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

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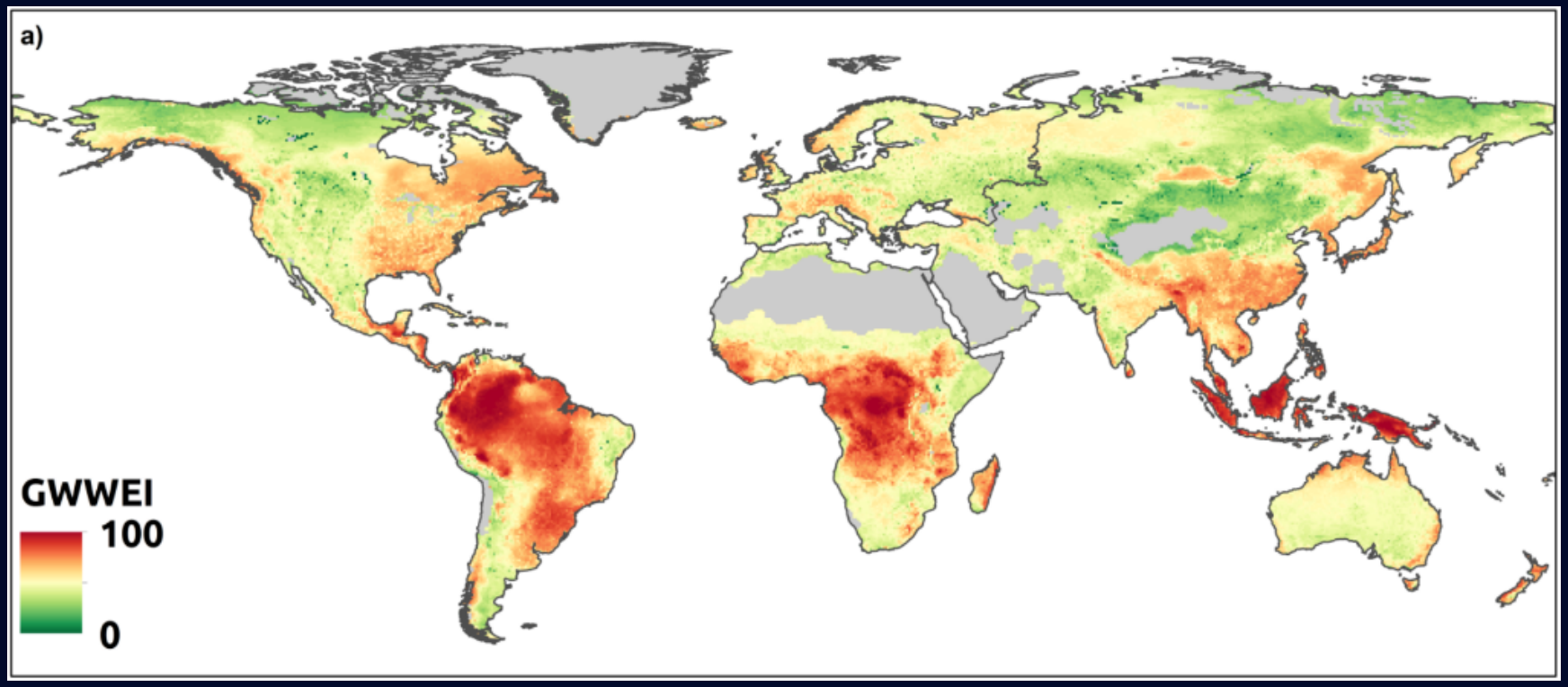

Global Wildfire Water Exposure Index

From: Robinne, et al. 2016. A Global Index for Mapping the Exposure of Water Resources to Wildfire. Forests 7 (1), 22 doi:10.3390/f7010022

USGS

65 % of the water supply in the West originates from forested watersheds* which are prone to wildfire

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*Brown et al., 2008. Spatial distribution of water supply in the coterminous United States. Journal of the American Water Resources Association 44, 1474–1487.

InciWeb
Incident Information System

Incidents > OREGON > Columbia River Gorge National Scenic Area > Eagle Creek Fire

Eagle Creek Fire

Incident Information | Announcements | Closures | News | Photographs | Maps

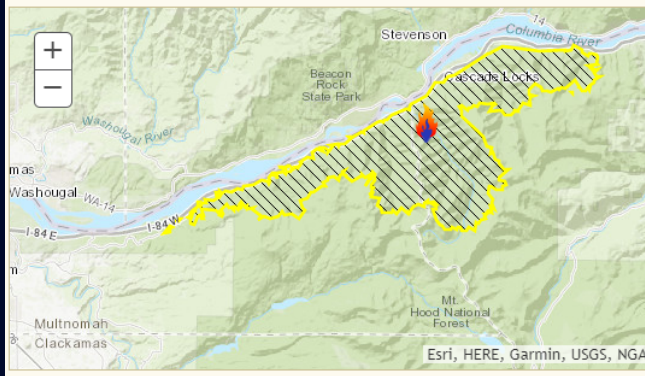
ANNOUNCEMENT

Tonight: Eagle Creek Fire Community Meeting
Eagle Creek Fire Community Meetings Representatives from the Columbia River Gorge National Scenic Area and Eagle Creek fire will host two community meetings this week to share findings and... more

INCIDENT UPDATED 1:05 HRS. AGO

Approximate Location

45.63 latitude, -121.904 longitude zoom to incident



https://inciweb.nwcg.gov/incident/5584/

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http://www.oregonlive.com/wildfires/index.ssf/2017/09/flight_over_eagle_creek_fire_r.html

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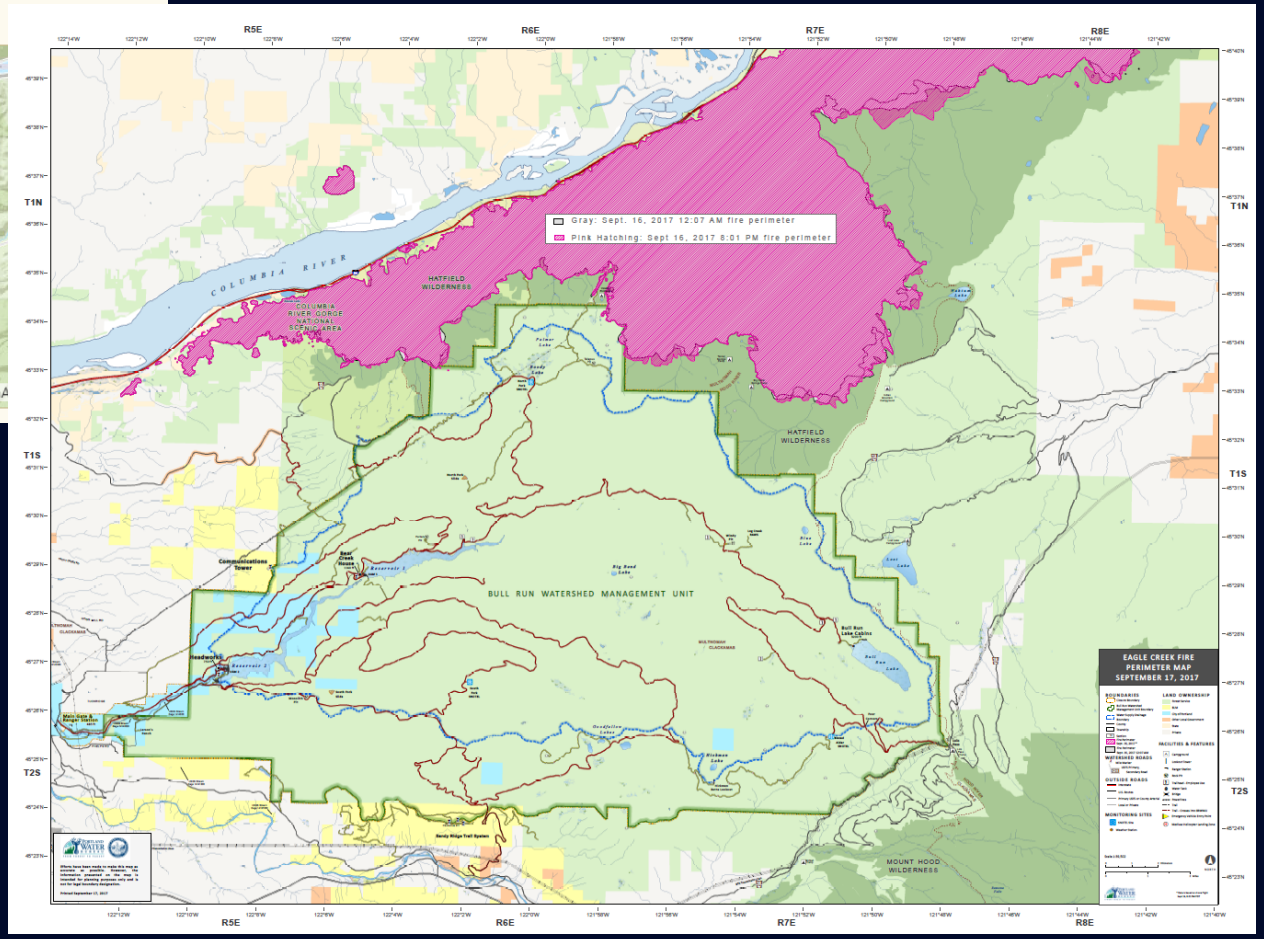
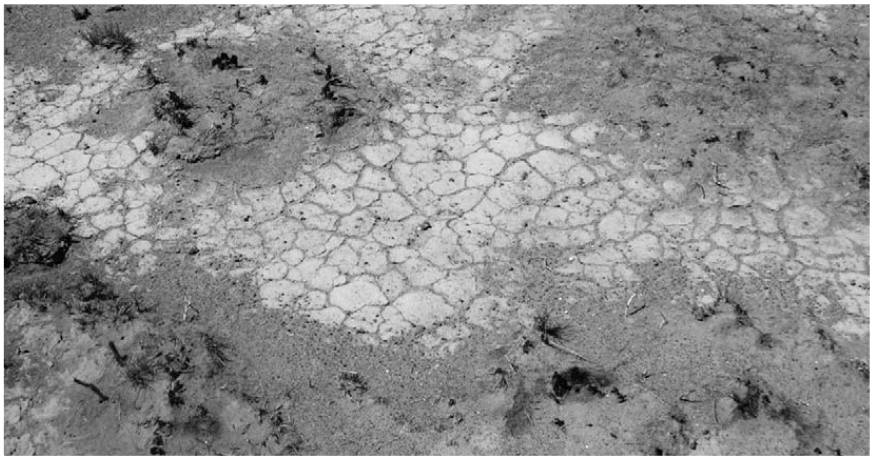


https://www.portlandoregon.gov/water/article/655188

Fire effects on soil



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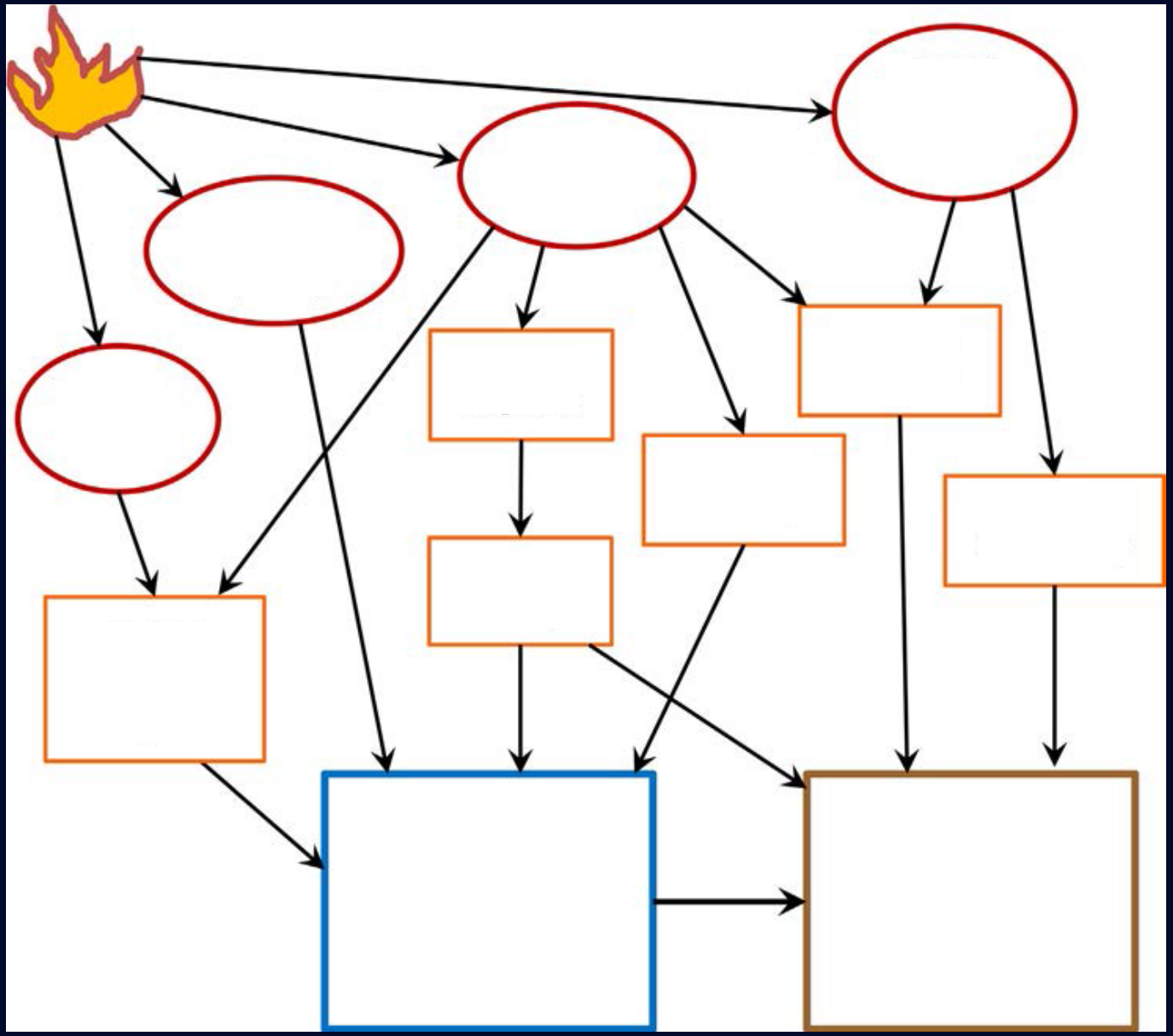
Photos from InciWeb, Jason Kreitler and Joel Sankey

Fire effects on soil



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Wagenbrenner et al., 2015. Effects of post-fire salvage logging and a skid trail treatment on ground cover, soils, and sediment production in the interior western United States. Forest Ecology and Management 335, 176–193.

Ash and sedimentation saturating a stream in Las Conchas, New Mexico. (Photo credit: USDA Forest Service)

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AGU PUBLICATIONS

Geophysical Research Letters

RESEARCH LETTER
10.1002/2017GL073979

Key Points:
- Model ensemble synthesis projects 10% increase in postfire sedimentation for nearly nine tenths of western USA watersheds by mid-21st century
- Postfire sedimentation projected to increase by >100% for more than one third of watersheds by mid-21st century
- Many watersheds with projected increases in fire and sedimentation are important surface water supply for downstream human communities

Supporting Information:
- Supporting Information S1

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Abstract 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 climate, fire, and erosion models, we show that postfire sedimentation is projected to increase for nearly nine tenths of watersheds by >10% and for more than one third of watersheds by >100% by the 2041 to 2050 decade in the western USA. The projected increases are statistically significant for more than eight tenths of the watersheds. In the western USA, many human communities rely on water from rivers and reservoirs that originates in watersheds where sedimentation is projected to increase. Increased sedimentation could negatively impact water supply and quality for some communities, in addition to affecting stream channel stability and aquatic ecosystems.

1. Introduction

The area burned by wildfires worldwide is expected to increase over the next century due to climate change [*Westerling et al.*, 2006; *Gedalof et al.*, 2005; *Littell et al.*, 2009; *Hawbaker and Zhu*, 2012a; *Stephens et al.*, 2014; *Dennison et al.*, 2014; *Barbero et al.*, 2015; *Pelletier et al.*, 2015; *Robinne et al.*, 2016]. Increased sedimentation due to soil erosion in burned watersheds [*Pierce et al.*, 2004; *Shakesby and Doerr*, 2006; *Moody and Martin*, 2009; *Miller et al.*, 2011] can negatively impact downstream aquatic ecosystems and the quality and supply of water [*Weidner and Todd*, 2011; *Murphy et al.*, 2015; *Smith et al.*, 2011]. Impacts to aquatic ecosystems range from biophysical effects on fish habitat to alterations of stream channel morphology [*Shakesby and Doerr*, 2006; *Smith et al.*, 2011]. Sedimentation can negatively impact water supply by reducing reservoir storage, which increases the need and cost for reservoir maintenance and the cost to treat and supply water to municipalities [*Palmieri et al.*, 2001]. Water quality can be further degraded by nutrients and pollutants that adsorb to individual sediment grains and aggregates [*Smith et al.*, 2011].

Fire frequency and burned area are expected to increase in many watersheds of the western USA in coming decades, particularly for the warmer climate change scenarios [*Hawbaker and Zhu*, 2012a; *Barbero et al.*, 2015] (Figures 1a and 1b). At least 65% of the water supply in the western USA originates in watersheds with fire-prone vegetation [*Brown et al.*, 2008]. Understanding how changing fire frequency, extent, and location will affect watersheds, reservoirs, and ecosystem services to communities is therefore of great societal importance [*Weidner and Todd*, 2011; *MacDonald*, 2010]. We use an ensemble modeling approach to examine how postfire sedimentation will change in western USA watersheds with future fire. Projections of areas burned by future wildfires for several climate change scenarios and general circulation models (GCMs) exist for all watersheds of the western USA [*Hawbaker and Zhu*, 2012a]. Predictions of postfire hillslope soil erosion rates also exist for many of these watersheds [*Miller et al.*, 2011] (Figure 1c). We synthesize these data sources to project sediment yield from future fires for watersheds through the year 2050 at the hydrologic unit 8 (HUC8) scale. We demonstrate a parsimonious, ensemble model synthesis approach to project future changes in postfire watershed sediment yield that could also be applied to other regions of the world.

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http://onlinelibrary.wiley.com/doi/10.1002/2017GL073979/abstract

The premise for our study

- The area burned annually by wildfires has increased in recent decades and is expected to increase in the future due to climate change for much of the Western USA
- Burned areas within watersheds increase soil erosion rates, which can increase sedimentation in downstream rivers and reservoirs
- Increased sediment can dramatically – often negatively – impact aquatic ecosystems, and decrease water quality and supply for people
- However, which watersheds will be impacted by future wildfires is largely unknown.

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Sankey et al., 2017, *Geophysical Research Letters*.

Objective

- How will post-fire sedimentation change in western USA watersheds with future fire?

Photos from InciWeb and Jason Kreitler

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Sankey et al., 2017, *Geophysical Research Letters*.

Methods

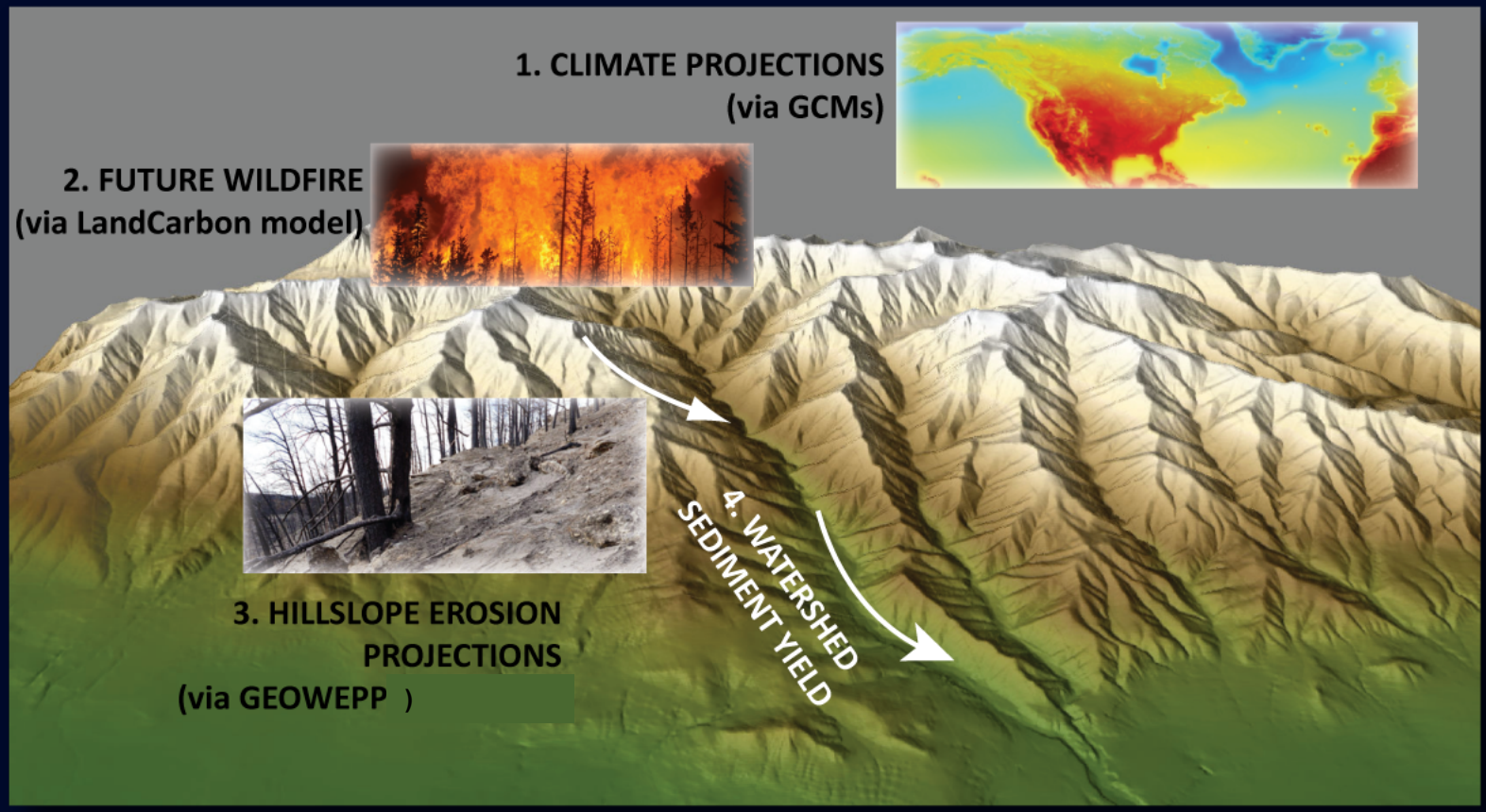

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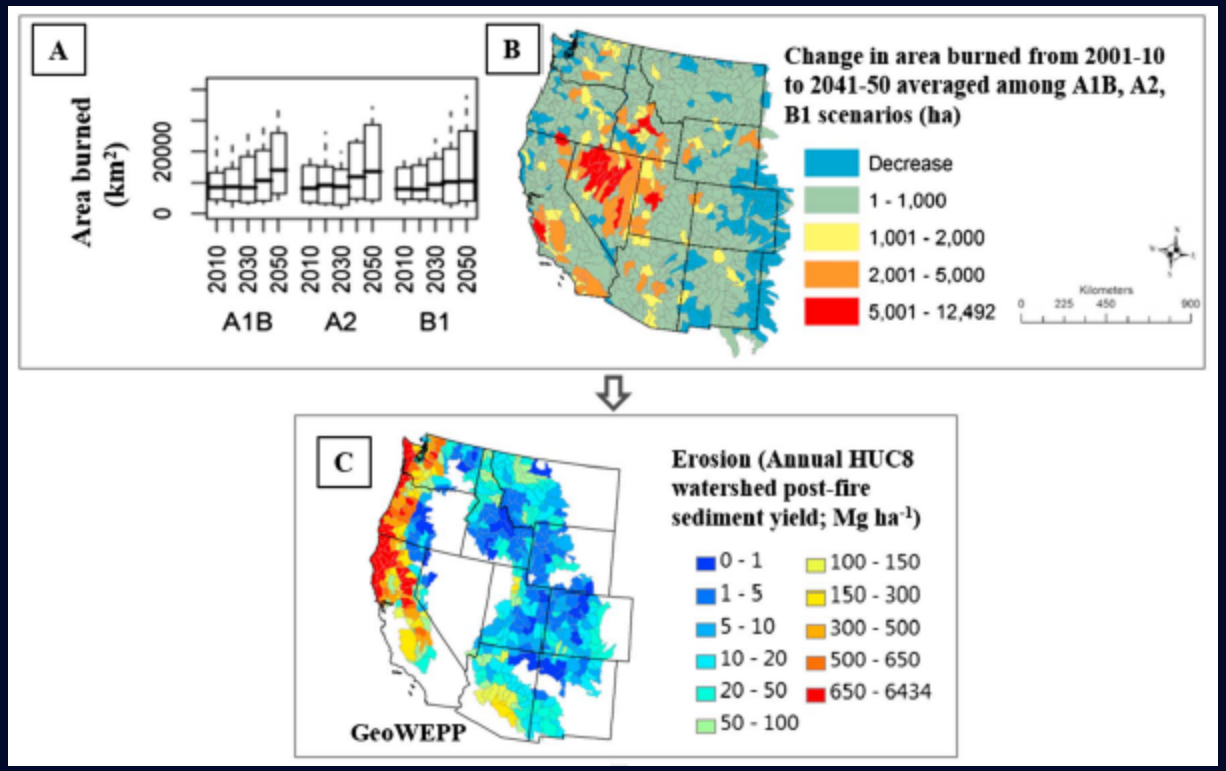
Figure made by A. Kasprak

Sankey et al., 2017, *Geophysical Research Letters*.

Methods



3 climate/fire scenarios X 1 erosion models
=
ensemble projection of post-fire watershed sediment yield

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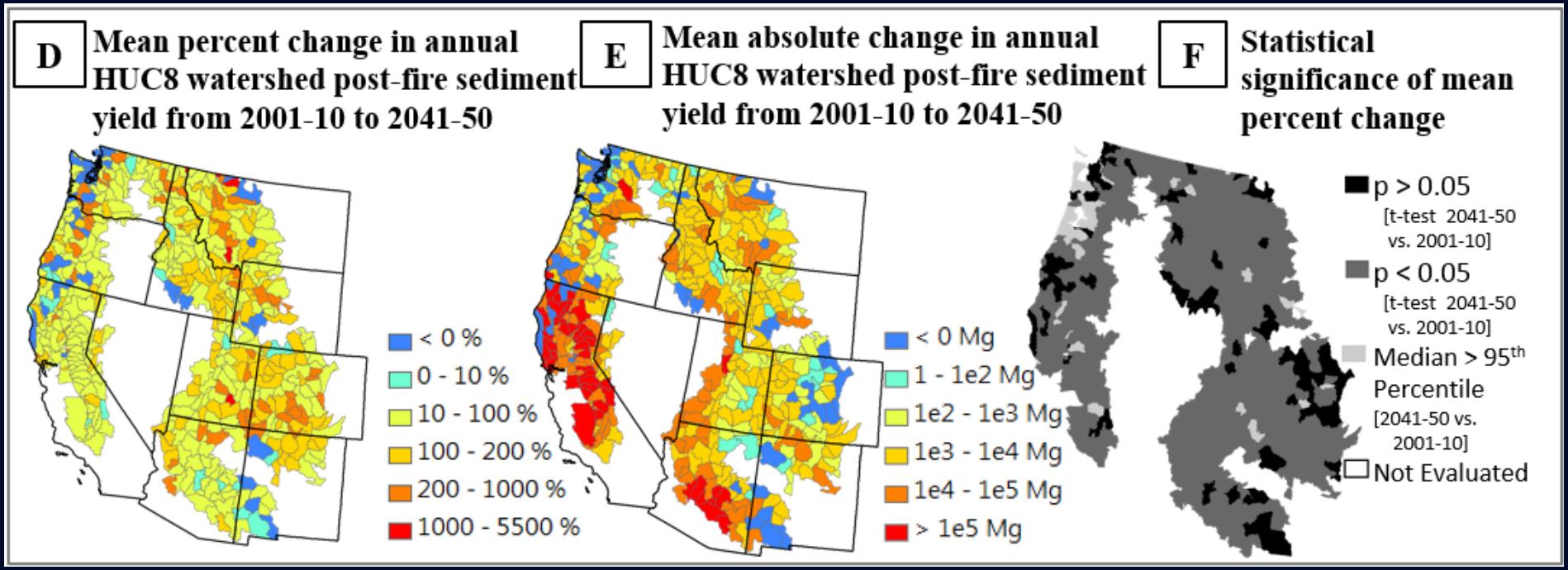
Sankey et al., 2017, *Geophysical Research Letters*.

Results



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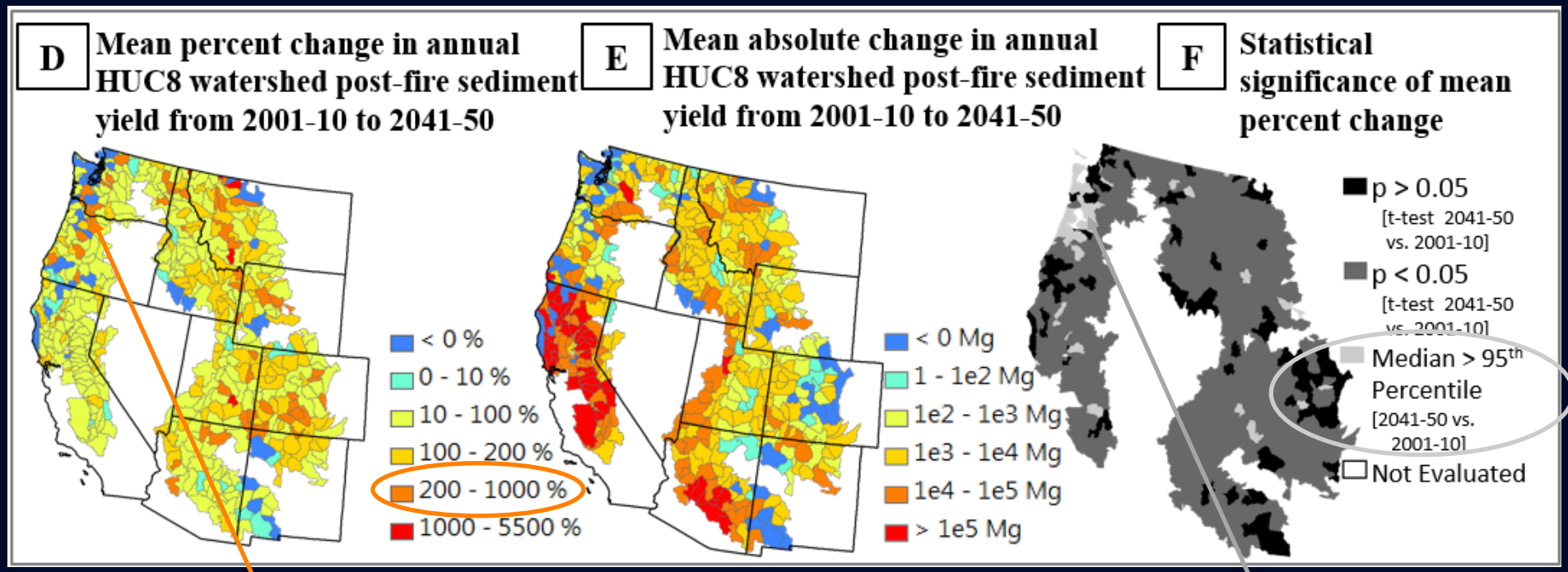

HUC8 Watershed Containing Bull Run Subwatershed and Eagle Creek Fire

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Sankey et al., 2017, *Geophysical Research Letters*.

Summary

- First research to use an ensemble of climate, fire, and erosion models to project variability in post-fire sediment yield at a watershed scale as a function of future wildfire conditions across the West.
- Project 10% increase in postfire sedimentation for nearly nine tenths of western USA watersheds by mid-21st century
- Postfire sedimentation projected to increase by >100% for more than one third of watersheds by mid-21st century
- Many watersheds with projected increases in fire and sedimentation are important surface water supply for downstream human communities

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Sankey et al., 2017, *Geophysical Research Letters*.

Research Publication

AGU PUBLICATIONS

Geophysical Research Letters

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Data Publication

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USGS 2017 JSankey: Climate, Wildfire, and Erosion Data, Western US

View

Data for journal manuscript: Climate, wildfire, and erosion ensemble foretells more sediment in western USA watersheds

Dates

Publication Date : 2017-09-07
Start Date : 2001
End Date : 2050

Citation

Sankey, J.B., 2017, Climate, wildfire, and erosion data, western US: U.S. Geological Survey data release, https://doi.org/10.5066/F7BV7DS8.

Summary

These data were used to examine how post-fire sedimentation might change in western USA watersheds with future fire from the decade of 2001-10 through 2041-50. The data include previously published projections (Hawbaker and Zhu, 2012a, b) of areas burned by future wildfires for several climate change scenarios and general circulation models (GCMs) that we summarized for 471 watersheds of the western USA. The data also include previously published predictions (Miller et al., 2011) of first year post-fire hillslope soil erosion from GeoWEPP that we summarized for 471 watersheds of the western USA. We synthesized these summarized data in order to project sediment yield from future fires for 471 watersheds through the year 2050 at the hydrologic unit 8 (HUC8) scale. The detailed methods, results, and original data sources (i.e.: Hawbaker and Zhu, 2012a, b; Miller et al., 2011) were reported in the manuscript.

Contacts

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Originator : Joel B Sankey
Metadata Contact : Terry Arundel
Publisher : U.S. Geological Survey
Distributor : U.S. Geological Survey - ScienceBase
USGS Mission Area : Ecosystems
SDC Data Owner : Southwest Biological Science Center

Attached Files

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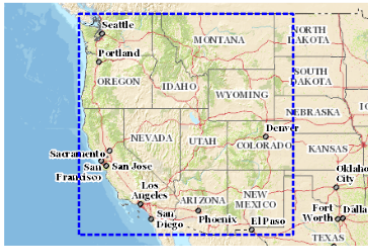
USGS_2017_JSankey_Climate_Wildfire_Erosion_Metadata.xml *Original FGDC Metadata*	View	36.57 KB

Map »



Communities

- USGS Data Release Products
- USGS Southwest Biological Science Center (SBSC)

Tags

Theme : A1B emission scenario, A2 emission scenario, Annual Post-fire Sediment Yield, Average Burned Area, B1 emission scenario, Burned area projections, Climate Change, Decadal summaries, Erosion, First year post-fire, Future post-fire sediment yield, Future wildfires, GCM, GIS-based erosion model, General circulation model, HUC, HUC8, Hillslope soil erosion rates, Hydrologic unit code, Post-fire, Projected watershed sediment yield, Sediment, Sediment yield, Simulations, Watershed sediment yield estimates, Watersheds, Wildfire perimeters, Wildfires
Place : Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Western US
Harvest Set : USGS Science Data Catalog (SDC)

https://www.sciencebase.gov/catalog/item/59541714e4b062508e3c7d98

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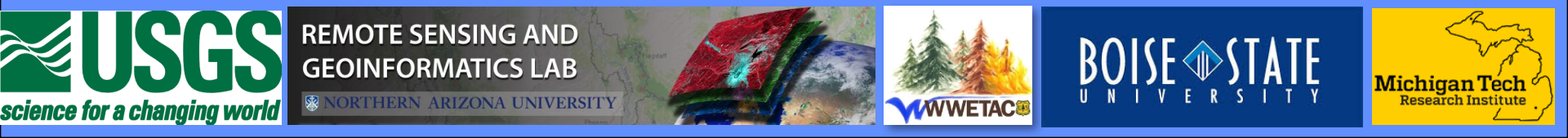

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Changes to Watershed Vulnerability Under Future Climate, Fire Regimes, and Population Pressures

Cement Creek Following Storm Event, Animas Watershed —Douglas Yager, USGS, 2004

▸ Project Overview

▾ Investigators

Lead Investigator:
Jason Kreitler, USGS Western Geographic Science Team

Other Investigator(s):
Joel Sankey, Todd Hawbaker, Nicole Vaillant, Scott Lowe

Project Contact:

▸ Additional Details

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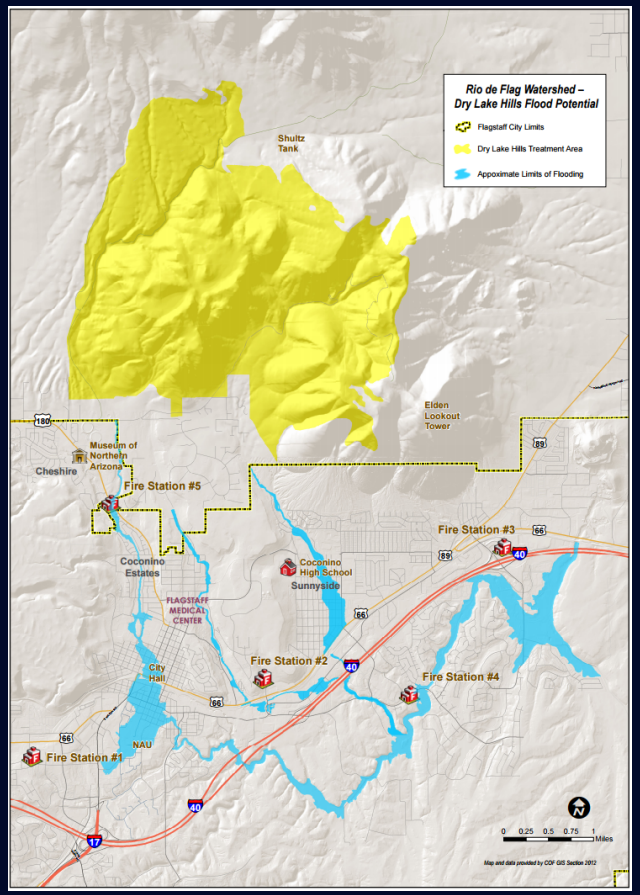

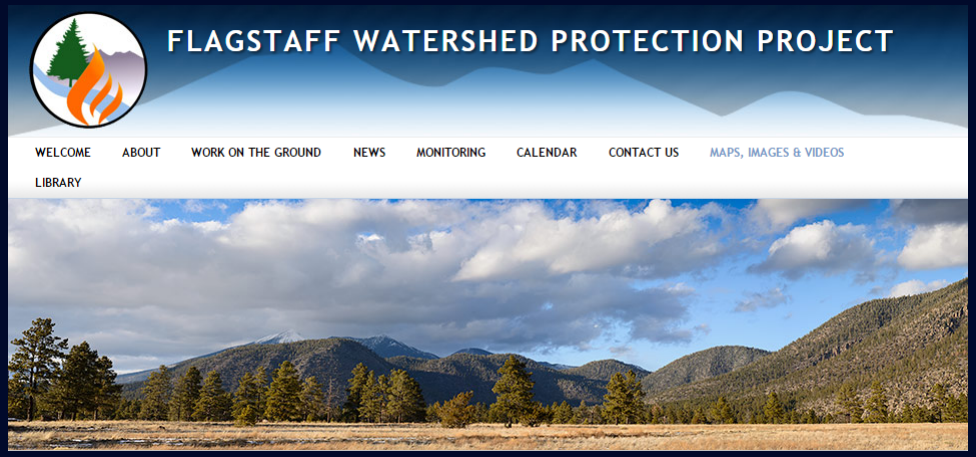

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http://www.flagstaffwatershedprotection.org/