Discussion of “Effect of the 2022 summer drought across forest types in Europe”
Gharun et al.

Reviewers' comments are in italic. The Authors´ responses are marked in blue.

Author Response to Referee 1

This study explores the impacts of the 2022 summer droughts on the forest canopy across different European land covers, utilizing two remote-sensing vegetation datasets: near-infrared reflectance of vegetation (NIRv) and solar-induced fluorescence (SIF). The authors analyzed the extent of forests affected and examined the correlations between canopy condition anomalies and drought severity, defined by anomalies in vapor pressure deficit (VPD) and soil moisture. The findings reveal significant drought effects in 2022, distinguishing this year from other extreme years, such as 2003 and 2018. This timely research contributes to our understanding of the drought-ecosystem nexus under intensifying climate extremes. It aligns closely with the theme of this special issue and likely sparks considerable interest within the drought research community.

My primary concern revolves around the manuscript’s conclusion on the legacy effects and declining forest resilience given the higher damage found in 2022, which are stressed across the manuscript (e.g., lines 38-40, lines 319-323, lines 395 - 399). The presented results may not be straightforward enough to support these claims, and could potentially be misleading. For instance, the extensive forest damage highlighted in e.g., Fig. 3, along with changes in vegetation-climate relationships shown in Fig. 7 and 8 might simply reflect the varied geographical locations of droughts and heatwaves over the years (i.e., 2003,2018, and 2022). Notably, the broader impact areas in 2022, predominantly in southern Europe—a region already limited by water availability in normal years (Fig. 2)—suggest that ecosystems there may have a smaller drought-tolerance margin and are more sensitive to droughts compared to Northern Europe forests. This may explain the smaller overall negative effects on forests in 2018 even under a larger relative drought, because the drought may not hit the “right” vulnerable target. The observed variations likely arise from examining distinctly different ecosystems (e.g., evergreen needleleaf forests versus deciduous broadleaf forests, as shown in Figure 1), rather than a general increase in ecosystem vulnerability or a decrease in resilience due to legacy effects. Therefore, I recommend tempering the conclusions. Simply summarizing the main findings would provide ample insight without overextending the implications.

Response: Thank you for your feedback. In the revised version of the manuscript, we will tone down the conclusion and summarize the main findings to avoid overextending the implications of our findings. See our response to further comments (also from reviewer Nr. 2) please to see how we plan to do this.

Other minor comments and questions:

Ln 85-87: "Elevated temperatures can …. reducing anthropogenic CO2 emission": I can not see how this could make anthropogenic CO2 reduce, further clarification is needed.

Response:
We will rewrite this sentence to make it clear. We will write:
"Elevated temperatures can also increase rates of respiration from the soil and from the trees which leads to reduced net capacity of forests for carbon uptake and capacity of forests for reducing anthropogenic CO_2 emissions"

Ln 130: For analysing the total areas of affected forests, would be good to mention in the Methods section how grid datasets at degree resolution could be converted to surface area in km2, if trigonometric difference in the sphere is considered.

Response:
The trigonometric difference arising due to Earth's spherical shape (Ellipsoid) was considered while converting the area from grid datasets to km^2. We will add the details in the methods section.

Ln 147: the use of NIRv is quite interesting. But EVI could also correct canopy background noise and should be less sensitive to soil conditions. What is the advantage of using NIRv over EVI? Perhaps more information is needed.

Response:
Studies that did a comparison of NIRv and EVI against flux-estimated GPP show that NIRv reflect vegetation phenology better than EVI (see Zhang et al. 2022). We will clarify this in the methods section.

Ln 236: Would be good to indicate what the shaded areas mean for Fig. 3 and other similar figures (i.e., the orange, white and green). I notice that you have labelled them in Fig. 5, but why not do that earlier?

Response:
We will add to the caption of the figure: "Orange-shaded area marks below normal and green-shaded area marks above normal conditions.