patient, so conversations are more successful than lessons. We always expect, and try, to learn something from those we seek to 'teach'. Where there is a genuine uncertainty we must not ignore it. We find that being defensive, over-confident or dogmatic are not successful strategies. Humour and humility are useful in keeping people on board and one's sanity intact.

The pause is easy to fit into a pre-defined narrative — 'climate change is not as bad as we thought' — while the reasons we might see a slowdown are many, uncertain, complex and technical. But we should see the pause as an opportunity, offering a clear hook to explore exciting aspects of climate science; to draw back the curtain on active scientific discussions that are often invisible to the public. The pause is a grand 'whodunnit' at the edge of our scientific understanding — we have an unusual (but not totally unexpected) event, with incomplete but rapidly improving information and understanding. The outcome of our investigations is important at the global scale, both in the near-term (decadal) and the long-term (end of century). The challenge is to embrace the complexity of the situation, to acknowledge the uncertainty and the nuance, to welcome questions and investigation and show the process of climate science in good health. Online engagement would seem to be essential in this endeavour. ❐

Ed Hawkins is at the National Centre for Atmospheric Science, Department of Meteorology, University of Reading, Reading RG6 6BB, UK, (twitter: @ed_hawkins). Tamsin Edwards is at the School of Geographical Sciences, University of Bristol, Bristol BS8 1SS, UK, (twitter: @flimsin). Doug McNeall is at the Met Office Hadley Centre, FitzRoy Road, Exeter EX1 3PB, UK, (twitter: @dougmcneall).*
**e-mail: e.hawkins@reading.ac.uk*

References

1. IPCC *Climate Change 2013: The Physical Science Basis.* (eds Stocker, T. *et al.*) (Cambridge Univ. Press, 2013).
2. Fyfe, J., Gillett, N. & Zwiers, F. *Nature Clim. Change* **3,** 767–769 (2013).
3. Kosaka, Y. & Xie, S. *Nature* **501,** 403–407 (2013).
4. Cowtan, K & Way, R. G. *Q. J. R. Meteorol. Soc.* http://doi.org/qbj (2013).
5. McGrath, M. IPCC climate report: humans 'dominant cause' of warming. *BBC online* (27 September 2013); http://go.nature.com/NVEvbo
6. Mooney, C. Who created the global warming "pause"? *Grist* (October 2013); http://go.nature.com/dNeCRW
7. Whitehouse, D. Has global warming stopped? *New Statesman* (19 December 2007); http://go.nature.com/NqtiX7
8. Rose, D. The Great Green Con no. 1: The hard proof that finally shows global warming forecasts that are costing you billions were WRONG all along. *Daily Mail* (16 March 2013); http://go.nature.com/AbCx7L
9. A sensitive matter. *The Economist* (30 March 2013); http://go.nature.com/iquFxP
10. Schmidt, G. *Nature Geosci.* **1,** 208 (2008).
11. Betts, R. Widening the climate conversation. *Nature.com blog* (18 January 2012); http://go.nature.com/cBwYuG
12. Brönnimann, S. *Nature Geosci.* **2,** 735–736 (2009).
13. Rahmstorf, S. *et al. Science* **316,** 709 (2007).
14. Manabe, S., Bryan, K. & Spelman M. J. *J. Phys. Oceanogr.* **20,** 722–749 (1990).
15. Deser, C., Knutti, R., Solomon, S. & Phillips, A. S. *Nature Clim. Change* **2,** 775–779 (2012).
16. Knutson, T. R., Zeng, F. & Wittenberg A. T. *J. Climate* **26,** 8709–8743 (2013).
17. Sheldon, T. Communicating the slowdown. *Science Media Centre* (24 July 2013); http://go.nature.com/PVLJAL
18. Shukman, D. Why has global warming stalled? *BBC online* (22 July 2013); http://go.nature.com/gOQ1jK
19. Easterling, D. R. & Wehner, M. F. *Geophys. Res. Lett.* **36,** http://doi.org/dxd85x (2009).
20. Knight, J. *et al. BAMS* **90,** S20 (2009).
21. Hawkins, E. *Weather* **66,** 175–179 (2011).
22. Spiegelhalter, D., Pearson, M. & Short, I. *Science* **333,** 1393–1400 (2011).
23. Stephens, E. M., Edwards, T. L. & Demeritt, D. *WIRES Climate Change* **3,** 409–426(2012).
24. Broad, K., Leiserowitz, A., Weinkle, J. & Steketee, S. *Bull. Amer. Meteor. Soc.* **88,** 651–667 (2007).
25. Trend and Variation. *YouTube* (4 January 2012); http://go.nature.com/pvKLkx
26. Harrabin, R. Human role in warming 'more certain' – UN climate chief. *BBC online* (17 October 2013); http://go.nature.com/QLRWbc
27. Pielke, R. A. *Bull. Amer. Meteor. Soc.* **84,** 331–335 (2003).
28. Palmer, M., McNeall, D. & Dunstone, N. *Geophys. Res. Lett.* **38,** http://doi.org/fbwb2r (2011).
29. Rose, D. Global warming stopped 16 years ago, reveals Met Office report quietly released...and here is the chart to prove it. *Mail Online* (16 October 2012); http://go.nature.com/3h8Z8g
30. Hawkins, E. Updated comparison of simulations and observations. *Climate Lab Book* (8 February 2013); http://go.nature.com/dpcAxC
31. Connor, S. Exposed: The myth of the global warming 'pause'. *The Independent* (18 November 2013); http://go.nature.com/cXKC6C
32. http://dougmcneall.wordpress.com/links/
33. Morice, C. *et al. J. Geophys. Res. Atmos.* **117,** D08101 (2012).
34. Google trends (accessed 23 January 2014); http://go.nature.com/5w8zfM

Acknowledgements

We thank all those who have contributed to the many fascinating discussions that have helped form our thoughts on communicating complex climate issues on blogs and twitter. We also acknowledge useful suggestions from several other climate scientists that helped improve this Commentary. This Commentary represents the personal opinions of the authors.

COMMENTARY:

Media discourse on the climate slowdown

Maxwell T. Boykoff

We must not fall victim to decontextualized and ahistorical media accounting of climate trends.

In August 1968, protestors from the Students for a Democratic Society — an activist movement in the United States — repeatedly hurled the phrase 'the whole world is watching' outside the hotel in Chicago where the Democratic National Convention was being held. As Columbia University professor Todd Gitlin later documented in a book[1] titled by the same phrase, media coverage of the clashes accompanying the refrain then served to draw wider visibility to their antiwar activities and claims. He found that implications from the media representations were twofold: first, coverage largely framed the protests as a fringe action promoted by marginalized actors; however, second, the increased media coverage of the Students for a Democratic Society actions actually boosted awareness and bolstered member enrolments in the student-led movement.

These insights from Gitlin, along with those of other scholars across a range of perspectives, help inform considerations of the interactions between climate science, policy, media and the public today. Specifically, these findings guide our thinking about the swirling media discourses of a global warming pause, or hiatus or slowdown, that gained momentum, especially in this past year.

Discourses are essentially sets of categories, ideas and concepts that give meaning to phenomena. Maarten Hajer has pointed out that they can "frame certain problems … [and can] dominate the way a society conceptualizes the world"[2]. Through

© 2014 Macmillan Publishers Limited. All rights reserved

media representations, framing processes have had important effects on marginalizing some discourses while contributing to the amplification of others. Among early media discourses that sought to explain this climate phenomenon, environmental scientist Bob Carter penned an op-ed in *The Telegraph* of London in 2006 called 'There IS a problem with global warming... it stopped in 1998'[3] where he pointed to University of East Anglia Climatic Research Unit records of stalled global surface temperatures. Blog posts and media stories in the years that followed (for example, Real Climate, Watts Up With That, Tom Nelson, Andrew Revkin at DotEarth and the *New York Times*) logically sought to better understand this trend.

So while this meme had been circulating sporadically for a number of years before, media attention to this phenomenon really picked up steam in 2013. Basic searches of 'global warming' or 'climate change' and 'pause' or 'hiatus' — across 50 media sources in 20 countries over the past decade — show this trending in media discourse (Box 1).

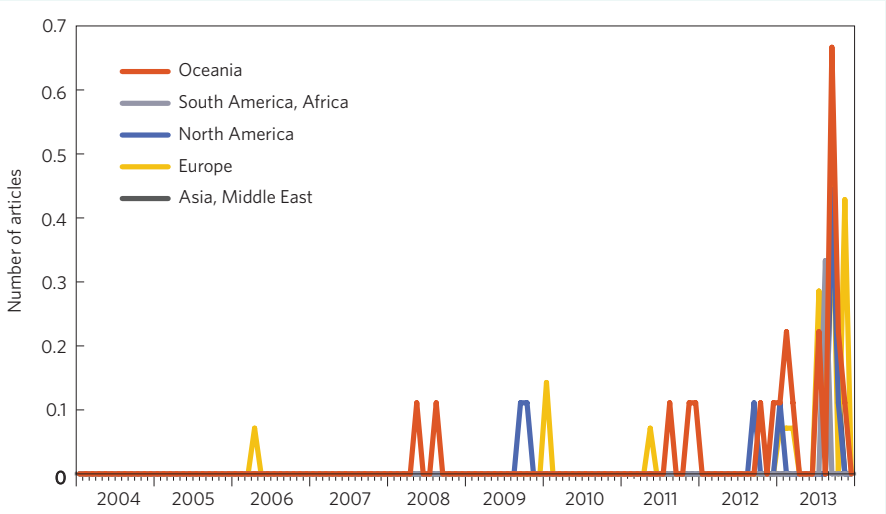
Increased media coverage of the global warming pause can be explained in part by how the issue has been framed. In working to explain the phenomenon using terms such as 'pause' and 'hiatus', this phrase then sets terms of engagement with wider questions of climate change through one indicator, that of global surface temperatures.

As readers here know, there are differences in the definitions of the terms 'climate change' and 'global warming'. While 'climate change' is a broader term that accounts for changes in many climate characteristics, such as rainfall, ice extent and sea levels, 'global warming' refers to a more specific facet of climate change: the increase in temperature over time. These discourses were also fuelled by active peer-reviewed research[4] and in particular, the contributions of scientists such as James Hansen[5] and Kevin Trenberth[6] who sought to explain this slowdown or missing heat.

As the terms 'pause', 'slowdown' and 'hiatus' increasingly populated discussions in the public sphere, these terms then served to settle discursive attention on just one element of larger climate changes. And word choices matter: discourses are tethered to material realities and social practices[7]. From attempts by actors across the ideological spectrum seeking to call this phenomenon 'climate change' over 'global warming' (or vice versa)[8,9] to struggles over the official naming of the 2010 Gulf of Mexico oil spill, acts of discursive positioning critically shape (and are shaped by) perception and potential behavioural change.

Disagreement and dissention certainly have value in reshaping understanding.

Box 1 | Trend in media discourse on the climate slowdown.



The figure tracks coverage of 'climate change' or 'global warming' and 'pause' or 'hiatus' in headlines and lead paragraphs in 50 media sources across 20 countries and 6 continents over 10 years (January 2004 to December 2013) normalized by articles in each source per month. Initial searches were then followed up by manual readings to avoid peripheral treatment of these terms. For a few examples: a piece by Susan Delacourt from the *Toronto Star* starts with "Politicians insist it is possible to press the 'pause' switch on their own election campaigns. Today, Paul Martin appears at a climate-change conference in his capacity as Prime Minister…"[18] and a column in the *Hindustan Times* uses these terms but by starting the piece "The Kyoto agreement belatedly came into effect after a hiatus of some seven years"[19]. The sources (grouped by country) are: *Clarín* (Argentina), *The Age*, *The Australian*, *Daily Telegraph*, *Courier-Mail*, *Sydney Morning Herald* (Australia), *Globe and Mail*, *National Post*, *Toronto Star* (Canada), *South China Morning Post* (China), *Prague Post* (Czech Republic), *Fiji Times* (Fiji), *Hindu*, *Hindustan Times*, *Indian Express*, *The Times of India* (India), *Irish Times* (Ireland), *Jerusalem Post*, *Jerusalem Report* (Israel), *Japan Times*, *Yomiuri Shimbun* (Japan), *New Straits Times* (Malaysia), *Dominion Post*, *New Zealand Herald*, *The Press* (New Zealand), *Nation* (Pakistan), *The Straits Times* (Singapore), *Financial Mail*, *Business Day* (South Africa), *Korea Herald*, *Korea Times* (South Korea), *El Pais* (Spain), *the Nation* (Thailand), *Daily Express*, *Sunday Express*, *Daily Mail*, *Mail on Sunday*, *Guardian*, *Observer*, *The Herald*, *Independent*, *Sunday Independent*, *Mirror*, *Sunday Mirror*, *The Scotsman*, *Scotland on Sunday*, *South Wales Evening Post*, *The Sun*, *News of the World*, *The Telegraph*, *Sunday Telegraph*, *Times*, *Sunday Times* (UK), *Daily News*, *Los Angeles Times*, *The New York Times*, *USA Today*, *Wall Street Journal*, *The Washington Post* (USA).

However, when these are not effectively placed in context, our understanding through framing is only partial. So along with considering how the pause was framed, it is critically important to place it into the context of a dynamic public arena[10]. This helps to map out how social problems rise and fall, to take into account arenas where social problem definitions are articulated and contested, as well as assess the positions of the actors who make claims about them. In tandem with considerations of framing, this process of contextualization helps to appraise institutional, political and cultural factors that influence possible problem formulations.

Furthermore, these various factors intersect with the mobilization of journalistic values and pressures. For example, journalist Stephanie Paige Ogburn attributed the discursive traction of the climate change pause in media accounts in part to the "lure of a captivating headline"[11]. As one journalistic norm, personalization strongly influenced reporting on the 'pause' — essentially telling climate stories by way of individual actions. In particular, social movements from the ideological right

© 2014 Macmillan Publishers Limited. All rights reserved

seized on this notion of a pause or hiatus in the public sphere and amplified claims of a global warming myth in the process[12,13].

Returning to Gitlin's book, even though these outlier claims were overwhelmingly dismissed through mainstream media accounts, coverage served to spotlight contrarian individuals and climate counter-movement pressure-group messages, while influencing larger public opinion. In other words, media attention on the slowdown may have inadvertently swelled the ranks of adherents to contrarian views of wider climate changes. While recent polling has found that the proportion of US citizens who believe that climate change is not happening has increased by seven percentage points since April 2013, study co-authors Anthony Leiserowitz and Edward Maibach have both commented that media coverage of the pause has contributed to the trends they detected[14,15].

In a 2013 study, Shawn Olson and I[16] explored the role of climate contrarianism, emitted from actors of the ideological right who have drawn culturally from anti-regulatory, anti-environmental and neoliberal environmental perspectives traced back to the US-based Wise Use movements — coalitions of groups promoting the expansion of private property rights and reduction of government intervention. We found that through media representations, these views were catalysed by the fundamental notion that it was relatively easy to confuse rather than clarify dimensions of this complex climate challenge in the public arena. In other words, it was easier to muddy the public waters of deliberation than to clean them up. Moreover, Robert Brulle has pointed to oft-critical political economic dimensions of this amplification process, namely funding for contrarian discourses from carbon-based industry groups[17].

Media coverage of the slowdown certainly taps into cultural resonances, while dredging up an often voluble minority view that climate change is not happening altogether. In the near-term, the timing of such attention in the public arena has contributed in part to a missed opportunity to communicate findings from the Fifth Assessment Report of the Working Group I of the Intergovernmental Panel on Climate Change, released in September 2013. Indeed, that may have been precisely one point of the attention paid to this meme by voices from the ideological right.

Over the longer term, in combination, climate change issues, events and developments that climb into the public arena through media representations do not do so merely for characteristics internal to the stories themselves. They become articles, segments and clips also by way of journalistic norms, such as personalization, along with concatenated contextual political, economic, social, environmental and cultural factors. Journalist Chris Mooney has pointed out: "Journalists take heed: Your coverage has consequences. All those media outlets who trumpeted the global warming 'pause' may now be partly responsible for a documented decrease in Americans' scientific understanding."[15]

On this critical issue of climate change — that cuts to the heart of our carbon-based industry and society interactions in the twenty-first century — the whole world will continue to watch the unfolding climate science, policy and media interactions in the public arena. Going forward, tracking the roots and shoots of representations of a global warming slowdown can help to trace the importance of language in shaping the possibilities for public engagement. ❐

Maxwell T. Boykoff is at the Cooperative Institute for Research in Environmental Sciences (CIRES), Center for Science and Technology Policy Research (CSTPR), UCB 488 CIRES CSTPR, University of Colorado, 1333 Grandview Avenue, Boulder, Colorado 80309, USA.
e-mail: boykoff@colorado.edu

References

1. Gitlin, T. *The Whole World is Watching* (Univ. California Press, 1980).
2. Hajer, M. in *The Argumentative Turn in Policy Analysis and Policymaking* (eds Fisher, F. & Forester, J.) 45–46 (Duke Univ. Press, 1993).
3. Carter, B. There IS a problem with global warming... it stopped in 1998. *The Telegraph* (9 April 2006); http://go.nature.com/D9CSlh
4. Kosaka, Y. & Xi, S-P. Recent global-warming hiatus tied to equatorial Pacific surface cooling. *Nature* **501,** 403–407 (2013).
5. Hansen, J., Sato, M. & Ruedy, R. Global temperature update through 2012. (15 January 2013); http://go.nature.com/loo2Iv
6. Balmaseda, M. A., Trenberth, K. E. & Källén, E. Distinctive climate signals in reanalysis of global ocean heat content. *Geophys. Res. Lett.* **40,** 1754–1759 (2013).
7. Hall, S. *Representation: Cultural Representation and Signifying Practices* (Sage, 1997).
8. Luntz, F. *The Environment: A Cleaner, Safer, Healthier America* 131–146 (The Luntz Research Companies, Straight Talk, 2003).
9. *Naming Global Warming* (ActionMedia, 2005).
10. Hilgartner, S. & Bosk, C. L. The rise and fall of social problems: a public arenas model. *Am. J. Sociol.* **94,** 53–78 (1988).
11. Ogburn, S. P. How media pushed climate change 'pause' into the mainstream. *Energy and Environment Daily* (4 November 2013); http://go.nature.com/3rxT35
12. Morano, M. UK Daily Mail: 'Global warming stopped 16 years ago' according to UK Met Office 'quietly released' report — 'Pause' in warming lasted about same time as when temps rose, 1980 to 1996. (*Climate Depot*, 13 October 2012); http://go.nature.com/T9opcu
13. Lloyd, G. IPCC head Pachauri acknowledges global warming standstill. *Global Warming Policy Foundation* (23 February 2013); http://go.nature.com/rnQLMt
14. Pappas, S. Climate change disbelief rises in America. *LiveScience* (16 January 2014); http://go.nature.com/ki1Dma
15. Mooney, C. Global-warming denial hits a 6-year high. *Mother Jones* (17 January 2014); http://go.nature.com/TvkUsz
16. Boykoff, M. & Olson, S. Wise contrarians' in contemporary climate science–policy–public interactions. *Celebrity Stud.* **4,** 276–291 (2013).
17. Brulle, R. J. Institutionalizing delay: foundation funding and the creation of US climate change counter-movement organizations. *Climatic Change* http://doi.org/f2pdbh (2013).
18. Delacourt, S. Putting on and taking off that election face. *Toronto Star* (7 December 2005).
19. The Hindustan Times An ecological disaster waiting to happen. *The Hindustan Times* (24 October 2010).

COMMENTARY:

Heat hide and seek

Lisa Goddard

Natural variability can explain fluctuations in surface temperatures but can it account for the current slowdown in warming?

Where is the heat? That is the question on the minds of many scientists, and many climate change sceptics. The 'global warming hiatus' — the fact that globally averaged air temperatures have not increased as quickly in the past decade as they have in previous decades[1,2] — is a hot topic, so to speak. It even has its own spotlight in Chapter 9 of the Working Group I report of the IPCC 5th Assessment Report[3].

Temperatures are going up. This decade is warmer than last decade, which is warmer than the decade before that. This response of global temperatures is expected from physical considerations of increased greenhouse gases in our atmosphere. At issue is the decreased

© 2014 Macmillan Publishers Limited. All rights reserved