Assignment 7 : Debris Prediction and Risk Assessment

According to introduction on the topic of hydrologic modeling and reference to the USGS report on sediment yields in California, Southern California was used as a model of wild land-urban interface and fire-flood sequence which often confronts with storms due to the fact that its location. Low-pressure systems during winter season can cause the storms which generate floods as well as debris flows along with floods. Wildfire and burning areas are factors which form destructive floods. Destructive floods have been recorded since 1800s. Other recognized storms caused widespread flooding were in 1934 to 2005. Debris flows were known which caused by burning since 1900s. Fire can lead debris flow by increasing heat in soil and may not limit infiltration of water into the soil. As same as increasing erosion by removing covering surfaces which protect soil from running off. Thus, this model tells the causes of storms, floods and debris flows which lead damages and injuries, also depict the risk and give predictions by applying statistical methods.

The study area, Browns Canyon in Oak Mountain, CA. was used in this assignment. It is a canyon which closes to urban. It has a stream order flows from the highest points to the lowest point. The necessary data for risk assessment and debris prediction are watershed which generated from DEM as well as individual average gradient within each watershed. First of all, DEM was used to create a slope surface and watershed by calculating the mean slope. The result would be a raster data which has individual gradient watershed within each pixels or watersheds. Next, select six watersheds in the sample area for collecting values and measurements. Import a stream layer, get rid of minor stream lines and clip it by using six watershed feature clips stream feature. Measure the length of each streams from the highest points to the lowest points within six watersheds, then find out a summary of each stream lengths and jot it down for the statistic calculation step. The next step is to determine the high and low elevation of each stream lengths using DEM feature and identify tool to sample the elevation values at each end of six streams. Lastly, put all measured values into Excel table and complete all values with a specify formula:

Assignment 7 : Debris Prediction and Risk Assessment

$$\log(V) = 2.2 + 0.7*\log(R) + 0.1*\sqrt{B} + 0.3*LE + 0.5*\log(A) + 0.02*S - 2.1*RR + 0.52*0.5$$

Where:

V is the volume of sediment yield (cubic meters)

R is the peak 1-hour rainfall (mm)

B is the area of watershed burned by most recent fire (square kilometers)

LE is the lingering effect (λ=0.5)

A is the watershed area (square kilometers)

S is the average watershed gradient (%)

RR is the relief ratio (m/m)

The result of this formula can be changed by adjusting an adjustable values such as amount of rainfall and percentage of burning.

Assignment 7 : Debris prediction and Risk assessment

Initial Values							
Watershed ID	**Watershed (sq.m.)**	**Watershed (sq.km.)**	**Rainfall (mm.)**	**Burn (%)**	**Area Burned**	**Most Recent Fire (yrs.)**	**Lingering Effect**
310	843,108.10	0.84	**25.4**	**0.45**	0.38	**6**	0.05
314	764,316.53	0.76	**25.4**	**0.45**	0.34	**6**	0.05
334	258,402.72	0.26	**25.4**	**0.45**	0.12	**6**	0.05
335	641,822.14	0.64	**25.4**	**0.45**	0.29	**6**	0.05
353	362,591.32	0.36	**25.4**	**0.45**	0.16	**6**	0.05
358	1,296,046.40	1.30	**25.4**	**0.45**	0.58	**6**	**0.05**

Stream Length (m.)	**Max Elv.**	**Min Elv.**	**Elv. Change (m.)**	**Relief Ratio**	**Basin Gradient**	**Log Volume**	**Debris predicted (cu.m.)**
2,408.00	783.76	424.85	358.91	0.15	17.83	3.39	2,462.93
1,246.25	481.45	409.06	72.39	0.06	15.18	3.51	3,200.53
1,185.15	494.62	392.09	102.53	0.09	16.94	3.22	1,662.24
2,019.92	585.61	392.01	193.60	0.10	17.02	3.42	2,629.62
1,320.36	439.95	369.64	70.31	0.05	17.15	3.37	2,369.17
2,513.91	585.73	396.56	189.17	0.08	19.16	4.61	5,165.08

*Red = Adjustable Value

Assignment 7 : Debris prediction and Risk assessment

Adjusted Values							
Watershed ID	**Watershed (sq.m.)**	**Watershed (sq.km.)**	**Rainfall (mm.)**	**Burn (%)**	**Area Burned**	**Most Recent Fire (yrs.)**	**Lingering Effect**
310	843,108.10	0.84	**40**	**0.75**	0.63	**2**	0.37
314	764,316.53	0.76	**40**	**0.75**	0.57	**2**	0.37
334	258,402.72	0.26	**40**	**0.75**	0.19	**2**	0.37
335	641,822.14	0.64	**40**	**0.75**	0.48	**2**	0.37
353	362,591.32	0.36	**40**	**0.75**	0.27	**2**	0.37
358	1,296,046.40	1.30	**40**	**0.75**	0.97	**2**	0.37

Stream Length (m.)	**Max Elv.**	**Min Elv.**	**Elv. Change (m.)**	**Relief Ratio**	**Basin Gradient**	**Log Volumn**	**Debris predicted (cu.m.)**
2,408.00	783.76	424.85	358.91	0.15	17.83	3.64	4,394.03
1,246.25	481.45	409.06	72.39	0.06	15.18	3.76	5,698.67
1,185.15	494.62	392.09	102.53	0.09	16.94	3.46	2,911.40
2,019.92	585.61	392.01	193.60	0.10	17.02	3.67	4,666.79
1,320.36	439.95	369.64	70.31	0.05	17.15	3.62	4,167.12
2,513.91	520.36	369.38	150.98	0.06	19.16	3.97	9,306.50

*Red = Adjustable Values

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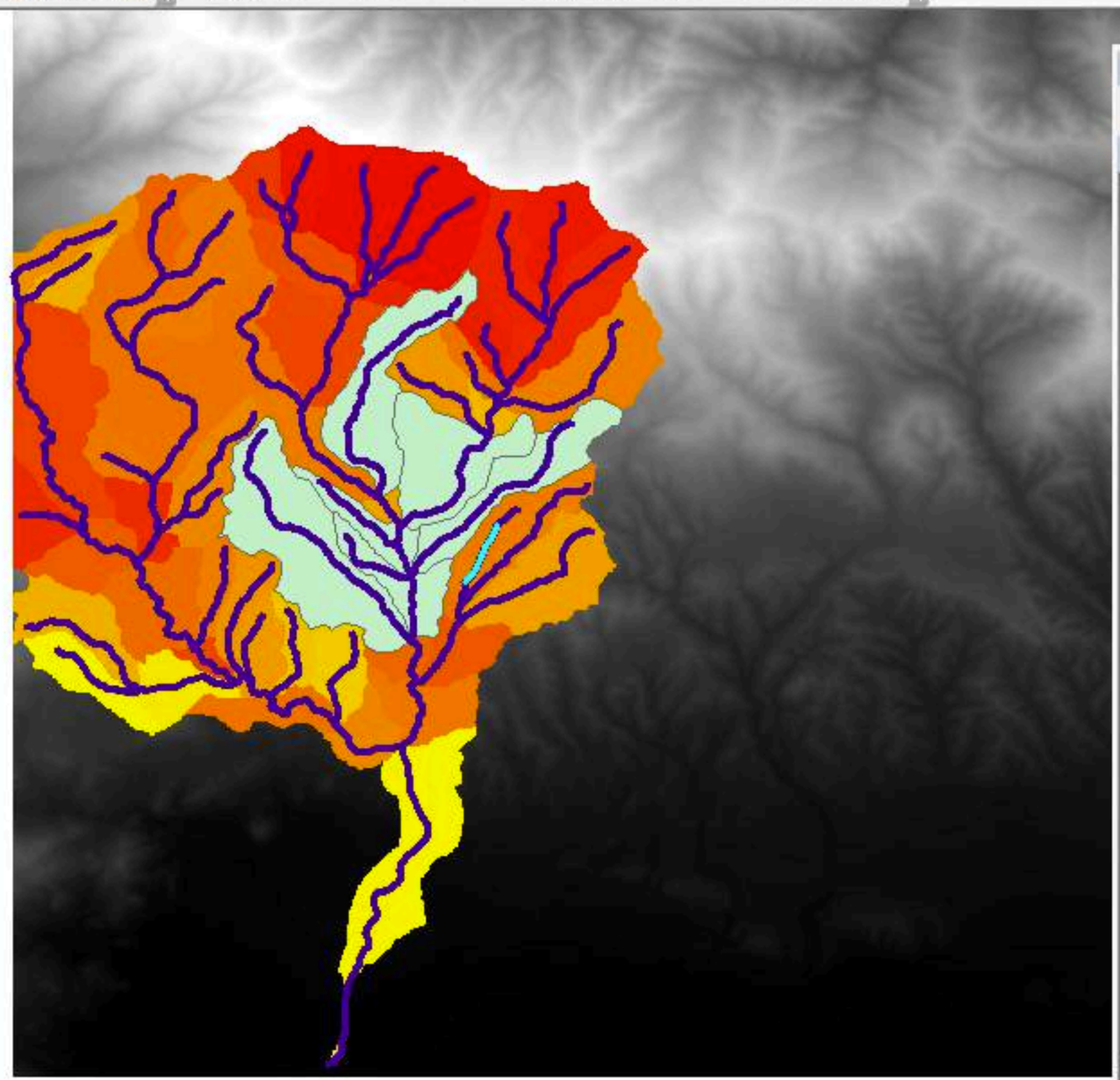
1:63,360

Editor

Table Of Contents

Layers

- streams_to_measure_utm
- watersheds_to_calculate_utm
- selected_watersheds_utm
- zonal_selected_watershed_2
  - Value
  - High : 29.6645
  - Low : 6.02883
- zonal_selected_watershed
- slope_dem
- oat_mtn_10m_dem
  - Value
  - High : 1141.39
  - Low : 272.42



Table

watersheds_to_calculate_utm

OBJECTID *	Shape *	Id	grid
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3	Polygon	334	
4	Polygon	335	
5	Polygon	353	
6	Polygon	358	

0 (0

watersheds_to_calculate_utm

-118.616 34.299 Decimal Degrees

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Debris Prediction and Risk Assessment
Oak Mountain, CA

Debris Prediction

Watershed	Debris(m^3)
310	2,462.93
314	3,200.53
334	1,662.24
335	2,629.62
353	2,369.17
358	5,165.08

When :
Rainfall (mm) = 25.4
Burned Area (%) = 0.45
Recent Fire (yrs.) = 2

Highest Risk

Watershed	V(m^3)
358	4.61
314	3.51
335	3.42
310	3.39
353	3.37
334	3.22

Lowest Risk

Formula :

$$\log(V) = 2.2 + 0.7*\log(R) + 0.1*\sqrt{B} + 0.3*LE + 0.5*\log(A) + 0.02*S - 2.1*RR + 0.52*0.5$$

Where :

V = The volume of sediment yield (cubic meter)
R = The peak 1-hour rainfall (millimeter)
B = The area of watershed burned by most recent fire (square kilometer)
LE = The lingering effect (λ=0.5)
A = The watershed area (square kilometer)
S = The average watershed gradient (%)
RR = The relief ratio (m/m)