# Probabilistic Soil Erosion Modeling Using the Erosion Risk Management Tool (ERMiT) After Wildfires

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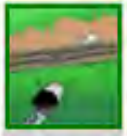
# Burned Area Assessment Tools

## Forest Service WEPP Interfaces

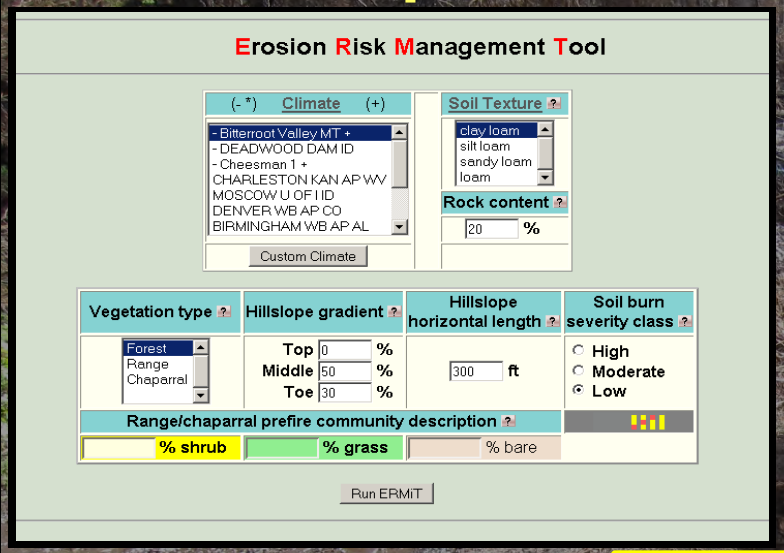
| | | | |
|---|---|---|---|
|  | Cross Drain | Rock:Clime |  |
|  | WEPP:Road | WEPP:Road Batch |  |
|  | Disturbed WEPP 2.0 | Tahoe Basin Sediment Model |  |
|  | FuME (Fuel Management) | ERMiT |  |
|  | Peak Flow Calculator | Batch FS WEPP & other |  |

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

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

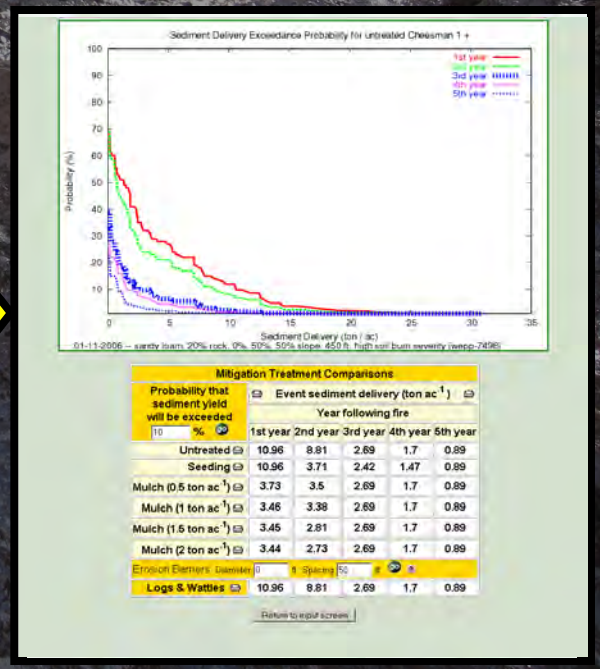
# Erosion Risk Management Tool (ERMiT)

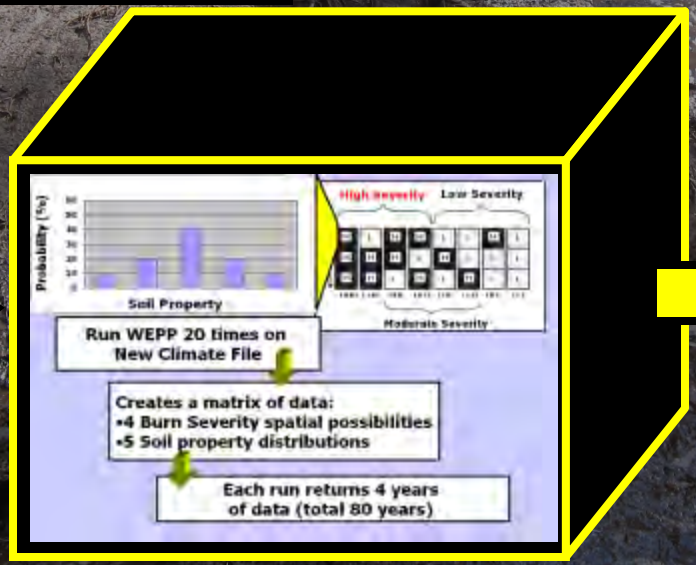
## User Input




- Event based
- Probabilistic
- Incorporates Variability

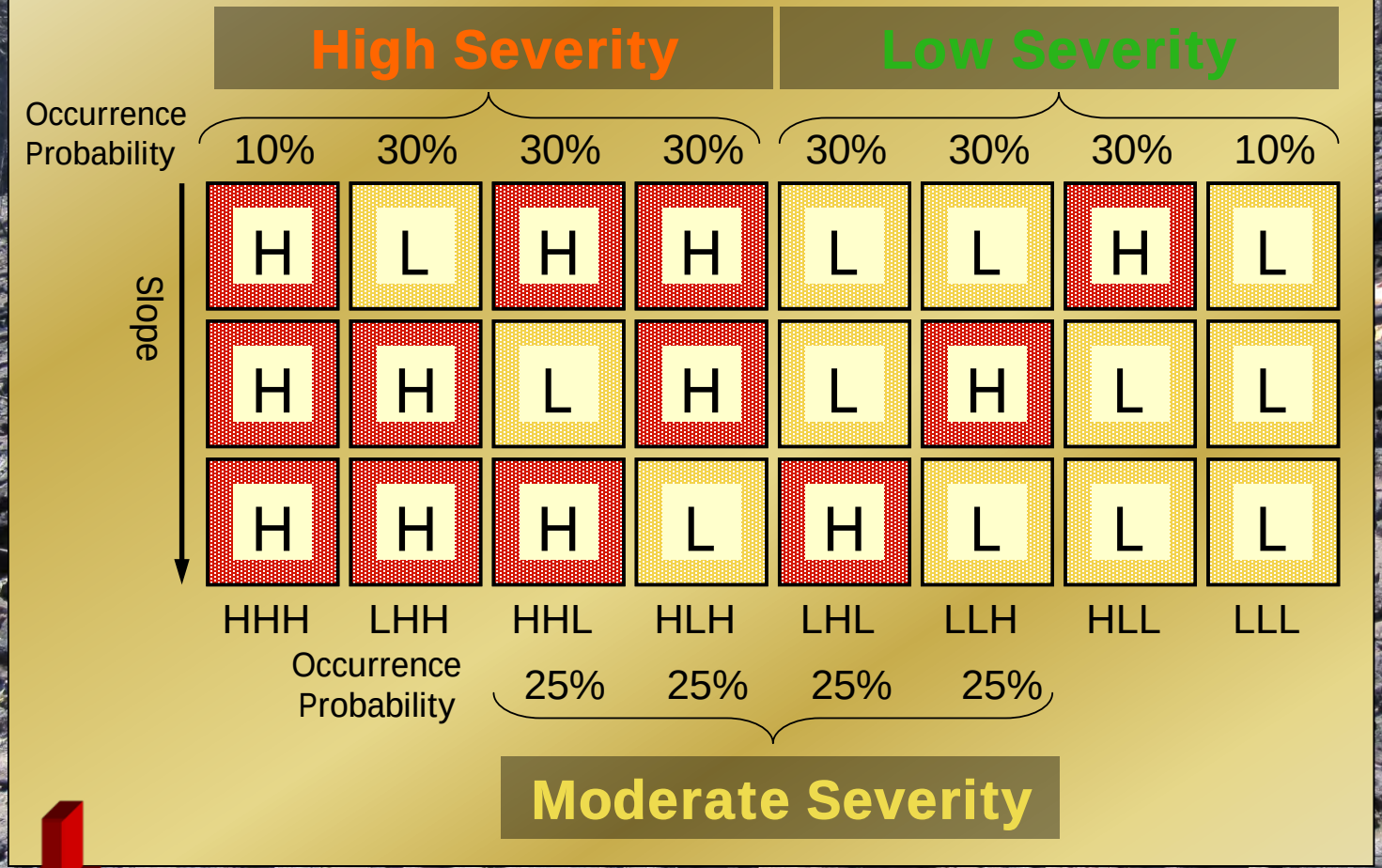
## Output




## Calculations

# ERMiT Burn Severity




**Creates a matrix of data:**

- **4 Burn Severity spatial possibilities**

# Fire Mosaic

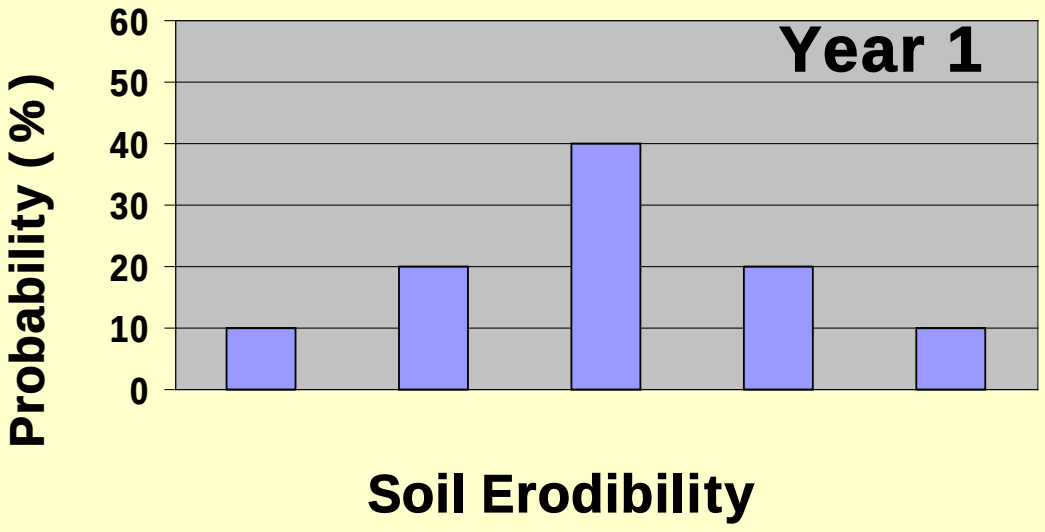
High Severity

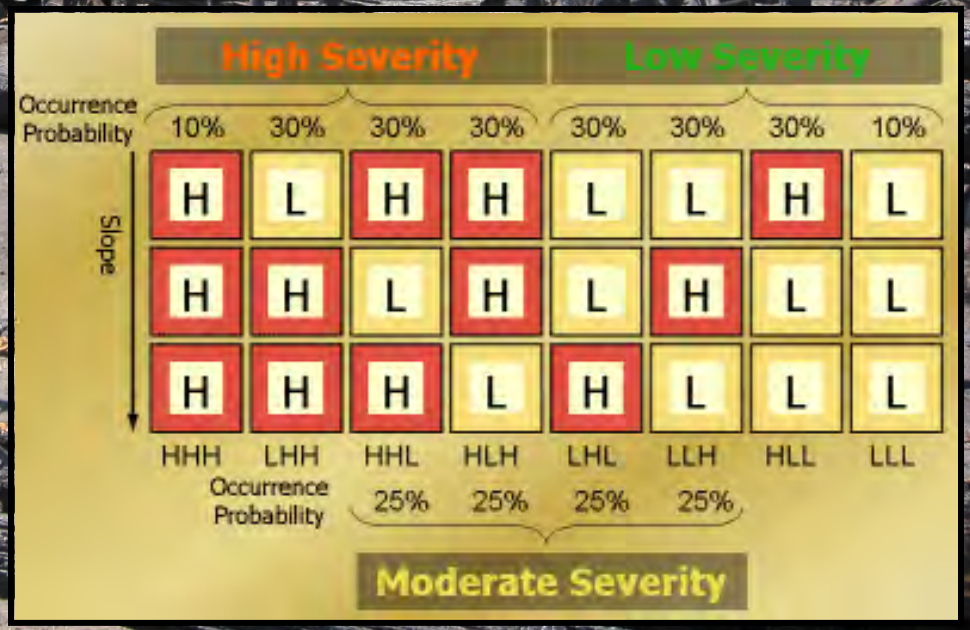
Moderate Severity

Low Severity



# ERMiT


Year 1
Probability (%)
60
50
40
30
20
10
0
Soil Erodibility


High Severity
Low Severity
Occurrence Probability
10%
30%
30%
30%
30%
30%
30%
10%
Slope
H L H H L L H L
H H L H L H L L
H H H L H L L L
HHH
LHH
HHL
HLH
LHL
LLH
HLL
LLL
Occurrence Probability
25%
25%
25%
25%
Moderate Severity

ERMiT

# P R I S M Precipitation

**for modifying STEVENSVILLE MT at 46.52°N 114.1°W and 1027 m elevation**

**Prism Location: 46.52°N 114.1°W and 1045 m elevation**

Select a value in the annual precipitation or elevation tables to move north, south, east, or west in the PRISM 2.5 minute (approximately 4 km) grid of values. The value in the center is your current location.

| *Station* Mean Precipitation (mm) | Month | *PRISM* Mean Precipitation (mm) |
|---|---|---|
| 26.16 | January | 33.2 |
| 19.81 | February | 20.93 |
| 20.57 | March | 18.89 |
| 20.57 | April | 19.37 |
| 36.07 | May | 36.23 |
| 38.86 | June | 39.26 |
| 21.84 | July | 20.11 |
| 22.61 | August | 27.12 |
| 27.69 | September | 25.74 |
| 21.34 | October | 18.98 |
| 26.92 | November | 24 |
| 28.96 | December | 29.22 |
| 311.4 | Annual | 313.05 |

**Annual Precipitation (mm)**

| | | |
|---|---|---|
| 317.64 | 310.18 | 335.35 |
| 309.27 | 313.05 | 350.99 |
| 312.3 | 313.24 | 375.97 |

N S W E

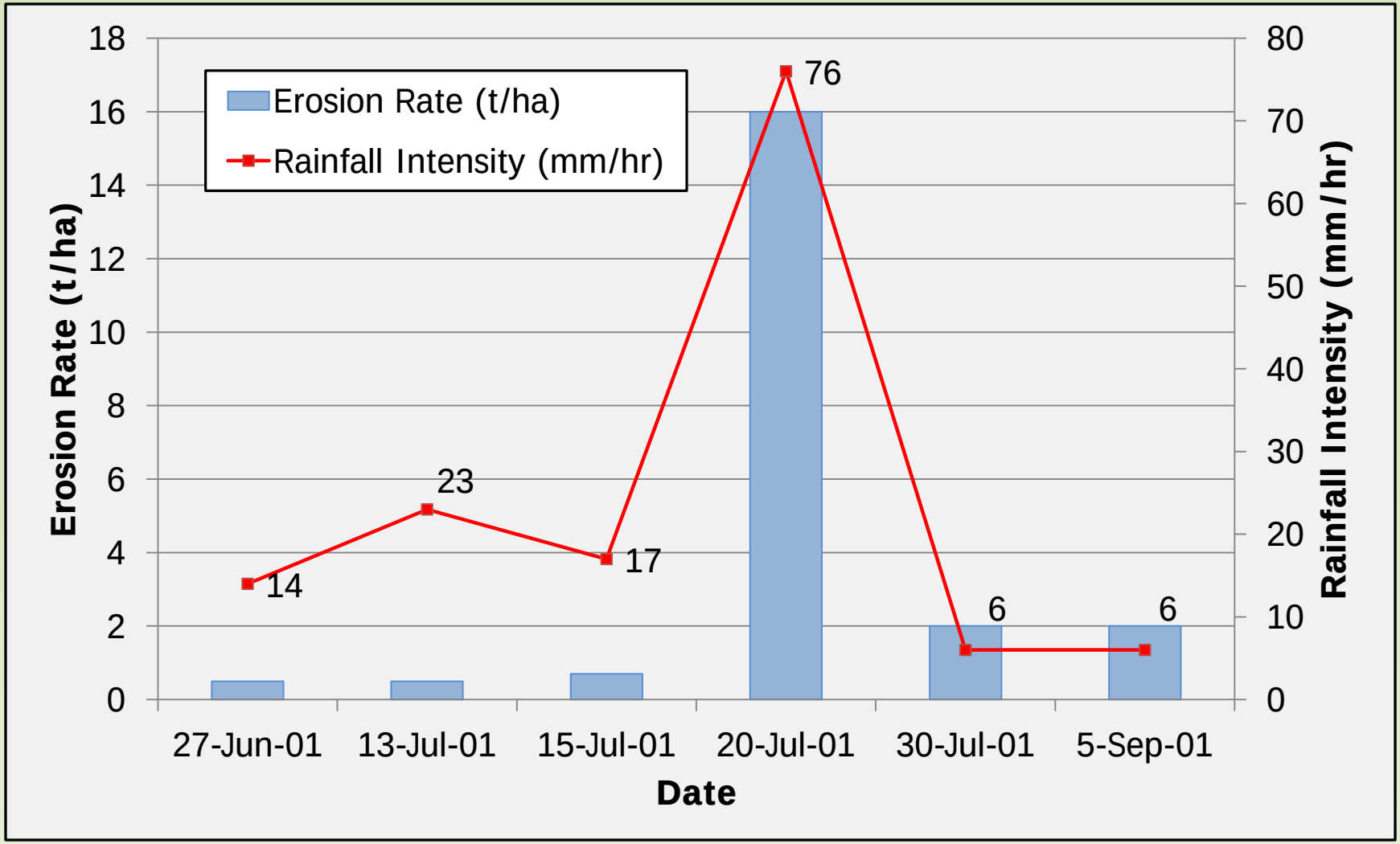
**Elevation (m)**

| | | |
|---|---|---|
| 1062 | 1036 | 1086 |
| 1043 | 1045 | 1123 |
| 1041 | 1048 | 1155 |

N S W E

Use PRISM values

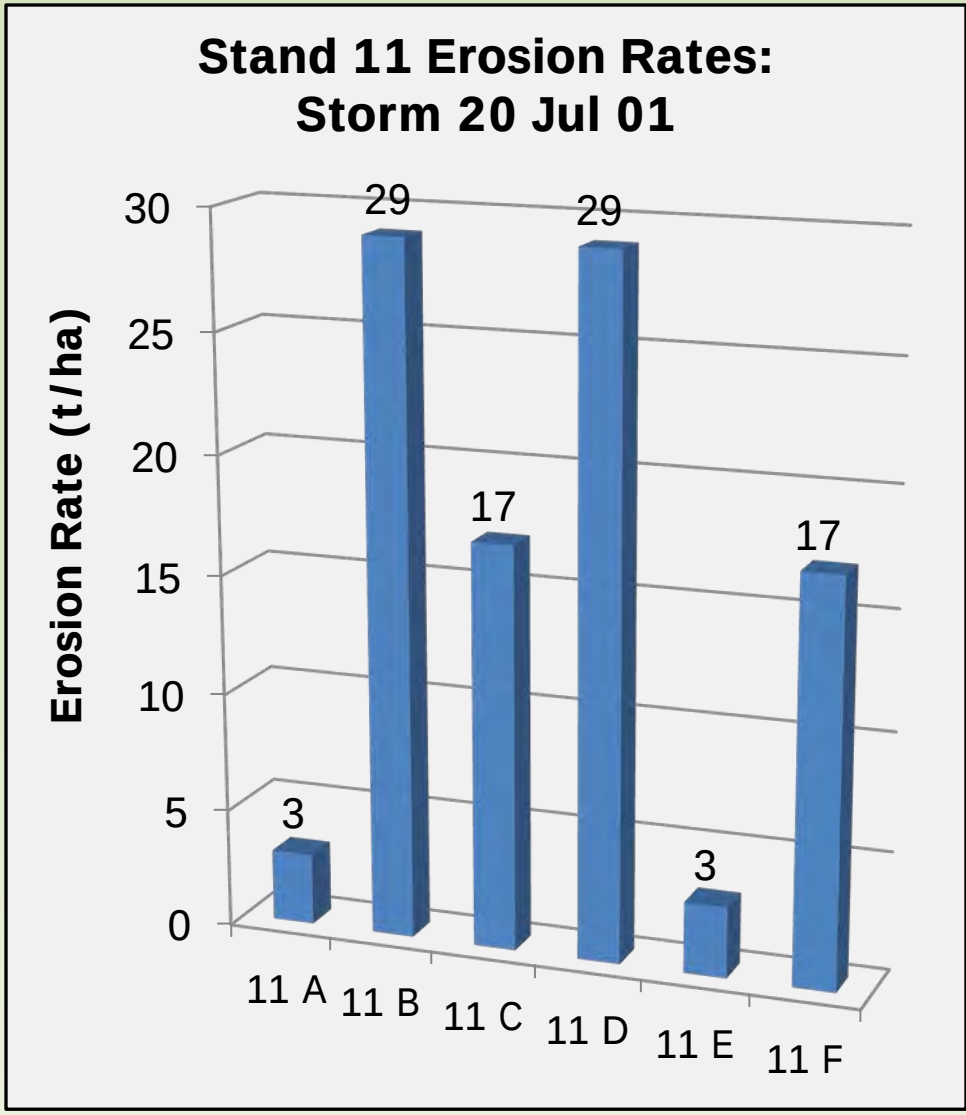
# Bitterroot Valley



# Four Sites Monitored

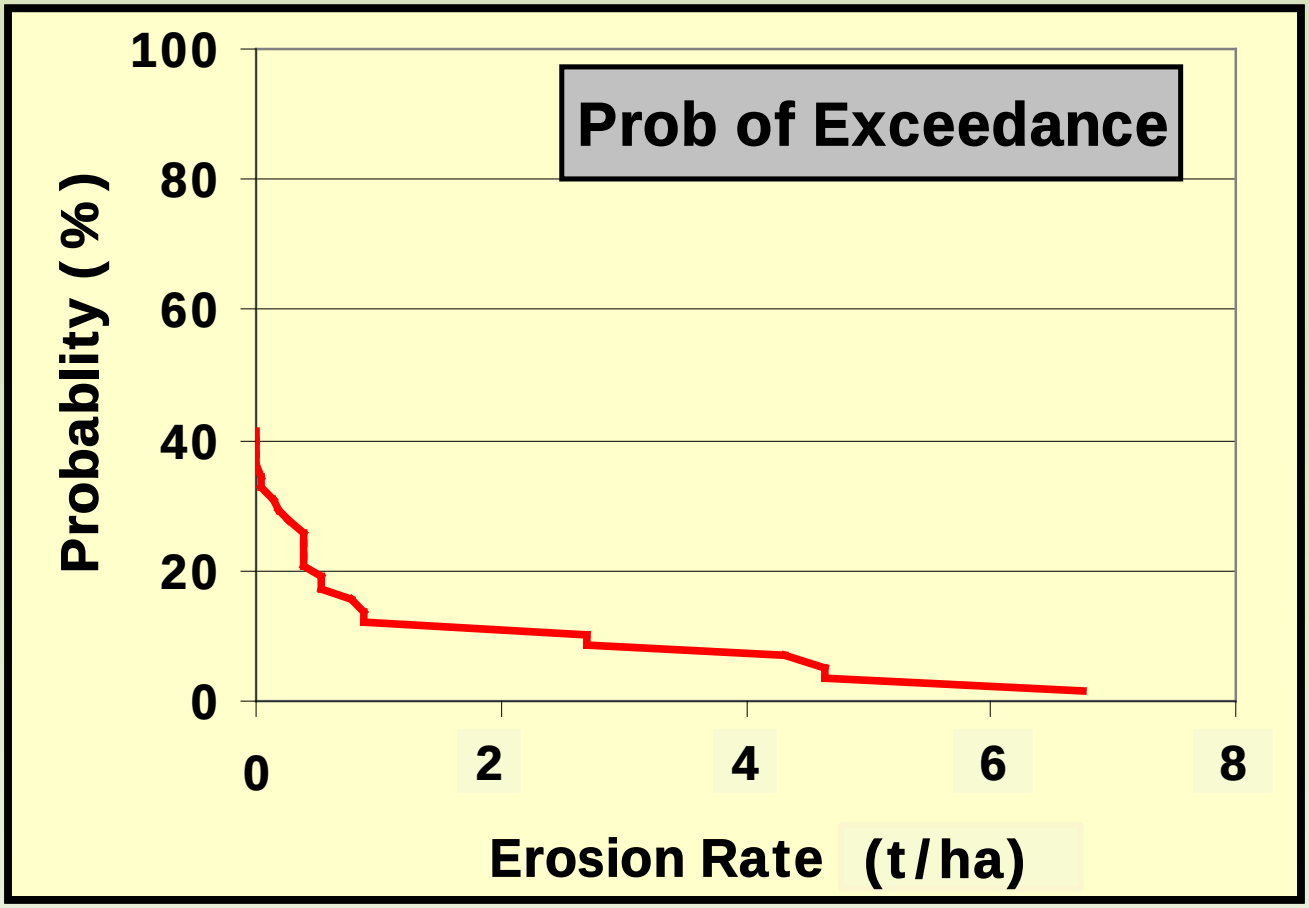
# Event Variability

Bitterroot Valley Fires 2000



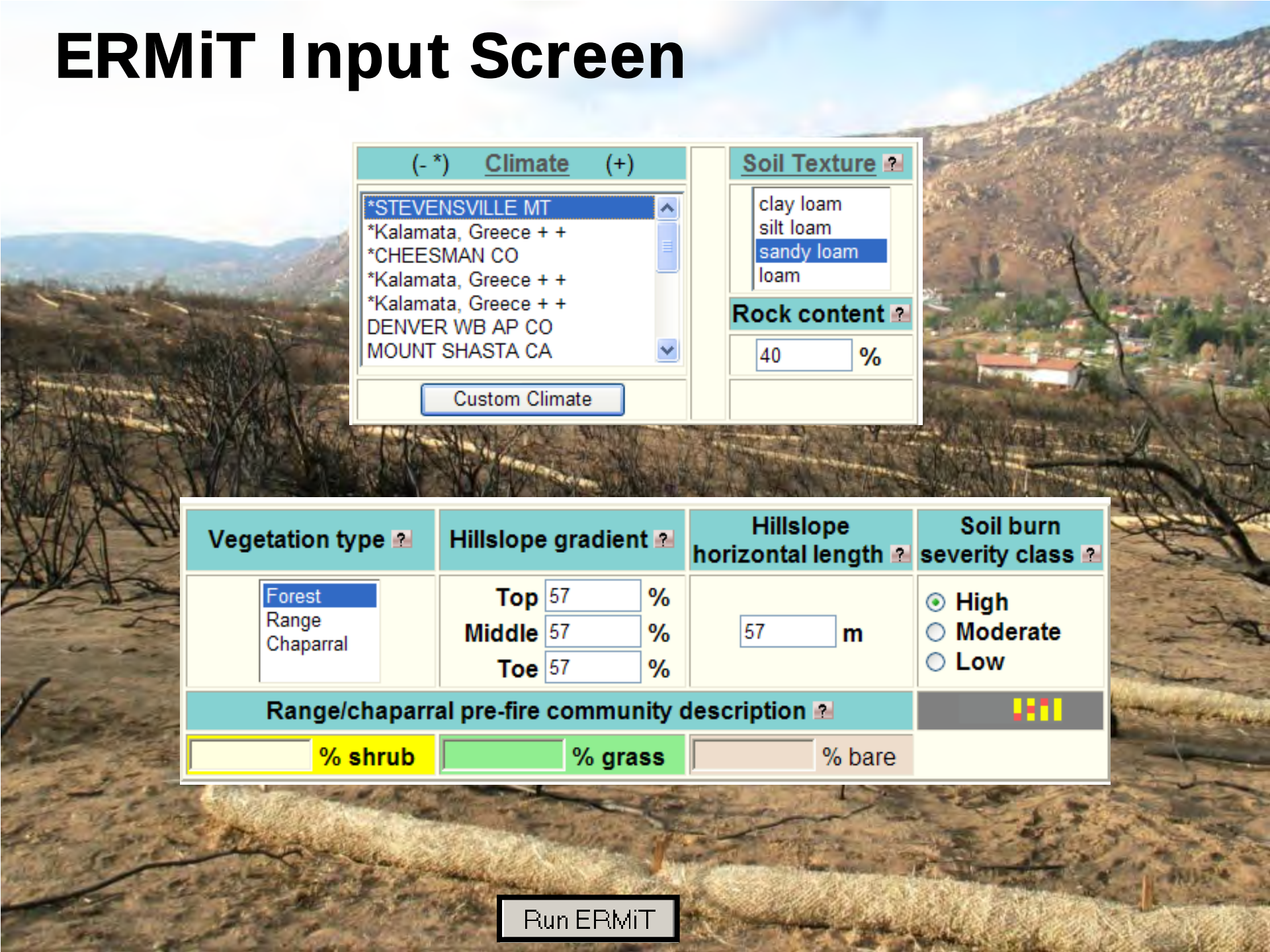
# Probability Of A Given Erosion Event

**Event Variability**
**Bitterroot Valley Fires, 2000**



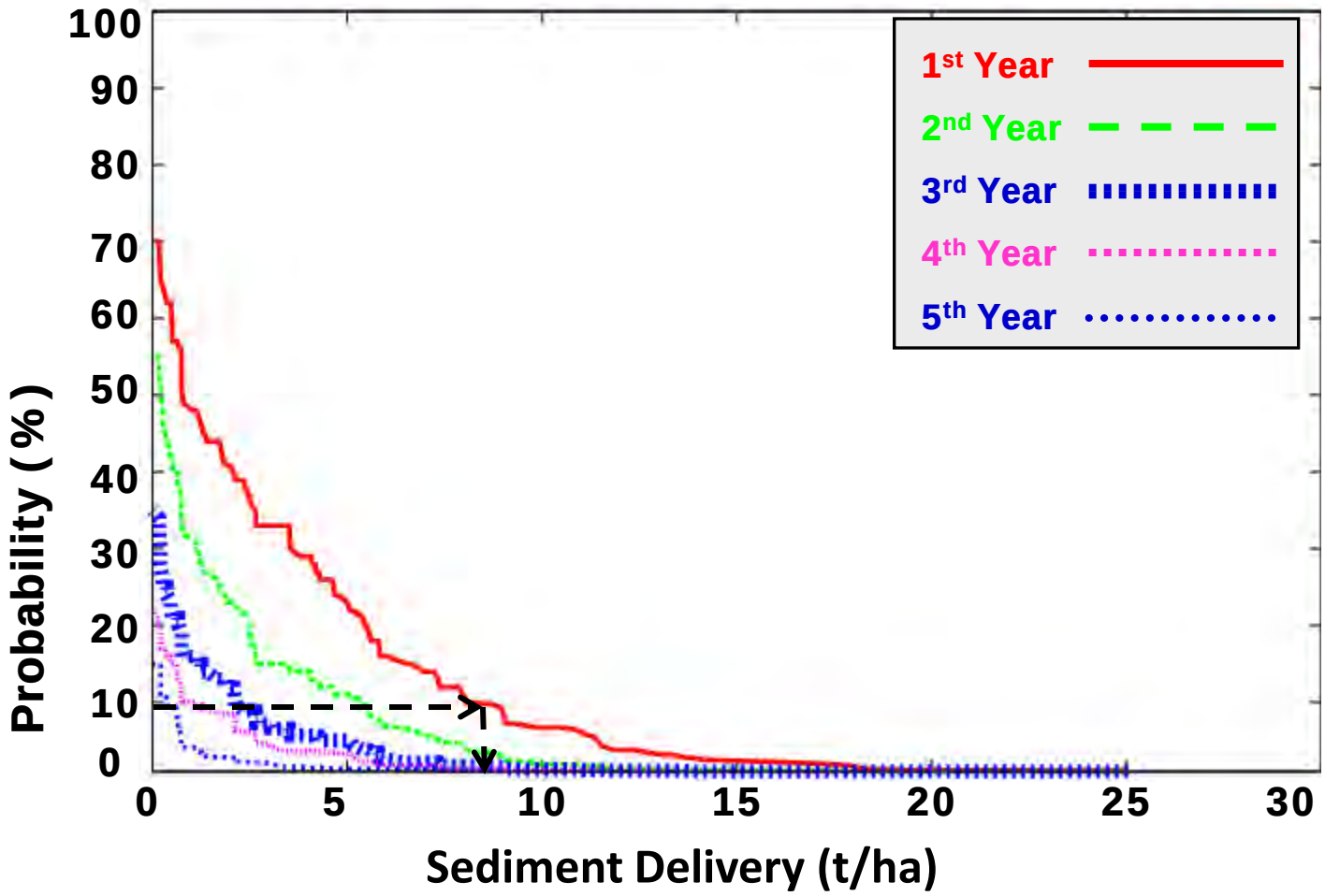

**How can we manage such high variability?**

# ERMiT Input Screen



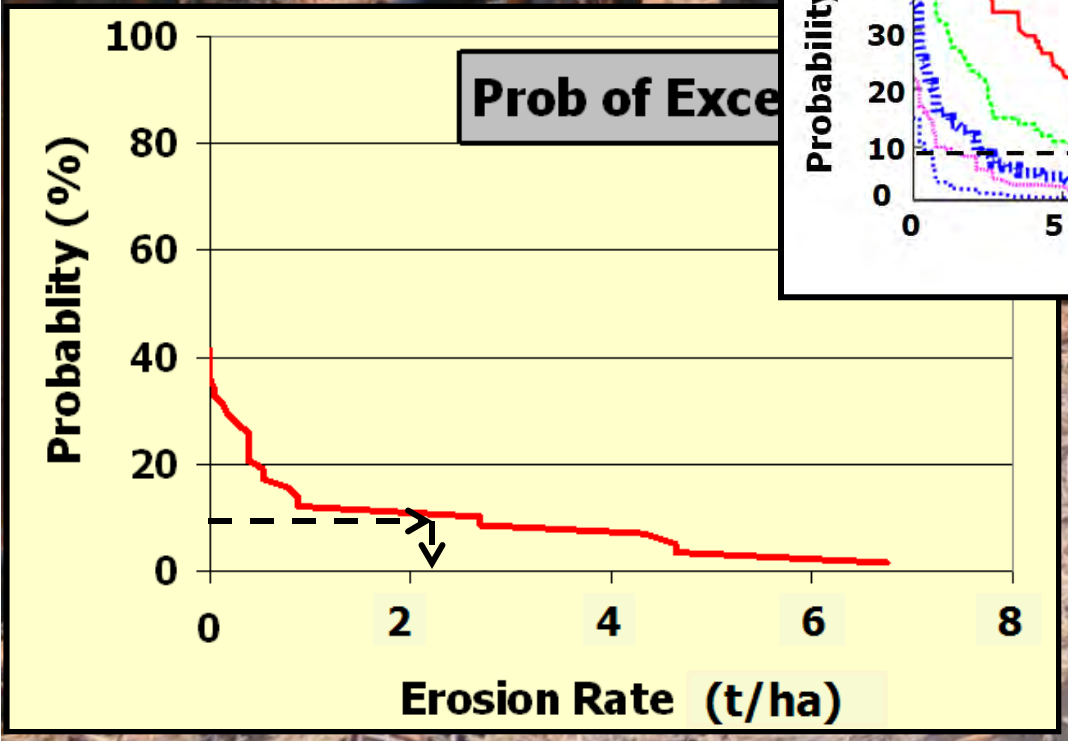
ERMiT

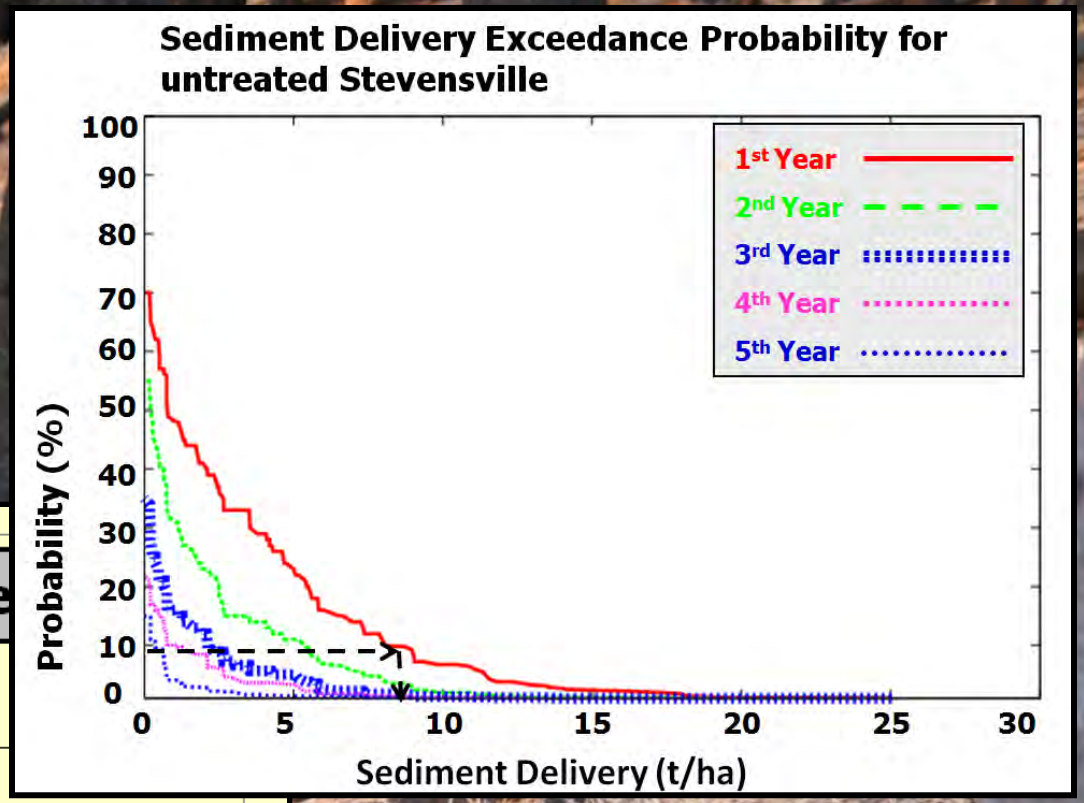
## Sediment Delivery Exceedance Probability for untreated Stevensville



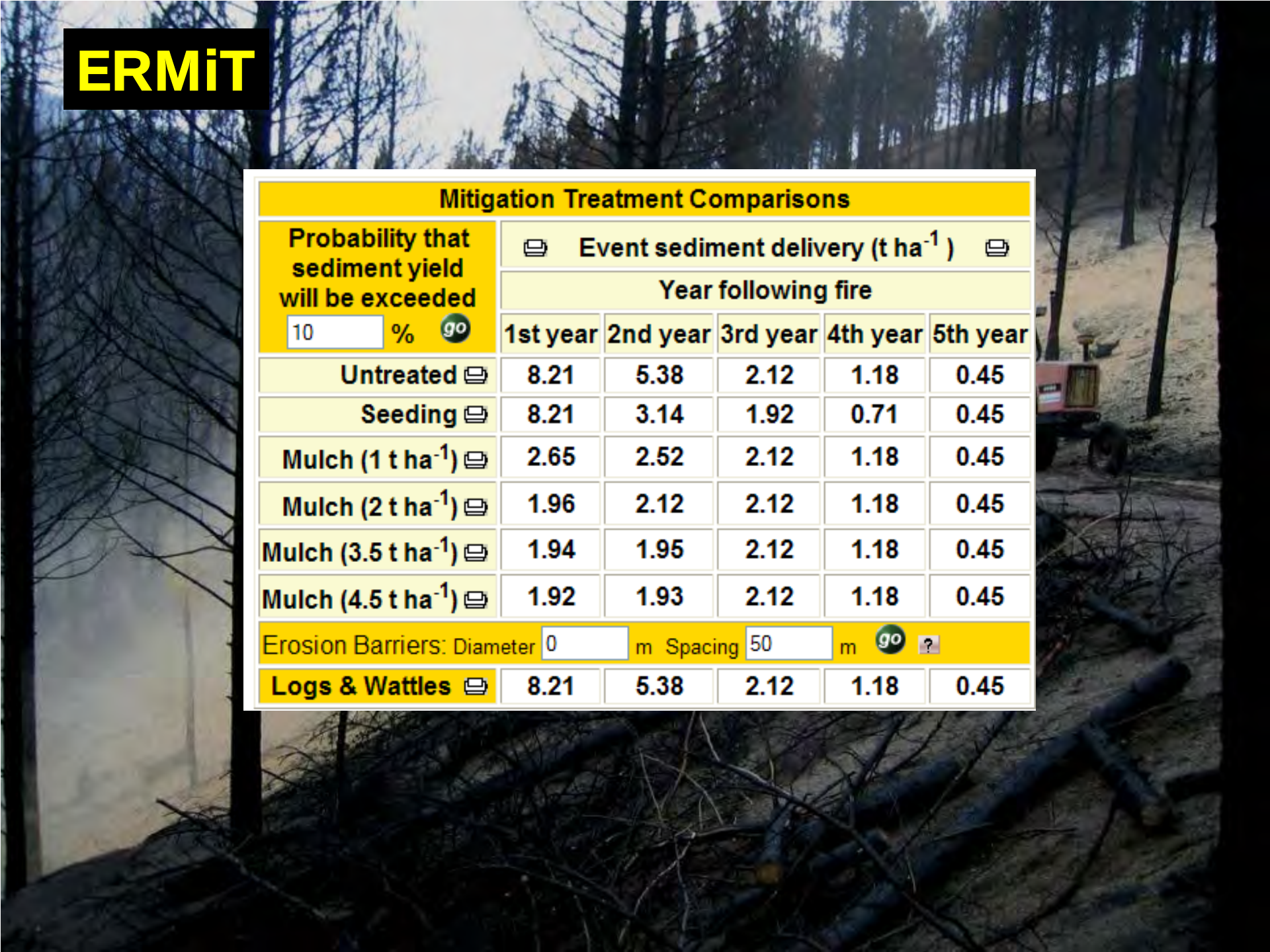

10 % Probability Erosion > 8 t/ha

# ERMiT Output vs. Observed Data




10 % Probability Erosion > 8 t/ha




## 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 | 8.21 | 5.38 | 2.12 | 1.18 | 0.45 |
| Seeding | 8.21 | 3.14 | 1.92 | 0.71 | 0.45 |
| Mulch (1 t ha$^{-1}$) | 2.65 | 2.52 | 2.12 | 1.18 | 0.45 |
| Mulch (2 t ha$^{-1}$) | 1.96 | 2.12 | 2.12 | 1.18 | 0.45 |
| Mulch (3.5 t ha$^{-1}$) | 1.94 | 1.95 | 2.12 | 1.18 | 0.45 |
| Mulch (4.5 t ha$^{-1}$) | 1.92 | 1.93 | 2.12 | 1.18 | 0.45 |
| Erosion Barriers: Diameter 0 m Spacing 50 m go ? | | | | | |
| Logs & Wattles | 8.21 | 5.38 | 2.12 | 1.18 | 0.45 |

# ERMiT

# Mitigation effects

10

**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 | 8.21 | 5.38 | 2.12 | 1.18 | 0.45 |
| Seeding | 8.21 | 3.14 | 1.92 | 0.71 | 0.45 |
| Mulch (1 t ha$^{-1}$) | 2.65 | 2.52 | 2.12 | 1.18 | 0.45 |
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| Mulch (3.5 t ha$^{-1}$) | 1.94 | 1.95 | 2.12 | 1.18 | 0.45 |
| Mulch (4.5 t ha$^{-1}$) | 1.92 | 1.93 | 2.12 | 1.18 | 0.45 |
| Erosion Barriers: Diameter 1 m Spacing 25 m go ? | | | | | |
| Logs & Wattles | 0 | 0 | 0 | 0 | 0 |

Rain Fall Intensity on 29 Jul

56 mm/hr

| | Hayman (t/ha) | | | | |
|---|---|---|---|---|---|
| 2003 | 18 Jul | 19 Jul | 29 Jul | 9 Aug | 30 Aug |
| Straw mulch | 0.002 | 0.004 | 7 | 0.04 | 0.7 |
| Control | 0.004 | 0.02 | 19 | 0.9 | 3 |

# ERMiT

## Mitigation effects

70 →

**Mitigation Treatment Comparisons**

| Probability that sediment yield will be exceeded 70 % go | Event sediment delivery (t ha$^{-1}$) — Year following fire | | | | |
|---|---|---|---|---|---|
| | 1st year | 2nd year | 3rd year | 4th year | 5th year |
| Untreated | 0 | 0 | 0 | 0 | 0 |
| Seeding | 0 | 0 | 0 | 0 | 0 |
| Mulch (1 t ha$^{-1}$) | 0 | 0 | 0 | 0 | 0 |
| Mulch (2 t ha$^{-1}$) | 0 | 0 | 0 | 0 | 0 |
| Mulch (3.5 t ha$^{-1}$) | 0 | 0 | 0 | 0 | 0 |
| Mulch (4.5 t ha$^{-1}$) | 0 | 0 | 0 | 0 | 0 |
| Erosion Barriers: Diameter 1 m Spacing 25 m go ? | | | | | |
| Logs & Wattles | 0 | 0 | 0 | 0 | 0 |

Rain Fall Intensity on 9 Aug 12.7 mm/hr

| | Hayman (t/ha) | | | | |
|---|---|---|---|---|---|
| 2003 | 18 Jul | 19 Jul | 29 Jul | 9 Aug | 30 Aug |
| Straw mulch | 0.002 | 0.004 | 7 | 0.04 | 0.7 |
| Control | 0.004 | 0.02 | 19 | 0.9 | 3 |

# Observed and Predicted Sediment yields

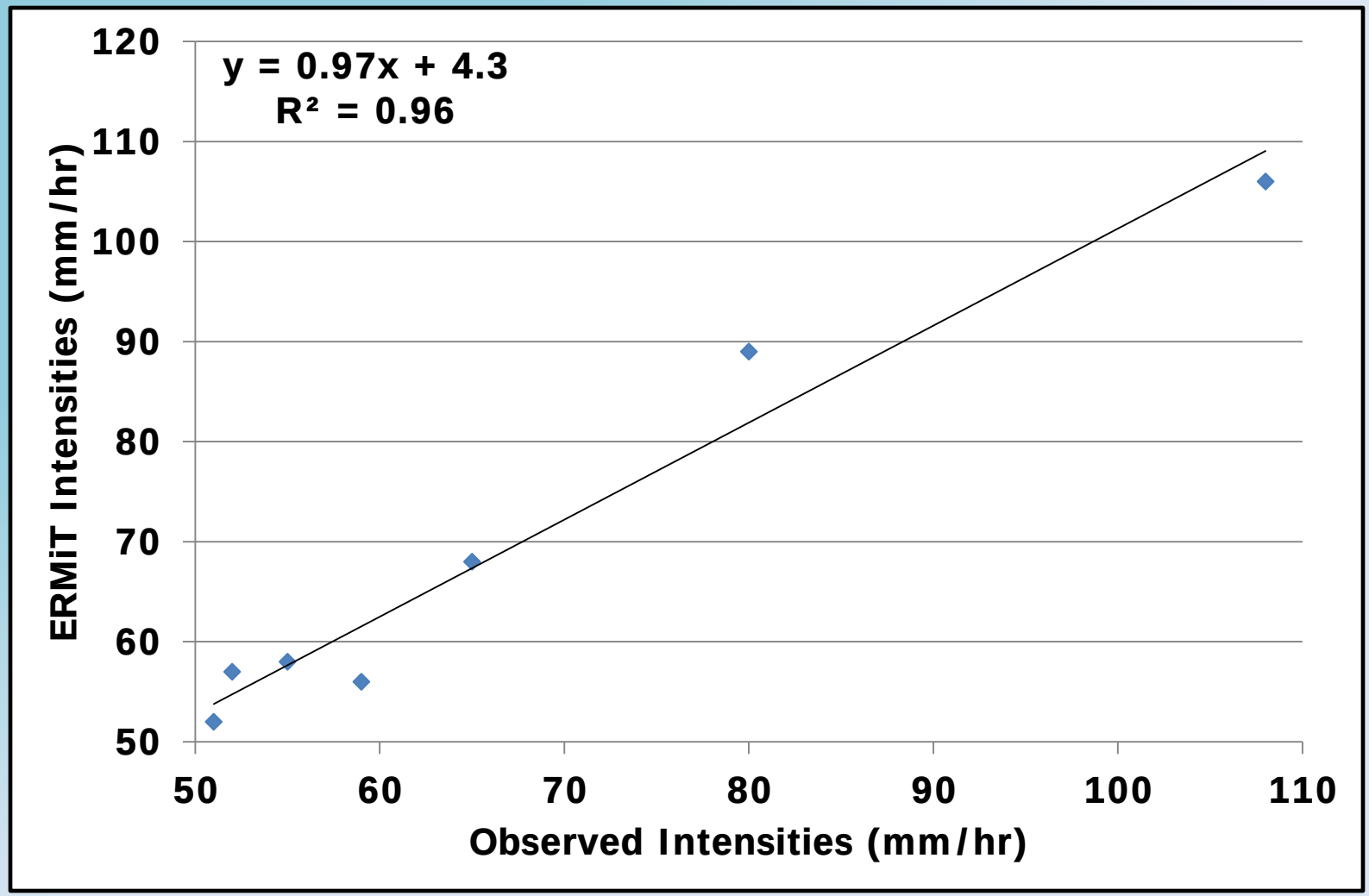
| Fire Name | Observed events in number of years | Mean sediment delivery (t/ha) | |
|---|---|---|---|
| | | Observed | Predicted |
| **Rocky Mountains** | | | |
| North 25 | 2 in 4 | 0.1 | 1.6 |
| Valley | 3 in 6<br>and 1 snow melt | 0.2 | 1.1 |
| Fridley | 4 in 7<br>including 1 rain + snow | 0.1 | 2.0 |
| Hayman *<br>Logs<br>Mulch | 6 in 8<br>8 in 8 | 4.1<br>5.6 | 2.0<br>0.4 |
| Cannon | 3 in 5 | 2.5 | 8.7 |
| Roberts | 0 in 4 | 0.0 | 9.6 |
| **California** | | | |
| Cedar | 6 in 6 | 0.9 | 3.1 |
| Mixing | 6 in 6 | 0.2 | 3.1 |
| | | | |
| Overall Mean | 4.3 in 6 | 2.0 | 2.9 |

* The observed weather and the events selected for the log sites were not the same as the mulched sites

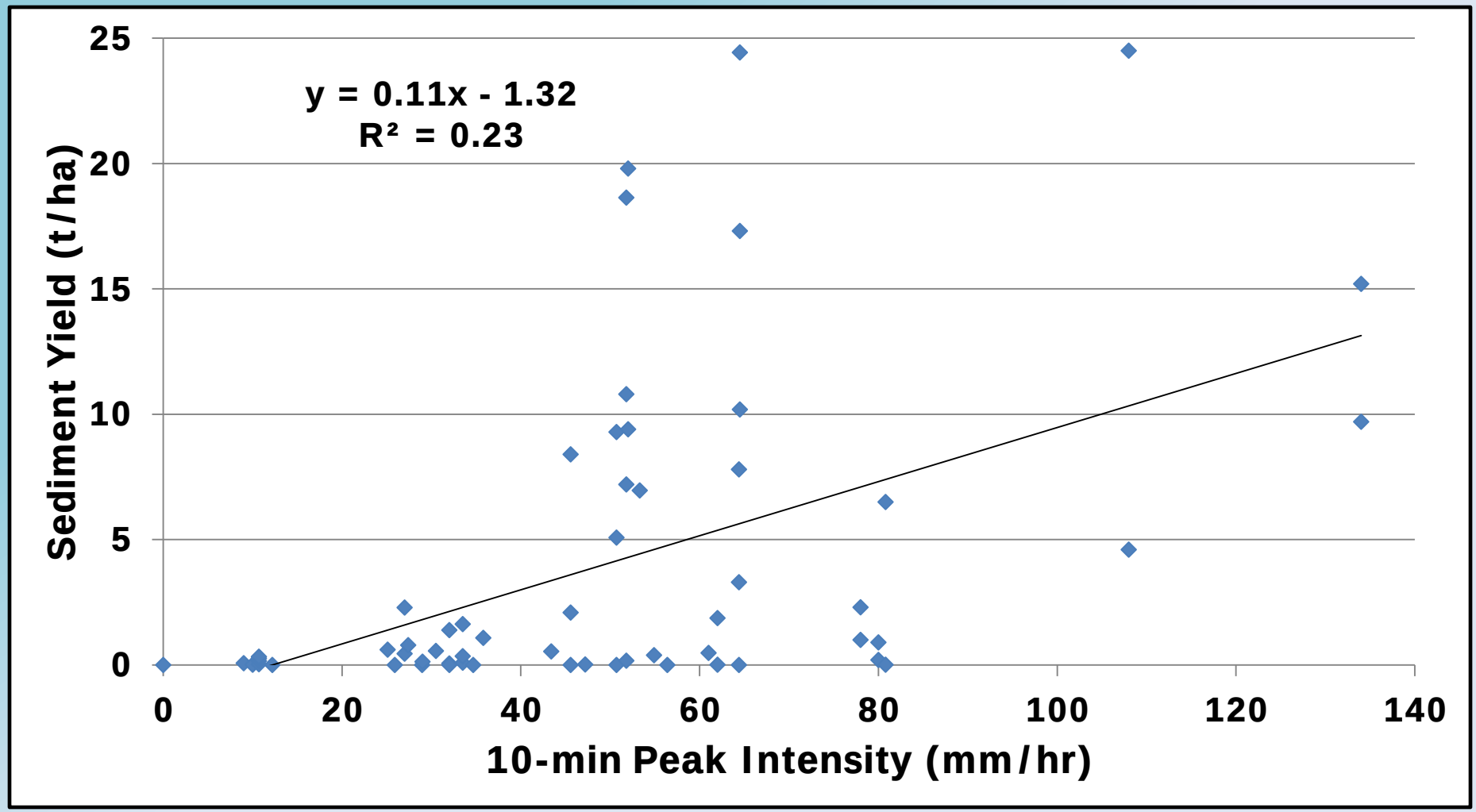
# Observed and Predicted

| Value | Observed | Predicted |
|---|---|---|
| Mean sediment delivery (t $ha^{-1}$) | 2.02 | 2.88 |
| Median of predicted sediment delivery (t $ha^{-1}$) | | 4.47 |
| Range of sediment delivery (t $ha^{-1}$) | 0 – 24.5 | 0 – 47.8 |
| Number of events with sediment delivery < 0.01 t $ha^{-1}$ | 65 | 76 |
| Number of times out of 122 observations that observed delivery was greater than the range of values predicted by ERMiT | 17 | |
| Number of times observed delivery was less than the range of values predicted by ERMiT | 11 | |

# ERMiT vs Observed Rainfall 10-min Intensities



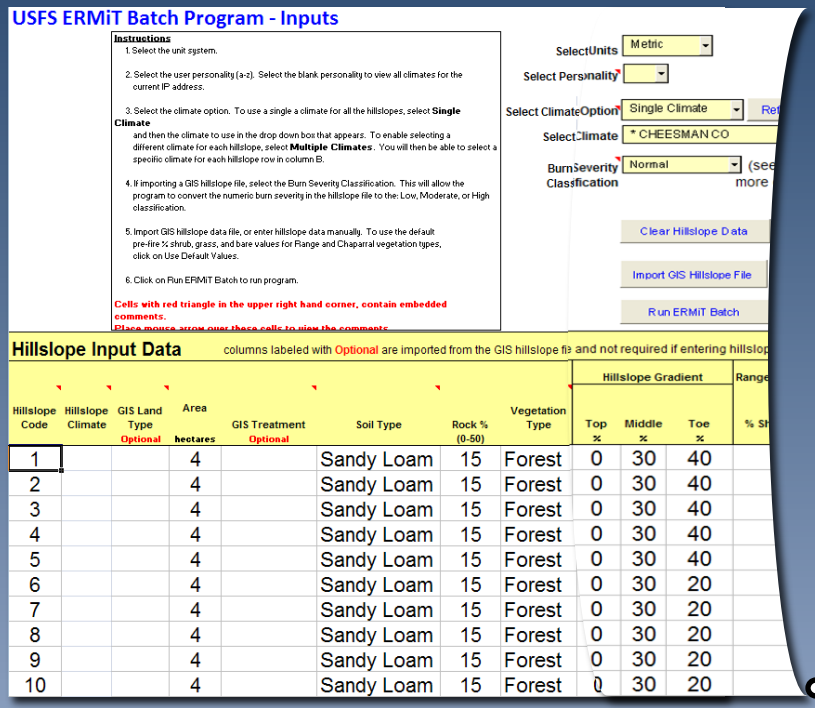
# Observed Sediment Yield vs 10-min Rainfall Intensity



# Conclusion: Modeling Tools

- Erosion Risk Management Tool (ERMiT)
- Reasonable results

NEW ERMiT Batch Program


**Models can be found at:**

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