Building Trustworthy AI for Weather and Climate

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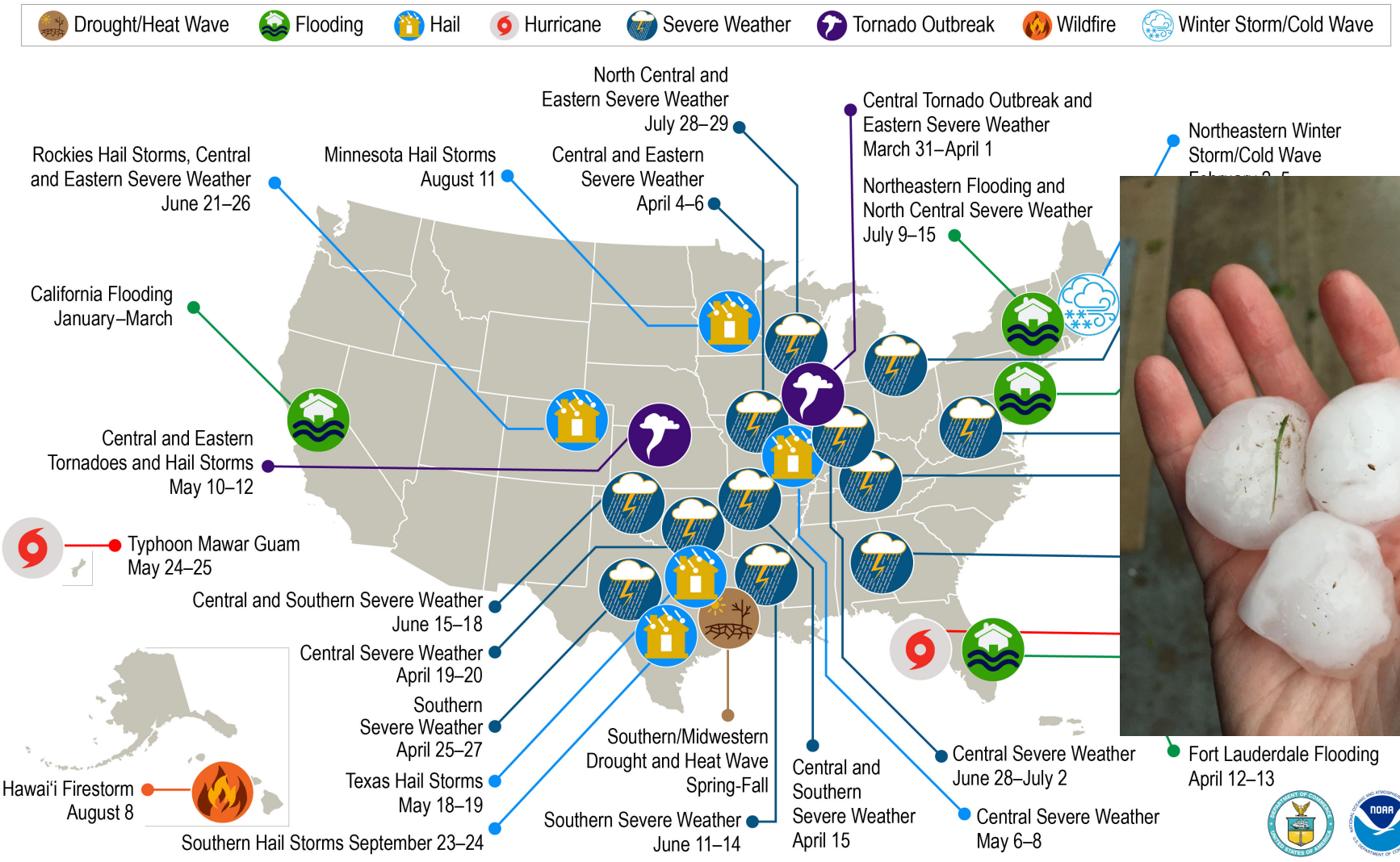
U.S. 2023 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **28 separate billion-dollar weather and climate disasters that impacted the United States in 2023.***

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Societal Impacts of Trustworthy AI for Weather and Climate

Trustworthy AI provides timely, reliable, and actionable information to decision makers

Using AI to improve weather prediction at all time scales can:

- Saves lives
- Protect property and crops
- Provide personalized risk management
- Improve societal climate resiliency

NSF AI Institute for Research on Trustworthy AI in Weather, Climate, and Coastal Oceanography (AI2ES)

AI2ES is developing *novel*, *physically based* AI techniques that are demonstrated to be *trustworthy*, and will directly improve *prediction, understanding, and communication* of high-impact weather and climate hazards, directly improving climate resiliency.

ai2es.org

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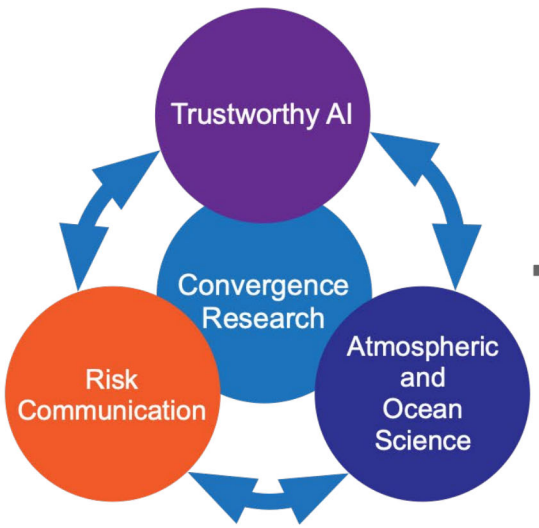
AI2ES Overview



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Ethical, Responsible, Use-Inspired AI

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Foundational research in trustworthy AI/ML

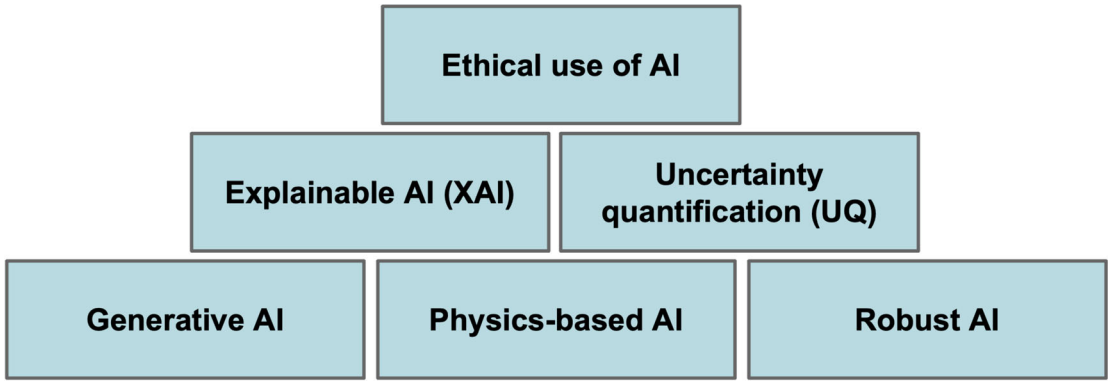
Earth science has different AI needs

- Physics-based methods
- Integrating spatiotemporal context
- Use in life-and-death decision making
- And more!

AI2ES Goals:

- Develop XAI & interpretable methods aligned with Earth science needs
- Develop physics-based AI techniques
- Develop robust AI prediction techniques

Foundational AI2ES AI topics for environmental sciences (ES)



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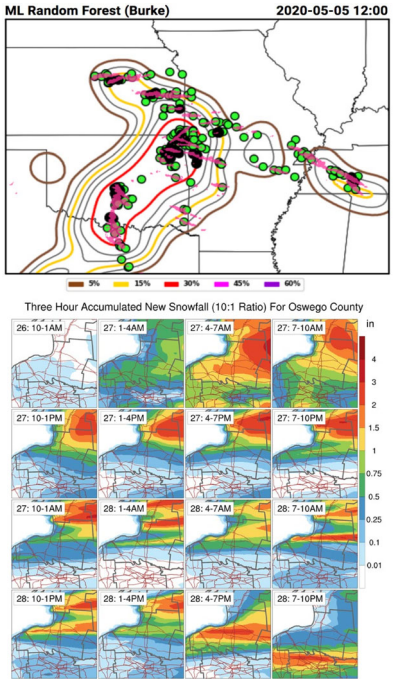
Use-inspired research in ES

- **Goal**: Use trustworthy AI to provide actionable information to diverse users
- **Goal**: Enhance scientific and physical understanding of basic processes through trustworthy AI

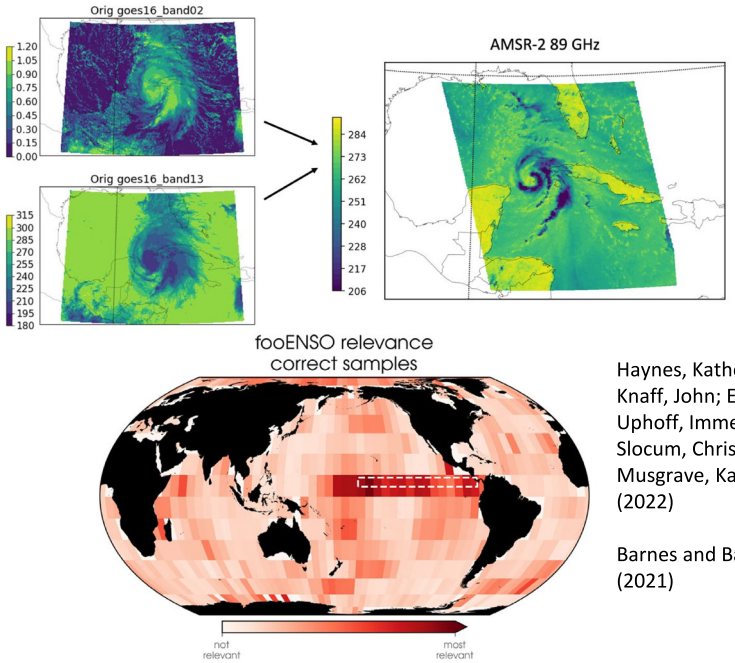
Convective and winter weather



Burke, Gagne, Snook, McGovern, WAF 2020

Predictive roadway risk tool developed for the New York State Department of Transportation, from N. Bassill

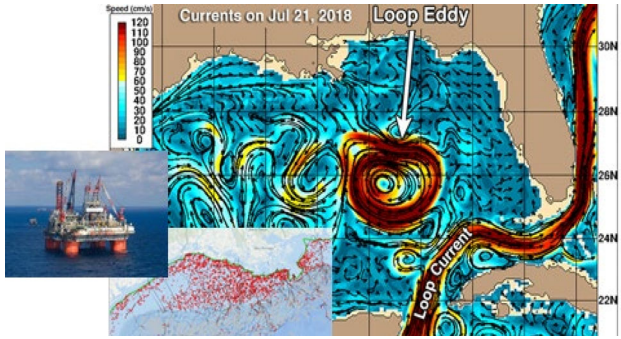
Tropical Cyclones and S2S



Haynes, Katherine; Knaff, John; Ebert-Uphoff, Imme; Slocum, Christopher; Musgrave, Kate (2022)

Barnes and Barnes (2021)

Coastal Oceanography



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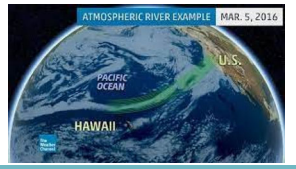
AI2ES Interdisciplinary Risk Communication research approach







Hazard Use Cases

Interdisciplinary Research Team

Risk Communication Scientists
Atmospheric Scientists
AI/ML Scientists and Developers

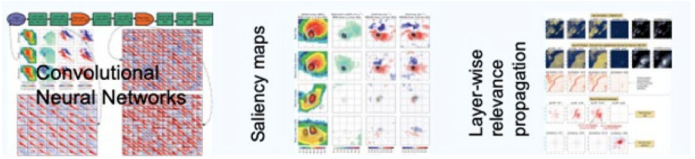
Social Science Methods

Semi-structured interviews

Randomized experiments

Surveys in naturalistic settings

AI/ML & eXplainable AI (XAI) Techniques



Decision Makers

NATIONAL WEATHER SERVICE

PREPAREDNESS RESPONSE RECOVERY MITIGATION EMERGENCY MANAGEMENT

DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA

US Army Corps of Engineers.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

USGS science for a changing world

Trustworthy & User-Driven AI/ML Guidance

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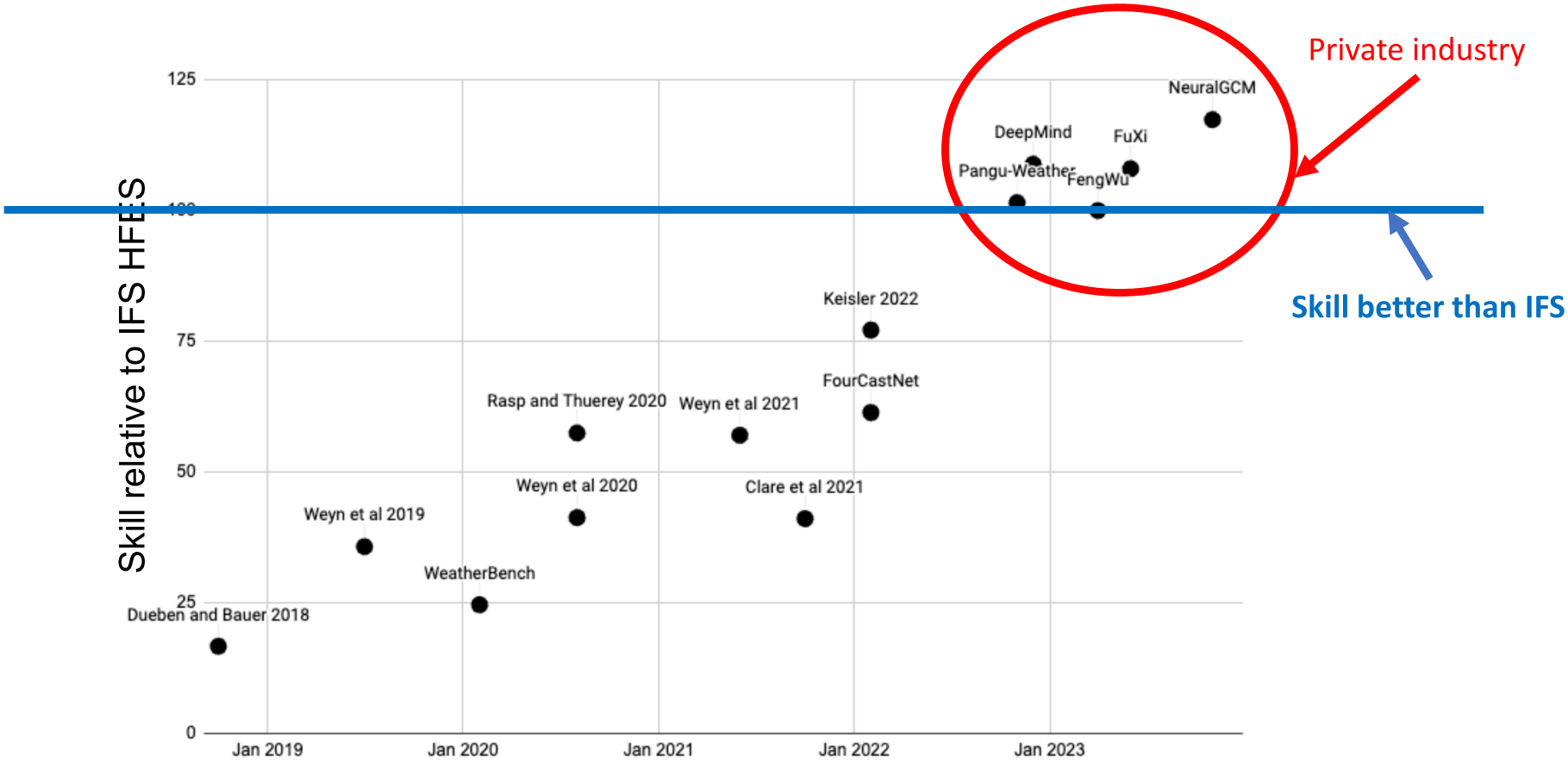
Cusp of an AI revolution for Weather



Data provided by WeatherBench 2, Plot provided by Stephan Rasp @ Google

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AI for Weather is Transformational

My vision: Multi-agency, multi-sector, transdisciplinary center

- Create a new kind of partnership that can work quickly!
  - Academia, Government, Private Industry, NGOs
  - Multi-agency (NSF, NOAA, DOE, NASA)
  - International partnerships
- Social sciences must be fully integrated

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