BAER and ES & R Treatments, Tools and Other Stuff

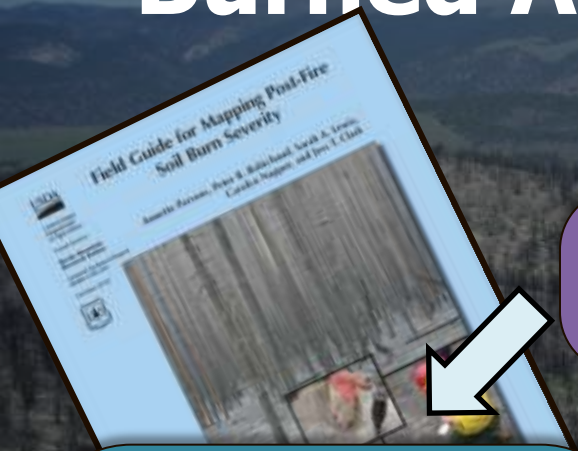
Pete Robichaud
Rocky Mountain Research Station
USDA Forest Service

What a year, 2014

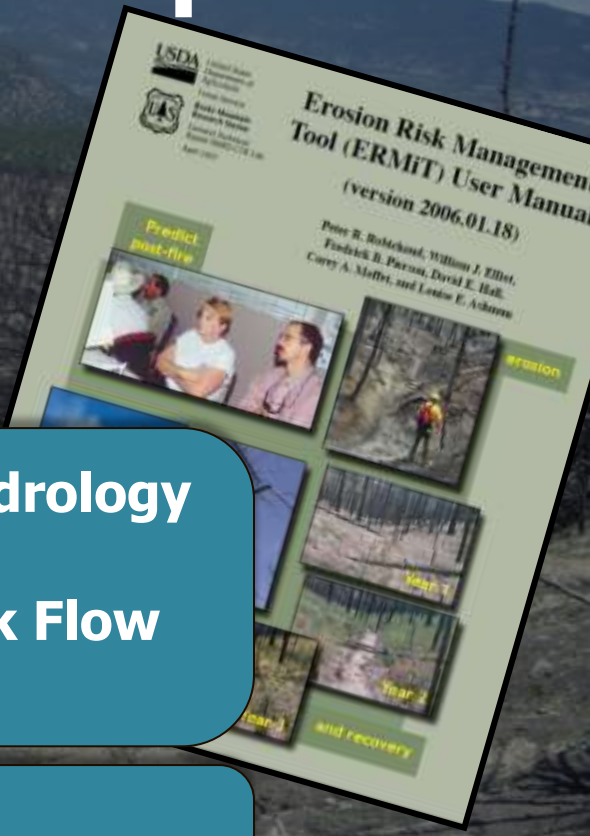
- Monitoring Results
- BAER DB
- FS WEPP
- Technological Developments
  - Unburned soils in ERMiT
  - Online GIS WEPP
  - Geo-WEPP
  - Ravel Rat
  - 6 pubs

- *Continued Monitoring*
  - 2011 Wallow Fire, AZ
  - 2012 High Park Fire, CO
- *New Sites*
  - 2013 Rim Fire, CA
  - 2014 Preacher Fire, ID wind

Burned Area Emergency Response (BAER) Tools



Remote Sensing Imagery

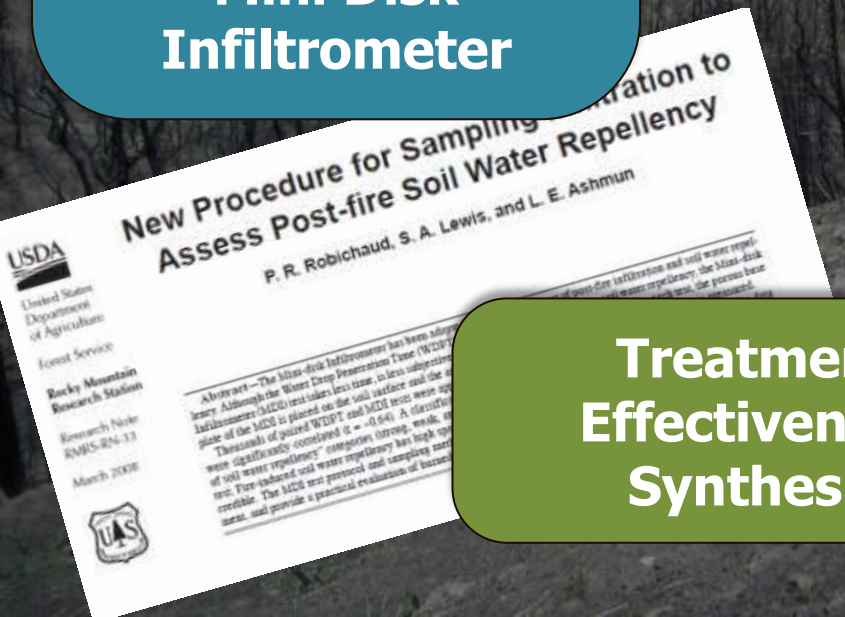


Soil Burn Severity Guide

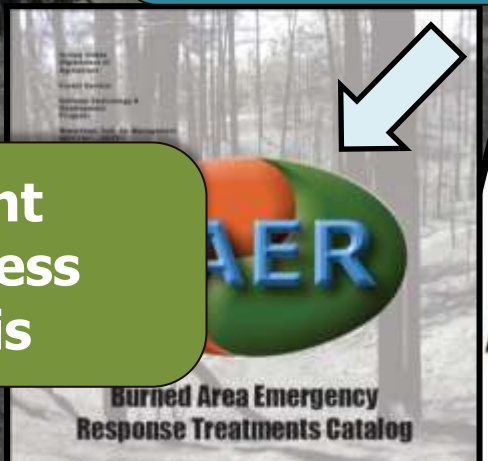
Mini Disk Infiltrometer

Erosion/Hydrology Predictions ERMiT, Peak Flow Calculator

VAR Tools



Treatment Effectiveness Synthesis



Evaluating Rehabilitation Treatments

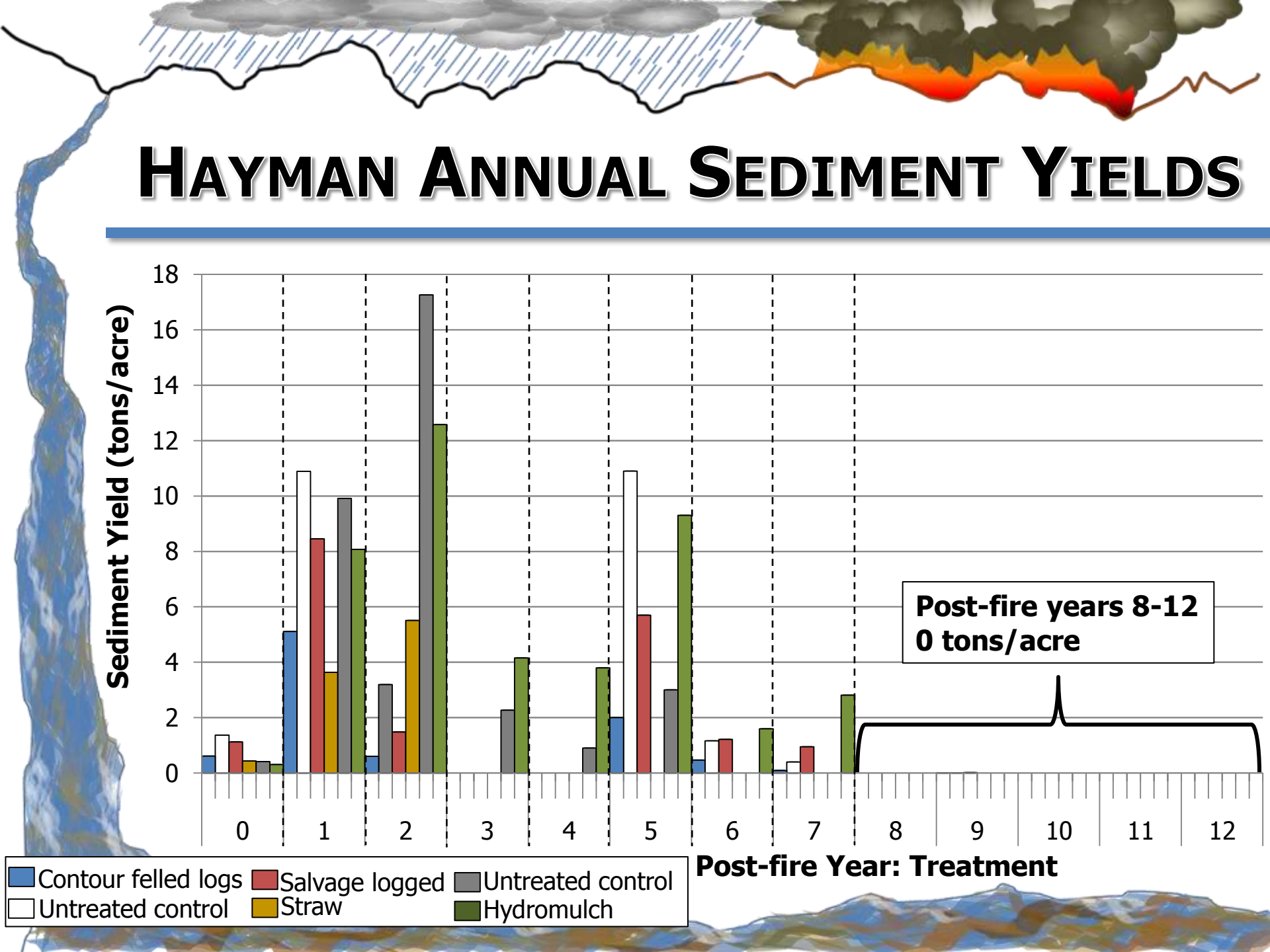
Evaluating Rehabilitation Treatments

		Straw mulches	Wood mulches	Hydro-mulches	Soil binders (PAM)	Contour-felled logs (LEBs)	Straw wattles
Overall effectiveness rating (1, 2, or 3)	High intensity rainfall (>2-yr return interval)	1	1	3	3	3	3
	Low intensity rainfall	1	1	1	2	1	1
	High rainfall amount (>50 mm in 6 hr)	1	1	2	3	2	2
Specific function	Remains functional for more than one year	more	more	less	less	more	more
	Provides ground cover	more	more	more	less	less	less
	Traps sediment	more	more	less	less	more	more

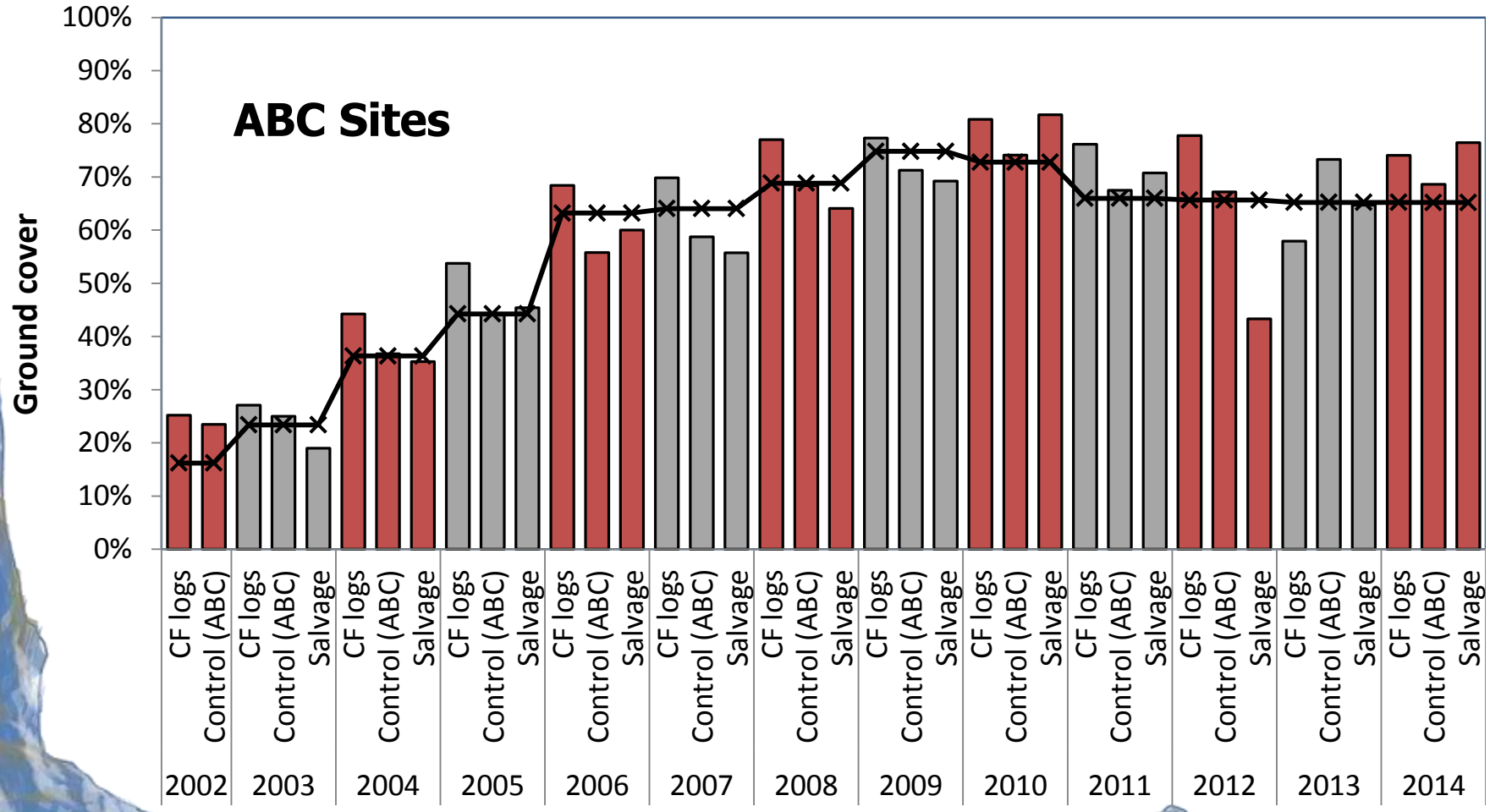
2002 Hayman Fire
Watershed Treatment Monitoring

12 Years after the Fire

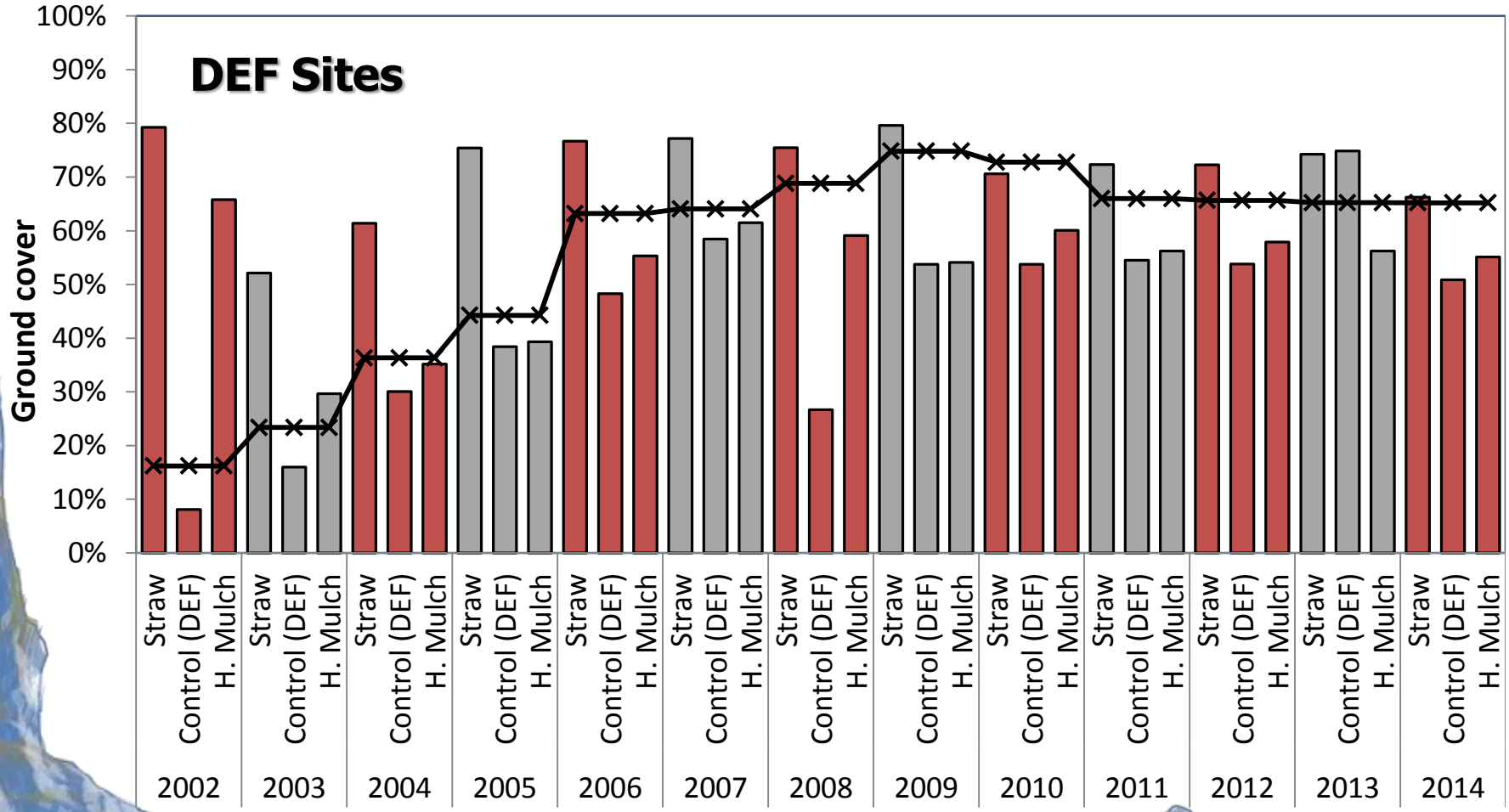
Hayman Annual Sediment Yields



Hayman Ground Cover 2002-2014



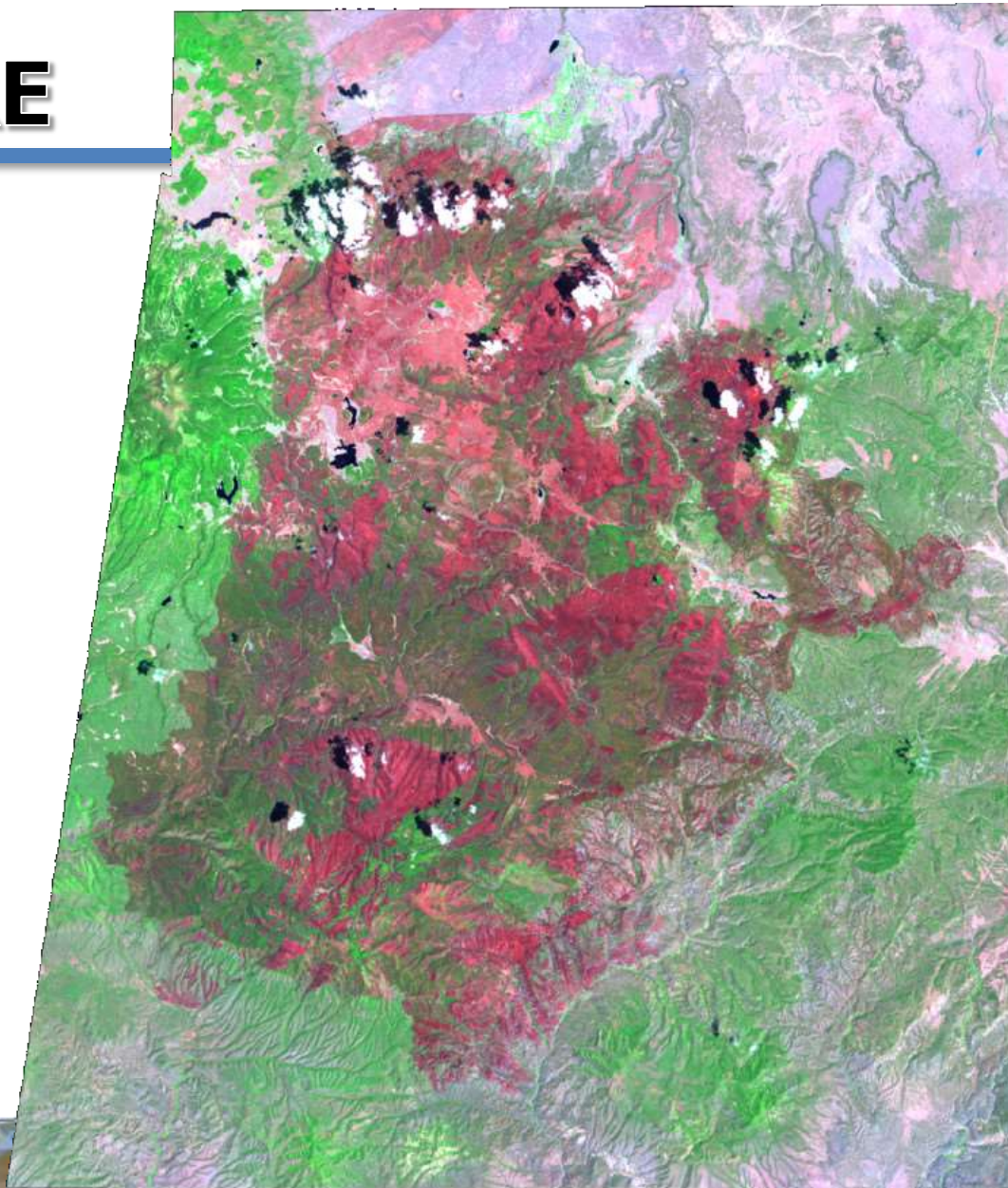
Hayman Ground Cover 2002-2014



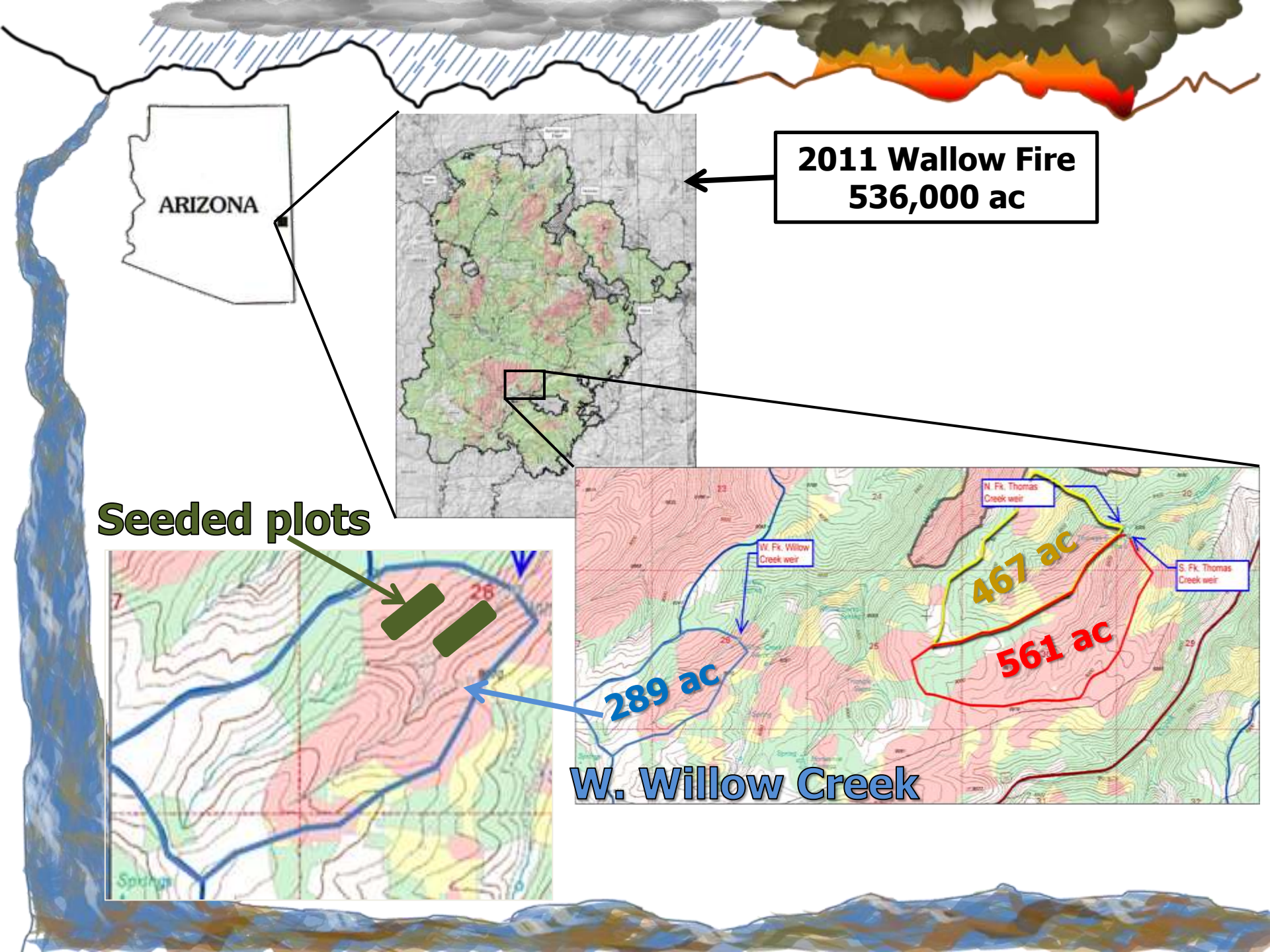
Summary of Hayman Monitoring

- Ground cover consistency
  - When will ground cover exceed 70%?
  - Development of canopy
- Max I_{10} in 2014 was 1.8 in/hr
- No sediment was produced
- Sediment through post-fire year 7 occurred during storms with 0.1 to 4.0 in/hr intensity

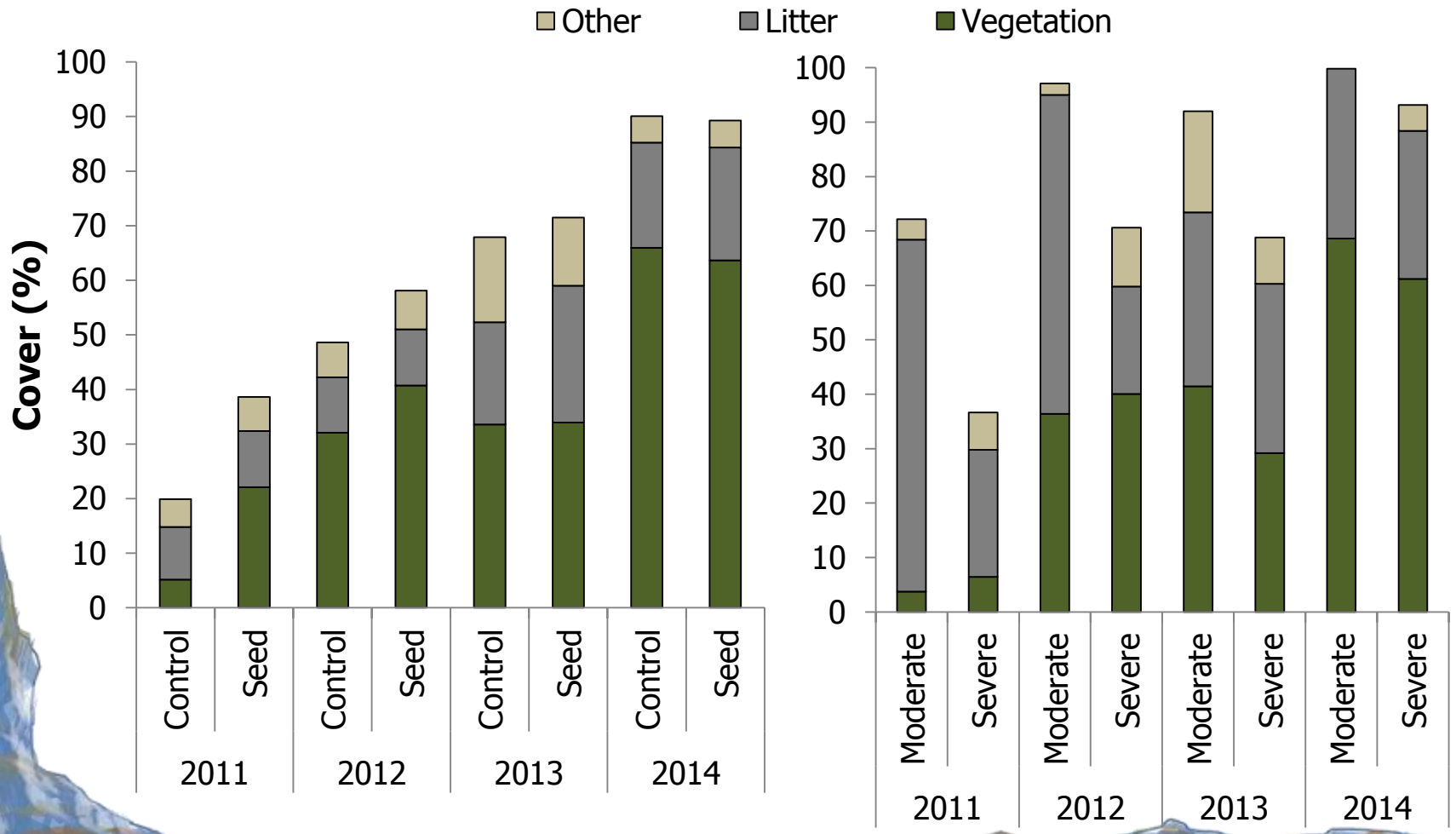
Wallow Fire
AZ, 2011



*Map is from Re
Application Center


ARIZONA
2011 Wallow Fire
536,000 ac
Seeded plots
N. Fk. Thomas Creek weir
W. Fk. Willow Creek weir
S. Fk. Thomas Creek weir
467 ac
561 ac
289 ac
W. Willow Creek

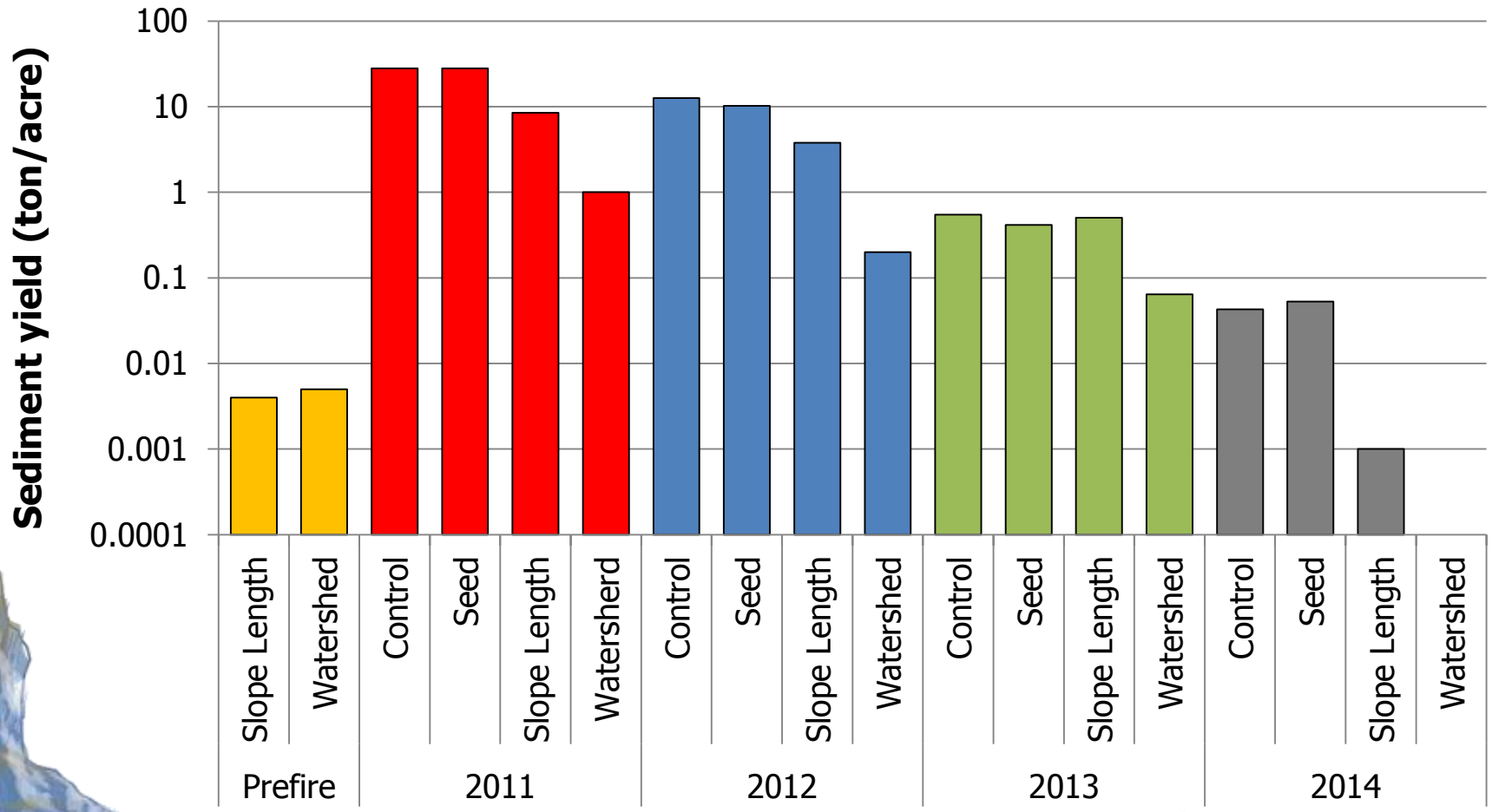
Wallow Ground Cover



Wallow Ground Cover Progression

	AUG 2011	JUNE 2012	JUNE 2013	AUG 2014
SEEDED				
CONTROL				

Wallow Sediment, 2014



Conclusions

- Fall 2011
  - **Seeding increased vegetative cover**
  - **Larger effect on NW aspect than SW**
  - **No difference in sediment yields between treatments**
- Fall 2012 through Fall 2014
  - **No difference in vegetative cover between treatments or aspects**
  - **No difference in sediment yields between treatments in 2012, 2013 or 2014**

Twitchell Canyon Fire

Straw Bale Check Dams Effectiveness

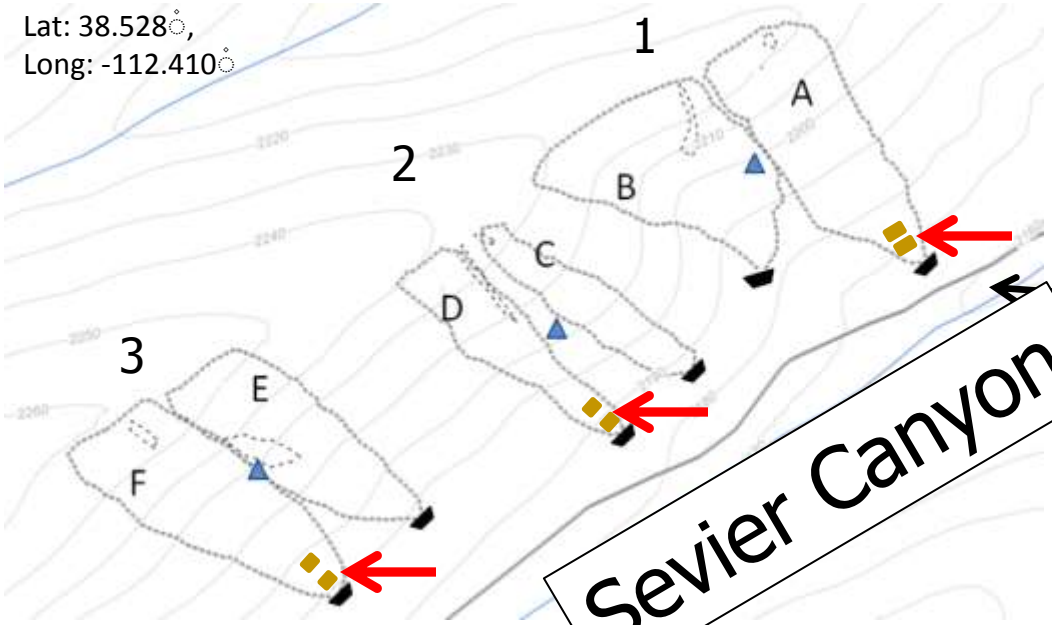
- 2010 - 2014

Twitchell Canyon Fire

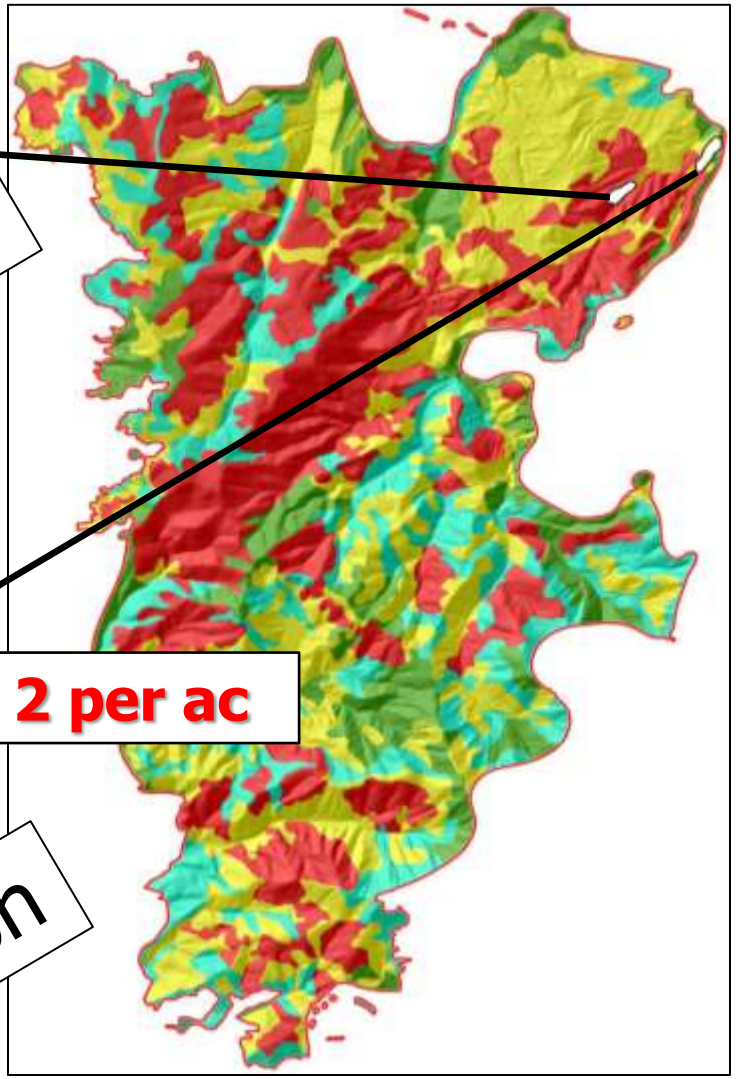
44874 ac

Site Elevation: 7380 ft

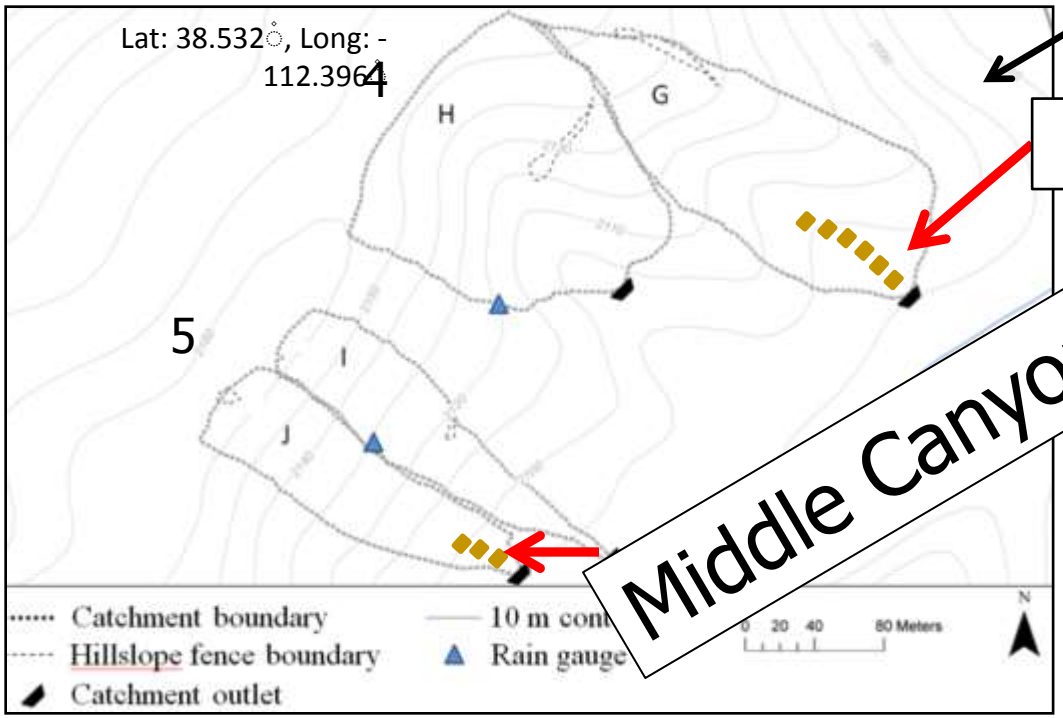
Average rainfall: May-Sep: 9.5 "



Sevier Canyon



2 per ac



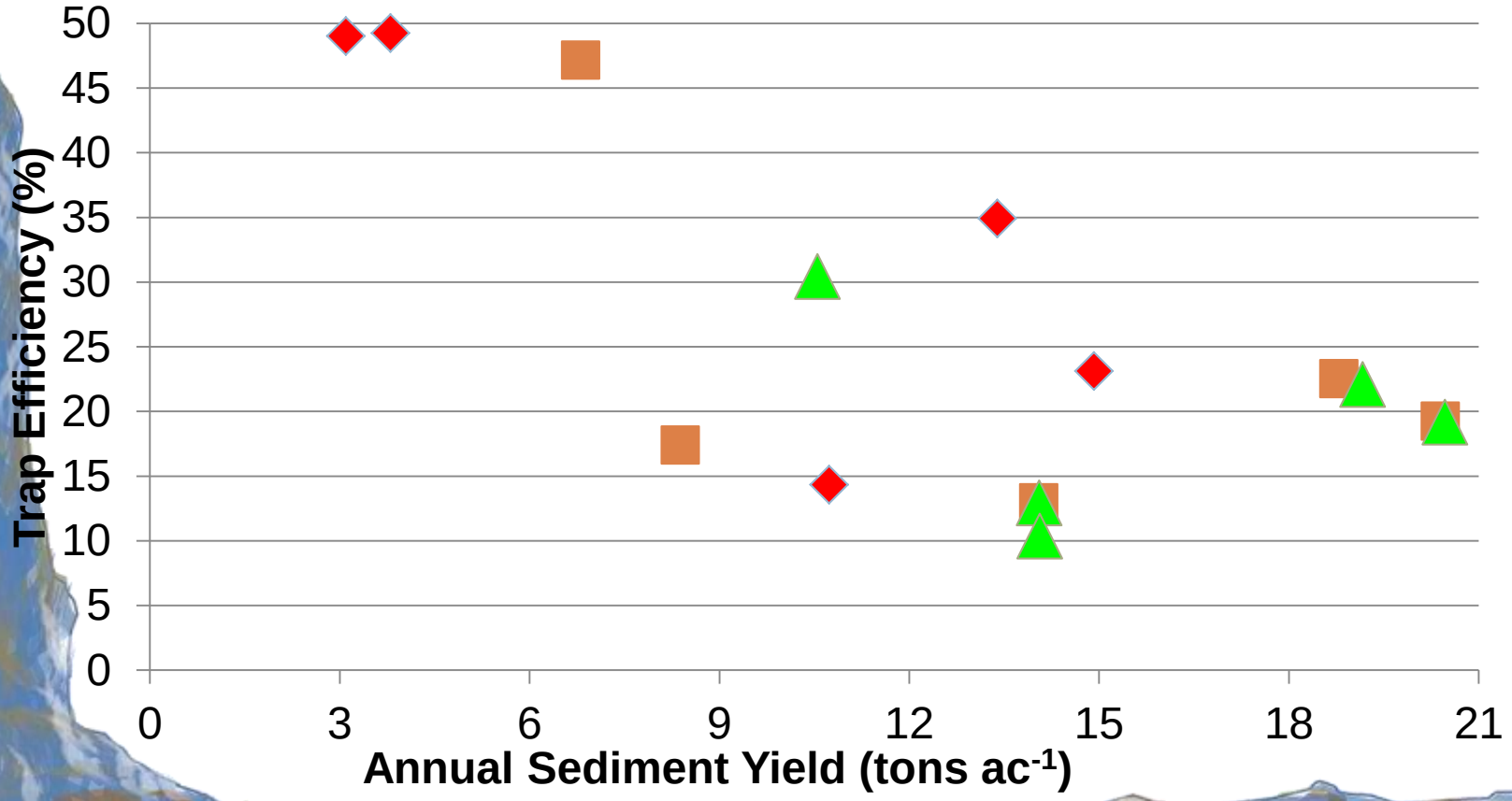
Middle Canyon

Trapped Sediment

- **Treatment Rate:**
  2 strawbale checkdams/ac
  - **1st year: 2.6 tons ac^{-1} (1.5-4.7)**
  - **3rd year: 2.9 tons ac^{-1} (1.5-4.2)**

ANNUAL DECREASE IN TRAP EFFICIENCY

Decreases with increasing total sediment yield



Strawbale Checkdams Treatment Considerations

- Treatment rate
- Underlying geology
  - Channel stability
- Channel gradient
- Channel shape
  - (U or V shaped)
- Storm intensity / Erosion potential

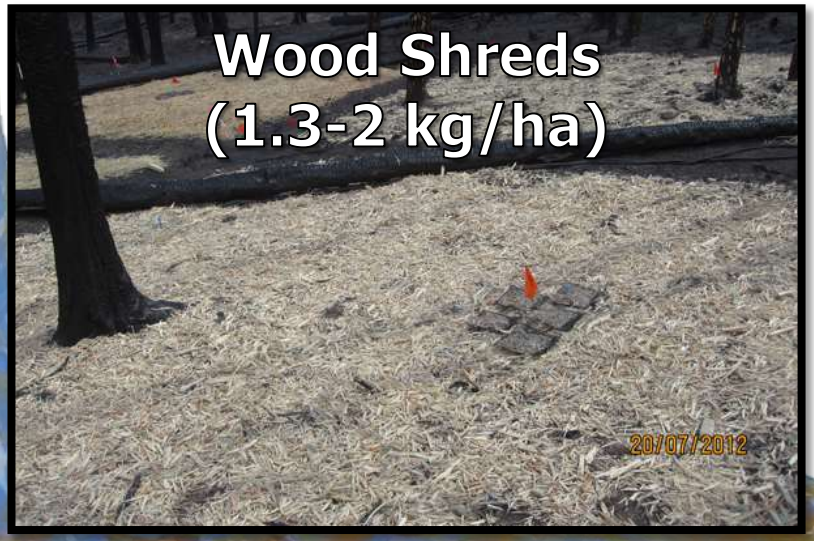
2012 High Park Fire, CO

- Do BAER treatments influence soil N availability for plant growth?
- Microbial processing of soil organic matter
- What are drivers?
  - Decomposition – fast or slow?
  - Mulch quality (C:N, labile C)
  - Physical changes
    - Increased moisture

Mulch Types


WoodStraw®
(1.3-2 kg/ha)


Ag/Wheat Straw
0.4-0.6 kg/ha

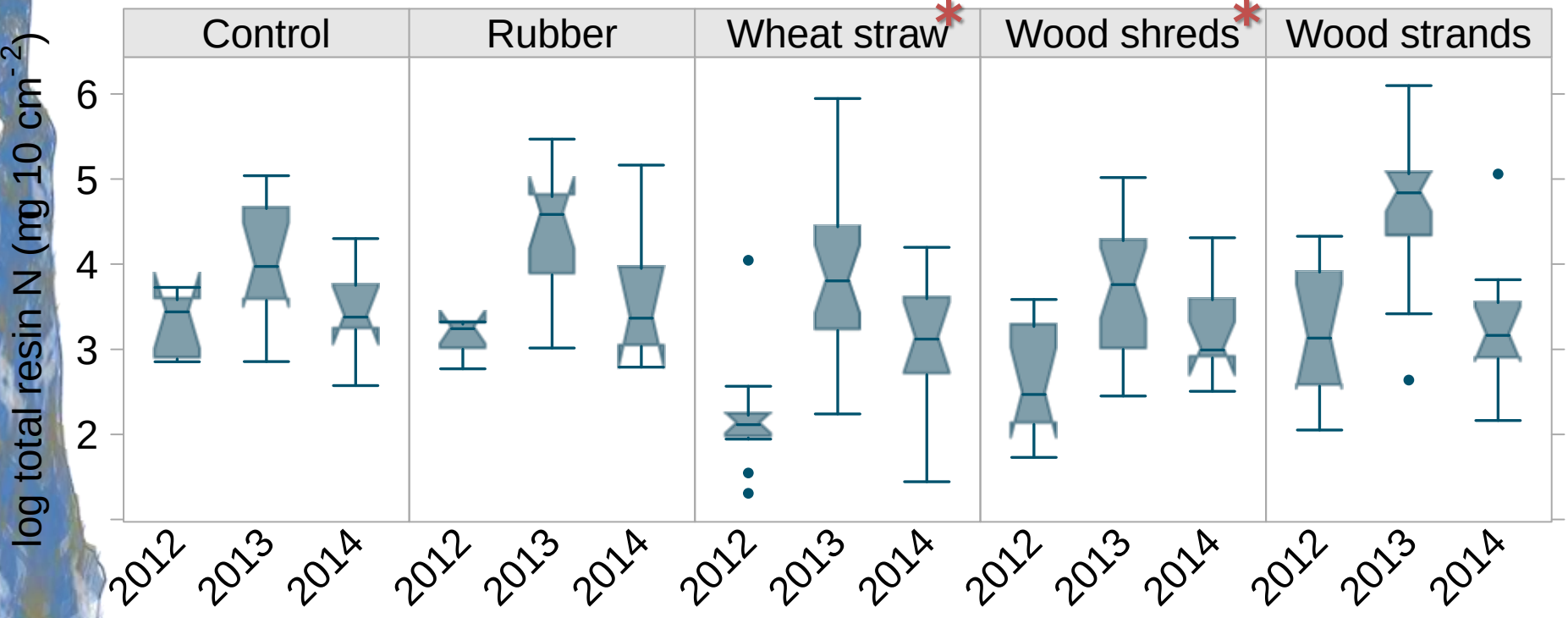

Wood Shreds
(1.3-2 kg/ha)
20/07/2012


Rubber Mulch
70% cover

Monitoring plant N availability

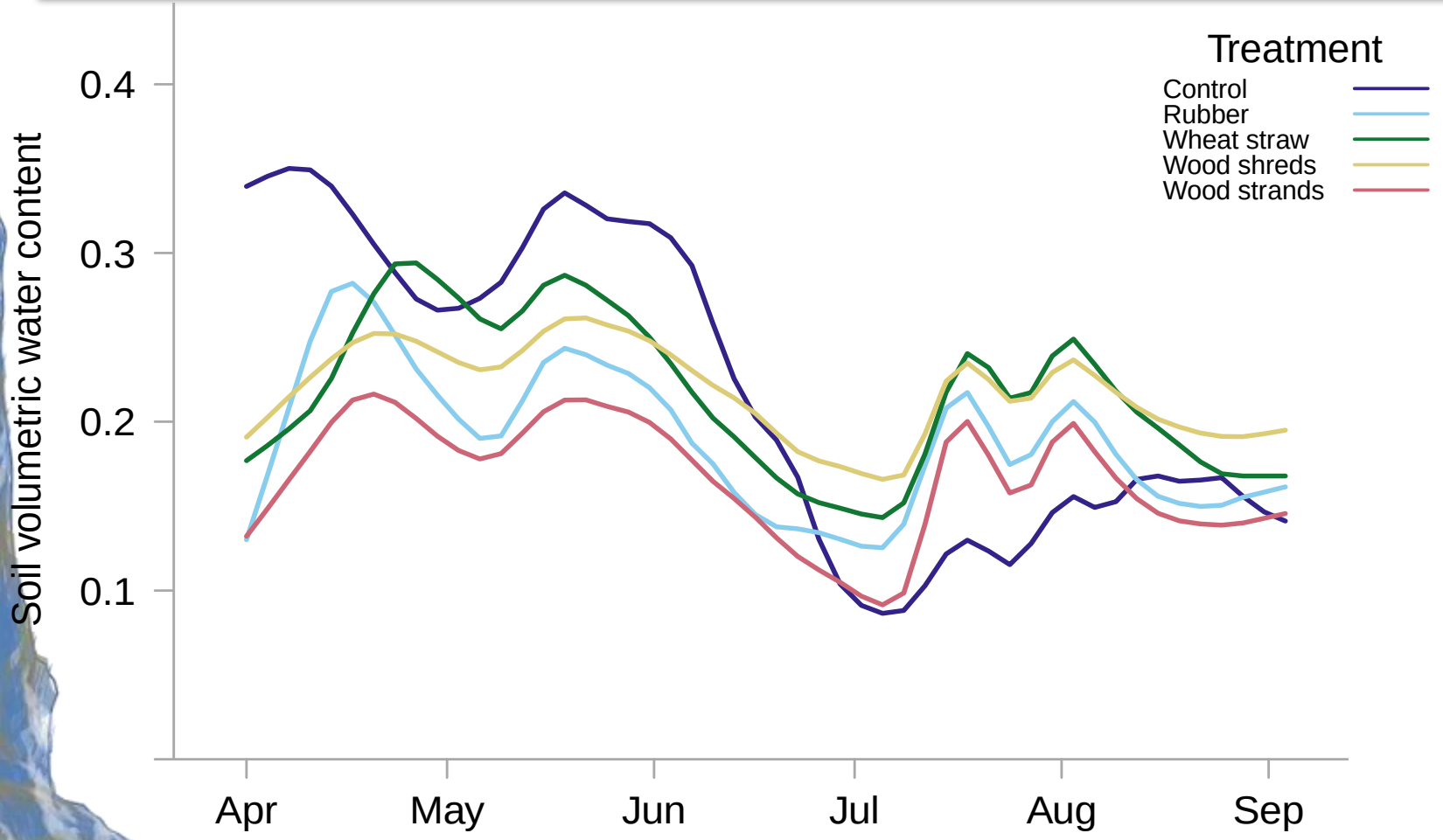
- Expect **rapid initial** immobilization in fastest-decomposing mulch (highest quality)
- **Slower**, but longer lasting N immobilization in high C:N material (wood)

Plant-available N was reduced by wheat and wood shreds

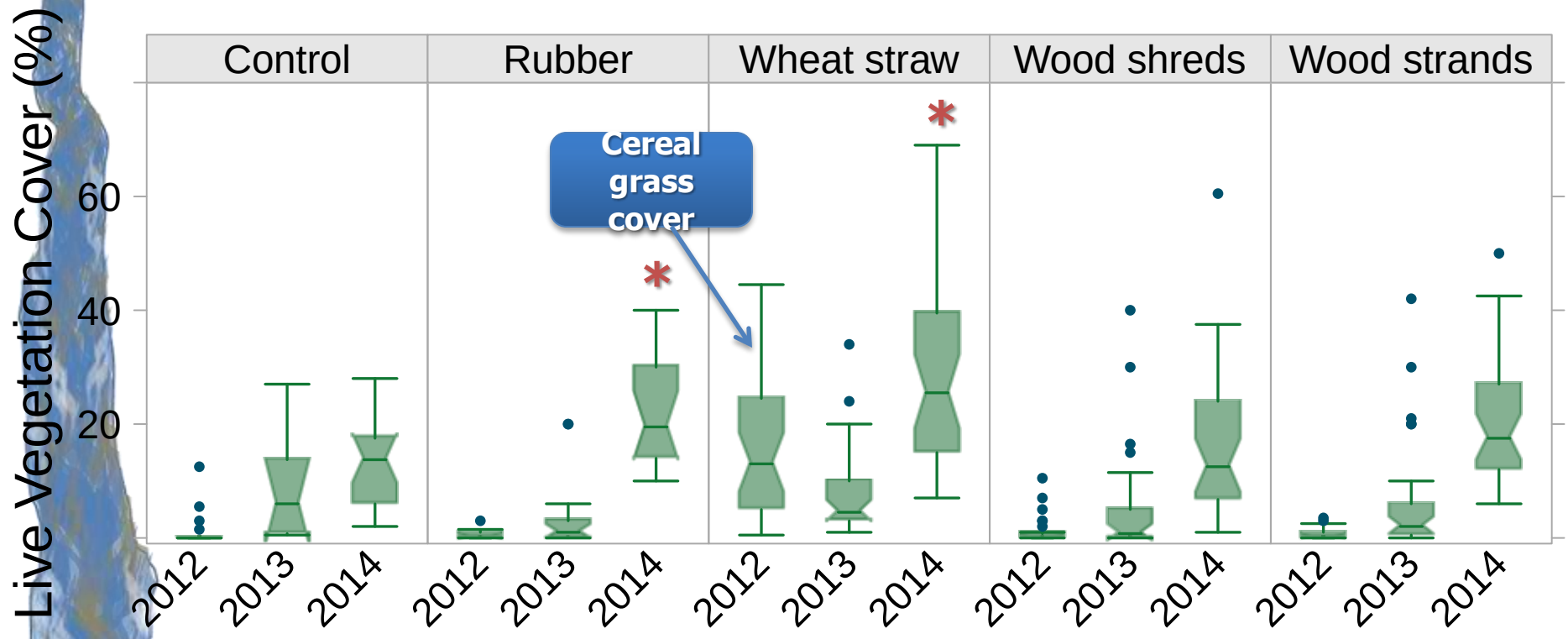


*Indicates significantly (*P*<0.05) lower N than control (all years combined)

Mulch increased soil moisture in 2014



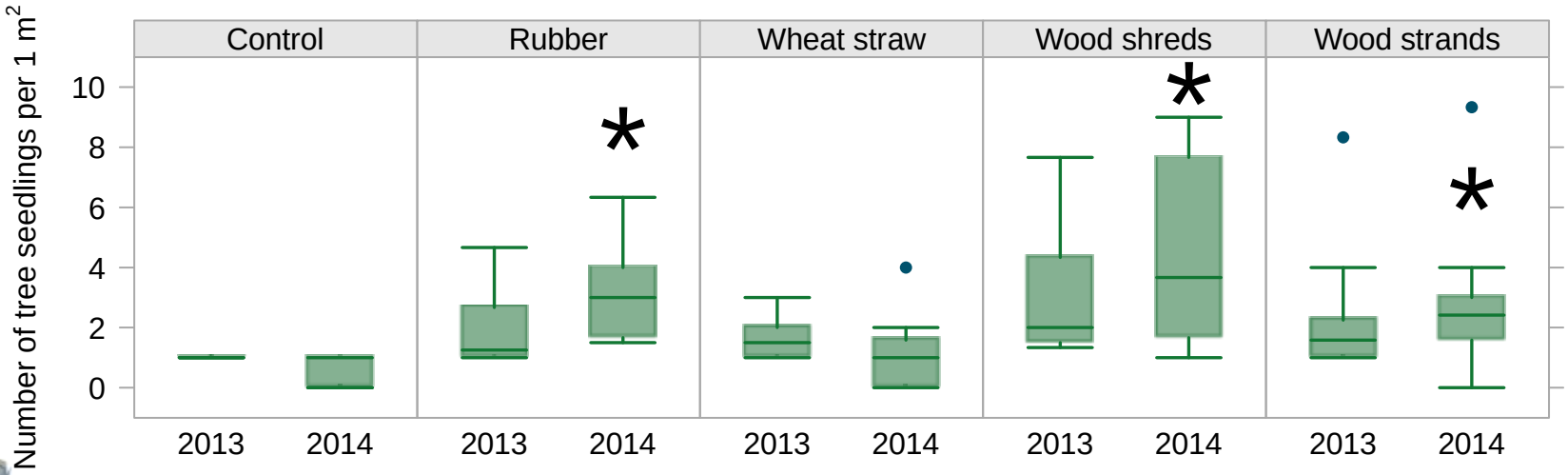
RUBBER AND WHEAT MULCH INCREASED LIVE PLANT COVER



*Indicates significantly (*P*<0.05) higher plant cover than control (2014 only).

MULCH INCREASED TREE SEEDLINGS, BUT NOT WHEAT STRAW

PICO seedlings



***Indicates significantly (*P*<0.05) higher seedling counts than control (2014 only).**

High Park Conclusions

- Mulch treatments increased soil moisture
- Mulch treatments promoted seedling establishment in year 2
- Wheat straw yielded high plant cover initially compared to other mulches and controls but declining in year 2
- Wheat and wood shreds supports microbial immobilization of soil N, possibly affecting recovering vegetation
- Important to follow through the degradation of wheat mulch to see if effects continue

BAER Burned Area Reports Database

- A searchable online database
- 1500+ 2500-8 reports, 4 decades, updated annually
- Displays summaries, complete 2500-8 reports downloadable
- Moscow Lab: http://forest.moscowfsl.wsu.edu > BAERTOOLS
- 1,000 queries in 2014

BAER Burned Area Reports Database

- A
- I
- D
- M
- I

USDA FOREST SERVICE

MFSL Home > BAER Tools

BAER Burned Area Reports DB

BAER Burned Area Reports DB is a database containing post-fire assessment information from four decades of US Forest Service Burned Area Reports. For more information and help, see BAER Burned Area Reports DB Guide.

Select which reports you want:

Location, by: National Forest

[All]
Angeles
Apache-Sitgreaves
Arapaho-Roosevelt
Ashley
Beaverhead-Deerlodge
Bighorn
Bitterroot
Black Hills
Boise

Treatment Types:

[All]
armored ford crossing
channel debris clearing
channel deflectors
contour felling
contour trenching
cross drain ditches
culvert inlet/outlet armoring
culvert maintenance
culvert overflow bypass

From date to (YYYY-MM-DD, or blank)

Choose how to view your reports:

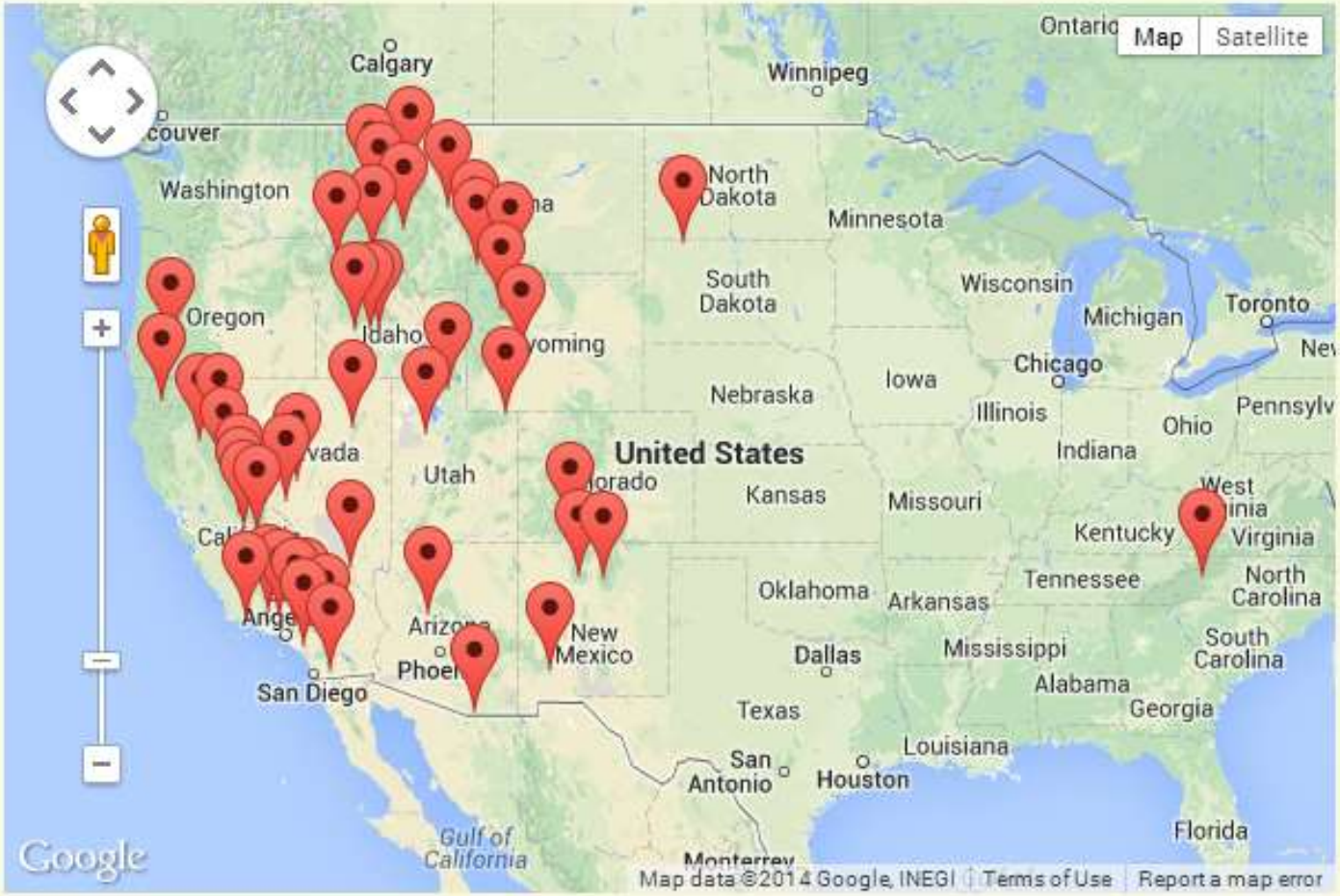
List view
Order by most recent
Show 10 reports per page
Map view

And finally:
Get reports

BAER Burned Area Reports

Found 51 BAER reports with this search:
Forests: [All]
Treatments: [All]
From 2013-01-01 to 2013-12-31

Map View



BAER Burned Area Reports

List View

Showing reports **1-10** out of **51 selected**, ordered by most recent fire date:

expand all shrink all English units

#	Fire	Forest	Started	Area	Expand
1	Table Rock Fire	Westwide Info (NC, rgn 0)	2013-NOV-12	1,044 ha	expand
2	Rock Creek	Custer (MT, rgn 1)	2013-AUG-20	389 ha	expand
3	Hough Complex	Plumas (CA, rgn 5)	2013-AUG-19	136 ha	expand
4	Lolo Creek Complex	Lolo (MT, rgn 1)	2013-AUG-18	4,412 ha	expand
5	Chestnut Fire	Humboldt And Toiyabe (NV, rgn 4)	2013-AUG-18	1,689 ha	expand
6	Rim Fire	Stanislaus (CA, rgn 5)	2013-AUG-17	103,962 ha	expand
7	Cleghorn	San Bernardino (CA, rgn 5)	2013-AUG-17	45 ha	expand
8	Spring Peak	Humboldt And Toiyabe (NV, rgn 4)	2013-AUG-14	5,759 ha	expand
9	Eureka	Beaverhead-Deerlodge (MT, rgn 1)	2013-AUG-12	2,618 ha	expand
10	Damnation	Flathead (MT, rgn 1)	2013-AUG-11	3,337 ha	expand

Previous 10 Reports | Next 10 Reports | Go to report #: | of 51

BAER Burned Area Reports

Total Expenditure for Hillslope Treatments In Millions of $USD

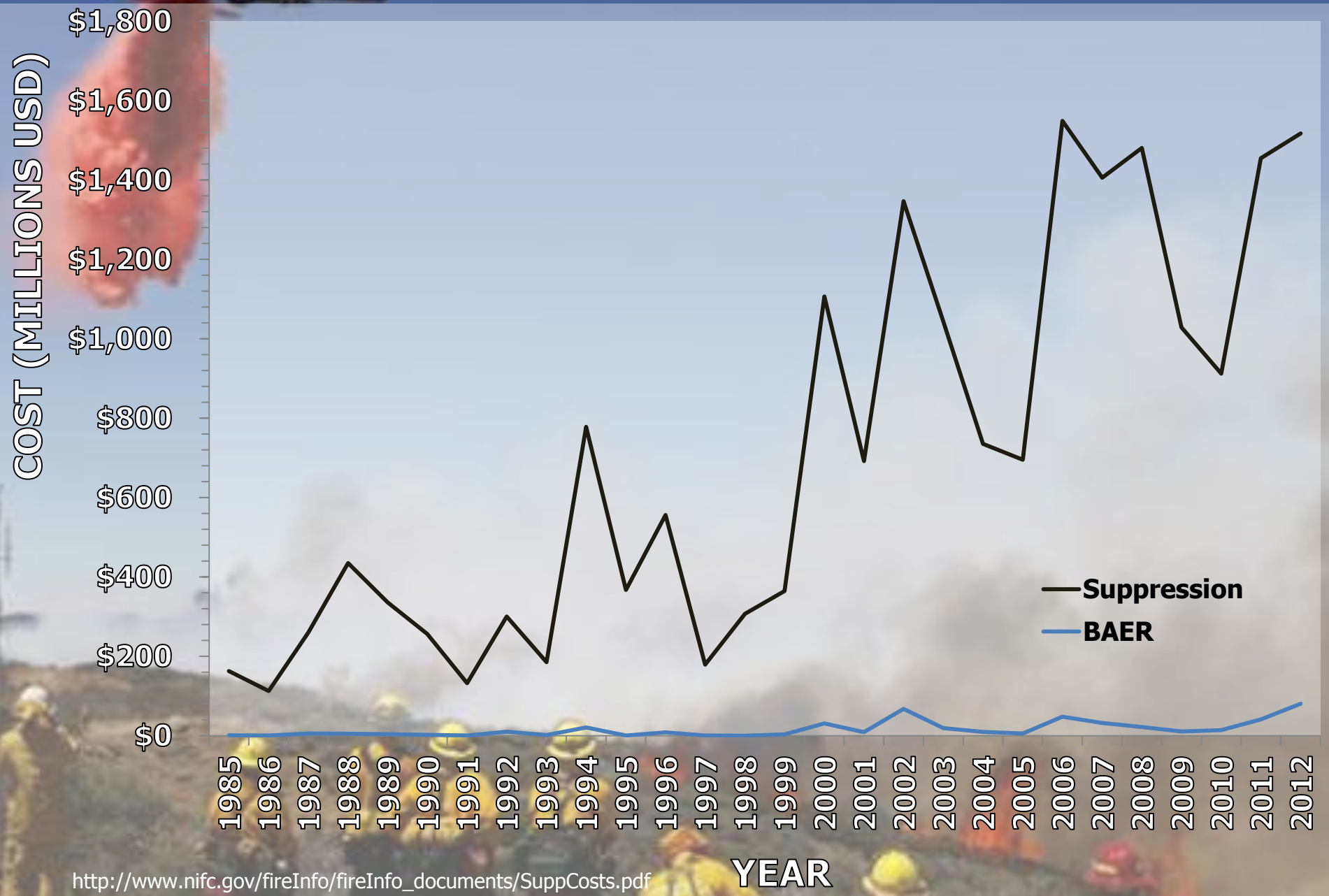
Treatment category[a]	Decade			
	1970s	1980s	1990s	2000s
Seeding	3.5	13.5	12	21
Fertilizer and seeding	2	3	1.3	1.4
Contour felled logs	0.2	6	29	8
Agricultural straw mulch	<0.1	0.2	3	80
Hydromulch	n.a.	n.a.	n.a.	41
Wood strand mulch	n.a.	n.a.	n.a.	3

10 Fires on USFS Lands with Largest Expenditures

BAER Expenditure				Suppression Expenditure			
Fire name	State	Yr	Expenditure Millions ($)	Fire Name	State	Yr	Expenditure Millions ($)
Tripod Complex	WA	2006	30	Biscuit	OR	2002	153
Hayman	CO	2002	25	Klamath	CA	2007	126
Cerro Grande	NM	2000	15	Zaca Two	CA	2008	122
Rodeo/Chediski Complex	AZ	2002	13	Wallow	AZ	2011	109
Foothills	ID	1992	13	Station	CA	2009	96
Rabbit Creek	ID	1994	12	Lightning Complex	CA	2008	95
Valley-Skalkaho Complex	MT	2000	12	Basin Complex	CA	2008	78
Biscuit	OR	2002	11	Day	CA	2006	78
Tyee Creek Complex	WA	1994	9	Iron & Alps Complex	CA	2008	74
Gap	CA	2008	7	Tripod Complex	WA	2006	68

Robichaud, P.R.; Rhee, H.; Lewis, S.A. 2014 *A synthesis of post-fire Burned Area Reports from 1972 to 2009 . . .* Int. J. of Wildland Fire 2014, 23, 929–944.

Suppression & BAER Cost in the U.S.



http://www.nifc.gov/fireInfo/fireInfo_documents/SuppCosts.pdf

http://a57.foxnews.com/global.fncstatic.com/static/managed/img/U.S./660/371/073110_fire.jpg?ve=1

http://forest.moscowfsl.wsu.edu/fswepp/

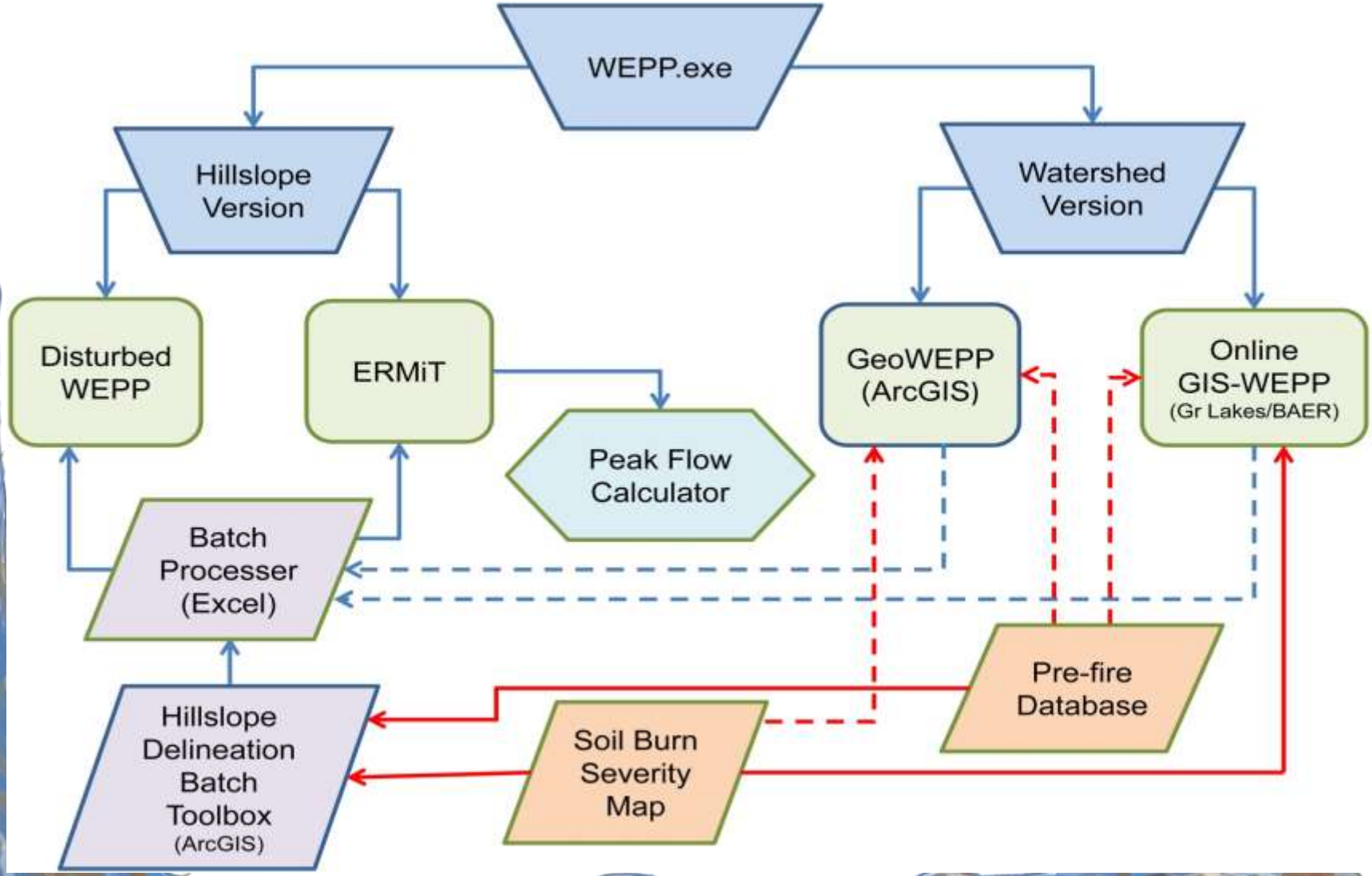
FSWEPP

Forest Service WEPP Interfaces

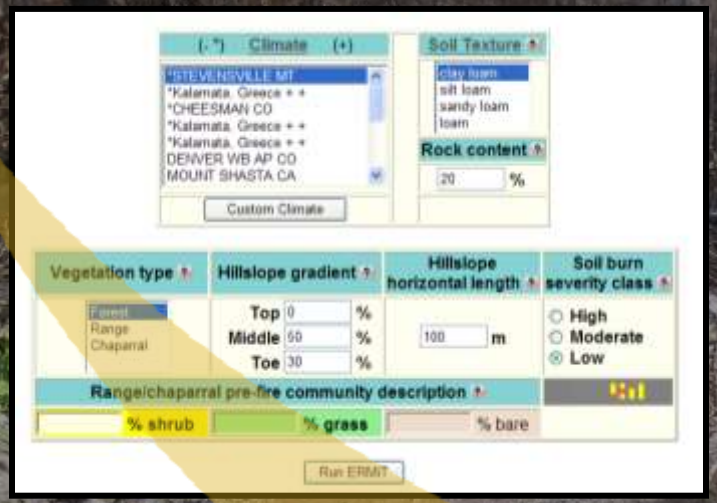
WEPP:Road 1989 runs YTD	**WEPP:Road Batch** 277 runs, 5478 segments YTD
ERMiT 1732 runs YTD	**ERMiT batch (download)** 43 runs YTD
Disturbed WEPP 4643 runs YTD	**Disturbed WEPP batch (download)** 206 runs YTD
Tahoe Basin Sediment Model 863 runs YTD	**Biomass Sediment Model** 43 runs YTD
FuME (Fuel Management) 210 runs YTD	**Rock:Clime**
WEPP Watershed Online GIS	**Peak Flow Calculator**
Water And Sediment Predictor Under development	**Other WEPP resources**

Units: metric U.S. customary personality (a to z)

WEPP Models


WEPP.exe
Hillslope Version
Watershed Version
Disturbed WEPP
ERMiT
GeoWEPP (ArcGIS)
Online GIS-WEPP (Gr Lakes/BAER)
Peak Flow Calculator
Batch Processer (Excel)
Pre-fire Database
Hillslope Delineation Batch Toolbox (ArcGIS)
Soil Burn Severity Map

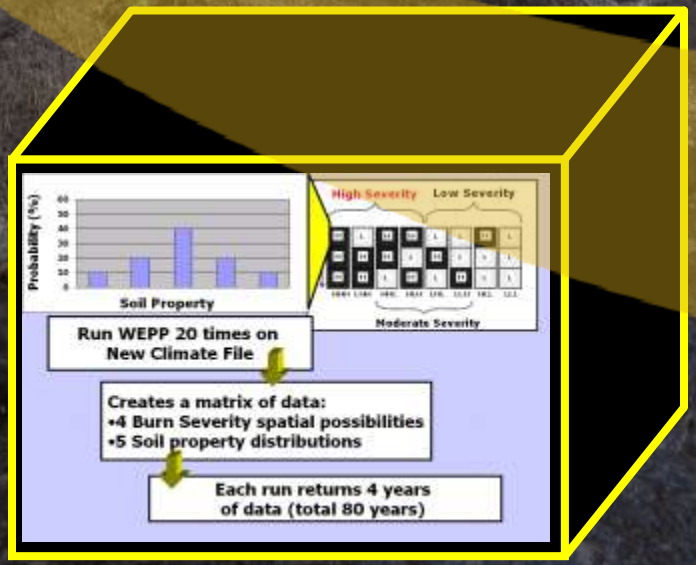
User Input



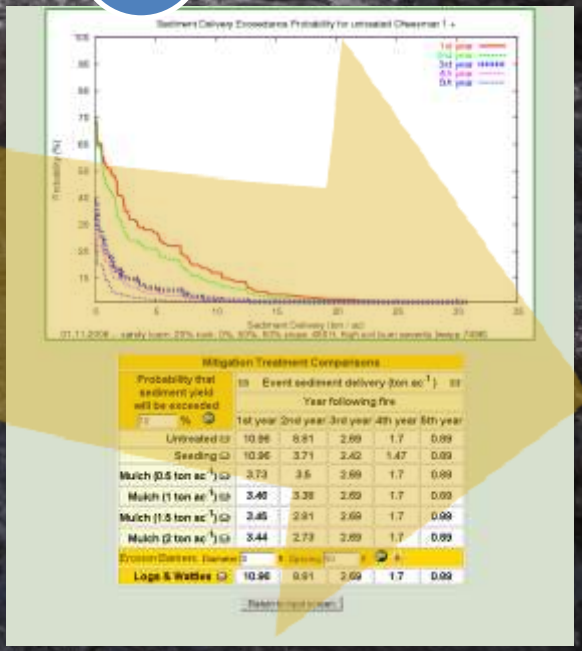
ERMiT

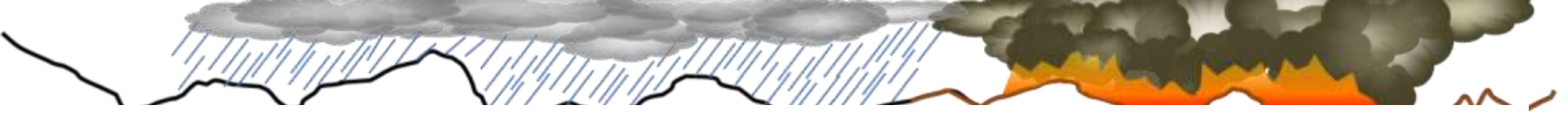
- Event based
- Probabilistic
- Incorporates Variability

Calculations



Output





Sediment Delivery

Probability that sediment yield will be exceeded 20 %	Event sediment delivery (ton ac^{-1})				
	Year following fire				
	1st year	2nd year	3rd year	4th year	5th year
Untreated	6.37	2.64	0.69	0.28	0.01
Seeding	6.37	0.89	0.36	0.15	0.01
Mulch (0.5 ton ac^{-1})	1.11	0.87	0.69	0.28	0.01
Mulch (1 ton ac^{-1})	0.37	0.63	0.69	0.28	0.01
Mulch (1.5 ton ac^{-1})	0.03	0.61	0.69	0.28	0.01
Mulch (2 ton ac^{-1})	0.02	0.44	0.69	0.28	0.01
Erosion Barriers: Diameter 0.8 ft Spacing 60 ft					
Logs & Wattles	2.6	0.35	0	0	0

Return to input screen

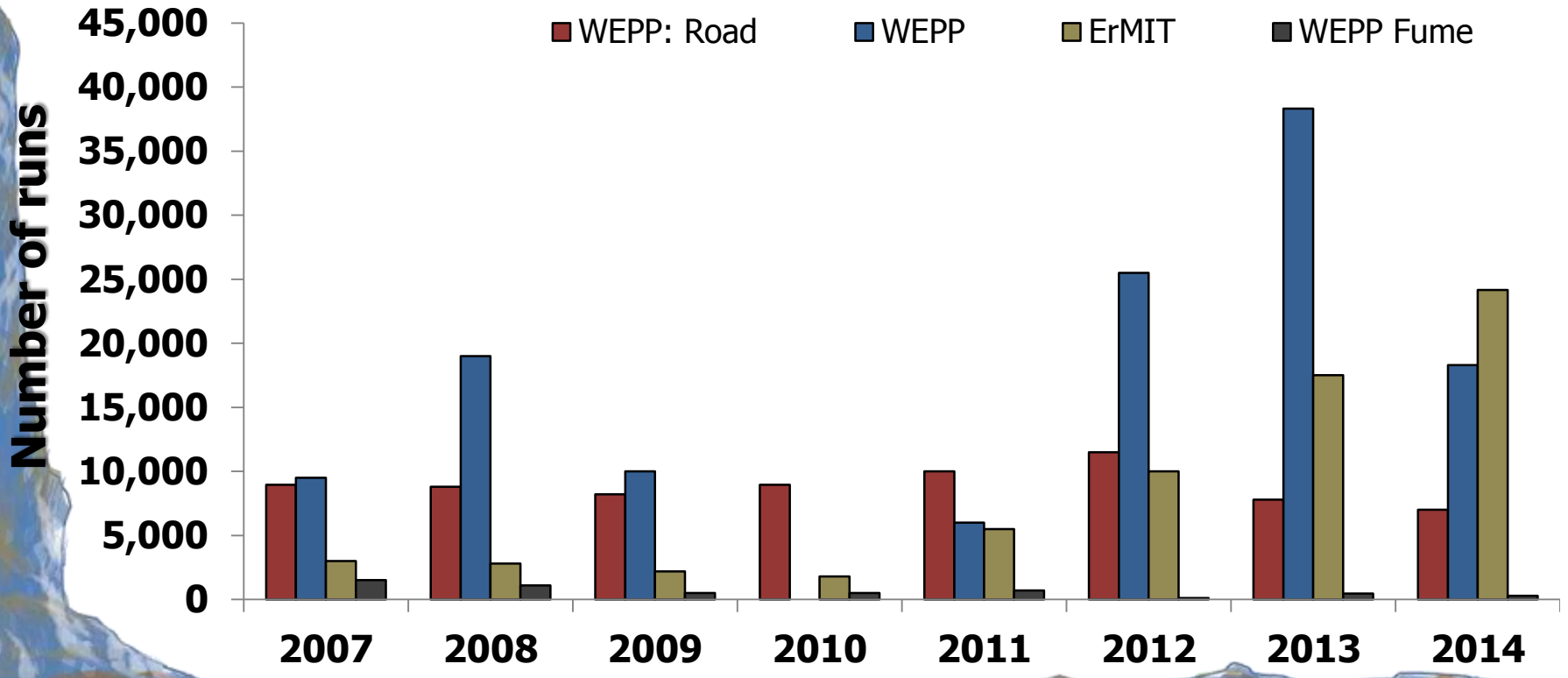
Forest Service Peak Flow Calculator
Estimated peak flow for burned areas using Curve Number technology

Manual entry
From ERMiT
From WEPP Online GIS

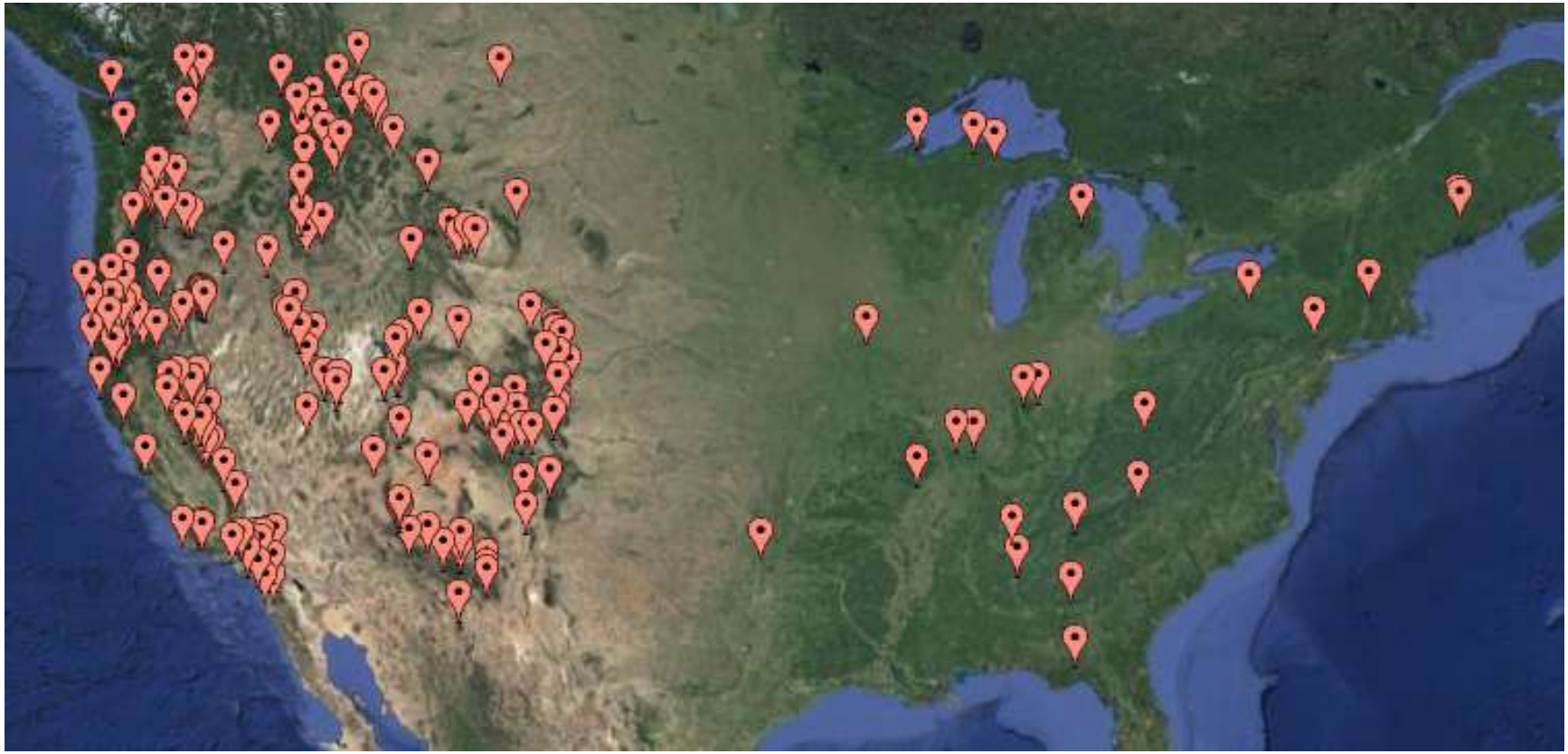
Run Description	Levan Fire Watershed 3					
Storm runoff, **Q**	17.5	mm	0.69	in		
Storm precipitation, **P**	33.3	mm	1.31	in	if Q > P use P ~ 2 Q	
Watershed area, **A**	155.8	ha	385	ac		
Watershed flow length, **L**	3011.9	m	9882	ft		
Avg watershed gradient, **Sg**	0.14	m/m	0.14	ft/ft		
Curve number, **CN**	93		93		CN estimate from ERMiT: 93	(forest)
Time of concentration, T_c	.55	hr	.55	hr	T_c ~ 0.55	hr (flat watershed; dry soil)
Ponding adjustment factor, **Fp**	1		1 ×		0% pond: 1.0; 1.0%: 0.87; 5.0%: 0.72	
RESULTS						
Surface storage, **S**	19	mm	0.75	in		
Initial abstraction, I_a	3.8	mm	0.15	in		
I_a/P	0.11		0.11			
Unit peak flow rate, q_u	2.08	m^3/s per ha/mm x 10^{-3}	1.1702	ft^3/s per acre/in x 10^{-3}		
Estimated peak flow rate, **q**	5.67	m^3/s	go	200.21	ft^3/s	view log | add to log | delete log
Culvert diameter, **D**	151.57	cm	go	59.67	in	**h** 2.0 m 6.6 ft

use Mica Creek example | clear |

FS WEPP Model	2014	FS WEPP Model	2014
WEPP:Road	7,012	*ERMIT*	24,153
WEPP: Road Batch	499	*ERMiT Batch*	280
Disturbed WEPP 2.0	18,289	*WEPP FuME*	280
Disturbed WEPP Batch	119	*Tahoe Basin*	492

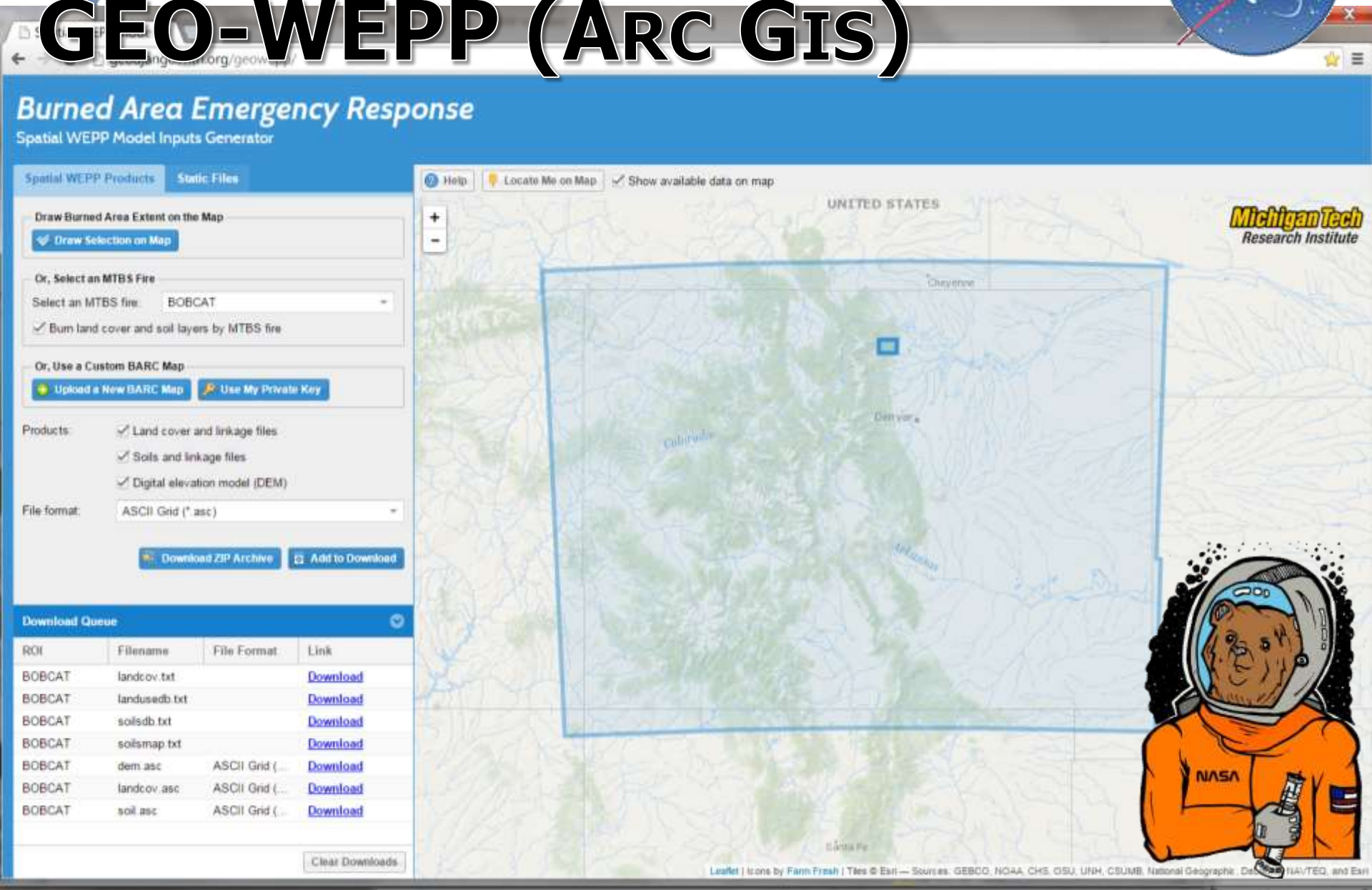


ERMiT runs



+ 100's of international locations

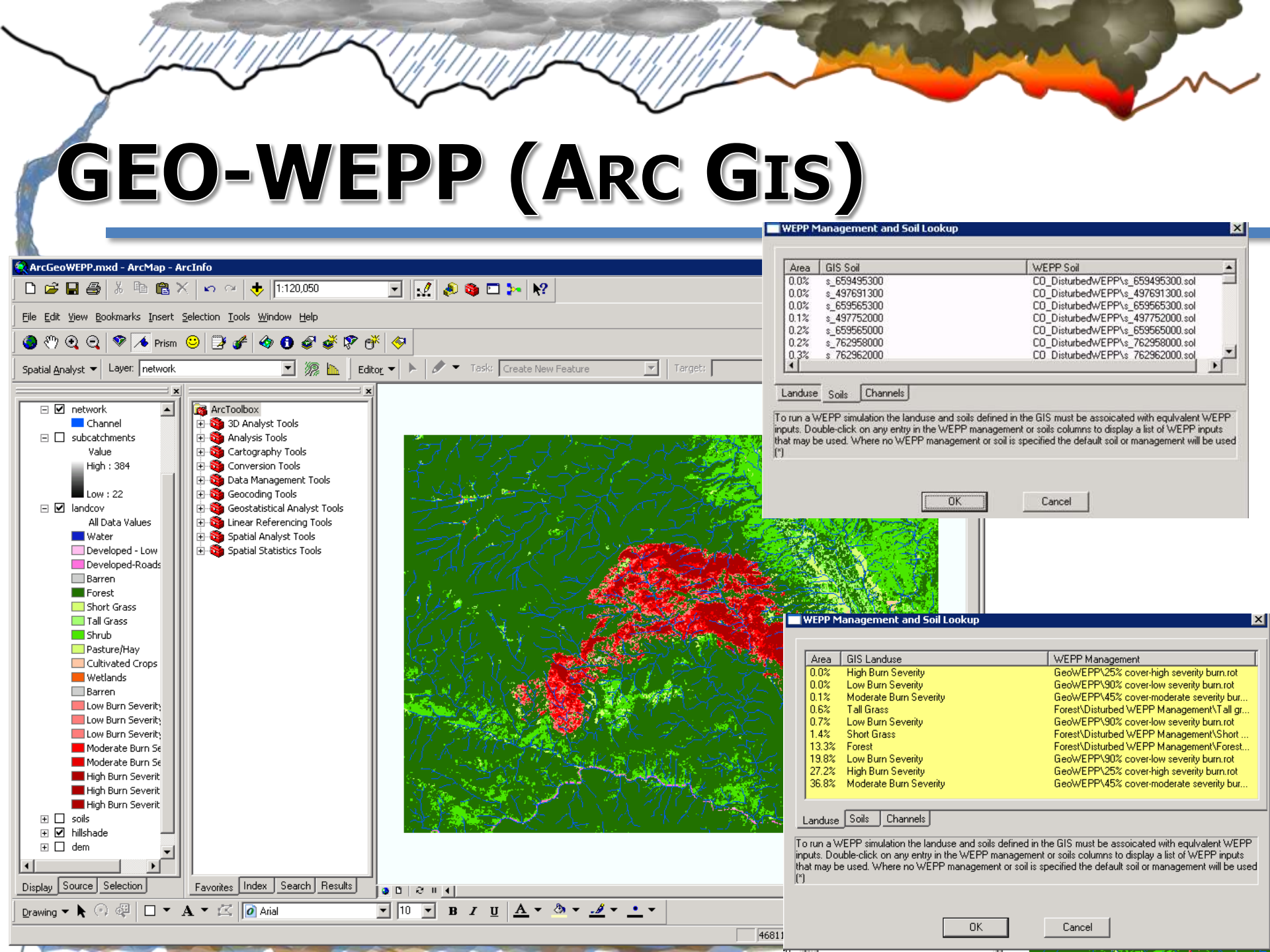
GEO-WEPP (ARC GIS)



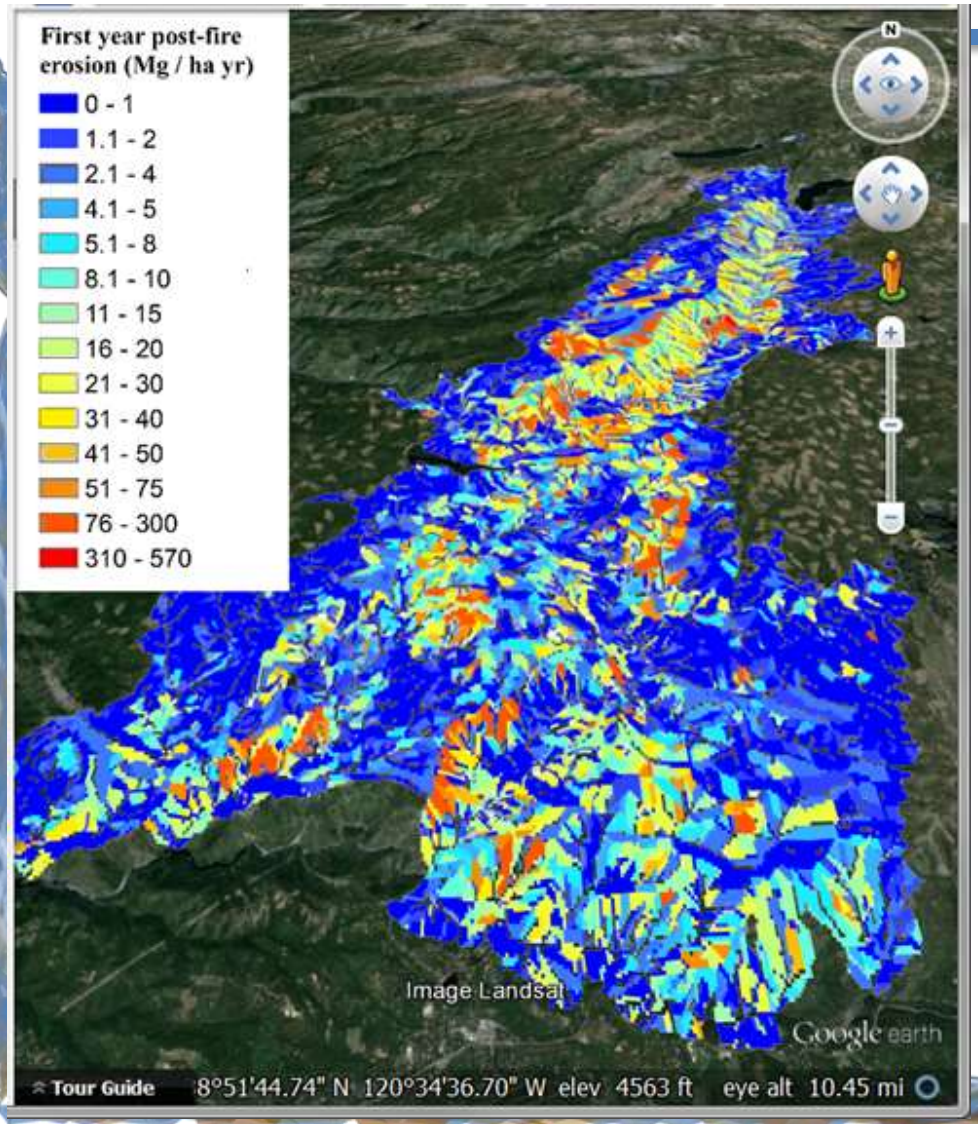
GEO-WEPP (ARC GIS) PRE-LOAD

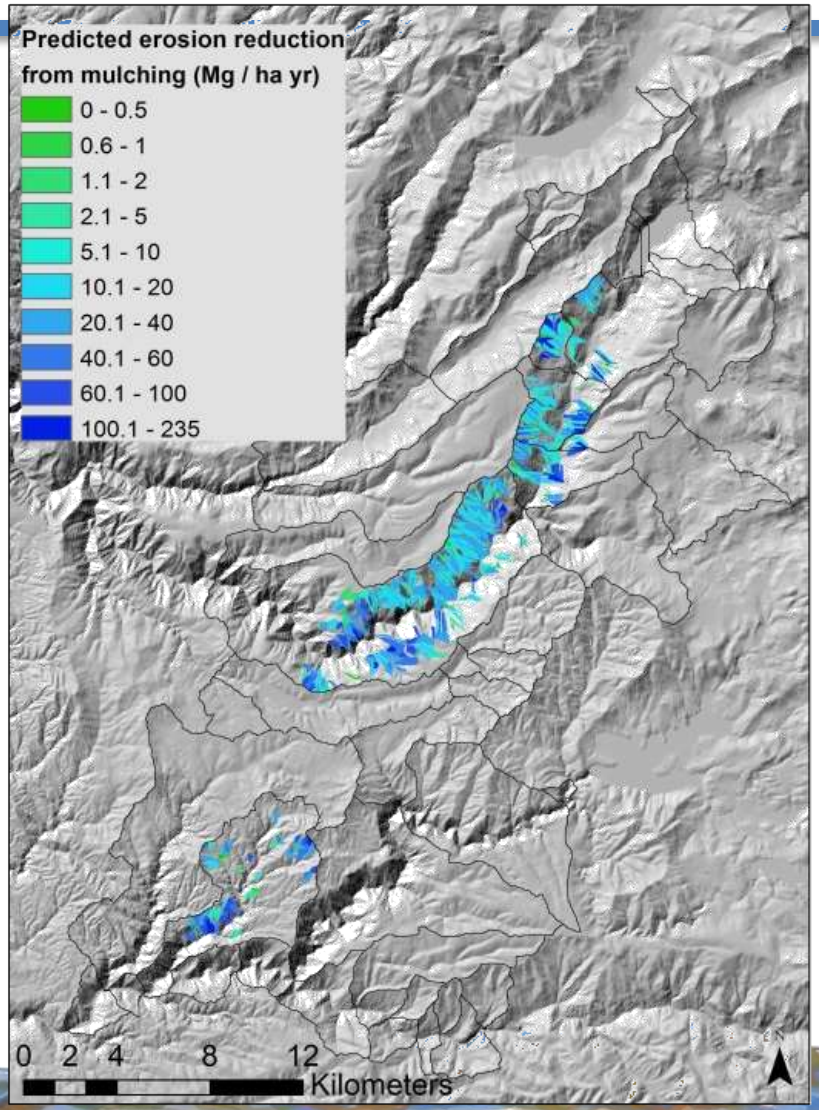
- Soils: USDA SSURGO and STATSGO datasets
- Land cover: Existing Vegetation Type LANDFIRE
- DEM USGS Seamless Data Warehouse
- Add Soil Burn Severity Map

GEO-WEPP (ARC GIS)

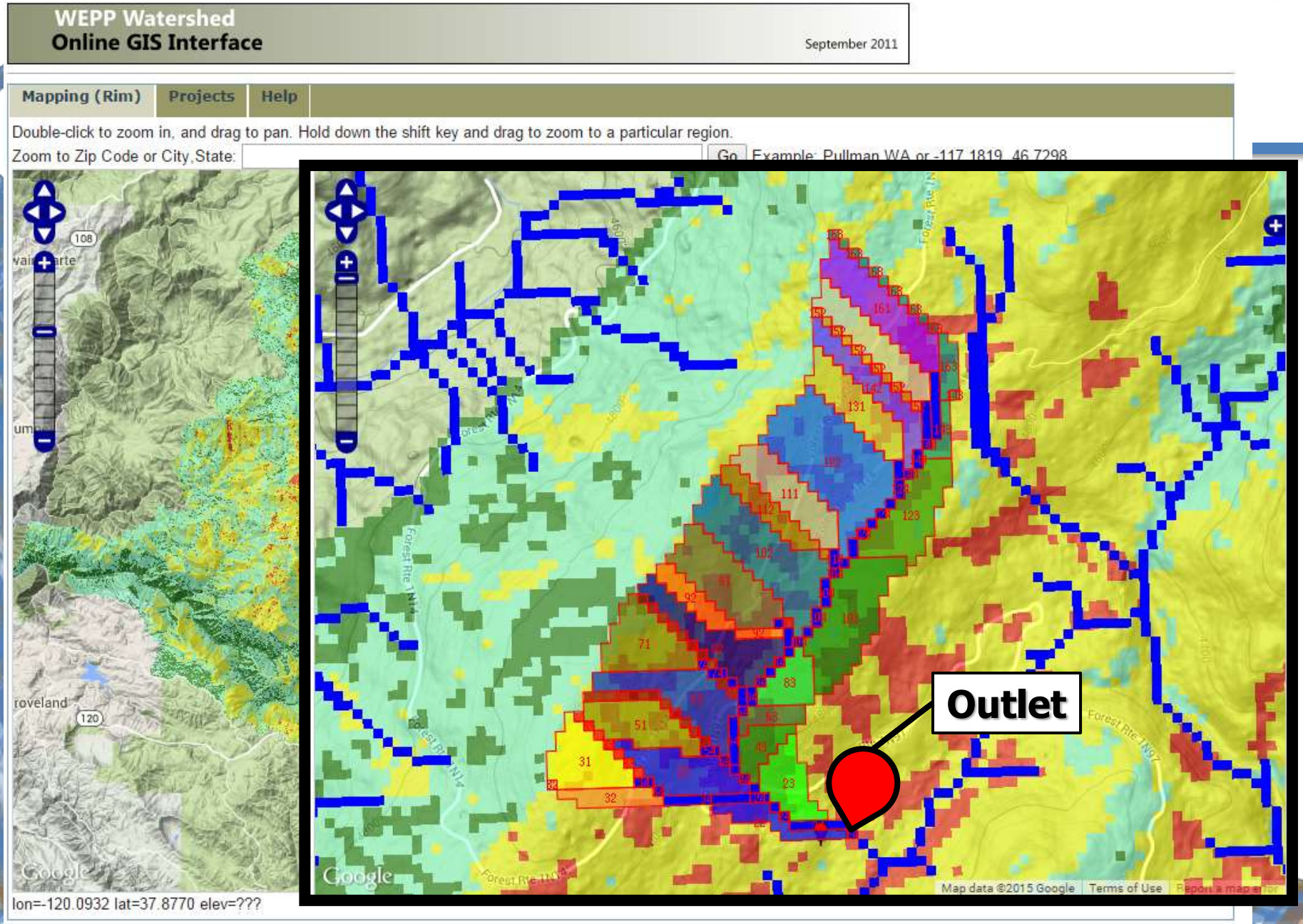


GEO-WEPP (ARC GIS): KING FIRE





Online GIS WEPP: Input

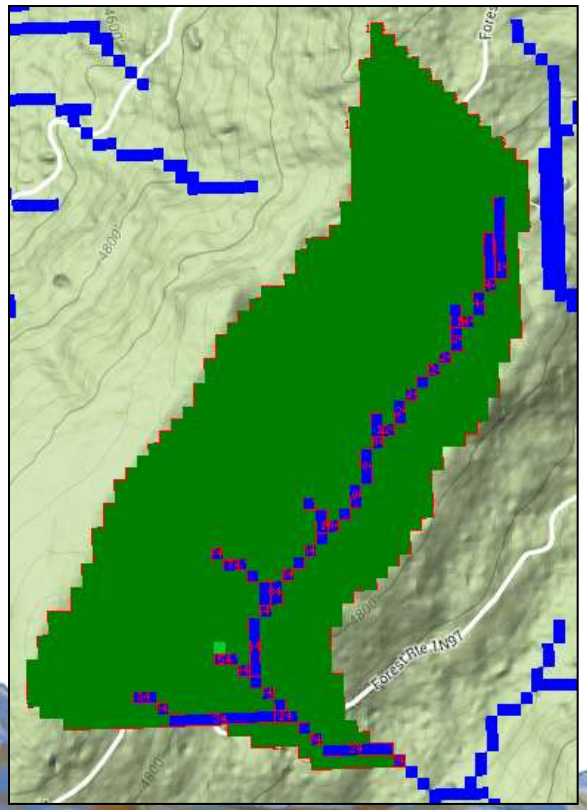


Online GIS WEPP:

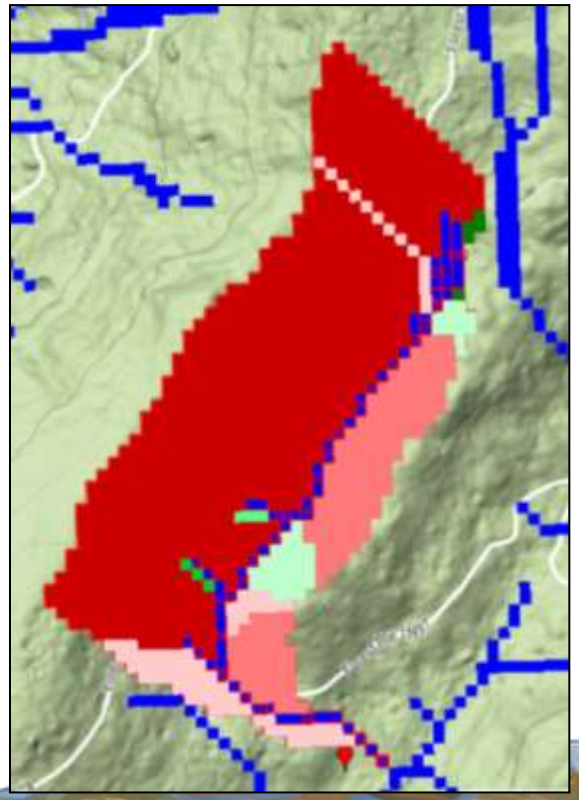
Map Output

Soil Loss 0 - 1.25 t/ha/yr
Soil Loss 1.25 - 2.5 t/ha/yr
Soil Loss 2.5 - 3.75 t/ha/yr
Soil Loss 3.75 - 5 t/ha/yr
Soil Loss 5 - 10 t/ha/yr
Soil Loss 10 - 15 t/ha/yr

Unburned



High severity



Online GIS WEPP: Output

	Unburned		Moderate & High Severity
Watershed Discharge Volume (m^3/yr)	4,000		780,000
Watershed Sediment Yield (tonne/yr)	35		3,400
Watershed Sediment Yield (tonne/ha/yr)	0.3		35
Watershed Sediment Delivery Ratio	0.99		0.30
Discharge at outlet (mm/year)	4		810

Online GIS WEPP : Output

10 YEAR SIMULATION FOR WATERSHED

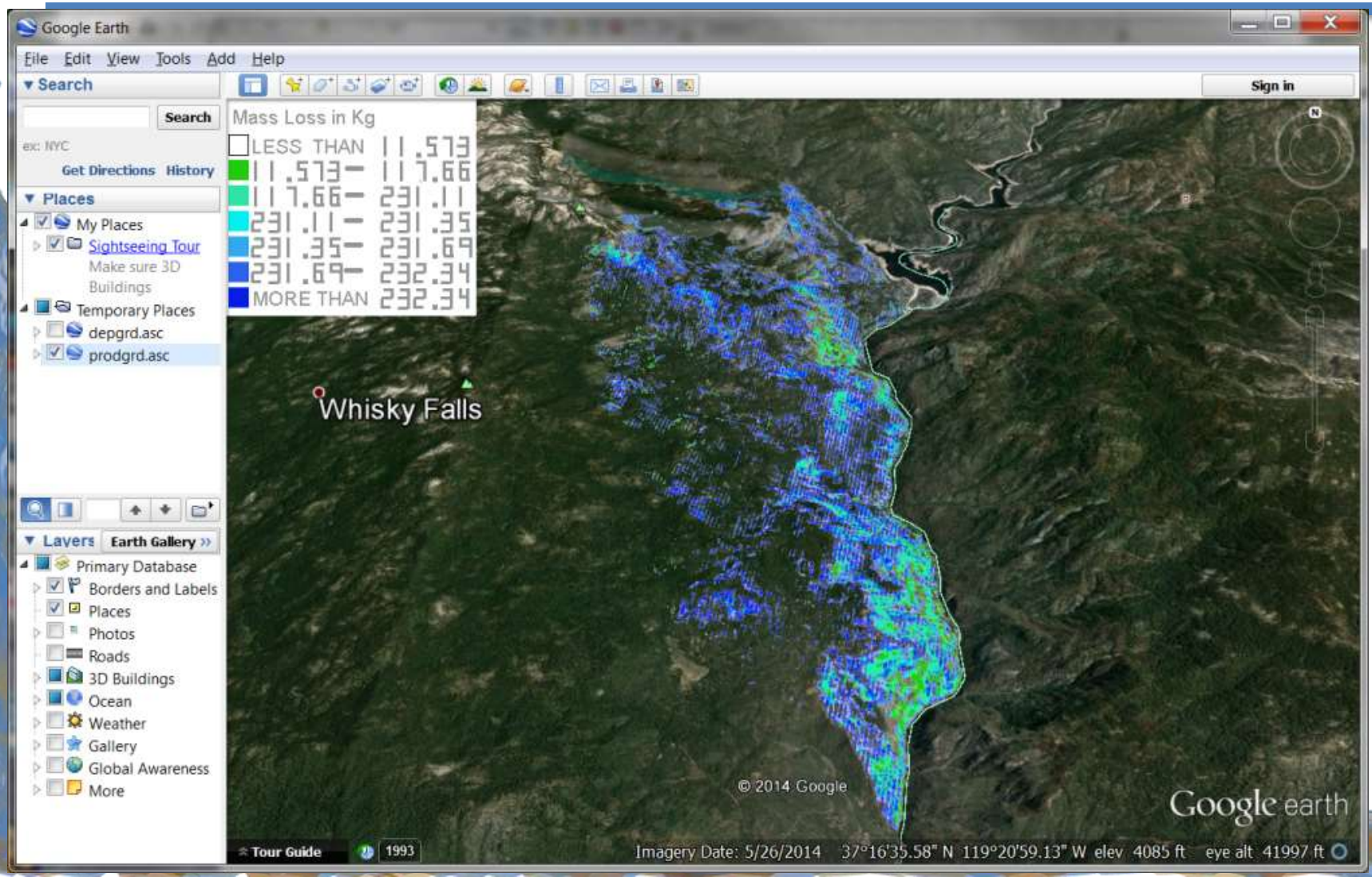
Number of events: 3600

Return Period of SEDIMENT YIELD by Event

Model	Recurrence Interval years	Day	Month	Year	Precip (mm)	Runoff (m^3)	Peak (m^3/s)	Sediment Yield (kg)
Unburned	2	29	1	3	41	171	0.1	4,000
	5	9	2	7	72	2350	0.9	36,000
High Severity	2	8	3	1	25	55,000	15	670,000
	5	12	2	5	80	95,000	25	800,000

RAVEL RAT

Code for the current FS interface.
Output are google earth KMLs.



Post-fire Wind Erosion Monitoring BLM Idaho

- **2014 Preacher Fire**
  - **BSNE, PM10, PM2.5**
  - **Weather station**

Alone we can do so little…

Together we can do so much! –Helen Keller

http://forest.moscowfsl.wsu.edu