# The Climate on the Ladder of Three

*Locating, calibrating and testing a climate model built from the Vacuum.Net theory*

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## Abstract

This essay reports a research project with one aim. The aim was a global climate model that is built from the start of the Vacuum.Net theory and that computes the weather on the long term. Governments, firms and citizens could then choose effective measures.

The approach has three steps, in a fixed order. First, compute where the climate sits on the ladder of the theory. Second, run the algorithm of the theory. Third, calibrate against an authorised, proven model. Measurements come last, as tests. All tests were fixed in advance. Independent judges recomputed the work with their own code.

The main results are these. The climate sits at depths 22 to 26 of the ladder: ground, water, weather, ozone layer and edge. Atoms sit at depth −6, molecules at −5, and the light through which they act on the climate at depths 2 and 5. Time layer 45 lasts 5.2 days. That is where measured weather in De Bilt turns into slower "macroweather", at 5 to 7 days. The closure rule of the theory, weather = −(ground + water), agrees with a radiation model built from laboratory spectral lines. It agrees in sign. In size it agrees up to the missing clouds.

Several attempts failed and are reported as they came out. Time series built from the net alone did not predict the weather after 1990. A model of cycles alone failed every test. The best physical model warms 0.16 to 0.44 degrees too much after 1990. Drought is not yet in the model. What remains open is a time rule and a starting state that follow from the theory itself, and the size of the tension in each layer.

*Keywords: Vacuum.Net theory, ternary ladder, closure, climate model, weather, macroweather, radiation from spectral lines, calibration, pre-registration, Respondent–Judge protocol*

## 1. Introduction

### 1.1 The question

The climate is changing. The public debate treats the change mostly as a matter of carbon dioxide. Money flows to projects such as storing carbon dioxide under the North Sea. Large parts of the world meanwhile suffer from hunger, and the main cause of acute hunger is conflict, not weather.[1]

People need something else from a climate model. They need to know how often heat, frost, heavy rain and drought will occur where they live. They need to know this per decade. That knowledge decides dikes, sewers, crop choice, water storage and cooling.

[1] FAO et al. (2026); Global Report on Food Crises (2025).

The question of this project was therefore simple. Can a climate model be built from the beginning of the Vacuum.Net theory, such that the weather on the long term comes out of it?

### 1.2 Why this theory

The Vacuum.Net theory reads nature as one closed strand of light that winds and crosses itself. What closes, remains. Its numbers are written in balanced ternary: −1, 0 and +1. The theory comes from physics. It descends from the quaternion form in which Maxwell wrote his equations, and from the nilpotent rewriting of Rowlands.[2][3]

Such a theory promises a climate model of a different kind. It does not start from energy as a substance that is burned and spent. It starts from oscillation, resonance and closure. Section 2 explains every term that this essay uses. No earlier knowledge of the theory is needed.

### 1.3 What this essay contains

- The theory, in brief (Section 2).
- The approach and its safeguards against bias (Section 3).
- Where the climate sits on the ladder (Section 4).
- The proven model used for calibration (Section 5).
- The calibration of the climate layers (Section 6).
- The rhythm of the weather (Section 7).
- All model runs and tests, including the failures (Section 8).
- Results that can be used for measures now (Section 9).
- What is open, and which errors were made (Section 10).

## 2. The Vacuum.Net theory in brief

### 2.1 One strand, three states

The theory starts from one strand. At each crossing of the strand there is a direction: one way, the other way, or no preference. These are written as +1, −1 and 0. Such a value is called a trit. A trit is not a quantity. It is a direction.

### 2.2 Windows and closure

Three neighbouring trits form a window. A window closes when the sum of its three trits is a multiple of three. Of the 27 possible windows, exactly 9 close:

- the empty window (0, 0, 0);
- the two uniform windows (+1, +1, +1) and (−1, −1, −1);
- the six windows that hold one of each value, such as (+1, 0, −1).

[2]Maxwell (1873).

[3]Rowlands (2007).

The rule of the theory is short: what closes, remains. A window that does not close carries tension. It passes that tension on.

## 2.3 The rewrite

The theory has one local rule of change. Each trit is replaced by minus the sum of its two neighbours:

$$R(t)_i = -(t_{i-1} + t_{i+1}) \quad (mod\ 3)$$

A ring in which every window closes does not change under this rule. A ring that does not close cycles. On a ring of $3^k$ places, the cycle lasts $3^k$ steps or a divisor of it.

## 2.4 The ladder of three

Each layer of the theory is three times larger than the one below. Layer n has length $3^n \cdot S_o$ and duration $3^n \cdot T_o$. The two units are fixed by the hydrogen atom:

$$S_o = 1/(2\ R_H) = 45.588\ nm \qquad T_o = S_o / c = 1.5207 \times 10^{-16}\ s$$

Here R_H is the Rydberg constant of hydrogen and c the speed of light. As a check, depth 2 is $9 \cdot S_o$ = 410.29 nm. That is the Hδ line of hydrogen.[4] The position of any object on the ladder is $\log_3$ of its size divided by $S_o$.

## 2.5 Three families

Every third layer belongs to the same family. The families are called A, B and C. Layers in one family carry the same kind of state. For the climate, family A holds ground, orbit and axis. Family B holds water and the slow swings of ocean and Sun. Family C holds weather and the sunspot rhythm.

## 2.6 The cube and the four theories

Three axes with a trit each give a cube of 27 cells. This cube is the Clifford algebra of three-dimensional space, Cl(3), written in signs.[5] Its 9 closing cells are the centre (the scalar, the reference), a hexagon of six cells (the rotating quaternion frame), and two corners (+I and −I, handedness). The same structure carries Maxwell's quaternions, Russell's octave and Larson's reciprocal system.[6][7]

From Larson this project takes two ideas. The natural zero is unity, where space and time are equal (s/t = 1). Change is a displacement from that unity.

## 2.7 Maxwell as the field form of the net

In the theory, Maxwell's equations are the field form of the net. The moduli of the medium (the capacity K, the conductivity C and the permeability μ) are functions of the local state. The displacement current is the term that makes every current close. Free charge is the residue of what does not close.[8] For the climate this means: radiation is closure between light and air. What does not close remains as tension.

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[4] Kramida et al., NIST Atomic Spectra Database.

[5] Hestenes (1999); Doran & Lasenby (2003).

[6] Larson (1959).

[7] Russell (1926).

[8] Maxwell (1873).

# 3. The approach

## 3.1 Three steps in a fixed order

The commissioner of this project set the order of work:

1. Compute at which level of the ladder the climate sits.
2. Let the algorithm of the theory run.
3. Only then calibrate.

## 3.2 What calibration means

Calibration here means setting a model with an authorised, proven model. It does not mean fitting a model to measurements. Two proven models serve this role:

- the hydrogen atom, for the units of length and time (Section 2.4);
- Maxwell's equations with Planck's law of radiation, for the climate.[9][10]

Measurements come after calibration. They serve as tests.

## 3.3 Safeguards against bias

Three safeguards were used.

- **Rules before results.** Every test was written down before the computation. Plans were hashed with a time stamp.
- **Independent judges.** In a Respondent–Judge round, three respondents built models without seeing each other's work. A judge for each respondent first ran its own test with its own code, and then checked every claim.
- **A bias judge.** A separate judge looked for bias in both directions: steam-engine language where none was needed, and unfair treatment of the complementary view.

The coordinator also wrote down his own expectation before the round. That made it possible to check afterwards whether he had been biased. He had been, as Section 8.5 shows.

# 4. Where the climate sits

## 4.1 The climate shell

The position of an object on the ladder is $\log_3(\text{size} / S_0)$. Table 1 gives the climate shell and what lies above it, up to the edge of the solar system.

| Layer | Family | What lies there | Position |
|---|---|---|---|
| 22 | A | ground and lowest air (1.4 km) | 22.04 |
| 23 | B | water (mean ocean depth 3.7 km) | 22.87 |
| 24 | C | weather layer, up to the tropopause (12.9 km) | 23.94 |

[9] Maxwell (1873).

[10] Planck (1901).

| | | | |
|---|---|---|---|
| 25 | A | crust and ozone layer (38.6 km) | 24.91 |
| 26 | B | edge of the atmosphere (116 km) | 25.87 |
| 27 | C | ionosphere | 26.87 |
| 28 | A | inner core of the Earth | 28.14 |
| 29 | B | outer core of the Earth | 29.10 |
| 30 | C | the Earth (radius) | 29.65 |
| 33 | C | orbit of the Moon | 33.38 |
| 34 | A | the Sun (radius) | 33.92 |
| 39 | C | orbits of Venus, Earth and Mars | 38.51–39.19 |
| 40 | A | orbit of Jupiter | 40.31 |
| 41 | B | orbits of Saturn and Uranus | 40.86–41.50 |
| 42 | C | orbit of Neptune, Kuiper belt | 41.91–42.37 |
| 43 | A | heliopause | 43.17 |
| 49 | A | Oort cloud, edge of the solar system | 48.66–48.87 |

Two things stand out. The orbits of Venus, Earth and Mars share layer 39. They lie in family C, with the weather layer. The edge of the solar system, one light year, sits at 48.87. That is the same number as the year in time, because one light year is what light covers in one year.

## 4.2 Elements and light

The climate debate speaks of carbon dioxide, ozone and water vapour as if they live in the climate layers. They do not. Table 2 places them on the same ladder.

| What | Depth | Family |
|---|---|---|
| atomic nucleus | −15 to −16 | — |
| atom (hydrogen, carbon, nitrogen, oxygen) | −6 | C |
| molecule (water, carbon dioxide, ozone) | −5 | A |
| sunlight; hydrogen lines Hδ 410 nm and Hα 656 nm | 2 | B |
| light of the Earth: ozone band 9.6 µm, window 11.08 µm, $CO_2$ bending 15 µm | 5 | B |
| rotating water molecule (about 25 µm) | 6 | C |
| climate shell | 22–26 | A, B, C, A, B |

An element does not enter the climate as a substance. It enters through its winding of light: at depth 2 for sunlight and at depth 5 for the light of the Earth. Between the molecule and the climate lie 27 layers. The chain runs element (−6), molecule (−5), light (2 and 5), climate shell (22–26). Each step passes through the families.

## 4.3 The climate in time

The same ladder gives durations. One day sits at position 43.50 and one year at 48.87. Table 3 gives the layers of family C, the family of the weather.

| Layer | Duration $3^n \cdot T_0$ | Reading |
|---|---|---|
| 45 | 5.20 days | one weather state |
| 48 | 140 days | the rhythm of about 154 days |
| 51 | 10.4 years | sunspots and Jupiter |
| 54 | 280 years | the long solar wave (about 208 years) |
| 57 | 7,700 years | the deepest weather layer |

## 5. The proven model: radiation from spectral lines

### 5.1 Construction

The proven model for the climate is Maxwell with Planck. Its content is the spectroscopy of molecules, measured in the laboratory. A column radiation model was built from first principles:

- Line data for water vapour, carbon dioxide and ozone come from HITRAN.[11] Every line is drawn with a Voigt shape.
- The lines are grouped into correlated-k tables per band, pressure and temperature.[12]
- The light of each layer follows Planck's law. The two-stream equation of Schwarzschild carries it up and down.
- The humidity profile follows Manabe and Wetherald.[13]

### 5.2 Checks against measurement

The model reproduces the measured light of the Earth.

- Outgoing light at the top, clear sky: 269 W/m². Satellites give about 266.
- Light returned to the ground, clear sky: 311 W/m². The measured value is about 314.
- A doubling of carbon dioxide gives an adjusted forcing of 4.63 W/m². The analytic theory gives a similar value.[14]
- The stratosphere cools by 8 degrees at 10 hPa and by 11 degrees at 3 hPa per doubling.
- The clear-sky feedback is 1.98 to 2.47 W/m² per degree. With the cloud and ice terms of the IPCC, the climate sensitivity is 2.3 to 3.3 degrees per doubling.

Water vapour grows with temperature. From the Magnus formula the growth is 7.3 % per degree at 0 °C, 6.5 % at 15 °C and 6.0 % at 27 °C.[15] Heavy rain grows with it.

[11] Gordon et al. (2022).

[12] Lacis & Oinas (1991).

[13] Manabe & Wetherald (1967).

[14] Jeevanjee et al. (2021).

[15] Alduchov & Eskridge (1996).

### 5.3 The language of this model

This model is a model of resonance. A molecule of carbon dioxide bends and vibrates at a fixed frequency, 667 $cm^{-1}$ (15 µm). It catches light of exactly that frequency. The model counts many thousands of such resonances, line by line. It contains no heat engine.

## 6. Calibrating the climate shell

### 6.1 Method

The net gives the layers, the families and the closure. The proven model gives the size of the tension in each layer. The tension of a layer is the change of net light flowing into it when the shell is disturbed. The disturbance used is a doubling of carbon dioxide, from 280 to 560 ppm, with temperatures held fixed. Ground and water share the surface by area: land 29 %, sea 71 %.

### 6.2 Result

| Layer | What | Tension (W/m²) | Trit |
|---|---|---|---|
| 22 | ground | +0.83 | +1 |
| 23 | water | +2.02 | +1 |
| 24 | weather layer (1.4–12.9 km) | +2.08 | +1 |
| 25 | ozone layer (12.9–38.6 km) | −1.45 | −1 |
| 26 | edge (less light leaves) | +3.47 | +1 |

Three findings follow.

4. **The closure rule agrees.** The rule weather = −(ground + water) gives +1 for layer 24. The proven model gives +1. The window (22, 23, 24) closes.
5. **The shell closes as a whole.** The inflows of all layers sum to zero. What one layer gains, another gives up.
6. **The two higher windows do not close.** The windows (23, 24, 25) and (24, 25, 26) stay open. There the ozone layer cools while the rest warms.

Sunlight was then added per layer, with the absorption of ozone and water vapour from Lacis and Hansen.[16] Sunlight does not change the result for the disturbance. It does show the size of the base state. Ground and water together receive +70.4 W/m² of net light. The weather layer loses 101.7. The gap of 31.3 is almost exactly the clear-sky shortfall at the edge of the model (34.5), which exists because the model has no clouds. Measured at the edge, all sky, the shortfall is about +1, in the other direction.[17][18]

What ground and water receive in excess, the weather layer carries away. That carrying is the weather itself: rising air, clouds and showers. The radiation model does not compute that motion.

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[16] Lacis & Hansen (1974).

[17] Loeb et al. (2021).

[18] Trenberth, Fasullo & Kiehl (2009).

The closure rule of the net describes exactly that closure. Up to the clouds it holds in size as well as in sign.

### 6.3 Read against the formal model

The formal model sets the standard. The physical model is tested against it. Read that way, the physical model passes on the window of ground, water and weather. It is incomplete on the two higher windows. The candidates for the missing part are the flow between the layers and the adjustment of the stratosphere.

## 7. The rhythm of the weather

### 7.1 The prediction

Layer 45 of the ladder lasts $3^{45} \cdot T_0 = 5.20$ days. If the ladder describes the weather, one weather state should last about that long. Beyond it, the weather should turn into a slower regime.

### 7.2 The measurement

Weather and climate are one process, read at different depths. Hasselmann showed that slow climate variation is weather summed by the ocean.[19] Lovejoy and Schertzer showed one cascade across scales, with a weather regime up to about ten days and "macroweather" beyond.[20] The limit of weather prediction lies at about two weeks.[21]

The fluctuation method of Haar was applied to the daily mean temperature in De Bilt.[22] The fluctuations grow up to a peak and then fall. The peak lies at 7 days for 1951–2025 and at 5 days for 1982–2011.

### 7.3 Reading

The transition of the measured weather falls on layer 45 of the ladder, without calibration. This is the strongest sign in this project that the ladder touches something real. It needs a sharper test on many stations. The transition moves with the period chosen, from 5 to 7 days. A band of 5.2 to 15.6 days, fixed in advance, held for one period and missed by a hair for the other.

## 8. Model runs and tests

All tests in this section were fixed before the computation. Calibration ran on data up to 1990. Tests ran on 1991–2025, which the models did not see.

### 8.1 Weather from the net alone

Four attempts built a time series of the weather from the rules of the net.

| Attempt | What it did | Outcome |
|---|---|---|

[19] Hasselmann (1976).

[20] Lovejoy & Schertzer (2013).

[21] Lorenz (1969).

[22] KNMI, daily data station 260 De Bilt.

| | | |
|---|---|---|
| netweer v0.1 | Sun from orbital geometry, air as memory, a ×3 cascade of closing windows | failed all three tests |
| netweer v0.2 | as v0.1, with a closure depth of $3^2 = 9$ days and air plus sea | failed; the 9-day prediction matched the data, the model did not |
| ladder periods | the rewrite on rings gives the ladder itself; strength and phase per period fitted | failed G1, G2 and G3 |
| phase calibration | only the starting phase per window fitted, on air pressure in De Bilt | failed; the slowest window scored 0.51 against 0.46 by chance ($p = 0.30$) |

The lesson is clear. Equal tension per layer gives a flat spectrum. Real weather has a hump at about one week. Closing within one triple only averages inside that triple. Above the transition the strength must fall.

## 8.2 The model alone, with Larson

Two further runs used no measurement at all. Larson's unity (trit 0) served as the starting state. Larson's progression served as the time rule. These runs give the rhythm of the weather. They do not give dates. The dates depend on a starting moment that the theory does not yet fix. Shifting it by one year shifts every date.

## 8.3 The Respondent–Judge round

Three respondents built models independently.

- **A, the physical model.** The radiation model of Section 5, an ocean in two layers, and the published forcings of the sun, gases, volcanoes and aerosols.[23][24][25]
- **B, the complementary model.** The climate built only from cycles: Sun, planets, Moon, orbit and El Niño. No energy balance and no carbon dioxide.
- **C, the weather layer.** The daily temperature distribution of 1951–1990, shifted with the annual mean. Rain is scaled with the growth of water vapour.

| Model | Global, error (G1) | Global, rise since 1990 (G2) | De Bilt (N1) | Judge |
|---|---|---|---|---|
| A physical | passes narrowly (0.341 against 0.349) | fails: 0.44 degrees too warm | passes | calculations reliable, report honest |
| B cycles | fails | fails | fails | confirmed; a fairer solar-driven variant also fails |
| C weather | — | — | warm days, frost days and heavy rain pass; dry spells fail | passes only if the annual temperature is right |

[23] Held et al. (2010); Geoffroy et al. (2013).

[24] Forster et al. (2025).

[25] Morice et al. (2021).

The judge of A found the cause of the warm bias. The fit chose the edge of the sensitivity range and the lowest heat capacity of the deep ocean. With a feedback of 1.70 and a normal deep ocean, the error falls to +0.08. That choice was made after seeing the data, so it counts only as a diagnosis.

### 8.4 An existing model through the same tests

The intermediate-complexity model SPEEDY was run for 30 years with observed sea temperatures.[26][27] It passed one of five tests: the shape of the extremes. It placed the transition of the weather at 25 days, not 5 to 7. It does get the seasonal cycle and the warmest day of the year much closer than the net model. Its grid of about 400 km lacks small, fast weather.

### 8.5 The bias judge

The bias judge found the main tilt in the plan, not in the respondents.

- The plan made B the opposite of A, instead of its complement. Rowlands' space plus antispace equal to zero asks for the two together. The plan excluded that.
- B was not allowed a slow component that is not a cycle. That largely fixed its failure in advance.
- The coordinator's own expectation was visible to the respondents.
- Fairness scores: A 8, B 8.5, C 7, the plan 5.5.

The expectation was right where it could not fail (B) and wrong where it could (A on G2).

## 9. Results that can be used now

### 9.1 Global warming per pathway

The physical model with feedback 1.70 gives, for 2091–2100 relative to 1850–1900:

- 1.9 degrees if concentrations stay at the 2025 level;
- 3.0 degrees on a middle pathway (SSP2-4.5);
- 1.9 degrees on a low pathway (SSP1-2.6).

This variant is still slightly too warm after 1990. Read it as an upper side. FaIR, the emulator used in IPCC assessments, gives 3.2 degrees on the middle pathway.[28][29] Even if nothing changes, 0.3 to 0.6 degrees of further warming is already committed.

### 9.2 The weather in De Bilt

At an annual mean 2 degrees above 1951–1990, which is about the level of today, the weather layer gives per year:

| Quantity | 1951–1990 | at +2 degrees | at +4 degrees |
|---|---|---|---|

[26] Molteni (2003).

[27] Kucharski et al. (2013).

[28] Leach et al. (2021).

[29] Meinshausen et al. (2020).

| | | | |
|---|---|---|---|
| days with mean temperature ≥ 20 °C | 10.7 | 26.1 | 55.3 |
| days with mean temperature < 0 °C | 25.7 | 13.4 | 6.8 |
| days with ≥ 20 mm rain | 4.0 | 5.7 | 7.9 |

The judge of C confirmed these numbers. Warm days are the most reliable. Frost days are less reliable, because cold years in the past were cold through cold winters. For heavy rain the table rests on the growth of water vapour, which the data before 1990 did not yet confirm. Use it as a lower bound for sewer capacity, with a margin. Values beyond +1.3 degrees are extrapolation.

### 9.3 The coming year

A very strong El Niño is under way. All 22 models of the IRI ensemble expect it to stay very strong through February 2027.[30] A regression of global temperature on the El Niño index, fixed in advance and tested on 2015–16, gives 1.20 to 1.22 degrees for 2027 at the surface (HadCRUT5), above the record of 1.17 in 2024.[31] The El Niño adds about 0.1 degrees. In the lower troposphere the effect peaks in March to May 2027.

### 9.4 Drought

Drought is a shortage of water where water is needed. It depends on two things: how much rain falls, and what ground and landscape do with it. Sand drains fast. Clay holds water. Peat acts as a sponge. Lakes, rivers, the sea and groundwater can supply water. The model holds only the first part, and even there it fails: it does not link a warmer year to longer dry spells. For water storage, use the measured values of 1991–2025 until a soil and water layer exists.

## 10. Discussion

### 10.1 What the net contributes

- A map of where the climate sits, from the atom to the edge of the solar system.
- The duration of one weather state, 5.2 days, from the ladder alone.
- A closure rule for ground, water and weather that agrees with the proven model in sign, and in size up to the clouds.
- A filled register of tension per layer, calibrated with Maxwell and Planck.

### 10.2 What is open

- **A time rule and a starting state.** The theory gives rhythms. It does not yet say where in each rhythm we stand. Without that, no dates follow.
- **The register of size.** The cube of Section 2.6 carries signs. Sizes so far come only from the proven model.
- **The higher windows.** The windows (23, 24, 25) and (24, 25, 26) do not close in the physical model.

[30] IRI ENSO forecast (2026); NOAA CPC ENSO diagnostic discussion, 8 October 2026.

[31] Morice et al. (2021); Copernicus Climate Change Service (2026).

- **Clouds.** They are input, not derived. They close the gap of Section 6.2.
- **Drought.** A soil and water layer is missing.

### 10.3 Errors made in this project

Four errors are reported, because they shaped the results.

7. **Levels were mixed.** Molecules and processes (carbon dioxide, ozone, rising air) were placed directly in the climate layers. They belong at depths −5, 2 and 5. Section 4.2 corrects this.
8. **Calibration was first done against measurements.** It should have been done against the proven model. Section 6 does it the right way.
9. **A starting state was chosen by hand.** The dates of Section 8.2 came from that choice, not from the theory.
10. **The plan of the Respondent–Judge round was tilted.** It set the complementary model up as an opponent.

An earlier article on the same model also contained an error that this project found. The beat of 96.6 years does not come from the periods 11.067 and 19.859 years directly. Their beat is 25.0 years. The 96.6 years come from 11.067 and half of 19.859 (9.93 years).

## 11. Conclusion

The project set out to build a climate model from the beginning of the Vacuum.Net theory, from which the long-term weather follows. That goal is reached in part.

The net says where the climate sits, how long one weather state lasts, and how ground, water and weather close. Calibrated with Maxwell and Planck, the closure holds. The duration of a weather state matches the measured turn of the weather. These results came from the ladder and the rules, not from fitting.

The net does not yet say which weather comes on which date. For that, the theory needs a time rule and a starting state of its own, and a register of size. Those are the next steps. They lie in the theory, not in more measurement.

Until then, the physical results of this project can serve measures now. They give the global warming per pathway, the weather in De Bilt per degree, and the coming record year. Each comes with its limits.

## Annotated references

The footnotes refer to this list. Each entry gives the source and then says what it carries in this article and where to read on.

Alduchov, O. A. & Eskridge, R. E. (1996). Improved Magnus form approximation of saturation vapor pressure. Journal of Applied Meteorology 35, 601–609.
*The formula used to compute how much water vapour air holds per degree. Use it to check the 6–7 % per degree in Sections 5.2 and 9.2.*

Copernicus Climate Change Service (2026). Climate bulletin, October 2026.
*October 2026 was the warmest October on record, 1.75 degrees above 1850–1900. The quickest monthly check on the state of the year.*

Doran, C. & Lasenby, A. (2003). Geometric Algebra for Physicists. Cambridge University Press.
*A clear modern account of Cl(3), bivectors and rotors. Read it to see why the trit cube of Section 2.6 has the structure of space.*

FAO, IFAD, UNICEF, WFP & WHO (2026). The State of Food Security and Nutrition in the World 2026. FAO, Rome.
*About 645 million people faced hunger in 2025, the third year of decline. The background for why measures must reach people, not only projects.*

Forster, P. M. et al. (2025). Indicators of Global Climate Change 2024. Earth System Science Data 17, 2641.
*The yearly update of human-caused forcing and warming. Respondent A used its forcing time series. The data are open on GitHub and Zenodo.*

Geoffroy, O. et al. (2013). Transient climate response in a two-layer energy-balance model. Part I. Journal of Climate 26, 1841–1857.
*Parameter values for the two-layer ocean fitted to many climate models. The source of the priors in Section 8.3.*

Global Network Against Food Crises (2025). Global Report on Food Crises 2025.
*Conflict was the leading driver of acute hunger in 2024, ahead of economic shocks and weather extremes. Read it to place climate measures among other causes of hunger.*

Gordon, I. E. et al. (2022). The HITRAN2020 molecular spectroscopic database. Journal of Quantitative Spectroscopy and Radiative Transfer 277, 107949.
*The laboratory line data behind the proven model of Section 5. Every absorption line of water vapour, carbon dioxide and ozone used here comes from this database.*

Hasselmann, K. (1976). Stochastic climate models. Part I: Theory. Tellus 28, 473–485.
*The classic argument that slow climate variation is fast weather summed by the ocean. It supports reading climate and weather as one process.*

Held, I. M. et al. (2010). Probing the fast and slow components of global warming by returning abruptly to preindustrial forcing. Journal of Climate 23, 2418–2427.
*Introduces the two time scales of the ocean response. The basis of the two-layer model of Respondent A.*

Hestenes, D. (1999). New Foundations for Classical Mechanics, 2nd edition. Kluwer, Dordrecht.
*The founding text of geometric algebra in physics. Read it for the link between quaternions, rotations and the algebra of space.*

IRI, Columbia University (2026). ENSO forecast, November 2026.
*All 22 models forecast a very strong El Niño through February 2027. The source for Section 9.3.*

Jeevanjee, N., Seeley, J. T., Paynter, D. & Fueglistaler, S. (2021). An analytical model for spatially varying clear-sky CO2 forcing. Journal of Climate 34, 9463–9480.
*Derives the carbon dioxide forcing from the shape of the 15 µm band. An independent check on the 4.63 W/m² of Section 5.2.*

KNMI (2026). Daily weather data, station 260 De Bilt. Royal Netherlands Meteorological Institute.
*Daily temperature, rain, pressure and evaporation since 1901. The measurement series behind Sections 7 and 9.2. KNMI notes that the series is not homogenised.*

Kramida, A., Ralchenko, Yu., Reader, J. & NIST ASD Team. NIST Atomic Spectra Database. National Institute of Standards and Technology.

*The reference values of the hydrogen lines. Use it to check that depth 2 of the ladder falls on Hδ at 410.2 nm.*

Kucharski, F. et al. (2013). On the need of intermediate complexity general circulation models: a "SPEEDY" example. Bulletin of the American Meteorological Society 94, 25–30.
*Describes SPEEDY and what it can and cannot do. The model run in Section 8.4.*

Lacis, A. A. & Hansen, J. E. (1974). A parameterization for the absorption of solar radiation in the Earth's atmosphere. Journal of the Atmospheric Sciences 31, 118–133.
*The absorption of sunlight by ozone and water vapour used in Section 6.2. Still a standard reference for simple models.*

Lacis, A. A. & Oinas, V. (1991). A description of the correlated k distribution method for modeling nongray gaseous absorption, thermal emission, and multiple scattering in vertically inhomogeneous atmospheres. Journal of Geophysical Research 96, 9027–9063.
*The method that turns millions of lines into a few numbers per band. Used to build the tables of Section 5.1.*

Larson, D. B. (1959). The Structure of the Physical Universe. North Pacific Publishers, Portland.
*The reciprocal system: space and time as two aspects of one motion, with unity as the natural zero. The source of the starting state in Section 8.2.*

Leach, N. J. et al. (2021). FaIRv2.0.0: a generalized impulse response model for climate uncertainty and future scenario exploration. Geoscientific Model Development 14, 3007–3036.
*The emulator used in IPCC assessments. Run in this project as an independent check on the projections of Section 9.1.*

Loeb, N. G. et al. (2021). Satellite and ocean data reveal marked increase in Earth's heating rate. Geophysical Research Letters 48, e2021GL093047.
*The measured imbalance at the top of the atmosphere, about +1 W/m². The reference against which the clear-sky edge of Section 6.2 is read.*

Lorenz, E. N. (1969). The predictability of a flow which possesses many scales of motion. Tellus 21, 289–307.
*Shows why weather cannot be predicted much beyond two weeks. The physical background of the transition in Section 7.*

Lovejoy, S. & Schertzer, D. (2013). The Weather and Climate: Emergent Laws and Multifractal Cascades. Cambridge University Press.
*One cascade from weather through macroweather to climate, measured with Haar fluctuations. The method of Section 7.2.*

Manabe, S. & Wetherald, R. T. (1967). Thermal equilibrium of the atmosphere with a given distribution of relative humidity. Journal of the Atmospheric Sciences 24, 241–259.
*The first sound column model of the greenhouse effect. Its humidity profile is used in Section 5.1.*

Maxwell, J. C. (1873). A Treatise on Electricity and Magnetism. Clarendon Press, Oxford.
*Maxwell wrote his equations in quaternions (Articles 591–619). The field form from which the Vacuum.Net theory descends and the first proven model of this project.*

Meinshausen, M. et al. (2020). The shared socio-economic pathway (SSP) greenhouse gas concentrations and their extensions to 2500. Geoscientific Model Development 13, 3571–3605.
*The concentration pathways used for the projections in Section 9.1.*

Molteni, F. (2003). Atmospheric simulations using a GCM with simplified physical parametrizations. I: Model climatology and variability in multi-decadal experiments. Climate Dynamics 20, 175–191.
*The original description of SPEEDY. Read it to judge the comparison in Section 8.4.*

Morice, C. P. et al. (2021). An updated assessment of near-surface temperature change from 1850: the HadCRUT5 data set. Journal of Geophysical Research: Atmospheres 126, e2019JD032361.
*The global temperature series used for calibration and tests. Calibration ran up to 1990, tests on 1991–2025.*

Planck, M. (1901). Ueber das Gesetz der Energieverteilung im Normalspectrum. Annalen der Physik 309, 553–563.
*The law of thermal radiation. Together with Maxwell it forms the proven model used to set the size of each climate layer.*

Rowlands, P. (2007). Zero to Infinity: The Foundations of Physics. World Scientific, Singapore.
*The nilpotent rewriting of physics: space plus antispace equals zero. A root of the Vacuum.Net theory and of the complementary view discussed in Section 8.5.*

Russell, W. (1926). The Universal One. University of Science and Philosophy.
*The octave of Russell, read in Section 2.6 as a form of the same graded structure.*

Trenberth, K. E., Fasullo, J. T. & Kiehl, J. (2009). Earth's global energy budget. Bulletin of the American Meteorological Society 90, 311–323.
*The budget of sunlight, light of the Earth and rising heat. It shows the size of what the weather layer carries away in Section 6.2.*