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Attribution to climate change of trends on European heatwaves conditioned to circulation

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Many studies have shown that the probability distribution of temperatures in Europe has evolved with climate change (e.g. Schär et al. (2003), Fischer et al. (2012)) and that consequently the occurrence of heatwaves in Europe is bound to increase (e.g. Seneviratne et al. (2016)). This change of distribution could be related to a shift of the temperature distribution related to the local mean temperature trend. It could also be related to a change in the shape of the temperature distribution. Hence, the trend of extreme temperatures does not necessarily equal the trend of mean temperatures. Here we study the residual trend related to heatwaves, i.e. the remaining trend of extreme temperature events once we substract the trend of mean temperatures.

More precisely, we focus on residual trends conditional to the atmospheric circulation. Heatwaves are related to persistent anticyclonic anomalies of circulation (e.g. Cassou (2005), Horton et al. (2015)). It is possible to simulate uchronic events, i.e. events that could have been with a circulation similar to the heatwave of interest given a different level of climate change using flow analogues (Jézéquel et al. (2017)).

They allow us to isolate the thermodynamical and dynamical components of the difference between those trends for singular events in order to answer the following questions : is there a difference between the trend conditional to a synoptic situation and the mean temperature trend in the region of interest ? Does the synoptic situation become more or less likely with climate change ? To answer the first question we calculate the trend on uchronic temperatures. To answer the second we calculate the trend on analogues distances. We use several reanalysis datasets (NCEP, ERA20C and 20CR) and an ensemble of CMIP5 models for different experiments (historical, RCP4.5 and RCP8.5). This approach is adapted for singular events case studies. We present results for the summer 2003 heatwave in Western Europe.