Cross-scale carbon governance challenges in the United States

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Outline

- What is carbon governance?
- Challenges
- Issue of scale
- Research project
  - Colorado
  - Pennsylvania
- Summary
Carbon Governance

“The planning, influencing and conducting of the policy and affairs of institutions that aim to minimize the amount of carbon dioxide released to the atmosphere or maximize the amount of carbon stored stably away from the atmosphere.”

- Governance does not always = government
- Effective carbon governance is being able to control the amount of carbon in the atmosphere.
Toward carbon governance?

**Inadvertent carbon management**
- Existing for millennia
- Will continue to dominate C management
- Depends on land type, land use, actors, markets, policy

**Deliberate carbon management**
- Increasing interest in past 10 yrs
- Small scale
- Pilot projects
- Voluntary efforts

**FUTURE ??**

**Carbon Governance?**
- Both deliberate and inadvertent
- Rules TBD
- Effective across scales
- Role of public policy
- Role of markets
Challenges to effective governance

- Diverse decision makers
  - Public (elected, civil, diff.scales)
  - Private (individuals, industry, business, shareholders)
  - Non-profit sector

- Carbon lacks immediacy and intrinsic value

- Verification of cause and effect

- Permanence
The problem of scale for carbon governance

- To be effective, carbon governance must be consistent across scales
  - Must account for leakage
- Variety of policy scales involved
- If C information is to inform decisions about carbon governance, potential problem of scale mismatch (e.g. Cash and Moser 2000)
Carbon governance through land use

- Diverse landscapes and land uses
- Highly distributed control/ownership
- Not managed for climate or carbon storage as main purpose
- Varied time scales of outcomes
- Multiple actors at multiple scales
Research questions

- What are the influences (including policies, laws, and market forces) at different scales that currently influence land use decision making (and, in turn, carbon fluxes)?
- At what scale are we currently producing C information that would be of use to these decision processes?
- Are there scale mismatches or needs for C information we are currently missing?
Case study: U.S. states of Colorado and Pennsylvania

Pennsylvania:
• Deciduous forest and pasture land
• primarily privately owned.
• reverting back to forest after agriculture migration
• 5% of the land is federally managed.

Colorado:
• Grassland, deciduous and evergreen forest, small grain agriculture, grassland, grazing land and shrubland.
• Forests are largely mature
• 50-85% of western half of CO is federally managed.
Approach

- Mapping scales of decision influences for biospheric portion of the C cycle
  - Review literature, existing data sets, public record
  - Identify decision making entities
  - Focus in on decision processes that are most important for carbon exchange
  - Conjoint analysis of specific decision makers’ responses

- Mapping carbon cycle science scales
  - Identify research activities through records and contacts

- Comparison of scales across scientific research and decision making; identify potential areas of opportunity
Colorado ownership pattern

- Private 58%
- Federal:
  - U.S. Forest Service 21%
  - Bureau of Land Management 13%
  - Bureau of Indian Affairs 2%
  - National Park Service, Dept. of Defense, (0.7 and 0.8%)
- State of Colorado 4%
  - Div. of Wildlife (0.5%)
- Minor landowners (<0.1%):
  - Bureau of Reclamation, Dept. of Commerce, Dept. of Energy, FAA, Fish and Wildlife, Nat. Rec. Area, city spaces

Data from USGS
Colorado Land Cover Types

- Dryland crops 16%
- Pinyon juniper 11%
- Irrigated crops 8%
- Spruce Fir 8%
- Big sagebrush shrubland 7%
- Ponderosa pine 6%
- Aspen 6%
- Sand dune complex (shrubland) 5%
- Lodgepole pine 4%
- Deciduous oak 4%
- Foothill mountain grassland 3%
- Midgrass prairie 2%
- Saltbrush fans and flats 2%
- Juniper 2%
- …Rest 16%

From CO GAP project
Metric Conjoint Analysis

Topics developed in collaboration with Pennsylvania Department of Conservation and Natural Resources (PADCNR)

- Forest Composition with Climate Change
  - CO$_2$ fertilization effect
  - Future growing seasons
  - Species migration

- Forest Regeneration
  - Acidic “hot spots”
  - Negative impact on species diversity
  - Loss of primary productivity

- Carbon Monitoring
  - Biomass monitoring at various scales
  - Estimations of biomass changes over time
  - Modeling carbon uptake
Metric Conjoint Analysis

- Preference based methodology
  - Stated vs. demonstrated preference

- Quantitative analysis of qualitative data

- Measurement of utility
  - Attributes and attribute clusters
  - Attribute trade-off

- Requires only small sampling pool.
  - Ideal do to limited number of organizations involved in carbon sequestration
## Example influences on private landowners

<table>
<thead>
<tr>
<th>Level</th>
<th>Influences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>Commodity markets, climate, policy</td>
</tr>
<tr>
<td>National</td>
<td>Subsidies, incentives, regulations, water compact</td>
</tr>
<tr>
<td>State</td>
<td>Water, environmental, population growth</td>
</tr>
<tr>
<td>County</td>
<td>Zoning, local policies, cultural trends</td>
</tr>
<tr>
<td>City</td>
<td>Zoning, local policy</td>
</tr>
</tbody>
</table>
Example influences on Federal landowner decision making

<table>
<thead>
<tr>
<th>Global</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>Regs, Congress. authority, mission, economic interests</td>
</tr>
<tr>
<td>State</td>
<td>Resource management goals, fire</td>
</tr>
<tr>
<td>County/Regional</td>
<td>Economic interests, recreation, regional authority (districts)</td>
</tr>
<tr>
<td>City</td>
<td>Quality of life</td>
</tr>
</tbody>
</table>
Summary

- Carbon governance will be a challenge
  - Diverse decision makers
  - Carbon only one of many values
  - Multiple scales of influence on decisions

- Understanding these scales will help both with the basic characterization of drivers of the carbon system and with eventually providing input for C management decisions

- Stay tuned for later results!
Thank you!

- Sponsored by NOAA
- Please feel free to contact me with questions:
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