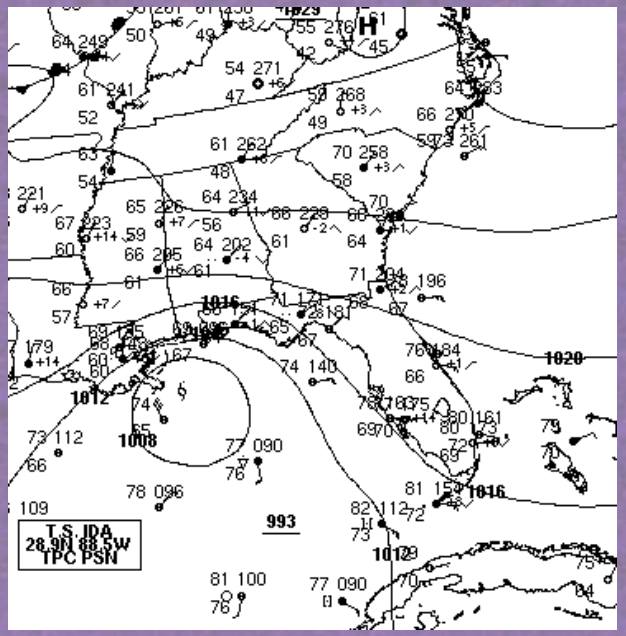
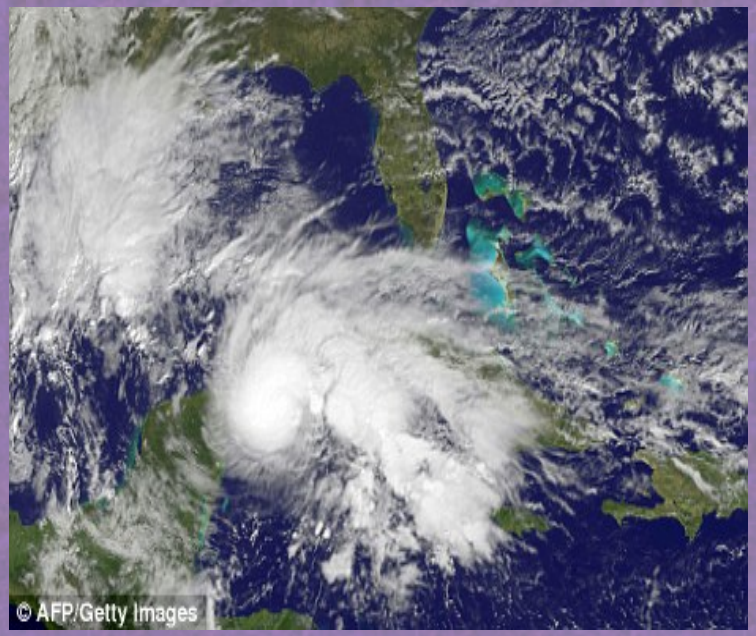
A Comparison of Model Precipitation Forecasts for Hurricane Ida (2009)





CMMAP Graduate School Colloquium

Wednesday August 3, 2011

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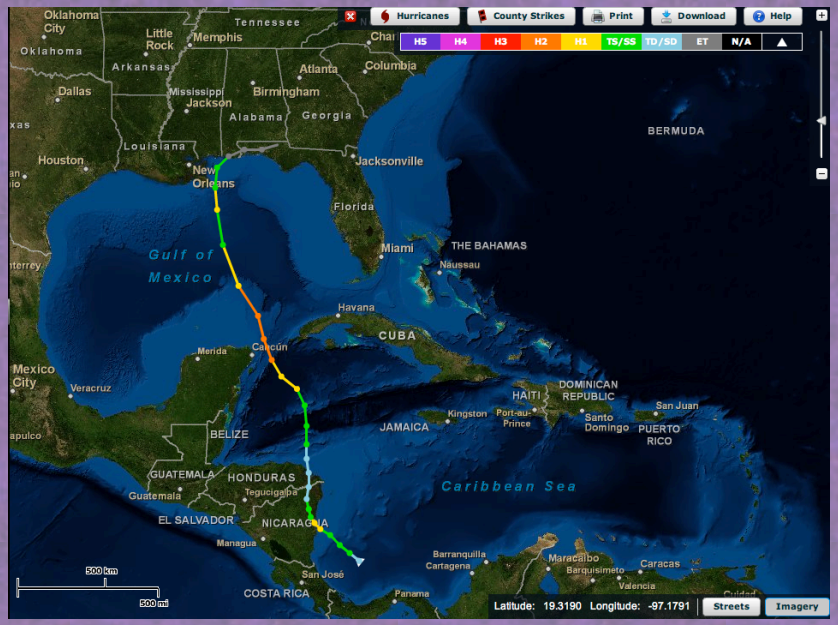
Introduction to Ida

- Hurricane Ida (2009) was a long-lived, weak, late season hurricane
- 4 November – 10 November
- Reached its peak at a category 2 with maximum wind speeds of 90 knots (103 mph)
- Made landfall in Alabama on November 10 as a tropical storm



Introduction (con't)

- Once landfall occurred, Ida became extratropical and merged with an occluded front, forming a new cyclone
- A low level anticyclone in the Northeast caused the new cyclone to stall in the Mid-Atlantic
- Maximum: 18.00" in Hampton, VA

Flooding in Norfolk, VA

Onancock Creek, Virginia

Images from http://www.nasa.gov

Introduction (con't)

- Ida is the most recent hurricane to affect the US with flooding, winds, and storm surge
- Caused $300+ million in damage
- Full development forecasted at 'medium' (30-50%) 18 hours before full formation
- No models had reasonably accurate QPF's until after Ida made landfall

http://www.nasa.gov

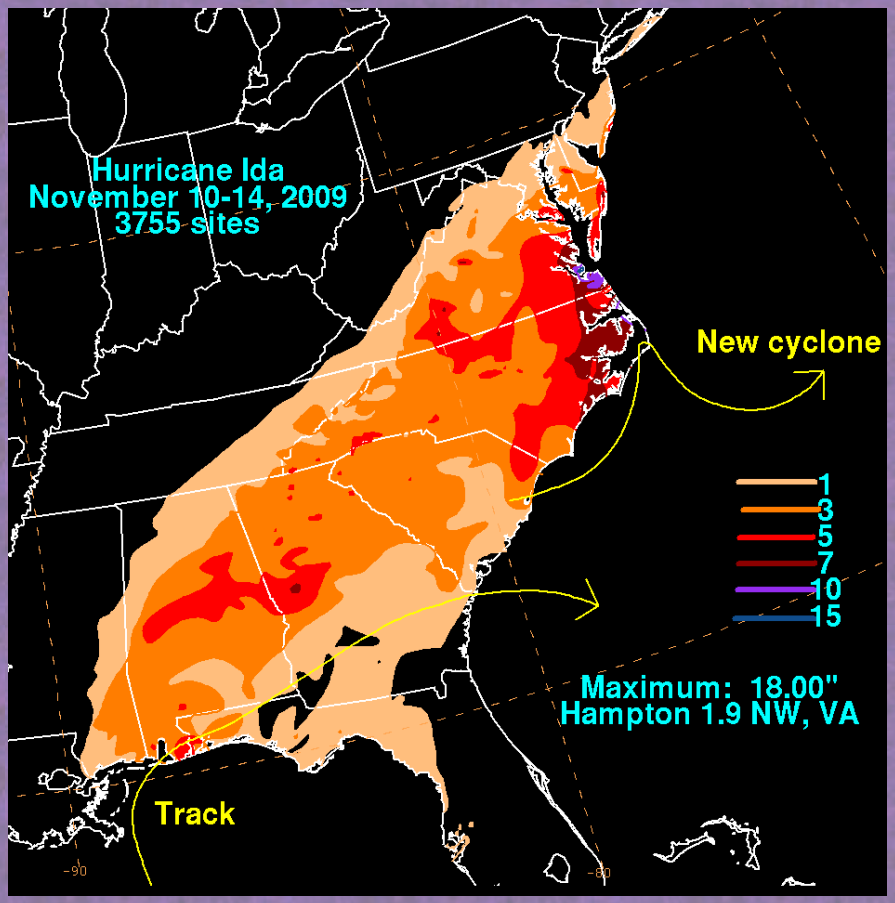
Ida's remnants on 13 November the mid-Atlantic

Objective

- To compare and analyze the quantitative precipitation forecasts (QPF) of the NAM, GFS & HWRF models
  - Pre-landfall: 12z runs from 09 November, out 72 hours
  - Post-landfall: 12z runs from 11 November, out 72 hours
- To determine which model predicted the precipitation forecasts with highest accuracy at each indicated time

Methods

- Pulled archived NAM & GFS data off NOAA site
- Collected HWRF files from local archives
- Created IDL programs to easily compare models
  - NAM, GFS, HWRF, and comparison
- Compared to actual rainfall from 3755 reported sites

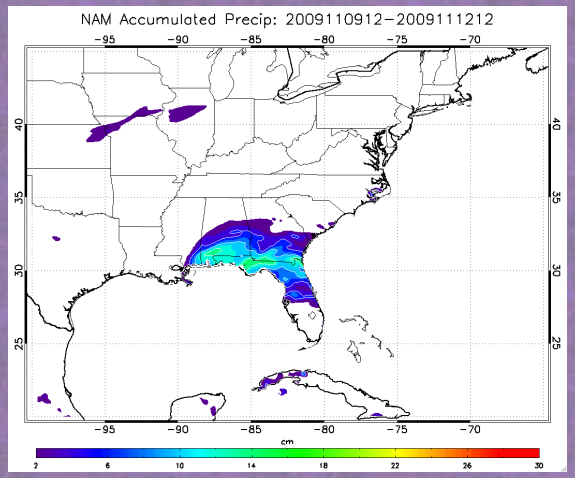


Rainfall map from David Roth, HPC

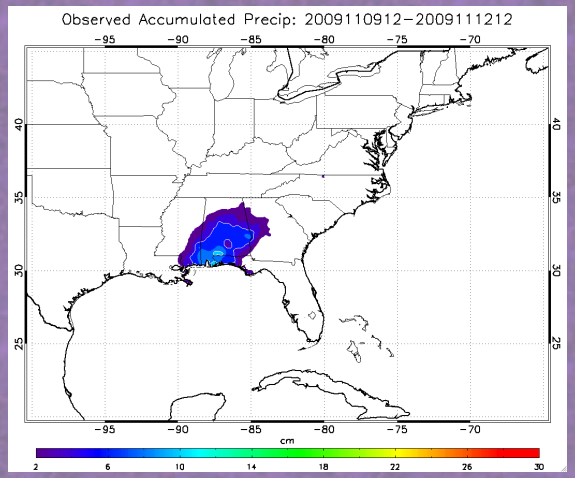
Data: About the NAM

- Uses model grid points nearest to the station
  - 1300+ stations
- Forecasts precip 00z and 12z runs only
  - 84 hr forecasts
- Initialized with a 12-h run of the NAM Data Assimilation System
  - uses all available current observations
- Horizontal grid spacing of 12 km

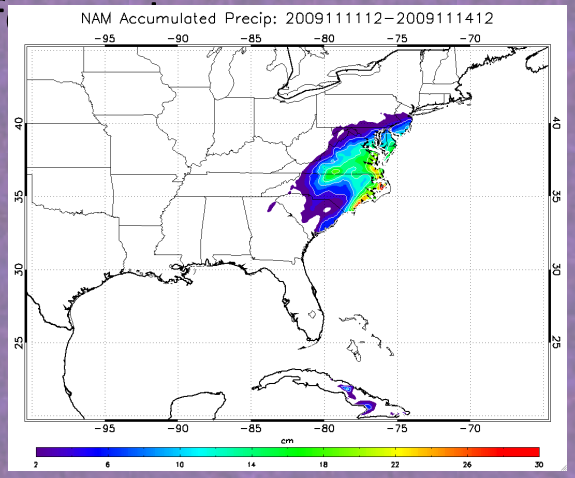
NAM vs. Actual



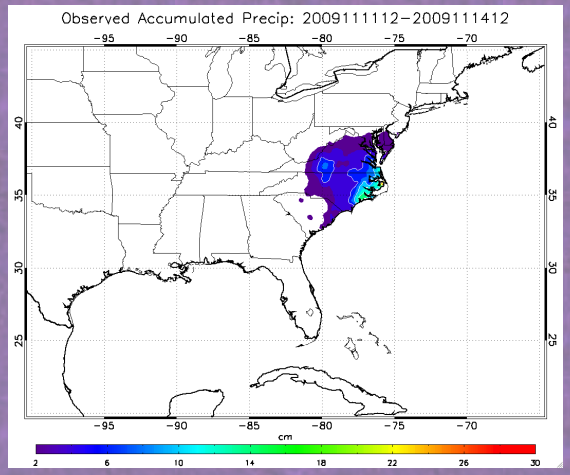
09 Nov 12z to 12 Nov 12z f



09 Nov 12z to 12 Nov 12z actual

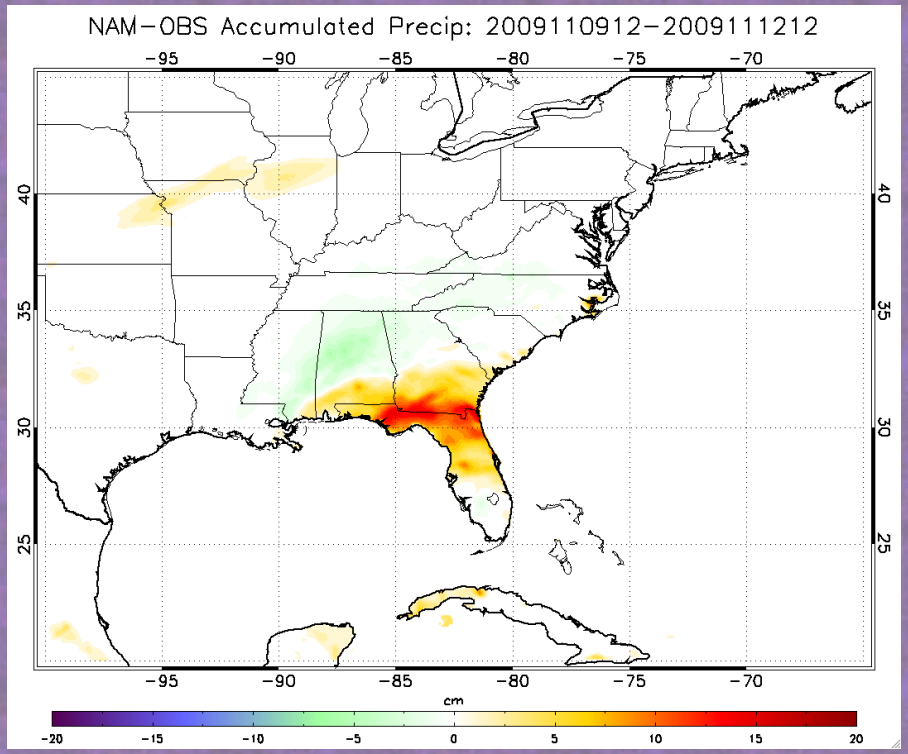


11 Nov 12z to 14 Nov 12z forecast

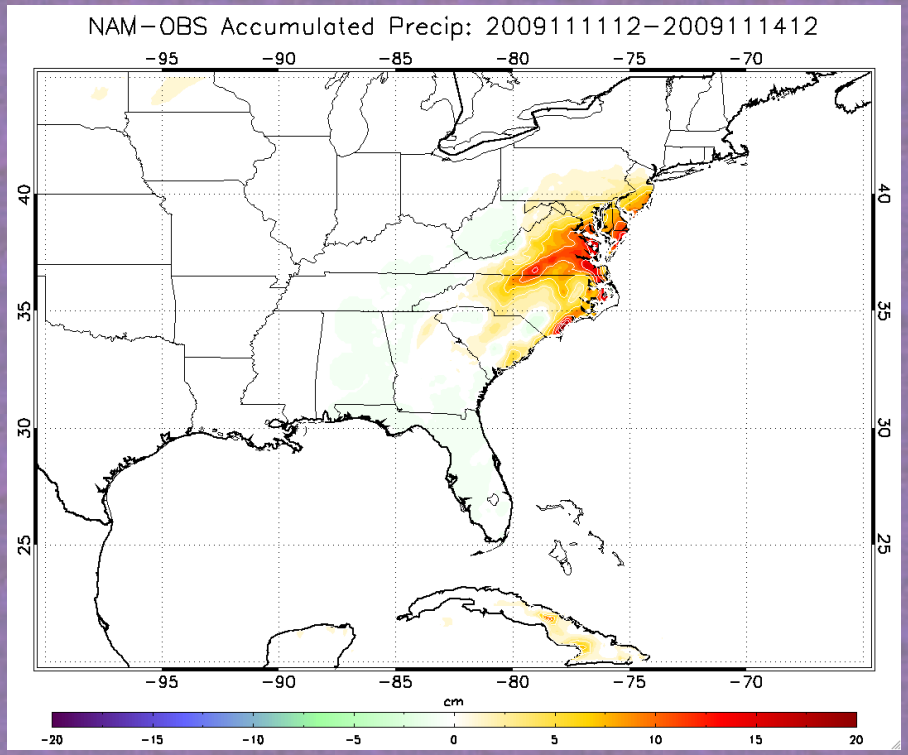


11 Nov 12z to 14 Nov 12z actual

NAM - Actual



09 Nov 12z to 12 Nov 12z forecast-actual

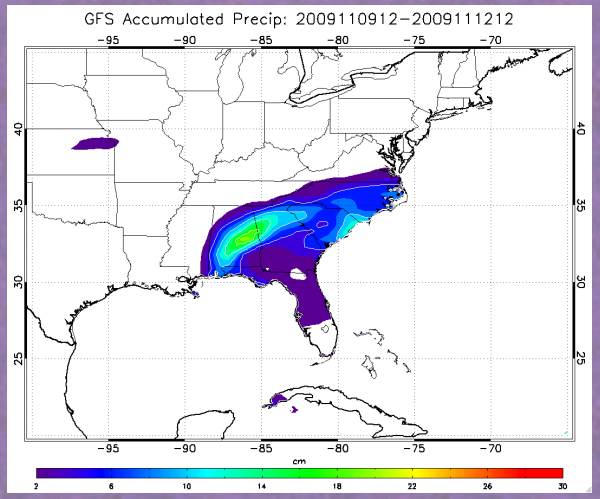


11 Nov 12z to 14 Nov 12z forecast-actual

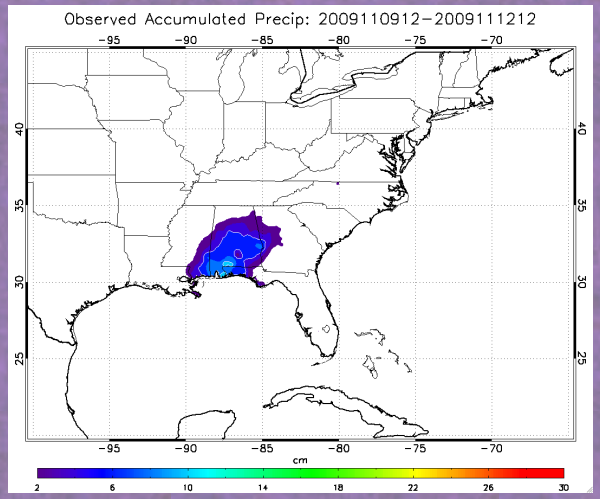
Data: About the GFS

- 384 hr forecasts is determined by the GDAS 9 hr, which are both fueled by GSI (gridpoint statistical interpolation)
- Uses 64 unequally spaced vertical layers, up to 15mb
- Has no initialization
- Horizontal grid of .5 degree

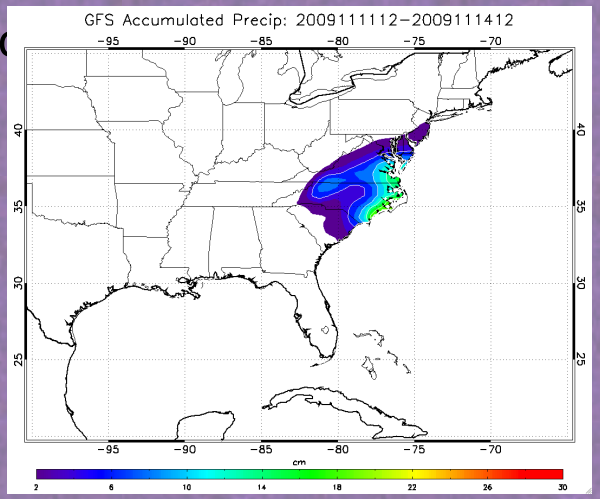
GFS vs. Actual



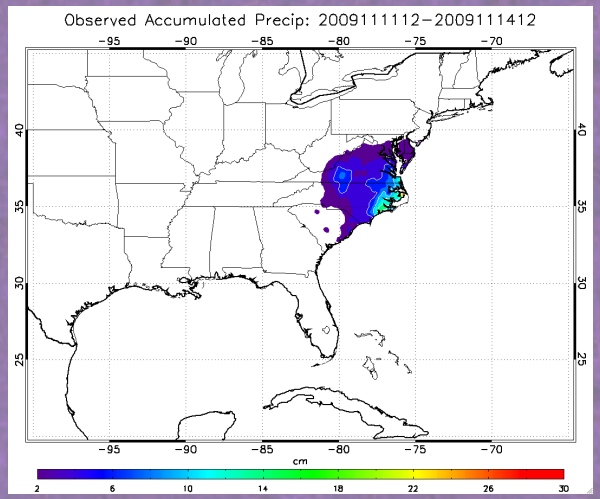
09 Nov 12z to 12 Nov 12z f



09 Nov 12z to 12 Nov 12z actual

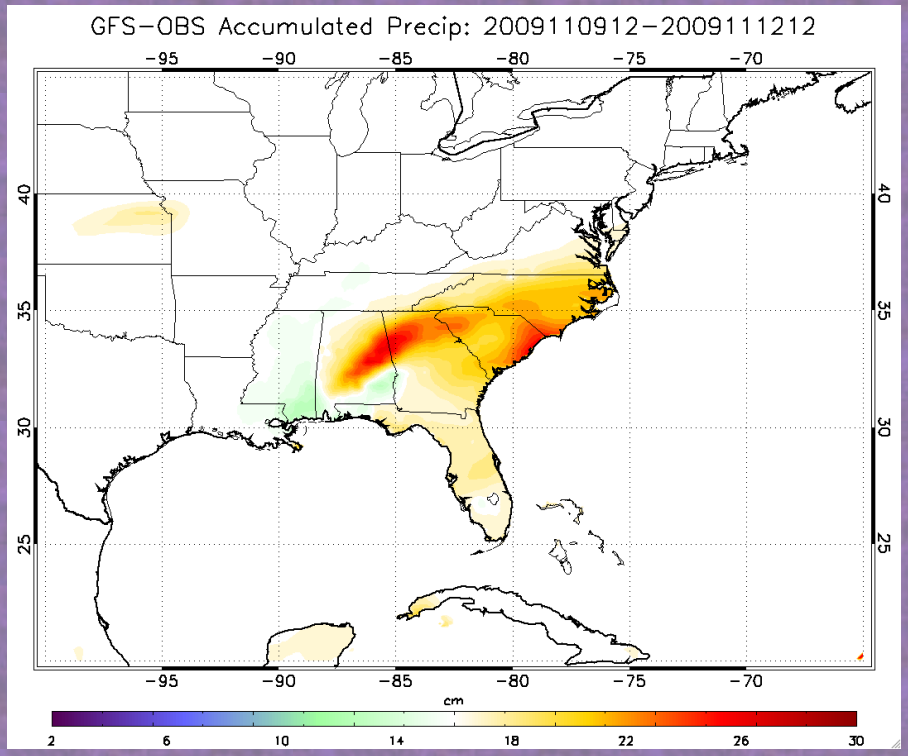


11 Nov 12z to 14 Nov 12z forecast

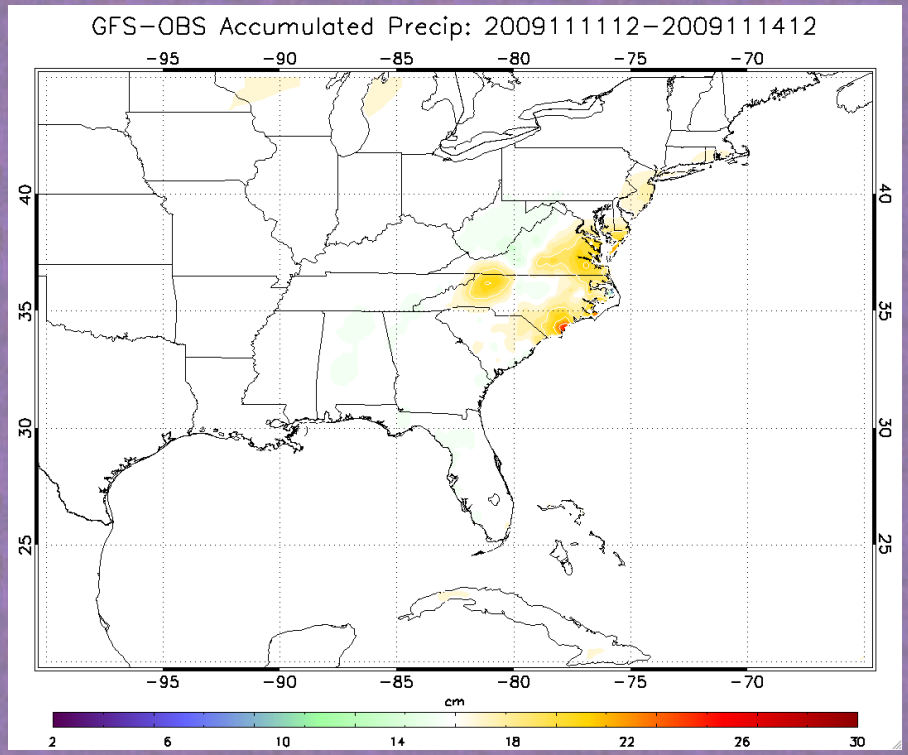


11 Nov 12z to 14 Nov 12z actual

GFS - Actual



09 Nov 12z to 12 Nov 12z forecast-actual

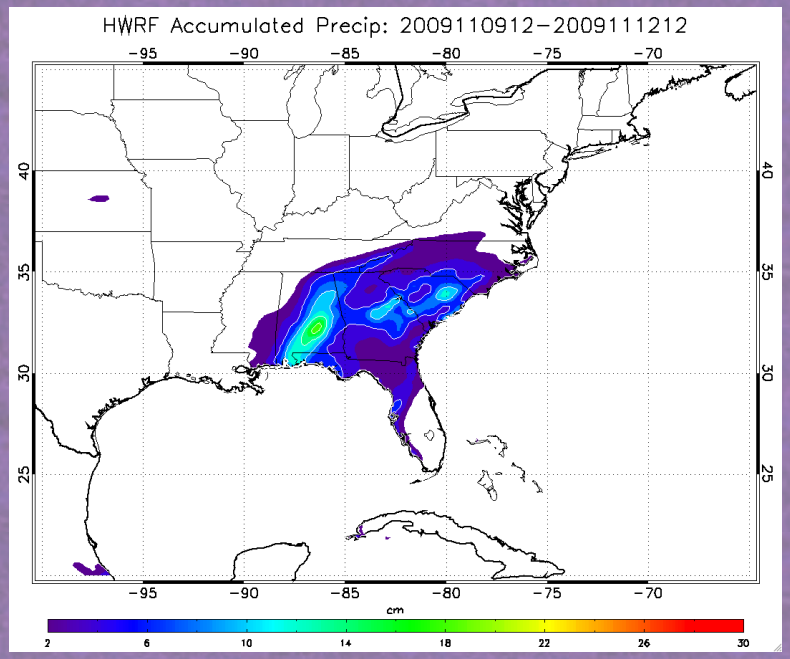


11 Nov 12z to 14 Nov 12z forecast-actual

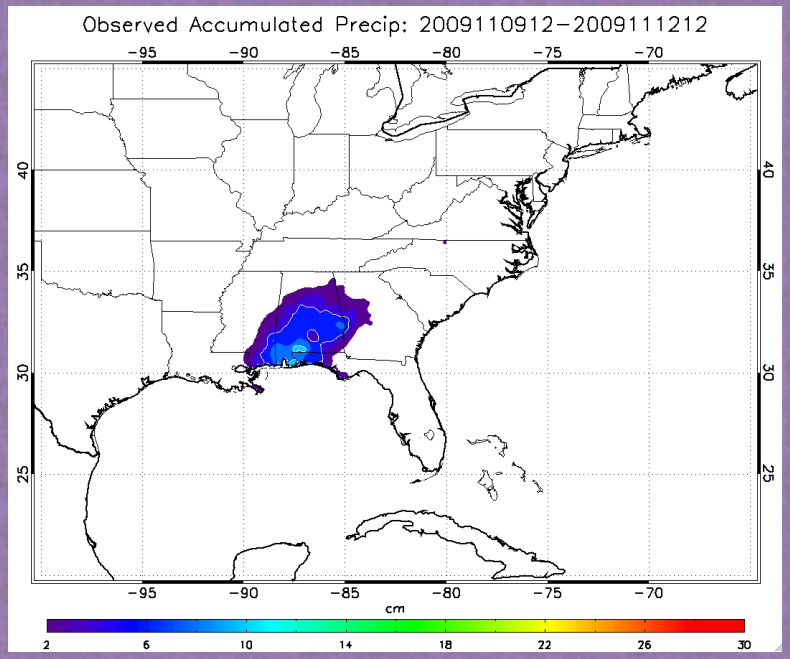
Data: About the HWRF

- Developed in 2007 specifically for tropical cyclone forecasts
- Detailed initialization of ocean and storm scale circulation
- .25 degree grid
- Composed of:
  - WRF software infrastructure
  - Non-Hydrostatic Mesoscale Model (NMM) dynamic core
  - 3D Princeton Ocean Model
  - NCEP coupler
  - physics specific to the tropics

HWRF vs. Actual

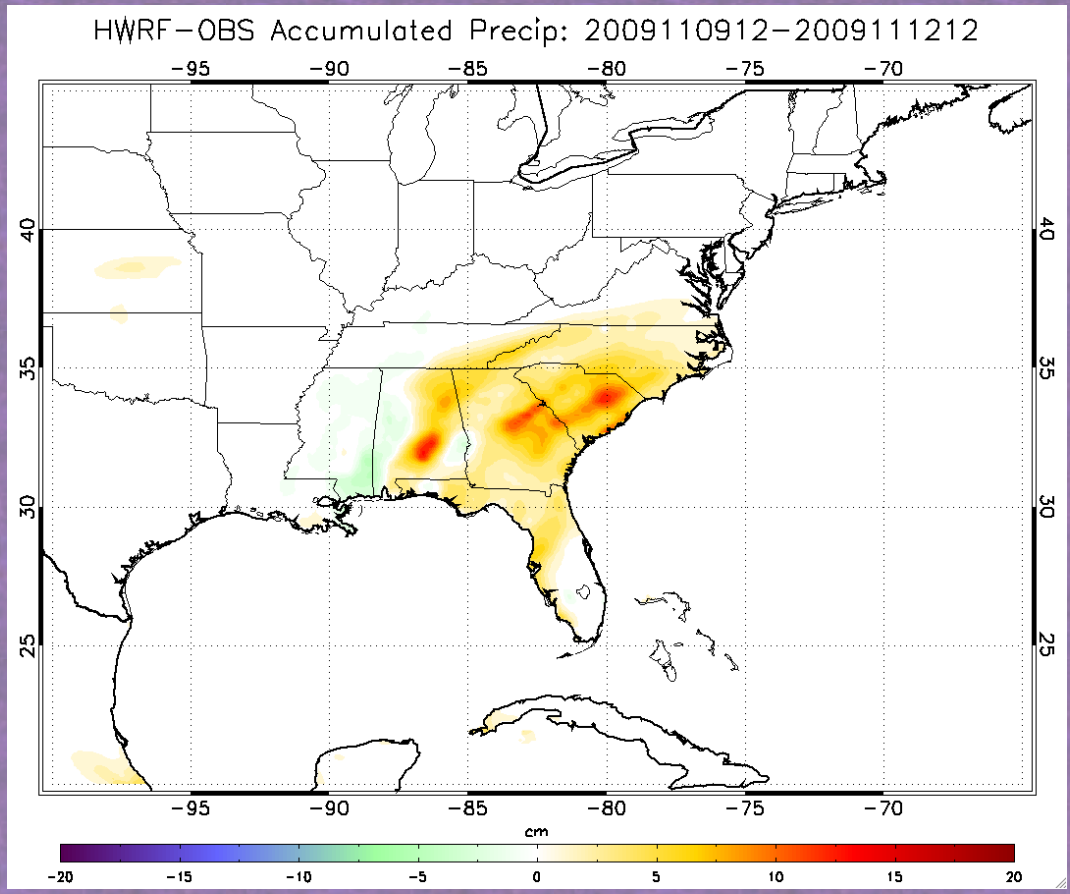


09 Nov 12z to 12 Nov 12z forecast



09 Nov 12z to 12 Nov 12z forecast

HWRF - Actual



09 Nov 12z to 12 Nov 12z forecast-actual

Conclusions

- Ida's remnants stalled along the mid-Atlantic due to a lower level high pressure system in the Northeast, causing the large amounts of rain
- Overall, all models forecasted more than observed rainfall amounts and reasonably accurate locations
- All models did better with totals and locations after landfall occurred
- For 09 November 12z – 11 November 12z, HWRF did best for rainfall amounts as well as locations
- For 11 November 12z – 14 November 12z, GFS did best with rainfall amounts and locations
- Different models performed better at different times, an average of all models should be used to best forecast hurricane rainfall amounts and locations
  - NAM limited by short range forecast
  - HWRF limited by forecasts post-landfall

Acknowledgements

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- I would also like to thank Dr. Wayne Schubert and Brian McNoldy for their assistance in this project, as well as the staff of CMMAP.

Millersville University
SEIZE THE OPPORTUNITY

NSF

Colorado State University

CMMAP
Reach for the sky.

References

- Actual rainfall track data: http://www.hpc.ncep.noaa.gov/tropical/rain/tcrainfall.html
- Archived NAM & GFS http://nomads.ncdc.noaa.gov/data.php?name=access#hires_weather_datasets
- Avila, L. A., & Cangialosi, J. NOAA, NHC. (2010). *Tropical cyclone report: hurricane ida (AL112009). Miami, FL: National Hurricane Center. Retrieved from http://www.nhc.noaa.gov/pdf/TCR-AL112009_Ida.pdf*
- Garcia, M., C. D. Peters-Lidard, and D. C. Goodrich (2008), Spatial interpolation of precipitation in a dense gauge network for monsoon storm events in the southwestern United States, *Water Resour. Res., 44, W05S13, doi:10.1029/2006WR005788.*
- Grumm, R. H. NOAA, NWS. (2010). *Heavy rains with the remnants of ida State College, PA: Retrieved from http://nws.met.psu.edu/severe/2009/12Nov2009.pdf*
- Kraft, J. E. NOAA, NCDC. (2009). *Storm data (0039-1972). Asheville, North Carolina: National Climatic Data Center. Retrieved from http://www1.ncdc.noaa.gov/pub/orders/96E52247-05C1-4B19-8742-5399AF33C0F4*
- *Models information: http://www.emc.ncep.noaa.gov*
- *Ida image: http://quibb.blogspot.com/2009_11_01_archive.html*
- *Surface Analysis image: http://archive.atmos.colostate.edu/data/sfc/QYAA00/0911/*

Thank you!

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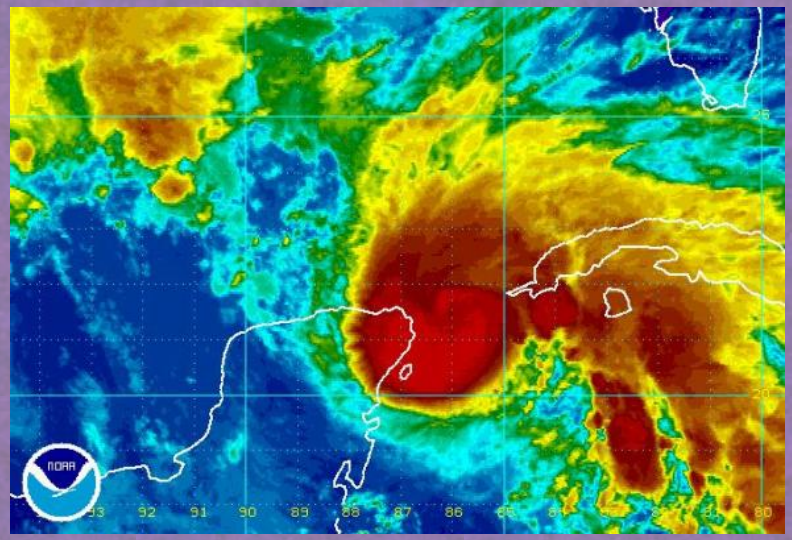

Questions?

http://thestormreport.com/wp-content/uploads/2009/11/rb-l.jpg