Application of the socio-ecological system framework to forest fire risk management: a systematic literature review

www.nrfirescience.org/resource/22780

Although increasing concern about climate change has raised awareness of the fundamental role of forest ecosystems, forests are threatened by human-induced impacts worldwide. Among them, wildfire risk is clearly the result of the interaction between human activities, ecological domains, and climate. However, a clear understanding of...

Author(s): Ingrid Vigna, Angelo Besana, Elena Comino, Alessandro Pezzoli
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Numerical study of the moisture content threshold under prescribed burning conditions

www.nrfirescience.org/resource/23250

The safety during prescribed burnings could be achieved by conducting these operations under marginal conditions of fire propagation. This type of fire can or cannot propagate on account of small deviations of the burning conditions, mainly the wind speed, the fuel load, and the fuel moisture-content. In this context, numerical...

Author(s): Carmen Awad, N. Frangieh, Thierry Marcelli, Gilbert Accary, D. Morvan, Sofiane Meradj, François Joseph Chatelon, Jean Louis Rossi
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

On the complexity of fire dinamics at the wildland-urban interface

www.nrfirescience.org/resource/22769

Complexity is the main feature of many fire-prone environments, in which the fire regime is driven by climate and socio-economic development on short and long timescales. In this study, the interaction between social and forest environments is modelled for the first time by assimilating socio-economic assets to a new flammable...

Author(s): Nadia Ursino
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Spatial analysis of wildfire incidence in the USA: the role of climatic spillovers

www.nrfirescience.org/resource/23126

Wildfires constitute a serious threat for both the environment and human well-being. The US fire policy aims to tackle this problem, devoting a sizeable amount of resources and resorting extensively to fire suppression strategies. The theoretical literature has established a link between climate conditions and wildfire incidence....

Author(s): Massimiliano Agovino, Massimiliano Cercielo, Aniello Ferraro, Antonio Garofalo
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Considerations for categorizing and visualizing numerical information: a case study of fire occurrence prediction models in the province of Ontario, Canada

www.nrfirescience.org/resource/23505

Wildland fire management decision-makers need to quickly understand large amounts of quantitative information under stressful conditions. Categorization and visualization 'schemes' have long been used
to help, but how they are done affects the speed and accuracy of interpretation. Using traditional fire management schemes can unduly...

Author(s): Den Boychuk, Colin B. McFayden, Douglas G. Woolford, B. Mike Wotton, Aaron Stacey, Jordan Evens, Chelene C. Krezek-Hanes, Melanie J. Wheatley
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

**Past variance and future projections of the environmental conditions driving western U.S. summertime wildfire burn area**

www.nrfirescience.org/resource/22719

Increases in Vapor Pressure Deficit (VPD) have been hypothesized as the primary driver of future fire changes. The Coupled Model Intercomparison Project phase 5 (CMIP5) models agree that western U.S. surface temperatures and associated dryness of air as defined by the VPD will increase in the 21st century for representative...

Author(s): Steven J. Brey, Elizabeth A. Barnes, Jeffrey R. Pierce, Abigail L. S. Swann, Emily V. Fischer
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

**Existing Improvements in Simulation of Fire–Wind Interaction and Its Effects on Structures**

www.nrfirescience.org/resource/23100

This work provides a detailed overview of existing investigations into the fire–wind interaction phenomena. Specifically, it considers: the fanning effect of wind, wind direction and slope angle, and the impact of wind on fire modelling, and the relevant analysis (numerical and experimental) techniques are evaluated. Recently, the...

Author(s): Maryam Ghodrat, Farshad Shakeriaski, David James Nelson, Albert Simeoni
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

**Empirical analyses of the factors influencing fire severity in southeastern Australia**

www.nrfirescience.org/resource/23489

Fire severity is a key component of fire regimes, and understanding the factors affecting it is critical given the increasing incidence of wildfires globally. We quantified the factors affecting the severity of the 2019–2020 fires in Victoria, southeastern Australia. We constructed statistical models of relationships between fire...

Author(s): David B. Lindenmayer, Chris Taylor, Wade Blanchard
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

**A critical review of fuel accumulation models used in Australian fire management**

www.nrfirescience.org/resource/22630

Various classifications of fuel accumulation models are used to describe the complex temporal relationship between fuel loads and vegetation dynamics. Fuel accumulation models are an important tool in wildfire management as fuel is the only component that can be directly controlled by fire managers. Here we discuss various strengths...

Author(s): Hilyati H. Zazali, Isaac N. Towers, J. Sharples
Year Published: 2021
Type: Document
Downscaled GCM climate projections of fire weather over Victoria, Australia. Part 1*: evaluation of the MACA technique

Anthropogenic climate change is expected to cause an increase in fire danger over south-eastern Australia during the 21st century, primarily driven by increased surface temperature. Studies of future fire weather in Victoria, Australia, have so far mostly utilised direct output from general circulation models, which have inadequate...

Author(s): Scott Clark, Graham A. Mills, Timothy J. Brown, Sarah Harris, John T. Abatzoglou
Year Published: 2021
Type: Document

Adapting a dynamic vegetation model for regional biomass, plant biogeography, and fire modeling in the Greater Yellowstone Ecosystem: evaluating LPJ-GUESS-LMfireCF

North American forests are threatened by changes in climate and disturbance dynamics. Current efforts to model future vegetation and fire dynamics are challenged by the lack of mechanistic representation of ecological processes, the spatial resolution to capture landscape-level heterogeneity, and the ability to model regional...

Author(s): Kristen Emmett, Katherine M. Renwick, Ben Poulter
Year Published: 2021
Type: Document

Multifidelity prediction in wildfire spread simulation: modeling, uncertainty quantification and sensitivity analysis

Wildfire behavior predictions typically suffer from significant uncertainty. However, wildfire modeling uncertainties remain largely unquantified in the literature, mainly due to computing constraints. New multifidelity techniques provide a promising opportunity to overcome these limitations. Therefore, this paper explores the...

Author(s): M.M. Valero, Lluís Jofre, Ricardo Torres
Year Published: 2021
Type: Document

Developing a geospatial data-driven solution for rapid natural wildfire risk assessment

Computational natural wildfire simulation is a computing-intensive process. The process is also challenging because of the need to integrate data with wide spatial and temporal variability. Our study sought to simulate rapidly spreading natural wildfire with fidelity and quality through computational realization. We developed a...

Author(s): Bishrant Adhikari, Chen Xu, Paddington Hodza, Thomas A. Minckley
Year Published: 2021
Type: Document

Understanding the effect of fire on vegetation composition and gross primary production in a
Wildfires in sagebrush (Artemisia spp.)-dominated semi-arid ecosystems in the western United States have increased dramatically in frequency and severity in the last few decades. Severe wildfires often lead to the loss of native sagebrush communities and change the biogeochemical conditions which make it difficult for sagebrush to...

Author(s): Karun Pandit, Hamid Dashti, Andrew T. Hudak, Nancy F. Glenn, Alejandro N. Flores, Douglas J. Shinneman
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Wildland fires have been a rising problem on the worldwide level, generating ecological and economic losses. Specifically, between wildland fire types, uncontrolled fires are critical due to the potential damage to the ecosystem and their effects on the soil, and, in the last decade, different technologies have been applied to fight...

Author(s): Felipe Vasquez, Ania Cravero, Manuel Castro, Patricio Acevedo
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Pyrogenic carbon (PyC) is a ubiquitous legacy of wildfire in terrestrial soils, yet how it affects the growth and function of regenerating plants has received little research attention. We examined responses to a natural gradient of PyC deposition 5 years following a severe fire in a northern boreal forest, based on measurements of...

Author(s): Nigel V. Gale, Sean C. Thomas
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Fire spread associated with violent pyrogenic convection is highly unpredictable and difficult to suppress. Wildfire-driven convection may generate cumulonimbus (storm) clouds, also known as pyrocumulonimbus (pyroCb). Research into such phenomena has tended to treat the fire on the surface and convection in the atmosphere above as...

Author(s): Rachel Badlan, J. Sharples, Jason P. Evans, Richard H. D. McRae
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

A significant amount of research has examined what motivates people living in fire-prone areas to mitigate their wildfire risk (i.e. engage in activities that reduce vulnerability and the effects of a wildfire risk...
Mixtures modeling identifies chemical inducers versus repressors of toxicity associated with wildfire smoke
www.nrfirescience.org/resource/23262
Exposure to wildfire smoke continues to be a growing threat to public health, yet the chemical components in wildfire smoke that primarily drive toxicity and associated disease are largely unknown. This study utilized a suite of computational approaches to identify groups of chemicals induced by variable biomass burn conditions that...
Author(s): Julia E. Rager, Jeliyah Clark, Lauren A. Eaves, Vennela Avula, Nicole M. Niehoff, Yong Ho Kim, Ilona Jaspers, M. Ian Gilmour
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

A multi-fidelity framework for wildland fire behavior simulations over complex terrain
www.nrfirescience.org/resource/22775
A method for the large-eddy simulation (LES) of wildfire spread over complex terrain is presented. In this scheme, a cut-cell immersed boundary method (CC-IBM) is used to render the complex terrain, defined by a tessellation, on a rectilinear Cartesian grid. Discretization of scalar transport equations for chemical species is done...
Author(s): Marcos Vanella, Kevin B. McGrattan, Randall McDermott, Glenn P. Forney, William E. Mell, Emanuele Gissi, Paolo Fiorucci
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Reaction intensity partitioning: a new perspective of the National Fire Danger Rating System
Energy Release Component
www.nrfirescience.org/resource/23177
The Rothermel fire spread model provides the scientific basis for the US National Fire Danger Rating System (NFDRS) and several other important fire management applications. This study proposes a new perspective of the model that partitions the reaction intensity function and Energy Release Component (ERC) equations as an alternative...
Author(s): Francis M. Fujioka, David R. Weise, Shyh-Chin Chen, Seung Hee Kim, Menas C. Kafatos
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Using machine learning to predict fire-ignition occurrences from lightning forecasts
www.nrfirescience.org/resource/22728
Lightning-caused wildfires are a significant contributor to burned areas, with lightning ignitions remaining one of the most unpredictable aspects of the fire environment. There is a clear connection between fuel moisture and the probability of ignition; however, the mechanisms are poorly understood and predictive methods are...
Author(s): Ruth Coughlan, Francesca Di Giuseppe, Claudia Vitolo, Christopher Barnard, Philippe
Summer air temperature for the Greater Yellowstone Ecoregion (770-2019 CE) over 1,250 years
www.nrfirescience.org/resource/23120
Projected warming of global surface air temperatures will further exacerbate droughts, wildfires, and other agents of ecosystem stress. We use latewood blue intensity from high-elevation Picea engelmannii to reconstruct late-summer maximum air temperature for the Greater Yellowstone Ecoregion (GYE) spanning 770-2019 CE. Using a...
Author(s): Karen J. Heeter, Maegen L. Rochner, Grant Harley
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Forest Structure Drives Fuel Moisture Response across Alternative Forest States
www.nrfirescience.org/resource/23503
Climate warming is expected to increase fire frequency in many productive obligate seeder forests, where repeated high-intensity fire can initiate stand conversion to alternative states with contrasting structure. These vegetation–fire interactions may modify the direct effects of climate warming on the microclimatic conditions...
Author(s): Tegan P. Brown, Assaf Inbar, Thomas J. Duff, Jamie Burton, Philip J. Noske, Patrick N. J. Lane, Gary J. Sheridan
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Novel method for a posteriori uncertainty quantification in wildland fire spread simulation
www.nrfirescience.org/resource/22708
Simulation is used to predict the spread of a wildland fire across land in real-time. Nevertheless, the large uncertainties in these simulations must be quantified in order to provide better information to fire managers. Ensemble forecasts are usually applied for this purpose, with an input parameter distribution that is defined...
Author(s): Frédéric Allaire, Vivien Mallet, Jean-Baptiste Filippi
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Guidelines for effective evaluation and comparison of wildland fire occurrence prediction models
www.nrfirescience.org/resource/23077
Daily, fine-scale spatially explicit wildland fire occurrence prediction (FOP) models can inform fire management decisions. Many different data-driven modelling methods have been used for FOP. Several studies use multiple modelling methods to develop a set of candidate models for the same region, which are then compared against one...
Author(s): Nathan Phelps, Douglas G. Woolford
Year Published: 2021
Type: Document
Book or Chapter or Journal Article
Assessing factors that influence landscape fuels treatment effectiveness

Policy initiatives such as the Collaborative Forest Landscape Restoration Program (Rep. Holt, 2009) have emphasized landscape-scale (> 10,000 ac) fuel reduction treatments to mitigate adverse impacts of large, uncharacteristic wildfires in the western United States. Over the past two decades, a nuanced understanding of the design...

What is wrong with post?fire soil erosion modelling? A meta?analysis on current approaches, research gaps, and future directions

In the near future, a higher occurrence of wildfires is expected due to climate change, carrying social, environmental, and economic implications. Such impacts are often associated with an increase of post?fire hydrological and erosive responses, which are difficult to predict. Soil erosion models have been proven to be a valuable...

Fire and soils: measurements, modelling, management and challenges

Fire is a natural element that has important effects on society, economy and environment. It is a critical element of many ecosystems, but when uncontrolled is the cause of the destruction of many socio-economic systems. These uncontrolled fires (wildfires) have temporal effects on soils, depending on the wildfire severity. The...

The changing risk and burden of wildfire in the United States

Recent dramatic and deadly increases in global wildfire activity have increased attention on the causes of wildfires, their consequences, and how risk from wildfire might be mitigated. Here we bring together data on the changing risk and societal burden of wildfire in the United States. We estimate that nearly 50 million homes are...

Sensitivity of grass fires burning in marginal conditions to atmospheric turbulence

Atmospheric forcing and interactions between the fire and atmosphere are primary drivers of wildland fire behavior. The atmosphere is known to be a chaotic system that, although deterministic, is very sensitive to small perturbations to initial conditions. We assume that as a result of the tight coupling
The challenges of an in situ validation of a nonequilibrium model of heat and moisture dynamics during fires
www.nrfirescience.org/resource/22957
With the increasing frequency and severity of fire, there is an increasing desire to better manage fuels and minimize, as much as possible, the impacts of fire on soils and other natural resources. Piling and/or burning slash is one method of managing fuels and reducing the risk and consequences of wildfire, but the repercussions to...
Author(s): Alexandra K. Jonko, Kara M. Yedinak, Juliana L. Conley, Rodman Linn
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Objective identification of thunderstorm gust fronts in numerical weather prediction models for fire weather forecasting
www.nrfirescience.org/resource/23358
Abrupt changes in wind direction and speed can dramatically impact wildfire development and spread, endangering firefighters. A frequent cause of such wind shifts is outflow from thunderstorms and organised convective systems; thus, their identification and prediction present critical challenges for fire weather forecasters. Here,...
Author(s): William J. Massman
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

A Deep Learning Approach to Downscale Geostationary Satellite Imagery for Decision Support in High Impact Wildfires
www.nrfirescience.org/resource/22891
Scarcity in wildland fire progression data as well as considerable uncertainties in forecasts demand improved methods to monitor fire spread in real time. However, there exists at present no scalable solution to acquire consistent information about active forest fires that is both spatially and temporally explicit. To overcome this...
Author(s): Nicholas McCarthy, Ali Tohidi, Yawar Aziz, Matt Dennie, M.M. Valero, Nicole Hu
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Direct and indirect disturbance impacts in forests
www.nrfirescience.org/resource/23282
Human and natural disturbances are key drivers of change in forest ecosystems. Yet, the direct and indirect mechanisms which underpin these changes remain poorly understood at the ecosystem level. Here, using structural equation modelling across a 150+ year chronosequence, we disentangle the direct and indirect effects of major...
Author(s): Elle J. Bowd, Sam C. Banks, Andrew Bissett, Tom W. May, David B. Lindenmayer
Year Published: 2021
Type: Document
Modelling the effect of accelerated forest management on long-term wildfire activity
www.nrfirescience.org/resource/21079
We integrated a widely used forest growth and management model, the Forest Vegetation Simulator, with the FSim large wildfire simulator to study how management policies affected future wildfire over 50 years on a 1.3 million ha study area comprised of a US national forest and adjacent lands. The model leverages decades of research...
Author(s): Alan A. Ager, Ana M. G. Barros, Rachel M. Houtman, Robert C. Seli, Michelle A. Day
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Physics-based model of wildfire propagation towards faster-than-real-time simulations
www.nrfirescience.org/resource/21976
This paper presents the mathematical formulation, numerical solution, calibration and testing of a physics-based model of wildfire propagation aimed at faster-than-real-time simulations. Despite a number of simplifying assumptions, the model is comprehensive enough to capture the major phenomena that govern the behaviour of a real...
Author(s): Paolo Grasso, Mauro S. Innocente
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Evaluating the Ability of FARSITE to Simulate Wildfires Influenced by Extreme, Downslope Winds in Santa Barbara, California
www.nrfirescience.org/resource/21619
Extreme, downslope mountain winds often generate dangerous wildfire conditions. We used the wildfire spread model Fire Area Simulator (FARSITE) to simulate two wildfires influenced by strong wind events in Santa Barbara, CA. High spatial-resolution imagery for fuel maps and hourly wind downscaled to 100 m were used as model inputs,...
Author(s): Katelyn Zigner, Leila M. V. Carvalho, Seth H. Peterson, Francis M. Fujioka, Gert-Jan Duine, Charles Jones, Dar A. Roberts, Max A. Moritz
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Climatic influences on forest fire and mountain pine beetle outbreaks and resulting runoff effects in large watersheds in British Columbia, Canada
www.nrfirescience.org/resource/22331
Many studies have defined the interrelationships between climate, forest disturbance, and runoff at small scales (<100 km2), but few have translated these relationships to large watersheds (>500 km2). In this study, we explore the relationship between climate, extreme forest fire seasons, mountain pine beetle (MPB) outbreaks,...
Author(s): Margot E. Vore, Stephen J. Déry, Yiping Hou, Xiaohua Wei
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

QUIC-fire: a fast-running simulation tool for prescribed fire planning
Coupled fire-atmospheric modeling tools are increasingly used to understand the complex and dynamic behavior of wildland fires. Multiple research tools linking combustion to fluid flow use Navier-Stokes numerical solutions coupled to a thermodynamic model to understand fire-atmospheric feedbacks, but these computational fluid...

Author(s): Rodman Linn, Scott L. Goodrick, Sara Brambilla, Martin J. Brown, R. S. Middleton, Joseph J. O’Brien, J. Kevin Hiers
Year Published: 2020
Type: Document

Prototyping a Geospatial Atlas for Wildfire Planning and Management

Wildland fire managers are increasingly embracing risk management principles by being more anticipatory, proactive, and “engaging the fire before it starts”. This entails investing in pre-season, cross-boundary, strategic fire response planning with partners and stakeholders to build a shared understanding of wildfire risks and...

Author(s): Matthew P. Thompson, Benjamin Gannon, Michael D. Caggiano, Christopher D. O’Connor, April Brough, Julie W. Gilbertson-Day, Joe H. Scott
Year Published: 2020
Type: Document

Commentary on the article “Burn probability simulation and subsequent wildland fire activity in Alberta, Canada - Implications for risk assessment and strategic planning” by J. L. Beverly and N. McLoughlin

Monte Carlo simulations using wildland fire spread models have been conducted to produce numerical estimates of fire likelihood, project potential fire effects, and produce event sets of realistic wildfires (Parisien et al., 2019). The application of these methods has greatly expanded over the last few decades as a result of...

Author(s): Marc-Andre Parisien, Alan A. Ager, Ana M. G. Barros, Denyse A. Dawe, Sandy Erni, Mark A. Finney, Charles W. McHugh, Carol Miller, Sean A. Parks, Karen L. Riley, Karen C. Short, Christopher A. Stockdale, Xianli Wang, Ellen Whitman
Year Published: 2020
Type: Document

Projecting impacts of wildfire and climate change on streamflow, sediment, and organic carbon yields in a forested watershed

Increasing temperatures and irregular precipitation associated with climate change, along with increasing frequency and severity of wildfires, contribute to increased downstream transport of sediment and total organic carbon (TOC), with potential impacts on aquatic ecosystem structure and resilience, recreational use of water bodies...

Author(s): Danielle Loiselle, Xinzhong Du, Daniel S. Alessi, Kevin D. Bladon, Monireh Faramarzi
Year Published: 2020
Type: Document
Emissions
www.nrfirescience.org/resource/20800
A simple, easy-to-evaluate, surrogate model was developed for predicting the particle emission source term in wildfire simulations. In creating this model, we conceptualized wildfire as a series of flamelets, and using this concept of flamelets, we developed a one-dimensional model to represent the structure of these flamelets which...
Author(s): Alexander J. Josephson, Troy M. Holland, Sara Brambilla, Michael J. Brown, Rodman Linn
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Modeling Wildland Firefighter Travel Rates by Terrain Slope: Results from GPS-Tracking of Type 1 Crew Movement
www.nrfirescience.org/resource/21926
Escape routes keep firefighters safe by providing efficient evacuation pathways from the fire line to safety zones. Effectively utilizing escape routes requires a precise understanding of how much time it will take firefighters to traverse them. To improve this understanding, we collected GPS-tracked travel rate data from US...
Author(s): Patrick R. Sullivan, Michael J. Campbell, Philip E. Dennison, Simon C. Brewer, Bret W. Butler
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

A multiscale model of wood pyrolysis in fire to study the roles of chemistry and heat transfer at the mesoscale
www.nrfirescience.org/resource/21511
Pyrolysis is a key process in all stages of wood burning from ignition to extinction. Understanding each stage is crucial to tackle wildfires and assess the fire safety of timber buildings. A model of appropriate complexity of wood pyrolysis and oxidation is missing, which limits the understanding of fires fuelled by wood. Progress...
Author(s): Franz Richter, Guillermo Rein
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Downscaling fire weather extremes from historical and projected climate models
www.nrfirescience.org/resource/22297
An important aspect of predicting future wildland fire risk is estimating fire weather-weather conducive to the ignition and propagation of fire-under realistic climate change scenarios. Because the majority of area burned occurs on a few days of extreme fire weather, this task should be able to resolve fire weather extremes. In...
Author(s): Piyush Jain, Mari R. Tye, Debasish Paimazumder, Michael D. Flannigan
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Ground wind generated near the base by the massive convective column of very large-scale mass fires
www.nrfirescience.org/resource/20737
In large-scale mass fires generated in forests or by a nuclear event, the area of the fire is large
(diameter 1 or more kilometers) whereas the flame height is relatively small (less than 10 m) creating a large turbulent buoyant plume. This paper determines a correlation for the magnitude of velocity such a flow generates near...

Author(s): Michael Delichatsios, Jianping Zhang
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Simulation modeling of complex climate, wildfire, and vegetation dynamics to address wicked problems in land management
www.nrfirescience.org/resource/21832
Complex, reciprocal interactions among climate, disturbance, and vegetation dramatically alter spatial landscape patterns and influence ecosystem dynamics. As climate and disturbance regimes shift, historical analogs and past empirical studies may not be entirely appropriate as templates for future management. The need for a better...

Author(s): Rachel A. Loehman, Robert E. Keane, Lisa M. Holsinger
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Using Landscape Simulation Modeling to Develop an Operational Resilience Metric
www.nrfirescience.org/resource/23065
Goals of fostering ecological resilience are increasingly used to guide U.S. public land management in the context of anthropogenic climate change and increasing landscape disturbances. There are, however, few operational means of assessing the resilience of a landscape or ecosystem. We present a method to evaluate resilience using...

Author(s): Robert E. Keane, Sharon M. Hood, Rachel A. Loehman, Lisa M. Holsinger, Philip E. Higuera, Donald A. Falk
Year Published: 2020
Type: Document
Conference Proceedings

Fire as a fundamental ecological process: Research advances and frontiers
www.nrfirescience.org/resource/21390
...

Year Published: 2020
Type: Document
Synthesis

Towards the Development of a Probabilistic Approach to Informal Settlement Fire Spread Using Ignition Modelling and Spatial Metrics
www.nrfirescience.org/resource/22258
Large conflagrations of informal settlements occur regularly, leaving thousands of people homeless
daily and taking tens of thousands of lives annually. Over the past few years, a large amount of data has been collected from a number of full-scale informal settlement fire experiments. This paper uses that data with a semi...

Author(s): Antonio Cicione, Lesley Gibson, Colleen Wade, Michael Spearpoint, Richard Walls, David Rush
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Global fire season severity analysis and forecasting
www.nrfirescience.org/resource/20694
Fire activity has a huge impact on human lives. Different models have been proposed to predict fire activity, which can be classified into global and regional ones. Global fire models focus on longer timescale simulations and can be very complex. Regional fire models concentrate on seasonal forecasting but usually require inputs...
Author(s): Leonardo N. Ferreira, Didier A. Vega-Oliveros, Liang Zhao, Manoel F. Cardoso, Elbert E.N. Macau
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Synoptic weather patterns for large wildfires in the northwestern United States-a climatological analysis using three classification methods
www.nrfirescience.org/resource/21812
Wildfire regimes respond to atmospheric variability on multiple time scales from interannual variations of drought to daily fluctuations of humidity and wind. Synoptic weather patterns effectively link both short- and long-term atmospheric variability, and thus, understanding fire-prone synoptic patterns is an integral part of fire...
Author(s): Shiyuan Zhong, Lejiang Yu, Warren Heilman, Xindi Bian, Hannah Fromm
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Learning-based prediction of wildfire spread with real-time rate of spread measurement
www.nrfirescience.org/resource/21316
A learning-based wildfire spread model was developed in this study to predict short-term wildfire spread. Real-time rate of spread (RoS) measurement was first conducted by calculating normal movements of fire fronts. Subsequently, machine learning was employed to correlate the local RoS and environmental parameters and predict the...
Author(s): Chunjie Zhai, Siyu Zhang, Zhaolou Cao, Xinmeng Wang
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Effect of weather forecast errors on fire growth model projections
www.nrfirescience.org/resource/22221
Fire management agencies use fire behaviour simulation tools to predict the potential spread of a fire in both risk planning and operationally during wildfires. These models are generally based on underlying empirical or quasi-empirical relations and rarely are uncertainties considered. Little attention has been given to the quality...
Author(s): Trent D. Penman, Dan Ababei, Jane G. Cawson, Brett Cirulis, Thomas J. Duff, W. Swedosh,
The effect of ignition protocol on grassfire development

www.nrfirescience.org/resource/20659

The effect of ignition protocol on the development of grassfires is investigated using physics-based simulation. Simulation allows measurement of the forward rate of spread of a fire as a function of time at high temporal resolution. Two ignition protocols are considered: the inward ignition protocol, where the ignition proceeds in...

Author(s): Duncan Sutherland, J. Sharples, K. A. M. Moinuddin

Fire-spotting generated fires. Part I: the role of atmospheric stability

www.nrfirescience.org/resource/21793

This is the first part of two papers concerning fire-spotting generated fires. In this part we deal with the impact of macroscale factors, such as the atmospheric stability, and in the second part we deal with mesoscale factors, such as the flame geometry. For this study we adopt an approach where the motion of the front is split...

Author(s): Vera N. Egorova, Andrea Trucchia, Gianni Pagnini

A smart approach for fire prediction under uncertain conditions using machine learning

www.nrfirescience.org/resource/22138

One of the most ubiquitous cause of worldwide deforestation and devastation of wildlife is fire. To control fire and reach the forest area in time is not always possible. Consequently, the level of destruction is often high. Therefore, predicting fires well in time and taking immediate action is of utmost importance. However,...

Author(s): Richa Sharma, Shalli Rani, Imran Memon

Corrigendum to: Modelling suppression difficulty: current and future applications

www.nrfirescience.org/resource/21755

Improving decision processes and the informational basis upon which decisions are made in pursuit of safer and more effective fire response have become key priorities of the fire research community. One area of emphasis is bridging the gap between fire researchers and managers through development of application-focused,...

Author(s): Francisco Rodriguez y Silva, Christopher D. O'Connor, Matthew P. Thompson, Juan Ramón Molina Martínez, David E. Calkin
Comparing contingency fire containment strategies using simulated random scenarios
www.nrfirescience.org/resource/22496
Contingency firelines can be used to back up primary lines to increase probability of fire containment, decrease fire losses, and improve firefighter safety. In this study, we classify firelines into primary, contingency, and response lines. We design a modeling process to iteratively implement a mixed integer programming model to...
Author(s): Yu Wei, Matthew P. Thompson, Erin J. Belval, Benjamin Gannon, David E. Calkin, Christopher D. O'Connor
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Evaluation of Global Fire Weather Database reanalysis and short-term forecast products
www.nrfirescience.org/resource/21175
Daily Fire Weather Index (FWI) System components calculated from the NASA Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2), are compared to FWI calculations from a global network of weather stations over 2004–2018, and short-term, experimental (8 d) daily FWI forecasts are evaluated for their...
Author(s): Robert Field
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Modelling hourly spatio-temporal PM2.5 concentration in wildfire scenarios using dynamic linear models
www.nrfirescience.org/resource/21989
Particulate matter with aerodynamic diameter < 2.5 μm (PM2.5) is one of the main pollutants generated in wildfire events with negative impacts on human health. In research involving wildfires and air quality, it is common to use emission models. However, the commonly used emission approach can generate errors and...
Author(s): Joseph Sánchez-Balseca, Agustí Pérez-Foguet
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Investigating live fuel moisture content estimation in fire-prone shrubland from remote sensing using empirical modelling and RTM simulations
www.nrfirescience.org/resource/21676
Previous research has demonstrated that remote sensing can provide spectral information related to vegetation moisture variations essential for estimating live fuel moisture content (LFMC), but accuracy and timeliness still present challenges to using this information operationally. Consequently, many regional administrations are...
Author(s): Eva Marino, Marta Yebra, Mariluz Guillén-Climent, Nur Algeet, José Luis Tomé, Javier Madrigal, Mercedes Guijarro, Carmen Hernando
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Fuel moisture content threshold leading to fire extinction under marginal conditions
www.nrfirescience.org/resource/22410
This paper evaluates the fuel moisture content (FMC) threshold that leads to fire extinction for a few
fuel types under marginal conditions. Influences of fuel load, fuel depth, Leaf Area Index (LAI) and packing ratio on this FMC threshold were also analyzed. This aim was reached by applying numerical simulations performed with...

Author(s): Carmen Awad, D. Morvan, Jean Louis Rossi, Thierry Marcelli, François Joseph Chatelon, Frederic Morandini, Jacques Henri Balbi
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

LES simulation of terrain slope effects on wind enhancement by a point source fire
www.nrfirescience.org/resource/21102
Fire-driven flows associated with wind intervention can dangerously threaten buildings in bushfire-prone areas by increasing pressure load on the structures through fire-wind enhancement phenomenon. This phenomenon through which wind is enhanced by interacting with fire is exacerbated when the affected terrain is located in a...

Author(s): Esmaeel Eftekharian, Maria Rashidi, Maryam Ghodrat, Yaping He, Kenny C.S. Kwok
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Radiant heat flux modelling for wildfires
www.nrfirescience.org/resource/21982
Accurate predictions for radiant heat flux are necessary for determining exposure levels to personnel and infrastructure in the event of wildfires. However, detailed physics-based calculations of radiant heat flux are complex and current modelling practice involves significant simplifications in order to make these calculations...

Author(s): J. E. Hilton, Justin E. Leonard, Raphaele M. Blanchi, Glenn J. Newnham, Kimberley Opie, Anthony Power, Chris Rucinski, W. Swedosh
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

PROPAGATOR: An Operational Cellular-Automata Based Wildfire Simulator
www.nrfirescience.org/resource/21627
PROPAGATOR is a stochastic cellular automaton model for forest fire spread simulation, conceived as a rapid method for fire risk assessment. The model uses high-resolution information such as topography and vegetation cover considering different types of vegetation. Input parameters are wind speed and direction and the ignition...

Author(s): Andrea Trucchia, Mirko D'Andrea, Francesco Baghino, Paolo Fiorucci, Luca Ferraris, Dario Negro, Andrea Gollini, Massimiliano Severino
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

The effect of ignition protocol on the spread rate of grass fires: a comment on the conclusions of Sutherland et al. (2020)
www.nrfirescience.org/resource/22385
Sutherland et al. (2020) used simulations from a physics-based numerical fire behaviour model to investigate the effect of the ignition protocol (namely length, direction and rate of ignition) on the spread rates measured in experimental fires. They concluded that the methods used by Cruz et al. (2015) were inadequate as the fires...
Wildfire detection using transfer learning on augmented datasets
www.nrfirescience.org/resource/20976
Wildfire detection is a time-critical application as the difficulty to pinpoint ignition locations in a short time-frame often leads to the escalation of the severity of fire events. This problem has motivated considerable interest from expert systems research to develop accurate early-warning applications and the breakthroughs in...

Author(s): Maria João Sousa, Alexandra Moutinho, Miguel Almeida
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Computational modeling of extreme wildland fire events: a synthesis of scientific understanding with applications to forecasting, land management, and firefighter safety
www.nrfirescience.org/resource/21959
The understanding and prediction of large wildland fire events around the world is a growing interdisciplinary research area advanced rapidly by development and use of computational models. Recent models bidirectionally couple computational fluid dynamics models including weather prediction models with modules containing algorithms...

Author(s): Janice L. Coen, Wilfrid Schroeder, Scott Conway, Leland W. Tarnay
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Wildfire decision support tools: an exploratory study of use in the United States
www.nrfirescience.org/resource/21587
In the United States, many decision support tools exist to provide fire managers with weather and fire behaviour information to inform and facilitate risk-based decision-making. Relatively little is known about how managers use these tools in the field and when and how they may serve to influence decisions. To address this gap, we...

Author(s): Claire Rapp, Emily Rabung, Robyn S. Wilson, Eric L. Toman
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Fire danger observed from space
www.nrfirescience.org/resource/22318
Biomass burning is one of the critical components of the Earth system, significantly affecting atmospheric emissions and carbon budgets. Fires occurring in the interface between wildland and urban areas also have important socioeconomic effects, affecting people’s lives and resources. Even though fires are natural in many...

Author(s): M. Lucrecia Pettinari, Emilio Chuvieco
Year Published: 2020
Type: Document
Book or Chapter or Journal Article
Mathematical modeling of wildland fire initiation and spread

www.nrfirescience.org/resource/20926

The aim of this paper is to create a user-friendly computational tool for analysis of wildland fire behavior and its effect on urban and other structures. A physics-based multiphase Computational Fluid Dynamics (CFD) model of wildfire initiation and spread has been developed and incorporated into the multi-purpose CFD software,...

Author(s): Vladimir Agranat, Valeriy Perminov
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Impacts of Forest Thinning on Wildland Fire Behavior

www.nrfirescience.org/resource/21955

Key message: We have explored the impacts of forest thinning on wildland fire behavior using a process based model. Simulating different degrees of thinning, we found out that forest thinning should be conducted cautiously as there could be a wide range of outcomes depending upon the post-thinning states of fuel availability, fuel...

Author(s): Tirtha Banerjee
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Processed-based fire models: New tools for an era of novel conditions

www.nrfirescience.org/resource/21520

The first few years of the 21st century brought a series of unprecedented natural disturbances to the southwestern U.S. A severe drought, later tagged as a “global change type drought,” triggered the mortality of 1,000 of native trees. For some species, such as the ponderosa pine, the drought was especially lethal due to high...

Author(s): Carolyn Hull Sieg, Rodman Linn, F. Pimont, Chad M. Hoffman, Joel D. McMillin, Judith Winterkamp, L. Scott Baggett
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Unitemporal approach to fire severity mapping using multispectral synthetic databases and Random Forests

www.nrfirescience.org/resource/22304

Fire severity assessment is crucial for predicting ecosystem response and prioritizing post-fire forest management strategies. Although a variety of remote sensing approaches have been developed, more research is still needed to improve the accuracy and effectiveness of fire severity mapping. This study proposes a unitemporal...

Author(s): Raquel Montorio Llovería, Fernando Pérez-Cabello, Daniel Borini Alves, Alberto García-Martin
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Asking "What-if" Questions: New ST-Sim Tool Helps Managers Forecast Future Rangeland Conditions

www.nrfirescience.org/resource/20765

Unforeseen Events and Climate Variability: How do land management decisions shape landscapes
decades into the future? With the influence of climate change and its associated stressors, it's an increasingly thorny question. According to Paulette Ford, a research ecologist with the Rocky Mountain Research Station in Albuquerque, New...

Author(s): Jessica M. Brewen  
Year Published: 2020  
Type: Document  
Research Brief or Fact Sheet

Global ecosystems and fire: Multi-model assessment of fire-induced tree-cover and carbon storage reduction  
www.nrfirescience.org/resource/21854

In this study, we use simulations from seven global vegetation models to provide the first multi-model estimate of fire impacts on global tree cover and the carbon cycle under current climate and anthropogenic land use conditions, averaged for the years 2001-2012. Fire reduces the tree covered area and vegetation carbon storage...

Author(s): Gitta Lasslop, Stijn Hantson, Sandy P. Harrison, Dominique Bachelet, Chantelle Burton, Matthias Forkel, Matthew Forrest, Fang Li, Joe R. Melton, Chao Yue, Sally Archibald, Simon Scheiter, Almut Arneth, Thomas Hickler, Stephen Sitch  
Year Published: 2020  
Type: Document  
Book or Chapter or Journal Article

Global sensitivity analysis of fuel-type-dependent input variables of a simplified physical fire spread model  
www.nrfirescience.org/resource/21466

A new global sensitivity analysis has been conducted of fuel-type-dependent input variables of the simplified physical fire spread model (PhyFire) to understand how the use of spatial averages, that is, fuel models, influences the results of PhyFire with a view to enhancing its understanding and improving its design. The model's...

Author(s): María Isabel Asensio-Sevilla, M. Teresa Santos-Martín, David Álvarez-León, Luis Ferragut-Canals  
Year Published: 2020  
Type: Document  
Book or Chapter or Journal Article

Evaluating the 10% wind speed rule of thumb for estimating a wildfire's forward rate of spread against an extensive independent set of observations  
www.nrfirescience.org/resource/22285

The prediction of wildfire rate of spread and growth under high wind speeds and dry fuel moisture conditions is key to taking proactive actions to warn and in turn protect communities. We used two datasets of wildfires spreading under critical fire weather conditions to evaluate an existing rule of thumb that equates the forward...

Author(s): Miguel G. Cruz, Martin E. Alexander, Paulo M. Fernandes, Musa Kilinc, Ángelo Sil  
Year Published: 2020  
Type: Document  
Book or Chapter or Journal Article

Wildfires front dynamics: 3D structures and intensity at small and large scales  
www.nrfirescience.org/resource/20698

The 3D structure of a fire front propagating through a homogeneous porous solid-fuel layer was studied numerically at laboratory and field scales. At laboratory scale, wind-tunnel fires propagating through
laser-cut cardboard fuel were numerically reproduced, while at field scale, simulations of grassland fires with quasi-infinite...

Author(s): N. Frangieh, Gilbert Accary, D. Morvan, Sofiane Meradji, Oleg Bessonov
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Combined estimation of fire perimeters and fuel adjustment factors in FARSITE for forecasting wildland fire propagation
www.nrfirescience.org/resource/21828
As bias and uncertainties inevitably exist on both wildland fire model states and parameters, fire simulations do not always accurately forecast the temporal and spatial progression of wildfires. In this paper, a novel approach is proposed to estimate fire perimeters and fuel adjustment factors simultaneously for FARSITE tool. Fire...
Author(s): Tengjiao Zhou, Long Ding, Jie Ji, Longxing Yu, Zhen Wang
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Burn weather and three-dimensional fuel structure determine post-fire tree mortality
www.nrfirescience.org/resource/23037
Context: Post-fire tree mortality is a spatially structured process driven by interacting factors across multiple scales. However, empirical models of fire-caused tree mortality are generally not spatially explicit, do not differentiate among scales, and do not differentiate immediate from delayed mortality. Objectives: We aimed to...
Author(s): Sean M.A. Jeronimo, James A. Lutz, Van R. Kane, Andrew J. Larson, Jerry F. Franklin
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

A machine-learning framework for rapid adaptive digital-twin based fire-propagation simulation in complex environments
www.nrfirescience.org/resource/21318
The objective of this work is to illustrate how to algorithmically integrate Machine-Learning Algorithms (MLA's) with multistage/multicomponent fire spread models. In order to tangibly illustrate this process, this work develops a framework for a specific model problem combining: (I) a meshless discrete element 'submodel' that...
Author(s): T. J. Zohdi
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Predicting forest recovery following high-severity fire - Final Report to the Joint Fire Science Program
www.nrfirescience.org/resource/22241
Novel combinations of fire regime and forest type are emerging in areas affected by climate change, fire exclusion, and other stressors. Species interactions following wildfire in these areas are not well understood. In Sierra Nevada mixed conifer forests, large patches of stand-replacing fire were once rare but are becoming...
Author(s): Carmen L. Tubbesing, Scott L. Stephens
Year Published: 2020
Integrating fire effects on vegetation carbon cycling within an ecohydrologic model
www.nrfirescience.org/resource/20679
Wildfire affects landscape ecohydrologic processes through feedbacks between fire effects, vegetation growth and water availability. Despite the links between these processes, fire is rarely incorporated dynamically into ecohydrologic models, which couple vegetation growth with water and nutrient fluxes. This omission has the...
Author(s): Ryan R. Bart, Maureen C. Kennedy, Christina Tague, Donald McKenzie
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Modeling the duration and size of extended attack wildfires as dependent outcomes
www.nrfirescience.org/resource/21807
Understanding the complex relationship between the duration and size of forest fires is important in order to better predict these key characteristics of fires for fire management purposes in a changing climate. Describing this relationship is also important for our fundamental understanding of fire science. Here, we develop and...
Author(s): Dexen D.Z. Xi, Charmaine B. Dean, Stephen W. Taylor
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Can we manage a future with more fire? Effectiveness of defensible space treatment depends on housing amount and configuration
www.nrfirescience.org/resource/22211
Context: Fire in forested wildland urban interface (WUI) landscapes is increasing throughout the western United States. Spatial patterns of fuels treatments affect fire behavior, but it is unclear how fire risk and fuel treatment effectiveness will change under future conditions. Objectives: (1) How do area burned, forest and fuel...
Author(s): Kristin H. Braziunas, Rupert Seidl, Werner Rammer, Monica G. Turner
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Training data requirements for fire severity mapping using Landsat imagery and random forest
www.nrfirescience.org/resource/21781
The ability to map fire severity is a requirement for fire management agencies worldwide. The development of repeatable methods to produce accurate and consistent fire severity maps from satellite imagery is necessary to document fire regimes, to set priorities for post-fire management responses, and for research applications....
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Assessment of HRRR model forecasts of convective outflows in the fire environment - Final Report to the Joint Fire Science Program
This study evaluated the ability of the High Resolution Rapid Refresh (HRRR) modeling system to forecast the characteristics of mesoscale atmospheric boundaries arising from thunderstorm outflows, gust fronts, and downburst winds (referred collectively as convective outflows) within the contiguous United States and Alaska. Such...

**Author(s): John D. Horel, Erik T. Crosman, Adam K. Kochanski, Robert Ziel**
**Year Published:** 2020
**Type:** Document
**Technical Report or White Paper**

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**Simulating the Effectiveness of Improvement Cuts and Commercial Thinning to Enhance Fire Resistance in West Coast Dry Mixed Conifer Forests**

Nine multipurpose silvicultural treatments, formulated as a synthesis of recently implemented prescriptions offered by forest managers, were simulated to evaluate their effectiveness at enhancing fire resistance. The Forest Vegetation Simulator was applied, within the BioSum Framework, on over 3,000 Forest Inventory and Analysis...

**Author(s): Theresa B. Jain, Jeremy S. Fried, Sara Loreno**
**Year Published:** 2020
**Type:** Document
**Book or Chapter or Journal Article**

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**The Use of Science in Wildland Fire Management: a Review of Barriers and Facilitators**

Purpose of Review: Science plays a critical role in natural resource management, and the use of science in decision-making is mandated by several policy initiatives. Other disciplines have documented the challenges associated with applying science to management and possible solutions to overcoming challenges, but the evaluation of...

**Author(s): Molly E. Hunter, Melanie M. Colavito, Vita Wright**
**Year Published:** 2020
**Type:** Document
**Book or Chapter or Journal Article**

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**Physical model of wildland fire spread: parametric uncertainty analysis**

For the physical model of wildland fire spread, errors or discrepancies in the prediction of spread rate may arise from uncertain, imprecise or improper determinations of the model parameters due to unreasonable assumptions, rough approximations, or inaccurate measurements. In this study, a parametric uncertainty analysis is made on...

**Author(s): Xieshang Yuan, Naian Liu, Xiaodong Xie, Domingos Xavier Viegas**
**Year Published:** 2020
**Type:** Document
**Book or Chapter or Journal Article**

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**Commentary on the article “Burn probability simulation and subsequent wildland fire activity in Alberta, Canada - Implications for risk assessment and strategic planning” by J. L. Beverly and N. McLoughlin**

Monte Carlo simulations using wildland fire spread models have been conducted to produce numerical estimates of fire likelihood, project potential fire effects, and produce event sets of realistic wildfires (Parisien et al., 2019). The application of these methods has greatly expanded over the last few
Animals as agents in fire regimes
www.nrfirescience.org/resource/21116
Fire is a powerful ecological and evolutionary force. Animals that modify drivers of fire behaviour could therefore have far-reaching effects on ecosystems. Yet, with a few notable exceptions, effects of animals on fire have been often overlooked. We show how animals can affect fire behaviour by modifying the amount, structure, or...
Author(s): Claire N. Foster, Sam C. Banks, Geoffrey J. Cary, Christopher N. Johnson, David B. Lindenmayer, Leonie E. Valentine
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

The Forest Fire Model: the subtleties of criticality and scale invariance
www.nrfirescience.org/resource/21986
Amongst the numerous models introduced with SOC, the Forest Fire Model (FFM) is particularly attractive for its close relationship to stochastic spreading, which is central to the study of systems as diverse as epidemics, rumors, or indeed, fires. However, since its introduction, the nature of the model's scale invariance has been...
Author(s): Lorenzo Palmieri, Henrik Jeldtoft Jensen
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Soft-computing-centric framework for wildfire monitoring, prediction and forecasting
www.nrfirescience.org/resource/21658
Wildfires are exorbitantly cataclysmic disasters that lead to the destruction of forest cover, wildlife, land resources, human assets, reduced soil fertility and global warming. Every year wildfires wreck havoc across the globe. Therefore, there is a need of an efficient and reliable system for real-time wildfire monitoring to...
Author(s): Harkiran Kaur, Sandeep K. Sood
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Predicting Fire Propagation across Heterogeneous Landscapes Using WyoFire: A Monte Carlo-Driven Wildfire Model
www.nrfirescience.org/resource/22398
The scope of wildfires over the previous decade has brought these natural hazards to the forefront of risk management. Wildfires threaten human health, safety, and property, and there is a need for comprehensive and readily usable wildfire simulation platforms that can be applied effectively by wildfire experts to help preserve...
Author(s): Cory W. Ott, Bishrant Adhikari, Simon P. Alexander, Paddington Hodza, Chen Xu, Thomas A. Minckley
Long-Term Impacts of Fuel Treatment Placement with Respect to Forest Cover Type on Potential Fire Behavior across a Mountainous Landscape

www.nrfirescience.org/resource/19659

Research Highlights: The impact of variation in fuels and fuel dynamics among forest cover types on the outcome of fuel treatments is poorly understood. This study investigated the potential effects of treatment placement with respect to cover type on the development of potential fire behavior over time for 48 km2 of forest in...

Author(s): Seth A. Ex, Justin P. Ziegler, Wade T. Tinkham, Chad M. Hoffman

Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Modelling the fire propagation from the fuel bed to the lower canopy of ornamental species used in wildland–urban interfaces

www.nrfirescience.org/resource/18999

South-eastern France is strongly affected by wildfires mostly occurring in the wildland–urban interfaces (WUIs). A WUI fire is often initiated in dead surface fuel, then can propagate to shrubs and trees when the lower canopy is close to (or touches) the ground. Whereas a previous study assessed the fire propagation from the fuel...

Author(s): L. Terrei, Aymeric Lamorlette, Anne Ganteaume

Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Integrated fire severity–land cover mapping using very-high-spatial-resolution aerial imagery and point clouds

www.nrfirescience.org/resource/20369

Wildfires cause substantial environmental and socioeconomic impacts and threaten many Spanish forested landscapes. We describe how LiDAR-derived canopy fuel characteristics and spatial fire simulation can be integrated with stand metrics to derive models describing fire behaviour. We assessed the potential use of very-low-density...

Author(s): Jeremy Arkin, Nicholas C. Coops, Txomin Hermosilla, Lori D. Daniels, Andrew Plowright

Year Published: 2019
Type: Document
Book or Chapter or Journal Article

The Vegetation Structure Perpendicular Index (VSPI): A forest condition index for wildfire predictions

www.nrfirescience.org/resource/19494

Wildfires are a major natural hazard, causing substantial damage to infrastructure as well as being a risk to lives and homes. An understanding of their progression and behaviour is necessary to reduce risks and to develop operational management strategies in the event of an active fire. Many empirical fire-spread models have been...

Author(s): Andrea Massetti, Christoph Rüdiger, Marta Yebra, J. E. Hilton

Year Published: 2019
Type: Document
Book or Chapter or Journal Article
Evaluating Model Predictions of Fire Induced Tree Mortality Using Wildfire-Affected Forest Inventory Measurements

Forest land managers rely on predictions of tree mortality generated from fire behavior models to identify stands for post-fire salvage and to design fuel reduction treatments that reduce mortality. A key challenge in improving the accuracy of these predictions is selecting appropriate wind and fuel moisture inputs. Our objective...

Author(s): Jason S. Barker, Jeremy S. Fried, Andrew N. Grey
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Scalability of a multi-physics system for forest fire spread prediction in multi-core platforms

Advances in high-performance computing have led to an improvement in modeling multi-physics systems because of the capacity to solve complex numerical systems in a reasonable time. WRF-SFIRE is a multi-physics system that couples the atmospheric model WRF and the forest fire spread model called SFIRE with the objective of...

Author(s): Angel Farguell, Ana Cortés, Tomàs Margalef, Josep R. Miró, J. Mercader
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Use of landscape simulation modeling to quantify resilience for ecological applications

Goals of fostering ecological resilience are increasingly used to guide U.S. public land management in the context of anthropogenic climate change and increasing landscape disturbances. There are, however, few operational means of assessing the resilience of a landscape or ecosystem. We present a method to evaluate resilience using...

Author(s): Robert E. Keane, Rachel A. Loehman, Lisa M. Holsinger, Donald A. Falk, Philip E. Higuera, Sharon M. Hood, Paul F. Hessburg
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Combining optimization and simulation modelling to measure the cumulative impacts of prescribed fire and wildfire on vegetation species diversity

Growth?stage optimization (GSO) offers a new approach to biodiversity conservation in fire?prone regions by estimating the optimal distribution of vegetation growth stages that maximize a species diversity index. This optimal growth?stage structure provides managers an operational goal explicitly linked to a positive...

Author(s): Matthew P. Chick, Alan York, Holly Sitters, Julian Di Stefano, Craig R. Nitschke
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Mortality reconsidered: Testing and extending models of fire-induced tree mortality across the US - JFSP Final Report
Predictive models of tree mortality and survival are vital for management planning and understanding fire effects in forests and woodlands, yet the underlying mechanisms of firecaused tree mortality remain poorly understood. This shortcoming limits the ability to accurately predict mortality and develop robust modelling...

Author(s): Sharon M. Hood, J. Morgan Varner, C. Alina Cansler
Year Published: 2019
Type: Document
Technical Report or White Paper

Consequences of climatic thresholds for projecting fire activity and ecological change

Aim: Ecological properties governed by threshold relationships can exhibit heightened sensitivity to climate, creating an inherent source of uncertainty when anticipating future change. We investigated the impact of threshold relationships on our ability to project ecological change outside the observational record (e.g., the 21st...)

Author(s): Adam M. Young, Philip E. Higuera, John T. Abatzoglou, Paul A. Duffy, Feng Sheng Hu
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Pixel-level statistical analyses of prescribed fire spread

Wildland fire dynamics are a complex three-dimensional turbulent process. Cellular automata (CA) is an efficient tool to predict fire dynamics, but the main parameters of the method are challenging to estimate. To overcome this challenge, we compute statistical distributions of the key parameters of a CA model using infrared images...

Author(s): Miles Currie, Kevin Speer, J. Kevin Hiers, Joseph J. O'Brien, Scott L. Goodrick, Bryan Quaife
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Rating Fire Danger from the Ground Up

Wildfires consumed more than 3.5 million hectares in the United States in 2018, and federal fire suppression costs topped US$3 billion. These fires destroyed more than 18,000 residences and caused the deaths of at least 85 people. Wildfire damages like these are not unique to the United States; they are a threat in many nations....

Author(s): Matthew R. Levi, Erik S. Krueger, Grant J. Snitker, Tyson Ochsner, Miguel L. Villarreal, Emile H. Elias, Dannele E. Peck
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

firebehavioR: An R Package for Fire Behavior and Danger Analysis

Wildland fire and ecological researchers use empirical and semi-empirical modeling systems to assess fire behavior and danger. This technical note describes the firebehavioR package, a porting of two fire behavior modeling systems, Crown Fire Initiation and Spread and a Rothermel-based framework, to the R programming language. We...

Author(s): Justin P. Ziegler, Chad M. Hoffman, William E. Mell
A spatial optimization model for resource allocation for wildfire suppression and resident evacuation
www.nrfirescience.org/resource/20619
Wildland-urban interface wildfires have been a significant threat in many countries. This paper presents an integer two-stage stochastic goal programming model for comprehensive, efficient response to a wildfire including firefighting resource allocation and resident evacuation. In contrast to other natural disasters, the...
Author(s): Siqiong Zhou, Ayca Erdogan
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

On the merits of sparse surrogates for global sensitivity analysis of multi-scale nonlinear problems: application to turbulence and fire-spotting model in wildland fire simulators
www.nrfirescience.org/resource/19162
Many nonlinear phenomena, whose numerical simulation is not straightforward, depend on a set of parameters in a way which is not easy to predict beforehand. Wildland fires in presence of strong winds fall into this category, also due to the occurrence of firespotting. We present a global sensitivity analysis of a new sub-model for...
Author(s): Andrea Trucchia, Vera N. Egorova, Gianni Pagnini, M. C. Rochoux
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Reply to Cruz and Alexander: Comments on “Evaluating Crown Fire Rate of Spread Predictions from Physics-Based Models”
www.nrfirescience.org/resource/19838
We have read Cruz and Alexander’s comments regarding our manuscript titled “Evaluating Crown Fire Rate of Spread Predictions from Physics-Based Models” [1] and appreciate the opportunity to respond to their comments. In our original manuscript [1], we presented an evaluation of crown fire rate of spread predictions from...
Author(s): Chad M. Hoffman, J. Ziegler, R. R. Linn, J. Canfield, W. Mell, Carolyn Hull Sieg, F. Pimont
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Applications of simulation-based burn probability modelling: a review
www.nrfirescience.org/resource/20540
Wildland fire scientists and land managers working in fire-prone areas require spatial estimates of wildfire potential. To fulfill this need, a simulation-modelling approach was developed whereby multiple individual wildfires are modelled in an iterative fashion across a landscape to obtain location-based measures of fire likelihood...
Author(s): Marc-Andre Parisien, Denyse A. Dawe, Carol Miller, Christopher A. Stockdale, O. Bradley Armitage
Year Published: 2019
Type: Document
Book or Chapter or Journal Article
A review of a new generation of wildfire–atmosphere modeling

www.nrfirescience.org/resource/19732

One of the first significant developments in wildfire modeling research was to introduce heat flux as wildfire line intensity (kW·m–1). This idea could be adapted to using weather station measurements, topography, and fuel properties to estimate rate of fire spread, shape, and intensity. This review will present, in an accessible...

Author(s): A. Bakhshaii, E. A. Johnson
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Standardized process to generate mapping of priority areas for protection against wildfires

www.nrfirescience.org/resource/19082

In the field of geographic information systems (GIS) there are certain tasks that are performed repetitively and are thus sometimes monotonous, where it is necessary to structure, integrate and analyze a series of georeferenced information, which, however, always carries the same sequence. Therefore, we developed a sequential model...

Author(s): José G. Flores Garnica, Uri David Casillas Díaz, Alejandra Macías Muro
Year Published: 2019
Type: Document
Conference Proceedings

Burn probability simulation and subsequent wildland fire activity in Alberta, Canada – Implications for risk assessment and strategic planning

www.nrfirescience.org/resource/20395

Burn probability maps produced by Monte Carlo methods involve repeated simulations of fire ignition and spread across a study area landscape to identify locations that burn more frequently than others. These maps have achieved broad acceptance for research investigations and strategic fire management planning. In this study, we...

Author(s): Jennifer L. Beverly, Neal McLoughlin
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Ensemble transform Kalman filter (ETKF) for large-scale wildland fire spread simulation using FARSITE tool and state estimation method

www.nrfirescience.org/resource/19521

Ensemble transform Kalman filter (ETKF) is an extension of ensemble Kalman filter (EnKF), which avoids using ‘perturbed observations’ to eliminate additional sampling errors. This paper demonstrates the capability of ETKF algorithm for sequentially correcting dynamically evolving fire perimeter positions at regular time intervals to...

Author(s): Tengjiao Zhou, Long Ding, Jie Ji, Lin Li, Weiwei Huang
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Response of simulated burned area to historical changes in environmental and anthropogenic factors: a comparison of seven fire models

www.nrfirescience.org/resource/20293
Understanding how fire regimes change over time is of major importance for understanding their future impact on the Earth system, including society. Large differences in simulated burned area between fire models show that there is substantial uncertainty associated with modelling global change impacts on fire regimes. We draw here...

Author(s): Lina Teckentrup, Stijn Hantson, Angelika Heil, Joe R. Melton, Matthew Forrest, Fang Li, Chao Yue, Almut Arneth, Thomas Hickler, Stephen Sitch, Gitta Lasslop
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

**A web-based wildfire simulator for operational applications**
www.nrfirescience.org/resource/18996

Wildfire simulators and decision support systems can assist the incident command teams in charge of tactical wildfire suppression. This paper presents a web-based wildfire simulator developed to provide real-time support for wildfire management. The paper describes the overall software architecture, the modelling chain...

Author(s): Bachisio Arca, Tiziano Ghisu, Marcello Casula, Michele Salis, Pierpaolo Duce
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

**Setting wildfire evacuation triggers by coupling fire and traffic simulation models: a spatiotemporal GIS approach**
www.nrfirescience.org/resource/19361

Wildfire evacuation triggers refer to prominent geographic features used in wildfire evacuation practices, and when a fire crosses a feature, an evacuation warning is issued to the communities or firefighters in the path of the fire. The existing wildfire trigger modeling methods consider evacuation time as an input from a decision...

Author(s): Dapeng Li, Thomas J. Cova, Philip E. Dennison
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

**User guide to the FireCLIME Vulnerability Assessment (VA) tool: A rapid and flexible system for assessing ecosystem vulnerability to climate-fire interactions**
www.nrfirescience.org/resource/20203

Decision makers need better methods for identifying critical ecosystem vulnerabilities to changing climate and fire regimes. Climate-wildfire-vegetation interactions are complex and hinder classification and projection necessary for development of management strategies. One such vulnerability assessment (VA) is FireCLIME VA, which...

Author(s): Megan Friggens, Rachel A. Loehman, Andrea E. Thode, William T. Flatley, A. Evans, C. Wilcox, S. Mueller, Larissa L. Yocom, Donald A. Falk
Year Published: 2019
Type: Document
Technical Report or White Paper

**Modelling of the Radiant Heat Flux and Rate of Spread of Wildfire within the Urban Environment**
www.nrfirescience.org/resource/18806

One approach to increase community resilience to wildfire impacts is the enhancement of residential construction standards in an effort to provide protective shelters for families within their own homes. Current wildfire models reviewed in this study assume fire growth is unrestricted by vegetation fuel bed
Investigating the application of a hybrid space discretisation for urban scale evacuation simulation
www.nrfirescience.org/resource/19336
The devastating effects of wildfires cannot be overlooked; these include massive resettlement of people, destruction of property and loss of lives. The considerable distances over which wild fires spread and the rates at which these fires can spread is a major concern as this places considerable challenges on the evacuation...
Author(s): Nitish Chooramun, Peter J. Lawrence, Edwin R. Galea
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

A review of a new generation of wildfire–atmosphere modeling
www.nrfirescience.org/resource/20114
One of the first significant developments in wildfire modeling research was to introduce heat flux as wildfire line intensity (kW·m⁻¹). This idea could be adapted to using weather station measurements, topography, and fuel properties to estimate rate of fire spread, shape, and intensity. This review will present, in an accessible...
Author(s): A. Bakhshaii, E. A. Johnson
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Adjusting the rate of spread of fire simulations in real-time
www.nrfirescience.org/resource/19327
Fire simulators allow predicting fire spread and behavior and some of which in real-time. Both strategies and tactics to suppress wildland fires depend on fire analysis which is generally based on fire simulations that need to be accurate for a proper decision making. However, limitations and assumptions of the fire models and...
Author(s): Adrián Cardil, Santiago Monedero, C. A. Silva, Joaquin Ramírez
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Development and Evaluation of a Reynolds-Averaged Navier-Stokes Solver in WindNinja for Operational Wildland Fire Applications
www.nrfirescience.org/resource/20085
An open source computational fluid dynamics (CFD) solver has been incorporated into the WindNinja modeling framework widely used by wildland fire managers as well as researchers and practitioners in other fields, such as wind energy, wind erosion, and search and rescue. Here we describe incorporation of the CFD solver and evaluate...
Author(s): Natalie S. Wagenbrenner, Jason M. Forthofer, Wesley G. Page, Bret W. Butler
Year Published: 2019
Type: Document
Book or Chapter or Journal Article
A Cautionary Note Regarding the Use of Cumulative Burnt Areas for the Determination of Fire Danger Index Breakpoints
www.nrfirescience.org/resource/19265
Identifying the links between fire danger metrics and fire activity is critical in various operational and research fields. A common methodology consists in analysing the relationship between cumulative burnt areas and fire danger metrics. Building on this approach, it has been proposed that fuel moisture content (FMC) drives fire...
Author(s): F. Pimont, Julien Ruffault, Nicolas K. Martin-StPaul, Jean-Luc Dupuy
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

A landscape model of variable social-ecological fire regimes
www.nrfirescience.org/resource/21250
Fire regimes are now recognized as the product of social processes whereby fire on any landscape is the product of human-generated drivers: climate change, historical patterns of vegetation manipulation, invasive species, active fire suppression, ongoing fuel management efforts, prescribed burning, and accidental ignitions. We...
Author(s): Robert M. Scheller, Alec Kretchun, Todd J. Hawbaker, Paul D. Henne
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

A promising new approach to estimate drought indices for fire danger assessment using remotely sensed data
www.nrfirescience.org/resource/20019
One of the crucial input variables in fire danger rating systems is the water content of the soil, as well as of the living and dead fuels. This study concentrates on the Keetch-Byram Drought Index (KBDI) and the Drought Code (DC), which are both used to estimate the soil moisture deficit (SMD) and are inherent parts of well-...
Author(s): Melanie Häusler, João Pedro Nunes, João M. N. Silva, Jan J. Keizer, Thorsten Warneke, Jose M. C. Pereira
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Wildland Fire Spread Modeling Using Convolutional Neural Networks
www.nrfirescience.org/resource/20627
The computational cost of predicting wildland fire spread across large, diverse landscapes is significant using current models, which limits the ability to use simulations to develop mitigation strategies or perform forecasting. This paper presents a machine learning approach to estimate the time-resolved spatial evolution of a...
Author(s): Jonathan L. Hodges, Brian Y. Lattimer
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Climate seasonality as an essential predictor of global fire activity
www.nrfirescience.org/resource/19166
Aim: Fire is a globally important disturbance that affects nearly all vegetated biomes. Previous regional studies have suggested that the predictable seasonal pattern of a climatic time series, or seasonality, might aid in the prediction of average fire activity, but it is not known whether these findings are applicable globally....

Author(s): Michael V. Saha, Todd M. Scanlon, Paolo D'Odorico
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Evaluating ecological resilience across wildfire suppression levels under climate and fuel treatment scenarios using landscape simulation modelling
www.nrfirescience.org/resource/19870
Continued suppression of wildfires may allow more biomass to accumulate to foster even more intense fires. Enlightened fire management involves explicitly determining concurrent levels of suppression, wildland fire use (allowing some fires to burn) and fuel treatments to manage landscapes for ecological resilience. This study used...
Author(s): Robert E. Keane, Kathy L. Gray, Brett Davis, Lisa M. Holsinger, Rachel A. Loehman
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Exposure Complexity and Community Capacity to Manage Wildfire Risk: A Coupled Biophysical and Social Analysis of 60 Communities in the Western United States
www.nrfirescience.org/resource/20550
Coordinated approaches to wildfire risk mitigation strategies that cross-ownership and management boundaries are found in many policies and programs worldwide. The ‘all lands’ approach of the United States (US) National Cohesive Strategy, for example, attempts to address the mismatches between biophysical risk and the social...
Author(s): Max W. Nielsen-Pincus, Cody Evers, Alan A. Ager
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Predictive modeling of wildfires: a new dataset and machine learning approach
www.nrfirescience.org/resource/19155
Wildfires, whether natural or caused by humans, are considered among the most dangerous and devastating disasters around the world. Their complexity comes from the fact that they are hard to predict, hard to extinguish and cause enormous financial losses. To address this issue, many research efforts have been conducted in order to...
Author(s): Younes Oulad Sayad, Hajar Mousannif, Hassan Al Moatassime
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Contrasting human influences and macro-environmental factors on fire activity inside and outside protected areas of North America
www.nrfirescience.org/resource/19770
Human activities threaten the effectiveness of protected areas (PAs) in achieving their conservation goals across the globe. In this study, we contrast the influence of human and macro-environmental factors driving fire activity inside and outside PAs. Using area burned between 1984 and 2014 for 11 ecoregions in Canada and the...
Assessing and reinitializing wildland fire simulations through satellite active fire data
www.nrfirescience.org/resource/19103
Large wildfires can cover millions of hectares of forest every year worldwide, causing losses in ecosystems and assets. Fire simulation and modeling provides an analytical scheme to characterize and predict fire behavior and spread in several and complex environments. Spatial dynamics of large wildfires can be analyzed using...
Author(s): Adrián Cardil, Santiago Monedero, Joaquin Ramírez, Alberto Silva
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Simulation of forest fires based on a two-dimensional three-phase model
www.nrfirescience.org/resource/20458
A two-dimensional three-phase mathematical model of forest fires constructed by the method of averaging over the height of the forest fuel layer is considered. The gas phase in the model is described by gas dynamics equations with the k ? ? turbulence model and the eddy breakup model to describe the rate of turbulent combustion...
Author(s): Andrey A. Kuleshov, Elena E. Myshetskaya, Sergey E. Yakush
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Optimizing smoke and plume rise modeling approaches at local scales
www.nrfirescience.org/resource/17793
Heating from wildfires adds buoyancy to the overlying air, often producing plumes that vertically distribute fire emissions throughout the atmospheric column over the fire. The height of the rising wildfire plume is a complex function of the size of the wildfire, fire heat flux, plume geometry, and atmospheric conditions, which can...
Author(s): Derek V. Mallia, Adam K. Kochanski, Shawn P. Urbanski, John C. Lin
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Modeling Fire Pathways in Montane Grassland?Forest Ecotones
www.nrfirescience.org/resource/17667
Fire plays a key role in regulating the spatial interactions between adjacent vegetation types from the stand to the landscape scale. Fire behavior modeling can facilitate the understanding of these interactions and help managers restore or maintain fire’s natural role. The Valles Caldera National Preserve (VALL), in the Jemez...
Author(s): Joshua L. Conver, Donald A. Falk, Stephen R. Yool, Robert R. Parmenter
Year Published: 2018
Type: Document
Book or Chapter or Journal Article
Some Requirements for Simulating Wildland Fire Behavior Using Insight from Coupled Weather—Wildland Fire Models
www.nrfirescience.org/resource/17610
A newer generation of models that interactively couple the atmosphere with fire behavior have shown an increased potential to understand and predict complex, rapidly changing fire behavior. This is possible if they capture intricate, time-varying microscale airflows in mountainous terrain and fire-atmosphere feedbacks. However, this...
Author(s): Janice L. Coen
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Modeling thinning effects on fire behavior with STANDFIRE
www.nrfirescience.org/resource/18335
Key message: We describe a modeling system that enables detailed, 3D fire simulations in forest fuels. Using data from three sites, we analyze thinning fuel treatments on fire behavior and fire effects and compare outputs with a more commonly used model. Context: Thinning is considered useful in altering fire behavior, reducing fire...
Author(s): Russell A. Parsons, F. Pimont, Lucas Wells, Greg M. Cohn, William Matt Jolly, Francois P. deColigny, Eric Rigolot, Jean-Luc Dupuy, William E. Mell, Rodman Linn
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

The sensitivity of US wildfire occurrence to pre-season soil moisture conditions across ecosystems
www.nrfirescience.org/resource/17379
It is generally accepted that year-to-year variability in moisture conditions and drought are linked with increased wildfire occurrence. However, quantifying the sensitivity of wildfire to surface moisture state at seasonal lead-times has been challenging due to the absence of a long soil moisture record with the appropriate...
Author(s): Daniel Jensen, John T. Reager, Brittany Zajic, Nick Rousseau, Matthew Rodell, Everett Hinkley
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Advancing the Science of Wildland Fire Dynamics Using Process-Based Models
www.nrfirescience.org/resource/18136
As scientists and managers seek to understand fire behavior in conditions that extend beyond the limits of our current empirical models and prior experiences, they will need new tools that foster a more mechanistic understanding of the processes driving fire dynamics and effects. Here we suggest that process-based models are...
Author(s): Chad M. Hoffman, Carolyn Hull Sieg, Rodman Linn, William E. Mell, Russell A. Parsons, Justin P. Ziegler, J. Kevin Hiers
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Framework for submodel improvement in wildfire modeling
www.nrfirescience.org/resource/17259
An experimental and numerical study was carried out to assess the performance of the different submodels and parameters used to describe the burning dynamics of wildfires. A multiphase formulation was used and compared to static fires of dried pitch pine needles of different bulk densities. The samples were exposed to an external...

Author(s): M. El Houssami, A. Lamorlette, D. Morvan, Rory Hadden, Albert Simeoni
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Modeling Fire Pathways in Montane Grassland?Forest Ecotones
www.nrfirescience.org/resource/18013

Fire plays a key role in regulating the spatial interactions between adjacent vegetation types from the stand to the landscape scale. Fire behavior modeling can facilitate the understanding of these interactions and help managers restore or maintain fire’s natural role. The Valles Caldera National Preserve (VALL), in the Jemez...

Author(s): Joshua L. Conver, Donald A. Falk, Stephen R. Yool, Robert R. Parmenter
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

A model-based framework to evaluate alternative wildfire suppression strategies
www.nrfirescience.org/resource/16478

The complexity and demands of wildland firefighting in the western U.S. have increased over recent decades due to factors including the expansion of the wildland-urban interface, lengthening fire seasons associated with climate change, and changes in vegetation due to past fire suppression and timber harvest. In light of these...

Author(s): Karen L. Riley, Matthew P. Thompson, Joe H. Scott, Julie W. Gilbertson-Day
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Some requirements for simulating wildland fire behavior using insight from coupled weather-wildland fire models
www.nrfirescience.org/resource/17104

A newer generation of models that interactively couple the atmosphere with fire behavior have shown an increased potential to understand and predict complex, rapidly changing fire behavior. This is possible if they capture intricate, time-varying microscale airflows in mountainous terrain and fire-atmosphere feedbacks. However, this...

Author(s): Janice L. Coen
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Interpolation framework to speed up near-surface wind simulations for data-driven wildfire applications
www.nrfirescience.org/resource/17889

Local wind fields that account for topographic interaction are a key element for any wildfire spread simulator. Currently available tools to generate near-surface winds with acceptable accuracy do not meet the tight time constraints required for data-driven applications. This article presents the specific problem of data-driven...

Author(s): O. Rios, W. Jahn, Elsa Pastor, M.M. Valero, E. Planas
Incorporating convective feedback in wildfire simulations using pyrogenic potential
www.nrfirescience.org/resource/19107
Modelling the dynamics of wildfires is very computationally challenging. Although three-dimensional computational fluid dynamics (CFD) models have been successfully applied to wildfires, the computational time required makes them currently impractical for operational usage. In this study, we develop a two-dimensional propagation...
Author(s): J. E. Hilton, Andrew L. Sullivan, W. Swedosh, J. Sharples, C. Thomas
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Wildfire fuel management: network-based models and optimization of prescribed burning
www.nrfirescience.org/resource/17866
Wildfires are a common phenomenon on most continents. They have occurred for an estimated 60 million years and are part of a regular climatic cycle. Nevertheless, wildfires represent a real and continuing problem that can have a major impact on people, wildlife and the environment. The intensity and severity of wildfires can be...
Author(s): Dmytro Matsypura, Oleg A. Prokopyev, Aizat Zahar
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
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

Effect of woody debris on the rate of spread of surface fires in forest fuels in a combustion wind tunnel
www.nrfirescience.org/resource/17730
The treatment of the contribution of woody debris (WD, such as branches or small logs >6–50 mm diameter) to the rate of forward spread of a fire in current operational forest fire spread models is inconsistent. Some models do not take into account this fuel at all (i.e. only consider the combustion of fine fuels (> 6 mm)... 
Author(s): Andrew L. Sullivan, N. C. Surawski, Daniel A. Crawford, Richard J. Hurley, Liubov Volkova, Christopher J. Weston, Carl P. Meyer
Year Published: 2018
Type: Document
Book or Chapter or Journal Article
Conditional Performance Evaluation: Using Wildfire Observations for Systematic Fire Simulator Development

www.nrfirescience.org/resource/17657

Faster than real-time wildland fire simulators are being increasingly adopted by land managers to provide decision support for tactical wildfire management and assist with strategic risk planning. These simulators are typically based on simple forward rate-of-spread algorithms that were predominantly developed using observations of...

Author(s): Thomas J. Duff, Jane G. Cawson, Brett Cirulis, Petter Nyman, Gary J. Sheridan, Kevin G. Tolhurst

Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Observations and predictability of gap winds in the Salmon River Canyon of Central Idaho, USA

www.nrfirescience.org/resource/18337

This work investigates gap winds in a steep, deep river canyon prone to wildland fire. The driving mechanisms and the potential for forecasting the gap winds are investigated. The onset and strength of the gap winds are found to be correlated to the formation of an along-gap pressure gradient linked to periodic development of a...

Author(s): Natalie S. Wagenbrenner, Jason M. Forthofer, Chris Gibson, Abby Indreland, Brian K. Lamb, Bret W. Butler

Year Published: 2018
Type: Document
Book or Chapter or Journal Article

The Rothermel surface fire spread model and associated developments: A comprehensive explanation

www.nrfirescience.org/resource/17537

The Rothermel surface fire spread model, with some adjustments by Frank A. Albini in 1976, has been used in fire and fuels management systems since 1972. It is generally used with other models including fireline intensity and flame length. Fuel models are often used to define fuel input parameters. Dynamic fuel models use equations...

Author(s): Patricia L. Andrews

Year Published: 2018
Type: Document
Technical Report or White Paper

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

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

An improved non-equilibrium model for the ignition of living fuel

www.nrfirescience.org/resource/17342
This paper deals with the modelling of living fuel ignition, suggesting that an accurate description using a multiphase formulation requires consideration of a thermal disequilibrium within the vegetation particle, between the solid (wood) and the liquid (sap). A simple model at particle scale is studied to evaluate the flux...

Author(s): A. Lamorlette, M. El Houssami, D. Morvan
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Quantile regression: an alternative approach to modelling forest area burned by individual fires
www.nrfirescience.org/resource/18056
Components of a fire regime have long been estimated using mean-value-based ordinary least-squares regression. But, forest and fire managers require predictions beyond the mean because impacts of small and large fires on forest ecosystems and wildland–urban interfaces are different. Therefore, different action plans are required...

Author(s): Baburam Rijal
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

A comparison of the US National Fire Danger Rating System (NFDRS) with recorded fire occurrence and final fire size
www.nrfirescience.org/resource/17126
Most previous research has assessed the ability of the National Fire Danger Rating System (NFDRS) to portray fire activity at either single sites or on small spatial scales, despite it being a nation-wide system. This study seeks to examine the relationships between a set of NFDRS fire danger indices (Fire Danger Ratings, Staffing...)

Author(s): Nicholas G. Walding, Hywel T. P. Williams, Scott McGarvie, Claire M. Belcher
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Random subset feature selection for ecological niche models of wildfire activity in western North America
www.nrfirescience.org/resource/17909
Variable selection in ecological niche modelling can influence model projections to a degree comparable to variations in future climate scenarios. Consequently, it is important to select feature (variable) subsets for optimizing model performance and characterizing variability. We utilize a novel random subset feature selection...

Author(s): James L. Tracy, Antonio Trabucco, A. Michelle Lawing, J. Tomasz Giemakowski, Maria D. Tchakerian, Gail M. Drus, Robert N. Coulson
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Existence of solution of a forest fire spread model
www.nrfirescience.org/resource/17872
We consider a wildfire spread model represented by the system (1). We use results from the theory of Hamilton-Jacobi equations to prove that there exists a classical solution of (1) for any (?,t)?R×(0,T)(?,t)?R×(0,T) and some T>0T>0 and satisfies particular initial conditions. We also use the method of characteristics...
Recent advancements in fire-atmosphere numerical modeling have increased the number of physical processes integrated into these coupled models. This greater complexity allows for more comprehensive representation of the coupled interactions and feedbacks between the fire and the atmosphere. However, as a consequence of these...

Author(s): Adam K. Kochanski, Jan Mandel, Aimé Fournier, Mary Ann Jenkins
Year Published: 2017
Type: Document
Technical Report or White Paper

The primary theme of our study is the cost-effectiveness of fuel treatment at multiple scales, addressing the question of whether fuel treatments can be justified on the basis of saved suppression costs. Our study was designed to track the influence of a dollar invested in fuel treatments on final fire outcomes, and to quantify this...

Author(s): Matthew P. Thompson, Karen L. Riley, Dan R. Loeffler, Jessica R. Haas
Year Published: 2017
Type: Document
Technical Report or White Paper

We characterized wildfire transmission and exposure within a matrix of large land tenures (federal, state, and private) surrounding 56 communities within a 3.3 million ha fire prone region of central Oregon US. Wildfire simulation and network analysis were used to quantify the exchange of fire among land tenures and communities and...

Author(s): Alan A. Ager, Cody Evers, Michelle A. Day, Haiganoush K. Preisler, Ana M. G. Barros, Max W. Nielsen-Pincus
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Restoration treatments in dry forests of the western US often attempt silvicultural practices to restore the historical characteristics of forest structure and fire behavior. However, it is suggested that a reliance on non-spatial metrics of forest stand structure, along with the use of wildland fire behavior models that lack the...

Author(s): J. Ziegler, Chad M. Hoffman, Michael A. Battaglia, William E. Mell
Year Published: 2017
Type: Document
Simulated fire behaviour in young, postfire lodgepole pine forests
www.nrfirescience.org/resource/16291
Early-seral forests are expanding throughout western North America as fire frequency and annual area burned increase, yet fire behaviour in young postfire forests is poorly understood. We simulated fire behaviour in 24-year-old lodgepole pine (Pinus contorta var. latifolia) stands in Yellowstone National Park, Wyoming, United States...
Author(s): Kellen N. Nelson, Monica G. Turner, William H. Romme, Daniel B. Tinker
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Hierarchical 3D fuel and consumption maps to support physics-based fire modeling - Final Report to the Joint Fire Science Program
www.nrfirescience.org/resource/17007
To meet the data requirements of physics-based fire models and FASMEE objectives, traditional fuel and consumption measures need to be integrated with spatially explicit, three-dimensional data. One of the challenges of traditional fuel measurement techniques is that they must either remove or alter the fuels that are a primary...
Author(s): Andrew T. Hudak, Susan J. Prichard, Robert E. Keane, E. Louise Loudermilk, Russell A. Parsons, Carl A. Seielstad, Eric Rowell, Nick Skowronski
Year Published: 2017
Type: Document
Technical Report or White Paper

How to generate and interpret fire characteristics charts for the U.S. fire danger rating system
www.nrfirescience.org/resource/15371
The fire characteristics chart is a graphical method of presenting U.S. National Fire Danger Rating System (NFDRS) indexes and components as well as primary surface or crown fire behavior characteristics. Computer software has been developed to produce fire characteristics charts for both fire danger and fire behavior in a format...
Author(s): Faith A. Heinsch, Patricia L. Andrews, D. A. Tirmenstein
Year Published: 2017
Type: Document
Technical Report or White Paper

The normal fire environment—Modeling environmental suitability for large forest wildfires using past, present, and future climate normals
www.nrfirescience.org/resource/16643
We modeled the normal fire environment for occurrence of large forest wildfires (>40 ha) for the Pacific Northwest Region of the United States. Large forest wildfire occurrence data from the recent climate normal period (1971–2000) was used as the response variable and fire season precipitation, maximum temperature, slope, and...
Author(s): Raymond J. Davis, Zhiqiang Yang, Andrew Yost, Cole Belongie, Warren B. Cohen
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Spatiotemporal dynamics of simulated wildfire, forest management, and forest succession in
central Oregon, USA

We use the simulation model Envision to analyze long-term wildfire dynamics and the effects of different fuel management scenarios in central Oregon, USA. We simulated a 50-year future where fuel management activities were increased by doubling and tripling the current area treated while retaining existing treatment strategies in...

Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Predicting post-fire tree mortality for 12 western US conifers using the First-Order Fire Effects Model (FOFEM)

Accurate prediction of fire-caused tree mortality is critical for making sound land management decisions such as developing burning prescriptions and post-fire management guidelines. To improve efforts to predict post-fire tree mortality, we developed 3-year post-fire mortality models for 12 Western conifer species—white fir (...

Author(s): Sharon M. Hood, Duncan C. Lutes
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

An uncertainty analysis of wildfire modeling [Chapter 13]

Before fire models can be understood, evaluated, and effectively applied to support decision making, model-based uncertainties must be analyzed. In this chapter, we identify and classify sources of uncertainty using an established analytical framework, and summarize results graphically in an uncertainty matrix. Our analysis...

Author(s): Karen L. Riley, Matthew P. Thompson
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

An improved canopy wind model for predicting wind adjustment factors and wildland fire behavior

The ability to rapidly estimate wind speed beneath a forest canopy or near the ground surface in any vegetation is critical to practical wildland fire behavior models. The common metric of this wind speed is the “mid-flame” wind speed, UMF. However, the existing approach for estimating UMF has some significant shortcomings....

Author(s): William J. Massman, Jason M. Forthofer, Mark A. Finney
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Effects of accelerated wildfire on future fire regimes and implications for the United States federal fire policy

Wildland fire suppression practices in the western United States are being widely scrutinized by
policymakers and scientists as costs escalate and large fires increasingly affect social and ecological values. One potential solution is to change current fire suppression tactics to intentionally increase the area burned under...

Author(s): Alan A. Ager, Ana M. G. Barros, Haiganoush K. Preisler, Michelle A. Day, Thomas A. Spies, John D. Bailey, John P. Bolte
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Incorporating resource protection constraints in an analysis of landscape fuel-treatment effectiveness in the northern Sierra Nevada, CA, USA
www.nrfirescience.org/resource/14012
Finding novel ways to plan and implement landscape-level forest treatments that protect sensitive wildlife and other key ecosystem components, while also reducing the risk of large-scale, high-severity fires, can prove to be difficult. We examined alternative approaches to landscape-scale fuel-treatment design for the same landscape...

Author(s): Christopher B. Dow, Brandon M. Collins, Scott L. Stephens
Year Published: 2016
Type: Document
Book or Chapter or Journal Article

STANDFIRE: an IFT-DSS module for spatially explicit, 3D fuel treatment analysis - Final Report to the Joint Fire Science Program
www.nrfirescience.org/resource/15584
Managers are increasingly called upon to implement fuel treatments to alter potential fire behavior, in order to mitigate threats to firefighters and communities, or to maintain or restore healthy ecosystems. While some case studies have shown positive results, many questions remain about how effective certain kinds of fuel...

Author(s): Russell A. Parsons, Lucas Wells, F. Pimont, William Matt Jolly, Rodman Linn, William E. Mell
Year Published: 2016
Type: Document
Technical Report or White Paper

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

A comparison of level set and marker methods for the simulation of wildland fire front propagation
www.nrfirescience.org/resource/13803
Simulating an advancing fire front may be achieved within a Lagrangian or Eulerian framework. In the former, independently moving markers are connected to form a fire front, whereas in the latter, values representing the moving front are calculated at points within a fixed grid. Despite a mathematical
Assessing the effectiveness of spatially heterogeneous fuels reduction restoration treatments - Final Report to the Joint Fire Science Program
www.nrfirescience.org/resource/17044
In response to increasing wildfire severity and extent across the dry forests of the western United States in the last several decades, federal policy initiatives have encouraged joint vegetation management and fuels treatments to restore ecosystem composition, structure and function and reduce the potential for extreme fire...
Author(s): Chad M. Hoffman, Michael A. Battaglia, Tony S. Cheng, Yvette Dickinson, Frederick W. Smith
Year Published: 2016
Type: Document
Technical Report or White Paper

A stochastic mixed integer program to model spatial wildfire behavior and suppression placement decisions with uncertain weather
www.nrfirescience.org/resource/13931
Wildfire behavior is a complex and stochastic phenomenon that can present unique tactical management challenges. This paper investigates a multistage stochastic mixed integer program with full recourse to model spatially explicit fire behavior and to select suppression locations for a wildland fire. Simplified suppression decisions...
Author(s): Erin J. Belval, Yu Wei, Michael Bevers
Year Published: 2016
Type: Document
Book or Chapter or Journal Article

Development of the rangeland vegetation simulator: a module for FVS
www.nrfirescience.org/resource/15570
The escalating awareness of non-forested landscapes and realization that more emphasis is needed for an all lands approach to management increasingly requires timely information to improve management effectiveness. The Forest Vegetation Simulator (FVS) has been used in a large number of studies to project future vegetation...
Author(s): Matthew C. Reeves
Year Published: 2016
Type: Document
Technical Report or White Paper

Near-term probabilistic forecast of significant wildfire events for the western United States
www.nrfirescience.org/resource/14704
Fire danger and potential for large fires in the United States (US) is currently indicated via several forecasted qualitative indices. However, landscape-level quantitative forecasts of the probability of a large fire are currently lacking. In this study, we present a framework for forecasting large fire occurrence – an extreme...
Author(s): Haiganoush K. Preisler, Karen L. Riley, Crystal S. Stonesifer, David E. Calkin, William Matt Jolly
Year Published: 2016
Evaluation and optimization of fuel treatment effectiveness with an integrated experimental/modeling approach - Final Report to the Joint Fire Science Program
www.nrfirescience.org/resource/17048
The effectiveness of a hazardous fuel reduction treatment must take into account both the physical change on fuel loading and structure and the effect that this change may have on wildland fire behavior. We first took a remote sensing and field measurement approach to quantify the effects of an aggressive fuel treatment program on...
Author(s): Nick Skowronski, Albert Simeoni, Kenneth L. Clark, William E. Mell, Rory Hadden
Year Published: 2016
Type: Document
Technical Report or White Paper

Exploring how alternative mapping approaches influence fireshed assessment and human community exposure to wildfire
www.nrfirescience.org/resource/13949
Attaining fire-adapted human communities has become a key focus of collaborative planning on landscapes across the western United States and elsewhere. The coupling of fire simulation with GIS has expanded the analytical base to support such planning efforts, particularly through the "fireside" concept that identifies areas where...
Author(s): Joe H. Scott, Matthew P. Thompson, Julie W. Gilbertson-Day
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
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

Climate-induced variations in global wildfire danger from 1979 to 2013
www.nrfirescience.org/resource/15322
Climate strongly influences global wildfire activity, and recent wildfire surges may signal fire weather-induced pyrogeographic shifts. Here we use three daily global climate data sets and three fire danger indices to develop a simple annual metric of fire weather season length, and map spatio-temporal trends from 1979 to 2013. We...
Author(s): William Matt Jolly, Mark A. Cochrane, Patrick H. Freeborn, Zachary A. Holden, Timothy J. Brown, G.J. Williamson, David M. J. S. Bowman
Year Published: 2015
Type: Document
Book or Chapter or Journal Article
Relationships between fire danger and the daily number and daily growth of active incidents burning in the Northern Rocky Mountains, USA

www.nrfirescience.org/resource/13170

Daily National Fire Danger Rating System (NFDRS) indices are typically associated with the number and final size of newly discovered fires, or averaged over time and associated with the likelihood and total burned area of large fires. Herein we used a decade (2003–12) of NFDRS indices and US Forest Service (USFS) fire reports to...

Author(s): Patrick H. Freeborn, Mark A. Cochrane, William Matt Jolly
Year Published: 2015
Type: Document
Book or Chapter or Journal Article

Modeling fuel treatment impacts on fire suppression cost savings: a review

www.nrfirescience.org/resource/13950

High up-front costs and uncertain return on investment make it difficult for land managers to economically justify large-scale fuel treatments, which remove trees and other vegetation to improve conditions for fire control, reduce the likelihood of ignition, or reduce potential damage from wildland fire if it occurs. In the short-...

Author(s): Matthew P. Thompson, Nathaniel Anderson
Year Published: 2015
Type: Document
Book or Chapter or Journal Article, Synthesis

The changing strength and nature of fire-climate relationships in the northern Rocky Mountains, U.S.A., 1902-2008

www.nrfirescience.org/resource/15636

Time-varying fire-climate relationships may represent an important component of fire-regime variability, relevant for understanding the controls of fire and projecting fire activity under global-change scenarios. We used time-varying statistical models to evaluate if and how fire-climate relationships varied from 1902-2008, in one...

Author(s): Philip E. Higuera, John T. Abatzoglou, Jeremy S. Littell, Penelope Morgan
Year Published: 2015
Type: Document
Book or Chapter or Journal Article

Developing a post-processor to link the Forest Vegetation Simulator (FVS) and the Fuel Characteristic Classification System (FCCS)

www.nrfirescience.org/resource/15561

In this project, we developed a Forest Vegetation Simulator (FVS, JFSP Project #) post-processor (FVS2FCCS) to convert FVS simulated treelist and surface fuel data into Fuel Characteristics Classification System (FCCS, JFSP Project #98-1-1-06) fuelbed format (.xml) that can be read and processed by the FCCS to create estimates of...

Author(s): Morris C. Johnson, Sarah J. Beukema, Stephanie A. Rebain, Paige C. Eagle, Kjell Swedin, Maria Petrova, Susan J. Prichard
Year Published: 2015
Type: Document
Technical Report or White Paper

Evaluating crown fire rate of spread predictions from physics-based models

www.nrfirescience.org/resource/13614
Modeling the behavior of crown fires is challenging due to the complex set of coupled processes that drive the characteristics of a spreading wildfire and the large range of spatial and temporal scales over which these processes occur. Detailed physics-based modeling approaches such as FIRETEC and the Wildland Urban Interface Fire...

Warning signals for eruptive events in spreading fires

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...

Modeling very large-fire occurrences over the continental United States from weather and climate forcing

Very large-fires (VLFs) have widespread impacts on ecosystems, air quality, fire suppression resources, and in many regions account for a majority of total area burned. Empirical generalized linear models of the largest fires (>5000 ha) across the contiguous United States (US) were developed at ?60 km spatial and weekly...

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

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...

Representation and evaluation of wildfire propagation simulations

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

A comparison of three approaches for simulating fine-scale surface winds in support of wildland fire management. Part II. An exploratory study of the effect of simulated winds on fire growth simulations
www.nrfirescience.org/resource/16922
The effect of fine-resolution wind simulations on fire growth simulations is explored. The wind models are (1) a wind field consisting of constant speed and direction applied everywhere over the area of interest; (2) a tool based on the solution of the conservation of mass only (termed mass-conserving model) and (3) a tool based on...
Author(s): Jason M. Forthofer, Bret W. Butler, Charles W. McHugh, Mark A. Finney, Larry S. Bradshaw, Richard D. Stratton, Kyle S. Shannon, Natalie S. Wagenbrenner
Year Published: 2014
Type: Document
Book or Chapter or Journal Article

A comparison of three approaches for simulating fine-scale surface winds in support of wildland fire management: Part I. Model formulation and comparison against measurements
www.nrfirescience.org/resource/16923
For this study three types of wind models have been defined for simulating surface wind flow in support of wildland fire management: (1) a uniform wind field (typically acquired from coarse-resolution (,4 km) weather service forecast models); (2) a newly developed mass-conserving model and (3) a newly developed mass and...
Author(s): Jason M. Forthofer, Bret W. Butler, Natalie S. Wagenbrenner
Year Published: 2014
Type: Document
Book or Chapter or Journal Article

Effects of topographic features on postfire exposed mineral soil in small watersheds
www.nrfirescience.org/resource/22976
Exposed mineral soil is an immediate result of forest fires with direct relevance on surface runoff and soil erosion. The goal of this study was to determine which topographic features influence the distribution of exposed mineral soil following wildfire in forested watersheds. In a field investigation 2 months after a simulated...
Author(s): Mariana Dobre, Joan Q. Wu, William J. Elliot, Ina S. Miller, Theresa B. Jain
Year Published: 2014
Understanding stochastic wildfire simulation results
www.nrfirescience.org/resource/12758
Stochastic simulations of wildfire occurrence and growth have become an integral part of both wildfire incident management and land management planning applications. The FSPro simulation system, implemented in the online Wildland Fire Decision Support System (WFDSS), acknowledges that weather inputs to wildfire growth...
Author(s): Joe H. Scott
Year Published: 2014
Type: Document

Forest fire management to avoid unintended consequences: a case study of Portugal using system dynamics
www.nrfirescience.org/resource/18905
Forest fires are a serious management challenge in many regions, complicating the appropriate allocation to suppression and prevention efforts. Using a System Dynamics (SD) model, this paper explores how interactions between physical and political systems in forest fire management impact the effectiveness of different allocations. A...
Author(s): Ross D. Collins, Richard de Neufville, João Claro, Tiago M. Oliveira, Abílio Pereira Pacheco
Year Published: 2013
Type: Document

Models for predicting fuel consumption in sagebrush-dominated ecosystems
www.nrfirescience.org/resource/11978
Fuel consumption predictions are necessary to accurately estimate or model fire effects, including pollutant emissions during wildland fires. Fuel and environmental measurements on a series of operational prescribed fires were used to develop empirical models for predicting fuel consumption in big sagebrush (Artemisia tridentata... 
Author(s): Clinton S. Wright
Year Published: 2013
Type: Document

Angular variation of fire rate of spread
www.nrfirescience.org/resource/12428
Laboratory fire tests were performed in still air, for variable inclinations (10°, 15°) and fuel bed dimensions (1.28 x 2.50-3.0 x 4.6 m2), with homogeneous fuel beds of pine needles and pine wood excelsior. The fire ignition was made at a point, along a closed line with no fuel inside and along a straight edge of the fuel bed...
Author(s): Jorge C. S. Andre, Joao C. Goncalves, Gilberto C. Vaz, Domingos Xavier Viegas
Year Published: 2013
Type: Document

Optimising fuel treatments over time and space
www.nrfirescience.org/resource/12039
Fuel treatments have been widely used as a tool to reduce catastrophic wildland fire risks in many forests around the world. However, it is a challenging task for forest managers to prioritise where, when, and how to implement fuel treatments across a large forest landscape. In this study, an optimisation model was developed for...

Author(s): Woodam Chung, J. Greg Jones, Kurt Krueger, Jody Bramel, Marco A. Contreras
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

Wildfire exposure and fuel management on western US national forests
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

Modelling conditional burn probability patterns for large wildland fires
www.nrfirescience.org/resource/12005
We present a technique for modelling conditional burn probability patterns in two dimensions for large wildland fires. The intended use for the model is strategic program planning when information about future fire weather and event durations is unavailable and estimates of the average probabilistic shape and extent of large fires...
Author(s): Pamela S. Ziesler, Douglas B. Rideout, Robin Reich
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

Quantifying the potential impacts of fuel treatments on wildfire suppression costs
www.nrfirescience.org/resource/16138
Modeling the impacts and effects of hazardous fuel reduction treatments is a pressing issue within the wildfire management community. Prospective evaluation of fuel treatment effectiveness allows for comparison of alternative treatment strategies in terms of socioeconomic and ecological impacts and facilitates analysis of tradeoffs...
Author(s): Matthew P. Thompson, Nicole M. Vaillant, Jessica R. Haas, Krista M. Gebert, Keith Stockmann
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

Wildland fire emissions, carbon, and climate: modeling fuel consumption
www.nrfirescience.org/resource/12442
Fuel consumption specifies the amount of vegetative biomass consumed during wildland fire. It is a two-stage process of pyrolysis and combustion that occurs simultaneously and at different rates depending on the characteristics and condition of the fuel, weather, topography, and in the case of prescribed fire, ignition rate and...
Author(s): Roger D. Ottmar
Current status and future needs of the BehavePlus Fire Modeling System
www.nrfirescience.org/resource/12392
The BehavePlus Fire Modeling System is among the most widely used systems for wildland fire prediction. It is designed for use in a range of tasks including wildfire behaviour prediction, prescribed fire planning, fire investigation, fuel hazard assessment, fire model understanding, communication and research. BehavePlus is based on...
Author(s): Patricia L. Andrews
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

Combustibility of a mixture of live and dead fuel components
www.nrfirescience.org/resource/12427
The problem of predicting the rate of spread of a linear fire front in a fuel bed composed of one live and one dead fuel component in no-slope and no-wind conditions is addressed. Two linear models based on the mass fraction of each fuel component are proposed to predict the rate of spread of a fire front as a function of the mass...
Author(s): Domingos Xavier Viegas, J. Soares, Miguel Almeida
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

Surface fire intensity influences simulated crown fire behavior in lodgepole pine forests with recent mountain pine beetle-caused tree mortality
www.nrfirescience.org/resource/12138
Recent bark beetle outbreaks have had a significant impact on forests throughout western North America and have generated concerns about interactions and feedbacks between beetle attacks and fire. However, research has been hindered by a lack of experimental studies and the use of fire behavior models incapable of accounting for the...
Author(s): Chad M. Hoffman, Penelope Morgan, William E. Mell, Russell A. Parsons, Eva K. Strand, Stephen Cook
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

A polygon-based modeling approach to assess exposure of resources and assets to wildfire
www.nrfirescience.org/resource/12048
Spatially explicit burn probability modeling is increasingly applied to assess wildfire risk and inform mitigation strategy development. Burn probabilities are typically expressed on a per-pixel basis, calculated as the number of times a pixel burns divided by the number of simulation iterations. Spatial intersection of highly...
Author(s): Matthew P. Thompson, Joe H. Scott, Jeffrey D. Kaiden, Julie W. Gilbertson-Day
Year Published: 2013
Type: Document
Book or Chapter or Journal Article
The relationship of large fire occurrence with drought and fire danger indices in the western USA, 1984-2008: the role of temporal scale
www.nrfirescience.org/resource/12025
The relationship between large fire occurrence and drought has important implications for fire prediction under current and future climates. This study's primary objective was to evaluate correlations between drought and fire-danger-rating indices representing short- and long-term drought, to determine which had the strongest...
Author(s): Karen L. Riley, John T. Abatzoglou, Isaac C. Grenfell, Anna E. Klene, Faith A. Heinsch
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

Effect of suppression strategies on federal wildland fire expenditures
www.nrfirescience.org/resource/17807
Policymakers and decisionmakers alike have suggested that the use of less aggressive suppression strategies for wildland fires might help stem the tide of rising emergency wildland fire expenditures. However, the interplay of wildland fire management decisions and expenditures is not well understood. In this study, we assess the...
Author(s): Krista M. Gebert, Anne E. Black
Year Published: 2012
Type: Document
Book or Chapter or Journal Article

Spatial bottom-up controls on fire likelihood vary across western North America
www.nrfirescience.org/resource/8311
The unique nature of landscapes has challenged our ability to make generalizations about the effects of bottom-up controls on fire regimes. For four geographically distinct fire-prone landscapes in western North America, we used a consistent simulation approach to quantify the influence of three key bottom-up factors, ignitions,...
Author(s): Sean A. Parks, Marc-Andre Parisien, Carol Miller
Year Published: 2012
Type: Document
Book or Chapter or Journal Article

Spatial variability in wildfire probability across the western United States
www.nrfirescience.org/resource/8322
Despite growing knowledge of fire-environment linkages in the western USA, obtaining reliable estimates of relative wildfire likelihood remains a work in progress. The purpose of this study is to use updated fire observations during a 25-year period and a wide array of environmental variables in a statistical framework to produce...
Author(s): Marc-Andre Parisien, Susan Snetsinger, Jonathan A. Greenberg, Cara R. Nelson, Tania L. Schoennagel, Solomon Z. Dobrowski, Max A. Moritz
Year Published: 2012
Type: Document
Book or Chapter or Journal Article

Modeling tree-level fuel connectivity to evaluate the effectiveness of thinning treatments for reducing crown fire potential
www.nrfirescience.org/resource/8295
Land managers have been using fire behavior and simulation models to assist in several fire management tasks. These widely-used models use average attributes to make stand-level predictions
without considering spatial variability of fuels within a stand. Consequently, as the existing models have limitations in adequately modeling...

**Do mountain pine beetle outbreaks change the probability of active crown fire in lodgepole pine forests? Comment 1 & 2, Reply 1**

*www.nrfirescience.org/resource/13342*

Comment 1 - Simard et al. (2011) have produced a comprehensive data set and analysis concerning mountain pine beetle (MPB; Dendroctonus ponderosae)-caused mortality and associated crown fire feedbacks in lodgepole pine (Pinus contorta)-dominated forests. Misapplication of the NEXUS fire modeling system (Scott and...

**Numerical simulation of crown fire hazard immediately after bark beetle-caused mortality in lodgepole pine forests**

*www.nrfirescience.org/resource/8325*

Quantifying the effects of mountain pine beetle (MPB)-caused tree mortality on potential crown fire hazard has been challenging partly because of limitations in current operational fire behavior models. Such models are not capable of accounting for fuel heterogeneity resulting from an outbreak. Further, the coupled interactions...

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

*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...

**A method for ensemble wildland fire simulation**

*www.nrfirescience.org/resource/12732*

An ensemble simulation system that accounts for uncertainty in long-range weather conditions and two-dimensional wildland fire spread is described. Fuel moisture is expressed based on the energy release component, a US fire danger rating index, and its variation throughout the fire season is modeled using time series analysis of...
Linking 3D spatial models of fuels and fire: effects of spatial heterogeneity on fire behavior

www.nrfirescience.org/resource/14161
Crownfire endangers fire fighters and can have severe ecological consequences. Prediction of fire behavior in tree crowns is essential to informed decisions in fire management. Current methods used in fire management do not address variability in crown fuels. New mechanistic physics-based fire models address convective heat transfer...

Author(s): Russell A. Parsons, William E. Mell, Peter McCauley
Year Published: 2011
Type: Document
Book or Chapter or Journal Article

A simulation of probabilistic wildfire risk components for the continental United States

www.nrfirescience.org/resource/12734
This simulation research was conducted in order to develop a large-fire risk assessment system for the contiguous land area of the United States. The modeling system was applied to each of 134 Fire Planning Units (FPUs) to estimate burn probabilities and fire size distributions. To obtain stable estimates of these quantities, fire...

Author(s): Mark A. Finney, Charles W. McHugh, Isaac C. Grenfell, Karen L. Riley, Karen C. Short
Year Published: 2011
Type: Document
Book or Chapter or Journal Article

Simulating fuel treatment effects in dry forests of the western United States: testing the principles of a fire-safe forest

www.nrfirescience.org/resource/8275
We used the Fire and Fuels Extension to the Forest Vegetation Simulator (FFE-FVS) to simulate fuel treatment effects on 45,162 stands in low- to midelevation dry forests (e.g., ponderosa pine (Pinus ponderosa Dougl. ex. P....

Author(s): Morris C. Johnson, Maureen C. Kennedy, David L. Peterson
Year Published: 2011
Type: Document
Book or Chapter or Journal Article

Analyzing wildfire exposure and source-sink relationships on a fire prone forest landscape

www.nrfirescience.org/resource/12736
We used simulation modeling to analyze wildfire exposure to social and ecological values on a 0.6 million ha national forest in central Oregon, USA. We simulated 50,000 wildfires that replicated recent fire events in the area and generated detailed maps of burn probability (BP) and fire intensity distributions. We also recorded the...

Author(s): Alan A. Ager, Nicole M. Vaillant, Mark A. Finney, Haiganoush K. Preisler
Year Published: 2011
Type: Document
Book or Chapter or Journal Article
A comparison of landscape fuel treatment strategies to mitigate wildland fire risk in the urban interface and preserve old forest structure

www.nrfirescience.org/resource/12725

We simulated fuel reduction treatments on a 16,000 ha study area in Oregon, US, to examine tradeoffs between placing fuel treatments near residential structures within an urban interface, versus treating stands in the adjacent wildlands to meet forest health and ecological restoration goals. The treatment strategies were evaluated...

Author(s): Alan A. Ager, Nicole M. Vaillant, Mark A. Finney
Year Published: 2010
Type: Document
Book or Chapter or Journal Article

Evaluating the ecological benefits of wildfire by integrating fire and ecosystem simulation models

www.nrfirescience.org/resource/19269

Fire managers are now realizing that wildfires can be beneficial because they can reduce hazardous fuels and restore fire-dominated ecosystems. A software tool that assesses potential beneficial and detrimental ecological effects from wildfire would be helpful to fire management. This paper presents a simulation platform called...

Author(s): Robert E. Keane, Eva C. Karau
Year Published: 2010
Type: Document
Book or Chapter or Journal Article

Wildfire risk and hazard: procedures for the first approximation

www.nrfirescience.org/resource/12726

This report was designed to meet three broad goals: (1) evaluate wildfire hazard on Federal lands; (2) develop information useful in prioritizing where fuels treatments and mitigation measures might be proposed to address significant fire hazard and risk; and (3) develop risk-based performance measures to document the effectiveness...

Author(s): David E. Calkin, Alan A. Ager, Julie W. Gilbertson-Day
Year Published: 2010
Type: Document
Technical Report or White Paper

Fine fuel heating by radiant flux

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

Effects of biomass removal treatments on stand-level fire characteristics in major forest types of the Northern Rocky Mountains

www.nrfirescience.org/resource/8189

Removal of dead and live biomass from forested stands affects subsequent fuel dynamics and fire potential. The amount of material left onsite after biomass removal operations can influence the
intensity and severity of subsequent unplanned wildfires or prescribed burns. We developed a set of
biomass removal treatment scenarios and...
Author(s): Elizabeth D. Reinhardt, Lisa M. Holsinger, Robert E. Keane
Year Published: 2010
Type: Document
Book or Chapter or Journal Article

Assessing crown fire potential in coniferous forests of western North America: a critique of
current approaches and recent simulation studies
www.nrfirescience.org/resource/8187
To control and use wildland fires safely and effectively depends on creditable assessments of fire
potential, including the propensity for crowning in conifer forests. Simulation studies that use certain fire
modelling systems (i.e. NEXUS, FlamMap, FARSITE, FFE-FVS (Fire and Fuels Extension to the Forest
Vegetation Simulator), Fuel...
Author(s): Miguel G. Cruz, Martin E. Alexander
Year Published: 2010
Type: Document
Book or Chapter or Journal Article

Seasonal predictions for wildland fire severity
www.nrfirescience.org/resource/11064
The National Fire Danger Rating System (NFDRS) indices deduced from the monthly to seasonal
predictions of a meteorological climate model at 50-km grid space from January 1998 through
December 2003 were used in conjunction with a probability model to predict the expected number of
fire occurrences and large fires over the U.S. West...
Author(s): Shyh-Chin Chen, Haiganoush K. Preisler, Francis M. Fujioka, John W. Benoit, John O.
Roads
Year Published: 2009
Type: Document
Conference Proceedings, Technical Report or White Paper

www.nrfirescience.org/resource/13824
In recent years, advances in computational power have led to an increase in attempts to model the
behaviour of wildland fires and to simulate their spread across landscape. The present series of articles
endeavours to comprehensively survey and précis all types of surface fire spread models developed
during the period 1990-2007....
Author(s): Andrew L. Sullivan
Year Published: 2009
Type: Document
Book or Chapter or Journal Article, Synthesis

Wildland surface fire spread modelling, 1990-2007. 3: Simulation and mathematical analogue
models
www.nrfirescience.org/resource/13825
In recent years, advances in computational power have led to an increase in attempts to model the
behaviour of wildland fires and to simulate their spread across landscape. The present series of articles
endeavours to comprehensively survey and précis all types of surface fire spread models developed
during the period 1990-2007....
Author(s): Andrew L. Sullivan
Year Published: 2009
Wildland surface fire spread modelling, 1990-2007. 1: Physical and quasi-physical models

In recent years, advances in computational power have led to an increase in attempts to model the behaviour of wildland fires and to simulate their spread across the landscape. The present series of articles endeavours to comprehensively survey and précis all types of surface fire spread models developed during the period 1990-...

Author(s): Andrew L. Sullivan
Year Published: 2009
Type: Document

Predicted fire behavior in selected mountain pine beetle-infested lodgepole pine

Using custom fuel models developed for use with Rothermel's surface fire spread model, we predicted and compared fire behavior in lodgepole pine (Pinus contorta Dougl. var. latifolia Engelm.) stands with endemic, current epidemic, and postepidemic mountain pine beetle (Dendroctonus ponderosae Hopkins) populations using standardized...

Author(s): Wesley G. Page, Michael J. Jenkins
Year Published: 2007
Type: Document

Testing the modeled effectiveness of an operational fuel reduction treatment in a small western Montana interface landscape using two spatial scales

Much of the coniferous zones in the Western United States where fires were historically frequent have seen large increases in stand densities and associated forest fuels due to 20th century anthropogenic influences. This condition is partially responsible for contemporary large, uncharacteristically severe wildfires. Therefore,...

Author(s): Michael G. Harrington, Erin Noonan-Wright, Mitchell Doherty
Year Published: 2007
Type: Document

A physics-based approach to modelling grassland fires

Physics-based coupled fire-atmosphere models are based on approximations to the governing equations of fluid dynamics, combustion, and the thermal degradation of solid fuel. They require significantly more computational resources than the most commonly used fire spread models, which are semi-empirical or empirical. However, there...

Author(s): William E. Mell, Mary Ann Jenkins, Jim Gould, Phil Cheney
Year Published: 2007
Type: Document

Guide to fuel treatments in dry forests of the Western United States: assessing forest structure and fire hazard
Guide to Fuel Treatments analyzes a range of fuel treatments for representative dry forest stands in the Western United States with overstories dominated by ponderosa pine (Pinus ponderosa), Douglas-fir (Pseudotsuga menziesii), and pinyon pine (Pinus edulis). Six silvicultural options (no thinning; thinning from below to 50 trees...)

Author(s): Morris C. Johnson, David L. Peterson, Crystal L. Raymond
Year Published: 2007
Type: Document
Technical Report or White Paper

Simulation of long-term landscape-level fuel treatment effects on large wildfires

A simulation system was developed to explore how fuel treatments placed in topologically random and optimal spatial patterns affect the growth and behaviour of large fires when implemented at different rates over the course of five decades. The system consisted of a forest and fuel dynamics simulation module (Forest Vegetation...)

Author(s): Mark A. Finney, Robert C. Seli, Charles W. McHugh, Alan A. Ager, Bernhard Bahro, James K. Agee
Year Published: 2007
Type: Document
Book or Chapter or Journal Article

Effects of alternative treatments on canopy fuel characteristics in five conifer stands

A detailed study of canopy fuel characteristics in five different forest types provided a unique dataset for simulating the effects of various stand manipulation treatments on canopy fuels. Low thinning, low thinning with commercial dbh limit, and crown thinning had similar effects on canopy bulk density (CBD) and canopy fuel load (...)

Author(s): Joe H. Scott, Elizabeth D. Reinhardt
Year Published: 2007
Type: Document
Conference Proceedings, Technical Report or White Paper

Windwizard: a new tool for fire management decision support

A new software tool has been developed to simulate surface wind speed and direction at the 100m to 300 m scale. This tool is useful when trying to estimate fire behavior in mountainous terrain. It is based on widely used computational fluid dynamics technology and has been tested against measured wind flows. In recent years it has...

Author(s): Bret W. Butler, Mark A. Finney, Larry S. Bradshaw, Jason M. Forthofer, Charles W. McHugh, Rick Stratton, Daniel M. Jimenez
Year Published: 2006
Type: Document
Conference Proceedings

An Overview of FlamMap Fire Modeling Capabilities

Computerized and manual systems for modeling wildland fire behavior have long been available (Rothermel 1983, Andrews 1986). These systems focus on one-dimensional behaviors and assume the fire geometry is a spreading line-fire (in contrast with point or area-source fires). Models included in these systems were developed to...
Comparison of crown fire modeling systems used in three fire management applications
www.nrfirescience.org/resource/11200
The relative behavior of surface-crown fire spread rate modeling systems used in three fire
management applications-CFIS (Crown Fire Initiation and Spread), FlamMap and NEXUS- is compared
using fire environment characteristics derived from a dataset of destructively measured canopy fuel and
associated stand characteristics. Although...
Author(s): Joe H. Scott
Year Published: 2006
Type: Document
Technical Report or White Paper

Evaluation of MM5 model resolution when applied to prediction of National Fire Danger Rating
indexes
www.nrfirescience.org/resource/7943
Weather predictions from the MM5 mesoscale model were used to compute gridded predictions of
National Fire Danger Rating System (NFDRS) indexes. The model output was applied to a case study
of the 2000 fire season in Northern Idaho and Western Montana to simulate an extreme event. To
determine the preferred resolution for automating...
Author(s): Jeanne L. Hoadley, Miriam L. Rorig, Larry S. Bradshaw, Sue A. Ferguson, Kenneth Westrick,
Scott L. Goodrick, Paul A. Werth
Year Published: 2006
Type: Document
Book or Chapter or Journal Article

Fuel Treatment Evaluator 3.0
www.nrfirescience.org/resource/11078
The Fuel Treatment Evaluator (FTE) 3.0 is a web-based tool that simulates uneven-aged and even-
aged silvicultural treatments on timberland in 12 western states. This tool simulates treatments to
reduce forest fire hazard to specific target levels and identifies the volume of biomass removed,
harvesting costs, and estimated biomass...
Author(s): U.S. Department of Agriculture, Forest Service
Year Published: 2006
Type: Document
Research Brief or Fact Sheet

Evaluation of the Experimental Climate Prediction Center's fire danger forecasts with remote
automated weather station observations
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
Cumulative effects of fuel management on landscape-scale fire behavior and effects - Final Report to the Joint Fire Science Program
www.nrfirescience.org/resource/11157
The project is concerned with modeling the long-term effects of landscape fuel treatment patterns on wildfire sizes and severity. The work was initiated based on theoretical fuel treatment patterns that appeared effective at changing fire growth across large landscapes, thus reducing the acreage burned and the chances that large...
Author(s): Mark A. Finney
Year Published: 2005
Type: Document
Technical Report or White Paper

Forest fuel treatments in western North America: merging silviculture and fire management
www.nrfirescience.org/resource/7948
In order to accomplish complex and multiple management objectives related to forest structure, fuels, and fire disturbance, these two disciplines must be effectively integrated in science and practice. The authors have linked scientific and management tools to develop an analytical approach that allows resource managers to quantify...
Author(s): Morris C. Johnson, David L. Peterson
Year Published: 2005
Type: Document
Book or Chapter or Journal Article

Modeling surface winds in complex terrain for wildland fire incident support - Final Report to the Joint Fire Science Program
www.nrfirescience.org/resource/11167
One major source of uncertainty in fire behavior and fire behavior modeling is the spatial variation in wind fields. Mountainsides, valleys, ridges, and the fire itself, influence both the speed and direction of wind flows. Small scale surface wind variations cannot be predicted by synoptic forecasting methods or on-site...
Author(s): Mark A. Finney, Larry S. Bradshaw, Bret W. Butler
Year Published: 2005
Type: Document
Technical Report or White Paper

Climatic controls of fire in the western United States: from the atmosphere to ecosystems - Final Report to the Joint Fire Science Program
www.nrfirescience.org/resource/11155
The objective of this project is to conduct a diagnostic analysis of the variations in climate that govern the characteristics of the fire season in the western United States on intra-annual through decadal and longer time scales. We propose a retrospective, model-based analysis to understand better the role of climate as a control...
Author(s): Steven W. Hostetler, Patrick J. Bartlein, Allen M. Solomon, J. O. Holman, Richard T. Busing, Sarah L. Shafer
Year Published: 2005
Type: Document
Technical Report or White Paper

Predicting cumulative watershed effects of fuel management with improved WEPP technology
The increase in severe wildfires in recent years is due in part to an abundance of fuels in forests. In an effort to protect values at risk, and decrease the severity of wildfires, forest managers have embarked on a major program of fuel reduction. Past research has shown that such fuel reduction may have minimal impact at a...

Author(s): William J. Elliot, Joan Q. Wu
Year Published: 2005
Type: Document
Conference Proceedings

Demonstration and integration of systems for fire remote sensing, ground-based fire measurement, and fire modeling - Final Report to the Joint Fire Science Program

Proof-of-concept research is being conducted to: compare airborne and in situ, ground-based fire measurement systems; begin evaluation of two fire-behavior simulation models with these data; test approaches to incorporating improved wind-field and weather data in these models; test the utility of the airborne remote sensing for...

Author(s): Colin C. Hardy, Philip J. Riggan
Year Published: 2005
Type: Document
Technical Report or White Paper

Landscape fire simulation and fuel treatment optimization

Fuel treatment effects on the growth and behavior of large wildland fires depend on the spatial arrangements of individual treatment units. Evidence of this is found in burn patterns of wildland fires. During planning stages, fire simulation is most often used to anticipate effects of fuel treatment units. Theoretical modeling shows...

Author(s): Mark A. Finney
Year Published: 2004
Type: Document
Technical Report or White Paper

A comment on models and modelling in fire/fuel management

'Modeling is fine as long as you know what you are doing.' General remark made to the author by a retired University of Alberta forestry professor a few years ago. The April 1988 issue of the Journal of Forestry published an article by John J. Garland that I have often handed out at various training courses and workshops to impress...

Author(s): Martin E. Alexander
Year Published: 2004
Type: Document
Technical Report or White Paper

Evaluating ASTER imagery and gradient modeling for mapping wildland fire fuels

Land managers need cost-effective methods for mapping and characterizing fire fuels quickly and accurately. The advent of sensors with increased spatial resolution may improve the accuracy and reduce the cost of fuels mapping. The objective of this research is to evaluate the accuracy and utility of imagery from the Advanced...

Author(s): Michael J. Falkowski
Fire whirls, fire tornados, and fire storms: physical and numerical modeling
www.nrfirescience.org/resource/11022
Fire whirls are a typically rare but potentially catastrophic form of fire. They are observed during urban and forest fires, where fire "tornadoes" are characterized by large-scale whirling flames which rise in 2 to 360 m diameter vortices from 10 to 1200 m high. These fire whirls accelerate combustion, produce significant suction...
Author(s): Robert N. Meroney
Year Published: 2003
Type: Document
Conference Proceedings

The spatial context of fire: a new approach for predicting fire occurrence
www.nrfirescience.org/resource/10993
Across North America, decades of fire suppression and recent patterns of human settlement have combined to increase the risks that wildland fires pose to human life, property, and natural resource values. Various methods can be used to reduce fuel hazards and mitigate these risks, but funding and other constraints require that these...
Author(s): Carol Miller
Year Published: 2003
Type: Document
Conference Proceedings, Technical Report or White Paper

Reaction times and burning rates for wind tunnel headfires
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

An initial analysis of relationships between 2- and 10-minute averaged winds at 10, 6, and 1.8 meters: implications for fire behavior and danger applications
www.nrfirescience.org/resource/8424
Recently there has been discussion in the National Wildland Fire Coordination Group (NWCG) fire danger and fire weather working teams about the impact of observations from different anemometer heights and more importantly, averaging times, on inputs to fire management systems such as National Fire Danger Rating System (Deeming and...
Author(s): Larry S. Bradshaw, Eugene Petrescu, Isaac C. Grenfell
Year Published: 2003
Type: Document
Conference Proceedings

Comparison of 2-D wind fields and simulated wildland fire growth
The paper discusses wildfire growth simulated by the FARSITE model using high-resolution wind fields over complex terrain extracted from operational runs of the MM5 weather forecast model supported by the USDA FS Rocky Mountain Center (RMC: http://www.fs.fed.us/rmc/). The original 12-km resolution wind field (simulated by MM5) has...

Author(s): Karl F. Zeller, Ned Nikolov, John S. Snook, Mark A. Finney, Jason M. Forthofer
Year Published: 2003
Type: Document
Conference Proceedings

Predicting surface winds in complex terrain for use in fire spread models

Fire behavior predictions and forecasts are vital to tactical planning on wildland firefighting incidents. One major source of uncertainty in fire behavior predictions is spatial variation in the wind fields used in the fire models. In most cases wind data are limited to only a few specific locations, none of which may be actually...

Author(s): Jason M. Forthofer, Bret W. Butler, Kyle S. Shannon, Mark A. Finney, Larry S. Bradshaw, Richard D. Stratton
Year Published: 2003
Type: Document
Conference Proceedings

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

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

Long lead statistical forecasts of area burned in western U.S. wildfires by ecosystem province

A statistical forecast methodology exploits large-scale patterns in monthly U.S. Climatological Division Palmer Drought Severity Index (PDSI) values over a wide region and several seasons to predict area burned in western U.S. wildfires by ecosystem province a season in advance. The forecast model, which is based on canonical...

Author(s): Anthony L. Westerling, Alexander Gershunov, Daniel R. Cayan, Tim P. Barnett
Year Published: 2002
Type: Document
Book or Chapter or Journal Article

Using FVS and its fire and fuels extension in the context of uncertain climate

While the prospect of a static climate is no longer tenable, the direction of change for particular localities is not yet clear. Modelling vulnerability of silvicultural options to various scenarios of climate change requires a modelling system that can represent major processes affected by climatic variability. The Forest...
Sequential use of simulation and optimization in analysis and planning
www.nrfirescience.org/resource/11045
Management activities are analyzed at landscape scales employing both simulation and optimization. SIMPPLLE, a stochastic simulation modeling system, is initially applied to assess the risks associated with a specific natural process occurring on the current landscape without management treatments, but with fire suppression. These...

Simulating fire patterns in heterogeneous landscapes
www.nrfirescience.org/resource/18408
A broad-scale probabilistic model of forest fires, EMBYR, has been developed to simulate the effects of large fires burning through heterogeneous landscapes. Fire ignition and spread are simulated on a gridded landscape by (1) examining each burning site at each time step, (2) independently evaluating the probability of spread to...

The Mann Gulch Fire and the Canadian Forest Fire Danger Rating System
www.nrfirescience.org/resource/8408
The year 1999 marks the 50th anniversary of the Mann Gulch Fire that occurred in western Montana on August 5, 1949 (Matthews 1999). There has been considerable interest amongst the Canadian wildland fire community in the 1949 Mann Gulch Fire ever since the publishing of MacLean's (1992) book ‘Young Men and Fire’ and Rothermel's (...)

An overview of the fire and fuels extension to the forest vegetation simulator
www.nrfirescience.org/resource/11037
The Fire and Fuels Extension (FFE) to the Forest Vegetation Simulator (FVS) has been developed to assess the risk, behavior, and impact of fire in forest ecosystems. This extension to the widely-used stand-dynamics model FVS simulates the dynamics of snags and surface fuels as they are affected by stand management (of trees or fuels...
Stevensville West Central Study
www.nrfirescience.org/resource/10981
This paper reports on an application of two modeling systems in the assessment and planning effort for a 58,038-acre area on the Bitterroot National Forest: SIMulating Vegetative Patterns and Processes at Landscape ScaLeS (SIMPPLLE), and Multi-resource Analysis and Geographic Information System (MAGIS). SIMPPLLE was a useful model...
Author(s): J. Greg Jones, Jimmie D. Chew, Nan K. Christianson, D. J. Silvieux, Catherine A. Stewart
Year Published: 2000
Type: Document
Conference Proceedings

Applying simulation and optimization to plan fuel treatments at landscape scales
www.nrfirescience.org/resource/11067
Fuel treatment activities are analyzed at the landscape scale by using both simulation and optimization. Simulating vegetative patterns and processes at landscape scales (SIMPPLLE), a stochastic simulation modeling system, is initially applied to assess wildfire risks on the current landscape without management treatments but with...
Author(s): J. Greg Jones, Jimmie D. Chew, Hans R. Zuuring
Year Published: 1999
Type: Document
Conference Proceedings, Technical Report or White Paper

Development of input data layers for the FARSITE fire growth model for the Selway-Bitterroot Wilderness Complex, USA
www.nrfirescience.org/resource/11240
Fuel and vegetation spatial data layers required by the spatially explicit fire growth model FARSITE were developed for all lands in and around the Selway-Bitterroot Wilderness Area in Idaho and Montana. Satellite imagery and terrain modeling were used to create the three base vegetation spatial data layers of potential vegetation,...
Author(s): Robert E. Keane, Janice L. Garner, Kirsten M. Schmidt, Donald G. Long, James P. Menakis, Mark A. Finney
Year Published: 1998
Type: Document
Technical Report or White Paper

A statistical-topographic model for mapping climatological precipitation over mountainous terrain
www.nrfirescience.org/resource/8361
The demand for climatological precipitation fields on a regular grid is growing dramatically as ecological and hydrological models become increasingly linked to geographic information systems that spatially represent and manipulate model output. This paper presents an analytical model that distributes point measurements of monthly...
Author(s): Christopher Daly, Ronald P. Neilson, Donald L. Phillips
Year Published: 1994
Type: Document
Book or Chapter or Journal Article

The Haines Index and Idaho fire growth
www.nrfirescience.org/resource/8306
[Excerpted from text] The growth of wildfires is related to three broad factors: fuel type, topography and weather. The National Fire Danger Rating System and the Fire Behavior Prediction System combine...
these factors to predict the probability and severity of wildland fires. However, these systems have mixed results in predicting...

Author(s): Paul A. Werth, Richard Ochoa
Year Published: 1990
Type: Document
Book or Chapter or Journal Article

**Predicting duff and woody fuel consumed by prescribed fire in the Northern Rocky Mountains**

www.nrfirescience.org/resource/11265

Relationships for predicting duff reduction, mineral soil exposure, and consumption of downed woody fuel were determined to assist in planning prescribed fires. Independent variables included lower and entire duff moisture contents, loadings of downed woody fuels, duff depth, National Fire-Danger Rating System 1,000-hour moisture...

Author(s): James K. Brown, Michael A. Marsden, Kevin C. Ryan, Elizabeth D. Reinhardt
Year Published: 1985
Type: Document
Technical Report or White Paper

**Modeling behavior of prescribed fires in Yosemite National Park**

www.nrfirescience.org/resource/8313

The National Fire Danger Rating System and the Fire Behavior Prediction System were tested on prescribed fires burning undercanopies in six fuel types in Yosemite National Park, California. The mean error for rate of spread was +0.03 .foot per minute for the NFDRS and -0.15foot for the FBPS. For flame length factors for...

Author(s): Jan W. van Wagendonk, Stephen J. Botti
Year Published: 1984
Type: Document
Book or Chapter or Journal Article

**Predicting slash depth for fire modeling**

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 = a\(x^n\). Values of "...

Author(s): Frank A. Albini, James K. Brown
Year Published: 1978
Type: Document
Technical Report or White Paper

**Fire danger rating network density**

www.nrfirescience.org/resource/11969

Conventional statistical techniques are used to answer the question, "What is the necessary station density for a fire danger network?" The Burning Index of the National Fire-Danger Rating System is used as an indicator of fire danger. Results are presented as station spacing in tabular form for each of six regions in the western...

Author(s): Rudy M. King, R. William Furman
Year Published: 1976
Type: Document
Technical Report or White Paper
Field test of a rate-of-fire-spread model in slash fuels
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

Mechanisms of fire spread research progress report no. 2
www.nrfirescience.org/resource/11937
In 1961 the National Science Foundation awarded grants to Washington State University and the Northern Forest Fire Laboratory of the Intermountain Forest and Range Experiment Station to further a joint study of the mechanisms of fire spread in wildland fuels. The combined efforts of the two research groups encompass theoretical...
Author(s): Hal E. Anderson
Year Published: 1966
Type: Document
Technical Report or White Paper

Calculating the National Fire-Danger Rating spread index by computer
www.nrfirescience.org/resource/11918
Changeover from use of the Intermountain Model-8 Burning Index Meter to use of the Spread Index of the National Fire-Danger Rating System required a comparative analysis of both systems. This note describes a program written in SPS to calculate various indexes of both systems on an IBM 1620 computer.
Author(s): Richard J. Barney
Year Published: 1964
Type: Document
Research Brief or Fact Sheet

Conversion tables for use with the National Fire-Danger Rating System in the Intermountain Area
www.nrfirescience.org/resource/11919
Two tables prepared for use with the National Fire-Danger Rating System replace 10 tables previously used with the Model-8 Fire-Danger Rating System. They provide for the conversion of Spread Index values at various altitudes, aspects, and times of day. A rate of spread table facilitates converting Spread Index values to chains per...
Author(s): Dwight S. Stockstad, Richard J. Barney
Year Published: 1964
Type: Document
Research Brief or Fact Sheet