

Land use decision making as a driver of carbon sequestration at multiple scales: A Colorado Case Study



Lisa Dilling and Betsy Failey
University of Colorado, Boulder

Human Decisions

1. Driver of Earth system changes

2. Provide "usable science"

Information

Alternatives/Options



Land use and carbon

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- Important part of global carbon budget (~1.5 GT C per yr to atmosphere)
- Key negotiating element for UNFCCC
 - ▣ Flexibility mechanism
 - ▣ Increase participation
 - ▣ Preventing deforestation
- Seen as lower cost
- Many decision makers at different scales affect balance



The problem of scale

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- 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)

Research questions

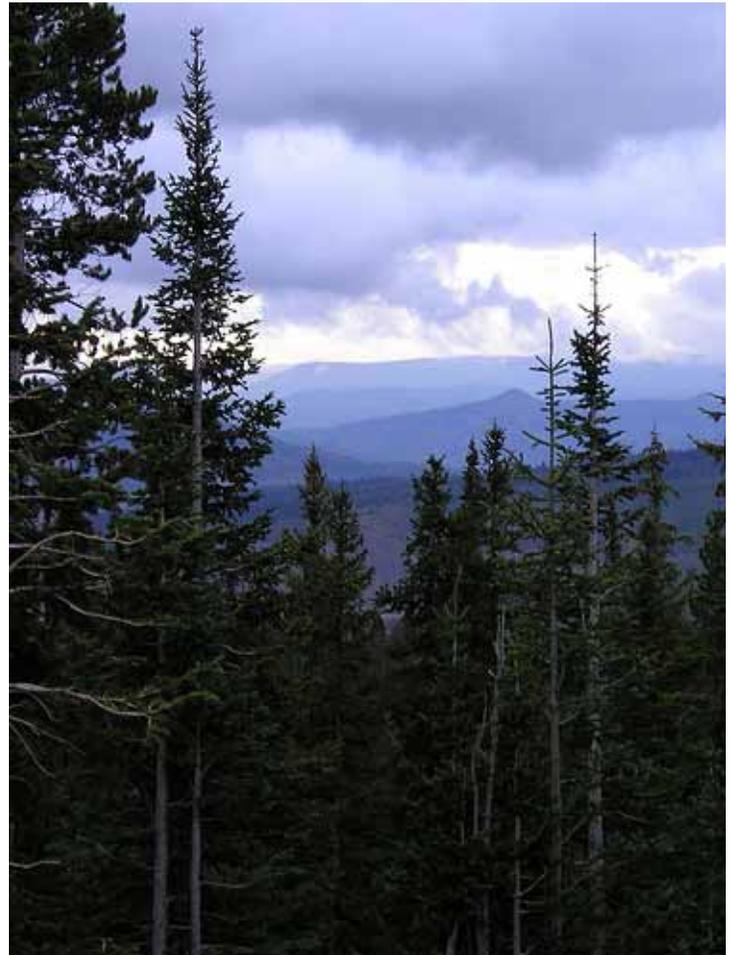
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- How do ownership patterns correspond with carbon stocks and flux patterns?
- What are the influences (including policies, laws, and market forces) at different scales that currently influence land use decision making (and, in turn, carbon fluxes)?
- Where are the opportunities or conflicts with existing policy?
- Are there scale mismatches or needs for C information we are currently missing?

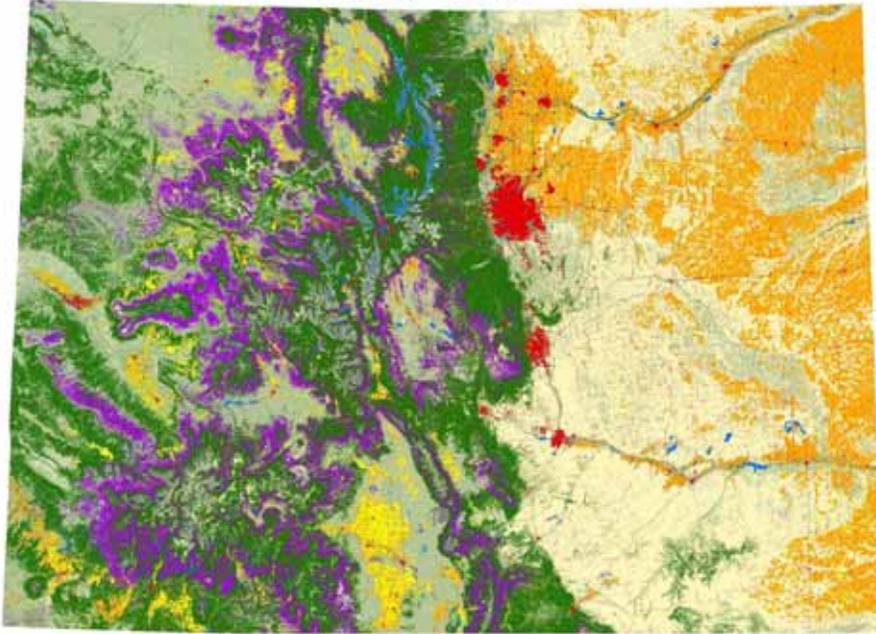
Methods

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- Case study of Colorado
- Existing databases of COMaP and LANDFIRE
- C stocks and fluxes from the literature
- Conducted 31 semi-structured interviews with public and private land managers across the state
 - ▣ Selected by attending Conservation District meetings and letters to county contacts

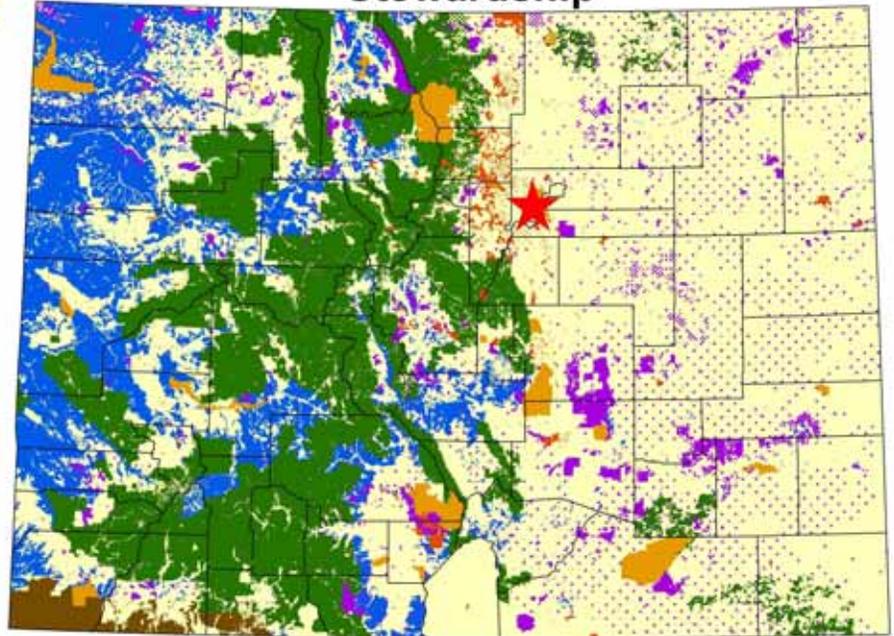


Land Cover

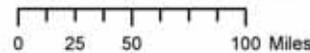


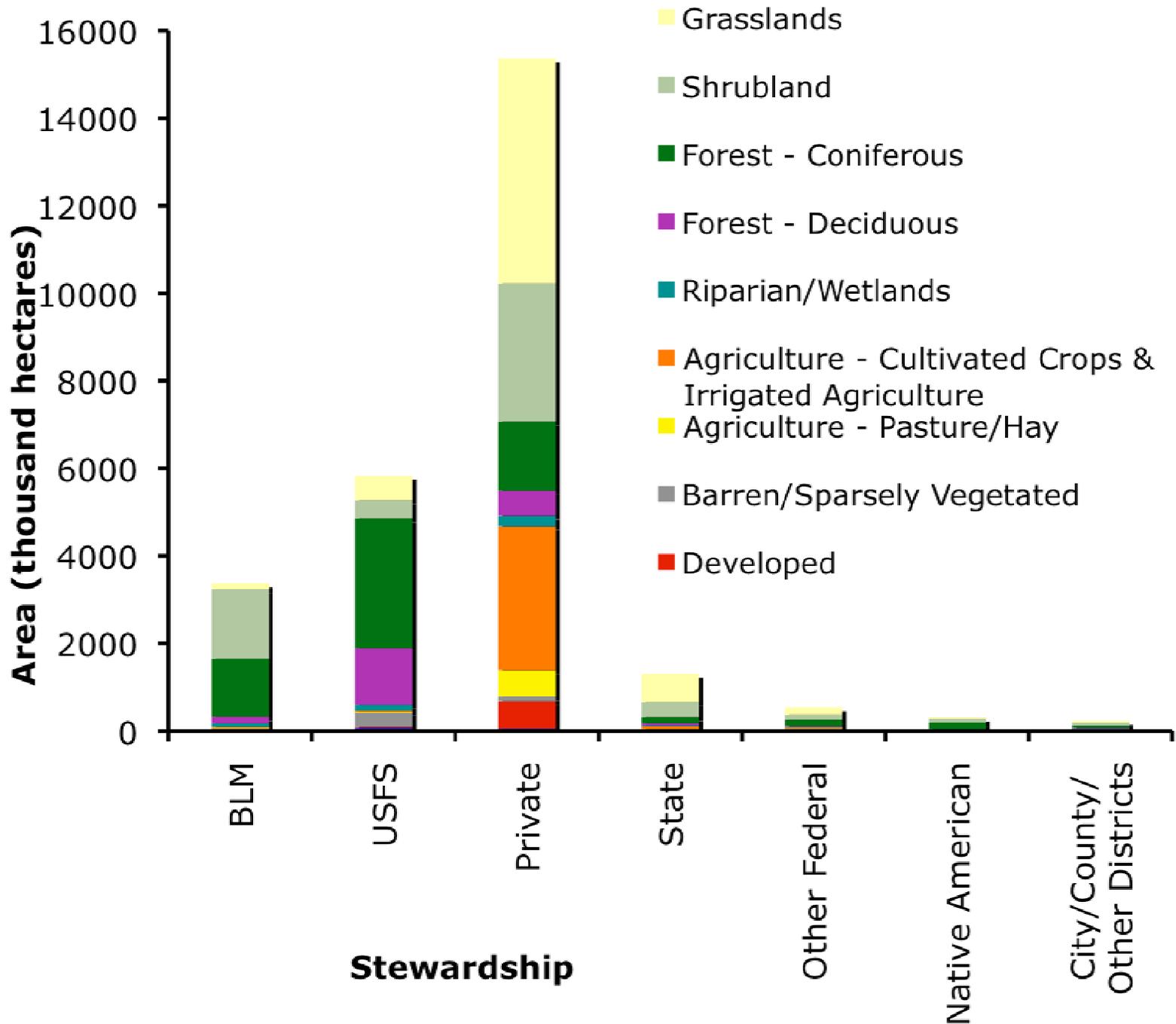
- Water/Snow/Ice
- Developed
- Barren/Sparsely Vegetated
- Agriculture-Pasture/Hay
- Agriculture-Cultivated Crops & Irrigated Agriculture
- Forest - Deciduous
- Forest - Coniferous
- Shrubland
- Grasslands
- Riparian/Wetlands

Stewardship



- Denver
- county boundaries
- Bureau of Land Management
- U.S. Forest Service
- Private
- State
- Other Federal Land
- Native American Reservation
- City/County/Other Districts





LANDCOVER	Flux Low (Mg C/ha/yr)	Flux High (Mg C/ha/yr)	Stock Low (Mg C/ha)	Stock High (Mg C/ha)	Sources
Forest – Coniferous	-0.09	-0.40	138.24	316.06	COLE accessed 11/19/08 Conant et al. CO Report Houghton & Hackler 2000
Forest – Deciduous	-0.09	-0.35	162.40	213.24	CCSP 2007 COLE accessed 11/19/08 Conant et al. CO Report Houghton & Hackler 2000
Grasslands	-0.01	0.18	24.37	107	CCSP 2007 Conant et al. CO Report Houghton & Hackler 2000
Shrubland	-0.01	-0.04	24.37	107	CCSP 2007 Conant et al. CO Report Houghton & Hackler 2000
Ag. – Cultivated Crops & Irrigated Ag.	0	-0.22	21.46	80	CCSP 2007 Pacala et al. 2001 Houghton & Hackler 2000
Developed	0	-0.31	7.4	10	CCSP 2007 Golubiewski 2006
Ag. – Pasture/Hay	0	-0.11	21.46	80	CCSP 2007 Lal et al. 2003 Houghton & Hackler 2000
Riparian/Wetlands	-0.03	-0.17	0	164.5	Conant et al. CO Report CCSP 2007

Stewardship	Area 1000 ha	Flux low Tg C yr-1	Flux high Tg C yr-1	Stock low Tg C	Stock high Tg C
Private	15367	-0.28	-1.06	600.9	1866.5
USFS	5835	-0.40	-1.59	642.6	1343.0
BLM	3372	-0.15	-0.64	249.4	649.2
State	1311	-0.03	-0.01	52.6	169.5
Other Fed	537	-0.03	-0.09	51.4	110.6
Native American	308	-0.02	-0.07	24.5	62.3
City/County/Other districts	231	0	-0.03	11.7	33.1

Breakdown by land cover type

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Stewardship	Area (10 ⁴ ha)	Flux Low (Tg C/yr)	Flux High (Tg C/yr)	Stock Low (Tg C)	Stock High (Tg C)
Private	1537	-0.28	-1.06	600.90	1866.53
Forest – Coniferous	158	-0.14	-0.63	218.93	500.55
Forest – Deciduous	56	-0.05	-0.20	91.61	120.29
Grassland	515	-0.05	0.93	125.37	550.47
Shrubland	315	-0.03	-0.13	76.84	337.36
Ag. – Row Crops & Irrigated	329	0	-0.72	70.60	263.20
Ag. – Pasture/Hay	60	0	-0.07	12.93	48.21

Preliminary numbers

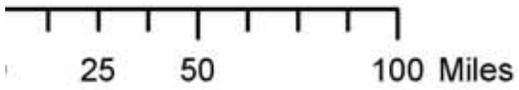
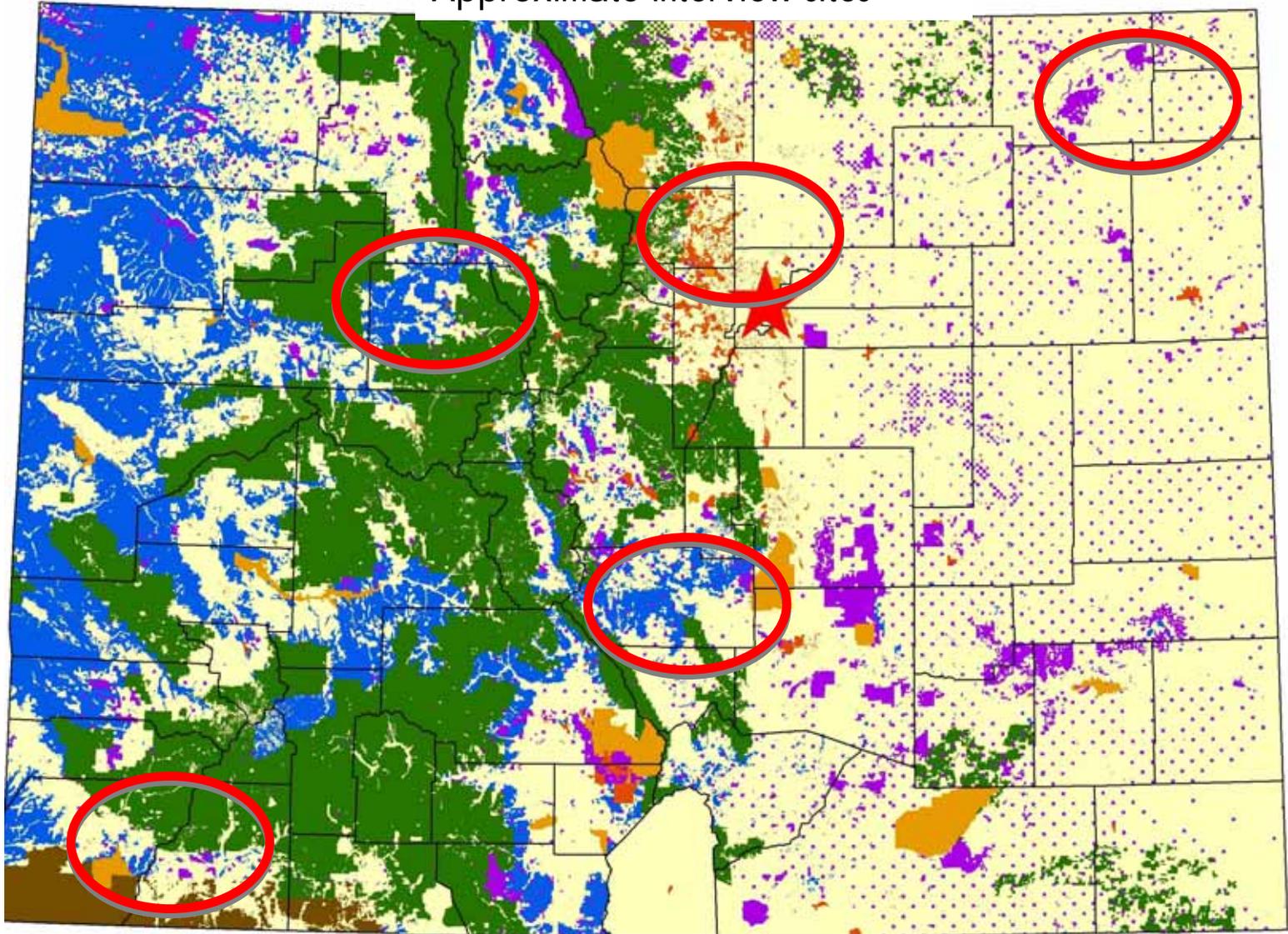
Interviews

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- Spring, summer 2008
- 15 Federal
 - USFS, 3 levels
 - BLM, 2 levels
 - NRCS
- 12 Private
 - Farmers (dryland and irrigated)
 - Ranchers
 - Forest
- 3 State/County
- 1 Native American reservation



Approximate interview sites



6 Categories of interest

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- Scale of decision– how much land area
- Latitude, flexibility in decision making
- Primary influential factors (legal and otherwise)
- Awareness of carbon markets
- Information use and source of information
- Partners in decision making

Scale of decision

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- Most people we interviewed were directly responsible for land management, from small farms of 200 acres to public land units of 600,000 acres or more.
- Most people responded that they had at least some autonomy in decision making.

Public sector influences

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- Decisions governed by 15 year management plans and NEPA process
- Public input key for many decisions
- Prevalent themes: fire management, beetle outbreak, recreation
- Overall influence from national policy directions, but rare to have direct national level input into most decisions

Increasing scale



Private sector influences

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- Strong land ethic, generational history
- Economics- markets for commodities
- Water availability, water rights
- Most have participated in government programs, at state and/or Federal level

Carbon awareness- public managers

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- Not yet managing for carbon; on the horizon
- DOI does have executive order (from Babbitt's tenure) to consider climate, but no standard guidance
- Awareness in Forest Service of Climate Change Strategic Framework planning process (now complete)
- Some sense that would be difficult to participate in a market per se, but perhaps could act as a type of insurance

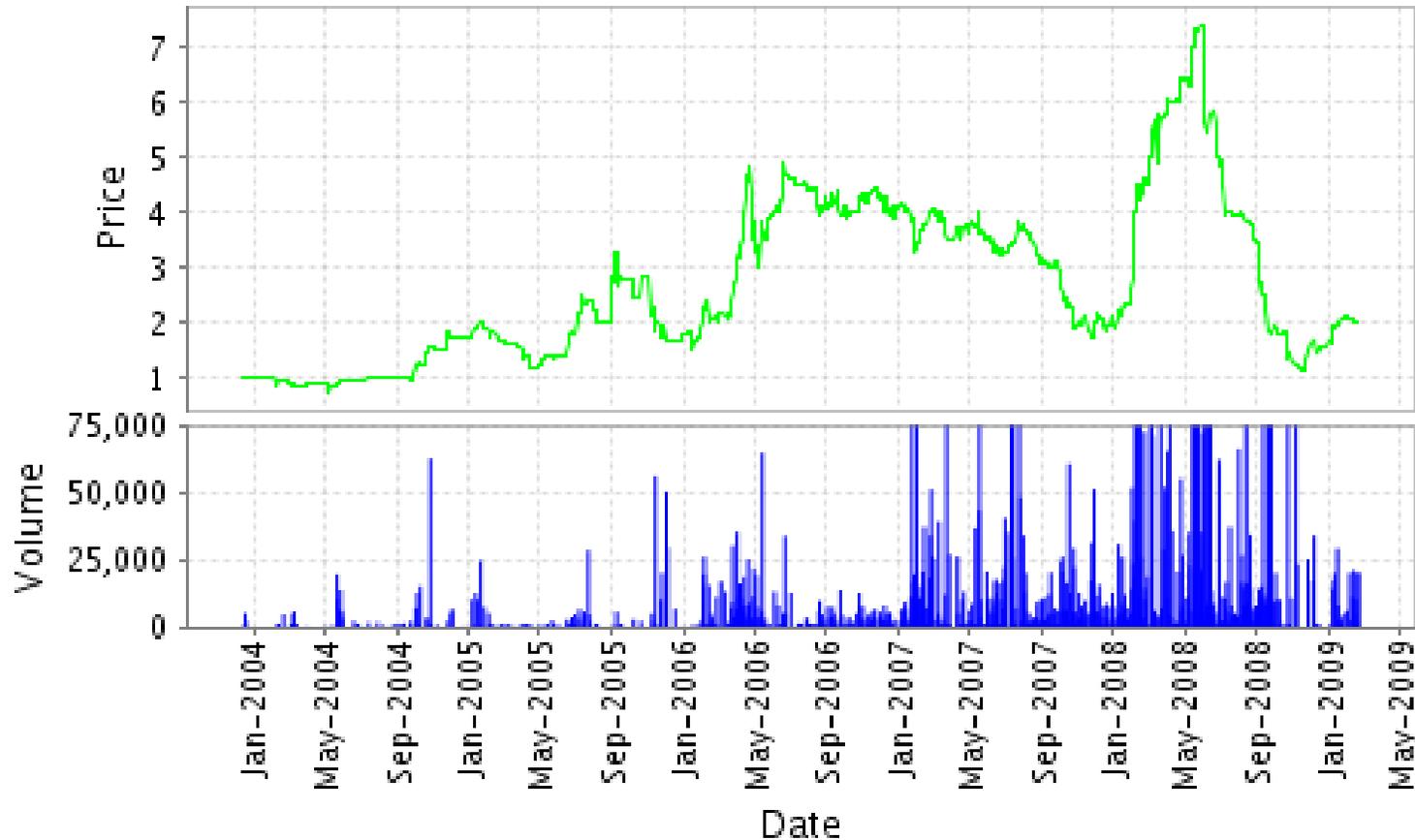
Carbon awareness- private sector

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- Mixed response to voluntary market engagement
 - ▣ Difficulty of changing practices
 - ▣ Low financial incentive
 - ▣ Questioning efficacy
 - ▣ “anything to help me keep the farm going”
- In Colorado, Farmer’s Unions are trying to enroll farmers in CCX-linked program and the State may begin this as well

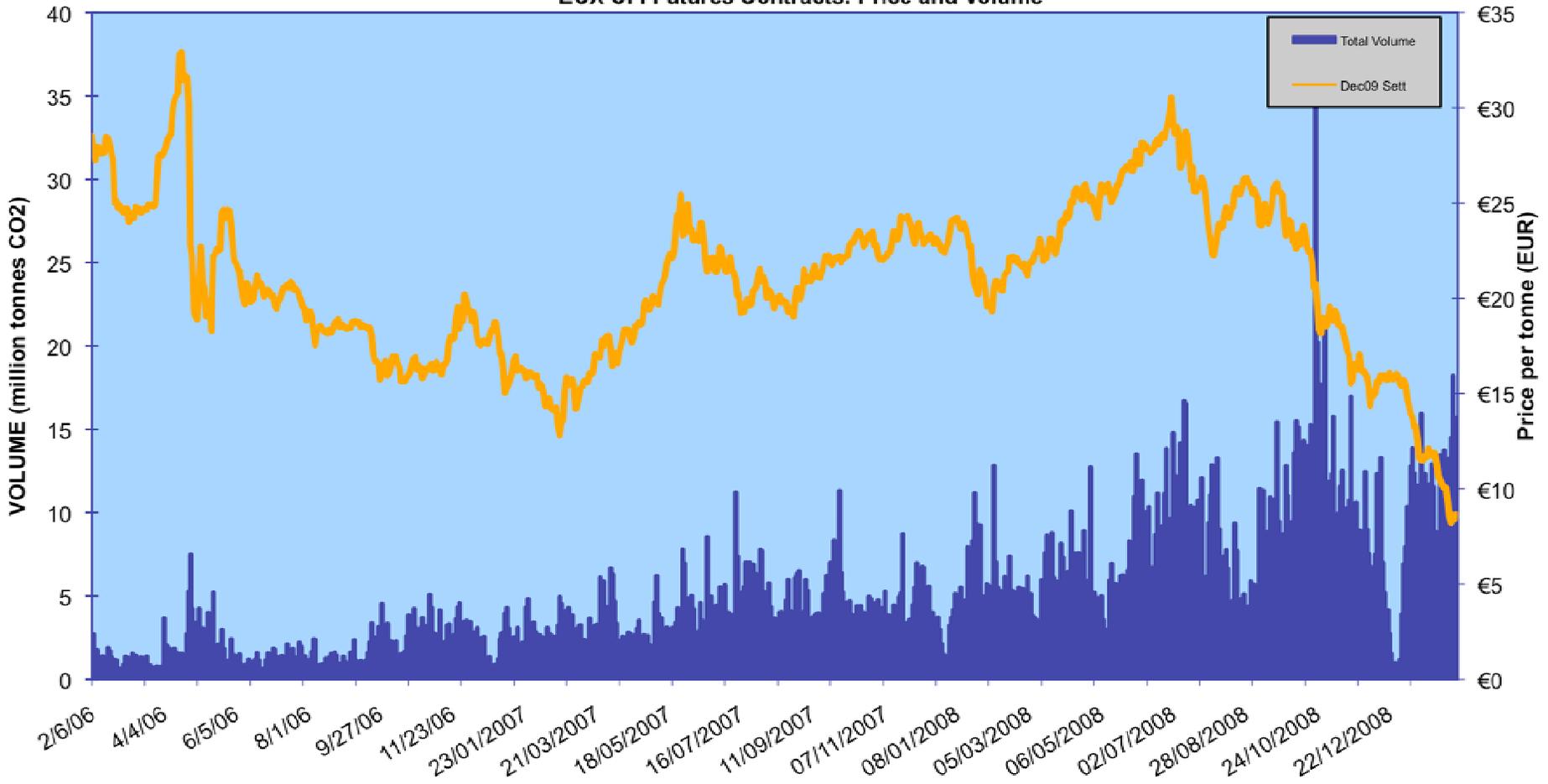
Chicago Climate Exchange Market Data

CCX Carbon Financial Instrument (CFI) Contracts Daily Report



Price and volume reported in metric tons CO2

ECX CFI Futures Contracts: Price and Volume



Information use- Public sector

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- Much mention of “unbiased” science, robust science, reliable information
- But, need “proof” of impact or response at their scale of decision in order for information to be robust (against litigation)
 - ▣ E.g. impact of one new well, or 1000 new wells being drilled on climate
 - ▣ Difficulties mentioned ultimate use of fuel, accounting issues, models and scale

Private Sector- information use

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- Direct use of science not mentioned
- Some obtain information through “brokers” such as USDA programs, conservation districts, private companies (e.g. fertilizers, etc.), carbon market recruiters
- Some mentioned magazines, friends and neighbors, etc.

Intersections and Partnerships

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- Multiple agencies involved in public land management (even the same piece of land); e.g. BLM, FS, US F&W, State (DOW), County
- “we manage the land, they manage the wildlife”
- Private sector individuals often have conservation support for their land from the Federal level, state level, and sometimes private foundations, grants.

Next steps, implications for NACP

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- Who are the key information brokers for carbon?
- Is it possible to model multiple criteria decision making in an agent-based framework to better understand the carbon implications?
- Are there information needs still in setting up the rules, or is it in mainly verifying carbon?
- More cases and quantitative studies are needed to understand how representative these results are.

Summary

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- Land use decision makers are influenced by multiple scales
- Differences between public and private sector abilities to manage for carbon
- Carbon not primary driver
- C stocks at risk from beetles
- At the moment, full potential for land to be managed for carbon purposes seems unlikely to be realized

Thank you!

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- Betsy Failey, co-author
- Bill Easterling, co-PI
- NOAA, sponsor
- NCAR, help with GIS
- For more information:
ldilling@colorado.edu

