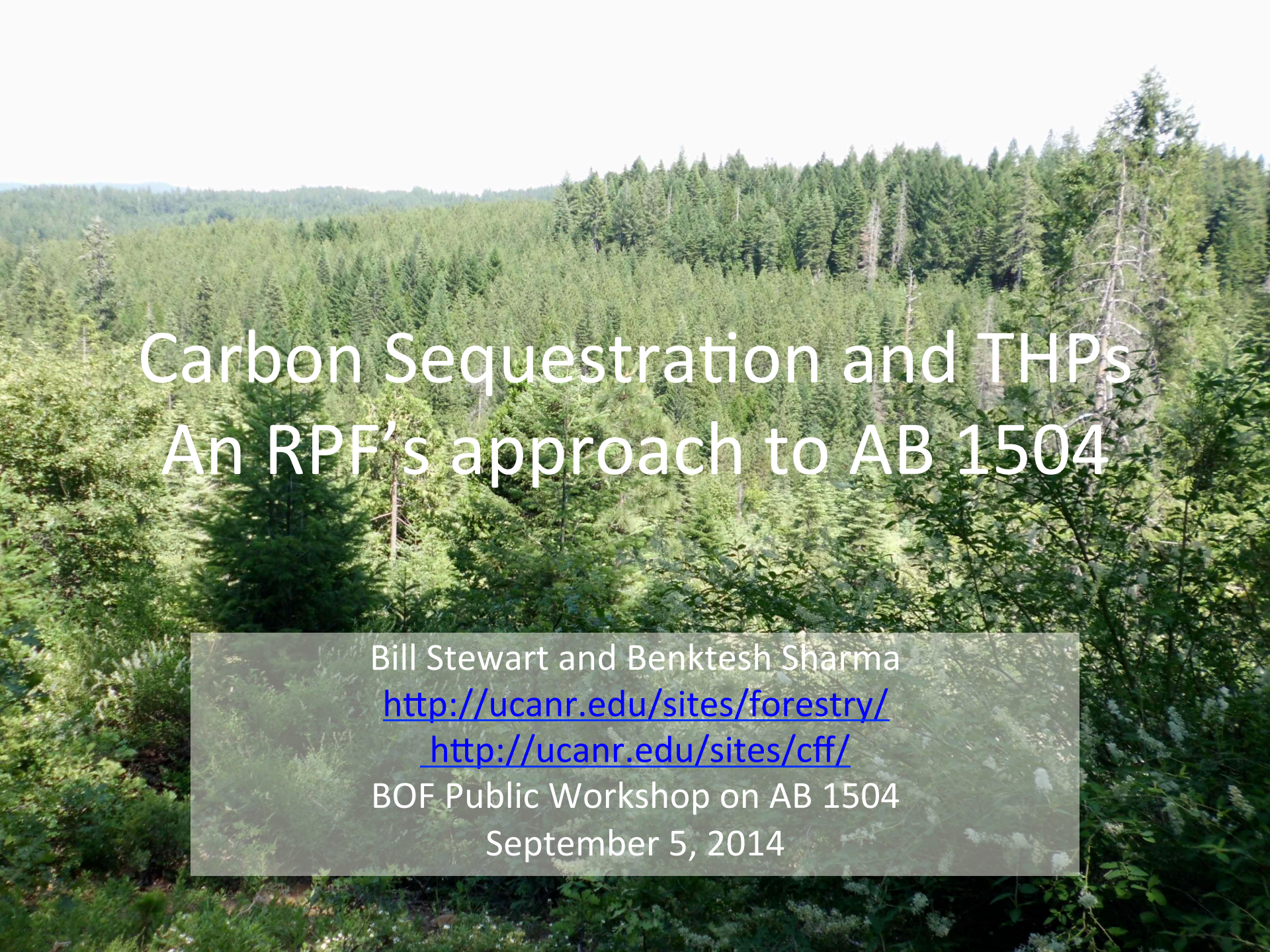


Carbon Sequestration and THPs
An RPF's approach to AB 1504

Bill Stewart and Benktesh Sharma
http://ucanr.edu/sites/forestry/
http://ucanr.edu/sites/cff/

BOF Public Workshop on AB 1504
September 5, 2014

Key points

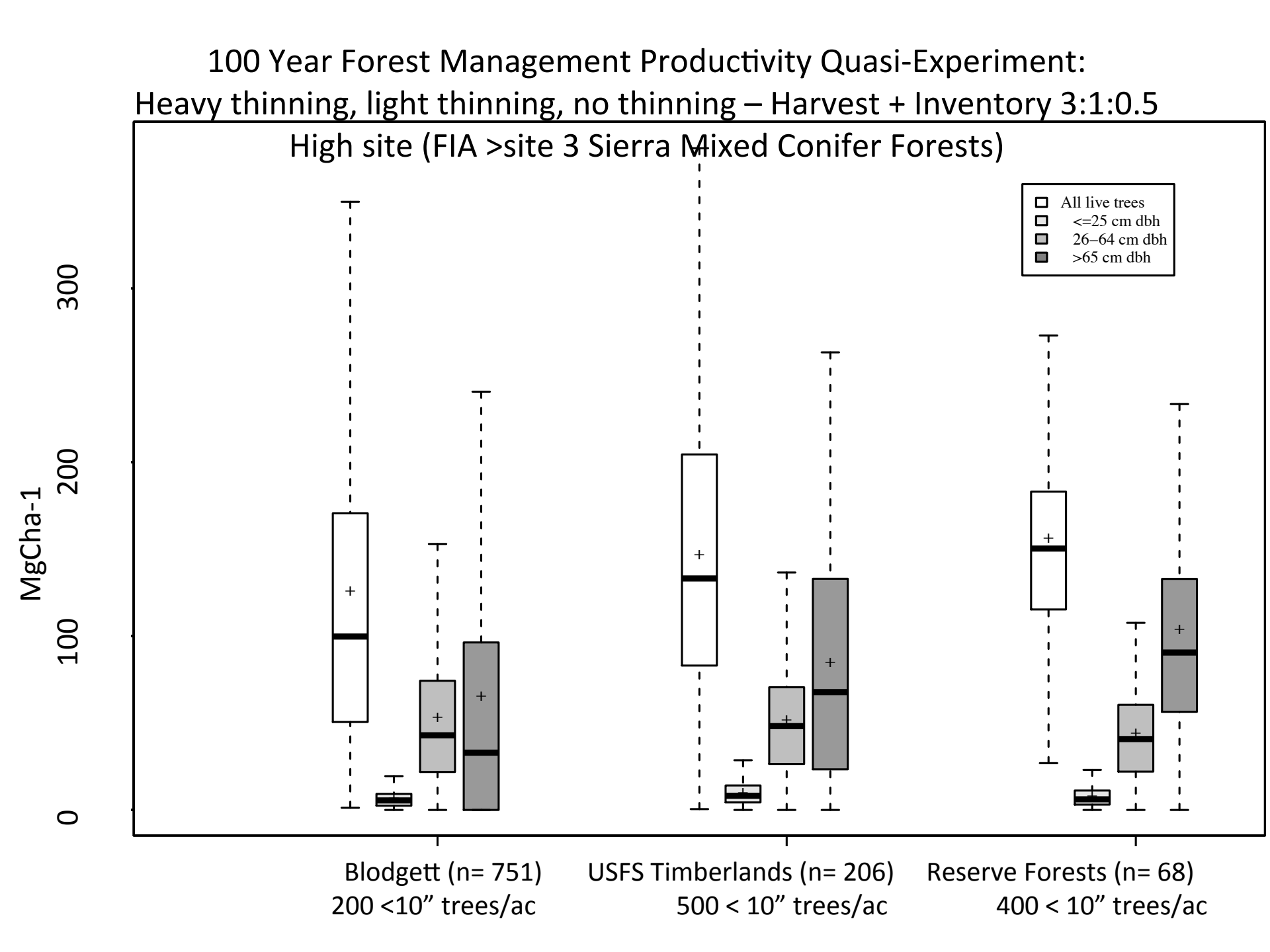
- PRC 4512-4513 has a few key goals *(maintain timberland productivity, produce high quality products, give due consideration to related public benefits including a new one from "*AB 1504, Skinner. Forest resources: carbon sequestration"*)*
- Carbon sequestration is a rate per year; carbon sinks may be expanding, shrinking, or constant
- Climate benefits measured by society-wide emission reductions/carbon sequestration related to forest and forest products are spread across many GHG emission sectors in both ARB and USEPA accounting

A warning for modelers

Projecting Mature Forest Sequestration rates over the next decade is a complex task with numerous examples of large divergence between empirical measurements and model estimates

Same place, same journal – but carbon measurements are different than carbon models

- Turner DP, Ritts WD, Yang Z, Kennedy RE, Cohen WB, Duane MV, Thornton PE, Law BE. 2011. Decadal trends in net ecosystem production and net ecosystem carbon balance for a regional socioecological system. Forest Ecology and Management 262: 1318-1325.
- They modeled ~150 gCm-2yr-1 of new carbon sequestration on public lands in PNW from 1995 to 2007
- Gray AN, Whittier TR. 2014. Carbon stocks and changes on Pacific Northwest national forests and the role of disturbance, management, and growth. Forest Ecology and Management 328: 167-178.
- They measured 0.63 gCm-2yr-1 of new carbon sequestration on public lands in PNW from 1995-2002
- Take Home Message: Forest disturbances in mature forests are poorly captured by many growth models


100 Year Forest Management Productivity Quasi-Experiment:
Heavy thinning, light thinning, no thinning – Harvest + Inventory 3:1:0.5
High site (FIA >site 3 Sierra Mixed Conifer Forests)
All live trees
<=25 cm dbh
26–64 cm dbh
>65 cm dbh
MgCha-1
0
100
200
300
Blodgett (n= 751)
200 <10” trees/ac
USFS Timberlands (n= 206)
500 < 10” trees/ac
Reserve Forests (n= 68)
400 < 10” trees/ac

A life cycle analysis for assessing forest management impacts on carbon sequestration

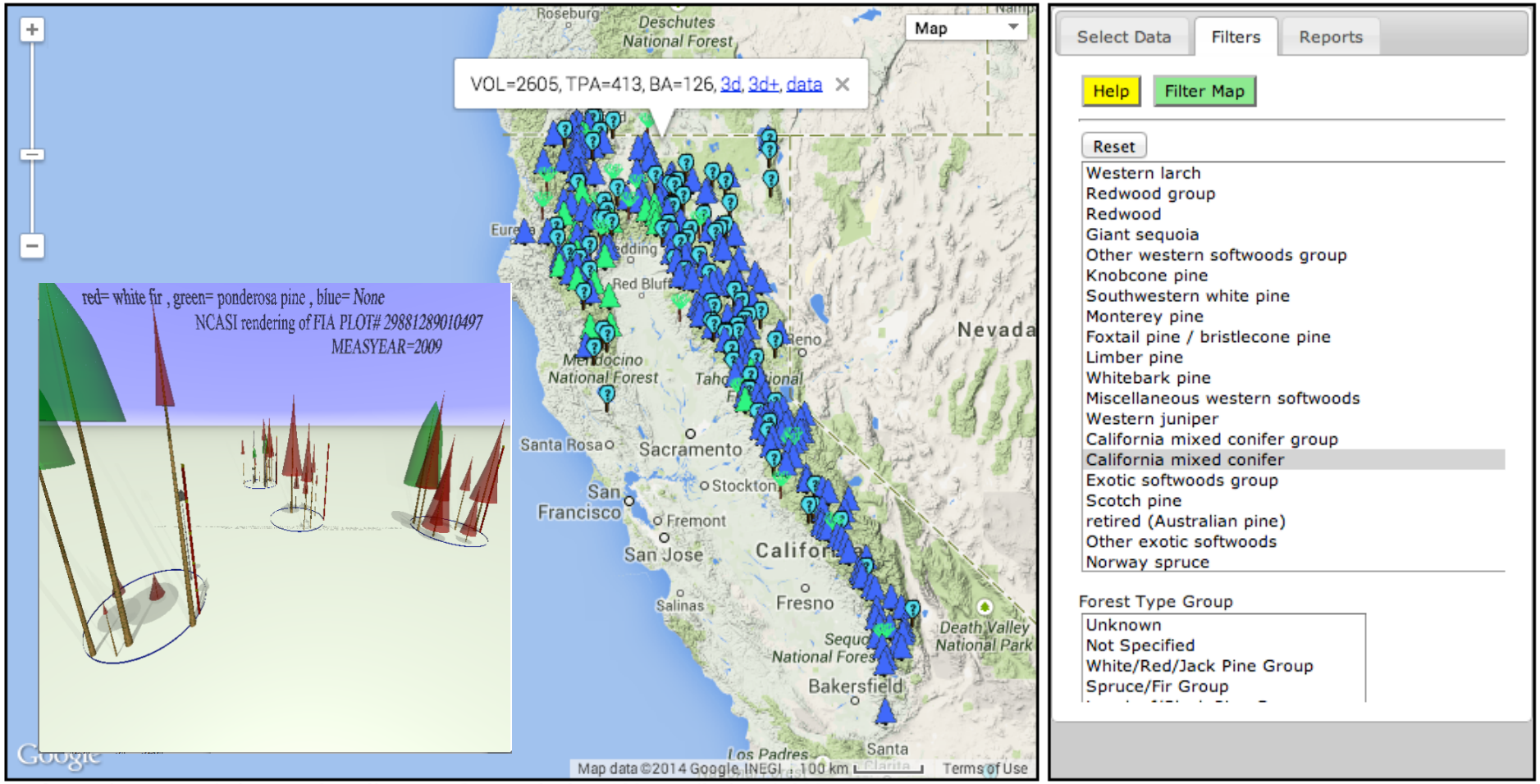
- CA FPR is all about the full life cycle – forest now and post-treatment or post-disturbance, high quality products, work to limit scope of wildfires, etc.
- Reforestation is required by law after harvests
- USFS FIA, TPO and FPL regularly improve analysis of average and best practices for the whole forest value chain
- California's output of ~ ½ high quality products and ~ ½ bioenergy (Morgan 2012) requires the consideration of wood products and energy, in addition to estimated changes in forest carbon inventories

Steps for generating forest type & silviculture specific AB1504 estimates for THPs with the tool at http://ucanr.edu/sites/forestry/Carbon_Sequestration_Tool_for_THPs/

- Accessing public FIA data with COLE3 to create relevant baselines
- Use same forest growth model for poor/nonstocked, let-grow, and managed forest scenarios
- Check that professional (mbf/ac) can be translated to climate (Carbon tons/ha) units
- Compare relevant forest management options for relevant forest type
- Project carbon sequestration benefits in regenerating forest AND products used by society
- Sum up the carbon sequestration benefits by where they occur

http://www.ncasi2.org/GCOLE3/gcole.shtml

Welcome to COLE 3.0, the next generation Carbon On Line Tool. Home | Help

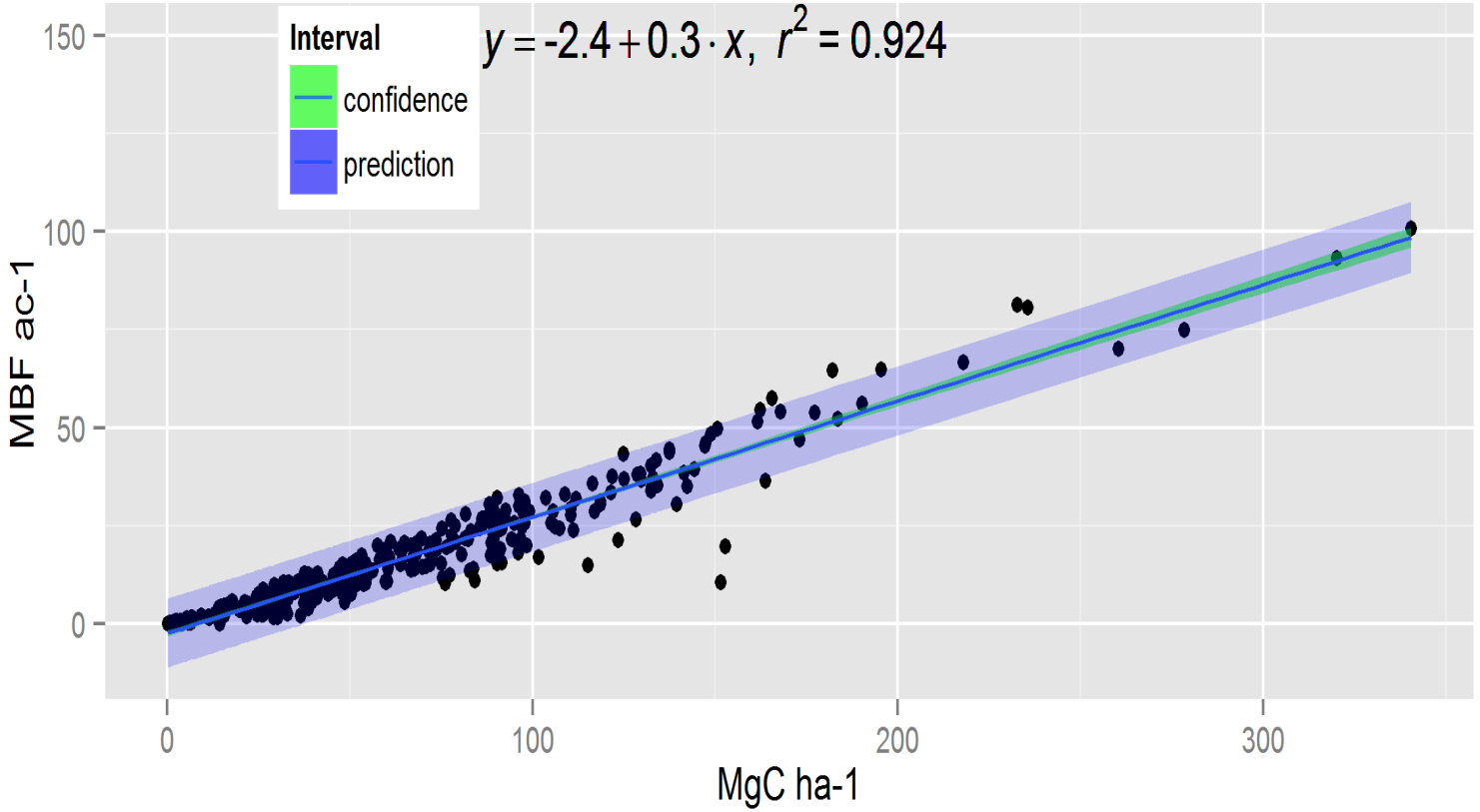


N of recently measured plots meeting Filter Map Query criterion: 1397, N displayed: 300

ncasi

The database summarizes one point in time estimates of forest carbon and generates 'carbon reports' for selected forest types. FIA is scheduled to release the California FIA report with carbon sequestration by owner class in 2015

MBF/ac and MgC/ha measurements are reasonably well correlated



Source: Benktesh Sharma analysis of FIA data for California

Use baseline or new input variables

MixCon Even T40H80U75 - Mixed Conifer Even aged thin@yr40, harvest@yr80, utilize 75% of logging slash for bioenergy and leave rest

2 20 2014 analysis CMC live tree tC/ha - all forest til 80, then faster growing private forest for 80

Based on y = a(1 − e^(−b∗AGE))^3 - Von Bertalanffy growth equation

-

Color Key	
Input	Any input that can be changed by user
Calculation	Intermediate calculation.
Linked Cell	The cell is linked to some other cells.
Output	Output value produced
Note/remarks	Any remark or default value is described

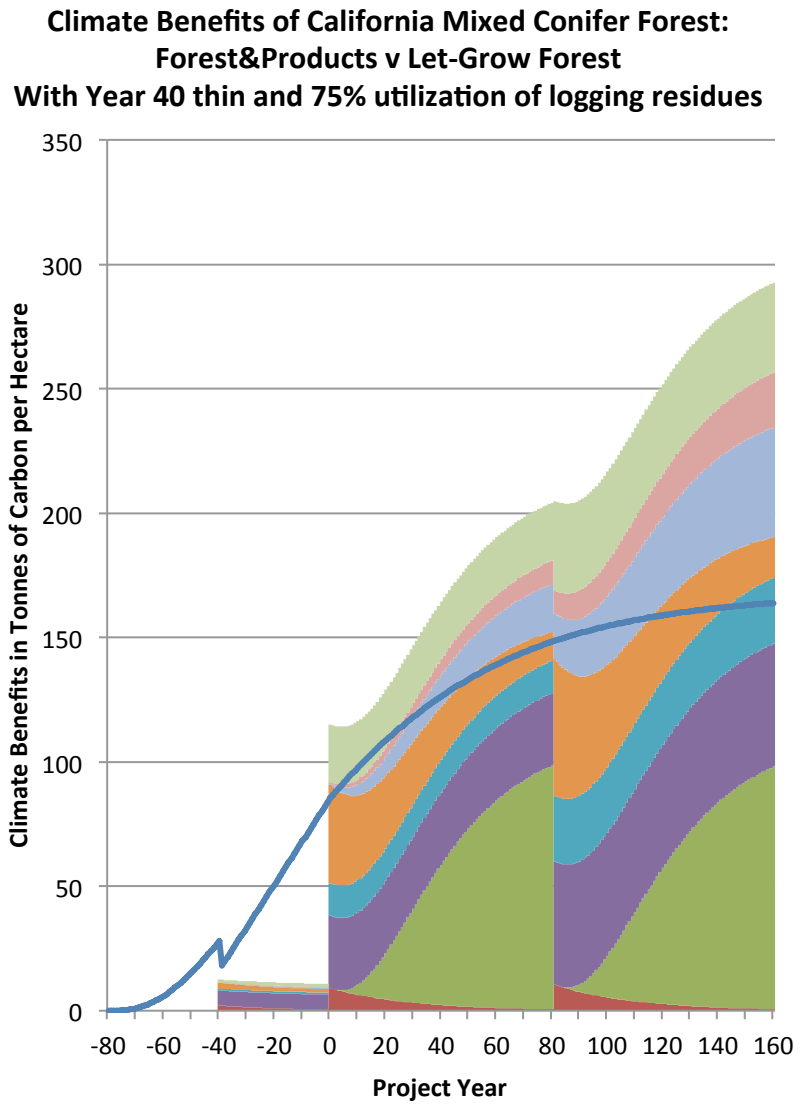
from COLE:Carbon On Line Estimator www.ncasi2.org/COLE/

	all cmc	pvt cmc	cmc - poor or non-stocked
FIA est. of live tree carbon/ha	121.4	84.4	
Von Bertalanffy growth equation coefficients			
a	168.03	110.94	39.64
b	0.02	0.04	0.04
std error	120.14	77.91	27.97
No of FIA plots in COLE2 dataset	1374	351	241

	Used-Bioenergy	Used-Products	Unused	Remarks
Thinning utilization	0.72	0.28		Based on partial thinnings(72% chips, 28% sawlogs) in Stewart and Nakamura (2012)
Logging slash - use/leave ratios	0.75	0	0.25	Default 0.75 used, 0.25 unused logging residues left to decompose on site
Sawmill energy/product/waste ratios	0.24	0.75	0.01	Default 0.24 usedfor energy, 0.75 into products, 0.01 waste
1:1 Substitution benefits applied wood products used in buildings (McKeever 2011)		0.57	0.43	57% of wood products go into buildings where substitution benefits are significant (FPL-GTR-199, McKeever 2011)

(Morgan et al. PNW-GTR-866. 2012)

http://ucanr.edu/sites/forestry/Carbon_Sequestration_Tool_for_THPs/



Where benefits get accounted for

US EPA/ ARB sector	
Dispersed across products and energy	
Elec. Gen.	Elec. Gen.
SWDS	Recycling
Forestry	NA
Energy	Industrial
Elec. Gen.	Elec. Gen.
Forest	Forest
Forest	Forest
Forest	Forest

Average Annual Climate Benefits in Mixed Conifer Forests in $MgCha^{-1}$

Scenario	Live trees and down wood	Wood Products	Bioenergy	Landfill storage	Building Product Substitution Benefits	Total Benefits
Let Grow – 160 years	77	0	0	0	0	77
Manage - 160 years	43	12	26	6	12	99
Let Grow – 240 years	104	0	0	0	0	104
Manage - 240 years	47	19	48	15	20	149

Based on a disturbance free growth model (an overestimate for most California forests) for both let-grow and managed forests (this examples is an even aged system), managed forests are projected to provide more overall climate benefits when benefits across all sectors are considered.

Variations by forest type and silviculture: MgC ha^{-1} yr^{-1} over a 160 year cycle

	Mixed conifer	Ponderosa pine	Douglas-fir	Redwood
Poor or Nonstocked*	28	25	36	36
Let Grow - past and future rotations (no disturbance)	79	63	160	217
Even – T@40,H@80,U00	87	85	203	226
Even - T@40,H@80,U25	91	89	213	237
Even - T@40,H@80,U75	99	98	233	260
Uneven - T@40,H@80,U75,20+	102	96	235	285

T@ - thin year, H@ - harvest year, U - % of logging slash collected for energy, 20+ - harvest cycle
Managed stands provided 4-35% more sequestration when all sectors are considered

Key Findings

- A life cycle analysis approach is a better match for a forest management project but may not roll up as easily into some GHG accounting schemes
- The significant unknowns are how threats and changing climate will affect future forest growth
- Good forest management at all stocking levels provides more carbon sequestration for California
- California's Forest Practice Rules were climate-friendly before AB 1504 – but now require additional documentation
- The UC spreadsheet model is available at http://ucanr.edu/sites/forestry/Carbon_Sequestration_Tool_for_THPs/
- UCCE Forestry Specialists and Advisors are engaged in the forest*climate nexus