Climate Reality

Physics-Based Vs. Model-Based-CO_2-Theory

- might as well add CH_4-Theory to that

Bernie McCune's

Presentation to CASF

Saturday October 17, 2020

"Using measurements of hundreds of thousands of individual "line strengths" of the major greenhouse gases in Earth's atmosphere, they show that methane (CH4) is nearly irrelevant to global warming."

. . . and that doubling of atmospheric CO_2 is of little consequence

The Presentation is based on:

http://co2coalition.org/wp-content/uploads/2019/11/Methane-and-Climate_Happer_vanWijngaarden11-25-19.pdf

A Discussion of Climate

- The discussion has little to do with climate or science, it is really about “the future of our environment and our children”

- It is about CO_2 especially human emissions of CO_2 and warming, extreme weather and energy choices

- Controlling a narrative that claims we are responsible for every bad outcome in our natural environment is the main goal

- We certainly do have some responsibility for bad choices but most of the above series of climate claims is not exactly what we are led to believe

Humans and the strong gas "forcers"

- Human emissions of CH_4 and CO_2 are assumed to be significant by some climate scientists

- It is not at all clear that one can find much influence from the present amounts of these human derived gases in the atmosphere

- But with most of this discussion of the influence of these gases especially the above mentioned ones, no one is trying to distinguish between natural and human derived gases. But see the last few slides where the following is discussed

- All the evidence to date indicates that compared to the natural out gassing of CO_2 from the oceans and the small amount of out gassing of CH_4 from earth, plants and animals, human sources make up a tiny fraction of the atmospheric total

Basis of Model Theory

- Early models were somewhat based on physics
- They did assume that CO_2 had a significant radiative effect which it does - to a point
- But they guessed that upon doubling, CO_2 would have a continuing temperature effect on surface temperature, even though CO_2 has already reached saturation in the atmosphere
- They made up (with no basis in science) the concept of ECS (Equilibrium Climate Sensitivity) but under current and future conditions, radiative physics measurements show that the effective value of ECS at most is $< 0.6^{o}$ C which is in the noise
- Modelers claimed in the past that ECS - upon a doubling of atmospheric CO_2 - global temperature would increase in a range of 4.5 to 6^{o} C (the range is still presently 1.5 to 4.5^{o} C)

Basis of the radiative Physics

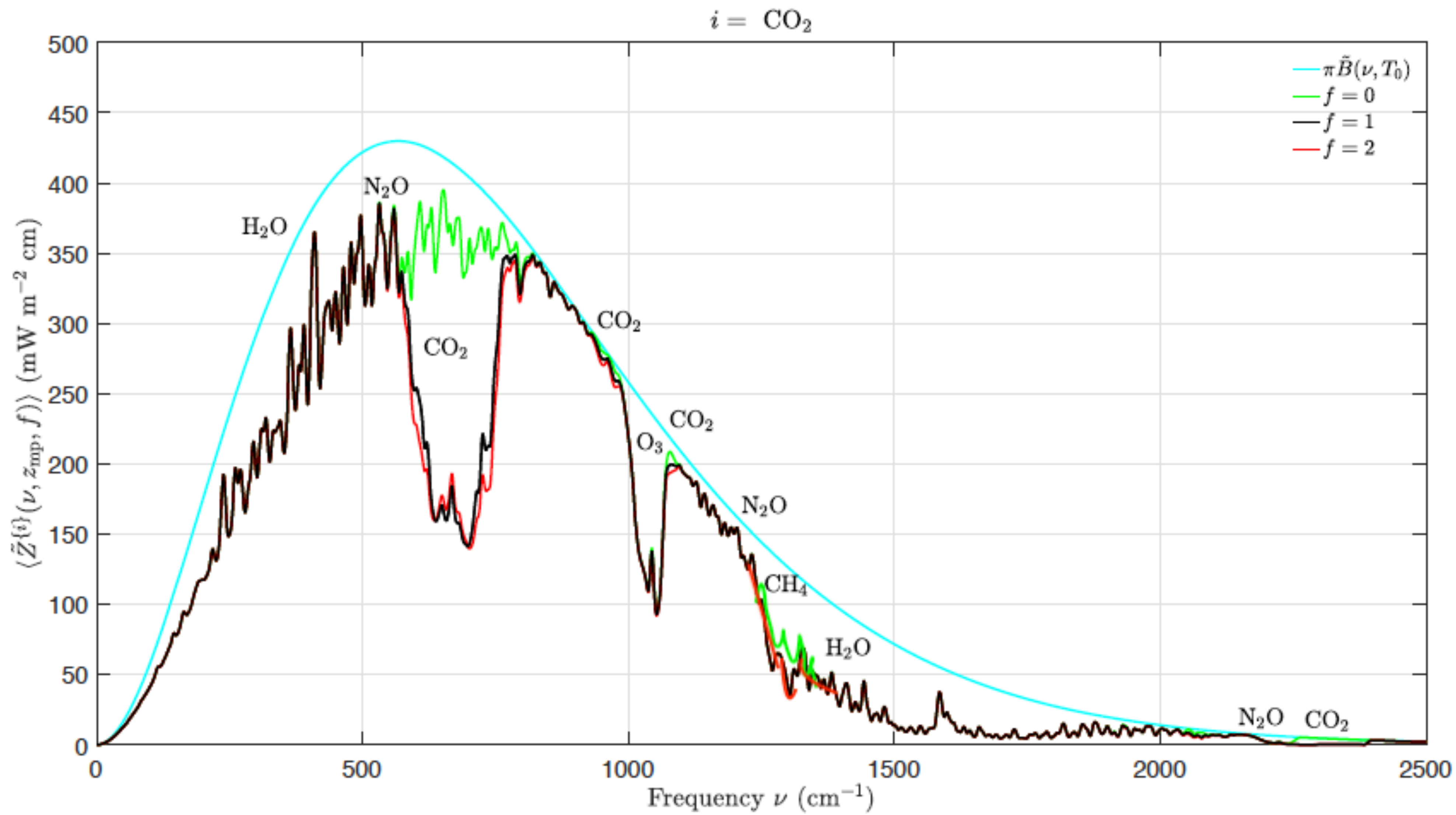
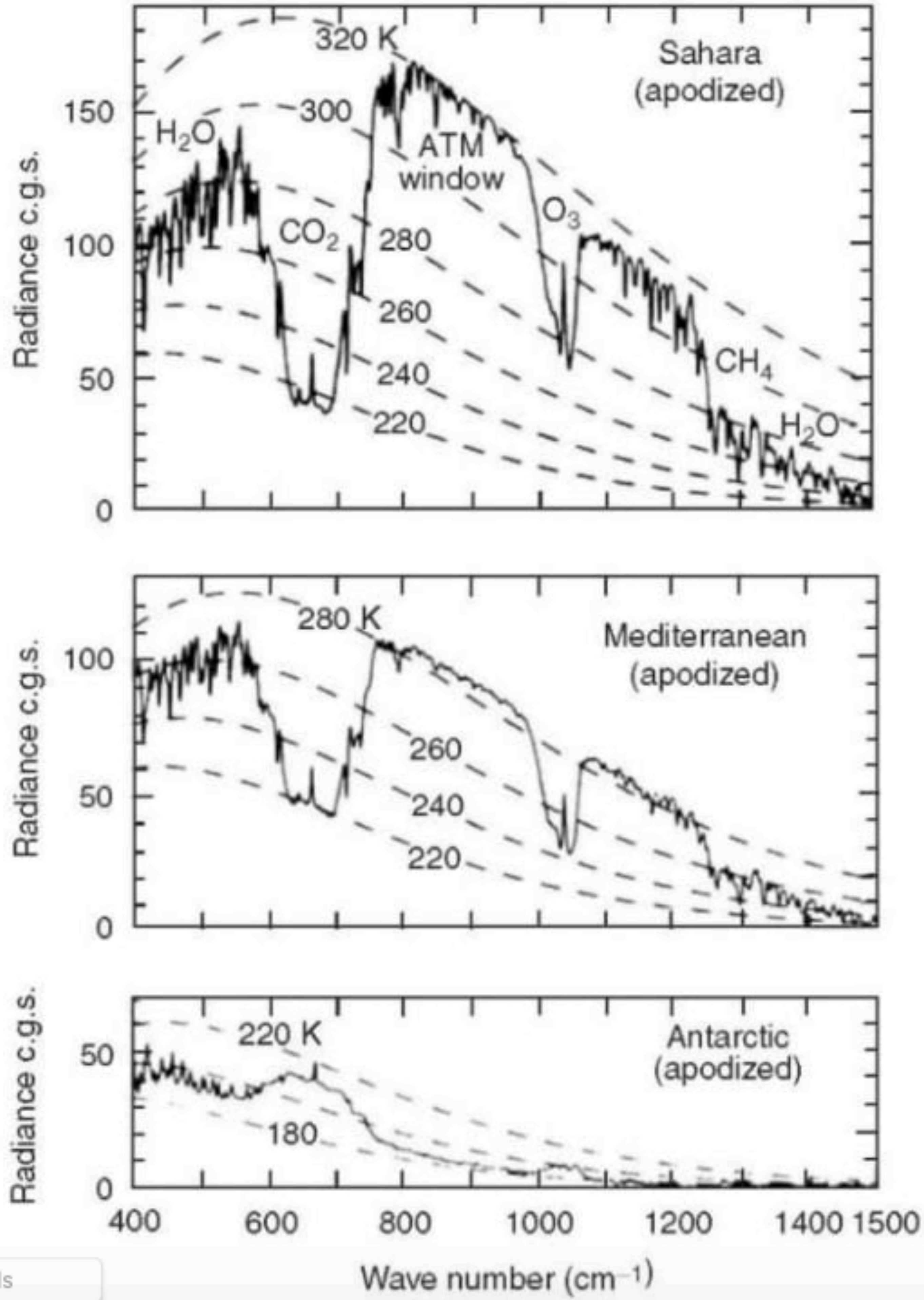


Figure 4&5 The spectral forcing at current levels of carbon dioxide, CO_2, (the black curve with $f = 1$), or if concentrations of carbon dioxide are doubled (the red curve with $f = 2$), or if all carbon dioxide is removed (the green curve with $f = 0$).

Both CO_2 and CH_4 are plotted for no atmospheric gas (green f=0), present gas concentration (black f=1), and double the particular gas concentration (red f=2). H_2O with f=0 would dramatically have the large parts of the black line approach the blue line.



Sahara (apodized)
320 K
300
280
260
240
220
H_2O
CO_2
ATM window
O_3
CH_4
H_2O
Mediterranean (apodized)
280 K
260
240
220
Antarctic (apodized)
220 K
180
Radiance c.g.s.
0
50
100
150
400
600
800
1000
1200
1400
1500
Wave number (cm^{-1})

What does this mean?

- The physics of this radiative plot is that with little or no gases (or temperature change) in the atmosphere the jagged black line would approach value of the smooth blue line (where all energy **in** would be all radiated back **out**)

- It is clear that doubling (red) of both CO_2 and CH_4 from the original black line will have little to almost no effect on the present radiative forcing

- If one were to integrate the area under that blue line, they would obtain the spectral flux for a transparent atmosphere (394 w/m^2)

- And there **are** gases in the atmosphere namely H_2O, N_2O, O_3 and CH_4 (as well as CFCs)

- The **radiation transfer in a cloud free atmosphere** is controlled by **2 things** a) the **temperature** as a function of altitude and b) the **number densities** of specific molecules

Concentration of Atmospheric Gases

- Water vapor concentration in the troposphere varies significantly but at sea level is about 7750 ppm

- Clouds in the troposphere have very significant radiative effects both by blocking the sun in the day and blocking heat radiation to space at night (these will be ignored in this early discussion)

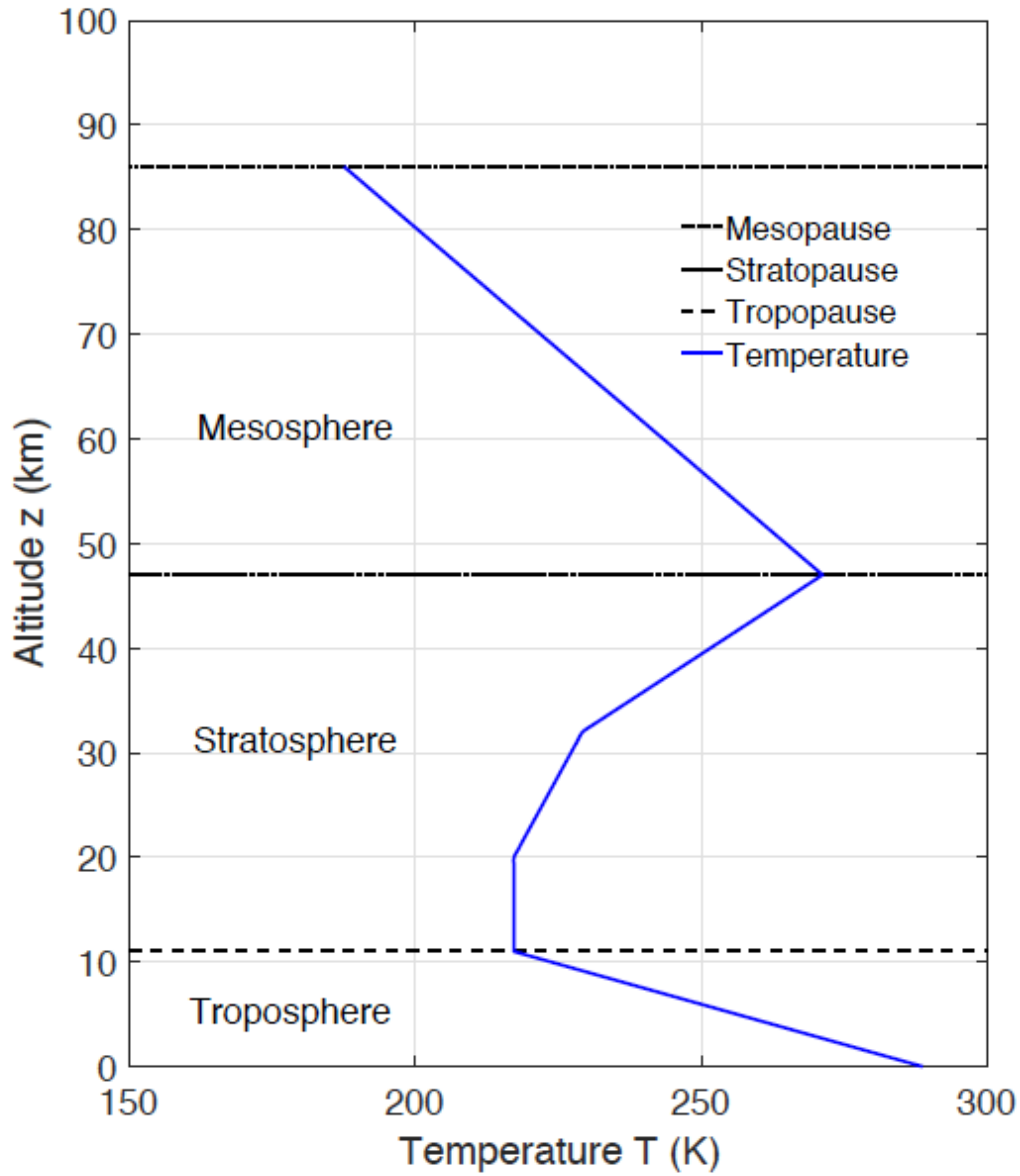
- CH_4 methane (1.8 ppm) and CO_2 carbon dioxide (410 ppm) both have fairly steady concentrations in the atmosphere and both have been increasing over the past few decades

- The global atmosphere is saturated with CO_2 but not saturated with CH_4

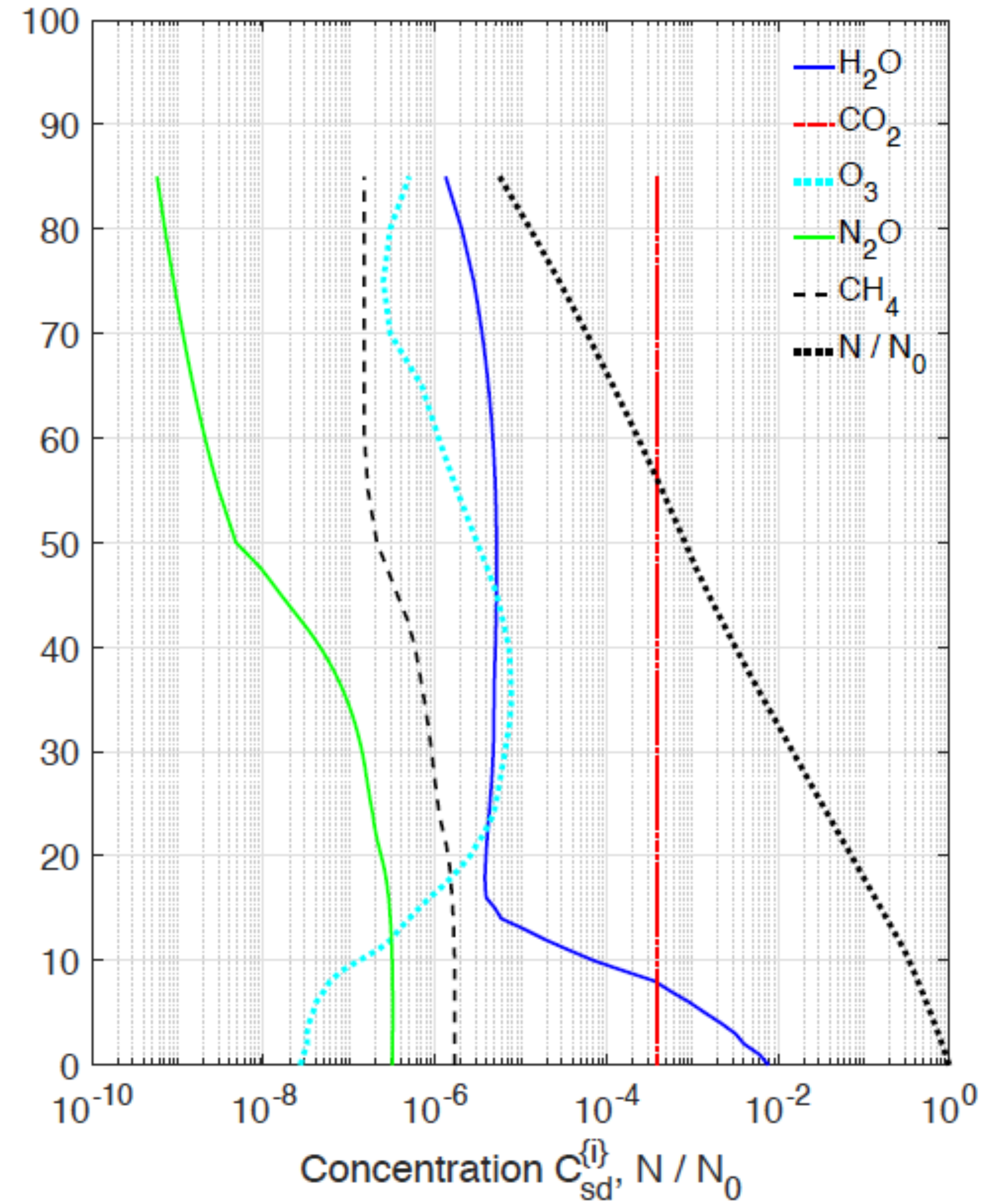
- The rest - N_2O = 0.32 ppm, O_3 peaks at 7.8 ppm @ 35 km

These values have been measured

A general data set for temperature



Concentration of Atmospheric gases



These are standard atmosphere plots and do vary some by latitude and longitude

The Specific Values of the Parameters

- From the surface to the top of the Troposphere the temperature dramatically drops to very cold (-65^{o} C) and remains cold into the lower Stratosphere (H_2O)

- Then temperature warms (O_3 ozone) as we continue up to the Stratosphere-Mesosphere boundary where it cools (CO_2) again into the very cold edge of space

- Sea-level gas concentrations: H_2O = 7750 ppm, CH_4 =1.8 ppm* and N_2O = 0.32 ppm*

- O_3 concentration peaks at 7.8 ppm at 35 km and CO_2 is now about 410 ppm at all altitudes

* Both these gases remain steady in concentration in the troposphere but vary a lot into the the atmosphere above it

Atmospheric Characteristics

- In the troposphere (up to 11 km) air parcels are warmed by contact with the solar heated surface and they rise and cool and create unstable “weather” conditions

- These parcels release latent heat and pick up water vapor that condenses to water or ice (in the tropics there are very large “lapse rates” in the troposphere)

- The stratosphere is more stable with heating from ozone O_3 (from a temperature of 220K back up to about 275K)

- The stratopause is at 47 km

- The mesosphere again sees significant cooling by CO_2 to a temperature below 200K

- The low pressure thermosphere begins at an altitude of 87 km where there is negligible convective mixing and temperatures of up to 1000K (extreme UV, solar wind, gravitational stratification, etc.)

Forcing and Flux

- Atmospheric gases affect energy transfer through Earth's atmosphere and is quantitatively determined by the radiative forcing, F

- The difference between Flux through a transparent atmosphere and Flux through an obstructed atmosphere is Radiative Flux

- The forcing F and the flux Z are usually specified in units of W/m2. The radiative heating rate,

$$R = \frac{dF}{dz},$$

is equal to the rate of change of the forcing with increasing altitude z.

- Over most of the atmosphere R < 0, so thermal infrared radiation is a cooling mechanism that transfers internal energy of atmospheric molecules to space or to the Earth's surface. Forcing depends on latitude, longitude and the altitude, z.

Transparent atmosphere surface flux = 394 w/m²

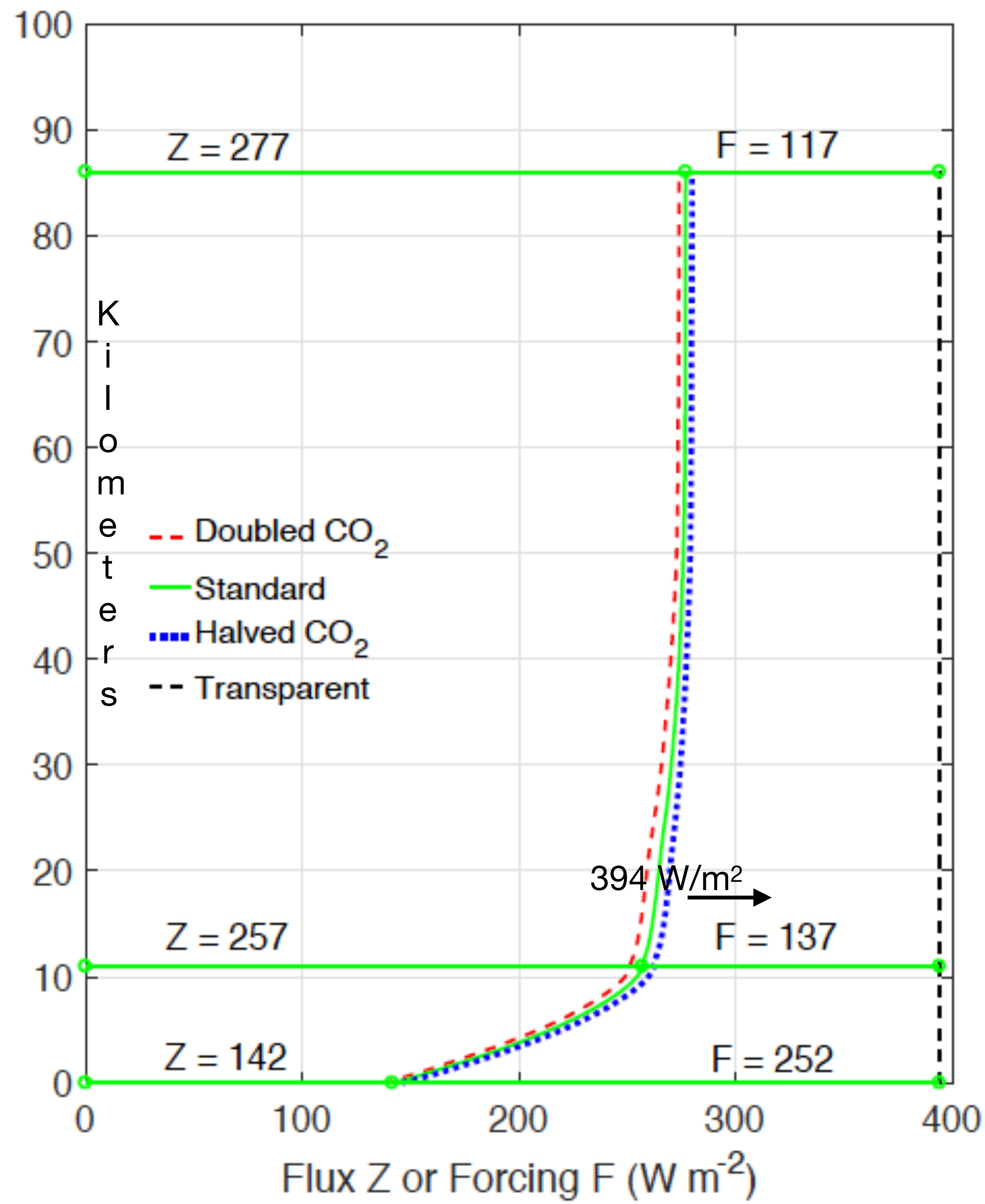
Surface Temperature is assumed to be 288.7 K (15.55 C)

Major Flux change is found in the troposphere and slight change in the lower mesosphere

With current gas concentrations the surface flux = 142 w/m² and at the tropopause = 257 w/m²

From the tropopause through the rest of the atmosphere there is a flux change of only 20 w/m²

Forcing/Radiative Heating effect mostly occur in the troposphere



More details on Z(flux) and F(forcing)

- Top of the atmosphere (TOA) solar input is about 1350 w/m^2
- Flux change and Forcing change from the TOA to the Tropopause is small = 20 w/m^2
- Both Flux change and Forcing in the Troposphere = 115 w/m^2
- In the NM desert, water vapor variations in the Troposphere can change the solar incident radiation at the surface from 850 w/m^2 (monsoon summer) to 950 w/m^2 and more (dry fall and winter) so apparently all other other atmospheric gases may be swamped and at times have only an influence of about 10s of w/m^2
- When the El Chichon volcano erupted in 1982, during the peak of stratospheric particulate concentration that occurred during the next 6 months, incident solar radiation dropped by 100 w/m^2 again mostly swamping all other atmospheric gases including water vapor

Flux Dynamics

- With current atmospheric gases, surface flux 143 w/m^2 is less than 1/2 the surface flux of 394 w/m^2 for a transparent atmosphere

- This is because of gases in the troposphere above the surface (mostly H2O and CO2?)

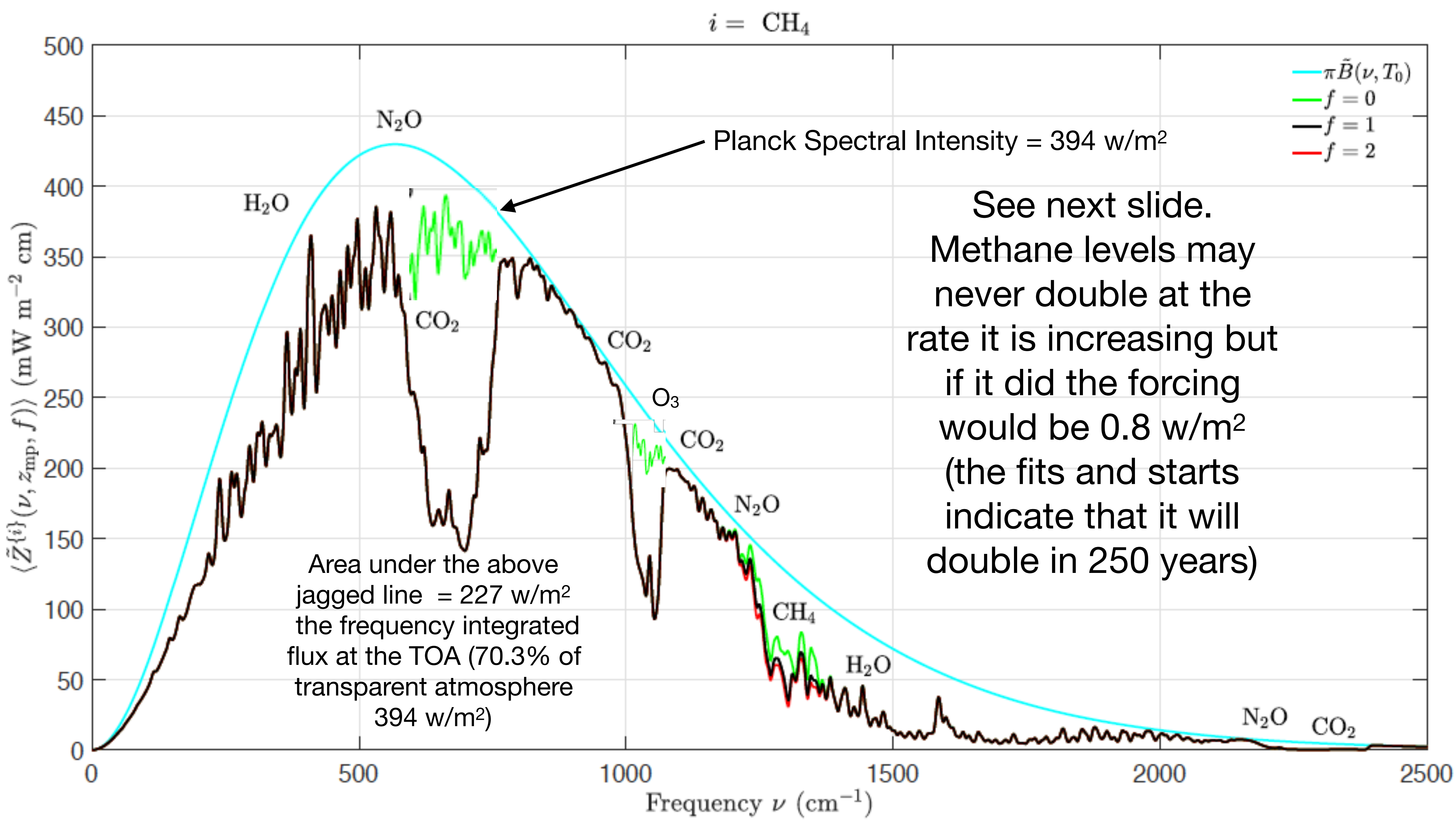
- At the tropopause the surface flux is 257 w/m^2, 11 km above the surface

- Gases in the troposphere have radiated this energy that is replaced by radiated power coming from convection of moist air

- Direct absorption of sunlight in the troposphere makes a much smaller contribution (is this true? see previous slide and what about clouds?)

- The flux increase between the tropopause and the TOA is another 20 w/m^2 and replacement energy comes from the absorption of solar UV by O_3 in the the stratosphere and mesosphere

Special Forcings



See next slide. Methane levels may never double at the rate it is increasing but if it did the forcing would be 0.8 w/m² (the fits and starts indicate that it will double in 250 years)

Atmospheric Methane

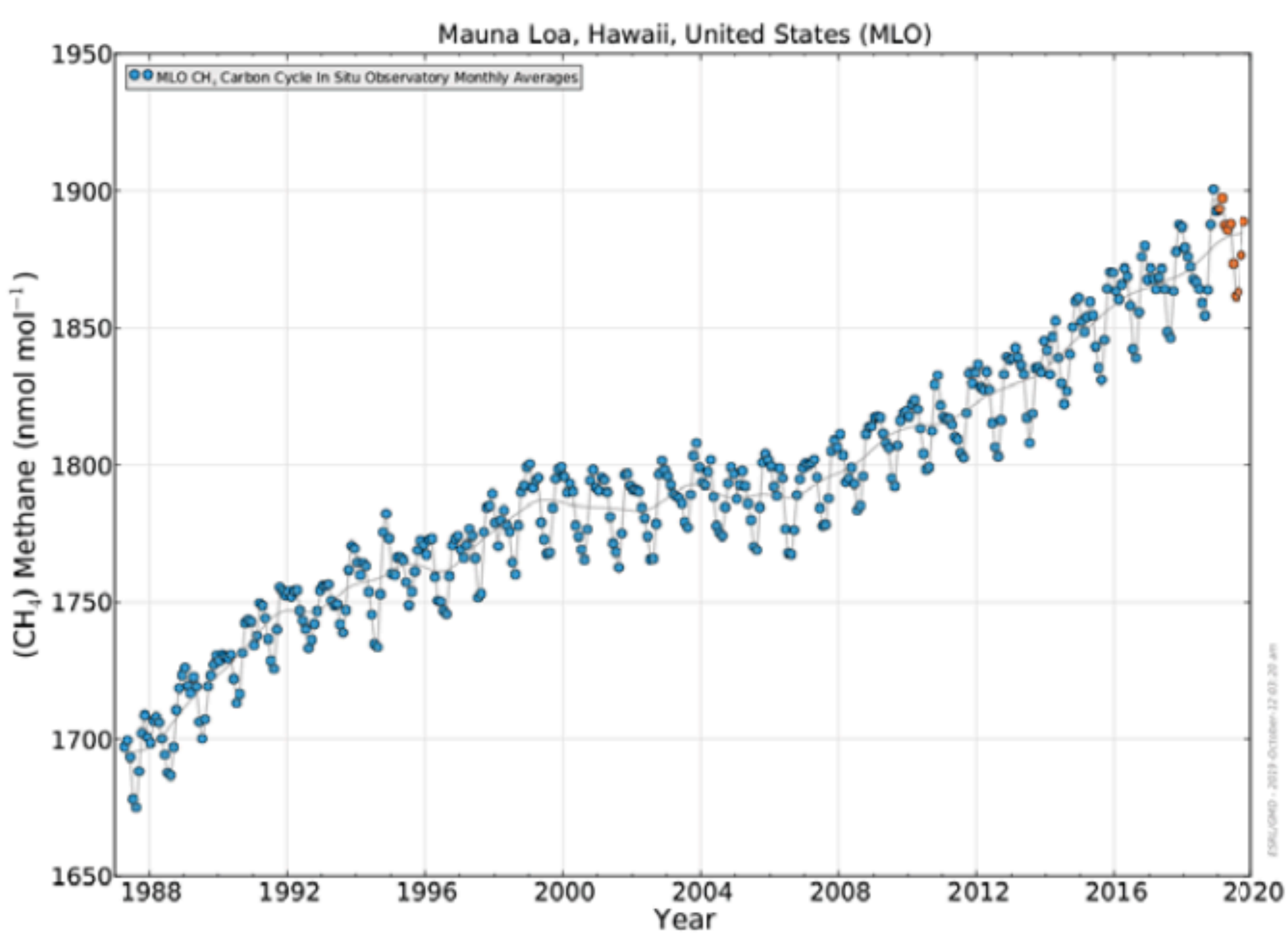


Figure 7: Atmospheric concentrations $\overline{C}^{\{i\}}$ of methane molecules (i = CH_4) versus time [20]. For the past 10 years, the average rate of increase has been about $d\overline{C}^{\{i\}}/dt = 0.0076$ ppm/year.

Doubling CO_2 - A Story

- Using instantaneous forcing increments to calculate temperature changes is very difficult which causes models to predict much more warming than is observed

- Doubling CO_2 concentration slightly decreases the radiation flux through the atmosphere

- In response, the atmosphere will slightly change its properties to ensure that the average energy absorbed from sunlight is returned to space as thermal radiation

- Both the surface and the atmospheric gas molecules radiate more intensely at higher temperatures, temperature increases are the way of restoring the equality of incoming and outgoing energy

The Story - More

- The amount of water vapor and clouds in the atmosphere will also change, since water vapor is evaporated from the oceans and from moist land

- Water is also precipitated from clouds as condensed rain or snow

- Low, warm clouds reflect more sunlight and reduce solar heating, with little hindrance of thermal radiation to space

- High, cold cirrus clouds reduce the thermal radiation to space, but are wispy and do little to hinder solar heating of the earth

What Change Means

- The simplest response to changes in radiative forcing would be a uniform temperature increase dT, at every altitude and at the surface

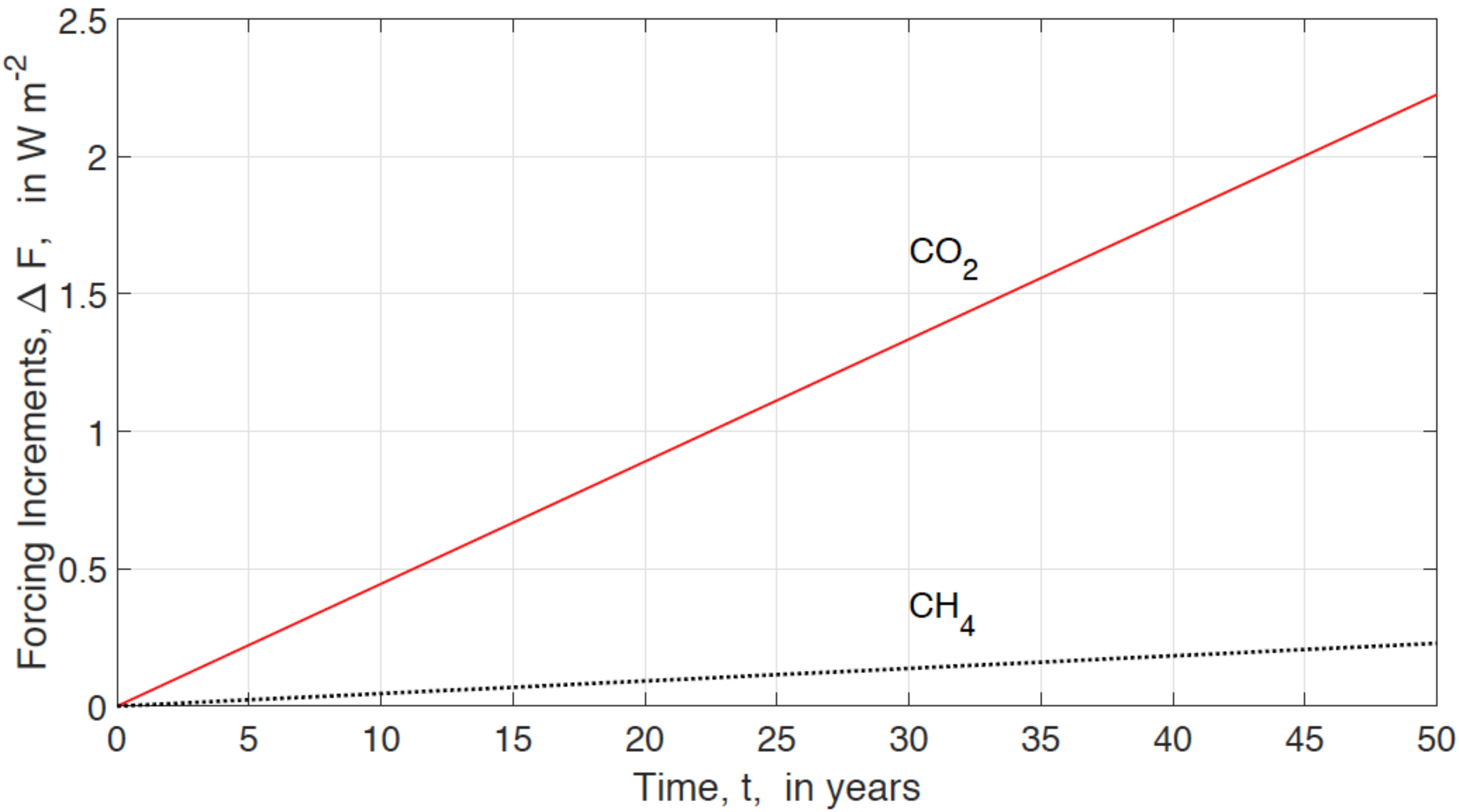
- The rate of increase of TOA flux with a uniform temperature is

$$\frac{dZ}{dT} = 3.9 \text{ W m}^{-2} \text{ K}^{-1}.$$

- For a uniform temperature increase, the forcing increase $\triangle F$ = 0.23 w/m^2 after 50 years (assuming methane regularly increases over that time)

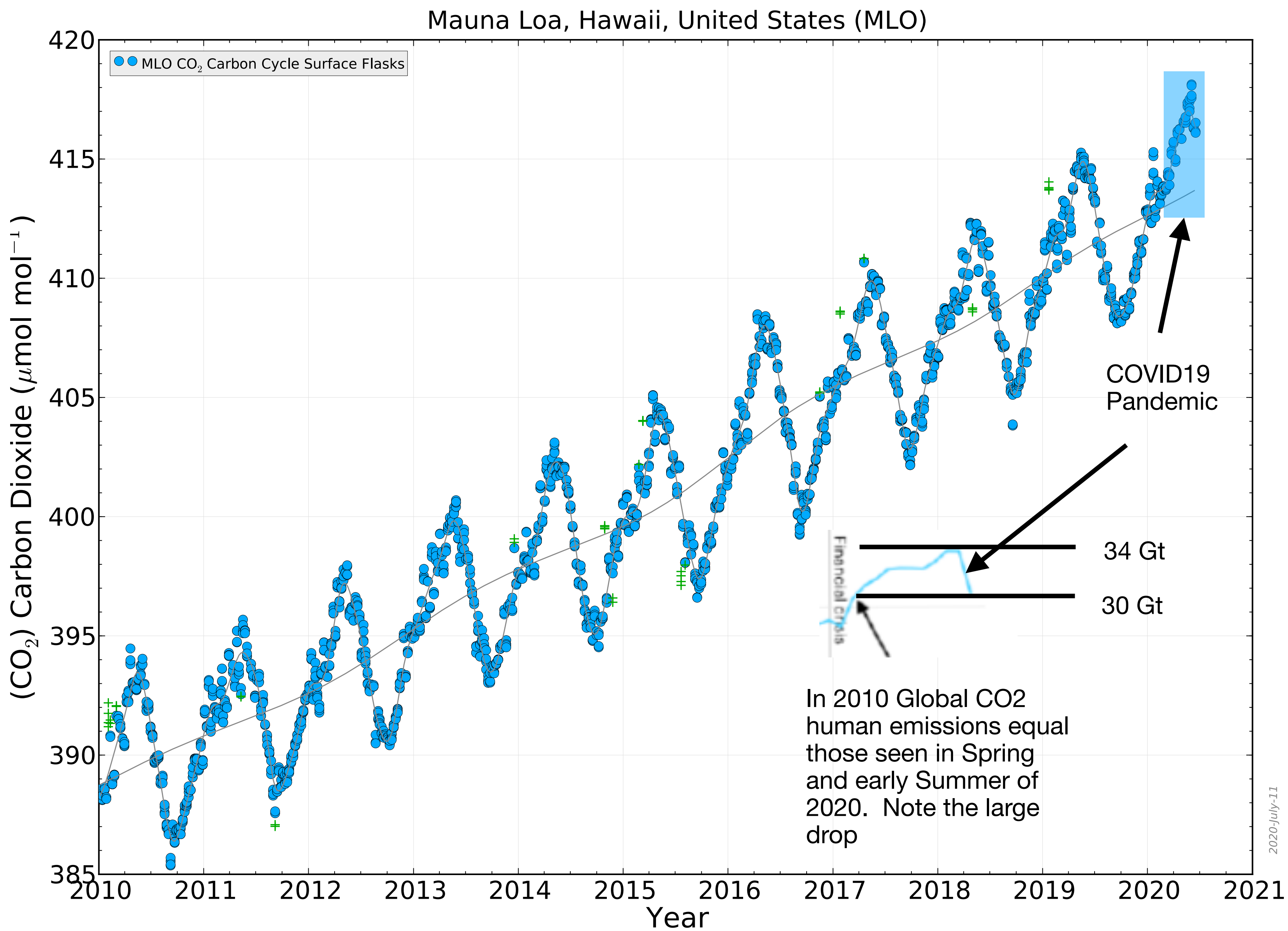
- This would cause a surface temperature increase of 0.05 C. For CO_2 a forcing of 2.2 w/m^2 after 50 years of uniform concentration increase would cause a temperature increase of 0.59 C

50 Yr Forcing values for CH_4 and CO_2



There are good reasons to expect that the temperature changes will be altitude dependent and have increase in concentration of water vapor in the troposphere and increases surface warming by 1.6 or 60%

What is the human CO_2 contribution



If human CO2 emissions rather than outgassing of CO2 from the oceans dominated the atmospheric CO2 content, a drop in human emissions of 4 Gt would have dropped atmospheric ppm from 415 ppm to 395 ppm. Clearly there is no visible effect on the plot so that natural atmospheric changes dominate human changes in emissions to the point human emissions seem to have no visible effect.

Future forcing from CH_4 & CO_2

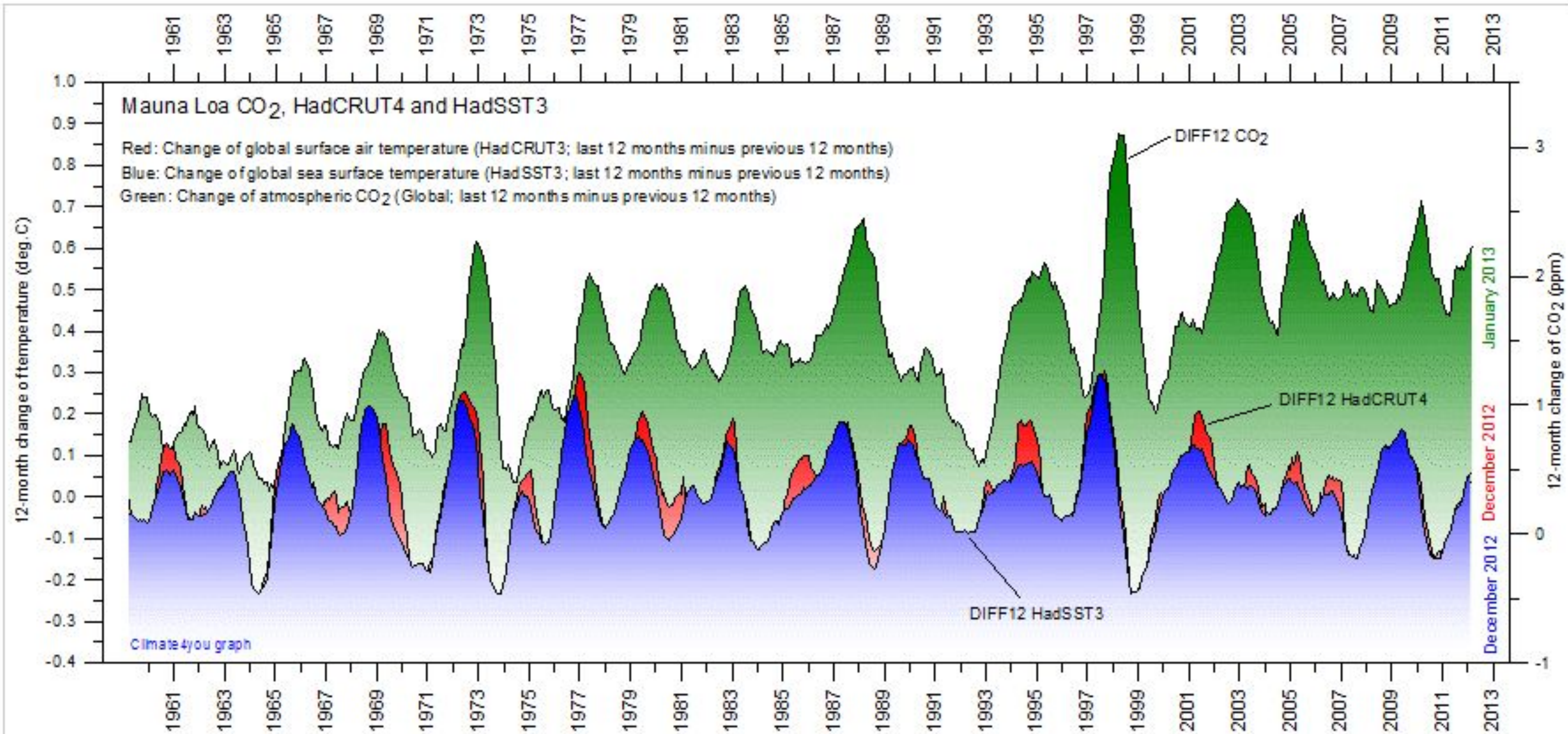
- Methane and CO_2 levels may slowly increase over the next 100 years (or they may not)

- Doubling for CH_4 may take 250 years or more and doubling for CO_2 may take 150 years more or less (probably depends on natural warming and cooling cycles)

- Doubling of CH_4 would only increase forcing by 0.8 w/m^2 while doubling of CO_2 would only increase forcing by 2.2 w/m^2

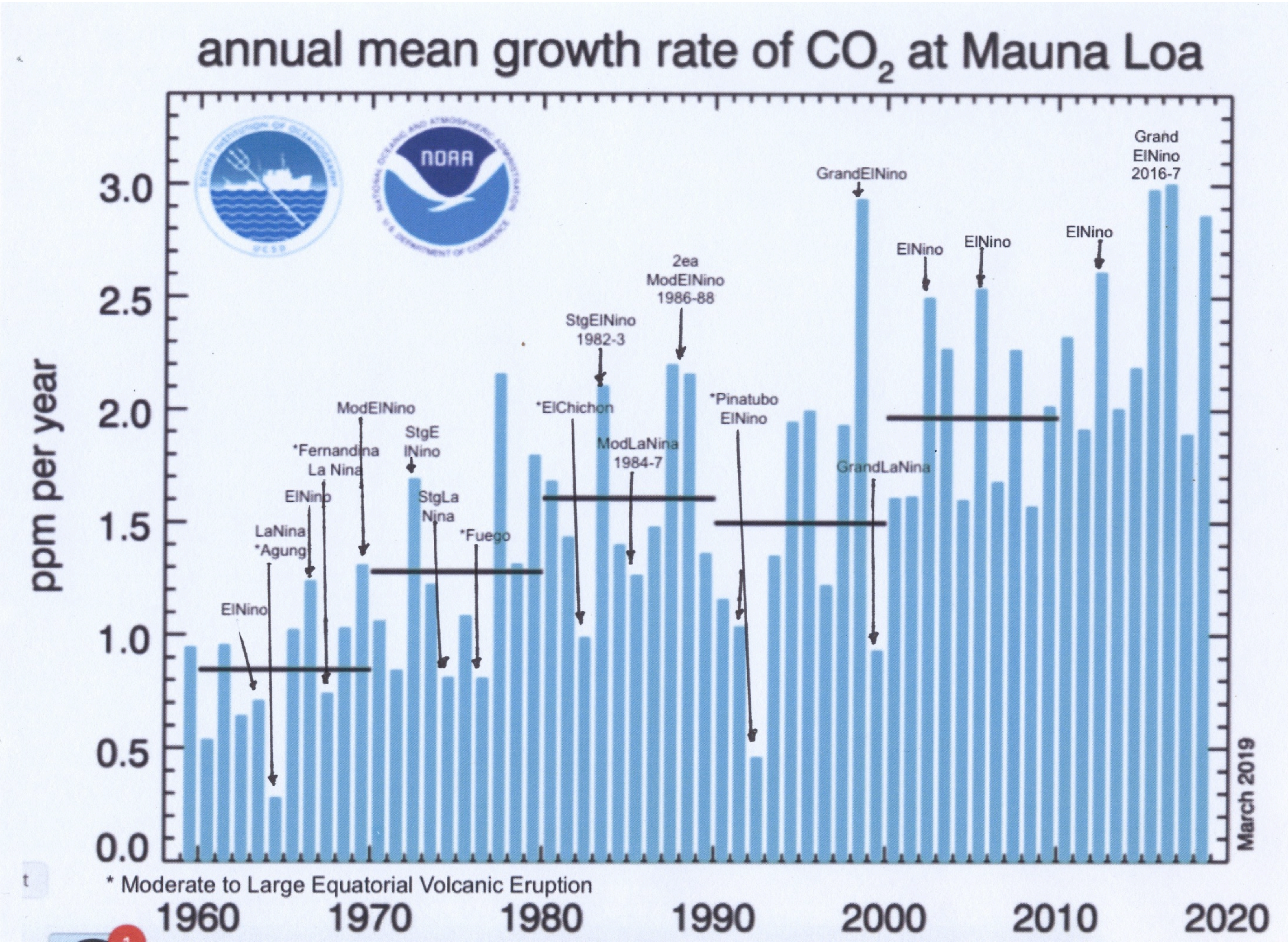
- Density of CO_2 molecules presently is 200 times greater than CH_4 molecules so the absorption bands of CO_2 are much more saturated than those of CH_4 and each new CO_2 molecule causes only 5 times more forcing increase than one of CH_4

What do human emissions have to do with it?



Henry's Law helps us understand that warming of the oceans releases large quantities of CO_2 so that warming increases atmospheric CO_2 rather than CO_2 causing warming

Natural Warming Drivers of Atmospheric CO_2



Evidence of Nature’s “Hand”

- The previous set of graphics are evidence of a natural influence rather than a man-made influence on warming or cooling temperatures and atmospheric gas levels

- And the influence of atmospheric gases on the climate has been shown to be there in the past but to not be of much future consequence even at foreseeable rates of change expected in the next 100 years

- Prediction beyond 50 years even for technology innovation is very difficult, while nature in terms of 100 years is still a complete mystery

- Only recently have we begun to learn about limited elements of natural warming and cooling cycles that have a strong influence on the climate

180 YEARS OF ATMOSPHERIC CO2 GAS ANALYSIS BY CHEMICAL METHODS
by
Ernst-Georg Beck

Note: It is well known that chemical sampling methods of this period produced values that were too low (estimated to be 20 ppm)

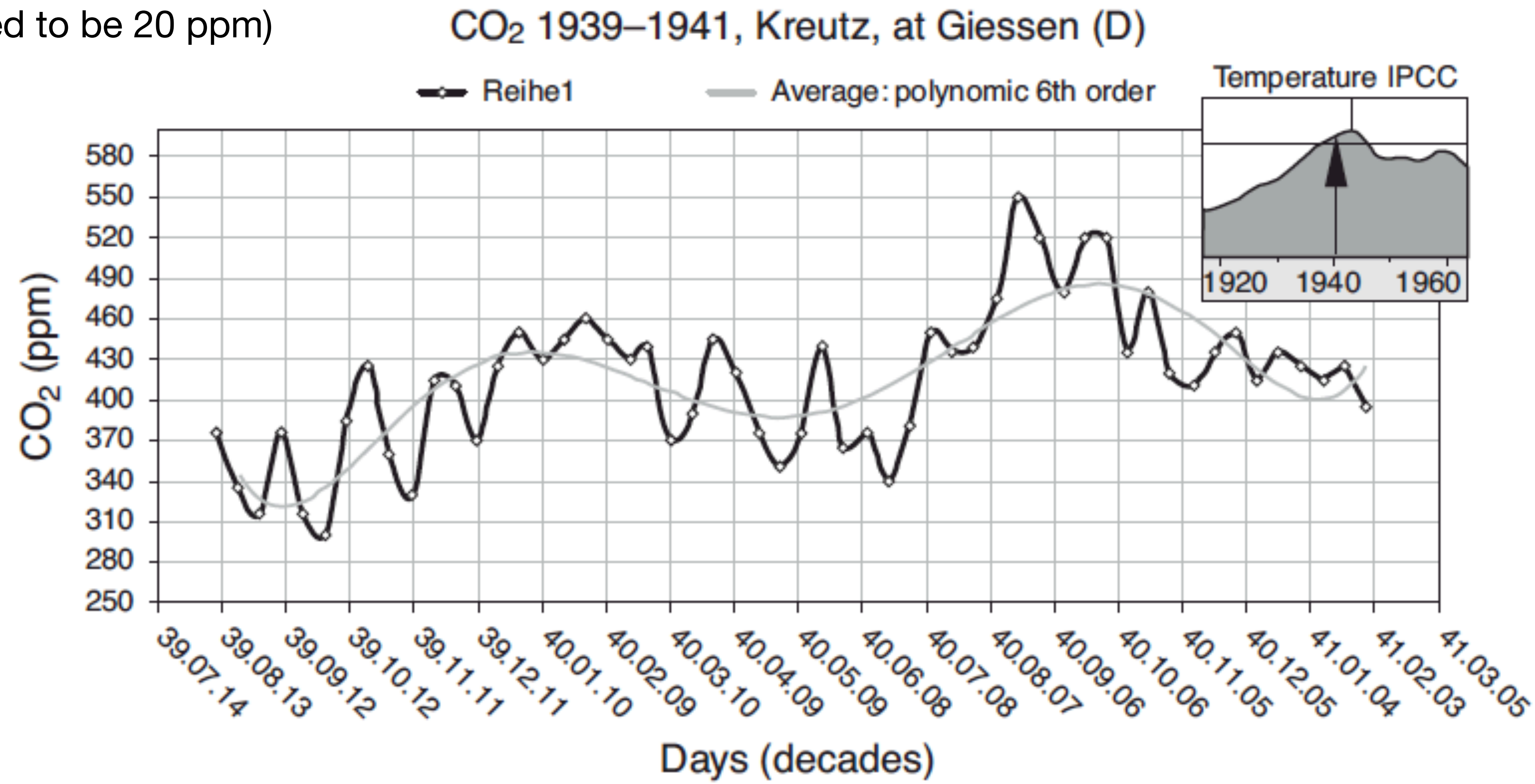
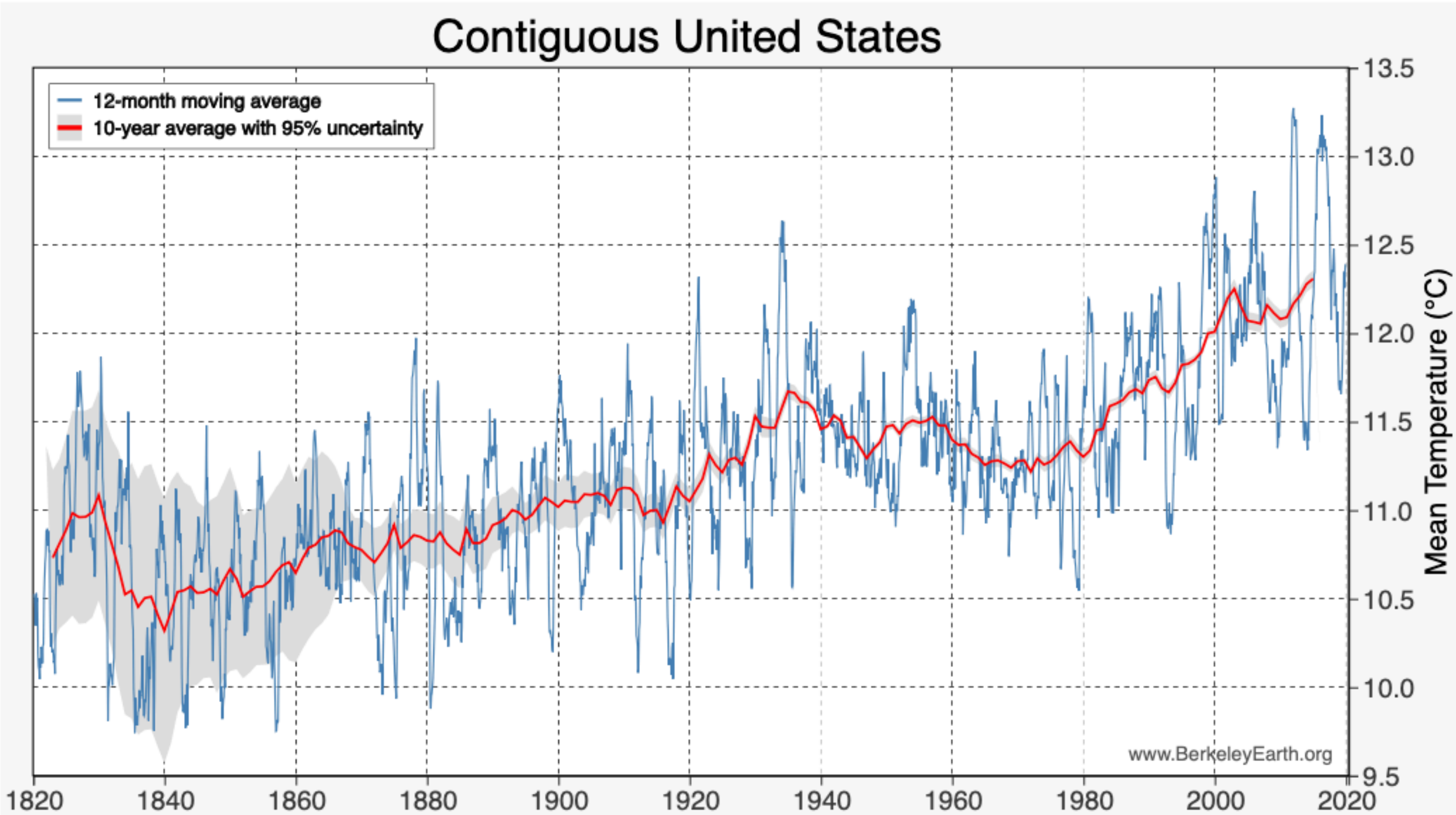
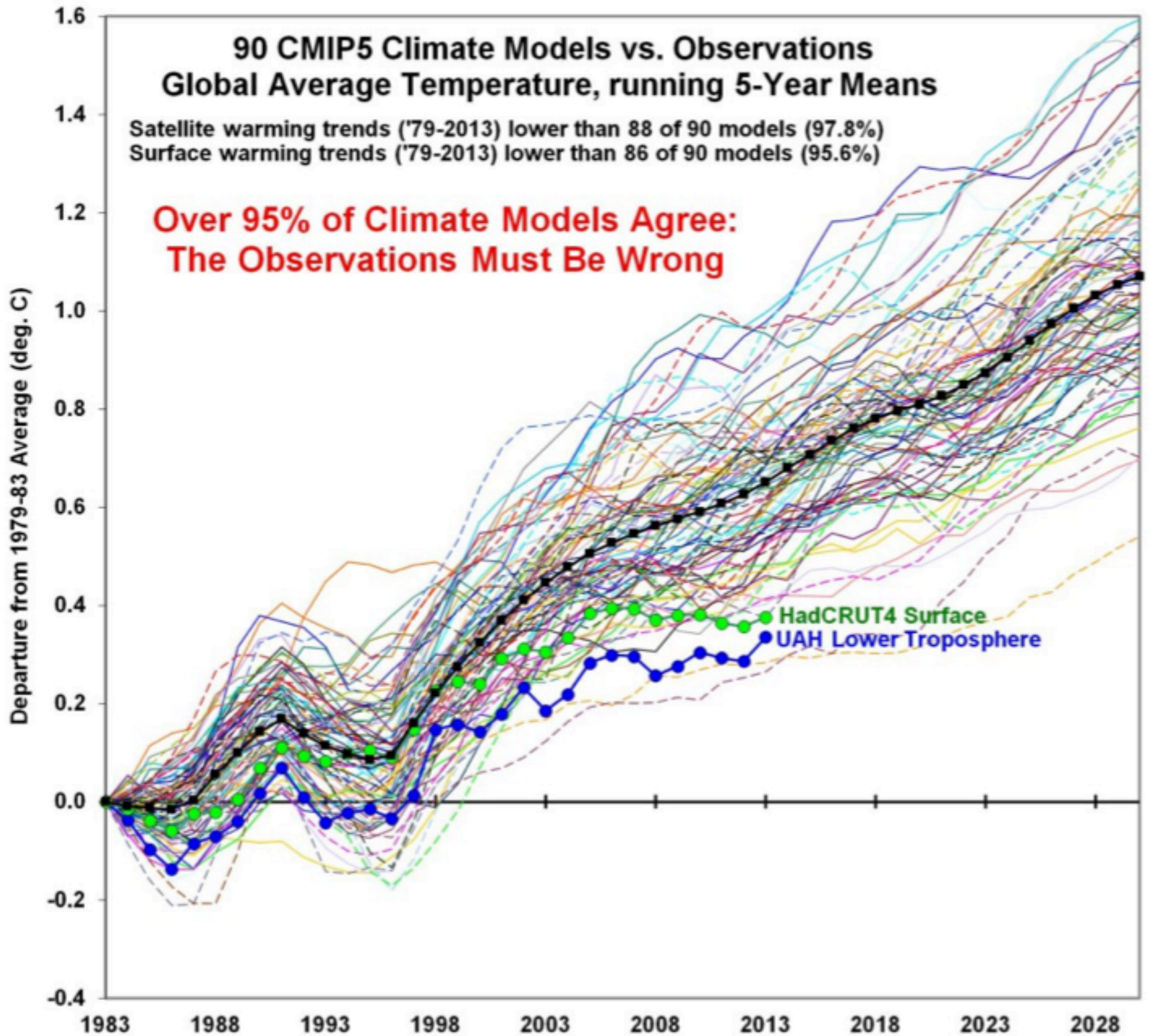


Figure 5: CO_2 concentrations in 2 m sampling height (0; 0,5;14 m available) at the meteorological station near Gießen (Germany) 1939/41 [38] also showing monthly cycling. Sampling and analysing time per value: some minutes; gas analyser in room with constant temperature; location: several 100 m far from buildings in periphery of the city of Giessen, well ventilated; average: 438.5 ppm; very cold winter 1939/40; summer 1940: probably regional influence detectable.



Contiguous United States
12-month moving average
10-year average with 95% uncertainty
Mean Temperature (°C)
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
www.BerkeleyEarth.org

One More Look at Models vs. Observations



https://thebestschools.org/special/karoly-happer-dialogue-global-warming/happer-major-statement/

Software (Model) Independent Verification and Validation

- In one of my earlier lives, I managed a group that did software development for several NASA programs (SPARTAN was one)
- Our software groups had to perform IV&V analysis on any "flight" software that was used on any of the flight satellite systems
- It was a very rigorous independent check of flight code and operation by other software developers than the original development team
- The review leader made a formal presentation of the findings where the development team was present and periodically "grilled", questions were aired, agreement was sought and action items were documented

IV & V Resolution

- During the review process specific bad code was flagged and some validation issues were brought up for resolution
- Any action items that could not be resolved between the developers and the reviewers were kicked up the chain for further discussion and resolution
- An added effort to resolve the action items and the special problems resulted in another final formal presentation
- Everything was documented in preliminary and final reports that were then submitted to NASA
- I have not noticed even a hint that any of these models or the software running them have had much V&V much less IV&V

“It is absolutely essential that this sort of open review and resolution be completed before any further expense or discussion relative to these models occurs”

–Bernard M McCune