# Cycles, Not Lines

The Vacuum.Net model of the climate compared with the integrated assessment model of Detlef van Vuuren, and what follows for climate policy

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## Abstract

This essay compares two models of the climate. The first is built from the Vacuum.Net theory. It describes nature as one network of windings. Each winding has a fixed cycle. The second is IMAGE, the integrated assessment model that Detlef van Vuuren has shaped for two decades. IMAGE describes a chain from society to emissions to climate to damage. It runs along a straight line of time to the year 2100.

We first explain the Vacuum.Net model step by step. We show what it computes: a cycle for every depth, a duration for every cycle, and a short list of depths where the cycles are pure. One of them lasts about a year. The next lasts eighteen years. A longer one lasts about fifteen thousand years. One calibration on the orbit of the Earth sets all of them.

We then describe IMAGE from its own documentation. We place its scales on the same ladder. Two links of its chain join depths whose cycles do not close together. These are the step from regional emissions to the global climate and the step from local damage back to regional money. Time in IMAGE is a line. Cycles are averaged away. The Sun is an input series.

We end with the consequences for climate policy and with six proposals. All numbers were recomputed by independent judges with their own code.

*Keywords:* Vacuum.Net theory, climate cycles, IMAGE, integrated assessment, Van Vuuren, MAGICC, scenarios, climate policy, calibration

## 1. Purpose

Climate policy rests on models. The most influential are integrated assessment models. They link the economy to the climate. IMAGE, built by PBL Netherlands Environmental Assessment Agency, is one of the leading ones. Detlef van Vuuren has led much of its scenario work. He co-designed the scenario frameworks used by the IPCC. In 2026 he led the design of the scenarios for the next generation of climate models.

This essay asks one question. What does IMAGE leave out when it is read against a model built on cycles? To answer, we first set out the Vacuum.Net model in full. Then we describe IMAGE. Then we show where the two do not fit, and what that means for policy.

## 2. The Vacuum.Net model

All statements in this section come from the Foundational Paper of the theory (Konstapel 2026a). Numbers are referred to by the theorem labels of that paper.

### 2.1 One strand, three directions

The theory starts from one closed strand that crosses itself. At each crossing the strand has one of three directions. They are written +, 0 and −. A string of such directions is the state of the network.

A plain example helps. Think of three people at a table. Each can push for a plan, push against it, or stay neutral. The table is settled when the pushes cancel out.

## 2.2 Windows and closure

Three neighbouring crossings form a window. Count + as 1 and − as −1. A window closes when the sum of its three values is a multiple of three. Exactly 9 of the 27 possible windows close (T9). They are the windows whose three values are all equal or all different (T10).

## 2.3 One rule of change

The network changes by one rule (T14). Each crossing takes minus the sum of its two neighbours, counted modulo three. All crossings change at once. Nothing else is added. There is no chance and no outside force. The same start always gives the same future. The model is deterministic.

A ring in which every window closes does not change. Every other ring moves on. Because a ring has finitely many states, it must return to an earlier state. From then on it repeats. That repeat is its cycle.

## 2.4 A worked example

Take a ring of five crossings. Start with one + and four zeros. Table 1 shows what the rule does.

**Table 1. The rule on a ring of five crossings. After eight steps the start returns.**

| Step | Ring of five crossings |
|---|---|
| 0 | + 0 0 0 0 |
| 1 | 0 − 0 0 − |
| 2 | − 0 + + 0 |
| 3 | 0 0 − − 0 |
| 4 | 0 + + + + |
| 5 | + − + + − |
| 6 | − + 0 0 + |
| 7 | + + − − + |
| 8 | + 0 0 0 0 |

The push spreads to both sides at once. It has no preferred direction. After eight steps the ring is back where it began. Nobody chose the number eight. It follows from the rule and the size of the ring.

## 2.5 Depth is a number of windings

The network repeats its construction at every scale (axiom N5). Each step to the next depth multiplies the number of states by three. A state at depth n consists of n sites, one for each winding (T7). Depth is therefore a count of windings. It starts at the first winding. There are no negative depths.

Sizes in the network are ratios. Each winding is three times the one before. The model itself is dimensionless (Part VII of the paper).

## 2.6 Units and the speed of light

For comparison with instruments, the paper fixes one length and one time by hydrogen (Part VII.2). The length is $S_0 = 45.588$ nm. The time is $T_0 = S_0/c = 1.5207 \times 10^{-16}$ s, where c is the speed of light. A winding at depth n has length $3^n \cdot S_0$.

Light runs through each winding. One pass through a winding at depth n therefore lasts $3^n \cdot T_0$. This gives the network its time rule. One step of the rule at depth n lasts $3^n \cdot T_0$. Space and time are one ladder. A winding is at once a distance and a duration.

### 2.7 Two ladders

The network carries two ladders: one of factor three and one of factor two. They never meet exactly, because a power of two is even and a power of three is odd (T15). Their best near-meetings are the closure depths 1, 2, 5, 12, 41, 53, 306 (T16). At depth 12 they miss by the Pythagorean comma (T17). Between the closure depths, nothing closes better.

## 3. What the model computes

### 3.1 The cycle of every depth

We computed the cycle of the rule for every depth from 3 to 81. The method is exact. It uses the algebra of polynomials over three values (Lidl and Niederreiter 1997). It does not depend on the starting state. For depths 3 to 11 we also followed every possible state one by one. Both methods agree. The structure of such cycles on rings is known from the study of simple additive rules (Martin, Odlyzko and Wolfram 1984).

**Table 2. The cycle of the rule at selected depths.**

| Depth | Cycle (steps) | Remark |
|---|---|---|
| 5 | 8 | the ring of Table 1 |
| 9 | 9 | a power of three: cycle equals depth |
| 27 | 27 | a power of three |
| 37 | 19,682 | $= 3^9 - 1$ |
| 45 | 72 | $= 2^3 \cdot 3^2$ |
| 48 | 48 | $= 2^4 \cdot 3$ |
| 53 | 2,541,865,828,328 | $= 3^{26} - 1$ |
| 54 | 54 | $= 2 \cdot 3^3$ |
| 81 | 81 | a power of three |

Most depths have cycles with large and irregular factors. A few have cycles built only from twos and threes. At those depths the two ladders of Section 2.7 meet cleanly. We call them pure depths.

### 3.2 From steps to time

With the time rule of Section 2.6, the cycle of depth n lasts its number of steps times $3^n \cdot T_0$. Table 3 lists the pure depths with cycles between a second and millions of years.

**Table 3. Pure depths and the duration of their cycles.**

| Depth | Cycle | Duration before calibration |
|---|---|---|
| 30 | $2^3 \cdot 3$ | 0.75 seconds |
| 36 | $2 \cdot 3^2$ | 6.9 minutes |
| 45 | $2^3 \cdot 3^2$ | 374.4 days |
| 48 | $2^4 \cdot 3$ | 18.45 years |
| 54 | $2 \cdot 3^3$ | about 15,100 years |
| 60 | $2^4 \cdot 3$ | about 9.8 million years |

Between depth 36 and depth 48, depth 45 is the only pure depth. Its cycle is $2^3 \cdot 3^{47} \cdot T_0$. That is 374.4 days. It is the year of the network. Depth 48 lasts exactly eighteen of these years, because $48 \cdot 3^{48}$ equals 18 times $72 \cdot 3^{45}$.

### 3.3 Calibration on a proven model

The method has three steps. First the depth is fixed. Then the rule runs. Only then is the model set with one proven model. Measurements come last, as tests.

The proven model here is the orbit of the Earth. Its tropical year lasts 365.2422 days (Meeus 1998). One constant sets the year of the network equal to it: k = 365.2422 / 374.37 = 0.9756. The same constant applies to every cycle. Nothing else is adjusted.

**Table 4. Cycles after one calibration on the orbit of the Earth.**

| Depth | Calibrated cycle | Note |
|---|---|---|
| 45 | 1 year | set by the calibration |
| 48 | 18 years (6,574 days) | follows; not adjusted |
| 54 | 14,762 years | follows |
| 60 | 9.57 million years | follows |

The eighteen years were not fitted. They follow from the structure of the network. As a check against proven celestial mechanics: the Saros cycle of Sun, Moon and Earth lasts 6,585.3 days (Espenak and Meeus 2006). The network gives 6,574 days. The difference is 11 days.

## 4. The model of Van Vuuren

### 4.1 IMAGE

IMAGE is an integrated modelling framework of interacting human and natural systems (Stehfest et al. 2014; PBL, IMAGE framework). It computes population, economy, energy, food, land, emissions and climate.

Its scales are set out in its documentation. Socio-economic processes run in 26 world regions. Land use runs on a grid of 5 by 5 arc minutes, about 9 km. Plant growth, carbon and water run on 30 by 30 arc minutes, about 55 km. The human system and the Earth system run in annual or five-year steps. The documentation says the focus is on long-term trends. The model runs to 2050 or 2100 (PBL, IMAGE framework summary; IAMC documentation).

### 4.2 The climate inside IMAGE

IMAGE does not compute the climate itself. It uses MAGICC 6, a simple climate model tuned to reproduce more complex models (Meinshausen et al. 2011). MAGICC works as an energy balance. A forcing in watts per square metre enters. Heat is taken up by the ocean. Temperature rises. The global result is spread over the map with fixed patterns from large climate models.

### 4.3 The chain

Van Vuuren has drawn the structure of IMAGE as a chain: economic activity, emissions, climate change on the globe and the grid, physical impacts per sector, and monetary impacts (Van Vuuren 2014).

### 4.4 Scenarios

The future in IMAGE is explored with scenarios. The Shared Socioeconomic Pathways describe five possible worlds (O'Neill et al. 2014; Riahi et al. 2017). Policy variants are added on top. For the new round of climate models, Van Vuuren led a set of seven scenarios, from very low to high emissions. They give a warming in 2100 from about 1.5 °C to almost 3.5 °C (Van Vuuren et al. 2026a). In that design, future solar activity enters as an input series.

### 4.5 Recent work

IMAGE now adds the impacts of climate change on labour, economy and other sectors (Van Vuuren et al. 2026b). Others in the field call for impacts to feed back into the scenarios, to close the loop (Tebaldi et al. 2026).

## 5. The two models side by side

**Table 5. The two models compared.**

| Aspect | Vacuum.Net | IMAGE |
|---|---|---|
| Basic form | a network of windings | a chain of modules |
| Time | cycles; every depth has its own | a line of 1- or 5-year steps to 2100 |
| Rule | one deterministic rule | many sector models and scenarios |
| Climate | depths with cycles | energy balance (MAGICC) |
| Sun | depths above the Earth, part of the network | an input series |
| Resolution | each winding | averages per region, grid cell and step |
| Decision maker | a winding inside the network | outside: chooses the scenario |
| Calibration | one constant on a proven model | tuning to complex models |

The author calls the right-hand column steam-engine thinking. Something enters, something is stored, something comes out, along a line of time. The left-hand column describes cycles inside cycles.

## 6. Where the two do not close

### 6.1 The scales of IMAGE on the ladder

We place the scales of IMAGE on the ladder of Section 2.6. Each size is divided by $S_0$. The depth is the number of factors of three, rounded.

**Table 6. The scales of IMAGE on the ladder of three.**

| Scale used by IMAGE | Depth | Role |
|---|---|---|
| grid, 5 arc minutes | 24 | land use, local impacts |
| grid, 30 arc minutes | 25 | climate on the map, impacts |
| one of 26 regions | 29 | economy, emissions, money |
| the whole Earth | 31 | global climate (MAGICC) |
| step of 1 year | 49 | annual steps |
| step of 5 years | 50 | five-year steps |
| 1970–2100 | 53 | the scenario period |

The chain runs through space as 29 → 31 → 25 → 29. It starts and ends at the region.

### 6.2 Two links whose cycles do not close together

Two depths return to their start together only at the common multiples of their cycles. The larger their common divisor, the more often they return together. Table 7 gives the common divisor of the cycles along the chain.

**Table 7. Common divisors of the cycles of the depths of IMAGE.**

| Link | Common divisor | Result |
|---|---|---|
| region (29) → Earth (31) | 2 | do not close together |
| Earth (31) → grid (25) | 242 | close together |
| grid (25) → region (29) | 8 | do not close together |
| region (29) ↔ 1 year (49) | 2,186 | close together |
| grid (25) ↔ 5 years (50) | 59,048 | the same cycle |

Two links of the chain do not close. The first is the step from regional emissions to the global climate. This is the step IMAGE hands over to MAGICC. The second is the step from local physical damage back to regional money. Only the middle link, from the Earth to the grid, closes.

An independent judge tested 27 variants of the measures and the rounding. In all of them the region and the Earth share a divisor of 2 or 8, never more.

### 6.3 What joins the parts lies far above the Earth

Among depths 3 to 81 only one depth shares a large divisor with the region, the Earth and the grid. It is depth 71. On the ladder, depth 70 to 72 is the size of the observable universe. IMAGE stops at depth 31.

### 6.4 Time

IMAGE steps through time in years and five-year blocks. The network has a pure cycle of eighteen years. Five does not divide eighteen. Each five-year step therefore cuts the cycle at a different phase. The rhythm disappears from view. The horizon 2100 lies about 73 years ahead. That is about four cycles of eighteen years, not a natural point of the network.

### 6.5 Cycles that are averaged away

IMAGE averages within regions, grid cells and time steps. The Sun enters as a series of numbers. The planets and the Moon do not appear. In the network these are depths with their own cycles. They do not average out. They are the structure.

## 7. Consequences for policy

Climate policy follows the chain. It sets national emission budgets. It aims at a global temperature. It names a target year.

1. National budgets act at the regional depth. The target is the global temperature at the depth of the Earth. Between them lies the link whose cycles do not close. The network therefore does not support a direct lever from national budgets to global temperature.
2. A target year is a point on a line. In the network, time returns in cycles of one year, eighteen years and about fifteen thousand years. A target that ignores the phase of those cycles can be met or missed for reasons that have nothing to do with policy.
3. Averages remove the rhythm. A policy built on averages sees a trend where the network shows a cycle.
4. The model places the decision maker outside the system. In the network the government, the negotiators and the modellers are windings inside it. They move with the cycles they try to steer.
5. IMAGE does not know the cycles computed here. They are new. The cause of the gap is not neglect. It is that the knowledge was not available.

## 8. What we propose

6. Plan in cycles. Replace fixed target years by rounds of eighteen years, set within the longer cycle. Review each round at its end.
7. Do not rest policy on the region-to-globe link alone. Measures that act at the regional depth should be judged at the regional depth, where their effect closes.
8. Bring the Sun and the depths above the Earth into the climate model as part of the network, not as an input series.
9. Treat governments, institutions and modellers as part of the system that the model describes.
10. Test the cycles of the network against long series before large commitments are made. A suitable first test is the daily record of De Bilt from 1901 onwards.
11. Weigh climate spending against direct human needs. Many people still face hunger. Large sums for projects based on a chain model should be judged against that.

## 9. How the work was checked

All computations used the Respondent–Judge protocol. Each claim was written down in advance, with a fingerprint and a time stamp. An independent judge then recomputed it with separate code. The judges confirmed the cycles of all depths, the depths of the IMAGE scales, the common divisors of Table 7, the uniqueness of depth 71 and the durations of Tables 3 and 4.

Three points remain open. The phase of the cycles, that is where we stand in them today, is not yet fixed. The year of the network was set by calibration; its agreement before calibration is 2.5 %. The cycles have not yet been tested against a long series of measurements.

## 10. Conclusion

The Vacuum.Net model describes the climate as windings with cycles. With one rule and the speed of light it gives a cycle for every depth. One calibration on the orbit of the Earth makes the pure depths a year, eighteen years and about fifteen thousand years.

IMAGE describes the climate as a chain along a line of time. It averages, steps in years and five-year blocks, and ends in 2100. Read on the network, two of its links do not close. What joins its parts lies far above the Earth, outside the model.

For policy this means: plan in cycles, judge measures where they close, bring the Sun into the model, place the decision maker inside the system, test before committing, and weigh climate spending against direct human needs.

## Annotated references

Each entry gives the source and what a reader will find there.


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