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Choosing a Future

Keywords:

When predicting the outcome of complex systems, it is very difficult to claim anything with absolute certainty; indeed this would be closed-minded to unknowns and possibilities, thus unscientific. Yet, if something has a probability of occurring >50%, then it is more likely to happen than not. And as probability rises, e.g. 90%, then there is high confidence of occurrence unless an improbable event alters conditions.

The long-established, independent and rigorous scientific understanding of earth and planetary systems, and of mathematics and physics, describes and explains with very high confidence, e.g. 99.9%, that the planet is experiencing a recent and rapid warming above what would otherwise be expected by long-term orbital changes or other *natural* factors. Further, it is with a similar degree of confidence that this is occurring due to human activity, principally by the release of CO_2 through combustion of fossil fuels. The CO_2 emitted from these has an isotopic ratio that differs from natural sources. The isotopic ratio of CO_2 species in the atmosphere has been reconstructed for the past millennia using direct sampling, tree rings and ice cores, and identifies the onset of the industrial revolution and the contribution of fossil fuel combustion as correlated with the observed increase in atmospheric CO_2.[1] Similar signatures exist for methane[2], another potent greenhouse gas (GHG).

There is strong correlation between the recent rise of GHG and rise in global average temperature. However, due to the variation and complexity of thermal sinks and transfer systems across the planet, including atmosphere, oceans, land masses and biosphere, future conditions resulting from rising temperature become increasingly difficult to predict. Differential heating has already been observed, with polar regions warming faster than the global average, and subsequent changes in ice and snow cover will likely result in accelerated heating and subsequent abrupt changes in thermal transfer, i.e. regional climates, such as the Atlantic meridional overturning circulation (AMOC).

Through understanding the drivers and variations in current and pre-historical climates, at regional and local scales, models are constructed to simulate what may be expected in a warmer future. These may include rainfall patterns, their intensity and timing, regional temperatures that may vary significantly from the global average, and the effects on Earth's biological systems, including terrestrial and marine. Changes in any of these systems feeds back into, and affects, both the planetary climate driver as well as each other. Models suggest that as temperature continues to rise, climate becomes less stable, harder to predict, and more hostile to the current assemblage of biology on earth, including humans. Indeed, numerous reports suggest that exceeding 4ºC poses an existential risk to humanity:

> "…there is.. no certainty that adaptation to a 4°C world is possible… The projected 4°C warming simply must not be allowed to occur—the heat must be turned down. Only early, cooperative, international actions can make that happen."[3]

[Note: This warning was issued in 2012, yet in 2019 emissions continue to rise, economic growth under the business as usual paradigm continues unabated, whilst international and national political cooperation and initiatives, relating to emissions reduction, appear to have slowed or may fail to meet the nationally determined contributions (NDCs) which underpin the Paris Agreement.]

Under the Paris Agreement (2016), nations have committed to limit emissions such that temperature remains near 1.5C above pre-industrial levels. Given cumulative and projected emissions, there is a very low probability that this can be achieved. It would require decreasing reliance on fossil fuels by 50%

[1] https://www.e-education.psu.edu/earth103/node/1018

[2] Nesbit E. G., et al., (2016) "Rising atmospheric methane: 2007–2014 growth and isotopic shift", Global Biogeochemical Cycles, Vol. 30 Issue 9, pp 1356-1370

[3] The World Bank, (2012), "Turn Down the Heat: Why a 4C Warmer World must be avoided", International Bank for Reconstruction and Development / The World Bank, Washington

within 11 years, and to zero by 2050. Yet emissions continue to climb, and fossil fuel consumption linked to economic activity and growth is projected to increase through to 2040[4]. Despite nearly 50 years of warnings, the pervasiveness and momentum of the economic growth paradigm has led to an institutionalised GHG emissions dreadnought that seems to neither be steered or halted.

Given current trajectory, it is suggested that 2°C is almost certain to be reached by ~2050, and that further temperature increase can be expected due to cumulative and expected human activity, and also due to self-reinforcing warming processes. These *positive feedbacks* are expected to begin when temperature or condition-thresholds are breached, starting from present warming, as seen with already rapid ice melt, and almost certainly by 2C and above. They include but are not limited to:

- accelerating release of CO_2 and methane from permafrost, shallow ocean clathrates, coastal and terrestrial swamps
- reduced efficiency of GHG sinks due to sea surface CO_2 saturation, decline in micro-marine organisms, methane-reducing hydroxyl radical depletion in atmosphere, and reduced terrestrial vegetation cover and changed soil transpiration
- reduced albedo effect from land and sea snow/ice, and changes in cloud cover
- increased burning of forest-cover and desertification.

Many national and regional GHG mitigation and adaption plans do not grasp the magnitude of the problem. They acknowledge that local regions will suffer effects and need to adapt; however, there is a failure to take into account the interconnectedness of all life and human systems on the planet. Should 4°C be reached by 2100, therefore in 80 years, the equatorial third of the planet will periodically, and increasingly, experience heat stress fatal to most mammalian life. There will be disruption of food, water and ecosystems at all latitudes, and there is likely to be mass human migrations and global conflict. The historical record attests that even small changes in climate have dramatic and typically disastrous impacts on complex societies; and this was when the human population was orders of magnitude lower, resources were abundant, and militaries less mobile and destructive. While 4°/2100 is a reference point, there is evidence that climate change is already contributing to agricultural failure, water scarcity and conflict, e.g. in the Middle East, Africa and India; testing already over-exploited resources. This is expected to increase and challenge all countries, including members of the OECD.

The risks associated with climate change have been thoroughly communicated to world leaders, as well as to industry and populations when they chose to listen. The multitude of solutions are ridiculously simple, e.g. renewable energy, and can easily lead to a more equitable, safe and prosperous world. However, the human population is caught in a death spiral because it cannot imagine and move beyond the current political and economic systems paradigm that increasingly consolidates wealth and power to an elite with a propensity toward indiscriminate malevolence. It appears that democracy can fail populations as catastrophically as any tyranny; indeed, potentially even more so.

Many in the scientific and wider community are perplexed that the world continues to gather pace toward an uninhabitable Earth despite scientific evidence and political and civic activism. Often the wider population is blamed, with beliefs such as market demand and economic development. However, these statements are misguided and do not address the root cause, being that there is still money to be made by powerful vested interests in maintaining the status quo, and then profiting from any future calamity. This strategy will take humanity to the very precipice, and if it miscalculates, both the 99% and the 1% will perish together.

Status: Draft for critical review.

[4] BP