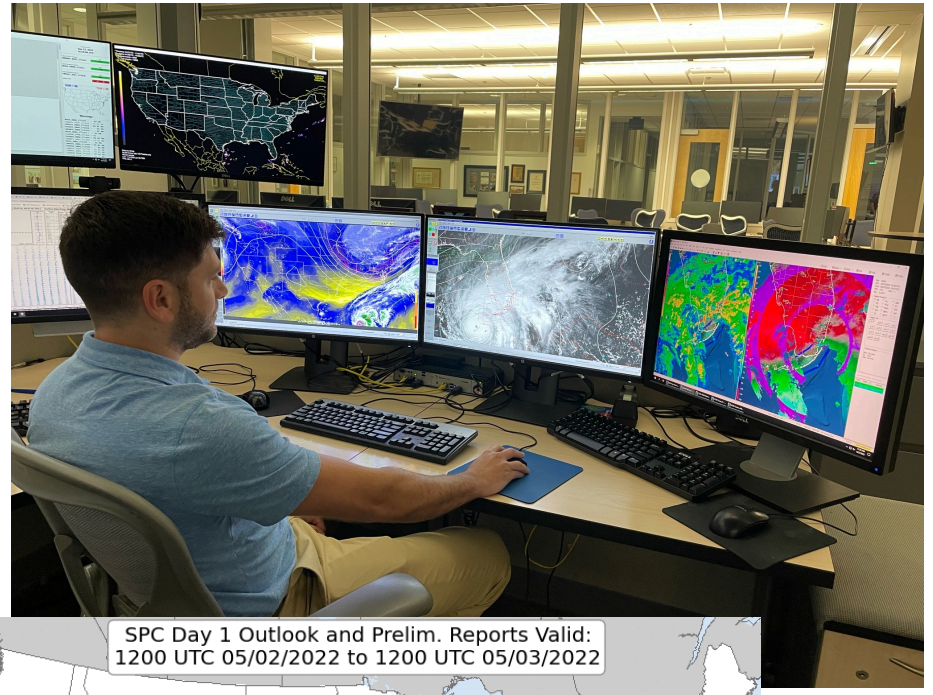
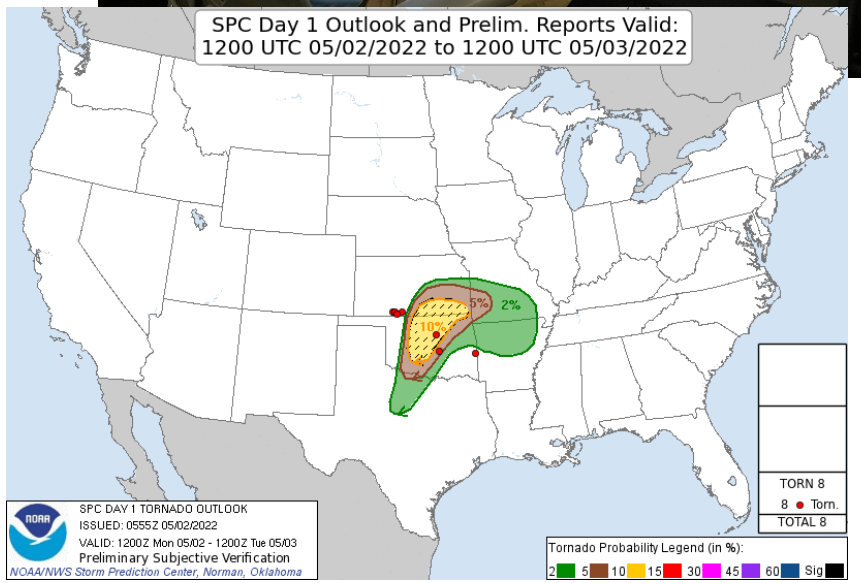
Forecast Applications Research at CIWRO/SPC

David Jahn, Andrew Wade, David Harrison, Nathan Dahl, Jake Vancil, Kevin Thiel, and Joseph Trujillo-Falcón

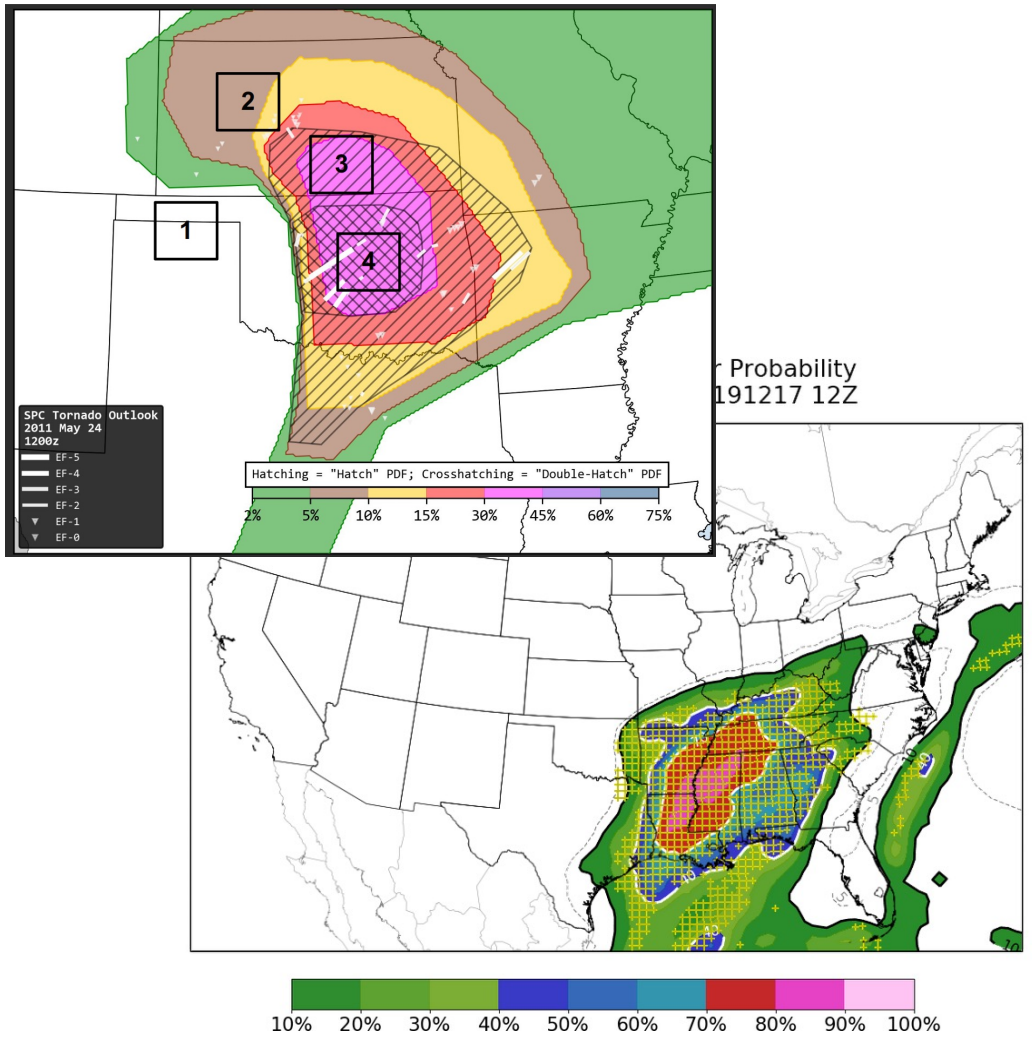




CIWRO/SPC is conducting targeted research in order to enhance the visualization and interpretation of weather data and to improve the technological capabilities afforded operational forecasters in the identification of severe weather threats.

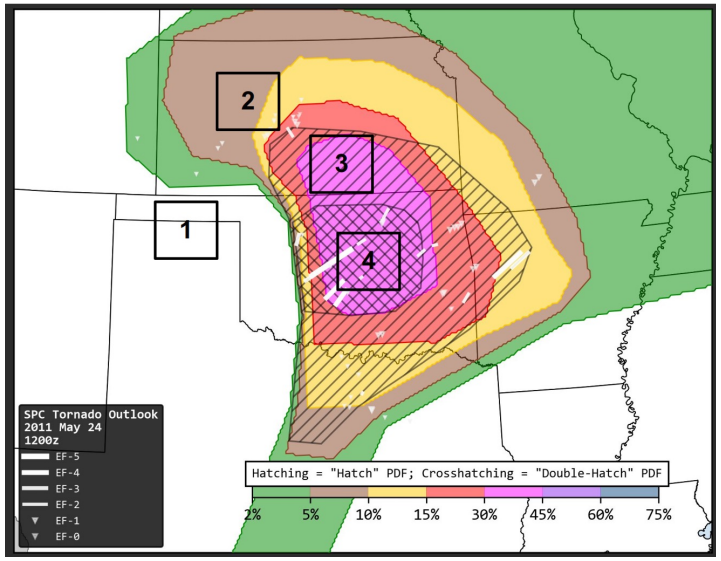
Some of current initiatives to support SPC forecasters:

- Making available CAM wind information to better meet forecaster needs
- Differentiate environment characterizing significant severe weather
- Verify significant wind reports
- Formulate satellite-based products for operational use
- Investigate the use of conditional intensity forecasts
- Address issues in translating forecasts to other languages



Conditional Intensity Forecast Bin Statistics

Jacob Vancil



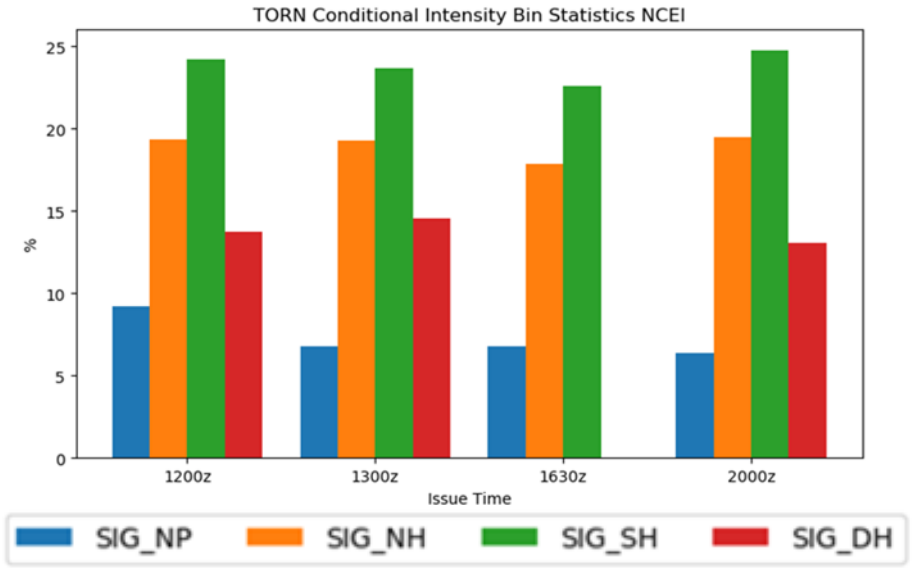
- Color-filled fields: Severe weather frequency

- Hatched areas: Severe weather intensity
  - 1: probability < 2%
  - 2: probability > 2%, no hatched
  - 3: probability > 2%, single hatched
  - 4: probability > 2%, double hatched

- Analysis of ratio of observed significant weather to observed severe weather by forecasted conditional intensity categories.

- Data from Nov. ‘21-Apr ‘22

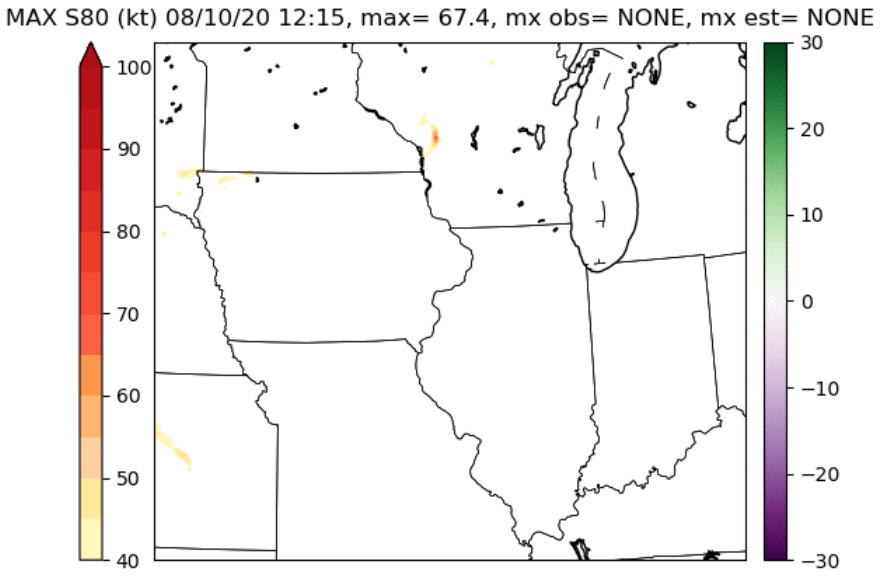
Percentage ratio sig. obsv./severe obsv.

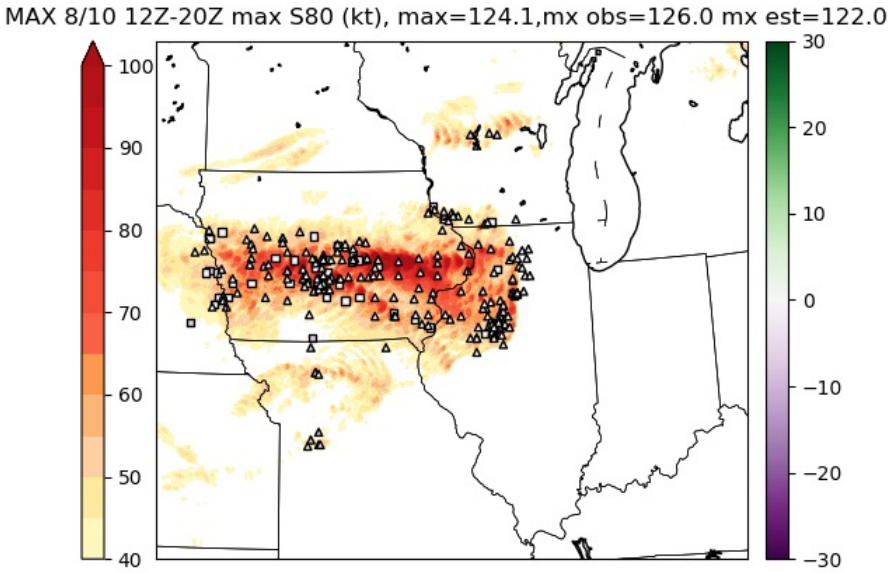


Using WoFS for Severe Wind Verification

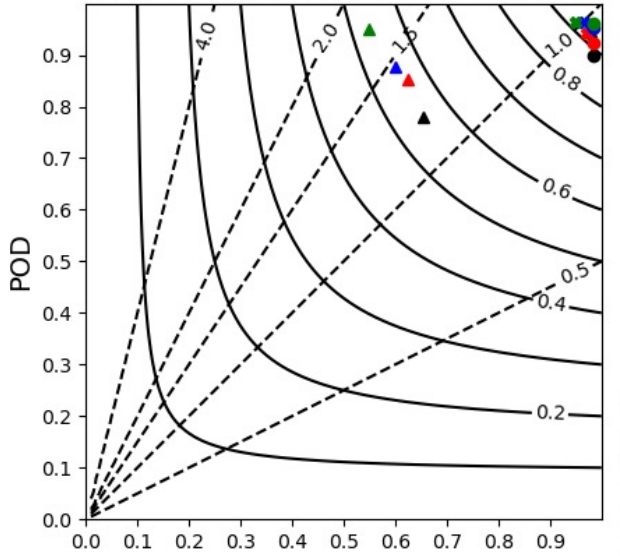
Dr. Nathan Dahl

- Wind LSRs often sparse and unreliable
- Possible solution using time-max 80 m wind output from WoFS 15-min cycles
- Impressive accuracy in timing and magnitude for mesoscale wind events (e.g. 10 Aug 2020 Iowa derecho)
- Less accurate for isolated events; also, accuracy varies widely by region
- Ongoing efforts to augment raw output using machine learning

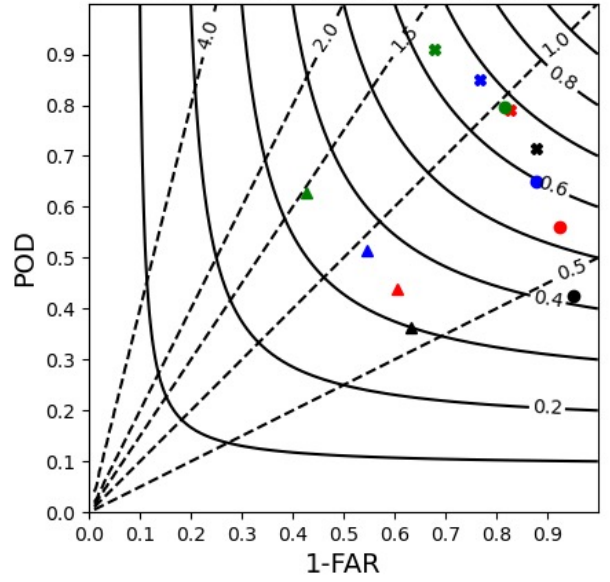




10 Aug 2020 results, 20 km neighborhood



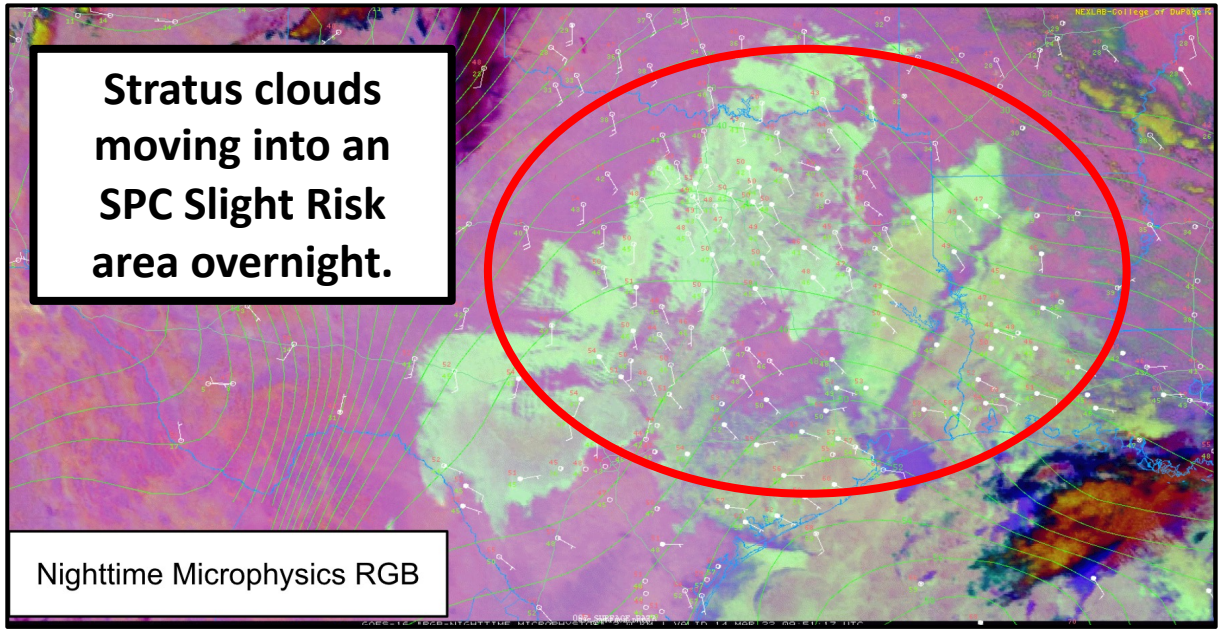
Full 2020 results, 20 km neighborhood



Integrating GOES-R Products into SPC Operations

Kevin Thiel

- Initial evaluation (Survey)
- Strong use of individual ABI bands (visible, water vapor, IR, etc.)
- RGB products
  - Multi-channel composites from ABI
  - ID features not seen in one ABI channel alone (e.g. cloud depth/height)
- Nighttime Microphysics Testbed
  - 4 weeks with 5 SPC forecasters
  - RGB Applications: Identify low-level boundaries, cloud heights/depths, and CI at night
  - Supplement for visible imagery?



First-Guess Convective Watches

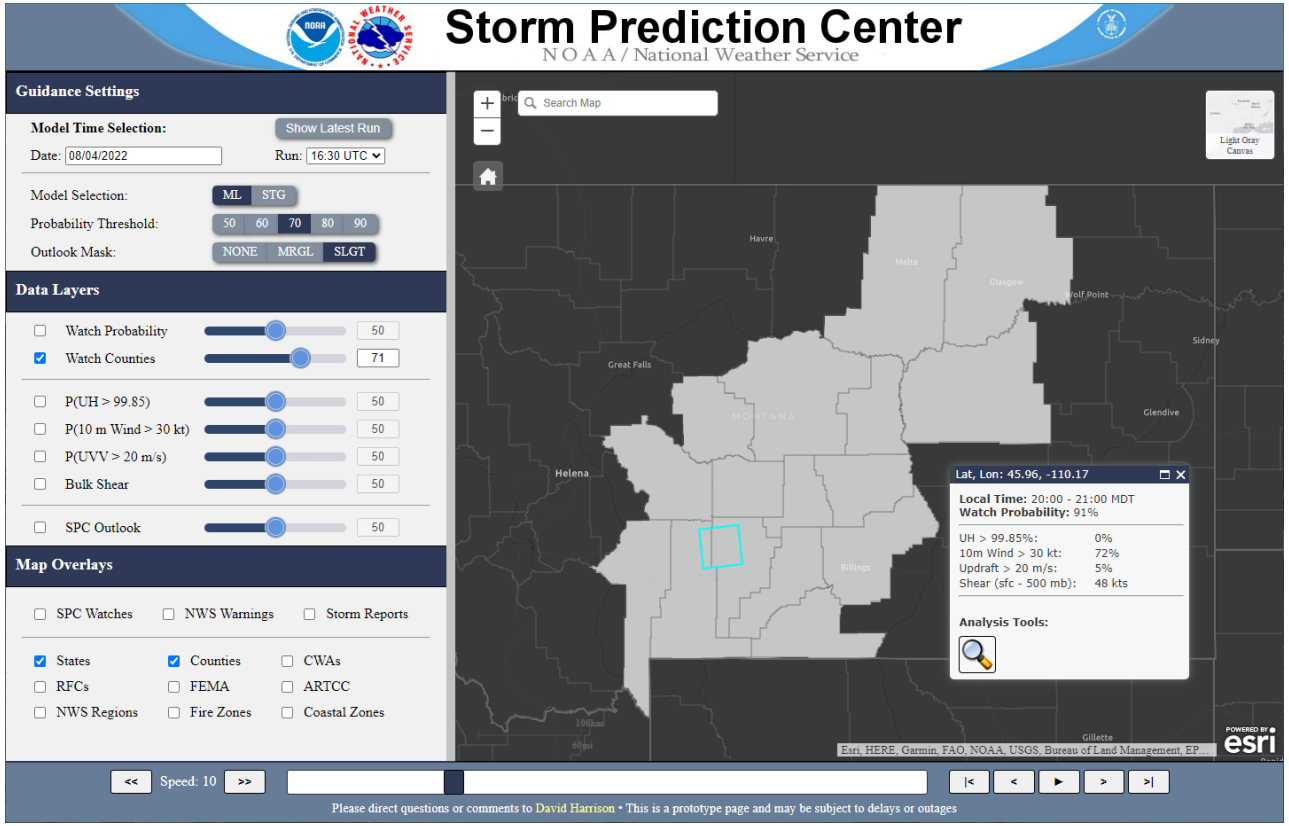
Dr. David Harrison

- **Goal**: Apply machine learning techniques to produce dynamic, probabilistic forecast guidance to help SPC forecasters strategize where and when to issue mesoscale discussions and convective watches

- Input HREF storm-scale and environment variables chosen in coordination with SPC forecasters

- Counties included in a first-guess watch at a given forecast hour if:

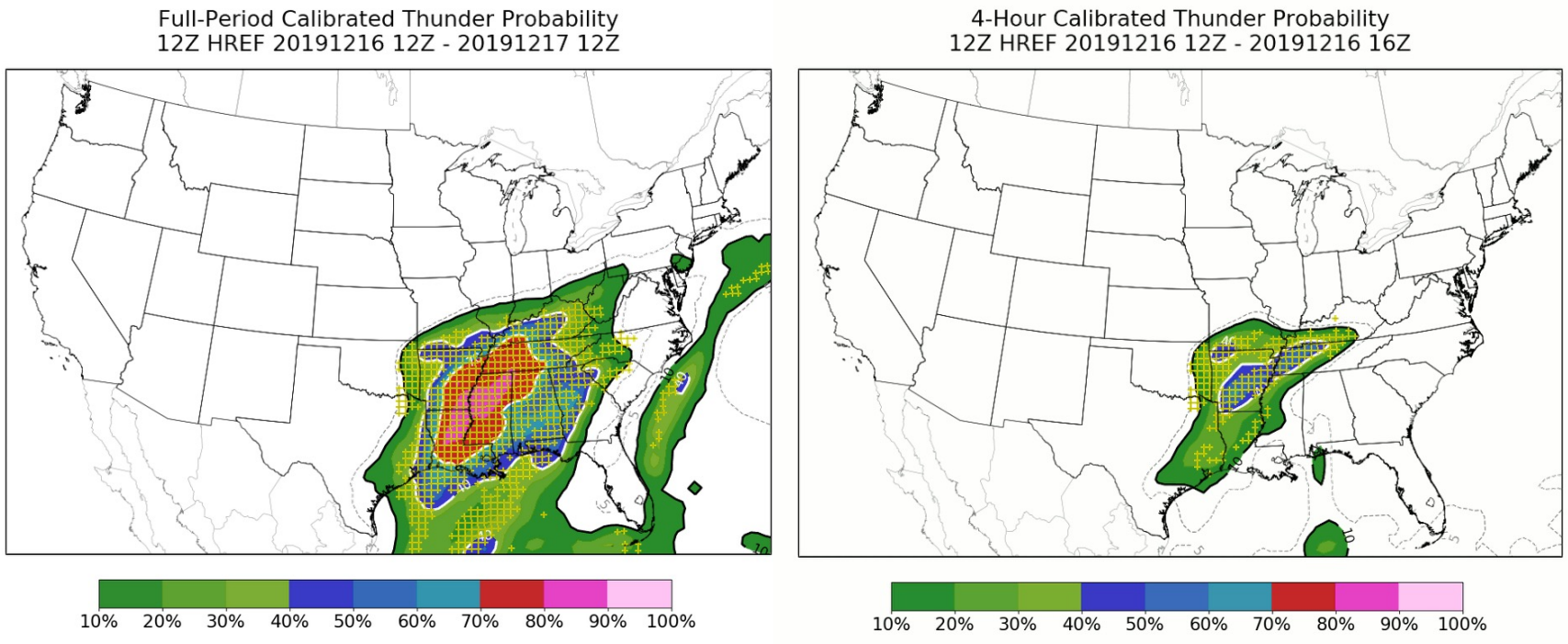
  - The mean watch probability within the county **≥ 70%**
  - The county falls within a 13z D1 (06z D2) **Slight** risk
  - Counties are removed from the first-guess watch once these conditions are no longer met
  - First-guess watches aim for 2 – 3 hours of lead time
  - First-guess watch criteria adjustable by SPC forecasters via interactive experimental interface



HREF Calibrated Thunder Guidance

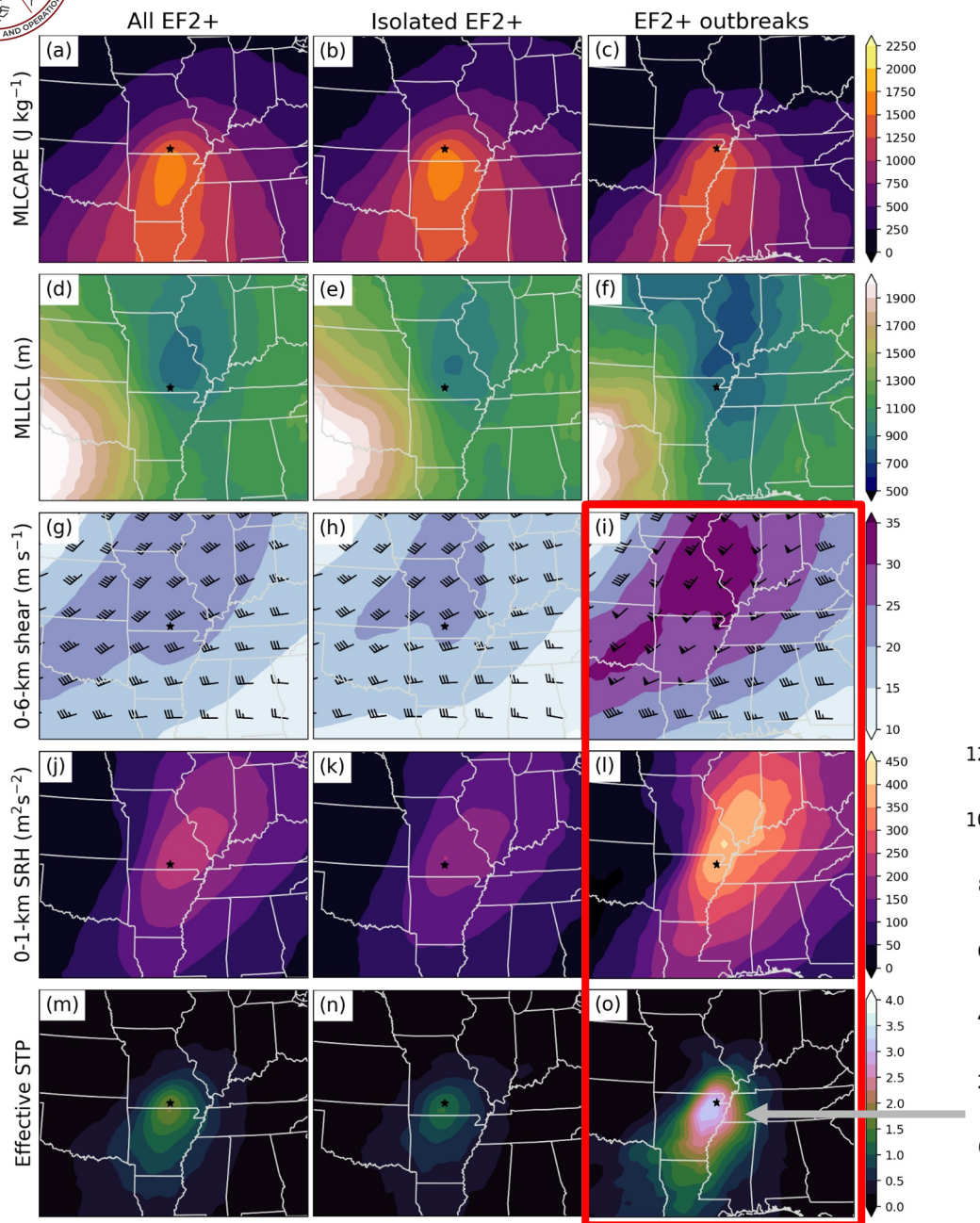
Dr. David Harrison

- 1-h, 4-h, and 24-h probabilities of at least 1 CG lightning flash within 12 miles of a point
- Calibrated statistical model based on HREF storm-scale attributes and environment forecasts
- Developed in direct coordination with SPC forecasters
- Outperforms previous standard SREF Calibrated Thunder guidance
- Available to the public at: https://www.spc.noaa.gov/exper/href/
- For more info: https://www.spc.noaa.gov/publications/harrison/hrefcalb.pdf

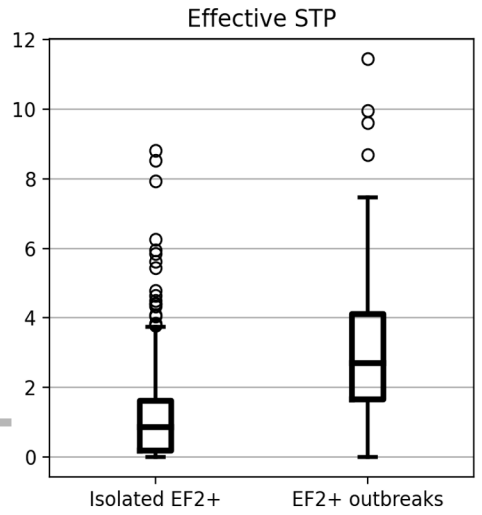


Climatology and environments of significant severe outbreaks

Dr. Andrew Wade



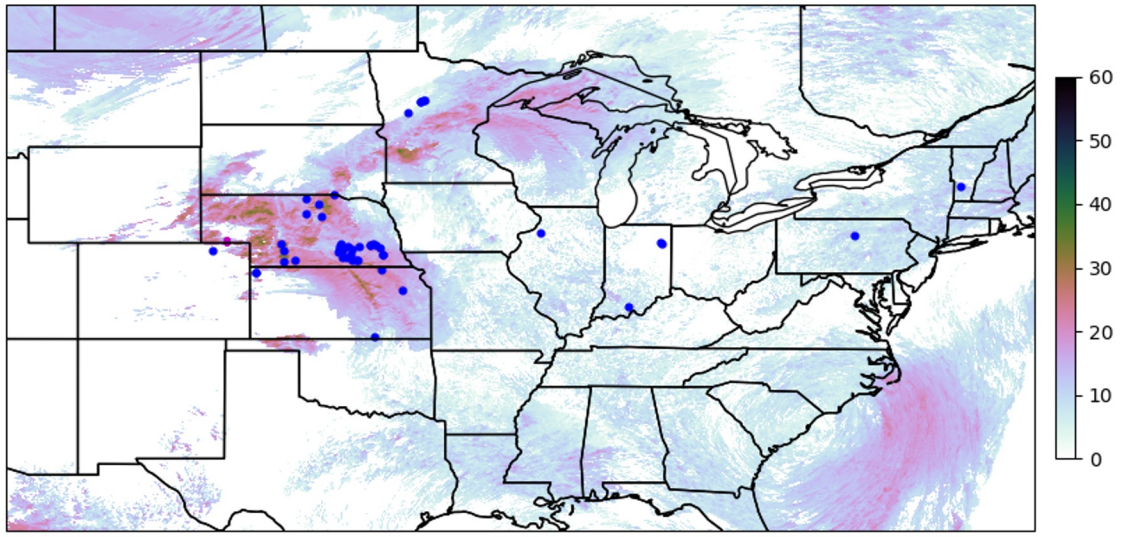
- Top 10% of U.S. significant tornado days by maximum practically perfect hindcast (PPH) probability of EF2+, 2007 - 2021 inclusive:
- 4 days/year; **75% of fatalities**; 65% injuries; 50% property damage
- EF2+ outbreaks vs. isolated EF2+ have much greater mean and median:
  - 0-6km shear: max. contour 35 ms-1 vs. 25 ms-1
  - 0-1 km SRH: max. contour 450 m2s-2 vs. 250 m2s-2
  - STP: max. contour 4 vs. 1.5

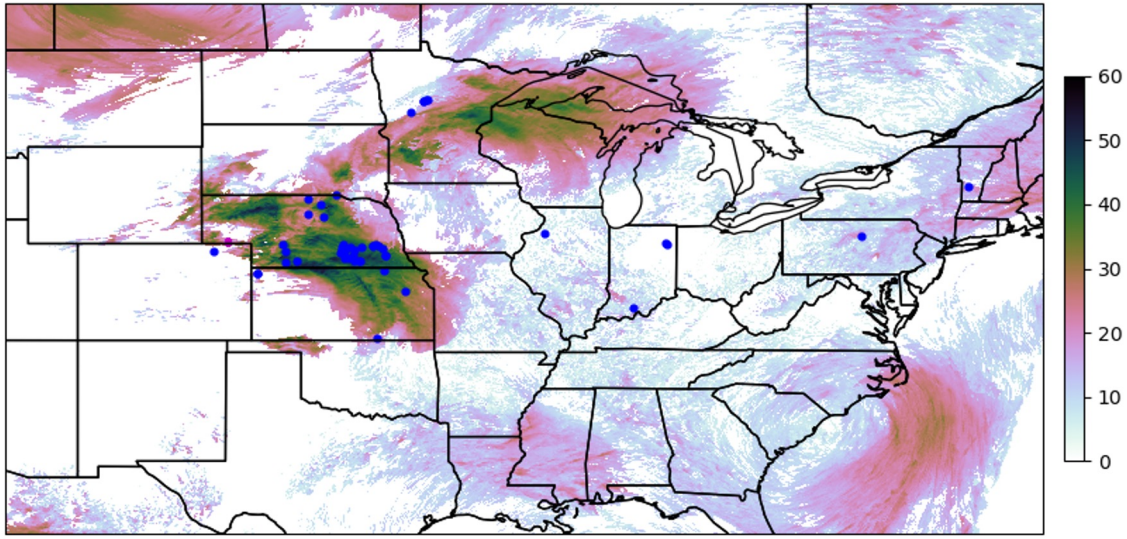


Experimental wind products in NSSL-WRF

Dr. Andrew Wade

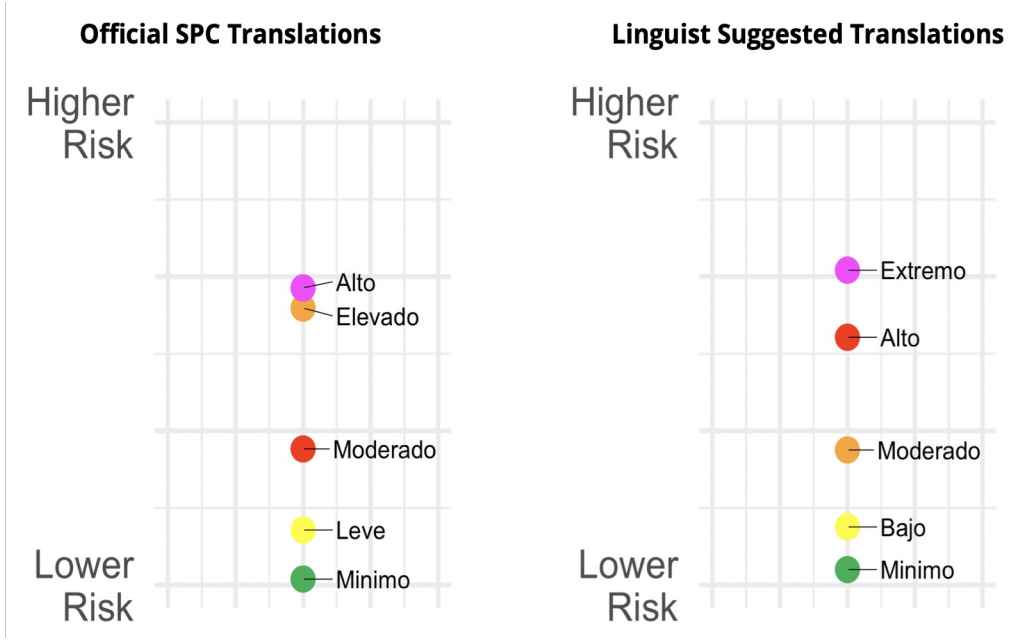
- Forecasters noticed extreme modeled wind speeds at rear-inflow jet level in significant severe warm-season MCSs
- Two fields added to NSSL-WRF: maximum 0-2-km AGL convective wind speed, and convective wind speed vertically integrated over 0-2-km layer (analogous to updraft helicity)





Bilingual Risk Communication and R2O Efforts

Joseph Trujillo-Falcón

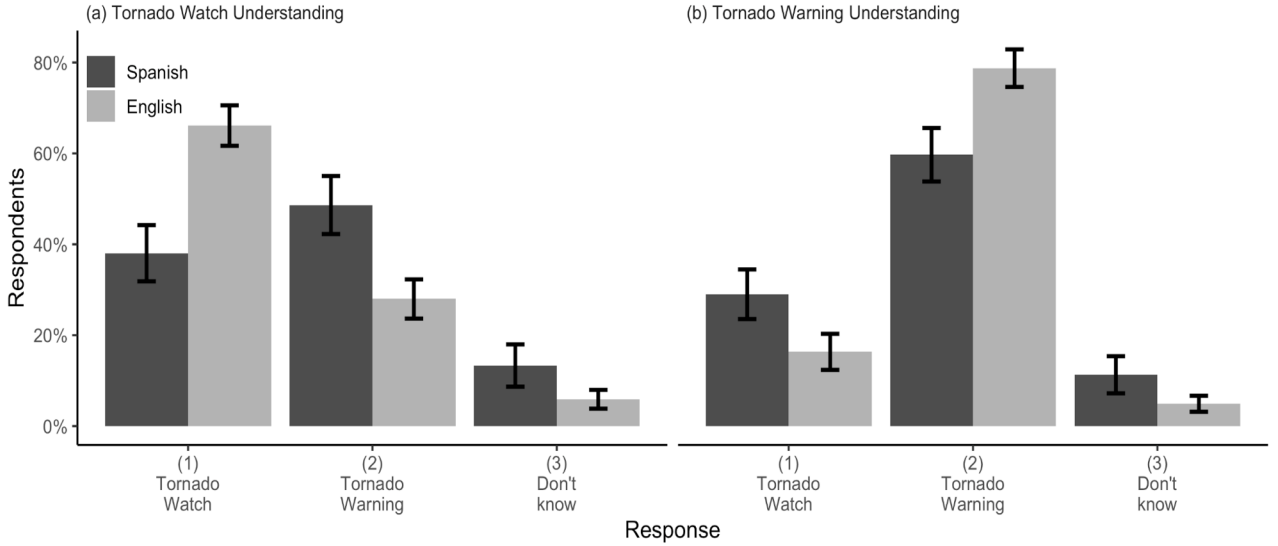


SPC Risk Categories

- Original translations were not communicating the same level of *urgency* in Spanish
- Surveyed 1,050 U.S. Spanish speakers and found proposed terminology was understood better
- R2O: New words now available at spc.noaa.gov

Watch, Warning, and Advisory

- Identified significant language inequities among U.S. English and Spanish speakers
- Proposed new terminology that translate the ***meaning***, not the ***word*** of risk messages
- In Spanish, the current NWS translation of "advisory" communicates more urgency than "warning" and "watch"



If you'd like more information on the research presented or have ideas for collaboration, please contact us:

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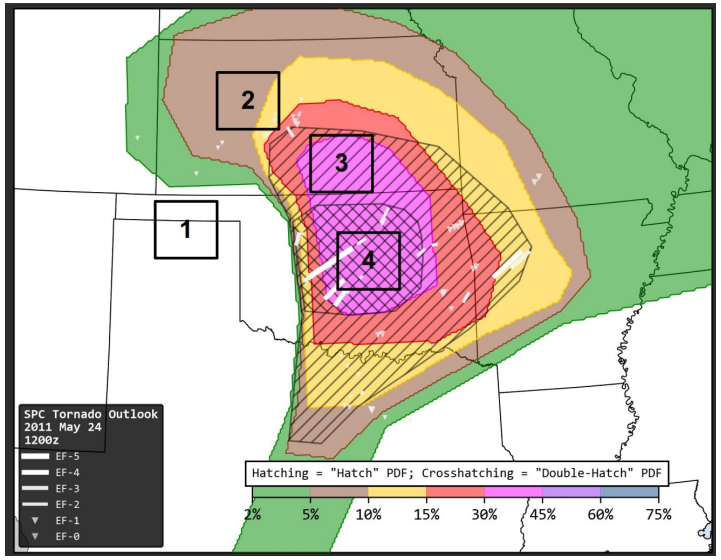
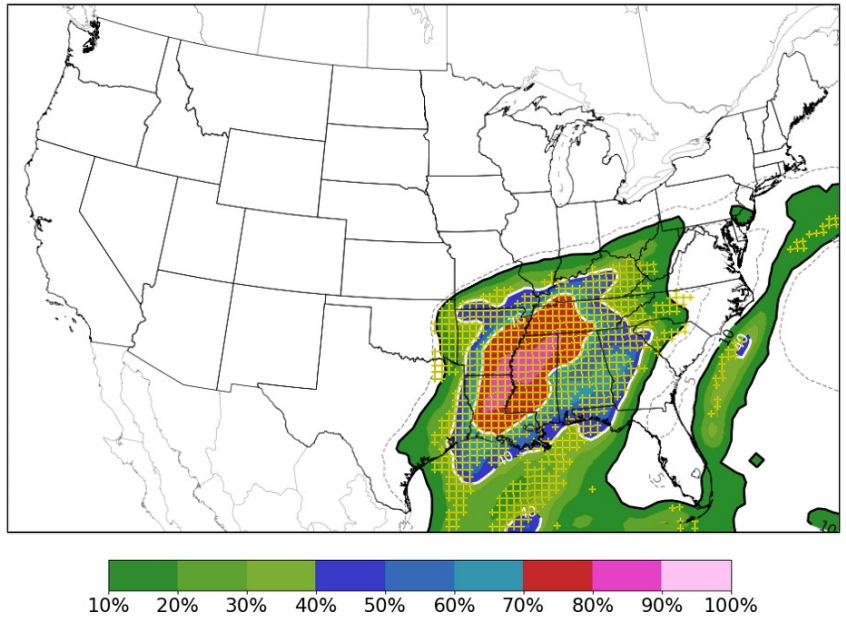


Full-Period Calibrated Thunder Probability
12Z HREF 20191216 12Z - 20191217 12Z



Extra Slides

Conditional Intensity Forecast Bin Statistics

Jacob Vancil

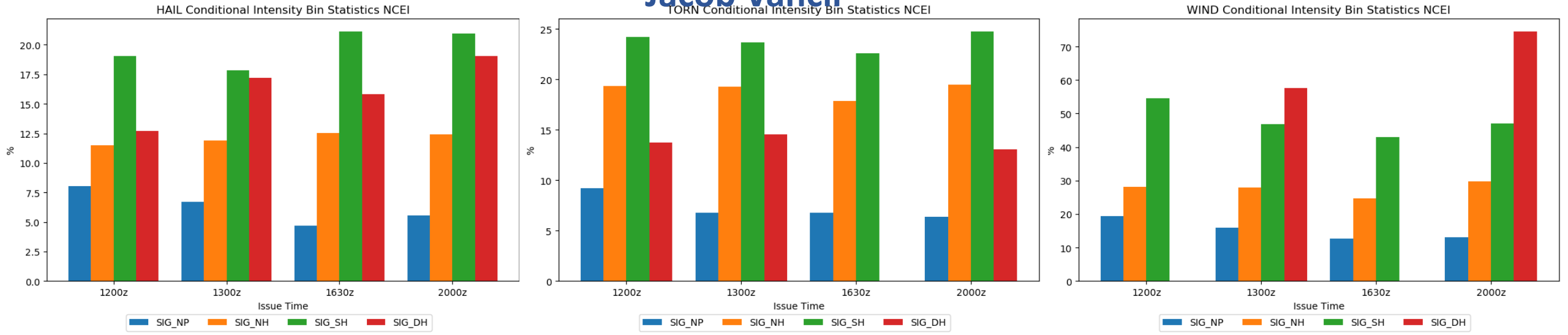


Fig (1): Ratio of significant severe storm reports to severe storm reports within the four conditional intensity forecast bins. The conditional intensity forecasts bins are “No probabilities” (SIG_NP), “No hatching” (SIG_NH), “Single hatching” (SIG_SH), and Double hatching” (SIG_DH). Ratios are calculated from SPC issued, experimental conditional intensity forecasts from November 2021 through May 2022.

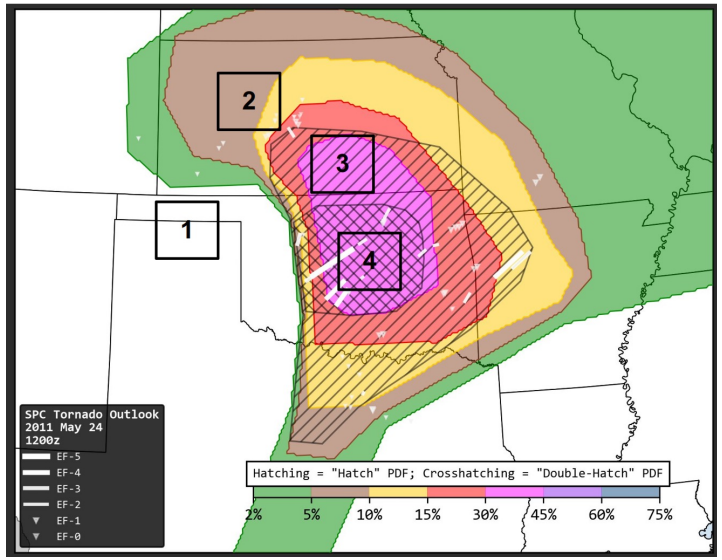


Fig (2): Example conditional intensity tornado forecast. Each of the four conditional intensity bins are shown by 1) “No probabilities”, 2) “No hatching, 3) “Single hatching”, and 4) “Double hatching”. White paths are shown as tornado tracks with the line width representing the tornado rating.

Using WoFS for Severe Wind Verification

Dr. David Harrison

- LSRs often sparse and unreliable, radar obs include errors (e.g., due to beam height/direction)

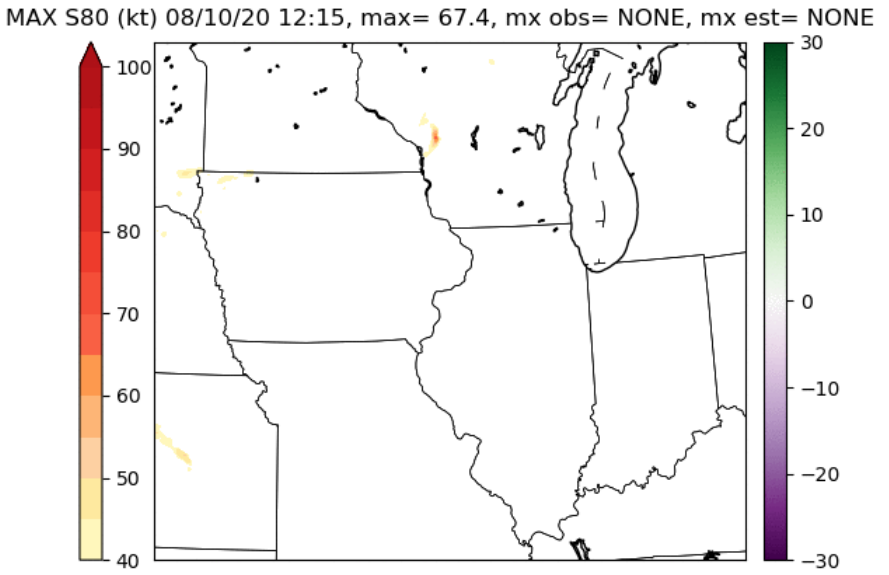
- possible solution using time-max wind output from WoFS 15-min cycles

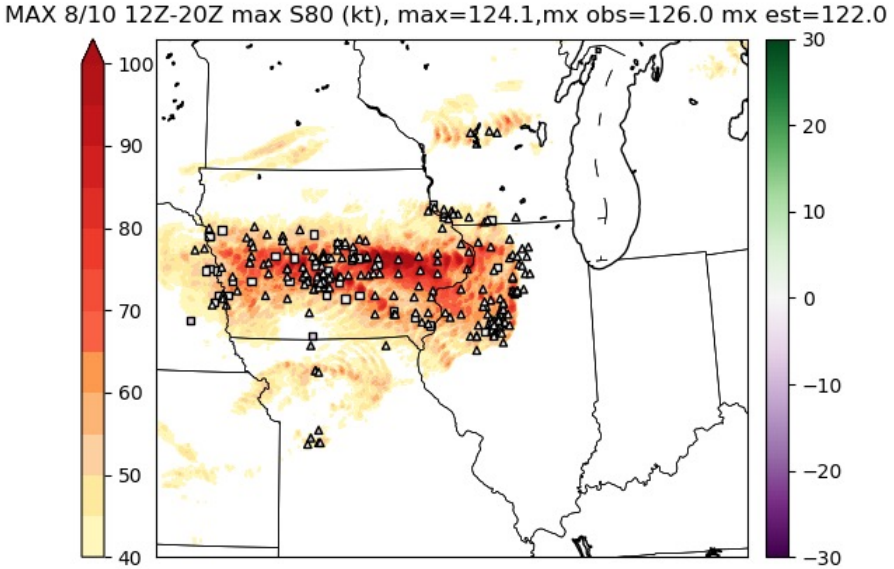
- model 10 m winds generally too weak, but 80 m winds (suggested by NSSL) show more promise as analogue for actual 10 m winds

- impressive accuracy in timing and magnitude for mesoscale wind events (e.g. 10 Aug 2020 Iowa derecho)

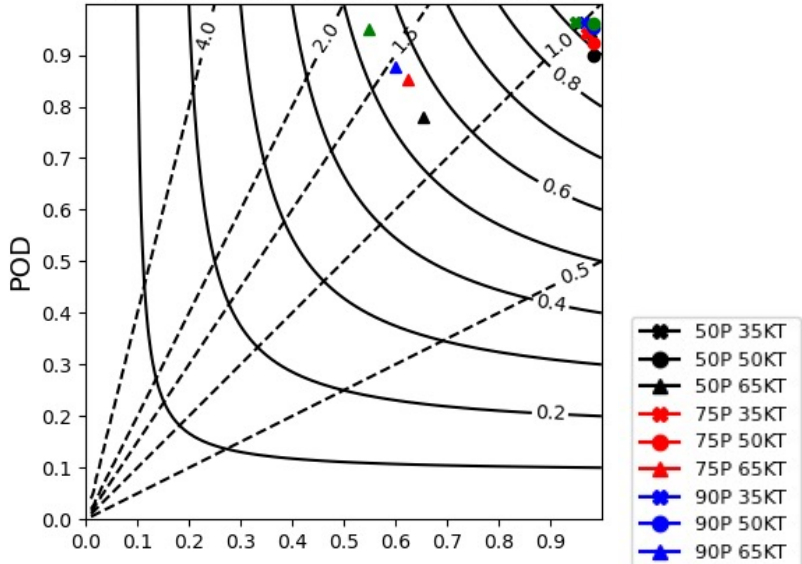
- less accurate for isolated events; also, accuracy varies widely by region

- ongoing efforts to augment raw output using machine learning





10 Aug 2020 results, 20 km neighborhood



Full 2020 results, 20 km neighborhood