Erosion Risk Management Tool (ERMiT)

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Overview

- Purpose
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Risk Assessment Tool

ERMiT: Erosion Risk Management Tool

USDA Forest Service, Rocky Mountain Research Station, Moscow, Idaho

- **WEPP Model (Water Erosion Prediction Project).**
- **WEB based tool.**
- **Incorporates a probabilistic approach.**
- **Predict the probabilities of single storm and annual soil erosion rates in the years following the wildfire.**
- **Estimate potential loss of onsite productivity, or potential offsite damage from sediment.**

Purpose

- Provide a distribution of rain event erosion rates with the likelihood of exceeding these values.
- Web-based application that uses WEPP to predict erosion in probabilistic terms on burned and recovering forest, range, and chaparral lands,
  - with and without mitigation treatments.
- Combines weather variability with spatial and temporal variability of soil properties to model the range of post-fire erosion rates that are likely to occur.

Model Inputs

Erosion Risk Management Tool

(- *) Climate (+)

- Bitterroot Valley MT +
- DEADWOOD DAM ID
- Cheesman 1 +
- KAHRAMANMARAS Turkey
CHARLESTON KAN AP WV
MOSCOW U OF I ID
DENVER WB AP CO

Custom Climate

Soil Texture

clay loam
silt loam
sandy loam
loam

Rock content

20 %

Vegetation type	Hillslope gradient	Hillslope horizontal length	Soil burn severity class
Forest Range Chaparral	Top 0 % Middle 50 % Toe 30 %	300 ft	○ High ○ Moderate ◉ Low

Range/chaparral prefire community description

% shrub | % grass | % bare

Run ERMiT

Citation:

Robichaud, Peter R.; Elliot, William J.; Pierson, Frederick B.; Hall, David E.; Moffet, Corey A. 2006. **Erosion Risk Management Tool (ERMiT) Ver.** 2006.01.18. [Online at <http://forest.moscowfsl.wsu.edu/fswepp/>.] Moscow, ID: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

1476 ERMiT runs in 2006. Personality ""

Climate

- Rock:Clime provides climate parameter files for more than 2600 weather stations across the United States.

- Allows user to create a custom climate parameter file by modifying an existing climate parameter file.

Climate

- Climate parameter file as input to CLIGEN to generate a WEPP formatted stochastic daily weather data file.
- Weather data file includes
  - daily precipitation amount, duration, time-to-peak, and peak intensity;
  - minimum, maximum, and dewpoint temperature; and
  - solar radiation; and
  - wind velocity and direction.

Additional Inputs

- Soil Texture
- Rock content
  - proportion in upper soil profile.
  - up to 50 percent may be specified
  - no mechanism for rock outcrops or surface rock cover.
- Hillslope Gradient and Horizontal Length
  - maximum horizontal length is 300 m
- Soil Burn Severity Class

Additional Inputs

- **Vegetation Type and Range/Chaparral Pre-fire Community Description**
  - **three vegetation types forest, range, or chaparral.**
  - **"range" or "chaparral" is chosen, the user may specify the proportion of shrub, grass, and bare soil in the prefire community.**

Process

- WEPP Models the processes:
  - interrill and rill erosion
  - evapotranspiration
  - infiltration
  - runoff
  - soil detachment
  - sediment transport
  - sediment deposition

➢ To predict runoff and erosion at the hillslope scale

Process

- Spatial and temporal variability in weather, soil parameter values, and soil burn severity are incorporated into ERMiT.
  - determine a range of parameter values from field measurements,
  - select five representative values from within the range, and
  - assign an "occurrence probability" for each selected value.

Process

- Temporal variation, the change in soil parameter values over time due to recovery, is modeled by changes in the occurrence probabilities assigned to the selected values for each year of recovery.

Process

- **100-year WEPP Run**

- The 5th-, 10th-, 20th-, 50th-, and 75th-largest runoff events are selected.
  - WEPP re-run for 10 soil parameter sets and four, six, or eight soil burn severity scenarios.

- The sources of variation (climate, burn severity, and soil parameters) are each assigned an occurrence probability independently.

Erosion Mitigation Treatments

- Seeding
  - little measured effect first year post-fire
  - more evident in the second+ year
  - occurrence probabilities associated with the soil parameter sets are adjusted to reflect the increase in ground cover
- Mulch
- Log erosion barriers (contour-felled logs or straw wattles)
  - regression relationship based on user-specified mean log or wattle diameter spacing between rows and hillslope gradient

Output

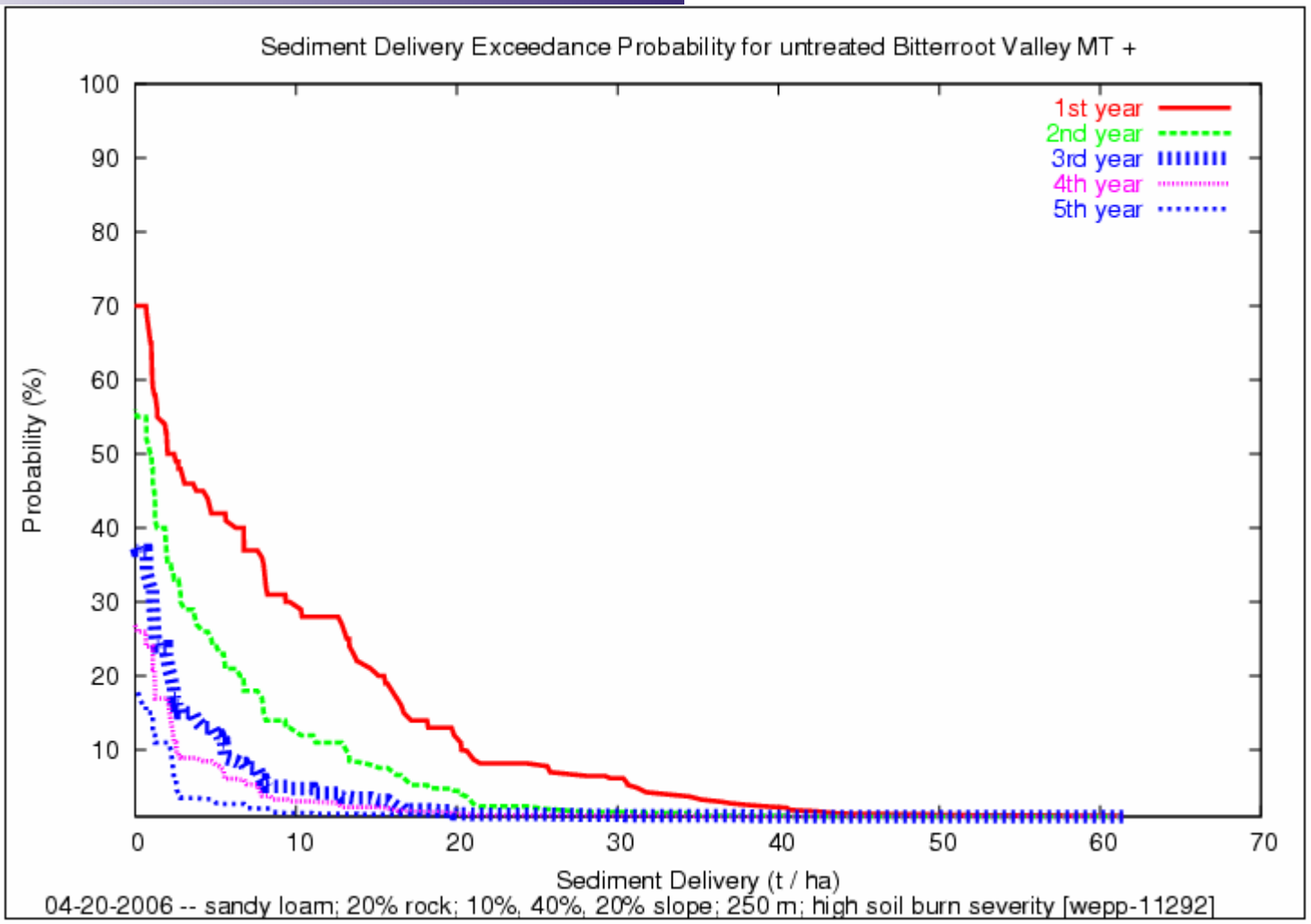
- **Precipitation and runoff values from the initial WEPP run** (100-year Run)
- **Selected storm characteristics**
- **Sediment Delivery Exceedance Probability Graph for Untreated Condition**
- **Mitigation Treatment Comparisons Calculator**
- **Supporting Tables**

Output

Storm Rank (return interval)	Storm Runoff (mm)	Storm Precipitation (mm)	Storm Duration (h)	10-min Peak Rainfall Intensity ($mm\ h^{-1}$)	30-min Peak Rainfall Intensity ($mm\ h^{-1}$)	Storm Date
1	43.2	69.5	3.12	133.95	95.55	July 26 year 27
5 (20-year)	18.7	37.3	1.79	53.50	42.45	July 15 year 94
10 (10-year)	17.1	43.1	2.97	115.87	71.71	June 2 year 62
20 (5-year)	13.6	29.3	2.45	77.70	48.42	June 13 year 60
50 (2-year)	7.5	26.8	2.12	30.76	25.70	June 23 year 40
75 ($1^1/_3$-year)	3.7	17.2	1.96	27.19	20.84	September 12 year 37

Figure 10 *-- Precipitation rankings (based on runoff) and characteristics from the selected storms.*

Output



Output graph showing exceedance probability versus sediment delivery for five years after the fire from the modeled, untreated hillslope.

Output

Mitigation Treatment Comparisons					
Probability that sediment yield will be exceeded 10 % go	Event sediment delivery (t ha^{-1})				
	Year following fire				
	1st year	2nd year	3rd year	4th year	5th year
Untreated	20.53	13.11	5.55	2.63	2.22
Seeding	20.53	7.91	4.89	2.39	2.22
Mulch (1 t ha^{-1})	7.72	7.17	5.55	2.63	2.22
Mulch (2 t ha^{-1})	5.54	5.6	5.55	2.63	2.22
Mulch (3.5 t ha^{-1})	5.53	5.55	5.55	2.63	2.22
Mulch (4.5 t ha^{-1})	5.51	5.53	5.55	2.63	2.22
Erosion Barriers: Diameter 0 m Spacing 50 m go ?					
Logs & Wattles	20.53	13.11	5.55	2.63	2.22

Model Assumptions

- **ERMiT runs WEPP cropland version**
  - **adjustments in the management and soil files to simulate post-fire forest, range, and chaparral environments.**

- **assumptions in terms of the WEPP model:**
  - **Model year begins the day after the wildfire occurs and ends on the anniversary day of the fire.**
  - **Ground cover effects are modeled by adjusting soil erodibility/cover values based on field measurements from a variety of soil types and soil burn severity conditions.**

Model Assumptions

- **Management file "Plant Section:"**
  - No biomass
  - No decomposition
  - Initial conditions set to give 1 percent cover
  - No surface effects

- **Soil Input file (TABLE 2):**
  - one soil layer
  - % organic matter (5 % in forest & 1 % in range and chaparral)
  - initial saturation level soil porosity is 0.75 m/m
  - depth of soil surface to bottom of soil layer is 400 mm
  - Most parameters determined by soil texture


THANKS