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Interactive comment on "Bivariate return periods of temperature and precipitation explain a large fraction of European crop yields" *by* Jakob Zscheischler et al.

Anonymous Referee #2

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This study seeks the linkage between multivariate climate conditions and crop yields. This paper is one of the first which employs bivariate return periods of temperature and precipitation as the indicator of climate variability to explain crop yield variability. It is clearly written and obtains the interesting finding that the combination of temperature and precipitation can explain more crop yield variability than models relying directly on temperature and precipitation as predictors on average in Europe. The result also reveals different sensitivities of crops to climate conditions. A need to incorporate the nonlinear impacts into the climate-crop yield assessment is highlighted. For all these reasons, I recommend publication after addressing a few comments regarding the statistical examinations.

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Discussion paper

One comment is related to the calculation of return periods. As explained by the authors, a return period of RP, also known as a recurrence interval is an estimate of the likelihood of an event to occur, i.e., an occurrence probability of 1/RP every year. If the event of interest happens every year or the annual maximum/minimum data is in use, the mean interarrival time is 1 yr (i.e., the numerator in Eq. 1). If I understand correctly, the authors applied copulas to the seasonal and 2-month averaged climate variables for return period calculation. For such case, why the mean interarrival time is 1 yr? Instead, the mean interarrival time should be calculated as the length of data in years (L)/ the number of occurred events in the length of data (n), i.e., L/n.

The authors examined 6 types of copulas in order to represent different combined effects of temperature and precipitation, i.e. dry and hot, dry and cold, wet and hot, wet and cold. My understanding is that the impact of these combinations can be due to a single variable or both variables being in an extreme state. The examined copulas, however, do not include extreme-value copulas, which are usually considered more appropriate for reproducing the interrelationship/interdependence structure between rare events. Did the authors compare the result using extreme-value copulas?

Here the authors applied copulas to the seasonal and 2-month averaged climate variables. One of the prerequisites to apply copula is the assumption of temporal independence of variables, e.g. by examining the autocorrelation. Did the input variables meet this requirement?

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