MULTI-SECTOR CLIMATE IMPACTS

COLLABORATIVE EFFORTS TO MITIGATE MULTI-SECTOR CHANGE

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Climate Information for Managing Risks Conference
Orlando, FL
May 25, 2011
Climate Change Impacts: Not just warming, but more extremes

**Heavy Downpours**
More rain is already coming in very heavy events, and this trend is projected to increase across the nation. Such events are harmful to transportation infrastructure, agriculture, water quality, and human health.

**Energy Supply**
Warming will decrease demand for heating energy in winter and increase demand for cooling energy in summer. The latter will result in significant increases in electricity use and peak demand in most regions.

**Agriculture**
Increasing heat, pests, floods, weeds, and water stress will present increasing challenges for crop and livestock production.

**Heat Waves**
Heat waves will become more frequent and intense, increasing threats to human health and quality of life, especially in cities.

**Coastal Communities**
Sea-level rise and storm surge will increase threats to homes and infrastructure including water, sewer, transportation, and communication systems. Many barrier islands and coastal marshes that protect the coastline and support healthy ecosystems will be lost.

**Water and Energy**
As warming increases competition for water, the energy sector will be strongly affected as power plants require large amounts of water for cooling.

**Water Supply**
Reduced summer runoff, increased winter runoff, and increasing demands will compound current stresses on water supplies and flood management, especially in the West.

USGCRP, 2009
Some Key Issues for the Southeast

- **Projected increases in air and water temperatures** will cause heat-related stresses for people, plants, and animals.

- **Decreased water availability** is very likely to affect the region’s economy as well as its natural systems.

- **Sea-level rise** and the likely **increase in hurricane intensity** and associated **storm surge** will be among the most serious consequences of climate change.

- **Ecological thresholds** are likely to be crossed throughout the region, causing major disruptions to ecosystems and to the benefits they provide to people.

- **Quality of life** will be affected by increasing heat stress, water scarcity, severe weather events, and reduced **availability of insurance** for at-risk properties.

USGCRP, 2009
Climate-related changes can interact with and exacerbate many social and environmental stresses...

- Invasive species, weeds, etc.
- Energy demand
- Vector-born diseases
- Air pollution
- Population shifts
- Urbanization
- Etc.

Climate perturbations can both simultaneously affect multiple sectors and cause “ripple effects” through related systems.

Figure: www.water.ca.gov/climatechange/factsheet.cfm
Example: Ozone and Agriculture

- Ozone ($O_3$) formed in the troposphere when volatile organic compounds (VOCs) and nitrogen oxides combine in the presence of heat and sunlight.

- Higher air temps result in more $O_3$.

- $O_3$ has significant public health outcomes (e.g., respiratory effects).

- $O_3$ levels have risen in U.S. rural areas over the last 50 years.

- $O_3$ is forecast to increase with warming, especially under higher emission scenarios.

- Plants are sensitive to $O_3$, and crop yields are reduced as ozone levels increase.
  - Particularly sensitive: soybeans, wheat, oats, green beans, peppers, some types of cotton.

\[
\text{VOC} + \text{NO}_x \xrightarrow{\Delta} \text{hv} \rightarrow O_3
\]

USGCRP, 2009
Figure: NASA
### Possible impacts of climate change due to changes in extreme weather and climate events

<table>
<thead>
<tr>
<th>Phenomenon and direction of trend</th>
<th>Likelihood of future trends</th>
<th>Examples of major projected impacts by sector</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture, forestry and ecosystems</strong></td>
<td></td>
<td><strong>Water resources</strong></td>
</tr>
<tr>
<td>Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights</td>
<td>Virtually certain&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Increased yields in colder environments; decreased yields in warmer environments; increased insect outbreaks</td>
</tr>
<tr>
<td>Warm spells/heat waves. Frequency increases over most land areas</td>
<td>Very likely</td>
<td>Reduced yields in warmer regions due to heat stress; increased danger of wildfire</td>
</tr>
<tr>
<td>Heavy precipitation events. Frequency increases over most areas</td>
<td>Very likely</td>
<td>Damage to crops; soil erosion, inability to cultivate land due to waterlogging of soils</td>
</tr>
<tr>
<td>Area affected by drought increases</td>
<td>Likely</td>
<td>Land degradation; lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire</td>
</tr>
<tr>
<td>Intense tropical cyclone activity increases</td>
<td>Likely</td>
<td>Damage to crops; windthrow (uprooting) of trees; damage to coral reefs</td>
</tr>
<tr>
<td>Increased incidence of extreme high sea level (excludes tsunamis)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Likely&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Salinisation of irrigation water, estuaries and fresh-water systems</td>
</tr>
</tbody>
</table>

<sup>a</sup> See Working Group I Table 3.7 for further details regarding definitions.

<sup>b</sup> Based on projections for 21st. Century using SRES scenarios.

<sup>c</sup> Warming of the most extreme days and nights each year.

<sup>d</sup> Extreme high sea level depends on average sea level and on regional weather systems. It is defined as the highest 1% of hourly values of observed sea level at a station for a given reference period.

<sup>e</sup> In all scenarios, the projected global average sea level at 2100 is higher than in the reference period. The effect of changes in regional weather systems on sea level extremes has not been assessed.
Addressing Multi-sector Impacts

- Begin planning **now** for adaptation

- Develop new tools and institutions to manage climate-related risks across a broad range of sectors and spatial scales

- Adaptation decisions made by State/local government, private sector, and society at large

- These efforts will be much more effective with **national-level coordination**

*National Research Council, 2011*
Interagency Climate Change Adaptation Task Force

- Executive Order of October 5, 2009, called on the Task Force to recommend how the policies and practices of Federal agencies can be made compatible with and reinforce a national climate change adaptation strategy.

- Task Force began meeting in Spring 2009.

- Co-chaired by the CEQ, NOAA, and the OSTP.

- Task Force is composed of more than 20 Federal agencies and Executive branch offices.


- Federal Agencies currently preparing Agency-specific adaptation plans.

http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation
Policy Goals & Recommended Actions for the Federal Government

• Encourage and Mainstream Adaptation Planning across the Federal Government

• Improve Integration of Science into Decision Making

• Address Key Cross-Cutting Issues
  • Improve water resource management in a changing climate
  • Protect human health by addressing climate change in public health activities
  • Build resilience to climate change in communities
  • Facilitate the incorporation of climate change risks into insurance mechanisms
  • Address additional cross-cutting issues

• Enhance Efforts to Lead and Support International Adaptation

• Coordinate Capabilities of the Federal Government to Support Adaptation
Guiding Principles for Adaptation

• **Adopt Integrated Approaches**
  Adaptation should be incorporated into core policies, planning, practices, and programs whenever possible.

• **Prioritize the Most Vulnerable**
  Adaptation plans should prioritize helping people, places and infrastructure that are most vulnerable to climate impacts and be designed and implemented with meaningful involvement from all parts of society.

• **Use Best Available Science**
  Adaptation should be grounded in the best available scientific understanding of climate change risks, impacts, and vulnerabilities.

• **Build Strong Partnerships**
  Adaptation requires coordination across multiple sectors and scales and should build on the existing efforts and knowledge of a wide range of public and private stakeholders.
Guiding Principles for Adaptation (cont.)

• **Apply Risk Management Methods and Tools**
  Adaptation planning should incorporate risk management methods and tools to help identify, assess, and prioritize options to reduce vulnerability to potential environmental, social, and economic implications of climate change.

• **Apply Ecosystem based Approaches**
  Adaptation should, where relevant, take into account strategies to increase ecosystem resilience and protect critical ecosystem services on which humans depend to reduce vulnerability of human and natural systems to climate change.

• **Maximize Mutual Benefits**
  Adaptation should, where possible, use strategies that complement or directly support other related climate or environmental initiatives, such as efforts to improve disaster preparedness, promote sustainable resource management, and reduce greenhouse gas emissions including the development of cost-effective technologies.

• **Continuously Evaluate Performance**
  Adaptation plans should include measurable goals and performance metrics to continuously assess whether adaptive actions are achieving desired outcomes.
EXAMPLE: SENRLG LAND CONSERVATION AND RESTORATION CRAFT PROJECT*

Thanks to Jim Fox/UNC Asheville for input to this section
Why we did this project…

- SENRLG decided to address the issue of climate impacts and vulnerabilities

- Agreed to use CRAFT Process – Comparative Risk Assessment Framework and Tools

- The process encourages cross agency cooperation and consensus building through a structured process

- Identify priority areas of potential collaboration using existing programs
CRAFT helps teams understand situations and problems

- Focus on issues
- Organize the analysis
- Bring the right tools and data to the table
- Incorporate team’s values

DATA + VALUES = DECISION
**Example: Using team values to define measurable goals and objectives**

<table>
<thead>
<tr>
<th>Values</th>
<th>Goal</th>
<th>Objective</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water availability</td>
<td>Maintain appropriate water quantity</td>
<td>Maintain water-holding capacity of soil</td>
<td>Minimize loss of forested area to preserve soil</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sustain stream flow levels</td>
<td>Maintain evergreen vegetation along streams</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sustain groundwater flow levels and avoid increased surface runoff</td>
<td>Limit forest canopy loss and impervious surfaces</td>
</tr>
<tr>
<td>Wildlife viability</td>
<td>Maintain habitat for wildlife</td>
<td>Prevent the introduction/spread of exotic-invasive plants</td>
<td>Limit vehicle access and forest fragmentation in high-value wildlife areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provide diversity of native wildlife forage (food)</td>
<td>Increase early successional habitat</td>
</tr>
<tr>
<td>Critical species habitat</td>
<td>Sustain habitat for critical/endangered species</td>
<td>Monitor and prioritize sensitive areas for species conservation</td>
<td>Preserve areas with high-value rare native plant communities</td>
</tr>
<tr>
<td>Forest productivity</td>
<td>Maintain forest productivity</td>
<td>Sustain forested landcover</td>
<td>Implement restoration of grass/agriculture to forestland</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prevent tree mortality from water stress</td>
<td>Encourage drought-tolerant tree species</td>
</tr>
</tbody>
</table>
Example: Identify, Prioritize and …..

Apply Risk Management

Legend:
- Red-cockaded Woodpecker Translocation Projects (DOD)
- Gopher Tortoise Habitat (F&WS)
- Long Leaf Pine Historical Habitat (USFS)
- Southeastern Ecological Framework (EPA)
What we committed to do (so far!)

✓ Determine what we are going to work on (problem definition)

✓ Establish a common vocabulary

✓ Share what is important (values) to each of our agencies

✓ Structure these values into categories, essential attributes and metrics

✓ Begin identifying vulnerable areas in the Southeast based on these values/metrics

✓ Prioritize to be able to move from assessment to action

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**Essential Attributes**

- Landscape Condition
- Biotic Condition
- Chemical and Physical Characteristics (Water, Air, Soil, Sediment)
- Ecological Processes
- Hydrology and Geomorphology
- Natural Disturbance Regimes

The Team also included the attributes:

- Cultural
- Societal

*A Framework for Assessing and Reporting on Ecological Condition, EPA, 2002*
Problem Definition

- **Issue.** Climate change currently affects and has unknown potential to affect and impact ecosystems and human communities including natural, cultural and socio-economic resources in known and unknown ways. As Federal land and environmental resource management and regulatory agencies, we are charged with providing leadership to protect, conserve and restore natural and cultural resources while protecting and sustaining human communities.

- **Benefits and Consequences.** Effective, efficient, cohesive decisions and collaborative actions are required to mitigate effects and provide tangible results; to create resilient landscapes; and to create viable, adaptable and healthy natural and social communities.

- **No Action.** Failure to act collaboratively will result in devastating consequences to our Southeast United States ecological, economic and social environment.
Our Approach

Using the South Atlantic LCC area as a test case:

1. Identify ecological, cultural, and societal resources and services likely to be significantly impacted by climate change and variability (complete)

2. Identify common resources (complete)

3. Create a toolset of information from numbers 1 & 2 (complete)

4. Begin prioritizing areas/issues (complete)

5. Identify climate change impact areas where agencies share common set of values and which would benefit from direct attention (complete)

6. Work to build resiliency in the system from climate impacts
THANK YOU!

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