

## **Two methods for calculating wildland fire rate of forward spread**

[www.nrfirescience.org/resource/20911](http://www.nrfirescience.org/resource/20911)

Accurate estimation of a wildland fire's progression is critical for the development of robust fire spread prediction models and their validation. Two methods commonly used to determine spread rate are the cumulative spread rate, calculated as the total distance travelled by a fire divided by the total time of travel, and the...

Author(s): James S. Gould, Andrew L. Sullivan

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

## **The behaviour of wood crib fires under free burning and fire whirl conditions**

[www.nrfirescience.org/resource/20854](http://www.nrfirescience.org/resource/20854)

The dynamics of wood crib fires were investigated under fire whirl (FW) and free burning (FB) conditions in a small-scale apparatus. For open-packed cribs, the burning rates and fire spread rates of the FB and FW cribs were almost identical. However, as the number of sticks per layer (n) increased from 3 to 7, the burning rate for...

Author(s): Monica T. Diab, Jan B. Haelssig, Michael J. Pegg

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

## **Modeling ground firefighting resource activities to manage risk given uncertain weather**

[www.nrfirescience.org/resource/20415](http://www.nrfirescience.org/resource/20415)

Wildland firefighting requires managers to make decisions in complex decision environments that hold many uncertainties; these decisions need to be adapted dynamically over time as fire behavior evolves. Models used in firefighting decisions should also have the capability to adapt to changing conditions. In this paper, detailed...

Author(s): Erin J. Belval, Yu Wei, Michael Bevers

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

## **The FireFlux II experiment: a model-guided field experiment to improve understanding of fire-atmosphere interactions and fire spread**

[www.nrfirescience.org/resource/19449](http://www.nrfirescience.org/resource/19449)

The FireFlux II experiment was conducted in a tall grass prairie located in south-east Texas on 30 January 2013 under a regional burn ban and high fire danger conditions. The goal of the experiment was to better understand micrometeorological aspects of fire spread. The experimental design was guided by the use of a coupled fire-...

Author(s): Craig B. Clements, Adam K. Kochanski, Daisuke Seto, Braniff Davis, Christopher Camacho, Neil Lareau, Jonathan Contezac, Joseph C. Restaino, Warren Heilman, Steven K. Krueger, Bret W. Butler, Roger D. Ottmar, Robert E. Vihnanek, James Flynn, Jean-Baptiste Filippi, Toussaint Barboni, Dianne E. Hall, Jan Mandel, Mary Ann Jenkins, Joseph J. O'Brien, Benjamin Hornsby, Casey Teske

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

## **Applications of the United States Forest Inventory and Analysis dataset: a review and future directions**

[www.nrfirescience.org/resource/18287](http://www.nrfirescience.org/resource/18287)

The United States Forest Inventory and Analysis (FIA) program has been monitoring national forest resources in the United States for over 80 years; presented here is a synthesis of research applications for FIA data. A review of over 180 publications that directly utilize FIA data is broken down into broad categories of application...

Author(s): Wade T. Tinkham, Patrick R. Mahoney, Andrew T. Hudak, Grant M. Domke, Michael J. Falkowski, Christopher W. Woodall, Alistair M. S. Smith

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Dimensional analysis on forest fuel bed fire spread**

[www.nrfirescience.org/resource/16440](http://www.nrfirescience.org/resource/16440)

A dimensional analysis was performed to correlate the fuel bed fire rate of spread data previously reported in the literature. Under wind condition, six pertinent dimensionless groups were identified, namely dimensionless fire spread rate, dimensionless fuel particle size, fuel moisture content, dimensionless fuel bed depth or...

Author(s): Jiann C. Yang

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Wildland fires behaviour: wind effect versus Byram's convective number and consequences upon the regime of propagation**

[www.nrfirescience.org/resource/18133](http://www.nrfirescience.org/resource/18133)

With fuel moisture content and slope, wind velocity (UW) is one of the major physical parameters that most affects the behaviour of wildland fires. The aim of this short paper was to revisit the relationship between the rate of spread (ROS) and the wind velocity, through the role played by the two forces governing the trajectory of...

Author(s): D. Morvan, N. Frangieh

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Data Descriptor: TerraClimate, a high-resolution global dataset of monthly climate and climatic water balance from 1958-2015**

[www.nrfirescience.org/resource/17794](http://www.nrfirescience.org/resource/17794)

We present TerraClimate, a dataset of high-spatial resolution (1/24°, ~4-km) monthly climate and climatic water balance for global terrestrial surfaces from 1958–2015. TerraClimate uses climatically aided interpolation, combining high-spatial resolution climatological normals from the WorldClim dataset, with coarser resolution...

Author(s): John T. Abatzoglou, Solomon Z. Dobrowski, Sean A. Parks, Katherine C. Hegewisch

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Appropriate Sample Sizes for Monitoring Burned Pastures in Sagebrush Steppe: How Many Plots are Enough, and Can One Size Fit All?**

[www.nrfirescience.org/resource/18950](http://www.nrfirescience.org/resource/18950)

Statistically defensible information on vegetation conditions is needed to guide rangeland management decisions following disturbances such as wildfire, often for heterogeneous pastures. Here we evaluate sampling effort needed to achieve a robust statistical threshold using > 2 000 plots sampled on the

2015 Soda Fire that burned...

Author(s): Cara Applestein, Matthew J. Germino, David S. Pilliod, Matthew R. Fisk, Robert S. Arkle

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **A VIIRS direct broadcast algorithm for rapid response mapping of wildfire burned area in the western United States**

[www.nrfirescience.org/resource/18835](http://www.nrfirescience.org/resource/18835)

We present a direct broadcast (DB) rapid response burned area mapping algorithm for Visible Infrared Imaging Radiometer Suite (VIIRS) data that combines products driven by the spectral signal of fire-affected areas from both emissive and reflective spectral bands. The algorithm processes VIIRS infrared M-bands (750 m) using...

Author(s): Shawn P. Urbanski, Bryce L. Nordgren, Carl Albury, Brenna Schwert, David Peterson, Brad Quayle, Wei Min Hao

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **It matters when you measure it: using snow-cover Normalised Difference Vegetation Index (NDVI) to isolate post-fire conifer regeneration**

[www.nrfirescience.org/resource/18734](http://www.nrfirescience.org/resource/18734)

Landsat Normalized Difference Vegetation Index (NDVI) is commonly used to monitor post-fire green-up; however, most studies do not distinguish new growth of conifer from deciduous or herbaceous species, despite potential consequences for local climate, carbon and wildlife. We found that dual season (growing and snow cover) NDVI...

Author(s): Melanie K. Vanderhoof, Todd J. Hawbaker

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **An evaluation of NDFD weather forecasts for wildland fire behavior prediction**

[www.nrfirescience.org/resource/18326](http://www.nrfirescience.org/resource/18326)

Wildland fire managers in the United States currently utilize the gridded forecasts from the National Digital Forecast Database (NDFD) to make fire behavior predictions across complex landscapes during large wildfires. However, little is known about the NDFDs performance in remote locations with complex topography for weather...

Author(s): Wesley G. Page, Natalie S. Wagenbrenner, Bret W. Butler, Jason M. Forthofer, Chris Gibson

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **An Empirical Model for the Effect of Wind on Fire Spread Rate**

[www.nrfirescience.org/resource/18138](http://www.nrfirescience.org/resource/18138)

Predicting wind-driven rate of fire spread (RoS) has been the aim of many studies. Still, a field-tested model for general use, regardless of vegetation type, is currently lacking. We develop an empirical model for wind-aided RoS from laboratory fires (n = 216), assuming that it depends mainly on fire-released energy and on the...

Author(s): Carlos G. Rossa, Paulo M. Fernandes

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Assessing the Influence of Roads on Fire Ignition: Does Land Cover Matter?**

[www.nrfirescience.org/resource/18030](http://www.nrfirescience.org/resource/18030)

In human-affected fire environments, assessing the influence of human activities on the spatial distribution of wildfire ignitions is of paramount importance for fire management planning. Previous studies have shown that roads have significant effects on fire ignition. However, since different land cover classes are subject to...

Author(s): Carlo Ricotta, Sofia Bajocco, Daniela Guglietta, Marco Conedera

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Flame-front rate of spread estimates for moderate scale experimental fires are strongly influenced by measurement approach**

[www.nrfirescience.org/resource/17768](http://www.nrfirescience.org/resource/17768)

Understanding wildfire rate of spread (RoS) is often a key objective of many fire behavior modelling and measurement exercises. Using instrumented moderate scale laboratory burns we provide an assessment of eight different methods of flame front RoS determination, including visible imagery (VIS) analysis techniques, use of...

Author(s): Joshua M. Johnston, Melanie J. Wheatley, Martin J. Wooster, Ronan Paugam, G. Matt Davies, Kaitlin A. DeBoer

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Improving Fire Behaviour Data Obtained from Wildfires**

[www.nrfirescience.org/resource/17190](http://www.nrfirescience.org/resource/17190)

Organisations that manage wildfires are expected to deliver scientifically defensible decisions. However, the limited availability of high quality data restricts the rate at which research can advance. The nature of wildfires contributes to this: they are infrequent, complex events, occur with limited notice and are of relatively...

Author(s): Alexander I. Filkov, Thomas J. Duff, Trent D. Penman

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Wyoming's forest resources, 2011-2015**

[www.nrfirescience.org/resource/18841](http://www.nrfirescience.org/resource/18841)

This report summarizes the most recent inventory of Wyoming's forests based on field data collected between 2011 and 2015. The report includes descriptive highlights and tables of area, numbers of trees, biomass, carbon, volume, growth, mortality, and removals. Most sections and tables are organized by forest type or forest-type...

Author(s): R. Justin DeRose, John D. Shaw, Sara A. Goeking, Kate Marcille, Chelsea P. McIver, James Menlove, Todd A. Morgan, Chris Witt

Year Published: 2018

Type: Document

Research Brief or Fact Sheet

**Corrigendum 1 (published 19 Sep 2018) and Corrigendum 2 (published 11 Dec 2018) to:**

### **Wildland fires behaviour: wind effect versus Byram's convective number and consequences upon the regime of propagation**

[www.nrfirescience.org/resource/18783](http://www.nrfirescience.org/resource/18783)

The authors wish to acknowledge that the values of the rate of spread for the grass fires in Fig. 2 (blue circles) were extracted the following reference: Cheney NP, Gould JS, Catchpole WR (1998) Prediction of fire spread in grasslands. *International Journal of Wildland Fire* 8, 1–13. doi:10.1071/WF9980001  
Additionally, the authors...

Author(s): D. Morvan, N. Frangieh

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Fire behavior in chaparral—Evaluating flame models with laboratory data**

[www.nrfirescience.org/resource/18347](http://www.nrfirescience.org/resource/18347)

Flame and mass loss data for chaparral, a mixture of shrub plants from the Mediterranean climate zone of southwestern North America, from five previously reported experiments were used to evaluate several published models relating flame characteristics to mass loss and heat release rates. These data are unique with fuel moisture...

Author(s): David R. Weise, Thomas H. Fletcher, Wesley Cole, Shankar M. Mahalingam, Xiangyang Zhou, Lulu Sun, Jing Li

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

### **Interacting effects of fire severity, time since fire and topography on vegetation structure after wildfire**

[www.nrfirescience.org/resource/16674](http://www.nrfirescience.org/resource/16674)

Fire is an important disturbance in forest ecosystems globally. Many of the effects of fire on forest processes are mediated through effects on vegetation structure. Understanding how fire properties, fire regimes and environmental variation interact to affect structure is required in the face of predictions of increasing size and...

Author(s): Michelle Bassett, Steven W.J. Leonard, Evelyn K. Chia, Michael F. Clarke, Andrew F. Bennett

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

### **Spatio-Temporal Linkages between Declining Arctic Sea-Ice Extent and Increasing Wildfire Activity in the Western United States**

[www.nrfirescience.org/resource/17201](http://www.nrfirescience.org/resource/17201)

We examined relationships between monthly Arctic sea-ice extent (ASIE) and annual wildfire activity for seven regions in the western United States during 1980-2015 to determine if spatio-temporal linkages exist between ASIE, upper-level flow, and surface climatic conditions conducive to western U.S. wildfire activity. Winter ASIE...

Author(s): Paul A. Knapp, Peter T. Soulé

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

### **Climate change and the eco-hydrology of fire: will area burned increase in a warming western USA?**

[www.nrfirescience.org/resource/14916](http://www.nrfirescience.org/resource/14916)

Wildfire area is predicted to increase with global warming. Empirical statistical models and process-based simulations agree almost universally. The key relationship for this unanimity, observed at multiple spatial and temporal scales, is between drought and fire. Predictive models often focus on ecosystems in which this...

Author(s): Donald McKenzie, Jeremy S. Littell

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

### **Effects of season on ignition of live wildland fuels using the forced ignition and flame spread test apparatus**

[www.nrfirescience.org/resource/16525](http://www.nrfirescience.org/resource/16525)

An understanding of what variables affect the ignition of live wildland fuels is crucial to predicting crown fire spread, the most poorly understood type of wildland fire. Ignition tests were performed over the course of an entire year for ten species (three species in year one, seven in year two) to evaluate seasonal changes in...

Author(s): Sara S. McAllister, David R. Weise

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

### **Trend analysis of fire season length and extreme fire weather in North America between 1979 and 2015**

[www.nrfirescience.org/resource/16407](http://www.nrfirescience.org/resource/16407)

We have constructed a fire weather climatology over North America from 1979 to 2015 using the North American Regional Reanalysis dataset and the Canadian Fire Weather Index (FWI) System. We tested for the presence of trends in potential fire season length, based on a meteorological definition, and extreme fire weather using the non-...

Author(s): Piyush Jain, Xianli Wang, Michael D. Flannigan

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

### **The impact of aging on laboratory fire behaviour in masticated shrub fuelbeds of California and Oregon, USA**

[www.nrfirescience.org/resource/14580](http://www.nrfirescience.org/resource/14580)

Mastication of shrubs and small trees to reduce fire hazard has become a widespread management practice, yet many aspects of the fire behaviour of these unique woody fuelbeds remain poorly understood. To examine the effects of fuelbed aging on fire behaviour, we conducted laboratory burns with masticated *Arctostaphylos* spp. and...

Author(s): Jesse K. Kreye, J. Morgan Varner, Jeffrey M. Kane, Eric E. Knapp, Warren P. Reed

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

### **Predicting large wildfires across western North America by modeling seasonal variation in soil water balance**

[www.nrfirescience.org/resource/14021](http://www.nrfirescience.org/resource/14021)

A lengthening of the fire season, coupled with higher temperatures, increases the probability of fires throughout much of western North America. Although regional variation in the frequency of fires is well



established, attempts to predict the occurrence of fire at a spatial resolution <10 km<sup>2</sup> have generally been unsuccessful. We...

Author(s): Richard H. Waring, Nicholas C. Coops

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

### **Measuring radiant emissions from entire prescribed fires with ground, airborne, and satellite sensors - RxCADRE 2012**

[www.nrfirescience.org/resource/13855](http://www.nrfirescience.org/resource/13855)

Characterising radiation from wildland fires is an important focus of fire science because radiation relates directly to the combustion process and can be measured across a wide range of spatial extents and resolutions. As part of a more comprehensive set of measurements collected during the 2012 Prescribed Fire Combustion and...

Author(s): Matthew B. Dickinson, Andrew T. Hudak, Thomas J. Zajkowski, E. Louise Loudermilk, Wilfrid Schroeder, Luke Ellison, Robert L. Kremens, William Holley, Otto Martinez, Alexander Paxton, Benjamin C. Bright, Joseph J. O'Brien, Benjamin Hornsby, Charles Ichoku, Jason Faulring, Aaron Gerace, David L. Peterson, Joseph Mauceri

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

### **Contribution of cut-off lows to precipitation across the United States**

[www.nrfirescience.org/resource/15602](http://www.nrfirescience.org/resource/15602)

A chronology of cutoff lows (COL) from 1979 to 2014 alongside daily precipitation observations across the conterminous United States was used to examine the contribution of COL to seasonal precipitation, extreme-precipitation events, and interannual precipitation variability. COL accounted for between 2% and 32% of annual...

Author(s): John T. Abatzoglou

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

### **High-resolution infrared thermography for capturing wildland fire behaviour: RxCADRE 2012**

[www.nrfirescience.org/resource/13856](http://www.nrfirescience.org/resource/13856)

Wildland fire radiant energy emission is one of the only measurements of combustion that can be made at wide spatial extents and high temporal and spatial resolutions. Furthermore, spatially and temporally explicit measurements are critical for making inferences about fire effects and useful for examining patterns of fire spread. In...

Author(s): Joseph J. O'Brien, E. Louise Loudermilk, Benjamin Hornsby, Andrew T. Hudak, Benjamin C. Bright, Matthew B. Dickinson, J. Kevin Hiers, Casey Teske, Roger D. Ottmar

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

### **Measurements relating fire radiative energy density and surface fuel consumption - RxCADRE 2011 and 2012**

[www.nrfirescience.org/resource/13845](http://www.nrfirescience.org/resource/13845)

Small-scale experiments have demonstrated that fire radiative energy is linearly related to fuel combusted but such a relationship has not been shown at the landscape level of prescribed fires. This paper presents field and remotely sensed measures of pre-fire fuel loads, consumption, fire radiative

energy density (FRED) and fire...

Author(s): Andrew T. Hudak, Matthew B. Dickinson, Benjamin C. Bright, Robert L. Kremens, E. Louise Loudermilk, Joseph J. O'Brien, Benjamin Hornsby, Roger D. Ottmar

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

### **The Influence of Climate Model Biases on Projections of Aridity and Drought**

[www.nrfirescience.org/resource/15624](http://www.nrfirescience.org/resource/15624)

Global climate models (GCMs) have biases when simulating historical climate conditions, which in turn have implications for estimating the hydrological impacts of climate change. This study examines the differences in projected changes of aridity [defined as the ratio of precipitation (P) over potential evapotranspiration (PET), or...

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

### **Controls on interannual variability in lightning-caused fire activity in the western US**

[www.nrfirescience.org/resource/15601](http://www.nrfirescience.org/resource/15601)

Lightning-caused wildfires account for a majority of burned area across the western United States (US), yet lightning remains among the more unpredictable spatiotemporal aspects of the fire environment and a challenge for both modeling and managing fire activity. A data synthesis of cloud-to-ground lightning strikes, climate and...

Author(s): John T. Abatzoglou, Crystal A. Kolden, Jennifer Balch, Bethany A. Bradley

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

### **Role of buoyant flame dynamics in wildfire spread**

[www.nrfirescience.org/resource/13377](http://www.nrfirescience.org/resource/13377)

Large wildfires of increasing frequency and severity threaten local populations and natural resources and contribute carbon emissions into the earth-climate system. Although wildfires have been researched and modeled for decades, no verifiable physical theory of spread is available to form the basis for the precise predictions...

Author(s): Mark A. Finney, Jack D. Cohen, Jason M. Forthofer, Sara S. McAllister, Michael J. Gollner, Daniel J. Gorham, Kozo Saito, Nelson K. Akafuah, Brittany A. Adam, Justin D. English

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

### **Limitations and utilisation of monitoring trends in burn severity products for assessing wildfire severity in the USA**

[www.nrfirescience.org/resource/15631](http://www.nrfirescience.org/resource/15631)

The Monitoring Trends in Burn Severity project is a comprehensive fire atlas for the United States that includes perimeters and severity data for all fires greater than a particular size (,400 ha in the western US, and,200 ha in the eastern US). Although the database was derived for management purposes, the scientific community has...

Author(s): Crystal A. Kolden, Alistair M. S. Smith, John T. Abatzoglou

Year Published: 2015

Type: Document

Book or Chapter or Journal Article



### **Forecasting integrated lightning and fuels ignition potentials in a system with real-time analysis of fire weather prediction accuracy**

[www.nrfirescience.org/resource/15557](http://www.nrfirescience.org/resource/15557)

Weather forecasts can help identify environmental conditions conducive to prescribed burning or to increased fire danger. These conditions are important components of fire management tools such as fire ignition potential maps, fire danger rating systems, fire behavior predictions, and smoke dispersion modeling. Fire managers use...

Author(s): Miriam L. Rorig, Stacy Drury

Year Published: 2015

Type: Document

Technical Report or White Paper

### **Fuel loads and simulated fire behavior in 'old-stage' beetle-infested ponderosa pine of the Colorado Plateau**

[www.nrfirescience.org/resource/14527](http://www.nrfirescience.org/resource/14527)

Recent bark beetle outbreaks in western North America have led to concerns regarding changes in fuel profiles and associated changes in fire behavior. Data are lacking for a range of infestation severities and time since outbreak, especially for relatively arid cover types. We surveyed fuel loads and simulated fire behavior for...

Author(s): E. Matthew Hansen, Morris C. Johnson, Barbara J. Bentz, A. Steven Munson

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

### **Warning signals for eruptive events in spreading fires**

[www.nrfirescience.org/resource/13265](http://www.nrfirescience.org/resource/13265)

Spreading fires are noisy (and potentially chaotic) systems in which transitions in dynamics are notoriously difficult to predict. As flames move through spatially heterogeneous environments, sudden shifts in temperature, wind, or topography can generate combustion instabilities, or trigger self-stabilizing feedback loops, that...

Author(s): Jerome M. Fox, George M. Whitesides

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

### **Deriving fundamental statistical shrub fuel models by laser scanning and combustion experimentation**

[www.nrfirescience.org/resource/15558](http://www.nrfirescience.org/resource/15558)

We exploited the measurement capacity of a terrestrial laser scanner to precisely characterize shrub fuel matrices in a laboratory setting, to abstract fuel elements for fire behavior modeling, and to identify strengths and limitations of TLS for these purposes. Simultaneously, we produced statistical distributions of combustion...

Author(s): Carl A. Seielstad, Thomas H. Fletcher, David R. Weise

Year Published: 2015

Type: Document

Technical Report or White Paper

### **Daily weather and other factors influencing burn severity in central Idaho and western Montana**

[www.nrfirescience.org/resource/15316](http://www.nrfirescience.org/resource/15316)

Burn severity as inferred from satellite-derived differenced Normalized Burn Ratio (dNBR) is useful for evaluating fire impacts on ecosystems but the environmental controls on burn severity across large forest fires are both poorly understood and likely to be different than those influencing fire extent. We related dNBR to...

Author(s): Donovan Birch, Penelope Morgan, Crystal A. Kolden, John T. Abatzoglou, Gregory K. Dillon, Andrew T. Hudak, Alistair M. S. Smith

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

### **Observed and projected changes in absolute temperature extremes across the contiguous United States**

[www.nrfirescience.org/resource/15657](http://www.nrfirescience.org/resource/15657)

Changes in the extent of absolute, all-time, daily temperature records across the contiguous United States were examined using observations and climate model simulations. Observations from station data and reanalysis from 1980 to 2013 show increased extent of absolute highest temperature records and decreased extent of absolute...

Author(s): John T. Abatzoglou, Renaud Barbero

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

### **Climate and very large wildland fires in the contiguous western USA**

[www.nrfirescience.org/resource/13009](http://www.nrfirescience.org/resource/13009)

Very large wildfires can cause significant economic and environmental damage, including destruction of homes, adverse air quality, firefighting costs and even loss of life. We examine how climate is associated with very large wildland fires (VLWFs > or =50,000 acres, or ~20,234 ha) in the western contiguous USA. We used composite...

Author(s): E. Natasha Stavros, John T. Abatzoglou, Narasimhan K. Larkin, Donald McKenzie, E. Ashley Steel

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

### **Impacts of mega-fires on large U.S. urban area air quality under changing climate and fuels**

[www.nrfirescience.org/resource/15569](http://www.nrfirescience.org/resource/15569)

Mega-fires can adversely impact air quality in the United States and the impacts are likely to become more serious in the future due to the possibility of more frequent and intense mega-fires in response to the projected climate change. This study investigated U.S. mega-fires and fuel conditions and their environmental impacts under...

Author(s): Yongqiang Liu, Scott L. Goodrick, John A. Stanturf, Hanqin Tian

Year Published: 2014

Type: Document

Technical Report or White Paper

### **Representation and evaluation of wildfire propagation simulations**

[www.nrfirescience.org/resource/12390](http://www.nrfirescience.org/resource/12390)

This paper provides a formal mathematical representation of a wildfire simulation, reviews the most common scoring methods using this formalism, and proposes new methods that are explicitly designed to evaluate a forest fire simulation from ignition to extinction. These scoring or agreement methods are tested with synthetic cases in...

Author(s): Jean-Baptiste Filippi, Vivien Mallet, Bahaa Nader  
Year Published: 2014  
Type: Document  
Book or Chapter or Journal Article

### **Seasonal climate variability and change in the Pacific Northwest of the United States**

[www.nrfirescience.org/resource/15671](http://www.nrfirescience.org/resource/15671)

Observed changes in climate of the U.S. Pacific Northwest since the early twentieth century were examined using four different datasets. Annual mean temperature increased by approximately 0.6°–0.8°C from 1901 to 2012, with corroborating indicators including a lengthened freeze-free season, increased temperature of the coldest...

Author(s): John T. Abatzoglou, David E. Rupp, Philip W. Mote  
Year Published: 2014  
Type: Document  
Book or Chapter or Journal Article

### **Questionable evidence of natural warming of the northwestern United States**

[www.nrfirescience.org/resource/15655](http://www.nrfirescience.org/resource/15655)

Johnstone and Mantua (1) claim that changes in atmospheric circulation were the primary cause of the observed warming of sea surface temperature around the northeastern Pacific margins and surface air temperature (SAT) in Northern California, Oregon, and Washington from 1901 to 2012. The results of Johnstone and Mantua's report...

Author(s): John T. Abatzoglou, David E. Rupp, Philip W. Mote  
Year Published: 2014  
Type: Document  
Book or Chapter or Journal Article

### **Fuel treatment effectiveness in reducing fire intensity and spread rate -- an experimental overview**

[www.nrfirescience.org/resource/16924](http://www.nrfirescience.org/resource/16924)

Fuel treatments represent a significant component of the wildfire mitigation strategy in the United States. However, the lack of research aimed at quantifying the explicit effectiveness of fuel treatments in reducing wildfire intensity and spread rate limits our ability to make educated decisions about the type and placement of...

Author(s): Eric Mueller, Nick Skowronski, Albert Simeoni, Kenneth L. Clark, Robert L. Kremens, William E. Mell, Michael R. Gallagher, Jan C. Thomas, Alexander I. Filkov, M. El Houssami, John L. Hom, Bret W. Butler  
Year Published: 2014  
Type: Document  
Conference Proceedings

### **Are the applications of wildland fire behaviour models getting ahead of their evaluation again?**

[www.nrfirescience.org/resource/12417](http://www.nrfirescience.org/resource/12417)

Evaluation is a crucial component for model credibility and acceptance by researchers and resource managers. The nature and characteristics of free-burning wildland fires pose challenges to acquiring the kind of quality data necessary for adequate fire behavior model evaluation. As a result, in some circles it has led to a research...

Author(s): Martin E. Alexander, Miguel G. Cruz  
Year Published: 2013  
Type: Document  
Book or Chapter or Journal Article

### **A study of flame spread in engineered cardboard fuelbeds: part II: scaling law approach**

[www.nrfirescience.org/resource/12419](http://www.nrfirescience.org/resource/12419)

In this second part of a two part exploration of dynamic behavior observed in wildland fires, time scales differentiating convective and radiative heat transfer is further explored. Scaling laws for the two different types of heat transfer considered: Radiation-driven fire spread, and convection-driven fire spread, which can both...

Author(s): Brittany A. Adam, Nelson K. Akafuah, Mark A. Finney, Jason M. Forthofer, Kozo Saito

Year Published: 2013

Type: Document

Conference Proceedings

### **Wildfire exposure and fuel management on western US national forests**

[www.nrfirescience.org/resource/12756](http://www.nrfirescience.org/resource/12756)

Substantial investments in fuel management activities on national forests in the western US are part of a national strategy to reduce human and ecological losses from catastrophic wildfire and create fire resilient landscapes. Prioritizing these investments within and among national forests remains a challenge, partly because a...

Author(s): Alan A. Ager, Michelle A. Day, Charles W. McHugh, Karen C. Short, Julie W. Gilbertson-Day, Mark A. Finney, David E. Calkin

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

### **Uncertainty associated with model predictions of surface and crown fire rates of spread**

[www.nrfirescience.org/resource/12418](http://www.nrfirescience.org/resource/12418)

The degree of accuracy in model predictions of rate of spread in wildland fires is dependent on the model's applicability to a given situation, the validity of the model's relationships, and the reliability of the model input data. On the basis of a compilation of 49 fire spread model evaluation datasets involving 1278 observations...

Author(s): Miguel G. Cruz, Martin E. Alexander

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

### **Capturing fire: RxCADRE takes fire measurements to whole new level**

[www.nrfirescience.org/resource/12425](http://www.nrfirescience.org/resource/12425)

Models of fire behavior and effects do not always make accurate predictions, and there is not enough systematically gathered data to validate them. To help advance fire behavior and fire effects model development, the Joint Fire Science Program is helping fund the RxCADRE, which is made up of scientists from the U.S. Forest Service...

Author(s): Gail Wells

Year Published: 2013

Type: Document

Research Brief or Fact Sheet

### **Evaluating regression model estimates of canopy fuel stratum characteristics in four crown fire-prone fuel types in western North America**

[www.nrfirescience.org/resource/8312](http://www.nrfirescience.org/resource/8312)

Two evaluations were undertaken of the regression equations developed by M. Cruz, M. Alexander and

R. Wakimoto (2003, International Journal of Wildland Fire 12, 39-50) for estimating canopy fuel stratum characteristics from stand structure variables for four broad coniferous forest fuel types found in western North America. The...

Author(s): Miguel G. Cruz, Martin E. Alexander

Year Published: 2012

Type: Document

Book or Chapter or Journal Article

### **Entrainment regimes and flame characteristics of wildland fires**

[www.nrfirescience.org/resource/16925](http://www.nrfirescience.org/resource/16925)

This paper reports results from a study of the flame characteristics of 22 wind-aided pine litter fires in a laboratory wind tunnel and 32 field fires in southern rough and litter-grass fuels. Flame characteristic and fire behaviour data from these fires, simple theoretical flame models and regression techniques are used to...

Author(s): Ralph M. Nelson, Bret W. Butler, David R. Weise

Year Published: 2012

Type: Document

Book or Chapter or Journal Article

### **A comparison of statistical downscaling methods suited for wildfire applications**

[www.nrfirescience.org/resource/11973](http://www.nrfirescience.org/resource/11973)

Place-based data is required in wildfire analyses, particularly in regions of diverse terrain that foster not only strong gradients in meteorological variables, but also complex fire behaviour. However, a majority of downscaling methods are inappropriate for wildfire application due to the lack of daily timescales and variables such...

Author(s): John T. Abatzoglou, Timothy J. Brown

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

### **Characterization of flame radiosity in shrubland fires**

[www.nrfirescience.org/resource/16927](http://www.nrfirescience.org/resource/16927)

The present study is aimed at quantifying the flame radiosity vertical profile and gas temperature in moderate to high intensity spreading fires in shrubland fuels. We report on the results from 11 experimental fires conducted over a range of fire rate of spread and frontal fire intensity varying respectively between 0.04–0.35 m s...

Author(s): Miguel G. Cruz, Bret W. Butler, Domingos Xavier Viegas, Pedro Palheiro

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

### **Characterization of convective heating in full scale wildland fires**

[www.nrfirescience.org/resource/16929](http://www.nrfirescience.org/resource/16929)

Data collected in the International Crown Fire modeling Experiment during 1999 are evaluated to characterize the magnitude and duration of convective energy heating in full scale crown fires. To accomplish this objective data on total and radiant incident heat flux, air temperature, and horizontal and vertical gas velocities were...

Author(s): Bret W. Butler

Year Published: 2010

Type: Document

Conference Proceedings

### **Fine fuel heating by radiant flux**

[www.nrfirescience.org/resource/16903](http://www.nrfirescience.org/resource/16903)

Experiments were conducted wherein wood shavings and Ponderosa pine needles in quiescent air were subjected to a steady radiation heat flux from a planar ceramic burner. The internal temperature of these particles was measured using fine diameter (0.076 mm diameter) type K thermocouples. A narrow angle radiometer was used to...

Author(s): David Frankman, Brent W. Webb, Bret W. Butler, Donald J. Latham

Year Published: 2010

Type: Document

Book or Chapter or Journal Article

### **In-situ characterization of wildland fire behavior**

[www.nrfirescience.org/resource/16932](http://www.nrfirescience.org/resource/16932)

A system consisting of two enclosures has been developed to characterize wildland fire behavior: The first enclosure is a sensor/data logger combination that measures and records convective/radiant energy released by the fire. The second is a digital video camera housed in a fire proof enclosure that records visual images of fire...

Author(s): Bret W. Butler, Daniel M. Jimenez, Jason M. Forthofer, Paul Sopko, Kyle S. Shannon, James J. Reardon

Year Published: 2010

Type: Document

Conference Proceedings

### **Rx-CADRE (Prescribed Fire Combustion-Atmospheric Dynamics Research Experiments) collaborative research in the core fire sciences**

[www.nrfirescience.org/resource/16939](http://www.nrfirescience.org/resource/16939)

The Rx-CADRE project was the combination of local and national fire expertise in the field of core fire research. The project brought together approximately 30 fire scientists from six geographic regions and seven different agencies. The project objectives were to demonstrate the capacity for collaborative research by bringing...

Author(s): Daniel M. Jimenez, J. Kevin Hiers, Roger D. Ottmar, Matthew B. Dickinson, Robert L. Kremens, Joseph J. O'Brien, Andrew T. Hudak, C. Clements

Year Published: 2009

Type: Document

Conference Proceedings

### **Wildfires, weather, and productivity**

[www.nrfirescience.org/resource/11016](http://www.nrfirescience.org/resource/11016)

The object of this paper is to show the intercorrelations existing between statistics of wildfires (occurrences: N; areas burned: A), climatic parameters (precipitation: P; temperature: T) and net primary productivity: NPP. To this purpose, statistics of wildfires have been studied in several regions of the world, focusing on...

Author(s): Michel L. Bernard, Nouredine Nimour

Year Published: 2007

Type: Document

Conference Proceedings

### **Statistical model for forecasting monthly large wildfire events in the western United States**

[www.nrfirescience.org/resource/8123](http://www.nrfirescience.org/resource/8123)



The ability to forecast the number and location of large wildfire events (with specified confidence bounds) is important to fire managers attempting to allocate and distribute suppression efforts during severe fire seasons. This paper describes the development of a statistical model for assessing the forecasting skills of fire-...

Author(s): Haiganoush K. Preisler, Anthony L. Westerling

Year Published: 2007

Type: Document

Book or Chapter or Journal Article

### **Planetary wave breaking and nonlinear reflection: seasonal cycle and interannual variability**

[www.nrfirescience.org/resource/15713](http://www.nrfirescience.org/resource/15713)

Forty-six years of daily averaged NCEP–NCAR reanalysis data are used to identify the occurrence of planetary wave breaking (PWB) in the subtropical upper troposphere. As large-amplitude waves propagate into the subtropics where the zonal flow is weak, they may break. PWB is diagnosed by observing the large-scale meridional...

Author(s): John T. Abatzoglou, Gudrun Magnusdottir

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

### **Biomass consumption during prescribed fires in big sagebrush ecosystems**

[www.nrfirescience.org/resource/11419](http://www.nrfirescience.org/resource/11419)

Big sagebrush (*Artemisia tridentata*) ecosystems typically experience stand replacing fires during which some or all of the ignited biomass is consumed. Biomass consumption is directly related to the energy released during a fire, and is an important factor that determines smoke production and the effects of fire on other resources....

Author(s): Clinton S. Wright, Susan J. Prichard

Year Published: 2006

Type: Document

Conference Proceedings

### **Evaluation of the Experimental Climate Prediction Center's fire danger forecasts with remote automated weather station observations**

[www.nrfirescience.org/resource/8208](http://www.nrfirescience.org/resource/8208)

The Scripps Experimental Climate Prediction Center has been routinely making regional forecasts of atmospheric elements and fire danger indices since 27 September 1997. This study evaluates these forecasts using selected remote automated weather station observations over the western USA. Bias and anomaly correlations are computed...

Author(s): Hauss J. Reinbold, John O. Roads, Timothy J. Brown

Year Published: 2005

Type: Document

Book or Chapter or Journal Article

### **Probability based models for estimation of wildfire risk**

[www.nrfirescience.org/resource/12709](http://www.nrfirescience.org/resource/12709)

We present a probability-based model for estimating fire risk. Risk is defined using three probabilities: the probability of fire occurrence; the conditional probability of a large fire given ignition; and the unconditional probability of a large fire. The model is based on grouped data at the 1 km<sup>2</sup>-day cell level. We fit a...

Author(s): Haiganoush K. Preisler, David R. Brillinger, Robert E. Burgan, John W. Benoit

Year Published: 2004

Type: Document  
Book or Chapter or Journal Article

### **Assessing canopy fuel stratum characteristics in crown fire prone fuel types of western North America**

[www.nrfirescience.org/resource/7917](http://www.nrfirescience.org/resource/7917)

Application of crown fire behavior models in fire management decision-making have been limited by the difficulty of quantitatively describing fuel complexes, specifically characteristics of the canopy fuel stratum. To estimate canopy fuel stratum characteristics of four broad fuel types found in the western United States and...

Author(s): Martin E. Alexander, Ronald H. Wakimoto

Year Published: 2003

Type: Document

Book or Chapter or Journal Article

### **Reaction times and burning rates for wind tunnel headfires**

[www.nrfirescience.org/resource/8211](http://www.nrfirescience.org/resource/8211)

Catchpole et al. (1998) reported rates of spread for 357 heading and no-wind fires burned in the wind tunnel facility of the USDA Forest Service's Fire Sciences Laboratory in Missoula, Montana for the purpose of developing models of wildland fire behavior. The fires were burned in horizontal fuel beds with differing characteristics...

Author(s): Ralph M. Nelson

Year Published: 2003

Type: Document

Book or Chapter or Journal Article

### **Statistical forecast of the 2001 western wildfire season using principal components regression**

[www.nrfirescience.org/resource/8396](http://www.nrfirescience.org/resource/8396)

Description not entered

Author(s): Anthony L. Westerling, Daniel R. Cayan, Alexander Gershunov, M. D. Dettinger, Timothy J. Brown

Year Published: 2001

Type: Document

Book or Chapter or Journal Article

### **Making sense of fire weather**

[www.nrfirescience.org/resource/8122](http://www.nrfirescience.org/resource/8122)

This paper analyzes data from 339 large wildland fires that occurred in the Continental United States from 1971 through 1984. Each fire burned 1,000 acres (400 ha) or more. Each fire was associated with the nearest upper-air weather station and classified according to its season (spring, summer, autumn, or winter). Results of this...

Author(s): Brian E. Potter

Year Published: 1997

Type: Document

Book or Chapter or Journal Article

### **Intermountain West lightning-caused fires: climatic predictors of area burned**

[www.nrfirescience.org/resource/11460](http://www.nrfirescience.org/resource/11460)

An increase in continuous fine fuels promoted by the expansion of aggressive annual exotic grasses in the Intermountain West has altered the region's fire regimes, with both ecologic and economic

ramifications. I examine the predictive nature of seasonal climatic variables, seasonal precipitation and temperature data up to 2 years...

Author(s): Paul A. Knapp

Year Published: 1995

Type: Document

Book or Chapter or Journal Article

### **Predicting behavior and size of crown fires in the northern Rocky Mountains**

[www.nrfirescience.org/resource/11195](http://www.nrfirescience.org/resource/11195)

Assessment of crown fire conditions calls for two important judgments: (1) identifying conditions for the onset of severe fires, and (2) predicting the spread rate, intensity, and size of expected crown fires. This paper addresses the second problem and provides methods for making a first approximation of the behavior of a running...

Author(s): Richard C. Rothermel

Year Published: 1991

Type: Document

Technical Report or White Paper

### **Monoammonium phosphate: effect on flammability of excelsior and pine needles**

[www.nrfirescience.org/resource/11959](http://www.nrfirescience.org/resource/11959)

The study quantified differences between fire-retarding abilities of monoammonium phosphate samples from five different sources. Ponderosa pine needles and aspen excelsior fuel beds were spray-treated with different levels of chemical solutions, dried, and burned under controlled laboratory conditions.

Flame spread and energy...

Author(s): Aylmer D. Blakely

Year Published: 1983

Type: Document

Technical Report or White Paper

### **Predicting slash depth for fire modeling**

[www.nrfirescience.org/resource/11954](http://www.nrfirescience.org/resource/11954)

Development of equations for predicting fuel bed depth (called "bulk depth" herein) appropriate for modeling fire behavior in slash is described. Bulk depth ( $y$ ) was correlated with the expected number of 1/4-to 1-inch-diameter particle intercepts per foot of vertical plane transect ( $x$ ) by regressions of the form  $y = ax$ . Values of "...

Author(s): Frank A. Albini, James K. Brown

Year Published: 1978

Type: Document

Technical Report or White Paper

### **Field test of a rate-of-fire-spread model in slash fuels**

[www.nrfirescience.org/resource/11945](http://www.nrfirescience.org/resource/11945)

Predicted rates of fire spread using a mathematical model were consistently greater but in reasonably close agreement with rates observed on test fires in ponderosa pine and Douglas-fir slash. Fuel loading, bulk density, particle density, particle surface-to-volume ratio, heat content, total plant salt content, silica-free salt,...

Author(s): James K. Brown

Year Published: 1972

Type: Document

Technical Report or White Paper

## **The seasonal trends in moisture content, ether extractives, and energy of ponderosa pine and Douglas-fir needles**

[www.nrfirescience.org/resource/11943](http://www.nrfirescience.org/resource/11943)

The moisture, ether extractive, and energy content of ponderosa pine (*Pinus ponderosa* Laws.) and Douglas-fir (*Pseudotsuga menziesii* L.) foliage were measured during two fire seasons. The moisture content of 1- and 2-year-old needles was found to rise throughout the summer. The ether extractive content was highest in the fir foliage...

Author(s): Charles W. Philpot, Robert W. Mutch

Year Published: 1971

Type: Document

Technical Report or White Paper

## **Characteristics of backfires and headfires in a pine needle fuel bed**

[www.nrfirescience.org/resource/11920](http://www.nrfirescience.org/resource/11920)

Burning characteristics of backfires, headfires, and no-wind fires in fuel beds of ponderosa pine needles were compared at the Northern Forest Fire Laboratory. Data gathered under controlled laboratory conditions indicate that fires backed into the wind (backfires) consistently burn slower, longer, and deeper than fires burned with...

Author(s): William R. Beaufait

Year Published: 1965

Type: Document

Research Brief or Fact Sheet