Changes in heat-attributable deaths in Prague, Czech Republic, over 1982–2019

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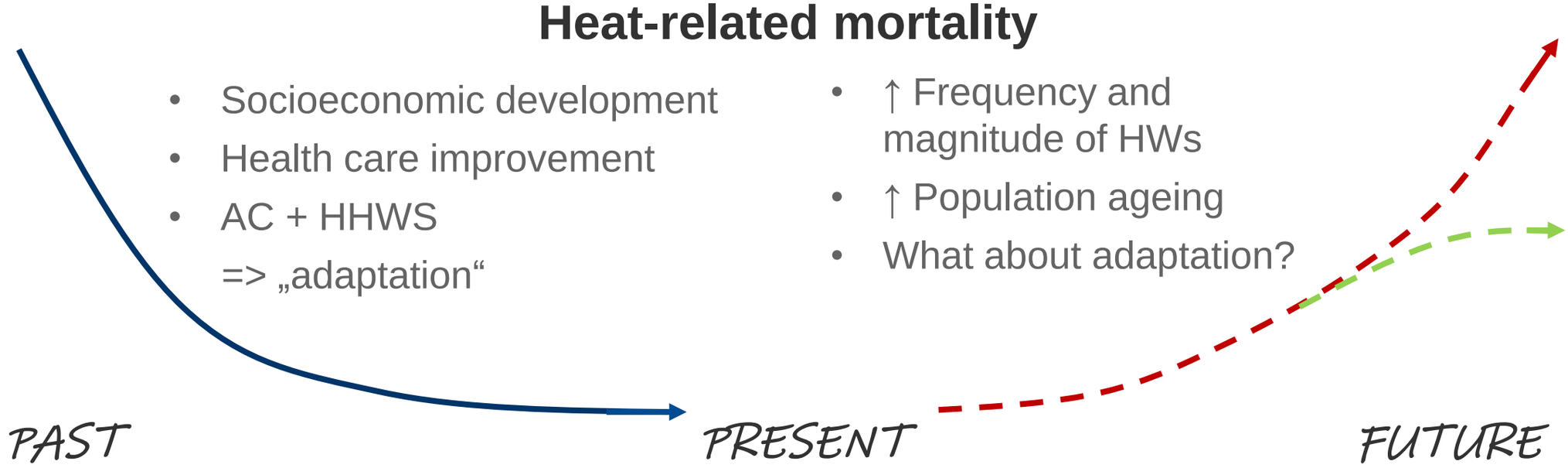
Motivation

- Heatwaves represent the major atmospheric hazard regarding the number of fatalities/excess deaths in Europe.
- In association with the climate change, increased frequency and magnitude of heatwaves are projected in Europe for the 21st century.
- Discrapancy between historical observations and future projections



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Data and goals

- **DATA:**
- 38 years of daily all-cause mortality data in Prague (1982–2019)
- Daily temperature (Tavg) records from Prague-Ruzyně airport
- **AIMS:**
- to analyse temporal changes in heat-related mortality over almost 4 decades
- Taking into account acclimatization to increasing temperature
- 5 warmest months (May–September) in 1980s, 1990s, 2000s, 2010s

Methods – R-package *dlnm*

- Conditional Poisson regression in Distributed Lag Non-linear Model (**DLNM**):

$$Log(\mu_t) = \alpha + \beta Crossbasis + \lambda Stratum_t$$

- *Crossbasis* = the non-linear and delayed effect of temperature (Gasparrini et al. 2015)
  - Tavg – a quadratic B-spline with one internal knot placed at the 75th percentile of season-specific temperature distributions.
  - Lag variable – a natural cubic B-spline with two internal knots placed at equally spaced values in the log scale; 10 day lag.
  - **Calculates the relative risk (RR) of mortality considering the lagged effect of Tavg up to 10 days**
- *Stratum* = indicator variable composed of year, month, and day of the week (Year:Month:DOW) to control for long-term and seasonal trends (Fonseca-Rodriguez et al. 2020)

Methods – R-package *FluMoDL*

- From RRs - attributable number of deaths (ADs) and the attributable fraction (AF %) of total May–September deaths on hot days were calculated for each decade and each year.
  (Gasparrini and Leone 2014)
- **Hot days** - daily mean temperature larger than the 95th percentile of the May-September Tavg distribution.
- Heat Wave Index (**HWI**) – sum of temperature deviations above the 95th percentile on hot days

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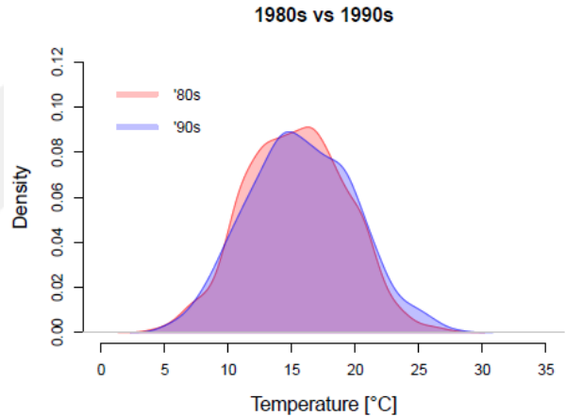
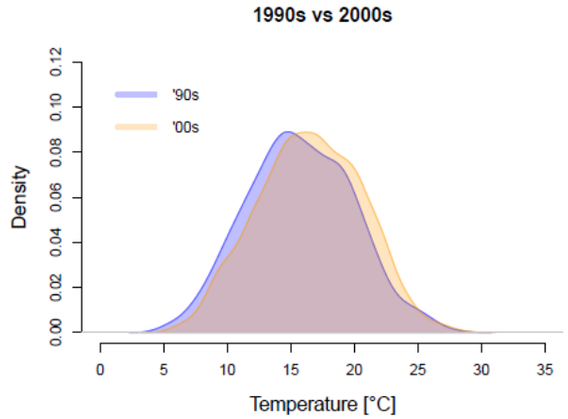
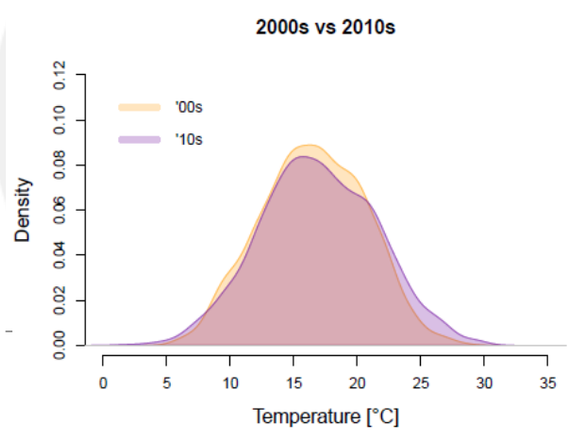
Results – increasing heatwave stress

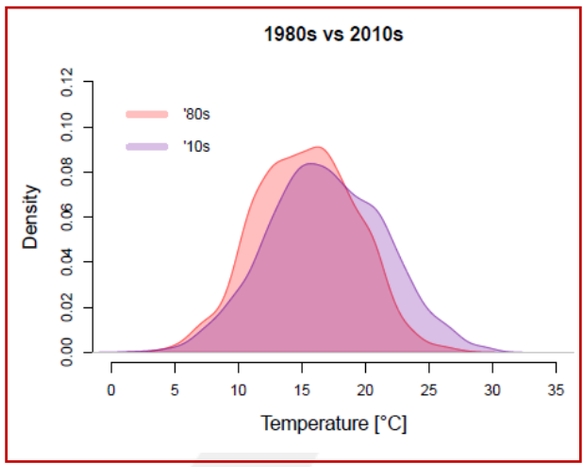
- Hot day = 95th percentile of daily mean temperature in Prague-Ruzyně, May-September 1982–2019 – 38 years
- Heatwave (HW) = at least 2 consecutive hot days

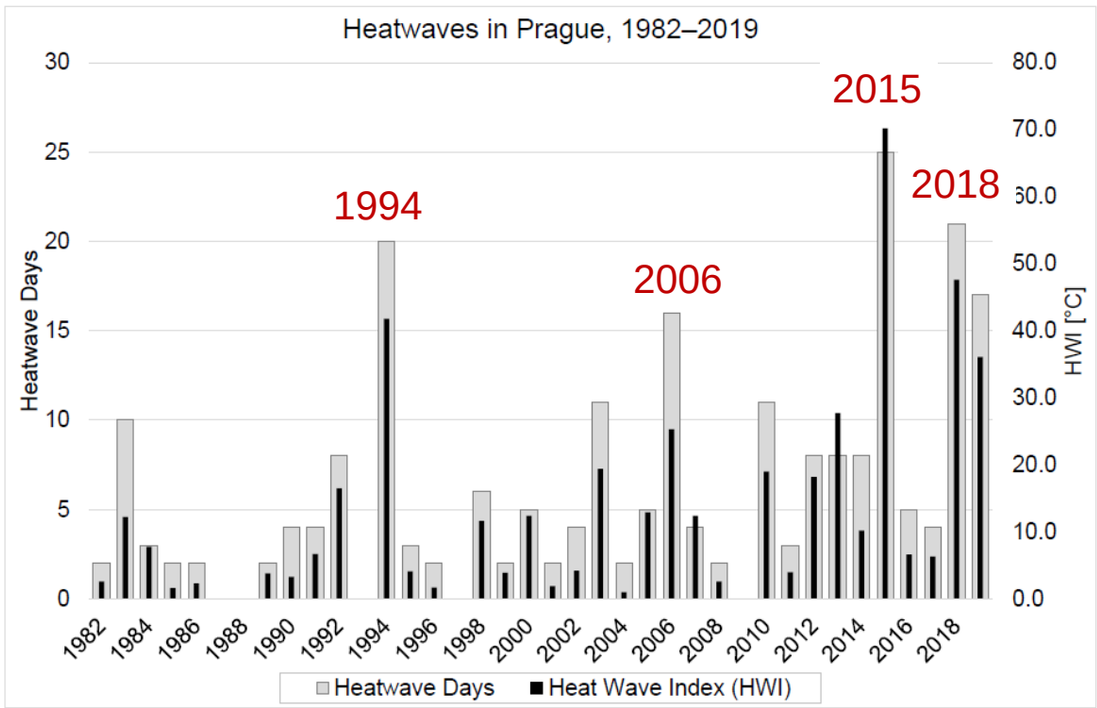
	Hot days	Mean length of HW (days)	HWs/year	T (°C)
1980s	29	2.6	1.3	15.3
1990s	62	5.1	1.9	15.7
2000s	73	5.1	1.9	16.5
2010s	***139***	***11.0***	***3.3***	***16.9***



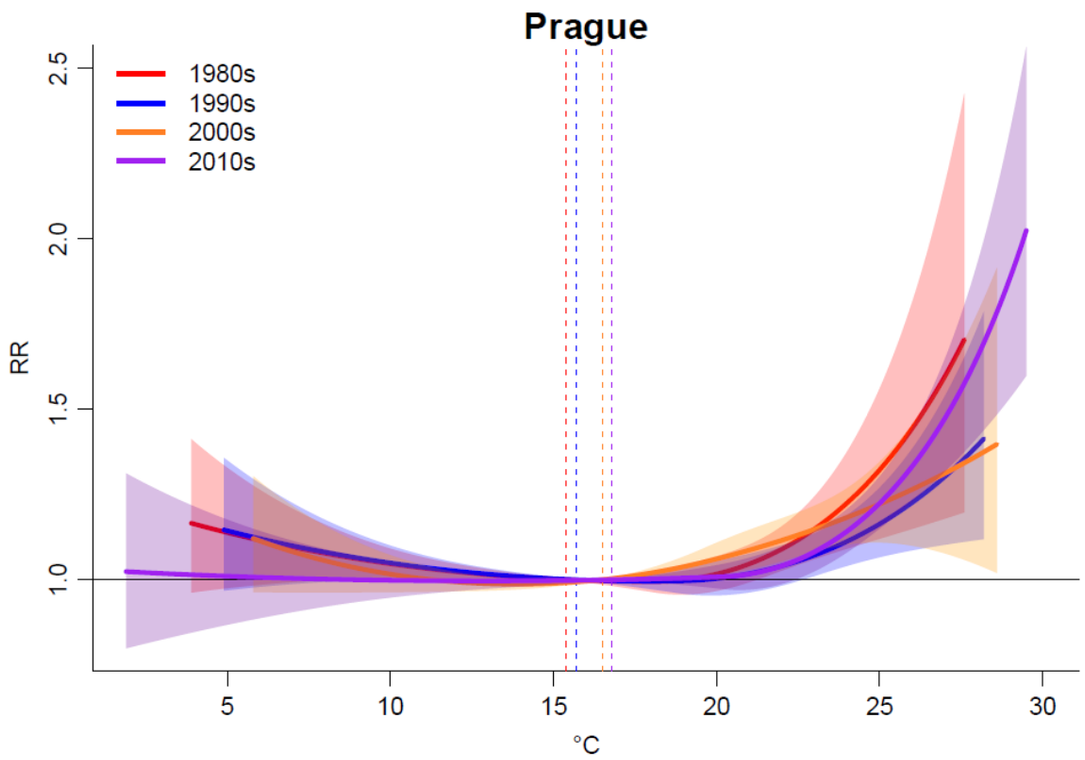


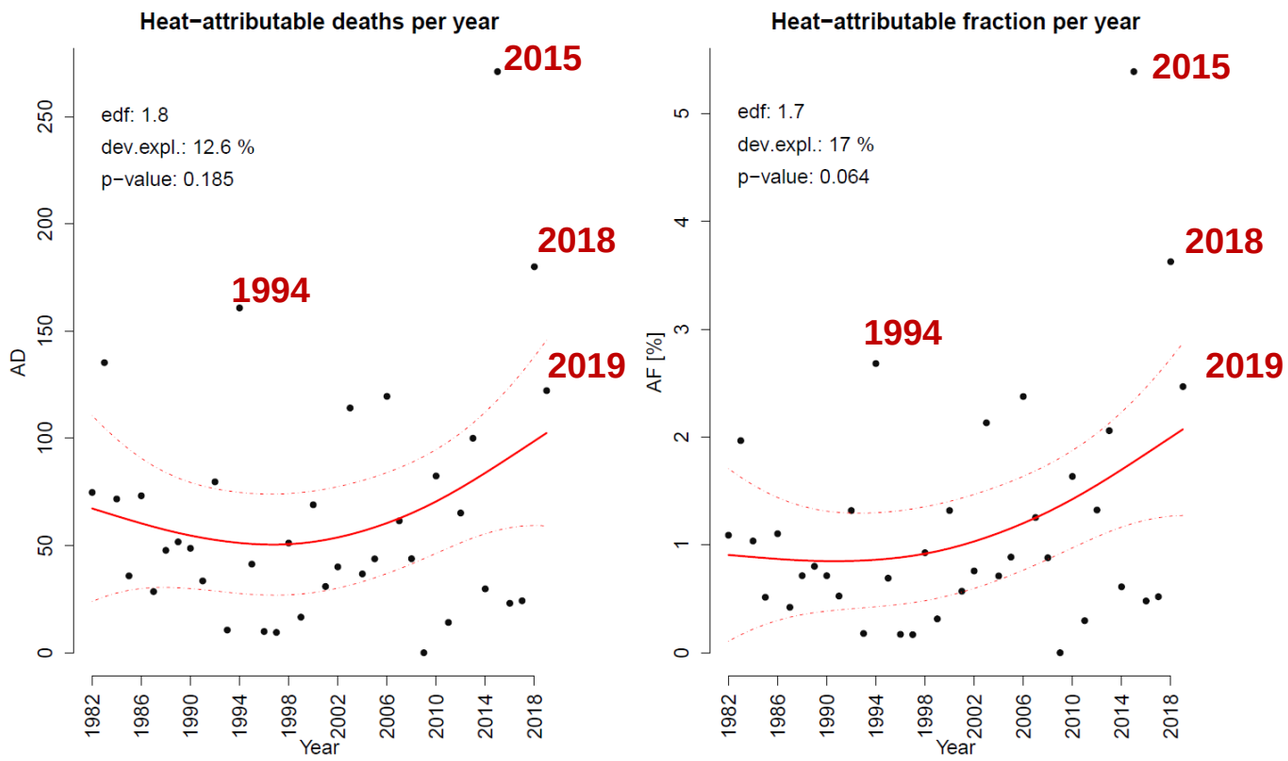






Results – reversal trend in heat-mortality





Smoothed (generalized additive model) trend estimates

- The risk of temperature-related mortality (RR) in summer months in Prague over the last four decades.
- Heat-attributable deaths = excess mortality calculated from RRs

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Results – summary

heat threshold defined for each decade separately!

	hot days	Tmean	HWI per year	RR (Q99)	AN per year	AF (%)
1980s	62	23.1	12	1.22 (1.09, 1.37)	61	0.90
1990s	79	24.3	15	***1.19 (1.08, 1.32)***	43	0.73
2000s	79	24.4	12	1.24 (1.11, 1.39)	53	1.03
2010s	88	25.8	16	***1.50 (1.33, 1.69)***	86	1.75

RR difference

Decades	**p-value**
90s vs 80s	0.83
00s vs 80s	0.80
10s vs 80s	0.06
00s vs 90s	0.55
10s vs 90s	***0.04***
10s vs 00s	0.08

- Increasing trend in the number of deaths attributable to heat.
- Maximum in the 2010s and minimum in the 1990s.
- The total number of heat-attributable deaths increased from ≈43 to almost 90 per year between the 1990s and the 2010s
- corresponds to the fraction of 0.73 and 1.75 %, respectively, of the total number of deaths in the May–September season.
- Reversal of heat-attributable mortality?

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IAP

Thanks for your attention!

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