Tropical Storm Relocation in the North America Model (NAM)

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1. Introduction

The operational North America Model (NAM) at NCEP has been complementary to the global forecast system (GFS) in providing higher resolution products to forecasters. But it has been lagging the GFS in the tropical storm track forecasts. One reason is because the storm center in the analysis, on which forecasts are based, is sometimes too far off from the observed storm location. The GFS has instituted a storm center relocation which the NAM currently does not have. In order to increase the accuracy of NAM track forecasts, the storm center relocation scheme is tested by moving the analyzed storm center to the observed location, hence making the NAM initial conditions more in alignment with reality.

Indeed, results show that not only the initial analysis location of a relocated storm center is closer to the observed than that without relocation; the forecast accuracy of storm tracks is also increased as the initial conditions are improved. The plan is to implement TS relocation into the operational NAM in an upcoming upgrade.

2. Technical procedures for relocating a storm center to the observed location

It is basically a so-called "mechanical relocation" scheme and the automated system involving many steps: (a) Detect TC vitals, define a storm domain and determine the number of storms; (b) Run NPS (NAM Preprocessing System) to get boundary conditions from GDAS 6hr forecasts, and create a 70x70 lat-lon nest centered on the storm center; (c) Get NDAS variable fields to be relocated from the restart files; (d) Combine GDAS and NDAS data, using GDAS data to fill in NDAS data gaps; (e) Generate environment fields, splitting the perturbation from environment (the perturbation patches are on a 30x30 lat-lon nest); (f) Combine perturbations with environment fields in the new location, smoothing gradually toward the edges; (g) Merge the relocated fields into the restart file; (h) Repeat the process for multiple storms if necessary; (i) In the prep buffer data, remove SYNDATA and dropwinsonde within a 200km radius from the center of the storm; (j) Use the relocated restart file to produce the analysis. The procedures are carried out at T-06 and T-00 hours. At the end of the T-00 procedure, 84-hour forecasts are produced.

3. Retrospective relocation and control experiments

Two experiments are carried out using the most recent NAM version (nam.v3.1.0) at the time: the first using the relocation scheme and the second without relocation as the control experiment. Everything else in the NAM is exactly the same.

There are 8 named tropical storms from 2012 to 2014 chosen for these experiments due to their impacts on land. Geographically they are distributed over the Atlantic Basin, Gulf of Mexico and East Pacific Basin. Figure 1 shows the zonal wind differences before and after relocation for Hurricanes Sandy and Tony on 12Z October 25, 2012. It is clear that the winds near the storm centers have been altered. The

rest of the forecast area is identical, which is exactly what the system is designed to do – moving the storm perturbation to the observed location without impacting the outside area.

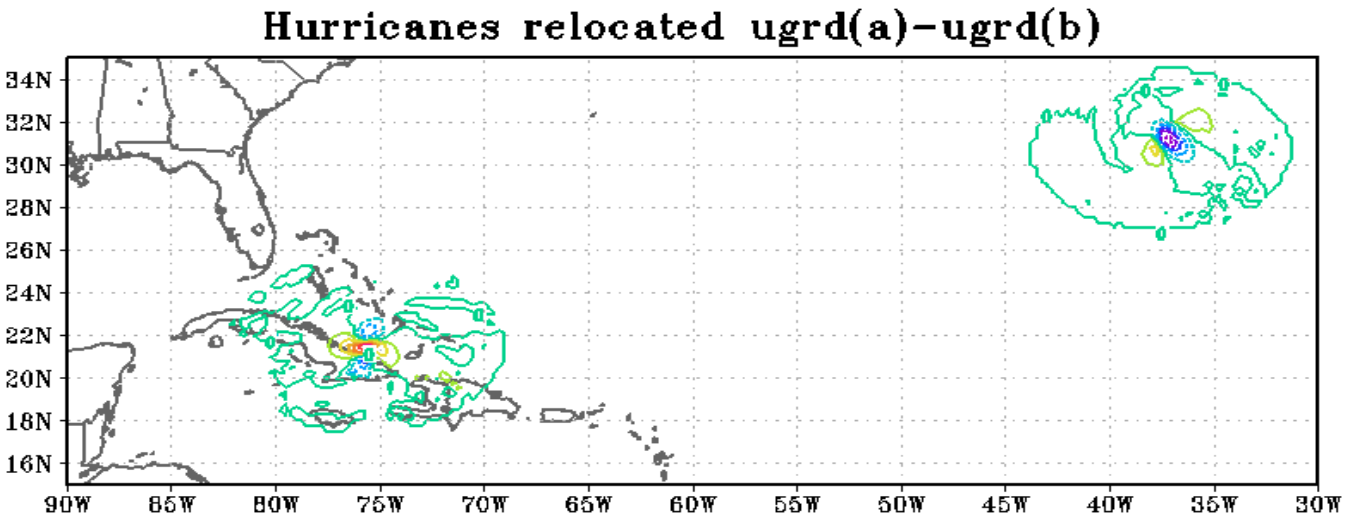

Figure 1. Zonal wind differences before and after relocation is done

4. Statistical results

All verifications are against real time NHC storm center reports. Figure 2 shows track errors for the relocated centers (blue), control (red) and operational NAM (green). It is clear that the relocated center errors are always smaller than the control run errors. This demonstrates that not only initial center errors are reduced (0.67 NM), but also the forecast track errors are consistently decreased (up to 2.93 NM at 72 hours) compared to the control runs.

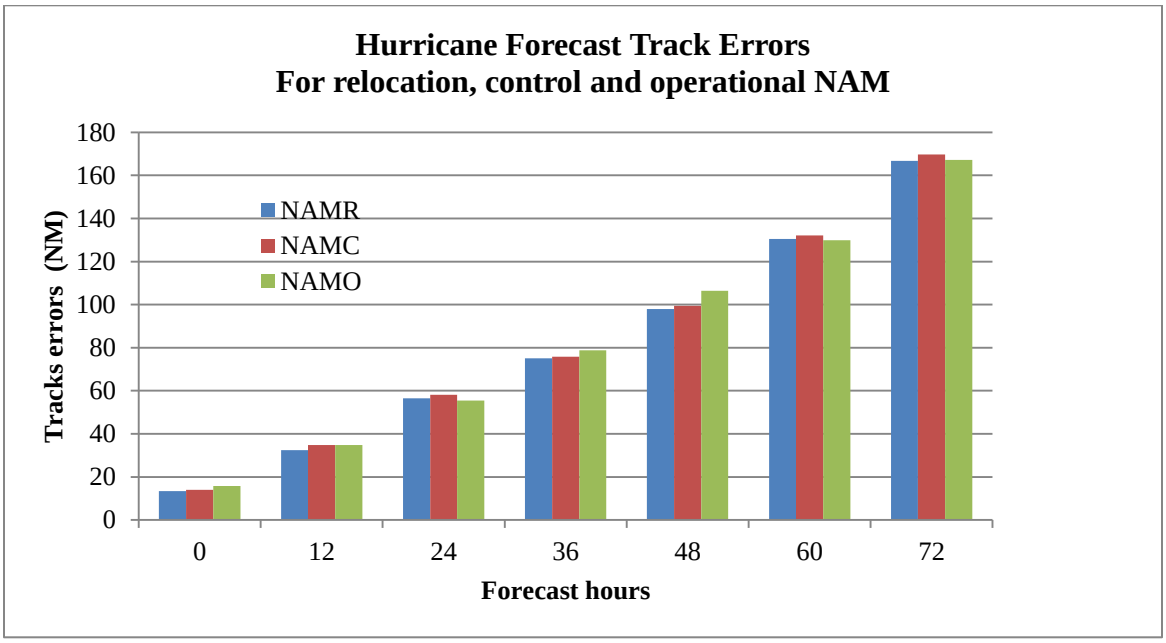

Figure 2. Track errors for NAM (R-relocation, C-control, O-operational)