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Climate of the Past Discussions

Interactive comment on "Climate signatures of grape harvest dates" *by* M. Krieger et al.

M. Krieger et al.

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Comment 3.1: Paper is clearly presented. The figures should be improved, putting areas of non significant correlations in white, instead of masking the significant areas, which makes colour indentification sometimes difficult.

Reply: We will improve the distinction between significant and non-significant areas in the revised version

Comment 3.2: But the scientific interest of this paper is poor. The few relevant conclusions of this paper are already well established.

Reply: This paper provides several new findings, e. g. spatial information about the (well-established) grape harvest date (GHD) - April-to-August temperature (AAT) connection. It shows that, beyond this connection, the winter months have an influence on

the GHD on decadal to multidecadal time scale. We also found a climatic explanation why the spring/summer temperature correlation increases in the last decades. We are aware that some of these findings have to be presented in a much clearer way. Please see also our general comment to all reviewers.

Comment 3.3: * The criterion described as "correlation". I assume this is "Pearson product-moment correlation coefficient". Implicit then is the assumption that all relationships should be linear - why should they be linear? Linearity of relationships should be at least investigated. Note also that more robust measures of correlation may be used (Kendall, etc...).

Reply: We used the Pearson product-moment correlation coefficient. The empirical relationship, displayed using scatterplot on the raw data (Fig R1), does not show any strong deviations from linearity. As a linear relationship is a first order approximation for any relationship in a limited data range, it is reasonable to rely on the Pearson correlation in our study. Further, similar results for the AAT-GHD relationship were also obtained using rank correlation methods. Spearman's rank correlation coefficient is slightly higher (-0.76) than Pearson's correlation coefficient (-0.72) and the time evolution of the correlation between GHD and AAT is similar (Figure R2).

Comment 3.4: * A significant correlation does not mean that the relationship is useful or high. Given the length of the series, any observed correlation greater than .19 will be significant at 0.05 level, but 0.19 is peanuts. It would lead to 4% of explained variance in a simple regression analysis. Apart from well known relationships (link between GHD and spring or summer relationships), the exhibited relationships are low, at best. At this stage, I would suggest to restrain the spatial coverage of the study to western Europe, rather than covering regions from Iceland to Oural.

Reply: We are well aware of the fact that significant relationship and strong relationship are not equivalent. The usefulness of a relationship depends on the significance (=likelihood to have arisen by chance) and on the purpose. For prediction purposes,

we agree with the reviewer that 4% explained variance is not very useful. For the detection of an influence, and therefore to gain understanding about mechanisms, however, even small but significant relationships are useful. In our case, the “weak” relationship of the GHD and decadal winter temperature variations helps to explain the current mismatch between GHD and summer temperature on decadal timescales and to explain the increase in the summer-GHD relationship in the recent decades.

Comment 3.5: * Grape growth is a complex biological process, where temperatures and precipitations play a role, possibly including those of the year before. Analysing each field separately will likely fail to find finer relationships. Multivariate statistical modelling of the phenomenon could help in understanding the relative influence of each factor, and probable interactions among them.

Reply: We agree with the reviewer that different influences likely affect the GHD in concert and therefore a multivariate analysis would be more appropriate to detect these influences. In the revised version, we applied multilinear regression and demonstrate that decadal winter temperature as well as the summer temperature influence the GHD. This is a robust result, which we already detected in the separate linear regressions to summer and winter temperature. Multilinear regression strongly supports our finding that the effect of winter is not just an indirect effect via the summer temperature. In general, we are reluctant to use extensively multivariate analysis on this dataset, as this increases the danger of overfitting and therefore the detection of spurious results.

Comment 3.6: * Note that harvests usually occuring in september, correlation of GHD with SON season would have little meaning. Lag 1 and 2 winter relationships are... weak, at best. If authors continue in their study, a common tool used by "teleconnexions adepts" is PCA analysis, and correlation to principal components.

Reply: In order to only interpret robust results, we will omit lag correlations in the revised version. Their purpose was only to motivate the analysis of filtered data. We would like to thank the reviewer for the advice of using PCA analysis. However, we

see no advantage in this special case of using PCA analysis on the climate fields prior to the analysis of the relation of GHD. The advantage would be to reduce the number of correlations compared to a gridpoint wise approach. On the other hand, it is unclear why the first modes of climate variability should also dominate the GHD variability. Including multiple EOF’s renders the results much more difficult to interpret for the reader.

Comment 3.7: * Stability of correlations over time. Which criterion led to split the samples according to year 1947 (or 1948)? End of paragraph 4.3 : about what occured during first and last half of century, is there any reference supporting those words?

Reply: The split in 1947/1948 is motivated by the fact, that the running correlation of winter temperature and GHD is positive up to 1947 and negative after 1948. This additional information was missing in the manuscript. Nevertheless, we will omit these figures in the revised version as we will put a stronger focus on specific results (see also the comment to all reviewers).

Comment 3.8: Appart from homogeneity of datasets - which might play a crucial role there - since harvest dates highly depends on varieties, etc... , change in sign of weak winter correlations is not a very meaningful result.

Reply: The change in sign of the winter correlation is very unlikely caused by inhomogeneities of the climate data sets, as temperature, SST and SLP correlations show the same properties but are affected by different error types. Varieties have not changed in the Burgundy region (Garcia de Cortazar-Atauri et al., 2010). We agree with the reviewer that the change in sign itself is not very meaningful. But as the April-to-August temperature and the decadal winter temperature influence the GHD, it is important how summer and winter temperature are related to each other (see general comment). We recognize that this point have to be presented in a clearer way in the revised version.

Comment 3.9: More interesting is Figure 3 (b), that exhibits an increase in correlation. But this feature may also be the result of a non-linear relationship. During years char-

acterized by colder summers, harvest occurs in any case before a given date, even if the grapes are not totally mature, in order to prevent icing - while early harvest is the sign of good maturation. Higher correlations would then be naturally observed during the latest warming phase.

Reply: We would like to thank the reviewer for proposing this interesting hypothesis. We tested this idea using temperature data from the Burgundy region and conclude from this analysis that early frost events had no significant effect on the GHD: We analysed the daily minimum temperature from the weather station Besancon (http://eca.knmi.nl) to derive the day of first freeze of each year and compared this quantity with the GHD (Fig R3). During the last century, only very few years showed less than 10 days difference between the first day of freeze and the GHD. To test the effect on the GHD-AAT relationship, we calculated the GHD-AAT correlation after omitting years in which the time difference between GHD and first freeze was lower than a fixed threshold (Figure R4). The correlation is only weakly affected (dR<0.05) by the removal of the specific "early frost" years. We therefore conclude that the linear relationship of GHD and AAT was not strongly affected by early frost events.

Comment 3.10: Additionally Pearson correlation is sensitive to outliers, influence of 2003 should be checked also.

Reply: Most of our results were computed for the years 1901 to 2002 and are therefore not influenced by the year 2003. In the revised version, we will use the same instrumental period (1901 - 2002) for all correlations. The results are not influenced by this choice. Concerning the Pearson correlation, see our reply to comment 3.3.

Interactive comment on Clim. Past Discuss., 6, 1525, 2010.

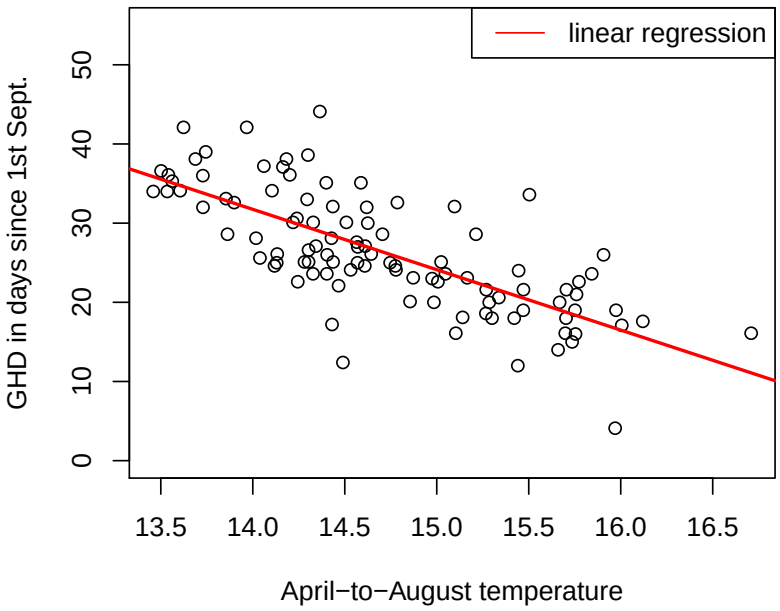

Fig. 1. Scatterplot between GHD and AAT (1901-2002). No significant deviation from a linear relationship is detected.

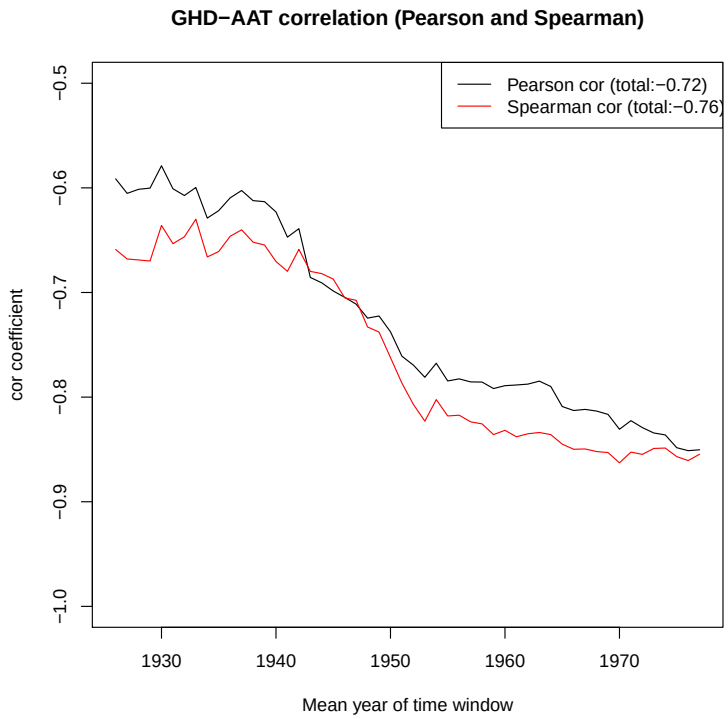

Fig. 2. Running correlation of GHD and AAT. Comparison of Pearson's and Spearman's correlation coefficient.

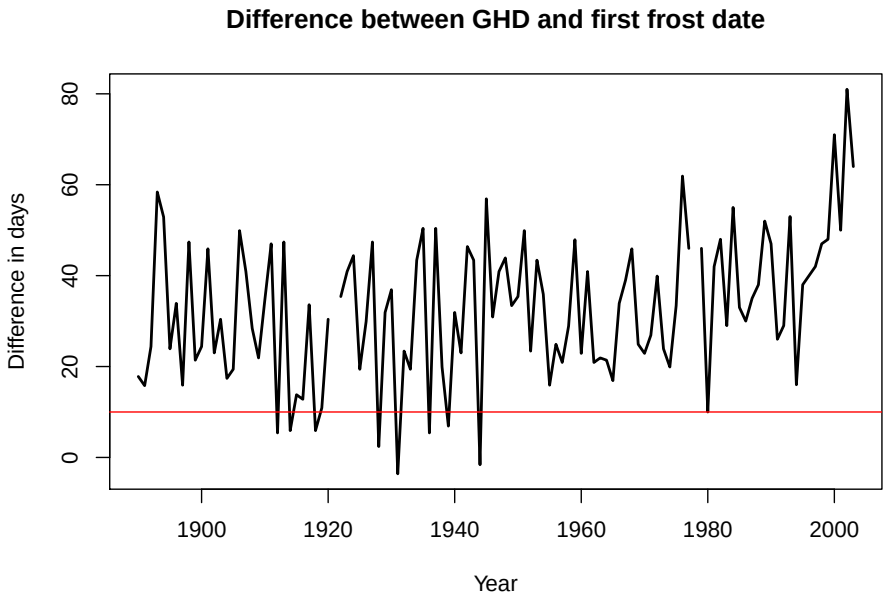

Fig. 3. Difference of the GHD and day of the first frost.

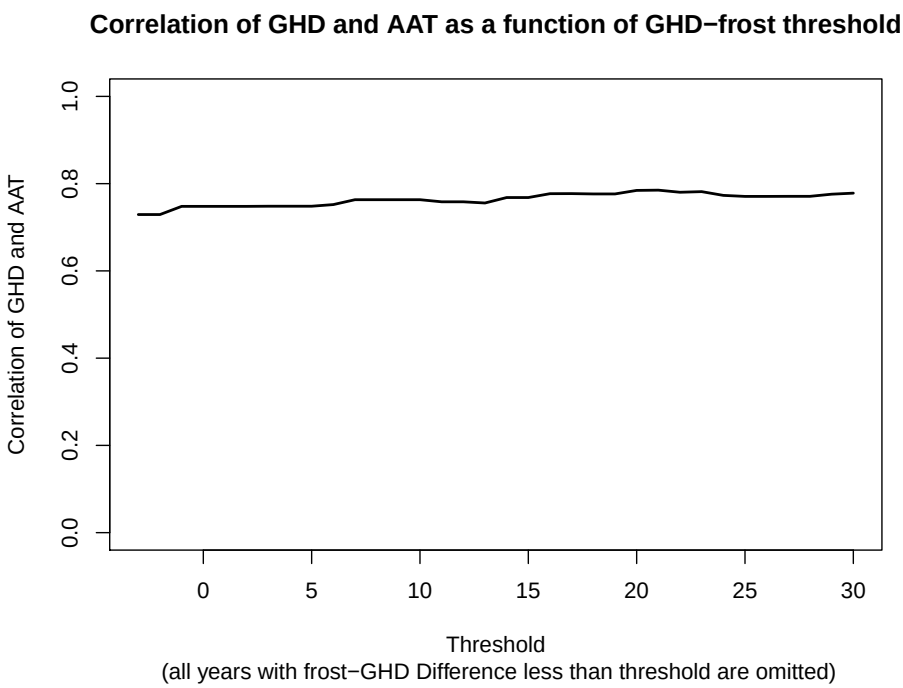

Fig. 4. GHD-AAT correlation. All years with a GHD- first frost difference less than the threshold are omitted prior correlation