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Science, Models, and Historians: Toward a Critical Climate History

Abstract

Environmental historians are largely absent from current climate change conversations. This essay outlines an agenda for critical climate history—asserting that it is critical for environmental historians to be more involved today and that they ought to be more critical of climate change discourse, policies, and scientific modeling of climate scenarios and the data that nourish those models. Using a case study from the Peruvian Andes and briefly describing parallel situations in the Himalaya and US Pacific Northwest, the essay shows that climate-glacier-hydrology models are inadequate and can even be misleading without the integration of historical human variables. Environmental historians are well poised to analyze and contribute to climate modeling that brings together science/knowledge, the physical environment, and societal forces. Moreover, a goal of critical climate history is to inject historical perspectives into present-day climate science and policy to help rethink the hegemony of climate science, to question the dominant climate discourse and framing, and to critique mainstream approaches to climate change mitigation and adaptation. This Forum on climate change and environmental history illustrates on a broader scale both the contributions and the unfulfilled opportunities for future scholarship in critical climate history.

INTRODUCTION

This essay calls for a more critical climate history. By critical, I mean three things. First, history is critical for understanding present-day and even future climate-related issues. Environmental historians have long recognized this, but very few are involved with climate research.[1] Second, environmental historians should be more critical of climate change discussions, media coverage, policies, science, and modeling. Here the lesson comes from science and technology studies that tend to question science and discourse more than environmental historians do.[2] Such critiques, however, should not deny or ignore climate change and its potential impacts; nor should they diminish climate scientists' excellent contributions. Third, historians should be self-consciously critical of our own field, of our own analysis of climate and history. As this Forum shows, there is great diversity in terminology and underlying assumptions about what climate is and how scholars analyze it, about how different spatial and temporal scales intersect and interact (or do not), about the interplay between nature's agency and environmental determinism, about environmental historians' responsibility to engage the general public and policymakers, about whether historians use or criticize contemporary natural sciences, and about our capacity and willingness to collaborate with scientists, engineers, and other disciplines even beyond the academy. All of these issues are central to climate history. Yet scholars treat them differently and unevenly. Remaining self-consciously critical of these issues and others can significantly strengthen the field of climate history.

Critical climate history, as I see it, should thus be useful for analyzing and approaching the past as well as for understanding the present—something historians often shy away from. It should engage with current climate discussions, put historians into the conversation, and, most importantly, bring the fruits of environmental history scholarship to bear on both broader histories and current climate issues. Sometimes, environmental historians' critical interventions on environmental issues can help rethink agendas and even yield policy shifts, such as with wilderness. A brief case study of climatic and hydrologic modeling shows how historians can contribute—and why they must.

SANTA RIVER BASIN, PERU

The prospect of future climate change has many societies worried not only about the weather but also about dwindling water supplies, especially in glaciated parts of the planet. Glaciers are some of the great water towers of the world. Hundreds of millions of people in mountain ranges worldwide live in river valleys fed by glacier runoff (meltwater), such as the Ganges in India, the Yellow and Yangtze Rivers in China, the Indus in Pakistan, the Columbia in North America, and the Santa in Peru. They depend on the water for drinking, irrigation, hydroelectricity, spirituality, and livelihoods—particularly in the dry season when melting ice releases water at a time when little precipitation falls. But the impact of glacier retreat on water use and societies has often been oversimplified and even overstated.

Scientists and journalists have suggested that water shortages in the Andes are particularly worrisome. Lima is a desert city with 8 million people. La Paz and Quito, as well as rural areas where millions more live, are also in desert-like locations where people depend on glaciated watersheds for water. The environmental writer Mark Lynas represents journalists' climate-related concerns, saying quite darkly that in a few decades when glaciers in the Cordillera Central above Lima vanish, "meltwater from the rapidly-retreating ice fields, will suddenly—and disastrously—dry up for half the year." As a result, he says, "life will quickly become impossible. . . . [T]he massive majority of Lima's population, who already have difficulty accessing reliable water supplies, will be forced to move or die."[3] For Lynas and many others, climate change will yield a very clear (environmentally determined) path forward.

Scientists also have offered similarly dire predictions. For Peru's Cordillera Blanca mountain range, the most glaciated tropical mountain range in the world, some scientists have used global climate models to simulate future glacier behavior and downstream water supplies. And they project dismal consequences stemming from future climate-caused glacier shrinkage, such as a 20 percent decline in Santa River flow by midcentury and an 11 percent reduction in hydroelectricity generation if 50 percent glacier loss occurs.[4]

But to forecast certain socioeconomic impacts or even to tie human water use for hydroelectricity solely or primarily to the availability of water paints a misleading portrait of both the future and the past. Water availability in glaciated basins depends on many factors, from environmental variables such as climatic conditions and glacier size to the influence of groundwater, weather patterns such as El Niño Southern Oscillation, and ecological factors like vegetation coverage. How

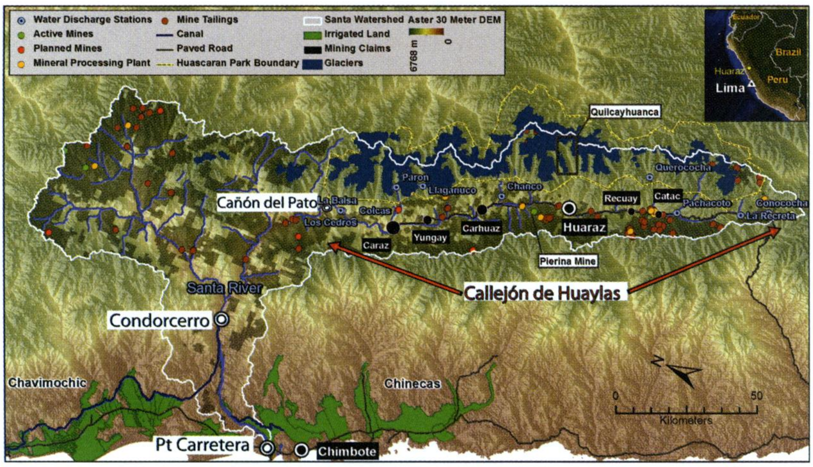

Figure 1: Map of the Cordillera Blanca and Santa River watershed, 2013. Credit: Jeffrey Bury.

much the glaciers influence downstream water supplies—and at what point in time—remain unanswered questions in most mountain regions. Human factors such as water withdrawals, consumption patterns, land use change, and many other variables that environmental historians can expose are perhaps even more important in watershed hydrology than these environmental forces, even though these societal aspects are almost entirely overlooked in climate-glacier-hydrology models. A look at the history of Peru's Santa River basin and actual water use since about 1950 shows that the picture is significantly more complicated—and that the Lynas interpretation is off target, even counterproductive, for tackling future water issues.

Peruvians in the Santa River valley have significantly expanded their water use over the last half century—despite continuous glacier retreat and a 17 percent reduction in water flow between 1954 and 1997.[5] Glacier size must thus be disentangled from downstream water use. Two examples illustrate this increased water use in the Santa River basin.[6] First, state and private hydroelectric companies using glacier runoff in the Santa River have boosted energy production at the Cañón del Pato Hydroelectric Station, Peru's seventh largest, from zero megawatts before it opened in 1958 to 263 megawatts since 2001 when it was last expanded.[7] In other words, they generated more megawatts with less water and a loss of nearly 30 percent of glacial ice, despite dire predictions to the contrary. Various hydroelectricity expansions since 1958 thus had less to do with available water in the Santa River than with the political climate in Peru that facilitated (or thwarted) investment, the government in place in Lima that funded (or ignored) the state hydroelectric companies running Cañón del Pato, the cost and availability of technology, and the views of diverse local populations and authorities who either invited, accepted, or rejected new hydroelectric projects. The biggest boost in hydroelectric production came in 2001, right after the US company Duke Energy arrived in Peru as a result of neoliberal restructuring that privatized the state hydroelectric company and sold it to a private company with capital to invest. Global political-economic trends and the amount of glacial meltwater have both simultaneously influenced the last fifty-five years of hydrology and water use. It is therefore crucial in all studies of climate change and climate history to put these dynamic intersecting social and environmental forces together and not simply accept model projections without concomitant historical analysis.

Second, export crop cultivation in the Santa watershed has increased by nearly 16,000 percent since 1960. Coastal irrigation in the lower Santa River valley grew from an estimated 7,500 irrigated hectares in 1958 to 174,000 hectares today.[8] Peru has become one of the world's top exporters of asparagus, artichokes, and avocados, among other crops. A notable portion of this booming agriculture occurs in the Chavimochic Irrigation Project on the Santa River's north bank—thanks in part to glacier runoff but also thanks to the vast irrigation infrastructure of the Chavimochic Project constructed largely when Alan Garcia of the American Popular Revolutionary Alliance party was president of Peru in the 1980s and early 2000s. Other factors beyond the supply of glacier runoff further explain Peru's rapid growth in export agriculture during the last five to ten years, including its political-economic conditions favorable to businesses; free trade agreements with the European Union, China, and the United States; a cheap and abundant labor supply; and a favorable climate.[9] Again, climate-induced glacier shrinkage is only one among many social and environmental variables affecting water use in glaciated watersheds.

HUMAN VARIABLES IN CLIMATE-WATER MODELS

The water use history in the Santa River basin unveils a remarkably different portrait of water use below shrinking glaciers than the various mathematical models simulating past and future water availability in the watershed. The historical data challenge climatic and hydrologic models, making them more uncertain when they project into the future. Of course, if the glaciers disappear completely in a few centuries and annual water flow declines by 30 percent, as Baraer and others suggest, then impacts would be significant.

Nevertheless, history reveals steady growth in water use despite a steady decline in water supply. And the main drivers of those water use changes were social, cultural, economic, political, and technological factors—not just temperature, precipitation, and glacier mass balance. Economic policies, technological innovations, political reforms fluctuating between authoritarian and democratic governments, neoliberal reforms, and other societal factors shaped water management below shrinking glaciers. Thus, when mathematical models ignore human adaptation practices, new technologies, changing upstream water management, water and energy laws, new capital investments, and the national and international political-economic climate, they distort how water actually works as it flows from the snout of a glacier to the Pacific Ocean. Yet models of hydrology under certain future climate scenarios neglect these human factors at play in the watershed, reducing the climate scenario to a simplified (environmentally determined) story in a world without humans, without politics and economics, and without social relations and cultural values.

This is why we need more environmental historians thinking about present-day climate change—and why collaboration among historians, scientists, and modelers is essential, and doable.[10] Human factors and historical variables have to be part of the future scenarios presented in models, which are then popularized by the media and inserted into public dialogue and policymaking. Projections of climate-induced sea level rise, for example, will be much more robust and useful if they consider historical trajectories for real people and actual trends in demographics, infrastructure development, urban planning, living preferences, and leisure activities that drive people to coastal areas.

Scientists' and activists' worries about climate-caused glacier melting and ensuing water shortages also exist elsewhere. In the US Pacific Northwest, studies demonstrate sustained glacier shrinkage over at least a half century, with important implications for downstream water supplies for hydroelectric energy, irrigation, and livelihoods in the Columbia River basin, north Cascades, and surrounding the large ice-covered volcanoes such as Mounts Rainier, Hood, and Adams. But scientists have only just begun to question how downstream hydrology is influenced not only by glacier runoff but also by myriad other forces such as bedrock conditions and annual snowpack, as well as by the Columbia River treaty, salmon protection efforts, irrigation practices, hydroelectric generation, forest management, and tourism and recreation activities.[11] Though mentioned briefly by scientists, these political, agricultural, energy, and economic variables have unfortunately not yet been the focus of social scientific or environmental history research, thereby leaving the climate-glacier-water-society equation largely unknown in the Pacific Northwest.

In the greater Himalayan region, most climate-glacier models calculating ice loss have offered dire forecasts.[12] And environmental groups like Greenpeace explain that "the rapid melting of glaciers caused by global warming is jeopardizing the water supply for 1.3 billion Asians who live in the watershed of the 7 great rivers that originate in the region" including the Yangtze, Yellow, Ganges, Indus, and others.[13] But the story is more complicated than many scientists and environmental groups have suggested. New studies show that glacier recession in the Himalaya is not as uniform or rapid as previously suggested.[14] Others question how shrinking Himalayan glaciers actually affect downstream water supplies. As the US National Academy of Sciences recently concluded, "retreating glaciers over the next several decades are unlikely to cause significant changes in water availability at lower elevations, which depend primarily on monsoon rains."[15] Suddenly, the claim of 1.3 billion people thirsty from glacier retreat looks extremely exaggerated, even though the National Academy nonetheless recognizes that climate-induced glacier retreat will reduce higher-elevation water availability. Importantly, the report says that groundwater depletion and increasing human water use—as opposed to reduced supply from glacial runoff—will reduce low-elevation water supplies, thus signaling that, like in the Andes, human forces intersect with climate, glaciers, water, and topography to influence downstream hydrology. Moreover, even people in the upper watershed, at least in the Khumbu region of eastern Nepal, get their potable water not from glacier-fed rivers, but rather from tributaries that depend on snowfall, not glaciers. Precipitation affects glaciers, but the direct link between glacier size and water supplies for residents misses on-the-ground reality.[16]

CONCLUSIONS

Critical climate history could analyze these and other aspects of climate modeling. Projecting climate change up to 2100, for example, requires not only data about climatic conditions, but also, among other things, the effects of greenhouse gases on climate. But these greenhouse gases are emitted by people. That is to say, climatic conditions in the future will be affected by a host of human variables and factors, such as population, energy use, economic development, energy sources and emissions, consumption patterns, and regulatory policies—all issues that are or should be fed into climate models. Inferring these future scenarios requires inputting historical data and trajectories, even though historians do not seem to be involved with model production. We learn from Sherry Johnson's essay in this Forum that any predictions about the severity of societal disruption caused by climate crises must include considerations of power dynamics and the response paths chosen by, or available to, institutional authorities and affected populations.

Critical climate histories could also analyze who has historically done the climate modeling, and who benefits (and loses) from it. Historian Paul Edwards points out that "The elite world of global climate simulation still includes no members from South America, Central America, Africa, the Middle East, or south Asia."[17] Yet we know that when certain regions, countries, or social groups control the science, then even well-intentioned science can alienate people, facilitate imperialism, or yield injustice and inequality. James Fleming argues in the Forum that geoengineers who act on metaphors that medicalize climate change run the risk of unleashing unforeseeable and potentially dangerous consequences that may weigh inequitably on different societies around the world—perhaps yet another technoscientific agenda originating in the Global North that affects everyone worldwide.

There is a key role for historical information from local people in climate models, such as in the Himalaya where local herders in Tibet can contribute vital proxy information about changing environmental and snow conditions to climate models.[18] It is thus essential for social scientists familiar with particular places and peoples to collaborate with climate modelers. Adrian Howkins shows the importance of collaborating with scientists because the researchers in Antarctica help expose the long-term environmental change and how it might be related to the Anthropocene that Howkins provocatively analyzes. More self-consciously critical climate histories might allow environmental historians following Howkins's lead both to collaborate with scientists and to critically examine the sociopolitical contexts in which science is produced, circulated, and utilized.

Climate models tend to emphasize environmentally deterministic scenarios, as in the Andes water story, but collaboration and critical analysis may help avoid climatic determinism. Referring to these models, climate researcher Mike Hulme calls this practice "climate reductionism" because the future is reduced to climatic conditions that serve as "universal predictors of future social performance and human destiny."[19] Unlike historians, modelers tend to be natural scientists and quantitative economists, not social theorists. Yet their models try to predict human behavior whenever they estimate future climatic conditions given the importance of emissions, regulatory policies, industry compliance, consumption behaviors, energy use, governance, and other issues that shape future climate scenarios. Models also tend to emphasize certain quantifiable outcomes and atmospheric constructions, such as meters of sea level rise or, especially, the changing atmospheric conditions represented by degrees of warming or quantities of carbon dioxide—aspects profoundly influenced by human behavior, not just environmental variables. Environmental groups such as Bill McKibben's 350.org help reinforce this quantitative conceptualization of the atmosphere, a view emerging in part from climate models. Climate treaties, cap-and-trade initiatives, and emissions policies also depend on and build from climate models. And these efforts have all helped commodify the air.[20] Of course any commodification process yields winners and losers. Climate models are amazing tools. But, as Fleming makes clear in his critique of "planetary physicians," environmental historians should be both contributing to them and analyzing them to understand how they have helped radically transform the way societies interact with air and manage the atmosphere.

Historians should, in short, be asking critical questions about the production, circulation, and use of climate-related models—or about the role of natural and life sciences in environmental history research and the place of our research in public policy. These models not only could benefit from greater input from historians, such as in the climate-glaciers-water case in the Andes, Cascades, and Himalaya. But the models also have implications well beyond climate change—for humanity as well. Environmental historians are well poised to analyze and contribute to climate modeling that brings together science/knowledge, the physical environment, and societies. Philip Garone points to the various ways that public lands management agencies are responding directly to climate modeling predictions to adapt their policies and retool their missions, increasingly integrating federal, state, and tribal expertise and perspectives into their planning. Yet historians are often quick to state that our knowledge is about the past, not the future, and most would balk at the thought of modeling future scenarios, whether of human societies or of flora and fauna. But we cringe and recoil at our own peril. It makes us lose control not only of the future, but also the past because modelers generate incomplete and simplified historical data to simulate future scenarios. The example of increased water use in Peru demonstrates, in contrast to modeled simulations, that human and nonhuman variables intersect in critical (but still largely unexamined) ways that shaped history and will no doubt influence the future.

The discussion of climatic determinism in scientific models points to a larger issue from this entire Forum: the line between environmental determinism and the agency of nature, or the capacity for climate to shape history without predetermining it. Lawrence Culver, for instance, points to how climate created definite limits and possibilities for European settlement in the Americas, but also how private and public efforts—based on perceptions of climate—responded to those climatic conditions or overcame them to maximize societal benefits. Sam White also shows, on the one hand, the role of climate change and panzootics on pastoral societies while, on the other hand, showing how pastoralist societies often weathered climatic extremes more successfully than agriculturalists, thereby navigating the interplay in the agency of both humans and nature. Critical climate history means keeping these sometimes thorny questions about agency at the forefront of the research.

Another goal of critical climate history is more present-day focused: to inject historical perspectives to help rethink the hegemony of climate science, to question the dominant climate discourse and framing even among environmental groups perhaps exaggerating apocalyptic climate change narratives, and to more broadly critique mainstream approaches to climate change mitigation and adaptation. In the context of vulnerability and resilience, Georgina Endfield calls attention to the importance of particularized lived experiences and cultural memories for understanding how societies perceive and respond to climate risks, and for avoiding neo-deterministic approaches. As some scholars pushing for climate justice increasingly recognize, existing climate science and discourse are structured by social power and can thus reinforce colonialist, capitalist, and patriarchal power structures.[21] Geographer Erik Swyngedouw claims that current climate framing embraces a rather uncritical acceptance of apocalyptic climate change narratives and technoscience, what he refers to as a "post-political and post-democratic regime" because so few people are deeply or critically analyzing the historical portrayal of climate change and climate science.[22] This is not to disregard the effects of climate change or to dismiss climate science. Rather the goal is to probe deeper into current climate change discussions by approaching it from historically informed cultural perspectives, by asking who wins and who loses with certain discursive framings of climate, by uncovering the socioeconomic and political contexts of climate science, and by refining the knowledge base available to analyze climate change impacts, responses, and perspectives in the past and present, and for the future.

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Notes

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