User-Centered Research Framework
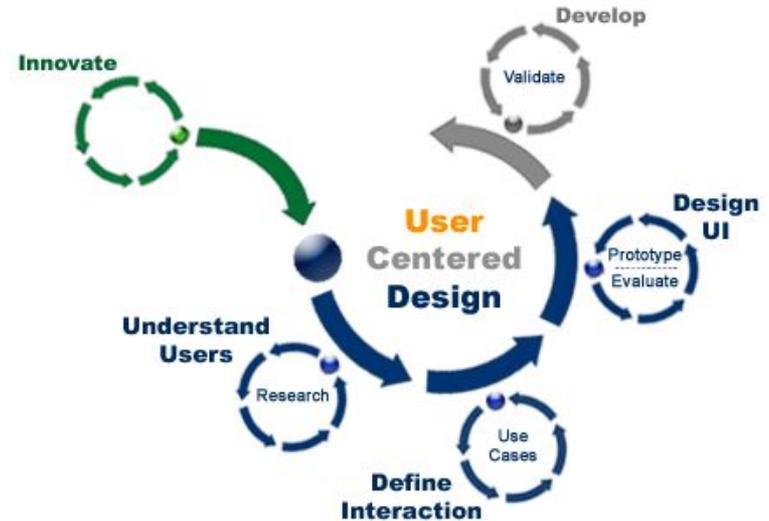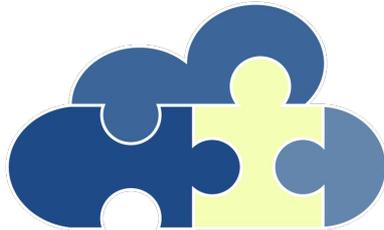
Social and Behavioral Sciences

Kim Klockow-McClain, PhD; CIWRO Research Scientist; WRDD

NSSL is an OAR leader in its inclusion of social and behavioral sciences.

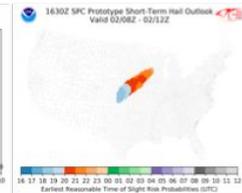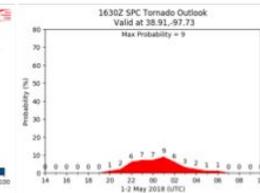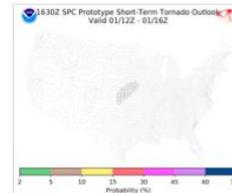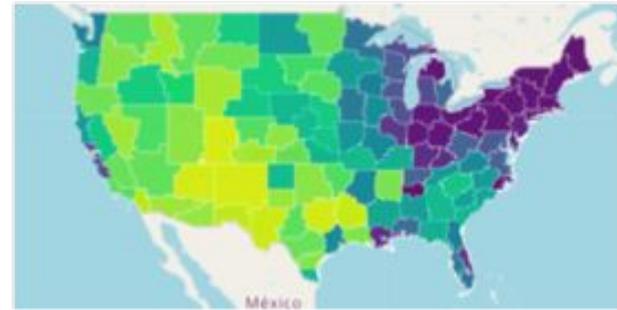User-centered design: Integral to R2O2R approach

Key Themes of SBS Work

Explore and enhance severe **weather warning/communication system** (end-user research & local/population issues)

Improve forecast/warning reception, understanding, and decision-making with **uncertainty** information (FACETs)

- Improve NOAA/NWS ability to meet the needs of core partners and publics, reduce loss of lives and protect property
- **Fundamental shift from solely observing the atmosphere** to observing the weather **communication structure** and individual **decision-making**; new evaluation concept

How we measure success

- 20 Publications, 15 OU Undergraduate students mentored, 5 Hollings/REU students mentored, 5 GRAs supported

- Hundreds of users engaged for feedback, including 450-500* forecasters, 93 emergency managers, and 150-170* broadcast meteorologists since 2015

- Social sciences included in major NSSL R&D programs

- Contributed evidence-based policy solutions to NWS, WMO, The Academies

- AMS Editor's Award 2019

- AMS Award for Early-Career Professional Achievement 2021

  - Joseph E. Trujillo-Falcón "for innovative and extensive collaboration in risk communication for Spanish-speaking communities and leadership as an exceptional student member across multiple AMS boards and committees."

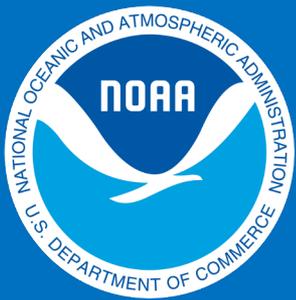# Having a **diverse, thriving, fully embedded presence** is our most significant accomplishment
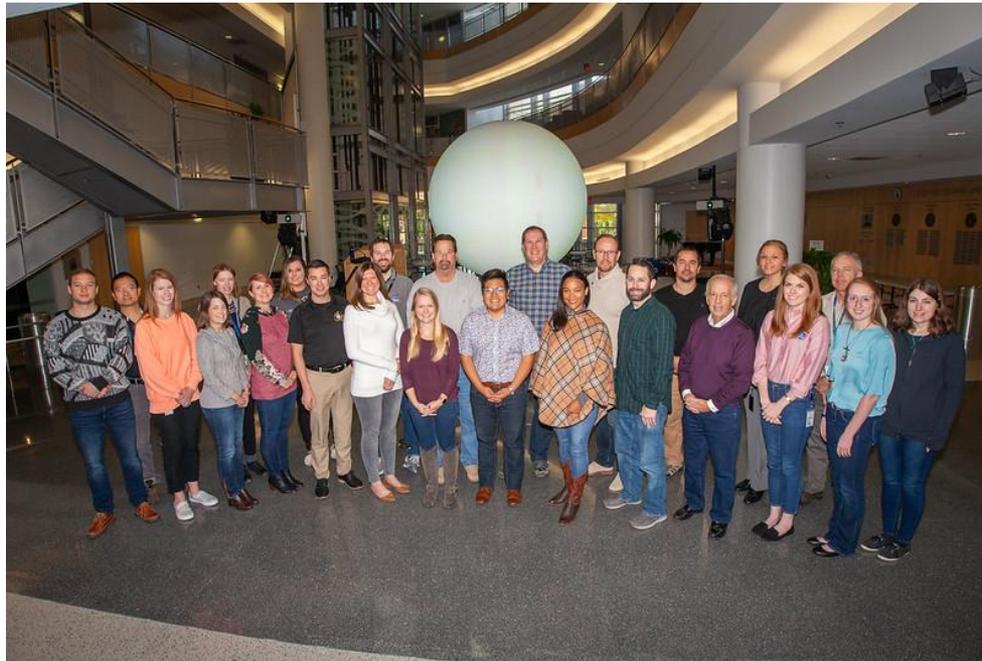
Up next
Dr. Kodi Berry: FACETs
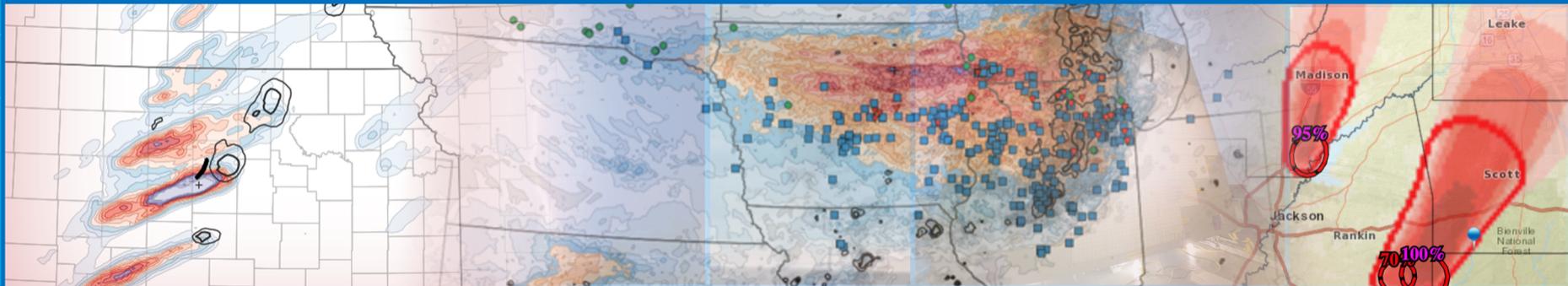Dr. Kim Klockow McClain: SBE R2O
Joseph Trujillo: Partnerships

User-Centered Research Framework

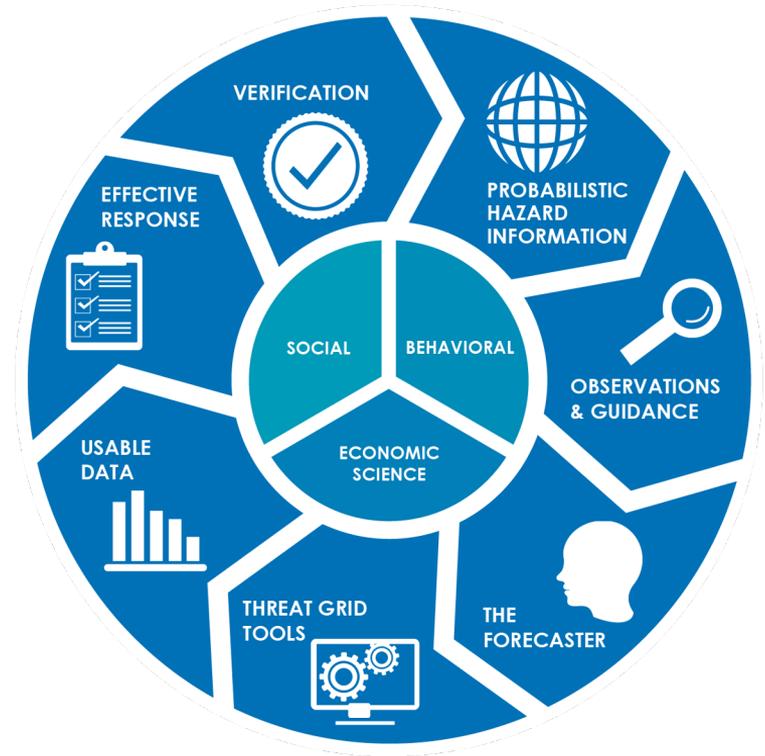# Forecasting A Continuum of Environmental Threats (FACETs)

Kodi Berry, PhD; NSSL FACETs Program Lead; WRDD

What is FACETs?

- Proposed modernization of the entire forecast and warning system to provide more actionable information when it's available

- Integration of physical and social/behavioral sciences

Goals of FACETs

- Better individual decision making

- More consistent communication & impact-based decision support services

- Meaningful quantification of hazard probabilities

- To produce a continuous stream of high-resolution probabilistic hazard information extending from days to within minutes of an event – for *all environmental hazards*

Facet 1: Probabilistic Hazard Information

- Grid-based probabilities

- Already exists in some of the NWS product suites

- Serves as the foundation for impact-based decision support services
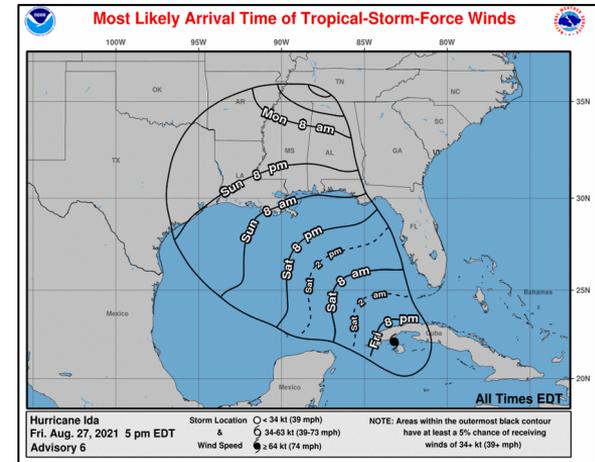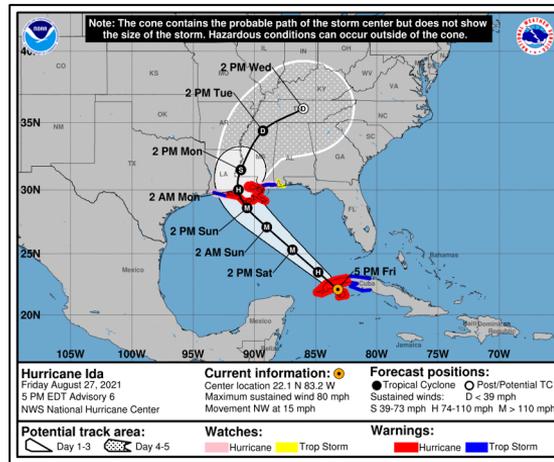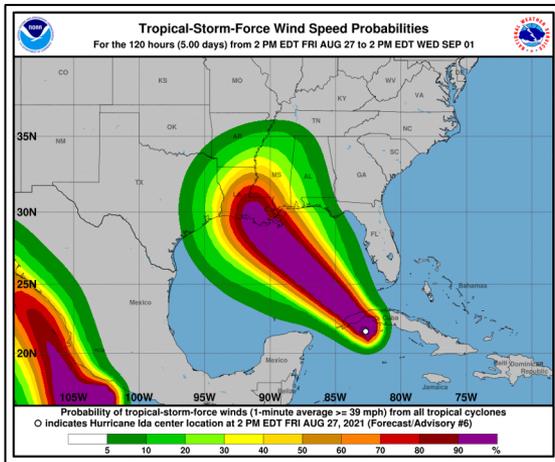
Facet 2: Observations & Guidance

- What forecasters use to make decisions
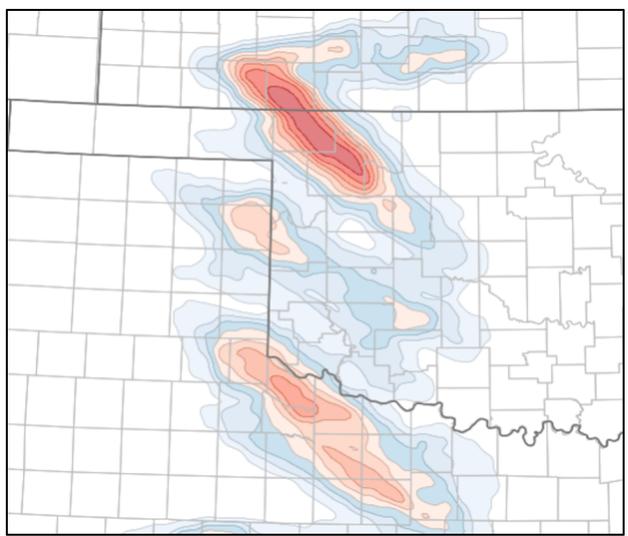
Probability of severe hail from the Warn-on-Forecast System.
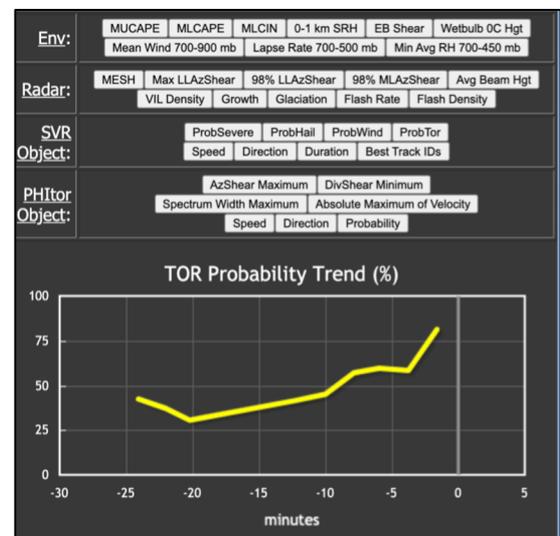
Probability of tornado from random forest algorithm.
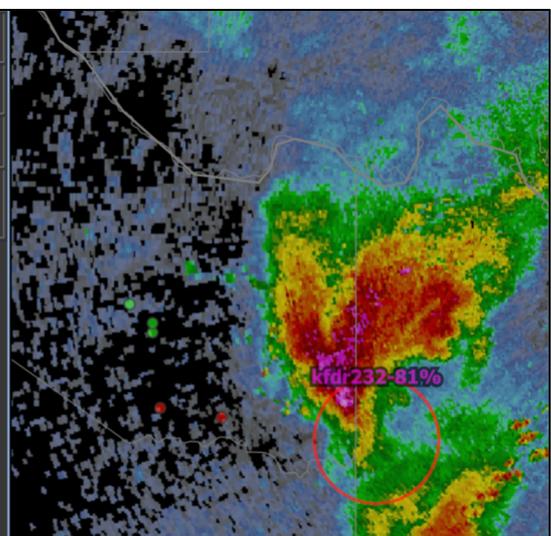
Facet 3: The Forecaster

- The person making the forecast & warning decisions
  - As essential as ever to the entire forecast & warning process
  - Knowledge, skills, abilities

- New paradigm = new training
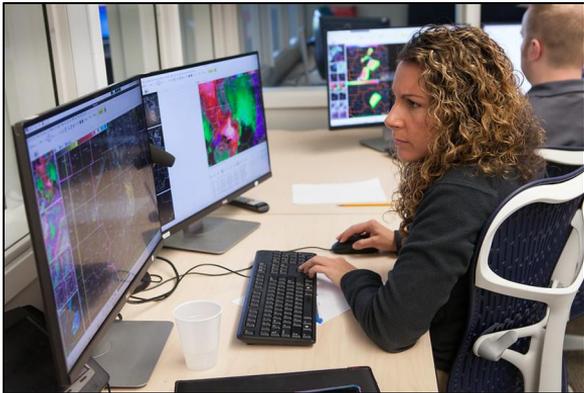
Facet 4: Threat Grid Tools

- What forecasters use to create the probabilistic hazard information

PHI Prototype Webtool → Hazard Services PHI
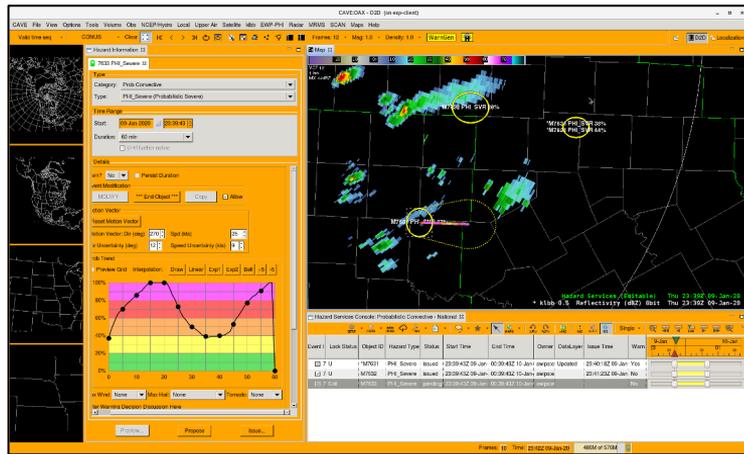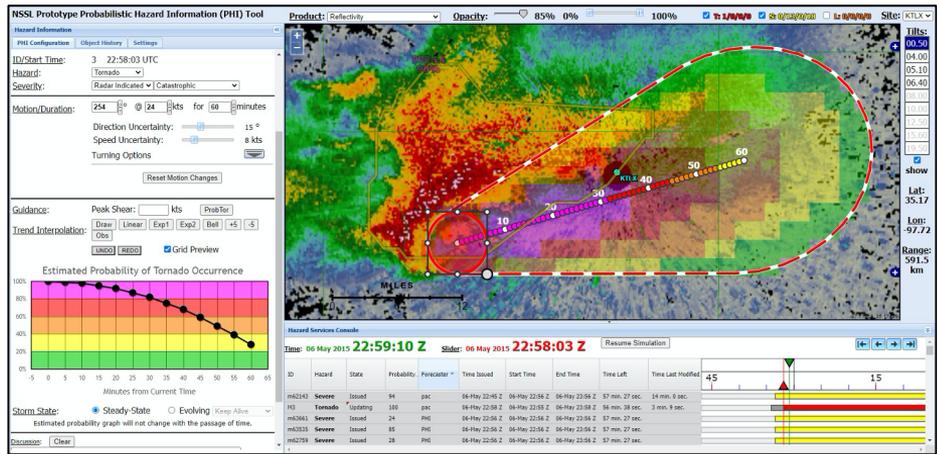
Facet 5: Usable Data

- What the end users see & hear
  - Graphical, textual, auditory, etc.

- Social/behavioral sciences are key
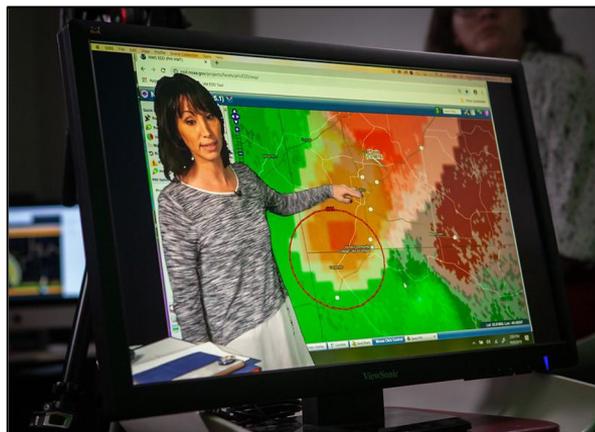
Facet 6: Effective Response

- What the end users do
  - The physical/social interface
  - The most important facet

- Where social & behavioral science research pays off

Facet 7: Verification

Evaluating system effectiveness

Verifying forecasts & warnings
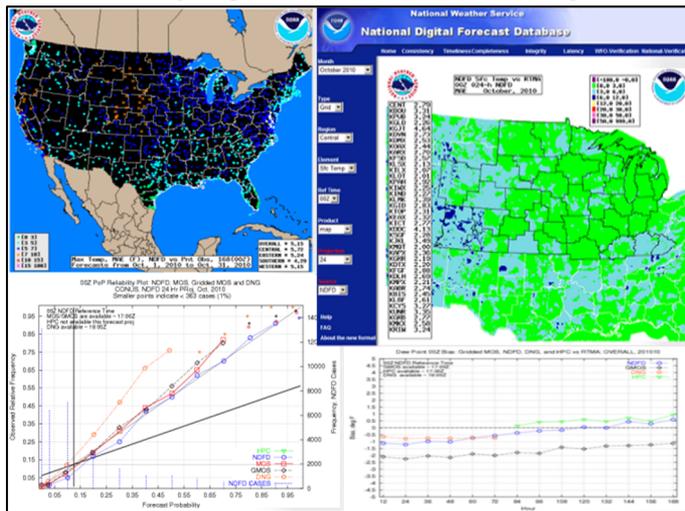
Verifying public response & understanding
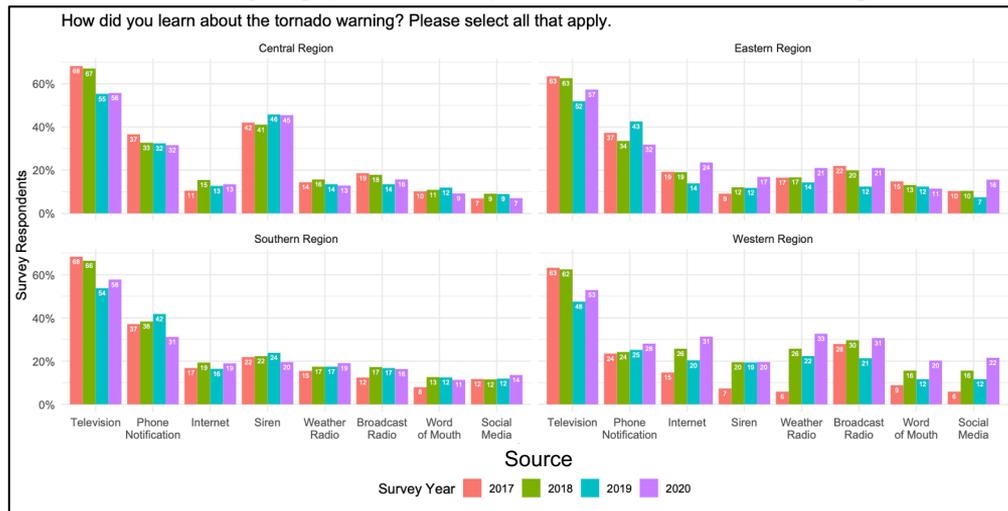
Severe Weather & Society Dashboard

- **Baseline survey** on where the U.S. public gets severe weather information and their understanding of current severe products

- Deployed each year to monitor **changes**

- Database of survey data from 2017-2021

- Developed a Dashboard to allow forecasters to view **community statistics**

- Transitioned to NWS cloud services

- **Spanish** survey data available in 2021

- Developing companion survey and database for **tropical cyclone** and **winter weather threats**
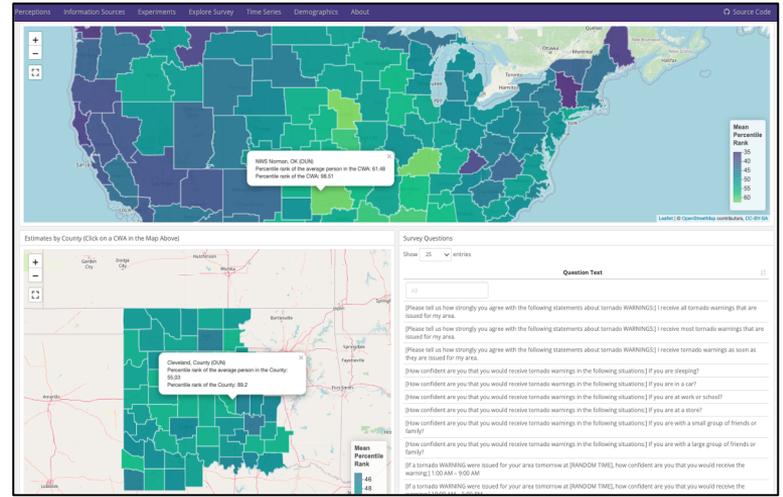
Example of how forecasters can use the Dashboard to look at national, county warning area, and county information.

Threats-in-Motion (TIM)

- Severe thunderstorm and tornado warnings that move with the storm

- Initial step to shift the current NWS convective watch and warning paradigm toward a more *continuous flow of information*
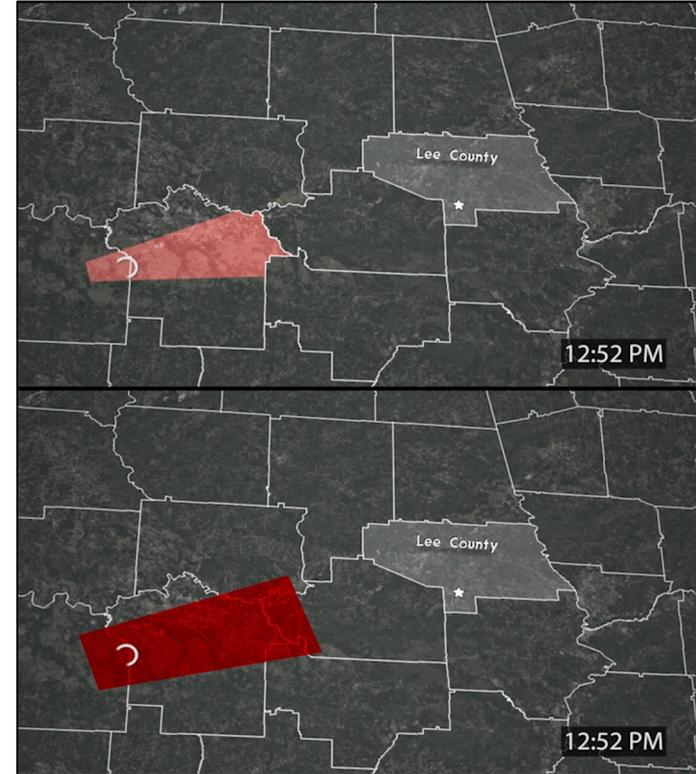
Future FACETs Work

Cross-division effort to ensure FACETs-related research and products tell a cohesive story across time and space scales
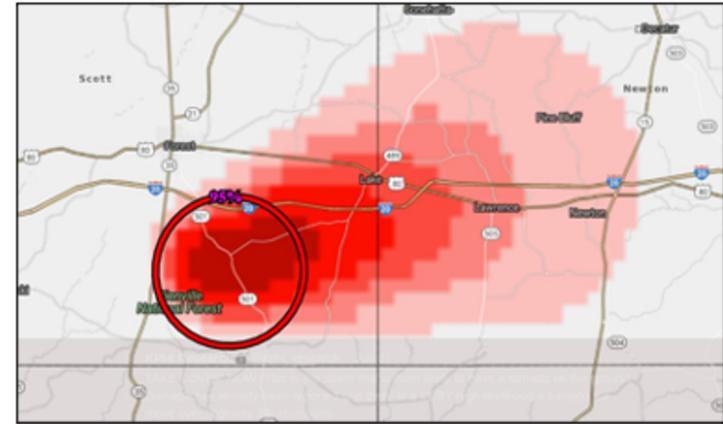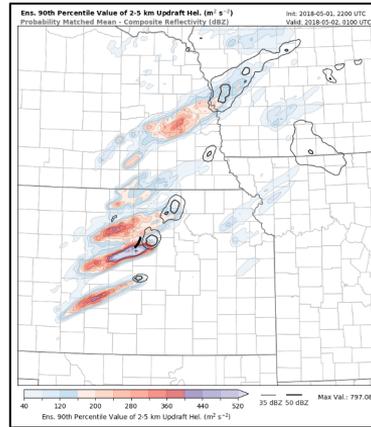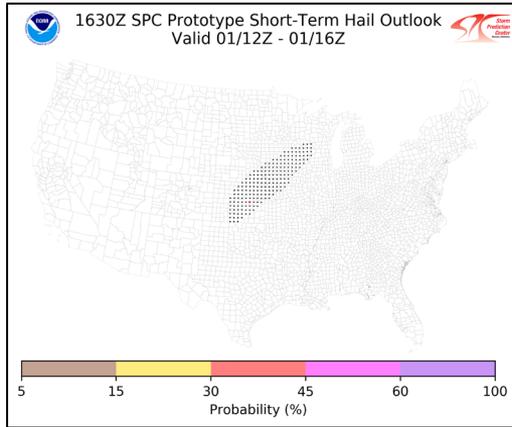
User-Centered Research Framework

Interweaving SBE through all R2O

Kim Klockow-McClain, PhD; CIWRO Research Scientist; WRDD

Strategy

What: Integrate insights from the social, behavioral and economic sciences end-to-end into NSSL research activities.

How: Institutionalize social science research across NSSL, Enhance social science R2O/O2R linkages

Effect of the Strategy

- Improve **efficiency** of weather R&D by considering user and public needs from the beginning
- Improve **usability, usefulness, and societal uptake** of weather forecast technologies

Examples of Progress: Meaningful Integration

Brought SBE methods/instruments to an in-house testing facility (HWT) that was previously dominated by physical science development
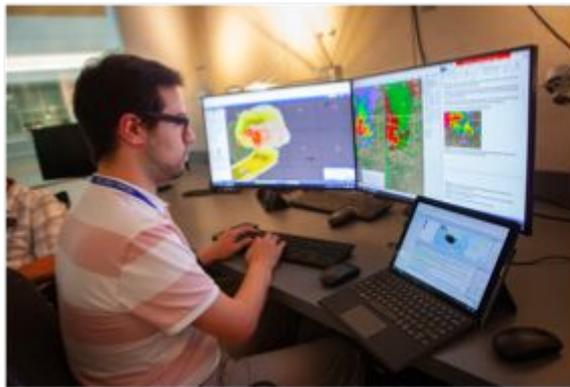
Examples of Progress: Iteration, Inclusion

Evolved thinking about FACETs technologies and their use

Treating TIM as separate advancement

New prototype/ warning ideas

Early prototypes put before users

Making multiple probability products tell a cohesive story

Multiple probability products introduced

Warning linkages to hazard probabilities expanded
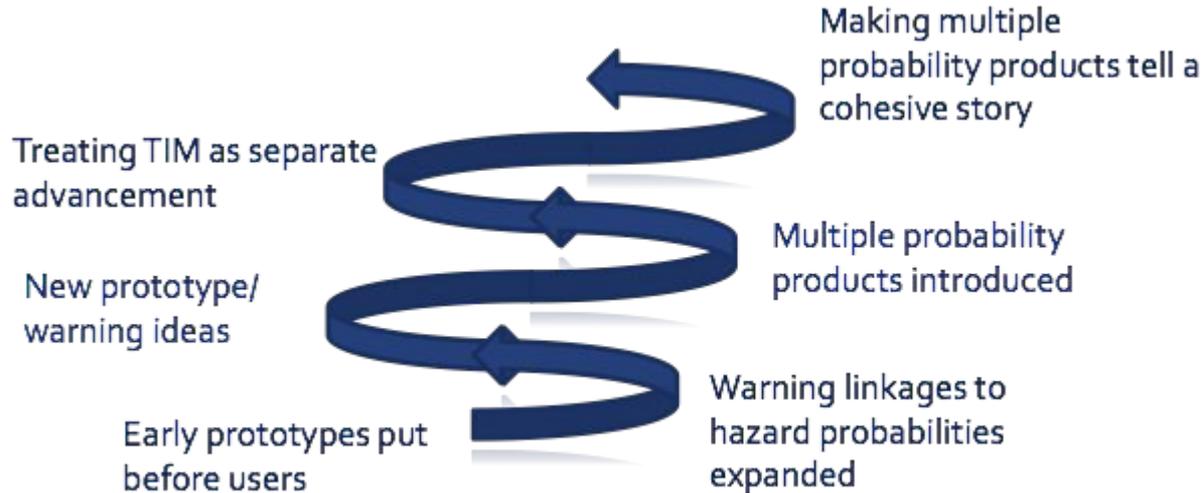
Examples of Progress: Stakeholder Engagement

TIM Stakeholder Engagement Workshops

- 2019: Introduction to Threats-in-Motion and identifying most pressing issues

- 2021: Focus solely on dissemination and communication issues related to Threats-in-Motion

NWS, Emergency Management, and Broadcast Media Vendors were represented at both workshops

Examples of Progress: New Hiring Model

O2R Practitioner

R2O Scientist

Future Work

- Evolve the new O2R & R2O Scientist Roles
- Bring more insights from users & publics into **front end** design & physical science research processes
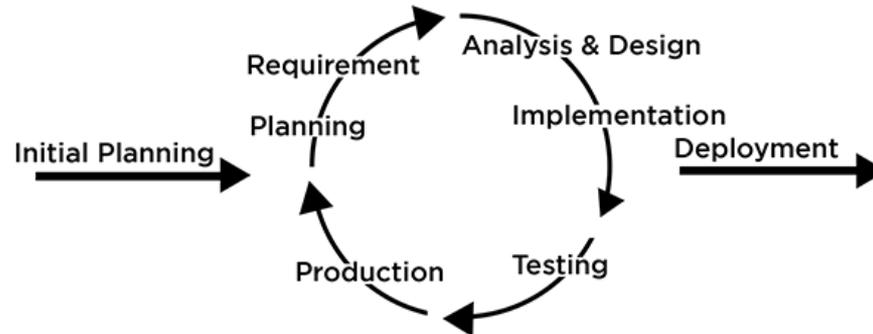
User-Centered Research Framework

Collaboration efforts with NWS and other entities

Joseph Trujillo-Falcón; CIWRO Graduate Research Assistant; WRDD
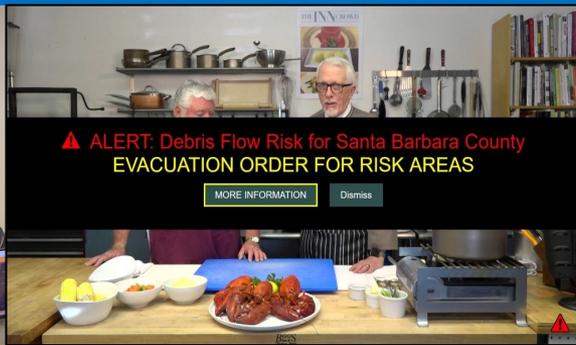
Summarized Story to Tell

Successful social science research, development, and applications involve **new, innovative partnerships**

Relevance

We want NSSL research and development to be **informed by the needs of society**

NWS & Natural Hazards Center

- Today, forecast & warning effectiveness is studied in **<1%** of all tornadoes

- **Need**: Standardized, routine measurement

- **NSSL**: Organized working group, developed survey, obtained Institutional Review Board approval

- **Next steps**: Integration in NWS Damage Assessment Toolkit, Tornado Touchdown App, Natural Hazards Center Quick Response Funding Call

NATURAL HAZARDS CENTER

Bilingual Research-to-Operations Efforts

- Collaboration with OU's Center for Risk and Crisis Management, SPC, NWS Multimedia Assistance in Spanish Team and NWS Spanish Outreach Team provided insights in serving U.S. Spanish speakers
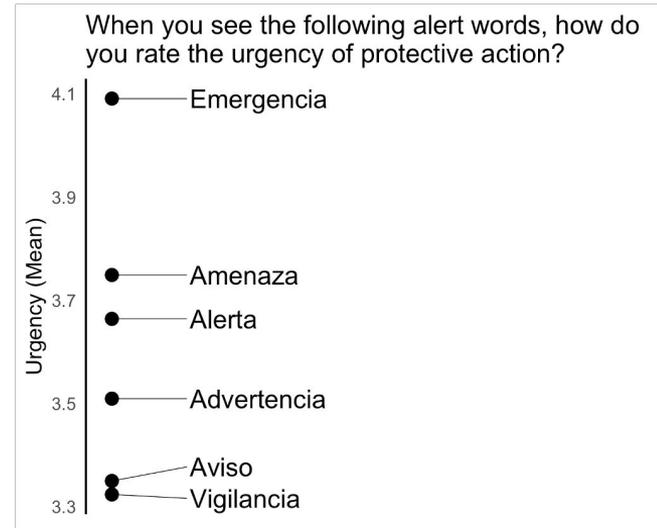
- Findings revealed inconsistencies in current translated material and risk literacy

- A proposed infrastructure has been showcased at the National Academies and recently, a NOAA/NWS leadership briefing

When you see the following alert words, how do you rate the urgency of protective action?

Urgency (Mean)	
4.1	Emergencia
3.9	
3.7	Amenaza / Alerta
3.5	Advertencia
3.3	Aviso / Vigilancia

The University of Oklahoma
Center for Risk & Crisis Management

Establishing Best Practices for Researching U.S. Hispanic/Latinx Communities

- Going beyond ethnicity in surveys
  - Heritage?
  - Generational Ancestry?
  - Immigration Status?

- The usefulness of mixed-methods approaches in studying vulnerable groups

- Under publication and will be presented to NOAA's Weather Program Office

Advanced Warning and Response Network

- Collaborative project to begin understanding how the next-generation broadcast standard could change severe weather communication with the public

- Conduct **focus groups** in Nebraska to investigate what kind of **rich content** viewers might want during severe weather

- **Design prototype displays** and **conduct usability testing**, including eye tracking and think aloud interviews
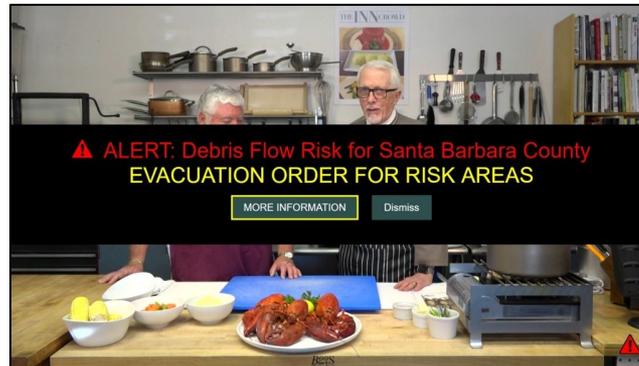
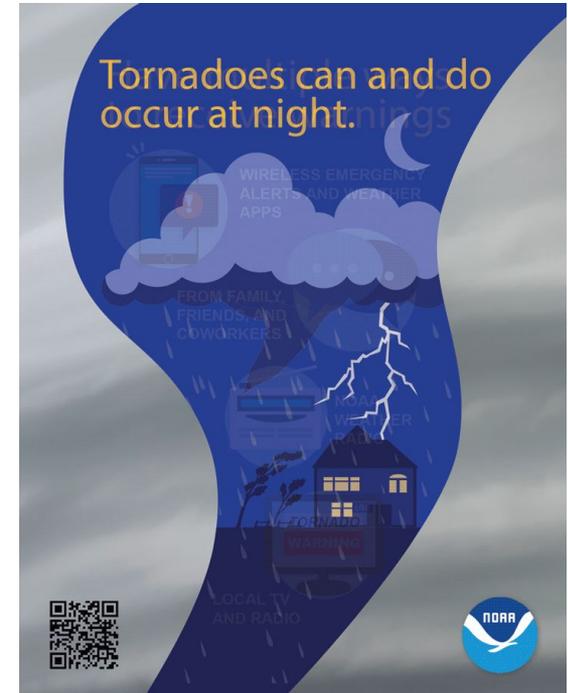# VORTEX-SE & MS/AL Sea Grant Collaboration

- Create a model to integrate VORTEX-SE physical and social science research into local communities
- Support two-way dialog on the needs of local communities that are vulnerable to severe weather events
- Respond to those needs with accurate, trusted information delivered by extension specialists, researchers, and other experts

Tornadoes can and do occur at night.

VORTEX-SE & MS/AL Sea Grant Collaboration

Severe Weather Awareness Expo

- June 2021, hosted in collaboration with the First Baptist Church of Biloxi, Mississippi (Harrison County)
- Community partners brought resources to share with participants on severe weather topics such as hurricanes, tornadoes, and floods.

Mapping exercises included mapping first, second and third choice severe weather safe space options. This allowed for reflection and dialogue, revealing maladaptation and unrealistic expectations about time to reach safe spaces as well as what would be open/accessible.

Future work (1-3 years)

- Work with Natural Hazards Center to successfully implement the Tornado Quick Response call throughout 2022

- Officially launch Tornado Touchdown App in 2022

- Complete NWS Damage Assessment Tool Integration

- Establish best practices in researching Hispanic/Latinx communities to NOAA's Weather Program Office

- Begin to centralize efforts across NOAA/NWS in translation and interpretation of Spanish-language material

- Launch Vortex-SE Advisory Council