P01. Understanding wildfire science use and needs in Oregon and Washington
Presenter: ChadKooistra, Research Assistant (Post-doc), Oregon State University
Additional Authors: Ellison, Autumn, Research Assistant, Institute for a Sustainable Environment at the University of Oregon
Moseley, Cassandra, Associate Vice President for Research, Professor and Director of the Institute for a Sustainable Environment, University of Oregon
Johnson, Geoffrey, PhD Student (Department of Geography) and Intern at the Institute for a Sustainable Environment, University of Oregon
Creighton, Janean, Associate Professor and Extension Specialist, Forest Ecosystems and Society, Oregon State UniversityBerger, Carrier, Extension Associate (faculty), Forest Ecosystems and Society, Oregon State University

Incorporating scientific research findings into wildfire management is an important process towards informing defensible and effective management practices. The Northwest Fire Science Consortium (NWFSC) provides fire science users in WA and OR access to wildfire research and a space to connect managers and researchers to improve communication and science integration into management decisions. Previous needs assessments about integrating research to inform land management surrounding issues such as wildfire and climate change reveal an ongoing need to better understand what kinds of scientific information are of greatest value to managers and other stakeholders and how new information affects management. One issue that consistently arises is the need for local information due to difficulties in applying research findings from other areas in different ecological and social contexts.

This poster describes a current needs assessment project in WA and OR to investigate how science is used to inform planning and management, to better understand OR and WA wildfire science users' locally specific fire science needs, and to identify the most feasible means to organize and present that information to them. Specifically, the goals of the assessment are to understand the nature of the topics and contexts in which more local research is required, how managers can move ahead with projects without having locally specific research, and how consortia like the NWFSC can help address gaps in relevant research needs.

Data is being collected through interviews with wildfire managers, decision and policy makers, collaborative groups, private landowners, and other stakeholders involved in fire-related management issues (e.g., fuels mitigation, fire behavior modelling, smoke management, firefighting techniques, and post-fire restoration) on public, private, and tribal lands in Oregon and Washington (n ~ 100). The semi-structured phone and in-person interviews focus on understanding how wildfire science is used by managers and other stakeholders, the social, political, and ecological factors that determine the scale at which wildfire research can be applied to a specific landscape or project, and the process by which fire science users engage to find relevant information during the planning and implementation phases. Interviews will be digitally recorded, transcribed, summarized, and thematically coded for analysis and comparison among different groups of science users and

ecoregions. We present findings and implications to help prioritize future research and funding efforts in the Pacific Northwest, inform the NWFSC's efforts to provide access to site specific information when available, and facilitate the application of non-local science/research when needed.

Keywords: Fire science, needs assessment, consortium, boundary organization, science-informed management

Bio: Chad is a faculty research assistant (post-doc) at Oregon State University (OSU). His dissertation research at OSU explored people's perceptions of post-fire landscape recovery. Part of his current appointment involves working with the NW Fire Science Consortium through OSU and the University of Oregon. The main project for this work is conducting a fire science needs assessment among fire science users in Washington and Oregon to inform future communication, outreach, and funding strategies to help the consortium meet the needs of fire managers and other stakeholders who use fire science to inform their land management decisions and activities.

P02. Learn and Publish Courses Online via the Fire Research and Management Exchange System (FRAMES) Online Course System
Presenter: GinaWilson, Research Web Developer, Northwest Knowledge Network, University of Idaho
Additional Authors: Wilson, Gina M., Research Web Developer, Northwest Knowledge Network, University of Idaho
Sheneman, Luke, NKN Director, Northwest Knowledge Network, University of Idaho
Hyde, Josh, Fire Research Scientist, University of Idaho
Wells, Lynn, FRAMES Program Manager, University of IdahoStrand, Eva K., Associate Professor, University of Idaho

The demand for online education and training is increasing. According to the National Student Clearinghouse Research Center, the number of institutions launching online learning opportunities increased by 23% between 2012 and 2013. By 2019, 50% of all classes are predicted to have online delivery options. Reasons why online learning has become so popular are many. Online training is effective because it eliminates the students' need to relocate or travel to obtain training and allows students to attend lectures and labs from their office or home via remote access technology. This freedom is essential because many do not have the option to leave jobs, or funding constraints limit the ability to obtain training or education. The online delivery method also enables instructors to live and work in a location that fits the needs of their jobs.

The FRAMES Online Course System (FOCS), managed and hosted by the University of Idaho's Northwest Knowledge Network (NKN), is a platform for hosting online training. The system currently hosts over 3,000 students with approximately 40 courses offered by several organizations including the National Wildfire Coordination Group (NWCG), the National Advanced Fire & Resource Institute (NAFRI), the Wildland Fire Training Center (WFTC), LANDFIRE, Wildland Fire Management RD&A, and the Human Performance & Innovation Organizational Learning group. Examples of such training include the NWCG S-495 Geospatial Fire Analysis, Interpretation and Application course; the Smoke Management and Air Quality for Land Managers course sponsored by the Smoke Committee; and various self-study courses including BehavePlus.
Training managers and instructors elect to use the FOCS for several reasons. The system provides secure access for all federal, state, local and private agencies in the wildland fire community, and

courses can be accessed via any desktop or mobile device. NKN uses Moodle, an open-source learning management system, designed for effective learning and teaching. Instructors can upload course material, create interactive learning content, manage tests and quizzes, and maintain a secure database of grades and issued certificates. NKN provides timely support to instructors by assisting with instructional technology and design, and support to students by guiding them through course navigation and account management.

The purpose of this poster is to bring awareness to the online courses that are currently offered via the FRAMES Online Course System and to provide information about the services that NKN and FRAMES can provide for your online course offerings and needs.

Keywords: online training, online courses, fire training, FRAMES

Bio: Gina works as a research web developer for the Northwest Knowledge Network, a unit within the University of Idaho, that provides research data management and computer application support for UI researchers and their collaborators. Gina spent 5 years as a web developer for the University of Idaho, Fire Sciences department on various projects for WFMRDA and FRAMES and started developing online course delivery for the wildland fire community. Currently, Gina manages and develops the FRAMES Online Course System and assists in developing the FRAMES website.

P03. Prescribed Fire Council Characteristics, Priorities, and Needs
Presenter: JenniferFawcett, Extension Associate, North Carolina State University
Additional Authors: Morris, Priscilla, Graduate Student, North Carolina State University

Prescribed fire managers face increasingly complex challenges. If the concerns and misunderstandings that generate those challenges are not responded to collaboratively, they might limit or threaten the use of prescribed fire as a management tool. Thirty-three Prescribed Fire Councils exist in 29 states across the United States, and serve as mechanisms to assist fire practitioners, policymakers, regulators, and citizens with issues surrounding prescribed fire use. Often, Councils provide practitioners with educational and experiential opportunities, members with opportunities to come together to discuss fire science and land management activities, and citizens with a better understanding of fire. In order to better understand the current structure, membership status, priorities, and needs within each Council, an online survey was conducted in fall of 2017. All 33 Councils participated in the survey for a 100% response rate. Findings indicate that while some Councils have no formal membership process, others reported membership ranging from less than 50 to more than 200 people. Of the Councils with a formal membership process, two Councils reported a decrease in membership over the past five years, four Councils reported an increase, and 13 reported having stable membership numbers. Priorities for the coming year ranged from hosting meetings to membership growth and development of new legislation. Needs included items such as lessons learned and successful strategies from other Councils, recruitment of younger members, legal guidance, and funding assistance. Results show that there is a continuum of experience and needs across the Councils, from those just starting out and looking for assistance to those who have been established for decades and can provide models for success. This study is meant to highlight the similarities and differences between Prescribed Fire Councils across the country, and to create better opportunities for success of these councils by collaborating with and learning from one another.

Keywords: Prescribed Fire Council

Bio: Jennifer Fawcett is an Extension Associate in the Department of Forestry and Environmental Resources, Extension Forestry at North Carolina State University. She serves as Coordinator the Southeast Regional Partnership for Planning and Sustainability (SERPPAS) Prescribed Fire Work Group and also assists in implementing prescribed fire-related education and outreach programs across the Southern region. She received her B.S. in Animal Science from the University of Delaware, M.S. in Forest Resources from Clemson University, and is working towards her Ed.D. in Agricultural and Extension Education at NCSU. She currently serves as an Advisory Board member for the Southern Fire Exchange.

P04. The Interagency Fuels Treatment Decision Support System (IFTDSS)
Presenter: HydeJosh, Fire Research Scientist, University of Idaho
Additional Authors: Ernstrom, Kim, Fire Application Specialist, Wildland Fire Management RD&A - DOI
Strand, Eva, Associate Professor, University of Idaho

The Interagency Fuels Treatment Decision Support System (IFTDSS) is an internet-based application designed to make fuels planning and monitoring easier, quicker, and more efficient.
IFTDSS is intended to assist fuels planning for all users, both federal and non-federal.

From 2010 to 2014 versions One and Two of IFTDSS focused on building a "proof of concept" framework of fire behavior and fire effects models in conjunction with a basic mapping interface. In April 2017, a new version of the system was released. This version has been re-built on a new framework, updating the user interface and mapping capabilities for continued use into the future. The new version brings modeling capabilities, geospatial data downloading and editing, and treatment monitoring, into a single user interface. It allows users to leverage the capabilities of ArcGIS online, FlamMap fire behavior modeling, the Fuels Treatment Effectiveness Monitoring system, and LANDFIRE landscape (.lcp) data from 2012 onward, within a single application, and export .lcp and fire behavior data for use outside the application as needed. IFTDSS also features a robust help and support system, as well as a new design approach to guide users through the fuels planning process. Modeling functionality is initially focused on fire behavior, but is continuing to be built out to support risk management, prescribed burn planning, and fire effects management in subsequent releases.

This latest version of IFTDSS is the result of management by Wildland Fire Management RD&A staff, agile software development by IBM, technology transfer from the University of Idaho, and funding from the US Forest Service and Department of Interior.

Keywords: modeling, planning, fuels, online application

Bio: Josh works with groups including the Wildland Fire Management Research Development and Application team, National Wildfire Coordinating Group's Smoke Committee, and the Fire Research and Management Exchange System team. He develops application support, educational materials, instructional support, documentation, and research to address fuels and smoke management. Josh's background includes a B.Sc. in Rangeland Ecology and M.Sc. in Forest Resources from the University of Idaho. Josh works as a Fire Research Scientist for the University of Idaho working from the Pacific Wildland Fire Sciences Laboratory in Seattle WA.

P05. Smoke Management Information Resources on the FRAMES Emissions and Smoke Portal
Presenter: JoshHyde, Fire Research Scientist, University of Idaho College of Natural Resources
Additional Authors: Smith, Alistair, Professor, University of Idaho College of Natural Resources
Strand, Eva, Associate Professor, University of Idaho College of Natural Resources
Wells, Lynn, FRAMES Program Manager, University of Idaho College of Natural Resources
Lahm, Peter, Air Resource Specialist, USDA Forest ServiceFitch, Mark, Smoke Management
Specialist, National Park Service

Smoke is a dynamic aspect of wildland fire engaging the attention of managers, researchers, regulators, and the public. The field of emissions and smoke is continually changing as new research, regulations, and evolving management approaches progress. Such progression is exciting, yet also creates a challenge to land managers seeking to stay informed on the variety of smoke and emissions topics.

The Fire Research and Management Exchange System (FRAMES) Emissions and Smoke Portal seeks to address this issue by making information on smoke management, research, training, and committee activities easily available from a central location (www.FRAMES.gov/smoke). Defined topic areas address different aspects of emissions and smoke, and material ranging from specific guidebooks and regulatory documents, to a general tutorial, event announcements, and searchable resource catalog. These aspects of the Emissions and Smoke portal make it easier to stay informed on the latest emissions and smoke topics, and the portals location nested within the wider FRAMES, facilitates access to many other related wildland fire resources. The portal is a collaborative product of the National Wildfire Coordinating Group's (NWCG) Smoke Committee, FRAMES, and the University of Idaho College of Natural Resources.

Keywords: Continuing education, information resources

Bio: Josh works with groups including the Wildland Fire Management Research Development and Application team, National Wildfire Coordinating Group's Smoke Committee, and the Fire Research and Management Exchange System team. He develops application support, educational materials, instructional support, documentation, and research to address fuels and smoke management. Josh's background includes a B.Sc. in Rangeland Ecology and M.Sc. in Forest Resources from the University of Idaho. Josh works as a Fire Research Scientist for the University of Idaho working from the Pacific Wildland Fire Sciences Laboratory in Seattle WA.

P06. Detection and Inventory of Intense Pyroconvection from New Generation Geostationary Sensors
Presenter: DavidPeterson, Meteorologist, Naval Research Laboratory, Monterey, CA
Additional Authors: Fromm, Michael, Naval Research Laboratory, Monterey, CA
Hyer, Edward, Naval Research Laboratory, Monterey, CA
Surratt, Melinda, Naval Research Laboratory, Monterey, CA
Campbell, James, Naval Research Laboratory, Monterey, CA

Intense fire-triggered thunderstorms, known as pyrocumulonimbus (or pyroCb), can alter fire behavior, influence smoke plume trajectories, and hinder fire suppression efforts. PyroCb are also known for injecting a significant quantity of aerosol mass into the upper-troposphere and lower-stratosphere (UTLS). The Naval Research Laboratory (NRL) has developed the first automated near-real-time pyroCb detection algorithm using the current generation of GOES imagers in North

America, providing evidence that pyroCb are likely an endemic feature of regional summer climate. This algorithm was recently applied to the new generation Advanced Himawari Imager (AHI), extending pyroCb detection capabilities to Asia and Australia. PyroCb detection was also available during the fire season of 2017 over North America using the Advanced Baseline Imager (ABI) aboard GOES-16. The algorithm uses multispectral infrared observations to isolate deep convective clouds with the distinct microphysical signal of pyroCb. Imagery is posted immediately to an NRL-maintained web page for rapid analysis of potential pyroCb events. Application of this algorithm in regions known to have a high frequency of pyroCb occurrence resulted in detection of individual intense events, pyroCb embedded within traditional convection, and multiple, short-lived pulses of activity. Comparisons with a community inventory indicate that this algorithm captures the majority of pyroCb. A total of 26 intense pyroCb events were inventoried across western North America during the fire season of 2013, including 31 individual updraft pulses. This systematic inventory was combined with meteorological data to build the first physical conceptual model for pyroCb development. The primary limitation of the current system in North America is that pyroCb anvils can be small relative to satellite effective pixel size, especially in regions with large viewing angles. The algorithm is also sensitive to some false positives from traditional convection that either ingests smoke or exhibits extreme updraft velocities. New generation geostationary sensors offer significant advantages for pyroCb and fire detection.

Keywords:

Bio: Dr. David Peterson is a meteorologist at the US Naval Research Laboratory in Monterey, CA. He has broad scientific interests in both meteorology and satellite remote sensing. He currently supports the US Navy's global aerosol modeling efforts, with a focus on extreme wildfires and smoke transport.

07. A Method to Mitigate Satellite-Based Fire Sampling Limitations in Deriving Biomass Burning Emissions
Presenter: JunWang, Professor, University of Iowa
Additional Authors: Yun Yue
Yi Wang
Charles Ichoku
Luke Ellison

Largely used in several independent estimates of fire emissions, fire products based on MODISsensors aboard the Terra and Aqua polar-orbiting satellites have a number of inherent limitations, including(a) inability to detect fires below clouds, (b) significant decrease of detection sensitivity at the edge of scanwhere pixel sizes are much larger than at nadir, and (c) gaps between adjacent swaths in tropical regions.To remedy these limitations, an empirical method is developed here and applied to correct fire emissionestimates based on MODIS pixel level fire radiative power measurements and emission coefficients from theFire Energetics and Emissions Research (FEER) biomass burning emission inventory. The analysis wasperformed for January 2010 over the northern sub-Saharan African region. Simulations from WRF-Chemmodel using original and adjusted emissions are compared with the aerosol optical depth (AOD) productsfrom MODIS and AERONET as well as aerosol vertical profile from CALIOP data. The comparison confirmed an30–50% improvement in the model simulation performance (in terms of correlation, bias, and spatial patternof AOD with respect to observations) by the adjusted emissions that not only increases the originalemission amount by a factor of two but also results in the spatially continuous estimates of instantaneous fi reemissions at

daily time scales. Such improvement cannot be achieved by simply scaling the original emissionacross the study domain. Even with this improvement, a factor of two underestimations still exists in themodeled AOD, which is within the current global fire emissions uncertainty envelope.

Keywords: satellite, fire

Bio: Jun Wang is a Professor in the University of Iowa (UI), with joint appointments in the Department of Chemical and Biochemical Engineering and the Iowa Informatics Initiative, and secondary affiliation with the Center for Global and Regional Environmental Studies and Department of Civil and Environmental Engineering. His research focuses on the integration of satellite remote sensing and chemistry transport model to study air quality, wildfires, aerosol-cloud interaction, and land-air interaction. Jun Wang has authored or co-authored 100+ citable works in the peer-reviewed literature, and has been a science team member of several NASA missions. More about his research team's work can be found at: http://arroma.uiowa.edu

P08. CALIOP-based Biomass Burning Smoke Plume Injection Height
Presenter: AmberSoja, Assoicate Research Scientist, Associate Program Manager, NASA LaRC / NIA
Additional Authors: Choi, Hyun-Deok, Reserach Scientist, NIA / NASA LaRC
Fairlie, Thomas Duncan, Senrior Research Scientist, NASA LaRC
Pouliot, George, Physical Scientist, EPA Atmospheric Modeling Division/NERL/ORD
Baker, Kirk, Physical Scientist, EPA Atmospheric Modeling Division/NERL/ORDDibb, Jack, Research Associate Professor, University of New Hampshire
Polashenski, Chris, Research Geophysicist, Cold Regions Research and Engineering Laboratory

Carbon and aerosols are cycled between terrestrial and atmosphere environments during fire events, and these emissions have strong feedbacks to near-field weather, air quality, and longer-term climate systems. Fire severity and burned area are largely under the control of weather and climate, and fire emissions have the potential to alter numerous land and atmospheric processes that, in turn, feedback to and interact with climate systems (e.g., changes in patterns of precipitation; black/brown carbon deposition on ice and snow; alteration in landscape, atmosphere and cloud albedo). If plume injection height is incorrectly estimated, then the transport and deposition of those emissions will also be incorrect.

The heights to which smoke is injected governs short- or long-range transport, which influences surface pollution, cloud interaction (altered albedo), and modifies patterns of precipitation (cloud condensation nuclei). We are working with the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) science team and other stakeholder agencies, primarily the Environmental Protection Agency and regional partners, to generate a biomass burning (BB) plume injection height database using multiple platforms, sensors and models (CALIOP, MODIS, NOAA HMS, Langley Trajectory Model). These integrated data have the capacity to provide enhanced smoke plume injection height parameterization in regional, national and international scientific and air quality models.

Statistics that link fire behavior and weather to plume rise are crucial for verifying and enhancing plume rise parameterization in local-, regional- and global-scale models used for air quality, chemical transport and climate. Specifically, we will present: (1) a methodology that links BB injection height and CALIOP air parcels to specific fires; (2) the daily evolution of smoke plumes for specific fires; (3) plumes transported and deposited on the Greenland Ice Sheet; and (4) compare CALIOP-derived

smoke plume injection to CMAQ modeled smoke plume injection. These results have the potential to provide value to national and international modeling communities (scientific and air quality) and to public land, fire, and air quality management and regulations communities.

Keywords: remote sensing, aerosols, air quality, climate, fire feedbacks, fire emissions

Bio: Dr. Soja is resident in the Climate Science and Chemistry and Dynamics Branches of Atmospheric Sciences at NASA Langley Research Center. She has been working in the fire community for decades, and she has expertise in fire science, fire program management, and in transitioning scientific data to stakeholder organizations. Her scientific focus has been on using satellite, Geographic Information Systems and modeled data as tools to explore the dynamic relationships that exist between fire regimes, fire weather, the biosphere, atmosphere and climate systems.

P09. Characterization of Volatile Organic Compounds (VOCs) from North American Wildfires and Agricultural Fires during NASA Airborne Missions and Fire Lab Experiments
Presenter: NicolaBlake, Project Scientist, University of California, Irvine
Additional Authors: Blake, Donald, Distinguished Professor, University of California, Irvine
Simpson, Isobel, Specialist, University of California, Irvine
Meinardi, Simone, Associate Researcher, University of California, Irvine
Barletta, Barbara, Associate Researcher, University of California, Irvine

In order to understand the contribution of fire emissions to air quality and climate change it is important to identify North American terrestrial emissions and their relative contribution to atmospheric composition. Trace gas signatures derived from our whole air canister measurements of volatile organic compounds (VOCs), combined with air mass classification based on backward trajectories, have previously identified the influence of a wide variety of sources, including emissions from wildfires, vehicles, agriculture, biofuel, coal, oil and gas, industrial activities, and marine sources. We present an overview of results from previous airborne and laboratory field campaigns in North America including NASA ARCTAS, DC3, SEAC4RS, and FLAME-4. For example during the 2008 ARCTAS campaign we characterized VOC emission ratios (ERs) and emission factors (ERs) from boreal forest fires, including 45 species that were quantified from boreal forest fires for the first time (e.g., monoterpenes; Simpson et al., 2011). During the 2013 SEAC4RS campaign we calculated VOC EFs for wildfires in the western United States (Yates et al., 2016; Liu et al., 2017) and agricultural fires in the Mississippi River valley (Liu et al., 2016), which improved the characterization of these relatively understudied biomass burning sources. VOC ratios (e.g., i-pentane/n-pentane; benzene/propane) provided clear source characterization during the mission. During the 2012 DC-3 mission our biomass burning tracers were used to follow a biomass burning plume that was ingested by a convective storm over Colorado (Apel et al., 2015), and our tracer ratios were used as non-soluble organic tracers to determine CH_2O scavenging efficiencies for mid-latitude convection over the central U.S. (Fried et al., 2016). During the FLAME-4 laboratory experiment our results were compiled into a comprehensive EF database (Hatch et al., 2017) and were also used to assess the impact of specific VOCs on SOA production (Tkacik et al., 2017).

Keywords: active fires, atmosphere, smoke plumes, trace gas emissions, hydrocarbons, VOCs, chemistry, aircraft measurements

Bio: Nicola has worked as an atmospheric chemist at the University of California, Irvine since graduating with a PhD from the University of East Anglia in England in 1990.

Her career has mostly involved employing "flying laboratory" aircraft to investigate the chemical composition of the lower atmosphere all over the planet: from Europe to North America and Asia - and from the Arctic to Antarctica. These various field campaigns have been funded mostly by NASA and NSF.
She currently works from her home on the Island of Martha's Vineyard, MA.

P10. Fire Emission Measurements Using Lightweight Sensors and Samplers on Unmanned Aerial Systems
Presenter: BrianGullett, Senior Research Engineer, U.S. EPA, Office of Research & Development
Additional Authors: Aurell, Johanna, Ph.D., Senior Research Scientist, Univ. Dayton Res Inst
Holder, Amara, Ph.D., Senior Research Scientist, U.S. EPA/ORD
Mitchell, Bill, Senior Electronics Engineer, U.S. EPA/ORD
Todd Hoefen, Physical Chemist, USGSVed Chirayath, Ph.D., NASA Ames
Joshua Johnston, Natural Resources Canada

Emission measurement systems making use of miniaturized sensors and samplers have been developed for portable and aerial sampling from aerial platforms. Small, shoebox-sized systems called "Kolibri", weighing 3-4.5 kg, have been deployed on USGS- and NASA-flown unmanned aerial systems (UASs, or "drones") to characterize plume emissions from open area combustion sources. A 5 m diameter, tethered, helium-filled aerostat (balloon) has been used to loft a larger instrument system (20+ kg) called the "Flyer" into combustion plumes. Both the Kolibri and Flyer use sensors to measure CO and CO_2 and miniature samplers for PM2.5/10, PAHs, VOCs, SVOCs, carbonyls, black/elemental/organic carbon (BC/EC/OC), inorganic halogens, and real time BC. New capabilities are being added including IR cameras, NOx sensors, and a real time sampler for particle size distributions. Telemetry systems on both the Kolibri and Flyer transmit data to the ground crew to enable flight, battery, and sample monitoring. The Flyer has been used to determine emission factors from a variety of open burning sources including oil burns, waste pile burns, agricultural field burning, prescribed wildland fires, and open burning/open detonation of military ordnance. The Kolibri has been successfully and safely deployed in five campaigns to determine emission factors from prescribed fires and open burning and detonation demilitarization processes.

This abstract has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication.

Keywords: emissions, sensors, sampler, combustion

Bio: Brian is an ST level scientist at EPA's Office of Research and Development. His work on formation mechanisms of chlorinated dioxins and furans led him into the field of open combustion measurements. Currently he is serving as the Acting Director of the Air and Energy Management Division of the National Risk Management Laboratory located in Research Triangle Park, North Carolina.

P11. NWCG Smoke Committee (SmoC)
Presenter: DavidMueller, Natural Resource Specialist, Bureau of Land Management
Additional Authors:

The Smoke Committee (SmoC) provides national leadership in smoke and air resource management pertinent to wildland fire management. The SmoC develops and disseminates strategies and guidance to help member agencies and partners effectively, efficiently, and consistently manage smoke within their fire and fuels programs. The SmoC provides a forum for air resource and wildland fire management leaders to address technical, regulatory and policy issues related to planned and unplanned fire emissions and air quality impacts on firefighter and public safety and health.

Keywords: Smoke Management, Air Quality, Wildland Fire

Bio: Dave has been in wildland fire management for almost 4 decades. He has worked for the USFS and currently is with the BLM performing as a Natural Resource Specialist for the BLM Fire Planning and Fuels Management Division at the National Interagency Fire Center (NIFC), Boise ID.

P11.1. Emissions from heated extracts-rich fuels and impacts on smoke dynamics
Presenter: FengjunZhao, Assocaite Professor, Chinese Academy of Forestry
Additional Authors:
FALSE

Extracts are an important property for many forest fuels. While the importance of other fuel properties such as loading and moisture for wildfires has been well recognized, our understanding of fuel extracts is very limited. This study is to investigate the emissions from extracts-rich fuels and the roles in smoke dynamics. Forest fuels were collected from three coniferous species. The needles and twigs from the fuels were heated in a vacuum oven at 200 oC, and the emissions within 15 min were sampled using Tenax tubes. Gas chromatography–mass spectrometry served as an analytical instrument. The results show that the emissions contained high proportion of monoterpenes, such as α-pinene, camphene, β-pinene, 3-carene, and D-limonene. The monoterpene emissions differ significantly not only among species but also between needles and twigs. The emissions from heated needles and twigs of Pinus pumila, Larix gmelinii, and Pinus sylvestris were about 40~60 mg g-1 dry weight for needles, and 120~210 mg g-1 dry weight for twigs). Large impacts on fire behavior are expected from these emissions. The close relationships between extract concentrations and heat values are found. Numerical simulations indicate that burning of the extracts-rich fuels releases large heat value, which further modifies smoke plume rise and transport.

Keywords:

Bio: Yongqiang Liu, Research Meteorologist, USDA Forest Service

P12. BLM and Fuels Management
Presenter: DavidMueller, Natural resources Specialist, Bureau of Land Management, National Interagency Fire Center
Additional Authors:

The BLM Fuels Management Program focuses on protecting communities and our natural resources. The program uses collaborative approaches to reduce wildfire risk to the nation's public and private lands, while providing rural economic opportunities through community wildfire protection plans (CWPPs), fuels treatments, biomass utilization and contracting.
The program manages vegetation to meet specific resource and fire management objectives while promoting the safety of wildland firefighters and the public.
The BLM Fuels Management Program also aims to conserve the sagebrush steppe, which means protecting habitat for the greater sage-grouse and other sensitive species from the threat of wildfire and invasive weeds. The expansion of conifer into rangelands would naturally be controlled by fire. However, the removal of fire from the landscape may have allowed expansion in areas not historically occupied by conifer, thus altering the sagebrush steppe landscape. Fuels management activities mimic the natural wildfire disturbance process.

Keywords: Fuels Management, Great Basin, Prescribed Fire, Treatment Effectivness

Bio: Dave is currently serving BLM as a Natural Resource Specialist. Dave has almost 4 decades of wildland fire and fuels management experience, has performed as BLM fuels program lead, served on numerous NWCG committees, and performed as lead or subject matter expert for multiple interagency wildland fire policy and guide publications (IARX Guide, RX Fire Complexity Analysis System, 2009 Wildland Fire Policy and others).

P13. Pre- and post-burn fuel characterization and tree mortality assessment for the Forest Resiliency Burning Pilot
Presenter: JamesCronan, Research Forester, U.S. Forest Service
Additional Authors: Joe Restaino
Jesse Kreye

We present surface fuel consumption at six sites that were prescribed burned in 2016 and 2017 and an evaluation of the Consume fuel consumption and emissions prediction software. This project was a component of the Forest Resiliency Burning Pilot project in Washington State. We established plots within operational prescribed burn units on federal and state lands. Vegetation at each site was typical for natural stands of dry coniferous forests with a mixed-severity fire regime. Dominant overstory species included Douglas-fir (Pseudotsuga menziesii) and ponderosa pine (Pinus pondersa). Surface fuels were measured within month before and one month after the prescribed fire to calculate pre- and post-fire loading, and consumption. We sampled the following surface fuel strata: duff, litter, downed woody debris by time-lag class, herbs, and shrubs. Fuel moisture for each strata was collected prior to burning. We describe fuel consumption by strata and compare measured consumption with predicted consumption from Consume (v. 2.1 and 4.2). Simulations were parameterized with pre-fire surface fuel loading data and day-of-burn fuel moisture. This information will contribute to the growing body of data used to assess the accuracy of this widely used software program.

Keywords: fuel, consumption, prescribed fire, tree mortality, fire ecology

Bio: Jim Cronan lives in Seattle, WA where he is a Research Forester at the U.S. Forest Service, Pacific Wildland Fire Sciences Laboratory. He holds MS from Yale University and is a PhD candidate at the University of Washington. His research interests include fuels and fire behavior, fire ecology, and restoration ecology.

P14. Lolo National Forst Wildfire Risk Assessment
Presenter: AnneRysSikora, Fire Planner, USFS Lolo National Forest
Additional Authors: Ward, Laura, Forest Fire Management Officer

Two posters work in tandem with each other. They present information about the Lolo National Forest Wildfire Risk Assessment completed in 2016. Each poster was assembled to explain and educate Forest employees and Cooperators as to what the assessment is and how the assessment was completed. The first poster is an overview with many call out boxes outlining the steps, thoughts and process by which the assessment was completed. The Second poster is paired with the first, and has overlapping information but drills down with greater depth explaining the first output product used by the forests fire management organization: Strategic Wildfire Management Zones. The assessment followed the direction provided by the Rocky Mountain Research Station General Technical Report 315: A Wildfire Risk Assessment Framework for Land and Resource Management and was a combined effort between Lolo National Forest Fire Management and the Missoula Fire Sciences Lab's Fire Modeling Institute.

Keywords: Risk, Wildfire, Strategic Wildfire Management Zones

Bio: Anne RysSikora began working for the Lolo National Forest in 1985 as a member of the Missoula Ranger District fire crew. In the years that followed she has served as an Engine Forman, Forest Level Fuels Specialists, the Regional Office Fire GIS Specialists and is currently the forest's Fire Planner. Anne serves as a PIO1 on Turman's Northern Rockies Type 1 Incident Management Team. She graduated from the University of Montana with a B.A. in 1986 and studied Forestry at Oregon State University in Corvallis Oregon 2004 - 2007.

P15. Lolo National Forest Wildfire Response 2017
Presenter: AnneRysSikora, Fire Planner, USFS Lolo National Forest
Additional Authors: Ward, Laura, Forest Fire Management Officer

A review of the wildfire management actions on the Lolo National Forest in the 2017 fire season are discussed in this story map. Fire season is the time when fire preparedness, fire resilient communities and fire impacts become most visible. The work to mitigate and prepare for large fires is a continual, year-round, decade long process. The National Fire Plan through The Cohesive Strategy are guiding documents that provide important direction for decision makers as they respond to wildfire, seek to achieve healthy forests and work with partners to promote resilient communities.
Nine wildfire incidents are highlighted. Informational maps are provided on soil severity impacts of each incident. Operational objectives as permitted by the Forest's Land and Resource Management Plan are discussed in the context of coincident land designations, ownership and wildfire protection responsibility. Further discussion include how weather trends affected fire behavior and how smart landscaping can combat fire behavior for the homeowner. Historical fire occurrence data illustrating patterns in human caused starts and suggested link between those starts and the percentage of large wildfires are provided.

Fire management encompasses both the very visible work of firefighters, equipment and aircraft as wall as the less visible planning that Managers do when reviewing Wildland Fire Decision Support System (WFDSS) values at risk matrices. This process includes the assessment of infrastructural and ecological values during times of multiple fire starts in consideration of the forests' Wildfire Risk Assessment. This story map discusses how resource availability was prioritized and dispatched throughout the season and how safety considerations, public information outlets, lookouts and aerial detection are part of the fire managers workload. All these issues play an important role in wildfire response and are captured in this story map.

Keywords: Wildfire, Risk, Communities, Fire Behavior, Weather Events, Fire Management

Bio: Anne RysSikora began working for the Lolo National Forest in 1985 as a member of the fire crew at Missoula Ranger District. In the years that followed she has served as an Engine Forman, Forest Level Fuels Specialists, the Regional Office Fire GIS Specialists and is currently the forests Fire Planner. Anne serves as a PIO1 on Turman's Northern Rockies Type 1 Incident Management Team. She graduated from the University of Montana with a B.A. in 1986 and studied Forestry at Oregon State University in Corvallis Oregon 2004 - 2007.

P16. Lolo National Forest Hazardous Fuels Reduction - Reducing Threat to Communities
Presenter: AnneRysSikora, Fire Planner, USFS Lolo National Forest
Additional Authors: Ward, Laura, Forest Fire Management Officer

The Lolo National Forest has a long history of implementing hazardous fuels reduction projects which positively effect the communities within the wildland urban interface. This Story Map provides detail about hazardous fuels reduction projects ongoing to address community concerns along the US Interstate 90 corridor. Following the direction laid out in The Cohesive Strategy and the National Fire Plan, working with the Rocky Mountain Research Station a wildfire and fuels management strategy was developed using the best available science. The Lolo National Forest has since begun a series of fuels reduction projects located in an area from Bonner to St. Regis Montana defined as the I-90 Corridor Community Protection Zone. Working across jurisdictional boundaries with partners and non-profit organizations, the Lolo National Forest has restored and maintained resilient landscapes which help create fire-adapted communities and reduce the risk of managing unwanted wildfires. This Story Map has been built to inform citizens in western Montana about these efforts.

Keywords: Wildfire, Risk, Communities, Fuels Reduction, Fuels Mitigation, , Fire Managers

Bio: Anne RysSikora began working for the Lolo National Forest in 1985 as a member of the fire crew at Missoula Ranger District. In the years that followed she has served as an Engine Forman, Forest Level Fuels Specialists, the Regional Office Fire GIS Specialists and is currently the forests Fire Planner. Anne serves as a PIO1 on Turman's Northern Rockies Type 1 Incident Management Team. She graduated from the University of Montana with a B.A. in 1986 and studied Forestry at Oregon State University in Corvallis Oregon 2004 - 2007.

P17. An Assessment of High-Cost Wildfires in Relation to the Native Range of Ponderosa Pine for the Eleven Western States (2000-2016)
Presenter: MatthewPanunto, Ecologist, U.S. Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory
Additional Authors: Williams, Jerry, Former National Director of Fire & Aviation Management, U.S. Forest Service, Retired

A number of investigations have noted that ponderosa pine forests, which are often dry site indicators, have undergone significant transformation, increasing their vulnerability to uncontrollable wildfires. At the turn of the last century, fire behavior in these forests was relatively benign. As a result of frequent, low-intensity surface burning, they were described in early accounts as having open, sparse understories, and overstories that were elevated with open-canopies. Ironically, many of today's worst wildfires are now occurring in these forests as they become densely populated with less fire-tolerant species, thus increasing their fuel loadings, and contributing to a loss of the vegetative mosaic that once characterized western landscapes. These changes, along with warmer, drier, and longer-lasting fire seasons, help explain the onset of today's mega-fire phenomenon. We attempt to illustrate the relationship between the West's highest cost wildfire incidents, and the natural distribution of ponderosa pine. Our assessment finds that, between 2000 and 2016, 100 of the West's 155 highest cost incidents occurred within ponderosa pine's natural range. These 100 fires comprise 67% of the total reported burned acreage from our 155 fire dataset, as well as 67% of the total reported suppression cost. This effort is intended to communicate the relationship between deteriorated forest conditions and the risks of catastrophic wildfires, as well as the extent of this relationship throughout the West's ponderosa pine forests. The results substantiate the observations of earlier investigations, at the macro-scale. The high suppression costs, private property losses, natural resource damages, and other environmental impacts that accompany these incidents challenge land managers, policy-makers, and law-makers to re-examine wildfire protection approaches in regulations, plans, budgets, and policies. Our assessment emphasizes the need for appropriately scaled solutions to these challenges. The results may also provide a basis for prioritizing fuel treatments and weighing greater fuel reduction investments, as a means of reducing expected future wildfire impacts.

Keywords: Ponderosa Pine Suppression Cost Fuel Load

Bio: Matt Panunto is an Ecologist with the Fire Modeling Institute, part of the US Forest Service's Fire Sciences Lab in Missoula, Montana. His work generally involves compiling and managing large geospatial datasets in support of fire research. Matt also had his first experience supporting wildfire incidents during the summer of 2017 as a GISS trainee. He has a BS in Environmental Studies from Wesley College and an MS in Geography & Environmental Systems from The University of Maryland Baltimore County.

P18. Large Tree Mortality in Fuels-Treatment Projects in Central Oregon
Presenter: AlisonDean, Fire Effects Monitoring Coordinator, Central Oregon Fire Management Service
Additional Authors:

A survey of monitoring plots in prescribed burns in central Oregon showed less than 1% average mortality in large trees and 11% average mortality in all trees. The plots included 802 trees, of which 377 were large trees defined as ≥ 18 inches (46 cm) diameter at breast height (dbh). Treatments in the monitored projects included thin-and-underburn, thin-and-pile-burn, thin-with-fire, and underburn-only. Most of the plots were remeasured at five or more years post burn. In untreated-unburned control plots there was 0% mortality in large trees and 3% in trees of all size classes (n=77). Variability of burn objectives and ecological sites precluded statistical tests, but broad relationships were evident between mortality and potential contributing factors. Sites with a higher proportion of fir species to Ponderosa pine had more mortality, as did sites with higher surface fuel load. North slopes, higher tree density, and smaller average diameter were also linked with increased mortality. Season of burn had surprisingly little effect. No correlation was evident between tree mortality and shrub height or percent shrub cover.

Central Oregon Fire Management Service (COFMS) is an aggregation of fire and fuels managers working on the Deschutes NF, Ochoco NF, and Prineville District BLM. In 2006, five years after COFMS was created, its leadership initiated a formal fire-effects monitoring program using plots with FIREMON standardized protocols (Lutes, et al., 2006). In 2016 we surveyed a subset of plots to determine how much large-tree mortality was attributable to prescribed fire. The criteria were prescribed-burn projects with monitoring plots in plant association groups with timber, where pre-burn and post-burn measurements were done, with at least 20 tagged trees. The resulting data set comprised 14 projects ranging from dense lodgepole pine to mixed conifer to open ponderosa forest, with a variety of treatment objectives.

Keywords: prescribed fire, tree mortality, old-growth, burn, monitoring

Bio: Alison started out as a soil scientist and watershed manager involved in monitoring erosion following the Cerro Grande Fire. She subsequently worked four years on Prineville Hotshots and many seasons on federal fire engines. Since 2009 she has studied the effects of fires and fuel treatments on FS and BLM land in Central Oregon. She holds a B.S. in Soil and Water Science and M.S. in Watershed Management/Hydrology, both from the University of Arizona.

P19. Monitoring Medusahead and Prescribed Fire on Crooked River National Grassland
Presenter: AlisonDean, Fire Effects Monitoring Coordinator, Central Oregon Fire Management Service
Additional Authors:

As in much of the west, the Crooked River National Grassland (CRNG) is facing a simultaneous expansion of juniper and invasion of exotic annual grasses. While restoring fire can be a cost-effective remedy for juniper, fire is also linked to worsening the annual-grass problem. A prescribed fire on CRNG in 2011 gave an opportunity to better define the conditions that promote or constrain annual grass growth after fire. Using a randomized complete block design, we monitored herbaceous cover in four conditions: Untreated, Burned, Cultivar-seeded-after-burn, and Native-seeded-after-burn. These eight blocks have been measured pre-burn, at two years after the burn, at four years, and at six years. The study is designed primarily to examine densification of medusahead

(Taeniatherum caput-medusae) relative to perennial bunchgrasses in areas that initially had a low-density presence of the annual grass. Additially, at each block a separate array of transects tracks outward expansion from the original patch of medusahead.

Measurements at two years post-burn showed a remarkable decrease in both medusahead and cheatgrass (Bromus tectorum), and an increase in perennial bunchgrass compared to pre-burn. Cover of annuals and perennials at four years had returned to approximately their pre-burn levels, and at six years the annuals increased relative to the perennials. We used Analysis of Variance to test the correlations of treatment and vegetative growth, but there also seems to be an unexpected degree of influence by annual weather variability.

Keywords: Annual grass, monitoring, medusahead, prescribed fire, grassland

Bio: Alison started out as a soil scientist and watershed manager involved in monitoring erosion following the Cerro Grande Fire. She subsequently worked four years on Prineville Hotshots and many seasons on federal fire engines. Since 2009 she has studied the effects of fires and fuel treatments on FS and BLM land in Central Oregon. She holds a B.S. in Soil and Water Science and M.S. in Watershed Management/Hydrology, both from the University of Arizona.

P20. A National Position on Prescribed Burning
Presenter: DebSparkes, Senior Project Officer, AFAC
Additional Authors:

The National Burning Project was a major national collaboration between the Australasian Fire and Emergency Service Authorities Council (AFAC) and Forest Fire Management Group (FFMG). It was designed to bring together inter-related aspects of prescribed burning across Australasia to develop guiding frameworks and principles for a more holistic and consistent approach to prescribed burning.

A key component was to deliver the National Position on Prescribed Burning. Drivers for a national approach came from the National Strategy for Disaster Resilience (COAG, 2011), the National Bushfire Management Policy Statement for Forests and Rangelands (FFMG, 2014) and the National Inquiry on Bushfire Mitigation and Management (Ellis et al., 2004), which recommended:

"…that the Council of Australian Governments adopt a statement of national principles as the framework for the future direction of bushfire mitigation and management in Australia."

After extensive collaboration among Australian fire and land management agencies, a fundamental position statement emerged, along with a number of agreed principles to guide and support prescribed burning. These are:

• Protection of life is the highest consideration
• Landscape health is linked to fire and fire management
• Prescribed burning is a risk management tool
• Engagement with community and business stakeholders is important
• Prescribed burning is done in the context of measurable outcomes
• Informed knowledge of fire in the landscape is important
• Capability development is important
• Traditional Owner use of fire in the landscape is acknowledged
• An integrated approach is required across land tenures
• Prescribed burning is carried out under legislative, policy and planning requirements.

The National Position on Prescribed Burning was approved by AFAC Council and FFMG in October 2016. The National Position has subsequently been identified by the Fire MOU Partnerhsip in California as having direct relevance to their program.
This poster presents the National Position on Prescribed Burning as a successful model of collaboration leading to the production of fundamental doctrine that builds consensus, assists in aligning thinking and strengthens support for the work of those that deliver prescribed burning programs.

Keywords: prescribed burning principles

Bio: Deb Sparkes is a Senior Project Officer working with AFAC to deliver national projects including the Centre of Excellence for Prescribed Burning and the National Fire Danger Rating System.

Prior to this she worked with rural fire and land management agencies involved in prescribed burning to help deliver outcomes of the National Burning Project for AFAC and the Forest Fire Management Group.

Deb has a Masters of Forest Ecosystem Science and is captivated by the links between fire and landscape health. Her current roles draw on a convergence of her previous experiences in project management, stakeholder engagement, professional writing and service delivery.

P21. LANDFIRE MoD-FIS: Near real-time monitoring of fuel conditions
Presenter: JamesNapoli, Senior Scientist, Stinger Ghaffarian Technologies (SGT, Inc.)
Additional Authors:

LANDFIRE vegetation and fuels data products are consistently produced and updated biennially for the entire United States. In addition, regionally developed fuels products are also being created to capture more current fuel conditions. Modeling Dynamic Fuels with an Index System (MoD-FIS) products take into account local drivers of fuel changes and model them more frequently. Beginning in 2017, provisional products became available for the Great Basin and Southwestern (GB/SW) US based on herbaceous production. Preliminary analyses have shown MoD-FIS data better represent actual fire behavior on multiple active and historic wildfire incidents compared to the static LANDFIRE fuels data. Future research and development will focus on expanding the drought based MoD-FIS products into Southeastern areas of the US, expanding the herbaceous production based methods into more of the Western US, and development of new products in the northeast, mountain west, Alaska, and Hawai'i. The southeast data are currently available through the Wildland Fire Decision Support System whereas the GB/SW data are available through landfire.gov. Future work will also seek to make all products available through multiple sources. This presentation will focus on the 2017 seasonal products for the GB/SW US by summarizing results and lessons learned.

Keywords: MoD-FIS Seasonal Fuel Product

Bio: James is a senior scientist with Stinger Ghaffarian Technologies (SGT, Inc.), Technical Support Services Contractor (TSSC) to the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center. He is responsible for producing fuels layers within the LF production system. This production process includes: coordinating with other LF production teams to insure logic and spatial accuracy, coordinating with external partners for input and product accuracy, and quality control of the final fuel products.

• Started with LF in 2006 at the Rocky Mountain Research Station, Missoula Fire Science Lab, Missoula, MT
• Ecological Monitoring Database Facilitator, University of Hawaii Research Center 2005
• Cartographic Technician, Yellowstone National Park Spatial Analyst Center 2002-2005
• M.S. in geography and GIS (2003) from Northern Illinois University
• B.S. in geography and GIS (2000) from Pennsylvania State University

P25. Human Cognition and Wildland-Fire Decision Making
Presenter: VanMiller, Professor, Central Michigan University
Additional Authors: Kurt H. Loess, Assistant Professor, East Tennessee State University

To suppress a wildland fire, decisions must be made and subsequent actions taken. The incident command team (ICT) decisions that precede crew firefighting actions rely first on human cognition from ICT members and then depend on cognitive and physical efforts at the crew level. Though the latter can be of considerable consequence (e.g., the Yarnell Hill fire), the focus in this presentation will delve into the conceptual models that attempt to explain how incident commanders mentally decide on courses of action for their crews.

As demonstrated in this presentation, the literature published on the cognitive models that explain ICT decision making is quite sparse and hardly definitive. After discussing this literature, a comprehensive framework for encapsulating it will be presented. The framework rests on a foundation composed of three decision-making traditions—the Kahneman and Tversky finding of biases in human heuristics, the Klein notion of recognition-primed decision making (RPDM) for high-stress situations, and the Gigerenzer contention of effective human heuristics due to successful evolutionary adaptation. To analyze these three traditions, an explanatory superstructure of relevant decision-making attributes is developed and utilized to reveal differences and similarities in the traditions. With the relevant attributes at hand, the possible impact of each tradition on wildland-fire decision making and actions is illustrated for the case of the 2011 Las Conchas wildfire in northern New Mexico. By applying these three traditions to a real fire and discussing the likelihood of differing outcomes, there is an expectation that the importance of cognitive models will become obvious.

Based on this illustrated framework, an integrative model for ICT decision making will be proposed for future development. In terms of prudent science, the proffered model represents a tentative theory whose components must be treated as initial hypotheses and then tested. Without such testing, they lack validity. A concluding suggestion, flowing from the analysis of the three decision-making traditions, points toward initial testing of one of the most contentious attributes in the framework—bias and error. If the debate over bias and error could be resolved, then arguments about cognitive models could be lessened and improvement in wildland-fire decision making could be made.

Keywords: Decision Making Cognition

Bio: Van V. Miller received his B.A. in Philosophy and Political Science from the University of Kansas in 1970 and his Ph.D. in International Business in 1984 from the University of New Mexico. In addition, he earned an MBA from the University of Missouri and an M.A. from the University of New Mexico. Most of his research focused on decision making and managerial actions in highly uncertain environments. Since 2012, his efforts have focused on water, forests, and wildland-fire decision making; he is a certified wildland firefighter, an active member of the Brazos Canyon Volunteer Fire Department, and a licensed Emergency Medical Responder.

Dr. Loess received his MBA and Ph.D. degrees from Case Western Reserve University. He has been a faculty member in the Department of Management and Marketing at East Tennessee State University since 1998. He has taught Human Resources Management courses (HRM Survey, Compensation, Training and Development, Labor Relations and Negotiation, Research Methods) at graduate and undergraduate levels. His research interests have included collaboration in international joint ventures, offshore employment practices of Mexican Maquiladoras, and "cognitive frames" for decision-making in multiple resource allocation settings.

P26. Comparison of two methods for quantifying coarse surface fuel loading
Presenter: KatelynnBowen, Forester, Mark Twain National Forest
Additional Authors: Christopher R. Keyes, Research Professor, W.A. Franke College of Forestry & Conservation, University of Montana
Sharon M. Hood, Fire, Fuel, and Smoke Science Program, Rocky Mountain Research Station, US Forest Service
Carl Seielstad, Associate Research Professor, W.A. Franke College of Forestry and Conservation, University of Montana
Duncan Lutes, Fire, Fuel, and Smoke Science Program, Rocky Mountain Research Station, US Forest Service

Evaluating the impacts and effectiveness of fuel treatments commonly includes monitoring of surface woody debris. In this study, we aimed to compare planar intersect transect and fixed-area plot sampling methods for that objective. Both methods are commonly used in research and management but have tradeoffs in execution and accuracy that managers must consider. For this comparative analysis we used 2015 fuel sampling datasets from a northern Rockies ponderosa pine/Douglas-fir stand at western Montana's Lick Creek Demonstration/Research Forest. Our findings indicated that estimates at the stand level did not significantly differ by method. However, plot-by-plot, fixed-area plot sampling was more likely to capture CWD occurrence; transects estimated zero load on 23-47% of plots. Results of this study will provide forest managers with guidance for measuring coarse woody debris in this forest type.

Keywords: planar intersect sampling, Brown's transects, planar intercept, fixed-area plot sampling, monitoring, hazardous fuels, Pinus ponderosa, Pseudotsuga menziesii

Bio: Katelynn J. Bowen received her MS in Forestry from the University of Montana and is currently a forester for the Mark Twain National Forest in Houston, Missouri.

P29. The Canadian Fire Information Toolbox: International Application of the FWI System
Presenter: NatashaJurko, Geo Spatial Fire Technologist, Canadian Forest Service, Natural Resources Canada
Additional Authors:

The Canadian Forest Fire Weather Index (FWI) System has been used to assess landscape-level fire danger for daily operational fire management decision-making in Canada for the last half century. It is a primary sub-system of the Canadian Forest Fire Danger Rating System (CFFDRS). The FWI System has been adapted, or adopted, by many other countries and global regions over the last few decades, and it is now the most widely used fire danger rating system in the world. As a result, there is a continuous demand from international fire management agencies for FWI System applications,

tools, and training.   The Canadian Forest Service (CFS) of Natural Resources Canada has a long history of cooperating with international fire organizations to provide training and development of fire danger rating and early warning system tools based on the FWI System. A recently created decision-aid tool, the Canadian Fire Information Toolbox (CFIT) is an ESRI ArcGIS toolbox that seeks to use readily available, industry standard tools to calculate FWI parameters and map results through friendly user interface. CFIT allows users to integrate multiple data sources such as ground-based weather station networks with new and ever-improving remotely sensed, modeled and forecasted weather data streams. CFIT uses the established fire weather database to calculate FWI System values. It uses interpolations to create a visualization of the data, and a mapping tool guides the user through outputting multiple index maps. Furthermore, the whole process can be set-up to run outside ESRI through scripting as an automated product. CFIT has been introduced in Armenia and Georgia where their forestry departments are developing early fire warning products for the first time. Meanwhile, additional training in Indonesia, Malaysia (representing the Association of South East Asia Nations) and Mexico has introduced CFIT to aid in their current early warning processes. The objective of this poster is to illustrate the CFIT project, describe methods to setup the weather database, the development of the toolset, and international training on how to use the FWI System for fire danger assessment.

Keywords: fire weather, fire danger, fire early warning

Bio: Natasha Jurko is a geographic information systems specialist working in forest fire science at the Great Lakes Forestry Center, part of the Canadian Forest Service. Natasha provides geospatial analysis and support on multiple wildland forest fire projects.

P30. Canadian Conifer Pyrometrics - a New Empirical Fire Spread Modelling Scheme
Presenter: DanielPerrakis, Fire Research Scientist, Natural Resources Canada - Canadian Forest Service
Additional Authors: Taylor, Steve, Research Scientist, Canadian Forest Service
Marty Alexander, Wild Rose Fire Behaviour, Alberta, Canada
Miguel Cruz, Bushfire Behaviour and Risks, CSIRO Land and Water, Australia

Operational prediction of wildfire behaviour is routinely conducted for decision support related to personnel and public safety, fire management efficiency, and related topics in fire operations. Across Canada, the Canadian Forest Fire Danger Rating System (CFFDRS) has been the standard suite of tools used for fire weather and fire behaviour forecasting by land managers for over 30 years, and incorporated into various software and policy instruments.

Although the CFFDRS is familiar to Canadian users, its limitations have become apparent, particularly with respect to fuel type and structure. The CFFDRS sub-component Fire Behaviour Prediction System (FBPS) produces various fire behaviour outputs, including spread rate and fire intensity, but relies mainly on inflexible categorical fuel types that correspond to boreal forest vegetation types across central and northern Canada. Efforts to increase the number of fuel types have been hindered by the need for extensive experimental burning as a source of empirical data.

Recently, additional spread models using the CFFDRS dataset have been developed (Cruz, Alexander and Wakimoto 2003, 2004, 2005) that offer more flexible options in terms of fuel structure, while maintaining the empirical convention and familiar inputs of the CFFDRS. To date these models have only dealt with crown fire rate of spread (ROS) and crowning initiation probability.

This project proposes a scheme, called 'Canadian Conifer Pyrometrics' (CCP) for linking some simple options for surface fire spread with the Cruz et al. (2003-5) models. The result is a modelling system that will be familiar to operational users in Canada and elsewhere and can be readily compared and integrated with FBPS predictions.

Integral to understanding the CCP in its present form is an interactive visualization tool, called FuelGraph, that allows users to compare predicted ROS in an interactive graph. Fire weather and fuel moisture conditions are input variables that resemble the existing CFFDRS Fire Weather Index system; fuel structure inputs include fuel strata gap and canopy bulk density. This allows for ROS prediction in stands subjected to hazard reduction treatments in addition to fully stocked stands. Outputs can also be overlaid with existing FBP fuel type outputs to facilitate validation and training.

At the present time, FuelGraph and the CCP are shown on the ubiquitous MS Excel Platform, but efforts are underway to integrate it into more flexible platforms for further programming and online delivery.

Keywords: Spread rate, empirical models, FBAN, decision support, fuel treatment, FBP, crown fire, Canada

Bio: Daniel is a new Fire Research Scientist at the Pacific Forestry Centre in Victoria, British Columbia, Canada. He is a wildfire behaviour and ecology specialist with nearly 20 years of wildfire experience. He has worked as an initial attack firefighter, Fire Ecology Specialist with Parks Canada, and Fire Science Officer for the British Columbia Wildfire Service. He is also a Type I Fire Behaviour Analyst and instructor for the biennial Canadian Wildfire Behaviour Specialist course. His main research interests include developing operational tools for fire behaviour prediction to aid in safety, efficiency, and fire restoration efforts in western Canadian forests.

P31. Fire Regime Analysis of Army Garrison Camp Williams, Utah
Presenter: MartinAlexander, Former Full Adjunct Professor, Department of Wildland Resources, Utah State University
Additional Authors: Frost, Scott, Former Graduate Research Assistant, Deparment of Wildland Resources, Utah State University
Jenkins, Mike, Former Professor, Department of Wildland Resources, Utah State University

This study investigated the modern day fire regime of Army Garrison Camp Williams (AGCW), a military base located in northern Utah near the community of South Jordan. The fire regime analysis involved two approaches. One statistical in nature, the other largely theoretical.

AGCW exhibits a semi-arid climate. Nearly half of the landscape involves slopes exceeding 26% in steepness. Grasslands and shrublands are the predominant vegetative fuel types on the base.

Wildfire report data from 1985-2012 was summarized from the local records available for AGCW. A total of 86 fires burned an area of 12,279 ha over the course of 28 years. Both "small" and "large" fire history maps were produced. Large fires (i.e., > 400 ha) occurred on average roughly every four years and tended to take place between mid-June and mid-September. Based on the fire report data, the fire cycle for AGCW was calculated to be 32 years based on an annual area burned of 3.1%. Of the ignition sources on record, only 28% were ignited by lightning, the remainder were human-caused

fires. Nearly 50% of the recorded fires in modern times were caused by live fire training exercises conducted on the base.

Landscape Fire and Resource Management Planning Tools (LANDFIRE) data were utilized to build context to the base's fire environment. Maps from the LANDFIRE data were developed to spatially summarize mean fire return interval, fire regime category, general vegetation type, and fire behavior fuel model type. There was relatively good agreement between the results obtained from the wildfire statistical data and the LANDFIRE modeled output products.

Keywords: fire history, fire occurrence

Bio: Dr. Alexander served as a Full Adjunct Professor of wildland fire science in the Department of Wildland Resources at Utah State University from 2011-2015. During this time he collaborated with Dr. Mike Jenkins and graduate students Wesley Page (PhD) and Scott Frost (MSc). He is presently the Proprietor of Wild Rose Fire Behaviour, Leduc County, Alberta.

P32. Wildfire Behavior Case Study of the 2010 Machine Gun Fire, Army Garrison Camp Williams, Utah
Presenter: MartinAlexander, Former Full Adjunct Professor, Department of Wildland Resources, Utah State University
Additional Authors: Frost, Scott, Former Graduate Research Assistant, Deparment of Wildland Resources, Utah State University
Jenkins, Mike, Former Professor, Department of Wildland Resources, Utah State University

Large wildfire events at Army Garrison Camp Williams (AGCW), a military base in northern Utah, such as the Machine Gun Fire of September 19, 2010, have underscored the difficulty of planning for and mitigating against the adverse impacts of both human-caused and lightning-ignited wildfires. Subsequent wildfires in grass and shrub fuels types (e.g. Gambel oak (Quercus gambelii, Nutt.) burn frequently and with moderate to high severity. To protect nearby communities and other values-at-risk, effective fuel treatments must be planned, both spatially and temporally, with an understanding of the fire regime (i.e., the characteristic pattern of fire over time for a given geographic area) in mind. Furthermore, an understanding of how modeled fire behavior compares to observed fire behavior provides critical interpretive inference for predictions of fire behavior in relation to fuel treatments in the future.

At AGCW, a large wildfire incident has yet to be documented and analyzed following a formal case study format. The Machine Gun Fire, which occurred on September 19, 2010 provided just such an opportunity to do so. This fire was selected for a wildfire behavior case study analysis because of its large size (1498 ha) and destructive nature in relation to the wildland urban-interface area adjoining the base. Observed rates of spread for seven different fire run segments compiled by AGCW personnel in the form a fire progression map were compared to predicted rates of spread using BehavePlus. The required inputs were obtained from a LANDFIRE fuel model classification map, digital terrain model data, and weather observations from a nearby station. Of the seven different fire run segments compared, three of the predicted segments were within 60% of the observed fire spread rates, while the other four were drastically different. It's of note that the maximum rate of fire spread, as observed over a 9-minute period, was 164 m/min.

Keywords: rates of fire spread

Bio: Dr. Alexander served as a Full Adjunct Professor of wildland fire science in the Department of Wildland Resources at Utah State University from 2011-2015. During this time he collaborated with Dr. Mike Jenkins and graduate students Wesley Page (PhD) and Scott Frost (MSc). He is presently the Proprietor of Wild Rose Fire Behaviour, Leduc County, Alberta.

P33. Fuels, fire behavior, and fire effects monitoring on active wildfires – support for Incident Command Teams, land managers, and fire scientists
Presenter: MatthewDickinson, Research Ecologist, USDA Forest Service, Wildland Fire Management Research, Development & Application Program
Additional Authors: Matthew B. Dickinson, Research Ecologist, USDA Forest Service, Northern Research Station
Alicia L. Reiner, Fire Ecologist, USDA Forest Service, Enterprise Program
Carol M. Ewell, Fire Planner, USDA Forest Service, Stanislaus National Forest

Despite concerns about the direction of wildfire management in the US, limited capabilities exist to study the relationships among fuels, active fire behavior, and ecological effects. The Fire Behavior Assessment Team (FBAT) has over 10 years of experience collecting data on active wildfires in collaboration with Incident Management Teams (IMTs) and land managers and with the support of the US Forest Service (USFS) Enterprise Program (EP) and other USFS units (e.g., Pacific Southwest Region, Research & Development). FBAT is led by an EP fire ecologist and fields teams led by individuals with extensive operations and monitoring experience. In addition to on-call members, wildland fire modules often provide support. FBAT's primary objectives are: (1) safety through integration with IMTs; (2) rapid collection and delivery of information to IMTs to support fire behavior or emissions modeling, weather prediction, general intelligence, and public relations; (3) developing and implementing monitoring programs to answer questions raised by land managers (for example, a current project is assessing effects of tree mortality density on crown fire initiation, spread, and spotting behavior in the Sierra Nevada Mountains); (4) rapid delivery of reports to local land managers at the end of wildfire assignments; and (5) developing an archive of more than 10 years of integrated fuels, fire behavior (including video), and fire effects data for use by fire behavior specialists, educators, and the fire science and management communities. Since FBAT's inception in 2002 (see Vaillant and others 2014), data have been collected on 24 wildfires and two prescribed fires. In turn, data have been used in a peer-reviewed study assessing measured and modeled fuel consumption and emissions in California (Lydersen and others 2014); in reports summarizing fuels, fire behavior, and fire effects on individual fires; and in case studies on fuel treatment effectiveness. FBAT active-fire video has supported education and public relations activities. FBAT is currently developing a charter and associated Advisory Group that will be tasked with providing strategic support (e.g., setting priorities for FBAT's applied science portfolio, guiding organizational development, strengthening links with incident and land managers, etc.) and help securing support outside the fire season to improve module capability and readiness (e.g., gear rehabilitation, instrument/measurement development, data analysis and archiving, publishing, training, etc.). In this poster, we describe FBAT operations and products and encourage dialog as the module considers its future strategic vision and operations approach.

Keywords: Fire Behavior Assessment Team, FBAT, fuels, fire behavior, fire effects, monitoring, instrumentation, measurements, tree mortality

Bio: Nicole Vaillant is currently a Fire Application Specialist with the US Forest Service, Rocky Mountain Research Station, Wildland Fire Management Research Development and Application group. She is part of the core team developing the Interagency Fuel Treatment Decision Support System (IFTDSS). Prior to the WFM RD&A she was a Fire Ecologist with the Pacific Northwest Research Station and the Adaptive Management Services Enterprise Team and a seasonal wildland firefighter.

P34. Wind Tunnel Measurements of Gas Phase Pyrolysis Products from Southern Wildland Fuels using Extractive Infrared Spectroscopy
Presenter: AshleyOeck, Post Bachelors Research Associate, Pacific Northwest National Laboratory
Additional Authors: Scharko, Nicole, Post Doctorate Research Associate, Pacific Northwest National Laboratory
Danby, Tyler, Post Bachelors Research Associate, Pacific Northwest National Laboratory
Chong, Joey, Physical Science Technician, USDA Forest Service- Pacific Southwest Research Station
Corcoran, Bonni, Biological Technician, USDA Forest Service- Pacific Southwest Research Station Burke, Gloria, Forestry Technician, USDA Forest Service- Pacific Southwest Research Station
Bernacki, Bruce, Senior Research Scientist, Pacific Northwest National Laboratory

As wildland fires become more prevalent in the United States, prescribed burns are frequently used to manage ecosystems by reducing hazardous fuel buildup. Identifying the gas-phase products emitted during prescribed burns is crucial for the health of those involved with the burns and the communities located downwind. Most models for prescribed burns and wildfires are based on experimental results from dead plants. Currently, little is known about the combustion and pyrolysis products of live plants. Pyrolysis and combustion are two sequential phases that occur in both wildland and prescribed fires. Distinguishing between these two phases is important since pyrolysis products make up the fuel required for ignition. This study investigated the pyrolysis processes by using an FTIR spectrometer to detect and quantify the gas-phase products from thermal decomposition of live fuels native to forests located in the southeastern United States. In particular, live fetterbush (Lyonia lucida), inkberry (Ilex glabra), and Darrow's blueberry (Vaccinium darrowii) plants were distributed among dead longleaf pine needles (Pinus palustris) throughout a wind tunnel, and the gas-phase products were extracted using a metal probe inserted in the path of the flame. The products were monitored via the use of a variable long path gas cell coupled to an infrared spectrometer. Preliminary measurements indicated species such as CO_2, CO, C_2H_2, C_2H_4, CH_4, $HCHO$, CH_3OH, isoprene, 1,3-butadiene, phenol and NH_3 were produced as part of the thermal decomposition process.

Keywords: Pyrolysis, Live fuel, Extractvie FTIR, Wind tunnel

Bio: Ashley Oeck is currently a scientist at Pacific Northwest National Laboratory specializing in chemistry and spectroscopy. Her current interests include collecting and analyzing gas-phase products of pyrolysis and combustion in biomass burning.

P38. What We Know About Mountain Big Sagebrush Fire Ecology, Postfire Recovery Time, and Fire Regimes
Presenter: RobinInnes, Ecologist, Missoula Fire Sciences Laboratory, Rocky Mountain Research Station, USFS
Additional Authors: Zouhar, Kris, Ecologist, Missoula Fire Sciences Laboratory
Ilana Abrahamson, Supervisory Ecologist, Missoula Fire Sciences Laboratory

The distribution of mountain big sagebrush ecosystems has been greatly reduced since European-American settlement, and is likely to be further reduced, due to a variety of causes including land development, woodland expansion, nonnative invasive plants, and climate change. Thus, conservation and proper management of these ecosystems has been a priority, especially following the recent listing review of greater sage-grouse (Centrocercus urophasianus). The Fire Effects Information System (FEIS, www.feis-crs.org/feis/) recently partnered with the Northern Rockies Fire Science Network to synthesize published research on sagebrush ecosystems.

New publications include a Species Review of mountain big sagebrush (Artemisia tridentata subsp. vaseyana) fire ecology and a Fire Regime Synthesis of the frequency, severity, pattern, and size of fires in mountain big sagebrush communities before and after European-American settlement. These publications compliment the recent Species Review on sage-grouse (Centrocercus spp.), which are obligate species that depend on sagebrush communities for both food and cover. This obligate relationship might suggest the need to protect remaining sagebrush ecosystems from disturbances such as fire, but sage-grouse habitat requirements vary seasonally, so the species may be best served by a mosaic of successional stages that provide diverse, productive forage near security and thermal cover; such mosaics are considered beneficial to many wildlife species. Fire is an important driver in creating and maintaining these mosaics. Therefore, understanding fire history, fire effects, and postfire recovery dynamics is critical for making sound management decisions and avoiding long-term negative impacts to sagebrush communities and associated wildlife.

Historically, wildfires in mountain big sagebrush communities were stand-replacing, mostly small, and formed a mosaic of burned and unburned patches. Frequency of wildfires varied among regions, and appeared to be most frequent in the western portion of its range and least frequent in the eastern portion. Mountain big sagebrush is easily killed by fire and does not sprout, thus postfire establishment depends on seed in the soil or dispersed from unburned plants. Rate and success of postfire recovery depend on interactions among several variables, including prefire vegetation – especially abundance of nonnative annual grasses; soil moisture and temperature regimes; fire characteristics; and postfire land use. Our analysis of postfire recovery patterns on 269 burned sites suggest that full recovery (27% canopy cover, on average) required 26 to 30 years on average. However, postfire recovery times varied within and among regions, highlighting the importance of site-specific variables when estimating postfire recovery time and when making management decisions.

Keywords: fire ecology, fire regimes, mountain big sagebrush, sage-grouse

Bio: Robin Innes is a contract Ecologist with the Missoula Fire Sciences Laboratory, part of the U.S. Forest Services' Rocky Mountain Research Station. She writes syntheses of information on fire ecology and fire regimes for the Fire Effects Information System (FEIS, http://www.feis-crs.org/feis/). She has a master's degree in Ecology from the University of California Davis and a bachelor's degree in Wildlife Management from the University of New Hampshire. She lives in New Hampshire with her family.

P41. Why do we continually do the things we do? Help wanted in changing a mindset about prescribed fire in the South
Presenter: JohnKush, Assistant Professor, Auburn University School of Forestry & Wildlife Sciences

Additional Authors: Kush, John, Research Fellow, Auburn University School of Forestry & Wildlife Sciences
Barlow, Becky, Associate Professor and Extension Specialist, Auburn University School of Forestry & Wildlife Sciences
Maggard, Adam, Assistant Professor and Extension Specialist,Auburn University School of Forestry & Wildlife Sciences
Armstrong, Jim, Professor and Coordinator, Extension Forestry, Wildlife, and Natural Resources, Auburn University School of Forestry & Wildlife SciencesHermann, Sharon, Assistant Professor, Auburn University Department of Biological Sciences

A perfect example of several common issues with the use of prescribed fire exists in Auburn, AL on the Mary Olive Thomas Demonstration Forest (MOT). MOT is a 162 ha tract 8 kilometers from Auburn University (AU). It was bequeathed to the Alabama Cooperative Extension System (ACES) in 1983. The School of Forestry and Wildlife Sciences oversees management with an overall management objective of developing and maintaining the property for extension, teaching, and research and so maximize benefit to AU and ACES by providing information to landowners and managers. Some frequent comments heard from those who have not yet visited MOT include:
You cannot burn young longleaf pine. Longleaf pine was planted in 1997 and no follow-up prescribed fires were applied. An inventory in 2014 found the density and basal area of longleaf pine averaged 180 trees ha-1 and 2.3 m2 ha-1, respectively. For loblolly pine, the density and basal area averaged 1,310 trees ha-1 and 16.5 m2 ha-1, respectively. Hardwood stems, dominated by water oak and sweetgum, averaged 1,295 stems ha-1 and 13.3 m2 ha-1. Despite planting, longleaf pine was not a dominant component of the forest vegetation because the stand was not burned when the longleaf were young.
I do not want to burn my hardwood stand. A 4-ha upland oak-hickory stand demonstrates the use and importance of prescribed fire in upland hardwood management. We hope over time this demonstration will not only improve the condition of this stand, but will also help address some of the concerns and misconceptions about the use of prescribed fire in southern hardwood management. With three prescribed fires we have removed the leaf litter layer, are beginning to eliminate some of the mid-story American beech competition, and have not observed any damage to the oaks.
We always burn in the wintertime (dormant season). MOT contains a series of small plots demonstrating the effects of 1-, 2-, and 3-year fire return intervals during the dormant season and a no-burn comparison in a loblolly pine plantation. The understory's of 2- and 3-year return intervals are dominated by top-killed hardwood stems. While the 1-year return area appears to be dominated by grasses, when you look closely, hardwood stems are lurking, waiting for their chance to take over. How do we in the science world get information to landowners to help change their perspective? Help and demonstrations are needed.

Keywords: Southeastern USA, upland hardwoods, longleaf pine, fire effects

Bio: Sharon M. Hermann is an Assistant Professor (Department of Biological Sciences, Auburn University). She has a BA in zoology and an MA in botany (both from University of Iowa); her PhD is in Biology/Ecology (University of Illinois at Chicago). For many years, prior to moving to Auburn, Sharon was the Plant and Fire Ecologist at Tall Timbers Research Station. Most of her research interests are based in community ecology or topics of conservation concern and include influence of habitat structure on species composition, ecological restoration, and especially fire regimes and effects. Sharon assists with maintaining long-term fire research projects.

P45. Wildflowers and Post-Fire Restoration
Presenter: CoreyGucker, Writer and Program Support Specialist, University of Nevada, Reno
Additional Authors: Shaw, Nancy, Research Botanist (Emeritus), Forest Service
Anne Halford, Idaho State Botanist, Bureau of Land Management
Génie MontBlanc, Great Basin Fire Science Exchange Coordinator University of Nevada, Reno

Larger fires because of and resulting in nonnative species dominance in the West, especially the Great Basin, make active restoration necessary to break the cycle of increased fire frequency and loss of native vegetation and wildlife habitat. Native forbs (wildflowers) long overlooked in restoration play important roles in ecosystem functioning and thus restoration success. Over the past 15 years, considerable research investment has gone into understanding the ecology of western forb species and establishing guidelines for their successful use in restoration. This has been an extensive collaborative, multi-disciplinary and multi-agency effort. However, this information is scattered through the literature and has yet to be synthesized. Gathering and synthesizing published data as well as unpublished protocols information is necessary for seed collectors, growers, practitioners, and land managers to increase the supply and use of appropriate seed sources of native forbs for restoration of sagebrush steppe and other western ecosystems.

An online book, Forbs of the Intermountain West: Seed Knowledge and Tools for Restoration, is in the process of being written to synthesize the information on the biology, ecology, and seed-based restoration knowledge available for a prioritized list of western forb species. The poster for The Fire Continuum Conference will describe the book format, sections, utility, and highlight specific post-fire restoration knowledge for the species thus far reviewed in the project. The authors hope that this poster session will provide exposure for this project, resources currently available, and collaboration opportunities.

Keywords: post-fire restoration, native forbs, synthesis

Bio: Corey L. Gucker has more than 10 years professional experience researching, writing, and editing technical reports about plant and disturbance ecology in the West. In 8 years as a writer for the Fire Effects Information System website, Gucker completed more than 90 technical synthesis reports. Gucker also edited and compiled the Great Basin Native Plant Progress Report and edited and provided content to the Field Guide to Plants of the Boise Foothills in 2013.

P46. Ecotoxicological Effects of Wildfire Ash from Forest and Shrubland Catchments.
Presenter: Stefan H.Doerr, Professor of Physical Geography, Swansea University
Additional Authors: Harper, Ashleigh, PhD Student, Swansea University
Santin, Cristina, Senior Lecturer, Swansea University
Froyd, Cynthia, Senior Lecturer, Swansea University
Albini, Dania, PhD student, Swansea University

The impacts of wildfires are of growing concern around the world with climate change and human activities set to continue to increase the vulnerability to severe wildfire in many regions. It is well established in fire-prone regions (e.g. Australia, Western USA, Iberian Peninsula) that wildfires can cause a range of considerable changes to the hydrological dynamics of freshwater catchments. Limited research, however, has focused on understanding the effects of ash contamination on aquatic biota, particularly comparing ecosystem types and in less fire-prone temperate regions (e.g. UK).

To address the research gap, this project provides a comparative assessment of the role of wildfire-generated ash as a potential source of diffuse contamination for downstream water bodies. Ash samples from wildfires in three contrasting ecosystems (i) UK upland heath (ii) Spanish pine forest and (iii) Australian Eucalypt are used in a set of bioassays determining ash ecotoxicity on two species representing key functional levels of aquatic systems; a primary producer (Pseudokirchneriella subcapitata) and a food for fish species (Daphnia magna). Fulfilling the respective ecotoxicological guideline requirements (OECD, 2004; 2006; EPA, 2016) 48-hour acute toxicity tests were conducted on both species using a range of concentrations of each ash type. Daphnia magna were subjected to an acute immobilisation test, and an established technique for monitoring chlorophyll fluorescence was adapted for use here to provide a highly sensitive bioindicator of toxicity on Pseudokirchneriella subcapitata, through a 48-hr inhibition of photosynthesis test. This study constitutes the first of its kind to be undertaken using ash originating from the UK and relevant to temperate upland ecosystems.
This contribution will provide a full summary of this research project.

Keywords: Wildfire, ecotoxicology, water quality, ash, bioassays

Bio: Professor Stefan Doerr is a Physical Geographer at Swansea University interested in addressing fundamental and applied questions relating to wildland fire, C emissions, hydrology, erosion, soils, biochar/pyrogenic carbon/charcoal and water repellency. Stefan is the Editor-in-Chief of the International Journal of Wildland and the Associate Editor of SOIL (EGU).

P47. Downstream legacy effects on water quality and aquatic ecology after wildfire in large river systems: The critical importance of fine sediment-phosphorus dynamics
Presenter: MikeStone, , University of Waterloo
Additional Authors: Emelko, Monica Professor of Civil and Environmental Engineering, University of Waterloo, Canada
Silins, Uldis Professor Department of Renewable Resources, University of Alberta, Canada
Williams, Chris Graduate Student, Department of Renewable Resources, University of Alberta, Canada
Martens, Amanda Graduate Student, Department of Renewable Resources, University of Alberta, CanadaCollins, Adrian   Sustainable Soils and Grassland Systems Department, Rothamsted Research, North Wyke, Okehampton, UK

Wildfires in forested watersheds can deteriorate many aspects of water quality; resultant changes in nutrient levels and forms can be particularly significant. While relatively rapid post-fire recovery in phosphorus export has been reported in some cases, no recovery in P export or associated effects on stream benthos after >5 years post-fire has been reported in other cases. While downstream propagation of these effects might be expected depending on wildfire size and severity, the downstream propagation and longevity of these effects, as well as the geochemical mechanisms regulating them, have not been documented extensively at large river basin scales. Here, phosphorus (P) speciation and sorption behavior to/from suspended sediment were examined in two river basins impacted by a severe wildfire in southern Alberta, Canada. Fine grained suspended sediments (<125 μm) were sampled continuously during ice-free conditions over a two year period (2009-2010), 6 and 7 years after the wildfire. Suspended sediment samples were collected from upstream reference (unburned) river reaches, multiple tributaries within the burned areas, and in downstream reaches of the burned areas, in the Crowsnest and Castle River basins. Total particulate phosphorus [TPP], particulate phosphorus forms (non-apatite inorganic P [NAIP], apatite P [AP],

organic P [OP]), and the equilibrium phosphorus concentration (EPC0) of suspended sediment were determined. Concentrations of TPP and the EPC0 were significantly higher downstream of wildfire impacted areas compared to those from sediment collected in upstream reference (unburned) river reaches. Sediments from the burned tributary inputs contained higher levels of bioavailable particulate P (NAIP). These also were observed downstream at larger river basin scales. Notably, the wildfire-associated increases in NAIP and the EPC0 persisted for at least 6 and 7 years after wildfire. While both river systems exhibited elevated TPP downstream of wildfire-impacted areas, wildfire-associated increases in NAIP, POC, and the EPC0 , as well as some sediment associated metals (e.g., Al, Fe, Mn, and Ca) were more pronounced in the Crowsnest River than the Castle River. This underscored the importance of also considering system flow dynamics and scale, especially when evaluating and comparing disturbance impacts and recovery in diverse systems. Gravel bed storage of fine sediment in these rivers is a significant long-term instream source of bioavailable P, thus contributing to a legacy of wildfire impacts on downstream water quality, aquatic ecology, and drinking water treatability.

Keywords: wildfire, fine sediment, phosphorus form and mobility, legacy effects

Bio: Dr. Stone is a Professor in the Department of Geography and Environmental Management at the University of Waterloo. His research interests include the study of sediment water interactions and their effect on the source, transport and fate of contaminants in aquatic environments. He is the Downstream Propagation Node Leader of the Southern Rockies Watershed Project and has convened seven International Conferences on a range of topics including Impacts of Wildfire on Water Quality, Sediment-associated Contaminant Transport and Assessment of Best Practices for Road Salt Management.

P48. The Transformation and Mobilization of Water-Soluble Soil Organic Carbon and Nitrogen from Thermally-Altered Surface Soils
Presenter: Yun (Rosa)Yu, , Department of Civil, Environmental, and Architectural Engineering University of Colorado Boulder
Additional Authors: Ariel Retuta, Environmental, and Architectural Engineering, University of Colorado Boulder
Fernando L. Rosario-Ortiz, Environmental, and Architectural Engineering, University of Colorado Boulder

Wildfires are a natural form of disturbance in forests and range-lands. However, the frequency and severity of wildfires has increased as human activities in and near natural forest and foothill areas have increased. In addition, higher spring and summer temperatures and earlier spring snow-melt are resulting in a longer fire season and fires of higher intensity and longer duration. During the year of 2017, there were 66,131 wildfires in the United States and about 9.8 million acres were burned according to the National Interagency Fire Center. These numbers compare to 65,575 wildfires with 5.4 million acres burned in 2016. It is widely acknowledged that wildfires can result in significant increases in runoff and erosion, which can adversely impact water quality in streams, rivers, lakes, and reservoirs within a watershed. Perhaps most importantly, higher post-fire sediment loads into surface waters, transported by runoff from erosive upland areas, can increase the amount of water-soluble soil organic matter (SOM) leached into aquatic systems. Furthermore, SOM may undergo a series of physicochemical alternations upon heating during a fire, which in turn changes its chemical properties and thus its solubility in water. Most research hitherto has focused on fire-induced changes in concentrations of suspended sediment and nutrients (e.g., nitrate and phosphorus),

whereas few studies have investigated the mobilization of thermally-altered terrestrially-derived organic compounds into water-bodies in fire-impacted watersheds. Therefore, this study evaluated the changes in the flux of water-soluble soil organic carbon and nitrogen from thermally-altered surface soils that were heated at progressive burn temperatures. More importantly, the molecular compositions and structures of the water-extractable fraction of pyrogenic SOM were characterized using a combination of advanced analytical techniques including resin fractionation, 13C solid-state nuclear magnetic resonance (NMR) spectroscopy, and ultra-performance liquid chromatography-quadrupole time-of-flight mass spectrometry (UPLC-qTOF). The goal was to elucidate SOM thermal alternation mechanisms on a molecular level and to identify its representative thermal degradation products that might potentially be indicators in fire-affected natural waters. Our study revealed that aromatic carboxylic acids were formed as predominant thermal degradation products of soil humic substance, which also explained the increased solubility of SOM in water after thermal alternation. The discovery regarding the export of aromatic carboxylic acids from heated soils can also contribute to the understanding of ecological impacts of post-fire runoff and erosion on aquatic environment and species.

Keywords: wildfire, water-soluble soil organic matter, thermal-alternation, water quality, aromatic carboxylic acids

Bio: Yun (Rosa) Yu earned her M.S. and Ph.D. in Environmental and Water Resources Engineering at the University of Massachusetts, Amherst in 2016. Currently, she works as a Research Associate at the University of Colorado, Boulder on a research project looking at the physical and chemical transformations of soil organic matter (SOM) after forest fires and the role of pyrogenic SOM as emerging precursors for drinking water disinfection byproducts (DBPs).

P52. Effects of Wildfire on Soil Organic Matter and Source Water After 14 Years
Presenter: HuanChen, Post-doctoral Research Associate, Clemson University
Additional Authors: Tsai, Kuo-Pei
Rhoades, Charles
Fegel, Timothy
Pierson, DerekChow, Alex

Both quantity and chemical composition of natural organic matter in a burned watershed are definitely different from its pre-burned condition, and consequently altering dissolved organic matter and nutrient exports in source water. However, the duration of these alterations is unclear. Here, we collected soil and water samples in 2014-2015 within perimeters of 2002 Hayman Fire in Colorado for analysis in order to evaluate the long-term effect of a wildfire. Results demonstrated that carbon quantity in surface O-horizon from burned areas were significantly lower ($p < 0.05$) than unburned areas even after 14-year natural recovering process. Pyrolysis Gas Chromatography / Mass Spectrometry coupled with factor analysis illustrates aromatic carbon in O-horizon increased with burning severity and suggests aromatic hydrocarbon and nitrogen compunds to lignin and phenolic carbon ratio (i.e., [ArH + Ntg] / [LgC + PhC]) could be used as a potential indicator tracking the impacts of wildfire. In addition, water exported from the moderately burned watersheds contained 60% more DOC concentration with 24% higher specific THM formation potential than those from unburned watersheds. Greater formation potential of nitrogenous disinfection byproducts such as haloacetonitriles were also observed when water from the tributaries of moderately burned watersheds were chlorinated. Results of this study demonstrated the impacts of a wildfire on soil organic matter and water exported could last for more than a decade.

Keywords:

Bio: Dr. Huan Chen received his B.E. degree (envir. eng.) from Southwest Jiaotong University, China, M.S. degree (envir. eng.) from Peking University, China, and M.S. (stat.) and Ph.D. (civil eng.) degrees from University of Tennessee, Knoxville, U.S. He is an environmental scientist with a general goal of reducing or eliminating the environmental damages due to the industrialization and urbanization. He has a broad research interesting, including in 1) statistical and data analysis (i.e., machine learning and data mining), 2) computational programming (i.e., MATLAB, R, and Python), 3) analytical chemistry, and 4) contaminant fate modeling.

P54. Physical characteristics, chemical composition and water contamination potential of wildfire ash from different ecosystems
Presenter: Stefan H.Doerr, Professor, Swansea University (UK)
Additional Authors: Santin, Cristina, Senior Lecturer, Swansea University (UK)
Otero, Xose Luis, Associate Professor, University of Santiago de Compostela (Spain)
Neris, Jonay, Senior Researcher, Swansea University (UK)
Yokelson, Bob, Professor, University of Montana (US)Arcenegui, Vicky, Lecturer, Miguel Hernández University (Spain)
Hvenegaard, Steven, Senior Researcher, FPInnovations (Canada)

Wildland fires leave a powdery residue on the ground: wildfire ash, which consists of mineral materials and charred organic components. Its quantities and characteristics depend mainly on the total amount and type of fuel burnt and the fire characteristics. Up to several tens of tons of ash per hectare have been quantified in different post-fire environments.

As a new material present after a wildland fire, ash can have profound effects on ecosystems. It affects biogeochemical cycles, including the carbon cycle, stimulates microbial activity and helps the recovery of vegetation. Ash incorporated into the soil increases soil pH and nutrient pools temporarily and changes soil physical properties such as albedo, soil texture and hydraulic properties. Ash also modifies soil and landscape-scale hydrological behaviour. Its high porosity makes it very effective at absorbing rainfall, but it can also contribute to catastrophic debris flows when ash is mobilised by large storm events. Its 'fragile' nature makes ash very susceptible to wind and water erosion, facilitating its transfer to the hydrological system. Runoff containing ash from burnt areas carries soluble nutrients and pollutants, which can have detrimental impacts on aquatic ecosystems and the supply of potable water.

In this presentation we will report on the physical characteristics, chemical composition and associated water pollution risk from ash produced across a range of fuel and fire types: high-intensity and smouldering boreal forest fires from the boreal Canada; high-intensity and moderate-intensity fires from Australian sclerophyllous forests; and a range of typical US wildland fuels burnt during the FIREX experiment at the Missoula Fire Sciences Laboratory.

Keywords: ash, water contamination, nutrients, pollutants, size particle, black spruce, jack pine, eucalypt, FIREX

Bio: Stefan H. Doerr is Professor of Physical Geography and leads the Environmental Dynamics Research Group at Swansea University, UK. He has investigated for over two decades the

environmental impacts of wildfires in Europe, Australia, and North America. He is Editor-in-Chief for the International Journal of Wildland Fire.

P56. Evaluating Satellite Microwave Sensors for Fire Danger Assessment in Boreal and Arctic Regions
Presenter: Mary EllenMiller, Research Engineer, Michigan Technological University
Additional Authors: Michael Battaglia, Research Scientist, Michigan Technological University
William Buller, Research Engineer, Michigan Technological University
Michael Billmire, Research Scientist, Michigan Technological University
Kyle McDonald, PhD, Professor and Research Engineer, The City College of New YorkChelene Hanes, Canadian Forest Service
Randi Jandt, University of Alaska

In Alaska and Canada, the Canadian Forest Fire Danger Rating System (CFFDRS) is used to estimate fuel moisture in the organic soil layers. Satellite based Synthetic Aperture Radar (SAR) and passive microwave radar (e.g. NASA's Soil Moisture Active Passive (SMAP) satellite) have potential to provide complementary data to CFFDRS. As a weather-based point source system, CFFDRS has inherent limitations that could be greatly improved with synoptic moisture information from a satellite sensor at high repeat frequency but low spatial resolution, such as SMAP, as well as complementary high spatial resolution but low repeat frequency SAR data. However, most calibration and validation of satellites is not conducted in boreal and arctic regions and thus fine tuning of the satellite products to high northern latitudes is necessary. Research is underway to assess the utility of the 9 & 36 km resolution SMAP moisture products for fuel moisture monitoring across boreal and arctic North America. Several key questions concerning the application of SMAP products in arctic and boreal landscapes are being addressed, including: 1) Do SMAP moisture products relate to CFFDRS fuel moisture codes? 2) What depth of moisture is being sensed in the peat soils? 3) What is the impact of extensive surface water found in the arctic and boreal regions on the SMAP signal? 4) How does spatial heterogeneity of soil moisture driven by land cover type affect SMAP? An initial evaluation of SMAP soil moisture products has been carried out for comparison to the broadscale network of weather-based CFFDRS fuel moisture estimates. Results show SMAP has a 0.62 coefficient of determination for predicting CFFDRS drought code, which is representative of the deeper more compact organic soil layers (~18 cm).
For further development of SAR moisture retrieval algorithms and a more complete understanding of the spatial heterogeneity within a SMAP grid cell, 3 field locations that are representative of SMAP 36 km grid cells are being intensively studied. The grid cells are located in the tundra of Alaska's north slope, boreal peatlands of Alberta, and boreal uplands of Ontario.   Using these field data, high resolution (5-30 m) satellite SAR imagery will be used to refine fuel moisture retrieval algorithms for a variety of boreal and arctic ecosystems. The overall investigation will yield a more complete understanding of the relationship between field measurements, the CFFDRS DC, SAR and SMAP soil moisture. Finally, methods for integration of the high resolution SAR with the coarse resolution SMAP will be conducted to create products for fire managers.

Keywords: fire danger, fuel moisture, CFFDRS

Bio: Dr. Miller has over 15 years of experience solving problems in the fields of GIS, Environmental Remote Sensing and Modeling. Her research interests include developing practical methods of supporting land management with remote sensing and environmental modeling, large scale mapping of vegetation, land cover and land use change, and developing and improving

environmental models. Current projects include developing an erosion modeling database to support post-fire remediation and fuels planning, mapping wetland connectivity and vegetation in the Great Lakes Basin, and mapping land cover and historical fire occurrences in the Arctic Tundra.

P58. Patrick Freeborn
Presenter: PatrickFreeborn, Research Physical Scientist, USDA, Forest Service, RMRS, Fire Sciences Laboratory
Additional Authors: W. Matt Jolly

Fire danger indexes output from fire danger rating systems are evaluated based on their association – or lack thereof – with fire activity. Historically the only information available to quantitatively characterize fire activity has been the discovery date and the final size recorded on agency reports. Hence the United States National Fire Danger Rating System (USNFDRS) has traditionally been evaluated based on the ability to discriminate non-fire days from new-fire days. Limiting the description of fire activity to new fires has steered the purpose of Fire Danger Rating Operating Plans (FDOPs) towards fire prevention and pre-suppression planning since fire managers select fire danger indexes and staffing level breakpoints that coincide with initial attack density. To provide a more complete link between fire weather conditions, day-to-day fire activity (i.e., new and existing fires), and management responses (i.e., initial attack and extended attack), we propose the inclusion of daily fire observations as part of the fire danger evaluation process. Although daily fire growth can be reconstructed from incident reports for large fires, we associate NFDRS indexes with active fire pixels detected by the Moderate Resolution Imaging Spectroradiometer (MODIS). With a few methodological updates, we utilize the same analytical framework as FireFamily Plus (FFP) to assess – in parallel – the relationships between fire danger, the propensity for new fires, and the size and intensity of fires that burn late into the fire season. Expanding the scope of the evaluation process beyond new fires will extend the utility of the NFDRS by allowing fire managers to associate fire danger indexes with fire activity from the period of peak initial attack to the end of the fire season.

Keywords: NFDRS, evaluation, daily fire activity

Bio: Patrick Freeborn is a remote sensing specialist with 10+ years of experience interpreting burned area and active fire observations from multiple satellite platforms. His primary area of technical expertise is the satellite detection and characterization of active fires. Patrick's research interests include the fusion of multiple polar-orbiting and geostationary fire products for enhanced biomass burning characterization, and the use of multiple satellite fire products to investigate regional relationships between biomass burning characteristics and fire danger conditions.

P22. Post-Harvest Fuel Loading and Other Ecological Effects Related to Biomass Harvest Variability from Forest Restoration Treatments in the Southwest
Presenter: GrahamWorley-Hood, Student, University of Montana
Additional Authors: Goodburn, John, Professor, University of Montana
Battaglia, Michael, Research Forester, USFS Rocky Mountain Research Station
Dodson, Elizabeth, Professor, University of Montana

In southwestern ponderosa pine and mixed conifer forests, much work has been done to plan, implement, and monitor the efficacy of treatments that reduce hazardous fuels and restore reference conditions. Harvesting systems are utilized in these projects to extract not only marketable timber, but also forest biomass (which has traditionally been burned onsite for disposal)

for use by the renewable energy sector. Based on the silvicultural prescriptions and available markets, varying levels of biomass are removed creating the potential for differences in post-harvest fuel loading and other ecological effects related to harvest intensity. As land managers evaluate the extent of biomass extraction from treatment sites, a greater understanding of the associated ecological effects is necessary to ensure desirable outcomes. Our research aims to contribute analysis toward standardized best management practices focused on forest restoration operations that harvest biomass for energy production in the southwestern U.S. Five active operations were selected to evaluate harvest systems and effects, spanning from northern Arizona through northern New Mexico and representing a range of operations and prescriptions in the region. Data are being collected at treatment sites pre- and post-implementation, and additionally at comparable retrospective (treated 5-8 years prior) and untreated control sites to evaluate the impacts of different operations and harvest intensities. Plots are located within each treatment boundary using a random systematic grid design. At each plot location we are sampling trees and saplings within a fixed radius plot, fuels and soil disturbance along three transects extending from plot center, and understory vegetation within nested subplots along each transect. These data will be used to analyze and model the effects of each treatment in relation to forest structure and composition, soil disturbance, and predicted fire behavior over time. The Forest Vegetation Simulator (FVS) along with the Fire and Fuels extension (FFE) are being used for growth, fuels, and fire behavior modeling. Preliminary results from the first year of data collection will be presented.

Keywords: ecological effects, fuel loading, fire behavior, biomass harvest, hazardous fuel treatments, forest restoration, southwest

Bio: Graham is currently in his second semester as a M.S. student in the Department of Forest Management within the W.A. Franke College of Forestry and Conservation at the University of Montana. He has worked in fire suppression and fuels management since 2001 for the US Forest Service in California, and the Bureau of Land Management in Alaska. He hopes to return to federal fire and fuels management following his education.

P23. LiDAR as a Tool for Assessing Hazard Fuel Reduction Projects
Presenter: JuliaOlszewski, Master's Student, Oregon State University, Forest Engineering and Resource Management
Additional Authors: Dr. John Bailey, Professor, Oregon State University

Land management practices in much of the western US that included wildland fire suppression has led to greater fuel loads than has been typical of historical fire regimes. In response to the increased wildland fire risk, "restoration" has emerged as a forest management goal. Restoration involves removal of uncharacteristic amounts and combinations of fuels by prescribed fire or mechanical thinning with the goal of reducing the destructive potential of wildland fire. While the practice of fuel reduction is widespread in forest management, there has been little research broadly assessing its effectiveness. Most of the existing research has involved either small-scale opportunistic case studies on wildland fires encountering recent restoration projects, or targeted studies on specific fuel reduction projects with a limited scope of inference. It is important to know at the forest level whether restoration practices are successful so that they may be improved where needed. This study investigated whether LiDAR (a form of remote sensing) taken before and after a restoration project in the Malheur National Forest can be used to quantify changes in the number of stems by size class and the amount of ladder fuels. The advantage of LiDAR is that it offers the opportunity to gather data on a larger scale than by field observations alone. Analysis was performed with FUSION, a

computer program developed by the US Forest Service to analyze LiDAR data, and calibrated with field data taken concurrently with LiDAR acquisition. This study offers forest managers a new tool for evaluating the potential effectiveness of fuel reduction treatments in reducing potential damage due to wildland fire.

Keywords: Fuel Reduction, LiDAR, Restoration

Bio: Currently a Graduate Research assistant at Oregon State University, pursuing a Master's Degree in Sustainable Forest Management. Prior to graduate study, worked for the National Park Service as a wildland firefighter, park ranger, and park dispatcher. Also worked for the US Forest Service and Washington DNR as a forestry technician.

P35. Post-fire Propagule Availability Following Short Interval Fires in California Closed-Cone Conifer Forests

Presenter: MichelleAgne, Graduate Student, University of Washington
Additional Authors: Fontaine, Joseph, Lecturer, Murdoch University
Enright, Neal, Professor, Murdoch University
Bisbing, Sarah, Assistant Professor, University of Nevada--Reno
Harvey, Brian, Assistant Professor, University of Washington

There is mounting evidence from forested ecosystems globally that climate change is eroding resilience – defined as an ecosystem's capacity to experience a disturbance without transitioning to an alternative state. Further changes in ecosystem resilience are predicted to result from direct effects of climate change, including increased temperature and decreased moisture availability, and indirect effects, including increases in fire, pathogens, and insect outbreaks. These effects are likely to compound and constrain tree populations, particularly in dry, fire-prone ecosystems that rely on the presence of a canopy seed bank for regeneration following stand-replacing fire. One mechanism by which these populations may be constrained is through dampened propagule availability at the time of fire. Warm, dry conditions and resulting moisture stress post-fire can slow cone production in dry forested systems, but how this effect is mediated by biotic factors, including proximity to neighbors, seed predation, and tree disease, is not well understood. Such information is critical to predicting how altered fire regimes will affect forest resilience.

Using California closed-cone conifer forests as a model system for canopy seed-banking forests adapted to stand-replacing fires, we asked: do warmer, drier post-fire conditions interact with biotic factors to dampen propagule availability at multiple spatial scales? We collected data on stand structure, cone abundance, and tree health from 45 previously burned plots, spanning a range of landscape positions across varying times since last fire, within three forest types in coastal California: bishop pine [Pinus muricata], knobcone pine [Pinus attenuata], and Sargent's cypress [Hesperocyparis sargentii]. Preliminary analyses showed no relationship between cone abundance and topoclimate. However, biotic factors influenced cone abundance at various scales. Squirrel predation was associated with decreased cone abundance at the individual tree level, but this relationship did not scale up to the stand level. Conversely, disease incidence was associated with decreased cone abundance at the stand level, but there was no relationship at the individual tree level. Increased stand density was associated with decreased cones per tree, but increased cone abundance at the stand level, which reached an asymptote at mean stand density of the study sites. Collectively, these results suggest that compensatory mechanisms at individual tree level play an important role in governing reproductive capacity at the population level, which will have effects on

the subsequent cohort of trees. The drivers that influence propagule availability in these ecosystems are complex and further analyses will be conducted to assess interactions among drivers.

Keywords: climate change, cone production, propagule availability, serotiny

Bio: Michelle Agne is a PhD student earning a joint degree in the School of Environmental and Forest Sciences at the University of Washington and in the School of Veterinary and Life Sciences at Murdoch University. Michelle earned M.S. in Sustainable Forest Management at Oregon State University in 2013. She continued as a faculty research assistant at Oregon State, conducting research on interactions among forest insects, forest pathogens, fire, and management in Oregon. Michelle's PhD research focuses broadly on changing forest disturbance regimes, and their impacts on structure, composition, and function of western North American coniferous forests.

P36. How do fuel treatments impact trees and seedlings in a ponderosa pine forest 1 year vs 9 years post-fire?
Presenter: JessieDodge, Graduate Student Researcher, University of Idaho
Additional Authors: Strand, Eva K., Associate Professor at the University of Idaho
Hudak, Andrew T, Research Forester, RMRS Forest Service
Bright, Benjamin, Bright C., Geographer, RMRS Forest Service

Land managers have been using mechanical treatments such as slash and pile burns to reduce fuel loads and alter fuel continuity in ponderosa pine (Pinus ponderosa) forests for ecosystem restoration and to mitigate high severity wildfire effects. Before the 2007 Egley Fire Complex, slash and pile burns were implemented as fuel reduction treatments in the dry ponderosa pine dominated Malheur National Forest in eastern Oregon. The objectives of this project are to 1) document to what extent tree density, tree basal area, and seedling density varied across the burn severity gradient through time (1 and 9 years post-fire), 2) quantify to what extent pre-fire fuel treatments affected tree density, tree basal area, and seedling density through time, and 3) compare remotely sensed NBR values to ground measurements taken in 2008 and 2016. To compare post-fire vegetation recovery between mechanical treatments and untreated control areas, 35 treated and untreated paired sites were sampled in 2008 and 2016. Sites were broadly distributed across elevations, aspects, and the burn severity (low, moderate, or high) gradient indicated by satellite image-derived Normalized Burn Ratio (NBR). Post-fire vegetation response was monitored remotely using annual NBR images fitted by LandTrendr, a Landsat time series analysis algorithm, and assessed on the ground at the 35 paired field sites by measuring tree density, tree basal area, and seedling density. A paired t-test confirms significantly lower burn severity in treated (T) vs. untreated (U) plots (n=35, t=4.26, p<0.0001). dNBR was 201 ± 137 (low) for T sites and 371 ± 192 (moderate) for U sites. A Blocked Multi-response Permutation Procedure (MRBP) analyzing 2008 tree canopy cover showed no significant difference between T and U sites. However an MRBP analyzing 2016 tree canopy cover showed significantly higher tree canopy cover in T vs. U sites (P = 0.04, A = 0.43), suggesting delayed mortality in 2008 tree canopy cover. An MRBP analyzing seedling density for T vs. U site pairs was not significant for either year, suggesting treatments had little effect on seedling density. Results will help managers determine the long-term effectiveness of fuel treatments, inform about 1 and 9 year post-fire vegetation responses between T and U areas, and evaluate the remotely sensed NBR for assessing tree measurements.

Keywords: Burn Severity, mechanical fuel reduction treatments, long-term post-fire effects, remote sensing, dry forest

Bio: Jessie Dodge is a M.S. student in the Forest, Rangeland, and Fire Science Department at the University of Idaho. She received my B.A. in Environmental Biology and Ecology from Western State Colorado University. Her professional interests include; plant defenses from herbivores, plant attractions to pollinators, plant evolution, plant persistence after fires, and pollinator persistence after fires. Through her research, Jessie hopes to demonstrate 1) the importance of fire in areas that have evolved with high-frequency, low severity fires, 2) the effectiveness of mechanical treatments, and 3) how fires affect not only the understory plant composition, but also pollinator diversity.

P37. Assessing post-wildfire confer regeneration: Validation of a non-destructive seedling aging method

Presenter: EmilyMangini, Student, University of Idaho
Additional Authors: Hammond, Darcy, PhD Candidate, University of Idaho
Strand, Eva, Professor, University of Idaho

Accurate aging of natural conifer regeneration in post-fire sites is crucial to understanding ecological trajectories and predicting post-fire effects in conifer forests. However, traditional methods of determining seedling age via growth ring counts requires killing seedlings, while the validity of non-destructive alternatives, such as the terminal bud scar method is undetermined in many species. In the summer of 2017 we sampled ponderosa pine (Pinus ponderosa) and grand fir (Abies grandis) seedlings in two fires that burned in central Oregon (dry ponderosa pine) and southeast Washington (dry mixed conifer) in 2007 and 2005, respectively. Seedling age was estimated in the field by counting terminal bud scars and seedlings were cut at ground level for transportation to the lab. The "true" age was then determined by counting basal growth rings using WinDENDRO software. Based on previous studies and data from the ponderosa pine seedlings, the terminal scar count method seems to be most accurate on seedlings younger than ~15 years (likely due to bark formation over early scars) and on non-suppressed seedlings (young and tall/wide). It also underestimates the ring count age by 1.8 years on average. The complete results will be compiled into guidelines describing differences between forest types and species and how to best practice this non-destructive method for aging conifer seedlings.

Keywords: Seedling, aging, rings, conifer, regeneration

Bio: Emily Mangini is a second-year undergraduate student studying Ecology and Conservation Biology at the University of Idaho. She is a research technician working on projects studying phytotoxic effects of herbicides on root egress in conifers, post-fire effects on pollinators, and seedling aging processes in post-fire forest ecosystems.

P39. Spatial Characteristics of Burn Severity Patches and Effects on Post-Wildfire Conifer Regeneration in Ponderosa Pine Forests

Presenter: Darcy H.Hammond, Graduate Research Assistant, Department of Forest, Rangeland, and Fire Sciences, College of Natural Resources, University of Idaho
Additional Authors: Strand, Eva K., Associate Professor, Department of Forest, Rangeland, and Fire Sciences, College of Natural Resources, University of Idaho
Hudak, Andrew T., Research Forester, Rocky Mountain Research Station, U.S. Forest Service

Burn severity is often a main concern following large wildfires, where burn severity refers to the ecological change following a fire and includes some expectation of ecosystem recovery time. An

ecosystem could be considered "recovered" when it returns to the same vegetation type, structure, and composition as it was pre-fire. How burn severity affects post-fire vegetation recovery has been the topic of much investigation in forested ecosystems. For research and particularly management applications burn severity is commonly classified into four main severity categories (high, moderate, low, unburned), however the spatial patterns formed by patches of these differing levels is one aspect of post-fire recovery that has received less attention. Understanding spatial patterns is critical in part given concerns of an increase in larger patches of high burn severity as a result of climate change and other factors. Many previous studies that have examined burn severity spatial patterns have focused only on high severity patches or have used only metrics calculated at the patch scale such as patch size. These methodologies have the potential to ignore the larger picture of post-fire landscape pattern and recovery as it relates to burn severity by minimizing the interactions of patches of different types, sizes, and shapes. We used classified burn severity products based on the Normalized Burn Ratio (from the Monitoring Trends in Burn Severity database) to describe the spatial characteristics of unburned, low, moderate, and high severity patches in three large wildfires [Hayman Fire (CO), Jasper Fire (SD), Egley Complex (OR)] that burned in ponderosa pine-dominated forest. High severity burn accounted for 43%, 29%, and 14% of the area of these fires, respectively, with low severity having the highest percent of the landscape at Jasper (35%) and Egley (20%). Using a moving window in Fragstats, we calculated the value for various spatial metrics at three spatial scales based on known ponderosa pine seed dispersal distance and average patch size. These values were then used as inputs for a predictive model of ponderosa pine seedling presence and density. The spatial relationships of all burn severity levels, and unburned patches, to each other within a fire is an important next step in our understanding of how different patches interact to ultimately affect landscape pattern formation. The potential to use these spatial relationships to predict on-the-ground recovery would aid managers in prioritizing localities for targeted post-fire rehabilitation efforts.

Keywords: burn severity; dNBR; spatial pattern; post-fire recovery; seedling regeneration

Bio: Darcy H. Hammond is a PhD candidate in the Department of Forest, Rangeland, and Fire Sciences in the College of Natural Resources at the University of Idaho. Her work examines effects of burn severity on post-fire conifer and understory regeneration across four western U.S. forest ecosystems.

P40. Is a new invasive species, Ventenata dubia, altering fire regimes and native plant communities?
Presenter: ClaireTortorelli, Graduate Student, Oregon State University
Additional Authors: Day, Michelle, Faculty Research Assistant, Oregon State University
Kerns, Becky, Research Ecologist, USDA Forest Service
Krawchuk, Meg, Assistant Professor, Oregon State University

Wildfire regimes play a pivotal role in shaping the structure and function of ecosystems, and sudden changes to these regimes can compromise ecosystem stability. Plant invasions can alter fuel composition, which in turn influences fire severity, extent, seasonality, and frequency. Invasive plants that recover quickly after fire may facilitate positive feedbacks between fire and invasion, resulting in losses to native biodiversity and changes to ecosystem processes. Annual grass invasions in the Great Basin by Bromus tectorum (cheatgrass) and Taeniatherum caput-medusae (medusahead) have shortened fire return intervals and converted sagebrush communities to grasslands dominated by invasive annuals. A new, rapidly spreading invasive annual grass, Ventenata dubia (ventenata) may pose a similar threat to dry woodland and forest ecosystems in the Pacific

Northwest. While ventenata's potential to alter fire characteristics and out-compete native species is not known, similar vegetative traits, phenology, and vigor as cheatgrass and medusahead lead us to believe that ventenata will increase fuel loads, recover vigorously after fire, and reduce the diversity and abundance of native species in invaded ecosystems. We propose a quantitative field study to: 1) evaluate the influence of ventenata on fuel load, continuity, and seasonality in invaded communities; 2) determine how ventenata populations respond to wildfire; and 3) characterize the impacts of ventenata on native plant communities within the Blue Mountains Ecoregion of northeastern Oregon. To meet these objectives, we will compare ventenata abundance, fuels, and plant community composition from field sites with variable fire histories. Here, we present the conceptual framework for our proposed research on ventenata invasion in the Blue Mountains Ecoregion. This study will deepen our understanding of the extent to which introduced species affect and restructure invaded ecosystems, ultimately helping researchers and land managers develop strategies to best adapt to and manage these threats.

Keywords: Fire Regime, Ventenata, Invasive Grass, Fuels, Plant Community

Bio: Claire is graduate student at Oregon State University, currently researching the dynamics of a new invasive species, Ventenata dubia, on fuels, fire, and plant communities in the Blue Mountains Ecoregion of northeastern Oregon. Before heading to Oregon, Claire spent a handful of seasons botanizing around the western United States and Alaska. She is broadly interested in plant-disturbance interactions and conservation, and hopes that her research can help managers develop adaptive strategies to best conserve native plant communities.

P42. Building Social-Ecological Resilience to Wildfire in the Williams Lake Community Forest, British Columbia
Presenter: KelseyCopes-Gerbitz, PhD Student, University of British Columbia
Additional Authors: Daniels, Lori, Professor, Faculty of Forestry, University of British Columbia

Resilience of human and ecological communities to wildfire is a key topic driving forest management decisions, particularly in British Columbia's (BC) dry, fire-prone ecosystems. In 2017, BC experienced its worst wildfire season in recorded history, prompting a 70-day state of emergency with over 1.2 million hectares (ha) burned and 65,000 people evacuated. Despite efforts since the 2003 BC "firestorm" to initiate community engagement and hazardous fuels treatments, most communities are still vulnerable to detrimental effects from wildfire because of a myopic view of the historic role of fire in both an ecological and social-cultural context. To enhance our understanding of this context, this research aims to answer the questions (1) What was the social, cultural and ecological role of fire over time? and (2) What social, political, and ecological drivers may have altered this role through time? Utilizing an interdisciplinary, mixed-methods approach, the objectives of this research are to (a) understand the historical, ecological elements of the fire regime (such as fire frequency and severity), (b) explore the Indigenous paradigm regarding wildfire, and (c) profile the changing wildfire governance (policy and practice) through time. The research area is the 6000ha Ne Sextsine (Flat Rock) block of the Williams Lake Community Forest (WLCF), situated in the fire-prone Douglas-fir forest and located in the wildland-urban interface of Williams Lake, one of the largest communities in BC's interior region. As a partnership between the Williams Lake Indian Band and City of Williams Lake, the WLCF is managed for a range of values, including a mandate to protect the WLCF from losses due to wildfire. In collaboration with the Williams Lake Indian Band, this research seeks to develop a holistic understanding of the historical role of fire through focus groups with Elders, dendrochronology and forest structure sampling, and a systematic document review of

wildfire policy. Preliminary investigations indicate a potential mixed-severity fire regime, with a differentiation in the forest structure between the dry and mesic forests in the Ne Sextsine block and higher rates of tree establishment (and denser sub-canopies) spatially coincident with the primary cultural-use areas. Through this site-scale understanding of the social and ecological history, this research will help facilitate forest management discussions aimed at enabling both human and ecological community resilience to wildfire.

Keywords: resilience, social-ecological systems, fire history, mixed-severity fire regime

Bio: Kelsey Copes-Gerbitz is a PhD student in the Tree-Ring Lab in the Department of Forest and Conservation Sciences at the University of British Columbia, where she studies the historical role of fire in an ecological and cultural context. Kelsey uses an interdisciplinary, mixed-methods approach to explore changes in forest landscapes through time and the natural and anthropogenic drivers of that change. Her work centers on a collaborative approach that incorporates community engagement with Indigenous Elders and wildfire policy experts, and forest history sampling through dendrochronology (tree-ring dating) in order to support community resilience to wildfire.

P43. The Big Burns Project: Biogeochemical Legacies of Wildfire in Subalpine Forests of the Northern Rocky Mountains
Presenter: KyraWolf, Graduate Research Assistant, University of Montana
Additional Authors: Higuera, Philip, Associate Professor, University of Montana
Mclauchlan, Kendra, Associate Professor, Kansas State University
Chileen, Barrie, M.S. Student, Kansas State University
Pompeani, David, Postdoctoral Researcher, Kansas State University

Quantifying the net impact of wildfires on carbon and nutrient budgets is challenging, particularly in subalpine forests, where long and variable fire-return intervals can create biogeochemical legacies that last for decades to millennia. While the ecosystem impacts of individual fire events have been well-studied in subalpine forest ecosystems, the impacts of multiple fire events over time are less certain, particularly in the context of varying fire activity and climate change. Paleoecological records, capturing variability in fire activity over centuries to millennia, are well-suited to investigate questions about the causes and consequences of fire-regime variability. In combination with ecosystem modeling, this approach can reveal ecosystem dynamics that are otherwise not apparent from studying modern landscapes alone.
Here, we report on preliminary findings from the Big Burns Project, an interdisciplinary effort combining paleoecological records and ecosystem modeling to investigate coupled fire-climate-ecosystem dynamics over the past 2500 years in Rocky Mountain subalpine forest. We present records of fire history and ecological change spanning the past 200-300 years from four lakes in subalpine watersheds in the Bitterroot Mountains of Montana and Idaho. These sites span a ~100-km north-south transect in the Lolo National Forest, with 25% of the study area impacted by regionally synchronous burning in the 1910 fires. We use charcoal, pollen, and biogeochemical proxies to reconstruct the frequency, severity, and spatiotemporal synchrony of past fire events, and assess biogeochemical impacts from watershed to regional scales. Our results are interpreted in the context of 20th century fire history and modern ecosystem properties at the study sites, including soil and foliar biogeochemistry. Our records help contextualize large regional fire events, like those in 1910 and more recently, and reveal the rates and patterns of post-fire ecosystem recovery.

Keywords: paleoecology; disturbance; fire history; fire regime; biogeochemistry; ecological recovery

Bio: Kyra is an M.S. student in the Systems Ecology Program at the University of Montana. She is studying the causes and biogeochemical consequences of wildfires over the past 2500 yr in the Northern Rockies. Kyra graduated from Colorado College in 2016 with a B.A. in Environmental Science.

P44. Relationship of Soil Type and Burn Severity to Post-Fire Vegetation Response
Presenter: AudreyMaclennan, Master's Student, Oregon State University, College of Forestry, Forest Engineering, Resources and Management Department
Additional Authors: Jim Kiser, Instructor, College of Forestry Oregon State University
Chris Dunn, Research Associate, College of Forestry Oregon State University

Public lands in the Pacific Northwest are managed for multiple uses including timber production, recreation and aesthetic value, maintaining wildlife habitat, conserving native species, and carbon storage. Wildfires impact large areas encompassing broad environmental conditions. Interactions among underlying environmental gradients and alteration of overstory competition by fire of varying severities often leads to a diverse vegetation response in the post-fire environment. Plant community succession following a fire event is influenced by biotic and abiotic factors including the pre-fire community, burn severity, burn intensity, distance to nearest seed source, previous fires, and site specific topographic and soil characteristics. Many studies investigate vegetation response following wildfires within a few years of fire occurrence, leaving a knowledge gap about how conditions following a fire lead to more persistent vegetation communities. The 2003 B&B Fire Complex burned 36,000 hectares within the Metolius Basin on the Sisters Ranger District of the Deschutes National Forest. A unique feature of this particular landscape are the soils. These forest soils are highly irregular as a result of volcanic deposits from nearby Mount Washington, Mount Jefferson, and Three Fingered Jack. We hypothesize that soil type, and its interaction with burn severity, is strongly correlated with the observed vegetation response. The purpose of this study will be to characterize and model post-fire community response as a function of the interaction between burn severity and soil type in the B&B Complex Fire in Central Oregon, USA.

Keywords: Community ecology, post-fire landscapes, soil

Bio: Audrey Maclennan is a Sustainable Forest Management M.S. student at Oregon State University in the Forest Engineering, Resources and Management Department. She is interested in using silvicultural treatments and fire to create landscapes that meet multiple land use objectives.

P49. Comparison of two methods for quantifying coarse surface fuel loading
Presenter: Katelynn J.Bowen, Forester, Mark Twain National Forest
Additional Authors: Christopher R. Keyes, Research Professor, W.A. Franke College of Forestry & Conservation, University of Montana
Sharon M. Hood, Fire, Fuel, and Smoke Science Program, Rocky Mountain Research Station, US Forest Service
Carl Seielstad, Associate Research Professor, W.A. Franke College of Forestry and Conservation, University of Montana
Duncan Lutes, Fire, Fuel, and Smoke Science Program, Rocky Mountain Research Station, US Forest Service

Evaluating the impacts and effectiveness of fuel treatments commonly includes monitoring of surface woody debris. In this study, we aimed to compare planar intersect transect and fixed-area plot sampling methods for that objective. Both methods are commonly used in research and management but have tradeoffs in execution and accuracy that managers must consider. For this comparative analysis we used 2015 fuel sampling datasets from a northern Rockies ponderosa pine/Douglas-fir stand at western Montana's Lick Creek Demonstration/Research Forest. Our findings indicated that estimates at the stand level did not significantly differ by method. However, plot-by-plot, fixed-area plot sampling was more likely to capture CWD occurrence; transects estimated zero load on 23-47% of plots. Results of this study will provide forest managers with guidance for measuring coarse woody debris in this forest type.

Keywords: planar intersect sampling, Brown's transects, planar intercept, fixed-area plot sampling, monitoring, hazardous fuels, Pinus ponderosa, Pseudotsuga menziesii

Bio: Katelynn J. Bowen received her MS in Forestry from the University of Montana and is currently a forester for the Mark Twain National Forest in Houston, Missouri.

P50. Do You CBI What I See? Relationships among Multiple Field Measures of Burn Severity in the Interior PNW and US Northern Rockies
Presenter: SabaSaberi, Master's student, University of Washington
Additional Authors: Harvey, Brian, Assistant Professor, University of Washington

Increasing wildfire activity across western North America raises questions about how fire regimes are changing and how forests are responding to these changes. These potential alterations to fire regimes necessitate measuring and monitoring components of burn severity – the degree of ecological change caused by fire. Accurate measurement and quantification of burn severity is integral to understanding the ecological effects of fires as well as post-fire recovery processes. Many studies use the Composite Burn Index (CBI) protocol, developed primarily for calibrating satellite indices of burn severity. In CBI plots, burn severity is assessed in the field across five strata in the substrate, understory, and overstory. CBI calculations are produced by averaging ordinal ocular estimates of fire effects across the five vertical strata. To some degree, estimates depend on user familiarity with the forest ecosystem, which could lead to variation in consistently applying CBI as a calibration for remote imagery. Directly quantified field measures (e.g., char cover on the forest floor, charring/scorching of vegetation, and tree mortality) have also been used in burn severity studies, but how CBI relates to these quantitative measures of burn severity has not been widely tested.
In this study, we assessed relationships between CBI and other quantitative field measures of burn severity in recently burned forests across the Interior Pacific Northwest and the Greater Yellowstone Ecosystem. In the summer of 2017, we collected data in 87 field plots (~700 m2) that burned in 2016. In addition to recording CBI, we collected direct measurements of surface char cover, bole char height, deep charring on tree boles, bole circumference scorch, crown scorch height, post-fire needle retention, and tree mortality (by stems and basal area). For analyses, all variables were all averaged to the plot level. Spearman Rank correlations between CBI and other direct measurements ranged from r=0.48 to r=0.99. The highest correlations were between CBI and measures of canopy-tree burn severity, such as crown scorch height (r=0.99), percent bole scorch (r=0.91), and char height (r=0.94). Correlations between CBI were lower for variables measuring surface burn-severity, such as surface char cover (r = 0.88) and the level of deep charring on tree boles (r = 0.48). Further analyses will assess relationships between remotely sensed indices of burn severity (e.g., dNBR,

RdNBR, and RBR) and quantitative field measures. Ultimately, our study will help improve the accuracy of satellite-derived burn severity maps across the northwestern US.

Keywords: CBI, burn severity, field measurements, Interior PNW, Greater Yellowstone Ecosystem

Bio: Saba Saberi is a Master's student in the Harvey Lab in the School of Environmental and Forest Sciences at UW. She earned her BS in Environmental Science from the College of Natural Resources at University of California, Berkeley in the spring of 2017. Saba is interested in using remote sensing methods and GIS along with field studies to study how forests of the western United States respond to disturbances, especially within the contexts of climate change and forest management. A Southern California native, Saba is excited to live in and study the forests of the Pacific Northwest.

P51. Do trends in climate influence the increase in area of high-severity wildfire in the southwestern, US from 1984 to 2015?
Presenter: StephanieMueller, Graduate Student, Northern Arizona University
Additional Authors: Thode, Andrea, Associate Professor, Northern Arizona University
Yocom, Larissa, Assistant Professor, Utah State University

Over the past 30 years, in woodland and forested ecosystems across the southwestern US, there has been a significant increasing trend in total area burned and area burned at high severity. Climatic variability is a major driver of fire severity in these ecosystems and understanding how changes in climate are potentially influencing the increase in severity will guide future land use planning. This study will examine fire-climate relationships affecting the trend in increasing area burned at high severity from 1984 to 2015 using satellite-derived burn severity data, the relative differenced Normalized Burn Ratio (RdNBR), and coarse-scale weather and climate on burned areas in Arizona and New Mexico. This will include assessing potential trends in the energy release component (ERC) with gridded ERC data and relating this information to the variation in fire severity. We anticipate that trends in precipitation-drought and temperature indices, specifically, across the Southwest explain increasing severity over time. Managers will have to face the implications of increasing high severity fire in these woodland ecosystems as increasing temperatures and drought stress continue to drive their occurrence.

Keywords: fire severity, climate, ERC

Bio: Family trips out west as a child led her to pursue an undergraduate degree in Conservation Biology in her home state of Wisconsin. Recently she worked her way up through internships to a permanent position with the Bureau of Land Management working on post-fire rehabilitation and land management. These experiences spiked her interest in fire ecology and caused her to pursue her master's degree in Forestry at NAU. Her long-term goal is to work for a federal land management agency on conservation through fire management with the hope of helping to bridge the gap between science and management.

P53. Mechanisms of post-fire water repellency degradation
Presenter: EkaterinaRakhmatulin, Doctoral Student, UC Berkeley Civil and Environmental Engineering
Additional Authors: Sally Thompson, Associate Professor, University of California, Berkeley

"There have been multiple studies that describe the phenomena of the formation of a water repellent layer in soil after wildfires. This layer's location and degree of water repellency, or

hydrophobicity, largely depends on the organics present in the soil during combustion, fire temperature, and burn duration. While induction of water repellency has been well studied in post-fire soils, the mechanisms of its decay throughout time have been poorly studied.

The aim of this project is to characterize the degradation of soil hydrophobicity in post-fire soils in the context of Sierra Nevada montane watersheds. Soil samples were obtained from a coniferous forest and subjected to heat in a laboratory setting to simulate fire occurrence. The degree of hydrophobicity was measured using Molarity of Ethanol Drop (MED) test. A combination of five cycle regimes were applied to soil samples to isolate mechanisms of soil hydrophobicity loss. Studied regimes were: wet/dry, dry/freeze/thaw, wet/freeze/thaw, wet/freeze/thaw/dry, and wet/dry/freeze/thaw. Additionally, Fourier Transform Infrared (FTIR) spectra were obtained at the beginning and end of series of cycles to further investigate changes in soil properties for each regime.

Results show that the primary regime responsible for the degradation of soil's hydrophobic properties is a wet/freeze/thaw regime resulting in the greatest decrease in soil water repellency. On the other hand, dry/freeze/thaw regime resulted in no substantial change in hydrophobicity after many applied cycles. Results and observations suggest that soil wetting leaches compounds that contain hydrophobic groups, while freezing and thawing of wet soil alters soil's physical properties and creates preferential flow paths. "

Keywords: soil hydrophobicity, water repellency, wildfire, Sierra Nevada

Bio: Katya Rakhmatulina is a PhD student at UC Berkeley, working in Illilouette Creek Basin in Yosemite National Park and Sugarloaf Creek Basin in Sequoia-Kings Canyon National Park. She is studying the role of unsuppressed fires, within the context of changing climate, on hydrology and vegetation of the mountainous watersheds in the Sierra Nevada. The results of her research will aide in making important fire management decisions with the goal of minimizing catastrophic fires, promoting landscape diversity, and increasing water yield.

P55. Catchment-scale validation of a physically-based, post-fire runoff and erosion model
Presenter: DylanQuinn, Graduate Research Assistant, University of Idaho
Additional Authors: Brooks, Erin, Associate Professor, University of Idaho
Robichaud, Peter, Research Engineer, U.S. Forest Service - Rocky Mountain Research Station
Brown, Robert, Hydrologist, U.S. Forest Service - Rocky Mountain Research Station
Wagenbrenner, Joseph, Research Hydrologist, U.S. Forest Service - Pacific Southwest Research Station

After the flames, wildfire can induce profound ecological changes which affect watershed hydrology and downstream water quality, often resulting in extreme flooding, high sediment concentrations, and debris flows. Forest managers tasked with mitigating these cascading consequences need methods to evaluate the effectiveness of their decisions, particularly those affecting hydrological recovery. Various hillslope-scale interfaces of the physically-based Water Erosion Prediction Project (WEPP) model have been successfully validated for this purpose using fire-affected plot experiments, however these interfaces are explicitly targeted towards single hillslopes. In this validation study, we apply a spatially-distributed watershed version of the WEPP model to three forested catchments (W. Willow, N. Thomas, and S. Thomas) that burned in the 2011 Wallow Fire in Northeastern Arizona, USA. The performance of the model was assessed using five years of post-fire

catchment water yield, peak flow, and sediment delivery during the monsoon season. With calibration, the model shows close agreement with observed flow (NSE: ~0.70), and can reasonably estimate the magnitude of erosion at the hillslope and watershed. Without calibration, the model still performs well, which promotes its utility as a viable post-fire management tool.

Keywords: Post-fire Hydrology Modeling Sediment

Bio: Dylan is a current graduate student at the University of Idaho pursuing a M.S. in Water Resources in the Water Resources Graduate Program. His thesis topics explore the impacts of wildfire on soil and water using processed based hydrological models.

P57. The impact of US National Fire Danger Rating System (NFDRS) 1-day forecast accuracy on concurrent fire activity.
Presenter: NicholasWalding, PhD Candidate, University of Exeter
Additional Authors: Williams, Hywel, Senior Lecturer in Data Science, University of Exeter
McGarvie, Scott, Senior Research Fellow, University of Exeter
Belcher, Claire, Professor in Earth System Science, University of Exeter

The accurate prediction of fire danger indices, and their effective communication, are important factors when responding to wildfire activity. The US Forestry Service's NFDRS currently deploys 1-day forecasts of fire danger through the Wildland Fire Assessment System, and other state-focussed outlets. To date there has been no examination of how accurate these 1-day forecasts are when compared to observed NFDRS fire danger indices, and no consideration of how differing levels of forecasting inaccuracy corresponds to concurrent fire activity across the country. This study looks to consider these two factors in the following set of analyses. Firstly, spatial correlations of three forecasted and observed daily fire danger indices are conducted across the conterminous US over an eight year time period. Strong correspondence between forecasted and observed fire danger indices was found for the majority of regions across the US, however clear instances of over- and under-forecasted fire danger conditions were evident. Using a ±2 Standard Deviation boundary from 'prefect' forecast accuracy, populations of over-, under-, and correct-predictions of fire danger were created for each of the fire danger indices. These populations of inaccuracy were then examined both spatially and temporally against two metrics of wildfire activity; fire occurrence, and final fire size, in order to identify when and where NFDRS outputs were found to be inaccurate and how this potentially results in differing levels of fire occurrence or larger final fire sizes. The regions with the highest percentage of inaccurate forecasts were found to be in the Northern Rockies and Great Basin Geographic Area Coordination Centers (GACCs). Over-prediction was found to mainly occur between February and May, whilst peaks in the under-prediction of fire danger were found both in spring and late summer. These peaks also appeared to track peaks in fire occurrence and fire size through the year. When considering the relationships between inaccurate prediction and fire activity across the conterminous US, the majority of the country was found not to show significant correlations. However, in regions where significant correlations were found, these regions exhibited both strong positive and negative relationships. The findings from this study highlight how accurate the 1-day forecasts of fire danger conditions from the NFDRS are across the conterminous US and through the year. We identify spatial and temporal relationships between different forms of forecast inaccuracy and its impact on fire activity, which should have useful implications for future utilisation of the NFDRS by fire managers.

Keywords: fire danger indices, forecasting, fire activity, NFDRS

Bio: Nicholas Walding is a PhD researcher in the wildFIRE Lab at the University of Exeter. He graduated from the University of Exeter with a first class BSc Geography (Hons) degree in 2014 and his current research explores the economic impact of large wildfire events and assesses the US National Fire Danger Rating System by relating records of fire activity and fire danger across temporal and spatial scales in order to aid future fire management. His previous research has aimed to identifying future fire threats associated with future shifts in vegetation distributions in North America.

P59. A Comparison of Machine Learning Algorithms for Hyperspatial Mapping of Post-Fire Effects
Presenter: DaleHamilton, Assistant Professor of Computer Science, Northwest Nazarene University
Additional Authors: Hamilton, Dale, Assistant Professor of Computer Science, Northwest Nazarene University

Support Vector Machines (SVM), K-Nearest Neighbor (kNN), Naive Bayesian (NB) and Decision Tree (DT) common machine learning algorithms. When classifying an image, the SVM creates a hyper plane, dividing the input space between classes, classifying based upon which side of the hyperplane an unclassified object lands when placed in the input space. The kNN uses a system of voting to determine which class an unclassified object belongs to, considering the class of the nearest neighbors in the decision space. The NB builds a conditional probability model to determine the class of an unlabeled object. The DT builds an entropy based decision tree which is used to classify unlabeled objects. While all algorithms yield positive results regarding the accuracy in which they classify the images, the SVM provides better results than the other algorithms.

Keywords: sUAS, Burn Severity, Remote Sensing, Artificial Intelligence

Bio: Dale Hamilton and Brendan Peltzer

P60. Evaluation of Image Spatial Resolution for Machine Learning Mapping of Wildland Fire Effects
Presenter: DaleHamilton, Assistant Professor of Computer Science, Northwest Nazarene University
Additional Authors: Hamilton, Dale, Assistant Professor of Computer Science, Northwest Nazarene University

Many different machine-learning algorithms have previously been used to map wildland fire effects using satellite imagery from the Landsat satellites with 30-meter spatial resolution. Small-unmanned aircraft systems (sUAS) can capture images with five-centimeter (hyperspatial) resolution. Consequently, the amount of data needing to be stored and analyzed is greatly increased. There is a need for more tools that focus on extracting actionable knowledge from hyperspatial imagery and providing timely information for management of wildland fires. This analysis shows that the mapping accuracy of fire effects from hyperspatial imagery is increased over lower resolution imagery available from satellite systems. The classifier developed to do this analysis uses a Support Vector Machine (SVM) to determine the burn severity by classifying image pixels into canopy crown, surface vegetation, white ash, and black ash

Keywords: sUAS, Burn Severity, Remote Sensing, Artificial Intelligence

Bio: Dale Hamilton, Blake Johanson, Nicholas Hamilton

P62. Assessing the flammability of boreal broadleaf forest patches in interior Alaska
Presenter: MaijaWehmas, Master's Student, University of Alaska Fairbanks, School of Natural Resources and Extension
Additional Authors: Dr. David Verbyla, Professor, University of Alaska Fairbanks

Climate warming in boreal Alaska has changed the wildfire regime. As the fire regime changes, and an increase in broadleaf forest relative to conifer forest is likely, which may reduce landscape flammability. However, the current and future flammability of broadleaf forest in a warming climate is not well understood. We used pre-fire and post-fire geospatial data to investigative the flammability of upland boreal forest patches in Interior Alaska. Our objectives were to assess burning of broadleaf forest patches during Normal vs. Large Fire Years and by week within a fire season. Using 30-meter land cover and fire severity grids, we estimated the flammability of upland broadleaf forest patches during Large and Normal Fire Years. Moderate Resolution Imaging Spectroradiometer (MODIS) hotspots were used to track the spatial extent of burns during the fire season by examining the periods of fire activity and intensity. Flammability of broadleaf forest patches varied in time and space. Even in Normal Fire Years, broadleaf forest patches had substantial flammability, with a mean of over 50% patch area burned. Patch flammability was significantly higher during Large Fire Years. Broadleaves forest patches burned most frequently in late June-early July. Contrary to "conventional wisdom", broadleaf forest patches in boreal Alaska were susceptible to burning even during Normal Fire Years. With climate warming, the flammability of broadleaf forest is likely to increase due to more extreme fire weather events. Thus, although the frequency of broadleaf forest patches on the landscape is likely to increase with more frequent and severe wildfires, their effectiveness as a fire break may decrease in the future.

Keywords: Broadleaf, flammability, large fire years, temporal scale

Bio: Maija Wehmas is currently studying at the University of Alaska-Fairbanks to earn a Master of Science in Natural Resources Management building upon knowledge from the University of Wisconsin-Platteville where she received a Bachelor of Science in Biology. She works as a research assistant with her thesis investigating the flammability of broadleaves in Interior Alaska. Her research involves extensive use of ArcGIS in conjunction with the programming language Python.