Impact of Canopy Nitrogen Deposition on Forest Carbon Storage: A Manipulative Experiment at the Howland AmeriFlux Site

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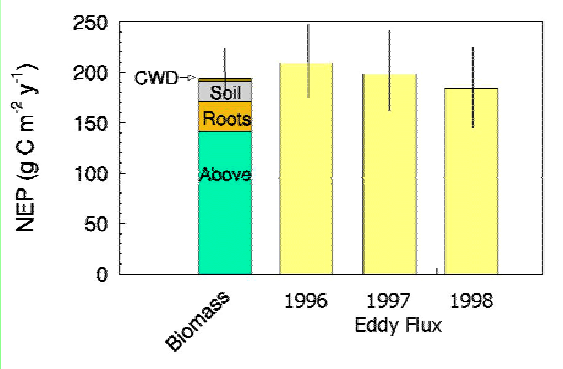
Economically Viable Forest Harvesting Practices That Increase Carbon Sequestration

Rationale

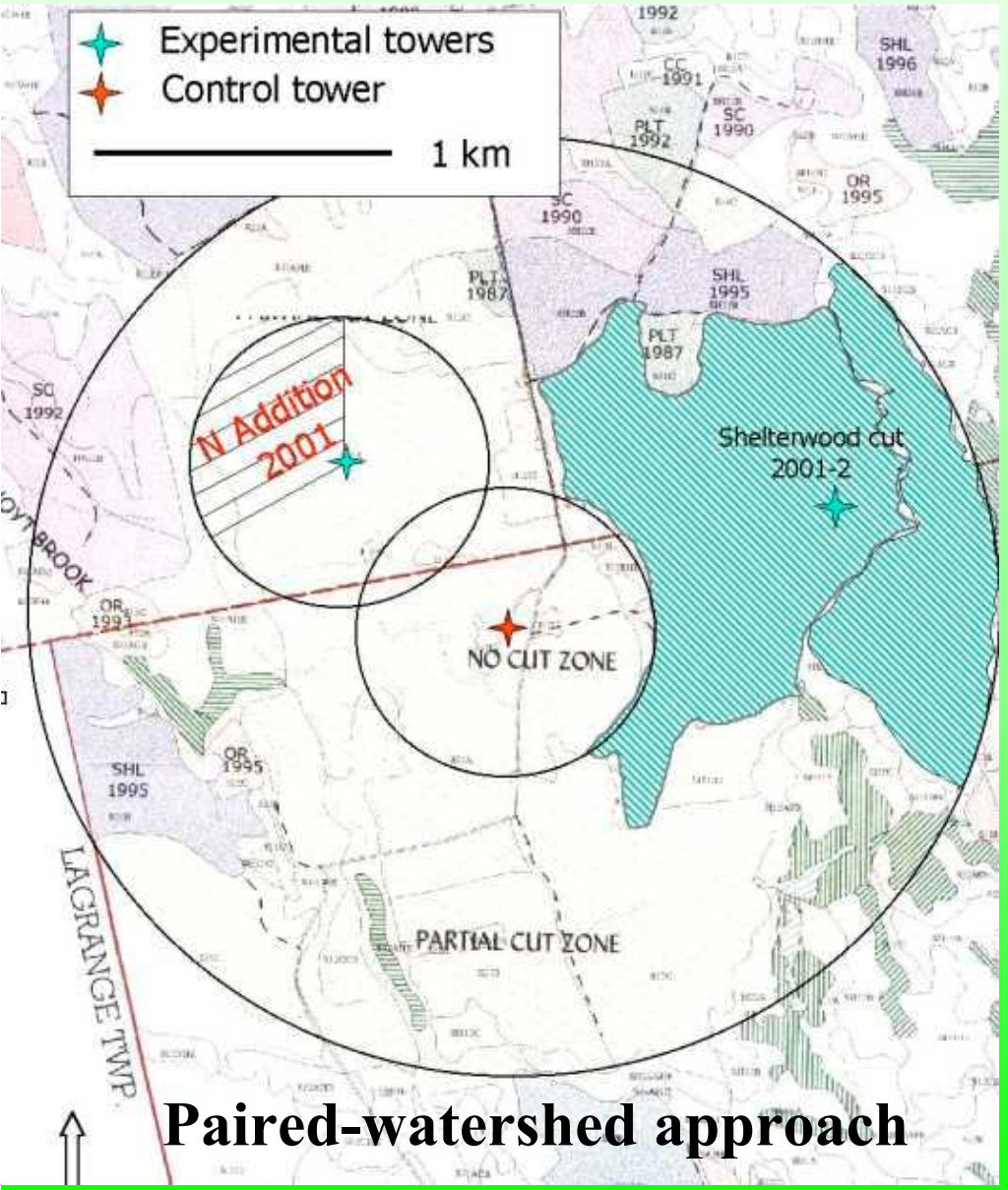
- Northern hemisphere forests are a strong C sink
- Mechanisms include CO_2 fertilization, N fertilization, recovery from disturbance
- Importance of different mechanisms influence longevity of sink
- Previous N additions – ground applications, little impact on C sink
- Optimal forest management for C sequestration



Hypotheses

- N addition to the canopy will increase C sequestration rates - more than ground-based N applications?
- Shelterwood harvesting will enhance C sequestration rates

Howland Integrated Forest Towers and Treatment Areas



Paired-watershed approach

N addition experiment

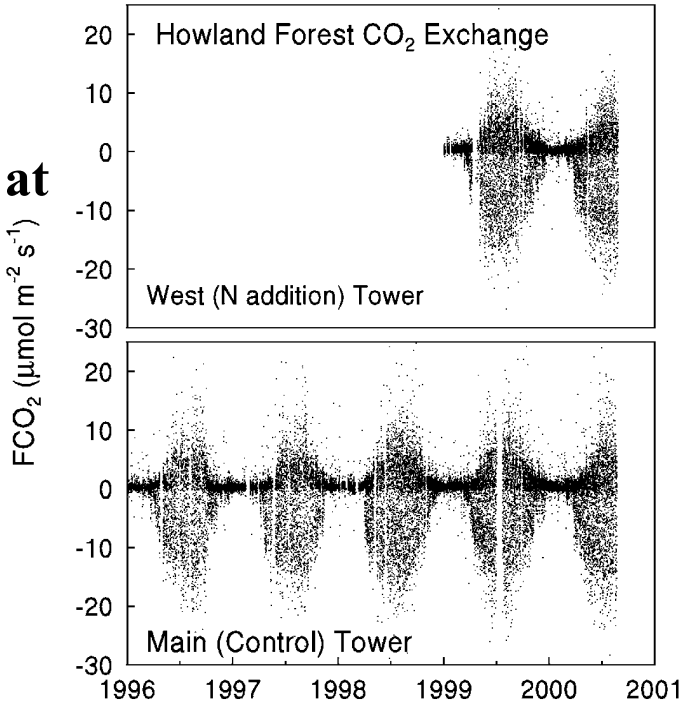
- 18 kg N $ha^{-1}y^{-1}$ (6 additions in growing season
- ^{15}N plots to examine fate of N
- Tree growth (FIA)
- N fluxes (throughfall, volatilization, leaching, litterfall)
- NEE by eddy covariance
- Soil temperature, moisture, respiration, N content
- Footprint modeling, NEE simulation

Shelterwood Harvest

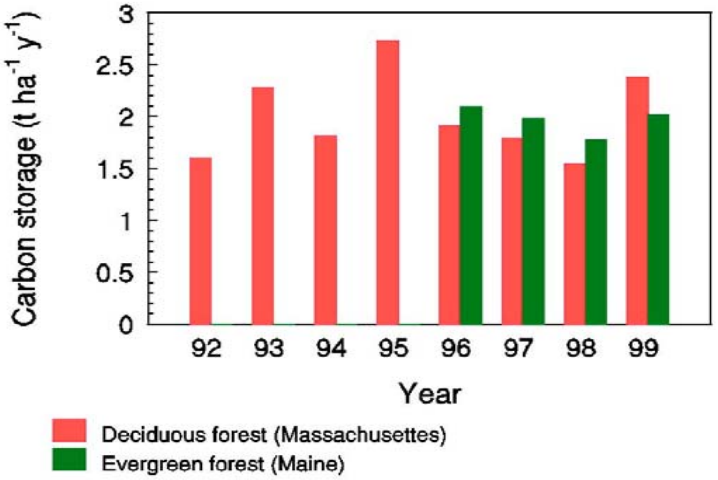
- ~30% of basal area removed
- Quantify wood removal by species
- NEE by eddy covariance
- Slash production/decay, litterfall
- Tree growth (FIA)
- Soil temperature, moisture, respiration
- Fate of wood products
- C budget simulation

Results

CO_2 exchange from 2 towers at Howland forest.



Annual C storage at 2 long-term flux sites.

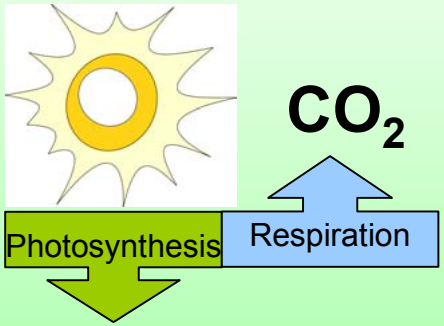


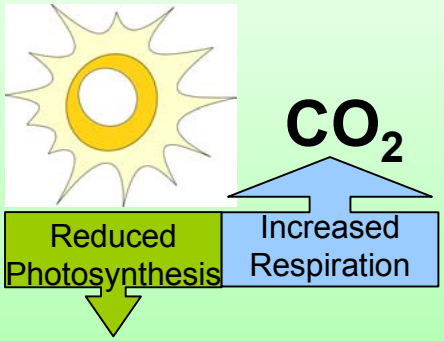
Deciduous forest data courtesy S. Wofsy

Variable	Slope	Intercept	R^2
Tair	1.001	-1.78	0.997
Photon flux	0.952	3.6	0.985
Net rad.	0.892	-0.81	0.978
Wind speed	1.002	0.26	0.76
PPT	0.90	0.007	0.77
Heat flux	0.874	1.37	0.89
Latent en.	0.983	6.2	0.75
CO_2	0.998	0.0007	0.79

Carbon consequences of shelterwood harvest

Large areas of managed forest in the US





Harvest
- **Increase tree growth**
- **Increase respiration**
- **Wood products**
- **Net balance??**

Harvest

Debris

\+

Timber

Forest regrowth

CO_2

Paper products

Wood products

Sawdust

Mechanism(s) behind current C sink

How long will it last?