

Climate Science & Economics

Medicine Hat Branch APEGA

Ken Gregory, P.Eng.
Friends of Science Society
February 18, 2020.

Ken Gregory, P.Eng.

- Retired professional engineer
- Studied climate science for 13 years
- Webmaster; FriendsOfScience.org
- CliSci Newsletter editor
- Science News, Quarterly newsletters
- YouTube videos >200
- FOSS has very active Facebook page and Twitter

FOSS Climate Event in Calgary

Friends of Science Society 17th Annual Climate Science Event

April 6th, 2020 • 6:00pm - 9:00pm • Red and White Club • McMahon Stadium, Calgary

Freedom of Speech! NO Climate Emergency!



Donna Laframboise

Journalist

Climate Activists
Want Your Freedom



Dr. Roy Spencer

Principal Research Scientist

No Climate Emergency:
10 Reasons

- Buffet Dinner Included
- Free Parking after 6pm
- Easy LRT Accessible



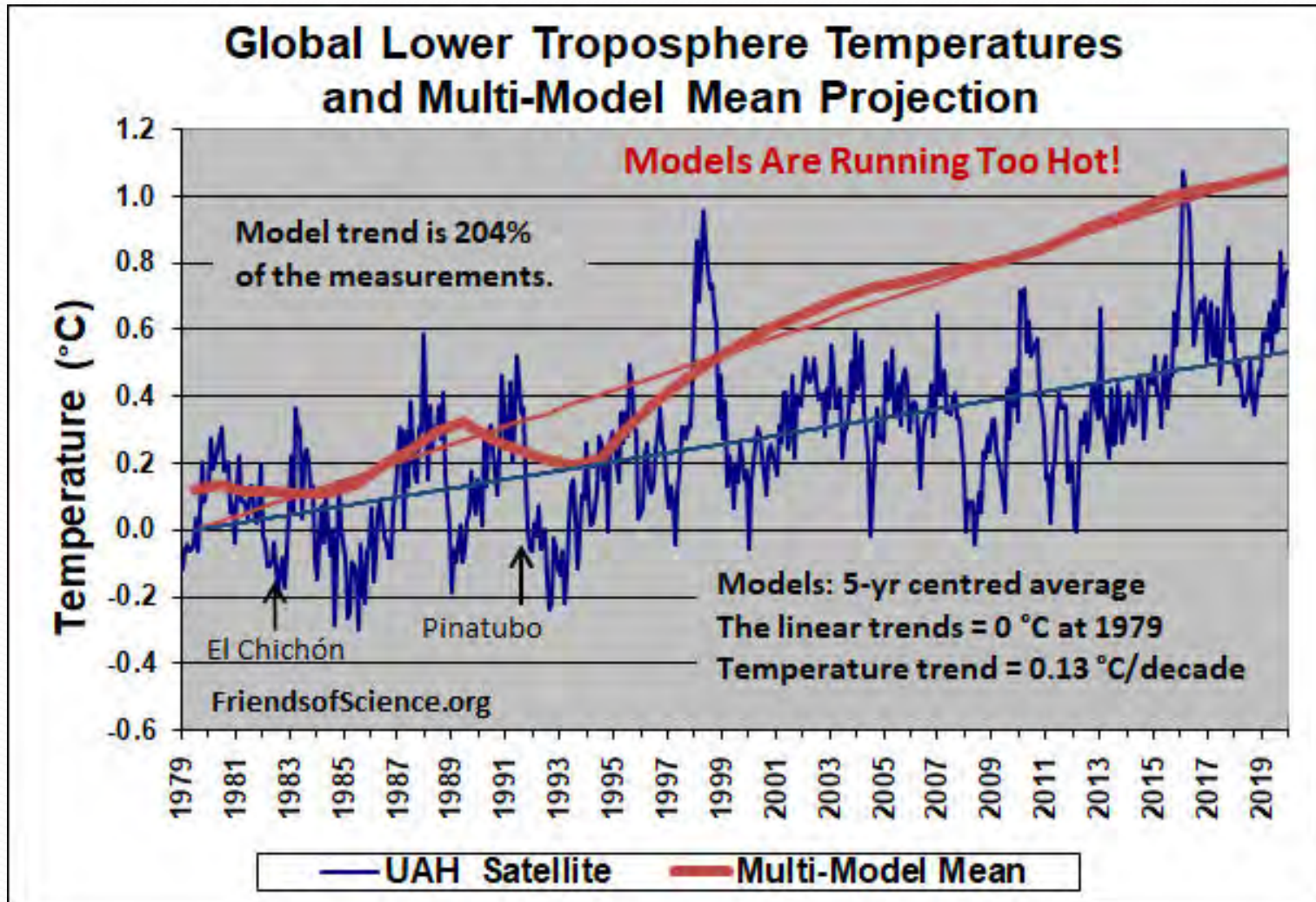
www.friendsofscience.org

Order tickets by **March 27, 2020**

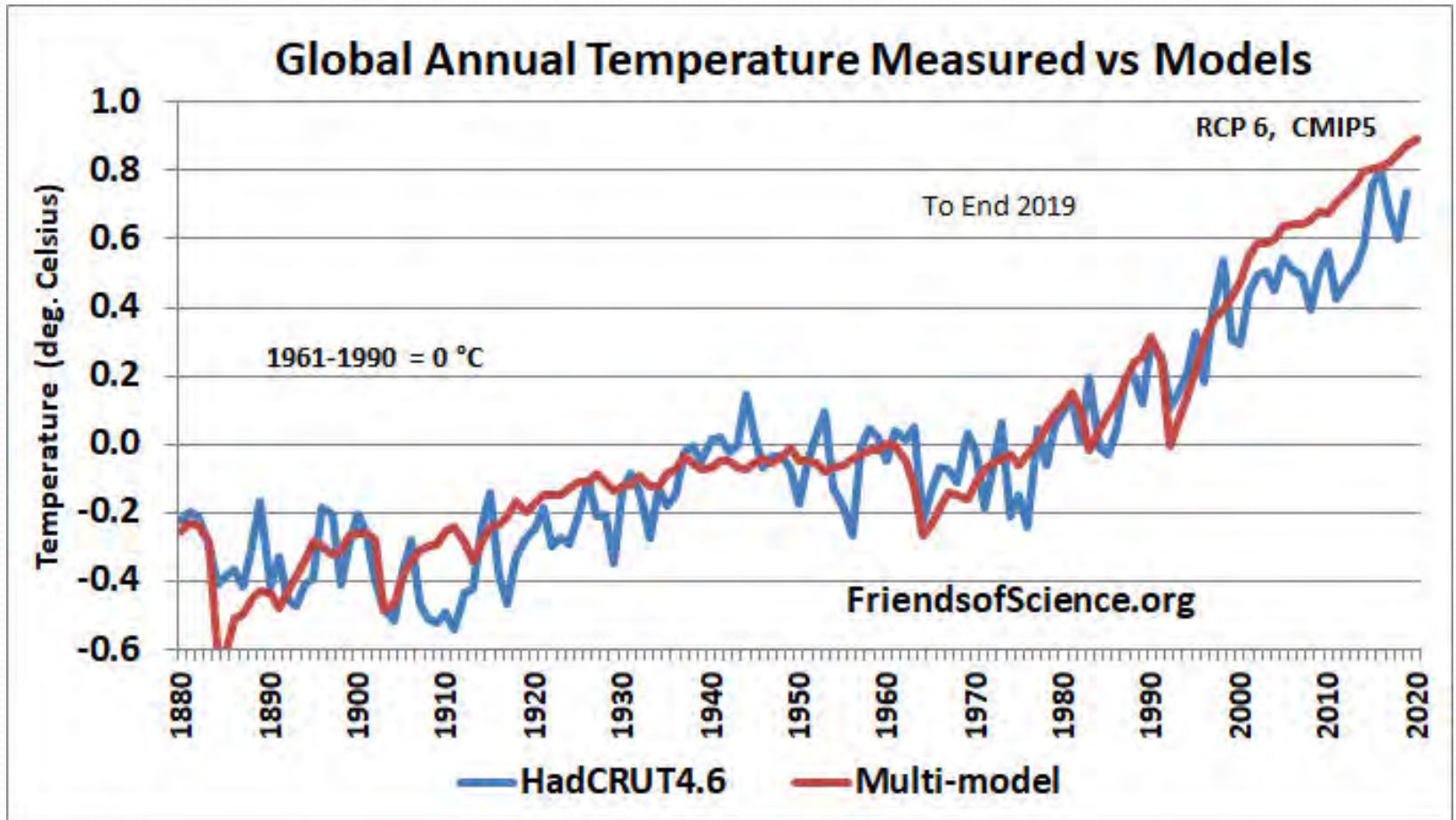
Early Bird Pricing ends **February 29, 2020**

Note: This event is not affiliated with or endorsed by the University of Calgary

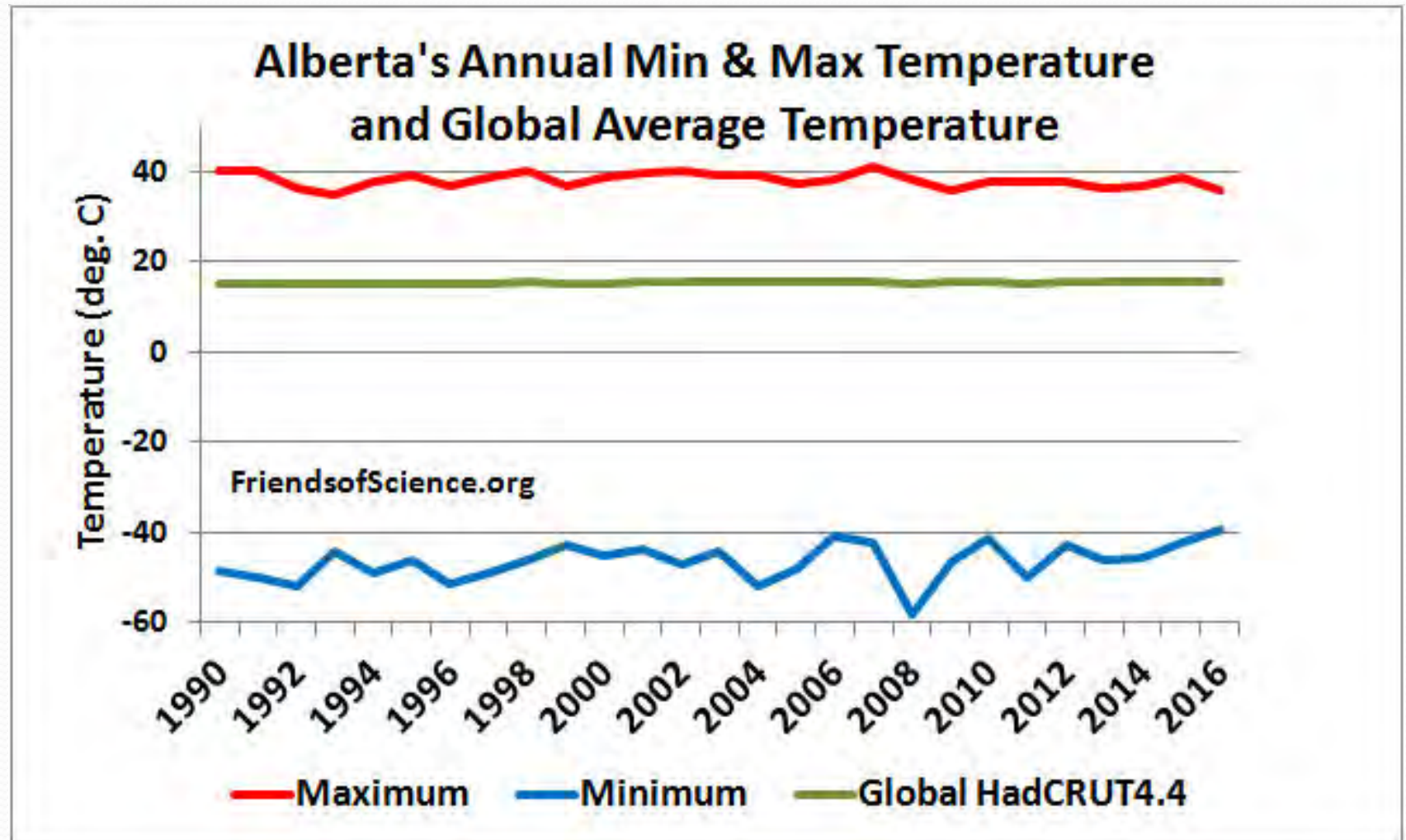
Global Air Temperatures



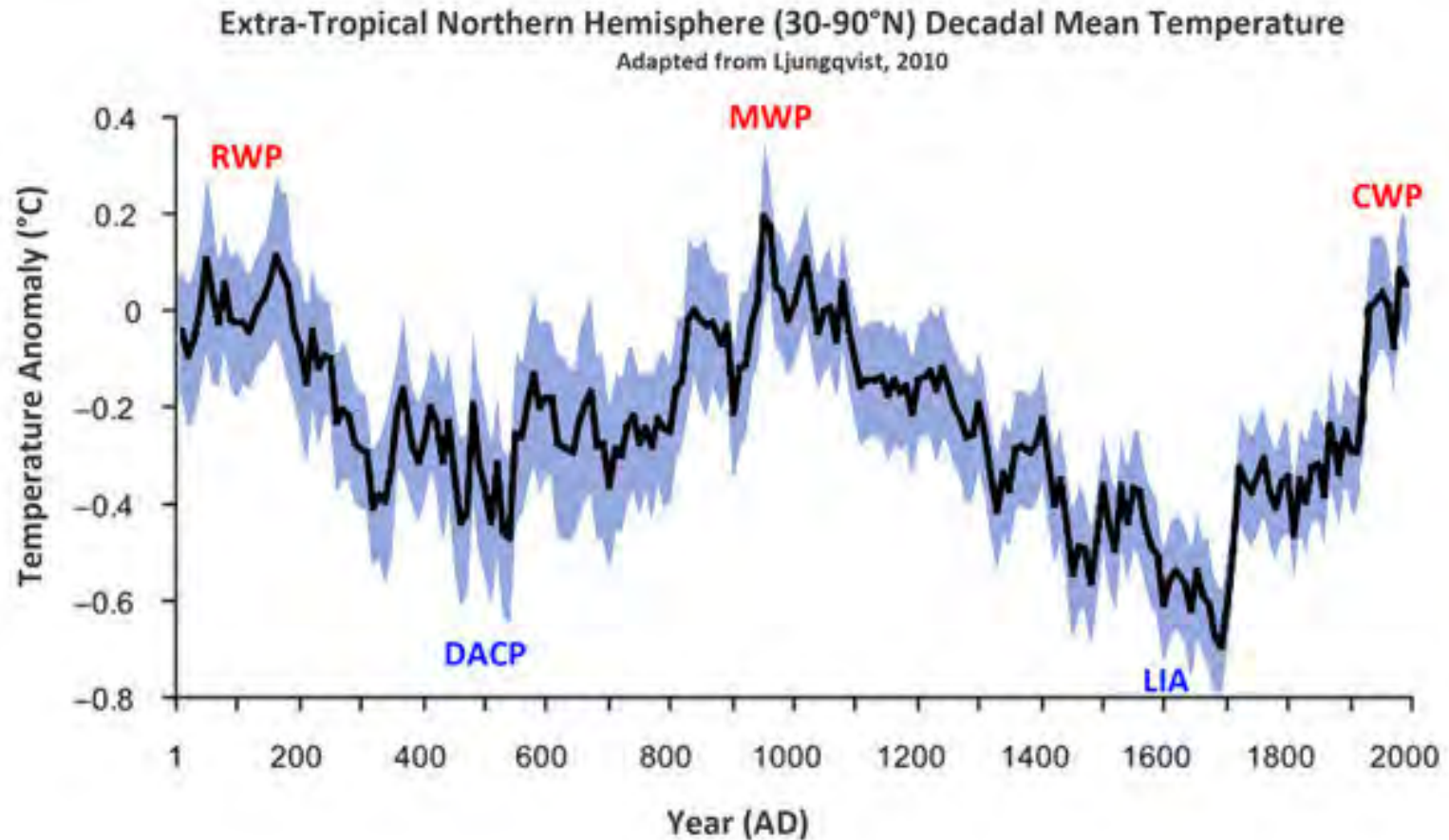
Global Surface Temperatures



Alberta and Global Temperatures



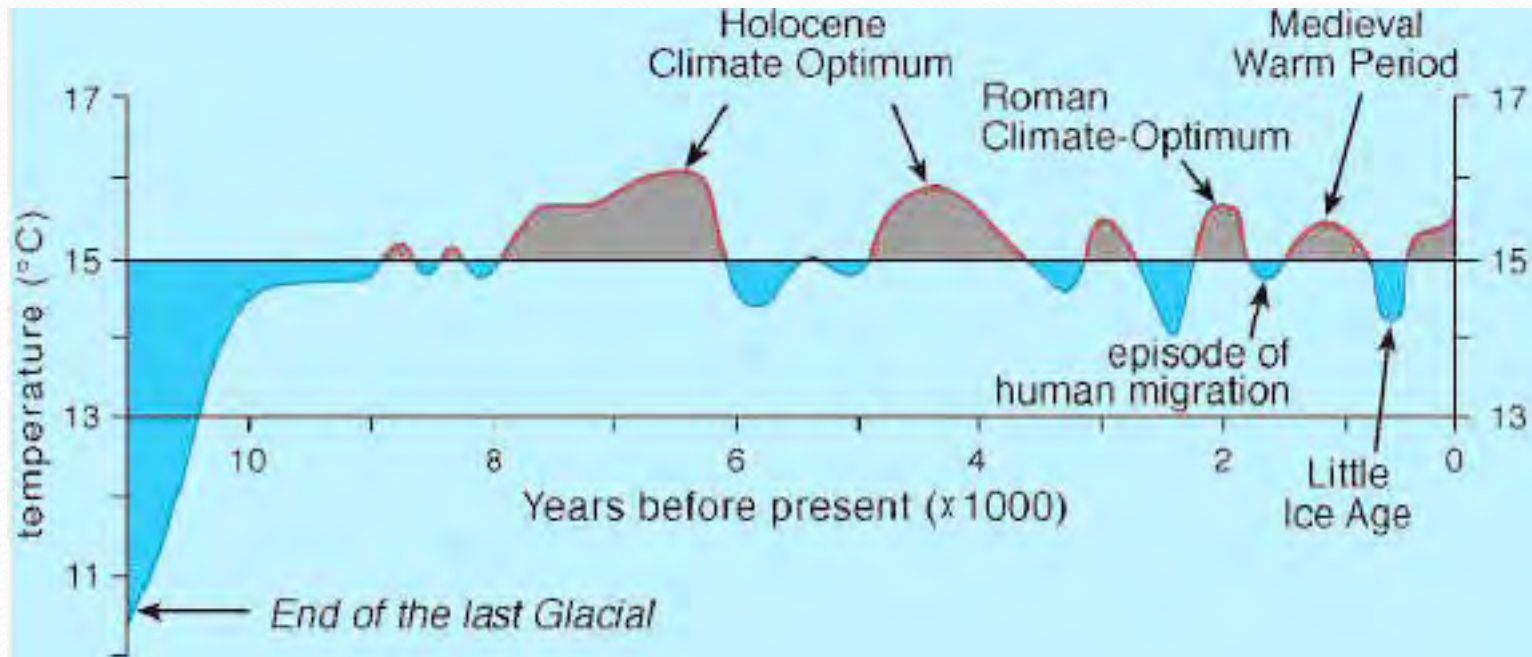
Northern Hemisphere Temperatures



Millennium cycle to 1900: $0.084^{\circ}\text{C}/\text{century}$

Previous Warm & Cold Periods

Climate always changes with no help from Man.



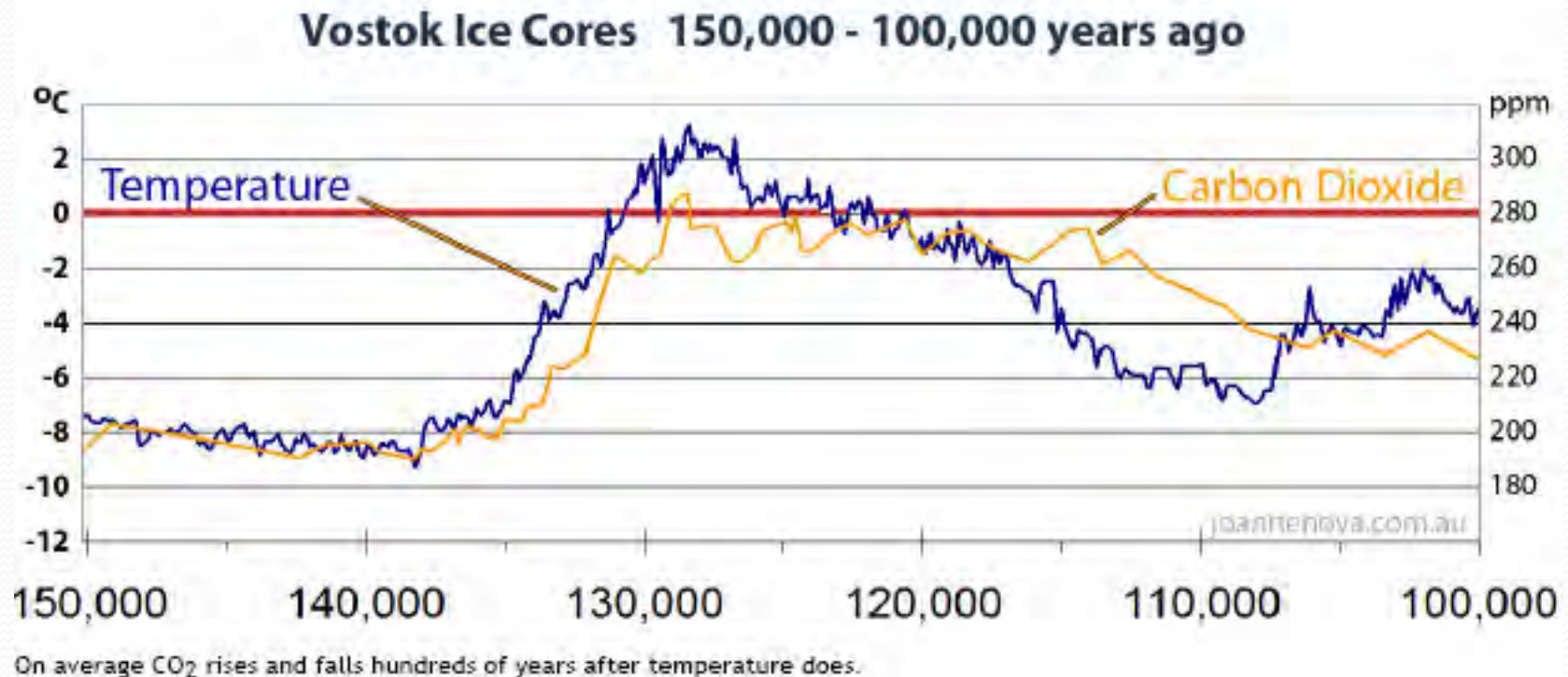
Average near-surface temperatures of the northern hemisphere during the past 11,000 years (after Dansgaard et al., 1969, and Schönwiese, 1995)

Climate Change by CO₂

- The direct effect of double CO₂ is 1.1 °C warming.
- Climate models amplify by feedback, increasing water vapour, decreasing cloud.
- 1% change in water vapour = 5.4% change in CO₂.
- Equilibrium climate sensitivity: 2X CO₂, wait 2000 years.
- Transient climate response: 2X CO₂, near 1%/year

	ECS	TCR
Climate model Ave.	3.2 °C	1.8 °C
Reality	1.0 °C	0.85 °C

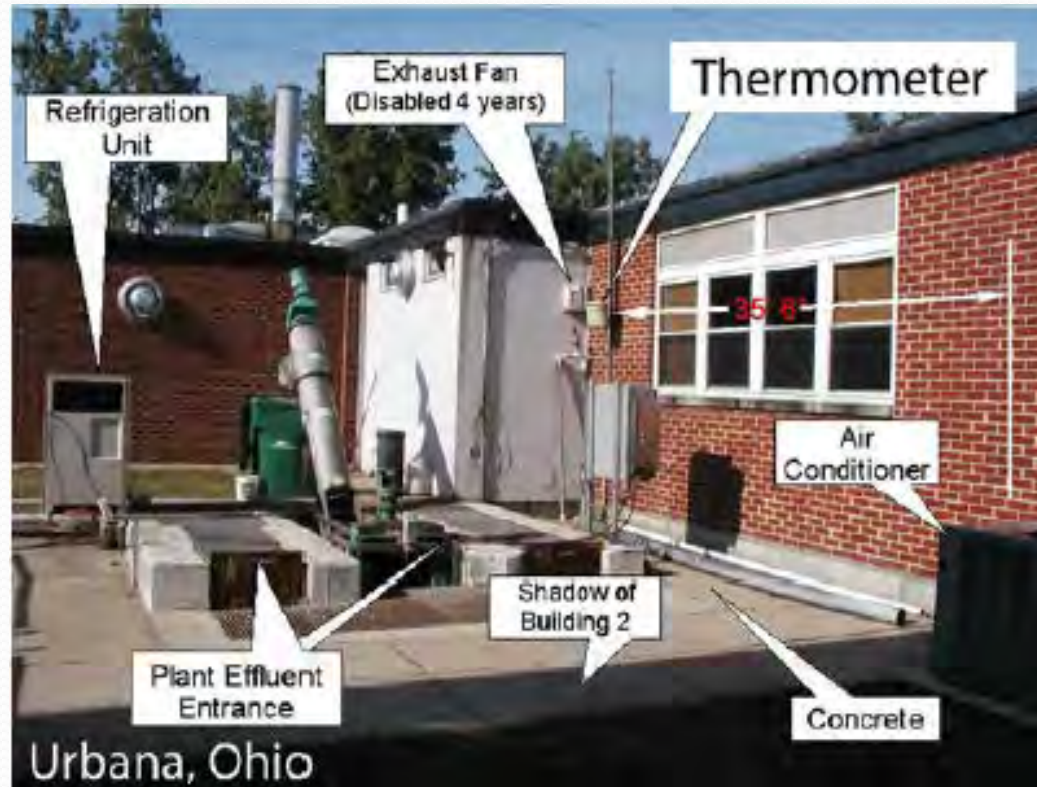
CO₂ Lags Temperature Changes



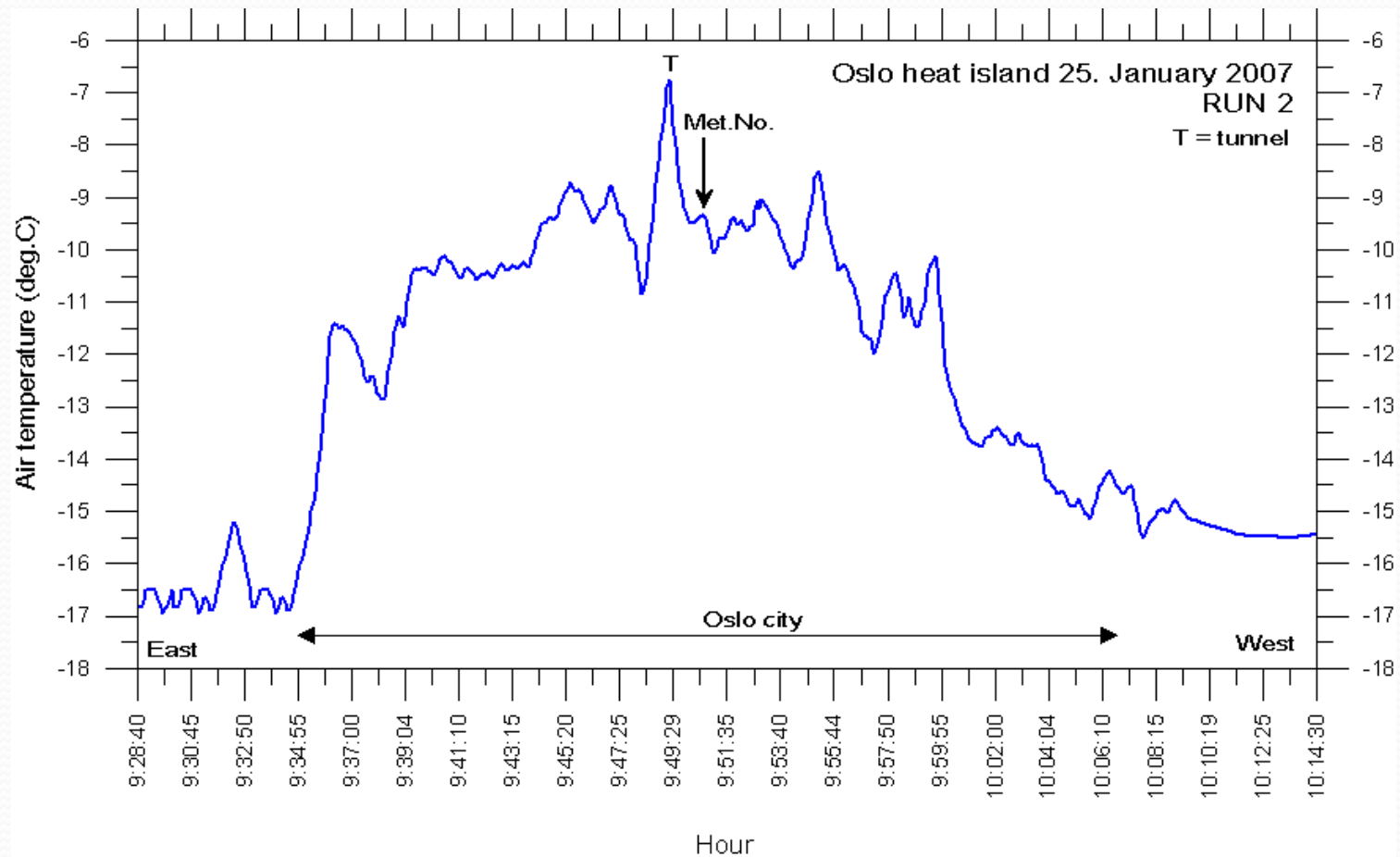
Temperature leads CO₂ changes by about 800 – 1000 years.
CO₂ cannot be a main cause of climate change before 1980.

Urban Heat Island Effect

- In the USA, only 11% of stations are in suitable locations, 69% are within 10 m of an artificial heat source.



Urban Heat Island – Oslo, Norway



59% of US Warming is Bogus

Compliant: $0.204^{\circ}\text{C}/\text{decade}$

Non-compliant: $0.319^{\circ}\text{C}/\text{decade}$

Final Adjusted: $0.324^{\circ}\text{C}/\text{decade}$



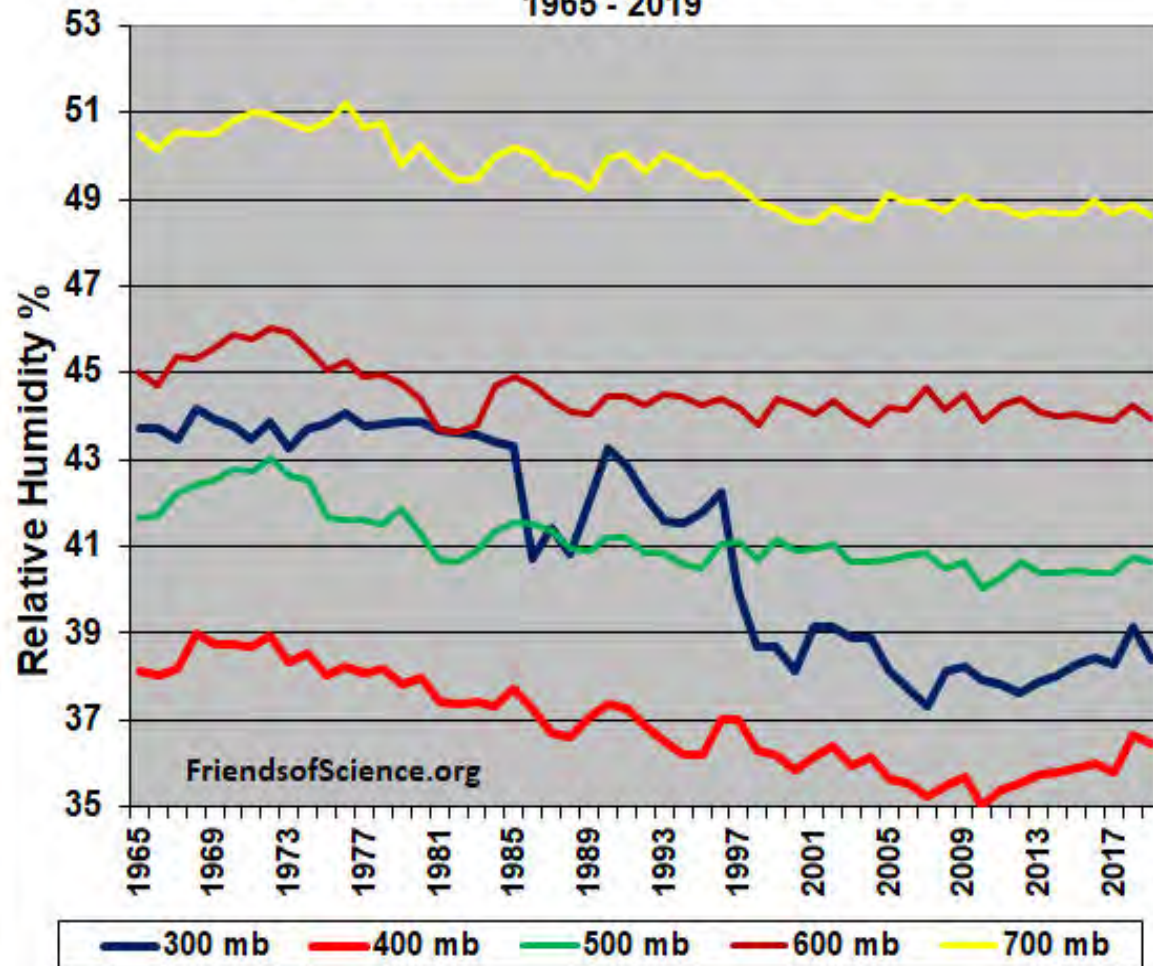


Urban Heat Island Effect

- McKittrick and Michaels 2007: About half of warming over land is due to urban development
- GISS index: 45% of adjustments increase the warming trend
- IPCC Nonsense: “the locations of greatest socioeconomic development are also those that have been most warmed by atmospheric circulation changes.”
- Reduces global trend from 1980 by $0.042^{\circ}\text{C}/\text{decade}$.

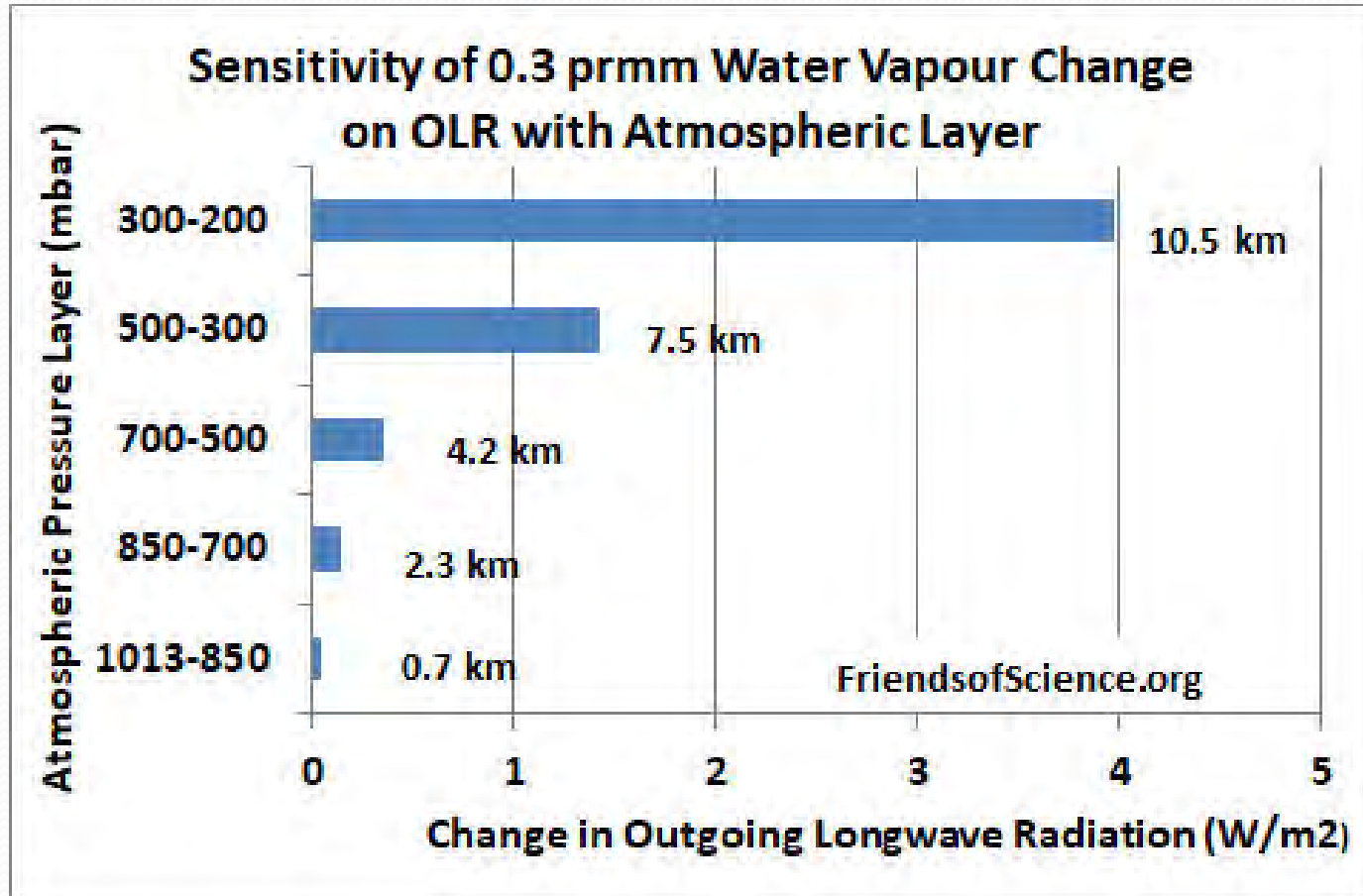
Upper Relative Humidity Declines

Global Relative Humidity 300 - 700 mb
1965 - 2019



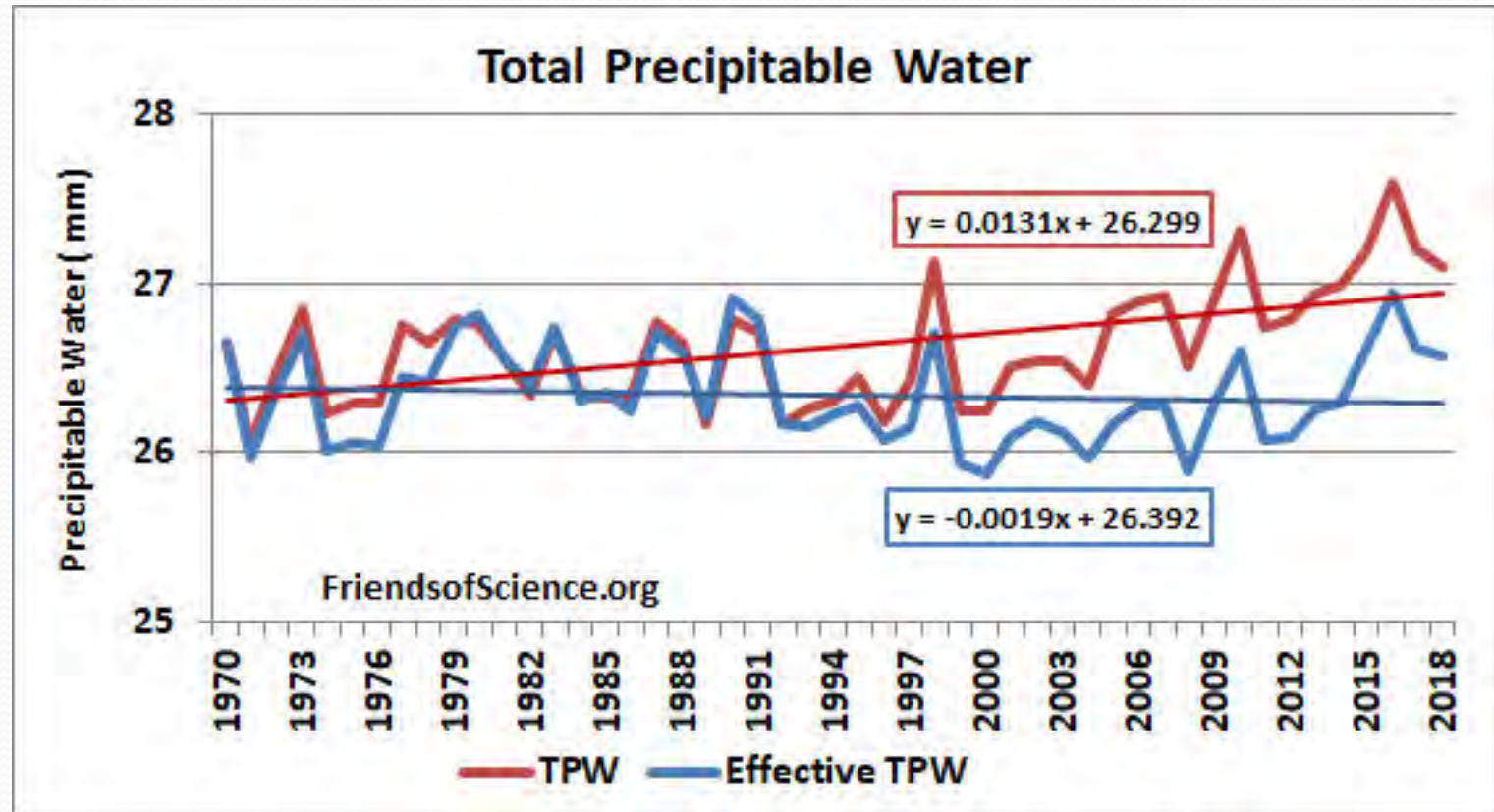
- Climate models all assume relative humidity stays constant.
- Radiosonde data show that upper atmosphere relative humidity declines with warming.
- 300 mbar pressure level is about 9 km altitude.
- The Water vapor effect at 11 km is 81 times that at the surface.

GHG Sensitivity with Altitude



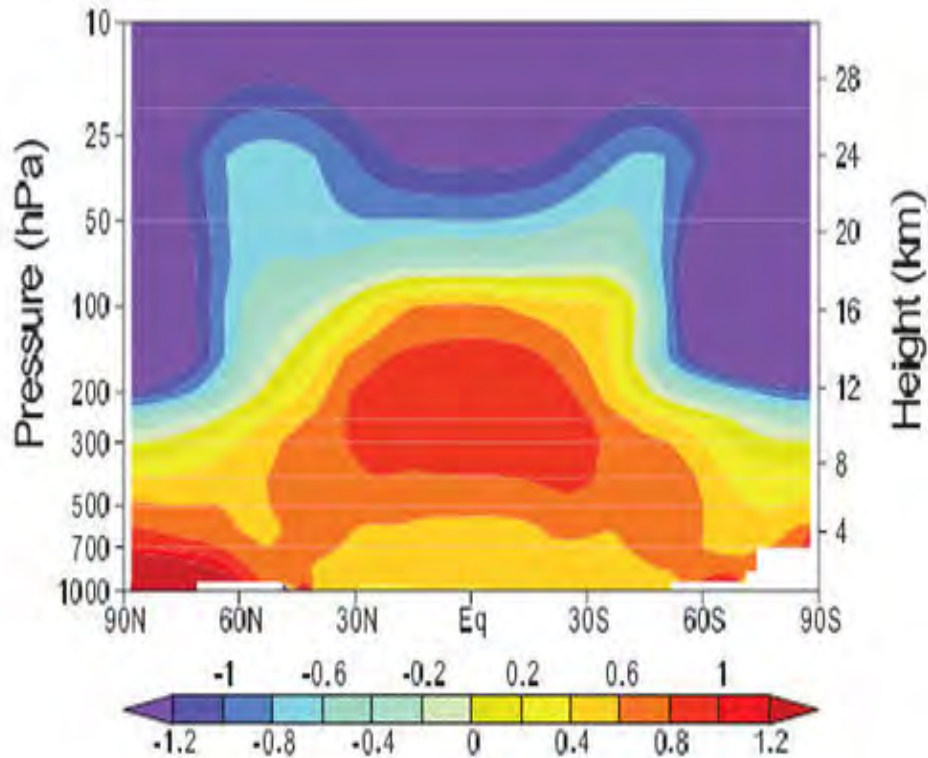
Water vapour change at 11 km altitude has 81 X the greenhouse effect as the same change in the near surface layer.

Effective Water Vapour Declining

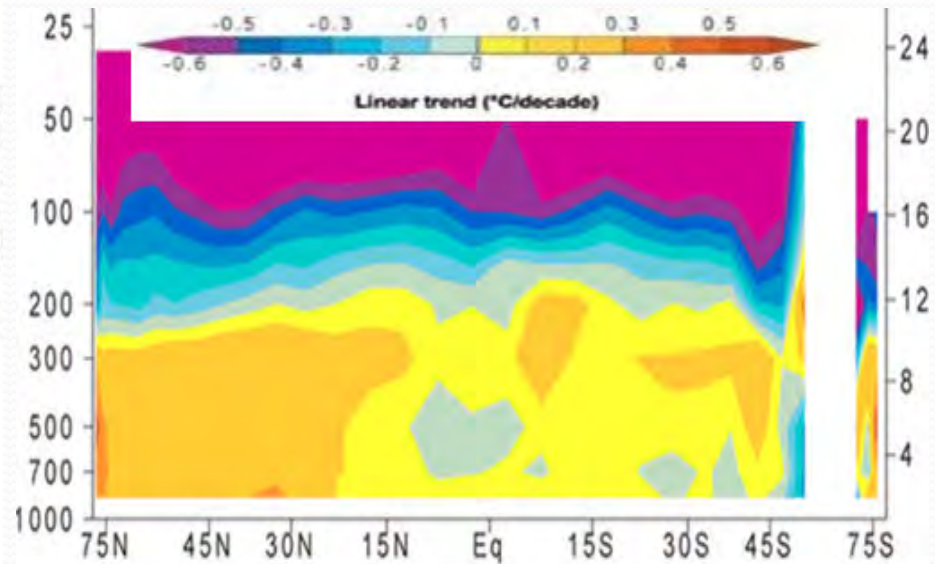


IPCC Theory: GHE of water vapour increases with warming, but the effective total water in the atmosphere is declining.

Missing Upper Atmosphere Hotspot



Model

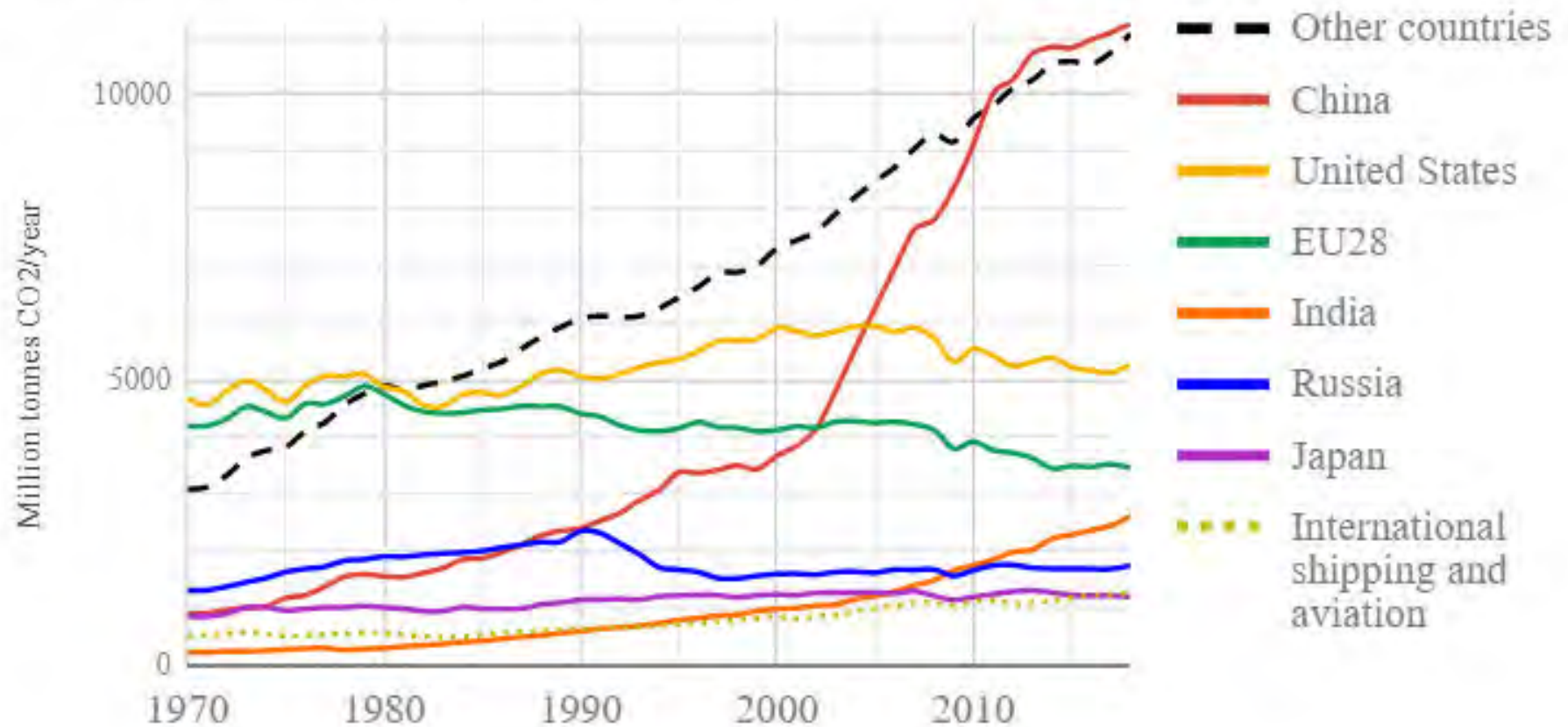


Actual

Models predict an enhanced warming rate over the tropics 8-14 km altitude due to predicted increase in water vapour. The radiosonde and satellite data show no enhanced warming at all.

CO2 emission from FF by Region

World fossil carbon dioxide emission 1970-2018



Transient Climate Response Estimates

	TCR BE	TRC 5-95%
UN IPCC AR ₅	1.8	0.6 – 3.0
Lewis & Curry 2018 Energy Balance	1.20	0.90 – 1.70
With Natural Warming of millennium cycle	1.04	0.75 – 1.55
With Natural Warming & UHIE	0.88	0.60 – 1.40

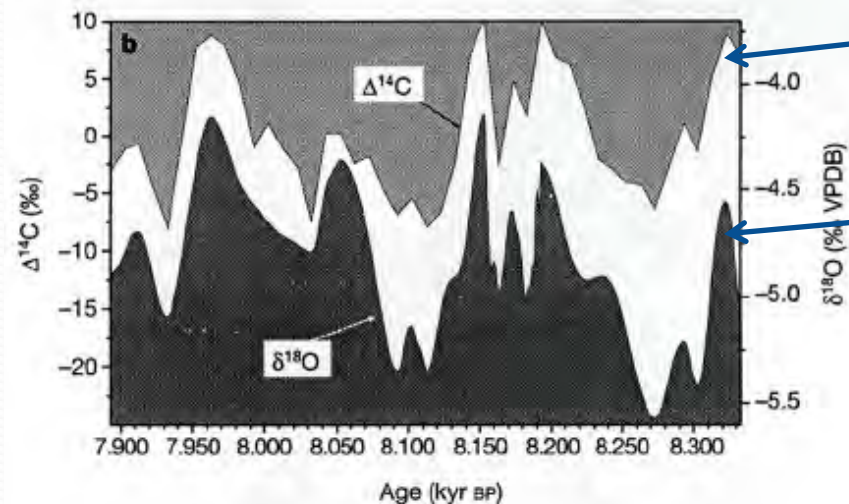
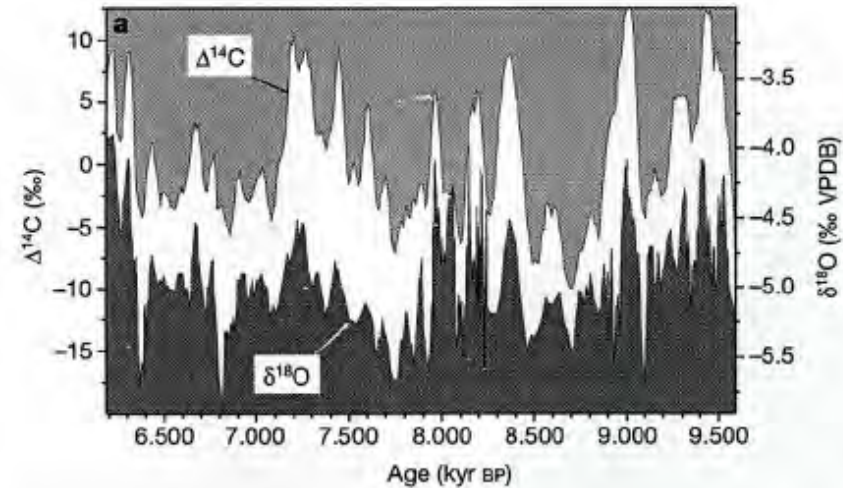
TCR is temperature change due to double CO₂ at that time, about 125 years.

IPCC Best Estimate (BE) of TCR is over 2 times too high!

The Sun and Temperature Proxies

Solar proxy $\Delta^{14}\text{C}$
vs temperature
 $\delta^{18}\text{O}$ over 3000
years.

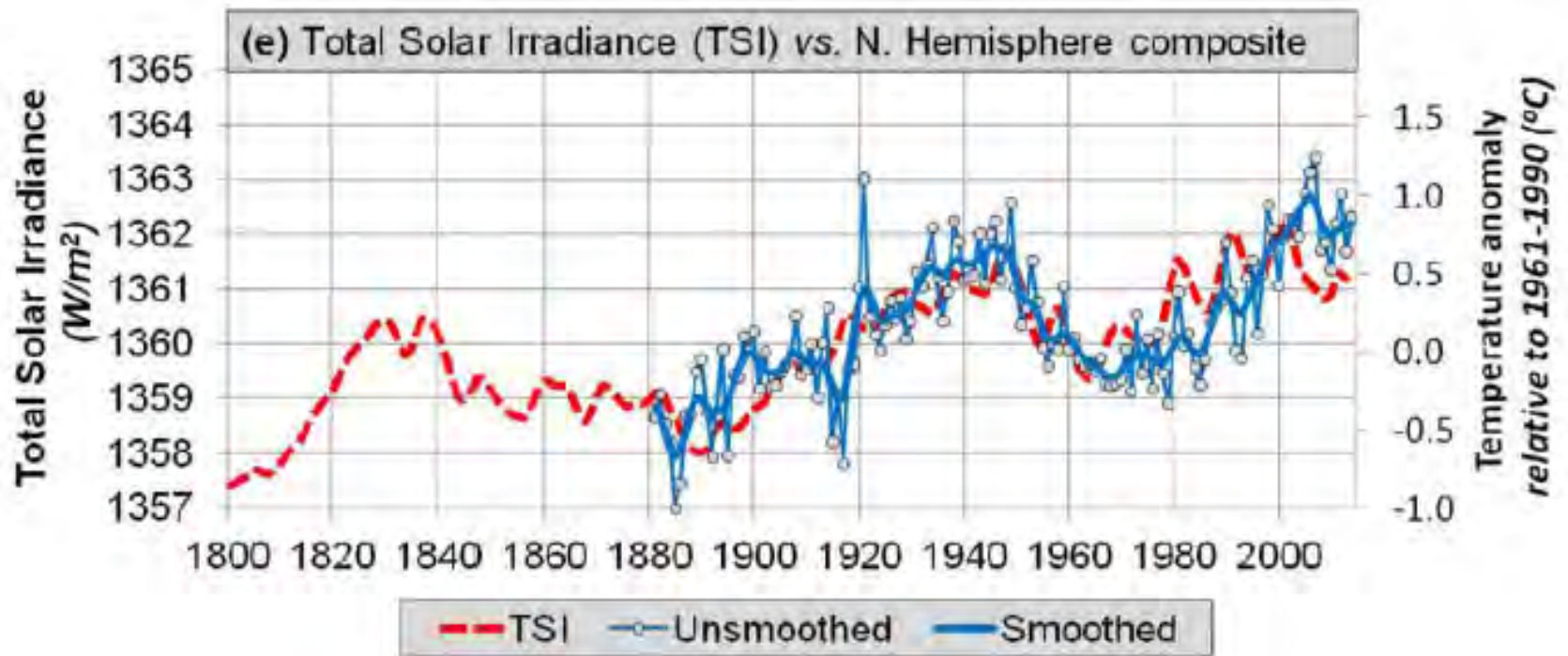
Solar Activity and Climate (as seen by proxies)



The Sun

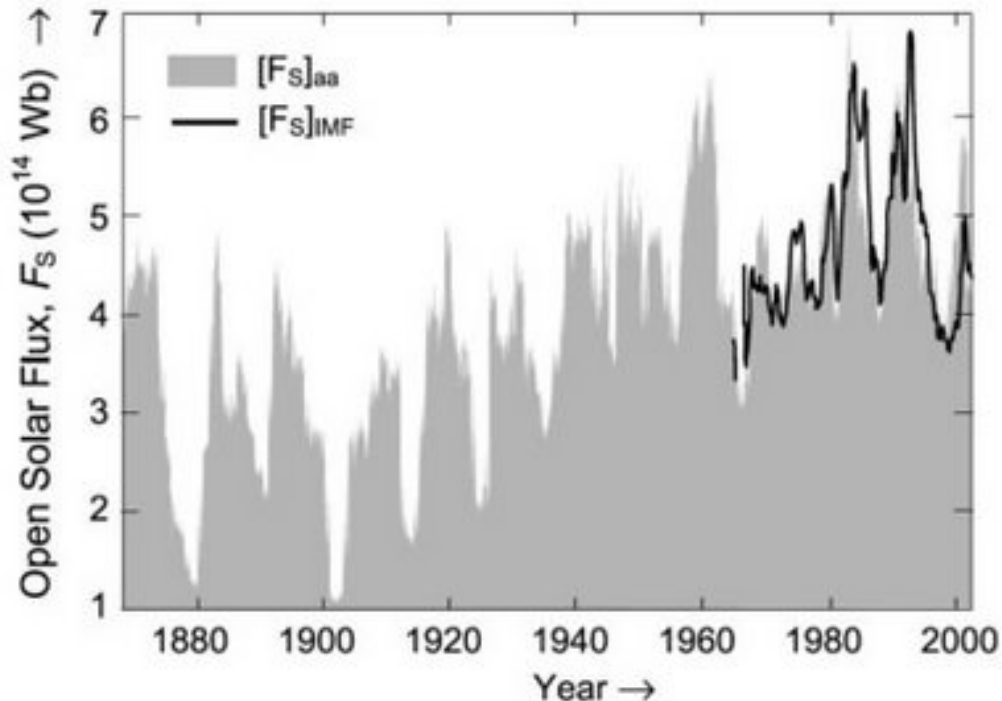
Temperature

Solar Activity and Northern Temperatures



Soon et al 2015; strong correlation between Northern Hemisphere exo-tropic temperatures and total solar irradiance (TSI).

Solar Magnetic Flux



More active Sun → more magnetic flux → less cosmic rays → less aerosols → less low clouds → more sun light to the surface → global warming.

IPCC - Intergovernmental Panel on Climate Change

- Write reports on human-causation of climate change
- Reports to support Rio Summit – UNFCCC 1992
- Based on models that do not include natural causes
- Charney report 1979 ECS 1.5-4.5 °C per double CO₂
- IPCC AR5 report 2013 ECS 1.5-4.5 °C per double CO₂
- Distribute \$100 billion a year from industrial countries to others





AGW by 2100

- TCR of 0.88 °C gives 0.67 °C 2018 to 2100
 - Assuming exponential CO₂ increase + other GHGs
- IPCC RCP8.5 HIGH forecasts 3.6 °C 2018 to 2100
 - Extremely High forecast
 - CO₂ change 0.55%/yr to 1.2%/yr by 2070
 - 10 fold increase in coal use by 2100
 - The ability of oceans to absorb CO₂ fail
 - It is a “barking mad scenario” sold as “business as usual”;
Mat Ridley

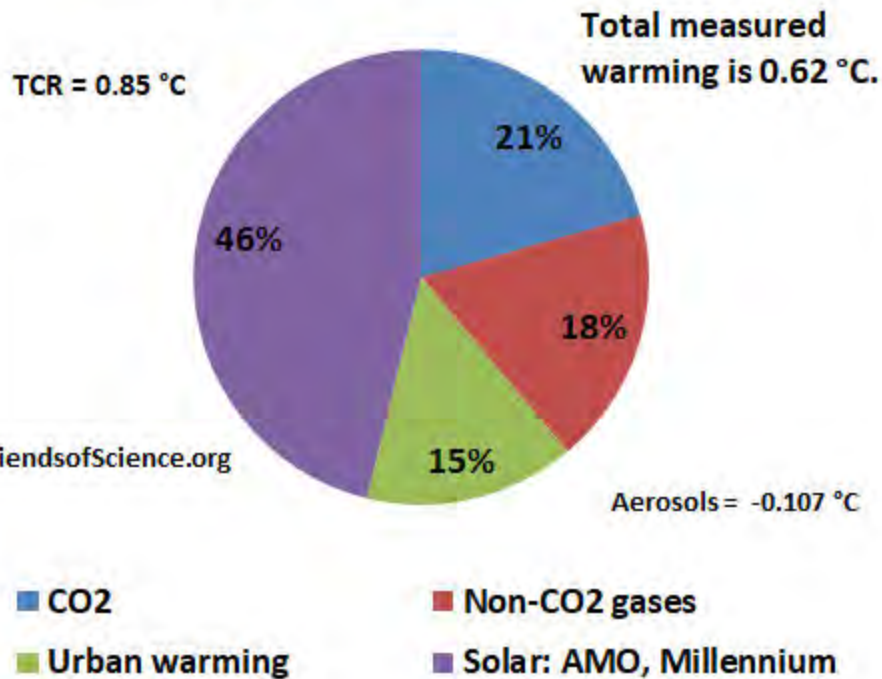


IPCC 5th Report – Ignores the Sun

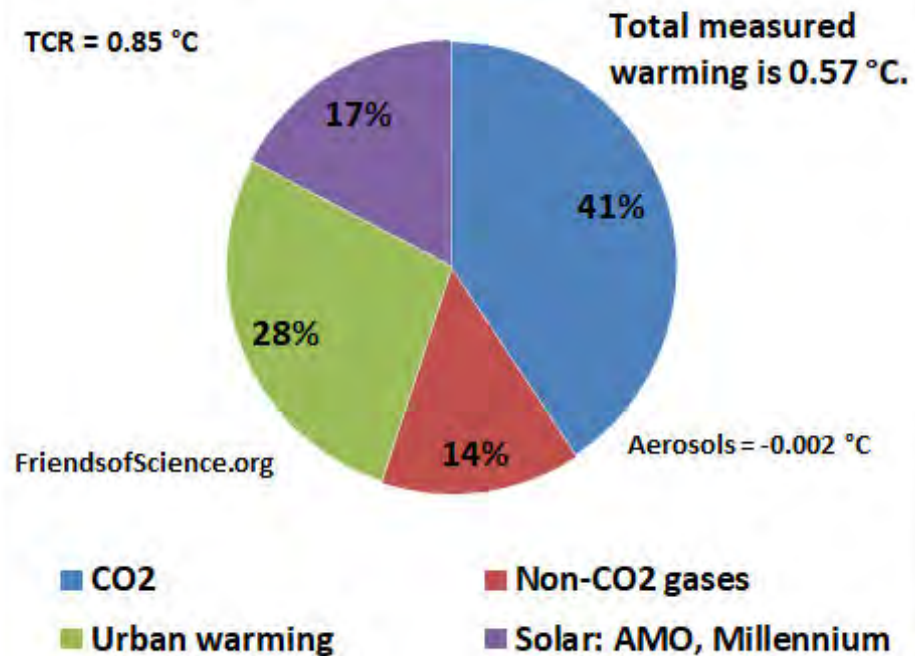
- 2,015 scientific papers published 2004-2018 skeptical of IPCC position. Sun, ocean oscillations, low CS.
- Also, 543 papers in 2014-2018 show sun-climate link
- IPCC: “The forcing from changes in total solar irradiance alone does not seem to account for these observations, implying the existence of an amplifying mechanism”
- Then, ignores solar effects.

Causes of Global Warming

Causes of 1910 to 1980 Global Warming

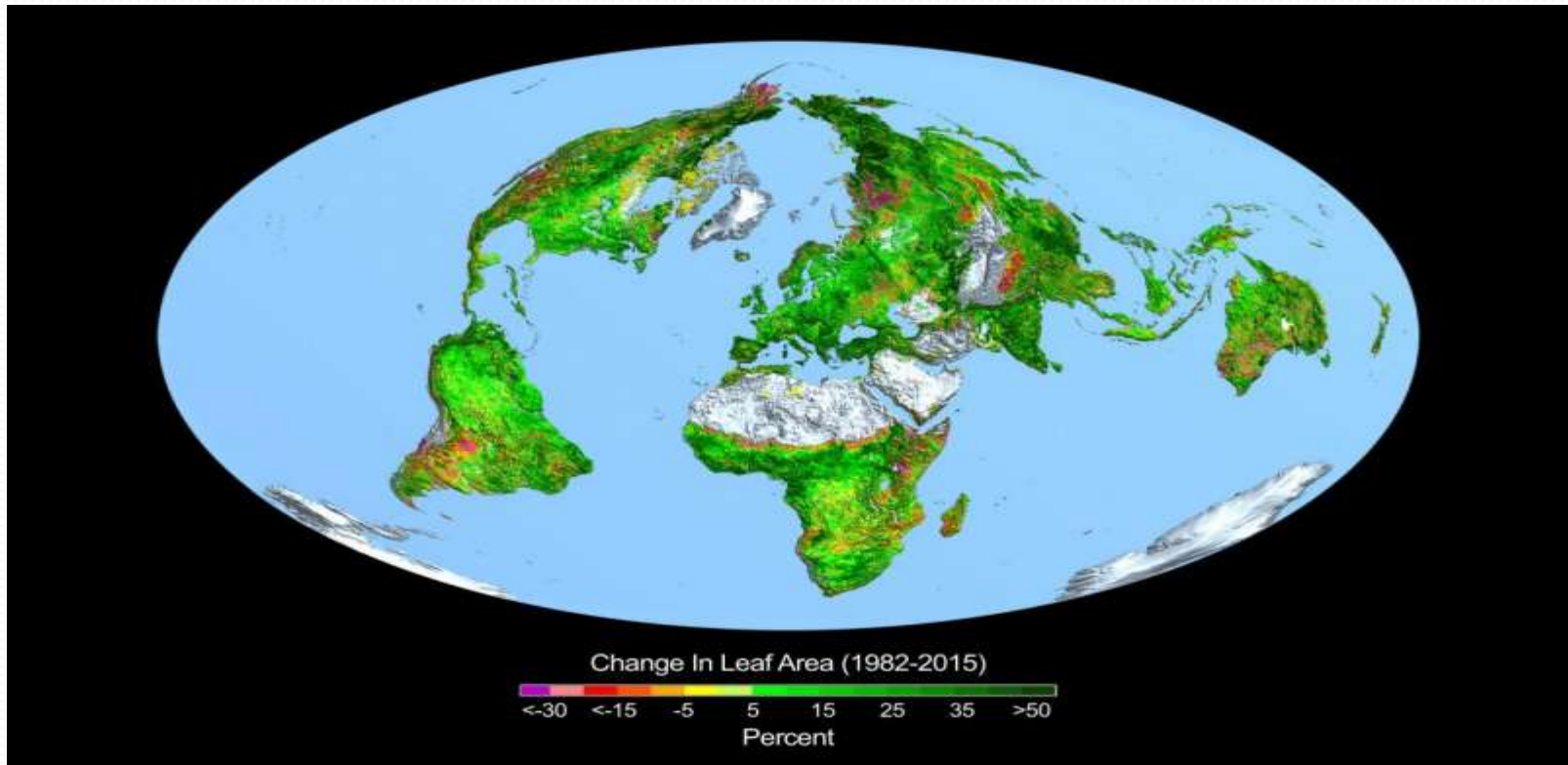


Causes of 1980 to 2018 Global Warming



CO₂ is Greening the Planet

- CO₂ fertilization caused a global greening of 12.4% over 33 years.
- Equivalent to adding a green continent twice the size of mainland USA (18 million km²)



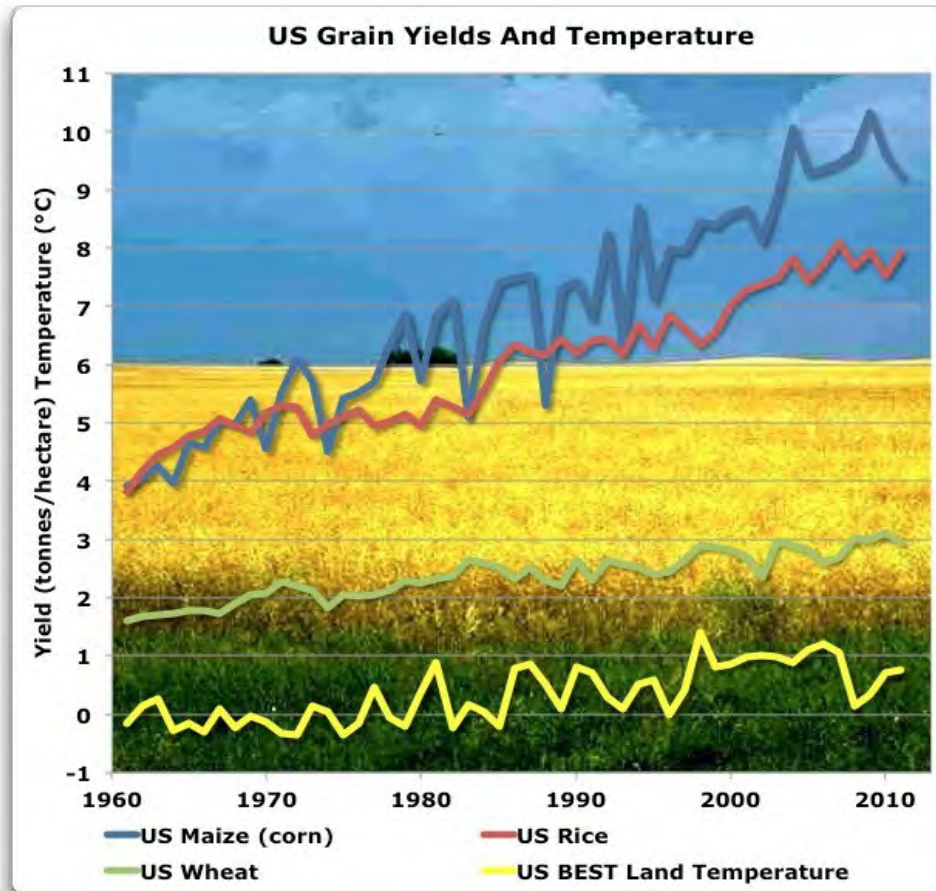
CO₂ is Plant Food

- CO₂ increases since 1950 have enhance crop yields by 16%.
- A 50% increase in CO₂ causes a 23% increase in wheat yields in dry conditions.
- A 300 ppm CO₂ increase would raise the productivity of woody plants by about 50%.
- CO₂ fertilization added \$3.8 Trillion to global crop yields 1961 to 2011.



Canada's GDP = \$1.8 Trillion

USA Grain Yields and Temperature

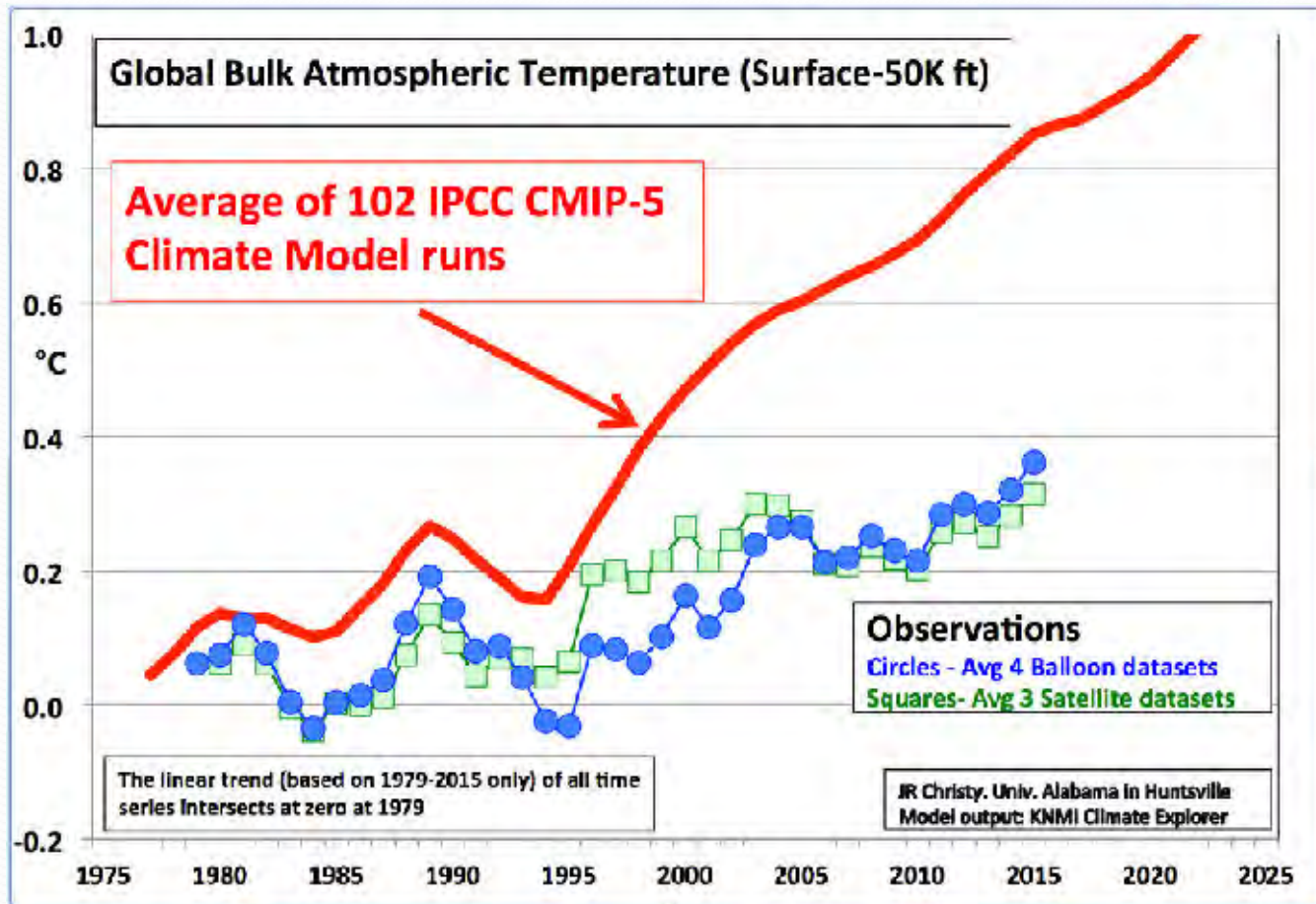




Net Benefit to Canada of CO₂ Emissions

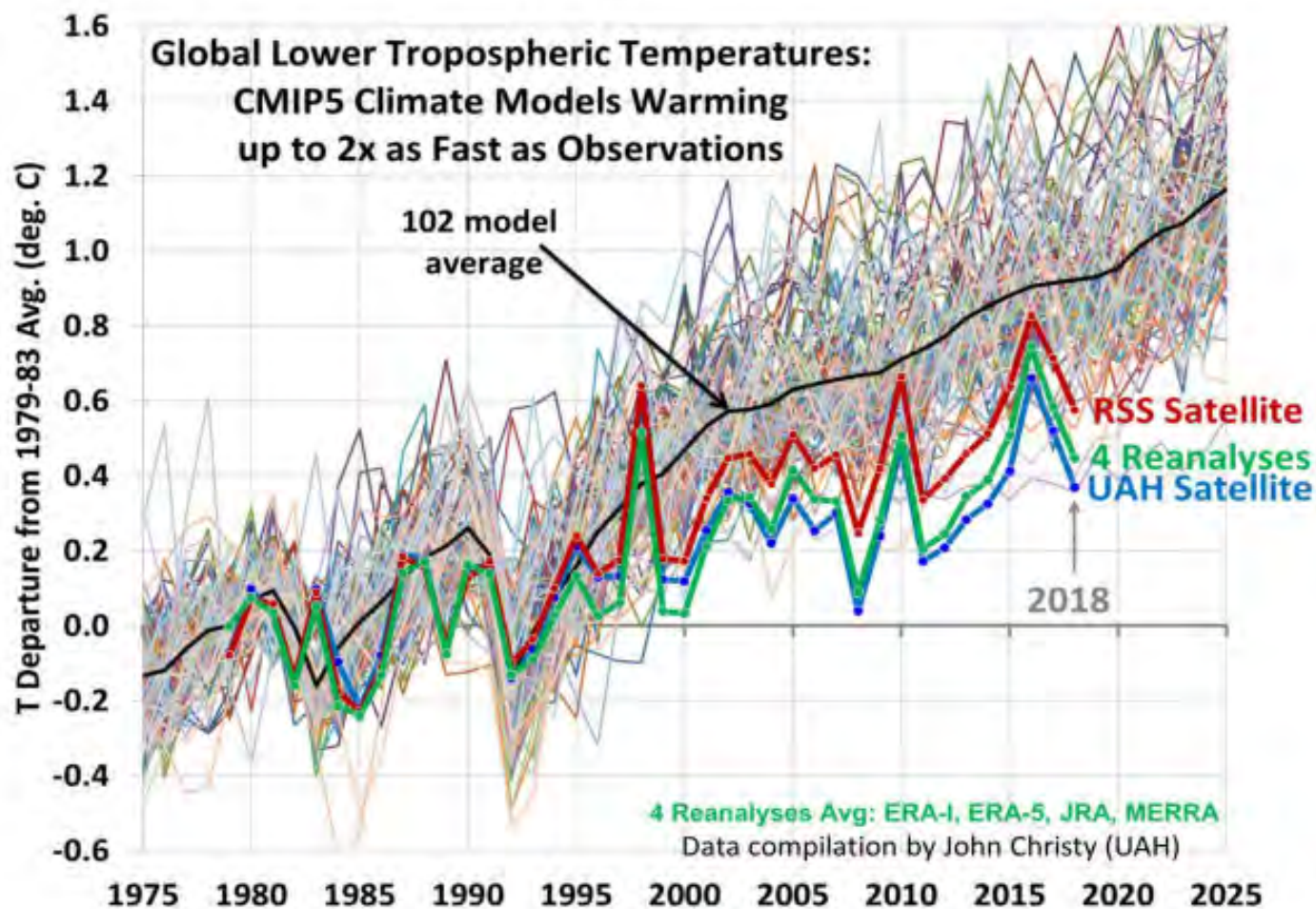
- In Canada, net benefits of CO₂ increase throughout the 21st century.
- Canada net benefits are at least \$30 billion/yr by 2100 in current dollars.
- Canada's income/person in 2100 will be 2.7 X today despite warming.
- Carbon taxes transfers wealth from us to the very wealthy.

Climate Models vs Reality



Data points are 5-year averages, surface to 15 km.
Model trend is 2.5 X reality

Global: Models vs Measurements

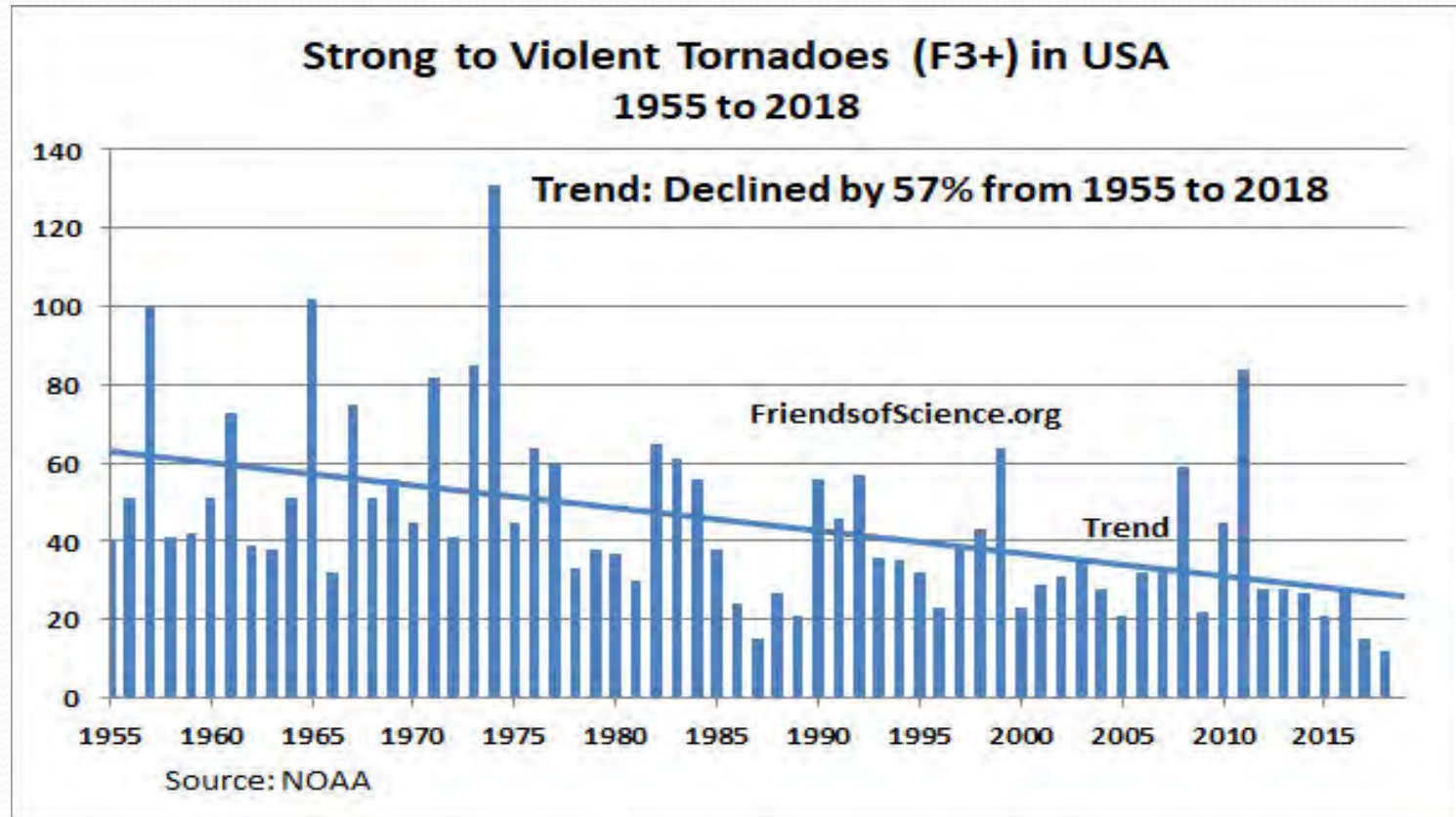




Warming Reduces Deaths

- In U.K., death records show cold kill 10X as many as heat.
- Death rate in Canada is 100 deaths/day greater in January than July.
- Study of 13 countries: Cold weather kills 17 times as many people as hot weather.

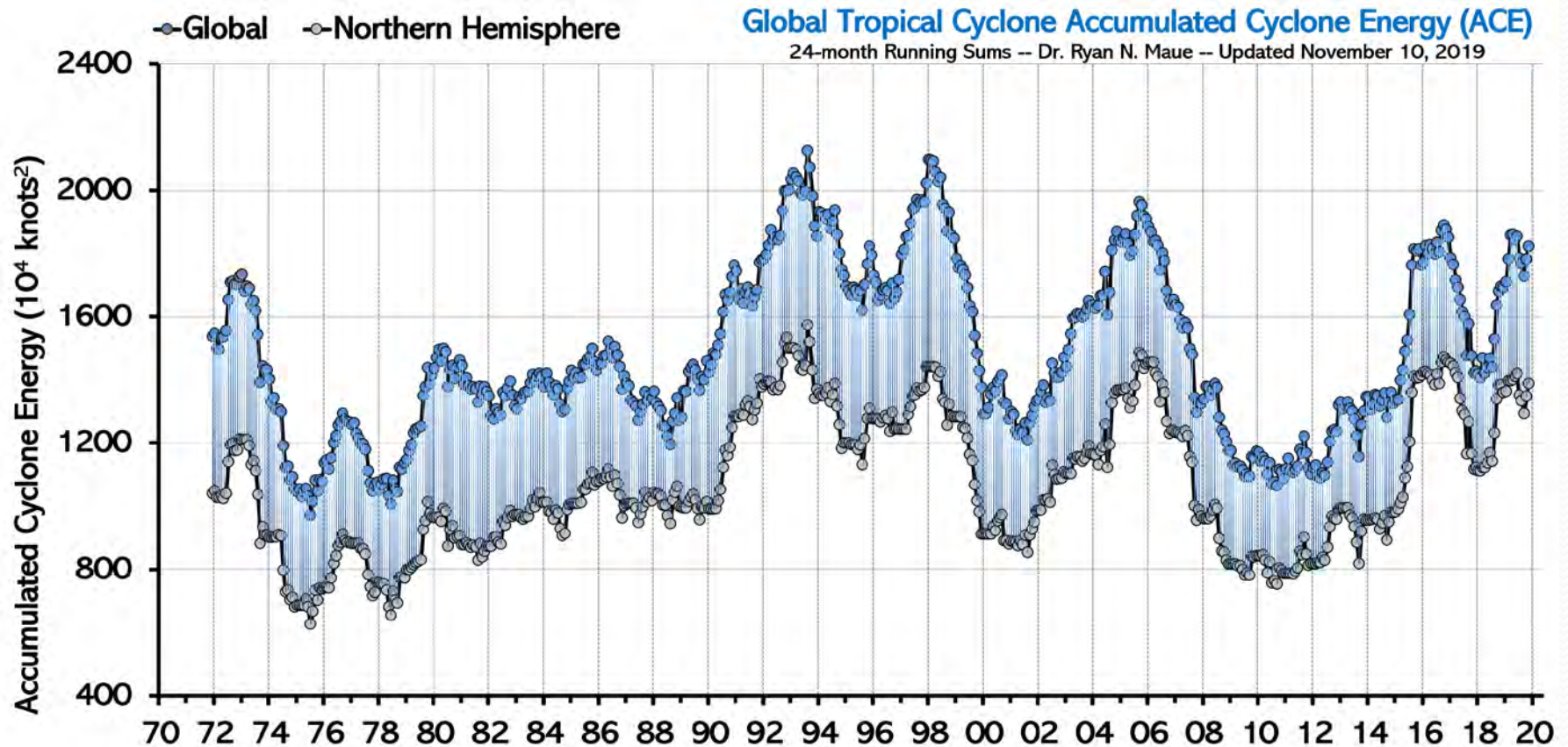
Tornado Trend Declines with Warming



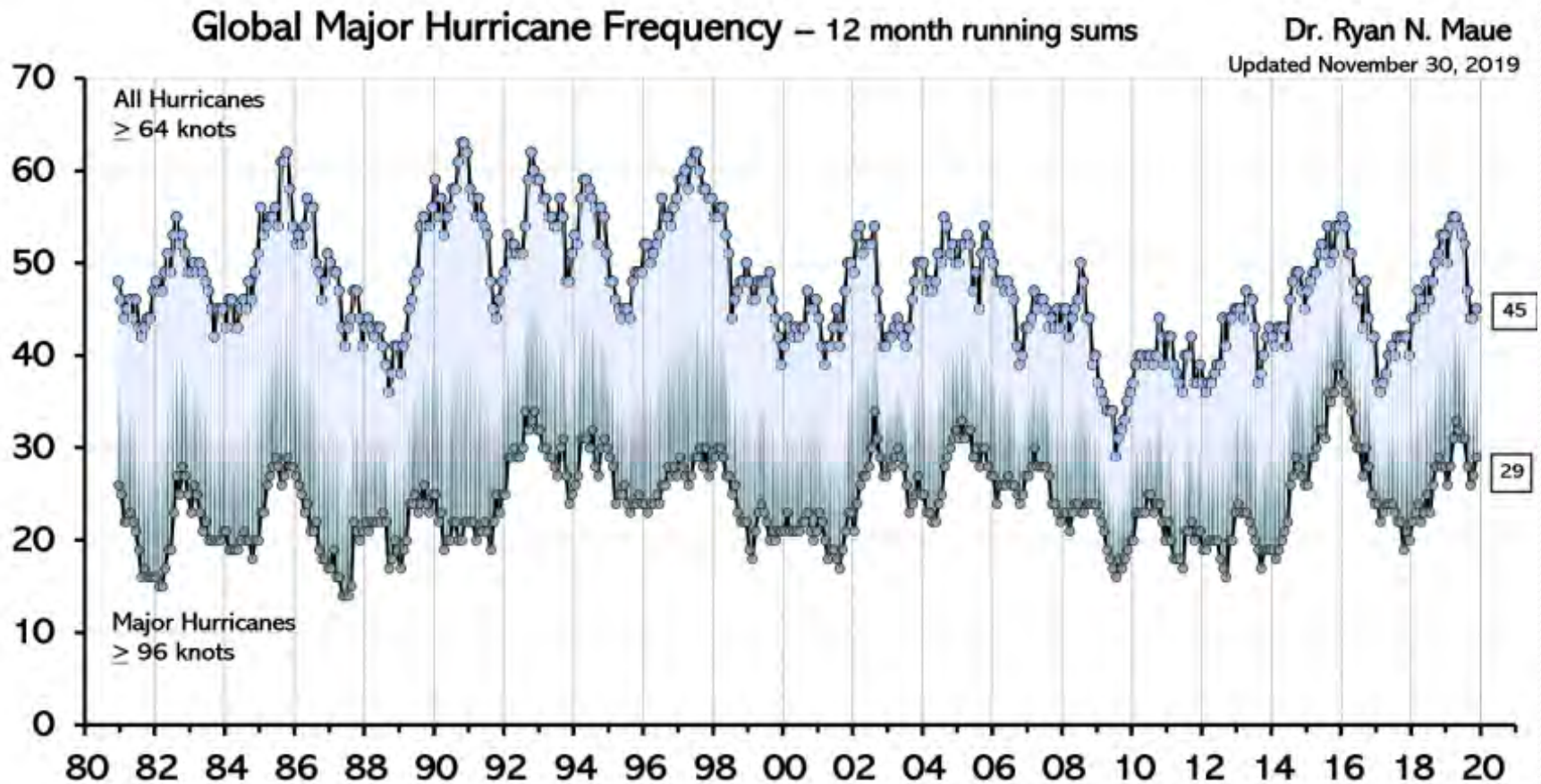
Tornadoes require a cold front colliding with warm air. Northern warming makes tornadoes less likely.

Hurricanes: No Relation to Temperature

No significant trend of hurricane energy

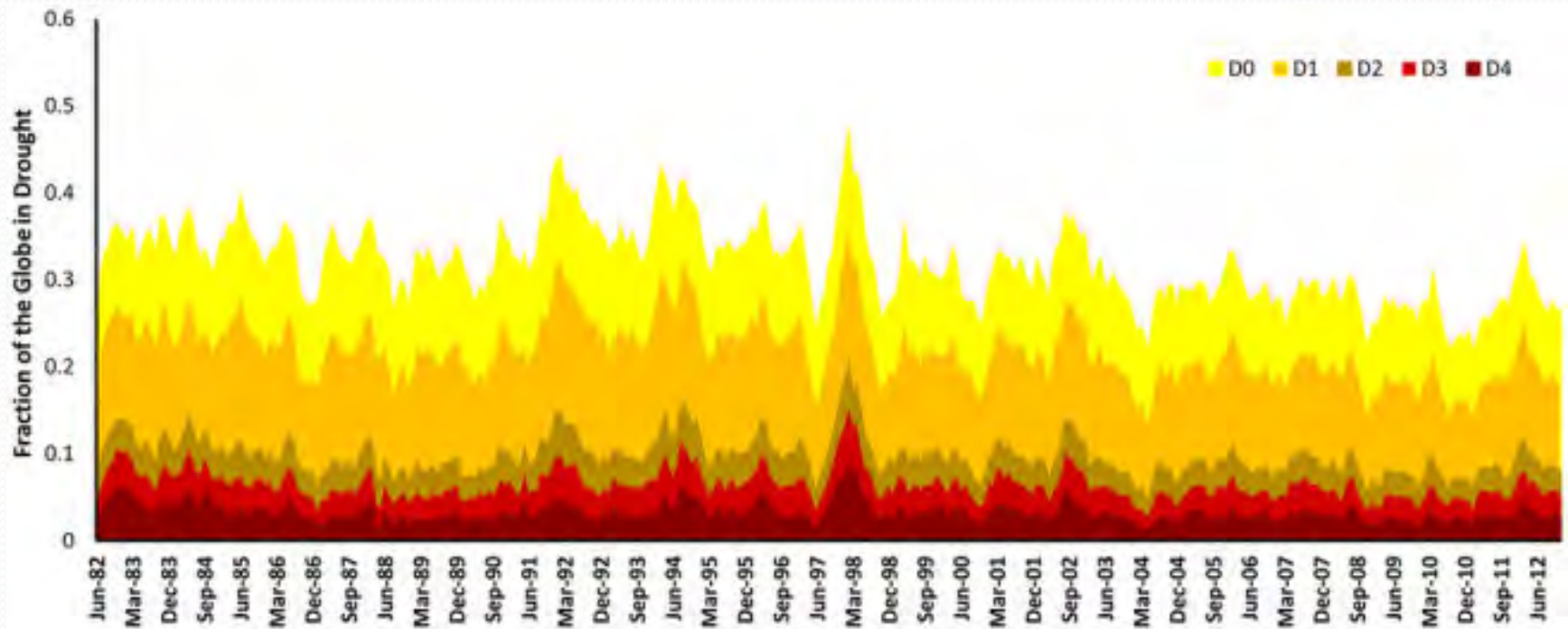


Global Hurricane Frequency

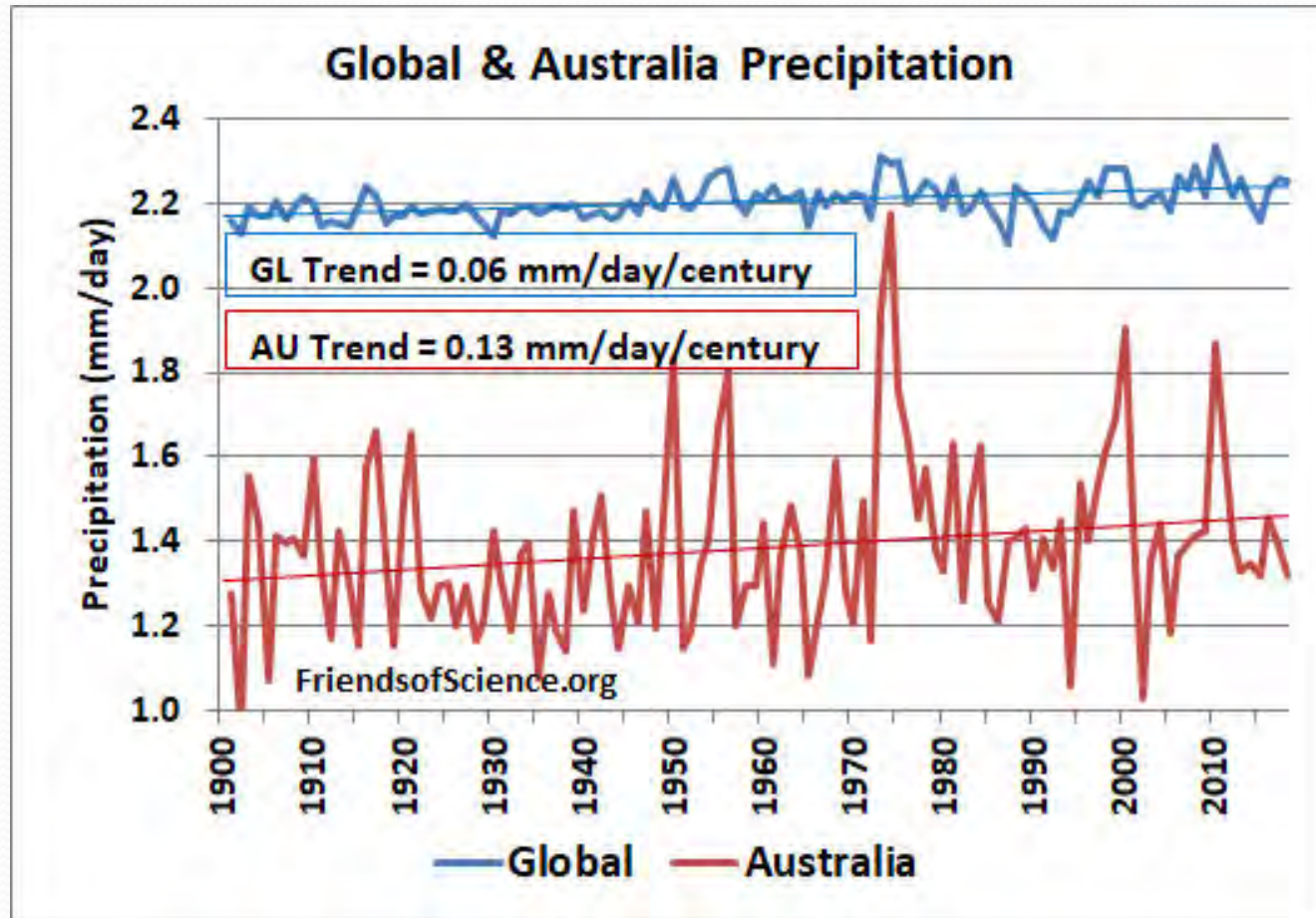


Global Drought Declining

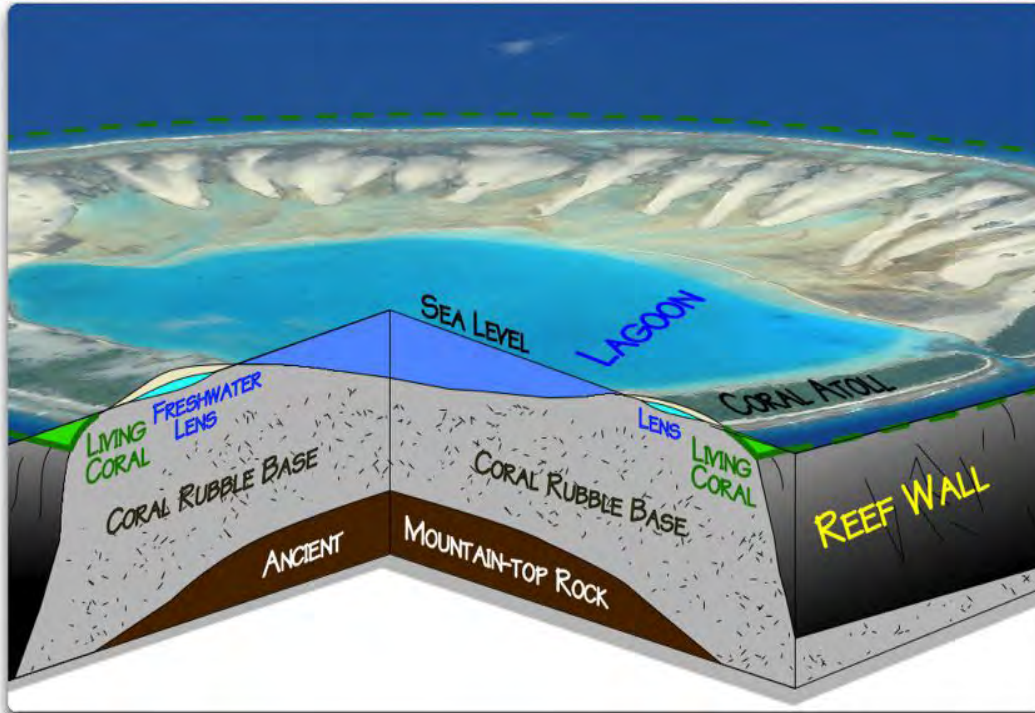
Global Integrated Drought Monitoring and Prediction System
There is a small declining trend of total drought throughout the period



Warming Caused Increasing Precipitation



Tropical Coral Islands Not at Risk from SLR

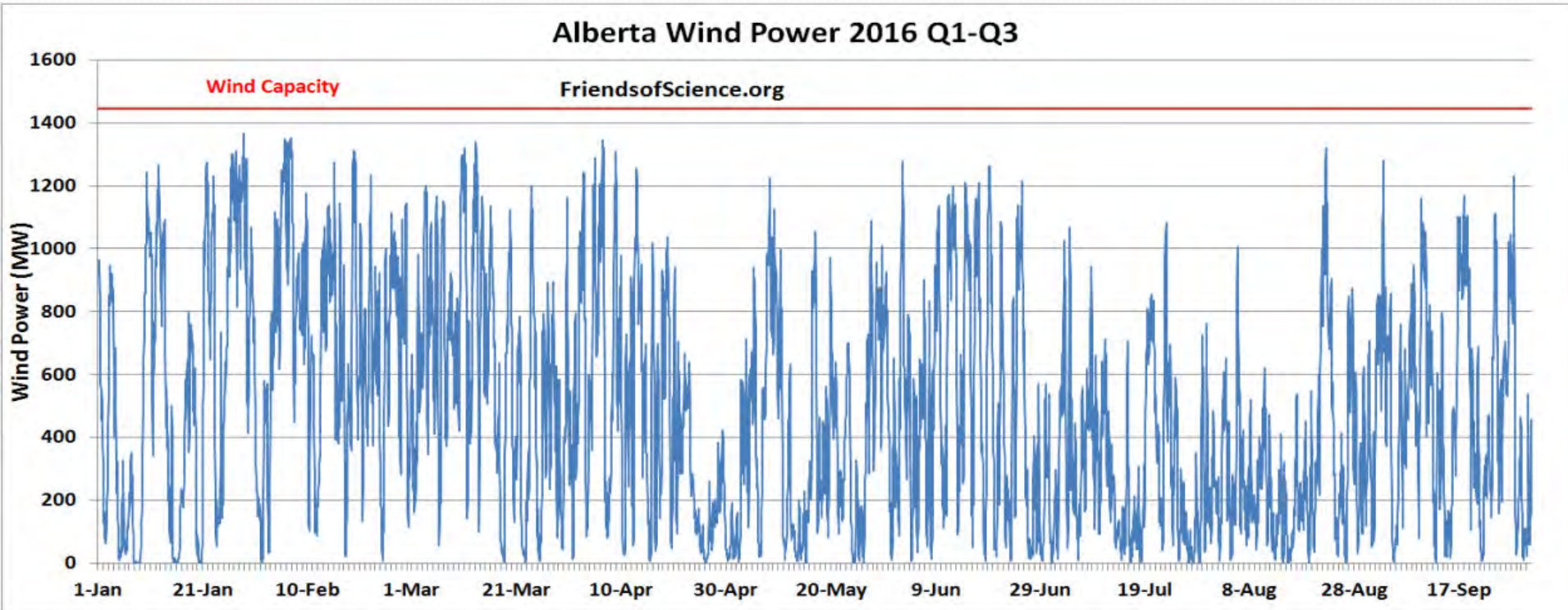


- Tropical coral islands grow as fast as SLR.
- Aerial photos show that 23 of 27 islands grew or stayed the same area since 1950.
- Island atolls rise with sea levels.

Benefits of Warming

- Longer growing season
- Greater area of arable land
- Lower heating costs
- Fewer cold-related deaths and illness
- Low cost of outdoor activity
 - Lower construction costs
 - Lower road maintenance costs
- Reduced tropics to pole temperature gradient
 - Fewer severe storms

Alberta Wind Power – Extreme Variability

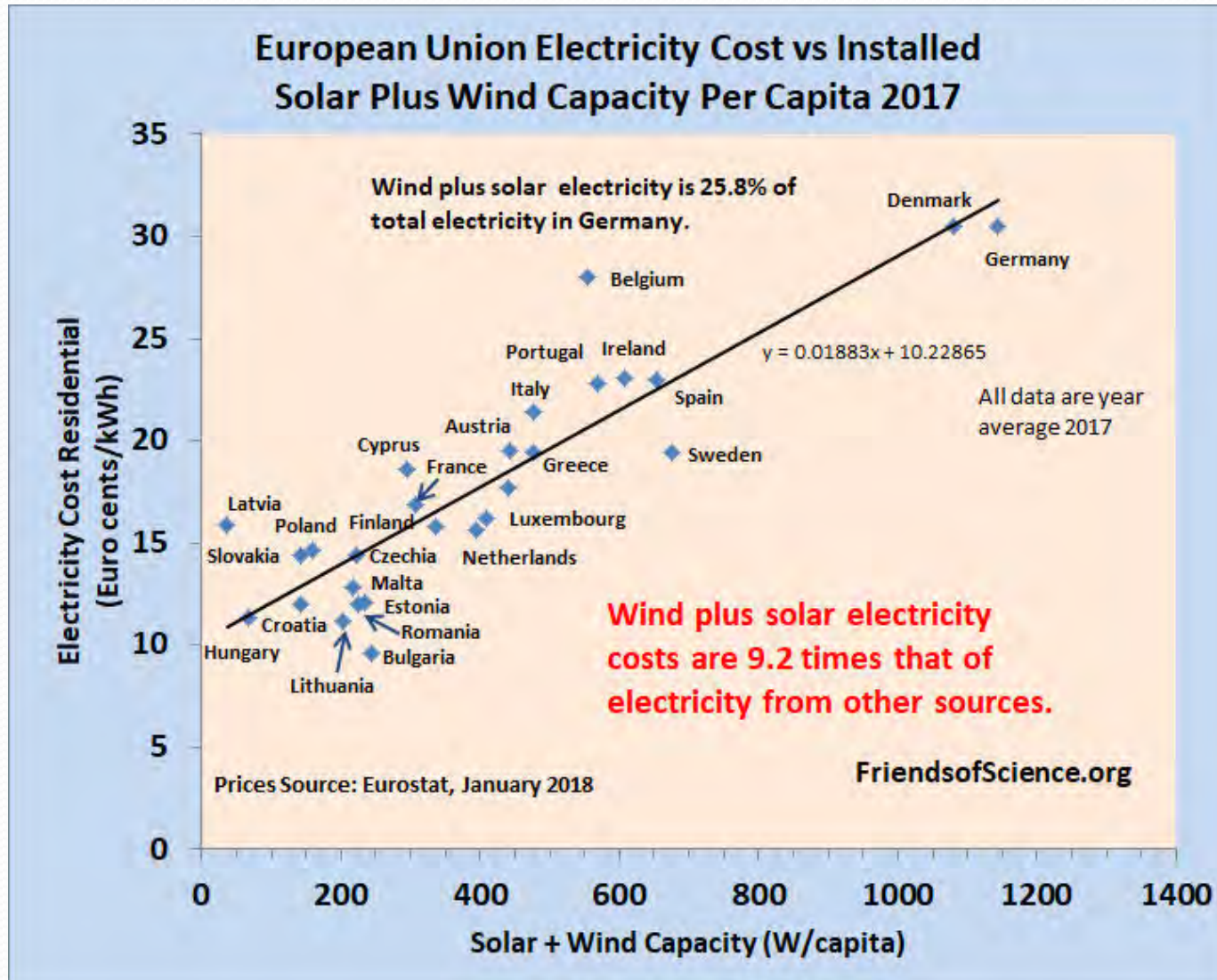


Average load factor: 34%

Ontario Solar Feed-in Tariffs

Type	Price (¢/kWh)
Solar (PV) Rooftop	22.2 – 31.3
Solar (PV) Non-Rooftop	20.9 – 21.4
ENMAX energy charge April 2019	6
Ontario solar FIT costs up to 5 times the cost of Alberta electricity.	


Europe Wind & Solar Electricity Cost





Affect of Alberta's Climate Plan

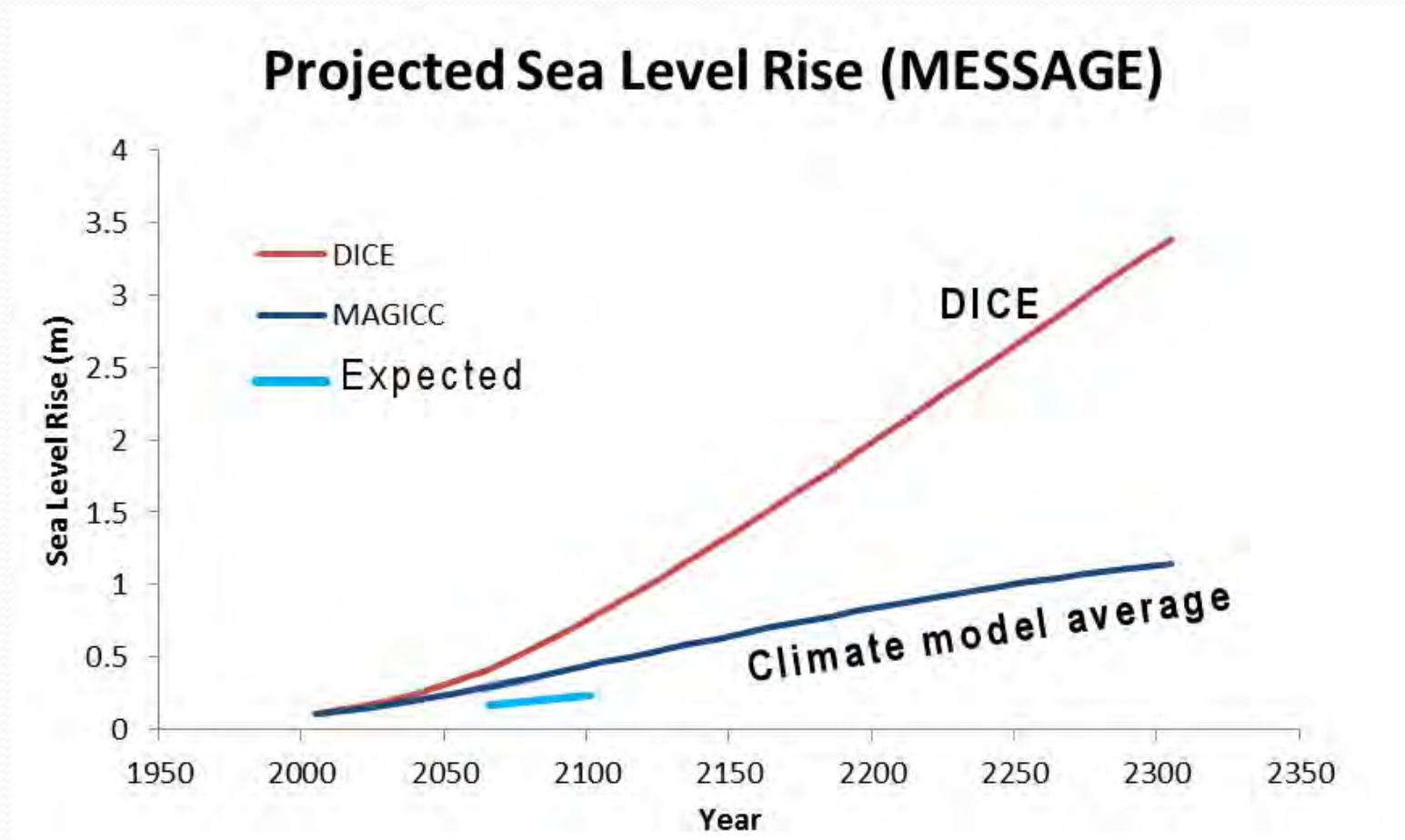
- Compared to business-as-usual;
 - Reduce CO₂e emissions by 50 MtCO₂e by 2030
 - Reduce CO₂ by 0.026 ppm by 2030
 - Reduce global temperatures by 0.00007 °C
 - Insignificant and undetectable



Social Cost (Benefit) of Carbon (Dioxide)

- SCC is the social cost (benefit) of CO₂ emissions per tonne CO₂. Used to set carbon taxes.
- The U.S. Government uses three economic models:
 - FUND, PAGE and DICE
- PAGE and DICE have no CO₂ fertilization effect, ignores benefits.
- The DICE model assumes that the optimum climate at 1900, near end of Little Ice Age.
- PAGE explicitly does not include adaptation.

Sea Level Rise: DICE vs Climate Models




Test the Energy Sector of FUND



Article

Economic Impact of Energy Consumption Change Caused by Global Warming

Peter A. Lang ^{1,*}  and Kenneth B. Gregory ²

¹ Centre for Applied Macroeconomic Analysis, Crawford School of Public Policy, Australian National University, Canberra, ACT 2601, Australia

² P.Eng. (Non-Practicing), Life Member of The Association of Professional Engineers and Geoscientists of Alberta (APEGA), 1500 Scotia One, 10060 Jasper Avenue NW, Edmonton, AB T5J 4A2, Canada

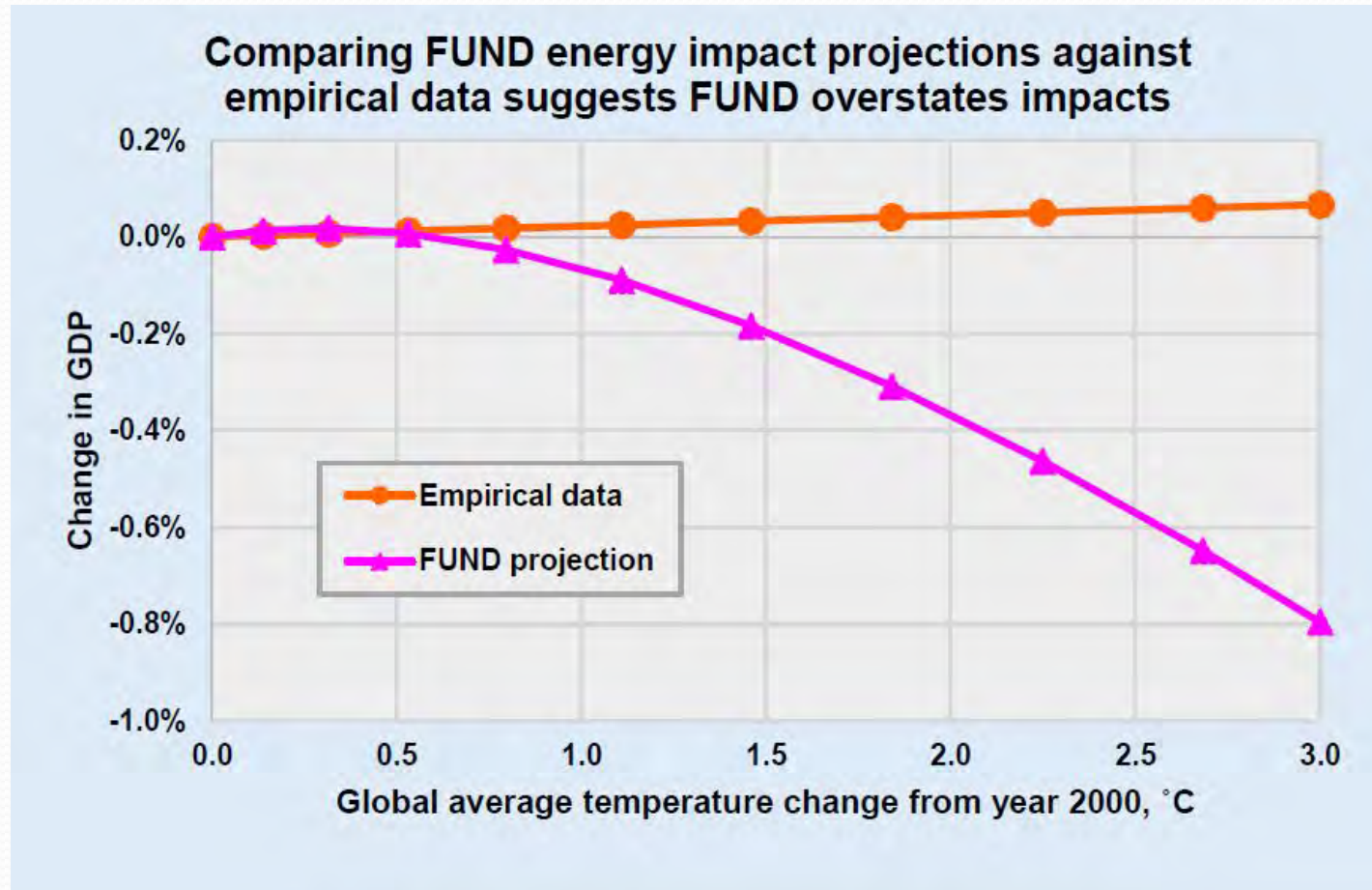
* Correspondence: peter.lang@alumni.anu.edu.au

Received: 28 June 2019; Accepted: 27 August 2019; Published: 19 September 2019



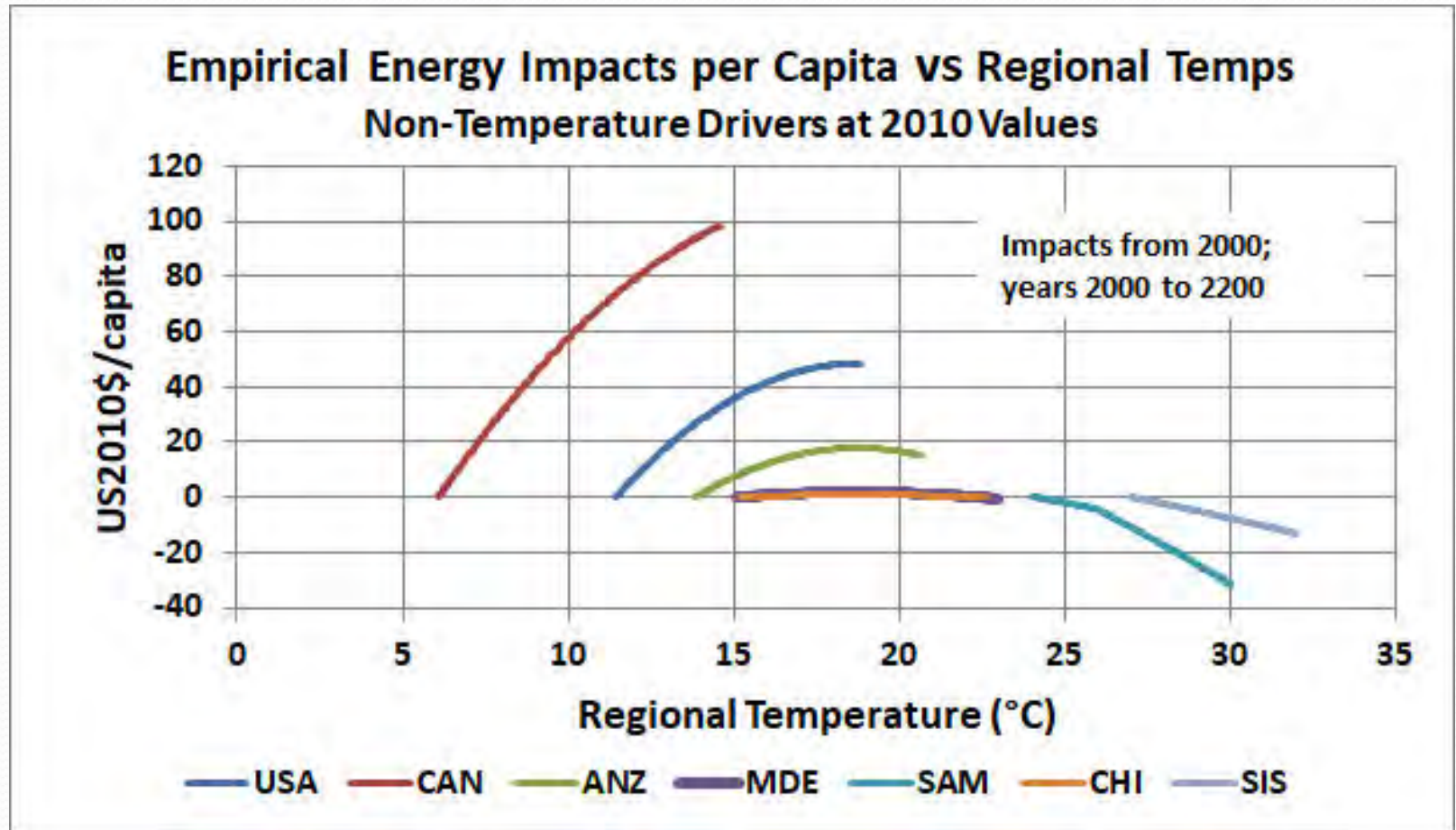
Abstract: This paper tests the validity of the FUND model's energy impact functions, and the hypothesis that global warming of 2 °C or more above pre-industrial times would negatively impact the global economy. Empirical data of energy expenditure and average temperatures of the US states and census divisions are compared with projections using the energy impact functions with non-temperature drivers held constant at their 2010 values. The empirical data indicates that energy expenditure decreases as temperatures increase, suggesting that global warming, by itself, may reduce US energy expenditure and thereby have a positive impact on US economic growth. These findings

Testing FUND with U.S. Empirical Data

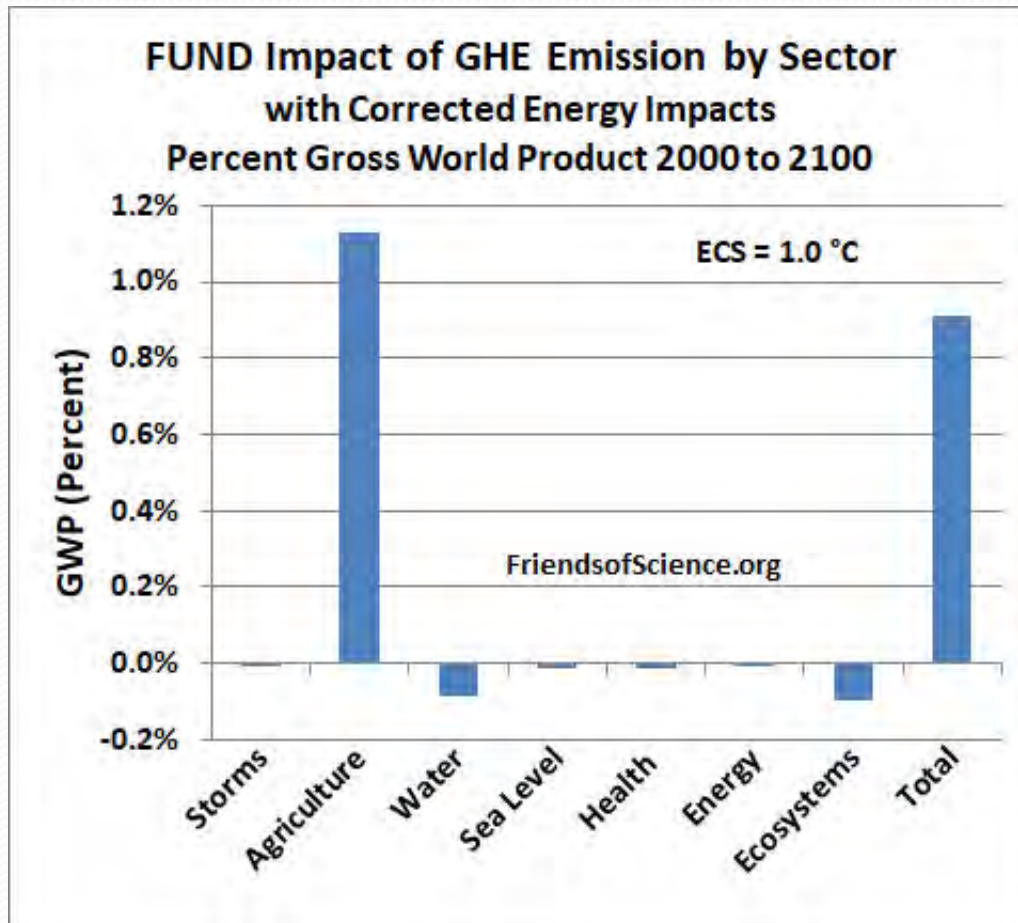


Non-temperature drivers held constant at 2010 values.

Energy Impact of Temperature by Region

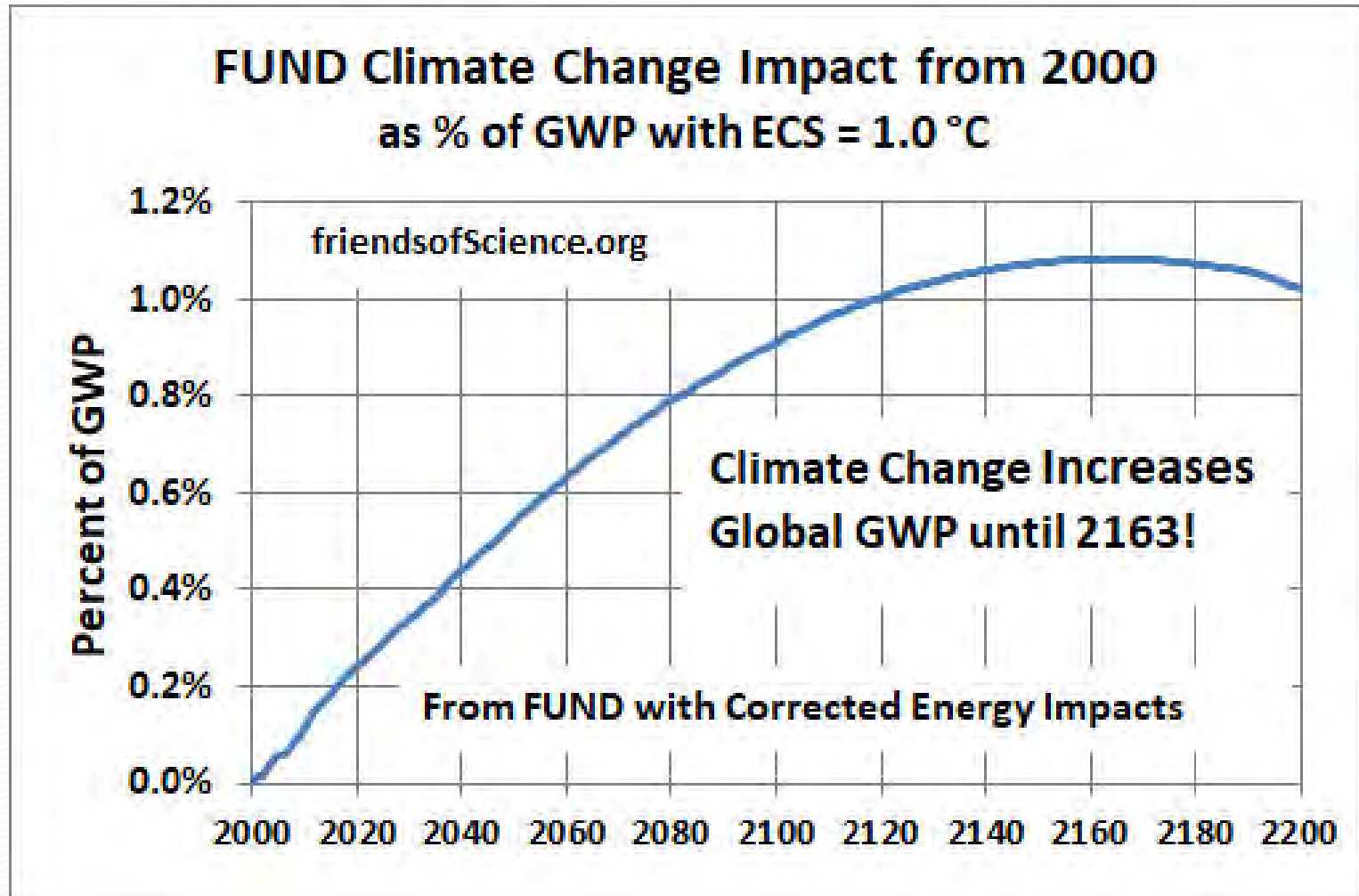


FUND Global Impact by Sector



- GHG emissions cause agriculture to increase gross world product by 1.13%, 2000 to 2100, ECS = 1.0 °C
- Corrected energy impacts.
- Total impact is **0.91%** of GWP!

GHG Impact GWP% by FUND; ECS = 1.0 °C





FUND Social Cost (Benefit) of CO₂

with IPCC ECS vs. L&C ECS with +30% CO₂ Fertilization

	Roe-Baker	L&C2018 +30%
3.0% Discount rate	2018US\$/tCO ₂	2018US\$/tCO ₂
2020	+ \$23.11	- \$3.28
5.0% Discount rate		
2020	+ \$3.04	- \$4.08
2030	+ \$3.96	- \$4.08
2050	+ \$6.28	- \$3.43

- Assumes no natural climate change from Little Ice Age, no urban warming, no correction to energy impacts.
- So these values are much too high!
- “Roe-Baker” is climate model ESC
- “L&C2018 +30%” is with ESC median 1.5 °C and FUND CO₂ fertilization increased by 30%.

Source: Dayaratna, McKittrick & Michaels 2020



Private Benefit of CO₂

- The private benefit of CO₂ is the marginal consumer benefit of using fossil fuel per tonne of CO₂ emission.
- Private benefit of CO₂ is 2018US\$472/tCO₂
- Private benefit of residential electricity from fossil fuel is 2018US\$2156/tCO₂
- These values increase if fossil fuel use is restricted.



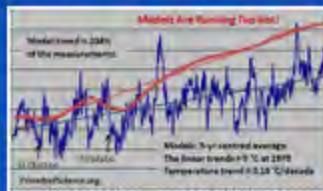
Conclusions

- Human-caused CO₂ emissions cause climate change.
- Total water vapour increases, effective water vapour decreases with warming.
- Transient climate sensitivity is low, about 0.85 °C/2XCO₂.
- CO₂ causes 41% of 0.57 °C warming 1980-2018, or 0.23 °C.
- Climate models are a farce. Global model trend is >2X reality.
- GHG emissions will increase global economic wealth by >1.1% from 2000 to 2160.
- Social net benefit of CO₂ > CDN\$ 5.40/tonne CO₂.
- Private benefit of CO₂ is CDN\$ 628/tCO₂.

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Global Temperatures



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Friends of Science Society 17th Annual Climate Science Event

April 6th, 2020 • 6:00pm - 9:00pm • Red and White Club • McMahon Stadium, Calgary

Freedom of Speech! NO Climate Emergency!



Donna Laframboise
Journalist

Climate Activists
Want Your Freedom



Dr. Roy Spencer
Principal Research Scientist

No Climate Emergency:
10 Reasons

- Buffet Dinner Included
- Free Parking after 6pm
- Easy LRT Accessible



www.friendsofscience.org
Order tickets by **March 27, 2020**
Early Bird Pricing ends **February 29, 2020**

Note: This event is not affiliated with or endorsed by the University of Calgary

Click [here](#) To purchase tickets and for more information. Early Bird ticket pricing ends February 29th so get your tickets today!

Environmental Charities — Their Finances, Power and Implications for