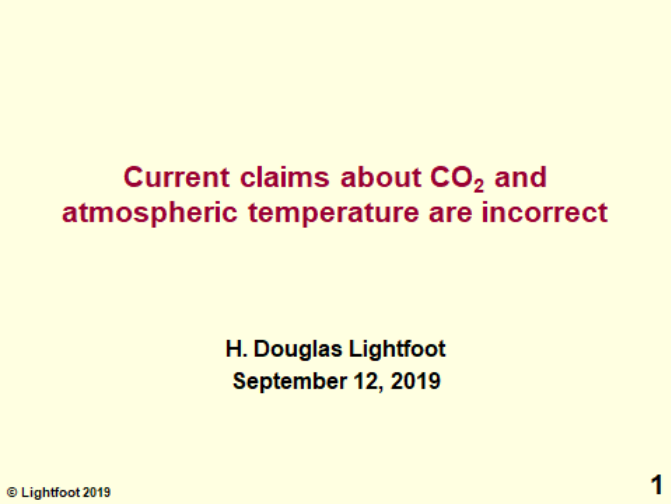
A PowerPoint presentation:

A new look at current climate science and carbon dioxide

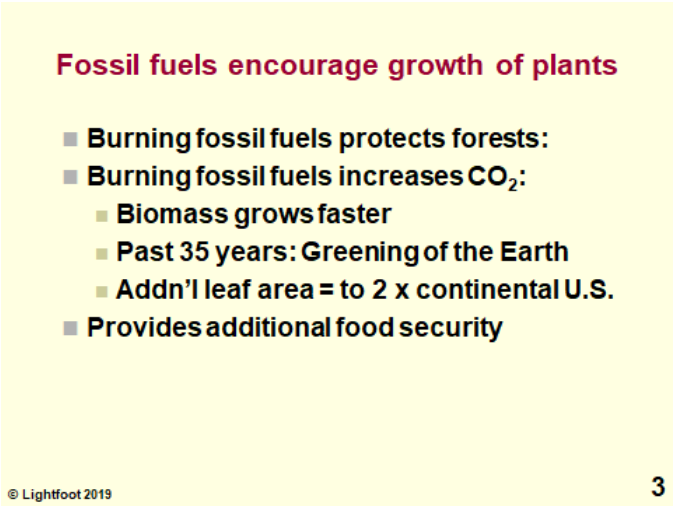
Presented by: H. Douglas Lightfoot
2019

Slide 1: A new look at current climate science and carbon dioxide. Scientific evidence is presented to support the title. Background is provided so everyone has the same and sufficient information. Slides are numbered to direct questions and facilitate discussion.

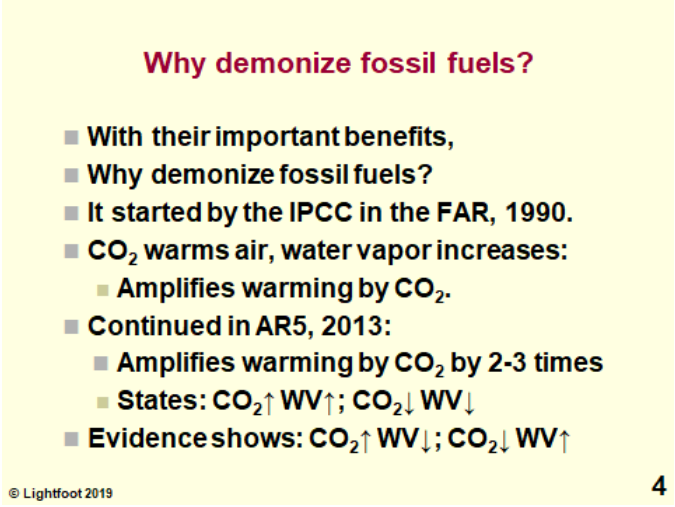


Slide 2: Four sources of energy on Earth. There are only four sources of energy available to the inhabitants of Earth: nuclear fusion in the sun, nuclear fission, tidal energy from the moon and hydropower from the Earth's gravity. Currently, the most important is nuclear fusion energy from the sun because it provides stored solar energy in the form of coal, oil and natural gas, the fossil fuels, and biomass [1]. It is stored solar energy that has made the world a better and safer place for humans and provides food security. Until plentiful coal, oil and natural gas became available, humans depended on trees for fuel. As the industrial age progressed, the demand for fuel increased dramatically. Trees were being burned faster than they could grow and forests were disappearing. Then came the switch to coal and the trees were saved. This occurred in Europe in the Early 1700s and in the U.S. about 1850. The amount of forest area appears to have increased slightly since then.

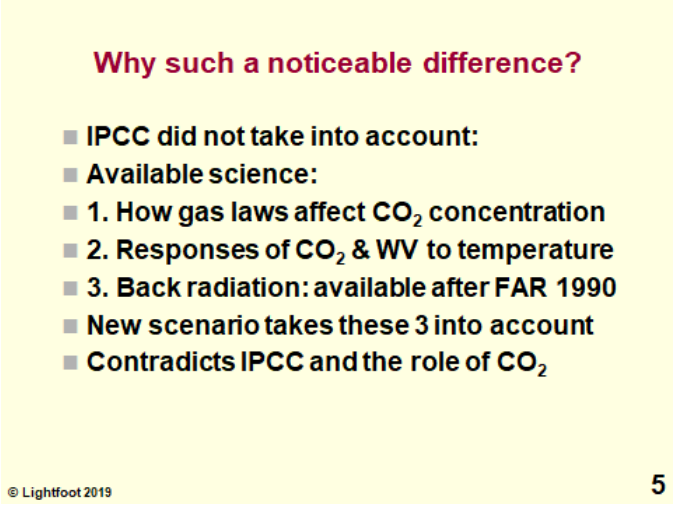
Slide 3: Fossil fuels encourage growth of plants. Today, fossil fuels protect the forest environment directly and also indirectly by increasing the level of carbon dioxide (CO_2) in the atmosphere that increases the growth rate of plants. Over the past 35 years, images from satellites show the greening represents an increase in leaves on plants and trees equivalent to an area twice that of the continental United States [2]. The Earth is measurably greener as plants proliferate [3] [4].



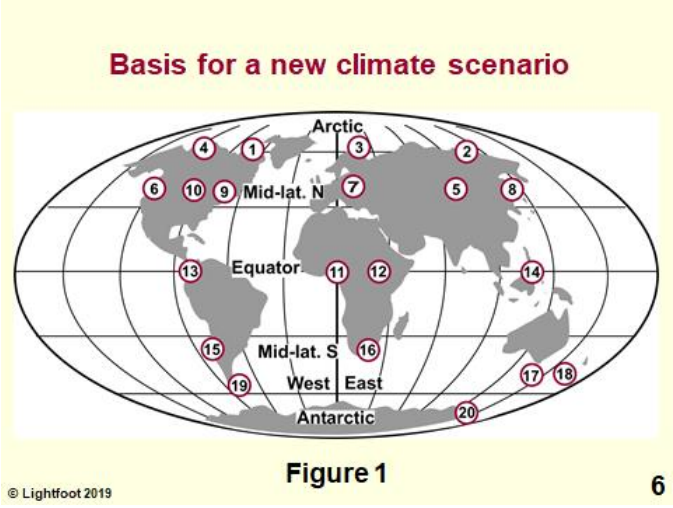
Slide 4: Why demonize fossil fuels? Fossil fuels are so beneficial to mankind the question arises: Why is there so much demonization of fossil fuels, and especially the carbon dioxide that is produced when they are burned to release energy? The answer lies in the Intergovernmental Panel on Climate Change (IPCC) First Assessment Report (FAR) issued in 1990 [5] as on page xxvii that claims water vapor amplifies warming by CO_2. IPcc AR5 in 2013 expanded the idea by quantifying the amplification as "a typical factor between two and three". The statement further includes the concept that as CO_2 goes up, water vapor goes up and as CO_2 goes down, water vapor goes down. Actually, the opposite is true, i.e., as CO_2 goes up, water vapor goes down and vice versa.



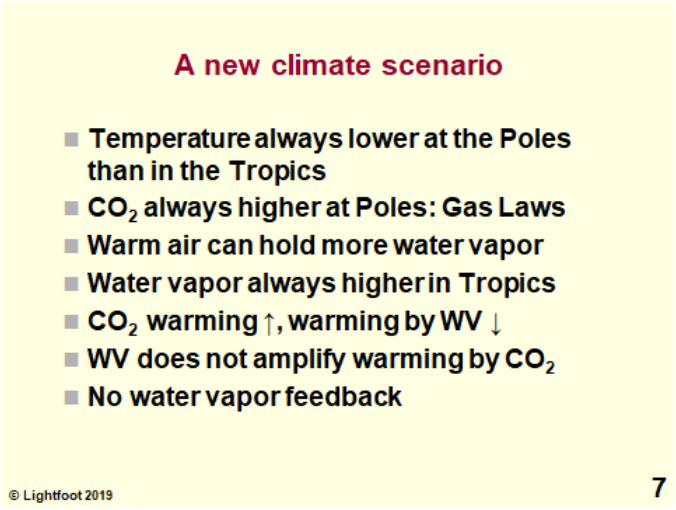
Slide 5: Why such a noticeable difference? The scientists writing for the IPCC did not take into account how the gas laws affect CO_2 concentration, the response of CO_2 and water vapor to changes in atmospheric temperature and measurements of back radiation that only become usefully available after publication of the FAR. Back radiation is the radiation back to Earth from all of the greenhouse gases [6]. The methodology for the new scenario takes all of these items into account.



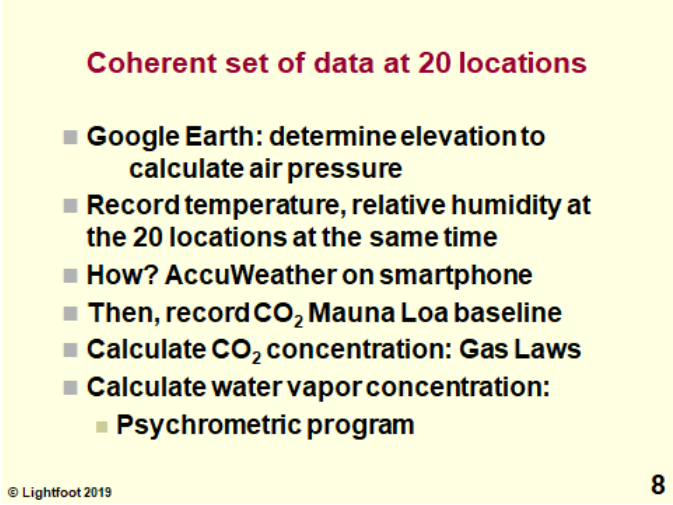
Slide 6: Basis for a new scenario. A new scenario applies the gas laws to CO_2 and examines the response to CO_2 and to water vapor to changes in atmospheric temperature. It starts with Figure 1, which is a map of the world with 20 locations distributed through five latitude regions. From the Poles to the Equator, the air becomes warmer, expands by the Gas Laws, and CO_2 concentration falls. In contrast, as air warms towards the Equator it can hold more water vapor. As CO_2 concentration goes up that of water vapor goes down in response to temperature and vice versa. This is the key difference between the scenarios. The remainder of this presentation provides the numerical evidence to support this new scenario.



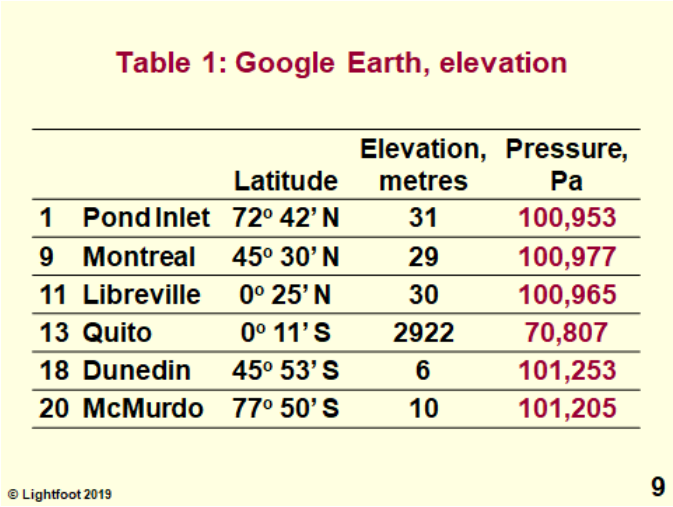
Slide 7: **New climate scenario.** The basis for the new scenario is so important and unknown it bears repeating. Temperature is always lower at the Poles than in the Tropics; therefore, CO_2 concentration is always higher at the Poles. The warm air in the Tropics can hold more water vapor and the concentration is always higher than at the Poles. As the concentration of CO_2 goes up that of water vapor goes down when they are together in the atmosphere. Water vapor does not amplify warming by CO_2 and there is no water feedback loop.



Slide 8: **Coherent set of data:** The elevation at each of the 20 locations is determined from Google Earth. The air pressure required for the pressure part of the gas laws is calculated from the elevation by a proven method. Then, the temperature and relative humidity (RH) is recorded at the same time at the 20 locations on the map of Slide 4. This is readily achieved by using AccuWeather on a smartphone. The CO_2 baseline issued daily by the Mauna Loa Observatory is recorded. The CO_2 concentration at each point using the Gas Laws is calculated and the concentration of water vapor is calculated by a psychrometric program.



Slide 9: **Table 1: Google Earth, elevation.** For the pressure part of the Gas Laws, Google Earth provides latitude, longitude and elevation for each of the 20 locations. For clarity, this table shows latitude, elevation and pressure for only six of the 20 locations. Pond Inlet and McMurdo Station are in the Arctic and Antarctic, Montreal and Dunedin are mid-latitudes North and South and Libreville and Quito are on the equator. Elevation obtained from Google Earth is converted to pressure in Pascals (Pa) as in Table 1.



		Latitude	Elevation, metres	Pressure, Pa
1	Pond Inlet	72° 42' N	31	100,953
9	Montreal	45° 30' N	29	100,977
11	Libreville	0° 25' N	30	100,965
13	Quito	0° 11' S	2922	70,807
18	Dunedin	45° 53' S	6	101,253
20	McMurdo	77° 50' S	10	101,205

Slide 10: Table 2: Time, temperature RH, CO_2, WV.
In Table 2, AccuWeather provides Columns A, B and C taken at the same time at the 20 locations. There are actually 13 minutes between the first and last cities recorded. To ensure the results are correct, the sequence of cities was immediately run through again and no changes were found. The temperature converted to Kelvin, the pressure from Table 1 and the CO_2 baseline of 405.65 ppm are used to calculate CO_2 concentration in Column D. The temperature and RH are used with a psychrometric program to calculate the concentration of water vapor in Column E. Table 2 shows CO_2 concentration is highest at the Poles and lowest in the Tropics. The concentration of water vapor is the opposite: it is lower at the Poles than in the Tropics. Thus, concentrations and warming effect of CO_2 and water vapor move in opposite directions in the atmosphere. These are real, verifiable numbers based on actual physical measurements.

Table 2: Time. temperature, RH, CO_2, WV

Mauna Loa CO_2 Sept 21, 2018 = 405.65 ppm

	A Montreal time	B Temp, °C	C RH, %	D CO_2, ppm	E WV, ppm
Pond Inlet	6:15	-5	99	411.7	3,971
Montreal	6:12	15	81	381.7	13,926
Libreville	6:21	28	78	366.6	30,230
Quito	6:16	10	54	273.5	9,482
Dunedin	6:14	7	97	395.2	9,730
McMurdo	6:19	-21	50	438.9	466

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Slide 11: CO_2 and water vapor vs. temperature.
The plot of the results in Table 2 is Figure 3. The CO_2 concentration falls from McMurdo at -21°C to Libreville at +28°C as expected from the Gas Laws. CO_2 concentration is always lower in the Tropics than at the Poles and water vapor concentration is always higher. From the Poles to the Tropics, water vapor increases by approximately 30,000 ppm. The number of water vapor molecules increases from 1.1 to 85 times that of the number of CO_2 molecules. A linear trend line shows higher CO_2 concentrations are associated with lower temperatures in accordance with the Gas Laws. This is proof the concentrations and the warming effects of CO_2 and water vapor move in opposite directions in response to temperature as components of the atmosphere.

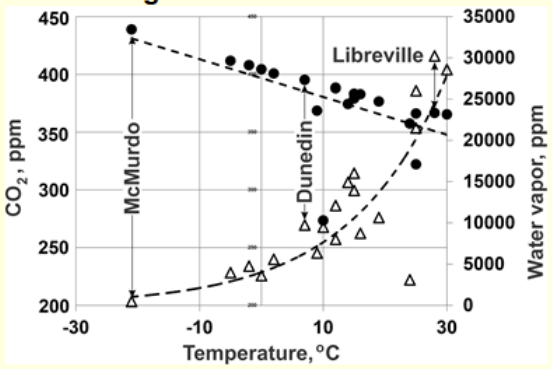

Figure 3
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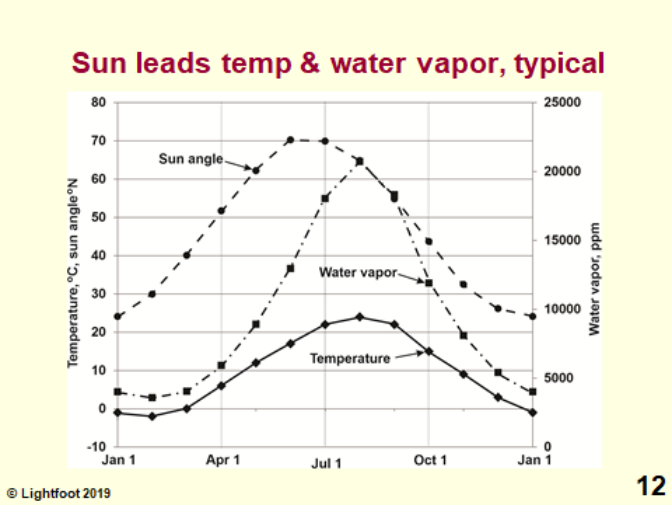
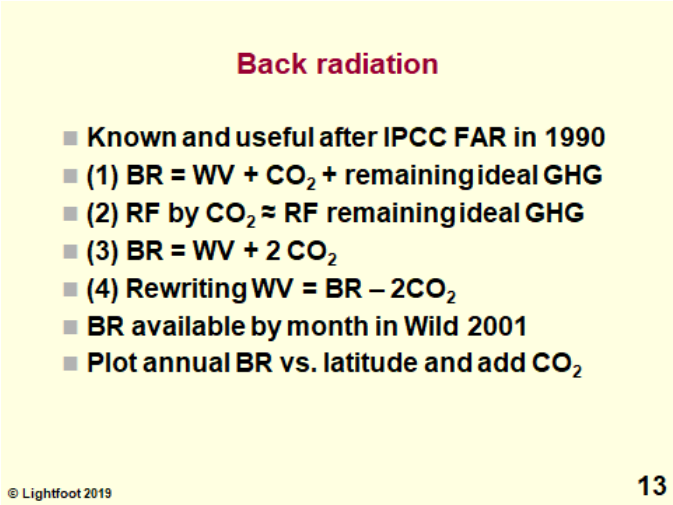
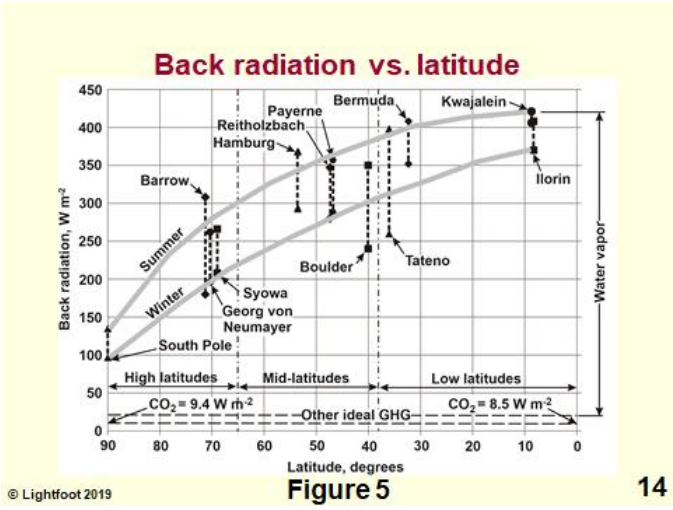
<u>Slide 12:</u> Sun leads Temp & water vapor, typical. These curves are the average annual cycle at Toronto, Canada, and are typical of any place on Earth. Atmospheric temperature is controlled by the sun angle that varies from -23°C at the Poles to 90° at the Equator. Atmospheric temperature follows the sun angle by approximately six weeks and water vapor follows the temperature. The sun angle increases water vapor exponentially in Figure 3; it decreases CO_2 by what appears to be linearly because of the short range of the quadratic from Figure 6. The sun controls the Earth's temperature annually and over decades and centuries [7].



<u>Slide 13:</u> Back radiation. Back radiation, the sum of radiation back to the Earth from all of the GHG, is used to compare the warming effects of each GHG directly in Watts per square meter (W m^{-2}). Back radiation, also known as downward longwave radiation, became usefully available sometime after publication of the IPCC First Assessment Report in 1990. Back radiation can be written as in Line 1. In Line 2, the RF of CO_2 is approximately equal to RF of the remaining GHG as in Figure SPM.5 of the Summary for Policymakers in AR5. Thus, back radiation can be written as in Line 3. Rewriting in favor of water vapor gives Line (4). Back radiation measurements are available from Wild (2001) as plotted in the next slide. The warming effects of CO_2 and the remaining GHG that act as ideal gases are added to the figure.



<u>Slide 14:</u> Back radiation vs. latitude. This graph is constructed from Table 1 and Figure 4 of Wild (2001) [8]. Figure 4 of Wild (2001) has curves of the average monthly back radiation measurements from which are chosen the maximum (summer) and the minimum (winter) values for each of the twelve locations. The overall range from the winter minimum to the summer maximum is 320 W m^{-2} and atmospheric temperature increase is ≈50°C. Over the same range, the warming effect of CO_2 drops by 0.9 W m^{-2}, equivalent to a temperature drop of ≈0.14°C. Compared to back radiation, warming by CO_2 is slightly negative and likely has insignificant effect on atmospheric temperature.



<u>Slide 15:</u> CO_2 vs. warming effect (RF) in W m^{-2}. The slope of the line for CO_2 in Slide 11 was calculated from the curve on this slide. The curve on this slide is a quadratic that starts at zero, exactly covers the points for $\Delta RF = 5.22\ln(C/C_o)$ over the range of 275 to 378 ppm, and then reaches an asymptote. The asymptote is necessary because the amount of radiation is limited and each additional CO_2 molecule has less and less IR available. This curve is an approximation and is used in this presentation until a better approximation is available.

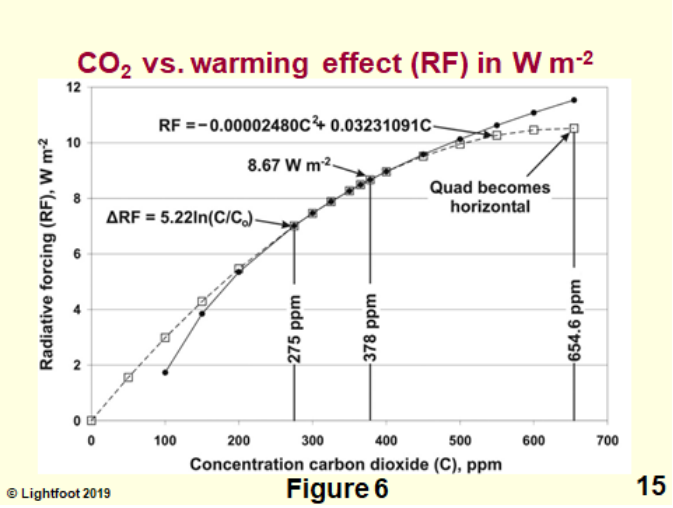
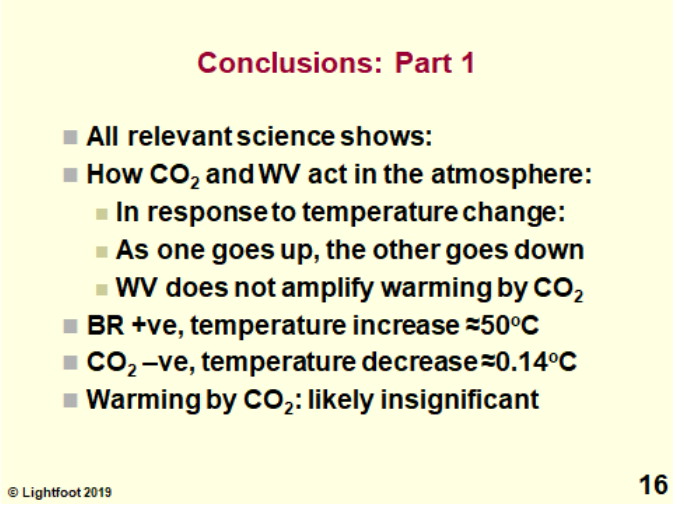
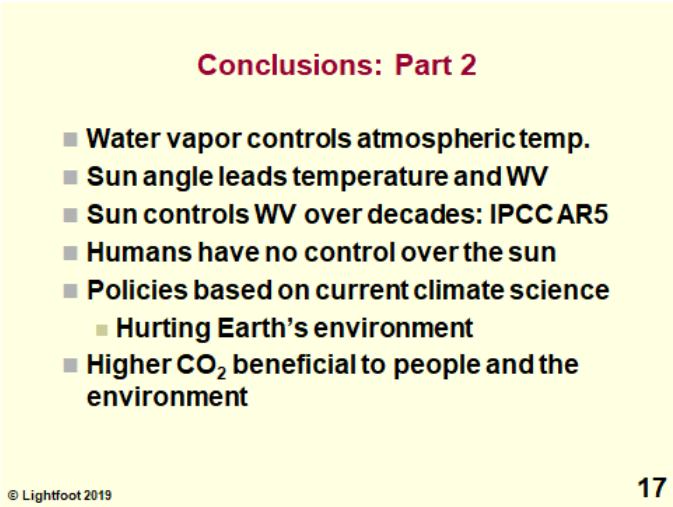


Figure 6

Slide 16: Conclusions: Part 1. Considering all of the relevant information shows how CO_2 and water vapor act In response to atmospheric temperature increase. As CO_2 concentration goes down, water vapor concentration goes up and vice versa, as do their respective warming effects. Water vapor does not amplify warming by CO_2. The warming effect of back radiation, which is mostly from water vapor, is ≈320 W m^{-2} higher in the Tropics than at the Poles and is why the Tropics are so much warmer. This causes an increase in warming of ≈50°C. Over the same range warming by CO_2 drops by 0.9 W m^{-2} which is equivalent to a temperature drop of ≈0.14 W m^{-2}. The warming effect of CO_2 on atmospheric temperature, if any, is likely insignificant.



<u>Slide 17:</u> Conclusions: Part 2. Water vapor controls atmospheric temperature. Annually it leads atmospheric temperature and water vapor follows. Water vapor controls temperature over decades and longer based on the work of K. Willett et al and reported in IPCC AR5. With the sun in control, there is no man made warming of the atmosphere. Policies based on current climate science that promote CO_2 as the cause of climate change are hurting Earth's environment. The reality is that higher levels of CO_2 in the atmosphere are beneficial to people, plants and the environment.



For those who wish more background, supplementary information follows

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Slide 18: Supplementary information. This is list of supplementary information that might be useful to some people.

Supplementary information

- Google Earth
- AccuWeather
- Psychrometric chart
- Gas laws: Boyle, Charles/Gay-Lussac
- Daily CO_2 at Mauna Loa Observatory
- Water vapor and temperature, IPCC AR5
- MODTRAN climate model
- Interesting questions for scientists

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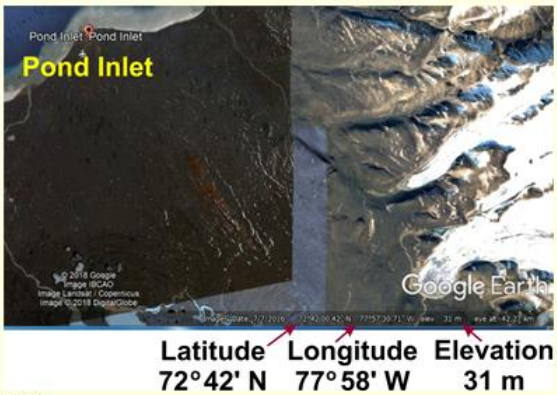
Slide 19: Elevations from Google Earth. For the pressure part of the Gas Laws, the elevation of each location is required. Pond Inlet is used as an example. The latitude, longitude and elevation are given at the bottom right of the picture under the "Google Earth" logo. Because the cursor gives the elevation under it, the cursor should be to the left and off the picture to avoid spurious readings.

Elevations from Google Earth



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Slide 20: Smartphone access to AccuWeather. After the 20 locations are entered in the smartphone, run the series and obtain the data. Image 1 shows the name of the city, the local day, date and time and the current temperature. In this slide it is Saturday, January 12 at 1:49 PM and the temperature is -14°C. Tap Image 1 to bring in Image 2 to provide relative humidity (RH) as 53%. To go back to Image 1, tap the "Go back" triangle at the bottom left of the screen and Image 1 will come in again. For the next city, tap the arrow at the upper left of Image 2.

Smartphone access to AccuWeather

Image 1 Image 2

Image 1: record date, local time, temperature.
Then, tap Image 1 to bring in Image 2. Record relative humidity (RH) of 53%.
Use the "Go back" triangle to return to Image 2.
To go to the next city, tap the arrow to the left of Montreal in Image 2.

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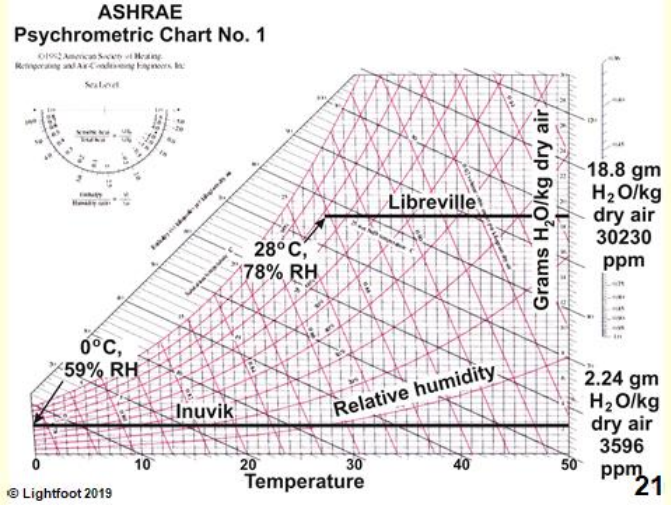
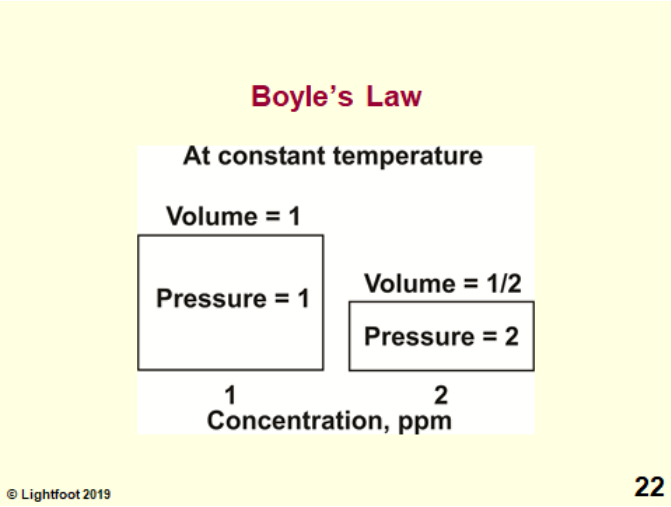
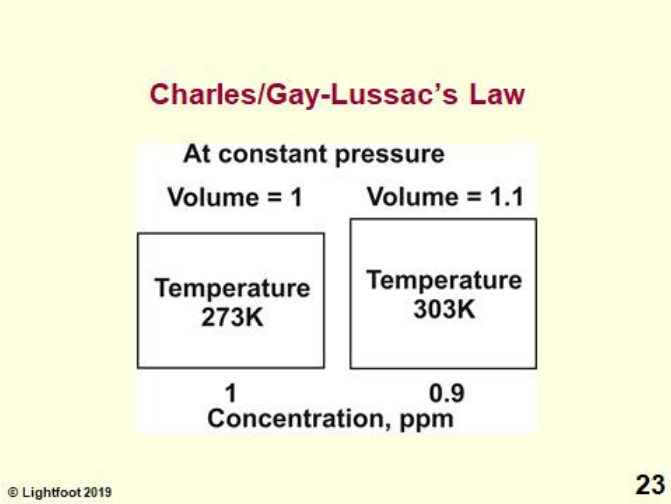
Slide 21: ASHRAE Pysychrometric Chart No. 1. This chart shows how to find the grams of water per kg of dry air from which to calculate the concentration of water vapor in ppm. Libreville is on the equator and Inuvik is above the Arctic Circle. This graph is available as a computer program; Humidair by MegaWatSoft and is much easier to use.



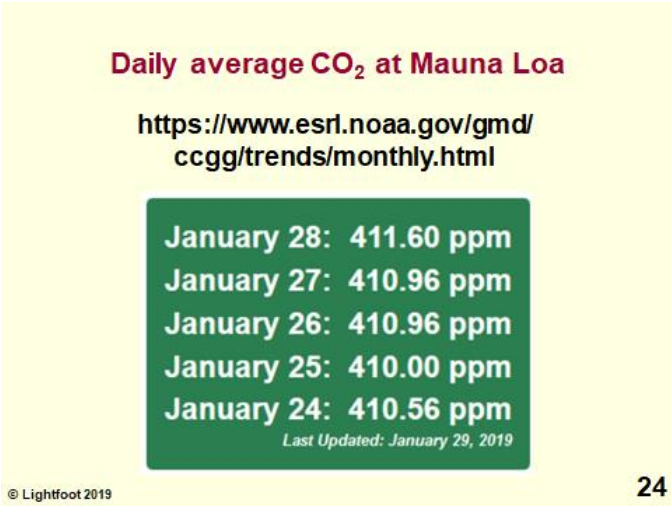
Slide 22: Boyle's Law. Boyle's Law states that at constant temperature the volume of a gas is inversely proportional to its pressure. For example, if the pressure is doubled, the volume is halved and the concentration is doubled as shown graphically on this slide.



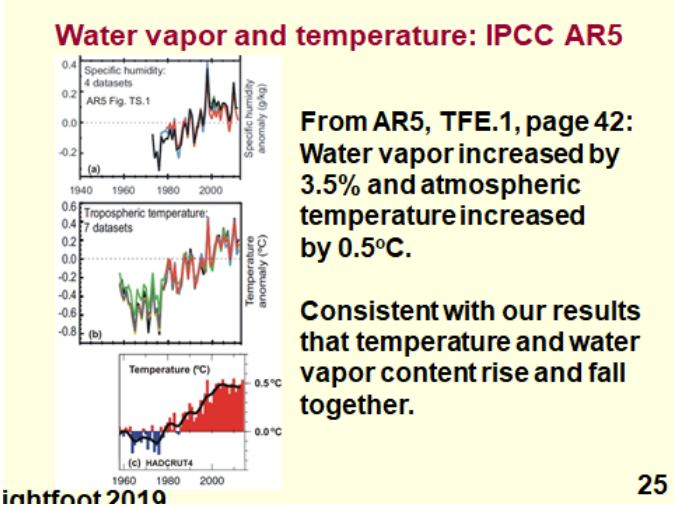
Slide 23: Charles/Gay-Lussac's law. Charles/Gay-Lussac's Law states that at constant pressure the volume of a gas is proportional to the absolute temperature, degrees Kelvin. The concentration is changed proportionally with temperature as shown graphically on this slide.



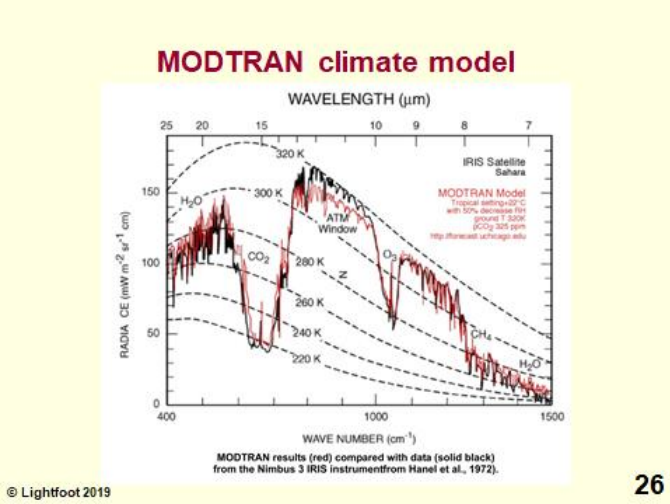
Slide 24: Daily average CO_2 at Mauna Loa. This table is updated every day. A similar table provided 405.65 ppm for September 21, 2018. This is the number of molecules of CO_2 per million molecules of dry air, but can be used as parts per million by volume with negligible error. The ppm is proportional to the number of molecules in a given volume and allows comparison of the numbers of CO_2 and water vapor molecules.



<u>Slide 25:</u> Water vapor and temperature: IPCC AR5. These figures are from IPCC report Climate Change 2013: The Physical Science Basis (AR5), page 38. They show the concentration of water vapor increasing with temperature. The sun is the only source of energy large enough to evaporate sufficient water vapor to change the concentration. Therefore, the sun must have caused the increase in water vapor concentration. The sun controls Earth's temperature over decades and longer.



<u>Slide 26:</u> MODTRAN climate model. MODTRAN (MODerate resolution atmospheric TRANsmission) is a climate model designed to simulate transmission of infrared (IR) radiation through the atmosphere to space. This graph from MODTRAN [4] has a radiation spectrum with suggestions for radiation levels at suggested wave lengths for the GHG, CO_2, methane and water vapor. It appears from this chart that the values for each gas are positive, i.e., in the same direction. IPCC reports appear to support this concept [9]. As we saw earlier, the concentrations of the ideal gases, CO_2 and methane, move in the opposite direction to that of water vapor. Thus, if the warming effect of water vapor is positive, the warming effect of CO_2 must be negative. There is nothing in the MODTRAN documentation to indicate this is taken into account. If it is not taken into account it represents an error in MODTRAN, and is likely evident in other climate models.



References

]1] Lightfoot H. D., A Strategy for Adequate Future World Energy Supply and Carbon Emission Control. Published in: 2006 IEEE EIC Climate Change Conference , **DOI:** 10.1109/EICCCC.2006.277266

[^{2}] NASA Carbon Dioxide Fertilization Greening Earth Study Finds, April 26, 2016. Available at: https://www.nasa.gov/feature/goddard/2016/carbon-dioxide-fertilization-greening-earth.

[3] IPCC, *Climate Change, The IPCC Scientific Assessment*, 1990, edited by Houghton J T, Jenkins G J and Ephraums J J. Prepared by Working Group 1, Cambridge University Press, 1990. See page xxvii.

]4] IPCC, 2013: *Climate Change 2013: The Physical Science Basis.* Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp. See page 667, FAQ 8.1.

[5] IPCC, 1990: CLIMATE CHANGE The IPCC Scientific Assessment Report Prepared for IPCC by Working Group 1 Houghton J. T., Jenkins G. J., and Ephraums J.J., (eds), (Meteorological Office, Bracknell, United Kingdom).

[6] The Science of Doom, Evaluating and Explaining Climate Science, The Amazing Case of "Back-Radiation". Available at: https://scienceofdoom.com/2010/07/17/the-amazing-case-of-back-radiation/

[7] Reference [2] See Figure TS.1 page 38 and Box TFE.1 page 42.

[8] Wild M et al, *Evaluation of Downward Longwave Radiation in General Circulation Models*, Journal of Climate, American Meteorological Society, Vol. 14, pp 3227-3239, Table 1, page 3229, Figure 4, page 3233.

[9] Reference [4], See page 667, FAQ 8.1.

About the author:

H. Douglas Lightfoot: Co-founder of the Lightfoot institute: www.thelightfootinstitute.ca

A retired Mechanical Engineer, H. Douglas Lightfoot graduated from the University of British Columbia, in Applied Science in 1952, and received an MBA from Concordia University in 1976. He spent eighteen years with Domtar Inc. at the Research Centre in Senneville, Quebec, working on research, engineering and economic studies of alternate energies as well as a wide variety of projects for the pulp and paper, chemicals and construction materials businesses. During this period, he wrote 21 research reports as sole author and 18 with co-authors.

Prior to joining Domtar, he spent a year as Business Analyst and five years as Design Engineer designing, building and starting up chemical plants at DuPont of Canada, Montreal, Quebec. Before that, twelve years of project engineering at Standard Chemical Limited, Beauharnois, Quebec.

He is a retired member of the Order of Engineers of Quebec, Professional Engineers of Ontario, and a Life Member of the American Society of Mechanical Engineers.

He continues to have an active interest in energy related subjects and the environment. He was an affiliated member of the McGill University's Centre for Climate and Global Change Research (C^2GCR) and continued when it was replaced by Quebec's Global Environmental and Climate Change Centre (GEC3). He was associated from 1992 until closure of GEC3 in 2015. Since 1992, he has 12 published scientific papers, contributed to published works and has written reports for the Centre on various subjects related to energy.

Address questions and requests for additional information to: contact@thelightfootinstitute.ca