Commentary: Pause for thought

A pause for thought?

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The recent slowdown (or 'pause') in global surface temperature rise is a hot topic for climate scientists and the wider public. We discuss how climate scientists have tried to communicate the pause and suggest that 'many-to-many' communication offers a key opportunity to directly engage the public on important science issues.

Since the late-1990s, global mean surface temperature increased more slowly than during the preceding period. The reasons for this 'pause' have been actively debated by the climate science community[1,2,3,4]. The recent Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5) concluded in their Summary for Policymakers (SPM) that this slowdown "*is due in roughly equal measure to a reduced trend in radiative forcing and a cooling contribution from natural internal variability*"[1].

Discussion of the pause, while a relatively small part of the IPCC report, was prominent in the mainstream media reporting[5] at the release of the AR5 WG1 SPM, much of which accurately reflected the views of scientists, while some were less aligned with IPCC conclusions. This media attention was perhaps predictable, given a long-term sceptical narrative around the pause which can be traced back to at least 2006[6]. For example, in 2007, New Statesman magazine proclaimed that 'global warming has stopped'[7], starting a pervasive trend in some parts of the media (especially in the UK) to prominently highlight the slowdown and suggest that climate models are 'running too hot'[8] or that climate sensitivity is on 'negative watch'[9].

These media articles raise questions about the public communication embarked on by the climate science community, especially since the 'Climategate' affair of 2009, and highlight the need for climate scientists to accurately convey information of societal relevance to a very wide range of interested parties[10,11]. Did the climate science community do enough in communicating the pause, and how could it do better in future?

Communicating the possibility

The IPCC suggests that the pause is likely due to a combination of factors[1]. Here we mainly focus on the communication of one particular aspect – the role of internal climate variability – but the radiative forcing changes are also important.

The peer-reviewed literature contains much discussion of unforced decadal fluctuations in global surface temperature and the IPCC discusses internal climate variability extensively in all of their reports. Such variability has been invoked to help explain both the early 20th century warming[12] and the faster warming during the 1980s and 1990s[13]. In addition, projections from

global climate models (GCMs) have shown decadal periods of cooling embedded within longer-term warming since they were first developed[14] to the present[15,16].

However, to our knowledge, the possibility that warming might slow due to internal variability was not highlighted by the mainstream media prior to 2006, raising the possibility that climate scientists did not stress enough the importance of such variability. For example, during an otherwise successful UK press briefing on the pause in 2013[17], one senior science journalist remarked that he had "*never heard leading researchers mention the possibility [of a slowdown] before*"[18]. What might have caused a breakdown in communication of this magnitude?

Firstly, it is possible that the chance of a slowdown was communicated effectively to the media, and subsequently ignored as not newsworthy. Alternatively, previous communications may have focused on long-term changes to inform mitigation discussions, whereas there is now more focus on near-term adaptation issues. Although several papers have estimated the probability of a pause[19,20,21], these were published after it had started. Also note that the IPCC has not included a clear statement of the chance of a slowdown in any of its SPMs (see Box).

Secondly, although 'no one size fits all' in communicating climate projections[22,23], graphically presenting future projections as ensemble means and spreads, without showing the individual simulated trajectories[24], could have led to an under-appreciation of the possible role of variability. For example, users of hurricane predictions were found to over-emphasise the most likely path, potentially unduly influencing evacuation decisions[25].

The real world will not evolve like an ensemble mean, but will behave more like an individual simulation[15,26]. As an illustration, ten simulations with the same climate model and forcing pathway show an ensemble mean trend of around 0.2˚C per decade over the next 40 years (Figure 1), but different 15-year periods within individual simulations show trends in the range 0.0–0.4˚C per decade. For comparison, the observed trend is 0.04˚C per decade for the 1998-2012 period. Note that each simulation shows periods, often lengthy, outside the ensemble spread. Consequently, we should *expect* observations to fall outside the projected ensemble spread some of the time.

The communication of the pause, its features and implications is complex. Although the most recent decade is the warmest since 1850[1], this does not mean there is no pause as some have suggested[27]. To overcome these communication challenges, some have discussed the overall energy budget of the Earth, which has been suggested as a more robust indicator of climate change than surface temperature alone[28,29]. However, surface warming impacts people directly, is readily understood by the public, and is also the canonical example of climate change which has been iconic for many years.

Media influence, the role of social media and some lessons learned

Trends in online searches suggest that media articles, even if published in a single country, can drive interest and discussion amongst the global public. Google trends (Figure 2) suggest that searches for 'global warming stopped' increased sharply in early 2008, just after the New Statesman article[7]. A peak in October 2012 can potentially be traced to an article in Mail Online[30]. From March 2013, the term 'global warming pause' became popular, coincident with the phrase's use in articles in Mail Online[8] and Economist magazine[9]. Another peak in September 2013 is coincident with media coverage of the launch of the IPCC AR5 WG1 SPM[1].

Those who do search online find content that is dominated by blog posts from popular commentators, often 'sceptics', and sometimes matched by 'mainstream' counterparts. This is a fast-paced, often vitriolic and enormously prolific stream of opinions and analyses responding to climate science news. Such blogs massively dominate those of climate scientists in both number and traffic, resulting in a potential misrepresentation of the discussion. Twitter is also an active 'many-to-many' forum for climate science talking points, often discussing rather complex technical issues of the latest literature.

There is undoubtedly still a clear need for traditional forms of communication via the media, public events and peer-reviewed activities such as the IPCC. However, if climate scientists are to communicate more effectively, then increasing their online and interactive presence offers a real opportunity to reach a broader range of interested parties directly. For example, an unpublished figure in a recent blog post[31] was subsequently used in media articles[8,9] and even a U.S. Senate hearing. A recent paper[4] on the pause used webpages and online videos to enhance communication, which may have helped generate a front page article in The Independent newspaper[32].

There is a small, but dedicated, community[33] of climate scientists engaging on blogs and social media with a diversity of approaches to online engagement, and more would be welcomed[10,11]. Although online conversations can be unpredictable, rambunctious and frustrating, they are often personally rewarding. However, potential benefits need to be weighed against the time and effort expended and the real risks of feeling under attack. Additional recognition amongst academic employers of the value and importance of such activities would also help.

From our experience, the online 'audience' is often technically proficient, but neither captive, nor necessarily interested or 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 pause 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 long term (end of century). The challenge is to embrace the complexity of the situation; to acknowledge the uncertainty; the nuance, the edge of our understanding; to welcome questions and investigation, and show the *process* of climate science in rude health. Online engagement would seem to be essential in this endeavour.

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IPCC summary statements on the role of climate variability

AR1 SPM 1990 – *‘the Earth’s climate would still vary without being perturbed by any external influences. This natural variability could add to, or subtract from, any human-made warming; on a century time-scale this would be less than changes expected from greenhouse gas increases.’*

AR2 SPM 1995 – *‘Any human-induced effect on climate will be superimposed on the background "noise" of natural climate variability’*

AR3 SPM 2001 – *‘Changes in climate occur as a result of both internal variability within the climate system and external factors’*

AR4 SPM 2007 – *‘On [regional] scales, natural climate variability is relatively larger,*

making it harder to distinguish changes expected due to external forcings'

AR5 SPM 2013 – *'In addition to robust multi-decadal warming, global mean surface temperature exhibits substantial decadal and interannual variability. Due to natural variability, trends based on short records are very sensitive to the beginning and end dates and do not in general reflect long-term climate trends.'*

Figure 1: The role of variability in global temperatures. Observed global mean surface air temperatures (HadCRUT4[34], solid black line) and recent 1998-2012 trend (dashed black line), compared with ten simulations of the CSIRO Mk3.6 global climate model which all use the RCP6.0 forcing pathway (grey lines). The grey shading represents the 16-84% ensemble spread (quantiles smoothed with a 7 year running mean for clarity); the ensemble mean trend is around 0.20K/decade. Two different realisations are highlighted (blue), and linear trends for specific interesting periods are shown (red, green, purple lines). **Left:** the highlighted realisation shows a strong warming in the 1998-2012 period, but a 15-year period of no warming around the 2030s. **Right:** the highlighted realisation is more similar to the observations for 1998-2012, but undergoes a more rapid warming around the 2020s. Note also that this realisation appears outside the ensemble spread for 9 out of 10 consecutive years from 2003-2012.

Figure 2: Global internet search trends. Quantity of Google searches[35] for the terms 'global warming stopped' (blue) and 'global warming pause' (red) over the period from January 2007 to December 2013, expressed as 'relative interest' with the highest monthly total given an index of 100. Note that the Google data was accessed on 23rd January 2013 and is subject to change.

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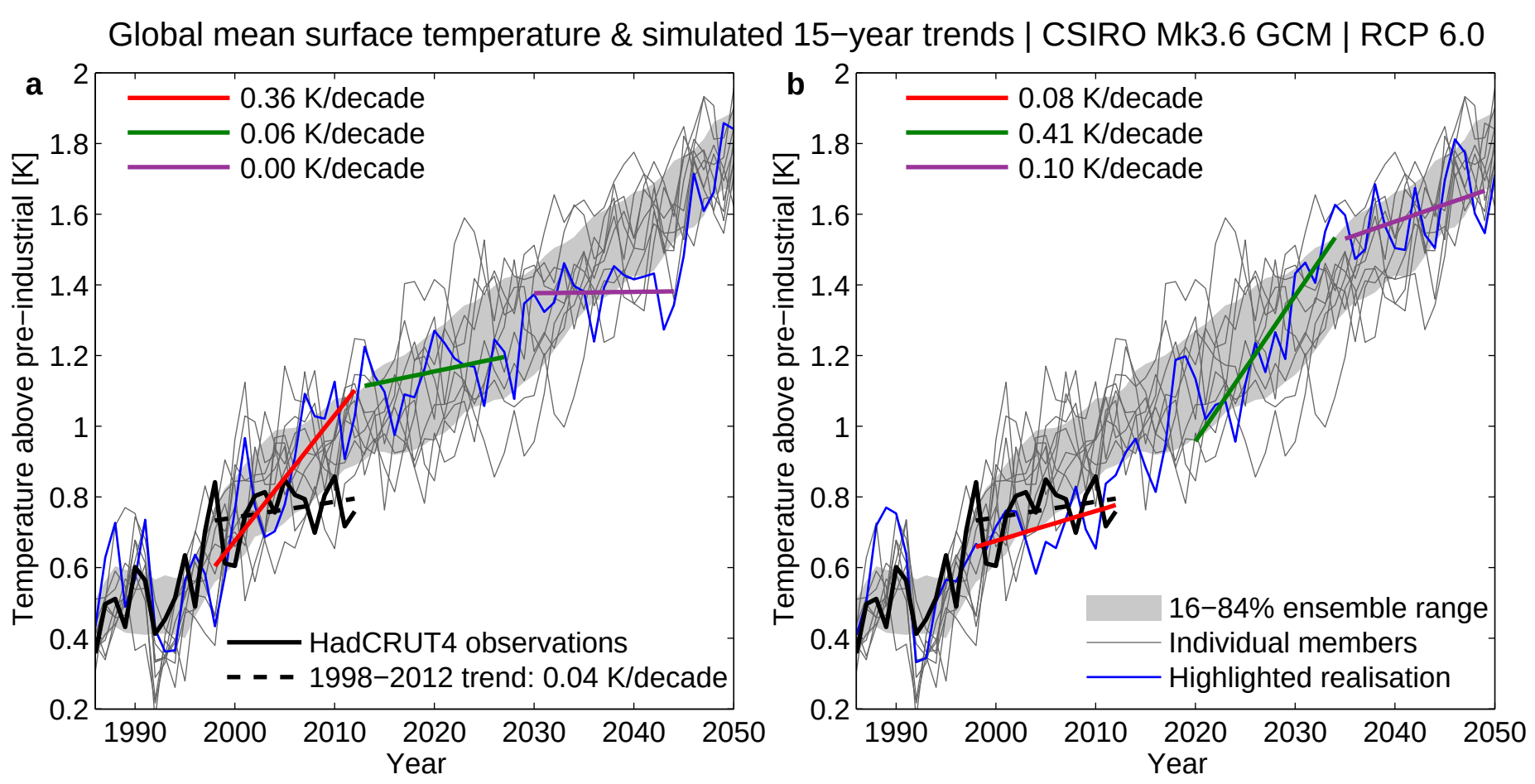
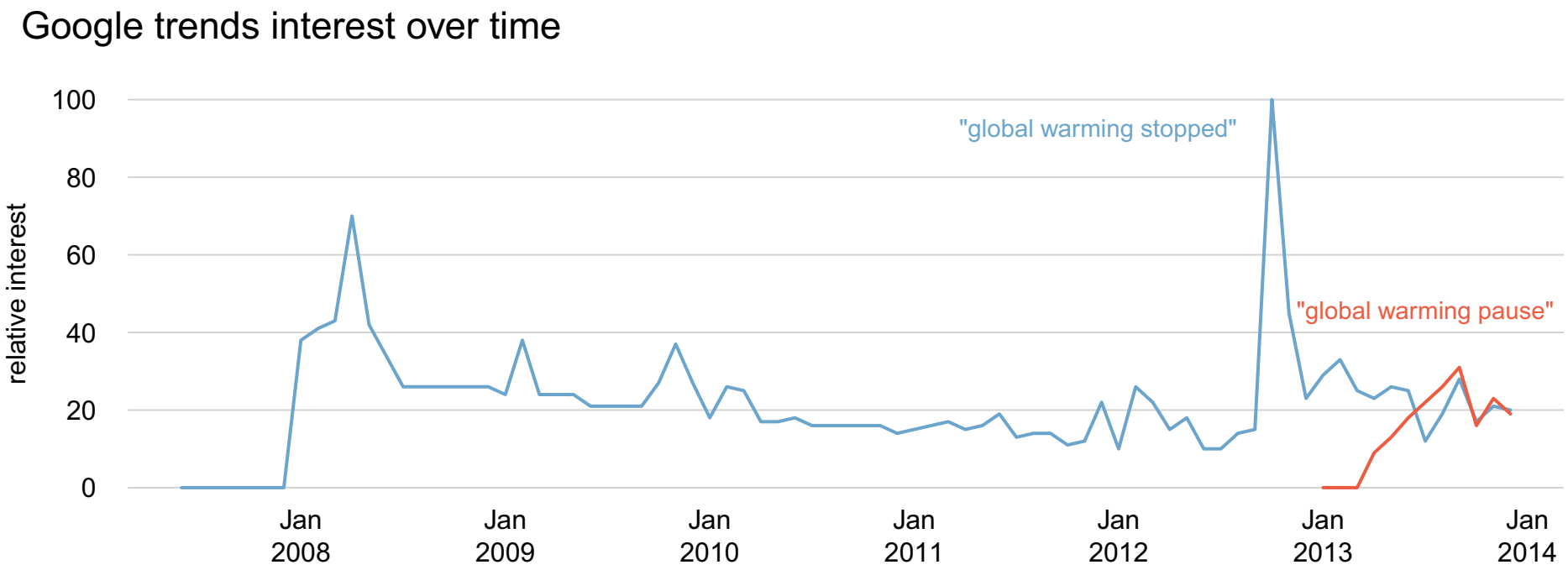

Global mean surface temperature & simulated 15−year trends | CSIRO Mk3.6 GCM | RCP 6.0
a
b
0.36 K/decade
0.06 K/decade
0.00 K/decade
0.08 K/decade
0.41 K/decade
0.10 K/decade
HadCRUT4 observations
1998−2012 trend: 0.04 K/decade
16−84% ensemble range
Individual members
Highlighted realisation
Temperature above pre−industrial [K]
Year
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
1990
2000
2010
2020
2030
2040
2050


Google trends interest over time
relative interest
100
80
60
40
20
0
"global warming stopped"
"global warming pause"
Jan 2008
Jan 2009
Jan 2010
Jan 2011
Jan 2012
Jan 2013
Jan 2014