I’ve been with the NPS since 2012 and have had an opportunity to visit and talk about climate change with about a third of the Southeast Region Parks. I’ve learned a tremendous amount about how we’ve taken action to adapt to climate change. I can say “taken action” and use the appropriate past-tense terms with confidence, mostly because of our fantastic Park staff. Let me explain...

When I first started working with the NPS, my supervisor at the time, Sherri Fields, told me I needed to get out in the Parks. This terrified me! I worried that I would be akin to a tolerated mother-in-law who invites themselves over for the day. I had nothing to bring to the table, there were no processes, no standard practices, and worse, I had little to no models or information, so I stalled while I tried to figure out how my visit could benefit these Parks.

Well, with the end of the fiscal year looming, I collected what information I could and embarked on the dreaded Park visits. Now, I’m hooked! It was a fantastic experience and I learned so much! I brought with me the best available models, information, literature reviews, presentations, information about ongoing projects and what our DOI partners are doing and sparked fantastic conversations about climate change and Parks.

When I started talking about how climate change is predicted to unfold at a Park, 9 times out of 10, resource managers told me about how they’d noticed that change, then described the actions that had been taken to preserve the Park resources.

That makes sense, especially in light of the fact that 75% of our Parks are in the 5th percentile of their historic temperature, 16% are experiencing drought and 20% are getting far more rain than typical. Of course Parks are adapting!

Our resource managers are in-tune with the status of Park resources and they pick up on changes in their condition and take action. Here are some examples of adaptations that Parks took that were important for a variety of reasons, but are also climate adaptations...

(continued on p. 5)
Park Visitation and Warming Temperatures: Focus on the Southeast Region

Climate change will affect not only natural and cultural resources within national parks, but also visitation patterns. Where, when, and how many people visit parks in the Southeast Region and the rest of the National Park System is likely to change with continued warming. Whether park visitors track climate change and shift their behavior will depend on multiple environmental and socioeconomic factors. However, understanding potential change in visitation based on historical trends and future patterns of temperature change is a crucial first step for park managers and local communities to anticipate, plan for, and proactively affect future visitation.

Recently published research (Fisichelli et al. 2015) sought to understand the temperature visitation relationship in 340 units of the National Park System, including 58 parks in the Southeast Region. Researchers evaluated the historical relationship between long-term average monthly air temperature and visitation (1979-2013), and then modeled potential future visitation (2041-2060) based on two warming-climate scenarios and two visitation-growth scenarios. Here we report Southeast Region findings compared with the rest of the National Park System; park-specific summaries are available at the National Park Service Science and Nature website http://science.nature.nps.gov/climatechange/.

**Study Highlights:**

- Long-term historical monthly visitation across the National Park System is strongly tied to mean air temperatures (Figure 1)
- 71% of parks in the Southeast Region and 90% of parks in the rest of the system show a strong relationship between visitation and air temperature (>50% of variation in visitation related to temperature)
- 69% of the variation in visitation across the system is associated with air temperature
- Visitation increases with warming temperatures, but only to a point; visitation declines as monthly average temperatures exceed roughly 80 °F
- Based on the historical relationship of air temperature and visitor use, the National Park System and most individual parks show increases in potential future (2041-2060) visitation with warming temperatures (Figure 2, Table 1)
- Some parks with already very warm months are projected to see decreases in potential visitation and/or shifts in the timing of visitation to cooler months

The research presented here is not a forecast of what the future will be but rather a projection of how visitation may change. Many factors will alter and constrain actual future visitation patterns, including population changes, economic trends, and leisure time availability. Contact: nicholas_fisichelli@nps.gov

Figure 1. Relationship between historical (1979-2013) monthly average temperature and visitation (proportion of annual) across the U.S. national park system. Observed visitation data (black circles and error bars) are based on 2.5 °C bins, model estimates in green.

Figure 2. Potential future total annual visitation (2041-2060) expressed as a percentage of historical values (1979-2013) under a major warming and high visitation growth scenario.
Protected Areas, such as National Parks, provide disaster risk reduction from episodic events such as hurricanes and from chronic impacts such as sea level rise through wetlands and offshore barrier islands, often referred to as natural infrastructure. Based on storm attenuation research in recent years for both coastal marshes and swamps and for barrier islands, coupled with studies post Hurricane Katrina and Superstorm Sandy, there is strong evidence that these ecosystems play a role in the protection of populated coastal communities.

At the International Union for the Conservation of Nature (IUCN) World Parks Congress in Sydney, Australia, the Climate Change Response Program organized a session on how Parks Support Human Life. The Southeast Region’s Dr. Ford presented talks focused on how our parks help reduce risk from storms and rising sea level.

Coastal wetlands can reduce the impact from storm surge. After Sandy, healthy urban marshes in New York, New Jersey, and Delaware demonstrated how natural defenses can provide risk reduction from storm damage. Restored marshes in Jamaica Bay held strong during Sandy and helped attenuate the storm’s destructive wave action.

A healthy swamp ecosystem can also contribute to protecting hurricane protection levees. During Katrina, levees with swamps bordering them did not fail, while those open to the surge sustained damages including breaching. Jean Lafitte National Historical Park and Preserve (JELA) borders the West Bank communities of New Orleans. None of the levees bordering JELA were breached during Hurricane Katrina.

Gulf Islands National Seashore (GUIS) provides protection to mainland Mississippi by reducing wave and storm surge heights. Healthy ecosystems can provide the U.S. as much as $23.2 billion worth of storm protection annually (Royal Swedish Academy of Sciences). The cost of protection is a small number when you think about the cost of Katrina ($81 billion) and Sandy ($65 billion). The $400 million cost of the restoration of the Mississippi GUIS seems like a smart investment in light of the damage brought by unchecked storm surge.

Restoration of these ecosystems by returning sediments back into the transport systems, strategic beneficial placement of dredged materials, conducting vegetative plantings, constructing earthen berms, and constructing living shorelines such as carefully placed oyster reefs can attenuate storm surges and sea level rise. Continued conservation of National Park coastal areas will reduce natural disaster risks, as well as attenuate chronic effects from impacts such as sea level rise.

- Mark Ford, Regional Wetlands Ecologist

Natural Defense Against Climate Impacts
The Congressional Research Service developed a report that reviews current actions (as of January 2015) of selected federal departments and agencies to adapt their own missions, infrastructure, operations, and personnel to projected climate change. It identified common approaches among agencies, examples of specific actions, and notable barriers the federal government faces.

This report was spot-on in terms of the status of NPS higher-level guidance and policies, but totally misses the target in reporting on-the-ground adaptations. If you’re not sure what I’m talking about, check out the cover story.

The report says that as of December 2014, almost 40 federal departments and agencies had, to varying degrees, produced climate change adaptation plans, climate change vulnerability assessments, adaptation milestones, and/or metrics to evaluate adaptation performance. These efforts have identified wide-ranging vulnerabilities to potential climate changes, as well as some opportunities.

In the report, it’s noted that NPS is addressing climate change through research, education, and adaptive management, as well as through efforts to reduce its own carbon footprint. Some have suggested that managing the parks for adaptation requires a fundamental rethinking of the NPS mission, from one that has historically focused on preserving lands in an unimpaired state to one that would steward NPS resources for continuous change that is not yet fully understood.

NPS released its Climate Change Response Strategy in September 2010, focusing on four types of actions: science, adaptation, mitigation, and communication. It followed this with a Climate Change Action Plan in November 2012, emphasizing the same four response areas and detailing over 50 immediate actions to incorporate climate change considerations into NPS operations.

All of these things are true, but where the report misses the mark is when it says that “Despite these initiatives at the agency management level, it is not clear to what extent the planning efforts have translated into adaptation actions at individual park units.” It cites a 2012 study of climate change adaptation on public lands in Colorado, Utah, and Wyoming found that 78% of surveyed NPS unit managers and staff reported either that no adaptation planning was taking place at their unit, or that they did not know whether such planning was occurring.

In 2012, staff cited budget constraints, lack of information at a relevant scale, and uncertainty of available information as barriers to adaptation planning. Hummm, I’m not that surprised, after all, it was 2012, a lot has changed since then, but it’s important not to dismiss two very important lessons from this report: 1. There is no special fund source for on-the-ground climate adaptation, and 2. When we adapt to changing conditions, we should identify if the change is in part or whole related to climate change and take credit for adapting by telling others how we did it.
There’s a lot of overlap among processes for climate adaptation planning. One resource available to you is the Climate Resilience Toolkit https://toolkit.climate.gov/. The toolkit itself is a nice compilation of guide+tools, and if you’re interested, there’s a great video about the Toolkit created by the Southeast Climate Science Center. This presentation is by Jim Fox from the National Environmental Modeling and Analysis Center. He provides an overview of the status of climate adaptation in the U.S., describing where Agencies are in taking steps for adaptation, how many people are using the hundreds of “tools” that are available, and how they’re using case studies to narrow the field of resources to those most valuable to climate adaptation. Check out the video here National%20Environmental%20Modeling%20and%20Analysis%20Center.

Climate Resilience Toolkit Video

Ocmulgee National Monument decided to eradicate Chinese tallow to conserve amphibian habitat. There’s a known interaction between climate change, presence of Chinese tallow, and amphibian impacts.

Cape Lookout National Seashore has nourished the beach in front of the lighthouse and keepers quarters, conserving sea turtle habitat and reducing vulnerability for the structures. Sea level rise is expected to enhance erosion and storm surge, both threats to habitat and structures.

Fort Sumter National Monument explored a potential revetment to preserve the fort walls.

Little River Canyon National Preserve is experiencing seasonal drought, they removed trees around pitcher plant bogs that appeared to be struggling to stop uptake by tree roots and maintain water in the bog.

Big Cypress National Preserve closed canals that could drain fresh water from the Park and funnel salt water into fresh water environments. This maintains sheet flow and water pressure on the coast to push against sea level rise driven saltwater intrusion.

Jean Lafitte National Historical Park and Preserve worked with the Gulf Coast Ecosystem Restoration Council to secure funds to fill over 16 miles of oil and gas canals to recreate freshwater wetlands and restore hydrology. Filling these canals that go to the ocean will help delay sea level rise driven saltwater intrusion into the freshwater ecosystem.

Chattahoochee River National Recreation Area engaged partners to conserve lands upstream and improve water quality. Lowered dissolved oxygen is a known impact of increased temperatures, and impacts to aquatic life are worse if there is a higher bacterial load.

I could keep describing ways Parks have adapted to climate change, but that’s not the point of this article. The point is that we’ve adapted and are continuing to adapt. Sometimes we know we’re adapting to a changing climate, and sometimes we observe a change or risk and take the steps needed to reduce that risk or mitigate the change. Ultimately what matters is that it’s happening. If you have time to watch the climate resilience toolkit video described above, you’ll hear Jim Fox mention that most of the U.S. is stuck at determining vulnerability.

For the most part, we’re at step 5, “take action” and are now realizing that some of the actions we’ve taken have been in response to climate influenced problems, and I think we’ll continue to see threats that carry greater risk because of a changing climate.

Of course, like any good mother-in-law, I will end with unasked for advice. “Some Parks have some tough choices that need attention, and they’re mobilizing, so, for now, keep adapting!”

Janet Cakir,
SER Climate Change Coordinator
Everything you ever wanted to know about sea level rise modeling

The Southeast Climate Science Center funded a project to develop a handbook on sea level rise modeling for managers.

The purpose of the handbook is to describe and categorize the suite of data, methods, and models and their design, structure, and application for hindcasting and forecasting the potential impacts of sea level rise in coastal ecosystems.

The data and models cover a broad spectrum of disciplines involving different designs and scales of spatial and temporal complexity for predicting environmental change and ecosystem response.

This is the first time these data and models have been synthesized. Some models are demonstration tools for non-experts, whereas others require more expert capacity to use for any given park, refuge, or regional application.

Fortunately, Maria Caffrey, an NPS Partner, is working with the Climate Change Response Program (CCRP) to model sea level rise and storm surge for coastal parks. Storm surge has been completed and the resulting maps are being presented to each coastal park by Janet Cakir in order to collect feedback to provide to Maria. For more information, contact Janet Cakir.

South Atlantic LCC Blueprint 2.0 Released

The Blueprint is a landscape scale climate change and urbanization adaptation plan.

The South Atlantic LCC Conservation Blueprint is a living spatial plan for sustaining natural and cultural resources in the face of future change. [http://www.southatlanticlcc.org/page/conservation-blueprint].

This Blueprint is one of five that will be seamed together to create a Southeast Conservation Adaptation Strategy (SECAS).
It takes pretty far-sighted vision to invest in a large management tool. You have to be sure of both the need and organizational support. Fortunately, both of those came together in the development of a tool called Template for Assessing Climate Change Impacts and Management Options (TACCIMO). I’ve described TACCIMO in previous newsletters, it summarizes and organizes literature related to climate adaptation, streamlining vulnerability assessment.

Organizing literature may sound like an ivory tower exercise at first glance, but talk to someone who’s tried to tackle the question of how to adapt to climate change, and they’ll tell you about the articles, webinars, news announcements, and tools released almost daily that they’re trying to track. It can be overwhelming, and if it’s not your every day job, exhausting.

TACCIMO tackles this problem by gleaning the key points from articles about climate change adaptation, converting those into quotes, and loading them into a citation database that can be searched spatially and topically.

The benefit to Parks is that vulnerability assessments, grounded in the best available science, can be developed far more quickly and easily, enabling a multi-scale approach. The forest service HUB SERCH agreed to test-drive TACCIMO by partnering with Paul Super of GRSM on a vulnerability assessment for GRSM that would nest within a larger effort underway with CCRP, NASA, and the Appalachian LCC (more about that effort in our next newsletter).

To get started, Paul met with Forest Service’s Emrys Treasure in Raleigh, along with NCSU’s meteorology student Aurelia Swanson and Janet Cakir to develop a vulnerability assessment for GRSM.

The first step in the process was a discussion of Park concerns related to climate change and the need for the vulnerability assessment. Next, the team used TACCIMO to download an annotated bibliography of literature about climate adaptation relevant to the Park. Then, once the hundreds of citations were reviewed, the team formed an outline and volunteered to write various sections according to each member’s expertise.

What’s really exciting about this is that the vulnerability assessment could be compiled by a small team in a week or so. The result is a document that describes all the ways climate change is affecting the Park.

The vulnerability assessment will highlight how the park is exposed, sensitive to, and inherently adaptive to climate change. This will provide a resource-specific roadmap to understanding climate change that can help inform decisions, point to needed research, and focus efforts to Partner with others like the Appalachian LCC.

Coming up next: NPS’s Leonard Pearlstine has collected over 400 citations from peer reviewed literature about coastal and marine climate adaptation. He and Jed Redwine reached out to the TACCIMO group at the forest service and offered to share the annotated bibliography! That means that, once the annotated bibliography is loaded into TACCIMO, it will be applicable to coastal Parks and benefit a broad set of Partners from a host of Agencies all working on coastal adaptation. Check the next newsletter for updates on this valuable project. Kudos Guys!
Recently Released Reports and Articles


**Climate Resilience Toolkit Presentation:** If you missed Jim Fox's (National Environmental Modeling and Analysis Center) presentation on the U.S. Climate Resilience Toolkit, find his presentation and web recording. [http://globalchange.ncsu.edu/triangle-climate-brown-bags/](http://globalchange.ncsu.edu/triangle-climate-brown-bags/).


**A Lesson from Hurricane Katrina:** Former SE Climate Science Center Fellow, Adrienne Wootten, reflects back on Hurricane Katrina's 10th Anniversary, The Scientist and the Real World. [https://www.eccforum.org/the_scientist_the_real](https://www.eccforum.org/the_scientist_the_real).

**Webinar Recording:** If you missed the SE Climate Science Center webinar on “Genetic Rescue” of Coral Reefs from Warming Oceans, a recording is now available. [https://www.youtube.com/watch?v=-0IF691-EwM](https://www.youtube.com/watch?v=-0IF691-EwM).

**White House Releases “Actions to Build Resilience to Climate Change Impacts in Vulnerable Communities”:** On July 9, 2015, the White House released a new fact sheet describing initiatives to build resilience to climate change impacts. These “actions” include Launching a Resilience AmeriCorps Pilot Program, Helping Tribes Prepare for Climate Impacts, and Providing Data and Tools for Climate Preparedness. [https://www.whitehouse.gov/administration/eop/ceq/Press_Releases/July_09_2015](https://www.whitehouse.gov/administration/eop/ceq/Press_Releases/July_09_2015)

**Translating Climate Change Effects into Everyday Language: An Example of More Driving and Less Angling:** The authors of this article posit that with some additional thought and relatively simple summaries, the responses of fish and other species to climate change can be translated into everyday language that will facilitate climate science communication. [http://bit.ly/1MNOm3U](http://bit.ly/1MNOm3U).

**Obama Administration Unveils New Climate Resilience Tools:** As part of the Obama Administration’s Climate Data Initiative, U.S. Secretary of the Interior Sally Jewell announced a new set of online climate data resources to help Arctic communities with climate change planning, adaptation and management. [https://www.doi.gov/pressreleases/obama-administration-unveils-new-climate-resilience-tools](https://www.doi.gov/pressreleases/obama-administration-unveils-new-climate-resilience-tools).


Historical Climatology: HistoricalClimatology.com shares interdisciplinary climate change research with policymakers, journalists, scholars, and the general public. Listen to a podcast with Geoffrey Parker of Ohio State University, which explores how a cooling climate disrupted societies across the seventeenth-century world. http://www.historicalclimatology.com/interviews


Must-Follow Science Feeds: For those interested in science communication who use twitter and blogs, check out some of these great suggestions, such as the Last Word on Nothing, Biodiversity Heritage Library, and WTF, Evolution?! http://www.wired.com/2015/08/the-new-cultural-literacy-science-feeds


New Video: Oceanographer Josh Willis from NASA's Jet Propulsion Laboratory narrates this video about the causes of sea level rise and how sea level has changed over the last two decades as observed by the Jason series of satellite missions https://www.youtube.com/watch?t=86&v=GTBWjDukTzl

A Compilation of Climate Funding Opportunities (as of July 2015): NOAA has compiled a list of Climate Funding Opportunities. This document provides a snapshot of currently available, climate-related funding opportunities (as of July 2015). http://ntrda.me/1PgZhmj

NOAA Science on a Sphere: The revolutionary software takes SOS technology and datasets, usually found at museums and science centers, and makes them accessible to everyone including teachers and their classrooms. http://research.noaa.gov/News/NewsArchive/LatestNews/TabId/684/ArtMID/1768/ArticleID/11339/NOAAs-Science-On-a-Sphere174-animations-coming-to-your-desktop.aspx

A Collaborative Effort Against Sea Level Rise: The NOAA Sentinel Site Program was started by NOAA's National Ocean Service (NOS) in 2011 as a means of creating a cooperative effort to measure the ecological impacts of sea level rise and apply science-based solutions to coastal regions. http://seagrant.noaa.gov/News/FeatureStories/TabId/268/ArtMID/715/ArticleID/580/A-Collaborative-Effort-Against-Sea-Level-Rise.aspx
Landscape Conservation Cooperative News:

Appalachian LCC: Managing for Species Adaptive Capacity

A new paper authored by researchers at federal agencies, regional partnerships, and universities, including Appalachian LCC Coordinator and Senior Scientist Dr. Jean Brennan, proposes a new conceptual paradigm for adaptive capacity, discusses managing for species adaptive capacity in an ecosystem context, and suggests a path forward in light of the role that adaptive capacity information could play in improving conservation assessments, plans, and actions. [http://applcc.us5.list-manage.com/track/click?u=0b8e1649b356eeb59eea16e90&id=bd6fbbc34b&e=baac12d375](http://applcc.us5.list-manage.com/track/click?u=0b8e1649b356eeb59eea16e90&id=bd6fbbc34b&e=baac12d375)

South Atlantic LCC:

The South Atlantic LCC has approved version 2 of their Blueprint. In their next steps they will fund two new projects to further improve the Blueprint. 1) Improving the connections with urban communities and 2) Improving the connection between coastal actions and marine impacts.

Peninsular Florida LCC:

Check out Peninsular Florida’s [Landscape Conservation and Climate Scenarios](http://peninsularfloridalcc.org/page/climate-change-scenarios) at [http://peninsularfloridalcc.org/page/climate-change-scenarios](http://peninsularfloridalcc.org/page/climate-change-scenarios). They were used to develop Florida’s [Cooperative Conservation Blueprint](http://peninsularfloridalcc.org/page/climate-change-scenarios) found at [http://peninsularfloridalcc.org/page/climate-change-scenarios](http://peninsularfloridalcc.org/page/climate-change-scenarios). (FYI—lots of high priority areas identified around BICY and EV-ER)

Gulf Coast Plains and Ozarks LCC:

Four Landscape Conservation Cooperatives along the Gulf partnered with the Gulf of Mexico Alliance to conduct the Gulf Coast Vulnerability Assessment (GCVA). The GCVA uses an expert-opinion approach to qualitatively assess the vulnerability of four pilot habitat types – mangroves, oyster reefs, tidal marsh, and island beaches and dunes - as well as many of the wildlife species dependent on them. [http://gulfcoastprairielcc.org/resources-tools/webinars/the-gulf-coast-vulnerability-assessment/](http://gulfcoastprairielcc.org/resources-tools/webinars/the-gulf-coast-vulnerability-assessment/)

Caribbean LCC:

Ecosystem governance knowledge base completed. The project assessed priority issues in the Caribbean, evaluated existing collaboration, the knowledge base will be used to define and refine goals, to sequence and prioritize actions, and to evaluate progress of the CLCC toward a unified vision of land and seascapes in the Caribbean.