Investigating the relationship between mortality and temperature and a possible acclimatization effect in Finland

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Several studies have found U-, V- or J-shaped dependencies between mortality and temperature, with increasing mortality during both heat waves and cold spells. The minimum mortality is found at different temperature levels, varying by climate zone due to acclimatization. The influence of climate on mortality in the Finnish population was studied by comparing daily mortality with daily mean temperature, both aggregated over hospital districts in Finland during the period 1971-2010.

Heat wave in July 2010 – about 400 extra deaths in Finland

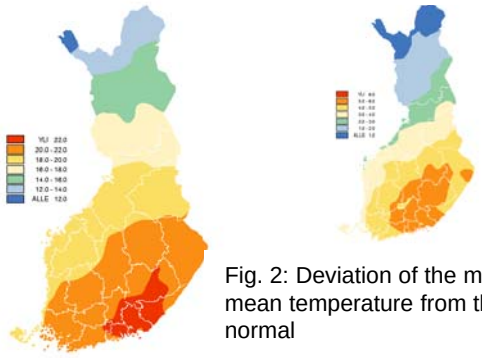

Fig. 1: Monthly mean temperature, July 2010

Fig. 2: Deviation of the monthly mean temperature from the normal

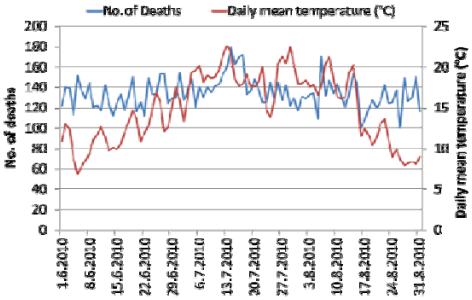

Fig. 3: Number of deaths and daily mean temperature in Finland, June-August 2010

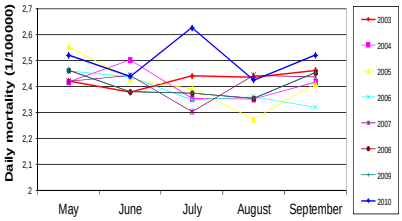

Fig. 4: Summer mortality in Finland, 2003-2010

During the heat wave in July 2010 a new maximum air temperature record, 37.2°C, was recorded in Joensuu, Eastern Finland. The July monthly mean temperature was higher than the climatological normal value across the whole of Finland, the anomaly exceeding 5 °C in southern Finland (Figs 1 and 2). It is estimated that about 400 extra deaths occurred in Finland as a direct consequence of the heat wave (cf. Figs 3 and 4).

Temperature dependence of mortality, 1971-2010

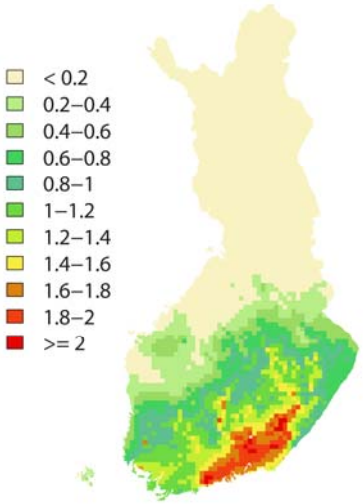

Fig. 6: Estimated excess daily mortality due to July 2010 heat wave (1/100.000)

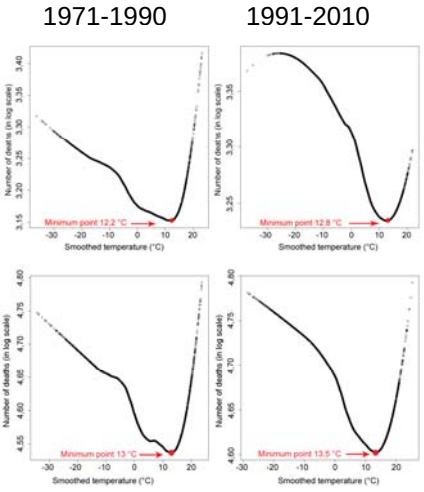

Fig. 5: Temperature dependence of mortality in southern *(lower)* and northern *(upper)* Finland in 1971-1990 *(left)* and 1991-2010 *(right).*

All-cause daily mortality and mean temperatures were compared with various lags (0-40 days) for each hospital district for all ages and separately for elderly (>65 years). Acclimatization of the population was studied by analyzing data in 20-year sub-periods: 1971-1990 and 1991-2010. The small population in Finland made it necessary to aggregate hospital districts into larger regions for the analysis in order to obtain more robust statistical outcomes.

A V-shaped relationship between the mortality and temperature data was found to fit better than a U-shape (Fig 5.). The shape of the dependence and the temperature at which minimum mortality occurs varied according to the hospital districts: in general in southern districts the minimum temperature is higher than in northern districts. As a possible sign of acclimatization of the population, in several hospital districts minimum mortality was found to occur at a higher temperature in the latter than the former period.

Results are being used to visualize and quantify the potential impact of climate change in the MAVERIC-project (Map-based assessment of vulnerability to climate change employing regional indicators). We defined a baseline mortality as the estimated minimum value (see Fig. 5). The excess mortality due to heat can then be calculated as the difference between model results for a given day and the baseline value and accumulated for a period. The spatial pattern of heat-related mortality was estimated using gridded daily temperature data (see preliminary results in Fig. 6).