Methane
the Irrelevant GreenHouse Gas

ICSF and CLINTEL presentation

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Essential Clarification

• Methane (CH$_4$) DOES meet the definition of a GHG

• However, it is *irrelevant* because of:
  • the physical properties of the *real* atmosphere
  • The numerical realities of infrared absorption
  • The amount and type of radiation emitted from the surface

• It is urgent that this reality becomes widely known
  • Otherwise, money is poured down the drain
Outline: Two Parts

1. Review achievements of van Wijngaarden & Happer
   particularly regarding CH$_4$ and N$_2$O
   They Got it Right -- agrees with data
   Their method is valid
   Their projections are trustworthy

2. Explain why *Global Warming Potential* numbers are useless
   oversimplified concept
   applied incorrectly

**Bottom Line:** tighter regulations are pointless and unnecessary
Acknowledgements

The science reported here is based on the accomplishments of William van Wijngaarden & Will Happer & co-workers.

I’m just the chronicler.

But as a member of the CO$_2$ Coalition, I’m proud to proclaim the significance of their work.

And I hope this will lead to government policy revisions.
Will Happer’s presentation of June 2021
several graphs that you saw last year

Wm. Van Wijngaarden & Will Happer on greenhouse gases:
They used the HITRAN data base to calculate the intensities of
spectral lines across the infrared

Their model atmosphere was *real*

  Included H$_2$O
  Not the “US Standard atmosphere” which contains no H$_2$O
  remember: a laboratory gas is NOT the real atmosphere!
  That is an enduring flaw in all the IPCC calculations

They “Got It Right”
  Exceptionally good quantitative agreement with satellite observations
What is “Forcing”?  

Term “Forcing” refers to radiation that carries energy.  

Customary unit is Watts per square meter.  

340 W/m² reaches earth from sun constantly (+ 3 %).  

Earth responds:  

100 W/m² reflected back into space (30%). \( \alpha = 0.3 \)  

239 W/m² enter earth’s atmosphere or surface  

Several mechanisms of energy transfer and disposal  

239 W/m² emitted back out into space  

Forcing is pertinent to greenhouse calculations.
Radiation Input and Output

EARTH'S ENERGY BUDGET

Incoming solar energy 100%

- Reflected by atmosphere 6%
- Reflected by clouds 20%
- Reflected from earth's surface 4%
- Radiated to space from clouds and atmosphere 64%
- Absorbed by atmosphere 16%
- Absorbed by clouds 3%
- Conduction and rising air 7%
- Carried to clouds and atmosphere by latent heat in water vapor 23%
- Absorbed by land and oceans 51%

Reflected
6% + 20% + 4% = 30%

Radiated to Space
64% + 6% = 70%
GHG Properties, Per-Molecule

• From a paper by van Wijngaarden & Happer in 2019:

Also calculated are per-molecule forcings in a hypothetical, *optically thin* atmosphere, where there is *negligible saturation* of the absorption bands, or *interference* of one type of greenhouse gas with others. For an optically thin atmosphere, the per-molecule forcings at the tropopause are largest for CO$_2$, with lesser but *comparable* forcings by O$_3$, H$_2$O, N$_2$O and CH$_4$. 
“saturation” of a spectrum

- Molecular energy levels include vibrational and rotational energy
- A molecular spectrum contains thousands of lines
- Center of the band absorbs/emits most intensely
- As density increases, the “wings” of the band participate
- Progression of active states grows logarithmically
- Absorption curve falls off exponentially
CO$_2$ saturation curve

As carbon dioxide increases it has less warming effect.

Temperature change from the addition of 20ppm CO$_2$. Most of carbon's warming effect comes in the first 20ppm.

* Assumes a climate sensitivity of 0.15°C/W/m$^2$ following Lindzen and Choi, 2009.
The GreenHouse Effect

• Earth emits BlackBody radiation (smooth curve)
  • Determined by surface temperature
• Atmosphere absorbs and emits *some* radiation
• This slows down the planet’s cooling (radiation to space)
  • Surface is warmer than if there were no atmosphere
• Net radiation escaping is *lower than* the BlackBody emission
• Total area between the two curves is the Greenhouse effect
Early data – theory comparison
Guam, 1970, with $T_{\text{surface}} \sim 295$ K
• Calculations were done for the *real* atmosphere
• All five GHGs were present at once
  • Real concentrations used
  • NOT the per-molecule case
  • H₂O and CO₂ were in a state of “saturation”
• H₂O is the dominant GHG (no surprise)
• CO₂ is secondary, but finite (~ 25%)
• O₃ matters in the stratosphere
• CH₄ and N₂O vanish in importance
van Wijngaarden & Happer calculations

**satellite measurements**

a) Sahara Model

b) Sahara Observations

c) Mediterranean Model
d) Mediterranean Observations

e) Antarctica Model

f) Antarctica Observations

Stunning agreement with measurements
Major Accomplishment

• THIS is the correct use of the Scientific Method:
• Because the agreement is so good between their calculations and actual measurements,
• At last we have a computational method that is trustworthy!
• Consequently, we can now conduct numerical experiments with CO₂ doubled, halved, etc.
• We do not have to rely upon artificially constructed numbers like “Global Warming Potential”
Numerical experiment: $\text{CO}_2$ comparison

\[ i = \text{CO}_2 \]

\[ \pi \tilde{B}(\nu, T_0) \]

\[ f = 0 \]

\[ f = 1 \]

\[ f = 2 \]
Effect of adding increments of CO$_2$

Flux $\tilde{Z}$ (mW cm$^{-2}$ m$^{-2}$)

Frequency $\nu$ (cm$^{-1}$)

- CO$_2$ = 0 ppm
- CO$_2$ = 50 ppm
- CO$_2$ = 100 ppm
- CO$_2$ = 200 ppm
- CO$_2$ = 400 ppm
- CO$_2$ = 800 ppm

Gases:
- H$_2$O
- CO$_2$
- N$_2$O
- CH$_4$
- O$_3$
- H$_2$O
- N$_2$O
- CO$_2$
Effect of adding increments of CO$_2$
CO$_2$ saturation curve

As carbon dioxide increases it has less warming effect.

Temperature change from the addition of 20ppm CO$_2$.

Most of carbon's warming effect comes in the first 20ppm.

* Assumes a climate sensitivity of 0.15°C/W/m$^2$ following Lindzen and Choi, 2009.
CH4 Comparison

\[ i = \text{CH}_4 \]

\[ \pi \tilde{B}(\nu, T_0) \]

- \( f = 0 \)
- \( f = 1 \)
- \( f = 2 \)

\( \langle \tilde{Z}_i(\nu, z_{\text{mp}}, f) \rangle \) (mW m\(^{-2}\) cm\(^{-1}\))

Frequency \( \nu \) (cm\(^{-1}\))

Species:
- H\(_2\)O
- CO\(_2\)
- CH\(_4\)
- O\(_3\)
- N\(_2\)O
N$_2$O comparison
$N_2O$ comparison

$\pi \tilde{B}(\nu, T_0)$

- $f = 0$
- $f = 1$
- $f = 2$

Frequency $\nu$ (cm$^{-1}$)

- $CO_2$
- $O_3$
- $N_2O$
- $CH_4$
- $H_2$
Results of Numerical Experiments
(What it All Means)

- If \( CO_2 \) were zero, it would make a big difference (about 25%), and the earth would be cooler.
- If \( CO_2 \) were doubled, it would make a very small difference.
- \( CH_4 \) and \( N_2O \) are extremely hard to find on any graph. Clearly, their contribution to the greenhouse effect is trivial.
- Molecules of tiny concentration have even less effect.
  - Example of HFCs, with extremely high GWP numbers.
Scientific Implications

• Agreement between theory and experiment is the hallmark of good science.
• The method of van Wijngaarden & Happer meets that criterion.
• It is far superior to the GCM results featured in IPCC reports, which always predict too high Temperatures.

  More CO₂ makes only a tiny difference.

  More N₂O or CH₄ is tinier still, far less than CO₂’s effect.
Policy Implications

Acknowledge that “They Got it Right.”
Accept the results of van Wijngaarden & Happer, instead of words in IPCC Summary-for-Policymakers

There is NO climate emergency!

Greenhouse gases can’t stop the ever-changing climate
Therefore:
• Do not take expensive actions to mitigate climate change
• Do not strive to reduce CO$_2$ or other GreenHouse Gases
How did we get into today’s situation?

- A “Summary for Policy-Makers” is written by diplomats, *NOT* scientists!
- Busy people only read the highlights of the summary
- Real science gets buried very deep inside
- IPCC reports are lengthy and detailed
  - Working Group 1 examines the science
  - Working Group 2 asks what will happen
  - Working Group 3 asks what should be done about it.
- If WG1 said “no problem,” WG2 & WG3 would be out of business
  - Prestige, money, and momentum all reject that possibility.
IPCC’s fundamental errors (1)

• Real air vs. Dry air
  • The “standard atmosphere” doesn’t exist in the real world
  • It is a laboratory gas, made by artificial means
    • It’s easy to do calculations about dry air
  • Real air always contains some H$_2$O
    • Enough so that saturation of the absorption bands occurs

• H$_2$O is the major greenhouse gas
  • It should be calculated first, not later
    • Nobody ever does “perturbation” calculations that way
IPCC’s fundamental errors (2)

• Feedback mechanism
  • IPCC assumed *positive* feedback
    • Rising T $\rightarrow$ more H2O evap $\rightarrow$ GHGs closer to ground $\rightarrow$ rising T
      - Ref: Manabe’s Nobel Lecture
  • Nature contains *negative* feedback mechanisms
    • LeChatelier’s Principle
  • Feedback amplification misunderstood (Monckton *et al*)
    • Feedback acts on the entire signal, not just the delta
Part 2: Why GWP is Useless

- Computational method is described in AR 4, pp 210 – 214
- Intent is to get a *ratio* of this gas compared to CO$_2$
- The text presents an equation containing a triple integral
  - That intimidates most readers
  - People skim over the pages of verbiage that follows
- Simplifying assumptions immediately follow
  - Because of scant data, complicated functions are set = 1
  - Happer: “fuzzed up with poorly-known forcing times, indirect effects, etc.”
- A lengthy table of GWP values is presented
  - Notably CH$_4$ & N$_2$O, but many more, including Freons.
Three Reasons why CH₄ is Irrelevant
[ same is true for N₂O ]

1. There isn’t very much methane ( < 2 ppm)
   - Compare: CO₂ = 400 ppm and H₂O = `15,000 ppm ±

2. H₂O out-competes CH₄ in the same spectral region
   Collision-broadening of lines creates “overlap” in the troposphere
   Only up in stratosphere do the “comb” of lines miss each other

3. Little energy emitted by earth in CH₄’s absorption band
   Remember: blackbody spectrum for 288 °K peaks at 15 microns
   - less that 20% of peak at 7.5 microns
   - CH₄ absorption band is very narrow

• None of these are taken into account in GWP factor
Global Warming Potential
GWP is the ratio of two slopes

• Compares saturation curve for 2 gases
  • Vertical axis is absorption
  • Horizontal axis is concentration

• Concentration of CO₂ = 385 ppm (in AR 4, 2007)
  • CO₂ absorption is very nearly saturated
  • Curve is very close to flat, and slope is a tiny negative number

• Concentration of CH₄ = 1.8 ppm
  • Absorption curve declines steeply at low concentration
  • Slope is a substantial negative number
As carbon dioxide increases it has less warming effect. Temperature change from the addition of 20 ppm CO2.

Most of carbon’s warming effect comes in the first 20 ppm.

* Assumes a climate sensitivity of 0.15°C/W/m² following Lindzen and Choi, 2009.
“Diminutive Denominator” problem

• Q = N / D
• You can’t divide by zero
• When the denominator is close to zero, the quotient will be huge
• For an increase (delta) of only 1 ppm:
  • CO₂ saturation curve changes very little
    • 410 → 411 ppm
    • Near-flat slope hardly changes at all
  • CH₄ saturation curve changes a lot
    • 1.8 → 2.8 ppm
    • Large slope becomes slightly less large
Tiny denominator yields:

- CH$_4$: GWP $\sim$ 28
- N$_2$O: GWP $\sim$ 300
- Freons: GWP $>$ 1000
- Every one of these numbers is *meaningless*
- The actual spectrum (vW & H) shows the reality
Famous Last Words

• The climate system is a coupled non-linear chaotic system, and therefore the long-term prediction of future exact climate states is not possible.

  -- IPCC, Third Assessment Report

• This needs to be made clear to Elected officials everywhere
Policy Implications

Accept the results of van Wijngaarden & Happer, rather than the IPCC Summary-for-Policymakers OR the faulty contrived GWP values

The trace gases don’t influence the greenhouse effect

There is NO climate emergency

Greenhouse gases can’t halt the ever-changing climate

Therefore:

• Do not take expensive actions to mitigate climate change
• Do not strive to reduce CO₂ or other greenhouse gases
• Do not impose new regulations upon farmers
Questions?