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Using statistical approaches to quantify the synergy of heat stress and air pollution on human mortality for a Mediterranean city

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The latest Intergovernmental Panel on Climate Change (IPCC) report estimates that the global mean temperature increase will be up to 5.4°C. One of the most affected areas globally is the Eastern Mediterranean and Middle East (EMME), a wide and highly diverse region, identified as a hotspot that is warming twice as fast compared to the global increase. Climate change, in conjunction with poor air quality are two key factors impacting human health. In this work, we use flexible statistical modeling approaches to quantify the joint effect of temperature, humidity and air quality on human mortality for the city of Thessaloniki in Greece. In this work we briefly expose the statistical methodology we propose, and how it was used to quantify the joint effects of temperature, humidity and air quality over prolonged periods of exposure, on human mortality.

More specifically, we utilize data on all-cause but also cause-specific daily mortality and model this as a function of temperature, humidity, ozone, PM_{10} and nitrogen dioxide – all measured from monitoring stations in Thessaloniki. We implement the well-established framework of Distributed Lag Models (DLMs) as Generalized Additive Models (GAMs), to capture the complex interactions between the aforementioned exposures on the risk of mortality. Such models capture the exposure effect through time and thus enable understanding into how prolonged periods of poor air quality and heat stress affect human health. Results confirm the intuition that exposure to extreme heat and humidity in conjunction with poor air quality significantly increases the risk of mortality. This increase in risk varies considerably by case-of-death and also by age group. We show how the type of air pollutant results in different risk profiles, but also that there are correlations across the pollutants that affect the risks.