Climate Change Impacts in the Americas: A Student-led Case Study Approach to Raise Awareness

Hubert, M.^; Maldonado Benites L.`, Jeong, E.*, Neuenfeldt H.*`, Shebell M.`, Salisbury, David S.*^

*Department of Geography and the Environment, ^Environmental Studies Program,`International Studies Program, University of Richmond

Climate Change Poster Session, Annual Meeting of the Association of American Geographers; Washington D.C.; April 4th, 2019

Introduction

Humans have caused an estimated 1˚C of global warming above pre-industrial levels with warming and associated impacts predicted to increase for centuries (IPCC 2018). The Americas, a region replete with biodiversity, large coastal cities, and extensive food production systems, has already experienced ecosystem disruption, sea level rise, and increased variability in extreme events among other impacts. The Pan American Institute of Geography and History (PAIGH) formed an Atlas of Climate Change in the Americas Working Group to strategize how best to raise awareness of climate change and climate change impacts in the Americas. The Atlas working group identified 11 climate change impact themes of particular importance to the region that can both capture the attention of Atlas readers while educating them about climate change risks, vulnerabilities, and adaptation. Eight students at the University of Richmond researched case studies of selected impacts in particular locations to provide templates for the proposed Atlas. The thematic case studies included changes in agriculture, biodiversity, climate-induced migration, food security, glacier retreat, hurricanes, indigenous livelihoods and sea level rise in locations in Argentina, Brazil, Central America, Mexico, Perú, and the USA. Students conducted literature reviews of these case studies to create short image driven Atlas entries. Results showed the potential of the Atlas project and the benefits of student participation but underscored the challenges of compiling and integrating analysis from disparate sources.

Background

The Climate Change Atlas of the Americas (CCAA) was first suggested during the PAIGH Technical Consultation Meetings where 17 geographers representing 11 countries discussed the merits of the project. In 2017, an Atlas of Climate Change in the Americas Working Group with representatives from six countries met in Bogotá, Colombia to create an outline of how to research and design the Atlas. Now, in 2019, the CCAA Working Group continues to meet virtually to identify potential datasets and topics that should be included in the Atlas (Salisbury et al. 2018). The initial vision is to provide an accessible perspective of the changing landscapes, existing challenges, and potential solutions and opportunities associated with climate change in the Western Hemisphere. The Atlas could potentially contain a series of maps relating to each of the twenty-three countries in South, Central, and North America. Each map might be the centerpiece of a case study of climate change in the style of Mapping Latin America: A Cartographic Reader (Dym and Offen 2011). The focus on the climate change atlas and geo-visualization resonates with a target audience increasingly comfortable with both climate change as a clear and present danger and image-based learning given the younger generations are coming of age in both the Anthropocene and the information age.

A Class-Led Approach

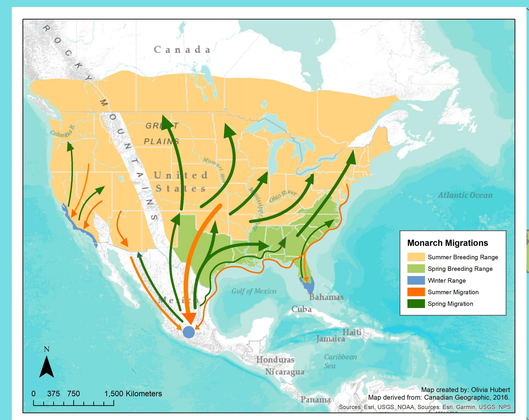
The University of Richmond's Department of Geography and the Environment offers a course entitled *Global Sustainability: Society, Economy, and Nature.* In this class, students take leadership of their learning experience by curating the course curriculum to best fit their interests within the scope of global sustainability. The students used the inclusive class design to identify the material they thought most important to their sustainable future, choosing to focus on topics such as climate change, systems thinking, pollution, biodiversity, energy, sustainable cities, and difficult conversations. The Atlas project complemented the class by providing the opportunity to contribute research in a real-world context, and probe questions of how University of Richmond students can take action to make change and educate the general public on climate change impacts.

Conclusion

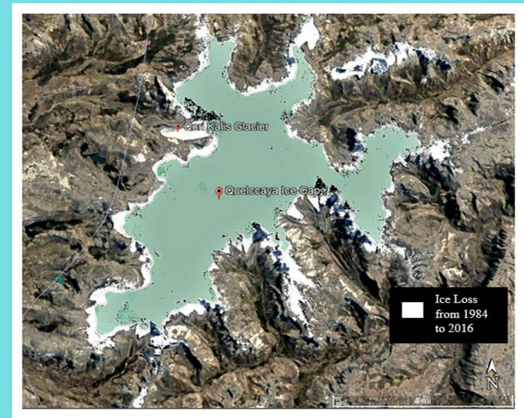
One of the major challenges presented by creating a physical Atlas of Climate Change is its static nature. Climate change data is constantly changing, creating challenges for print publications. More recently, discussions in the CCAA Working Group have focused on web based geo-visualizations rather than book bound static maps of dynamic case studies. The production of such geo-visualizations provides new challenges, but ultimately the same research is necessary to identify the charismatic case studies and provide thorough overviews of climate change impacts in the Americas.

References

Agrawal, A. A., & Inamine, H. (2018, June 22). Mechanisms Behind the Monarch's Decline. *Science Magazine*, Vol. 360, Issue 6395, pp. 1294-1296.
Canadian Geographic [Chris Brackley]. (2014). Range and migration information based on Monarch Butterfly Fall and Spring Migrations [map].
DaMatta, Fábio M., & Ramalho, José D. Cochicho. (2006). Impacts of drought and temperature stress on coffee physiology and production: a review. *Brazilian Journal of Plant Physiology*, 18(1), 55-81.
Dym, J., & Offen, K. (2011). Mapping Latin America; A Cartographic Reader. *University of Chicago Press*.
Leyk, S., Runfola, D., Nawrotzki, R. J., Hunter, L. M., & Riosmena, F. (2017). Internal and International Mobility as Adaptation to Climatic Variability in Contemporary Mexico: Evidence from the Integration of Census and Satellite Data. *Population, Space and Place, 23(6).* doi:10.1002/psp.2047
Martin, Oscar Luis Pyszczek, Rigaud Sanabria, and Patricia Perla Snaider. (2018). "El Atlas Del Cambio Climático De Las Américas." *Revista Geográfica, no. 159* (January): 5–22.
Oberhauser, K., Nail, K., & Altizer, S. (Eds.). (2015). Monarchs in a Changing World: Biology and Conservation of an Iconic Butterfly. Ithaca; London: *Cornell University Press.*
Salisbury, D. S., Aguirre, C.N., Gudiño, M. E., Martin, F. L., Pyszczek, O. L., Sanabria, R., & Snaider, P. P. (2018). El Atlas Del Cambio Climático De Las Américas. Revista Geográfica, 159, 5–22.
Strauss, B. H., Kulp, S., & Levermann, A. (2015). Mapping Choices: Carbon, Climate, and Rising Seas Our Global Legacy. Climate Central Research Report.
Stroup, J.S., Kelly M.A, Lowell, T.V., Applegate P.J., & Howley, J.A. (2014). Late Holocene Fluctuations of Qori Kalis Outlet Glacier, Quelccaya Ice Cap, Peruvian Andes. *Geology 42*(4): 347–50.
Stylianou, N. (2017, June 19). Coffee under Threat. BBC News, Retrieved from https://www.bbc.co.uk



Monarch butterflies (*Danaus plixippus*) are an iconic species, primarily known and admired for their amazing migration. It takes four generations of monarchs to complete the migration journey north, throughout early spring and summer. Over winter, the monarchs will stay in their protected microclimate habitats after migrating south. These special locations provide the species the precise conditions for survival, until it is warm enough to head north once again. (Agrawal et al., 2018).



The Quelccaya Ice Cap (QIC) is located in the Peruvian Andes, more specifically in Cordillera Vilcanota, and is the world's largest tropical ice cap. The Qori Kalis Glacier is the main outlet of the ice cap and as temperatures have risen due to anthropogenic climate change, the glacier has melted considerably.

Case Studies

Monarch Butterfly Migration in North America

Throughout the migration of monarch butterflies, they face a number of diverse threats, including habitat reduction due to the diminishing availability of milkweed and illegal logging, the increase of disease, and extreme weather. They continue to be studied for the connections they make across boundaries, promoting the importance and understanding of biological phenomena. Their need for protection has required the conservation of forest land in Mexico by prohibiting logging, while there has been regrowth of milkweed in the Midwest and a reduction of harmful herbicides (Oberhauser et al, 2015).

Climate-Induced Migration: Mexico

For decades, there have been large amounts of emigration occurring from Mexico. Most of these migrants have chosen their destination to be within the United States. While several factors persist as drivers for migration, climate change effects on rural households are intensifying and pushing Latin Americans away from their countries of birth (Leyk, 2017).

Peruvian Andes: Climate Change & Glacial Retreat

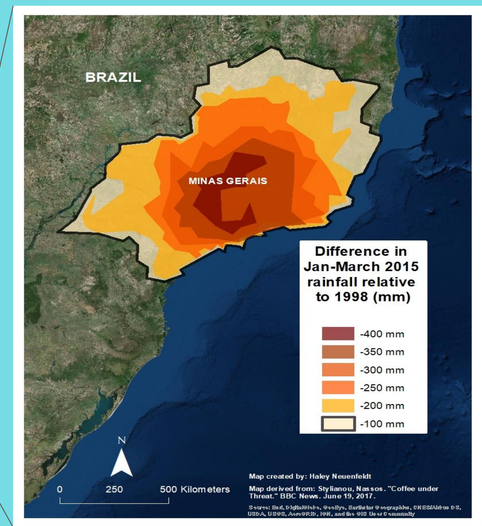
The melt of the Quelccaya Ice Cap and the Qori Kalis glacier exemplify the impacts that result from retreating glaciers and the harm that can come to the surrounding communities. The volume of the Quelccaya ice cap has decreased by 25% in the last 50 years and the portion of the glacier that has seen the most substantial melt over the past 25 years took more than 1,600 years to form (Stroup et al, 2014).

Climate Change & Coffee Production in Eastern Brazil

This map represents a drought that occurred in southeastern Brazil within a three-year period of low rainfall between 2012 and 2015. The map depicts the rainfall difference from January to March 2014 relative to 1998-2015, which severely threatened the coffee industry because the state of Minas Gerais is Brazil's largest coffee producing region (DeMatta, 2004).

Sea Level Rise & Coastal Cities: Buenos Aires, Argentina

Buenos Aires, Argentina is experiencing a severe and rapid sea level rise. If the global temperature increases by 4 degrees Celsius, most of the coastal and southern areas of Buenos Aires, Argentina will be underwater. If the global temperature increases by 2 degrees Celsius, a significant amount of coastal areas and the southern lowlands of Buenos Aires, Argentina will still be underwater (Strauss, 2017). Notably, the most vulnerable population within the Buenos Aires province will be most severely affected by the sea level rise.



Southeastern Brazil is the country's primary coffee producing region and Brazil is the world's largest coffee producer. Projected climatic changes would result in an estimated 25 percent decrease in the area suitable for Arabica coffee production and a shift in suitable climates from 400 to 1500 meters above sea level to 800 to 1600 meters above sea level.