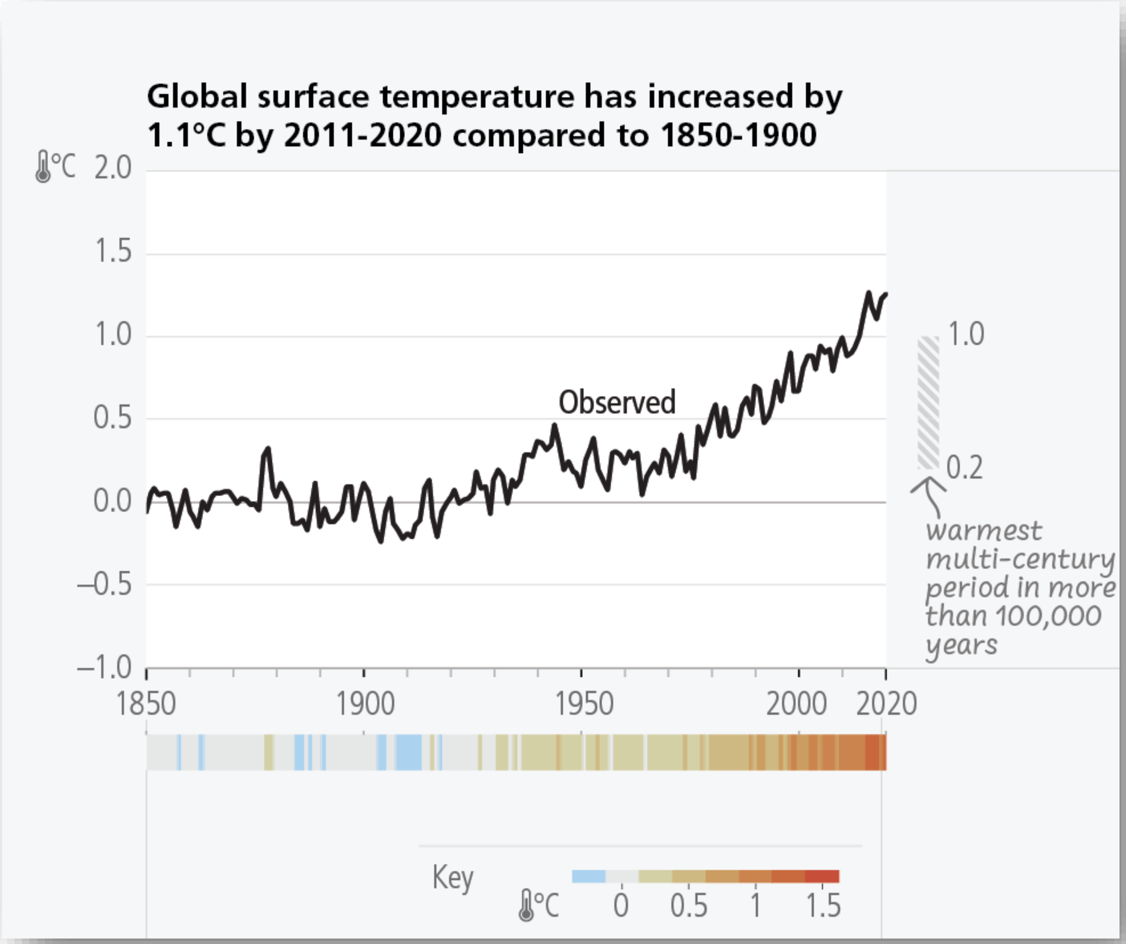
THE IMPACT OF CLIMATE AND DEMOGRAPHIC CHANGES ON FUTURE MORTALITY IN BRUSSELS, BELGIUM

Risk and health impact assessment
Sciensano, Belgian health institute

Dr Claire Demoury

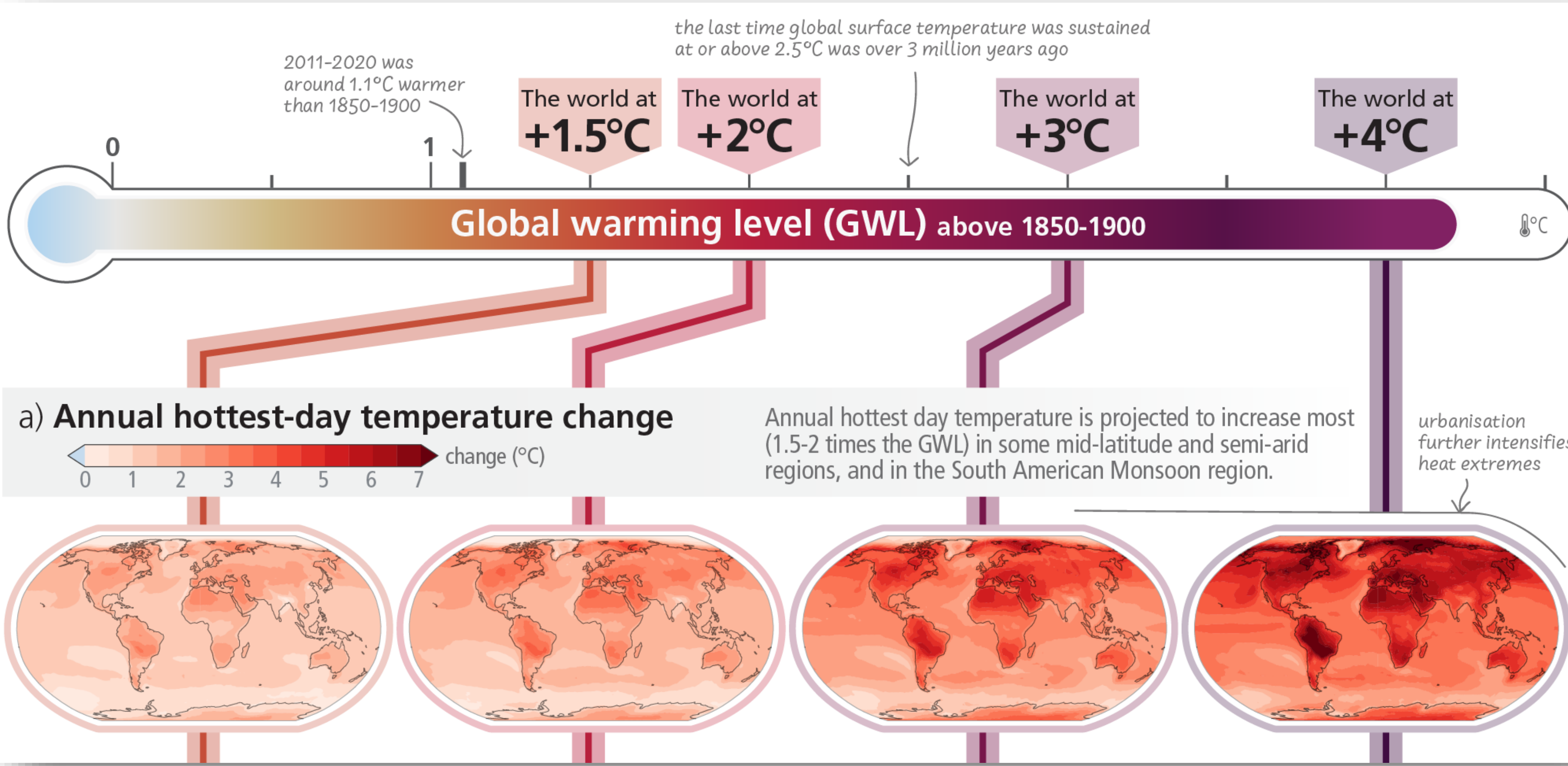
18/03/2025

Global surface temperature



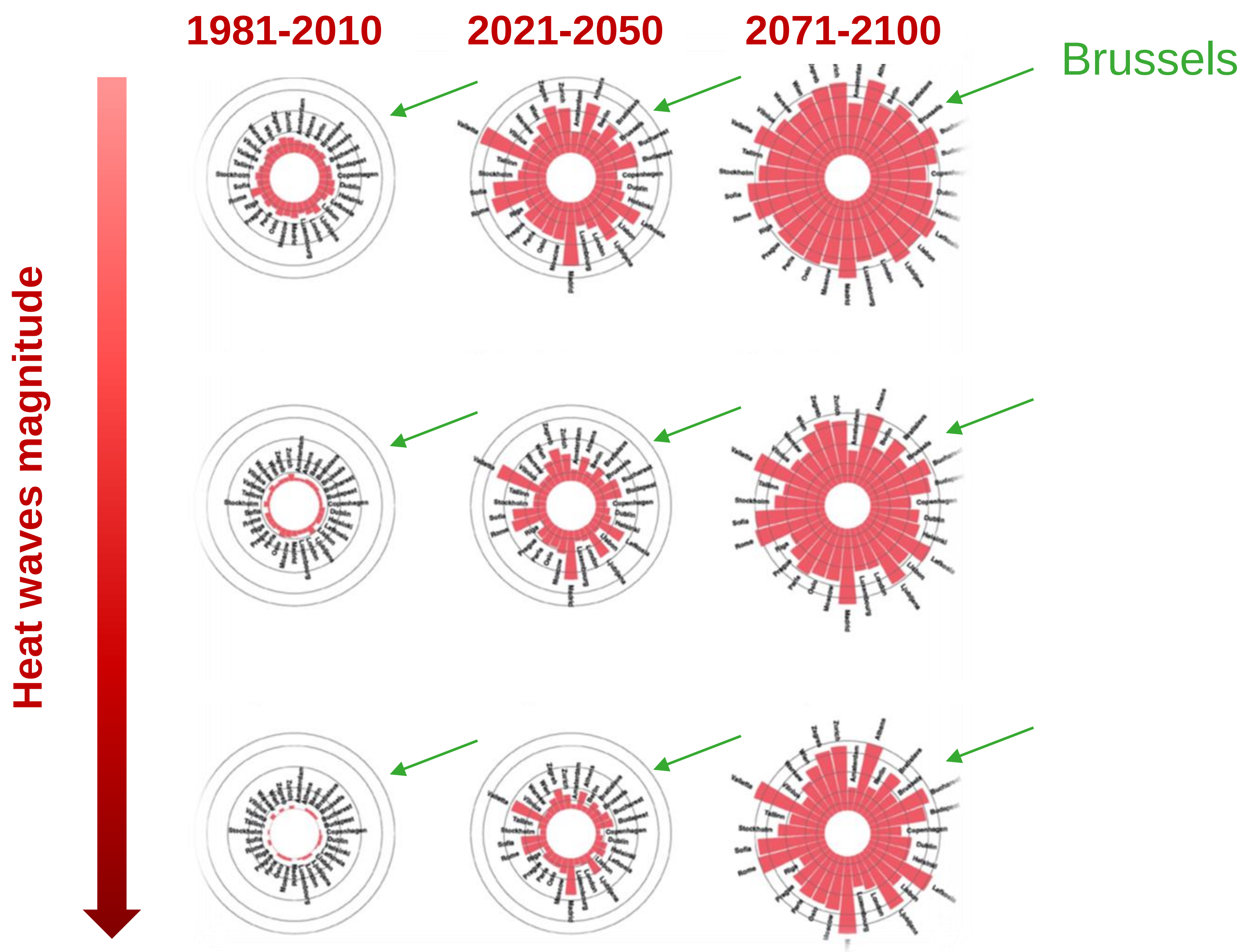
Intergovernmental Panel on Climate Change, 6th Assessment Report

Regional consequences of warming



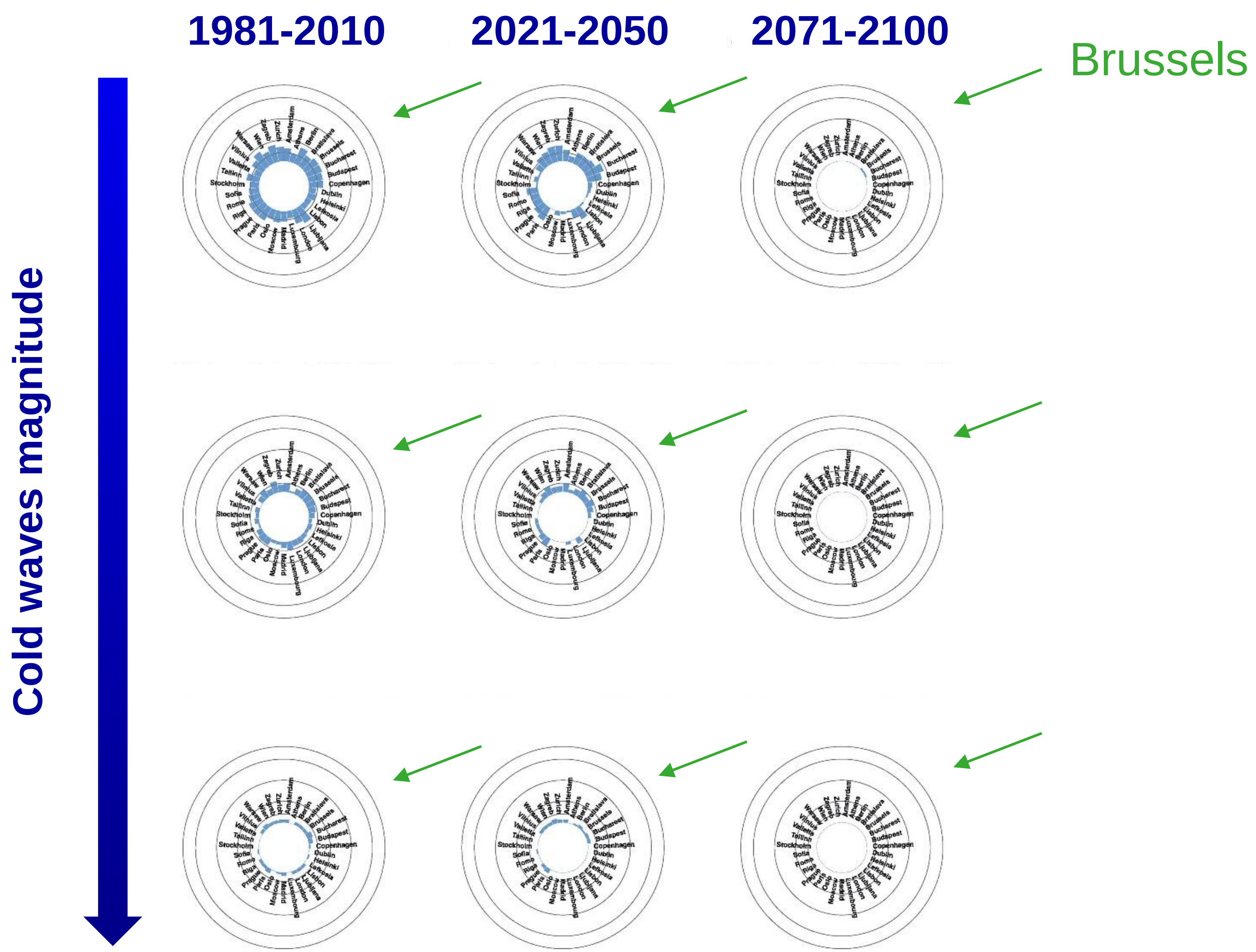
Intergovernmental Panel on Climate Change, 6th Assessment Report

Exposure to heat waves in Europe: Probability of occurrence in 31 capitals



Smid et al. (2019). *Urban Clim*

Exposure to cold waves in Europe: Probability of occurrence in 31 capitals

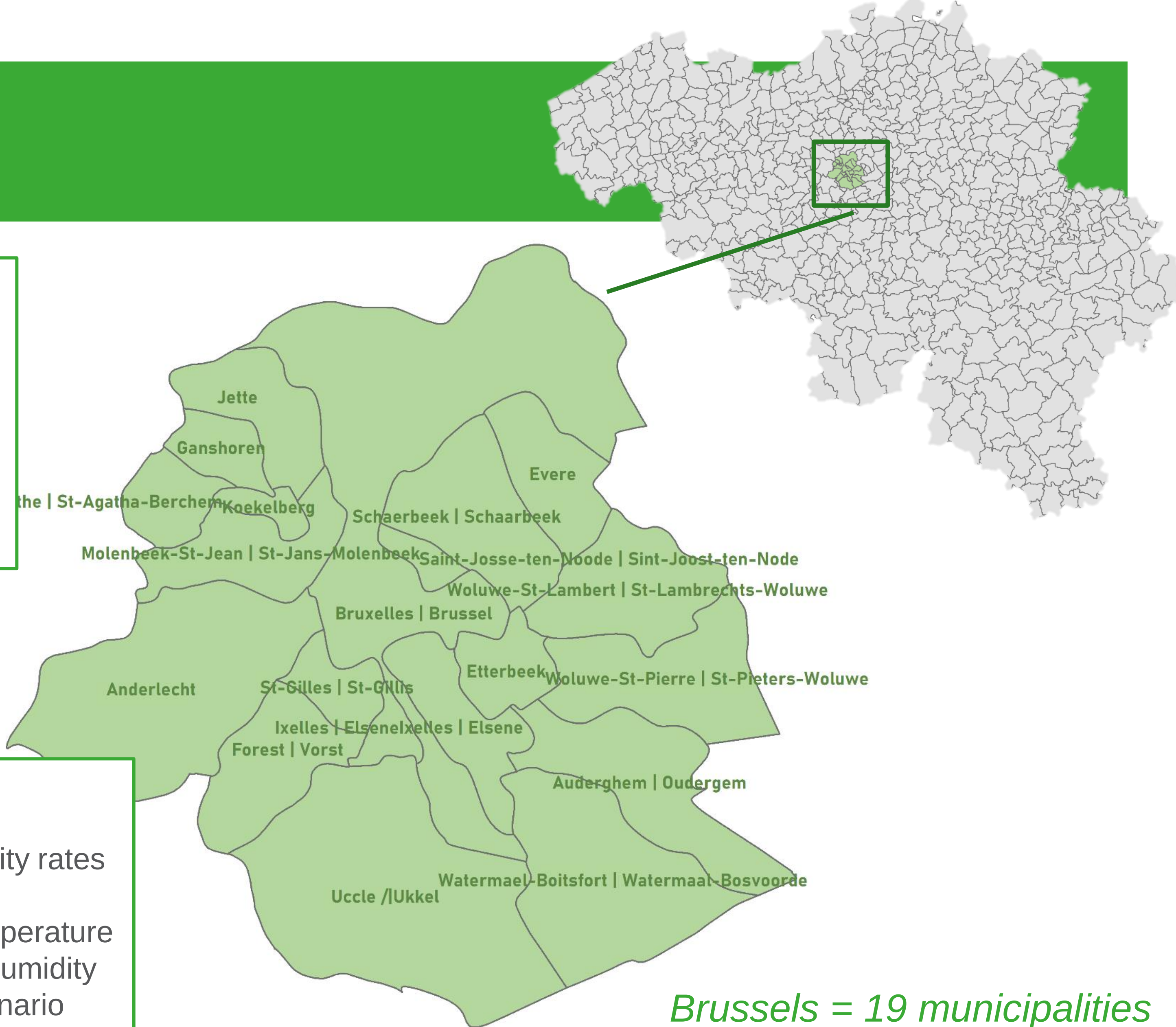


Smid et al. (2019). *Urban Clim*

Data

Historical (municipality)

- Daily number of (all-causes) deaths
- Daily maximum temperature + average relative humidity

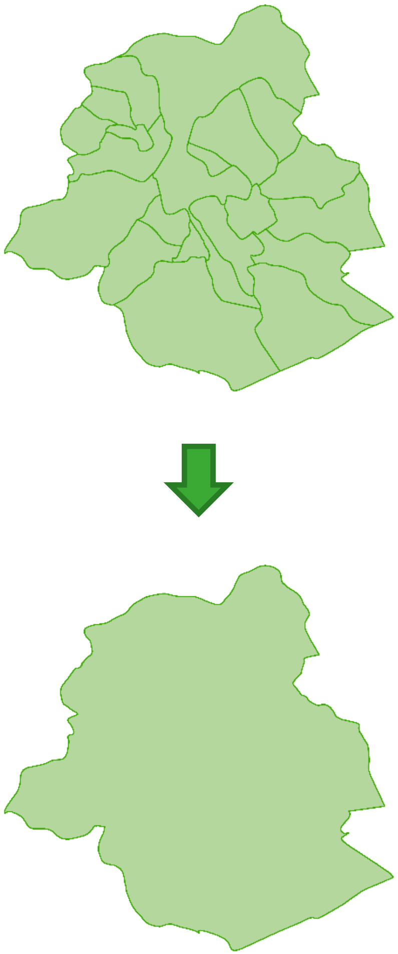


Projections (Region)

- Yearly population projections + mortality rates for the region
- Daily maximum temperature + average relative humidity (10 RCM under scenario RCP8.5)

Brussels = 19 municipalities

Historical temperature-mortality relationship



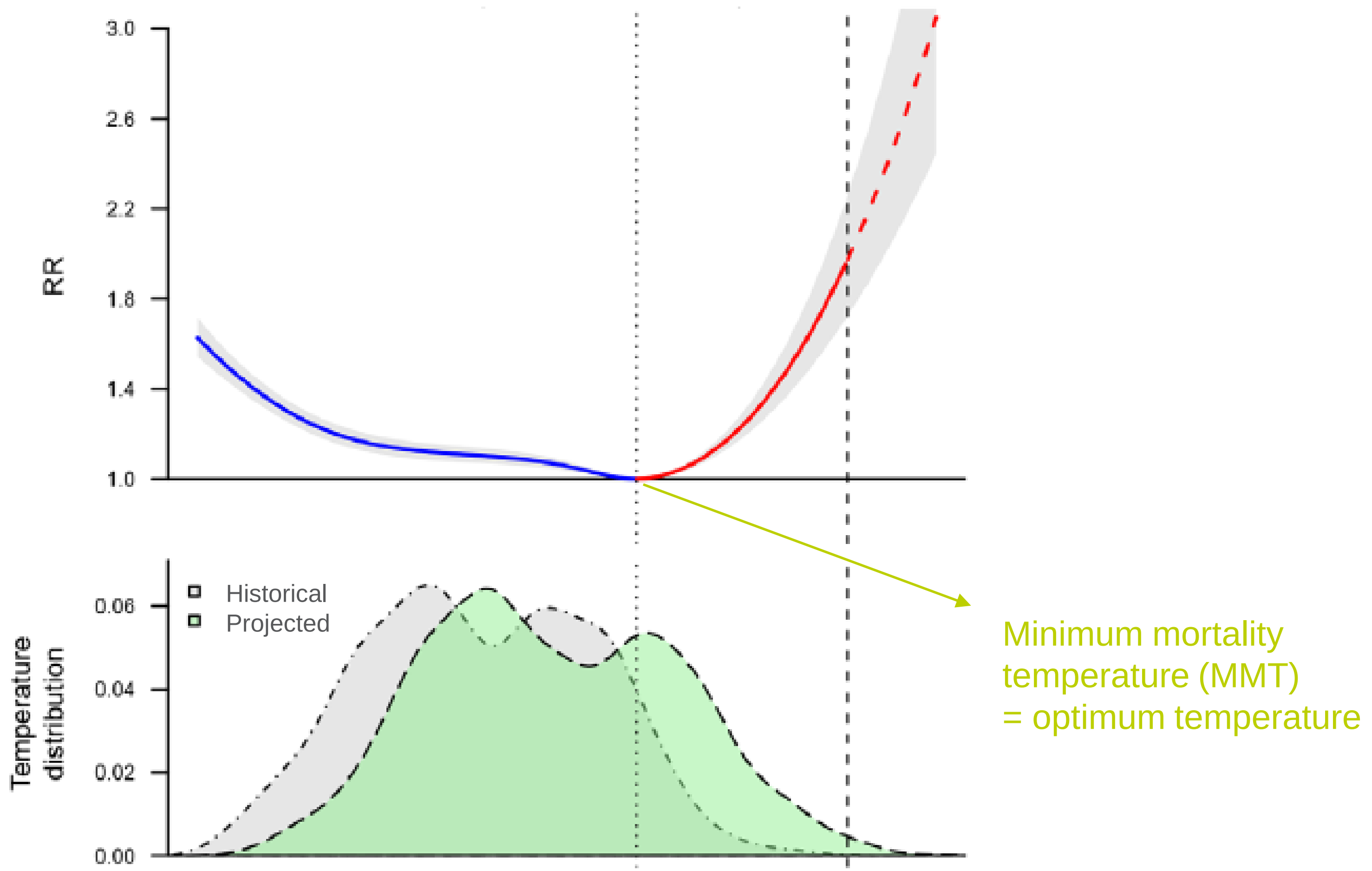
- Quasi-Poisson regressions with distributed lag non-linear models (dlnm) to estimate the relationship in each municipality

$$Log(deaths) = cb + dow + holiday + ns(humidity) + ns(time, df)$$

- Municipality-specific estimates pooled with a random-effect meta-analysis to obtain the temperature-mortality relationship for all Brussels

Gasparrini et al. (2010). *Stat Med*

Historical temperature-mortality relationship extrapolation



Vicedo-Cabrera et al. (2019). *Epidemiol*

Climate and demographic changes contributions

- Daily attributable numbers and fractions of deaths
- Daily results averaged over the ten RCMs and aggregated by 25-year periods:
  - baseline: 1994-2019
  - near future: 2020-2044
  - mid future: 2045-2069
-

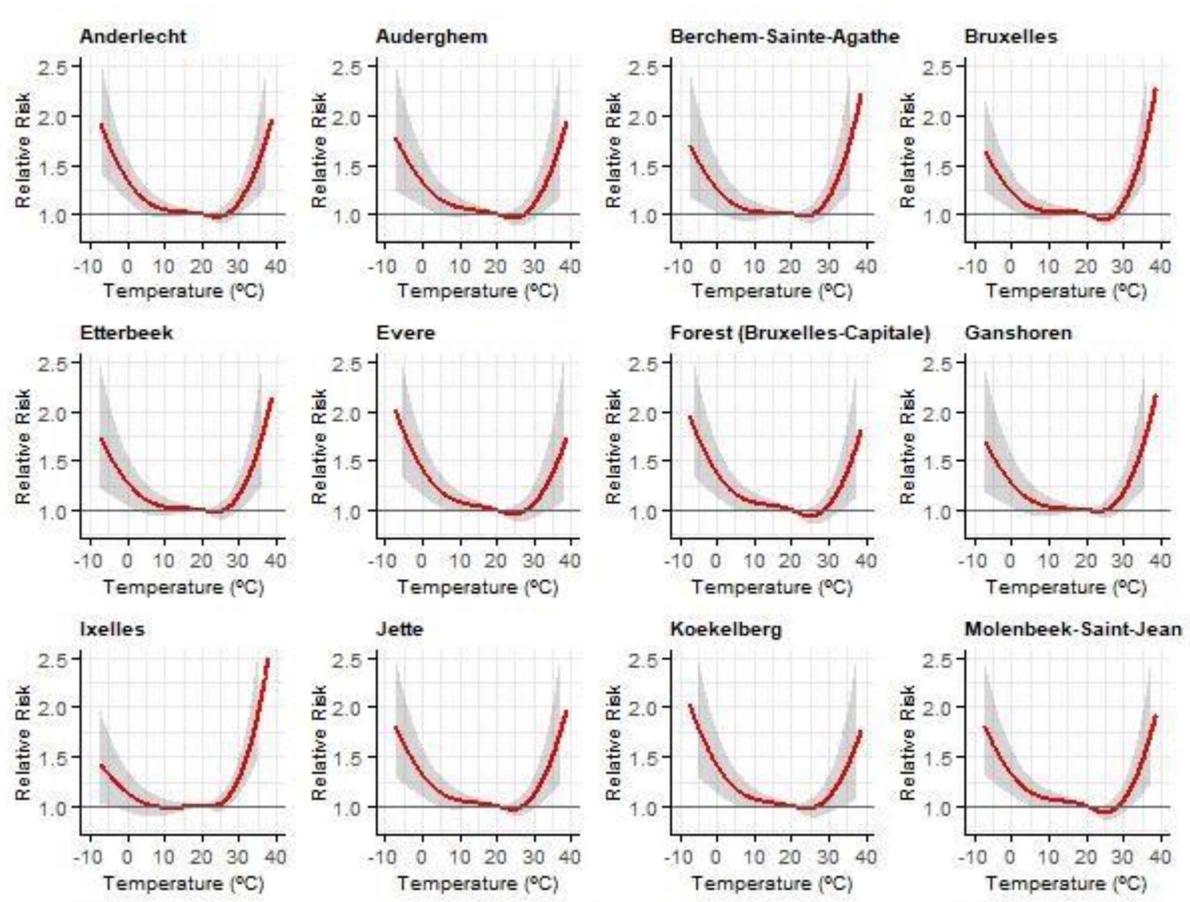
Scenarios	Climate change	Demographic changes
DEM + CLIM	Yes	Yes
CLIM	Yes	No (N constant to 1994-2019)
DEM	No (climate of 1994-2019)	Yes

CLIM: as compared to the baseline reference = effect of climate

DEM: as compared to the baseline reference = effect of demography

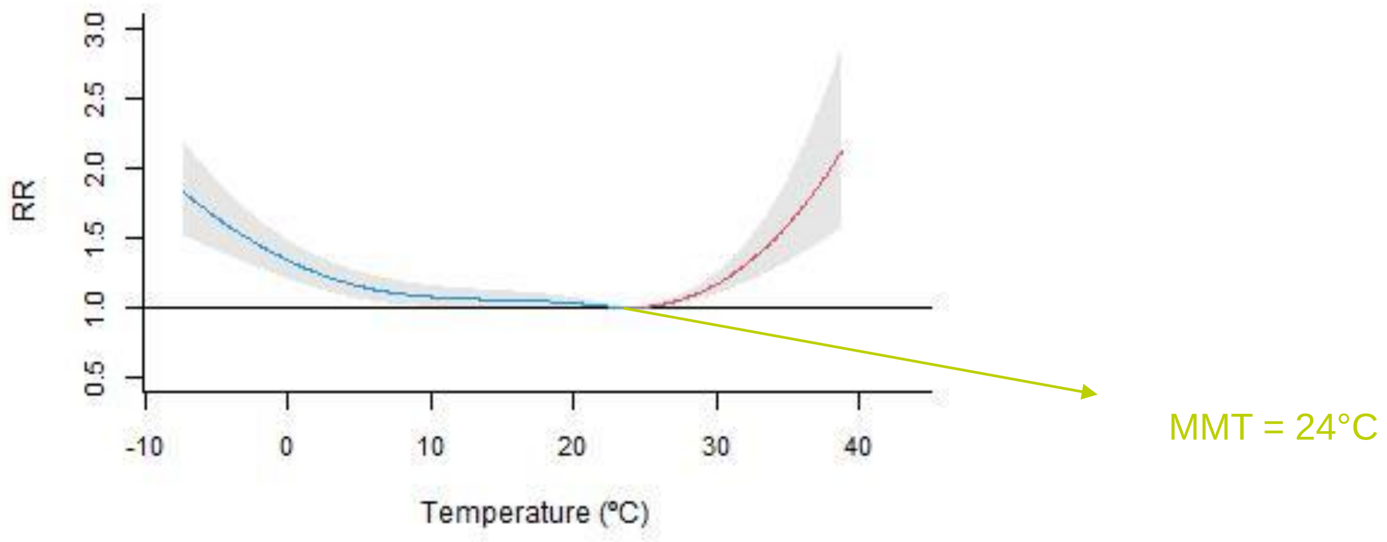
Results

Historical temperature-mortality relationships



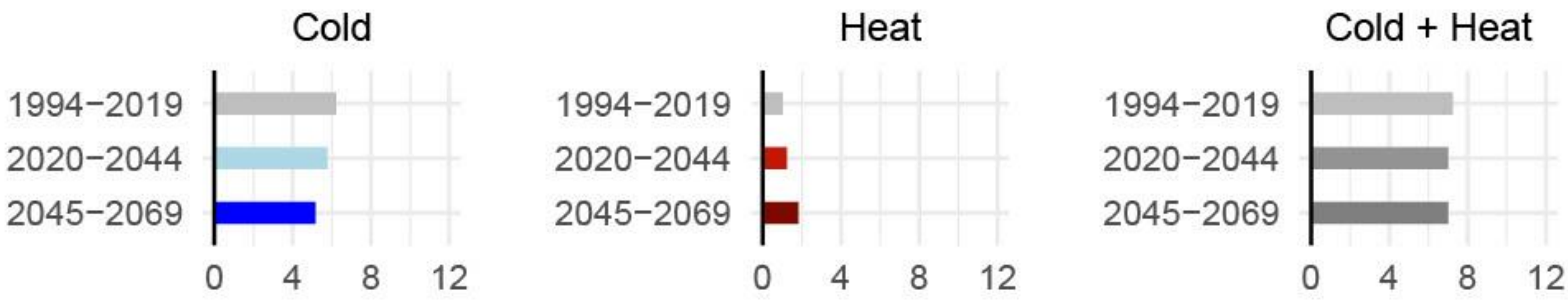
Temperature-mortality relationships for the municipalities of Brussels, 1992-2019

Pooled historical temperature-mortality relationship



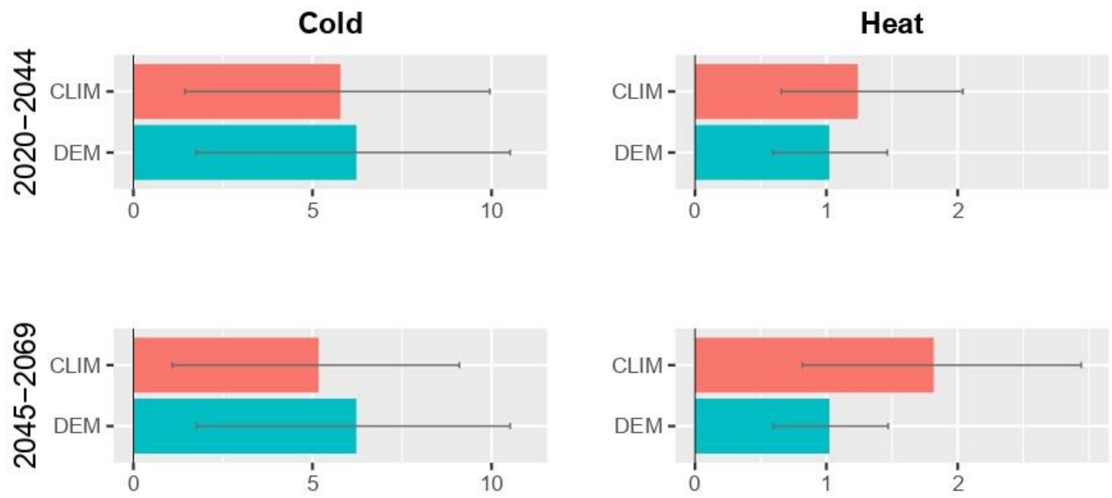
Pooled temperature-mortality relationship for Brussels, 1992-2019

Attributable fractions of death



Temperature-attributable fractions for the periods 1994-2019, 2020-2044, and 2045-2069

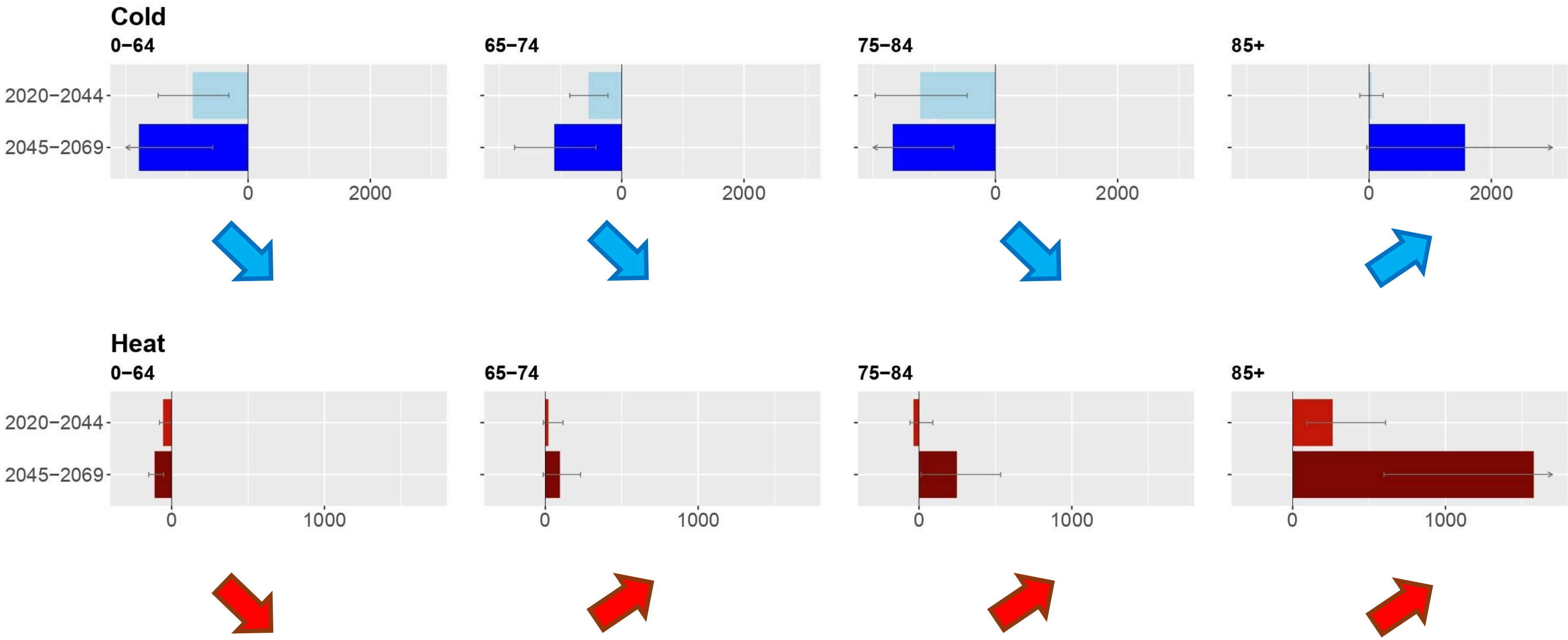
Contributions of climate and demography



Cold- and heat-attributable fractions of deaths in scenarios CLIM and DEM

Scenario CLIM includes climate changes but constant demography => effect of climate only
scenario DEM includes demographic changes but constant climate => effect of demography only

Age-stratified analyses



Attributable number of deaths - Difference with the reference period 1994-2019

Conclusions

Key messages - results

- ↘ in cold-related deaths but ↗ in heat-related deaths in the future

- Age stratified analyses, in contrast to other age groups :
  - ↗ in cold-related deaths for people > 85 yrs (↗ population)
  - ↘ in heat-related deaths for people ≤ 64 yrs (lower mortality rate)

- Larger impact of ***demography*** on future cold-attributable mortality
- Larger impact of ***climate*** on future heat-attributable mortality

Discussion

- Large uncertainties in predictions
- Constant temperature-mortality relationship throughout the study period ➡ no adaptation
- Same temperature-mortality relationship for all the age groups

For more details

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Original Research

The impact of climate and demographic changes on future mortality in Brussels, Belgium

C. Crouzier [a, b], B. Van Schaeybroeck [c], F. Duchêne [c], M. Duchêne [c], R. Hamdi [c], F. Kirakoya-Samadoulougou [b], C. Demoury [a, *]

[a] Sciensano, Risk and Health Impact Assessment, Brussels, Belgium
[b] Centre de Recherche en Epidémiologie, Biostatistique et Recherche Clinique, Ecole de Santé Publique, Université Libre de Bruxelles, Brussels, Belgium
[c] Royal Meteorological Institute of Belgium, Brussels, Belgium

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ABSTRACT

Objectives: City populations are particularly vulnerable to climate change, but it is difficult to reliably estimate the impact on health due to the lack of high-resolution data. We used recently developed regional climate model projections at kilometre resolution combined with demographic projections to estimate the future mortality burden associated with temperatures in the region of Brussels, Belgium.
Study design: The study incorporated a time-series analysis.
Methods: Based on quasi-Poisson regression with distributed-lag non-linear models for the historical temperature–mortality relationship, we derive the mortality burden for the near (2020–2044) and mid (2045–2069) future and disaggregated the contributions of demographic and climate changes.
Results: The cold-related attributable fraction of deaths is expected to decrease from 6.22% (95% empirical confidence interval: 1.76%; 10.52%) in 1994–2019 to 5.17% (1.08%; 9.09%) in 2045–2069, whereas for heat, this fraction will increase from 1.02% (0.59%; 1.47%) to 1.83% (0.82%; 2.96%), with contributions of both climate and demographic changes. In stratified analyses by age, we found that because of demographic changes, the number of cold-attributable deaths will increase for people aged above 85 years, with 6815 (95% empirical confidence interval: 1424; 12,003) deaths expected in 2045–2069 compared to 5245 (1462; 8867) deaths in 1994–2019. For people aged below 65 years, on the other hand, the number of heat-related deaths will decrease from 456 (265; 658) to 344 (154; 561) deaths.
Conclusions: Public health policies that especially target the elderly and the summer-time period are needed to limit the impact of climate change on health.

sciensano

Contact

Claire Demoury • claire.demoury@sciensano.be • +32 2 642 53 57

Projections of temperature-attributable number (AN) and fractions (AF) of deaths

Projected temperatures

$$AN = \left(1 - e^{-\left(f(Tproj,\theta) - f(MMT,\theta)\right)}\right) \times N$$

historical temperature-mortality relationship and its minimum mortality temperature

Total future number of deaths = yearly population x daily projected mortality rate

$$AF = \frac{AN}{Total\ number\ of\ deaths}$$