
CLIMATE CHANGE

Non-anthropogenic causes and post-truth

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1. INTRODUCTION

This short text sets out to focus attention on the evolving climatic processes of natural origin (that is, of non-anthropogenic character) that affect planet Earth, offering an account which, though general and aimed at a wide readership, is nonetheless suited to placing the growing severity of the climate in context. Politics, the economy, finance and the great regulators all require an extremely concrete and objective forward-looking view in order to adjust their risk-management policy and to safeguard a framework of sustainability, for which they bear a direct responsibility.

To this end, the question of the climate narrative is also addressed, together with some foundational considerations.

Finally, since the subject, and the approach we wish to pursue, is not confined to markets and infrastructure but is acquiring an ever-greater reach and bearing across many planes, it seems necessary to draw also on powerful instruments of interpretation, of critique, of hermeneutic analysis, so as to allow thought an ethical reading: to bring out values, perspectives and goals that are not hidden away in the folds of numbers and of the digital. The text therefore gathers the reflections of a number of great thinkers who, as our contemporaries, confront the present climatic, communicative and technological challenges, or who, though more distant in time, nonetheless offer us valuable keys of interpretation.

2. FOREWORD

This analysis aims to be thoroughly pragmatic and to avoid visions or digressions of an ideological nature; it is the consequence and the fruit of the work and the know-how generated, in an industrial setting, by the R&D structures of Radarmeteo and Hypermeteo, whose purpose is the development of knowledge, the provision of representative data and the implementation of services useful for resilient climate adaptation, in order to meet the specific needs and requirements of a market that must read every signal of innovation and of the transitions under way.

3. THE CLIMATE OF THE CENOZOIC UP TO THE PRESENT DAY: NATURAL AND/OR ANTHROPOGENIC INFLUENCES?

The Earth's climate has certainly been subject to very pronounced variability during the preceding geological eras; yet that variability, with rare aberrant exceptions, unfolded over the course of millions of years. The recent warming therefore departs radically from the planet's natural climatic dynamics, and constitutes an anomalous phenomenon, since it is manifesting itself as an extremely rapid perturbation of the climatic equilibrium, occurring within a period that is itself relatively brief, namely the Holocene, which denotes the most recent geological epoch, begun around 11,700 years ago and characterised by that favourable climate which permitted the development and spread of humankind across much of the globe. To support these considerations, it is enough to compare the climatic variability

of past geological epochs with that of the present day, both in its values and in the causes that produced it.

The description of the natural climatic processes (and of the ways in which they shaped climatic variability over the last hundreds of thousands and millions of years) makes clear their negligible impact on the events of the last 200 years. These processes, capable of acting upon the Earth's climate system and designated in climatology by the term "forcings", are: variation in the solar radiation received by the Earth, volcanic activity, and variation in the chemical composition of the atmosphere (in terms of aerosols and of greenhouse-gas concentration). Examining the influence of the natural forcings on climate change does no more than confirm, as the sole factor correlated with the rise in global mean temperatures, the increase in the concentration of greenhouse gases of anthropogenic origin in the atmosphere.

As palaeoclimatological studies demonstrate, on a geological timescale the climate system will continue to tend towards the pursuit of an equilibrium among its various components, a process that will also bear upon the different forms of life and their evolution, but always at a millennial pace, and with outcomes not necessarily capable of ensuring the survival of humankind on the planet, or on a large part of it.

3.1. A few comparisons with the... distant past

The present geological era, known as the Cenozoic¹ and begun around 66 million years ago, has undergone considerable climatic variations, well summarised by the global mean-temperature anomalies relative to the 1850–1900 climatological mean shown in Fig. 1.

It may be divided into seven principal phases:

- 1) from 60 Ma (million years) ago to 45 Ma ago: an initial phase of transient warming, reaching the early-Eocene climatic optimum, with a rapid and intense warming episode known as the Palaeocene–Eocene Thermal Maximum, which occurred around 55 Ma ago;
- 2) from 45 to 30 Ma ago: the slow drift of the tectonic plates, the consequent orogeny and the expansion of forests favoured a concurrent decline in atmospheric CO₂ concentrations and a cooling phase that led to the formation of the Antarctic polar ice cap;
- 3) around 3 Ma ago: the intensification of cooling, driven by climatic feedbacks arising from interactions among tectonics, glacial albedo, ocean circulation, land cover and greenhouse gases, brought about the development of the ice caps in the northern hemisphere;
- 4) a succession of glacial–interglacial periods over timescales of tens or hundreds of thousands of years, governed chiefly by the orbital forcings, namely changes in the

¹It is the most recent geological era, having begun roughly 66 million years ago and still ongoing.

eccentricity of the Earth's orbit, and axial precession and obliquity (Milankovitch cycles), particularly pronounced over the last million years;

- 5) a transition from the Last Glacial Maximum, around 20,000 years ago, to the present interglacial epoch known as the Holocene;
- 6) continued warming followed by a slight cooling after the mid-Holocene, with superimposed fluctuations at the centennial and decadal scale caused, among other things, by volcanic activity;
- 7) the present-day warming, caused by greenhouse-gas emissions of anthropogenic origin.

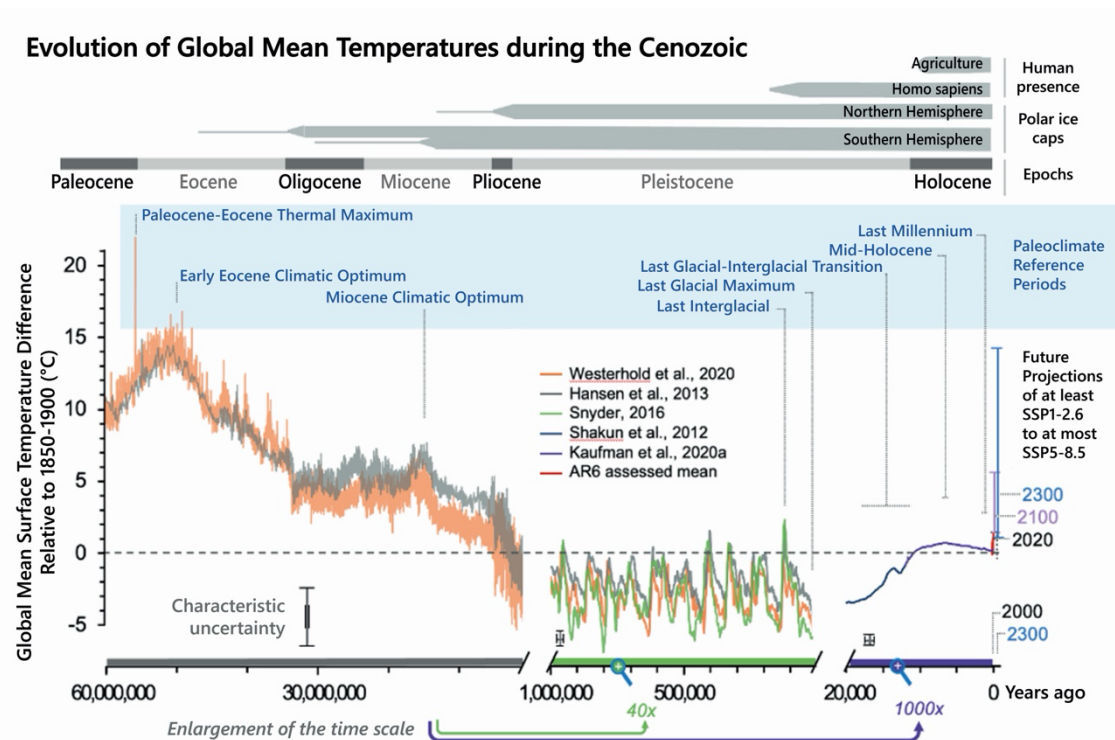


Figure 1: Evolution of global mean surface temperature during the Cenozoic, shown on three different timescales, relative to the 1850–1900 reference period. The grey horizontal bars at the top indicate important events. The future projections span the range of best estimates of global surface air temperature for the SSP1–2.6 and SSP5–8.5 scenarios described in Section 1.6. The range shown for 2100 is based on the CMIP6 multi-model mean for the 2081–2100 period from Table 4.5 of the IPCC AR6 report. (Source: adaptation of the image in Chapter 2 of the IPCC AR6 Report, 2021.)

Observing Fig. 1, three aspects stand out:

- 1) The first lies in the complete disconnection of the warming now under way from the cyclical patterns that have characterised the climate of the last few million years on planet Earth. The evolution of the human species has unfolded within a relatively brief interval, confined to the Quaternary², which, in the wider context of the

²The most recent geological period, which began about 2.58 Ma ago and is characterised by extreme climatic variability, with a continuous succession of glaciations and warmer (interglacial) intervals.

Cenozoic, represents only a small fraction of the Earth's climatic history. During the Quaternary, temperatures were generally colder than, or similar to, those of today relative to the rest of the Cenozoic era. Moreover, the rapid progress of human civilisation was favoured by the relatively stable and warm climate of the Holocene³, which began around 11,700 years ago with the end of the last glaciation (the Würm glaciation⁴). The interglacial period in which we live is part of the natural cycle of glaciations and warmer intervals that alternated throughout the Quaternary, driven by natural factors such as the tilt of the Earth's axis, orbital variations and global climate dynamics; the present warming, by contrast, being substantially of anthropogenic origin, brings about an alteration of this natural cyclicity between more stable, warm phases and glacial phases.

- 2) The second aspect, by far the more troubling, concerns the great variability of the climate projections, which depend directly on the possible scenarios of greenhouse-gas emissions produced by human activity (the SSP–RCP scenarios⁵) and on which the drafting of the IPCC reports is based (Intergovernmental Panel on Climate Change⁶). Indeed, while the lowest-emission socioeconomic scenario (SSP1–2.6) could bring about, between now and 2300, a temperature rise comparable to that recorded in the last interglacial period (that is, between 1 °C and 2.2 °C), the more realistically attainable intermediate scenario, SSP2–4.5, could cause, again by 2300, a temperature rise of between 2.3 °C and 4.6 °C, comparable instead to the mid-Pliocene Thermal Maximum, which occurred around 3 Ma ago. Were one then to envisage reaching the most extreme emissions scenario, SSP5–8.5 BAU (Business As Usual, that is, the total absence of mitigation measures), global mean temperatures would exceed those typical of the Miocene climatic optimum, a period dating back to around 15 Ma ago and marked by a global mean surface temperature roughly 5 °C above the values typical of the 1850–1900 period; these values would be comparable to those of the Eocene, a period dating to around 55–35 Ma ago, during which, albeit with significant variations in time and

³The last epoch of the Quaternary, which began at the close of the Würm glaciation around 11,700 years ago (from roughly 9700 BC) and continues to the present day.

⁴The most recent glacial period on Earth, occurring between 110,000 and 11,700 years ago.

⁵The SSP–RCP scenarios combine two approaches to exploring the possible futures of climate change. The Shared Socioeconomic Pathways (SSPs) represent different developmental trajectories for society, the economy and technology, while the Representative Concentration Pathways (RCPs) describe various levels of greenhouse-gas emissions and the corresponding radiative forcing (the warming effect on the Earth). Pairing an SSP with an RCP makes it possible to explore how socioeconomic choices may shape long-term climate change, with variable impacts on global temperature and on mitigation policy.

⁶The Intergovernmental Panel on Climate Change (IPCC) is an international scientific body created by the United Nations and the World Meteorological Organization (WMO) with the aim of assessing, in an objective and transparent manner, the scientific, technical and socioeconomic information relevant to climate change. Founded in 1988, the IPCC issues periodic reports that synthesise the state of the science on climate change, its impacts and the strategies for mitigation and adaptation. Its reports are a fundamental reference for governments and for global climate policy.

space, the global mean surface temperature was around 8–10 °C higher than the values typical of the 1850–1900 period.

- 3) The third aspect highlighted by the analysis is the rapidity with which the present phase of great warming has developed, and how it finds no precedent at any point in the wide climatic variability that characterised the millions of years of the entire Cenozoic.

4. THE NATURAL CAUSES

This chapter describes the climatic history of the planet during the Cenozoic (the geological era that began around 66 million years ago and is still in progress), with the aim of viewing the warming now under way within a broader context, and of examining more closely the role of natural agents in its causes and in its magnitude.

As we have seen, the climate of the Cenozoic was marked by considerable variability: it began with a period far warmer than the present, followed by a general cooling that brought about, around 3 million years ago, the formation of ice caps at both poles. It must be said that, in that period, the planet was very different from the one we know today; continents, oceans and seas were far from their present configuration. Since then, the climate has been characterised by a continuous succession of colder (glacial) and warmer (interglacial) phases, during which global mean temperatures held to values more akin to those of today. Taken as a whole, however, this variability shows important discontinuities with what has been happening since the industrial era, setting it apart, in terms of acuity and magnitude, from the phenomena that preceded it.

It must indeed be observed that one of the most striking anomalies lies precisely in the rapidity of the phenomenon, which opens the way to troubled reflection.

The evolution of the human species was favoured by the relatively stable and warm climate that characterised the most recent geological epoch, the Holocene, whose duration is, however, negligible by comparison with the entire geological era to which it belongs, the Cenozoic, in whose first part (60–30 Ma ago) the planet's climatic characteristics were profoundly different. The present warming is altering the natural cyclical alternation between warm and cold periods that has characterised the last 3 Ma, opening up entirely new scenarios, since the climate projections are a direct function of the scenarios of greenhouse-gas emissions caused by human activity, and hence of the choices made regarding socioeconomic development, rather than of natural factors. On this hypothesis, the intermediate emissions scenario (SSP2–4.5) may return the planet to the climatic equilibrium typical of around 3 Ma ago, while the worst-case scenario (SSP5–8.5) will take it to the climate of 15–50 Ma ago, when humankind had not yet appeared on the planet, and when the environmental conditions would in any case have determined an evolutionary line that could scarcely have found its synthesis in *Homo sapiens sapiens* as we know it today.

To demonstrate that the present rise in temperatures is strongly bound up with the effects of human activity, we introduce the concepts of the Earth system's energy balance and of

effective radiative forcing, and analyse the following principal natural forcings capable of inducing changes in the equilibria of the climate system:

- solar forcing: influenced by orbital factors and by the intensity of solar activity, it has undergone no particular variation over the last two centuries, with an effective radiative forcing on the planet's energy balance that is virtually nil;
- volcanic forcing: although capable of altering the chemical composition of the atmosphere, even at the level of greenhouse-gas concentration, its effect tends to be a cooling of the climate in the short term, hence at odds with what is now occurring; moreover, over the last two centuries volcanic activity has not been especially intense;
- forcing linked to variation in greenhouse-gas concentration: this is the only source capable of accounting for the climate change now under way, as Fig. 3 makes clear; it has undergone a substantial positive increase in recent decades owing to human activity;
- forcing linked to aerosols: this too is tied to both natural and anthropogenic activity, and on the whole exerts a cooling effect on the climate; it cannot, therefore, be associated with the rise in temperatures.

The analysis focuses on the effects that these forcings have had since around 1750, and on the ways in which they may have conditioned the climatic variability of the Quaternary.

In order to include among the possible hypotheses the climatic aberrations as well, responsible for episodes of drastic and abrupt climate change in the past, the picture is completed by palaeoclimatological analyses; from this comparison a worrying picture emerges. Even considering one of the most rapid and intense climatic aberrations of the Cenozoic, namely the Palaeocene–Eocene Thermal Maximum, it transpires that the present alteration of the atmosphere's chemical composition in terms of carbon dioxide, and the consequent rise in temperatures, are occurring 4 to 10 times faster. This means that the planet will be able to restore a state of equilibrium following such an aberration only over geological timescales on the order of hundreds of thousands of years, while also reaching temperature values far above present levels and incompatible with human tolerances.

4.1. The planet's energy balance and the forcings

To explain the causes of such an alteration of the climate, one must take into account the impacts that natural and anthropogenic climatic forcings may have had on the planet's energy balance, and examine the timescales of their variability in the past.

The principal influencing factors considered here are: changes in insolation due to variations in solar activity or in the orbital characteristics of planet Earth; the emission of aerosols into the stratosphere as a result of intense volcanic eruptions; and variation in the tropospheric concentrations of greenhouse gases (in particular carbon dioxide, methane and nitrous oxide) and of aerosols.

The climate is a physically complex system, since it rests on the continuous interaction among its various components: atmosphere, hydrosphere, biosphere, cryosphere and land surface. To describe and understand its variability, the mechanisms of interaction and the effect that the forcings mentioned can have on the planet's energy balance, climatology employs the concept of the "Earth system energy balance".

This balance, whose principal processes are schematised in Fig. 2, is driven chiefly by solar radiation, which powers the system and supplies the Earth with energy in the form of electromagnetic radiation. Of this energy received from the Sun (on average around 340 W m^{-2}), part is reflected back out of the Earth system by clouds, by atmospheric aerosols and by the albedo of the land surface; the remainder governs the various processes of mass and energy exchange among the different components of the climate system, before being re-emitted out of the atmosphere as infrared radiation.

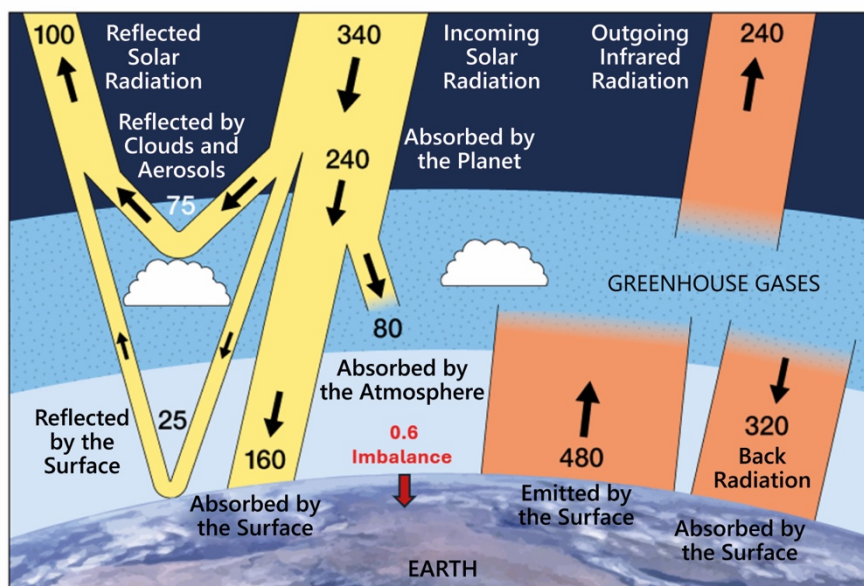


Figure 2: Schematic representation of the Earth's global mean energy balance. The figures indicate the best estimates of the magnitudes of the components of the global mean energy balance in W m^{-2} , representing climatic conditions at the start of the twenty-first century.

In a system in equilibrium, the quantity of incoming energy tends, over the long term, to equal that which is re-emitted, even in the presence of fluctuations due to internal climatic variability; an alteration of that state produces a disequilibrium that drives the system towards the pursuit of a new balancing of the energy fluxes.

Several forcings can act upon this process; a clear example is the emission of greenhouse gases of anthropogenic origin which, by altering the absorption of infrared radiation in the atmosphere, prevent its complete re-emission to space, thereby causing an accumulation of energy in the Earth's climate system and a consequent state of "energy imbalance" (Earth system energy imbalance).

The impact that the various forcings can generate on the complex interactions of the climate system is estimated using the concept of effective radiative forcing, which quantifies, in W m^{-2} , the energy entering or leaving the Earth system as a result of an imposed perturbation (for example, changes in greenhouse gases, in aerosols or in solar irradiance).

An effective radiative forcing will tend to favour global warming if it is positive in sign, and to reduce it if it is negative; and, as will be seen in the following sections, the resultant of the principal natural forcings taken together is unable to explain the global warming of the last 250 years.

4.1.1. Solar forcing

Solar forcing is bound up with the quantity of solar radiation reaching the Earth's surface. Its variability depends on two distinct aspects: the variations assumed by the Earth's orbit and by the relative position of Earth and Sun (known as orbital forcings), and the intensity of solar activity.

The effect on the Earth's climate of the cyclical variations in the position of the Earth relative to the Sun was first described by Milankovitch⁷ in 1941; he identified the following orbital forcings:

- variation in eccentricity (the more or less marked departure from a circular orbit), with a periodicity of 100,000 years;
- variation in the obliquity of the Earth's axis, due to the tilt of the axis relative to the orbital plane, with a periodicity of 41,000 years;
- variation in the precession of the Earth's axis, the process bound up with its slow conical motion (much like a spinning top), with a periodicity of about 26,000 years.

Identifying these three cycles was fundamental to explaining the alternation of glacial and interglacial periods that occurred in the most recent geological period, the Quaternary, and also at the beginning of the present interglacial epoch, the Holocene, marked by an increase in the solar radiation received by the atmosphere⁸; but on their own they are unable to account for the present warming.

Total solar radiation, and hence solar magnetic activity, is also subject to cycles with a periodicity of 11 years (the Schwabe cycle), producing variations that can reach at most 1 W m^{-2} . Taking the albedo into account, and the fact that the planet is a geoid, this variation translates into a change in the energy available to the Earth of 0.17 W m^{-2} , a value that is negligible by comparison with the radiative forcing caused by greenhouse-gas emissions, estimated at around 2.7 W m^{-2} in 2019, taking 1750 as the reference. This point is emphasised in the IPCC's AR6 report (2021) as well, according to which solar activity, though relatively high even in the nineteenth century and not exceptional by comparison with the

⁷Milankovitch M., 1941.

⁸Engels S. and Bas van Geel, 2012.

last 9,000 years, produced a global radiative effect of between -0.06 and $+0.08 \text{ W m}^{-2}$, hence wholly negligible when set against the impact generated by greenhouse gases (Fig. 3).

4.1.2. Volcanic forcing

Before the industrial period, explosive volcanic eruptions represented the principal climatic forcings at the global scale over short timescales, from interannual to multi-decadal; they are, moreover, usually excluded from the production of climate projections because their occurrence is unpredictable. It must also be borne in mind that volcanism has a complex impact on the climate, owing to the simultaneous emission of aerosols and of greenhouse gases, phenomena that affect the Earth system's energy balance over different timescales and with opposing effects.

Analysing the last 2,500 years, one finds that volcanic eruptions sufficiently intense to generate an effective radiative forcing greater than -1 W m^{-2} have occurred, on average, twice per century. The most recent was that of Pinatubo (1991), but in the preceding century there were considerably more intense eruptions, such as that of Mount Tambora (1815), which produced the so-called "year without a summer" and the consequent near-total failure of agricultural production in the northern hemisphere.

The major eruptions affect the climate system for several years, depending on the location of the volcano, which influences the dispersion of the gases and aerosols emitted, on the effective injection height⁹, and on the time of year at which the event occurs. They normally produce both short-term effects, due to the emission of aerosols into the stratosphere, which increase the reflection of incoming solar radiation and so cool the planet, and longer-term effects, owing to the enhancement of the greenhouse effect following the emission of gases. This second effect, however, is negligible by comparison with the impact generated in the short term, and is of marginal magnitude even when set against emissions of anthropogenic origin.

In short, then, the great eruptions generate a reduction in global mean temperature of variable duration, on account of the direct radiative effect of the emission of aerosols into the stratosphere. Volcanic eruptions can also prolong their impact on the global climate over several years, affecting particularly sensitive regional contexts, for example through a change in the monsoon circulation, or through induced modifications of the marine cryosphere.

Despite their unpredictability, scenarios have nonetheless been developed that take into account the impact of potential, very intense volcanic eruptions in the present century; from these it emerges that such events could delay the crossing of the $1.5 \text{ }^{\circ}\text{C}$ global-warming threshold by a few years¹⁰.

⁹This refers to the altitude at which the material ejected during an eruption (such as ash, gas and rock) is injected into the atmosphere to a significant degree, reaching atmospheric layers capable of influencing the climate or public health.

¹⁰Bethke I. et al., 2017.

That said, for any appreciable effect in attenuating global warming, numerous great eruptions would be needed within the same century, an eventuality that is statistically improbable and fraught with extremely negative consequences, such as the destruction of various ecosystems and the deterioration of air quality.

Fig. 3 highlights the intense negative radiative forcing produced by the eruptions of Tambora and Pinatubo.

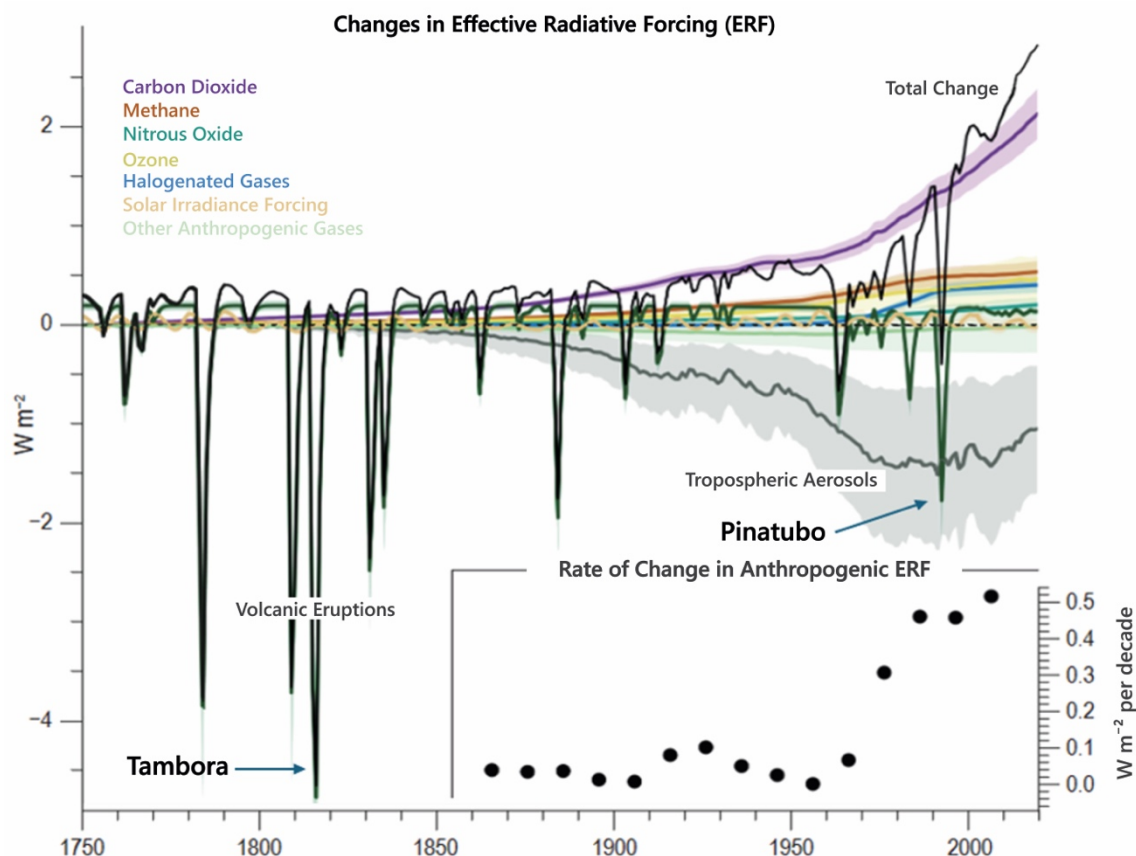


Figure 3: Time evolution of the effective radiative forcing (ERF) associated with the principal climatic forcings. The plot at lower right shows the rate of change in total anthropogenic radiative forcing (the total excluding solar and volcanic forcing) over 30-year periods centred on each point.

4.1.3. Forcing due to variation in greenhouse-gas concentration

As may be seen, the time course of the concentration of carbon dioxide in the atmosphere (Fig. 4) and the evolution of the planet's temperatures (Fig. 1) are exactly superimposable, demonstrating that variation in greenhouse-gas concentration is closely connected with the course of global temperatures.

The natural causes of these variations are manifold: strong volcanic activity; wildfires; changes in ocean currents and in the temperature of the oceans, with consequent influence on their capacity to store carbon (they are one of the major sinks of atmospheric carbon dioxide); but also slower processes such as erosion and sedimentation, which bear directly

on the carbon cycle. Soil erosion, indeed, degrades the surface of the land, reducing the capacity for vegetation to develop, with a consequent decline in photosynthesis and in carbon uptake. Sedimentation, by contrast (which also includes the anaerobic decomposition of organic matter from which fossil fuels originate), favours the storage of atmospheric carbon on the seabed and in the Earth's crust.

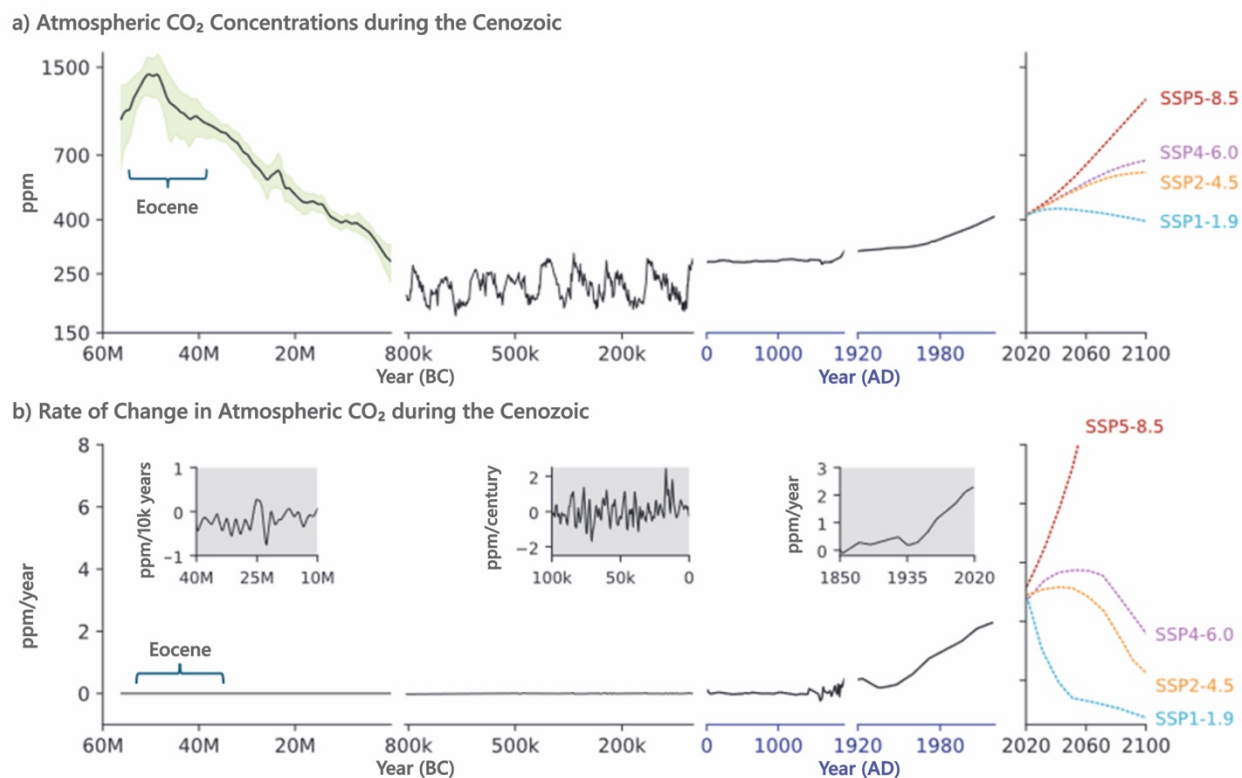


Figure 4: Changes in the concentration of carbon dioxide in the atmosphere (a) and its rates of change (b) over the last 60 million years, with projections for the following 300 years according to the three common SSP emissions scenarios commonly used in the CMIP6 project. (Source: adaptation of the figure in the IPCC AR6 report.)

There is no longer any doubt that the principal cause of variation in greenhouse-gas concentration is to be sought in human action: in the use of fossil fuels, in the spread of carbon-based industrial activity, and in changes in land use such as deforestation and urbanisation. It is precisely human activity that accounts for the rapid increase in the atmospheric concentration of greenhouse gases that took place in the twentieth century and is still under way, and for the consequent rise in temperatures on record. The warming effect of these gases (in particular carbon dioxide, methane and nitrous oxide) is evident in Fig. 3, where it can be seen that all three have produced an ever more intense positive effective radiative forcing from 1750 to the present.

Greenhouse gases have, moreover, been subject to important variations over the history of our planet. As Fig. 4 shows, throughout the entire Cenozoic the fluctuations in carbon dioxide ranged between values of 150 ppm (parts per million) and 1,500 ppm, the latter reached in the Eocene. In accordance with palaeoclimatic reconstructions, however, the

alterations in the chemical composition of the atmosphere that occurred in the past were spread over millions of years, and took place at a rate not even comparable with that of present-day emissions. Fig. 4b shows that the rate of change in carbon dioxide, in ppm/year, was virtually nil over the last 60 million years, whereas at present it is rising at a pace of around 2.5 ppm/year. The course of the atmospheric concentration of the other two principal greenhouse gases (methane and nitrous oxide) is likewise comparable to that of carbon dioxide; it too has therefore been subject to an unprecedented increase over the last 100 years.

Even allowing for the fact that this rate also depends on the temporal resolution of the palaeoclimatic proxies used in the historical reconstruction, the IPCC's AR5 report¹¹ (2013) finds that, taking the last 800,000 years as the reference, since the beginning of the industrial era the variation in the atmospheric concentration of carbon dioxide has occurred at an unprecedented rate. This evidence, together with the undeniable correlation between the increase in the atmospheric concentration of greenhouse gases and the rise in temperatures, confirms that the true cause of the present climate change is the emission of greenhouse gases of anthropogenic origin, which has brought the atmospheric concentration of carbon dioxide to the levels of around 3 million years ago (the mid-Pliocene Thermal Maximum)¹².

4.1.4. The effect of aerosols

Relative to the pre-industrial era, human activity (in particular the burning of biomass and of fossil fuels) has brought about a notable increase in the emission of aerosols and of their precursors. The greater concentration of aerosols in the atmosphere has repercussions both on the processes of scattering and absorption of solar radiation (the direct effect) and on cloud formation (the indirect effect).

In climate projections, the estimate of the effective radiative forcing caused by the presence of aerosols in the atmosphere is marked by great uncertainty, these being processes that are

¹¹IPCC Report, 2013.

¹²In the Pliocene (a geological epoch whose climate bore many analogies to the scenarios now taking shape in our own time), atmospheric CO₂ concentrations were likewise comparable to those of today (around 400 ppm). In the absence of anthropogenic activity, this was due to the fact that certain natural processes, which influence the carbon cycle and hence the concentration of greenhouse gases in the atmosphere, operated differently from the way they do today. Indeed, the Pliocene climate was characterised by a state of equilibrium under conditions very different from the present: sea level was 20–25 m higher than today, the polar ice caps were greatly reduced, tropical forests extended to higher latitudes, and ocean circulation was profoundly different owing to the different arrangement of the continents and the absence of the Isthmus of Panama. Other relevant factors to consider are the important differences in atmospheric circulation, due to a smaller thermal gradient between the poles and the equator; the presence of different vegetation, lacking C4-type plants (species suited to hot climates with limited water availability); and a lower efficiency of rock "weathering". The combination of all these elements helped to maintain a state of quasi-equilibrium in the global climate, with temperatures about +2–3 °C higher than at present, attributable only in part to greenhouse-gas concentrations. For the reasons described, therefore, while it represents an important climatic analogue, the Pliocene cannot provide an exhaustive comparison with the present and future climate, which, moreover, is passing through a markedly evolving phase, with all of its components yet to reach the new equilibrium in response to the perturbation imposed by anthropogenic emissions.

difficult to simulate and each form of aerosol presenting its own peculiarities. Most aerosols, such as sulphates, tend to cause a cooling of the climate (negative forcing), while others, such as black carbon, favour a warming (positive forcing). The estimates produced suggest that the resulting radiative forcing is negative, and hence counteracts the effects of the increase in greenhouse-gas concentration, as may be seen from the plot in Fig. 3; this means that the increase in atmospheric aerosols causes, on the whole, a cooling of the climate. The sum of the direct and indirect effects of tropospheric aerosols is estimated to generate a radiative forcing of around $-0.9 \pm 0.5 \text{ W m}^{-2}$, and this forcing is estimated to be changing over time in relation to the change in anthropogenic emissions (IPCC AR6, 2021)¹³.

In recent years a decline has been noted in the concentration of aerosols emitted from anthropogenic sources in Europe and North America, while important positive trends in black-carbon emissions have been observed in southern Asia and East Africa. The combination of these two developments has brought about a reduction in the net cooling induced by tropospheric aerosols. The global trend stands at a decrease of 0.03% per year, with a consequent reduction in their mitigating effect on global warming (Fig. 3). One may therefore note that human activity, with respect to the emission of aerosols into the atmosphere, can also contribute to a cooling of the climate, but that the warming effect of greenhouse gases discussed in the previous section is markedly dominant.

It is worth observing, moreover, that the environmental policies aimed at countering atmospheric pollution are bringing about a decrease in aerosol concentration, thereby tilting the energy balance still further in favour of the warming due to greenhouse gases.

4.2. Palaeoclimatology and the concept of climatic aberration

One of the principal scientific findings of palaeoclimatology is the occurrence of “climatic aberrations”: climatic changes extraordinary by comparison with the prevailing trend of their period.

This is a relative concept, in that the aberrations, while producing significant discontinuities in the climate system, which uses them as mere forms of energy re-equilibration, may prove fatal for the forms of life and the ecosystems caught up in them.

Such aberrations have typically occurred in the wake of intense and temporary perturbations of the climate system, such as a sudden release of greenhouse gases into the atmosphere. Classic examples of climatic aberrations are phenomena such as Snowball Earth (millennial phases in the geological history of the Earth during which the planet was wholly or almost wholly blanketed by ice, both on the emerged lands and in the oceans), as in the Sturtian glaciation (around 717–660 Ma ago) and the subsequent Marinoan glaciation (around 650–635 Ma ago).

¹³IPCC Report, 2021.

Analysing and understanding the evolution of these radical events yields fundamental information about the Earth system and about its capacity for resilience, adaptability and the restoration of conditions of life suited even to humankind.

The changes now under way present analogies with those of the Palaeocene–Eocene Thermal Maximum, which occurred around 55 Ma ago through the abrupt doubling of atmospheric CO₂ concentrations¹⁴, and which led to a rise in global mean temperatures of 5–8 °C. The Earth system took around 100,000 years to recover from this perturbation.

Now, drawing a comparison with the present climate crisis, were it to reach the values of the worst-case scenario (SSP5–8.5), at least 500,000 years would be required to return to pre-industrial levels of atmospheric CO₂, a span equivalent to 20,000 human generations. Notwithstanding the aberration described, throughout the entire Cenozoic the rate of CO₂ release was nonetheless 4 to 10 times slower than the present rate. This, and other reconstructions of the past climate, leave no doubt that the present global warming constitutes a climatic aberration, since both the rapidity and the magnitude of the phenomenon far exceed the variability that distinguished entire preceding geological eras¹⁵. Adopting a comparison with the intermediate emissions scenario (SSP2–4.5), CO₂ will reach 600 ppm by 2100; under the worst-case scenario (SSP5–8.5), by the same date 1,000 ppm will be reached, values off the scale when set against the last 800,000 years of the planet's history.

Other characteristics of the present warming, moreover, are wholly different from the climatic variations of the late Holocene. Raphael Neukom¹⁶, analysing the Little Ice Age (LIA: a period of climatic cooling between the fourteenth and nineteenth centuries), particularly in the regions of the northern hemisphere, found that the coldest epoch of the last millennium did not exhibit any spatio-temporal coherence across the various areas of the planet, but rather a variability of a stochastic kind. This confirms that the climatic variations of the pre-industrial period were not sufficiently intense to produce coherent and uniform temperature changes at the global scale over multi-decadal and centennial timescales. By contrast, his research emphasised that the warming now under way is affecting 98% of the planet's surface, further confirmation of how it diverges, both in intensity and in spatio-temporal coherence, from the climatic variations that occurred during the Holocene.

¹⁴As described in *The Paleocene–Eocene Thermal Maximum: A Perturbation of Carbon Cycle, Climate, and Biosphere with Implications for the Future* (2011), although there is scientific consensus that the PETM was caused by a strong release of carbon into the atmosphere, there is as yet no clear explanation as to the causes of such a release. The five sources of the carbon release still under discussion are: the release of methane clathrates owing to rising temperatures; wildfires and the burning of peat and coal deposits laid down during the Palaeocene; the release of thermogenic methane through the interaction of magma with sediments rich in organic matter; the desiccation of epicontinental seas, with the consequent rapid oxidation of the organic matter present on the continents; and the release of large quantities of carbon stored in the Antarctic permafrost.

¹⁵Tierney J. et al., 2020.

¹⁶Neukom R. et al., 2019.

In conclusion, palaeoclimatology confirms that the Earth tends constantly towards the attainment of a stage of dynamic equilibrium among the energy fluxes, in continuous interaction with the biotic, abiotic and merobiotic components; but it is not given that this evolutionary configuration will always correspond to the conditions of human life, not least in view of the fact that the mere re-equilibration of climatic inertias requires very long timescales, which often transcend the horizons and scenarios of mitigation and adaptation.

5. REALISM OR POST-TRUTH?

One frequently encounters a technical, political and media narrative of the climate problem (at times of a denialist cast) that resorts to tendentious reconstructions and, on occasion, to ex-post manipulations of a past made to serve its own communicative ends. It is easy to observe that these are constructions divorced from considered judgement, serving an approach that uses the tools of social media for the mere aggregation of consensus. This proposition is, unfortunately, lent weight by various surrounding conditions, beginning with the confusion between meteorology and climate (the one oriented towards the short term and the atmospheric weather of the coming days, the other towards long-term scenarios), but often also by unconvincing technological and industrial approaches, as well as by a fragmentation of the international framework of responsibilities.

It also finds a foothold in the broader anthropological context, being culturally immersed in a post-modernity that blurs the contours of values and removes them towards horizons in continual transition, devoid of certainties, towards liquid and unstable scenarios, today summed up in the acronym V.U.C.A. (Volatility, Uncertainty, Complexity and Ambiguity).

Those who seek greater clarity and objectivity may draw on two instruments.

First and foremost on critical sense: the fruit of a familiarity with reading, with study, with doubt; avoiding the immediate and simplifying recourse to ready-made conclusions and apodictic assertions; treating the digital and the technicalities as instrumental factors; in a perspective of values of a more analogical, ethical and teleological content, for it is to these that sustainability must be referred.

The second instrument consists in a more industrial and numerical approach. Mitigation, adaptation and resilience demand a new kind of progress, one that originates in the remodelling of industrial processes, of infrastructure networks, of credit and of risk management, for these are the factors that bear deeply on the fabric of society, on people's expectations, on the way they live, on the places they inhabit, on the value of time.

These triggers, which produce cascading effects on the micro-economy, on society, on families and on citizens, can be set in motion by governments and by the great regulators (central banks, national and international, and international bodies) through the adoption of an industrial plan that traces clearly the new design of a resilient world, with all its complexities and interactions. To achieve this objective (not least in view of its strong social impact), reliable, representative and shareable figures and scenarios are required. The climate datum, in that context, becomes a discriminating factor in design, in decision-making

and in the monitoring of decisions. The data used must therefore possess certain salient characteristics, such as quality, representativeness and third-party impartiality; they must be expressed in a formal taxonomy and be accessible on an open plane of abstraction.

By its very nature, which transcends meteorological and local events, the strength of the climate parameter is expressed both in the forward-looking, medium- and long-term view and in the historical view to which comparisons must be referred, whether in terms of emissions reduction or of the implementation of accompanying policies; it is indeed through this reading of the datasets that one is able to obtain a numerical grasp of what is happening, what may happen, or what will happen. A sad confirmation of this is the news that, as these pages are being written, the overshoot of the climatic parameters that would have allowed the limits set by the Paris Agreement¹⁷ to be respected has been reached, owing to the incremental drift sustained by the emissions already present in the atmosphere.

All the same, the close succession of years marked by very high global mean temperatures is at last opening the eyes of at least that broad band of bodies, individuals and heads of various organisations who, over the last twenty years, could only repeat that, in order to believe in global warming, they first wanted to “see the data”: data that, had there been any real will, were available long ago in formats that were accessible, clear and intelligible to a wide public.

Today, a broad set of proactive components of the industrial, technical, scientific, political, communicative and social world, who have a direct understanding of the change, being themselves directly involved, converge on a number of fundamental theses and propositions, useful for bringing clarity to certain key aspects of this narrative and for preventing it from dissipating into a welter of less relevant considerations, at times banal or, worse, untrue. Here are the principal ones.

Save humankind, not the planet. Humanity’s astral position must not be severed from the physical workings of the solar system, but must instead be contextualised and relativised. In Genesis, humankind, created by God in His own image, sits firmly at the centre of the universe; but the history of thought after the Bible, and after many other cosmogonies, gradually removes humanity from this position. With Copernicus the Earth is displaced from the centre of the solar system to its outer orbits; Darwin, later, distributes the moment of creation across a more mediated evolutionary process that makes humankind kin to all the other forms of life. Then, with Lévi-Strauss and Freud (but more generally with anthropology and psychoanalysis, and indeed already with the “Know thyself” of Delphi), humankind is even deprived of part of the control over itself and over its own will.

Moreover, quite apart from any mythical or mystical dimension, a single glance at the reaches of space, or at the depths of the atom, is enough to grasp that there is no anthropocentric universe whose timescales or whose centres of gravity are commensurate with those of humanity.

¹⁷COP21 (2015).

It is precisely this set of observations that brings out the anthropo-centric niche which houses humankind and its qualities, unique and exceptional though they are, such as freedom of thought and the capacity for transcendence; and within that niche it becomes meaningful to exercise the responsible action that can develop at the point, and along the trajectories, of mutual encounter and equilibrium between humankind and nature.

To save humankind, then, and the natural ecosystems as instruments of life, of biodiversity, of adaptation, necessary to maintain that homeostatic equilibrium which requires a constant and attentive evolutionary attunement between the conditions of life and those of the planet. A different reading (of an astral, naturalist or pantheist cast) can only end in utopian and nihilistic hypotheses.

From its origins, the Earth has never undergone a climatic cycle like the present one.

Over its long history, the planet would not always have been able to host humankind; it is only during the very last few million years that the evolutionary conditions suited to it came about. Among these was the climatic environment: comparisons among the Earth's different climatic phases must therefore be confined within this parenthesis. There is no sense, for example, in comparing our own time with the early-Eocene climatic optimum, which occurred 50 million years ago and was marked by global mean temperatures around 15 degrees higher than those of the pre-industrial period; and not only that, but this took place on a planet different from the present one, with a different arrangement of the continents, with different characteristics of the oceans, of the atmosphere, of life.

Referring, then, to the Quaternary, the only significant and recurrent phenomena have been the glaciations that succeeded one another over the last million years, down to the recent Little Ice Age (LIA, between 1300 and 1800).

All the other cyclical events typical of the planet (and in particular the significant solar forcings linked to the Earth's orbit and axis) have a periodicity ranging from 20,000 to 400,000 years, and cannot therefore be held responsible for the present warming; nor can solar magnetic activity which, though particularly vigorous in this century, exerts through its 11-year cycle an utterly negligible influence.

But what specifically distinguishes these last two centuries, quite apart from the absolute values, is the rapidity of the rise in atmospheric carbon dioxide due to emissions, a phenomenon that finds no counterpart or fossil testimony, whether prehistoric or primordial.

The evidence of this climatic transition is, in any case, now within everyone's experience, the experience of a humanity witnessing the materialisation of the foretold physical risks in real, recurrent and catastrophic events, with ever more devastating impacts.

Global warming grows in proportion to anthropogenic emissions, for it is a direct function of them. The observations and measurements carried out for many years now by technical, scientific, financial, insurance, governmental and non-governmental, international and independent bodies (and used to monitor present situations and to produce scenarios at various territorial scales and time horizons) give evidence of a direct correlation between

the production of anthropogenic emissions and the rise in temperatures. The factors of a natural character, equally well known and quantified, are not significantly influencing the phenomenon.

The beat of a butterfly's wings in the Amazon does NOT cause a tornado in Europe.

This is a notion that has enjoyed a certain fortune, and perhaps it could once help to represent the global interaction and interdependence among the great climatic events (the melting of the glaciers, the alteration of ocean currents, the thermal rise of the seas), but it finds no correspondence with any concrete hypothesis. It proves, indeed, harmful at the moment when it furnishes an alibi for the supposed ineffectiveness of mitigation and adaptation actions, subjecting them to a fate that is utterly uncontrollable, imponderable and insubstantial, whereas those actions require constant and persistent policies, investment, new industrial approaches, a new culture, and hence a great universal commitment.

Let us in any case bring our own contribution, even at the local level, to adaptation.

"Fragmentation and conflict" are the words used by the UN's IPCC to characterise the SSP3–7.0 climate scenario, a label describing the global situation resulting from the adaptation policies adopted. This confirms that we will not be able to count on any strong worldwide coordination in the governance of climate mitigation and adaptation. This, after all, is what humanity is; to expect anything different belongs to the great and small utopias, to aspirations, to ambitions, at times to dreams.

Yet it is precisely in these differences (a north and a south, an east and a west, cultures, religions, histories) that there arises the potential needed to sustain that challenge which a world homogenised in the manner of G. Orwell¹⁸ would be unable to sustain, on account of the intrinsic weakness of simple systems by comparison with complex ones.

Indeed, every type of resilience must have its own original characteristics, as a function of the starting context, of territorial and climatic specificities, of social and cultural features, of the resources available; in this way it brings a specific adaptive value of its own, capable of amplifying the result of more general policies, which must in any case be strenuously pursued.

There is, finally, a stronger reason for working in the direction of commitment in any case: that of handing down to the new generations a legacy that contains solid foundations of sustainability, understood as an ethical and cultural value, and hence as a practice of life upon which to remodel (or to refund) our economic, political and social models.

6. THOUGHT AND THINKERS

To provide a climate narrative that is honest, credible and capable of being shared seems today an achievement hard to come by; it is difficult even to agree on at least a few points of reference around which to engage, including critically. These are the years of the

¹⁸Orwell G., 1984, Milan, 2021.

aprioristic smoothing of consciences over simplified templates, of homogenisations, of a totalising Manichaeism that closes itself to listening and to dialogue.

Faced with this situation, to set out reasons does no more than sharpen the polemic; for this reason, in concluding the brief physical survey, we wish to give voice to the critical and speculative analysis that certain significant thinkers (philosophers, anthropologists, sociologists) have brought to bear in the search for an overall and finalistic logic of human action.

Climate change, global warming, social liquidity, post-modernity, transitions, decarbonisation, artificial intelligence, migrations, conflicts, poverty, complexity and political, social, technological, existential and ethical interdependencies: these are by no means the first challenges for humanity, and once again there is no other means of grasping and confronting them than the force, the depth, the variety and the originality of thought, an instrument that dons the colour of every century, yet remains perennially current. The metaphysics of yesterday is today called hermeneutics, but only so as to orient it towards a closer adherence to a reality in which thought finds itself confronting, and being interrogated on, matters for which technology, pragmatism and rationalism often map out paths that diverge from a solid ethical basis, thereby losing, in the longer view, political and social sustainability.

Finally, we have gathered also the opinion of those philosophers (among whom Italy is very well represented) who have devoted particular attention to the subjects of greatest technological currency.

"Modern" times?

Wilhelm Erb (1840–1921), from "The Growing Nervousness of Our Time"

"Let us cast a swift glance at our modern life and the form it has come to assume, as is at once evident from a whole series of general facts: the extraordinary achievements of the modern age, the discoveries and inventions in every field, the maintenance of progress in the face of growing competition: all this has been attained, and can be maintained, only by means of great intellectual labour. The degree of performance demanded of the individual in the struggle for existence has increased considerably, and he can meet these demands only by deploying all his spiritual energies; at the same time the wants of the individual and his demands for the enjoyment of life have grown in every class; an unheard-of luxury has spread to strata of the population that had previously been excluded from it; irreligion, dissatisfaction and greed have increased across vast social spheres. Through the boundless intensification of traffic and the networks of telegraphic and telephonic communication that embrace the whole world, the conditions of commerce have wholly changed: everything is done in haste and agitation, the night is used for travelling and the day for business; even 'recreational' journeys have become occasions of strain for the nervous system. Great political, industrial and financial crises spread agitation through far broader strata of the population than before; participation in political life has become general: political, religious and social struggles, party activity,

electoral campaigns, the boundless growth of associations inflame minds and force them to ever new exertions, robbing time from recreation, from sleep and from rest. Life in the great cities grows ever more refined and restless. Exhausted nerves seek relief in more intense stimuli, in piquant pleasures, only to tire themselves the more. Modern literature concerns itself chiefly with the most scabrous problems, which stir up all the passions, encouraging sensuality and the thirst for enjoyment, the contempt for every ethical principle and every ideal; it presents to the reader's mind pathological figures, problems of sexual psychopathy, revolutionary and other types. Our ears are stimulated and over-excited by an invasive and clamorous music, administered in large doses; the theatres hold all the senses captive with their provocative spectacles; even the figurative arts turn by preference to the repugnant, the deformed and the exciting, and do not hesitate to set before our eyes, with revolting realism, even the most monstrous aspects offered by reality."

Nicholas of Cusa (1401–1464), from "De vera sapientia", in Opera omnia, ed. Ernst Hoffmann et al.

"Si quis, tota die currens, pervenit ad vesperam, satis est. (If a man, having run all day, arrives at evening, then he has done enough.)"

Jorge Luis Borges (1899–1986), from "Other Inquisitions"

"The past is another present."

John Steinbeck (1902–1968), from "The Acts of King Arthur and His Noble Knights"

"I seek the future by rummaging through the lumber of the past."

Philosophy in order to understand

Plato (428–348 BC), from "The Republic, Book V"

"The exercise of government belongs to the philosophers."

Luciano Floridi (b. 1964), from "The Philosophy of Information"

"We need philosophy to grasp the very nature of problems, to anticipate and direct the ethical implications of ICT, to trace the correct conceptual framework within which to semanticise our complexity (to endow it with meaning and so to understand it) and to improve the economic, social and political dynamics of information. In short, we need a philosophy of information as the philosophy of our time and for our time."

Luciano Floridi (b. 1964), from "The Fundamental Difference"

"We are in desperate need of a new philosophy of our time for our time, one that not only digs, deconstructs, analyses, unveils or calls into question old and new questions, but that also produces, builds, elaborates, supports and defends new solutions."

Emanuele Severino (1929–2020), from "The Essence of Nihilism"

"Philosophy is the inevitable future of humanity... Practical knowledge (the capacity to make, to produce) can free us from every limit, save the one consisting in the doubt that everything we are or have may be swept away in an imminent catastrophe. Only the logic

of truth can dispel that doubt. And it is precisely for this reason that philosophy, as the place of truth, is the future of humankind."

Ludwig Wittgenstein (1889–1951), from "Tractatus Logico-Philosophicus"

"Philosophy is not a natural science, nor a doctrine, but an activity, whose aim is the logical clarification of thoughts. It consists essentially of elucidations; it must render clear and sharply delimit the thoughts that would otherwise be turbid and blurred."

Immanuel Kant (1724–1804), from "Critique of Pure Reason"

"Philosophy is the science of the relation of all knowledge to the essential ends of human reason."

Qoheleth, or Ecclesiastes (3rd or 5th century BC), from the Hebrew and Christian Bible

"For everything there is a season, and a time for every matter under heaven: a time to be born, and a time to die; a time to plant, and a time to uproot what has been planted. A time to kill, and a time to heal; a time to tear down, and a time to build. A time to weep, and a time to laugh; a time to mourn, and a time to dance. A time to cast away stones, and a time to gather stones together; a time to embrace, and a time to refrain from embracing. A time to seek, and a time to lose; a time to keep, and a time to throw away. A time to tear, and a time to sew; a time to keep silence, and a time to speak. A time to love, and a time to hate; a time for war, and a time for peace."

Telmo Pievani (b. 1970), from "The Earth After Us"

"The environmentalism of the future will be the highest form of humanism."

Andrew J. Hoffman (b. 1961), from "How Culture Shapes the Climate Change Debate"

"... the climate-change debate is not about carbon dioxide and greenhouse gases; it is about the clash of the cultural values and worldviews through which the science is viewed."

Nature vs humanity

David Hume (1711–1776), from "An Enquiry concerning Human Understanding"

"Nature will always maintain her rights, and prevail in the end over any abstract reasoning whatsoever."

Pierre Bayle (1647–1706), cited in Michel Foucault (1926–1984), "History of Madness in the Classical Age"

"The order that nature has willed to establish in the universe always proceeds at its own pace: the only thing to be said is that what nature would not have obtained from our reason, it obtains from our folly."

Charles Dickens (1812–1870), from "The Chimes"

"It seems as if we can never go right, or do right, or be rightly served, said Toby. I had little schooling when I was young, and I cannot make out whether we have any business on the

face of the earth or not. Sometimes I think we must have, a little; and sometimes I think we must be intruders."

Benedict de Spinoza (1632–1677), from "Ethics"

"Human power is greatly limited, and infinitely surpassed by the power of external causes; and so we do not have an absolute power to adapt to our use the things that are outside us. Nevertheless, we shall bear with equanimity those events that run contrary to what the calculation of our advantage requires, if we are conscious of having done our duty, and that the power we possess could not have extended so far as to enable us to avoid them, and that we are part of the whole of nature, whose order we follow. If we understand this clearly and distinctly, that part of us which is defined by the intellect (that is, the better part of us) will find complete satisfaction in it, and in that acquiescence it will strive to persevere. For, in so far as we understand, we can desire nothing but what is necessary, nor, in the absolute sense, find satisfaction in anything but the truth; and therefore, in so far as we understand these things rightly, the striving of the better part of us is in accord with the order of the whole of nature."

Telmo Pievani (b. 1970), from "Introduction to Darwin"

"The thinking species is perhaps not the ultimate end of natural history."

No country for (climatologists alone)

Ludwig Wittgenstein (1889–1951), from "Tractatus Logico-Philosophicus"

"The limits of my language mean the limits of my world."

Pope Francis (Jorge Mario Bergoglio, 1936–2025), from "Laudato si'", § 63

"If we take into account the complexity of the ecological crisis and its many causes, we ought to recognise that the solutions cannot come from a single way of interpreting and transforming reality. It is necessary to draw also on the various cultural riches of peoples, on art and poetry, on the interior life and spirituality... no form of wisdom can be set aside... the Catholic Church is open to dialogue with philosophical thought."

Karl R. Popper (1902–1994), from "The Logic of Scientific Discovery"

"I take an interest in science and philosophy only because I want to learn something about the riddle of the world in which we live, and the riddle of the knowledge that humankind has of that world. And I believe that only a revival of interest in these riddles can save the sciences and philosophy from narrow specialisation and from an obscurantist faith in the special skill of the expert and in his personal knowledge and authority, a faith that fits so well with our 'post-rationalist' and 'post-critical' age, proudly engaged in the destruction of the philosophy of nature and of rational thought itself."

A planet for all seasons

Plato (428–348 BC), from "Timaeus"

"The cosmos is a sensible god."

Maurizio Ferraris (b. 1956), from "Documanity. Philosophy of the New World"

"As for saving the planet: no thank you. The planet has no need of our intervention, for the fate of the Earth is already sealed and would coincide with the heat death of the universe. What is at stake, rather, is the attempt to preserve the environment that makes the human form of life possible. There is no nature as such, but only an interaction between nature and culture, and it is a primarily constructive interaction. The world in its state of nature is no more meaningful or benevolent than our own. It is up to us to aim at something better: saving ourselves, and not the planet, which has no need of us or of our help."

Maurizio Ferraris (b. 1956), from "Manifesto of New Realism"

"As for the planet, let us reassure ourselves: it will go on existing for millions of years in a luxuriant exuberance of life forms, only without us, at least if we carry on at this rate."

Telmo Pievani (b. 1970), from "Introduction to Darwin"

"Geology also allowed Darwin to perceive, for the first time, the non-finalistic character of natural phenomena, their indifference to the fate of human beings, their brutal and solemn independence from our providentialist personalisations."

Telmo Pievani (b. 1970), from "The Earth After Us"

"Losing, all in all, a single species of mammal (just one, and hence with a minimal reduction in biodiversity), life would begin again more vigorous than ever, covering over our ruins... and no one would feel our absence... the biosphere has always managed, and will manage this time too."

"... the planet is a system that changes incessantly; it does not stand waiting for us. It is therefore possible that our insistent perturbing of its cycles of self-regulation (from the composition of the atmosphere to the ocean currents) will, sooner or later, lead to new changes, which will be 'normal' from the planet's point of view and 'catastrophic' for us."

Guido Morselli (1912–1973), from "Dissipatio H.G."

"The end of the world? One of the jokes of anthropocentrism: to describe the end of the species as entailing the death of plant and animal nature. The very end of the Earth. The falling of the heavens. There is no eschatology that does not regard the permanence of humankind as essential to the permanence of things. It is conceded that things may begin before us, but not that they may end after us."

Claude Lévi-Strauss (1908–2009), from "Tristes Tropiques"

"The world began without humankind and will end without it. In this, humanity is unable to play an independent role; it works, rather, at the disaggregation of an original order, driving a powerfully organised matter towards an ever-increasing inertia. From the moment it appeared on the scene down to the recent industrial society, humankind has done nothing but dissociate billions of structures, reducing them to a state in which they are no longer susceptible of integration. Civilisation, taken as a whole, may be defined as a prodigiously complex mechanism in which we might be tempted to see the chance

offered to our universe to survive, were its function not that of manufacturing what physicists call entropy, that is, inertia."

Jessica E. Tierney (b. 1982) et al. (2020), from "Past Climates Inform Our Future"

"Our planet will recover; but for human beings, and for the organisms with which we share this planet, climate change will appear as a permanent change of state."

Humankind and climate

Marc Augé (1935–2023), from "Why Do We Live?"

"Events of a meteorological order are, in a sense, paradigmatic: to interpret them, to seek their causes and their meaning, is an imperative duty if we are to control their effects. To interpret the event means to insert it into that chain of causes and effects regarded as the natural order of things; in this way the event is transformed into a structural, expected manifestation, the opposite of something unforeseeable and dangerous. Natural events such as the seasons have marked the life of humankind and of humanity, and have represented fundamental topical moments, both in an agricultural and hence alimentary key, and in connection with aspects and times of religion and its rites, or with rites of passage of a more naturalistic and superstitious, if not magical, cast. People claimed to know what was happening, to know its causes, effects and consequences. Ritual anticipation struggles against the event, interprets it and inserts it into a comprehensible context."

John Steinbeck (1902–1968), from "East of Eden"

"And always, without fail, in the dry years the people forgot about the rich years, and in the wet years they lost all memory of the dry years. It was always so."

Amitav Ghosh (b. 1956), from "The Great Derangement"

"To be sure, there has never been an age in which atmospheric events and geology did not weigh upon our existence; but they have never pressed upon us so inexorably and so directly."

Sapiens sapiens

UNCED (United Nations Conference on Environment and Development) (1992), from the "Rio Declaration on Environment and Development", Principle 1

"Human beings are at the centre of concerns for sustainable development."

Immanuel Kant (1724–1804), from "Idea for a Universal History from a Cosmopolitan Point of View"

"From the crooked timber of humanity no perfectly straight thing can ever be made."

Luciano Floridi (b. 1964), from "The Fourth Revolution"

"Thanks to Copernicus we are no longer at the centre of the universe; thanks to Darwin we are no longer at the centre of evolution; thanks to Freud we are not even able to know and consciously guide ourselves; only God still regards us as the centre of the universe and the masters of nature. But the great philosophers, from Pascal to Turing, uphold the force

and the dignity of thought, which today relocates us at the centre of what is called the infosphere, that sophisticated ontological present in which the boundaries between online and offline life dissolve. Our relative exceptionality exists because we are very different from the nature we know; but it is therefore 'eccentric' rather than central, special yet marginal, in an 'anthropo-eccentric' rather than an 'anthropocentric' position."

Pope Francis (Jorge Mario Bergoglio, 1936–2025), from "Laudato si", § 118

"But one cannot prescind from humanity. There will be no new relationship with nature without a new human being. There is no ecology without an adequate anthropology."

Dipesh Chakrabarty (b. 1948), from "The Human Condition in the Anthropocene"

"Anthropogenic climate change is the unintended consequence of the very existence of human beings as a species."

Amitav Ghosh (b. 1956), from "The Great Derangement"

"The climate events of our era are, then, the distillate of the whole of human history: they express the entirety of our being in time."

Mahatma Mohandas Gandhi (1869–1948), from "Young India"

"God forbid that India should ever take to industrialisation after the manner of the West. If an entire nation of three hundred million people (sic) were to take to such exploitation of resources, the world would be stripped bare, as if by a plague of locusts."

The social human

Ludwig Wittgenstein (1889–1951), from "Tractatus Logico-Philosophicus"

"The world and life are one."

Doris Lessing (1919–2013), from "Briefing for a Descent into Hell"

"The chief characteristic of human beings, at present, is their inability to feel, or to understand one another, in ways that are not simply the outcomes of their instincts or functions. They have not yet reached a degree of evolution such as to ensure an understanding of their own existence as individuals (as mere parts of a single entity, in the first place humanity, their own species), let alone to attain a conscious knowledge of humankind as part of Nature: plants, animals, birds, insects, reptiles, all joined together to form a small chord in the Cosmic Harmony."

Marc Augé (1935–2023), from "Why Do We Live?"

"The phenomenon of globalisation has worked for markets, for communications, for networks, but it has not also brought about the creation of a planetary consciousness, which travels along far deeper and more complex channels, with profound and distant historical roots. Nor are the nation-states united by any underlying cultural homogeneity: one need only see how ISLAM constitutes a far stronger bond than that carried by the individual national cultures within the Islamic nations."

Émile Durkheim (1858–1917), from "Lessons in Sociology"

"Democracy is the regime of reflection; it allows the citizen to accept the laws of his country with greater intelligence, and hence with less passivity. Since there are constant communications between individuals and the State, the State is no longer, for them, an external force that imparts to them a purely mechanical impulse. Thanks to the constant exchanges between them and the State, its life is bound up with theirs as theirs is bound up with its own."

Jürgen Habermas (b. 1929), from "The Theory of Communicative Action"

"When state power loses its sacred covering, the unity of the collective can still be produced and maintained only as the unity of a community of communication, that is, through a consensus reached communicatively in the political public sphere."

Thomas Hobbes (1588–1679), from "Leviathan"

"On the need for regulation: new normative requirements take their beginning within a context of jus (right: the liberty to do or to forbear), in order to attain a state of lex (law: the obligation to do or not to do), and the two are incompatible with respect to the same matter."

Truth vs nihilism

Emanuele Severino (1929–2020), from "The Essence of Nihilism"

"The history of the West is the history of nihilism."

Alfred Tarski (1902–1983), from "The Concept of Truth in Formalized Languages", in Logic, Semantics, Metamathematics

"A statement is true when it asserts that the state of affairs is in a certain way, and the state of affairs is in that way... The truth of a statement consists in its correspondence with reality."

Bertrand Russell (1872–1970), from "Is There a God?"

"If I were to suggest that, between the Earth and Mars, there were a china teapot revolving about the Sun in an elliptical orbit, nobody would be able to disprove my hypothesis, provided I were careful to add that the teapot is too small to be revealed even by our most powerful telescopes. But if I were to go on to say that, since my assertion cannot be disproved, it is intolerable presumption on the part of human reason to doubt it, I should rightly be thought to be talking nonsense. If, however, the existence of such a teapot were affirmed in ancient books, taught every Sunday as sacred truth and instilled into the minds of children at school, hesitation to believe in its existence would become a mark of eccentricity and would earn the doubter the attentions of the psychiatrist in an enlightened age, or of the Inquisitor in an earlier one."

Maurizio Ferraris (b. 1956), from "Manifesto of New Realism"

"Not all those (that is, the majority of humanity) who are convinced that humanity is destined for catastrophe would admit to being nihilists, but only because they do not think about it. We fail to consider, for example, that to propose, as a remedy for the ecological

crisis, a degrowth that can only be unhappy; as a remedy for the economic crisis, nothing at all; and as a remedy for the political crisis, again nothing at all (universal or unilateral disarmament, universal love, or what have you): this is nihilism. In short, one may have one's heart full of good intentions and yet be more nihilistic than Dostoevsky."

Karl R. Popper (1902–1994), from "The Open Society and Its Enemies"

"There is no possibility of a return to a harmonious state of nature. If we turn back, we must go the whole way: we must return to the beasts."

Severinus Boethius (c. 477–524), from "The Consolation of Philosophy"

"Among these things, moreover, I do not deem even worthy of mention popular favour, which springs from no just discernment and never abides steadfastly."

Leonardo da Vinci (1452–1519), from "Treatise on Painting"

"And it truly happens that, wherever reason is lacking, shouting takes its place, which does not occur where things are certain. For this reason we shall say that where there is shouting, there is no true science."

Amitav Ghosh (b. 1956), from "The Great Derangement"

"The question of global warming... has given a particular tone to political debate. Instead of being regarded as a phenomenon requiring concrete countermeasures (as it is in the Netherlands and in Denmark) or as a threat to existence (as in the Maldives or in Bangladesh), the climate crisis has become one of the many issues over which people line up according to opposing ideologies."

Technology and intelligences

Luciano Floridi (b. 1964), from "The Fourth Revolution"

"Power no longer lies in the ownership of the means of production, but in that of information."

Maurizio Ferraris (b. 1956), from "Documanity. Philosophy of the New World"

"The good news is that we are emerging from the industrial world, and that technology has never commanded anyone, save those who have voluntarily submitted to it."

Maurizio Ferraris (b. 1956), from "Documanity. Philosophy of the New World"

"Artificial intelligence and human intelligence (reason) have opposite ends and opposite paths. While the latter seeks, through automation, to bring about the emergence of meaning, AI uses automation to produce correlations and profilings irrespective of their meaning. Whereas human intelligence is therefore a movement that runs from technological competence ideally towards epistemological understanding, AI follows the inverse movement, in that it sets out from the presumed identification, by a human intelligence, of ends and frameworks, and aims at technological competence and effectiveness. Are we sure that a super-robot cannot generate a finalistic intelligence? Yes, because AI does not come even remotely close to the holistic syntheses of human intelligence, to its analogical visions, to its contingent variability; for the end will always

have to be identified by a human need, by the system of needs that characterises the human being as a consumer."

Pope Francis (Jorge Mario Bergoglio, 1936–2025), from "Laudato si'", § 136

"When technique does not acknowledge the great ethical principles, it ends by regarding any practice whatsoever as legitimate... technique divorced from ethics will hardly be capable of limiting its own power."

Luciano Floridi (b. 1964), from "The Fundamental Difference"

"AI is not to be understood as some kind of intelligence, but as a form of agency without intelligence. It has nothing to do with thought; on the contrary, it is concerned exclusively with the successful handling of tasks and problems, with zero intelligence."

Luciano Floridi (b. 1964), from "The Fundamental Difference", p. 183 (with reference to Newman 2020; Morley et al. 2021)

"The 'normalisation' of AI makes it a new form of utility; it is increasingly offered as a service, AlaaS (Artificial Intelligence as a Service)."

Luciano Floridi (b. 1964), from "The Fundamental Difference"

"The real risk does not lie in the appearance of some form of ultra-intelligence, but in the fact that we may misuse our digital technologies, to the detriment of a substantial part of humanity and of the entire planet. Conclusion: the problem is not artificial intelligence, but humanity as a whole."

Liquidity and post-truth

Maurizio Ferraris (b. 1956), from "Post-truth and Other Enigmas"

"Post-truth is the explosion of the post-modern, the absolutism of the reason of the strongest; it characterises Nazism, communism and populism. Today it is sustained by the web, which contributes to the fragmentation and atomisation of the social fabric. Reality presents itself as documediality, that is, the union of the constructive force of documents, as the foundations of social reality, with the deconstructive force of the web."

Zygmunt Bauman (1925–2017), from "Liquid Modernity"

"On liquid society and post-modernity: there is no longer a stable horizon of problems and solutions. We live, and shall go on living, in a continuous transition; this is the new rule of the game: there is no stable point of arrival. We are modern in so far as we are post-modern; that is, we are already somewhere else."

Maurizio Ferraris (b. 1956), from "Augustine. Making the Truth"

"In nature there is no truth; there is only reality. But thanks to his own technological endowments, humankind can pass from ontology (reality) to epistemology (truth). Moreover, humans are the only living beings interested in truth, since truth is of value not only as such but also fulfils a teleological function: it furnishes us with goals and values, and with the means of attaining them."

The ethical factor

Pope Francis (Jorge Mario Bergoglio, 1936–2025), from “Laudato si’”, § 10

“In him (St Francis of Assisi, Eds.) one sees just how inseparable are concern for nature, justice towards the poor, commitment to society, and interior peace.”

Luciano Floridi (b. 1964), from “The Fourth Revolution”

“One must understand the technological transformations if one wishes to steer the digital revolution in a direction of social equity and environmental sustainability.”

Jürgen Habermas (b. 1929), from “Discourse Ethics”

“Social rationalisation, if pursued in view of the maximum economic development, ends by denying the optimal development of humankind.”

Luciano Floridi (b. 1964), from “The Fundamental Difference”

“From an ethical standpoint, consider that we come from a consumerist culture that has, for almost a century, placed excessive emphasis on the value of the product or output. This culture is now compelled to rethink the importance of the process, of the source, and of the relation between source and product.”

Alvise Cornaro (1484–1566), from “Discourses on the Sober Life”

“This sober life is so happy!”

Jonathan Franzen (b. 1959), from “What If We Stopped Pretending?”

“An all-out war on climate change made sense only as long as it was winnable. Once we accept that we have lost it, other kinds of action take on greater meaning. Preparing for fires, floods and an influx of refugees is a relevant example. But the looming catastrophe makes almost every action to improve the world more urgent. In a time of growing chaos, people seek protection in tribalism and in the resort to arms, rather than in the rule of law, and our best defence against this kind of dystopia is to keep democracies functioning, legal systems functioning, communities functioning. In this respect, any move towards a more just and civil society can be regarded as a meaningful action for the climate. Securing fair elections is climate action. Fighting extreme economic inequality is climate action... upholding racial and gender equality, and promoting respect for the law, are all meaningful actions for the climate.”

7. BIBLIOGRAPHY

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