The Autotrophic Contribution to Soil Respiration in Black Rock Forest

Jennifer H. Levy [1], Kevin L. Griffin [1], and William S.F. Schuster [2]

[1] Columbia University, Earth and Environmental Science Department New York, NY, USA [2] Black Rock Forest Consortium Cornwall, NY USA

Background

♦Soils are the primary component of the terrestrial carbon sink[1].and they are responsible for 60-70% of the carbon dioxide (CO_2) released from a forest ecosystem[2,3].They play a dominant role in the global carbon cycle.

♦The efflux of CO_2 from the earth's surface is known as soil respiration and is typically divided into two source components- autotrophic (plant activity) and heteotrophic(decomposers) respiration.

♦Within the past eight years, growing evidence for a large autotrophic contribution, between 50-65% of total soil respiration[4], has motivated the ecological community to work towards a better understanding of respiratory partitioning on a global basis and associated environmental influence

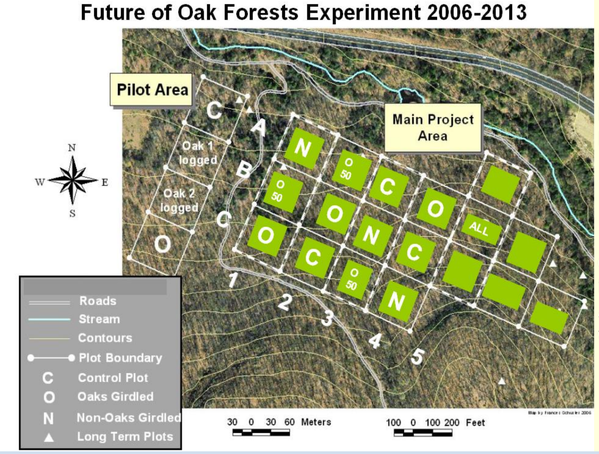
♦Species composition of a forest may also play an important role in driving soil respiration patterns[5,6]

GOALS

1) To evaluate contribution of *Quercus* and its associate mychorrizal fungi to total soil respiration
2) To better understand the partitioning of autotrophic and heterotrophic respiration at Black Rock Forest

Methods

Black Rock Forest
Future of Oak Forests Experiment 2006-2013



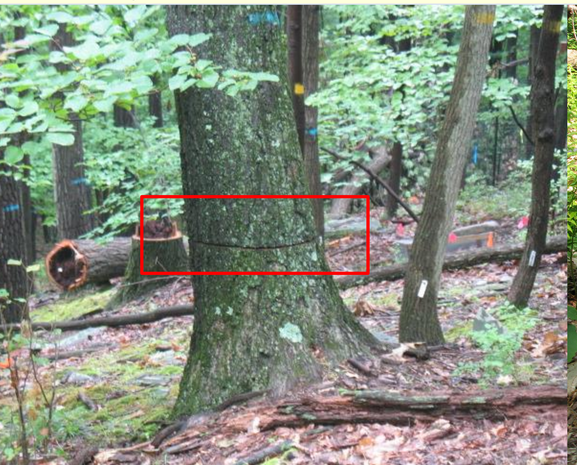
♦ **Study site and Experimental design**
Black Rock Forest (BRF) is a 1,530 ha preserve located in the Hudson Highlands, New York (41°21′ N, 74°01′ E).

Twenty 75m x75 m study plots that contain center plots of 25m x 25m located on the north slope of the forest (figure 1) were used. All measurements are taken within the 25m x 25m center plots

♦ **Soil moisture and temperature**
Volumetric soil water content (SWC) using time-domain reflectometry and soil temperature was measured continuously at two locations on each of two plots from each treatment. Soil moisture probes were inserted at 45 degree angles and soil temperature at 6 cm depth. The daily mean was used for analysis.

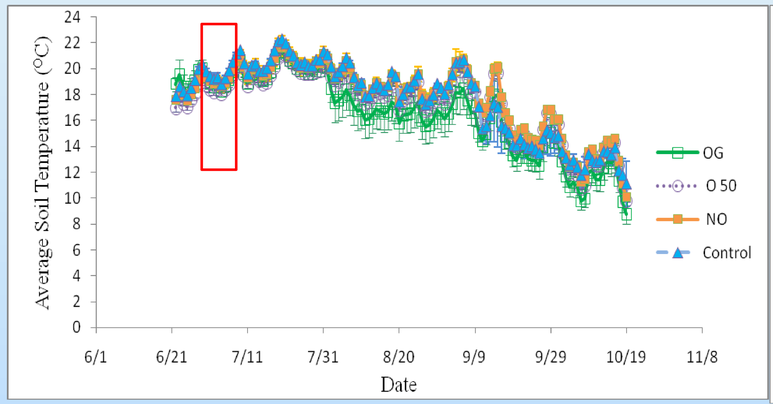
♦**Data analysis**
The effect of treatment on soil respiration rate was analyzed with a general additive model (GAM) based on mean plot respiration of each treatment, slope position, a uniform date of treatment, and date of measurement

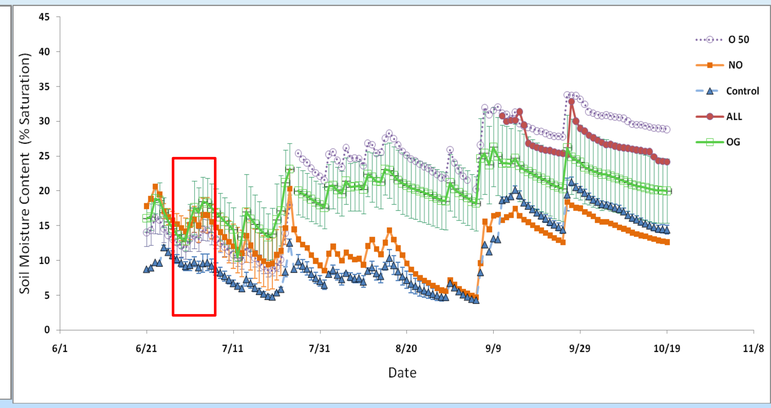
♦ **Tree girdling**
Trees were girdled by making a 5 cm deep incision at breast height around the circumference of the tree, with a chain saw. Girdling took place from June 27 to July 9.



♦ **Soil respiration**
10 measurements were taken with a LiCor-6400 gas exchange system on each sub-plot between 8 am and 1 pm. Leaf litter was removed from each collar prior to the measurement and replaced directly after.

RESULTS





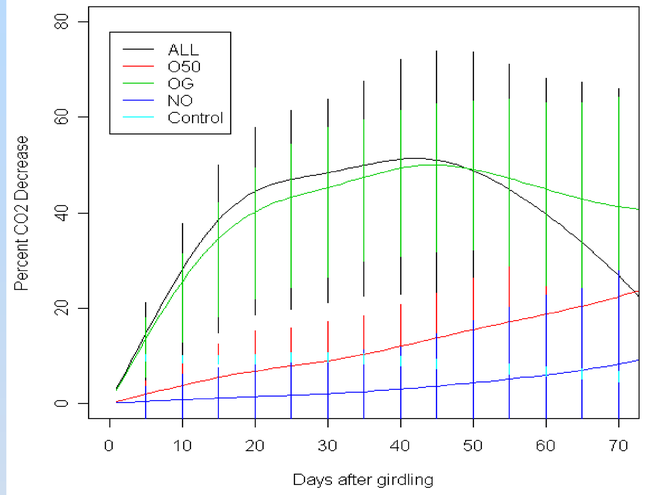
♦ Difference in soil temperature between control and OG took place after 5 weeks, just as respiration rate approached its maxium decline
♦ The difference was sustained for more than a month while the difference in respiration rate was dynamic→ soil temperature was not the main driving factor

♦Soil moisture increased on all plots after 3.5 weeks likely due to decreased transpiration by girdled trees
♦O50 and OG plots both experienced an increase in soil moisture but had different responses of respiration rate→ soil moisture was not the main driving factor
♦ Non oak girdled plots had the most similar moisture contents to the control

♦If all trees were girdled on July 3, the predicted response for ALL and O are similar in magnitude (50%) and timing (45 days) of respiration decline

♦Statistically, O 50 (p= 0.1) and NO (p=0.4) were similar to the control

♦ Treatment effect was non linear, cannot distinguish Oak contribution to soil respiration



Conclusions

♦ The Autotrophic contribution to soil respiration is approximately 50%

♦The turnover rate of carbon from recently fixed photosynthates to its release as soil respiration is between 4-6 weeks

♦The non oak trees were not immediately responsive to the girdling treatment

♦There may be an underground network of mycorrhizal fungi maintaining belowground activity on the 50% oak girdled plots, thereby sustaining root activity on the 050 plots but not OG plots

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Acknowledgements

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