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Climate of the Past Discussions

Interactive comment on "Heterogeneous response of Siberian tree-ring and stable isotope proxies to the largest Common Era volcanic eruptions" *by* Olga V. Churakova et al.

Anonymous Referee #2

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This manuscript attempts to investigate the response of multiple tree-ring proxies, such as ring width (TRW), maximum latewood density (MXD), cell wall thickness (CWT), and δ13C and δ18O in tree-ring cellulose derived from northeastern Yakutia (YAK), eastern Taimyr (TAY) and Russian Altai (ALT) sites, to six major volcanic events, and further to explore climate change (temperature, precipitations, VPD, and sunshine duration) caused by these six major stratospheric volcanic eruptions during the past 1500 years. They argued that heterogeneous response of Siberian tree-ring and stable isotope proxies to these major volcanic eruptions occurred. The heterogeneous response varied with complexity in terms of timing of volcanic eruptions, sites and tree-ring proxy types.

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The results are not strange because only three sites with various climate types and different and longitudes latitudes and different tree-ring proxies representing different climatic signals are chosen for this study. Generally, distinct temperature-sensitive tree-ring records from a large number of tree-ring sampling sites across the northern Hemisphere are chosen for the detection of climate-volcanic relationship. In this case, it can maximize common climate signals (especially temperature signal) represented by tree-ring records and minimize heterogeneous local/regional internally generated variability, and consequently allowing the effect of external forcing factors such as volcanic events to be addressed. Different approach was adopted in this study. The authors chose five tree-ring proxies from three sites with different longitudes and latitudes and elevations and focus on six time segments of volcanic eruption events during the past 1500 years. It is easy to be expected that heterogeneous climate response to the volcanic eruptions represented by Siberian tree-ring and stable isotope proxies would occur because different climate or synoptic and circulation conditions are characterized by the three studied sites. At any rate, some sentences would be necessary and very helpful for clarifying the differences between this topic and prior large-scale studies. In addition, advantages and uncertainties of this study related to limited three sites and multi-proxies should be also complemented.

Comments:

The title needs a change since the chosen six volcanic events do not represent the largest volcanic eruptions, as stated in lines 179-180.

The term Common Era seems to be inconsistent with the studied span ‘the past 1500 years’.

Lines 72, 92, 119, 181 and Section 3.1 line: I am not sure about the wording ‘Stratospheric volcanic eruptions’.

Lines 99-101 and lines 470-472 seem to be contradictory. Please check it.

Lines 126-127 are not clear and need rephrasing.

Fig. 1: five volcanic eruptions (vertical lines) are indicated but one eruption is missing.

From the map, the two eruption sites (two black circles) are located in tropical areas. It would be more clear to point out in the text and abstract.

Line 184: the authors stated each studies segment is 'around $\pm$ 10 years', but Fig.2 caption says 'the specific periods 15 years before and after the eruptions'. It is confusing.

Sections 2.6 and 2.7 can be combined together.

Superposed Epoch Analysis (SEA) results need significance tests to enhance scientific rigor of the relevant descriptions (for example, section 3.1).

Section 3.1 and section 3.2 should be swapped.

Fig. 2: the gray line is not clear. It is suggested to change the line color to enhance visibility.

For TRW and MXD, they are affected by both temperature and precipitation (see Fig. 3). It is difficult to separate temperature signals alone. However, the authors chose them as only temperature indicator.

Lag between volcanic events and response in tree rings is easy to understand for carbon isotope and ring width. But for oxygen and MXD, it is generally accepted that there is no legacy effect from previous year.

The authors argued for findings of the heterogeneity with different volcanic eruptions each but a potential associated mechanism is missing, for example, climate response to 1815 Tambora eruptions.

If available, additional evidence such as historical documents and long instrumental observations are much needed to strengthen the results.

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