

Visualizing Glacial Retreat in Maps: An Empirical Evaluation Study

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Abstract:

Climate change is one of the most urgent global challenges, necessitating effective communication strategies to convey its complex dynamics to the public. Geovisualization, particularly through 2D planimetric maps, plays a crucial role in making climate data more accessible and comprehensible, especially for climate impacts that are not always visible to the majority of the world's citizens. Glacial retreat, in that way, has recently been highlighted as an environmental impact that is clearly linked through attribution science to global climatic change, even while large portions of humans are not able to see these changes. Maps of glacial retreat, however, have limitations, yet are some of the more common representations of this impact. These maps, by illustrating the tangible consequences of glacier retreat, help bridge the gap between scientific data and public understanding. While much attention has been given to various forms of climate visualization, the specific impact of differently designed planimetric maps of glacial change on cognition and emotion remains underexplored.

This study focuses on how different designs of planimetric maps for visualizing glacier retreat are understood and impact emotions of map readers. By investigating how these maps influence public perception and emotional responses, this research aims to contribute to the broader field of climate change communication, and by assessing the different perceptions and emotions of readers of different map designs, this research aims to fill an important research gap in cartography. Emotions have been shown to be nearly as important as understanding in the field of climate change communication. This is because different emotional responses are more likely to lead to certain types of pro-environmental behaviors. This study will provide insights into how designing maps can enhance climate communication and foster a deeper understanding of environmental changes, potentially helping to shape more effective outreach and engagement efforts.

We used an online between-subjects quantitative user study to examine how three different designs of planimetric maps influence participants' perceptions and emotional responses to glacier retreat. The user study was distributed via Prolific and hosted on Qualtrics. Participants were randomly assigned into one of three map conditions where they saw maps of glacial retreat of South Cascade Glacier in Washington State in the northwest United States. In each of the three map designs, the glacial extents were digitized from satellite imagery of the glacier. South Cascade Glacier is a benchmark glacier which means that it has been selected for long-term glacial monitoring for glaciologists. This long-term monitoring also presents interesting opportunities for cartographers to use the data on glacial retreat to assess understanding and emotions to climate change information related to visualization of glacial retreat. The three different map designs are shown in Figure 1. The first condition used different colors lines to designate glacial extent at five satellite-verified years as visible measurements of glacial extent. The second used filled polygons with an inner glow of the same data, and the third uses clipped satellite imagery of the glacial extents at the designated years. After viewing one of the three maps, participants completed an online survey answering questions assessing their cognitive and emotional reactions. Results from the survey indicate that there are differences in understanding of glacial extents and the connection between glacial changes and climate change. We will continue to evaluate the results from the user study to present in August. The results will help cartographers to make better decisions about types of designs used for glacial retreat and will be a useful first step in assessing the potential of different map designs for illustrating glacial retreat.

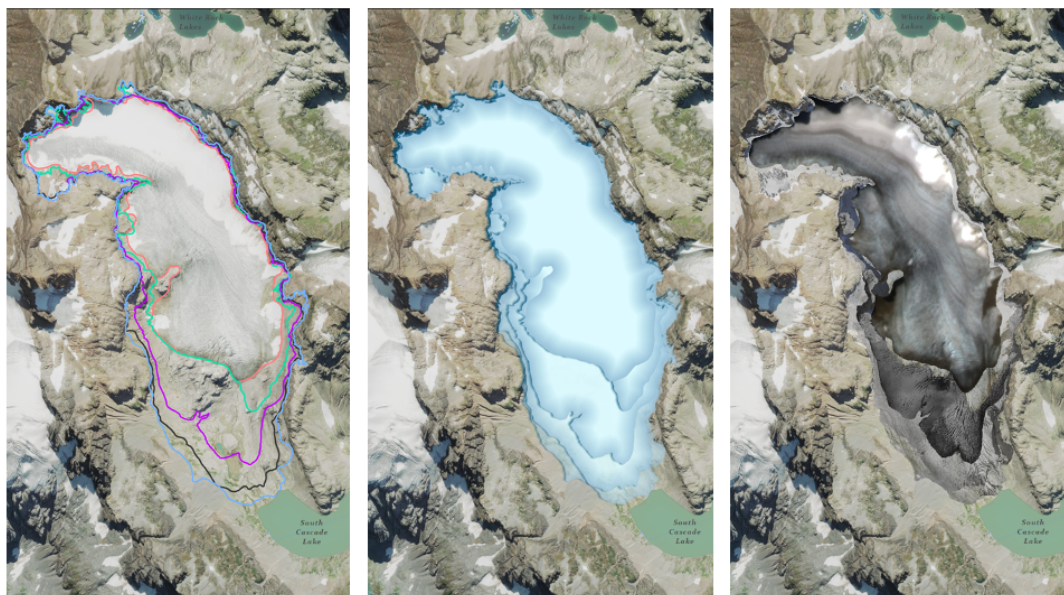


Figure 1. Three map designs used in user study of emotions and cognition of glacial retreat of South Cascade Glacier, Washington State, United States.