Model Rainfall Forecasts for the Historic 1-5 October 2015 South Carolina Rainfall Event

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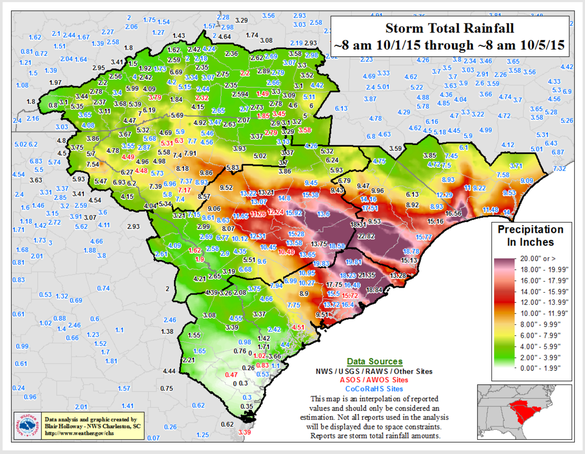
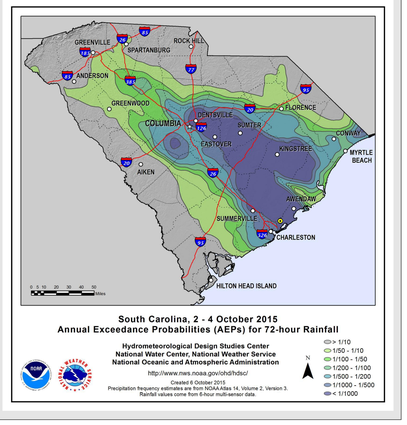
1. Motivation & Background

- Historic rainfall event that produced widespread significant impacts across SC and portions of NC
- $1.492 billion in damages in SC with 19 fatalities (SC Emergency Management Division)
- Approximately 410 roads and bridges closed due to flooding and/or damage, including a 74 mile stretch of I-95 in SC (U.S. Department of Interior Office of Emergency Management)
- Confirmed failure of 36 regulated dams (SC Department of Health and Environmental Control)
- Major river flooding, with recorded peaks of record at 17 river gauges and 15 others that had peaks in the top 5 for the period of record (USGS)

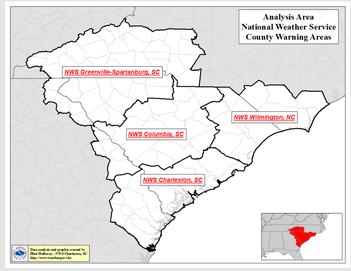


- Widespread area with rainfall totals 12”-18” or more
- Top 5 recorded 4 day totals:
  1. 26.88” Mount Pleasant 6.4 NE (CoCoRaHS)
  2. 24.22” Huger 3 NNE (USGS)
  3. 23.61” Charleston 5.4 SSE (CoCoRaHS)
  4. 23.35” Kingstree 9.5 NW (CoCoRaHS)
  5. 22.82” Kingstree 1 SE (USGS)
- Numerous 1, 2, 3, and 4 day rainfall records broken
- Many areas experienced rainfall, at numerous time ranges, with AEP’s equivalent to a 200, 500, or 1000 year rainfall event



2. Objective and Methodology

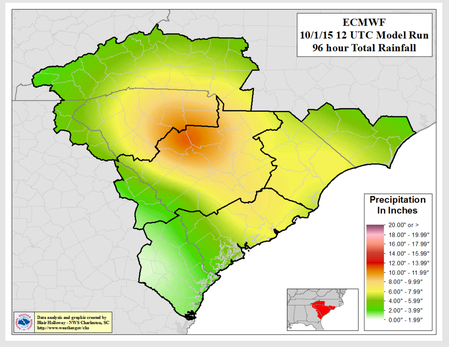
- Evaluated model rainfall forecasts from the 12 UTC 1 October 2015 model run
- Used the 4 day period ending 12 UTC 5 October 2015 for the “event” as that is the time period that encompassed all of the significant rainfall
- Chose the ECMWF, GFS, and NAM for analysis as they are widely used at this time range
- Study area included the NWS offices that serve SC and included the location of the heaviest rain and significant impacts
- Compared model forecasts to observed values using raster datasets in ArcGIS
- Chose the 12 UTC 1 October 2015 model cycle because it was from this point onward that forecasts and messaging ramped up

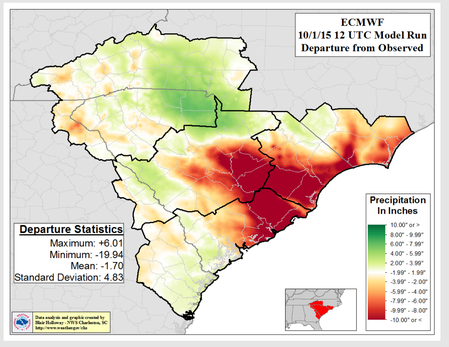


3. Model Rainfall Forecasts and Difference Fields

ECMWF

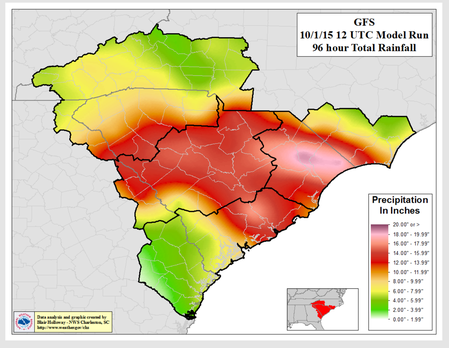
- Almost 20” too dry in the area where the highest rainfall totals were observed
- Maximum rainfall total of approximately 10” displaced inland of the observed maximum
- Too much rain in the NC foothills and the NC/SC piedmont
- Generally did well across the SC Upstate region
- Did an excellent job on the west and southwest periphery of the heaviest rain with departure values of around 1-2”, best of the 3 models in this area
- Driest of the 3 models with an average departure across the study area of -1.70”

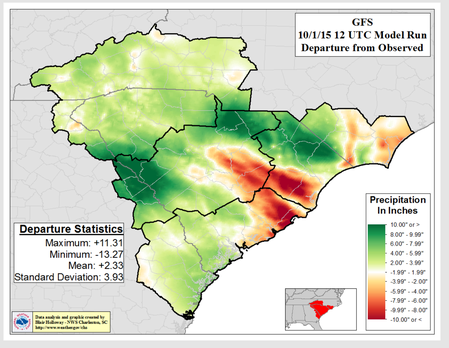




GFS

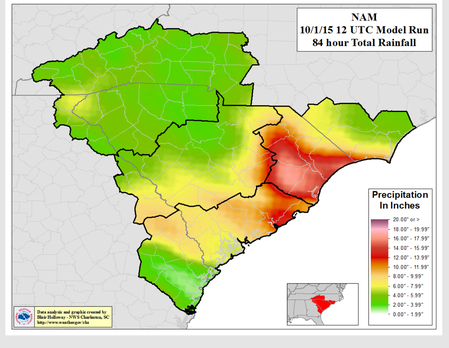
- Highest rainfall totals of the 3 models with a maximum of approximately 18” in very close proximity to the observed maximum
- Too wet on the north side of the observed rainfall maximum, appears to be that its heaviest precipitation was shifted slightly north
- Also too wet inland along the central SC/GA state line as well as across the higher terrain of NC and SC
- Similar to the observed rainfall by showing 2 bands of maximum swaths along the SC coast, but too wet across the entire domain with an average departure of +2.33”

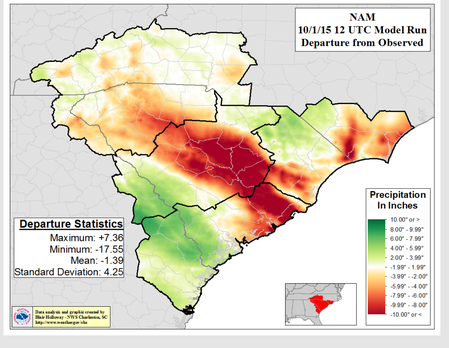




NAM

- NAM run length is 84 hours, 12 hours less than the analysis period
- Maximum rainfall totals around 16” closely located to the observed maximum values
- Didn’t spread heaviest rainfall far enough inland across the NWS Columbia, SC area
- Too wet on the west and southwest periphery of the heavy rain axis
- Lowest departure across the study area with an average of -1.39” and it seemed to be on to something with lesser amounts across the NC mountains
- On the same track as the GFS in showing 2 bands of maximum swaths along the SC coast, but much too dry in the greatest impact area





4. Summary and Conclusions

- Overall, the 12 UTC 1 October 2015 model runs resulted in increased confidence that a very high magnitude rainfall event would occur
- Models varied with the exact placement of the axis of the heaviest rain and the tight gradient, but still provided beneficial forecasts
- This was a critical time frame and these model forecasts combined with WPC guidance allowed local NWS offices to begin ramping up forecast rainfall amounts and issue Flash Flood Watches
- Also, this was the time period when briefings and DSS activities for federal, state, and local emergency management officials began to take place and NWS offices started using enhanced wording such as “Historic Rainfall and Life Threatening Flash Flooding”
- Future work: analyze other model cycles, ensembles, or specific time periods during the event