Short comment SC3:

This is a very interesting study documenting the drivers of floods in Europe. I have a small comment on line 195, about the use of 30-day antecedent rainfall. How are the results sensitive to the choice of this 30-day average ? With basin sizes ranging from 5 to 100 000 km2, it is likely that 30-day antecedent rainfall is a rough approximation of the actual soil moisture conditions for this range of basin sizes. For very small basins, 30-day rainfall could be enough, but maybe larger accumulations periods could be more adapted for larger basins. Why not consider an API, as in Woldemeskel and Sharma (2016) ? The question behind my question is: do we under-estimate the effects of antecedent soil moisture by using only a 30-day antecedent rainfall ?

Woldemeskel, F., and Sharma, A. (2016), Should flood regimes change in a warming climate? The role of antecedent moisture conditions, Geophys. Res. Lett., 43, 7556– 7563, doi:10.1002/2016GL069448.

Note: line 65, Tramblay et al. 2013 is wrong, the correct reference is Tramblay et al., 2019 (https://doi.org/10.5194/hess-23-4419-2019).

Yves Tramblay

Reply to Short comment SC3:

We would like to thank Yves Tramblay for his comment. In this study we used 30-day antecedent precipitation (AP30) as an indicator of antecedent moisture condition in the catchments because temporal windows of 30 days or less are typically used in the literature. In fact, antecedent precipitation (AP) refers to a wide range of temporal windows, from one hour to 30 days, and no explicit guidelines on this duration are available (Ali and Roi, 2010).

In this study, we investigated the correlation between the decadal changes in the drivers and flood quantiles; therefore, the long-term evolution of the drivers (quantified by smoothed time-series through a LOESS regression) influences the results rather than their exact value. For this reason, we tested the impact of this choice in two ways:

1. We calculate and compare the trend in antecedent precipitation for all catchments using windows of 30, 45 and 60 days (i.e. AP30, AP45 and AP60, see Fig. SC1). Figure SC1 shows that the spatial pattern and magnitude of the trend in AP30 (Fig. SC1a) are very similar to those obtained with longer temporal windows (Fig. SC1b and SC1c).
2. We visually compare the long-term evolution of AP30, AP45 and AP60 in a number of catchments randomly selected in northwestern, southern and eastern Europe (regions defined as in Bertola et al., 2020) for different ranges of catchment area (see Fig. SC2). Small (<100 km^2), medium (100-1000 km^2), large (1000-10000 km^2) and very large catchments (>10000 km^2) are compared. Figure SC2 shows that, despite the value of AP increases with longer temporal windows (as expected), its long-term oscillation is nearly the same (in the range 30-60 days). This is observed for catchment sizes and regions.

We conclude that using a longer temporal window for antecedent precipitation would not significantly change the results of our study, even for very large catchments.

We prefer not to use the antecedent precipitation index (API) because additional assumptions on its parameters would be required (i.e. the decay factor and maximum lag parameter, as defined in Woldemeskel and Sharma, 2016). Furthermore, the maximum lag parameter (similar to the temporal window of the antecedent precipitation) is often assumed as 14 days or less (e.g. Mediero et al., 2014; Woldemeskel and Sharma, 2016). Even though we prefer not to change the soil moisture index, we will mention the issue in the discussion of the revised paper.

We would like to thank Yves Tramblay for spotting the error in the reference; we will correct it in the revised manuscript.

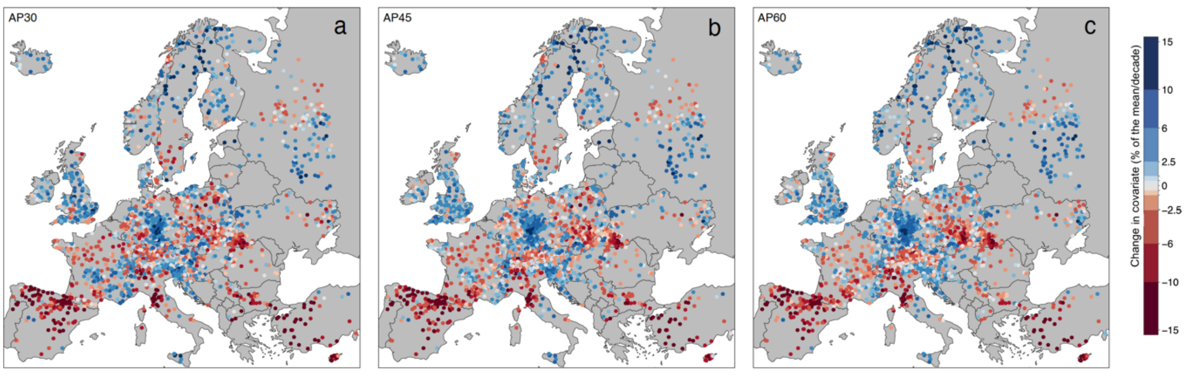

Figure SC1: trend of catchment-averaged antecedent precipitation for temporal windows of 30 (a), 45 (b) and 60 (c) days for each station over the period 1960-2010.

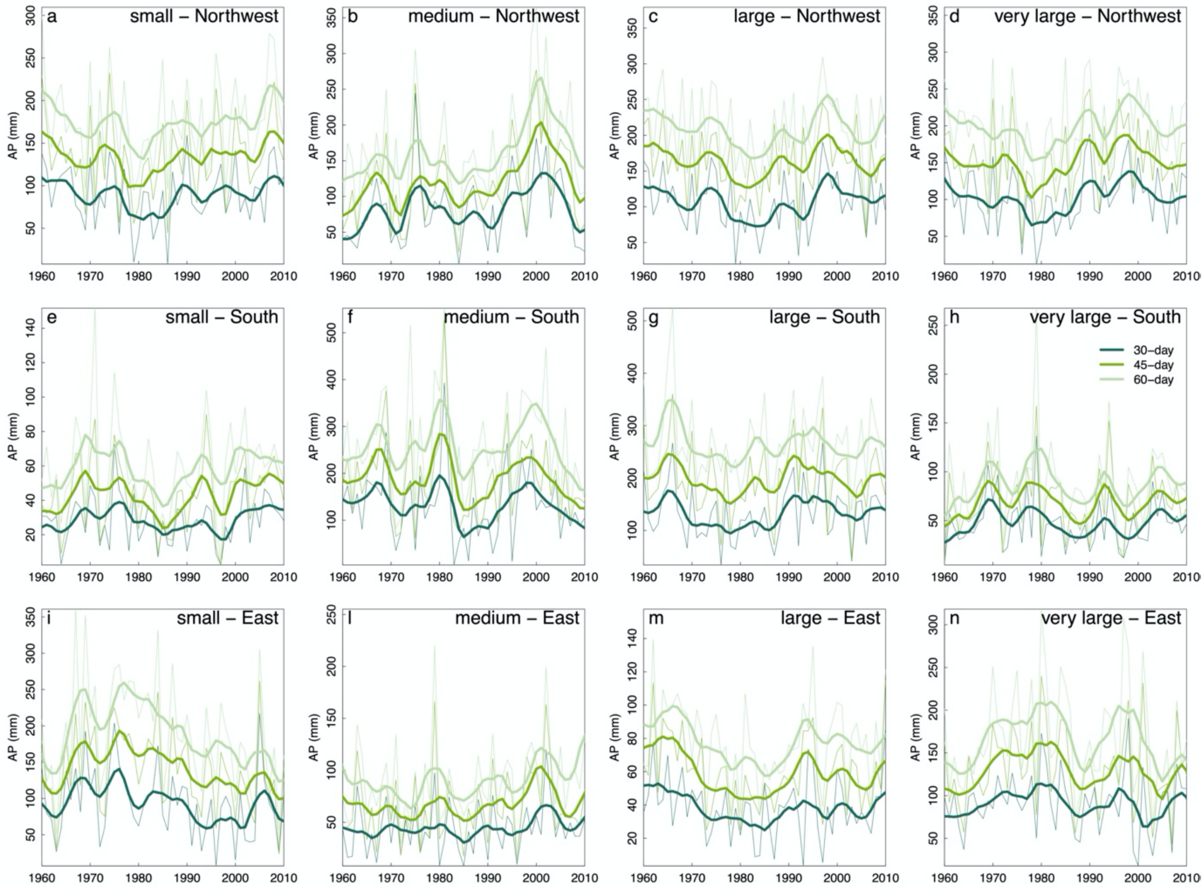

Figure SC2: long-term evolution of 30-, 45- and 60-day antecedent precipitation for randomly selected catchments in northwestern (first row), southern (second row) and eastern (third row) Europe with distinction on catchment area. Small (≤100 km^2), medium (100-1000 km^2), large (1000-10000 km^2) and very large catchments (>10000 km^2). Thin lines refer to yearly values of the antecedent precipitation and thick lines to their smoothed series (with LOESS regression).

References:

Ali, G. A. and Roy, A. G.: A case study on the use of appropriate surrogates for antecedent moisture conditions (AMCs), Hydrol. Earth Syst. Sci., 14, 1843–1861, https://doi.org/10.5194/hess-14-1843-2010, 2010.

Bertola, M. et al. (2020) ‘Flood trends in Europe: are changes in small and big floods different?’, Hydrology and Earth System Sciences, 24(4), pp. 1805–1822. doi: 10.5194/hess-24-1805-2020.

Mediero, L. et al. (2014) ‘Detection and attribution of trends in magnitude, frequency and timing of floods in Spain’, Journal of Hydrology. Elsevier B.V., 517, pp. 1072–1088. doi: 10.1016/j.jhydrol.2014.06.040.

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