1204

The Nested Domains of Version 4 of the NAM Forecast System

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Introduction

Version four of the North American Mesoscale Forecast System (NAMv4) features many changes to its model and data assimilation components that serve to improve forecast quality from its convection-allowing, nested domains. A subset of these changes include:

(a) Updates to the Ferrier-Aligo microphysics scheme to reduce noted high-precipitation biases and improve stratiform precipitation.

(b) Improved consistency between model dynamics and physics through calling the physics routines more frequently.

(c) Advecting humidity every dynamics Δt. See poster by Ferrier et al. (#1205, next door!).

(d) 3 km grid-spacing for CONUS (was 4 km), Alaska (was 6 km), Hawaii, and Puerto Rico. The requestable Fire Weather domain uses a grid-spacing of 1.5 km.

(e) An hourly forecast-analysis assimilation cycling period, which includes radar and lightning observations, prior to initializing the free forecasts at the traditional times of 00, 06, 12, and 18Z.

(f) Distinct data assimilation cycles for the CONUS and AK nest domains (NAMv3 only featured a distinct cycle for the 12 km parent domain).

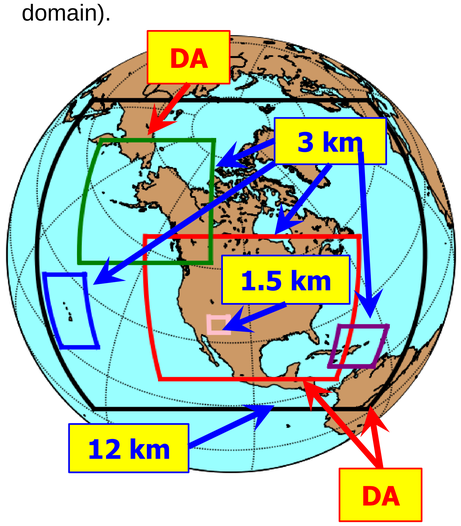

Figure 1. All six NAMv4 domains. Note that all nest domains are 3 km with the exception of the on-demand FireWx domain, which is 1.5 km (requestable in CONUS or AK).

Updates to Data Assimilation

Three significant updates to the data assimilation system have been made to the NAMv4 system. The first of which is the change from a 12-h long, 3-h update frequency data assimilation cycle (Fig. 2) to one that is 6-h long and features hourly updates (Fig 3.). The second major change involves the addition of the 3 km CONUS and AK nest domains to the data assimilation cycle (Figs 1 and 3). Finally, the third major update is the introduction of a complex cloud analysis and the use of lightning (Fig. 4) and radar-derived heating tendencies in the initialization of the CONUS nest domain.

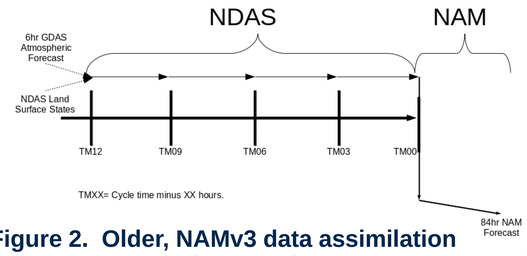

Figure 2. Older, NAMv3 data assimilation diagram. The analysis cycle features a 12-h spin-up of the 12 km parent domain using 3-h analysis updates. Nests not cycled; initialized from 12 km parent.

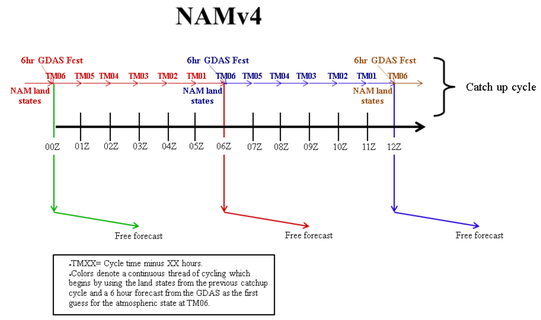

Figure 3. NAMv4 data assimilation diagram. The analysis cycle now features a 6-h spin-up of the 12 km parent, *3 km CONUS nest, and 3 km Alaska nest* domains with *hourly updates*. Non-cycled nests are still initialized from the 12 km parent domain at TM00 (i.e. 3 km Hawaii, 3 km Puerto Rico, and 1.5 km FireWx). See Fig. 1 for domain locations.

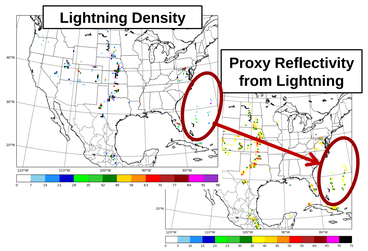

Figure 4. Lightning data can provide a clear indication of storms where radar coverage is poor.

Microphysics

Ferrier-Aligo (FA) microphysics have undergone updates to improve the representation of stratiform reflectivity and anvil structure (Fig. 5) as well as improve the notable high QPF bias in the NAM's nest domains (Fig. 6).

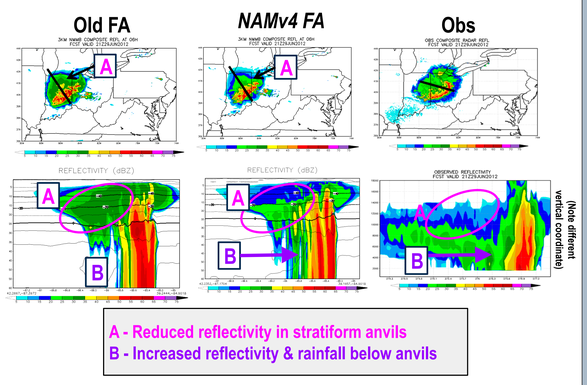

Figure 5. Radar reflectivity comparisons of NAMv3 FA (left column), NAMv4 FA microphysics (middle column), and observations (right column). The case depicted is from June 29th, 2012 – at 21Z. Forecasts are 6 hours in duration.

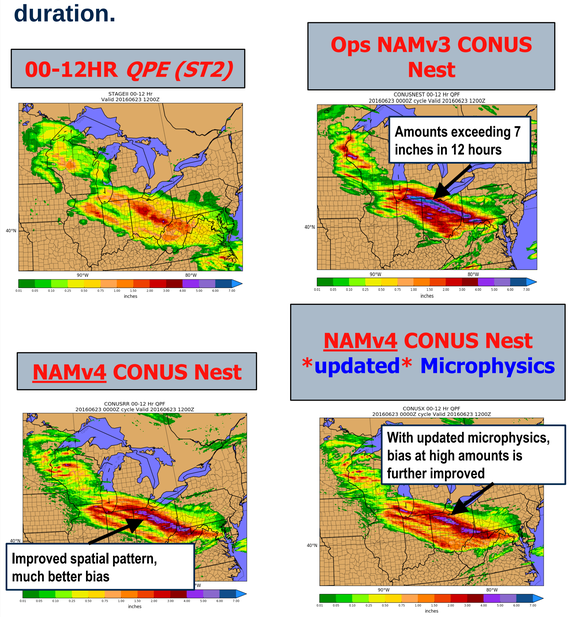

Figure 6. 12 hour QPF forecast comparisons, against Stage II (upper left) among NAMv3 CONUS nest (upper right), NAMv4 CONUS nest with old FA (lower left), and NAMv4 with updated FA microphysics (lower right).. The case depicted is from June 23rd, 2016 – at 12Z.

Verification

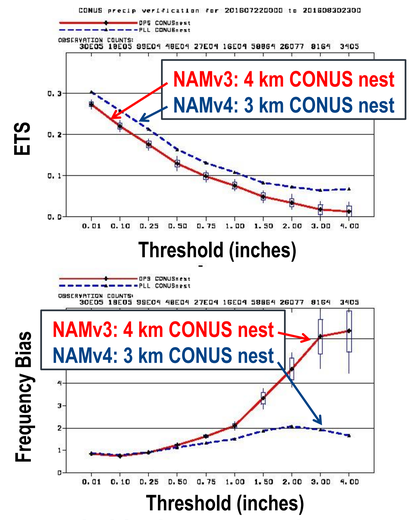

Figure 7. Equitable threat score (ETS; upper panel) and frequency bias (lower panel) precipitation verification statistics comparing the NAMv3, 4 km CONUS nest to the new, NAMv4 3 km CONUS nest. Verification covers forecast hours 24-60 from July 22nd to August 30th, 2016.

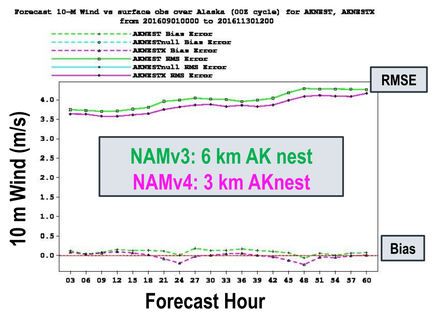

Figure 8. 10 m wind verification statistics comparing the NAMv3, 6 km AK nest to the new NAMv4, 3 km AK nest. Verification covers 00Z forecasts from September 1st to November 30th, 2016.

Summary

- Operational implementation in Feb. 2017 (soon!)
- Improved QPF, storm structure
  - Especially in the short term for the CONUS nest with the use of radar and lightning data
- Faster spin-up for CONUS and AK nests, owing to new DA cycles for these domains.
- Improved upper level and surface stats (not focused on here)

Other NAMv4 Presentations at the AMS Annual Meeting

- Aligo et al., Session 4B.4 (Tues 1/24) on microphysics changes
- Ferrier et al., Poster Session 3, #1205 (Wed 1/25) on NMMB model changes (next door!)
- Liu et al., Session 9.5 of IOAS Conference (Wed 1/25) on radar and lightning assimilation
- Rogers et al., Session 3B.4 (Mon 1/23) on NAMv4 and the Evolution to a High-Resolution Ensemble Forecast System