Climate and Conservation: tools and data at the scale of land use decision-making

Karen Gaffney & Tom Robinson
Conservation Planning Program

SONOMA COUNTY AGRICULTURAL PRESERVATION AND OPEN SPACE DISTRICT
Sonoma County
Agricultural Preservation & Open Space District

- community vision: 1990
- re-authorized 2006 (76%)
- multi-objective: agriculture, open space, biodiversity, water, recreation, urban
- ¼ cent sales tax:
  - annual: $16-22 million
  - through 2031: $650-900 million
- to date: protection of 106,000 acres to date (easements/fee title)
- implications for climate change
Conservation Planning

• current state - internal capacity, data and analyses to support:
  – decision making: prioritization of land acquisition and stewardship
  – reporting and messaging: constituents & others
  – credible metrics and performance measurement
  – funding leverage
• local carbon applications:
  – land use decisions & GHG reduction goals = local
  – ancillary benefits: other partners, private sector
• state/federal applications:
  – tracking and aligning with state and federal objectives
  – AB32, SB 375: state climate legislation (regulatory, funding)
• NASA/University of Maryland data and products:
  – enhance/leverage local investment and credibility/accuracy
Key Initiatives

supported by NASA CMS/UMD products

- Local Initiatives (next three years):
  - Sonoma County Vegetation Mapping and LiDAR Program
  - Climate Action Through Conservation
  - Healthy Lands & Healthy Economies
  - Groundwater & land conservation nexus
  - Riparian Corridor analyses
  - Ten Year Strategic Plan
  - Urban Footprint Scenario Planning
  - Climate Action 2020

- Regional Collaborations (ongoing):
  - North Coast Resource Partnership
  - Bay Area Integrated Regional Water Management
  - Bay Area Sustainable Communities Strategy “One Bay Area”
Vegetation Mapping and LiDAR Program

- **Goal:** current inventory of the natural landscape
  - vegetation structure
  - wide-spread habitats (e.g., oak woodlands)
  - small-area patches (e.g., vernal pools)
  - pervious/impervious surfaces

- **High quality data for local planning, conservation, and resource management**
  - conservation planning
  - public and private land/forest management
  - public policy development
  - messaging, funding development, etc.
Vegetation Mapping and LiDAR Program

NASA CMS/Dubayah collaboration

- “Climate-smart” modeling capability from CMS biomass estimates:
  
  Quantify GHG emissions of natural land conversion AND benefits of conservation (avoided emissions + sequestration)

- LiDAR adds habitat modeling capability through forest structure (size and canopy closure classes)
Vegetation Mapping and LiDAR Program

Other CMS added value

• Sparked a consortium: Brought many state and local partners to the table through LiDAR derivative products

• NASA ROSES grant brought six federal, state, and local partners to the table, leveraging $1.5M of USGS, state, and local funds

• LiDAR derivative products (DEM, contours, building envelopes) are useful for numerous natural resource objectives
Timing

- Fall 2015 – Publish 27-class lifeform vegetation map using CMS LiDAR and derivatives in eCognition (Definiens)
- Summer 2015 – Evaluate and incorporate CMS biomass estimates
- Fall 2016 – Publish 45-class vegetation and habitat map using CMS canopy closure and vegetation height to crosswalk with California Wildlife Habitat Relationships classification
- Fall 2016 – Incorporate data findings into 10-year countywide conservation plan
Climate Action Through Conservation

• Data, accounting framework, and incentives for counties to engage in climate change solutions through conservation and land use, using Sonoma County as pilot

• Method to calculate the GHG reduction co-benefits of natural resource conservation scenarios (e.g., acquisition + policy + management) over the next 20 years
Climate Action Through Conservation

- Renewable energy, energy conservation
- Transportation

- Habitat
- Water
- Climate mitigation and resilience
- Economy
- Fire regimes

Accounting framework

Slide courtesy of The Nature Conservancy California Program
Climate Action Through Conservation

• Above-ground carbon Inventory

  **Goals**: To provide spatially explicit estimates of the amount of carbon currently stored in forests and grasslands in the county. To provide a starting point for future projections, and a basis for monitoring GHG emissions and reductions over time.

  **Criteria**: Replicable, accurate, sensitive to carbon stock changes, cost-effective.

  Tool currently uses FIA forest inventory and LandFire vegetation data (historic datasets, high likelihood of continuance)
Total C stock (1990):
214 Tg CO2e

Total Inventoried Carbon Stock (CO2)
Tonnes/Ac - 1990

- 15 - 50
- 51 - 150
- 151 - 300
- 301 - 400
- 401 - 540
- 541 - 1,324
Climate Action Through Conservation

• Baseline emissions projections

To establish baseline trend, a historic inventory was created by “re-vegetating” areas converted between 1990 and the earliest LandFire dataset (2001) by using other land cover datasets (LandSat TM, CA Department of Conservation data)

CMS LiDAR-derived carbon/biomass data could be used to create a predictive model that can yield more accurate and precise estimates of carbon at greater spatial resolution.
Total C stock change:
15 Tg CO2e
750,000 Mg CO2e annually
Climate Action Through Conservation

- Renewable energy, energy conservation
- Transportation

- Climate policies
- incentives for...

- land use, management & conservation

- Climate mitigation and resilience
- Habitat
- Water
- Economy
- Fire regimes

positive and negative impacts on...

Accounting framework

Slide courtesy of The Nature Conservancy California Program
Accounting Framework

1. Map Carbon
2. Establish baseline emission trend
3. ID drivers of emission (e.g., conversion)
4. ID conservation, management, policy activities
5. Model activity scenarios (acquisition + policy + management)
6. Conservation priorities ("Greenprint")
7. Show resulting change in C
8. Show conservation co-benefits (e.g., groundwater recharge)
Key Component: Modeled Activities

- What potential conservation/restoration actions need to be accounted for?
  - Avoided conversion (what could have happened?)
  - Reforestation
  - Improved forest management
  - Urban forest management
Riparian Forest Restoration
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- Edge of Riparian Corridor
- Vineyard
- Woody Vegetation
- Stream Channel
- Edge of Existing Riparian Policy Protection
Conservation Values Assessment:
Draft Framework for Avoided Conversion

Themes

- Food Production
- Water Ecosystem Services
- Terrestrial Habitat

Components

- Irrigated cropland and rangelands
- Headwater stream quality
- Groundwater recharge
- Human disturbance, rare habitats, and wildlife linkages
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**Example of GHG Baseline and Reduction Scenarios**

![Graph showing baseline and reduction scenarios for CO2e](image-url)
### Example of GHG Baseline and Reduction Scenarios

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<td>Scenario II</td>
<td>Thin redwood/Douglas-fir forests from below instead of removing dominant trees</td>
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#### Chart Description
- **Baseline**
- **Scenario**
- **Reductions/Removals**

#### Graph Data
- Year: 2010 to 2020
- CO2e stocks: 220,000,000 to 300,000,000
- Reductions/Removals: 10,000,000 to 30,000,000
Timing

Spring/Summer 2015:

• Complete project report, documentation and tool v.1
• Verify inventory assumptions
• Assess uncertainty of inventory and projections

Ongoing – Continue outreach for additional county and regional pilots
Multiple Benefits of Conservation

• conservation = unique tool for addressing climate change
• integration of multiple objectives/benefits
  – cost effective in achieving multiple goals
  – carbon sequestration, emissions avoidance, climate adaptation, biodiversity, human health, food security, water quality and supply
  – biophysical data with socio-economic data: quality of life
  – Impact/relevance, “lands” with decision makers, funders and the public
  – helps us leverage local investment
• NASA/UM collaboration, products, high resolution data:
  – enhance the accuracy of these multi-benefit analyses
  – foundational to their credibility & success
Three county coalition – monetizing the multiple benefits of conservation

CMS data and products are foundational to this initiative

Providing decision support locally and statewide

Influential in California policy & legislation
  - Water bond
  - AB 32 implementation
  - Local county measures – Measure Q in Santa Clara (Silicon Valley)
Cooley Ranch Conservation Easement
¼ of Lake Sonoma watershed
Conservation Co-benefits
• Avoid fragmentation maintain wildlife habitat connectivity
• Avoid impervious surfaces over groundwater recharge areas
• Recreation and public health
• Protect and restore riparian zones for biodiversity and ecosystem services
• Benefits to green infrastructure (e.g., reduced fire hazards, reduced sediment loading, pollutant buffering)
Multiple Benefits – Carbon PLUS

- Wildlife Corridors & Biological Diversity
- Climate Adaptation
  - Species movement/dispersal
  - Natural capital resiliency
- Scenic
- Recreation
- Water Quality/Supply

Marin – Sonoma Linkage: 63,710,812 Tons C

Carbon sequestered within critical habitat linkages
Multiple Benefits: C + Coastal Resilience

- forest based carbon in coastal areas
- use of LiDAR/CMS products to investigate “green infrastructure” alternatives for coastal resilience to sea level rise/storm surge/flooding
- partnership with county planning, NOAA, USGS, Coastal Conservancy, Ocean Protection Council, Stanford University, local communities
- recreation, terrestrial/marine habitats, tourism
Integration of Multiple Sectors

• CMS products as a “convening tool” with multiple, evolving applications
• public sector (examples)
  – CalFire
    • quantifying carbon for grant evaluations
    • fire/fuel load modeling and emissions implications
  – Sonoma County Water Agency
    • catastrophic wildfire (emissions and C impacts on water intakes)
    • emissions and C reporting in stream maintenance program, infrastructure
    • co-benefits of groundwater recharge and use for hydro-modeling
• private sector applications (benefits of providing via public agency)
  – farmers and ranchers: carbon projects under AB 32
  – engineering firms, restoration ecologists and habitat restoration groups
  – landowners
• integration: Urban Footprint scenario modeling tool/EEMS
  – decision support using CMS data with all sectors
  – local capacity building with long term benefits
Thank You

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Sonoma County Water Agency
County of Sonoma
City of Petaluma
The Nature Conservancy, California
Save the Redwoods League

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Visit http://www.sonomavegmap.org
Follow @SonomaVegMap

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⁴ East West Forestry Associates
⁵ Tukman Geospatial
⁶ EnvisionGeo

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