BAMS InBox

Progress in Federal Coordination to Advance Meteorological Services

Annarita Mariotti, Scott Weaver, Nirmala Kannankutty, Mark Paese, and Martin Yapur

ABSTRACT: In 2020, the federal government completed the first major restructuring of its interagency coordination for meteorological services in over 50 years. The Interagency Council for Advancing Meteorological Services (ICAMS) now provides White House–level coordination of federal resources to advance the full suite of meteorological services now and into the future. Of particular relevance to the external community is ICAMS' objective to strengthen and expand partnerships with nongovernment sectors. This article outlines ICAMS intellectual foundations, progress, and near-term plans, including efforts to develop a long-term strategy, as means to foster community engagement. ICAMS will continue to provide coordination across federal agencies and opportunities for input from, and engagement with, nongovernmental entities. The development of a long-term strategy is a process that ICAMS is embarking on in earnest, and sustained external community engagement is key to sound development and effective implementation.

KEYWORDS: Policy; Operational forecasting; Community; Decision making

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Corresponding author: Annarita Mariotti, annarita.mariotti@noaa.gov
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AFFILIATIONS: Mariotti and Weaver—Office of Science and Technology Office, Executive Office of the President, Washington, D.C.; **Kannankutty**—National Science Foundation, Alexandria, Virginia; **Paese and Yapur**—National Oceanic and Atmospheric Administration/National Environmental Satellite, Data, and Information Service, Silver Spring, Maryland

Extreme weather, water, and climate events continue to break records in the United States and globally. Recent years have included unprecedented tornado outbreaks, hurricanes, inland and coastal flooding, droughts, heat waves, and wildfires.[1] The total cost of billion-dollar U.S. weather and climate disasters since 1980 has exceeded 2 trillion dollars.[2] The impacts of these extreme events on natural and human systems are pervasive, oftentimes characterized by cascading and compounding events. Beyond extremes, routine meteorological forecasts have significant benefits, e.g., for agriculture, energy, transportation, and water resources.[3] Accordingly, high-quality and comprehensive meteorological ("met" hereafter) services have never been more essential to mitigate severe economic impacts, reduce weather-related fatalities and injuries, and support socioeconomic prosperity and health. In April 2017, the Weather Research and Forecasting Innovation Act[4] required the establishment of an interagency structure "to improve coordination of relevant weather research and forecast innovation activities across the Federal Government." In response, the federal government reorganized its coordination to advance met services in 2020, replacing a structure that had been in place since the 1960s.[5] The federal government established a White House–level council,[6] the Interagency Council for Advancing Meteorological Services (ICAMS), for leadership, and the supporting Interagency Meteorological Coordination Office (IMCO) for administrative support. This short article provides a summary of the intellectual foundations for ICAMS and an update on progress. The intent is to foster community engagement as ICAMS implements near-term activities and embarks on the development of its long-term strategy.

[1] www.ametsoc.org/ams/index.cfm/publications/bulletin-of-the-american-meteorological-society-bams/explaining-extreme-events-from-a-climate-perspective/

[2] www.ncei.noaa.gov/access/billions/

[3] For example, Leviäkangas (2009), Jeon et al. (2022), and Kull et al. (2021).

[4] Public Law No. 115-25, title IV, sec. 402 (Apr. 18, 2017), 15 U.S.C. § 8542.

[5] For information regarding ICAMS and its charter, visit www.icams-portal.gov. For additional background on ICAMS refer to Droegemeier and Jacobs (2022).

[6] The Council is co-chaired by the Director of the White House Office of Science and Technology policy or their delegate and includes Senate-appointed cabinet-level principals.

Motivation

The aim of the ICAMS restructuring is to better capitalize on all meteorological investments across the federal government and accelerate progress in all activities that support advances in the provision of met services. A key novelty is ICAMS' Earth system approach[7] to coordination, convening the meteorological enterprise around common goals and breaking down barriers between historically disparate disciplines and communities: science and service, weather and climate, and observations and modeling. ICAMS recognizes the important identity of each community while fostering shared understanding and collaborations to bridge gaps that typically inhibit the rapid

[7] The Earth system approach considers all of the relevant factors in the atmosphere, the ocean and hydrosphere, the terrestrial realm, the cryosphere, and the biosphere that contribute to the characteristics, behaviors, and their dynamics for any element of the Earth under consideration.

advancement of services.[8] ICAMS redefines "met services"[9] to be more inclusive and better aligned with the definition of services used by the World Meteorological Organization,[10] to more holistically address service needs and underpinning coordination activities. To do so, ICAMS coordination is grounded in an integrated Earth system approach considering the planet and its multiscale interactions[11] as a whole, rather than just focusing on individual Earth system components. This approach recognizes the importance of Earth system processes for met predictability and the impacts of met anomalies across the Earth system and associated service needs (e.g., drought and anomalous weather impact wildfires, air quality, and ecosystems).

Another related key novelty of the ICAMS restructuring is sustained and strengthened coordination across an expanded range of agencies that develop, deliver, and utilize met services. Bi-directional engagement across this array of agencies with different cultures and missions is crucial to make progress on the shared goal to accelerate the advancement of services. This advancement depends on a suite of activities: progress in knowledge and understanding, the effective transition of research to operations or applications (R2O or R2X) and service community feedback on research needs, also known as operations to research (O2R). Public–private partnerships have an important role to play across this suite of activities. The ICAMS structure elevates federal met enterprise coordination to the White House-level, recognizes the importance of the met enterprise and provides a forum for effective decision-making. Committees cover broad core areas essential for met service advancement and are responsible for coordinating across committees and with relevant external groups. Committees focus coordination as needed, for example, with new subgroups that address fire threat, flooding and air quality issues. Additionally, the heightened federal coordination enabled by ICAMS and its objective to strengthen and expand partnerships with nongovernmental entities provides a renewed opportunity for the meteorological community writ-large to engage with federal agencies.

[8] For example, the met science community focuses on foundational understanding, observations, process research, and model and prediction system's development, while the met services community focuses on providing timely and reliable meteorological products and decision support to the public based on monitoring and modeling and prediction systems. A historical challenge has been bridging these communities so that science advances rapidly translate into improved services and vice versa, service needs drive science requirements. ICAMS directly targets this gap.

[9] Under ICAMS, met services encompass weather, climate, hydrological, ocean, and related environmental services. The term "services" broadly includes all relevant activities that provide value to society whether over land, at sea, or in the air, including for the protection of life and property, personal and public health, quality of life, sustainability of the natural world, and economic and national security.

[10] https://public.wmo.int/en/media/press-release/congress-endorses-shift-%E2%80%9Cearth-system%E2%80%9D-approach

[11] Very fine-scale processes, regional and global processes, and also extra-planetary interactions.

Status update

Standing up the full ICAMS coordination structure, including fostering the transition from the former structure to ICAMS and establishing the IMCO was completed in December 2021.[12] The ICAMS structure and supporting organization (Fig. 1) was developed via thorough and systematic analysis of the preexisting federal met coordination structure, of needed coordination functions and gaps, and extensive discussions with key federal stakeholders on the pros and cons of possible options.[13] Decision criteria included having a structure that minimizes the number of committees and subgroups, while ensuring that key coordination functions stay in focus, and that duplication and gaps are avoided.

Under ICAMS, meteorological coordination is now based on the abovementioned Earth system approach and organized by four committees that span the pillars of the met services value chain: observational systems; cyber, facilities, and infrastructure; research and innovation; and services. ICAMS leadership is organized at the highest levels of the

[12] The ICAMS Transition Team provided executive leadership for ICAMS development during September 2020 to December 2021. The team was composed of Annarita Mariotti (team lead and IMCO Acting Executive Director until December 2021, OSTP), Martin Yapur (IMCO Deputy Director, NOAA), Nirmala Kannankutty (OSTP and NSF), and Mark Paese (NOAA); Shaima Nasiri (DOE) was a member of the team until March 2021. Scott Weaver is the IMCO Executive Director (OSTP) as of January 2022.

[13] For more discussion, see Droegemeier and Jacobs (2022).

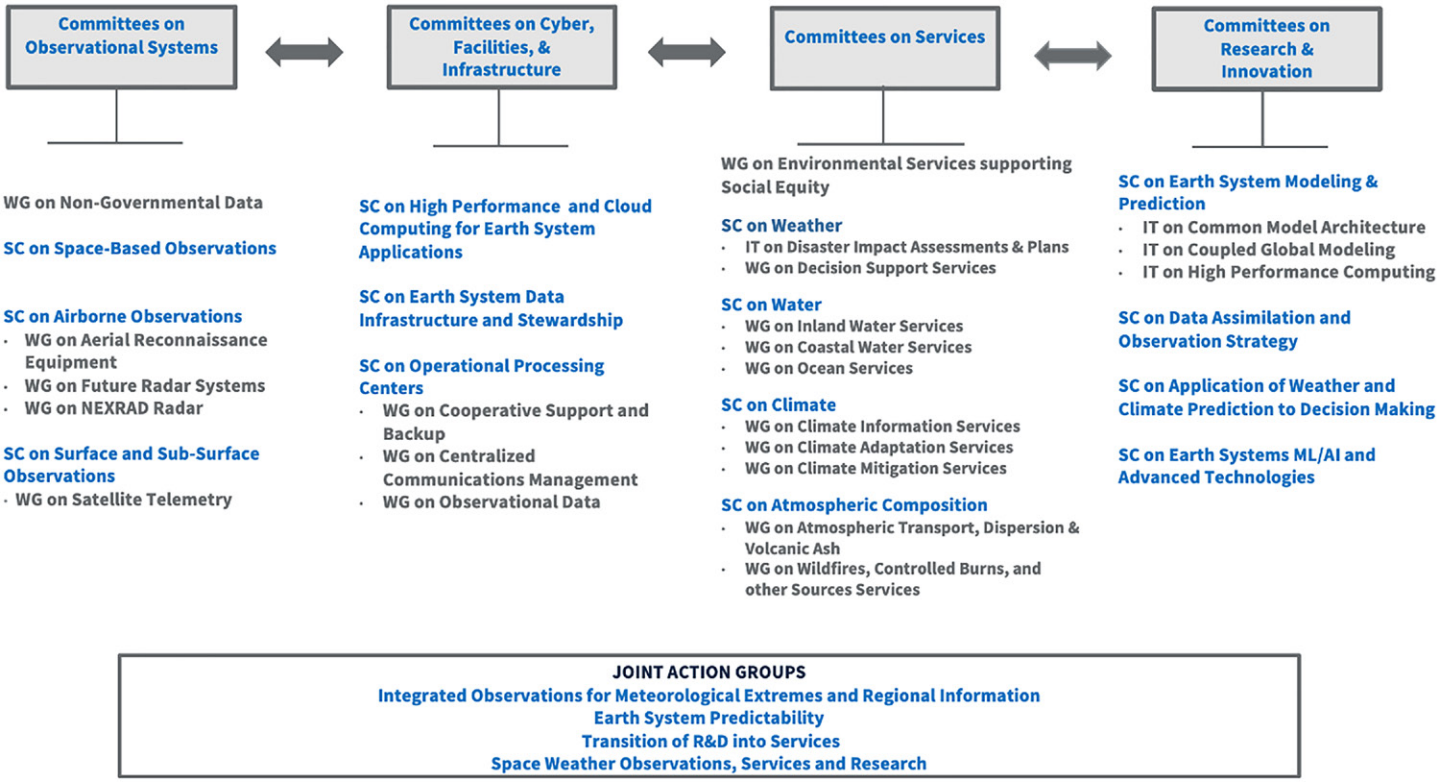

Fig. 1. ICAMS Committees and their current subgroup structure. SC: Subcommittee, WG: Working Group, IT: Implementation Team. Joint Action Groups are joint between ICAMS and other federal organizations. The Council provides high-level leadership for all activities of ICAMS committees and their subgroups.

federal government. The Council, co-chaired by leaders at the White House Office of Science and Technology Policy and the National Oceanic and Atmospheric Administration, directs all activities; its membership consists of executives across federal agencies with significant interests in meteorological services and the Earth system science that advances such services, and whose participation is necessary to coordinate these activities within the federal government.

ICAMS committees and their subgroups perform essential roles and functions of former federal meteorological coordination groups previously under the Office of the Federal Coordinator for Meteorology. Effective committee interplay is crucial and is facilitated by the IMCO. For instance, coordination on cyber, facilities, and infrastructure supports all other committees, e.g., for storage and use of observational and model data and computing resources that are foundational for research, innovation, and services. Similarly, observational systems' coordination supports services, research, and innovation activities. The research and services committees interact closely, leveraging infrastructure and observational systems, and also drive corresponding requirements.

ICAMS committees are defined in its charter, and subgroups are created as needed to assist with implementation of priorities and long-term strategy. This provides flexibility for evolutionary adjustments, as both implementation and long-term strategy development proceeds. Joint Action Groups provide coordination for prevalent areas that cross-cut several committees and also external coordination groups, e.g., for extremes, for transition of research into operations, and for Earth system predictability. Other cross-cutting functions are inherent to each ICAMS group and coordinated via the IMCO. Examples include communication and engagement with public audiences and coordination with National Science and Technology Council bodies, among others. Implementation teams provide means for sustained external engagement with federally funded research and development centers on implementation-type activities.

From its inception, ICAMS has implemented a bottom-up model with sustained federal enterprise engagement and opportunities for input from the meteorological science and services community, to ensure a community-driven agenda where the groups consider priorities and define the needs and gaps and course of action through their workplans. Going forward, ICAMS will increasingly engage the external community utilizing mechanisms such as town halls, workshops, and webinars, as well as requests for information to the public. Communication and coordination across the ICAMS structure and with relevant external groups is highly emphasized to avoid unnecessary duplication of effort. For example, the ICAMS committees and subgroups met for the first time in August 2021 to collectively discuss their workplans and begin to chart the course for the development of a long-term ICAMS strategy. Over 250 federal employees involved in ICAMS across 20 agencies participated in this ICAMS federal community event, and the excitement for future opportunities was palpable. To date, external engagement opportunities have included three ICAMS town halls, two at the 2021 and 2022 Annual Meetings of the American Meteorological Society (AMS) and one at the 2021 American Geophysical Union (AGU) Fall Meeting. As with the federal event, these public-facing events equally demonstrated the community's eagerness to engage in ICAMS activities.

Although ICAMS is still relatively young and just embarking on the development of its first decadal strategic plan, all groups are implementing their annual workplans and have ongoing activities to begin to address ICAMS aspirational goals. There is initial evidence that the ICAMS design is working. As an example, ICAMS is making significant short-term progress coordinating on wildfire issues, especially with regard to informing ICAMS agency science and technology priorities and processes for wildfire observations, and coordinating relevant wildfire modeling activities across the weather-climate interface (i.e., prediction time scales of hours to seasons). ICAMS will build on such near-term progress while simultaneously developing a long-term strategy to unleash the innovation necessary to make transformational change.

Near-term opportunities and challenges

The 2021 ICAMS federal community event highlighted areas of shared interest across the ICAMS community. In addition, committees and their subgroups identified coordination needs specific to the scope of their group. An unprecedented set of federal met coordination opportunities emerged, which informed their workplans. Below are highlights of planned cross-cutting met coordination activities, provided to illustrate near-term ICAMS priorities and to foster community engagement for the development of a long-term strategy. This list is by no means exhaustive regarding the broad coordination provided by ICAMS groups across all relevant meteorological areas, as reflected by the ICAMS structure (Fig. 1).

- Strengthen linkages and collaborations with other existing federal organizations for an Earth system approach to advance met service–supporting activities: across disciplines, research and services, agencies, and committees.
- Enable coordination for an enhanced set of met services for fire preparedness and response. For example, to readily spot, track, and forecast the occurrence of existing fires; to forecast the potential of new fires (on a range of time scales), fire evolution, and impacts on people and the environment; and to provide air quality information to communities.
- Assess Earth system–based forecast and research requirements, as well as approaches to accelerate the advancement of met services. Develop a sustained process which considers validated requirements (e.g., policy, legislation, executive orders) and needs on the ground to identify and prioritize Earth system–based met forecast and research needs across federal agencies. Assess best practices, barriers, and near-term actions to accelerate the transition of research into services.

- Foster the development of next-generation public-private partnerships for met services, to more fully leverage ingenuity and capabilities across the broader enterprise. Develop a framework to incorporate external partners' perspectives in a sustained, meaningful, and ongoing manner.
- Advance social equity and diversity in the met enterprise and met services that better support the most vulnerable communities. Support ICAMS agency efforts to increase workforce diversity and broaden representation in the ICAMS community (e.g., via the sharing of best practices across agencies and purposeful outreach activities). Partner with meteorological information users on a sustained, iterative, and coordinated manner (e.g., via workshops and requests for information) to understand the met services gaps for vulnerable communities, assess ways to improve service and product accessibility, and identify opportunities for more effective products.

These opportunities set out a bold vision and are not without significant challenges. For instance, ICAMS has a broader scope than the previous coordination structure as it aims to bridge disciplines and communities, each with different cultures. Additionally, it will be challenging to advance beyond historical and existing stove pipes, despite being critically needed to provide the nation with the needed services in the face of increasing impacts from weather, water, and climate extremes. ICAMS will need to establish productive collaborations with other federal coordination bodies such as those under the National Science and Technology Council to highlight the complementary roles of the different groups to ensure the minimization of gaps across efforts when serving national priorities.

There are also differences in agencies' capabilities to participate in ICAMS, given varied organizational structures and missions. It will take sustained effort to collaborate with different types of federal institutions, incorporate fresh perspectives, and diversify engagement. While ICAMS agencies and departments have their own planning processes, ICAMS can form a two-way conduit to work across agencies and provide a forum for collaboration on new initiatives. There are also statutory boundaries regarding nonfederal involvement in ICAMS, which will need to be factored in when developing community engagement plans and mechanisms for next generation public–private partnerships. Such boundaries practically determine the terms of external community participation in ICAMS meetings, their input in planning activities, and collaboration mechanisms. These are all challenges to be collectively aware of as ICAMS strives to make progress.

Paths forward

For sustained progress, ICAMS must begin developing its long-term strategy. With a 10–20-yr time horizon for such a strategy, there are many unknowns to consider. For instance, which met services may be needed in the future? What are the most urgent needs for usable met services on the ground? How will met services be delivered in the future? Will evolution in science and technology significantly impact service development and delivery mechanisms? Who are the ICAMS stakeholders and partners of the future? These types of questions are items that ICAMS will need to contend with. Doing so will require flexibility in structure and approach. ICAMS is engaging with the community on these issues through a variety of mechanisms to hear broad perspectives. Below are examples of critical considerations as ICAMS forges its path forward.

- An ICAMS strategy needs to build on the strengths of all agencies and departments to most effectively leverage the various missions and plans to advance ICAMS goals.

- ICAMS does not operate in a vacuum; therefore, it must work in concert with other federal coordination entities, for example, those under the National Science and Technology Council, each with their own mandates and plans. Effective coordination with these science and technology groups will serve to sharpen the ICAMS strategy for mutual benefit.
- To be successful, ICAMS and its agencies require long-term congressional support—specifically to build and maintain a durable strategy that fulfills current legislative mandates, while also providing flexibility to implement future mandates. Effective communication across OSTP, the Office of Management and Budget, and Congress, as appropriate, is a critical element.
- For ICAMS to be effective, there must be a balance between near-term successes and long-term pursuits that enable breakthroughs by considering how to build in risk tolerance to foster the necessary innovation that significantly advances met services.
- To more fully leverage ingenuity and capabilities across the broad met enterprise, an ICAMS strategy must consider how to enable the emergence of a new generation of public–private partnerships.
- To serve and benefit all Americans, ICAMS must build a met enterprise that is truly diverse in expertise and demographic characteristics and must prioritize consideration of how to increase the diversity and inclusion of the met workforce, its committees, and the range of stakeholders who are engaged. ICAMS must strive to consider how to more deliberately address the met service needs of those who are currently underserved and also disproportionately affected by extreme events.
- ICAMS must develop the capacity to foster a new generation of professionals and early career scientists to inform the long-term plan and support its effective implementation.

The successful establishment of ICAMS provides a White House–level Earth system–based meteorological coordination structure leveraging the four ICAMS committees and IMCO. ICAMS will continue to provide coordination across federal agencies and increase opportunities for input from, and engagement with, non-governmental entities. In addition to public-facing events such as workshops, town halls, and roundtables, the public will be able to provide specific input on key strategic questions in response to public requests for information via Federal Register Notices. The development of a long-term ICAMS strategy is a process that ICAMS is embarking on in earnest, and sustained external community engagement is key to the development of a sound strategy and its effective implementation.

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