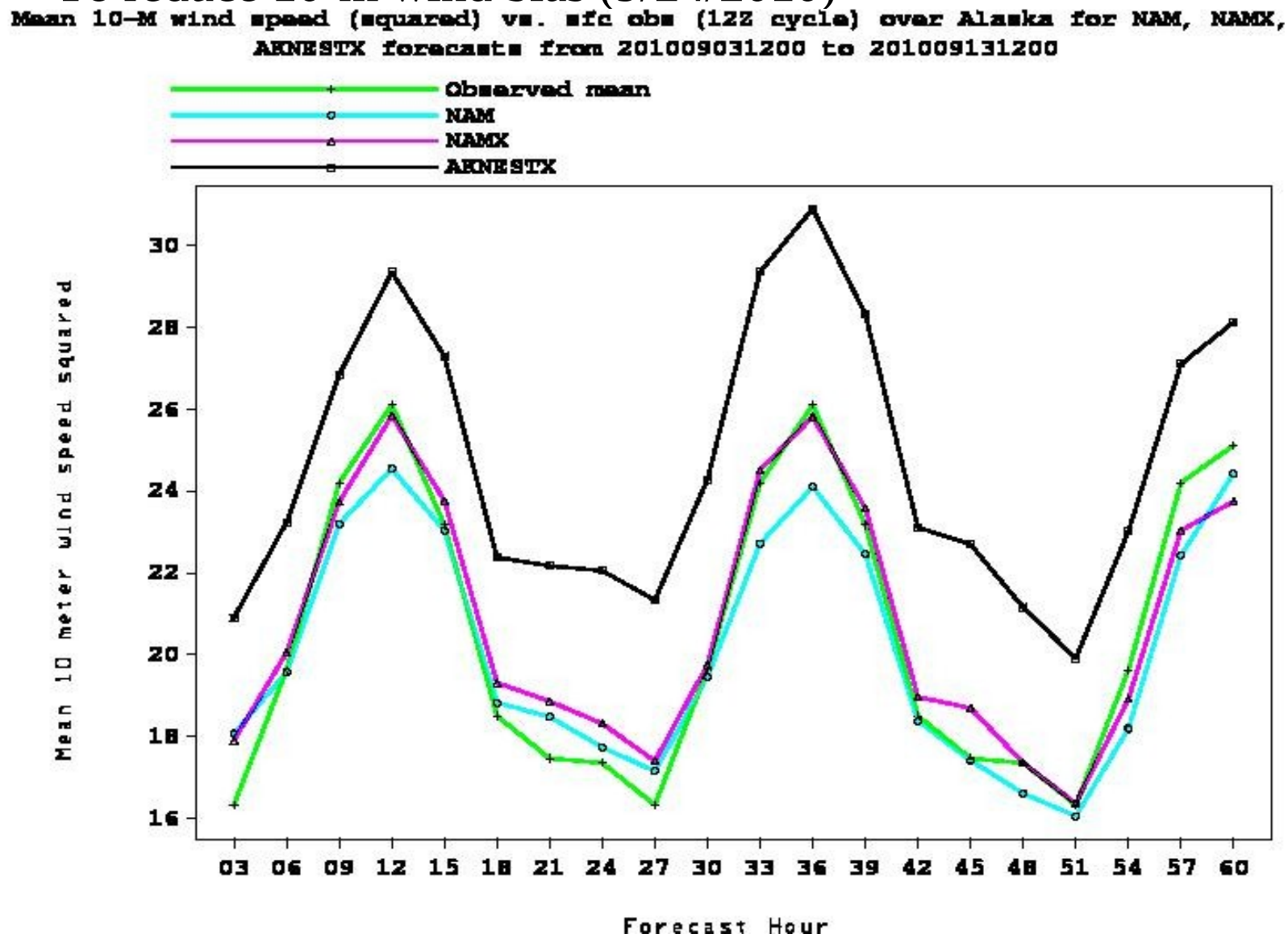




Please also note the differences over the elevated terrain east of Juneau. That region and the coastal mountains of British Columbia east of the Queen Charlotte Islands was where I would first see the most dramatic differences when we started looking at GWD in the NAM. That area was also the epicenter for mountain blocking. You can see it when comparing the reduced surface friction velocities after the change versus before the change as well as noticeable differences over the Brookes Range in northern Alaska.

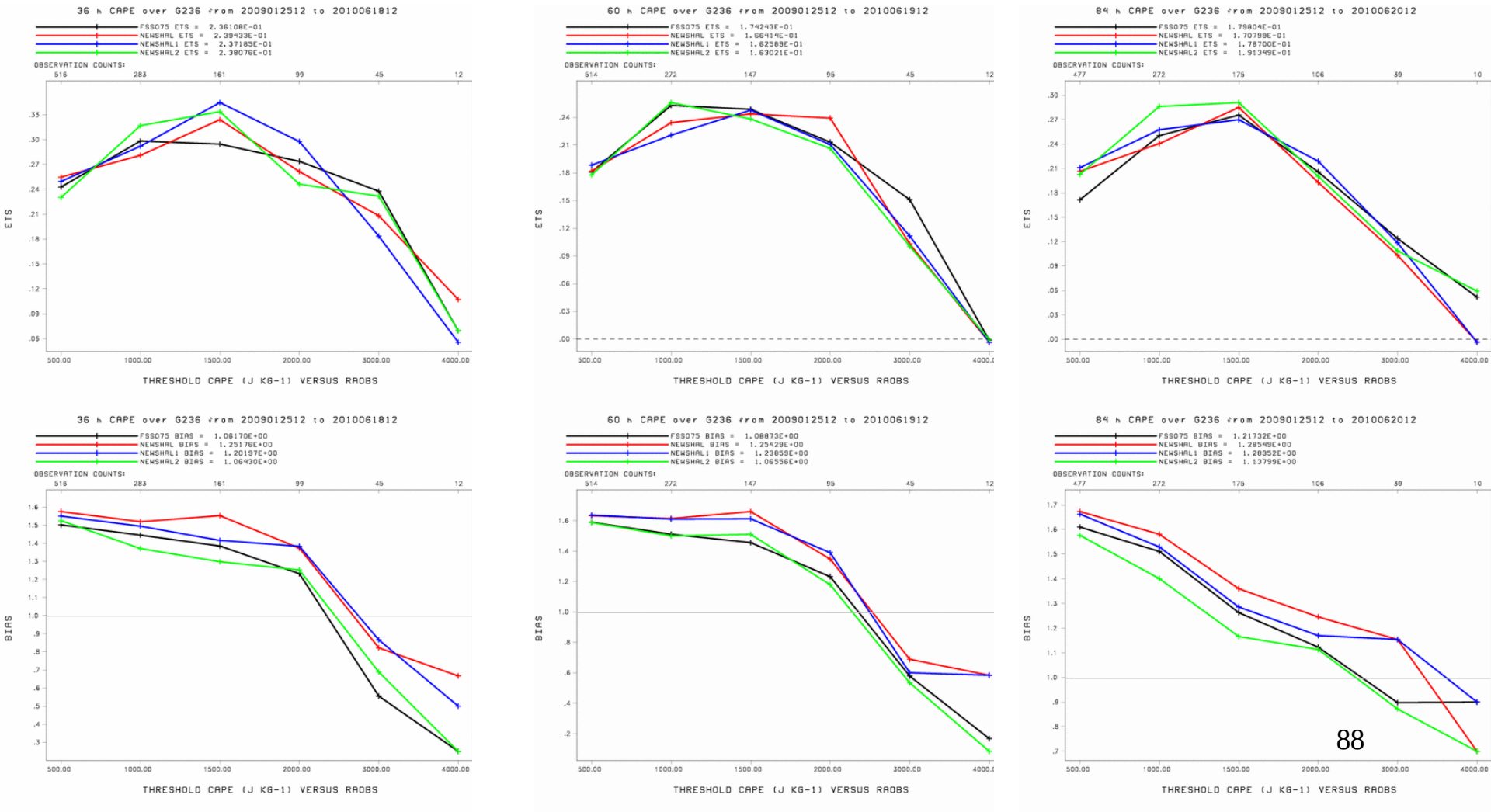
Turn on gravity wave drag/mountain blocking in 6 km Alaska nest

- To reduce 10-m wind bias (9/24/2010)



CAPE Verification of Shallow Convection Tests

- The CAPE verification for tests of different versions of the shallow convection is available at http://www.emc.ncep.noaa.gov/mmb/bf/launcher/series20/cape/



CAPE Verification of Deep Convection Tests

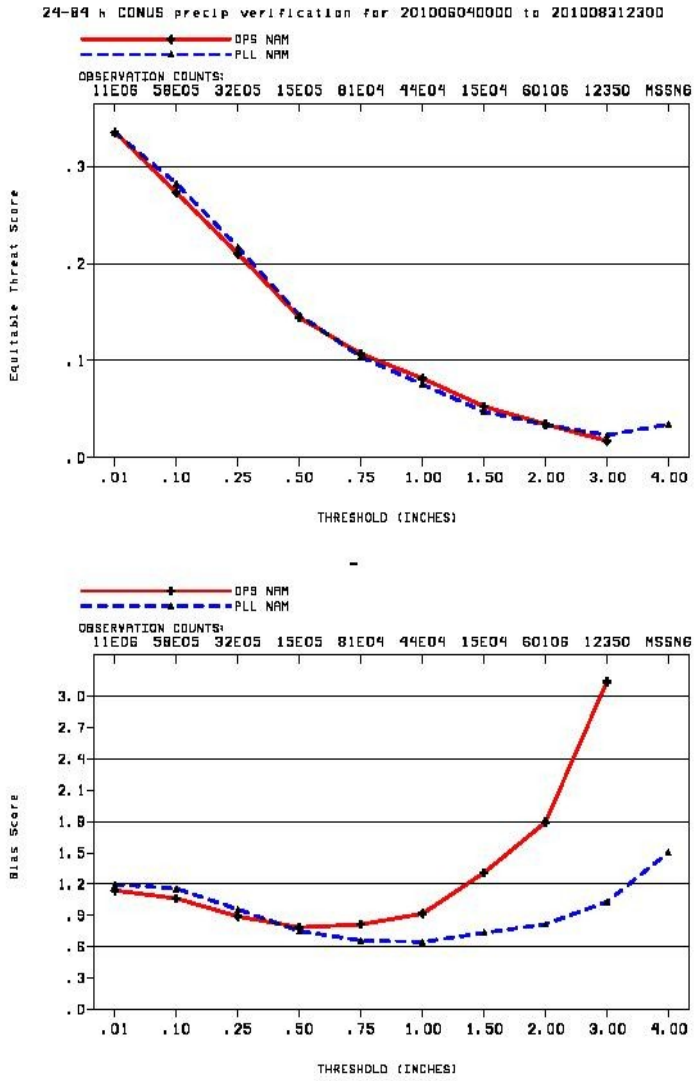
- This site <http://www.emc.ncep.noaa.gov/mmb/bf/launcher/series12/cape shows the scant CAPE verification for the cases mentioned. Focusing just on the nests for the moment, the 4-km CONUS nest runs with the bmj_dev convection run (BMJDEV, green) compare favorably in terms of objective verification for most forecast hours compared with the 4-km nest runs w/o convection (NOCONV, blue), but some issue of low biases for the bmj_dev runs in high CAPE conditions (>= 3000 J/kg) at 36h http://www.emc.ncep.noaa.gov/mmb/bf/launcher/series12/cape/ver02.gif & at 60 h http://www.emc.ncep.noaa.gov/mmb/bf/launcher/series12/cape/ver04.gif .
- The NAM consistently has higher ETS for CAPE forecasts compared to the NMMB parent, which is consistent with Eric's results below, but I think the reason is because the NAM has compensating errors due to warmer biases (e.g. here http://www.emc.ncep.noaa.gov/mmb/mmbpll/pllstats.namb_namx_smag/conustemp.bias.html in the upper half of the troposphere compared to the NMMB. The 1000-hPa cold bias is pretty noticeable in the NMMB, and it seems to over state things compared to the 2-m temperature verification (e.g., here for 0z http://www.emc.ncep.noaa.gov/mmb/mmbpll/pllstats.namb_namx_smag/NAMBconus.T2M_00Z.jpg and here for 12Z http://www.emc.ncep.noaa.gov/mmb/mmbpll/pllstats.namb_namx_smag/NAMBconus.T2M_12Z.jpg)
- 1000-hPa RAOB verification has few obs and only those at low elevation, but it could hint at a cold bias over low-elevation RAOB sites near coastal areas.

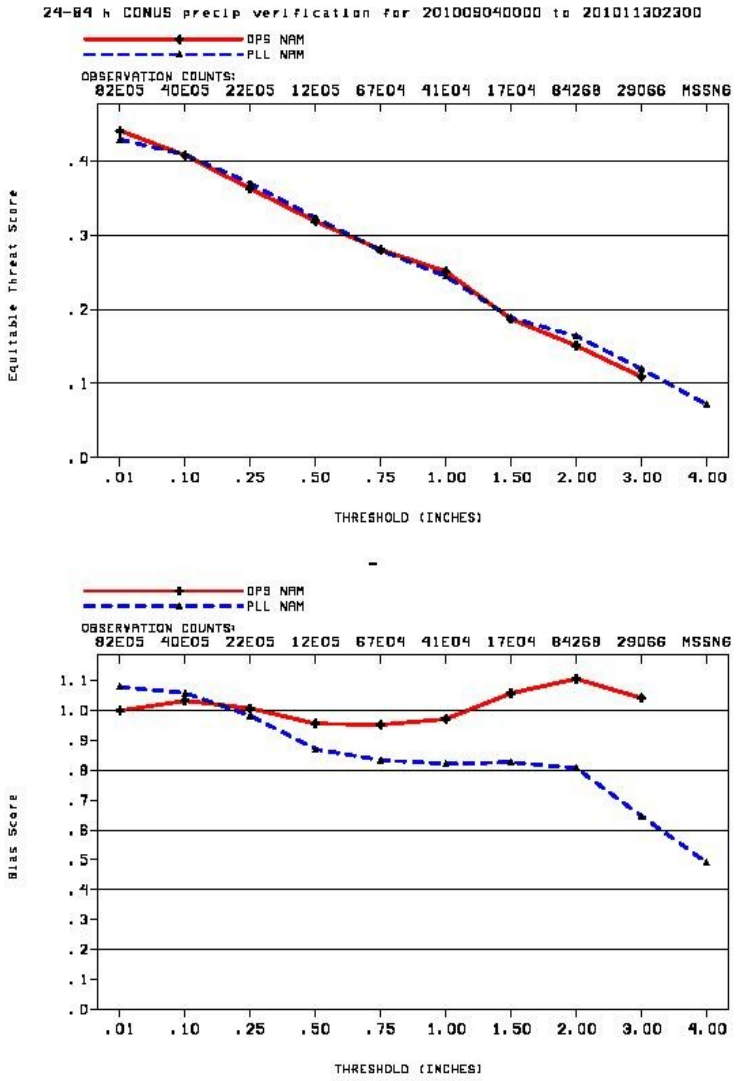
Selected Seasonal Quantitative skill scores for 12 km NAM vs 12 km parallel NAM

24-h QPF scores : Ops (Red) vs Pll NAM (blue)
24-84 h forecast

Equit. Threat Score

Bias





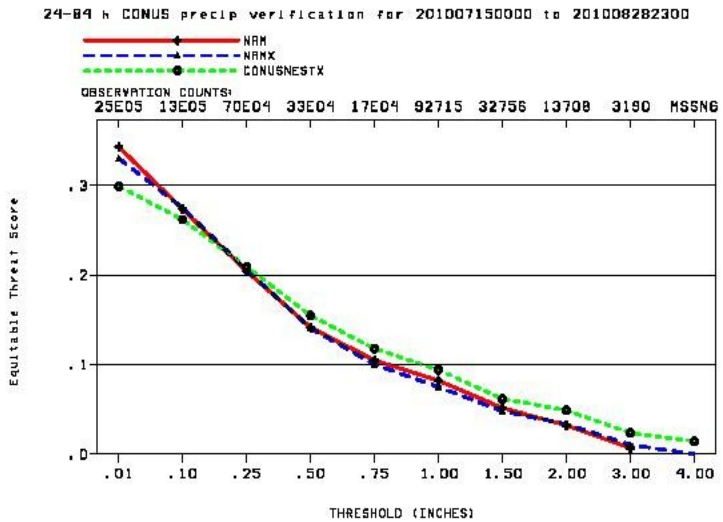
June-August 2010

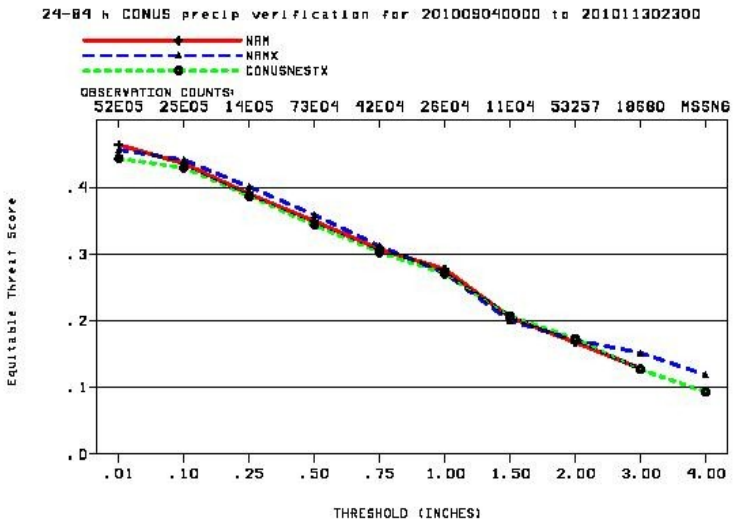
Sept-Nov 2010

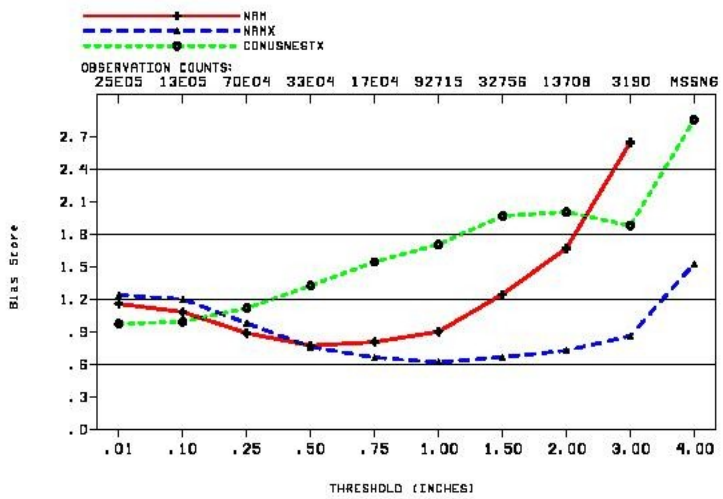
24-h QPF scores : Ops (Red) vs Pll NAM (blue) vs CONUSNest(green) 24-84 h forecast

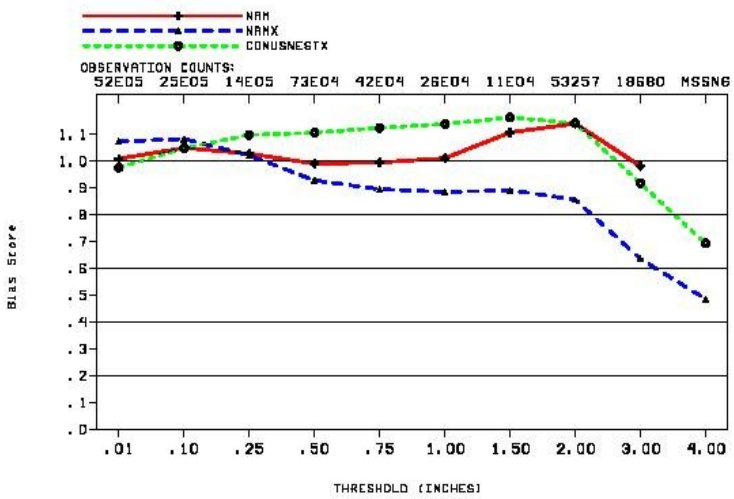
Equit. Threat Score

Bias









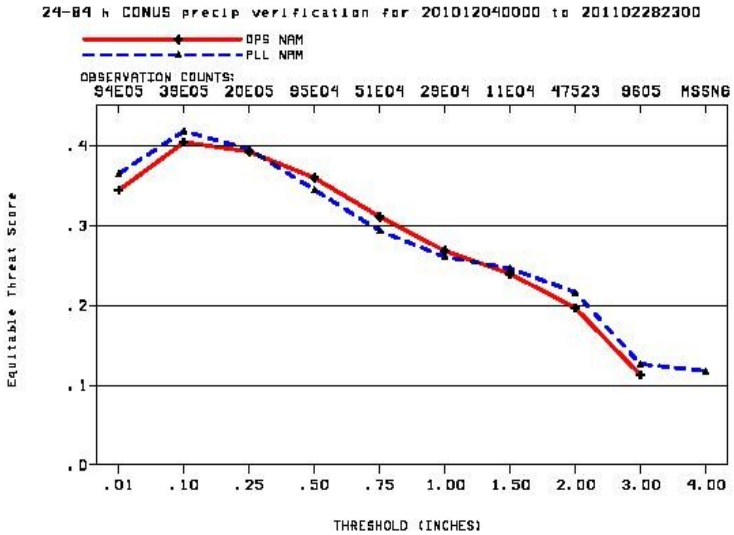
June-August 2010

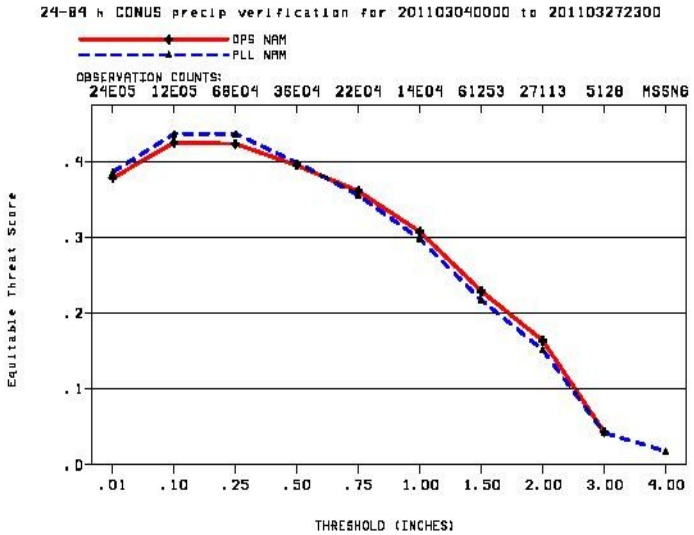
Sept-Nov 2010

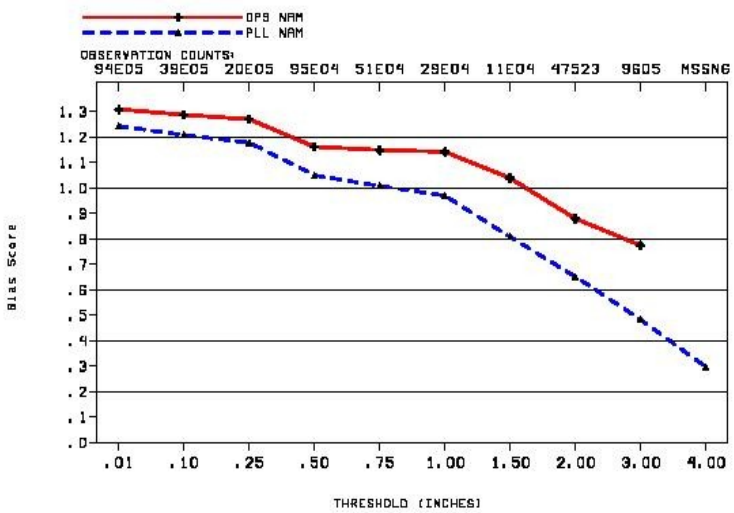
24-h QPF scores : Ops (Red) vs Pll NAM (blue)
24-84 h forecast

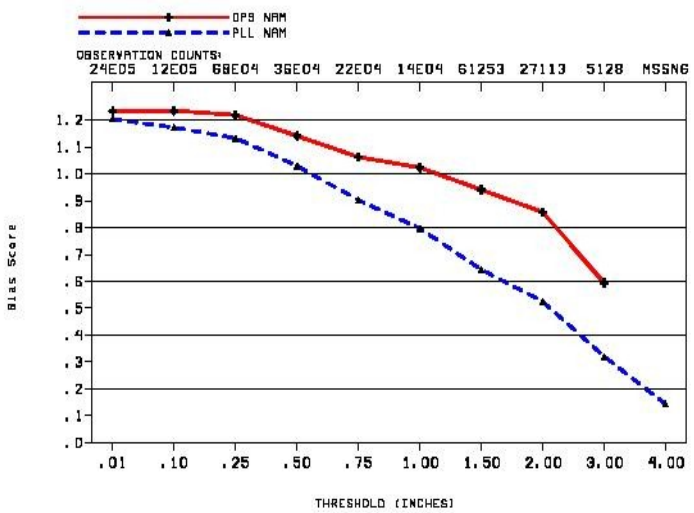
Equit. Threat Score

Bias









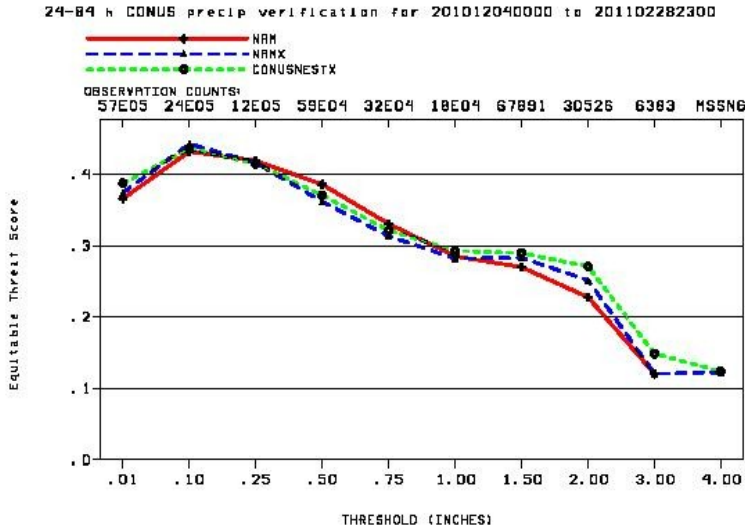
Dec 10-February 11

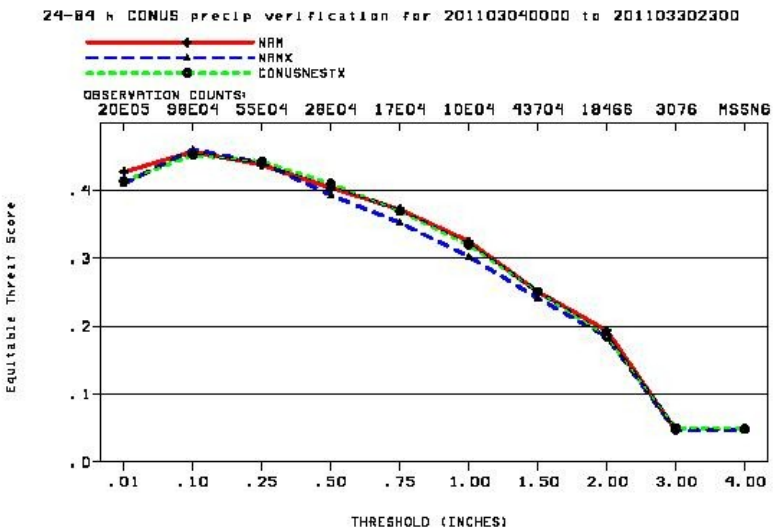
March 2011

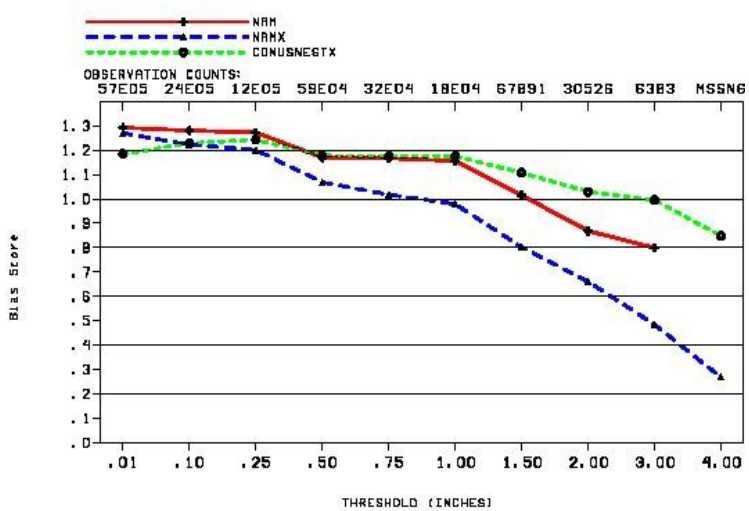
24-h QPF scores : Ops (Red) vs Pll NAM (blue) vs CONUSNest(green) 24-84 h forecast

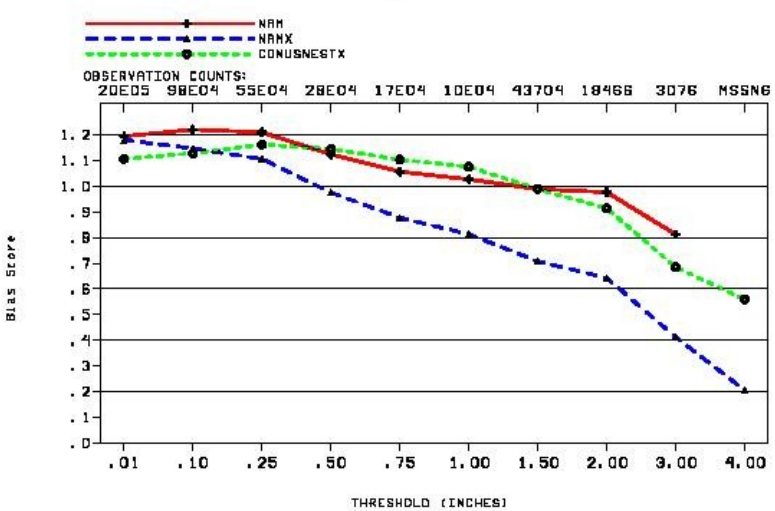
Equit. Threat Score

Bias









Dec 10-February 11

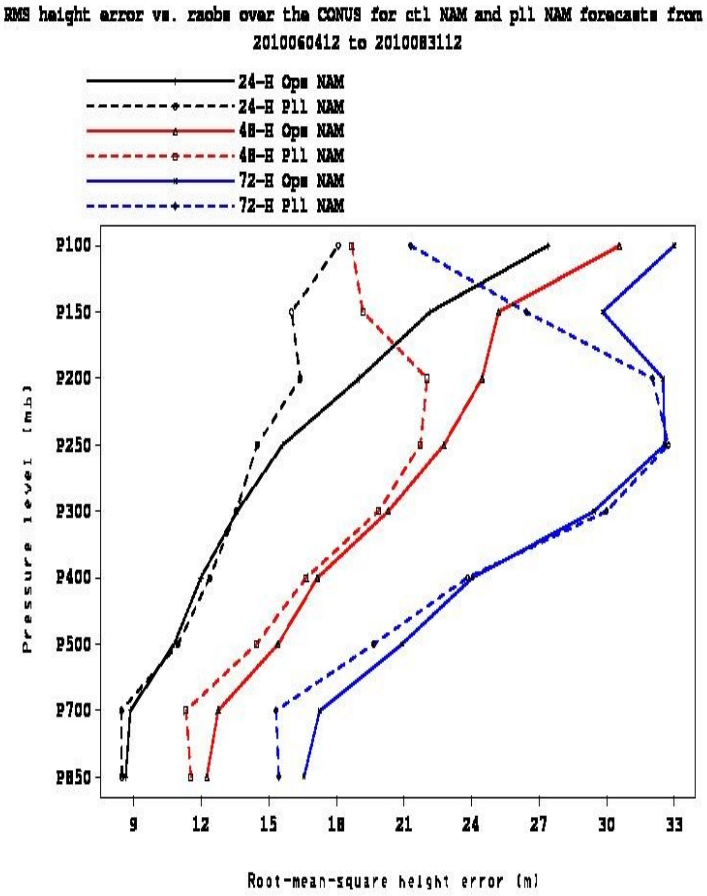
March 2011

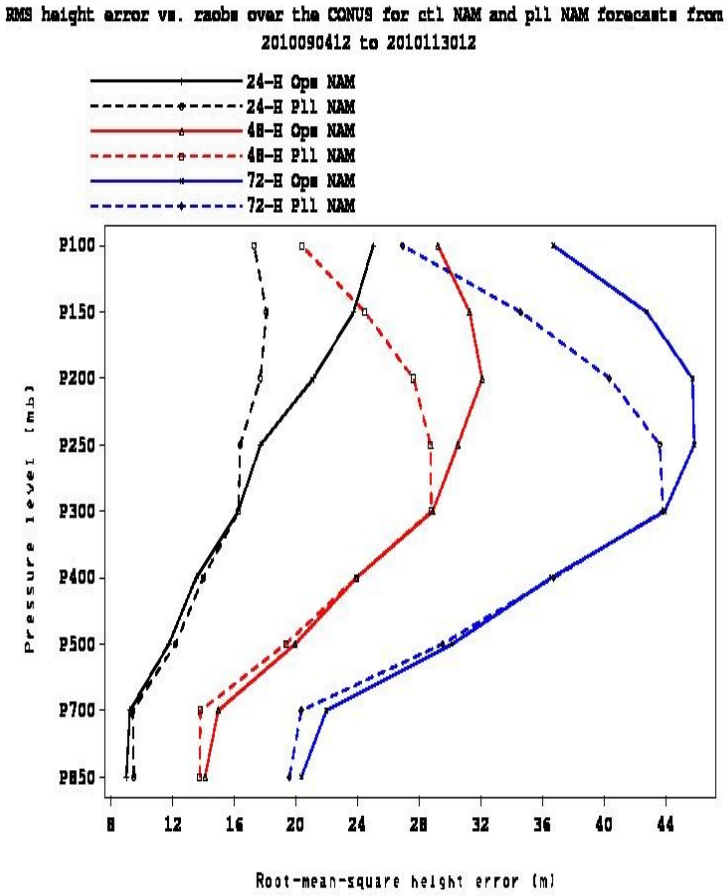
Vertical Distribution of CONUS Height RMS Error : Ops NAM (solid) vs Pll NAM (dashed)

24-h fcst=Black

48-h fcst=Red

72-h fcst=Blue





June-August 2010

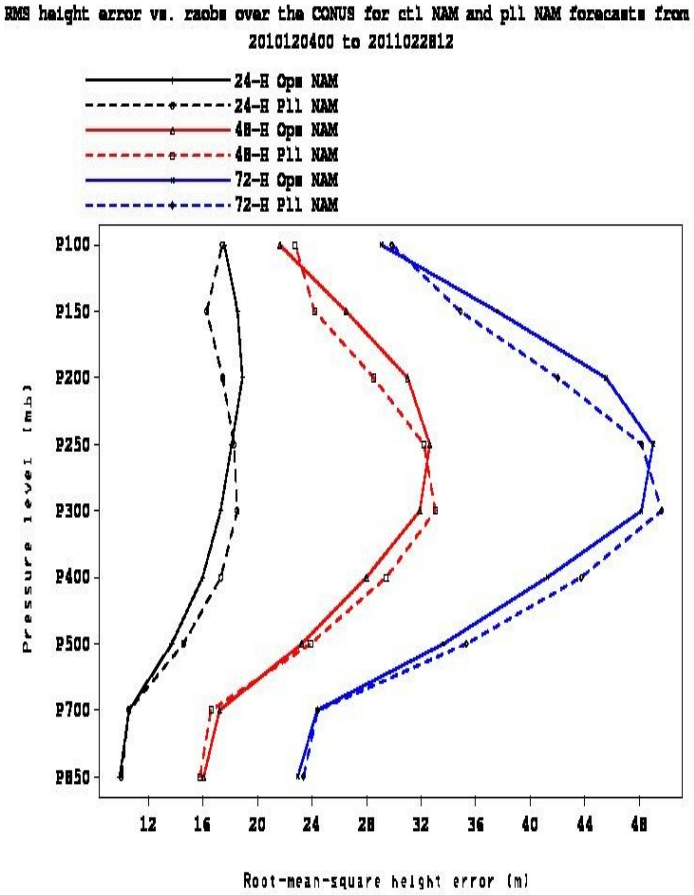
Sept-Nov 2010

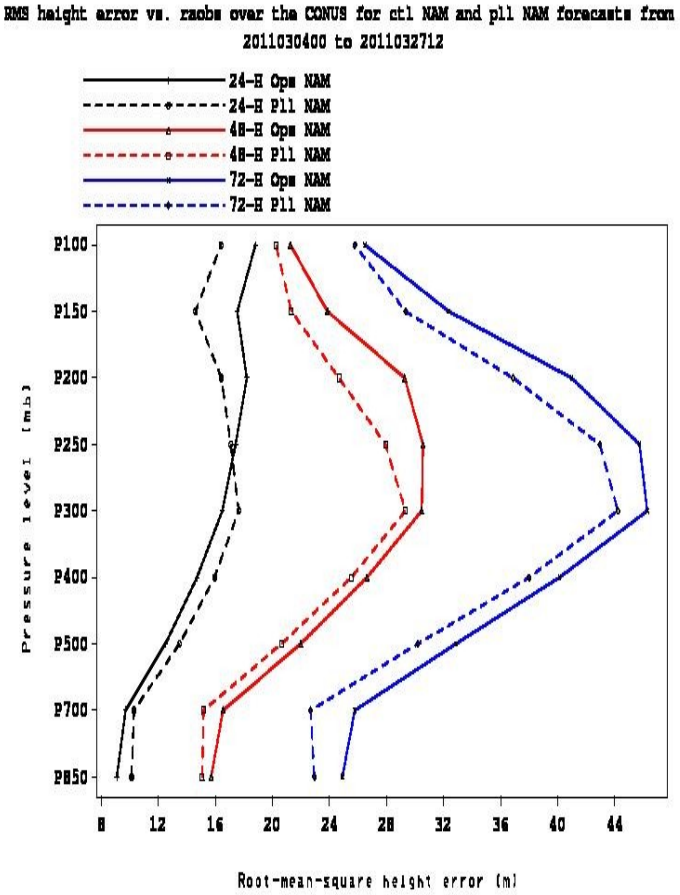
Vertical Distribution of CONUS Height RMS Error : Ops NAM (solid) vs Pll NAM (dashed)

24-h fcst=Black

48-h fcst=Red

72-h fcst=Blue



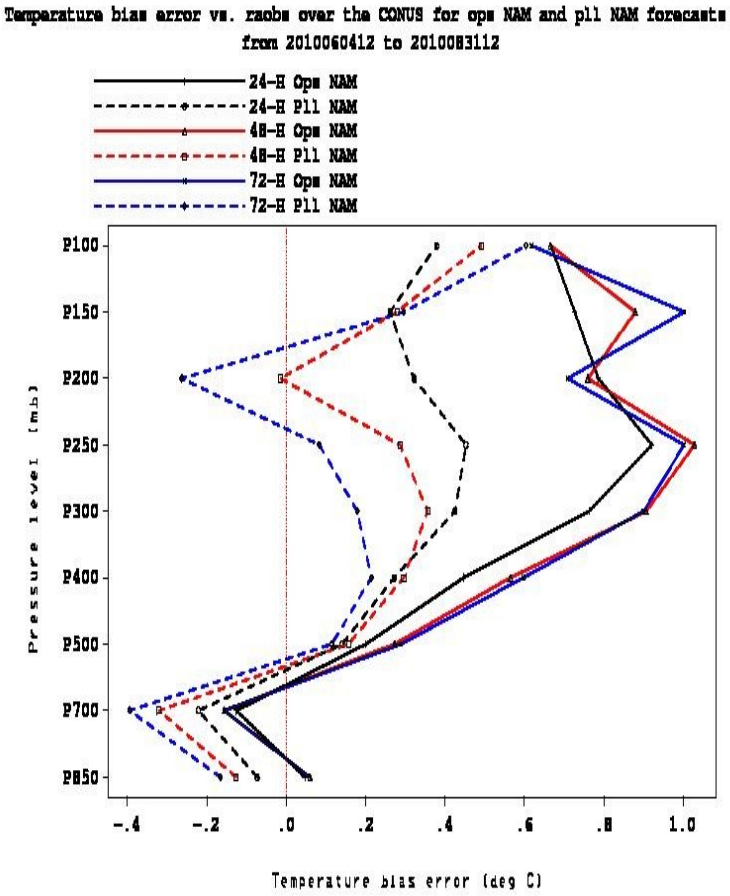


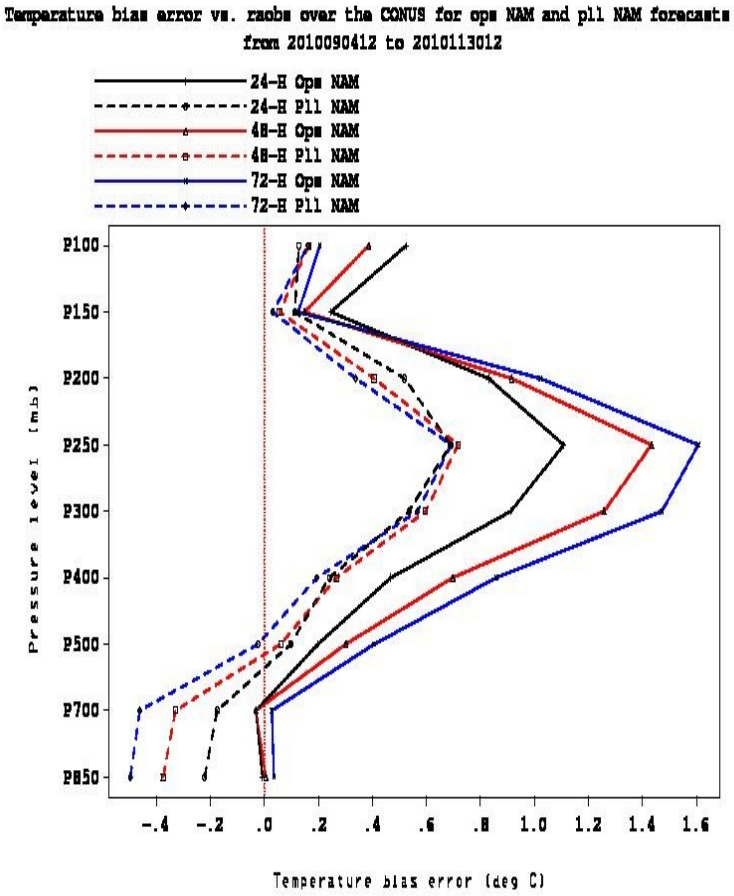
Dec 10-February 11

March 2011

Vertical Distribution of CONUS Temperature Bias Error : Ops NAM (solid) vs Pll NAM (dashed)

24-h
fcst=Black
48-h
fcst=Red
72-h
fcst=Blue





June-August 2010

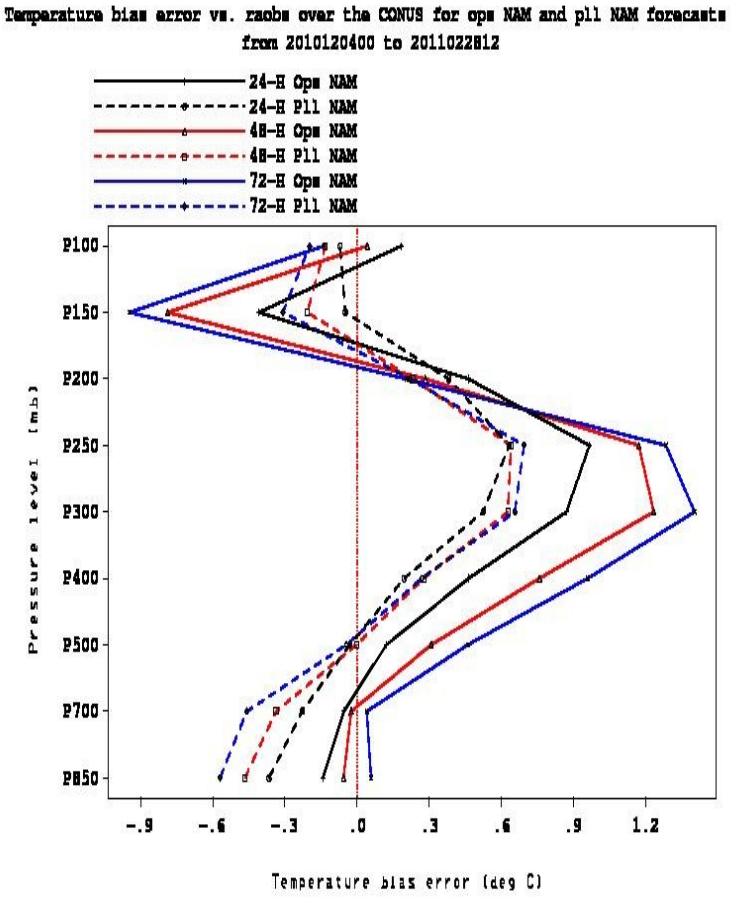
Sept-Nov 2010

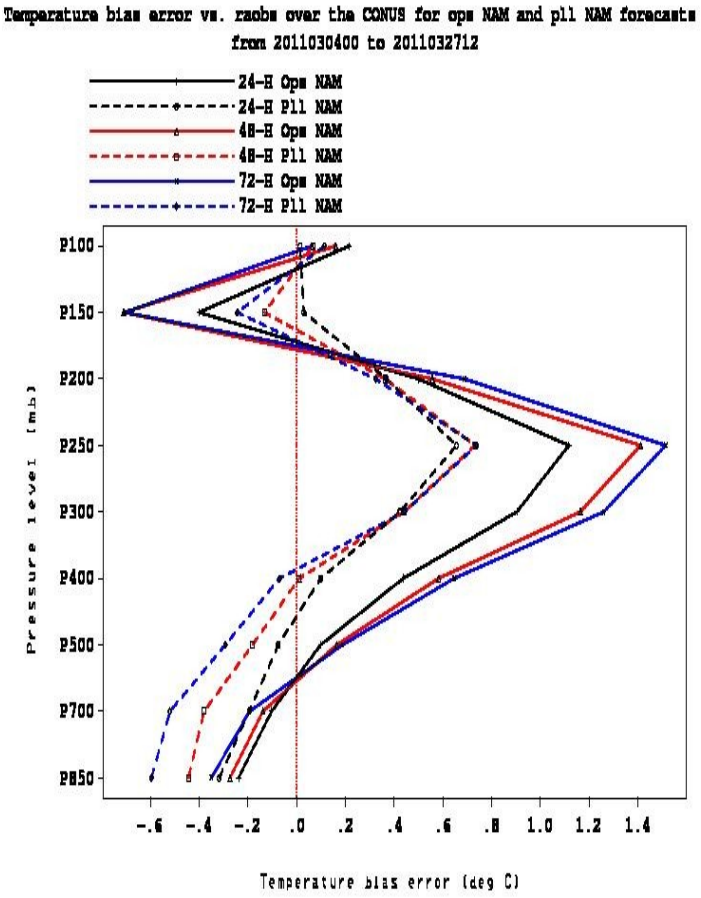
Vertical Distribution of CONUS Temperature Bias Error : Ops NAM (solid) vs Pll NAM (dashed)

24-h fcst=Black

48-h fcst=Red

72-h fcst=Blue



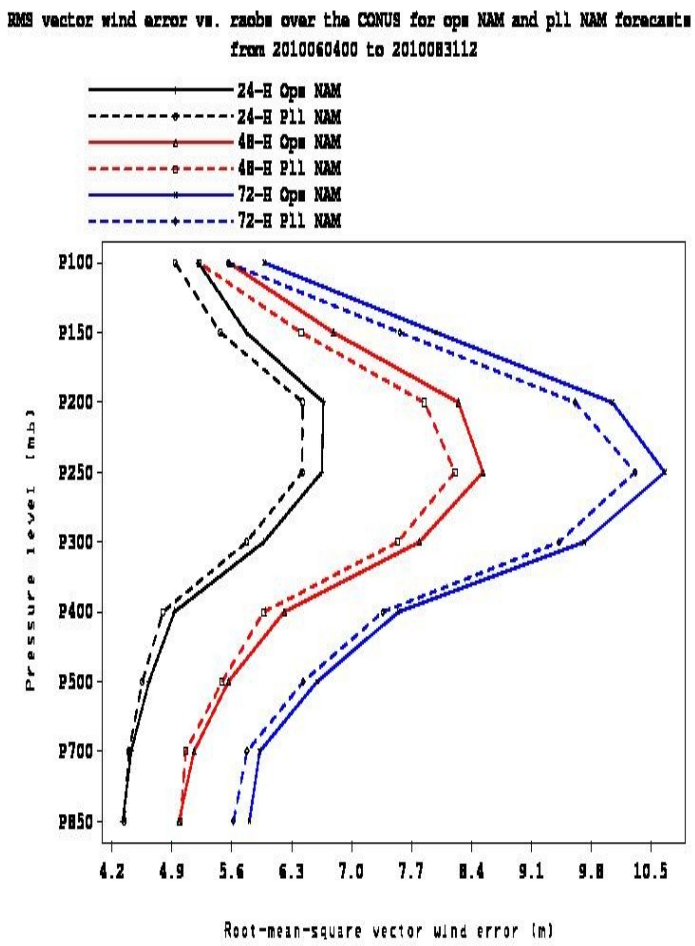


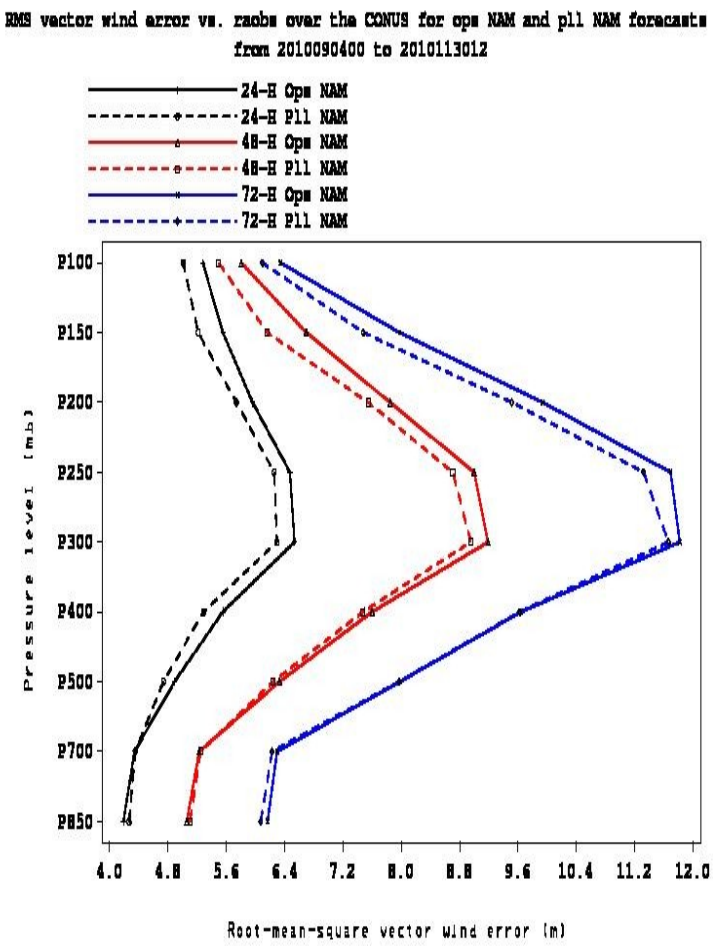
Dec 10 – February 11

March 2011

Vertical Distribution of CONUS Vector Wind RMS Error : Ops NAM (solid) vs Pll NAM (dashed)

24-h
fcst=Black
48-h
fcst=Red
72-h
fcst=Blue





June-August 2010

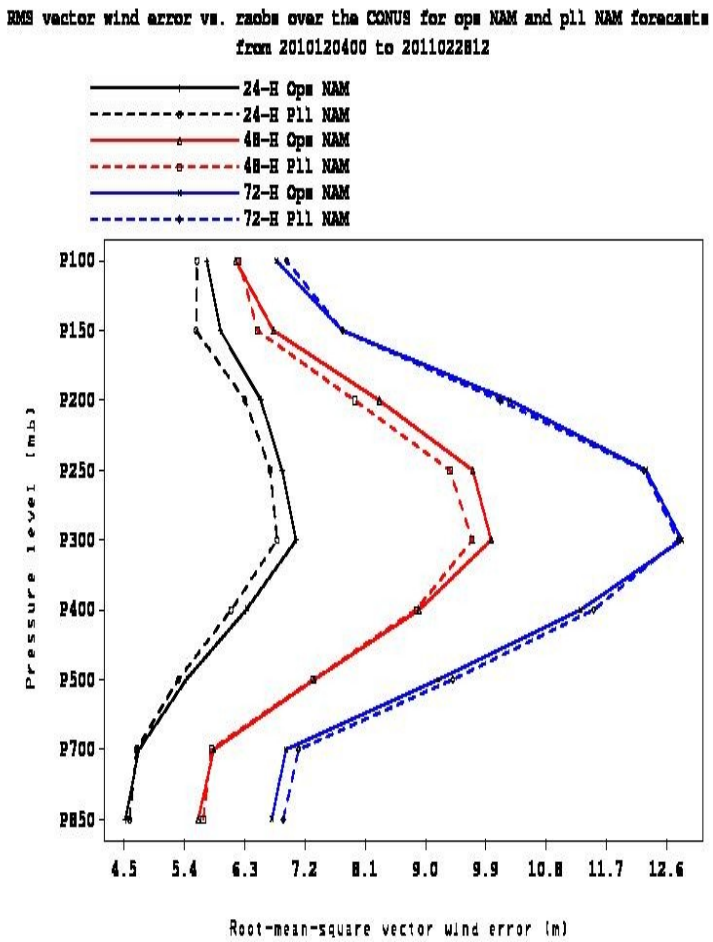
Sept-Nov 2010

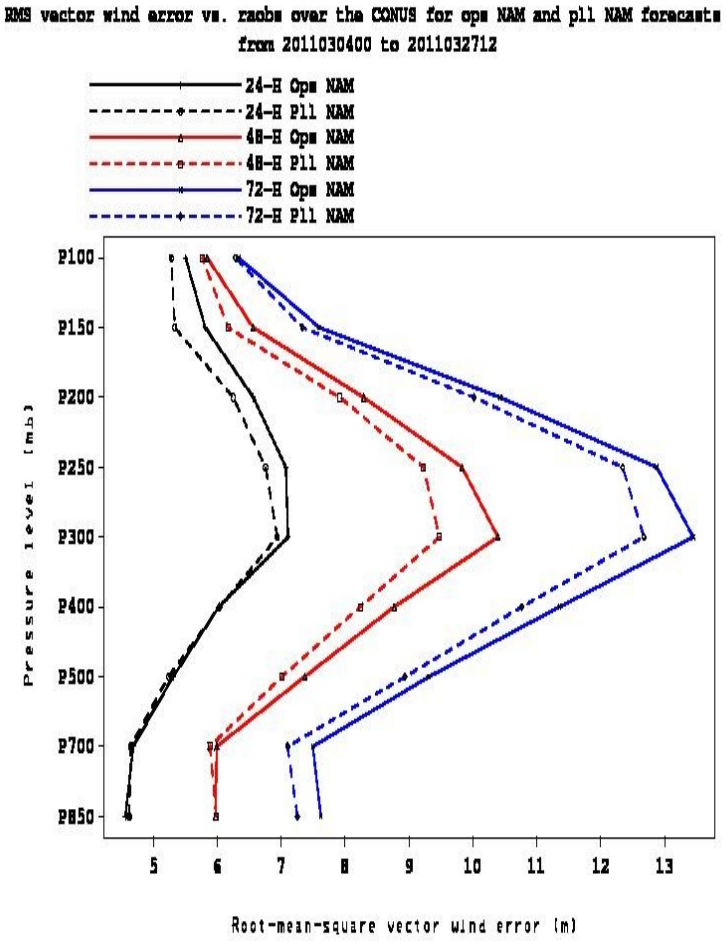
Vertical Distribution of CONUS Vector Wind RMS Error : Ops NAM (solid) vs Pll NAM (dashed)

24-h fcst=Black

48-h fcst=Red

72-h fcst=Blue

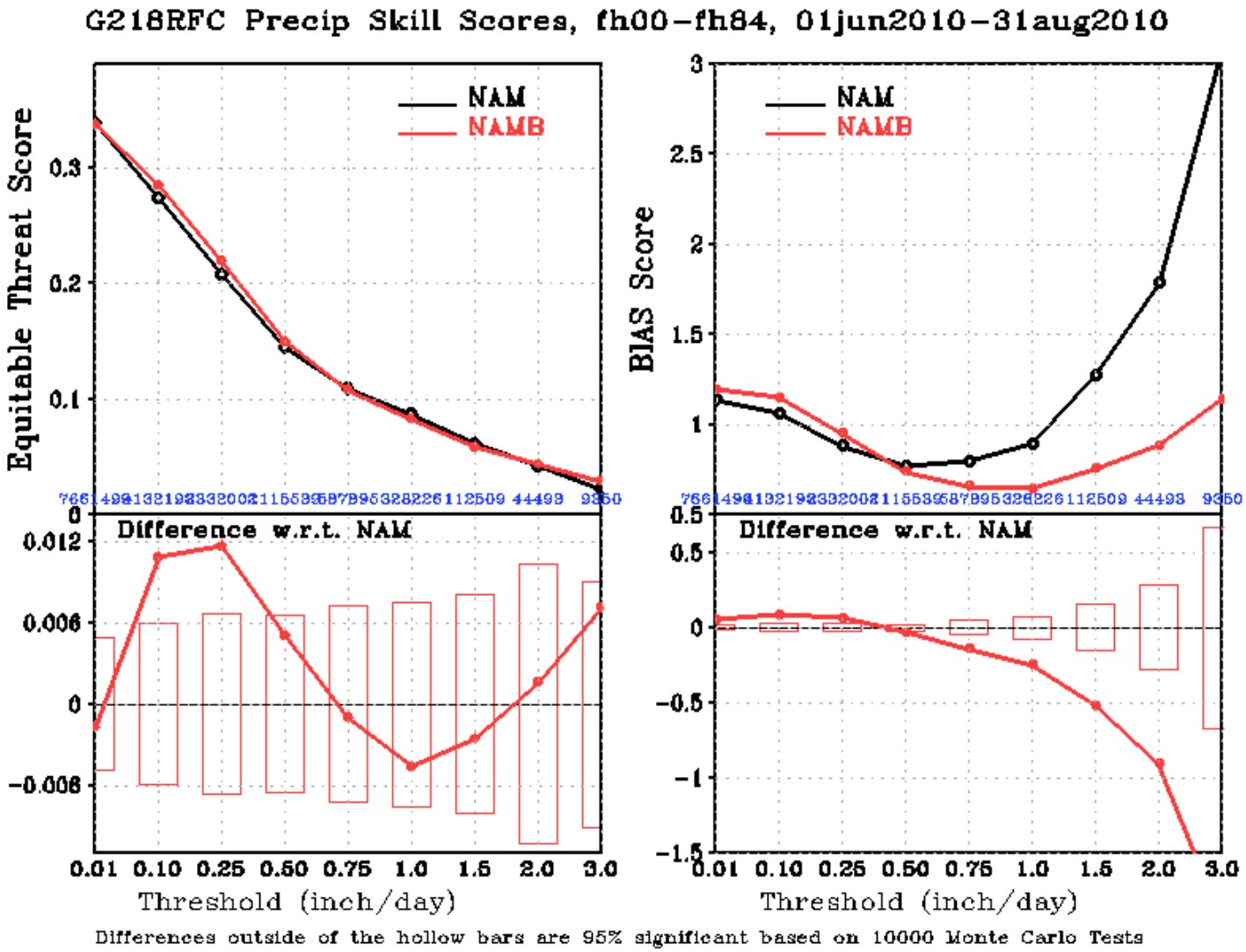




Dec 10 – February 11

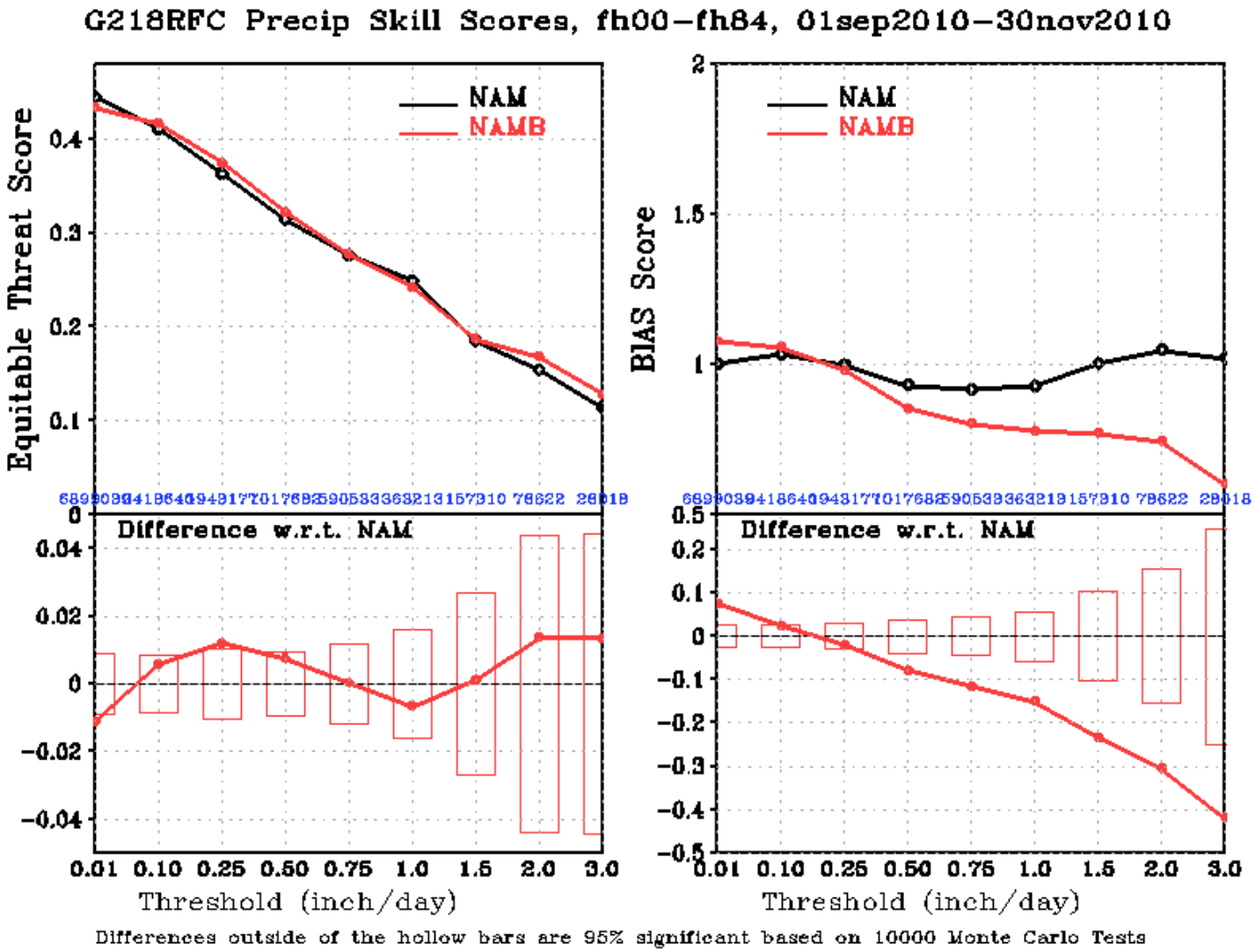
March 2011

Seasonal 24-h QPF scores w/confidence level : Ops NAM (black) vs Pll NAMB (red), 24-84 h forecast



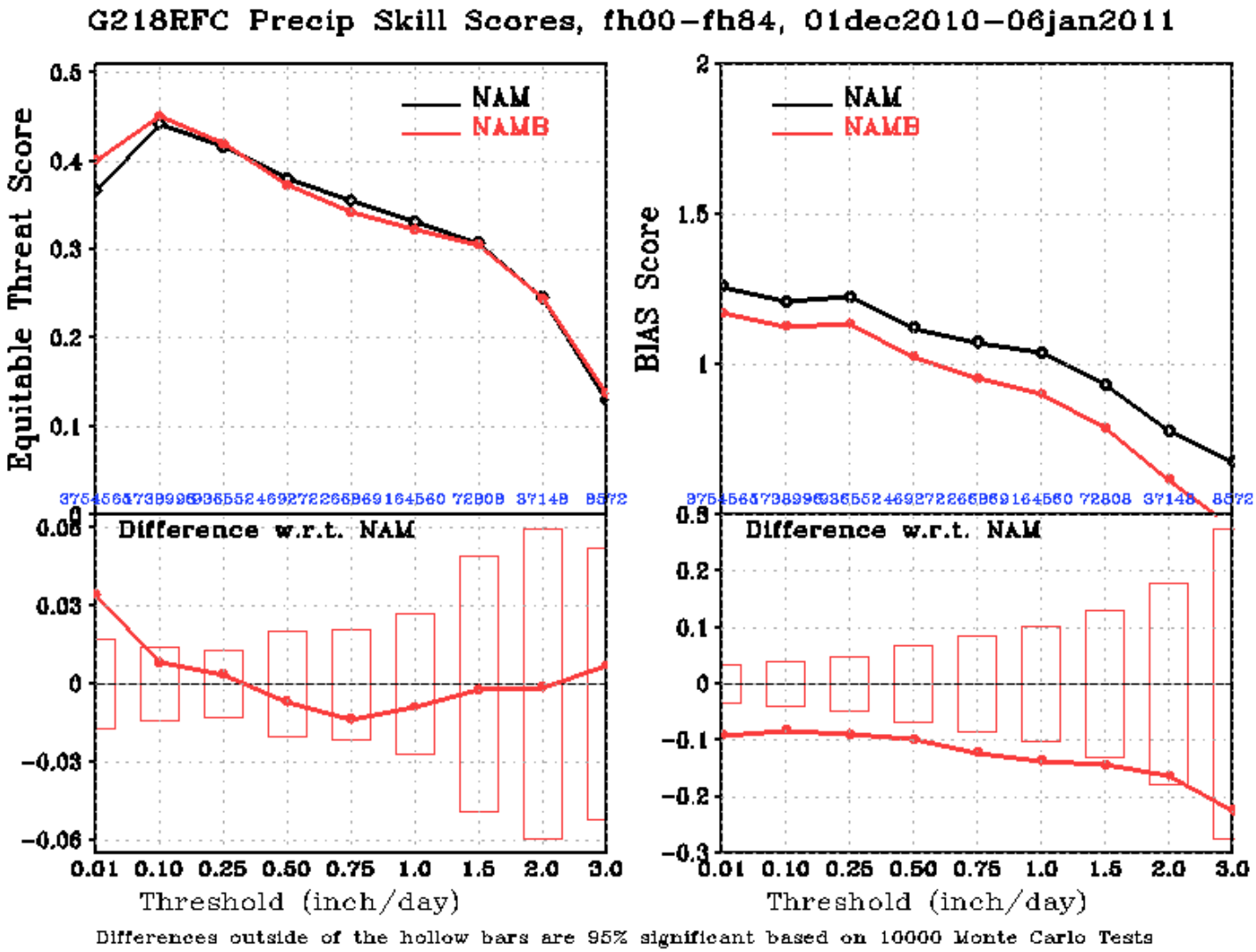
June-August 2010

Seasonal 24-h QPF scores w/confidence level : Ops NAM (black) vs Pll NAMB (red), 24-84 h forecast



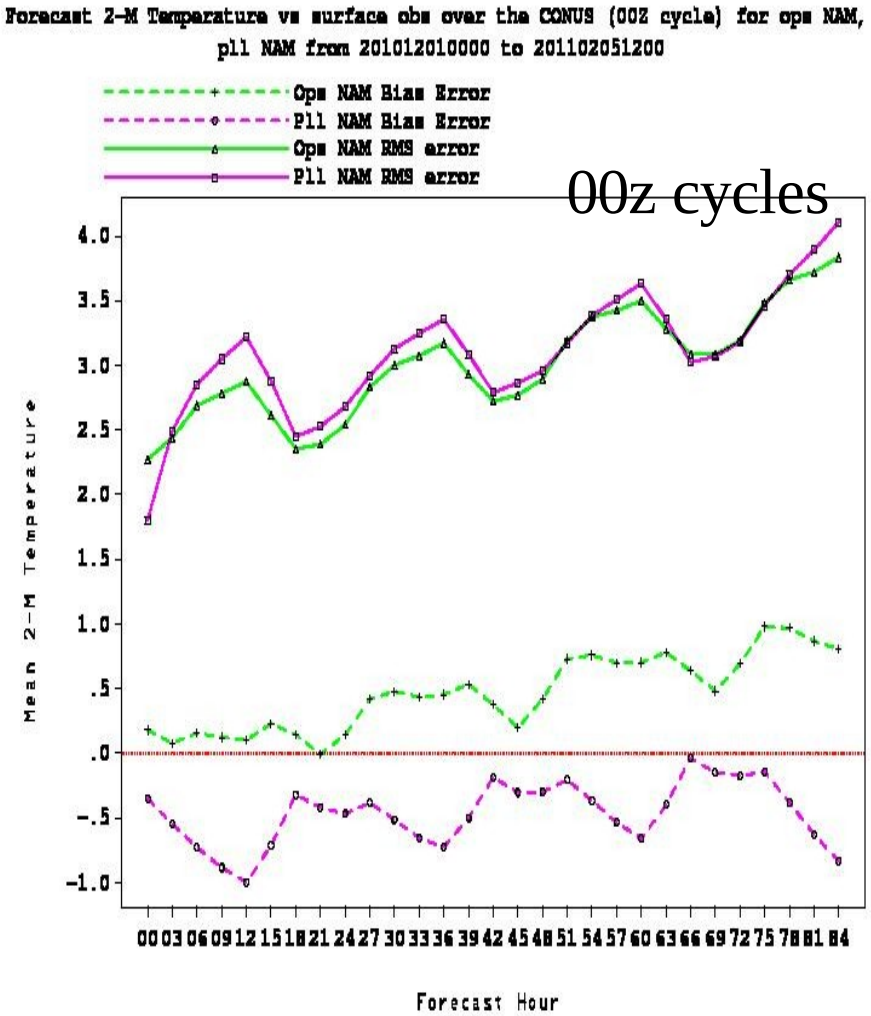
September-November 2010

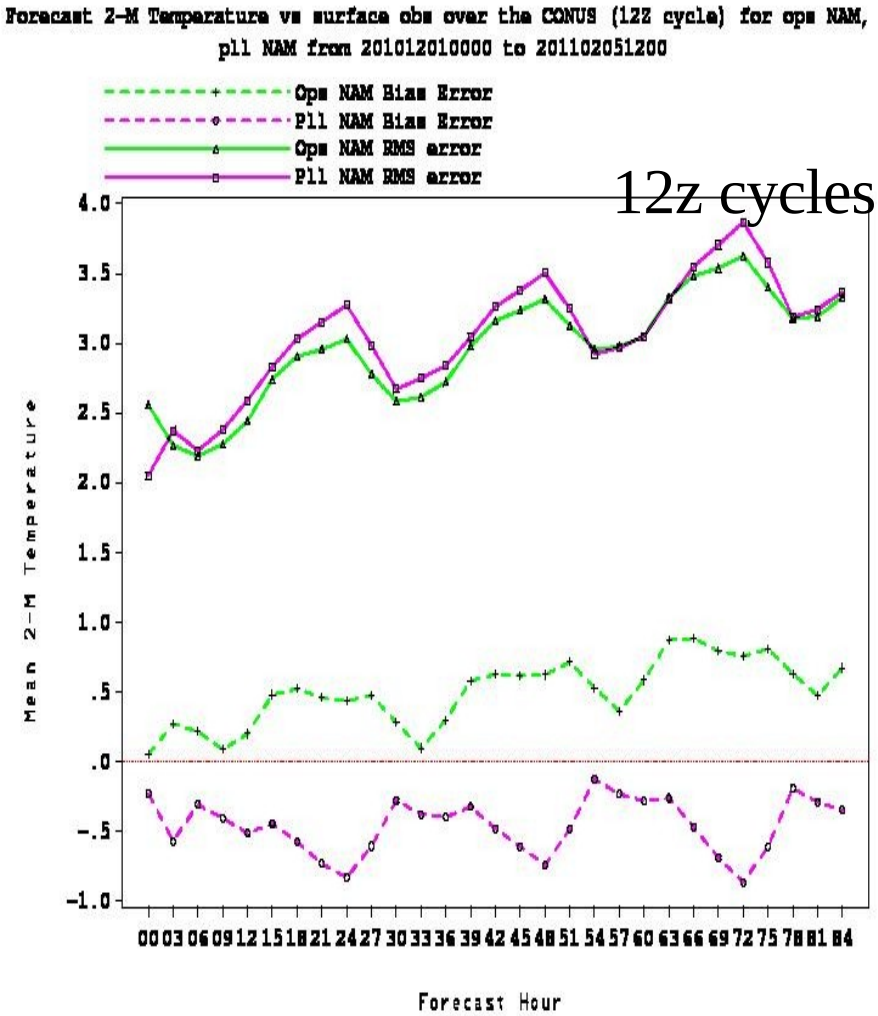
Seasonal 24-h QPF scores w/confidence level : Ops NAM (black) vs Pll NAMB (red), 24-84 h forecast



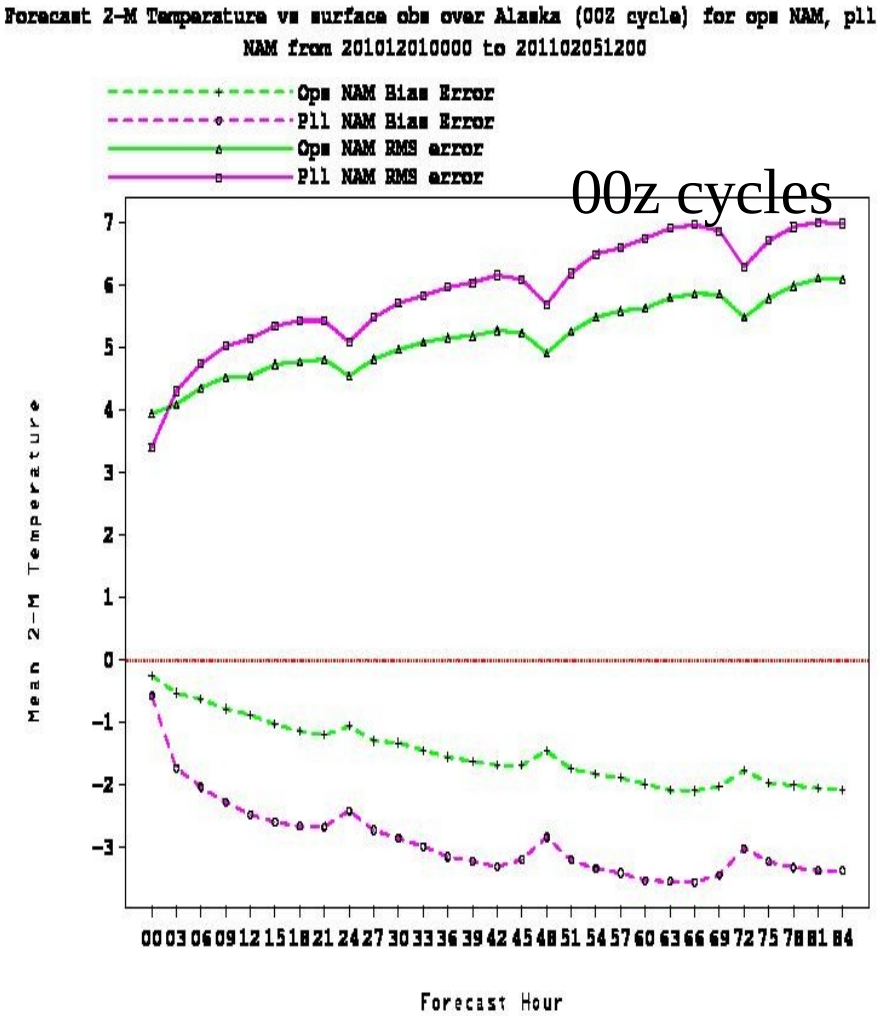
December 2010 – January 2011

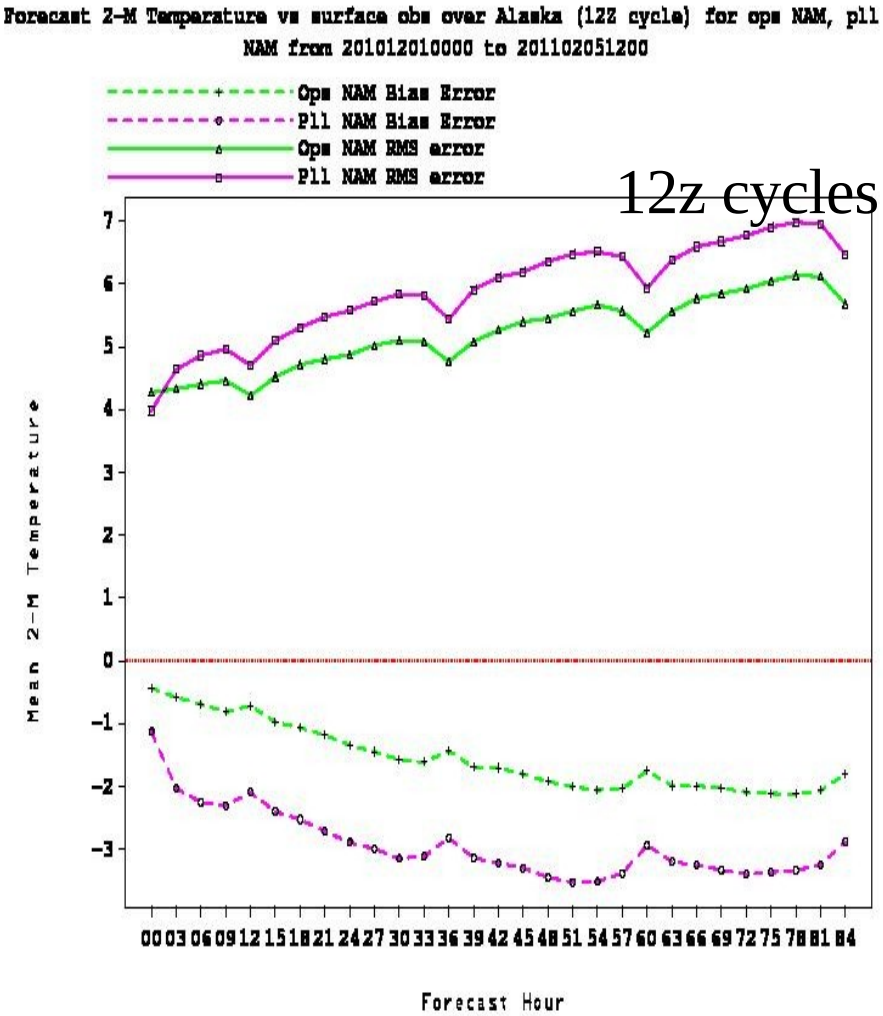
12/1/10 – 2/5/11 Cumulative Stats – 2-m Temp over CONUS





12/1/10 – 2/5/11 Cumulative Stats – 2-m Temp over Alaska





Albedo bug in NMMB

- Changed the NEMS code to read the base or snowfree albedo from the NEMSIO input file created by NPS at the start of each NDAS run. The code was previously only reading the dynamic albedo, using it as the base albedo. This led to erroneously high albedo over shallow/patchy snow cover. (Thx to George Gayno and Jun Wang)
- Put into NAMX parallel at 00z 2/6

4 km NMMB run

psfc change

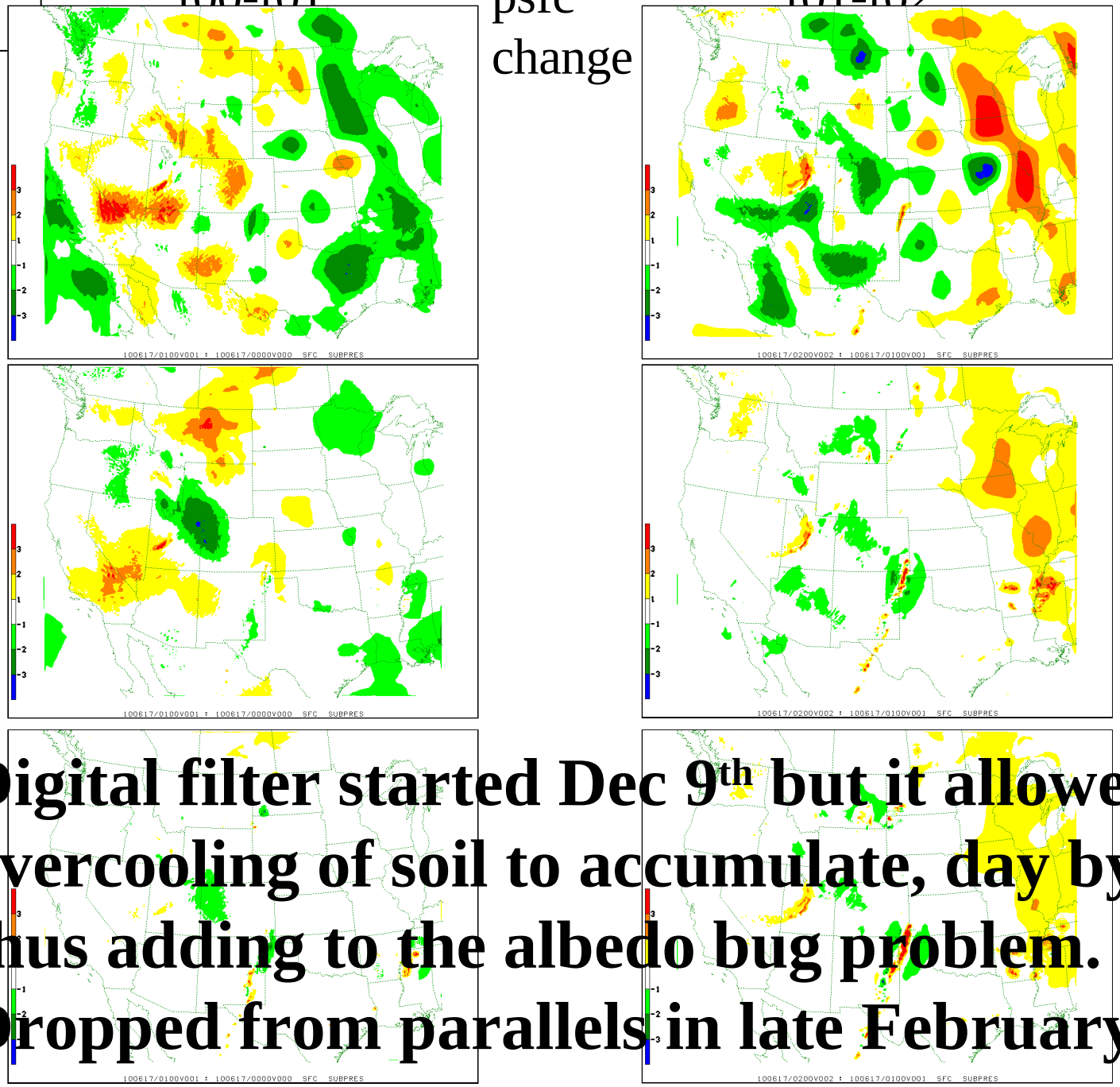
f00-f01

f01-f02

No digital filter

30 min filter

60 min filter



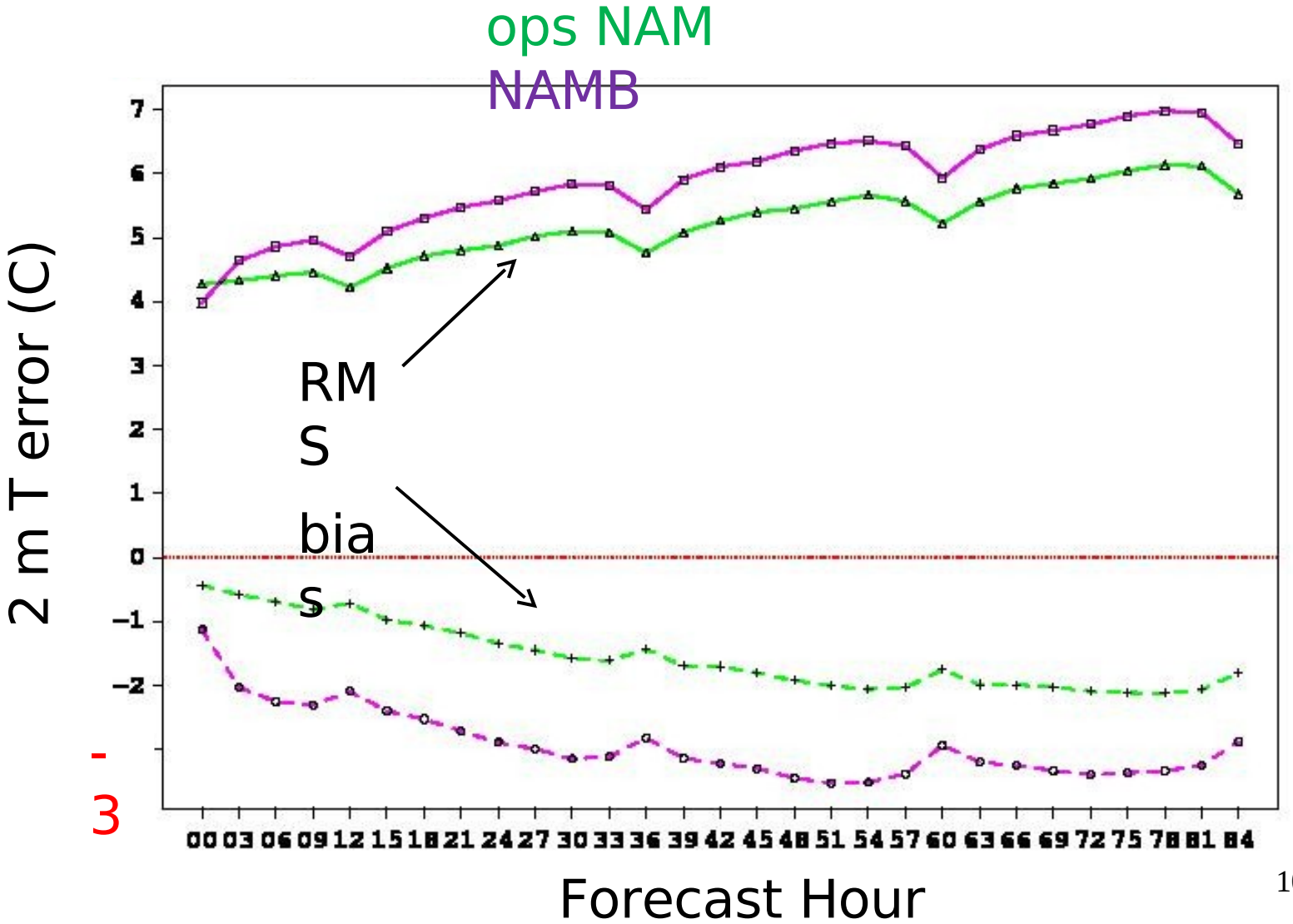
Digital filter started Dec 9th but it allowed for overcooling of soil to accumulate, day by day thus adding to the albedo bug problem. Dropped from parallels in late February.

Alaska issues in the NAM/NMMB implementation (courtesy Matt Pyle)

- Recent efforts made trying to understand a significant winter cold bias in 2 m temperature over Alaska:
  - Cold bias also exists over CONUS, but not nearly as extreme.
  - Two issues (albedo bug and overly cold cycled soil due to DFI) were corrected in late February, alleviating some of the problem.
  - However, radiation/land surface/surface layer issues remain, with no fix due in this bundle.
  - Best to continue common practice of bias correcting with Boise Verify.
- Other land-surface physics related work

2 m temp errors over AK, Dec 2010 - Feb 2011

12Z cycles only

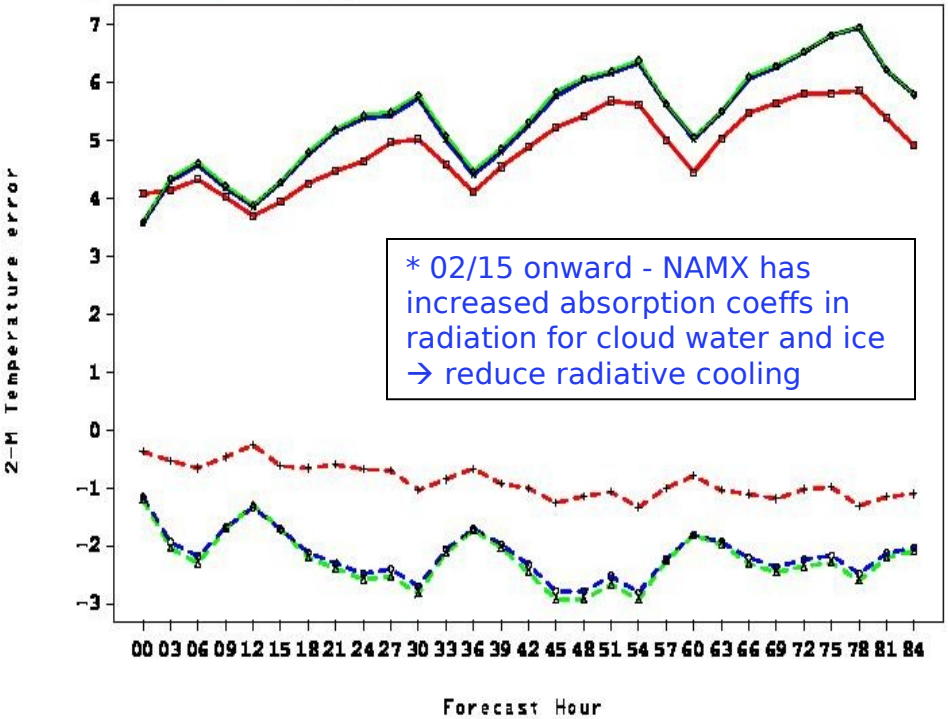


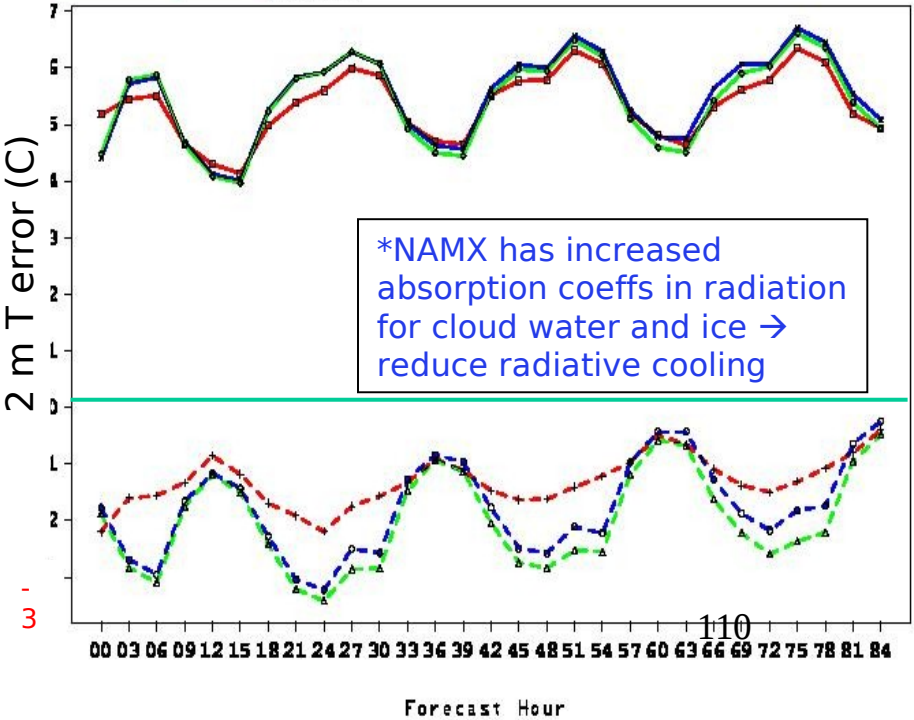
2 m T errors AK, Feb 12 to Feb 22 2011 (pre bug-fixes) and 2 m T errors AK, Feb 28 to Mar 10 2011 (post bug-fixes)

ops NAM **NAMB**

NAMX*

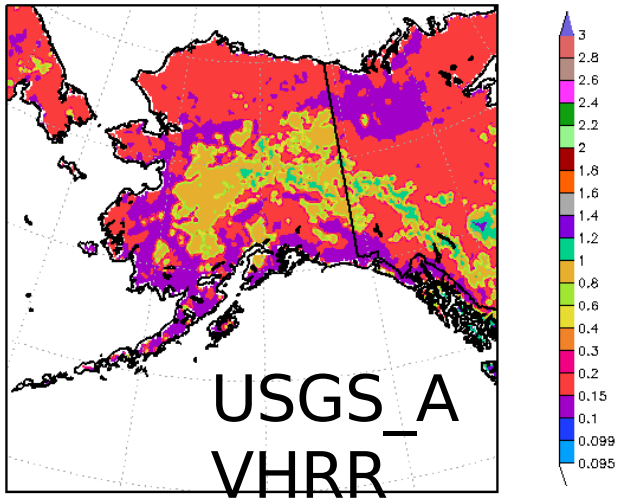
12Z cycles only

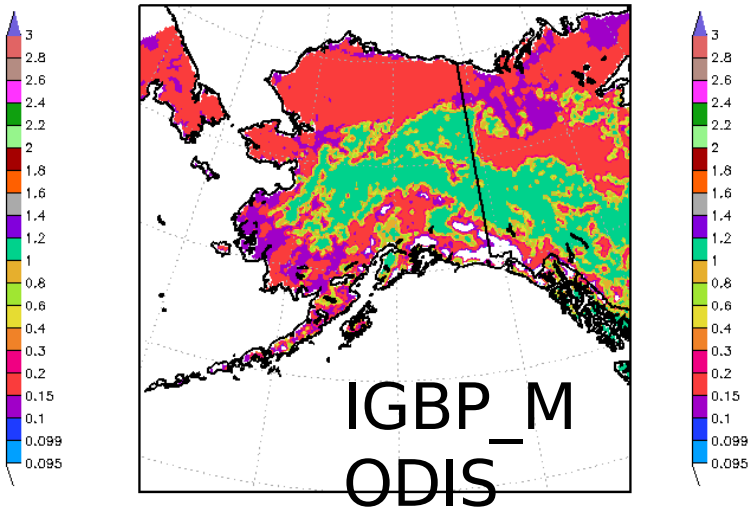




Transition to a new landuse classification:

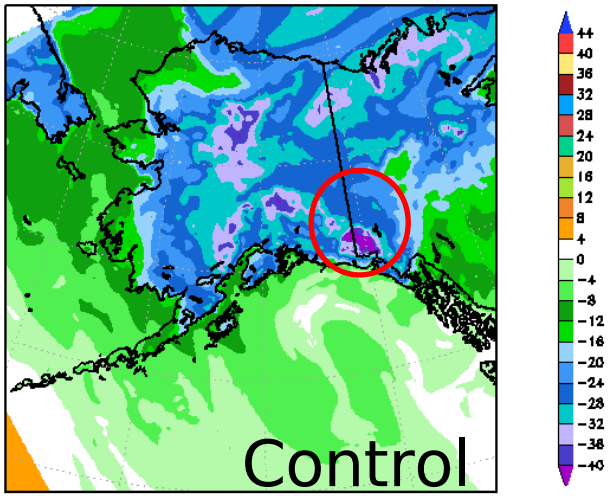
Roughness Length

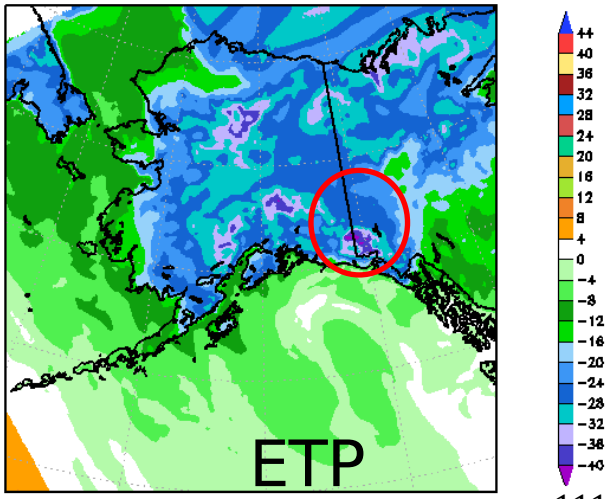




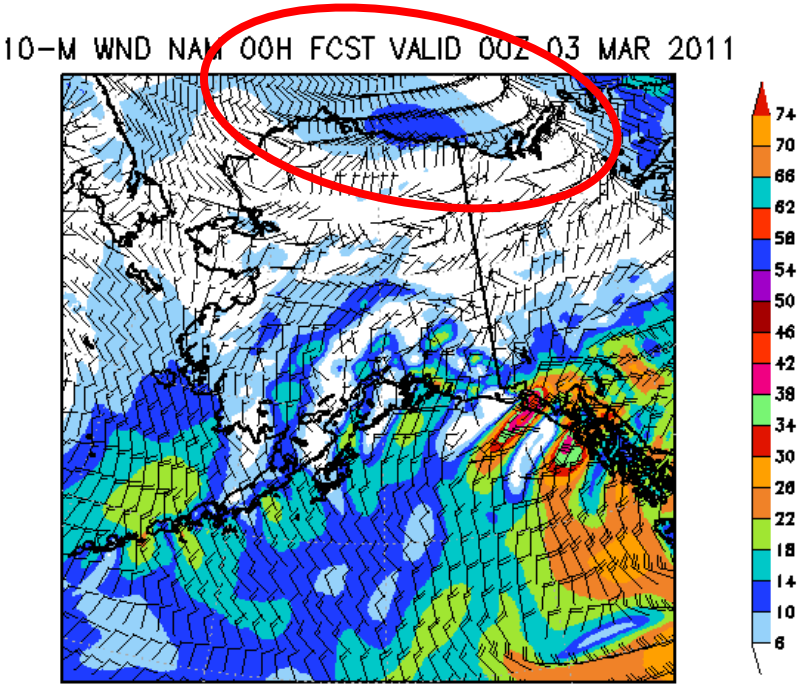
Limit dew/frost fall in stable flow to damp Td crashes (ETP change):

2 m Dew Point Temp

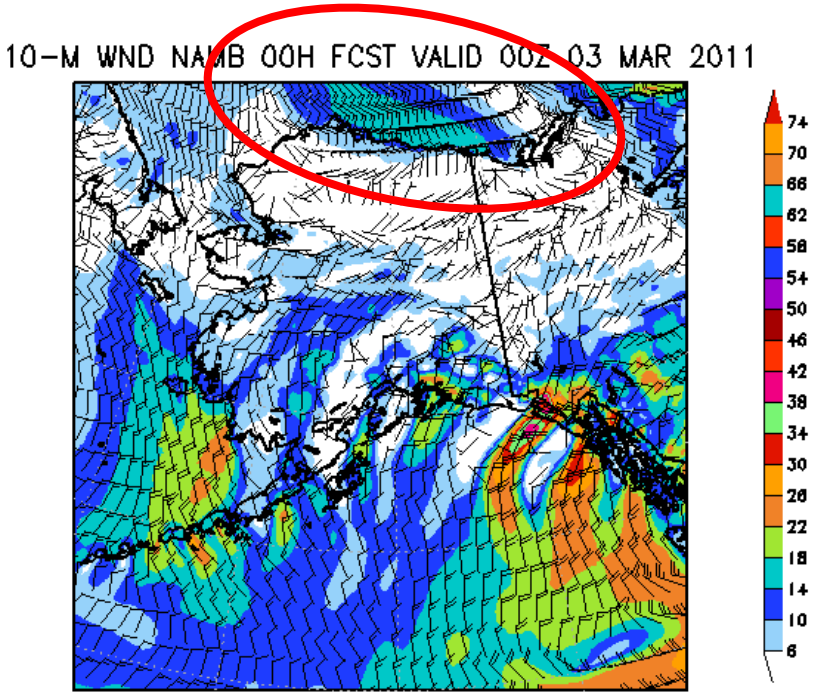




Impact of lower sea-ice roughness on 10 m wind speed

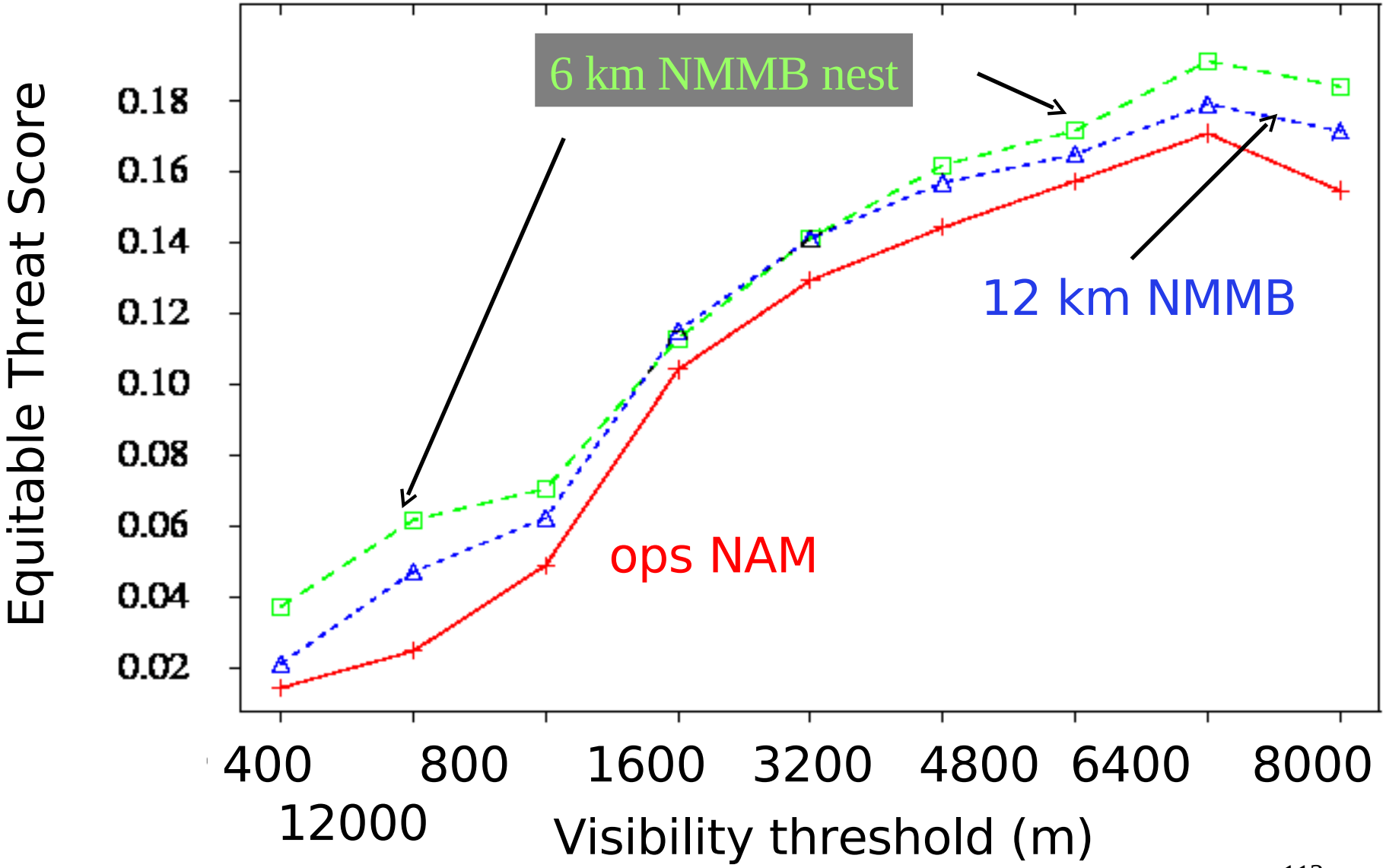


NAM (Z_0ice ~ 0.101 m)



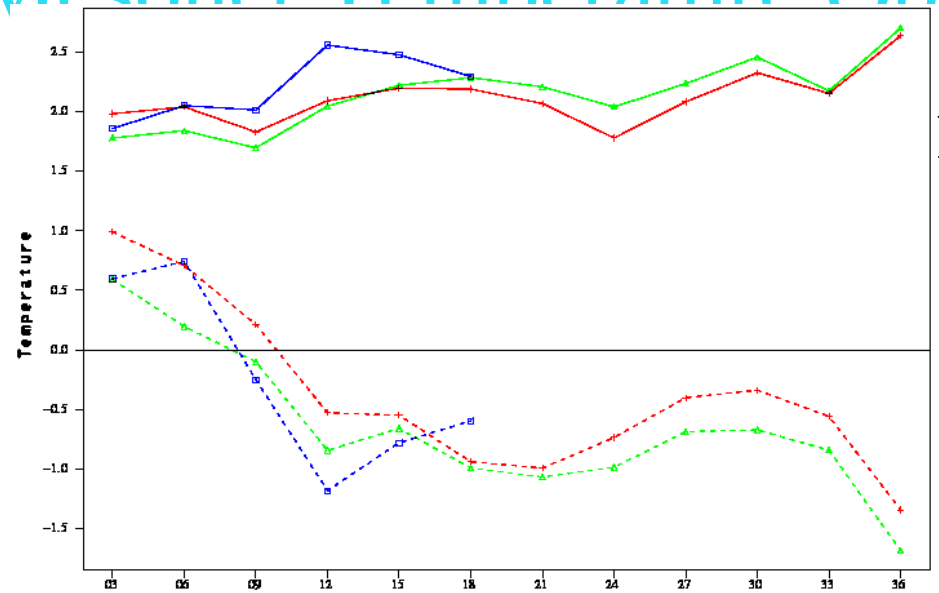
NAMB (Z_0ice ~ 0.001 m)

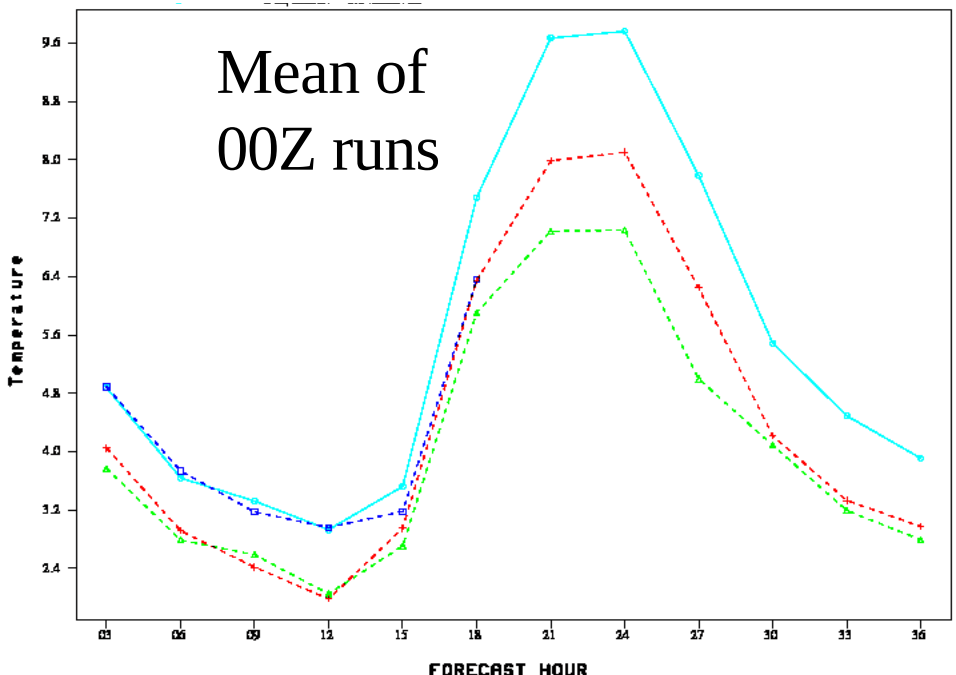
Visibility Verification over AK
1 Sep 2010 to 1 Jan 2011

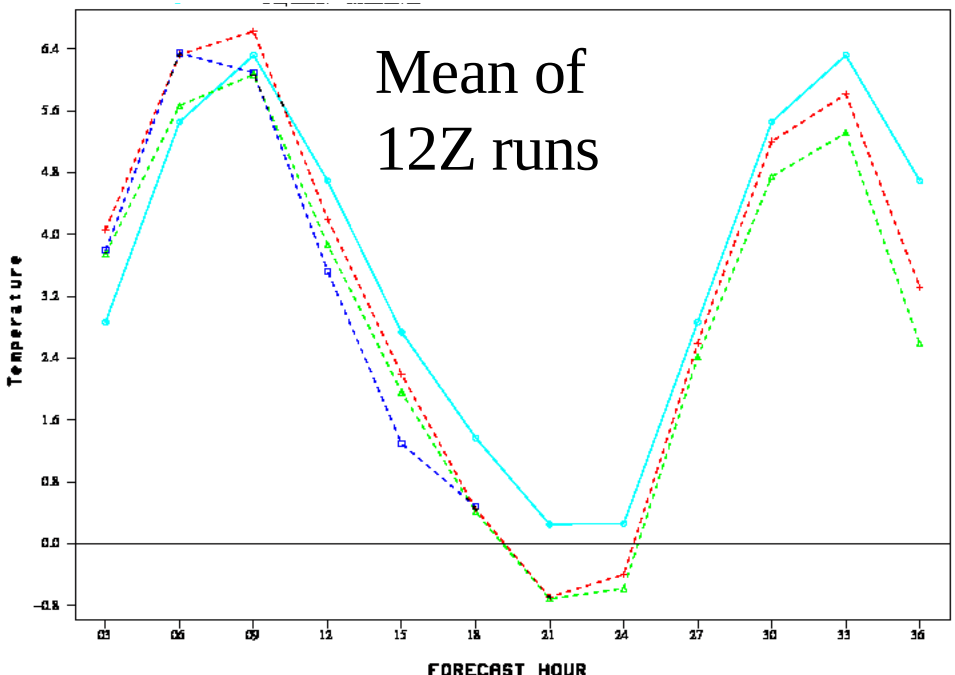


Slide courtesy Perry Shafran via Matt

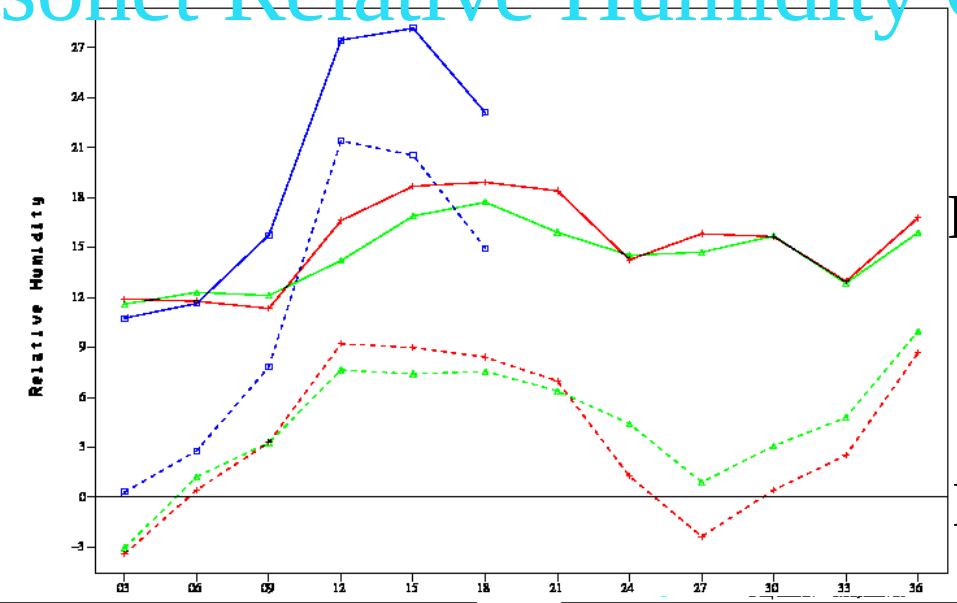
NAM, RUC & FWIS Run Verification vs Mesonet Temperature Obs

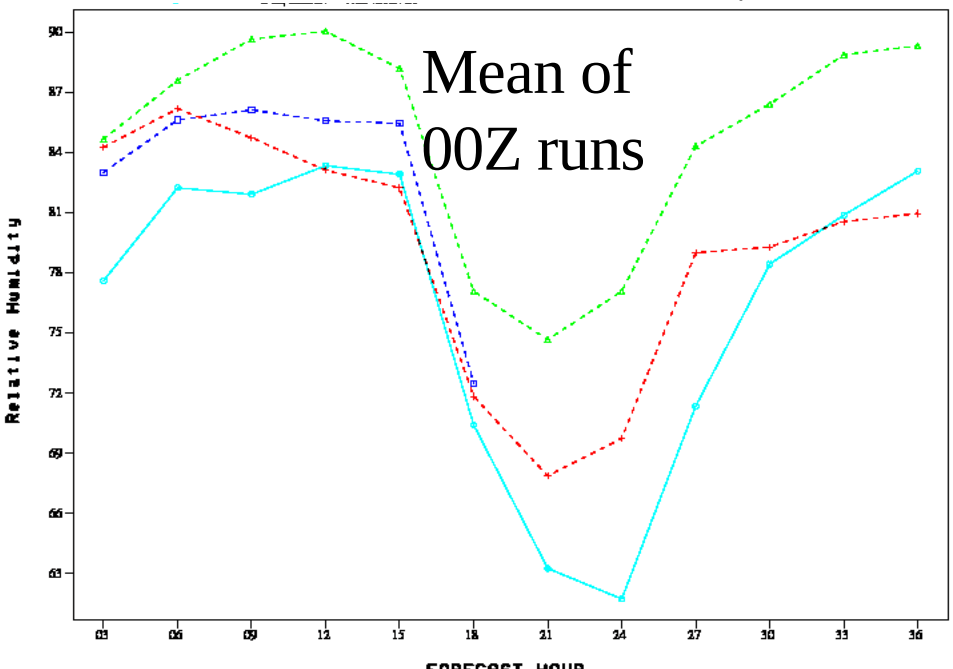


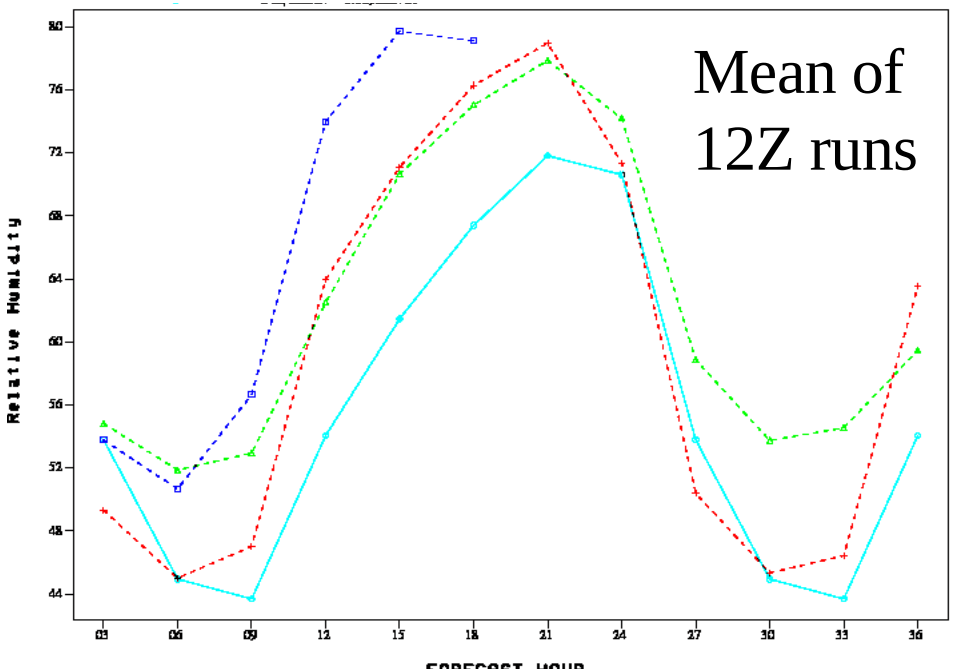




NAM, RUC & FWIS Run Verification vs Mesonet Relative Humidity Obs

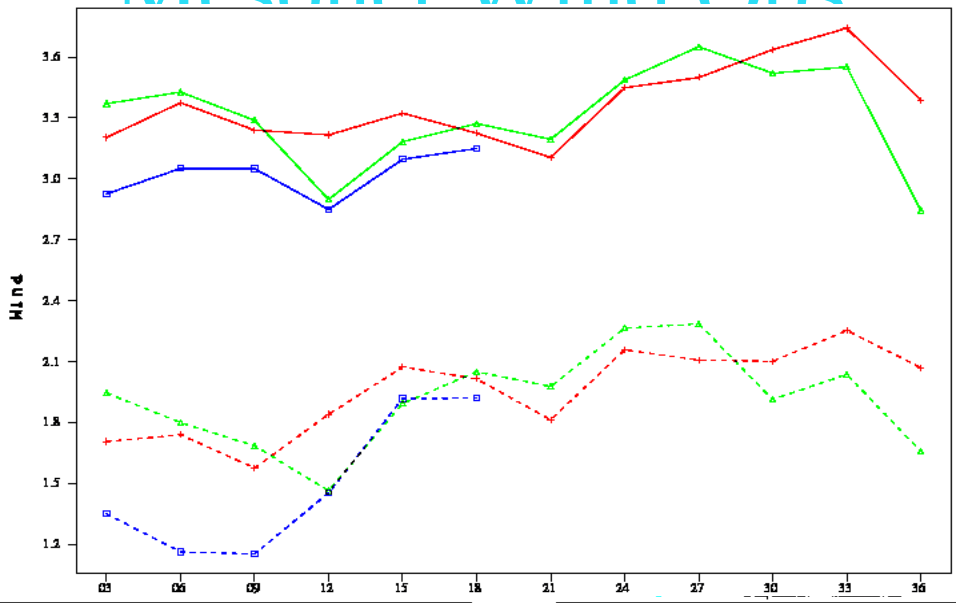


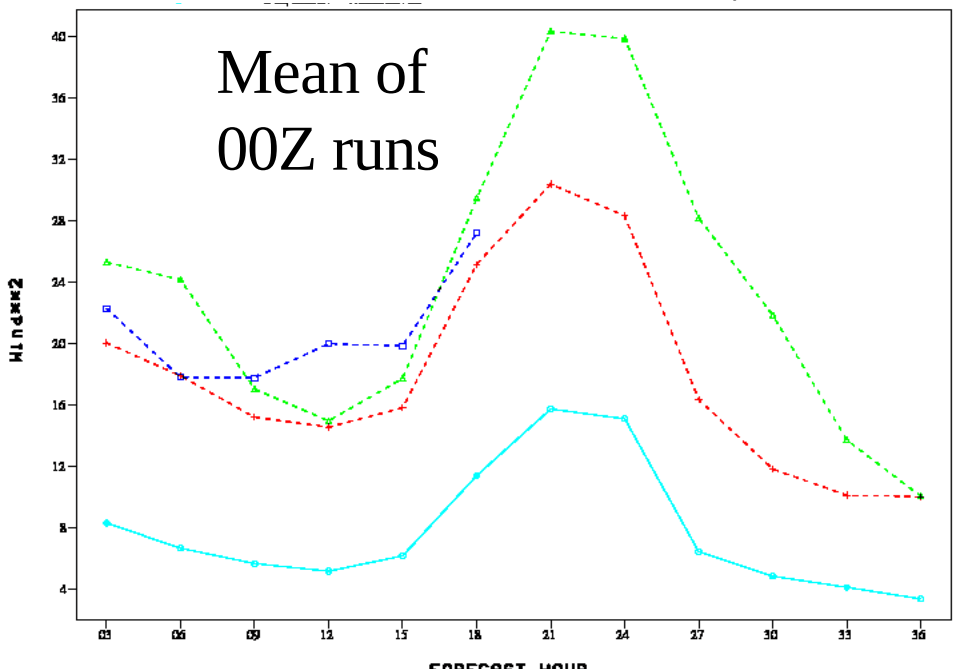


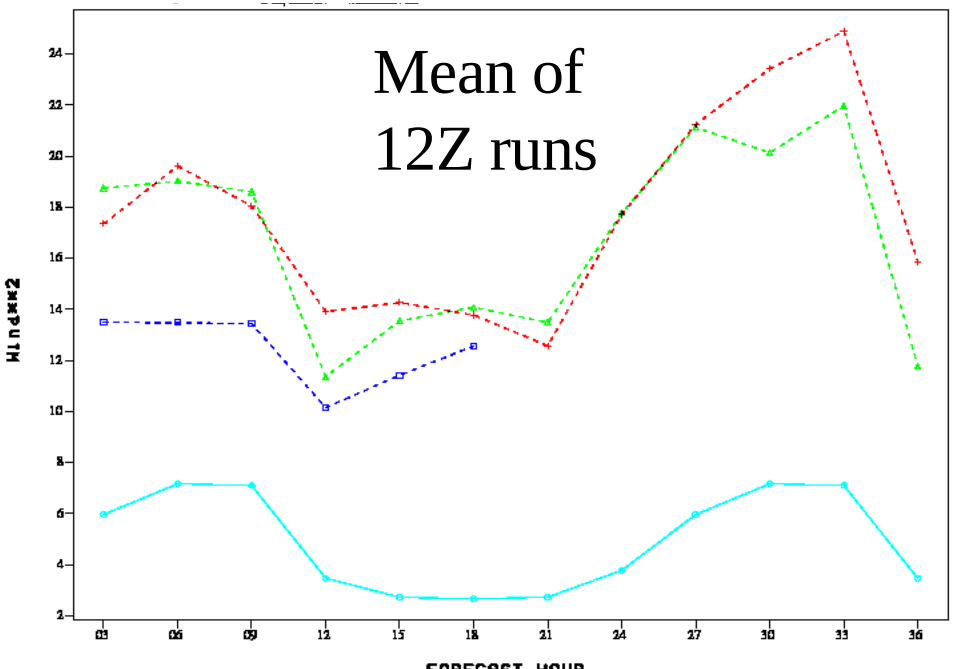


NAM, RUC & FWIS Run Verification vs Mesonet Wind Obs

NOTE: Mesonet winds tend to be biased too slow due to obstructed site location







NCEP's Unified Model Post-Processor

- Generates diagnostic quantities in model's computational domain, i.e. prior to any interpolation.
- Runs on most all atmospheric models: RUC/RR, NAM, HiResWindow, SREF (Eta, RSM & WRF), Hurricane-WRF, GFS, GEFS, and CFS
- Produces simulated radar reflectivity and satellite imagery

Post-Processing & Product Generation

- Fire weather parameters
  - Has max/min T 2m, RH 2m & 10m wind (models now provides it also part of product generation or downscaling/smartinit)
  - Now has Mixing Height (Ri based PBL height), transport wind (mean wind over PBL), Ventilation Rate and Haines Index.
  - CWR, thunder & lightning parameters come from smartinit.

Post Changes in NAM Bundle

Algorithms used to compute two existing NAM products will be changed.

1. The height and wind speed at the maximum wind level will be computed by assuming the wind speed varies quadratically in height in the neighborhood of the maximum wind level.

   The previous algorithm defines maximum wind level at the level with the maximum wind speed among all the model levels.

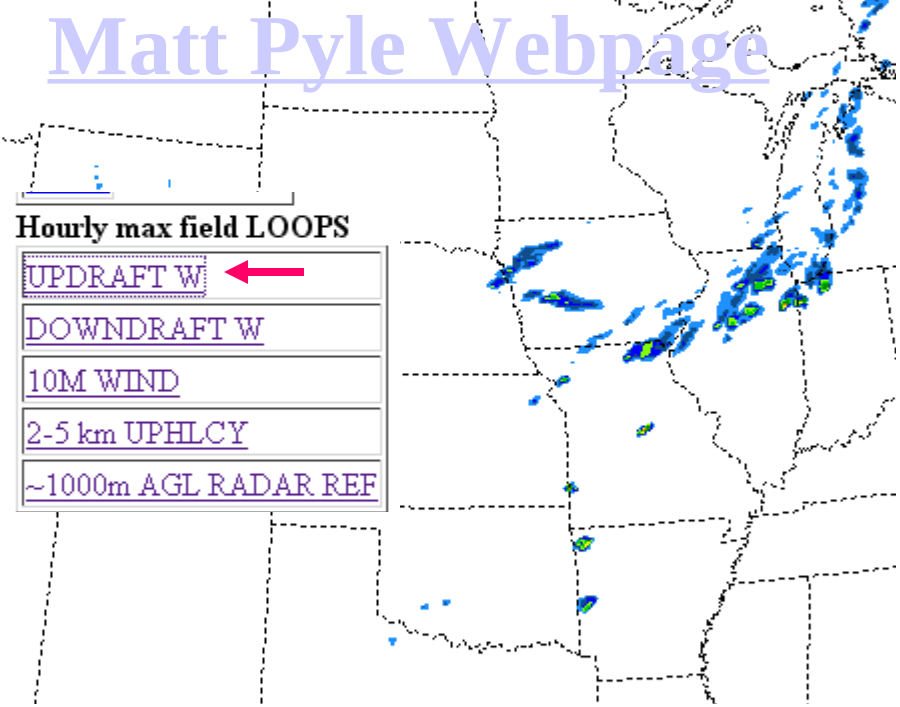
2. The static Tropopause level will be obtained by finding the lowest level that has a temperature lapse rate of less than 2 K/km over a 2km depth above it. If no such level is found below 50 mb, the Tropopause is set to 50 mb.

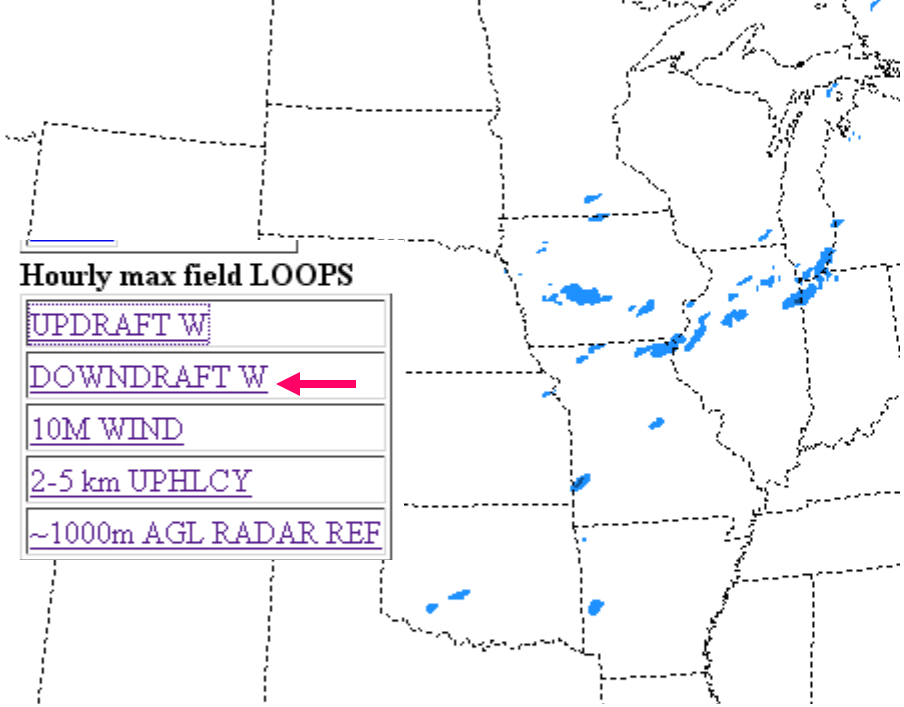
   The previous algorithm defines the Tropopause by finding the lowest level that has mean temperature lapse rate of 2 K/Km over three model layers.

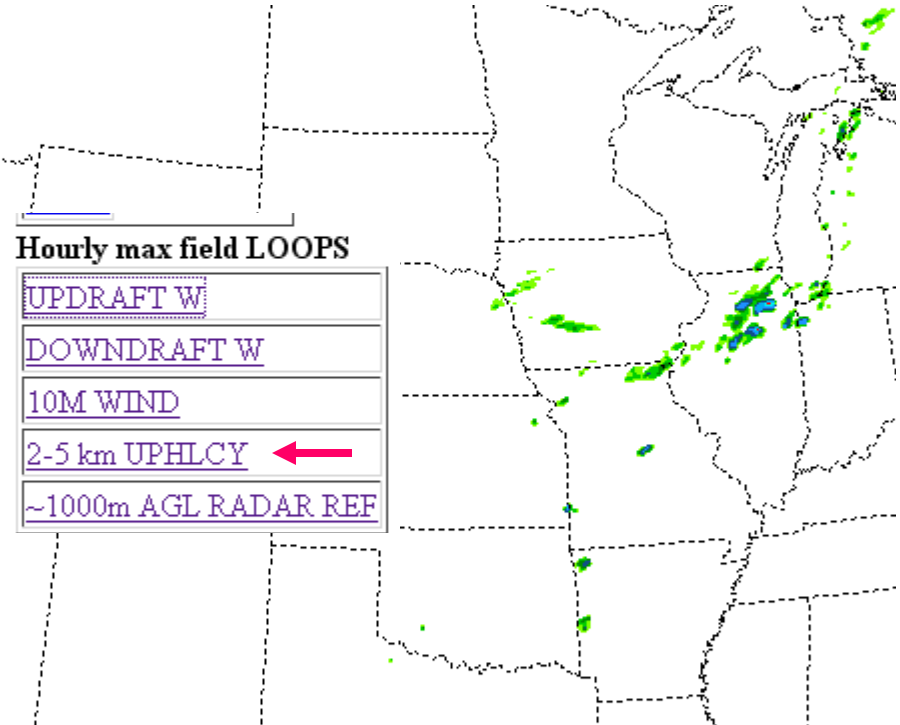
New Output Fields from NAM

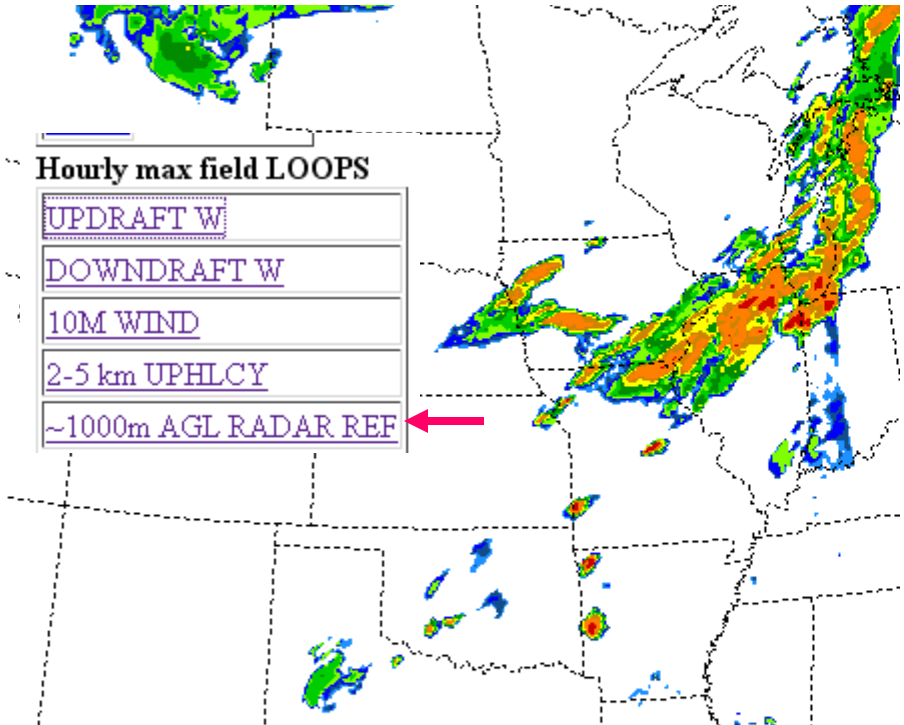
- Hourly maxima of:
  - 1000 m reflectivity
  - updraft velocity
  - downdraft velocity
  - updraft helicity
  - 10 m wind speed
  - 2 m temperature
  - 2 m RH
- Hourly minima of:
  - 2 m temperature
  - 2 m RH
- 80 m AGL U + V wind
- 80 m AGL temperature
- 80 m AGL spec humidity
- 80 m AGL pressure
- Radar echo top height (18 dBZ level)
- Richardson Number based PBL height
- Ventilation Rate
- Transport Wind
- Haines Index

Matt Pyle Webpage



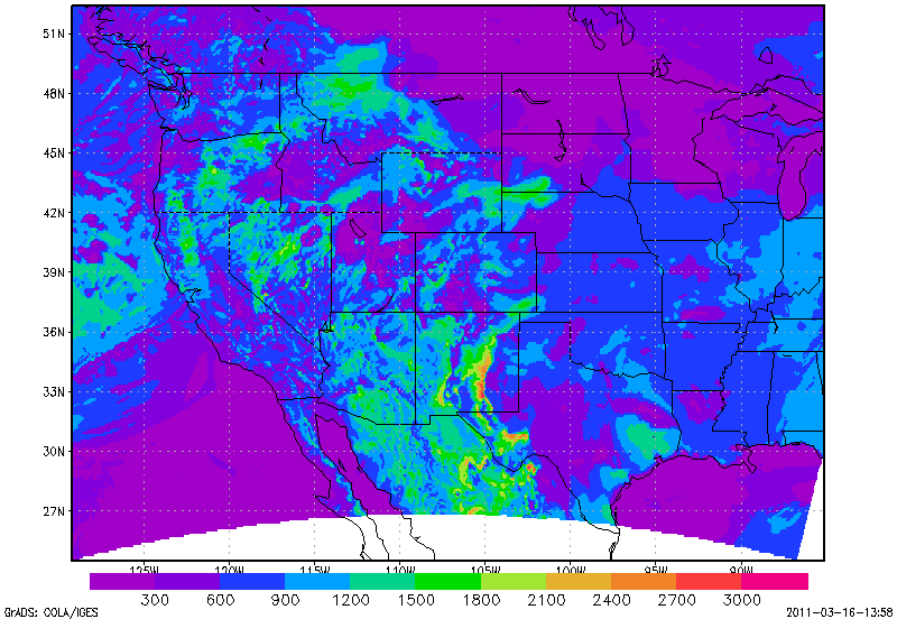




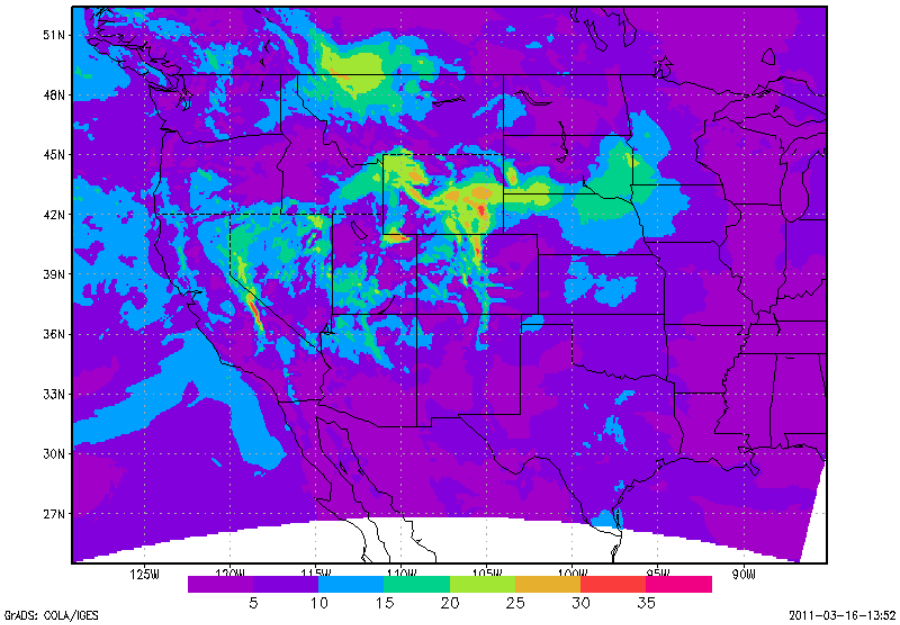


Sample Fire Wx Fields

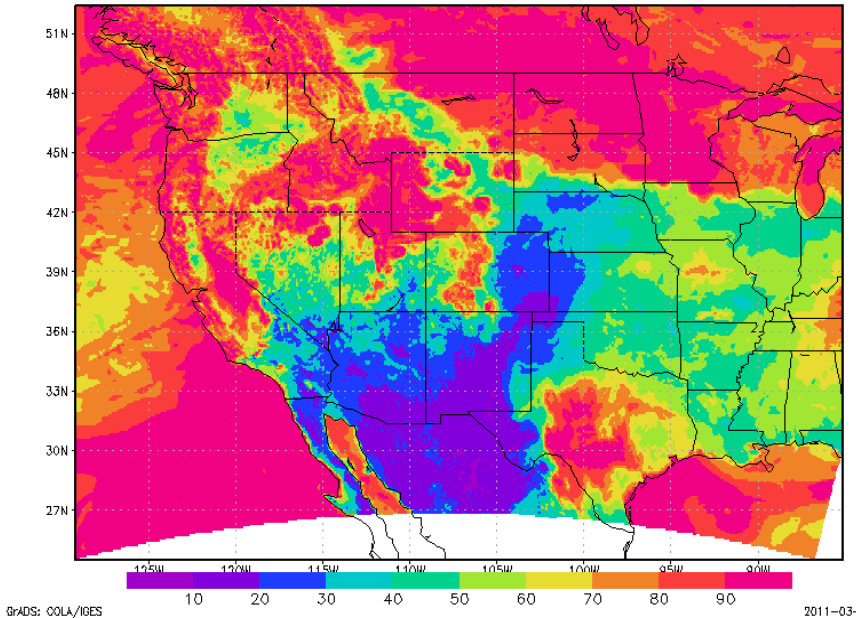
PBL H forecast from HIRES NMM run vt 2011031606F12



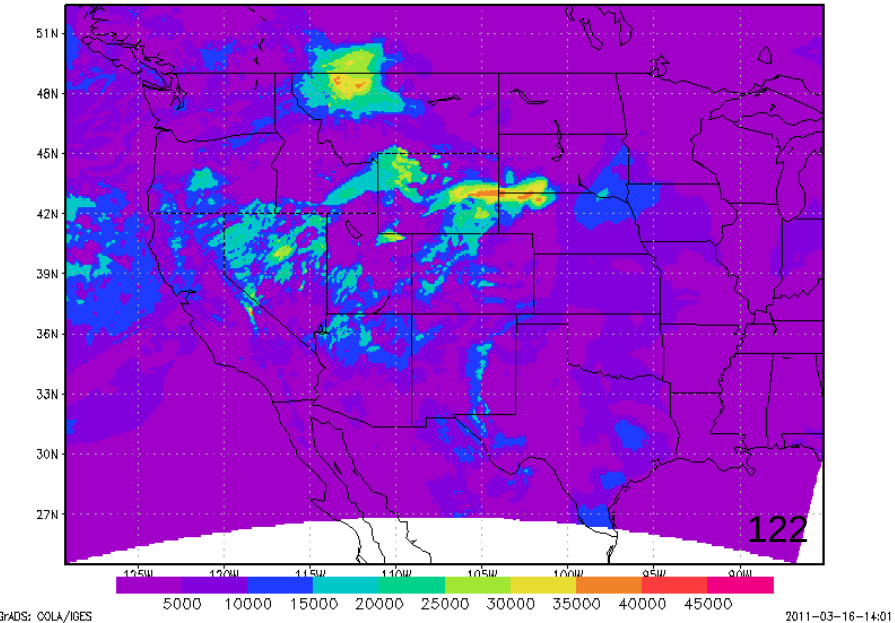
Transport wind speed forecast from HIRESNMM run vt 20110316



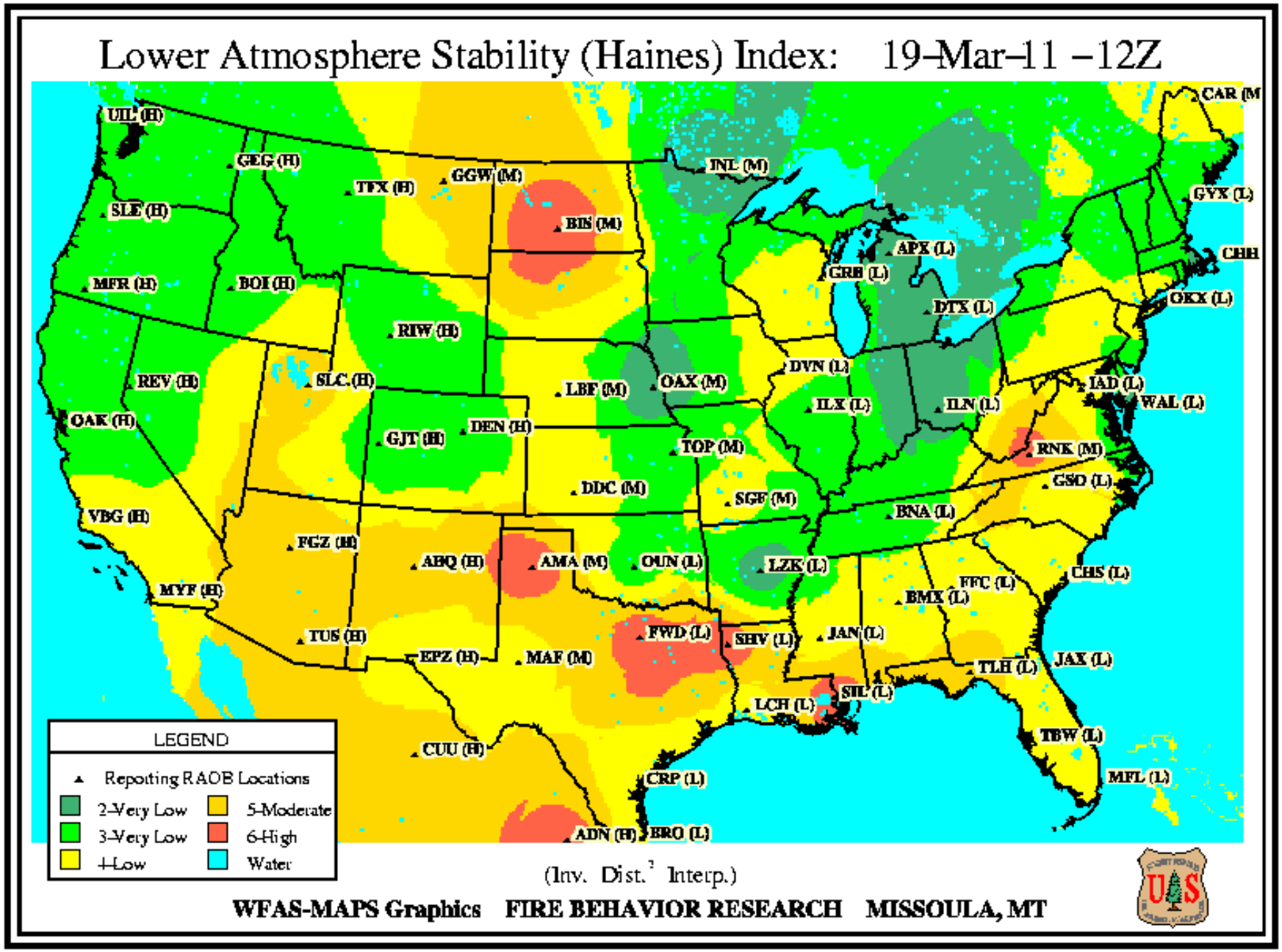
Min 2m RH orecast from HIRES NMM run vt 2011031606F12



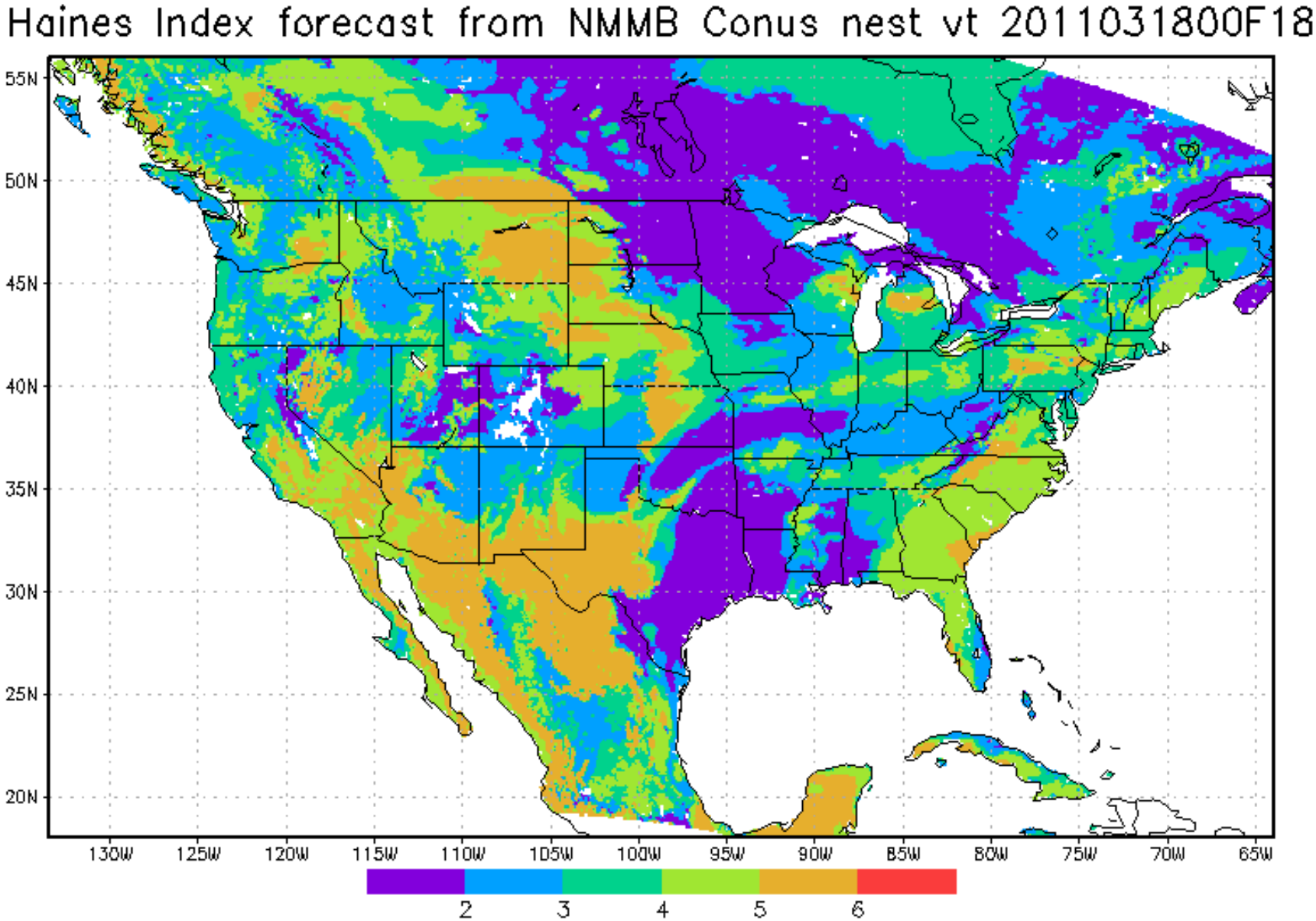
Ventilation rate forecast from HIRES NMM run vt 2011031606F12



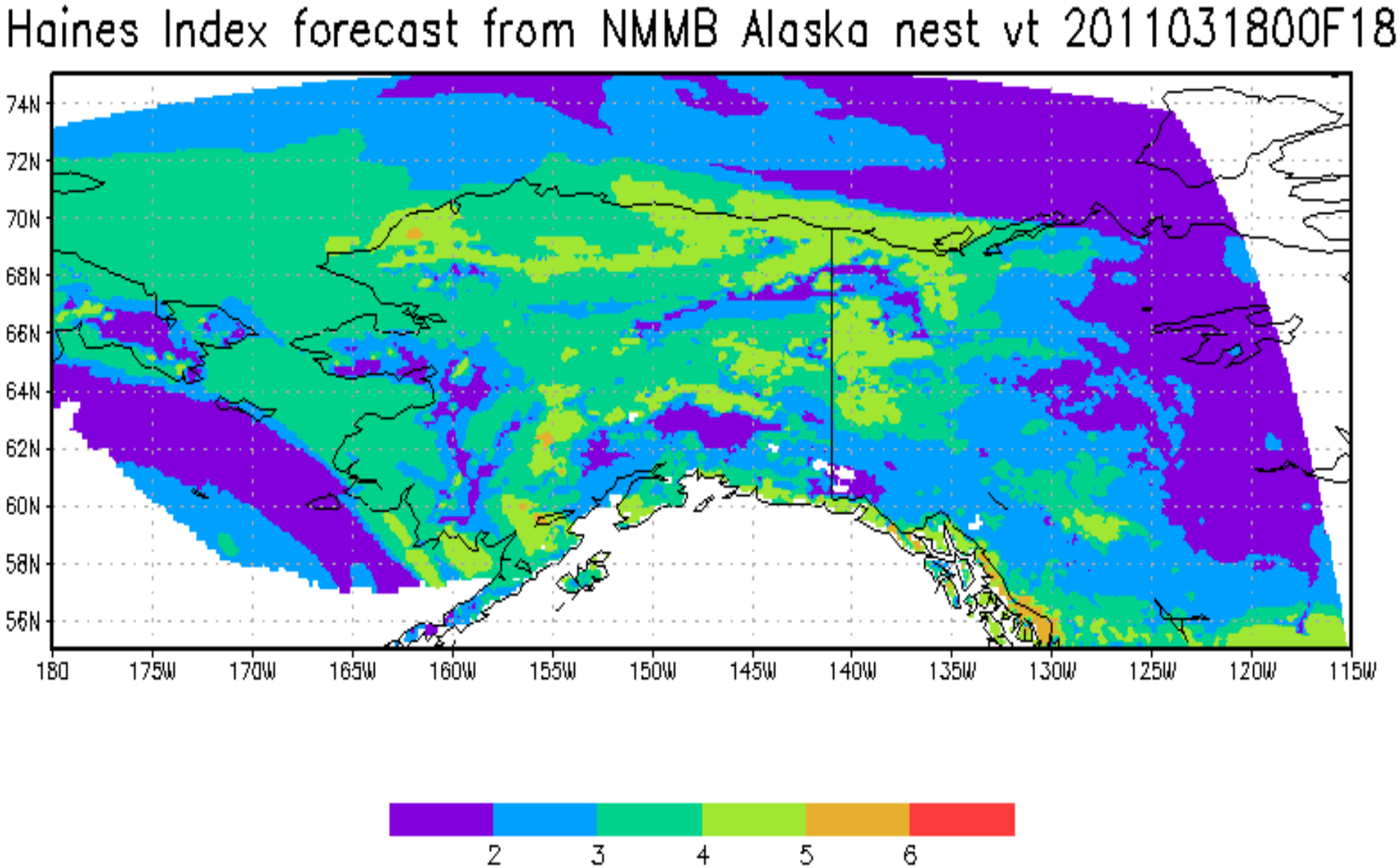
Haines Index Analysis from WFAS



Sample Haines Index 18 hr Forecast from parallel NAM's 4 km CONUS nest



Sample Haines Index 18 hr Forecast from parallel NAM's 6 km Alaska nest



Data Links 2011 NAM Upgrade

- Now on **NOMADS** & **ftp server** (but not SBN yet)

- Displays of grid domains and file inventories can be found at
http://www.emc.ncep.noaa.gov/mmb/namgrids/

- Displays of these runs can be seen at:
  http://mag.ncep.noaa.gov/NCOMAGWEB/app
  and
  http://www.emc.ncep.noaa.gov/mmb/mmbpll/n

NAM Logistics

- 12 km NAM parent output essentially unchanged
- Nests run through ‘smartinit’ and distributed in the form of NAM-DNG – also provided via NOMADS, ftp and possibly CONDUIT (LDM)
- FWIS grids provided through ftp and possibly CONDUIT (LDM)

AWIPS Precip GRIB Issue

- Geoff D. thinks it sounds like "only" a higher precision needs to be set for the GRIB output from the rain-bucket-subtractor code and asks would Becky be comfortable with fixing that with Geoff M’s help?
- Becky says: I’m willing to try my best to sweet-talk Chris if there's a model product change that needs to be made that isn't a big deal. If you had a header you needed to change, or something that's just a few changes in an isolated file or code. Your biggest problem is that I can't do the testing myself. But this one seems a bit more involved.
- If you want to try to do this now as a separate quick fix, instead of later with the NAM upgrade, I'm more than willing to ask nicely, but it's ultimately going to come down to Chris' comfort level. Sorry – I wish my answer were different.

Precip GRIB Issue – Eric - 1

- Thinks Geoff D. is trivializing it
- There are actually 8 codes:
  - drwxrwsr-x 2 nwprod prod 32768 Jul 31 2009 nam_makeprecip_150.fd
  - drwxrwsr-x 2 nwprod prod 32768 Dec 22 2008 nam_makeprecip_212.fd
  - drwxrwsr-x 2 nwprod prod 32768 Dec 22 2008 nam_makeprecip_215.fd
  - drwxrwsr-x 2 nwprod prod 32768 Dec 22 2008 nam_makeprecip_217.fd
  - drwxrwsr-x 2 nwprod prod 32768 Jul 31 2009 nam_makeprecip_218.fd
  - drwxrwsr-x 2 nwprod prod 32768 Dec 22 2008 nam_makeprecip_242.fd
  - drwxrwsr-x 2 nwprod prod 32768 Dec 22 2008 nam_makeprecip_251.fd
  - drwxrwxr-x 2 nwprod prod 32768 Dec 23 2008 nam_makeprecip_afwa.fd
- The original group is for grids 212-251. Geoff M. can correct me, but I think the only difference is the grid dimensions in the source code.
- I created the code for the AFWA grids, so that one source code makes the binaries for all 4 AFWA grids.
- I also added accumulated snowfall in the AFWA version.
- I encountered the same precision issues that plague the precipitation in the other codes, and in this version I did figure out a way around it by having 3 local copies of some w3 routines. I don't know how similar it is (if at all) to what Geoff M. has figured out.

Precip GRIB Issue – Eric - 2

- There are 2 other flies in the ointment.
- Fly #1, the nam_makeprecip_150.fd, set up by me, is for that old Caribbean grid we set up for Jim Miller of CPC eons ago, Lord knows if anyone ever looks at it. It not only does 3-h buckets for precip, but also accumulated evaporation and storm surface runoff (!). It also has the precision fix I put in the AFWA version.

- Fly #2 is another code called "nam_addprecip" whose sole purpose, as far as I can tell, is to make 6-h bucket records for the NAM 06z and 18z cycle (which has 3-h buckets) grids 104 and 221 output for the old FOUS code.

SPC Requested Retrospective Cases

SPC Request for 7 Retrospective NMM-B runs. These cases include a variety of severe weather regimes over different parts of the central and eastern CONUS during both warm and cool seasons. A 00z initialization time for each case date will provide useful comparisons with the operational NAM-WRF guidance for the initial SPC Day 1 Convective Outlook. In addition, the dates denoted by an asterisk (*) will also be used to examine comparative guidance for the initial Day 2 Convective Outlook period (36-60 hr forecast times). Initial time for all dates is 00z.

July 17, 2010: Tornadoes and significant hail and wind events over the upper Midwest, and separate clusters of severe storms over the northeast and Mid-Atlantic states.

*July 26, 2010: Severe storms over the northern plains including a killer tornado in northeast Montana, and a separate severe storm swath over the Tennessee Valley into South Carolina. (This run can also provide guidance for the July 27, Day 2 Convective Outlook.)

*August 12, 2010: Clusters of severe storms over the Dakotas and Minnesota, with separate track of severe storms from the Delmarva southward across the Tidewater. (This run can also provide guidance for the August 13, Day 2 Convective Outlook.)

September 16, 2010: Small clusters of severe storms over Appalachians and near New York City, including rare killer tornadoes in West Virginia and New York City.

*October 25, 2010: Start of “Superstorm” over northern/eastern states during the late night hours of October 25, or end of the Day 1 Outlook period. (This run can continue into the next day and provide guidance for the October 26, Day 2 Convective Outlook period.)

November 16, 2010: Severe storms over Appalachians that continued northeastward during the night including the after-midnight tornado in Baltimore.

*November 29, 2010: Severe storms over the south including significant tornadoes in Louisiana and Mississippi. (On the next day severe storms occurred over the east coast, so the 00z 29 November run can be used to cover the Day 2 Outlook for the next day.)

Product Delivery Delays

- We anticipate output delivery times for current NAM products will differ slightly throughout the run. These are contained in Louis' Memo to NWS/HQ and in the TIN.
- The precise amounts still need to come out of the final pre-implementation testing by NCEP Central Operations, but here is the worst case scenario.
- When the Fire Weather nest is run over CONUS during the first 36 hr of the forecast, product delivery will lag the current delivery by ~13 seconds each forecast hour such that 36 hr guidance will be 468 seconds or 7.8 minutes later than at present.
- Following the 36 hour point of the forecast when the Fire Weather nest stops, we will recover delivery time at roughly 10 seconds each forecast hour such that delivery of the 84 hr guidance will be at the same time as it is delivered today which is 10 minutes earlier than its target.
- As an example, for a 0000UTC run, the following delivery time differences would be expected (with current time in parentheses):
  - 12hr PRODUCTS at 01:52:52 (01:50:16)
  - 24hr PRODUCTS at 02:05:26 (02:00:14)
  - 36hr PRODUCTS at 02:17:49 (02:10:01)
  - 48hr PRODUCTS at 02:25:47 (02:19:59)
  - 60hr PRODUCTS at 02:34:04 (02:30:16)
  - 72hr PRODUCTS at 02:40:23 (02:38:35)
  - 84hr PRODUCTS at 02:50:23 (02:50:35).
- The target delivery for 84 hr guidance is 3:00:00.

NAM NEMS Upgrade

Project Status as of 01/7/11

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Project Information and Highlights

Lead: Geoff DiMego, EMC and Chris Magee, NCO

Scope:

1. Replace WRF-NMM with NEMS-NMMB
2. Add four concurrent/inline one-way interactive nests: 4 km CONUS, 6 km Alaska nest, 3 km Hawaii and 3 Puerto Rico
1. Mostly explicit convection with slight amount of convective parameterization active within the nests
2. Reinstate Fire Weather/IMETSupport (FWIS) run either in CONUS at 1.33 km or in Alaska domain at 1.5 km

Expected Benefits:

1. Eliminates need for smartinit and NAM DNG, i.e. WFOs can initialize their GFE directly from the nested output
2. Provides all the benefits of the HiResWindow guidance
   1. Delivered 3 hours earlier
   2. To every region every cycle
   3. Without threat of preemption by the hurricane runs
3. Conforms to OCWWS request to reinstate FWIS to 36 hr
4. Adds tactical fire weather guidance products to 84 hr

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Scheduling

Milestone (NCEP)	Date	Status
EMC testing complete/ EMC CCB approval	2/29/2011	EMC is testing 2-per-day with 4 fixed and 1 floatable fire weather nests
Initial Code Delivery to NCO	3/2/2011	
Technical Information Notice Issued	2/29/2011	
Initial Test Complete	3/30/2011	
CCB approve parallel data feed	4/2/2011	
IT testing begins	4/2/2011	
IT testing ends	4/18/2011	
Parallel testing begun in NCO	4/6/2011	
Real-Time Evaluation Ends	5/11/2011	
Management Briefing	5/18/2011	
Implementation	5/25/2011	

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Issues/Risks

Issues: EMC continues to request Q3 but realizes NCO must deal with resource availability. Will use NAM's maximum allotted resource for the life of the current CCS [85 nodes for 80 minutes 4 times per day]

Risks:

Mitigation:

G

Finances

Associated Costs:

Funding Sources: EMC Base: Dev & T2O 48 Man-months. NCO Base: 3 man-months for implementation, 1 man-month annually for maintenance

R Management Attention Required	Y Potential Management Attention Needed	G On Target

v1.0 09/14//07

Initial Analysis of Product Volume

NAM FY2011 upgrade

Disk Usage	Current Production	Expected New Production	Actual New Production
IBM CCS Disk	1324 GB/day	3000 GB/day	TBD
IBM CCS Tape Storage	699 GB/day	2200 GB/day	TBD
NCEP FTP Server	95 GB/day	225 GB/day	TBD
NWS FTP Server	17 GB/day	25 GB/day	TBD

Analysis of Product Availability

NAM FY 2011 upgrade

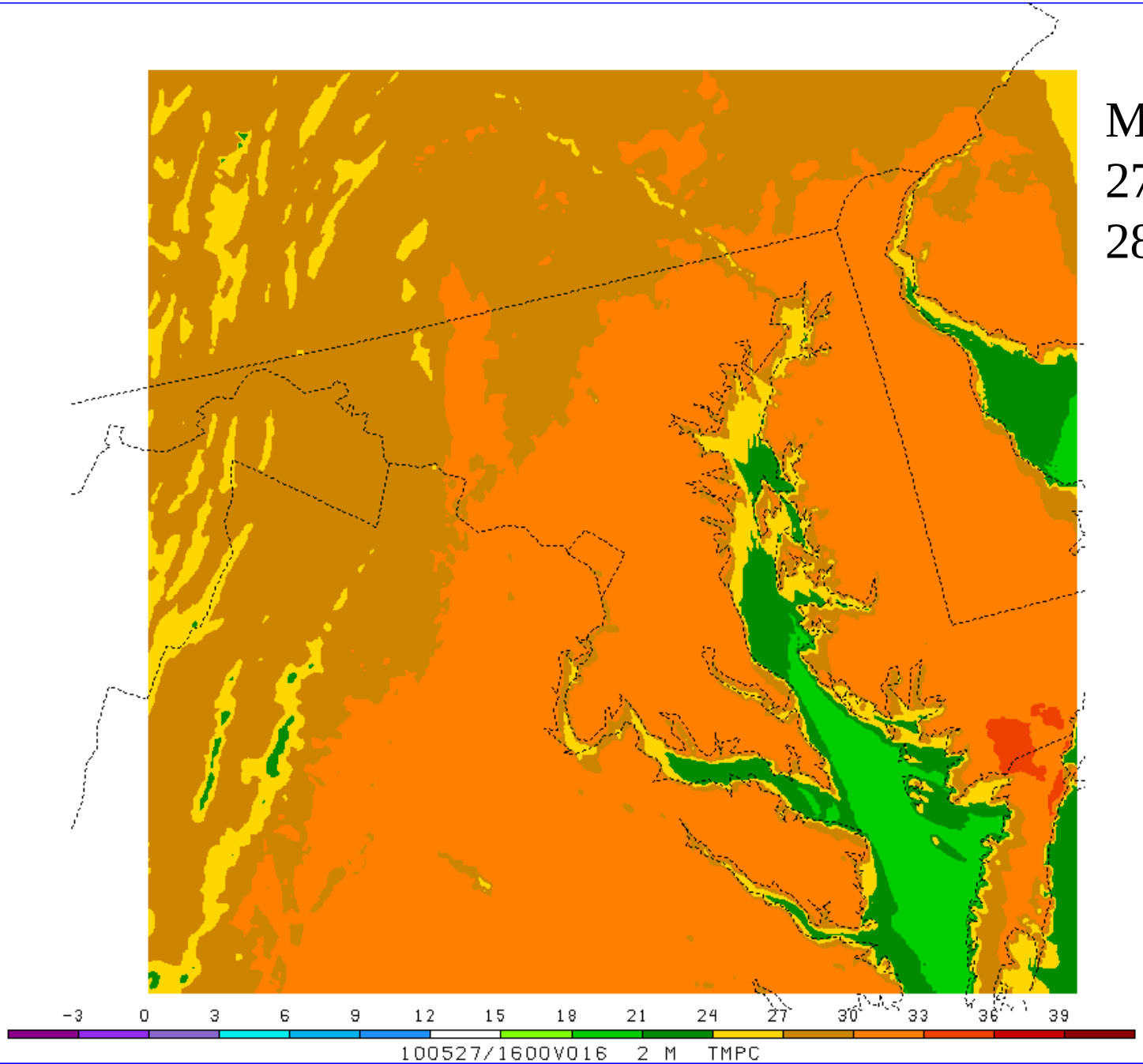
	Current Production	Proposed Production
NAWIPS (CENTERS)	YES	YES
NCEP FTP Server	YES	YES
NWS FTP Server	YES	YES
AWIPS/ NOAAPORT	YES	YES
CONDUIT	YES	YES

Analysis of Production Resources

NAM FY2011 upgrade

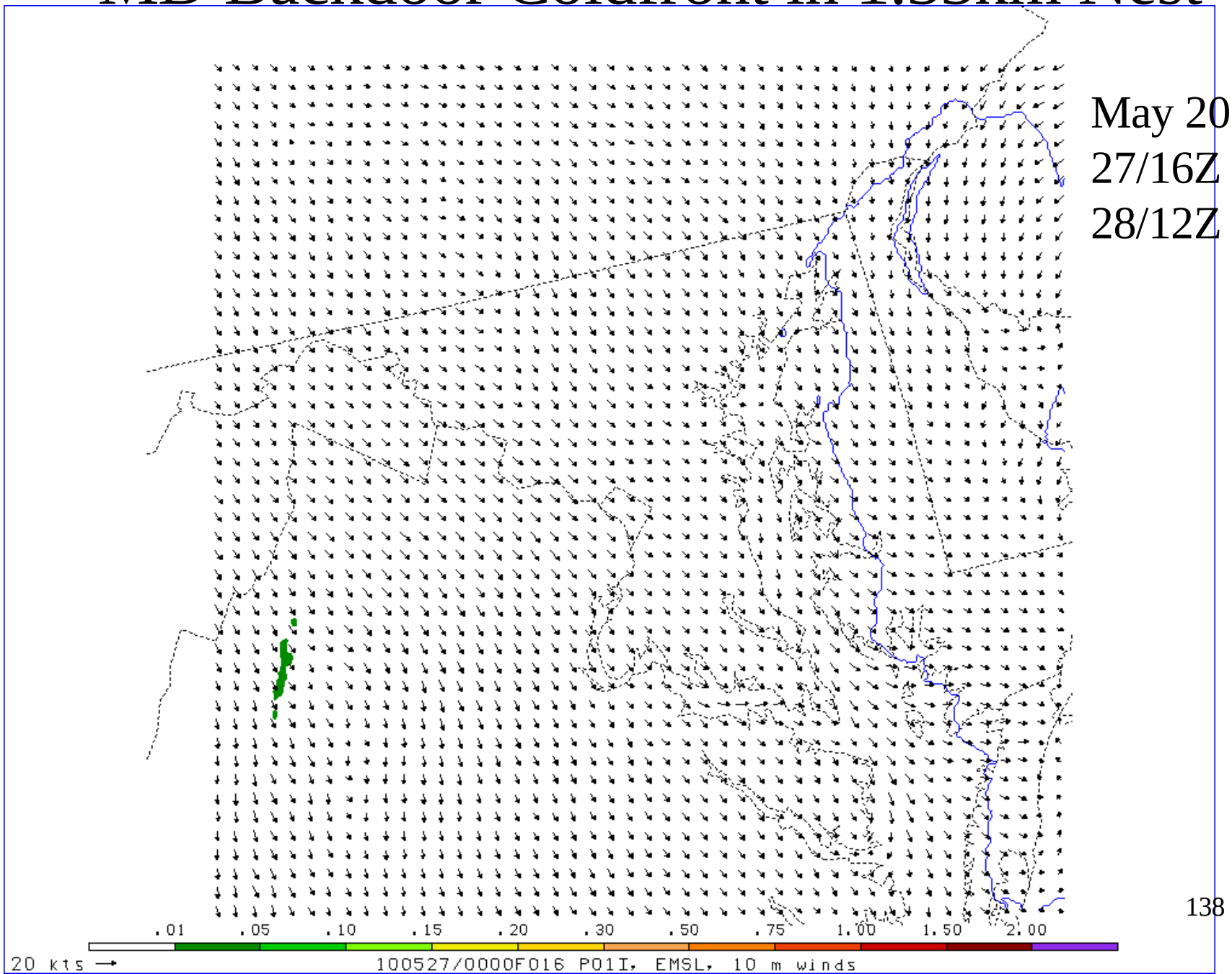
Job Step	Current Production		Expected Production		Actual Production	
	Nodes/ Tot Tasks	Runtime (min)	Nodes/ Tot Tasks	Runtime (min)	Nodes/Tot Tasks	Runtime (min)
Prep + lateral boundary condition generation	1/12	1.25	1/32	LBC longer but can start sooner	TBD	TBD
analysis	2/20	7	16/512	7	TBD	TBD
forecast	8/360	70	85/4936	70	TBD	TBD
post (usage is per forecast hr, runtime is for 0-84 h)	1/12	70	1/12 (parent) 1/24 (conus) 1/12 (others)	70	TBD	TBD

MD Backdoor Coldfront in 1.33km Nest

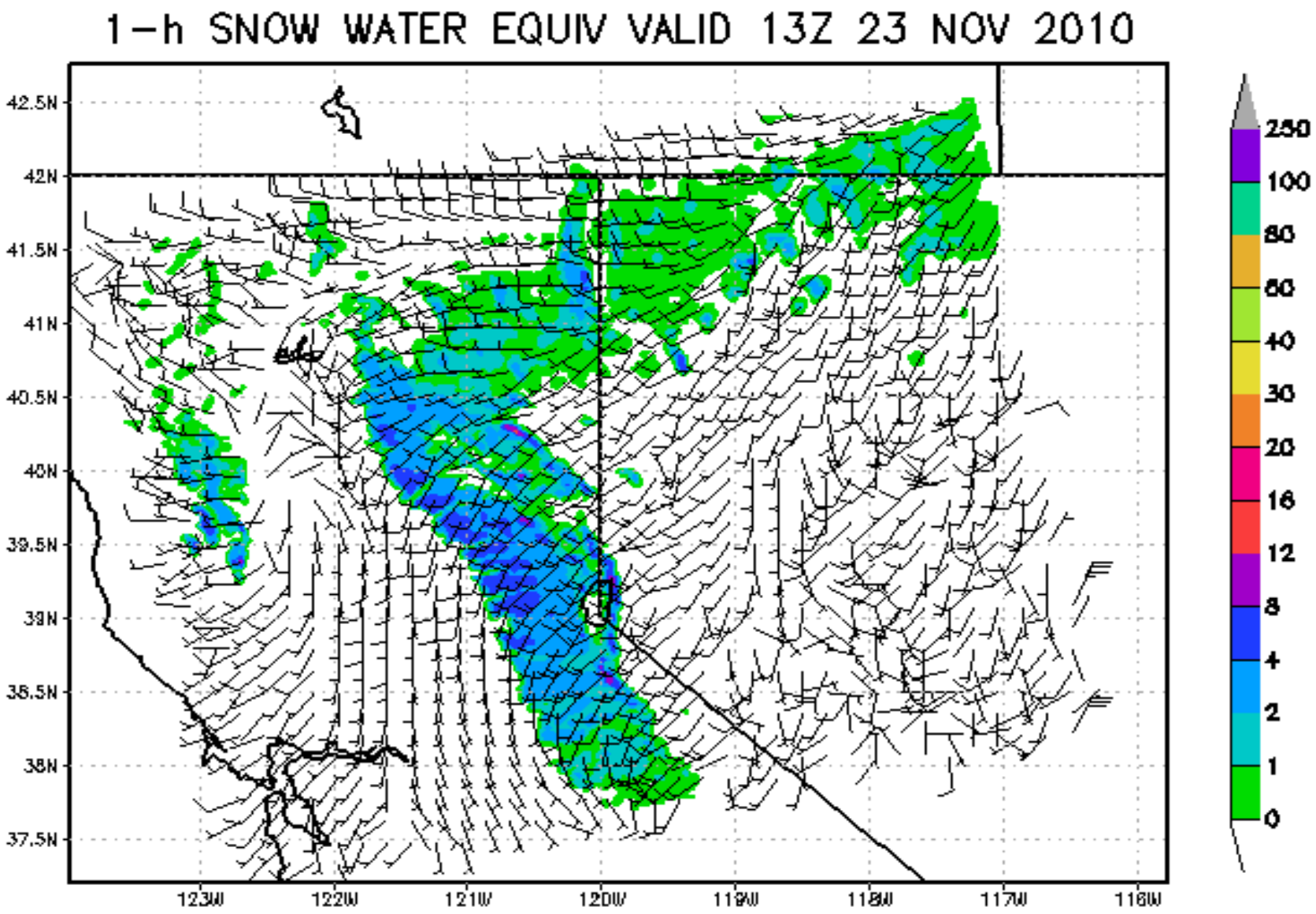


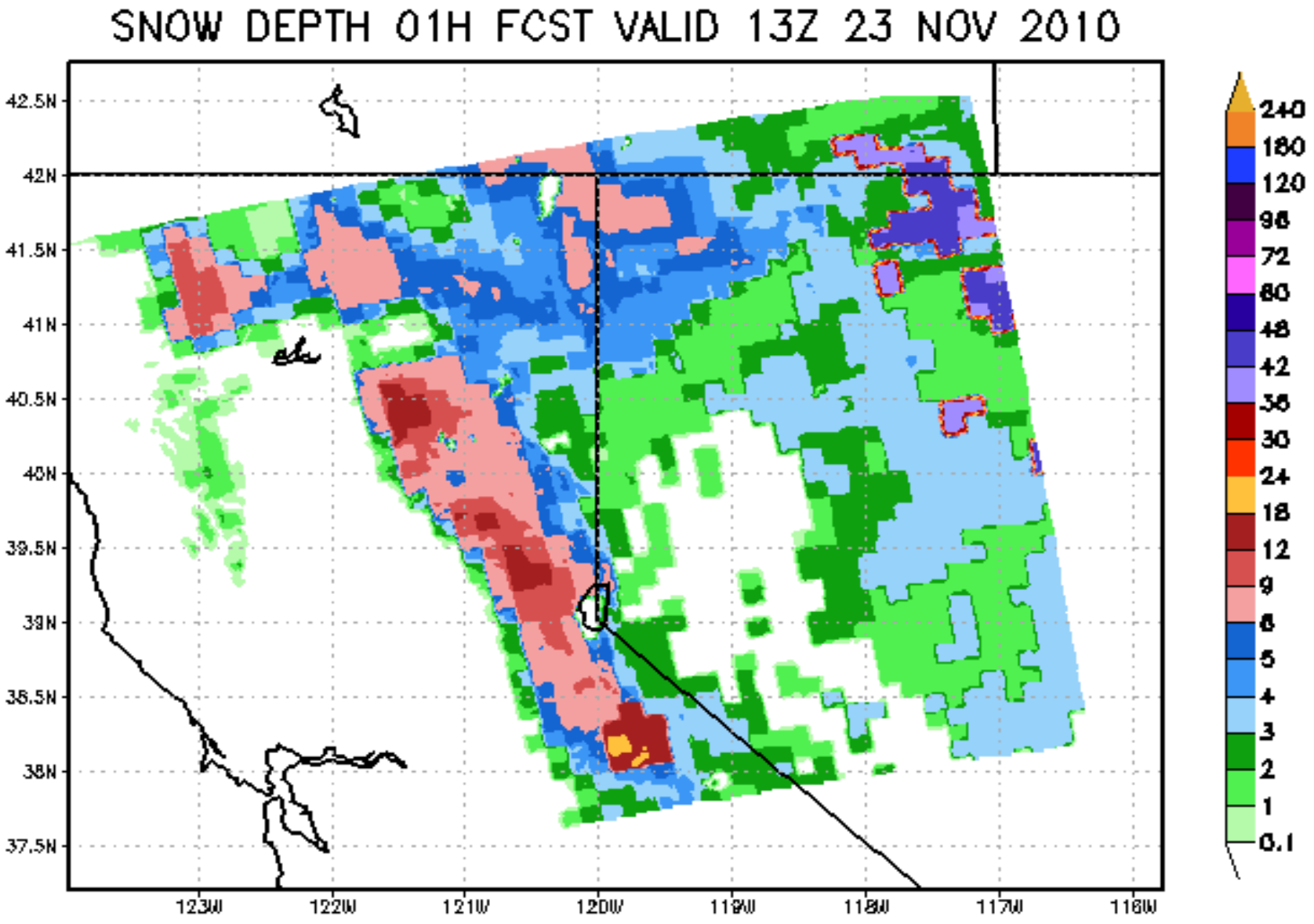
May 2010
27/16Z to
28/12Z

MD Backdoor Coldfront in 1.33km Nest



May 2010
27/16Z to
28/12Z


1-h SNOW WATER EQUIV VALID 13Z 23 NOV 2010
42.5N
42N
41.5N
41N
40.5N
40N
39.5N
39N
38.5N
38N
37.5N
123W
122W
121W
120W
119W
118W
117W
116W
250
100
80
60
40
30
20
16
12
8
4
2
1
0


SNOW DEPTH 01H FCST VALID 13Z 23 NOV 2010
42.5N
42N
41.5N
41N
40.5N
40N
39.5N
39N
38.5N
38N
37.5N
123W
122W
121W
120W
119W
118W
117W
116W
240
180
120
96
72
60
48
42
36
30
24
18
12
9
6
5
4
3
2
1
0.1

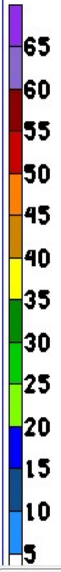
Washington Fire Wx Run

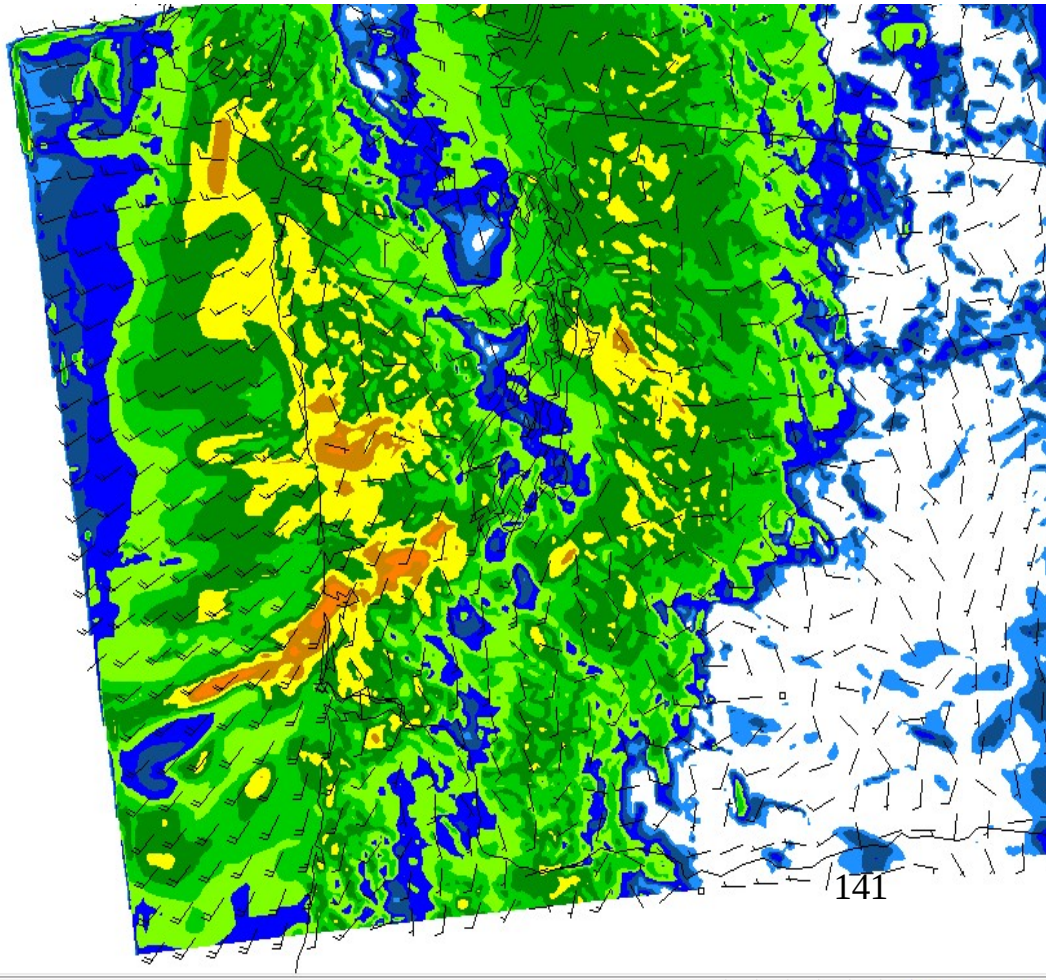
NAM Fire Weather High Resolution Nested Runs

This page will show selected fields from the most recent 00z and 12z NAM Parallel High Resolution "Fire Weather" nested run. This nest runs inside either parallel NAMX CONUS or Alaska nest. It runs to 36-h and has a resolution of 1.333 km (if in CONUS) or 1.5 km (if in Alaska).

During parallel testing the domain will move around to test this capability over different regions.

Parameter	00z 1/5/2011 Run
Sea-level Pressure, 1-h Accumulated Precip, 10-m Wind	X
1-h Accumulated Convective Precip, 10-m Wind	X
Composite Radar Reflectivity, 10-m Wind	X
1000 m AGL Radar Reflectivity, 10-m Wind	X
Shelter (2-m) Temperature, 10-m Wind	X
Terrain Height, 10-m Wind	X
Total Column Condensate	X
925 mb Height, Wind	X
850 mb Height, Temperature	X
700 mb Height, RH	X
500 mb Height, Wind	X
250 mb Height, Wind	X





Texas Fire Wx Run

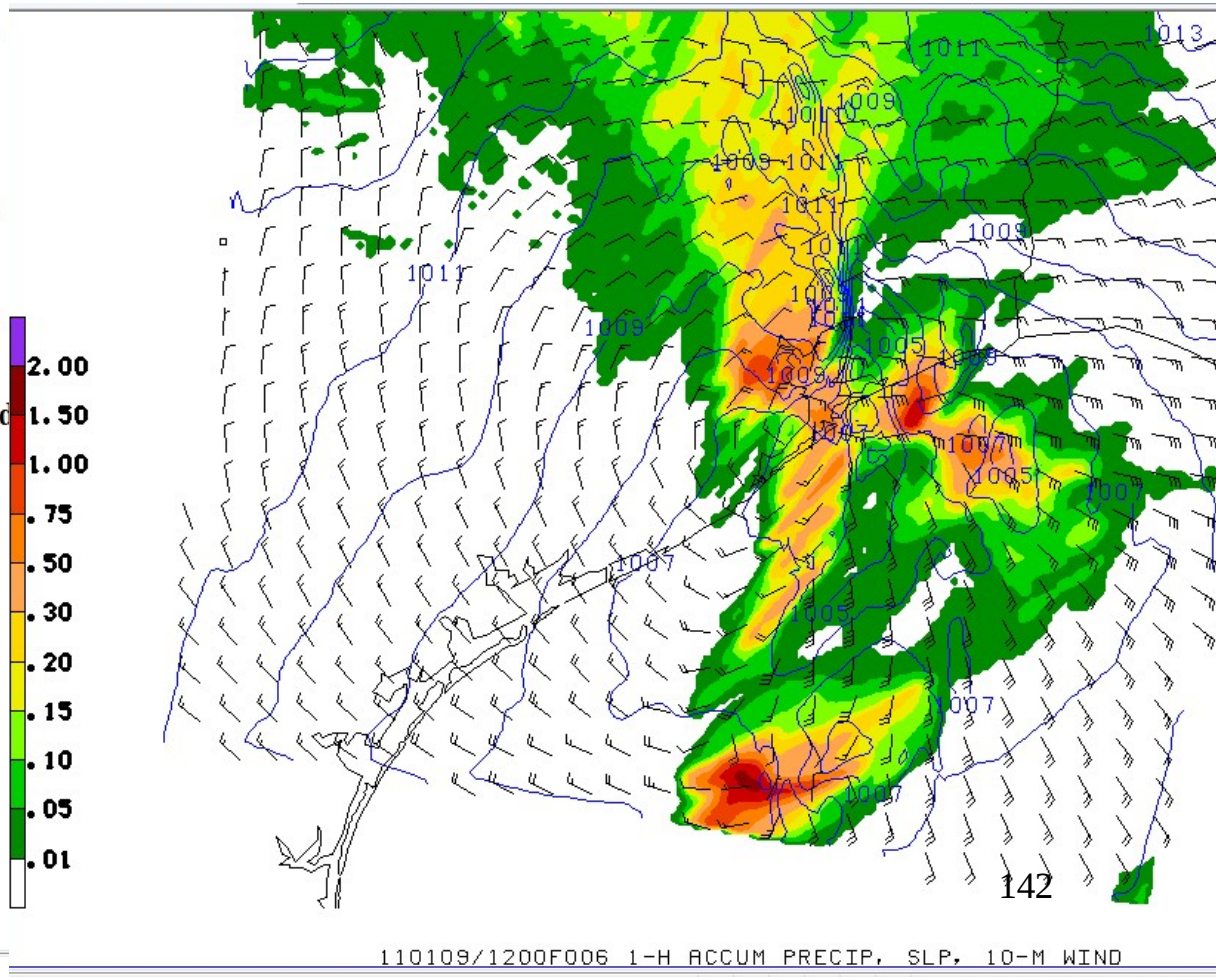
n 9 January 12z the 1.333 km nest domain was over east Texas as the low passes along the coast. Graphics saved at http://www.emc.ncep.noaa.gov/mmb/mmbpll/firewx.2011010912/

NAM Fire Weather High Resolution Nested Runs

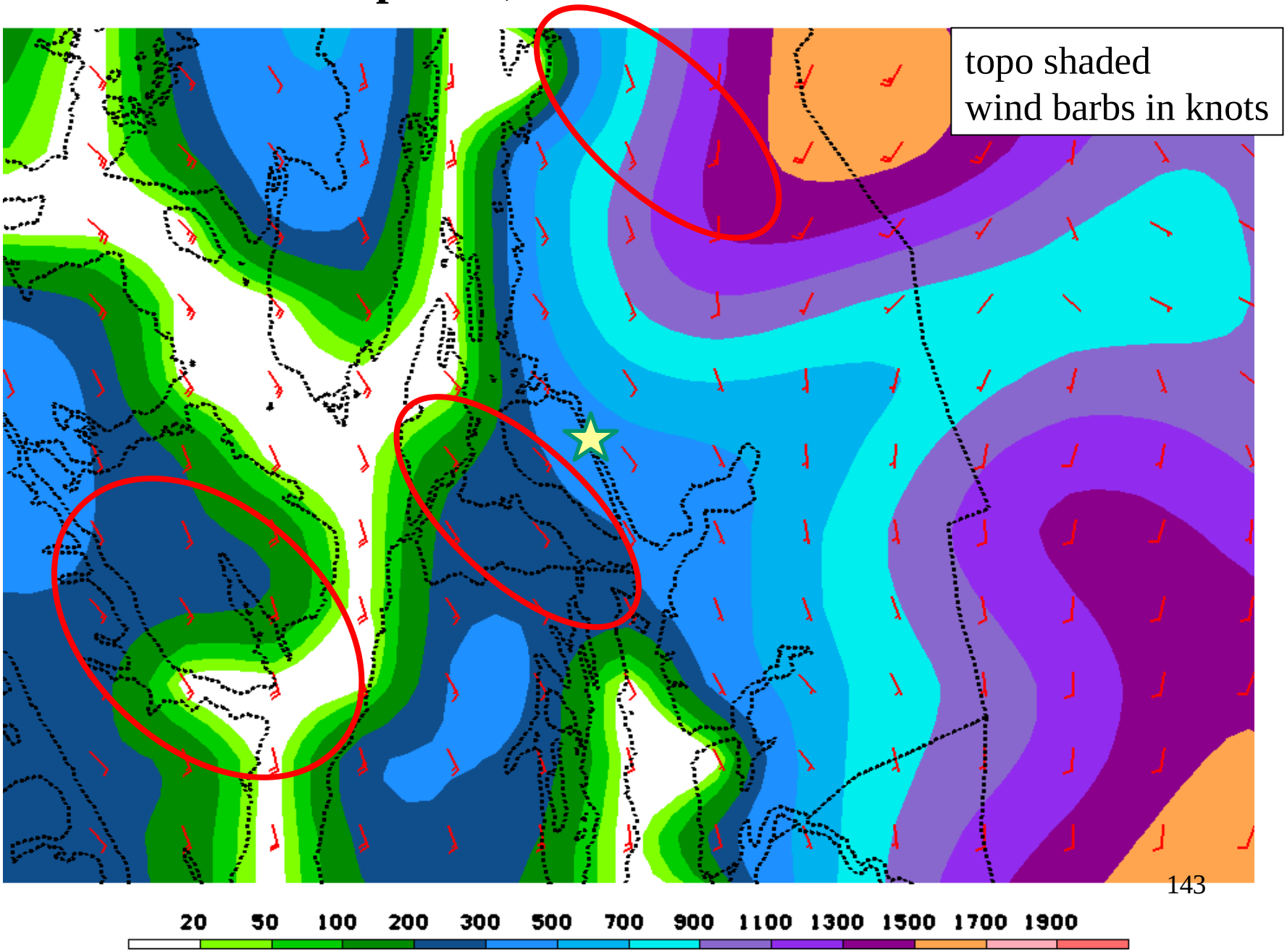
This page will show selected fields from the most recent 00z and 12z NAM Parallel High Resolution "Fire Weather" nested run. This nest runs inside either parallel NAMX CONUS or Alaska nest. It runs to 36-h and has a resolution of 1.333 km (if in CONUS) or 1.5 km (if in Alaska).

During parallel testing the domain will move around to test this capability over different regions.

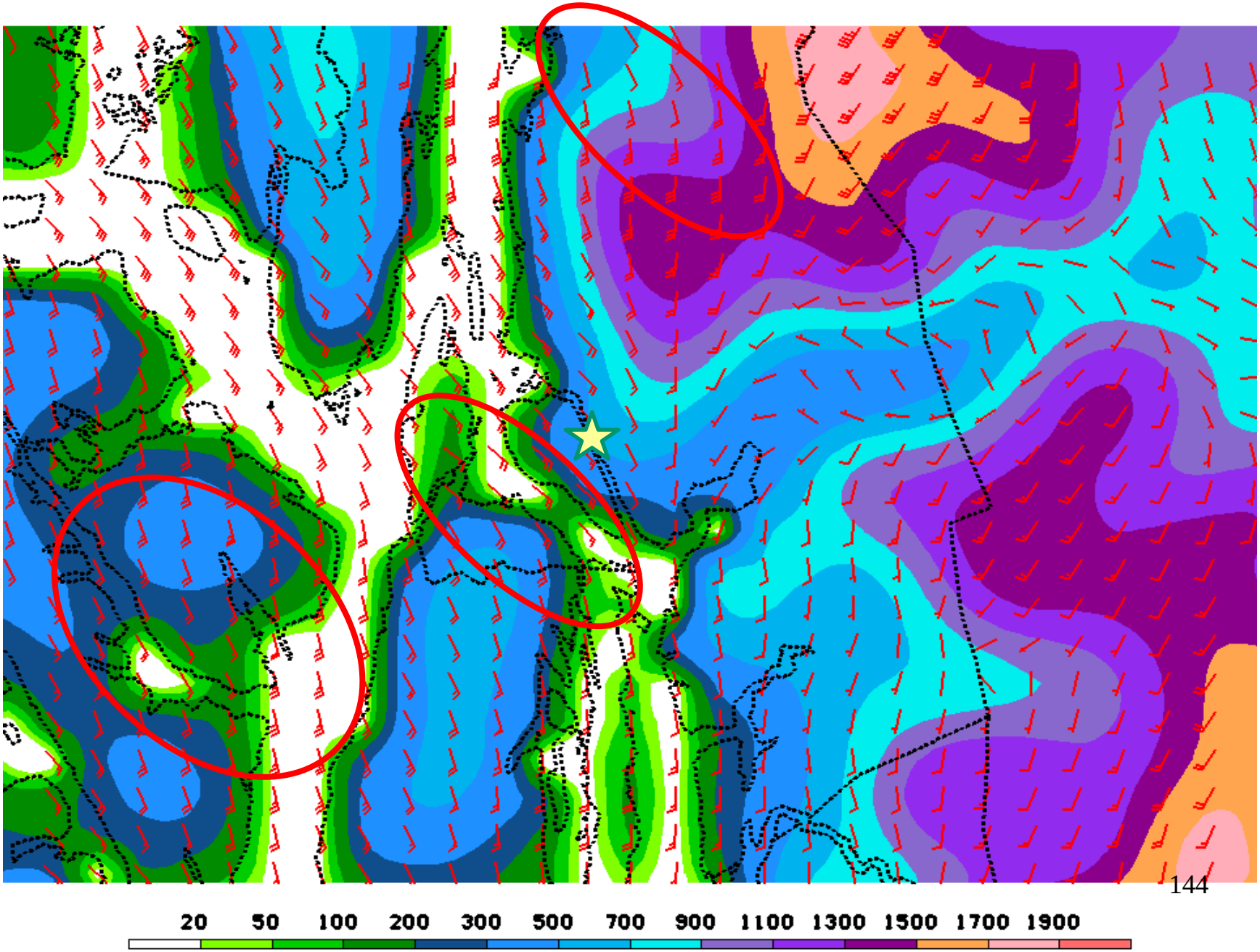
Parameter	00z 1/5/2011 Run
Sea-level Pressure, 1-h Accumulated Precip, 10-m Wind	X
1-h Accumulated Convective Precip, 10-m Wind	X
Composite Radar Reflectivity, 10-m Wind	X
1000 m AGL Radar Reflectivity, 10-m Wind	X
Shelter (2-m) Temperature, 10-m Wind	X
Terrain Height, 10-m Wind	X
Total Column Condensate	X
925 mb Height, Wind	X
850 mb Height, Temperature	X
700 mb Height, RH	X
500 mb Height, Wind	X
250 mb Height, Wind	X



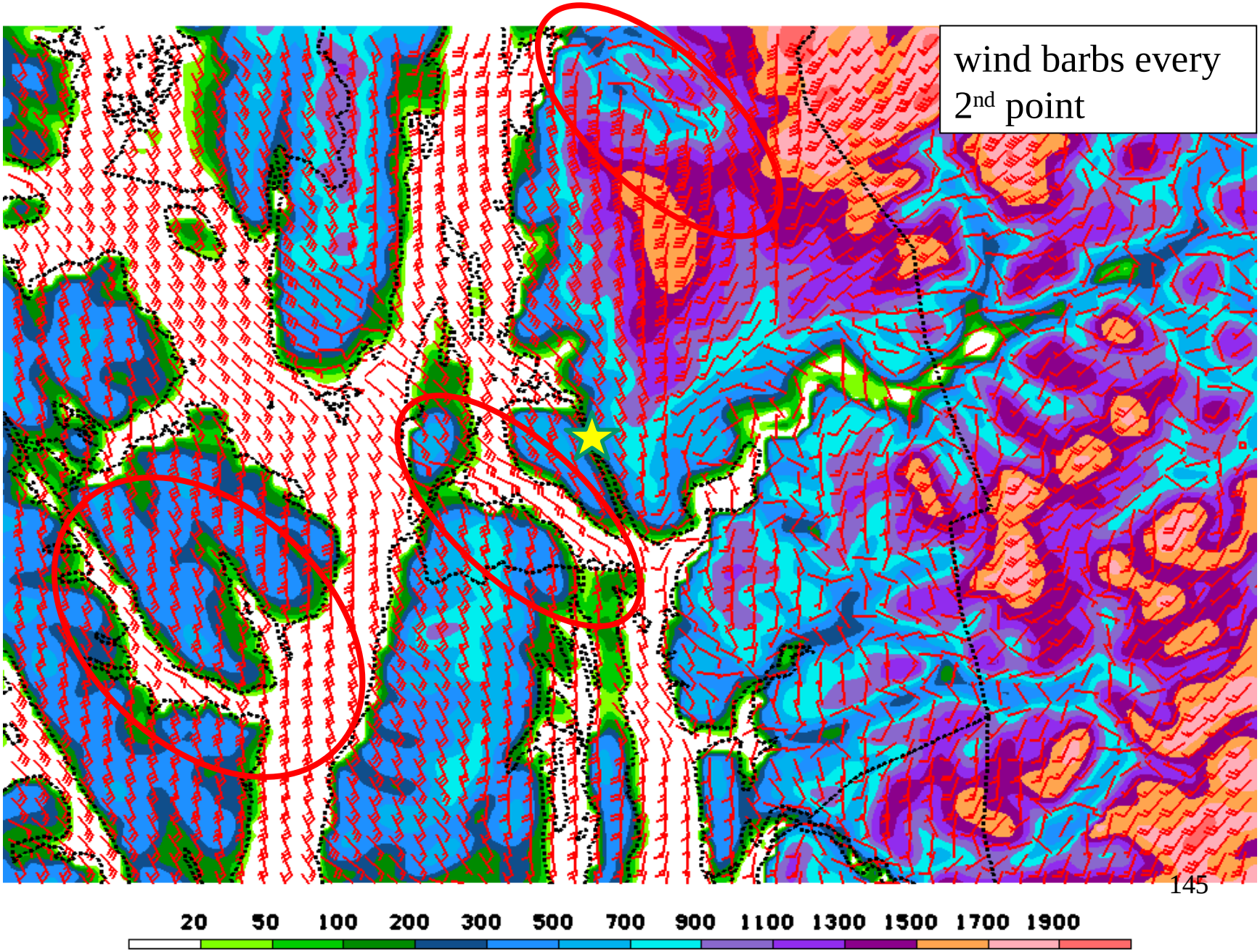
12 km NMMB parent, 12 h forecast valid 20110201/12Z



6 km NMMB nest, 12 h forecast valid 20110201/12Z



1.5 km NMMB nest, 12 h forecast valid 20110201/12Z



NOAA/ARL's HYSPLIT Dispersion Model

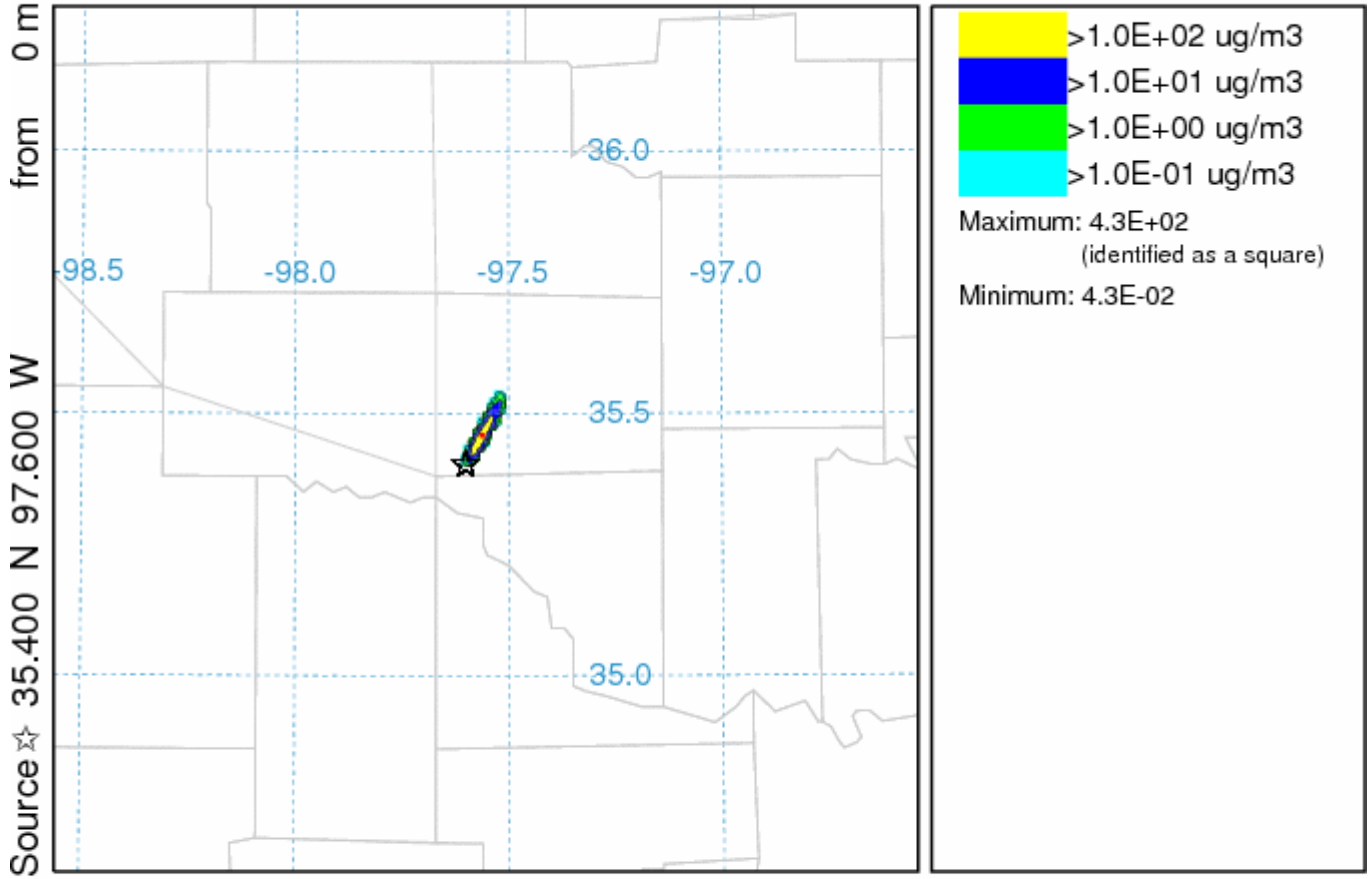
- Wild-fire smoke applications driven by NAM, NAM nests & FWIS via NOAA/ARL's READY-testbed site

Oklahoma Wild Fires

- March 11, 2011 fires in Central Oklahoma:
  - Harrah and Chatow counties

NOAA HYSPLIT MODEL

Concentration (ug/m3) averaged between 0 m and 100 m
Integrated from 0000 11 Mar to 0100 11 Mar 11 (UTC)
PM25 Release started at 0000 11 Mar 11 (UTC)



NAM METEOROLOGICAL DATA

This is not a NOAA product, produced by a web user
Release: lat.: 35.4 lon.: -97.6 Hgt: 0 m
Pollutant: PM2.5
Release Quantity: 1 g Start: 11 03 11 00 Duration: 0 hrs, 0 min
Pollutant Averaging/Integration Period: 1 hrs and 0 min
Dry Deposition rate: 0 cm/s Wet Removal: None #Part: 4200
Meteorology: 0000Z 11 Mar 2011 - NAM12
Job ID: 2135 Job Start: Mon Mar 14 15:55:52 UTC 2011

HYSPLIT READY FORECAST USING NAM 12 March 2011

HYSPLIT

Event, Release Type, Meteorology & Source Location

Release Type: Unknown Material (Generic Mass)

Event Type: Exercise Real Event

Meteorology: NMMB Fire Weather (12h fcst, 1 km, 1 hrly, Moveable, Hyb-sigma) **Help**

- NAM Tile(48h fcst, 12 km, 1 hrly, CONUS, sigma)
- NMMB Fire Weather (12h fcst, 1 km, 1 hrly, Moveable, Hyb-sigma)
- NMMB (24h fcst, 12 km, 1 hrly, CONUS, Hyb-sigma)
- NMMB (24h fcst, 2 km, 1 hrly, Hawaii, Hyb-sigma)
- NAM (48h fcst, 12 km, 3 hrly, CONUS, pressure)
- NAM (48h fcst, 12 km, 1 hrly, Alaska, sigma)
- NAM (48h fcst, 12 km, 1 hrly, Hawaii, sigma)
- RUC Model (12h fcst, 1 hrly, CONUS, pressure)
- GFS Model (192h fcst, 3 hrly, Global, pressure)

osen forecast file.
Upper-air Sounding

Source Location (choose one of the 5 options below)

Nuclear Plant (country: name: lat: lon):

City (Country or State: name: lat: lon):

Airport or WMO ID (i.e., dca): **ID Lookup**

Decimal Degrees Latitude: N Longitude: W

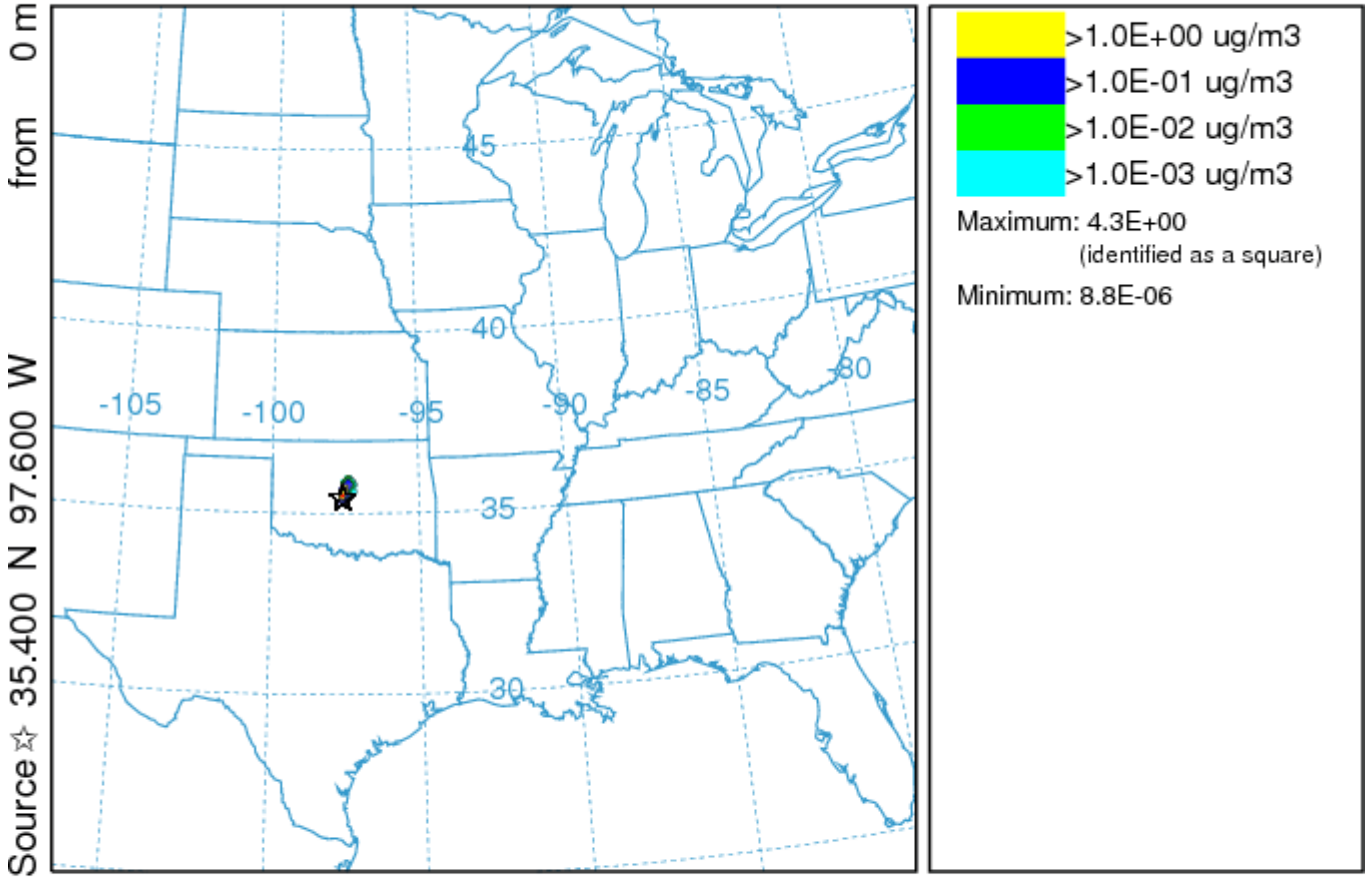
DDD/MM/SS Latitude: N Longitude: W

Deg. Min. Sec. Deg. Min. Sec.

Look here to find/see domain of FWIS run

NOAA HYSPLIT MODEL

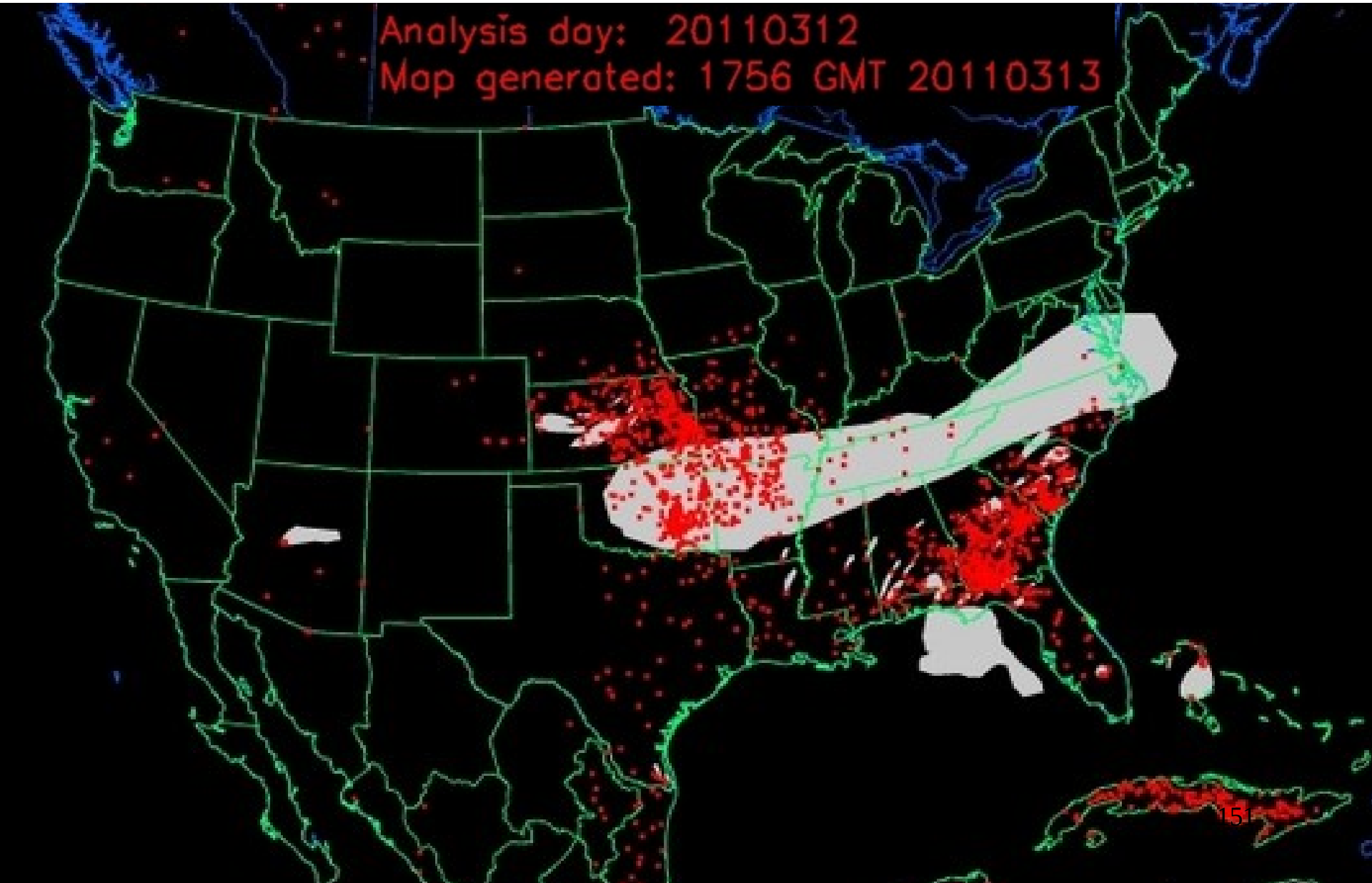
Concentration (ug/m3) averaged between 0 m and 3000 m
Integrated from 0000 12 Mar to 0100 12 Mar 11 (UTC)
PM25 Release started at 0000 12 Mar 11 (UTC)



NAM METEOROLOGICAL DATA

This is not a NOAA product, produced by a web user
Release: lat.: 35.4 lon.: -97.6 Hgt: 0 m
Pollutant: PM2.5
Release Quantity: 1 g Start: 11 03 12 00 Duration: 0 hrs, 0 min
Pollutant Averaging/Integration Period: 1 hrs and 0 min
Dry Deposition rate: 0 cm/s Wet Removal: None #Part: 12600
Meteorology: 0000Z 12 Mar 2011 - NAM12
Job ID: 2302 Job Start: Tue Mar 15 12:04:21 UTC 2011

Smoke Verification Map



Contingency/downstream/IT testing for **GSI component** of NAM bundle

- A problem with the GSI was when the obs prepbufr file existed but was zero length.
- This problem is fixed in the version of GSI being implemented in GFS/GSI May bundle and is part of the NAM bundle as well. GSI now checks each bufr file size and makes sure it is larger than 0.
- ESRL/GSD (Ming Hu) also did a test to run GSI without any data (ina limited area application) and it exits normally with 0 iterations within the GSI.

Contingency/downstream/IT testing (Rogers) for NAM bundle - 1

- 1) Have successfully tested running NAM with all nests off GDAS first guess if NDAS does not run. Will delay start of NAM forecast by ~ 8 minutes.
  2) Julia (who has been running the same bundle from optimus) has successfully been able to restart the NAM model forecast with all nests at a non-zero forecast hour (would be invoked in operations if a system glitch killed the NAM forecast).
  3) We will provide a capability to run only the NAM 12-km domain with no nests if there are any problems with the pre-processing of the nest's initial conditions (may not be ready by 14 April)

Contingency/downstream/IT testing (Rogers) for NAM bundle - 2

A few downstream efforts that NCO won't have to set up (we didn’t use to do this, but …)

1) I'm successfully running the NAM_GEMPAK and NAM_GEMPAK_META jobs in my parallel.

2) Have got working the job to make GEMPAK files from the nests, based on lists of variables desired by NCEP service centers. Will start routine creation of these files immediately in my parallel for the CONUS nest to start.

Downstream Applications Testing

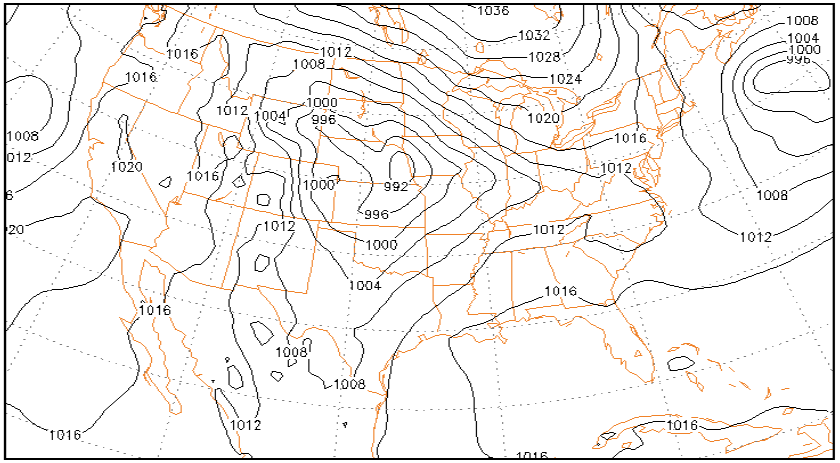
NAM/NEMS/NMM-B	Q3					14-Apr-11	
		Developer POC	Tested with NAM Parallel	Mechanically works with NAM	Output Issues?	Requires RFC	RFC Submit Goal
NAM - CMAQ (CB04)	Q3	Huang	CBO4 complete	yes		yes - 5	7-Apr-11
CMAQ (CB05)	Q3	Huang	CBO5				
NAM - SREF	Q3	Du	still testing			yes - 3 changes	7-Apr-11
NAM - WAVES (including Great Lakes)	Q3	Alves	still testing	yes		1 RFC for mask, bundled	7-Apr-11
NAM - HYSPLIT Smoke	Q3	Manikin	still testing				7-Apr-11
NAM - RUC	Q3	Manikin	n/a				n/a
NAM - RTMA	Q3	Pondeca	still testing				7-Apr-11
NAM Smartinits (CONUS, AK, HI, PR)	Q3	Manikin	still testing			yes - updated fix file for all	7-Apr-11
NAM - NAM DNG	Q3	Manikin	still testing			yes	7-Apr-11
NAM - HYSPLIT Volc Ash & Homeland Security	Q3	Glenn Rolph	still testing				7-Apr-11
NAM - Verification	Q3	J. Zhu	still testing			yes	7-Apr-11
NAM - HiRes Window	Q3	Pyle	still testing	Yes		no	7-Apr-11
NAM - DTRA notification	Q3	Mcqueen	NOTIFIED			NO	COMPLETE
NOS Models		Aikman, Zhang	still testing				7-Apr-11

Eta SLP forecasts (f00 and f87hr)

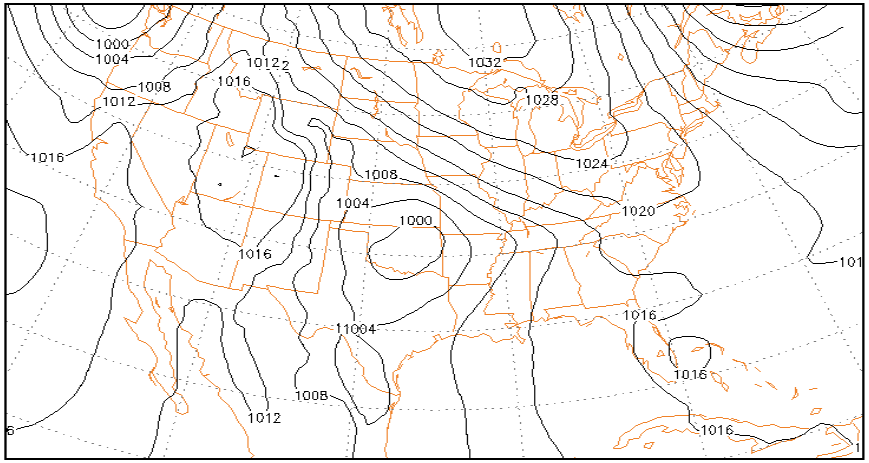
Upper panel: current NMM-NDAS

lower panel: new NMMB-NDAS (new)

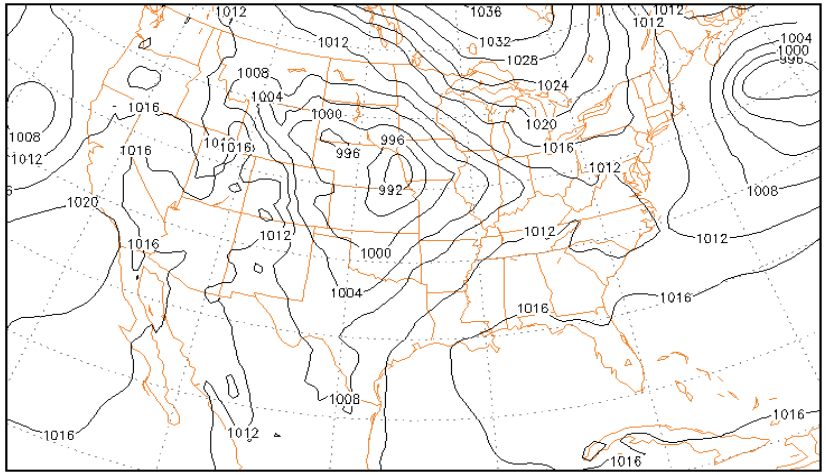
COM_US SLP(mb) 00H fcst from 21Z 22 MAR 2011 (mem 1)
verified time: 21z, 03/22/2011



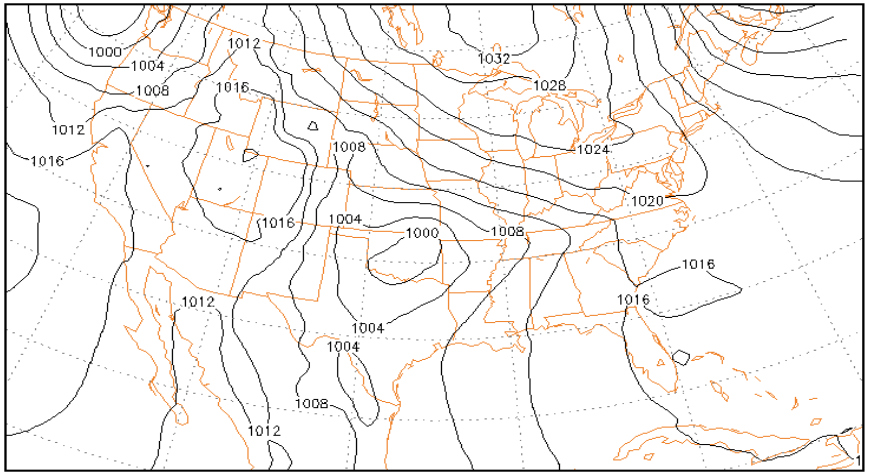
COM_US SLP(mb) 87H fcst from 21Z 22 MAR 2011 (mem 1)
verified time: 12z, 03/26/2011



COM_US SLP(mb) 00H fcst from 21Z 22 MAR 2011 (mem 2)
verified time: 21z, 03/22/2011



COM_US SLP(mb) 87H fcst from 21Z 22 MAR 2011 (mem 2)
verified time: 12z, 03/26/2011



Produced by JUN DU, EMC/NCEP/NOAA

Produced by JUN DU, EMC/NCEP/NOAA

FSYNC Code – Carolyn Pasti

I have written and tested a sample fsync call from fortran. The code is ->

The standard xlf_r compiler is used to compile it.

The fsync interface needs to be declared, use getfd to get a valid posix file descriptor and then pass the descriptor to fsync.

That is it.

However I don't think this can be done in the nam post because the post is having trouble opening the file.

It needs to be fsync'd prior to close by the owner.

Fsync requires the file to be open so you can flush it to disk.

It should be the last thing that is done prior to closing the file.

What my other program/tool does that you call from a script is to open the file, sync it and then close it.

However this is done at the end of the job and you can't do that since the post runs along side

```
PROGRAM TEST
        ! Declare the interface for POSIX fsync function
        interface
          function fsync (fd) bind(c,name="fsync")
          use iso_c_binding, only: c_int
            integer(c_int), value :: fd
            integer(c_int) :: fsync
          end function fsync
        end interface

        IMPLICIT NONE
        ! Variable declaration
        integer :: ret,fn,cfd,getfd

        ! Opening unit 10
        fn=10
        open (fn,file="foo")

        ! ...
        ! Perform I/O on unit 10
        ! ...
        write (fn,*) "This is a test"

        ! Flush and sync
        flush(fn)

        !Get file descriptor for interlanguage call to C fsync
        cfd=getfd(fn)
        ret=fsync(cfd)

        ! Handle possible error
        if (ret.ne.0) then
          print *,"Error calling FSYNC"
          print *, "ret = ",ret
        endif
        close(10)
        END PROGRAM TEST
```

NMMB-CMAQ Upgrades for NAQFC Implementation

April 6, 2011

NOAA/OAR/ARL and NWS/NCEP/EMC

Air Quality Team

Charter Overview

CONUS Production

- NWS Milestone
- SCOPE
  - **NMMB-CMAQ 12 km/L22 Coupling:**
    - Interpolation to CMAQ coordinate (PREPHYB, PREMAQ, CMAQ)
    - Use NMMB IGBP land-use characteristics (PREMAQ, CMAQ)
  - **Continue Gas phase Carbon Bond IV (CB-IV) mechanism**
    - PM Predictions not available
    - Reduced Volatile Organic Compounds (VOC) speciation
  - ***2005 Emissions Inventory updated for 2011 by April 12, 2011***
  - **Static Lateral Boundary Conditions (LBCs)**
  - **Outputs: No Change**
    - **For parallel testing /aqmp2 directory used to not overwrite current AQM NCO parallel**

Charter Overview

O-CONUS (Alaska-Hawaii) Production

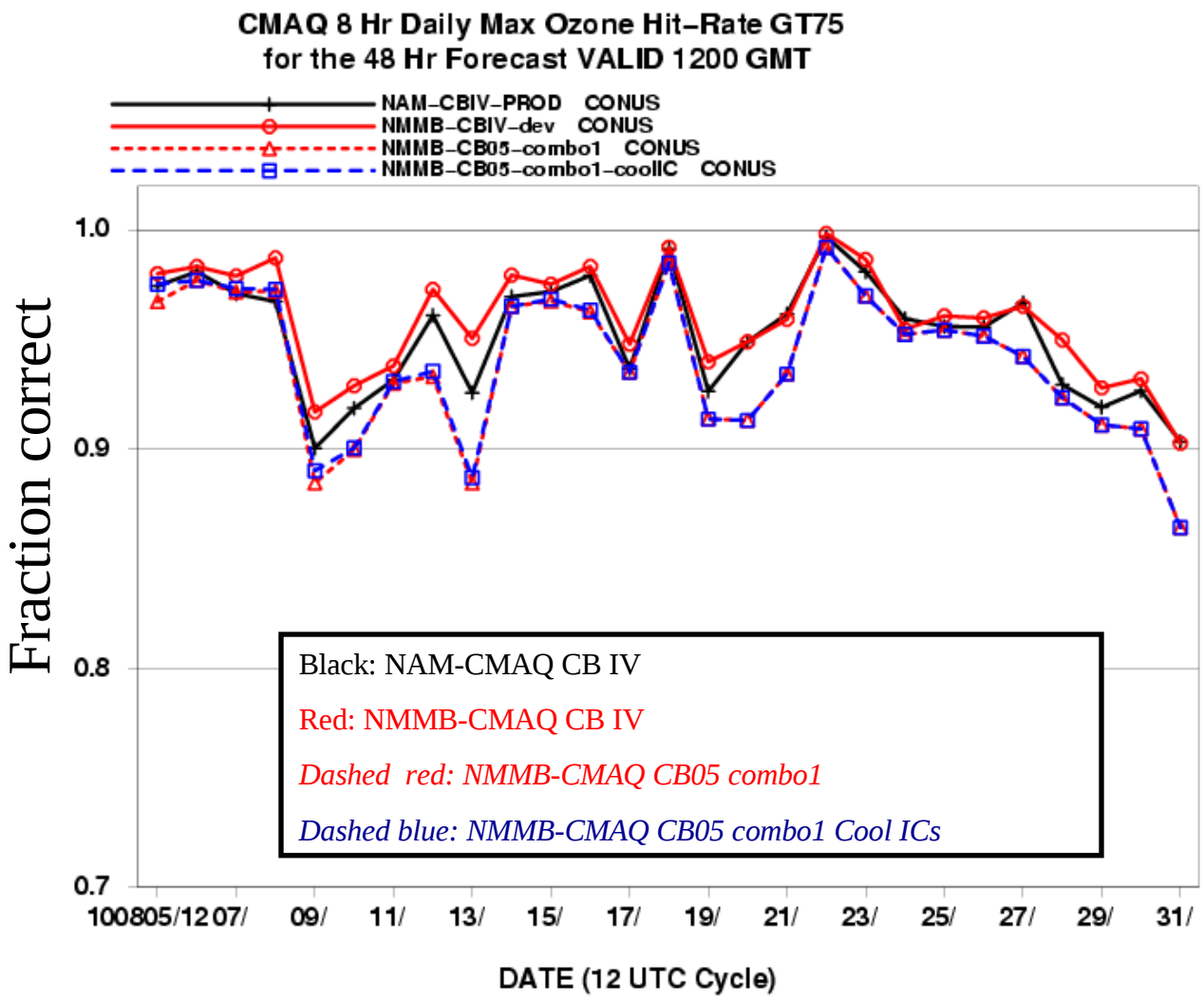
- NWS Milestone
- SCOPE
  - **NMMB-CMAQ 12 km/L22 CB05 System Coupling:**
    - Interpolation to CMAQ coordinate (PREPHYB, PREMAQ)
    - Use NMMB IGBP land-use characteristics (PREMAQ)
  - ***Combo1: bundled upgraded CB05 System***
    - M-O similarity theory deposition velocity (PREMAQ)
    - Improved canopy resistance (PREMAQ)
    - 10m Forest canopy height (PREMAQ)
    - Minimum PBL height of 50 m (PREMAQ)
    - LBCs from GEOS-Chem monthly averages to 7 km. Limit O3 above to 70 ppb (PREPHYB)
    - Removed GFS Ozone LBC file creation (PREPHYB)
  - ***Scripts, codes unified for all CB05 domains*** (POST1, POST2, POST3)
  - ***2005 Emissions Inventory to be updated for 2011 by April 12, 2011***

EMC Parallel Evaluation

August 2010 CONUS Retrospectives

Simulation	**System**	**CMAQ physics**	**CMAQ chem**	**Vertical Coupling**	**Land use class**
Control	NAM PROD	Default	CB-IV	Unified	USGS
Candidate 1 hpss:1.0 TB	*NMMB* CB-IV	Default	CB-IV	*Interpolated*	*IGBP → USGS*
Candidate 2 (1.6 TB)	*NMMB CB05 combo1*	*Vd PBLH LBCs*	*CB05, AERO-IV*	Interpolated	IGBP→ USGS
Candidate 3 (1.6 TB)	NMMB CB05 combo1 *cool ICs from CB-IV*	Vd PBLH LBCs	CB05 AERO-IV	Interpolated	IGBP→ USGS

Day 2 CMAQ driven by NAM vs NMMB
Aug. 2010 Daily 8h-max O_3 (ppb) CONUS

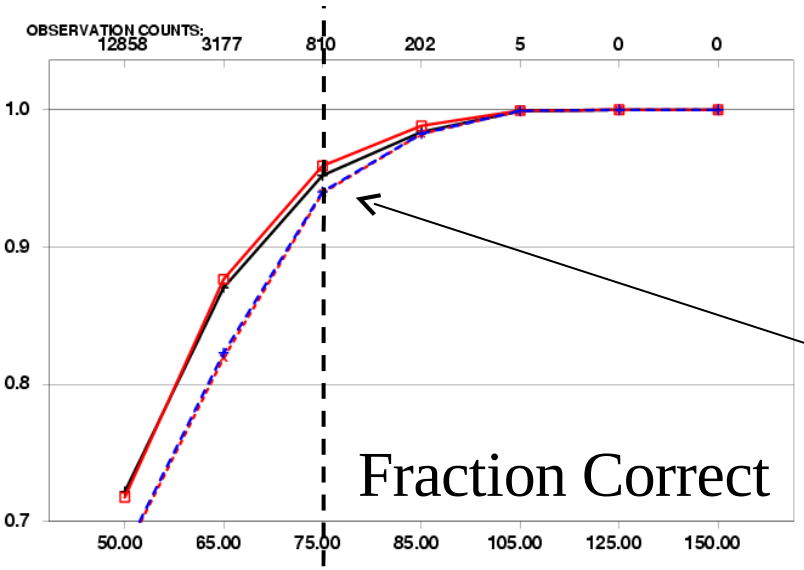


Fraction correct with respect to 75 ppb threshold is comparable for NMMB CB-IV and control (NAM CB-IV production) runs

Fraction correct for two CB05 runs converges as IC influence diminishes

Fraction correct is higher for CB-IV runs

Day 2 CMAQ driven by NAM vs NMMB
Aug. 2010 Daily 8h-max O_3 (ppb) CONUS



Black: NAM-CMAQ CB IV

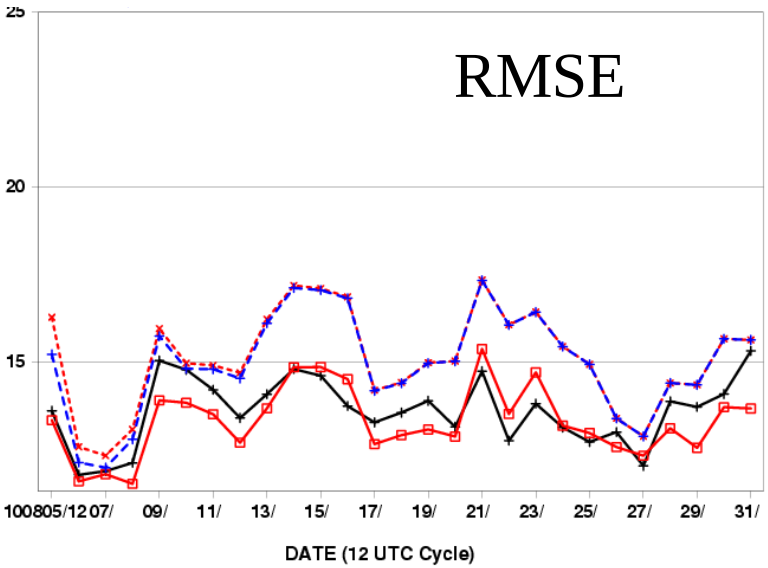
Red: NMMB-CMAQ CB IV

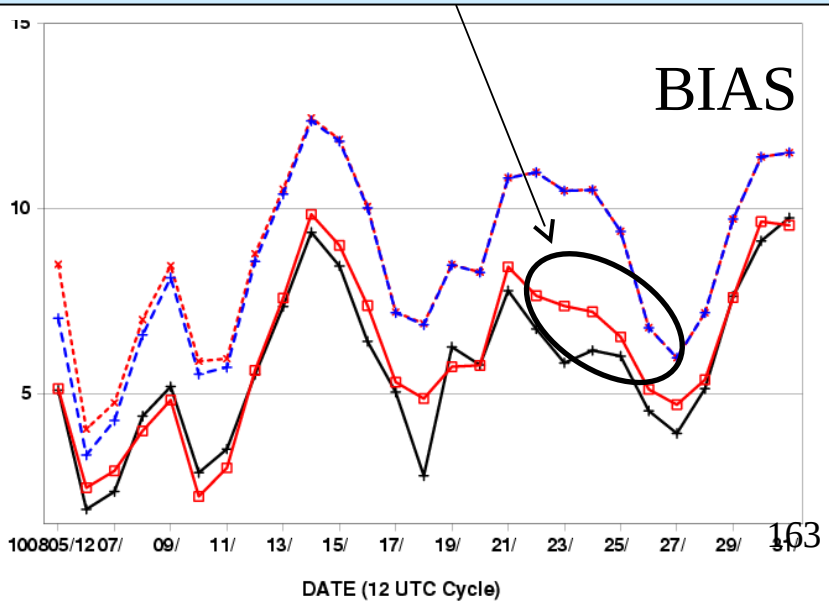
Dashed red: NMMB-CMAQ CB05 combo1

Dashed blue: NMMB-CMAQ CB05 combo1 Cool ICs

- NMMB-CBIV improved compared to NAM-CBIV and NMMB-CB05 for >50 thru >75 thresholds

- NMMB-CBIV BIAS worse from 8/21 → 8/25

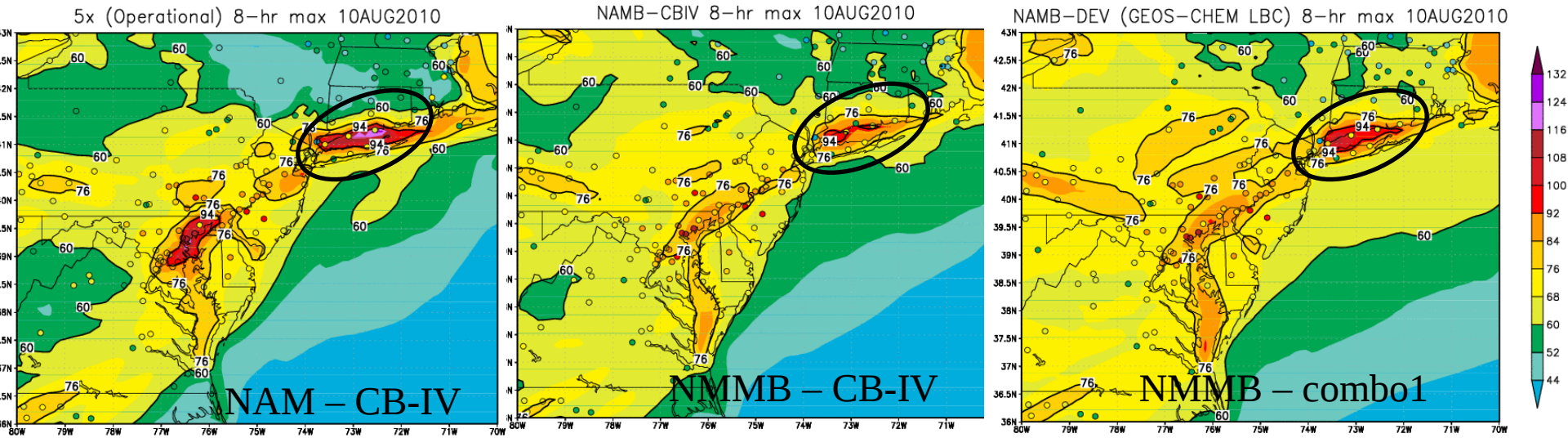




NMMB Impact on CMAQ

Day 2 Ozone 8h daily maximum

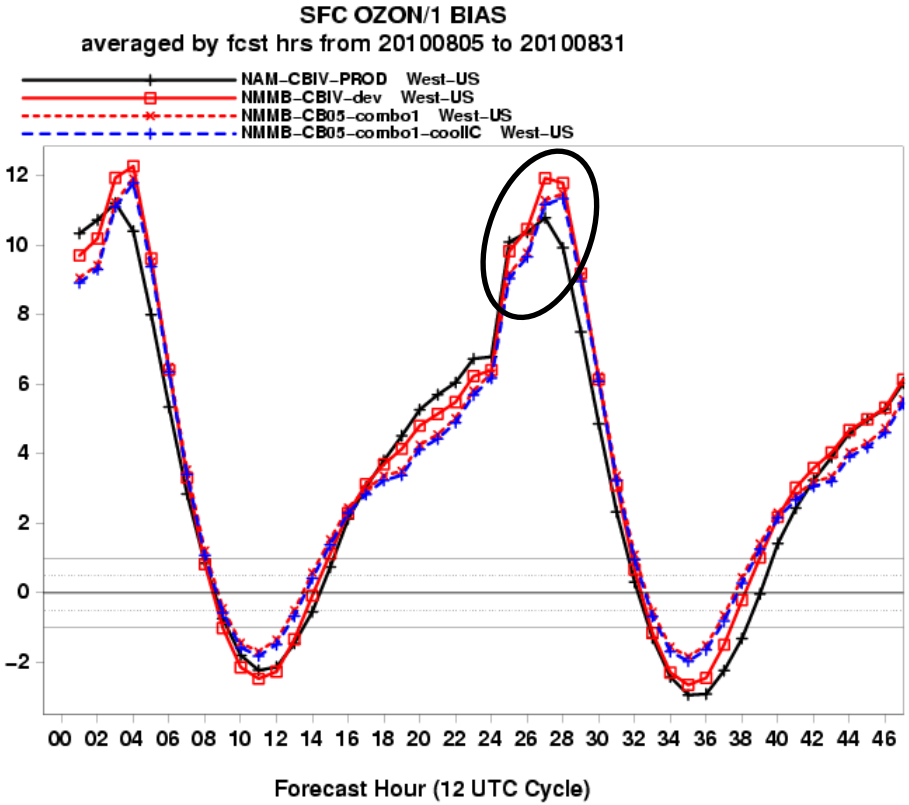
August 10, 2010 Case



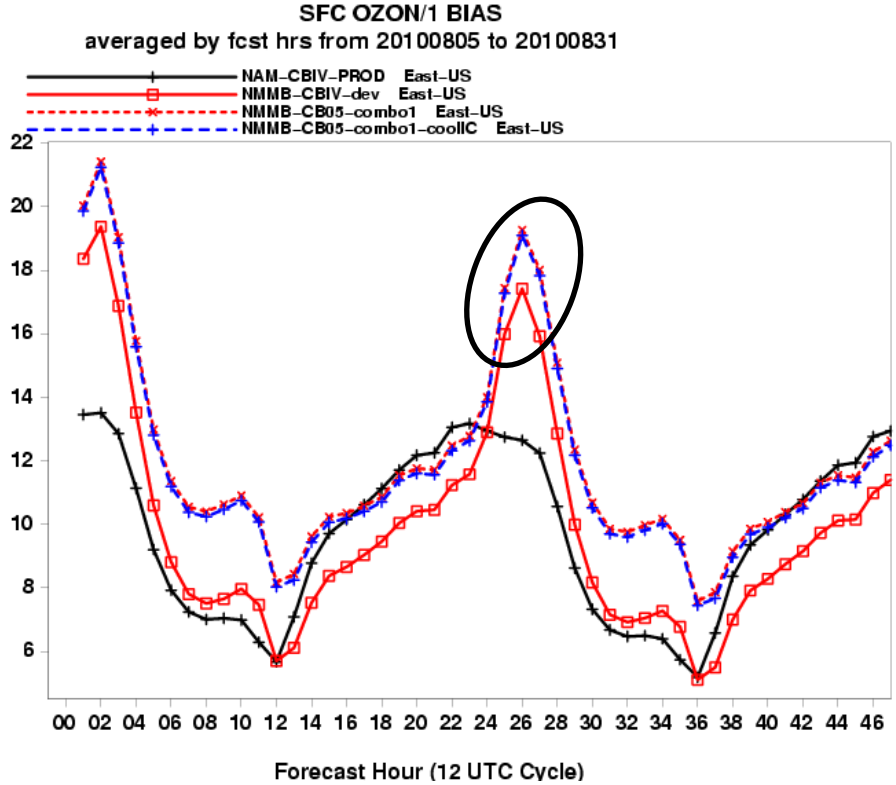
- NMMB CB-IV runs:
  - Improved along Long Island Sound
  - Underpredicted Max O3 over Baltimore-Washington areas
- NMMB CB05 combo1 run: Overestimates in low ozone regions (e.g.: Upstate NY, Mass)

Diurnal Cycle 1 hr O3 BIAS (ppb)
August 2010 West vs East

Western US



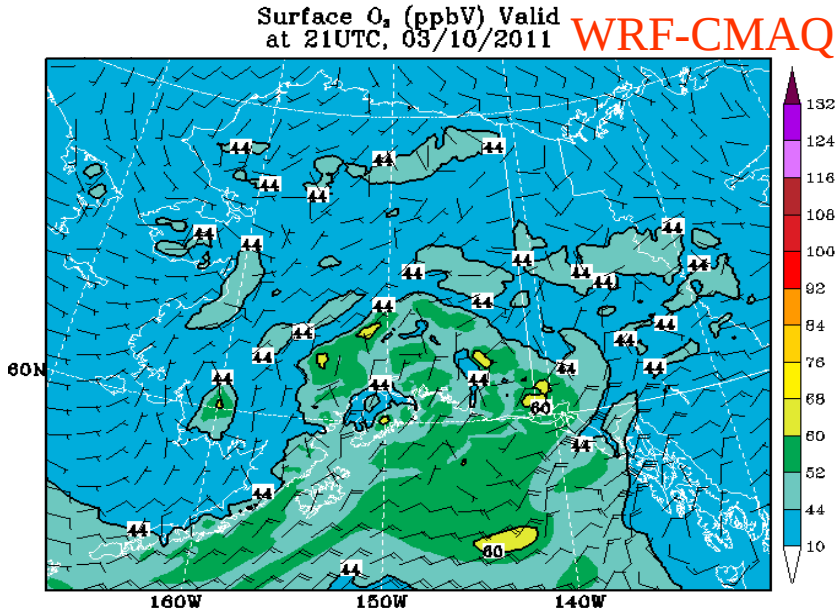
Eastern US

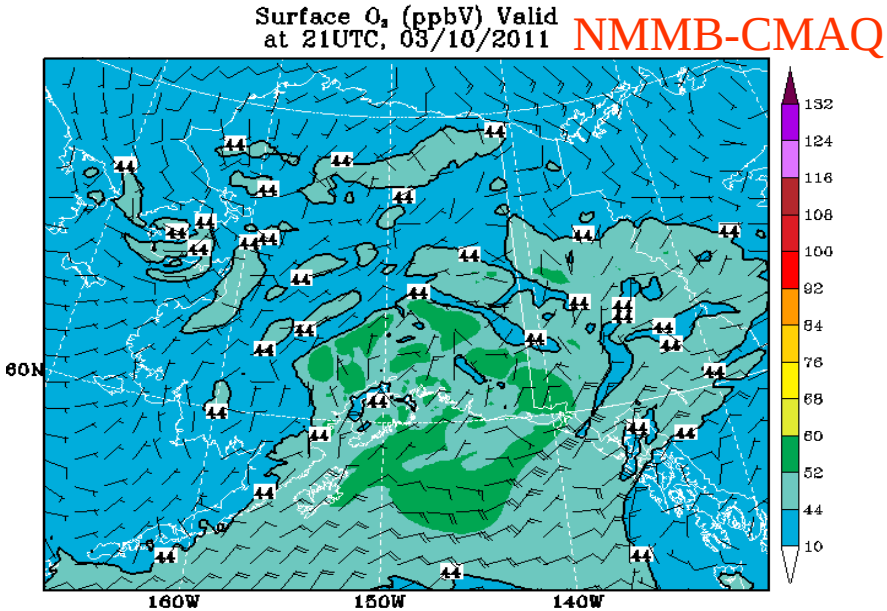


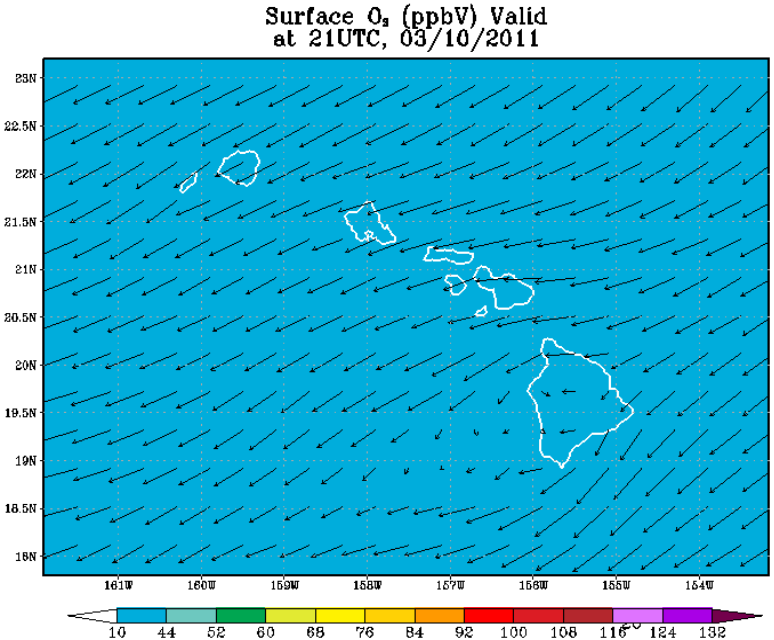
- Early morning error spike for only NMMB runs in East
- Early morning error spike for all runs in West

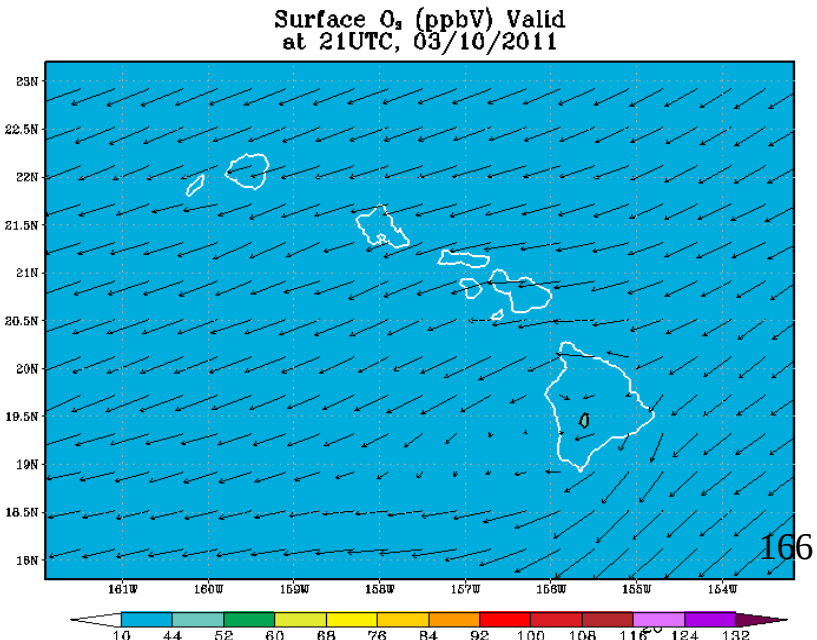
  Deeper PBLH in NMMB mixes down residual pollutant air mass

O-CONUS Testing









Summary

Recommendation:

- **Implement NMMB CB-IV configuration for ozone prediction with updated point sources**
  - Performs best for 8 h average fraction correct over CONUS and most regions, except over Southwest
  - Loss in skill in early morning ozone predictions

CMAQ CB05:

- Implement Combo1 configuration for O-CONUS Production and CONUS Parallel cycles

- Additional testing to be based on CB05 with updated emissions, tighter coupling with NMMB, updated CMAQ version 4.7.1 after this implementation

Initial Analysis of Product Volume

CMAQ AQM FY 2011 upgrade (no change)

Disk Usage	Current Production	Expected New Production	Actual New Production
IBM CCS Disk *tmpdir*	181 GB/day	181 GB/day	TBD
IBM CCS Tape Storage	128 GB/day	128 GB/day	TBD
NCEP FTP Server	120 MB/day	120 MB/day	TBD
NWS FTP Server	1 MB/day	1 MB/day	TBD

Analysis of Product Availability

CMAQ AQM FY 2011 upgrade

	Current Production	Proposed Production
NAWIPS (CENTERS)	YES	YES
NCEP FTP Server	YES	YES
NWS FTP Server	YES	YES
AWIPS/ NOAAPORT	NO	NO
CONDUIT	NO	NO

Analysis of Production Resources

CMAQ CONUS AQM FY2011 upgrade (no change)

Job Step	Current Production		Expected Production		Actual Production	
	Nodes/ Tot Tasks	Runtime (min)	Nodes/ Tot Tasks	Runtime (min)	Nodes/Tot Tasks	Runtime (min)
prep	1/1	48	1/1	48	TBD	TBD
premaq	1/1	29	1/1	29	TBD	TBD
forecast	2/64	58	2/64	58	TBD	TBD
post (total for one 48 h forecast)	1/1	3	**1/1**	3	TBD	TBD

Post Production/Product Generation

- Continue Dissemination through ftpprd, NDGD and EPA T1 network connection

- Add DBNET Alert for NOMADS to access surface ozone files

- Downstream dependencies:
  - NDGD
  - EPA AIRNOW Sonoma Tech
  - AQ State Forecasters
  - NOMADS

Corrections from last Implementation

1. Ensure that all source codes are compiling (*e.g: aqm_premaq_HI.fd problem*).

2. Unnecessary libraries, parm, fix files, source codes removed from directories.
   - Ensure that all directories can have copy permission (*e.g: the fix directory*) and remove unneccesary files.
   - Ensure there are not duplicate files (*e.g.: aqm_static_pro*) in multiple directories.
   - Keep only needed specific emissions in your emission directories.

3. Set RUN varb correctly in JAQM_PREMAQ_

4. Change "export COMNAM=*/com/aqm/prod/*${RUN}.${PDY}" to "*/com/*${NET}/${envir}/${RUN}.${PDY}"

1. Ensure that SPA copies the correct initial condition files: *(e.g.: init_cmaq_cb05_20100201.bin, init_cmaq_cb05_20100201.bin_cp)*

3. Have instructions for changing environmental variables from your local directories to /nwpara directories.

Preliminary IT Testing

- GDAS for NAM initialization:
  - Code added to initial meteorological grids from previous NDAS run
- Missing CMAQ chemical initial conditions
  - Check to use previous successful forecast
    - +6 h → +48 h (from day – 2)
- Bad Emissions File
  - Developmental scripts written to check and test run with next month data provided by ARL

NAQFC : Upgrade of CONUS/HI/AK Predictions

Project Status as of 04/06/11

Scheduling G

CONUS PROD CB-IV

Milestone (NCEP)	Date	Status
EMC testing complete/ EMC CCB approval	03/18/2011	
Initial Code Delivery to NCO	03/29/2011	CONUS Production
Technical Information Notice Issued	05/17/2011	
Initial Test Complete	04/15/2011	
CCB approve parallel data feed	04/20//2011	
IT testing begins	04/19/2011	
IT testing ends	05//03/2011	
Parallel testing begun in NCO	05/17/2011	
Real-Time Evaluation Ends	06/14/2011	
Management Briefing	06/24/2011	
Implementation	6/30/2011	

O-CONUS PROD CB05

Milestone (NCEP)	Date	Status
EMC testing complete/ EMC CCB approval	03/29/2011	
Initial Code Delivery to NCO	04/12/2011	CB05 based
Technical Information Notice Issued	05/17/2011	
Initial Test Complete	04/29/2011	
CCB approve parallel data feed	05/04//2011	
IT testing begins	05/03/2011	
IT testing ends	05/17/2011	
Parallel testing begun in NCO	05/31/2011	O-CONUS Paras
Real-Time Evaluation Ends	06/14/2011	O-CONUS Paras
Management Briefing	06/24/2011	
Implementation	6/30/2011	O-CONUS Only.

R Management Attention Required	Y Potential Management Attention Needed	G On Target

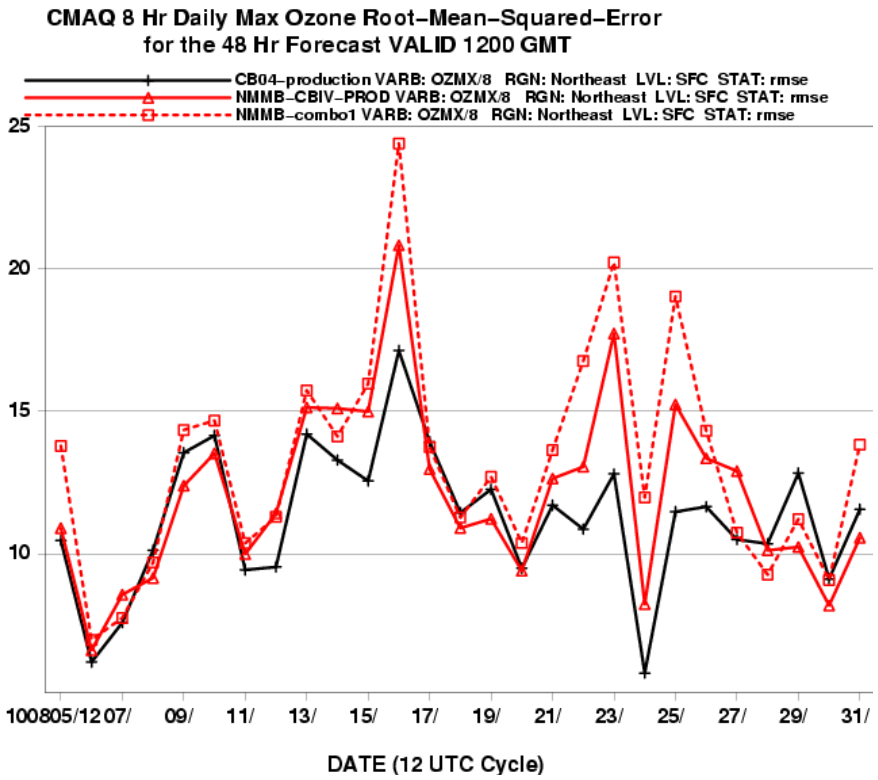
AIR QUALITY BACKUPS

Daily RMSE : Sub-regions 8h-max O_3

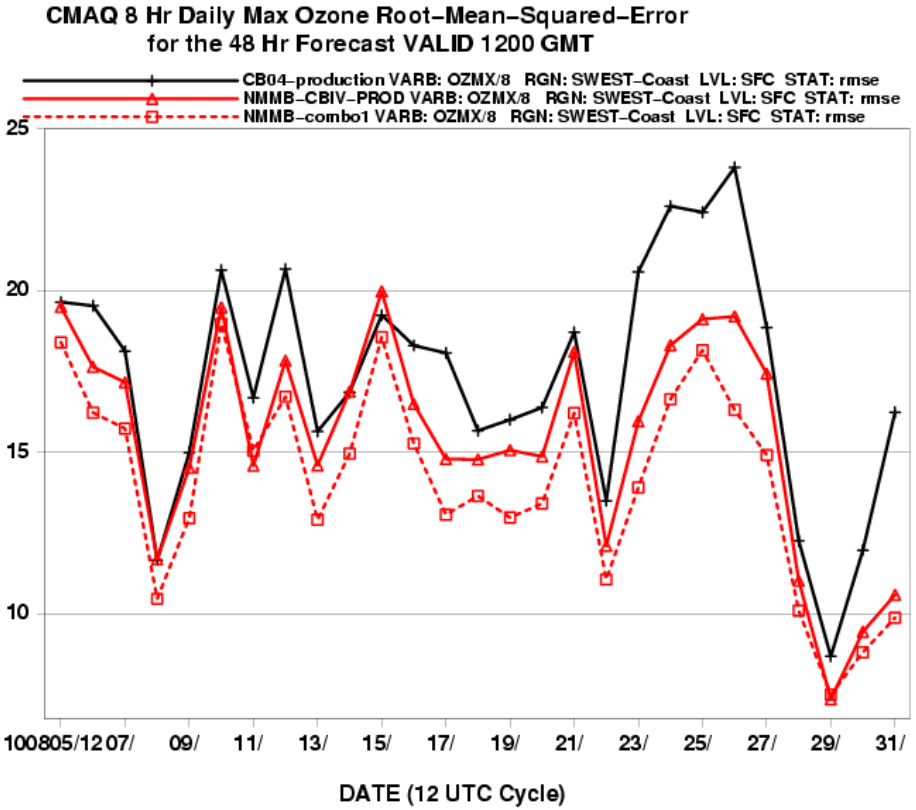
Black: NAM-CMAQ CB IV

Red: NMMB-CMAQ CB IV

Dashed: NMMB-CMAQ CB05 combo1



Northeast RMSE



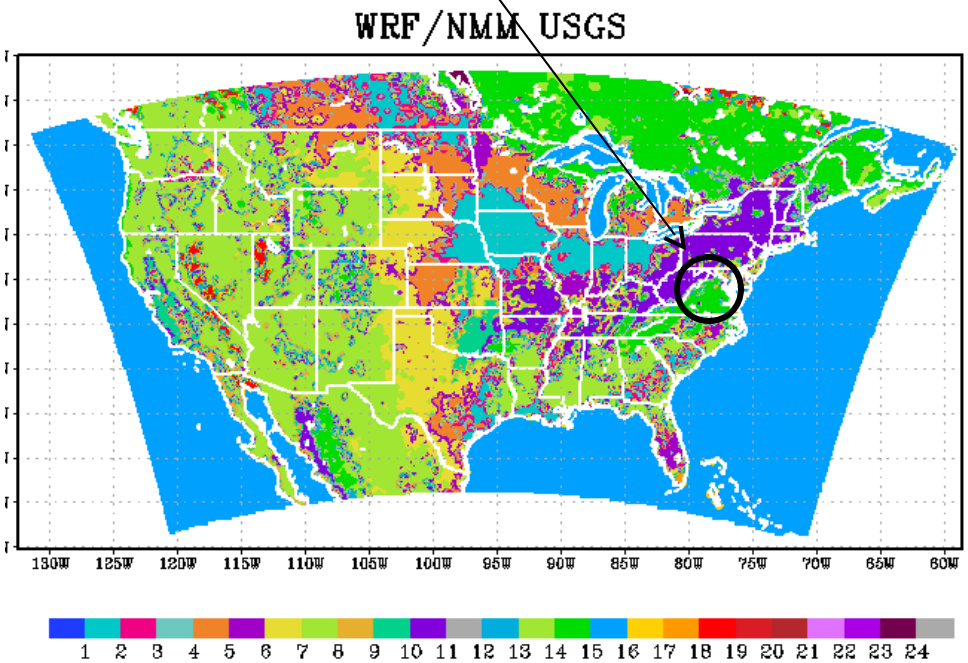
Southwest RMSE

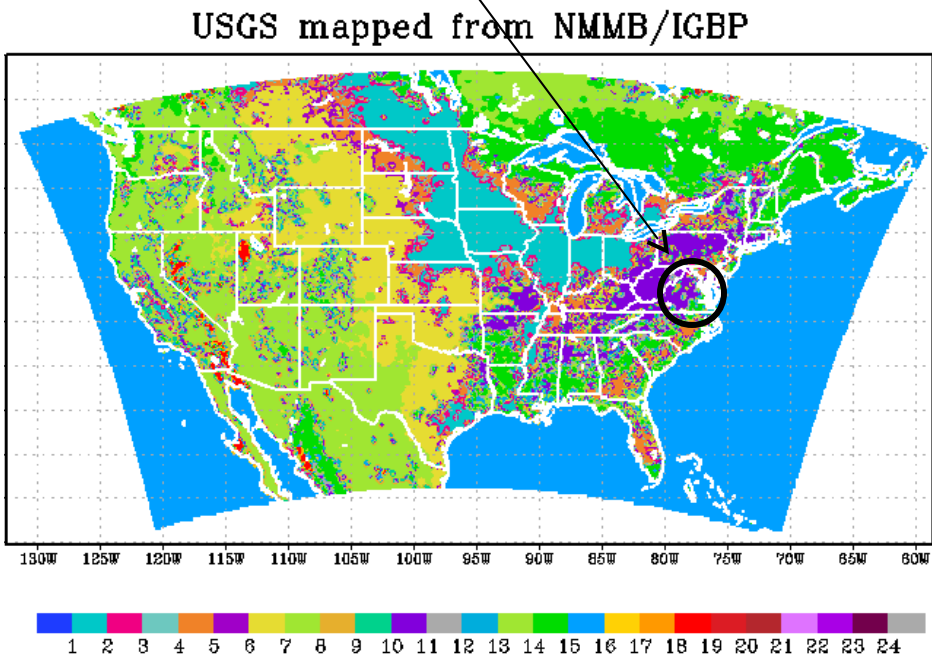
- NMMB-CBIV worse than Production over North East
- NMMB-CBIV & CB05 better than Production over South West

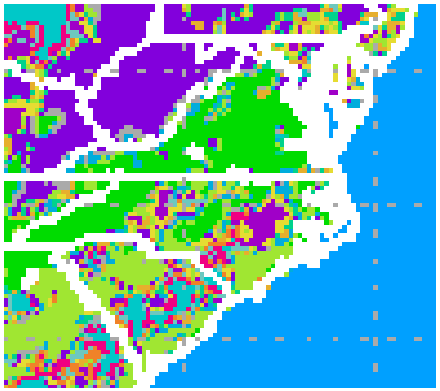
2. NMMB new IGBP Land Use

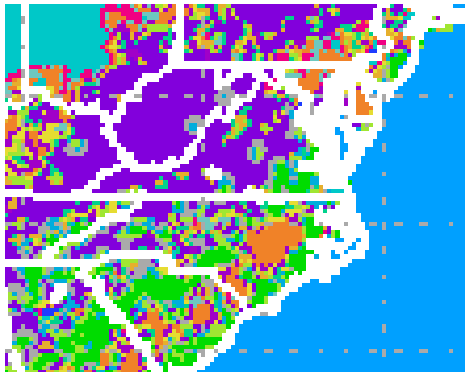
15: Mixed Forest

11: Deciduous Broadleaf Forest

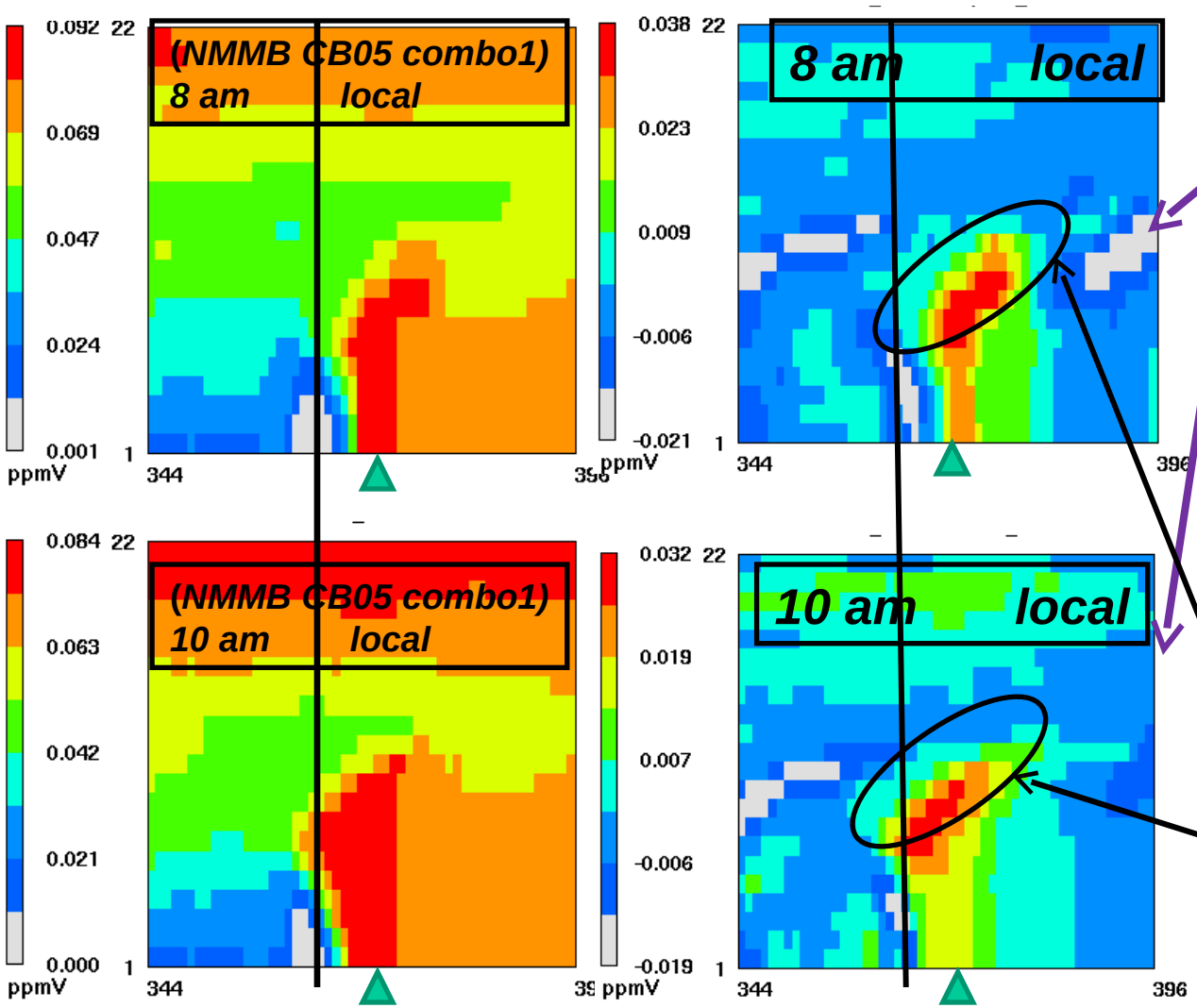








Contributions to early morning O3 spike: Fumigation



Difference plot :
(NMMB CB05 combo1)
Minus
(wrf-nmm CB05 combo1)

Legend:
Latitudinal Cross-section on Philadelphia, PA.

<u>Vertical black</u> line indicates location of Philadelphia, PA.

Stronger fumigation for nmmb in morning

O_3 concentration (ppb) Y-Z cross-section at Philadelphia traversed W-E 600km on Aug 21, 2010

NAQFC : Upgrade of CONUS/HI/AK Predictions

Project Status as of 04/06/11

Project Information and Highlights

Lead: Jeff McQueen, EMC, Chris Magee, NCO

Scope:

1. Introduce loose coupling between NMMB and CMAQ grids.
2. Upgrade anthropogenic emissions with 2011 base year estimates.

Specific to O-CONUS CMAQ CB05 Systems:

1. Upgrade CMAQ CB05 with improved deposition & PBL limits.
2. Upgrade lateral boundary conditions w/ GEOS-Chem monthly averages.

Expected Benefits:

1. AQM is incrementally improved through improved chemistry and physics and the overall forecast skill is raised.
2. Compatibility with NEMS/NMMB
3. Improved unified scripts for all regional runs.

Issues/Risks

Issues:

- Updated FY11 emissions to replace FY05 based data.

Risks:

- Minimal impact since only point sources will be updated

Mitigation:.

- Continue to use FY05 emissions.

G

Scheduling

Milestone (NCEP)	Date	Status
EMC testing complete/ EMC CCB approval	03/18/2011	
Initial Code Delivery to NCO	03//29/2011	
Technical Information Notice Issued	05/15/2011	
Initial Test Complete	04/16/2011	
CCB approve parallel data feed	04/20//2011	
T testing begins	04/18/2011	
T testing ends	05//02/2011	
Parallel testing begun in NCO	04/24/2011	
Real Time Evaluation Ends	05/11/2011	
Management Briefing	05/25/2011	
Implementation	05/31/2011	

G

Finances

Associated Costs:

Funding Sources: EMC Base: T2O 4 Man-months

NCO Base: 2 man-months for implementation, 1 man-month annually for maintenance

R	Management Attention Required	Y	Potential Management Attention Needed	G	On Target