APCEL Climate Change Adaptation Platform

Flirting with dangerous climate change. Are we closer than we think?

by

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Twenty-five years ago, at the 1992 United Nations Framework Convention on Climate Change (UNFCCC), the UN issued a bold and prophetic statement: "*humanity must achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent **dangerous** anthropogenic interference with the climate system*"[1]. Twenty two years later, in 2014, the UN Intergovernmental Panel on Climate Change (IPCC), in its Fifth Assessment Report (AR5), concluded that evidence for the warming of the Earth's atmosphere and ocean system was *unequivocal*, and it was *extremely likely* that human influence was the dominant cause of global warming due to atmospheric greenhouse gas (GHG) emissions[2].

Although the term 'dangerous' was not scientifically defined at the time of the UNFCC, it subsequently became synonymous with a global average surface temperature increase of no more the two degrees centigrade (2^{o}C) relative to the pre-industrial period. The 2^{o}C climate goal supposedly serves as a 'guardrail' to maintain the stable climate conditions that human civilisation has adapted to since the end of the last ice age about 11,600 years ago. It is intended to avoid the worst impacts of climate change, as manifested by drought, heat waves, flooding, and sea level rise. In terms of the likelihood of *not* exceeding the 2^{o}C limit, the IPCC stated in the AR5 report that, without new policies to mitigate climate change, an increase in global mean temperature by 2100 of up to 4.8^{o}C is possible (within a potential range of 2.5 - 7.8^{o}C when accounting for climate uncertainty)[3].

Embraced as the aspirational goal in the Copenhagen Accord at the 15th Conference of the Parties (COP 15) in 2009[4], the 2^{o}C goal then became the foundation of the Paris Climate Agreement (PCA).[5] On 12 December 2015, at COP 21, the PCA committed the world to "holding the increase in the global average temperature to well below 2^{o}C above pre-industrial levels" and went further by stating the need to "pursue efforts to limit the temperature increase to 1.5^{o}C". This lower, more stringent, goal was adopted in response to mounting scientific evidence that the global climate system is more sensitive to ongoing greenhouse gas emissions than previously thought.

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The PCA requires countries party to the UNFCCC to adopt nationally determined contributions (NDCs) to limit GHG emissions in accordance with the 2°C and 1.5°C climate goals. The agreement also aims to strengthen the ability of vulnerable countries to deal with climate change via an appropriate flow of finance and technology.

Although the PCA is commendable as a major diplomatic achievement, a significant disparity still exists between the actual GHG reductions required and those pledged within the NDCs. According to the International Energy Agency (IEA), the NDCs, in their current form, will result in temperature increases of up to 2.7°C by 2100, and over 3°C soon thereafter[6]. This disparity has been brought into sharp focus in the new UN Emission Gap Report (October 2017)[7] which states that current pledges for emission cuts cover only one-third of those needed by 2030 to keep below 2°C of global warming by 2100. By 2030, global emissions should be no more than 42 gigatonnes of CO_2-equivalent (i.e. accounting for all GHG emissions, not just CO_2). Based on pledges to date, then the emission gap for 2°C is 11-13 $GtCO_{2eq.}$, and for 1.5°C is 16-19 $GtCO_{2eq.}$ - prompting the UN to call the emission gap "alarmingly high". Ominously, the UN is now warning that if this disparity is not closed by 2030 then "it is extremely unlikely that the goal of holding global warming below 2°C can still be met".

In short, the current trajectory of global GHG emissions is not consistent with limiting global warming to below 2°C relative to pre-industrial levels (let alone 1.5°C) and will commit the world to dangerous anthropogenic climate change. Further, the efficacy of the PCA has been recently denigrated by the unilateral decision of the USA, the world's second largest emitter of CO_2 after China, to withdraw from the agreement. This is clearly contrary to warnings that continued high emissions of greenhouse gases could induce what the IPCC has referred to as 'abrupt' and 'irreversible' climate change. A recent report in the journal Nature warns that, based on the current CO_2 emission trajectory, the carbon budget to avoid 1.5°C of global warming will be spent as early as 2021[8].

In the context of the PCA climate goals, it is worth noting that the average global surface temperature in 2016 reached the highest level in the instrumental records, at 1.24°C above the 1880-1920 baseline[9,10]. Although temperatures in 2016 were partly boosted by the 2015-16 El-Niño weather event, warming in the Arctic was closer to 3°C above average[9]. In 2017 average temperatures have lessened, but on-going measurements indicate that this year is on track to be the second warmest[11].

A new World Meteorological Organization (WMO) report, released in October 2017[12], confirms that atmospheric concentrations of CO_2 in 2016 were the highest on record, at 403.3 ppm. This CO_2 level, based on available paleoclimate data of the Earth's climate history, is the highest in the last 800,000 years and stands at 145% of pre-industrial CO_2 concentrations. The WMO report mentions that during the mid-Pliocene, some 3 to 5 million years ago, atmospheric CO_2 concentrations were similar to those of today, but 'equilibrium' climate temperature was 2-3^{o}C above the present, and sea-level was 10-20m higher than today. The time required to reach climate equilibrium is debateable, but the physics is not. The WMO report shows that the rate of accumulation of CO_2 in the atmosphere has accelerated. The annual jump in the CO_2 level in 2016, at 3.1 ppm, was 50% higher than the previous 10-year average and estimated to be about 100 times faster than at the end of the last ice-age.

Although the 2015-2016 El-Niño is partly responsible for the jump in CO_2 levels, there is concern that carbon emissions, in the form of CO_2 and methane (CH4), may be coming from natural global carbon reservoirs, such as Arctic permafrost rather than manmade emissions. If such high CO_2 concentrations persist in the atmosphere, then it is looking inevitable that tipping points in the climate system will be crossed. If so-called 'positive-feedback loops' are triggered then climate change essentially becomes irreversible - at least on a timescale that matters to humanity. More extreme sea level rise will also become locked-in. In the 2007 AR4 Synthesis Report[13], the IPCC specifically warned of the risk of abrupt and irreversible risks to the world's coastlines via inundation of low-lying coastal areas as a result multi-metre sea level rise due to the disintegration world's great ice sheets, including Greenland and Western Antarctica.

In another recent publication, in the journal 'Earth System Dynamics, Hansen et al. (2017)[14] reported that global warming in the past 50 years has raised average temperatures to above the range of the current Holocene period, with temperatures now matching those of the previous the last interglacial period the Eemian, when 126,000 years ago sea level was 6 to 9 meters higher than today.

Such data contrast with the perception that the world has started to mitigate climate change by ratifying the PCA. It is now beyond doubt that the world needs to dramatically slash carbon emissions if it wants to meet the goals of the Paris Agreement. But by how much? In Hansen et al.'s publication, the authors examined the GHG emission reductions required to restore the Earth's current energy imbalance, and bring temperature back to a level compatible with the Holocene[14]. Basically, global warming can now only be held at below the 1.5^{o}C guide-rail if rapid reductions of global CO_2 emissions begin almost immediately, with cuts of at least 3% per year and, critically, assuming that there is no net-growth in other temperature-induced positive feedback emissions of GHGs from natural carbon reservoirs.

Although the current trajectory of GHG emissions under the NDC pledges of the PCA fall short of the climate goals, there are, nonetheless some green-shoots of optimism. The 2017 Energy Technology Perspectives report[17] of the International Energy Agency (IEA) presents evidence that the global energy sector is changing. Renewable sources of energy (wind, solar, hydroelectric), as well as nuclear power, are now supplying the majority of new global power generating capacity. From 2010 to 2015 renewable-power generation grew by more than 30 percent, and is forecast to grow by another 30 percent by 2020, thanks largely to a rapid drop in the cost of solar and wind power[16]. As a further sign of rapid change, innovative low-carbon transportation technologies are gaining momentum. This has resulted in global carbon emissions stalling in the last several years - even though the world's economy has continued to grow.

Optimistically, the IEA and the UN say that capping global warming to 2^{o}C is still possible - but only just, and only if the deployment of renewable power sources further accelerates to provide an additional 40% of total power generating capacity by 2025. Indeed, the IEA predicts that the power sector could even reach carbon neutrality by 2060 which, in turn, will limit future temperature increases to no more than 1.75^{o}C by 2100 i.e. the midpoint of the PCA climate goals. However, this goal will require strong investment in carbon capture & sequestration (CCS), and associated negative emission technologies (NETs). According to Hansen et. al. (2017)[14], ongoing delays in carbon emission cuts mean that extraction of 100Gt of carbon (about 10 years of current CO_2 emissions) is needed this century in order to restore the Earth's energy imbalance. A rapid phase-down of fossil fuel consumption with improved agricultural and forestry practices, could provide much of the required CO_2 extraction from the atmosphere. However, the authors also warn that methods of CCS, such as bioenergy with carbon capture and storage (BECCS), or direct air-capture of CO_2, will come at a costs of up to US$535 trillion and are associated with large uncertainties and risk. Without aggressive emission reductions, the authors argue that today's young people are committed to a massive atmospheric carbon clean-up, more deleterious climate impacts - or both.

The near-global ratification of the PCA demonstrates almost worldwide support to address climate change, and the complex sustainability challenges facing humanity in the 21st century. Encouraging trends in the transition to a low-carbon economy are emerging, but the scale and urgency to mitigate global GHG emissions should not be underestimated. International policy must be galvanised and strengthened to ensure that a cooler, safer, and more secure world prevails.

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