ICAMS

INTERAGENCY COUNCIL FOR ADVANCING METEOROLOGICAL SERVICES

ICAMS First AI/ML Workshop: Earth System Predictability

Washington, DC
September 2025

ICAMS First Artificial Intelligence and Machine Learning (AI/ML) Workshop: Earth System Predictability

Meeting date: November 4, 2024

Introduction:

The Interagency Council for Advancing Meteorological Services (ICAMS), specifically its Committee on Research and Innovation (CoRI), Subcommittee on Earth System AI/ML and Advanced Technologies, hosted a virtual workshop on November 4, 2024, focused on AI/ML development, usage, and services for Earth Observations, Predictions, and Services. This was the first in a series of envisioned workshops aimed at identifying key opportunities for ICAMS member agencies to substantially enhance their research and operational capabilities. The Office of Science and Technology (OSTP) strongly encouraged ICAMS to organize discussion around AI/ML. The workshop served as a critical platform for participating agencies to present their significant successes, current challenges, and areas for cross-agency collaboration. The workshop was attended by 257 participants from various organizations (Figure 1).

Goals and Objectives:

The primary goals of the workshop were to:

- Familiarize attendees with agency-specific successes in AI/ML research and development.
- Identify knowledge and capability gaps within participating agencies for advancing AI.
- Understand and foster areas for potential cross-agency collaboration.
- Define topics for subsequent workshops.

Workshop Structure and Key Presentations

The workshop commenced with short presentations from agencies including USGS, NSF, NOAA, NASA, DOE, and DOD (both Navy and Air Force). These talks illuminated the types of problems that agencies are using AI/ML to address as well as techniques and workforce training efforts.

The afternoon sessions were devoted to three facilitated breakout groups. The guidance for these discussions was to take either a science-driven approach, a technique-driven approach, or a combination of both. The science-driven discussions asked about new science that AI/ML techniques currently enable that wasn't previously possible and grand challenge problems in Earth system predictability where machine learning enables new methods. The technique-driven focus considered ML model development, ML applications in science, and ML inference and interpretation. Each group ultimately chose to use a combination of both approaches.

Summary of Key Findings

The presentations and discussions throughout the day revealed several common themes. Participants highlighted numerous successes in AI/ML application, including its use for storm tracking and data quality assurance, developing an AI strategy for environmental monitoring and water quality prediction, and integrating machine learning into numerical weather prediction.

Common challenges identified included the need for AI-ready data, along with access to sufficient cloud and High-Performance Computing (HPC) resources. Other challenges included insufficient staffing, the lack of a rigorous theory for expanding AI applications, and difficulties with software development synchronized with operational requirements. These discussions led to the identification of several key areas for collaboration, such as model development and calibration, data sharing and standardization, and the development of common software and best practices.

Breakout Sessions and Findings

The workshop featured three parallel breakout groups on Earth system predictability, focusing on modeling and observations (Figure 2). The discussions within these groups highlighted several crucial gaps that need to be addressed to advance predictive understanding and modeling using AI/ML in Earth system science.

A fundamental gap exists in fully understanding the inherent predictability of Earth system models and determining the optimal scales at which AI/ML can effectively enhance predictions. A significant challenge is the "black box" nature of many ML models, which creates gaps in scientific interpretability and physical consistency. A critical barrier is the availability and accessibility of consistent, high-quality, and "AI-ready" datasets. Participants noted a lack of uniform resource solutions and a gap in developing and retaining a skilled workforce. A significant practical challenge is integrating new ML models with existing legacy code bases.

Despite these gaps, the groups identified several promising avenues for inter-agency collaboration. These included data sharing and integration, establishing common validation and verification standards, and a more uniform approach to resource allocation. The groups also highlighted the potential for public-private partnerships and the joint development of foundation models for Earth system predictability.

Overall, the discussions underscored the transformative potential of AI/ML in unlocking scientific insights and enabling cost-effective ensemble forecasts.

The presentations from all agencies are available online, in accordance with the workshop agenda.

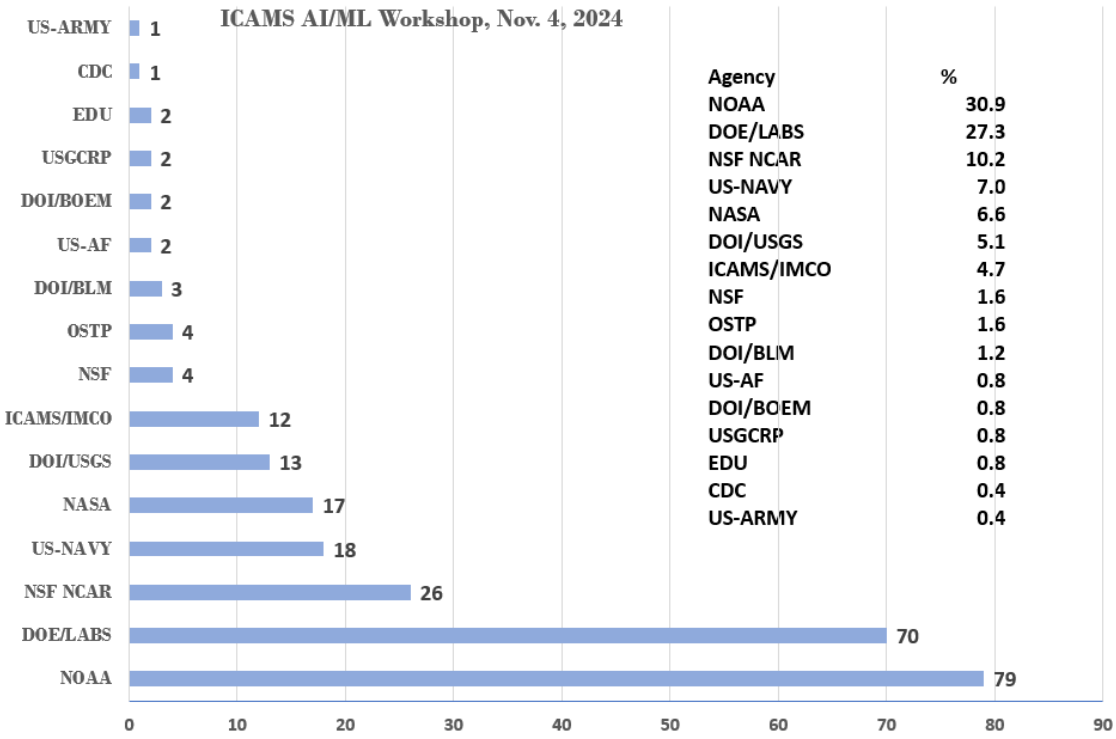

Figure 1: Agency-wise distribution of attendees at the ICAMS AI/ML workshop, November 4, 2024.

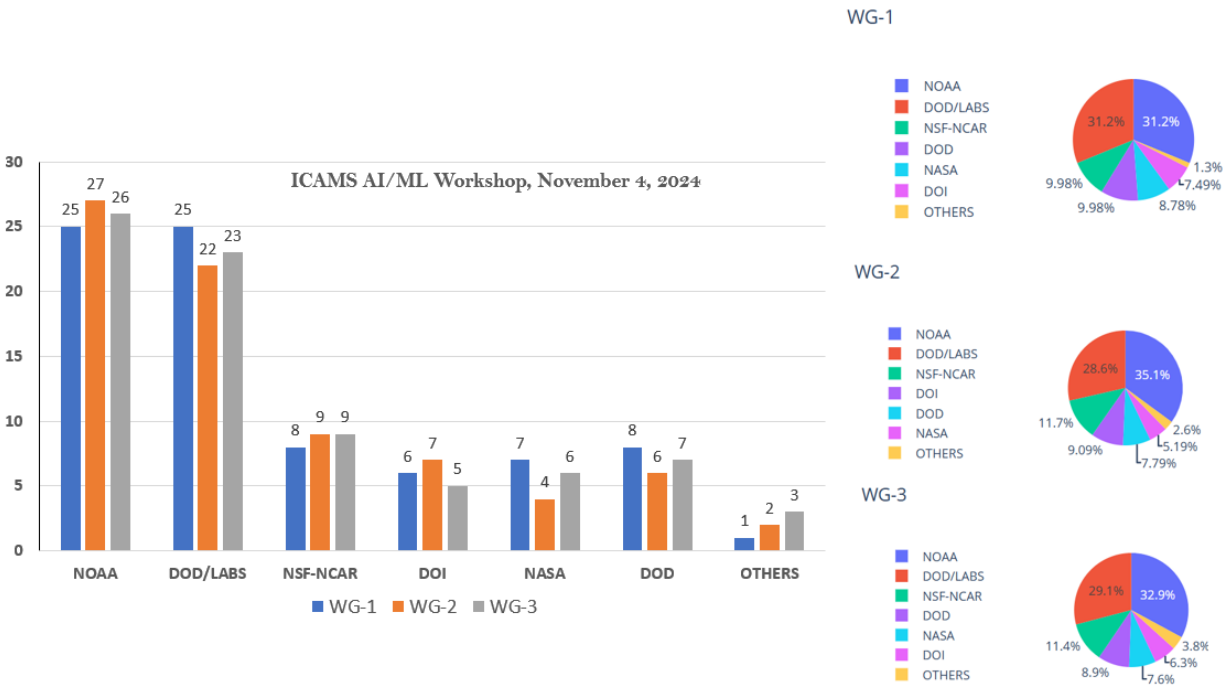

Figure 2: Agency-wise participation count and percentage of attendees across three breakout groups for the ICAMS AI/ML workshop, November 4, 2024.

Workshop Agenda

TIME (ET)	TOPIC	PRESENTER (AGENCY)
9:30 - 9:40	Welcome from ICAMS	Dr. Daniel Melendez, DD, ICAMS/IMCO
9:40 - 9:50	Introductory Talk-01	Dr. Joe Cione, ED, OSTP/ICAMS
9:50 - 10:00	Introductory-Talk-02	Dr. Michael Morgan, A/S, NOAA
10:00-10:10	Scope of the workshop (expectations, goals & follow on topics for the workshop series)	Workshop co-chairs: Renu Joseph (DOE)/Jebb Stewart (NOAA)
10:10-12:30	Agency updates on AI/ML for Earth System Predictability,	USGS -Anne Kinsinger NSF - Eric DeWeaver NOAA - Rob Redmon NASA- Katherine H. Breen DOE - Gary Geernaert DOD-Navy - Josh Cossuth DOD-AF - Lt Col Michael A. Greene
12:30-13:30	BREAK	
13:30-15:30	Parallel breakout panels on predictability	Breakout 1 co-chairs: Bill Collins (DOE-LBNL), Jun Wang (NOAA), Manil Maskey (NASA) Breakout 2 co-chairs: V Ramaswamy (NOAA), Sue Haupt (NSF-NCAR), Ruby Leung (DOE-PNNL) Breakout 3 co-chairs: Jeff Anderson (NSF-NCAR), Katherine H. Breen (NASA), Pete Doucette (USGS)
15:30-16:20	BREAK	
16:20-17:00	Report Out from breakouts emphasizing: 1) Gaps/new opportunities; 2) Synergies across agencies; 3) Topics for future workshops	
17:00	END OF WORKSHOP	

Table 1: ICAMS AIML Workshop Planning Committee (PC)

Name	Position	Agency
Renu Joseph	(PC-Co-Chair)	DOE
Jebb Stewart	(PC-Co-Chair)	NOAA
Jason Nachamkin	Primary	DOD
Tsengdar Lee	Primary	NASA
Eric DeWeaver	Primary	NSF
Kristin Ludwig	Primary	OSTP
Xujing Davis	Secondary	DOE
Monica Youngman	Secondary	NOAA
David Sidoti	Secondary	DOD
Donifan Barahona	Secondary	NASA
Mike Bonadonna	Secondary	NOAA
Kunhikrishnan Thengumthara	CoRI IC	ICAMS/IMCO
Ken Barnett	CyFI IC	ICAMS/IMCO
Erin McNamara	CoS IC	ICAMS/IMCO
Daniel Melendez	Dy. Director	ICAMS/IMCO
Joe Cione	Executive Director	OSTP/ICAMS
Gary Geernaert	CoRI Co-chair	DOE
Chris Ekstrom	CoRI Co-chair	DOD
Jack Kaye	CoRI Co-chair	NASA
John Cortinas	CoRI Co-chair	NOAA

Table 2: Agency Presentations

Presenter Name	Agency
Rob Redmon	NOAA
Kathy Breen	NASA
Eric DeWeaver	NSF
Davis, Renu	DOE
Lt Col Michel Greene	DOD-AF
Anne Kinsinger	USGS
Josh Cossuth	DOD-NAVY-ONR

Table 3: Break Out Sessions -Leads

Name	Agency
V. Ramaswamy	NOAA
Jun Wang	NOAA
Ruby Leung	DOE
Bill Collins	DOE
Manil Maskey	NASA
Kathy Breen	NASA
Sue Haupt	NCAR
Jeff Anderson	NCAR