



ISSUE TWO : SPRING 2016
OPEN RIVERS : RETHINKING THE MISSISSIPPI

IMAGINING WATER

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from multiple perspectives within and beyond the academy.

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The cover image is by Harold Fisk, 1944, plate fifteen, sheet one, showing stream courses from *The Alluvial Valley of the Lower Mississippi River*. The map covers sections of Arkansas, Missouri, and Tennessee.

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INTRODUCTION

INTRODUCTION TO ISSUE TWO

By Patrick Nunnally, Editor

We commonly think of rivers as, for the most part, staying where they belong, in the river bed, occasionally coming out into the floodplain under fairly predictable conditions conducive to high water that we call “floods.”

The writing in this issue of *Open Rivers* belies this notion of predictability, to a large degree. In disparate ways our authors write as if rivers should be understood as fundamentally restless, existing under conditions that are dramatically changing. The terms we use to describe these changes matter a great deal; is a flood a “disturbance” or part of the river’s inherent dynamic? Christopher Morris asks us to reflect on this distinction. More pointedly, Richard M. Mizelle Jr. reminds us that periods of high water are commonly understood to be shaped by a combination of “natural” and “intentional” factors;

what is consistent is that the people suffering the worst impacts are communities of color and the poor.

Much of the work in this issue of *Open Rivers* is derived from the spring 2015 symposium, “The Once and Future River: Imagining the Mississippi in an Era of Climate Change,” which was funded by the Andrew W. Mellon Foundation through a John E. Sawyer Seminar grant. The essays by Patrick Hamilton and Lark Weller, plus Phyllis Mauch Messenger’s interview with meteorologist Paul Huttner all speak directly to the impacts a changing climate may have on rivers. If rivers have an inherent (and cultural) instability, and are manifestly affected by a changing climate, then how can we “know” the rivers in our landscape?



Harold Fisk, 1944, The Alluvial Valley of the Lower Mississippi River. Plate fifteen, sheet one, showing stream courses in sections of Arkansas, Missouri, and Tennessee.

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Other writers represented here have answers, to one degree or another. Kirk MacKinnon Morrow offers us a pathway to learn about the Mississippi by listening to the Dakota, the people who have lived in this place for the longest time. Kate Brauman suggests that “big data” can help us understand worldwide water issues, but only to a degree. Simi Kang recommends learning from one of the preeminent historical geographers in the country. And Len Kne reminds us that mapping is always a valuable way to understand what’s around us.

If you have noted a great deal of equivocation in this introduction, that is because equivocation may be an apt rhetorical stance for addressing a changeable subject such as rivers. Our knowledge must, to a large degree, be understood as contingent rather than definitive. Toward that end, we expect that the writing and images offered here will be the first word in provocative discourses, rather than the last word that settles things “once and for all.”

Happy reading!

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About the Author

Patrick Nunnally coordinates the River Life Program in the Institute for Advanced Study at the University of Minnesota. He serves as editor for *Open Rivers* and was one of the lead scholars for the University’s John E. Sawyer Seminar, “Making the Mississippi: Formulating New Water Narratives for the 21st Century and Beyond,” funded by the Andrew W. Mellon Foundation.

FEATURE

FUTURE RIVER - THE MISSISSIPPI IN LIGHT OF A LIFETIME IMMERSION IN WATER

By Patrick Hamilton

The Mississippi River, and all rivers everywhere, are canaries in a global birdcage. Their fates are no longer determined solely by the actions and behaviors of those who live and work within their watersheds. Their fates are now intimately intertwined with what collectively all 7.3 billion of us on Earth decide will be the fate of the global atmosphere.

The atmosphere and rivers have always been intimately connected and as humanity's global influence has waxed so has its interference with the flows of water and energy between the skies above us and the rivers amongst us. My appreciation of these relations has been a life-long growing consciousness that we all now reside on a human-dominated planet.

Early Influences

I love water. Always have, always will. I delight in skimming across it in my kayak and dropping down into it with mask, fins, and snorkel. I was born in Detroit Lakes, Minnesota, and credit my early years amidst the lakes and streams of west-central Minnesota with imbuing me with a fascination of water that has endured my whole life. When I was five, my parents moved my three older brothers and me to Moorhead. You could argue that the Red River Valley, with its languid namesake river that meanders tortuously down its middle, is lacking in freshwater drama. And you would be correct if you only looked at that



*Patrick wading in a lake circa 1963.
Image courtesy Patrick Hamilton.*

vast, flat panorama. But arching over that level landscape is a giant bowl of a sky capable of spectacular displays of atmospheric drama.

Growing up in Moorhead, I learned to spot a summer thunderstorm coming from three hours away. The ethereal cirrus tendrils of

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cumulonimbus off to the west in North Dakota would, to the discerning eye, gradually attenuate the bright afternoon sunlight. Then as the clouds thickened, the air would go completely still just before the dense gray curtain of rain and wind bent down the trees and peeled shingles off roofs. In winter, there was never a blizzard that I didn't adore (and they still captivate me as long as I am watching them from behind the windows of my living room and not the windshield of my car).

My fascination with the atmosphere further jelled in our backyard on a hot July afternoon in the summer after I graduated from high school. As a line of developing thundershowers passed overhead, I decided on a lark to set up the Sears and Roebuck telescope given to me for Christmas by my parents ten years earlier during the height of the NASA Apollo program. Rather than training it on the sun or moon, I focused instead on the tops of the clouds quickly sweeping eastward. This macro view revealed a bubbling cauldron of convection currents rapidly ascending high into the atmosphere and then quickly spreading out into the signature anvil-shaped tops of thunderheads.

After spending my freshman year of college at what was then Moorhead State University, I decided it was time to pursue my studies (from my perspective) at an eastern university. At the University of Minnesota in Duluth, I was astonished by a city with so much wild water and came to the realization that geography was the discipline that would allow me to study water in all its forms and manifestations. On my long hikes from the hilltop campus to the Hotel Duluth (where the overflow masses of freshman



*Patrick on the evening of his high school graduation in 1976.
Image courtesy Patrick Hamilton.*

and sophomores were then housed in fall 1977), I trekked through elegant neighborhoods of stately homes dissected by cascades of water rushing down steep forested ravines. And then there was Lake Superior itself. Sure, at the time getting to it from the hotel required scrambling down slag piles, crossing abandoned rail lines, and snaking past broken foundations and abandoned buildings, but once you got to its gravel beaches and bedrock headlands you were face to face with a vast tempestuous magnificence.

Graduate Training in Geography

In 1980 I moved to the Twin Cities to study geography at the University of Minnesota. My small apartment in Minneapolis left me yearning for the rugged shoreline of Lake Superior and the woods and lakes of west-central Minnesota. Fortunately, I discovered the Mississippi River gorge. I spent many hours exploring the

riverbanks and bluffs, finding fossils left behind by a very ancient sea. The Mississippi down below the city was a flowing reminder that a world of woods and wetlands, lakes and sloughs still existed, if one just followed the river north into the countryside.

Creating Exhibits about Water and Rivers

After receiving my master's degree, I worked for a year as an environmental planner for the Metropolitan Council of the Twin Cities as part

of a large team grappling in the early 1980s with how to manage the enormous quantities of garbage produced by a large metropolitan area.



Mist entrance to the H₂O: Water = Life international touring exhibit organized by the American Museum of Natural History and the Science Museum of Minnesota in collaboration with the National Center for Earth-surface Dynamics.

Image courtesy Science Museum of Minnesota.



Ground Water Plaza in the Science Museum of Minnesota's Big Back Yard. Image courtesy of Science Museum of Minnesota.

I joined the Science Museum of Minnesota in summer 1984. Since then, I have produced a wide range of exhibits about water and about rivers—H₂O Minnesota, Watershed Science, Three Rivers Initiative, Mississippi River Gallery, Groundwater Plaza, Water Planet, and more.

My responsibility now is to produce environmental projects, especially exhibits and programs, for the Science Museum that explore the challenges and opportunities of living on a human-dominated planet. I conceive of ideas for new projects and then seek to convince those within the museum that there is a public appetite for these topics while persuading those outside the museum that

the realization of those topics into public experiences would be worth their investments, whether that be money or their own time and effort. My job in short is pushing circles of self-interest together with the goal of achieving as much mutual interest and public impact as possible. All of my projects over 32 years at the Museum have involved collaborating with a wide array of partners. But by far the most significant collaboration over those three decades has been with the University of Minnesota on a project about rivers that initially was planned to run 10 years but is still going after 13 years and counting. It started with a phone call.

Launching the National Center for Earth-surface Dynamics

Professor Efi Foufoula called me in January 2001. She and her colleagues Chris Paola and Gary Parker were in the midst of preparing a multi-year, multi-institutional, multi-million dollar proposal to the National Science Foundation (NSF). Did the Science Museum want to be a partner? Absolutely. Getting a big proposal funded by NSF requires a big idea, and they had one.

Rivers are vital to the physical, economic, social, and cultural well-being of billions of people around the world. And geologists, ecologists and economists have been studying rivers for decades, even centuries. But these academic discipline-driven ways of knowing had never coalesced into a more systemic understanding of rivers, to the detriment of rivers everywhere and the people dependent upon them. So Efi, Chris, and Gary envisioned that their proposed National Center for Earth-surface Dynamics would create a new synthetic science they called earth-process science that would enable multi-disciplinary quantitative understandings of rivers.

As can be imagined, such an ambitious proposal received intense scrutiny and months of review. But we made it through the gauntlet and the National Center for Earth-surface Dynamics (NCED) was established in summer 2002. I got to be one of the principal investigators, not as a scientist, but as the point person tasked with imagining how to bring the research and insights of this big collaborative scientific enterprise with researchers from a dozen campuses to the attention of large public audiences.

It was a great gig. I got to eat with these scientists, drink with them, and visit their research sites. But after engaging in this work for several years,

I realized that I was hearing different versions of the same story from different scientists. The geomorphologists told me, “Do you realize that humanity is now the dominant agent of landscape change?” The sedimentologists asked, “Are you aware that humans are now responsible for the movement of more rock and sediment annually



Chris Paola, Gary Parker, and Efi Foufoula, founders of the National Center for Earth-surface Dynamics. Image courtesy NCED, University of Minnesota.

than all rivers and glaciers on the planet combined?” And the ecologists stated, “It is no longer possible to study an ecosystem on the surface of

this planet without taking human influences into consideration.”

The Future Earth Initiative

Inspired by my interactions with NCED scientists and equipped with these new insights, I, too, wrote a proposal to NSF. It was funded, and in 2009 the Science Museum of Minnesota began the Future Earth Initiative. This project created a suite of exhibits, films, and programs about humanity’s new relationship with the world around it. While the project concluded in 2014, the three key ideas that drove the messaging of Future Earth continue to serve as the organizing principles of my work at the Science Museum:

- Humanity now is the dominant agent of global change – Humanity now dominates many of

the physical, chemical, and biological processes that make this world habitable.

- Humanity has many assets – This planet is now home to the healthiest, wealthiest, best-educated, most innovative, creative, and connected populace in history.
- Humanity needs to innovate and now – Humanity needs to be highly innovative technologically, economically, politically, and socially, because humans collectively have set in motion large-scale planetary changes.

The Once and Future River

So when I consider the once and future Mississippi River in light of the above, the one thing for certain is that the future river will not be the same as the one in the present. The question for me is whether we will mourn this future river for what it once was and no longer is or cherish and celebrate it for what it still retains and what it has reclaimed. I suspect that we will be both mourning and cherishing the future Mississippi River. The degree to which we engage in one or the other will be determined by human decision making, either by default or by design, by accident or by intention.

The Mississippi River is a manifestation at all scales of humanity’s domination of our planet. The river and its watershed integrate all that we

do locally, regionally, and globally. After all, a river and its watershed are inseparable; they are complementary elements of the same system. The Mississippi River is an expression of the land use choices we have made locally through, for example, how we design and engineer our cities. The Mississippi River is an indicator of regional and national forces because how we use the watershed of the river is shaped by demands that others elsewhere place on the resources of that watershed, whether those be potatoes from fields carved out of recently cleared forests or wood products sourced from sustainably managed forests. And the Mississippi River and its watershed are a measure of whether and how we as a global species come to terms with how we manage the atmosphere that we all share in common.

Is Our River Resilient?

Resilience to me is an easy word to use, but a difficult one to define. Here is how I consider the term. Resilience is the ability of a system to continue providing desired goods and services despite it having to endure increasingly disruptive forces, forces that may be beyond the bounds of what was originally imagined that system could accommodate. In the case of the Mississippi River, increased resilience to me means, in the face of disruptive changes that are occurring with increasing frequency and decreasing warning, that the river still has the ability to provide:

- water for human wants and needs;
- habitat for a richness and fecundity of plant and animal life;
- an essential respite from our human-dominated landscapes.

How resilient the future Mississippi River is will depend on how resilient our societies choose to become locally, nationally, and internationally. It may not be an easy path for some to take since



*Mississippi River in flood in downtown Saint Paul in spring, 2014.
Image by Patrick Hamilton.*

the pursuit of resilience is an acknowledgement of vulnerability, which can be a humbling experience that some may prefer to avoid. But the pursuit of greater resilience can involve both defensive and offensive measures. I contend that for greater resilience of the future Mississippi River ultimately to be successful we will need to act in ways both reactive and proactive.

Our collective societal realization of a more resilient Mississippi River will be a blend of both

adaptation and mitigation measures. It will be adaptive through a common, shared awareness and appreciation that some changes are now unavoidable. Climates across the huge watershed of the Mississippi are already changing, and climate change will continue and likely accelerate in coming decades as heat-trapping gases continue to accumulate in the global atmosphere. The greater resilience of the future Mississippi River should be informed by these already discernible climate trends.

Changing Weather Patterns

Temperatures are increasing across the state in all seasons and especially during winter. The ice-free season for the Mississippi River and for lakes across the state is trending longer. Episodes of high temperatures combined with high dew points leading to extreme heat indices are occurring more frequently. On July 19, 2011, an extraordinary combination of high heat and humidity made my home town of Moorhead the hottest spot on the planet with a heat index of 135F!

Extreme rainfall events are occurring with increasing frequency. Southern Minnesota experienced three 1-in-1,000-year storms between 2004 and 2010. These storms, exceptional because they dropped six inches of water or more in 24 hours or less across 1,000 square miles or more, had only a 0.1 percent probability of occurring in any given year. The fact that several occurred in the span of only six years suggests that the atmosphere now is behaving substantially differently than it has over the past 130 years since a network of volunteer citizen weather observers was established across Minnesota in the late nineteenth century.

The most recent storm in September 2010 dropped almost no rain on Saint Paul but deluged south-central Minnesota with so much water

that the Blue Earth River surged into flood and then disgorged so much water into the Minnesota River that it too flooded. That river in turn poured so much water into the Mississippi River where the two meet below Fort Snelling that the City of Saint Paul had to barricade roads, sandbag utilities, and otherwise mobilize for its first fall flood in recorded history.

Along with more incidences of extreme wetness, the state of Minnesota is experiencing more protracted periods of dryness. Climatologists are still studying the phenomenon, but evidence is accumulating that rapid warming of the Arctic is lowering the temperature contrast between high and mid latitudes, and thereby reducing pressure gradients and thus the speed by which the jet stream transports weather systems across the North American continent. Weather patterns in Minnesota, as a result, appear increasingly to oscillate between excessive wetness and protracted dryness. On the summer solstice of June 2012, for example, the City of Duluth and surrounding communities suffered a 1-in-500-year rainstorm and resulting flash flooding that caused over \$135 million in damage to public and private property. The Arrowhead region, along with the rest of Minnesota, then fell into drought, and the St. Louis River went from recording its largest

discharge ever to one of its lowest flows on record just three months later.

In the face of these climatic changes and more on the way, we will need to take steps to temper their impacts on the Mississippi River. In light of rising air temperatures, for example, we should consider retarding the rise in Mississippi River water temperatures that likely will stress native fish species by further lowering discharges of heat from human sources, such as power plants, along the river. In response to the increasing frequency

of extreme rainfalls, we should consider implementing measures to inhibit the overland flow of runoff into the Mississippi River, as exemplified by new state regulations to more vigorously enforce the buffer zone between farm fields and waterways. In light of increasing frequency of periods of dryness and wetness, we will need to pursue measures that make the watershed of the Mississippi River more porous so that we capture and retain more water during wet periods for availability during periods of drought.

International Efforts

But our efforts to increase the resilience of the Mississippi River must also be informed by an awareness that there are limits to climate adaptation and that our ability ultimately to realize a more resilient Mississippi River will depend on agreements among nations to not allow global climate change to rage out of control. Climate change adaptation is comparable to pumping water out of the hold of a ship taking on water. Doing so helps protect those living and working on lower decks and directly at risk from the rising water and, of course, it slows the rate of sinking. Adaptation enables us to better cope with the new realities of climate change but eventually will prove ineffectual if we permit climate change to advance to the point where it overwhelms our abilities to cope. Successful climate adaptation ultimately will depend on our slowing and finally ending the flow of water into the hold of the global ship we are all traveling on through space.

The recent international climate agreement reached in Paris on December 12, 2015 is a very encouraging development. For the first time in history, an overwhelming global consensus has been reached that addressing climate change has never been more necessary, nor more possible. Many nations already are experiencing loss and

damages due to climate change, while at the same time costs of renewable energy have plunged so precipitously in recent years that their prices often are competitive and preferable to fossil fuel energy sources.

While we in Minnesota contemplate what adaptation steps to take to increase the resiliency of the Mississippi River to disruptive climate change, our success ultimately will depend on a partner in the form of a federal government that is working to mitigate the amount of future climate change with which we will need to grapple. As of this writing, climate change is a topic neither being addressed nor acknowledged by Congress nor by any of the Republican candidates vying to be our next president and the leader of the free world.

This situation is not just scientifically indefensible, but dangerous. Above all else, our political leaders have a responsibility to protect us, not just from those threats they may be most inclined to deal with, but from all of them. The present inability of our Congress to grapple constructively with the issue of climate change is the ultimate threat to the resilience of the once and future Mississippi River.

So here we are:

- Humanity now dominates many of the chemical, biological, and physical processes that drive the functioning of the Mississippi River.
- At the same time, Minnesota is home to one of the healthiest, wealthiest, best educated, most innovative, creative, and connected populaces in the history of the world.
- We, the citizens of this state, need to innovate creatively at all scales because the fate of the future Mississippi River will be determined not just by us, but by all 7.3 billion of us on this planet.

Changing the chemical composition of the atmosphere, as we are presently doing, inevitably alters the way the atmosphere works. Changes in the flow of heat and water around the planet inescapably will change the behavior of rivers everywhere. The alterations that humanity has already made to the global atmosphere are already affecting the behavior of the Mississippi River and rivers everywhere. The decision before us all now, either by default or by design, by accident or by intention, is whether future changes in the Mississippi River and all rivers due to climate change will be manageable or overwhelming.

We now live in a world where securing the future health and vitality of the Mississippi River requires that we collectively act to safeguard the well-being of all rivers everywhere.

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About the Author

Patrick Hamilton is Director of Global Change Initiatives at the Science Museum of Minnesota, where he develops projects that investigate the challenges and opportunities of humanity as the dominant agent of global change. Away from the museum, Patrick and his wife J. like to kayak and grow organic, blue-ribbon-winning pears, peaches, and plums in St. Paul.

FEATURE

PRINCEVILLE AND THE ENVIRONMENTAL LANDSCAPE OF RACE

By Richard M. Mizelle, Jr.

Traveling east on Interstate 64 from the capital city of Raleigh, North Carolina you will see a sign for a town called Princeville. Like

so many small towns and cities in the South, Princeville has a rich, contested, complicated, and all too forgotten history. There are no Civil War



The muddy deserted streets of flood ravaged Princeville, North Carolina stand in silent testimony to the destruction wrought by the Tar River. Princeville, NC 9/28/99.

Photo By Dave Saville/FEMA News Photo.

battlegrounds to commemorate inside the town limits nor was it particularly visible as a place of protest during the Civil Rights Movement. Nonetheless Princeville is a remarkable symbol of environmental resiliency dating back to the end of the American Civil War. This essay uses Princeville as a window into the long history of environmental racism. Princeville has a unique environmental history, initially situated on land, discarded and unwanted by whites, that was prone to frequent flooding, and surviving back-to-back hurricanes in 1999. Yet this was only half the environmental burden, as residents also dealt with Jim Crow-era vigilante violence directed at a self-sufficient all-black town. While scholars have often defined issues of environmental racism emerging from a post-Civil Rights era momentum in the 1970s and 1980s, Princeville provides an important case study of continuity; it links the disciplining of African Americans into marginal land in the nineteenth century to questions of forced displacement in the late twentieth century.

Freedom Hill was the name given in 1865 to a settlement of recently freed slaves near the Tar River in territory occupied by Union troops.[i] Across the South former slaves bolted for Union encampments and protection during the Civil War, many willing to fight in exchange for their freedom. When word arrived that the defiant Confederacy would not prevail, angry and bitter planters evicted former slaves out into the cold, penniless and with only the clothes on their backs.[ii] Facing a harsh winter, ex-slaves often set up encampments along the border spaces of sometimes unsympathetic Union settlements; the wives and children of enlisted men were being promised food and clothes that did not always come. Others died in the snow, suffering from malnutrition, hypothermia, and disease. As historian Jim Downs writes, “Bondspeople who fled from plantation slavery during and after the war, and embraced their freedom with hope and optimism did not expect that it would lead to sickness, disease, suffering, and death. The Civil War, however, produced the largest biological



Originally known as Freedom Hill, Princeville was settled by freed slaves on an unwanted floodplain.

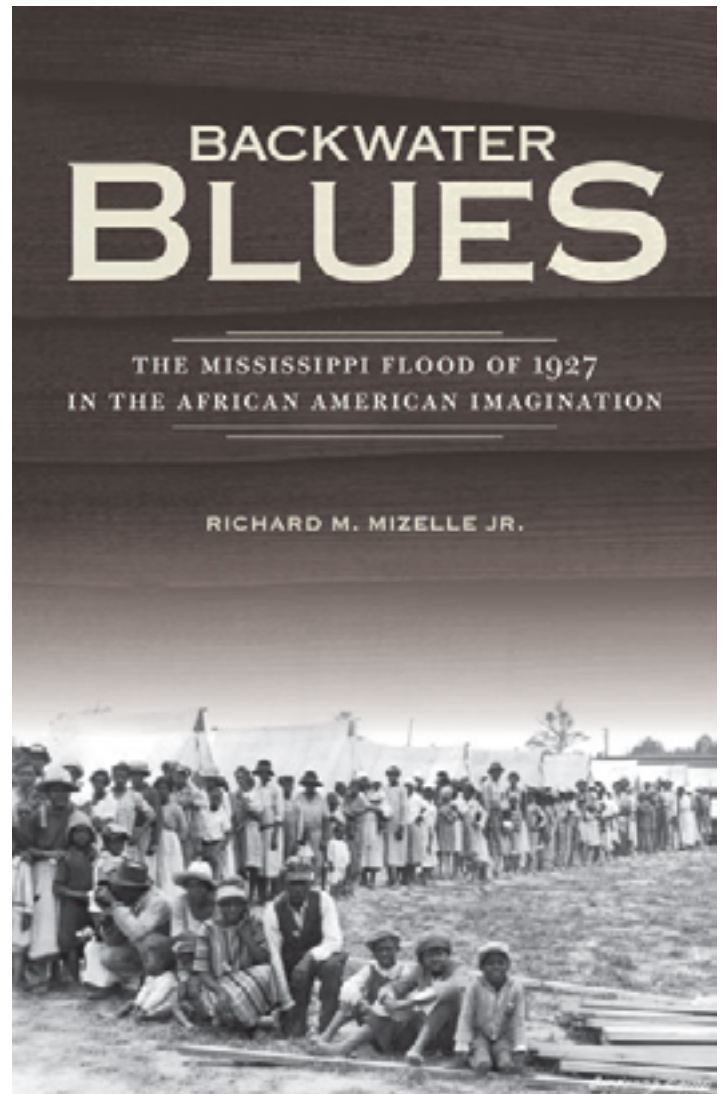
crisis of the nineteenth century...Emancipation liberated bondspeople from slavery, but they often lacked clean clothing, adequate shelter, proper food, and access to medicine in their escape toward Union lines. Even after the war ended, they continually struggled to survive in a region torn apart by disease and destruction.”[iii] Former slaveholders and pro-slavery physicians would argue that African Americans were dying and becoming sick from tuberculosis, cholera, pneumonia, and other diseases because they were biologically unfit for freedom and citizenship. It was a convenient and self-serving scientific argument that hoped to re-inscribe control over former slaves by suggesting that African Americans were inherently and biologically prone to disease, and that the paternalistic plantation economy protected African Americans from illness.[iv] Diseases that ex-slaves suffered were the result of starvation, abject poverty, poor clothing and housing, and lack of resources. [v] The mere survival of African Americans in the years after the Emancipation Proclamation showed resiliency.

A Town's Namesake

Richard Turner Prince was among the roughly 10,000 slaves around Edgecombe County on the eve of the Civil War laboring on tobacco and cotton farms, and as brick masons and blacksmiths. Born in 1843 under slavery, Prince joined other former slaves in the early settlement of Freedom Hill. Though not much is currently known about this portion of Prince's life, by 1873 he worked as a carpenter and purchased a plot of land to build a house for his wife Sarah and children Ephraim, Sarah, and Cora. Prince was instrumental in the early history of Freedom Hill, spearheading the construction of buildings and living spaces for residents. When Freedom Hill was officially incorporated in 1885, residents paid homage to the area's strongest and earliest advocate by calling the new town, Princeville.[vi]

The area known as Freedom Hill, and later Princeville, was initially situated on marshy and swampy land along the Tar River, south of Tarboro, North Carolina.[vii] African Americans have often been forced into the most degraded and treacherous environmental spaces to live and work, the early history of Princeville providing an important example. Princeville represents an important case of historical environmental injustice because of the ways in which early Princeville settlers were forced to occupy the most vulnerable riparian landscape in the nineteenth century.

As I argue in my book, *Backwater Blues: The Mississippi Flood of 1927 in the African American Imagination*, too often scholars narrowly frame questions of environmental injustice as emerging from two moments. Beginning in 1978, mostly poor white and African Americans residents in upstate New York demanded answers regarding the toxic materials and carcinogens that began percolating from sealed underground containers causing nausea, deformity, birth defects, and other sickness. Known as the Love



Backwater Blues: The Mississippi Flood of 1927 in the African American Imagination.

Canal disaster, the events that unfolded in this Niagara Falls community have long been regarded as helping to shift the consciousness of environmental activism.[viii] Secondly, scholars point to the protest over the dumping of polychlorinated biphenyls in a predominately working-class African American community in Warren County, North Carolina in 1982.[ix] An interracial coalition of activists spearheaded the non-violent protests and demonstrations that mirrored strategies of the Civil Rights Movement. In what would become a powerful image of environmental activism, demonstrators attempted to

prevent dump trucks carrying the toxic materials from entering the community by lying in the street.[x] On the heels of the Modern Civil Rights Movement and Black Power Era of the 1960s and 1970s, the environmental injustice era certainly gained momentum with the national attention and protests these two episodes of environmental racism generated. However, by placing too much of a focus on environmentalism and race in the 1970s and 1980s, we can miss earlier moments of environmental racism that in part help inform later movements and ideologies.

In his classic 1937 text, *Caste and Class in a Southern Town*, sociologist John Dollard uses a lens of mostly class, power, and occasionally race to highlight a historical connection between spatial vulnerability and environmental landscapes. [xi] Most likely Dollard was describing the Yazoo Mississippi Delta town of Indianola, Mississippi (MS) in Sunflower County, approximately 90 miles north of Jackson, MS. According to Dollard, Indianola “is a small town, just about large enough to qualify under the census as an urban area. It is flat as a tennis court but with a bit of a tilt, the white people living on the upper half. Should floods come, the Negro quarter would be first under water. Southerntown is bisected by a railroad, and its tracks divide people according to color, the whites living on one side and the Negroes on the other.”[xii] Dollard’s text provides a framework for thinking about the early history of Princeville and environmental injustice, in particular how African Americans and people without power have often been relegated to the most dangerous, marginal, and vulnerable spaces.

Perhaps no space represents the periphery of human existence as do swamps. Not fully land and not fully water, swamps were dreaded spaces in the nineteenth century, a place of unknown danger where “miasmas” and “effluvias” arose from enigmatic and ghostly landscapes that

caused sickness and death in pre-germ theory consciousness.[xiii] Nineteenth-century perceptions of swamps were that these places were inherently diseased and dangerous. Swamps were places that foreign “beasts” or alligators inhabited; animals that did not reside fully in water or fully on land were particularly feared in swamplands. Historian Conevery Bolton Valencius describes these places as “alien and threatening, the animals inhabiting swamps were symbolic of their pervasive and clinging dangers.”[xiv] Both the animals that inhabited swamps and the terrain itself were dangerous. Yet, swamplands have a more complicated history and narrative. During slavery, swamplands, though dangerous and a place where it seemed like a multitudinous number of animals converged and evoked strange and frightening noises, provided a route for escape from slavery for runaways. Runaway slaves were safer fleeing near swamplands and escaping through these spaces as dogs might lose their scent and planters attempting to track them down might fear entering into these dreaded places.[xv] The Great Dismal Swamp between North Carolina and Virginia was the home of maroons, runaway slaves who defied plantation slave economies throughout the New World by living in mountains, swamps, and forests within territories of slavery.[xvi]

Early Princeville residents had to endure harsh swampland to survive. Their existence in this space was not a matter of chance or choice, but instead the discarded and unwanted space was what former slaveholders allowed them to occupy. Historian Sylvia Washington Hood describes this as the environmental “others,” or those “forced to live in geographical spaces (communities) within the society that are or are becoming environmentally compromised because of their ‘otherness’...they are the proper place for everything deemed to be undesirable (people and waste).”[xvii]

The Environmental Landscape of Race

The early years of Freedom Hill and Princeville were extremely difficult because of the landscape of place and the landscape of race. The Tar-Pamlico River's headwaters begin in the Piedmont region of the state and the river slowly meanders through the eastern coastal part of the state, ultimately spilling into the Atlantic Ocean. Approximately 180 miles long, The Tar River-Pamlico basin is the fourth largest in the state,

and one of only four rivers whose boundaries are located completely inside the state of North Carolina. The Tar River is a slow-moving body of water, low-lying, marshy, and swamp-like in certain places, historically susceptible to flooding and overflows.[xviii] Documented floods of the Tar-Pamlico River basin occurred in 1800, 1865, 1889, 1919, 1924, 1940, and 1958.



*Tar River water level elevated almost to reach the bridge. Date from negative sleeve.
Daily Reflector (Greenville, N.C.), January 26, 1954.*

Like other towns in the river basin, Princeville's legacy is one of perseverance and endurance against the constant threat of seasonal flooding in a very difficult landscape. But Princeville had more to persevere against than seasonal flooding. The mere presence and economic self-sufficiency and stability of an all-black town during the segregated Jim Crow south were an affront to racial segregationists. Put in more stark terms, Princeville infuriated segregationists who opposed any type of self-sufficiency and power among African Americans. Predominately African American and self-sufficient towns as well as black business districts in places like Tulsa, Oklahoma or Durham, North Carolina experienced violent opposition from segregationists in the early twentieth century.[xix] Historian Rayford Logan coined the term Nadir to describe the heightened racial violence and lynching experienced by African Americans between the 1880s and 1930s when roughly 3,800 people were lynched in the United States.[xx] African

Americans were lynched for any of a number of transgressions against white society in Jim Crow America, including entrepreneurship and being self-sufficient. Well known is the story of Ida B. Wells-Barnett's friend lynched in Memphis, Tennessee for owning a successful store, an experience that would lead her into the anti-lynching crusade.[xxi] Throughout the twentieth century, Princeville residents constantly dealt with racial attacks and intimidation, as well as economic social isolation from the state. Infrastructural neglect from state officials was consistent during the era of segregation and beyond. Princeville's story is, therefore, representative of an argument that I make in other contexts, particularly that African Americans have often dealt with a double burden of environment that includes human and non-human factors.[xxii] The frequent flooding of the Tar River can only be understood alongside the high tide of violence Princeville residents evoked by the mere audacity of their existence.

Princeville and Contested Meanings of Water

The story of Princeville is also about the historical misuses of water. Leisure, for instance, has been defined through the politics of difference. During the Jim Crow era, public beaches, resorts and parks, from California to Florida, excluded African Americans from being able to swim and enjoy nature.[xxiii] African Americans and other minorities were often locked out of access to water in the form of leisure. Battles to desegregate access to beaches could be as vitriolic as those to desegregate lunch counters in Alabama, the desegregation of housing in Chicago, and schools in Topeka, Kansas. The large and sparkling municipal swimming pools built in southern cities were mostly off limits to black swimmers, who instead had to swim in creeks, lakes, and rivers

that could be dangerous. Powerful undertows, water moccasins, and alligators were just some of what black swimmers had to contend with in these uncontrollable bodies of water. African Americans entering a southern municipal pool would have been perceived as a profound transgression of racial norms that could easily provoke violence, particularly when scantily clad white women and black men were in the same space. [xxiv]

The color line of segregation extended beyond pools and into other bodies of water. When the 1919 Chicago race riot began because of a black boy crossing an imaginary racial line while swimming, it reflected what was widely considered a

commentary of race, but rarely considered an issue of race and nature, even though the key to the moment was access to nature and access to water.[xxv] For most scholars of African American history and environmental history, this key component of one of the most violent race wars in American history is subsumed under the ensuing conflict. The important role of water is lost, and particularly the idea that white access to this public water was somehow natural; African Americans must always know their “place” even when that place is in water.

On yet another level, water infuses the narrative of the Civil Rights Movement. Swimming pools were not only a site of segregation in terms of swimming, but as I argue in my earlier work, water was harshly employed by cities and municipalities as a way of attempting to discipline black bodies away from activism. When civil rights activists attempted to bring segregation to an end in places like Birmingham, Alabama, the police and firefighters turned water hoses on them with such force that it knocked some protestors down and literally ripped the skin off others. A natural and life sustaining resource to all human beings, in this instance water was transformed into a weapon of racial violence.[xxvi]

By 1965 Princeville was successful in initiating some modern environmental improvements that allowed the town to continue to prosper and grow, including the construction by the United States Army Corps of Engineers of a dike for the protection of Princeville against flooding. [xxvii] While Princeville’s population remained small, there was an upsurge of population and business interest in the town during the decades after 1965. By the end of the twentieth century, Princeville and the region continued to face many economic problems, however. The eastern part of North Carolina is the poorest region in the state. The median family income for Edgecombe County, where Princeville is located, is just \$34,000 per year. The rate of individuals living below the poverty line in the county of over 55,000 residents is almost 23 percent, roughly 8 percent higher than the state-wide average. The 41 counties that make up the eastern portion of the state have a higher rate of almost every disease than the rest of the state. Morbidity and mortality rates from diabetes, cancer, cardiovascular disease, and stroke are high in the region, as are rates of obesity that are directly related to questions of poverty. African Americans and Hispanics in the region suffer disproportionately from these diseases and illnesses, mirroring state-wide and national trends.[xxviii]

Princeville and the 1999 Hurricanes

This was the backdrop in 1999 when back-to-back hurricanes occurred. In early September 1999, Hurricane Dennis struck the coast of North Carolina, bringing winds of just over 70 mph. Just 10 days later another hurricane, Floyd, would hit the coast bringing significantly higher winds of 130 mph. Floyd was a broad storm with a wing-span of some 580 miles that liberally spread rainfall and high winds up the east coast and Atlantic states. Still reeling from the saturated landscape and 6 to 8 inches of rain brought by Hurricane Dennis, North Carolinians nervously

anticipated the arrival of Floyd which came ashore in the early morning hours of September 16th on the Cape Fear coast. The storm quickly brought an additional 12 to 15 inches of rain on the eastern part of the state during the first day, and altogether more than thirty North Carolina counties were impacted by the storm. The Tar River, Pamlico River, Neuse River, Roanoke River, and other smaller creeks and streams began flooding from the rainfall of Floyd, pushing floodwaters onto the farmland of eastern North Carolina. Officially there were 51 recorded deaths

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from Hurricane Floyd, though the accurate recording of deaths from environmental disasters has always been an inexact science. More than 17,000 homes were destroyed and another 56,000 partially damaged by wind force or flood waters that kept Princeville under water for 11 days. Still, thousands of eastern North Carolinians lived for years in what were called “FEMA-villes.” This compilation of make-shift trailers, nicknamed “Camp Depression” by some residents, was located outside of Rocky Mount near a landfill. Using the lens of Princeville’s founding and the history of environmental activism against toxic materials and the unwanted placement of a dump in Warren County just under two decades earlier, Princeville residents found themselves once again in a continuum of

poor people and minorities being forced into degraded spaces.

In many ways Princeville was a powerful, yet unacknowledged precursor to Hurricane Katrina six years later. Many of the frustrations with the Federal Emergency Management Agency (FEMA) were registered by both Princeville and Katrina survivors, particular in terms of how long it took the organization to provide relief. In a 2014 report on Princeville, current and former residents of Princeville believed that relief from FEMA after the hurricane was slow, echoing similar criticisms of FEMA after Katrina.[xxix] The report also acknowledged the strong historical ties of place that both Princeville and New Orleans residents voiced after being displaced from their homes. “Like New Orleans, the natives



*Aerial photograph of inland flooding caused by Hurricane Floyd.
Photographer J. Jordan of the US Army Corps of Engineers.*

of Princeville exhibited a strong connection to the community.”[xxx] At stake was the legacy and memory of Freedom Hill.

By 1999 Princeville was still a relatively small town with just over 2,000 residents, many of whom were direct descendants of the original settlers. There were roughly 850 single-family homes, approximately 40 businesses, and 3 churches, one of which, Mt. Zion Primitive Baptist Church, was constructed in 1876. Flooding from Hurricane Floyd submerged the entire residential and business area of Princeville for almost two weeks with 15 to 20 foot high floodwaters. For this historic town, Hurricane Floyd was nothing short of devastating. For residents of Princeville, the hurricanes might have seemed fortuitous to those interested in their demise. Though Princeville’s first settlers were initially forced into environmentally degraded land, by the mid-twentieth century their waterfront location had been re-defined by local and state officials as prime real estate property. The result is that Princeville has often dealt with both real and imagined pressure to cease existing as an all-black community, and to allow their property to be annexed by surrounding towns.

In the weeks after the storm hit the North Carolina coast, rumors began circulating that perhaps the suffering of Princeville was not completely the result of Hurricane Floyd. Soon the rumors were confirmed. The city of Rocky Mount, located roughly sixteen miles to the west of Princeville along highway 64, had opened the floodgates to the Tar River Reservoir Dam during the first days of the storm in the hopes of averting disaster. The Tar River Reservoir was completed in 1971 as a drinking water conservation project primarily for the city of Rocky Mount which had been suffering through severe droughts in recent years. The decision and actions of Rocky Mount seemed to have occurred very quickly during the first 48 hours of Hurricane Floyd as the Tar Reservoir, like other natural and unnatural water systems in the region, was threatening to

flood. In an interview with UNC-TV that aired December 6, 1999, Peter Varney, the assistant city manager for Rocky Mount, suggested that the city was “wrapped up in an unbelievable flood of decisions, problems, and issues. We just went ahead and dropped that...gate. It appeared to us that what would come by lowering the gate by two feet would not be noticeable.”[xxxii]

By “dropping that gate” Rocky Mount became part of a long and contested narrative of self-preservation and folklore around flood control. During the 1927 Mississippi River Flood, the City of New Orleans deliberately destroyed the levee around Plaquemines Parish; their hope was that if a neighboring area flooded, New Orleans would remain safe from the harshest elements of the flood. Neighbors up and down the Mississippi River and tributaries placed armed guards on levees to prevent sabotage by neighbors.[xxxiii] There were rumors that levees were deliberately blown in black neighborhoods during Hurricane Betsey in 1965 that nearly destroyed New Orleans, and again in 2005 during Hurricane Katrina. Because of what occurred in New Orleans during the 1927 flood, such rumors were never without some merit of concern as historical rumors and memory might hold grains of truth and reality.[xxxiiii] Importantly, the use of water technology in the creation of suffering is crucial to the story as well. In his classic work *The Whale and the Reactor: A Search for Limits in an Age of High Technology*, social theorist Langdon Winner asks whether “artifacts have politics” and how we might imagine culture, politics, class dynamics, and race within the theoretical and practical development of technological systems. “At issue is the claim that the machines, structures, and systems of modern material culture can be accurately judged not only for their contributions to efficiency and productivity and their positive and negative environmental side effects, but also for the ways in which they can embody specific forms of power and authority.”[xxxv] Technological systems have politics precisely because technology does not and cannot exist outside of human

intervention, therefore people make choices about levees and dams, and when to “drop that gate” or not.

State officials argued that Rocky Mount’s actions were acceptable under the circumstances, and made the point that opening the flood gate likely did not increase the level of downstream flooding

to a significant degree. However it has never been confirmed how much water was actually sent downstream by Rocky Mount’s actions. The moral and ethical tension of the situation also revolved around whether Rocky Mount was required to, or should have informed their downstream neighbors of their impending action.

Who Controls Water?

The fundamental question of the Princeville disaster was who controlled the water? Questions of water control, riparian laws, and the rights of upstream and downstream neighbors have been part of legal case studies since at least the early nineteenth century. Legal cases, dealing mostly with upstream actions on downstream neighbors, including but not limited to mill operations and dam use, leaned heavily upon precedent cases of ancient water use laws or “reasonable use.”[xxxv] While this history of water use law is fairly extensive, the literature around more emergency uses of water in the context of environmental disasters is less developed. This is the particular niche where the Princeville disaster comes to light. To be sure, water rights laws remain complex in the twenty first century and it remains unclear if Rocky Mount city officials actually did anything wrong when they opened the floodgates that perhaps increased floodwaters toward their downstream neighbors. The optimal word here is uncertainty. Water and particularly flooding can be a difficult concept to measure in this context, and perhaps we can never fully know whether the actions of Rocky Mount contributed significantly to the downstream flooding of Princeville. Perhaps the town of Princeville would have endured a similar fate regardless of the actions of Rocky Mount. However, I would make the case this is beside the point. The perception, whether real or imagined, that Princeville was sacrificed by their upstream neighbor goes a long way into tapping into the frustrations of not simply race

and class, but the two century long struggle of downstream neighbors to fend off and demand equality from the seemingly sacrificial actions of those more pristinely situated up-river. In this particular case, it also represents Princeville’s century long struggle for survival against both environmental and human threat.

The story provides an important case study for historians and others to think about water usage and law during environmental disasters and the ways in which decisions of water rights reflect long-standing legal narratives of the control of water. In a certain sense, history is just as much about what we can “prove” as what we think. The perception of African Americans in the eastern part of the state was that the water-front property of Princeville and the lives of Princeville residents were much less valuable than those of Rocky Mount. Interestingly enough, this was the argument made by riparian plaintiffs in the eighteenth and nineteenth centuries.[xxxvi] But Princeville also fits into the conversation of power and advantage. Decisions are not made within a vacuum, but importantly can be linked through history to questions of worthy and unworthy sufferers. Freedom Hill survived an environmentally difficult landscape in the immediate period after the Civil War. Princeville residents have been fighting all kinds of environments along the Tar River ever since.

Conclusion

Princeville is a story of resiliency in the face of harsh environments. Though it never generated the headlines of Hurricane Katrina or Superstorm Sandy, Princeville represents an important narrative of disaster and survival. In ways similar to New Orleans, Princeville has struggled to rebuild its community fabric and infrastructure in

the more than a decade since the hurricanes. Yet, traveling on highway 64 the sign for Princeville is still there, signaling the presence of a resilient community located on space that was as contested in the nineteenth century as it remains today.

Footnotes

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[ii] Jim Downs, *Sick From Freedom: African-American Illness and Suffering during the Civil War and Reconstruction* (New York: Oxford University Press, 2012).

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[vi] Victor E. Blue, "Reclaiming Sacred Ground: How Princeville is Recovering from the Flood of 1999," *North Carolina Crossroads*, Vol. 4, No. 3 (November/December 2000).

[vii] Blue, "Reclaiming Sacred Ground."

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- [xxviii] Statistics come from the East Carolina University Center for Health Disparities.
- [xxix] "Princeville, NC Flood Risk Management Report.
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About the Author

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FEATURE

DISTURBING THE MISSISSIPPI: THE LANGUAGE OF SCIENCE, ENGINEERING, AND RIVER RESTORATION

By Christopher Morris

From top to bottom, projects aimed at restoring the Mississippi River are underway in both deed and word. In the area of the Twin Cities,

the U. S. Army Corps of Engineers is dredging pools along the floodplain and using the sediment to construct islands and restore wetland



Flooding in New Orleans.

NASA image courtesy Lawrence Ong, EO-1 Mission Science Office, NASA GSFC.

fish and waterfowl habitat. In the area of New Orleans, a coalition of engineers, scientists, and nonprofit organizations is likewise dredging and redirecting sediment in an effort to stem erosion of the Mississippi River delta and the Louisiana coastline. In between the upper- and lower-most portions of the river, conservation groups are restoring a forested floodplain habitat upon the batture, the ribbon of land between the levees and the river. Restoration of river and floodplain habitat in the Mississippi valley is part of a national and international trend. Across the country, decades-old dams are coming down, floodwaters are returning to floodplain, and migratory fish are swimming in streams where they

have not been seen in living memory. Around the world, from the U.K. to India, governments and NGOs are formulating plans and raising funds to restore river and floodplain habitat.[i] Much of this restoration work is undertaken in the interest of minimizing or rolling back the effects of disturbances, such as hurricanes, erosion, and urban development, and shoring up resilience, a river's natural ability to resist disturbances. However, the words used to explain river systems have come to explain what threatens them, and to explain what river restoration must therefore accomplish. Words shape deeds. This essay explores some of the history of the language of river science, engineering, and restoration.

River Restoration

River restoration is a concept whose time has come. It is inspired by the growing awareness of human alterations of the global environment, and of climate change perhaps most of all. It also represents a reaction to the absolutely wretched state of so many rivers and the problems they pose for human health and welfare if remediation efforts are not undertaken.[ii] In some cases, modifications of rivers made during the industrial era have outlived their usefulness, so they may be dismantled without controversy.[iii] There is no shortage of good reasons to restore the world's rivers. However, there may also be reason to question some of the assumptions behind so many river restoration projects, including those underway along the Mississippi River.

Many of the Mississippi River restoration project planners invoke the concept of disturbance. For example, a proposal by the Lower Mississippi River Conservation Committee to restore floodplain forest habitat upon the batture between Cairo, Illinois and Vicksburg, Mississippi explains that many of the targeted locations comprise

“relatively intact ecosystems,” which “tend to respond better to disturbances.” A report authored by a group of scientists and engineers working to restore the Mississippi River delta discusses the relationship between what it calls bottom-up and top-down disturbances. An Army Corps of Engineers paper on Upper Mississippi River System Ecosystem Restoration Objectives considers how the river's ecosystems might be managed so as to be “more productive of native life forms and resilient to human and natural disturbances.” According to a Nature Conservancy report on the Mississippi River alluvial valley in Louisiana, centuries of “natural disturbance,” including hurricanes, disease, and fire, shaped the region into one of “the most productive ecosystems in North America,” until human disturbance, such as levees and deforestation, degraded the system. [iv]

Concepts of Disturbance and Resilience

Promotional literature for many river restoration projects offers only a simple gloss on the concept of disturbance. Nevertheless, it betrays the science upon which the projects are frequently based. Conservationists speak of natural and human disturbances to ecological systems, and of the resilience of those systems in the face of disturbances. Engineers and city planners seek to prevent flood disturbances and to make human communities more resilient. Disturbance has become a widely used concept within stream ecology to describe forces that intrude upon and often upset ecosystems, which, if resilient, survive and quickly rebound.

Science, which we like to think of as hypotheses formulated and tested with data carefully collected by objective researchers, owes much to language. The word “disturbance” means the interruption of or interference with the regular order or process. A disturbance, by definition, cannot be part of the system it upsets. It exists and acts upon the system from outside of it. A flood, for example, considered as a disturbance cannot be considered as a component of the floodplain ecological system, not because research indicates it is not—which may or may not be the case—but because the word by definition means it cannot be part of the floodplain ecological system. Scientists, like all people, use words to convey meaning and understanding, to conceptualize observed phenomena, to formulate questions that guide investigations. Once used, however, once fixed in the scientific lexicon, some words can take on lives quite apart from the research and ideas of the scientists who first used them. A scientist who sets out to study the effect

of flood disturbance on a floodplain ecosystem has already decided what the relationship between a flood and a floodplain is, before initiating any research, and thus all research will help prove that floods are indeed disturbances, that they are outside forces that disrupt or interfere with floodplain ecologies. To consider floods as otherwise would require an imaginative leap over a linguistic hurdle.

The power of words can give rise to more and equally powerful words. An ecological system’s resilience to disturbance is a linguistic contrivance. Whatever the physical and material relationship is between floods and ecological systems, scientists, engineers, and conservationists have chosen to characterize it in terms of disturbance. Because they see floods as disturbances, they also see ecological systems in terms of resilience. Research into resilience—resilience studies is a rapidly growing field—assumes disturbance and cannot question or challenge it, for without disturbance there can be no resilience. So long as the words are used, research, no matter how careful, thorough, or objective, will necessarily confirm the apparent reality of disturbance and resilience. The relationship between a river and its floodplain, ostensibly an object of investigation, is assumed from the outset. The work of stream ecologists often informs the work of engineers, and increasingly, the work of conservationists.

History of the Concept of Disturbance

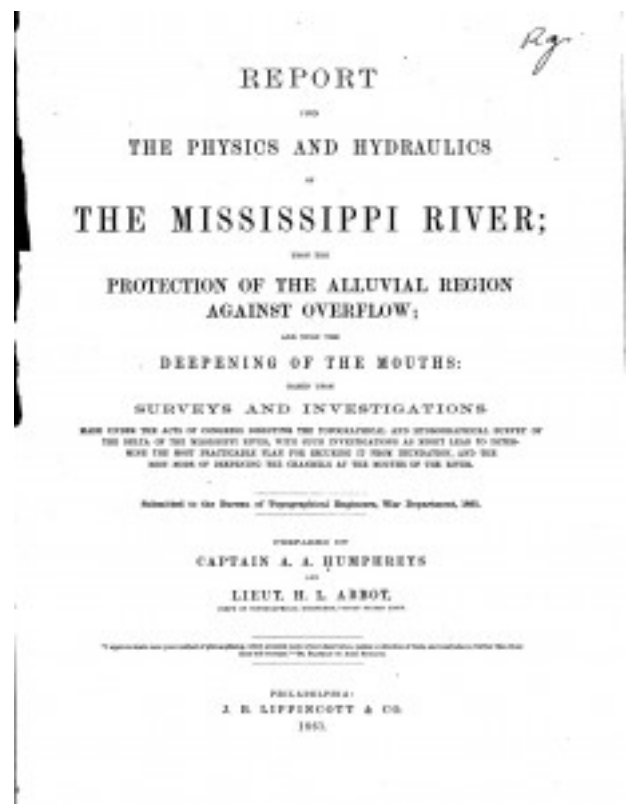
Where did the concept of disturbance, in particular as applied to the Mississippi River, originate, and why that word? It has not always been used to describe the river. In 1861, Andrew Atkinson Humphreys and Henry Larcom Abbot released the first scientific survey of the lower Mississippi River. Nearly six hundred pages in length, with chapters on the state of the science of hydraulics, methods of gauging velocity and discharge, and experimental theories of water in motion, and with over one hundred pages of tabulated gauge registers, soundings, velocities, and computed dimensions of river cross-sections, the report was nothing if not thorough. The authors claimed to have ascertained “every important fact connected with the various physical conditions of the river and the laws uniting them.” After more than four hundred pages of mind-numbing data and discussion, with not one doubt that they might have lost their readers’ attention hundreds of pages earlier, they at last made their point: The Mississippi River could be controlled with levees only, from Cape Girardeau to the Gulf of Mexico. [v]

Humphreys’s and Abbot’s conclusion settled a long debate over how best to control flooding along the Mississippi River. Since the days of the French and Spanish governors, many methods had been proposed, but authorities hesitated to fund one or another unproven scheme. Of course, no scheme could be proven to work until money was spent and construction completed. But the Humphreys-Abbot report seemed a safe bet, because it was so long and thorough. Whereas other engineers and hydrologists presented proposals based on succinct and sometimes even elegant theories, Report of the Physics and Hydraulics of the Mississippi River crushed all theory under an onslaught of numbers. The authors practiced science rather like the army that employed them would battle in the war just



Andrew A. Humphreys, Chief of Engineers, who conducted the first scientific survey of the Mississippi River.

Image source Library of Congress Prints and Photographs Division. Brady-Handy Photograph Collection.



Cover page to Chief Humphreys’s scientific survey, by A.A. Humphries, and H. L. Abbot, 1861.

then getting underway. By war's end the flood control structures, which had been so inadequate when Humphreys and Abbot first set about their research, lay in ruins. The landowners and states responsible for maintaining them were

impoverished. Congress had to act. Republished in 1867, the Humphreys-Abbot report guided the science and engineering of the Mississippi River well into the next century.

Theories of River Behavior

Humphreys and Abbot approached science empirically. They said nothing about disturbance or resilience. They resisted proposals to control flooding based on theories of rivers and deltas. The Mississippi may have been pulled over the surface of the Earth by gravity, same as any river, and it may have meandered and topped its banks like many rivers—other engineers liked to compare it to Italy's Po River—but ultimately, the Mississippi River was like no other river. It was exceptional, Humphreys and Abbott argued, and therefore it had to be thoroughly understood on its own terms. Knowledge of other rivers would not take engineers very far toward understanding how to control the Mississippi.

At the moment that Humphreys and Abbot were rejecting theories of river behavior, biologists and ecologists were becoming more theoretical. In 1859, two years before the publication of the Humphreys-Abbott report, Charles Darwin published *On the Origin of Species*. In 1876,

three years before the establishment of the Mississippi River Commission and the beginning of the implementation of many of Humphreys's and Abbot's recommendations, Lester Ward published an article that proposed a modification of the Darwinian theory. Evolution could not be the result of adaptation to natural environment, Ward argued, because many plants were in fact not ideally suited to their environments, and thrived when transplanted to places where they were not normally found. In many settings, Ward argued, plants lived in a state of static equilibrium forced upon them by the other plants in their community. When an outside force disturbed that community, however, plants adapted, some better and sooner than others. Thus, the process and pace of evolutionary change depended on equilibrium and its opposite, disturbance.[vi] Ward went on to a noted career as a sociologist, leaving others to pursue his original work in botany. Very quickly there emerged a consensus that the normal state for biological communities



The Po River by Giorgio Galeotti.

was one of equilibrium, which was to be expected because a disturbance, by definition, could not be normal. For decades, researchers debated the nature of the state of equilibrium, whether it was “forced,” to use Ward’s word, upon individual species by the competition among them, as they pushed against each other in a kind of Newtonian world of opposing forces, or whether equilibrium was the result of mutual interests among species existing within a harmonious interlocking community, what Frederic Clements

called a super organism. Early into the twentieth century, Clements proposed a concept of plant communities that, barring disturbances such as fire or agriculture, moved through a succession of stages toward a final climax stage of stability and equilibrium. Regardless of whether equilibrium was a standoff between competing species, or a harmonious balance between them, equilibrium was thought to be normal, and disturbance, no matter how inevitable, frequent, or regular, was not normal.[vii]

Balance and Equilibrium

The concept of equilibrium as normal spread beyond science and informed the popular notion of the balance of nature. Disturbances upset the balance. Old growth forests epitomized the balance of nature. Logging and forest fires epitomized disturbance. For anyone who thought about rivers, whether professionally or because they lived near one, floods were disturbances that upset the balance of nature along the river’s edge. Geologist Harold Norman Fisk applied equilibrium theory to his research on the Mississippi River, arguing that the river had moved through several stages of development, from several braided streams to a single meandering stream that regularly jumped its banks and changed course, to an increasingly straight and stable stream, as forces of gravity, resistance, and turbulence came into balance. Floods, Fisk argued, were disturbances, signs of instability, which in time would diminish as the river settled into its final, climactic stage. Indeed, Fisk believed that levees and other devices could even assist a river system’s progress toward climax and stable equilibrium.[viii]

On April 6, 1937, Chief of Engineers Edward Murphy Markham submitted his “Comprehensive Flood-Control Plan for Ohio and Lower Mississippi Rivers” to President Franklin Delano Roosevelt, who reviewed and endorsed it, and

then three weeks later submitted it to the chairman of the House Committee on Flood Control.



Harold N. Fisk’s Ancient Courses of the Mississippi River, Plate 22, Sheet 9. SOURCE: H. N. Fisk, Geological Investigation of the Alluvial Valley of the Lower Mississippi River, Oversized Plates (Vicksburg: Mississippi River Commission, 1944).

That year an Ohio River flood broke records. More than 500,000 people fled their homes. As the crest of water moved into the Mississippi River valley, it tested structures put in place over the previous decade. For the most part, the Mississippi’s levees held, and the floodways and



Chief Engineer Edward Murphy Markham on the St. Francis River levee in Arkansas, with Harry Hopkins, Head of the Roosevelt Special Flood Commission, February 1, 1937. Image reverse [available](#). Image used with permission, Jeff Daly.

spillways worked. Successful flood control on the Mississippi proved that new engineering would work on the Ohio and elsewhere.

Chief Markham's plan recommended nearly half a billion dollars in appropriations for new flood control structures. This was quite a request in a year when the economy collapsed into recession, as GDP fell by 30 percent. The Chief justified the expense by pointing to the success his engineers had had in the Mississippi valley, and by noting that the costs barely surpassed the estimated damages of a major flood. Most of all, he justified the expense in terms of human costs. "While

figures have been compiled to establish the monetary benefits from the construction of the works that have been described," Markham argued, "and to establish their economic justification, I am of the opinion that the real justification for this large expenditure is to be found in the saving of human life and suffering, and in the prevention of the disturbance of the affairs of the Nation brought about by a flood disaster. I do not hesitate to recommend the construction of the works on these grounds alone."^[ix] And there was the word, "disturbance," used perhaps for the first time officially in reference to engineering in the Mississippi valley. Markham used the word to



1937 Ohio River Flood.

represent the river as an outside force intruding into human affairs. In the next decade, the Corps of Engineers hired Harold Fisk and began to

redesign the Mississippi and its tributaries in accord with his theories of stages of climax and equilibrium.

Resilience

In 1973, Clifford “Buzz” Holling, then at the Institute of Resource Ecology at the University of British Columbia, published an article on the resilience of ecological systems, in which he defined resilience as a system’s ability “to absorb change and disturbance and still maintain the same relationships between populations or state variables.”[x] What Holling sought was a way of

understanding change and stasis, disturbance and equilibrium. The concept of resilience recognized that disturbance was frequent, and frequently quite natural, so natural, in fact, that systems often bounced back quite quickly. The normal state of ecological systems, argued Holling, was not static equilibrium, but adjustment and change to meet forces of disturbance.

Holling was among the first scientists to break free of the concept of equilibrium, which had dominated ecology for much of the twentieth century. Equilibrium meant nothing without the idea of disturbance, a force capable of upsetting equilibrium, and yet as a scientific concept, disturbance remained undeveloped until much later in the century. Holling focused on resilience, shifting emphasis away from undisturbed equilibrium and toward the speed and means with which systems recovered from disturbance. Disturbance and resilience, not equilibrium, were normative, Holling argued. Although Holling was not specifically interested in disturbance, his interest in resilience necessarily drew attention to it as a concept, which others began to develop into formal theory. In 1988, Vincent Resh and a large team of co-authors published a groundbreaking report on “The Role of Disturbance in Stream Ecology.”[xi]

Holling, Resh, and other writers sought to move their field beyond the concepts of equilibrium and climax, and yet they persisted in thinking of disturbances as outside forces acting upon closed systems, just as Ward and Clements had done. Even theorists who, by the 1990s, began to see Mississippi River floods as integral to the health of floodplain ecologies, still thought of them as intrusions. In an important article published in 1990, Richard Sparks argued that the 1973 Mississippi River flood, while “a major disturbance to man,” “was not a disturbance to the biota, because it occurred in the spring at the time ‘expected’ by the floodplain spawners and migratory birds, and simply increased spawning and feeding habitat available.” However, Sparks’s continued use of the word “disturbance” limited his efforts to integrate flooding into the floodplain ecology through what he termed the flood pulse concept, because he continued to regard floods as intrusions. He distinguished intrusions into ecological systems that upset those systems from intrusions that did not—there were disturbances that disturbed and there were disturbances that did not disturb—but the word meant he could



Clifford S. Holling discussing his concept of resilience.

Source: [YouTube](#).

only conceive of a flood as a force from outside the system and not as an integral component of it. Similarly, resilient systems for Sparks were those that were not easily disturbed by disturbances. The word itself, which originated with the concept of equilibrium, continued to shape the science of stream ecology long after ecologists rejected the concept of equilibrium.[xii]

Resilience is no more real, that is to say, no more natural than a state of equilibrium. Indeed, the concept of a disturbance regime, in which resilience and disturbance are balanced, is, I would argue, equilibrium theory in new packaging. Equilibrium, resilience, and disturbance are concepts—words—for articulating observed ecological change or system behavior. But what is inside and outside is constructed by the terms. The boundaries of an ecological system end where a river meets its bank, where water meets land, liquid meets solid. But these boundaries exist only partly in nature, for they also exist in the language scientists use to describe nature. The boundaries are never really interrogated, because the words that define them also reify and naturalize them. Land and water and the ecological systems upon and within them are defined as separate, each outside of the other, and when they mix they are each seen as disturbing the other, to greater or lesser degrees depending on the resilience of each to the other. Water

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disturbs the floodplain; silt disturbs the river. Both bounce back if they are resilient. In this linguistic context, the distinction between what is human and what is natural can really muddy the waters, so to speak. Levees disturb the interaction between river and floodplain, except when that interaction is itself a disturbance that levees can prevent. A human disturbance put in place to counter a natural disturbance raises questions

for river restorationists: What is the real disturbance? The naturally occurring flood? The human-constructed levee? The flood that occurs because of the levee? The human-construction of devices to counter the effect of levees? The debates that occur after disasters—was Katrina a natural disaster or was it caused by human recklessness?—stem in part from the dichotomy perpetuated by the language of disturbance.[xiii]



In the spring of 1973 the Mississippi River reached its highest level in more than 150 years.

Restoration as Creative Disturbance

For ecologists, engineers, and even landscape architects who work on ecological restoration projects, human intrusions into a system that are intended to improve resilience, even though they come from outside the system, are not thought of as disturbances because they contradict or cancel other disturbances. Ecological restoration uses targeted human intrusions to restore ecological systems to an undisturbed state. Initially, a disturbance was anything that disrupted a state of equilibrium; where there was no equilibrium, there had to be disturbance. In time, disturbance came to mean anything from which a system could not rebound, anything that overpowered a system's resilience. Where resilience failed, there must be disturbance. But what, then, of restoration? How do we think of outside forces—disturbances—that improve resilience to outside forces? The politics of river restoration can become tricky the more one person's human disturbance becomes another person's effort to enhance resilience.[xiv]

Recent uses of the concept of disturbance tend to collapse differences between natural and human forces that act upon ecological systems. They also confuse the efforts of scientists to distinguish between what might be called creative and destructive disturbances. For example, human modifications of rivers originally intended to prevent natural disturbances (e.g. levees) have come to be thought of as themselves disturbances that reduce natural resilience. If, however, human modifications can make a river system more resilient in the face of natural disturbances—fires, storms, floods, weather events—then those modifications are not called disturbances. Proactive conservation measures, which are, after all, human intrusions into a natural system, are seen as less disturbing than natural disturbances.

Human (destructive) disturbances have modified the Mississippi River delta and the coastal marshes of Louisiana, making them less resilient to the natural disturbances of hurricanes, coastal erosion, and saltwater intrusion. In response, there are growing human interventions—creative disturbances, though they are not referred to as such—aimed at restoring the natural resilience of the delta and the coast. Natural disturbances are treated as destructive or creative in relationship to human disturbances. In the narrative of delta and coastal degradation, hurricanes and tides are (creative) disturbances that maintain coastal wetland resilience, until human (destructive) disturbances, such as levees and the activities of the gas and oil industry, weaken their ability to withstand natural (now destructive) disturbances. To save the Louisiana coast, to make it more resilient, requires still more human intervention, that is to say, human (creative) disturbances.

The problem, of course, is with the word. In 1937 Chief Engineer Markham sought congressional funds and authorization for levees that would stop the river from flooding. A half-century later, Richard Sparks surveyed some of the damage done to the Mississippi River system by those levees, and argued for a program of restoration engineering that included floating breakwaters, artificial islands, and the planting of aquatic macrophytes. Left alone, rivers recover somewhat, he argued, from both human and natural disturbances, however, “human intervention and continued maintenance will likely be required to maintain habitat diversity and desirable functional system characteristics.” More to the point, he concluded, “man is required to take over many of the rejuvenating functions” that rivers once performed on their own.[xv] But whether they identified man or nature as villain, Markham and Sparks both called for people to step in heroically to stop disturbances. The meaning of the word

is unclear, in part because as its meaning has changed over time, it nevertheless carries residual meanings. One cannot hear Richard Sparks use the word without also hearing a little of Chief Markham. Consequently, the concept

of disturbance is no longer very explanatory, if it ever was, and its application to phenomena thought to be destructive, creative, or both at once can seem rather arbitrary.

Designing Stability and Clarity

In the August 2013 issue of *Landscape Architecture Magazine*, regular contributor Lisa Speckhardt reported on the stream restoration work of two landscape architects. Paraphrasing them, Speckhardt wrote, “Disturbance, of course, affects how watercourses work, but in a dynamic way.” She continues, quoting architect Chris Sass: “Streams will go through a series of three or four adjustments in form to achieve a new stability.” Thus, Speckhardt concluded, “It is important to know what the stream’s succession is going to be and where you are in that succession in order to do restoration.” I suggest, however, that the relationship between “disturbance,” “stability,” and “restoration” demand interrogation. The first two words, disturbance and stability, are clearly set in tension, which means restoration is all about resolving that tension. But is that tension real, that is to say, observable in the natural river system? Or is it a product of the language

ecologists, engineers, and landscape architects use to describe rivers? What if floods are not disturbances, but rather are stabilizers, or restorers, or transformers? Whatever we call them and however we decide to think about them, they are still floods caused by water and land, gravity and resistance, friction and turbulence, and they contain and touch, feed and drown, many living organisms and communities of organisms; that much we know. Are they disturbances? What does resilience mean if we think of floods as restorative? What is restored by river restoration projects if we no longer have a concept of disturbance? Remove the word disturbance and thereby remove the tension? These are questions that do not get asked, largely because the word disturbance answers them preemptively. Inquiry into the behavior of rivers stops the moment our words—disturbance, stability, resilience, restoration—tell us how rivers behave.[xvi]

Drawing Lines

The lines that separate what is inside and outside a system are not always clear, though they must be drawn if systems, or portions of them, are to be isolated, studied, and understood. Engineers tasked with controlling floods need to draw lines between where water can and cannot go. Scientists studying ecological systems need to mark the limits of those systems, or they end up trying to comprehend everything on the planet touched by the sun. River restoration programs need to identify goals, which means drawing lines

that distinguish between what will be restored and what will not, who will benefit and who will not, who is to be included in the program and who is not. At the very least, the politics of restoration requires that lines be drawn. But in certain instances, lines drawn for very practical reasons in one context get passed along to other contexts where, perhaps, they do not belong. Lines harden over time to where they seem to be natural, though they were originally human contrivances drawn for pragmatic or heuristic reasons. The

line between a system and the forces from without that upset it, more or less, depending on its resilience, is such a line.

When biologists thought of closed communities of plants or animals moving toward static equilibrium, the forces that upset that equilibrium were disturbances. Later, when biologists began to think of ecological systems as normally dynamic rather than static, which encouraged them to think of disturbances as normal and even necessary for the health of those systems, they continued to use a word inherited from the earlier era, a word that encouraged them to draw lines between what lay inside the system and what did not and to think of those lines as natural. In the case of stream ecology, the concept of disturbance reinforces the notion that floods are forces that

lie outside the floodplain ecology. It reinforces the notion that the ecology on the land is separate from the ecology in the river. It reinforces the idea that land and water ought to be kept separate, which makes it very difficult for engineers responsible for preventing floods to work with ecologists who see floods as necessary for the health of a resilient floodplain. One can imagine a conversation between an engineer set on stopping a flooding river from disturbing the land and human communities and an ecologist who insists that floods are necessary to the well-being of life on the land, and that it is the engineer's levee that will cause the real disturbance. And then one can imagine two legislators offering opposing bills, with each declaring his or her bill to be essential for stopping dangerous disturbances.

Facts, Conjectures, and Words In Between

The debate over the health of the Mississippi River delta exemplifies some of the confusion that comes, not from drawing lines between resilient systems and intruding disturbances, but from seeing those lines as natural. The delta has always changed, moved, eroded here and accrued there. The levees that seem to have caused the unwanted erosion of the coastline are also the levees that have kept the river in the channel that flows past New Orleans. To take down the levees in the name of restoring the delta so it can protect New Orleans from hurricanes would be to assume New Orleans would survive the dismantling of the levees, which it probably would not. Without the levees, the mouth of the river would be far to the west of its present location, and the delta around New Orleans, and the city itself, would go the way of the Chandeleur Islands, a former delta that long ago sunk into the sea. So lines must be drawn to designate levees that should remain to protect the city and its inhabitants from flood disturbances and levees that should be dismantled so that flooding can help rebuild the delta's

resilience against storms and rising oceans, but also against human disturbances, including levees. All of this might be more clear if we were not so committed to the words "disturbance" and "resilience," or at least, if we used the words with careful consideration, precise definition, and clear intent.[xvii]

"There is something fascinating about science," wrote Mark Twain, in *Life on the Mississippi*. "One gets such wholesale returns of conjecture out of such a trifling investment of fact." Twain took his name from the unceasing accumulation of facts about river depth, the conjectures, that is, the theories of pilots about their significance for the safe passage of riverboats, and from the words that connected fact and conjecture. I think he well understood the value of both fact and conjecture and of the relationship between the two. The "wholesale returns" he spoke of come when fact and conjecture are confused. The problem is not with conjecture or with fact, but with language that, when used without due consideration,



Chandeleur Islands.
USGS.

confuses the two, turning conjecture into fact or vice versa. It is a fact that the Mississippi River is prone to flooding. However, what if anything a flood disturbs is a matter of conjecture. Similarly, it is a fact that levees interfere with the river's natural flood patterns. However, whether that interference is a disturbance or not is a matter of conjecture. It is a fact that the Mississippi River

delta is shifting, sinking, eroding, and generally receding but also moving westward, and that the causes are both natural and human. But whether those causes, both the human and the natural, are disturbances, and whether efforts to stop them amount to restoration, or are themselves disturbances—those are conjectures, too.

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“the recurrent disturbance of the ATTZ by the flood pulse.” (p. 120). The ATTZ is the Aquatic/terrestrial transition zone, i.e., the floodplain. Thus, Clements used “disturbance” to describe anomalies in climax theory. RCC and flood-pulse theory replaced climax theory for floodplain ecologies, yet continued to use here the concept of disturbance. Connell pushed matters further, when he suggested that disturbances often led to greater species diversity, meaning that disturbances were beneficial, even necessary, for the maintenance of a highly species-diverse ecology. Nevertheless, even beneficial and necessary disturbances, such as storms on a coral reef, are considered outside forces, or else they would not be disturbances. Joseph H. Connell, “Diversity in Tropical Rain Forests and Coral Reefs,” *Science* 199 (Mar. 24, 1978): 1302-1310. Emily H. Stanley, Stephen M. Powers, and Noah R. Lottig, “The Evolving Legacy of Disturbance in Stream Ecology: Concepts, Contributions, and Coming Challenges,” *Journal of the North American Benthological Society* 29 (2010): 67-83. Resilience is often measured by species diversity, which often increases following disturbances. See Connell, “Diversity in Tropical Rain Forests and Coral Reefs.” On human community resilience see Lance Gunderson, “Ecological and Human Community Resilience in Response to Natural Disasters,” *Ecology and Society* 15 (2010), online at <http://ecologyandsociety.org/vol15/iss2/art18/>, accessed 02-28-2014. See also, Thomas Homer-Dixon, *The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization* (Washington, D. C.: Island Press, 2008), 281-287.

[xiii] Stanley, Powers, and Lottig, “The Evolving Legacy of Disturbance in Stream Ecology,” 69. The imagined separation of land and water ecologies is reinforced by academic disciplinary boundaries.

[xiv] For a clear definition of disturbance defined as the cause of a system response, which is defined as the effect of a disturbance, see Rykiel, Jr., “Towards a Definition of Ecological Disturbance.”

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About the Author

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GEOGRAPHIES

MAPS, GEOGRAPHIES, AND THE MISSISSIPPI

By Len Kne

U-Spatial provides support for spatial research. We make maps. And help colleagues at the University of Minnesota discover and analyze geospatial data. We collaborate with people in public health, nursing, business, history, anthropology, education, design, engineering, natural resources, and even dentistry. Thanks to popular apps like Google Maps, billions of people are thinking spatially and becoming more aware of geography throughout the world.

There are countless ways to think about the geography of the Mississippi River. In physical terms, we can, for example, look at tributaries, watersheds, water flow, and water quality (figure 1). In human terms, the river crosses countless cities and neighborhoods, and it shapes transportation, utilities, agriculture, land ownership, commerce, demographics, and zoning. While maps are a great way to show how we interact with the river, getting started with mapping can be daunting. This article will introduce you to some resources that can help.



*Confluence of the Minnesota and Mississippi rivers.
Using satellite imagery, we can compare the amount of sediment coming into the
Mississippi River from the Minnesota River (the lower river).
Satellite Image Courtesy of DigitalGlobe Foundation.*

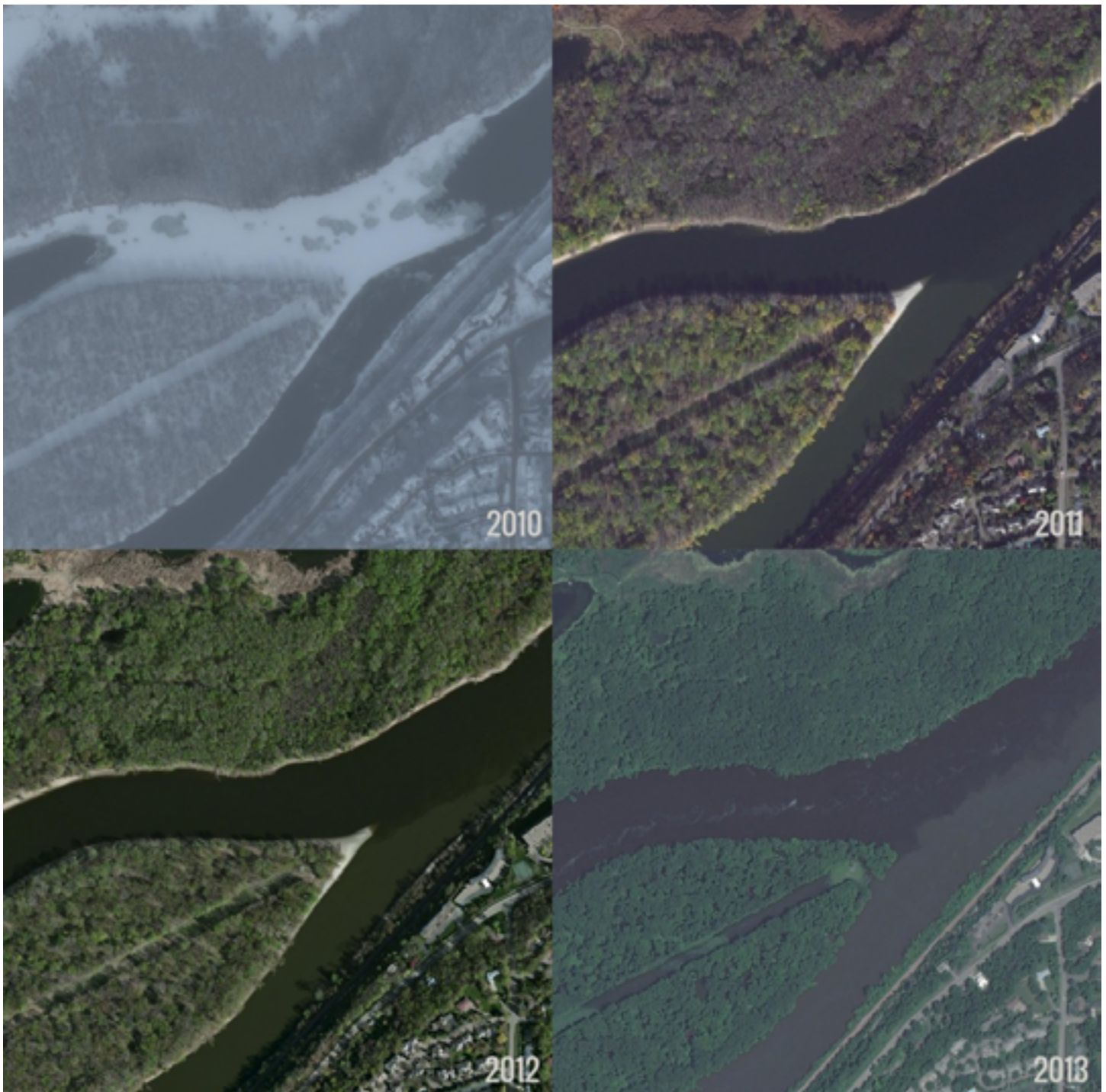


Figure 1. Confluence of the Minnesota and Mississippi rivers. Using satellite imagery, we can compare the amount of sediment coming into the Mississippi River from the Minnesota River (the lower river). Satellite Image Courtesy of DigitalGlobe Foundation.

Geographic Information Systems (GIS) aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information (Bolstad 2005). Most of us are familiar with spatial data through our use of Google Maps. Spatial data can be defined as information that has coordinates (i.e., latitude and longitude), as well as attribute data. GIS takes spatial data and creates a model of the real world that we can use to perform analysis, answer questions, and, yes, make maps.

Three core concepts go a long way when thinking spatially: layers, scale, and spatial relationships. Spatial information and data are stored in **thematic layers** that a GIS can mash together to answer questions. Finding data can be challenging; then, once the data are discovered, harmonizing multiple data sources in order to overlay it on a map can be time consuming. A good starting point for finding data is the Borchert Map Library, located at the University of

Minnesota. Later in this article, we will introduce ArcGIS Online, another tool for discovery and mapping of spatial data.

Map Scale is an important consideration when representing spatial data. Commonly seen as a scale bar, the map uses a representative fraction to show distance. For example, U.S. Geological Survey (USGS) topographic maps commonly use a 1:24,000 scale, which indicates that one inch on the map is equal to 24,000 inches (2,000 feet) on the ground. The amount of detail we want to show on a map determines how we represent a feature. When looking at the entire length of the Mississippi River, we represent the river as a line. However, when looking at an individual reach of the river, we want to show the width of the river and, thus, display it as a polygon (figure 2).

Spatial relationships define how we interact with the data. Three common spatial relationships are “adjacency,” “within,” and

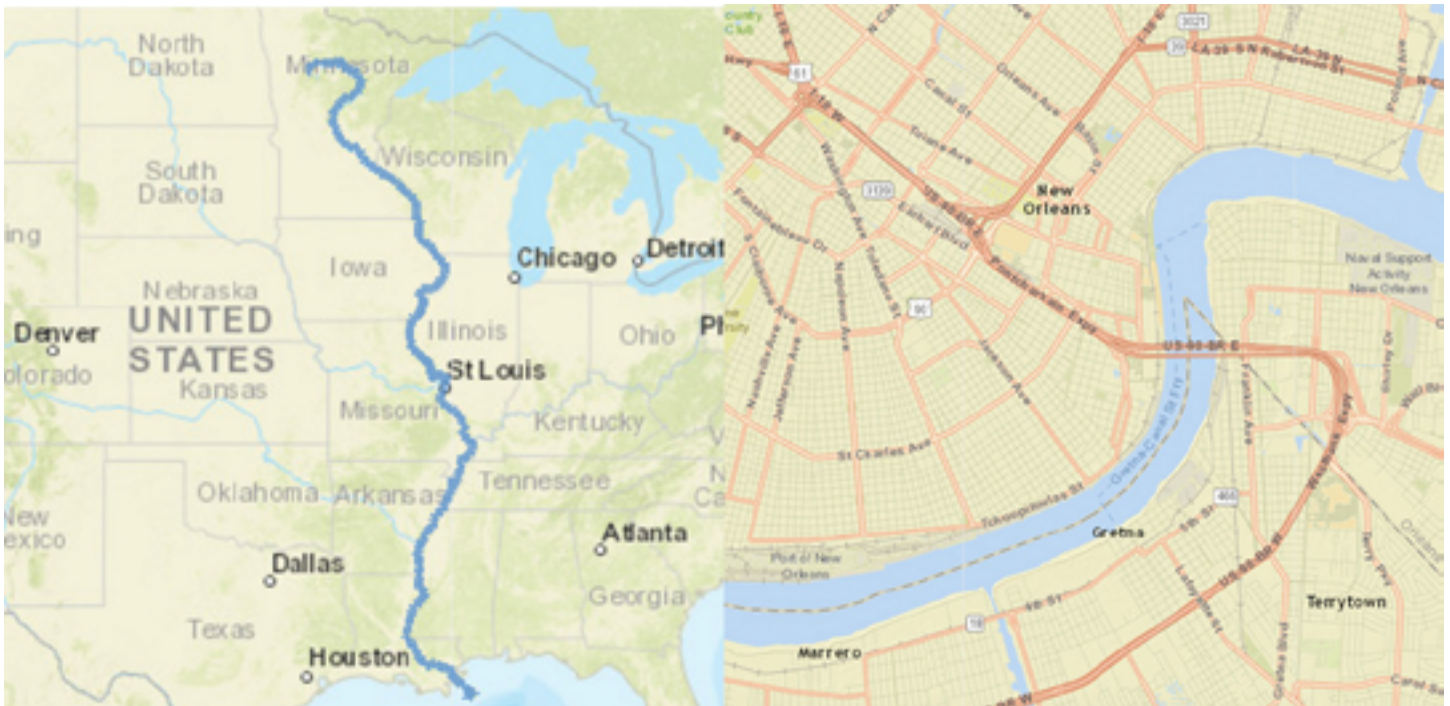


Figure 2. Demonstrating scale.

The map on the left is small scale, with the Mississippi River represented as a line.

The map on the right is large scale, with the river represented as a polygon.

Map illustration by Len Kne. Courtesy of U-Spatial.

“connectivity.” Minnesota is adjacent to Iowa, Hannibal is within Missouri, and the Mississippi River connects St. Paul and New Orleans. We can use GIS operations to query data using these spatial relationships. For example, how many people live within 10 miles of the Mississippi River in the St. Louis area? We use the buffer tool to pad the river by 10 miles on each side and

then the overlay tool to sum the population from a census layer in the buffered area. The answer is 1,935,000 for 2015 (see figure 3 for other selected statistics of the area).

Creating informative maps has gotten easier, thanks to several web-based GIS tools. I like **ArcGIS Online** because it has a vast collection



Total Area (sq miles)	2015 Population	Total Employees	Households with dog	Land Use				
				Developed	Forest	Crops	Wetland	Other
5,630	1,935,031	1,024,674	299,700	15%	30%	44%	5%	6%

Figure 3. This map shows a 10-mile buffer (blue) of the Mississippi River near St. Louis, MO. Using ArcGIS Online, we can enrich the area by overlaying a variety of data with a few clicks of the mouse.

Map illustration by Len Kne. Courtesy of U-Spatial.

of data (check out the [Living Atlas of the World](#)), as well as the tools needed to analyze the data and make compelling maps that can be easily shared. For example, here is the [map used in the St. Louis illustration](#) above. Another example demonstrates a geodesign application that models practices that can improve the water quality of the Minnesota River (figure 4). ArcGIS Online offers a free trial account that allows anyone to explore the world using their tool. Most universities have a license agreement for students, faculty, and

staff to access ArcGIS Online. All K-12 schools have free access through the [Esri ConnectedED](#) program.

The [U-Spatial website](#) is a good place to start when looking for help with mapping and spatial analysis. The site provides links to training, data, and GIS tools. Another resource is [GeoMentors](#); they can help bring spatial thinking into the K-12 classroom. Happy mapping.

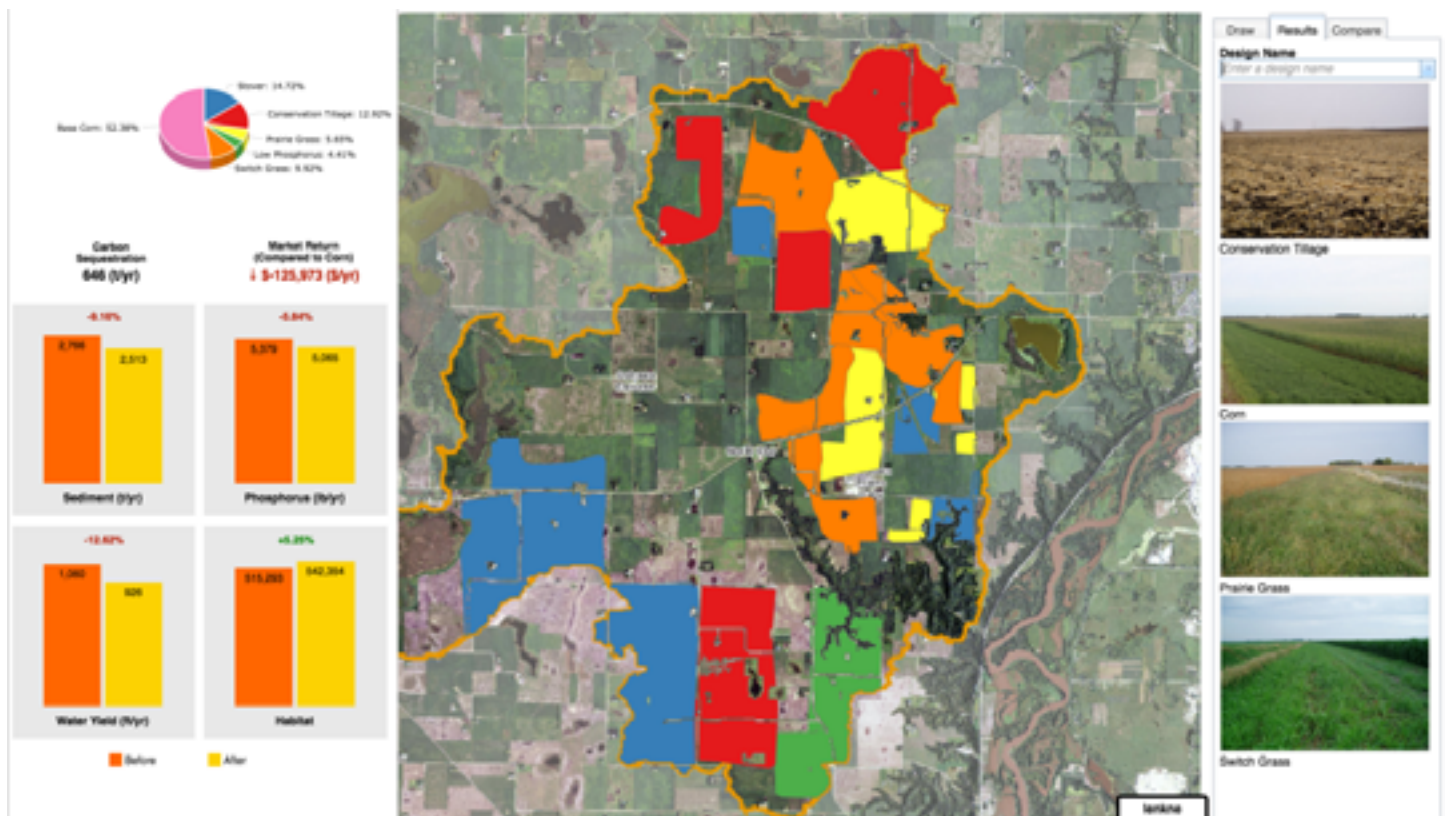


Figure 4. The *New Agricultural Bioeconomy Project* provides state-of-the-art technology and a participatory process for exploring opportunities to enhance economy, environment, and community vitality. This example of geodesign looks at land use change to encourage a biofuels market and improve water quality in the Seven Mile Creek watershed district near Mankato, MN. The Minnesota River is visible on the east side of the image. Participants are able to try multiple scenarios in real time and look for the best scenario.

Map illustration by Len Kne. Courtesy of U-Spatial.

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Recommended Citation

Kne, Len. 2016. "Maps, Geographies, and the Mississippi" *Open Rivers: Rethinking The Mississippi*, no. 2. <http://editions.lib.umn.edu/openrivers/article/maps-geographies-and-the-mississippi/>.

About the Author

Len Kne is the Associate Director of U-Spatial, a center at the University of Minnesota that provides support for spatial research. He is an alumnus of the University of Minnesota with a B.S. in recreation resource management and an M.S. in geographic information science. He is on the faculty of the Master of Geographic Information Science program and teaches project management, spatial databases, and a variety of graduate seminar classes focusing on the use of technology in GIS. He is looking forward to the day when everyone is thinking spatially.

IN REVIEW

SOUTHERN WATERS

By Simi Kang

Prior to reading *Southern Waters: the Limits to Abundance*, I knew water was important in the American South. Living in New Orleans, it is impossible to ignore how easily water becomes both friend and foe, flooding streets in a light rain just as it provides relief on the hottest August days. What I wasn't aware of was that the South as we have come to know it takes its shape from water-based decisions: New Orleans itself was founded because of its strategic location along three bodies of water—the Gulf of Mexico, the Mississippi River to its south, and

Lake Pontchartrain to the north. What settlers failed to recognize was that by ignoring Southeast Louisiana's swampland, they built a city that, on its best days, sits just below sea level, leaving it vulnerable to the same water that made it such a good place to settle in 1718. This is a simple example of a very complex problem, and, on their own, bodies of knowledge rooted in single disciplines, from ecology to history, can only go so far to link those first decisions with today's water issues.



*A map of the parts of America claimed by France under the names of Louisiana in 1720.
By Herman Moll.*

Enter Craig E. Colten, the Carl O. Sauer Professor of Geography and Anthropology at Louisiana State University, who tacitly asks readers to abandon their mono-disciplinary understandings of natural resources. He does this by using a keen understanding of historical geography to forward a blueprint for something akin to a folkloric water science.

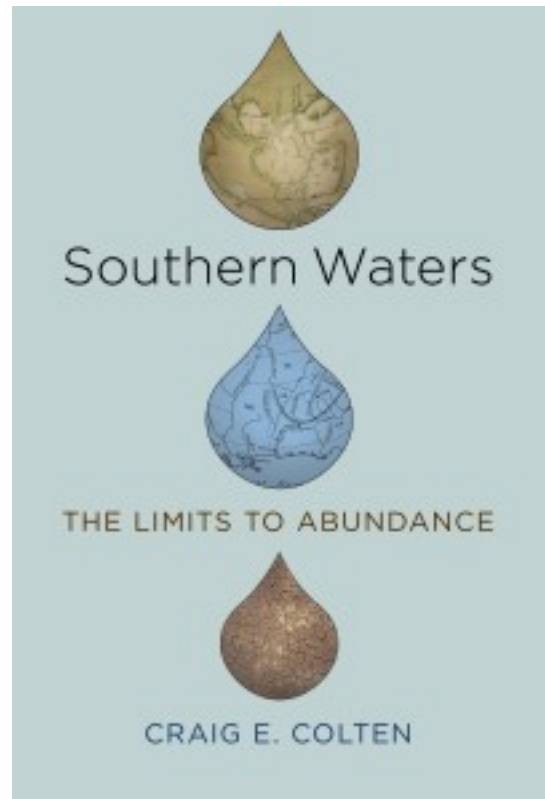
Colten opens the book with histories of water's significance for Indigenous communities, European settlers, and enslaved West Africans. By identifying how each group understood and engaged with water, the book's introduction establishes a settler-centric origin for how Southern waters have been used and managed since the moment European notions of water were applied to the region. Examining settlers' assumption about water's eternal abundance, Colten identifies the basis for a long-standing ethos of water territorialism, ownership, and access in North America, which has shaped both the region's geography and its water policies.

He then turns to a close reading of recent histories of Southern rivers, streams, and swamps to understand the South's long struggle with overuse, over-management, and diversions. Colten argues that managing water resources has historically "followed the path of maximum exploitation to meet short-term needs rather than one of sustainability" (Colten 2014: 8). In what follows, he asks what a present shaped by these historical legacies looks like. Further, he implores: what steps should we take to change national, regional, state, community-based, and individual responses to living with water in the South?

Southern Waters' central chapters each concentrate on interdisciplinary case studies that bring together particular waterways, Southern sub-regions, and political, socioeconomic, and ecological contexts. I began to think of these chapters as "water events," as they expertly bring disparate places, moments, and management

strategies into conversation to illustrate the effects of one or more issues significant to water in the South. However, Colten never massifies events or places; each river, stream, basin, and swamp is historicized and articulated across time and space through a clear sense of place, usage, and cultural relevance.

Each "water event" centralizes stories of human intervention, from the role of everyday citizens and environmentalists to the gradual (and sometimes extraordinarily fast-paced) effects of human management in places like the Atchafalaya Basin, where its function as a Mississippi River flood zone has changed the natural habitat so much that mangroves and the species that rely on them have disappeared. It is here where Colten is most methodical, asking what happens when we can no longer control water, who is liable for



Southern Waters: The Limits to Abundance,
Craig E. Colten, 2014,
LSU Press, 280 pages, \$29.95.

the resulting floods, diversions, and drought, what do these actors do to impede or accelerate solutions, and how might these actions create more problems?

I most enjoyed the way Colten weaves state, regional, and federal law, as well as history and environmental and human geography, into *Southern Waters*, investing them with a life that exceeds percepts of water as merely a resource to be managed. *Southern Waters* learns from the water itself, asking how dam regulation in Virginia and North Carolina is related Alabama navigability laws, and how these all inform capitalists' and citizens' investments in water. It goes on to consider how, by extension, local, regional, and federal policy shapes water usage and protections. While this book is a guide for those who work in policy and environmental preservation, it would just as comfortably sit on the shelves of Southern fishers, hobbyist historians, farmers, birders, and anyone who wades into and is enamored by the waterways of this region.

At times, *Southern Waters* veers into the purely historical and in so doing, loses some of its complexity. In these moments, Colten seems to flatten his otherwise complex analysis, drawing black/white comparisons and assessments of events and policies. However, he always seems

to catch himself, acknowledging the limits of the archive and retracing his steps to invest these studies with nuance and dimension. From a dense narration of waterway naming practices, he reverts to a multi-disciplinary approach, considering the humanized landscapes of the South and the everyday storytelling that brings the physical into the psychic, showing how humans impact water as much through singular and collective imagination as through industrial mills.

Over the course of the book, Colten's case studies give readers an arsenal of geographic, ecological, historic, and socio-legal knowledge to understand the region's current fight to maintain safe, sustainable water supplies, and the conflicts that arise from hazardous, unnavigable, and disappearing water. One of his greatest gifts as a writer is the care he takes with each place, weaving compelling stories that bring the Everglades and Atchafalaya Basin, streams from the East Coast to Texas, and floods along the Mississippi and its subsidiary streams together. The arguments he crafts from these relational analyses are more than the sum of their parts: Colten offers us a way to think about the South beyond its complicated regionalism, focusing on its particularities and in so doing, erupting the way the area has often been singularized as a place frozen in time and temperament.

Recommended Citation

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About the Author

Simi Kang is a Ph.D. Candidate in Feminist Studies at the University of Minnesota, Twin Cities. A native Minnesotan, she is currently conducting fieldwork in New Orleans with Vietnamese and Vietnamese New Orleanian food producers. Her dissertation engages the work of local farmers, fishermen, and restaurateurs to understand how cultivating, harvesting, and making food has become an act of resistance against racializing local and state policies, as well as everyday discourse that circulates about Vietnamese-ness in Southeast Louisiana.

PERSPECTIVES

CLIMATE CHANGE AND RIVERS

By Paul Huttner and Phyllis Mauch Messenger

Open Rivers contacted Paul Huttner [PH], Chief Meteorologist for Minnesota Public Radio (MPR). Huttner writes the Updraft blog and hosts MPR's weekly Climate Cast. We wanted to learn more about the impact climate change is having on rivers and communities and how discussions about environmental issues and water are changing.

He spoke by phone with Phyllis Messenger of Open Rivers [OR] in February 2016 from the

Huttner Weather Lab in Victoria, Minnesota. The interview has been edited for length and clarity.

[OR] I listen to the weekly Climate Cast on MPR, which focuses on research about climate and its consequences. Tell me how that came about.

[PH] It's going on three years now that we've been doing Climate Cast. Several months before that, I approached the MPR managers with the idea, given all the breaking science on climate that was coming out every week. I said, you know,



View north into Minneapolis up the Mississippi River gorge.

Image from the Metropolitan Design Center Image Bank.

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there's not a lot of content coming out regularly on radio, and I believe this is a growing and important topic, both locally and nationwide. And we really should be doing this every week. So I pitched the idea for Climate Cast. They liked it and we began doing it, starting three years ago as a segment in the morning with Kerri Miller (Thursdays at 9:45). It's gotten a great response. Our listeners appreciate the in-depth information that we give. We've expanded it to an hour once a month now, because 15 minutes goes so fast, you really can't dig in as deep as you'd like to and there's plenty of new content, plenty of interesting science. It's grown over time, and continues to be a staple of our programming. I'm happy about that and I'm told by some of my peers in the business that we are the only regular weekly radio show on climate change in the country. I don't know if that is still the case—there are other shows that air periodically. It's a staple for us, a feather in our cap for science coverage at Minnesota Public Radio.

[OR] You have said that at first there were questions of “Is it real?” and now it is more a question of, “Well, what can we do?”

[PH] I sense a big shift in the last three years, and polls show this, too. People's minds have changed. A vast majority of people in the U.S. now believe in human-caused climate change. We're hearing that reflected in our audience, and I'm seeing that anecdotally in the people I meet on the street every day. It's encouraging. It's good to see that the science is gaining greater acceptance, and I'm optimistic that we will find a way to fix this.

[OR] I want to step back to your early years, which were spent around water in Minnesota. How did that inform your choice of a profession?

[PH] One of my early mentors was Dick Gray from the Freshwater Society. He used to write a column called “Passwords” in the newspaper every week, and did a collection of those in

his book, *Passwords*, back in the '70s. I was given that as a gift at a critical time in my life—I suppose I was 13 or 14 years old. I just went through that with glee. And growing up near Lake Minnetonka certainly piqued my interest in water and its importance. So I began to connect the dots on how water and weather and, eventually, climate are related. So I may not have understood at the time how it was all connected. But growing up near a body of water like Lake Minnetonka, and Minnehaha Creek, and the Mississippi River was an early influence on my career path.



*Dick Gray at the
Gray Freshwater Lakeside Laboratory.
Image courtesy of the Freshwater Society.*

[OR] How does living near the Mississippi River shape you today?

[PH] Our rivers and lakes are a barometer of climate change. We're seeing much higher volatility in our river systems and our hydrologic cycle. It's well documented that it's not raining as often in Minnesota, but when it does, it's raining harder. That fits with the shift in climate. You increase the vapor in the atmosphere by roughly four or five percent, and you get exponential increases in rainfall when it does rain. I'll give you an example. In 2013 the Mississippi River level at St. Cloud went from the seventh highest reading to

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the third lowest reading in just over two months. So we've seen this trend toward wetter springs and early summers in Minnesota, toward an increase in early warm season precipitation. And then it shuts off later in the summer. So we're getting a trend toward these high variabilities in our river levels, where we're getting record floods in early spring and summer, and then a record drop to low water levels in late summer and early fall. That doesn't happen every year, but we're seeing a trend. There is higher volatility in our river systems, and the Mississippi is part of that.

[OR] So that causes some challenges for cities and urban planning and so forth, doesn't it?

[PH] Indeed it does. City managers around the state are scrambling to deal with that. Our urban infrastructure was built around a certain set of climate assumptions from more than a hundred years ago. Those climate assumptions are no longer valid, especially when it comes to precipitation intensity. The 2012 Duluth flood is a great example of a city being overwhelmed by the kind of extreme weather we've been having. We have had four major 1000-year rainfall events



DULUTH, Minn. – An aircrew from Coast Guard Air Station Traverse City, Mich., conducts a damage-assessment overflight of severely flooded areas of Fond du Lac, June 24, 2012. Coast Guard Air Station Traverse City's flights provided search and rescue assistance as well as key witness to the extent of the flooding.

U.S. Coast Guard photo by Petty Officer 1st Class Matthew Schofield.

in Minnesota since 2007. Three of them were in southern Minnesota, one in the Duluth area. That was a \$100 million infrastructure damage event in Duluth. Cities all around the area are dealing with these higher water events, where places like Mound, near Lake Minnetonka, were overwhelmed by high water levels. It's interesting to watch, as climate shifts, even when it seems like our national policy makers are slow to react, our local cities policy makers are well aware of this. They're on the front lines of climate change and they're dealing with it every year.

[OR] You've been to some recent conferences where people have been discussing these issues.

[PH] I have. The Third Minnesota Climate Adaptation Conference was just a few weeks ago, and the mayors of St. Paul, Falcon Heights, Bemidji, and St. Louis Park were all part of a panel about climate change and their communities, and how they are adapting to it. Again, it's something that hits home at the local level and it has a great effect on their operations and their budget.

[OR] So how do we persuade those politicians and those policy makers who aren't yet persuaded?

[PH] That might be the million or billion dollar question for us in the coming decades. I think it's a multi-tiered approach. I think the science is powerful, and it works, but only to a degree. For people who don't believe that climate change is a significant threat, the science doesn't convince them. We are seeing that these extreme events are convincing people, which is unfortunate. We have a crisis mentality at times in this country. We wait for the crisis to react. We wait for the barn door to be open before we see that there is a problem. I think it's science and it's communication, convincing people on a different level. I have found that the economic opportunity persuasion is very effective, too. I don't think we've talked enough about how we are going to grow a new energy economy that's going to

create new economic opportunities. It's already creating jobs. There are over 200,000 solar jobs in the United States, with growth at 20 percent a year, and those jobs pay very well. There are over 15,000 green energy jobs in Minnesota now. That's also growing rapidly and those jobs also pay well above state average. So, we're seeing the growth in renewable energies, and that is sort of a transition. I've even called it a moon-shot opportunity in the coming century, and even shorter term than that. I think it's starting to happen faster than a lot of people predicted it would.

[OR] Are there good models around the world that we should be looking at?

[PH] Absolutely. Europe is ahead of us when it comes to renewable energy and policies on renewable energy. Oddly enough, China, which is often tagged as one of the biggest greenhouse gas producers on the planet (which of course it is), is also investing tremendous sums in solar and wind and renewable energy. They're literally choking on their carbon production in China, and they get it. The United States, politically, has been very slow to react to this, but the economic opportunities are there and they're growing. If we go back to the Climate Adaptation Conference, we had General Mills, Best Buy, 3M, all major Fortune 500 Minnesota companies who already are seeing the effects of climate change in their supply chains. Corporate America gets this, and they're acting accordingly, because it's affecting their bottom line. So I think in the United States, we're going to see this coming from the ground up, from the city level higher, from the corporate level higher, and eventually I think this will become politically a more national project.

[OR] Do you see other places where the leadership is coming from?

[PH] Yes, You look at organizations like Climate Minnesota that are out there, trying to do awareness and outreach and education. I think the train is rolling down the tracks. It still has to

gain some momentum. You know, I have teachers at the fifth-grade level who are using content from my Updraft Blog to teach their students. I think the younger generation is more attuned to climate change. Let's face it; they're the ones who are going to inherit the planet that we give them. I think it's reaching critical mass. It's a very large problem; it's very hard to see out your window every day. You know carbon dioxide is invisible to us, but the effects are increasingly apparent.

[OR] What should be on our radar that isn't? What are issues that could be affecting rivers and communities along rivers that maybe we're just not thinking of yet in relation to climate change?

[PH] I go back to the volatility. Look at the record Mississippi floods in Missouri in wintertime in the last several months. I think that we're going to see more unprecedented river events. That's a problem, because a lot of our civilizations have been built on waterways. For good reasons: they're beautiful, they provide a source of freshwater, they offer economic transportation opportunity. As the hydrologic cycle amplifies, we're going to continue to see more of this kind of overwhelming flood and drought events. Don't underestimate drought. We're seeing the effects of arctic amplification, where the arctic is warming faster than the middle latitudes at the equator. That slows the jet stream down, and it tends to produce stuck weather patterns that are prolonged. That tends to produce droughts, like the one in California, that are becoming more extreme, and we're getting into drought faster because water is evaporating more quickly from the surface in a warmer climate. So I think the fluctuation and the extremes that we're seeing on rivers and waterways is only going to continue. And cities and areas will be faced with situations that they haven't seen before. I am concerned about nuclear plants that are on waterways. Obviously they have multiple backup systems. But as we know from Fukushima, it's not a perfect world. Stuff happens, so I think we



Winter warming trends since 1970. December, January, February 1970-2014/15. Source: NOAA/NCEI Climate at a Glance.

need to build resilience into what we're doing in the future when it comes to these extreme water levels on rivers.

[OR] I've heard you and others talk about climate change as the most serious national security challenge that we're facing.

[PH] Yes, and that's an interesting angle, because it's not some liberal think tank that came up with that idea. It's the national security apparatus and the Pentagon, and the CIA, and the intelligence community, and they've assessed and war-gamed this out. They have discovered that even small climate shifts can have outsized impacts when it comes to social unrest. A lot of people are pointing at the situation in Syria as being triggered or at least exacerbated by the severe drought that they had. Farmers left the land and people moved to cities, which led to social unrest, and the rest is history, as we say. What happens when that occurs in populated areas like India or South Asia, or other parts of the globe, where even a small shift in climate has an outsized impact? So, that's what the national security people are looking at and saying, this is a problem, we need to be ready to deal with it. What happens when our military bases are threatened by flooding? I was in Norfolk, Virginia last year. That's one of those places that is very susceptible to sea level

rise. They've realized that small changes can cause outsized impacts, and they're planning for that accordingly.

[OR] Is it hard to be optimistic?

[PH] It can be, but I'm not a gloom-and-doom person. I realize that along with the magnitude of the problem that we're dealing with for climate change, there are also going to be opportunities. It's going to require a shift in the way we think, a shift in the way we use energy, and a shift in the way we build infrastructure. These are large problems that manifest themselves on the local scale. Humans have an amazing capacity to adapt, and an amazing capacity to change what we're doing. Look at how far we've come. I've heard the saying, "We didn't leave the stone age because we ran out of stones." Right? We have always moved forward as a society, and I have every reason to believe that we're going to do that with regard to energy. It's just a matter of how quickly it's going to happen and what the impacts will be on our climate.

I see a lot of good signs and I see that the pace of awareness and action on climate change has increased more quickly than I thought it would in the last three to five years. If that trend continues, we could be in a lot better shape 10, 20, 30 years down the road. If we don't change as quickly as we need to, we are in for some tumultuous times in the next century, but I'm at least hopeful. That's one of the things that I'm happy about with Climate Cast. We have an opportunity every week to talk about the science and the ground truth about what's happening with climate change. I think as that conversation moves forward, more people are getting in tune with the question: How can we change our lives for the better, and still take care of our planet at the same time?

[OR] Do you think that the agreements that came out of COP21 [the 2015 United Nations Climate Change Conference, held in Paris] will help us move forward?

[PH] Well, it's certainly a step forward. Even before that, the U.S. and China came together and set ambitious goals on carbon. So, yes, I'm optimistic about that. I'm not a Pollyanna about it. I realize there are lots of dominoes that need to get knocked over before eliminating the two-degree Celsius rise in temperature. We're already halfway there globally. Last year was one degree Celsius, hotter than the pre-industrial average. So we only have another degree to go. Two degrees, some people say we could adapt to that, but the higher-end climate models go four to eight degrees. If that happens, it's going to be a very different planet than we have today. To be determined, I guess. Stay tuned.

[OR] What do you want people to understand about our relationship to the river?

[PH] That's a great question and something I need to think more about. I live in my own little world of weather and climate. When I go to the rivers and the lakes, I go there to relax. They're a source of beauty for me. I want to keep them healthy and keep them around. Minnesota is built on water, let's face it, we're not only the land of 10,000 lakes, but the river systems are critical, too. And we're very fortunate in that we sit on a watershed. No water really flows into the state of Minnesota. Water is something we export. Fortunately, we don't have to deal with pollution as one of those things coming from other places. But we have a responsibility to make sure that the water we're sending downstream is as healthy and well managed as it can be reasonably. I ask people not to take water for granted in Minnesota. When they go to their favorite lake or their favorite river, they need to remember that the things we do to the climate and the land use practices that we have all have an impact on that watershed. And I think that is something for all of us to remember.

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About the Authors

Paul Huttner is chief meteorologist for Minnesota Public Radio. An award-winning veteran broadcaster for 30 years, Huttner earned the American Meteorological Society's Certified Broadcast Meteorologist designation in 2008, in recognition of the quality of his weather broadcasts. Paul is a graduate of Macalester College in St. Paul and holds a bachelor's degree in geography with an emphasis in meteorology.

Phyllis Mauch Messenger is grants consultant for the Institute for Advanced Study and administrative editor for Open Rivers. She has edited, co-edited, or co-authored five books on archaeology and heritage, and is currently editing two volumes of essays on the pedagogy of heritage. She has worked on archaeological projects in Mexico, Honduras, and the U.S. and led study abroad programs to Mexico, Peru, and Southeast Asia.

PERSPECTIVES

THE NATIONAL PARK SERVICE'S MISSISSIPPI RIVER FORUM: MEALS WITH GREAT MINDS

By Lark Weller

Most of us have imagined with which leaders and remarkable people we'd like to share conversation over dinner. But what about breakfast? Studies show it's the most important meal of the day! Imagine sharing conversation, learning, and ideas with politicians, researchers studying bald eagles and river otters, people who make your water drinkable and those who clean your used water (who are different people, at least for now...), and those thinking about and establishing policies and practices to help protect the Mississippi—all over fresh coffee and pastries each month. That's exactly what the Mississippi River Forum offers.

The Mississippi River Forum is a monthly meeting series facilitated by the Mississippi National River and Recreation Area (the Twin Cities' national park!), and made possible through the support of its philanthropic partner, the Mississippi Park Connection, as well as the McKnight Foundation. Each month, we gather to hear a speaker share their work involving the Mississippi River or water resources more broadly, to visit with each other, and to expand the reach of our work and the ideas generated by each month's speaker and participants.



View of the Mississippi River from the Science Museum of Minnesota by J. Pellgen.

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The Mississippi River Forum is a valuable source of information and networking thanks to its multidisciplinary participants—water resource practitioners and decision makers whose day-to-day work impacts the river—as well as its express focus on enhancing collaboration across sectors. Landscape architects, engineers, environmental organization representatives, urban planners, elected officials, natural resource managers, scientists and researchers, and foundation staff build a unique monthly conversation that reflects the nuances of the river itself. Conversations established at Forum meetings have led to important new partnerships, approaches, and projects.

On February 26, 2016 Saint Paul Mayor Chris Coleman addressed the Mississippi River Forum. Mayor Coleman had recently returned from the United Nations' Climate Change Conference in Paris as a representative of the Mississippi River Cities and Towns Initiative (MRCTI), and joined the Forum to share his experiences. In Paris, Mayor Coleman and other members of MRCTI led discussions with representatives from global river basins in France, Germany, Mexico, Senegal, China, and India about achieving food and water security through commitments to sustainable agriculture, clean water, and improved urban management of water resources.



Maria DeLaundreau presents cottonwood research findings to the Mississippi River Forum audience.

Photo by Melissa Buss, courtesy of the National Park Service.

As a Mississippi River mayor, Coleman understands the importance of a clean and healthy river in communities' resilience, and the importance of the river to our daily lives and economies. He spoke of the critical role that local governments like the City of Saint Paul play in establishing and modeling policies and practices that can help communities worldwide as they seek to protect natural and human resources from the impacts of climate disruption. Coleman sees efforts like Saint Paul's sustainable planning and development practices as key to preventing the worst climate change impacts, and as tools to be adopted by other communities around the globe in search of climate mitigation strategies. He—along with over 120 other U.S. mayors and 440 mayors worldwide—has signed the Compact of Mayors, committing these cities over the next three years to establish greenhouse gas emissions targets, develop climate action and resiliency plans, and consistently assess progress toward these goals. (A draft of Saint Paul's climate resilience plan will be available later this spring.) Though climate change is, by definition, a global issue, solutions and on-the-ground changes take place largely at the local level.

After the mayor's report back from Paris, Mississippi River Forum participants had over an hour to discuss with him everything from how to protect local waters from salt (chloride) pollution

Recommended Citation

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About the Author

Lark Weller is the Water Quality Coordinator for the Mississippi National River and Recreation Area, a unit of the National Park Service. She works closely with park partners to minimize the negative impacts of human activities on the park's water resources, and is also helping the National Park Service improve its institutional equity, inclusion and employee engagement. Lark has a bachelor's of science degree in agriculture, sociology, and anthropology, as well as a master's degree in urban and regional planning, from the University of Minnesota.

to how the redevelopment of the Ford Plant offers a once-in-a-lifetime opportunity to practice water- and climate- protective strategies at a rare, "mini urban" scale. (The Ford Motor Company closed its Saint Paul production facility in 2011; the City is working with numerous community partners to plan the redevelopment of these 135 acres along the Mississippi River into a mixed-use 21st-century neighborhood.) The conversation was truly an example of local government in action: engaged community members chewing on bagels and complex issues with a mayor working to protect an internationally significant river through local practices.

When is the last time you visited with a mayor over breakfast on a Friday morning? Join the National Park Service for the next Mississippi River Forum and be sure you never miss another opportunity to create meaningful conversations about building a healthier Mississippi River! Meetings are held each month, and alternate between locations in the Twin Cities and Saint Cloud, Minnesota.

For more information about the Mississippi River Forum, including upcoming and past presentations, visit <https://www.nps.gov/miss/learn/nature/riverforum.htm>, or contact the park's Water Quality Coordinator at lark_weller@nps.gov.

PRIMARY SOURCES

GLOBAL WATER DATA: WE'LL SHOW YOU THE WORLD, SORT OF

By Kate A. Brauman

There are regular calls for more global water data. And there are also many, many global water data sets out there, so many that we're practically swimming in water data. What's the disconnect?

My work focuses on global trends in water availability, water use, and water productivity, which means I spend a lot of time using diverse global data sets and also wishing there were more. Recently, I analyzed the outputs of a global water resources model, WaterGAP3, to assess the frequency with which people consume most of the annually renewable water in a watershed. Interestingly, it turned out we could break down the findings into distinct categories—in a small fraction of watersheds, people use up most of the

renewable water that's available all year (~2% of watersheds); there are many more watersheds where we're using up most of the water during the dry season (9%) or during dry years (21%); in the other 67% of the world's watersheds, we're using up very little of the water.

Doing this work, I've identified four big, interconnected issues to explain the simultaneous abundance and scarcity of global water data. First, the category of water data potentially encompasses a tremendous number of things. Second, global data coverage is uneven. Third, lots of water questions require very detailed data to address them. And fourth, big data are unwieldy and frequently hard to interpret—in other words, big data are big.

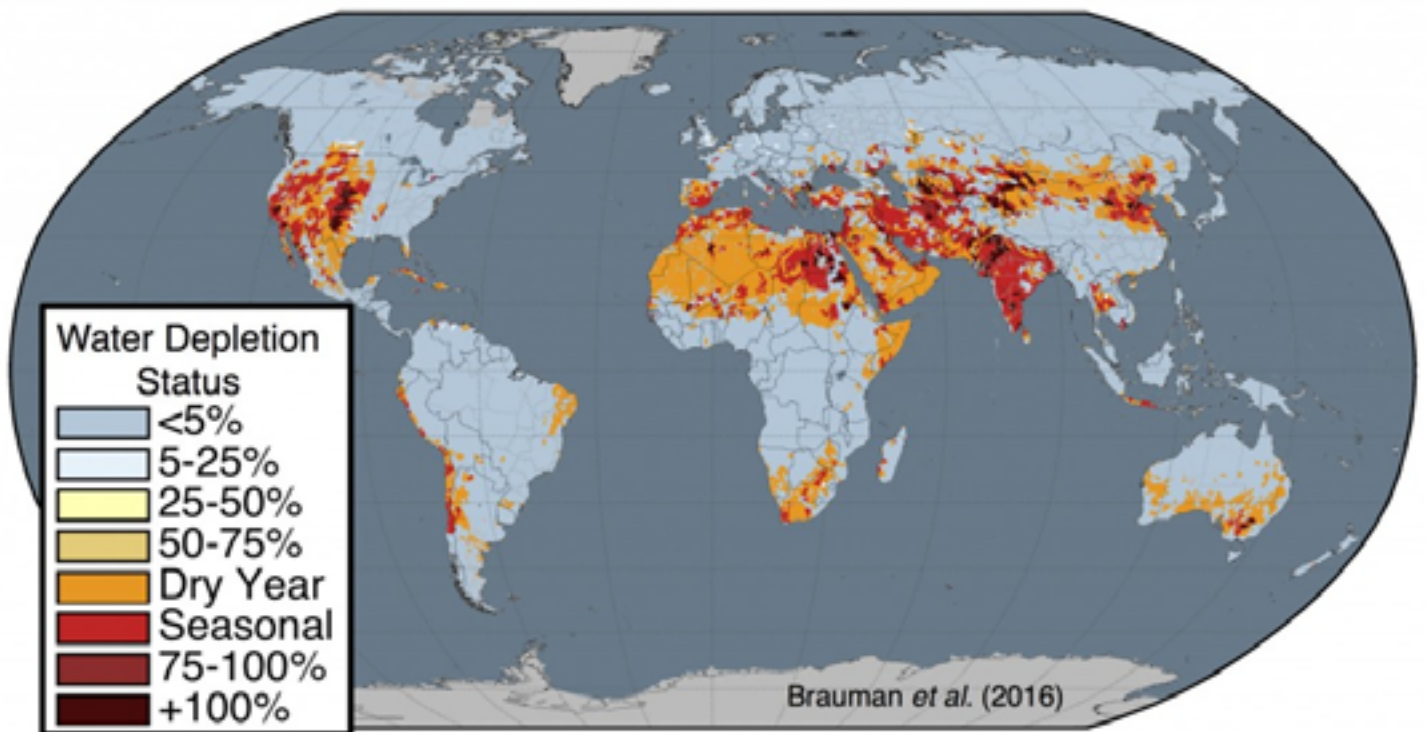


Tributaries of the Chester River by J. Albert Bowden II.

Before I start, though, I want to clarify what I mean by global water data. In this context, I'm talking about two things. One is measured biophysical data, including everything from water quality measurements to rainfall measurements to the locations of pipes under a city. The second is modeled data, which can include everything from model outputs that fill in missing measurements to calculations of global water availability based on geographic information and driven by climate inputs. Neither one is wholly reliable—I've spent enough time working in the field to know that rainfall collectors get backed up with leaf litter and data loggers stop working, and I've also worked with enough modeled data to know that equations and assumptions that provide reasonable answers in some places spit out nonsense in others. That doesn't mean we shouldn't use or trust both types of data. It does mean that we should be critical of what data tell us and how much confidence we should have about an answer.

On to the disconnect between not enough data and too much data. The first reason I've

identified for this mismatch is that the topics and measurements that fall into the category of water data are nearly endless. On the biophysical side, there are climate data—such as the amount, frequency, and intensity of precipitation now, in the past, and into the future. There are hydrologic data—river flow or aquifer characteristics, and data about water quality. Somewhere between the biophysical and social realms are data related to infrastructure—everything from the location of water withdrawals to the direction of inter-basin transfers to the location, age, and materials of pipes under a city. There are also many, many social data related to water—what kind of water governance system exists, who has water rights, where those water rights are located. Especially for social data, we frequently don't have global coverage of variables of interest. When we do have biophysical or social data in hand, it may not be the right information to address our question. And almost any water question could probably be answered better if it were informed by each of the categories above. So it's no wonder we hear a constant clamoring for more data. For logistical reasons, however, it's hard to imagine we'll ever



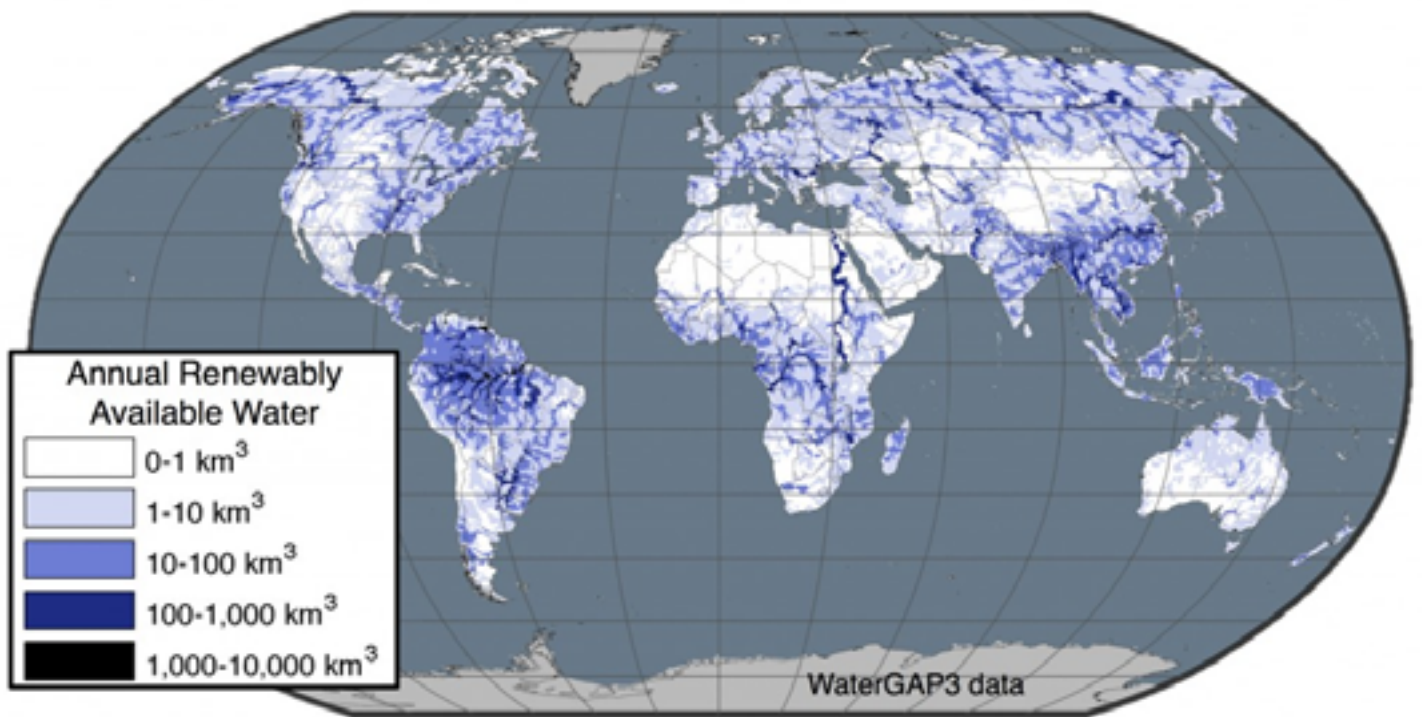
Water depletion status.

collect every piece of information that might someday inform the answer to a water question, so as a water community we need to prioritize which data to collect, particularly at the global scale. We can start to do this by assessing which questions are the most important to answer at a global scale and what data are crucial to answering them.

A second reason abundant data can seem sparse is that the coverage of global data is uneven, in both space and time. I focus primarily on biophysical data from here onwards, both because it's what I know best and because so much more of it is rapidly becoming available. Usually with global data, we're aiming to get information that's distributed evenly all over the world: for example, annual rainfall totals for every country, county, or grid square formed by latitude and longitude lines. We generally get these global data by stitching together local data. Sometimes the data are the same everywhere, such as images from satellites. However, in many cases the source data sets are at different resolutions, because in some

places we take a lot of measurements, in others not so many. Even for something as seemingly straightforward as rainfall data, we still use a model to fill in the gaps between individual measuring gauges. If there are a lot of gauges, the model is more likely to provide an accurate number for the spaces in between, but even when we have a lot of measurements there is still quite a bit of uncertainty in global data. In places where little local data are available, global data are particularly important because they allow us to make inferences about a local water situation, and yet these are exactly the places for which we've had to do the most modeling and interpolation.

A third reason water data can appear sparse or incomplete is because the answers to many questions can only be illuminated with information that is very detailed in time and space. Lead in tap water is a great example. Global data about infrastructure age could conceivably tell us where lead might be a problem by highlighting which cities are likely to be affected, based on the materials likely used to construct a system in



Annual renewably available water.

a given place at a given time. Global data might even suggest what fraction of the population is likely affected. Knowing exactly which people are affected requires much more detailed data about in-home water quality or the materials in pipes going to specific homes. From a global perspective, high resolution data frequently means a grid square, often one of the more than 9 billion 5 arc-minute grid cells that make up the globe; from the perspective of a farm or a house or person on foot, the approximately 60 square km inside each grid cell is pretty big. The data point for a grid square represents an average or majority or some other simplification of what's inside. There are plenty of questions that are best answered on a global scale, especially inquiries that compare distant places, identify hotspots, or evaluate global and regional trends, but not every question needs a global answer. One critical insight global data can provide is guidance on where more detailed local data would likely provide answers to pressing questions.

A fourth reason abundant data may not be recognized and used is that even with computing power increasing, big data take a lot to store and analyze. Most days I work with global water and crop data at five arc-minute resolution (60 minutes in 1 degree, so that's 1/12th of the square made by latitude and longitude lines 1 degree apart, about 8 km by 8 km at the equator). When I spread those data out into a grid, it measures 4,320 rows by 2,160 columns, a lot more than

a spreadsheet program can handle. Looking for patterns in a global data set and making sense of what we see requires analytic tools. For example, satellites now provide high-resolution images of the earth that are updated regularly. This provides a whole new way to track changes visible in the landscape, like identifying newly build dams. To do that, you could hire someone to look at every single grid square individually, every year, or you could figure out how to identify dams using markers a computer can sense and write a sophisticated computer program to search for them. Big water data can provide amazing insights, but we have to advance analysis and better articulate questions in ways that our analytic tools can respond to.

There are a lot of global water data, but they can't answer all our water questions. We have more biophysical data than social data, and most of the existing data are some combination of measurements and model outputs. There are some exciting questions we can ask of global data, and some interesting answers. But we'll never be able to answer local questions at the global scale, nor would we even know the appropriate local questions. Instead, we have the exciting challenge ahead of identifying the global water questions of importance, figuring out how to analyze the data we have, identifying what additional global data would really improve our analysis, and then going out and collecting, storing, and sharing it.

Further Reading

The Brauman, Richter et al. (2016) analysis of global water depletion is freely available online at <http://elementascience.org/articles/83> and the data can be downloaded from <http://www.earthstat.org>.

Sevruk, Ondrás et al. (2009) explains how the World Meteorological Organization needs to and does normalize measured rainfall data from governments all over the world to make them comparable.

Döll, Douville et al. (2015) provides an overview of the challenges in global water modeling, and Sood and Smakhtin (2015) review the major global hydrologic models.

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Kate A. Brauman is the Lead Scientist for the Global Water Initiative at the University of Minnesota’s Institute on the Environment. Through research as diverse as payments for watershed services, global variation in “crop per drop,” and worldwide trends in water consumption and availability, Kate works to better understand how water use affects the environment and our ability to live well in it.

TEACHING AND PRACTICE

TOWARD A PEDAGOGY OF PLACE: THE *BDOE FIELD TRIP* AND ABSENT NARRATIVES IN THE CLASSROOM

By Kirk MacKinnon Morrow

The lessons we teach, much like the places we inhabit, are multivalent and layered in the stories they tell. At the Minnesota Humanities Center, we have long sought to empower educators to create lessons that recognize and

amplify *absent narratives*, the stories that have been systematically marginalized or left out in classrooms and curricula for generations. By interrogating their own worldviews and personal experiences, educators recognize absent



*Walking between sites at Oheyawahi/Pilot Knob.
Photo by Michael Murray; courtesy of the Minnesota Humanities Center.*

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narratives in their work and develop strategies to surface these stories in a respectful way. Perhaps unsurprisingly, engaging with questions of equity requires a deep knowledge of oneself and a firm commitment to one's community and relationships. In essence, it is grounded in place—not place in the fickle, cartographic sense, but place as the sum of relationships and physical geography, self and the messy complexity of a shared humanity. A deep knowledge of self is always at once a deep knowledge of place.

That said, if place is the organizing principle through which we can effect the kind of searching personal awareness that, in coalescing among teams of educators, begins to countervail centuries of marginalization and absencing, then there is perhaps no more important place than

the one on which we stand. As Dakota artist and scholar Mona Smith enjoins educators involved in Humanities Center programming, “To know who you are, you have to know where you are.” This, at its core, is the purpose of the professional development offering *Bdote Field Trip: Dakota in the Twin Cities*.^{*} Developed out of the multimedia art and deep mapping project *Bdote Memory Map*, a partnership between Allies: media/art and the Humanities Center, the trip provides an experiential introduction to absent narratives and the human cost of erasure as Dakota scholars and educators tell stories of this land and its first people.

A circle of stones recognizes the seven council fires of Dakota people. Photo by Michael Murray; courtesy of the Minnesota Humanities Center.



*A circle of stones recognizes the seven council fires of Dakota people.
Photo by Michael Murray; courtesy of the Minnesota Humanities Center.*

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A circle of stones recognizes the seven council fires of Dakota people. Photo by Michael Murray; courtesy of the Minnesota Humanities Center. While the confluence, or bdote, of two rivers at the heart of the Minneapolis/St. Paul area might lend itself easily to metaphors of communities coming together, hearing the lived histories of communities and their relationship to this place surfaces more complex truths.

See the seventeen minute video [Know Where You Are - Bdote](#)

Editor's Note : The video above is linked as such for technical reasons. The original is on the website [Bdote Memory Map](#) which is a joint project between [The Minnesota Humanities Center](#) and [Allies: media/art](#).

Throughout the Bdote Field Trip, Mona and colleagues Ethan Neerdaels and Ramona Kitto Stately guide participants on walks at sites of significance to Dakota people and share personal stories that shape an understanding of Minnesota as a Dakota place despite centuries of oppression. Throughout the journey, participants come to see different dimensions of a region they call home and open their minds to honor Indigenous ways of knowing and being in relationship to place.

The trip's crescendo comes at midday when sage is burned and participants gather in circle at the site of Historic Fort Snelling. Situated atop the river bluff surrounded by both a thicket of trees and the incessant din of traffic, the site speaks its rawness. In this circle, Ramona shares of the sacred importance of bdote to Dakota people; of



Throughout the day, participants listen to stories of bdote told by Dakota scholars. Photo by Michael Murray; courtesy of the Minnesota Humanities Center.

how Wita Tanka (Pike Island) is the site of genesis; of how treaties signed here took hundreds of thousands of acres of Dakota land; of how 1,600 Dakota women, children, and elders were force marched here from Lower Sioux Agency and held in concentration camps after 38 Dakota men were executed by the United States government; of how a military fort, an airport, and multiple freeways were built over these sites of sacredness and wounding; of how this duality of trauma and birth figures in the story of her own family; of how erasure forecloses efforts to engage one another in reciprocal learning to this day.

In this moment, something changes for participants on the trip. The place speaks to them, calls them to action and understanding in a way no training seminar could ever hope to do. Listening to the incontrovertible, human truths of Ramona's story and grounding in the

stirring tranquility of the bdote site, the dangers of absence and erasure are palpable. Planes roar overhead and the fort's outline looms atop the river bluff, offering constant reminders of how a dominant narrative has marginalized and ignored the humanity of this land's first people. Participants leave feeling an overwhelming desire to share what they have learned and do what they can to promote healing for this place. This is a powerful seed of change that, if nourished through practice and collaboration, can create real and meaningful engagement for students of all backgrounds.

*Bdote Field Trips are open to educators and members of the general public. Visit <http://mnhum.org/bdotefieldtrip> to learn more and sign up for upcoming trips.

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About the Author

Kirk MacKinnon Morrow works with the Minnesota Humanities Center on education and public humanities programming that amplifies stories absented from public discourse to promote a more equitable and engaged future. He has a background in comparative literature and is a frequent writer of essays and short fiction.