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EMC/NCO Kickoff Meeting

NAM V3.1

Presented by:

Eric Rogers

Presentation Outline

- Charter Overview
  - **Currently scheduled for FY14Q3**
  - **System description**
  - **Planned changes in the system**
  - **Expected benefits to end users from upgrade**
- Pre-implementation testing to date
- Parallel evaluation
- CPU & Disk resource estimates
- Status / Readiness level for EE
- Draft Schedule

North American Mesoscale (NAM) v3.1.0

Project Status as of 11/25/2013

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Project Information and Highlights

Lead: Geoff DiMego / Eric Rogers EMC and Chris Magee, NCO

Scope:

1. Upgrade NMMB prediction model
    1. Upgrade Gravity Wave Drag/Mountain Blocking
    2. Replace legacy GFDL radiation with RRTM
    3. Upgraded Ferrier-Aligo microphysics
2. New obs or ob treatments in analysis and data assimilation
    1. GPS-RO bending angle observations replace use of refractivity;
    2. Add Meteosat-10 satwind subtypes with different data thinning
    3. GOES-15 radiances
    4. New VAD winds
3. Upgrades to GSI analysis and data assimilation
    1. Hybrid 3dvar - global ensembles from EnKF in background error
    2. New satellite bias correction scheme
    3. Cloud assimilation with diabatic digital filter
    4. Mesonet wind obs directional use list from RTMA
    5. Variational QC scheme in GSI code
    6. Use GDAS ozone in GSI for radiance assimilation enhancement
    7. Raob level enhancement
4. Improve / enhance output products

Expected Benefits:

1. Significant reduction in error level and growth rate of tropospheric temperature, wind and moisture (fits to radiosondes); improved convective storm structure

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Scheduling

Milestone (NCEP)	Date	Status
Initial EE setup (NCO Support)	04/04/2014	
EMC testing complete/ EMC CCB approval	04/25/2014	
Code delivered to NCO	04/28/2014	
Technical Information Notice Issued	04/26/2014	
CCB approve parallel data feed	05/06/2014	
Parallel testing begun in NCO	05/31/2014	
Real-Time Evaluation Ends	05/30/2014	
IT testing begins	05/31/2014	
IT testing ends	06/07/2014	
Management Briefing	06/08/2014	
Implementation	06/13/2014	

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Issues/Risks

Issues: Afternoon surface cold bias in winter over CONUS is worse than current NAM; bias has been reduced with recent microphysics/radiation changes

Risks: This might degrade NAM-MOS forecasts

Mitigation:

Provide MDL with NAM parallel results to derive new MOS coefficients. Continue efforts to eliminate or reduce this cold bias.

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Finances

Associated Costs:

Funding Sources:

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

Charter Overview

- **Currently scheduled for FY14Q3**
- **System description**
  - **Utilized by weather forecasters (NWSFOs, NCEP centers, private industry)**
  - **Provides North American guidance at 12-km resolution to 84-h;**
  - **NAM nests (4 km CONUS, 6 km Alaska, 3 km Hawaii/Puerto Rico) provide higher resolution localized guidance to 60-h (nests used for NAM NDFD grids to 60-h)**
  - **“Placeable” 1.33 km fire weather nest run to 36-h used by IMET’s during fire season; NCEP Centers and NWSFO during cool season**

Charter Overview – Model Changes

- Replace legacy GFDL radiation with RRTM
- Modified Gravity Wave Drag/Mountain Blocking
  - More responsive to subgrid-scale terrain variability
  - Target : Improve synoptic performance w/o adversely impacting 10-m wind forecasts
- New version of Betts-Miller-Janjic convection
  - Moister convective profiles, convection triggers less
  - Target : Improve QPF bias from 12-km parent
- Ferrier-Aligo microphysics
- Modified treatment of snow cover/depth
  - Use forecast rime factor in land-surface physics
  - Target : Reduce snow depth in marginal winter conditions w/complex precipitation type
- Reduce roughness length for 5 vegetation types
  - Target : Improved 10-m wind in eastern CONUS

Charter Overview – Model changes targeting NAM nests

- **Current NAM nests**
  - 4 km CONUS, 6 km Alaska, 3 km Hawaii/Puerto Rico, "Placeable" 1.33 km (CONUS) or 1.5 km (Alaska) nest; primarily for fire weather support in summer, varied use during other seasons. CONUS/AK/HI PR nests used as input to NAM Downscaled (NDFD) grids
  - Have "reduced" convective triggering
  - All run to 60-h except 36-h for fire weather nest
- **Nests in NAM upgrade; no change in resolution**
  - All nests except Alaska will run with explicit convection
  - Measures to improve severe storm signatures:
    - Extensive modifications to microphysics (Ferrier-Aligo)
    - Reduce 2nd order diffusion in nests (improves vertical storm structure in cases suggested by SPC)
    - Separate microphysics species advection

Charter Overview – Analysis/Assimilation Changes

- Hybrid variational ensemble analysis with global EnKF
- New satellite bias correction scheme
- Variational Quality Control
- Raob level enhancement
- Use mesonet wind reject list from RTMA
- Use GFS ozone analysis in radiance assimilation
- Cloud analysis and diabatic digital filter initialization with radar-derived temperature tendencies (12 km NDAS only)
- Resume calculation of NDAS long-term precip budget adjustment (used to bias correct Stage II/IV analyses) using CCPA
- New observation types
  - GPS bending angle data
  - GOES-15 radiances
  - New VAD winds (higher vertical resolution)

Charter Overview – Other Changes

- Discontinue use of the AFWA snow depth product in the NDAS due to severe quality control problems. NDAS snow depth will continuously cycle (similar to RAP). Checking once/day, NDAS snow will be removed at any point that is snow-free in the IMS snow cover analysis
- Discontinue use of GLERL water temperatures over the Great Lakes, use MMAB 1/12th deg RTG_SST_HR (SST used in the rest of the NAM domain)
- 28 additional BUFR sounding stations

Charter Overview

- **Expected benefits to end users from upgrade**
  - **Improved large-scale synoptic performance**
  - **Improved 10-m winds over Eastern CONUS**
  - **Increased precipitation bias in 12-km NAM domain**
  - **Improved depiction and vertical structure of severe convective storms (e.g., DC Derecho of June 2012) in the NAM nests**

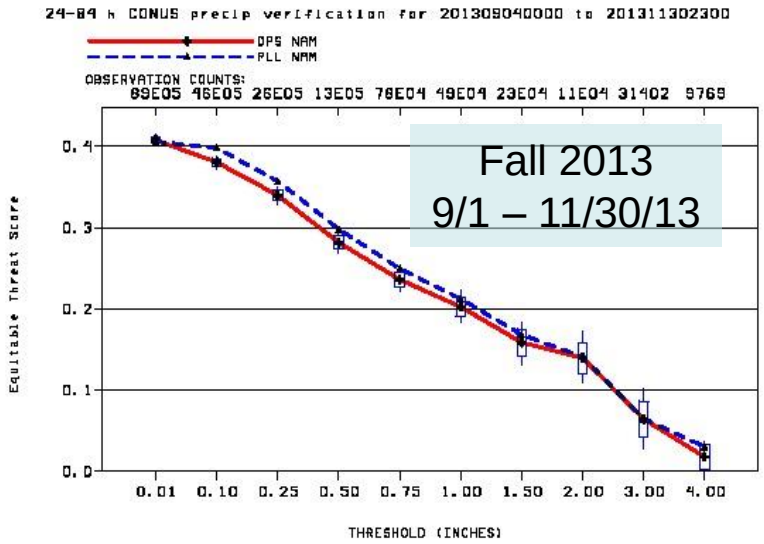
Pre-Implementation Testing

- Primary focus has been with real-time parallel runs
  - Began testing individual components in NAM parallels in August 2011
  - Preliminary versions of the three major component changes (hybrid GSI w/global EnKF, RRTM radiation, gravity wave drag/mountain blocking changes) in place and running together in NAM parallels by April 2012
  - Real-time DGEX parallel started Nov 2013

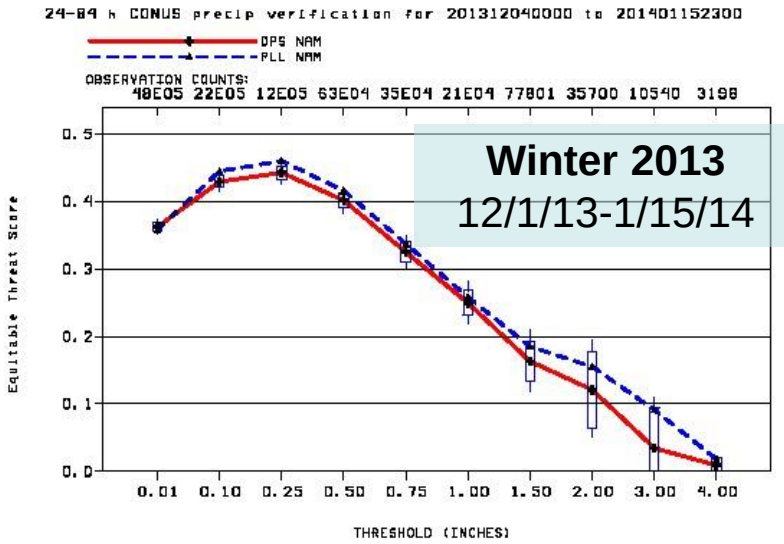
Pre-Implementation Testing

- Retrospective testing :
  - Full NDAS/NAM retrospective systems built on WCOSS and Zeus
  - Extensive case study runs made by Ferrier/Aligo using NAM parallel launcher
- Primary use up to now has been to test impact of microphysics changes on severe storm cases (DC Derecho, May 2013 Moore, OK tornadic outbreak), results have been shared w/SPC.
- Winter-related changes being evaluated as part of WPC's Winter Weather Experiment
- Retrospective periods will be run to provide input to MDL for MOS testing and the MMB AQ group

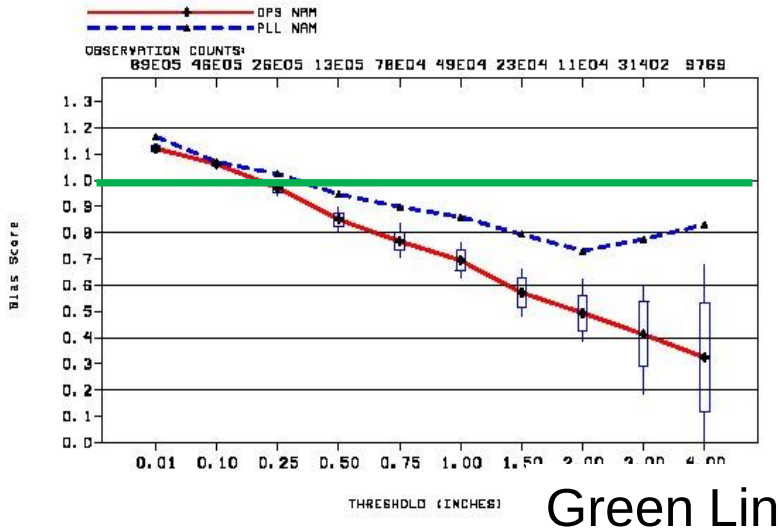
Seasonal QPF ETS (top)/Bias (bottom) : Ops (red) vs Pll (blue) NAM 12 km over CONUS

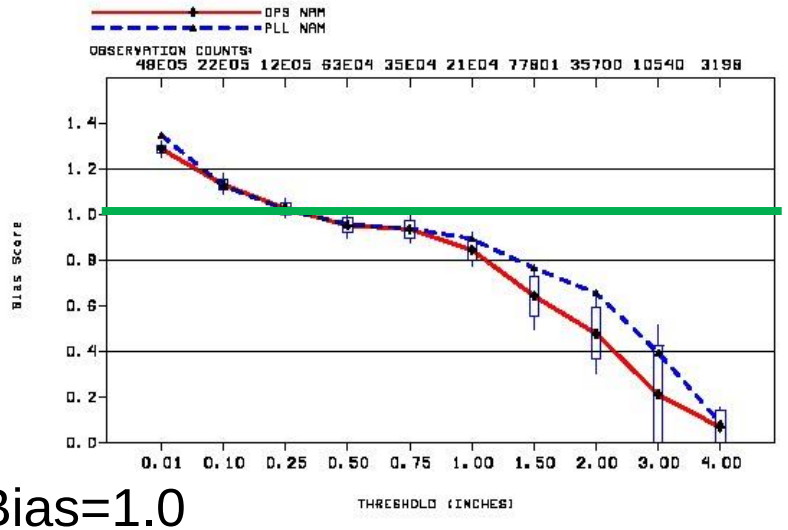


Fall 2013
9/1 – 11/30/13



Winter 2013
12/1/13-1/15/14

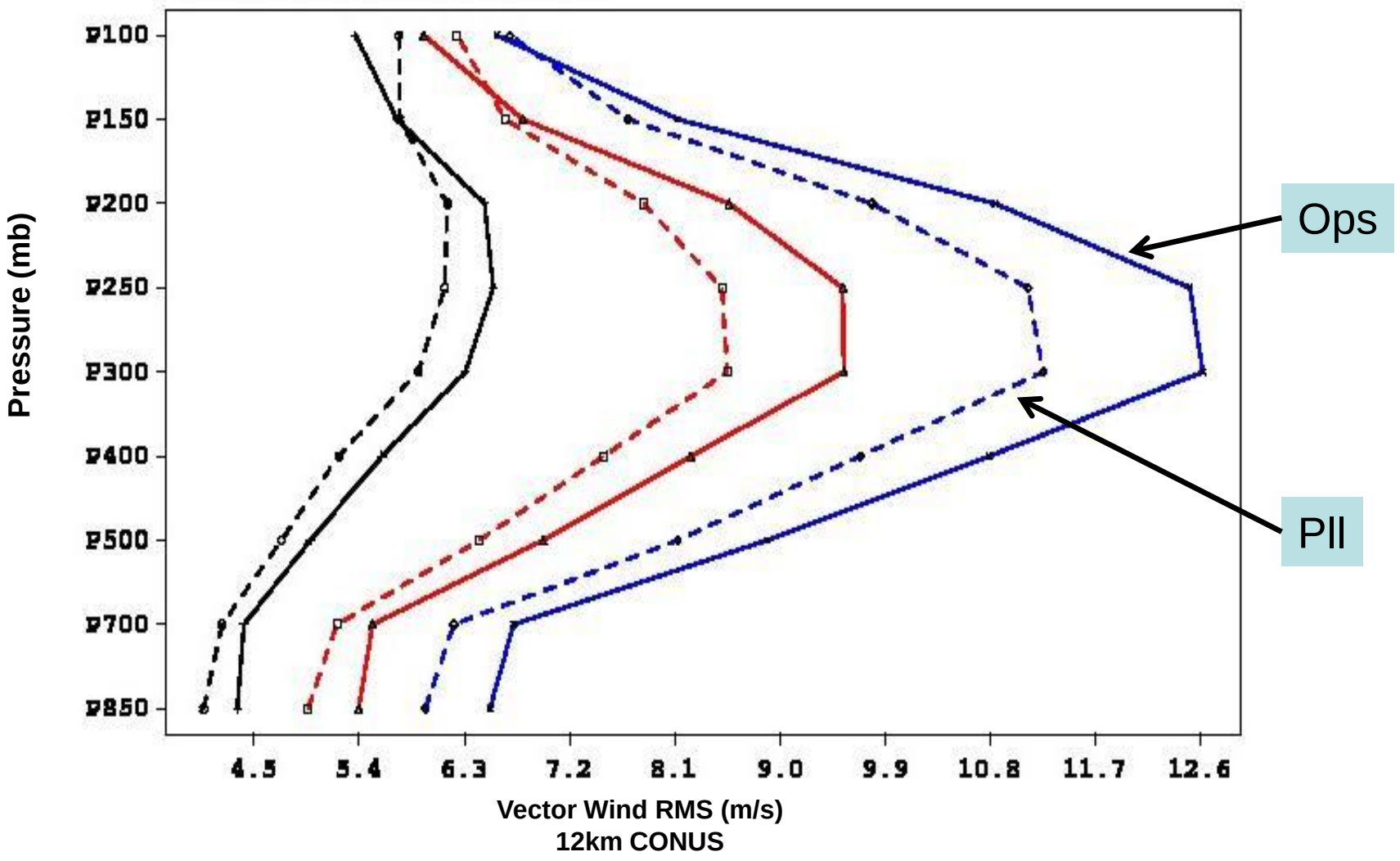




Green Line : Bias=1.0

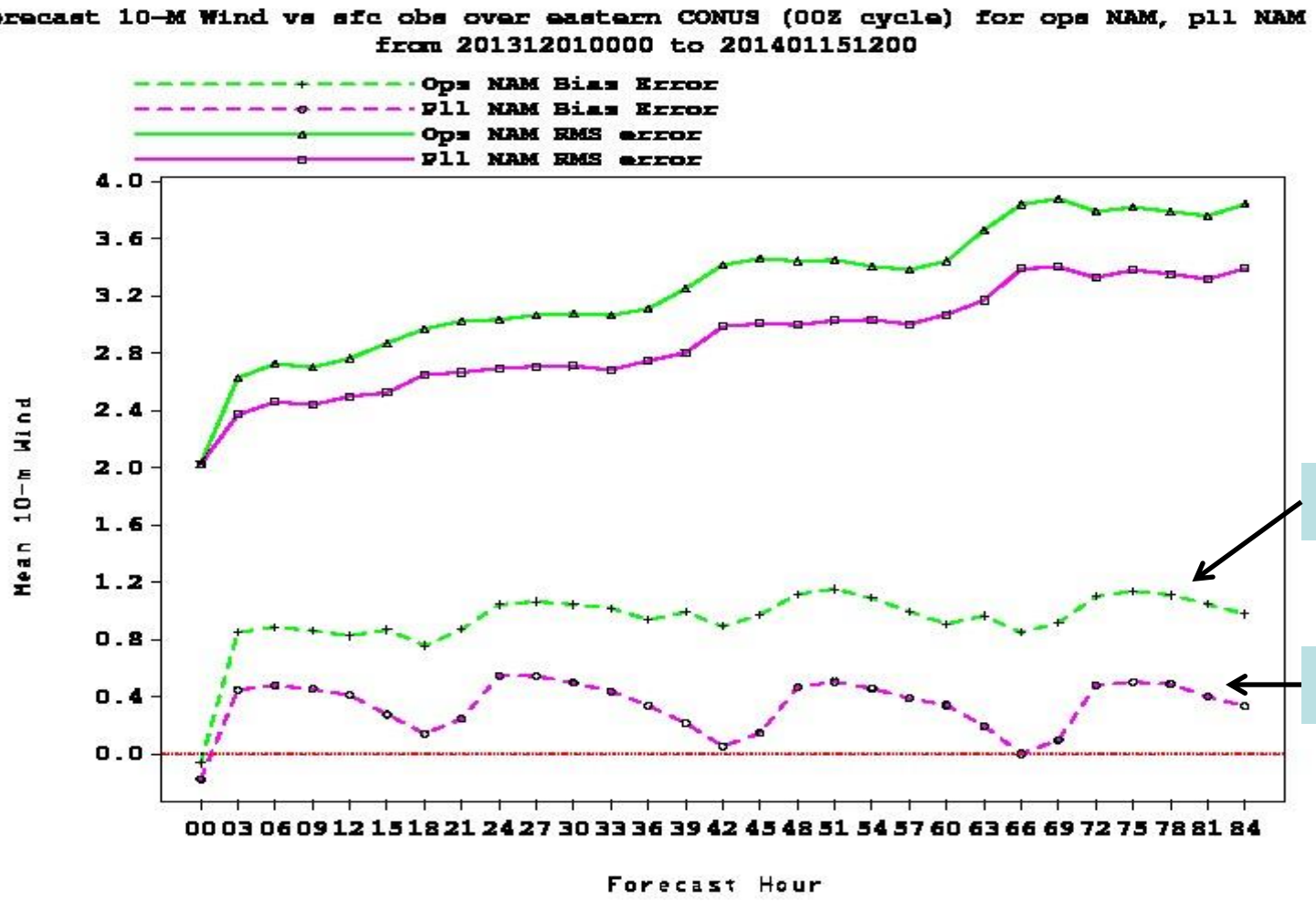
Test Results for NAM FY14 Upgrade Package

Verification vs GFS from 1 October 2013 – 15 January 2014



Test Results for NAM FY14 Upgrade Package

Ops vs parallel NAM 10-m wind RMS/bias over Eastern CONUS from 12/1/13-1/15/14



Ops NAM

Pll NAM

Parallel Evaluation

- Test results for severe convective cases have been shared with SPC as part of the bi-weekly EMC-SPC Modeling Exchange group.
- WPC has been downloading parallel NAM runs in real-time and it has been evaluated as part of the WPC Winter Weather Experiment.
- WPC should be interested in evaluating the QPF performance during warm season; SPC will be interested in severe storm performance by NAM CONUS nest
- NWS Regions also should be contacted

CPU Usage

Current component	Tasks/tasks per node	Proposed tasks/tasks per node, comments
0-60 h NAM forecast	2368/16	~2750-2850/16; increase comes from 1) RRTM and 2) separate microphysics species advection. Code will be given to IBM applications for optimizing prior to handoff
60-84 h NAM forecast	320/16	~380/16
NDAS 3-h forecast	160/16	~192/16 ; increase from RRTM radiation and digital filter
DGEX CONUS	40/16	48/16 ; runs 500 sec faster
DGEX Alaska	40/16	48/16 ; runs 350 sec faster

CPU Usage

Current component	Tasks/tasks per node	Proposed tasks/tasks per node, comments
NDAS analyses	256/16	T.B.D, currently using 224/16, timings are faster by ~ 1 minute if not doing cloud anl, about 1 minute slower if doing cloud anl.
NAM analyses	256/16 for all except CONUS 4 km, uses 304/16	T.B.D, currently using 224/16 but need to adjust to improve timings as much as possible
NAM-12 post	16/8	16/16; IBM provided changes that reduced memory usage in UPP
NAM nest post	16/8 (CONUS) 8/8 (other nests)	No changes
NAM-12 GOES post	64/8	64/16; IBM provided changes that reduced memory usage in UPP
NAM-4 GOES (new)	-	64/8

Additional jobs added with this package

- Job to make simulated satellite grids for NAM CONUS 4-km nest (64 tasks on 8 nodes)
- Additions for DGEX downscaling
  - New DGEX Job (NAM78H_TO_DGEX) to interpolate the NAM 78-h forecast b-grid to the CONUS DGEX b-grid
  - To make DGEX downscaled products to 192-h, need to run an extension of GEFS2SREF job for 93-192 h (currently runs 0-90 h as part of SREF). Decision needed on where this is going to run (DGEX, DGEX smartinit, or SREF)

Disk Usage

- Very few additions to NAM-12/ NAM nest output grids
  - u/v-component of 0-6 km wind shear
  - Radar-derived vertically integrated liquid (CONUS nest only)
  - 2-m specific humidity and cloud bottom height added to NAM grid #218 file
- One additional DGEX native grid (to be used for downscaling to 192-h)
- Model history files ~ 10% bigger, model restart files ~20% bigger, will add ~ 6 GB/day to HPSS and increase scratch space used in /tmpnwprd by NAM/NDAS/DGEX

Output grids/products

- No library changes required now, will use special version of “copygb” with Mark Iredell’s w3lib routine change that fixes silent failures of the copygb step in the NAM fire weather nest post-processing job

Status / Readiness level for EE

- First NAM implementation to be in EE/vertical structure
- Nearly done with final testing, expect to freeze the package by early March
- Have made appropriate script changes for NAM EE, will implement in real-time parallel when package is frozen and will proceed to prepare Subversion tag

Tentative Draft Schedule

Milestone (NCEP)	Date	Status
Initial EE setup	04/04/2014	
EMC testing complete / EMC CCB approval	04/25/2014	
Code delivered to NCO	04/28/2014	
Technical Information Notice Issued	04/11/2014	
Initial Test Complete	05/07/2014	
CCB approve parallel data feed	05/13/2014	
IT testing begins	05/13/2014	
IT testing ends	05/20/2014	
Parallel testing begins	05/20/2014	
Parallel testing ends	06/17/2014	
Management Briefing	06/24/2014	