Shorter cyclone clusters modulate changes in European wintertime precipitation extremes

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Wintertime extreme precipitation from cyclone clusters, i.e. consecutive cyclones moving across the same region, can lead to flooding and devastating socio-economic impacts in Europe. Previous studies have suggested that the future direction of the changes in these events are uncertain across climate models. By employing an impact-based metric of accumulated precipitation extremes, we show that projections of cyclone clusters are instead broadly robust, i.e. consistent in sign, across models. A novel physical diagnostic shows that accumulated precipitation extremes are projected to grow by only +1.0 \%/K on average across Europe, although the mean precipitation per cyclone increases by +4.7 \%/K. This results from a decreased number of clustered cyclones, associated with decreased wintertime storminess, the extent of which varies from northern to southern Europe and depends on the future storyline of atmospheric circulation change. Neglecting the changes in the number of clustered cyclones, i.e. assuming that accumulated precipitation extremes would change as the mean precipitation per cyclone, would lead to overestimating the population affected by increased accumulated wintertime precipitation extremes by 130–490 million across Europe.