

The Annotated “Take AIM at Climate Change”

Verse 1

MC: Yoh, let's talk about the Earth, really talk about survival

We can talk about the Poles where the cold is unrivaled¹

The Arctic, top of the world², got people³ and polar bears⁴,

Antarctica⁵, crazy penguins⁶ chillin' down there

Miles and miles of ice and glaciers⁷

But something ain't straight with our polar neighbors⁸

¹ Earth's coldest temperature was recorded at Russia's Vostok Station, in the heart of East Antarctica, at minus 129 degrees F.

² <http://en.wikipedia.org/wiki/Arctic>

³ Earth's Poles both have snow and ice, but they're not alike and in some ways they're opposites: the Arctic, in the North, is an ocean, surrounded by land. The Antarctic, down South, is a continent, where the land is covered by ice up to 3 miles thick and surrounded by ocean. About 4 million people live above the Arctic Circle, but Antarctica is the only continent on Earth that has never had an indigenous population. To find out more about the Native peoples of the North, visit: <http://www.arcticpeoples.org/category/indigenous-peoples/>

⁴ Another difference between the North and South is that some creatures, such as polar bears, are only found in the Arctic, up North, and others, like penguins, are found only in the Southern hemisphere. Polar bears, Earth's largest terrestrial carnivore, depend on frozen sea ice to hunt seals, their favorite prey, and to raise their young. For more on polar bears and why they have been placed on the Endangered Species List, see: <http://www.fws.gov/home/feature/2008/polarbear012308/polarbears promo.html>

⁵ <http://en.wikipedia.org/wiki/Antarctica>

⁶ OK, so maybe we shouldn't call penguins “crazy”, but Adelie penguins (one of the two species which breed on the Antarctic mainland: the other is the Emperor) are curious, cute and inherently engaging. For more on Adelies, facts about their life cycle, and information on how they're responding to climate change, please see: <http://penguinscience.com>

⁷ Antarctica is larger than the United States and Mexico combined, and is home to 90% of all the ice on Earth, and 70% of all our planet's fresh water. Greenland, in the North, is Earth's largest island, and is mostly covered by the largest ice sheet in the North.

⁸ Earth's Poles are the places where climate change has shown up first and where temperatures are rising most rapidly. Down South, the Antarctic Peninsula, the point of land that extends towards South America, has increased about 3 degrees C in the past 100 years, and mid-winter temperatures have increased by what is (to climate scientists) an amazing 6 degrees since 1950. (Source: <http://www.americanscientist.org/issues/feature/2008/4/ecological-responses-to-climate-change-on-the-antarctic-peninsula/2>) In the North, in Alaska – America's only “arctic” state – annual average air temperatures have increased by 3.5 degrees F (not C) and by 6 F in the winter. (http://www.usatoday.com/weather/climate/2006-05-29-alaska-globalwarming_x.htm) “Something ain't straight” may be our rapper's way of expressing the unsettling changes, but Alaskan Natives have contributed eloquent first-person observations to a fascinating collection entitled “The Earth is Faster Now” edited by Smithsonian anthropologist Igor Krupnik and Dyanna Jolly. (http://www.amazon.com/Earth-Faster-Now-Observations-Environmental/dp/0972044906/ref=sr_1_1?ie=UTF8&s=books&qid=1230757529&sr=8-1)

It's a change in the climate, a change in the weather⁹
It's heating up now but it's not for the better.¹⁰

See, the heat comes down from the Sun to the Earth¹¹
But now the heat can't escape, it just can't disperse...¹²

⁹ There's a large and important difference between *climate* and *weather*: weather is the short-term variation in temperature, precipitation, wind, etc., which we experience over days or a few weeks. Climate is the average of those variations over much longer periods, such as over decades or centuries. "Weather" will always have short term variations, hotter and colder, but it's "climate" which measures the longer-term changes which, for example, cause polar ice sheets to grow, or melt, and sea level to rise or fall. For more, please see:

http://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html

¹⁰ According to the Federal government's Climate Change Science Program (CCSP), "Based on evidence from tree rings, other natural records, and scientific observations made around the world, Earth's average temperature is now warmer than it has been for at least the past 1,300 years" and "During the 20th century, Earth's globally averaged surface temperature rose by approximately 1.33 °F (0.74 °C). Though the total increase may seem small, it likely represents an extraordinarily rapid rate of change compared to changes in the previous 10,000 years." The CCSP's "Climate Literacy" (<http://climatecience.gov>) booklet continues, "Over the 21st century, climate scientists expect Earth's temperature to continue increasing, very likely more than it did during the 20th century. Two anticipated results are rising global sea level and increases in the frequency and intensity of heat waves, droughts and floods. These changes will affect almost every aspect of human society, including economic prosperity, human and environmental health, and national security." "Global warming" is a common term for the world's overall increase in temperature, but though a little counter-intuitive, some places may actually get cooler even though global temperatures do warm. So the phrase "climate change" is preferred by many. But the "not for the better" line in our lyrics is, admittedly, a value judgment, not a purely scientific observation. Some people and places may well benefit from increased heat, such as the potential wheat growing areas of Russian Siberia. Cities in Canada may have ports that are open for navigation year-round, rather than closed by ice in winter. But most researchers believe that there'll be more downsides than benefits, with disruption to Native peoples and species at the Poles, increased drought in warmer regions, and a rise in sea level that will threaten low-lying nations in the Pacific and heavily-populated countries such as Bangladesh. Again, from CCSP: "Scientists and economists predict that there will be both positive and negative impacts from global climate change. If warming exceeds 2 to 3 °C [3.6 to 5.4 °F] over the next century, the consequences of the negative impacts are likely to be much greater than the consequences of the positive impacts." More developed nations like Holland or the USA should find it easier to adapt. It's Earth's poorest people who will experience additional hardships.

¹¹ White surfaces reflect light, such as sunlight, more efficiently than dark surfaces. That's why wearing a white T-shirt in summer keeps you cooler than dark clothing. The technical term for that reflectivity is "albedo", a measure of how reflective a surface is.

(<http://www.eoearth.org/article/Albedo>) White snow and ice reflects sunlight more efficiently than dark ocean water. When polar ice melts, revealing sea water or land, polar temperatures increase, setting up a positive feedback loop which makes more ice melt, and temperatures rise still more. The imagery behind Tommy in the video is from NASA: <http://svs.gsfc.nasa.gov/vis/a010000/a010000/a010021/index.html>

¹² "Certain gases in the atmosphere, such as water, carbon dioxide (CO₂), methane, chlorofluorocarbons (CFCs), and nitrous oxide, absorb infrared light that would otherwise escape to space, radiating it back toward the planet's surface. These 'greenhouse gases', as they are called,

Cos of carbon dioxide from power plants and factories,¹³
Cars and trucks¹⁴, so much more than you can find naturally¹⁵

So the Poles get warm, and the Earth gets hotter
All that necessary ice melts down into water¹⁶

have always had a critical role in determining the temperature of the Earth's surface and the livability of the planet. Now, with the amounts of CO₂ and other greenhouse gases increasing in the atmosphere due to human activities, the possible implications for climate are the subject of much research." (<http://www.esrl.noaa.gov/csd/greenhouse.html>) The greenhouse effect is a natural process. Greenhouse gases absorb and trap heat radiated by the earth. This keeps our planet habitable. Human emissions of greenhouse gases like CO₂ are *enhancing* the greenhouse effect, trapping more heat and warming the planet. (<http://www.ncdc.noaa.gov/oa/climate/globalwarming.html#q1>)

¹³ On CO₂, carbon dioxide: "The natural production and absorption of carbon dioxide (CO₂) is achieved through the terrestrial biosphere and the ocean. However, humankind has altered the natural carbon cycle by burning coal, oil, natural gas and wood and since the industrial revolution began in the mid 1700s, each of these activities has increased in scale and distribution. Carbon dioxide was the first greenhouse gas demonstrated to be increasing in atmospheric concentration with the first conclusive measurements being made in the last half of the 20th century. (This is the famous "Keeling curve" developed by Charles David Keeling through 50 years of careful measurements of atmospheric CO₂.) Prior to the industrial revolution, concentrations were fairly stable at 280ppm. Today, they are around 370ppm (in 2008, CO₂ concentration had exceeded 386 ppm – P2K adds), an increase of well over 30%. The atmospheric concentration has a marked seasonal oscillation that is mostly due to the greater extent of landmass in the northern hemisphere and its vegetation. A greater drawdown of CO₂ occurs in the NH spring and summer as plants convert CO₂ to plant material through photosynthesis. It is then released again in the fall and winter as the plants decompose." (<http://lwf.ncdc.noaa.gov/oa/climate/gases.html#cd>)

¹⁴ Using gasoline in cars and trucks for transportation makes up 27% of US energy use, and emits 33% of total CO₂ emissions from fossil fuel combustion. (<http://www.epa.gov/climatechange/emissions/usinventoryreport.html>) This is the largest single "end use" sector. But several simple steps can also reduce the amount of gas used: if you inflate your tires properly, you improve your miles per gallon by 3%. Car-pooling, combining multiple errands into fewer trips – all these relatively easy actions can reduce CO₂ emissions.

¹⁵ The current level of CO₂ in Earth's atmosphere is 386 ppm, which – as demonstrated by the oldest ice cores yet studied (the EPICA core from Antarctica) is a level higher than at any time in the past 800,000 years. (If you're interested in the underlying research, check out the article by Dieter Luethi et al, in Nature, <http://www.nature.com/nature/journal/v453/n7193/full/nature06949.html>) As you can see in a simplified chart based on that data (found on page 7 of the POLAR-PALOOZA handouts – <http://passporttoknowledge.com/polar-palooza/handouts/>), there has been a natural warming and cooling of the planet, based on the slight irregularity of its orbit around the Sun. (For more, see: <http://www.ncdc.noaa.gov/paleo/milankovitch.html>) When CO₂ levels are lower, around 180 ppm, Earth experiences ice ages. When CO₂ reaches 280, you have warmer periods, called "interglacials." 180, 280, 180, 280... it's like the natural heart beat of the planet. But when you reach 380 and above, it's clear that something non-natural is happening – and just about all climate scientists – including the US Climate Change Science Program – ascribe this to humans emitting increasing levels of CO₂.

¹⁶ You don't need a PhD to appreciate that when temperatures warm, ice melts. You do need lots of scientists to measure how fast certain parts of the polar regions are melting, and that's just what has been happening during the 4th International Polar Year, which ran from March

And the impact, the sad fact, is it can only escalate,¹⁷
So – for real – we gotta act now, before it's too late...¹⁸

CHORUS:

Take aim at climate change...¹⁹
(Gotta take aim, y'all)
Take aim at climate change...
(Think long term)
Take aim at climate change...
(Adapt, innovate)
Take aim at climate change...

2007 through March 2009. In the North, the Jakobshavn Glacier doubled its speed after 1997 (though it's since slowed down.) <http://www.realclimate.org/index.php/archives/2008/04/moulins-calving-fronts-and-greenland-outlet-glacier-acceleration/> In the South in 2002, in the rapidly warming Antarctic Peninsula, a 12,000 year old ice sheet, called Larsen-B, crumbled and disappeared in less than 6 weeks. More recently, in July 2008, the Wilkins Ice Sheet ruptured. (<http://earthobservatory.nasa.gov/IOTD/view.php?id=8931>) The most rapidly moving Antarctica glacier is the “PIG” or Pine Island Glacier. Check out the 4-part POLAR-PALOOZA podcast to see how and why researchers are studying the PIG so intently and urgently. (<http://passporttoknowledge.com/polar-palooza/pp06pig01.php>)

¹⁷ In an overview of temperatures projected for Earth at the end of the 21st century by the IPCC, the federal Environmental Protection Agency reported that, “The average surface temperature of the Earth is likely to increase by 2 to 11.5°F (1.1-6.4°C) by the end of the 21st century, relative to 1980-1990, with a best estimate of 3.2 to 7.2°F (1.8-4.0°C) (see Figure 1). The average rate of warming over each inhabited continent is very likely to be at least twice as large as that experienced during the 20th century.”

<http://www.epa.gov/climatechange/science/futuretc.html> Even the lowest amount of temperature increase will require humans to respond in terms of agriculture, coastal protection, and more – which is why this rap calls for three related strategies, each of which will likely prove necessary: Adapt, Innovate, and “Mitigate”, which means to “make something less harsh, severe or violent.” (Microsoft dictionary.)

¹⁸ In 2007, the Chairman of the Intergovernmental Panel on Climate Change (IPCC), Dr. Rajendra Pachauri, said “If there’s no action before 2012, that’s too late. What we do in the next two to three years will determine our future. This is the defining moment.” In a letter to the new US President, the Director of the MIT Energy Initiative, Ernest J. Moniz, wrote, “The country faces energy challenges that we cannot put off to a next administration or a next generation. We are running out of time to develop and deploy technologies that can mitigate climate risk and enhance national security.” (*Technology Review*)

¹⁹ For a digest of many things you can do as an individual, member of a family, church, school, or other community, please visit: <http://polar-palooza.com/whatyoucando>