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Correspondence:

[sccklima@hotmail.com](mailto:sccklima@hotmail.com)

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## Welcome to Budapest and the Hungarian Academy of Sciences

Budapest is the capital and most populous city of Hungary. It is Hungary's primate city with 1.7 million inhabitants and its greater metro area has a population of about 3.3 million, representing one-third of the country's population and producing above 40 % of the country's economic output. Budapest is the political, economic, and cultural center of the country, among the ten largest cities in the European Union and the second largest urban area in Central and Eastern Europe. Budapest stands on the River Danube and is strategically located at the center of the Pannonian Basin, lying on ancient trade routes linking the hills of Transdanubia with the Great Plain.

Budapest is a global city, consistently ranked among the 50 most important cities in the world, belongs to the narrow group of cities with a GDP over US\$100 billion, was named a global cultural capital as having high-quality human capital, and is among the 35 most liveable cities in the world. The city is home to over 30 universities with more than 150,000 students, most of them attending large public research universities that are highly ranked worldwide in their fields, such as Eötvös Loránd University in natural sciences, Budapest University of Technology in engineering and technology and Semmelweis University in medicine.



**The Milutin Milankovics Memory Plaque in the Reading Room of the Library of the Hungarian Academy of Science. The theory about the link between the long-term changes in climate and astronomical factors affecting the amount of solar energy receiving the Earth was founded here.**

The Hungarian Academy of Sciences, celebrating its bicentenary in 2025/2026, is Hungary's foremost and most prestigious learned society. Its headquarters are located along the banks of the Danube in Budapest. The Academy's primary functions include the advancement of scientific knowledge, the dissemination of research findings, the support of research and development, and the representation of science in Hungary both domestically and around the world. A small but significant development in the history of the academy from the point of view of climate science is that the Serbian Milutin Milankovitch was allowed to spend his whole WWI internment period (1914 – 1918) with research work in the Library of the Hungarian Academy of Science.

László Szarka, the Hungarian Clintel ambassador, successfully organized a historic meeting in the

magnificent building of the Hungarian Academy of Sciences in Budapest on 8 December 2025. The event was called *Beyond the Climate Change Consensus*, or short BCCC.

The idea of this conference emerged in May 2025 in an open discussion at the General Assembly of the Hungarian Academy of Sciences, when the President, Tamás Freund, declared that the Academy was willing to organize an international climate-energy conference, where researchers representing both pro and con views could confront their arguments. When Szarka mentioned this potential occasion to renowned scientists from all over the world, quite a few of them expressed their willingness to accept an invitation. Then it turned out at the September 23 meeting of the Earth Science Section of the Academy that mainstream scientists objected the whole idea. It was not surprising. Neither was the fact that the written response arrived only on October 7. Szarka then proposed a minimum half-day conference with keynote lectures and comments, and this was approved. Szarka describes the whole process in his introductory paper found later in this volume.

The main part of the conference was the three lectures in the Grand Hall of the Academy, given by outstanding scientists, and it was perfectly chaired by Dr. Gábor Náray-Szabó. The first lecture was *What is Climate Science?* by Dr. Laszlo Sarka himself. He is a geophysical engineer and Ordinary Member of the Hungarian Academy of Sciences. Between 1977 and 2010, as a researcher at the Geotectonic and Geophysical Research Institute of the Hungarian Academy of Sciences, he developed electromagnetic exploration methods. He got his PhD in 1987, and became Doctor of Earth Science in 1997. At the local university of Sopron, after his return from Associate Professorship at Université Paris XI, in 2000, he initiated a bio- and geoscience-based curriculum in environmental science. He had functions among others at the International Association of Geomagnetism and Aeronomy (IAGA), International Year of Planet Earth (IYPE, 2007-2009). Between 2010 and 2015 he was the administrative head of the research network of the Hungarian Academy of Sciences. From 2016 to 2018 he acted as Director General of the Research Centre of Astronomy and Earth Sciences. He is the author of more than 400 papers.

The next lecture was *H<sub>2</sub>O, CO<sub>2</sub>, Climate Change* by Dr. Demetris Koutsoyiannis, who is professor emeritus of Hydrology and Analysis of Hydrosystems in the National Technical University of Athens. He has served as Dean of the School of Civil Engineering, Head of the Department of Water Resources and Environmental Engineering, and Head of the Laboratory of Hydrology and Water Resources Development. He was Editor of Hydrological Sciences Journal for 12 years, and member of the editorial boards of Hydrology and Earth System Sciences, Journal of Hydrology, Water Resources Research, and Hydrology. He also contributes as an author and a member of the editorial board of our journal *Science of Climate Change*. He has many distinctions, and has published about 1200 research, technology and education items, 275 of which in refereed scientific journals. His research experience extends into the areas of hydrology, stochastics, climatology, analysis of hydrosystems, water resources engineering and management, water and energy, and hydroinformatics. Dr. Koutsoyiannis works climate science wonders with his stochastics.

The final lecture was *The EU's misleading decarbonization and its geopolitical consequences*, by Dr. Samuel Furfari. He has a PhD in energy from the Université Libre de Bruxelles. Then he worked for 36 years as a senior European official in the European Commission's Directorate-General for Energy, eventually becoming Advisor to the Director-General. He has contributed to the development of nearly all areas of energy technology and policy, including strategy, hydrogen, environment, climate change, renewable energy, and energy efficiency. He was in charge of climate change during the negotiations of the Kyoto Protocol.

Dr. Furfari taught energy policy and geopolitics at the Université Libre de Bruxelles from 2003 to 2021. Currently, he teaches Energy Geopolitics at ESCP London Business School and is an honorary professor at the Polytechnic School of the University of Madrid. He is a member of the World Federation of Scientists' Permanent Monitoring Panel on Energy and served as President of the European Society of Engineers and Industrialists from 2019 to 2022. He is the author of more than 21 books. Among the other contributors, we find a Spanish climate researcher (Javier Vinós), Hungarian geologists (István János Kovács, Director of the HUN-REN Institute of Earth Physics and Space Science, Antal Embey-Isztin) and engineers (László Báder and Csaba Huszár).

# **Science of Climate Change**

**Volume 6.2**

**March 2026**

## **Proceedings of the Beyond the Climate Change Consensus Conference**

**The Hungarian Academy of Sciences**

**The Grand Hall**

**On December 8, 2025**

**ISSN 2703-9072**

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## **Preface**

Science of Climate Change (SCC) is an independent, peer-reviewed, open-access scholarly journal dedicated to advancing rigorous scientific understanding of the Earth's climate system and its governing processes.

The journal is founded on the principle that climate science progresses through continuous scrutiny of prevailing assumptions, critical examination of explanatory frameworks, and the testing of competing ideas supported by scientific analysis.

SCC provides a platform for the publication of original research articles, comprehensive review papers, methodological developments, data analyses, discussion papers, and other scholarly contributions that address climate variability and change across spatial and temporal scales.

Established in 2021, SCC has developed into an international publication and operates under a not-for-profit framework supported by moderate article processing charges that sustain editorial management, peer review coordination, and digital dissemination. All content is freely accessible worldwide immediately upon publication, ensuring broad scientific exchange without subscription barriers. The SCC journal has been published by the SCC Publishing association since the beginning of 2025.

This is a special issue Vol 6.2 of the Science of Climate Change which contains extended abstracts from the *Beyond the Climate Change Consensus* main conference on December 8 in Budapest, as well as from the morning Pre Conference and the Afternoon Event.

In this issue, you will find the conference program, the Table of Contents for this issue as well as the submitted abstracts.

A complete report of the conference can be found on the Clintel website:

<https://clintel.org/beyond-the-climate-change-consensus-historic-meeting-at-the-hungarian-academy-of-sciences/>

1 March 2026

### **Chief-Editor**

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A digital version of this volume can be found here: <https://doi.org/10.53234/scc202603/13>

# **The Beyond the Climate Change Consensus Conference Programme**

## **Monday 8 December 2025**

### **The main conference**

2:00 PM to 2:05 PM

#### **Welcome and programme description**

Gábor Náray-Szabó O. M.

2:05 PM to 2:30 PM

#### **What is climate science?**

László Szarka O.M.

2:30 PM to 3:15 PM

#### **H<sub>2</sub>O, CO<sub>2</sub>, Climate Change**

Demetris Koutsoyiannis

3:15 PM to 4:00 PM

#### **The Conventional Energy Counter-revolution**

Samuel Furfari

4:00 PM to 4:55 PM

#### **Discussion**

4:55 PM to 5:00 PM

#### **Closing Words**

Gábor Náray-Szabó O. M.

### **The Morning Pre Event**

#### **Thermodynamics vs Radiative Climate Change**

Javier Vinós

#### **Clintel News**

Marcel Crok

#### **Comments at the Academy in the afternoon**

#### **Radiative vs Thermodynamic Climate Change (short version)**

Vinós

#### **On the Consensus**

Embey-Isztin

#### **Geological CO<sub>2</sub> emissions**

Kovács

#### **Surface Energy Balance: Quick Assessment Using General Systems Theory and Climatic Energy Balance Diagram**

Báder

#### **Argued answers to questions about the climate situation and energy production**

Huszár

### **Written submissions**

Sánta R, Garbai L: **Investigation of the dynamic equilibrium of atmospheric CO<sub>2</sub> concentrations. Air Qual Atmos Health**

Soon, W: **The Science of Climate Change: Comparing and contrasting the roles of atmospheric CO<sub>2</sub> and the Sun**

Scafetta, N: **Impacts and risks of “realistic” global warming projections for the 21st century,**

Zharkova, V: **1. Global Warming Issue 2. Grand Solar Minimum and Little Ice Age,**

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Michelets vei 8 B  
1366 Lysaker Norway

ISSN: 2703-9072

Correspondence:

szarka@ggki.hu

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## Introduction

### Conference “Beyond the Climate Change Consensus” at the Hungarian Academy of Sciences

László Csaba Szarka

Batthyány Society of Professors, Budapest,

HUN-REN Institute of Earth Physics and Space Science, Sopron, Hungary

#### Abstract

This is an introductory article to the papers based on presentations at the conference “Beyond the Climate Change Consensus” (BCCC, Hungarian Academy of Sciences, December 8, 2025) and its pre-event. It was a unique symbol: unprecedented for a country’s national academy to provide an official scientific forum on climate without censorship. In this paper the organizational phase, the course of the conference and its pre-event, and the preliminary impacts are described.

**Keywords:** climate science; discussion; consensus; energy; Hungarian Academy of Sciences

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#### 1. Preparation

The idea of the conference Beyond the Climate Change Consensus emerged in May 2025 in an open discussion at the General Assembly of the Hungarian Academy of Sciences, in response to my oral contribution, when the President (Tamás Freund) declared that the Academy was willing to organize an international climate-energy conference, where researchers representing both pro and con views could confront their arguments (Szarka 2025a). When I mentioned this potential occasion to renowned scientists from all over the world, at my greatest pleasure, quite a few of them expressed their willingness to accept an invitation. The Academy President, in his letter, as a response to my second written request, defined the conditions. Then it turned out at the September 23 meeting of the Earth Science Section of the Academy that mainstream scientists objected the whole idea. It did not surprise me, of course. Neither did the fact that the written response arrived only October 7. In order to provide an opportunity to present and discuss views “beyond the climate change consensus”, on the following day I submitted four versions (A, B, C, and D) for the President. Version D was a half day conference with keynote lecturers and comments. November 3, 2025, this version finally was accepted by the President. He made clear that “*presentations, although delivered at the Academy of Sciences, do not represent the opinion of the Academy, which is supported by the fact that the relevant members of the competent Scientific Sections will not come to the event.*” The programme was published on the website of the Hungarian Academy of Sciences (MTA 2025) and also at that of Academia Europaea (AE 2025), but otherwise the conference was not actively advertised by the Academy.

## **2. The Conference and its Pre Event**

The conference took place in the afternoon of December 8, 2025, in the Grand Hall of the Hungarian Academy of Sciences. It was chaired by Gábor Náray-Szabó whom I acknowledge his correct chairmanship.



*Figure 1: Headquarters of the 200 years old Hungarian Academy of Sciences on December 8, 2025. Photo: Wim Röst*

After the introductory lecture (László Csaba Szarka: What is Science?) there were two keynote lectures (Demetris Koutsoyiannis: H<sub>2</sub>O, CO<sub>2</sub>, Climate Change, and Samuel Furfari: The EU's misleading decarbonization and its geopolitical consequences) followed by five oral contributions. Four ones presented original results (Javier Vinós on his thermodynamic climate theory, István János Kovács on underestimated geological CO<sub>2</sub> emissions, László Báder on surface radiation balance, and Csaba Huszár on three topics: saturation of the radiative effect of CO<sub>2</sub>; water vapor issues; renewable energy by pyrolysis of crop residues, while one contributor (Antal Embey-Isztin) argued for the "consensus". At the end of the conference the lecturers had an occasion to respond to the contributions. The central issue was the consensus, if it is scientific or not. According to the lecturers, the Consensus building is a method that does not belong to science. To the question, why the Consensus has not reached 100 %, Koutsoyiannis said: *"If 95% or 99% or 100% of scientists agree with the orthodox theory, what does it mean? Somebody says 95% - 97% of scientists agree with whoever funds them."* And he added: *"...there are still people who are scientists, and even though they get zero money, they want to remain scientists, and this is a very simple answer"*.

Four written-only comments (by Róbert Sánta and László Garbai, Willie Soon, Nicola Scafetta, Valentina Zharkova) are considered also as BCCC contributions.

Before the conference, in the morning of December 8, 2025, the Energy Working Group of the Batthyány Society of Professors (PBK EM) organized a connecting pre-event in the Small Hall of the Library and Information Centre of the Hungarian Academy of Sciences, with two further lectures: Javier Vinós (Spain) and Marcel Crok (Clintel). Vinós talked about his book "Solving the Climate Mystery" (which is going to be published also in Hungarian), while the Director of Clintel provided a summary about Clintel's activity. He acknowledged to Guus Berkhout, the former President for founding Clintel, and he informed the Hungarian community that on December 4, 2025 Václav Klaus, former Czech state president was nominated to act as new president. In 2026 Clintel, networked throughout the world, is looking forward to a very active period.

Choosing The Library of the Hungarian Academy of Sciences as the venue of the pre-event was not at all accidental. The Academy Library had played a historical role in climate science: it provided ideal research conditions for the Serbian scientist Milutin Milankovitch for four years throughout the Great War (WWI), between 1914 and 1918 (Szarka et al. 2021). As it stands on the Milankovitch memory plaque in the Reading Room of the Library, the theory about the link between the long-term changes in climate and astronomical factors affecting the amount of solar energy received by the Earth was founded here. To have the results to be published, Milankovitch had to have the German manuscript translated into French (Milankovitch 1920). The same Reading Room was also a venue of a meeting with Richard Lindzen in February 2025 (PBK Energy Working Group 2025a).

In the evening, several contributors of the BCCC first day enjoyed the cathartic Advent atmosphere of the Art Evening organized by the Academy Club.

One week after, on December 15, 2025, there was a BCCC discussion event in Hungarian language (PBK EM 2025b). And a few days later the full BCCC report was published (PBK EM 2025c, Clintel 2025). Since the BCCC conference took place in the year of the 200th anniversary of the Hungarian Academy of Sciences a report was started with a quote from Count István Széchenyi the founder of the Hungarian Academy of Sciences, reminding to the mission of the national Academies: *“To spread clear concepts and clean confused ones from their dross as much as possible...”* (Széchenyi 1842)

The reports (PBK EM 2025 and Clintel 2025) include hyperlinks to all videorecords and all presentation files. The direct links are published in the Appendix, too.

### **3. Take-away messages**

*„Consensus Building” is outside the rules of science.*” (László Szarka)

*“Human CO<sub>2</sub> as the climate control knob is empirically untenable once we properly account for: (1) natural CO<sub>2</sub> fluxes (~25× larger); (2) the effect of H<sub>2</sub>O (vapour + clouds, ~20× larger); (3) the huge complexity of the climate system, including the biosphere’s role.”* (Demetris Koutsoyiannis)

*“Scientists’ job is to kill bad theories and rip science back from politics — not posture as saviours of the planet.”* (Demetris Koutsoyiannis)

*“Energy addition, not transition: fossil fuels remain the bedrock of progress.”* (Samuel Furfari)

*“Changing the amount of heat transported between two regions with different GHE, changes the outgoing emissions, the energy content, and the climate.”* (Javier Vinós)

*“Thank you, Guus Berkhout! Welcome President Klaus!”* (Marcel Crok)

*“What prevents climate scientists of both sides to reach a consensus?”* (Antal Embey-Isztin)

*“Geological carbon dioxide emissions represent a fundamental but still poorly quantified component of the global carbon cycle,”* (István Kovács)

*“Although average evaporation has increased somewhat in the watershed, the sensible heat has also increased. The current amount of evaporation in the Danube basin is not sufficient to remove the incoming excess energy.”* (László Báder)

*“By transforming plant waste into pyrolysis products and oxidizing them, fossil energy needs could be met simply by rearranging chemical bonds, without the investment of external energy”* (Csaba Huszár)

### **4. Echoes**

The atmosphere of the BCCC day was described authentically by Koutsoyiannis (2025). Such a conference and such reports act slowly but they may act deeply. The press coverage in December was poor, but in January 2026 two interviews were published: one with Demetris Koutsoyiannis (Hernádi 2026, Koutsoyiannis 2026), and one with László Csaba Szarka (Newman 2026), where they made themselves noticed. Substantive comments are also starting to accumulate, mainly in

private correspondences. Our message has reached the advisors of decision makers. As far as the sceptical view (PBK EM 2024) is considered by them as extremist one, we cannot make changes in Hungary from inside, in spite of the susceptibility of some advisors to our arguments.

It is a clear, historical reaction that in January 2026, the Hungarian mainstream side started to organize a climate debate. Their invitation and request for suggestions were sent to the initiator-organizer of the BCCC conference, trying to completely ignore BCCC conference itself. However, this will no longer work. A new era has started. The new era was started not because of the BCCC conference. The conference is a symbol: it was the first occasion that a country's national academy provided an official scientific forum on views beyond the climate change consensus, without censorship and bans.

### **Funding**

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**Co-Editor:** Stein Storlie Bergsmark

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Acknowledgements to Tamás Freund, President of the Hungarian Academy of Sciences, László Monok, Director of the Library and Information Centre of the Hungarian Academy of Sciences, for offering worthy venues, to Gábor Náray-Szabó for the correct chairing. I also would like to acknowledge to Antal Embey-Isztin for summarizing the substance of the mainstream arguments. Travel and hotel fees of the designated keynote lecturers were covered by the Academy of the Hungarian Sciences. The pre-event was organized by the Energy Working Group of the Batthyány Society of Professors, a core of the emerging Clintel Hungary. We thank Clintel for promoting the conference with its prominent presence and publications. I would like to thank the journal Science of Climate Change for providing the publication opportunity.

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## Appendix

### Direct BCCC Links

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Michelets vei 8 B  
1366 Lysaker Norway

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Correspondence:

szarka@ggki.hu

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# What is Climate Science?

László Csaba Szarka

Batthyány Society of Professors, Budapest,

and HUN-REN Institute of Earth Physics and Space Science, Sopron, Hungary

## Abstract

Around the world, in the field of environment, as connected to energy and climate, many common concepts are inherently confusing or have become confused. This paper highlights some of the related contradictions in such very basic concepts as science, climate, climate system, climate change. Historical documents (among others, the birth document of the Consensus in Villach, 1985, and the 1992 UN Framework Convention on Climate Change, UNFCCC) testify, how the climate science has been distorted step-by-step, to the point, where physical reality is no longer the reference for some researchers, but the problem itself. In reality, the physics-oriented climate science can exclusively be regarded as basis for climate science, as far as the rules of sciences are strictly followed. The so-called “science-for-policy” is nothing else than sophistry. Healthy and honest climate science can only be considered beyond any enforced climate change “consensus”.

**Keywords:** science; climate; climate system; climate change; climate science, sophistry

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## 1. Introduction

Since its foundation in 2022, the Energy Working Group of the Batthyány Society of Professors, a conservative think-tank (PBK EM) has been warning about the unsustainability of mainstream climate policy in Hungary. Although our lecture series in 2024–2025 included presentation even from Richard Lindzen (Lindzen 2025), of notable fame, our views have only seldom reached the Hungarian public. In 2025, the Chair of the Energy Working Group, as one of the Ordinary Members of the Hungarian Academy of Sciences, managed to organize an international conference at the premises of the Hungarian Academy of Sciences, entitled „Beyond the Climate Change Consensus” (BCCC). This paper was presented as the introductory lecture at the BCCC conference, held on December 8, 2025, followed by two keynote lectures, one by Koutsoyiannis (2025b) and another by Furfari (2025), which are also published in this issue. The goal of this presentation has been to demonstrate, purely on the basis of historical documents, how the basic concepts of climate science were distorted, leading to a sophistry-for-climate-policy which lacks all the prerequisites for being considered as true science. There are no numbers or formulas in this presentation, so hopefully the message will be understandable to a wider audience.

## 2. Science, Climate, Climate System, Climate Change

### 2.1 What is Science?

All classical definitions of the term science sound very similar to the broad, albeit clear enough and self-explaining concept given by the President of the Hungarian Academy of Sciences over a century ago (Kornis 1922): Science is “...*a methodological and systematic human activity aimed at learning about reality*”. About the Greek origin of the concept see Koutsoyiannis (2025a). Various features of science were highlighted from time to time. For example, according to Popper (1935) “*science progresses by attempting to falsify or refute hypotheses*”, in empiric, objective,

*Science of Climate Change*

<https://scienceofclimatechange.org>

and rational ways. Kuhn (1962) defined the periods of “*normal science*” within a shared paradigm and periodic “*revolutions*”, where a new paradigm replaces the old one. I also recall the approach by Ván (2025): “*science is an everlasting self-correction*”. All the aforementioned approaches elucidate different aspects of the same principle of science, called briefly “*common sense*” by Feynman (1969).

Feyerabend’s (1975) postmodern “*science*”, as he defined it, “*is an essentially anarchistic enterprise: theoretical anarchism is more humanitarian and more likely to encourage progress than its law-and-order alternatives*”, it is actually not science, because the reality is subordinated to terms independent of the subject of science, such as “*progress*”. Feyerabend’s suggested approach of “*anything goes*”, violates the rules of science. The so-called consensus building is also outside the rules of science, since any consensus is based on values and/or interests of people, and not exclusively on the physical reality.

## 2.2. What is Climate?

The ancient Greek „κλίμα” means inclination, slope, latitude. The Hungarian „éghajlat” means „the bend of the sky”, a very expressive concept. Herbertson’s (1907) definition (“*climate is what on an average we may expect, weather is what we actually get*”) is exact, while in the modern concepts, which sounds in AI wording as „*the average weather patterns in a region over a long period, typically 30 years or more, including temperature, precipitation, and humidity*, is also problematic.

These modern definitions of climate, as it has been observed by Demetris Koutsoyiannis, do not highlight the non-static nature. As Koutsoyiannis (2021) has reminded us: „*Climate is represented as a time average... A time average of a stochastic process (...) is not a number but a stochastic process per se.*”

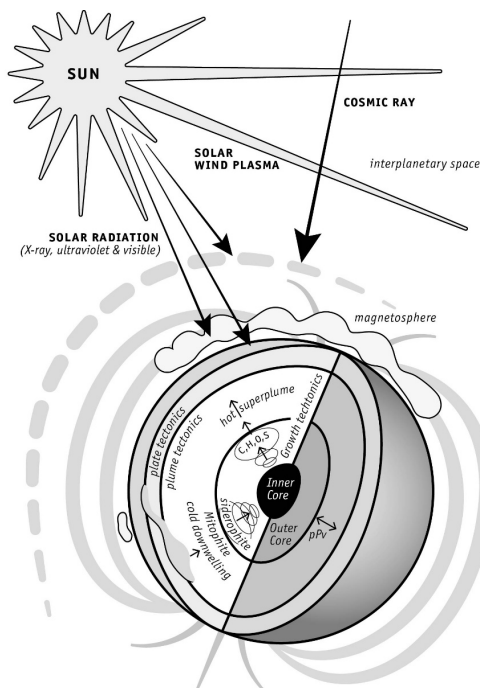


Figure 1: Several elements of the Earth System, based on Yuen et al. (2007). The figure in the title page was redrawn by Márton Juhász (JmTypography).

### 2.3 What is the Climate System?

Since the atmosphere in a simple model can be considered like an “apple peel” around the planet Earth (see Figure 1), in my geophysical approach (Szarka 2021) the climate system is the ensemble of elements of the Earth System with their interactions. One group of these elements is extra-terrestrial (Sun, Solar System, space), another group is terrestrial: the phenomena of the atmosphere, geosphere, hydrosphere, cryosphere, biosphere (including human contribution). Among the interactions, many are not precisely known and many are completely unknown.

At a first glance, the concept of Climate System by UNFCCC (1992) seems to be complete (“*totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions*”), however, it is restrictive: for example, the Sun is completely missing from it.

### 2.4. What is Climate Change?

The Concept of Climate Change by WMO is considered as if it would be changes in numbers: “*Climate change is the term used to describe changes in the state of the climate that can be identified by changes in the average and/or the variability of its properties and that persists for an extended period, typically decades or longer.*” In geophysical approach, the term climate change has meant changes in the characteristic climatic state of a region, due to the ever-changing components of the Earth System. In a given region it is a series of numbers, changing on a decadal scale, But, according to Koutsoyiannis (2021), Climate Change is a process, since “*the climate, like the weather, has been ever-changing*”. In this approach Climate Change is just a redundancy, so the whole concept is merely pleonasm.

At the same time, according to UNFCCC (1992), the Climate Change is “*attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*”. The UNFCCC definition is restrictive; it is in conflict even with the WMO definition.

Since all these bricks of climate science are controversial, before defining climate science itself, we should look at a few documents in more details, first of all, the UN Framework Convention on Climate Change (UNFCCC 1992).

## 3. Thought Diverting Documents

### 3.1. UNFCCC

UNFCCC (1992) puts human-caused greenhouse gases (GHGs) in the spotlight of research. All phenomena and all interactions outside the UNFCCC framework are largely ignored or attributed implicitly, sometimes explicitly, to humans. The study area of UNFCCC’s “climate “Science” is restricted only to what is inside the Framework Convention. With other words: this Framework Convention has framed the thoughts of those involved with climate science. The study of space, solar system, Sun, complexity of H<sub>2</sub>O roles (including hydrosphere, cryosphere and clouds), geodynamics (including volcanos), biodynamics (e. g., global greening), energy transports and feedbacks (e.g., Le Chatelier’s principle) are largely subordinated to the Framework Convention. Most so-called climate scientists ignore most of the world outside UNFCCC. Climate scientists should be reminded, that a single point, as an entity with zero dimensions, is fundamentally unable to represent a sphere, which is a three-dimensional object.

*It is evident that the restricted focus and restrictive definitions lead to biased conclusions.* From 1992 on, the UNFCCC has been leading science to wrong conclusions. The reference basis of UNFCCC was the „Climate Consensus”.

### 3.2 How and when was the Climate Consensus declared?

The declaration of the climate consensus was made more than 40 years ago. It was well prepared, of course. The ID card details of the Consensus contain the following (WMO 1986):

*Name:* International Conference on the Assessment of the Role of Carbon Dioxide and of the Other Greenhouse Gases in Climate Variations and Associated Impacts. *Parentage:* UNEP, ICSU, WMO (that time with new leadership). *Place of birth:* Villach (Austria). *Date of birth:* October 9-15, 1985. *Birth document:* WMO-No. 661.

As written on page 7 of WMO (1986): “*this conference has two important tasks:*

- *to develop a consensus statement on the present state of our scientific knowledge of increases in CO<sub>2</sub> and other radiatively active gases, and the physical and socio-economic impacts, and*
- *to develop sound recommendations for action by countries and by international agencies, based on this scientific consensus.*”

Item 1 of the consensus has been, in effect, the same for four decades: “(1) *The amounts of some trace gases in the troposphere, notably carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>), ozone (O<sub>3</sub>) and chloro-fluorocarbons (CFC) are increasing. These gases are essentially transparent to incoming short-wave solar radiation but they absorb and emit longwave radiation and are thus able to influence the Earth's climate.*”

It is a fact that the Consensus lacks all scientific knowledge born after 1985. For example, at that time there was no idea about the Earth's energy balance at the top of the atmosphere, elements of which have been monitored by NASA only since 2000. It is known from NASA CERES data basis (e.g., Miller 2023) that the actual warming in the 21<sup>st</sup> century is due first of all to an increase in Absorbed Shortwave Radiation (ASR), and the trends are changing on a decadal scale both in ASR and in Outgoing Longwave Radiation (OLR).

The Consensus-declaring Villach conference, as a reference basis, had a crucial role on the evolution of the climate science. According to the Hungarian meteorologist, Rudolf Czelnai (1933–2025, Assistant/Deputy Secretary-General of the that time WMO): “*...the position of the great powers ... was that climate change is a political issue. We ourselves felt ... who understand it better than us take charge of stirring up the international public's interest in the climate issue.* He added in his charming style: “*With this, we strayed onto somewhat swampy ground.*” (Czelnai 2006). One of the visible consequences of the Villach meeting has been directly manifested in the loosening of the scientific standards of the Geneva climate conferences from 1979 to 1991. Czelnai (2006) described it ironically as follows: “*The difference is about the same as buying bread in a small bakery or a supermarket. The latter has more bread, but the former is much better.*”

### 3.3. Distortion of Climate Science in Hungary

Well-documented Hungarian sources (Faragó 1981, 2010, 2021, 2025) tell that Hungary has been involved in the activities of international environmental organizations from the very beginning, including cooperation in climate science and climate policy. Both the World Council of Economy and Development (WCED, in its popular name, the Brundtland Committee), and its Program Council had Hungarian members.

One of the conclusions of a huge “climate science” project in Hungary („VAHAVA” 2003–2006, led by the former WCED member) explicitly urged “*a comprehensive domestic climate policy*” (Faragó 2021). The unequal relationship between climate science and politics is well illustrated by the following sentence: “*...the conclusions of the scientific community's analyses have been and are being taken into account in policy programs 'more or less', depending on other aspects and priorities*”. Politics fatally embraced Hungarian climate science, too.

## 4. The Present Situation

The present situation is completely illustrated by a few selected documents.

- It is a common turn of phrase in argument that “*we have known the determining cause for a long time*” (Haszpra 2022).

- It is openly admitted that reality for the mainstream think-tanks is disturbing: “Climate science requires a methodological shift away from its initial „physics-first” orientation toward one of usability-centered science-for-policy” (Jebeile, Roussos 2023). It is amazing that they would indeed like indeed to isolate climate science from the physical reality: “physical science’s „value-free ideal” can hamper the production of usable science-for-policy”.
- Melissa Fleming (UN Under-Secretary-General for Communication) spoke about the science of climate change without restraint at the WEF event of October 2022: “We own the science” (WEF 2022).

## 5. Finally, what is Climate Science?

Climate science should simply follow the rules of Science: it is “a methodological and systematic human activity aimed at learning about” the climate of Earth. Only physics-oriented climate science can be considered as science, as far as the rules of science are strictly followed. Climate science is far from being settled; questions are always welcome.

In climate science, "anything goes" and consensus building does not work the same way as in science in general. Therefore, what the mainstream and the public calls “science-for-climate-policy” is nothing else than sophistry-for-science-policy. Dogmatic adherence to a frozen view based on the 1985 consensus is “no way” science. It is time to rigorously re-examine each and every climate claim. I recommend to start this re-examination with comparing two U.S. documents: the physics-oriented Climate Working Group (2025) and the policy-oriented Dessler and Kopp (2025).

Symbolizing science with watercrafts (see Figure 2), science in the past was a raft, with various hypotheses on it. Presently we have a huge warship, with CO<sub>2</sub> inside as ammunition. It is a sophistry-for-climate-policy and not science. In the future a return to a true climate science is unavoidable: a sailing boat should again carry again exciting and conflicting hypotheses, and the doves above the sailing boat should remind us to the strict rules of science, and the roots of the common sense, coming from the heaven.

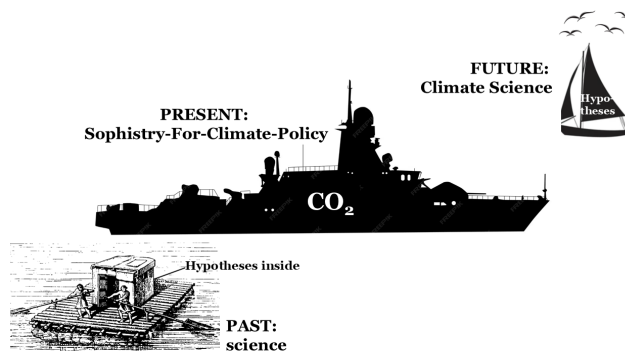


Figure 2: The past, present and hopeful future state of climate science are symbolized by watercrafts. The raft symbol is taken from Márki (1910).

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SCC Publishing  
Michelets vei 8 B  
1366 Lysaker Norway

ISSN: 2703-9072

Correspondence:

dk@itia.ntua.gr

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# H<sub>2</sub>O, CO<sub>2</sub>, Climate Change

## A holistic refutation of “climate science”

Demetris Koutsoyiannis

Professor Emeritus, National Technical University of Athens, Athens, Greece

### Abstract

This paper is a summary of recent results of the author, documented in 14 peer-reviewed journal papers and other research items published in the last 5 years. A list of collected telltale signs makes it obvious that “climate science” is not science. The misguidance is illustrated by a few striking examples. The main scientific results, which altogether provide a complete refutation of the CO<sub>2</sub> hypothesis, are summarized 10 points, called a decalogue. The 10 points are open for discussion.

**Keywords:** Greenhouse effect; radiative forcing; climate science; causality

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### 1. Introduction

This paper is an extended abstract of the keynote lecture, given by the author at the conference “Beyond the Climate Change Consensus” held at the Hungarian Academy of Sciences on December 8, 2025 (Koutsoyiannis 2025). The summary presented here includes: (1) telltale signs that today’s so-called climate science is sophistry, along with examples of misguidance, (2) the author’s recent scientific results in 10 points, called a decalogue, and (3) a few scientific and science policy conclusions.

### 1. Telltale signs and examples of misguidance

Here are some telltale signs that “climate science” is not science:

- Mixing of scientific knowledge with politics.
- Hostility towards scientific dialogue.
- Endless predictions of catastrophes that are almost always proven wrong.
- Promotion of the idea of world salvation.
- Promotion of ambiguity and inaccuracy.
- Appeal to consensus.
- Censorship and silencing of dissenting voices.
- Labelling of dissenting scientific opinion as “denialism” and of those expressing them as “deniers”.
- Reversal of cause and effect.
- Preference of model outputs to observational data.
- Discrimination in research funding and banning of non-conforming ideas.
- Laughable “scientific” studies to instil fear of various fanciful climate impacts (e.g. kidney stones).

There are some striking examples of misguidance:

- Ambiguous language and replacement of scientific terminology with political slogans.

- This includes fundamental notions, such as “climate change” (as if climate has ever been unchanging) and “greenhouse effect” (as if the atmosphere resembles a greenhouse).
- Downgrade in the importance of H<sub>2</sub>O and clouds in climate.
- Elevation of minor agents in climatic processes — mostly of CO<sub>2</sub> as the climate control knob.
- Avoidance of stating time lags for atmospheric CO<sub>2</sub>.
- Construction of fallacious conceptions, such as:
  - The dependence of the CO<sub>2</sub> behaviour on its origin, with anthropogenic CO<sub>2</sub> staying longer in the atmosphere.
  - The “Suess effect”.
- Use of a blatantly erroneous response function of atmospheric CO<sub>2</sub>.
- Neglect of natural CO<sub>2</sub> dynamics.

## 2. The Decalogue

The climate decalogue (author’s main results of recent research, documented in 14 peer reviewed journal papers and other research items published in the last 5 years (Koutsoyiannis 2021, 2024a-g; Koutsoyiannis, and Kundzewicz 2020; Koutsoyiannis et al. 2022a,b, 2023; Koutsoyiannis and Iliopoulou 2024; Koutsoyiannis and Vournas 2024; Koutsoyiannis and Tsakalias 2025):

No 1. *Climate change is real* — and climate crisis too (but only in politics).

- Climate change has been real throughout Earth’s entire 4.5-billion-year history.
- Climate crisis is a purely political issue, with no relationship to the real world.

No 2. There is *no greenhouse effect* (GHE), nor greenhouse gases (GHG), in the atmosphere.

- These are misleading terms, whose real meanings are “atmospheric radiation effect” (ARE) and “radiatively active gas” (RAG), respectively.

No 3. The ARE mostly depends on the *temperature gradient* in the atmosphere.

- At the equilibrium (an isothermal atmosphere) the ARE is zero.
- In case of temperature inversion, the ARE results in cooling, not warming of the Earth.

No 4. In the standard atmosphere (with gradient of 6.5 K/km) the *ARE is dominated by H<sub>2</sub>O* (water vapour and clouds).

- CO<sub>2</sub> is playing a very minor role (quantified at 4-5 %).

No 5. *The century-long observations* of longwave (LW) radiation show no change in the ARE.

- The substantial increase of atmospheric [CO<sub>2</sub>] did not give a discernible signal.

No 6. There is **no proof** that the increase of atmospheric [CO<sub>2</sub>] *causes temperature increase*.

- On the contrary, paleoclimatic and modern observational data support the reverse causality as the increase of temperature happens before that of [CO<sub>2</sub>].
- Climate models suggest a causality direction opposite from that seen in the data.

No 7. The carbon balance in the atmosphere is *dominated by natural processes*.

- Human CO<sub>2</sub> emissions (by burning fossil fuels etc.) are only 4 % of the total.
- The increase of temperature resulted in substantial increase of natural CO<sub>2</sub> emissions.

No 8. The *isotopic carbon data* ( $\delta^{13}\text{C}$ ,  $\Delta^{14}\text{C}$ ) show changes in the isotopic synthesis of atmospheric  $\text{CO}_2$ , but *no sign of human influence*.

- They show that the changes seen are driven by natural processes.

No 9. The dynamics of atmospheric  $\text{CO}_2$  can be recovered from *natural processes only*.

- Multiple evidence confirms a residence time of atmospheric  $\text{CO}_2$  at 4 years, despite “climate science” longer estimates reaching thousands of years.

No 10. Temperature increase in the 21st century is *consistent with changes in the solar* (shortwave—SW) *radiation* absorbed by the Earth.

### 3. Conclusions: What the evidence actually shows

- Human  $\text{CO}_2$  as the climate control knob is empirically untenable once we properly account for:
  - (1) natural  $\text{CO}_2$  fluxes ( $\sim 25\times$  larger);
  - (2) the effect of  $\text{H}_2\text{O}$  (vapour + clouds,  $\sim 20\times$  larger);
  - (3) the huge complexity of the climate system, including the biosphere's role.
- Climate models are in disagreement with observation while *reversing cause and effect*.
- In complex systems, data are sovereign — and the data have falsified the mainstream climate theory.
- The emission-centric paradigm was a *political project that conscripted science to provide authority*.
- “Climate science” is therefore not just corrupted science — it is purpose-built instrumentation *wearing the lab coat of science while abandoning its method*.
- *Scientists' job is to kill bad theories and rip science back from politics — not posture as saviours of the planet*.

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Michelets vei 8 B  
1366 Lysaker Norway

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Correspondence:  
sfurfari@gmail.com

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# Energy Geopolitics and the EU: Between Decarbonisation Dreams and Economic Realities

Summary of the talk at the BCCC Conference on December 8, 2025

Samuel Furfari

ESCP London; Université Libre de Bruxelles

## Abstract

This presentation, delivered at the Hungarian Academy of Sciences (Furfari 2025), provides a critical examination of the European Union's current energy policy, with a particular focus on decarbonisation and the rapid integration of renewable energy technologies. Drawing on decades of professional experience in energy policy and geopolitics within the European Commission, the analysis reveals a disparity between policy objectives and the global context of energy demand and supply. It contrasts with the EU's declining competitiveness and the limited global impact on its emissions reduction efforts with the persistent dominance of fossil fuels, the technological revolution in natural gas, and the geopolitical shifts driven by the United States' shale revolution. The conference calls for a pragmatic reassessment of the EU's strategy, advocating a return to the foundational principles of cheap, abundant energy

**Keywords:** energy geopolitics; decarbonization; energy policy; European Union

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## 1. The Fundamentals of Energy and Development

The European Union (EU) is at a crossroads with regard to its energy policy. Once a beacon of integration and economic progress, the EU is now facing mounting challenges stemming from its ambitious decarbonisation agenda. Over the past decade, enthusiasm for EU ideals has given way to scepticism and disillusionment, much of which is rooted in the perceived failures of energy policy. This conference aims to shed light on the key issues underlying this crisis by placing them in the broader context of global energy geopolitics and economic development.

At its core, energy is synonymous with work – the capacity to displace force – the fundamental condition of life, and subsequently, quality of life. There is a direct correlation between energy consumption, life expectancy, economic growth and societal well-being. As the global population increases, so does the demand for energy. The relentless rise in primary energy demand, with only temporary dips during crises such as the oil shocks of the 1970s or the 2020s's pandemic, highlights the importance of energy for human progress.

## 2. The Changing Landscape of Global Energy Demand

The idea that future energy demand will decline is fundamentally flawed. On the contrary, development – even if it is labelled 'sustainable' – particularly in Africa and Asia, necessitates a substantial increase in energy consumption. For decades, the European Commission had worked to ensure the provision of cheap, abundant energy, thereby laying the groundwork for economic prosperity and geopolitical stability.

Around 2005, however, the Commission suddenly reversed this approach, shifting its focus from cheap and abundant energy to clean energy, and subsequently to decarbonising energy and reducing energy demand by law. In September 2024, the Mario Draghi report on EU competitiveness showed that the high energy prices were placing a heavy burden on EU industry and needed to be addressed swiftly.

While the EU has seen a reduction in energy consumption over the past decade, this is not indicative of a global trend. The real growth in energy demand is occurring in Asia, with China and India at the forefront. Currently, nearly 50 % of global energy demand comes from Asia, and this figure is expected to increase as India's population surpasses China's and African nations pursue economic development.

Earlier EU policies under leaders such as Jacques Delors and Jean-Claude Juncker focused on establishing a flexible electricity and gas market, as well as an integrated infrastructure capable of efficiently distributing energy across member states. This vision was rooted in pragmatism and economic necessity, recognising the diverse sources of natural gas surrounding the EU – including Russia – and the crucial need for energy security.

### **3. Policy Shifts and Strategic Missteps**

The arrival of new leadership in the European Commission marked a dramatic shift in policy. Under the influence of advisers who are staunchly opposed to nuclear and fossil fuels, the EU's energy strategy has moved towards decarbonisation, even eschewing the mention of nuclear energy despite the fact that legal obligations enshrined in the 1958 Euratom Treaty are still in force.

The post-Ukraine war energy strategy, as set out by the Commission, focuses on improving energy efficiency, using more hydrogen, reducing dependence on Russian gas and further promoting wind and solar power. Notably absent from this strategy are fossil fuels and nuclear energy. This reflects the political dominance of member states such as Germany, where anti-nuclear sentiment prevails, and reveals a fundamental disconnect from the realities of the global energy supply and demand landscape.

### **4. The Gas Revolution: Technology and Geopolitics**

The most significant development in recent energy geopolitics has been the natural gas revolution, which has been driven by technological advances in the United States. Innovations in shale gas extraction have turned the US into the world's leading gas exporter, overtaking even Qatar. The ability to transport liquefied natural gas (LNG) by the sea has freed both suppliers and buyers from the limitations of pipeline geopolitics, creating a more flexible and competitive market.

Spearheaded by pioneers such as George Mitchell and engineers like Chris Wright, this revolution has upended traditional energy dynamics. The US is now pursuing a strategy of energy dominance, with the capability to deliver energy molecules to any corner of the globe. This diminishes the strategic leverage of traditional producers and enables the US to negotiate from a position of unprecedented strength. To reinforce this strategy, Donald Trump nominated Chris Wright as energy secretary, aiming to produce and export more natural gas. This process is ongoing and will largely be implemented thanks to new authorisations for LNG export terminals.

### **5. The Illusion of EU Decarbonisation and Its Economic Consequences**

The EU's commitment to decarbonisation, which includes the goal of achieving net-zero emissions by 2050, has taken a heavy toll on the region's economic competitiveness. While policy-makers are proud that the EU has reduced its energy consumption by 6.1 exajoules over the past decade, this is actually a symptom of economic stagnation. Meanwhile, energy demand outside

the EU has increased by 77 exajoules, 77 % of which has been met by fossil fuels.

The global gap between fossil fuels and renewables is not narrowing – it is widening. While wind and solar power are growing, their expansion pales in comparison to the sevenfold growth of fossil fuels, which remain indispensable for providing the cheap, abundant energy that underpins economic development.

## **6. Global Emissions: The Limits of European Action**

The EU's efforts to reduce carbon emissions have had little impact on the global trajectory. Although the EU and countries such as Hungary have achieved reductions of 30% and 32% respectively, the world's total emissions have increased by 65% since the Rio Conference (which I call the COP Zero).

The rapid rise in emissions from developing economies, particularly in China, India, and Indonesia, highlights the futility of unilateral action. If India were to match the EU's current per capita energy consumption levels, its emissions would far exceed the EU's current total. Meanwhile, Indonesia, the world's largest coal exporter and nickel producer, openly prioritises economic growth over climate commitments.

## **7. The Failure of International Climate Policy**

The history of international climate negotiations is one of repeated failure. A turning point came at COP15 in Copenhagen, when heads of state recognised that stringent emission targets would result in an economic catastrophe. Subsequent conferences have failed to produce meaningful outcomes, as developing nations prioritise development over decarbonisation. The widely publicised COP21 and its Paris Agreement failed to deliver any concrete results. Furthermore, the only binding requirements of this international agreement relate to bureaucratic procedures; nothing is mandatory, not even the reference year for measuring progress over time. I explore these shortcomings in detail in my recent book *The Truth About the COP: 30 Years of Illusions*, dedicating a chapter titled 'Paris Disagreement' to COP21 to emphasise that what was presented as the Paris Agreement is, in reality, more of a disagreement with no binding commitments.

In this context, the EU's strategy seems increasingly quixotic. Pursuing decarbonisation at the expense of economic vitality risks undermining the very foundation of the European project. While the rest of the world embraces fossil fuels as a 'gift from God', as Ilham Aliyev, the president of Azerbaijan, said at the opening of COP29, the EU faces the prospect of self-inflicted decline.

## **8. The urgency to reverse to rational Energy Policy**

The current trajectory of EU energy policy is unsustainable in economic, political and social perspectives. The founding principle of the European project was to provide cheap and abundant energy, enabling prosperity and integration for citizens and industry alike. However, the relentless pursuit of decarbonisation and energy transition, divorced from global realities, does not merely threaten to unravel these achievements – it is already dismantling the very foundation of our progress and the future prosperity of the European Union.

A rapid, pragmatic reassessment is needed that acknowledges the indispensable role of fossil fuels and nuclear energy in the global energy mix. The EU cannot ignore this growing reality. Rather than clinging to the unattainable dream of rapid decarbonisation, the EU must return to policies that prioritise economic competitiveness and energy security, and provide solutions for those less fortunate. Only by doing so can the EU hope to restore public confidence, safeguard its economic

future and reassert its relevance on the global stage.

After spending 36 years trying to provide everyone with abundant, affordable and clean energy, I am truly saddened and shocked by all the increasingly harsh and virulent criticism levelled at 'Brussels' because of its energy and therefore societal shift. We really need a European Union, but the one we had before, before all these decarbonisation policies that lead nowhere and this energy transition that is utopian.

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1366 Lysaker Norway

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Correspondence:

[antoba@t-online.hu](mailto:antoba@t-online.hu)

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## In Terms of Scientific Consensus, Modern Climate Change Stands Apart From All Other Scientific Disciplines

Antal Embey-Isztin

Hungarian Natural History Museum, Budapest

Comment

When it comes to public consensus, climate science is in a critical phase. On the one hand, publishing climate scientists do show a massively overwhelming consensus on what causes present-day climate change, on the other side, climate sceptics categorically deny this. At the same time, they fail to reach an internal consensus; as there is no agreement among them on what specific natural agent is responsible for the current warming trend, they never tell you what specific natural factor must be blamed. They only speak in general terms about different natural factors such as water, clouds, solar radiation, volcanic eruptions, and natural ocean currents, etc., which they believe may have caused the warming of the last hundred years. However, they fail to demonstrate a correlation between temperature and any of these agents during the **relevant** time span, a correlation that could be the basis of a solid consensus. In other words, climate sceptics are unable to provide reasonable explanations for the temperature rise in the last century. On the other hand, 97-99 % of actively publishing climate scientists, biophysical scientists, geologists support the conclusion that human activities are the primary driver of recent global warming (Benestad et al., 2016; Cook et al., 2013; Lynas et al., 2021). The most recent analyses indicate this consensus now exceeds 99% (Mytych, 2024), making it one of the few instances in scientific history where almost all experts in a field agree on a particular topic (see Fig. 1).

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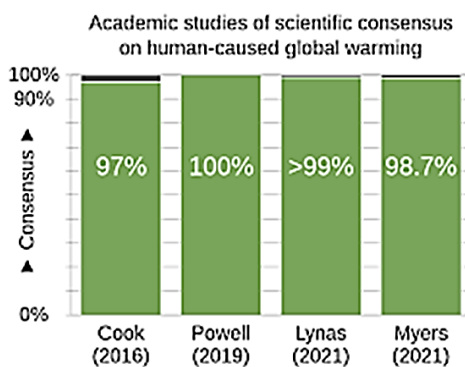


Figure 1: The degree of agreement on the cause of current global warming.

The strange situation arose because the rejection of the consensus, especially when no suitable alternative perspective is advanced, may in fact be regarded as a rejection of science. True, the Earth's climate has always changed due to natural causes, but the warming observed since the early 20th century stands out as unusual in both its speed and pattern. Multiple lines of scientific evidence demonstrate they cannot explain the magnitude and characteristics of warming experienced over the last century. The timing, geographic distribution, and rate of recent temperature

increases point to human activities, particularly the emission of greenhouse gases from burning fossil fuels, as the primary cause of modern climate change. This conclusion is supported by climate models, direct observations, and statistical analyses that consistently show natural variability alone falls short of explaining current warming trends. The relationship between CO<sub>2</sub> and global temperature shows an excellent correlation, with atmospheric concentrations rising from 280 ppm before industrialization to over 398 ppm by 2013, representing approximately a 40 % increase. The scale of this change is unprecedented - CO<sub>2</sub> concentrations never rose above 300 ppm between the advent of human civilization roughly 10,000 years ago and 1900.

The mechanism behind CO<sub>2</sub>'s warming effect is well understood - it acts as a heat-trapping gas that allows sunlight to reach Earth's surface but prevents heat from escaping back to space. In addition, ocean acidification represents a *distinct and independent* line of evidence for anthropogenic climate change, separate from, but complementary to atmospheric warming. While both processes stem from the same source - increasing atmospheric CO<sub>2</sub> concentrations from human activities - they operate through different physical and chemical mechanisms (Zoccola et al., 2016). Ocean acidification occurs through direct chemical reactions when CO<sub>2</sub> dissolves in seawater, - an issue that addresses the same fundamental cause but manifests as a separate environmental problem (Owens et al., 2021). The World Meteorological Organization now officially recognizes ocean acidification as one of seven key global climate indicators, alongside atmospheric CO<sub>2</sub> concentrations, surface ocean temperature, ocean heat content, sea level, sea ice, and glaciers (Metzl et al., 2024). The strength of climate science lies in the convergence of evidence from multiple independent climate indicators across the atmosphere, continents and oceans. This multi-indicator approach makes the evidence particularly robust because it would be nearly impossible for natural variability alone to create consistent warming signals across so many different measurement systems simultaneously. Seeing from a broader perspective, it doesn't even matter if the consensus number is 90 % or 10 0%. The level of scientific agreement on anthropogenic global warming is overwhelmingly high because the supporting evidence is overwhelmingly strong and robust.

Science should be viewed as a single entity. There can be no such a thing as "science beyond previous science." Instead, we must mutually and respectfully acknowledge the merits of each other's scientific achievements. For example, the result that CO<sub>2</sub> does not always correlate perfectly with climate warming observed during a short period must be welcomed (typical chicken and egg problem). This suggests that while CO<sub>2</sub> is the dominant long-term driver, the relationship between emissions and temperature changes may involve complex timing and feedback mechanisms that are not immediately apparent. Similarly, the ocean's massive heat capacity can mask or delay the full temperature response to greenhouse gas increases, potentially affecting how we interpret the timing and magnitude of CO<sub>2</sub>'s warming effects. However, these factors don't diminish the fundamental role of carbon dioxide in driving climate change, but they highlight the complexity of the climate system and the importance of considering multiple indicators and timeframes when assessing the relationship between greenhouse gas emissions and observed warming patterns.

Now, the big question: What prevents climate scientists of both sides to reach a consensus?

To this end, I find Reusswig' thoughts highly revealing: „Climate change stands apart from other areas of scientific consensus because of its profound economic and political implications. While climate scientists themselves are often apolitical, the issue they study is inherently political in nature. If global warming were caused solely by natural factors, society would only need to adapt, but the reality of anthropogenic climate change demands something far more disruptive: the decarbonisation of the global economy” (Reusswig, 2013).

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Michelets vei 8 B  
1366 Lysaker Norway

ISSN: 2703-9072

Correspondence:

[jvinos@  
gmail.com](mailto:jvinos@gmail.com)

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## Radiative versus Thermodynamic Climate Change

Javier Vinós

Independent researcher

### Abstract

The predominant view attributes climate change to altered atmospheric radiative properties caused by greenhouse gases and aerosols. This paper proposes an additional thermodynamic framework, emphasizing the role of meridional (horizontal) energy transport between the tropics and poles. Because the greenhouse effect is strong in humid tropics and weak in dry polar regions, changes in poleward energy flux necessarily affect Earth's total energy balance. Increased transport cools the planet; reduced transport warms it. Observations of late-1990s Arctic winter warming, unaccounted for by radiative models, align with this mechanism. Paleoclimate data further show stable tropical temperatures but large polar changes, implying that global climate depends mainly on the tropical–polar temperature gradient. This model also explains the strong effects of small Milanković orbital variations, suggesting that horizontal energy redistribution, rather than radiative forcing alone, governs the planet's long-term climate dynamics.

**Keywords:** Greenhouse effect; radiative forcing; meridional heat transport; thermodynamic climate theory; temperature gradient.

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### Beyond the Climate Consensus Conference contribution. – Budapest, December 8<sup>th</sup>, 2025

Honourable members of the Hungarian Academy of Sciences, ladies and gentlemen,

The prevailing scientific consensus on climate today holds that the fundamental cause of the climate change observed in recent decades lies in an alteration of the radiative properties of the atmosphere, driven by changes in the concentrations of greenhouse gases and aerosols. We speak, however, of a scientific consensus, but progress in science is not achieved through a democratic agreement on the most popular theory.

This consensus does rest on a reasonable theoretical foundation: the Earth's climate system, taken as a whole, is an open system that can substantially change its energy content only through radiative exchange with outer space at the top of the atmosphere. For this reason, climate models are built upon the paradigm of vertical energy transport, assuming—as a premise and without demonstration—that horizontal energy transport, known as meridional transport, does not have the capacity to significantly alter the planet's climate.

Today, I wish to defend here the hypothesis that changes in meridional energy transport not only have the capacity to alter the climates of the planet and modify the global energy content of the climate system, but that they constitute one of the principal mechanisms for doing so—and have been doing so throughout Earth's history. This thermodynamic hypothesis does not refute the principle that changes in greenhouse gas concentrations can influence the climate, but it greatly diminishes their importance.

The foundation of the thermodynamic hypothesis is based on two arguments that are not open to dispute.

The first is that the greenhouse effect is not uniform throughout the planet's atmosphere. Water vapor is responsible for about 75 % of Earth's greenhouse effect, yet water vapor is not homogeneously distributed. The tropical atmosphere may contain up to 4 % water vapor, whereas the polar atmosphere during winter contains essentially 0 % (see Fig. 1). Therefore, the tropical atmosphere retains solar energy with great efficiency, while the polar atmosphere efficiently loses the energy it has received from lower latitudes via meridional transport.

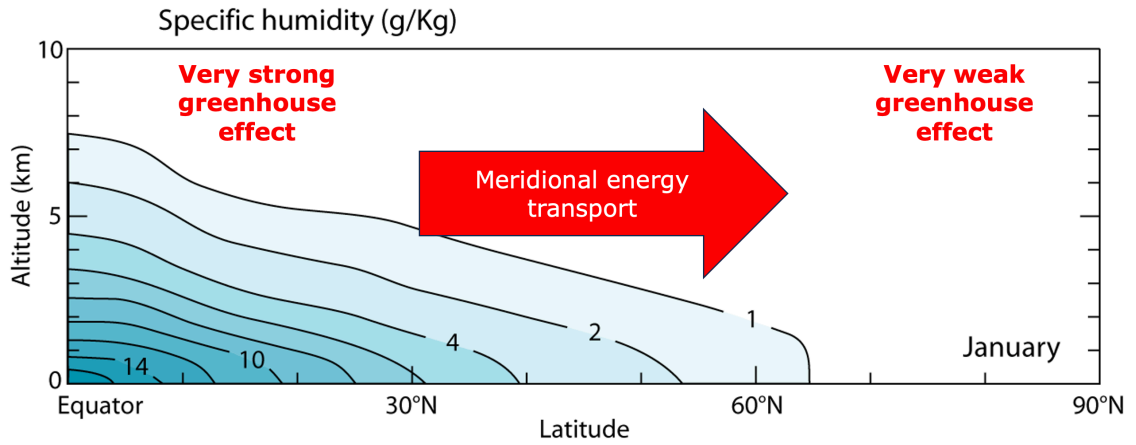


Figure 1: The greenhouse effect is very uneven on Earth due to water vapor differences.

The second argument is that, because of this heterogeneity in the greenhouse effect, any significant change in the amount of energy transported from the tropics to the poles must necessarily alter the total energy contained within the climate system. If more energy is transported poleward, the system loses energy and cools; if less energy is transported, the system gains energy and warms. The climate system comprises two well-differentiated zones: the tropics —where temperature depends essentially on the greenhouse effect— and the extratropics, where the temperature becomes increasingly dependent on meridional transport with distance from the equator.

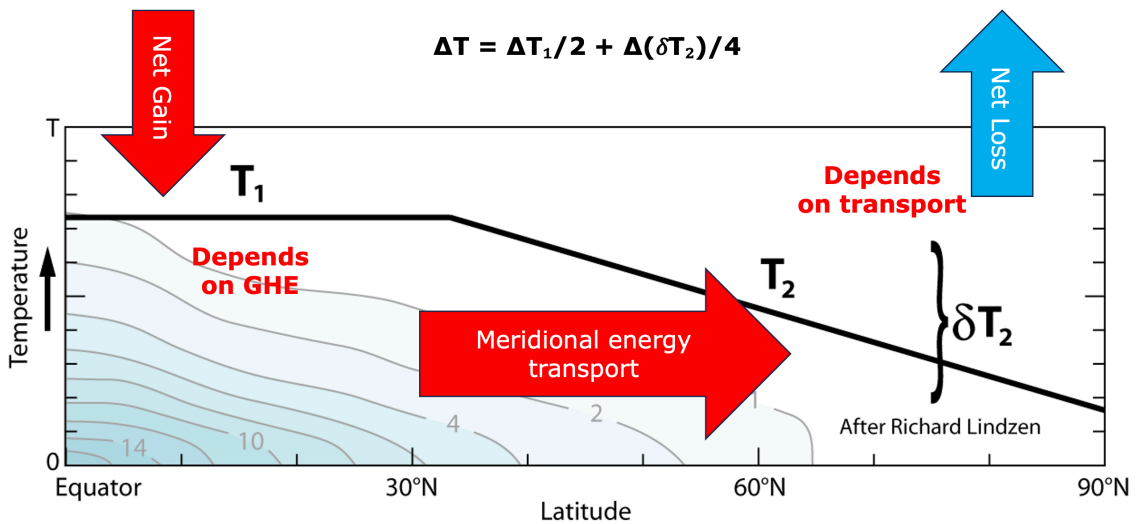
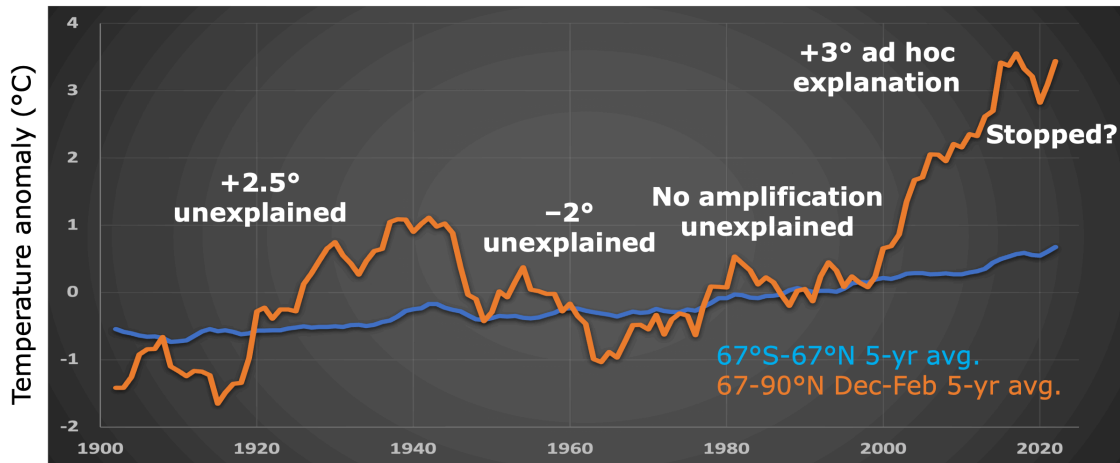


Figure 2: The gradient is key for temperature changes.

These two arguments are not debatable because they rest on basic physical principles and well-established observations. It suffices to demonstrate that there are changes in the amount of energy that meridional transport moves from the tropics to the poles, for the mechanism underlying the hypothesis to be automatically proven. And that demonstration is quite straightforward.

In winter, the Arctic receives no solar radiation. Since its atmosphere contains virtually no water vapor, it also contains virtually no clouds. Its surface is colder than the overlying air —a situation

known as a thermal inversion. Under these conditions, increasing CO<sub>2</sub> makes the polar atmosphere more efficient at emitting radiation to space, causing it to cool. The only way the Arctic can warm in winter is by receiving additional heat from lower latitudes — that is, through an increase in meridional transport— which confirms the hypothesis. Such wintertime Arctic warming did not begin when the planet started warming in 1975, but more than twenty years later, beginning in the late 1990s. Moreover, this recent warming of about three degrees is not fundamentally different from the roughly 2.5-degree warming that occurred between 1917 and 1944. These observations cannot be explained by the consensus hypothesis or by climate models, which fail to reproduce them.



<https://psl.noaa.gov/data/atmoswrit/timeseries/index.html>

Figure 3: Consensus theory does not explain Arctic winter temperature changes, meridional transport does.

We know from proxy evidence that tropical temperatures change very little, and that it is the temperature gradient between the tropics and the poles that determines the planet's overall temperature. Since the Last Glacial Maximum, the tropics may have warmed by perhaps one degree, while the poles have warmed by roughly twenty degrees. The impact of these changes on the global mean temperature would be about half a degree due to the tropics and the greenhouse effect, and about five degrees due to the extratropics and meridional transport.

$$\Delta T = \Delta T_1/2 + \Delta(\delta T_2)/4$$

Glacial to interglacial:  $\Delta T_1 = +1^\circ$   $\Delta(\delta T_2) = +20^\circ$

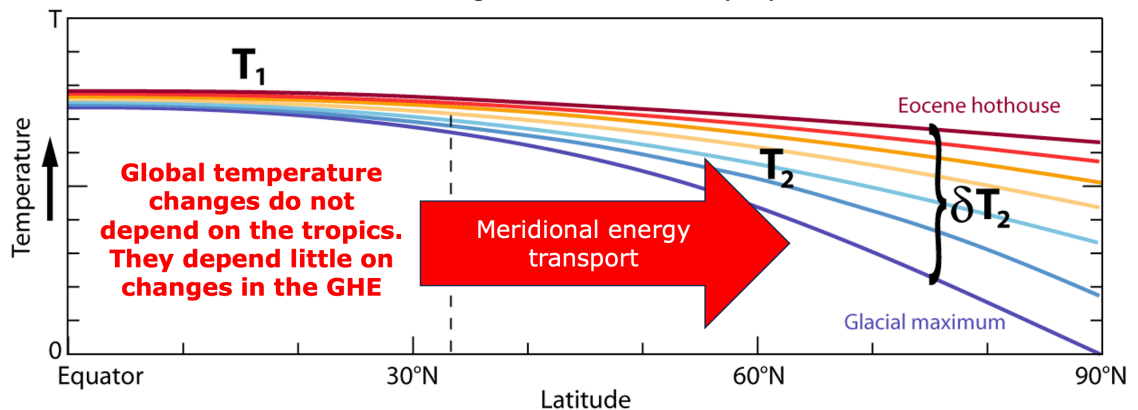


Figure 4: The gradient is key for temperature changes.

The thermodynamic hypothesis of climate change explains the paradoxical, enormous impact on climate of Milanković orbital variations, which operate through very small changes in solar insolation, occurring mainly at high latitudes and without affecting the tropics, yet they are capable

of mobilizing the vast energy changes required to transport enough moisture to build the immense ice sheets that cover parts of a hemisphere within only a few thousand years. This occurs by altering the temperature gradient and therefore meridional energy transport —supporting the view that it is a much more important climate-change mechanism than the greenhouse effect.

Thank you for your attention.

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Michelets vei 8 B  
1366 Lysaker Norway

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Correspondence:

[kovacs.istvan.janos@epss.hun-ren.hu](mailto:kovacs.istvan.janos@epss.hun-ren.hu)

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# On Geological CO<sub>2</sub> Emissions

## What we know and what we don't know about

István János Kovács

HUN-REN Institute of Earth Physics and Space Science, Sopron, Hungary

### Abstract

Geological CO<sub>2</sub> emissions from intraplate regions remain poorly quantified despite their relevance to the long-term carbon cycle. Observations from the Pannonian Basin indicate measurable mantle-derived degassing, highlighting the need for improved constraints on non-volcanic geological CO<sub>2</sub> fluxes.

**Keywords:** Carbon dioxide; pargasosphere; degassing; Pannonian Basin

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### 1. Introduction

*“In scientific debate, it is neither power nor authority that should carry decisive weight, but only scientific truth itself”* (Ferenc Deák, 1803–1876, Hungarian Stateman). When an Academy of Sciences distances itself from non-mainstream or less widely accepted scientific views, it does not strengthen public confidence—on the contrary, it risks weakening it. Avoiding open discussion for strategic, political, or institutional reasons may create the impression that the Academy is unable or unwilling to engage in transparent, evidence-based dialogue. Such avoidance does not protect science; instead, it endangers public trust, fosters misunderstanding, and ultimately diminishes citizens' confidence in scientific institutions. A genuinely strong scientific community demonstrates its integrity not by avoiding challenging questions but by addressing them openly, rigorously, and respectfully.

In this context some important issues must be discussed indeed appears to be “Beyond the Climate Change Consensus” such as the significance of geological CO<sub>2</sub> emissions and the global knowledge gap in this regard.

### 2. Uncertainties

Geological carbon dioxide emissions represent a fundamental but still poorly quantified component of the global carbon cycle. Despite the well-documented dominance of anthropogenic sources over volcanic CO<sub>2</sub> at present, the natural geological flux from Earth's interior continues to play an essential role in regulating atmospheric CO<sub>2</sub> over geological timescales. One of the central challenges is that our understanding is heavily biased toward areas of active volcanism, while intraplate regions — far from magma chambers and subduction zones remain critically undersampled and poorly constrained.

Modern global estimates of volcanic CO<sub>2</sub> emissions range between 0.18 and 0.44 Gt/year, including both eruptive and non-eruptive degassing sources. By contrast, anthropogenic emissions exceed 35 Gt/year. Although this comparison emphasizes the minor role of volcanoes in today's atmospheric budget, these volcanic estimates do not include diffuse, tectonically controlled, or deep-mantle-derived CO<sub>2</sub> fluxes outside volcanic arcs. Recent studies show that continental

regions without active volcanism can still host significant mantle-derived CO<sub>2</sub> release. For example, mantle volatiles continuously ascend along large lithospheric deformation zones and extensional structures in the Pannonian Basin, with estimated mantle-related CO<sub>2</sub> fluxes of 10<sup>3</sup>–10<sup>5</sup> mol km<sup>-2</sup> yr<sup>-1</sup>, values comparable to fluxes from quiescent volcanic systems. These findings challenge the traditional view that significant mantle degassing only occurs near magmatic centres. The problem is the massive data gap in intraplate regions. A critical theme emerging from all uploaded studies is that geological CO<sub>2</sub> fluxes in intraplate settings remain largely unconstrained. The 'pargasosphere hypothesis' explicitly predicts that cooling asthenosphere beneath young lithosphere can generate diffuse CO<sub>2</sub> emanations even far from active volcanism (Fig. 1). Deep lithospheric mantle beneath continental interiors can store and subsequently release large quantities of CO<sub>2</sub> over millions of years, especially during phases of lithospheric rejuvenation, thermal relaxation, and metasomatism. Recent data from the Bakony–Balaton Highland Volcanic Field indicate CO<sub>2</sub> accumulation of ~103 Gt over 10 Myr during post-rift lithospheric thickening. Degassing studies across the Pannonian Basin reveal that mantle-derived CO<sub>2</sub> is transported through lithospheric deformation zones, even in the absence of magma, producing fluxes overlapping with volcanic systems. Together, these results show that deep lithospheric CO<sub>2</sub> flux is neither negligible nor spatially restricted, yet global models currently lack robust parameters for these contributions.

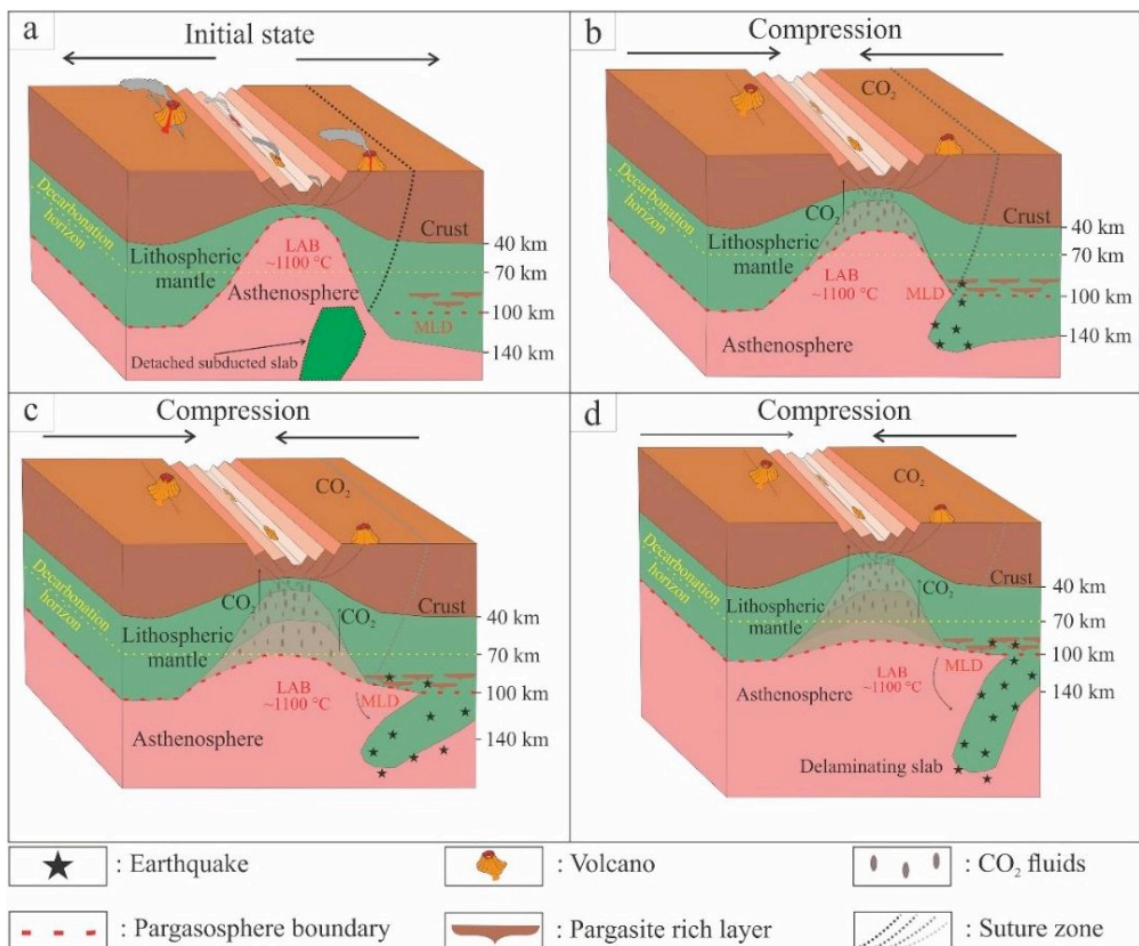


Figure 1: The cooling asthenosphere can be the source of significant amounts of CO<sub>2</sub> (Fig. 5 in Kovács et al., 2021).

Geological CO<sub>2</sub> emissions—such as those derived from: 1) deep-rooted fault zones; 2) degassing of trapped fluids or partial melts in the lithospheric mantle or at the lithosphere–asthenosphere

boundary; 3) metamorphic decarbonation in lower crustal settings; 4) inherited CO<sub>2</sub>-rich lithospheric mantle reservoirs, remain one of the least quantified fluxes in the global carbon budget. In regions like the Pannonian Basin, noble gas systematics, C–He ratios, and isotopic fingerprints demonstrate a complex mix of mantle, crustal, and atmospheric components, with extensive subsurface CO<sub>2</sub> trapping, dissolution, and re-release processes that complicate flux estimation. Moreover, the new xenolith-based constraints show that lithospheric mantle processes can accumulate enormous CO<sub>2</sub> reservoirs, which may episodically release carbon during tectonic or thermal disturbances. This dynamic behaviour is almost entirely missing from current climate-carbon system models.

## 2. Consequences

Because diffuse geological emissions outside volcanic arcs are still poorly measured, current climate models likely underestimate the natural lithospheric–mantle CO<sub>2</sub> flux. This underestimation has two major consequences: 1) It oversimplifies the natural baseline of pre-industrial atmospheric CO<sub>2</sub>; 2) It complicates attribution studies aiming to separate anthropogenic from natural contributions on millennial to million-year scales. The uncertainty does not diminish the dominant role of human emissions today, but it means that the long-term evolution of atmospheric CO<sub>2</sub> cannot be fully understood without integrating intraplate geological sources. Research targeting diffuse CO<sub>2</sub> degassing in intraplate environments—such as the Pannonian Basin—will directly contribute to constraining the magnitude of deep mantle CO<sub>2</sub> fluxes, improving global carbon cycle models, refining geodynamic interpretations of lithosphere–asthenosphere interactions, providing essential data for paleoclimate reconstructions, reducing the uncertainty of natural CO<sub>2</sub> sources in global climate assessments.

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1366 Lysaker Norway

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Correspondence:

laszlo.bader@  
edu.bme.hu

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## Surface Energy Balance of the Danube Region

### Assessment of changes between 1961-1990 and 1991-2020 using General Systems Theory and Climatic Energy Balance Diagram

László Báder

*Budapest University of Technology and Economics, Department of Hydraulic and Water Resources Engineering, Faculty of Civil Engineering, H-1111 Műegyetem rkp. 1. Budapest, HU*

#### Abstract

The surface of the Earth is heated by solar radiation (shortwave radiation) passing through the atmosphere. The air near the earth's surface is heated from below using this energy converting the shortwave radiation to other forms. According to the law of conservation of energy, the incoming and outgoing energies are equal. Continents are warming faster than the global average warming as published in an IPCC 2019 report. These facts encourage us to examine energy transport processes and their changes applying Ludwig von Bertalanffy's General System Theory. The input of the system is net shortwave radiation and the outputs are distributing this energy via different processes after transformation (thermal radiation, sensible heat and latent heat).

Major terms of this surface energy distribution system are compared in the Danube Region in two thirty-year periods. The energy input to the system has increased, resulting in an increase on the output side as well. If we use the evaporation fraction as an indicator to evaluate the performance of the distribution process, we can see that the efficiency of the distribution process – illustrated by the Climatic Energy Balance Diagram – is roughly the same. However, this is not enough to remove the increased energy from the surface: both latent heat and sensible heat have increased.

If we decompose the energy increase between the two periods into components on the output side, another problem becomes visible. The excess energy no longer leaves the surface in the form of evaporation at the same rate as before, but at a smaller rate, and the proportion of energy converted into sensible heat increases. In summer the availability of water for evaporative cooling becomes a problem. The role of plants and transpiration is being appreciated, a paradigm shift is needed. They provide the most important environmental services.

**Keywords:** surface energy balance; General systems theory; Climatic Energy Balance Diagram; latent heat; sensible heat, evaporative cooling

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#### 1. Introduction

The surface of the Earth is heated by solar radiation (short-wave radiation) passing through the atmosphere. This is the main energy source for life on Earth. This incoming energy is partially reflected back and the remaining part is converted into other forms of energy. The air near the earth's surface is heated from below. Data published by the IPCC in 2019 shows that the air over land is warming faster than the average warming of the Earth's atmosphere (IPCC 2019). This suggests that something is happening differently on land than over the oceans, which cover most of the Earth's surface.

The aim of the study is to examine the land surface as a complex system, determine its function,  
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<https://scienceofclimatechange.org>

and identify its main subsystems and processes. General systems theory seems to be an effective tool for analysis (Bertalanffy 1968, Báder 2023). Too much energy is just as harmful to life as too little, so understanding the role of the subsystems becomes key for maintaining a sustainable environment. Note: The topic of work focuses on the Earth's surface, choosing the temperate Danube region as a case study.

## 2. Material and method

According to the law of conservation of energy, in a state of equilibrium, the incoming and outgoing energies of the system are equal. The inextricably linked atmospheric and hydrological cycles together with the vegetation form an inseparable climatic energy transport and distribution system on the continents. The structure and core functions of this system can be identified by applying General Systems Theory.

Fig. 1a shows the energy balance model of vegetated land (Ryplová et al. 2024), this model is used to determine the key subsystems. Incoming shortwave (solar) radiation ( $R_{s\downarrow}$ ) is partially reflected in the same form ( $R_{s\uparrow}$ ). This net shortwave radiation is considered as energy input to the surface. Some of the energy, after being converted into heat, leaves the surface as long-wave radiation ( $R_{nL}$ ). The "rest" of the energy stays at or near the surface, and is called net radiation ( $R_n$ ). Most of the net radiation is converted into latent heat of evaporation (LE) or sensible heat that warms the air (H). A small fraction of solar energy (no more than 1 %) is bound by photosynthesis into biomass (P) and heats the biomass of the vegetation (J). Another part of the energy heats the ground (G = ground heat flux) during warm seasons, but during cold periods it gives this energy back.

Considering the total amount of shortwave energy reaching the surface, we could interpret  $R_{s\downarrow}$  as input, and all other terms as output (Eqv. 1). This is the interpretation in Fig 1a.:

$$Input = R_{s\downarrow} = R_{s\uparrow} + R_{nL} + (LE + H + J + P + G) = Output \quad (1)$$

Note: net radiation terms (all the terms that are converted on the surface to other forms of energy) are shown in the bracket:  $R_n = LE + H + J + P + G$

Another option is to consider net shortwave radiation on the input side, and all the other terms on the output side (Eqv. 2). In the later part of the study, this interpretation was selected for analysis applying the General Systems Theory. A simplification was used, where the smaller terms J, P and G are not shown separately, but are included in the H term:

$$Input = R_{s\downarrow} - R_{s\uparrow} = R_{nL} + R_n = R_{nL} + LE + H = Output \quad (2)$$

Data used in this study are from the ECMWF ERA5-Land reanalysis database (Muñoz-Sabater, 2019) with spatial resolution of  $0.1^\circ \times 0.1^\circ$  (approximately 9 km  $\times$  11 km in the study area). Monthly averaged data for the Danube basin were downloaded between  $8.0^\circ - 29.9^\circ$  E longitudes and  $42.0^\circ - 50.3^\circ$  N latitudes (an  $84 \times 221$  grid matrix for each month and each parameter). ERA5-Land "ssr" parameter represents net shortwave radiation: Incoming solar radiation ( $R_{s\downarrow}$ ) less reflected ( $R_{s\uparrow}$ ). Short- and long-wave radiation parameters ("ssr" and "str") were used to calculate net radiation ( $R_n = ssr + str$ ). The evapotranspiration ("e") variable was used for LE. Sensible heat (H) was calculated as  $H = R_n - LE$ , so this component of the energy balance equation includes all other smaller items (photosynthesis, ground heat flux and heating the biomass). All flux measurement units were converted to water-depth equivalents via the latent heat of vaporization (2,48 MJ/kg). One kg of water represents a unit mm water depth over one  $m^2$ . The slight dependence of the latent heat of vaporization on temperature was not considered.

The efficiency and effectiveness of the natural processes cooling the surface can be examined using a simple Climatic Energy Balance Diagram (CEBD), showing the ratio of latent and sensible heat compared to the energy available at the surface:  $LE/R_n$  respectively  $H/R_n$  (Báder 2025a). Long-wave thermal radiation is not considered in CEBD, as it is not directly available for use on

the surface, the focus is on the level of the  $R_n$  energy and the split between latent and sensible heat (LE and H).

Fig. 1b shows the monthly averages of the major terms over a thirty-year period (the smaller terms are embedded in sensible heat). The yellow envelope curve shows the energy input per month, and the stacked bars show the output energy terms (Báder 2025b).

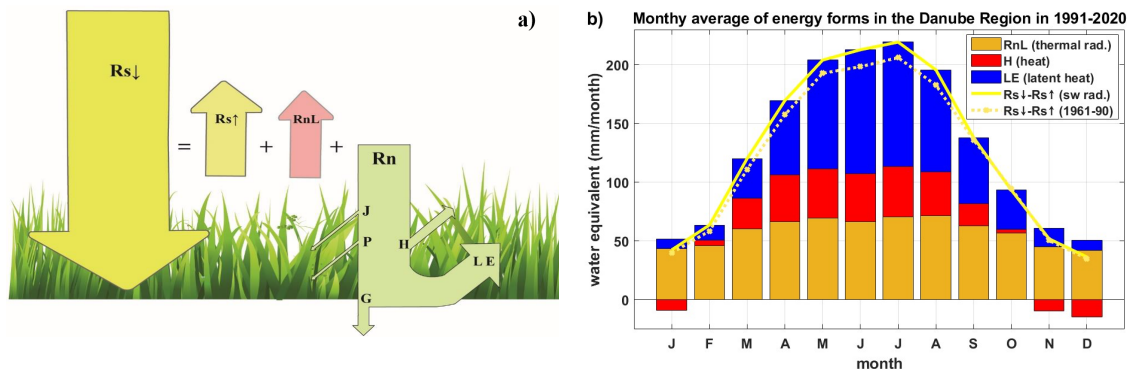


Figure 1: Main components of the surface energy distribution process: shortwave solar radiation ( $R_{s\downarrow}$ ) reflected solar radiation ( $R_{s\uparrow}$ ), net thermal radiation ( $R_{nL}$ ), net radiation ( $R_n$ ), latent heat of evaporation (LE), sensible heat (H), photosynthesis into biomass (P), heating of the biomass of vegetation (J) Fig 1a (left): The surface energy balance diagram (source: Ryplová et al. 2022).

Fig 1b (right): 30-year monthly average of energy forms in the Danube Region (ERA5-Land data). The yellow envelope curve shows the incoming energy, the bars show the outgoing energy (Báder 2025b)

### 3. Results

A high-level model of the surface energy distribution process can be formulated based on the principles of General Systems Theory. The model aims to help better understand climate and weather processes and their phenomena. Some definitions and boundary conditions need to be given at the beginning of the model development.

The subject of the System is the surface of the Earth. The name of the system can be Surface Energy Distributions System. The Function of the System is energy distribution; managing the transfer and transformation of energies on the surface to maintain energy balance. Key parts of a system are inputs and outputs. These are the interfaces of the system to the outside world. Our System consists of one input (net shortwave radiation,  $R_s$ ) and three outputs (Latent heat, sensible heat and net thermal radiation). Within the System, there are Subsystems that perform transformations. In this simple example we eliminate the details how shortwave energy turns into heat, how thermal emission transfers energy, how water evaporates, how plant transpiration works etc. Covering any further details (such as feedbacks, regulation processes, etc.) exceeds the scope of this work. This simple setup is still sufficient to make observation and draw some conclusions.

Fig. 2a shows the segmentation of annual values of net radiation ( $R_n$ ) on the Climatic Energy Balance Diagram (CEBD). The two components of  $R_n$ , latent heat of evaporation (LE) and sensible heat (H), are the axes of the diagram. The values of LE and H determine a working point for each year, which always falls on the  $R_n$  diagonal line of that year. The lines representing annual  $R_n$  values for the period 1961–1990 are marked in blue, and the lines for the period 1991–2020 are marked in yellow. The thirty-year averages are in bold blue and red respectively, where the lines projected onto the axes also show the ET and H values.

The figure clearly shows that with the increase in net radiation, both latent and sensible heat values increased. The shift of the 30-year average working point from 1961-1990 to 1991-2020 is indicated by a red arrow (Báder 2025a). The figure also illustrates that if we want to maintain the sensible heat value even if net radiation increases (keep it under control and prevent warming), then the latent heat value would have to be significantly increased. This is indicated by the vertical grey arrow. Similarly, if we want to maintain the latent heat value (not allowing evaporation to

increase), then the sensible heat value will increase significantly. This is indicated by the horizontal grey arrow.

Fig 2b shows the monthly distribution of changes in the outgoing energy terms between the two thirty-year meteorological normal periods. The orange, red and blue stacked bars indicate changes in thermal radiation (RnL), sensible heat (H) and latent heat (LE) respectively. The shift in proportions is striking; of the main energies leaving the surface, the rate of evaporation has noticeably decreased in the summer months, while the rate of sensible heat has increased.

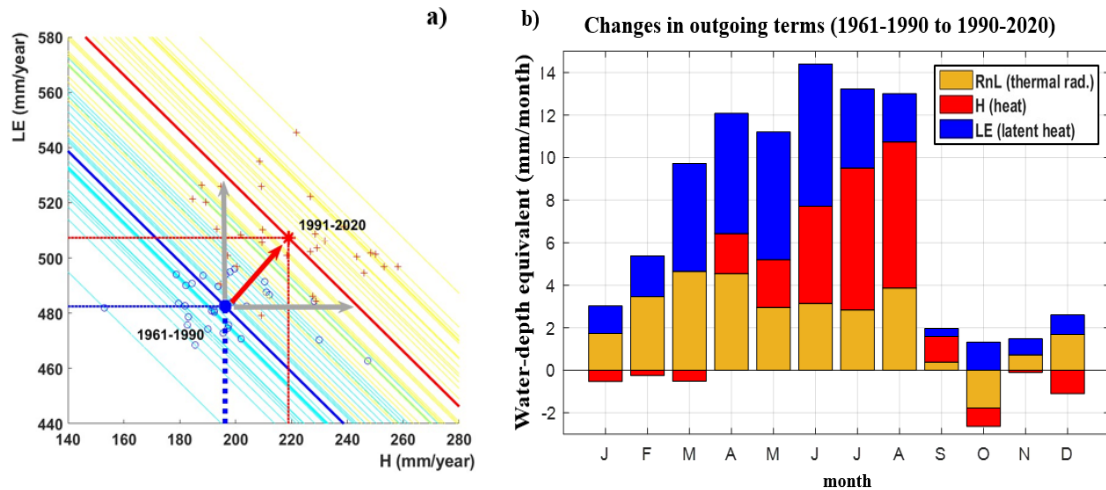


Figure 2: Changes in the main outgoing components of the surface energy distribution system of the Danube Region (ERA5-Land data). Unit of measure is in mm of water-depth equivalent.

Fig 2a (left): Detail of the Climatic Energy Balance Diagram. The shift of the 30-year average working point from 1961-1990 to 1991-2020 is indicated by a red arrow (Báder 2025a).

Fig 2b (right) Segmentation of the changes in the monthly average outgoing energy forms comparing periods 1961-1990 and 1991-2020 (Báder 2025b).

#### 4. Conclusions and discussion

Examining the process of atmospheric warming from a systems perspective, we started from the energy distribution processes of the earth's surface, where the warming of air around us begins. A simple model based on the General Systems Theory helps to segment and visualize the main elements of the system consisting of one input (net shortwave radiation) and three outputs (latent heat, sensible heat and net thermal radiation). The monthly share of these terms to energy distribution and their changes become tangible.

Although average evaporation has increased somewhat in the Danube region, the sensible heat has also increased. The conditions and indicators of the surface energy distribution system have changed during 30 years: the availability of water for evaporative cooling in summer becomes a problem. The current amount of evaporation in the Danube basin is not sufficient to remove the incoming excess energy. This situation suggests that there is not enough (cooling) water left in the landscape for the hottest period.

Climate change has an impact on water balance on continents. Hydrological processes play an important role on life on Earth, they supply plants with water. Plants can effectively participate in maintaining environmental conditions through their evaporative cooling effect (Ellison et al. 2024). "Plants ensure water circulation on the Earth, retain water in the landscape and influence significantly our climate" (Ryplová et al. 2024). In efforts to combat climate change, sustainable solutions therefore also require that sufficient water reaches the landscape and remains available for the warmer seasons at all points in the landscape.

Saving water in the landscape referring to climate change is a contra productive approach, a self-destructing trap of civilizations. The efficiency and effectiveness of the surface energy

distribution process is eroding with each drop of water which we leave out of the small water circle. A paradigm shift is needed. The abundant water supply of thriving biologically active surfaces supports dynamic self-regulatory processes.

Further research is needed to clarify the feedback mechanisms and regulatory effects – such as cloudiness, surface temperature, moisture recycling, biologically active surfaces, etc. – whose deterioration causes the tipping points leading to significant changes. But above all, people should appreciate natural processes much more. Modern man, having moved away from nature, feels less the importance of natural cycles, considers them a given. Water is not only a resource for human activities, but a fundamental condition for life on Earth. The extraordinary physical properties of water, its specific heat and heat of vaporization, make it essential in itself for maintaining a habitable terrestrial environment.

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1366 Lysaker Norway

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Correspondence:

[huszarcsaba14@gmail.com](mailto:huszarcsaba14@gmail.com)

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## Argued Answers to Questions about the Climate Situation and Energy Production

*Csaba Huszar retired chemist*  
*László Garbai retired energeticist*  
*Antal Gajary retired chemist*

### Abstract

Nowadays, public discourse and scientific interest seem to be dominated by one topic: climate change. The facts are stubborn, extraordinary atmospheric and geological phenomena have multiplied in recent decades and are occurring with unusual intensity. It is foolish to deny their objectivity. However, a meaningful discourse could be conducted about the underlying causes. Are the fluctuations in the climate the result of a series of events superimposed on each other, or is it just a matter of repeating cycles?

According to the followers of the dominant hypothesis, the anthropogenic strengthening of the atmospheric greenhouse effect is responsible for the fact that the average temperature of the Earth is rising. The main reason for this is the proven upward trend in the atmospheric concentration of so-called greenhouse gases. Of these, carbon dioxide and methane are attributed a prominent role. Are they right? The purpose of the following calculation is to clarify the role of carbon dioxide and methane in the increase of the atmospheric temperature. Our method is to use only measured and derived data, we ignore all model calculations, we rely only on our physical-chemical knowledge. We do not look for errors in the subtleties of complex climate models or theories. Our arguments are easy to understand even without a mathematical or natural science background. In our calculations, we use physical and chemical relationships taught at universities.

**Keywords:** climate change; emitted IR photons; carbon dioxide molecules; relaxation time of excited molecules; change in internal energy - temperature increase; pyrolysis

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### 1. Introduction

We have calculated all values below according to valid natural laws, using measured data. We have omitted any data that can be linked to any model. We use  $J/m^2s$  instead of the  $W/m^2$  dimension for energy flux, because this way we can also handle changes over time.

### 2. Relationship between carbon dioxide molecules and the number of photons emitted from the earth's surface

Divide the atmosphere into regular inverted truncated pyramids, the height of which are 80 km, and their base is a regular pentagon or hexagon of  $1 m^2$ . The atmosphere can be assembled seamlessly from such 3D elements. It is important that the composition of the air does not change when it is blown from one hypothetical volume to another by the wind. The number of carbon dioxide molecules present in this cubature can be calculated using the following formula as shown in Figure 1.

$(M/m) \times c \times A$ = number of carbon dioxide molecules in the atmosphere
$M = 5.137 \times 10^{18}$ kg, mass of dry atmosphere
$m = 0.028971$ kg, average molar mass of air
$c$ = carbon dioxide fraction of dry air
$A = 6 \times 10^{23}$ , Avodagro's number

Figure 1: Equation used in our calculations

Dividing this value by the surface area of the earth, we can obtain the number of carbon dioxide molecules in an inverted truncated pyramid with a base area of  $1 \text{ m}^2$ . The amount of energy radiated from  $1 \text{ m}^2$  of the earth's surface calculated based on the Stephan-Boltzmann law at 288.15 K is:  $390.89 \text{ J/m}^2\text{s}$ . This value is independent of the composition of the atmosphere! Starting from Wien's law, the energy of the photons with the maximum wavelength at 288.15 K: ( $E = 2.05 \times 10^{-20} \text{ J}$ ) and the number ( $n = 1.9 \times 10^{22}/\text{m}^2\text{s}$ ) can be calculated in the flux of  $390.89 \text{ J/m}^2\text{s}$ .

We can conclude that even at the beginning of the industrial revolution, there were 3 orders of magnitude more carbon dioxide molecules in the atmosphere, which were able to absorb the energy flux arriving per second:  $1.9 \times 10^{22}/\text{m}^2\text{s}$  photons.

The absorption bands of carbon dioxide in infrared radiation:  $\lambda = 2.36\text{-}3.02$ ;  $4.01\text{-}4.80$ ;  $12.5\text{-}16.5 \text{ }\mu\text{m}$ . 98% of the infrared spectrum falls between 3 and  $80 \text{ }\mu\text{m}$ . Integrating the equation  $E = hc/\lambda$  between the given limits, the carbon dioxide fraction of the energy flux of  $390.89 \text{ J/m}^2\text{s}$  is only:  $87.416 \text{ J/m}^2\text{s}$  (22.41 %). Only for this intensity it is needed to find carbon dioxide molecules from the total surface radiation in the air bath. (Calculated in this way, the water vapor share is 62.42 %). This also further increases the  $\text{CO}_2$  surplus by an order of magnitude.

The radiation lifetime of the carbon dioxide molecule excited by an IR photon can be calculated, its value is about 1 s, after which it returns to its ground state and is capable of absorption again. If we add to this that the excited  $\text{CO}_2$  molecules can return to their ground state not only by emitting electromagnetic energy - the reaction time of which is about 1 s - but also by thermalization - by collision with non-IR absorbing  $\text{N}_2$  and  $\text{O}_2$  molecules, - then the excess is even more frightening, because the energy transfer time in this case is only  $420 \text{ }\mu\text{s}$ , about five ten-thousandths of the electron emission. Given that  $1.9 \times 10^{22}$  photons are emitted per second from  $1 \text{ m}^2$  of the surface, from this point on, in principle - calculated with one secundum of excitation and 1 secundum of charge loss -  $2 \times 1.9 \times 10^{22} = 3.8 \times 10^{22}$   $\text{CO}_2$  molecules may be sufficient numerically to carry out the energy transfer. *Thus, in principle, only 0.065 % of the carbon dioxide molecules in the atmosphere can be in an excited state. This is an astonishing result. The fact that the carbon dioxide concentration has increased by 46 % over the years does not change the situation.*

*The carbon dioxide molecules existing in a virtual inverted truncated pyramid with a base area of  $1 \text{ m}^2$  had sufficient absorption capacity even at a solar constant 3 orders of magnitude higher at the beginning of the industrial revolution ( $c = 280 \text{ ppm}$ ). The absorption capacity of methane produced by living organisms is similar to that of carbon dioxide, and it decomposes into carbon dioxide within a short time, so methane emissions do not*

have a climate-influencing role, because they only add to the huge excess of carbon dioxide.

According to farmers, an increase in the concentration of carbon dioxide in the atmosphere of up to 0.12 % would be particularly beneficial and would lead to an increase in production averages. There is no danger of carbon dioxide! The life cycle of a carbon dioxide molecule is more important – from its formation through excitation to charge loss – than just its mere existence, but rather how its encounter with an infrared photon, and what changes this may produce depending on time!

### 3. Change in the mass of the hydrosphere.

Hydrocarbon molecules coming from the Earth burn into water and carbon dioxide when are used. The water molecules thus formed were not previously part of the hydrosphere, the hydrogen atoms are extracted from the depth of the Earth. Since the mining of hydrocarbons, the volume of the hydrosphere has increased by an amount of  $1.54 \times 10^{14}$  kg, which has not been taken into account in any calculations so far. This is 1.3 % of the mass of the hydrosphere. This will increase as long as we burn oil and natural gas under terrestrial conditions.

### 4. The increase in internal energy is not from the Sun.

During the oxidation of coal and hydrocarbons, carbon dioxide and water capable of phase change are formed at temperatures of 1000-2000 °C. At this time, the rearrangement of chemical bonds occurs, it is no longer important what the released bond energy is transformed into (mechanical, electrical, etc.). The resulting gaseous carbon dioxide and superheated water vapor capable of phase change then cool down to the average temperature of the Earth, driven by the pursuit of energy balance. The latter can still undergo two phase transformations, some of it mixes with the air: therefore, during cooling, it plays a role primarily in cloud formation. However, these water molecules arrive in the condensation air layers from a different direction; not by evaporation from the Earth's surface due to warming, but by the cooling, expansion, mixing, and convection of high-temperature combustion products from the air. One is powered by solar energy, the other gains the energy needed for the gaseous state through bond rearrangements in an oxidation process. This is depicted in Figure 2.

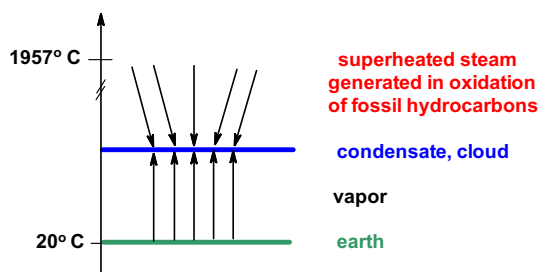


Figure 2: Formation of moisture in the air

This results in a higher condensation temperature, which in turn increases the saturation value assigned to it, and consequently there will be more water vapor in the air. The rate of evaporation varies almost linearly with temperature, while the atmosphere's water

vapor-holding capacity increases by a power of ten. This seems as if energy were being pumped into the Earth's atmosphere from another celestial body. The value of the internal energy increases, and the average temperature rises ( $dU = \delta Q + \delta W$ ).

Our calculations prove that the reason for the temperature increase experienced in the atmosphere is not to be found in the assumed increased reflection of surface IR radiation caused by the increasing amount of carbon dioxide molecules present. The real reasons are: the energy released during the combustion of coal and hydrocarbons, the energy released when the flame temperature carbon dioxide and superheated water vapor molecules are cooled due to the rearrangement of chemical bonds (+ nuclear energy\*). This process has been going on for more than 150 years, continues today, and will continue every day as long as we mine coal, oil, and natural gas from the earth's crust and burn them for energy production. (The energy released during nuclear fission and fusion is also not of solar origin, which also increases the internal energy). The amount of energy released during the oxidation of fossil-derived materials and nuclear fission is the order of  $10^{24}$  J. We can state that the increase in carbon dioxide concentration has no effect, but the binding energy released during its formation has a temperature-raising effect ( $dU = \delta Q + \delta W$ ). The production of carbon dioxide, water and heat between 1850-2025 are shown in Table 1.

Table 1: Production of Carbon Dioxide, Water and Heat from Fossil Fuels

Fossil source (Carbon content) 1850-2025	Production of Carbon Dioxide, Water and Heat from Fossil Fuels				
	Quantity of Carbon, kg	Resulting carbon dioxide, mol	Resulting water		Released amount of heat, kJ
			number of moles	kg	
Coal (90 %)	$4.5 \times 10^{14}$	$1 \times 10^{13}$	0	0	$8.27 \times 10^{15}$
Crude oil (85 %)	$1.62 \times 10^{14}$	$3.6 \times 10^{12}$	$3.6 \times 10^{12}$	$6.48 \times 10^{13}$	$6.85 \times 10^{15}$
Natural gas (75 %)	$1.13 \times 10^{14}$	$2.5 \times 10^{12}$	$5 \times 10^{12}$	$8 \times 10^{13}$	$2 \times 10^{16}$
<i>Total</i>	$\approx 10^{14}$	$\approx 1.6 \times 10^{13}$	$8.6 \times 10^{12}$	$1.54 \times 10^{14}$	$3.5 \times 10^{16}$

Since the Industrial Revolution, the concentration of carbon dioxide in the atmosphere has increased by 130 ppm according to Equation 1. This corresponds to a mass of  $1.1 \times 10^{18}$  kg of carbon dioxide. The mass of fossil carbon dioxide is  $(1.6 \times 10^{13} \text{ mol}) \times 44 \text{ kg/mol} = 7 \times 10^{14} \text{ kg}$ . The ratio of the two carbon dioxide masses is 0.00036. This means that the amount of carbon dioxide from fossil energy sources between 1850 and 2025 is only 0.036 % of the total increase in carbon dioxide concentration. Then  $3.5 \times 10^{16}$  kJ amount of heat raises the temperature of the seas and oceans by only  $6.3 \times 10^{-5}$  K. And  $3.5 \times 10^{16}$  kJ amount of heat raises the temperature of the atmosphere by only  $6.6 \times 10^{-3}$  K.

### 5. Safe energy production

The energy supply of humanity could be solved with a technology known for 3500 years, the pyrolysis of carbohydrates, by heating them in an oxygen-poor environment. (A fundamental difference from biogas production and the pyrolysis of plastics). According to this, without the

investment of external energy, the spontaneous rearrangement of chemical bonds produces elemental carbon and a gaseous product, pyrolysis gas (wood gas), which can be utilized in many ways due to its content of hydrogen (50 %), methane (38 %) and carbon monoxide (1.5 %).

Approximately 150 Gt of carbohydrate-containing plant waste is generated worldwide each year. Their average calorific value is 15 MJ/kg. When coal, oil and natural gas are burned,  $3.5 \times 10^{13}$  MJ of energy is released annually. This amount of energy could be obtained by burning  $2.33 \times 10^{12}$  kg (about 2.5 Gt) of plant waste. However, iron ore cannot be smelted with cereal straw. This is where pyrolysis comes into play. By converting plant waste into pyrolysis products and oxidizing them, humanity's fossil energy needs could be met simply by rearranging chemical bonds, without any external energy investment (Figure 3)! Humanity's energy needs could be met by feeding elemental carbon, which can be obtained from carbohydrates through pyrolysis, into thermal power plants. In the pyrolysis of carbohydrates, carbon production is the most essential element.

By pyrolysis of plant waste, 50 % elemental carbon and 25 % *generator-gas* (caloric value 5 MJ) can be produced on a dry basis<sup>1,2</sup>. By converting and oxidizing plant waste into pyrolysis products, humanity's fossil energy needs could be met simply by rearranging chemical bonds, without the investment of external energy! There would be no need for nuclear energy (which, including the production of the fuel element, has one of the largest carbon footprints and environmental impacts, and zero energy balance when including the energy demand of production), wind turbines, or solar panels.

The prototype is operating in Hungary (Pyrowatt Kft Kiskunmajsa)<sup>3</sup>, and this should be scaled up. The only way to solve humanity's energy problem is to use solar energy. Energy problem be solved. The carbon dioxide thus produced would no longer burden the environment, because it had previously participated in an assimilation process.

By spreading pyrolysis coal on farmland, its water-holding capacity can be increased, thereby delaying the occurrence of a drought. *Pyrolysis coal is a source of "green" hydrogen.*

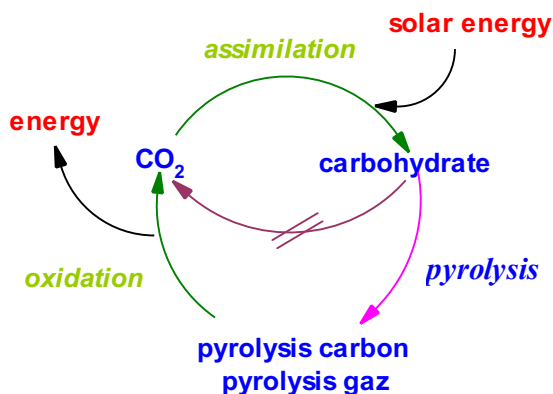


Figure 3. Perfect energy-generating carbon cycle

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\*This article is elaborated in 3 papers in an expanded form, with detailed calculations.



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Michelets vei 8 B  
1366 Lysaker Norway

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Correspondence:

garbai.laszlo@  
gmail.com  
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# Absorption of Thermal Radiation in the Atmosphere in the Presence of CO<sub>2</sub>: A Photon Gas Model

László Garbai

Budapest University of Technology and Economics, Faculty of Mechanical Engineering, Department of Building Services and Process Engineering, Hungary

Róbert Sánta

University of Dunaujváros, Institute of Engineering, Department of Mechanical Engineering and Energy Systems, Hungary

Csaba Huszár

Budapest University of Technology and Economics, Hungary

## Abstract

The paradigmatic challenges of our time include the presence of greenhouse gases in the atmosphere, their influence on the Earth's climate, global warming, and the green transition. The assessment of these issues and their relative importance divides the scientific community. Some researchers deny the existence of a significant greenhouse effect and its influence on weather and climate, while others, in our view, tend to overemphasize it. In this paper, a Simple Model (SM) is presented to address this question. The use of General Circulation Models (GCMs) is considered unnecessary, as their complexity introduces substantial uncertainty in describing the role of greenhouse gases. It is difficult to understand why, despite the well-established principles of thermodynamics, energy transfer, and fluid mechanics, a definitive resolution of this issue has not yet been achieved, and no clear position has emerged regarding the role of CO<sub>2</sub>. The approach relies exclusively on fundamental equations that are part of standard university curricula. Only well-known and verified relationships are used. These are further developed through mathematical analysis, and the resulting conclusions provide a clear interpretation of the magnitude of climate change, the need to reassess the green transition, and the justification for maintaining both nuclear and hydrocarbon-based energy systems.

**Keywords:** thermal radiation; gas model; greenhouse effect

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## 1. Introduction

In our previous papers [1,2], the increase in atmospheric CO<sub>2</sub> concentration from 1960 to the present was examined. The question was raised to what extent this increase can be considered anthropogenic and how large the contribution of natural inflow is. The problem was analyzed using a reservoir-type model. The result indicated that, contrary to the prevailing scientific view, approximately 95 % of the CO<sub>2</sub> exchange between the Earth and the atmosphere is of natural origin, and only about 5 % is anthropogenic.

In the present study, it is demonstrated that the greenhouse effect attributed to CO<sub>2</sub>, and the associated atmospheric warming, has become negligible because the atmospheric CO<sub>2</sub> concentration had already reached a level by 1960 at which the relevant absorption bands (frequency ranges in the Planck distribution) were effectively saturated. Any further increase in CO<sub>2</sub> concentration

beyond this level did not enhance the greenhouse effect and did not cause additional warming of the Earth's atmosphere.

This raises the further question of what has caused the global warming observed since then. In this paper, the fundamental equations related to the theory are formulated, and the relationship between the increase in CO<sub>2</sub> concentration and atmospheric warming is examined based on the available data from the period considered.

The fundamental equations describing the absorption of thermal radiation in the atmosphere by CO<sub>2</sub> molecules are standard university-level material. The photon absorption capability and emissivity of CO<sub>2</sub> can be analyzed using an inhomogeneous linear differential equation with constant coefficients. Surprisingly, this straightforward and fully adequate approach is not discussed in the literature, although it represents the only appropriate state model (SM).

A state equation has been established that expresses a logarithmic relationship between CO<sub>2</sub> concentration and emissivity. This relationship has not been previously explored or published in the literature. It is emphasized that the derivations and conclusions are based on conventional tools of mathematical analysis, without the use of prior assumptions or impermissible simplifications. The theory is fully consistent with the Stefan–Boltzmann law, Planck distribution, and the Beer–Lambert law.

## 2. Photon Theory of Thermal Radiation

In the following, the equations are presented that allow the emissivity in the atmosphere to be related to CO<sub>2</sub> concentration. Based on this relationship, the associated atmospheric temperature rise can be described, and a prognosis can be given regarding how temperature is expected to change if the CO<sub>2</sub> concentration is doubled or multiplied under a repeated “business as usual” scenario.

### 2.1 Physical model for the description of thermal radiation

The normal-direction thermal radiation intensity originating from 1 m<sup>2</sup> of the Earth's surface is considered. Thermal radiation is treated as a lossy photon flux, where the loss is caused by energy absorption by CO<sub>2</sub> molecules. The photon flux can be interpreted as a photon gas that propagates within a radiation tube, adopting terminology analogous to that used in fluid mechanics.

### 2.2 Fundamental Equations of Photon Flux

#### 2.2.1 Radiation spectrum – Planck distribution

$$i_{\lambda}^{(0)}(\lambda, T) = \frac{\partial e^{(0)}}{\partial \lambda} = C_1 \frac{\lambda^{-5}}{e^{c_2/(\lambda T)} - 1}, \quad (1)$$

where

$i_{\lambda}^{(0)}(\lambda, T)$  spectral radiation intensity of a black body.

$\lambda$  wavelength,

$T$  temperature,

$C_1, C_2$  constants,

$e$  Euler's number,

$e^{(0)}$  total radiation of the black body

#### 2.2.2 Stefan-Boltzmann law

$$e^{(0)}(T) = \sigma_0 T^4 \quad (2)$$

where

$\sigma_0$  Stefan-Boltzmann constant.

$e^{(0)}$  total radiation intensity of the black body over the entire wavelength range.

### 2.2.3 Gas medium – Radiation intensity and Beer's law

$$\frac{i_{\lambda,\varphi}(\lambda,T_g)|_{x=X} - i_{\lambda,n}^{(0)}(\lambda,T_g)}{i_{\lambda,\varphi}|_{x=0} - i_{\lambda,n}^{(0)}(\lambda,T_g)} = e^{-k_{i,\lambda} p_i X} \quad (3)$$

where

$i_{\lambda,\varphi}$  the radiation intensity in the direction  $\varphi$

$i_{\lambda,n}^{(0)}$  normal spectral intensity of a black body,

$k_{i,\lambda} \cong k$  spectral absorption (extinction) coefficient of the absorbing gas species,

$p_i$  partial pressure of the absorbing gas species,

$X$  coordinate along the radiation path.

### 2.2.4 Absorption–emission factor (degree of blackness) of a gas layer

$$\varepsilon = \frac{i_{\lambda,n}(x)}{i_{\lambda,n}^{(0)}} = \varepsilon_\lambda \equiv \alpha_\lambda = 1 - e^{-k_i p_i x} \quad (4)$$

The product  $px \equiv [bar][m]$  and can be combined into a single variable  $py \equiv [bar][m]$

### 2.2.5 Transmissivity factor of the gas layer

$$\tau_\lambda = 1 - \varepsilon_\lambda. \quad (5)$$

## 3. Emission (Absorption) Factor. Analysis of the Intensity Absorbed by CO<sub>2</sub>. The Problem of CO<sub>2</sub> “Doubling” (Lindzen’s Statements [3])

### 3.1 Single CO<sub>2</sub> concentration

The limiting value of emissivity is

$$\lim_{x \rightarrow \infty} \varepsilon_1 = \lim_{px \rightarrow \infty} (1 - e^{-kp_0 x}) = 1 \quad (6)$$

where  $p_0$  is the partial pressure corresponding to a single CO<sub>2</sub> concentration.

An infinitely extended gas body behaves as a black body. It cannot absorb or emit more radiation.

### 3.2 Doubling of the CO<sub>2</sub> concentration, or doubling of (px)

$$\varepsilon_1 = 1 - e^{-kp_0 x} = 1 - e^{-ky} \quad (7)$$

$$\varepsilon_2 = 1 - e^{-k2p_0 x} = 1 - e^{-k2y} \quad (8)$$

### 3.3 Relationships between $\varepsilon_2$ and $\varepsilon_1$

#### 3.3.1 Logarithm of the transmissivity ratio

$$\gamma_1 = \ln \frac{1 - \varepsilon_2}{1 - \varepsilon_1} = \ln \frac{e^{-k2p_0 x}}{e^{-kp_0 x}} = \ln e^{-kp_0 x} = -kp_0 x \quad (9)$$

The ratio  $\gamma_1$  is a function of  $x$ . If  $x$  is constant, the ratio is also constant and independent of the doubling of CO<sub>2</sub> concentration.

$$\lim_{x \rightarrow \infty} \gamma_1 = 0$$

- Difference of emissivities

$$\varepsilon_2 = 1 - e^{-k2p_0x} \quad (10)$$

$$\varepsilon_1 = 1 - e^{-kp_0x} \quad (11)$$

$$\gamma_2 = \varepsilon_2 - \varepsilon_1 = \Delta\varepsilon = e^{-k2p_0x} + e^{-kp_0x} - e^{-kp_0x} = e^{-kp_0x} (e^{-kp_0x} + 1) \quad (12)$$

$\lim_{x \rightarrow \infty} \gamma_2 = \Delta\varepsilon = 0$ . The difference tends to zero.

- Ratio of transmissivities

$$\gamma_3 = \frac{1-\varepsilon_2}{1-\varepsilon_1} = \frac{e^{-k2p_0x}}{e^{-kp_0x}} = e^{-kp_0x} \quad (13)$$

$\lim_{x \rightarrow \infty} \gamma_3 = 0$  The ratio of transmissivities tends to zero.

- Ratio of logarithms of transmissivities

$$\gamma_4 = \frac{\ln(1-\varepsilon_2)}{\ln(1-\varepsilon_1)} = \frac{-k2p_0x}{-kp_0x} = 2 \quad (14)$$

The ratio of logarithms is constant and independent of the doubling. This may be the point misinterpreted by Lindzen [3]. From this,

$$\ln(1 - \varepsilon_2) = 2 \ln(1 - \varepsilon_1) \quad (15)$$

$$1 - \varepsilon_2 = (1 - \varepsilon_1)^2 \quad (16)$$

$$\varepsilon_2 = 1 - (1 - \varepsilon_1)^2 \quad (17)$$

if  $\varepsilon_1 \rightarrow 0$ , then  $\varepsilon_2 \rightarrow 0$ , if  $\varepsilon_1 \rightarrow 1$ , then  $\varepsilon_2 \rightarrow 1$ .

*The emissivity corresponding to doubled CO<sub>2</sub> concentration can be calculated from the emissivity at single concentration.*

- Limiting value of emissivity

$$\varepsilon = 1 - e^{-kpx} \quad (18)$$

$$\lim_{x \rightarrow \infty} \varepsilon = 1 \quad (19)$$

An infinitely extended gas body behaves as a black body, independently of the CO<sub>2</sub> concentration.

$$i_{\lambda,n} = i_{\lambda,n}^0 \quad (20)$$

From the above, the validity of Lindzen's statements [3] is not confirmed. However, Lindzen's intention and effort toward climate scepticism [3] are viewed as favourable from our perspective.

#### 4. Formulation of the General State Equation

Let an arbitrary multiplicity be introduced. In this case, Equation (17) can be written as

$$\varepsilon_n = 1 - (1 - \varepsilon_0)^n \quad (21)$$

where  $n$  is arbitrary and  $n > 0$ .

## 5. The Past, the present, and the Future

Between 1960 and 2020, the total anthropogenic heat input to the atmosphere was approximately 9000 EJ, which corresponds to 18,000 kJ/m<sup>2</sup> when averaged over the Earth's surface. During the same period, the atmospheric temperature increased by 0.5 °C. The associated increase in atmospheric enthalpy, calculated from this temperature rise, was 7,850 kJ/m<sup>2</sup>. This indicates that the heat released from anthropogenic fuel use was more than sufficient to account for the observed increase in atmospheric enthalpy.

In 1960, the atmospheric CO<sub>2</sub> concentration was 315 ppm, and the absorption bands were already saturated. As a result, additional warming of the air due to the greenhouse effect of CO<sub>2</sub> was no longer possible. Between 1960 and 2020, the total increase of 100 ppm in CO<sub>2</sub> concentration consisted of approximately 20% anthropogenic origin, while the remaining portion was of natural origin.

At present, the anthropogenic CO<sub>2</sub> input has stabilized at approximately 5 ppm per year. The anthropogenic CO<sub>2</sub> fraction behaves as a self-adjusting system. Theoretically, over an infinite time horizon, this input would result in an increase of 20 ppm with a time constant of 4 years, and 50 ppm with a time constant of 10 years. If this trend were to continue in the future, and if a greenhouse effect and corresponding atmospheric temperature rise were hypothetically assigned to this process, the following theoretical—but practically unrealizable—temperature increases could be estimated.

Table 1: Self-adjusting effect of anthropogenic CO<sub>2</sub> inflow and the associated theoretical temperature increase for different time constants.

Time constant (e-time)	Anthropogenic CO <sub>2</sub> inflow	Self-adjustment time	Self-adjusted concentration increase	Concentration increases during e-time	Atmospheric temperature increases during e-time	Temperature increases over the full self-adjustment time (infinite time)
4 years	5 ppm/year	Infinite	20 ppm	12.6424 ppm	0.05495 °C	0.08694 °C
10 years	5 ppm/year	Infinite	50 ppm	31.606 ppm	0.13739 °C	0.21739 °C

A complete cessation of anthropogenic CO<sub>2</sub> emissions (full green transition) would, hypothetically and over an infinite time horizon, “avoid” only a 0.08614 °C temperature increase.

## 6. Validation of the State Equation and Visualization of the Calculations

The performed calculations show, in agreement with the results of Tibor Ónodi [4] and Csaba Huszár [5], that the absorption wavelengths associated with CO<sub>2</sub> concentration were already saturated by 1960. At that time, the emissivity of the CO<sub>2</sub> gas body had already reached a value of 0.99, which increased only to 0.996962 by 2020 despite the additional 100 ppm rise in concentration. Since an analytical continuous function cannot represent discontinuities, singularities, or breaks, and its limit tends toward unity, this is considered to confirm the validity of the saturation hypothesis.

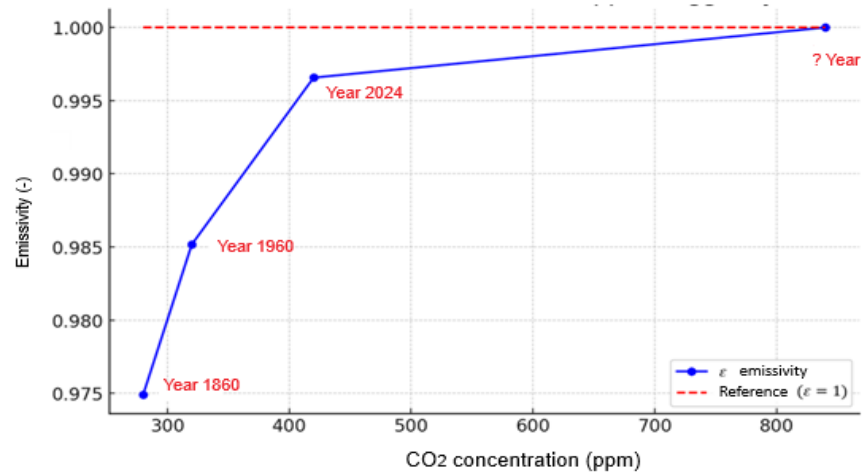


Figure 1: Emissivity as a Function of CO<sub>2</sub> Concentration

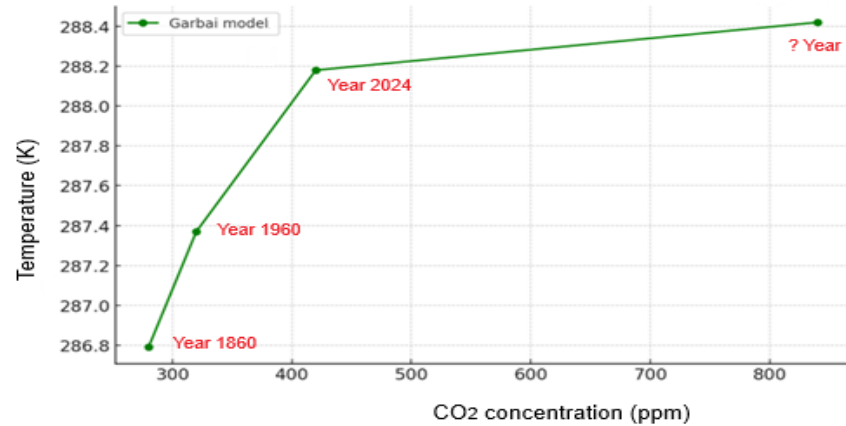


Figure 2: Temperature as a Function of CO<sub>2</sub> Concentration

## 7. Conclusions

On July 23, 2025, a report was published by a U.S. governmental department stating that efforts aimed at preventing climate change may be considered more harmful than preparing for its impacts. The report assessed the role of the greenhouse effect as negligible, regarded the electrification of the automotive industry as unnecessary, supported the continued production of gasoline-powered vehicles, and characterized the green transition as potentially detrimental. The authors of the present paper consider these positions to be consistent with the conclusions drawn from their earlier research and view their findings as supporting this perspective.

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1366 Lysaker Norway

# Modern Grand Solar Minimum (2020-2053)

## Little Ice Age started

Valentina Zharkova<sup>1,2</sup>

ISSN: 2703-9072

1 - ZVS Research Enterprise Ltd., London, UK; 2 – Northumbria University, Newcastle, UK

Correspondence:

valentina.zhar-  
kova@northum-  
bria.ac.uk

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### Abstract

The two Principal Components (eigenvectors) derived with Principal Component Analysis from the solar background magnetic field defining two largest magnetic waves of the poloidal field of the Sun are shown to be generated in two layers by the solar dynamo with the dipole magnetic sources. The two magnetic waves revealed a noticeable phase shift between them resulting in the variations of 11-year cycle amplitudes in the summary curve modulated by the envelope curve with a period of 330-380 years defined by the usual wave interference with a small phase shift. This envelope curve defines the grand solar cycles separated by grand solar minima (GSMs), similar to those observed in the past: Maunder, Wolf, Oort and other grand minima. There are the two modern GSMs approaching: GSM1 (2020-2053) and GSM2 (2375-2410). During a GSM a reduction of solar irradiance is expected by about 3 W/m<sup>2</sup> from the modern level that causes a decrease of the average terrestrial temperature by about 1.0 °C. This temperature reduction is already observed for the GSM1 clearly in the Northern hemisphere from the West to East signalling the arrival of *Little Ice Age* for GSM1.

**Keywords:** Sun: magnetic field; sun: solar activity; sun: double dynamo; grand solar minimum; little ice age

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## 1. Introduction

### 1.1 Solar background magnetic field

The solar background magnetic field (SBMF) plays the essential role in dynamics of the Sun and the whole solar system by expanding the interplanetary space, forming *Parker's spiral* Parker, 1958) and *Heliospheric Current Sheet* (HCS) (Smith, 2001), while interacting with the planetary magnetic fields defining some planetary patterns. There are daily observations of solar magnetic field by Wilcox Solar Observatory (Stanford, US) with full disk magnetograms with lower spatial resolution that excludes strong magnetic fields of sunspots providing daily synoptic magnetic maps of SBMT, the surface SBF represents a summary of all the magnetic waves generated by the Sun's background magnetic field, which reach the solar surface (photosphere).

### 1.2 Natural frequencies

It is well known that any system has its own unique oscillations on *natural frequencies*<sup>[4]</sup> which need to be known and considered in any future exploitation of the system. Natural frequency, measured in terms of *eigenfrequency*, is the rate at which an oscillatory system tends to *oscillate* in the absence of disturbance. Here are the two cases when the *natural frequencies* were ignored which led a) in 1940 to the collapse of Tahoma bridge, US

([https://en.wikipedia.org/wiki/Tacoma\\_Narrows\\_Bridge\\_\(1940\)](https://en.wikipedia.org/wiki/Tacoma_Narrows_Bridge_(1940))) caused by a strong gale inducing the bridge vibration on its natural frequency or b) in 2001 to the uncontrolled swinging of the Millennium bridge in London, UK, ([https://www.engr.psu.edu/ae/thesis/failures/MKP/failures/failures.wikispaces.com/Millennium\\_Bridge\\_Performance\\_Issues.html](https://www.engr.psu.edu/ae/thesis/failures/MKP/failures/failures.wikispaces.com/Millennium_Bridge_Performance_Issues.html)) oscillating on its natural torsional frequency induced by walking people.

### 1.3 Relevance to solar activity

Our understanding of solar activity is tested by the accuracy of its prediction. The latter became very difficult to derive from the observed sunspot numbers and to fit sufficiently close into a few 11-year cycles or even into a single cycle until it is well progressed. In addition to sunspots for the current index of solar activity with averaged sunspot numbers (SSN) and considered as proxies of a strong (toroidal) magnetic field of the Sun, we used a weak solar background (poloidal) magnetic field (SBMF) captured by the Wilcox Solar Observatory in cycles 21-23 (Hoeksema, 1984).

## 2. Natural frequencies, or eigen vectors, of SBMF

Natural frequencies (*eigenvalues*) of magnetic waves (*eigenvectors*) on the Sun's surface measured from the magnetograms of SBMF can be found by applying Principal Component Analysis (PCA) (Jolliffe, I. T. (2002). and calculating two Principal Components, or eigenvectors (EVs) shown in Fig.1 from the historic daily magnetic synoptic maps of the Wilcox Solar Observatory (Stanford, US) for cycles 21-23 (Shepherd et al, 2014; Zharkova et al, 2015) confirmed later for cycles 21-24 (Zharkova and Shepherd, 2022).

The authors discovered that there are two principal components, or EVs, of SBMF with close but not equal eigenvalues and another three pairs with smaller but the significant eigenvalues. The pairing denotes that the solar magnetic waves are generated in the two layers of the Sun. The PCA helps to separate magnetic waves into significant eigenvectors of wave components with given eigenvalues defined by the data variance. The first two eigenvectors, were representing the 39 % of the magnetic data variance, the next pair of eigen vectors covers 18 % of data variance, and the next pair of eigenvectors covers 9 % of the data variance.

This pairing of magnetic waves allowed the authors (Shepherd et al, 2014; Zharkova et al., 2015) to derive the mathematical expressions for these two PCs as a function of time enabling the prediction of these EVs forward for cycles 24-26 (Fig.1).

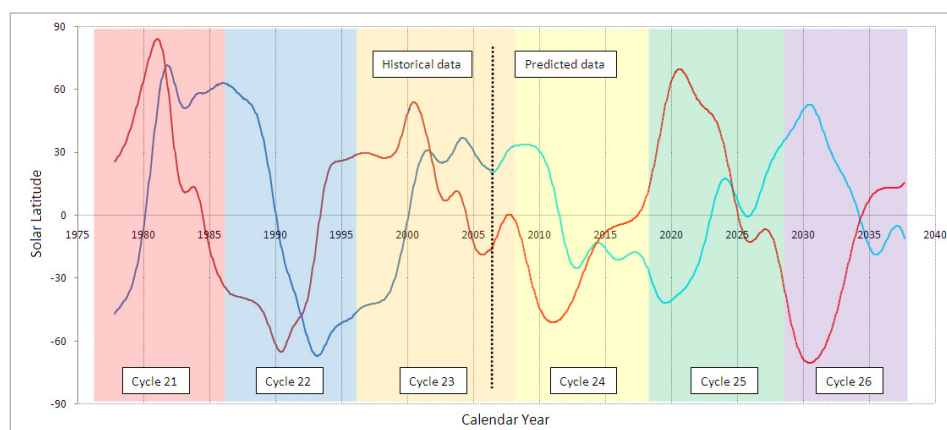


Fig.1. Two eigenvectors, or magnetic waves, derived from the solar background magnetic field with PCA in cycles 21-23 and expanded with the formula to cycles 24-26. Positive numbers indicate the northern polarity of magnetic field and negative one - the southern polarity.

Hence, the first two PCs, or EVs, derived from PCA, shown in Fig.1, reflect the two primary magnetic waves with the different magnetic polarities (northern for positive numbers of axis Y and southern for negative ones).

In order to understand the physical meaning of the derived EVs, Zharkova et al. (2015) calculated the *summary curve* of these two EVs (Fig. 2) and their *modulus summary curve* (Fig. 3) reflecting all negative EVs into the positives.

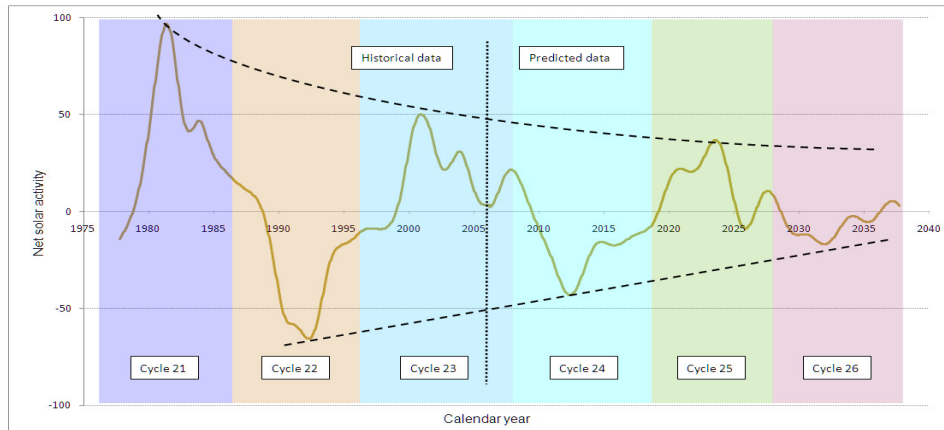


Fig.2. Summary curve of two PCs, or magnetic dynamo waves, produced by dipole magnetic sources for cycles 21-26. Positive numbers indicate the northern polarity of the summary curve and negative one – the southern polarity.

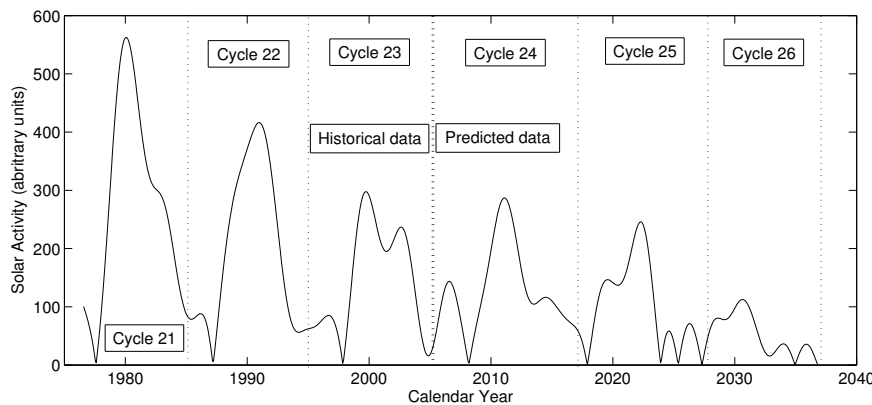


Fig.3. Modulus summary curve (mirroring the negative numbers of the summary curve in Fig.2 to the positive axis Y) of two PCs reflecting the dipole magnetic waves for cycles 21-26 showing a significant reduction of the cycle amplitude towards cycle 26.

The *Summary curve* in Fig. 2 shows continuous reduction of the resulting EV magnitudes of SBMF clearly seen in Fig. 3 when these magnitudes were reflected to the positive numbers only.

Hence, the *physical meaning of the natural frequencies* of the SBMF is defined by the action of **solar dynamo** (Cameron et al, 2017) the intrinsic source of **solar activity**. Keeping in mind that the solar background magnetic field (SBMF) represents poloidal magnetic field (like ocean waters) while the sunspots are considered to be proxies of the toroidal magnetic field (or magnetic loops, like boats appearing on the surface), it makes these two types of magnetic waves (poloidal and toroidal) as the two necessary components of **solar dynamo** defining **solar activity**. Each of

these types of magnetic waves is still generated in the two layers of the solar interior presenting their superposition on the surface as SBMF (poloidal field) and magnetic loops (toroidal field) with the places where they are embedded into the photosphere seen as sunspots (proxies of toroidal field).

The poloidal and toroidal magnetic waves generated by the Sun are well anti-correlated during [solar cycle](#) (Stix, 1996; Zharkov et al, 2008) confirming the dynamo process as the solar activity driver converting one type of the magnetic waves into another.

### 3. Summary and modulus summary curves as a complimentary solar activity index

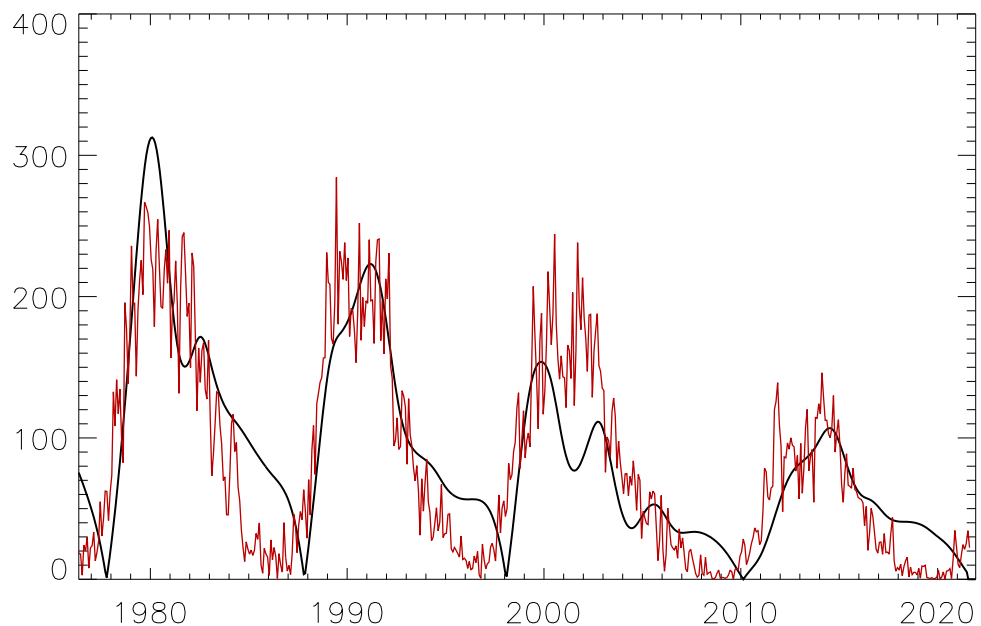


Fig.4. Comparison of the modulus summary curve with the [sunspot numbers](#) for cycles 21-24. Courtesy of Zharkova and Shepherd, 2022.

Comparison of the *modulus summary curve* (MSC) of two EVs of SBMF with the current solar activity index, averaged sunspot numbers<sup>[14]</sup> for cycles 21-24 is shown in Fig.4. We showed that the sunspot activity is associated with the modulus summary curve, which is a derivative from these two-wave summary curve and not from a single one (Zharkova et al, 2015, Zharkova and Shepherd, 2022). It can be seen that the MSC of two EVs, or the waves induced by a dipole magnetic field, roughly reproduce the averaged [sunspot numbers](#) used as the current [solar activity](#) index intuitively introduced by Wolf nearly two centuries ago (Wolf, 1852).

There is more rigorous comparison of the *modulus summary curve* (MSC) with the averaged sunspot numbers (SSN) in cycles 1-25 as shown in Fig.5 (Zharkova et al, 2015). Since these two indices, MSC and SSN, represent the different entities of solar activity, respectively: magnetic waves of the background (poloidal) and sunspot (toroidal) magnetic fields of the Sun, they are not identical but complimentary by default as shown below according to the dynamo models (Zharkova, 2015, Zharkova et al, 2023).

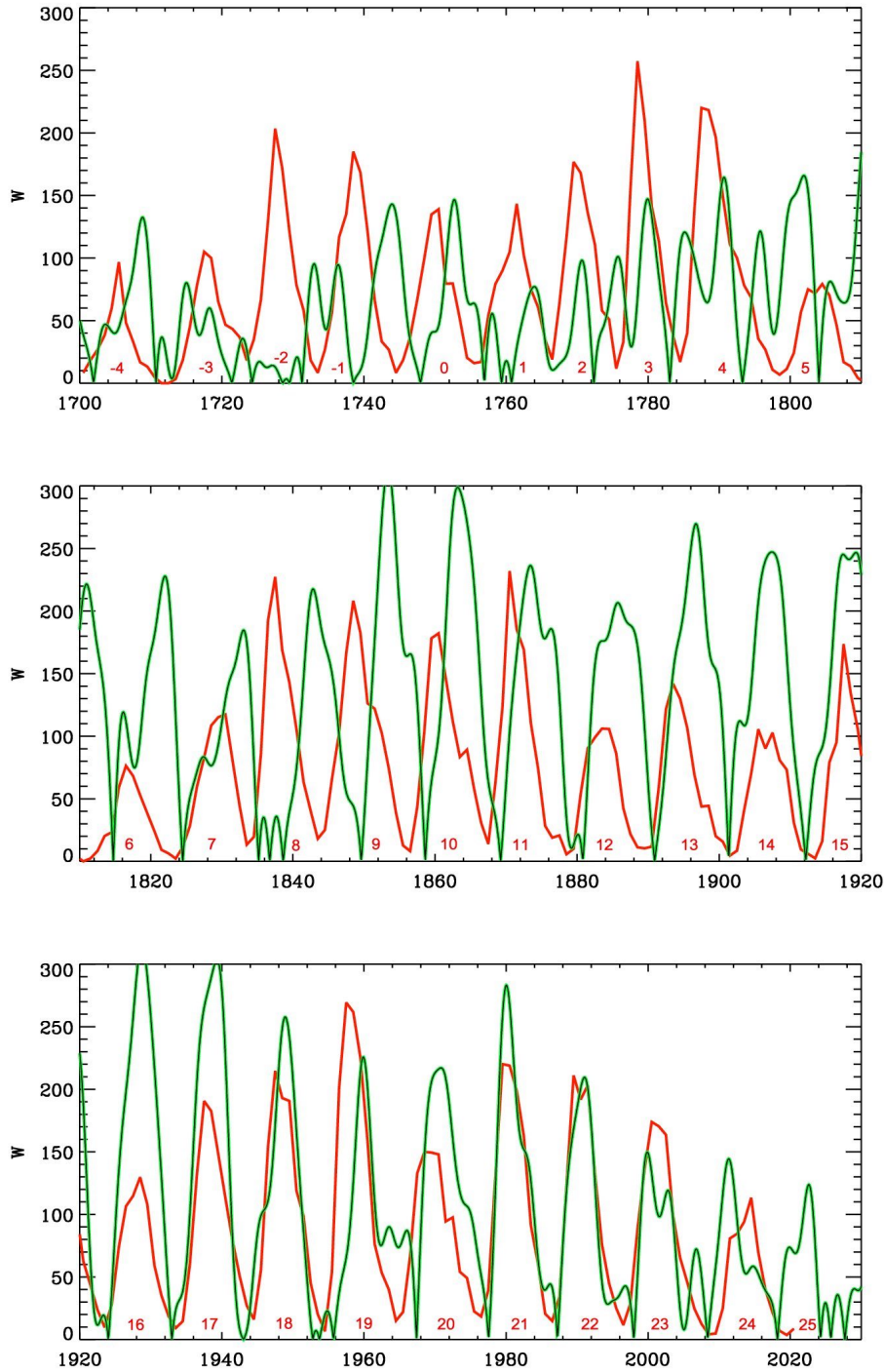


Fig.5. Comparison of the modulus summary curve (green line) with all the sunspot indices in all the sunspot cycles from 1700 (red line). Courtesy of Zharkova et al, 2023.

The summary curve for dipole magnetic sources gives 67 % correlation with sunspot activity index including all the waves, not only dipole ones. Popova et al. (2018) has demonstrated that by adding to the summary curve the pair of magnetic waves induced by quadruple magnetic sources which are also found to be responsible for flaring activity on the Sun, at least, in soft X-ray emission (Zharkova and Shepherd, 2022) allows to improve this correlation with sunspot index to about 80 %.

Hence, the summary curve of two largest eigenvectors, or two dynamo magnetic waves, produced by solar dipole magnetic sources, defines the appearance of the magnetic field on the solar surface. This summary curve revealed the occurrence of grand solar cycles with duration of 330-380 years separated by grand solar minima fitting numerous observations of the solar activity (Zharkova et al, 2015, 2018, 2023).

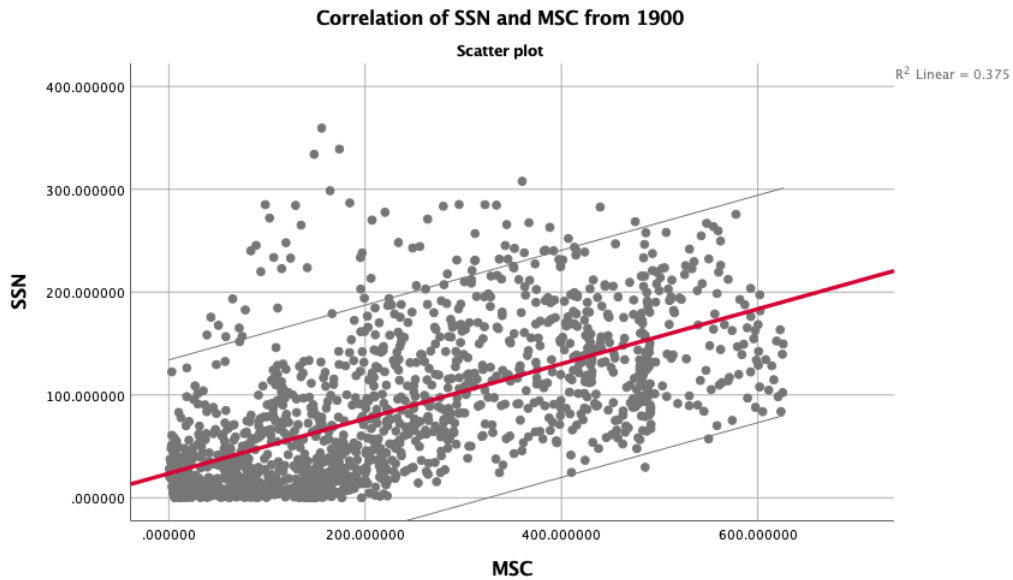


Fig.6. A scatter plot of the correlation of the modulus summary curve with the averaged sunspot numbers SSN measured from 1900 until 2022 years.

#### 4. Grand solar cycles (GSCs) and grand solar minima (GSMs)

The derived analytical formula for the two principal components of SBMF, or dynamo magnetic waves, allows one to present the *summary curve* for years 1200-3200 shown in Fig.7 (Zharkova et al, 2015). This expanded *summary curve* reveals the distinct periodic variations of the 11-years cycle amplitudes with the envelope period of 330–380 years, or Grand Solar Cycles (GSCs). These GSCs are separated by Grand Solar Minima (GSMs), lasting from 3 to 7 solar cycles when these amplitudes of 11 years cycles become rather small, similar to those reported during Maunder, Wolf, Oort GSMs in AD or Homeric GSM in BC and many other Grand Solar Minima occurred in the past or to occur the future (Zharkova et al, 2018b).

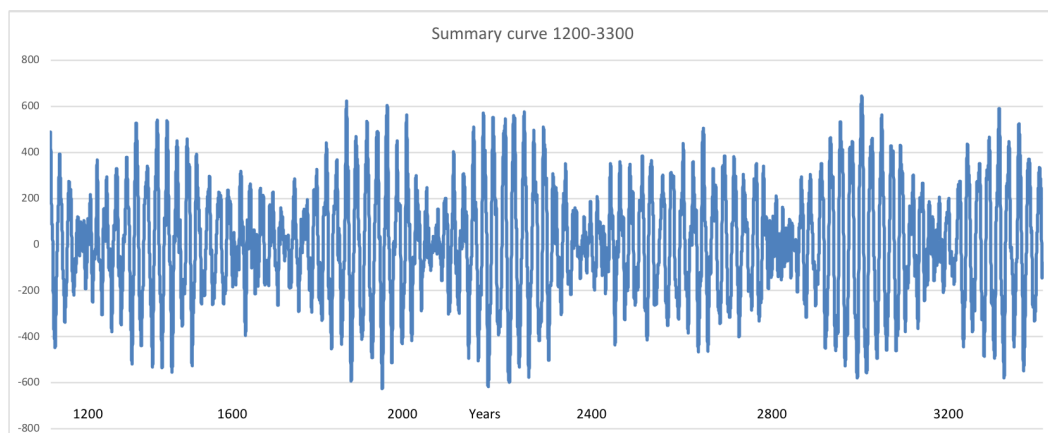


Fig.7. Summary curve of two PCs expanded to years 1200-3200 (Zharkova et al, 2015, Zharkova, 2020) revealing grand solar cycles (GSCs) of 330-380 years and grand solar minima (GSMs) between them.

Most importantly, the *summary curve* has timely uncovered the fact that there is a modern Grand Solar Minimum to occur in cycles 25–27, or in 2020–2053 (Zharkova et al, 2015), which can cause a substantial reduction (up to 1.0 °C) of the terrestrial temperature (Lean et al, 1995, Zharkova, 2020) like it has occurred during **Maunder Minimum** in the 17th century. The occurrence of the modern GSM in cycles 25-27 was also confirmed by Bayesian representation of averaged sunspot numbers SSN by Velasco Herrera et al (2021) considering the most accurate part of SSN after 1900 (Svalgaard and Schatten, 2016).

The expansion of this *summary curve* of two PCs, or EVs, up to 3000 years backwards shown that the *summary curve* reveals many Grand Solar Minima in the past, like named ones: Maunder, Wolf, Oort in last two millennia plus also the Homeric minimum about 800 years in the millennium BC (see Fig.8) and (Zharkova et al, 2018a,b).

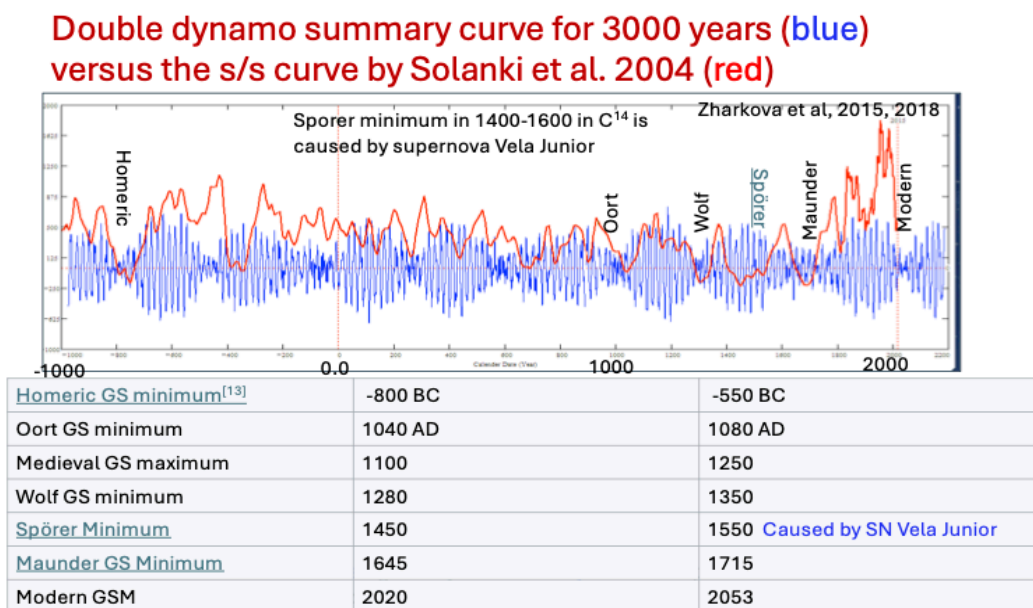


Fig.8. Solar activity index for 3200 years presented by the *summary curve* of eigen vectors (blue line) (Zharkova et al, 2015) versus the solar activity index derived from the isotopes C14 abundances in the terrestrial biomass (red line) (Solanki et al., 2004).

The most GSMS in the Holocene were nicely recovered by the *summary curve* index shown in Fig.8 (Zharkova et al, 2018a) besides Spörer's solar minimum (Zharkova et al., 2017, 2018a) that is likely related to the increase Galactic Cosmic Rays (GCRs) background intensity on Earth in the times of Spörer minimum. This increase was strongly affected by the explosion of supernova Vela Junior at the close distance of 650 light years from the Sun which significantly increased the GCR background radiation used in time dating leading to the potential errors in calculating the timing from C14 isotopes by up to 300 years (Zharkova et al, 2017). In fact, Zharkova et al, 2017 shows that the visual observations of large sunspots by Chinese astronomers, Aurora Borealis large intensities, the ice areas reduction in Greenland, the temperature variations and the increase of viral diseases on Earth during this period, all indicate to a maximum of solar activity and not the minimum as it was claimed.

## 5. Two natural frequencies of SBMF versus a dynamo model

In order to understand the natural frequencies of the *summary curve* derived from the full disk solar magnetograms, Parker's two layers  $\alpha\Omega$ -dynamo model was utilised for the dipole magnetic sources of the Sun producing dynamo magnetic waves for both poloidal and toroidal components in the two layers (inner and outer) with the opposite directions of meridional circulation

(Zharkova et al, 2015). One layer is assumed located deeply in the solar interior near the bottom of convective zone and another layer appearing beneath the solar surface. The original *summary curve* with the Grand Solar Cycles of SBMF (Zharkova et al, 2015) shown in Fig. 7 was fit pretty closely all GSCs and GSMs by Parker's two layers  $\alpha\Omega$ -dynamo model (Parker, 1993, Popova 2018) for both, poloidal and toroidal magnetic field components using very reasonable parameters of the solar interior in both layers with the only difference in meridional circulation velocities of about 1 km/s leading to the required phase shift between the two magnetic waves (Zharkova et al., 2023).

## 6. Effects of grand solar minimum on the terrestrial temperature

A significant reduction of the solar activity during a grand solar minimum reflected in the reduction of the amplitude of the summary curve of two eigenvectors or a reduction in an averaged sunspot number leads to a noticeable (about  $3 \text{ W/m}^2$ ) reduction of the solar radiation sent to Earth (Lean et al, 1995, Steinhilber et al, 2012). This reduction of solar radiation is shown to lead to a decrease the terrestrial temperature by  $1.0 \text{ C} - 1.5 \text{ C}$  over the whole Globe (Pfister, 1995; Shindell et al., 2001) as shown in Fig. 9 for the Northern hemisphere for Maunder minimum, (1645-1710), the previous grand solar minimum in the 17<sup>th</sup> century. The temperature decrease is not similar in different parts of the Earth as shown by colour bars in Fig. 9.

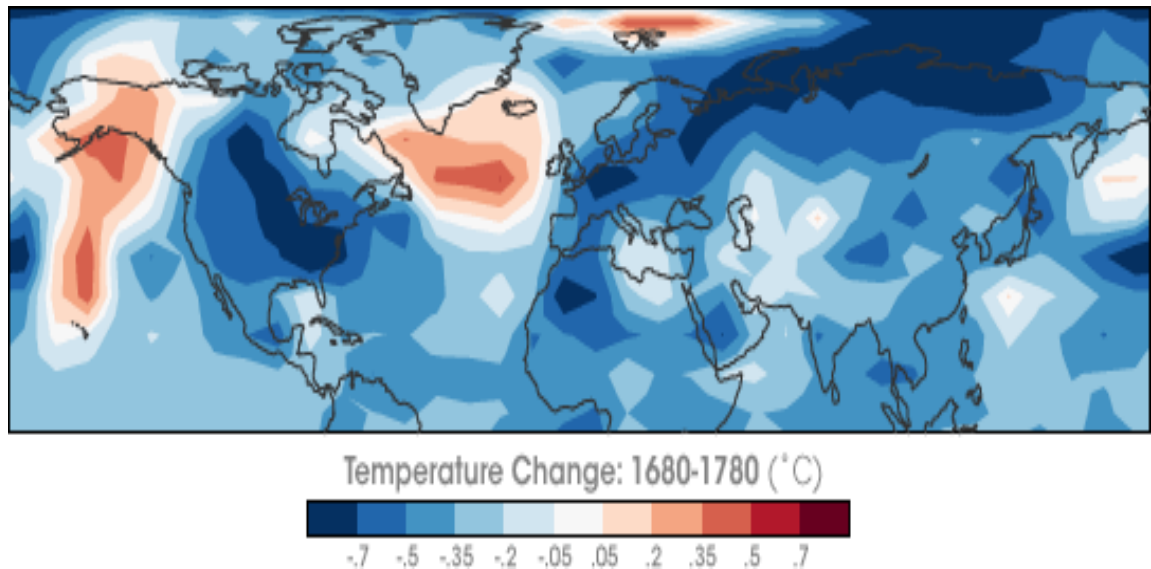


Fig.9. Annual change of the averaged surface temperature (in  $^{\circ}\text{C}$ ) in the northern hemisphere from 1780 to 1680 during the GSM. Courtesy of Shindell et al., 2001.

Shindell et al, 2001 used a version of General Circulation Model (GCM) of the Goddard Institute for Space Studies (GISS), which included a detailed representation of the stratosphere, and simulated the difference between the temperature measured in the GSM period and a century later, after the solar output became relatively high and stable. The model utilized a mixed-layer ocean, allowing sea surface temperatures (SSTs) to respond to radiative forcing, and has been shown to capture reasonably well the observed wintertime temperature variations induced by this GSM (Shindell et al, 1999). The GCM also included a parameterization of the response of ozone to solar irradiance, temperature, and circulation changes (Shindell et al, 1999), based on results for preindustrial conditions from their two-dimensional chemistry model (Shindell et al, 1998).

The simulations shown that the reduced Maunder Minimum irradiance leads to the increased

abundances of the upper stratospheric ozone that, in turn, leads to a decrease of the lower stratospheric ozone. These two processes produce a negative radiative forcing, e.g. the reduced solar irradiance during the Maunder Minimum causes a shift toward the low-index of AO/NAO (the Arctic Oscillation (AO) pattern or the North Atlantic Oscillation (NAO)) as demonstrated in Fig.10). These arctic jets led to Europe and Northern America to become unusually cold during the Maunder Minimum.

The surface temperature changes in November – February in Northern hemisphere show the alternating warm oceans and cold continents at the NH mid-latitudes (Fig. 9), with a maximum temperature decrease by 2.0-4.0 C in winter. During December to February, even the surface temperature in the tropics and subtropics is found to cool by 0.4 ° to 0.5 °C because of the reduced incoming radiation and the upper stratospheric ozone increase. Cooling in the tropical and subtropical upper troposphere is even more pronounced (0.8 °C) because of cloud feedbacks, including an 0.5 % decrease in high cloud cover induced by ozone through surface effects.

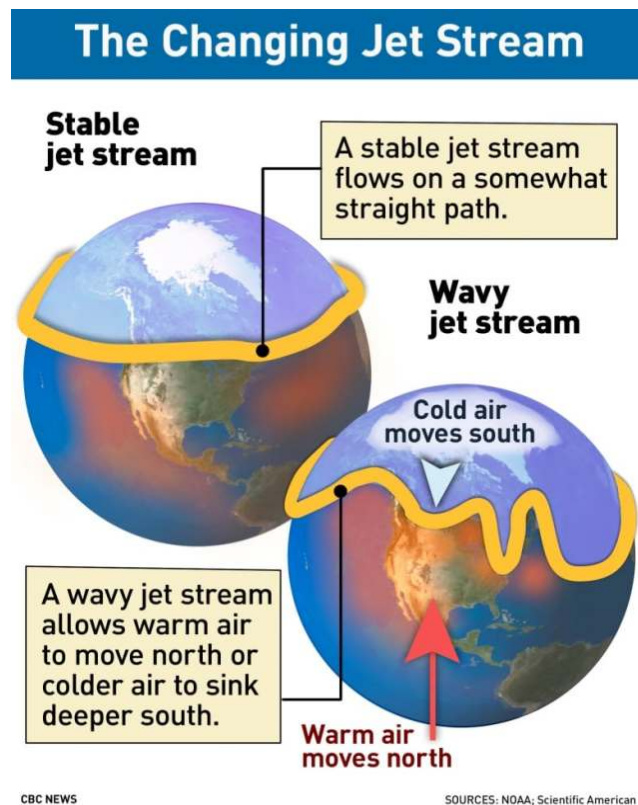


Fig. 10. Cartoon demonstrating formation of wavy jet wiggles in AO/NAO allowing the excursions of the arctic cold air into lower latitudes.

## 7. The signs of cold patches in the modern GSM

Currently, in January-February 2026 there are snows and frost all over the Northern hemisphere <https://solargsm.com> from the East (Japan, China) through Europe to the West (USA and Canada). The frost and snow reached subtropics in Florida and Caribbean (Cuba), there is also reported a cold weather in tropics (Singapore, Laos). There were the signs of cold in the Southern hemisphere as well like a frost and snow in Canberra on the 2 December 2026, the lowest January temperature -49.8 C in Antarctica, cold and wet weather in January in New Zealand. It shows that these arctic jets mentioned above are already making their ways to lower latitudes of each hemisphere including subtropics and tropics.

And all this cold is happenings while the sun just passed a maximum of cycle 25. Much more signs of cooling will be observed during the descending phase of cycle 25 and especially during a minimum between cycles 25 and 26 and 26 and 27. The next cycle 26 is predicted (Fig. 4) to have much less activity than other cycles. Moreover, it is shown (Vasilieva and Zharkova, 2023) that there is expected strong volcanic activity during cycle 26 that can contribute to further cooling of the terrestrial atmosphere. This puts into the focus the need of maximal reliable and continuous 24/7 energy resources required to heat people houses and food to feed humankind and animals.

## **8. Conclusions**

In summary, it can be concluded that the modern grand solar minimum (2020-2053) predicted 10 years ago by Zharkova et al, 2015 has arrived and will progress as expected until the mid of century. There is the cold weather with huge frosts and snows recorded in January- February 2026 in the whole Northern hemisphere from the West to the East and from the North to the equator. The little ice age associated with the modern grand solar minimum is here, and the humankind needs to deal with it.

Each country needs more reliable and continuous energy resources helping humans keep their houses warm. All the governments need to find alternative resources to grow up or transport from the meat, vegetables, fruits and wheat/rye to supply food for population and animals.

In addition, let us remember that the GSM indicates a reduction of the solar background magnetic field (SBMF), which expands into the interplanetary space and reaches the planets. It means that this weakened interplanetary magnetic field gives all initiatives back to the planetary magnetic fields including the Earth magnetic field. This is the time to look more closely what is expected from the terrestrial pole swapping for the Earth, in general, and for the humankind, in particular.

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