

Climate Change and Simulation/Gaming: Learning for Survival

Simulation & Gaming

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If you've heard this before,
don't stop me because I'd like to hear it again.

Graucho Marx

People can't change the truth,
but the truth can change people.

Unknown

The truth is incontrovertible;
malice may attack it, ignorance may deride it,
but in the end, there it is.

Winston Churchill

Tell people something they know already and they will thank you for it.

Tell people something new and they will hate you for it.

George Monbiot

Abstract

This editorial outlines a number of connections between climate change and simulation/gaming/debriefing. First, the development of this symposium is mentioned, including appreciation for contributors, especially Klaus Eisenack, James E. Hansen, Dennis Meadows, and Diana Reckien. Second, a wide range of climate change dimensions is outlined, with emphasis on the increasingly important role that simulation/gaming and debriefing should play in educating people to combat climate change. Climate issues include anthropogenic warming, due largely to ever-increasing greenhouse gas emissions, resulting in massive and irreversible upheaval of the biosphere and the socioeconomic system. Given the massive direct and indirect negative impact of climate change on health and mortality, due largely to the lethargy of politicians and big business, such people, in a saner world, could be facing accusation of crimes

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against humanity. The topic of climate change needs to become the backbone of education round the world, with simulation/gaming and debriefing being one of the main methods for learning to survive in 'pockets of resilience'. Topics for simulation/games and debriefing could include resilience, urgency, climate change science, indicators, and effects (feedback loops, rising sea levels, storm severity, food scarcity and security, water, war, denial, nuclear power, irresponsibility of politicians, etc.). Third, the absurdities of the push for growth in a finite world and of the burning of more coal are highlighted. Simulation/gaming and debriefing provide opportunities for learning to survive with a dangerously changing climate.

Keywords

anthropogenic climate change, Arctic ice, climate change, climate change impact, climate crime, climate deaths, climate education, climate inertia, climate learning, climate science, climate urgency, coal, CO₂, debriefing, denial, Dennis Meadows, dynamic modeling, folly of growth, fossil fuel, gaming, glacier retreat, global temperature, global warming, governments, greed, greenhouse gasses, health threat, ice melt, James E. Hansen, modeling, natural resources, nuclear power, peak oil, plundering, policy, politics, projections, resilience, role-play, scenarios, sea level, simulation, Stephen Schneider, survival, sustainability, temperature anomalies, tragedy

This symposium and double issue of *Simulation & Gaming: An Interdisciplinary Journal of Theory, Practice and Research (S&G)* is devoted to the relations between climate change and modeling, simulation and gaming, which includes debriefing. The symposium contains articles (a) on a wide range of simulation/game formats, all the way from board games to computer models of climate change perception, and (b) on the ways in which simulation/gaming may help reduce the impact of climate change, how it may help people learn to survive the coming climate catastrophe.

A range of dimensions of climate change are tackled: aspects of climate (such as CO₂), but also ramifications such as international relations, large-scale problems, interdisciplinarity, communication, education, adaptation, economics, environment, sustainability, water management, land policies, perceptions, and beliefs. This is probably the first collection of articles, in any journal or book that focuses on the joint theme of simulation/gaming and climate change. It is fitting that this first appears in *S&G*, as both the journal and climate change are strongly interdisciplinary.

I initiated this symposium some seven years before it was published, with a letter to over a dozen climate scientists. Here are extracts from the letter:

I edit an international journal, *S&G: Simulation & Gaming: An Interdisciplinary Journal of Theory, Practice and Research* (SAGE Publications, Calif., USA). The journal regularly publishes symposia on a topic of special interest. Recent examples have been: crisis & risk, natural resource management, . . . , utility deregulation.

It is time that *S&G* addressed the urgent issue of climate change. I am looking for someone or a small team who would like to guest edit a symposium (one or more issues) on this topic.

Simulation and modeling are central tools in climate change research. However, various hybrid methods of simulation/gaming are often used to teach people about climate change, particularly the human, social and economic impact that it will have. It would be good to include both aspects in the special issue. The subtitle of the journal is *Theory, Practice and Research*. Usually, the ‘hard’ research feeds into the more pedagogical actions (such as classroom games). Indeed, it is vital for everyone to understand climate change—from policy makers and stakeholders to teachers and school children. They all need to know the scientists’ work and warnings, and to be aware of what is likely to hit them in the future.

With joint guest editorship, each editor can bring their expertise to the project. I am particularly keen to see this symposium come to fruition. I see it as the most important S&G symposium of all. And I would like to think that it might make some small positive difference in the plight of the planet.

Many thanks in advance. I look forward to hearing from you shortly. Best wishes, David

Responses ranged from a polite ‘sorry, but courage’ to ‘accept with enthusiasm.’ Overall, encouragement was strong, and I am grateful to all who responded so positively. The impression that I have had during that time is that climate scientists are among the busiest people in the world. I was particularly encouraged by an email from Stephen Schneider, one of the world’s leading climate scientists, and particularly pleased as I had had the privilege of meeting him as co-facilitator in 1989 at the Student Pugwash International Conference, University of Colorado at Boulder, USA. Here is what he wrote to me, in November 2007:

Hi from IPCC Plenary in Valencia. Thanks for the invite. I am away much of the time—like next 6 weeks—but know my young colleague [name] could do this for you very well. Others from the economics side are [name] . . . , an economist who is much broader than typical for that group. . . . It interests me but I am so over the top now I can’t take on any more new commitments. Contact me again later next year and maybe I’ll be less overcommitted. Good luck with your venture, Steve

A year later, in October 2008, I invited Steve to become an S&G Ed Board member. Here is his reply:

Thanks, David, much appreciate the invite and CONGRATULATIONS on four decades!! At *Climatic Change* we’ve just passed thirty years and it is growing too fast and driving me and my limited staff nuts trying to get reviewers lined up and following through. As you might suspect, this takes up more than all the spare time (joke) I have, so it would not be likely I could do much more than cheer lead for another editorial assignment. So don’t waste a slot on me given my unlikely ability to agree to do reviews, decision help etc. Good luck, Steve

After I responded to him, he replied:

OK David, you’ve twisted enough—I agree. But what do I fill out where?? If there was an attachment before on this please resend. Cheers, Steve

PS I am still in full molecular remission seven years post bone marrow transplant, and for mantle cell lymphoma that is virtually unheard of—so maintenance therapy works and that idea is finally catching on around the medical world, but docs are very slow to learn new methods like Bayesian updating.

That touched a chord in me, because of both my keen interest in climate change and my concern for my late wife’s fight with cancer. It came as a real shock later to hear that Steve had also died, but he died of pulmonary embolism, not cancer (my experience also). It is a pity that Steve’s cancer website, patientfromhell.org, is no longer up, but his book, *The Patient From Hell*, is available. When I received the news, I decided

that this symposium must be dedicated to Steve Schneider, and I invite you to read the tribute to him in this issue.

During the time that this symposium was being prepared, another scientist and ardent supporter of climate change science died unexpectedly—of a heart attack. This was my uncle, John Crookall-Greening. My sense of loss was immense. It was all the more difficult as it was John who had often enlightened me on aspects of climate plight and who had given inspiration to me for this symposium, which is thus also dedicated to John. I thank my cousin, Christopher, himself a climate consultant, for writing the tribute. When I asked John from whom I should invite an introductory article, his immediate reply was Jim Hansen. It is thus with more than intellectual satisfaction that I welcome Jim's contribution to this symposium.

In early 2008, I was lucky to find three people, Mary Pettenger and Niki Young (Western Oregon University, USA), and Richard Warrick (University of the Sunshine Coast, New Zealand), who responded positively to my invitation, and who agreed to carry the flame forward, despite their already heavy commitments. During the following 6 months, some interesting discussions took place on the scope of the symposium and on drafting the CfP, which was felt to be a key to getting the symposium off the ground. Mary also enlisted the help of one of her students, Betsey Culliton. Also during that time, incidentally, the publisher and I decided to move *S&G* from four to six issues a year, which meant that we would have more space.

In mid-2008, I sent a casual question to two authors of an excellent article on urban sprawl, which had been published in *S&G*. I asked, "I will be in touch again with you soon about climate change—are you both involved much with that?" Their reply was swift:

Just a short note on that. Yes, Klaus and I, we have both been working on climate change issues for a long time. I started to work with it professionally in 1999 already. I am awaiting your questions and am curious. Cheers, Diana

In October the same year, Diana Reckien and Klaus Eisenack accepted to join the guest editorial team. Someone suggested that each of the five members of the team do an introduction. Here are extracts from those by Diana and Klaus. I have not included those by Mary, Niki, and Richard, for reasons that will become clear shortly.

Klaus: But let me briefly introduce myself, since we don't know each other yet. I'm assistant professor for environment and development economics at the University of Oldenburg in Germany. Before that I worked at the Potsdam Institute for Climate Impact Research (PIK). Thus, my main focus of research is the economics of climate change, but I'm also strongly involved in transdisciplinary research in practice and theory. I love using games in teaching. A major breakthrough in this respect was developing and publishing the climate change board game KEEP COOL (www.spiel-keep-cool.de), which drew a lot of attention and brought me into contact with teachers at public schools, educational science, and various NGOs.

Diana: A short one on myself as well. I am a post-doc researcher at the Potsdam Institute for Climate Impact Research and lecturer at the University of Potsdam. During most of my time as a scientist I worked on the interface between urban research and climate change as well as on urban (un)sustainability. In many projects, I saw that communication between scientists and decision makers is

limited, although we often try to inform decision makers or policy makers. Therefore, I started to think of alternative ways of knowledge dissemination and interaction. With colleagues I developed a role-play (directed to planning decision makers) that enables a better understanding of urban migration and suburban development. . . . Recently, I started to work with architects from Berlin to use multimedia tools for making climate change issues and their impacts on urban systems, more tangible for guests at exhibitions. So, I am really interested what means other people use and which they regard as useful (or not).

Thus, by early 2009, the five-member guest editorial team had carefully crafted the CfP, with some chirping in from me. The call went through about nine iterations; the last one is provided below, as it sets the scene for the symposium.

This is a time when the scientific and academic communities must focus on an issue of utmost concern—climate change, and the ensuing plight of our planet and of humanity.

This symposium (special issue) of *Simulation & Gaming: An Interdisciplinary Journal* will explore the numerous pedagogical and investigative methods employed to examine climate change—methods that cross disciplines, from the natural and geo sciences, through social sciences, to education. Climate change is a quintessential issue requiring rigorous analysis and careful understanding by scientists, educators, policy makers and global citizens.

We are seeking submissions from multiple disciplines and perspectives, employing a variety of methods to understand and teach a broad variety of climate change dimensions—process, causes, consequences and responses—social, economic and geopolitical impacts, such as international migration, reconfiguration of states, poverty, trade wars, wars, etc. We encourage articles related to climate change involving such methods as:

- games, role-plays, simulations, simulation/games, experiential learning exercises, case studies, etc.;
- internet-based games and simulations, digital games, serious games, etc.;
- modeling, game theory, computer simulation, etc.;
- virtual reality, augmented reality, virtual environments, etc.

The CfP was distributed widely—electronically and manually.

During this time, too, Mary, Niki, and Richard found that their university work and personal obligations had increased fairly drastically; new responsibilities, new appointment. They wished to step down in their capacity as Guest Editors. I would like here to record my gratitude to all three for their tremendous early work on the symposium. Without their work, I doubt that we would have got off the ground when we did. I am also grateful to Mary for agreeing to continue her contribution and be on the Editorial Review Board for this symposium. Betsey continued to help during her stint as a student.

Thus, Diana Reckien and Klaus Eisenack summoned the courage to continue with the symposium, despite being increasingly “loaded with work”. Klaus also managed to persuade Maren Petersen to help out. In early 2011, 16 proposals had been received, and by May 2012, the first article had been published in OnlineFirst. Just over a year later, the symposium was completed. I express my sincere gratitude to the authors of the articles. These people have done the spadework. You will see their articles in the body of this symposium, each one commented by Diana and Klaus in their Guest

Editorial. My appreciation also goes to their international editorial board for the symposium (some of whom were authors); their work has contributed to the high quality of the manuscripts.

- **Gilbert Ahamer**, Austrian Academy of Sciences, Austria
- **Erin Coughlan**, Red Cross Red Crescent Climate Centre & International Research Institute for Climate and Society (IRI), Columbia University, USA
- **Patrick d'Aquino**, Centre de coopération internationale en recherche agronomique pour le développement (Cirad), France
- **Tom Fennwald**, Indiana University Bloomington, USA
- **David Ford**, Texas A&M University, USA
- **Uta Fritsch**, European Academy of Bozen, Italy
- **Gabriele Gramelsberger**, Free University of Berlin, Germany
- **Bernd Hezel**, Potsdam Institute for Climate Impact Research, Germany
- **Louis Lebel**, Chiang Mai University, Thailand
- **Matthias K.B. Lüdeke**, Potsdam Institute for Climate Impact Research, Germany
- **Heike Munderloh**, Potsdam Institute for Climate Impact Research (PIK), Germany
- **Susanne Nawrath**, Klimahaus Bremerhaven, Germany
- **Edward A. Parson**, University of California, Los Angeles (UCLA), USA
- **Mary Pettenger**, Western Oregon University, USA
- **Katherine J. Thompson**, Center for Research on Environmental Decision, Columbia University, USA
- **Peter Valkering**, Maastricht University, The Netherlands
- **Martin Welp**, University of Applied Sciences, Eberswalde, Germany
- **Annemie Wyckmans**, Norwegian University of Science and Technology (NTNU), Norway

I must also express my deep gratitude to two giants in sustainability and climate science, Dennis Meadows and Jim Hansen. Dennis is well known and respected for his pioneering and influential work on sustainability—on humans' plundering of the planet's natural resources. His book, published in 2004, with Donella Meadows and Jørgen Randers, *Limits to Growth: The 30-Year Update*, is a detailed analysis of the acute problem that we face on this planet. Based on computerized modeling, World 3, and real data, it showed that humanity has reached, and in some areas exceeded, the planet's carrying capacity, that 'we' have become unsustainable. You will also find a series of recently videoed interviews of Dennis at the University of Cambridge Programme for Sustainability Leadership (CPSL), <http://www.cpsl.cam.ac.uk/Resources/Videos/Dennis-Meadows.aspx>, as well as on other websites. He is, of course, much appreciated by people in simulation/gaming for his FISH BANKS, his other games and books on games, as well as his participation in the International Simulation and Gaming Association, and his membership of the editorial board of *S&G*. Dennis "is an important mentor for us all in facing some of the most difficult problems humans have ever had to face" (Peter Senge, *The Fifth Discipline*).

The connection between plundering of natural resources, pushing greedily beyond the limits to growth on a finite planet, and one of its most dangerous effects, climate change, should be clear to every sentient being and every scientific mind. A new film, *Last Call*,

due out in 2013, will examine, along with other things, the links between ‘global over-growth’ and global warming. See <http://www.lastcallthefilm.org/>. See also <http://www.donellameadows.org/last-call-a-documentary-film-about-the-limits-to-growth/>.

We are therefore also lucky, in this *S&G* symposium, to have James E. Hansen contribute. He needs no introduction to climate scientists, nor indeed to all those with even a passing interest in sustainability and climate change. Jim Hansen is one of the world’s leading climate change scientists. Joe Romm has called him “A man for all seasons. . . . a modern day Paul Revere”, and provided a nice account of Jim’s contribution to the world, see <http://thinkprogress.org/climate/2013/04/24/1899981/a-man-for-all-seasons-james-hansen-wins-the-ridenhour-courage-prize/>. You will find many of his recent scientific articles at <http://www.columbia.edu/~jeh1/publications.shtml>, and previous ones at <http://pubs.giss.nasa.gov/authors/jhansen.html>. Jim Hansen’s book, *Storms of My Grandchildren*, is important reading for all those who care for this planet and for its younger voyagers. Recent praise can be found here: <http://www.guardian.co.uk/science/political-science/2013/apr/02/james-hansen-retires-science-politics>.

“Jim Hansen is a one of the true giants of climate science”, said Jeffrey Sachs, director of The Earth Institute (Columbia University, USA). Dennis Meadows is one of the true giants of sustainability. I take the liberty here of paraphrasing Sachs’ tribute to Jim Hansen on his retirement; his words about Hansen can easily be applied to Meadows for sustainability and earth resources more generally:

Their pioneering work has enabled humanity to understand the planet’s climate dynamics and limited resources, to interpret the lessons of the Earth’s long history, and to peer ahead to the perils we face if we continue on the business-as-usual path. When humanity finally wakes up to the profound risk facing us—and it will—we will owe humanity’s future wellbeing to Dennis Meadows’ and Jim Hansen’s brilliance, boldness, and clarity of thought and expression. (Paraphrased from <http://www.earth.columbia.edu/articles/view/3077>)

My uncle John (see tribute in this symposium) admired both Dennis and Jim for their work on what can justifiably be called their quest to save the planet from greed and plundering and the tragic consequences of that plundering, a quest that they have followed unflinchingly despite acerbic criticism and unfounded attack from several misguided quarters. I hope that this symposium helps to nudge things in the right direction through a multiplier effect—educators using simulation/gaming to educate the young to the horrendous future that they will face if their governments continue to pay lip service to the hard-nosed work of scientists like Dennis Meadows, Jim Hansen, and their colleagues.

Both Dennis and Jim came to their early projections of future problems through painstakingly detailed science and complex dynamic modeling. In time, their predictions, which indicated irresponsible overshoot on a massive scale, have been shown to be uncannily accurate. Now, several decades later, based on real data, Meadows’s, Hansen’s, and colleagues’ early simulation-based predictions (extrapolations from computer simulations) have turned out to be remarkably accurate,

and tally closely with real data. If anything, current trends are worse than their previous projections. Their work is all the more remarkable, given that it concerns two highly complex and interrelated systems—the earth's resources and climate. To simplify in the extreme, I will say that human greed and consumption (bolstered by selfish democracy and flawed economics) lead to the plundering of the very resources that sustain life, with resulting massive overproduction of GHGs, which in turn lead to anthropogenic climate change and its destructive powers round the globe.

Of course, both resources and climate interact at many levels and in many ways, and both have been and continue to be irreparably damaged by greedy humans and irresponsible governments. Dennis Meadows and Jim Hansen deserve to receive the Nobel Prize for peace—the peace that they have and will have managed (maybe unwittingly) to encourage by making humanity aware of its predicament, and we hope avoiding wars on a more massive scale than we have seen. We are honored to have them contribute to this symposium.

The two people who here deserve our greatest gratitude for this symposium are Diana Reckien and Klaus Eisenack. They have been working tirelessly, over several years, helping to shape and disseminate the CfP, reaching out to potential authors, coaching the articles through the review process, making difficult decisions, encouraging authors, editing articles, nudging the editor ☺, and never tiring. Without their endurance and insight, this symposium would not now be a reality. It has also been a great pleasure to work with them.

Despite seven years in the making, the timing of this symposium is 'good' because the CO₂ level in the atmosphere is bad. Just a few weeks before this symposium was published, the atmospheric concentration of CO₂ passed the symbolic value of 400 ppm. The web page <http://climate.nasa.gov/400ppmquotes/> gives some NASA scientists' reactions to reaching 400 ppm. However, we need to keep in mind that the global warming, sea rise, glacier and ice-sheet melting, storms, refugees, deaths, and other effects that are occurring now 'before our very eyes' are a result of the GHGs emitted several decades ago. The massive amounts of GHGs emitted today will make themselves felt in the decades and centuries to come, when young people today and later their children and grandchildren will be growing up. I wonder what replies parents will give to their questions:

What did you do to stop resource plundering and climate change? How did you mitigate the human suffering and tragedy that are happening all round now? Did you knowingly vote for politicians who lied and would not have the guts to make a strong stand? Did you insist that our schools and universities teach us about the coming climate change calamities? Did you lift at least a finger to make the world aware of this humanitarian crime?

In talking with people, including my students, I have come to realize, to my dismay, that many otherwise highly educated and intelligent people know little about resource depletion, climate change, sustainable development, and resilience today or dangers for tomorrow. I have started to make these an element or the main topic in as many of my courses as I can. My strong opinion is that sustainability, climate change, and resilience must be included in one way or another in every

single course, at all levels, primary to university, across the world. They must, of course, be truthful, and not be an excuse for peddling skimpy nonsense put about by unscrupulous deniers. Education systems aim to produce citizens with skills in and knowledge of essentials—language (native and foreign), mathematics, business, economics, physics, communication, geography, history, art, and so on, even if, as we know, those aims are not properly achieved. ‘Sustainability, climate change, and resilience’ is so urgent and essential that it needs to take first place of all subjects. Instead of including bits of climate change in, say, a business seminar or in a language course or a negotiation workshop or a physics class, all curricula should be built around climate change. Thus, a course such as ‘climate change and business’ would have climate change as the backbone, and the various business topics (facts, knowledge, skills, perspectives, behaviors, etc.) would be woven round climate issues. A course on ‘sustainability and resilience in international marketing’ would follow the same principle. It does not require unreachable imagination to do that. Climate change and resilience courses can be used to teach language, mathematics, history, chemistry, medicine, economics, computer science, finance, management, and most other subjects. Climate change and sustainable development have already had, and will increasingly have, an impact on all those areas. Many businesses and industries have begun to implement climate adaptation and resilience measures, and they are usually ahead of educational establishments. Some municipalities are way ahead of governments in this area. In the decades to come, climate change, resilience, and natural resource leadership (see previous *S&G* symposium on this, vol. 38, 2) will become our major global frame of reference—the defining paradigm for our individual and collective thinking and action. For many it is already happening, but education and government are lagging far behind (as usual).

In similar vein, all media should be required to devote a small percentage of their space or time to resilience and climate change. For example, The *Daily Mail* should publish one page a week devoted in some way to climate change (e.g., “The royals and climate change”). The topic is so vast that shortage of material would never be a problem; it could even include a portion of humdrum content, such as advertising for solar panels. Radio and TV stations would devote a portion of their output to climate change. Every object sold, such as a box of pencils, a computer or a bottle of soda, should carry a climate change indicator. Every web page would be required to include at least one link to a climate change web site. Of course, the content of such communication would be subject to control that it is scientifically sound.

One of the main methods that enlightened educators use today to help people learn is, of course, experiential learning (à la Kolb), which includes debriefing games and simulations of all shapes and types. Simulation/gaming and debriefing will play increasingly stronger roles as trainers and policy makers gain skills in using such methods, especially to help people understand and adapt to a world of plundered resources and runaway climate change. Ultimately, learning from experience (simulation/game), properly processed (debriefed), will help people learn to survive—survive the turmoil and upheaval that have only just begun. This symposium will contribute to

that thrust. In addition to *The IPCC Climate Education Programme*, in the years and decades to come, a massive effort needs to be made to develop whole libraries and databases of learning experiences and materials, along with training packages for users (trainers, teachers), and made available for free. Some of the funding currently put into renewable energies and climate mitigation should be earmarked for the design of such materials and training users; it could well be one of the highest ROIs in resilience. Every money unit spent on training materials would be recouped many times over in the long run.

The people who read the articles in this symposium will most likely already be familiar with climate change concepts and processes. In any case, two excellent summaries of basic processes and the current state of things will be found here—in the Prolegomenon, by Jim Hansen, and in the Guest Editorial, by Diana Reckien and Klaus Eisenack. The Foreword to the symposium, by Dennis Meadows, sets our agenda for the development of simulation/games in the service of combating climate change and its effects. The future of climate change simulation/gaming and debriefing needs to be framed in the spirit expressed in this symposium. I would like to think that this symposium will contribute significantly to this effort. As I write, I discover two interesting initiatives: <http://www.windows2universe.org/games/games.html> and <http://www.learnnc.org/lp/pages/6723>. Excellent leads to other work are the articles in this issue, especially the overview of climate games by Diana Reckien and Klaus Eisenack.

Climate journals provide the hard substance, and journals such as *S&G* provide support—ultimately for learning to survive. Of course, people other than the many climate scientists have raised clear voices above the clamor to strengthen awareness of climate change. They include commentators, journalists, photographers, and filmmakers, such as John Abraham, Nafeez Ahmed, Yann Arthus-Bertrand, Gary Braasch, Lester Brown, Arthur Dahl, Al Gore, Nicolas Hulot, Bill McKibben, George Monbiot, Dana Nuccitelli, Jacques Perrin, Jeremy Rifkin, Joe Romm, and hundreds (thousands?) of others (apologies to those whose names should have been mentioned). We must also mention organizations (incl web sites), such as 350.org, 350resources.org, Alliance for Climate Education, Al Jazeera, the BBC, Carbon Brief, Citizens Climate Lobby, Climate Central, Climate Change Guide, Climate Change Is Elementary, Climate Communication, Climate Progress, Climatica, European Climate Foundation, Global Warming Is Real, *The Huffington Post*, *InsideClimate News*, the IPCC, Learning for Sustainability, National Center for Science Education, NASA Innovations in Climate Education, the *NYT*, One Climate, Real Climate, SEA Change CoP, Skeptical Science, Stockholm Resilience Centre, *The Guardian*, UKCIP, and many others. It seems that about the only people of negative influence is a small bunch of rowdy deniers, bullying and bribing politicians who seem unable to show their courage and put money where their mouth is. Must we conclude that many politicians and big businesses are fundamentally hypocritical?

Two giants of modern thought and insight also need to be mentioned, especially for their contribution to generating awareness of sustainability and climate change and of

the need for urgent action. These are Noam Chomsky and Tenzin Gyatso. Chomsky is blunt, and hits an important nail squarely on the head:

Treating the claims of climate change deniers (re: dunces who comprise 2% of the population) with the same amount of respect as you do those who believe it exists (re: 98% of field experts) doesn't just damn you, it damns the future. (<http://www.prosebeforehos.com/video-of-the-day/03/17/noam-chomsky-on-climate-change/>)

Chomsky ably situates climate change politics in the context of American forms of capitalism and democracy.

Researcher Kelly Sims Gallagher finds that "One hundred and nine countries have enacted some form of policy regarding renewable power, and 118 countries have set targets for renewable energy. In contrast, the United States has not adopted any consistent and stable set of policies at the national level to foster the use of renewable energy." . . . The fact that the public is influenced by science is deeply troubling to those who dominate the economy and state policy. . . . Environmental catastrophe is far more serious: The externality that is being ignored is the fate of the species. And there is nowhere to run, cap in hand, for a bailout. . . . In future, historians (if there are any) will look back on this curious spectacle taking shape in the early 21st century. For the first time in human history, humans are facing the significant prospect of severe calamity as a result of their actions—actions that are battering our prospects of decent survival. . . . Those historians will observe that the richest and most powerful country in history, which enjoys incomparable advantages, is leading the effort to intensify the likely disaster. Leading the effort to preserve conditions in which our immediate descendants might have a decent life are the so-called "primitive" societies: First Nations, tribal, indigenous, aboriginal.

The countries with large and influential indigenous populations are well in the lead in seeking to preserve the planet. The countries that have driven indigenous populations to extinction or extreme marginalization are racing toward destruction. Thus Ecuador, with its large indigenous population, is seeking aid from the rich countries to allow it to keep its substantial oil reserves underground, where they should be.

Meanwhile the U.S. and Canada are seeking to burn fossil fuels, including the extremely dangerous Canadian tar sands, and to do so as quickly and fully as possible, while they hail the wonders of a century of (largely meaningless) energy independence without a side glance at what the world might look like after this extravagant commitment to self-destruction. (<http://truth-out.org/opinion/item/14980-noam-chomsky-will-capitalism-destroy-civilization>)

Several videos of Chomsky talking about climate change, including one on peak oil and climate change, are more than worth your time, and can be useful supporting material for courses, simulation/games and their debriefing. Here are a few links:

- <http://www.thenation.com/article/157434/peak-oil-and-changing-climate;>
- [http://climateforce.net/2012/01/20/noam-chomsky-peak-oil-and-a-changing-climate/;](http://climateforce.net/2012/01/20/noam-chomsky-peak-oil-and-a-changing-climate/)
- [http://www.prosebeforehos.com/video-of-the-day/03/17/noam-chomsky-on-climate-change/;](http://www.prosebeforehos.com/video-of-the-day/03/17/noam-chomsky-on-climate-change/)
- <http://www.treehugger.com/corporate-responsibility/noam-chomsky-on-why-america-cant-tackle-climate-change-video.html>.

The other giant of thought and action is Tenzin Gyatso, the 14th Dalai Lama. Here is what he says:

Peace and survival of life on earth as we know it are threatened by human activities that lack a commitment to humanitarian values. Destruction of nature and natural resources results from ignorance, greed, and lack of respect for the earth's living things. This lack of respect extends even to the earth's human descendants, the future generations who will inherit a vastly degraded

planet if world peace doesn't become a reality and if destruction of the natural environment continues at the present rate.

Our ancestors viewed the earth as rich and bountiful, which it is. Many people in the past also saw nature as inexhaustibly sustainable, which we now know is the case only if we care for it. It is not difficult to forgive destruction in the past that resulted from ignorance. Today, however, we have access to more information. It is essential that we re-examine ethically what we have inherited, what we are responsible for, and what we will pass on to coming generations.

Clearly this is a pivotal generation. Global communication is possible, yet confrontations take place more often than meaningful dialogues for peace. Our marvels of science and technology are matched, if not outweighed, by many current tragedies, including human starvation in some parts of the world and extinction of other life forms. . . . We have the capability and the responsibility. We must act before it is too late. (<http://www.dalailama.com/messages/environment/universal-responsibility>)

Other web pages worth exploring include the following:

- <http://www.reuters.com/article/2009/11/30/us-australia-carbon-dalailama-idUSTRE5AT16B20091130>;
- <http://www.wbur.org/2012/10/15/dalai-lama-climate-change-mit>;

Writings, photographs and films both by scientists and by public figures can support simulation/games, as part of preparation and of debriefing and follow-up. We can also draw inspiration from a great many other concerned educationalists developing and using simulation/games about climate change and resilience, especially those who have contributed to this symposium. Simulation/gaming and debriefing are ideally suited to educating people about climate change, resource sustainability, and resilience; they provide education regarding the cognitive aspects, including its complexity and changing dynamics over time, and they also provide the affective and social dimensions of the topic in ways that traditional methods are unable to do. Students need to experience, to be players in, the swishing and rumble tumble of climate change and resource sustainability; simulation/gaming provides almost the only way to achieve that, in a short time, in a learning situation (e.g., a classroom or a policy think tank). Simulation/gaming of course also provides powerful tools to develop policy, test out scenarios, and conduct research, for example, in the development of resilience programs. In addition, simulation/gaming allows for the multidimensional and interdisciplinary nature of climate change and resilience. This spirit and commonality of approach makes *S&G* a natural home for climate change education. The key element of debriefing can also be used (with or without simulation/gaming) to help people become more resilient in the face of tragedy and overcome trauma resulting from that tragedy.

I make the assertion here that simulation/gaming/debriefing together constitute one of the most powerful ways in which scientists and educators can communicate and raise awareness about climate science and the impact of climate change. I also assert that facilitators who run simulation/games about such complex issues, and that carry fundamentally unwelcome messages probably involving strong emotions,

need to debrief their sessions fully and thoroughly. A sufficiently strong and long debriefing must always be planned and structured, and this involves, among other things, defusing the emotional charge from involvement, thinking in silence, listening carefully, sharing and debating ideas, and linking the simulation/game to reality. To do otherwise is foolhardy. This is partly why Diana's and Klaus's work in guest editing this special issue is so admirable.

Let us now look more specifically at climate change itself—the substance that forms the core of all climate change simulation/gaming/debriefing. To bring home to you the massive anthropogenic changes that have already occurred, and that continue to occur at an accelerating pace, I offer here some visuals—mostly trend graphs and interval photos. Many of the sites from which they are drawn contain useful materials, many of which can be used for simulation/games (design, briefing, resource materials, debriefing, follow-up). The web pages, http://climate.nasa.gov/key_indicators and <http://mydasdata.larc.nasa.gov/> provide a marvelous exposition of key climate trend indicators, such as CO₂ concentration, surface temperature, sea and land ice, and sea level. They also provide downloadable data sets and tutorials, which can be used with or to design educational simulations and games. The visuals offered here tend to focus on the change in climate itself, but a few illustrate the social and human effects of this change, such as hardship, trauma, health, and death. It is probably in the area of the complex interface between physical planet changes and learning for adaptation, resilience, and mitigation that simulation/gaming/debriefing can contribute the most. Simulation and modeling, mostly inside computers, are of course major tools used extensively by climate scientists as part of their research and hypothesis building; I hope that this will be a topic for a subsequent *S&G* symposium.

For the graphics below, I provide no or minimal commentary, partly as the picture is usually self-explanatory, partly as full commentary can be found on the referenced websites, and partly because the main purpose here is visual impact. Also, it illustrates the ease with which climate material can be found on the internet; we should be grateful to climate science for making so much of its work freely available.

One of the most famous graphs is known as the Keeling curve (see below), from the late Charles David Keeling, who was the first to demonstrate empirically that CO₂ has been on the increase.

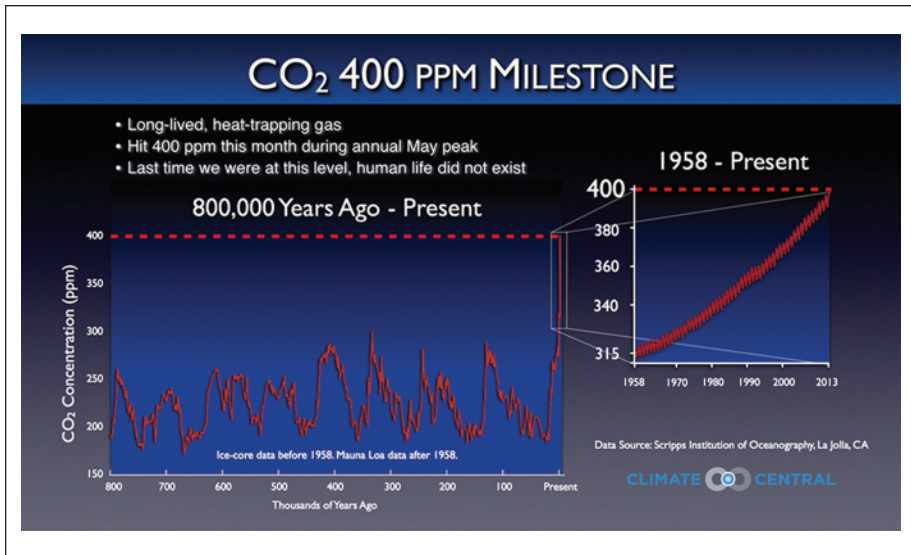


Figure 1. CO₂ increase.

Source: <http://www.climatecentral.org/news/carbon-dioxide-passes-400ppm-milestone-for-first-time-in-modern-human-histo>. For a weekly update on CO₂ readings from Mauna Loa, see <http://keelingcurve.ucsd.edu/> (see also <http://www.onearth.org/blog/scientist-ralph-keeling-curve-reaching-400-ppm>).

Temperature increase correlates closely with increase in GHG (maintained by elimination inertia). Temperature trends are unlikely to change much in the foreseeable future, given that temperatures now are a result of GHGs spewed into the atmosphere several generations ago. If GHG emissions continue unabated, or increase, which appears to be the current trend, with the irresponsible opening up of CO₂-boosting coal tar sands, then temperatures are likely to increase over the next generations, boosted by additional feedbacks and forcings, such as the release of methane from previously frozen tundra, the diminishing absorption of latent heat in land and sea ice melt, and the destruction of CO₂-absorbing forests. A recent article, published in 2013, by Shaun Marcott et al. indicates that

Surface temperature reconstructions of the past 1500 years suggest that recent warming is unprecedented in that time. Here we provide a broader perspective by reconstructing regional and global temperature anomalies for the past 11,300 years from 73 globally distributed records. . . . Intergovernmental Panel on Climate Change model projections for 2100 exceed the full distribution of Holocene temperature under all plausible greenhouse gas emission scenarios.

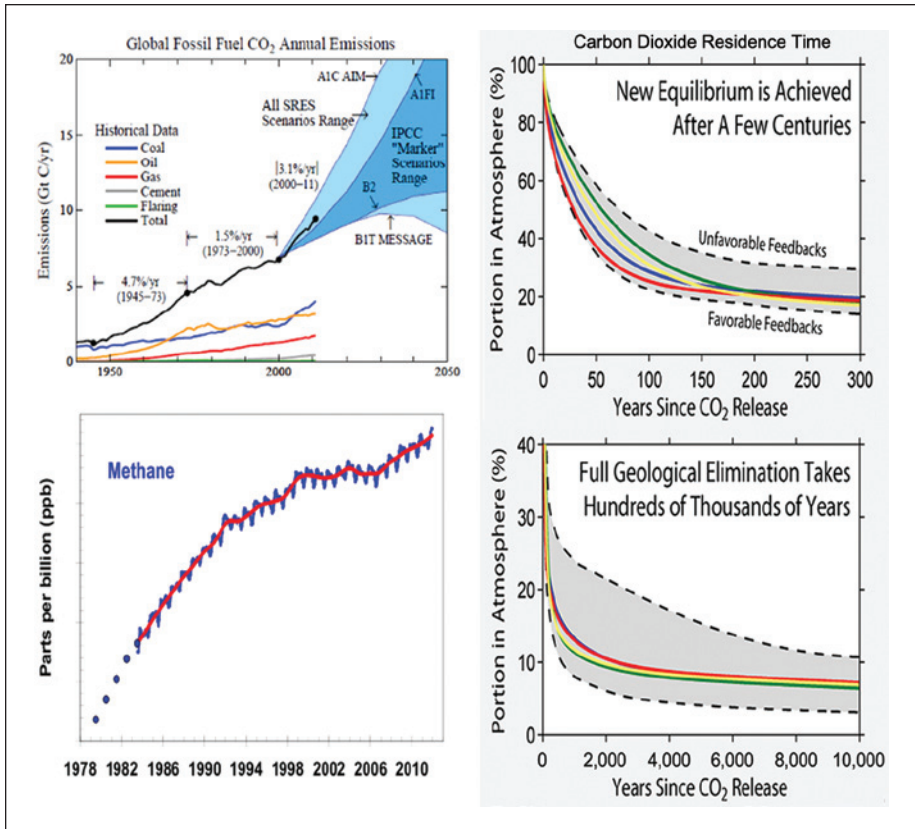
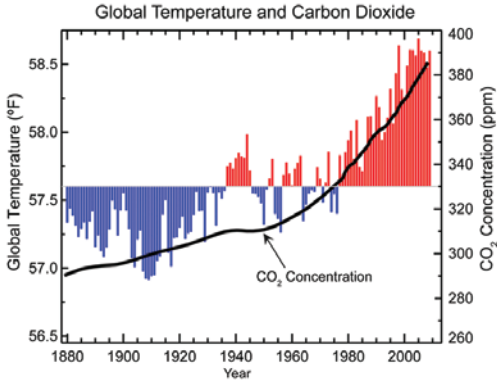


Figure 2. CO₂ projections and inertia, CH₄ increase.

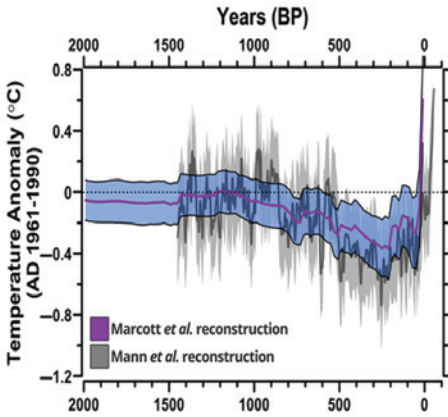
Sources: <http://iopscience.iop.org/1748-9326/8/1/011006/>, <http://www.esrl.noaa.gov/gmd/aggi/>, http://www.globalwarmingart.com/wiki/File:Carbon_Dioxide_Residence_Time.png.

Global temperature, therefore, has risen from near the coldest to the warmest levels of the Holocene within the past century, reversing the long-term cooling trend that began ~5000 yr B.P. Climate models project that temperatures are likely to exceed the full distribution of Holocene warmth by 2100 for all versions of the temperature stack. (<http://www.sciencemag.org/content/339/6124/1198>)

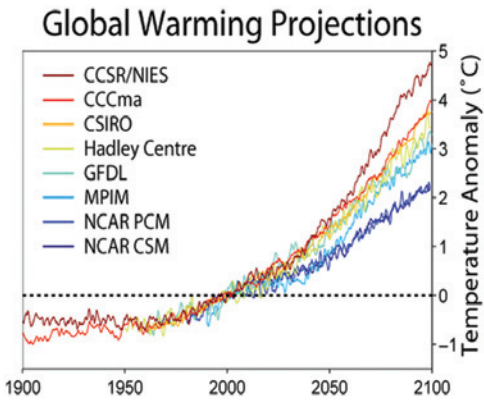
A fascinating graph summarizing their work can be found at <http://www.sciencemag.org/content/339/6124/1198/suppl/DC1>.



Source: <http://www.ncdc.noaa.gov/>.



Source: <http://www.motherjones.com/blue-marble/2013/03/new-hockey-stick-graph-scarier>.



Source: http://www.globalwarmingart.com/wiki/Predictions_of_Future_Change_Gallery.

Figure 3. Anthropogenic global warming.

The above graphs should scare anyone with an ounce of wit, especially those who care about the future of humanity and the planet that it has the privilege of occupying. If they are not scary enough, then some visual indication of the results of the warming are easily visible in the pictures below.

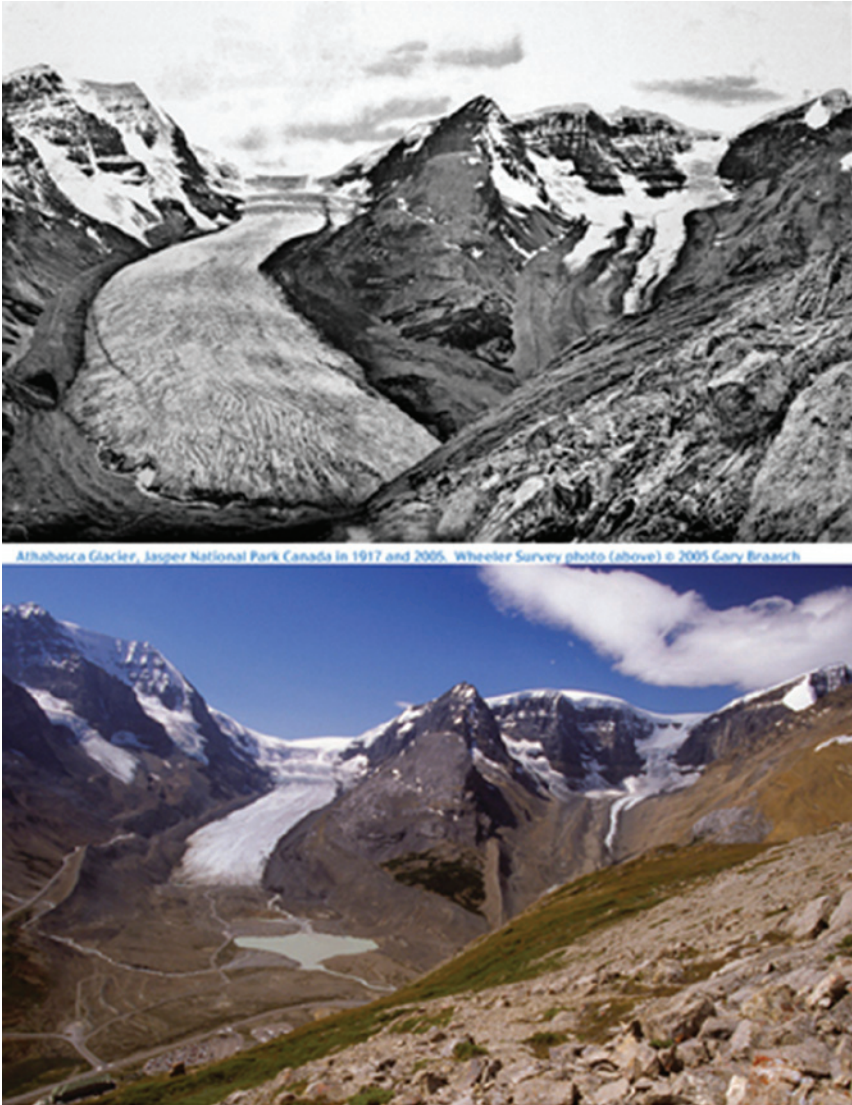


Figure 4. Land ice melt: 1919 to 2005.

Source: <http://www.worldviewofglobalwarming.org/pages/glaciers.php>



Figure 5. Land ice melt: 1958 to 2003.

Source: McCall Glacier, Alaska; 1958 and 2003. http://climate.nasa.gov/state_of_flux. See also the slider photo here: <http://www.nytimes.com/2013/04/05/world/americas/1600-years-of-ice-in-perus-andes-melted-in-25-years-scientists-say.html>.

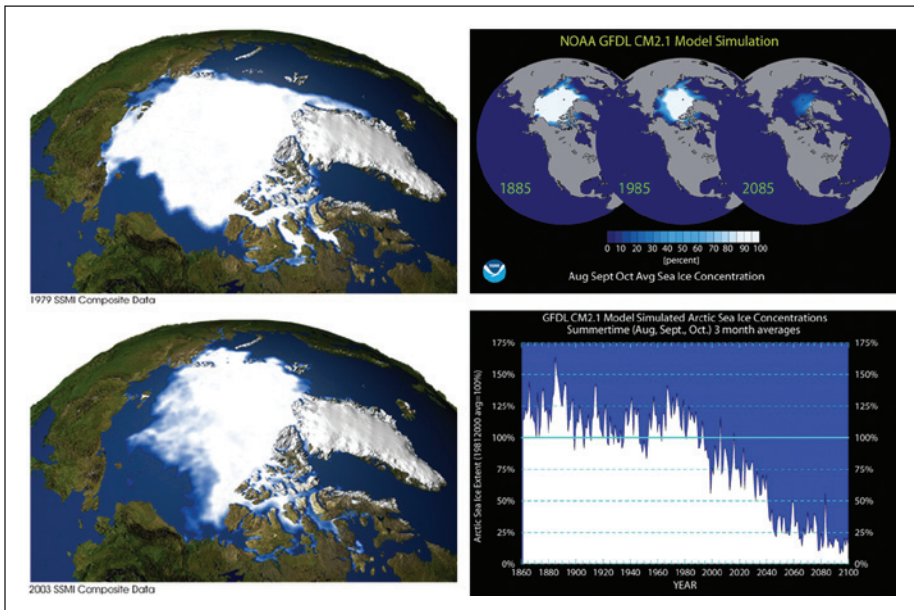
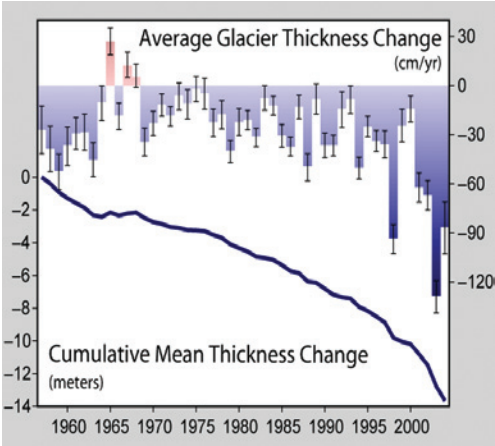


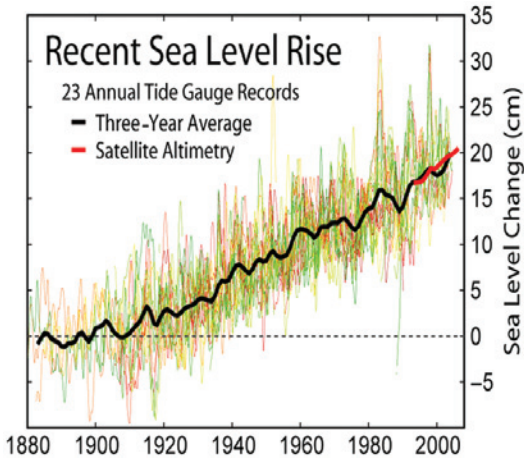
Figure 6. Sea ice melt.

Sources: http://archive.org/details/Arctic_SSMI1979-03, <http://earthobservatory.nasa.gov/IOTD/view.php> and <http://www.gfdl.noaa.gov/the-shrinking-arctic-ice-cap-ar4>.

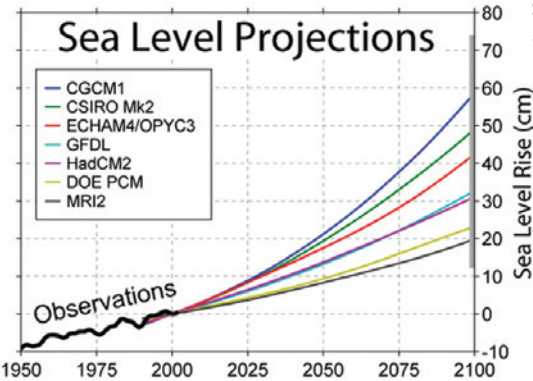


Source: http://www.globalwarmingart.com/wiki/Glacier_Gallery.

Since 1992, the polar ice sheets have contributed, on average, 0.59 ± 0.20 millimeter year⁻¹ to the rate of global sea-level rise. <http://www.sciencemag.org/content/338/6111/1183.abstract>.

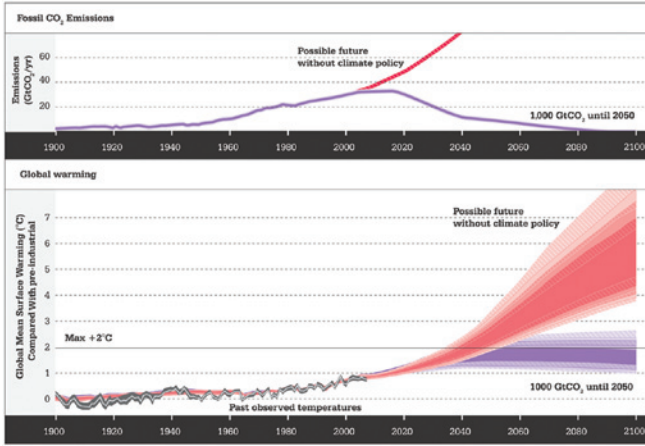


http://www.globalwarmingart.com/wiki/Sea_Level_Gallery.

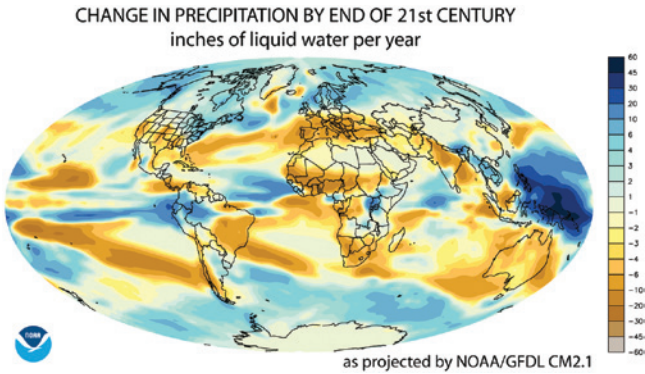


Source: http://www.globalwarmingart.com/wiki/Sea_Level_Gallery.

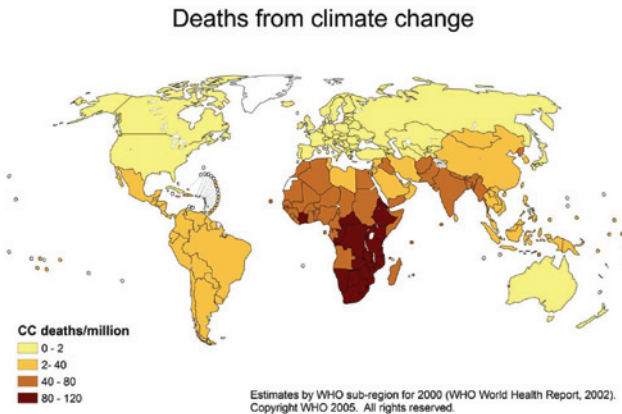
Figure 7. Ice melt and sea level.



Source: <http://climatecommission.gov.au/report/the-critical-decade/>.



Source: <http://www.gfdl.noaa.gov/will-the-wet-get-wetter-and-the-dry-drier>.



Source: <http://www.who.int/heli/risks/risksmaps/en/index5.html>.

Figure 8. Other effects of climate change.

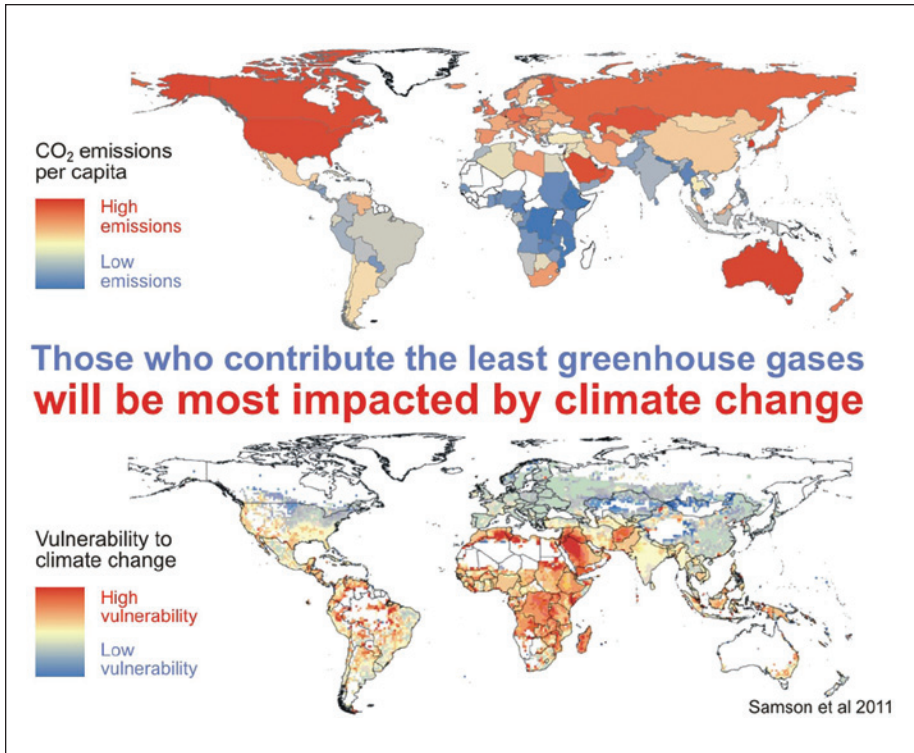


Figure 9. Rich (make the rules and GHGs) and poor (make do and graves).

Source: <http://onlinelibrary.wiley.com/doi/10.1111/j.1466-8238.2010.00632.x/abstract> and <http://www.skepticalscience.com/graphics.php>.

Climate change thus results in a wide range of adversity and tragedy in many areas, particularly for those with the lowest levels of GHG emissions. The list of effects is long, for example: water scarcity, drought, extreme weather, disease, sea level rise, flooding, habitat loss, mortality, food scarcity and insecurity, sanitation problems, shelter and human settlement problems, and population migration. Visuals such as those offered here should be pasted in large on all classroom walls round the globe, particularly in the higher polluting countries.

Two important and related areas are health and death, as indicated in the above graphs. Health has suffered and deaths have increased as a result of climate change. Here is a strong, but realistic, statement. In 2004,

a WHO assessment, taking into account only a subset of the possible health impacts, concluded that the modest warming that has occurred since the 1970s was already causing over 140 000 excess deaths annually by the year 2004. (<http://www.who.int/mediacentre/factsheets/fs266/en/>)

In 2009, *The Lancet* boldly asserted that “Climate change is the biggest global health threat of the 21st century.”

The big message of this report is that climate change is a health issue affecting billions of people, not just an environmental issue about polar bears and deforestation. (<http://www.ucl.ac.uk/news/news-articles/0905/09051501>)

Climate change is the biggest global health threat of the 21st century. . . . Climate change will have its greatest impact on those who are already the poorest in the world: it will deepen inequities and the effects of global warming will shape the future of health among all peoples. Yet this message has failed to penetrate most public discussion about climate change. And health professionals have barely begun to engage with an issue that should be a major focal point for their research, preparedness planning, and advocacy (the UK’s Climate and Health Council is a notable exception). ([http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(09\)60922-3/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)60922-3/fulltext))

In 2012, DARA, an independent organization committed to improving the quality of aid for vulnerable populations suffering from conflict, disasters, and climate change, published a report that estimates that

the deaths related to climate change and its chief driver, fossil fuels, were roughly 5 million in 2010. That number makes climate change one of the leading causes of death in the world; for comparison, cancer causes about 7.6 million deaths per year. These deaths are caused by a variety of factors related to climate and carbon. A changing climate not only makes agriculture less productive in many areas of the world, decreasing access to food, but also leads to greater food spoilage from heat; these effects alone lead to diarrheal illnesses and hunger that caused around 310,000 deaths in 2010. Heat and cold illnesses, malarial and vector-borne diseases, meningitis and environmental disasters account for the rest of the almost 700,000 deaths attributable to these direct climate impacts. Pollution, indoor smoke, and occupational hazards related to the carbon economy cause the rest of those 5 million deaths through ailments like skin and lung cancer. (<http://www.policymic.com/articles/21419/climate-change-kills-5-million-people-every-year-here-s-how>; see also, <http://daraint.org/climate-vulnerability-monitor/climate-vulnerability-monitor-2012/>)

In 2012, an article by Drew Shindell et al., titled “Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security,” showed that, with proper vision and implementation, measures to slow climate change are possible.

Tropospheric ozone and black carbon (BC) contribute to both degraded air quality and global warming. . . . We identified 14 measures targeting methane and BC emissions that reduce projected global mean warming ~0.5°C by 2050. This strategy avoids 0.7 to 4.7 million annual premature deaths from outdoor air pollution and increases annual crop yields by 30 to 135 million metric tons due to ozone reductions in 2030 and beyond. (<http://www.sciencemag.org/content/335/6065/183>)

Healthcare simulation/gaming has expanded enormously since the early 2000s, especially with the impetus initiated by pioneers like Dave Gaba, Doris Østergaard, Ed Salas, John Schaefer, Tore Lærdal - see, for example, an early meeting entitled “Training facilitators of medical simulation,” <http://medical.simulation.free.fr/>, and the founding of several sister journals, including *Simulation in Healthcare* and *Clinical Simulation in Nursing*. This huge expansion, however, does not appear yet to have fully taken on board patient health care and medical needs resulting specifically from climate change impacts. Simulation has been used to study the impact of

climate change on various health issues (such as increase in infectious diseases), and on-line games to make people aware of the climate-health connection, such as Playgen's CLIMATE HEALTH IMPACT, although the on-line debriefing material here is woefully inadequate. The next step for health and medical simulation/gaming/debriefing is to address the specific health and medical problems deriving from the causes and effects of climate change. This, in my view, is the next big challenge for healthcare simulation/gaming and debriefing, including debriefing for climate trauma victims.

Some people, including deniers, go to dangerous lengths, using spurious arguments and abusive derision, to quash climate change information and ridicule scientists. Some even fork out colossal sums of money in attempts to hide the truth. Luckily, some influential people are combating this.

Pervverting the course of evidence-based policy on climate-change adaptation and mitigation damages our health resilience, our economic prosperity and our environmental stability. Transparency around climate-sceptic funders is essential. We support freedom of information to reveal those deliberately preventing the UK's sustainable future. [Signed by eminent scholars.] (<http://www.guardian.co.uk/environment/2012/jan/26/transparency-donors-climate-sceptic-lobby>)

These kinds of issues should be translated into classroom simulation/games, to make young people aware of the deniers' chicanery, and maybe include issues related to NSA and GCHQ spying on environmental activists.

Given the above figures for climate-caused death, it appears that people (heads of government and big industry especially) are not overly concerned with 'dying by climate'. However, when a nuclear power station breaks down, we then get hit by mass hysteria, and governments the other side of the world vow to shut down their nuclear power stations. The effect of this is to spark the burning of even greater quantities of fossil fuel, generating increased and longer-term global warming, with further catastrophic effects, such as a heavier death toll. The health threat from climate change and increased fossil fuels is bigger than that from nuclear power, as indicated by the World Health Organization (WHO) and *The Lancet* (above). Governments shut down nuclear power plants basically out of fear, not of dying, but of not getting reelected; they build and crank up even more lethal, coal-burning stations, which they merely hope will get them reelected, but which will kill more people. American-style democracy thus perverts long-term well-being.

Given the massive and unstoppable toll from climate change, what alternatives exist? I recall that James Lovelock, who became famous with the Gaia hypothesis, declared about a decade ago that only nuclear power, by reducing reliance on carbon fuel, can help slow global warming. In regard to mortality, Jim Hansen and colleagues have recently demonstrated that nuclear power is far safer in the long run than climate change (especially of the magnitude that will hit in generations to come if we continue to burn fossil fuels as we are doing now). See the graph below, indicating deaths prevented by nuclear power (yes, you read that right).

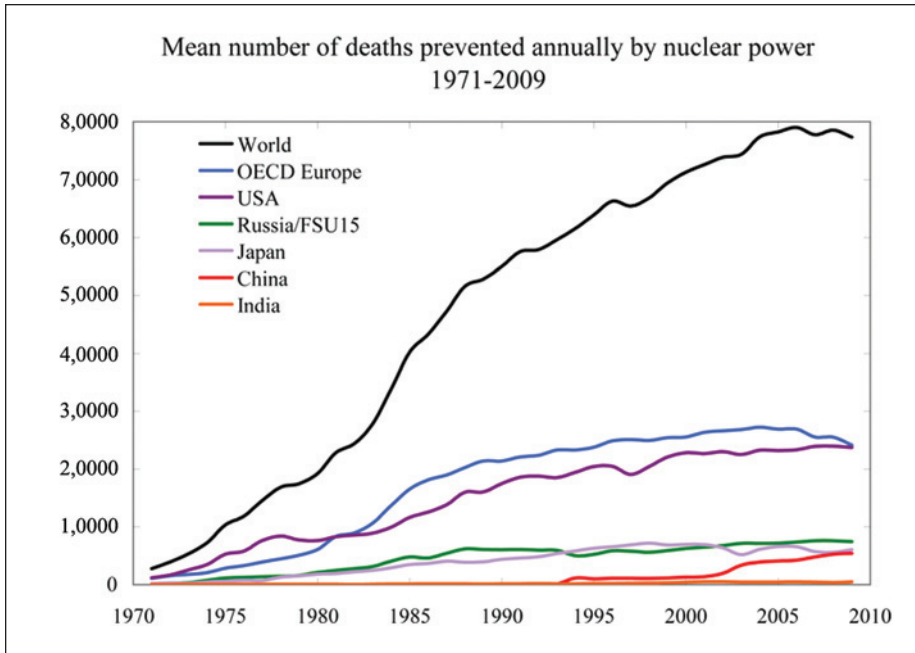


Figure 10. Deaths prevented by nuclear power.

Source: http://www.giss.nasa.gov/research/briefs/kharecha_02/ and <http://pubs.giss.nasa.gov/abs/kh05000e.html>.

I speculate that the horrendous economic cost of climate change far outweighs the relatively minor cost of nuclear power (even when hidden costs and subsidies are included). I speculate that if studies similar to the above type of study conducted by Hansen et al. on death prevention were to be applied to such areas as financial cost or negative economic impact, they would also indicate that climate change is far more damaging than nuclear power. For an early study on the economics of climate change, see Godard's article reviewing the Stern report available here: <http://sapiens.revues.org/240>.

I speculate that people (rich ones especially) are more attached to their pockets than to their lives, or at least react with greater energy when their current pockets are under threat than when their future life is in danger. Few seem to care that millions are suffering because a few greedy and powerful people refuse to, or cannot, learn the science, and then cannot or refuse to act on it. Maybe if such people are not afraid of the impact of climate change on their or other people's health, they will take greater notice when it starts to draw on their, often ill-gotten, gains. If people think that climate change is likely to hit their pockets, then they may take more notice than if they feel that health is

the only danger. Projections from socioeconomic models could provide guides for human suffering in the future, in similar fashion to the climate simulations.

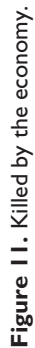
Great advantages would accrue from integrating the various models and simulations, so that we can understand the dynamics of future trends and interactions between the physical and socioeconomic worlds. A number of 'global models' have been developed over the past decades. These include the various climate change models and sustainability models, such as GCMs and World 3. A range of other models, each focusing on clusters of variables, should be examined. One list of these is provided by Peter Brecke (a global modeler) on his website—<http://www.inta.gatech.edu/peter/globmod.html>. One model that has been under continual development over the past few decades is Barry Hughes's IFs—<http://www.ifs.du.edu/introduction/ifs.aspx>. Other scholars have developed interesting insights using models of varying complexity, including Dick Chadwick, Richard Powers (the COMMONS GAME, based on Hardin's work), Martin Shubick, Warren Thorngate, and Jon Wilkenfeld (apologies for omissions), all authors in *S&G*. A particularly powerful, results-oriented, grassroots methodology, involving agent-based models and role-playing games, called *Companion Modeling*, has been developed over the past decade by people like Olivier Barreteau, François Bousquet, Christophe Le Page, and Guy Trébuil (authors in *S&G*); one of them, Patrick d'Aquino, has an article in this symposium. The efforts by CERFACS Climate Modelling and Global Change, <http://www.cerfacs.fr/3-25708-Home.php>, should be included. Regional or local models have been developed by other organizations round the world, such as Mistra-SWECIA and the Stockholm Resilience Centre. Others are no doubt missing from this abbreviated list.

An integration of various models would produce a more realistic projection of the socioeconomic effects of resource plundering and climate change. This would include such variables as mass migration (land has become unproductive, been swallowed by the waves of rising seas, otherwise become agriculturally unsustainable, or cannot support communities because of melting permafrost), famine, increasingly obscene gap between rich and poor, within and among states, economic crises, heat waves, and water wars. Historical events too can be included, as indicated by Geoffrey Parker; see <http://chronicle.com/article/The-Inevitable-Climate/139423/>. He quotes paleontologist Richard Fortey:

There is a kind of optimism built into our species that seems to prefer to live in the comfortable present rather than confront the possibility of destruction, with the result that "human beings are never prepared for natural disasters". (<http://chronicle.com/article/The-Inevitable-Climate/139423/>)

For example, an integration of feedback loops and variables among resource depletion (World 3), climate change (GCM), health and mortality, sociopolitical change, political stability, propensity for war, transparency (level of corruption), and so on could be achieved. Research on the interrelations among these types of phenomena (variables) could reveal tipping points or catastrophe theory cusps, and they could then be integrated into larger, global environmental-human models. These in turn would allow us to develop more effective simulation/games and debriefing, and thus contribute to the building of what Dennis Meadows calls *pockets of resilience*. Even though it is in their long-term interest, major funders, such as governments, would probably be reluctant

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to support such initiatives, as they are likely to highlight governments' woeful inadequacy. However, some enlightened municipalities and industries seem to have recently taken the lead in climate change mitigation measures; they could easily fund some critical model and simulation integration efforts, and they would be the first to benefit. Of course, the role of debriefing as an aid in research would be beneficial here too. If scientists have managed to simulate sustainability and climate change over time with such remarkable accuracy, validity, and reliability, then it should not take that much more ingenuity to integrate some existing models. The graph above, from the *New Scientist* (some five years ago), gives an idea of how apparently disparate variables could be linked in a comprehensive model.

Let us take one example of connecting two variables: climate and crime. What are the links between climate change and crime? At least two perspectives can be developed: (a) the influence of climate (and weather) on crime, and (b) the crime of contributing to climate change. The first is climate change causing crime, and the second is the crime of causing climate change. An outline of the first is contained in the following quote:

Temperature has a strong positive effect on criminal behavior, with little evidence of lagged impacts.

Between 2010 and 2099, climate change will cause an additional 30,000 murders, 200,000 cases of rape, 1.4 million aggravated assaults. (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2111377)

The second perspective is controversial. It is interesting to speculate about whether humanity will hold industrialists, government politicians, and deniers responsible, in an international court, for knowingly making or allowing massive (industrial) GHG emissions. The United Nations should set up an international climate court to try such people. This is not as preposterous as it may sound initially. Governments have done similar things in other areas, such as set up courts to try war criminals (for acts that were made criminal relatively recently). Given that climate change kills millions each year, it can be argued that it is akin to a crime against humanity. If aircraft were to kill, on a continual basis, as 'few' as one thousandth (0.1%) of the number of people dying annually from climate change (about 400,000 annually, according to a recent report by the *Climate Vulnerability Monitor*), we would have uproar, and governments around the world would be unanimous on the need to ground the entire world's fleet. If airlines continued to fly, it would be with empty aircraft. If governments attempted to make airlines fly, they would be accused of major crimes. Yet, for climate crime (about 33,000 people a month, or 1,000 a day), little seems to be done. Selfish and corrupt leaders and governments want power and money, even if they 'have to' kill millions of people. Besides, if some governments set up a court to try climate criminals, they would in effect have to judge themselves—hardly an enticing prospect. Better to deny the problem.

One difficulty is that climate deaths happen quietly, one by one, each one in their own hidden corner, mostly poor people, without a voice and out of the eye of most mainstream media. The local, and often self-censoring, media do not see it, and western populations either shrug it off or refuse to believe it. As George Monbiot says,

If the governments promoting biofuels do not reverse their policies, the humanitarian impact will be greater than that of the Iraq war. Millions will be displaced, hundreds of millions more could go hungry. This crime against humanity is a complex one, but that neither lessens nor excuses it. If people starve because of biofuels, Ruth Kelly and her peers will have killed them. Like all such crimes it is perpetrated by cowards, attacking the weak to avoid confronting the strong. (<http://www.monbiot.com/2007/11/06/an-agricultural-crime-against-humanity/>)

It is worth quoting the following article in full.

Should Accountability for Global Warming Be Linked to Crimes Against Humanity?

James O'Dea

We define as having criminal intent any person who calculates that there is a definite possibility their actions will result in harm to others. Equally, we define as criminally negligent anyone who is aware that an individual is likely to harm others but who ignores the situation. In the not-too-distant future will politicians who intentionally ignore global climate change, or who obstruct action to implement conscientious policies to prevent deterioration of climate conditions, be deemed criminally negligent? The scale of death and destruction resulting from global warming may potentially exceed losses due to genocides and world wars. We need discussion of legal and moral accountability for gross negligence when it comes to destruction at this level.

Given the tools at our disposal to measure the adverse climate impact of human behavior and the overwhelming consensus of climate scientists about the causes of global warming any conscious choice to deny it and refuse to take action must be considered extremely risky behavior and, I believe, criminal negligence.

As record-breaking floods, fires, and drought affect more regions of the world, the risk of not just more loss of life but massive and sustained loss of life becomes statistically inevitable. How any one of us responds to the risk of harm to others defines whether we are morally clear or morally clouded. Here is a simple analogy about our moral and legal responsibility for taking risks.

You take little Jenny to school and you are met by the principal who says his electrician tells him the school's electrical wiring is old and faulty and there is significant chance it will overheat in places and cause a fire. The principal, who has no expertise in inspecting wiring, says the electrician doesn't know what he is talking about. Any school official or parent who knowingly sent their child into that school would be held criminally negligent if it caught fire.

The same is true for climate change; we have to make morally coherent choices based on the information currently available to us if we don't want to be held accountable as accessories to what may be the crime of the century.

The Pentagon, acting in a responsible way, has done its own scenario planning for very large-scale social and political chaos arising from climate change disruptions. The military knows you pay attention to risk. But our government and so many others have drifted into an immoral paralysis on this issue.

I write and teach about human rights and global peace building and it's very clear when governments are responsible for crimes against humanity. It is becoming increasingly clear that climate disruptions are going to increase global conflicts over resources, food and water, and create climate refugees. Global warming will destroy any chances of global peace. In international law we have established an international criminal court and war crimes tribunals to try those found guilty of crimes against humanity. But who will be held accountable for inaction on global warming and how will they be brought to justice? (http://www.huffingtonpost.com/james-odea/accountability-global-warming-crime_b_1723704.html)

See also William Tucker's long article "Is Climate Change Denial a Crime?" in *Ecology Law Quarterly* (Vol. 39, p. 831), <http://www.boalt.org/elq/>. Jim Hansen reminds us that

our children and grandchildren will judge those who have misled the public, allowing fossil fuel emissions to continue almost unfettered, as guilty of crimes against humanity and nature. But the eventual conviction of these people in the court of public opinion will do little to ease the burdens that will have been created for today's young people and future generations. (<http://www.guardian.co.uk/environment/2012/jan/23/climate-sceptic-lawson-thinktank-funding>)

In his blog, <http://blogs.law.widener.edu/climate/>, and book, Marco Rubio explains “why politicians may not ethically rely on their own uninformed opinion about climate science and [indicates] 10 questions that the press should ask politicians about climate science in light of this responsibility” (<http://blogs.law.widener.edu/climate/2013/02/12/>).

The integration of models and simulations, suggested above, would also benefit from including variables related to climate change denial—with the various types of denial and their effects constituting a variable in the overall (maybe agent-based) models. Recent research into this devilish denier disease is shedding light and helping us to see how its carriers may be inoculated. It also shows up the pockets of primitive structures of the human brain in the modern world. Some interesting simulation/games, probably in the form of emotionally charged role-plays, could be designed based on this work. The web page https://en.wikipedia.org/wiki/Climate_change_denial is a good start; it could be supplemented by a host of other writings, both in the serious press (such as *The Guardian*, Joe Romm's and George Monbiot's blogs) as well as in the scientific outlets, such as the book by Kari Marie Norgaard, *Living In Denial: Climate Change, Emotions, and Everyday Life*, and the chapter by Riley E. Dunlap and Aaron M. McCright's “Climate Change Denial: Sources, Actors and Strategies” (in the *Routledge Handbook of Climate Change and Society*). Several articles, recently published in SAGE journals, shed useful light (search titles at <http://www.sagepub.com>); they include the following:

- Michael E. Mann: A scientist in the crosshairs of climate-change denial.
- Climate change denial books and conservative think tanks: Exploring the connection.
- Climate change skepticism and denial: An introduction.
- “What sceptics believe”: The effects of information and deliberation on climate change scepticism.
- Human geographies of climate change: Landscape, temporality, and lay knowledges.
- Global warming: How skepticism became denial.

Also, *The Oxford Handbook of Climate Change and Society* may have some useful material. Isaac Asimov's words seem to ring true here: “The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom”. However, carefully designed and properly debriefed simulations, games, and role-plays could provide an added pinch of wisdom.

It will be clear that, with climate changing literally as you read, we cannot afford to wait around until others do something. Let no one say that they have not been warned; the science is clear. Policy and action need to be at least as clear. Developing research simulations, educational simulations, learning games, role-play, case studies, policy exercises, and similar tools to focus on various aspects of climate change, as discussed in this symposium will, of course, move things in the right direction. However, as Dennis Meadows points out in his Foreword, such methods need to focus on specific

objectives, and even then cannot by themselves have the necessary impact. Education about climate change, and simulation/games to make that education powerful, needs to be introduced widely throughout the world's classrooms. One might say that climate change without education is a nonstarter for young people, and that education without climate change as a central component is adrift. Both are needed, and simulation/gaming with proper debriefing is the cement that binds them.

In 2009, Warren Thorngate and I ended an editorial on the relationship between action and knowledge, with these words:

We offer . . . quotes that illustrate the urgency of uniting action and knowledge in three interrelated areas critical to the survival of this planet and the humans that it carries. The areas are the mad rush for global economic growth, the impending disaster of climate change, and the folly of conflict and war. These are prime examples, on a grand scale, of people and their governments knowing what to do, but simply not taking the necessary action. Is it conceivable that simulation/gaming can make an impact in these areas sufficient for more effective action to be undertaken? (see the full article here: <http://sag.sagepub.com/content/40/1/8.full.pdf+html>)

One of the quotes was from a 2008 issue of the *New Scientist*, which outlines the issues starkly. It is interesting to read the introduction to that issue in the light of the intervening five years, which have just seen CO₂ go beyond the symbolic 400 ppm, way above Jim Hansen's recommended manageable 350 ppm. Peak oil has gone by, coal production is on the increase, and governments are unable both to recover from global economic crisis and to honor their pledge to reduce the gap between poor and rich. Yet, these same failing governments the world over, with few exceptions, are hell-bent on growth at all costs. Load the ship as heavily as possible, push out gaily into stormy seas, and never mind if it sinks and we all perish.

Consumption of resources is rising rapidly, biodiversity is plummeting and just about every measure shows humans affecting Earth on a vast scale. Most of us accept the need for a more sustainable way to live, by reducing carbon emissions, developing renewable technology and increasing energy efficiency.

But are these efforts to save the planet doomed? A growing band of experts are looking at figures like these and arguing that personal carbon virtue and collective environmentalism are futile as long as our economic system is built on the assumption of growth. The science tells us that if we are serious about saving Earth, we must reshape our economy.

This, of course, is economic heresy. Growth to most economists is as essential as the air we breathe: it is, they claim, the only force capable of lifting the poor out of poverty, feeding the world's growing population, meeting the costs of rising public spending and stimulating technological development—not to mention funding increasingly expensive lifestyles. They see no limits to that growth, ever.

In recent weeks it has become clear just how terrified governments are of anything that threatens growth, as they pour billions of public money into a failing financial system. Amid the confusion, any challenge to the growth dogma needs to be looked at very carefully. This one is built on a long-standing question: how do we square Earth's finite resources with the fact that as the economy grows, the amount of natural resources needed to sustain that activity must grow too? It has taken all of human history for the economy to reach its current size. On current form it will take just two decades to double.

In this special issue, *New Scientist* brings together key thinkers from politics, economics and philosophy who profoundly disagree with the growth dogma but agree with the scientists monitoring

our fragile biosphere. . . . why our economy is blind to the environmental costs of growth, . . . technological fixes won't compensate for the hair-raising speed at which the economy is expanding. . . . green values have no chance against today's capitalism, . . . only a global government-led effort can shift the destructive course we are on . . .

. . . it is crucial to demolish one of the main justifications for unbridled growth: that it can pull the poor out of poverty.

Today's economists dismiss such ideas as naive and utopian, but with financial markets crashing, food prices spiralling, the world warming and peak oil approaching (or passed), they are becoming harder than ever to ignore. (<http://www.newscientist.com/article/mg20026786.000-special-report-how-our-economy-is-killing-the-earth.html>)

What has improved in those five years, 2008 to 2013? Not a whole lot; if anything, things are worse. So maybe we should go back further and give ourselves twenty years to see if knowledge has been met with action. Over twenty years ago, governments were given an even stronger and starker warning. This was the *World Scientists' Warning to Humanity*, signed by 1,700 of the world's leading scientists, including the majority of Nobel laureates in the sciences. Here are some extracts:

Human beings and the natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. If not checked, many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes are urgent if we are to avoid the collision our present course will bring about.

We the undersigned, senior members of the world's scientific community, hereby warn all humanity of what lies ahead. A great change in our stewardship of the earth and the life on it is required, if vast human misery is to be avoided and our global home on this planet is not to be irretrievably mutilated.

We must bring environmentally damaging activities under control to restore and protect the integrity of the earth's systems we depend on.

We must, for example, move away from fossil fuels to more benign, inexhaustible energy sources to cut greenhouse gas emissions and the pollution of our air and water. Priority must be given to the development of energy sources matched to Third World needs—small-scale and relatively easy to implement.

We must halt deforestation, injury to and loss of agricultural land, and the loss of terrestrial and marine plant and animal species.

A new ethic is required—a new attitude towards discharging our responsibility for caring for ourselves and for the earth. We must recognize the earth's limited capacity to provide for us. We must recognize its fragility. We must no longer allow it to be ravaged. This ethic must motivate a great movement, convincing reluctant leaders and reluctant governments and reluctant peoples themselves to effect the needed changes.

The scientists issuing this warning hope that our message will reach and affect people everywhere.

We need the help of many. (<http://www.ucsusa.org/about/1992-world-scientists.html>)

How many governments and leaders have really heard, taken heed, and acted? Ignoring such statements, makes politicians look like fools—in the everyday sense of *stupid*, and in the original sense of the word, from the French *fou*, meaning *insane*. The question here is: Might simulation/games be effective in countering such tendencies, and building a logic of sufficiency, as espoused by Bhumibol Adulyadej (King of Thailand),

Thomas Princen, among others, and promoting true sustainability, even if in pockets of resilience - as lived, for example, by the lobster fishermen of Monhegan Island. Part of the answer comes from Richard Powers. He points out that

... the big problem for so many of us is that the negative consequences of climate change are still in the future (most of them anyway) and humans (except perhaps climate change scientists) are not programmed to respond to future events well.

So, how can we use simulation/gaming to make folks *feel* the future, so that they are primed to act immediately? Can we change the education of our children so that they are trained to react to important future threats proactively? Civilizing children means that we toilet train them, teach them the rules of living among others, and so on. Part of this training should be to teach them to respond to the major threats to life on earth by learning that they can and should do something to prevent that threat right now. For example, after such training, it would be as difficult for a politician to get elected if they denied climate change problems as it would be if they were a convicted child molester.

The catch here is that climate action is urgent. For simulation/games to promote the kind of change that Richard would like to see, they need to be introduced massively and debriefed properly; and then we probably need to wait for a generation to become climate educated enough to vote in governments that will act intelligently.

Warren Thorngate's brainstorm produced some wonderful ideas for some shorter term intervention:

So I wonder about more short-term tactics. Should we, for example, offer free simulation weekends to the spouses of politicians in hopes they convert, then preach in private moments? Should we promote online simulations that allow any internet user to move sliders, click buttons and watch how they affect predicted climate changes in their own community? Should we send politicians and energy CEOs requests to take a Climate Change Genius test to see how knowledgeable they are of the results of various simulations, then publish the scores (and refusals) of each politician? Should we provide climate change simulations for use on national television news or weather shows? Should we sponsor contests in an "International World Future Day" for citizens who produce the best simulations of climate change?

For the moment, however, let us try a thought simulation. A bomb defusal squad arrives in your office or on your campus and announces that a bomb has been discovered in the plot of land of being prepared for a new building extension. Your boss (office chief, company director, or university president) laughs at the squad and pours scorn over them, insisting that no danger is present, ordering the squad out, and declaring that building work will continue. That day, your children have come to work with you and are playing in the staff room. What do you do? Here are a few options:

- a. Run away as fast as possible? (with the risk that your boss will accuse you of desertion);
- b. Argue vociferously with your boss? (with the risk that you lose your job);
- c. Call the police? (with the risk that you will be accused of whistle-blowing);
- d. Seize and tie up the boss? (with the risk that you will be accused of illegal detention);
- e. Send out posts on all your social web media? (with the risk that people will not believe such a crazy story);
- f. Pretend to side with your boss and hope for the best? (with the risk that your children get blown up with you);

- g. Stay put, but send your young kids away? (with the risk that they get run over or that you get blown up and leave your children as orphans);
- h. Do nothing? (with the risk that your children, if they survive, and that the rest of your family and friends, will deride you for having done nothing);
- i. Other options? (imagine them yourself).

Unlikely scenario? Well, this is somewhat akin to the climate bomb situation in which whole populations are caught with their governments, which supposedly represent their interests. Maybe we can excuse them, however, as the climate bomb is exploding more slowly and is on such a grander scale than a mere campus or company. After all, politicians are in the habit of sending their minions to the slaughter house of war; so why not maintain the tradition and send them to the inferno of global warming?

In some places, businesses and local authorities seem to be acting in a concrete fashion, and achieving results, but how big is this impact, given the pressure from big business hand in glove with government? Maybe it needs more time, so that education, with simulation, gaming, and debriefing, can open the eyes of a new generation of globally responsible citizens, who force their governments to act. However, it is urgent, as sustainability and climate scientists like Meadows and Hansen are at pains to point out. Also, it is not as though anthropogenic warming was discovered yesterday; this year is the 75th anniversary of the publication of Guy Stewart Callendar's almost prophetic article titled "The Artificial Production of Carbon Dioxide and Its Influence on Temperature"—note the term *artificial*.

The planet has already moved beyond sustainability, and major climate change cannot now be stopped, at least not in the next few hundred years, unless nuclear power is developed on a massive scale or nuclear fusion becomes a reality. The planet is heading toward catastrophe. H. G. Wells (1866-1946) wrote, "Human history becomes more and more a race between education and catastrophe" and "Adapt or perish, now as ever, is Nature's inexorable imperative". With the help of simulation, gaming, and debriefing, maybe education will win and humanity will adapt. However, the simulation/games need to become far more effective and widespread than they are today, and that largely passes through thorough debriefing, which itself seems to have its own deniers, but that is another story for another time.

Let me finish with a few more quotes—and a poem:

- *Experiential learning: Experience as the source of learning and development.* David Kolb.
- Change is inevitable. Growth is optional. Buddhist saying.
- We do not have an ecological crisis. The ecosphere has a human crisis. William Rees.
- Why are ecologists and environmentalists so feared and hated? This is because in part what they have to say is new to the general public, and the new is always alarming. Garrett Hardin.
- We have not inherited the world from our forefathers; we have borrowed it from our children. Kashmiri proverb.
- Only when the last tree is cut, only when the last river is polluted, only when the last fish is caught, will they realize that you can't eat money. Native American proverb.
- The only thing more dangerous than ignorance is arrogance. Albert Einstein.
- It has become appallingly obvious that our technology has exceeded our humanity. Albert Einstein.

Who has seen the wind?
Neither I nor you:
But when the leaves hang trembling,
The wind is passing through.

Who has seen the wind?
Neither you nor I:
But when the trees bow down their heads,
The wind is passing by.

Christina Rossetti, 1830-1894

Author's Note

Opinions expressed herein can in no way be construed as those of the author's employer or of the publisher of this journal.

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