An integrated assessment of future risks of climate change for Austria: spatio-temporal trends of ozone, heat, and social vulnerability

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Assessing the spatio-temporality of risks associated with climate change have become dominant in disaster risk research. However, integrated assessments of spatio-temporal aspects combing hazard, exposure and social vulnerability is still under-researched, especially in the fields extreme heat events and heightened ozone concentrations. Studies frequently tend to concentrate either solely on the hazard dimension, such as heatwaves and ozone exceedances, neglecting their interactions (Feron et al. 2023), or solely on isolated spatio-temporal assessments of social vulnerability and exposure (Santos et al. 2022). Using the recent risk conception of the latest IPCC report, we analyze risk as the cumulative interaction of hazard, exposure and vulnerability for historical trends and near future scenarios.

A novel data set allows for an integrated assessment of historic spatio-temporal trends as well as near-future trends using different SSP-RCP combinations (SSP2-4.5 & SSP3-8.5) at census tract level. To assess the combined impact of temperature and ozone extremes, we utilize bias-corrected model fields from high resolution runs of the coupled chemistry-climate model WRF-Chem. Population data was projected until 2050 by combining historical growth rates for selected indicators with national change rates from the Shared Socio-economic Pathways (SSP) database by IIASA (Riahi et al. 2017). Regional variations in national SSP change rates are weighted with regionalized projections for population and age groups, and historic data on income and education from the Eurostat Database.

Methodologically, we use the Adjusted Mazziotta-Pareto Index (AMPI) normalization method to overcome the limitations of comparing z-scored values over time as reported by Santos et al. (2022). This has the advantaged that all values across all periods of time are considered in normalization (Mazziota & Pareto 2022). Bases on the integration into a composite indicator, we, first, performed a multivariate analysis of how sub-indicators for hazard, exposure and social vulnerability relate to each other for Austria. Second, we applied global and local Moran's I statistics to analyze if the spatial patterns have changed in terms of spatial heterogeneity or spatial
clustering over time.

The paper concludes by highlighting the needs of integrated risk assessments and discusses the potentials and limitations of our assessment approach. Finally, possible benefits of the interdisciplinary and small-scale use of SSP-RCP combinations for a more comprehensive formulation of informed policy guidelines.


