

The manuscript by Fu et al., entitled "Spatiotemporal changes in the boreal forest in Siberia over the period 1985–2015 against the background of climate change" presents a change analysis in forest cover over a broad area in Central Siberia. The changes in forest are then examined in the context of climate change. The analysis is based on time series of Landsat TM images that are validated with high resolution images from a satellite instrument named Gaofen-2. The specific research questions ask 1) what the extent of change in forest cover and proportions of tree species are, 2) at what latitude forest cover and tree species are most sensitive to climate change, and 3) which climate change factor is the main driver influencing the observed changes. The main findings state that the total forest cover increased over the study period, with coniferous and broadleaved forests showing different patterns of change at different latitudes. The authors identified the forest changes are driven mostly by temperature instead of precipitation.

As the authors state, global change is especially affecting and driving changes in the high latitude boreal forests. These changes are less often studied in boreal forests of northern Eurasia compared to, e.g., North America. Hence, the premise of the study is interesting and the topic merits examination. The study covers a broad area, and the quality of the technical work is very high. However, I do not think that all the conclusions of the study are credible. This concern is especially related to research question three that examines the connection between the climatic variables and forest changes. In my opinion, the changes observed in forest cover and the proportion of deciduous and coniferous forest are too easily attributed to climate change. Furthermore, the role of natural forest dynamics and disturbances is completely disregarded in the manuscript although they could have a strong explanatory power on the observed changes. I think the results need to be interpreted also in this context! I also think that the quality of the study could be increased with a more thorough examination of the used remote sensing data. For example, what is the proportion of non-forest land turning into forest dominated by broadleaved forest during the study period, what influence do major disturbances such as fire have on the results? I think the material used in this study (i.e. Landsat images) would also enable considering the role of forest disturbances. As a second major concern, I think that the text needs a thorough revision to enhance its readability. These and my other concerns are described in more detail below.

Major comments:

1. I am not convinced that the observed increase in the proportion of broadleaved forest is solely driven by changes in temperature – correlation does not necessarily mean causation. The natural succession of Siberian boreal forests typically follows a pathway where broadleaved trees or *Larix spp.* dominate the early successional stage. In later successional stages the broadleaved trees with short longevity are often replaced by conifers such as *Pinus spp.* and *Picea spp.* if stand-replacing disturbances remain absent. The disturbance regime of the area examined in this study includes both ground and crown fires, the latter occurring especially in young coniferous forests that also have woody debris that acts as a fuel load. According to Kharuk et al. 2021 (<https://doi.org/10.1007/s13280-020-01490-x>) and fire maps compiled by Global Forest Watch, large fires have occurred in the studied area, even during the study period. I would be interested to know what is the role of these disturbances and forest dynamics in, e.g., explaining the observed increases in the proportion of broadleaved trees? Similarly, cessation of anthropogenic land use, such as abandonment of agricultural land and clearcutting without reforestation may start a natural succession and increase the proportion of broadleaved trees (as hinted by the authors at L. 325). I think the role of these processes should be examined prior stating that the observed changes are driven by climate change. Maybe you could use the Landsat images to quantify the rate at which non-forest land converted to broadleaved or conifer forest during the study period, and check whether disturbances could explain some of this conversion (see <https://doi.org/10.1016/j.rse.2019.111403>)? Forest fire and climate are also interlinked as rising temperatures and potentially declining precipitation may increase the fire prevalence in Siberia. This could also be considered in the paper.

2. How were coniferous and broadleaved trees separated in the study? According to the paragraph title this should be explained in the paragraph starting at L. 110, but I do not find the information from therein. According to Hovi et al. 2017 (<https://doi.org/10.14214/sf.7753>), *Larix spp.* and certain deciduous trees have similar spectral characteristics. Is it possible that certain *Larix spp.* stands were falsely classified as broadleaved trees, influencing the obtained results?

3. I would be interested to know if the observed changes in forest cover are due to forests with open canopy structure becoming denser or conversion of previously non-forested land into forests? These two processes have very different significance for forest dynamics. Including results of this examination in the study would increase its information content and general interest.

Minor comments:

L. 1 (title): In the manuscript text the authors state that the study area ranges from temperate to boreal forests. If that is the case, I suggest rephrasing the title of the study.

L. 10: At a faster rate compared to where?

L. 11 – 12: I would argue that there is quite a lot of evidence on how the climate change is changing boreal forests. This view is shared by the authors as the introduction at L. 45 states that “There has been much research on the effect of climate change on boreal forest”. I think that in this context there has been limited focus on Central Russian boreal forests. Please rephrase the introduction.

L. 15: At first, I did not know what was meant by the term “forest species”, but after reading on I understood that they refer to broadleaved and coniferous forests. I would not call these “forest species” but forest types. I would change “forest species” to “forest type” and explicitly say that by forest type you mean coniferous and broadleaved forests.

L. 31 – 32: What is “geographical footprint”? Largest area?

L. 32: Remove “and encircles the globe at northern latitudes” as circumpolar distribution is already mentioned at L. 30.

L. 32 – 35: I find the ending of this sentence paradoxical. It reads that research of range shifts in boreal forests has focused on species-specific responses on temperate tree species (i.e. different biome). Please rephrase what is meant by this.

L. 40 – 41: Could you be a bit more specific – what kind of changes in biodiversity are expected due to climate change?

L. 42 – 44: The message of this sentence is very difficult to understand. Please clarify the point that the sentence tries to make.

L. 46 – 47: Could you give an example of the spatiotemporal differences in tree growth in the boreal biome that are caused by climate change?

L. 49: White spruce (*Picea glauca*) is a species that is native to boreal North America. Changes in growth of white spruce are then hardly relevant in the context of Eurasian boreal forest, right? Could this be replaced with an example from the same study region?

L. 59 – 61: This statement is not true. See, e.g., <https://doi.org/10.1007/s10980-020-00979-w> on the use of multispectral aerial photographs for this purpose.

L. 70 – 71: What is meant by “from the temperature to the frigid zones”?

L. 83 (Fig. 1): An inset map would be helpful in locating the study region.

L. 111 – 118: Why is discriminating forested/vegetated areas from non-vegetated areas presented twice in these paragraphs?

L. 126: Did you visually classify the sampling points based on GF-2 images?

L. 153 – 154: That the forest cover has not changed much over the study period does not mean that the forests are not significantly affected by climate change but that the influence does not manifest as changes in forest cover. Please rephrase.

L. 157 – 158: Similar to the previous comment, from the fact that the strongest change in forest cover was observed in the northernmost zone it does not follow that the forests in these areas were mostly affected by climate change (see also my comment on forest dynamics). Rephrase “The fastest change was observed in the northern zone from 63°N–69°N, which means that this is the area where the forest has been most affected by climate” for example to “The fastest change was observed in the northernmost zone (63°N–69°N) that is also the zone where the climate warming is also projected to be the highest”.

L. 187: Change to “not found north of the latitude 67°N in the studied region.

L. 202: Change “increase” to “change” as the forest cover may also decrease, right?

L. 217 – 219: As I have stated in my previous comments, the fact that the coverage of broadleaved forests has increased in the study region is not necessarily only due to climate change. Please revise.

L. 228 – 229: Also other drivers than climate change may explain the decrease in the cover of coniferous forest. Please revise.

L. 254 – 255: See the previous two comments.

L. 318 – 320: For me it is uncertain if the author suggest that the results indicate a northwards shift in the range of temperate biome. Such range shifts occur during longer time scales than those considered in this study. Please clarify what is meant by this sentence.

L. 319: Replace “temperature” with “temperate”.

L. 320: Are you suggesting that the southernmost forests of the study region are transforming into subtropical or tropical forests? Please rephrase.

L. 324: Also other drivers than climate change may explain the identified patterns.

L. 333 – 334: The term “significant difference” refers to differences that are statistically significant. However, the significance of the changes in forest cover was not statistically tested in the study. Please rephrase.

L. 335 – 336: That the forest cover changed increased the most in the northernmost latitudes does not automatically mean that this region is the most sensitive to climate change. Instead, these forest might be – for example – recovering from a major disturbance. Please revise.