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Current and future occurrences of health-relevant, compound heat and ozone pollution events in six European ozone-temperature regions

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Air pollution and heat events present two major health risks, both already independently posing a significant threat to human health and life. High levels of ground-level ozone (O_3) and air temperature often coincide due to the underlying physical relationships between both variables. The most severe health outcome is in general associated with the co-occurrence of both hazards (e.g. Hertig et al. 2020), since concurrent elevated levels of temperature and ozone concentrations represent a twofold exposure and can lead to a risk beyond the sum of the individual effects. Consequently, in the current contribution, a compound approach considering both hazards simultaneously as so-called ozone-temperature (o-t-)events is chosen by jointly analyzing elevated ground-level ozone concentrations and air temperature levels in Europe.

Previous studies already point to the fact that the relationship of underlying synoptic and meteorological drivers with one or both of these health stressors as well as the correlation between both variables vary with the location of sites and seasons (e.g. Otero et al. 2016; Jahn, Hertig 2020). Therefore, a hierarchical clustering analysis is applied to objectively divide the study domain in regions of homogeneous, similar ground-level ozone and temperature characteristics (o-t-regions). Statistical models to assess the synoptic and large-scale meteorological mechanisms which represent main drivers of concurrent o-t-events are developed for each identified o-t-region.

Compound elevated ozone concentration and air temperature events are expected to become more frequent due to climate change in many parts of Europe (e.g. Jahn, Hertig 2020; Hertig 2020). Statistical projections of potential frequency shifts of compound o-t-events until the end of the twenty-first century are assessed using the output of Earth System Models (ESMs) from the sixth phase of the Coupled Model Intercomparison Project (CMIP6).

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