Climatic 1: The Greenhouse Effect

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Climate change! The temperature's going on up
Listen up: the climate's been disrupted[1]
You gotta clear away the wool that's in your eyes and overcome the
Lies from deniers who are just pawns steppin' on the

Truth is climate's different by the way
From weather, climate's thirty years or more weather's day by day.
Current average temperature on planet Earth is fifteen °C[2]
that's fifty nine Fahrenheit if you ain't thinkin' metrically.

Our climate for ten thousand years has had the perfect qualities for
nurturing civilization also life's diversity
'Tween summer highs and winter lows it's perfect for our crops to grow.[3]
Anywhere: China, Italy, Brazil or Idaho

CHORUS
Our planet earth is a greenhouse
The climate we've come to depend on is based on this greenhouse
Everyone lives in this greenhouse
And we're learning our burning has jacked up the heat in the greenhouse.

Our atmosphere, all those gases in the sky floating so high
Are mostly nitrogen and oxygen molecules[4]
But there are some others like CO_2 mixed up in that
Stew up there just traces in the air

CO_2's concentration 'bout point zero four percent[5]
Yet its presence makes a huge dent in the climate
System 'cause of its role as a greenhouse gas,
Methane, nitrous oxide, CFCs are in the same class.[6]

These gases let sunlight through to shine on Earth's face
Molecules on land and sea absorb the light and vibrate
That vibration emits infrared radiation
Just heat energy into the atmosphere

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[1] This musical lecture was inspired by and attempts to convey some key ideas from *The Case for Young People and Nature: A Path to a Healthy, Natural, Prosperous Future*, by James Hansen et. al, available at http://www.columbia.edu/~jeh1/mailings/2011/20110505_CaseForYoungPeople.pdf

[2] See http://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html

[3] See Hansen (note 1 above), page 2.

[4] Our atmosphere is approximately 78% nitrogen and 21% oxygen. http://www.physicalgeography.net/fundamentals/7a.html

[5] Carbon dioxide concentration is rising. CO_2 concentration is usually measured in parts per million (ppm). CO_2's concentration as of February, 2013, was 396.80 ppm (parts per million), or 0.0396%. The US National Oceanographic and Atmospheric Administration (NOAA) tracks CO_2 levels at http://www.esrl.noaa.gov/gmd/ccgg/trends/

[6] You can learn more about greenhouse gases from the NOAA's http://www.ncdc.noaa.gov/oa/climate/gases.html

There it meets molecules like CO_2 and CFCs
All those gases resonate with infrared frequencies,
They vibrate, each emitting heat in all directions,
Some of which comes back to Earth, it's greenhouse gas perfection!

Now you see why CO_2's a *greenhouse gas*,
it's just like greenhouse glass, trappin' heat while allowing light's passage[7]
And remember this is nothin' bad, nothin horrid
With no Greenhouse effect we'd all be frozen solid

With planetary average temperatures of 18°C below[8]
Look outside, all you'd see is frozen ice and snow,
So enjoy the warmth, to greenhouse gases sing,
but remember, too much of a good thing can be a bad thing.

CHORUS

We shouldn't blame ourselves for what transpired when we realized
Fossil fuels were awesome fuels for fires to power anything like
Lamps, or steam engines, diesel trains or furnaces
Jet planes, space shuttles, coal-fired generators.

Fossil fuels are made of carbon that was once in the sky
Carbon dioxide molecules that floated by
Sucked into a plant or algae during photosynthesis,
In the Carboniferous era long ago.[9]

Later on the plant died no one cried as it was buried 'neath the soil
Pressure and the heat making coal, gas and oil[10]
Now each time those fossil fuels get consumed,
That buried carbon gets released as CO_2 fumes.

Hundreds of years of fossil fuel conflagration
Has vastly increased CO_2's concentration
280 ppm before the rise of industry
Our burning's raised the level over 390[11]

390 parts per million CO_2, three ninety molecules
You'd find in a box of a million molecules of air
Seems unfair such a harmless and
Invisible gas could be causing so much trouble

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[7] A description of the Greenhouse effect can be found on Wikipedia at http://en.wikipedia.org/wiki/Greenhouse_effect

[8] See "Global Warming, Frequently Asked questions," at www.ncdc.noaa.gov/oa/climate/globalwarming.html

[9] The Carboniferous era was over 300 million years ago, when much of the Earth had a humid, tropical climate, ideal for growing the forests that later developed into many of today's coal deposits. Some coal formations are from more recent times, but even these originate in carbon deposits that are at least tens of millions of years old.

[10] Oil, or petroleum, develops similarly to coal, but from deposits of marine organisms. See http://en.wikipedia.org/wiki/Petroleum#Formation

[11] See note 5 above.

But this extra dose of CO_2, carbon we sent up the flue
Traps more earthly infrared like extra blankets in your bed
It's kind of like each square meter of our earthly globe
Got planted with a tiny little Christmas bulb

Each bulb shining with just about a watt and
Imagine all those trillions of bulbs they're making planet Earth hot.[12]
Temperature will rise until a balance is restored
But that won't happen soon because we keep on burning more.

We've warmed point eight °C in the past century,[13]
From CO_2 made by people just like you and me.
The warming, by end of this century,
Will range from 1.1 to 6.4 degrees °C.[14]

If that doesn't sound like much in part two you'll see,
How emissions are changing climate drastically.
We'll be an ice-free planet, open Arctic sea,
I ain't making this up, ask the IPCC![15]

CHORUS

[12] The concept here is "radiative forcing." A good description of the process and how it can be quantified can be found at MIT News, "Radiative Forcing Explained" http://web.mit.edu/newsoffice/2010/explained-radforce-0309.html.

[13] This data is from NASA: http://data.giss.nasa.gov/gistemp/2005/

[14] These estimates of temperature rise are from the Intergovernmental Panel on Climate Change (IPCC), which describes itself as the "leading international body for the assessment of climate change." The IPCC was established by the UN, and includes the leading climate scientists from 195 countries. Its estimates for temperature rise can be found at http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch10s10-es-1-mean-temperature.html

[15] See note 14 above for information about the IPCC.