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

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

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

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

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

www.nrfirescience.org/resource/19349

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

firebehavioR: An R Package for Fire Behavior and Danger Analysis

www.nrfirescience.org/resource/19886

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
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

www.nrfirescience.org/resource/19332

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

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...

Author(s): Nicolas Mansuy, Carol Miller, Marc-Andre Parisien, Sean A. Parks, Enric Batllori, Max A. Moritz
Year Published: 2019
**Pixel-level statistical analyses of prescribed fire spread**
www.nrfirescience.org/resource/19200
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

**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

**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

**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

**A web-based wildfire simulator for operational applications**
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

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

Modelling of the Radiant Heat Flux and Rate of Spread of Wildfire within the Urban Environment

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 geometry; the head fire...

Author(s): Greg Penney, Steven Richardson
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

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

Investigating the application of a hybrid space discretisation for urban scale evacuation simulation

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

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

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

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

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
A review of a new generation of wildfire–atmosphere modeling

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

Climate seasonality as an essential predictor of global fire activity

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

Modeling Fire Pathways in Montane Grassland?Forest Ecotones

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

Some Requirements for Simulating Wildland Fire Behavior Using Insight from Coupled Weather—Wildland Fire Models

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

The sensitivity of US wildfire occurrence to pre-season soil moisture conditions across ecosystems
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

Interpolation framework to speed up near-surface wind simulations for data-driven wildfire applications

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

Framework for submodel improvement in wildfire modeling

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

Wildfire fuel management: network-based models and optimization of prescribed burning

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

Some requirements for simulating wildland fire behavior using insight from coupled weather-wildland fire models

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

**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

**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

**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
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

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

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
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 Giermakowski, Maria D. Tchakerian, Gail M. Drus, Robert N. Coulson
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

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) and some T>0 and satisfies particular initial conditions. We also use the method of characteristics...

Author(s): Michal Fe?kan, Július Pa?uta
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

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

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

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

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

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
Evaluating spatiotemporal tradeoffs under alternative fuel management and suppression policies: measuring returns on investment - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/16996

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

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

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

www.nrfirescience.org/resource/15134

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)

www.nrfirescience.org/resource/16493

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]
www.nrfirescience.org/resource/14997
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
www.nrfirescience.org/resource/16445
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
www.nrfirescience.org/resource/16267
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

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

The normal fire environment—Modeling environmental suitability for large forest wildfires using past, present, and future climate normals
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

Network analysis of wildfire transmission and implications for risk governance

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

Spatially explicit measurements of forest structure and fire behavior following restoration treatments in dry forests

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
Book or Chapter or Journal Article

Simulated fire behaviour in young, postfire lodgepole pine forests

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

Modeling support for FASMEE experimental design using WRF-SFIRECHEM - Final Report to the Joint Fire Science Program

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
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
Type: Document
Book or Chapter or Journal Article

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. Battagilia, Tony S. Cheng, Yvette Dickinson, Frederick W. Smith
Year Published: 2016
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

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

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

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 equivalence between the two...
Author(s): Anthony S. Bova, William E. Mell, Chad M. Hoffman
Year Published: 2016
Type: Document
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

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...

Author(s): Chad M. Hoffman, J. Ziegler, Rodman Linn, William E. Mell, Carolyn Hull Sieg, F. Pimont
Year Published: 2015
Type: Document
Book or Chapter or Journal Article

Warning signals for eruptive events in spreading fires

www.nrfirescience.org/resource/13265

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

Author(s): Jerome M. Fox, George M. Whitesides
Year Published: 2015
Type: Document
Book or Chapter or Journal Article

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.
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

Fuel treatment effectiveness in reducing fire intensity and spread rate -- an experimental overview
www.nrfirescience.org/resource/16924
Fuel treatments represent a significant component of the wildfire mitigation strategy in the United States. However, the lack of research aimed at quantifying the explicit effectiveness of fuel treatments in reducing wildfire intensity and spread rate limits our ability to make educated decisions about the type and placement of...
Year Published: 2014
Type: Document
Conference Proceedings

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

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...
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...

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

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...

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

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...

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 tested with synthetic cases in...
Wildland fire emissions, carbon, and climate: modeling fuel consumption

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
Year Published: 2013
Type: Document
Book or Chapter or Journal Article, Synthesis

Current status and future needs of the BehavePlus Fire Modeling System

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

Forest fire management to avoid unintended consequences: a case study of Portugal using system dynamics

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
Book or Chapter or Journal Article

Combustibility of a mixture of live and dead fuel components

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

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
A polygon-based modeling approach to assess exposure of resources and assets to wildfire
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...

The relationship of large fire occurrence with drought and fire danger indices in the western USA, 1984-2008: the role of temporal scale
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...

Models for predicting fuel consumption in sagebrush-dominated ecosystems
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...
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

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

Author(s): Chad M. Hoffman, Penelope Morgan, William E. Mell, Russell A. Parsons, Eva K. Strand, Stephen Cook
Year Published: 2012
Type: Document
Book or Chapter or Journal Article

Entrainment regimes and flame characteristics of wildland fires

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

Author(s): Ralph M. Nelson, Bret W. Butler, David R. Weise
Year Published: 2012
Type: Document
Book or Chapter or Journal Article

Spatial bottom-up controls on fire likelihood vary across western North America

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

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

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
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...
A method for ensemble wildland fire simulation

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...

Author(s): Mark A. Finney, Isaac C. Grenfell, Charles W. McHugh, Robert C. Seli, D. Trethewey, Richard D. Stratton, Stuart Brittain
Year Published: 2011
Type: Document

Linking 3D spatial models of fuels and fire: effects of spatial heterogeneity on fire behavior

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

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

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

Wildfire risk and hazard: procedures for the first approximation

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

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

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

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

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...
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
Type: Document
Book or Chapter or Journal Article, Synthesis

Wildland surface fire spread modelling, 1990-2007. 1: Physical and quasi-physical models
www.nrfirescience.org/resource/13823
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
Book or Chapter or Journal Article, Synthesis

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
Guide to fuel treatments in dry forests of the Western United States: assessing forest structure and fire hazard
www.nrfirescience.org/resource/11166
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
www.nrfirescience.org/resource/8166
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
www.nrfirescience.org/resource/11129
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

Testing the modeled effectiveness of an operational fuel reduction treatment in a small western Montana interface landscape using two spatial scales
www.nrfirescience.org/resource/8410
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
Conference Proceedings

Predicted fire behavior in selected mountain pine beetle-infested lodgepole pine
www.nrfirescience.org/resource/12113
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
Book or Chapter or Journal Article

**A physics-based approach to modelling grassland fires**
www.nrfirescience.org/resource/14842

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
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

**Windwizard: a new tool for fire management decision support**
www.nrfirescience.org/resource/16902

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

**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
Evaluation of MM5 model resolution when applied to prediction of National Fire Danger Rating indexes

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...

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...
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

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

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

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

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

Evaluating ASTER imagery and gradient modeling for mapping wildland fire fuels

www.nrfirescience.org/resource/11280

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
Year Published: 2004
Type: Document
Research Brief or Fact Sheet

A comment on models and modelling in fire/fuel management

www.nrfirescience.org/resource/12394

'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

Comparison of 2-D wind fields and simulated wildland fire growth

www.nrfirescience.org/resource/11019

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

www.nrfirescience.org/resource/8438

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
Assessing canopy fuel stratum characteristics in crown fire prone fuel types of western North America
www.nrfirescience.org/resource/7917
Application of crown fire behavior models in fire management decision-making have been limited by the difficulty of quantitatively describing fuel complexes, specifically characteristics of the canopy fuel stratum. To estimate canopy fuel stratum characteristics of four broad fuel types found in the western United States and...
Author(s): Martin E. Alexander, Ronald H. Wakimoto
Year Published: 2003
Type: Document
Book or Chapter or Journal Article

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

Using FVS and its fire and fuels extension in the context of uncertain climate
www.nrfirescience.org/resource/11011
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...
Author(s): Albert R. Stage
Year Published: 2002
Type: Document
Conference Proceedings

Long lead statistical forecasts of area burned in western U.S. wildfires by ecosystem province
www.nrfirescience.org/resource/8377
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

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...)
Author(s): Sarah J. Beukema, Elizabeth D. Reinhardt, Werner A. Kurz, Nicholas L. Crookston
Year Published: 2000
Type: Document
Conference Proceedings

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...
Author(s): William W. Hargrove, Robert H. Gardner, Monica G. Turner, William H. Romme, Don G. Despain
Year Published: 2000
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. Silvieus, Catherine A. Stewart
Year Published: 2000
Type: Document
Conference Proceedings

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...
Author(s): Hans R. Zuuring, Jimmie D. Chew, J. Greg Jones
Year Published: 2000
Type: Document
Conference Proceedings

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 (...)
Author(s): Martin E. Alexander
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 underneith canopies 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 Wagtenendonk, Stephen J. Botti
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 \(y = a\cdot x\). 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

Conversion tables for use with the National Fire-Danger Rating System in the Intermountain Area
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

Calculating the National Fire-Danger Rating spread index by computer

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

ArcFuels

ArcFuels is a library of ArcGIS macros developed to streamline fire behavior modeling and spatial analyses for fuel treatment planning. The macros link: 1) key wildfire behavior models; 2) fuels and vegetation data (e.g. Landfire, FVS databases); 3) MS Office, and 4) ArcGIS. ArcFuels is used to rapidly design and test fuel...

Type: Website

FSPro Calibration

Why is calibrating the fire behavior models important to predicting fire behavior - an interview with Mark Finney a Research Scientist at the RMRS Fire Sciences Lab. Mark highlight's considerations an analyst should make when validating fire behavior models to fire behavior.

Type: Media

Near Real-time Wildfire Simulation Using Spark Big Data Platform

There has been a lack of tools and platforms for real-time prediction of wildfire movement and risk. Commonly used models do not address the dynamic nature of an area’s current meteorological conditions such as the wind, humidity, and precipitation when determining the direction and speed of fire propagation. Near-real time...

Type: Media

First Order Fire Effects Model (FOFEM)

First Order Fire Effects Model (FOFEM) is a computer program that was developed to meet needs of
resource managers, planners, and analysts in predicting and planning for fire effects. Quantitative predictions of fire effects are needed for planning prescribed fires that best accomplish resource needs, for impact assessment, and for...

Type: Website

Introduction to Fire Behavior Fuel Models
www.nrfirescience.org/resource/17985
This video describes how and why fire behavior fuel models were developed, and introduces how they are used today.
Type: Media

BehavePlus Fire Modeling System
www.nrfirescience.org/resource/16640
The BehavePlus fire modeling system is managed by the U.S. Forest Service, Rocky Mountain Research Station, Fire, Fuel, and Smoke Science Program (FFS) in Missoula, Montana. In 2014, information on BehavePlus was transferred from www.FireModels.org to https://www.frames.gov/partner-sites/behaveplus/home/. If you are looking for...
Type: Website

Modeling and Mapping the Potential for High Severity Fire in the Western U.S.
www.nrfirescience.org/resource/18377
The ecological effects of wildland fire – also termed the fire severity – are often highly heterogeneous in space and time. This heterogeneity is a result of spatial variability in factors such as fuel, topography, and climate (e.g. a map of mean annual temperature). However, temporally variable factors such as daily weather and...
Type: Media

Landscape Burn Probability Walk-Through
www.nrfirescience.org/resource/19863
A short video walk-through outlining how to run the Landscape Burn Probability (LBP) model in IFTDSS.
Type: Media

NFDRS Episode 3 - Fire Weather Data Collection and Distribution
www.nrfirescience.org/resource/19670
Episode 3 of the Fire Danger Learning System describes the dataflow of weather data into the various databases and processors that provide fire danger calculations for the US National Fire Danger Rating System.
Type: Media

Introduction to the 2017 Prescribed Fire Complexity Rating System Guide and Worksheets
www.nrfirescience.org/resource/17780
This 45 minute webinar covers significant changes made to the 2017 Prescribed Fire Complexity Rating
Fire.org
www.nrfirescience.org/resource/114
Fire.org is the home page of Systems for Environmental Management, a Montana nonprofit research and educational corporation. For over 29 years we've specialized in issues concerning wildland fire planning, behavior, fuel, weather, and effects. Here we post many of the publications and software packages we've developed in cooperation...
Type: Website

NFDRS Episode 1 - NFDRS Indices and Components
www.nrfirescience.org/resource/19668
Episode #1 of the Fire Danger Learning Series presents the components and indices that compose the US National Fire Danger Rating System.
Type: Media

The US National Fire Danger Rating System: Past, Present and Future
www.nrfirescience.org/resource/17778
This one hour webinar explores the US National Fire Danger Rating System, history and updates, that is in use today.
Type: Media

FSPro settings
www.nrfirescience.org/resource/19664
Mark Finney provides some considerations when setting up FSPro analyses - What is it you want to know from the analysis - is it the likely hood something is going to happen or is it the potential something is going to happen? These are different questions and the analyst can approach them differently or use different suites of tools...
Type: Media

Fire and Fuels Extension to the Forest Vegetation Simulator
www.nrfirescience.org/resource/18005
The Fire and Fuels Extension (FFE) to the Forest Vegetation Simulator (FVS) simulates fuel dynamics and potential fire behaviour over time, in the context of stand development and management. The Fire Effects Model Extension is a new extension to FVS and the PPE that allows users to simulate the effects of fire on a number of...
Type: Website

FlamMap
www.nrfirescience.org/resource/17995
FlamMap software creates raster maps of potential fire behavior characteristics (ROS, flame length, crown fire activity, etc.) and environmental conditions (dead fuel moistures, mid-flame wind speeds, and
solar irradiance) over an entire FARSITE landscape. These raster maps can be viewed in FlamMap or exported for use in a GIS,...
Type: Website

Website

Improving Parameterization of Combustion Processes in Coupled Fire-Atmosphere Models through Remote Sensing
www.nrfirescience.org/resource/18384
Coupled fire-atmosphere models intended to be used for landscape-scale fires (domains of hundreds of meters to 10s of kilometers), typically divide the simulation domain up into a mesh of grid cells and these grid cells typically range in size from 1-30 meters on a side. As the processes governing combustion of an individual fuel...
Type: Media

Seminar

NFDRS Episode 2 - NFDRS 2016: A Quick Introduction
www.nrfirescience.org/resource/19669
Episode 2 of the Fire Danger Learning Series discussing the forthcoming 2016 revision to the US National Fire Danger Rating System.
Type: Media

Video

BehavePlus Updates and Changes
www.nrfirescience.org/resource/17779
In this 38 minute webinar, Faith Ann briefly describes major changes from version 5 to version 6; shows sample Runs demonstrating these changes; provides suggestions for calculating surface fire behavior using BehavePlus v6; describes how changes in BehavePlus affect NWCG courses that use this program (e.g., S-490; RX-301/341); and...
Type: Webinar