

Adaptation Strategies and Approaches for Managing Fire in a Changing Climate

www.nrfirescience.org/resource/24455

As the effects of climate change accumulate and intensify, resource managers juggle existing goals and new mandates to operationalize adaptation. Fire managers contend with the direct effects of climate change on resources in addition to climate-induced disruptions to fire regimes and subsequent ecosystem effects. In systems...

Author(s): Martha Sample, Andrea E. Thode, Courtney L. Peterson, Michael R. Gallagher, William T. Flatley, Megan Friggens, Alexander M. Evans, Rachel A. Loehman, Shaula J. Hedwall, Leslie A. Brandt, Maria K. Janowiak, Christopher W. Swanston

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Book or Chapter or Journal Article

Global increase in wildfire risk due to climate driven declines in fuel moisture

www.nrfirescience.org/resource/24172

There is mounting concern that global wildfire activity is shifting in frequency, intensity, and seasonality in response to climate change. Fuel moisture provides a powerful means of detecting changing fire potential. Here, we use global burned area, weather reanalysis data, and the Canadian fire weather index system to calculate...

Author(s): T. Michael Ellis, David M. J. S. Bowman, Piyush Jain, Michael D. Flannigan, Grant J. Williamson

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Book or Chapter or Journal Article

Tamm Review: Ecological principles to guide post-fire forest landscape management in the Inland Pacific and Northern Rocky Mountain regions

www.nrfirescience.org/resource/24148

Post-fire landscapes are the frontline of forest ecosystem change. As such, they represent opportunities to foster conditions that are better adapted to future climate and wildfires with post-fire management. In western US landscapes, post-fire management has been mostly defined by short-term emergency mitigation measures, salvage...

Author(s): Andrew J. Larson, Sean M.A. Jeronimo, Paul F. Hessburg, James A. Lutz, Nicholas A. Povak, C. Alina Cansler, Van R. Kane, Derek J. Churchill

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Book or Chapter or Journal Article

Missing climate feedbacks in fire models: limitations and uncertainties in fuel loadings and the role of decomposition in fine fuel accumulation

www.nrfirescience.org/resource/24413

Climate change has lengthened wildfire seasons and transformed fire regimes throughout the world. Thus, capturing fuel and fire dynamics is critical for projecting Earth system processes in warmer and drier future. Recent advances in fire regime modeling have linked land surface models with fire behavior models. Such models often...

Author(s): Erin J. Hanan, Maureen C. Kennedy, Jianning Ren, Morris C. Johnson, Alistair M. S. Smith

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Book or Chapter or Journal Article

Tree mortality response to drought-density interactions suggests opportunities to enhance

drought resistance

www.nrfirescience.org/resource/24340

The future of dry forests around the world is uncertain given predictions that rising temperatures and enhanced aridity will increase drought-induced tree mortality. Using forest management and ecological restoration to reduce density and competition for water offers one of the few pathways that forests managers can potentially...

Author(s): John Bradford, Robert K. Shriver, Marcos D. Robles, Lisa McCauley, Travis J. Woolley, Caitlin M. Andrews, Michael A. Crimmins, David M. Bell

Year Published: 2022

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Book or Chapter or Journal Article

Wildfire atmospheric chemistry: climate and air quality impacts

www.nrfirescience.org/resource/24538

Wildfires emit significant amounts of material into the atmosphere. To fully understand the impact of these emissions an accurate understanding of wildfire smoke chemistry is needed. This perspective highlights our chemical understanding and research gaps regarding the impacts of wildfire smoke on air quality and climate.

Author(s): Stephanie R. Schneider, Jonathan P. D. Abbatt

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Book or Chapter or Journal Article

Climate and wildfire adaptation of inland Northwest US forests

www.nrfirescience.org/resource/24320

After a century of intensive logging, federal forest management policies were developed in the 1990s to protect remaining large trees and old forests in the western US. Today, due to rapidly changing ecological conditions, new threats and uncertainties, and scientific advancements, some policy provisions are being re-evaluated in...

Author(s): Paul F. Hessburg, Susan Charnley, Andrew N. Gray, Thomas A. Spies, David W. Peterson, Rebecca L. Flitcroft, Kendra L. Wendel, Jessica E. Halofsky, Eric M. White, John D. Marshall

Year Published: 2022

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Book or Chapter or Journal Article

Combined effects of climate and fire-driven vegetation change constrain the distributions of forest vertebrates during the 21st century

www.nrfirescience.org/resource/24525

Aim: Biodiversity conservation relies in part on enduring habitat in protected areas. In fire-prone ecosystems, shifts in species' ranges will result both from changes in climate and fire-catalysed vegetation change, which could lead to niche contraction and undermine protected-area efficacy. We explored these dynamics for three...

Author(s): Tyler J. Hoecker, Monica G. Turner

Year Published: 2022

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Book or Chapter or Journal Article

Fire and ice: the impact of wildfire-affected albedo and irradiance on glacier melt

www.nrfirescience.org/resource/24499

Wildfire occurrence and severity is predicted to increase in the upcoming decades with severe negative impacts on human societies. The impacts of upwind wildfire activity on glacier melt, a critical source of

freshwater for downstream environments, were investigated through analysis of field and remote sensing observations and...

Author(s): Caroline Aubry-Wake, André Bertoncini, John W. Pomeroy

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Book or Chapter or Journal Article

A global synthesis of fire effects on ecosystem services of forests and woodlands

www.nrfirescience.org/resource/24473

Fire is a primary disturbance in the world's forested ecosystems and its impacts are projected to increase in many regions due to global climate change. Fire impacts have been studied for decades, but integrative assessments of its effects on multiple ecosystem services (ES) across scales are rare. We conducted a global analysis...

Author(s): Jose V. Roces-Díaz, Cristina Santin, Jordi Martinez-Vilalta, Stefan H. Doerr

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Book or Chapter or Journal Article

Past and future of wildfires in Northern Hemisphere's boreal forests

www.nrfirescience.org/resource/24244

The boreal forests of the Northern Hemisphere (i.e., covering the USA, Canada and Russia) are the grandest carbon sinks of the world. A significant increase in wildfires could cause disequilibrium in the Northern boreal forest's capacity as a carbon sink and cause significant impacts on wildlife and people worldwide. That is why...

Author(s): Victor M. Velasco Herrera, Willie Soon, César Pérez-Moreno, Graciela Velasco Herrera, Raúl Martell-Dubois, Laura Rosique-de la Cruz, Valery M. Fedorov, Sergio Cerdeira-Estrada, Eric Bongelli, Emmanuel Zúñiga

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Book or Chapter or Journal Article

Extreme fire spread events and area burned under recent and future climate in the western USA

www.nrfirescience.org/resource/24468

Aim Wildfire activity in recent years is notable not only for an expansion of total area burned but also for large, single-day fire spread events that pose challenges to ecological systems and human communities. Our objectives were to gain new insight into the relationships between extreme single-day fire spread events, annual area...

Author(s): Jonathan D. Coop, Sean A. Parks, Camille Stevens-Rumann, Scott M. Ritter, Chad M. Hoffman

Year Published: 2022

Type: Document

Book or Chapter or Journal Article

Emerging palaeoecological frameworks for elucidating plant dynamics in response to fire and other disturbance

www.nrfirescience.org/resource/24217

Motivation: Rapid climate change is altering plant communities around the globe fundamentally. Despite progress in understanding how plants respond to these climate shifts, accumulating evidence suggests that disturbance could not only modify expected plant responses but, in some cases, have larger impacts on compositional shifts...

Author(s): Joseph D. Napier, Melissa L. Chipman

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Book or Chapter or Journal Article

Megafires and thick smoke portend big problems for migratory birds

www.nrfirescience.org/resource/24164

In 2020, the fire season affecting the western United States reached unprecedented levels. The 116 fires active in September consumed nearly 20,822 km² (<https://inciweb.nwccg.gov/accessible-view/> Accessed 2020-09-29) with 80% of this footprint (16,567 km²) from 68 fires occurring within California, Oregon, and Washington....

Author(s): Cory T. Overton, Austen A. Lorenz, Eric James, Ravan Ahmadov, John M. Eadie, Fiona McDuie, Mark J. Petrie, Chris A. Nicolai, Melanie L. Weaver, Daniel A. Skalos, Daniel A. Skalos, Shannon M. Skalos, Andrea L. Mott, Desmond A. Mackell, Anna Kennedy, Elliott L. Matchett, Michael L. Casazza

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Book or Chapter or Journal Article

Fire ecology for the 21st century: conserving biodiversity in the age of megafire

www.nrfirescience.org/resource/24420

Fire is one of Earth's most potent agents of ecological change. This Special Issue comes in the wake of a series of extreme wildfires across the world, from the Amazon, to Siberia, California, Portugal, South Africa and eastern Australia (Duane et al., 2021). These "megafires," variously defined according to their size,...

Author(s): Dale G. Nimmo, Alan N. Andersen, Sally Archibald, Matthias M. Boer, Lluís Brotons, Catherine L. Parr, Morgan W. Tingley

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Book or Chapter or Journal Article

Global increase in wildfire risk due to climate-driven declines in fuel moisture

www.nrfirescience.org/resource/24356

There is mounting concern that global wildfire activity is shifting in frequency, intensity, and seasonality in response to climate change. Fuel moisture provides a powerful means of detecting changing fire potential. Here, we use global burned area, weather reanalysis data, and the Canadian fire weather index system to calculate...

Author(s): Todd M. Ellis, David M. J. S. Bowman, Piyush Jain, Michael D. Flannigan, Grant J. Williamson

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Book or Chapter or Journal Article

Warming weakens the night-time barrier to global fire

www.nrfirescience.org/resource/24334

Night-time provides a critical window for slowing or extinguishing fires owing to the lower temperature and the lower vapour pressure deficit (VPD). However, fire danger is most often assessed based on daytime conditions^{1,2}, capturing what promotes fire spread rather than what impedes fire. Although it is well appreciated that...

Author(s): Jennifer Balch, John T. Abatzoglou, Maxwell B. Joseph, Michael J. Koontz, Adam L. Mahood, Joe McGlinchy, Megan E. Cattau, A. Park Williams

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Book or Chapter or Journal Article

A bioeconomic projection of climate-induced wildfire risk in the forest sector

www.nrfirescience.org/resource/24535

Under the influence of climate change, wildfire regimes are expected to intensify and expand to new areas, increasing threats to natural and socioeconomic assets. We explore the environmental and economic implications for the forest sector of climate-induced changes in wildfire regimes. To retain genericity while considering local...

Author(s): Miguel Rivière, F. Pimont, Philippe Delacote, Julien Ruffault, Antonello Lobianco, Thomas Opitz, Jean-Luc Dupuy

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Book or Chapter or Journal Article

The magnitude, direction, and tempo of forest change in Greater Yellowstone in a warmer world with more fire

www.nrfirescience.org/resource/24319

As temperatures continue rising, the direction, magnitude, and tempo of change in disturbance-prone forests remain unresolved. Even forests long resilient to stand-replacing fire face uncertain futures, and efforts to project changes in forest structure and composition are sorely needed to anticipate future forest trajectories. We...

Author(s): Monica G. Turner, Kristin H. Braziunas, Winslow D. Hansen, Tyler J. Hoecker, Werner Rammer, Zakary Ratajczak, Anthony L. Westerling, Rupert Seidl

Year Published: 2022

Type: Document
Book or Chapter or Journal Article

Fire and rain: a systematic review of the impacts of wildfire and associated runoff on aquatic fauna

www.nrfirescience.org/resource/24524

Climate and land-use changes are expected to increase the future occurrence of wildfires, with potentially devastating consequences for freshwater species and ecosystems. Wildfires that burn in close proximity to freshwater systems can significantly alter the physicochemical properties of water. Following wildfires and heavy rain,...

Author(s): Daniel F. Gomez Isaza, Rebecca L. Cramp, Craig E. Franklin

Year Published: 2022

Type: Document
Book or Chapter or Journal Article

Self-thinning forest understoreys reduce wildfire risk, even in a warming climate

www.nrfirescience.org/resource/24487

As climatic changes continue to drive increases in the frequency and severity of forest fires, it is critical to understand all of the factors influencing the risk of forest fire. Using a spatial dataset of areas burnt over a 65 year period in a 528 343 ha study area, we examined three possible drivers of flammability dynamics....

Author(s): Philip Zylstra, S. Don Bradshaw, David B. Lindenmayer

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Type: Document
Book or Chapter or Journal Article

Climate-induced fire regime amplification in Alberta, Canada

www.nrfirescience.org/resource/24469

Acting as a top-down control on fire activity, climate strongly affects wildfire in North American ecosystems through fuel moisture and ignitions. Departures from historical fire regimes due to climate change have significant implications for the structure and composition of boreal forests, as well as fire management and operations...

Author(s): Ellen Whitman, Sean A. Parks, Lisa M. Holsinger, Marc-Andre Parisien

Year Published: 2022

Type: Document

Book or Chapter or Journal Article

Wildfire catalyzes upward range expansion of trembling aspen in southern Rocky Mountain beetle-killed forests

www.nrfirescience.org/resource/24219

Aim: Climate warming is expected to drive upward and poleward shifts at the leading edge of tree species ranges. Disturbance has the potential to accelerate these shifts by altering biotic and abiotic conditions, though this potential is likely to vary by disturbance type. In this study, we assessed whether recent wildfires and...

Author(s): Katherine Nigro, Monique E. Rocca, Michael A. Battaglia, Jonathan D. Coop, Miranda Redmond

Year Published: 2022

Type: Document

Book or Chapter or Journal Article

Restoration of forest resilience to fire from old trees is possible across a large Colorado dry-forest landscape by 2060, but only under the Paris 1.5? goal

www.nrfirescience.org/resource/23732

Fire-prone dry forests often face increasing fires from climate change with low resistance and resilience due to logging of large, old fire-resistant trees. Their restoration across large landscapes is constrained by limited mature trees, physical settings, and protection. Active restoration has been costly and shown limited...

Author(s): William L. Baker

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Type: Document

Book or Chapter or Journal Article

How climate change and fire exclusion drive wildfire regimes at actionable scales

www.nrfirescience.org/resource/22742

Extreme wildfires are increasing in frequency globally, prompting new efforts to mitigate risk. The ecological appropriateness of risk mitigation strategies, however, depends on what factors are driving these increases. While regional syntheses attribute increases in fire activity to both climate change and fuel accumulation through...

Author(s): Erin J. Hanan, Jianning Ren, Christina Tague, Crystal A. Kolden, John T. Abatzoglou, Ryan R. Bart, Maureen C. Kennedy, Mingliang Liu, Jennifer C. Adam

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Book or Chapter or Journal Article

Towards a comprehensive look at global drivers of novel extreme wildfire events

www.nrfirescience.org/resource/23131

Extreme wildfire events in recent years are shaking our established knowledge of how fire regimes respond to climate variables and how societies need to react to fire impacts. Albeit fires are stochastic and extreme in nature, the speed, intensity, and extension of new extreme fires that have occurred during the last years are...

Author(s): Andrea Duane, Marc Castellnou, Lluís Brotons

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Book or Chapter or Journal Article

Effects of climate change on natural-caused fire activity in western U.S. National Forests

www.nrfirescience.org/resource/23619

Climate change, with warming temperatures and shifting precipitation patterns, may increase natural-caused forest fire activity. Increasing natural-caused fires throughout western United States national forests could place people, property, and infrastructure at risk in the future. We used the fine K nearest neighbor (KNN) method...

Author(s): Hadi Heidari, Mazdak Arabi, Travis Warziniack

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Type: Document

Book or Chapter or Journal Article

Crowded and Thirsty: Fire Exclusion Leads to Greater Drought Sensitivity in Mixed-Conifer Forests

www.nrfirescience.org/resource/22632

Wildfires were a frequent source of disturbance in forests of the Western United States prior to Euro-American settlement. Following a series of catastrophic wildfires in the Northern Rockies in 1910, the U.S. Forest Service adopted a broad wildfire suppression policy that has resulted in forests thick with small trees. These...

Author(s): Andrea Watts, Frederick C. Meinzer, Thomas A. Spies, Andrew G. Merschel, Steven L. Voelker

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Technical Report or White Paper

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

www.nrfirescience.org/resource/23126

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

Author(s): Massimiliano Agovino, Massimiliano Cerciello, Aniello Ferraro, Antonio Garofalo

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Adapting western North American forests to climate change and wildfires: ten common questions

www.nrfirescience.org/resource/23576

We review science-based adaptation strategies for western North American (wNA) forests that include restoring active fire regimes and fostering resilient structure and composition of forested landscapes. As part of the review, we address common questions associated with climate adaptation and realignment treatments that run counter...

Author(s): Susan J. Prichard, Paul F. Hessburg, R. Keala Hagmann, Nicholas A. Povak, Solomon Z. Dobrowski, Matthew D. Hurteau, Van R. Kane, Robert E. Keane, Leda N. Kobziar, Crystal A. Kolden, Malcolm P. North, Sean A. Parks, Hugh Safford, Jens T. Stevens, Larissa L. Yocom, Derek J. Churchill, Robert W. Gray, David W. Huffman, Frank K. Lake, Pratima Khatri-Chhetri
Year Published: 2021
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A trait-based approach to assessing resistance and resilience to wildfire in two iconic North American conifers

www.nrfirescience.org/resource/22613

Ongoing changes in fire regimes have the potential to drive widespread shifts in Earth's vegetation. Plant traits and vital rates provide insight into vulnerability to fire?driven vegetation shifts because they can be indicators of the ability of individuals to survive fire (resistance) and populations to persist (resilience)...

Author(s): Kyle Rodman, Thomas T. Veblen, Robert A. Andrus, Neal J. Enright, Joseph B. Fontaine, Angela D. Gonzalez, Miranda Redmond, Andreas P. Wion
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Decadal changes in fire frequencies shift tree communities and functional traits

www.nrfirescience.org/resource/23055

Global change has resulted in chronic shifts in fire regimes. Variability in the sensitivity of tree communities to multi-decadal changes in fire regimes is critical to anticipating shifts in ecosystem structure and function, yet remains poorly understood. Here, we address the overall effects of fire on tree communities and the...

Author(s): Adam F. A. Pellegrini, Tyler Refsland, Colin Averill, Cesar Terrer, Monica G. Turner, J. Morgan Varner
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Long-term empirical evidence shows post-disturbance climate controls post-fire regeneration

www.nrfirescience.org/resource/23987

Increased wildfire activity and climate change have intensified disturbance regimes globally and have raised concern among scientists and land managers about the resilience of disturbed landscapes. Here we test the effects of climate, topographic variation, and pre-fire stand structure on regeneration in lodgepole pine (*Pinus...*

Author(s): Jaclyn Guz, Nathan S. Gill, Dominik Kulakowski
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Climate change and wildfire-induced alteration of fight-or-flight behavior

www.nrfirescience.org/resource/23417

The acute stress response is a cornerstone of animal behavior research, but little is currently understood about how responses to acute stressors (i.e. discrete noxious stimuli) may be altered in future climates. As climate change ensues, animals may experience chronic stress due to persistent warmer temperatures and environmental...

Author(s): Camdon B. Kay, David J. Delehanty, Devaleena S. Pradhan, Joshua B. Grinath

Year Published: 2021
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Book or Chapter or Journal Article

Record-setting climate enabled the extraordinary 2020 fire season in the western United States

www.nrfirescience.org/resource/22599

The 2020 fire season in the western United States (the West) has been staggering: over 2.5 million ha have burned as of 31 September, including over 1.5 million ha in California (3.7% of the state), in part from five of the six largest fires in state history; over 760,000 ha have burned in Oregon and Washington, most occurring...

Author(s): Philip E. Higuera, John T. Abatzoglou

Year Published: 2021

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Book or Chapter or Journal Article

Understanding and modelling wildfire regimes: an ecological perspective

www.nrfirescience.org/resource/23974

Recent extreme wildfire seasons in several regions have been associated with exceptionally hot, dry conditions, made more probable by climate change. Much research has focused on extreme fire weather and its drivers, but natural wildfire regimes – and their interactions with human activities – are far from being comprehensively...

Author(s): Sandy P. Harrison, Iain Colin Prentice, Keith J. Bloomfield, Ning Dong, Matthias Forkel, Matthew Forrest, Ramesh K. Ningthoujam, Adam F. A. Pellegrini, Yicheng Shen, Mara Baudena, Anabelle W. Cardoso, Jessica C. Huss, Jaideep Joshi, I Oliveras, Juli G. Pausas, Kimberley J. Simpson

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Book or Chapter or Journal Article

Contrasting the role of human- and lightning-caused wildfires on future fire regimes on a Central Oregon landscape

www.nrfirescience.org/resource/23379

Climate change is expected to increase fire activity in many regions of the globe, but the relative role of human vs. lightning-caused ignitions on future fire regimes is unclear. We developed statistical models that account for the spatiotemporal ignition patterns by cause in the eastern slopes of the Cascades in Oregon, USA...

Author(s): Ana M. G. Barros, Michelle A. Day, Haiganoush K. Preisler, John T. Abatzoglou, Meg A. Krawchuk, Rachel M. Houtman, Alan A. Ager

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Type: Document

Book or Chapter or Journal Article

The changing risk and burden of wildfire in the United States

www.nrfirescience.org/resource/22574

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

Author(s): Marshall Burke, Anne Driscoll, Sam Heft-Neal, Jiani Xue, Jennifer Burney, Michael Wara

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Book or Chapter or Journal Article

US wildfire potential: a historical view and future projection using high-resolution climate data

www.nrfirescience.org/resource/22898

Recent wildfires in the western United States have led to substantial economic losses and social stresses. There is a great concern that the new climatic state may further increase the intensity, duration, and frequency of wildfires. To examine temporal and spatial features of historical wildfire trends and future changes, a common...

Author(s): Emily K. Brown, Jiali Wang, Yan Feng

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Adapting western North American forests to climate change and wildfires: 10 common questions

www.nrfirescience.org/resource/23946

We review science-based adaptation strategies for western North American (wNA) forests that include restoring active fire regimes and fostering resilient structure and composition of forested landscapes. As part of the review, we address common questions associated with climate adaptation and realignment treatments that run counter...

Author(s): Susan J. Prichard, Paul F. Hessburg, R. Keala Hagmann, Nicholas A. Povak, Solomon Z. Dobrowski, Matthew D. Hurteau, Van R. Kane, Robert E. Keane, Leda N. Kobziar, Crystal A. Kolden, Malcolm P. North, Sean A. Parks, Hugh Safford, Jens T. Stevens, Larissa L. Yocom, Derek J. Churchill, Robert W. Gray, David W. Huffman, Frank K. Lake, Pratima Khatri-Chhetri

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Book or Chapter or Journal Article

What makes a resilient landscape? Climate, fire, and forests in the Northern Rockies

www.nrfirescience.org/resource/23344

Determining whether forest landscapes can maintain their resilience to fire – that is, their ability to rebound and sustain – given rapid climate change and increasing fire activity is a pressing challenge throughout the American West. Many western forests are well adapted to fire, and even subalpine forests that experience...

Author(s): Monica G. Turner

Year Published: 2021

Type: Document

Research Brief or Fact Sheet

Climate change and western wildfires

www.nrfirescience.org/resource/24298

This feature explores topics of enduring ecological concern – fire regimes, climate change, and forest management of the North American West. The authors describe the dual challenges of past forest management legacies and fire exclusion confronted by a changing fire regime due to the coupling of stark climatic changes and abundant...

Author(s): David S. Schimel, Juan C. Corley

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Impacts of burn severity, microclimate, and soil properties on initial post-fire tree regeneration -

Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/23944

Climate warming and increased frequency and severity of wildfires have the potential to undermine forest resilience to wildfires. Species demography implies that vegetation responses to fires depend on a series of population filters, including adult survival, seed availability, germination, establishment, and survival; the impacts...

Author(s): Kyra D. Wolf, Philip E. Higuera, Kimberley T. Davis

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Type: Document

Technical Report or White Paper

Fire and climate change: a comment

www.nrfirescience.org/resource/22870

Stephens et al. (2020) do an excellent job of encouraging us to sharpen our focus on the ecological consequences of forest and fire management activities, but at the same time they did not emphasize that those consequences differ substantially among forest types. Even though Stephens et al. clearly state that their comments apply...

Author(s): Richard L. Hutto

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Book or Chapter or Journal Article

Restoration of forest resilience to fire from old trees is possible across a large Colorado dry-forest landscape by 2060, but only under the Paris 1.5°C goal

www.nrfirescience.org/resource/23283

Fire-prone dry forests often face increasing fires from climate change with low resistance and resilience due to logging of large, old fire-resistant trees. Their restoration across large landscapes is constrained by limited mature trees, physical settings, and protection. Active restoration has been costly and shown limited...

Author(s): William L. Baker

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Book or Chapter or Journal Article

Fire Earth: The Effects of Fire Intensity on Trees and Productivity

www.nrfirescience.org/resource/24283

Climate change is projected to exacerbate the intensity of heat-waves and drought, leading to greater incidences of large and high-intensity wildfires in forested ecosystems. While commonly-used remotely-sensed spectral assessments can provide useful information about the areal extent of fires and resultant changes in vegetation...

Author(s): Alex W. Kirkpatrick

Year Published: 2021

Type: Document

Research Brief or Fact Sheet

Low-density aspen seedling establishment is widespread following recent wildfires in the western United States

www.nrfirescience.org/resource/23812

Sexual regeneration is increasingly recognized as an important regeneration pathway for aspen in the western U.S., a region previously thought to be too dry for seedling establishment except for during unusually wet periods. Due to this historical assumption, information on aspen seedling establishment

and factors influencing its...

Author(s): Mark R. Kreider, Larissa L. Yocom

Year Published: 2021

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Book or Chapter or Journal Article

The changing risk and burden of wildfire in the United States

www.nrfirescience.org/resource/23271

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

Author(s): Marshall Burke, Anne Driscoll, Sam Heft-Neal, Jiani Xue, Jennifer Burney, Michael Wara

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Book or Chapter or Journal Article

Resilient landscapes and fire regimes: Meaning, metrics, and management: Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/23788

The National Cohesive Wildland Fire Management Strategy (hereafter: Cohesive Strategy) mandates the restoration and maintenance of landscapes, with the goal that “landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.” This policy includes using wildland fire to...

Author(s): Sharon M. Hood, Donald A. Falk, Martin Nie

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Technical Report or White Paper

Biotic and abiotic drivers of plant–pollinator community assembly across wildfire gradients

www.nrfirescience.org/resource/22756

Understanding how abiotic disturbance and biotic interactions determine pollinator and flowering?plant diversity is critically important given global climate change and widespread pollinator declines. To predict responses of pollinators and flowering?plant communities to changes in wildfire disturbance, a mechanistic...

Author(s): Joseph A. LaManna, Laura A. Burkle, R. Travis Belote, Jonathan A. Myers

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Book or Chapter or Journal Article

The Effect of Seeding Treatments and Climate on Fire Regimes in Wyoming Sagebrush Steppe

www.nrfirescience.org/resource/23197

Wildfire size and frequency have increased in the western United States since the 1950s, but it is unclear how seeding treatments have altered fire regimes in arid steppe systems. We analyzed how the number of fires since 1955 and the fire return interval and frequency between 1995 and 2015 responded to seeding treatments,...

Author(s): Chris Bowman-Prideaux, Beth A. Newingham, Eva K. Strand

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Type: Document

Book or Chapter or Journal Article

Missing climate feedbacks in fire models: limitations and uncertainties in fuel loadings and the role of decomposition in fine fuel succession

www.nrfirescience.org/resource/23650

In recent decades, climate change has lengthened wildfire seasons globally and doubled the annual area burned. Thus, capturing fire dynamics is critical for projecting Earth system processes in warmer, drier, more fire prone future. Recent advances in fire regime modeling have linked land surface and Earth system models with fire...

Author(s): Erin J. Hanan, Maureen C. Kennedy, Jianning Ren, Morris C. Johnson, Alistair M. S. Smith

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/22719

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

Author(s): Steven J. Brey, Elizabeth A. Barnes, Jeffrey R. Pierce, Abigail L. S. Swann, Emily V. Fischer

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Some challenges for forest fire risk predictions in the 21st century

www.nrfirescience.org/resource/23130

Global wildfire activity has experienced a dramatic surge since 2017. From Chile to Indonesia, unprecedented fire behavior has occurred in many areas worldwide including, but not limited to, Portugal, Siberia, Australia, the Amazon and Orinoco basins, and the Western US. This surge in global wildfire activity has led to a dramatic...

Author(s): Víctor Resco de Dios, Rachael H. Nolan

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Wildfires and global change

www.nrfirescience.org/resource/23605

No single factor produces wildfires; rather, they occur when fire thresholds (ignitions, fuels, and drought) are crossed. Anomalous weather events may lower these thresholds and thereby enhance the likelihood and spread of wildfires. Climate change increases the frequency with which some of these thresholds are crossed, extending...

Author(s): Juli G. Pausas, Jon E. Keeley

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Record-setting climate enabled the extraordinary 2020 fire season in the western United States

www.nrfirescience.org/resource/22631

The 2020 fire season in the western United States (the West) has been staggering: over 2.5 million ha have burned as of 30 September, including over 1.5 million ha in California (3.7% of the state), in part

from five of the six largest fires in state history; over 760,000 ha have burned in Oregon and Washington, most occurring...

Author(s): Philip E. Higuera, John T. Abatzoglou

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Summer air temperature for the Greater Yellowstone Ecoregion (770-2019 CE) over 1,250 years

www.nrfirescience.org/resource/23120

Projected warming of global surface air temperatures will further exacerbate droughts, wildfires, and other agents of ecosystem stress. We use latewood blue intensity from high-elevation *Picea engelmannii* to reconstruct late-summer maximum air temperature for the Greater Yellowstone Ecoregion (GYE) spanning 770-2019 CE. Using a...

Author(s): Karen J. Heeter, Maegen L. Rochner, Grant Harley

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Asthma exacerbation due to climate change-induced wildfire smoke in the Western US

www.nrfirescience.org/resource/24060

Climate change and human activities have drastically altered the natural wildfire balance in the Western US and increased population health risks due to exposure to pollutants from fire smoke. Using dynamically downscaled climate model projections, we estimated additional asthma emergency room visits and hospitalizations due to...

Author(s): Jennifer D. Stowell, Cheng-En Yang, Joshua S. Fu, Noah Scovronick, Matthew J. Strickland, Yang Liu

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Is whitebark pine less sensitive to climate warming when climate tolerances of juveniles are considered?

www.nrfirescience.org/resource/23483

Whitebark pine (*Pinus albicaulis*) (PIAL) is a proposed threatened species that plays a keystone ecological role in the Greater Yellowstone Ecosystem (GYE). Its population response to climate change is of high interest to managers because climate-induced declines may adversely affect critical ecosystem services that this species...

Author(s): Andrew J. Hansen, Alyson East, Robert E. Keane, Matt Lavin, Kristin Legg, Zachary A. Holden, Chris Toney, Franklin Alongi

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Towards resilient health systems for increasing climate extremes: insights from the 2019–20 Australian bushfire season

www.nrfirescience.org/resource/22604

The public health emergency associated with the 2019–20 bushfires in Australia was a wake-up call to increase the resilience of our health systems to respond to climate extremes. We must combine our understanding of predictions of extreme weather events with our knowledge on emergency preparedness and response to protect the...

Author(s): Aparna Lal, Mahomed Patel, Arnagretta Hunter, Christine Phillips

Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Climate-driven tree mortality and fuel aridity increase wildfire's potential heat flux

www.nrfirescience.org/resource/23985

Wildfire is capable of rapidly releasing the energy stored in forests, with the amount of water in live and dead biomass acting as a regulator on the amount and rate of energy release. Here we used temperature and fuel moisture data to examine climate-driven changes in fuel moisture content over the past three decades. We then...

Author(s): Marissa J. Goodwin, Harold S. Zald, Malcolm P. North, Matthew D. Hurteau

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Tree-planting: a double-edged sword to fight climate change in an era of megafires

www.nrfirescience.org/resource/23403

The world's forests are one of the largest carbon sinks, making a substantial contribution to counterbalance the increase in atmospheric carbon from anthropogenic sources (Bastin et al., 2019). For this reason, there is broad support to forest conservation and restoration as an effective way to fight climate change. The European...

Author(s): Virgilio Hermoso, Adrián Regos, Alejandra Morán-Ordoñez, Andrea Duane, Lluís Brotons

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Wildfire and spruce beetle outbreak have mixed effects on below-canopy temperatures in a Rocky Mountain subalpine forest

www.nrfirescience.org/resource/22575

Aim: Fine-scale topography and canopy cover can play an important role in mediating effects of regional-scale climate change on the below-canopy environment in mountain forests. The aim of this study was to determine how below-canopy temperatures in a high-elevation Rocky Mountain forest have been affected by canopy change...

Author(s): Amanda R. Carlson, Jason S. Sibold, Jose F. Negron

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Global wildfire plume-rise dataset and parameterizations for climate model applications

www.nrfirescience.org/resource/22919

The fire plume height (smoke injection height) is an important parameter for calculating the transport and lifetime of smoke particles, which can significantly affect regional and global air quality and atmospheric radiation budget. To develop an observation-based global fire plume-rise dataset, a modified one-dimensional...

Author(s): Ziming Ke, Yuhang Wang, Yufei Zou, Yongjia Song, Yongqiang Liu

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Evidence for widespread changes in the structure, composition, and fire regimes of western

North American forests

www.nrfirescience.org/resource/23948

Implementation of wildfire- and climate-adaptation strategies in seasonally dry forests of western North America is impeded by numerous constraints and uncertainties. After more than a century of resource and land use change, some question the need for proactive management, particularly given novel social, ecological, and climatic...

Author(s): R. Keala Hagmann, Paul F. Hessburg, Susan J. Prichard, Nicholas A. Povak, Peter M. Brown, Peter Z. Fule, Robert E. Keane, Eric E. Knapp, Jamie M. Lydersen, Kerry L. Metlen, Matthew J. Reilly, Andrew Sanchez Meador, Scott L. Stephens, Jens T. Stevens, Alan H. Taylor, Larissa L. Yocom, Michael A. Battaglia, Derek J. Churchill, Lori D. Daniels, Donald A. Falk, Paul Henson, James D. Johnston, Meg A. Krawchuk, Carrie R. Levine, Garrett W. Meigs, Andrew G. Merschel, Malcolm P. North, Hugh Safford, Thomas W. Swetnam, Amy E. M. Waltz

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Warming enabled upslope advance in western US forest fires

www.nrfirescience.org/resource/23378

Increases in burned area and large fire occurrence are widely documented over the western United States over the past half century. Here, we focus on the elevational distribution of forest fires in mountainous ecoregions of the western United States and show the largest increase rates in burned area above 2,500 m during 1984 to 2017...

Author(s): Mohammad Reza Alizadeha, John T. Abatzoglou, Charles H. Luce, Jan F. Adamowski, Arvin Farid, Mojtaba Sadegh

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Increasing synchronous fire danger in forests of the western United States

www.nrfirescience.org/resource/22566

Widespread fire activity taxes suppression resources and can compound wildfire hazards. We examine the geographic synchronicity of fire danger across western United States forests as a proxy for the strain on fire suppression resource availability. Interannual variability in the number of days with synchronous fire danger —...

Author(s): John T. Abatzoglou, Caroline S. Juang, A. Park Williams, Crystal A. Kolden, Anthony L. Westerling

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Wildfire and climate change adaptation of western North American forests: a case for intentional management

www.nrfirescience.org/resource/23945

Forest landscapes across western North America (wNA) have experienced extensive changes over the last two centuries, while climatic warming has become a global reality over the last 4 decades. Resulting interactions between historical increases in forested area and density and recent rapid warming, increasing insect mortality, and...

Author(s): Paul F. Hessburg, Susan J. Prichard, R. Keala Hagmann, Nicholas A. Povak, Frank K. Lake

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Effects of elevation and selective disturbance on soil climate and vegetation in big sagebrush communities

www.nrfirescience.org/resource/22873

Changing climatic conditions prompt concerns about vegetation response to disturbance under future compared to past conditions. In this long-term study, we examined soil climate and vegetation differences at lower, mid, and upper elevations in two separate locations in the Great Basin, USA. We hypothesized that soil climate and...

Author(s): Bruce A. Roundy, Jeanne C. Chambers

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Widespread regeneration failure in forests of Greater Yellowstone under scenarios of future climate and fire

www.nrfirescience.org/resource/23342

Changing climate and disturbance regimes are increasingly challenging the resilience of forest ecosystems around the globe. A powerful indicator for the loss of resilience is regeneration failure, that is, the inability of the prevailing tree species to regenerate after disturbance. Regeneration failure can result from the interplay...

Author(s): Werner Rammer, Kristin H. Braziunas, Winslow D. Hansen, Zakary Ratajczak, Anthony L. Westerling, Monica G. Turner, Rupert Seidl

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Fire Earth: Climate Change and Fire Suppression: Drivers of Fire Regimes at Actionable Scales

www.nrfirescience.org/resource/24294

The frequency of catastrophic wildfires is increasing around the globe. Our ability to mitigate the risks associated with these fires, and the toll they take on communities, life, and the environment, will depend in large part on understanding their driving causes. But there remains significant debate over how interacting factors...

Author(s): Alex W. Kirkpatrick

Year Published: 2021

Type: Document

Research Brief or Fact Sheet

High-severity wildfire potential – associating meteorology, climate, resource demand and wildfire activity with preparedness levels

www.nrfirescience.org/resource/22538

National and regional preparedness level (PL) designations support decisions about wildfire risk management. Such decisions occur across the fire season and influence pre-positioning of resources in areas of greatest fire potential, recall of personnel from off-duty status, requests for back-up resources from other areas, responses...

Author(s): Alison Cullen, Travis Axe, Harry Podschwit

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Wildfires: a conflagration of climate-related impacts to health and health systems. Recommendations from 4 continents on how to manage climate-related planetary disasters

www.nrfirescience.org/resource/23835

The globe is struggling with concurrent planetary health emergencies: COVID-19 and wildfires worsened by human activity. Unfortunately, a lack of awareness of climate change as a health issue, as well as of the interconnections between biodiversity loss, habitat change, inequality, and zoonotic infections risks having decision...

Author(s): Attila J. Hertelendy, Courtney Howard, Roberto de Almeida, Kate Charlesworth, Lwando Maki

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Early avian functional assemblages after fire, clearcutting, and post-fire salvage logging in North American forests

www.nrfirescience.org/resource/22865

Increased demand for timber, the reduction in the available timber resources, and more frequent and severe forest fires under a changing climate have increased the use of salvage logging in North American forests despite concerns regarding impacts on biodiversity and long-term forest productivity. We aimed to complement previous...

Author(s): Fidèle Bognounou, Lisa A. Venier, Steven L. Van Wilgenburg, Isabelle Aubin, Jean-Noel Candau, Andre Arsenault, Christian Hebert, Jacques Ibarzabal, Samantha J. Song, Louis De Grandpré

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Plant species richness at archaeological sites suggests ecological legacy of Indigenous subsistence on the Colorado Plateau

www.nrfirescience.org/resource/23279

Humans have both intentional and unintentional impacts on their environment, yet identifying the enduring ecological legacies of past small-scale societies remains difficult, and as such, evidence is sparse. The present study found evidence of an ecological legacy that persists today within an semiarid ecosystem of western North...

Author(s): Bruce M. Pavlik, Lisbeth A. Louderback, Kenneth B. Vernon, Peter M. Yaworsky, Cynthia Wilson, Arnold Clifford, Brian F. Coddling

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Fire Earth: Changes in the Climate-Fire Relationship: Patterns Locally and Around the Globe

www.nrfirescience.org/resource/24280

Wildfires are occurring more frequently and with greater severity domestically and around the globe. Across a series of studies, researchers at the University of Idaho set out to identify how and when climate variability affects wildfire frequency and behavior. They studied wildfire on scales ranging from local to ecoregional to...

Author(s): Alex W. Kirkpatrick

Year Published: 2021

Type: Document

Research Brief or Fact Sheet

Forest restoration and fuels reduction: Convergent or divergent?

www.nrfirescience.org/resource/23800

For over 20 years, forest fuel reduction has been the dominant management action in western US

forests. These same actions have also been associated with the restoration of highly altered frequent-fire forests. Perhaps the vital element in the compatibility of these treatments is that both need to incorporate the salient...

Author(s): Scott L. Stephens, Michael A. Battaglia, Derek J. Churchill, Brandon M. Collins, Michelle Coppoletta, Chad M. Hoffman, Jamie M. Lydersen, Malcolm P. North, Russell A. Parsons, Scott M. Ritter, Jens T. Stevens

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Short-term impacts of 2017 western North American wildfires on meteorology, the atmosphere's energy budget, and premature mortality

www.nrfirescience.org/resource/23207

Western North American fires have been increasing in magnitude and severity over the last few decades. The complex coupling of fires with the atmospheric energy budget and meteorology creates short-term feedbacks on regional weather altering the amount of pollution to which Americans are exposed. Using a combination of model...

Author(s): Diana N. Bernstein, Douglas S. Hamilton, Rosalie Krasnoff, Natalie M. Mahowald, David S. Connelly, Simone Tilmes, Peter G. M. Hess

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Biotic and anthropogenic forces rival climatic/abiotic factors in determining global plant population growth and fitness

www.nrfirescience.org/resource/20734

Multiple, simultaneous environmental changes, in climatic/abiotic factors, interacting species, and direct human influences, are impacting natural populations and thus biodiversity, ecosystem services, and evolutionary trajectories. Determining whether the magnitudes of the population impacts of abiotic, biotic, and anthropogenic...

Author(s): William F. Morris, Johan Ehrlén, Johan P. Dahlgren, Alexander K. Loomis, Allison M. Louthan

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

An added boost in pyrogenic carbon when wildfire burns forest with high pre-fire mortality

www.nrfirescience.org/resource/21933

Background: Wildfires produce pyrogenic carbon (PyC) through the incomplete combustion of organic matter, and its chemical characterization is critical to understanding carbon (C) budgets and ecosystem functions in forests. Across western North American forests, fires are burning through landscapes with substantial tree mortality...

Author(s): Anna C. Talucci, Lauren M. Matosziuk, Jeff A. Hatten, Meg A. Krawchuk

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

'Climate crisis' and 'bushfire disaster': Implications for tourism from the involvement of social media in the 2019-2020 Australian bushfires

www.nrfirescience.org/resource/21515

This research note seeks to draw attention to the potential impact of social media climate change

debates on the Australian tourism industry during and after the devastating 2019-2020 Australian bushfires. Whilst acknowledging the tremendous role of all media forms in the emergency management response, the present paper argues that...

Author(s): Stephen Schweinsberg, Simon Darcy, David Beirman

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Fire and biodiversity in the Anthropocene

www.nrfirescience.org/resource/22359

BACKGROUND: Fire has shaped the diversity of life on Earth for millions of years. Variation in fire regimes continues to be a source of biodiversity across the globe, and many plants, animals, and ecosystems depend on particular temporal and spatial patterns of fire. Although people have been using fire to modify environments for...

Author(s): Luke T. Kelly, Katherine M. Giljohann, Andrea Duane, Núria Aquilué

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Global fire season severity analysis and forecasting

www.nrfirescience.org/resource/20694

Fire activity has a huge impact on human lives. Different models have been proposed to predict fire activity, which can be classified into global and regional ones. Global fire models focus on longer timescale simulations and can be very complex. Regional fire models concentrate on seasonal forecasting but usually require inputs...

Author(s): Leonardo N. Ferreira, Didier A. Vega-Oliveros, Liang Zhao, Manoel F. Cardoso, Elbert E.N. Macau

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Summer PM2.5 pollution extremes caused by wildfires over the western United States during 2017-2018

www.nrfirescience.org/resource/21825

Using observations and model simulations (ESM 4.1) during 1988–2018, we show large year-to-year variability in western U.S. PM2.5 pollution caused by regional and distant fires. Widespread wildfires, combined with stagnation, caused summer PM2.5 pollution in 2017 and 2018 to exceed 2 standard deviations over long-term...

Author(s): Yuanyu Xie, Meiyun Lin, Larry W. Horowitz

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

How climate change might affect tree regeneration following fire at northern latitudes: a review

www.nrfirescience.org/resource/21471

Climate change is projected to increase fire severity and frequency in the boreal forest, but it could also directly affect post-fire recruitment processes by impacting seed production, germination, and seedling growth and survival. We reviewed current knowledge regarding the effects of high temperatures and water deficits on post-...

Author(s): Dominique Boucher, Sylvie Gauthier, Nelson Thiffault, William Marchand, Martin P. Girardin, Morgane Urli

Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Pleistocene to Pyrocene: fire replaces ice

www.nrfirescience.org/resource/22321

Fire offers a special perspective by which to understand the Earth being remade by humans. Fire is integrative, so intrinsically interdisciplinary. Fire use is unique to humans, so a tracer of humanity's ecological impacts. Anthropogenic fire history shows the long influence of humans on Earth and even climate; in particular, it...

Author(s): Stephen Pyne
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Climate?altered fire regimes may increase extirpation risk in an upper subalpine conifer species of management concern

www.nrfirescience.org/resource/21763

Climate change is transforming forest structure and function by altering the timing, frequency, intensity, and spatial extent of episodic disturbances. Wildland fire regimes in western U.S. coniferous forests are now characterized by longer fire seasons and greater frequency, with further changes expected.

Identifying the impacts of...

Author(s): Elizabeth R. Pansing, Diana F. Tomback, Michael B. Wunder
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA

www.nrfirescience.org/resource/20655

Background: Wildfires in the Pacific Northwest (Washington, Oregon, Idaho, and western Montana, USA) have been immense in recent years, capturing the attention of resource managers, fire scientists, and the general public. This paper synthesizes understanding of the potential effects of changing climate and fire regimes on Pacific...

Author(s): Jessica E. Halofsky, David L. Peterson, Brian J. Harvey
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Finding common ground: agreement on increasing wildfire risk crosses political lines

www.nrfirescience.org/resource/21438

Wildfire is a growing threat in the western US, driven by high fuel loads, a warming climate, and rising human activity in the wildland urban interface. Diverse stakeholders must collaborate to mitigate risk and adapt to changing conditions. Communication strategies in collaborative efforts may be most effective if they align with...

Author(s): Joel Hartter, Lawrence C. Hamilton, Mark J. Ducey, Angela Boag, Jonathan D. Salerno, Nils D. Christoffersen, Paul T. Oester, Michael W. Palace, Forrest R. Stevens
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Wildfire and the ecological niche: diminishing habitat suitability for an indicator species within semi-arid ecosystems

www.nrfirescience.org/resource/22315

Globally accelerating frequency and extent of wildfire threatens the persistence of specialist wildlife species through direct loss of habitat and indirect facilitation of exotic invasive species. Habitat specialists may be especially prone to rapidly changing environmental conditions because their ability to adapt lags behind the...

Author(s): Shawn T. O'Neil, Peter S. Coates, Brianne E. Brussee, Mark A. Ricca, Shawn Espinosa, Scott C. Gardner, David J. Delehanty

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Increased fire severity triggers positive feedbacks of greater vegetation flammability and favors plant community type conversions

www.nrfirescience.org/resource/21739

Questions: Increased wildfire activity is resulting in plant community type conversions worldwide. In some regions, fire-sensitive forests are being replaced by flammable fire-resilient communities, increasing the likelihood of reburning due to positive fire feedbacks. Here we evaluated whether fire severity affects postfire...

Author(s): Jennifer B. Landesmann, Florencia Tiribelli, Juan Paritsis, Thomas T. Veblen, Thomas Kitzberger

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Fire as a fundamental ecological process: Research advances and frontiers

www.nrfirescience.org/resource/21390

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Author(s): Kendra K. McLauchlan, Philip E. Higuera, Jessica R. Miesel, Brendan M. Rogers, Jennifer A. Schweitzer, Jacquelyn Kremper Shuman, Alan J. Tepley, J. Morgan Varner, Thomas T. Veblen, Solny A. Adalsteinsson, Jennifer Balch, Enric Batllori, Erica R. Bigio, Paulo M. Brando, Megan E. Cattau, Janice L. Coen, Raelene M. Crandall, Lori D. Daniels, Neal J. Enright, Wendy S. Gross, Brian J. Harvey, Jeff A. Hatten, Sharon M. Hermann, Rebecca E. Hewitt, Leda N. Kobziar, Jennifer B.

Landesmann, Michael M. Loranty, S. Yoshi Maezumi, Linda Mearns, Max A. Moritz, Jonathan A. Myers, Juli G. Pausas, Adam F. A. Pellegrini, William J. Platt, Jennifer Roozeboom, Hugh Safford, Fernanda Santos, Robert M. Scheller, Rosemary L. Sherriff, Kevin G. Smith, Melinda D. Smith, Adam C. Watts

Year Published: 2020

Type: Document

Synthesis

A climatic dipole drives short- and long-term patterns of postfire forest recovery in the western United States

www.nrfirescience.org/resource/22299

Researchers are increasingly examining patterns and drivers of postfire forest recovery amid growing concern that climate change and intensifying fires will trigger ecosystem transformations. Diminished seed availability and postfire drought have emerged as key constraints on conifer recruitment. However, the spatial and temporal...

Author(s): Caitlin E. Littlefield, Solomon Z. Dobrowski, John T. Abatzoglou, Sean A. Parks, Kimberley T. Davis

Year Published: 2020

Type: Document
Book or Chapter or Journal Article

Vegetation response to wildfire and climate forcing in a Rocky Mountain lodgepole pine forest over the past 2500 years

www.nrfirescience.org/resource/22282

Wildfire is a ubiquitous disturbance agent in subalpine forests in western North America. Lodgepole pine (*Pinus contorta* var. *latifolia*), a dominant tree species in these forests, is largely resilient to high-severity fires, but this resilience may be compromised under future scenarios of altered climate and fire activity. We...

Author(s): Barrie V. Chileen, Kendra K. McLauchlan, Philip E. Higuera, Meredith Parish, Bryan N. Shuman

Year Published: 2020

Type: Document
Book or Chapter or Journal Article

Seedlings? The unexpected elders of understory trees - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/22546

Over the past several decades, the impacts of climate change have threatened the health and functioning of forested ecosystems on a global scale. Warming and drying trends have altered disturbance regimes and have created significant uncertainty about tree regeneration and postdisturbance recovery in subalpine ecosystems. Aging...

Author(s): Zoe Schapira, Camille Stevens-Rumann

Year Published: 2020

Type: Document
Technical Report or White Paper

Millennial-scale climate and human drivers of environmental change and fire activity in a dry, mixed-conifer forest of northwestern Montana

www.nrfirescience.org/resource/21138

Warm summer temperatures and longer fire seasons are promoting larger, and in some cases, more fires that are severe in low- and mid-elevation, dry mixed-conifer forests of the Northern Rocky Mountains (NRM). Long-term historical fire conditions and human influence on past fire activity are not well understood for these...

Author(s): Dave McWethy, Mio Alt, Elena Argiriadis, Dario Battistel, Richard G. Everett, Gregory T. Pederson

Year Published: 2020

Type: Document
Book or Chapter or Journal Article

A changing climate is snuffing out post-fire recovery in montane forests

www.nrfirescience.org/resource/22110

Aim: Climate warming is increasing fire activity in many of Earth's forested ecosystems. Because fire is a catalyst for change, investigation of post-fire vegetation response is critical to understanding the potential for future conversions from forest to non-forest vegetation types. We characterized the influences of climate...

Author(s): Kyle Rodman, Thomas T. Veblen, Michael A. Battaglia, Marin Chambers, Paula J. Fornwalt, Zachary A. Holden, Thomas E. Kolb, Jessica R. Ouzts, Monica T. Rother

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

A broader perspective on the causes and consequences of eastern Australia's 2019–20 season of mega-fires: A response to Adams et al.

www.nrfirescience.org/resource/21708

This article is a Response to Adams et al. 26, 3756–3758. See also the Letter by Nolan et al. 26, 1039–1041. In a response to our Letter on the causes and consequences of the 2019–20 forest fires in eastern Australia (Nolan et al., 2020), Adams, Neumann, and Shadmanroodposhti (2020) argued that fuel loads were causal to the...

Author(s): Ross A. Bradstock, Rachael H. Nolan, Luke Collins, Víctor Resco de Dios, Hamish G. Clarke, Meaghan E. Jenkins, Belinda Kenny, Matthais M. Boer

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Warmer and drier fire seasons contribute to increases in area burned at high severity in western US forests from 1985 to 2017

www.nrfirescience.org/resource/22500

Increases in burned area across the western US since the mid-1980's have been widely documented and linked partially to climate factors, yet evaluations of trends in fire severity are lacking. Here, we evaluate fire severity trends and their interannual relationships to climate for western US forests from 1985–2017....

Author(s): Sean A. Parks, John T. Abatzoglou

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Climate change beliefs shape the interpretation of forest fire events

www.nrfirescience.org/resource/20957

Using a naturalistic quasi-experimental design and growth curve modeling techniques, a recently proposed climate change risk perception model was replicated and extended to investigate changes in climate change risk perception and climate policy support in relation to exposure to forest fires. At the start of the study, above-...

Author(s): Karine Lacroix, Robert Gifford, Jonathan Rush

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Topography and fire legacies drive variable post-fire juvenile conifer regeneration in eastern Oregon, USA

www.nrfirescience.org/resource/22099

Increasingly frequent large wildfires in the western US raise questions about the effects of climate and site-level factors on forest ecosystem resilience. This study presents findings from seedling and sapling surveys conducted across 179 sites 15–21 years post-fire in eastern Oregon's Blue Mountain ecoregion. We found wide...

Author(s): Angela Boag, Mark J. Ducey, Michael W. Palace, Joel Hartter

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Fuel treatment effectiveness in the context of landform, vegetation, and large, wind-driven wildfires

www.nrfirescience.org/resource/21599

Large wildfires (>50,000 ha) are becoming increasingly common in semi-arid landscapes of the western United States. Although fuel reduction treatments are used to mitigate potential wildfire effects, they can be overwhelmed in wind-driven wildfire events with extreme fire behavior. We evaluated drivers of fire severity and...

Author(s): Susan J. Prichard, Nicholas A. Povak, Maureen C. Kennedy, David W. Peterson

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Demographic trends in community functional tolerance reflect tree responses to climate and altered fire regimes

www.nrfirescience.org/resource/22453

Forests of the western U.S. are undergoing substantial stress from fire exclusion and increasing effects of climate change, altering ecosystem functions and processes. Changes in broad-scale drivers of forest community composition become apparent in their effect on survivorship and regeneration, driving demographic shifts. Here we...

Author(s): Laura A. Marshall, Donald A. Falk

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/20765

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

Author(s): Jessica M. Brewen

Year Published: 2020

Type: Document

Research Brief or Fact Sheet

Drought Increases Vulnerability of Pinus ponderosa Saplings to Fire-Induced Mortality

www.nrfirescience.org/resource/21946

The combination of drought and fire can cause drastic changes in forest composition and structure. Given the predictions of more frequent and severe droughts and forecasted increases in fire size and intensity in the western United States, we assessed the impact of drought and different fire intensities on Pinus ponderosa saplings....

Author(s): Raquel Partelli-Feltrin, Daniel M. Johnson, Aaron M. Sparks, Henry D. Adams, Crystal A. Kolden, Andrew S. Nelson, Alistair M. S. Smith

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Integrating functional connectivity and fire management for better conservation outcomes

www.nrfirescience.org/resource/21516

Globally, the mean abundance of terrestrial animals has fallen by 50% since 1970, and populations

face ongoing threats associated with habitat loss, fragmentation, climate change and disturbance. Climate change can influence the quality of remaining habitat directly, and indirectly by precipitating increases in the extent, frequency...

Author(s): Holly Sitters, Julian Di Stefano

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Forest management under megadrought: urgent needs at finer-scale and higher-intensity

www.nrfirescience.org/resource/22436

Drought and warming increasingly are causing widespread tree die-offs and extreme wildfires. Forest managers are struggling to improve anticipatory forest management practices given more frequent, extensive, and severe wildfire and tree die-off events triggered by “hotter drought”—drought under warmer than historical...

Author(s): Jason P. Field, David D. Breshears, John Bradford, Darin J. Law, Xiao Feng, Craig D. Allen

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Simulation modeling of complex climate, wildfire, and vegetation dynamics to address wicked problems in land management

www.nrfirescience.org/resource/21832

Complex, reciprocal interactions among climate, disturbance, and vegetation dramatically alter spatial landscape patterns and influence ecosystem dynamics. As climate and disturbance regimes shift, historical analogs and past empirical studies may not be entirely appropriate as templates for future management. The need for a better...

Author(s): Rachel A. Loehman, Robert E. Keane, Lisa M. Holsinger

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Disjunct and decoupled? The persistence of a fire-sensitive conifer species in a historically frequent-fire landscape

www.nrfirescience.org/resource/21483

Local and regional species extirpations may become more common as changing climate and disturbance regimes accelerate species' in situ range contractions. Identifying locations that function as both climate and disturbance refugia is critical for biodiversity conservation. Here, we investigate the persistence of a disjunct, fire-...

Author(s): William M. Downing, James D. Johnston, Meg A. Krawchuk, Andrew G. Merschel, Joseph H. Rausch

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Climatic influences on forest fire and mountain pine beetle outbreaks and resulting runoff effects in large watersheds in British Columbia, Canada

www.nrfirescience.org/resource/22331

Many studies have defined the interrelationships between climate, forest disturbance, and runoff at small scales (<100 km²), but few have translated these relationships to large watersheds (>500 km²). In this study, we explore the relationship between climate, extreme forest fire seasons, mountain pine beetle (MPB) outbreaks,...

Author(s): Margot E. Vore, Stephen J. Déry, Yiping Hou, Xiaohua Wei
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Earlier fall precipitation and low severity fire impacts on cheatgrass and sagebrush establishment

www.nrfirescience.org/resource/20672

In arid and semiarid ecosystems, invasion by exotic grasses may be driving state changes in vegetation defined by losses of native shrub communities. Changes in wildfire regimes and fall precipitation timing related to climate change may promote fluctuations in resource availability that reinforces invasion and state changes in...

Author(s): Tara B. B. Bishop, Baylie C. Nusink, Rebecca Lee Molinari, Justin B. Taylor, Samuel B. St. Clair
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

The role of fire in the coevolution of soils and temperate forests

www.nrfirescience.org/resource/21817

Climate drives the coevolution of vegetation and the soil that supports it. Wildfire dramatically affects many key eco?hydro?geomorphic processes but its potential role in coevolution of soil?forest systems has been largely overlooked. The steep landscapes of southeastern Australia provide an excellent natural laboratory to...

Author(s): Assaf Inbar, Petter Nyman, Patrick N. J. Lane, Gary J. Sheridan
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Compounded heat and fire risk for future U.S. populations

www.nrfirescience.org/resource/21442

Climate change is increasing the risk of extreme events, resulting in social and economic challenges. I examined recent past (1971–2000), current and near future (2010–2039), and future (2040–2069) fire and heat hazard combined with population growth by different regions and residential densities (i.e., exurban low and high...

Author(s): Brice B. Hanberry
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Warmer and drier fire seasons contribute to increases in area burned at high severity in western US forests from 1985-2017

www.nrfirescience.org/resource/22316

Increases in burned area across the western US since the mid?1980's have been widely documented and linked partially to climate factors, yet evaluations of trends in fire severity are lacking. Here, we evaluate fire severity trends and their interannual relationships to climate for western US forests from 1985?2017....

Author(s): Sean A. Parks, John T. Abatzoglou
Year Published: 2020
Type: Document
Book or Chapter or Journal Article

Fire and climate change: conserving seasonally dry forests is still possible

www.nrfirescience.org/resource/21761

The destructive wildfires that occurred recently in the western US starkly foreshadow the possible future of forest ecosystems and human communities in the region. With increases in the area burned by severe wildfire in seasonally dry forests expected to result from climate change, judicious, science-based fire and restoration...

Author(s): Scott L. Stephens, Anthony L. Westerling, Matthew D. Hurteau, M. Zachariah Peery, Courtney Schultz, Sally Thompson

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Fire and distance from unburned forest influence bird assemblages in Southern Andean Yungas of Northwest Argentina: a case study

www.nrfirescience.org/resource/21412

Background: Wildfires affect vegetation structure, functions, and other attributes of forest ecosystems. Among these attributes, bird assemblages may be influenced by the distance from undisturbed to fire-disturbed forests. Information about this influence is essential for designing management plans aimed at conserving birds'...

Author(s): Adriana Marisel Morales, Natalia Politi, Luis Osvaldo Rivera, Constanza Guadalupe Vivanco, Guillermo E. Defosse

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/22309

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

Author(s): Danielle Loiselle, Xinzhong Du, Daniel S. Alessi, Kevin D. Bladon, Monireh Faramarzi

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Wildfire Trends Across the Western US: Forest Fires Have Increased in Size, Severity, and Frequency Across Western Forests

www.nrfirescience.org/resource/21368

Wildfire is a natural disturbance and ecological process in forested ecosystems across the western United States. However, warmer temperatures, frequent droughts, and legacies of past land management are impacting western forests, leaving them at a higher risk for large, uncharacteristic wildfire that has dramatic impacts on...

Author(s): Tzeidle N. Wasserman

Year Published: 2020

Type: Document

Technical Report or White Paper

Downscaling fire weather extremes from historical and projected climate models

www.nrfirescience.org/resource/22297

An important aspect of predicting future wildland fire risk is estimating fire weather-weather conducive to the ignition and propagation of fire-under realistic climate change scenarios. Because the majority of area burned occurs on a few days of extreme fire weather, this task should be able to resolve fire weather extremes. In...

Author(s): Piyush Jain, Mari R. Tye, Debasish Paimazumder, Michael D. Flannigan

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Can wildland fire management alter 21st-century subalpine fire patterns and forests in Grand Teton National Park?

www.nrfirescience.org/resource/21728

In subalpine forests of the western United States that historically experienced infrequent, high-severity fire, whether fire management can shape 21st-century fire regimes and forest dynamics to meet natural resource objectives is not known. Managed wildfire use (i.e., allowing lightning-ignited fires to burn when risk is low...

Author(s): Winslow D. Hansen, Diane Abendroth, Werner Rammer, Rupert Seidl, Monica G. Turner

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Are plant community responses to wildfire contingent upon historical disturbance regimes?

www.nrfirescience.org/resource/22134

Background: Ecological disturbance is a major driver of ecosystem structure and evolutionary selection, and theory predicts that the frequency and/or intensity of disturbance should determine its effects on communities. However, adaptations of species pools to different historical disturbance regimes are rarely considered in the...

Author(s): Jesse E. D. Miller, Hugh Safford

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Robust ecological drought projections for drylands in the 21st century

www.nrfirescience.org/resource/21709

Dryland ecosystems may be especially vulnerable to expected 21st century increases in temperature and aridity because they are tightly controlled by moisture availability. However, climate impact assessments in drylands are difficult because ecological dynamics are dictated by drought conditions that are difficult to define and...

Author(s): John Bradford, Daniel Schlaepfer, William Lauenroth, Kyle Palmquist

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Exploring the impact of resident proximity to wildfires in the northern Rocky Mountains: perceptions of climate change risks, drought, and policy

www.nrfirescience.org/resource/21096

Wildfire disaster risks are being heightened globally due to climate change. Here, we present a United States-based wildfire case study of the northern Rocky Mountains to investigate links between wildfire experience, knowledge, and perceived risk due to climate change and potential policy support for two

internationally relevant...

Author(s): Christopher A. Craig, Myria W. Allen, Song Feng, Matthew L. Spialek

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Climatic Controls on Post-fire Ponderosa Pine and Douglas-fir Regeneration and Growth

www.nrfirescience.org/resource/22100

Climate change is causing increased wildfire activity across the western US and creating post-fire conditions that are warmer and drier than they were in the past. Scientists and managers are concerned with the potential for post-fire tree recruitment failures in dry mixed-conifer forests. Tree seedlings are more sensitive to...

Author(s): Kimberley T. Davis, Lacey Hankin

Year Published: 2020

Type: Document

Research Brief or Fact Sheet

Low-severity fire as a mechanism of organic matter protection in global peatlands: thermal alteration slows decomposition

www.nrfirescience.org/resource/21649

Worldwide, regularly recurring wildfires shape many peatland ecosystems to the extent that fire-adapted species often dominate plant communities, suggesting that wildfire is an integral part of peatland ecology rather than an anomaly. The most destructive blazes are smoldering fires that are usually initiated in periods of drought...

Author(s): Neal E. Flanagan, Hongjun Wang, Scott Winton, Curtis J. Richardson

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Sagebrush rangelands and greater sage-grouse in Northeastern California [Chapter 4.3]

www.nrfirescience.org/resource/22489

Sagebrush (*Artemisia* species) habitat, an intricate, species-rich mosaic of different sagebrush species and a remarkably diverse assemblage of grasses, forbs, and other shrubs, once covered about 170 million acres (69 million ha) across the Western United States (fig. 4.3.1). Noss et al. (1995) note that sagebrush habitat is an...

Author(s): R. Kasten Dumroese

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Wildland fire reburning trends across the US West suggest only short-term negative feedback and differing climatic effects

www.nrfirescience.org/resource/20940

Wildfires are a significant agent of disturbance in forests and highly sensitive to climate change. Short-interval fires and high severity (mortality-causing) fires in particular, may catalyze rapid and substantial ecosystem shifts by eliminating woody species and triggering conversions from forest to shrub or grassland ecosystems....

Author(s): Brian Buma, Shelby A. Weiss, Kathy Geier-Hayes, Melissa S. Lucash

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Variable thinning and prescribed fire influence tree mortality and growth during and after a severe drought

www.nrfirescience.org/resource/22011

California's high density, fire-excluded forests experienced an extreme drought accompanied by warmer than normal temperatures from 2012 to 2015, resulting in the deaths of millions of trees. We examined tree mortality and growth of mixed-conifer stands that had been experimentally treated between 2011 and 2013 with two different...

Author(s): Eric E. Knapp, Alexis Bernal, Jeffrey M. Kane, Christopher J. Fettig, Malcolm P. North

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Identifying and protecting wildfire refugia in a warmer, drier Pacific Northwest - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/22814

Wildfires are common across the Pacific Northwest, however climate change is projected to cause increases in wildfire activity and severity. Wildfires create a heterogeneous pattern across the landscape from severely burned areas to unburned patches. Unburned areas that are associated with critical habitat where biota can persist (e...

Author(s): Arjan J. H. Meddens, Andrew T. Hudak, Crystal A. Kolden

Year Published: 2020

Type: Document

Technical Report or White Paper

Wildfire-driven forest conversion in western North American landscapes

www.nrfirescience.org/resource/21525

Changing disturbance regimes and climate can overcome forest ecosystem resilience. Following high-severity fire, forest recovery may be compromised by lack of tree seed sources, warmer and drier postfire climate, or short-interval reburning. A potential outcome of the loss of resilience is the conversion of the prefire forest to a...

Author(s): Jonathan D. Coop, Sean A. Parks, Camille Stevens-Rumann, Shelley Crausbay, Philip E. Higuera, Matthew D. Hurteau, Alan J. Tepley, Ellen Whitman, Timothy J. Assal, Brandon M. Collins, Kimberley T. Davis, Solomon Z. Dobrowski, Donald A. Falk, Paula J. Fornwalt, Peter Z. Fule, Brian J. Harvey, Van R. Kane, Caitlin E. Littlefield, Ellis Q. Margolis, Malcolm P. North, Marc-Andre Parisien, Susan J. Prichard, Kyle Rodman

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Influence of drying and wildfire on longitudinal chemistry patterns and processes of intermittent streams

www.nrfirescience.org/resource/22451

Stream drying and wildfire are projected to increase with climate change in the western United States, and both are likely to impact stream chemistry patterns and processes. To investigate drying and wildfire effects on stream chemistry (carbon, nutrients, anions, cations, and isotopes), we examined seasonal drying in two...

Author(s): Ruth B. MacNeille, Kathleen A. Lohse, Sarah E. Godsey, Julia N. Perdrial, Colden V. Baxter

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Origins of abrupt change? Postfire subalpine conifer regeneration declines nonlinearly with warming and drying

www.nrfirescience.org/resource/19044

Robust tree regeneration following high-severity wildfire is key to the resilience of subalpine and boreal forests, and 21st century climate could initiate abrupt change in forests if postfire temperature and soil moisture become less suitable for tree seedling establishment. Using two widespread conifer species, lodgepole pine (...)

Author(s): Winslow D. Hansen, Monica G. Turner

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Wildfire and topography impacts on snow accumulation and retention in montane forests

www.nrfirescience.org/resource/19009

Wildfires are increasing in frequency, severity, and size in many parts of the world. Forest fires can fundamentally affect snowpack and watershed hydrology by restructuring forest composition and structure. Topography is an important factor in snowpack accumulation and ablation as it influences exposure to solar radiation and...

Author(s): Jordan D. Maxwell, Anson Call, Samuel B. St. Clair

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Climate will increasingly determine post-fire tree regeneration success in low-elevation forests, Northern Rockies, USA.

www.nrfirescience.org/resource/19947

Climate change is expected to cause widespread shifts in the distribution and abundance of plant species through direct impacts on mortality, regeneration, and survival. At landscape scales, climate impacts will be strongly mediated by disturbances, such as wildfire, which catalyze shifts in species distributions through widespread...

Author(s): Kerry Kemp, Philip E. Higuera, Penelope Morgan, John T. Abatzoglou

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Living on the edge: trailing edge forests at risk of fire-facilitated conversion to non-forest

www.nrfirescience.org/resource/19625

Forests are an incredibly important resource across the globe, yet they are threatened by climate change through stressors such as drought, insect outbreaks, and wildfire. Trailing edge forests—those areas expected to experience range contractions under a changing climate—are of particular concern because of the potential for...

Author(s): Sean A. Parks, Solomon Z. Dobrowski, John D. Shaw, Carol Miller

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Can wildland fire management alter 21st-century subalpine fire and forests in Grand Teton National Park, Wyoming, USA?

www.nrfirescience.org/resource/20515

In subalpine forests of the western United States that historically experienced infrequent, high-severity fire, whether fire management can shape 21st-century fire regimes and forest dynamics to meet natural resource objectives is not known. Managed wildfire use (i.e., allowing lightning-ignited fires to burn when risk is low...

Author(s): Winslow D. Hansen, Diane Abendroth, Werner Rammer, Rupert Seidl, Monica G. Turner

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Impacts of growing-season climate on tree growth and post-fire regeneration in ponderosa pine and Douglas-fir forests

www.nrfirescience.org/resource/23032

We studied the impacts of climate variability on low-elevation forests in the U.S. northern Rocky Mountains by quantifying how post-fire tree regeneration and radial growth varied with growing-season climate. We reconstructed post-fire regeneration and radial growth rates of *Pinus ponderosa* and *Pseudotsuga menziesii* at 33...

Author(s): Lacey Hankin

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Microclimatic buffering in forests of the future: the role of local water balance

www.nrfirescience.org/resource/19440

Forest canopies buffer climate extremes and promote microclimates that may function as refugia for understory species under changing climate. However, the biophysical conditions that promote and maintain microclimatic buffering and its stability through time are largely unresolved. We posited that forest microclimatic buffering is...

Author(s): Kimberley T. Davis, Solomon Z. Dobrowski, Zachary A. Holden, Philip E. Higuera, John T. Abatzoglou

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Short-interval fire erodes the resilience of subalpine lodgepole pine forests

www.nrfirescience.org/resource/21729

Subalpine forests in the northern Rocky Mountains have been resilient to stand-replacing fires that historically burned at 100- to 300-year intervals. Fire intervals are projected to decline drastically as climate warms, and forests that reburn before recovering from previous fire may lose their ability to rebound. We studied recent...

Author(s): Monica G. Turner, Kristin H. Braziunas, Winslow D. Hansen, Brian J. Harvey

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Spatiotemporal variability of human-fire interactions on the Navajo Nation

www.nrfirescience.org/resource/20437

Unraveling the effects of climate and land use on historical fire regimes provides important insights into broader human-fire-climate dynamics, which are necessary for ecologically based forest management. We developed a spatial human land-use model for Navajo Nation forests across which we sampled a network of tree-ring...

Author(s): Christopher H. Guiterman, Ellis Q. Margolis, Christopher H. Baisan, Donald A. Falk, Craig D.

Allen, Thomas W. Swetnam
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Examining post-fire vegetation recovery with Landsat time series analysis in three western North American forest types

www.nrfirescience.org/resource/19436

Background: Few studies have examined post-fire vegetation recovery in temperate forest ecosystems with Landsat time series analysis. We analyzed time series of Normalized Burn Ratio (NBR) derived from LandTrendr spectral-temporal segmentation fitting to examine post-fire NBR recovery for several wildfires that occurred in three...

Author(s): Benjamin C. Bright, Andrew T. Hudak, Robert E. Kennedy, Justin D. Braaten, Azad Henareh Khalyani

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Land-cover dependent relationships between fire and soil moisture

www.nrfirescience.org/resource/20414

For this study, we characterized the dependence of fire counts (FCs) on soil moisture (SM) at global and sub-global scales using 15 years of remote sensing data. We argue that this mathematical relationship serves as an effective way to predict fire because it is a proxy for the semi-quantitative fire-productivity relationship that...

Author(s): Alexander J. Schaefer, Brian I. Magi

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Climate will increasingly determine post-fire tree regeneration success in low-elevation forests, Northern Rockies, USA

www.nrfirescience.org/resource/18803

Climate change is expected to cause widespread shifts in the distribution and abundance of plant species through direct impacts on mortality, regeneration, and survival. At landscape scales, climate impacts will be strongly mediated by disturbances, such as wildfire, which catalyze shifts in species distributions through widespread...

Author(s): Kerry Kemp, Philip E. Higuera, Penelope Morgan, John T. Abatzoglou

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Climate seasonality as an essential predictor of global fire activity

www.nrfirescience.org/resource/19166

Aim: Fire is a globally important disturbance that affects nearly all vegetated biomes. Previous regional studies have suggested that the predictable seasonal pattern of a climatic time series, or seasonality, might aid in the prediction of average fire activity, but it is not known whether these findings are applicable globally....

Author(s): Michael V. Saha, Todd M. Scanlon, Paolo D'Odorico

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Modeling long-term effects of fuel treatments on fuel loads and fire regimes in the Great Basin - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/20381

The principal motivation for this study is that sagebrush-steppe ecosystems are undergoing significant state changes, and land managers are challenged with optimizing their resources for both short- and long-term use. Yet, limited knowledge is available regarding how the sagebrush-steppe will respond to environmental changes related...

Author(s): Nancy F. Glenn, Alejandro N. Flores, Douglas J. Shinneman, David S. Pilliod

Year Published: 2019

Type: Document

Technical Report or White Paper

Predicting increasing high severity area burned for three forested regions in the western United States using extreme value theory

www.nrfirescience.org/resource/18791

More than 70 years of fire suppression by federal land management agencies has interrupted fire regimes in much of the western United States. The result of missed fire cycles is a buildup of both surface and canopy fuels in many forest ecosystems, increasing the risk of severe fire. The frequency and size of fires has increased in...

Author(s): Alisa Keyser, Anthony L. Westerling

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Use of landscape simulation modeling to quantify resilience for ecological applications

www.nrfirescience.org/resource/20184

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

Author(s): Robert E. Keane, Rachel A. Loehman, Lisa M. Holsinger, Donald A. Falk, Philip E. Higuera, Sharon M. Hood, Paul F. Hessburg

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Will landscape fire increase in the future? A systems approach to climate, fire, fuel, and human drivers

www.nrfirescience.org/resource/19068

The extent of the Earth's surface burned annually by fires is affected by a number of drivers, including but not limited to climate. Other important drivers include the amount and type of vegetation (fuel) available and human impacts, including fire suppression, ignition, and conversion of burnable land to crops. Prior to the...

Author(s): Karen L. Riley, A. Park Williams, Shawn P. Urbanski, David E. Calkin, Karen C. Short, Christopher D. O'Connor

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Topography and post-fire climatic conditions shape spatio-temporal patterns of conifer establishment and growth

www.nrfirescience.org/resource/20108

Background: Concern is mounting that larger, stand-replacing forest fires may accelerate compositional shifts or conversions to non-forested states under a warming climate. Post-fire climatic conditions influence system trajectories by facilitating or hindering juvenile recruitment. But without an accurate, long-term understanding...

Author(s): Caitlin E. Littlefield

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Turning down the heat: vegetation feedbacks limit fire regime responses to global warming

www.nrfirescience.org/resource/20712

Climate change is projected to dramatically increase boreal wildfire activity, with broad ecological and socioeconomic consequences. As global temperatures rise, periods with elevated fire weather are expected to increase in frequency and duration, which would be expected to increase the number and size of fires. Statistical...

Author(s): Jean Marchal, Steve G. Cumming, Eliot J. B. McIntire

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Post-fire forest regeneration shows limited climate tracking and potential for drought-induced type conversion

www.nrfirescience.org/resource/19037

Disturbance such as wildfire may create opportunities for plant communities to reorganize in response to climate change. The interaction between climate change and disturbance may be particularly important in forests, where many of the foundational plant species (trees) are long-lived and where poor initial tree establishment can...

Author(s): Derek J. N. Young, Chhaya M. Werner, Kevin R. Welch, Truman P. Young, Hugh Safford, Andrew Latimer

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Tamm Review: Reforestation for resilience in dry western US forests

www.nrfirescience.org/resource/19956

The increasing frequency and severity of fire and drought events have negatively impacted the capacity and success of reforestation efforts in many dry, western U.S. forests. Challenges to reforestation include the cost and safety concerns of replanting large areas of standing dead trees, and high seedling and sapling mortality...

Author(s): Malcolm P. North, Jens T. Stevens, David F. Greene, Michelle Coppoletta, Eric E. Knapp, Andrew Latimer, Christina M. Restaino, Ryan Tompkins, Kevin R. Welch, Robert A. York, Derek J. N. Young, Jodi Axelson, Thomas N. Buckley, Becky L. Estes, Rachel N. Hager, Jonathan Long, Marc D. Meyer, Steven M. Ostojka, Hugh Safford, Kristen L. Shive, Carmen L. Tubbesing, Heather Vice, Dana Walsh, Chhaya M. Werner, Peter Wyrsh

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Wildfires and climate change push low-elevation forests across a critical climate threshold for tree regeneration

www.nrfirescience.org/resource/18982

Climate change is increasing fire activity in the western United States, which has the potential to accelerate climate-induced shifts in vegetation communities. Wildfire can catalyze vegetation change by killing adult trees that could otherwise persist in climate conditions no longer suitable for seedling establishment and survival...

Author(s): Kimberley T. Davis, Solomon Z. Dobrowski, Philip E. Higuera, Zachary A. Holden, Thomas T. Veblen, Monica T. Rother, Sean A. Parks, Anna Sala, Marco Maneta

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Impacts of growing-season climate on tree growth and post-fire regeneration in ponderosa pine and Douglas-fir forests

www.nrfirescience.org/resource/19945

We studied the impacts of climate variability on low-elevation forests in the U.S. northern Rocky Mountains by quantifying how post-fire tree regeneration and radial growth varied with growing-season climate. We reconstructed post-fire regeneration and radial growth rates of *Pinus ponderosa* and *Pseudotsuga menziesii* at 33...

Author(s): Lacey Hankin, Philip E. Higuera, Kimberley T. Davis, Solomon Z. Dobrowski

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Climate, environment, and disturbance history govern resilience of western North American forests

www.nrfirescience.org/resource/20622

Before the advent of intensive forest management and fire suppression, western North American forests exhibited a naturally occurring resistance and resilience to wildfires and other disturbances. Resilience, which encompasses resistance, reflects the amount of disruption an ecosystem can withstand before its structure or...

Author(s): Paul F. Hessburg, Carol Miller, Sean A. Parks, Nicholas A. Povak, Alan H. Taylor, Philip E. Higuera, Susan J. Prichard, Malcolm P. North, Brandon M. Collins, Matthew D. Hurteau, Andrew J. Larson, Craig D. Allen, Scott L. Stephens, Hiram Rivera-Huerta, Camille Stevens-Rumann, Lori D. Daniels, Ze'ev Gedalof, Robert W. Gray, Van R. Kane, Derek J. Churchill, R. Keala Hagmann, Thomas A. Spies, C. Alina Cansler, R. Travis Belote, Thomas T. Veblen, Michael A. Battaglia, Chad M. Hoffman, Carl N. Skinner, Hugh Safford, R. Brion Salter

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Consequences of climatic thresholds for projecting fire activity and ecological change

www.nrfirescience.org/resource/23035

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

Author(s): Adam M. Young, Philip E. Higuera, John T. Abatzoglou, Paul A. Duffy, Feng Sheng Hu

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Climate change likely to reshape vegetation in North America's largest protected areas

www.nrfirescience.org/resource/19611

Climate change poses a serious threat to biodiversity and unprecedented challenges to the preservation and protection of natural landscapes. We evaluated how climate change might affect vegetation in 22 of the largest and most iconic protected area (PA) complexes across North America. We use a climate analog model to estimate how...

Author(s): Lisa M. Holsinger, Sean A. Parks, Marc-Andre Parisien, Carol Miller, Enric Batllori, Max A. Moritz

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

A Double Whammy: Climate Change and Stand-Replacing Wildfires

www.nrfirescience.org/resource/20493

In the Intermountain region of the Western United States, most forested landscapes are fire prone and adapted to a semiarid climate. With the severity of wildfires increasing as a result of excessive fuels, land managers are concerned about forest converting to non-forest types such as shrubland or grassland. "And then when you...

Author(s): Rocky Mountain Research Station

Year Published: 2019

Type: Document

Research Brief or Fact Sheet

Wildfire refugia in forests: severe fire weather and drought mute the influence of topography and fuel age

www.nrfirescience.org/resource/20433

Wildfire refugia (unburnt patches within large wildfires) are important for the persistence of fire-sensitive species across forested landscapes globally. A key challenge is to identify the factors that determine the distribution of fire refugia across space and time. In particular, determining the relative influence of climatic...

Author(s): Luke Collins, Andrew F. Bennett, Steven W.J. Leonard, Trent D. Penman

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Wildfire detection and communication-aerospace applications-trade study

www.nrfirescience.org/resource/19177

Wildfires have increased in frequency, duration, and intensity worldwide. Climate change, drought, and other factors have not only increased susceptibility to wildfires, but have also increased the duration of the season. There are a number of factors affecting wildfires: detection, speed of communication/response time, resources/...

Author(s): Setrigo W. Crawford, Kamran Eftekhari Shahroudi

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Widespread severe wildfires under climate change lead to increased forest homogeneity in dry mixed-conifer forests

www.nrfirescience.org/resource/20407

Climate warming in the western United States is causing changes to the wildfire regime in mixed-conifer forests. Rising temperatures, longer fire seasons, increased drought, as well as fire suppression and changes in land use, have led to greater and more severe wildfire activity, all contributing to altered forest composition...

Author(s): Brooke A. Cassell, Robert M. Scheller, Melissa S. Lucash, Matthew D. Hurteau, E. Louise Loudermilk

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Aboveground forest carbon shows different responses to fire frequency in harvested and unharvested forests

www.nrfirescience.org/resource/18801

Sequestration of carbon in forest ecosystems has been identified as an effective strategy to help mitigate the effects of global climate change. Prescribed burning and timber harvesting are two common, co-occurring, forest management practices that may alter forest carbon pools. Prescribed burning for forest management, such as...

Author(s): Luke Collins, Ross A. Bradstock, Fabiano de Aquino Ximenes, Bronwyn Horsey, Robert Sawyer, Trent D. Penman

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Living on the edge: trailing edge forests at risk of fire-facilitated conversion to non-forest

www.nrfirescience.org/resource/19138

Forests are an incredibly important resource across the globe, yet they are threatened by climate change through stressors such as drought, insect outbreaks, and wildfire. Trailing edge forests-those areas expected to experience range contractions under a changing climate-are of particular concern because of the potential for abrupt...

Author(s): Sean A. Parks, Solomon Z. Dobrowski, John D. Shaw, Carol Miller

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Wildfires misunderstood

www.nrfirescience.org/resource/20250

Rain is a natural process that provides a range of services to humans but certainly not all rainfall events (eg those generating floods) are beneficial to human societies. Biodiversity can also deliver a variety of services, even though there are species capable of harming humans. Likewise, the vast majority of life depends (...)

Author(s): Juli G. Pausas, Jon E. Keeley

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Biophysical feedback of global forest fires on surface temperature

www.nrfirescience.org/resource/19109

...

Author(s): Zhihua Liu, Ashley Ballantyne, L. Annie Cooper

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

From Farms to Forests: Landscape Carbon Balance after 50 Years of Afforestation, Harvesting, and Prescribed Fire

www.nrfirescience.org/resource/20152

Establishing reliable carbon baselines for landowners desiring to sustain carbon sequestration and identify opportunities to mitigate land management impacts on carbon balance is important; however, national and regional assessments are not designed to support individual landowners. Such baselines become increasingly valuable when...

Author(s): Doug P. Aubrey, John I. Blake, Stanley J. Zarnoch

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Biological and geophysical feedbacks with fire in the Earth system

www.nrfirescience.org/resource/17407

Roughly 3% of the Earth's land surface burns annually, representing a critical exchange of energy and matter between the land and atmosphere via combustion. Fires range from slow smouldering peat fires, to low-intensity surface fires, to intense crown fires, depending on vegetation structure, fuel moisture, prevailing climate, and...

Author(s): Sally Archibald, Caroline E. R. Lehmann, Claire M. Belcher, William J. Bond, Ross A.

Bradstock, Anne Laure Daniau, K. G. Dexter, Elisabeth J. Forrestel, M. Greve, Tianhua He, Steven I.

Higgins, William A. Hoffmann, Byron B. Lamont, D. J. McGlenn, G. R. Moncrieff, Colin P. Osborne, Juli

G. Pausas, Owen F. Price, Brad S. Ripley, Brendan M. Rogers, Dylan W. Schwilk, M. F. Simon, Merritt

R. Turetsky, Guido R. Van der Werf, Amy E. Zanne

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Large-scale restoration increases carbon stability under projected climate and wildfire regimes

www.nrfirescience.org/resource/17573

Changing climate and increasing area burned pose a challenge to forest carbon (C) storage, which is compounded by an elevated risk of high-severity wildfire due to long-term fire suppression in the western US. Restoration treatments that reduce tree density and reintroduce surface fire are effective at moderating fire effects...

Author(s): Shuang Liang, Matthew D. Hurteau, Anthony L. Westerling

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Evidence for declining forest resilience to wildfires under climate change

www.nrfirescience.org/resource/16189

Forest resilience to climate change is a global concern given the potential effects of increased disturbance activity, warming temperatures and increased moisture stress on plants. We used a multi-regional dataset of 1485 sites across 52 wildfires from the US Rocky Mountains to ask if and how changing climate over the last several...

Author(s): Camille Stevens-Rumann, Kerry Kemp, Philip E. Higuera, Brian J. Harvey, Monica T. Rother,

Daniel C. Donato, Penelope Morgan, Thomas T. Veblen

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Wildfire-vegetation dynamics affect predictions of climate change impact on bird communities

www.nrfirescience.org/resource/17360

Community-level climate change indicators have been proposed to appraise the impact of global warming on community composition. However, non-climate factors may also critically influence species distribution and biological community assembly. The aim of this paper was to study how fire-vegetation dynamics can modify our ability to...

Author(s): Adrián Regos, Miguel Clavero, Manuela D'Amen, Antoine Guisan, Lluís Brotons

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Climate change vulnerability and adaptation in the Northern Rocky Mountains - Part 2

www.nrfirescience.org/resource/17540

The Northern Rockies Adaptation Partnership (NRAP) identified climate change issues relevant to resource management in the Northern Rockies (USA) region, and developed solutions intended to minimize negative effects of climate change and facilitate transition of diverse ecosystems to a warmer climate. The NRAP region covers 183...

Author(s): Jessica E. Halofsky, David L. Peterson, S. Karen Dante-Wood, Linh Hoang, Joanne J. Ho, Linda A. Joyce

Year Published: 2018

Type: Document

Technical Report or White Paper

Effects of climate change on ecological disturbance in the Northern Rockies (Chapter 7)

www.nrfirescience.org/resource/17279

Disturbances alter ecosystem, community, or population structures and change elements of the biological and/or physical environment. Climate changes can alter the timing, magnitude, frequency, and duration of disturbance events, as well as the interactions of disturbances on a landscape, and climate change may already be affecting...

Author(s): Rachel A. Loehman, Barbara J. Bentz, Gregg DeNitto, Robert E. Keane, Mary Manning, Jacob P. Duncan, Joel M. Egan, Marcus B. Jackson, Sandra Kegley, I. Blakley Lockman, Dean E. Pearson, James A. Powell, Steve Shelly, Brytten E. Steed, Paul J. Zambino

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Effects of climate change on ecosystem services in the Northern Rockies Region [Chapter 11]

www.nrfirescience.org/resource/17534

In this chapter, we focus on the ecosystem services provided to people who visit, live adjacent to, or otherwise benefit from natural resources on public lands. Communities in the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and the Greater Yellowstone Area (GYA), hereafter called the Northern Rockies region...

Author(s): Travis Warziniack, Megan Lawson, S. Karen Dante-Wood

Year Published: 2018

Type: Document

Technical Report or White Paper

Thinning combined with biomass energy production impacts fire-adapted forests in western United States and may increase greenhouse gas emissions

www.nrfirescience.org/resource/17270

Biomass energy produced as a byproduct of forest clearing is increasingly being advocated in the western United States as a “win-win” for reducing fire risks and replacing fossil fuels. Many assumptions that justify thinning and biomass approaches, however, need to be substantiated to determine whether they are in fact...

Author(s): Dominick A. DellaSala, M. Koopman

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

It takes a few to tango: changing climate and fire regimes can cause regeneration failure of two subalpine conifers

www.nrfirescience.org/resource/18334

Environmental change is accelerating in the 21st century, but how multiple drivers may interact to alter forest resilience remains uncertain. In forests affected by large high-severity disturbances, tree regeneration is a resilience linchpin that shapes successional trajectories for decades. We modeled stands of two widespread...

Author(s): Winslow D. Hansen, Kristin H. Braziunas, Werner Rammer, Rupert Seidl, Monica G. Turner

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Climate Change and Wildlife in the Northern Rockies Region [Chapter 9]

www.nrfirescience.org/resource/17532

Temperature and moisture affect organisms through their operational environment and the thin boundary layer immediately above their tissues, and these effects are measured at short time scales. When a human (a mammal) wearing a dark insulative layer walks outdoors on a cold but sunny day, he or she feels warm because energy from the...

Author(s): Kevin S. McKelvey, Polly C. Buotte

Year Published: 2018

Type: Document

Technical Report or White Paper

Tree water balance drives temperate forest responses to drought

www.nrfirescience.org/resource/18273

Intensifying drought is increasingly linked to global forest diebacks. Improved understanding of drought impacts on individual trees has provided limited insight into drought vulnerability in part because tree moisture access and depletion is difficult to quantify. In forests, moisture reservoir depletion occurs through water use by...

Author(s): A. B. Berdanier, J. S. Clark

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Climate change and future wildfire in the western USA: An ecological approach to nonstationarity

www.nrfirescience.org/resource/21259

We developed ecologically based climate-fire projections for the western United States. Using a finer ecological classification and fire-relevant climate predictors, we created statistical models linking climate and wildfire area burned for ecosections, which are geographic delineations based on biophysical variables. The...

Author(s): Jeremy S. Littell, Donald McKenzie, Ho Yi Wan, Samuel A. Cushman
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Effects of climate change on wildlife in the Northern Rockies [Chapter 8]

www.nrfirescience.org/resource/17530

Few data exist on the direct effects of climatic variability and change on animal species. Therefore, projected climate change effects must be inferred from what is known about habitat characteristics and the autecology of each species. Habitat for mammals, including predators (Canada lynx, fisher, wolverine) and prey (snowshoe hare...

Author(s): Kevin S. McKelvey, Polly C. Buotte
Year Published: 2018
Type: Document
Technical Report or White Paper

Assessing the effects of fire disturbance and timber management on carbon storage in the Greater Yellowstone Ecosystem

www.nrfirescience.org/resource/18043

Accurate characterization of Carbon (C) consequences of forest disturbances and management is critical for informed climate mitigation and adaptation strategies. While research into generalized properties of the forest C cycle informs policy and provides abstract guidance to managers, most management occurs at local scales and...

Author(s): Feng A. Zhao, Sean P. Healey, Chengquan Huang, James P. McCarter, Chris Garrard, Sara A. Goeking, Zhiliang Zhu
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Effects of climate change on forest vegetation in the Northern Rockies Region [Chapter 6]

www.nrfirescience.org/resource/17528

The projected rapid changes in climate will affect the unique vegetation assemblages of the Northern Rockies region in myriad ways, both directly through shifts in vegetation growth, mortality, and regeneration, and indirectly through changes in disturbance regimes and interactions with changes in other ecosystem processes, such as...

Author(s): Robert E. Keane, M. F. Mahalovich, Barry Bollenbacher, Mary Manning, Rachel A. Loehman, Theresa B. Jain, Lisa M. Holsinger, Andrew J. Larson, Andrew J. Webster
Year Published: 2018
Type: Document
Technical Report or White Paper

The nature of the beast: examining climate adaptation options in forests with stand-replacing fire regimes

www.nrfirescience.org/resource/17869

Building resilience to natural disturbances is a key to managing forests for adaptation to climate change. To date, most climate adaptation guidance has focused on recommendations for frequent fire forests, leaving few published guidelines for forests that naturally experience infrequent, stand-replacing wildfires. Because most...

Author(s): Joshua S. Halofsky, Daniel C. Donato, Jerry F. Franklin, Jessica E. Halofsky, David L. Peterson, Brian J. Harvey
Year Published: 2018

Type: Document
Book or Chapter or Journal Article

Effects of climate change on snowpack, glaciers, and water resources in the Northern Rockies Region [Chapter 4]

www.nrfirescience.org/resource/17521

Water is critical to life, and the effects of climate change on ecosystems are mediated through changes in hydrology. Changes in how snow accumulates and melts are one of the more consistently noted climate-induced changes to water in the western United States (Barnett et al. 2005; Service 2004), and these changes affect when water...

Author(s): Charles H. Luce

Year Published: 2018

Type: Document

Technical Report or White Paper

Climate change vulnerability and adaptation in the Northern Rocky Mountains - Part 1

www.nrfirescience.org/resource/17514

The Northern Rockies Adaptation Partnership (NRAP) identified climate change issues relevant to resource management in the Northern Rockies (USA) region, and developed solutions intended to minimize negative effects of climate change and facilitate transition of diverse ecosystems to a warmer climate. The NRAP region covers 183...

Year Published: 2018

Type: Document

Technical Report or White Paper

Piecing together the fragments: elucidating edge effects on forest carbon dynamics

www.nrfirescience.org/resource/17579

Forest fragmentation is pervasive throughout the world's forests, impacting growing conditions and carbon (C) dynamics through edge effects that produce gradients in microclimate, biogeochemistry, and stand structure. Despite the majority of global forests being <1 km from an edge, our understanding of forest C dynamics is...

Author(s): Ian A. Smith, Lucy R. Huttyra, Andrew B. Reinmann, Julia K. Marrs, Jonathan Thompson

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Fire intensity impacts on post-fire temperate coniferous forest net primary productivity

www.nrfirescience.org/resource/17364

Fire is a dynamic ecological process in forests and impacts the carbon (C) cycle through direct combustion emissions, tree mortality, and by impairing the ability of surviving trees to sequester carbon. While studies on young trees have demonstrated that fire intensity is a determinant of post-fire net primary productivity, wildland...

Author(s): Aaron M. Sparks, Crystal A. Kolden, Alistair M. S. Smith, Luigi Boschetti, Daniel M. Johnson, Mark A. Cochrane

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Effects of climate change and climate-altered fire regimes on whitebark pine populations - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/17562

As climate change alters global fire regimes, fire and forest managers must prioritize management actions that simultaneously protect sensitive resources and allow fire to maintain its ecological role. Over the last twenty years, this task has become more difficult, as increased fire severity and season length have caused...

Author(s): Diana F. Tomback, Elizabeth R. Pansing

Year Published: 2018

Type: Document

Technical Report or White Paper

Human impacts on 20th century fire dynamics and implications for global carbon and water trajectories

www.nrfirescience.org/resource/17317

Fire is a fundamental Earth system process and the primary ecosystem disturbance on the global scale. It affects carbon and water cycles through changing terrestrial ecosystems, and at the same time, is regulated by weather and climate, vegetation characteristics, and, importantly, human ignitions and suppression (i.e., the direct...

Author(s): Fang Li, David M. Lawrence, Ben Bond-Lamberty

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Fine-scale spatial climate variation and drought mediate the likelihood of reburning

www.nrfirescience.org/resource/16808

In many forested ecosystems, it is increasingly recognized that the probability of burning is substantially reduced within the footprint of previously burned areas. This self-limiting effect of wildland fire is considered a fundamental emergent property of ecosystems and is partly responsible for structuring landscape heterogeneity...

Author(s): Sean A. Parks, Marc-Andre Parisien, Carol Miller, Lisa M. Holsinger, Scott L. Baggett

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Effects of Climate Change on Cultural Resources in the Northern Rockies Region [Chapter 12]

www.nrfirescience.org/resource/17536

People have inhabited the Northern Rocky Mountains of the United States since the close of the last Pleistocene glacial period, some 14,000 years B.P. (Fagan 1990; Meltzer 2009). Evidence of this ancient and more recent human occupation is found throughout the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and...

Author(s): Carl M. Davis

Year Published: 2018

Type: Document

Technical Report or White Paper

Climate Change and Rocky Mountain Ecosystems

www.nrfirescience.org/resource/17274

Climate Change and Rocky Mountain Ecosystems describes the results of a cutting-edge effort to assess climate change vulnerabilities and develop adaptation options for ecosystems in the Northern Rocky Mountains region of the United States, focusing on national forests, grasslands, and parks in Northern Idaho, Montana, North Dakota,...

Year Published: 2018

Type: Document
Book or Chapter or Journal Article

New development and application needs for Earth system modeling of fire–climate–ecosystem interactions

www.nrfirescience.org/resource/18339

Wildfire, climate and ecosystem are interactive components of the Earth system (Bowman et al 2009, Andela et al 2017). Climate and fuel moisture, which is heavily impacted by atmospheric conditions, are primary drivers for fire occurrence and behavior, while vegetation provides necessary fuels for combustion (Pyne et al 1996). On...

Author(s): Yongqiang Liu
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Effects of climate change on recreation in the Northern Rockies Region [Chapter 10]

www.nrfirescience.org/resource/17533

Outdoor recreation is an important benefit provided by Federally managed and other public lands throughout the Rocky Mountains. National forests in the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and Greater Yellowstone Area (a region hereafter called the Northern Rockies region) have an estimated 13.3...

Author(s): Michael S. Hand, Megan Lawson
Year Published: 2018
Type: Document
Technical Report or White Paper

Fine-scale spatial climate variation and drought mediate the likelihood of reburning

www.nrfirescience.org/resource/21736

In many forested ecosystems, it is increasingly recognized that the probability of burning is substantially reduced within the footprint of previously burned areas. This self-limiting effect of wildland fire is considered a fundamental emergent property of ecosystems and is partly responsible for structuring landscape heterogeneity...

Author(s): Sean A. Parks, Marc-Andre Parisien, Lisa M. Holsinger, L. Scott Baggett, Carol Miller
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

The nature of the beast: examining climate adaptation options in forests with stand-replacing fire regimes

www.nrfirescience.org/resource/17221

Building resilience to natural disturbances is a key to managing forests for adaptation to climate change. To date, most climate adaptation guidance has focused on recommendations for frequent-fire forests, leaving few published guidelines for forests that naturally experience infrequent, stand-replacing wildfires. Because most...

Author(s): Joshua S. Halofsky, Daniel C. Donato, Jerry F. Franklin, Jessica E. Halofsky, David L. Peterson, Brian J. Harvey
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Fire refugia: What are they, and why do they matter for global change?

www.nrfirescience.org/resource/18303

Fire refugia are landscape elements that remain unburned or minimally affected by fire, thereby supporting postfire ecosystem function, biodiversity, and resilience to disturbances. Although fire refugia have been studied across continents, scales, and affected taxa, they have not been characterized systematically over space and...

Author(s): Arjan J. H. Meddens, Crystal A. Kolden, James A. Lutz, Alistair M. S. Smith, C. Alina Cansler, John T. Abatzoglou, Garrett W. Meigs, William M. Downing, Meg A. Krawchuk

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Effects of climate change on ecological disturbance in the Northern Rockies Region [Chapter 8]

www.nrfirescience.org/resource/17531

This chapter describes the ecology of important disturbance regimes in the Forest Service, U.S. Department of Agriculture (USFS) Northern Region and the Greater Yellowstone Area, hereafter called the Northern Rockies region, and potential shifts in these regimes as a consequence of observed and projected climate change. The term...

Author(s): Rachel A. Loehman, Barbara J. Bentz, Gregg DeNitto, Robert E. Keane, Mary Manning, Jacob P. Duncan, Joel M. Egan, Marcus B. Jackson, Sandra Kegley, I. Blakley Lockman, Dean E. Pearson, James A. Powell, Steve Shelly, Brytten E. Steed, Paul J. Zambino

Year Published: 2018

Type: Document

Technical Report or White Paper

A Statement of Common Ground Regarding the Role of Wildfire in Forested Landscapes of the Western United States

www.nrfirescience.org/resource/18177

For millennia, wildfires have markedly influenced forests and non-forested landscapes of the western United States (US), and they are increasingly seen as having substantial impacts on society and nature. There is growing concern over what kinds and amounts of fire will achieve desirable outcomes and limit harmful effects on people...

Author(s): Max A. Moritz, Christopher Topik, Craig D. Allen, Paul F. Hessburg, Penelope Morgan, Dennis C. Odion, Thomas T. Veblen, Ian M. McCullough

Year Published: 2018

Type: Document

Technical Report or White Paper

Putting climate adaptation on the map: Developing spatial management strategies for whitebark pine in the Greater Yellowstone Ecosystem

www.nrfirescience.org/resource/18842

Natural resource managers face the need to develop strategies to adapt to projected future climates. Few existing climate adaptation frameworks prescribe where to place management actions to be most effective under anticipated future climate conditions. We developed an approach to spatially allocate climate adaptation actions and...

Author(s): Kathryn Ireland, Andrew J. Hansen, Robert E. Keane, Kristin Legg, Rob Gump

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Drought and fire in the western USA: Is climate attribution enough?

www.nrfirescience.org/resource/21257

Purpose of Review: I sought to review the contributions of recent literature and prior foundational papers to our understanding of drought and fire. In this review, I summarize recent literature on drought and fire in the western USA and discuss research directions that may increase the utility of that body of work for twenty-first...

Author(s): Jeremy S. Littell

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Effects of climate change on rangeland vegetation in the Northern Rockies Region [Chapter 7]

www.nrfirescience.org/resource/17529

Rangelands are dominated by grass, forb, or shrub species, but are usually not modified by using agronomic improvements such as fertilization or irrigation (Lund 2007; Reeves and Mitchell 2011) as these lands would normally be considered pastures. Rangeland includes grassland, shrubland, and desert ecosystems, alpine areas, and some...

Author(s): Matthew C. Reeves, Mary Manning, Jeff P. DiBenedetto, Kyle Palmquist, William Lauenroth, John Bradford, Daniel Schlaepfer

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

Effects of climate change on forest vegetation in the northern Rockies (Chapter 5)

www.nrfirescience.org/resource/16482

Increasing air temperature, through its influence on soil moisture, is expected to cause gradual changes in the abundance and distribution of tree, shrub, and grass species throughout the Northern Rockies, with drought tolerant species becoming more competitive. The earliest changes will be at ecotones between lifeforms (e.g., upper...

Author(s): Robert E. Keane, M. F. Mahalovich, Barry Bollenbacher, Mary Manning, Rachel A. Loehman, Theresa B. Jain, Lisa M. Holsinger, Andrew J. Larson

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Climate vulnerability of native cold-water salmonids in the Northern Rockies Region [Chapter 5]

www.nrfirescience.org/resource/17526

During the 21st century, climate change is expected to alter aquatic habitats throughout the Northern Rocky Mountains, intermountain basins, and western Great Plains. Particularly in montane watersheds,

direct changes are likely to include warmer water temperatures, earlier snowmelt-driven runoff, earlier declines to summer baseflow...

Author(s): Michael K. Young, Daniel J. Isaak, Scott Spaulding, Cameron A. Thomas, Scott A. Barndt, Matthew C. Groce, Dona L. Horan, David E. Nagel

Year Published: 2018

Type: Document

Technical Report or White Paper

New development and application needs for Earth system modeling of fire-climate-ecosystem interactions

www.nrfirescience.org/resource/17867

Research has traditionally focused on the wildfire impacts of climate and vegetation, using the approaches developed mainly based on empirical and statistical weather–fire behavior relationships as well as empirical and process-based vegetation–fire relationships. Recent studies have turned more attention to the feedbacks of...

Author(s): Yongqiang Liu

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Woody material structural degradation through decomposition

www.nrfirescience.org/resource/16439

Dead woody material (DWM) plays numerous important roles in forest ecosystems; however, through the process of decomposition, it undergoes structural and chemical changes that progressively alter its function in these roles. Much remains unknown about how DWM mechanical strength and structural integrity change through decomposition...

Author(s): Shawn Fraver, Mehdi Tajvidi, Anthony W. D'Amato, Daniel I. Lindner, Jodi A. Forrester, Amy M. Milo

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Historical and projected climate in the Northern Rockies Region [Chapter 3]

www.nrfirescience.org/resource/17520

Climate influences the ecosystem services we obtain from forest and rangelands. Climate is described by the long-term characteristics of precipitation, temperature, wind, snowfall, and other measures of weather that occur over a long period in a particular place, and is typically expressed as long-term average conditions. Resource...

Author(s): Linda A. Joyce, Marian Talbert, Darrin Sharp, Jeffrey T. Morrisette, John Stevenson

Year Published: 2018

Type: Document

Technical Report or White Paper

Human presence diminishes the importance of climate in driving fire activity across the United States

www.nrfirescience.org/resource/16345

Growing human and ecological costs due to increasing wildfire are an urgent concern in policy and management, particularly given projections of worsening fire conditions under climate change. Thus, understanding the relationship between climatic variation and fire activity is a critically important scientific question. Different...

Author(s): Alexandra D. Syphard, Jon E. Keeley, Anne H. Pfaff, Ken Ferschweiler

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

Disturbances catalyze the adaptation of forest ecosystems to changing climate conditions

www.nrfirescience.org/resource/16855

The rates of anthropogenic climate change substantially exceed those at which forest ecosystems – dominated by immobile, long-lived organisms – are able to adapt. The resulting maladaptation of forests has potentially detrimental effects on ecosystem functioning. Furthermore, as many forest-dwelling species are highly dependent...

Author(s): Dominik Thom, Werner Rammer, Rupert Seidl

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Tamm Review: Shifting global fire regimes: Lessons from reburns and research needs

www.nrfirescience.org/resource/19958

Across the globe, rising temperatures and altered precipitation patterns have caused persistent regional droughts, lengthened fire seasons, and increased the number of weather-driven extreme fire events. Because wildfires currently impact an increasing proportion of the total area burned, land managers need to better understand...

Author(s): Susan J. Prichard, Camille Stevens-Rumann, Paul F. Hessburg

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Interactions of landscape disturbances and climate change dictate ecological pattern and process: spatial modeling of wildfire, insect, and disease dynamics under future climates

www.nrfirescience.org/resource/15531

Context: Interactions among disturbances, climate, and vegetation influence landscape patterns and ecosystem processes. Climate changes, exotic invasions, beetle outbreaks, altered fire regimes, and human activities may interact to produce landscapes that appear and function beyond historical analogs. Objectives We used the...

Author(s): Rachel A. Loehman, Robert E. Keane, Lisa M. Holsinger, Zhiwei Wu

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Selective breeding of lodgepole pine increases growth and maintains climatic adaptation

www.nrfirescience.org/resource/16649

Climate change is disrupting historical patterns of adaptation in temperate and boreal tree species, causing local populations to become maladapted. Tree improvement programs typically utilise local base populations and manage adaptation using geographically defined breeding zones. As climates shift, breeding zones are no longer...

Author(s): Ian R. MacLachlan, Tongli Wang, Andreas Hamann, Pia Smets, Sally N. Aitken

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

www.nrfirescience.org/resource/15725

The Constitution of the State of Montana, ratified in 1972, affirms Montanans' inalienable "right to a clean and healthful environment" (State of Montana 1972). Since the signing of the constitution, that declaration has galvanized Montanans to protect the state's air and water, and to work toward keeping the state free from...

Author(s): Cathy L. Whitlock, Wyatt Cross, Bruce D. Maxwell, Nick Silverman, Alisa A. Wade

Year Published: 2017

Type: Document

Management or Planning Document

Analog-based fire regime and vegetation shifts in mountainous regions of the western US

www.nrfirescience.org/resource/15521

Climate change is expected to result in substantial ecological impacts across the globe. These impacts are uncertain but there is strong consensus that they will almost certainly affect fire regimes and vegetation. In this study, we evaluated how climate change may influence fire frequency, fire severity, and broad classes of...

Author(s): Sean A. Parks, Lisa M. Holsinger, Carol Miller, Marc-Andre Parisien

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Methods to reduce forest residue volume after timber harvesting and produce black carbon

www.nrfirescience.org/resource/16572

Forest restoration often includes thinning to reduce tree density and improve ecosystem processes and function while also reducing the risk of wildfire or insect and disease outbreaks. However, one drawback of these restoration treatments is that slash is often burned in piles that may damage the soil and require further restoration...

Author(s): Deborah S. Page-Dumroese, Matt Busse, Jim Archuleta, Darren McAvoy, Eric Roussel

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

A Tree Species Effect on Soil That Is Consistent Across the Species' Range: The Case of Aspen and Soil Carbon in North America

www.nrfirescience.org/resource/17211

Trembling aspen covers a large geographic range in North America, and previous studies reported that a better understanding of its singular influence on soil properties and processes is of high relevance for global change questions. Here we investigate the potential impact of a shift in aspen abundance on soil carbon sequestration...

Author(s): Jérôme Laganière, Antra Božić, Helga Van Miegroet, David Paré

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Effects of climate change on rangeland vegetation in the northern Rockies

www.nrfirescience.org/resource/16538

A longer growing season with climate change is expected to increase net primary productivity of many rangeland types, especially those dominated by grasses, although responses will depend on local climate and soil conditions. Elevated atmospheric carbon dioxide may increase water use efficiency and productivity of some species. In...

Author(s): Matthew C. Reeves, Mary Manning, Jeff P. DiBenedetto, Kyle Palmquist, William Lauenroth,

John Bradford, Daniel Schlaepfer
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Adaptive silviculture for climate change: a national experiment in manager-scientist partnerships to apply an adaptation framework

www.nrfirescience.org/resource/15232

Forest managers in the United States must respond to the need for climate-adaptive strategies in the face of observed and projected climatic changes. However, there is a lack of on-the-ground forest adaptation research to indicate what adaptation measures or tactics might be effective in preparing forest ecosystems to deal with...

Author(s): Linda Nagel, Brian J. Palik, Michael A. Battaglia, Anthony W. D'Amato, James M. Guldin, Christopher W. Swanston, Maria K. Janowiak, Matthew P. Powers, Linda A. Joyce, Constance I. Millar, David L. Peterson, Lisa Ganio, Chad Kirschbaum, Molly R. Roske

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Disturbance and productivity interactions mediate stability of forest composition and structure

www.nrfirescience.org/resource/16499

Fire is returning to many conifer-dominated forests where species composition and structure have been altered by fire exclusion. Ecological effects of these fires are influenced strongly by the degree of forest change during the fire-free period. Response of fire-adapted species assemblages to extended fire-free intervals is highly...

Author(s): Christopher D. O'Connor, Donald A. Falk, Ann M. Lynch, Thomas W. Swetnam, Craig P. Wilcox

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Post-fire forest regeneration in a changing climate - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/17003

Severe disturbance such as wildfire may create important opportunities for plant communities to reorganize in response to environmental change, including climate change. Disturbance may be particularly important in forests where the foundational plant species (trees) are long-lived and usually establish soon after disturbance. The...

Author(s): Derek J. N. Young, Andrew Latimer

Year Published: 2017

Type: Document

Technical Report or White Paper

Adapting fuel treatments in a changing climate - Prescribed fire, mechanical treatments, wildfire, and restoration

www.nrfirescience.org/resource/15075

The Available Science Assessment Project (ASAP) leads, EcoAdapt and Oregon State University's Institute for Natural Resources, hosted a workshop during the International Association of Wildland Fire's 5th Fire Behavior and Fuels Conference, in cooperation with the Northwest Fire Science Consortium and the Northern Rockies...

Author(s): Corey L. Gucker

Year Published: 2017
Type: Document
Research Brief or Fact Sheet

Decomposition rates of surface and buried forest-floor material

www.nrfirescience.org/resource/16459

Mechanical site preparation is assumed to reduce soil C stocks by increasing the rate at which the displaced organic material decomposes, but the evidence is equivocal. We measured rates of C loss of forest-floor material in mesh bags either placed on the surface or buried in the mineral soil at four sites in different regional...

Author(s): Cindy E. Prescott, Anya Reid, Shu Yao Wu, Marie-Charlotte Nilsson

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Climate changes and wildfire alter vegetation of Yellowstone National Park, but forest cover persists

www.nrfirescience.org/resource/22829

We present landscape simulation results contrasting effects of changing climates on forest vegetation and fire regimes in Yellowstone National Park, USA, by mid-21st century. We simulated potential changes to fire dynamics and forest characteristics under three future climate projections representing a range of potential future...

Author(s): Jason A. Clark, Rachel A. Loehman, Robert E. Keane

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Wildfire–vegetation dynamics affect predictions of climate change impact on bird communities

www.nrfirescience.org/resource/17774

Community-level climate change indicators have been proposed to appraise the impact of global warming on community composition. However, non-climate factors may also critically influence species distribution and biological community assembly. The aim of this paper was to study how fire–vegetation dynamics can modify our...

Author(s): Adrián Regos, Miguel Clavero, Manuela D'Amen, Antoine Guisan, Lluís Brotons

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/16407

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

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

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/14916

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

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

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Direct and indirect climate controls predict heterogeneous early-mid 21st century wildfire burned area across western and boreal North America

www.nrfirescience.org/resource/16312

Predicting wildfire under future conditions is complicated by complex interrelated drivers operating across large spatial scales. Annual area burned (AAB) is a useful index of global wildfire activity. Current and antecedent seasonal climatic conditions, and the timing of snowpack melt, have been suggested as important drivers of...

Author(s): Thomas Kitzberger, Donald A. Falk, Anthony L. Westerling, Thomas W. Swetnam

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Montana Climate Assessment VIGNETTE: forest Management and a Changing Climate with Diana Six

www.nrfirescience.org/resource/15727

Diana Six has been studying pine bark beetles for 25 years, and still can't say she completely understands them. Lately, she's been diving into a topic she has always found even more confounding - forest management. This article describes an interview with Six that describes forest resilience in face of climate change.

Year Published: 2017

Type: Document

Research Brief or Fact Sheet

Climate, wildfire, and erosion ensemble foretells more sediment in western USA watersheds

www.nrfirescience.org/resource/15526

The area burned annually by wildfires is expected to increase worldwide due to climate change. Burned areas increase soil erosion rates within watersheds, which can increase sedimentation in downstream rivers and reservoirs. However, which watersheds will be impacted by future wildfires is largely unknown. Using an ensemble of...

Author(s): Joel B. Sankey, Jason Kreitler, Todd J. Hawbaker, Jason L. McVay, Mary Ellen Miller, Erich R. Mueller, Nicole M. Vaillant, Scott E. Lowe, Temuulen T. Sankey

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/16643

We modeled the normal fire environment for occurrence of large forest wildfires (>40 ha) for the Pacific

Northwest Region of the United States. Large forest wildfire occurrence data from the recent climate normal period (1971–2000) was used as the response variable and fire season precipitation, maximum temperature, slope, and...

Author(s): Raymond J. Davis, Zhiqiang Yang, Andrew Yost, Cole Belongie, Warren B. Cohen

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Climate Science Special Report: Fourth National Climate Assessment, Volume 1

www.nrfirescience.org/resource/15720

As a key part of the Fourth National Climate Assessment (NCA4), the U.S. Global Change Research Program (USGCRP) oversaw the production of this stand-alone report of the state of science relating to climate change and its physical impacts. The Climate Science Special Report (CSSR) is designed to be an authoritative assessment of...

Author(s): Donald J. Wuebbles, David Fahey, Kathy Hibbard, David J. Dokken, Brooke C. Stewart, Thomas Maycock

Year Published: 2017

Type: Document

Technical Report or White Paper

Adapt to more wildfire in western North American forests as climate changes

www.nrfirescience.org/resource/15327

Wildfires across western North America have increased in number and size over the past three decades, and this trend will continue in response to further warming. As a consequence, the wildland–urban interface is projected to experience substantially higher risk of climate-driven fires in the coming decades. Although many plants,...

Author(s): Tania L. Schoennagel, Jennifer Balch, Hannah Brenkert-Smith, Philip E. Dennison, Brian J. Harvey, Meg A. Krawchuk, Nathan Mietkiewicz, Penelope Morgan, Max A. Moritz, Ray Rasker, Monica G. Turner, Cathy L. Whitlock

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Climate change and wildfire effects in aridland riparian ecosystems: An examination of current and future conditions

www.nrfirescience.org/resource/16556

Aridland riparian ecosystems are limited, the climate is changing, and further hydrological change is likely in the American Southwest. To protect riparian ecosystems and organisms, we need to understand how they are affected by disturbance processes and stressors such as fire, drought, and non-native plant invasions. Riparian...

Author(s): D. Max Smith, Deborah M. Finch

Year Published: 2017

Type: Document

Technical Report or White Paper

Climate drives episodic conifer establishment after fire in dry ponderosa pine forests of the Colorado Front Range, USA

www.nrfirescience.org/resource/19438

In recent years, warming climate and increased fire activity have raised concern about post-fire recovery of western U.S. forests. We assessed relationships between climate variability and tree establishment after fire in dry ponderosa pine forests of the Colorado Front Range. We harvested and

aged over 400 post-fire juvenile...
Author(s): Monica T. Rother, Thomas T. Veblen
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/17201

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

Author(s): Paul A. Knapp, Peter T. Soulé
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Climate drives inter-annual variability in probability of high severity fire occurrence in the western United States

www.nrfirescience.org/resource/15249

A long history of fire suppression in the western United States has significantly changed forest structure and ecological function, leading to increasingly uncharacteristic fires in terms of size and severity. Prior analyses of fire severity in California forests showed that time since last fire and fire weather conditions predicted...

Author(s): Alisa Keyser, Anthony L. Westerling
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Effects of climate oscillations on wildland fire potential in the continental United States

www.nrfirescience.org/resource/16506

The effects of climate oscillations on spatial and temporal variations in wildland fire potential in the continental U.S. are examined from 1979 to 2015 using cyclostationary empirical orthogonal functions (CSEOFs). The CSEOF analysis isolates effects associated with the modulated annual cycle and the El Niño–Southern Oscillation...

Author(s): Shelby A. Mason, Peter E. Hamlington, Benjamin D. Hamlington, William Matt Jolly, Chad M. Hoffman
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Potential Climate Feedbacks of Changing Fire regimes in the U.S.: A review - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/17024

Wildland fire is a disturbance that can profoundly impact the environment and human health and welfare. While climate is generally a critical driving factor shaping the occurrence and impacts of fire, fire can also play a role in shaping climate. With an increasing trend in wildland fire occurrence and extent, it is important to...

Author(s): Anping Chen, Richard A. Birdsey
Year Published: 2017

Type: Document
Synthesis

Estimating the Effects of Changing Climate on Fires and Consequences for U.S. Air Quality, Using a Set of Global and Regional Climate Models - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/16995

Emissions of aerosols and gases from fires have been shown to adversely affect US air quality at local to regional scales as well as downwind regions far away from the source. In addition, smoke from fires negatively affects humans, ecosystems, and climate. Recent observations have shown an upward trend of area burned over western...

Author(s): Jeffrey R. Pierce, Maria Val Martin, Colette L. Heald

Year Published: 2017

Type: Document

Technical Report or White Paper

Analog-based fire regime and vegetation shifts in mountainous regions of the western US

www.nrfirescience.org/resource/17773

Climate change is expected to result in substantial ecological impacts across the globe. These impacts are uncertain but there is strong consensus that they will almost certainly affect fire regimes and vegetation. In this study, we evaluated how climate change may influence fire frequency, fire severity, and broad classes of...

Author(s): Sean A. Parks, Lisa M. Holsinger, Carol Miller, Marc-Andre Parisien

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Non-deforestation fire vs. fossil fuel combustion: the source of CO2 emissions affects the global carbon cycle and climate responses

www.nrfirescience.org/resource/14328

Non-deforestation fire – i.e., fire that is typically followed by the recovery of natural vegetation – is arguably the most influential disturbance in terrestrial ecosystems, thereby playing a major role in carbon exchanges and affecting many climatic processes. The radiative effect from a given atmospheric CO2 perturbation is...

Author(s): Jean-Sebastien Landry, H. Damon Matthews

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Area burned in alpine treeline ecotones reflects region-wide trends

www.nrfirescience.org/resource/14828

The direct effects of climate change on alpine treeline ecotones – the transition zones between subalpine forest and non-forested alpine vegetation – have been studied extensively, but climate-induced changes in disturbance regimes have received less attention. To determine if recent increases in area burned extend to these...

Author(s): C. Alina Cansler, Donald McKenzie, Charles B. Hansler

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

High and dry: post-fire tree seedling establishment in subalpine forests decreases with post-fire drought and large stand-replacing burn patches

www.nrfirescience.org/resource/18412

Aim Climate warming and increased wildfire activity are hypothesized to catalyse biogeographical shifts, reducing the resilience of fire-prone forests world-wide. Two key mechanisms underpinning hypotheses are: (1) reduced seed availability in large stand-replacing burn patches, and (2) reduced seedling establishment/survival...

Author(s): Brian J. Harvey, Daniel C. Donato, Monica G. Turner

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Management impacts on carbon dynamics in a Sierra Nevada mixed conifer forest

www.nrfirescience.org/resource/14230

Forest ecosystems can act as sinks of carbon and thus mitigate anthropogenic carbon emissions. When forests are actively managed, treatments can alter forests carbon dynamics, reducing their sink strength and switching them from sinks to sources of carbon. These effects are generally characterized by fast temporal dynamics. Hence...

Author(s): Sabina Dore, Danny L. Fry, Brandon M. Collins, Rodrigo Vargas, Robert A. York, Scott L. Stephens

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Changing disturbance regimes, ecological memory, and forest resilience

www.nrfirescience.org/resource/14800

Ecological memory is central to how ecosystems respond to disturbance and is maintained by two types of legacies – information and material. Species life-history traits represent an adaptive response to disturbance and are an information legacy; in contrast, the abiotic and biotic structures (such as seeds or nutrients) produced...

Author(s): Jill F. Johnstone, Craig D. Allen, Jerry F. Franklin, Lee E. Frelich, Brian J. Harvey, Philip E. Higuera, Michelle Mack, Ross K. Meentemeyer, Margaret R. Metz, George L.W. Perry, Tania L. Schoennagel, Monica G. Turner

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

How will climate change affect wildland fire severity in the western US?

www.nrfirescience.org/resource/13983

Fire regime characteristics in North America are expected to change over the next several decades as a result of anthropogenic climate change. Although some fire regime characteristics (e.g., area burned and fire season length) are relatively well-studied in the context of a changing climate, fire severity has received less...

Author(s): Sean A. Parks, Carol Miller, John T. Abatzoglou, Lisa M. Holsinger, Marc-Andre Parisien, Solomon Z. Dobrowski

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Climate change velocity underestimates climate change exposure in mountainous regions

www.nrfirescience.org/resource/14683

Climate change velocity is a vector depiction of the rate of climate displacement used for assessing climate change impacts. Interpreting velocity requires an assumption that climate trajectory length is proportional to climate change exposure; longer paths suggest greater exposure. However, distance is an imperfect measure of...

Author(s): Solomon Z. Dobrowski, Sean A. Parks

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

The science of firescapes: achieving fire-resilient communities

www.nrfirescience.org/resource/13924

Wildland fire management has reached a crossroads. Current perspectives are not capable of answering interdisciplinary adaptation and mitigation challenges posed by increases in wildfire risk to human populations and the need to reintegrate fire as a vital landscape process. Fire science has been, and continues to be, performed in...

Author(s): Alistair M. S. Smith, Crystal A. Kolden, Travis B. Paveglio, Mark A. Cochrane, David M. J. S. Bowman, Max A. Moritz, Andrew D. Kliskey, Lilian Alessa, Andrew T. Hudak, Chad M. Hoffman, James A. Lutz, Lloyd P. Queen, Scott J. Goetz, Philip E. Higuera, Luigi Boschetti, Michael D. Flannigan, Kara M. Yedinak, Adam C. Watts, Eva K. Strand, Jan W. van Wagtendonk, John Anderson, Brian J. Stocks, John T. Abatzoglou

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Impact of anthropogenic climate change on wildfire across western US forests

www.nrfirescience.org/resource/14670

Increased forest fire activity across the western continental United States (US) in recent decades has likely been enabled by a number of factors, including the legacy of fire suppression and human settlement, natural climate variability, and human-caused climate change. We use modeled climate projections to estimate the...

Author(s): John T. Abatzoglou, A. Park Williams

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Is resilience maladaptive? Towards an accurate lexicon for climate change adaptation

www.nrfirescience.org/resource/14618

Climate change adaptation is a rapidly evolving field in conservation biology and includes a range of strategies from resisting to actively directing change on the landscape. The term 'climate change resilience,' frequently used to characterize adaptation strategies, deserves closer scrutiny because it is ambiguous, often...

Author(s): Nicholas A. Fisichelli, Gregor W. Schuurman, Cat Hawkins Hoffman

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Fire-based management for promoting drought resistance of woody seedlings in a changing climate - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/17051

Shifts in rainfall patterns due to climate change are expected to increase drought-induced stress and mortality in forests, with widespread, negative consequences for forest productivity. Additionally, the

extent, frequency and severity of natural and anthropogenic fires are rapidly changing, highlighting the need to understand the...

Author(s): Jennifer Fraterrigo, Tyler Refsland

Year Published: 2016

Type: Document

Technical Report or White Paper

Increased water deficit decreases Douglas fir growth throughout western US forests

www.nrfirescience.org/resource/14548

With ongoing public concern regarding climate change and recent drought that has affected many areas of the western United States, this study provides context and direct evidence for the negative impact of water stress on forest ecosystems. The response of trees to drought is a tangible example of the impacts of climate change on...

Author(s): David L. Peterson, Jeremy S. Littell

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Fire and drought

www.nrfirescience.org/resource/14525

Historical and presettlement relationships between drought and wildfire have been well documented in much of North America, with forest fire occurrence and area burned clearly increasing in response to drought. Drought interacts with other controls (forest productivity, topography, and fire weather) to affect fire intensity and...

Author(s): Jeremy S. Littell, David L. Peterson, Karen L. Riley, Yongqiang Liu, Charles H. Luce

Year Published: 2016

Type: Document

Technical Report or White Paper

Replacing time with space: using laboratory fires to explore the effects of repeated burning on black carbon degradation

www.nrfirescience.org/resource/19123

Soil organic matter plays a key role in the global carbon cycle, representing three to four times the total carbon stored in plant or atmospheric pools. Although fires convert a portion of the faster cycling organic matter to slower cycling black carbon (BC), abiotic and biotic degradation processes can significantly shorten BC...

Author(s): Wade T. Tinkham, Alistair M. S. Smith, Philip E. Higuera, Jeff A. Hatten, Nolan W. Brewer, Stefan H. Doerr

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Elevational shifts in thermal suitability for mountain pine beetle population growth in a changing climate

www.nrfirescience.org/resource/14987

Future forests are being shaped by changing climate and disturbances. Climate change is causing large-scale forest declines globally, in addition to distributional shifts of many tree species. Because environmental cues dictate insect seasonality and population success, climate change is also influencing tree-killing bark beetles....

Author(s): Barbara J. Bentz, Jacob P. Duncan, James A. Powell

Year Published: 2016

Type: Document
Book or Chapter or Journal Article

Using scientific conferences to engage the public on climate change

www.nrfirescience.org/resource/15600

Climate change is often perceived as controversial in the public's view. One meaningful way scientists can address this problem is to engage with the public to increase understanding of climate change. Attendees of scientific conferences address climate change within meetings yet rarely interact with the public as part of...

Author(s): Jeffrey A. Hicke, John T. Abatzoglou, Steven Daley-Laursen, Jamie Esler, Lauren E. Parker
Year Published: 2016

Type: Document
Book or Chapter or Journal Article

Engaging communities and climate change futures with Multi-Scale, Iterative Scenario Building (MISB) in the western United States

www.nrfirescience.org/resource/14428

Current projections of future climate change foretell potentially transformative ecological changes that threaten communities globally. Using two case studies from the United States Intermountain West, this article highlights the ways in which a better articulation between theory and methods in research design can generate proactive...

Author(s): Daniel Murphy, Carina Wyborn, Laurie Yung, Daniel R. Williams, Cory Cleveland, Lisa A. Eby, Solomon Z. Dobrowski, Erin Towler

Year Published: 2016

Type: Document
Book or Chapter or Journal Article

Is 'resilience' maladaptive? Towards an accurate lexicon for climate change adaptation

www.nrfirescience.org/resource/16876

Climate change adaptation is a rapidly evolving field in conservation biology and includes a range of strategies from resisting to actively directing change on the landscape. The term 'climate change resilience,' frequently used to characterize adaptation strategies, deserves closer scrutiny because it is ambiguous, often...

Author(s): Nicholas A. Fisichelli, Gregor W. Schuurman, Cat Hawkins Hoffman

Year Published: 2016

Type: Document
Book or Chapter or Journal Article

Climate change and novel disturbance regimes in national park landscapes

www.nrfirescience.org/resource/18425

Climate and disturbance regimes are both changing rapidly, and it is increasingly important for ecologists and park managers to understand the past and anticipate what lies ahead. The frequency, severity, and extent of natural disturbances are changing substantially as climate warms; effects on many ecosystems may be profound (...)

Author(s): Monica G. Turner, Daniel C. Donato, Winslow D. Hansen, Brian J. Harvey, William H. Romme, Anthony L. Westerling

Year Published: 2016

Type: Document
Book or Chapter or Journal Article

A new method comparing snowmelt timing with annual area burned

www.nrfirescience.org/resource/14250

The interactions between climate and wildland fire are complex. To better understand these interactions, we used ArcMap 10.2.2 to examine the relationships between early spring snowmelt and total annual area burned within a defined region of the Rocky Mountains of the western United States....

Author(s): Donal S. O'Leary, Trevor D. Bloom, Jacob C. Smith, Christopher R. Zemp, Michael J. Medler

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Human-caused climate change is now a key driver of forest fire activity in the western United States

www.nrfirescience.org/resource/14809

Effects of climate warming on natural and human systems are becoming increasingly visible across the globe. For example, the shattering of past yearly records for global high temperatures seems to be a near-annual event, with the five hottest years since 1880 all occurring since 2005 (1). Not coincidentally, the single hottest year...

Author(s): Brian J. Harvey

Year Published: 2016

Type: Document

Book or Chapter or Journal Article, Synthesis

Attribution of extreme weather events in the context of climate change - Report in brief

www.nrfirescience.org/resource/14069

As climate has warmed over recent years, a new pattern of more frequent and more intense weather events has unfolded across the globe. Climate models simulate such changes in extreme events, and some of the reasons for the changes are well understood. Warming increases the likelihood of extremely hot days and nights, favors...

Author(s): Committee on Extreme Weather Events and Climate Change Attribution

Year Published: 2016

Type: Document

Technical Report or White Paper

Climate change and indigenous peoples: a synthesis of current impacts and experiences

www.nrfirescience.org/resource/14756

A growing body of literature examines the vulnerability, risk, resilience, and adaptation of indigenous peoples to climate change. This synthesis of literature brings together research pertaining to the impacts of climate change on sovereignty, culture, health, and economies that are currently being experienced by Alaska Native and...

Author(s): Kathryn Norton-Smith, Kathy Lynn, Karletta Chief, Karen Cozzetto, Jamie Donatuto, Margaret Hiza Redsteer, Linda E. Kruger, Julie Maldonado, Carson Viles, Kyle P. Whyte

Year Published: 2016

Type: Document

Synthesis, Technical Report or White Paper

Regeneration of montane forests 24 years after the 1988 Yellowstone fires: A fire-catalyzed shift in lower treelines?

www.nrfirescience.org/resource/14619

Forests near the lower limit of montane tree cover are expected to be particularly vulnerable to warming climate, potentially converting to non-forest for prolonged periods if affected by canopy-removing disturbances. Such disturbance-catalyzed shifts are by nature stochastic, offering few opportunities to

test these predictions. We...

Author(s): Daniel C. Donato, Brian J. Harvey, Monica G. Turner

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Achievable future conditions as a framework for guiding forest conservation and management

www.nrfirescience.org/resource/13788

We contend that traditional approaches to forest conservation and management will be inadequate given the predicted scale of social-economic and biophysical changes in the 21st century. New approaches, focused on anticipating and guiding ecological responses to change, are urgently needed to ensure the full value of forest ecosystem...

Author(s): Stephen W. Golladay, Katherine L. Martin, James M. Vose, David N. Wear, Alan P. Covich, Richard J. Hobbs, Kier D. Klepzig, Gene E. Likens, Robert J. Naiman, Allan W. Shearer

Year Published: 2016

Type: Document

Book or Chapter or Journal Article, Synthesis

Particulate air pollution from wildfires in the western US under climate change

www.nrfirescience.org/resource/14558

Wildfire can impose a direct impact on human health under climate change. While the potential impacts of climate change on wildfires and resulting air pollution have been studied, it is not known who will be most affected by the growing threat of wildfires. Identifying communities that will be most affected will inform development...

Author(s): Jia Coco Liu, Loretta J. Mickley, Melissa P. Sulprizio, Francesca Dominici, Xu Yue, Keita Ebisu, Georgiana Brooke Anderson, Rafi F.A. Khan, Mercedes Bravo, Michelle L. Bell

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Forest health in a changing world: effects of globalization and climate change on forest insect and pathogen impacts

www.nrfirescience.org/resource/14992

Forests and trees throughout the world are increasingly affected by factors related to global change. Expanding international trade has facilitated invasions of numerous insects and pathogens into new regions. Many of these invasions have caused substantial forest damage, economic impacts and losses of ecosystem goods and services...

Author(s): T. D. Ramsfield, Barbara J. Bentz, M. Faccoli, H. Jactel, E. G. Brockerhoff

Year Published: 2016

Type: Document

Book or Chapter or Journal Article, Synthesis

Recent advances and remaining uncertainties in resolving past and future climate effects on global fire activity

www.nrfirescience.org/resource/15603

Fire is an integral component of the Earth system that will critically affect how terrestrial carbon budgets and living systems respond to climate change. Paleo and observational records document robust positive relationships between fire activity and aridity in many parts of the world on interannual to millennial timescales....

Author(s): A. Park Williams, John T. Abatzoglou

Year Published: 2016

Type: Document
Book or Chapter or Journal Article

Increasing western US forest wildfire activity: sensitivity to changes in the timing of spring

www.nrfirescience.org/resource/14468

Prior work shows western US forest wildfire activity increased abruptly in the mid-1980s. Large forest wildfires and areas burned in them have continued to increase over recent decades, with most of the increase in lightning-ignited fires. Northern US Rockies forests dominated early increases in wildfire activity, and still...

Author(s): Anthony L. Westerling

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Mid-21st-century climate changes increase predicted fire occurrence and fire season length, Northern Rocky Mountains, United States

www.nrfirescience.org/resource/14968

Climate changes are expected to increase fire frequency, fire season length, and cumulative area burned in the western United States. We focus on the potential impact of mid-21st-century climate changes on annual burn probability, fire season length, and large fire characteristics including number and size for a study area in the...

Author(s): Karen L. Riley, Rachel A. Loehman

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Future mega-fires and smoke impacts

www.nrfirescience.org/resource/15579

"Megafire" events, in which large high-intensity fires propagate over extended periods, can cause both immense damage to the local environment and catastrophic air quality impacts on cities and towns downwind. Increases in extreme events associated with climate change (e.g., droughts, heat waves) are projected to result in more...

Author(s): Narasimhan K. Larkin, John T. Abatzoglou, Donald McKenzie, Brian E. Potter, E. Ashley Steel, Brian J. Stocks

Year Published: 2015

Type: Document

Technical Report or White Paper

Tree mortality from drought, insects, and their interactions in a changing climate

www.nrfirescience.org/resource/13635

Climate change is expected to drive increased tree mortality through drought, heat stress, and insect attacks, with manifold impacts on forest ecosystems. Yet, climate-induced tree mortality and biotic disturbance agents are largely absent from process-based ecosystem models. Using data sets from the western USA and associated...

Author(s): William R.L. Anderegg, Jeffrey A. Hicke, Rosie A. Fisher, Craig D. Allen, Juliann Aukema, Barbara J. Bentz, Sharon M. Hood, Jeremy W. Lichstein, Alison K. Macalady, Nate McDowell, Yude Pan, Kenneth F. Raffa, Anna Sala, John D. Shaw, Nathan L. Stephenson, Christina Tague, Melanie Zeppel

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Biomass and fire dynamics in a temperate forest-grassland mosaic: Integrating multi-species herbivory, climate, and fire with the FireBGCv2/GrazeBGC system

www.nrfirescience.org/resource/13195

Landscape fire succession models (LFSMs) predict spatially-explicit interactions between vegetation succession and disturbance, but these models have yet to fully integrate ungulate herbivory as a driver of their processes. We modified a complex LFSM, FireBGCv2, to include a multi-species herbivory module, GrazeBGC. The system is...

Author(s): Robert A. Riggs, Robert E. Keane, Norm Cimon, Rachel Cook, Lisa M. Holsinger, John Cook, Timothy DelCurto, Scott L. Baggett, Donald Justice, David Powell, Martin Vavra, Bridgett J. Naylor

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Impacts of changing fire regimes in the alpine treeline ecotone

www.nrfirescience.org/resource/15577

We studied the effects of a shift in the fire regime of an ecosystem that is very sensitive to climate change: the ecotone from closed forest to open alpine tundra, hereafter the alpine treeline ecotone (ATE). Results suggest that ATEs will become more complex spatially in a warming climate, rather than moving up or down en masse....

Author(s): Donald McKenzie, C. Alina Cansler

Year Published: 2015

Type: Document

Technical Report or White Paper

Ecological implications of climate change in Yellowstone: moving into uncharted territory?

www.nrfirescience.org/resource/13548

Climate science and understanding how climate change may affect the Greater Yellowstone Ecosystem (GYE) have come a long way since our 1992 Yellowstone Science article (Romme and Turner 1992, based on Romme and Turner 1991). In 1992, the potential for global warming driven by anthropogenic emissions of...

Author(s): William H. Romme, Monica G. Turner

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Climate-induced variations in global wildfire danger from 1979 to 2013

www.nrfirescience.org/resource/15777

Climate strongly influences global wildfire activity, and recent wildfire surges may signal fire weather-induced pyrogeographic shifts. Here we use three daily global climate data sets and three fire danger indices to develop a simple annual metric of fire weather season length, and map spatio-temporal trends from 1979 to 2013. We...

Author(s): William Matt Jolly, Mark A. Cochrane, Patrick H. Freeborn, Zachary A. Holden, Timothy J. Brown, Grant J. Williamson, David M. J. S. Bowman

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Climate-induced variations in global wildfire danger from 1979 to 2013

www.nrfirescience.org/resource/15322

Climate strongly influences global wildfire activity, and recent wildfire surges may signal fire weather-induced pyrogeographic shifts. Here we use three daily global climate data sets and three fire danger indices to develop a simple annual metric of fire weather season length, and map spatio-temporal trends from 1979 to 2013. We...

Author(s): William Matt Jolly, Mark A. Cochrane, Patrick H. Freeborn, Zachary A. Holden, Timothy J. Brown, G.J. Williamson, David M. J. S. Bowman

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

A new model to simulate climate-change impacts on forest succession for local land management

www.nrfirescience.org/resource/13877

We developed a new climate-sensitive vegetation state-and-transition simulation model (CV-STSM) to simulate future vegetation at a fine spatial grain commensurate with the scales of human land-use decisions, and under the joint influences of changing climate, site productivity, and disturbance. CV-STSM integrates outputs from four...

Author(s): Gabriel I. Yospin, Scott D. Bridgham, Ronald P. Neilson, John P. Bolte, Dominique Bachelet, Peter J. Gould, Constance A. Harrington, Jane A. Kertis, Cody Evers, Bart R. Johnson

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

The climate space of fire regimes in north-western North America

www.nrfirescience.org/resource/18921

Aim: Studies of fire activity along environmental gradients have been undertaken, but the results of such studies have yet to be integrated with fire-regime analysis. We characterize fire-regime components along climate gradients and a gradient of human influence. Location: We focus on a climatically diverse region of north-western...

Author(s): Ellen Whitman, E. Batllori, Marc-Andre Parisien, Carol Miller, Jonathan D. Coop, Meg A. Krawchuk, Geneva W. Chong, Sandra L. Haire

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

The Columbia River treaty and the dynamics of transboundary water negotiations in a changing environment: how might climate change alter the game?

www.nrfirescience.org/resource/15653

This is a book chapter describing how climate change may alter water negotiations.

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Projected major fire and vegetation changes in the Pacific Northwest of the conterminous United States under selected CMIP5 climate futures

www.nrfirescience.org/resource/13743

Climate change adaptation and mitigation require understanding of vegetation response to climate change. Using the MC2 dynamic global vegetation model (DGVM) we simulate vegetation for the Northwest United States using results from 20 different Climate Model Intercomparison Project Phase 5 (CMIP5) models downscaled using the MACA...

Author(s): Timothy J. Sheehan, Dominique Bachelet, Ken Ferschweiler
Year Published: 2015
Type: Document
Book or Chapter or Journal Article

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

Disturbance interactions: characterization, prediction, and the potential for cascading effects

www.nrfirescience.org/resource/13423

Disturbances are fundamental components of ecosystems and, in many cases, a dominant driver of ecosystem structure and function at multiple spatial and temporal scales. While the effect of any one disturbance may be relatively well understood, multiple interacting disturbances can cause unexpected disturbance behavior...

Author(s): Brian Buma
Year Published: 2015
Type: Document
Book or Chapter or Journal Article

Forest disturbance across the conterminous United States from 1985-2012: the emerging dominance of forest decline

www.nrfirescience.org/resource/13688

Evidence of shifting dominance among major forest disturbance agent classes regionally to globally has been emerging in the literature. For example, climate-related stress and secondary stressors on forests (e.g., insect and disease, fire) have dramatically increased since the turn of the century globally, while harvest rates in the...

Author(s): Warren B. Cohen, Zhiqiang Yang, Stephen V. Stehman, Todd A. Schroeder, David M. Bell, Jeffrey G. Masek, Chengquan Huang, Garrett W. Meigs
Year Published: 2015
Type: Document
Book or Chapter or Journal Article

Climate Contributors to Forest Mosaics: Ecological Persistence

www.nrfirescience.org/resource/15625

It is hypothesized that climate impacts forest mosaics through dynamic ecological processes such as wildfires. However, climate-fire research has primarily focused on understanding drivers of fire frequency and area burned, largely due to scale mismatches and limited data availability. Recent datasets, however, allow for the...

Author(s): Crystal A. Kolden, John T. Abatzoglou, James A. Lutz, C. Alina Cansler, Jonathan T. Kane, Jan W. van Wageningen, Carl H. Key
Year Published: 2015
Type: Document

Book or Chapter or Journal Article

Climate change presents increased potential for very large fires in the contiguous United States

www.nrfirescience.org/resource/13373

Very large fires (VLFs) have important implications for communities, ecosystems, air quality and fire suppression expenditures. VLFs over the contiguous US have been strongly linked with meteorological and climatological variability. Building on prior modelling of VLFs (>5000 ha), an ensemble of 17 global climate models were...

Author(s): Renaud Barbero, John T. Abatzoglou, Narasimhan K. Larkin, Crystal A. Kolden, Brian J. Stocks

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Representing climate, disturbance, and vegetation interactions in landscape models

www.nrfirescience.org/resource/13639

The prospect of rapidly changing climates over the next century calls for methods to predict their effects on myriad, interactive ecosystem processes. Spatially explicit models that simulate ecosystem dynamics at fine (plant, stand) to coarse (regional, global) scales are indispensable tools for meeting this challenge under a...

Author(s): Robert E. Keane, Donald McKenzie, Donald A. Falk, Erica A. H. Smithwick, Carol Miller, Lara-Karena B. Kellogg

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

The potential impact of regional climate change on fire weather in the United States

www.nrfirescience.org/resource/13208

Climate change is expected to alter the frequency and severity of atmospheric conditions conducive for wildfires. In this study, we assess potential changes in fire weather conditions for the contiguous United States using the Haines Index (HI), a fire weather index that has been employed operationally to detect atmospheric...

Author(s): Ying Tang, Shiyuan Zhong, Lifeng Luo, Xindi Bian, Warren Heilman, Julie Winkler

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Modeling study of the contribution of fire emissions on BC concentrations and deposition rates

www.nrfirescience.org/resource/15578

Regional air quality simulations were performed to evaluate the contributions of wildland fires to inter-annual variability of black carbon (BC) concentrations and to assess the contributions of wildfires vs. prescribed fires to BC concentrations and deposition rates to glacier areas and snow-covered surfaces in the western US....

Author(s): Serena H. Chung, Brian K. Lamb, Farren Herron-Thorpe, Rodrigo Gonzalez-Abraham, Vikram Ravi, Tsengel Nergui, Joseph K. Vaughan, Narasimhan K. Larkin, Tara Strand

Year Published: 2015

Type: Document

Technical Report or White Paper

Climate, snowpack, and streamflow of Priest River Experimental Forest, revisited

www.nrfirescience.org/resource/13114

The climate record of Priest River Experimental Forest has the potential to provide a century-long history of northern Rocky Mountain forest ecosystems. The record, which began in 1911 with the Benton Flat Nursery control weather station, included observations of temperature, precipitation, humidity, and wind. Later, other...

Author(s): Wade T. Tinkham, Robert Denner, Russell T. Graham

Year Published: 2015

Type: Document

Technical Report or White Paper

The cost of climate change: ecosystem services and wildland fires

www.nrfirescience.org/resource/13074

Little research has focused on the economic impact associated with climate-change induced wildland fire on natural ecosystems and the goods and services they provide. We examine changes in wildland fire patterns based on the U.S. Forest Service's MC1 dynamic global vegetation model from 2013 to 2115 under two pre-defined scenarios:...

Author(s): Christine Lee, Claire Schlemme, Jessica Murray, Robert Unsworth

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Indicators of climate impacts for forests: recommendations for the US National Climate Assessment indicators system

www.nrfirescience.org/resource/13969

The Third National Climate Assessment (NCA) process for the United States focused in part on developing a system of indicators to communicate key aspects of the physical climate, climate impacts, vulnerabilities, and preparedness to inform decisionmakers and the public. Initially, 13 active teams were formed to recommend indicators...

Author(s): Linda S. Heath, Sarah M. Anderson, Marla R. Emery, Jeffrey A. Hicke, Jeremy S. Littell, Alan Lucier, Jeffrey G. Masek, David L. Peterson, Richard Pouyat, Kevin M. Potter, Guy Robertson, Jinelle Sperry, Andrzej Bytnerowicz, Sarah Jovan, Miranda H. Mockrin, Robert Musselman, Bethany K. Shulz, Robert J. Smith, Susan I. Stewart

Year Published: 2015

Type: Document

Technical Report or White Paper

Interactions among spruce beetle disturbance, climate change and forest dynamics captured by a forest landscape model

www.nrfirescience.org/resource/13909

The risk of bark beetle outbreaks is widely predicted to increase because of a warming climate that accelerates temperature-driven beetle population growth and drought stress that impairs host tree defenses. However, few if any studies have explicitly evaluated climatically enhanced beetle population dynamics in relation to climate-...

Author(s): Christian Temperli, Thomas T. Veblen, Sarah Hart, Dominik Kulakowski, Alan J. Tepley

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Climate Contributors to Forest Mosaics: Ecological Persistence Following Wildfire

www.nrfirescience.org/resource/18953

It is hypothesized that climate impacts forest mosaics through dynamic ecological processes such as

wildfires. However, climate-fire research has primarily focused on understanding drivers of fire frequency and area burned, largely due to scale mismatches and limited data availability. Recent datasets, however, allow for the...

Author(s): Crystal A. Kolden, John T. Abatzoglou, James A. Lutz, C. Alina Cansler, Jonathan T. Kane, Jan W. van Wagtendonk, Carl H. Key

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Managing for climate change on federal lands of the western United States: perceived usefulness of climate science, effectiveness of adaptation strategies, and barriers to implementation

www.nrfirescience.org/resource/12997

Recent mandates in the United States require federal agencies to incorporate climate change science into land management planning efforts. These mandates target possible adaptation and mitigation strategies. However, the degree to which climate change is actively being considered in agency planning and management decisions is...

Author(s): Kerry Kemp, Jarod Blades, P. Zion Klos, Troy E. Hall, Jo Ellen Force, Penelope Morgan, Wade T. Tinkham

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Indicators of climate change in Idaho: an assessment framework for coupling biophysical change and social perception

www.nrfirescience.org/resource/15637

Climate change is well documented at the global scale, but local and regional changes are not as well understood. Finer, local- to regional-scale information is needed for creating specific, place-based planning and adaptation efforts. Here the development of an indicator-focused climate change assessment in Idaho is described. This...

Author(s): P. Zion Klos

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Improved Bias Correction Techniques for Hydrological Simulations of Climate Change

www.nrfirescience.org/resource/15630

Global climate model (GCM) output typically needs to be bias corrected before it can be used for climate change impact studies. Three existing bias correction methods, and a new one developed here, are applied to daily maximum temperature and precipitation from 21 GCMs to investigate how different methods alter the climate change...

Author(s): David W. Pierce, Daniel R. Cayan, Edwin P. Maurer, John T. Abatzoglou, Katherine C. Hegewisch

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Climate change beliefs and hazard mitigation behaviors: homeowners and wildfire risk

www.nrfirescience.org/resource/14535

Downscaled climate models provide projections of how climate change may exacerbate the local impacts of natural hazards. The extent to which people facing exacerbated hazard conditions

understand or respond to climate-related changes to local hazards has been largely overlooked. In this article, we examine the relationships among...

Author(s): Hannah Brenkert-Smith, James R. Meldrum, Patricia A. Champ

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Regional likelihood of very large wildfires over the 21st century across the western United States: motivation to study individual events like the Rim Fire, a unique opportunity with unprecedented remote sensing data

www.nrfirescience.org/resource/13681

Studies project that a warming climate will likely increase wildfire activity in many areas (Westerling and others 2002; Flannigan and others 2005, 2009; Littell and others 2009). These analyses are often of aggregate statistics like annual area burned, which are insufficient for analyzing changes in seasonality of fire events, the...

Author(s): E. Natasha Stavros, John T. Abatzoglou, Zachary Tane, Van R. Kane, Sander Veraverbeke, Bob McGaughey, James A. Lutz, Narasimhan K. Larkin, Donald McKenzie, E. Ashley Steel, Carlos Ramirez, David S. Schimel

Year Published: 2015

Type: Document

Conference Proceedings

Global fire size distribution is driven by human impact and climate

www.nrfirescience.org/resource/13256

In order to understand fire's impacts on vegetation dynamics, it is crucial that the distribution of fire sizes be known. We approached this distribution using a power-law distribution, which derives from self-organized criticality theory (SOC). We compute the global spatial variation in the power-law exponent and determine the main...

Author(s): Stijn Hantson, Salvador Pueyo, Emilio Chuvieco

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Climate change impacts on fire regimes and key ecosystem services in Rocky Mountain forests

www.nrfirescience.org/resource/16832

Forests and woodlands in the central Rocky Mountains span broad gradients in climate, elevation, and other environmental conditions, and therefore encompass a great diversity of species, ecosystem productivities, and fire regimes. The objectives of this review are: (1) to characterize the likely short- and longer-term effects of...

Author(s): Monique E. Rocca, Peter M. Brown, Lee H. MacDonald, Christian M. Carrico

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/15671

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

Author(s): John T. Abatzoglou, David E. Rupp, Philip W. Mote

Year Published: 2014
Type: Document
Book or Chapter or Journal Article

Climate change impacts in the United States: The third National Climate Assessment

www.nrfirescience.org/resource/18981

Climate change is already affecting the American people in farreaching ways. Certain types of extreme weather events with links to climate change have become more frequent and/or intense, including prolonged periods of heat, heavy downpours, and, in some regions, floods and droughts. In addition, warming is causing sea level to rise...

Year Published: 2014
Type: Document
Technical Report or White Paper

Climate and very large wildland fires in the contiguous western USA

www.nrfirescience.org/resource/13009

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

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

Year Published: 2014
Type: Document
Book or Chapter or Journal Article

Observed changes in false springs over the contiguous United States

www.nrfirescience.org/resource/15668

Climate warming fosters an earlier spring green-up that may bring potential benefits to agricultural systems. However, advances in green-up timing may leave early stage vegetation growth vulnerable to cold damage when hard freezes follow green-up resulting in a false spring. Spatiotemporal patterns of green-up dates, last spring...

Author(s): Alexander G. Peterson, John T. Abatzoglou

Year Published: 2014
Type: Document
Book or Chapter or Journal Article

Relative effects of climate change and wildfires on stream temperatures: a simulation modeling approach in a Rocky Mountain watershed

www.nrfirescience.org/resource/12998

Freshwater ecosystems are warming globally from the direct effects of climate change on air temperature and hydrology and the indirect effects on near-stream vegetation. In fire-prone landscapes, vegetative change may be especially rapid and cause significant local stream temperature increases but the importance of these increases...

Author(s): Lisa M. Holsinger, Robert E. Keane, Daniel J. Isaak, Lisa A. Eby, Michael K. Young

Year Published: 2014
Type: Document
Book or Chapter or Journal Article

A primer on global climate-change science

www.nrfirescience.org/resource/15665

Most of us are familiar with the terms climate change and global warming, but not too many of us understand the science behind them. We don't really understand how climate change will affect us, and for that reason we might not consider it as pressing a concern as, say, housing prices or the quality of local education. This book...

Author(s): John T. Abatzoglou, J.F.C. DiMento, P. Doughman, S. Nespor

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

US strategy for forest management adaption to climate change: building a framework for decision making

www.nrfirescience.org/resource/12443

Recent policy changes in the USA direct agencies managing federal forests to analyze the potential effects of climate change on forest productivity, water resource protection, wildlife habitat, biodiversity, and other values. This paper describes methods developed to (1) assess current risks, vulnerabilities, and gaps in knowledge...

Author(s): V. Alaric Sample, Jessica E. Halofsky, David L. Peterson

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Challenges and opportunities for large landscape-scale management in a shifting climate: the importance of nested adaptation responses across geospatial and temporal scales

www.nrfirescience.org/resource/12994

The Yellowstone to Yukon Conservation Initiative (Y2Y) was established over 20 years ago as an experiment in large landscape conservation. Initially, Y2Y emerged as a response to large scale habitat fragmentation by advancing ecological connectivity. It also laid the foundation for large scale multi-stakeholder conservation...

Author(s): Gary M. Tabor, Anne Carlson, R. Travis Belote

Year Published: 2014

Type: Document

Technical Report or White Paper

Adapting to climate change

www.nrfirescience.org/resource/13430

Federal agencies have led the development of adaptation principles and tools in forest ecosystems over the past decade. Successful adaptation efforts generally require organizations to: (1) develop science-management partnerships, (2) provide education on climate change science, (3) provide a toolkit of methods and processes for...

Author(s): Constance I. Millar, Christopher W. Swanson, David L. Peterson

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Playing with fire: how climate change and development patterns are contributing to the soaring costs of western wildfires

www.nrfirescience.org/resource/12974

Strong scientific evidence shows that climate change is producing hotter, drier conditions that contribute to larger fires and longer fire seasons in the American West today. The annual number of large wildfires on federally managed lands in the 11 western states has increased by more than 75 percent: from

approximately 140 during...

Author(s): Rachel Cleetus, Kranti Mulik

Year Published: 2014

Type: Document

Technical Report or White Paper

Resilience to stress and disturbance, and resistance to *Bromus tectorum* L. invasion in cold desert shrublands of western North America

www.nrfirescience.org/resource/12897

Alien grass invasions in arid and semi-arid ecosystems are resulting in grass-fire cycles and ecosystem-level transformations that severely diminish ecosystem services. Our capacity to address the rapid and complex changes occurring in these ecosystems can be enhanced by developing an understanding of the environmental factors and...

Author(s): Jeanne C. Chambers, Bethany A. Bradley, Cynthia S. Brown, Carla M. D'Antonio, Matthew J. Germino, James B. Grace, Stuart P. Hardegee, Richard F. Miller, David A. Pyke

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Linking environmental research and practice: lessons from the integration of climate science and water management in the western United States

www.nrfirescience.org/resource/12626

Efforts to better connect scientific research with people and organizations involved in environmental decision making are receiving increased interest and attention. Some of the challenges we currently face, however—including complex questions associated with climate change—are unlike most of the environmental issues encountered...

Author(s): Daniel B. Ferguson, Jennifer Rice, Connie Woodhouse

Year Published: 2014

Type: Document

Synthesis, Technical Report or White Paper

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

www.nrfirescience.org/resource/15569

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

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

Year Published: 2014

Type: Document

Technical Report or White Paper

Current climate and recent trends

www.nrfirescience.org/resource/15670

While the paleoclimatic record is based on indirect measurements—for example, biological and geological indicators—more recent climate history is defined largely by in situ observations over the last 100–150 years. This chapter centers on what these observations and theoretical understanding reveal about the climate of North...

Author(s): Kelly T. Redmond, John T. Abatzoglou

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Regional projections of the likelihood of very large wildland fires under a changing climate in the contiguous western United States

www.nrfirescience.org/resource/13006

Seasonal changes in the climatic potential for very large wildfires (VLWF > or = 50,000 ac ~20,234 ha) across the western contiguous United States are projected over the 21st century using generalized linear models and downscaled climate projections for two representative concentration pathways (RCPs). Significant ($p < 0.05$)...

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

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Climate change effects, adaptation, and mitigation

www.nrfirescience.org/resource/15666

Most of us are familiar with the terms climate change and global warming, but not too many of us understand the science behind them. We don't really understand how climate change will affect us, and for that reason we might not consider it as pressing a concern as, say, housing prices or the quality of local education. This book...

Author(s): John T. Abatzoglou, Crystal A. Kolden, J.F.C. DiMento, P. Doughman, S. Nespor

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Front page or "buried" beneath the fold? Media coverage of carbon capture and storage

www.nrfirescience.org/resource/24574

Media can affect public views and opinions on science, policy and risk issues. This is especially true of a controversial emerging technology that is relatively unknown. The study presented here employs a media content analysis of carbon capture and storage (CCS), one potential strategy to reduce greenhouse gas emissions. The...

Author(s): Amanda D. Boyd, Travis B. Paveglio

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Questionable evidence of natural warming of the northwestern United States

www.nrfirescience.org/resource/15655

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

Author(s): John T. Abatzoglou, David E. Rupp, Philip W. Mote

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Briefing: climate and wildfire in western U.S. forests

www.nrfirescience.org/resource/12991

Wildfire in western U.S. federally managed forests has increased substantially in recent decades, with

large (>1000 acre) fires in the decade through 2012 over five times as frequent (450 percent increase) and burned area over ten times as great (930 percent increase) as the 1970s and early 1980s. These changes are closely linked...

Author(s): Anthony L. Westerling, Timothy J. Brown, Tania L. Schoennagel, Thomas W. Swetnam, Monica G. Turner, Thomas T. Veblen

Year Published: 2014

Type: Document

Technical Report or White Paper

Future fire probability modeling with climate change data and physical chemistry

www.nrfirescience.org/resource/15143

Climate has a primary influence on the occurrence and rate of combustion in ecosystems with carbon-based fuels such as forests and grasslands. Society will be confronted with the effects of climate change on fire in future forests. There are, however, few quantitative appraisals of how climate will affect wildland fire in the United...

Author(s): Richard Guyette, Frank R. Thompson, Jodi Whittier, Michael C. Stambaugh, Daniel C. Dey

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

The climate-wildfire-air quality system: interactions and feedbacks across spatial and temporal scales

www.nrfirescience.org/resource/13698

Future climate change and its effects on social and ecological systems present challenges for preserving valued ecosystem services, including local and regional air quality. Wildfire is a major source of air-quality impact in some locations, and a substantial contributor to pollutants of concern, including nitrogen oxides and...

Author(s): E. Natasha Stavros, Donald McKenzie, Narasimhan K. Larkin

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Exploring how deliberation on scientific information shapes stakeholder perceptions of forest management and climate change - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/12967

Climate change has resulted in rapid biophysical changes in forests of the western US and has prompted the need for an increased understanding of potential impacts and adaption measures. Land managers, policy makers, and community officials lack locally relevant climate change science and are urgently calling for research to inform...

Author(s): Troy E. Hall, Jarod Blades

Year Published: 2014

Type: Document

Technical Report or White Paper

Climate change and United States forests

www.nrfirescience.org/resource/12393

This volume offers a scientific assessment of the effects of climatic variability and change on forest resources in the United States. Derived from a report that provides technical input to the 2013 U.S. Global Change Research Program National Climate Assessment, the book serves as a framework for managing U.S. forest resources in...

Author(s): David L. Peterson, James M. Vose, Toral Patel-Weynand

Year Published: 2014
Type: Document
Book or Chapter or Journal Article

Estimating critical climate-driven thresholds in landscape dynamics using spatial simulation modeling: climate change tipping points in fire management - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/11983

Climate projections for the next 20-50 years forecast higher temperatures and variable precipitation for many landscapes in the western United States. Climate changes may cause or contribute to threshold shifts, or tipping points, where relatively small shifts in climate result in large, abrupt, and persistent changes in landscape...

Author(s): Robert E. Keane, Rachel A. Loehman

Year Published: 2013

Type: Document

Technical Report or White Paper

The missing mountain water: slower westerlies decrease orographic enhancement in the Pacific Northwest USA

www.nrfirescience.org/resource/15674

Trends in streamflow timing and volume in the Pacific Northwest United States have been attributed to increased temperatures, because trends in precipitation at lower-elevation stations were negligible. We demonstrate that observed streamflow declines are probably associated with declines in mountain precipitation, revealing...

Author(s): Charles H. Luce, John T. Abatzoglou, Zachary A. Holden

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Postfire changes in forest carbon storage over a 300-year chronosequence of Pinus contorta-dominated forests

www.nrfirescience.org/resource/13540

A warming climate may increase the frequency and severity of stand-replacing wildfires, reducing carbon (C) storage in forest ecosystems. Understanding the variability of postfire C cycling on heterogeneous landscapes is critical for predicting changes in C storage with more frequent disturbance. We measured C pools and fluxes for...

Author(s): Daniel M. Kashian, William H. Romme, Daniel B. Tinker, Monica G. Turner, Michael G. Ryan

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Wildland fire emissions, carbon, and climate: modeling fuel consumption

www.nrfirescience.org/resource/12442

Fuel consumption specifies the amount of vegetative biomass consumed during wildland fire. It is a two-stage process of pyrolysis and combustion that occurs simultaneously and at different rates depending on the characteristics and condition of the fuel, weather, topography, and in the case of prescribed fire, ignition rate and...

Author(s): Roger D. Ottmar

Year Published: 2013

Type: Document

Book or Chapter or Journal Article, Synthesis

Climate change and wildfires

www.nrfirescience.org/resource/12438

Wildland fire regimes are primarily driven by climate/weather, fuels and people. All of these factors are dynamic and their variable interactions create a mosaic of fire regimes around the world. Climate change will have a substantial impact on future fire regimes in many global regions. Current research suggests a general increase...

Author(s): William J. de Groot, Michael D. Flannigan, Brian J. Stocks

Year Published: 2013

Type: Document

Conference Proceedings, Technical Report or White Paper

Appendix 3: Response of western mountain ecosystems to climatic variability and change: a synthesis from the Western Mountain Initiative

www.nrfirescience.org/resource/11904

The Western Mountain Initiative (WMI), a consortium of research groups in the Western United States, focuses on understanding and predicting responses-especially sensitivities, thresholds, resistance, and resilience-of mountain ecosystems to climatic variability and change (Peterson et al. 2012). The WMI addresses how climatic...

Author(s): Crystal L. Raymond

Year Published: 2013

Type: Document

Synthesis, Technical Report or White Paper

The merits of prescribed fire outweigh potential carbon emission effects

www.nrfirescience.org/resource/12426

While North American ecosystems vary widely in their ecology and natural historical fire regimes, they are unified in benefitting from prescribed fire when judiciously applied with the goal of maintaining and restoring native ecosystem composition, structure, and function. On a modern landscape in which historical fire regimes...

Author(s): Association for Fire Ecology, International Association of Wildland Fire, Tall Timbers Research Station, The Nature Conservancy

Year Published: 2013

Type: Document

Technical Report or White Paper

Appendix 1: Regional summaries - Northwest

www.nrfirescience.org/resource/11901

The state of knowledge about climatic effects on forests of the Northwest region was recently summarized in a peer reviewed assessment of these effects in Washington (Littell et al. 2009, 2010) and a white paper on climatic effects on Oregon vegetation (Schafer et al. 2010). Recent PNW and West-wide modeling studies provide...

Author(s): Jeremy S. Littell

Year Published: 2013

Type: Document

Synthesis, Technical Report or White Paper

Impacts of disturbance on the terrestrial carbon budget of North America

www.nrfirescience.org/resource/12404

Because it is an important regulator of terrestrial carbon cycling in North America, extensive research

on natural and human disturbances has been carried out as part of the North American Carbon Program and the CarboNA project. A synthesis of various components of this research was carried out, and the results are presented in the...

Author(s): Eric S. Kasischke, Brian D. Amiro, Nichole N. Barger, Nancy H. F. French, Scott J. Goetz, Guido Grosse, Mark E. Harmon, Jeffrey A. Hicke, Shuguang Liu, Jeffrey G. Masek

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Culture, law, risk and governance: contexts of traditional knowledge in climate change adaptation

www.nrfirescience.org/resource/16973

Traditional knowledge is increasingly recognized as valuable for adaptation to climate change, bringing scientists and indigenous peoples together to collaborate and exchange knowledge. These partnerships can benefit both researchers and indigenous peoples through mutual learning and mutual knowledge generation. Despite these...

Author(s): Terry Williams, Preston Hardison

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

The climate velocity of the contiguous United States during the 20th century

www.nrfirescience.org/resource/15681

Rapid climate change has the potential to affect economic, social, and biological systems. A concern for species conservation is whether or not the rate of on-going climate change will exceed the rate at which species can adapt or move to suitable environments. Here we assess the climate velocity (both climate displacement rate and...

Author(s): Solomon Z. Dobrowski, John T. Abatzoglou, Alan Swanson, Jonathan A. Greenberg, Alison R. Mynsberge, Zachary A. Holden, Michael K. Schwartz

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

The impacts of climate change on ecosystem structure and function

www.nrfirescience.org/resource/12405

Recent climate-change research largely confirms the impacts on US ecosystems identified in the 2009 National Climate Assessment and provides greater mechanistic understanding and geographic specificity for those impacts. Pervasive climate-change impacts on ecosystems are those that affect productivity of ecosystems or their ability...

Author(s): Nancy B. Grimm, F. Stuart Chapin, Britta Bierwagen, Patrick Gonzalez, Peter M. Groffman, Yiqi Luo, Forrest Melton, Knute Nadelhoffer, Amber Pairis, Peter A. Raymond, Josh Schimel, Craig E. Williamson

Year Published: 2013

Type: Document

Book or Chapter or Journal Article, Synthesis

Evaluation of CMIP5 20th century climate simulations for the Pacific Northwest USA

www.nrfirescience.org/resource/15675

Monthly temperature and precipitation data from 41 global climate models (GCMs) of the Coupled Model Intercomparison Project Phase 5 (CMIP5) were compared to observations for the 20th century, with a focus on the United States Pacific Northwest (PNW) and surrounding region. A suite of statistics,

or metrics, was calculated, that...

Author(s): David E. Rupp, John T. Abatzoglou, Katherine C. Hegewisch, Philip W. Mote

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Relationships between climate and macroscale area burned in the western United States

www.nrfirescience.org/resource/12027

Increased wildfire activity (e.g. number of starts, area burned, fire behaviour) across the western United States in recent decades has heightened interest in resolving climate-fire relationships. Macroscale climate-fire relationships were examined in forested and non-forested lands for eight Geographic Area Coordination Centers in...

Author(s): John T. Abatzoglou, Crystal A. Kolden

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

When relationships estimated in the past cannot be used to predict the future: using mechanistic models to predict landscape ecological dynamics in a changing world

www.nrfirescience.org/resource/16834

Researchers and natural resource managers need predictions of how multiple global changes (e.g., climate change, rising levels of air pollutants, exotic invasions) will affect landscape composition and ecosystem function. Ecological predictive models used for this purpose are constructed using either a mechanistic (process-based) or...

Author(s): Eric J. Gustafson

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Climate change in the Northwest

www.nrfirescience.org/resource/15673

In understanding causes of changes in global or regional climate, scientists often distinguish between processes external to the climate system and processes internal to the climate system. External processes include solar and volcanic forcings and the long-lived greenhouse gases. Internal processes include fluctuations in water...

Author(s): Philip W. Mote, John T. Abatzoglou, Kenneth E. Kunkel

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Cultural impacts to tribes from climate change influences on forests

www.nrfirescience.org/resource/16123

Climate change related impacts, such as increased frequency and intensity of wildfires, higher temperatures, extreme changes to ecosystem processes, forest conversion and habitat degradation are threatening tribal access to valued resources. Climate change is and will affect the quantity and quality of resources tribes depend upon...

Author(s): Garrett Voggesser, Kathy Lynn, John Daigle, Frank K. Lake, Darren Ranko

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Wildfire and fuel treatment effects on forest carbon dynamics in the western United States

www.nrfirescience.org/resource/11981

Sequestration of carbon (C) in forests has the potential to mitigate the effects of climate change by offsetting future emissions of greenhouse gases. However, in dry temperate forests, wildfire is a natural disturbance agent with the potential to release large fluxes of C into the atmosphere. Climate-driven increases in wildfire...

Author(s): Joseph C. Restaino, David L. Peterson

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Climatic stress increases forest fire severity across the western United States

www.nrfirescience.org/resource/12012

Pervasive warming can lead to chronic stress on forest trees, which may contribute to mortality resulting from fire-caused injuries. Longitudinal analyses of forest plots from across the western US show that high pre-fire climatic water deficit was related to increased post-fire tree mortality probabilities. This relationship...

Author(s): Phillip J. van Mantgem, Jonathan C. B. Nesmith, MaryBeth Keifer, Eric E. Knapp, Alan L. Flint, Lorraine E. Flint

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Assessing social vulnerability to climate change in human communities near public forests and grasslands: a framework for resource managers and planners

www.nrfirescience.org/resource/14673

Public land management agencies have incorporated the concept of vulnerability into protocols for assessing and planning for climate change impacts on public forests and grasslands. However, resource managers and planners have little guidance for how to address the social aspects of vulnerability in these assessments and plans....

Author(s): A. Paige Fischer, Travis B. Paveglio, Matthew S. Carroll, Daniel Murphy, Hannah Brenkert-Smith

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Do carbon offsets work? The role of forest management in greenhouse gas mitigation

www.nrfirescience.org/resource/12450

As forest carbon offset projects become more popular, professional foresters are providing their expertise to support them. But when several members of the Society of American Foresters questioned the science and assumptions used to design the projects, the organization decided to convene a task force to examine whether these...

Author(s): Marie Oliver

Year Published: 2013

Type: Document

Research Brief or Fact Sheet

Bridging natural resource communication boundaries: public perceptions of smoke from wildland fires and forest managers' perspectives of climate change science

www.nrfirescience.org/resource/13479

Land managers of the northern Rocky Mountains and south-central U.S. are challenged with numerous social and ecological changes, many of which are linked to climate change. The work presented here focuses on two important research gaps: 1) managers do not understand public opinions toward smoke from prescribed fires (a necessary...

Author(s): Jarod Blades

Year Published: 2013

Type: Document

Dissertation or Thesis

Consequences of spatial heterogeneity for ecosystem services in changing forest landscapes: priorities for future research

www.nrfirescience.org/resource/13431

Changes in key drivers (e.g., climate, disturbance regimes and land use) may affect the sustainability of forest landscapes and set the stage for increased tension among competing ecosystem services. We addressed two questions about a suite of supporting, regulating and provisioning ecosystem services in each of two well-studied...

Author(s): Monica G. Turner, Daniel C. Donato, William H. Romme

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Managing forests and fire in changing climates

www.nrfirescience.org/resource/12433

With projected climate change, we expect to face much more forest fire in the coming decades. Policy-makers are challenged not to categorize all fires as destructive to ecosystems simply because they have long flame lengths and kill most of the trees within the fire boundary. Ecological context matters: In some ecosystems, high-...

Author(s): Scott L. Stephens, James K. Agee, Peter Z. Fule, Malcolm P. North, William H. Romme, Thomas W. Swetnam, Monica G. Turner

Year Published: 2013

Type: Document

Book or Chapter or Journal Article, Synthesis

The impacts of changing disturbance regimes on serotinous plant populations and communities

www.nrfirescience.org/resource/12406

Climatic change is anticipated to alter disturbance regimes for many ecosystems. Among the most important effects are changes in the frequency, size, and intensity of wildfires. Serotiny (long-term canopy storage and the heat-induced release of seeds) is a fire-resilience mechanism found in many globally important terrestrial...

Author(s): Brian Buma, Carissa D. Brown, Daniel C. Donato, Joseph B. Fontaine, Jill F. Johnstone

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Drought seasonality explains patterns in widespread aspen forest mortality across the western United States

www.nrfirescience.org/resource/15679

Globally documented widespread drought-induced forest mortality has important ramifications for plant community structure, ecosystem function, and the ecosystem services provided by forests. Yet the characteristics of drought seasonality, severity, and duration that trigger mortality events have received little attention despite...

Author(s): Leander Anderegg, William R.L. Anderegg, John T. Abatzoglou, Alexandra M. Hausladen, Joseph A. Berry
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

Aquatic species invasions in the context of fire and climate change

www.nrfirescience.org/resource/11273

This paper focuses on the nexus among native and nonnative fishes with respect to fire and climate change in the western United States. Although many taxa are involved, I emphasize native and nonnative salmonids because these are obligate coldwater species that might be expected to respond strongly to fire and because most research...

Author(s): Michael K. Young

Year Published: 2012

Type: Document

Technical Report or White Paper

Climate change, forests, fire, water, and fish: building resilient landscapes, streams, and managers

www.nrfirescience.org/resource/11270

Fire will play an important role in shaping forest and stream ecosystems as the climate changes. Historic observations show increased dryness accompanying more widespread fire and forest die-off. These events punctuate gradual changes to ecosystems and sometimes generate stepwise changes in ecosystems. Climate vulnerability...

Author(s): Charles H. Luce, Penelope Morgan, Kathleen A. Dwire, Daniel J. Isaak, Zachary A. Holden, Bruce E. Rieman

Year Published: 2012

Type: Document

Technical Report or White Paper

What are Plants Doing and When? Using Plant Phenology to Promote Sustainable Natural Resources Management

www.nrfirescience.org/resource/18955

Climate change models for the northern Rocky Mountains predict changes in temperature and water availability that in turn will alter vegetation. Changes include timing of plant life-history events, or phenology, such as green-up, flowering and senescence, and shifts in species composition. Moreover, climate changes may favor...

Author(s): Geneva W. Chong, Leslie A. Allen

Year Published: 2012

Type: Document

Research Brief or Fact Sheet

Experimental forests and climate change: views of long-term employees on ecological change and the role of Experimental Forests and Ranges in understanding and adapting to climate change

www.nrfirescience.org/resource/11278

In this project, we examined the views of 21 long-term employees on climate change in 14 Rocky Mountain Research Station Experimental Forests and Ranges (EFRs). EFRs were described by employees as uniquely positioned to advance knowledge of climate change impacts and adaptation strategies due to the research integrity they provide...

Author(s): Laurie Yung, Mason Bradbury, Daniel R. Williams

Year Published: 2012
Type: Document
Technical Report or White Paper

Chapter 2: Effects of climatic variability and change

www.nrfirescience.org/resource/12588

Climate profoundly shapes forests. Forest species composition, productivity, availability of goods and services, disturbance regimes, and location on the landscape are all regulated by climate. Much research attention has focused on the problem of projecting the response of forests to changing climate, elevated atmospheric carbon...

Author(s): Michael G. Ryan, James M. Vose
Year Published: 2012
Type: Document
Synthesis, Technical Report or White Paper

Can climate change increase fire severity independent of fire intensity? - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/11228

We tested the idea that climate may affect forest fire severity independent of fire intensity. Pervasive warming can lead to chronic stress on forest trees (McDowell et al. 2008; Raffa et al. 2008), resulting in higher sensitivity to fire-induced damage (van Mantgem et al. 2003). Thus, there may be ongoing increases in fire severity...

Author(s): Phillip J. van Mantgem, MaryBeth Keifer, Robert C. Klinger, Eric E. Knapp
Year Published: 2012
Type: Document
Technical Report or White Paper

Effects of climatic variability and change on forest ecosystems: a comprehensive science synthesis for the U.S. forest sector

www.nrfirescience.org/resource/12567

This report is a scientific assessment of the current condition and likely future condition of forest resources in the United States relative to climatic variability and change. It serves as the U.S. Forest Service forest sector technical report for the National Climate Assessment and includes descriptions of key regional issues and...

Year Published: 2012
Type: Document
Synthesis, Technical Report or White Paper

Climate change in grasslands, shrublands, and deserts of the interior American West: a review and needs assessment

www.nrfirescience.org/resource/11267

Recent research and species distribution modeling predict large changes in the distributions of species and vegetation types in the western interior of the United States in response to climate change. This volume reviews existing climate models that predict species and vegetation changes in the western United States, and it...

Author(s): Deborah M. Finch
Year Published: 2012
Type: Document
Synthesis, Technical Report or White Paper

Effect of crown class and habitat type on climate-growth relationships of ponderosa pine and Douglas-fir

www.nrfirescience.org/resource/11938

There is increasing interest in actively managing forests to increase their resilience to climate-related changes. Although forest managers rely heavily on the use of silvicultural treatments that manipulate stand structure and stand dynamics to modify responses to climate change, few studies have directly assessed the effects of...

Author(s): Gunnar C. Carnwath, David W. Peterson, Cara R. Nelson

Year Published: 2012

Type: Document

Book or Chapter or Journal Article

Adaptation: planning for climate change and its effects on federal lands

www.nrfirescience.org/resource/12449

National forest managers are charged with tackling the effects of climate change on the natural resources under their care. The Forest Service National Roadmap for Responding to Climate Change and the Climate Change Performance Scorecard require managers to make significant progress in addressing climate change by 2015. To help land...

Author(s): Marie Oliver

Year Published: 2012

Type: Document

Research Brief or Fact Sheet

Fuel treatment impacts on estimated wildfire carbon loss from forests in Montana, Oregon, California, and Arizona

www.nrfirescience.org/resource/8324

Using forests to sequester carbon in response to anthropogenically induced climate change is being considered across the globe. A recent U.S. executive order mandated that all federal agencies account for sequestration and emissions of greenhouse gases, highlighting the importance of understanding how forest carbon stocks are...

Author(s): Scott L. Stephens, Ralph E. Boerner, Jason J. Moghaddas, Emily E. Y. Moghaddas, Brandon M. Collins, Christopher B. Dow, Carleton B. Edminster, Carl E. Fiedler, Danny L. Fry, Bruce R. Hartsough, Jon E. Keeley, Eric E. Knapp, James D. McIver, Carl N. Skinner

Year Published: 2012

Type: Document

Book or Chapter or Journal Article

Climate extremes and their linkage to regional drought over Idaho, USA

www.nrfirescience.org/resource/15683

To investigate consequences of climate extreme and variability on agriculture and regional water resource, twenty-seven climatic indices of temperature and precipitation over Idaho, USA, were computed. Precipitation, mean temperature and maximum temperature, self-calibrated Palmer Drought Index and Standardized Precipitation Index...

Author(s): Mohammad Sohrabi, Jae H. Ryu, John T. Abatzoglou, John Tracy

Year Published: 2012

Type: Document

Book or Chapter or Journal Article

Synthesis of knowledge: fire history and climate change

www.nrfirescience.org/resource/12582

This report synthesizes available fire history and climate change scientific knowledge to aid managers

with fire decisions in the face of ongoing 21st Century climate change. Fire history and climate change (FHCC) have been ongoing for over 400 million years of Earth history, but increasing human influences during the Holocene epoch...

Author(s): William T. Sommers, Stanley G. Coloff, Susan G. Conard

Year Published: 2011

Type: Document

Synthesis, Technical Report or White Paper

Continued warming could transform Greater Yellowstone fire regimes by mid-21st century

www.nrfirescience.org/resource/8358

Climate change is likely to alter wildfire regimes, but the magnitude and timing of potential climate-driven changes in regional fire regimes are not well understood. We considered how the occurrence, size, and spatial location of large fires might respond to climate projections in the Greater Yellowstone ecosystem (GYE) (Wyoming),...

Author(s): Anthony L. Westerling, Monica G. Turner, Erica A. H. Smithwick, William H. Romme, Michael G. Ryan

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Fire and fish dynamics in a changing climate

www.nrfirescience.org/resource/13509

Wildland fire is a natural disturbance that affects the distribution and abundance of native fishes in the Rocky Mountain West (Rieman and others 2003). Fire can remove riparian vegetation, increasing direct solar radiation to the stream surface and leading to warmer summer water temperatures. Fire can also consume vegetation and...

Author(s): Lisa M. Holsinger, Robert E. Keane

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

A comparison of statistical downscaling methods suited for wildfire applications

www.nrfirescience.org/resource/11973

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

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

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Modeling climate changes and wildfire interactions: effects on whitebark pine (*Pinus albicaulis*) and implications for restoration, Glacier National Park, Montana, USA

www.nrfirescience.org/resource/11897

Climate changes are projected to profoundly influence vegetation patterns and community compositions, either directly through increased species mortality and shifts in species distributions, or indirectly through disturbance dynamics such as increased wildfire activity and extent, shifting fire regimes, and pathogenesis. High-...

Author(s): Rachel A. Loehman, Allissa Corrow, Robert E. Keane

Year Published: 2011

Type: Document
Conference Proceedings

Changes in climatic water balance drive downhill shifts in plant species optimum elevations

www.nrfirescience.org/resource/15690

Uphill shifts of species' distributions in response to historical warming are well documented, which leads to widespread expectations of continued uphill shifts under future warming. Conversely, downhill shifts are often considered anomalous and unrelated to climate change. By comparing the altitudinal distributions of 64 plant...

Author(s): Shawn M. Crimmins, Solomon Z. Dobrowski, Jonathan A. Greenberg, John T. Abatzoglou, Alison R. Mynsberge

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Can fuel-reduction treatments really increase forest carbon storage in the western US by reducing future fire emissions?

www.nrfirescience.org/resource/8300

It has been suggested that thinning trees and other fuel-reduction practices aimed at reducing the probability of high-severity forest fire are consistent with efforts to keep carbon (C) sequestered in terrestrial pools, and that such practices should therefore be rewarded rather than penalized in C-accounting schemes. By evaluating...

Author(s): John L. Campbell, Mark E. Harmon, Stephen R. Mitchell

Year Published: 2011

Type: Document

Book or Chapter or Journal Article, Synthesis

It's a small world - How oceans and the climate can affect wildland fires thousands of miles away

www.nrfirescience.org/resource/8331

Sometimes it is hard to study the past. This is especially true if the past you want to study was hundreds or thousands of years ago. It is made more difficult if the past you want to study has no written records. Some scientists, such as archeologists and paleontologists, use items from the past as clues. Archeologists usually use...

Author(s): Barbara McDonald, Jessica Nickelsen, Michelle Andrews, Rachel Small

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

A synthesis of current knowledge on forests and carbon storage in the United States

www.nrfirescience.org/resource/12598

Using forests to mitigate climate change has gained much interest in science and policy discussions. We examine the evidence for carbon benefits, environmental and monetary costs, risks and trade-offs for a variety of activities in three general strategies: (1) land use change to increase forest area (afforestation) and avoid...

Author(s): Duncan C. McKinley, Michael G. Ryan, Richard A. Birdsey, Christian P. Giardina, Mark E. Harmon, Linda S. Heath, Richard A. Houghton, Robert B. Jackson, James F. Morrison, Brian C.

Murray, Diane E. Pataki, Kenneth E. Skog

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Forest responses to climate change in the northwestern United States: ecophysiological foundations for adaptive management

www.nrfirescience.org/resource/8297

Climate change resulting from increased concentrations of atmospheric carbon dioxide ([CO₂]) is expected to result in warmer temperatures and changed precipitation regimes during this century. In the northwestern U.S., these changes will likely decrease snowpack, cause earlier snowmelt, increase summer evapotranspiration, and...

Author(s): Daniel J. Chmura, Paul D. Anderson, Glenn T. Howe, Constance A. Harrington, Jessica E. Halofsky, David L. Peterson, David C. Shaw, J. Brad St. Clair

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Wildfire extent and severity correlated with annual streamflow distribution and timing in the Pacific Northwest, USA (1984-2005)

www.nrfirescience.org/resource/8375

Climate change effects on wildfire occurrence have been attributed primarily to increases in temperatures causing earlier snowpack ablation and longer fire seasons. Variability in precipitation is also an important control on snowpack accumulation and, therefore, on timing of meltwater inputs. We evaluate the correlation of total...

Author(s): Zachary A. Holden, Charles H. Luce, Michael A. Crimmins, Penelope Morgan

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Modeling effects of climate change and fire management on western white pine (*Pinus monticola*) in the northern rocky mountains, USA

www.nrfirescience.org/resource/13512

Climate change is projected to profoundly influence vegetation patterns and community compositions, either directly through increased species mortality and shifts in species distributions or indirectly through disturbance dynamics such as increased wildfire activity and extent, shifting fire regimes, and pathogenesis. Mountainous...

Author(s): Rachel A. Loehman, Jason A. Clark, Robert E. Keane

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Disturbance ecology of high-elevation five-needle pine ecosystems in western North America

www.nrfirescience.org/resource/11896

This paper synthesizes existing information about the disturbance ecology of high-elevation five-needle pine ecosystems, describing disturbances regimes, how they are changing or are expected to change, and the implications for ecosystem persistence. As it provides the context for ecosystem conservation/restoration programs, we...

Author(s): Elizabeth M. Campbell, Robert E. Keane, Evan R. Larson, Michael P. Murray, Anna W. Schoettle, Carmen Wong

Year Published: 2011

Type: Document

Conference Proceedings, Synthesis

Responding to climate change in national forests: a guidebook for developing adaptation options

www.nrfirescience.org/resource/13428

This guidebook contains science-based principles, processes, and tools necessary to assist with developing adaptation options for national forest lands. The adaptation process is based on partnerships between local resource managers and scientists who work collaboratively to understand potential climate change effects, identify...

Author(s): David L. Peterson, Constance I. Millar, Linda A. Joyce, Michael J. Furniss, Jessica E. Halofsky, Ronald P. Neilson, Toni Lyn Morelli

Year Published: 2011

Type: Document

Synthesis, Technical Report or White Paper

Climate change in western US deserts: potential for increased wildfire and invasive annual grasses

www.nrfirescience.org/resource/15691

Anthropogenic climate change is hypothesized to modify the spread of invasive annual grasses across the deserts of the western United States. The influence of climate change on future invasions depends on both climate suitability that defines a potential species range and the mechanisms that facilitate invasions and contractions. A...

Author(s): John T. Abatzoglou, Crystal A. Kolden

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Estimating the vulnerability of fifteen tree species under changing climate in Northwest North America

www.nrfirescience.org/resource/16883

In the Pacific northwestern(PNW)region of North America, climatic conditions have significantlywarmed since a predominantly cool phase of the Pacific North American circulation patterns between 1950 and 1975. What are the implications of this shift in climate for the vulnerability of native tree species? To address this question, we...

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

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Sink or source? Fire and the forest carbon cycle

www.nrfirescience.org/resource/12620

As the size and severity of fires in the western U.S. continue to increase, it has become ever more important to understand carbon dynamics in response to fire. Many subalpine forests experience stand-replacing wildfires, and these fires and subsequent recovery can change the amount of carbon released to the atmosphere...

Author(s): Christine Frame

Year Published: 2010

Type: Document

Research Brief or Fact Sheet

Effects of climate change and wildfire on stream temperatures and salmonid thermal habitat in a mountain river network

www.nrfirescience.org/resource/11440

Mountain streams provide important habitats for many species, but their faunas are especially vulnerable to climate change because of ectothermic physiologies and movements that are constrained to linear networks that are easily fragmented. Effectively conserving biodiversity in these systems requires accurate downscaling of...

Author(s): Daniel J. Isaak, Charles H. Luce, Bruce E. Rieman, David E. Nagel, Erin E. Peterson, Dona L. Horan, Sharon Parkes, Gwynne L. Chandler

Year Published: 2010

Type: Document

Book or Chapter or Journal Article

A synthesis of the science on forests and carbon for U.S. forests

www.nrfirescience.org/resource/12589

Forests play an important role in the U.S. and global carbon cycle, and carbon sequestered by U.S. forest growth and harvested wood products currently offsets 12-19% of U.S. fossil fuel emissions. The cycle of forest growth, death, and regeneration and the use of wood removed from the forest complicate efforts to understand and...

Author(s): Michael G. Ryan, Mark E. Harmon, Richard A. Birdsey, Christian P. Giardina, Linda S. Heath, Richard A. Houghton, Robert B. Jackson, Duncan C. McKinley, James F. Morrison, Brian C. Murray, Diane E. Pataki, Kenneth E. Skog

Year Published: 2010

Type: Document

Book or Chapter or Journal Article

Fire and climate variation in western North America from fire-scar and tree-ring networks

www.nrfirescience.org/resource/8221

Fire regimes (i.e., the pattern, frequency and intensity of fire in a region) reflect a complex interplay of bottom-up and top-down controls (Lertzman et al., 1998; McKenzie et al., in press). Bottom-up controls include local variations in topographic, fuel and weather factors at the time of a burn (e.g., fuel moisture and...

Author(s): Donald A. Falk, Emily K. Heyerdahl, Peter M. Brown, Thomas W. Swetnam, Elaine Kennedy Sutherland, Ze'ev Gedalof, Larissa L. Yocom, Timothy J. Brown

Year Published: 2010

Type: Document

Book or Chapter or Journal Article, Synthesis

Fire-climate interactions in the American west since 1400 CE

www.nrfirescience.org/resource/11992

Despite a strong anthropogenic fingerprint on 20th Century wildland fire activity in the American West, climate remains a main driver. A better understanding of the spatiotemporal variability in fire-climate interactions is therefore crucial for fire management. Here, we present annually resolved, tree-ring based fire records for...

Author(s): Valerie Trouet, Alan H. Taylor, Eugene R. Wahl, Carl N. Skinner

Year Published: 2010

Type: Document

Book or Chapter or Journal Article

A century of climate and ecosystem change in Western Montana: what do temperature trends portend?

www.nrfirescience.org/resource/13097

The physical science linking human-induced increases in greenhouse gasses to the warming of the global climate system is well established, but the implications of this warming for ecosystem processes

and services at regional scales is still poorly understood. Thus, the objectives of this work were to: (1) describe rates of change in...

Author(s): Gregory T. Pederson, Lisa Graumlich, Daniel B. Fagre, Todd Kipfer, Clint C. Muhlfeld

Year Published: 2010

Type: Document

Book or Chapter or Journal Article

Effects of fuel treatments on carbon-disturbance relationships in forests of the Northern Rocky Mountains

www.nrfirescience.org/resource/8188

Fuel treatments alter conditions in forested stands at the time of the treatment and subsequently. Fuel treatments reduce on-site carbon and also change the fire potential and expected outcome of future wildfires, including their carbon emissions. We simulated effects of fuel treatments on 140 stands representing seven major habitat...

Author(s): Elizabeth D. Reinhardt, Lisa M. Holsinger

Year Published: 2010

Type: Document

Book or Chapter or Journal Article

Prescribed fire as a means of reducing forest carbon emissions in the western United States

www.nrfirescience.org/resource/8328

Carbon sequestration by forested ecosystems offers a potential climate change mitigation benefit. However, wildfire has the potential to reverse this benefit. In the western United States, climate change and land management practices have led to increases in wildfire intensity and size. One potential means of reducing carbon...

Author(s): Christine Wiedinmyer, Matthew D. Hurteau

Year Published: 2010

Type: Document

Book or Chapter or Journal Article

Carbon concentrations and carbon pool distributions in dry, moist, and cold mid-aged forests of the Rocky Mountains

www.nrfirescience.org/resource/8416

Although 'carbon' management may not be a primary objective in forest management, influencing the distribution, composition, growth, and development of biomass to fulfill multiple objectives is; therefore, given a changing climate, managing carbon could influence future management decisions. Also, typically, the conversion from...

Author(s): Theresa B. Jain, Russell T. Graham, David Adams

Year Published: 2010

Type: Document

Conference Proceedings

Climate change and bark beetles of the western United States and Canada: direct and indirect effects

www.nrfirescience.org/resource/8219

Climatic changes are predicted to significantly affect the frequency and severity of disturbances that shape forest ecosystems. We provide a synthesis of climate change effects on native bark beetles, important mortality agents of conifers in western North America. Because of differences in temperature-dependent life-history...

Author(s): Barbara J. Bentz, Jacques Regniere, Christopher J. Fettig, E. Matthew Hansen, Jane L. Hayes, Jeffrey A. Hicke, Rick G. Kelsey, Jose F. Negrón, Steven J. Seybold

Year Published: 2010
Type: Document
Book or Chapter or Journal Article, Synthesis

Managing for multiple resources under climate change: National Forests

www.nrfirescience.org/resource/13435

This study explores potential adaptation approaches in planning and management that the United States Forest Service might adopt to help achieve its goals and objectives in the face of climate change. Availability of information, vulnerability of ecological and socio-economic systems, and uncertainties associated with climate change...

Author(s): Linda A. Joyce, Geoffrey M. Blate, Steven G. McNulty, Constance I. Millar, Susanne Moser, Ronald P. Neilson, David L. Peterson

Year Published: 2009

Type: Document

Book or Chapter or Journal Article

Global warming and stress complexes in forests of western North America

www.nrfirescience.org/resource/8360

A warmer climate in western North America will likely affect forests directly through soil moisture stress and indirectly through increased extent and severity of disturbances. We propose that stress complexes, combinations of biotic and abiotic stresses, compromise the vigor and ultimate sustainability of forest ecosystems. Across...

Author(s): Donald McKenzie, David L. Peterson, Jeremy J. Littell

Year Published: 2009

Type: Document

Book or Chapter or Journal Article, Synthesis

Understanding the science of climate change: talking points - impacts to prairie potholes and grasslands

www.nrfirescience.org/resource/11144

Climate changes in the Prairie Potholes and Grasslands bioregion include increased seasonal, annual, minimum, and maximum temperature and changing precipitation patterns. Because the region is relatively dry with a strong seasonal climate, it is sensitive to climatic changes and vulnerable to changes in climatic regime. For example...

Author(s): Rachel A. Loehman

Year Published: 2009

Type: Document

Technical Report or White Paper

Climate and wildfire area burned in western U.S. ecoprovinces, 1916-2003

www.nrfirescience.org/resource/8228

The purpose of this paper is to quantify climatic controls on the area burned by fire in different vegetation types in the western United States. We demonstrate that wildfire area burned (WFAB) in the American West was controlled by climate during the 20th century (1916-2003). Persistent ecosystem-specific correlations between...

Author(s): Jeremy S. Littell, Donald McKenzie, David L. Peterson, Anthony L. Westerling

Year Published: 2009

Type: Document

Book or Chapter or Journal Article

Modeling the effects of fire and climate change on carbon and nitrogen storage in lodgepole pine (*Pinus contorta*) stands

www.nrfirescience.org/resource/13547

The interaction between disturbance and climate change and resultant effects on ecosystem carbon (C) and nitrogen (N) fluxes are poorly understood. Here, we model (using CENTURY version 4.5) how climate change may affect C and N fluxes among mature and regenerating lodgepole pine (*Pinus contorta* var. *latifolia* Engelm. ex S. Wats.)...

Author(s): Erica A. H. Smithwick, Michael G. Ryan, Daniel M. Kashian, William H. Romme, Daniel B. Tinker, Monica G. Turner

Year Published: 2009

Type: Document

Book or Chapter or Journal Article

Climate and wildfire area burned in western US ecoprovinces, 1916-2003

www.nrfirescience.org/resource/18977

The purpose of this paper is to quantify climatic controls on the area burned by fire in different vegetation types in the western United States. We demonstrate that wildfire area burned (WFAB) in the American West was controlled by climate during the 20th century (1916–2003). Persistent ecosystem-specific correlations between...

Author(s): Jeremy S. Littell, Donald McKenzie, David L. Peterson, Anthony L. Westerling

Year Published: 2009

Type: Document

Book or Chapter or Journal Article

Understanding the science of climate change: talking points - impacts to western mountains and forests

www.nrfirescience.org/resource/11213

Observed climate changes in the Western Mountains and Forests bioregion include increased seasonal, annual, minimum, and maximum temperatures, altered precipitation patterns, and a shift toward earlier timing of peak runoff. These climatic changes have resulted in widespread mortality in western forests, species range shifts and...

Author(s): Rachel A. Loehman, Greer Anderson

Year Published: 2009

Type: Document

Technical Report or White Paper

Climate and fire in the northern Rockies: past, present, and future

www.nrfirescience.org/resource/11080

The Northern Rocky Mountains have sustained wildfire for centuries. Fires are widespread throughout the region during certain years, most recently in 2000, 2003, 2006, and 2007. However, until very recently there was little understanding of whether such years of widespread fire occurred prior to the 20th century or of the role of...

Author(s): Rachel Clark

Year Published: 2009

Type: Document

Research Brief or Fact Sheet

Landscape heterogeneity following large fires: insights from Yellowstone National Park, USA

www.nrfirescience.org/resource/8198

We characterised the remarkable heterogeneity following the large, severe fires of 1988 in Yellowstone National Park (YNP), in the northern Rocky Mountains, Wyoming, USA, by focussing on spatial

variation in post-fire structure, composition and ecosystem function at broad, meso, and fine scales. Ecological heterogeneity at multiple...

Author(s): Tania L. Schoennagel, Erica A. H. Smithwick, Monica G. Turner

Year Published: 2008

Type: Document

Book or Chapter or Journal Article

Multi-season climate synchronized historical fires in dry forests (1650-1900), Northern Rockies, USA

www.nrfirescience.org/resource/8388

Our objective was to infer the climate drivers of regionally synchronous fire years in dry forests of the U.S. northern Rockies in Idaho and western Montana. During our analysis period (1650-1900), we reconstructed fires from 9245 fire scars on 576 trees (mostly ponderosa pine, *Pinus ponderosa* P....

Author(s): Emily K. Heyerdahl, Penelope Morgan, James P. Riser

Year Published: 2008

Type: Document

Book or Chapter or Journal Article

Climate and forest wildfire in the western US

www.nrfirescience.org/resource/8183

This chapter has three goals. First, to define what climate, as opposed to weather, is, and to explain what this implies for climate versus weather forecasts. Second, to describe the scientific community's current understanding of the relationships between climate variability and forest wildfire in the western United States. And...

Author(s): Anthony L. Westerling

Year Published: 2008

Type: Document

Book or Chapter or Journal Article, Synthesis

Climate change effects on historical range and variability of two large landscapes in western Montana, USA

www.nrfirescience.org/resource/8162

Quantifying the historical range and variability of landscape composition and structure using simulation modeling is becoming an important means of assessing current landscape condition and prioritizing landscapes for ecosystem restoration. However, most simulated time series are generated using static climate conditions which fail...

Author(s): Robert E. Keane, Lisa M. Holsinger, Russell A. Parsons, Kathy L. Gray

Year Published: 2008

Type: Document

Book or Chapter or Journal Article

Charcoal and carbon storage in forest soils of the Rocky Mountain West

www.nrfirescience.org/resource/7920

Charcoal represents a super-passive form of carbon (C) that is generated during fire events and is one of the few legacies of fire recorded in the soil profile; however, the importance of this material as a form of C storage has received only limited scientific attention. Here, we review the formation of charcoal in temperate and...

Author(s): Thomas H. DeLuca, Gregory H. Aplet

Year Published: 2008

Type: Document

Book or Chapter or Journal Article, Synthesis

Multi-season climate synchronized forest fires throughout the 20th century, Northern Rockies, USA

www.nrfirescience.org/resource/8163

We inferred climate drivers of 20th-century years with regionally synchronous forest fires in the U.S. northern Rockies. We derived annual fire extent from an existing fire atlas that includes 5,038 fire polygons recorded from 12,070,086 ha, or 71% of the forested land in Idaho and Montana west of the Continental Divide. The 11...

Author(s): Penelope Morgan, Emily K. Heyerdahl, Carly E. Gibson

Year Published: 2008

Type: Document

Book or Chapter or Journal Article

Climate change impacts on northwestern and intermountain United States rangelands

www.nrfirescience.org/resource/8327

Our focus is on the Pacific Northwest and Intermountain Region including the Great Basin, Columbia Plateau, Colorado Plateau, and surrounding areas. The climate of this large, arid to semiarid region is defined by generally low and highly variable precipitation. Much of the yearly precipitation arrives as winter snow because most of...

Author(s): Jeanne C. Chambers, Michael L. Pellant

Year Published: 2008

Type: Document

Book or Chapter or Journal Article

The fire-climate connection

www.nrfirescience.org/resource/11985

JFSP-funded research is exploring and quantifying relationships among the large-scale drivers of climate and the occurrence and extent of wildfire in the various regions of the western United States.

Author(s): Gail Wells

Year Published: 2007

Type: Document

Research Brief or Fact Sheet

Factors in United States Forest Service district rangers' decision to manage a fire for resource benefit

www.nrfirescience.org/resource/21723

United States wildland fire policy and program reviews in 1995 and 2000 required both the reduction of hazardous fuel and recognition of fire as a natural process. Despite the fact that existing policy permits managing natural ignitions to meet resource benefits, or Wildland Fire Use (WFU), most fuel reduction projects rely on...

Author(s): Martha A. Williamson

Year Published: 2007

Type: Document

Book or Chapter or Journal Article

The asymmetry of trends in spring and autumn temperature and circulation regimes over western North America

www.nrfirescience.org/resource/15710

Observational evidence shows that spring temperatures over western North America have undergone significant warming over the past half century, while autumn temperatures have shown relatively little

change. Low-frequency modes of atmospheric variability for spring and autumn are demonstrated to account for a great deal of the...

Author(s): John T. Abatzoglou, Kelly T. Redmond

Year Published: 2007

Type: Document

Book or Chapter or Journal Article

Climate Change: what it means for us, our children, and our grandchildren

www.nrfirescience.org/resource/15711

Most of us are familiar with the terms climate change and global warming, but not too many of us understand the science behind them. We don't really understand how climate change will affect us, and for that reason we might not consider it as pressing a concern as, say, housing prices or the quality of local education. This book...

Author(s): J.F.C. DiMento, P. Doughman

Year Published: 2007

Type: Document

Book or Chapter or Journal Article

Forest fire and climate change in western North America: insights from sediment charcoal records

www.nrfirescience.org/resource/7930

Millennial-scale records of forest fire provide important baseline information for ecosystem management, especially in regions with too few recent fires to describe the historical range of variability. Charcoal records from lake sediments and soil profiles are well suited for reconstructing the incidence of past fire and its...

Author(s): Daniel G. Gavin, Douglas J. Hallett, Feng S. Hu, Kenneth P. Lertzman, Susan J. Prichard, Kendrick J. Brown, Jason A. Lynch, Patrick J. Bartlein, David L. Peterson

Year Published: 2007

Type: Document

Book or Chapter or Journal Article, Synthesis

Carbon storage on landscapes with stand-replacing fires

www.nrfirescience.org/resource/18456

Many conifer forests experience stand-replacing wildfires, and these fires and subsequent recovery can change the amount of carbon released to the atmosphere because conifer forests contain large carbon stores. Stand-replacing fires switch ecosystems to being a net source of carbon as decomposition exceeds photosynthesis—short...

Author(s): Daniel M. Kashian, William H. Romme, Daniel B. Tinker, Monica G. Turner, Michael G. Ryan

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/15713

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

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

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

Carbon storage in coniferous landscapes with stand-replacing fires: effects of fire frequency, post-fire recovery, and ecosystem processes

www.nrfirescience.org/resource/7950

Many conifer forests experience stand-replacing wildfires, and these fires and subsequent recovery can change the amount of carbon released to the atmosphere because conifer forests contain large carbon stores. Stand-replacing fires switch ecosystems to being a net source of carbon as decomposition exceeds photosynthesis - a short-...

Author(s): Donald M. Kashian, William H. Romme, Daniel B. Tinker, Monica G. Turner, Michael G. Ryan

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

Empirical analyses of plant-climate relationships for the western United States

www.nrfirescience.org/resource/11512

The Random Forests multiple-regression tree was used to model climate profiles of 25 biotic communities of the western United States and nine of their constituent species. Analyses of the communities were based on a gridded sample of ca. 140,000 points, while those for the species used presence-absence data from ca. 120,000...

Author(s): Gerald E. Rehfeldt, Nicholas L. Crookston, Marcus V. Warwell, Jeffrey S. Evans

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

Combustion properties of Bromus tectorum L.: influence of ecotype and growth under four CO₂ concentrations

www.nrfirescience.org/resource/11409

We grew from seed the exotic invasive annual grass Bromus tectorum L., collected from three elevation ecotypes in northern Nevada, USA. Plants were exposed to four CO₂ atmosphere concentrations: 270, 320, 370, and 420 $\mu\text{mol mol}^{-1}$. After harvest on day 87, above-ground tissue was milled, conditioned to 30% relative humidity, and...

Author(s): Robert R. Blank, Robert H. White, Lewis H. Ziska

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

Response of western mountain ecosystems to climatic variability and change: the Western Mountain Initiative

www.nrfirescience.org/resource/8157

Mountain ecosystems within our national parks and other protected areas provide valuable goods and services such as clean water, biodiversity conservation, and recreational opportunities, but their potential responses to expected climatic changes are inadequately understood. The Western Mountain Initiative (WMI) is a collaboration...

Author(s): Nathan L. Stephenson, David L. Peterson, Daniel B. Fagre, Craig D. Allen, Donald McKenzie, Jill Baron

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

Regional relationships between climate and wildfire-burned area in the Interior West, USA

www.nrfirescience.org/resource/11507

Recent studies have linked the Atlantic Multidecadal Oscillation (AMO) and the Pacific Decadal Oscillation (PDO) with drought occurrence in the interior United States. This study evaluates the influence of AMO and PDO phases on interannual relationships between climate and wildfire-burned area during the 20th century. Palmer's...

Author(s): Brandon M. Collins, Philip N. Omi, Phillip L. Chapman

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

Carbon cycling at the landscape scale: the effect of changes in climate and fire frequency on age distribution, stand structure, and net ecosystem production - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/11151

We are working in Yellowstone National Park to determine how initial post-fire structural heterogeneity controls carbon dynamics over the full cycle of individual forest stands, and how climate-mediated changes in the fire regime could potentially alter the behavior of the entire Yellowstone ecosystem as a net sink or net source in...

Author(s): Michael G. Ryan, Daniel M. Kashian, Erica A. H. Smithwick, William H. Romme, Monica G. Turner, Daniel B. Tinker

Year Published: 2005

Type: Document

Technical Report or White Paper

Climate drivers of fire and fuel in the Northern Rockies: past, present & future - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/11154

This 3-year research project is identifying the climate drivers of regional fire and fuel dynamics in the Northern Rockies in the past, present, and future. We are identifying regional fire years from two sources: multicentury tree-ring reconstructions and multidecadal fire atlases. To elucidate the climate forcing of past fires, we...

Author(s): Penelope Morgan, Emily K. Heyerdahl, Carol Miller, Matthew G. Rollins

Year Published: 2005

Type: Document

Technical Report or White Paper

Climatic controls of fire in the western United States: from the atmosphere to ecosystems - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/11155

The objective of this project is to conduct a diagnostic analysis of the variations in climate that govern the characteristics of the fire season in the western United States on intra-annual through decadal and longer time scales. We propose a retrospective, model-based analysis to understand better the role of climate as a control...

Author(s): Steven W. Hostetler, Patrick J. Bartlein, Allen M. Solomon, J. O. Holman, Richard T. Busing, Sarah L. Shafer

Year Published: 2005

Type: Document

Technical Report or White Paper

Effects of tree density and stand age on carbon allocation patterns in postfire lodgepole pine

www.nrfirescience.org/resource/8263

Validating the components of the carbon (C) budget in forest ecosystems is essential for developing allocation rules that allow accurate predictions of C pools and fluxes. In addition, a better understanding of the effects of natural disturbances on C cycling is critical, particularly in light of alterations to disturbance regimes...

Author(s): Creighton M. Litton, Michael G. Ryan, Dennis H. Knight

Year Published: 2004

Type: Document

Book or Chapter or Journal Article

The impact of twenty-first century climate change on wildland fire danger in the western United States: an applications perspective

www.nrfirescience.org/resource/8343

High-temporal resolution meteorological output from the Parallel Climate Model (PCM) is used to assess changes in wildland fire danger across the western United States due to climatic changes projected in the 21st century. A business-as-usual scenario incorporating changing greenhouse gas and aerosol concentrations until the year...

Author(s): Timothy J. Brown, Beth L. Hall, Anthony L. Westerling

Year Published: 2004

Type: Document

Book or Chapter or Journal Article

Climate change, carbon, and forestry in northwestern North America: proceedings of a workshop

www.nrfirescience.org/resource/11203

Interactions between forests, climatic change and the Earth's carbon cycle are complex and represent a challenge for forest managers—they are integral to the sustainable management of forests. In this volume, a number of papers are presented that describe some of the complex relationships between climate, the global carbon cycle and...

Author(s): David L. Peterson, John L. Innes, Kelly O'Brian

Year Published: 2004

Type: Document

Technical Report or White Paper

Climatic changes, wildfire, and conservation

www.nrfirescience.org/resource/8156

Climatic variability is a dominant factor affecting large wildfires in the western United States, an observation supported by palaeoecological data on charcoal in lake sediments and reconstructions from fire-scarred trees. Although current fire management focuses on fuel reductions to bring fuel loadings back to their historical...

Author(s): Donald McKenzie, Ze'ev Gedalof, David L. Peterson, Philip W. Mote

Year Published: 2004

Type: Document

Book or Chapter or Journal Article, Synthesis

Mountains, fire, fire suppression, and the carbon cycle in the western United States

www.nrfirescience.org/resource/11044

Most mountain regions in the western United States are covered by forests, which are for the most part recovering from historical harvesting and have been experiencing active fire suppression over approximately the past 100 years (Tilman and others 2000). Whereas many western landscapes are

currently perceived as pristine natural...

Author(s): David S. Schimel

Year Published: 2004

Type: Document

Technical Report or White Paper

The interaction of fire, fuels, and climate across Rocky Mountain forests

www.nrfirescience.org/resource/13583

Understanding the relative influence of fuels and climate on wildfires across the Rocky Mountains is necessary to predict how fires may respond to a changing climate and to define effective fuel management approaches to controlling wildfire in this increasingly populated region. The idea that decades of fire suppression have...

Author(s): Tania L. Schoennagel, Thomas T. Veblen, William H. Romme

Year Published: 2004

Type: Document

Book or Chapter or Journal Article

Western forest, fire risk, and climate change

www.nrfirescience.org/resource/11114

Climate warming may first show up in forests as increased growth, which occurs as warmer temperatures, increased carbon dioxide, and more precipitation encourage higher rates of photosynthesis. The second way that climate change may show up in forests is through changes in disturbance regimes-the long-term patterns of fire, drought...

Author(s): Valerie A. Rapp

Year Published: 2004

Type: Document

Research Brief or Fact Sheet

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

Climate and wildfire in the western United States

www.nrfirescience.org/resource/8184

A 21-yr gridded monthly fire-starts and acres-burned dataset from U.S. Forest Service, Bureau of Land Management, National Park Service, and Bureau of Indian Affairs fire reports recreates the seasonality and interannual variability of wildfire in the western United States. Despite pervasive human influence in western fire regimes,...

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

Year Published: 2003

Type: Document

Book or Chapter or Journal Article

The role of climate and vegetation change in shaping past and future fire regimes in the northwestern U.S. and the implications for ecosystem management

www.nrfirescience.org/resource/8382

Fire is an important part of the disturbance regimes of northwestern US forests and its role in maintaining and altering forest vegetation is evident in the paleoecological record of the region. Long-term reconstructions of Holocene fire regimes, provided by the analysis of charcoal, pollen, and other fire proxies in a network of...

Author(s): Cathy L. Whitlock, Sarah L. Shafer, Jennifer R. Marlon

Year Published: 2003

Type: Document

Book or Chapter or Journal Article

Interannual to decadal drought and wildfire in the western United States

www.nrfirescience.org/resource/8344

Twentieth-century wildfire suppression and land management policies have promoted biomass accumulations in some ecosystems in the western United States where wildfire is a natural and necessary element. These changes have fueled large, stand-replacing crown fires in southwestern ponderosa pine forests, where they were rare under...

Author(s): Anthony L. Westerling, Thomas W. Swetnam

Year Published: 2003

Type: Document

Book or Chapter or Journal Article, Synthesis

Training ecologists to think with uncertainty in mind

www.nrfirescience.org/resource/12642

Predictive capacity is needed to anticipate the consequences of global change. Along with the computational challenges inherent in accounting for uncertainty in models of ecological and physical processes related to global change, we face educational challenges related to developing the intellectual capital for thinking with...

Author(s): Carol A. Brewer, Louis J. Gross

Year Published: 2003

Type: Document

Book or Chapter or Journal Article, Synthesis

Climate change and forest disturbances

www.nrfirescience.org/resource/13399

This article examines how eight disturbances influence forest structure, composition, and function, and how climate change may influence the severity, frequency, and magnitude of disturbances to forests. We focus on examples from the United States, although these influences occur worldwide. We also consider options for coping with...

Author(s): Virginia H. Dale, Linda A. Joyce, Ronald P. Neilson, Steven G. McNulty, Matthew P. Ayres, Michael D. Flannigan, Paul J. Hanson, Lloyd C. Irland, Ariel L. Lugo, Chris J. Peterson, Daniel Simberloff, Frederick J. Swanson, Brian J. Stocks, B. Mike Wotton

Year Published: 2001

Type: Document

Book or Chapter or Journal Article

Are old forests underestimated as global carbon sinks?

www.nrfirescience.org/resource/7916

Old forests are important carbon pools, but are thought to be insignificant as current atmospheric carbon sinks. This perception is based on the assumption that changes in productivity with age in complex, multiaged, multispecies natural forests can be modelled simply as scaled-up versions of individual trees or even-aged stands....

Author(s): Elieen V. Carey, Anna Sala, Robert E. Keane, Ragan M. Callaway

Year Published: 2001

Type: Document

Book or Chapter or Journal Article

Interactions between fire, grazing, and climate change at Wind Cave National Park, SD

www.nrfirescience.org/resource/7909

Projected changes in global climate have important ramifications for the future of national parks and other reserves set aside to conserve ecological uniqueness. We explored potential implications of climatic changes on lifeform distribution and growth at Wind Cave National Park (WCNP), South Dakota, which lies on a climatically...

Author(s): Dominique Bachelet, James M. Lenihan, Christopher Daly, Ronald P. Neilson

Year Published: 2000

Type: Document

Book or Chapter or Journal Article

Fire-climate interactions in the Selway-Bitterroot Wilderness area

www.nrfirescience.org/resource/11887

Tree-ring reconstructed summer drought was examined in relation to the occurrence of 15 fires in the Selway-Bitterroot Wilderness Area (SBW). The ten largest fire years between 1880 and 1995 were selected from historical fire atlas data; five additional fire years were selected from a fire history completed in a subalpine forest...

Author(s): Kurt F. Kipfmüller, Thomas W. Swetnam

Year Published: 2000

Type: Document

Conference Proceedings

Assessing simulated ecosystem processes for climate variability research at Glacier National Park, USA

www.nrfirescience.org/resource/8378

Glacier National Park served as a test site for ecosystem analyses that involved a suite of integrated models embedded within a geographic information system. The goal of the exercise was to provide managers with maps that could illustrate probable shifts in vegetation, net primary production (NPP), and hydrologic responses...

Author(s): Joseph D. White, Steven W. Running, Peter Thornton, Robert E. Keane, Kevin C. Ryan, Daniel B. Fagre, Carl H. Key

Year Published: 1998

Type: Document

Book or Chapter or Journal Article

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

www.nrfirescience.org/resource/11460

An increase in continuous fine fuels promoted by the expansion of aggressive annual exotic grasses in the Intermountain West has altered the region's fire regimes, with both ecologic and economic ramifications. I examine the predictive nature of seasonal climatic variables, seasonal precipitation and temperature data up to 2 years...

Author(s): Paul A. Knapp

Year Published: 1995
Type: Document
Book or Chapter or Journal Article

Soil-water trends following wildfire on the Entiat Experimental Forest

www.nrfirescience.org/resource/18575

From the text ... 'The quantitative effects of the reduction in soil-water loss by evapotranspiration vary under different physiographic conditions, intensities or vegetation removal or deadening, and the kind of vegetation removed. Intense wildfire can destroy all foliar vegetation and would be expected to have the greatest impact...

Author(s): G. O. Klock, J. D. Helvey
Year Published: 1976
Type: Document
Conference Proceedings

Climate change, disturbances and landscape dynamics

www.nrfirescience.org/resource/18407

This chapter is within a book by Walker and Steffen that presents a collection of essays by leading authorities who address the current state of knowledge. The chapters bring together the early results of an international scientific research program designed to address what will happen to our ability to produce food and fiber...

Type: Document
Book or Chapter or Journal Article

Climate change 2014: Mitigation of climate change

www.nrfirescience.org/resource/18411

The Working Group III contribution to the IPCC's Fifth Assessment Report (AR5) assesses literature on the scientific, technological, environmental, economic and social aspects of mitigation of climate change. It builds upon the Working Group III contribution to the IPCC's Fourth Assessment Report (AR4), the Special Report on...

Type: Document
Book or Chapter or Journal Article

The Impacts of Wildfire Characteristics and Employment on the Adaptive Management Strategies in the Intermountain West

www.nrfirescience.org/resource/18758

Widespread development and shifts from rural to urban areas within the Wildland-Urban Interface (WUI) has increased fire risks to local populations, as well as introduced complex and long-term costs and benefits to communities. We use an interdisciplinary approach to investigate how trends in fire characteristics influence adaptive...

Author(s): Liana Prudencio, Ryan Choi, Emily Esplin, Muyang Ge, Natalie Gillard, Jeffrey Haight, Patrick Belmont, Courtney Flint
Type: Document
Book or Chapter or Journal Article