



Freeman Dyson, Debunked

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The Most Important Thing to know about Dr. Dyson & Climate Models

- ▶ “I am glad we are now talking about more general issues and not about technical details. I do not claim to be an expert about the details.” [Emphasis added]
 - ▶ Cite: Dr. Freeman Dyson, in an email response to questions from The Independent, a British Newspaper, which was asking Dr. Dyson to explain his views on climate change.
- ▶ Cite: <http://www.independent.co.uk/environment/climate-change/letters-to-a-heretic-an-email-conversation-with-climate-change-sceptic-professor-freeman-dyson-2224912.html>



Freeman Dyson, On CO₂

- Question: “I take it you accept for instance that carbon dioxide is a powerful greenhouse gas that warms the planet (1); that atmospheric concentrations of CO₂ have risen since direct measurements began several decades ago (2); and that CO₂ is almost certainly higher now than for at least the past 800,000 years (3), if you take longer records into account, such as ice-core data. Would you also accept that CO₂ levels have been increasing as a result of burning fossil fuels and that global temperatures have been rising for the past 50 years at least, and possibly for longer (4)?”
- Answer from Dr. Dyson: “yes(1), yes(2), yes(3), maybe(4).”
 - Cite: Ibid



Dyson's 6 Concerns with Climate Change Models and Predictions

- “**First**, the computer models are very good at solving the equations of fluid dynamics but very bad at describing the real world. The real world is full of things like clouds and vegetation and soil and dust which the models describe very poorly. **Second**, we do not know whether the recent changes in climate are on balance doing more harm than good. The strongest warming is in cold places like Greenland. More people die from cold in winter than die from heat in summer. **Third**, there are many other causes of climate change besides human activities, as we know from studying the past. **Fourth**, the carbon dioxide in the atmosphere is strongly coupled with other carbon reservoirs in the biosphere, vegetation and top-soil, which are as large or larger. It is misleading to consider only the atmosphere and ocean, as the climate models do, and ignore the other reservoirs. **Fifth**, the biological effects of CO₂ in the atmosphere are beneficial, both to food crops and to natural vegetation. The biological effects are better known and probably more important than the climatic effects. **Sixth**, summing up the other five reasons, the climate of the earth is an immensely complicated system and nobody is close to understanding it.” [Emphasis added]

- Cite: Ibid



Response to Dr. Dysons' 6 Concerns

How this presentation is formatted, how the reader can delve more deeply into any of the points.

Dr. Dyson's Concerns

- In these sections, we will look at each of his six concerns, one at a time.

Rebuttals

- I will list several research papers from esteemed universities and institutes with published research on the topic Dr. Dyson comments on, and casts doubt upon.



Response to Dr. Dysons' 6 Concerns

How this presentation is formatted, how the reader can delve more deeply into any of the points.

- ▶ After the initial slide on each of Dr. Dyson's concerns, with rebuttal studies appearing opposite his concern, we will delve more deeply into each area with detailed responses from universities and research institutes around the globe.
- ▶ Each quote and graphic will be followed with a cite to the paper from which the information was retrieved.
- ▶ The reader should understand that all the cites provided, both in the initial rebuttal and in subsequent slides support our view that Dr. Dyson is incorrect.
- ▶ In this way, I hope to make it simple for the reader to fact-check everything in this response. I encourage the reader to note at least two things: One, the sources cited in the response are not political sources – these are not citations to opinion pieces, these are objective studies of the issues. Second, by including links to every citation, I encourage the reader to delve more deeply into any issue. Dr. Dyson, and others, want to gloss over the complex challenge of climate change. I want the opposite. I want the reader to learn about the science, economics, and national security questions raised by climate change.



Dyson's First Concern

First Concern

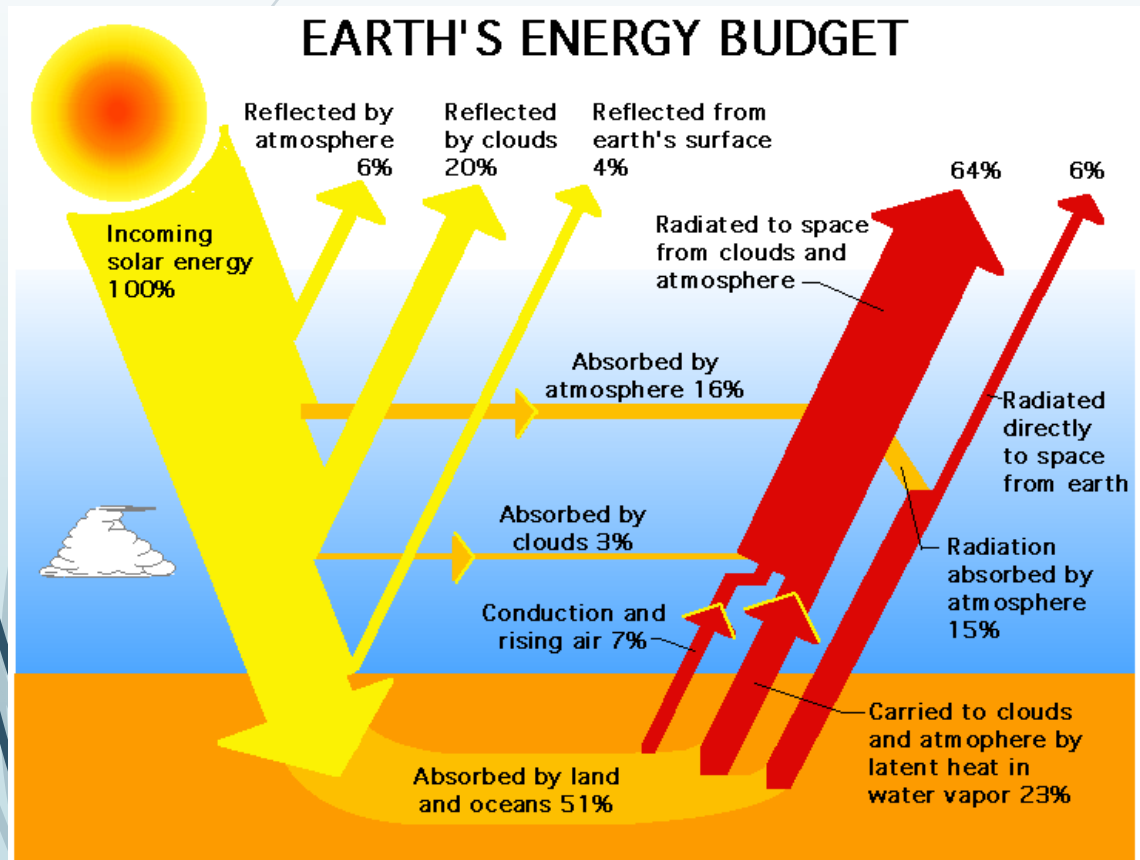
- “First, the computer models are very good at solving the equations of fluid dynamics but very bad at describing the real world. The real world is full of things like clouds and vegetation and soil and dust which the models describe very poorly.”

Rebuttal

- http://essea.strategies.org/module.php?module_id=99
- <http://academic.emporia.edu/aberrjame/student/scott1/feedback.html>
- <http://www.nature.com/scitable/knowledge/library/studying-and-projecting-climate-change-with-earth-103087065>

Dyson's First Concern

"The real world is full of things like clouds and vegetation and soil and dust which the models describe very poorly."



- Dr. Dyson is here referring in part to the albedo effect; his points regarding vegetation and soil are repeated in his fourth and fifth concerns – so we will deal with those in great detail when we address those concerns. For now, albedo.
- Albedo is the measurement of how much radiation a surface reflects. Solar radiation is either absorbed by the earth, or reflected by the earth.
- Graphic: National Science Digital Library



Dyson's First Concern

“The real world is full of things like clouds and vegetation and soil and dust which the models describe very poorly.”

“Humans are now conducting a long-term, uncontrolled climate experiment by emitting greenhouse gases into the Earth's atmosphere, converting forest into farmland, and otherwise changing the natural environment. Climate models solve mathematical equations that describe the physics of the atmosphere, ocean, and the land surface (left side of Figure 1) to help us understand how Earth's climate is changing. Even if humans had no influence on climate, climate models would help us understand and predict natural variations in the climate, like the El Niño Southern Oscillation (ENSO).

Climate, however, is not shaped by the physics of radiation and fluids alone. Biological and chemical processes impact climate. Both over the course of the year and over the course of Earth's history, growing plants and respiring microbes change atmospheric CO₂ levels and the albedo (reflectivity) of the Earth's surface. And biological processes are affected by climate. The circulation of the ocean controls the nutrients available to phytoplankton, while temperature and precipitation affect the metabolism of biological organisms on land. Studying how biological processes and climate are related requires a new type of climate model: the Earth system model (ESM).

ESMs include physical processes like those in other climate models but they can also simulate the interaction between the physical climate, the biosphere, and the chemical constituents of the atmosphere and ocean (right side of Figure 1). ESMs include processes, impacts, and complete feedback cycles; for example, they can simulate droughts as well as the resulting change in plant cover due to the drought, which may lead to more or less drought. They can even include the impact of human decision-making. ESMs never perfectly simulate the processes they include, but they are useful tools for extrapolating what we know about the present Earth system to the past and the future. There are several types of ESM, but we focus here on models of full complexity that simulate the atmosphere and ocean in three dimensions.” [Emphasis added]

Cite: <http://www.nature.com/scitable/knowledge/library/studying-and-projecting-climate-change-with-earth-103087065>



Dyson's First Concern

“The real world is full of things like clouds and vegetation and soil and dust which the models describe very poorly.”

“Humans are now conducting a long-term, uncontrolled climate experiment by emitting greenhouse gases into the Earth's atmosphere, converting forest into farmland, and otherwise changing the natural environment.”

ESMs include physical processes like those in other climate models but they can also simulate the interaction between the physical climate, the biosphere, and the chemical constituents of the atmosphere and ocean (right side of Figure 1). ESMs include processes, impacts, and complete feedback cycles...They can even include the impact of human decision-making. ESMs never perfectly simulate the processes they include, but they are useful tools for extrapolating what we know about the present Earth system to the past and the future.” [Underscored section of preceding slide.]

Dyson's First Concern

"The real world is full of things like clouds and vegetation and soil and dust which the models describe very poorly."



- ▶ "Albedo is a measure of the reflectivity of the Earth's surface. Ice-albedo feedback is a strong positive feedback in the climate system. Warmer temperatures melt persistent ice masses in high elevations and upper latitudes. Ice reflects some of the solar energy back to space because it is highly reflective. If an equivalent area of ice is replaced by water or land, the lower albedo reflects less and absorbs more energy, resulting in a warmer earth."

- ▶ Cite: http://climate.nasa.gov/resources/education/pbs_modules/lesson2Engage/

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Dyson's First Concern

“The real world is full of things like clouds and vegetation and soil and dust which the models describe very poorly.”

- Conclusion: Dr. Dyson implies in his first concern that the models “describe very poorly” “clouds and vegetation and soil”. As this section demonstrates, with cites to experts, the impact of clouds (and ice) are well understood as contributing to the albedo effect. In later sections, we will address his concerns with vegetation and soil.



Dyson's Second Concern

Second Concern

- ▶ “Second, we do not know whether the recent changes in climate are on balance doing more harm than good. The strongest warming is in cold places like Greenland. More people die from cold in winter than die from heat in summer.”

Rebuttal

- ▶ <http://www.skepticalscience.com/The-Good-The-Bad-and-The-Ugly-Effects-of-Climate-Change.html>
- ▶ <http://www.giss.nasa.gov/tools/modeli/>
- ▶ http://www.slideshare.net/GDCKUL/climate-change-and-vegetation-31620338?from_action=save
- ▶ <https://www.aip.org/history/climate/simple.htm>



Dyson's Second Concern

“Second, we do not know whether the recent changes in climate are on balance doing more harm than good. The strongest warming is in cold places like Greenland. More people die from cold in winter than die from heat in summer.”

- ▶ “The economic impacts of climate change may be catastrophic, while there have been very few benefits projected at all. The Stern Report made clear the overall pattern of economic distress, and while the specific numbers may be contested, the costs of climate change were far in excess of the costs of preventing it...Disruptions to global trade, transport, energy supplies and labor markets, banking and finance, investment and insurance, would all wreak havoc on the stability of both developed and developing nations. Markets would endure increased volatility and institutional investors such as pension funds and insurance companies would experience considerable difficulty.”
- ▶ Cite: <http://www.skepticalscience.com/The-Good-The-Bad-and-The-Ugly-Effects-of-Climate-Change.html>



Dyson's Second Concern

“Second, we do not know whether the recent changes in climate are on balance doing more harm than good. The strongest warming is in cold places like Greenland. More people die from cold in winter than die from heat in summer.”

- ▶ “Warmer winters would mean fewer deaths, particularly among vulnerable groups like the aged. However, the same groups are also vulnerable to additional heat, and deaths attributable to heat waves are expected to be approximately five times as great as winter deaths prevented. It is widely believed that warmer climates will encourage migration of disease-bearing insects like mosquitoes and malaria is already appearing in places it hasn't been seen before.”
- ▶ Cite: <http://www.skepticalscience.com/The-Good-The-Bad-and-The-Ugly-Effects-of-Climate-Change.html>
- ▶ Conclusion: Dr. Dyson is wrong.



Dyson's Third Concern

Third Concern

- ▶ “Third, there are many other causes of climate change besides human activities, as we know from studying the past.”
- ▶ <http://www3.epa.gov/climatechange/science/causes.html>
- ▶ http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf
- ▶ http://www2.sunysuffolk.edu/man-dias/global_warming/natural_causes_climate_change.html
- ▶ <http://ossfoundation.us/projects/environment/global-warming/human-caused>



Dyson's Third Concern

“Third, there are many other causes of climate change besides human activities, as we know from studying the past.”

“The idea that global warming is natural is not an absurd question. In the natural cycle, global warming is natural. The better question is, 'is current global warming natural'? There are multiple lines of evidence that point us to the origin of our current warming:

1. Greenhouse gases trap infrared heat energy.
2. The isotopic signature clearly shows that the extra CO₂ in the atmosphere is from fossil fuels.
3. We are no longer in the natural cycle. We have largely departed from the natural course of climate and there is no natural mechanism that explains it.
4. The models and the observations match.
5. There is simply no other mechanism that can explain the significantly altered climate path and the changes in the radiative forcing other than human causes.”

Cite: <http://ossfoundation.us/projects/environment/global-warming/human-caused>



Dyson's Third Concern

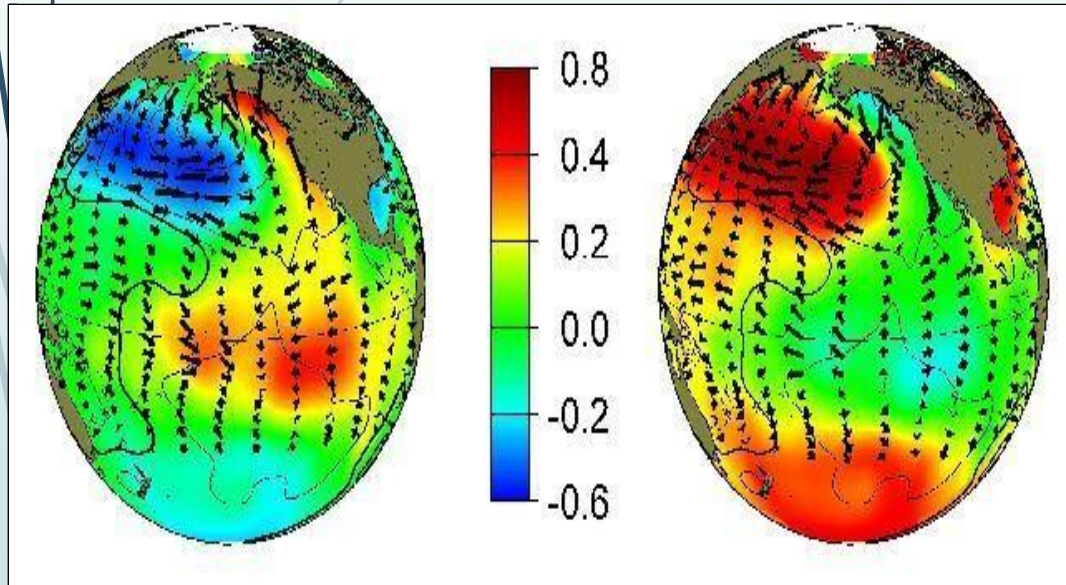
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"When one examines the natural causes for climate change it becomes quite apparent that none of these can explain the modern day climate change..."

- ▶ Because plate tectonics changes climate over millions of years, it cannot be responsible for the rapid climate change observed today.
- ▶ The tilt of the Earth varies between 22.2° and 24.5° over a period of 41,000 years. This change in tilt causes long-term variations in the amount of seasonal radiation received on Earth, especially at higher latitudes. Increased tilt amplifies the seasonal differences while decreased tilt reduces the seasonal differences...Because Milankovic cycles cause climate to change over tens to hundreds of thousand years, it cannot be responsible for the rapid climate change observed today.
- ▶ Cite:
http://www2.sunysuffolk.edu/mandias/global_warming/natural_causes_climate_change.html

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- The Pacific Decadal Oscillation (PDO) is a long-lived El Niño-like pattern of Pacific climate variability. PDOs typically last between 20 and 30 years while El Niño/Southern Oscillation (ENSO) events last between six to 18 months. PDOs influence the sea surface temperature and wind patterns in the North Pacific with secondary influences existing in the tropics - the opposite is true for ENSO. Figure 4.5 illustrates the warm and cool phases of the PDO. (Mantua, 2000)

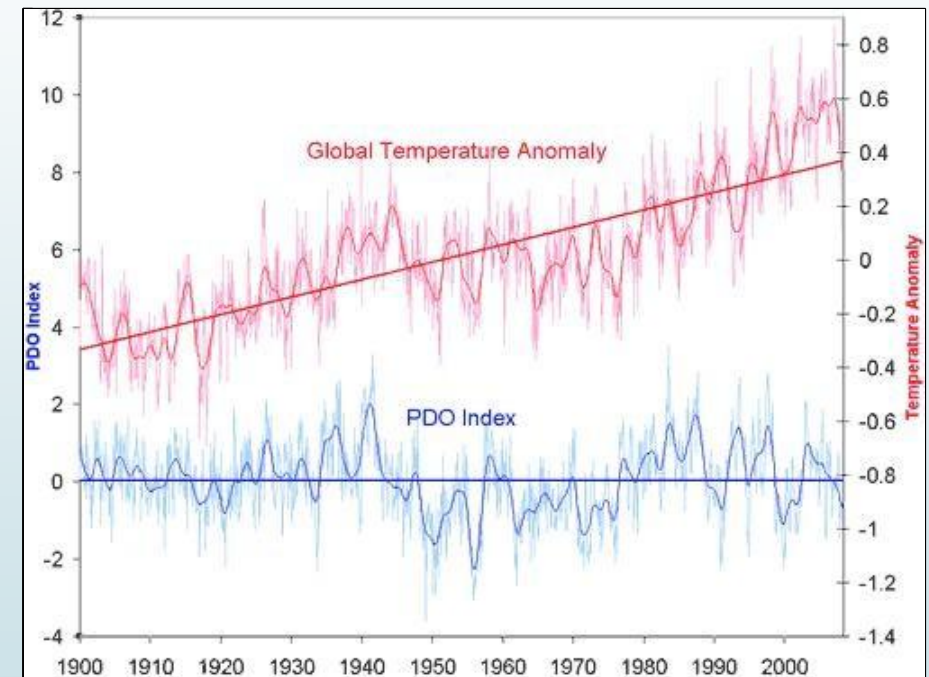
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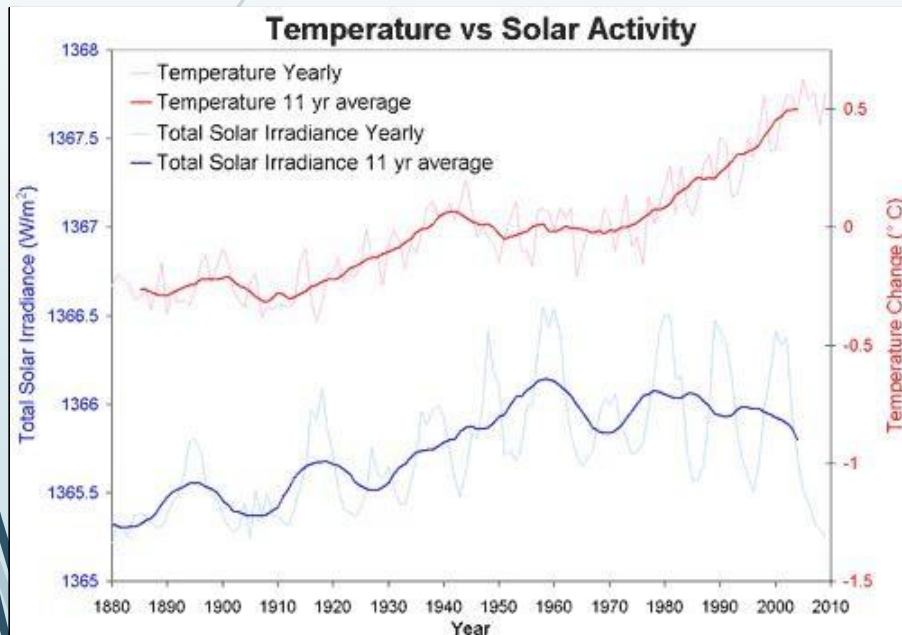
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- Causes for the PDO are not currently known. Likewise, the potential predictability for this climate oscillation are not known. Some climate simulation models produce PDO-like oscillations, although often for different reasons. However, like ENSO, the warm and cool phases typically cancel out in the long run so the PDO cannot explain the long term warming trend observed in the modern climate record. Figure 4.7 (Cook, 2008) illustrates this quite well."
- Cite:
http://www2.sunysuffolk.edu/mandias/global_warming/natural_causes_climate_change.html



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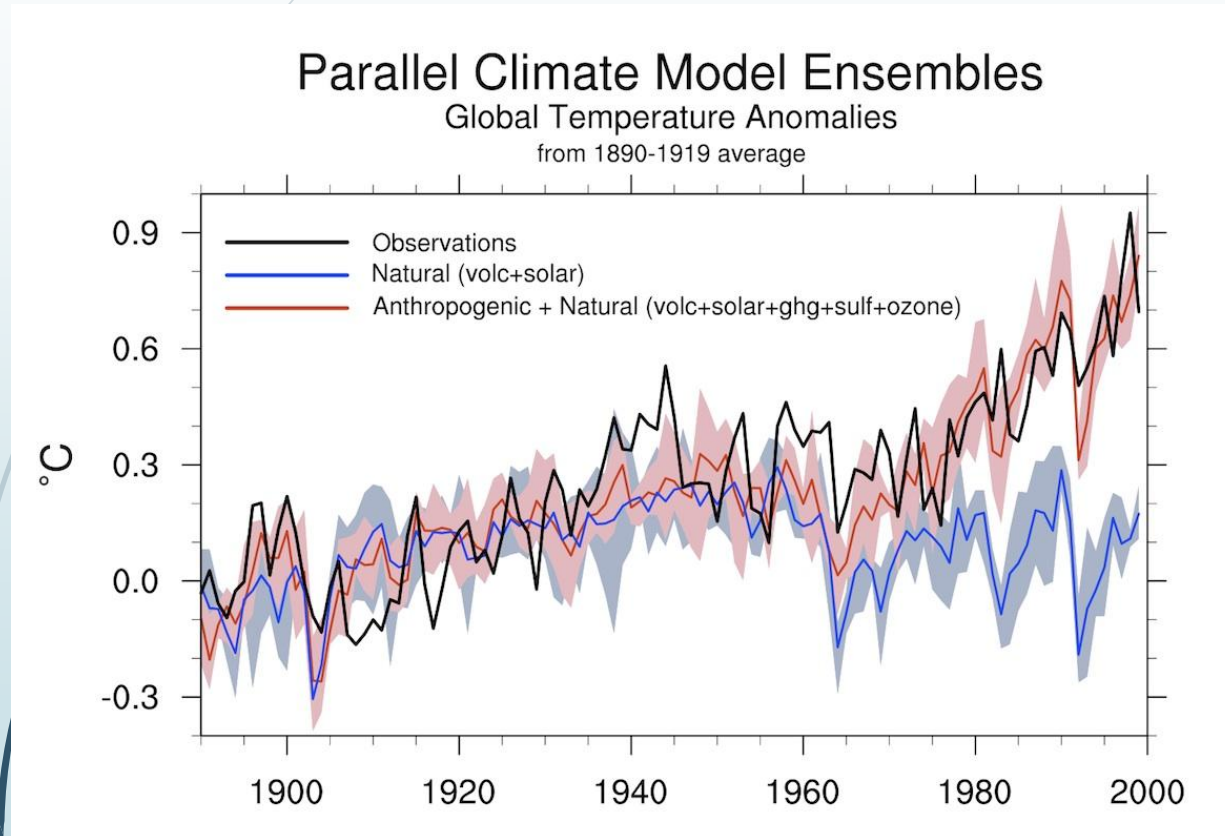


“When one examines the natural causes for climate change it becomes quite apparent that none of these can explain the modern day climate change...”

- Figure 4.8a (Cook, 2010) shows that total solar irradiance cannot explain the rise in temperatures since 1980. Furthermore, solar activity has been very low in the second half of the 2000s yet temperatures are still higher than the previous few decades. 2009 was the 2nd warmest year on record according to NASA GISS data while the sun was at its weakest in over 100 years!
- According to the IPCC (2007) current estimates suggest that only 0.1 oC of the 0.8 oC of warming since the late 1800s is due to solar irradiance. More importantly, since direct satellite measurements (1980 – present) solar contribution to the observed rapid warming is negligible. There is no evidence that variations in the strength of the sun are the cause of the modern day climate change.”
- Cite: http://www2.sunysuffolk.edu/mandias/global_warming/natural_causes_climate_change.html

Dyson's Third Concern

"Third, there are many other causes of climate change besides human activities, as we know from studying the past."



➤ Conclusion: Dr. Dyson is incorrect.

Graphic: <http://ossfoundation.us/projects/environment/global-warming/human-caused>



Dyson's Fourth Concern

Fourth Concern

- “Fourth, the carbon dioxide in the atmosphere is strongly coupled with other carbon reservoirs in the biosphere, vegetation and top-soil, which are as large or larger. It is misleading to consider only the atmosphere and ocean, as the climate models do, and ignore the other reservoirs.”

Rebuttals

- http://earthguide.ucsd.edu/virtualmuseum/climatechange1/05_2.shtml
- <http://www.sciencedaily.com/releases/2012/06/120611193701.htm>
- <http://www.sciencedaily.com/releases/2015/04/150415090022.htm>
- <http://www.sciencedaily.com/releases/2014/12/141223114233.htm>
- <http://www.sciencedaily.com/releases/2014/04/140424140907.htm>
- <http://www.sciencedaily.com/releases/2013/08/130801142430.htm>
- <http://www.sciencedaily.com/releases/2014/07/140723114140.htm>
- <http://www.sciencedaily.com/releases/2014/09/140903133313.htm>



Dyson's Fourth Concern

“Fourth, the CO₂ in the atmosphere is strongly coupled with other carbon reservoirs in the biosphere, vegetation and top-soil, which are as large or larger. It is misleading to consider only the atmosphere and ocean, as the climate models do, and ignore the other reservoirs.”

- ▶ This is the most patently false and absurd claim Dr. Dyson offers. Studies from the following universities and institutes fully debunk this claim:
 - ▶ University of California – Irvine
 - ▶ Carnegie Institution
 - ▶ National Center for Atmospheric Research
 - ▶ Northern Arizona University
 - ▶ Princeton University
 - ▶ U.S. Department of Energy, Office of Science
 - ▶ University of Exeter
 - ▶ Max Planck Institute for Biogeochemistry
 - ▶ University of Zurich
 - ▶ University of California – San Diego



Dyson's Fourth Concern

“Fourth, the CO₂ in the atmosphere is strongly coupled with other carbon reservoirs in the biosphere, vegetation and top-soil, which are as large or larger. It is misleading to consider only the atmosphere and ocean, as the climate models do, and ignore the other reservoirs.”

- ▶ Some highlights from the myriad studies totally debunking this claim:
- ▶ Soils store three times as much carbon as plants and the atmosphere... Consequently, the Kyoto Protocol permits the signatory countries to count soils and forests against greenhouse gas emissions as so-called carbon sinks. [University of Zurich]
- ▶ The response of soil microbial communities to changes in temperature increases the potential for more carbon dioxide to be released from the world's soils as global temperatures rise, scientists have revealed. [University of Exeter]
- ▶ Increased plant growth caused by rising atmospheric carbon dioxide is associated with higher rates of carbon dioxide release from soil. If rising carbon dioxide enhances soil carbon storage at all, the effect will be small. Soil carbon may not be as stable as previously thought, and soil microbes exert more direct control on carbon buildup than global climate models represent. [U.S. Department of Energy, Office of Science]
- ▶ An increase in human-made carbon dioxide in the atmosphere could initiate a chain reaction between plants and microorganisms that would unsettle one of the largest carbon reservoirs on the planet -- soil. Researchers developed the first computer model to show at a global scale the complex interaction between carbon, plants and soil. [Princeton University]



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- ▶ New research has found that increased levels of carbon dioxide in the atmosphere cause soil microbes to produce more carbon dioxide, accelerating climate change. This research challenges our previous understanding about how carbon accumulates in soil. [Northern Arizona University]
- ▶ Scientists from UC Irvine and the National Center for Atmospheric Research have developed a new computer model to measure global warming's effect on soil worldwide that accounts for how bacteria and fungi in soil control carbon. [University of California – Irvine & National Center for Atmospheric Research]



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- ▶ Some highlights from the myriad studies totally debunking this claim:
- ▶ The planet's soil releases about 60 billion tons of carbon into the atmosphere each year, which is far more than that released by burning fossil fuels. Short-term warming studies have documented that rising temperatures increase the rate of soil respiration. As a result, scientists have worried that global warming would accelerate the decomposition of carbon in the soil, releasing more carbon dioxide into the atmosphere and accelerating global warming. [Carnegie Institution]
- ▶ Vast stores of carbon in U.S. forest soils could be released by rising global temperatures, according to a study by UC Irvine and other researchers in a recent online edition of *Proceedings of the National Academy of Sciences*. [University of California – Irvine]



Dyson's Fourth Concern

“Fourth, the CO₂ in the atmosphere is strongly coupled with other carbon reservoirs in the biosphere, vegetation and top-soil, which are as large or larger. It is misleading to consider only the atmosphere and ocean, as the climate models do, and ignore the other reservoirs.”

- ▶ As the previous five slides make abundantly clear, there is only one possible conclusion:
- ▶ Dr. Dyson's Fourth Concern is completely without basis in fact.



Dyson's Fifth Concern

Fifth Concern

- “Fifth, the biological effects of CO₂ in the atmosphere are beneficial, both to food crops and to natural vegetation. The biological effects are better known and probably more important than the climatic effects.”

Rebuttal

- <http://www.iatp.org/documents/a-risky-proposition-crop-insurance-in-the-face-of-climate-change>
- <http://blogs.ei.columbia.edu/2013/12/17/multi-model-assessments-predict-effects-of-climate-change-on-agriculture/>
- www.stat.columbia.edu/~gelman/stuff_for_blog/SchlenkerRoberts.pdf
- <http://www.globalagriculture.org/report-topics/adaptation-to-climate-change.html>
- <http://dapa.ciat.cgiar.org/what-happens-to-the-50-most-important-global-crops-with-climate-change/>
- <http://naldc.nal.usda.gov/download/47399/PDF>
- <http://sedac.ciesin.columbia.edu/data/set/crop-climate-effects-climate-global-food-production>



Dyson's Fifth Concern

“Fifth, the biological effects of CO₂ in the atmosphere are beneficial, both to food crops and to natural vegetation. The biological effects are better known and probably more important than the climatic effects.”

- ▶ Dr. Dyson has an arguably correct position when he states that “[t]he biological effects...are probably more important than the climatic effects.” But he is wrong to state that the effects are “beneficial”. It can be argued, very generally, that the effects are beneficial in northern climes, and negative in southern climes.
 - ▶ See. E.g., “Estimating the Impact of Climate Change on Crop Yields: The Importance of Non-Linear Temperature Effects”, Schlenker & Roberts, 2006, e.g., “Although there is some consensus that warming will likely be harmful to agriculture in tropic and subtropic zones, active debate continues about whether warming will be a net gain or loss for agriculture in the more temperate United States and Europe.”
- ▶ But the effects, according to every study cited in the rebuttal section of the preceding slide, are unprecedented: The world is already seeing a massive change in agriculture production. And that change will only accelerate with warmer temperatures from climate change.



Dyson's Fifth Concern

“Fifth, the biological effects of CO₂ in the atmosphere are beneficial, both to food crops and to natural vegetation. The biological effects are better known and probably more important than the climatic effects.”

- ▶ The U.S. Department of Defense issued a report that reads in part: “Among the future trends that will impact our national security is climate change. Rising global temperatures, changing precipitation patterns, climbing sea levels, and more extreme weather events will intensify the challenges of global instability, hunger, poverty and conflict. They will likely lead to food and water shortages, pandemic disease, disputes over refugees and resources, and destruction by natural disasters in regions across the globe. In our defense strategy, we refer to climate change as a ‘threat multiplier’ because it has the potential to exacerbate many of the challenges we are dealing with today – from infectious disease to terrorism. We are already beginning to see some of these impacts.”
- ▶ Cite: Department of Defense 2014 Climate Change Adaptation Roadmap



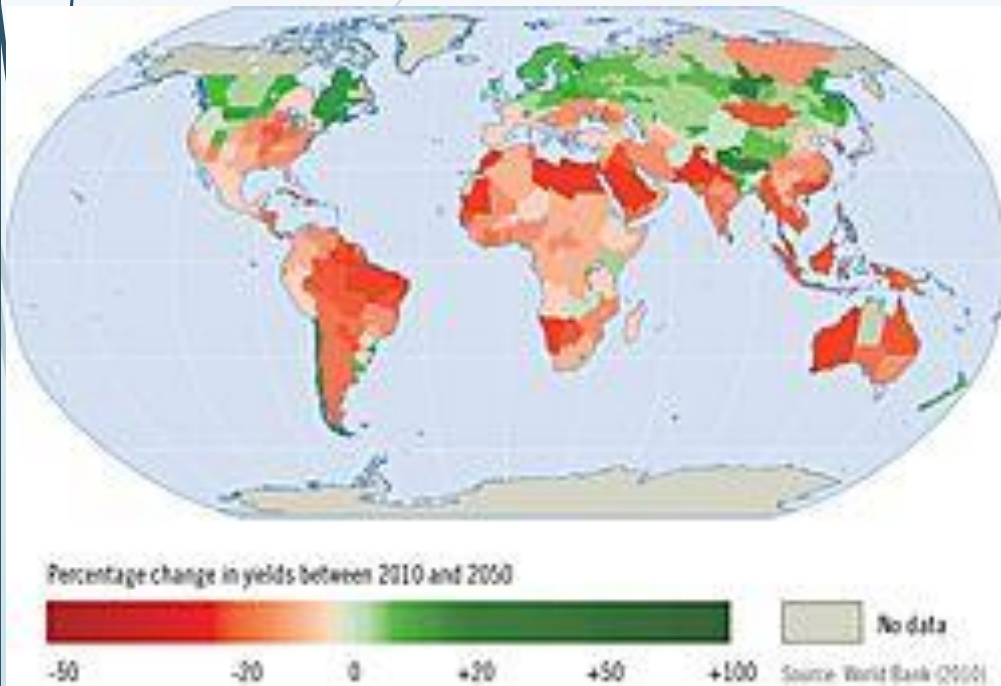
Dyson's Fifth Concern

“Fifth, the biological effects of CO₂ in the atmosphere are beneficial, both to food crops and to natural vegetation. The biological effects are better known and probably more important than the climatic effects.”

- ▶ Crop insurance, and the financial losses from drought and flooding in the United States, is a major concern of the U.S. agriculture and insurance industries.
- ▶ “Farmers are facing unprecedented risk today from volatility in the market and the field...We believe that the extreme weather associated with climate change will make insurance programs much more expensive in future years.” [Institute for Agriculture and Trade Policy, “A Risky Proposition: Crop Insurance in the face of Climate Change.”, 2012]

Dyson's Fifth Concern

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- ▶ “From what we know today, Africa, Latin America and South Asia will suffer the most from the impact of climate change. In some northern regions of Europe, Asia and America, by contrast, agricultural productivity may even increase, at least temporarily, as a result of climate change.
- ▶ In the medium term, however, today's major export nations and bread baskets of the world, such as the Midwestern United States, Australia, Brazil, Thailand and Vietnam, as well as large parts of India and China, will be threatened by substantial crop losses.”
- ▶ Cite: <http://www.globalagriculture.org/report-topics/adaptation-to-climate-change.html>



Dyson's Fifth Concern

“Fifth, the biological effects of CO₂ in the atmosphere are beneficial, both to food crops and to natural vegetation. The biological effects are better known and probably more important than the climatic effects.”

- ▶ “Due to the enormous uncertainties surrounding climate change, estimates of cropland reductions vary widely – from 10 to 50 percent. But this much is clear: global warming is likely to alter production of rice, wheat, corn, soybeans, and potatoes – staples for billions of people and major food crops in both North America and Africa.”
 - ▶ Cite: Cornell University, <http://ciesin.org/docs/004-138/004-138.html>
- ▶ There appears to be a strong scientific consensus that agriculture will change as a result of climate change, as stated earlier, Dr. Dyson has a defensible position that there will be net benefits, but as the U.S. Department of Defense and every other research institute cited agrees, we are talking about a major shift in earth's food production.



Dyson's Fifth Concern

“Fifth, the biological effects of CO₂ in the atmosphere are beneficial, both to food crops and to natural vegetation. The biological effects are better known and probably more important than the climatic effects.”

- ▶ “However, given global gains in crop suitability, food security does not necessarily have to worsen. But responding to unprecedented and dynamic shifts in climate will require a wide range of tools, including technology and financial transfer; preparation for potential migration corresponding to geographical shifts in suitable areas; domestic, regional, and international cooperation and coordination.”
- ▶ Cite: Decision and Policy Analysis Research Area, International Center for Tropical Agriculture, CIAT <http://dapa.ciat.cgiar.org/what-happens-to-the-50-most-important-global-crops-with-climate-change/>
- ▶ Conclusion: Dr. Dyson is arguably correct that there will be some benefits to agriculture from climate change – but he is wrong to present it as “beneficial”. It is a vast change, leading to unprecedented shifts in food production – creating major financial, insurance, and strategic risks.

A dark grey arrow points to the right from the left edge of the slide. Several thin, curved lines in shades of blue and grey originate from the left side and sweep across the slide towards the text.

Dyson's Sixth Concern

“Sixth, summing up the other five reasons, the climate of the earth is an immensely complicated system and nobody is close to understanding it.”

- ▶ Dr. Dyson's sixth concern is tautological, “the needless repetition of an idea, without imparting additional force or clarity.” In addition to being tautological, it is deceptive. It implies that there is no understanding whatsoever of the climate of the earth. This paper does not include every study rebutting Dr. Dyson's claim that “nobody is close to understanding” the earth's complicated climate system, but this paper includes cites to over 30 research studies that obliterate four of Dr. Dyson's concerns, and that clearly prove that his fifth “concern” regarding the “benefits” to agriculture is overly simplistic and wholly ignorant of the financial, humanitarian, insurance, and security risks posed by climate change.