M1 OK-FIRE: A Weather-Based Operational Decision Support System for Wildland Fire Management

Presenter: *Carlson, J. D., Associate Researcher, Oklahoma State University*
Additional Author(s):
Jabrzemski, Rafal, University of Oklahoma
Bain, Nathan, University of Oklahoma

"OK-FIRE" is an operational weather-based decision support system which has been developed over the past eight years for wildland fire managers throughout Oklahoma. Applications include wildfire anticipation/suppression, prescribed fire, and smoke management. Users include multiple federal and state agencies as well as local fire departments, emergency managers, and private landowners.

Using the Oklahoma Mesonet of 120 automated weather stations for current/past weather conditions and 84-hr forecast output (updated four times per day) from the North American Mesoscale model for future weather conditions, OK-FIRE offers a suite of past, real-time, and forecast products for fire weather, fire danger, and smoke dispersion accessible via a dedicated website (http://okfire.mesonet.org). Product formats include tables, charts, and maps capable of animation and zooming.
The fire danger model used in OK-FIRE is a modified form of the 1988 National Fire Danger Rating System (NFDRS). Modified versions of the 1988 NFDRS fuel models are used. Dead fuel moisture for 1-h, 10-h, 100-h, and 1000-h fuels is calculated via the Nelson model. Weekly 1-km resolution NDVI satellite data is used to estimate live fuel moisture as well as set the dynamic loads of live fuel and dead fuel in each 1-km pixel based on the fuel model assigned that pixel. Fire model output includes NFDRS indices such as burning index and spread component.
With respect to wildfire, OK-FIRE benefits include better anticipation of high fire danger conditions, the ability to determine optimal short-term staffing levels, and better suppression strategies during the wildfire itself. Benefits to prescribed fire include better pre-burn planning and management during the burn, as well as guidance for smoke management.
Since 2006 the first author has conducted regional training workshops throughout the state and has taught over 1000 fire professionals. OK-FIRE has seen explosive growth since its debut in 2006, an indication that the program is having an impact. In 2013 the website had over 27 million hits and the average monthly number of unique visitors was 5827. During the large wildfire outbreaks of August 2012, over 18,000 unique visitors consulted the website.
OK-FIRE, while specific to Oklahoma, should be of general interest to wildland fire managers since it can serve as a prototype for operational systems in other geographical areas. The oral presentation will give an overview of the OK-FIRE program, including its products, web site, and training, and also provide specific examples of output during past wildfire episodes.

Keywords: operational, fire danger, fire weather, decision-support

Bio: Dr. J. D. Carlson has been a faculty member since 1991 in the Biosystems & Agricultural Engineering department at Oklahoma State University, where he serves as fire meteorologist and manager of the operational OK-FIRE program. In particular, his expertise includes boundary-layer meteorology, fire danger, and atmospheric dispersion. His degrees include a BS in Physics from Michigan State University, an MS in Meteorology from the University of Wisconsin, and a PhD in Atmospheric Sciences from The

Ohio State University. Dr. Carlson is a member of the American Meteorological Society and a Fellow in the Royal Meteorological Society.

M2 Exposure of Human Populations To Wildland Fires: A Case For Multiple Landowner Mitigation

Presenter: *Haas, Jessica R., M.S.*
Additional Author(s):
Calkin, David, Research Forester, RMRS
Thompson, Matthew, Research Forester, RMRS

Wildfires are a global phenomenon that in some circumstances can result in human casualties, economic loss, and ecosystem service degradation. The objective of this study is to identify areas of highest exposure of human populations to wildland fires under extreme, but not uncommon weather events. In addition we aim to determine if the land ownership designation of wildfire ignitions provides differential levels of exposure to human populations, and therefore a high level of risk transmission. We quantify varying levels of exposure in terms of population affected by simulated ignitions within the Front Range of Colorado, USA. We use probabilistic fire simulation modeling to address where fire ignitions are most likely to cause the highest impact to human communities, and to explore the role that federal lands play in that transmission of risk. Our results indicated that, given an ignition and the right fire weather conditions, large areas along the Front Range in Colorado could be exposed to wildfires with high potential to impact human populations, and that overall private ignitions have the potential to impact more people than Federal ignitions. Thus, recent high loss wildfire events in the area are not necessarily unprecedented nor would it be unlikely to experience similar high loss events in the future. This work illustrates the value of using burn probability modeling to quantify the exposure of human populated areas to wildfire, and to identify areas of risk transmission. The results of wildfire exposure assessment can be useful for strategic planning efforts to address multi-stakeholder risk mitigation.

Keywords: human population exposure, risk transmission, WUI, Colorado Front Range

Bio: Jessica Haas is a spatial analysist for the National Fire Decision Support Center (NFDSC) economics research group. Her research is focused on using quantative spatial techniques and computer programming to develop wildland fire management decision support and risk assessment/mitigation tools and software. Current projects include incorporating future climate change weather scenarios into wildland fire simulation modelling to assess how wildland fire risk to highly valued resources may be changing in the future. She is also involved in projects related to Wildland Urban Interface mapping and risk assessment.

M3 Duration of the effectivity of long term retardants in preventive treatment. Field data

Presenter: *Mans, Vincent, Mr, General Manager, Budenheim Iberica*
Additional Author(s):
Enfedaque, Alberto, Mr, Operations Chief, Budenheim Iberica

A field study on duration of long term retardants is carried out taking data from prevetive applications like in railway sides and in fire breakes protecting housing zones. The effectivity of the flame retarding properties were evaluated by analyzing the phosphorous content in the vegetation samples. A

correlation with raining rates measured in meteo stations could conclude in real field numbers to predict how long the retardants can be effective.

Keywords: retardants, durability, efficiency, rain

Bio: Chemical Engineer.
General Manager at Budenheim Iberica.
Head of the Business Line Wildfire in Budenheim.
President of EAPFP (European Association for Passive Fiire Protection).
Involved in retardants and wildfires in Spain since 1980.
Author of related patents and articles.
Member of IAWF.

M4 Using Prescribed Fire To Reduce The Risk Of Smoke Related Traffic Problems On I-95

Presenter: *Steven R. Miller*

In many areas of the United States, prescribed burning near highways is considered too risky because of the potential for smoke impacts to the highway. In one area in Florida prescribed fire is used to reduce the risks of smoke related impacts to Interstate 95. The St Johns River Water Management District manages over 400,000 acres of land. Seventy percent of those lands are wetlands, and nearly 200,000 acres of the wetlands are marsh systems which require fire for their perpetuation. Some of those marsh acres are immediately adjacent to Interstate 95 near Cocoa, in Brevard County, Florida. Prior to 1993, the District had no formal wildland fire program. All wildland fire management responsibilities on District lands were abdicated to the Florida Division of Forestry. In the 1980's Florida suffered several severe droughts and associated wildfire seasons. On multiple occasions, the marshes next to !-95 supported lightning ignited wildfires when the sites were so dry that organic soils began to burn. These wildfires burned for weeks, resulting in smoke impacts to I-95, and even smoke related vehicle accidents. In 1989, the Division of Forestry requested that the Water Management District begin to participate in a program to use prescribed fire on a frequent basis, at least every third year, in an effort to reduce the risk of wildfires that could ignite the organic soil. It took some time for the District to build a program capable of conducting a complex 4600 acre prescribed burn using aerial ignition immediately adjacent to an Interstate Highway, but in 1996, the first prescribed burn was conducted. Since that time that burn zone has been burned five additional times. The conditions under which the zone is burned are very exact, but to date there have been no smoke related accidents from either prescribed burning or wildfires. In fact, despite being subject to several severe droughts, the area has not supported a wildfire since managed fire began.

Keywords: Prescribed Fire, Smoke, Fire Prevention

Bio: Bio for Steven R. "Torch" Miller
Steve graduated from the University of Wisconsin Stevens Point with a degree in Forest Administration in 1985. He has since worked for a private forestry consultant, the USDA Forest Service, Texas Forest Service, and Florida Division of Forestry and is currently the Chief of the Land Management Bureau for the St. Johns River Water Management District. In his present capacity, Steve is responsible for directing a multiple use land management program on over 600,000 acres, including a fire program whose goal is

to prescribed burn 65,000 acres/year. Steve has experience in both prescribed fire and fire suppression and is currently qualified as a Type I Burn Boss and a Type II Operations Section Chief. He serves as Operations Chief on the Florida Red Overhead Team. He is married and the father of two; one of whom aspires to be a second-generation forester and fire manager..

M5 Assessing the physiological drivers of the 'Spring Dip' in Jack Pine and Red Pine foliar moisture content and potential their relationship to extreme crown fire activity

Presenter: *W. Matt Jolly*
Additional Author(s):
John Hintz
Rachael C. Kropp
Elliott T. Conrad
Jim Barnier

Both firefighters and fire scientists have observed a period of peak crown fire activity in Jack pine (Pinus banksiana) and Red pine (Pinus resinosa) during spring that is coincident with a dip in live foliar moisture content. For decades, the cause and timing of this 'spring dip' have been poorly understood and its impact on fire behavior has been speculative. Here we summarize a study aimed at determining the cause of the spring dip and its impact on Jack pine and Red pine crown fire behavior. Foliar samples were taken from both tree species for one full year and needle moisture, chemistry, heat content, and flammability were determined in the laboratory. During that time, local firefighters documented fire behavior on wildland fires throughout the study area. We found that that foliar density, rather than absolute foliar water content, drove the apparent changes in measured live foliar moisture content and that density alone explained over 90% of the variation in foliar moisture content. The period of highest flammability occurred during the moisture content dip and was coincident with the timing of the most extreme fire behavior observed by local firefighters. This period corresponded with a 10-fold increase in needle starch content and a 20% increase in foliar density. We use these findings to explore their potential impacts on fire behavior using two CFD-based fire behavior models, FIRETEC and WFDS. These findings may lead to a new way of assessing live foliage flammability and they may help us to understand the causes of observed extreme crown fire behavior.

Keywords: fire behavior, moisture content, spring dip, jack pine, red pine

Bio: Dr. W. Matt Jolly is a Research Ecologist in the Fire, Fuel and Smoke Science Program of the US Forest Service, Fire Sciences Laboratory in Missoula, MT. He received a BA with high distinction in Environmental Science from the University of Virginia and a PhD in Forestry from the University of Montana. His main research interest is to improve our understanding of the roles that live fuels play in wildland fires and to use this improved understanding to develop predictive tools that can help support strategic and tactical fire management decisions.

M6 Challenges In Predicting Fire Behavior On The Wesley Fire

Presenter: *Richard McCrea*

The Wesley Fire started on Sept. 10, 2012 from a lightning strike in central Idaho, USA, on the Payette National Forest, eventually burning more than 15,000 acres. Much of the area of the fire was forested except for the south slopes which were a mix of sage and grass. Subalpine fir dominated the higher elevations with mixed conifer being the main vegetation type at the lower elevations.
This fire was very challenging due to the mountainous terrain, and the extreme dryness of the fuels, with the energy release component (ERC) for fuel model G (dense conifer stands with heavy accumulation of downed woody fuels) registering historic record or near record levels for the duration of the fire.

The terrain was very rugged with much of the area being roadless especially the north end of the fire. Fire crews on the Wesley fire encountered extreme fire behavior on several days with a high resistance to control, which made it difficult to contain the fire using direct line construction and burnouts. Weather data was obtained from one permanent remote automated weather station (RAWS), and three portable RAWS that were setup just for the incident. Weather forecasts and briefings were provided by an Incident Meteorologist (IMET). Fuels and vegetation data were obtained from the LANDFIRE system. Fire behavior predictions and briefings were completed by a Fire Behavior Analyst (FBAN) and a Long Term Analyst (LTAN) assigned to the fire using standard fire behavior tools such as the BEHAVE software program, and the Wildland Fire Decision Support System (WFDSS), coupled with direct observations of fire behavior in the field. Addition fire behavior prediction support was provided by Wildland Fire Management Research Development and Application (WFM RD&A) staff members, which was done virtually using the internet and email. WFM RD&A staff provided fire behavior projections using the WFDSS Near-Term Fire Behavior (NTFB) fire growth model.

Fire behavior predictions can be challenging with extremely dry fuels and complex topography. Fire teams on the Wesley fire effectively used an onsite FBAN, LTAN, IMET and virtual assistance from other fire behavior specialists to provide planning and support for this incident.

Keywords: Fire Behavior Predictions, Wesley Fire, BEHAVE, WFDSS, Extreme Fire Behavior, Fuels, Fire Behavior Analyst, Long Term Analyst, Fuels

Bio: Rich works as a wildland fire management consultant and freelance writer. During his career, he worked 32 years with the Department of Interior in fire management and forestry. Outfitted with a degree in Forestry, he started his career as a seasonal employee with the Forest Service as a forestry technician and member of the Helena Hotshot Crew, then moved on to permanent positions with the Bureau of Indian Affairs as a Forester and Fire Management Officer. Rich has considerable experience working with incident management teams including over 20 years' experience as a qualified fire behavior analyst.

M7 Automated Identification of Firefighter Safety Zones Using Lidar and Multispectral Data

Presenter: *Dennison, Philip*
Additional Author(s):
Fryer, Gregory, , University of Utah
Cova, Thomas, Professor, University of Utah

Lookouts, communications, escape routes, and safety zones (LCES) are critical components of a system designed to protect wildland firefighters from entrapment and burnover. Safety zones include both a “safe area” large enough to contain personnel and equipment and a “separation distance” that reduces heat exposure. High resolution lidar and multispectral remotely sensed data can provide detailed spatial information on fuels and topography, allowing automated identification of potential safe areas. We will demonstrate a flexible method that incorporates canopy height retrieved from lidar data, the number of personnel and pieces of equipment, terrain slope, and flame length to map safe areas within a 22 square km (8.5 square mile) area of the southern Sierra Nevada. Safe areas large enough to shelter 20 firefighters and 2 pieces of heavy equipment were relatively rare, covering less than 0.5% of the study area at 4 m (13 ft) flame length. The number and size of safe areas decreased as flame length was increased up to 10 m (33 ft). Distance to the closest road was also determined for each safe area. While any safety zone requires field verification, automated mapping methods may provide multiple options for safety zones, reducing the risk of firefighter injury and fatality.

Keywords: safety zone, entrapment, flame length, lidar, remote sensing, spatial modeling

Bio: Dr. Philip Dennison is an Associate Professor of Geography at the University of Utah and Director of the Utah Remote Sensing Applications (URSA) Lab. Dr. Dennison and his students use remote sensing to map vegetation species and functional types, measure vegetation characteristics related to fire danger, insect damage, seasonal cycles, and invasive species, and to directly measure fire or atmospheric properties.

M8 Using Terrestrial LiDAR to Model Shrub Fuel Beds for Fire Behavior Simulation

Presenter: *Adams, Theodore*
Additional Author(s):
Seielstad, Carl, Fire and Fuels Program Manager / Associate Professor, University of Montana-Fire Center

Terrestrial LiDAR provides a basis for accurate, replicable fuel inputs to a variety of 3-D fire models. At present, this application of technology has not yet been demonstrated, and the state of science for fuel models remains semi-statistical distributions of fuel elements within simple volumes such as cubes and spheres. In diffuse-form shrubs such as chamise and sagebrush, the absence of discrete fuel elements presents additional complications for fire modelers. The purpose of this study was to develop fuel matrices for chamise and sagebrush at very fine resolution for use in sub-grid fire behavior simulations. T-LiDAR was used to characterize the spatial distribution of biomass in laboratory fuel beds before and after combustion. T-LiDAR’s ability to characterize physical traits of shrubs within volumes was tested and issues associated with misrepresenting the geometry of scanned samples were identified. Occlusion of biomass in fuel bed interiors remains a shortcoming of the technique that requires generalization of at least part of the fuel bed. Despite the limitations of T-LiDAR in this setting, the findings of the study show that the technology can be used to estimate volume, structure, and biomass for individual shrubs. Models relating filled volume to fuel mass (Adj. R2: 0.598, P-Value: 0.0012) and mass loss following combustion (Adj. R2: 0.7796, P-Value: <0.0001) show considerable improvements over current methods of fuels estimation and have potential for broader application in fire modeling.

Keywords: T-LiDAR, 3D Fuels Models, Fire Behavior Input

Bio: Ted Adams is a research assistant for the Fire Center and a wildland firefighter on the Payette National Forest. Ted has been fighting fire since 2006, working in Wyoming and Nevada before Idaho. Ted completed his B.S. in Environmental Science at the University of Idaho with a certificate in Fire Ecology and Management. Currently, he is completing his M.S. in Forestry at the University of Montana. When not in study or on the line, Ted enjoys fly fishing, back-country snowboarding, or hiking. Ted might also be found enjoying one of the fine local brews from Montana or Idaho.

M9 Overview of Ongoing Field and Modeling Studies in Oklahoma for Dynamic Grassland Fuels

Presenter: *Carlson, J. D., PhD, Associate Researcher, Oklahoma State University*
Additional Author(s):
Engle, David, Oklahoma State University
Twidwell, Dirac, University of Nebraska
West, Andrew, Oklahoma State University
Fuhlendorf, Sam, Oklahoma State University
Ochsner, Tyson, Oklahoma State University

Herbaceous fuels play a critical role in fire behavior not only in grasslands but also in mixed fuel complexes where herbaceous fuels are a sizeable component. It is these fuels which are frequently involved in the initiation and maintenance of wildland fire. Thus, they are a fitting subject for study, especially considering the enormous land area over which they occur worldwide. During the 2005-2006 fire season, thousands of quick-moving grassland fires burned over 3 million acres in Texas and Oklahoma alone, while claiming 25 lives and destroying over 1100 homes.
Some of the biggest unknowns in fire danger/behavior modeling pertain to live and dead fuel loads, as well as live fuel moisture (not only what the values are but also how they change throughout the year). Current methods to model these variables have also largely ignored the effect of soil moisture on fuels. Soil moisture networks are increasing in spatial density across the country, yet the science to support the use of such data in fuel modeling is lacking.
A research project is currently being conducted in Oklahoma to study the dynamics of grassland fuels. Using intensive biweekly field sampling from 2012 and 2013, dynamic vegetation models will be developed and later evaluated for grassland fuels under variable fire and grazing regimes. Variables to be modeled include live and dead herbaceous fuel loads, live-to-total fuel load ratio, and live fuel moisture. A variety of input data will be used for modeling purposes: weather and soil moisture data, and remote sensing data from satellites and a hand-held spectrometer.
The presentation will focus on the intensive field study of perennial grasslands that took place in 2012 and 2013. Grassland fuel bed properties were sampled biweekly in each of nine patches (each approximately 1/6 by 1/4 mile). Each sampling consisted of field weighing of six separate live fuel and dead fuel clippings as well as the overall live-dead mix taken from within a 0.25 m2 quadrat at 12 locations along a transect. From the separate live and dead fuel samples, live and dead fuel moisture were calculated (after oven drying), and the live and dead fuel loads estimated using the constituent differential method. In addition, other variables were measured, such as fuel bed depth, canopy reflectance in five different wavelength bands using a hand-held spectrometer, and surface-to-volume ratio. The presentation will conclude with brief mention of another related project involving unmanned aerial vehicles.

Keywords: grassland fuels, wildland fuels, fuel moisture, fuel loads

Bio: Dr. J. D. Carlson has been a faculty member since 1991 in the Biosystems & Agricultural Engineering department at Oklahoma State University, where he serves as fire meteorologist and manager of the operational OK-FIRE program. In particular, his expertise includes boundary-layer meteorology, fire danger, and atmospheric dispersion. His degrees include a BS in Physics from Michigan State University, an MS in Meteorology from the University of Wisconsin, and a PhD in Atmospheric Sciences from The Ohio State University. Dr. Carlson is a member of the American Meteorological Society and a Fellow in the Royal Meteorological Society.

M10 Practical Tools for Assessing Potential Crown Fire Behaviour and Canopy Fuel

Presenter: *Alexander, Marty, PhD, RPF, Adjunct Professor, Department of Renewable Resources and Alberta School of Forest Science and Management, Univesity of Alberta, Edmonton, Alberta, Canada*
Additional Author(s):
Cruz, Miguel, Research Scientist. CSIRO Ecosystem Sciences, Canberra, ACT, Australia

This poster will provide overviews of two software applications developed by the authors, namely the Crown Fire Initiation and Spread (CFIS) system and the Canopy Fuel Stratum Characteristics Calculator. Both of these tools are based on research that has appeared in the scientific peer-reviewed literature and that have also under gone several performance evaluations with good results. CFIS incorporates models designed to simulate several aspects of crown fire behaviour (e.g., crown fire occurrence or initiation, type of crown fire, and crown fire rate of spread). CFIS has applicability as a decision support aid in a wide variety of fire management activities ranging from near-real time prediction of fire behaviouur to analyzing the impacts of fuel treatments on potential crown fire behavior. The Canopy Fuel Stratum Characteristics Calculator is based on regression equations for estimating the canopy base height, bulk density and fuel load in ponderosa pine, lodgepole pine, Douglas-fir and mixed conifer fuel types based on three stand characteristics (average height, basal area and stand density that have now been programmed into an excel spreadsheet. Table versions of the calculator also exist.

Keywords: fire and fuel dynamics, fire and fuel potential, fire modelling

Bio: Dr. Marty Alexander retired in November 2010 as a Senior Fire Behavior Research Officer with the Canadian Forest Service stationed at the Northern Forestry Centre in Edmonton, Alberta, following 34.5 years of public service and now serves as an Adjunct Professor at the University of Alberta. His research and technology transfer has focused on practical applications of wildland fire behavior knowledge. His work over the years has taken him to many parts of the world, including the continental USA and Alaska, Australia, New Zealand, Portugal, Greece, Italy, Fiji, and Turkey, as well as every Canadian province and territory.

M12 WIFIRE: A Real-Time Cyberinfrastructure for Wildfire Sensing and Prediction

Presenter: *Jessica Block, Research Associate, Qualcomm Institute at UCSD*
Additional Author(s):
Michael Gollner, Assistant Professor, Department of Fire Protection Engineering at the University of Maryland

Arnaud Trouve, Associate Professor, Department of Fire Protection Engineering at the University of Maryland
Raymond de Callafon, Associate Professor, Mechanical and Aerospace Engineering at UCSD
Ilkay Altintas, Director for the Scientific Workflow Automation Technologies Lab, SDSC at UCSD
Hans-Werner Braun, Director, HPWREN at UCSD
Larry Smarr, Director, Qualcomm Institute at UCSD

WIFIRE (wifire.ucsd.edu) is a UC San Diego project in collaboration with the University of Maryland and funded by the National Science Foundation that is doing research on ways to integrate large amounts of real-time data related to wildfire in order to pro-actively respond to fire hazards as fast as weather and fire conditions are able to change. Examples of the data being integrated are weather sensors, satellite images, web cameras, and physics models which will be utilized to determine and predict fire locations and responses.

WIFIRE is leveraging San Diego's networked environmental sensor data, merging weather sensors from the UCSD-based High Performance Wireless Research and Education Network (HPWREN), San Diego Gas and Electric Company (SDG&E), and Federal sensor networks to create a community of meteorological sensors at a scale, complexity, and resolution that is unprecedented. The combined set of weather sensors is the densest in the US and will be used to develop an accurate way of modeling rate of spread and perimeter updates in real-time during a fire. This high spatial and temporal resolution of weather data makes San Diego an excellent place to prototype real-time data-driven prediction for large wildland fires.

Based on the expertise of our team and experiences working with wildfire communities, WIFIRE is being built with extensive data management and visualization tools using cyberinfrastructure at the San Diego Supercomputer Center. Software designed by the team will build scientific workflows to coordinate the execution of real-time data processing and fire propagation tools on distributed computing environments. Further approaches include signal processing for data assimilation, parameter estimation and wildfire spread prediction, and portals for dissemination of data to different end users that include scientists, first responders and public notification of user-defined real-time alerts via various receivers and Web 2.0-based public systems. The scientific workflow component includes all real-time data processing tools for data assimilation of different wildfire spread models, recursive parameter estimation, and real-time prediction of wildfire spread. WIFIRE's end goal is to provide an open source tool for first responders, researchers, and the public to monitor and analyze the rapidly changing ecology of Southern California in order to make it a safer and more sustainable place to live in the face of changing climate dynamics.

Keywords: cyberinfrastructure, modeling, alerts, sustainability, fire management, visualization, data management

Bio: Jessica Block is a staff research associate at UC San Diego's Qualcomm Institute. As an interdisciplinary geologist, she studies the dynamic relationship between urban and wildland environments focusing on wildfire hazards, water resource management, and tectonics. After receiving her BS in geology from UCLA, she researched geologic hazards for the US Geological Survey in the Pacific Northwest. Her MS in geological sciences from Arizona State University has a focus on Urban Ecology and Sustainability. Her work is stakeholder-driven and is currently researching the use of technologies for wildfire response in collaboration with firefighters across the US, Australia, and Spain.

M13 Extreme temperature conditions and wildland fires in Spain

Presenter: *Cardil A, PhD Student, University of Lleida*
Additional Author(s):
Molina, Domingo, PhD. Professor, University of Lleida

Extreme temperature events have consequences for human health and mortality, impacts on forest disturbance patterns, agricultural productivity, and the economic repercussions of these consequences combined. These extreme temperature events are also known as negative impacts on forest fires. This work analyzes the effects of high temperature days on medium and large fires (those larger than 50 ha) from 1978 to 2010 in Spain A high temperature day was defined when air temperature was higher than 95th percentile of air temperature at 850 hPa in the 4-month study period from June to September. Temperature at 850 hPa was chosen because it properly characterizes the low troposphere state, and some of the problems that affect surface reanalysis do not occur. The number of high temperature days increased significantly in many areas in Spain, mainly in the Mediterranean Coast. Their effects on forest fires were remarkable and significant in terms of fire number (15 % of total medium and large fires occurred under high temperature days), burned area (25 % of the total burned area occurred under high temperature days) and fire size. Fire size was significantly higher under condition of high lower troposphere temperature. Additionally, both number of fires and burned area decreased under non high temperature days but not under high temperature days.

Keywords: forest fire, temperature, climate change, Spain

Bio: Adrián is a PhD student at the University of Lleida. He has a bachelor degree with honors in forest engineering and has published 5 papers in different international journals. He has attended to several international conferences. His work fall in the field of climate change and forest fires.

M14 Synoptic Weather Regimes Associated with Dormant-Season Wildfire Outbreaks in the Southern Great Plains

Presenter: *Carlson, J. D., PhD, Associate Researcher, Oklahoma State University*

The southern Great Plains, which includes large portions of the states of Texas, Oklahoma, and Kansas, is subject to frequent wildfires in grasslands as well as in other fuel complexes. A large portion of these states consist of wildlands, and their presence, combined with certain synoptic weather patterns, result in high fire danger periods, especially during late fall through early spring when native grasses and deciduous woody fuels are dormant.
This presentation will focus on three synoptic weather regimes that are associated with wildfire outbreaks in the southern Great Plains during the dormant season. Using selected wildfire outbreaks identified during the 2009 through 2011 dormant seasons, the presentation will illustrate the synoptic regimes using Oklahoma weather and fire danger conditions as monitored by the Oklahoma Mesonet of 120 automated weather stations and as calculated by the fire danger model in the OK-FIRE system, an

operational tool for wildland fire management. Radar and satellite imagery will also be used to show the location of the wildfires in the scenarios discussed.
The three synoptic weather regimes to be discussed are as follows: (1) pre-trough, where the region is on the back (west) side of a high pressure region with moderate to strong S / SW winds and the air mass is dry (moisture return is limited or blocked out); (2) post-frontal, in which a dry air mass enters the region with moderate to strong NW / N winds behind a cold front; and (3) dry line, with strong W / SW winds and extremely dry air behind (to the west of) the dry line. In situations (1) and (2) a large portion of the geographical area experiences low relative humidity (RH), while in (3) there is a strong RH gradient across the dry line, with very low RH to the west and much higher RH to the east.
The presentation will utilize some striking examples of wildfire outbreaks occurring under each of the three synoptic weather regimes discussed above. Examples of wildfire outbreaks in the pre-trough regime (1) include wildfires during January 29, March 11, April 2, April 5, April 17, and April 29, 2011. Post-frontal regime (2) wildfire outbreaks will be illustrated by fires occurring on March 23 and April 15, 2011. Finally, the dry line regime (3) will be represented by the intense wildfire outbreaks of April 9, 2009, which consumed 117,000 acres and destroyed 228 structures.

Keywords: fire weather, fire danger, synoptic weather regimes, dry line

Bio: Dr. J. D. Carlson has been a faculty member since 1991 in the Biosystems & Agricultural Engineering department at Oklahoma State University, where he serves as fire meteorologist and manager of the operational OK-FIRE program. In particular, his expertise includes boundary-layer meteorology, fire danger, and atmospheric dispersion. His degrees include a BS in Physics from Michigan State University, an MS in Meteorology from the University of Wisconsin, and a PhD in Atmospheric Sciences from The Ohio State University. Dr. Carlson is a member of the American Meteorological Society and a Fellow in the Royal Meteorological Society.

M16 California Wildfire in a Changing Climate and Built Environment

Presenter: *Michael Mann PhD*
Additional Author(s):
Moritz, Max, Fire outreach, UC Berkeley ESPM
Berck, Peter, Assistant Professor, UC Berkeley Economics
Batllori, Enric, Postdoc, UC Berkeley ESPM
Waller, Eric, PhD Candidate, UC Berkeley ESPM
Krawchuck, Meghan, Assistant Professor, Simon Fraser University

Climate and weather constitute key drivers of regular fire occurrence over California. However, humans are responsible for igniting over 95% of wildfires in California, and bear the lion's share of its consequences source. Drawn by natural amenities, a ballooning housing sector, and enormous state and federal subsidies, Californians have rushed to build on the fire-prone edges of the urban-wildland interface (WUI). In this paper we examine the role of historical determinants of wildfire in California and explore the effects of a changing climate and built environment. We find that total burned area is expected to increase but at a decreased rate. On the other hand, with continued development on fire-prone land, damages to human settlements are expected to triple by 2050.

Keywords: Wildfire costs, climate change, housing development, California

Bio: After working in the horn of Africa, Michael Mann received his masters in Environmental Policy and Management and PhD in quantitative Geography from Boston University. His current work started at UC Berkeley looks at the economic and social costs of residential development in fire-prone areas throughout California. Michael has published peer-reviewed journals including Proceedings of the National Academy of Sciences, European Central Bank Working Papers, Energy Journal, and Ecological Economics. He has widely applied his modeling skills to topics as diverse as land-use change in the Amazon, oil price determination, and the role of Chinese sulphur emissions on global temperatures.

M17 Fire Weather Associated with the New Mexico (USA) June 2012 Little Bear Fire

Presenter: *Fred J. Schoeffler*

On Monday, June 4, 2012, the Little Bear Fire was ignited by a lightning strike, near White Horse Hill in the White Mountain Wilderness area on the Smokey Bear Ranger District (SBRD) of the Lincoln National Forest (LNF) in southern New Mexico (NM).

Initial and extended attack wildland firefighting resources successfully worked on containing the fire for the next several days.

By June 8, 2012, the firefighters had the fire virtually contained at eight (8) acres (3 hectares) and felt fairly comfortable with their efforts. However, dry air intrusions advected into the Southwest and influenced the fire weather for the worse. In addition, due to a lee-surface trough in advance of an approaching upper trough and associated cold front, the fire weather changed drastically and progressively increased the fire behavior. The firefighters faced single digit relative humidity (RH) and stout, steady winds throughout the preceding night while they attempted to keep it contained.

The firefighters experienced fairly high nighttime temperatures, very low RH, and increasingly strong, downslope winds throughout the early morning and daytime hours on 8 June vastly increasing the fire behavior. Single tree torching led to group torching down below the fire lines, and resulted in several long-distance spot fires over the ridge and beyond the firefighters' positions into the tall, thick cured grass. Between 1300 and 1400 MDT, with very low RH and strong downslope winds, the fire behavior and spotting further intensified. This resulted in the fire aggressively sweeping into the dense conifer thickets and very heavy dead and down fuels and grew to 100 acres. It would be 1,000 acres by the day's end and exhibit very aggressive and very intense downslope fire behavior. The fire would ultimately be 100% controlled on 2 July 2012 after burning 44,330 acres (17,939 hectares) and 254 homes and structures.

I suggest that the fire weather originated and continued to persist from a series of dry air intrusions and dry slots that advected into the Southwest and the fire area. Among other factors, I also suggest that the intense fire behavior was the result of lee-slope eddying and channeling, a concept examined by some Australian meteorologists and researchers. I further investigate this mechanism in the paper. Weather elements that will be analyzed include humidity, Haines Index, wind, overnight temperatures, and drought conditions. Ensemble air parcel trajectories will also be included to determine the origin(s) of the dry air.

Keywords: Little Bear Fire, dry air intrusions, dry slots, high nighttime temperatures, lee-slope eddying, channeling

Bio: Retired from the U.S. Forest Service in 2007 after 34 years in fire management, 26 of those as the Payson Hot Shot Superintendent. Stay active on wildfires as a Call-When-Needed Fireline Supervisor. Actively involved in researching mid- to upper- level atmospheric influences on wildland fire weather.

M18 Firefighter Observations on Mountain Pine Beetle Post-outbreak Lodgepole Pine Fires: Expectations, Surprises and Decision-making

Presenter: *Moriarty, Kevin, Master's Candidate, Colorado State University*

Recent wildfires in mountain pine beetle (Dendrocronas ponderosae; MPB) post-outbreak lodgepole (pinus contorta var. latifolia) stands in the western United States have generated concern among stakeholders and disagreement over predicted fire behavior in the scientific literature. A study was conducted of wildland firefighters' observations of fire behavior in beetle-killed lodgepole pine forests to garner a better understanding of expected vs. observed fire behavior, with a focus on what fire behaviors surprised firefighters. Twelve MPB post-break wildfires and one prescribed fire were identified in northern Colorado and southern Wyoming using USDA aerial surveys, USGS MODIS based perimeter mapping and local knowledge. Twenty-eight wildland firefighter interviews were conducted among 7 different federal, state, county, local and non-profit agencies with a total of 55 observations. Expectations, observations, surprising fire behavior and tactical decisions were categorized using qualitative coding and interpretation. Expectations were greatly based on prior wildland fire experiences rather than the scientific research results. Surprising fire behavior in the red phase included increased fire behavior in moderate conditions, increased spotting, faster crown fire transition and crown fire transition with limited or no ladder fuels. Surprising fire behavior in the grey phase included crown ignition and crown fire propagation. Observations support the hypothesis of increased fire behavior in MPB post-outbreak red phase and diverge from studies predicting reduced crown fire potential in red and mixed phases. Firefighters formed new expectations of active fire behavior potential in all weather conditions and MPB phases. However, respondents concluded that specific conditions of fuel, weather and topography are the main driving forces in fire behavior and MPB influence was limited to distinct events. Firefighters changed tactics by taking more indirect suppression approaches due to fire behavior and tree hazard.

Keywords: Fire Observations

Bio: Before Kevin returned to school in pursuit of a master's degree in fire science, he worked for fifteen years in the field of natural resources and the last eleven in fire. Kevin has worked on an engine, hotshot crew, fuels crew and wildland fire module for the U.S. Forest Service, National Park Service and the Nature Conservancy. As CSU president of SAFE, Kevin has implemented a graduate level seminar with 6 distinguished speakers, conducted two prescribed fire trips students who in turn burned 7,000 acres in Nebraska and organized a High Park fire field trip to examine fuel treatment effectiveness. In addition, Kevin has help raised over 5000 dollars in travel grants for CSU SAFE to support field trips and conferences. As national president of SAFE, Kevin has helped solidify and distribute 10,000 dollars in SAFE chapter funding.

M19 Can We Automatically Cluster Historical Wildfire Behavior to Assist Rapid Risk Mapping

Presenter: *Guerin, Stephen, CEO, SimTable*
Additional Author(s):
Gattiker, James, PhD, Los Alamos National Laboratory

Historical wildfire records can be used to derive empirical relationships that help to understand the nature of future fires, using machine learning clustering and agent-based modeling approaches. Information available during an wildfire event includes: detailed terrain, recent climate, coarse indications of fuel type and fuel load, and current and forecasted wind, precipitation, and temperature. Characterization of historical wildfires using these quantities allows an empirical understanding of fire spread that can be used in several ways. The characteristics of fire spread can suggest refined indicators of potential fire hazard and mitigation strategies. Similar previous fire events can be recalled during fire situation assessment to provide qualitative guidance on possible fire behavior. Simple semi-empirical models of fire progression can be tuned on these historical relationships to assess likely fire progression. More complex models can be calibrated based on the extracted historical targets. A critical aspect underlying these assessments is the quantification of uncertainty. There is an inherent high uncertainty in many aspects of wildfire assessment and projection due to inherent limitations in dataset detail and phenomenological models. Therefore, a particular challenge in ongoing wildfire characterization is development of approaches that will appropriately express uncertainty in datasets and inferences. This talk will present the results of the ongoing research project in these areas.

Keywords: situation awareness, wildfire datasets, wildfire modeling, uncertainty quantification

Bio: Stephen Guerin is currently president of RedfishGroup and CEO of SimTable. His work centers on the design and visualization of self-organizing systems. He recently worked as a Senior Software Developer at BiosGroup and participated as a member of Stuart Kauffman's research group. There, he created Complexity Science-based applications for Fortune 100 and Government clients.

M20 Wildfire Risk and Treatment Effectiveness of Protecting Highly Valued Resources and Assets with Fuels Management

Presenter: *Thompson, Matthew*
Additional Author(s):
Cochrane, Mark, Professor, Geospatial Sciences Center of Excellence, South Dakota State University
Freeborn, Patrick, Geospatial Sciences Center of Excellence, South Dakota State University
Gilbertson-Day, Julie, Rocky Mountain Research Station, US Forest Service
Jon Rieck, Rocky Mountain Research Station, US Forest Service

A critical component for fuel treatment and pre-suppression planning is an understanding of the conditions under which fuel treatments will be effective. Characterizing fuel treatment success depends on ascertaining how treatments alter spatial patterns of wildfire likelihood and intensity within and outside of treated areas, as well as how treatments affect suppression operations. We will present results of an expansive analysis of historical wildfire-treatment interactions, in which we attempt to characterize treatment success as a function of treatment type, treatment age, fire weather conditions,

and suppression operations. Importantly, our analysis framework considers previous wildfires as a form of fuel treatment, enabling quantification of the influence of landscape-scale treatments on fire activity. Our analysis is premised on the coupling of Earth observation data and wildfire incident records with stochastic wildfire simulations, geospatial analysis, and risk assessment methods. We will summarize results quantifying how the presence of fuel treatments altered patterns of burn probability and the exposure of highly valued resources and assets to wildfire. We will further describe how this information can be integrated into suppression response planning, in particular as it relates to the spatiotemporal pathways for treatment-wildfire interactions and measures of suppression effectiveness and safety. Lastly, we will present select results from a case study of the 2011 Las Conchas Fire, preliminary results for which indicate substantial influences of past fire scars on suppression effectiveness. To conclude, we will discuss how this information can expand our understanding of risk-based assessment of fuel treatment effectiveness, and can ideally be used to foster linkages at the nexus of fuel treatment planning, pre-suppression planning, and wildfire incident decision making.

Keywords: risk; fire and fuels planning; decision making

Bio: Background in systems engineering (BS), industrial engineering and operations research (MS), forest management (MS), and forest engineering (PhD). Research Forester since 2009 working on wildfire economics, risk analysis, and decision science.

M21 Planning for Future Ignitions in the Tenmile Municipal Watershed, Helena National Forest, Montana

Presenter: *Gilbertson-Day, Julie, Biological Scientist, Rocky Mountain Research Station*
Additional Author(s):
Thompson, Matthew, PhD, Research Forester, Rocky Mountain Research Station

The Tenmile municipal watershed supplies drinking water to the city of Helena and surrounding communities. In the last decade, the forested watershed, like much of the surrounding forest-land has experienced extensive insect-based disturbances. Nearby residents, water company representatives, and Forest officials fear the outcome of wildfire ignition in this area. Additionally, the watershed holds a historic, wooden-trestle, water supply flume that transports water from the Chessman Reservoir approximately 5 miles to the Scott Reservoir. Protecting the flume is a high priority for the water company and much of it resides on Forest land. The Helena National Forest and USDA Forest Service Region 1 personnel sought input from the Rocky Mountain Research Station to help identify areas of greatest impact for fuel treatment and fire mitigation – with hopes that strategically placed fuel treatments could both reduce negative fire effects on the watershed and at the same time reduce likelihood of fire transmission to nearby communities. Treatment design challenges in this landscape stem from mixed ownership, steep terrain, and roadless areas. The risk assessment process and fuel treatment objectives and subsequent evaluation criteria can lend support to the NEPA process and facilitate decision making and implementation.

Using simulated fire perimeters from the large fire simulation system (FSim) and methodology based on the emerging 'fireshed' concept for fire-adapted community planning, this research examines where ignitions burn the largest portion of the watershed and highlights stands most likely to transmit risk to communities and structures. This presentation will primarily focus on the innovative methodologies

used in the planning process to highlight areas of high risk under current and future landscape conditions, including how the fire modeling landscape was updated to reflect beetle kill. Finally, I will briefly summarize how these analyses were used by the Helena National Forest in their planning process to date, including how the fire modeling informed treatment design strategies to reduce exposure to the watershed and transmission of risk to nearby communities.

Keywords: fireshed, FSim, fuel treatment planning

Bio: Julie conducts spatial analysis and provides wildfire economics research support for the National Fire Decision Support Center in Missoula, Montana. Current research interests include data and spatial scale issues related to wildfire modeling and risk assessments, downscaling regional wildfire risk assessments, historical fire and fire expenditure data analysis, fire behavior modeling and using risk assessment tools to identify potential fuels treatment locations.

M22 From Sensor to Incident Commander, The Silver Fire 2013

Presenter: *Hansen, Cassandra, PhD Canidate, University of Nevada, Reno, GIO FireWhat.Inc*
Additional Author(s):
Hansen, Cassandra, PhD Canidate, University of Nevada, Reno, GIO FireWhat.Inc
Doherty, Paul, Disaster Response Program, ESRI
Avela, Ryan, COO FireWhat.Inc

Wildfires in the Western United States are a natural and inevitable occurrence, yet changing conditions have increased the risk to human populations in the wildland urban interface. Since the 1990's, the response to these events have relied heavily on the use of traditional geographic information systems (GIS) for planning and operations. However, with evolution of more advanced information systems, GIS can now be used as a platform for sharing geographic information in new and innovative ways. Here we provide a case study as an example to raise awareness and discuss best practices going forward. The Silver Fire started on August 7, 2013 but ended up making wildland fire history. The Silver Fire was an extremely fast moving fire in a populated area of Banning, California. It destroyed 48 structures and burned over approximately 20,292 acres. At the peak of this fire there were over 2,106 fire personnel on scene. Yet, the response to this fire was dramatically altered with the integration of remote sensing, traditional GIS, and WebGIS. For instance, the delivery of wildfire location and geographic extent from an infrared sensor to an incoming incident management team was shortened from 12 hours to 40 minutes via dynamic web maps. We will describe the impact and show examples of WebGIS on the timeliness of information sharing for planning, operations, and public information and hope to provide an informative framework for future response.

Keywords: Applied Geography, Disaster Response, Web GIS, Wildfire

Bio: Sam Lanier has worked in a vast array of professional fields in the government, public, and non-profit sectors. He is co-founder and CEO of FireWhat.Inc which is the parent company of wildlandfire.com. His goal is to create a better way in which information is shared among the Fire and Emergency Services Communities. Lanier believes that by incorporating technology into the Fire and Emergency Services, a safer, better trained and more efficient work force will emerge.

M23 JFSP Project: Risk Perception, Sensemaking and Resilient Performance: The Sounds of Wildland Firefighting in Action

Presenter: *Thomas, Dave. Consultant, Renoveling, Ogden, UT.*
Additional Author(s):
Ziegler, Jennifer, Dr. Graduate Program Director Department of Communication, Valparaiso University, Valparaiso, IN.
Gabor, Elena, Dr. Assistant Professor, Organizational Communication, Bradley University, Peoria, IL
Fox, Rebekah, Dr. Assistant Professor, Department of Communication Studies, Texas State University-San Marcos, TX

In this presentation we describe the research objectives for a 2015 Joint Fire Science Plan project dealing with communications processes wildland firefighters use in sizing up and controlling wildfires. Managing wildland fire is an exercise in risk perception, sense-making and resilient performance. Risk perception begins with sizing up a wildland fire to determine the most appropriate course of action, then constantly updating this assessment. This individual action often quickly becomes collective as the fire management team builds a common perception of risk. Karl Weick has called this 'sensemaking'. Sensemaking is an act of communication, of collecting information, selecting what's important, naming it, and then passing it on, in various forms and stages of completeness, from one individual or fire team to another to enable resilient performance - managing the fire safely and efficiently. Because all subsequent actions rely on this, risk perception is a critical activity. It is hard work and prone to error, as numerous accident reviews, here and abroad, have found. Because communication issues continue to play such a primary role in accident reviews, we believe it is time to take a close, structured look at wildland fire incident communications processes.
We propose to examine communication practices using multiple disciplinary and theoretical angles. We will identify areas of communication competencies and constraints that affect the perception and communication of risk in wildland fire management. We seek to develop- for the first time - a comprehensive and coordinated perspective on incident communications, resulting in a set of insights into practice and assessment methods to support continuous improvement in risk perception, sensemaking and resilient performance.
No one sets out to participate in or contribute to an accident. Therefore, we seek to study normal practice in real-time wildland fire operations. We seek to understand and map where it is working well, and how it might be modified to better perceive and communicate risk. Using transcripts of radio recordings from wildland fire incidents, we will articulate the operative model of communication for firefighters – the model 'in use' and how firefighters are socialized to communicate ('best practices'), and compare this to a theorized model. We will assess those practices for their productivity and efficacy in helping firefighters to manage risks individually and collectively. In doing so, we hope to help them diagnose and repair communication problems in the moment, as well as identify improvements for training and practice.

Keywords: Firefighter communication, risk, decision making, resiliency

Bio: Dave Thomas retired from the Forest Service after a 37-year career. He graduated from the University of Montana with a degree in cultural geography. Dave has been a district FMO on the Lolo and Clearwater National Forests, served in various positions on Type I and II fire overhead teams, and when he retired, was the Regional Fuels Specialist for Region 4 of the USFS. Dave has been active in bringing the human element into fire operations, work that has included designing the first staff rides to Mann Gulch and the Dude Fire, and co-coordinating with Ted Putnam the first "human factors" workshop in Missoula, MT.

M25 An Investigation of LandScan Suitability for Strategic Decision Making in the Wildland Fire Decision Support System

Presenter: *Butler, Benjamin*
Additional Author(s):
Bailey, Andrew - Data Manager, Wildland Fire Management RD&A

The Wildland Fire Decision Support System (WFDSS) is a data rich application that graphically displays spatial data and information to assist fire managers and analysts in making strategic, risk-based decisions for wildland fire incidents. Understanding where buildings are located and where people live is a critical piece of information for the development of risk-informed management strategies. WFDSS has partially filled this need by developing and maintaining a "building cluster" data layer. Building clusters are tax parcel centroids where the parcel improvement value indicates the presence of a building. These data indicate the presence of property in need of protection from wildland fire, but they do not tell the whole story. The incorporation of the LandScan USA dataset in HSIP Gold provides a potential supplement to an infrastructure-centric view of risk. LandScan USA augments census block-level population measures with the spatial precision of 90-meter pixels from satellite images of night-time lights. The incorporation of population data into WFDSS could provide an assessment of risk to population by wildland fires consistently across the United States.
A comparative analysis was conducted to investigate the suitability of LandScanTM data for use in WFDSS to aid in making risk based strategic decisions. Specifically, the analysis investigated the correlation between where buildings are located according to the building cluster data and where they live/spend their time according to LandScanTM. WFDSS Incident Planning Areas were used to define the sampling areas in the study and all Planning Areas in WFDSS that returned positive building cluster point counts were used in the analysis. A total of 1,972 Planning Areas and Values Inventory results were explored and compared to three the different LandScanTM data products (daytime, night, and ambient population distribution).

Keywords: WFDSS, Spatial Data, Strategic Decision, LandScan, Population, Analysis

Bio: Ben Butler is the Wildland Fire Decision Support System (WFDSS) GIS Specialist. Based in Boise, ID at the National Interagency Fire Center (NIFC) Ben's position is within the Wildland Fire Management RD&A (WFM-RD&A). His responsibilities include the management of WFDSS geospatial data, integration of disparate interagency data sources into single data sets, and technical GIS support within the WFM-RD&A and to WFDSS.
With an undergraduate degree in geography/GIS and a Master of Natural Resources degree with a concentration in fire ecology, Ben's interests and experience emphasize leveraging geospatial technologies to solve natural resource and wildland fire issues.

M26 Enhancing Scientist-Manager Relationships to Foster Ecosystem Resilience

Presenter: *Colavito, Melanie, PhD Candidate, University of Arizona*

The concept of resilience is increasingly being discussed in ecosystem science and land management as the impacts associated with large wildland fires, climate change, and other disturbances manifest themselves on the landscape. In its most basic sense, resilience is the ability of something to return to its original form after being stressed. This can be applied in both social and ecological systems, which can be stressed after large wildland fires or other disturbances. However, as the scale and impacts of many disturbances increase, our understanding of resilience must evolve if we are to effectively adapt to and mitigate the stresses that both social and ecological systems are experiencing. Large-scale ecosystem disturbances and changes create numerous challenges, which scientists and land managers alike are beginning to tackle. These changes necessitate new sources of information, science, and management strategies, as well as new forms of collaboration among scientists, land managers, and other stakeholders. To that end, it is important to begin to better understand what constitutes resilience, both social and ecological, and how these concepts are determined. Moreover, how is resilience being addressed in land management, as well as in the sciences? What types of knowledge and in what forms are needed to foster resilience? How can land managers, scientists, and other stakeholders most effectively work together to integrate different types of knowledge about resilience into management decisions? This presentation will begin to address these questions and will present the results of interviews with scientists, land managers, and other stakeholders who are working to foster ecosystem resilience in the Southwest. These interviews are being conducted immediately after the upcoming “Fostering resilience in Southwestern ecosystems: A problem solving workshop” in Tucson, Arizona, this February. The interviews will be conducted with willing workshop attendees to better understand how to enhance the relationships between scientists, land managers, and other stakeholders in order to most effectively address the concept of resilience. The results from this research will provide important insight into questions about how to manage for resilience and facilitate dialogue about this important topic. As we begin to better understand how to enhance relationships between scientists, land managers, and other stakeholders, we will be able to more effectively take actions to foster resilience and keep pace with the scale of the disturbances to which we must more frequently respond.

Bio: Melanie Colavito is a PhD Candidate in the School of Geography and Development at the University of Arizona with a minor in Remote Sensing and Spatial Analysis and graduate certificates in College Teaching and Geographic Information Systems. Melanie’s research interests include collaboration, the role of science, and connecting science with decision-making in forest restoration and management. Her dissertation investigates the extent to which collaboration leads to better integration of science and other knowledge into decision-making for forest restoration and management in the Southwest. Melanie is a social scientist whose research employs a use-inspired framework and both qualitative and quantitative methods.

M27 The EPRIF Baztan: A Small Community Based Project to Solve a Big Socio-Ecological Problem

Presenter: *José Luis Duce Aragüés*

Geographically located in the Mediterranean basin, Spain is one of the countries in Europe with the highest number of fire incidents and hectares burnt in uncontrolled fires. With an average of 16,814 incidents and 114,734 hectares burnt between 2002 and 2012 , national and regional agencies are trying to understand the role of fire in ecological and social terms, to plan strategies and actions to mitigate against the destruction caused by large fires.

Created in 1998, the EPRIF program - Equipo de Protección Integral contra Incendios Forestales (Forest Fires Integral Prevention Teams)- , is one of the major efforts the 'Área de Defensa Contra Incendios Forestales' (National Forest Fires Agency) has developed to contribute to this reality. It is an official central government tool offered to regional administrations to supplement their local fire-fighting agencies, with a social based focus. EPRIF teams now number 18 and they are located in rural areas where fire (both natural and controlled) plays an important role.

Four-person teams are assigned and get 'immersed' into specific areas in the region to become familiar with the local and regional policies, as well as problems, realities, challenges, and difficulties. Local stakeholders include farmers, ranchers, shepherds, hunters, environmentalists, conservationists, and 'regular' civilians. Each team is responsible for assessing, monitoring, and managing their area. They must meet stakeholders, develop natural resource management plans, research fire effects, create training courses, or plan and implement controlled burns.

The EPRIF Baztan, based in the Valle de Baztan (Navarra), northern Spain, is one of these teams. The valley encompasses almost 40,000 hectares and 8000 people. The team works with regional environmental and fire-fighting agencies to gather information, understand the real situation, and protect different group-interests, while meeting environmental, socio-economic, cultural, and emergency response criteria.

The most important part of the team is their close interaction with locals, many of whom still use fire traditionally, as done for centuries, to burn the gorse extensions, maintain their pasture lands and preserve ecosystems. The presentation will focus on how the team strives to work with locals to make these traditional controlled burns safer for the individual and the community, while still allowing them to maintain their lands, preventing larger wildfires.

Keywords: Controlled Burns, Socio-ecological perspective, prevention teams.

Bio: Born in Zaragoza (Spain) in 1973. He has developed his passion for fire during more than 20 years, in different positions and resources: hand, engine and helicopter crew member, or firing and burn boss. He is a Crew Boss in one of the BRIF elite helitack crews of the Ministry of Enviroment, and a Burn Boss in the North of Spain.

He has been training people and leading exchange programs in the States and Spain. He is the Latinamerican projects manager of Wildland Restoration International, and recently published 'Incendios de Interfaz. Manual de Actuación', a practical manual about interface.

M28 Fire Suppression-Driven Oak Regeneration Failure Results in Xeric Juniper-Dominated Woodlands: an Expanded View of the Mesophication Process

Presenter: *Andruk, Christina, PhD Candidate, University of Texas at Austin*
Additional Author(s):
Fowler, Norma, PhD, Professor, University of Texas at Austin

Oaks (Quercus spp.) are not regenerating in many woodland sites in central Texas, resulting in fewer saplings than mature trees. Oak regeneration failure is also occurring in forested sites in the eastern United States (US) and the Ozark Mountains in the central US. As oaks decline they are often replaced by shade-tolerant, fire-intolerant species. In the eastern US oaks are most often replaced by maples (Acer spp.) a process called mesophication. In parts of the south-central US, fire suppression causes a shift not to more mesic-adapted species, but to juniper (Juniperus spp.), which is at least as xeric-adapted as oak. However, the shift from a fire-dependent oak-dominated woodland to a surface fire-resistant juniper-dominated woodland shares many characteristics with the transition from an oak-dominated system to a maple-dominated one. In both instances fire-intolerant and shade-tolerant species (maple, juniper) replace oak species; in both instances they alter the fuel load, making surface fire less likely. The processes differ in that although surface fires are less likely to occur after juniper invasion, the probability of catastrophic crown fires likely increases. Therefore, our thinking of the “oak regeneration problem” needs to be revised and expanded to include the diverse regions that are affected.

To support this expanded view of the mesophication process, we present data from two studies conducted at woodlands co-dominated by Ashe juniper (Juniperus ashei) and Texas red oak (Quercus buckleyi) at Balcones Canyonlands National Wildfire Refuge in central Texas. The first is a five-year experimental study that examined the effects of low-intensity prescribed fire and deer herbivory on hardwood regeneration. The second is an observational study that compared unburned woodlands to four woodlands that burned when a prescribed fire in a nearby savanna escaped. In both studies, fire killed juniper seedlings, saplings and mature trees. In contrast, oak and other common hardwood species vigorously resprouted after fire. The escaped prescribed fires also increased hardwood sapling abundance, more so in sites that were burned twice and more recently. The consistently positive response of hardwoods, particularly oak, to fire, and the negative response of juniper, suggests that hardwoods, rather than juniper dominated pre-settlement woodlands. Prescribed fires are a viable strategy to reduce juniper dominance and trigger resprouting by oak and other hardwoods. However, there is no evidence in these shorter-term studies that fire increases oak seedling abundance, a key component of the regeneration process.

Keywords: oak, juniper, woodland, restoration, mesophication

Bio: Christina Andruk will receive her Ph.D. in May 2014 from the Ecology, Evolution and Behavior program at the University of Texas Austin while working with Dr. Norma Fowler. Her Ph.D. research examines the effects of fire and deer herbivory on vegetation dynamics in central Texas woodlands. She has also conducted dissertation research on the resistance and resilience of native and invaded savanna to high-intensity prescribed fire and seed addition. She is currently a co-leader of central Texas SAFE.

M29 Simulating the Historical Range of Variability in Fire-Adapted Forests

Presenter: *Kori Blankenship*
Additional Author(s):
Frid, Leonardo, Systems Ecologist, ApexRMS
Smith, James, LANDFIRE Project Lead, The Nature Conservancy
Swaty, Randy, Ecologist, The Nature Conservancy

Knowledge of the historical range of variability (HRV) may provide fire and resource managers context for assessing the impacts of large wildland fires and offer information to help guide post-fire recovery and restoration strategies. For many ecosystems, the paucity of historical data limits our ability to directly quantify the HRV. For this reason, methods such as "departure analysis" rely on calculating departure from a simulated mean value rather than a range. While the mid-point is a useful benchmark, a range acknowledges local knowledge, and offers managers more information and potentially greater flexibility in management options. We developed a simulation approach for estimating a range of HRV based on information contained within the LANDFIRE vegetation dynamics models. This approach offers a repeatable process for calculating the HRV using data that are available for many of the more than 300 ecosystems mapped by LANDFIRE in the U.S. In this presentation we will demonstrate the method by using it to estimate a range of variability for fire-adapted forests in the Pacific Northwest and discuss its implications for land management activities.

Keywords: historical range of variability, HRV, fire ecology, vegetation dynamics, LANDFIRE

Bio: Kori Blankenship is a fire ecologist with The Nature Conservancy. Kori earned an M.S. in Geography from Western Washington University and has worked for the LANDFIRE program since 2005 in mapping, vegetation modeling and technology transfer roles. Kori's current focus is on helping users modify LANDFIRE data for local application. From 1995 to 2002, Kori worked seasonally in fire and resource management for the U.S. Forest Service and National Park Service.

M30 Biological Constraints to Fire Regimes in Florida Scrub

Presenter: *Menges, Eric, Program Director, Plant Ecology Program, Archbold Biological Station*
Additional Author(s):
Smith, Stacy, Research Assistant, Archbold Biological Station
Haller, Sarah, Research Assistant, Archbold Biological Station
Koontz, Stephanie, Research Assistant, Archbold Biological Station

Wildland fires cause many changes, including litter removal, topkill and resprouting, mortality, subsequent recruitment, ash deposition, altered nutrient dynamics, and altered population viability. We integrate several studies to ask how fire regimes (particularly fire frequencies, time-since-fire, and intensity) constrain responses and affect vegetation dynamics in Florida scrub, a pyrogenic shrubland that is a center for endemism. Gaps within dominant shrubs are key microhabitats for many species, particularly endemic herbs. Fire creates gaps in the shrub matrix that may be small and short-lived in areas dominated by resprouting shrubs, and larger and more permanent in areas dominated by fire-sensitive post-fire seeders. Gap traits after fire are affected by fire coverage, fire intensity, and the previous time-since-fire. Larger gaps support more species and some species have minimum gap sizes

for occupancy. Species ranging from short-lived obligate seeding herbs to resprouting herbs to shrubs to a ground lichen all show different responses to various aspects of the fire regime. Post-fire recovery of an obligate seeding foundation shrub, Florida rosemary, is characterized by very high seedling survival, variable age of first flowering, and a lack of density-dependent growth during the first 15 years after fire. A minimum age for flowering in Florida rosemary (about 8 years) defines a fire frequency constraint in Florida rosemary scrub. Population viability modeling of obligate seeding herbaceous plants co-occurring with Florida rosemary defines an upper constraint on fire return interval of about 30 years. While obligate seeders can help define bounds on fire frequency, most resprouting herbs (e.g. scrub blazing star) and shrubs (e.g. scrub pawpaw) appear insensitive to a wide range of fire return intervals. Resprouting is very high in most species and is not strongly affected by the vegetation context, fire intensity, or fire season. In addition, a fire frequency experiment in an area dominated by resprouting shrubs shows only subtle effects of very frequent fires and varying fire intensities on subsequent survival and growth. Long intervals between fires, while benefiting some species, generally results in lower diversity. In addition, loss of subordinate resprouting species and decay of persistent seed banks may constrain the responses of long-unburned Florida scrub to subsequent fires. Consequently, land managers need to burn consistently and often, but with pyrodiversity built into fire plans, to protect biodiversity.

Keywords: fire, resprouting, obligate seeder, fire management, Florida scrub, pyrodiversity

Bio: Eric Menges is the Director of the Plant Ecology Program at Archbold Biological Station in south-central Florida. Since 1988, he has collected long-term demographic, vegetation, and fire response data on nearly two dozen species, many of which are narrowly endemic and have strong responses to the fire regime. He has published over 120 papers, mentored over 100 research interns, and been involved with over 80 of prescribed burns and wildfires.

M31 Evidence of high-severity fire in a 1915-25 inventory of ~200,000 forested hectares in eastern Oregon

Presenter: *Keala Hagmann*

Spatially explicit, landscape-level timber inventories conducted early in the 20th century by the Bureau of Indian Affairs across hundreds of thousands of forested hectares provide detailed records of coniferous forests on the slopes and foothills east of the Cascade Range in Oregon. More than 20% of the area in ~200,000 ha of mixed-conifer and ponderosa pine forests was sampled in a systematic strip cruise tied to documented survey points. Cruisers recorded live conifers at least 15 cm dbh by species and diameter on 1.6 ha sample units. Inventoried area overlaps a 1918 fire of ~80,000 ha in ponderosa pine-lodgepole pine forests and includes high-severity burn patches in hemlock-fir forests with huckleberry understory. Patches 100-400 ha in size of few to no live trees and abundant reproduction in documented burn areas were recorded in association with the 1918 fire and at the upper elevation boundary of the moist mixed-conifer habitat where it interleaves with wetter, colder forest types. Transects in this area differ from the rest of the mixed-conifer habitat in abundance and contiguity of area occupied by few to no trees (< 25 tph), less ponderosa pine, and fewer large trees. Large, treeless openings (≥1.6 ha), which might result from high-severity disturbance, were uncommon at the time of the inventory on these sites except for patches within the perimeter of a large fire and in the transition to wetter, colder forest types. The ubiquitous presence and abundance of large trees and ponderosa pine in all size classes supports an inference of predominantly low-severity fires in a mixed-severity fire regime with infrequent or limited high-severity fire effects. The absence of stands composed solely of small-diameter trees provides further evidence that high-severity wildfires with an extensive stand-replacement component were either absent or uncommon; such stands would presumably have existed if large gaps or openings had been created.

Keywords: historical dry forest conditions, reference conditions, mixed-conifer and ponderosa pine forests

Bio: Keala Hagmann is a graduate student at the University of Washington. She has worked closely and extensively with Professors Jerry Franklin and Norm Johnson (Oregon State University) to resurrect a spatially extensive and explicit 1915-25 timber inventory cruise of ~200,000 hectares of dry, fire-frequent forests. Keala has worked with and been supported by The Klamath Tribes, The Nature Conservancy, USFS Pacific Northwest Research Station, and The Confederated Tribes of Warm Springs to develop and explore the relevance of this data set to contemporary management of forested socio-ecosystems.

M32 Natural Regeneration after the Storrie Fire in Lassen National Forest, Northeastern California

Presenter: *Crotteau, Justin, Graduate Student, University of Montana*
Additional Author(s):
Varner, J. Morgan, Assistant Professor, Mississippi State University
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Large scale mixed-severity fires have become more frequent in the western United States. Relatively few studies have investigated post-fire natural regeneration and associated woody shrub cover after large wildfires in the Southern Cascades-Northern Sierras. We established a study in the 2000 Storrie Fire, a 23000 ha burn that occurred in the Lassen and Plumas National Forests across a 1200-2000 m elevation band. We quantified post-fire natural regeneration across four levels of burn severity (unchanged, low-severity, moderate-severity, high-severity) and three vegetation types (mixed conifer, low-elevation fir, high-elevation fir) on the Lassen during the summers of 2009 and 2010. We found both patchy and abundant mature conifer seedlings across much of the landscape. Median seedling densities varied substantially by burn severity (ANOVA, P=0.0035), ranging from 1,918 seedlings ha-1 (1 SE: 152) in the unchanged units; 4,838 seedlings ha-1 (893) in the low-severity units; 6,484 seedlings ha-1 (586) in the moderate-severity units; and 710 seedlings ha-1 (88) in the high-severity units. Fire-tolerant pine species seedling abundance, however, was observed to be less than half of the regenerating species composition; we highlight the significance of a species shift toward fir in post-burn stands. We also verified that high-severity fire resulted in greater shrub cover (ANOVA, P<0.001). In an analysis of regenerating shrub species, we found that proportional cover by species varied across the stratified study area, but the data showed no influence of burn-severity or cover type on species diversity (Shannon's Diversity and Pielou Evenness indices). Interpretation of our data is useful in aiding land management decisions and better understanding regeneration dynamics in response to large, complex wildfires in fire-prone western landscapes.

Keywords: mixed-severity; ponderosa pine; white fir; California black oak; Composite Burn Index

Bio: Justin Crotteau is a graduate student at the University of Montana where he studies the effects of forest management on tree growth, natural regeneration, and fuels dynamics under the advising of Dr. Christopher Keyes in the Applied Forest Management Program. He received his MS from Humboldt State University in 2011 studying post-fire natural regeneration trends.

M33 Evaluating Restoration Treatments Objectives: Creating Spatially Heterogeneous Structure and Reducing Fire Behavior

Presenter: *Ziegler, Justin, Graduate Student, Colorado State University*
Additional Author(s):
Hoffman, Chad, Assistant Professor, Colorado State University
Battaglia, Mike, Research Forester, Rocky Mountain Research Station, USDA Forest Service

Forest managers are increasingly using restoration treatments in dry forests to reduce fire hazard and create heterogeneous forest structure characteristic of pre-settlement forests. Specifically, these treatments desire to attempt to create a spatially aggregated distribution of trees including a matrix of individual trees, openings, and clumps of trees. However, there has been little evaluation of the resulting spatial pattern of restoration treatments and past investigations of restoration treatments on potential fire behavior have utilized point prediction models. The models cannot account for a spatially heterogeneous fuels and their influence on within-stand wind flow, limiting our ability to understand the implications of restoration treatments. The overall objective of this project was to evaluate if restoration treatments can simultaneously create heterogeneous spatial structures and reduce the potential fire behavior at the stand scale. We hypothesized, 1) Treatments would result in the heterogeneous structure desired, and 2) These treatments would reduce potential fire behavior. To address these questions, we stem-mapped and inventoried stumps and residual trees in seven 4 ha plots across ponderosa pine (Pinus ponderosa) dominated, treated stands across the Southern Rockies and Colorado Plateau. Spatial statistical analyses were used to evaluate changes in the spatial distribution present in plots before and after treatment. Potential fire behavior was modeled across a range of wind speeds using the Wildland urban-interface Dynamics Simulator (WFDS). WFDS is a physics-based model capable of representing fuel in 3-D and captures fuel-atmosphere-fire dynamics through space and time. Our results show that treatments did result in aggregated tree distributions, though aggregation was also commonly observed before treatment, and that treatments did promote within-stand structural characteristics desired by breaking up large areas of continuous canopy fuels. Second, we found, despite that treatments are increasing wind speeds below and within the canopy, this is compensated by removal of canopy fuel, resulting in an overall decreased level of fire behavior. Though our results suggest that all treatments were generally successful in maintaining forest structure heterogeneity, we found a great deal of variability in potential fire behavior that is likely attributed to the particular arrangement of canopy fuels.

Keywords: restoration, fuels treatments, ponderosa pine, fire behavior, spatial, WFDS

Bio: Justin Ziegler is currently a Masters of Science student in the Department of Forest and Rangeland Stewardship at Colorado State University researching the dynamics between forest structure and fire behavior. Inspired by two Americorps terms restoring forest and woodland systems in Texas, he earned B.S degrees from the University of Idaho in both Forest Resources and Fire Ecology & Management. Pursuing his graduate degree, he has developed skills ranging from fuels assessment methods, to fire behavior modeling, and spatial analytical methods. Following graduation, he looks forward to returning to on-the-ground management and improving forest resiliency in the West.

M34 Agency-stakeholder trust in fire-prone communities: An international collaboration drawing on research and management experience in Australia, Canada, and the United States

Presenter: *Olsen, Christine, PhD, Fire Social Scientist, Oregon State University*
Additional Author(s):
Shindler, Bruce, Professor, Oregon State University
McGee, Tara, Associate Professor, University of Alberta
McFarlane, Bonita, Senior Human Dimensions Specialist, Natural Resources Canada - Canadian Forest Service
Christianson, Amy, Fire Social Scientist, Natural Resources Canada - Canadian Forest Service
McCaffrey, Sarah, Research Forester, USDA Forest Service
Curtis, Allan, Professor, Charles Sturt University

Wildfires have increased in frequency and severity in many countries around the world, causing considerable environmental and social consequences to fire-prone communities in recent years. As a result, fire management agencies face growing complexity in their management decisions and interactions with the public. Successful interactions most often depend on trustworthy relations among agency personnel and property owners at the wildland-urban interface. Without trust, the public may become frustrated in their interactions with the agency and withhold support for management decisions.
In this presentation we describe the unique collaborative process used to develop a trust planning guide for wildfire agencies and practitioners in Australia, Canada, and the United States. This process included research and management experience as well as focus groups of fire managers and other experts in fire-prone communities in each of the three countries. Graphics from the guide will be discussed and copies of the publication will be available. We will also present an analysis of how practitioners view trust and its relevance to management agencies, the role of trust in management situations, and actions for achieving outcomes that build trust.

Keywords: public participation, citizen-agency relationships, fuel redction, public-agency interactions

Bio: Christine Shaw Olsen, Ph.D., is a Research Social Scientist and Instructor in the Department of Forest Ecosystems & Society at Oregon State University in Corvallis, Oregon. Dr. Olsen is co-investigator of the Northwest Fire Science Consortium and conducts research on citizen-agency interactions, public opinions about fire and fuel reduction activities, and communication and education about forestry and fire. Her most recent projects examine public perceptions of smoke, citizen-agency trust, and coupled human-natural systems in fire-prone landscapes. Dr. Olsen teaches classes about forest management for multiple resource values, managing in the wildland-urban interface, sustainable natural resource management, and social science methods.

M35 Sustainable Biomass Supply from Forest Health and Fire Hazard Reduction Treatments: A Biomass Assessment of Federally Owned Land in Eastern Oregon

Presenter: *Vogler, Kevin, Graduate Research Assistant, Oregon State University, Sustainable Biomass Supply from Fuel Reduction Treatments: A Biomass Assessment of Federally Owned Land in Eastern Oregon*
Additional Author(s):
Bailey, John, Associate Professor, Oregon State University

In order to alter the current annual trend of an ever increasing number of uncharacteristically large and high severity wildfires, a proactive fuels management strategy that produces significant results, at meaningful scales, must be undertaken by the federal land agencies. One challenge that hinders the development of large forest restoration programs, is the relatively low value of material generated from fuel reduction treatments. There is currently opportunities to utilize that low value material in newly emerging biomass and non-traditional forest product markets where the scale of development can be appropriately matched with current and future biomass feedstock supply. My research quantifies the availability of biomass feedstock generated from landscape level restoration treatments in Eastern Oregon using a model framework that integrates FIA forest data with the ArcFuels and Landscape Treatment Designer model tools. A model sensitivity analysis was conducted on a range of silvicultural prescriptions and management intensity levels in in order to understand the relationship between feedstock generation and fire hazard reduction.

Keywords: Biomass, FVS, ArcFuels, Fire Hazard

Bio: Kevin Vogler is a graduate student working towards his Master of Science in silvilculture at Oregon State University. He completed his undergraduate education at State University of New York College at Oneonta where he received a bachelor’s degree in environmental science and environmental biology.