Impact of temperature anomaly on the cardiovascular mortality rate of elderly in Taipei:

from seasonal forecast to health warning system

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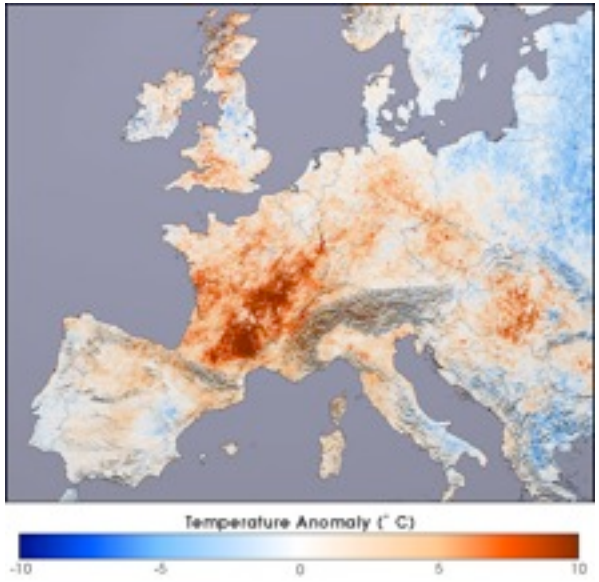
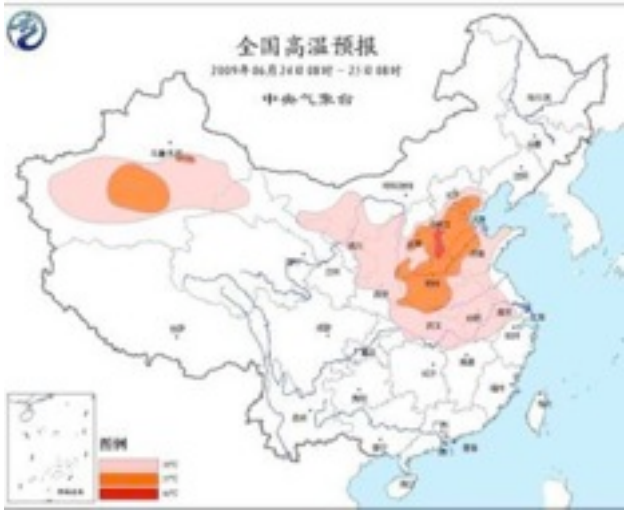
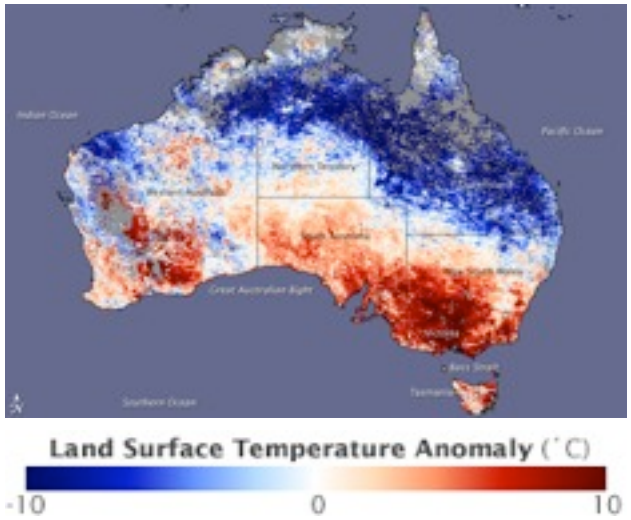






1995 Chicago Heat Wave

Kaiser et al. (2007)

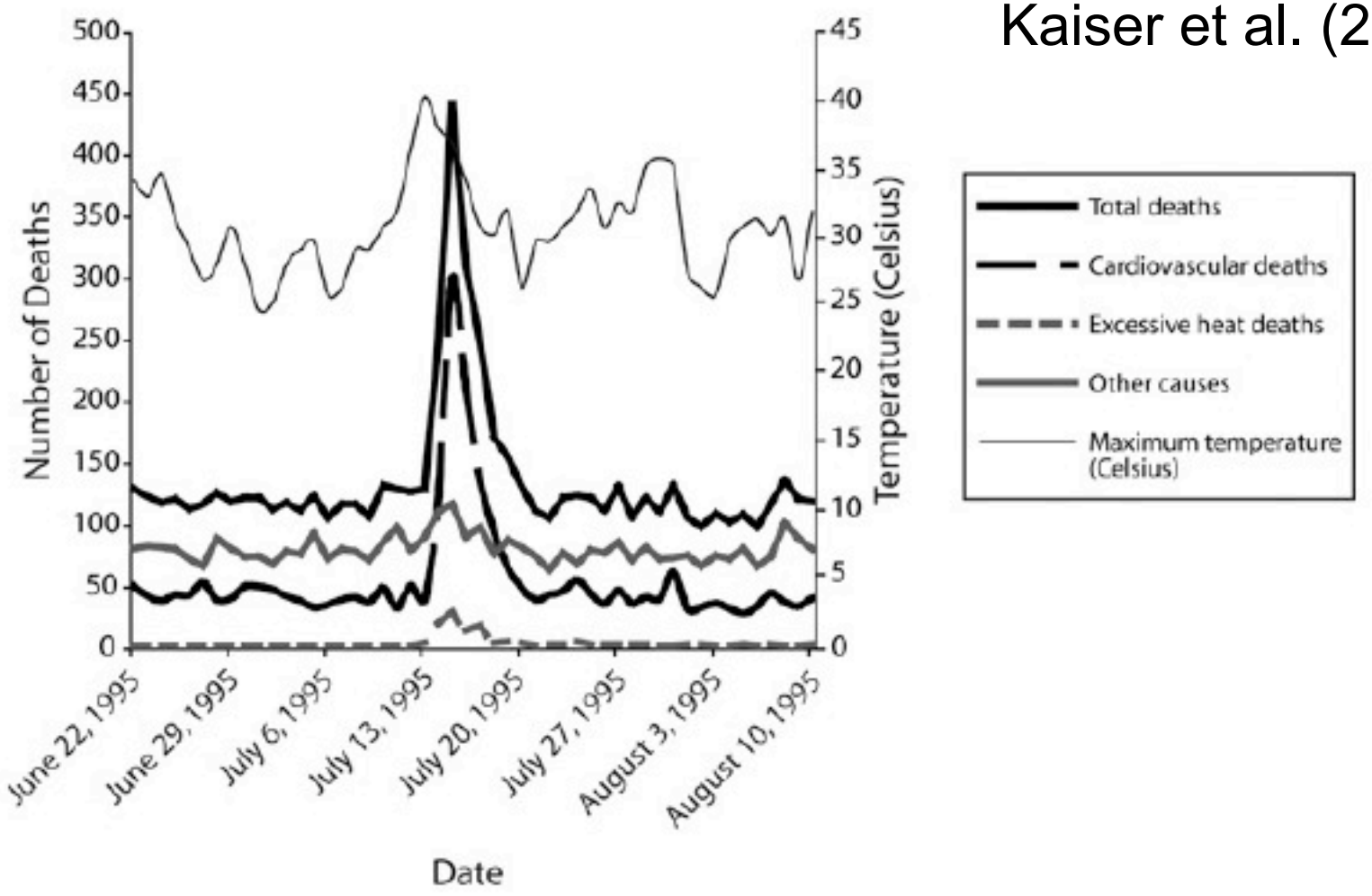
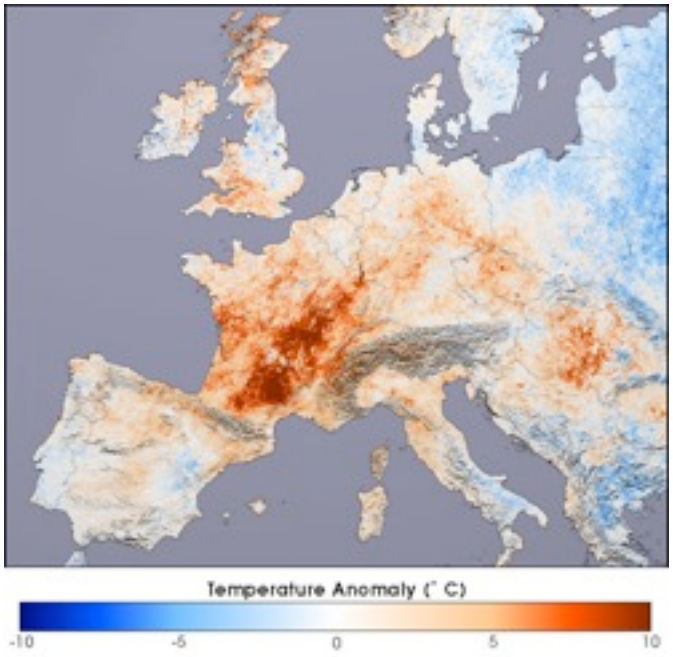
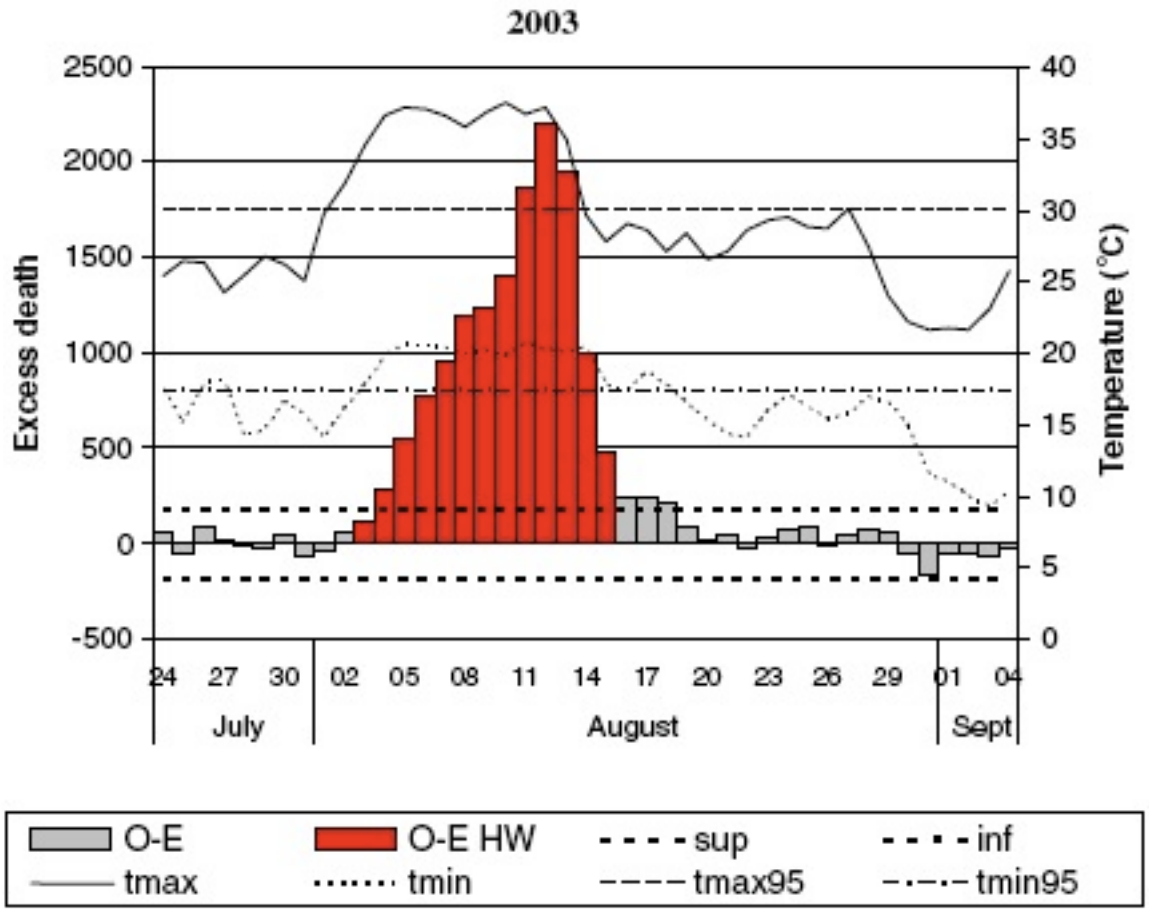


FIGURE 1— Daily number of deaths and maximum temperature during the Chicago heat wave: June 22, 1995–August 10, 1995.

2003 France Heat Wave



Rey et al. (2007)



Relationship between daily mortality and temperature

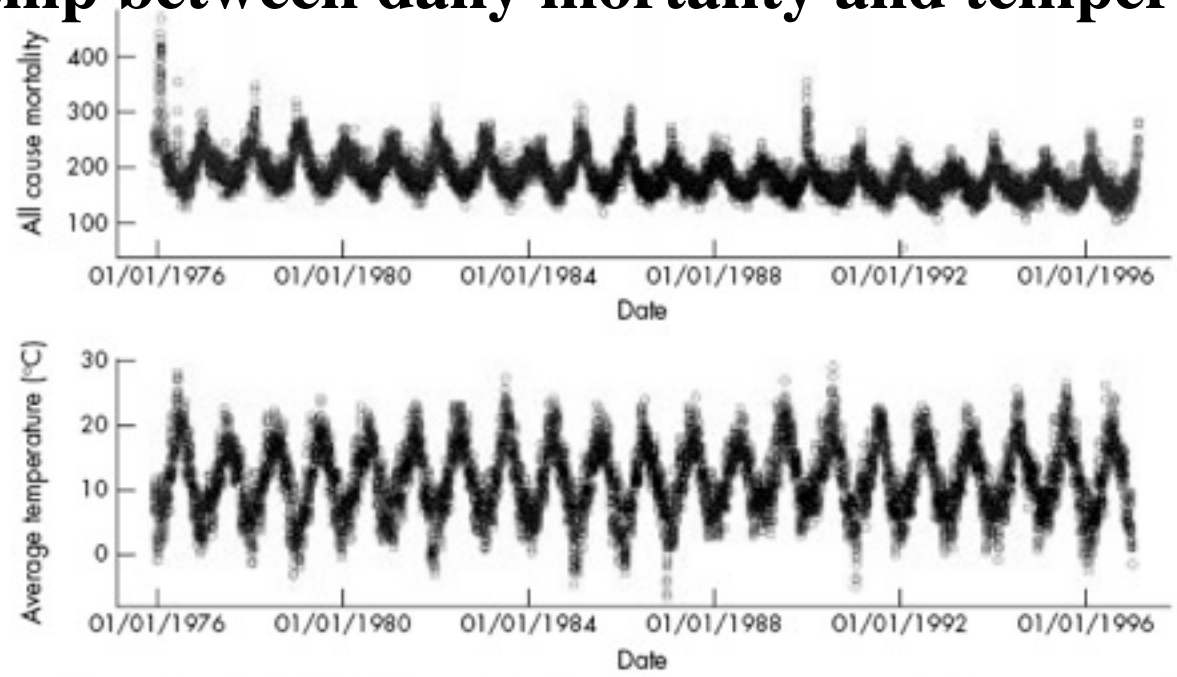


Figure 1 Time series of the total number of daily deaths and the daily average temperature in London between 1976 and 1996.

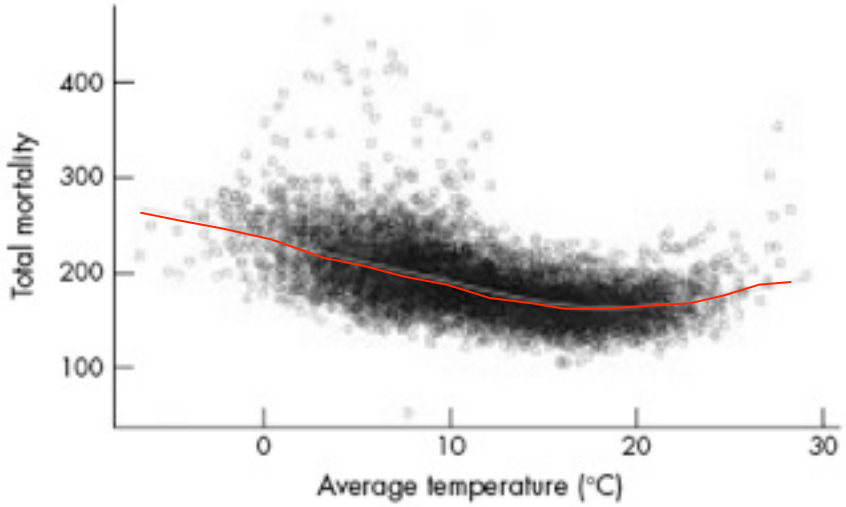


Figure 2 Plot of mortality against average temperature, with a 5df smoothing spline overlaid to help show the basic relation.

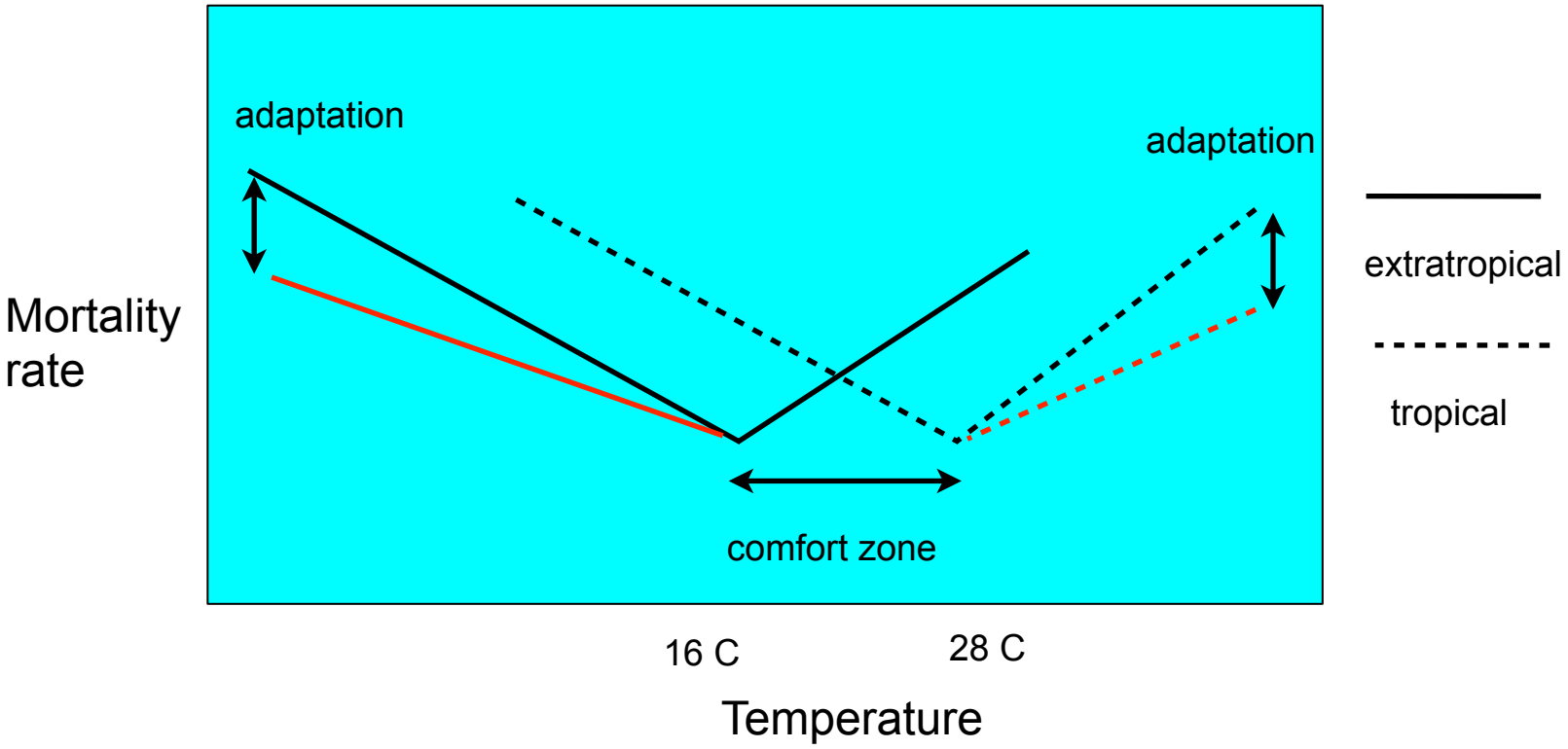
Hajat et al. (2002)

Patz et al. (2005) Nature (Review)

- Exposure to both extreme hot and cold weather is associated with increased morbidity and mortality, compared to an intermediate 'comfortable' temperature range.
- Heat mortality follows a V-shaped function with a steeper slope at higher temperatures. The comfortable or safest temperature range is closely related to mean temperature, with an upper bound from as low as 16.5℃ for the Netherlands and 19℃ for London, to as high as 29℃ in Taiwan

Regional difference due to local climate, socio-economic environments, and adaptation

Different adaptation methods applied:
Extratropical: Heating system
Tropical: Air-conditioner



Heat and mortality in Taipei Metropolitan Area

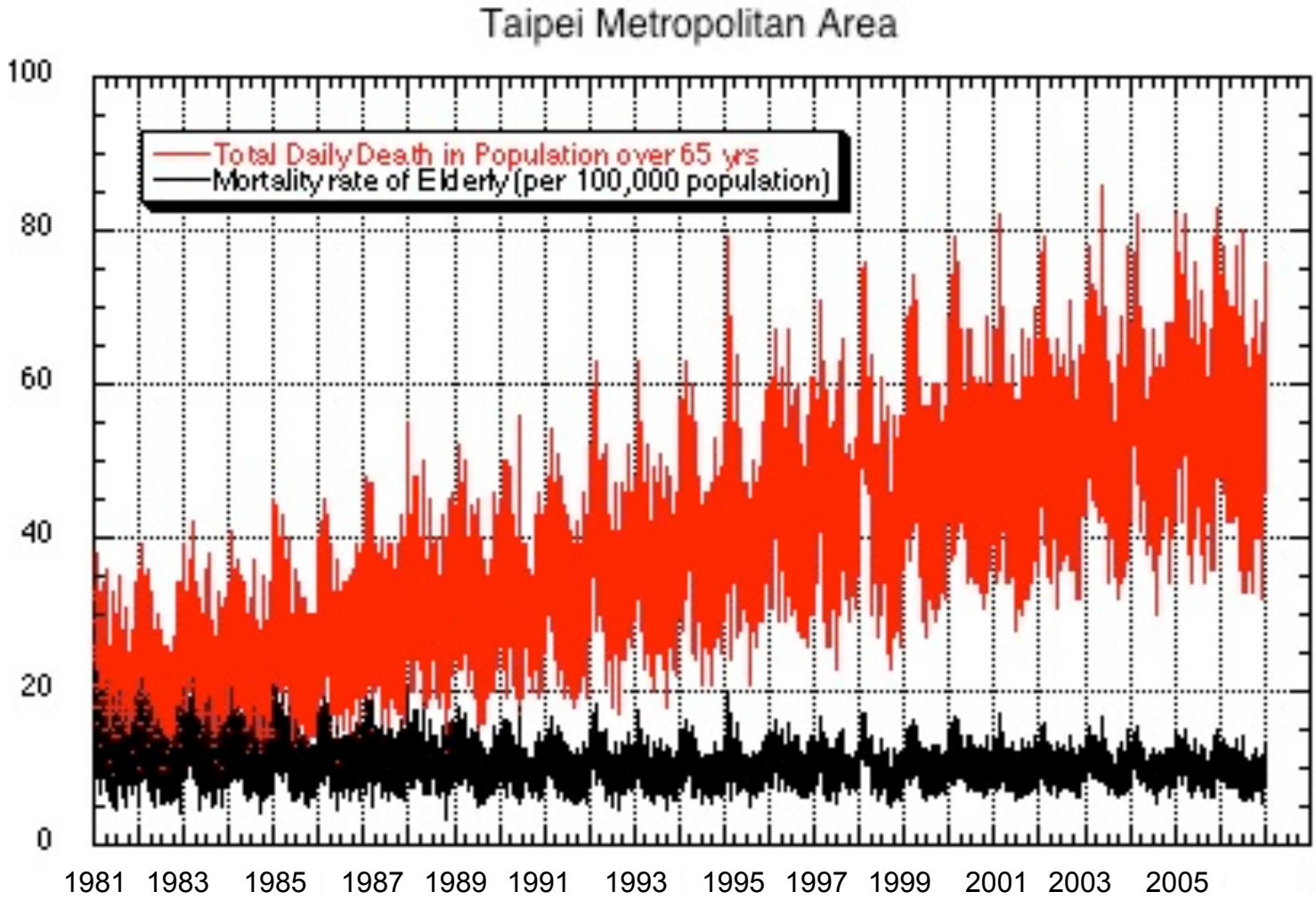
Objectives

- To study the temperature thresholds that lead to excessive daily mortality rate of elderly (> 65 years old) due to cardiovascular and respiratory diseases.
- To estimate the impact of heat waves and cold surges on the excessive daily mortality rate of elderly

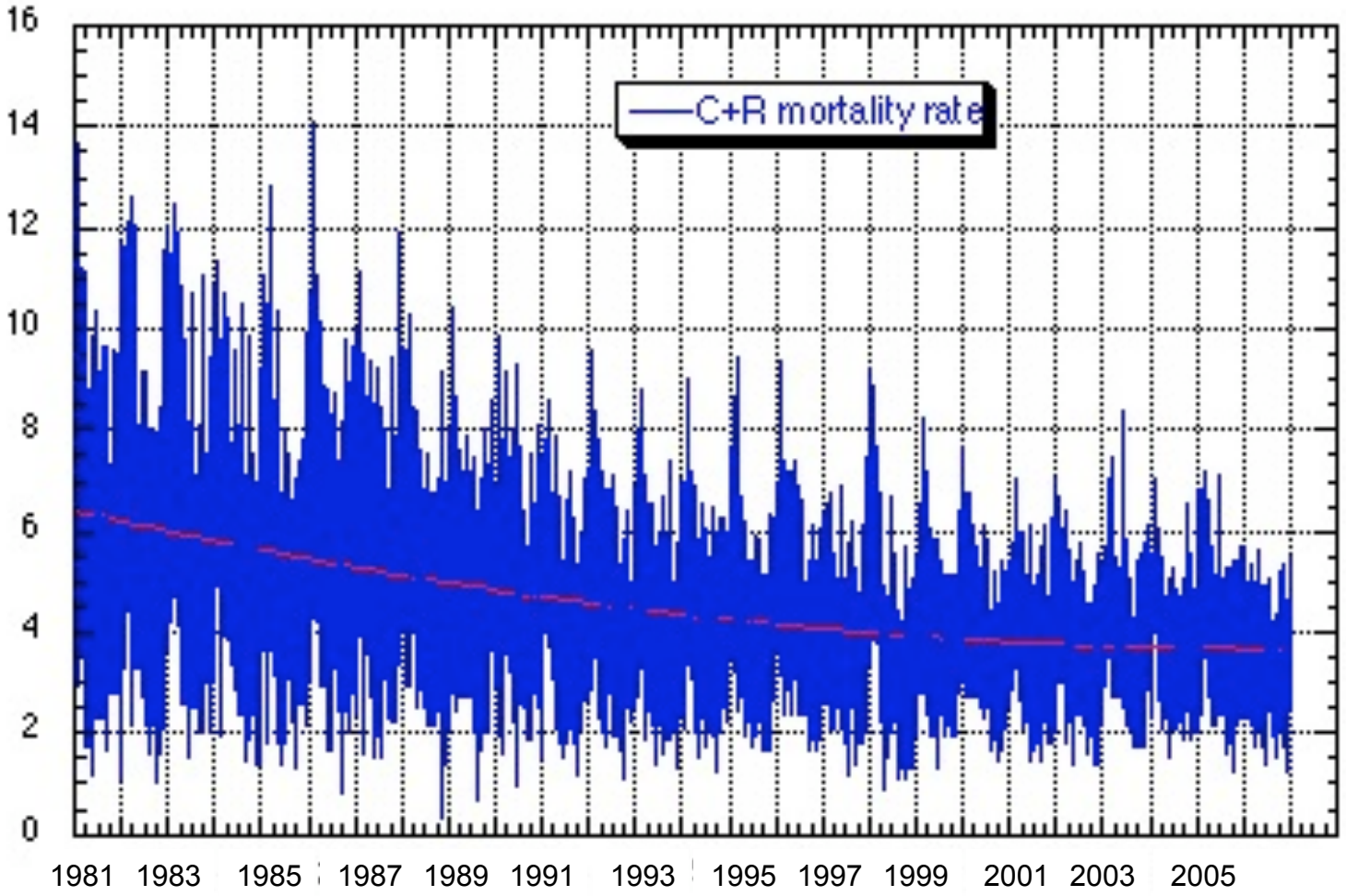
Data

- Daily deaths and population in Taipei metropolitan area by department of health: 1981-2006 (classified by ages, gender and cause of death) focused on death of elderly (> 65 years old) due to cardiovascular and respiratory diseases.
- Daily maximun, minimum temperature at Taipei station (also for 1981-2006 period)

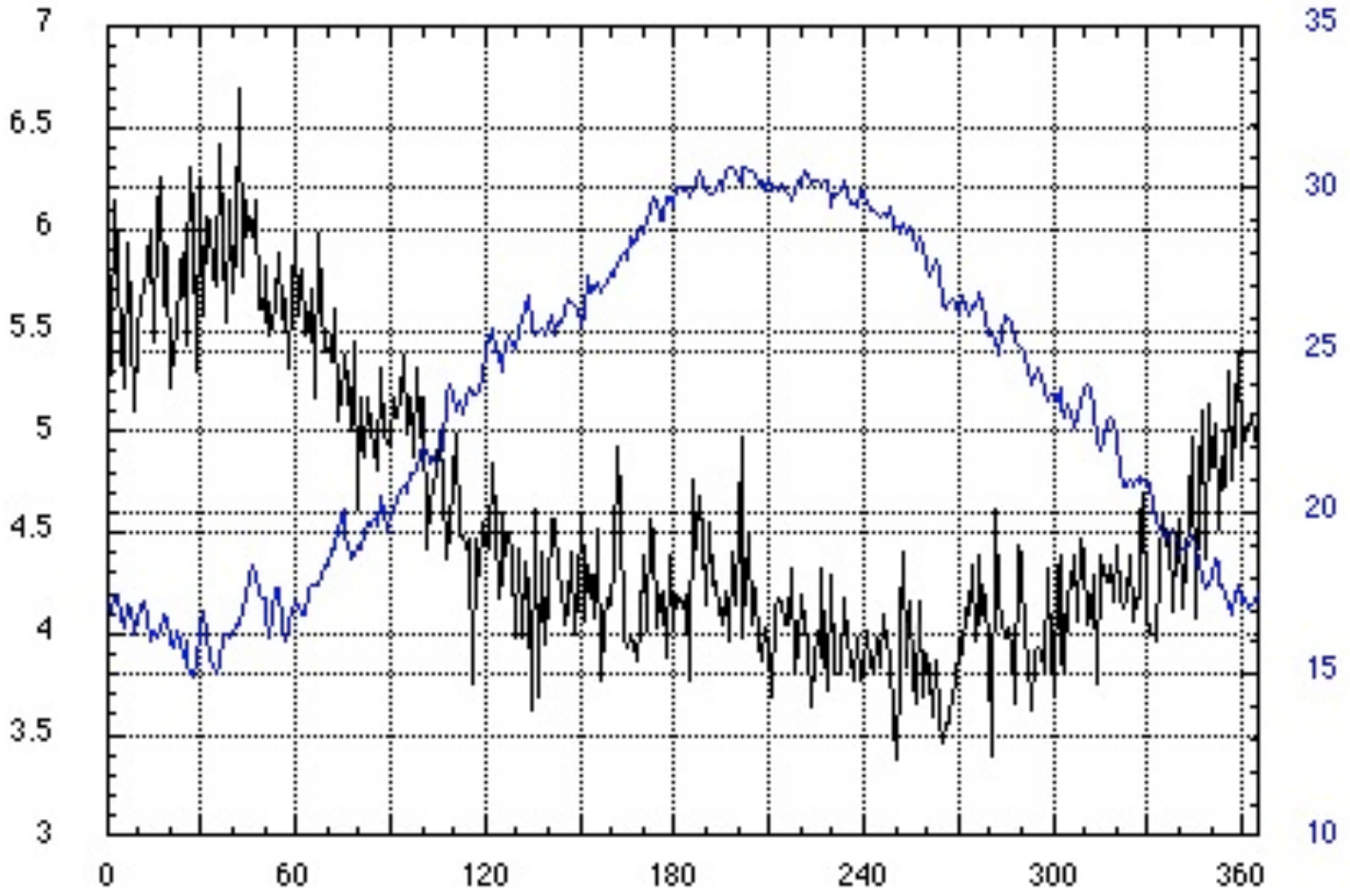
Total daily deaths (upper curve) and mortality rate (per 100,000) for persons > 65 years old, Taipei metropolitan Area



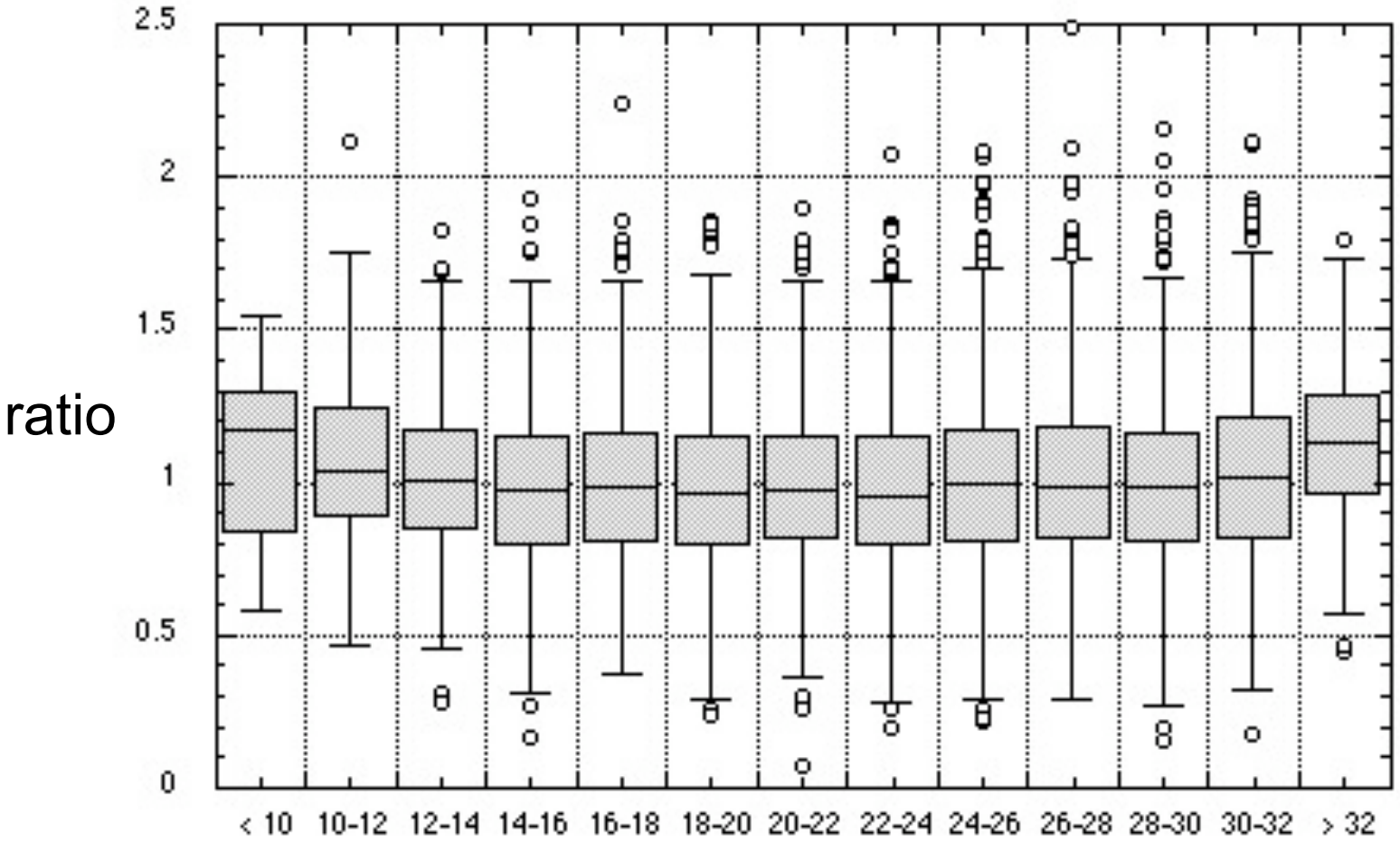
Remove the trend in cardiovascular and respiratory mortality rate (per 100,000) for persons > 65 years old



Seasonal cycle in mortality rate and temperature



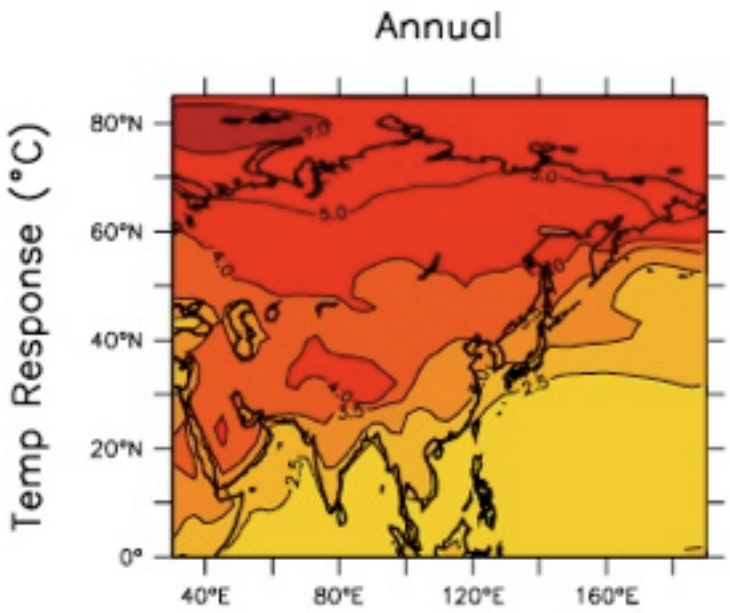
- Removed trend and seasonal cycle from mortality data to get the expected mortality rate
- Bin the ratio of daily observed and expected mortality rate in different mean daily temperature (yesterday's maximum and today's minimum)



IPCC AR4 SPM

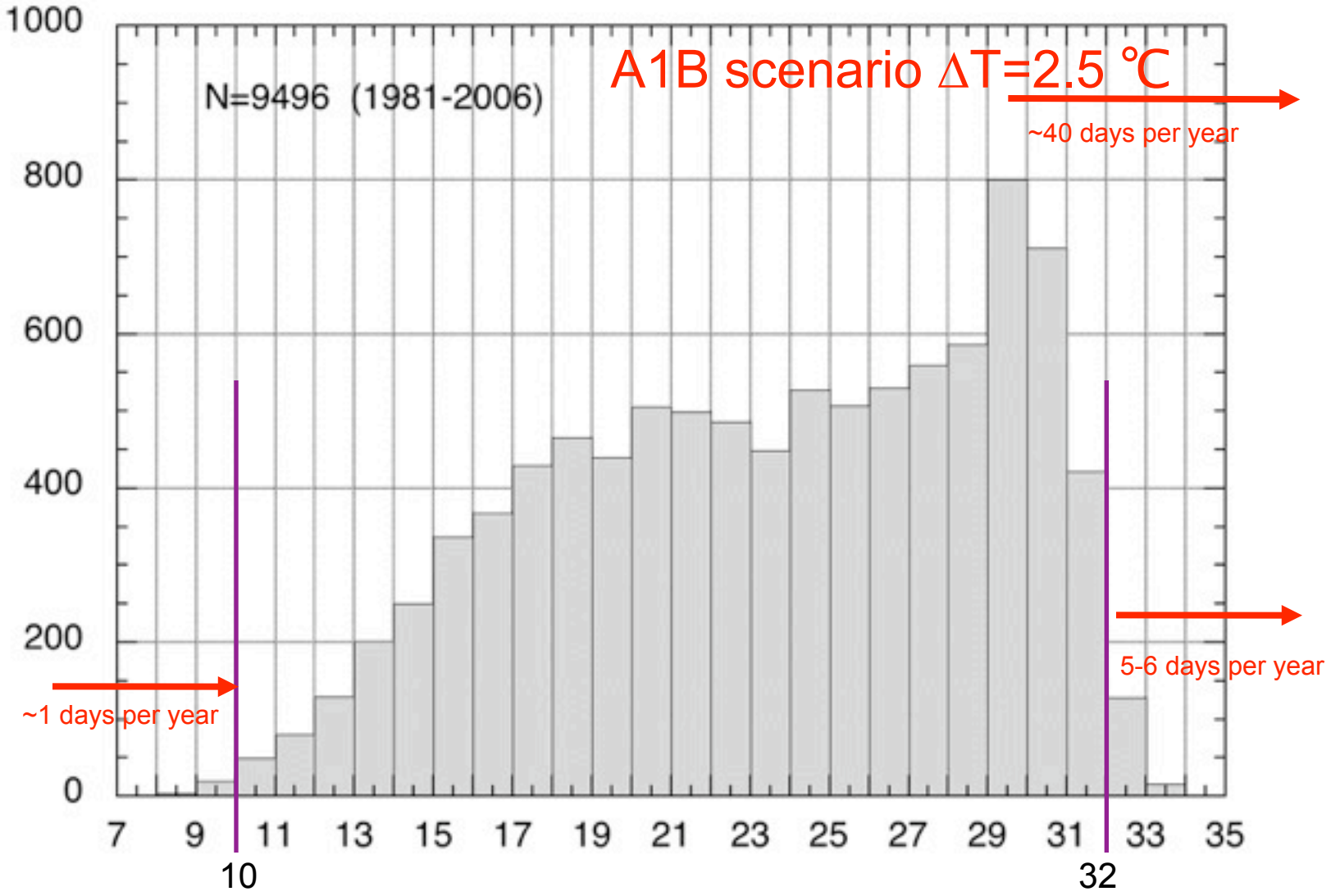
Table SPM.2. *Recent trends, assessment of human influence on the trend and projections for extreme weather events for which there is an observed late-20th century trend. (Tables 3.7, 3.8, 9.4; Sections 3.8, 5.5, 9.7, 11.2–11.9)*

Phenomenon[a] and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend[b]	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	*Very likely*[c]	*Likely*[d]	*Virtually certain*[d]
Warmer and more frequent hot days and nights over most land areas	*Very likely*[e]	*Likely (nights)*[d]	*Virtually certain*[d]
Warm spells/heat waves. Frequency increases over most land areas	*Likely*	*More likely than not*[f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas			*Very likely*
Area affected by droughts increases			*Likely*
Intense tropical cyclone activity increases			*Likely*
Increased incidence of extreme high sea level (excludes tsunamis)[g]			*Likely*[i]



Histogram: Taipei mean daily temperature

(yesterday's maximum and today's minimum)



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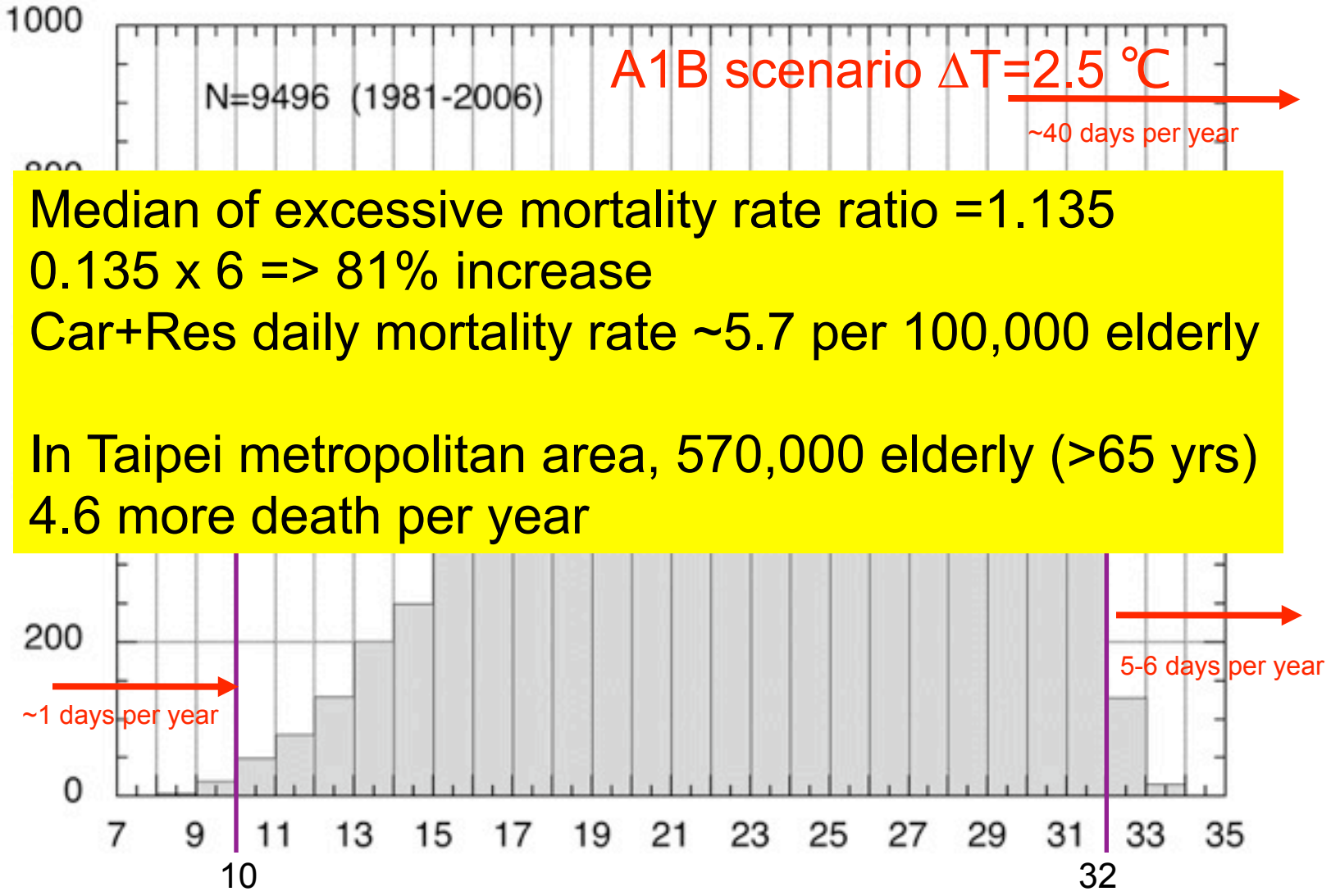

Median of excessive mortality rate ratio =1.135

0.135 x 6 => 81% increase

Car+Res daily mortality rate ~5.7 per 100,000 elderly

In Taipei metropolitan area, 570,000 elderly (>65 yrs)

4.6 more death per year

Concluding Remarks and Implication

- For Taipei metropolitan area (well adapted to heat waves, less to cold surges), the temperature thresholds for excessive mortality rate of elderly due to cardiovascular and respiratory disease are 32℃ and 10℃. A simple heat/ health warning system can be developed for extreme weather events such as heat wave and cold surge.
- Seasonal forecast of well-above or well-below normal temperature can still provide guideline to link extreme weather based on current observation statistics.
- More than 10% of excessive mortality rate are found in extreme warm or cold condition. For future climate change projection, the extreme warm conditions are expected to be much more frequent and lead to large increase in the health risk.