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The Sword of Damocles behind the Curtain of the Earth's Global Warming: A Review

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Abstract

The "mainstream" climatology (MSC)—*i.e.* which includes the Intergovernmental Panel on Climate Change (IPCC) community—considers the present day massive release of greenhouse gases into the atmosphere as the main cause of the current global warming trend. The main inference from this stance is that the increase in temperature must occur after the release of greenhouse gases originating from the anthropic activities. However, no scientific evidence has been provided for this basic notion. Earth paleoclimatic records document the antecedence of temperature over CO_2 levels. For the past 65 Ma, the temperature parameter has controlled the subsequent increase in CO_2. This includes the three rapid aberrant shifts and extreme climate transients at 55 Ma, 34 Ma, and 23 Ma [1]. The simple fact of their existence points to the potential for highly nonlinear responses in climate forcing. Whatever these shifts and transients are, CO_2 remains a second order parameter in their evolution through time. Confronted with the past, a suitable response must therefore be given to the unresolved question of whether the CO_2 trends precede the temperature trends in the current period, or not. The assertion that the current global warming is anthropogenic in origin implicitly presupposes a change of paradigm, with the consequence (the increase in CO_2 levels) that occurred in Earth's past being positioned as the cause of the warming for its present day climatic evolution. The compulsory assumption regarding the antecedence of CO_2 levels over the temperature trends is associated with the haziness of the methodological framework—*i.e.* the paradigm—and tightens the research fields on the likely origins of global warming. The possible involvement of an "aberrant" natural event, hidden behind the massive release of greenhouse gases, has not been considered by the MSC.

Keywords

Climate, CO_2, Temperature, Paleoclimate, Warming

1. Background

The accelerated recession of mountain glaciers, the retreat of Arctic sea ice and the melting of Greenland's ice are indisputable markers of global warming. Satellite measurements confirm the rise in the Earth's average temperature. The recent global warming of the planet is a well-established concept. No one disputes it.

Closely associated with the rise in temperature, and the increase in the concentration of carbon dioxide and all the other greenhouse gases is the signature of a significant change in the chemical composition of the Earth's atmosphere.

The close evolution between the carbon dioxide levels in the records and the average temperature variations of the Earth over geological time (we are talking here in terms of thousands, or even tens and hundreds of thousands of years) is a strongly established fundamental concept. Ice core drilled from the Vostok site (Antarctica) that serves as a physical record of the last 400,000 years (**Figure 1**) provides convincing evidence of this close evolution. The correlation of CO_2 and temperature variations remains detectable for the recent period (~past 150 years) as shown by National Oceanic and Atmospheric Administration (NOAA) records documented between 1980 and 2008 at the Mauna Loa observatory (see the NASA website). The concentration of CO_2 in the Earth's atmosphere varies with temperature with a close trend in the evolution of CO_2 levels and temperature over time.

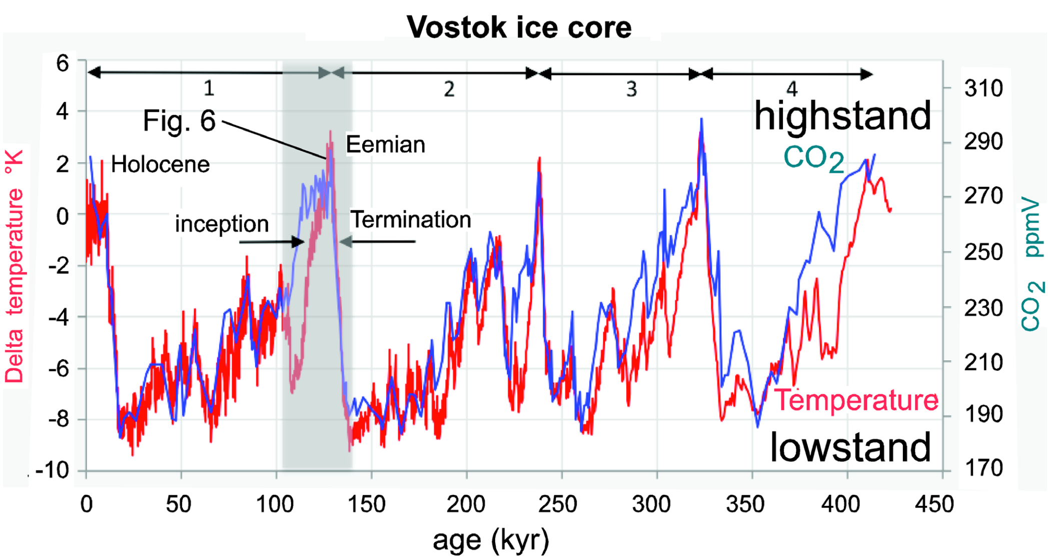

Figure 1. Temperature (ΔT ˚K, red) and CO_2 (blue) co-variance from Vostok ice core (Antarctica). Records show an almost perfect co-variation between ΔT ˚K and CO_2 for the past 420 ka (modified from [2]). However, time segments following major Termination show decoupling between T and CO_2 records. The grey strip shows the transition from full glacial climate to full interglacial climate during the Eemian (Termination II, Marine Isotope 6, 130 ka to 115 ka ago, hot spike at 128 ka ago). 1 to 4 numbers show glacial cycles. Note the perfect superposition of ΔT ˚K and CO_2 curves before the hot spike at 128 ka ago. Following the spike (128 to 115 ka ago) records exhibit a clear divergence (see details at **Figure 6**).

2. Is the Earth Global Warming Originating from Anthropic CO_2?

Breon [3] as contributor to the chapter "Natural and anthropogenic radiative forcings" in the 5th Intergovernmental Panel on Climate Change (IPCC) report as well as to the summary for policymakers wrote: "The driver of climate change over the last million years is not the same as that over the last century", and added: "Climatologists are not predicting rising temperatures based on an observed correlation with CO_2 in the past, but on the basis of an understanding of the physical mechanisms that link the two".

These physical mechanisms, which we cannot conceive to be different from those of the past, would therefore substantiate the founding proposal for a "New Climatology" (one different from that of the past). This New Climatology—*i.e.* mainstream climatology, (MSC hereafter)—proposes that CO_2 controls the temperature in the first instance. The increase in the CO_2 content in the atmosphere—*i.e.* CO_2 originating from anthropic activities—must therefore necessarily precede the increase in the temperature. This basic concept has not been demonstrated yet.

Bréon [3] clarifies the axiomatic nature regarding the notion of the antecedence of CO_2: "The rise in temperatures is therefore proven and it is almost certain that it is linked to the increase in the concentration of greenhouse gas". The wording "almost certain" must be kept in mind. The MSC proposes, without demonstration, that a major disruption in the Earth warming process is currently occurring. This scientific community contemplates that an absence of warming would be more than surprising given the increase in concentrations of greenhouse gases in the atmosphere. However, this is a matter of pure intuitiveness.

3. Actualism versus Catastrophism

Actualism is the assumption that the natural laws and processes that operate in our present-day scientific observations have always operated on Earth in the past. Under the principlesof actualism, evidence in geology can and should be explained in terms of physical processes that are working at present day. Conversely, mechanisms or processes that are at work today are considered powerful models for explaining the cause and effect relationships at play in the development and interpretation of geological situations of the Earth's past. Actualism is associated with the Scottish geologist James Hutton (1726-1797) often referred to as the "Father of Modern Geology". He, together with Jean-André Deluc (1727-1817) of France, played a key role in establishing geology as a modern science. Subsequently, these concepts were widely popularized by Charles Lyell (1797-1875).

In geology, Catastrophism is the theory that the Earth has largely been shaped by sudden, short-lived, violent natural disaster events, possibly worldwide in scope. The concept of mass extinction is often considered as an example of Catastrophism. Additionally, meteorite impacts, ice ages, and ocean acidification are all catastrophic phenomena that are categorized as representative events in Catastrophism.

To contemplate major meteorite impacts as originating from exceptional catastrophic events occurring fortuistously outside the normal course of the Earth's natural history. In that sense meteorite impacts should be considered catastrophic events typical of Catastrophism. In contrast, "ice ages" are geologic events that have repeatedly affected the planet Earth for the past several Myr. Ice ages result from recurring astronomical situations (see below) that can be reconstructed, if they occurred in the past, or that can be predicted in the context of the future of the Earth [1] [4]. Although considered as catastrophic events, ice ages are events representative of Actualism, and they are intimately associated with predictable Earth behavior.

The massive release of CO2 into the atmosphere as the essential cause of the current global warming puts MSC within the framework of an implicit paradigm shift. Indeed, the temperature is no longer considered the parameter that controls the levels of greenhouse gases in the atmosphere as was the case during Earth's geological past. This would indicate a causal reversal in the recent period. Proponents of the anthropogenic origin of the current warming are implicitly in the philosophical framework of a rupture. The greenhouse gases released in the atmosphere is settling down as the fundamental mechanism for the control of the Earth's climate. This causal reversal is an exceptional event, never experienced by the Earth. The paradigm framework of the Earth would be changing at this time from Actualism to Catastrophism. The MSC community must carefully documented the antecedence of CO_2 over temperature, this is not an option.

4. Antecedence of Temperature over CO_2 in the Earth's Past

The concept of "climatic aberrations" was first articulated by [1]. These aberrations were short-lived catastrophic events occurring during the Cenozoic (65 Ma to present). They included 1) the thermal maximum at the end of the Paleocene time (LPTM, 55 Myr ago) with an increase in surface water temperature of 8˚C in less than 10,000 yrs and concentrations of 1000 to 2000 ppm CO_2 equivalent in the atmosphere (2 to 5 times more than current levels); 2) the appearance of the Antarctic ice sheet at the Eocene-Oligocene boundary 34 Myr ago, in less than 400,000 yrs; and 3) the glacial maximum at the Oligocene-Miocene boundary (23 Myr ago), whose duration has been approximately 200,000 yrs. The concept of "climatic aberrations" for these one-off events with a very strong geo-climatic signature is paradoxical in that they seem to strengthen Catastrophism as a paradigm. This is not the reality, however since it is the case on the one hand that the history of the planet is punctuated by cataclysmic events, which are the intrinsic, natural expression of the climatic process, and on the other hand, that these events evolved through the antecedence of temperature over CO_2. The paradigm framework for these events is thus the Actualist framework.

A massive release (2600 Gigatons of methane) of seabed methane hydrates (clathrates) occurred during the LPTM event [5]. Because clathrate development requires specific pressure-temperature (PT) conditions at the seabed, such massive destabilization allows it to be inferred that a threshold has been crossed. The sea level that controls pressure at the seabed has a lower potential (*i.e.* low potential of sea level variation) for variation in destabilization than temperature. Indeed, the LPTM event is characterized by a 5˚C to 6˚C rise in deep sea temperature [1]. Whatever the origin of the seabed warming, it precedes and induces the massive release of CH_4 into the atmosphere.

The other two climatic aberrations of the Cenozoic age were extreme events in Antarctica related to temperature and ice volume [6] [7]. Even if the forcing (disruption of the climate balance) of greenhouse gases is considered a possible amplifier, it is not considered the primary cause of these climatic aberrations. Tectonic evolutions in association with orbital forcing (**Figure 2**) were the mechanisms triggering these climatic aberrations. These mechanisms act on the

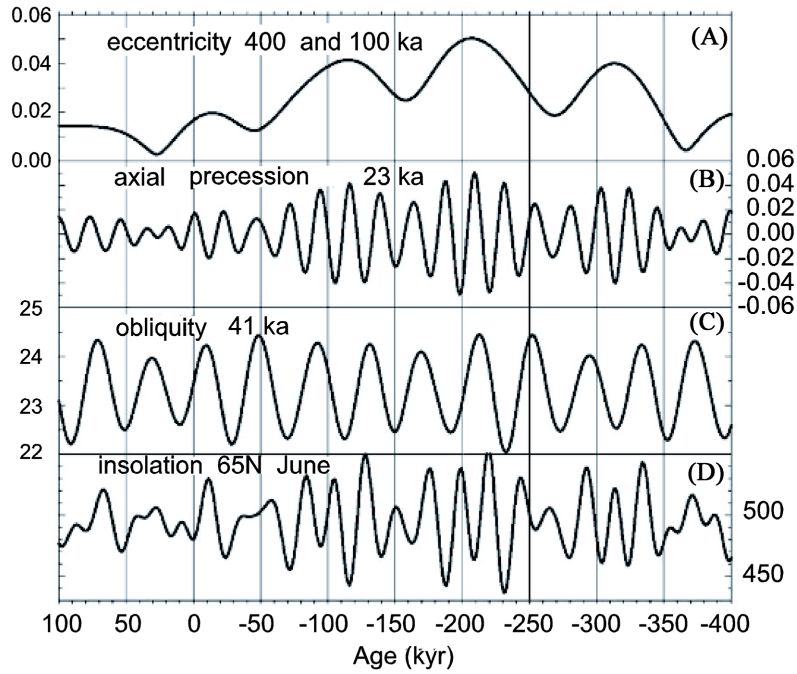

Figure 2. Basic orbital components controlling the Earth insolation—*i.e.* temperature—(modified from [1] [29]). (A)-(C) show the Earth's primary orbital components. Gravitational forces from other planets affect Earth's orbit. This controls the distribution of solar radiation (insolation, (D)), which oscillates over time. There are three orbital disturbances with four main periods: (A) Eccentricity (400 ka and 100 ka), (B) precession (23 and 19 ka), and (C) obliquity (41 ka). Eccentricity refers to the shape of the Earth's orbit, which variations have little influence on the climate. (B) precession refers to the oscillation of the axis of rotation, which describes a circle in space with a period of 26 ka. Precession modulated by eccentricity determines where in the orbit around the sun the seasons occur. This increases the seasonal contrast in one hemisphere and decreases it in the other. (C) Obliquity refers to the tilting of the Earth's axis relative to the plane of the ecliptic. A high angle increases the contrast of the seasons (warmer summers and colder winters).

climate system through a physical temperature threshold originating from a reorganization of the ocean/atmosphere circulation, which induces the rapid growth of ice sheets. Here, as during LPTM, the temperature precedes the variation in the concentration of greenhouse gases and then acts as a second-order biochemical feedback in line with the concept of climate sensitivity. The paradigm framework for extreme events in Antarctica is that of Actualism.

The climate system of the Earth's past shows the existence of temporally punctual and catastrophic natural events. A temperature threshold triggers these global climate events. These recurrent climatic aberrations have different origins and are an intrinsic part of natural climate variability. The increase in current temperature could originate from natural, internal, or external events or mechanisms (such as during the Cenozoic) in which a temperature threshold accelerates the response of the climate system.

The massive release of greenhouse gases associated with human activity could therefore have a hazardous aspect since it would be masking a natural climatic event of an aberrant type. By their very existence, aberrant climatic events support the need to promote more open research than that which is heavily padlocked by the only anthropogenic cause currently envisioned. It would be suitable for the MSC scientific community to abandon the strictly anthropogenic framework. Furthermore the conceptual implications from the "all anthropogenic" explanation seem neither truly evaluated nor fully justified (see above).

5. Natural versus Anthropogenic CO_2 Sources

Approximately half of human CO_2 emissions remain in the atmosphere, while the ocean and continents (soils, etc.) absorb the rest. This assessment should not mask the core of the problem. It is indeed difficult to truly measure the respective share of natural and anthropogenic emissions at the origin of global warming. In addition, uncertainties remain on the climate response with regard to the lack of information and measurement on this subject.

The available data acquired by the OCO-2 satellite operated by NASA give an idea of the problems in identifying the origin of CO_2 emissions along with the location of absorption areas (CO_2 sinks). The OCO-2 satellite records (**Figure 3**) show a high CO_2 concentration belt (5˚S - 20˚S belt) connecting the Amazon and Congolese forests to Indonesia. At the same time, developed industrial areas with high population density in the Western world (North America, Western Europe) have relatively modest values with lower CO_2 concentrations. Only China exhibits a strong emission pole. Additionally, the North Pacific, the central Atlantic, and the high latitudes of the Antarctic oceanic belt act as CO_2 sink zones. The OCO-2 satellite map documents one of the main problems for the "all anthropogenic" concept. In the current state of knowledge, the CO_2 concentration in the atmosphere exhibits no distinctive features by which to identify its source. Elevated CO_2 over a region may have a natural cause or a human cause. In the current state, approximately half of the CO_2 emissions originating from human

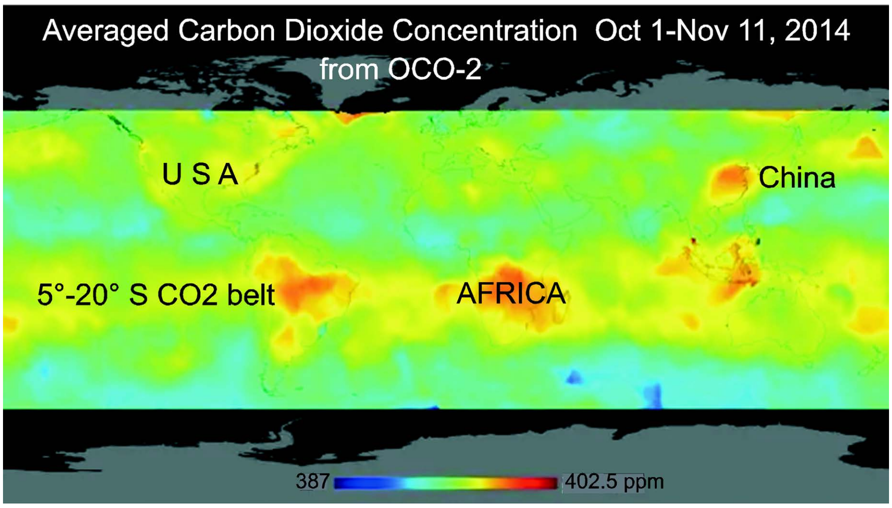

Figure 3. Global atmospheric CO_2 concentrations from October 1 to November 11, 2014 as recorded by the OCO-2 satellite operated by NASA. CO_2 concentrations are highest above NW Australia, southern Africa, and Brazil. Industrialized Northern Hemisphere regions such as Europe and North America exhibit less elevated CO_2 concentrations than along the 5˚S - 20˚S highest CO_2 belt. China shows an elevated concentration (image credit NASA). The 5˚S - 20˚S belt is migrating northward (15˚N - 35˚N) during N hemisphere summer. (https://www.eoportal.org/satellite-missions/oco-2#looking-ahead)

activities remain in the atmosphere, while oceans and land sinks are removing the rest. In other words, no evidence exists discriminating anthropic CO_2 from natural emissions.

6. Sea Level Rise

Sea level variations globally are a record of the physical and chemical factors controlling climate evolution over time. These factors include temperature and CO_2 regardless of the antecedence of one over the other. In other words, the sea level provides no evidence for identifying its origin, be it natural or induced from increases CO_2 concentration in the atmosphere that is connected to human activities.

Melting of ice sheets such as those from Antarctica, Greenland, and Patagonia is inducing sea level rise [8] [9] [10]. A sudden and significant rise of the global ocean would be a catastrophe since 20% of the world's population lives along the coastal areas. This potential hazard erected, as an imminent threat by the MSC becomes a prediction and thus is becoming a political weapon.

The global mean sea level (GMSL) rise results from two basic factors. These include a thermal expansion of seawater as it warms and water inflow from melting glaciers and ice sheets. Because the IPCC scientific community currently considers anthropogenic factors to control climate evolution the future rise in GMSL is believed to be dependent on which emission scenario is followed. In this line of thinking, sea level rise at the end of the century is projected to be faster under all scenarios, including those compatible with achieving the long-term temperature goal set out in the Paris Agreement. "GMSL will rise between 0.43 m (0.29 -

0.59 m, *likely* range; RCP2.6) and 0.84 m (0.61 - 1.10 m, *likely* range; RCP8.5) by 2100 (*medium confidence*) relative to 1986-2005".

Predicting our environmental future involves properly reading records from the geologic past of our planet. Sea level has risen by 120 to 130 m (**Figure 4**) since the Last Glacial Maximum ~20 ka. There is a great deal of reliable and concordant data that strongly documents this assertion. Assuming a linear evolution over time, this increase would be 0.65 m per century on average. We know that this is not the case because the sea level rise was rapid between 20 and 6 ka, and then slower thereafter. Sea level rise was ~6 m for the past 6 kyr, which would correspond to a rise of 0.10 m per century on average for the last six millennia.

The IPCC data reported a rise of 0.16 m ± 0.04 m for the period 1902-2015, which corresponds to a value of 0.14 m ± 0.03 m for a century. The excess rise in sea level proposed by the IPCC compared to that measured by geological records is between 1 cm and 7 cm for the period 1915-2015. Another IPCC estimate for the period 1901-2011 is somewhat higher at 0.16 m per century. Assuming that the reported measurements are accurate, we can conclude [12] that the sea level has risen by a maximum of 10 to 16 cm during the last century (between 1915 and 2015). Therefore, the IPCC accepted sea level rise for the period 1915-2015 is close to that reconstructed from geological data for the past 6 kyr. No evidence from geological archives exists documenting a catastrophic sea level rise by the end of the 21st century.

Indeed the average sea level rise measured by the TOPEX-POSEIDON and

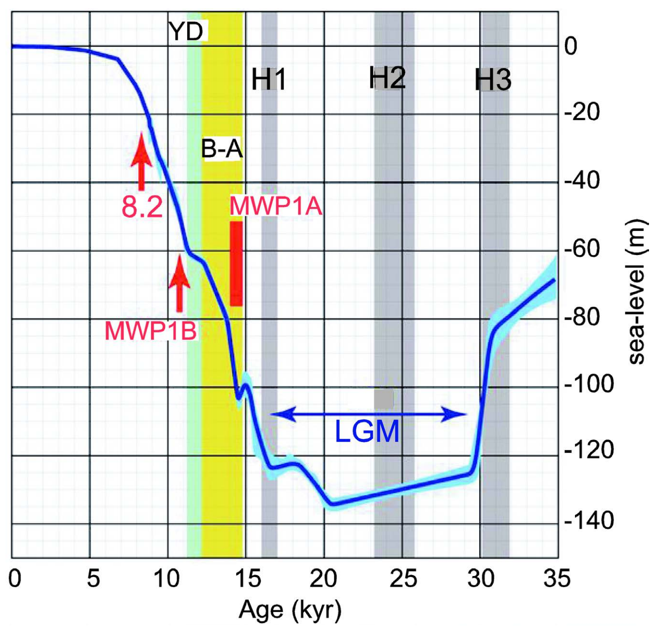

Figure 4. Sea level rise (modified from [11] since the Last Glacial Maximum (LGM optimum at about 20 ka ago). Note the significant slowdown during the past 6 kyr as shown by the flattening curve towards the recent period. B-A-warm Bolling-Allerod interstadial; H1, H2, H3-Heinrich events; MWP1A, MWP1B-Melt water pulses 1A and 1B; YD-Younger Dryas; 8.2-Cold event at 8.2 ka.

JASON satellites documents a rise of 0.04 m for the period 1995-2010, which would allow a projection of 0.26 m per century. Other measurements converge toward values that do not exceed 0.30 m per century [13] [14]. These values are far from those in the data published by Hansen [15]. He calculated a 1 cm contribution from ice sheets for the decade 2005-2015 and that it doubles each decade until the West Antarctic ice sheet is largely depleted. That time constant yields a sea level rise on the order of 5 m this century. Even though it has been largely diffused, the 5 m catastrophic scenario has been subsequently abandoned. In the recent years the IPCC has reported a sea level rise ranging from 0.50 to 2.40 m, depending on different greenhouse gas concentrations in the atmosphere, in the coming years to 2100.

Sea level rise as restored from the projection of geological data—*i.e.*, records for the ~past 6 kyr—and that reconstructed from meteorological data—*i.e.*, ~from the last century—are suggesting no flagrant sea level rise break development in the near future. Sea level rises based on estimates from models (IPCC, 2019) will be higher by an order of magnitude by the end of the century [16]. Sea level rise as a comprehensive record shows a conceptual break between the projections (Actualist framework) from geological dataset and the prediction (Catastrophism framework) from IPCC conceptual models exists.

7. Review of an Archetypal Scientific Publication

Hansen *et al.* [17] published a synthetic article outside the UN collegial assessments. It provides the general scientific frame for the IPCC climate philosophy. The last sentence of the abstract from this publication—"Burning all fossil fuels, we conclude, would make most of the planet uninhabitable by humans, thus calling into question strategies that emphasize adaptation to climate change"—supports the alarmist character widely propagated by the IPCC community. The Hansen *et al.* [17] publication also offers the opportunity to address discussion points of general interest such as the role of the Earth's orbital parameters, the contributions of ice drilling or the central concept of climate sensitivity. The following considers four discussion specific points including orbital parameters, temperature and CO_2 decorrelation, the climate sensitivity concept, and models.

7.1. Antecedence of Temperature and Orbital Parameters

Hansen *et al.* [17] claim that Cenozoic temperature, sea level and CO_2 covariations provide insights into climate sensitivity to external forcing and sea-level sensitivity to climate change. The pioneering work of Milankovitch [4] shows that the Earth's orbital parameters (eccentricity, obliquity and precession of the equinoxes) control the cyclic variations in the Earth's climate (**Figure 1**). Subsequently, Hays *et al.* [18] published an article in Science entitled: "Variations in the Earth's orbit: pacemaker of the Ice ages". This work shows that changes in the orbital geometry of the Earth (**Figure 2**) are the fundamental cause of the succession of Pleistocene glaciations (1.81 Ma to present). Orbital parameters control the Earth's insolation. For 500,000 years, major climate changes have followed variations in obliquity and precession [19].

Thus, during the Pleistocene, temperature and CO_2 (**Figure 1**) evolved in parallel under strict orbital control. The control of insolation by the orbital parameters, which implies in the first instance the increase or decrease in temperature [20] is easily considered as opposed, the direct control of CO_2 concentration by the orbital parameters—*i.e.*, before the increase in temperature—is difficult to conceive. In other words proposing that a variation in insolation would at first cause a variation in CO_2 in the atmosphere, which in turn would be the cause of an increase in temperature, is an incongruity. If by any chance this were the case, it would be appropriate to propose a demonstration of it.

The inversion that proposes the increase in CO_2 as the primary cause of the increase in temperature in the recent period can only operate within the framework of a paradigm shift, that is a route from the Actualism framework (antecedence of temperature) to Catastrophism (antecedence of CO_2). Nothing indicates the harmlessness of an Actualist analysis for the recent period. No quantified threshold for the release of greenhouse gases into the atmosphere is identified which would imply reversal of the cause with the primacy of CO_2 control over temperature rise.

7.2. Temperature and CO_2 Decorrelation

Ice coring at the Vostok site (Antarctica) has allowed recovering samples whose age covers the past 400 kyr. Before the Eemian climatic optimum at ~128 ka (**Figure 1**), the temperature covaried in a close correlation with CO_2. This occurred during the short phase—*i.e.* less than ~15 kyr—of global warming at the end of cycle 2 (**Figure 1**). After the climatic optimum at ~128 ka, CO_2 remained stable at approximately 274 ppmv (**Figure 5**) untill 114 ka, while the temperature decreased by approximately 4.5˚K. The decrease in temperature preceded that of the partial pressure of CO_2 in the atmosphere. Therefore temperature and CO_2 can evolve independently over a long period of time. Additionally, it should be noted that temperature and CO_2 exhibit a similar relationship over time, at least for the past 400 kyr. For the four past climate cycles (**Figure 1**), temperature and CO_2 exhibit a clear decorrelation during Earth cooling phases.

The correlation/decorrelation fluctuation appears to be modulated with a time constant controlled by orbital parameters. A long-term projection of orbital parameters without taking into account the anthropogenic effects shows that the Earth climate is heading toward a new glacial cycle [18]. Since the planet is currently in a period of climatic optimum comparable to that of the Eemian, it would be useful for scientific concerns to free themselves from injunctions of evidence to study in more detail one or more decorrelation scenarios between temperature and CO_2 (**Figure 5**). A comprehensive study of the decorrelation time period extending from 128 to 114 ka would be appropriated to appraise the Earth climate future in a more open way.

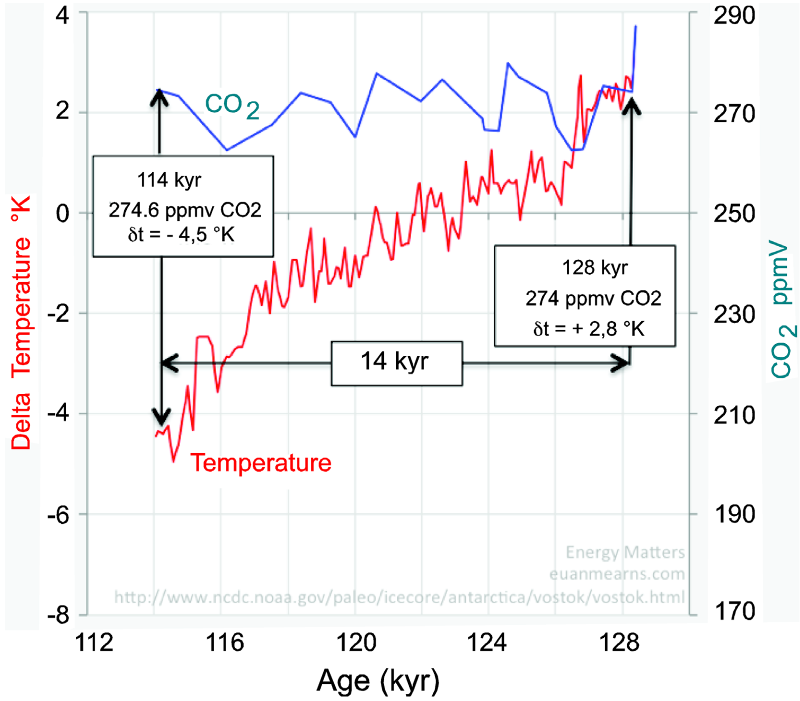

Figure 5. Temperature (ΔT ˚K) and CO_2 discrepancies following the Eemian climate optimum at 128 ka. From 128 to 114 ka CO_2 release into the atmosphere remain stable at ~274 ppmv while the temperature decreased by around 7.3˚K. The strict correlation of temperature and CO_2 that prevailed before the Eemian climatic optimum vanishes for 14 ka, the two uncorrelated parameters evolve independently (adapted from [21]).

Basic works [22] [23] have improved the temporal resolution of ice drillings carried out in Antarctica and Greenland. These works cover the last 800 kyr, thus capturing the crucial period of time 128 - 114 ka (**Figure 5**) during which CO_2 and temperature exhibit a de-correlation. Unfortunately, the sharing of their respective works, on the periods before and after 120 ka, leaves the 14 kyr time period following the Eemian climatic optimum on the margins of their scientific concerns.

7.3. Climate Sensitivity Concept

Hansen *et al.* [17] wrote: "Climate sensitivity depends on the initial climate state, but potentially can be accurately inferred from precise paleoclimate data. Pleistocene climate oscillations yield a fast-feedback climate sensitivity of 3˚C ± 1˚C for a 4 Wm^{-2} CO_2 forcing if Holocene warming relative to the Last Glacial Maximum (LGM) is used as calibration, but the uncertainty is substantial and partly subjective because of poorly defined LGM global temperature and possible human influences in the Holocene".

At this point the concept of climate sensitivity appears. The MSC uses the action of CO_2 on climate sensitivity, such as the temperature variation in ˚C associated with a doubling of the concentration of carbon dioxide in the atmosphere. An estimated increase in average Earth temperature of 4.1 Wm^{-2} for a doubling of CO_2 released into the atmosphere has been proposed [25]. Thus, rejection of a determined volume of CO_2 in the atmosphere induces an increase in temperature. This constrains the paradigm framework to Catastrophism since there is antecedence of CO_2 over temperature with inversion of the cause identified in paleoclimatology.

The MSC uses the climate sensitivity as a parameter injected into the modeling of global warming. This parameter is considered a general property of the climate system. In a coupled ocean-atmosphere global climate model, climate sensitivity becomes an emergent property. This emergent property is no longer a simple parameter of the model but the result of a combination of physical factors and estimated parameters. The model is no longer strictly "physical"; it becomes an "emergent model" used as a specific means for investigating the climate of the past. Hansen *et al.* [17] wrote: "We use a global model, simplified to essential processes, to investigate state dependence of climate sensitivity, finding an increased sensitivity toward warmer climates, as low cloud cover is diminished and increased water vapor elevates the tropopause". Conventional global models that become ineffective toward extreme climatic conditions (snowball, greenhouse) justify the use of a simplified ad hoc model. In this way, Hansen *et al.* [17] show a rapid response of 3˚C ± 1˚C for a CO_2 forcing corresponding to 4 Wm^2 for the Pleistocene period. They also propose for the last interglacial an increase of 3˚C to 4˚C for a CO_2 forcing of 4 Wm^2. These two examples show a weakness in the methodological framework. Indeed, the model has been developed to accept the antecedence of the CO_2 over temperature (Catastrophism framework) for evaluating two climate scenarios steered by temperature (Actualist framework). This paradigm agility is questionable.

The forcings that can influence and control Cenozoic climate mechanisms have been examined [1]. These include tectonics, the distribution of oceans and continents, the opening and closing of maritime corridors, the partial pressure of CO_2, the hydrological cycle, stimulation and orbital anomalies, and the existence of sills or eruptions of methane. All these forcings can lead to an alteration or a reinforcement of the climatic sensitivity with specific time constants. Thus, the historical paleoclimatology community has defined and used a conceptual meaning of the term "sensitivity" different than that used today by the MSC community. This is confusing since the MSC uses "sensitivity" with the two different meanings [17] *i.e.*, as a parameter injected into the modeling of global warming and as forcing concept exploring the Earth past climate through modeling.

Recently, a disruption of radiative forcing in Antarctica has been identified [26]. During the late Oligocene (~23 Ma), cooling (cold orbital conditions) at high latitudes occurred, while oxygen isotopes documented warming and loss of ice volume. The researchers propose that this anomaly results from tectonic forcing (subsidence) inducing a marine transgression (in Antarctica) with an atmospheric carbon dioxide response threshold, below which the Antarctic marine ice sheet grows and above which the warming of the oceans exacerbates the decline of the ice sheets. Thus a local tectonic event induces a disruption of radiative forcing that in turn induces a CO_2 response through a threshold switch.

In this complex causal chain, temperature controls the CO_2 response.

The climatic sensitivity concept, first used in paleoclimatology (Actualist framework) is basically a forcing that amplifies a second-order cause originating from insolation. The climatic sensitivity factor can accentuate or diminish the climatic response from the first-order forcing, *i.e.*, the temperature. As shown above, the concept of climate sensitivity as developed by the MSC is a parameter injected into the modeling of global warming that is directed to emergent properties. There is a deep diversion from the initial paleoclimatological meaning. This elucidates the possible origin for the increasing harmlessness of MSC models as proposed by [13] since it is associated with no explanation regarding the paradigm framework, including the implicit back and forth from Actualism to Catastrophism.

7.4. Models

Hansen *et al.* [17] claim the following: "We use a global model, simplified to essential processes, to investigate state dependence of climate sensitivity, finding an increased sensitivity toward warmer climates, as low cloud cover is diminished and increased water vapor elevates the tropopause". Using their global climate model—*i.e.*, ad hoc—they try evaluating its efficacy in reproducing the two extreme climatic situations of rapid feedback—*i.e.*, snowball and greenhouse, see below. This amounts to seeking the best value of the sensitivity factor to obtain the desired result from the model.

Hansen *et al.* [17] used the climatic state of the extreme situations to evaluate the response time of feedbacks. Climate feedbacks are rapid during snowball and greenhouse situations on Earth. When the land becomes cold enough for the ice cover to reach the tropics, the boost in albedo then causes the ice to expand rapidly to the equator. This state of the planet called the "snowball" (ice covering the Earth) is unstable in relation to a high sensitivity. Weak erosion originating from ice cover protection leads to an accumulation of volcanic CO_2 in the atmosphere. This results in rapid deglaciation. Therefore the accumulation of CO_2 is in the first instance the result of a variation in temperature, in this case a decrease. At the other end, a hot planet (greenhouse Earth) would lead to an increase in the amount of water vapor in the atmosphere, which would cause the emergence of radiation from the upper cold layers. The result would be a reduction in the energy emitted into space and an amplification of the greenhouse effect to the point of effects considered uncontrollable. Regarding the climate sensitivity estimates used in their global model, Hansen *et al.* [17] conclude: "Finally, we use an efficient climate model to expand our estimated climate sensitivities beyond the Cenozoic climate range to snowball Earth and runaway greenhouse conditions". The good results of the global model for extreme situations partly justify the relevance of the sensitivity values retained for the modeling.

For the recent period, their model is considered relevant to assess the impact of human activity on the climate [17]. Ice and ocean sediment drilling allow them to measure the climatic forcings caused by the evolution of greenhouse gas levels in the atmosphere and albedo. The global temperature change obtained by multiplying the sum of the two climatic forcings, greenhouse gases and albedo, by a sensitivity of 3˚C to 4˚C per Wm2 gives a remarkably good fit with the estimated warming of 4.5˚C between 20 and 11.5 ka (Last Glacial Maximum to Holocene). This good match in the Actualist framework (antecedence of temperature) between measurements acquired from ice drilling and the result of the model is used to justify the merits of its application in the Catastrophist framework (antecedence of CO_2). This in turn justifies a catastrophic climate prediction for the end of this century. In addition to the undocumented conceptual shift from one paradigm to another, it must be noted that the glaciations of the last 800 kyr are controlled in the first instance by orbital parameters, which imply the primacy of temperature over CO_2 and not the reverse.

As noted above, the conceptual content of climate sensitivity that has become a modeling parameter (Catastrophism) for the MSC is different from that accepted by Actualism paleoclimatology. In the historical context of geology, the governing physical parameter of the climate system is temperature. A second-order forcing (including CO_2) can then intervene and disturb the system by causing a response of amplification or reduction of the initial first-order forcing, the temperature. The global model [17] based on the antecedence of CO_2 has been used to evaluate its effectiveness over periods of the past for which we know the antecedence of temperature over CO_2 to be the case. What should we think of these models whose development is based on the use of two antagonist paradigms in a context where the antecedence of CO_2 has not received any demonstration? In his book entitled "Unsettled", Koonin [13] physicist, and climate adviser to former United States president Barack Obama devotes an entire section to the analysis of mathematical simulations of the climate system. He shows the increasingly imprecise nature of the models over time, the most recent being the least effective. This highlights in particular the difficulty of separating the role of natural CO_2 variability from that of human influences in the warming that has occurred since 1980 (**Figure 3**).

Regarding the IPCC models and their profusion (**Figure 6**), it is instructive to refer to a recent article [27]. Stark notes in the approach of the IPCC, a recourse and excessive confidence in the use of a "pseudoscience" known as "cargo cult", which consists of favoring evidence, that confirms a presumed hypothesis, contrary to the scientific method. To this must be added the overall approach that the IPCC regularly uses. It consists [27] of taking a group of models, calculating the mean and the standard deviation of their predictions, then treating the mean as if it were the expected value of the result (which it is not) and the standard deviation as if it were the natural variability of the process that generates the climate (which it is not).

8. Conclusions

The evolution of orbital parameters controls the insolation—*i.e.*, the temperature

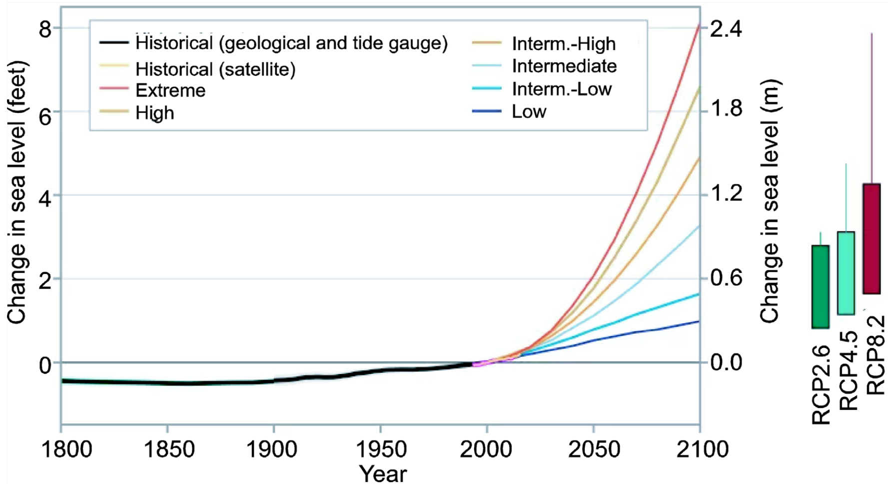

Figure 6. Colored lines show six different sea level rise scenarios relative to year 2000. The boxes on the right are the likely ranges in sea level by 2100 while the lines above the boxes show increases based on latest research on Antarctic. Credit: National Climate Assessment, Chapter 2, KM4: Sea Level Rise [24]. Figure revised in 2019 [28]. https://nca2018.globalchange.gov/chapter/2/. Note that no constraint exists for the time segment 1800 - 1900 yrs accepting a stable sea level. Also note the wide range of projected change in sea level rise—*i.e.* 0.5 to 2.4 m. RCP—Representative Concentration Pathway—related to different greenhouse concentrations scenarios. Interm.—Intermediate.

—of the Earth through time. This in turn induces the periodic variations in the Earth's climate, at least for the past 800 kyr. Ice coring (in Antarctica, and Greenland) documents a close covariation of temperature and CO_2 content in the atmosphere during time periods of Earth warming (**Figure 1**). In contrast, a strong decorrelation of these two parameters characterizes the time periods of a cooling Earth extending from climate optimums to terminations. No evidence exists documenting CO_2 antecedence over temperature during warm/cool Quaternary cycles.

During the Cenozoic, major events, such as the Late Paleocene Thermal Maximum or the glacial event that was initiated by the appearance of the Antarctica ice sheet at the Eocene-Oligocene boundary were primarily thermally controlled. The associated CO_2 content variation in the atmosphere occurred in the wake of thermal events through second-order forcing, positive or negative.

Conversely, the MSC considers the massive release of greenhouse gases in the atmosphere to be the main cause of warming in recent decades. This entails an implicit paradigm shift since the cause during the past history of the Earth then is presented as the consequence for the present time. This basic point is not demonstrated or even discussed. Qualified as "virtually certain", this becomes an axiom for the MSC models. By using ad hoc sensitivity parameters in their "efficient climate model" [17] discussion regarding CO_2 antecedence over temperature and associated paradigm shift can be avoided.

Basically, the MSC scientific community proposes models built on the idea of CO_2 antecedence over temperature. Because no evidence exists for this antecedence, something must be done to palliate this gap. That will entail testing the efficiency of the models for reproducing parameters characterizing the climate evolution for specific time periods of the Earth's past. Because these time periods are entirely controlled by the antecedence of temperature, it makes no sense to test a model based on the reverse—*i.e.*, CO_2 antecedence over temperature—. The back and forth from one paradigm to another (from Catastrophism to Actualism) explains, at least in part, the failure of the models as noted by Koonen [13]—*i.e.*, "Many muddled models" p. 77-96.

Considering that the antecedence of CO_2 over temperature has not been demonstrated, other avenues of research should be explored to characterize the possibility of an origin, not yet identified, of the current increase in temperature of our planet. If accepting that the main target is fighting against global warming, it is imperative to explore its potential origins in an exhaustive way.

The Earth's climate is currently in a climatic optimum phase (warm) comparable to the Eemian (128 ka). At that time, our planet was at the dawn of a shift toward a new glaciation [18]. The current warming could be just a short-lived incident masked by anthropogenic emissions Between 128 and 114 ka a decorrelation existed between the CO_2 and temperature. For 14 kyr, CO_2 remained stable, while the temperature dropped even though these two parameters are usually linked. Understanding the climatic process at the origin of such de-correlation can represent a way out for the climate anthropic dogma.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Zachos, J., Pagani, M., Sloan, L., Thomas, E. and Billups, K. (2001) Trends, Rhythms, and Aberrations in Global Climate 65 Ma to Present. *Science*, **292**, 686-692. https://doi.org/10.1126/science.1059412

[2] Petit, J.R., Jouzel, J., Raynaud, D., Barkov, N.I., Barnola, J.-M., Basile, I., Bender, M., Chappelaz, J., Davis, M., Delaygue, G., Delmotte, M., Kotlyakov, V.M., Legrand, M., Lipenkov, V.Y., Lorius, C., Pépin, L., Ritz, C., Saltzman, E. and Stievenard, M. (1999) Climate and Atmospheric History of the Past 420,000 Years from the Vostok Ice Core, Antarctica. *Nature*, **399**, 429-436. https://doi.org/10.1038/20859

[3] Bréon, F.-M. (2016) Changement Climatique, l'état des connaissances scientifiques. *Science et Pseudo-Sciences*, **317**, 11-19.

[4] Milankovitch, M. (1941) Kanon der Erdbestrahlung und seine Andwendung auf das Eiszeitenproblem. Royal Serbian Academy Special Publication 133, Belgrade, 633 p.

[5] Dickens, G.R. (2000) Methane Oxidation during the Late Paleocene Thermal Maximum. *Bulletin de la Société Géologique de France*, **171**, 37-49.

[6] Zachos, J., Quinn, T.M. and Salamy, K.A. (1996) High-Resolution (104 Years) Deep-Sea Foraminiferal Stable Isotope Records of the Eocene-Oligocene Climate Transition. *Paleoceanography*, **11**, 251-256. https://doi.org/10.1029/96PA00571

[7] Zachos, J., Flower, B.P. and Paul, H. (1997) Orbitally Paced Climate Oscillations across the Oligocene/Miocene Boundary. *Nature*, **388**, 567-571. https://doi.org/10.1038/41528

[8] Vaughan, D.G. (2005) How Does the Antarctic Ice Sheet Affect Sea Level Rise. *Science*, **308**, 1877-1878. https://doi.org/10.1126/science.1114670

[9] Das, S.B., Joughin, I., Behn, M.D., Howat, I.M., King, M.A., Lizarralde, D. and Bhatia, M.P. (2008) Fracture Propagation to the Base of the Greenland Ice Sheet during Supraglacial Lake Drainage. *Science*, **320**, 778-781. https://doi.org/10.1126/science.1153360

[10] Solomina, O.N., Bradley, R.S., Hodgson, D.A., Ivy-Ochs, S., Jomelli, V., Mackintosh, A.N., Nesje, A., Owen, L.A., Wanner, H., Wiles, G.C. and Young, N.E. (2015) Holocene Glacier Fluctuations. *Quaternary Science Reviews*, **111**, 9-34. https://doi.org/10.1016/j.quascirev.2014.11.018

[11] Lambeck, K., Rouby, H., Purcell, A., Sun, Y. and Sambridge, M. (2014) Sea Level and Global Ice Volumes from the Last Glacial Maximum to the Holocene. *Proceedings of the National Academy of Science*, **111**, 15296-15303. https://doi.org/10.1073/pnas.1411762111

[12] Moore, R. (2019) IPCC Report: Sea Level Rise Is a Present and Future Danger. Special Report on the Ocean and Cryosphere in a Changing Climate. Cambridge University Press, Cambridge, and New York, 755 p.

[13] Koonin, S.E. (2021) Unsettled—What Climate Science Tell Us, What It Doesn't and Why It Matters. BenBella Books, Inc., Dallas, 306 p.

[14] Koonin, S.E. (2022) Climat la part d'incertitude. Edition du Toucan, Paris, 348 p.

[15] Hansen, J.E. (2007) Scientific Reticence and Sea Level Rise. *Environmental Research Letters*, **2**, Article ID: 024002. https://doi.org/10.1088/1748-9326/2/2/024002

[16] Masson-Delmotte, V. (2022) Il y a encore aujourd'hui un déni de la gravité des enjeux climatiques. *CNRS Le Journal*, **308**, 13-21.

[17] Hansen, J., Sato, M., Russell, G. and Kharecha, P. (2013) Climate Sensitivity, Sea Level, and Atmospheric Carbon Dioxide. *Philosophical Transactions of the Royal Society A*, **371**, Article ID: 20120294. https://doi.org/10.1098/rsta.2012.0294

[18] Hays, J.D., Imbrie, J. and Shackleton, N.J. (1976) Variations in the Earth's Orbit: Pacemaker of the Ice Ages. *Science*, **194**, 1121-1132. https://doi.org/10.1126/science.194.4270.1121

[19] Ohneiser, C., Hulbe, C.L., Beltran, C., Riesselman, C.R., Moy, C.M., Condon, D.B. and Worthington, R.A. (2023) West Antarctica Ice Volume Variability Paced by Obliquity until 400,000 Years Ago. *Nature Geoscience*, **16**, 44-49. https://doi.org/10.1038/s41561-022-01088-w

[20] Yan, Y., Kurbatov, A.V., Mayewski, P.A., Shackleton, S. and Higgins, J.A. (2023) Early Pleistocene East Antarctic Temperature in Phase with Local Insolation. *Nature Geoscience*, **16**, 50-55. https://doi.org/10.1038/s41561-022-01095-x

[21] Energy Matters (2023) The Vostok Ice Core: Temperature, CO_2 and CH4. https://euanmearns.com

[22] Veres, D., Bazin, L., Landais, A., Toyé Mahamadou Kele, H., Lemieux-Dudon, B., Parrenin, F., Martinerie, P., Blayo, E., Blunier, T., Capron, E., Chappellaz, J., Rasmussen, S.O., Severi, M., Svensson, A., Vinther, B. and Wolff, E.W. (2013) The Antarctic Ice Core Chronology (AICC2012): An Optimized Multi-Parameter and Multi-Site Dating Approach for the Last 120 Thousand Years. *Climate of the Past*, **9**, 1733-1748. https://doi.org/10.5194/cp-9-1733-2013

[23] Bazin, L., Landais, A., Lemieux-Dudon, B., Toye Mahamadou Kele, H., Veres, D., Parrenin, F., Martinerie, P., Ritz, C., Capron, E., Lipenkov, V., Loutre, M.-F., Raynaud, D., Vinther, B., Svensson, A., Rasmussen, S.O., Severi, M., Blunier, T., Leuen-

berger, M., Fischer, H., Masson-Delmotte, V., Chappellaz, J. and Wolff, E. (2013) An Optimized Multi-Proxy, Multi-Site Antarctic Ice and Gas Orbit Chronology (AICC2012): 120-800 ka. *Climate of the Past*, **9**, 1715-1731. https://doi.org/10.5194/cp-9-1715-2013

[24] Hayhoe, K., Doherty, S., Kossin, J.P., Sweet, W.V., Vose, R.S., Wehner, M.F. and Wuebles (2017) Fourth National Climate Assessment, Chapter 2: Our Changing Climate.

[25] Hansen, J.E. (2005) Earth's Energy Imbalance: Confirmation and Implication. *Science*, **308**, 1431-1435. https://doi.org/10.1126/science.1110252

[26] Duncan, B., McKay, R. and Levy, R. (2022) Climatic and Tectonic Drivers of Late Oligocene Antarctic Ice Volume. *Nature Geoscience*, **15**, 819-825. https://doi.org/10.1038/s41561-022-01025-x

[27] Stark, P.B. (2022) Pay No Attention to the Models behind the Curtain. *Pure and Applied Geophysics*, **179**, 4121-4145. https://doi.org/10.1007/s00024-022-03137-2

[28] IPCC (2019) IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Cambridge University Press, Cambridge, and New York, 755 p.

[29] Berger, A. and Loutre, M.-F. (2004) Théorie astronomique des paleoclimats. *Comptes Rendus Geoscience*, **336**, 701-709. https://doi.org/10.1016/j.crte.2004.02.006