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Biogeosciences Discussions

Interactive comment on "Cajander larch (*Larix cajanderi*) biomass distribution, fire regime and post-fire recovery in northeastern Siberia" *by* L. T. Berner et al.

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General Comments:

"The manuscript presents a considerable contribution to the state of knowledge on boreal forest dynamics in Northern Eurasia at the high northern latitudes. The manuscript is well-written and presented in a clearly-structured and concise manner. The findings are important and the methodology is scientifically sound. However, the manuscript appears to cover too many components and tends to differ in rigor when addressing different issues. Specifically, while the methods for mapping and analysis for above ground biomass estimates appear solid, the components focusing on fire mapping, validation,

and analysis are comparatively less strong. The major weakness is a non-standard approach to establishing mapping accuracy for the MODIS burned area product (please refer to numerous papers on the subject and the MODIS burned area validation protocol). The analysis of fire regimes is also somewhat oversimplistic. However, these weaknesses do not diminish the net worth of the manuscript but rather highlight the focus areas for additional studies."

REPLY: We would like to thank AR1 for their careful reading of our manuscript and, in particular, for the constructive feedback related to the fire mapping and analysis components of this study. From the start, our primary objective was to investigate post-fire carbon cycling in larch forests at the landscape level; however, after visually interpreting 116 fires from Landsat imagery spanning four decades we decided that a simple analysis of the fire regime could prove insightful since this is a region that has received little attention in past studies. While a more robust evaluation of the MODIS burned area product was outside the scope of this study, after using the MODIS product to assist with dating recent fire scars and noticing that it considerably underestimated burned area, we felt that inclusion of that observation was warranted in the manuscript. We acknowledge that the manuscript attempts to cover a relatively wide range of topics, not all of which received the same degree of attention, and hope that it will therefore be of interest to a wide audience. Though we already indicated a number of worthwhile avenues of future research. We added the following text to the discussion on page 7579 starting at line 4:

"Future research on the regional fire regime could include a more exhaustive evaluation of burned area products, as well as investigation of the historical fire frequency using tree ring data."

Line-Specific Comments:

1. (page 7560 - line1): "Reference is needed for MCD45A1 product. The reference appears in the text later on page 7562 but not after the first mentioning of the product."

REPLY: This reference has been added at the noted location.

2. (page 7560- lines 13-15): "The information in the sentence beginning with "Global climate models predict a 3-7 ?C increase ..." has already been presented in the introductory text. This is an unnecessary duplication and should be removed."

REPLY: This duplicated text has been removed.

3. (page 7564, lines 5-10): "On the previous page in the manuscript the authors state that WorldView imaged came calibrated to the TOA reflectance. However, in this paragraph they refer to thresholding based on the Digital Numbers (DNs). This causes confusion in the interpretation of the methodology since DNs do not reflect physical properties of the observed object but rather refer to the engineering and data-driven stretch. Please refer to thresholds in physical measure of reflectance."

REPLY: This is a good methodological clarification. We used reflectance values between 0.17 and 0.37 to map tree shadows and have modified lines 6-9 (page 7564) to read:

"After testing a series of threshold values, we classified pixels as tree shadow if reflectance was between 0.17 and 0.37. This resulted in a 50 cm resolution binary map showing tree shadow and non-tree shadow."

4. (page 7566, lines 10): "The authors provided the definition for the Fire Return Interval but did not specify how it was assessed."

REPLY: In this study we did not assess Fire Return Interval (FRI), but instead used Fire Rotation (FR) as a descriptor of fire frequency and detailed the method lines 7-8 of page 7566. Since FRI is a more commonly used descriptor of fire frequency we felt that it would be helpful to readers if we defined FRI and noted the relationship between FRI and FR, as we did on page 7566 lines 10-12.

5. (page7566, lines 12-13): "It is not clear what the authors imply by "fire" in this definition. Is it "all fire events which constitute a single contiguous burned area?" or is

it a single fire event? It has been previously shown that large fire scars in Siberia can be composed of multiple fire events merging at some point during the fire season to form a single mega-scar (e.g. see Loboda and Csiszar, 2007). The definition of "fire density" therefore is ambiguous.

REPLY: This is an excellent point. We calculated fire density as the number of fire scars– a contiguous burned area constituting one or more fire events– formed in a given year. We edited lines 10-12 on page 7566 to read:

"We calculated fire density as the number of fire scars formed in a given year divided by the area over which they occurred. Defining fire density based on fire scars likely underestimates the true number of discrete fire events, as large fire scars in Siberia sometimes result from multiple fire events merging during the fire season (Loboda and Csiszar, 2007)."

Reference: Loboda, T. V., and Csiszar, I. A.: Reconstruction of fire spread within wildland fire events in Northern Eurasia from the MODIS active fire product, Global and Planetary Change, 56, 258-273, 10.1016/j.gloplacha.2006.07.015, 2007.

5. (page 5766, line 15): "It is unclear why the authors ascertain that the statistics are calculated for the period starting with 1969. If Landsat imagery was available since 1972, what dataset was used to determine that prior scars came from 1969 and not earlier? Please clarify."

REPLY: This is a very good observation on how we calculated fire statistics and definitely warrants clarification. As noted in the methods (page 2565, line 26-27) we observed that fire scars were generally visible in the NIR wavelengths for approximately six years following a fire and thus we tended to date fire scars that were visible in the 1972 imagery as having occurred in 1969 ï¿ś 3 years. We calculated fire statistics starting from 1969, though as AR1 noted, the fire scars visible in the 1972 imagery could have actually formed earlier. If we assume that fire scars were spectrally visible for six years and recalculate fire rotation and fire density starting from 1966, then

fire rotation becomes 301 years (vs. 276 years) and fire density becomes 0.023 fires yr-1 104 km-2 (vs. 0.024 fires yr-1 104 km-2). In retrospect, it is probably more valid to calculate these statistics starting from 1966 instead of 1969 and therefore we have modified these numbers in the revised manuscript. We also inserted a sentence on line 16 of page 7566 that reads:

"In basing these calculations on the ca. 1966-2007 time period, we are assuming that fires visible in the 1972 imagery occurred within the preceding six years."

6. (page 7578, lines 1-5): "This information has already been presented and is unnecessarily repeated here."

REPLY: This is a very good suggestion that will help streamline the manuscript. We modifed lines 1-9 on page 7578 to read:

"Obtaining an accurate picture of fire activity across Siberia necessitates the use of satellite data (Soja et al. 2004); however, systematic mapping of fires across broad spatial extents is not a trivial undertaking due to the necessity of using medium to coarse resolution data sets, the presence of thick clouds and smoke, and temporal changes in the optical characteristics of burned areas (Roy et al. 2008). In our study area, MODIS considerably underestimated the total area burned in comparison to that mapped using Landsat, though MODIS did detect the fires that were responsible for the vast majority of the area burned."

7. (page 7594): "What is the color combination for the Landsat imagery?"

REPLY: The Landsat imagery was displayed using bands 4, 3, 1 (RGB). We added the following text to the end of the caption of fig 2 (page 7594):

"The Landsat 5 imagery is displayed using bands 4, 3, 1 (RGB)."

Interactive comment on Biogeosciences Discuss., 9, 7555, 2012.