

What CO2 Does to the Heat

CO2 is one third of the warming. The rest is water.

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Sequel to "The Reading and the State". That essay treated where the CO2 comes from. This one treats what CO2 does to temperature.

Summary

The climate debate treats CO2 as a thermostat. The relation between CO2 and temperature exists and has been measured. It is also small. The whole rise since 1750 gives 0.72 K by itself. The measured warming is 1.44 K and still growing. The difference is water, as vapour, cloud and ice. For a doubling of CO2, the share of CO2 itself is 36% and the share of water 64%. The ice-core record shows the same proportion. In the vacuum.net reading, CO2 and temperature are two readings of one state. The part of the water that lies within reach is the water on the land. Every calculation is written out in the text.

1. The direct term

In 1750 the air held 278 ppm of CO2. The forecast annual mean for 2026 is 429.4 ppm. The radiative term follows from the standard logarithmic expression:

- ratio: $429.4 / 278 = 1.545$
- natural logarithm: 0.435
- term: $5.35 \times 0.435 = 2.33 \text{ W/m}^2$

A warmer Earth radiates more: 3.22 W/m² per kelvin (IPCC AR6). So:

- $2.33 / 3.22 = 0.72 \text{ K}$

That is the whole direct relation between the CO2 rise and temperature.

It has been measured in the field. Between 2000 and 2010 CO2 rose by 22 ppm. At two sites, in Oklahoma and Alaska, the downward radiation in the CO2 bands rose by 0.2 W/m² per decade (Feldman, 2015).

2. The measured warming

The global mean of 2025 stood $1.44 \pm 0.13 \text{ K}$ above the 1850–1900 mean (WMO). That is twice the direct term. The system has not settled either. The ocean still takes up about 90% of the surplus heat.

The difference is water, in three phases.

- **Vapour.** Warmer air holds more water vapour. Water vapour itself holds heat back.
- **Cloud.** Clouds shift and change in kind.
- **Ice and snow.** They retreat. Dark land and water take up more sunlight.

3. The proportions

The assessed terms per kelvin of warming (IPCC AR6, chapter 7):

- radiated away: 3.22 W/m^2
- returned by water vapour and the temperature profile: 1.30 W/m^2
- returned by clouds: 0.42 W/m^2
- returned by less snow and ice: 0.35 W/m^2
- net loss, with a small remaining term: 1.16 W/m^2

For a doubling of CO₂ the radiative term is $5.35 \times \ln 2 = 3.71 \text{ W/m}^2$.

- CO₂ alone: $3.71 / 3.22 = 1.15 \text{ K}$
- the whole: $3.71 / 1.16 = 3.2 \text{ K}$ (assessed range 2.5 to 4 K)
- share of CO₂ alone: $1.15 / 3.2 = 36\%$

The other 64% is water.

For the present step of 2.33 W/m^2 the settled value is $2.33 / 1.16 = 2.0 \text{ K}$. Of that, 0.72 K is CO₂ and 1.3 K is water.

Clouds are the least known term. Their assessed range runs from -0.10 to 0.94 W/m^2 per kelvin: from slightly cooling to strongly warming.

4. The ice-core record

Between the last ice age and the warm period after it, CO₂ went from 180 to 280 ppm:

- $280 / 180 = 1.556$
- natural logarithm: 0.442
- term: $5.35 \times 0.442 = 2.36 \text{ W/m}^2$

That is nearly the same step as today's 2.33.

The Earth was then 6.1 K colder (Tierney, 2020).

- CO₂ alone: $2.36 / 3.22 = 0.73 \text{ K}$, or 12% of 6.1 K
- with the water response: $2.36 / 1.16 = 2.0 \text{ K}$, or one third

The rest came from the ice sheets and the orbit of the Earth.

In the Antarctic ice, CO₂ and temperature rise in step. Neither leads the other by a significant margin (Parrenin, 2013).

5. Two things that belong with it

Each ppm does less. The relation is logarithmic. The term per added ppm is 5.35 divided by the level:

- at 278 ppm: $5.35 / 278 = 0.0192 \text{ W/m}^2$ per ppm
- at 429 ppm: $5.35 / 429 = 0.0125 \text{ W/m}^2$ per ppm

That is one third less.

Today's CO₂ does not come from a warmer ocean. In the ice-core record 100 ppm goes with 6.1 K: 16 ppm per kelvin. At 1.44 K that gives 24 ppm. The actual surplus is 151 ppm, and the ocean is taking CO₂ up. The surplus comes from burning and from depleted soils.

6. Reading and state

The vacuum.net picture is a fishing net under tension. Strands wind around each other. Where a winding returns in phase, a mesh closes and holds.

In that picture CO₂ and temperature are not cause and effect. They are two readings of one state. A state with more CO₂ in the air is a state with less passage for outgoing radiation near 15 micrometres. The ice cores show it: the two readings move together.

CO₂ shifts the tension by a small step. Water sets the form and the size of what is called climate change.

Climate policy treats the 36% as the whole. The water is not in the account.

7. The water within reach

The water of the atmosphere follows temperature. There is no handhold on it.

The water of the land is a different matter. It follows what people do with the ground.

Evaporating one millimetre of water per day from one square metre:

- mass: 1 kg per m² per day
- latent heat: 2.45 MJ/kg
- seconds per day: 86,400
- flux: $2,450,000 / 86,400 = 28.4 \text{ W/m}^2$

The whole CO₂ term is 2.33 W/m². At the place itself the difference is a factor of twelve.

Since 1700 about 3.4 million km² of inland wetland has been drained, 21% of the total (Fluet-Chouinard, 2023). The land now evaporates 1,260 to 3,500 km³ per year less than before (Boisier, 2014; Sterling, 2013). Taking the higher figure:

- 3,500 km³ is $3.5 \times 10^{15} \text{ kg}$
- times 2.45 MJ/kg: $8.6 \times 10^{21} \text{ J per year}$
- divided by 3.16×10^7 seconds: $2.7 \times 10^{14} \text{ W}$
- over the land surface ($1.49 \times 10^{14} \text{ m}^2$): 1.8 W/m^2
- over the whole Earth ($5.10 \times 10^{14} \text{ m}^2$): 0.53 W/m^2

With the lower figure: 0.66 W/m² over land and 0.19 W/m² over the whole Earth.

Where the water is gone, the heat stays at the ground. That is where people live and crops stand: the farmer on drained peat, the village on a sand ridge whose well has dropped.

8. Conclusion

CO₂ does what it does: 0.72 K for the whole rise so far. Whoever wants to understand the warming has to look at the water. So does whoever wants to do something about it.

The part of the water that lies within reach lies in the ground: the level in the polder, the ditch, the wetland, the peat. There the balance has an address.

9. Status

Established by measurement: the CO₂ level and its radiative term; the surface forcing of CO₂; the warming of 1.44 K; the terms per kelvin; the ice-age step in CO₂ and temperature; the wetland loss; the reduced evaporation of the land.

Calculated here from those sources: 0.72 K direct; 2.0 K settled for the present step; 36% CO₂ and 64% water for a doubling; 12% and one third for the ice age; 16 ppm per kelvin; 28.4 W/m² per mm per day; 0.19 to 0.53 W/m² for the land.

Reading from the net: CO₂ and temperature as two readings of one state; CO₂ as the small shift in tension and water as the form.

Annotated references

Konstapel, J. (2026). The Reading and the State. constable.blog. *Why read?* The predecessor of this essay. Where the CO₂ comes from, and why peat shows that water and carbon are one state.

IPCC (2021). AR6 Working Group I, chapter 7: The Earth's Energy Budget, Climate Feedbacks and Climate Sensitivity. *Why read?* The source of the proportion 36 to 64. All terms per kelvin stand in one table. *Reading advice:* go to table 7.10, then the section on clouds. It shows how wide the uncertainty is.

Feldman, D. R. et al. (2015). Observational determination of surface radiative forcing by CO₂ from 2000 to 2010. Nature 519, 339–343. *Why read?* The direct term, measured and not computed. In spring, when plants take up CO₂, the dip is visible in the radiation.

WMO (2026). State of the Global Climate 2025. *Why read?* The measured warming and the heat content of the ocean. The ocean figures show that the system has not settled.

NOAA Global Monitoring Laboratory (2026). Trends in Atmospheric Carbon Dioxide, Mauna Loa. gml.noaa.gov/ccgg/trends *Why read?* The CO₂ level itself, per month, with the method.

Met Office (2026). Mauna Loa carbon dioxide forecast for 2026. *Why read?* The annual mean of 429.4 ppm. Shows how the yearly rise moves with El Niño and La Niña through tropical land.

Parrenin, F. et al. (2013). Synchronous change of atmospheric CO₂ and Antarctic temperature during the last deglacial warming. Science 339, 1060–1063. *Why read?* The timing in the ice. CO₂ and temperature move in step. Whoever looks for a leader does not find one here.

Tierney, J. E. et al. (2020). Glacial cooling and climate sensitivity revisited. Nature 584, 569–573. *Why read?* The 6.1 K of the last ice age, from proxies and model combined. The scale against which the CO₂ step of then and now is read.

Sterling, S., Ducharne, A., Polcher, J. (2013). The impact of global land-cover change on the terrestrial water cycle. Nature Climate Change 3, 385–390. *Why read?* The 3,500 km³ per year. Wetlands and reservoirs show the largest changes.

Boisier, J. P. et al. (2014). Historical land-use-induced evapotranspiration changes. *Hydrology and Earth System Sciences* 18, 3571–3590. *Why read?* The lower estimate of $1,260 \pm 850 \text{ km}^3$, and an account of why the estimates differ. *Reading advice:* read it next to Sterling to see the width of the range.

Fluet-Chouinard, E. et al. (2023). Extensive global wetland loss over the past three centuries. *Nature* 614, 281–286. *Why read?* 3.4 million km^2 lost, on the basis of more than 3,000 records from 154 countries. Europe, the United States and China lead.

Konstapel, J. (2026). Setting the State, Not the Screen. *constable.blog*. *Why read?* The same reading applied to solar dimming. Contains the first derivation of the 28.4 W/m^2 lever.