Evaluation of Probabilistic Hazard Information (PHI) in Weather Forecast Offices: Initial Results of a Collaborative NSSL/NWS Research Effort

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Motivation for Collaboration

Probabilistic Hazard Information (PHI) at NSSL is a storm-based product that conveys the

motion, timing, and likelihood

of severe weather hazards (tornadoes, wind, hail, and lightning) within the next 1-2 hours.

This is accomplished by showing threat levels and spatial and temporal distributions through rapidly updating graphical depictions of hazard probability fields. Relative to deterministic warnings, PHI provides additional lead time and enhanced information for decision support, including:

- Threat location
- Time of arrival
- Time of departure
- Probability of threat existence

For forecasters, automated PHI has the potential to:

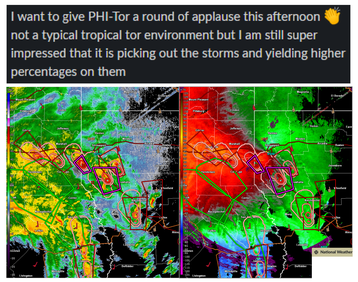
- Provide relatively early indication to forecasters of threat formation
- Inform communication graphics or warning area shape and extent

Starting in spring of 2023, the NWS and NSSL have participated in a collaborative research effort to evaluate and improve PHI by distributing research data feeds to select Weather Forecast Offices. The objectives of this effort have been to:

- Provide forecasters access to the latest PHI research
- Utilize forecaster feedback and insight to improve PHI

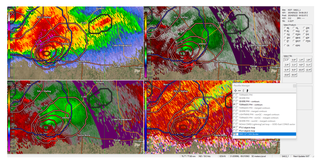
Notable Events and Feedback

Hurricane Beryl



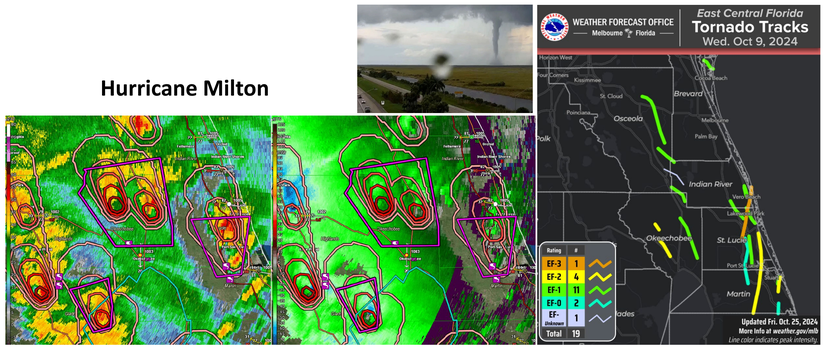
Quote from Columbia, SC forecaster and associated GibsonRidge (GR analyst) image from 1916 UTC on 8 July 2024, KSHV reflectivity (left) and Velocity (right); automated PHI tornado plumes (probability contoured in red every 20% starting at 10%) and NWS tornado warnings (magenta).

Warning-decision influence



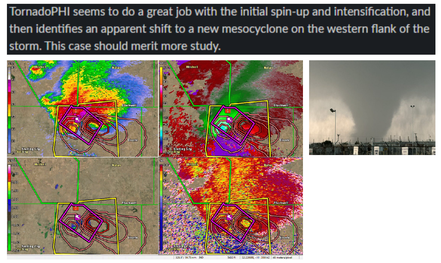
GR image from KSJT at 1952 UTC on 22 May 2024. Higher probabilities from algorithm helped forecaster in San Angelo, TX decide to issue tornado warning.

Hurricane Milton



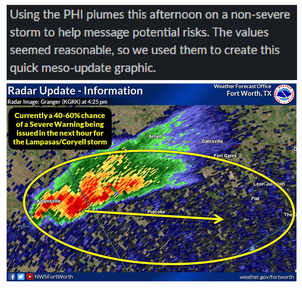
GR image from KTBW at ~1830 UTC on 9 October 2024, with associated NWS confirmed tornado tracks at right and highway camera capture of a Hurricane Milton tornado above.

Use of automated tornado PHI plumes



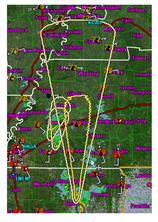
Forecaster quote from San Antonio, TX and GR display from KSJT at 2058 UTC on 3 May 2024 with associated spotter photo of tornado.

Use of PHI plumes in public graphics



Forecaster quote and public graphic released by Dallas-Ft. Worth on 8 May 2024.

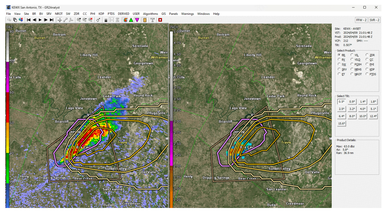
Algorithm improvement



Anomalous algorithm output captured and reported by forecaster in Huntsville, AL. GR display from KGWX at 1406 UTC on 9 July 2024.

Use of automated severe PHI plumes

After seeing Severe PHI for three events, it seems very good as an early indicator of severe potential, as well as the contours being a good predictor of downstream movement/development. Once storms are mature, the value of PHI is a little lower since the contours are pegged out and the storm evolution is generally discernable. However, the contours still have value in these cases for IDSS messaging and keeping warnings as small and focused as possible.



Forecaster quote from San Antonio, TX and GR display of 0.5 deg KEWX at 2101 UTC on 9 April 2024.

Automated Data Feeds

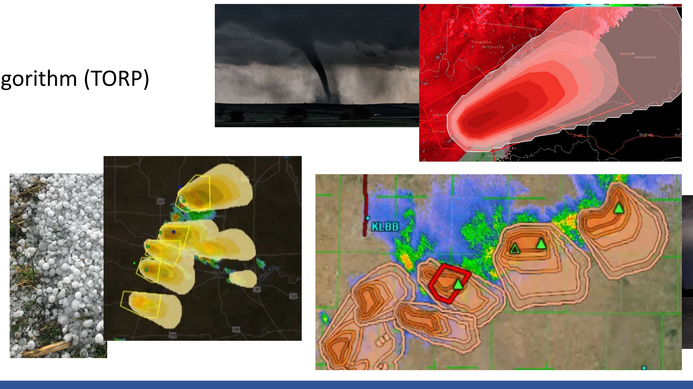
Automated PHI threat guidance is derived from machine learning algorithms and is created every two minutes. In PHI graphics, darker tones indicate higher probability of hazard occurrence at a location.

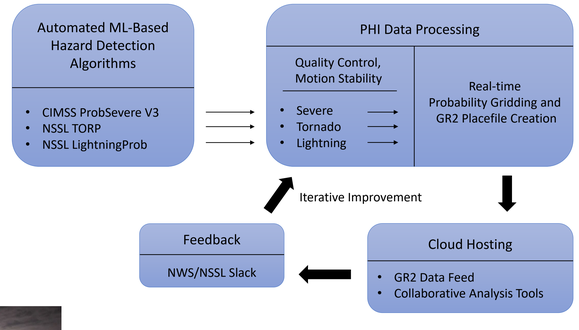
Improvements to PHI in recent years have advanced the technology to be capable of providing stable, automated hazard probabilities that are informed by machine learning algorithms for:

Tornado
- Red shading
- ML Alg: NSSL Tornado Probability Algorithm (TORP)

Severe Wind and Hail
- Yellow shading
- ML Alg: CIMSS ProbSevere

Lightning
- Orange shading
- ML Alg: NSSL ProbLightning





Learn more at phi.nssl.noaa.gov

Improvements Made and Future Plans

Feedback has led to several changes and improvements:
- Greater consistency in hazard information over time
- More accurate hazard speed and direction
- Fewer missed or false detections
- Improved filtering of information

Going forward, this research effort intends to:
- Develop new collaborative tools to
  - Interrogate and manage hazard information
  - Review and analyze PHI from past events
- Expand collaboration to new partners
- Continue to improve hazard information based on feedback