SHOUT Data Impact Study

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SHOUT Objectives

Overall Goal

- Demonstrate and test prototype UAS concept of operations that could be used to mitigate the risk of diminished high impact weather forecasts and warnings in the case of polar-orbiting satellite observing gaps

Objective 1

- Conduct data impact studies
  - Observing System Experiments (OSE) using data from UAS field missions
  - Observing System Simulation Experiments (OSSE) using simulated UAS data

Objective 2

- Improved understanding of tropical cyclone processes

Objective 3

- Evaluate cost and operational benefit through detailed analysis of life-cycle operational costs and constraints

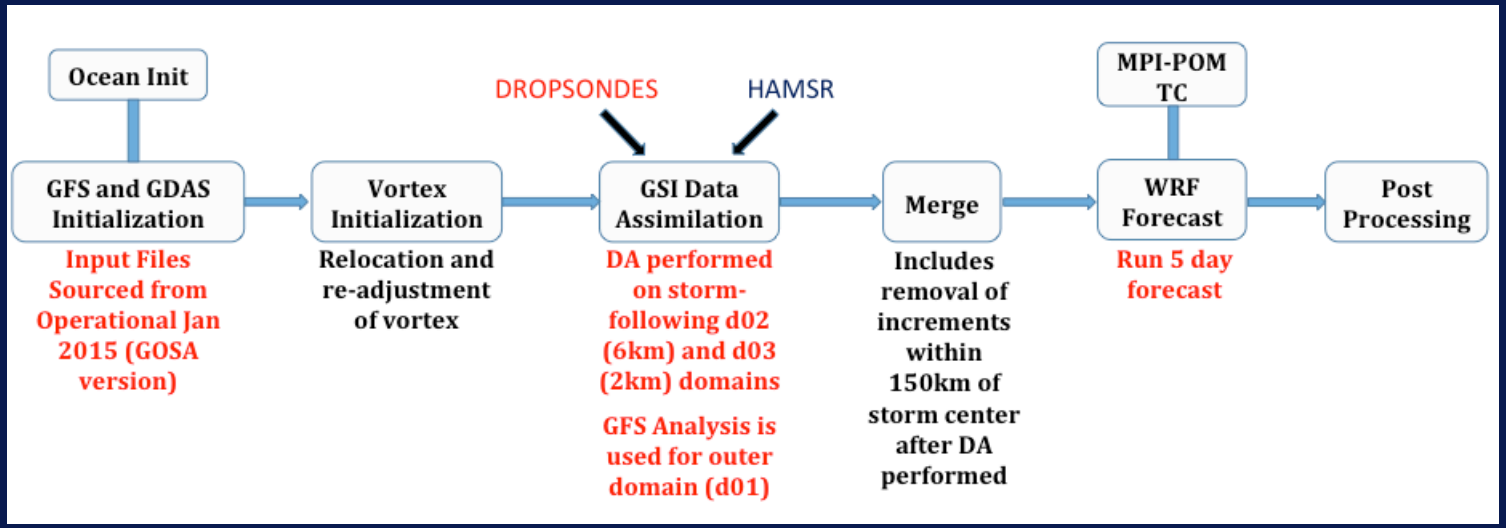
SHOUT Analysis Teams

- NOAA/OAR/AOML/HRD
  - Regional hurricane modeling
  - Led by Altug Aksoy
- NOAA/OAR/ESRL/GSD
  - Global model impacts
  - Led by Lidia Cucurull
- Collaboration with NOAA/NWS/NCEP/EMC

Outline

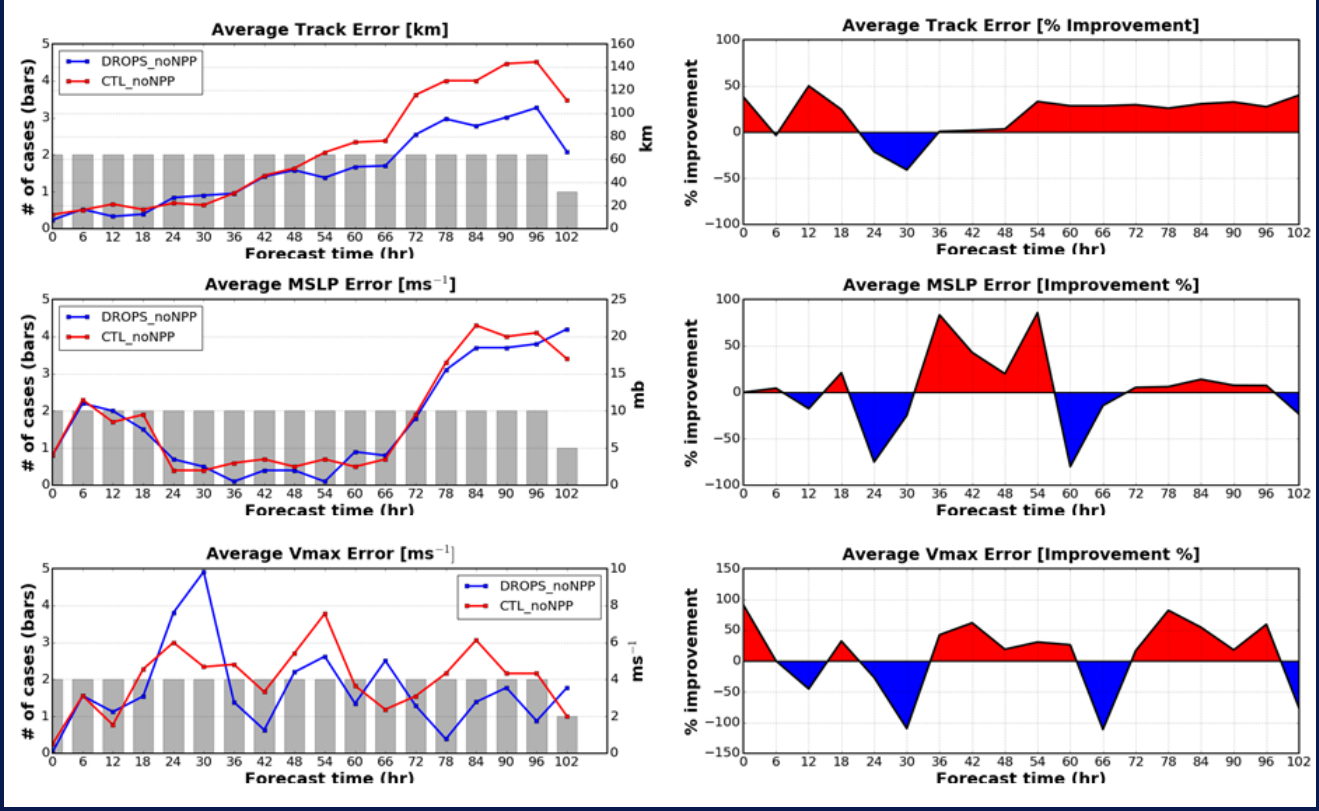
- Regional Hurricane Modeling Results
  - Operational HWRF
  - HWRF - HEDAS
- Global Modeling Results
  - GFS Hurricane Application
  - GFS El Niño Rapid Response Results
- Concluding Assessment

Operational HWRF Results



- 2015 version with 3-dimensional ensemble-variational hybrid assimilation scheme
- Studies to date conducted for Hurricane Matthew (2016)
  - noNPP: Operational – Suomi NPP ATMS & CrIS
  - DROPS_noNPP: noNPP + Dropsondes
  - HAMSR_noNPP: noNPP + HAMSR retrievals
- Consistent GFS boundary conditions
- Led by James Taylor

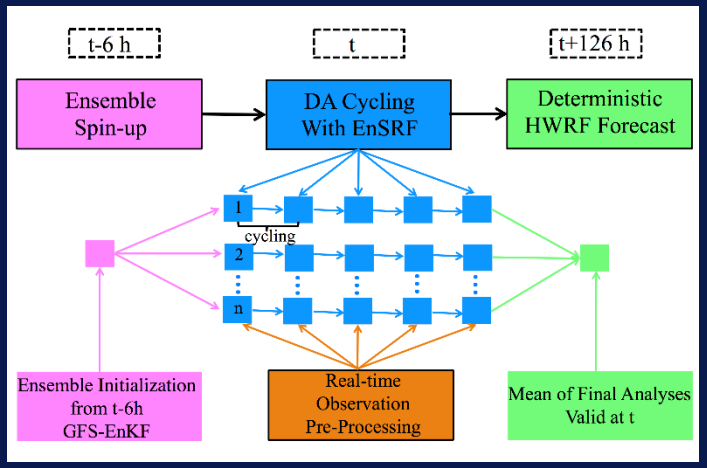
HWRF Dropsonde Impact - Matthew



Results courtesy J. Taylor

- Results averaged for 2 cycles on October 5
- Notable reduction in track error beyond 48 hours
- Postive intensity impact in medium-term

Analyses with HWRF-HEDAS

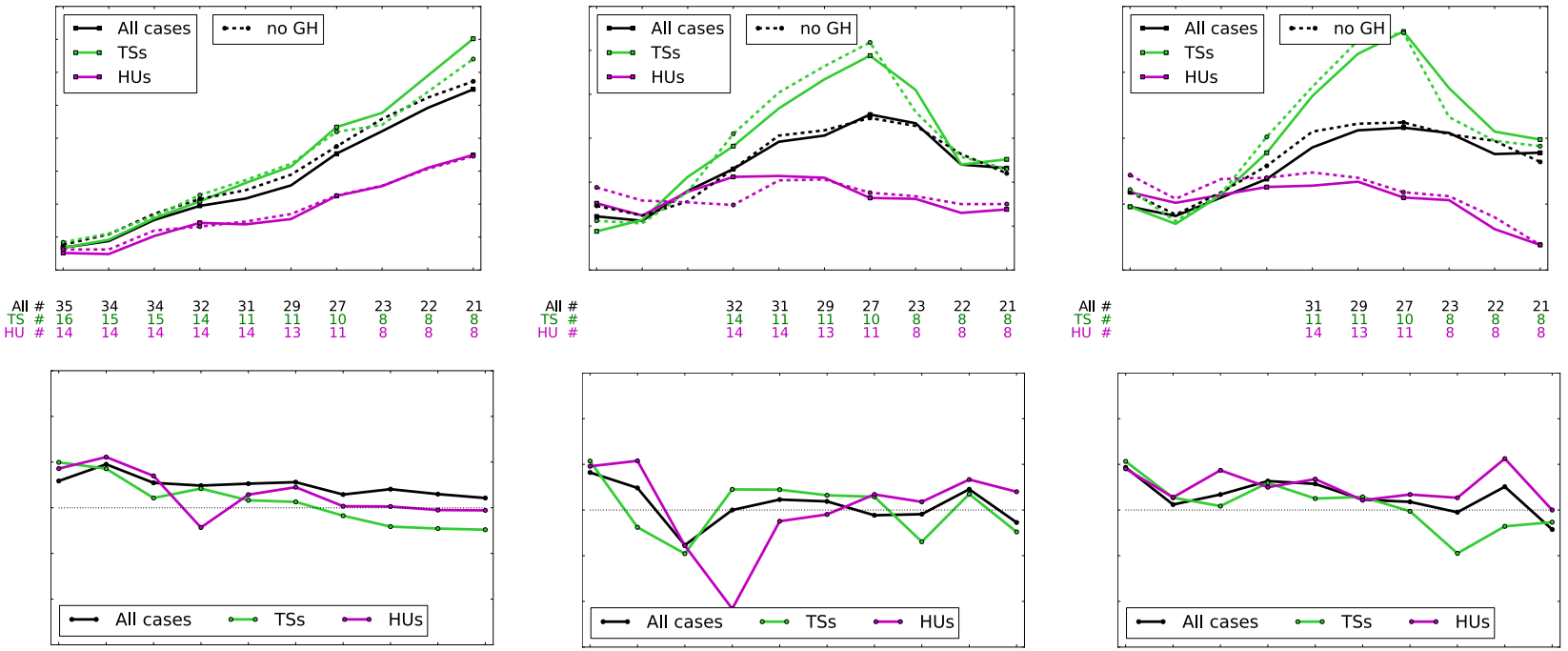


- Focus on TC inner-core DA for high-resolution vortex initialization
- Allows additional cycling during data assimilation

Graphic courtesy W. Christophersen

- AOML/HRD studies have employed the Hurricane Ensemble Data Assimilation System (HEDAS)
- Experiments encompassing multiple storms and payloads
  - Multi-storm composite dropsonde impact investigation
  - Satellite denial (AIRS) for Hurricane Edouard
  - Remotely sensed S-HIS and HIRAD data impact
- Led by Hui Christophersen and Kathryn Sellwood

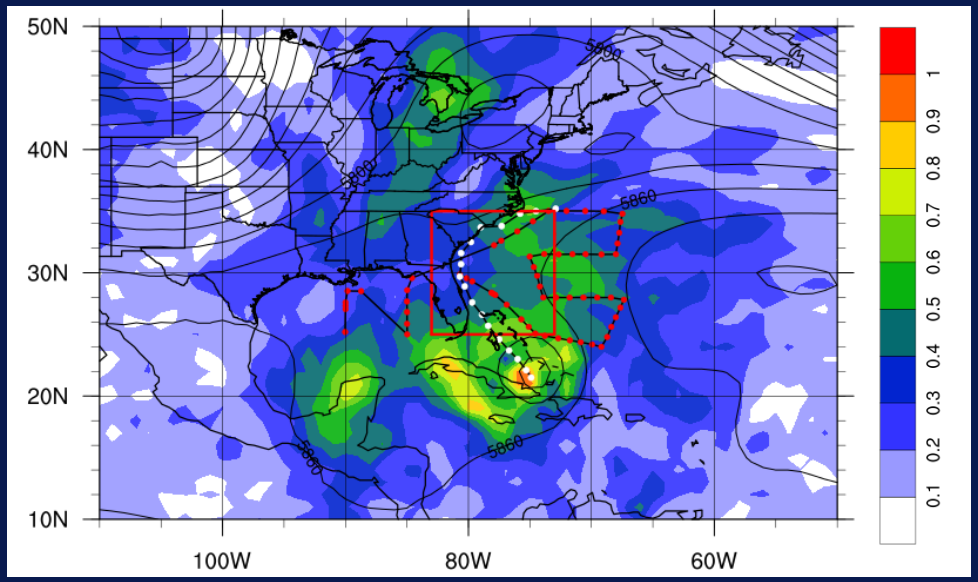
Composite Dropsonde Impact



Results courtesy H. Christophersen

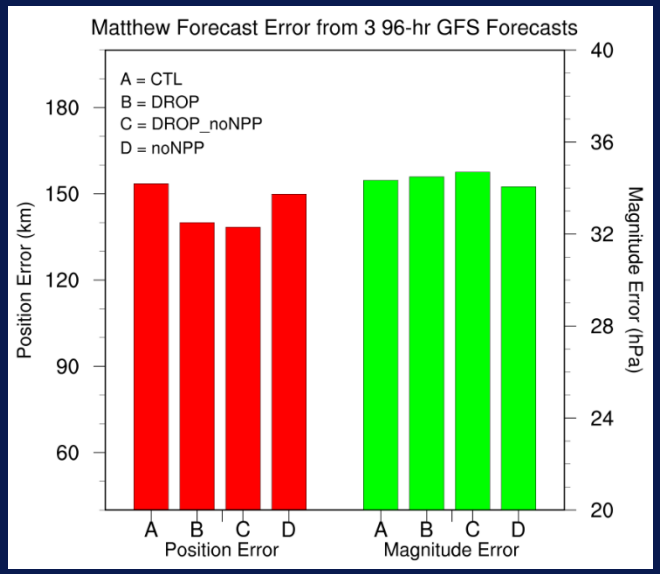
- Results combined for 10 storms
- Track accuracy improved on average throughout period
- Intensity results more mixed, but generally positive for p_{min}

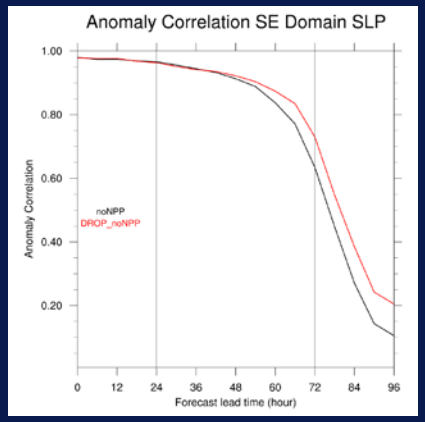
Operational GFS Hurricane Assessment

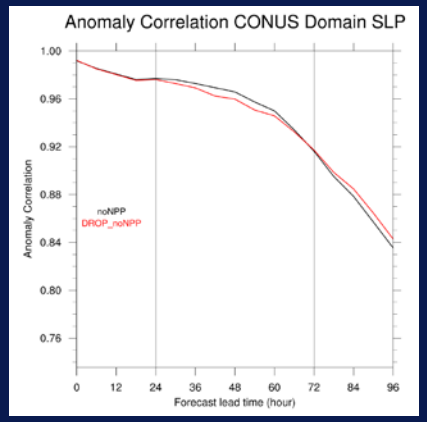


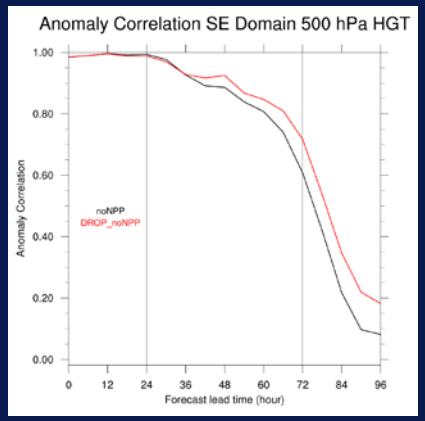
- Global Forecast System (GFS) model with 3-D variational assimilation
- Focus on dropsonde impact during Hurricane Matthew flights
- Impact examined both with and without a satellite gap
- Additional runs to provide HWRF boundary conditions
- Led by Andrew Kren

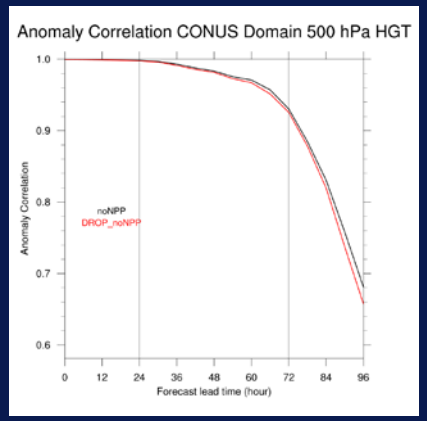
GFS Dropsonde Impact - Matthew







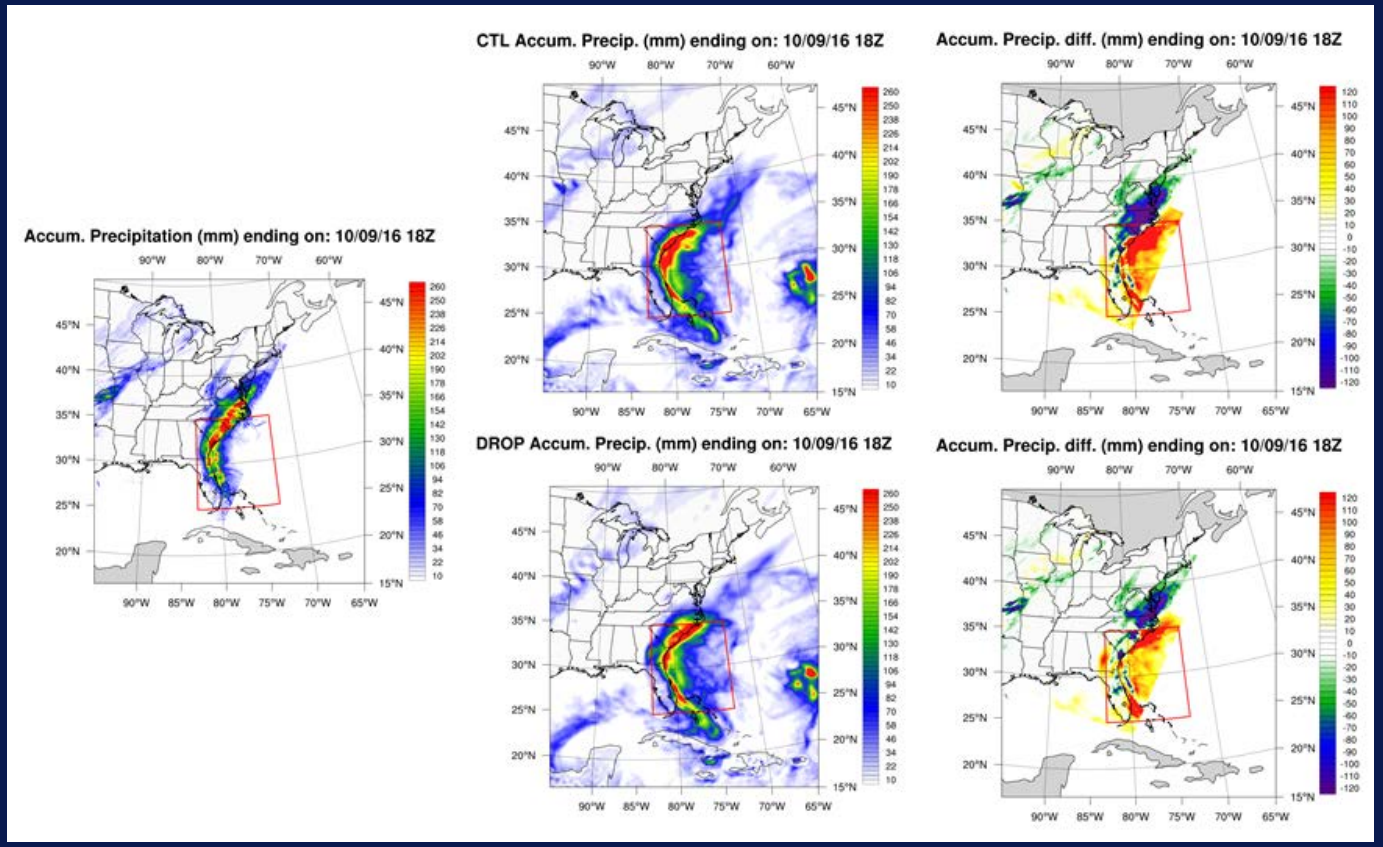




Results courtesy A. Kren

- Results here for 3 forecast cycles during first flight
- Track forecast and regional anomaly correlation improved
- Intensity and larger scale impacts neutral

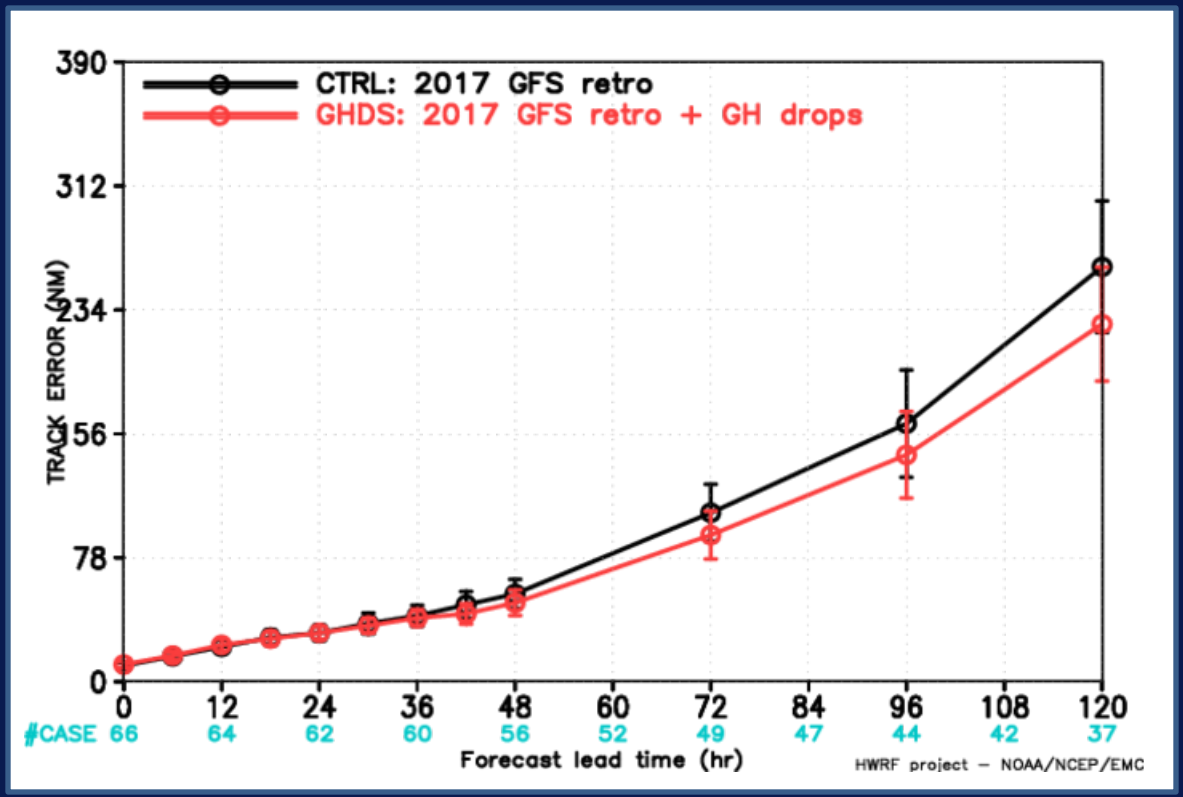
Precipitation Impact - Matthew



Results courtesy A. Kren

- Improved track forecast leads to improved precipitation forecast

New Operational GFS Impact

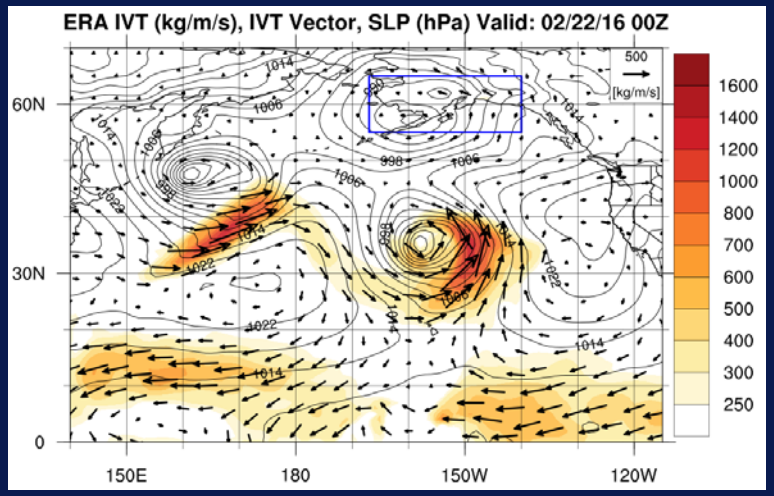


Results courtesy Jason Sippel and Kate Howard, NOAA/NCEP/EMC

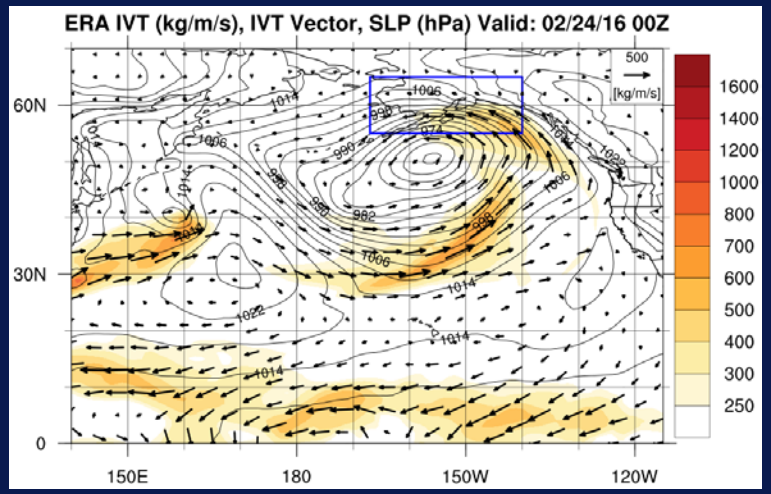
- Combines 2016 flights over Gaston, Hermine, Karl, and part of Matthew
- Runs with Q3FY17 GFS version due for May implementation
- Notable track error reductions at longer forecast lead times

Impact on GFS Forecasts of Pacific Weather

Targeting Time

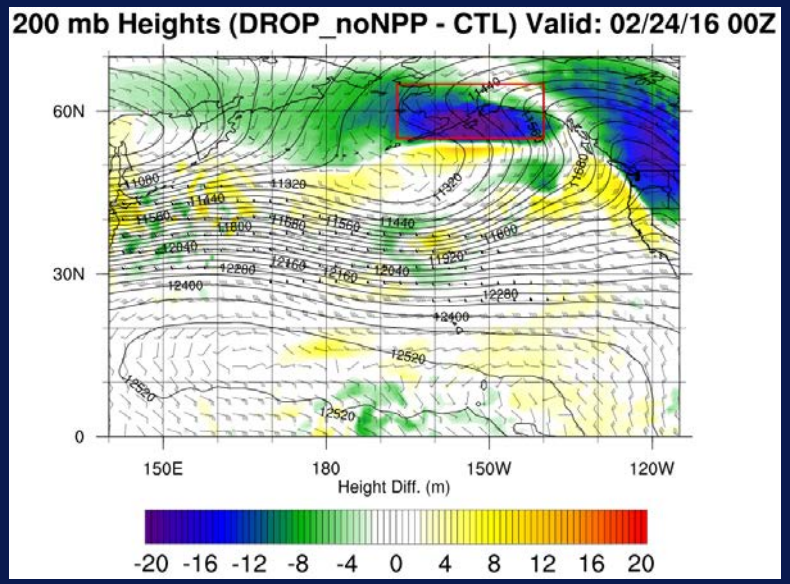


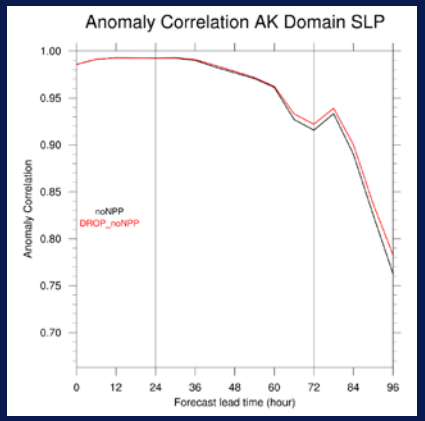
Verification Time

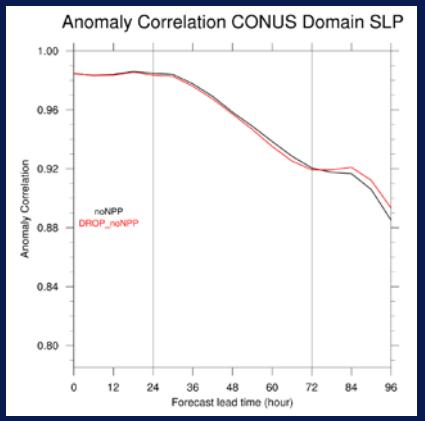


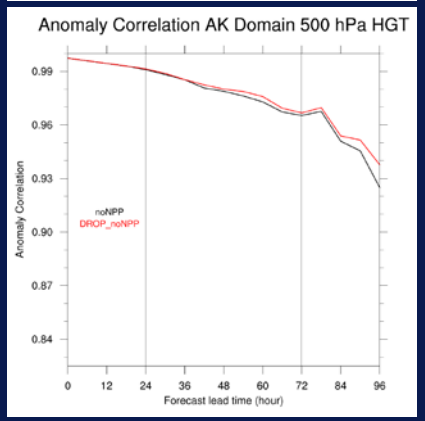
- Operational Global Forecast System (GFS) model with 3-D variational assimilation
- Forecast evaluation based on southern Alaska impacts following Feb 21-22 flight
- Analysis centered on dropsonde observations
- Impact examined both with and without a satellite gap
- Led by Andrew Kren

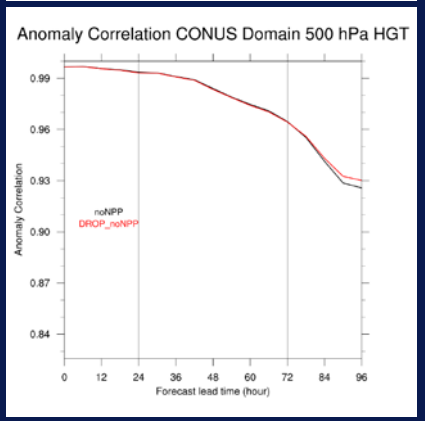
GFS Dropsonde Impact - Alaska











Results courtesy A. Kren

- Results averaged over 4 forecast cycles
- Positive forecast impact observed in targeted high-impact area
- Neutral results or forecast degradation on larger scale

Reporting of Results

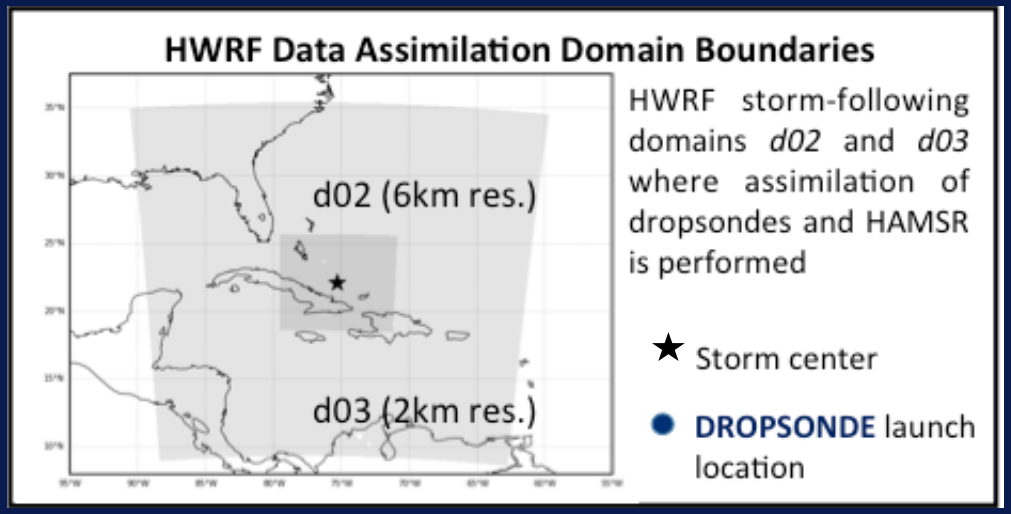
- Publications
  - One SHOUT analysis publication “in press”
  - Several additional papers in advanced preparation
- Conference presentations
  - 2017 AMS Annual Meeting – 10 presentations
  - 2016 AMS Tropical Conference – 6 presentations
  - 2016 AMS Annual Meeting – 6 presentations
- Internal NOAA reports
  - Interim impact reports in 2014, 2015, and 2016
  - Final report due at end of June

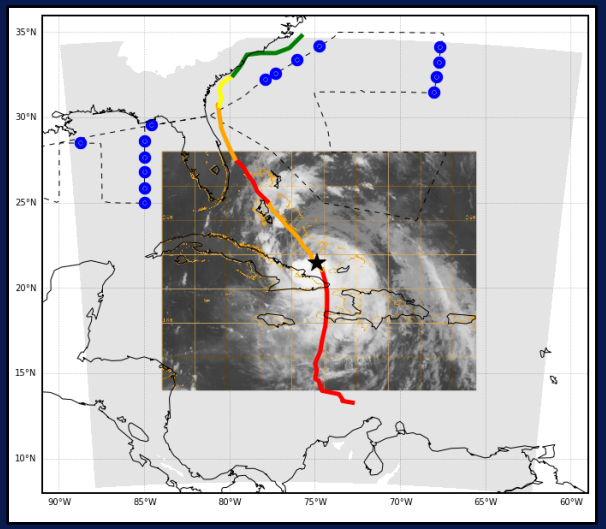
Concluding Assessment

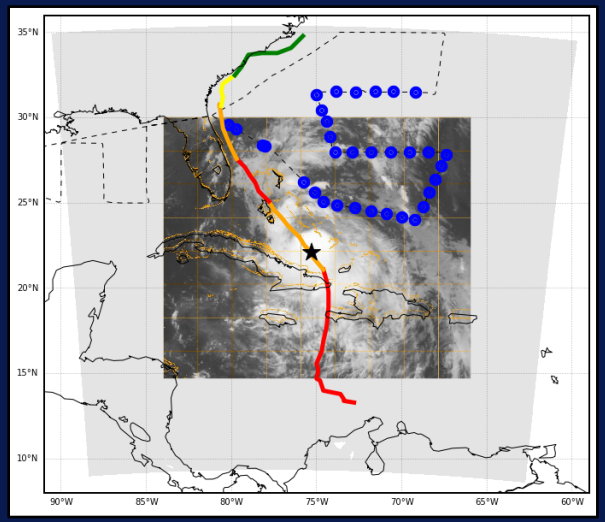
- Results consistently demonstrating measureable forecast benefits for high-impact weather events
- Results are particularly positive when elements of the satellite observing system are withheld
- Largest impacts seen in explicitly targeted regions and areas of greatest impact
- Global impacts largely neutral
- While demonstrating conclusive impact in an observational environment requires more analysis, results are very encouraging
- More work ongoing for impact of remote sensors

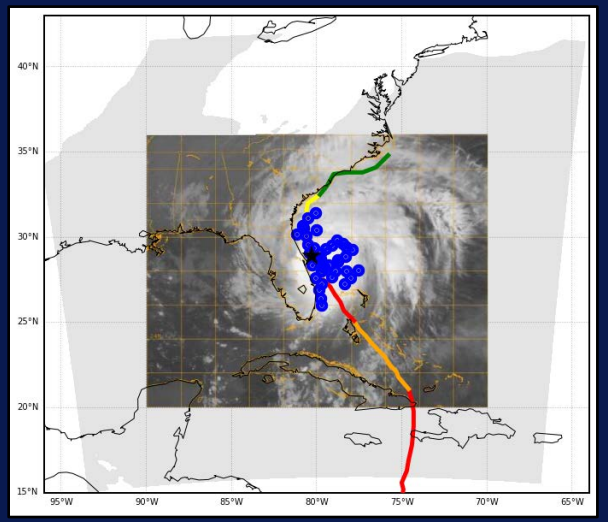
EXTRA SLIDES

HWRF Simulations of Hurricane Matthew



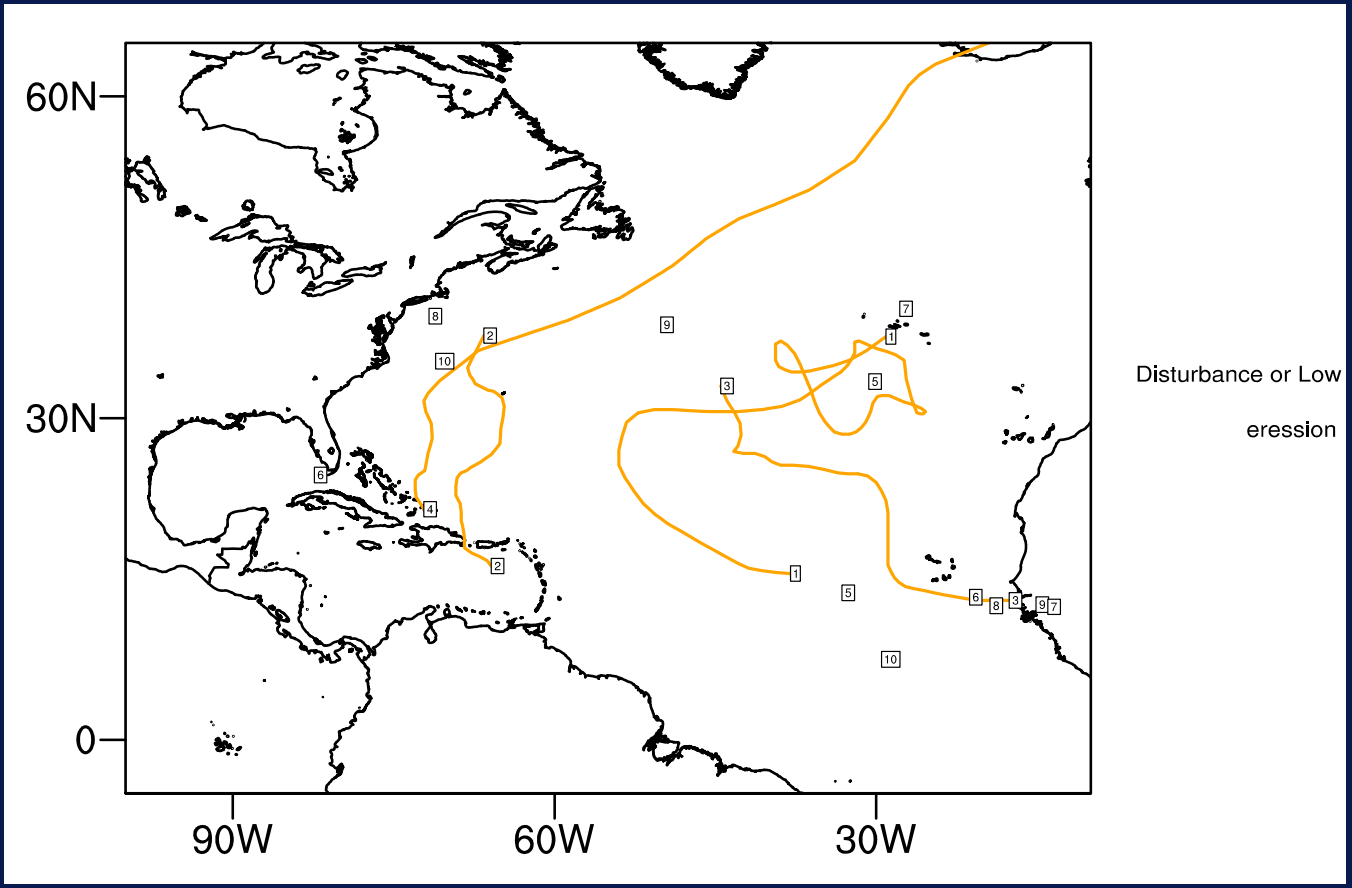






Graphics courtesy J. Taylor

10-Storm Composite Study Elements



Graphic courtesy H. Christophersen