

Hampton University Severe Weather Research Center

Presented to:

Hampton Roads Planning District Commission (HRPDC)

**Use of polar orbiting and geostationary weather satellite data for
real-time prediction of severe convective storms**

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Hampton University

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Hampton University Severe Weather Research Center (SWRC)

- Established September 2016 when the HU Direct Broadcast System (DBS) was installed in the Harbour Centre building
- Pioneering innovative uses of real-time satellite data to improve forecasts of rapidly developing weather systems
- Improving wind, rain, hail, hurricane and tornadic storm forecasts
 - location, lead time, intensity and timing accuracy
- Partnering with the University of Wisconsin at Madison, NASA, and NOAA



DBS dome for high wind and weather protection



DBS antenna system for 360° all sky tracking

The HU SWRC Provides Direct benefits to our State

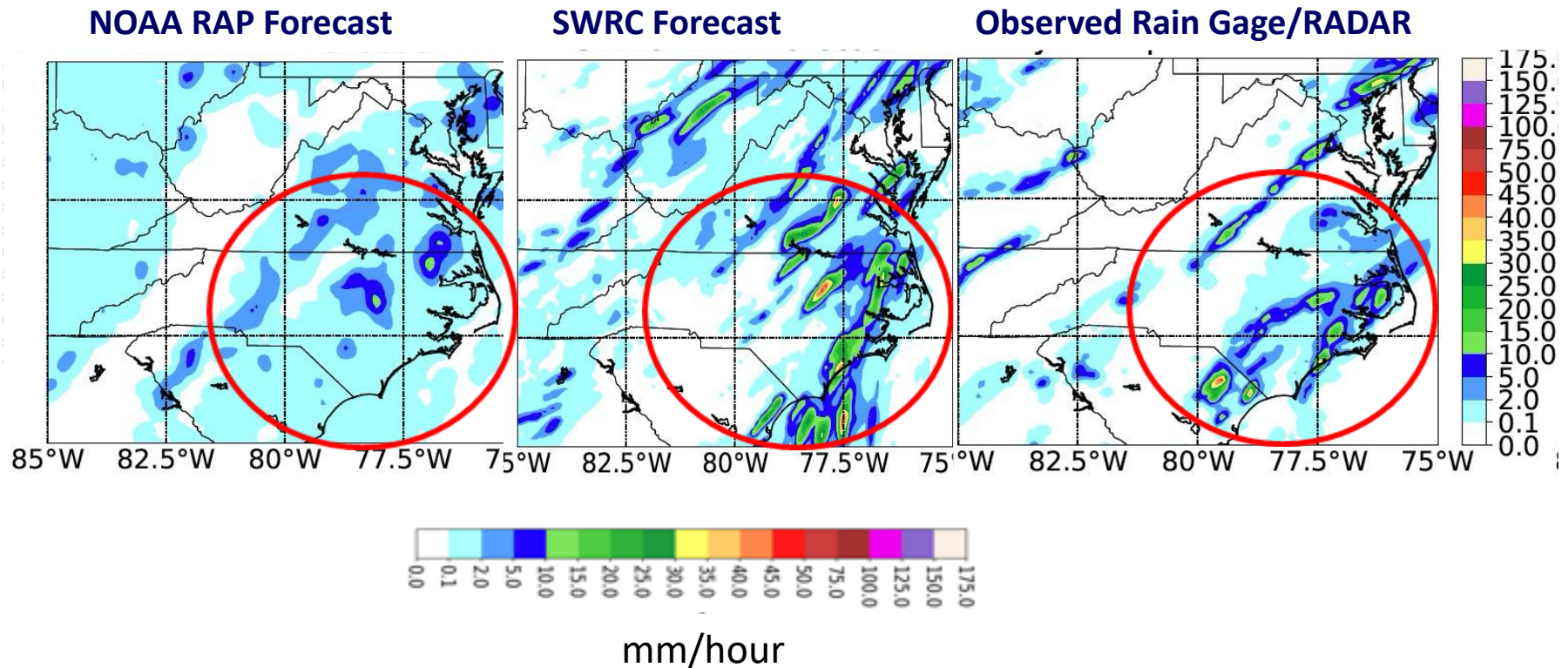
- A cutting edge state-of-the-art weather forecast research capability
 - Unprecedented time (~15 min) and space (~ 1 mi) forecast capabilities by combining polar and geostationary satellite data
 - SWRC forecasts use all polar orbiter satellite sounding data while the National Weather Service (NWS) uses less than 10%
- Higher accuracy predictions at longer warning lead times for forecasts of hurricanes, tornados and severe storms threatening a region
- State-of-the-art predictions of extreme precipitation leading to localized flooding, hail and hazardous winds
- Enables direct liaison with emergency planning offices to help provide accurate forecast updates and interpret current forecasts

Six recent examples of SWRC Capabilities

- Hampton Roads severe storm event on June 3, 2021
- Louisa County, VA Wind Line event on May 4, 2021
- Waverly, TN deadly flash flood event on August 21, 2021
- New York precipitation from hurricane IDA remnants caused deadly flooding on September 1 - 2, 2021
- Northeastern US tornados triggered by Hurricane IDA remnants on September 2, 2021
- Strong front caused high winds in the Hampton Roads area on March 12, 2022

Severe Storm Event in Hampton Roads

The HU SWRC 13-hour forecast for June 3, 2021 at 7 PM EDT shows a significantly improved forecast



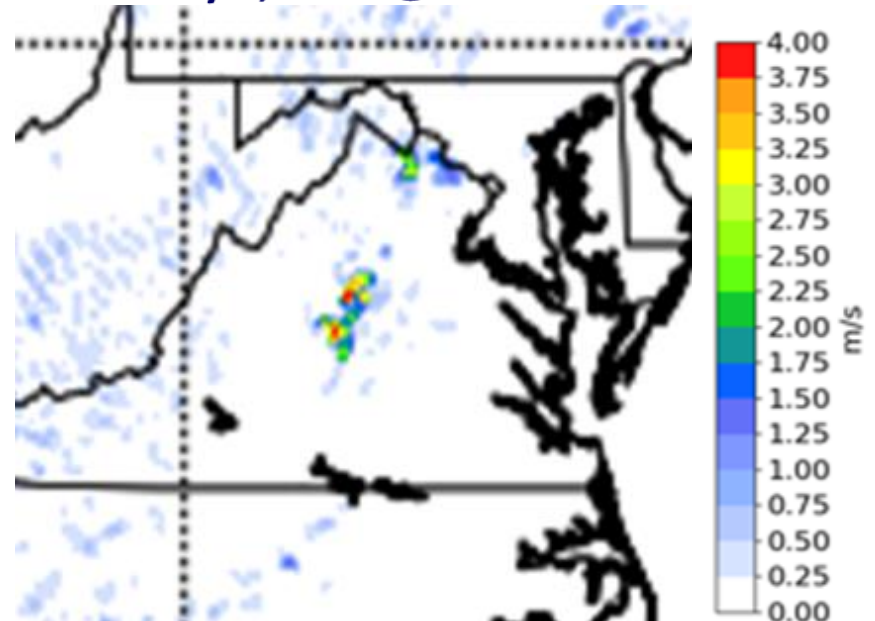
Louisa County, VA Wind Line event

SWRC forecasted a Wind Line event undetected by NOAA RAP

**NWS Storm Report for
May 4, 2021**



**HU 3-hr Forecast Updraft Velocities
May 4, 2021 @ 5 PM**

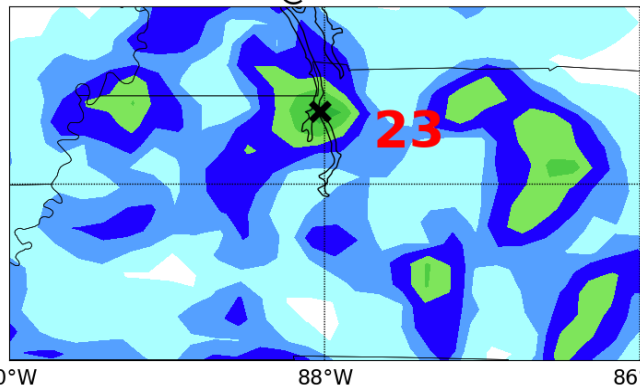


- Louisa County airport manager reported a peak wind gust of 89 MPH; highest thunderstorm wind gust ever recorded since the office opened
- SWRC predicted a strong wind line (no tornado) 3-hrs ahead of the event
- NWS Wakefield thought there might have been a tornado, but found no rotation

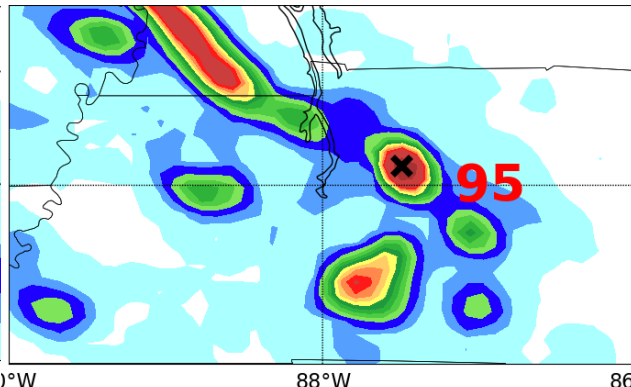
Waverly, TN deadly flash flood event

The HU SWRC 10-hour precipitation forecast for August 21, 2021 at 8 AM CDT gives a significantly improved forecast

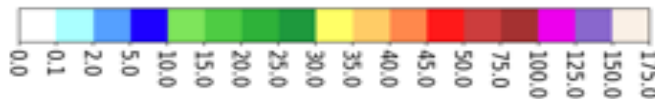
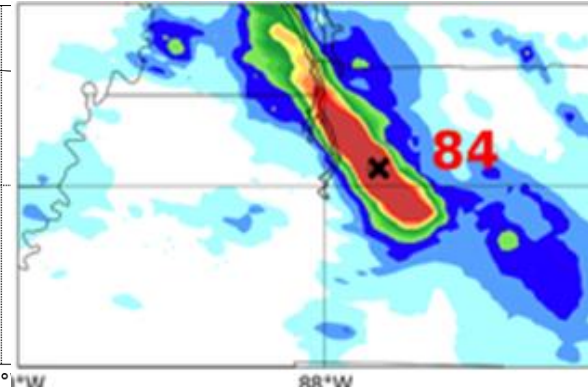
NOAA RAP 10-hr/13 km
Forecast, 8 AM CDT



SWRC 10-hr/8 km
Forecast, 8 AM CDT



Rain Gage/Radar Observations
7 to 8 AM CDT



mm/hour

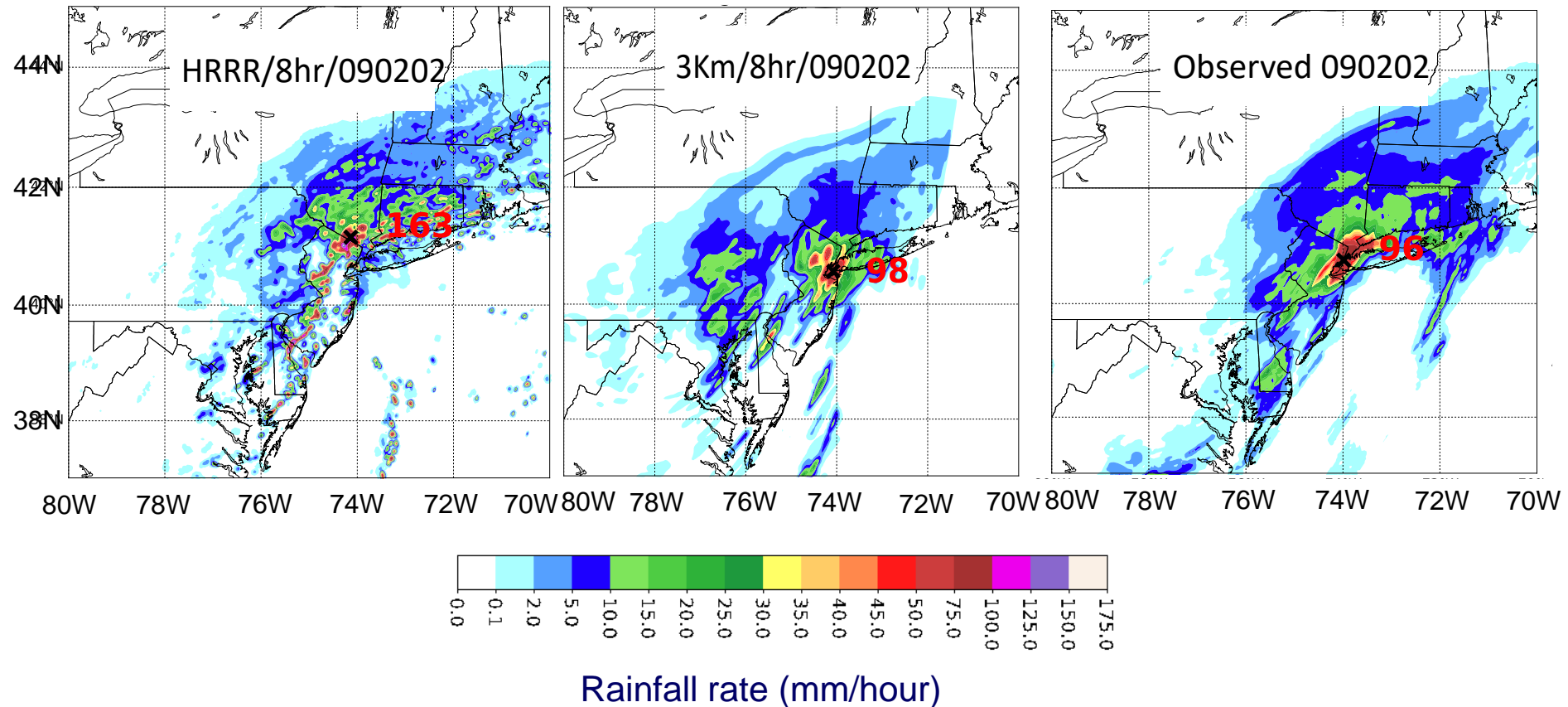
Red numbers are the maximum hourly rainfall rates observed and forecast

New York precipitation from hurricane IDA remnants caused deadly flooding on September 1 - 2, 2021

**NOAA 8-hr/HRRR
Forecast 0901 18UTC**

**SWRC 8-hr/3 km
Forecast, 0901 18 UTC**

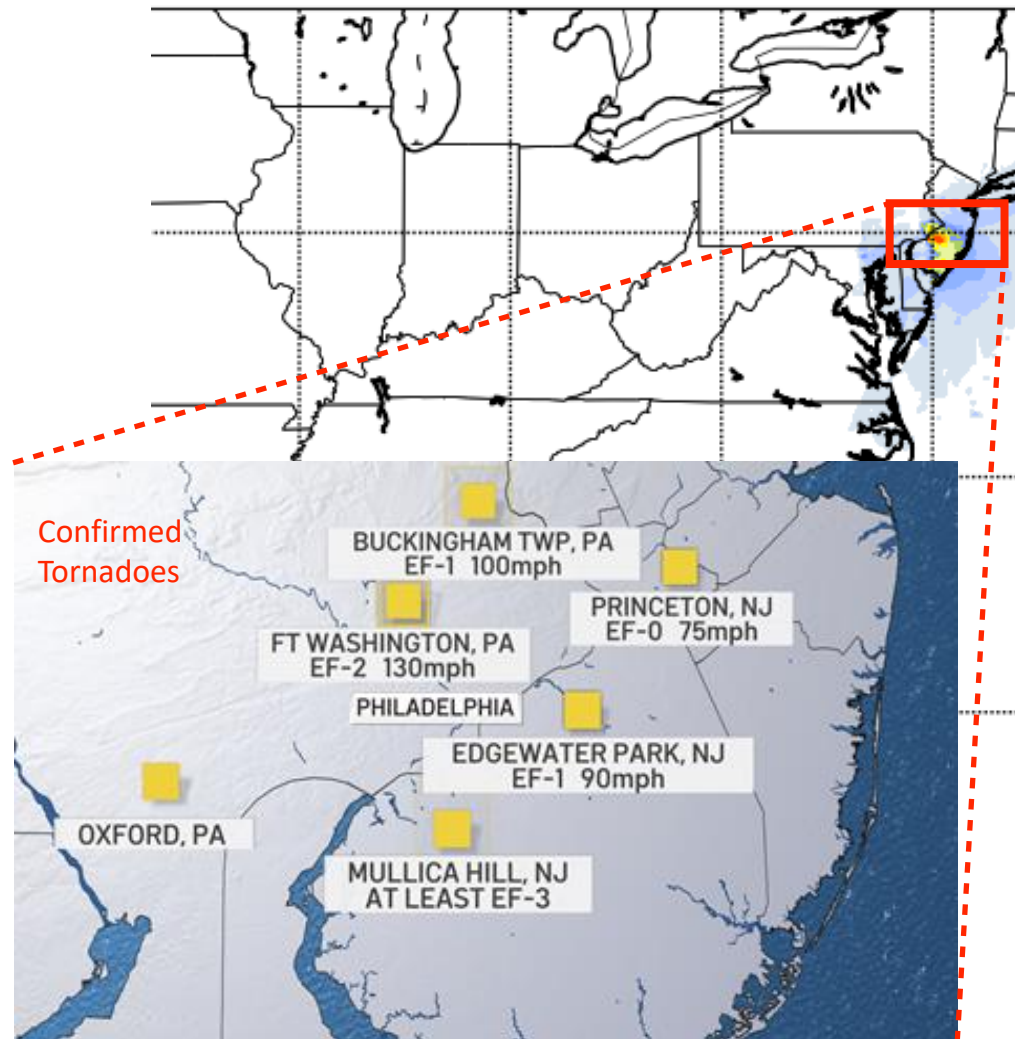
**Rain Gage/Radar Observations
0901 18UTC to 0902 02UTC**



Red numbers are the maximum hourly rainfall rates observed and forecasted

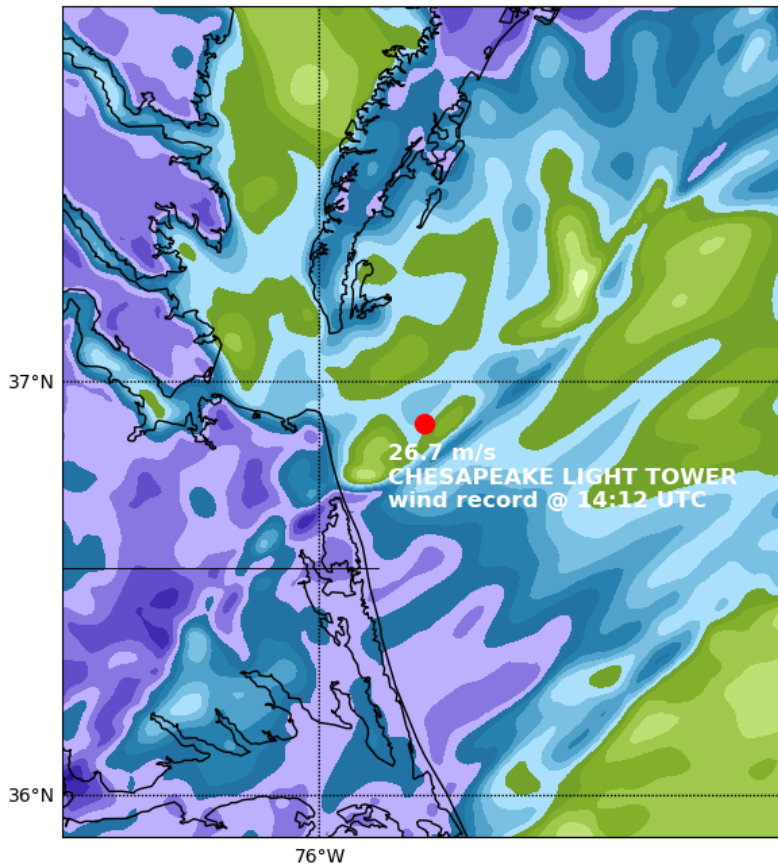
Hurricane IDA tornados in the northeast, September 2, 2021

SWRC provided high quality 12 Hour Advance tornado Forecast

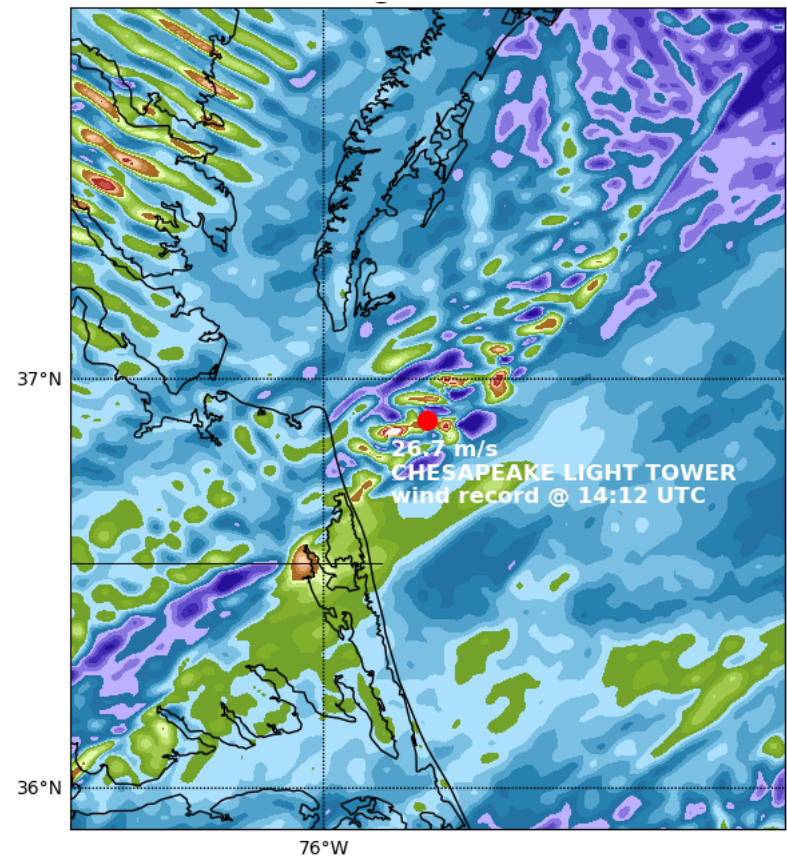


Strong winter front caused high winds in the Hampton Roads area on March 12, 2022

NOAA HRRR Wind
Forecast at 15:00 UTC



SWRC Wind
Forecast at 15:00 UTC



**NOAA wind forecast 16.5 m/s; SWRC 25.5 m/s; Observed 26.7 m/s
SWRC higher resolution is apparent**

SWRC Budget Request to the State

Total 3-year personnel operating budget:	\$1.90M
Total 3-year Cloud Computing Budget:	\$0.42M
SWRC Infrastructure upgrades over 3 years:	<u>\$0.87M</u>
Total SWRC 3-year budget request:	\$3.19M

SWRC Summary

1. What is the purpose of the SWRC?

To develop and implement an advanced hazardous weather prediction ability for the Virginia/Hampton Roads (VA/HR) region.

2. What organizations are participating in the SWRC R&D program?

The Hampton University (HU), University of Wisconsin (UW), NASA/LaRC, NOAA/NWS.

3. Why is the SWRC weather prediction capability better than provided by our nation's NOAA operational system?

The SWRC uses real-time advanced satellite 1-nautical mile/15-minute resolution atmospheric moisture data not yet used by this nation's NOAA operational weather forecast system.

4. Are SWRC Numerical Weather Prediction (NWP) models different than those used by NOAA?

The SWRC models are based on the same physics as NOAA's operational models but are tailored to utilize the advanced satellite moisture sounding, and associated wind, data to produce very high-resolution in NWP products for the VA/HR region.

SWRC Summary (continued)

- 5. What kind of hazardous weather improvements have been demonstrated with the SWRC research NWP system?**

Location and onset time of severe thunderstorms and tornadoes, intense rainfall and flooding, hurricane landfall location and time.

- 6. Is NOAA intending to incorporate Research capabilities into their future operational system?**

Yes, the utility of SWRC products, produced for the continental United States (CONUS) on NOAA super computers at the UW, is being evaluated during this coming May by NOAA during its 2022 Hazardous Weather Test-bed experiment.

- 7. Why not just wait for NOAA to implement SWRC R&D techniques into their operational system?**

It will take many years for NOAA to transition SWRC R&D capabilities into this nation's operational CONUS and global NWP systems. However, the HU can provide and maintain these advanced capabilities within a regional operational system that would greatly benefit VA/HR now, given the financial resources required to do so.

SWRC Summary (continued)

8. What VA/HR government and commercial programs will benefit from this regional NWP capability?

Hazardous weather warnings issued to protect life and property of local city and county residents, the Dominion Energy coastal VA offshore wind energy project, commercial and general aviation airport operations, DOD operations and the protection of aircraft and ship resources from hazardous weather such as hurricanes and tornadoes.

9. Why is the SWRC financial support needed now?

The NASA and NOAA federal funding which supported the initial development of SWRC capabilities has now expired. Funding is urgently needed to implement and maintain a fully operational regional VA/HR system to benefit the residents of the State. Funds are required for support staff, computational equipment, and the associated facility infrastructure to implement and maintain a system, with the continuous 24/7 reliability required to support government and commercial users of the advanced VA/HR HU SWRC weather prediction system.