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Master of Earth Science: A Culminating Portfolio

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Abstract

To satisfy my culminating master's degree requirement, I constructed a portfolio that focused on the relationship between content, tools, and analysis in my graduate work. Content is derived from scientific reading and coursework. Tools are programs or methods used to perform a specific function, for example Python or ArcGIS . Analysis is the result of using content and tools to draw conclusions. Much of my work focused on evaluating the accuracy of post-fire debris flow models in the Pioneer burn area. I drew upon content-based scientific reading and used ArcMap to perform an analysis and test my hypothesis.

MASTER OF EARTH SCIENCE: A CULMINATING PORTFOLIO

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Overview

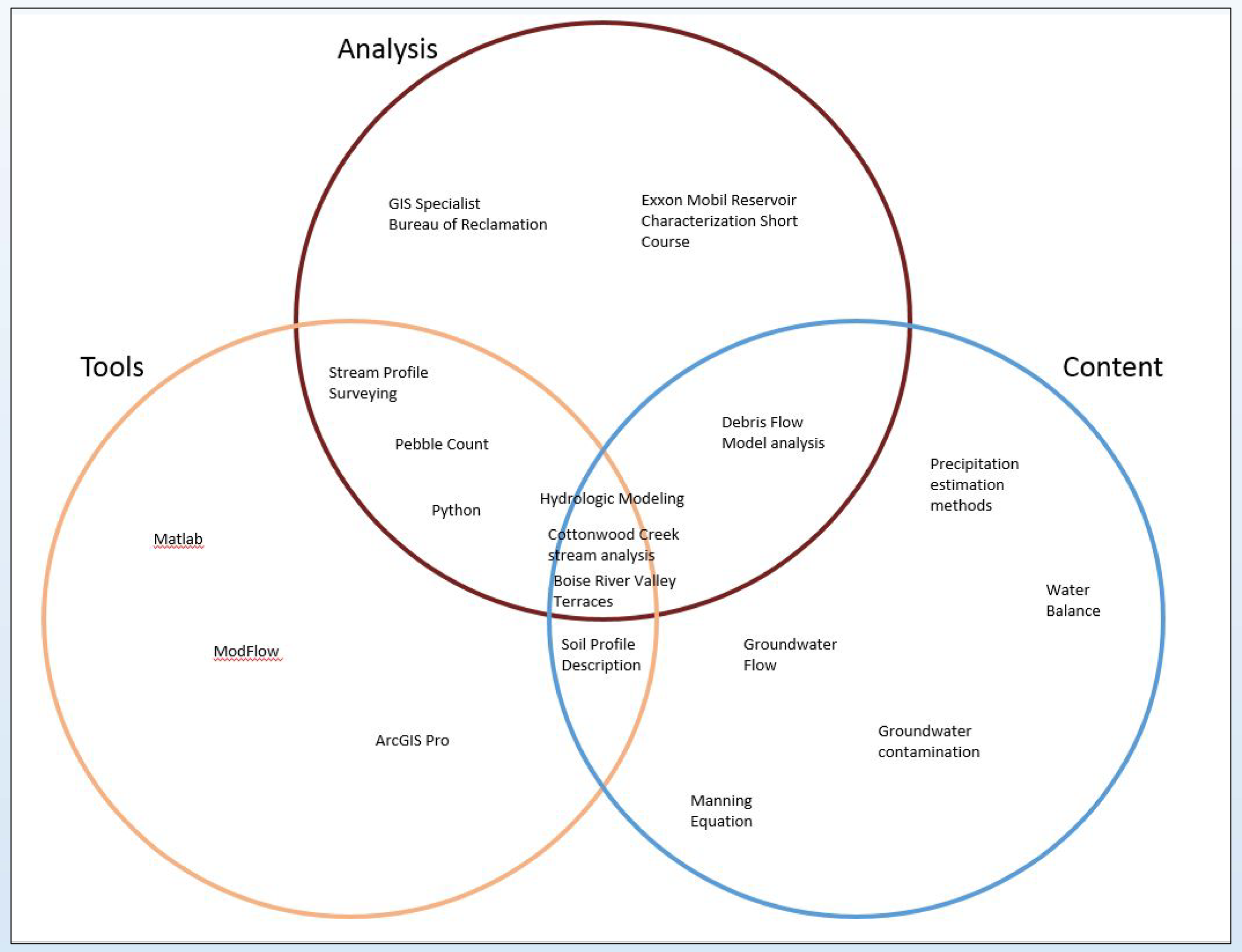

Figure 1. Venn Diagram showing examples of content, tools, and analysis in my graduate work

- For this culminating report, I examined the interplay of background content formed through course instruction and scientific reading and tools like ArcGIS and field methods that are used to perform scientific analysis.

Boise River Valley Terrace Study

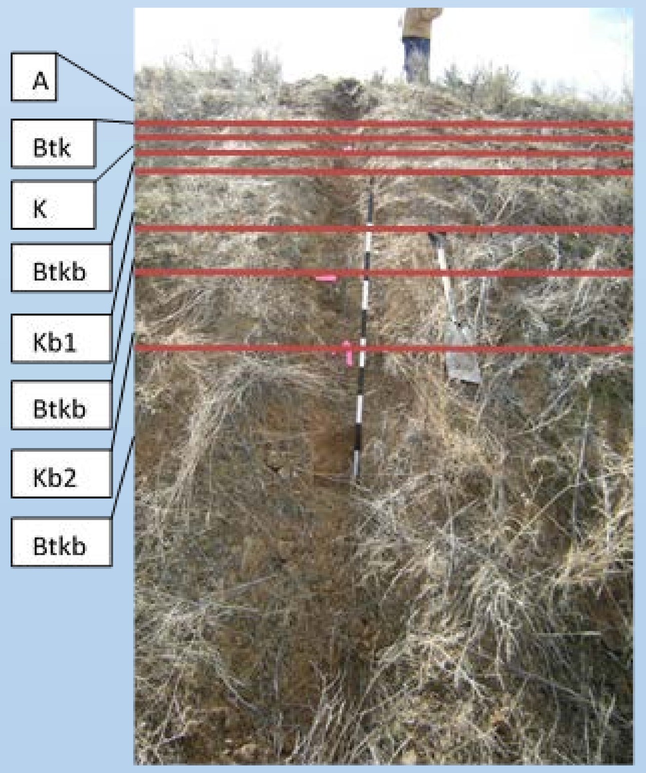

Figure 2: A picture of our soil profile and labeled horizons on the Gowen Terrace. The picture was taken at an angle and is not to scale. Photo courtesy of Vaughn Kimball.

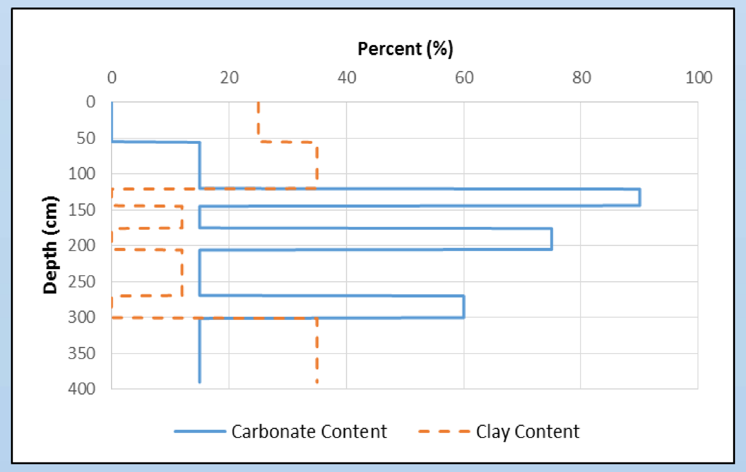

Figure 3. Figure showing estimated clay and carbonate content plotted with depth.

- Clay and carbonate content help identify the presence of buried soils and give clues to the age of the soil.

- In this study, I used scientific reading, course content, and field methods to make inferences about past environments and the relative age of a soil profile on the Gowen Terrace, near Lucky Peak Reservoir.

Debris Flow Modeling in the Pioneer Fire burn area

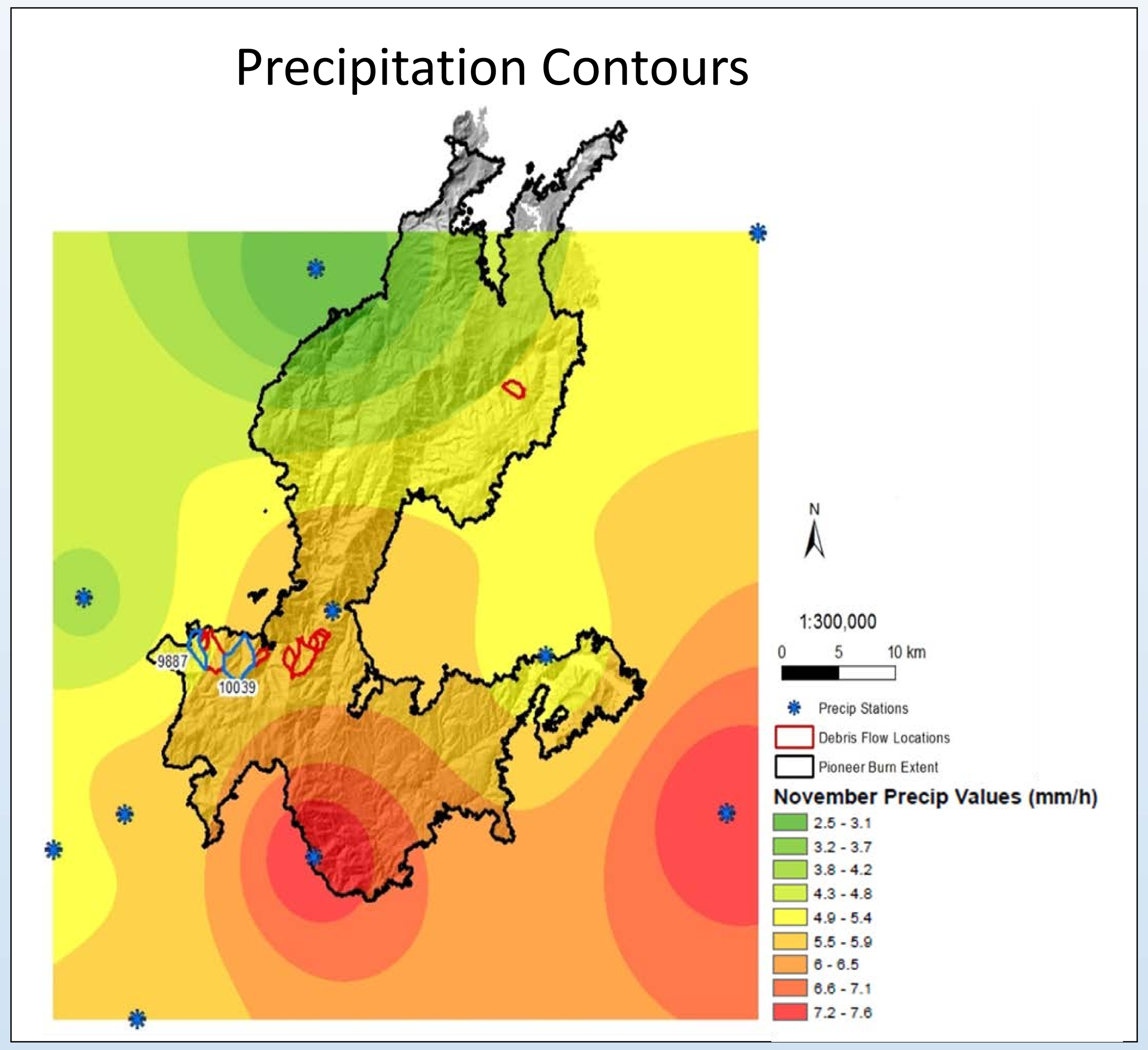

Figure 4. Figure showing maximum precipitation values and debris flow producing basins. Basins highlighted in blue show a greater than 20% probability of failure according to Model C

- I investigated the accuracy of debris flow models used by the USGS in the Pioneer Fire (Staley et al. 2016).
- Debris flow models are used to predict the probability and volume of a debris flow under specific precipitation conditions.

Debris Flow Models Fail to Predict Debris Flows

	Current Model (2016)	2010 Models		
Basin ID	Calculated Probability	Model A Probability (%)	Model B Probability (%)	Model C Probability (%)
4655	6.000	0.003	0.090	0.160
9887	5.700	15.650	0.004	29.710
9893	4.300	0.002	0.010	0.420
9947	6.500	0.001	0.020	0.180
9959	6.000	0.004	0.020	0.420
10001	6.500	0.003	0.015	0.430
10039	6.000	0.001	0.020	0.190
10048	6.900	12.260	0.006	23.600
10054	4.100	0.001	0.007	0.410
10064	6.300	0.004	0.016	0.420
10268	6.700	0.005	0.020	0.420
10304	6.900	0.002	0.010	0.400
10331	5.100	0.001	0.030	0.200

Figure 5. Calculated debris flow probabilities using current model in green and old models in purple, blue, and orange. (Staley et al. 2016, Cannon et al. 2010)

- Both current and old debris flow models failed to predict that a debris flow occurred.
- I used ArcGIS to calculate the variables (burn severity, slope, aspect) used in the new model and clay content, liquid limit, and organic matter used in the old models.

Fluvial Analysis of Cottonwood Creek

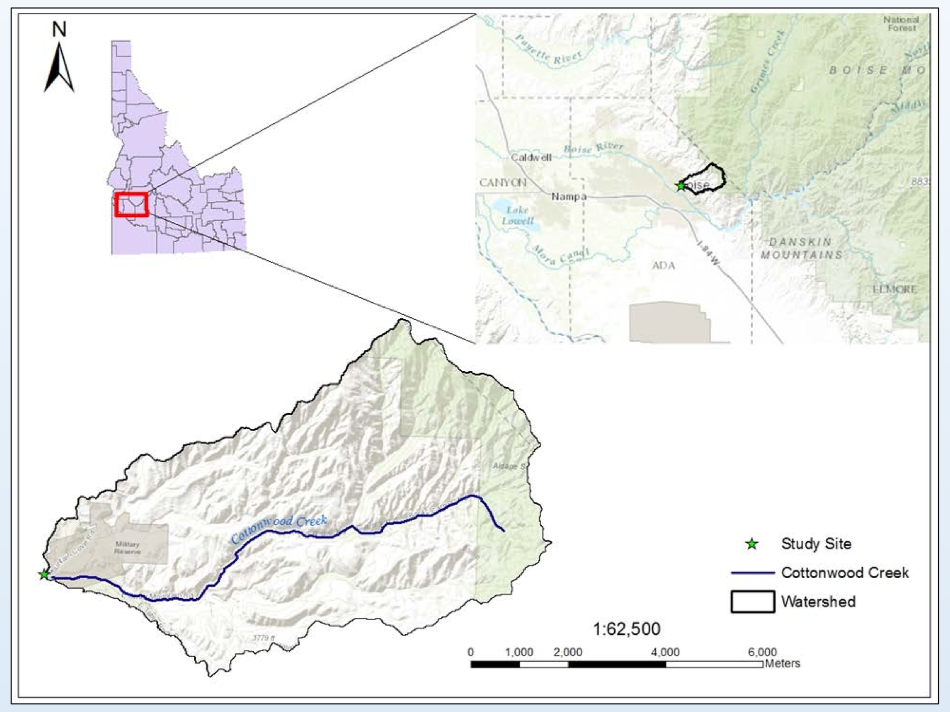

Figure 6. Cottonwood Creek study area, show in relation to Boise (inset right) and the state of Idaho.

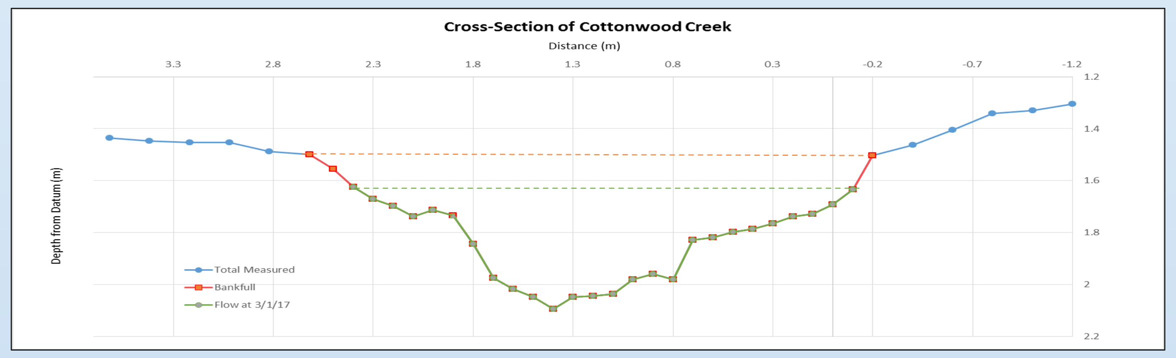

Figure 7. Cross Section of Cottonwood Creek reach.

Table 1. Comparison of laboratory and field measurements.

Description	Variable	Value	Units	Notes:
Date of direct Q measurement (March 14 or 21)	--		--	
Cross-sectional area (March 14 or 21 flows)	A	0.58	m^2	*from spreadsheet*
Cross-sectional area (bankfull)	A	0.91	m^2	*from spreadsheet*
Wetted perimeter (March 14 or 21 flows)	WP	2.7	m	*from spreadsheet*
Wetted perimeter (bankfull)	WP	3.09	m	*from spreadsheet*
Hydraulic radius (March 14 or 21)	R	0.214814815	m	*use formula*
Hydraulic radius (bankfull)	R	0.294498382	m	*use formula*
Slope	S	0.0076	--	*from spreadsheet*
Roughness	n	0.045	--	*from photographs and website*
Manning velocity (March 14 or 21)	V	0.70203162	m/s	*use formula*
Manning velocity (bankfull)	V	0.86454779	m/s	*use formula*
Discharge (Manning method) on March 14 or 21	Q	0.40717834	m^3/s	*use formula*
Discharge (Manning method) at bankfull	Q	0.786738489	m^3/s	*use formula*
Discharge (Direct Measurement) on March 14 or 21	Q	0.21	m^3/s	*use formula*
Median grain size	D50	0.035	m	*from spreadsheet*
Bed shear stress (March 14 or 21)	tb	15.99940741	N/m^2	*use formula*
Bed shear stress (bankfull)	tb	21.93423948	N/m^2	*use formula*
Shields critical shear stress	tc	24.696	N/m^2	*use formula*
Mean grain size (5 largest)	Dmax	102.2	mm	*from spreadsheet*
Critical velocity needed to transport D max	Vc	1.713464422	m/s	*use formula*
Assumptions:				
Density of water	ρw	1000	kg/m^3	
Density of sediment	ρs	2600	kg/m^3	
Acceleration due to gravity	g	9.8	m/s^2	

- This study compared Cottonwood field measurements to laboratory calculations.
- Combination of content, laboratory and field techniques, and analysis.

References

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