Comment on nhess-2022-41

Anonymous Referee #1

Referee comment on "Human influence on growing-period frosts like the early April 2021 in Central France" by Robert Vautard et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-41-RC1, 2022

General comments:

This manuscript is devoted to the analysis of an extreme cold spell in early April 2021 that occurred in a vast area of Western-Central Europe, including France. This outstanding event was preceded by an anomalously warm March, both months with record-breaking temperatures of reverse sign in France. The rapid heat accumulation (GDD) until the end of March led to an advancement of phenology (e.g. grapevines and temperate fruit trees), which significantly expose buds/flowers to chilling conditions and late frosts. This two-fold effect (phenology advancement & higher late frost risk) has been reported by several authors, including in studies of viticulture worldwide (a recent revision highlights this issue: doi:10.3390/app10093092). Furthermore, the authors explore, through an attribution analysis using climate model ensembles, the potential relationship between this event and anthropogenic forcing. Opposite trends were identified, either using fixed periods for the minimum temperatures or GDD-based periods, thus highlighting the importance of using heat accumulation as a time frame instead of the conventional DOY. Overall, I found that the results are scientifically sounding but highlight a still very large uncertainty in climate projections, particularly concerning extreme events like late frosts. The data and methods are also adequate for the purposes of the study. The manuscript is generally well written but deserves some improvements as is outlined below. Hence, I recommend its acceptance after some revisions.

Specific comments:

1. Fig.1 The symbols are not clear. Please remove the icons within the circles to better render the colour scale.

2. Ln 68: "The trend..." this sentence is unclear. Please either remove or better explain the opposite relationship between this cold spell and the projected intensification of the westerlies.

3. Fig2c: this panel should be only for France, allowing a better resolution of the target area. Please revise.

4. Equation 1: Please edit and improve quality.

5. Ln 130-141: the attribution method should be more clearly explained for a general reader not familiar with it. Please develop a bit further.

6. Ln 155: The reference to Fig. 4 is not appropriate at this stage. It needs some preliminary explanation beforehand.

7. Tables 1 and 2 are barely explained. Please develop their explanation, as there are several indicators that are not even mentioned in the text.

8. Table 2 caption: "Red color indicates a warming change and blue color a cooling change". No colours are shown. Please revise.

9. Section 4.1: You have used different anthropogenic radiative forcing scenarios in the different model ensembles: SSP2-4.5, RCP8.5, SSP3-7.0, which correspond to very different GHG emissions and concentration pathways. Please explain how these changes may influence your findings. Further, the spatial resolution of the models is not equal. Have you averaged all datasets within the selected domain? I suggest improving and rephrasing this whole section to improve clarity, as several options were taken and they need to be duly justified.

10. Ln 233-236: This paragraph is awkward. You mention that only some model simulations should be considered after the evaluation approach, but you eventually decided to use all of them. Please clarify.

11. In general, the quality of the figures and tables can be significantly improved. The physical units are not always shown and the resolution is poor, being some of their elements difficult to read. For instance, in Fig.5 caption there is no reference to the geographical area that is being considered. The same applies to other figures. Fig. 7 and 8 are very interesting and informative but difficult to read. I suggest adding labels and an

improvement in the captions. Their description in the text can be significantly enhanced to facilitate their interpretation by a larger audience.

12. English is fine. Only minor spell checking is necessary (e.g., 229 "The").