That's a Relief: Assessing Landform Clarity and Aesthetic Preference in Terrain Maps

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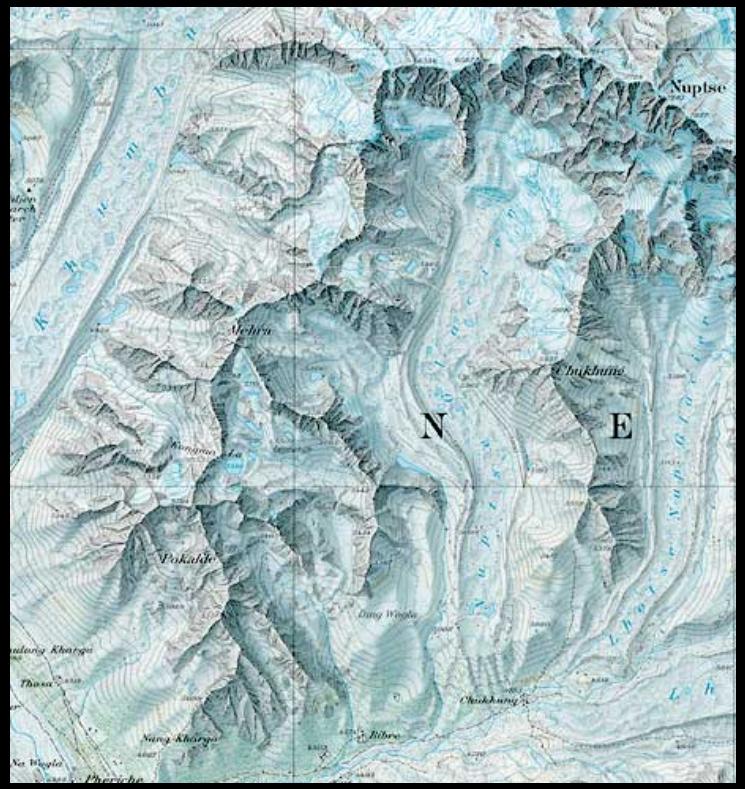
SATURDAY 10TH, 2021
AAG 2021

Introduction:

Maps can be more than just tools for navigation, for when you are lost, but works of art worth getting lost in reading.

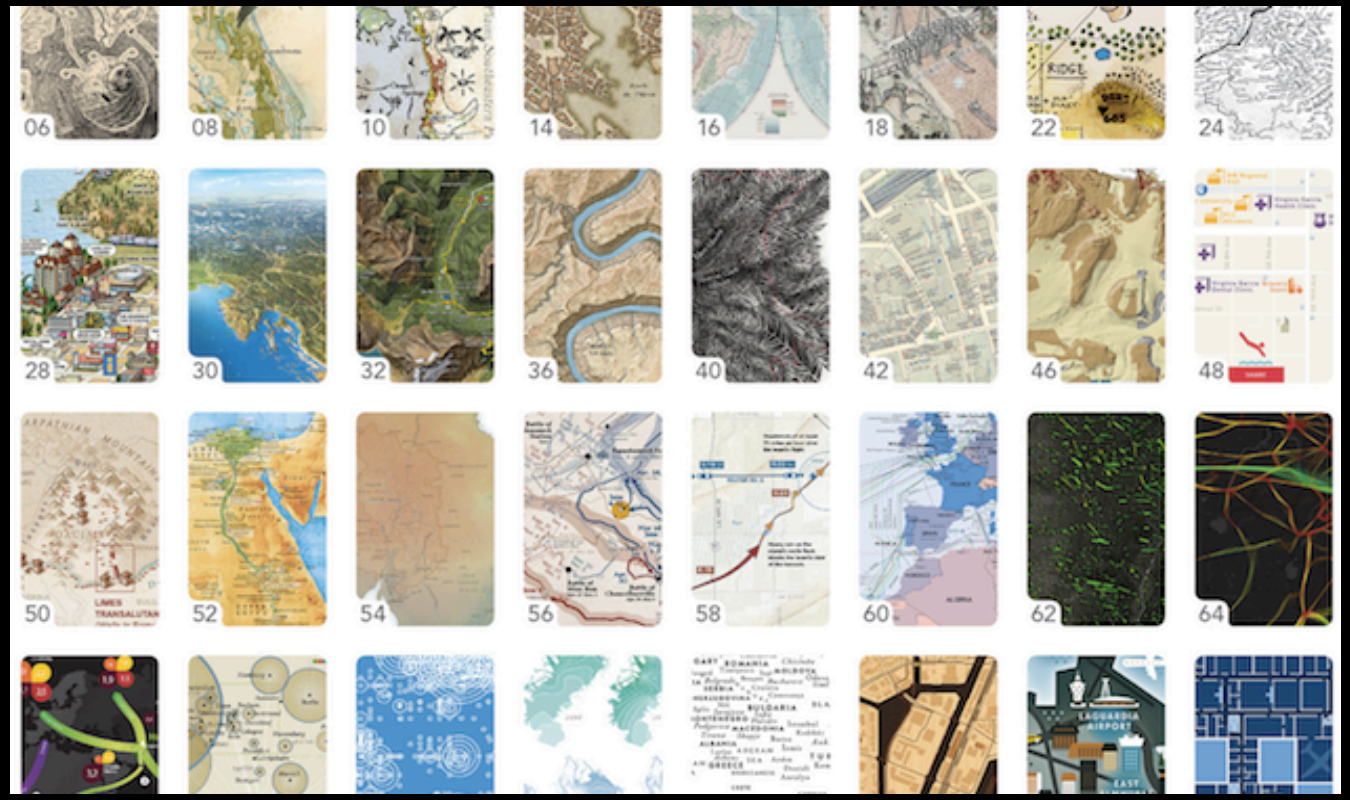
Introduction:



"Mount Everest" (section) © National Geographic Society, original scale 1:50,000 (size 60 x 93 cm), 1988.

"Physical Map of North America, Tom Patterson, (size *45.5 x 47" in.)*, 2021.

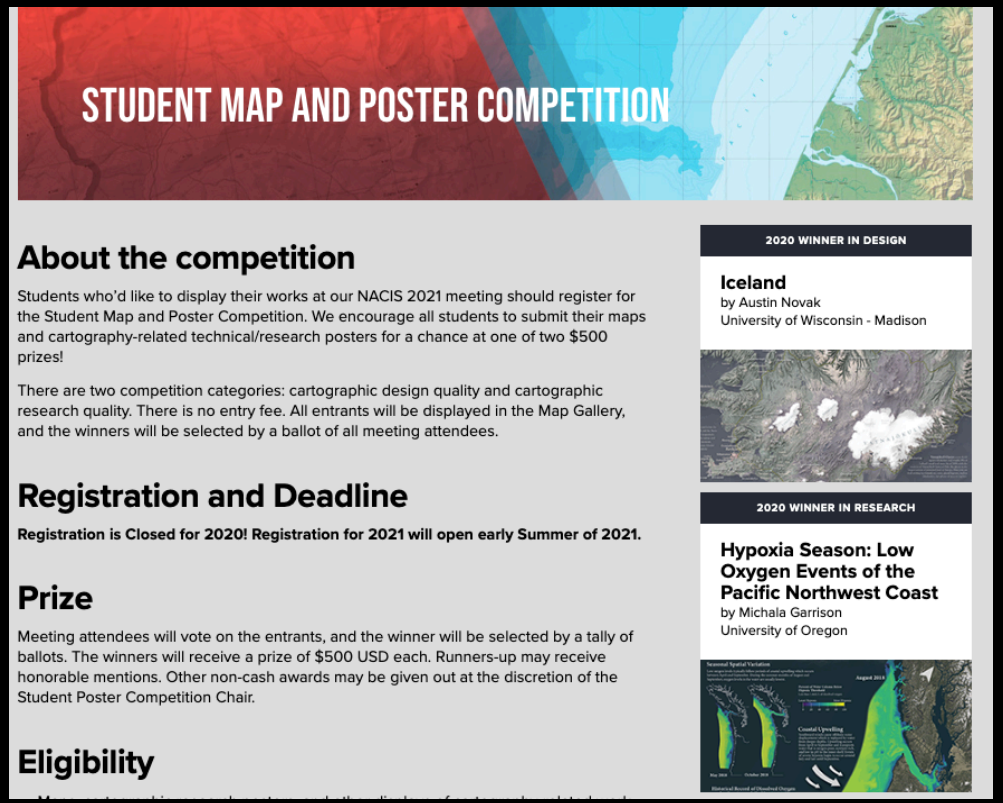
Content Analysis: Atlas of Design Vol 4 and 5

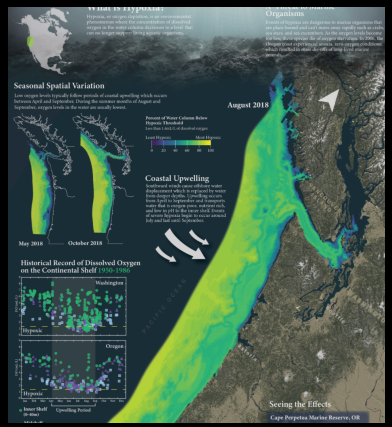


63 Maps in Total

https://atlasofdesign.org/

Content Analysis: NACIS Student Award Winning Maps





17 Maps in Total

https://nacis.org/awards/student-map-and-poster-competition/

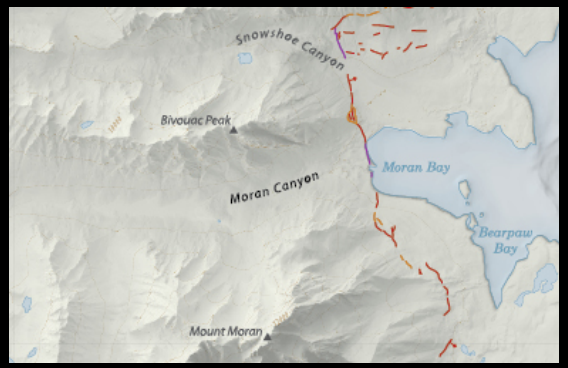
Content Analysis:

	# of Maps	Terrain Representation
NACIS	17	12 (70%)
Atlas of Design	63	34 (54%)
Total	80	46 (58%)

Content Analysis: Shaded Relief

Analytical Shaded Relief

Blender

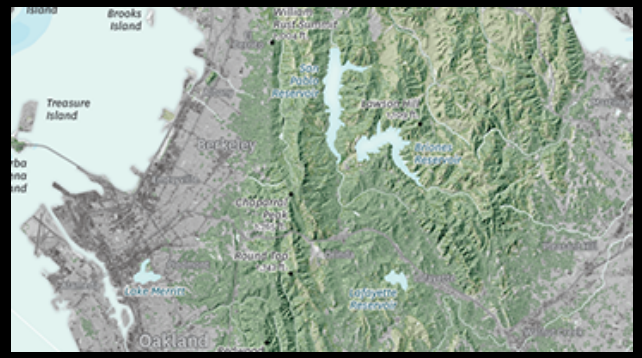


Manual

Content Analysis: Thematic Terrain Elements

Hypsometric Tinting

Landcover



Orthographic Imagery

Research Objective

RQ1: How do **manual** and **analytical** shaded relief techniques influence landform clarity in terrain maps that incorporate hypsometric tinting, landcover, and orthoimagery?

RQ2: How do **manual** and **analytical** shaded relief techniques influence aesthetic preference in terrain maps that incorporate hypsometric tinting, landcover, and orthoimagery?

Methodology

The research questions are answered through a two-part user study experiment.

RQ1 will be examined during part one of the experiment, where participants will rank the clarity of three landforms as they appear across nine permiatations of same location.

RQ2 will be investigated during the second part of the user study, where participants will be asked to rate each terrain map permutation based on two aesthetic qualities: beauty and realism.

Stimuli Design

Crater Lake, OR, USA

"Crater Lake inspires awe" – NPS Website

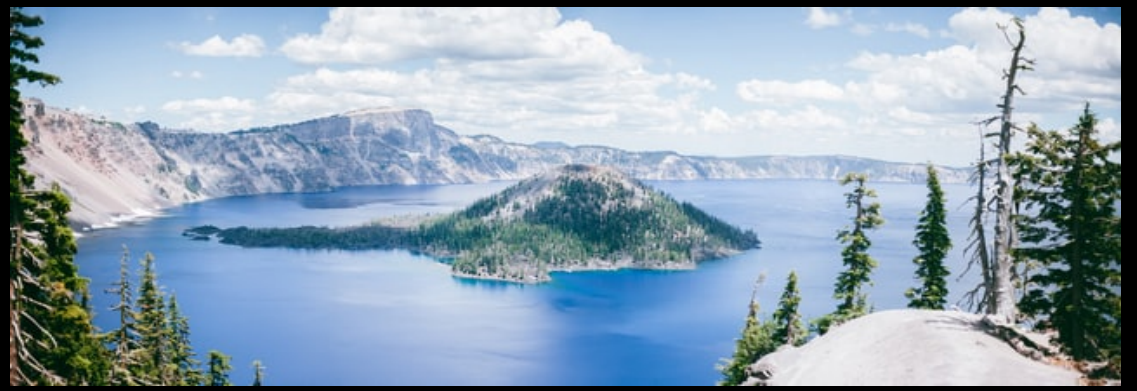
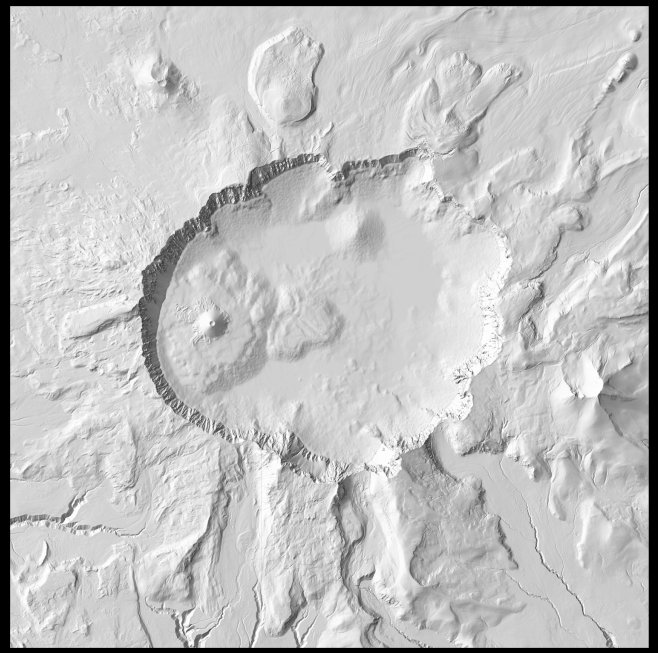


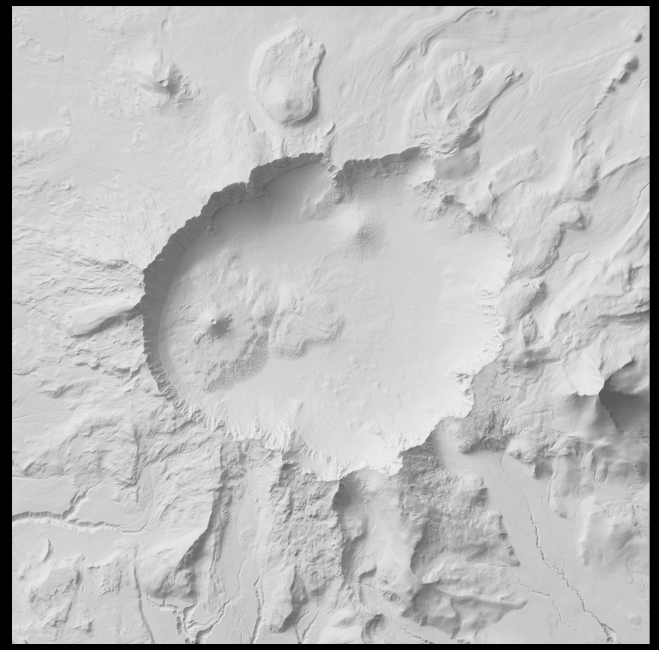
Photo by James Fitzgerald on Unsplash, shaded relief by Bill von Allmen on shadedreliefarchive.com

Shaded Relief

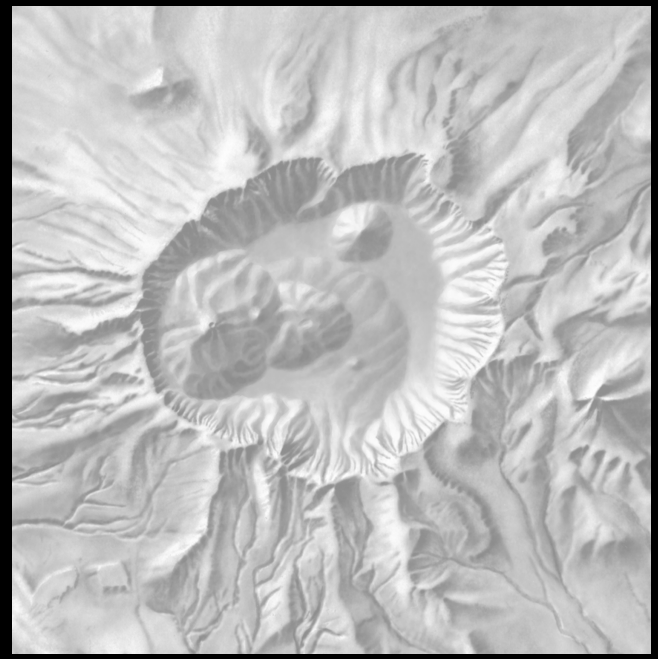
Multidirectional



Blender

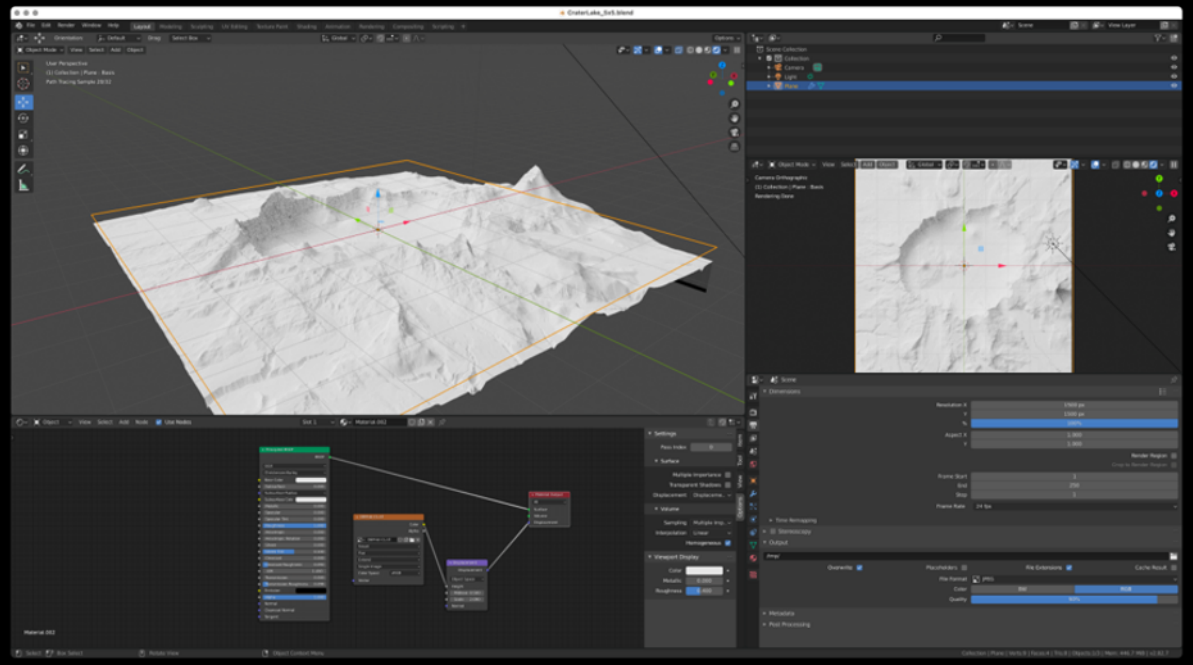


Manual

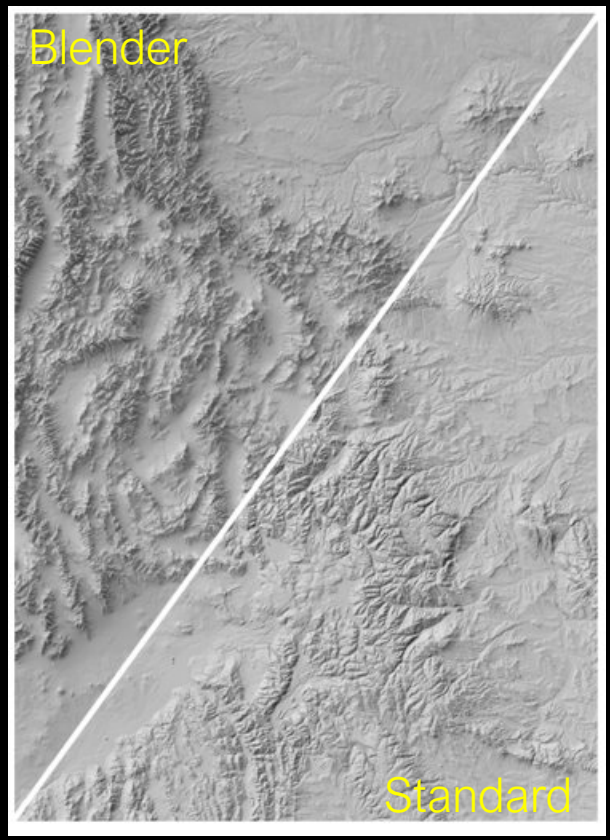


DEM courtesy of http://shadedrelief.com/SampleElevationModels/ , Bathymetry generated from USGS

Blender



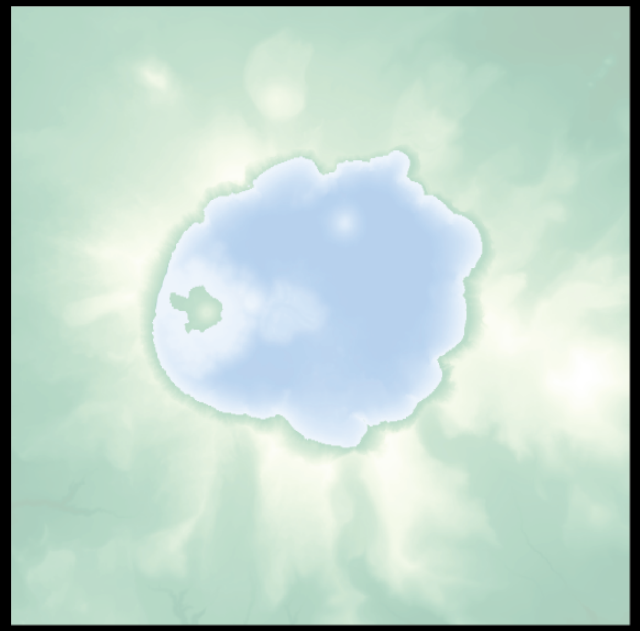
User interface of Blender



Blender vs. Standard Relief

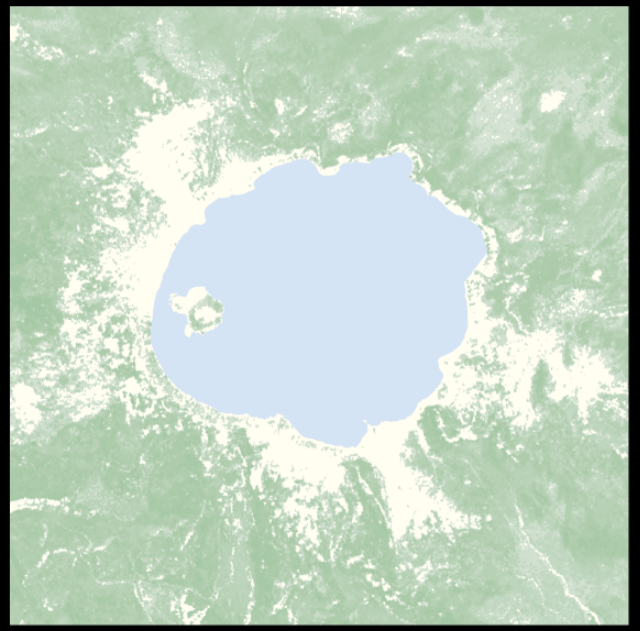
Thematic Terrain Elements

Hypsometric Tinting



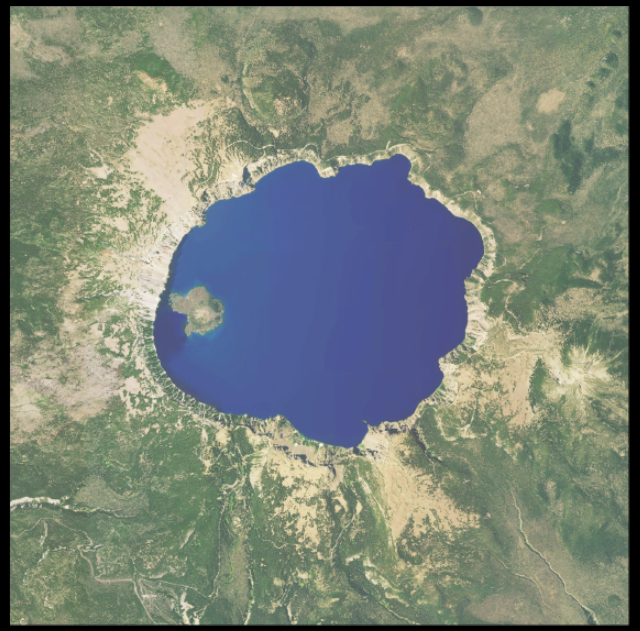
Hypsometric Tint

Thematic Landcover



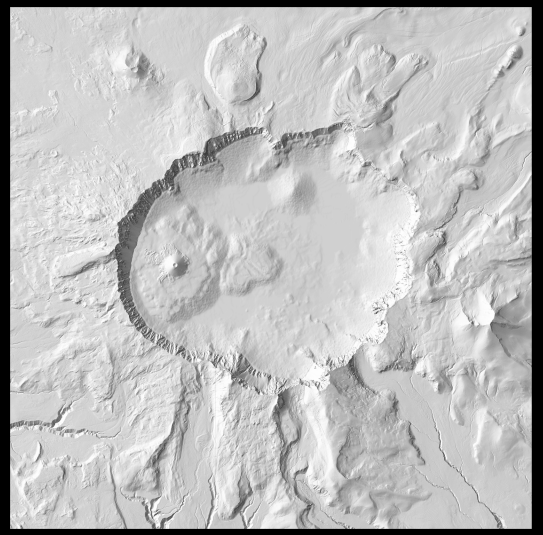
Land Cover

Orthoimagery



Orthographic Imagery

Terrain Maps



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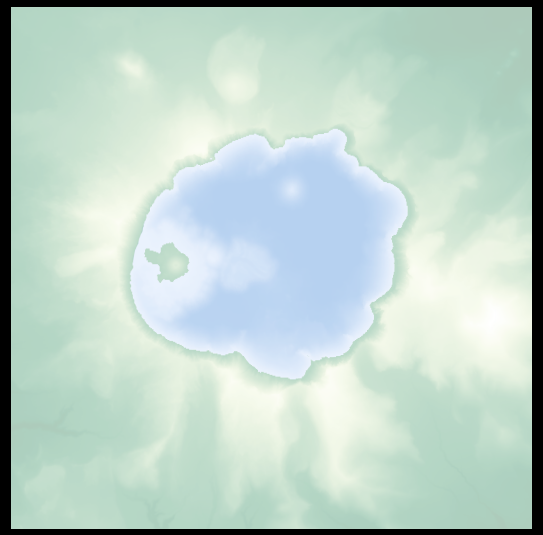

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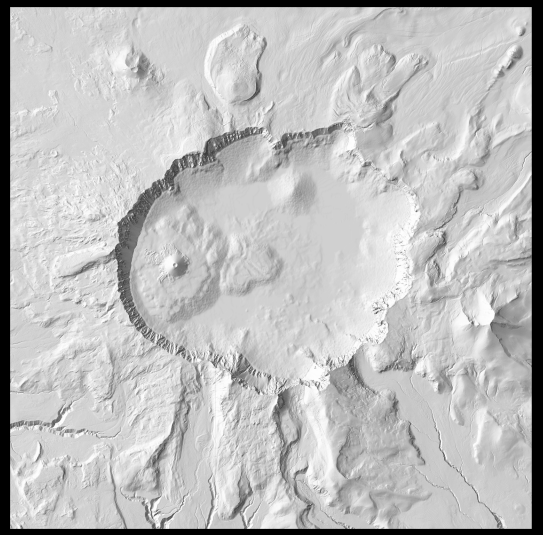
Terrain Maps



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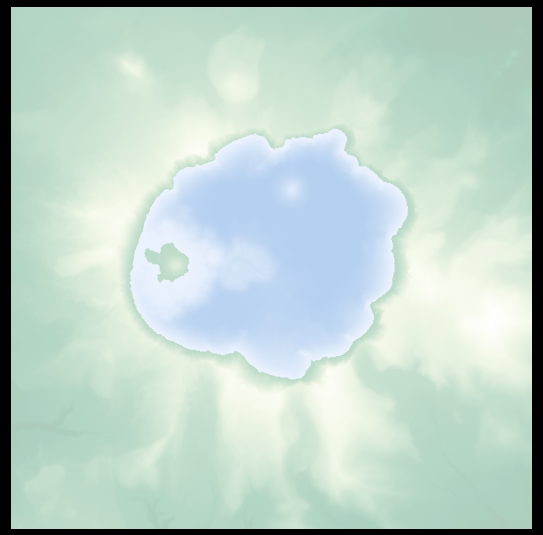

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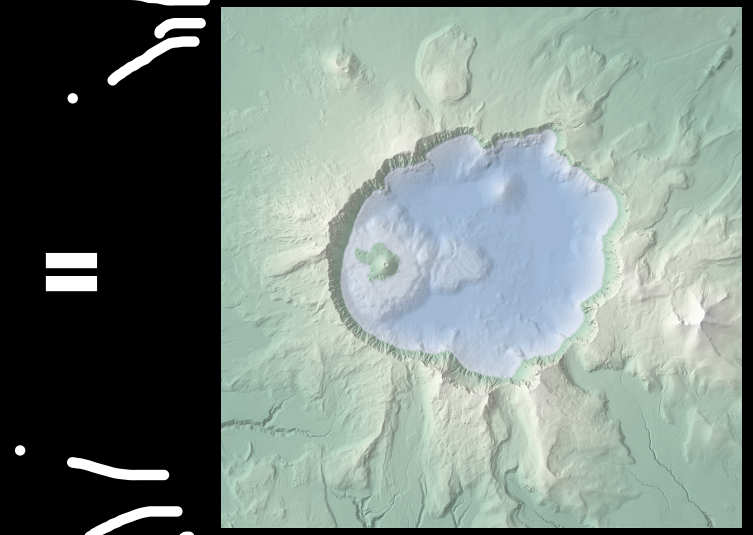
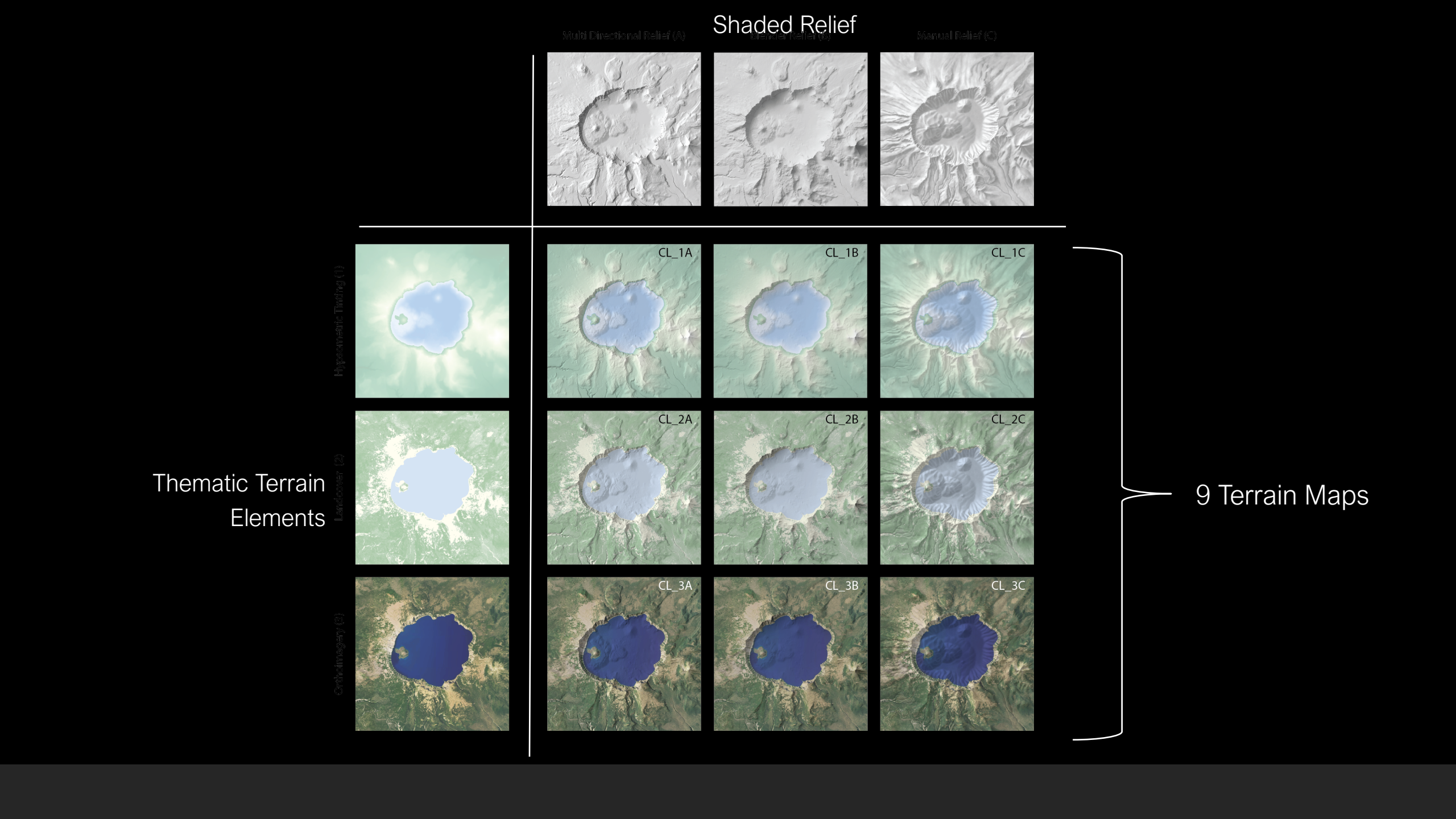
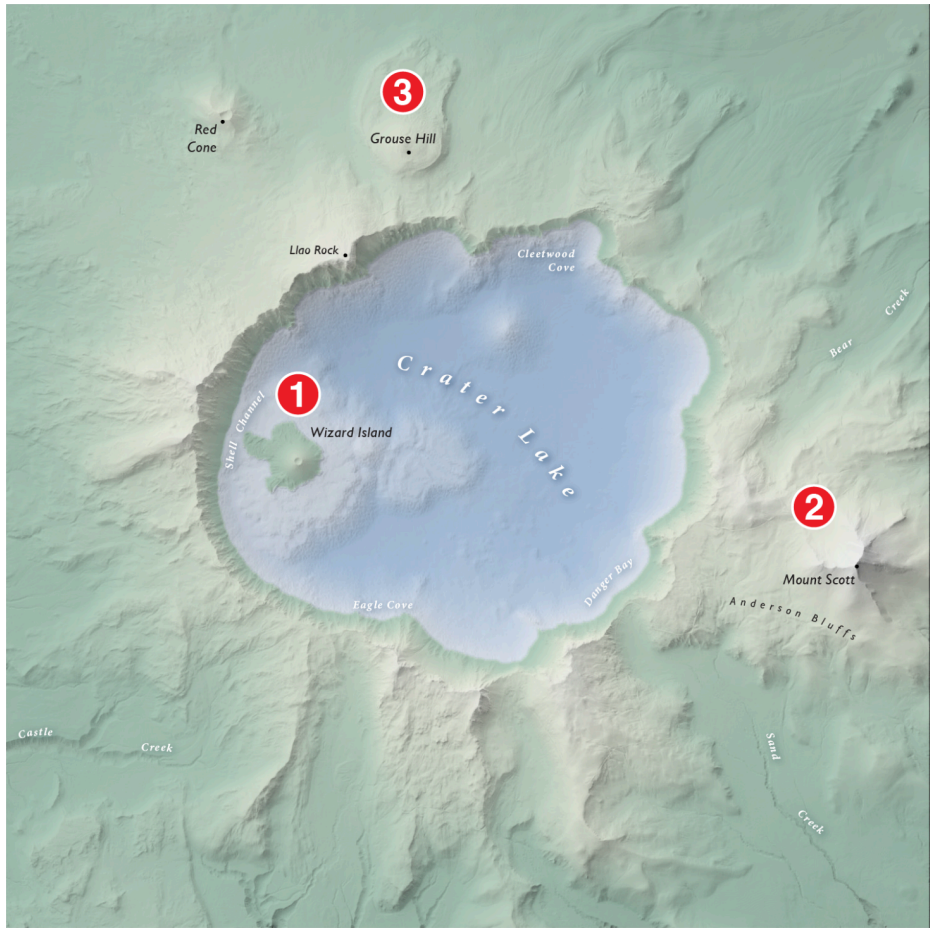



Shaded Relief
Multi Directional Relief (A)
Blended Relief (B)
Manual Relief (C)
Hypsometric Tinting (1)
Landcover (2)
Orthoimagery (3)
CL_1A
CL_1B
CL_1C
CL_2A
CL_2B
CL_2C
CL_3A
CL_3B
CL_3C
Thematic Terrain Elements
9 Terrain Maps

Part 1: Landform Rating Task

RQ1 - How do manual and analytical shaded relief techniques influence landform clarity in terrain maps that incorporate hypsometric tinting, landcover, and orthoimagery?

Participants will be asked to rank how clearly the three chosen landforms are represents.



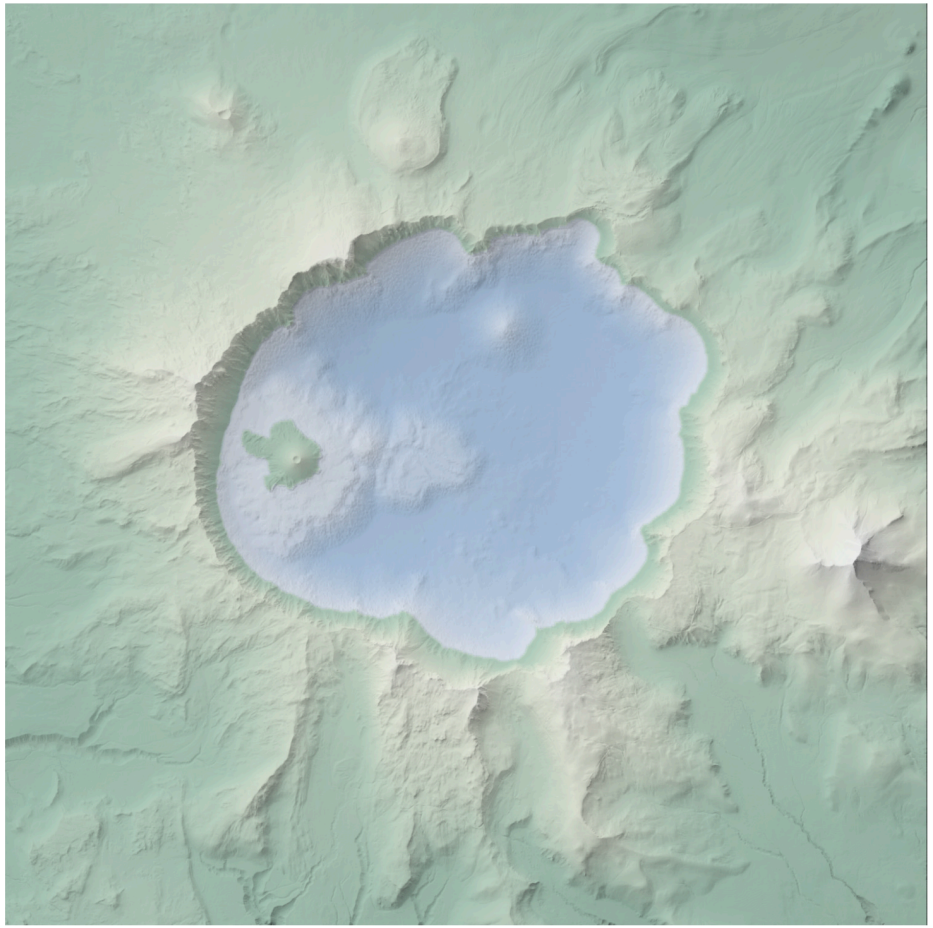
Rate the **clarity** of each landform in this map.

	Extremely unclear	Unclear	Neither clear nor unclear	Clear	Extremely clear
1.) Wizard Island	○	○	○	○	○
2.) Mount Scott	○	○	○	○	○
3.) Grouse Hill	○	○	○	○	○

Part 2: Aesthetic Rating Task

RQ2 - How do manual and analytical shaded relief techniques influence reader aesthetic preference in terrain maps that incorporate hypsometric tinting, landcover, and orthoimagery?

Participants will be asked to rate the overall beauty and realism of each map



Rate the map based on its overall **beauty**.

Not at all beautiful	Not so beautiful	Somewhat beautiful	Very beautiful	Extremely beautiful
○	○	○	○	○

Rate the map based on its overall **realism**.

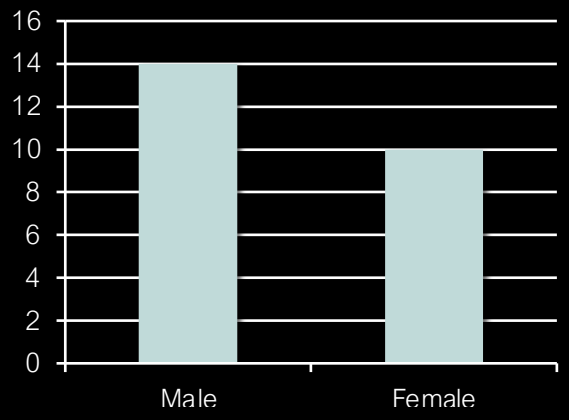
Not at all realistic	Not so realistic	Somewhat realistic	Very realistic	Extremely realistic
○	○	○	○	○

Results: Pilot Study

-24 University students

-Provided feedback on usability

-Promising initial results



Rated highest in beauty

Hypsometric tint + Multidirectional Relief

Rated highest in realism

Orthoimagery + Blender Relief

Results: Pilot Study

Great survey. sometimes I wished I could compare the maps to each other in order to make sure the hierarchy from my answers was even more consistent to my feelings, but I believe I still answered accurately.
It may be beneficial to have maps next to each other or ability to toggle back to previous maps, I found myself liking one map a lot then realized I found the next map more appealing. Having the ability to rank them next to each other by clarity, realism and beauty may add an additional layer of understanding. Best of luck!
Now I want to go to Crater lake!
Very cool! a couple of typos in the survey
Some of the early questions didn't have main bodies of text, so it defaulted to something like Put your text here.
Goog job, Nate! I think the red labels can be a bit distracting. Also, I think it's impossible not to compare images, so the answers of one map are influenced by the previous image in the survey. Just something to consider. Good luck in your presentation!
Wow, those are some brilliant maps that adapt to Crater Lake's landscape perfectly!

Enjoyed the maps, really liked how crater lake looked on some of the more realistic ones.

I interpreted realistic to be closer to photorealism rather than pure visual detail of relief.

Methodology: Participants and Collection

- Initial distribution: 100 participants
- User study hosted on Qualtrics
- Recruitment through Prolific
- Participants will be compensated $5 for 15 minutes of their time

Limitations and Future Research

Limitation: Qualitative user study

Future research: Test physiological and motor responses

Limitation: Conducted on novices

Future research: Comparing novice and experts in cartography

Conclusion

The results of this research ultimately aim to broadcast the use of user study-based experiments to assess the aesthetic and perceptual responses regarding terrain map design choices and landform clarity.

Thank you!

Any feedback is greatly appreciated!

Project funded by Dr. Carolyn Fish

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Photo by James Fitzgerald on Unsplash

Methodology: Procedure

Section 1: Informed Consent

Section 2: Pre-test questionnaire

Section 3: Tutorial

Section 4: User Study

- Shown each of the nine maps in a random order. A total of eighty-one different sequences of the nine maps.
- For each map participants will complete two rating tasks

Section 5: Post-test questionnaire