Research to Improve NOAA’s Hurricane Forecasts

#NOAAHurricaneAware

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2017 Hurricanes: Impacts
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Rockport, TX after Harvey 2017

Houston, TX during Harvey 2017

Marathon, FL after Irma 2017

San Juan, PR after Maria 2017
Tropical Cyclone Intensity

• HWRF skill has improved over the past few seasons, but rapid change cases are still a problem
  o Statistical models have difficulty forecasting rapid change
  o Dynamical models can forecast rapid change, but not reliably (e.g., Harvey, Irma, Maria)
• Consensus approach still shows best hope for modest improvements in forecast accuracy, but dramatic improvements still likely years away
• Large improvements requires increases in inner-core observations, higher resolution computer models, and better ways to get observations into models

So how do we get there?
Keys to Success

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- **Science**
  - Improve operational high-resolution coupled models (HWRF) – particularly intensity changes
  - Improve understanding from combination of observations & high-resolution models

- **Information Technology**
  - Develop research computing capacity to accelerate transition of research to operations

- **Observing Strategy**
  - Improve use of existing and planned systems

- **Improve Forecaster Products**
Since HFIP began in 2008, forecast error has decreased by 20-25% for 1-5 day forecasts.

- NOAA upgraded HWRF model resolution; now 1.5 km
- Remarkable improvements in HWRF since HFIP
• Under HFIP, the HWRF model demonstrated a 15-20% improvement in hurricane intensity forecast accuracy each year since 2011.
HWRF Improvements: Assimilation of Aircraft Recon

#NOAAHurricaneAware • NOAA P-3 transmitted Tail Doppler radar data in real-time for assimilation into HWRF

Hurricane Harvey (2017)

4 P-3 missions 24-26 August
HWRF Improvements: New Observations - 2018

Doppler Wind Lidar
• Compliments P-3 & G-IV Tail Doppler radar

Coyote
• Targets data gaps in hurricane boundary layer thermodynamics
• 1-2 Coyote in 2018
• Data sent to NHC

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Next steps — Basin-HWRF & fvGFS

2017 Basin-Scale HWRF
Mean Sea-Level Pressure (hPa; shading and contours)
Init: 00z Tue, Sep 05 2017 Forecast Hour:[117] valid at 21z Sat, Sep 09 2017

*Experimental Product of NOAA/AOML/HRD*
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2017 Basin-Scale HWRF Modeled Radar Reflectivity [dBz]
Init: 12z Fri, Sep 08 2017 Forecast Hour: [048]
Research Challenges -
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Priorities for HFIP to address Weather Act:

- Improve forecast confidence to enhance public response
  - Reduce largest track and intensity errors
  - Improve vortex/shear interactions
  - Improve initialization & physics impacting RI

- Maintain focus on forecast accuracy (track and intensity) to improve overall forecast performance

- Reduce uncertainty
  - Improve ensemble prediction products

- Improved forecasts for landfalling storms and increased emphasis on storm surge

- Incorporate risk communication into product suite
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