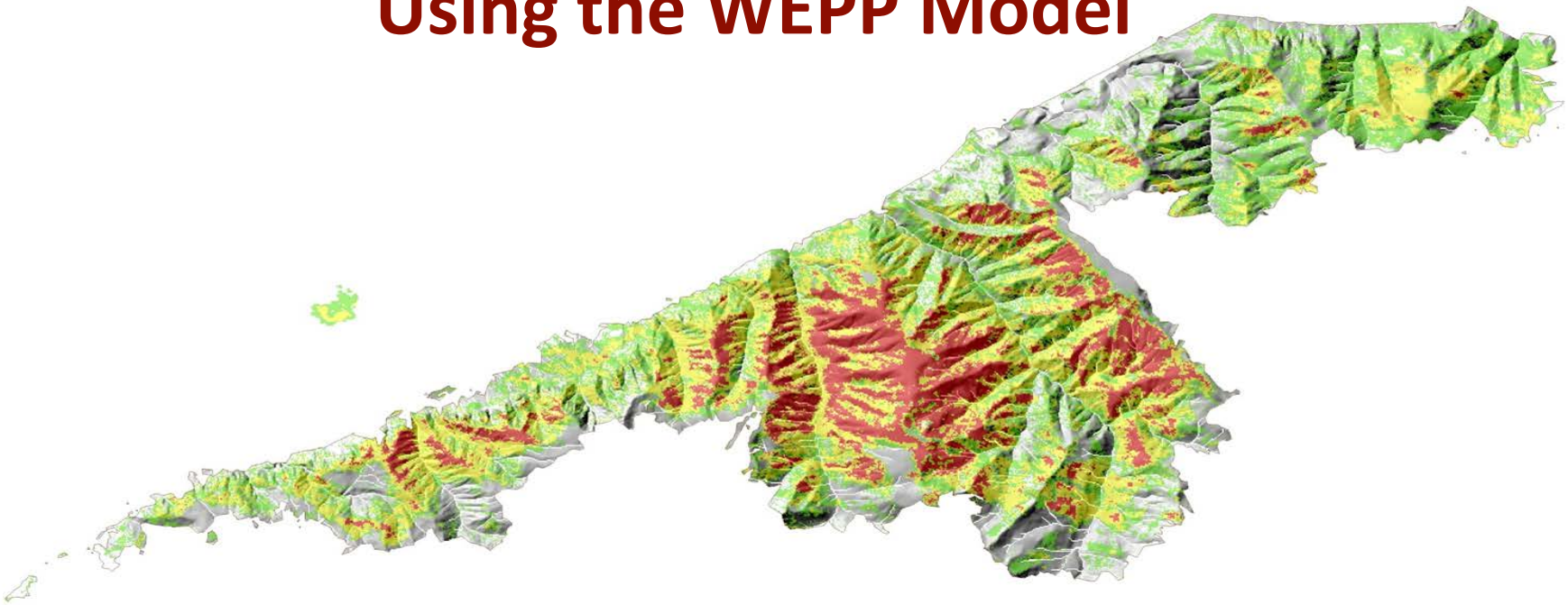
Eagle Creek Post Fire Erosion Hazard Analysis Using the WEPP Model



John Rogers & Lauren McKinney

Columbia River Gorge at Risk: Using LiDAR and GIS-based predictive modeling for regional-scale erosion susceptibility and hazard assessment in the wake of the Eagle Creek Fire, Oregon

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ABSTRACT

The Columbia River Gorge National Scenic Area is a federally protected area a section of the canyon where the Columbia River has carved through the Cascade Mountains, and is the largest national scenic area in the United States. The natural contrasts between desert and rainforest, sea level and alpine ecosystems, plateaus and massive cliffs, detail a unique natural environment showcasing how preservation has sustained biodiversity, hydrologic processes and , local economies and many more.

When the Eagle Creek Fire was reported on September 2nd,2017 near the town of Cascade Locks, Oregon, suppression began immediately as the persistent dry weather conditions, east winds and excessive heat caused by the fire quickly escalated the spread and burn severity, which would reach nearly 50,000 acres in just three days. Upon early October containment, major immediate safety concerns in the burn area arose such as the threat of landslides, rockslides and debris flow in the steep topography of the area, especially with anticipated heavy winter rainfall in the upcoming winter season.

The Burned Area Emergency Response team (BAER) released a soil burn severity analysis stating that in which is pertinent to slope stability after a severe forest fire. In some areas of this study area, much of the vegetation and underlying root systems that stabilize rocks, logs, soil, boulders, and ultimately entire hillsides, have been consumed by above and below ground fire, and as a result large debris will continue to fall in many areas. The relative risks of ecosystem and infrastructure damage associated with these conditions, especially erosion, are immense. Identifying areas of erosion susceptibility and risk assessment through the use of a LiDAR generated high resolution digital elevation model and predictive models will provide more detailed information for future risk reduction in hazard prone areas. Using the Water Erosion Prediction Project (WEPP) model approach for predicting post-fire erosion, this model will apply the characteristics and parameters of Eagle Creeks' regional landscape, soil composition, climate, and soil burn severity to model how much erosion we can reasonably expect in this next year. With this knowledge, we can identify at risk streams and trails, and plan to mitigate hazards accordingly.

TOPICS

BACKGROUND

- The Columbia Gorge
- The Eagle Creek Fire
- The BAER Team and Soil Burn Severity Maps

EROSION MODELING

- The Water Erosion Prediction Program (WEPP)
- How to get WEPP data & How to use the tool
- Using WEPP to Model Erosion from the Eagle Creek fire

TRAIL AND STREAM DANGER

- Erosion Danger to Trail System and Streams
- Locations of Possible Post Fire Landslides
- Future Analysis Goals

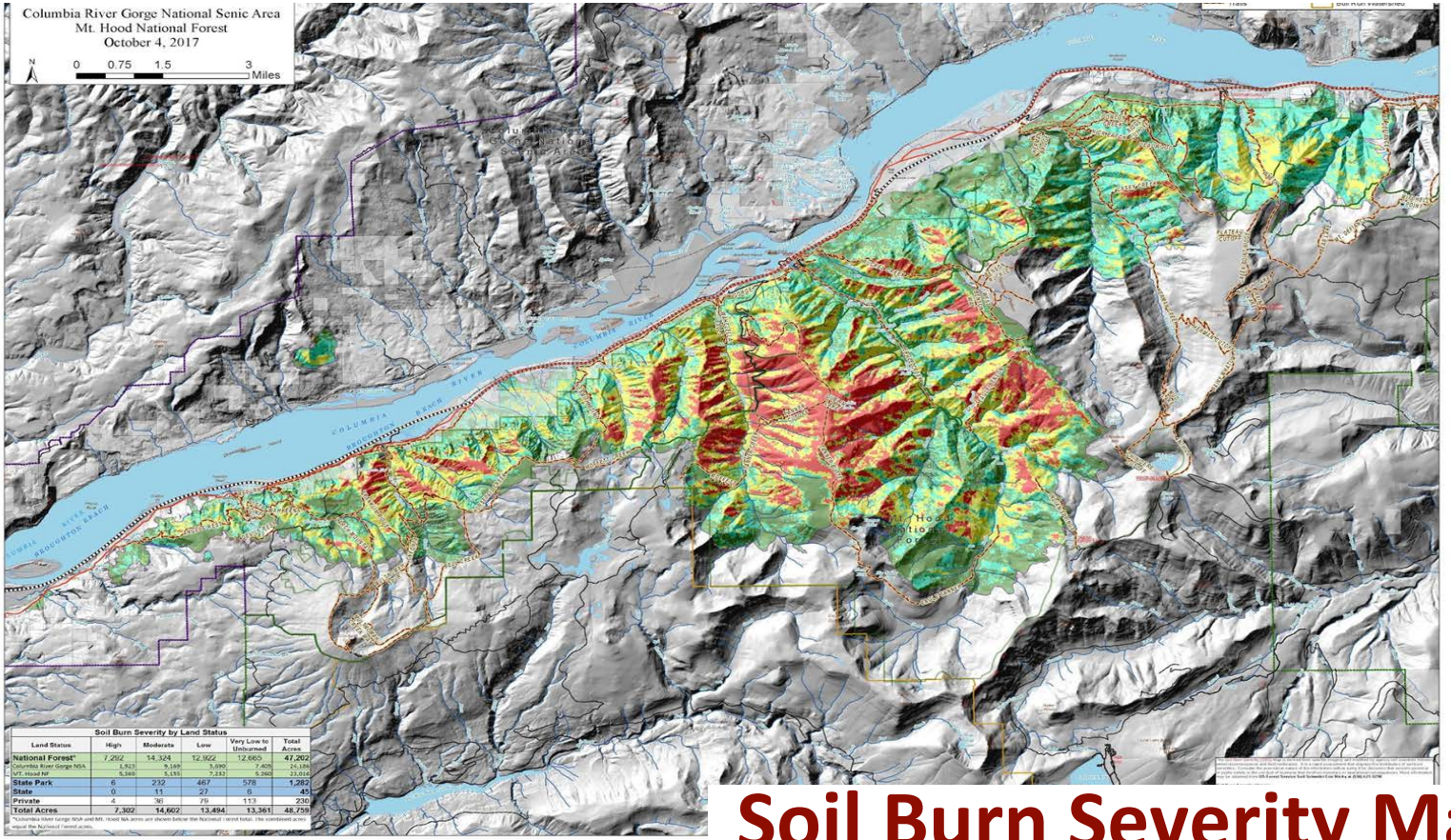
BACKGROUND: The Columbia Gorge

- Federally protected scenic area where the Columbia River carved through the Cascade Mountains
- Ecologically unique environment home to desert and rainforest, sea level and alpine ecosystems, plateaus and massive cliffs
- Preservation has sustained biodiversity, hydrologic processes, and local economies

BACKGROUND: The Eagle Creek Fire

- Eagle Creek Fire was reported on September 2nd, 2017 near the town of Cascade Locks, Oregon
- Persistent dry weather conditions, east winds and excessive heat quickly escalated the fire spread and burn severity
- As of November 9th, the fire has consumed about 50,000 acres.

BACKGROUND: The BAER Team

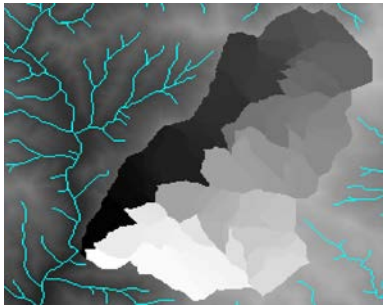


Soil Burn Severity by Land Status

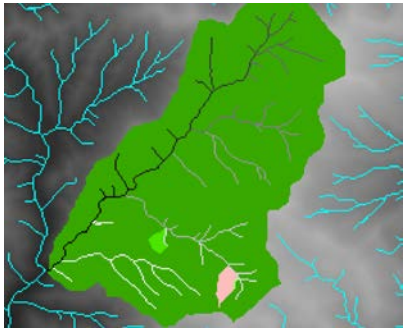
Land Status	High	Moderate	Low	Very Low to Unburned	Total Acres
National Forest*	7,292	14,324	12,922	12,665	47,202
Columbia River Gorge NSA	1,953	9,169	5,099	7,905	24,126
MT. Hood NF	5,349	5,155	7,233	5,360	23,016
State Park	6	232	467	578	1,282
State	0	11	27	6	45
Private	4	36	79	113	230
Total Acres	7,302	14,602	13,494	13,361	48,759

*Columbia River Gorge NSA and Mt. Hood NA acres are shown below the National Forest total, the combined acres equal the National Forest acres.

Soil Burn Severity Maps



WEPP

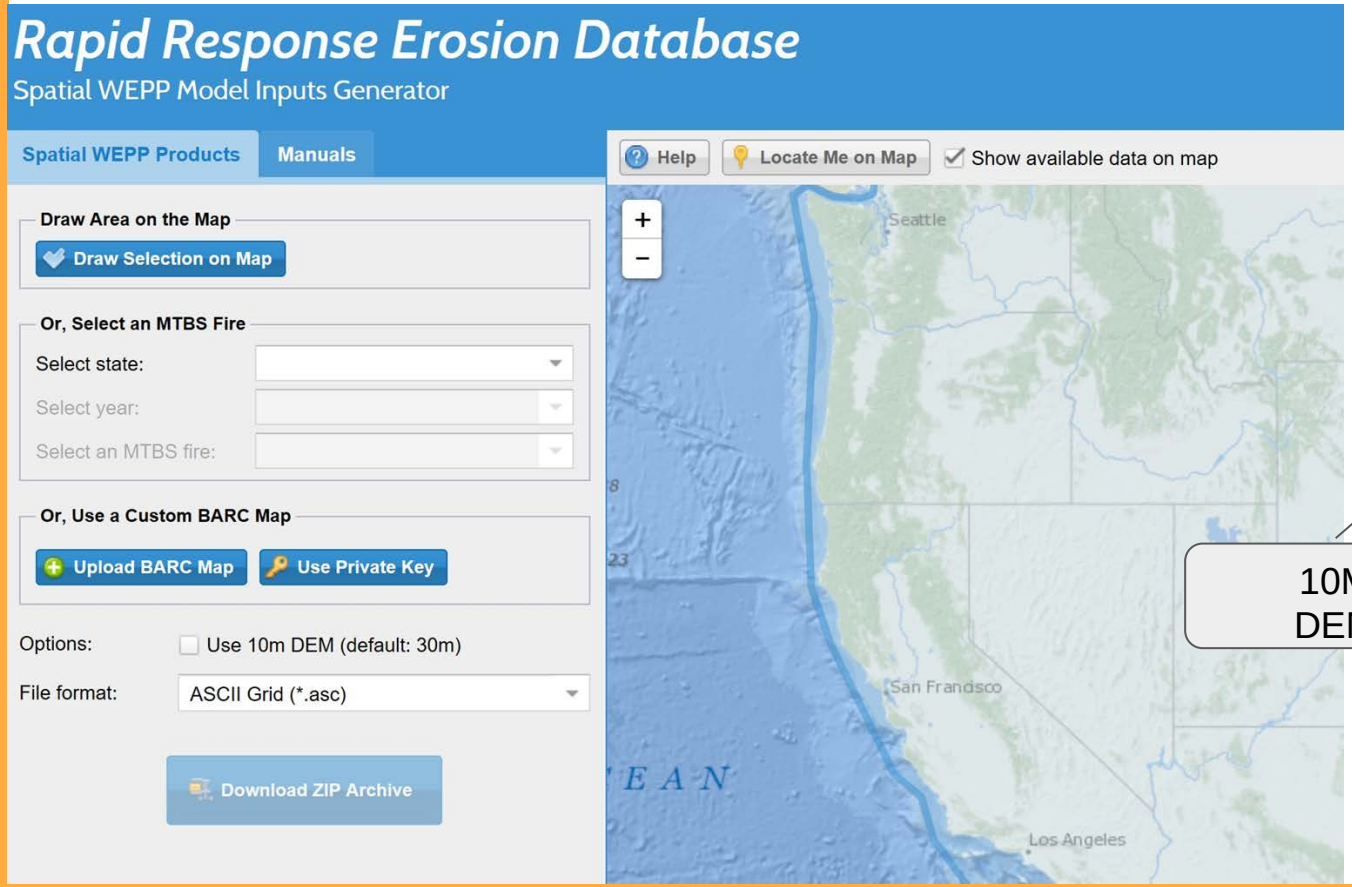


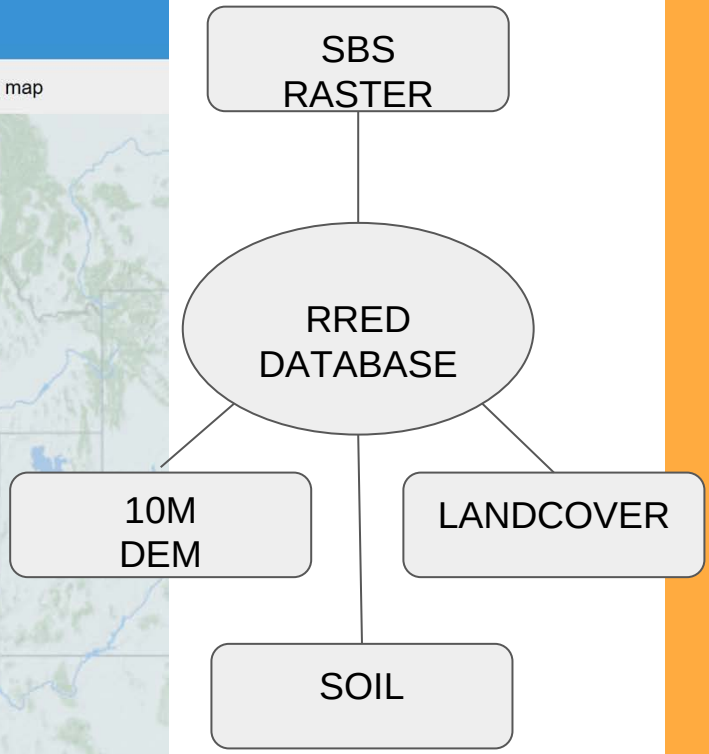
The Water Erosion Prediction Project

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

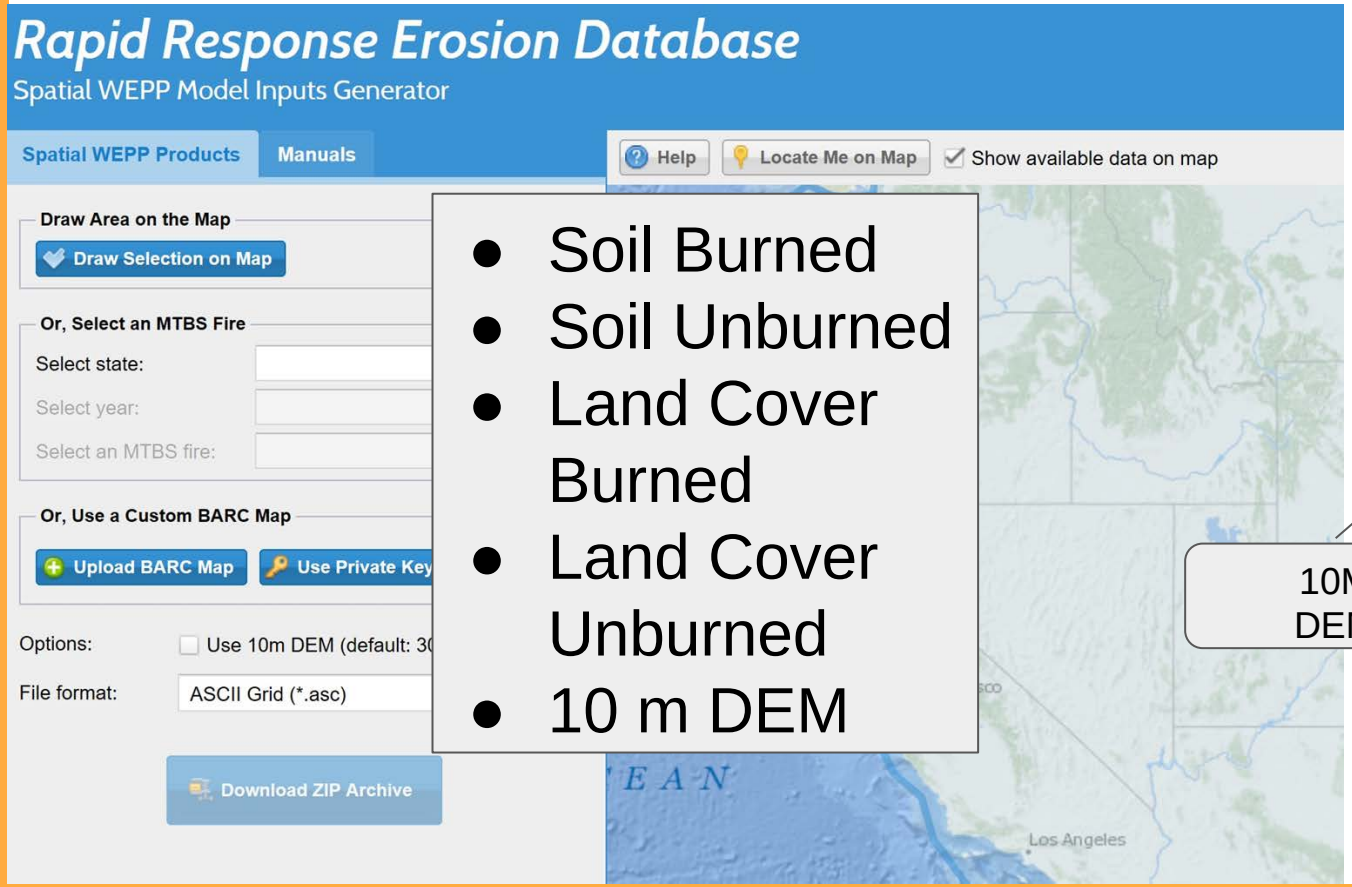
USDA

WEPP INPUTS: REDD DATABASE

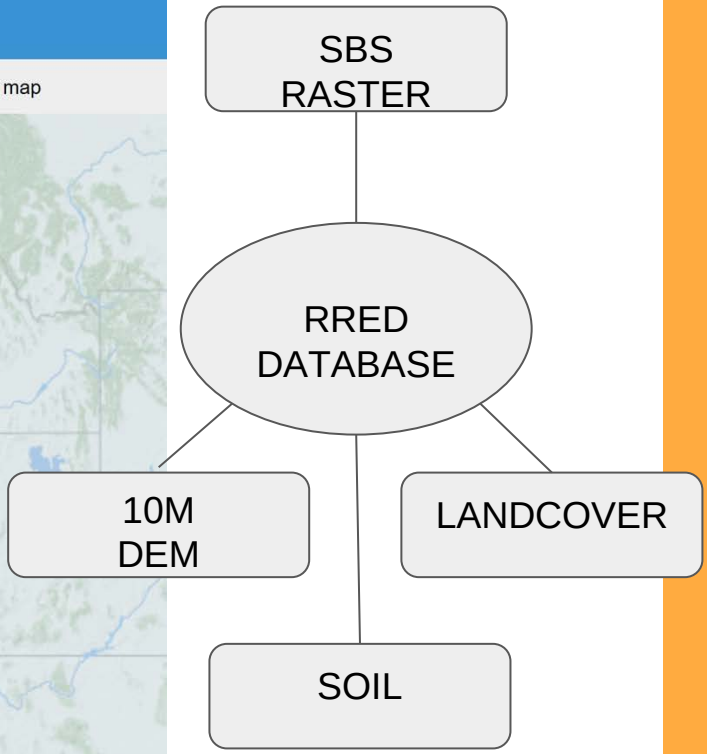




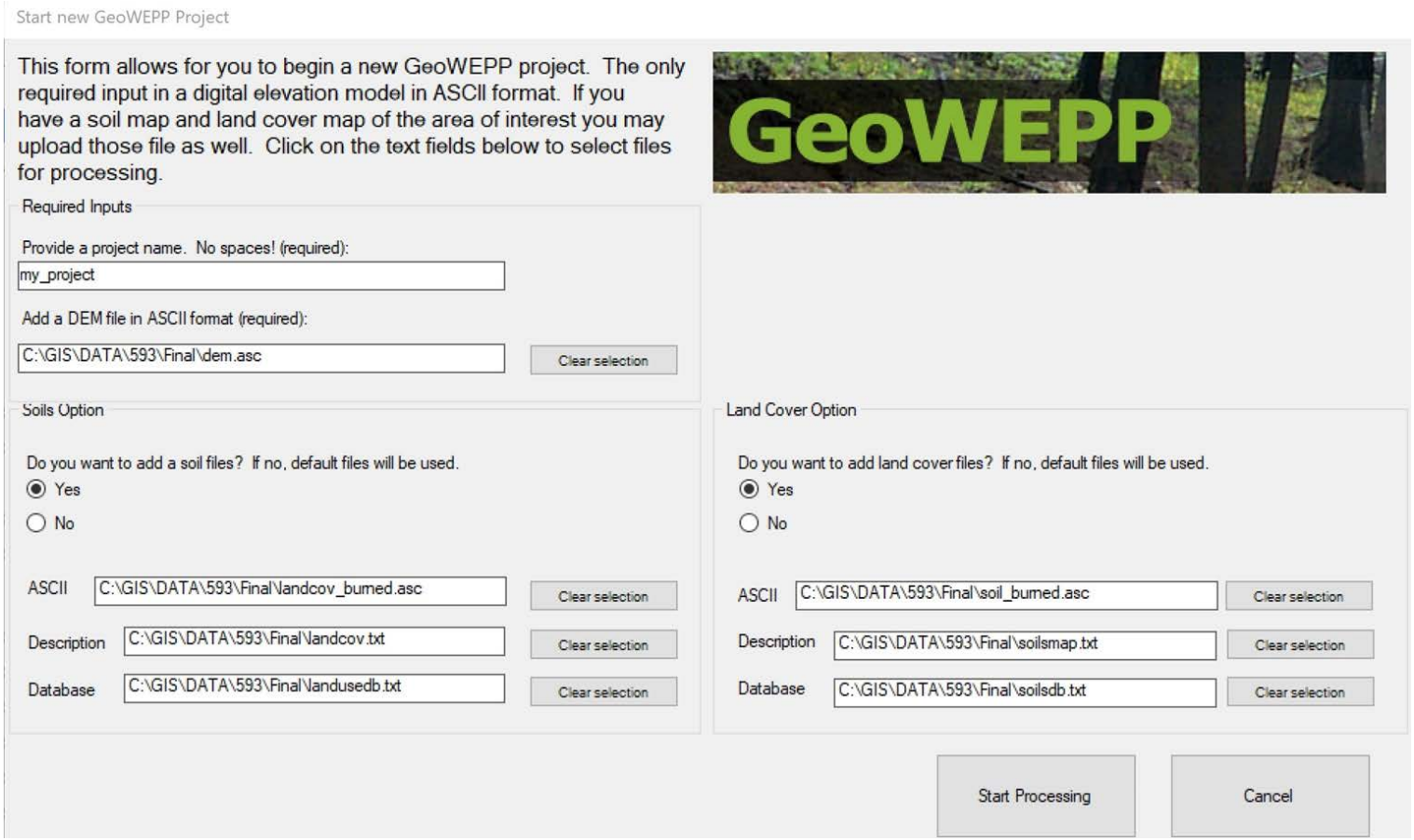
WEPP INPUTS: REDD DATABASE



- Soil Burned
- Soil Unburned
- Land Cover Burned
- Land Cover Unburned
- 10 m DEM



STARTING AND RUNNING THE WEPP



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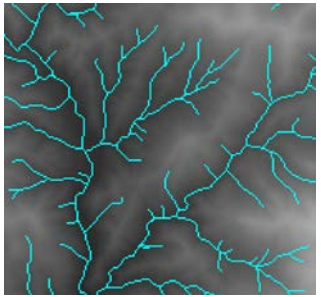
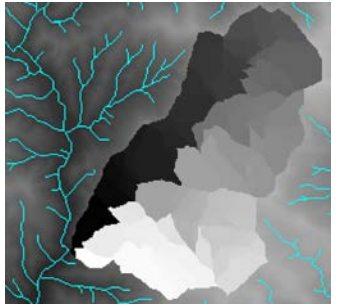
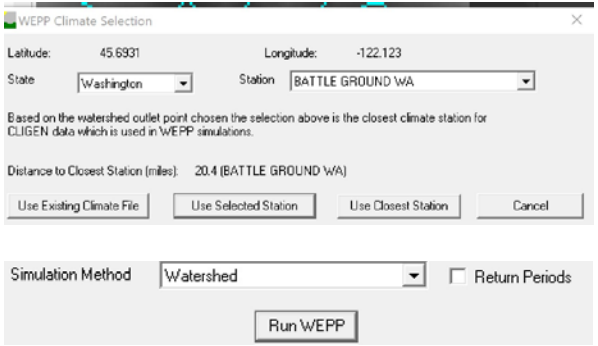


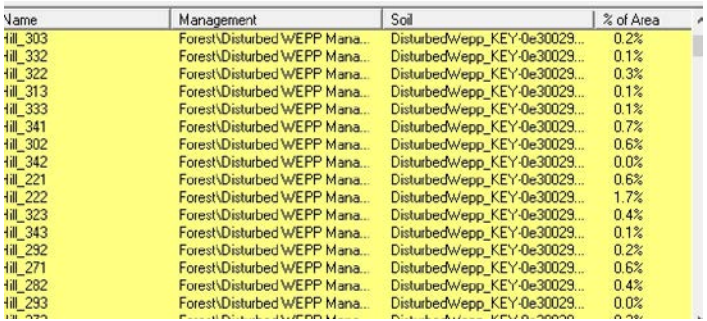
DELINEATED STREAMS



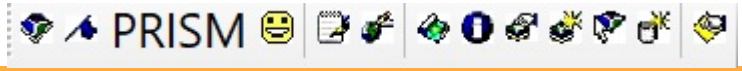
SUBCATCHMENTS



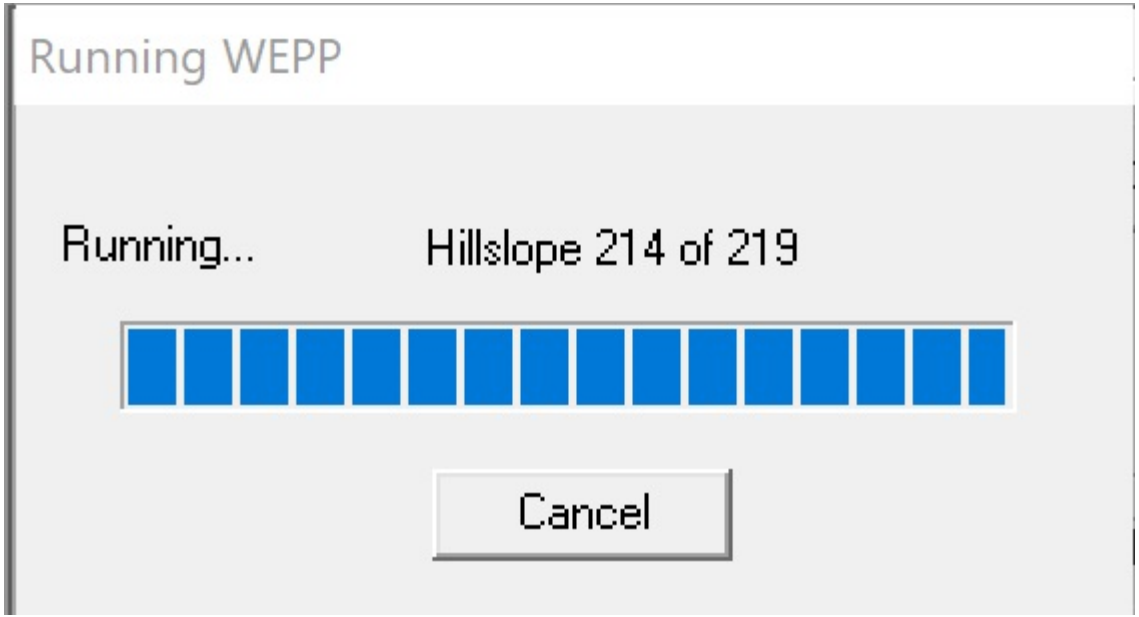
CHOOSE CLIMATE/
SIMULATION METHOD

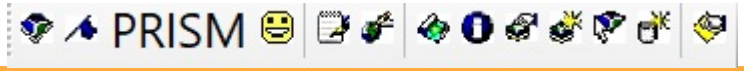


Name	Management	Soil	% of Area
Hill_303	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.2%
Hill_332	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.1%
Hill_322	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.3%
Hill_313	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.1%
Hill_333	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.1%
Hill_341	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.7%
Hill_302	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.6%
Hill_342	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.0%
Hill_221	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.6%
Hill_222	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	1.7%
Hill_323	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.4%
Hill_343	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.1%
Hill_292	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.2%
Hill_271	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.6%
Hill_282	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.4%
Hill_293	Forest\Disturbed WEPP Mana...	DisturbedWepp_KEY-0e30029...	0.0%



STARTING AND RUNNING THE WEPP





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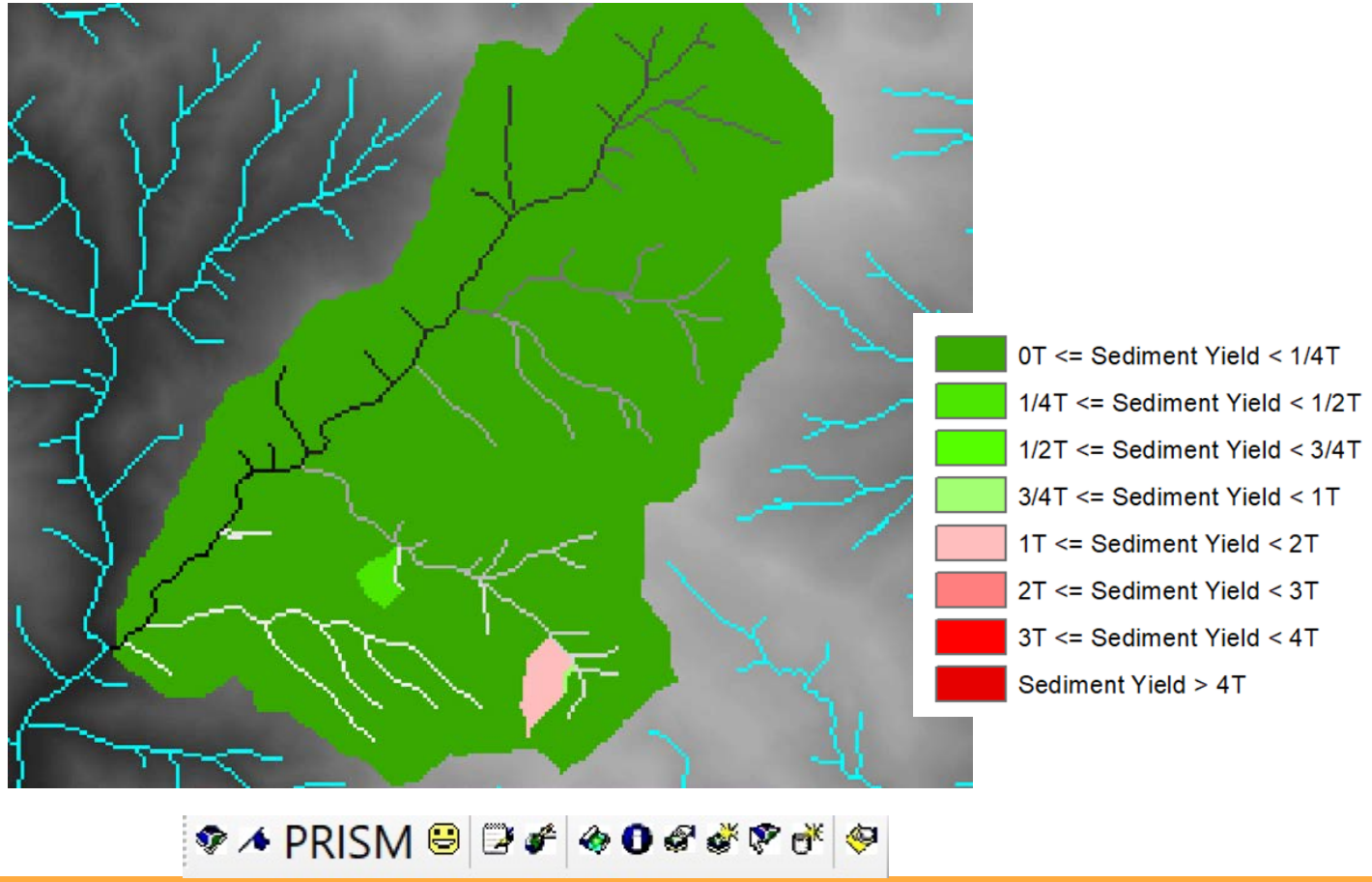
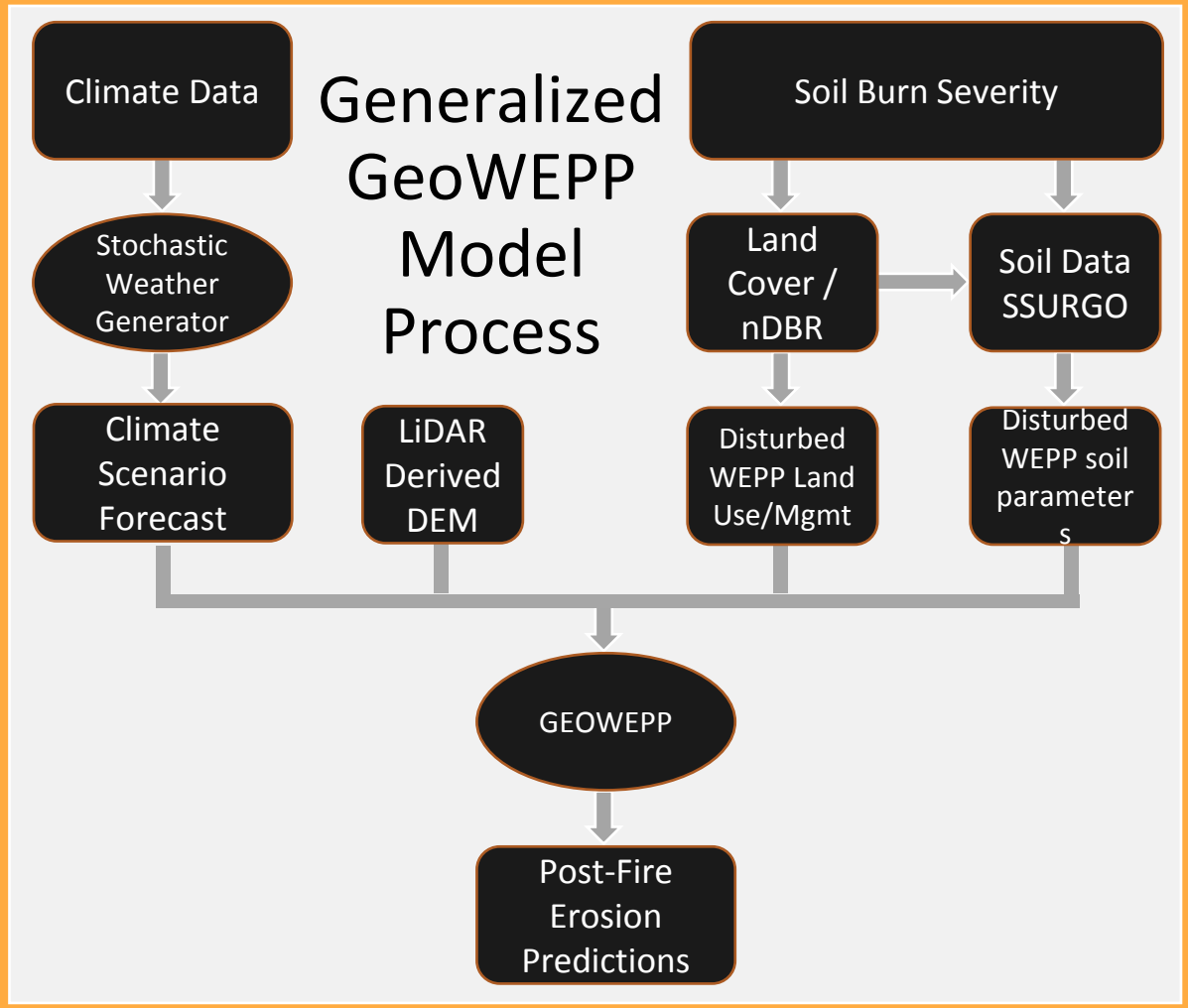


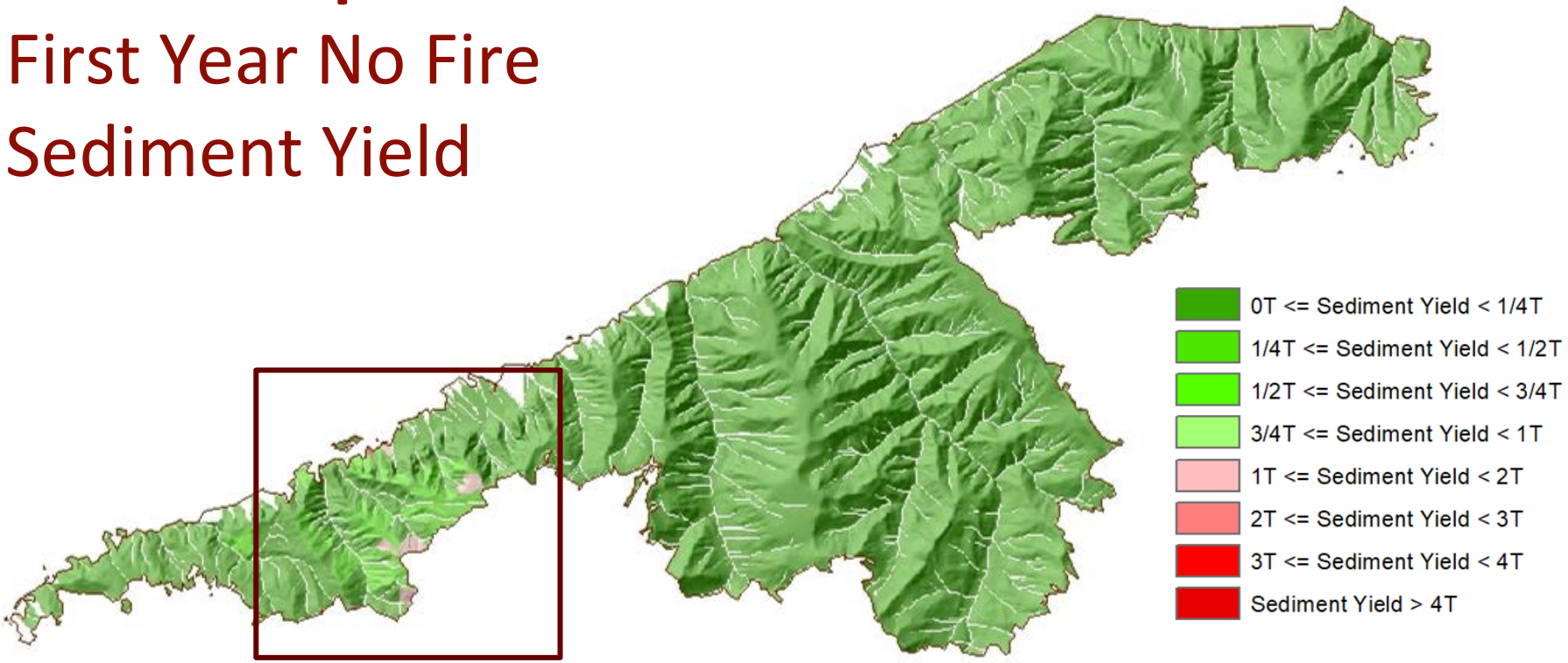

Generalized GeoWEPP Model Process
Climate Data
Stochastic Weather Generator
Climate Scenario Forecast
LiDAR Derived DEM
Soil Burn Severity
Land Cover / nDBR
Soil Data SSURGO
Disturbed WEPP Land Use/Mgmt
Disturbed WEPP soil parameters
GEOWEPP
Post-Fire Erosion Predictions

WEPP Outputs:

First Year Postfire Sediment Yield

WEPP Outputs:
First Year No Fire Sediment Yield

WEPP Outputs:
First Year No Fire Sediment Yield



WEPP Outputs:

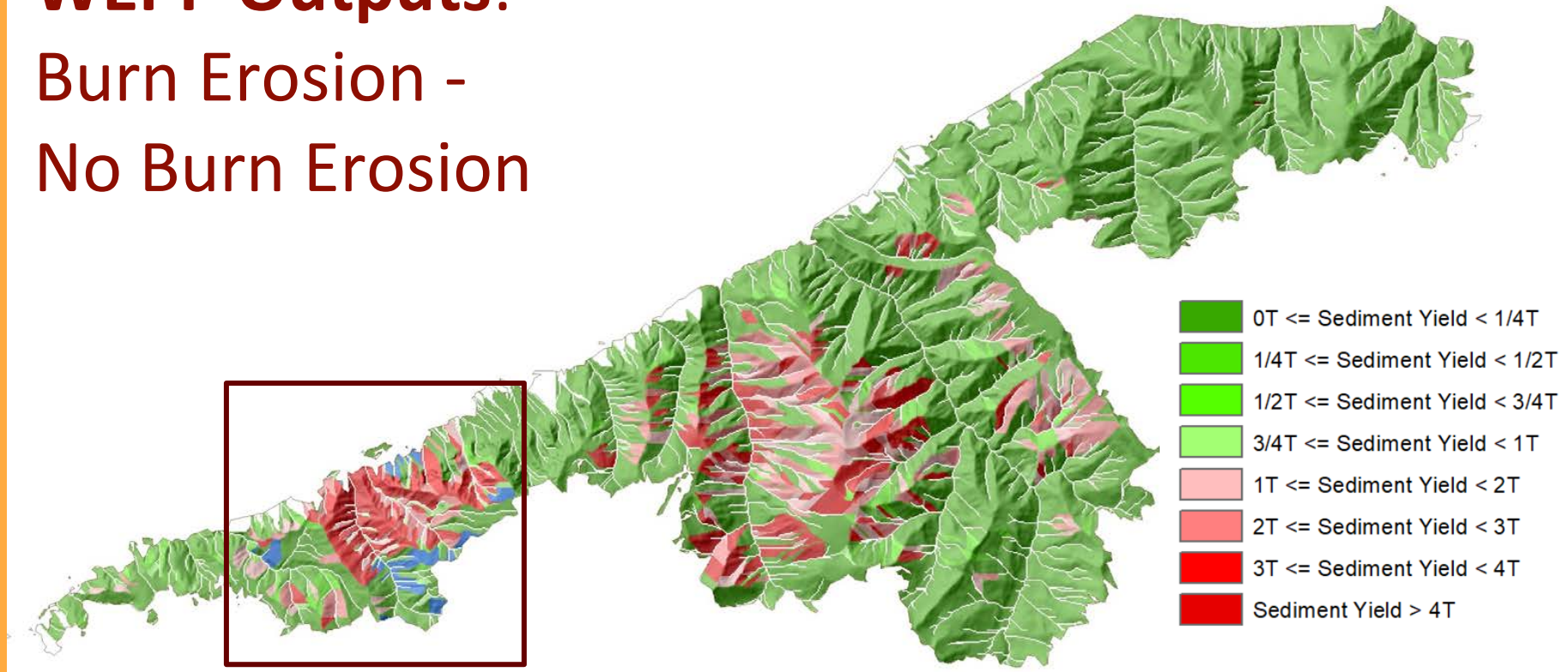
Burn Erosion -

No Burn Erosion

WEPP Outputs:

Burn Erosion -

No Burn Erosion

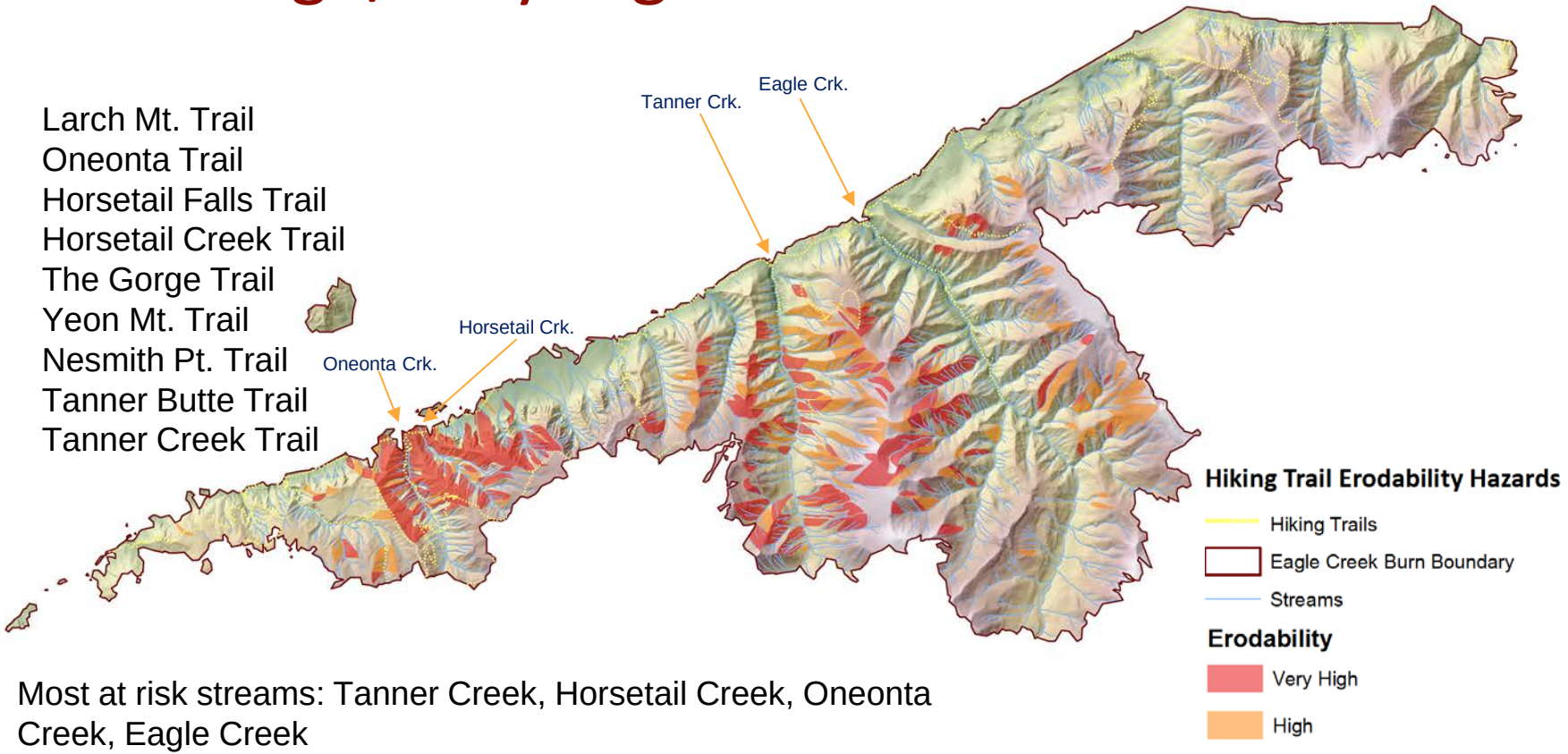


Danger to Trail Systems and Streams

https://lintvkoin.files.wordpress.com/2014/06/landslide-nets.jpg

Trails in High/Very High Erosion Hazard Areas

- Larch Mt. Trail
- Oneonta Trail
- Horsetail Falls Trail
- Horsetail Creek Trail
- The Gorge Trail
- Yeon Mt. Trail
- Nesmith Pt. Trail
- Tanner Butte Trail
- Tanner Creek Trail



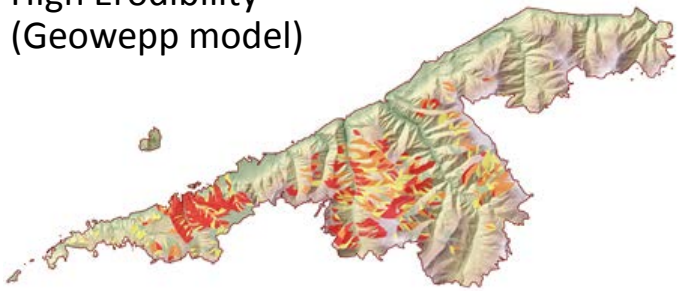
Most at risk streams: Tanner Creek, Horsetail Creek, Oneonta Creek, Eagle Creek

Table 1: Trails intersecting Highest Erosion areas, Trails within 50m of Highest Erosion, and Trail Intersection with Possible Landslide Areas

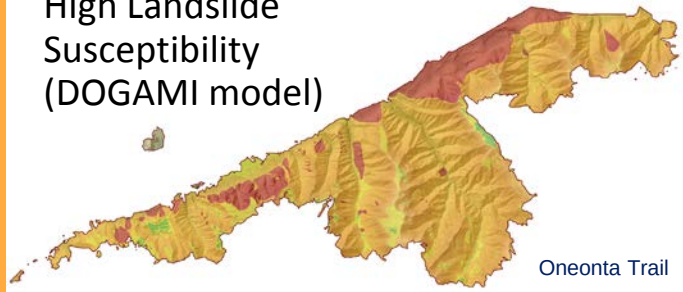
USFS Trail Name	Length in Highest Erosion Hazard (m)	Length Within 50m of High Erosion	Percentage of Trail Near High Erosion Hazard	Intersection w/ Landslide Hazard?
Larch Mountain	31 meters	594 meters	17%	Less Likely
Oneonta	1,624 meters	8,288 meters	1.5%	Likely
Horsetail Falls	1,150 meters	2,077 meters	100%	Less Likely
Gorge Trail	147 meters	3,193 meters	8.6%	Likely
Horsetail Creek	1,533 meters	7,976 meters	100%	Likely
Yeon Mt.	171 meters	178 meters	96%	Less Likely
Nesmith Point	206 meters	5,076 meters	80%	Less Likely
Franklin Ridge	740 meters	3,516 meters	100%	Likely
Tanner Butte	686 meters	4,457 meters	99%	Less Likely
Tanner Creek	144 meters	611 meters	83%	Likely

Locations of Possible Post-Fire Landslides

High Erodibility
(Geowepp model)

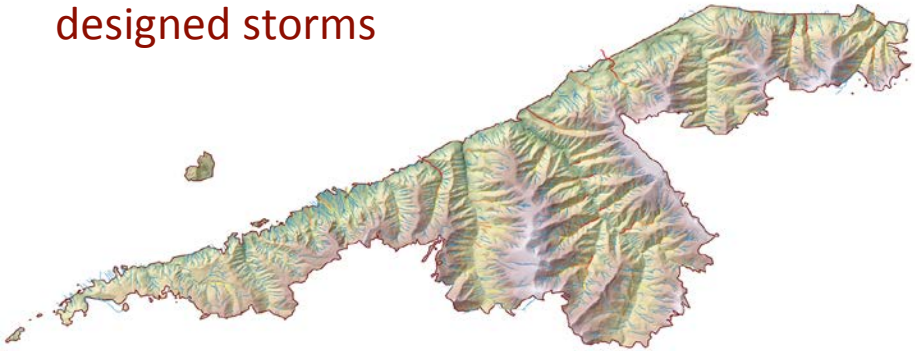


High Landslide
Susceptibility
(DOGAMI model)

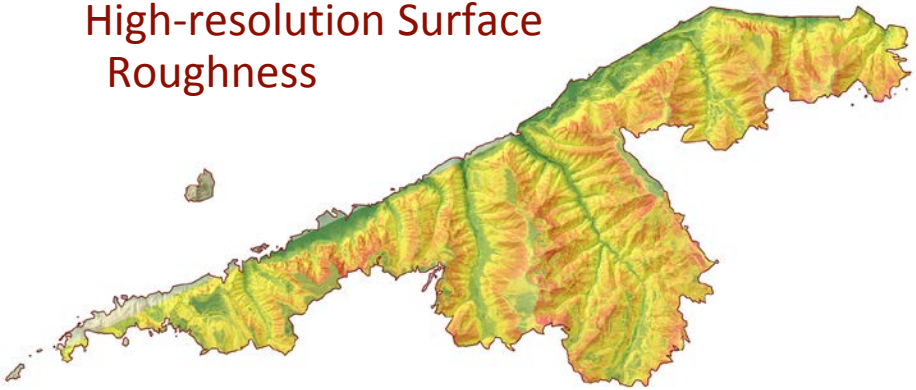


Future Analysis Goals:

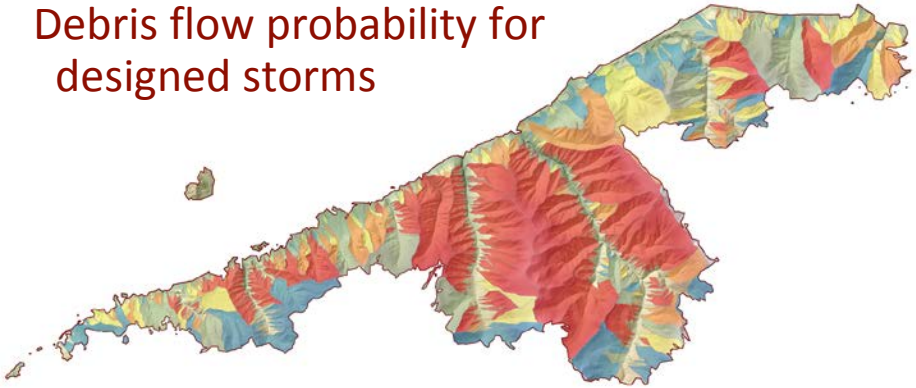
Debris flow volume for designed storms



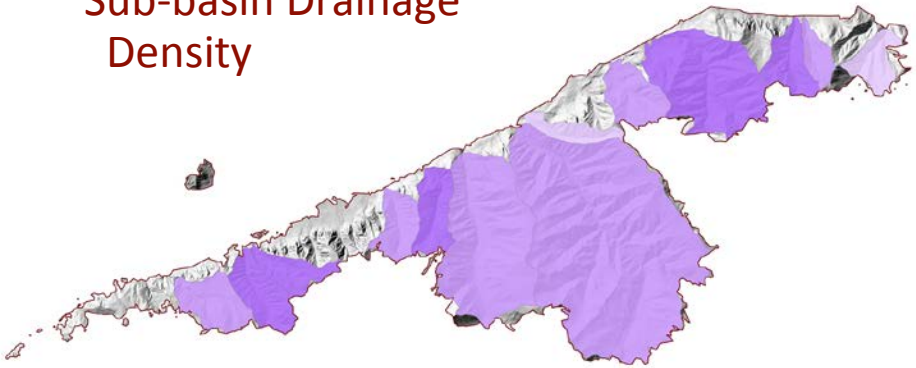
High-resolution Surface Roughness



Debris flow probability for designed storms



Sub-basin Drainage Density



Conclusions:

WEPP

- WEPP model is a somewhat easy to use tool for modeling erosion (fire based or otherwise).
- According to this model, Eagle Creek's post fire erosion will be significant. We will compare real world data with the outputs when it is available.

Trail/Stream Danger

- According to our model, certain trails have high risk of erosion. These include the Larch Mt. trail, Oneonta trail, and others.
- Overlaying the erosion model with DOGAMI's landslide model shows areas that could have especially high likelihood of landslides.

Continued Analysis:

- These models might be improved upon by including other inputs.
- The PSU and PCC GIS clubs are interested in studying the Eagle Creek Fire burn hazards, effects, and mitigations. If you are interested please contact us!

REFERENCES:

Burns, Scott. PhD in Geology, landslide expert. Portland State University. 2017.

Metro Pilot LiDAR Project. Portland, Oregon 2004. Bare Earth LiDAR DEM.

Mary Ellen Miller, Ph.D, Michigan Tech Research Institute. *Predicting post-fire hillslope erosion for the Eagle Creek fire, OR.* September, 29th, 2017.

Oregon Geospatial Data Library.

Oregon Department of Geology and Mineral Industries (DOGAMI), 2015.

Oregon Geologic Data Compilation, 2015.

Oregon SSURGO STATSGO Soils Compilation, 2016.

Pellicani et al, 2017. GIS-based predictive models for regional-scale landslide susceptibility assessment and risk mapping along road corridors.

Holtz, Andres. PhD in Geography, Fire ecology expert. Portland State University. 2017.

USGS, National Map 10 meter DEM.