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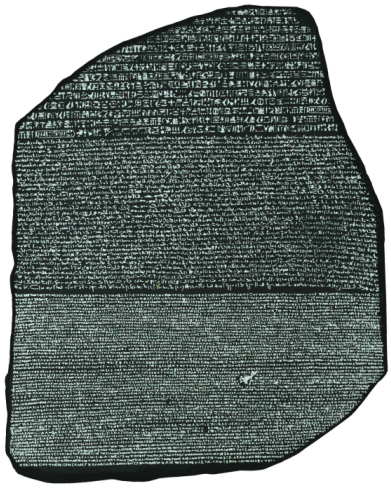

Climate Hysteria and Climate reality: a clash of cultures

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Climatology and social forces
Cybershed

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ABSTRACT

A feature of the 21st century is the undermining of the language of science by the language of social media. Here I investigate how inappropriate hyperbole hinders the ability to reason about what is happening to the climate. I will contrast these two languages not by opinion but by placing the hyperbole next to one of the very few datasets available, the Vostok ice cores from Antartica, to see how appropriate the hyperbole is. The conclusion is that the hyperbole has little to do with the data, being more appropriate to gathering attention and ultimately in the case of all media, generating subscription and advertising revenue.

CONTENTS

1 REPRODUCIBILITY

As with all my previous projects, independent reproducibility is a *sine qua non.* Without this, it is simply not science [1, 2].

In this case, the raw data is openly available thanks to its researchers and it can be found here[1]. A copy of this is included with the full reproducibility package for this paper and available here[2]. The reproducibility package assumes a basic Linux environment with bash, gnuplot, perl and R installed. Simply unzip the package and read README_REPRODUCE.txt which will tell you how to reproduce all diagrams, tables and analysis.

2 INTRODUCTION

The 21st century will probably be characterised by future generations as the age when social media and its digitally lubricated and largely unattributable communications enabled large numbers of people to be influenced in a very short time. It is the essence of opinion outreach and like all technologies has the capability of being used for good and bad simultaneously. If the 20th century was the zenith of mechanisation, science and engineering, the 21st century is already the first great age when bullshit ruled the earth.

One of the main casualties of this great outwelling of opinion has been science. There are many examples. In an age when medicine has achieved triumph after triumph and many awful diseases such as measles, mumps, diptheria, rubella (there is a very long list) have been conquered

[1] http://www.climatedata.info/proxies/data-downloads/.

[2] https://leshatton.org/Documents/ClimateHysteria_repopack_18Oct2023.zip

by vaccination, social media has managed to undermine this to an extent that vaccine hesitancy has never been higher. Measles outbreaks, once a thing of the past, have become common. This is in spite of the fact that vaccine development is guided by trials with the full weight of modern statistical and medical understanding and the overwhelming independently acquired evidence which underpins it. Sadly social media is not guided by rationality or numeracy but by opinion. The scientific method has been developing for several centuries but the zombification of rational thought lubricated by digital transmission has managed to undermine it in just two decades. Rationality whispers but Ignorance shouts.

Yet another casualty is the ability to talk rationally about the earth's climate without being automatically labelled as a "climate denier". Such is the power of social and other media, that it has reduced scientific debate to a binary "Do you believe?" (a climate activist) or "Do you not believe?" (a climate denier) choice to match its simple upvoting models. This is as woeful a distortion of the scientific method as it is possible to get.

This essay is about the climate and the words we use to describe it when such data as we have is assailed by media outlets struggling for ever more hyperbolic ways of describing it to generate attention, advertising income and perhaps more clandestinely, control through fear.

3 HYSTERIA

The climate is changing. Climatologists would be amazed if it didn't as it is subject to influences which are themselves changing; the sun's radiation budget, tectonic activity and vulcanism, non-terrestrial impact from asteroids, anthropogenic influences and so on. At the moment, it appears to be warming. Before I qualify the use of the word "appears", let me give some examples of words the media uses to describe this process[3].

We are in a climate catastrophe ...

We are facing a climate emergency ...

We are running out of time ...

We are approaching a tipping point of no return ...

The [hottest—wettest—coldest] since records began ...

...

It is easy to sympathize with these sentiments when an unusual weather event has occurred. When one does, the media will always feature an interview with somebody who says "I've never seen anything like this before." The hidden agenda here is to ascribe it to global warming, since it is without precedent in this person's memory.

Unfortunately, it dangerously biases how we describe such events dispassionately. Probably the biggest confounding factor in these statements is **time**. They are all written from a human point of view. Media outlets have a time-scale of just a few days. A month ago, the media focused on little else but Russia's illegal and continuing attempted invasion of Ukraine. As of the time of writing, this has disappeared off the radar to be replaced with the Israel-Palestine conflict.

Humans manage a little longer attention span and live seven or eight decades or so on average. "Since records began ..." might extend to 150 years or so, and that's it. If you weren't trying to slant the discussion, you would more reasonably say "since records began, although this only covers the last 150 years or so."

The point is that it is almost impossible to demonstrate how insignificant these time periods are when it comes to discussing climatology, biology and geology.

[3] All taken from current television and other media outlets.

Statistically, after only 150 years of measurement, we can't even say for certain that the climate is warming and if so, over what time scale. It very probably is but its not certain. To try and bridge this gap a little, we can extend our measurement record by *proxy*. In other words, we measure something which is reasonably correlated to changes in temperature if there are no direct measurements available. They are not as good as directly measuring temperature by a suitably calibrated thermometer but they give a generally reasonable guide. Tree ring data is often used to add a few more centuries to conventional temperature data and get up towards maybe a thousand years into the past. Quite apart from the difficulties of merging datasets with different independent variables (width of tree ring v. thermometric temperature) this is still only a tiny tick of the clock on which climatology, biology and geology operate.

4 TIME-SCALES AND THE CLASH WITH REALITY

What sort of time-scales are we dealing with then? Well, the earth geologically is somewhere around 4.5 billion years old. The word billion gets flung around a lot especially when it comes to wealth but lets write it out: 4,500,000,000 years. Life has been around for something over 3.6 billion years. Climates vary over various time scales but the period we can talk about most authoritatively is the last 800,000 years thanks to one of the very few measurement datasets we have, the Vostok Ice Cores from Antartica.

So why is this such a big deal? The clue is in the phrase "one of the very few". Everything we know about the climate before about 1 million years ago has to be inferred from the fossil record, an extremely difficult enterprise allowing broad-brush statements only. It tells us many things but only in rather general terms. In contrast the Vostok Ice Core dataset is a set of measurements over the last 800,000 years.

The only thing we have in science that ultimately protects us from opinion, conspiracy theories, fake news and all the other social media fuel is measurement. In short, *if a set of measurements exist which can be independently verified, and your theory does not match them, then your theory is wrong.* That's it, the uncompromising truth.

4.1 The Vostok Ice Core dataset

Perhaps the first thing to stress is that its a dataset, subject to quantifiable measurement error but its not perfect. The data is sampled in a way which only really allows a measurement every century. What happens between (with a time-scale of 50 years or less according to the Nyquist[4] theorem), we simply can't say. In fact faster changes can fold down into affecting slower changes in a process known as *aliasing*, but I will not pursue this here and focus only on the data as presented.

The data is itself also a proxy, although a close one. The temperature and CO2 levels at a particular level in the ice-core are inferred from oxygen isotope levels in the tiny bubbles trapped in the ice as the surface snow is buried and compacted over the centuries. Finally, the measurements pertain to just one small region of the globe. There are a few others reaching back perhaps a couple of hundreds of thousands of years but altogether they represent a fairly small part of the earth's surface, although they are broadly consistent with each other even though separated by thousands of miles[5].

However, these are relatively minor quibbles. The dataset remains one of the few handles we have on what was actually happening in the last 800,000 years. This may sound an age by the way, but if we represent life on earth by one hour on a clock, this measurement dataset tells us what happened in the last second. We do not as yet have any better

[4] https://en.wikipedia.org/wiki/Nyquist-Shannon_sampling_theorem

[5] https://wiki.icecoredata.org/mediawiki/index.php/Ice_Core_Wiki

measurement data either more fine-grained or longer lasting, partly of course because the Vostok ice-core datasets in Antartica where the ice is on average around 2km. thick, are as deep as it is possible to go on earth.

Let's have a look at this dataset to see how well some of the hyperbole stacks up. Figure 1 shows the Vostok temperature and CO2 data for the last 800,000 years,[6] The purple line is the temperature in degrees C relative to the present day and the green line is the CO2 level in parts per million (ppm). The extreme right hand side is today with the exception that the CO2 level is now around 420ppm. Broadly over the last 800,000 years, the temperature has fluctuated between about 4 degrees C hotter than today and just over 10 degrees C cooler in a series of grand cycles. The magnitude of these variations is not well-explained but the periodicity follows Milankovich's hypothesis based on the effects of the earth's orbit and its precessionary characteristics around the Sun[7].

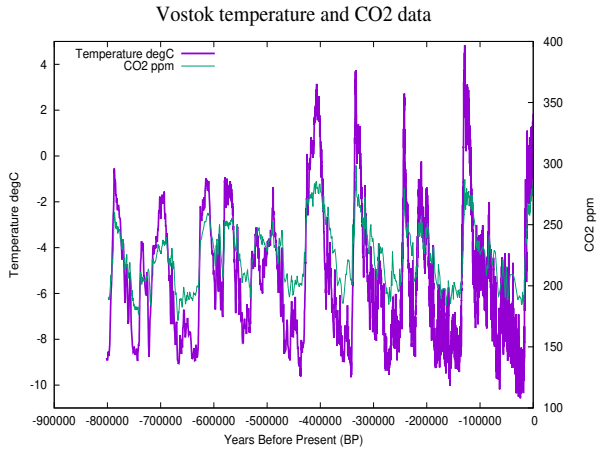

Figure 1. The Vostok ice core dataset for its entire history reaching back almost to 800,000 years in the past. This dataset has not been processed in any way, simply plotted and can be freely downloaded.

Let's make some more detailed observations on this. These contain no opinion and are uncontroversial, they simply follow directly from the data.

1. The peaks on the curve are known as interglacials and the troughs are ice ages.

2. The peaks have been getting generally hotter over this period.

3. Most (over 90%) of the time in the last 800,000 years has been colder than today.

4. Human activity on earth has absolutely nothing to do with anything you can see apart from the last couple of data points as we had no industrial activity and there were generally much fewer of us.

5. The last interglacial just over 100,000 years ago was around 4 degrees C hotter than today at its peak.

6. The last ice age which finished only some 20,000 years ago very nearly finished off land-based life because the CO2 level dropped to around 175 ppm, not very much above the 150 ppm minimum required to sustain land-based photosynthesis.

[6] It is freely downloadable from http://www.climatedata.info/proxies/data-downloads/. Don't take other peoples' opinions, check it for yourself.

[7] https://en.wikipedia.org/wiki/Milankovitch_cycles

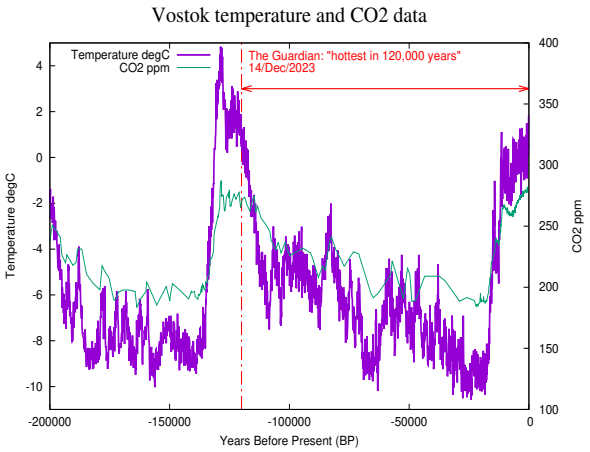

Figure 2. The Vostok ice core dataset for the last 200,000 years. This dataset has not been processed in any way and is a pure subset of Fig. 1. See later for a discussion of the quote from *the Guardian*.

7. Today's CO2 level of 420 ppm is the highest level attained in the last 800,000 years and we take an unknown proportion of the blame for this. I say unknown because the CO2 level fluctuates anyway as can be seen but you could make a reasonable statistical argument that since its never been higher than 300 ppm before the industrial era in this dataset, that we have added another 40% to this level.

8. The temperature rise in the last 100 years (thought to be about 0.8 degree C[8]) is not unusual in this climate record as we will see.

4.2 Digging a little deeper

How unusual is the last 100 years compared with the Vostok dataset? There are three factors worth considering:

4.2.1 Rate of temperature change We have seen above that its somewhere around 1 degree C in the last 100 years. This is an emotive and frequently conflated subject. At the current meeting of COP28 in the UAE, Dec 2023, the President of COP28, Al Jaber, said: "I accepted to come to this meeting to have a sober and mature conversation. I'm not in any way signing up to any discussion that is alarmist. There is no science out there, or no scenario out there, that says that the phase-out of fossil fuel is what's going to achieve 1.5C."

This statement was criticized because of the association of its speaker with the fossil fuel industry, however, he is correct. There is no supporting evidence that phasing out fossil fuel will achieve what so many people so fervently hope, that we can turn the thermostat up and down on the earth as if its a gas boiler. It would be nice, but there is no evidence. The physics of the greenhouse effect are a lot simpler than when they are embedded in something as complicated as the climate and its myriad energy-interchange mechanisms. The Vostok ice-core dataset casts interesting light on this aspiration.

Much indeed is made of the rapid increase in temperature this century. One degree C in 100 years seems very rapid for a climate. This would justify some of the hyperbole used if it were not for the fact that this has happened before in the Vostok record. *It has in fact occurred as greater than 1 deg C rise in 173 centuries and greater than a 1 deg C fall in 179 centuries.*

[8] NASA Goddard reports 1.1 degrees C since 1880 with current rise rates of 0.15-0.2 degrees C per decade which would correspond to around 1.5-2 degrees C per century, https://earthobservatory.nasa.gov/world-of-change/global-temperatures

Table 1. Previous occurrences of a more than 2 degree C change in a century with year and corresponding change in CO2. A + sign indicates an increase and a - sign a decrease.

Year	Temperature change (deg C)	-CO2 change (ppm)
-110100	+2.170	-0.267
-96000	+2.630	+0.113
-71000	-2.470	-0.042
-65100	+2.050	-0.350
-59400	-2.480	+0.291
-57300	+2.820	+1.986
-53000	-2.570	-0.666
-46000	+2.610	+0.516
-41200	-2.130	+0.000
-37900	+2.570	+0.000
-31700	-2.860	-0.272
-27600	-2.650	+0.101
-27400	+2.120	+0.101
-12500	+2.740	+3.400
-11300	-3.260	+3.400
-6400	-2.340	-3.500
-900	+2.050	+0.664
-800	-2.410	+1.700

Not only this but the value of 1 degree C change has been significantly exceeded in both directions on a number of occasions.

Table 1 shows the number of occasions this has happened for changes of more than 2 degrees C in a century, *twice* the current level, since the last interglacial.

Note that nearly all of this rapid change has taken place only in the last 200,000 years and none of it within the industrial era. Indeed it occurred just once before the last interglacial in year -229800 with a decrease of 2.03 degrees C. We can also note that the direction of temperature change and the corresponding direction of CO2 change do not correspond well. There is a reason for this as we will see now.

There is weak evidence that the CO2 rise *lags* the temperature rise by about 700 years as shown by Fig. 4. This is somewhat unexpected given the wide-spread belief that CO2 drives temperature change but the normalised cross-correlation is fairly flat here and the predicted lag could be anywhere within a few centuries of this, but most likely it is a lag. So it would appear that it is temperature change which drives CO2 change and not the other way round.

We can summarise the above by saying that a 1 deg C rise in a century is not really unprecedented at all. In fact, since the last interglacial peak around 130,000 years ago, the atmosphere has grown more volatile for reasons we do not fully understand but nothing to do with us, a change of at least 1 deg C in a century has been recorded on 263 occasions (127 up and 136 down). In other words, 263/1300 centuries have exhibited a change of at least 1 degree C or 20% of the time, so it is scarcely unusual and certainly does not deserve the epithet ”emergency”.

4.2.2 Current temperature and targets The current hyperbole states that we are ”running out of time” and ”must keep to the agreed climate targets”. This of course assumes that we have any real control over them. So do we?

The last interglacial was one of the most vigorous in the last 800,000 years. In fact it’s peak temperature exceeded that of the current day by almost 4 degrees C 128,700 years ago. This unpleasant truth needs discussing much more as it strongly suggests that the global average temperature is not perhaps as controllable as we would like; there are clearly non-anthropogenic influences here. Its not as though the leading perpetrators of hyperbole are unaware of this. The UK newspaper *”The Guardian”* has been beating the drum for hyperbole for years. At the end of COP28 on 14-Dec-2023, it produced this text *”THE LOSERS: The climate — The Paris Agreement’s most ambitious goal of limiting global heating to 1.5C was left nominally alive by Cop28, but has been killed off by the lack of urgency and specifics in the agreement.* ***Despite the hottest summer in 120,000 years****, the oil, gas, coal and farming companies that are heating the planet can continue to expand production for the foreseeable future ...”*

Note the emboldened text in the above and refer back to Fig. 2. The statement is correct but highly misleading to say the least. In the urge to trumpet its message, it is disguising one of the most important attributes of the Vostok Ice Core dataset.

Given the trend of this dataset, it seems likely that *even if humans had never existed*, something similar would have occurred anyway in the peak of the current interglacial, given the trend in this dataset, and as we see above fluctuations of 1 deg C or more are pretty normal.

We should therefore anticipate a peak of perhaps 4 degrees C higher than today in the next few centuries irrespective of what we do. Legislating to keep this below 1.5C brings to mind King Canute’s efforts to stem the tide. Bureaucracy and physics are unnatural bed-fellows. These are natural forces we still do not understand whatever we may trumpet on social or indeed other media. We would be much better employed in attempting to mitigate the effects of the inevitable rise in this interglacial, whatever it goes to.

Of course, it may go higher. Life has survived CO2 levels anywhere between as high as 7000ppm in the distant past and as low as 172ppm some 667,600 years ago. The earth’s climate balances itself with water vapour and seems in no danger of a ”tipping point”. The concept of a tipping point comes from chaotic system dynamics. In and amongst all the tumultous events in earth’s long history, there has never been what you would call a climate tipping point. In the sense used here it is intended to suggest that an irreversible change occurs - the atmosphere will flip into some other unpredictable state from which it will never return. To put this into context with our meagre efforts, the Chicxulub impactor event of 66 million years ago, when a 10km asteroid collided with the earth in the Yucatan peninsula travelling fast enough to travel round the earth in 30 minutes, was incomparably more destructive. Yet its effects on the atmosphere, (essentially a very dark winter for a few years), were only temporary although the effect on land-based life was indeed catastrophic. This mass extinction event is now known as the Cretaceous–Paleogene (or K–Pg). About 75% of all species became extinct[9]. Life however also bounced back very quickly although in a different form with a lot less dinosaurs. This is just one of many things which makes geology so interesting - you can still see the 10cm layer of dark ash which fell out of the atmosphere in the years following this event at various places in the world[10].

Whether or not life can sustain the migration pressures of however many billions of humans there are when (rather than if) the climate warms is an entirely different story. That’s down to us, after all, survival is optional.

4.2.3 Rate of CO2 change There is an elephant in the room which this dataset cannot answer. The largest CO2 rise recorded in a century in this dataset is around 10 ppm (-129000 and -100 years) and the largest fall -13.1 ppm (-128300 years). *This last century has exceeded 120 ppm.*

[9] See `https://en.wikipedia.org/wiki/Extinction_event`

[10] There is a spectacular picture of this at `https://en.wikipedia.org/wiki/Extinction_event/media/File:KT_boundary_054.jpg`

The earth normally responds to big rises in CO2 by greening and this is indeed happening[11] but this does not play into humanity's plans for the natural world as we continue to deforest and to wipe out habitats.

This is a genuine climate conundrum. Climatologists have essentially two avenues to follow to resolve questions like this. The first is to find a similar situation in the past and see what happened then. The problem with the current rate of CO2 change is that there is no such similar situation known, at least for which we have any data. In this case, climatologists must resort to the second alternative and that is to model the situation in a computer. In effect, that is what we currently do when you hear all those predictions about how high the temperature will go. There is nothing wrong with computer modelling - I've spent my career doing it - but there is a problem with climatological computer modelling. It's exceedingly hard and you can't put much trust in the results.

This paragraph is rather technical so just skip it if you want. Climatological computer modelling is arguably the second most difficult problem to resolve in theoretical physics. The reason is that independently of whether we are modelling weather or climate, the underlying equations - the Navier-Stokes equations - are time-dependent non-linear coupled partial differential equations which have to be solved in energy-conserving form on a rotating oblate spheroid whilst taking account of a plethora of frequently poorly understood energy mechanisms. Theoretical physicists normally cheat a bit with non-linear equations by a process called "linearising" but if you do that with these equations, all the interesting stuff such as the whole of the weather and climate inconveniently disappear[12]. If that weren't enough, they are not closed and the energy mechanisms have to be "parameterised", as an educated guess is called. They have to deal with water, a really significant component, in all three phases, solid, liquid and vapour including cloud formation and dissipation and they also have to deal with how the surface (water or land) interacts with the atmosphere above it. For land, this is a whole process unto itself known as evapo-transpiration. And if that weren't enough, they are fairly sensitive to the conditions from which you start off the prediction. These complexities are no mere quibble. To my knowledge, no climate model can successfully "backcast" to produce the patterns of the Vostok ice-core dataset from the present day and it should be remembered that backcasting is easier than forecasting. All in all, climate and weather modellers earn their crust of bread. Before moving on, you are probably wondering what the most difficult problem in theoretical physics is. The fluid being modelled in climatology is the atmosphere, a mixture of largely non-interacting gases. All you need to do to make it really difficult is to make the fluid being modelled magnetic, so that it affects its own flow. This takes us into the strange arcane world of magneto-hydrodynamics and resolving questions like "How come the earth still has a magnetic field after over 4 billion years?". Good question - I'll pass on that one. Solving the equations for a rotating black hole for example is an absolute doddle by comparison.

5 CONCLUSIONS

So is the current temperature rise of around 1 degree C per century unprecedented? **No.** The last interglacial contained comparable rises *and* falls on over 250 occasions in the last 200,000 years and changes of twice this amount on 18 occasions. Its nothing to do with us but the atmosphere appears to be getting more volatile.

Has the earth been significantly warmer in the recent past? **Yes,** in the last interglacial and it was nothing to do with anthropogenic effects.

[11] https://climate.nasa.gov/news/2436/co2-is-making-earth-greenerfor-now/

[12] The frontal systems you see marching across our weather forecasts are generated by something called baroclinic instability, an entirely non-linear phenomenon.

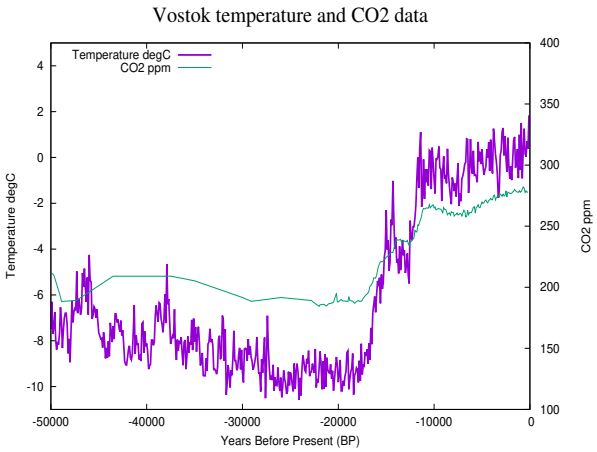

Figure 3. The Vostok ice core dataset for the last 50,000 years. This dataset has not been processed in any way and is a pure subset of Fig. 1.

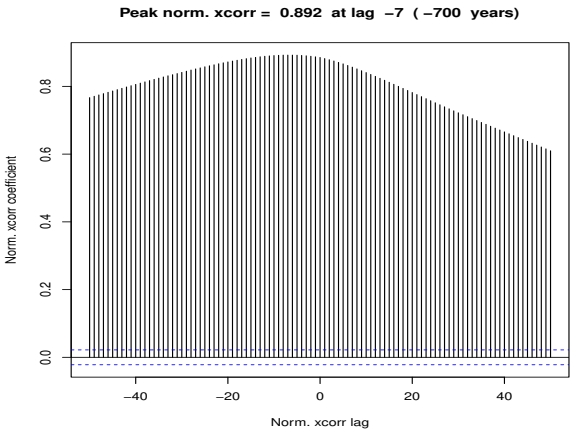

Figure 4. Normalised cross-correlation between the temperature and CO2 Vostok curves indicating weak evidence of temperature leading CO2 by around 700 years.

Do we have a climate catastrophe or emergency? **No.** Given the number of times this has happened in the recent geological past without any help from us, it seems likely that the climate will be fine as it always has been. Its worth repeating that the current era is relatively cold and low in atmospheric CO2 even with our efforts.

Will life be OK if there is a several degree C rise in temperature? **Yes,** because it has been before when we were much less technologically capable. 900 years ago, the temperature climbed by 2.05 deg C in one century and then fell by 2.41 deg C the following century. It has however been much more threatened by temperature falls and the ensuing ice ages in the 800,000 years of the Vostok ice cores.

Will humanity be OK? **That depends.** If it spends all its resources trying to stem the inevitable rise in temperature expected to appear in this interglacial quite apart from anything we may add, rather than mitigating its effects, then no it won't be. However much CO2 we capture or prevent escaping, it seems more than likely that the temperature continues to rise as it did in the last interglacial and humanity will have to cope with mass migration amongst 10 billion souls and it will have to feed them. The real question is "Is humanity running out of time to plan for this?" That's one for the politicians, although planning for anything further away than a few years in the future has never been our strong point.

Further down the line of course, interglacials have always transitioned fairly quickly to ice ages and the lowest temperature recorded in the entire 800,000 years of the Vostok dataset was -10.58 deg C compared

with today and occurred only 24,100 years ago. Interglacial warm periods historically only tend to last a few thousand years before average temperatures begin to fall again, but that's also one for the future.

I will close by saying that using words like "urgent" are rather misleading in the context of climate dynamics. It may seem urgent when a wild fire threatens a holiday hotel and the temperature gets in the 40s Celsius but that's weather not climate. Climatologically, if the previous interglacial is repeated, the earth will get perhaps 4 degrees C warmer in the next century or two whatever we do and in a few thousand years will enter a new Ice Age. Humans have never had to plan on these time-scales before but perhaps its time we listened to the data rather than each other and started.

About the author

*Les Hatton Ph.D. is a mostly retired mathematician, geophysicist and computer scientist who started his career in numerical weather prediction and climatology.

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