ANALYZING THE EFFECTS OF AIR POLLUTION ON MORTALITY DURING HEAT WAVES IN THE NETHERLANDS (1986-2006)

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Severe heat waves in 2003 and 2006, causing tens of thousands excess deaths throughout Europe, have led to a number of publications on the effect of heat on mortality. Some of these also suggest a change in air pollution effects during heat waves. As part of a project intended to inform Dutch policy makers on the role of air pollution in the excess mortality during heat waves we assessed whether air pollution effects on mortality show an increase during heat waves in the Netherlands. In the Netherlands a heat wave is defined as a period of five or more consecutive days with a maximum temperature of at least 25 ºC, of which three or more days show a maximum temperature of at least 30 ºC, as measured in the centrally located town of De Bilt.

We present the analysis of covariate adjusted time series of daily mortality, air pollution and temperature in the Netherlands from 1986 up to 2006 using generalized additive models (GAM) with penalized splines to explore the effect of heat waves on the effect of air pollution on mortality. Additional covariates included relative humidity, ambient air pressure, influenza cases, national holidays, and day of the week. Daily air pollution data for particulate matter, ozone, nitrogen dioxide, nitric oxide, and black smoke were measured at the National Air Quality Measurement Network. Daily counts for total non-accidental, cardiovascular, respiratory, COPD, and pneumonia mortality were provided by Statistics Netherlands. Meteorological data were provided by the Royal Netherlands Meteorological Institute. We used the mgcv package in R for GAM modelling applying cubic regression splines.

Correlation between air pollution and temperature is at its highest for extreme temperatures, creating specific modelling challenges. We will show how we used correlation patterns for various lags and averages between air pollution, temperature, and mortality to select model variables. Our models reveal how air pollution effect estimates differ in sensitivity to temperature adjustment across summer periods, distinguishing days during heat waves from other summer days with moderate or elevated temperatures.