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Biogeosciences Discussions

Interactive comment on "Biogeochemical factors contributing to enhanced carbon storage following afforestation of a semi-arid shrubland" *by* J. M. Grünzweig et al.

Anonymous Referee #3

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General Comments

This paper calculates the quantity of carbon fixed over a period of 35 years through afforestation of a semi arid shrubland with Pinus halepensis in the north Negev Desert. This was achieved through the calculation of inventories in the afforested site and in adjacent shrubland.

Methods used for these calculations included: Production of site specific allometric equations to relate tree biomass and the measurement of stem diameter at breast height for the forest sites; Destructive sampling of subplots in the shrubland to determine shrub biomass; Calculation of soil organic carbon and nitrogen in afforested and

shrubland plots; Stable isotope analysis of carbon to determine residence times of soil organic; Measurement of decomposition rates using a litter bag technique; Measurement of nitrogen stocks in the various ecosystem components.

I believe that this is a good paper that examines an important and interesting topic, in a geographical region where insufficient studies of this sort have been conducted.

This paper gives a good indication of what the carbon sequestration potential of afforestation in a semi arid region can be, the potential carbon sequestration of afforestation reported here is similar to previously published studies ie. [Nosetto et al., 2006]. This data will therefore be important in evaluating the potential of using afforestation of marginal semi arid lands for sequestration of carbon under the clean development mechanism of the Kyoto Protocol [Perez et al., 2007; Roncoli et al., 2007]. In addition the paper examines some of the mechanisms in which the carbon sequestration occurs, including; increasing the N use efficiency of the forest, production of large quantities of large and fine roots, a large input of C into the SOC reservoir, and a reduction in the decomposition rate in forest derived litter.

Specific comments

In the calculation of herbaceous biomass from the forest (Lines 141-143), the quantity of herbaceous biomass is set to zero; due to the effects of grazing. My initial response was to think this was incorrect since a large part of the herbaceous biomass is in the below ground portion and this cannot be neglected, and that secondly the biomass that is removed through grazing will be partly replaced through defecation. It is later mentioned that the fine roots are included in below ground carbon stocks. Please make it clear that the belowground herbaceous biomass is not completely neglected.

In the section of “Laboratory methodology” it is not mentioned how the organic carbon is measured.

The residence time of SOC derived from shrubland vegetation which is still present

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in the forest system 35 years after afforestation is determined using the amount of shrubland derived SOC in the forest soil (Line 213-214). How do you determine what is the Cs-d? This is not clearly explained in the text.

Adding the amount of harvested biomass (assuming that it was all processed into long lifetime products) to the remaining ecosystem biomass to obtain a total afforestation generated C store (Line 283-287) is a simplistic approach at best. Firstly it is unlikely that all the biomass was converted into products with a medium to long lifespan (here some records would help) and secondly; if the forest had not been thinned the total biomass would not necessarily be the sum of the remaining ecosystem biomass and the removed biomass.

The addition of removed biomass to the standing aboveground biomass produces a logarithmic relationship between the total aboveground biomass and the belowground biomass (Line 288-293), this is a very interesting statement, however I am not entirely convinced, mostly due to the small sample size (n=5). This section should be developed by providing further data or a sound mechanism for this relationship.

Technical corrections

Line 49: “one of those means is afforestation” change to something like “one of the ways to achieve this is through afforestation”

Line 51: “Afforestation was defined as...” change to “Afforestation is defined as...” it is still defined as that.

Line 55: “tool of restoring” change to “tool for restoring”

Line 56: “afforestation resulted normally” change to “afforestation normally results in...” or “afforestation often results in...”

Line 58: “...soil C depended on the former...” change to “...soil C depend on...”

Line 63: “annihilated” please replace with a less brutal word

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Line 78: “...controlled by nutrient use efficiency of C input...” please change to something like “ the nutrient use efficiency at which the C input is used” it currently sounds like the C input has an efficiency at which it uses nutrients, it does not, it is just added to the system

Line 106: “(total vegetation height)” shouldn’t this be mean or maximum vegetation, total implies the sum of the vegetation height

Line 163: “litter was cleaned from mineral soil...” maybe separated is a better word than cleaned

Line 242: “clay content ranged from 32-53%”

Line 281: “...almost 2.5 time the...” change to “...almost 2.5 times...”

Line 282: “This increase originated to 43% aboveground and to 57% belowground” maybe this should be changed to something like “This increase in the total ecosystem C stock can be partitioned into 43% of the total increased C stock allocated to the aboveground portion and 57% to the belowground component”

Line 359-369: You make reference to the SOC sequestration which is high in comparison to various other studies, perhaps you can mention what their values are.

Appendix A Line 457-458: superscript “z” in line 457, shouldn’t this be in line 458?

References

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