Single Storm Analysis for Conservation Planning

Bill Elliot

Rocky Mountain Research Station

Objectives of Presentation

- To present overviews of a current interfaces that
  - Model average annual and single storm erosion
  - Have the ability to model altered climates

Current Online Interfaces for Postfire Analysis Developed by RMRS

- Disturbed WEPP Average Annual runoff, erosion and sediment yield
- Erosion Risk Management Tool (ERMiT) single storm tool for runoff and sediment yield
- Rock Clime interface to CLIGEN weather generator and PRISM database

Why Single Storm Analysis?

- Following wildfire, site recovery is rapid
  - Erosion rates drop about 90 percent per year
- Users are more interested in the risk of an erosion event in the first year after fire than an “average” value

Why not Design Storm Analysis?

- The greatest runoff and erosion may not be associated with the greatest storm
- Major runoff events are associated with wet soils or rain on melting snow

What Climate Factors Affect impact erosion?

- Storm properties
  - Amount
  - Duration
  - Peak Intensity
- Temperature
  - Rain or snow
  - ET, plant growth and residue decomposition

How can Climate Factors be Altered?

- Go to: http://forest.moscowfsl.wsu.edu/fswepp
- From any interface, go to the climate modification page
  - You may use the PRISM database to get there

What does the PRISM Database Interface Look Like?

Select a value in the annual precipitation or elevation tables to move north, south, east, or west in the PRISM 2.5 minute (approximately 2.5 mi) grid of values. The value in the center is your current location.

Station Mean Precipitation (in)	Month	*PRISM* Mean Precipitation (in)
2.60	January	2.39
2.05	February	2.04
2.58	March	2.70
2.75	April	2.91
3.04	May	3.05
3.34	June	3.76
3.63	July	3.53
3.31	August	3.70
3.70	September	4.21
3.02	October	3.12
3.48	November	3.63
2.83	December	3.42
36.33	Annual	38.46

Annual Precipitation (in)

37.45	37.95	39.47
38.37	38.46	41.90
41.54	41.00	42.75

N S W E

Elevation (ft)

813	892	1053
964	971	1266
1230	1178	1414

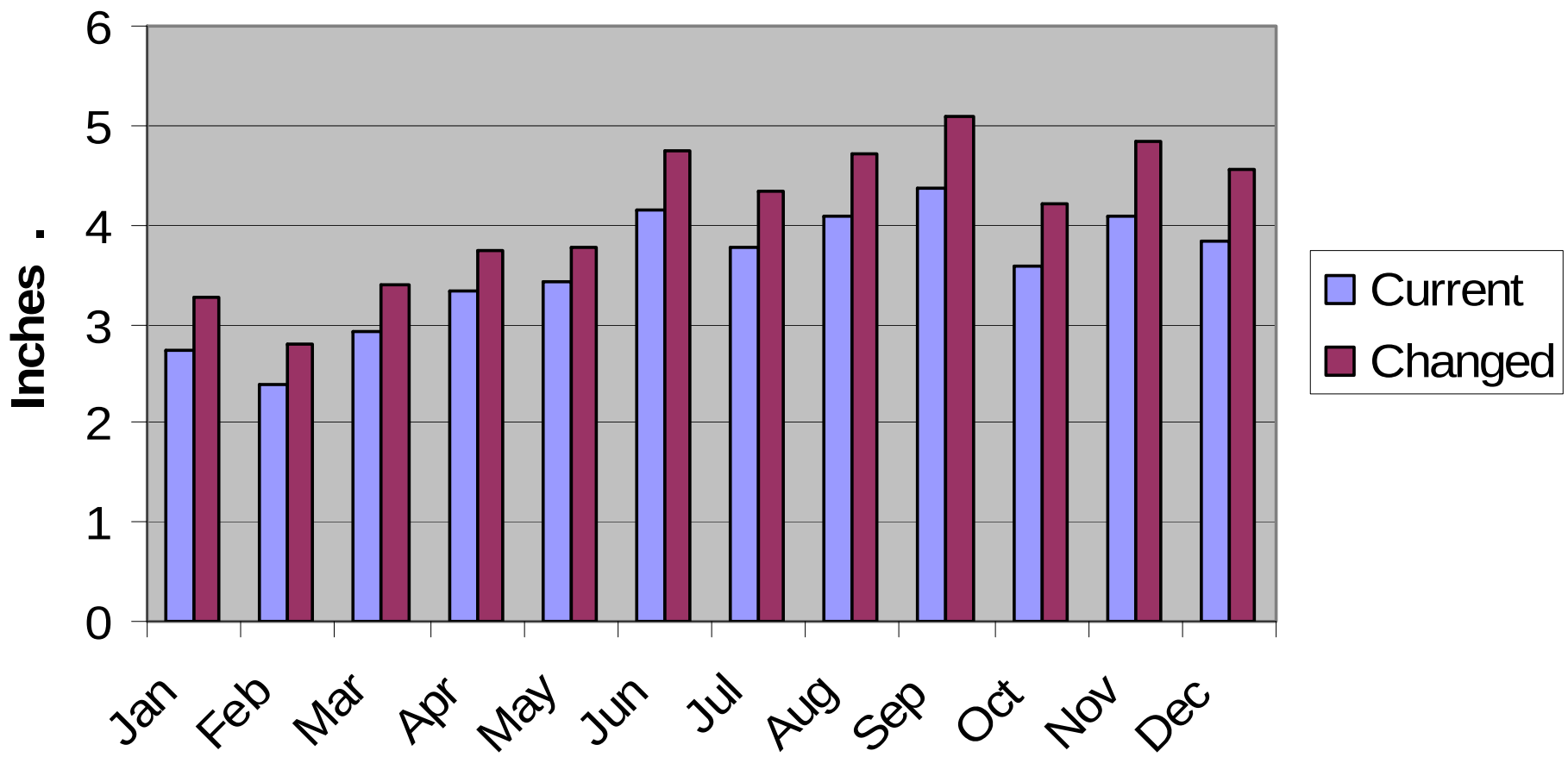
N S W E

How can I change the Climate?

Mean Maximum Temperature (°F)	Mean Minimum Temperature (°F)	Mean Precipitation (in)	Number of wet days	Month	Mean Maximum Temperature (°F)	Mean Minimum Temperature (°F)	PRISM Precipitation (in)	Number of wet days
32.79	18.50	2.60	15.30	January	31.16	17.14	2.72	15.30
34.83	18.94	2.05	11.41	February	33.2	17.58	2.38	11.41
43.99	25.73	2.58	11.73	March	42.36	24.37	2.92	11.73
57.33	36.10	2.75	11.45	April	55.7	34.74	3.32	11.45
68.92	45.90	3.04	11.27	May	67.29	44.54	3.41	11.27
77.43	55.38	3.34	9.29	June	75.8	54.02	4.16	9.29
81.31	59.87	3.63	9.30	July	79.68	58.51	3.77	9.30
79.34	58.32	3.31	9.73	August	77.71	56.96	4.09	9.73
72.61	51.95	3.70	9.74	September	70.98	50.59	4.38	9.74
62.01	42.34	3.02	11.19	October	60.38	40.98	3.59	11.19
48.85	33.56	3.48	13.37	November	47.22	32.2	4.09	13.37
37.10	23.57	2.83	14.88	December	35.47	22.21	3.82	14.88
		36.33	138.66	Annual			42.64	138.66
Change entire column (enter 0 to reset) > >					+/-0 °	+/-0 °	+/-0 %	+/-0 %

☑ Adjust temperature for elevation by lapse rate

How was the Precipitation Changed?



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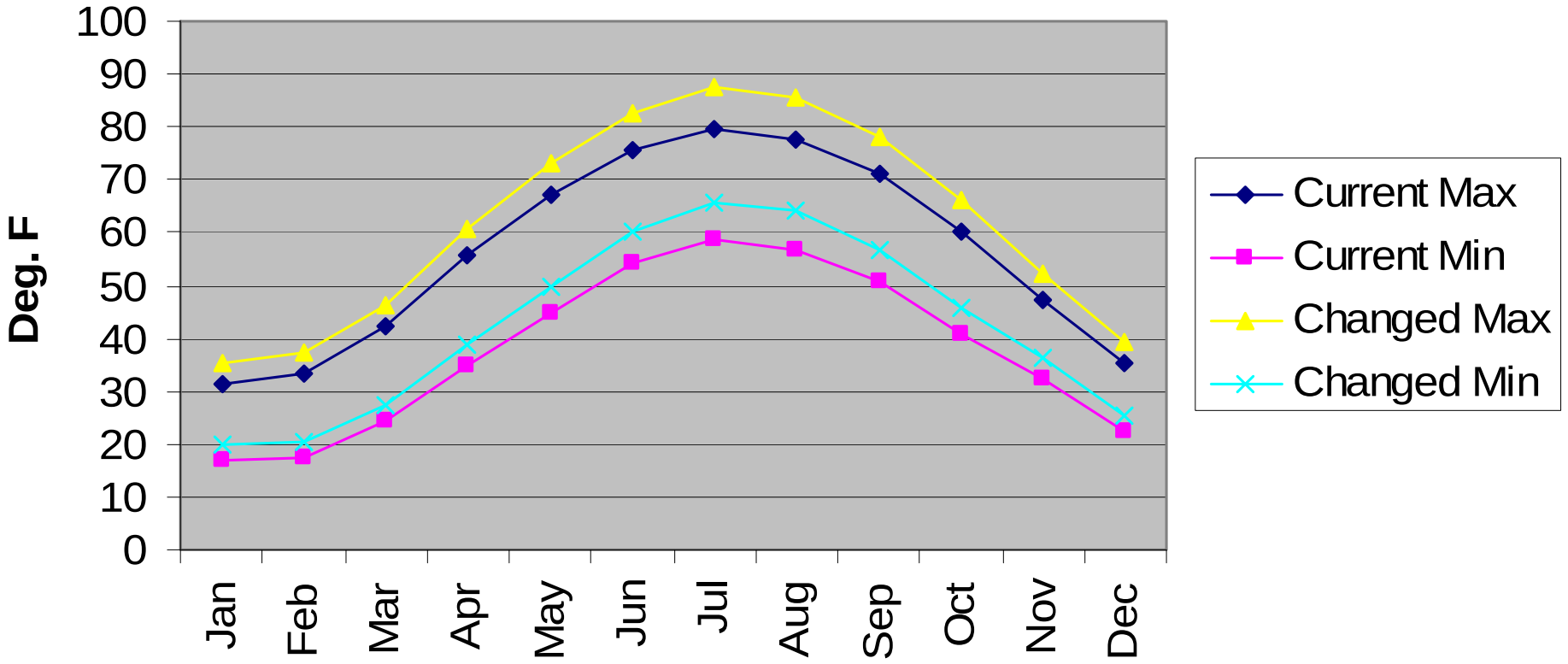
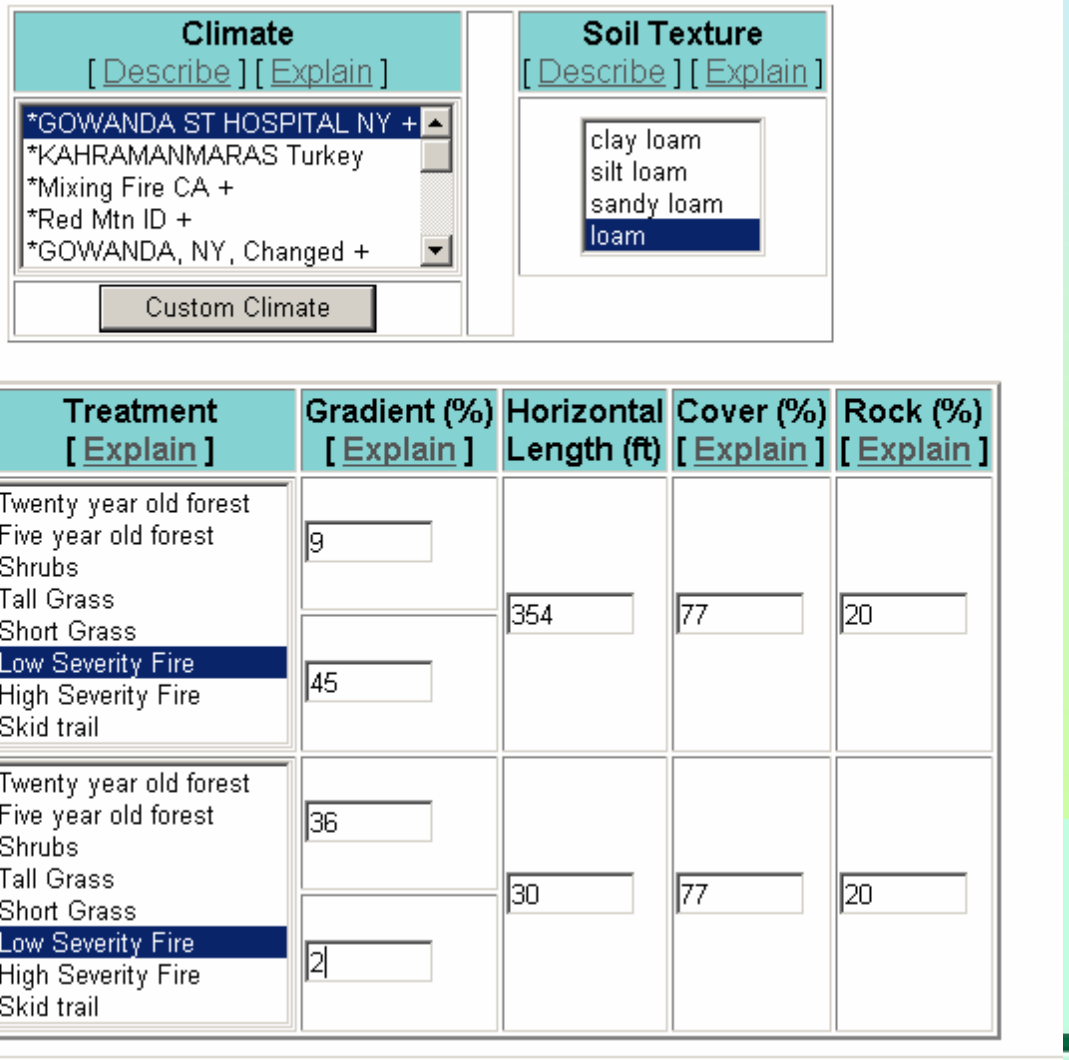


Conservation Practices that can be modeled

- Average Annual
  - Percent cover to model mulching after wildfire
- Single Storm
  - Percent cover to model mulching
  - Contour-felled logs

Current Input for Average Annual Interface



Current Output for Average Annual Interface

Mean annual averages for 50 years

43.26	in.	precipitation from	6931	storms
0.45	in.	runoff from rainfall from	171	events
0.04	in.	runoff from snowmelt or winter rainstorm from	11	events
2.172	t ac^{-1}	upland erosion rate (0.488 kg m^{-2})		
2.118	t ac^{-1}	sediment leaving profile (55.738 kg m^{-1} width)		

Return period analysis based on 50 years of climate

Return Period	Precipitation (in.)	Runoff (in.)	Erosion (t ac^{-1})	Sediment (t ac^{-1})
50 year	61.25	2.41	8.06	8.0015
25 year	56.07	1.47	6.68	6.6082
10 year	51.08	1.23	5.70	5.5481
5 year	48.25	0.92	3.54	3.4639
2.5 year	44.39	0.42	2.38	2.2990
Average	43.26	0.48	2.17	2.1182

RMRS

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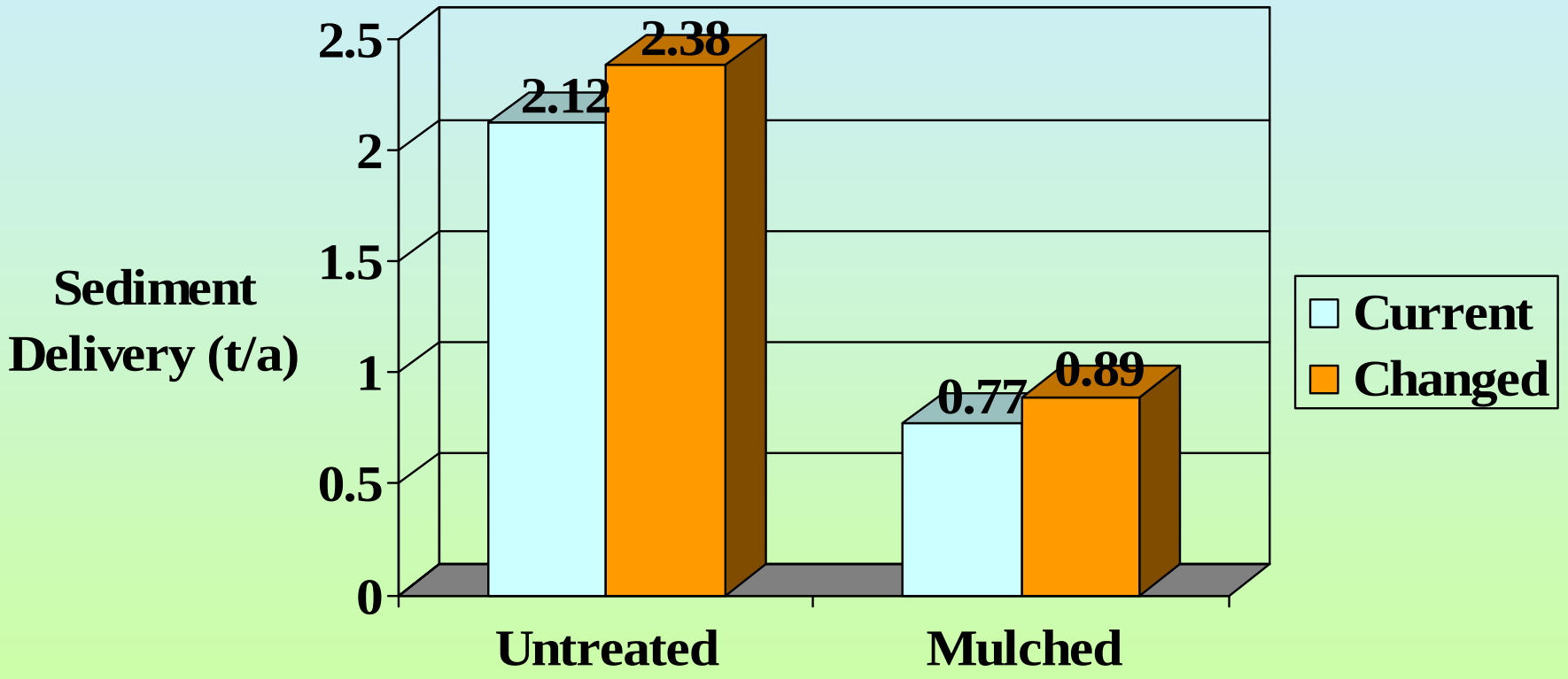
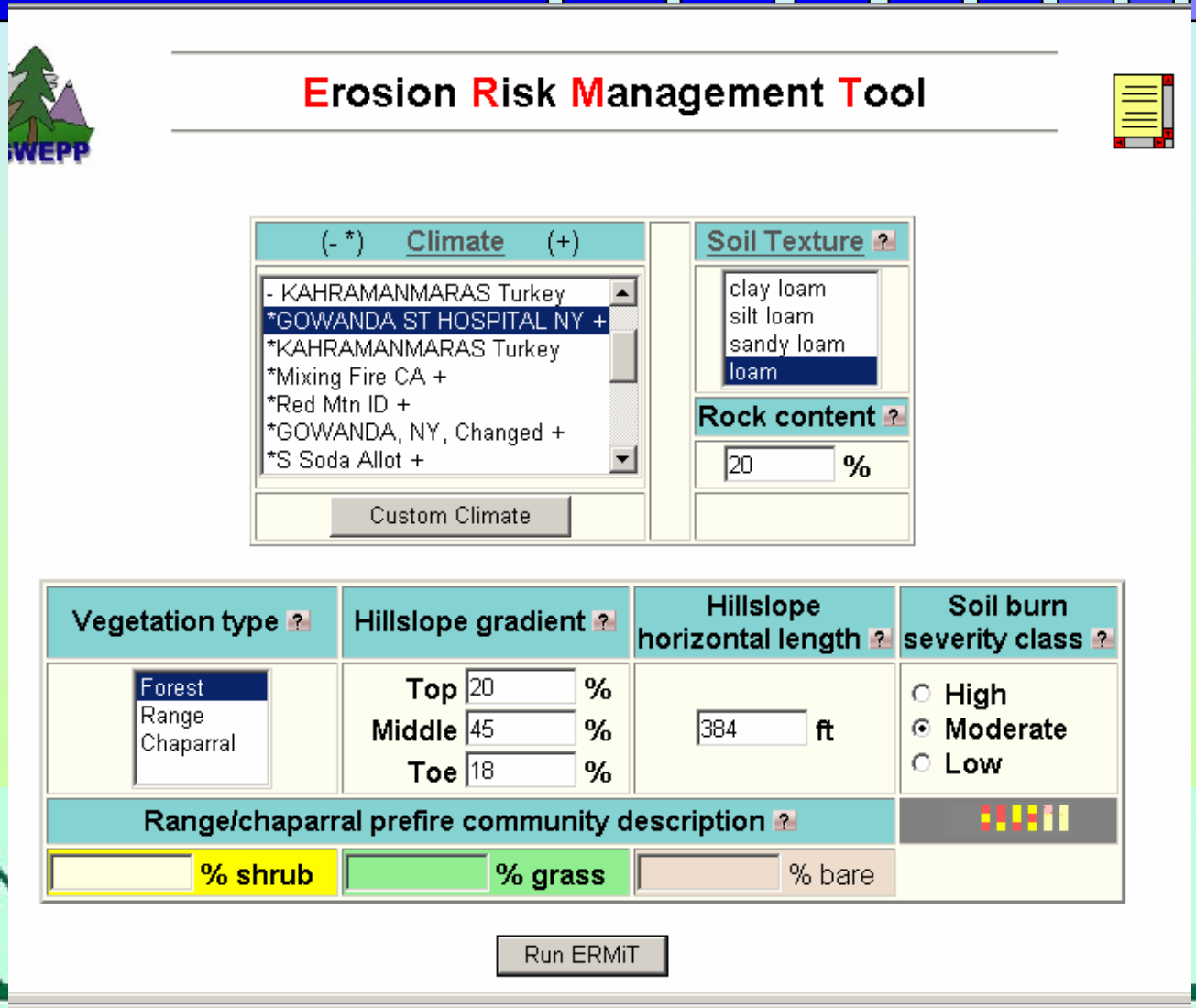
Results of Average Annual Runs



Mulching reduces erosion 70%

Single Storm Interface



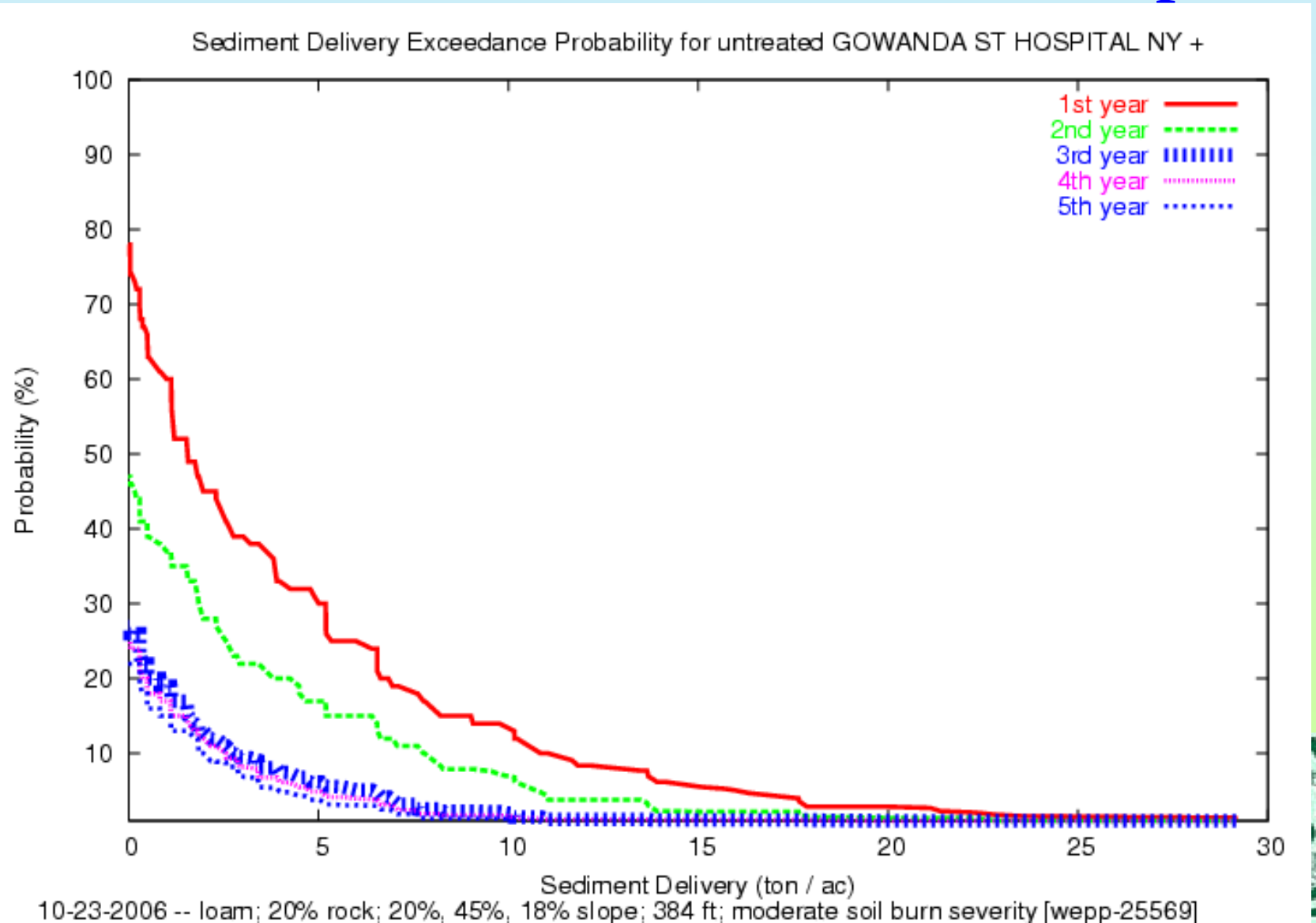
ERMiT Calculations

- Carry out 100 WEPP Runs
  - For years with five select storms
  - For hillslopes with five different soils
  - For hillslopes with four distributions of fire severity
- Carryout probability analysis on the 100 single runoff event predictions

ERMiT Storm Output Table

Storm Rank (return interval)	Storm RO (in)	Storm Precip (in)	Dur (h)	10-min Peak Intensity (in h^{-1})	30-min Peak Intensity (in h^{-1})	Storm Date
1	4.97	7.32	9.94	2.68	2.52	September 1 year 18
5 (20-year)	**2.39**	**3.61**	**7.61**	**5.62**	**4.29**	**September 14 year 83**
10 (10-year)	**1.83**	**2.90**	**3.08**	**4.47**	**3.42**	**July 15 year 81**
20 (5-year)	**1.37**	**0.59**	**2.60**	**0.83**	**0.65**	**February 11 year 46**
50 (2-year)	**0.98**	**1.96**	**3.54**	**2.06**	**1.73**	**June 12 year 63**
75 ($1^1/_3$-year)	**0.76**	**1.67**	**3.00**	**2.25**	**1.78**	**September 23 year 49**

ERMiT Sediment Delivery Exceedance Graph



ERMiT Mitigation Table

Mitigation Treatment Comparisons					
Probability that sediment yield will be exceeded 20 % go	Event sediment delivery (ton ac^{-1})				
	Year following fire				
	1st year	2nd year	3rd year	4th year	5th year
Untreated	6.86	3.94	0.87	0.36	0.31
Seeding	6.86	1.88	0.36	0.31	0.31
Mulch (0.5 ton ac^{-1})	1.71	1.7	0.87	0.36	0.31
Mulch (1 ton ac^{-1})	0.32	1.17	0.87	0.36	0.31
Mulch (1.5 ton ac^{-1})	0.03	1.11	0.87	0.36	0.31
Mulch (2 ton ac^{-1})	0.03	0.81	0.87	0.36	0.31
Erosion Barriers: Diameter 1 ft Spacing 50 ft go ?					
Logs & Wattles	1.9	1.38	0	0	0

Summary of ERMiT Analyses for 20 percent exceedance

	Current Climate	Changed Climate
Runoff	1.37 in. in Feb	1.49 in. in Apr
Untreated Delivery	6.87 tons/acre	9.66 tons/acre
Mulch at 1 t/a Delivery	0.32 tons/acre	2.51 tons/acre
Delivery with Logs	1.91 tons/acre	5.99 tons/acre

Can this technology be applied to Agriculture?

- The online interfaces are based on the WEPP technology
  - Complete agricultural practices and soils databases available
  - Capable of modeling hillslopes, terraces and watersheds

Conclusions for Average Annual Erosion

- Technology is available to address altered climates
- Average annual results with changed climate for sediment yields indicate
  - 10 percent increase in erosion
  - 70 percent reduction with mulching

Conclusions for Single Storm Analysis, for 20 percent exceedance

- 9 percent increase in runoff
- 41 percent increase in untreated sediment yield
- 684 percent increase in sediment delivery with mulching
- 214 percent increase in sediment delivery with contour-felled logs

The Bottom Line

- Single storm analysis is much more sensitive to climate change than average annual analysis
- Current conservation treatments may not be as effective with a change climate


Questions & Comments?