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Climate change: The necessary, the possible and the desirable Earth League climate statement on the implications for climate policy from the 5th IPCC Assessment

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Abstract The development of human civilisations has occurred at a time of stable climate. This climate stability is now threatened by human activity. The rising global climate risk occurs at a decisive moment for world development. World nations are currently discussing a global development agenda consequent to the Millennium Development Goals (MDGs), which ends in 2015. It is increasingly possible to envisage a world where absolute poverty is largely eradicated within one generation and where ambitious goals on universal access and equal opportunities for dignified lives are adopted. These grand aspirations for a world population approaching or even exceeding nine billion in 2050 is threatened by substantial global environmental risks and by rising inequality. Research shows that development gains, in both rich and poor nations, can be undermined by social, economic and ecological problems caused by human-induced global environmental change. Climate risks, and associated changes in marine and terrestrial ecosystems that regulate the resilience of the climate system, are at the forefront of these global risks. We, as citizens with a strong engagement in Earth system science and socio-ecological dynamics, share the vision of a more equitable and prosperous future for the world, yet we also see threats to this future from shifts in climate and environmental processes. Without collaborative action now, our shared Earth system may not be able to sustainably support a large proportion of humanity in the decades ahead.

1. Human Wellbeing Is at Risk From a Changing Climate

The development of human civilizations has occurred at a time of stable climate. This climate stability is now threatened by human activity. The rising global climate risk occurs at a decisive moment for world development. World nations are currently discussing a global development agenda consequent to the Millennium Development Goals (MDGs), which ends in 2015. It is increasingly possible to envisage a world where absolute poverty is largely eradicated within one generation and where ambitious goals are adopted on universal access to clean energy and water, and improvements in human health, education, and equal opportunities for dignified lives.

These grand aspirations for a world population approaching or even exceeding nine billion in 2050 [Andreev et al., 2013] is threatened by substantial global environmental risks and by rising inequality [Brito and Stanford-Smith, 2012; UNEP, 2012; Intergovernmental Panel on Climate Change (IPCC), 2013, 2014a]. Research shows that development gains, in both rich and poor nations, can be undermined by social, economic, and ecological problems caused by human-induced global environmental change [World Bank, 2012]. Climate change, and associated alterations in marine and terrestrial ecosystems that regulate the resilience of the climate system, is at the forefront of these global risks.

We, as citizens with a strong engagement in Earth system science and socio-ecological dynamics, share the vision of a more equitable and prosperous future for the world, yet we also see threats to this future from shifts in climate and environmental processes. Without collaborative action now, our shared Earth system may not be able to sustainably support a large proportion of humanity in the coming decades.

2. Scientists Speaking With One Voice

The scientific evidence is clear: by continuing to add greenhouse gases (GHGs) to the atmosphere we are laying a very dangerous path for our planet. The magnitude of future global temperature and related changes in regional weather extremes, rainfall patterns, and sea level will be determined by the extent to which our emissions of GHGs trigger reinforcing climate processes (positive feedbacks), some of which are likely to continue to accelerate as warming proceeds.

Recent evidence from both Polar Regions illustrates that such positive feedback effects may have already started. Satellite observations and field measurements show that summer melting of snow on Greenland now occurs over most of the ice sheet, which leads to a darker surface and, as a consequence, an increase in heat absorption, leading to further melt [Box et al., 2012]. A similar issue has been observed in the Arctic Ocean, as a consequence of the generally diminishing sea ice, leading to enhanced uptake of the sun's heat by the open ocean. In West Antarctica, where the ice sheet is grounded on the sea floor, ocean warming has been shown to cause ice retreat into deeper regions, which automatically leads to further loss of ice and, hence, greater retreat. Recent studies have suggested that some sections of the ice sheet are now undergoing the first signs of irreversible loss, with the risk of additional global sea level rise of one or more meters in the coming 50–100 years [Joughin et al., 2014; Mouginot et al., 2014]. Irreversible melt of the Greenland ice sheet, which holds an associated sea level rise of seven meters, might be triggered by less than 2°C of global warming compared to the pre-industrial climate [Robinson et al., 2012; IPCC, 2013]. Another significant risk is that of long-term carbon release from permafrost thawing in boreal zones, leading to substantial additional warming of the planet's surface [Schaphoff et al., 2013]. All the while, the risk of ecosystems transforming across the world increases strongly as a function of global mean temperature change [Ostberg et al., 2013].

Actual trends of CO_2 emissions suggest that the warming effect of our current GHG emissions rates might push us to 4°C above pre-industrial climatic conditions. If this occurs, our climate would be as different from pre-industrial conditions as it was when the Earth began to emerge from the last ice age some 18,000 to 20,000 years ago. The governments of the world have agreed that the global average temperature increase should not exceed 2°C (compared to the pre-industrial average) in order to avoid dangerous climate change (COP Cancun, 2010). Considerable risks with potentially serious impacts are expected already at 1 to 2°C warming, which will require large investments in adaptation [IPCC, 2014a].

Beyond such average global temperature increases, societies will experience increasing risks from extreme events and other changes that may be beyond adaptation capabilities, making several parts of the world susceptible to extremely high social and economic costs [IPCC, 2012]. This includes risks to global food production, freshwater supply and quality, significant sea level rise, changes in disease patterns, and possibly higher risk of pandemics (IPCC, 2014a).

As human-induced emissions of CO_2 increase, the likelihood of exceeding 2°C rises. Translating the climate sensitivities in the IPCC AR5 report into risk terms shows that at a greenhouse gas concentration of 450 ppm CO_2eq for all forcing agents, i.e., long- and short-lived gases as well as warming and cooling agents, the probability of exceeding 2°C at equilibrium is approximately 60% [Rogelj et al., 2012; GROI, 2013; IPCC, 2013]. Even if we focus on transient scenarios until 2100 with deep cuts in emissions during the second half of the century, we face at least a 30% probability of exceeding 2°C the by end of the century at 450 ppm CO_2eq [IPCC, 2014b]. We are virtually certain to reach an annual mean concentration of 400 ppm CO_2 in 2014 (we stood at 398 ppm CO_2 in early 2014 and are increasing at a rate of 2–4 ppm per year), which corresponds to approximately 450 ppm CO_2eq for all forcing agents. This is a very high risk level, especially given that we are already above 400 ppm, and is much greater than we normally accept for other potentially dangerous societal risks, such as nuclear power generation, terrorism, and human health epidemics.

Humanity still has a choice, either to continue on a high risk path, or to transition to a developmental paradigm that enhances human well-being within a safer future climate. This choice can be stated in terms of a maximum global carbon budget: a limit of approximately 600–1200 Gt of additional CO_2 emissions gives the world a 66% chance of meeting the target 2°C under optimistic assumptions (sustained carbon sinks, reduction in other GHGs, and non-occurrence of Earth system tipping points) [Meinshausen et al., 2009, 2011; Rogelj et al., 2012; IPCC, 2013, 2014]. With the current level of global fossil fuel CO_2 emissions of approximately 35 GtCO_2/year and rising, the world has only some 20–25 more years to complete the transition to a low-carbon economy. To succeed in staying within anything like this global carbon budget or, equivalently, to limit the global temperature rise to even near 2°C, global emissions would need to peak in the 2020s and fall to a very low level in the latter part of the century.

3. The Challenge for Global Society and Its Political Leaders

Politically and economically, emissions reductions are extremely challenging and represent a big investment that will pay off years later. There is, in our minds, no doubt that this is one of the largest world challenges of our time. But with challenges come huge opportunities. It might be possible with existing technologies to secure continued development and well-being for our rapidly growing global population, while performing a concerted global transformation to a low-carbon economy that ensures access to clean energy for all citizens and avoids the risks of climate change [GEA, 2012; World Bank, 2012].

The latest scientific assessment of global climate change by the IPCC comes at a critical juncture, as world nations prepare for the post-2015 world development framework, including both a global climate agreement to follow on from the Kyoto Protocol and the Sustainable Development Goals agenda to replace the MDGs (Griggs et al., 2013). The political challenge is to now design a transformational paradigm shift in development, away from growth at the expense of the climate system and, instead, transition toward a framework that ensures sustainable human well-being within the safe operating space of a stable environment [Rockström et al., 2009; Steffen et al., 2011].

The task ahead for world leaders involved in the UN processes on climate change and sustainable development is immense. The scientific reasoning behind the need for change is irrefutable, however. Our world, our society, if it wishes to avoid significant and irreversible global change, must commit to do everything it can to stabilize the climate system at, or below, the internationally agreed target of 2°C. It is encouraging that many countries are taking important first steps in this direction.

4. A Global Transformation Is Necessary and Possible . . . .

World economic growth has been fueled by decades of investments that have led to relatively cheap fossil energy sources, subsidized through “cost-free pollution” of the atmosphere and the biosphere, and little compensation to regions and communities impacted by industrial progress over the last two centuries. This path has led to substantial economic growth in many nations of the world, and our existing geopolitical framework. There is, therefore, an understandable temptation to continue with this well-proven growth model. Based on the evidence at hand, however, that approach puts both the climate system and the biosphere, upon which humanity depends, at risk, and thus also, future societal well-being and development. Because more than 70% of emissions are from fossil fuels, a global transformation to a low-carbon world economy is a necessary and urgent requisite for reducing the risks and costs to our future generations.

This transformation requires a global energy revolution [GEA, 2012], which has, we suggest, already started. Several sectors, businesses, civil society initiatives and countries are gradually implementing and scaling-up renewable energy systems, decoupling future growth from emissions, and improving energy efficiency, not primarily on environmental but on economic grounds [GEA, 2012]. Energy demand in many industrialized countries is falling even as their economies continue to grow. Wind power and solar photovoltaics are growing exponentially in several parts of the world, already accounting for 25% of electricity generation in countries such as Germany and Spain, and are rapidly outcompeting traditional energy sources, such as nuclear and fossil fuels on energy returns on investment (EROI) [World Energy Council, 2013], leading to the conclusion that many countries can today reach very high shares (30%) of electricity from solar and wind [IEA, 2014]. These changes need to be widespread and accelerated exponentially. Research and development on next-generation buildings, mobility, smart grids, low cost, and efficient storage and energy carriers, etc., show that decarbonization offers huge opportunities and that energy systems can be based on emissions-free sources. The world may be approaching a point where the technological feasibility and economic benefits clearly tip in favor of a large-scale transition to an economy powered by clean and efficient energy [GEA, 2012]. Ensuring unbiased and enabling policy, and regulatory frameworks could bring about the transformations that could lead to a carbon neutral society.

A transformation to global sustainability, including our ability to mitigate climate change, goes well beyond reducing emissions of CO_2. Safeguarding the resilience of the biosphere is necessary in order to sustain the huge carbon sink in the oceans (which absorb ~25% of anthropogenic CO_2 emissions) and land-based ecosystems (which take up another ~25% of CO_2 emissions) [IPCC, 2013]. Sustainable management of Earth's finite freshwater is also critical in this respect, as its role of regulating biomass growth and the functioning of ecosystems is an essential element of the Earth system. There is a great need for a far more advanced understanding of the multiple shocks and cascading effects, and the solutions and management systems of water in the context of climate change, that go far beyond the local to the regional and global levels.

The global food market is a significant contributor to human-induced climate change, yet it is also highly vulnerable to future change. A global transformation to sustainable food systems is therefore necessary. Changes in food production, consumption and supply, meeting rising food demands and shifting diets over the coming 30 years, will require approximately 50% increase in global food supply, and changes in diets, waste, yields, etc. This corresponds to a new green revolution based on sustainable intensification, and at the same time there must be a transformation from a carbon-intensive industry to one which helps reduce carbon emissions and conserves biodiversity, land, soil nutrients, and water.

Human migration, which may increasingly include climate-induced movement of people, is contributing to larger urban populations, which are growing at unprecedented rates. Urban technologies provide the opportunity to reverse the growing problems of GHG emissions, air pollution, and other environmental impacts. This opportunity must be seized, enabling sustainable development, in which urban areas are designed to combine improved services with GHG reductions. This can also prove to be cost effective in developing countries where urban infrastructure is not yet developed, and in developed countries through the avoidance of the long-term increased costs of a high emission infrastructure.

5. … and Desirable

Overwhelming evidence now shows that a transition to a sustainable future is not only necessary and possible, but also desirable if we wish to protect economies, reduce human suffering, and enhance wellbeing, both now and in the future. Rising volatility on global energy markets coupled with rapidly rising demand and decline in economically viable reserves [McKillop, 2011]; growing risks of social instability, insecurity, and conflict related to control over resources, including energy and water; and, risks of losing industrial competitiveness as EROI of fossil fuels continue falling, are all rational economic arguments for a transition away from 19th and 20th century energy solutions. The health costs of outdoor and indoor air pollution associated with fossil fuel consumption and biomass burning have become very high, with an estimated seven million deaths in 2012, and significantly shortened life expectancies among urban citizens [WHO, 2014]. Sustainable food systems cannot only deliver food with lower climate impacts but also healthier food, and contribute to maintaining landscape resilience [Gregory et al., 2005; Rockström et al., 2014]. These are human benefits before even considering the potentially high social costs of allowing climate change to exceed manageable levels [World Bank, 2012].

We find a world transition to a low-carbon economy can be made while ensuring the right to development among the world's developing nations, by prioritizing access to cheap modern energy systems and higher mitigation requirements on richer nations who have caused the bulk of CO_2 emissions from fossil fuels so far. This has to be accompanied by capacity development programs at all levels of governance and society.

Facing this greatest challenge, world leaders are able to make choices now, while this opportunity is still at hand, to safeguard a prosperous future for humanity on Earth. As scientists we believe the evidence to support decisions is convincing. As citizens we urge our leaders to create a more sustainable future.

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