TRCS

An independent, objective assessment of the Anthropogenic Global Warming (AGW) issue

### Harold H. Doiron, Chairman The Right Climate Stuff Research Team www.TheRightClimateStuff.com

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### **The Right Climate Stuff Research Team**

- Volunteer group of primarily retired NASA scientists and engineers who are veterans of the Apollo Program.
  - Other non-NASA related researchers and academics have joined our team
- The group formed in February 2012 as an independent, objective, research team of volunteers with no funding
  - INITIAL GOAL: Determine the extent to which burning fossil fuels can cause harmful global warming

### **The Right Climate Stuff Research Team**

- We aren't climate scientists per se
- We do have education, training, and experience in the same scientific disciplines that climate scientists use
- We have **expertise in identifying** and **solving Problems** from **exploring** the **unknowns** of **manned space flight** 
  - > We **define Problems** in terms of a **deviation from "normal"**
  - To be able to determine root cause of defined Problems
    - We specify Problems in terms of What?, Where? When? and How Much? has the process deviated from a normal range
    - We seek data on the "Is Not" answers to the same questions
    - **o** Important data for root cause within "IS" and "IS NOT" answers

### **Study Results: The Bottom Line**

#### **CONCLUSIONS:**

- Mainstream climate science computer models have overestimated climate sensitivity to Greenhouse Gases (GHG)
- Due to world-wide rising energy demand and rising fossil fuel prices, as proven reserves are consumed,
  - A market-driven transition to alternative fuels will be required before any climate problems can occur
  - Climate alarm has caused irrational energy-related Federal Government Policy Decisions
  - A free market with minimal Federal Government intervention will ensure future US energy independence and security

### **Extent of Global Warming From GHG**

#### **Extent of GHG Warming Is Dependent on Two Main Factors:**

- Sensitivity of Earth Surface Temperature to atmospheric Greenhouse Gas (GHG) and aerosol concentrations
  - $\circ$  GHG = CO<sub>2</sub>, Methane (CH4), N<sub>2</sub>O, Ozone, Halocarbons
  - $\circ$  CO<sub>2</sub> is the primary GHG, all others and aerosols contribute about 50% of the warming effect of CO<sub>2</sub>
  - Naturally occurring water vapor is a much more important GHG affecting Earth Surface Temperature
- Future trajectory vs. time of GHG and aerosol concentrations in our atmosphere; known as a

**• Representative Concentration Pathway (RCP)** 

### **Earth Surface Temperature Sensitivity to GHG**

#### **Climate Scientists Study Two GHG Sensitivity Metrics:**

#### **>**Transient Climate Response (TCR)

- Surface temperature increase caused by doubling atmospheric CO2 concentration at a rate of 1 percent per year
- $\circ$  CO2 concentration doubles in 70 years
- It will actually take about 230 years to double the 1850 CO2 concentration of about 285 ppm

#### ≻Equilibrium Climate Sensitivity (ECS)

- Surface temperature increase that will eventually occur at equilibrium after CO2 concentration is suddenly doubled
- $\circ$  It would take more than 1000 years for this hypothetical equilibrium state to be achieved

### **TRCS Assessment of GHG Warming Extent**

#### We defined and determined:

#### > Transient Climate Sensitivity (TCS)

• Amount of Global Mean Surface Temperature (GMST) increase that will occur by doubling atmospheric CO2 concentration in the way it is actually happening

#### - TCS is a quantity that can be verified by physical data!

 $\circ$  We determined TCS(1+ $\beta$ ) < 1.8 deg C or deg Kelvin (K)

- $\circ$   $\beta$  is an uncertain constant, with value about 0.5, and accounts for warming effects of GHG other than CO2 and the highly uncertain cooling/warming effects of atmosphere aerosol concentrations.
- $\circ~$  If  $\beta$  = 0.5, then TCS < 1.2C

**>** Future trajectory of CO2, other GHG and aerosol concentrations

• From burning all currently known world-wide reserves of coal, oil and natural gas by 2100. Reference Concentration Pathway (RCP) = RCP6.2

# **Report to Trump Transition Team at EPA**

RECOMMENDATIONS TO THE TRUMP TRANSITION TEAM INVESTIGATING ACTIONS TO TAKE AT THE ENVIRONMENTAL PROTECTION AGENCY (EPA)

A Report of The Right Climate Stuff Research Team

www.therightclimatestuff.com

Harold H. Doiron, Chairman

November 30, 2016

Houston, Texas

### **The Northern Hemisphere**

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Photo from John Kehr's Book: <u>The Inconvenient Skeptic</u> Earth has 71% ocean coverage total, but NH and SH markedly different



<u>Northern Hemisphere</u> (<u>NH)</u> has 41% land coverage

North Pole is ocean covered with ice and surrounded by land

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### **The Southern Hemisphere**

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<u>Southern Hemisphere only</u> has 19% land coverage – much of that is the Antarctica land mass covered with ice and always below freezing, 0°C

<u>Southern Hemisphere</u> responds much differently to its seasons than the NH because of its 81% ocean coverage

### **Key Historical Data from Greenland**



### GISP2 ICE CORE DATA

Ref: Alley, R.B.. 2004. GISP2 Ice Core Temperature and Accumulation Data. IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series #2004-013. NOAA/NGDC Paleoclimatology Program, Boulder CO, USA.

# **Proper Problem Specification**

• Problem Definition

A PROBLEM must be defined in terms of a HARMFUL DEVIATION from NORMAL, expected behavior

○ SPECIFICS: What?, Where?, When?, How Much?, Is, Is Not
➢ GISP2 Ice Core Data: PROBLEM? WHAT PROBLEM?





### **CO2 TRENDS IN ATMOSPHERE**



### **CO2 Level In Atmosphere**

![](_page_14_Figure_1.jpeg)

### **How Does Atm. CO2 Warm the Earth?**

![](_page_15_Figure_1.jpeg)

### **Un-Validated Climate Models Predict Future Global Warming Problems**

![](_page_16_Figure_1.jpeg)

# Earth Surface Energy Balance $s = 341.3 \text{ W/m}^2$ $e\sigma T^4 = 238.5$

 $e(W, C, G)\sigma T^4 = (1 - a)S - Q$ 

Q = 0.9

#### **Negligible Contributors**

- Incoming radiation from stars other than our Sun
- Heat rising from Earth's molten core
- Heat generation processes on the Earth's surface
  - Forest fires, decaying organic matter, burning fuels

 Use calculus to form a differential of the Earth Surface Power Balance Equation to evaluate effects of changes in variables

 $d\{e(W, C, G)\sigma T^4\} = d\{(1 - a)S - Q\}$ 

 $[(\frac{\partial e}{\partial W}\frac{\partial W}{\partial C} + \frac{\partial e}{\partial C})dC + (\frac{\partial e}{\partial W}\frac{\partial W}{\partial G} + \frac{\partial e}{\partial G})dG]\sigma T^{4} + 4e(W,C,G)\sigma T^{3}dT = (1-a)dS - Sda - dQ$  $\sigma = 5.67(10)^{-8} W/m^{2}/K^{4} \qquad e\sigma T^{4} = 238.5 W/m^{2}$ For T = 288K and e = 238.5/( $\sigma T^{4}$ ) = 0.611, 4e $\sigma T^{3}$  = 1/0.302

 $dT = [0.302]{- [changes in e(W, C, G)] \sigma T^4 + (1-a)dS - Sda - dQ }$ 

[changes in e(W, C, G)]σT<sup>4</sup> are called Radiative Forcing from GHG including water vapor (W) feedback effects

Radiative Forcing changes from rising atm. CO2 concentration relative to the 284.7 ppm concentration in 1850 can be modeled as:

$$\left[\frac{\partial e}{\partial C}dC(\text{year})\right]\sigma T^4 = 3.71\{\text{LOG}[C(\text{year})/284.7]/\text{LOG}[2]\} \text{ W/m}^2$$

Radiative Forcing changes from other GHG and aerosol concentration rise in atmosphere relative to 1850 can be modeled as a fraction,  $\beta$ , of CO2 radiative forcing

 $\left[\frac{\partial e}{\partial G}dG(\text{year})\right]\sigma T^{4} = (\beta)3.71\{\text{LOG}[C(\text{year})/284.7]/\text{LOG}[2]\} \text{ W/m}^{2}$ 

Radiative Force changes due to water vapor feedback effects can be modeled as a fraction, w, of CO2 and other GHG forcing

 $\left[\left(\frac{\partial e}{\partial W}\frac{\partial W}{\partial C}\right)dC + \left(\frac{\partial e}{\partial W}\frac{\partial W}{\partial G}\right)dG\right]\sigma T^{4} = w(1+\beta)(3.71)LOG[C(year)/284.7]/LOG[2]$ 

Other possible temperature feedbacks from GHG radiative forcing can also be expressed as a fraction, f, of GHG radiative forcing

Other radiative force feedbacks =  $f(1+\beta)(3.71)LOG[C(year)/284.7]/LOG[2]$ 

Using our expressions for radiative force changes since 1850 due to CO2, other GHG, aerosols and all feedbacks from GHG forcing

 $dT(year) = [0.302]{(1+w+f)(1+\beta)(3.71)LOG[C(year)/284.7]/LOG[2]+(1-a)dS-Sda-dQ}$ 

**Repeating from previous slide:** 

 $dT(year) = [0.302]{(1+w+f)(1+\beta)(3.71)LOG[C(year)/284.7]/LOG[2]+(1-a)dS-Sda-dQ}$ 

The RF for doubling atm. CO2 concentrations from 284.7 ppm in 1850 is 3.71 W/m<sup>2</sup> as computed from IR absorption bands of CO2

3.71{LOG[569.4/284.7]/LOG[2]} = 3.71 W/m<sup>2</sup>

Using our definition for TCS as temperature rise including all feedbacks from doubling atm. CO2,

TCS = [0.302](1+w+f)3.71 deg K

Therefore substituting with this definition for TCS,  $dT(year) = TCS(1+\beta)LOG[C(year)/284.7]/LOG[2] + 0.302{(1-a)dS - Sda - dQ}$ 

# Ljungqvist Temp Reconstruction

![](_page_22_Figure_1.jpeg)

Year AD

Ljungqvist (2010)

#### **Global Mean Surface Temp Variation Since 1850**

![](_page_23_Figure_1.jpeg)

### **Simple Climate Model Fit To Temp Data**

 $dT(year) = TCS(1+\beta)LOG[C(year)/284.7]/LOG[2] + 0.302\{(1-a)dS - Sda - dQ \}$ 

- dT(year) = HadCRUT4 Temp(Year) (1850 value) = Models $+ (TCS)(1+\beta){Log[CO2(year)/284.7]/Log[2]} (All GHG)$ + 0.021(year - 1850)/155 (Solar, dS) $+ A_LSin[2\pi(Year-1850)/1000 yr.] (da, dQ)$ 
  - +  $A_{s}$ Sin[2 $\pi$ (Year-1990)/64 yr.] (da, dQ)

**TCS**(1+ $\beta$ ) is a constant determined from function fit to temp time history data; Nominal value of  $\beta = 0.5$  used to determine **TCS** 

### **Extracting Most Conservative TCS Value**

#### Determination Of Transient Anthropogenic Climate Sensitivity Metric

![](_page_25_Figure_2.jpeg)

Year

#### **Small Amount of Natural Warming Lowers GHG Sensitivity**

![](_page_26_Figure_1.jpeg)

Year

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### **TRCS Assessment of GHG Warming Extent**

Our method for determining TCS from available physical data is known as an **Observational Method**....

- A growing number of recent peer-reviewed publications using Observational Methods to determine TCS, obtain values very similar to our results.
  - Observational Methods obtain much lower climate sensitivity metrics than unvalidated computer simulation models
  - Examples: Ring et. al. (2012), Otto et. al. (2013), Lewis and Curry (2015) Christy and McNider (2017), Lewis and Curry (2018) and others
- We observe a small, but growing schism within the climate science community regarding the extent to which un-validated models should be used to support public policy decisions

### **TRCS Assessment of GHG Warming Extent**

**Observational Methods, consistent with The Scientific Method, for determining ECS, find that...** 

**ECS** is near or below the IPCC lower estimate of 1.5C

Unjustifiably high ECS values coupled with RCP scenarios that are unconstrained by actual world-wide reserves of fossil fuels, lead to alarming global warming predictions!

Un-validated computer simulation models, preferred by most mainstream climate scientists, have far too much speculation imbedded in them for use in serious decision-making.

We urge technically trained personnel from other fields of science

- $\circ$  To perform their own independent assessment of the AGW threat
- To "weigh-in" on the Climate Science practice of using un-validated models vs. physical data to determine climate sensitivity to GHG and to guide government public policy decisions and high-impact regulations

### **US Gov't Over-Reacted to Climate Concern**

- Potential Problems don't require premature critical decisions with potentially severe adverse consequences
- EPA in the Obama Administration decided it must act to prevent a climate disaster
  - Based its uncertain GMST forecast on un-validated model predictions from United Nation's IPCC reports
  - Developed overly complex, scientifically indefensible Social Cost of Carbon (SCC) metric to justify benefits of CO2 emissions regulations and the Clean Power Plan (CPP)
- Based on recommendations of our research team and many others, President Trump has by EO outlawed use of SCC and backed-off implementing the CPP

## Recommendations

• We propose Transient Climate Sensitivity (TCS) as the appropriate metric to guide regulatory decisions

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> TCS = 1.2 deg K ; TCS(1 +  $\beta$ ) = 1.8K (Effects of all GHG)

- TCS uncertainty << ECS uncertainty << uncertainty in EPA SCC</p>
- AGW forecasts need highly reliable models assessing a reasonable range of GHG emissions scenarios for the future
  - Our simple, rigorously derived, algebraic bounding model provides conservative projections for AGW with slowly rising GHG
  - Models must recognize that the earth's eco-system removes about half of the fossil fuel CO2 emissions each year
  - Low climate sensitivity and reasonable emissions scenarios Threat

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# **BACK-UP CHARTS**

### **The Northern Hemisphere**

Photo from John Kehr's Book: <u>The Inconvenient Skeptic</u> Earth has 71% ocean coverage total, but NH and SH markedly different

![](_page_32_Picture_2.jpeg)

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North Pole is ocean covered with ice and surrounded by land

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### **The Southern Hemisphere**

Photo from John Kehr's Book: <u>The Inconvenient Skeptic</u>

![](_page_33_Picture_2.jpeg)

<u>Southern Hemisphere</u> only has 19% land coverage – much of that is the Antarctica land mass covered with ice and always below freezing, 0°C

Southern Hemisphere responds much differently to its seasons than the NH because of its 81% ocean coverage

### **Extracting Most Conservative TCS Value**

![](_page_34_Figure_1.jpeg)

### **Extracting Less Conservative TCS Value**

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![](_page_35_Figure_2.jpeg)

### Conclusions

- IPCC climate models not sufficiently accurate for use in critical AGW public policy decision-making
- AGW can be bounded using available data

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- Actual climate data forecasts < 1K additional AGW by 2100</p>
- Maximum expected warming should be beneficial; not necessarily harmful
- More CO2 in the atmosphere is definitely beneficial as a powerful plant fertilizer
- Current AGW "pause" should continue for about 20 years
- Economic justification for past EPA and DoE CO2 emissions control regulations were based on un-validated models

## Conclusions

- Equilibrium Climate Sensitivity (ECS) is not an appropriate climate sensitivity metric for regulatory decisions
  - > Currently used by EPA for 300 year forecast of AGW Temps

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- **ECS requires > 1000 years for final ECS temp value to be reached**
- Atmospheric CO2 will increase and then decline as fossil fuel reserves become more difficult to find and expensive to produce
- **Very unlikely** that CO2 in atmosphere will be rising after 2200
- > Need more realistic, verifiable metrics with much less uncertainty
- EPA's use of ECS for regulatory decisions for CO2 emissions needs independent, objective scientific review