Reply to 'A note of caution about the excess winter deaths measure'

Staddon *et al.* reply — Hajat and Kovats[1] question our conclusion that climate change may no longer be assumed to bring a health dividend due to the warming of winters[2]. We accept that the excess winter deaths (EWDs) measure is not perfect; more work is required to develop better temperature and health metrics relevant to seasons and years (rather than extrapolating from daily observations) as has been done for air pollution[3]. However, we do not agree that the EWDs measure is so flawed as to prevent its use in drawing conclusions about relationships between weather and mortality. Cold-related deaths that occur outside the December–March period are irrelevant because our study has focussed on winter deaths. We did this specifically because winter deaths have been predicted to fall as winters warm. The Health Protection Agency stated that "the number of cold-related deaths will likely decrease due to milder winters"[4]. The *UK Climate Change Risk Assessment*[5] concluded that "increased winter temperatures may lead to decreased levels of mortality and morbidity due to cold". The estimate made by Hajat and Kovats that 70% of all cold-related deaths occur on days warmer than the 5 °C threshold is misleading: this conclusion is based on the assumption that deaths occurring on days below 20 °C are cold-related and deaths on days above 20 °C are warm-related[6]; by this definition, most UK deaths are cold-related. However, we would challenge the simplicity of this notion given that temperature–mortality relationships show two inflections points, not one.

That the excess in winter deaths relative to those in summer may fall if summer heat-related death-rates rise is obvious, but is not germane to our observations of past trends. Indeed, we know of no evidence to suggest that summer heat-related deaths have significantly risen in the past couple of decades; the exception was the 2003 heatwave that caused 2,000 deaths in England and Wales[7] — which is small compared with the 25,000 expected annual EWDs. This heatwave event, which has garnered so much attention, had no discernible effect on the following winter's EWDs.

The publications of Hajat and Kovats[7,8] — which they cite to support the role of future winter warming in decreasing winter deaths — quantify the average relationship across years between temperature and mortality: they then extrapolate to determine the impact of warmer weather mortality. However, they assume that the daily temperature–mortality relationship is stable when, in fact, it changes both spatially and temporally, making it unreliable for projecting future cold-related mortality. Recent independent research by Ebi and Mills[9] also concludes that "climate change […] is unlikely to dramatically reduce overall winter mortality rates", and confirms our finding that influenza activity is now a key driver of year-to-year fluctuations in winter mortality[2,9,10].

We agree, that "climate change is an important public health challenge for the UK" and that "policymakers need to be informed by the best available evidence on the probable harms and benefits to human health." This was the motivation for our work. Our findings[2], corroborated by others[9,11], indicate that future warmer winters are unlikely to decrease winter mortality[2,9,11], especially if temperature volatility increases[12]. ❐

References

1. Hajat, S. & Kovats S. *Nature Clim. Change* **4,** 647 (2014).
2. Staddon, P. L., Montgomery, H. E. & Depledge, M. H. *Nature Clim. Change* **4,** 190–194 (2014).
3. Pope, C. A., Ezzati, M., Dockery, D. W. *New England J. Med.* **360,** 376–386 (2009).
4. *Health Effects of Climate Change in the UK 2012* (Health Protection Agency, 2012); www.hpa.org.uk/hecc2012
5. *UK Climate Change Risk Assessment* (DEFRA, 2012); http://go.nature.com/lNoqn7
6. Gasparrini, A. & Leone, M. *BMC Med. Res. Method.* **14,** 55 (2014).
7. Hajat, S. *et al. J. Epidemiol. Community Health* **68,** 641–648 (2014).
8. Donaldson, G., Kovats, R. S., Keatinge, W. R. & McMichael, A. J. in *Health Effects of Climate Change in the UK* (ed. Maynard, R. L.) 70–80 (Department of Health, 2002); http://go.nature.com/krpDqT
9. Ebi, K. L. & Mills, D. *WIREs Clim. Change* **4,** 203–212 (2013).
10. *Excess Winter Mortality in England and Wales, 2011/12 (provisional) and 2010/11 (final)* (Office for National Statistics, 2012); http://go.nature.com/SDtopj
11. Huang, C. & Barnett, A. *Nature Clim. Change* **4,** 173–174 (2014).
12. Woodward, A. *J. Epidemiol. Community Health* **68,** 595–596 (2014).

Philip Staddon[1]*, Hugh Montgomery[2,3] and Michael Depledge[1]

[1]University of Exeter Medical School European Centre for Environment and Human Health, Knowledge Spa, Royal Cornwall Hospital Trust, Truro TR1 3HD, UK, [2]University College London Institute for Human Health and Performance, Charterhouse Building, Archway Campus, Highgate Hill, London N19 5LW, UK, [3]NIHR University College London Hospitals Biomedical Research Centre, Maple House 1st floor, 149 Tottenham Court Road, London W1T 7DN, UK.
*e-mail: P.L.Staddon@exeter.ac.uk

CORRESPONDENCE:

Missing tree rings and the AD 774–775 radiocarbon event

To the Editor — Büntgen *et al.*[1] describe radiocarbon data from a subfossil pine tree in the Austrian Alps as an example of an event and method that might strongly support or strongly refute our missing-ring hypothesis[2,3]. Our hypothesis is that some trees growing near their thermal limits can fail to produce an annual ring during unusually cold growing seasons that can follow large volcanic eruptions. The missing ring causes the year preceding the eruption to masquerade as the eruption year. This has two potential impacts. First, the resulting chronology would not record the effects of the eruption because the ring from that year would be missing. Second, all previous years in the chronology would be shifted forward in time by the number of missing rings. This means that, even if the tree produced a growth ring following an older eruption, that ring would indicate the wrong year. In both cases, the hemispheric or global average temperatures derived from the records would underestimate the actual cooling. Thus, our hypothesis could explain the discrepancy between modelled and reconstructed responses to large eruptions[3].

An independent date is needed to confirm that all chronologies are complete, or that some are missing rings. The AD 774–775 radiocarbon event is unique in the time