Linking Landscape-scale Carbon Monitoring with Forest Management

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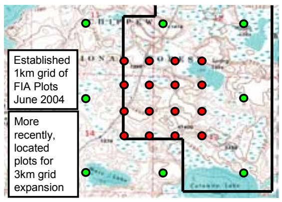
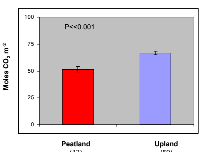
Objectives of landscape monitoring in the North American Carbon Program:

1. Augment coverage of the land surface by intensive monitoring sites
2. Facilitate scaling from intensive sites to landscapes
3. Model parameterization and validation

Northern Peatlands – Bogs, Fens, Managed Forests
Marcell Experimental Forest



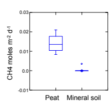
Upland vs peatland soil respiration



Methane Fluxes

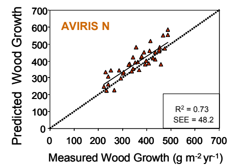
Static chamber sampling for CH_4 measured ~monthly May-August 2005, in uplands and wetlands

2006 sampling will focus on peatlands, expanding spatial and temporal coverage

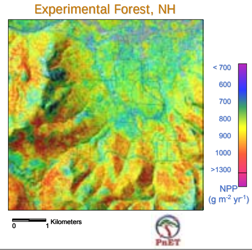


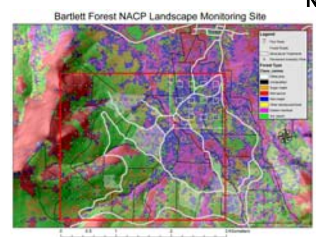
July and August sample periods

Northern Hardwoods, New Hampshire
Bartlett Experimental Forest

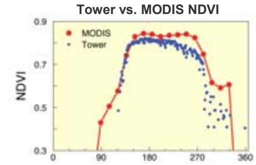


Predicted NPP, Bartlett Experimental Forest, NH





Tower vs. MODIS NDVI



NDVI calculated from tower radiometry generally parallels that from MODIS

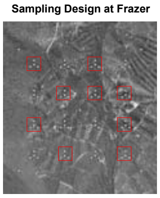
MODIS measurements don't capture gradual late-summer decline in NDVI.

Discrepancy between the two methods around DOY 280-330—spatial resolution issue?

Landscape Carbon Monitoring at a Network of Experimental Forests and other Research Sites

Rocky Mountains – 3 Sites

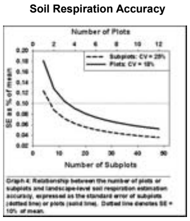
Sampling Design at Frazer



Alpine and Subalpine Vegetation
Glacier Lakes Ecosystems Experiment Site and AmeriFlux Site
Wyoming

Subalpine Forest Regrowth
Niwot Ridge Ameriflux Site
Colorado

Soil Respiration Accuracy



Managed Subalpine Forest
Frazer Experimental Forest,
Colorado

Evaluation of Sampling Design – Spatial Variability

Category	Variable	Units	Fraser Mean	Fraser CV	Glees Mean	Glees CV	Niwot Mean	Niwot CV	Allsites CV
Stand Structure	Mean Tree height	meters	12.9	17%	12.1	47%	10.8	11%	25%
	Leaf Area Index	m^2m^{-2}	5.11	57%	8.96	56%	4.25	53%	55%
	Basal Area	m^2ha^{-1}	41.4	45%	60.1	56%	47.9	40%	47%
	Tree Density	treesha^{-1}	1010	29%	975	79%	1821	52%	54%
Carbon pools	Aboveground live carbon	MgCha^{-1}	88.3	54%	133.1	63%	81.2	40%	52%
	Aboveground dead woody carbon		22.8	51%	55.3	118%	16.8	70%	79%
	Forest floor carbon		71.6	38%	61.6	69%	84.2	34%	47%
	Mineral soil carbon		51.2	30%	72.8	27%	59.2	37%	31%
Carbon fluxes	Live Biomass Increment	MgCha^{-1}yr^{-1}	0.83	46%	1.05	70%	1.15	44%	54%
	Litterfall		0.67	38%	0.85	82%	0.98	31%	50%
	Forest Floor Decomposition		0.94	43%	0.86	75%	1.12	43%	54%
	Net Ecosystem Carbon Balance		0.72	79%	1.47	64%	1.06	84%	76%
	Stand Structure CV			37%		59%		39%	45%
	Carbon Pools CV			46%		63%		46%	52%
	Carbon Fluxes CV			45%		79%		51%	58%

Pine Barrens - New Jersey
Silas Little Experimental Forest

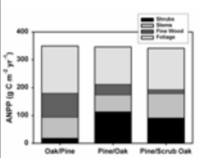
Two major goals in managing "natural" forests:

- ►Carbon sequestration
- ►Wildfire prevention

Fuel reduction treatments mandated by the Healthy Forest Initiative of 2003.

How is NEE of CO_2 partitioned into different fuel types?

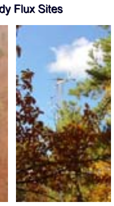
How much C is released by fuel reduction treatments?



LIDAR measurements and field plots to detect past wildfire effects on forest structure – profiling lidar

NJ Pinelands Eddy Flux Sites

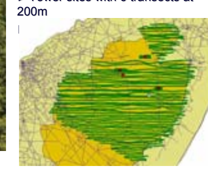
Oak/Pine – Silas Little



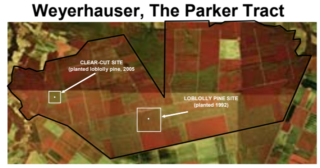
Pine/Oak- Ft. Dix

Pine/Scrub Oak- Cedar Bridge

- ►65 transects spaced a 1 km
- ►Tower sites with 6 transects at 200m



Intensive Pine Management, North Carolina
Weyerhauser, The Parker Tract



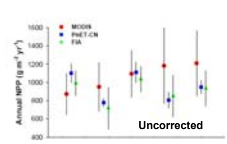
Flux Sites

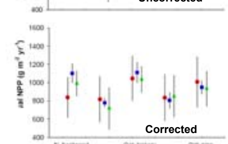
Soil Respiration

Sapflow and Canopy Interception

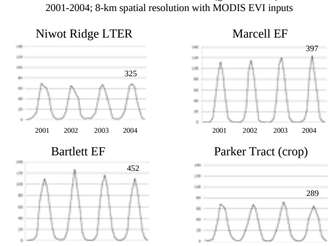
Precipitation Throughfall and Stemflow

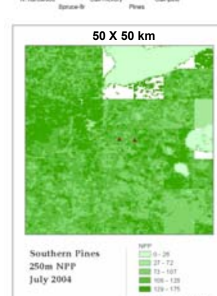
Cross-site comparison, scaling, and validation

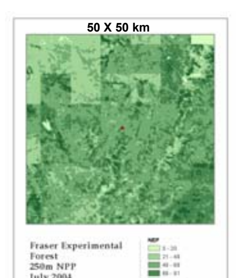




CASA Model Predictions of NPP (g C m^{-2} mo^{-1})
2001-2004; 8-km spatial resolution with MODIS EVI inputs







Simplified Decision Support "Roadmap" for Carbon Management

Extensive data:
- FIA/FHM
- Remote Sensing

Landscape data:
- Biometrics
- Remote sensing

Scale up

Intensive data:
- CO_2 flux
- Meteorology
- Field experiments

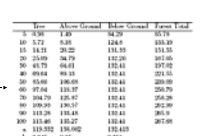
Ecoregion models:
- FORCARB
- CASA
- LANDIS
- PnET
- TEM

Tree/stand models
- FVS
- AMORPHYS
- UFORE
- CORRIM

Carbon manager

Decision support:
- COLE
- NIACS
- CQUEST
- Growout
- GHG inventory

Experimentation/ Monitoring → Modeling → Decision support



	Tree	Above Ground	Below Ground	Forest Total
5	0.96	1.49	94.29	95.78
10	5.72	8.38	124.8	133.19
15	14.21	20.22	131.33	151.55
20	25.09	34.79	132.20	167.05
30	45.73	64.61	132.41	197.02
40	69.64	89.13	132.44	221.55
50	85.06	106.65	132.44	239.09
60	97.04	118.37	132.41	250.79
70	104.79	125.87	132.41	258.28
80	109.30	130.37	132.41	262.39
90	113.28	133.48	132.41	265.9
100	115.46	135.27	132.44	267.68
a	119.332	136.062	132.415	
b	0.045	0.05	0.394	
c	25.245	28.49	36.504	

Table 19. Maple/Beech/Birch Group - Carbon Stocks (metric tonnes per hectare) by Age Class for Pennsylvania.

Annual Net Ecosystem Flux of Carbon – 2004 from MODIS inputs