

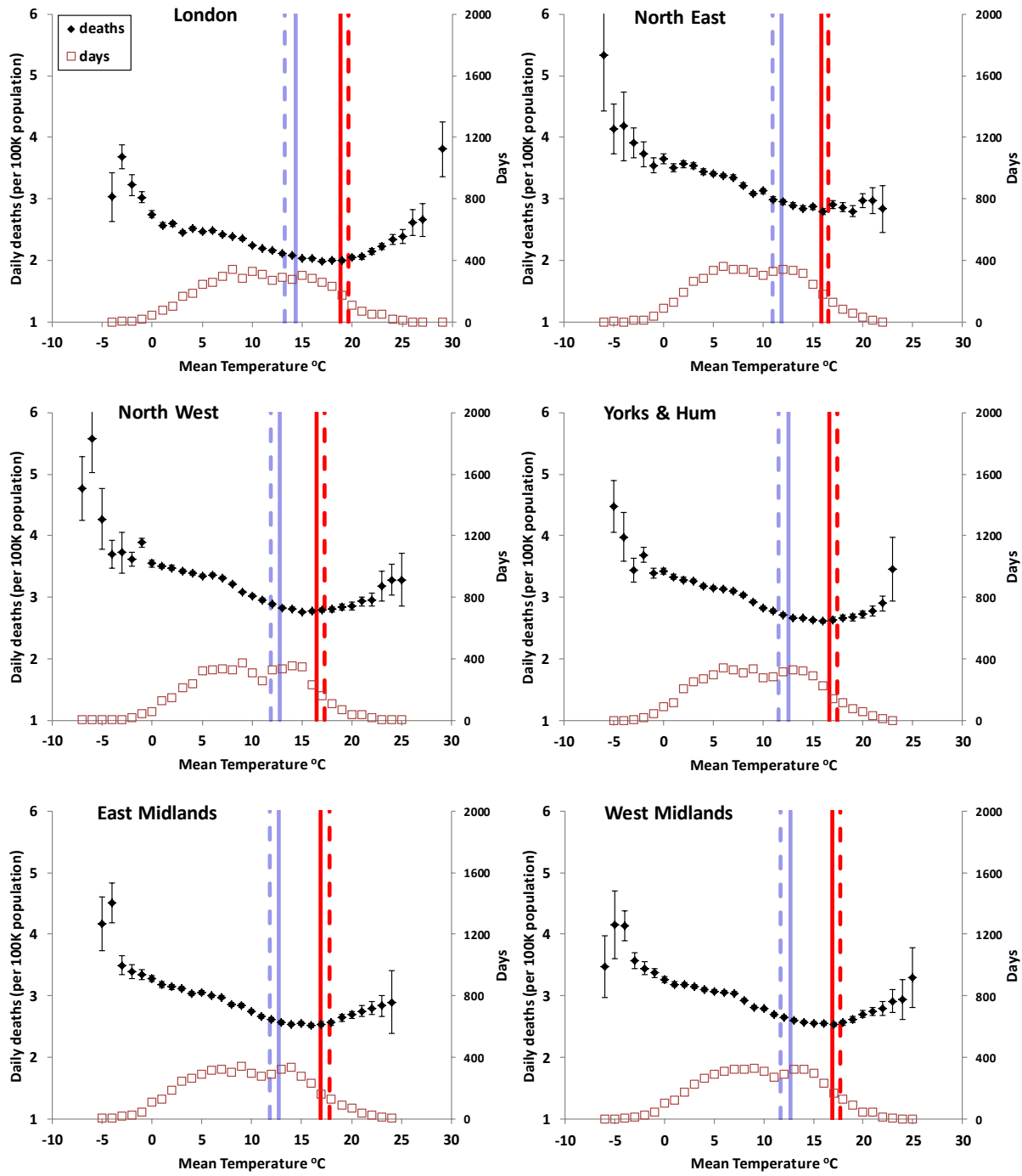
## **Supplemental Materials**

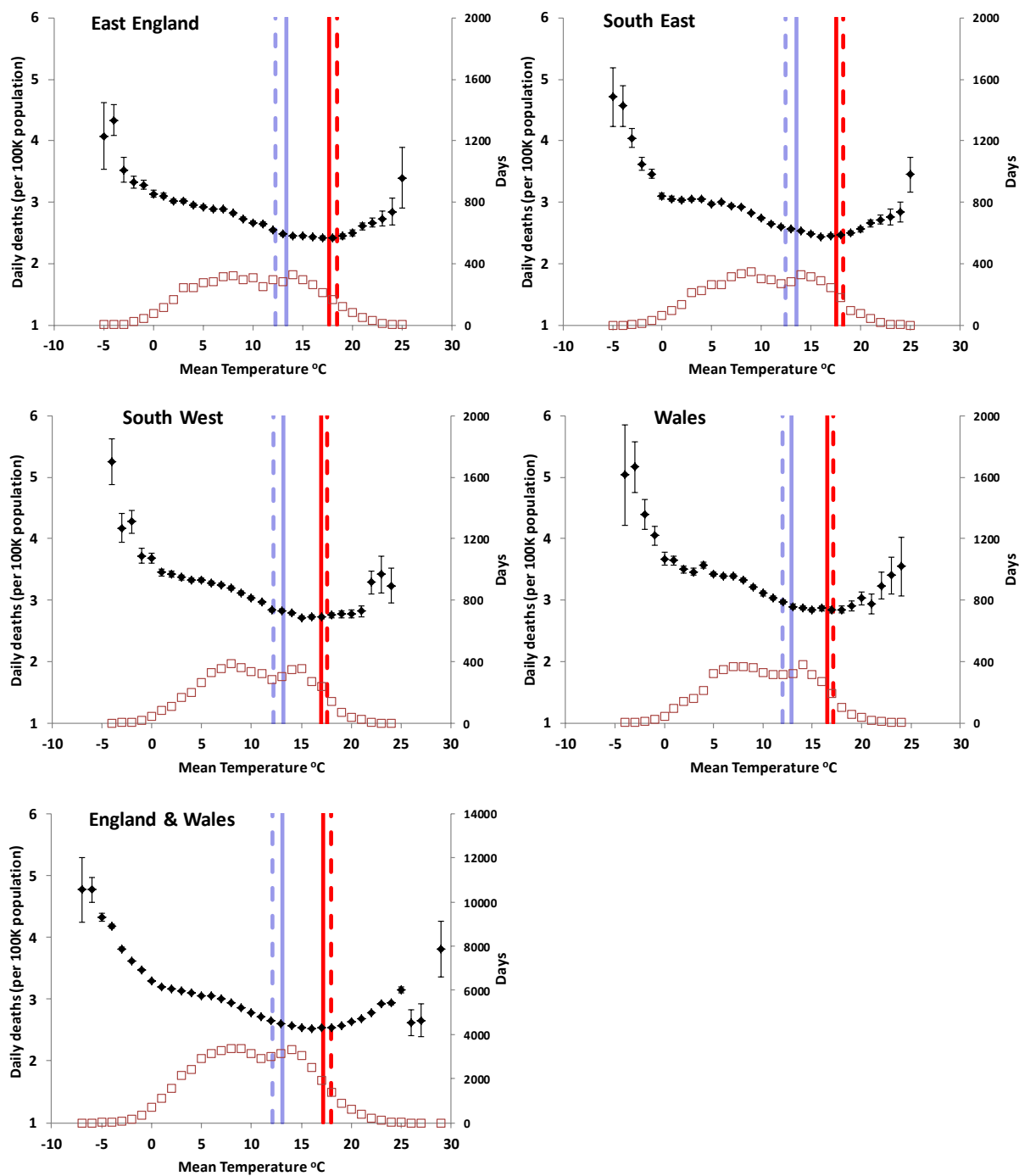
### **Comparative Assessment of the Effects of Climate Change on Heat- and Cold-Related Mortality in the United Kingdom and Australia**

Sotiris Vardoulakis, Keith Dear, Shakoor Hajat, Clare Heaviside, Bernd Eggen, and Anthony J.

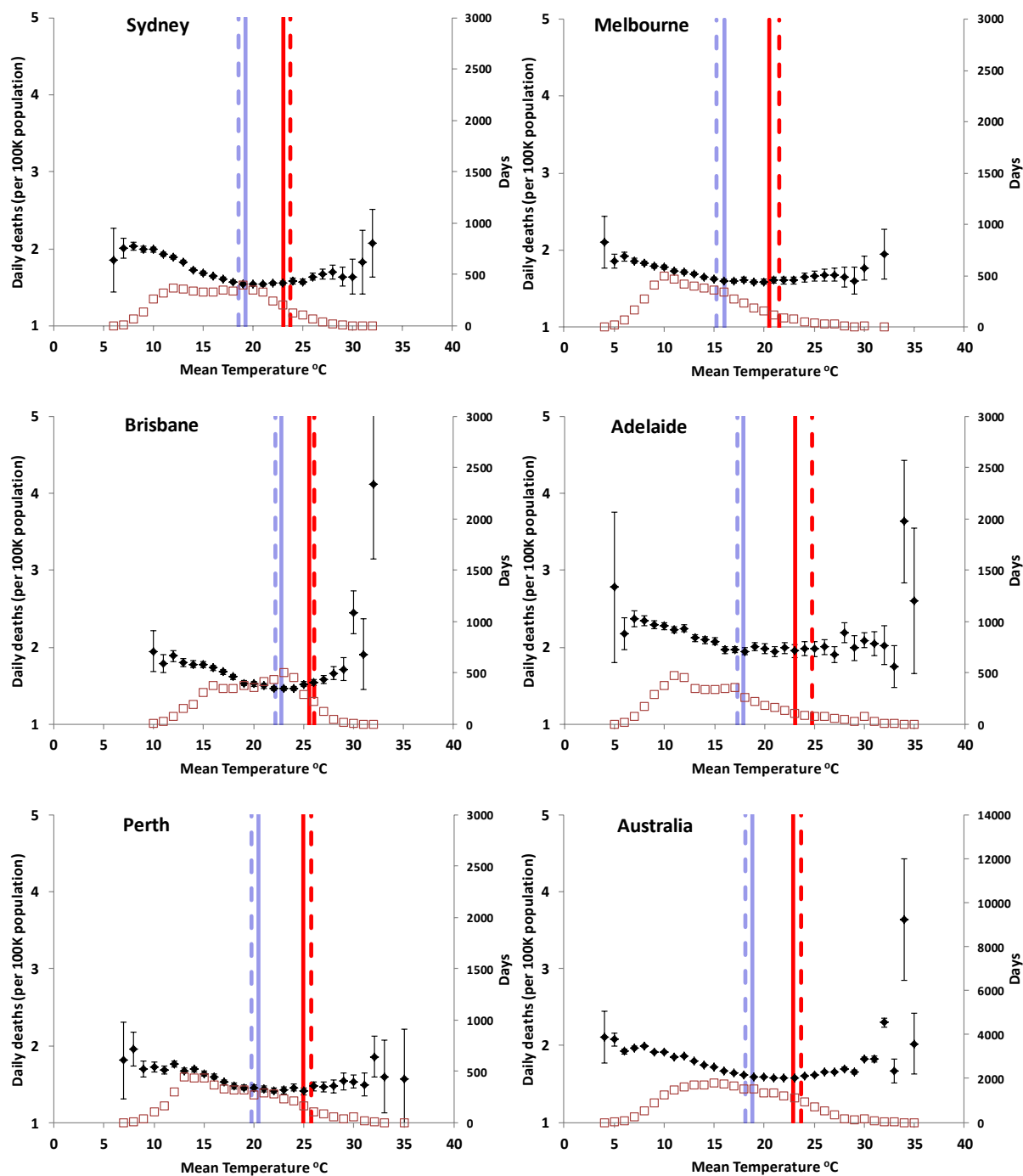
McMichael\*

\*Deceased

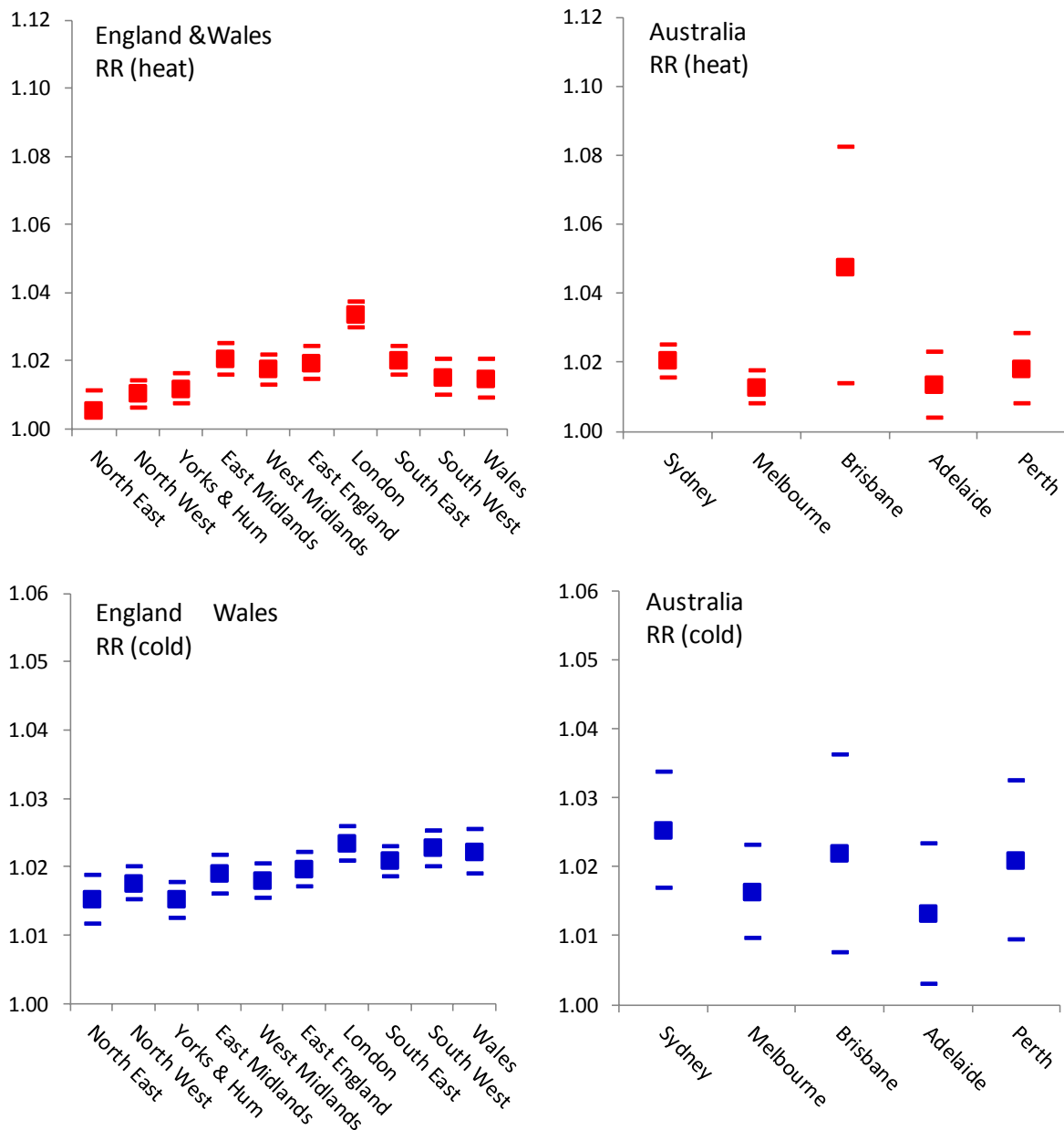




**Figure S1.** Mean daily deaths (per 100,000 population) and aggregate number of days associated with daily mean temperature in England and Wales regions. Cold and hot temperature thresholds are indicated: (a) 60<sup>th</sup> percentile (average of lags 0–27) and 93<sup>rd</sup> percentile (average of lags 0–1) of daily mean temperatures (**dashed lines**); (b) 65<sup>th</sup> percentile (average of lags 0–27) and 90<sup>th</sup> percentile (average of lags 0–1) of daily mean temperatures (**continuous lines**).



**Figure S2.** Mean daily deaths (per 100,000 population) and aggregate number of days associated with daily mean temperature in Australian cities. Cold and hot temperature thresholds are indicated: (a) 60<sup>th</sup> percentile (average of lags 0–27) and 93<sup>rd</sup> percentile (average of lags 0–1) of daily mean temperatures (**dashed lines**); (b) 65<sup>th</sup> percentile (average of lags 0–27) and 90<sup>th</sup> percentile (average of lags 0–1) of daily mean temperatures (**continuous lines**).



**Figure S3.** England and Wales region (left) or Australian city (right) estimated relative risks and 95% confidence intervals for all-cause mortality due to heat (top, temperature threshold: 90<sup>rd</sup> percentile, lags 0–1) and cold (bottom, temperature threshold: 65<sup>th</sup> percentile, lags 0–27) for all ages. The RRs were derived from time-series regression analyses assuming Poisson variation with scale overdispersion. Heat and cold effects were estimated separately.

**Table S1.** Estimated relative risks and 95% confidence intervals for all-cause mortality due to cold and hot weather for different age groups in England and Wales regions and Australian cities for two sets of temperature thresholds: 60<sup>th</sup> and 93<sup>rd</sup> percentiles; and 65<sup>th</sup> and 90<sup>th</sup> percentiles.

<b>Location and age group</b>	<b>Cold (&lt; 60th %ile) RR (95% CI)</b>	<b>Heat (&gt; 93rd %ile) RR (95% CI)</b>	<b>Cold (&lt; 65th %ile) RR (95% CI)</b>	<b>Heat (&gt; 90rd %ile) RR (95% CI)</b>
<b>UK</b>				
<i>All ages</i>				
North East	1.016 (1.012, 1.019)	1.012 (1.005, 1.019)	1.015 (1.012, 1.019)	1.006 (1.000, 1.011)
North West	1.018 (1.016, 1.021)	1.016 (1.012, 1.020)	1.018 (1.015, 1.020)	1.010 (1.006, 1.014)
Yorks & Hum	1.016 (1.013, 1.019)	1.020 (1.015, 1.026)	1.015 (1.012, 1.018)	1.012 (1.007, 1.017)
East Midlands	1.020 (1.017, 1.023)	1.029 (1.023, 1.034)	1.019 (1.016, 1.022)	1.021 (1.016, 1.025)
West Midlands	1.018 (1.016, 1.021)	1.025 (1.020, 1.030)	1.018 (1.015, 1.021)	1.017 (1.013, 1.022)
East England	1.020 (1.018, 1.023)	1.028 (1.023, 1.034)	1.020 (1.017, 1.022)	1.020 (1.015, 1.024)
London	1.024 (1.022, 1.027)	1.045 (1.040, 1.049)	1.024 (1.021, 1.026)	1.034 (1.030, 1.038)
South East	1.021 (1.019, 1.024)	1.030 (1.025, 1.034)	1.021 (1.019, 1.023)	1.020 (1.016, 1.024)
South West	1.021 (1.019, 1.024)	1.024 (1.018, 1.029)	1.023 (1.020, 1.025)	1.015 (1.010, 1.021)
Wales	1.023 (1.019, 1.026)	1.021 (1.015, 1.027)	1.022 (1.019, 1.026)	1.015 (1.009, 1.020)
<i>0-64</i>				
North East	1.007 (0.999, 1.015)	0.997 (0.981, 1.013)	1.006 (0.998, 1.014)	0.992 (0.981, 1.004)
North West	1.009 (1.004, 1.014)	1.014 (1.005, 1.023)	1.008 (1.003, 1.013)	1.012 (1.005, 1.019)
Yorks & Hum	1.003 (0.997, 1.009)	1.005 (0.992, 1.017)	1.002 (0.996, 1.008)	1.002 (0.993, 1.011)
East Midlands	1.011 (1.005, 1.018)	1.018 (1.005, 1.031)	1.011 (1.004, 1.017)	1.011 (1.002, 1.021)
West Midlands	1.007 (1.002, 1.013)	1.018 (1.007, 1.028)	1.007 (1.001, 1.012)	1.015 (1.007, 1.024)
East England	1.010 (1.004, 1.016)	1.022 (1.009, 1.035)	1.009 (1.003, 1.014)	1.014 (1.004, 1.023)
London	1.012 (1.007, 1.017)	1.028 (1.019, 1.037)	1.011 (1.006, 1.016)	1.022 (1.015, 1.029)
South East	1.011 (1.007, 1.016)	1.015 (1.004, 1.025)	1.009 (1.004, 1.014)	1.009 (1.001, 1.017)
South West	1.015 (1.008, 1.021)	1.008 (0.994, 1.022)	1.013 (1.006, 1.019)	1.006 (0.995, 1.017)
Wales	1.007 (1.000, 1.015)	1.000 (0.985, 1.015)	1.006 (0.999, 1.014)	1.001 (0.990, 1.013)

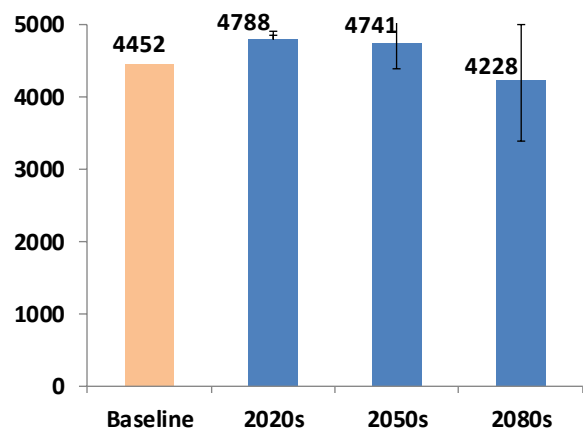
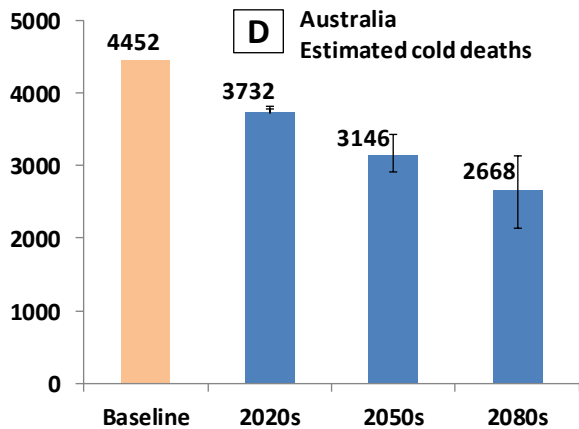
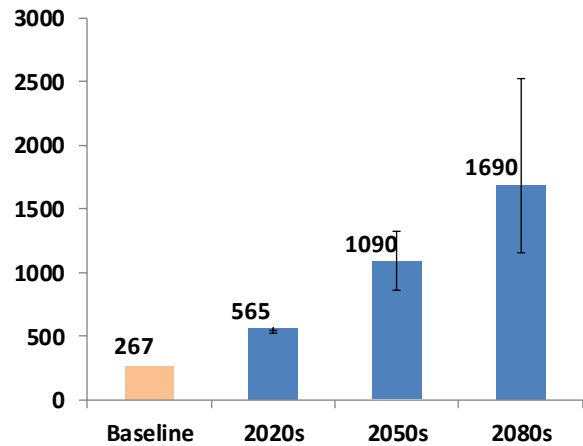
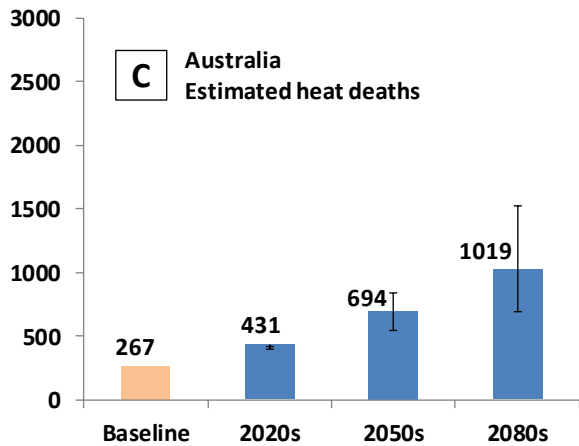
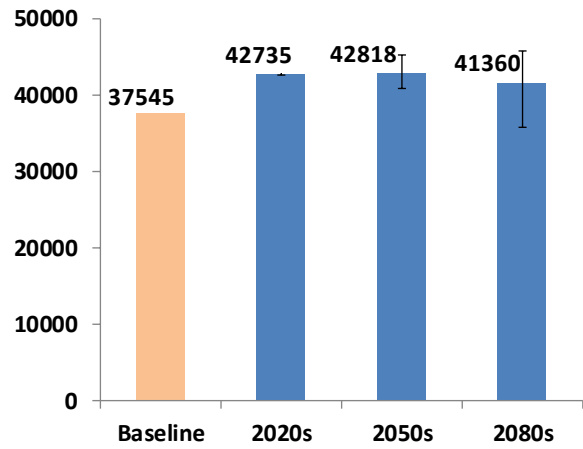
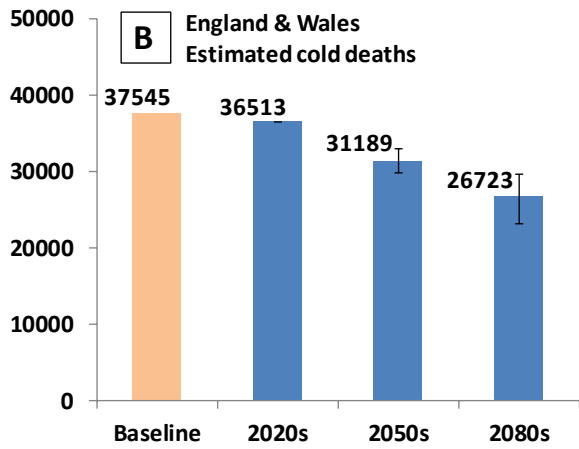
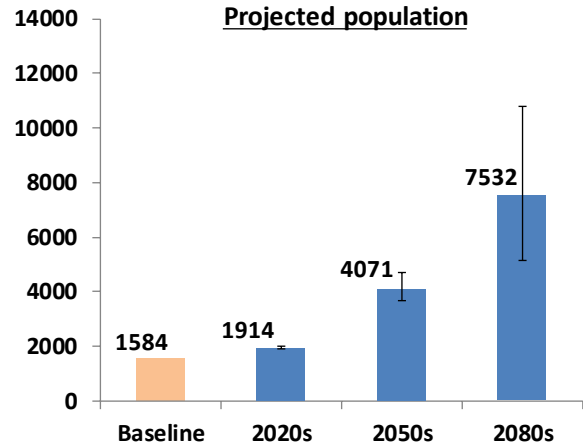
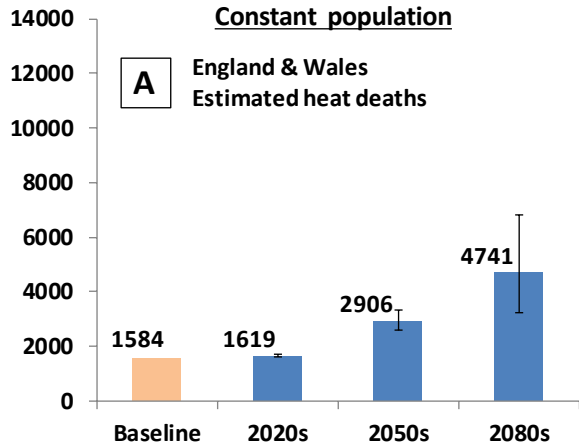
<b>Location and age group</b>	<b>Cold (&lt; 60th %ile) RR (95% CI)</b>	<b>Heat (&gt; 93rd %ile) RR (95% CI)</b>	<b>Cold (&lt; 65th %ile) RR (95% CI)</b>	<b>Heat (&gt; 90rd %ile) RR (95% CI)</b>
<b>65-74</b>				
North East	1.015 (1.008, 1.022)	1.021 (1.007, 1.036)	1.015 (1.008, 1.022)	1.012 (1.001, 1.023)
North West	1.013 (1.009, 1.018)	1.006 (0.997, 1.015)	1.013 (1.008, 1.017)	1.004 (0.997, 1.011)
Yorks & Hum	1.019 (1.013, 1.024)	1.024 (1.013, 1.036)	1.017 (1.012, 1.022)	1.011 (1.003, 1.019)
East Midlands	1.012 (1.006, 1.017)	1.015 (1.003, 1.027)	1.011 (1.006, 1.017)	1.009 (1.000, 1.018)
West Midlands	1.016 (1.011, 1.021)	1.024 (1.014, 1.034)	1.014 (1.009, 1.019)	1.014 (1.006, 1.023)
East England	1.014 (1.009, 1.019)	1.016 (1.005, 1.028)	1.014 (1.008, 1.019)	1.013 (1.004, 1.022)
London	1.023 (1.018, 1.028)	1.025 (1.016, 1.034)	1.021 (1.016, 1.026)	1.018 (1.011, 1.025)
South East	1.016 (1.012, 1.020)	1.025 (1.016, 1.035)	1.013 (1.009, 1.017)	1.015 (1.007, 1.022)
South West	1.020 (1.014, 1.025)	1.023 (1.010, 1.036)	1.017 (1.011, 1.022)	1.015 (1.005, 1.025)
Wales	1.009 (1.002, 1.016)	1.015 (1.002, 1.029)	1.009 (1.002, 1.015)	1.009 (0.998, 1.020)
<b>75-84</b>				
North East	1.022 (1.016, 1.028)	1.020 (1.008, 1.033)	1.022 (1.016, 1.028)	1.012 (1.002, 1.021)
North West	1.022 (1.018, 1.026)	1.010 (1.003, 1.018)	1.021 (1.018, 1.025)	1.006 (1.000, 1.012)
Yorks & Hum	1.018 (1.013, 1.022)	1.016 (1.008, 1.025)	1.017 (1.013, 1.021)	1.007 (1.000, 1.014)
East Midlands	1.024 (1.020, 1.029)	1.032 (1.022, 1.041)	1.023 (1.019, 1.028)	1.023 (1.016, 1.030)
West Midlands	1.018 (1.013, 1.022)	1.023 (1.015, 1.031)	1.017 (1.013, 1.021)	1.015 (1.009, 1.022)
East England	1.020 (1.016, 1.024)	1.029 (1.020, 1.038)	1.019 (1.015, 1.023)	1.019 (1.012, 1.026)
London	1.025 (1.021, 1.029)	1.048 (1.041, 1.056)	1.023 (1.019, 1.027)	1.036 (1.030, 1.042)
South East	1.025 (1.022, 1.029)	1.021 (1.014, 1.028)	1.022 (1.019, 1.026)	1.014 (1.008, 1.020)
South West	1.026 (1.022, 1.031)	1.026 (1.016, 1.035)	1.023 (1.019, 1.028)	1.015 (1.007, 1.023)
Wales	1.030 (1.025, 1.036)	1.022 (1.012, 1.033)	1.028 (1.023, 1.033)	1.016 (1.007, 1.025)

<b>Location and age group</b>	<b>Cold (&lt; 60th %ile) RR (95% CI)</b>	<b>Heat (&gt; 93rd %ile) RR (95% CI)</b>	<b>Cold (&lt; 65th %ile) RR (95% CI)</b>	<b>Heat (&gt; 90rd %ile) RR (95% CI)</b>
<b>85+</b>				
North East	1.016 (1.009, 1.023)	1.002 (0.987, 1.016)	1.014 (1.007, 1.021)	1.000 (0.990, 1.011)
North West	1.025 (1.021, 1.029)	1.031 (1.023, 1.039)	1.024 (1.020, 1.028)	1.019 (1.013, 1.026)
Yorks & Hum	1.021 (1.016, 1.026)	1.033 (1.023, 1.043)	1.019 (1.015, 1.024)	1.025 (1.017, 1.033)
East Midlands	1.026 (1.021, 1.031)	1.042 (1.032, 1.052)	1.025 (1.020, 1.030)	1.033 (1.025, 1.041)
West Midlands	1.031 (1.027, 1.036)	1.034 (1.025, 1.043)	1.029 (1.025, 1.034)	1.024 (1.016, 1.031)
East England	1.031 (1.026, 1.035)	1.038 (1.029, 1.047)	1.029 (1.025, 1.033)	1.028 (1.020, 1.036)
London	1.035 (1.030, 1.039)	1.064 (1.057, 1.072)	1.034 (1.030, 1.038)	1.050 (1.043, 1.056)
South East	1.029 (1.026, 1.033)	1.047 (1.040, 1.054)	1.028 (1.025, 1.031)	1.034 (1.027, 1.040)
South West	1.031 (1.027, 1.036)	1.029 (1.019, 1.038)	1.030 (1.025, 1.034)	1.020 (1.012, 1.028)
Wales	1.038 (1.032, 1.044)	1.034 (1.022, 1.046)	1.035 (1.029, 1.041)	1.025 (1.015, 1.035)
<b>Australia</b>				
<b>All ages</b>				
Sydney	1.026 (1.019, 1.034)	1.026 (1.017, 1.034)	1.025 (1.017, 1.034)	1.021 (1.016, 1.025)
Melbourne	1.017 (1.009, 1.026)	1.015 (1.010, 1.020)	1.016 (1.010, 1.023)	1.013 (1.008, 1.018)
Brisbane	1.022 (1.010, 1.034)	1.064 (1.025, 1.104)	1.022 (1.008, 1.036)	1.048 (1.014, 1.083)
Adelaide	1.014 (1.005, 1.022)	1.015 (1.003, 1.027)	1.013 (1.003, 1.023)	1.014 (1.004, 1.023)
Perth	1.020 (1.007, 1.033)	1.023 (1.010, 1.037)	1.021 (1.009, 1.032)	1.018 (1.008, 1.028)
<b>0-64</b>				
Sydney	1.013 (0.998, 1.029)	1.012 (1.003, 1.022)	1.013 (0.999, 1.027)	1.007 (1.000, 1.014)
Melbourne	1.018 (0.996, 1.041)	1.017 (1.006, 1.029)	1.014 (0.996, 1.033)	1.015 (1.006, 1.025)
Brisbane	1.002 (0.976, 1.028)	1.019 (0.967, 1.073)	0.998 (0.974, 1.022)	1.019 (0.979, 1.061)
Adelaide	1.004 (0.976, 1.032)	1.017 (1.001, 1.034)	1.011 (0.987, 1.035)	1.018 (1.006, 1.030)
Perth	1.000 (0.977, 1.022)	1.026 (1.007, 1.045)	1.007 (0.982, 1.032)	1.013 (1.000, 1.027)
<b>65-74</b>				
Sydney	1.018 (0.999, 1.038)	1.018 (1.004, 1.032)	1.018 (1.001, 1.035)	1.016 (1.004, 1.029)
Melbourne	1.008 (0.987, 1.029)	1.006 (0.995, 1.017)	1.007 (0.990, 1.025)	1.007 (0.997, 1.016)
Brisbane	1.031 (1.009, 1.053)	1.077 (1.018, 1.140)	1.022 (1.000, 1.045)	1.056 (1.015, 1.098)
Adelaide	1.020 (0.997, 1.044)	1.018 (1.000, 1.037)	1.001 (0.974, 1.029)	1.014 (0.999, 1.029)
Perth	1.031 (1.009, 1.052)	1.021 (0.997, 1.045)	1.035 (1.012, 1.059)	1.011 (0.995, 1.027)

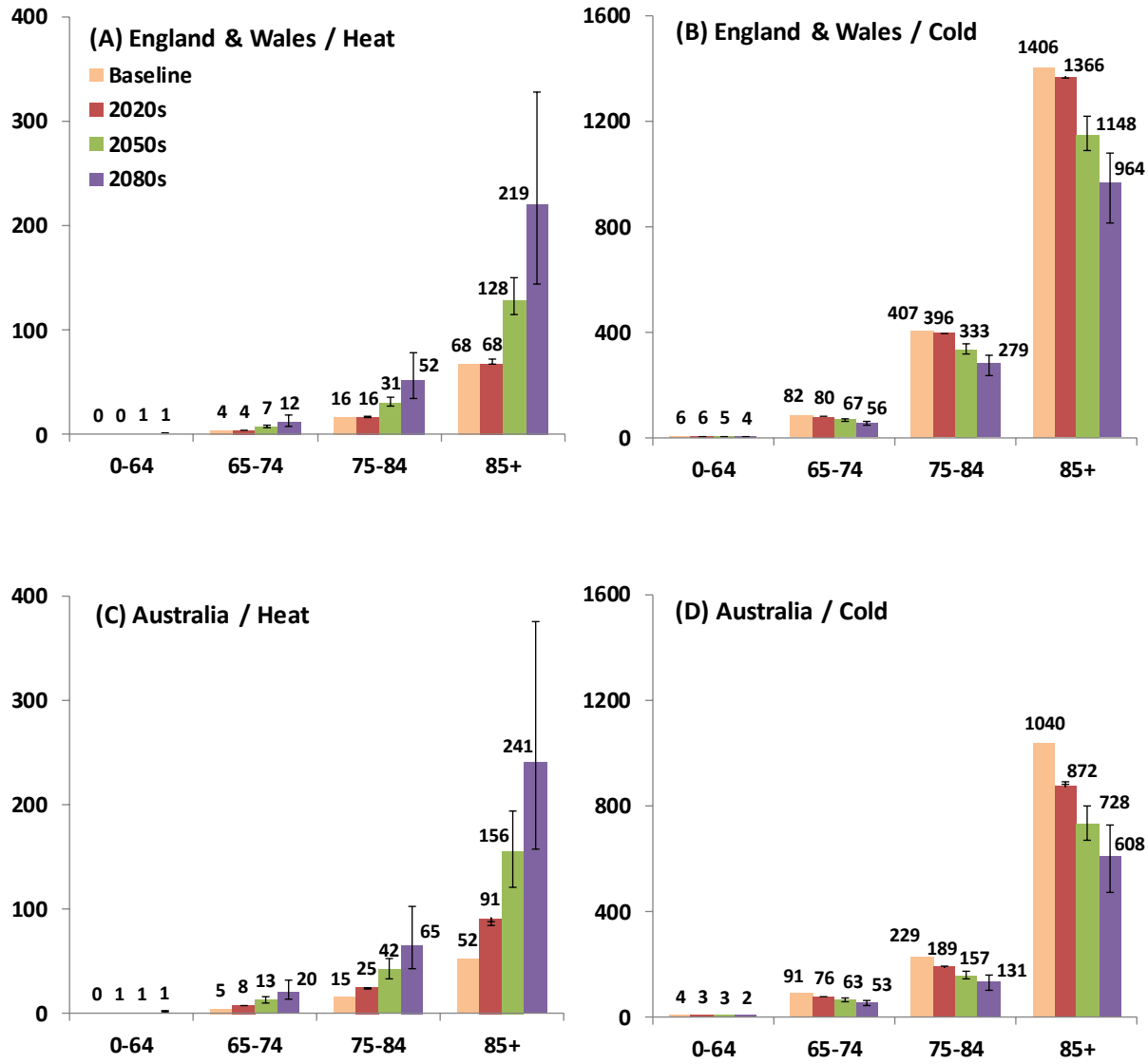


<b>Location and age group</b>	<b>Cold (&lt; 60th %ile) RR (95% CI)</b>	<b>Heat (&gt; 93rd %ile) RR (95% CI)</b>	<b>Cold (&lt; 65th %ile) RR (95% CI)</b>	<b>Heat (&gt; 90rd %ile) RR (95% CI)</b>
<b>75-84</b>				
Sydney	1.029 (1.016, 1.042)	1.027 (1.012, 1.042)	1.026 (1.014, 1.038)	1.023 (1.013, 1.032)
Melbourne	1.017 (1.007, 1.028)	1.013 (1.001, 1.025)	1.016 (1.007, 1.024)	1.010 (1.001, 1.019)
Brisbane	1.003 (0.967, 1.039)	1.076 (1.033, 1.121)	1.013 (0.977, 1.050)	1.051 (1.011, 1.093)
Adelaide	1.018 (1.002, 1.035)	1.019 (0.996, 1.043)	1.020 (1.005, 1.034)	1.016 (1.000, 1.033)
Perth	1.023 (1.003, 1.045)	1.045 (1.028, 1.062)	1.022 (0.999, 1.045)	1.033 (1.019, 1.048)
<b>85+</b>				
Sydney	1.042 (1.028, 1.057)	1.043 (1.024, 1.061)	1.040 (1.027, 1.053)	1.033 (1.019, 1.047)
Melbourne	1.023 (1.008, 1.039)	1.024 (1.014, 1.035)	1.025 (1.014, 1.037)	1.018 (1.007, 1.029)
Brisbane	1.054 (1.024, 1.086)	1.088 (1.013, 1.168)	1.050 (1.019, 1.082)	1.062 (1.005, 1.122)
Adelaide	1.011 (0.989, 1.032)	1.010 (0.997, 1.023)	1.015 (0.991, 1.041)	1.007 (0.997, 1.016)
Perth	1.024 (1.001, 1.047)	1.011 (0.988, 1.034)	1.023 (1.001, 1.045)	1.010 (0.993, 1.027)

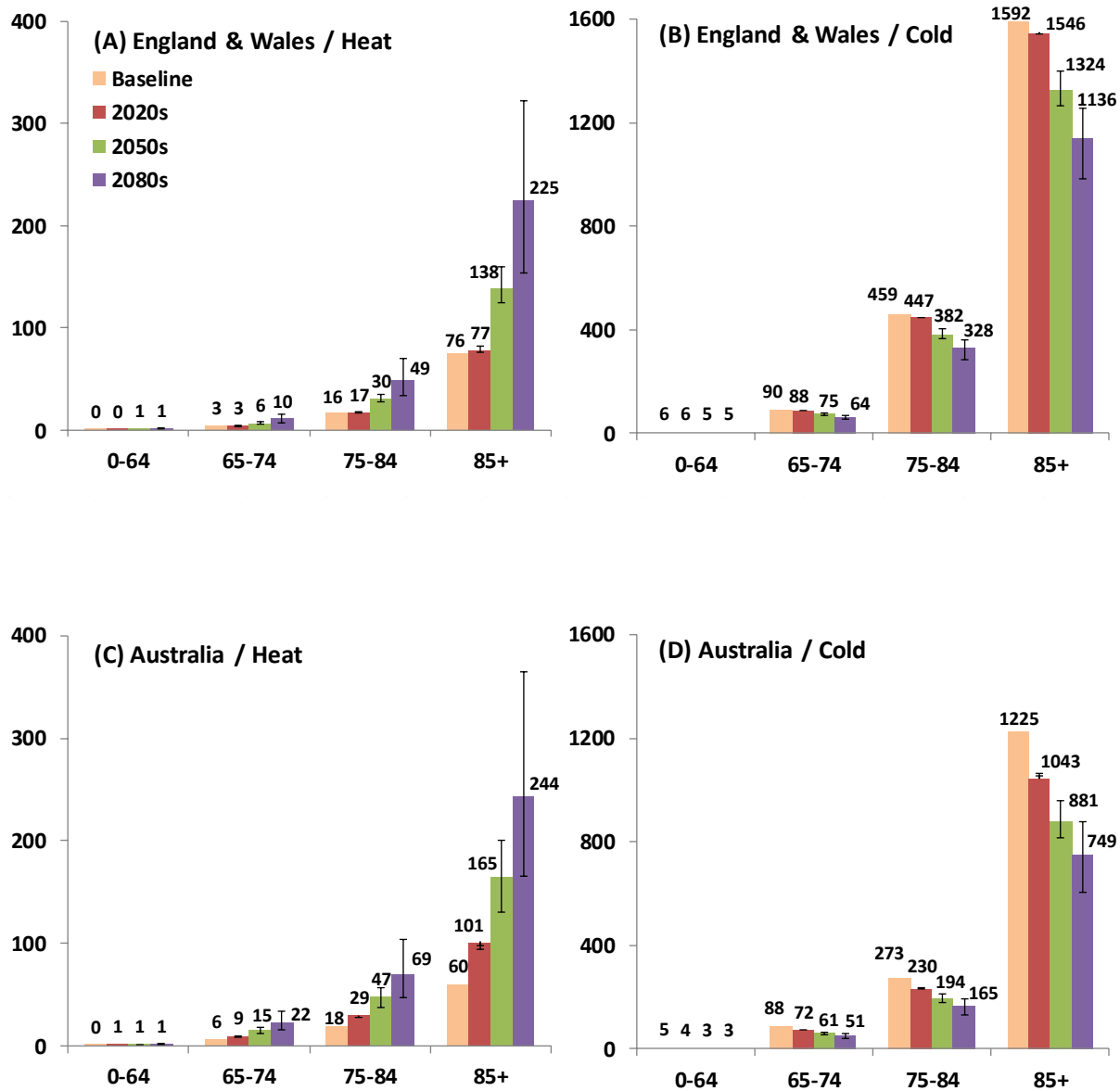
The *RRs* were derived from time-series regression analyses assuming Poisson variation with scale overdispersion. Heat and cold effects were estimated separately.



**Figure S4.** Heat-related and cold-related deaths in England and Wales regions (A, B) and five Australian cities (C, D) per year for all ages, for 2001 populations (left panel) and projected populations (right panel). The mortality estimates are based on estimated *RRs* for heat or cold effects in each region, the daily mortality rate for all-cause deaths and population size in each region, and regional daily mean temperatures. Coloured bars show estimates based on SRES A1B; B1 and A1FI estimates are shown as vertical lines. Temperature thresholds: 90<sup>th</sup> percentile for heat and 65<sup>th</sup> percentile for cold. Baseline period: 1993-2006.



**Figure S5.** Temperature-related deaths in England and Wales regions (A, B) and Australian cities (C, D) per year, per 100,000 population and by age group for heat (left panel) and cold (right panel). The mortality estimates are based on estimated *RRs* for heat or cold effects for the four age groups in each region, the daily mortality rate for all-cause deaths and population size of each age group in each region, and regional daily mean temperatures. Coloured bars show estimates based on SRES A1B; B1 and A1FI estimates are shown as vertical lines. Temperature thresholds: 93<sup>rd</sup> percentile for heat and 60<sup>th</sup> percentile for cold. Baseline period: 1993-2006.



**Figure S6.** Temperature-related deaths in England and Wales regions (A, B) and Australian cities (C, D) per year, per 100,000 population and by age group for heat (left panel) and cold (right panel). The mortality estimates are based on estimated *RRs* for heat or cold effects for the four age groups in each region, the daily mortality rate for all-cause deaths and population size of each age group in each region, and regional daily mean temperatures. Coloured bars show estimates based on SRES A1B; B1 and A1FI estimates are shown as vertical lines. Temperature thresholds: 90<sup>th</sup> percentile for heat and 65<sup>th</sup> percentile for cold. Baseline period: 1993-2006.