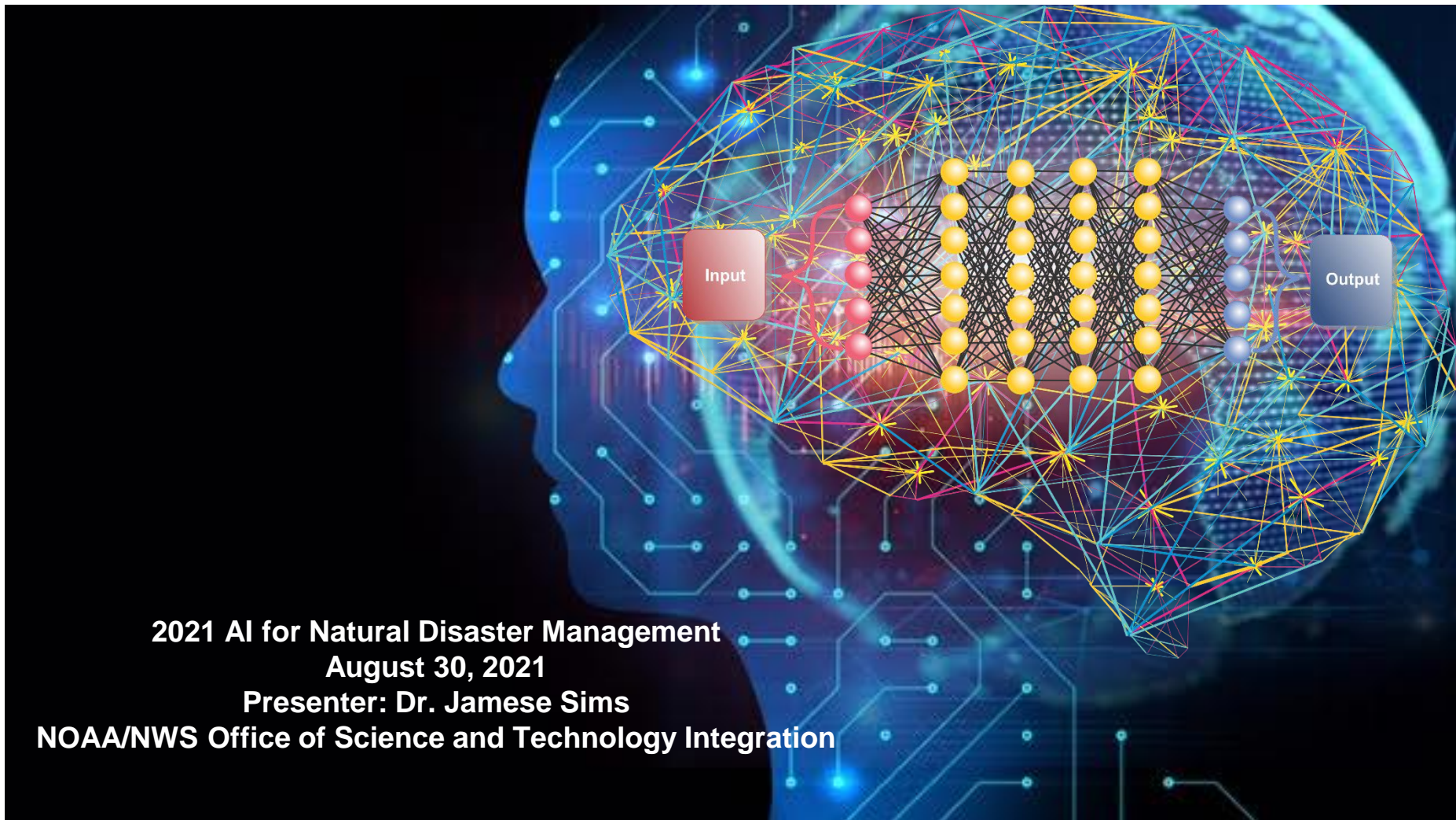


# NOAA Artificial Intelligence

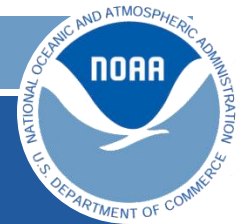


**2021 AI for Natural Disaster Management**

**August 30, 2021**

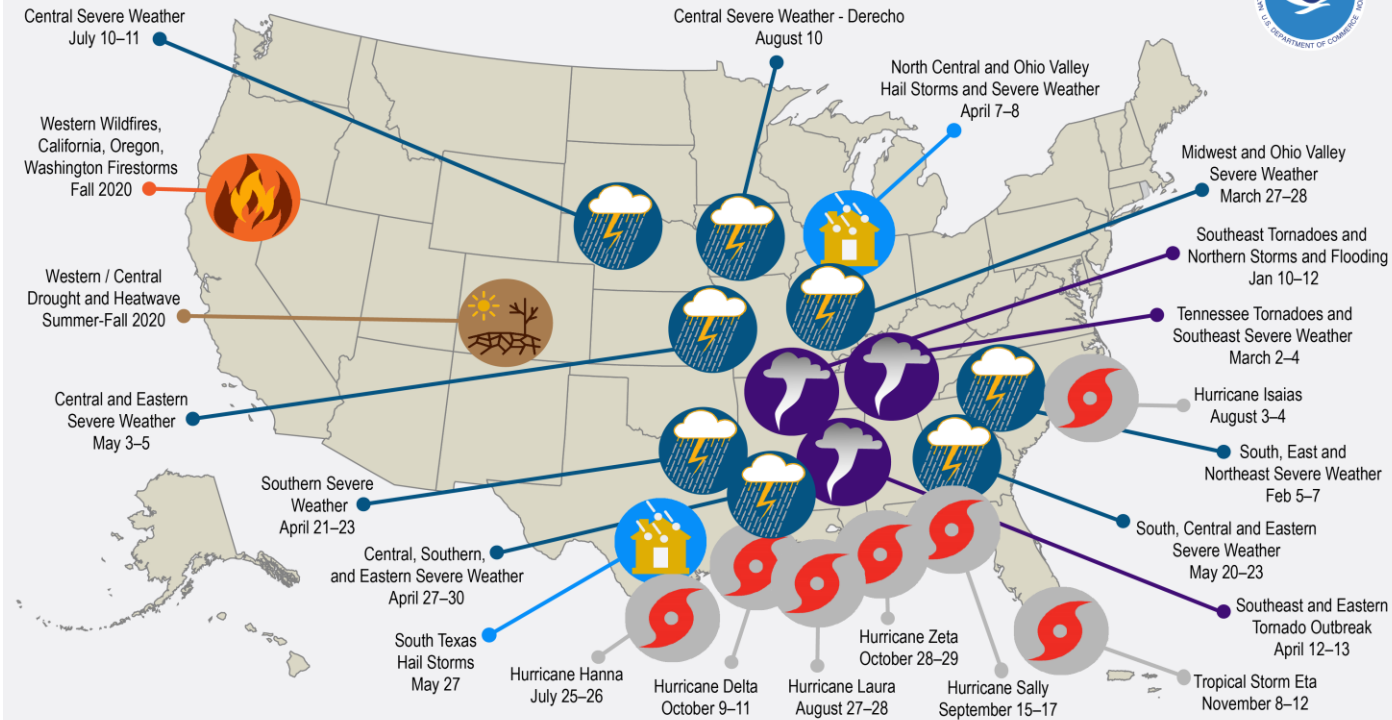
**Presenter: Dr. Jamese Sims**

**NOAA/NWS Office of Science and Technology Integration**



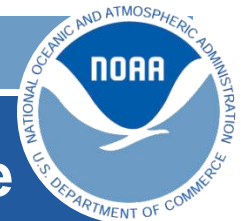
# NOAA's Data and Services Support Disaster Preparedness, Response, and Restoration

## U.S. 2020 Billion-Dollar Weather and Climate Disasters



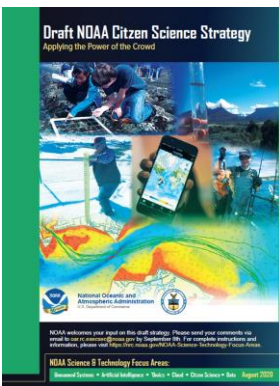
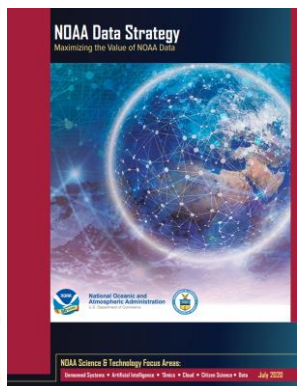
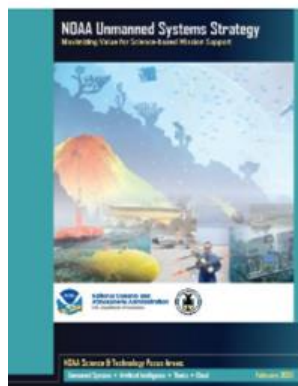
This map denotes the approximate location for each of the 22 separate billion-dollar weather and climate disasters that impacted the United States during 2020.





# NOAA Science and Technology Synergy Committee

The mission of the NOAA Science & Technology Synergy Committee is to *drive collaboration for strategic implementation of emerging science and technology, identify priorities, develop best practices to advance the NOAA science portfolio, and serve as a technical resource for the NOAA Science Council.*



Uncrewed Systems

Artificial Intelligence

'Omics

Cloud

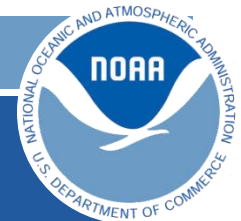
Data

Citizen Science

**Chair:** James Sims **Vice Chair:** Kelly Goodwin

**Executive Secretary:** Brian Meyer

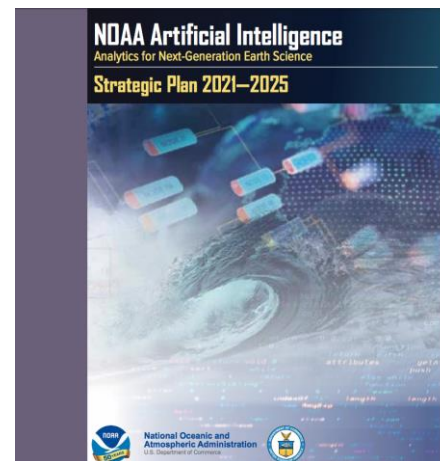
**Members:** Jeanette Davis ('Omics); Cynthia Decker (SAB Liaison); Greg Dusek (AI); David Fischman (Cloud); Monica Grasso (Social Science); Derek Hanson (General Council); Frank Indiviglio (OCIO); Tony LaVoi (Data); Wayne Mackenzie (TPO); Nancy Majower (Cloud); John McLaughlin (Citizen Science); Capt. William Mowitt (UxS); Laura Oremland (Citizen Science); Lemar Revis (AGO); Karen Sender (Data); Adrienne Simonson (Data); Jebb Stewart (AI); Kim Valentine (Data); Kelly Wright (TPO)

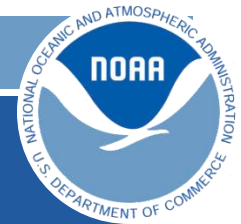


# NOAA Center for AI → FY21 Focuses

“In music, syncopation involves a variety of rhythms played together to make a piece of music, making part or all of a tune or piece of music off-beat” ⇒ Intelligent perturbation leads to Innovation and Positive Synchronization

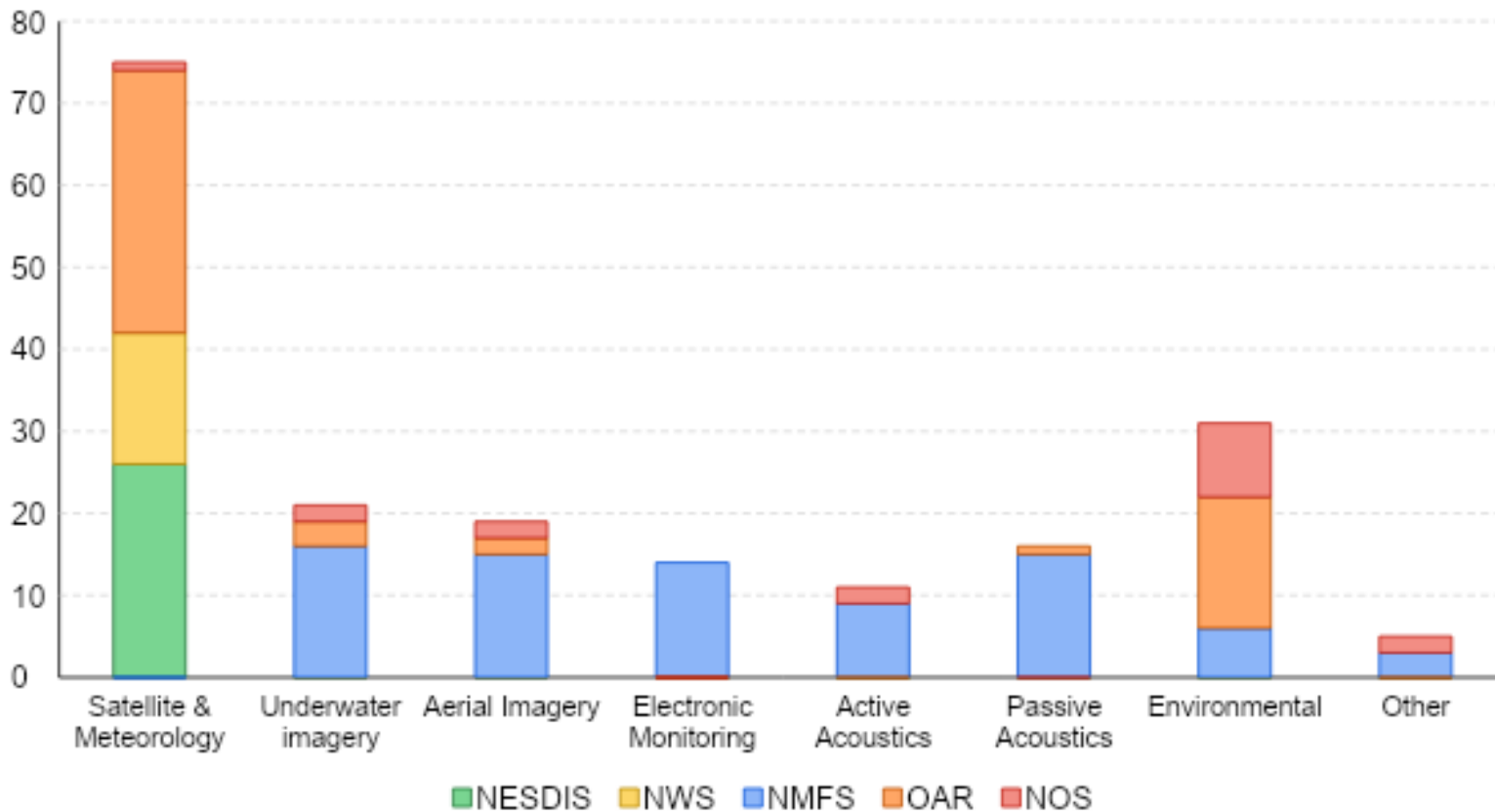
- **Goal 1: Organization & Process - *Stand up Congressionally Approved NCAI***
  - Empower the overall Community of AI Communities of Practice
  - Deploy Internal website for NOAA to Engage on Mission Areas
  - Develop Public website to support the AI Workshop
- **Goal 2: Advance AI Research**
  - Enhance cross-office collaboration and innovation through increased exchange of research awareness and opportunities.
  - Initiate AI-readiness metric Working Group (USG, Industry, Academia)
    - Stretch goal: + Demo an AI-ready dataset in the Cloud
- **Goal 3: Accelerate R2X**
  - Build on the success of 2020's Workshop in Slow Motion by expanding audience, topic diversity and mission areas
- **Goal 4: Strengthen & Expand Partnerships**
  - Create new NOAA Partnerships along workforce Training and AI-readiness
- **Goal 5: AI Proficiency**
  - Inspire Learning Journeys contributed from new Partnerships
    - e.g. UK Joint Centre for Excellence in Environmental Intelligence



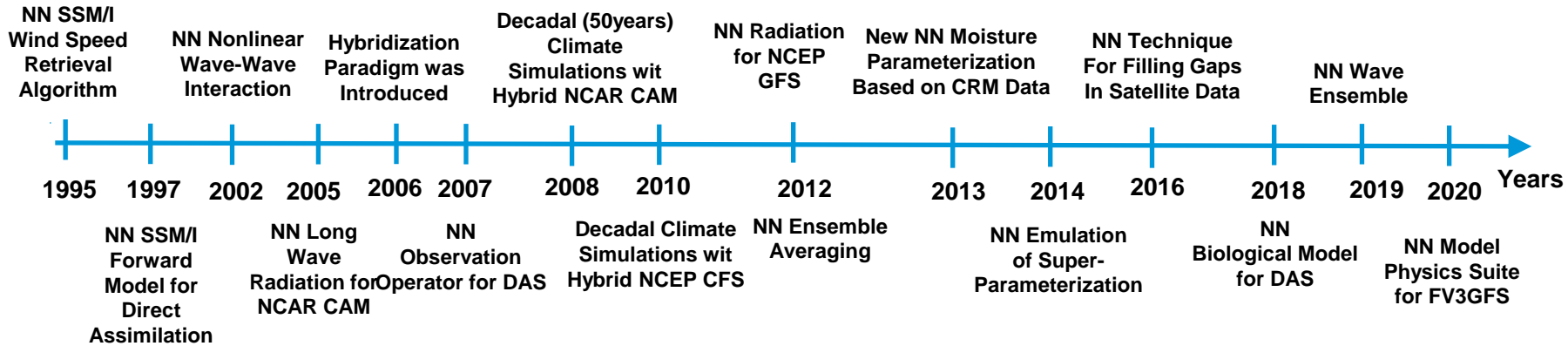


# NOAA AI Data Types

NOAA has applied AI-ML to a variety of environmental data demonstrating its interdisciplinary research and operational capabilities in support of its cross-functional mission requirements.

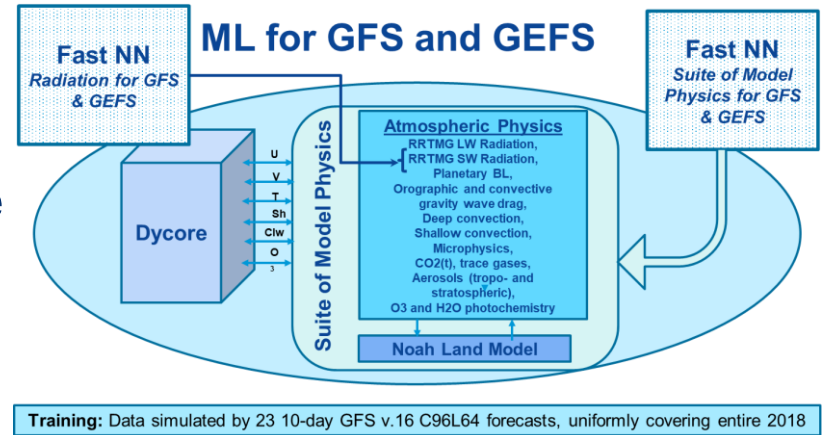


# NOAA Leadership in Machine Learning for Numerical Weather/Climate Modeling Systems

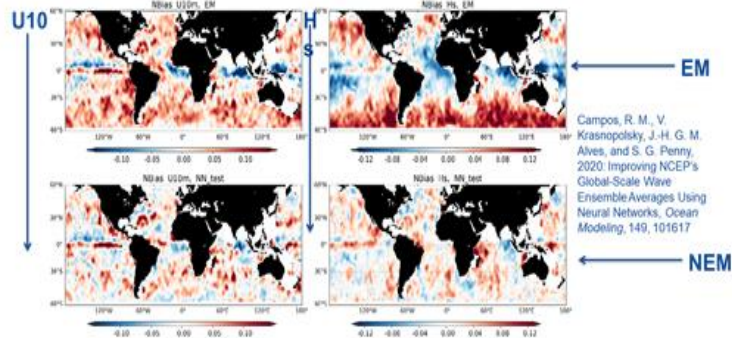


# NWS - Advancing Numerical Weather Prediction with AI Applications

- ML for GFS and GEFS
- NN Bias Correction in Global Wave Ensemble Systems
- NN to reduce RMSE

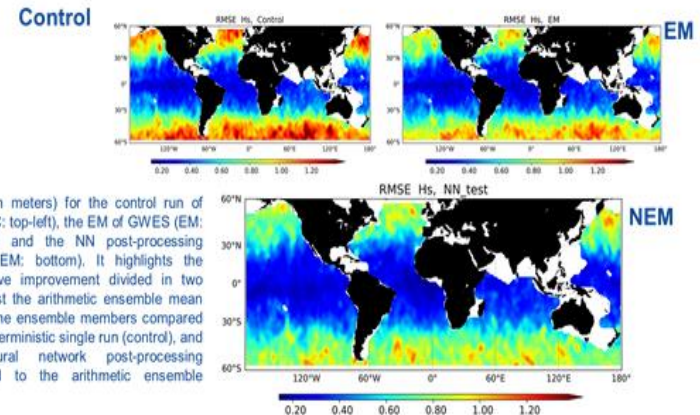


## NN Bias Correction in Global Wave Ensemble System



Normalized bias (NBias) for GWES ensemble mean (EM, top), and for NN ensemble mean (NEM, bottom) on an independent test set. The columns represent U10 (left) and Hs (right). Red indicates overestimation of the model compared to altimeter observations while blue indicates underestimation. Great part of large-scale biases in the mid- to high-latitudes has been eliminated by the NN ensemble mean simulation.

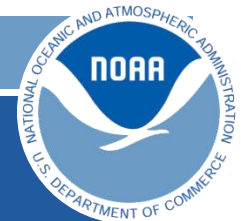
## NN also reduces RMSE



RMSE (in meters) for the control run of GWES (C: top-left), the EM of GWES (EM: top-right), and the NN post-processing result (NEM: bottom). It highlights the progressive improvement divided in two steps, first the arithmetic ensemble mean (EM) of the ensemble members compared to the deterministic single run (control), and the neural network post-processing compared to the arithmetic ensemble mean.

Principal investigator: [vladimir.krasnopolsky@noaa.gov](mailto:vladimir.krasnopolsky@noaa.gov)

V. M. Krasnopolsky 2013, 'The Application of Neural Networks in the Earth System Sciences', Springer, Netherlands, doi:10.1007/978-94-007-6073-8



# NOAA AI Projects – NWS

**Objective:** Drought monitoring and outlooks using ML methods

**Benefits:** Improved drought monitoring and outlooks can better inform water resource planning. More refined drought monitoring can help with targeted relief actions and specific mitigation actions. For the outlooks, the monthly and seasonal timescales exhibit low signal to noise ratio, and machine learning methods may enhance that ratio above other methods.

**Partnerships:** Drought community

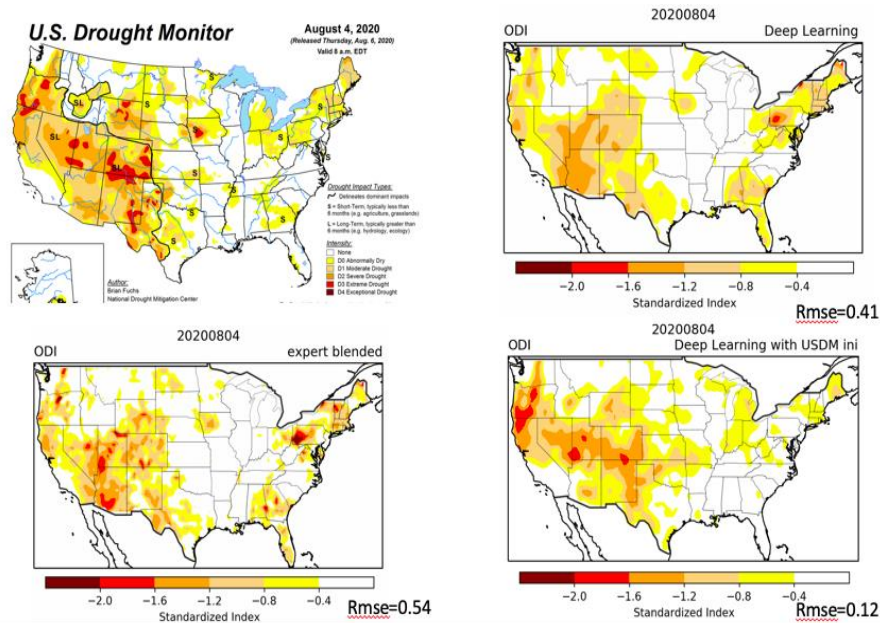
**Predictors:**

- Standardized Precipitation Index
- Standardized Runoff Index
- Soil Moisture
- Evaporative Stress Index
- Standardized Precipitation-Evapotranspiration Index

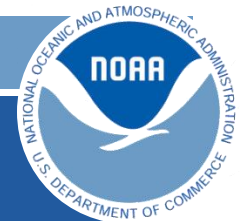
**Predictand:** Standardized index of drought – Drought Category

Principal investigator: Yun Fan/Li Xu

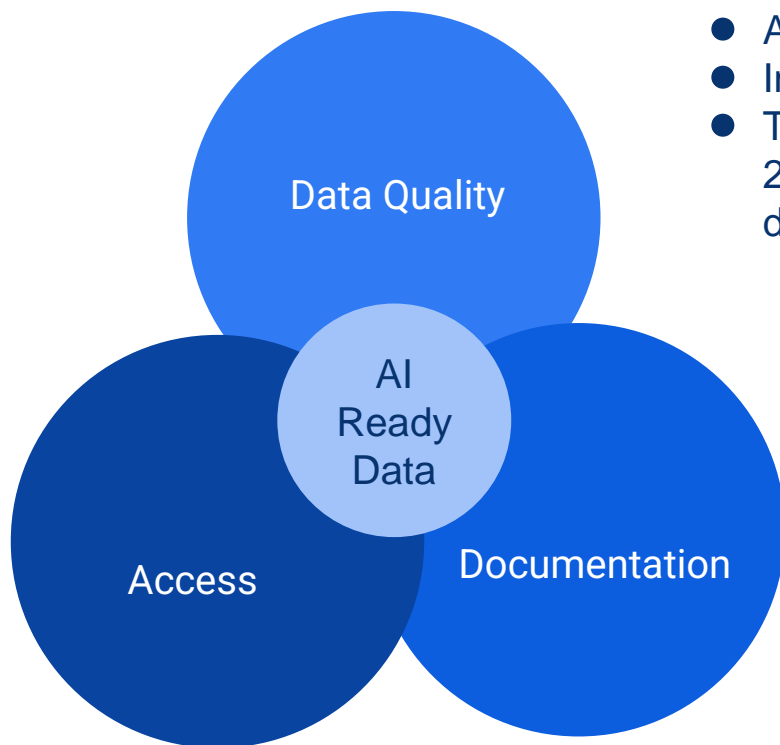
AI tools: hierarchical machine learning and Restricted Boltzman machines







# AI Ready Data



- Define data AI-readiness
- Assess AI-readiness for NOAA data
- Improve AI-readiness for NOAA data
- Tyler Christensen will be joining the NCAI full time August 2021 - January 2022 as a LANTERN detailee focused on developing an AI Ready Data metric for NOAA!!

Watch a recording of our AI-ready data panel discussion 29 January 2021:

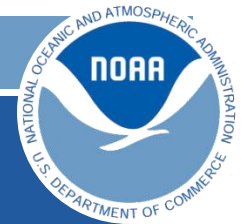
<https://youtu.be/zmXOWtOJX78>

Join the working group on AI-ready data:

[bit.ly/Already-signup](http://bit.ly/Already-signup)

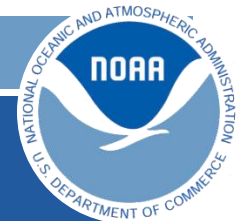
Collaborative work with Earth Science Information Partners community.





# AI/ML/Cloud Proficiency in the Workforce

- NOAA Science & Technology strategies and Information Resource Management (IRM) strategic plans demand a diverse and inclusive workforce to reflect, understand, and respond to the varied communities and stakeholders NOAA serves
  - Provide critical AI training resources and expand training opportunities for employees across NOAA (upskilling of individuals, external training opportunities)
  - NOAA Office of Education exploring the creation of **student internships, training, and experiential research opportunities** for undergraduate and graduate students, including students from diverse backgrounds and underrepresented groups
  - Leverage **joint expertise, optimize collaborative investments**, and facilitate scientific and technical information exchange between NOAA LOs and other organizations



# AI Partnerships

- Partnerships serve as force multipliers to optimize resources and collaborations for scientific and technological exchange that keeps NOAA current in the rapidly evolving field of AI.
- Creating a community of practice promotes innovation to accelerate NOAA's capabilities in AI, and increase our public catalog of AI-ready open data and applications.
- Leverage joint expertise, optimize collaborative investments, and facilitate scientific and technical information exchange between NOAA LOs and other organizations.
- Partnering with the NOAA Data Strategy, NOAA Cloud Strategy, and NOAA Big Data Program will leverage data and cloud services that are foundational for enhancing AI-ready data access and workflows for AI analytics.



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



