

## Climate Change and Future Katrinas

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### Introduction

Will destructive storms like Katrina be more frequent in the future? Driven by global warming, are they likely to become even more powerful? What does the future hold for low-lying coastal cities like New Orleans? And what is the role of capitalism in the climate catastrophe? This article will provide a background on global warming, summarize some scientific predictions for future storms, discuss why the global capitalist system is incompatible with sustainability and survival, and offer ecosocialism as an alternative to capitalism.

### Global Warming

A good way to understand the effect of a small increase in the global average temperature is to look to the past. Scientific studies estimate that 20,000 years ago, during the Last Glacial Maximum, the global average temperature was  $3^{\circ}\text{C}$  to  $6^{\circ}\text{C}$  *cooler* than now.

During the last Glacial Maximum ice sheets covered Canada and much of the United States while New York City and Chicago were buried under more than a mile of ice, and sea level was almost 400 feet below where it is now. This example from Earth's history illustrates how a change of only a few degrees of global average temperature has major planet-altering consequences [Archer].

At the current rate of global greenhouse gas emissions, warming of the planet above pre-industrial temperatures will shoot past two degrees Celsius by mid-century and reach 4 to  $6^{\circ}\text{C}$  by 2100. Consider that if a 4 to  $6^{\circ}\text{C}$  temperature *decrease* in global average temperature put New

York City and Chicago under a mile of ice, what would a 4 to 6°C temperature *increase* do? The answer is that it would transform the planet in ways that make it unrecognizable and even uninhabitable.

Hans Schellnhuber, director of the Potsdam Institute for Climate Impact Research, described the consequences of global warming: "the difference between two and four degrees [of warming] is human civilization...." A temperature rise of 4°C (which is an increase of 7.2°F) would likely end civilization as we know it, and a 6°C global average temperature increase could very well mark the extinction of humanity along with many other species.

The direct physical cause of global warming is the emission of greenhouse gases, especially carbon dioxide, methane, and nitrous oxide. The sources of emissions span the entire global economy, from electricity, heat and cement production to deforestation and agribusiness to transportation and industry.

In this situation, the Intergovernmental Panel on Climate Change (IPCC) reports that to stay even below 2°C of warming, already a very high and dangerous temperature limit, greenhouse gas emissions must decrease worldwide to zero well before the end of the century [Klein].

### **Greenhouse Gases and Ocean Effects**

When carbon dioxide in the air mixes with surface ocean water, the two react to form carbonic acid. This is the same acid in carbonated soft drinks that gives the tingling sensation to your tongue. But in the oceans, carbonic acid attacks coral reefs, certain kinds of phytoplankton, and swimming animals with shells (pteropods) which are critical food sources for fish [Archer].

Coral reefs are the rainforests of the ocean with a rich biodiversity estimated to hold more than a million species. Warming of ocean waters is causing coral bleaching as overheated coral

expel symbiotic algae. Ocean acidification, now worse than during the previous several million years, is reducing calcification of corals. The combined effects have already resulted in the mass mortality of ocean life [Hansen2].

In addition to the deadly effects of acidification, the warming of ocean waters tends to stratify the waters by temperature and decrease circulation, thereby lowering oxygen levels. Adding to this, chemical fertilizer runoff into the oceans has the effect of further depleting the ocean of oxygen. The result of oxygen depletion is the increasingly alarming appearance of dead zones in the ocean, devoid of life.

Sea level rise is another consequence of global warming because of ice melt from Greenland, Antarctica and glaciers, as well as thermal expansion from warming waters. The Eemian interglacial period (120,000 years ago) was 2°C warmer than the decades 1880–1920. Geologic evidence suggests a rapid sea level rise during that period eventually reaching 9 meters above present sea level.

The example of the Eemian interglacial period raises a serious possibility that a critical stability threshold was crossed at 2°C of warming that resulted in polar ice sheet collapse. Considering that most large cities in the world lie on a coast, the human consequences of global warming and sea level rise are enormous [Hansen2, Klein].

Predictions for the extent of sea level rise by 2100 vary widely. The 2013 IPCC report estimated about a meter of sea level rise, but some subsequent analyses put it much higher. James Hansen, one of the world's leading climate scientists, together with 18 international colleagues, warned that without substantial decrease in greenhouse gas emissions, global sea level is likely to increase "several meters over a timescale of 50 to 150 years" rendering most of

the world's coastal cities uninhabitable. Moreover, an increasing surface temperature gradient between the equator and the poles could energize unprecedented, devastating storms [Hansen].

A study published in the National Academy of Sciences in 2015 examined how much rising sea levels will eventually affect cities across the United States even if carbon emissions decrease. The most startling finding is that 414 coastal towns and cities in the U.S. have already passed their lock-in date, that is, the point at which it is guaranteed that more than half the city's populated land will eventually be underwater. Even if carbon emissions are drastically decreased it is not a matter of if but when. Of those 414 cities, New Orleans and Miami stand to be among the most compromised as sea levels rise [Strauss].

### **Hurricanes on a Warming Planet**

Computer models and other physical analyses indicate that the incidence of the strongest hurricanes will increase as the climate warms. In fact, there is already evidence that this is happening. More specifically, a 10 mile per hour increase in top hurricane wind speeds for every degree (Celsius) increase in surface sea temperatures is predicted by hurricane experts [Emanuel, Bender].

This is far more significant than it might first appear. As an example consider typhoon Haiyan in 2013. The Philippines regularly endures Category 5 typhoons, but they rarely make news because they seldom do much damage. A 100-year storm will have a landfall peak wind speed of about 170 mph, but Haiyan topped that with wind speeds beyond 190 mph, along with a huge storm surge. The difference between 170 mph, for which that nation was prepared, and 190 mph winds of Haiyan caused more than 6300 deaths and massive devastation of infrastructure.

Globally, satellite data show that storms are reaching peak energies at higher latitudes, as predicted by mathematical models. As a consequence of this trend, there may be reduced risk in

parts of the tropics but new risks of destructive storms the in middle latitudes of the planet [Emanuel].

Aside from greater wind speeds, an obvious reason that more damaging storms will occur is the rise in sea levels which will necessarily add to storm surges [Parris]. A storm surge is an increase in sea level caused mostly by cyclonal winds (as opposed to low air pressure). Storm surges from Katrina reached 25 to 28 feet, breaking all previous records, and was the source of the greatest destruction from the storm.

Taking into account these factors, Kerry Emanuel, an MIT climate scientist and a leading expert on hurricanes, summarized the prospects for the future of New Orleans as follows:

... adapting to the myriad changes expected over the next 100 years is such a horrendous prospect that otherwise intelligent people rebel against the idea even to the extent of denying the very existence of the risk. This recalcitrance, coupled with rising sea levels, subsiding land and increased incidence of strong hurricanes, all but guarantees that New Orleans will have moved or have been abandoned by the next century [Emanuel].

Looking beyond New Orleans and Katrina, the National Hurricane Center makes the following observations regarding the U.S. Atlantic and Gulf Coast. Quoting a National Hurricane Center document:

- Much of the United States' densely populated Atlantic and Gulf Coast coastlines lie less than 10 feet above mean sea level
- Over half of the Nation's economic productivity is located within coastal zones
- 72% of ports, 27% of major roads, and 9% of rail lines within the Gulf Coast region are at or below 4 ft elevation
- A storm surge of 23 ft has the ability to inundate 67% of interstates, 57% of arterials, almost half of rail miles, 29 airports, and virtually all ports in the Gulf Coast area [Surge]

Without drastic mitigation, we are likely to see all of these events and the dangers are very much the same for other parts of the world.

## **Technical Solutions**

Rising sea levels and the destruction of the biosphere are not inevitable consequences of human nature. Humanity has the means to live within the natural boundaries of the planet, and to live well. But achieving harmony with nature requires a fundamentally different system of human cooperation and profound changes in the way the world economy operates.

The good news is that the technology needed to carry out such a global transformation already exists. Detailed plans for zero carbon energy generation, electrified mass transportation, agricultural reform, low carbon footprint buildings, and contraction of damaging and unnecessary industries have been developed by numerous experts in their fields and are widely available [Altieri, Jacobson, Klein].

Humanity has within its grasp the means to avoid the worst effects of global warming and to create a thriving and sustainable future in harmony with nature. But virtually nothing has been done to accomplish this. What stops us? The barrier to our collective survival is the system of rules and relationships we are presently constrained to have with each other imposed by capitalism.

### **Capitalism or Sustainability**

Capitalism is waging a war against nature. Until this is widely understood and acknowledged, humanity will be limited to ineffective reformist projects harnessed to the profit motive. Such projects may slow the drive to ecological disaster, but they cannot stop it.

The reason that capitalism, including so-called green capitalism, is incompatible with sustainability of the planet is that capitalism must expand, and infinite expansion on a finite planet is impossible. Economists from liberal to conservative, from Milton Friedman to Paul Krugman, all agree that economic growth, or capitalist expansion, is unavoidable if capitalism is to survive [Klein, Smith]. But economic growth is killing the planet.

What does it mean for capitalism to expand? It means a perpetual increase of Gross Domestic Product (GDP). It means unending commodity production and resource extraction, ever increasing dumping of trash and toxic waste, depletion of natural resources, deforestation, species extinction, resource wars, and population growth.

One often hears that population growth is the fundamental problem, rather than capitalism. There are just too many people, so this argument goes. It is true that population cannot grow indefinitely on a finite planet, but there is much more to this story.

First, the poorest 3.5 billion people—half the planet—emit almost no greenhouse gases and so they are not the cause of global warming. On the other hand, a tiny fraction of humanity—the wealthiest—are responsible for the bulk of global greenhouse gas emissions [Klein].

Second, and most important, it is capitalism that causes both climate change and drives population growth. The highest population growth rates in human history coincide with the capitalist era [Piketty].

Efficiencies and growth of food production naturally lead to population increases. Capitalism also benefits from an increasing population because markets expand as populations expand, and so does the labor pool. An expanding labor pool lowers the cost of labor and increases profits.

In addition, capitalism concentrates wealth which creates widespread poverty. It is well known that impoverished women tend to have more children than those with better resources at their disposal. Capitalist expansion and population growth are therefore mutually reinforcing.

## **Ecosocialism and Lessons of Katrina**

As the Professor Emanuel's statement quoted earlier in this article suggests, New Orleans might not survive as a city through the end of this century. Hurricane Katrina was a wakeup call that climate change is real and that it is happening now. Katrina may be understood as one of many signposts of a new planetary climate regime. In recognition of the catastrophic changes to Earth's environment caused by human activity, some scientists now refer to the present geologic epoch as the Anthropocene, [Monastersky]. It will be impossible to completely avoid climate change and the destruction that entails, but there is still time to limit global warming to survivable levels and avoid the worst environmental consequences.

Achieving this will require mass movements and many committed activists. But climate activists who do not identify capitalism as the fundamental problem are unwittingly participating in planetary suicide. The only rational course of action is to mobilize openly against capitalism and to speak against it as an integral component of every climate action. But what alternatives to capitalism are there?

A growing number of people embrace an ecosocialist perspective. As the term suggests, ecosocialism promotes both socialist relations and the necessity for humanity to live within ecological constraints. An international grassroots organization, "System Change Not Climate Change" explains further on its website:

Ecosocialists start with the premise that environmental degradation and social injustice stem from the same source: a world where profit is the highest goal. We believe that the emancipation of people from capital and its masters goes hand-in-hand with the emancipation of the earth and its biosphere from the cancer of capitalism. Thus, unlike most branches of the environmental movement, ecosocialism provides an over-arching framework that see links between different struggles. [SCNCC].

A real possibility exists that in reorganizing human society to eliminate carbon emissions so that we can survive within natural boundaries, many other improvements within a socialist



framework could be carried out such as: universal free healthcare; universal free education including university education; free and efficient electrified mass transportation powered by renewable energy; moving agricultural production closer to where it is consumed; and the use of production efficiencies to meet needs and create more leisure time for all people. These and many other improvements are within reach of humanity if we exercise the will to abolish capitalism and embrace values beyond private profit.

## References

- [Altieri] Miguel A. Altieri and Fernando R. Funes-Monzote, "The Paradox of Cuban Agriculture," *Monthly Review*, Vol. 63, Issue 8, January 2012  
<http://monthlyreview.org/2012/01/01/the-paradox-of-cuban-agriculture>
- [Archer] David Archer, "Global Warming: Understanding the Forecast," second edition, John Wiley & Sons, Inc. 2012
- [Bender] Bender, M.A., T.R. Knutson, R.E. Tuleya, J.J. Sirutis, G.A. Vecchi, S.T. Garner, and I.M. Held. 2010. Modeled impact of anthropogenic warming on the frequency of intense atlantic hurricanes. *Science* 327(5964):454-458.
- [Emanuel] Kerry Emanuel, "Climate change and Hurricane Katrina: what have we learned?" *The Conversation*, August 24, 2015  
<https://theconversation.com/climate-change-and-hurricane-katrina-what-have-we-learned-46297>
- [Hansen] James Hansen et al, "Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2 °C global warming could be dangerous" *Atmospheric Chemistry and Physics*, 16, 3761-3812  
<http://www.atmos-chem-phys.net/16/3761/2016/> doi:10.5194/acp-16-3761-2016 (2016)
- [Hansen2] James Hansen, Makiko Sato, Gary Russell, Pushker Kharecha, "Climate sensitivity, sea level and atmospheric carbon dioxide," *Phil. Trans. R. Soc. A* 2013 371, 20120294, 16 September 2013
- [Jacobson] Jacobson, M.Z., and M.A. Delucchi, 2011. "Providing all Global Energy with Wind, Water, and Solar Power, Part I: Technologies, Energy Resources, Quantities and Areas of Infrastructure, and Materials," *Energy Policy*, 39, 1154-1169, doi:10.1016/j.enpol.2010.11.040.
- [Klein] David Klein, "Capitalism and Climate Change: The Science and Politics of Global Warming," illustrated and edited by Stephanie McMillan <https://gumroad.com/l/climatechange> and available on Amazon.

[Monastersky] Richard Monastersky, Anthropocene: The human age *Nature* **519**, 144–147 (12 March 2015) doi:10.1038/519144a

[Parris] Parris, A., P. Bromirski, V. Burkett, D. Cayan, M. Culver, J. Hall, R. Horton, K. Knuuti, R. Moss, J. Obeysekera, A. Sallenger, and J. Weiss, 2012. "Global Sea Level Rise Scenarios for the US National Climate Assessment." *NOAA Tech Memo OAR CPO-1*. 37 pp.

[Piketty] Tomas Piketty, "Capital in the Twenty-First Century," (Technical Appendix) Harvard University Press, 2014

[SCNCC] System Change Not Climate Change  
<http://systemchangenotclimatechange.org/ecosocialism>

[Smith] Richard Smith, "Green Capitalism: The God that Failed" World Economics Association, 2016  
<https://rwer.wordpress.com/2016/05/17/new-wea-paperback-green-capitalism-the-god-that-failed-by-richard-smith/>

[Strauss] Benjamin H. Strauss, Scott Kulp, and Anders Levermann, "Carbon choices determine US cities committed to futures below sea level" *Proceedings of the National Academy of Sciences*, vol. 112, no. 44, 13508–13513 (2015)

[Surge] Storm Surge Overview, National Hurricane Center, <http://www.nhc.noaa.gov/surge/>