

Spatiotemporal patterns of unburned areas within fire perimeters in the northwestern United States from 1984 to 2014

www.nrfirescience.org/resource/16632

A warming climate, fire exclusion, and land cover changes are altering the conditions that produced historical fire regimes and facilitating increased recent wildfire activity in the northwestern United States. Understanding the impacts of changing fire regimes on forest recruitment and succession, species distributions, carbon...

Author(s): Arjan J. H. Meddens, Crystal A. Kolden, James A. Lutz, John T. Abatzoglou

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

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

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

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 adaption and post-fire restoration of a foundational perennial in cold desert: Insights from intraspecific variation in response to weather

www.nrfirescience.org/resource/16523

1) The loss of foundational but fire-intolerant perennials such as sagebrush due to increases in fire size and frequency in semi-arid regions has motivated efforts to restore them, often with mixed or even no success. Seeds of sagebrush *Artemisia tridentata* and related species must be moved considerable distances from seed source to...

Author(s): Martha M. Brabec, Matthew J. Germino, Bryce A. Richardson

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

2017 Montana Climate Assessment - stakeholder driven science informed

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

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

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

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

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

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

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

Characterizing interactions between fire and other disturbances and their impacts on tree mortality in western U.S. forests

www.nrfirescience.org/resource/16268

Increasing evidence that pervasive warming trends are altering disturbance regimes and their interactions with fire has generated substantial interest and debate over the implications of these changes. Previous work has primarily focused on conditions that promote non-additive interactions of linked and compounded disturbances, but...

Author(s): Jeffrey M. Kane, J. Morgan Varner, Margaret R. Metz, Phillip J. van Mantgem

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

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

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

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 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

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

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

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

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 Kreidler, 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

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

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: 2017

Type: Document

Book or Chapter or Journal Article

Human exposure and sensitivity to globally extreme wildfire events

www.nrfirescience.org/resource/15038

Extreme wildfires have substantial economic, social and environmental impacts, but there is uncertainty whether such events are inevitable features of the Earth's fire ecology or a legacy of poor management and planning. We identify 478 extreme wildfire events defined as the daily clusters of fire radiative power from MODIS,...

Author(s): David M. J. S. Bowman, Grant J. Williamson, John T. Abatzoglou, Crystal A. Kolden, Mark A. Cochrane, Alistair M. S. Smith

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Mapping the future: U.S. exposure to multiple landscape stressors

www.nrfirescience.org/resource/15285

Landscape exposure to multiple stressors can pose risks to human health, biodiversity, and ecosystem services. Attempts to study, control, or mitigate these stressors can strain public and private budgets. An interdisciplinary team of Pacific Northwest Research Station and Oregon State University scientists created maps of the...

Author(s): Marie Oliver, Becky K. Kerns, John Kim, Jeffrey D. Kline
Year Published: 2017
Type: Document
Technical Report or White Paper

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

www.nrfirescience.org/resource/16643

We modeled the normal fire environment for occurrence of large forest wildfires (>40 ha) for the Pacific Northwest Region of the United States. Large forest wildfire occurrence data from the recent climate normal period (1971–2000) was used as the response variable and fire season precipitation, maximum temperature, slope, and...

Author(s): Raymond J. Davis, Zhiqiang Yang, Andrew Yost, Cole Belongie, Warren B. Cohen
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

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

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

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

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

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

Effects of drought on forests and rangelands in the United States: a comprehensive science synthesis

www.nrfirescience.org/resource/13910

This assessment provides input to the reauthorized National Integrated Drought Information System (NIDIS) and the National Climate Assessment (NCA), and it establishes the scientific foundation needed to manage for drought resilience and adaptation. Focal areas include drought characterization; drought impacts on forest processes...

Year Published: 2016

Type: Document

Synthesis, Technical Report or White Paper

Does prescribed fire promote resistance to drought in low elevation forests of the Sierra Nevada, California, USA?

www.nrfirescience.org/resource/14244

Prescribed fire is a primary tool used to restore western forests following more than a century of fire exclusion, reducing fire hazard by removing dead and live fuels (small trees and shrubs). It is commonly assumed that the reduced forest density following prescribed fire also reduces competition for resources among the...

Author(s): Phillip J. van Mantgem, Anthony C. Caprio, Nathan L. Stevenson, Adrian J. Das

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Resolving future fire management conflicts using multicriteria decision making

www.nrfirescience.org/resource/13893

Management strategies to reduce the risks to human life and property from wildfire commonly involve burning native vegetation. However, planned burning can conflict with other societal objectives such as human health and biodiversity conservation. These conflicts are likely to intensify as fire regimes change under future climates...

Author(s): Don A. Driscoll, Michael Bode, Ross A. Bradstock, David A. Keith, Trent D. Penman, Owen F. Price

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

Ecohydrological implications of drought for forests in the United States

www.nrfirescience.org/resource/14110

The relationships among drought, surface water flow, and groundwater recharge are not straightforward for most forest ecosystems due to the strong role that vegetation plays in the forest water balance. Hydrologic responses to drought can be either mitigated or exacerbated by forest vegetation depending upon vegetation water use and...

Author(s): James M. Vose, Chelcy Ford Miniati, Charles H. Luce, Heidi Asbjornsen, Peter V. Caldwell, John L. Campbell, Gordon E. Grant, Daniel J. Isaak, Steven P. Loheide II, Ge Sun

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

Global trends in wildfire and its impacts: perceptions versus realities in a changing world

www.nrfirescience.org/resource/14432

Wildfire has been an important process affecting the Earth's surface and atmosphere for over 350 million years and human societies have coexisted with fire since their emergence. Yet many consider wildfire as an accelerating problem, with widely held perceptions both in the media and scientific papers

of increasing fire occurrence,...

Author(s): Stefan H. Doerr, Cristina Santin

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

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

Projected changes in cold hardiness zones and suitable overwinter ranges of perennial crops over the United States

www.nrfirescience.org/resource/15604

Average annual absolute minimum temperatures (TN_n) provide a means of delineating agriculturally relevant climate zones and are used to define cold hardiness zones (CHZ) by the United States Department of Agriculture. Projected changes in TN_n, mean winter minimum temperatures, and CHZs over the conterminous United States (CONUS...

Author(s): Lauren E. Parker, 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

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

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

Complex challenges of maintaining whitebark pine in Greater Yellowstone under climate change: A call for innovative research, management, and policy approaches

www.nrfirescience.org/resource/14364

Climate suitability is projected to decline for many subalpine species, raising questions about managing species under a deteriorating climate. Whitebark pine (WBP) (*Pinus albicaulis*) in the Greater Yellowstone Ecosystem (GYE) crystallizes the challenges that natural resource managers of many high mountain ecosystems will likely face...

Author(s): Andrew J. Hansen, Kathryn Ireland, Kristin Legg, Robert E. Keane, Edward Barge, Martha Jenkins, Michiel Pillet

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Climate influences on whitebark pine mortality from mountain pine beetle in the Greater Yellowstone Ecosystem

www.nrfirescience.org/resource/14565

Extensive mortality of whitebark pine, beginning in the early to mid-2000s, occurred in the Greater Yellowstone Ecosystem (GYE) of the western US, primarily from mountain pine beetle but also from other threats such as white pine blister rust. The climatic drivers of this recent mortality and the potential for future whitebark pine...

Author(s): Polly C. Buotte, Jeffrey A. Hicke, Haiganoush K. Preisler, John T. Abatzoglou, Kenneth F. Raffa, Jesse A. Logan

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

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

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 Wagtenonk, John Anderson, Brian J. Stocks, John T. Abatzoglou

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

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

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

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

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

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

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

Charred forests accelerate snow albedo decay: parameterizing the post-fire radiative forcing on snow for three years following fire

www.nrfirescience.org/resource/14443

As large, high-severity forest fires increase and snowpacks become more vulnerable to climate change across the western USA, it is important to understand post-fire disturbance impacts on snow hydrology. Here, we examine, quantify, parameterize, model, and assess the post-fire radiative forcing effects on snow to improve hydrologic...

Author(s): Kelly E. Gleason, Anne W. Nolin

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

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

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

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

Complex response of white pines to past environmental variability increases understanding of future vulnerability

www.nrfirescience.org/resource/13522

Ecological niche models predict plant responses to climate change by circumscribing species distributions within a multivariate environmental framework. Most projections based on modern bioclimatic correlations imply that high-elevation species are likely to be extirpated from their current ranges as a result of rising growing...

Author(s): Virginia Iglesias, Teresa R. Krause, Cathy L. Whitlock

Year Published: 2015

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

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

Temperate forest health in an era of emerging megadisturbance

www.nrfirescience.org/resource/13722

Although disturbances such as fire and native insects can contribute to natural dynamics of forest health, exceptional droughts, directly and in combination with other disturbance factors, are pushing some temperate forests beyond thresholds of sustainability. Interactions from increasing temperatures, drought, native insects and...

Author(s): Constance I. Millar, Nathan L. Stephenson

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Observations of distributed snow depth and snow duration within diverse forest structures in a maritime mountain watershed

www.nrfirescience.org/resource/14278

Spatially distributed snow depth and snow duration data were collected over two to four snow seasons during water years 2011–2014 in experimental forest plots within the Cedar River Municipal Watershed, 50 km east of Seattle, Washington, USA. These 40 × 40 m forest plots, situated on the western slope of the Cascade Range,...

Author(s): Susan E. Dickerson-Lange, James A. Lutz, Rolf Gersonde, Kael A. Martin, Jenna E. Forsyth, Jessica D. Lundquist

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

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

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/15652

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

Author(s): Barbara Cosens, Alexander Fremier, Nigel Bankes, John T. Abatzoglou

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

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

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

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

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

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

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

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

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

Temperate forest health in an era of emerging megadisturbance

www.nrfirescience.org/resource/13501

Although disturbances such as fire and native insects can contribute to natural dynamics of forest health, exceptional droughts, directly and in combination with other disturbance factors, are pushing some temperate forests beyond thresholds of sustainability. Interactions from increasing temperatures, drought, native insects and...

Author(s): Constance I. Millar, Nathan L. Stephenson

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 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

Are high-severity fires burning at much higher rates recently than historically in dry-forest landscapes of the western USA?

www.nrfirescience.org/resource/13487

Dry forests at low elevations in temperate-zone mountains are commonly hypothesized to be at risk of exceptional rates of severe fire from climatic change and land-use effects. Their setting is fire-prone, they have been altered by land-uses, and fire severity may be increasing. However, where fires were excluded, increased fire...

Author(s): William L. Baker

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

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

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

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

Implications of climate change on wind erosion of agricultural lands in the Columbia plateau

www.nrfirescience.org/resource/15642

Climate change may impact soil health and productivity as a result of accelerated or decelerated rates of erosion. Previous studies suggest a greater risk of wind erosion on arid and semi-arid lands due to loss of biomass under a future warmer climate. There have been no studies conducted to assess the

impact of climate change on...

Author(s): B.S. Sharratt, J. Tatarko, John T. Abatzoglou, F.A. Fox, D. Huggins

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

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

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

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

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

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 Wagtendonk, Carl H. Key

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

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

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

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

Preliminary resource vulnerability assessment

www.nrfirescience.org/resource/13409

This document is an assessment of the FS Northern Region's key water resources, tree species, wildlife species, and disturbances, which includes descriptions of the species' current condition, existing stressors, sensitivity to and expected effects of climate changes, and adaptive capacity.

Author(s): Northern Region Adaptation Partnership

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. Hardegree, Richard F. Miller, David A. Pyke

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

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

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

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

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

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

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

The effects of previous wildfires on subsequent wildfire behavior and post-wildfire recovery

www.nrfirescience.org/resource/12650

Over the past several decades, size and extent of wildfires have been increasing in the western United States (Westerling et al. 2006; Littell et al. 2009). As the number and size of recent wildfires increases across landscapes, fire managers are questioning how past wildfires may influence the spread and effects of subsequent...

Author(s): Camille Stevens-Rumann, Susan J. Prichard, Penelope Morgan

Year Published: 2014

Type: Document

Synthesis

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

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

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

Large wildfire trends in the western United States, 1984-2011

www.nrfirescience.org/resource/12971

We used a database capturing large wildfires (> 405 ha) in the western U.S. to document regional trends in fire occurrence, total fire area, fire size, and day of year of ignition for 1984-2011. Over the western U.S. and in a majority of ecoregions, we found significant, increasing trends in the number of large fires and/or total...

Author(s): Philip E. Dennison, Simon C. Brewer, James D. Arnold, Max A. Moritz

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

Defining extreme wildland fires using geospatial and ancillary metrics

www.nrfirescience.org/resource/12953

There is a growing professional and public perception that 'extreme' wildland fires are becoming more common due to changing climatic conditions. This concern is heightened in the wildland-urban interface

where social and ecological effects converge. 'Mega-fires', 'conflagrations', 'extreme' and 'catastrophic' are descriptors...

Author(s): Karen O. Lannom, Wade T. Tinkham, Alistair M. S. Smith, John T. Abatzoglou, Beth A. Newingham, Troy E. Hall, Penelope Morgan, Eva K. Strand, Travis B. Paveglio, John Anderson, Aaron M. Sparks

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

Applying resilience thinking - Seven principles for building resilience in social-ecological systems

www.nrfirescience.org/resource/13407

This publication is a popular summary of the book “Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems”, published by Cambridge University Press (2014). This book, in turn, expands on the comprehensive review “Towards principles for enhancing the resilience of...

Author(s): Stockholm University

Year Published: 2014

Type: Document

Technical Report or White Paper

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

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

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

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

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

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

Learning to coexist with wildfire

www.nrfirescience.org/resource/15326

The impacts of escalating wildfire in many regions — the lives and homes lost, the expense of suppression and the damage to ecosystem services — necessitate a more sustainable coexistence with wildfire. Climate change and continued development on fire-prone landscapes will only compound current problems. Emerging strategies for...

Author(s): Max A. Moritz, E. Batllori, Ross A. Bradstock, A. Malcolm Gill, J. Handmer, Paul F. Hessburg, J. Leonard, Sarah M. McCaffrey, Dennis C. Odion, Tania L. Schoennagel, Alexandra D. Syphard

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

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

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

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

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 longlived 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

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

Appendix 1: Regional summaries - Great Plains

www.nrfirescience.org/resource/11902

Natural vegetation of the Great Plains is primarily grassland and shrubland ecosystems with trees occurring in scattered areas along streams and rivers, on planted woodlots, as isolated forests such as the Black Hills of South Dakota, and near the biogeographic contact with Rocky Mountains and eastern deciduous forests. Trees are...

Author(s): Linda A. Joyce

Year Published: 2013

Type: Document

Synthesis, 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

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

Modeled forest inventory data suggest climate benefits from fuels management

www.nrfirescience.org/resource/13480

As part of a recent synthesis addressing fuel management in dry, mixed-conifer forests, we analyzed more than 5,000 Forest Inventory and Analysis (FIA) plots, a probability sample that represents 33 million acres of these forests throughout Washington, Oregon, Idaho, Montana, Utah, and extreme northern California. We relied on the...

Author(s): Jeremy S. Fried, Theresa B. Jain, Jonathan Sandquist

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 Parris, Peter A. Raymond, Josh Schimel, Craig E. Williamson

Year Published: 2013

Type: Document

Book or Chapter or Journal Article, Synthesis

Simulating effects of land use policies on extent of the wildland urban interface and wildfire risk in Flathead County, Montana

www.nrfirescience.org/resource/12036

This study used a wildfire loss simulation model to evaluate how different land use policies are likely to influence wildfire risk in the wildland urban interface (WUI) for Flathead County, Montana. The model accounts for the complex socio-ecological interactions among climate change, economic growth, land use change and policy,...

Author(s): Travis B. Pavaglio, Tony Prato, Michael Hardy

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

Yellowstone National Park and the summer of fire

www.nrfirescience.org/resource/11997

Because of their close relationships with fires, western forest ecosystems are considered fire dependent. If we hope to sustain the communities of trees, plants, and animals that characterize these wildland forests, we need to understand the natural role of fire, changes brought about by suppressing fire, and alternatives for...

Author(s): Diane M. Smith

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Development of gridded surface meteorological data for ecological applications and modeling

www.nrfirescience.org/resource/15682

Landscape-scale ecological modelling has been hindered by suitable high-resolution surface meteorological datasets. To overcome these limitations, desirable spatial attributes of gridded climate data are combined with desirable temporal attributes of regional-scale reanalysis and daily gauge-based precipitation to derive a spatially...

Author(s): John T. Abatzoglou

Year Published: 2013

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

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

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

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 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

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

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

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

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

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

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

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

An evaluation of multi-scalar drought indices in Nevada and eastern California

www.nrfirescience.org/resource/15687

Nevada and eastern California are home to some of the driest and warmest climates, most mountainous regions, and fastest growing metropolitan areas of the United States. Throughout Nevada and eastern California, snow-dominated watersheds provide most of the water supply for both human and environmental demands. Increasing demands on...

Author(s): Daniel J. McEvoy, Justin L. Huntington, John T. Abatzoglou, Laura M. Edwards

Year Published: 2012

Type: Document

Book or Chapter or Journal Article

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

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

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

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

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

Climate and vegetation influences on fire impacts in Alaskan boreal forest: implications for carbon and fire management

www.nrfirescience.org/resource/15688

Boreal forest fires are an important source of terrestrial carbon emissions, particularly during years of widespread wildfires. Most carbon emission models parameterize wildfire impacts and carbon flux to area burned by fires, therein making the assumption that fires consume a spatiotemporally homogeneous landscape composed of...

Author(s): Crystal A. Kolden, John T. Abatzoglou

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

A case for developing place-based fire management strategies from traditional ecological knowledge

www.nrfirescience.org/resource/16101

Sustainability science promotes place-based resource management because natural processes vary among ecosystems. When local science is limited, land managers may be forced to generalize from other ecosystems that function differently. One proposed solution is to draw upon the traditional ecological knowledge that indigenous groups...

Author(s): Lily A. Ray, Crystal A. Kolden, F. Stuart Chapin

Year Published: 2012

Type: Document

Book or Chapter or Journal Article

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

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

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

The human dimension of fire regimes on Earth

www.nrfirescience.org/resource/190

Humans and their ancestors are unique in being a fire-making species, but 'natural' (i.e. independent of humans) fires have an ancient, geological history on Earth. Natural fires have influenced biological evolution and global biogeochemical cycles, making fire integral to the functioning of some biomes. Globally, debate rages...

Author(s): David M. J. S. Bowman

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

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

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

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

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

The future of high-elevation, five-needle white pines in western North America: Proceedings of the High Five Symposium. 28-30 June 2010; Missoula, MT

www.nrfirescience.org/resource/11894

High elevation five-needle pines are rapidly declining throughout North America. The six species, whitebark (*Pinus albicaulis* Engelm.), limber (*P. flexilis* James), southwestern white (*P. strobiformis* Engelm.), foxtail (*P. balfouriana* Grev....

Author(s): Robert E. Keane, Diana F. Tomback, Michael P. Murray, Cyndi M. Smith

Year Published: 2011

Type: Document

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

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

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

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

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

Comprehensive fuels treatment practices guide for mixed conifer forests: California, central and southern Rockies, and the Southwest

www.nrfirescience.org/resource/12630

The goal of this guide is to provide a resource for managers of mixed conifer forests of the Southwestern plateaus and uplands, the Central and Southern Rocky Mountains, the Sierra Nevada, and the Transverse and Peninsular Ranges in Southern California. Mixed conifer forests have different species, structures, and spatial patterns...

Author(s): Alexander M. Evans, Rick G. Everett, Scott L. Stephens, James A. Youtz

Year Published: 2011

Type: Document

Synthesis, Technical Report or White Paper

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

Disturbance and landscape dynamics in a changing world

www.nrfirescience.org/resource/13432

Disturbance regimes are changing rapidly, and the consequences of such changes for ecosystems and linked social-ecological systems will be profound. This paper synthesizes current understanding of disturbance with an emphasis on fundamental contributions to contemporary landscape and ecosystem ecology, then identifies future...

Author(s): Monica G. Turner

Year Published: 2010

Type: Document

Book or Chapter or Journal Article, Synthesis

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

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

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

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

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

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

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 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

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

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

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

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

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

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

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

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

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

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

Warming and earlier spring increase western U.S. forest wildfire activity

www.nrfirescience.org/resource/8397

Western United States forest wildfire activity is widely thought to have increased in recent decades, but surprisingly, the extent of recent changes has never been systematically documented. Nor has it been established to what degree climate may be driving regional changes in wildfire. Much of the public and scientific discussion of...

Author(s): Anthony L. Westerling, Hugo G. Hidalgo, Daniel R. Cayan, Thomas W. Swetnam

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, Brandon M. Collins, Philip N. Omi,

Phillip L. Chapman
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

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 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

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

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

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

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

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

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

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

The consequences of changing disturbance regimes for aspen in the western U.S.

www.nrfirescience.org/resource/14058

The consequences of changing disturbance regimes for quaking aspen in the western U.S. Dominik Kulakowski, Associate Professor, Clark University. Recorded talk from 2013 Restoring the West Conference at Utah State University. The conference focused on forest resilience and change agents in the West. From Utah State University...

Type: Media

Video

A Three-Step Decision Support Framework for Taking Climate Adaptation Actions

www.nrfirescience.org/resource/15933

We will present a framework for using available climate science to set forward-looking conservation goals and select among a menu of climate adaptation strategies. This decision support framework is designed to catalyze adaptation actions by bridging recent advances in climate science and adaptation planning, while also helping...

Type: Media

Webinar

Fire management, fuels, and climate change tipping points

www.nrfirescience.org/resource/13046

There will be dramatic changes to most landscapes of the western US over the next century, such as shifts in vegetation communities, changes in fire regimes, and increases in smoke emissions. These changes will result from complex interactions among vegetation, fuels, fire, and altered climate at the finest scales causing new and...

Type: Media

Webinar

Climate change adaptation, from concept to standard practice

www.nrfirescience.org/resource/14384

The U.S. Forest Service is working with other federal agencies and stakeholders to develop climate change vulnerability assessments and adaptation strategies for national forests and adjacent lands in the western United States. Teams of research scientists and resource managers are working across large biogeographic landscapes to (1...

Type: Media

Webinar

Can increasing productivity in a warmer future compensate for wildfire-induced ecosystem carbon loss in the Greater Yellowstone Ecosystem?

www.nrfirescience.org/resource/15163

This presentation was part of the 13th Biennial Scientific Conference on the Greater Yellowstone Ecosystem held at Jackson Lake Lodge in Grand Teton National Park, October 4-6, 2016. The conference theme was Building on the Past, Leading into the Future: Sustaining the Greater

Yellowstone Ecosystem in the Coming Century.

Type: Media

Webinar

A strategy for forest adaptation to climate change: aspen and spruce case study

www.nrfirescience.org/resource/14056

A review of sudden aspen decline illustrates anticipated impacts of climate change on forests. Bioclimate modeling was briefly introduced as a means of approximately quantifying and mapping those impacts. These models, optimized for a local planning area such as a national forest, can be used as part of a practical strategy of...

Type: Media

Webinar

Using state and transition simulation models to guide sustainable management of ecosystems: three case studies from across the US

www.nrfirescience.org/resource/14867

This webinar was conducted as a part of the Climate Change Science and Management Webinar Series, put on by the USGS National Climate Change and Wildlife Science Center and the FWS National Conservation Training Center. Sustainable management of natural resources under competing demands is challenging, particularly when facing novel...

Type: Media

Webinar

Restoration guidelines for creating resilient whitebark pine ecosystems using spatial simulation modeling

www.nrfirescience.org/resource/13044

To address declining whitebark pine ecosystems, a 2012 report A Range-Wide Restoration Strategy for Whitebark Pine Forests presents a strategy for restoring these ecosystems across their entire range. However, this report did not address changing climates in the implementation of a range-wide strategy. The Great Northern LCC has...

Type: Media

Webinar

Sagebrush responses to shifting climate and fire disturbances

www.nrfirescience.org/resource/14380

This presentation addresses issues confronting preservation and restoration of big sagebrush, focusing on climate, wildfire, and invasives. Preliminary and published insights on climate responses of sagebrush and implications for vulnerability assessments and post-fire restoration will be described. Responses of big sagebrush and...

Type: Media

Webinar

Simulating the effects of climate change and resource management on ecosystems: case studies from forest and rangeland systems using State-and-Transition Simulation Modeling

www.nrfirescience.org/resource/15151

This presentation was part of the 13th Biennial Scientific Conference on the Greater Yellowstone Ecosystem held at Jackson Lake Lodge in Grand Teton National Park, October 4-6, 2016. The conference theme was Building on the Past, Leading into the Future: Sustaining the Greater Yellowstone Ecosystem in the Coming Century.

Type: Media

Webinar

Applying resilience thinking

www.nrfirescience.org/resource/13406

Based on the recently published "Principles for Building Resilience: Sustaining Ecosystem Services in Social-Ecological Systems", this video presents an insightful overview of seven principles that could help you to apply ideas from resilience thinking into your practices.

Type: Media

Video

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

www.nrfirescience.org/resource/14573

The area burned by wildfires has increased in recent decades and is expected to increase in the future for many watersheds worldwide due to climate change. Burned areas within watersheds increase soil erosion rates, which can increase the downstream accumulation of sediment in rivers and reservoirs.

Using an ensemble of climate,...

Type: Media

Webinar

A framework for evaluating the vulnerability of multiple wildlife species to climate change at regional scales

www.nrfirescience.org/resource/14862

This webinar was conducted as part of the Climate Change Science and Management Webinar series, hosted in partnership by the USGS National Climate Change and Wildlife Science Center and the FWS National Conservation Training Center. Frameworks for evaluating the vulnerability of multiple species to decline or extinction are...

Type: Media

Webinar

Climate change and stress complexes in forests of western North America

www.nrfirescience.org/resource/13035

Stress complexes in Western forests are affected by a warmer climate, that is the interaction of fire, drought, insects, etc. can alter the vigor of forest ecosystems and potentially change their structure and function. This webinar will cover the concepts and present several case studies. The presenters will also discuss management...

Type: Media

Webinar

How to prioritize key areas for conservation efforts in a changing climate: a look at "climate refugia"

www.nrfirescience.org/resource/14332

This webinar is a part of the Climate Change Science and Management Webinar Series, co-hosted by the USGS National Climate Change and Wildlife Science Center and the FWS National Conservation Training Center. In this presentation, Toni Lyn Morelli summarizes the physical processes that create climate refugia, discusses a new...

Type: Media

Webinar

Yellowstone and Grand Teton's ecological past as a tool for understanding the future

www.nrfirescience.org/resource/15147

This presentation was part of the 13th Biennial Scientific Conference on the Greater Yellowstone Ecosystem held at Jackson Lake Lodge in Grand Teton National Park, October 4-6, 2016. The conference theme was Building on the Past, Leading into the Future: Sustaining the Greater Yellowstone Ecosystem in the Coming Century.

Type: Media

Webinar

The pyrogeography of western North America: how climate has affected fire regimes and fire history across the west, and where we may be going in the future

www.nrfirescience.org/resource/12870

A recent surge of scientific knowledge and interest in fire climatology derives from two factors: increasing understanding of broad-scale ocean-atmosphere climate forcings, such as the El Niño-Southern Oscillation, and their teleconnections to regional and local patterns of droughts and wildfires, and mounting evidence that global...

Type: Media

Webinar

Climate change - Ponderosa pine forests and fire

www.nrfirescience.org/resource/13942

Highlight featuring RMRS Research Forester Mike Battaglia and his research as it focuses on ponderosa pine forests and fire in terms of how it relates to resiliency, the effects of climate change and why it is relevant to the public.

Type: Media

Video

Identifying resilient terrestrial landscapes in the Pacific Northwest

www.nrfirescience.org/resource/13497

As the climate changes, species are moving and shifting ranges to stay within their preferred temperature and moisture conditions. How can land managers plan for the conservation of biodiversity at a site when those species might not be there in 50-100 years? Current conservation approaches often focus on predicting where species...

Type: Media

Webinar

Fire, carbon, and climate: past and future

www.nrfirescience.org/resource/13031

Fire has a short-term impact on the exchange of carbon between the forest and the atmosphere, but over a cycle of a stand-replacing fire and regrowth, the carbon balance is usually carbon neutral. The only ways to permanently lower forest carbon with fire or any other disturbance are if regeneration does not occur and the forest...

Type: Media

Webinar

Understanding the views of decision-makers on climate adaptation

www.nrfirescience.org/resource/15114

This webinar was part of the US Forest Service, Rocky Mountain Research Station's Social-Ecological Resilience and Changing Landscapes webinar series.

Type: Media

Webinar

The national climate assessment and wildland fire implications

www.nrfirescience.org/resource/12828

Tim Brown presented a webinar on the new National Climate Assessment (NCA). The NCA summarizes present day and future impacts of climate change on the United States. Observations are showing changes in temperature and precipitation patterns causing societal impacts outside of recent experience. Wildland fire examples include among...

Type: Media

Webinar

A strategy for managing forest adaptation to climate change with a case study of aspen and spruce in southwestern Colorado

www.nrfirescience.org/resource/13335

A review of sudden aspen decline will illustrate anticipated impacts of climate change on forests. Bioclimate modeling will be briefly introduced as a means of approximately quantifying and mapping those impacts. These models, optimized for a local planning area such as a national forest, can be used as part of a...

Type: Media

Webinar

Adaptation to climate change: embracing natural selection and genetics in restoration

www.nrfirescience.org/resource/14792

This presentation by Diana L. Six, Professor at University of Montana, was part of the 2016 Whitebark Pine Ecosystem Foundation Annual Science and Management Workshop - Successes and Challenges in Managing the Jewel in the Crown of the Continent that occurred September 16, 2016 in Whitefish, MT.

Type: Media

Webinar

Vulnerability of spring Chinook and bull trout to broad-scale disturbance processes: wildfire and climate change

www.nrfirescience.org/resource/13023

Rebecca Flitcroft, Research Fish Biologist with the USFS PNW Research Station, presents Vulnerability of spring Chinook and bull trout to broad-scale disturbance processes: wildfire and climate change

Type: Media

Webinar

Restoring whitebark pine ecosystems of the West in the face of climate change

www.nrfirescience.org/resource/13665

Speaker: Robert Keane, Research Ecologist, Rocky Mountain Research Station, USDA Forest Service, Missoula, Montana. Event: Restoring the West Conference 2015 - Restoration and Fire in the Interior West.

Type: Media

Video

Can plants keep pace with climate change? Climatic connectivity in a warming world

www.nrfirescience.org/resource/15102

A longstanding question in biogeography is how long-lived plants such as trees kept pace with climate

changes of the past. The question is also relevant today as climate change accelerates and habitats become fragmented. To help address this question, scientists have studied two facets of the problem:

1) How fast can plants...

Type: Media

Webinar

Can our forests take the heat? Fire, climate change and tree mortality in the western US

www.nrfirescience.org/resource/12814

As the climate gets warmer, many forests are feeling the heat. Impacts range from increased forest fire hazards and tree mortality to detrimental beetle outbreaks and alterations to leaf abundance and bloom. Persistent warming can lead to chronic stress on forest trees, resulting in higher sensitivity to fire-induced damage. So,...

Type: Media

Webinar

Fire and beetles and climate, oh my!

www.nrfirescience.org/resource/13284

This is a recording of a keynote lecture from the 12th Biennial Scientific Conference on the Greater Yellowstone Ecosystem. The talk focused on Yellowstone fire history, fire regimes, and post-fire regeneration as well as the impacts of bark beetle outbreaks on fire severity, fire effects, and ecosystem resilience.

Type: Media

Video

Impacts of climate, drought, and storms on trees and forests

www.nrfirescience.org/resource/14206

This presentation was recorded during the 2016 State of the State and Forest Health Conference in Corvallis, OR.

Type: Media

Video

Climate change and fire in the Southwest

www.nrfirescience.org/resource/13468

Global climate change will lead to shifts in climate patterns and fire regimes in the Southwest over coming decades. The intent of this webinar is to summarize the current state of scientific knowledge about climate change predictions in the Southwest as well as the pathways by which fire might be affected. While the paper is...

Type: Media

Webinar

Will whitebark pine restoration still work in the crown under future climates?

www.nrfirescience.org/resource/14772

This presentation by Bob Keane, Supervisory Research Ecologist, USFS Rocky Mountain Research Station, was part of the 2016 Whitebark Pine Ecosystem Foundation Annual Science and Management Workshop - Successes and Challenges in Managing the Jewel in the Crown of the Continent that occurred September 16, 2016 in Whitefish, MT.

Type: Media

Webinar

Fire, forests, and climate

www.nrfirescience.org/resource/13828

Penny Morgan with University of Idaho Department of Forest, Rangeland and Fire Sciences will present how changing climate is affecting fire and forests. Dr. Morgan, an expert on fire ecology, will highlight changing climate in the US northern Rockies and implications for forest fire extent and severity.

Drawing on recent research...

Type: Media

Webinar

Braids of truth - Part 2: climate change

www.nrfirescience.org/resource/14446

Part 2 of 3. Elders, scientists and cultural leaders discuss the effects of climate change on the earth, culture and peoples and the differences between western science and traditional ecological principles.

Type: Media

Video

Climate change impacts and vulnerabilities for US Northern Rocky Mountain Forests

www.nrfirescience.org/resource/14729

Bob Keane's presentation starts at 28:22. This presentation was given at the Adaptive Silviculture for Climate Change (ASCC) Northern Rockies Workshop was held June 28, 2016 at the Supervisor's Office of the Flathead National Forest in Kalispell, Montana, bringing together natural resource managers, collaborators and...

Type: Media

Webinar

A resilience ecology framework for southwestern forests: ecosystem shifts, landscape disturbance, and climate change

www.nrfirescience.org/resource/13600

Webinar presented by Don Falk and hosted by the Southwest Fire Science Consortium.

Type: Media

Webinar

Interdisciplinary applications of global terrestrial carbon cycle models

www.nrfirescience.org/resource/13772

Terrestrial carbon cycle models, or dynamic global vegetation models (DGVMs), have long been used to estimate biogeochemical and biophysical feedbacks to climate. At their core, DGVMs represent vegetation and landscape dynamics using process-based representations of photosynthesis, carbon allocation, stand...

Type: Media

Webinar

A synthesis of the science on forests and carbon for U.S. forests

www.nrfirescience.org/resource/14100

Dr. Mike Ryan, USDA Forest Service Research Forest Ecologist, presented a scientific synthesis of the forest carbon cycle. The synthesis covers the entire US, but Dr. Ryan focused on the western US for this webinar. Forests play a key role in the carbon cycle and their growth and harvested wood products currently offsets 12-19% of U...

Type: Media

Webinar

Relations among cheatgrass driven fire, climate and sensitive status birds

www.nrfirescience.org/resource/16094

As the distribution and abundance of non-native cheatgrass (*Bromus tectorum*) in the Great Basin has increased, the extent and frequency of fire in the region has increased by as much as 200%. These changes in fire regimes are associated with loss of the sagebrush (*Artemisia tridentata*) and native grasses and forbs in which many...

Type: Media

Webinar

Regional socio-economic vulnerability assessment

www.nrfirescience.org/resource/13761

Understanding differences in social vulnerability across a region can help public land management agencies assess potential tradeoffs associated with managing natural resources in the face of climate change. Regional social vulnerability assessments can also inform the development of policies and programs that aim to assist...

Type: Media

Webinar

Communicating about climate change - From impacts to solutions

www.nrfirescience.org/resource/13055

Americans are waking up to the reality of extreme weather events and are beginning to connect the dots to climate disruption. Effectively engaging the public as partners in addressing the challenge requires emphasizing local, current and personally relevant impacts and bridging to solutions.

Type: Media

Webinar

Big sagebrush ecosystem response to changing climate and disturbance

www.nrfirescience.org/resource/14400

Over the past few years, the USFWS R6 Science Applications program has been able to support several important research studies to increase our understanding of the response of sagebrush ecosystems in a changing world. Results of the completed and ongoing studies will have multiple applications to the Service's (and our partners)...

Type: Media

Webinar

Use of a regional climate model to diagnose circulation and surface climate controls of wildfire in the Pacific Northwest and GYE

www.nrfirescience.org/resource/15164

This presentation was part of the 13th Biennial Scientific Conference on the Greater Yellowstone Ecosystem held at Jackson Lake Lodge in Grand Teton National Park, October 4-6, 2016. The conference theme was Building on the Past, Leading into the Future: Sustaining the Greater Yellowstone Ecosystem in the Coming Century.

Type: Media

Webinar

Managing for resilience through a "portfolio approach" to reducing climate risk

www.nrfirescience.org/resource/14057

Managing for resilience through a "portfolio approach" to reducing climate risk. Greg Aplet, Senior Director of Ecology, The Wilderness Society. Recorded talk from 2013 Restoring the West Conference

at Utah State University. The conference focused on forest resilience and change agents in the West.
By Utah State University Extension...

Type: Media

Video

Quaking aspen management: a presentation by the Western Aspen Alliance

www.nrfirescience.org/resource/14879

On October 27, Paul Rogers of the Western Aspen Alliance discussed the impact of climate change on aspen ecosystems, with an emphasis on aspen fire types. The presentation covered the variability of aspen responses to fire and emphasized unique fire-related systems to wean practitioners from one-size-fits-all prescriptions for aspen...

Type: Media

Webinar

Understanding fire refugia and their importance to conservation in the Rocky Mountains of the U.S. and Canada

www.nrfirescience.org/resource/13045

Understanding fire refugia and its interactions with other stressors, poses extreme challenges to biodiversity conservation. An important and potentially efficient adaptation strategy will be the identification and protection of natural refugia that buffer biodiversity from the rate and magnitude of regional change. The most...

Type: Media

Webinar

Frequently asked questions about climate projections

www.nrfirescience.org/resource/14383

Climate scenarios offer one way to identify and examine the land management challenges posed by climate change. Selecting climate projections for any given application, question, or region, however, requires careful consideration of the natural resources under study, and where and how they are sensitive to climate. The selection...

Type: Media

Webinar

Short-and long-term responses of fire regimes to a changing climate

www.nrfirescience.org/resource/15795

Fire regimes will undoubtedly respond to a changing climate. Longer fires seasons and more frequent and extreme drought are expected, likely resulting in increased fire frequency and severity in the near-term. Over longer timeframes, however, climate change will alter species distributions and rates of biomass accumulation (i.e....

Type: Media

Seminar

The potential influence of changing climate on the persistence of inland native trout

www.nrfirescience.org/resource/13736

Bioclimatic models predict large reductions in native trout across the Rocky Mountains this century but lack specific details regarding how this change will occur. This project addresses the need for more complete evidence and more accurate vulnerability assessments to show how salmonid populations are adjusting to climate change....

Type: Media

Webinar

A customized model to predict climate-fire-vegetation dynamics for the Greater Yellowstone Ecosystem

www.nrfirescience.org/resource/15161

This presentation was part of the 13th Biennial Scientific Conference on the Greater Yellowstone Ecosystem held at Jackson Lake Lodge in Grand Teton National Park, October 4-6, 2016. The conference theme was Building on the Past, Leading into the Future: Sustaining the Greater Yellowstone Ecosystem in the Coming Century.

Type: Media

Webinar

Adapting to climate change in the western National Forests

www.nrfirescience.org/resource/14054

The U.S. Forest Service is leading several partnerships focused on (1) assessing the effects of climate change on natural resources, (2) developing adaptation options to reduce negative effects, and (3) implementing climate-smart resource management and planning in national forests. These partnerships have learned that...

Type: Media

Webinar

How will forests affect mountain snow storage in a warming climate

www.nrfirescience.org/resource/14863

Forests strongly influence snow processes and affect the amount and duration of snow storage on a landscape. Therefore, forest changes, from management activities or natural disturbances, have important consequences for spring and summer soil moisture availability, aquatic habitat, and water supply. Accounting for these effects of...

Type: Media

Webinar

Vulnerability of tree species and biome types to climate change in the U.S. Northern Rocky Mountains and Yellowstone

www.nrfirescience.org/resource/13043

This presentation assesses components of vulnerability of tree species and biome types to projected future climate within the Great Northern Landscape Conservation Cooperative (GNLCC) in the US Northern Rockies and the ecosystems surrounding Glacier and Yellowstone/Grand Teton National Parks. We drew on the results of five published...

Type: Media

Webinar

Herbivory in aspen forests: ecological context and mechanisms of defense

www.nrfirescience.org/resource/13719

The pressures facing quaking aspen (*Populus tremuloides*) forests in the Intermountain West are multifaceted. Fire suppression, climate change and browsing pressure by ungulates are just several of the factors that threaten the health of this foundation species. Here we present two leading scientists in North America who study aspen...

Type: Media

Webinar

Putting climate change on the map: developing specific, spatial management strategies for

whitebark pine in the Greater Yellowstone Ecosystem

www.nrfirescience.org/resource/15148

This presentation was part of the 13th Biennial Scientific Conference on the Greater Yellowstone Ecosystem held at Jackson Lake Lodge in Grand Teton National Park, October 4-6, 2016. The conference theme was Building on the Past, Leading into the Future: Sustaining the Greater Yellowstone Ecosystem in the Coming Century.

Type: Media

Webinar

Simulating vegetation, fire, and climate dynamics in a Northern Rocky Mountain landscape

www.nrfirescience.org/resource/12873

Robert Keane presents a webinar on the results of research using models to assess potential interacting effects of climate changes, pathogens, and wildfire on the distribution and density of whitebark pine in a high-elevation watershed in Glacier National Park, Montana, USA. Climate changes are projected to profoundly influence...

Type: Media

Webinar

Climate change impacts on forest and non-forest vegetation and disturbance interactions

www.nrfirescience.org/resource/13404

Note: Webinar recording includes a lot of logistics instruction at the beginning; webinar begins at time 11:00. This webinar was hosted by the Northern Rockies Adaptation Partnership, which is preparing for climate change through science-management collaboration. This webinar explores climate change effects on vegetation and...

Type: Media

Webinar

The NRAP assessment of climate change - Impacts on forest and non-forest vegetation

www.nrfirescience.org/resource/15539

This is a .pdf copy of the 51 slides presented in this webinar. The webinar talked about the interactions between climate, vegetation (forest and grassland), topography, and human activities. The objectives of the Northern Rockies Adaptation Partnership are to (1) Develop a framework and tools for resource...

Type: Media

Webinar

Climate change and fire projections in the West: why the science should matter to managers

www.nrfirescience.org/resource/13034

This webinar examines the relationship between climate and pre-settlement fire patterns, using fire history to gain insight into future fire projections. The main topics discussed include the nature of recent variability in areas burned by fire, how vegetation and fuels affect the relationship between climate and area burned,...

Type: Media

Webinar

Smoke consequences of new wildfire regimes driven by climate change

www.nrfirescience.org/resource/12838

Smoke from wildfires has adverse biological and social consequences, and various lines of evidence suggest that smoke from wildfires in the future may be more intense and widespread, demanding that methods be developed to address its effects on people, ecosystems, and the atmosphere. Don McKenzie presented webinar on March 19, 2014...

Type: Media

Webinar

Dust bowls and fire storms: changing vulnerability to climate

www.nrfirescience.org/resource/13026

Watch Tom Swetnam describe how fire management is changing in response to climate change. This was a recorded address for the plenary session of the Society for Range Management's 66th annual meeting in Oklahoma City

Type: Media

Webinar

Climate, Megafires, and Conservation Financing

www.nrfirescience.org/resource/16356

Join us in a discussion on how climatic changes can influence wildland fire activity across the globe and how these critical fire weather variables have changed over the last 40 years. These changes in key weather variables have combined to both lengthen the fire season and increase the fire weather severity within the fire season....

Type: Media

Webinar

Past and future wildfire in the Interior West

www.nrfirescience.org/resource/13668

Speaker: Richard Guyette, Associate Research Professor, School of Natural Resources, University of Missouri. Event: Restoring the West Conference - Restoration and Fire in the Interior West.

Type: Media

Video

The viability of evolutionary rescue in natural populations

www.nrfirescience.org/resource/15103

Extinction under environmental change is a race between demography and adaptive evolution. Evolutionary rescue (ER) occurs when genetic adaptation allows a population to recover from near extinction following rapid environmental change, with evidence coming from laboratory experiments and simulation modeling. Is ER feasible in...

Type: Media

Webinar

Fire management, fire science, and climate change: where do we go from here?

www.nrfirescience.org/resource/12815

Fire, climate, and vegetation are tightly linked from the time scale of a single fire event to the time scales associated with landscape and ecosystem change. But climate change - and, in many places, fire suppression - have changed the nature of fire regimes we thought we knew by changing the interactions between fire, climate and...

Type: Media

Webinar

Whitebark pine response to past climate change and fire activity: are we underestimating the resilience of the species?

www.nrfirescience.org/resource/13287

This is a video recording of a presentation from the 12th Biennial Scientific Conference on the Greater

Yellowstone Ecosystem. The presentation focused on using paleoecological records to inform potential future changes in whitebark pine with climate change predictions.

Type: Media

Video

Future climate suitability for mountain pine beetle outbreaks in the Crown of the Continent

www.nrfirescience.org/resource/14773

This presentation by Polly C. Buotte, Postdoc, University of Idaho, was part of the 2016 Whitebark Pine Ecosystem Foundation Annual Science and Management Workshop - Successes and Challenges in Managing the Jewel in the Crown of the Continent on September 16, 2016 in Whitefish, MT.

Type: Media

Webinar

Taking action on climate change in the Crown of the Continent

www.nrfirescience.org/resource/15505

The Crown Adaptation Partnership (CAP) is a stakeholder-driven process that brings together representatives from jurisdictions across the Crown of the Continent to establish a shared understanding of the effects of climate change, prioritize climate conservation targets, and identify and implement adaptation strategies that have the...

Type: Media

Webinar

A system in transition? Our high elevation forests

www.nrfirescience.org/resource/14210

This presentation was recorded during the 2016 State of the State and Forest Health Conference in Corvallis, OR.

Type: Media

Video

Aspen response to drought and climate change in the 21st century

www.nrfirescience.org/resource/13663

Recent elevated dieback of aspen after severe droughts in the 2000s has prompted concern about the future of aspen in a changing climate. I will give an overview of what we know and don't know about drought stress on aspen physiology and mortality, and what this means for the future of aspen forests in a changing climate.

Type: Media

Webinar

What is ecological drought? Exploring its impacts on natural and cultural resources

www.nrfirescience.org/resource/15095

Drought imposes many tangible impacts on human food and water supplies, but the effects of drought can actually go much deeper. Long periods without rainfall can alter the delicate balance of natural ecosystems and harm many fish and wildlife species. The term "ecological drought" encompasses and emphasizes these environmental...

Type: Media

Webinar

Resilience and regeneration after wildfire in dry mixed-conifer forests of the US Northern Rockies

www.nrfirescience.org/resource/12801

Over the past several decades, increases in area burned in the western U.S. have caused considerable concern about forest resilience following large wildfires. This concern is especially pronounced in dry mixed-conifer forests, where the combined effects of 20th century land management and land use have altered species composition,...

Type: Media

Webinar

Fires, beetles, and droughts, oh my!

www.nrfirescience.org/resource/14449

At 24:00 the webinar transitions into another webinar topic. Healthy forests are vital to our future, and consistent, long-term monitoring of forest health indicators is necessary to identify forest resources deteriorating across large regions. The Forest Health Monitoring (FHM) Program of the USDA Forest Service, with cooperating...

Type: Media

Webinar

Forests for the future: a shared agenda

www.nrfirescience.org/resource/14123

Climate change is no longer a threat; it's a reality. A rapidly changing climate is already transforming ecosystems and the processes that sustain them; greater changes lie in front of us. Climate change will change physical relationships (e.g. the baseflow in streams from a given amount of rainfall). Climate change will change...

Type: Media

Webinar

Climatic controls on post-fire conifer regeneration in low-elevation forests of the western U.S.

www.nrfirescience.org/resource/16764

This seminar was presented as part of the RMRS Missoula Fire Sciences Laboratory weekly seminar series for 2017-2018. A recording of the seminar is available from the link above.

Type: Media

Seminar

Using climate and climate change information for fire management

www.nrfirescience.org/resource/14102

The topics discussed include the role of using climate and climate change information for fire management. Examples will be provided of sources of climate information, and how this and climate change information is being considered for use in fire management. Presentations will include perspectives from researchers providing climate...

Type: Media

Webinar

Climate change trends for the Northern Rockies

www.nrfirescience.org/resource/14726

This presentation was recorded at the Adaptive Silviculture for Climate Change (ASCC) Northern Rockies Workshop was held June 28, 2016 at the Supervisor's Office of the Flathead National Forest in Kalispell, Montana, bringing together natural resource managers, collaborators and stakeholders from across the region.

Type: Media

Webinar

Climate change and the future impacts across the Southwest region

www.nrfirescience.org/resource/13597

What is Climate Change? How will our changing climate impact seasonal weather conditions across the Southwest? This webinar was hosted by the Southwest Fire Science Consortium and was presented to prepare attendees of the 'Fostering resilience in southwestern ecosystems: A problem solving workshop' event (<http://www.frames.gov/about...>)

Type: Media

Webinar

Diagnosing carbon-climate feedbacks in the contemporary carbon cycle

www.nrfirescience.org/resource/13765

The amount of carbon being taken up by the biosphere is clearly increasing; however, the variance in the global carbon cycle also appears to be increasing. This increasing variance may be indicative of C sink instability, or it may simply be noise in the global C cycle. Therefore identifying the mechanisms...

Type: Media

Seminar