P1. A Novel Application of Wildfire Risk Assessments in Land Management Plans

Jennifer Anderson, Regional Fuels Planner, US Forest Service
Additional Authors:
April Brough, GIS Programmer/Analyst, US Forest Service Contractor

Abstract: Recent updates in USFS policy and guidance require the designation of strategic fire management areas through spatial fire planning (SFP). Strategic fire management areas spatially depict fire-related LMP direction in SFP and guides implementation through the use of Wildland Fire Decision Support System (WFDSS). Under the 2012 Planning Rule, we use a risk-based approach in the Pacific Southwest Region (Region 5) to generate strategic fire management areas for the three Early Adopter forests in the Southern Sierra Nevada, as well as eight additional forests in the northern Sierra Nevada. We propose a six-step cycle of risk-based fire management that facilitates bringing a landscape closer to desired conditions, as outlined within the LMPs. The cycle consists of the following steps: 1) fire modeling, 2) asset and resource characterization, 3) effects analysis, 4) continuum analysis, 5) SFP integration, and 6) desired condition evaluation. Using a quantitative approach, this risk cycle uses location of risk and the likelihood of fire ignition, fire spread and intensity to assist managers in determining where wildfires are likely to have positive or negative outcomes on highly valued resource and assets. Using a continuum of actions ranging from full suppression to managing fires to meet protection and resource objectives, this spatially-explicit risk based approach will allow fire managers to more effectively achieve desired conditions for a more resilient landscape.

Keywords: wildfire risk assessment, land management planning, wildland fire, modeling, spatial

Presented Bio: Jennifer Anderson graduated with BA in Geography from Georgia State University and Master of Forest Resources from the University of Georgia. Jennifer has worked in a number of field stations for the US Fish & Wildlife Service, including Bon Secour NWR, Savannah NWR, Merritt Island NWR, in addition to Everglades National Park in a variety of Fire/Fuels and GIS positions. She has worked as a Fire Planner at the Regional level for 3 federal agencies. Jennifer is currently the Fuels Planner for the USFS Pacific Southwest Region where her focus is wildland fire planning, NEPA, and spatial fire risk assessments.

P2. Oregon's Prescribed Fire Council: working in the future with prescribed burning and managed wildfire

Amanda Stamper, Oregon Fire Management Officer, The Nature Conservancy

Abstract: As a member of the national network of prescribed fire councils, our focus in Oregon is first and foremost on the use of management-ignited fires that meet pre-planned landowner objectives. There is broad agreement within both the management and scientific communities on the effectiveness and unique benefits of prescribed burning across a wide range of Pacific Northwest ecosystems. These ecological benefits cannot be fully achieved through other, non-fire-based management approaches; restoration of cultural burning practices and fire regimes is included within this scope. We also acknowledge the very real and growing challenges facing fire and fuels managers in Oregon, particularly on federal lands, where fire seasons are increasingly long and resultant wildfires are increasingly severe, with little reprieve or optimism in sight relative to wildfire risks, budgets and personnel. Annual treatments to reduce wildfire hazard/risk account for only a small percentage of the area that needs attention and do not even compensate for continued growth of biomass/fuel. We therefore conclude that it is not feasible to fully address wildfire hazard in many areas outside of the wildland-urban interface or to significantly reduce wildfire risk across landscapes with mechanical treatments and/or manager-ignited prescribed fires. Many areas are too steep or remote for mechanical treatments, in designated wilderness or other reserved lands (where fire is the only tool for maintaining ecological health), or economically unfeasible to treat given current fiber markets and infrastructure; similarly, air quality management constraints, liability and personnel requirements frequently limit manager-ignited

prescribed burning. Consequently, we recognize the need to define and market "beneficial fire" more broadly, and to regard both prescribed fire and managed wildfire as important tools for bringing fire-adapted and fire-dependent ecosystems in Oregon into a more resilient condition. This redefined relationship with fire and resultant resilient landscapes will further serve to reduce the stress on fire management systems and our larger society over time relative to current realities.
Keywords: Prescribed fire, wildfire, fuel treatment, land management, fire risk, air quality
Presented Bio: John Duff Bailey, Ph.D. Associate Professor of Silviculture and Fire Management
John received his BS and MF from Virginia Tech (as a native Virginian) and then worked for 6+ years with the EPA in Corvallis, Oregon on forest responses to climate. He returned to school for a Ph.D. (Silviculture) at Oregon State University, then joined the faculty at Northern Arizona University for nine years working in semi-arid silviculture, fuels treatment and restoration. He returned to Oregon State in 2005 to continue work on fuels/fire management and ecosystem restoration in drier forest types, as well as resume research on multi-story management in wetter, mixed-fire-severity forest types. It is Oregon, after all.
Amanda Catherine Stamper, Fire Management Officer, The Nature Conservancy, Amanda started her career in fire management as a member of a 20-person firecrew in 1999. In 2001, after finishing her BA in Philosophy at the University of Oregon, she returned to fire management, working on hotshot crews, handcrews, and engines; as a fuels technician on the Deschutes National Forest; and assistant fire management officer in fuels management on the Ochoco National Forest and Crooked River National Grassland. She studied Natural Resources at Oregon State University and completed a Masters in Natural Resources, Fire Ecology, and Management at the University of Idaho in 2012. She has since worked for the Prineville Bureau of Land Management as a natural resource specialist coordinating post-fire emergency stabilization and rehabilitation; as invasives program manager for the Deschutes and Ochoco National Forests and Crooked River National Grassland; and fire management officer for the Nature Conservancy's Oregon Chapter. She co-founded, formerly chaired, and is currently the administrative coordinator for the Oregon Prescribed Fire Council.

P3. Experimental Research of Grass Ignition by the Heated up to High Temperatures Carbon Particle

Nikolay Baranovskiy, Assoc. Pr., National Research Tomsk Polytechnic University
Additional Authors:
Arkadiy V. Zakharevich, Associate Professor, National Research Tomsk Polytechnic UNiversity
Abstract: Research objective of paper is physical modeling of ignition processes of typical forest fuel (grass) by single carbon particle heated up to high temperatures and the basic laws revealing of this phenomenon. Typical video recording captures of grass ignition process by heated to high temperatures carbon particle are resulted. Following laws of ignition process are established as result of the analysis of visual observations and the video record. It is necessary to specify, that two variants of interaction of heated particles with forest fuel layer are possible: heating source drops out on a surface of a leaf plate or fails deep into a layer of grassy rags. Penetration of particle into forest fuel layer is characteristic for sources from steel owing to them bigger weights in comparison with particles from carbon. There is an inert warming up of forest fuel layer coming during the first short time period followed by the thermal decomposition of material with release of pyrolysis gaseous products. There is a transport of gaseous pyrolysis products to a heated layer surface and their mixing with an oxidizer in microporous forest fuel environment. Afterwards the gas mixture is heated with the subsequent stage of ignition. Grass ignition delay time dependence from initial temperature of carbonaceous particle is obtained. The lower ignition limit for such particle is defined by its initial temperature. Comparative analysis of pine needles and birch leaves ignition time dependences shows that ignition delay time also does not depend from the sizes of ignition source when initial temperature of a particle reaches 1300 K. Dependence of ignition

delay time vs. temperature can be approximated a straight line. Similar dependences are obtained and for others forest fuels.

Keywords: forest fuel, ignition, hot particle

Presented Bio: Baranovskiy Nikolay Viktorovich was born on April, 13th, 1978 in Tomsk (Russia). Has left municipal school № 47 of Tomsk in 1995. Then has entered on the faculty of mechanics and mathematics of Tomsk state university. In 2000 has graduated from the university and has entered in postgraduate study. Since 2005 worked as younger research assistant at Scientific research institute of applied mathematics and mechanics. In 2007 has presented the Ph. D. dissertation of the candidate of science in physics and mathematics on a theme «Mathematical modelling of the most probable scenarios and conditions of forest fires occurrence». Since 2008 training in doctoral studies of National research Tomsk polytechnic university. Since 2011 on the present time he work at Power institute of Natioanl research Tomsk polytechnic university as the Assistant professor.

P4. Mathematical Simulation of Heat Transfer in Coniferous Tree at the Forest Fire Influence

Nikolay Baranovskiy, Associate Professor, National Research Tomsk Polytechnic University
Additional Authors:
Kseniya Andreeva, student, National Research Tomsk Polytechnic University

Abstract: Report is devoted to mathematical simulation of forest fire influence on coniferous tree. Surface forest fire under consideration. We use three-layered structure of coniferous tree while make simulation. First layer is core, next one is subcrustal zone and last layer is bark. We consider influence of radiant thermal flux on single coniferous tree during computational experiments. We use partial differential equations to discribe heat transfer in tree. Temperature dependences on time and influence parameters are obtained and discussed. It is possible to use such models in geomonitoring systems.

Keywords: vegetation, forest fire, tree, heat transfer, simulation, mathematical model

Presented Bio: Baranovskiy Nikolay Viktorovich was born on April, 13th, 1978 in Tomsk (Russia). Has left municipal school № 47 of Tomsk in 1995. Then has entered on the faculty of mechanics and mathematics of Tomsk state university. In 2000 has graduated from the university and has entered in postgraduate study. Since 2005 worked as younger research assistant at Scientific research institute of applied mathematics and mechanics. In 2007 has presented the Ph. D. dissertation of the candidate of science in physics and mathematics on a theme «Mathematical modelling of the most probable scenarios and conditions of forest fires occurrence». Since 2008 training in doctoral studies of National research Tomsk polytechnic university. Since 2011 on the present time he work at Power institute of National research Tomsk polytechnic university as the Assistant professor.

P5. Geomonitoring of Forest Fire Danger Using GIS and Remote Sensing: Case Study for Typical Area of Tomsk Region

Nikolay Baranovskiy, Associate Professor, National Research Tomsk Polytechnic University
Additional Authors:
Elena Yankovich, Senior Lecturer, National Research Tomsk Polytechnic University
Marina Engel, Institute of atmosphere optics SB RAS
Vladimir Belov, Head of department, Institute of atmosphere optics SB RAS

Abstract: We use probabilistic criterion to estimate forest fire danger. It takes into account anthropogenic load, storm activity, meteorological condition and properties of forest cover. We implement program realization of probabilistic criterion by interaction with geoinformation system and software, which operate remote sensing date. We use desktop version of ArcGIS software. MODIS remote sensing files are used to obtain some meteorological conditions. We have conducted case study for the typical area of Tomsk region (Russia).

Keywords: forest fire danger, GIS, remote sensing, weather conditions

Presented Bio: Baranovskiy Nikolay Viktorovich was born on April, 13th, 1978 in Tomsk (Russia). Has left municipal school № 47 of Tomsk in 1995. Then has entered on the faculty of mechanics and mathematics of Tomsk state university. In 2000 has graduated from the university and has entered in postgraduate study. Since 2005 worked as younger research assistant at Scientific research institute of applied mathematics and mechanics. In 2007 has presented the Ph. D. dissertation of the candidate of science in physics and mathematics on a theme «Mathematical modelling of the most probable scenarios and conditions of forest fires occurrence». Since 2008 training in doctoral studies of National research Tomsk polytechnic university. Since 2011 on the present time he work at Power institute of National research Tomsk polytechnic university as the Assistant professor.

P6. Characterizing biogeographical variation in encounter rates between fire and fuel treatments in the conterminous United States

Kevin Barnett,The University of Montana
Additional Authors:
Helen T. Naughton, Associate Professor, Department of Economics, The University of Montana

Abstract: Federal land management agencies in the United States continue to invest considerable resources into fuel reduction programs in an effort to reduce fire hazard at landscape scales. A wealth of research has shown that fuel treatments (i.e., mechanical thinning and/or prescribed fire) can indeed help restore historical forest structure while also ameliorating future fire behavior and fire effects. However, the realization of such fuel treatment benefits can be conditional on subsequent burning by wildland fire. This 'fire-contingent' hypothesis implies that continued maintenance of treated areas will be necessary if fires do not burn into treatments during their effective lifespan, typically 5 – 15 years following initial treatment in dry forest types. Meanwhile, emerging research suggests that wildland fires can limit subsequent fire occurrence, spread, and behavior, thus having similar effects as traditional fuel treatment methods while covering much larger spatial extents. An improved understanding of the likelihood that a given fire will encounter a completed fuel treatment or previously burned area is necessary to inform long-term fire and fuels management planning. Using recent wildland fire and fuel treatment data across the conterminous United States, we summarize the encounter rates between wildland fires and fuel treatments, and among wildland fires, at the ecoregion level. In general, the encounter rate among wildland fires is substantially greater than between fire and fuel treatments, although variation among ecoregions is present. For the majority of ecoregions, the annual area reburned by fire is greater than the annual treated area burned by fire. We conclude by exploring the broader fire and fuels management implications of these findings, with a particular focus on the relative benefits of traditional fuel treatments versus wildland fire.

Keywords: leverage, fire management, hazard reduction, reburn

Presented Bio: Kevin obtained a BA in Economics in 2010 and an MS in Forest Management in 2014, both from The University of Montana. For his undergraduate thesis, Kevin examined the effects of dam removal on property values within a spatial hedonic modeling framework. His master's thesis research focused on fire risk assessment in wilderness landscapes. He now researches the effects of fire and fuel treatments on subsequent fire suppression expenditures.

P7. Tools for Improving Fire Behavior Fuel Model Spatial Data

Kori Blankenship, Fire Ecologist, The Nature Conservancy
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Don Helmbrecht, Wildland Fire Analyst, USDA Forest Service, TEAMS Enterprise Unit

Charley Martin, Landfire Project, Sr. Scientist Fire/Fuel & GIS Specialist, Stinger Ghaffarian Technologies (SGT, Inc.), Contractor to the U.S. Geological Survey (USGS)
Jim Napoli, Landfire Project, Sr. Scientist Fire/Fuel & GIS Specialist, Stinger Ghaffarian Technologies (SGT, Inc.), Contractor to the U.S. Geological Survey (USGS)

Abstract: Spatial data describing surface and canopy fuels offer the fire behavior analyst a useful tool for simulating fire behavior, spread and effects, but often these data need to be adjusted based on local information or current conditions. In this poster we describe a conceptual framework and two tools that can help fire behavior analysts adapt surface and canopy fuels spatial data. First we highlight information from the guide "Modifying LANDFIRE Geospatial Data for Local Applications" which provides important background information to help the analyst understand the strengths and weaknesses of LANDFIRE's fuel layers as well as describing a framework for modifying those data. Second, we demonstrate the use of the LANDFIRE Total Fuels Change Tool, an ArcGIS add-in that can be used to modify and update LANDFIRE fuel layers for local applications. Finally, we present how the LANDFIRE Drought Based Fuel Dynamic system can be used to improve the usability of the fuel products in the southeast U.S.A. by systematically modifying surface fuel models based on seasonal conditions. While we focus on LANDFIRE data because it is available for all lands in the U.S.A. and through the Wildland Fire Decision Support System, the approaches we describe could be used on nearly any spatial fuels dataset. This information offers the analyst tools for making more useful fire behavior predictions.
Keywords: spatial data, fire behavior, modeling, LANDFIRE, fuels

Presented Bio: Kori Blankenship is a fire ecologist for The Nature Conservancy working with the interagency LANDFIRE program. She earned undergraduate and graduate degrees in Geography from Western Washington University's Huxley College of the Environment; graduate research investigated seasonal changes in fire behavior and effects in the dry forests of north central Washington State. Kori worked as a GIS specialist at the Missoula Fire Sciences Lab and has worked as a wildland firefighter for the US Forest Service and National Park Service on fires across the western U.S. Her current focus is on taking the results of the first five years of the LANDFIRE project and applying the processes and products toward addressing conservation challenges on large landscapes.

P8. Relationships between Firing Technique, Fuel Consumption, and Turbulence and Energy Exchange during Prescribed Fires

Kenneth Clark, Research Forester, USDA Forest Service

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Eric Mueller, University of Edinburgh, Institute for Infrastructure and Environment, BRE Centre for Fire Safety Engineering, Edinburgh, UK
Albert Simeoni, Exponent, Inc., 9 Strathmore Road, Natick, MA 01760, USA

Abstract: Fuel loading and consumption during prescribed fires are well-characterized for many forests, but relationships between ignition technique, consumption rates, and above-canopy turbulence and energy exchange have received less attention. However, a better understanding of how firing techniques affect surface and canopy fuel consumption is important for "fine tuning" the effectiveness of fuel reduction treatments, while minimizing ember transport and adverse impacts to local air-quality due to smoke dispersion. We estimated fuel consumption using pre- and post-burn destructive

sampling and LiDAR data, and measured turbulence and energy exchange from a network of towers using eddy covariance and meteorological sensors during eight prescribed fires ranging in intensity from low-intensity backing fires to high-intensity head fires in the New Jersey Pinelands. Surface fuel loading and consumption followed the order fine fuels > understory vegetation > 1 + 10 hour wood in all stands. Fine and 1 + 10 hour fuel consumption was a function of initial loading rather than ignition technique, while there was a trend towards greater proportional consumption of understory vegetation with increased fire intensity. Torching and significant canopy fuel consumption occurred only during head fires.
Vertical wind speed, air temperature, and turbulent kinetic energy (TKE) measured above-canopy from towers during low-intensity backing fires were enhanced up to 1.1, 4.8 and 1.1 times over values at control towers, while during high-intensity fires, values were enhanced up to 4.3, 13.8, and 5.6 times over those at control towers, respectively. Maximum values for above-canopy vertical wind speed, temperature, and TKE in head fires were 9.4 m s-1, > 142 °C, and 9.7 m2 s-2. Our results indicate that low intensity fires can be highly effective at reducing fuels on the forest floor, but are less effective at reducing understory vegetation and ladder fuels. Head fires result in greater consumption of canopy fuels, but may be decoupled from forest floor consumption, and result in large increases in turbulent transfer above the canopy. These results can assist wildland fire managers identify tradeoffs between reducing hazardous fuels and controlling emissions during prescribed fires. Our research also provides valuable information for the evaluation of next-generation fire behavior and smoke emission models.
Keywords: Prescribed fires, turbulence, heat flux, fire behavior
Presented Bio: Kenneth Clark is a Research Forester with the USFS Northern Research Station, located at the Silas Little Experimental Forest in New Lisbon, New Jersey. His research focusses on fire weather, hazardous fuel assessments, and the use of eddy flux measurements to quantify energy, water and carbon exchange in forests.

P9. Back to the Fire and Fire Surrogate Study for Wisdom on Fuels Treatment Longevity

Justin Crotteau,University of Montana
Additional Authors:
Christopher R. Keyes, Research Professor, University of Montana
Abstract: The USDA Forest Service plans to spend 5.5% of its budget on wildland fuels management in Fiscal Year 2016. A number of studies have identified that active management can significantly reduce potential ecosystem damage from high severity fire (i.e., fire hazard) in the near term. However, relatively few studies can attest to the long term impacts of fire hazard mitigation on the forest ecosystem and on subsequent fire hazard. The national Fire and Fire Surrogates (FFS) Study was established in 2001 to test the effects of common fuels reduction strategies (thin-only, burn-only, thin-and-burn, and a no-action control) on dry forest ecosystems. In 2014 we revisited the northern Rocky Mountain implementation of the FFS Study with the following question: what role does fuel reduction strategy play in tree development and potential fire hazard many years later? Our preliminary results demonstrate that trees in the thin-only treatment grew twice as much in diameter at breast height as trees in unthinned treatments. The thin-only treatment resulted in significantly greater crown surface area than control and burn-only treatments. Additionally, we estimated total crown biomass was nearly three times greater for trees in thinned treatments than unthinned treatments. Overall, these results indicate that thinning-based fuel reduction strategies more positively affect tree growth. While this may be good for forest vigor and timber, resultant canopy bulk density and canopy continuity will likewise increase. This study supports the notion that that stands require fuel treatment regimes, not singular instances, to mitigate crown fire hazard.
Keywords: fuel reductiont; crown fire hazard; post-treatment growth; Lubrecht Experimental Forest

Presented Bio: Justin is studies silviculture at the University of Montana. His research examines the effects that fire and management have on stand dynamics, and how forest growth feeds back into future fire and management regimes.

P10. Blueprint For Survival, New Options, Skills, Procedure, For Extreme, Fast Fires

Troop Emonds, retired Fire Management Officer and 25 year smokejumper, Dragonslayers Inc.

Abstract: This is a procedure to position structures set in wild fuels so that Land Owners, Home Owners are converted into a ready, able resource to secure, and save their own homes if fire fighters cannot get there to take action to save homes.

This is also a procedure that enlists fire fighters to recognize /understand and take advantage of a new land management technique. then instantly remove light fuel calories away from the fire storm to disrupt the killer momentum of the fire storm.This is an option that sets up a critical site, so that it is instantly ready to withstand a fire storm. Both fire fighters and home owners are equally unschooled in this method that will give time and space to a situation that makes homes and people survivable. Home owners & fire fighters need to learn together the skills and opportunity to install, (indirect fire line) to secure enough "BLACK SPACE", to allow the fire storm to dissipate killer flame and radiant heat to allow the main fire storm to pass and do no harm.

Traditional suppression tactics have no place to start to defend homes, even with a lot of "Defensible Space". This new procedure converts homes set in light fuels to be survivable, in situations that look too risky to save. This procedure ensures time and space that fire fighters, now, cannot currently bring to the scene.

Fire fighters need a viable option to revert to, when these new age wildfires move so fast and homes are not set up with a workable plan. There is just no place to start dropping trees and cutting brush during the attack of the fast moving fire storm. There just is no time or space. It all has to be set up before as indirect line already installed.

Keywords: Survivable procedure, indirect line for manipulation of mechanics of fire.

Presented Bio: Captain in the Marine Corps during 3 years in Vietnam. Infantry Officer then asked to use fire in Agent Orange Areas to kill enemy forces.25 years as a smokejumper with 526 jumps all over Alaska, Canada, Western U.S., Ozarks and Appalachian Mts.Fire Mgt Officer with U.S. Fish and Wildlife Service developed endurable cabins and villages from fast moving fire storms as a specialty.

Private Fire Company to develop a wildfire hand tool system to advance the obsolete GSA fixed fire tools. Also, developed a fire management plan to eliminate loss of homes set in wildland fuels.

P11. Reluctant to Simplify: Examining Assumptions about Wildland Firefighting Communication

Rebekah Fox, Associate Professor, Texas State University

Additional Authors:

Elena Gabor, PhD, Associate Professor, Bradley University

Dave Thomas, Retired, U. S. Forest Service Wildland Fire Manager, Renoveling, Ogden, Utah

Jennifer Ziegler, PhD, and Dean, Graduate School & Continuing Education, Valparaiso University

Anne Black, PhD, Program Manager and Social Science Analyst, Rocky Mountain Research Station

Abstract: The goal of this poster is to share our initial observations about wildland firefighter communication practices taken from interview data, training materials, and field observations collected through our Joint Fire Science Program funded research. Even though this research is still in progress we present our initial findings and reflect on our research processes to encourage IWAF participants to reflect on their own communication practices.

One of our research themes asked about how being “reluctant to simplify assumptions,” as a mindful organizational practice, might surface in communication. The following three initial findings illustrate

simplifications related to communication that may limit training opportunities and get firefighters into trouble.

Our discussions of communication related issues themselves often suffer from a simplification that may inadvertently focus our attention on certain problems instead of others. The word "communication" itself is complex and has been stretched to mean everything from communications (referring to modes of communication such as radio, telephone, maps-on-the-hood-of-the-truck, etc.) to communication, referring to the verbal and non-verbal messages themselves.

Secondly, the theoretical models that guide much wildfire communication training include assumptions about communication. This includes training materials, practices, and procedures. Although the classic Sender-Receiver model does identify some of the basic elements involved in communication, it does not maintain the complexity related to communication and has been criticized for not taking into consideration concepts such as noise (literal noise or cognitive noise) or the socially constructed nature of communication. Because the model is transactional, rather than interactional, it focuses our attention on the sender's role because the receiver is "simply" a person waiting to become a sender.

A third simplification and likely stemming from the other two is the idea that one set of communication practices will work for all of the different roles in firefighting. Our initial research design sought to identify a standard set of radio communication principles yet our interviews indicated that these practices are individually intuited and not collectively shared. Radio dispatchers, firefighters on the line, air attack, and command all function in different physical, psychological, and relational environments that require different communication skills.

Keywords: Radio Communication, Reluctant to Simplify, Mindfulness

Presented Bio: Rebekah L. Fox is an Associate Professor in the Communication Studies Department at Texas State University. She has a BA and an MA in Communication from the University of Arkansas and a PhD in Communication from Purdue University. Dr. Fox also completed a post-doctoral fellowship at the Roudebush Veterans Administration Hospital in Indianapolis, IN. Dr. Fox has authored and co-authored peer-reviewed journal articles and book chapters, as well as presented regional, national, and international conference presentations. Her work appears in Environmental Communication: A Journal of Nature and Culture, American Journal of Nursing, Journal of Contemporary Rhetoric, and Health Communication.

P12. Two Frameworks for Post-fire Prediction of Tree Mortality Across Pyrogenic Landscapes

Michael Gallagher, Research Technician, USDA Forest Service

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Albert Simeoni, Physicist, Exponent, Inc., 9 Strathmore Road, Natick, MA 01760, USA

Abstract: Fire-induced tree mortality can produce both desirable and undesirable effects on forest stands that have prominent ecological, silvicultural, and economic implications. Mechanisms by which fire kills trees are well-established, and predictive tools that incorporate field observations into forest-type specific mathematical models have been developed for estimating mortality at discrete locations.

Such models are similar in form, yet parameters are inconsistent across forest types, limiting their utility in different forest types. These models also require extensive field survey and offer a limited perspective on the spatial patterning of tree mortality.

We present two alternative modeling approaches, logistic regression and machine learning models, for predicting fire-induced tree mortality, following wildland fires, using inputs of forest inventory data collected either pre- or post- burn and satellite imagery-derived burn severity estimates. These models were developed using Relative Differenced Normalized Burn Ratio (rDNBR) burn severity estimates and tree mortality data from research plots burned in 25 prescribed fires and 4 wildfires in pitch pine-dominated stands in the New Jersey Pinelands between 2012 and 2014. The first model uses a logistic regression approach, which had 77% accuracy in predicting mortality, while the second model used a machine learning learning approach via supervised classification with an entropy based J48 Decision Tree and had 80% accuracy.

This work provides a useful calibration dataset for these approaches, and demonstrates a consistent method that enables the estimation of tree mortality at higher spatial resolutions while minimizing additional field work. Our growing dataset of tree mortality and burn severity data will enable further analysis of model accuracy, the parameterization of additional species in the model, and the comparison of model parameters. This will enable a better understanding of the inter- and intra-species factors that influence susceptibility under different levels of fire severity. Since fire severity is largely proportional to fuel load and weather conditions during burning, a better understanding of how different fire severities impact tree mortality will enable greater sophistication of controlled burn prescriptions to accomplish specific silvicultural goals.

Keywords: fire effects, tree mortality, burn severity, dnbr, rdnbr

Presented Bio: Michael Gallagher is a 5th year PhD student at Rutgers University and the lead research technician for the USFS Silas Little Experimental Forest. His work focuses on fire behavior and fuels measurements, burn severity and fire effects, and remote sensing of the wildland fire environment.

P13. The Available Science Assessment Project: Evaluating the Supporting Science Behind Climate Adaptation Actions for Fire and Fuels Management

Rachel Gregg, Lead Scientist, EcoAdapt
Whitney Reynier, Associate Scientist, EcoAdapt
Additional Authors:
Lisa Gaines
Jeff Behan

Abstract: Climate change is one of the most pressing issues facing natural resource management. The disruptions it is causing now and projected to cause into the future require that we change the way we consider conservation and resource management in order to ensure the future of habitats, species, and human communities. Practitioners often struggle with how to identify and prioritize specific adaptation actions used in response to climate-induced stresses. Management actions may have a higher probability of being successful if they are informed by available scientific knowledge and findings; a systematic literature mapping process provides a mechanism through which to scientifically assess management-relevant questions. By evaluating specific actions on scientific knowledge and findings, we may be able to increase resource management effectiveness. The goal of the Available Science Assessment Project (ASAP) is to synthesize and evaluate the body of scientific knowledge on specific, on-the-ground climate adaptation actions to determine the conditions, timeframes, and geographic areas where particular actions may be most effective for resource managers. EcoAdapt and the Institute for Natural Resources derived a methodology that utilizes interviews, systematic literature mapping, scientific expert elicitation, and extensive engagement with natural resource managers throughout the Northwest Climate Science Center region – Washington, Oregon, Idaho, and western Montana. For this

pilot project, we evaluated the science behind specific actions used in response to climate-induced fire regime changes in national forests in the region, although findings may be more broadly applicable in scale and scope.
Keywords: climate change, adaptation, fire regimes, fuels treatments, resource management
Presented Bio: Rachel M. Gregg is a Lead Scientist at EcoAdapt with over a decade of experience in the application of natural and social science and management. She brings expertise in climate impacts assessment, identifying and evaluating climate adaptation actions, developing guidance to support decision-making and management in a changing climate, and communicating climate impacts and response strategies to diverse audiences. Rachel created and manages EcoAdapt's State of Adaptation program and serves as the Content Editor for the Climate Adaptation Knowledge Exchange (CAKE; www.CAKEx.org).
Whitney Reynier is an Associate Scientist at EcoAdapt. She primarily provides key research and workshop support to the Adaptation Consultation and State of Adaptation programs, and loves finding new ways to generate, summarize, and present climate information for managers and planning professionals to use in their own regional climate analyses and adaptation strategy development efforts.

P14. A GIS tool and framework for integrating White-headed woodpecker habitat models into Fire and Land Management Planning Scenarios

Jessica Haas, Ecologist, Rocky Mountain Research Station
Additional Authors:
Vicki Saab, Research Biologist, Rocky Mountain Research Station
Quresh Latif, Research Ecologist, Rocky Mountain Research Station
Abstract: The White-headed woodpecker occupies a limited distribution in the Inland West and is reliant on a mosaic of open and closed canopy Ponderosa Pine forests. This woodpecker is considered a species of conservation concern by state and federal agencies in the Inland West because of habitat loss, primarily due to wildland fire suppression and logging. Additionally, white-headed woodpeckers have been used as a focal species for Effectiveness Monitoring of Collaborative Forest Landscape Restoration Projects, because their presence is a useful indicator of historic forest conditions described as restoration targets. Land management objectives for areas inhabited by this bird include restoration of historic range and variability of large diameter Ponderosa Pine forests. We demonstrate how a habitat suitability index (HSI) model can be integrated with landscape change models within a Geographic Information System (GIS) to simulate future forest conditions under various management strategies. These scenarios can include expanded beneficial wildland fire, prescribed burning and selective harvesting, to name a few. The integration of these models can be used to compare the feasibility of alternative strategies for achieving the goal of restoring historic forest conditions and improving habitat suitability for White-headed Woodpeckers in green forests.
Keywords: habitat suitability modeling; forest planning; white-headed wood pecker; scenario analysis
Presented Bio: Jessica R Haas is an ecologist with the Rocky Mountain Research Station. Her research focuses on the development of decision support tools for analyzing risk of various hazards to human communities and watersheds. Her work has been used by government, research and non-government organizations in a variety of wildfire and post-fire debris flow risk assessments, ranging from large national scale assessment, to local level project planning.

P15. Development of a high-resolution (5-m) fuel model map based on LiDAR and NAIP and its application to Marin County, CA

Hilary Hafner, Sonoma Technology, Inc.
Additional Authors:
ShihMing Huang, Air Quality Scientist/Project Manager, Sonoma Technology, Inc.

Stacy Drury, Senior Fire Ecologist/Project Manager, Sonoma Technology, Inc.
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Christie Neill, Battalion Chief, Marin County Fire Department
Abstract: In response to growing fire risk in the wildland-urban interface (WUI), communities are increasingly using Community Wildfire Protection Plans (CWPPs) to help mitigate the risks posed by large wildfire events. Information about the distribution of fuels across a community is a valuable addition to CWPP development. Using up-to-date, high-resolution fuels maps, communities are able to assess fuels and model the fire behavior of a hypothetical wildfire event. Such models can be used to help prioritize fuel reduction efforts; however, accurate results rely on representative information about the type of fuels available to burn, fuel moisture, and weather. As part of Marin County's CWPP development effort, we compiled a 5 meter resolution fuel model map to provide an updated, high-resolution data layer of current fuel conditions.
The Marin County fuel model layer was developed using LiDAR returns, 1-meter National Agriculture Imagery Program (NAIP) imagery, local vegetation data sets, and the Classification and Assessment with LANDSAT of Visible Ecological Groupings (CALVEG) map. In addition, GIS processing algorithms were developed to help resolve vegetation cover in WUI areas using spatially explicit road and building footprint data sets. These data sources were integrated to assign 40 Scott and Burgen Fire Behavior Fuel Models to each pixel covering the county and to identify physical characteristics across the landscape. This custom fuel model map, when compared with the national-scale, 30-meter LANDFIRE data, provides an improved representation of fuel characteristics with respect to: (1) the delineation of tree cover versus grasslands and shrubs and (2) the distribution of vegetation and non-burnable fuel types in the WUI. Many modeling tools, including the widely used FlamMap fire behavior analysis software, are able to use the 5 meter fuels data. From the 5-meter fuels data, we also developed a 30 meter-resolution resampled data set that can be imported into key modeling platforms such as the Interagency Fuels Treatment Decision Support System (IFTDSS), allowing stakeholders to assess wildland fire risk and evaluate the potential benefits of fuels treatments on fire behavior. The methods we describe here can be implemented to better characterize and mitigate the risks posed by wildland fires in other communities.
Keywords: WUI, fire model, IFTDSS, LiDAR, fire behavior modeling, fuel model

P16. LANDFIRE Guidebook: Fire Behavior and Fuels of Vegetation Types in the Conterminous United States

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Additional Authors:
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Frank Fay, LANDFIRE Business Lead, USDOI
Abstract: The principal objective of this guidebook is to improve national, regional, and local mapping of LANDFIRE fuels. Improvement occurs through guidebook facilitated interaction of fire behavior, fuel, and vegetation specialists with LANDFIRE scientists, data, and models. LANDFIRE fuels are available nation-wide and are mapped using rules linked to vegetation and environment characteristics. Guidebook content is focused on linking fire behavior characteristics of the fuels to the vegetation. Users review and refine fuel mapping rules by vegetation type using vegetation and fire behavior characteristics. Lifeform, plant species, fuels, and other information are portrayed in tables and with brief descriptions.
Presented Bio: Wendel J. Hann, PhD, Landscape Fire Ecologist, University of Idaho, Wildland Fire RD&A. Wendel is an accomplished landscape fire ecologist with over 40 year's experience. Current work with the Wildland Fire RD&A involves LANDFIRE fire regime, fuel, and fire behavior mapping and

development of associated technology transfer. Wendel retired from the U.S. Forest Service in 2009 with more than 30 years experience ranging from early years fighting fires, packing mules, and clearing trails to work in land, wildland fire, and prescribed fire management to landscape ecology research to his last assignment as National Landscape Fire Ecologist. Wendel has a PhD from the University of Idaho, and MS and BS from Washington State University.

P17. Conterminous United States LANDFIRE Analysis and Remap of the Fire Regime Group Layer

Wendel Hann, Landscape Fire Ecologist, Wildland Fire Management RD & A; University of Idaho

Abstract: The project reviewed and revised the LANDFIRE version 2010 Fire Regime Group (FRG) layer for the Conterminous United States (CONUS). This map layer has been commonly referred to or specifically used in national, regional, and local rationale for fuel and vegetation management projects and budgets, environmental decision processes, policies, and project prioritization. The revision refined spatial resolution of the historical fire regime groups by providing additional attributes. These include frequency severity composition, lifeform, canopy closure, lifeform with missed fire intervals, and combinations. The current five class FRG map was retained within the layer to provide consistency.

Presented Bio: Wendel is an accomplished landscape fire ecologist with over 40 year's experience. Current work with the Wildland Fire RD&A involves LANDFIRE fire regime, fuel, and fire behavior mapping and development of associated technology transfer. Wendel retired from the U.S. Forest Service in 2009 with more than 30 years experience ranging from early years fighting fires, packing mules, and clearing trails to work in land, wildland fire, and prescribed fire management to landscape ecology research to his last assignment as National Landscape Fire Ecologist. Wendel has a PhD from the University of Idaho, and MS and BS from Washington State University.

P18. A Fire History of the White Cap Creek Watershed in the Selway-Bitterroot Wilderness in Idaho

Valentijn Hoff, GIS Analyst, FireCenter, The University of Montana

Abstract: At more than 1.3 million acres, the Selway-Bitterroot Wilderness is the third largest wilderness in the lower 48. It was established through an act of congress in 1964. The White Cap Creek drainage is a remote area in this wilderness, bordered by the Selway River in the west and the Idaho/Montana border in the east. The elevation ranges from a low of 930m at the confluence of White Cap Creek and the Selway River, up to 2680m at the summit of Vance Mountain. Located just south of the 46th parallel in the Northern Rocky mountains, where the maritime influence of the Pacific starts to give way to a more continental climate, the area contains large gradients of temperature and moisture. This creates a variety of vegetation types, leading to a variety of fuel types, fire return intervals and thus spatial and temporal fire interactions. In the 1960's the White Cap Creek area was chosen for a radical experiment: letting fires burn. In 1972 the lightning caused Bad Luck fire burned for 4 days, the first time a fire was allowed to run its course since aggressive suppression had been implemented in the aftermath of the 1910 fires. Many fires have burned since in this area, creating the burn mosaic of a natural fire regime. This poster provides an interesting visual representation of the fire history in this important area. The mixed use of typography and cartography creates a unique perspective of the interaction between the fires in the area, over the period 1889 – 2013.

Keywords: wildfire, wilderness, fire use, cartography

Presented Bio: Valentijn Hoff is a GIS analyst at the FireCenter at the College of Forestry and Conservation, The University of Montana, in Missoula, Montana. He enjoys using spatial technologies in helping natural resource managers answer their questions. During fire season he can be found embedded with Fire Management Modules, helping Incident Management Teams with GIS, or installing remote networks for fire surveillance. Valentijn has Master of Science degree in Forestry from the University of Montana.

P19. Inexpensive Smoke Sensors and Aerial Platforms for Smoke Monitoring and Model Validation

John Hom, Interdisciplinary Scientist, USDA Forest Service
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Stephen Gienow, Graduate Student, UMBCj

Abstract: Monitoring low level smoke for validating smoke modeling typically requires instrumentation on tall towers inside the burn and monitoring stations outside the burn. The placement of the sensors on towers are limited by their height, and tower location is fixed whereas prevailing wind direction during the burn may change. The expense of the reference smoke monitors precludes their use inside the burn, and low intensity smoke monitoring by standard fixed wing aircraft is neither safe nor cost effective.

A set of inexpensive sensors were developed, using commercial carbon monoxide sensors, smoke alarms, and a drone platform for monitoring smoke plumes from low intensity prescribed burns as part of a JFSP grant #09-1-04-2. The use small drones affords greater flexibility and lowers cost for monitoring low level smoke. A six rotor MiKroKopter drone logged carbon monoxide (CO) , relative humidity (RH), temperature (T), and Particulate Matter (PM, optical and ionized) during 2011 and 2012 burns using a customized smoke alarm and datalogger (EME, UCB) and calibrated CO sensors (DDG, Figaro) at 50 m steps at 1 minute intervals. Fights at prescribed burns and calibration flights are shown with outputs for smoke as CO, PM optical , and PM ionized at different heights. Results indicated that the CO sensor was pressure sensitive to relatively quick changes in altitude. The optical sensors as part of the smoke alarm performed well but PM is much more difficult to calibrate than CO sensors. New prototype smoke sensors using commercial dust particle sensors (optical sensors and PM2.5 cutoff) have been developed for use within burns and on drone platforms to directly monitor smoke outputs for model validation.

Keywords: Smoke monitoring , drone, carbon monoxide, particulate matter, model validation

Presented Bio: John Hom is an Interdisciplinary Scientist in the Climate, Fire and Carbon Cycle Sciences Group for the USDA Forest Service, Northern Research Station. His focus is on smoke monitoring, fuel mapping and fire meteorology. At the Riverside Fire Lab, he studied air pollution effects on forest species. Prior to the Forest Service, he served as the Biomass Program Director at San Diego State University, establishing biological field stations, eucalyptus woodlots and chaparral fuel reduction method for biomass energy.

P20. The Effect of Post-Mountain Pine Beetle Salvage Treatments on Fuel loads and Fuel Moisture in Colorado Lodgepole Pine Forests

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Abstract: Throughout the Rocky Mountain region, recent infestations by the mountain pine beetle (Dendroctonus ponderosae; MPB) have caused widespread tree mortality and accumulation of dead, woody fuels. As forest management strategies are implemented to reduce the increase in surface fuel loads, an understanding of the impacts of such actions is critical for making sound ecological decisions. A large-scale feasibility study, entitled “Sustainable biofuel feedstocks from beetle-killed wood: Bioenergy Alliance Network of the Rockies (BANR)”, is examining whether harvest of beetle-killed trees throughout the Rocky Mountains for use as a biofuel feedstock is plausible. As a researcher on this

project, my role is to analyze the potential impacts of various post-beetle salvage treatments on changes in fuels loading and fuel moisture.

We collected fuel loading data across three treatments in 10 experimental blocks. Each block compared whole-tree (i.e., biomass removal) and lop & scatter (i.e., biomass retention) harvest methods with untreated lodgepole MPB-killed forest in the Colorado State Forest in north-central Colorado. Biomass retention harvest methods resulted in 3x greater coarse fuels (1000hr) and ~1.5x greater activity fuels (1 & 10hr) than biomass removal methods. Harvested plots contained 2x more activity fuels than untreated plots. In untreated plots, windthrow may add an additional 20-30 Mg ha^{-1} of coarse fuels as beetle-killed trees fall.

To determine whether surface woody fuel moisture differed between untreated MPB stands and harvested stands, three fuel moisture stations were constructed at each of the 30 plots within the 10 block design in May 2015. Fuel moisture stations consisted of recently harvested fuels in each fuel moisture time-lag class (1, 10, 100, 1000-hour). Each fuel moisture station was measured weekly from late-May until mid-October and was calculated as percentage of dry biomass. Additionally, 10 weather stations, five in treated and five in untreated forest, were deployed. Data from the weather stations will be used to correlate differences in weather to changes in fuel moisture. We anticipate lower fuel moistures in the treated plots earlier in the season and for a longer duration throughout the season.

Keywords: Fuel Moisture, Fuels Loading, Mountian Pine Beetle, Fuels Treatments

Presented Bio: Paul Hood received his B.A. from the University of Minnesota Duluth in Geography and a minor in Environmental Studies. Post-graduation, Paul spent a number of years gaining experience in wildland fire and fuels, wildlife research and geographic information systems. He is currently a master's student studying fire ecology and fuel moisture dynamics at the University of Wyoming. His research focuses on the implications of forest harvest methods on fuel loads and fuel moisture dynamics.

P21. Smoke Management Information Resources on the FRAMES Emissions and Smoke Portal

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Abstract: Planning for fuels management often requires a comparison of fire effects under pre- and post-fuels treatment conditions. Smoke emissions are one key fire effect with the potential to impact large numbers of people. While proactive measures to address smoke have existed for many years and are continually advancing, there are few nationally-recognized training resources for land managers with the exception of the National Wildfire Coordinating Group's (NWCG) annual week-long Smoke Management Techniques Course (RX-410). The University of Idaho, the National Wildfire Coordinating Group's Smoke Committee (NWCG SmoC), and the Fire Research and Management Exchange System (FRAMES) maintain the Emissions and Smoke Portal (www.FRAMES.gov/smoke) to make the latest information on smoke issues, research, and resources more accessible to all land management professionals.

The Emissions and Smoke Portal highlights the latest smoke management and mitigation issues, research, and educational resources such as the Smoke Management and Air Quality for Land Managers modules, and Smokepedia glossary. The portal search function provides easy access to data, documents, programs, projects, tools and web pages documented in the FRAMES Resource Cataloging System. This makes it easy for land management professionals to quickly stay informed on wildland fire smoke topics.

Keywords: smoke, management, online resources

Presented Bio: Josh works with groups including the NWCG Smoke Committee, Wildland Fire Research Development and Applications Team, and the Fire Research and Management Exchange System Team to develop educational material, support documents, and extension materials to address smoke and fuels management. Josh's background includes a BSc in Rangeland Ecology and MSc in Forest Resources from the University of Idaho. Josh works for the University of Idaho as a Program Coordinator and works out of the Pacific Wildland Fire Sciences Laboratory in Seattle WA.

P22. The Southwest Fire Science Consortium: An Opportunity in Fire Science and Management

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Abstract: The Southwest is one of the most fire-dominated regions of the US. Managers and scientists are often not aware of each other or of the external resources available. We developed a Consortium to bring parallel efforts together to be more efficient and inclusive, allowing future fire science issues to be addressed from a broader perspective with more information, more partners, and more resources. With support from the Joint Fire Science Program (JFSP), we initiated the Southwest Fire Science Consortium (SWFSC) to promote communication and meet the fire knowledge needs of scientists and managers. We originally organized the Southwestern Fire Science Consortium around three key questions: (1) What do people need to know? Information needs are assessed through workshops, surveys, and organization of a community of practice of wildland fire professionals; (2) What information is already known? Synthesis of existing science; and (3) What are the key information gaps between what we need to know and what is already known? This question leads to the identification of critical areas for new research and management experiments. By focusing on these key questions we provide opportunities for managers, scientists, and policy makers to interact and share science in ways that can effectively move new information to management practices and facilitate new research based on management needs. To date, the SWFC has successfully brought together managers and scientists for numerous field trips and workshops to address fire science, share knowledge and science needs. The SWFSC is always looking for new ideas to disseminate fire science and reviews event and product proposals from the fire community regularly.

Keywords: fire science, communication, interdisciplinary, dissemination

Presented Bio: As a serial land manager, Chris has been working in western US ecosystems since 2005. From leading conservation corps crews to working with small-scale private forest products industries, he has sought to understand and make a positive impact on natural environments and the people who enjoy them. In 2011 Chris shifted gears and started a career as a wildland firefighter and not long after began working on a Master of Science in Forestry degree at Northern Arizona University. At NAU, he is researching the effectiveness of post-fire colonizing mosses, known as "fire mosses," as a tool for ecosystem restoration.

P23. Effectiveness and Longevity of Ponderosa Pine Fuels Reduction Treatments: A Legacy of Research at Lick Creek Demonstration/Research Forest in Montana, USA

Katelynn Jenkins, University of Montana

Additional Authors:
Christopher R Keyes, Research Professor, Applied Forest Management Program Director at the University of Montana
Sharon M Hood, Research Ecologist, USDA Forest Service Rocky Mountain Research Station Missoula Fire Sciences Lab
Abstract: In ponderosa pine ecosystems of the interior Western United States, fuels reduction treatments are common but their longevity and effectiveness are poorly understood. The Lick Creek Demonstration/Research Forest in western Montana is a unique long-term research site for ponderosa pine ecosystem restoration. In 1906, it was home to the first commercial ponderosa pine (Pinus ponderosa) timber sale in the Northern Region of the USDA Forest Service and has since been a rare example of long-term forest restoration and research in the northern Rockies. In 1991, the United States Forest Service partnered with the University of Montana (UM) to study ecosystem-based management strategies in Lick Creek, establishing permanent forest inventory plots in areas designated to be treated with shelterwood retention and commercial thin harvests. Units within both sites were burned one-to-three years after harvesting, using three contrasting burning treatments (low consumption, high consumption, and no burning) to simulate a range of burning conditions. These plots were remeasured in 2005 by Forest Service researchers and again in 2015 by UM graduate students and staff. The 2015 data collection included complete inventory of coarse woody debris size and decay class on half of the 288 1/10th-acre plots to more accurately determine fuel loading across each site. This study compares the long-term effectiveness of fuels reduction treatments in both thinning types and models the past, present, and potential fire behavior given fuel accumulation and forest stand conditions. Results of the study will provide forest managers a resource for implementing effective fuels reduction treatments in the future.
Keywords: ponderosa pine, restoration, fuels reduction, thinning treatments
Presented Bio: Katelynn Jenkins is a M.S. Forestry student at the University of Montana studying the long-term effects of fuels reduction treatments in ponderosa pine ecosystems. She has a background in forest inventorying and wildland firefighting, with emphasis on prescribed fire utilization for restoration of frequent-fire pine forests. Her professional interests include ponderosa pine restoration and the effects and utilization of fuels treatments and prescribed fire in forest restoration.

P24. Simulation of a Prescribed Fire Event in the Jones Ecological Research Center

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Xindi Bian, Meteorologist, USDA Forest Service
John L. Hom, Biological Scientist, USDA Forest Service
Matthew Patterson, Biological Science Tech., USDA Forest Service
Abstract: This paper presents results from a recent numerical modeling case study of a prescribed fire in a mixed pine-hardwood stand in the Joseph W. Jones Ecological Research Center in southwestern Georgia. To accurately represent regional and local forcing within the vicinity of the fire, a series of one-way nested simulations are executed, with horizontal grid spacing spanning from 2.7 km to 100 m. The Advanced Regional Prediction System (ARPS) model is utilized for all but the innermost domain, with the ARPS-CANOPY model, a version of ARPS with a canopy sub-model, applied in the innermost domain to allow for explicit resolution of turbulent flows inside the forest canopy. In the ARPS-CANOPY domain, sensible heat fluxes are imposed within a fixed area of the model domain to represent a low-intensity fire, with fire intensity and timing derived from observed data. For each case, momentum, scalar, and

turbulence fields are compared between the ARPS-CANOPY simulation and data obtained from a 30-m flux tower located inside the burn unit. Lastly, preliminary results are presented from smoke transport and dispersion modeling of the burn case using the FLEXPART Lagrangian particle dispersion model.
Presented Bio: Michael is an Assistant Professor in the Geography Department at Michigan State University specializing in numerical modeling of meso- to micro-scale atmospheric phenomena. He has worked on topics as varied as simulating mean and turbulent flow downstream of wildland fires to examining nocturnal cooling processes inside basins and valleys. Michael came to MSU as a post-doctoral research associate in 2009, and became an Assistant Professor in 2013. He holds a BS in Atmospheric Science from the University at Albany and MS and PhD degrees in Atmospheric Science from North Carolina State University.

P25. Comparative Study of Emission Factors and Mutagenicity of Red Oak and Peat Smoke from Smoldering and Flaming Combustion

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Michael Hays, Physical Scientist, U.S. Environmental Protection Agency
Matthew Landis, Environmental Health Scientist, U.S. Environmental Protection Agency
Abstract: Wildfire events produce massive amounts of smoke and thus play an important role in local and regional air quality as well as public health. It is not well understood however if the impacts of wildfire smoke are influenced by fuel types or combustion conditions. Here we developed a novel combustion and sample-collection system that features an automated tube furnace to control combustion conditions and a multi-stage cryo-trap system to efficiently collection particulate and semi-volatile phases of smoke emissions. The furnace sustained stable flaming and smoldering biomass (red oak and peat) burning conditions consistently for ~60 min. The multi-stage cryo-trap system (-10°C followed by -47°C, and ending in -70°C sequential impingers) collected up to 90% (by mass) of the smoke. Condensates were extracted and assessed for mutagenicity (polycyclic aromatic hydrocarbons (PAHs)- and nitroarene-type activity) in Salmonella strains TA100 and TA98+/-S9. Carbon dioxide, carbon monoxide (CO), and particulate matter (PM) concentrations monitored continuously during the combustion process were used to calculate modified combustion efficiency (MCE) and emission factors (EFs). We found that the MCE during smoldering conditions was 74% and 71% and during flaming conditions was 99% and 96% for red oak and peat, respectively. Red oak smoldering EFs for CO and PM were 209 g/kg and 147 g/kg, whereas flaming EFs were 16 g/kg and 0.6 g/kg, respectively. Peat smoldering EFs for CO and PM were 301 g/kg and 59 g/kg, respectively, whereas peat flaming EFs were 47 g/kg and 3 g/kg, respectively. The ranking of the mutagenicity-emission factors (revertants x 100,000/MJ in TA100 and TA98+S9, respectively) was red oak smoldering (14.1 and 6.3) > peat smoldering (13.7 and 4.1) > peat flaming (2.5 and 0.8) > red oak flaming (0.3 and 0.1). The greater mutagenicity in TA100+S9 than TA98+S9 indicates that the mutagenicity was associated with PAHs. The results demonstrate that 1) type of fuel and combustion conditions have dramatic differences in emission characteristics and mutagenicity, and 2) the presented system can be useful for the health risk assessment from inhalation exposure to wildfire smoke. [This abstract does not represent official USEPA policy.]
Keywords: emission factor, mutagenicity, red oak, peat, smoldering, flaming
Presented Bio: Yong Ho Kim is a National Research Council Senior Research Associate in the U.S. Environmental Protection Agency (EPA). He received a PhD degree in 2008 from the Department of

Chemical Engineering at the University of Southern California (USC) and then moved to the Department of Medicine at USC to study how inhaled particles interact with the lung cells as a postdoctoral research associate. In 2013, he joined the laboratory of M. Ian Gilmour (Branch Chief) at U.S. EPA and currently is working on adverse health effects of wildfire smoke from different fuel types or combustion conditions.

P26. Operational Maps Created from LiDAR Technology Identifying Landscape Firebreaks

Vesa Leppänen, CTO of Arbonaut Oy, Joensuu, Finland

Abstract: This study presents a specialized map for practical fire management and response planning. The goal is to aid fire managers in efficient decision making by optimizing scarce fire crew resources with better information. The visual display presents the fire fuels, fire breaks and other critical decision making information on top of a field map. Fire managers are then able to mitigate risk by sending resources to natural fire breaks or areas that have a low spread potential due to limited surface or canopy fuels.

Two demonstration fire management maps were created: one for a forest area in central British Columbia and one in Finland. The vegetation analysis for this study includes standard fuel estimations and thresholds according to Rothermel (1972, 1991) and Van Wagner (1977, 1993). Other important management information includes the maneuverability of large equipment.

The expectation is to provide fire managers an explanatory visual of where to establish a fire line and how to deliver the resources to the site safely and efficiently. This enables quick, strategic decisions about combating conflagration and planning fire prescriptions. The presented map is a template for future iterations that can be customized to the specifications of the users.

Keywords: Management Decisions, Firebreak Map, Fire Management, LiDAR, Canopy Fuels, Surface Fuels, Fire Lines.

Presented Bio: Vesa Leppanen is CTO of Arbonaut with focus on technology strategy and product development. He has participated in technology development for remote sensing based timber and carbon inventory and transmission line management. He has accrued experience and expertise in the remote sensing industry in positions at Utility Risk Management USA, Arbonaut, Finland and other companies. Vesa holds a MSc. degree in Forest Technology from University of Eastern Finland.

P27. Dependence of Daysmoke modeling of smoke plume vertical profiles on updraft core number

Yongqiang Liu, USDA Forest Service

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Abstract: Smoke observations of large-perimeter prescribed burns reveal the presence of several updraft cores or sub-plumes with varied sizes depending on the type, loading, and distribution of various fuels and ignition method. It is hypothesized that, with smaller in diameter than a single core updraft plume, multiple-core updraft plumes would be more impacted by entrainment and thus would have the maximum particle concentration layer occurring at lower elevations. This study tests this hypothesis by conducting smoke simulation and experiment with Daysmoe, an empirical local smoke dispersion and transport model. Daysmoke simulations were conducted for 20 prescribed burns in the southeastern United States. Experiments were conducted with varied updraft core numbers for each burn. The simulated vertical smoke profiles appear in four patterns with a peak smoke particle concentration layer occurring in the upper, middle, and lower portions, respectively, and with particle concentration almost constant first and then decreasing toward top of the smoke plume. Seven burns have the same patterns between the simulated profiles with one core and the measured ones. The number of burns with same profile patterns increases to 15 burns for the 12-core simulations, indicating an improvement of the

Daysmoke simulations of smoke plume vertical profiles with the multiple plume updraft core number. The degree of improvement however is less significant for 4-core than 12-core simulations.
Presented Bio: Dr. Yongqiang Liu is a Research Meteorologist and Team Leader in Center for Forest Disturbance Science, USDA Forest Service. His research interests include smoke measurement and simulation, the air quality and climate interactions, and future fire and smoke trends under climate change.

P28. Emissions Estimations and Smoke Plume Transport Analysis of the King Fire

Marlin Martínez, Doctoral Candidate, Universidad del Turabo

Abstract: Smoke forecasts provide information to manage wildfire smoke implications for public health, the environment, and global climate. This study quantifies the performance of the BlueSky Smoke Forecasting Framework, using the King Fire as a case study to evaluate modeled smoke forecasts with observations from surface monitoring sites. BlueSky is modified at multiple stages of the smoke modeling chain to appropriately assess multiple modeling configurations. The resulting comparison of modeled versus observed PM2.5 concentrations show the sensitivity of the framework to the model selection and parameterization methods. This analysis advances the fundamental science and operational utility of the smoke modeling system. The assessments laid the groundwork for continue evaluation and development of scientific knowledge to understand the land, fire, and atmosphere interactions occurring during a fire event.
Keywords: Wildfire Smoke, BlueSky Smoke Modeling, Smoke Forecast
Presenter Bio: Doctoral Candidate at the Universidad del Turabo in Gurabo, Puerto Rico, and Graduate Research Assistant with the USDA-Forest Service AirFire Team at the Pacific Northwest Research Station. Directs her research to the issues arising from fire smoke emissions and their interaction with the changing global climate. Primary career goal is to become a research scientist, to conduct investigations that aid managers in the decision making process by giving them information, tools, and new ideas of how to manage air quality issues.

P29. Does pre-spruce beetle outbreak history affect how outbreaks alter fuels?

Nathan Mietkiewicz, PhD Candidate, Clark University
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Abstract: Over the past 30 years, large infrequent disturbances have increased in size and frequency across the western United States, and are predicted to continue increasing due to climate change. These heightened forest disturbances, which include wildfire and bark beetle outbreaks, have received considerable attention in contemporary ecological literature, and are of utmost concern for policy makers and land managers. Spruce beetles (Dendroctonus rufipennis Kirby; SB) are among the most important forest insects that can cause widespread tree mortality, shaping post-disturbance stand and landscape spatial heterogeneity in the southern Rocky Mountains, USA. Outbreaks of bark beetles often lead to concern among the public and policy makers regarding perceived increases in fire risk, though recent studies have stressed that the effect of outbreaks on fires is complex and sometimes counterintuitive. Missing from our current understanding is how pre-outbreak forest conditions mediate the effects of outbreaks. To study how these complex interactions affect fuel load abundances in spruce beetle attacked stands, we collected fuels data across a chronosequence of post-outbreak sites stratified by young (<130 yrs) and old (>130 yrs) stands. Canopy and surface fuel loads were calculated for each tree and stand, and available crown fuel load, crown bulk density, and canopy bulk densities were estimated. Here we present our results and discuss how pre-outbreak conditions mediate the impacts of spruce beetle outbreaks on fuels.
Keywords: wildfire, fire behavior, spruce beetle, forest fuels, Colorado, climate change, modeling

Presented Bio: Nathan Mietkiewicz is a Ph. D. candidate at Clark University, specializing in terrestrial ecology and remote sensing with a direct interest in forest dynamics, compounded disturbance interactions, and fire ecology. His current research explores the complex interactions between forest disturbance, varying climatic conditions, and their influence on the abundance of forest fuels and fire behavior in the subalpine ecosystems of the Rocky Mountains, CO, USA. His research employs field-based data collection, remotely sensed image analysis, and modeling procedures to understand current and future fuel abundances and fire risk at the local, regional, and sub-continental level.

P30. Fire Emissions Inventory Systems' Organization and Costs

Helen Naughton, Associate Professor, University of Montana
Kendall A. Houghton, PhD student, University of Oregon

Abstract: Currently several fire emissions inventory systems (FEISs) are operational. Information that these FEISs provide about fire emissions is essential for decision- and policymaking. The purpose of our study is to determine the cost-effectiveness of seven different fire emissions inventory systems that cover at least the most fire-prone regions of the United States. Effectiveness in our study will be measured in terms of uncertainty and reliability of emissions data. Because different FEISs often serve specific purposes that vary from one system to another, cost-effectiveness measures provided by this study can only be considered one of many criteria for comparing the systems.

As part of the study, the FEIS annual operation costs were acquired from the system developers and operators. Each FEIS has costs directly attributed to its data processing and publishing. In addition there are costs associated with data products developed externally but used as inputs by the FEISs. While input data product costs were also surveyed, in most cases those costs should not be included in our analysis since these data products often have many uses other than serving the FEIS, e.g. the National Weather Service operations have many uses beyond providing input data for FEISs.

In addition to providing the results of our cost-effectiveness study, our poster will provide organizational maps for each FEIS in our study. These maps provide an overview of the data products and input data for each fire emissions inventory system.

Presented Bio: Helen Naughton is an Associate Professor of Economics at the University of Montana. Her research focuses on environmental and international economics. In recent years, wildfire topics have emerged more and more in her work.

P31. Evaluating shortwave radiation models for fuel moisture prediction

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Craig Baillie, Technician, School of Ecosystem and Forest Sciences, The University of Melbourne
Gary Sheridan, Senior Research Fellow, School of Ecosystem and Forest Sciences, The University of Melbourne

Abstract: Solar radiation is often the dominant climatic forcing resulting in spatially variable evaporation rates from fuels near the forest floor. The proportion of radiation that reaches the forest floor, or the transmission factor, is dependent on vegetation structure and the position of the sun in relation to topographic aspect and slope. In landscapes with variable vegetation and sloping terrain there are strong spatial-temporal interaction between the sun beam, vegetation parameters and terrain attributes. These interactions have large effects on transmission of radiation and therefore cause

variation in evaporation rates from fuels. However, the magnitude of errors in sub-canopy radiation models and their effects on fuel moisture prediction have rarely been quantified. In this study we examine the performance of two models in simulating direct shortwave radiation below the canopy using 6 months of hourly radiation data in forest environments ranging from open woodlands to tall open temperate forests in sloping terrain (16 sites in total). Both models in this study assume that solar transmission follows the Beer-Lambert's law of exponential light attenuation with path lengths and vegetation density. One model is formulated in terms of leaf area index (LAI) and assumes negligible effects of daily, seasonal and topographic-related variation in path length. The second model estimates the actual path length of the beam based on solar incident angle and canopy height. Model performance was assessed using sub-daily, daily and seasonal patterns in radiation fluxes. Implications of model errors are evaluated in terms the evaporation rates and flammability of fine surface fuels. Preliminary results show that both models can simulate the total daily sub-canopy radiation at north-facing sites reliably, particularly during summer when the sun is high in the sky. On steep south facing slopes and on other slopes during time periods when the incident angle is low, the radiation was strongly affected by path length and the model based on LAI therefore performed poorly. Explicitly accounting for path length is therefore necessary when modelling terrain effects, seasonality and daily variation in shortwave radiation; all of which are important for fuel moisture predictions in a landscape-scale context.
Keywords: Fuel moisture, radiation models, vegetation, complex terrain
Presented Bio: Petter is a research fellow at the School of Ecosystem and Forest Sciences, University of Melbourne, working on applied and theoretical research questions regarding water and sediment fluxes in forests. His research spans a range of disciplines from soil physics and geomorphology to forest meteorology and wildland fire. In his current project Petter aims to develop models that can be used to represent climatic and topographic drivers of fuel moisture dynamics in complex terrain.

P32. Planning for fire use and containment using a predictive spatial model of landscape-driven barriers to fire spread

Kit O'Connor, Ecologist, U.S. Forest Service Rocky Mountain Research Station
Additional Authors:
Dr. David Calkin, Research Forester, USFS RMRS
Dr. Matthew Thompson, Research Forester, USFS RMRS
Abstract: Fire management across landscapes with integrated and often conflicting social-ecological values at risk is becoming more common as encroachment of the Wildland Urban Interface (WUI) expands in the American west. Planning for fire occurrence and addressing societal and ecological needs are two major areas of the Nation Fire Planning process that need further development. Management of fire incidents rarely draws from available information about accumulated fire effects on landscapes that incorporate the balance of positive and negative net effects and history of past fire behavior. In this study we use a database of historical fire perimeters, fire severity transitions, and daily progression maps to develop a spatial model of landscape feature-driven barriers to fire progression. We propose that a predictive model of fire barriers can be used in the fire planning process to identify areas for designated fire use, predictive transitions in fire behavior, and more efficient direct and indirect attack of active fire during containment.
Keywords: Wildfire use, resource protection, firesheds, transition zones
Presented Bio: Kit O'Connor is an Ecologist with the USFS Rocky Mountain Research Station in Missoula, Montana working on the human dimensions of fire and forest changes resulting from land management and changing climate. His current projects involve support for the National Forest Planning process and critical examination of the incident command structure to assist in development of scalable, long-term forest and fire planning decision systems. Kit's previous work was centered on ecological reconstruction

of landscape changes, response to climate and human impacts, and projected changes to forest and disturbance dynamics in response to projected future climate conditions.

P33. Assessing Impacts of Climate Change and Human Population Growth on Forest Fire Potential in the Tropics - A Case Study of the Tain II Forest Reserve in Ghana

Eric Osei-Kwarteng, Student, Kwame Nkrumah University of Science and Technology

Abstract: The increase in human population pressure especially in forest fringe communities and the accelerated change of land use in tropical vegetations i.e. conversion of forested ecosystems into farming and pastoral ecosystems have led to an increase in the use of fire. While certain tropical dry forests and savannahs have been adapted to anthropogenic fire use over the years and show typical features of sustainable fire ecosystems, the opening and fragmentation of tropical evergreen forests has increased the risk of wildfires and this has destructive impacts on biodiversity and sustainability of these forest ecosystems. An assessment of potential impacts of climate change on fire regimes in the Tain II Forest Reserve of Ghana was carried out using the GCMs and a GCM derived lightning model (Goldammer and Price, 1997). Impacts of human population increase on forest fire potential in and around the forest reserve was also undertaken through the use of primary and secondary data sources. Primary data was obtained through interviews of community members and other stakeholders with the use of semi-structured questionnaires, field observations and focus group discussions. Secondary data was also obtained from existing literature relevant to the study. Considering the potential impacts of climate change on fire regimes in the Tain II Forest Reserve, the study concluded that, there is a high degree of certainty that land use and climate features under conditions of a 2xCO2 atmosphere will influence fire regimes in the area. In terms of impacts of human population increase on forest fire potential, the study concluded that, the potential for fire to occur in and around the reserve is high due to increased farming and grazing impacts which leads to the formation of open and sparse vegetation cover influencing a high potential for wildfires to occur in and around the reserve. Stakeholders in wildfire management and for that matter climate change issues need to be prepared for managing situations which, in the near future, may require the development of innovative technologies and the preparedness of administrations to accomplish tasks that may differ from today's situation.

Keywords: climate change, fire regime, human population, wildfire management

Presented Bio: Name: Eric Osei-Kwarteng, Education: Msc Agroforestry.Kwame Nkrumah University of Science & Technology, Kumasi-Ghana. Interests: Environmental Conservation

P34. FIRESEV East: Mapping higher severity fire potential for the Eastern U.S.

Matthew Panunto, Ecologist, USDA/ USFS

Additional Authors:

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Donovan S. Birch, Research Support Scientist, University of Idaho, Department of Forest, Rangeland, and Fire Sciences, Moscow, ID

Penelope Morgan, Professor, University of Idaho, Department of Forest, Rangeland, and Fire Sciences, Moscow, ID

Abstract: The objective of the Fire Severity Mapping System project (FIRESEV) is to provide fire managers across the U.S. critical information about the potential ecological effects of wildland fire at multiple levels of thematic, spatial, and temporal detail. A major component of FIRESEV is a

comprehensive map of the eastern U.S. depicting the potential for fires to burn with moderate to high severity should they occur. Developed as a 30-m resolution raster dataset, the map is intended to be an online resource that managers can download and use to evaluate the potential ecological effects associated with both ongoing and future fires. Using satellite-derived burn severity data from the Monitoring Trends in Burn Severity (MTBS) project for fires that burned from 1984 to 2013, we produced statistical models to determine the relationship between fire severity and the geospatial variables of topography, fuel moisture, and vegetative cover. We developed separate statistical models for forest and non-forest settings in each of 8 distinct ecological regions across the eastern US. For each statistical model, we selected the set of predictor variables (i.e., landscape characteristics) that provided the best possible predictions of moderate to high severity fire occurrence. We then used each region's respective forest and non-forest model to predict, for every 30-m pixel, the potential for moderate to high severity fire. This prediction is contingent on each pixel experiencing fire at a particular percentile level of a 1000-hour fuel moisture index. Developing this severe fire potential map provided an opportunity to improve our understanding of the factors that influence fire severity. When coupled with information regarding current landscape conditions, potential applications for this map could be in the tactical and logistical planning of resources during wildland fires, strategic planning before wildland fires occur, and in the identification of fire rehabilitation areas. This product is intended to be incorporated into existing decision support frameworks such as the Wildland Fire Decision Support System (WFDSS).
Keywords: Fire severity, mapping, geospatial, MTBS
Presented Bio: Matthew H. Panunto is an Ecologist with the USDA Forest Service's Fire Modeling Institute in Missoula, MT. Prior to joining FMI in 2015, Matthew worked at the US EPA's Office of Research and Development in Athens, GA where he assisted in the development of geospatial and hydrologic program applications for the Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) environmental analysis system. He has a B.S. in Environmental Studies from Wesley College (Dover, DE), and an M.S. in Geography and Environmental Systems from the University of Maryland Baltimore County (Baltimore, MD).

P35. Post-fire Logging Produces No Lasting Impacts on Understory Vegetation in Northeastern Oregon

David Peterson, Research Forester, USDA Forest Service, PNW Research Station
Additional Authors:
Erich K. Dodson, Forester, USDA Forest Service
Abstract: Assessing the resilience of natural ecosystems to disturbances often requires long-term studies. Post-fire logging often generates debate, in part owing to short-term studies that have documented reductions in understory plant cover and diversity in logged stands compared to stands not logged after fire. We studied the long-term response of understory vegetation to two post-fire logging treatments – commercial salvage logging with and without additional fuel reduction logging – as part of a post-fire logging experiment in northeastern Oregon, USA. We sampled understory plant cover and species diversity at 10-11 locations within nine experimental treatment units to see if post-fire logging treatments produced persistent effects on understory plant cover, species diversity, community composition, or exotic species cover. Post-fire logging treatments produced no significant effects on understory vegetation cover, diversity, or composition that persisted for 15 years after treatment. We found no significant treatment effects on grass, forb, woody plant, or exotic plant cover and species richness, and differences among treatment means were generally small. Multivariate analysis of the understory plant community found two major gradients in understory plant community composition, one correlated with regenerating forest (sapling) density and one correlated with residual overstory tree density, suggesting that initial fire severity (tree mortality) and post-fire regeneration may have greater long-term impacts on post-fire understory vegetation than post-fire logging. This study demonstrates that understory vegetation can be resilient to post-fire logging. The same practices that limit damage to

soils, like logging over snow, may also limit damage to understory vegetation and speed recovery. If further research produces similar results, post-fire logging debates will be able to focus on how to best partition snag resources and mitigate short-term disturbance impacts, rather than on concerns about long-term ecosystem degradation.

Keywords: post-fire logging, fuel reduction, species diversity, exotic species

Presented Bio: David W. Peterson is a Research Forester with the USDA Forest Service, Pacific Northwest Research Station, in Wenatchee, Washington. Dave's research focuses primarily on restoration and management of dry coniferous forests of the interior Pacific Northwest, with emphases on forest ecosystem responses to wildfires and post-fire forest management practices, including emergency slope stabilization treatments and post-fire logging. He also maintains ongoing research interests in dry forest restoration treatment effects, forest vegetation responses to climatic variability and change, and oak savanna ecology.

P36. Evaluating CMAQ's Ability to Simulate Ozone and PM2.5 from Wildland Fire Emissions

Thomas Pierce, NERL/ORD, U.S. EPA
Additional Authors:
George Pouliot, Research Physical Scientist, NERL/ORD, U.S. EPA
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Ana Rappold, Research Statistician, NHEERL/ORD, U.S.EPA

Abstract: The Community Multiscale Air Quality (CMAQ) modeling system is EPA's primary tool for assessing regional air quality across the United States. This poster will describe an evaluation study of CMAQ's performance for estimating ozone and speciated PM2.5 concentrations associated with wildfires and prescribed burns with five years of data from the CSN and IMPROVE observational networks. While demonstrating skill at capturing the impact of fire on air quality, many facets of the modeling system need to be addressed, such as plume rise and VOC emission profiles.

Keywords: CMAQ, air quality, model evaluation, ozone, PM2.5

Presented Bio: Tom Pierce is currently the Deputy Director of the Atmospheric Modeling and Analysis Division in the U.S. EPA's Office of Research and Development's National Exposure Research Laboratory. He has over 30 years of experience in the development, evaluation, and application of air quality simulation models. Improving the characterization of natural emissions phenomena, such as biogenic VOCs, soil NO, lightning NO, and wildland fires are among his research interests.

P37. Summarizing wildfire development with growth statistics

Harry Podschwit, Graduate Student, University of Washington
Additional Authors:
Brian Potter, Research Meteorologist, USFS
Narasimhan 'Sim' Larkin, Research Physical Climatologist and Team Leader, USFS
Brian Stocks, B.J. Stocks Wildfire Investigations Ltd.
Mike Wotton, Research Scientist, Canadian Forest Service

Abstract: Analysis of a wildfire's development over time is critical to understanding what individual factors during an incident's lifetime contributed to its eventual extent. However, wildfire growth can be characterized with a variety of statistics, each communicating different information about an incident's evolution through time. Indeed wildfire growth can be framed in many different terms including evenness through time, average, maximum, absolute and relative growth. Here we will present various summary statistics that can be used when working with wildfire development time series to describe various aspects of an incident's growth. We will discuss the advantages and limitations of each. We will also apply these statistics to a collection of real-world wildfire growth cases to assess their average value and natural variability.

Keywords: time series, wildfire growth, statistics
Presented Bio: Harry Podschwit is a third year Graduate Student in the Quantitative Ecology and Resource Management (QERM) program at the University of Washington. His research involves describing wildfire development and the effects of weather using simple statistical models. His undergraduate was in Applied and Computational Mathematical Sciences at the University of Washington.

P38. Synoptic Meteorology Associated with Large Fire Growth Episodes

Brian Potter, Research Meteorologist, Pacific Wildland Fire Sciences Lab, USDA Forest Service
Additional Authors:
Harry Podschwit, Graduate Student, Quantitative Ecology and Resource Management (QERM), University of Washington
Mike Wotton, Research Scientist, Canadian Forest Service
Brian Stocks, Wildfire Investigations, Limited
Narasimhan Larkin, Research Climatologist, Pacific Wildland Fire Sciences Lab, USDA Forest Service, Seattle, WA

Abstract: The concept of critical weather patterns associated with extreme fire behavior has been around for roughly 80 years, and the term has been used for over 50 years. Critical weather patterns are combinations of wind, humidity and other atmospheric properties that individually would be enough to raise fire danger, but act together to create far greater fire danger. They are generally associated with specific synoptic structures, such as thermal pressure troughs, breaking upper level ridges, or high pressure systems from northerly regions.

We examine 21 historically very large fires, all larger than 90,000 acres. Most of these fires exhibited large growth on one or two days of their existence, with relatively modest growth the rest of the time. We examine the synoptic patterns on the days of rapid growth and compare them with conventional critical weather patterns. We also look for similar synoptic patterns occurring during the same fires, but unaccompanied by large growth.

Keywords: critical weather patterns; very large fires
Presented Bio: Brian Potter studies fire-atmosphere interactions from the perspective of atmospheric dynamics. His research interests span spatial scales from the fire front (a few meters) to synoptic weather patterns affecting fire behavior and fire danger (hundreds of kilometers.)

P39. Effects of a British Columbia Wildfire on Soil Water Repellency

Aaren Ritchie-Bonar, Student- Thompson Rivers University
Additional Authors:
Dr. Wendy Gardner, Assistand Professor, Natural Resource Sciences at Thompson Rivers University
Dr. Tom Pypker, Assistant Professor, Natural Resource Sciences at Thompson Rivers University
Dr. John Karakatsoulis, Assistant Professor & Chair, Natural Resource Sciences at Thompson Rivers University

Abstract: Soil water repellency (SWR) is a naturally-occurring phenomenon observed in many parts of the world, but has not been extensively studied in interior forests of British Columbia. The degree of SWR has been known to be influenced by the heating of soil from wildfires, but has also been found on sites that have been absent from fire for decades. A high-intensity (Coldstream Creek) fire started on July 20th, 2015 near the town of Ashcroft, British Columbia, which burned a total area of 250 hectares. The fire was located upslope of about 20 homes, highway infrastructure, as well as the end of a large mining tailings pond. Objectives for this research were to determine whether the Coldstream Creek fire affected the presence of SWR from pre-fire measures, as well as any differing effects of fire severity on

the degree of repellency. In order to determine the effects of fire severity and site factors influencing SWR on an Interior Douglas-fir forest burnt by wildfire in the southern-interior of British Columbia, SWR was measured using the Water Drop Penetration Time (WDPT) test on soil core samples from unburnt control (n=9), and low (n=13), moderate (n=13), and high (n=10) severity burn sites within and adjacent to the fire area. Results showed that pre-fire soil characteristics had a low incidence of SWR, while samples taken within the fire area showed a high degree of SWR at various depths. The influence of varying fire severities were less conclusive on the degree of resultant SWR. Results indicated that fire did have a significant impact on the development of soil water repellency in the upper depths of soil occurring after the Coldstream Creek fire. Although the long-term persistence of water repellent soils has been shown to degrade over time, effects of SWR has implications for the hydrology of the landscape in the short-term. Rainfall events occurring directly after the fire could impact runoff, erosion, and preferential flow patterns in the area. This could cause concern for homeowners, transportation, and the nearby mine if a significant rainfall event were to occur along this landscape while water-repellent soils were present.
Keywords: fire severity, soil water repellency, British Columbia
Presented Bio: Aaren Ritchie-Bonar is a fourth year student in the Bachelor of Natural Resource Sciences Honours program at Thompson Rivers University. She has also been a wildland firefighter for the past six fire seasons, within the interior of British Columbia. Upon graduation, she hopes to begin her career in forestry and obtain status as a Registered Professional Forester. She also is interested in volunteering in international settings, and hopes to become involved with international projects in the future.

P40. Fire and Smoke Model Evaluation Experiment (FASMEE)

Roger Ottmar, Research Forester, Forest Service - Pacific Northwest Research Station
Additional Authors:
Narasimhan Larkin
Tim Brown
Susan Prichard
Adam Watts

Abstract: The primary objective of the Fire and Smoke Model Evaluation Experiment (FASMEE) is to provide critical observational data necessary to evaluate and advance fire and smoke modeling systems. The FASMEE planning phase will occur between March 2016 and June 2017 and will provide a comprehensive study plan that will include sampling methodology, safety, logistics, and data management. The FASMEE field campaign will be initiated in the fall of 2018 and extend through 2021. It will be conducted on 4 to 8 large (>500 acres) operational prescribed burns targeting heavy fuel loads and high intensity burn events located in the western and southeastern United States. Multiple agencies (i.e. NOAA, NASA, EPA, DoD) are being recruited to participate in the research project and assist in funding. Discipline leads have been identified through a Funding Opportunity Notice (FON) during the fall of 2015. Observational teams will be identified through a FON in the fall, 2016. Both groups will assist in completing the study plan development, observational data collection, reduction and analysis, data management, and initial model evaluation.
Presented Bio: Roger Ottmar is a Research Forester with the Fire and Environmental Research Applications Team, Pacific Northwest Research Station at the Pacific Wildland Fire Sciences Laboratory located in Seattle, Washington. He has been involved with fuels, fire, and smoke related research for over 35 years. He leads the Prescribed Fire Combustion and Atmospheric Dynamics Research Experiment (RxCADRE) and the Fire and Smoke Model Evaluation Experiment (FASMEE) to provide novel and critical observational data necessary to evaluate and advance fire and smoke modeling systems.

P41. Innovations in Post Fire Assessment and Recovery, Malheur National Forest, Canyon Creek Complex

Dana Skelly, Assistant Fire Staff, Malheur National Forest
Additional Authors:
Roy Walker, Fire Staff, Malheur National Forest
Ed Clark, Fuels Planner, Blue Mountain Ranger District

Abstract: The 2015 Canyon Creek Complex burned over 110,000 acres in the heart of Grant County, Oregon. Most of this fire occurred on the Malheur National Forest. While more than half of the forest acres burned were designated as wilderness, the remaining 41,000 acres were in the Wildland Urban Interface and tested over 11,000 treated acres. Most of these treatments represented the earliest projects collaborated on by the Malheur and Blue Mountain Forest Partners (BMFP). Thorough assessments of the treatments were critical for adaptive management as well as to honor these early collaborative efforts.
Earlier that spring, the forest and collaborative had also begun exploring in earnest research geared to define zones of agreement regarding post-fire and post-insect damage salvage logging. The Canyon Creek Complex provided an opportunity to address this.
To complete this work, combined with extensive Burned Area Emergency Response (BAER) work and the existing "Green Tree" program, new efficiencies were developed both in terms of technological application, integration across disciplines, and transparent dialogues. In this presentation we give an overview of these innovations.

Keywords: Collaborative, Fuels Treatment Effectiveness, Salvage Logging, Fire Recovery

Presented Bio: Dana Skelly is the Assistant Fire Staff and Fuels Program Manager for the Malheur National Forest, in Eastern Oregon.

P42. Multi-scale analyses of wildland fire combustion processes in open-canopied forests using coupled and iteratively informed laboratory-, field-, and model-based approaches

Nicholas Skowronski, Research Forester, USDA Forest Service
Additional Authors:
Albert Simeoni, Senior Manager, Exponent Inc.
Warren Heilman, Research Meteorologist, USDA Forest Service
Kenneth Clark, Research Forester, USDA Forest Service
William Mell, Research Combustion Engineer, USDA Forest Service
John Hom, Research Forester, USDA Forest Service
Joseph Charney, Research Meteorologist, USDA Forest Service

Abstract: Current predictive models used to simulate wildland and prescribed fire are empirically-based, with highly simplified physics that often fails to adequately predict fire outcomes because the models do not account for variability in fuel characteristics and interactions with important meteorological variables. We are using a suite of measurements at the fuel particle, fuel bed, field plot, and stand scales to quantify how variability in fuel characteristics and key meteorological factors interact to drive fire behavior during low intensity prescribed burns in the pitch pine- scrub oak fuel type. Our experiments have been designed to inform the development and evaluation of mechanistic, physics-based models that explicitly account for combustion, turbulent transfer, and energy exchange by coupling and scaling individual component processes. A strength of this work is the iterative approach that is employed, which promotes feedbacks between experimental findings and model simulations that will be used to sharpen the focus of further measurements at different scales and levels of control within and among the experimental components of the project. These will improve our understanding of, and ability to accurately predict, fire behavior under a wide range of management scenarios. Our approach will allow us to describe in detail the fundamental phenomena that are driving the combustion of different fuels

and to identify and quantify important fire-spread model parameters and evaluate their relative importance in driving fire behavior. This research will also result in data that will be invaluable to the fire behavior modeling community because the gap between the highly controlled experiments in the laboratory and open-field, or in situ, conditions has never been adequately addressed in the field under well-characterized wind conditions. Additionally, these studies will result in vital data for simulating multi-scale atmospheric dynamics, including the interactive effects of ambient-, fire-, and forest canopy-induced turbulence, on fire spread and convective heat transfer during low-intensity surface fires. Finally, and most importantly, additional sensitivity simulations will be carried out to assess whether fire propagation and heat flux processes identified during the small-scale field measurement component of the study affect fire propagation on management-scale type fires.

Keywords: WFDS, physical processes, multi-scale experimentation

Presented Bio: Nick Skowronski has been a Research Forester with the USDA Forest Service Northern Research Station (NRS) since 2007. His research is focused on the impacts that land management activities have on fuel loading, carbon cycling, and habitat quality. He is particularly interested in estimating canopy fuels in three-dimensional space using lasers on the ground and in aircraft. Having worked formerly in fire management, Nick is extremely interested in developing better relationships between scientists and land managers so that research can become more integrated with the needs in the field.

P43. Real-Time Smoke Monitoring Using Rapid Deploy Equipment to Aid in Fire Management and Ensure Public Safety

Mike Slate, Field Operations Manager, Air Resource Specialists
Ricardo Cisneros, Central Zone Manager, Seqouia National Forest

Abstract: The Sequoia National Forest and Air Resource Specialists developed and tested a variety of smoke monitoring systems that measure smoke concentrations and local meteorological data. The data is posted to a web-site in real-time so land mangers can use the data to make fire management decisions. This data can also be used to minimize smoke exposure to firefighters and any nearby public citizens. The systems are solar powered and utilize satellite communications allowing them to operate virtually anywhere.

Keywords: Smoke monitoring, particulate matter

Presented Bio: Mr. Slate and Mr. Cisneros each have over 15 years experience in the air quality profession. They both have extensive field experience with smoke monitoring instruments, projects, and applications.

P44. "Putting the "I" in Wildfire Preparedness: Insurance & NFPA Working Together on Social Change Understanding"

Michele Steinberg, Wildfire Operations Division Manager, National Fire Portection Agency
Additional Authors:
Jeffrey Cavanaugh, Senior Underwriting Portfolio Manager, USAA

Abstract: Communities at risk to fire across the United States share the common challenge to risk reduction of resident understanding and motivation. The insurance industry can and does play an active role in this shared responsibility with the resident on homeowner engagement and recognition for preparedness.

Hear from USAA about their recent research on the motivations of homeowners in the wildland urban interface; their work identifying reduced risk exposure of residents in Firewise Communities/USA Recognition Program communities; and the positive steps USAA is taking to affect social behavioral change and decision making in the wildland urban interface.

Keywords: Shared responsibility; community protection; risk assessment; insurance industry; homeowner, wildland urban interface;
Presented Bio: Michele Steinberg is the Wildfire Operations Division Manager for the National Fire Protection Association and has played an integral role in NFPA's wildland fire activities since 2002. As the Firewise Communities Program manager for more than a decade, she led the national Firewise Communities/USA® Recognition Program, which includes more than 1,100 communities across the U.S., and encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. She has served as a staff liaison on NFPA standards related to wildland fire. She holds a Bachelor of Arts degree in English from Brandeis University, and a Master of Arts in urban planning from Boston University.

P45. Development of Real-Time Particulate and Toxic-Gas Sensors for Firefighters

Fumiaki Takahashi, Professor, Case Western Reserve University
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Paul S. Greenberg, Research Scientist, NASA Glenn Research Center
Gary W. Hunter, Senior Electronics Engineer, NASA Glenn Research Center
Michael J. Kulis, Research Scientist, NASA Glenn Research Center
Susana Carranza, Senior Engineer, Makel Engineering, Inc.
Darby B. Makel, President, Makel Engineering, Inc.

Abstract: Removal of respiratory protection during fire overhaul activities can expose firefighters to unknown toxicants, but current practice relies solely on the CO concentration. Wildland firefighters do not wear respiratory protection despite intermittent high-level and long-term low-level exposure to smoke. Simultaneous monitoring of particulates, CO, irritants (formaldehyde and acrolein), and hydrocarbons are needed as they include carcinogens and can exceed the occupational exposure limits (OSHA, NIOSH, ACGIH) under certain conditions during fire overhaul and wildland firefighting. The greater concern with their exposure is the combination of irritants in wildland smoke.
The purpose of this project is to develop prototypes of compact, highly sensitive, real-time particulate/gas detection systems to reduce the number of firefighter fatalities and injuries. This study endeavors to: (1) combine the NASA-developed compact particulate and gas (O_2, CO, and hydrocarbons) sensors, (2) micro-fabricate and integrate new sensitive aldehyde sensors, and (3) test prototypes in the laboratories, burn rooms, fire overhaul, and wildland fire environments in cooperation with fire services. The preliminary testing of existing particulate and micro-fabricated gas sensors was conducted in a controlled-burn room environment using different fuels and in the laboratory using smoke from wood samples being pyrolyzed in a tube furnace. The preliminary testing resulted in further understanding of the device responses and room for improvement. Compact real-time particulate and toxic-gas detectors to be derived from the prototypes under development can be adopted by fire services eventually in the future.
Acknowledgement
This work was supported by the U.S. Department of Homeland Security, Federal Emergency Management Agency, Assistance to Firefighters Grant Program, Fire Prevention and Safety grants (Nos. EMW-2012-FP-01284 and EMW-2014-FP-00688).
Keywords: Firefighter environmental monitoring, Smoke, Irritants
Presented Bio: Dr. Fumi Takahashi is a professor in the Mechanical and Aerospace Engineering at Case Western Reserve University.
He works on fire science and engineering, including fire suppression, firefighter sensors, fire shelters, and fire blankets.

P46. Communities Using Early Wildfire Detection Technology to Successfully Reduce Risk, Damage, and Losses

Brendan Kramp, Director of Business Development, US & Canada, Insight Robotics

Abstract: Case studies from communities in North America, South Africa and China with significant wildfire risk will highlight how forestry and fire fighting officials employed automation and thermal technology to detect fires early, mobilize a first response and enable active risk management. The studies will demonstrate how early detection allowed responders to prevent widespread damage and reduce suppression costs as a result. Key learnings from testing and deploying early detection systems in environments with differing terrain, fuel types, ease of accessibility, proximity to human activity and other factors will be discussed. The application of existing wildfire monitoring methods will also be compared. Finally, attendees will be able to identify the key considerations required when evaluating technologies as part of a comprehensive wildfire management strategy to protect trees, property and lives.

Keywords: Wildfire Detection, Early Detection, Risk Reduction, Risk Management

Presented Bio: Brendan Kramp is Director of Regional Business Development, US and Canada, at Insight Robotics. Brendan is responsible for building strategic partnerships and helping customers in agriculture and forestry safeguard natural resources and infrastructure with intelligent threat detection. Prior to Insight Robotics, Brendan held several roles in fundraising, partnership development and business development for international institutions in the US, UK and Europe, including academic institutions, international conservation organizations, and an international media organization. Brendan holds an undergraduate degree from Brown University and an MBA from HEC Paris.

P47. Do Fuels Treatments Promote Drought Resistance in Lassen National Park

Mike Vernon, Graduate Research Assistant, Forestry Watershed and Wildland Sciences Graduate Program, Humboldt State University, Arcata, CA.

Additional Authors:

Rosemary Sherriff, Associate Professor of Geography and Faculty in the Forest, Watershed and Wildland Science Graduate Program, Humboldt State University, Arcata, CA.

Phillip van Mantgem, Research Ecologist, US Geological Survey, Redwood Field Station, Arcata, CA.

Abstract: Climate change is predicted to increase the frequency, duration and severity of drought events across many of earth's bioregions. Forest managers searching for adaptation strategies to these conditions have two primary tools that may promote resistance and resilience to drought, prescribed fire and mechanical thinning. Originally applied to reduce fuels and fire hazards, treated areas are expected to have reduced competition for resources which may translate to improved growth during drought. This potential benefit to forest management has not been well tested. In this study, we will investigate the influence of thinning and prescribed fire on tree growth responses to multi-year drought conditions in the dry forests of Lassen Volcanic National Park in northern California. Specific questions include: 1) Do fuel reduction treatments influence forest resistance to drought stress? 2) How do tree growth responses vary in response to different treatments (thinning and burning vs. thinning only)? 3) What individual tree-level and site-level factors (i.e. size, crown height, competition, pre-disturbance tree growth) influence tree growth responses? 4) Do tree growth responses change over years of successive drought stress? To address these questions we will collect and analyze tree core samples from drought affected forests of Lassen National Park. Tree ring data will be used to compare tree growth rates across a range of treatment conditions to determine the effect of forest management on tree growth response before and during drought. This information may help federal agencies decide on forest management practices that address issues associated with fire exclusion and simultaneously enhance forest resistance to severe drought events in the future.

Keywords: fuel treatments, drought, dendroecology

Presented Bio: Mike Vernon is currently a graduate student in Dr. Rosemary Sherriff's Dendroecology Lab at Humboldt State University. Prior to arriving at HSU, Mike spent several years working as a field botanist with researchers at Oregon State University as well as the U.S. Forest Service Pacific Northwest Research Station. Mike has been involved in a wide range of research projects, from long-term plant community responses to variable forest thinning in the Oregon coast range to the influence of Sudden Oak Death on fire risk in northern California forests. His research interests include: forest ecology, fire and fuels management and climate change ecology.

P48. Understory Vegetation Changes with Different Seasons and Intervals of Prescribed Burning

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Abstract: Fire exclusion has dramatically altered historical fire regimes in dry conifer forests across western North America; resulting in increased canopy cover and tree density, higher fuel loads, increased fuel continuity, and the potential for higher intensity and severity fires. In response, forest managers increasingly focus on reducing forest fuels with mechanical thinning and/or prescribed burning. These treatments often have additional objectives of restoring forest composition, structure, and ecosystem processes. There has been extensive research on the effects of fuel reduction and restoration treatments on trees, fuels, regeneration, and fire behavior; but less is known about how these treatments influence understory vegetation which contains the majority of vascular plant diversity in dry conifer forests. Of particular interest is how understory vegetation may respond to the season and interval of prescribed burning (SIB). SIB is often determined by operational constraints rather than historical fire regimes, potentially resulting in fire conditions and burn intervals to which native plants are poorly adapted. In this study with examined how understory vegetation has responded to SIB in ponderosa pine forests on the Malheur National Forest in the Blue Mountains of eastern Oregon, USA. Over 15 years of understory vegetation data has been collected on permanent plot in stands with different intervals (5 and 15 year) and season (spring versus fall) of prescribed burning. We quantified how SIB of prescribed burning has influenced understory vegetation diversity, compositional trajectories, indicator species, and heterogeneity of vegetation cover over time.

Keywords: Prescribed burning, understory vegetation, diversity

Presented Bio: Harold Zald is currently a research associate in the College of Forestry at Oregon State University. Dr. Zald received his Ph.D. in forest science from Oregon State University in 2010. Dr. Zald's research interests focus on forest responses to disturbance agents in complex mountain terrain, fuel-reduction and restoration treatments in dry conifer forests of western North America, integrating field data with remotely sensed imagery to support inventory and monitoring of forest ecosystems, and quantifying the landscape patterns and environmental drivers of tree invasion in mountain meadows.

P49. Facilitating Fire Potential Depictions in Preparation and Response Decisions: Integrating Tools Online

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Abstract: Weather information, surface observations and forecasts, is among the most widely viewed topics on the web. It is the one way that the history, current setting, and forecast fire potential can be quickly compared. Fire management users continue to access and share this information freely from a variety of sources. Integrations and interpretations, in the form of fire danger and fire behavior assessments, are increasingly available in other online environments available to the initiated and experienced users. However, bringing these tools to those charged with making decisions requires additional effort in calibrating the message and integrating it into the decision environment. Alaska Fire and Fuels (AKFF), a development of the Bureau of Land Management Alaska Fire Service and Mesowest, and Integrated Fire Management (IFM), a development of the Alaska Department of Natural Resources and Selkirk Systems, is an example of how this integration can facilitates informed decisions. It is also a lesson in the effort required to optimize the information for busy managers in critical situations.
Keywords: Fire Weather, Fire Danger
Presented Bio: Fuels and Fire Analyst for Predictive Services at the Alaska Interagency Coordination Center. Qualified as Fire Behavior Analyst (FBAN) and Long Term Analyst (LTAN) to National Wildfire Coordinating Group standards.

P50. National Wildfire Coordinating Group's Smoke Committee and Recent Air Quality Regulatory Updates

Peter Lahm et al.

Abstract: The National Wildfire Coordinating Group's Smoke Committee (SmoC) provides interagency leadership, coordination and integration of air resource and wildland fire management. Air quality is critical to human health and fire is a critical disturbance process in wildland ecosystems. SmoC promotes management and utilization of wildland fire while addressing smoke impacts, for the health and safety of the public and fire personnel. Members include federal, state and private land management and conservation agencies with state and local air quality agencies. SmoC has three subcommittees with projects such as the Smoke Management Guide revision, emission factor implementation for land managers and air quality applications, and use of visual range to inform behavior when smoke measurements are not available. SmoC partners with the University of Idaho and Fire Research and Management Exchange System (FRAMES) developing a website (www.frames.gov/smoke), which has interactive training on "Smoke Management and Air Quality for Land Managers" that reflects the latest in air quality regulations. SmoC products include the *Wildland Fire Personnel Smoke Exposure Guidebook* and the *Transportation and Smoke Workbook*. Activities include sharing the latest regulations which affect fire use, coordination during wildfire season on smoke and deployment of Air Resource Advisors and smoke monitoring instruments.