MEETING MINUTES OF THE

INTERAGENCY COUNCIL FOR ADVANCING METEOROLOGICAL SERVICES (ICAMS)

COMMITTEE ON RESEARCH AND INNOVATION (CoRI)

WILDFIRE WORKSHOP

1 APRIL 2022 12-3PM ET

The Wildfire Workshop focused on getting an inventory of what operational and technology wildfire support activities are going on in the federal agencies and related relevant research. The information from this workshop will help inform next steps to build collaborations, identify gaps and weaknesses, and help chart a path toward building better wildfire prediction capabilities.

Workshop Organizers: David Turner (NOAA), Lesley Ott (NASA), Olga Tweedy (DoE), Paul Steblein (USGS), Marc Stieglitz (NSF), Toral Patel-Weynand (USFS), Gary Geernaert (DOE), Stan Benjamin (NOAA).

Attendees:

ICAMS CoRI: Dr. Stan Benjamin (NOAA), Dr. Gary Geernaert (DOE), Co-Chairs

IMCO Executive Director: Dr. Scott Weaver

Presenters: Toral Patel-Weynand (USFS), Paul Steblein (USGS), Dave Turner (NOAA), Lesley Ott (NASA), Olga Tweedy (DoE), Marc Stieglitz (NSF)

130 registered for participation.

Introductory Remarks: Dr. Stan Benjamin (NOAA), Dr. Gary Geernaert (DOE), Co-Chairs, ICAMS Committee on Research and Innovation welcomed participants and reiterated that the purpose of this workshop is to learn from each other and identify gaps and opportunities in wildfire observation, understanding, and prediction support activities.

Remarks from Scott Weaver (OSTP), Director, Interagency Meteorological Coordination Office (IMCO):
Dr. Weaver described the background for ICAMS and noted that it fulfills the mandate of the 2017 Weather Research and Forecasting Innovation Act to improve coordination of relevant weather research and forecast innovation activities. ICAMS contributes to this mandate by fostering collaboration to advance meteorological services via an Earth system approach, providing societal benefits with information spanning local weather to global climate. A 10-year charter was put in place on July 31st, 2020, after a year of planning and robust engagement with 50+ leaders across ICAMS Federal departments and agencies.

The societal impacts of meteorological disasters have increased from about $50 billion in 1980 to $450 billion in recent years. Of these, the number of wildfires causing $billion disasters has increased from four between 1980-2000, to fifteen between 2001 – 2021.

The new ICAMS coordination structure aims to simplify and improve interagency coordination. There is a Council of Principals, who are senior executives from ICAMS departments and agencies. The four committees under the Council coordinate across critical topical areas – and with each other. Each committee has a subordinate structure that is flexible and adaptable. Committees are empowered to develop their subordinate structure. The entire ICAMS structure is to coordinate closely with relevant National Science and Technology Council (NSTC) bodies to fill gaps in the coordination to advance meteorological services while avoiding unnecessary duplication.

Dr. Weaver closed by highlighting the set of principles that guide the work of ICAMS.

Agency Presentations:

U.S. Forest Service (USFS): Toral Patel-Weynand described the efforts by USFS Research and Development (USFS R&D) to address the challenge of wildfires in the western U.S. These efforts are guided by the agency's wildfire crisis strategy, which was released in January 2021. The strategy is a science-informed plan to prioritize fuel management actions at the scale necessary to address the problem: the landscape scale. It recognizes decades of well-established science demonstrating how the exclusion of fire from many of our forests for more than a century has created an increase in the density of small- to medium-sized trees, adding considerably to the surface fuels that contribute to much of the extreme fire behavior that occurs today. In a warming climate, the urgency of restoring our forests is even greater, as our fire seasons are becoming nearly year-round.

The Wildfire Crisis Strategy prioritizes treating up to twenty million acres on the National Forest System lands as well as up to an additional thirty million acres of other Federal, Tribal, State, and private lands. This plan also provides for long-term maintenance of these treatments beyond 10 years. The recently passed Infrastructure Investment and Jobs Act (IIJA) represents a down-payment on this work.

This Wildfire Crisis Strategy rests on the three pillars of the National Cohesive Wildland Fire Management Strategy: fire-adapted communities, fire-resilient landscapes, and a safe and effective wildland fire response. These elements are connected in the USFS Wildfire Crisis Strategy and in their science as it relates to fuel conditions in the wildlands, extreme weather conditions, and vulnerable infrastructure in our communities. USFS R&D is conducting extensive research in support of these pillars.

Fire-adapted communities require efforts to address the vulnerability of communities themselves, as well as the exposure of communities to fire originating in the wildlands. USFS R&D addresses community vulnerability through ongoing research on fire-resistant building materials through the forest products laboratory, and social and economic risk factors through the social science research community, including efforts to incorporate environmental justice and equity into risk assessments.

Community exposure to wildfire is addressed through the concept of firesheds. Firesheds are 250,000 acre planning units that can be used to compare different landscapes based on values of concern, with the most exposed firesheds being assigned highest priority for additional investment through IIJA funding. Simulations of wildfire scenarios in firesheds are critically dependent on meteorological data to predict fire activity based on historical climate-fire relationships. The problem of community exposure is inherently a landscape fuels challenge, compounded by extreme fire weather that is most likely to occur in drier, frequent-fire forests and woodlands. Landscape resilience and forest health requires that surface fuels be reduced.

The fireshed analysis approach has been used to identify four different priority regions for additional investment through the IIJA: the interior Pacific Northwest, the Sierra Nevada Range in California, the

Front Range in Colorado, and the Southwest. USFS was appropriated $3 billion for ecological restoration over five years, including the removal of hazardous fuels. USFS is working on identifying projects and increasing its capacity to get started on on these projects as soon as possible, and is committed to working with state foresters, partners, and Tribes to identify and design projects that benefit these regions.

A key component of the USFS research strategy to support a safe and effective wildland fire management response is the Potential Operational Delinations (PODS) research program out of the Rocky Mountain Research Station. PODs are a framework to derive spatial containers for strategic wildfire response objectives – a science-based pre-planning approach to inform the response to wildfires when and where they occur.

As part of its National Engagement Strategy, the Wildfire Risk Reduction Infrastructure Team (WRRIT) designed a series of national/regional roundtables to help inform the development of a 10-year Wildfire Risk Reduction (WRR) Implementation Plan with employee and partner input. These roundtables are continuing, with the next one in the Pacific Northwest (Region 6) the first week of April. The WRRIT team and USFS R&D are collectively striving towards the incorporation of the best available science in support of this work, including integrating the biophysical and social sciences, understanding local contexts, improving their understanding of smoke dynamics, sharing platforms, databases, and datasets, and leveraging the Joint Fire Sciences Program.

U.S. Geological Survey (USGS): Paul Steblein reported on the U.S.G.S's Wildland Fire Science Program. Their program produces fundamental information to identify the causes of wildfires, understand the impacts and benefits of both wildfires and prescribed fires, and help prevent and manage larger, catastrophic events. Their fire scientists provide information and develop tools that are widely used by stakeholders to make decisions before, during, and after wildfires in desert, grassland, tundra, wetland, and forest ecosystems across the United States.

The scope of USGS fire science includes geographic, interdisciplinary (five mission areas: ecosystems, natural hazards, water, core science, energy, and minerals), thematic, and science organization and results.

The USGS Wildland fire science strategic plan for 2021-2026 was released about one year ago. It identifies four priorities with the first being to produce state-of-the-art, actionable fire science. This first priority has four goals:

- Goal 1: Improve understanding of the impacts of climate change and other ecosystem stressors, and their synergistic interactions, on fire behavior, fire risk, and fire effects in natural systems and human communities;
- Goal 2: Gain a better understanding of the relationships of fire and fire management to biodiversity conservation, ecosystem resilience, and post-fire recovery;
- Goal 3: Conduct science to help protect human lives, livelihoods, property, and infrastructure;
- Goal 4: Develop state-of-the-art tools and decision-support systems that enable land, fire, and emergency-managing bureaus and partners to obtain essential fire information.

A high-level conceptual diagram was shown to illustrate the complexity and interconnectedness of phases of fire and their relationship to options in recovery. Each of the threats, hazards values, and mitigation have layers of data and tools that are important to have available.

Vegetation provides fuel for fire and is a key part in all phases and recovery. Information about vegetation helps identify where to mitigate and position response assets before a fire. It drives fire behavior models to determine how to attack fire, when to back off, and burn severity to look at the potential for debris flow, flooding, and how to restore vegetation and control invasive species.

Building a connection between fire behavior characteristics and post-fire hazards establishes a framework for connecting many other fire-related research and models. Partnerships play a critical role across disciplines both internally and with other agencies and programs, and include remote sensing, process research, modeling and applications.

The USGS Advanced Integrated Fire Science Conceptual Model covers fire behavior and post-fire risks. It includes land-use/land-cover change, pre-fire management, post-fire response, climate change, and many other factors. This conceptual model has been used for the Colorado River Basin and for California and Washington disasters.

Paul closed by providing information about the USGS Catalog of Fire Science Scientists and Programs, the USGS Fire Science Publications/Products 2006-2017, and a sample of USGS science resources to support management before, during and after fires.

National Oceanographic and Atmospheric Administration (NOAA): Dave Turner reported that NOAA science and services support each phase of the fire lifecycle to include forecasting, monitoring, pre-ignition, detection, and post-fire. Fire weather customers/partners span local, regional, and national areas. Meaningful forecast information is based on science and technology development, forecasters using and communicating information, and supporting decisions based on available weather data.

NOAA provides an incident meteorologist to an active wildfire location to provide weather information to guide partners such as fire managers and community leaders in their decision processes. These partners provide feedback that helps guide NOAA research efforts to improve the weather information they need in decision support.

NOAA satellites are useful for fire detection and monitoring and are used to provide timely notification of wildfires, fire boundaries, and operational smoke forecasting. Research based on the newest generation of geostationary satellites is looking at air quality particulate modeling, smoke forecasting, and a range of other applications in the pre- and post-fire stages.

NOAA research conducts field campaigns to improve process knowledge. Aircraft data are used to sample wildfire emissions and meteorological conditions, long-term ground-based and satellite observations to monitor smoke/radiation/aerosol composition, improve trajectory and dispersion modeling, and research to improve subseasonal to seasonal (S2S) predictions to predict abnormally warm and dry regions where hazardous wildfire might be likely to occur. One of the forecast tools shows the smoke layer at the surface with impacts to public health and firefighters on the ground as well as an elevated smoke layer which impacts visibility at layers important to aircraft, which contributes to the aircraft sampling. High performance computing systems are needed to support modeling advancements.

A Fire Weather Testbed is needed to improve the interaction between the user community and the researchers. This Testbed would improve the speed at which new products and services can be developed and implemented into operations. A satellite proving ground could be used to improve satellite fire and aerosol product use for fire spread, air quality, and visibility.

Priority gaps that need to be addressed include:

- Fire, smoke and fuels observations
- Meteorological observations
- Modeling improvements (enable extreme fire behavior modeling and risk analyses)
- Decision Support Tools

National Aeronautics and Space Administration (NASA): Lesley Ott presented NASA's research contributions to the U.S. fire community. She noted that there are about twenty satellites in orbit currently with more planned in the future. NASA satellite data provide comprehensive information on vegetation and land surfaces that guides understanding of pre-fire risk and post fire recovery. NASA also works collaboratively with other agencies and international partners to harmonize datasets and provide expertise on cal/val and retrieval algorithms. Examples were shown of vegetation height, surface temperature, and soil moisture.

During a fire, data from MODIS and VIIRS provide information on fire intensity that is used to estimate emissions. Additional observations characterize plume composition, transport, and injection height. Following a fire, satellite-based precipitation can provide advance warning of conditions that could lead to deadly landslides.

NASA airborne observations provide additional information before, during, and after fires, covering areas of interest more frequently, at higher spatial resolution, and observing quantities not available from spaceborne observations. NASA aircraft data are also frequently used to survey fires in the western US and are used to map burn scars and characterize risk for post-fire debris flows.

NASA has developed multiple approaches to estimating fire emissions using both burned area and fire radiative power (FRP). FRP-based datasets like the Global Fire Emissions Database Near Real Time and the Quick Fire Emissions Dataset estimate emissions in near real time, helping communities worldwide estimate risks from smoke exposure. NASA's Global Earth Observing System Models assimilate aerosol optical depth to predict the evolution of smoke plumes. NASA also supports research efforts to assess the predictability of fire risk on S2S timescales.

NASA's data services and applications include online and in-person training sessions covering a range of datasets, web portals, and analytical tools and their application to climate, air quality, agriculture, disaster, land, and water resource management.

Lesley closed by summarizing major gaps and opportunities for collaboration in both observations and modeling to improve data services that support more reliable access, interoperability between datasets, streamline the research-to-operations (R2O) pathway, and facilitate more rapid adoption of new technologies and modeling approaches.

Department of Energy (DOE): Olga Tweedy reported that DOE executes its mission through diverse national labs. They address large-scale, complex research and development challenges with a multidisciplinary approach that translates basic science to technology. Their focus on wildfire and fire weather activities is performed at some of the DOE Laboratories. DOE National Lab scientists are not necessarily funded by the DOE alone. Funding can come from other federal agencies, internal funding, and state governments among other sources. Their scientists are actively collaborating with other research communities outside of the DOE labs.

DOE capabilities performed at its labs include observational and analytical capabilities, modeling and predictions, detection and assessment, process-oriented research, and applications and decision support systems. Their major focus is on pre-fire, during the fire, and wildland fire first-order impacts.

DOE labs support various analytical facilities, field measurements/studies, and networks of instrumentation. Examples of field studies include air quality in prescribed burns and prescribed fire behavior experiments.

DOE is very interested in improving model representation of wildland fires, fire weather, and related processes at different scales. Its lab scientists are actively involved in global and regional model development.

DOE labs including Los Alamos National Laboratory are actively engaged in model development and research in two areas relevant to fire weather: fine-scale fire behavior modeling and ecosystem modeling. Fire behavior modeling allows evaluation of the impact of atmospheric and fuel conditions on fire behavior on time scales of minutes to hours, as well as spatial scales of up to several kilometers. Ecosystem modeling enables the study of how atmospheric and soil conditions affect vegetation structure and fuel moisture on seasonal to interannual time scales and regional to global spatial scales. Both atmospheric and fuel conditions that result from soil and atmospheric moisture are important contributors to fire weather.

One of the strengths of the DOE wildland fire and fire weather efforts is the use of AI and ML for predictive modeling. These are used in models to predict wildfires several months in advance, predict seasonal fire risk, and assess US wildfire danger potential.

A variety of sensors and devices are funded by DOE for wildfire detection and mitigation. These are intended to identify and mitigate fire risk, provide detailed regional maps of surface vegetation conditions, and support modeling and hazard assessment activities.

DOE has process-oriented research to address fire dynamics, physical and chemical processes, and wildfire impacts. Examples include the regional impact of biomass burning aerosols, understanding urban and wildland fire dynamics, and wildfire effects on water quality in California. Another study examines how fire might change as the structure and health of forests and ecosystems change. DOE scientists also address challenging questions related to ecosystem resilience and land management practices which could potentially reduce the cost to fight wildfires and speed up ecosystem recovery.

Olga closed with a chart showing applications for wildfire detection, monitoring, risk assessment, fire behavior modeling, data management platforms for data sharing, and decision support tools for wildfire mitigation.

National Science Foundation (NSF): Marc Stieglitz reported on NSF’s Strategic Opportunity in Wildland Fire Science. He provided a broad overview of NSF funding in general and the portions directed to fire science. The overall funding for NSF was $8.5 billion in 2021. Fire-related awards have increased over the past 8 years from 2 in 2012 to 187 in 2021.

NSF has a diverse array of programs and approaches that can be employed to study various aspects of wildland fire. Fire-related research is supported through regular awards as well as special proposal types. Regular awards over the past 5 years totaled $287 million. Every state in the U.S. has had at least one fire-related award in the past 8 years.

The GEO Physical and Dynamic Meteorology program is one of the research focus areas and has recently funded a campaign (using facilities from NCAR Earth Observing Laboratory) called Sundowner Winds Experiment (SWEX), which will be conducted in Santa Barbara, California during April 1 – May 15, 2022. Its focus is on downslope windstorms at the lee of the Santa Ynez Mountains in Santa Barbara County, California. Sundowner winds are one of the most significant fire weather hazards affecting populated areas.

Examples of NSF-funded research:

- Before fire: Preparing communities for wildfire. Communities across the country worked with civic and research partners to propose innovative pilot projects with the potential for scalable, sustainable, and transferable impact.
- During fire: This is a strategic campaign to look at the impact on air quality from the large smoke plumes produced by wildfires in the western U.S.
- After fire: Earth Science responses to 2020 wildfire season with themes that included snow water storage, snowpack, flow paths, sediment dynamics, soil characteristics, geomorphic change in river estuary, and streamflow response.

NSF can lead with fundamental science questions and is also leading on convergence research. The difference is not so much whether it is "basic" or "applied" but how top-down or prescriptive the research is.

Concepts in NSF fire-related awards include vegetation and species, air quality, fire behavior, machine learning, remote sensing, fire regime change, climate change, and education.

Marc closed by identifying gaps in existing fire-related research at NSF and opportunities for cross-agency coordination/collaboration. Gaps:

- Wildland fire convergence research
- Infrastructure or facilities to support wildland fire data, modeling, and forecasting
- Non-academic partnerships
- Education programs for convergent professional learning and enhanced public engagement
- Dedicated support for Indigenous fire science
- Decision-making under uncertainties and uncertainty quantification

Opportunities for Cross-agency coordination/collaboration:

- Participate in other agencies' relevant meetings, hold regular interagency update meetings, or set up channels of communication among agencies.
- Explore coordinated opportunities for interagency wildland fire programs.

- Establish a network to coordinate wildfire related research (e.g., a portal for inventory of all wildfire related projects so that agencies can avoid over-allocating federal funds in one specific area).
- Build an integrative information system for wildfire management so that observations, modeling results, knowledge, and findings produced from projects of various agencies can be shared.
- Leverage the infrastructure of agencies with applied science and operations (e.g., NASA, USGS, NOAA, DOE, etc.).
- Explore ways to expand diversity, equity, and inclusion in research investments.
- Develop large scale interagency and interdisciplinary collaborative programs or research centers.

Panel Discussion: Representatives from each of the six agencies were introduced and responded to questions and comments from the Workshop participants.

Panelists:
USGS: J. Kevin Hiers, Brian Ebele, Kurtis Nelson
NOAA: Jenn Mahoney, Robyn Heffernan, Mike Pavolonis
NASA: Robert Field, Doug Morton, Liz Wigginis
DoE: Rod Linn, Charlie Koven, Jeffrey D. Mirocha
NSF: Kendra McLauchlan, Yulia Gel, Yu Gu
USFS: Toral Patel-Weynand, Charles Luce

Dr. Gary Geernaert moderated the panel discussion and opened with questions/comments posed by workshop participants.

Key comments about gaps, challenges, and opportunities in wildfire support operations, technologies, and research (in addition to those summarized in the Workshop agency presentations):

- The full cost of smaller fires may not have been included in the $billion disasters and may be substantially higher (cited NIST study)
- May be useful to track which events are WUI fires versus wildfires (affects factors driving risk and cost).
- Is there a distinction between short-term wildfire event costs of economic and productivity loss and recovery?
- What role do fire responders play in shaping the research agenda in each agency?
- Need a more realistic projection (using advanced modeling tools) of fire effects under climate change scenarios.
- NRT needs include rapid detection of new fires and near-constant monitoring of fire intensity.
- Vegetation and soils are critical connecting agents between pre-, during, and post-fire weather.
- The NOAA fire weather testbed is being designed to better connect end users to NOAA products and services.
- There is a big gap in understanding the diurnal cycle of fires and smoke emissions.
- Need to have improved observations of wind and thermodynamic profiles in the boundary layer.
- Should be more emphasis on mitigation of fires before they occur such as fuels treatment and adaptation of human communities.
- Needs to be consistency in all land-related products.

- Prescribed fires burn a larger acreage annually than wildfires. There is a research need for finer scale weather and emissions prediction to add to the toolset for managers.
- Whether or how do various agencies coordinate their capabilities and are they connected with user needs?
- How consistent are data standards among agencies to ensure interoperability among their efforts?
- Need for a more comprehensive IT strategy across science producers and the on-ramp with fire management.
- Need to have a collective strategic view of how science can support fire management in the longer term.
- Concern about the DoD prescribed fire program because it is inherently a fire-starting mission and targets fuels treatment on the interior rather than the "outside in" WUI approach of the rest of the federal fire community.
- Need to have a unified, all-agencies cloud strategy to make sure resources are used efficiently (many concerns about costs and commercial agreements).
- Need for an interagency advanced modeling collaborative for data and fire models.
- Need to understand which investments are going to have the best rates of return.
- Need to explore changes in adverse health impacts from a climate and health perspective.
- Need to address opportunities for research integration related to fire-hydrology-water quality.
- Need to define requirements for research grade wildfire datasets.
- Need to work fire science more collaboratively and with essential funding and leadership.
- Identify populations that are more vulnerable to smoke.
- Need tighter coupling to socioeconomic data/models at multiple agencies.
- How to include more agencies at the next workshop?
- How to accelerate fire science across agencies?
- Need success stories on agency fire weather collaboration.
- Need to review the readiness of current fire research activities to be transitioned to operations.

Wrap Up/Final Thoughts: Stan Benjamin will send out a survey for participants to provide challenges and opportunities to be addressed in the next workshop. A template will also be developed and provided for examples of agency wildfire support activity collaboration/cooperation.