Crunch Time: The Urgency to Take the Temporal Dimension of Sustainability Seriously

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ABSTRACT

This paper argues that, to tackle the issue of sustainability, we should pay more attention to the temporality of socioecological processes. Only thus can we better understand current subjective and institutional constraints, as well as envision new potential pathways for transformative change. Two main arguments are developed: (1) there is a uniqueness in the temporality of Earth system processes associated with planetary boundaries that deeply transforms our time horizon and the pace of change, and (2) this situation creates a disruption of the temporality embodied in dominant sociopolitical conventions such as the institutional definition and operationalisation of sustainable development. New research avenues and time policies are suggested towards responding meaningfully to the alarming current socioenvironmental trends.

KEYWORDS

Time, sustainability, time policy, temporality, planetary boundaries, Earth system processes

1. INTRODUCTION

In November 2019, on the fortieth anniversary of the first world climate conference, 11,258 scientists from 153 countries co-signed a statement entitled 'World Scientists' Warning of a Climate Emergency'. The scientists highlighted the urgency of the issues at stake, which are aggravated by our social inertia: 'Despite fourteen years of global climate negotiations, with few exceptions, we have generally conducted business as usual and have largely failed to address this predicament. The climate crisis has arrived and is *accelerating faster* than most scientists expected. It is *more severe than anticipated*, threatening natural ecosystems and the fate of humanity. Especially worrisome are potential *irreversible* climate tipping points and nature's reinforcing f*eedbacks*

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(atmospheric, marine and terrestrial) that could lead to a catastrophic 'hothouse Earth', well beyond the control of humans (Ripple et al. 2020).[1]

By and large, the overshoot of human pressure on essential life-supporting Earth system processes is well-documented in a growing number of scientific reports, which highlight the unique temporal features of the socioecological processes at stake (e.g. Meadows et al. 2009; Rockström et al. 2009; Steffen et al. 2018).

Recently, some scholars have begun to pinpoint the challenges of time inconsistencies in the Anthropocene (Chakrabarty 2009; Lockie 2014; Bensaude-Vincent 2016; Lockie and Wong 2018; Machin 2019). Yet little research has explicitly focused on a critical investigation of the inconsistencies between the temporality embodied in specific sociopolitical conventions around desirable socioecological change (e.g. sustainable development) and the unique and multiple temporalities of Earth system processes associated with planetary boundaries. This research standpoint is original insofar as most scholars who have developed a socioecological theorisation of time (e.g. Adam 1998; Urry 2000; Bensaude-Vincent 2016) have focused on how the 'habits of mind' linked to temporality in modern societies – especially the Newtonian assumptions of a linear, de-contextualised and abstract temporality – are responsible for the disconnection with local context, 'natural' rhythms and biophysical processes. 'But, as macro-level critiques of modernity, they have comparatively little to say about how we might better apprehend (and indeed reform) the techniques and processes through which such processes are coordinated in time' (Lockie and Wong 2018: 229).

The Anthropocene is sometimes presented as a crunch time. The raising sense of urgency resonates with questions that reflect our feeling of being 'crunched' by time. How much time do we have? Is it too late? What are we waiting for? Why have we been struggling for decades to grasp and manage environmental threats? To address these questions, I will argue for the importance of analysing the intermingling of temporalities in our interactions with Earth system processes to deepen our understanding of the constraints we face when tackling the current socioenvironmental threats, as well as to envision new potential pathways to social transformation.

The originality of this overview article is to connect two main arguments: (1) there is a uniqueness in the temporality of Earth system processes that deeply transforms our time horizon and the pace of change, and (2) this situation creates a disruption of the temporality embodied in dominant sociopolitical conventions such as the institutional definition and operationalisation of sustainable development. It is crucial to address these inconsistencies if we want to respond meaningfully to the alarming current socioenvironmental trends.

1. Since this initial publication, 2800 additional scientists have signed the declaration. An update was published in August 2021 focusing on 31 planetary vital signs.

2. CRUNCH TIME: THE UNIQUE TEMPORALITY OF EARTH SYSTEM PROCESSES

'We are the first generation to feel the effect of climate change and the last generation who can do something about it'. This famous quote by President Obama in the first session of the COP 21 in 2014 not only reflects the contemporary moods of our times but *of* time itself. The current historical period is often presented as a 'time-crunch': ecological breakdown is progressively materialising and requires decisive and drastic (re)action. In a deeper way, the age-old humanist distinction between natural history and human history is collapsing as 'the geologic now of the Anthropocene has become entangled with the now of human history' (Chakrabarty 2009: 212). Discourses around the temporality of socioenvironmental relations can be understood as a social construct. The rhetoric of urgency has been used by activists, intergovernmental organisations and the media for decades. If we consider that the urgency is nothing but a social construction to pressure people and governments into action, it could be considered a manipulative strategy. I would like to go a step further to explain the scientific drivers of this feeling of urgency, arguing that the temporality of the socioenvironmental processes at stake possess a uniqueness that deserves consideration.

Earth system science originally identified nine geobiophysical processes for which it is necessary to define planetary boundaries in order to maintain a safe and functional space for humanity. These are anthropogenic climate change; rate of biodiversity loss (terrestrial and marine); interference with the nitrogen and phosphorus cycles; stratospheric ozone depletion; ocean acidification; global freshwater use; change in land use; chemical pollution; and atmospheric aerosol loading (Rockström et al. 2009). This vision is mostly anthropocentric, as the main objective is to sustain conditions for human livelihoods. Yet human beings are not only impacted upon, but also themselves impact upon the dynamics of Earth system processes. There exist complex interlinkages within and between the nine Earth system processes, their societal drivers and their local impacts. In the context of ecological breakdown, the unique temporality of Earth system processes profoundly disrupts the temporality embedded in dominant sociopolitical conventions.

In this paper, longstanding debates in disciplines such as philosophy or physics around the ontology of time *(i.e. what time is)* will not be the focal point. The aim is *not* to contribute to the literature on the essence of time but rather to explore the mismatch between the temporality of socioecological processes and the temporality of the public policies' discourses intended for addressing the challenges at stake. Drawing on the work of scholars who developed a socioecological theorisation of time (e.g. Elias 1992; Adam 1998; Urry 2000; Murphy 2001; Newton 2003; Bansal and Knox-Hayes 2013; Bensaude-Vincent 2016; Lockie and Wong 2018; Semal 2019), the dichotomy

between 'nature time' and 'social time' will be questioned, thereby highlighting the interrelations between the biophysical and the sociocultural realms.

The starting point is the material aspects of the environment as an indicator of ecological disruptions and the complex ways that they are inter-related with sociocultural phenomena (Dunlap 2010). 'While abstracted notions of absolute time and space facilitate the coordination and commodification of human activity, they cannot abstract those activities from their material conditions and consequences. As the Anthropocene proposition reminds us, all economic and social activity is embedded in Earth system processes that lie within our sphere of influence but outside our sphere of control' (Lockie and Wong 2018: 332). The merit of the dichotomy between 'social time' and 'natural time' is to acknowledge the uniqueness and relative autonomy of the temporal and spatial attributes of Earth system processes. However, most social scientists consider 'natural time' as being mostly stable and homogeneous in comparison with the perceived time–space compression of social life (e.g. Elias 1992; Bansal and Knox-Hayes 2013). The multiple and complex temporalities of Earth system processes are thus largely ignored or downplayed, while understanding their uniqueness is critical for answering to current environmental threats in a meaningful way.

In that perspective, temporality will refer to the multiple and unique temporal features associated with socioecological processes and their interlinkages, such as pace, rhythmicity, duration, speed, intensity, synchronicity and timing. These temporal features can be perceived and experienced by individuals, socially organised, analysed and controlled through devices, conceptual frameworks, projects or technologies.

Hence, the remainder of this paper is organised as follows. First, I will analyse the temporal features of Earth system processes associated with planetary boundaries and explain some of our subjective difficulties in grasping them. Second, I will focus on the temporalities of the dominant institutional responses to environmental threats, namely 'sustainable development'. I will analyse the temporal frictions at the centre of the definition and operationalisation of this concept. Finally, I will suggest potential pathways for transforming the temporality of socioenvironmental relations.

3. CRUNCHED BY TIME

Five temporal features are usually associated with Earth system processes (e.g. Rockström et al. 2009; Steffen et al. 2015a; 2018): uncertainty, invisibility, irreversibility, acceleration and tipping points. These features have been identified in the literature from natural to social sciences, especially in their connection with anthropogenic climate breakdown (e.g. Adam 1998; Biermann 2012; Lockie 2014; Baum and Handoh 2014). However, to my knowledge, they have

neither been systematically discussed in a temporal perspective nor analysed with respect to the subjective reasons for which we struggle to grasp the temporality of those threats.[2] Broadly speaking, I will argue that the uniqueness of the temporality of Earth system processes deeply transforms our *time horizon* as well as the *pace* of change.

3.1. Time horizon: radical uncertainty, irreversibility and invisibility

The concept of time horizon refers to the reach of our vision both into the future and into the past. It is the estimated timespan of a process, event, plan, or project as well as the representations we have of our life expectancy (as individuals, species including other-than-humans).

The uncertainty, irreversibility and invisibility central to most 'man-made' environmental hazards create an existential threat, strongly calling into question the time horizon of current plans and projects as well as the present and future life courses of the human and the other-than-humans. The ecological breakdown profoundly disrupts our time horizon, not only by increasing its uncertainty, but also by producing threats that are invisible to our senses and potentially, irreversibly damaging. 'Thus understood, the catastrophist horizon is a negation of the continuous time of crisis: on the contrary, there is a time of rupture, when finitudes and irreversibilities materialize, like those played out on a smaller scale around Chernobyl or Fukushima' (Semal 2019). However, those features are very difficult to grasp from a subjective standpoint.

3.1.1. Uncertainty

First, many Earth system processes are characterised by the *radical uncertainty* of their trajectories and effects. In other words, the decision-making process is equivocal and indeterminate. As far as climate change is concerned, for instance, this uncertainty has been underlined repeatedly in reports by the Intergovernmental Panel on Climate Change (IPCC) since its very first publications in 1990. In brief, this does not mean that scientists are unsure that climate breakdown is real, or that it is a consequence of human activities. In scientific terminology, the word 'uncertain' is used to express the level of confidence concerning magnitudes such as timing, impacts or effectiveness and costs of potential responses.

The operationalisation of planetary boundaries is not neutral but depends on normative considerations, such as our relationship to risks or the precautionary principle (Biermann 2012; Baum et al. 2014). In this approach, there is an important distinction between boundaries and thresholds. Whereas thresholds are the points at which resilience is exceeded and the system transitions to

2. I have discussed some of these temporal features comparing the temporality of socioecological issues with some of the temporal features associated with the outbreak of the Covid-19 pandemic (see Ruwet 2021).

a different state, boundaries are self-imposed limits, supposedly under human control, above the thresholds. The exact localisation of thresholds is *uncertain* and expressed as a 'zone of uncertainty'. For some processes, such as atmospheric aerosol loading, our current knowledge appears too uncertain to allow for quantification, whereas other processes such as anthropogenic climate change have been associated with numeric threshold value. Setting planetary boundaries thus involves political choices and ethical debates around normative priority (e.g. equity) and socioeconomic development trajectories.

Whereas the future is unpredictable in essence, the contemporary novelty lies in the responsibility of human beings for the creation of uncertainties as well as their awareness – gained through scientific knowledge – of potential risks. The breakthrough came when, with the atomic bomb, technical power was able to eliminate humanity on Earth, and we then entered what Gunter Anders called 'the time of the end' (Semal 2019). These *manufactured uncertainties* are 'dependent on human decisions, created by society itself, immanent to society and thus externalizable, collectively imposed and thus individually unavoidable ... they are incalculable, uncontrollable and in the final analysis no longer (privately) insurable' (Beck 2009: 293).

Time is one key dimension of salience: we tend to prioritise the issues affecting us in the present moment and disregard those affecting other people or species, especially if they are distant in time and space. With most Earth system processes, the general tendency to discount the future is accentuated. If the phenomena are at odds with our representation of the world, a common reaction is what historical psychologist Robert Lifton called 'psychic numbing' (Lifton 1982 in Norgaard 2011: 4–5). If future threats are deemed to have massive consequences but low probability, we tend to withdraw our attention from them. The probability is not assessed according to a statistical criterion but rather according to what one can imagine, considering one's previous knowledge and experience of the world. Global scenarios depicted by environmentalists are so different from what we know that, for most people, scientific forecasts seem unlikely.

2.1.2. Invisibility

Second, many Earth system processes are *invisible* to our direct perception (e.g. climate change, atmospheric aerosol loading, ocean acidification, chemical pollution, nitrogen and phosphorus cycles) causing a spatiotemporal disjuncture between their sources and impacts. The transmission of the hazard is often latent. There is an undefined time gap between the origin of the problem and its materialisation, whose timespan itself is often unknown. What is more, there is a spatial disconnection between causes and effects; the latter do not necessarily manifest in the same place as where they were generated.

Denial can be defined as a subjective refusal to accept a past, present or future reality that manifests as a 'failure to integrate this knowledge into everyday

life or transform it into social actions' (Norgaard 2011: 11). It thus has a strong temporal dimension. Clearly, denial is made easier by the invisibility of the issues. Moreover, there is a degree of familiarity with the manifestations of most environmental threats that enhances the perceived invisibility of the phenomena. Compared to a terrorist attack, extreme weather events – one of the visible manifestations of climate change – are part of our accepted way of life and we are accustomed to seeing them as manageable.

3.1.3. Irreversibility

Finally, a third key temporal feature of Earth system processes affecting our time horizon is their *irreversibility* at the timescale of human civilisation. Most of the time, once they manifest, damages cannot be simply and easily fixed. Sometimes, the reversibility of some phenomena can be theoretically envisaged, but the costs are extreme in terms of resources and time. Once again, a striking example is climate breakdown. The longer we wait before we drastically diminish our greenhouse gas emissions, the more it will cost to adapt and mitigate climate change alongside bearing the consequences of past behaviours. This situation can be illustrated with the recurring and vehement climate talks between countries on differentiated responsibilities and compensations.

The irreversible changes described in scientific reports are simply unconceivable for most of us. This irreversibility is very difficult to grasp because of the disjunction between the time horizon of the biophysical world and the lifetime of humans (i.e., the time horizon as perceived by our subjectivities). The human time horizon has globally expanded with the overall improvement of the material conditions of existence. Yet our reference point is the state of the world we knew when we were children (Kahn 2002). In brief, we are shortsighted because our life expectancy is short compared to the timescale of the natural world. We are not able to experience changes occurring over a long period of time, such as drastic wildlife disappearance in the past 15 years. The American psychologist Peter Kahn called this phenomenon 'environmental generational amnesia': 'Since each generation experiences only incremental harm, based on a comparison to a not too distant past, even our hard-won knowledge is incomplete and so our sense of urgency often remains muted' (Kahn 2002: 113).

3.2. Pace of change: acceleration and tipping points

The second major effect that current socioecological predicaments have on temporality is a modification of the pace of change. This concept can be defined as rhythmicity of change. The pace of change of Earth system processes is mostly characterised by increasing speed and additive rhythms: that is, irregular shocks caused by abrupt and irreversible transformations occurring at once (*tipping points*). In other words, change is essentially nonlinear but happens

faster and faster as time moves on and, once a certain planetary threshold is crossed, a system of vicious circle is set in motion and leads to multiple cascade effects that are difficult to stop (the *tipping cascade)*.

Whereas the past decades witnessed an acceleration of change, some of the transformations also occurred at a slow, invisible pace. For instance, for a very long period, most of the changes that occurred due to climate breakdown – such as ocean acidification or the Antarctic ice melt – were not directly perceptible to the human senses. As for the transformation of the time horizon, we have great difficulties in integrating this sense of pace.

3.2.1. Acceleration

First, the *acceleration* of changes is key to understanding the uniqueness of the temporality associated with the current predicament. When looking at socioeconomic trends related to environmental issues over a long period of time, many curves are non-linear, almost flat, at the outset and then exhibit rapid and accelerating growth over time. For instance, whereas the increase in anthropogenic carbon dioxide emissions goes back to the industrial revolution of the nineteenth century, more than half of total carbon dioxide has been emitted in the past 30 years.

This phenomenon is well known. Acceleration, especially in the shape of exponential growth, was already considered the main driving force for overshoot in the 'Limits to Growth' report of 1972 (Meadows et al. 2009). The 'Great Acceleration' graphs represent those trends over a period of 260 years (1750–2010) and highlight that 'the last fifteen years have without doubt seen the most rapid transformation of the human relationship with the natural world in the history of humankind' (Steffen et al. 2015b: 82).

Trend acceleration is very difficult to grasp and to manage. The exponential bias (i.e. the tendency of the human brain to underestimate the speed of growth of these curves) has been well-known in social psychology since the work of Willem Wagenaar and Hans Timmers (1979). The most common psychological bias is to think of trends as linear and overlook the oncoming acceleration. We find it difficult to perceive slow change because, at the beginning, the function is very flat and transformation almost imperceptible. As Thomas Lovejoy puts it 'I find to my personal horror that I have not been immune to naïveté about exponential functions… While I have been aware that the interlinked problems of loss of biological diversity, tropical deforestation, forest dieback in the northern hemisphere and climate change are growing exponentially, it is only this very year that I think I have truly internalised how rapid their accelerating threat really is' (Lovejoy, cited in Meadows et al. 2009: 17). Unlike the recent spread of the Covid-19 pandemic, the timescale of most socioenvironmental upheavals is not counted in weeks but in decades, centuries or millennia (Ruwet, 2021). Acceleration, if it is real, is much less easily perceptible.

3.2.2. Tipping points

Finally, the temporality of socioecological ecosystem and Earth system processes features *tipping points*, which reflect a conception of time where radical changes may occur at once. A system of vicious (or sometimes virtuous) circles is set in motion and leads to multiple cascade effects that are difficult to stop (a tipping cascade). Most changes (e.g. loss of permafrost carbon and melting of large masses of ice, or species loss) are irreversible within the time frames that matter for contemporary societies (Rockström et al. 2009).

The time frame of the tipping point idea is at odds with our common sense of temporality. In the dominant climate narrative, changes are presented in a linear way: the higher the anthropogenic greenhouse gas emissions, the higher the global average temperature. However, work on non-linear dynamics with threshold effects, bifurcation, path dependence, etc., contradicts this assertion. Recently, a groundbreaking article by Steffen and his colleagues became the fourth most-mentioned published article in 2018 across the sciences.[3] The authors argued that once a certain planetary threshold has been crossed, the Earth system will be locked into a 'Hothouse Earth pathway', where biogeophysical feedbacks could become the dominant processes controlling the system's trajectory, even if human emissions are reduced (Steffen et al. 2018: 8254).

4. TEMPORAL FRICTIONS IN THE HEART OF SUSTAINABLE DEVELOPMENT

For more than three decades, *sustainable development* has been the dominant institutional response to the mounting environmental degradations and threats. Subject to multiple and conflicting interpretations and ambiguities (e.g. Hopwood et al. 2005), this concept originated from the environmental movement in the sixties, was institutionalised in October 1987 in the so-called 'Brundtland Report' and then widespread nationally and locally at the Rio Summit in 1992. What are the temporal features at the centre of the conceptualisation and operationalisation of sustainable development? I will argue that at the heart of sustainable development and the actions associated with it lies an anthropocentric, linear, abstract, invariant and absolute conception of temporality. One of the consequences is to blind us to the unique temporality of Earth system processes, thereby explaining the struggle in managing threats associated with sustainability.

4.1. Time horizon: continuity, anticipation and control

Time is central as an ethical imperative in the conceptualisation of sustainable development. One core normative principle of this is that we should be

3. https://www.altmetric.com/top100/2018/?details=46149236

meeting our needs in ways that will not undermine the possibility for others to meet their own needs (World Commission on Environment and Development (WCED) 1987: 43), be it in the short or long run (i.e. in the Brundtland Report, the overriding priority is given to the needs satisfaction of the world's poor, and limitations in the environment's ability to meet present and future needs are considered to be imposed by the state of technology and social organisation).

The temporality requirement that lies behind this definition is linear, absolute, and abstract. *Duration* is the continuity between present and future. To sustain is to keep up, to prolong, creating thereby a decontextualised expectation for long-term ontological security. Needs are defined from a human standpoint (Hopwood et al. 2005), underpinning an anthropocentric temporality. Most of the scientific community's efforts are directed toward *anticipating* the development of large-scale sustainability predicaments and *controlling* them using reconnaissance, scenarios, economic forecasting, political planning and models of the future (Boersema 2001; Lockie 2014).

By and large, modern societies do not consider the future to be a preexisting reality but a reality that can be shaped and controlled. Temporally speaking, the basic assumption is the *reversibility* of phenomena. Whereas many practices often closely linked with religion (e.g. prophecies, divinations, predictions, oracles or sacrifices) were developed over centuries worldwide to foresee or influence the future (e.g. Bourdieu 1990), in secular societies the future is not considered merely a continuation of the present but a consequence of it (Giddens 1990; Innerarity 2012).

As far as sustainability-driven changes are concerned, this sense of power and autonomy in the shaping of the future has ambiguous consequences. On the one hand, it brings the future into the present and gives us the strength to imagine and implement environmental policies. On the other hand, paradoxically, we tend to assume that if the effects of a potential hazard are not perceived as immediate, this decreases the pressure to act, since additional time creates additional options for human intervention (Arnocky et al. 2014) individual differences in CFC-Immediate and CFC-Future were examined as predictors of environmental concern (EC). In other words, we will rather opt for higher hypothetical long-term costs to avoid a short-term lowering of our living standards. For more than a decade, geoengineering ethicists warned us that the promise to mitigate anthropogenic climate change through new geoengineering techniques might be a way to justify inaction in the present (e.g. Gardiner 2020). The underlying assumption is that we can carry on with 'business-as-usual'; it is not necessary to call into question our way of life, for science and technology will eventually find a solution and reverse alarming trends.

From this perspective, as stated in the IPCC Special Report (SR15) published in 2018, some experts and governments are defending the possibility to temporarily exceed or 'overshoot' 1.5 degrees Celsius of warming by 2030,

in the hope of reversing the global temperature increase to below 1.5 degrees Celsius by 2100.[4] This scenario would entail greater reliance on techniques for removing greenhouse gases from the air that carry significant risks in terms of sustainability. With respect to environmental hazards and degradation, it entails the belief that 'mistakes can be undone, that increased knowledge and better technology can put right in the future mistakes of the past and damage inflicted on the environment now through pollution and the degradation of non-renewable resources' (Adam 1998: 42). Thereby, we tend to largely overlook 'lock-in' effects: namely, the inertia caused by factors such as path dependency or fear of switching costs.

Moreover, this futurisation of politics through essentially technocratic and managerial plans and objectives runs the risk of further postponing the necessary ethical debates and drastic political actions by deferring the problem to 'future generations' or withdrawing attention from issues that appear less 'time sensitive'.

4.2. Pace of change: invariant and incremental

Most models of socioenvironmental systems and institutional arrangements associated with sustainable development assume linear, incremental, reversible change. Yet changes derived from Earth system processes are accelerating and are often nonlinear, abrupt and irreversible. Analysing the rhythm associated with sustainable development, one can see major discrepancies between the temporality at stake in official declarations and the temporality of public policies. At first sight, this mismatch between discourses and actions may appear contradictory. However, the common feature is to organise changes through project management, control and incremental transformations of existing institutions.

The pace of Earth system processes is very difficult to grasp. Alarmist talks coupled with countdowns and deadlines have been repeatedly used for decades by officials as wake-up calls when they referred to the pace of change needed to face sustainability predicaments. The 1969 quotation from U Thant, third Secretary General of the United Nations, chosen to open the famous report *The Limits to Growth,* is probably one of the first discourses of this kind. Sharing his worries about predicaments such as environmental degradation, he warned: 'If such a global partnership is not forged *within the next decade*, then I very much fear that the problems I have mentioned will have reached *such staggering proportions* that they will be *beyond our capacity to control*' (Thant, [1969] in Meadow et al. 2009: 13).

Taking a closer look at the political declarations associated with sustainable development over time, we find the same temporal rhetoric articulating a

4. https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/

sense of urgency and control.[5] In 2001, Kofi Annan stated 'Today, though we have the human and material resources to win the fight against climate change, *the time for a well-planned transition to sustainable development is running out* – unless, that is, you do your part'.[6] The Copenhagen Climate Change Conference in 2009 was portrayed as the '*last chance* to bring climate under *control* before it is *too late*'.[7] Ten years later, in 2019, opening the Climate Action Summit, António Guterres, concluded 'Time is running out. But it is not too late'.

Translating the abstraction of models into the time metrics is used as a strategy to convey a sense of urgency. The ticking clock metaphor is the latest expression of this 'deadline-ism rhetoric'. The IPCC Special Report (SR15) claims that 'global warming is likely to reach 1.5C between 2030 and 2052 if it continues to increase at the current rate'.[8] Special websites were created with climate clocks[9] counting down each second towards exhausting the remaining carbon budget at *present levels* of greenhouse gas emissions until 'the end' (Asayama et al. 2019).

Using a countdown as a differentiator between existential crisis or not is problematic because it fails to account for the unique and multiple temporalities of the Earth system processes at stake, giving us the illusion of control. First, it negates the environmental disasters that have already occurred or currently exist, and that will continue to build at an accelerated pace. Irreversible environmental changes are already on our doorstep, and will worsen. The violence is, above all, slow and locally embedded.

Second, 'the scarcity mindset created by countdown clocks narrows measures of policy success to the single metric of meeting a deadline' (Asayama et al. 2019: 571). It potentially suggests that anything short of complete victory before the end of the countdown is pointless. But what would be success or victory in our current situation? It is likely the end of the countdown will pass without any loud global detonation or collapse. The risk is to turn a blind eye from the needs of drastic changes in the present moment to mitigate and adapt to coming changes. Adaptation measures are intrinsically linked with local context and require a long timescale to be assessed. 'The present is thus both tragically belated and perennially balanced on the cusp of disaster. Wherever

5. In this paper, the objective is not to carry out a systematic discourse analysis of the history of political speeches related to sustainable development but to include several examples for purposes of illustration.
6. https://www.scoop.co.nz/stories/WO0105/S00034/uns-kofi-annan-climate-change-speech-full-text.htm
7. See, for instance, the speech by Stavros Dimas EU Commissioner for the Environment in 2008, https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_08_570
8. https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/, p. 6
9. See, for instance, https://www.concordia.ca/news/climateclock.html or https://www.mcc-berlin.net/fileadmin/data/clock/carbon_clock.htm

the 'golden spike' is fixed that marks the advent of this epoch, though, the Anthropocene is under way. It is a predicament we must face rather than a problem we can solve' (Garrard 2020: 4).

Whereas the urgency and deadline-ism rhetoric shape the temporality of official discourses around the pace of change associated with sustainable development, the temporality of public policies promote incremental, reversible changes.

It is striking when analysing the temporality of dominant strategy for the operationalisation of the Brundtland Commission vision to guide decision-making, namely the Sustainable Development Goals (SDG). Also known as Agenda 2030 and adopted in 2015 by the UN General Assembly, the SDGs is first and foremost a global action plan for the coming decade. The deadline is a strong component of the strategy.

Temporally speaking, the methodology used illustrates the linear and incremental vision of change, thereby ignoring the scientific evidence regarding the possibility of abrupt and unexpected shocks *(tipping points)*. The ideal to be achieved is presented in the form of 17 goals in different sub-areas to end poverty, protect the planet and ensure prosperity. Each goal is associated with 169 targets aimed at facilitating the operationalisation and the ex-post monitoring of the goals. Finally, a set of 232 outcome-oriented indicators has been developed by the UN Statistical Agency for assessing progress in the implementation of the targets globally, locally and across countries. Once more, the Earth system processes are addressed through management and control with a problem-solving mindset, thereby denying the non-linearity and irreversibility of these processes.

Moreover, most of the time, there is no prioritisation between the SDGs nor ethical discussion around their interactions or conflicts (such as between poverty, climate change and 'sustainable growth') (Gusmão Caiado et al. 2018). We are blinded by the urgency of day-to-day problem-solving. The goals that are less time-sensitive and do not (yet) have visible manifestations are potentially neglected. This situation is somewhat paradoxical given that the effects of political decision-making tend to extend further and further into the future, especially as far as technologies are concerned.

5. DISCUSSION: TEMPORAL PATHWAYS TOWARD SOCIAL-ENVIRONMENTAL CHANGE

There are numerous subjective and institutional barriers to incorporating the specificities of the temporality associated with Earth system processes. The invisibility, irreversibility and tipping points at the heart of essential planetary boundaries are profoundly challenging current sociopolitical conventions and the rhythm of policy making. If the temporality associated with the

institutionalisation and operationalisation of sustainable development is misleading, then what are the alternatives? People have also started experimenting and imagining pathways to transform the temporal dimension of socioenvironmental relations. In this section, I will briefly discuss some of these proposed pathways, highlighting key issues for a research agenda exploring time policies in the limits of planetary boundaries either in theoretical or empirical terms.

5.1. Time horizon: finiteness and interpenetration of past-present-future

Just as we experience the finiteness of the 'other-than-human world' as we know it, we must reconcile ourselves with our own finiteness as human beings. 'Acknowledging the unknowability and deep unmasterability of the future (as distinct from a consensus projection of probable geophysical and biological effects) returns us to the frailty and finitude of the human person' (Garrard 2020: 5). Genuine resilience and adaptation require us to experience our present lives under deeper time horizons.

For most Earth system processes, the state of emergency should be seen not as a state of rare, time-limited, abnormal events before a return to stable life but rather as a continuous and complex process of adaptation to a radically new reality. In that respect, 'emergency' can be understood not as a 'state of exception' but as *emergence* (Adey et al. 2015). Governing emergencies would therefore involve moving beyond exceptional responses to imminent disasters and the assumption of the reversibility of processes at stake. In a non-negotiable context of profound environmental degradations, taking stock of the irreversibility and the invisibility of Earth system processes involves 'new ways of governing before and after emergencies have emerged and intensified. These include logics that involve action before emergency happens... and logics that prepare for the action as the emergency is emergent' (Adey 2015). New research challenges emerge in the articulation of the governance of emergencies and of the Earth system in a refocused democratic project.

Reshaping the temporality of our time-horizon will also entail a renewal of our understanding of the past-present-future triad. Some interdisciplinary works have started to explore this new research pathway. First, one of the key issues is to absorb the lessons learned from past environmental campaigns, as well as maintain and transmit traditional rituals and knowledge. From this perspective, individuals do not see themselves in isolation but as carrying the legacy of past generations. How could research on past environmental disasters or the indigenous temporal relationship to 'nature' (e.g. Winter 2020) inspire new time policies in Western societies as in the case of ecocide laws or environmental personhood?

5.2. Pace of change: kairological time and time wealth

This renewed perception of our time horizon may open the door to a different relationship to the pace of change. One of the main challenges is to find the appropriate posture, speed and pace to deal with each predicament. This involves setting up public acceleration and deceleration policies that are appropriate to each issue in its particularities, in terms of social impacts and local context. Not only are the temporalities of the Earth system processes and their materialisation in concrete events diverse and sometimes contradictory, but the change itself is also not continuous.

Acceleration and the spectrum of tipping points will lead to new disasters and potentially brutal shocks. The latter have already occurred and will be repeated locally at different points of the globe, following their own temporalities. How can we foster individual and collective resilience, i.e. the ability of our societies to absorb shocks while maintaining what is considered essential?

Coined in the 1990s in the context of research on sustainable lifestyles (i.e. combining 'post-growth' and the 'good life'), the concept of 'time wealth', encompassing the issues of time sovereignty and time autonomy, could be a fruitful avenue. The specificity of this approach, compared to the recurring debates around working time reduction, is to focus less on a quantitative increase of leisure time, but rather on a holistic and qualitative perspective on time (Geiger et al. 2021). 'Presence' is the ability to focus, mindfully, in accordance with biological rhythms and personal needs, rather than being rushed around and pressured into everyday life. Temporal self-determination, available time for meaningful activities and personal aspirations, synchronising with others, free time for resourcing, care and do-it-yourself activities, etc. are key features of this concept (Reisch 2015). Overall, 'time wealth' offers a response to the deadlock of time acceleration and time scarcity in modern societies (Rosa 2015) and opens a space for the ability to absorb potential shocks. It could also motivate people toward more frugality, whereby a reduction in working hours and material limitations would be associated with greater individual freedom of choice, as well as institutional support for dealing with the varieties of time and for creating community spaces for collective moments, including participatory decision-making processes (Schor 2011). Empirically, the relationship between sustainable lifestyle and the subjective experience of time wealth is under-explored and would require more investigation (Geiger et al. 2021). Some countries such as Finland have started translating these theoretical assumptions into concrete policies. Comparisons across countries or regions are also needed to study these changes empirically.

As far as the pace of change is concerned, one of the major challenges is 'to find the appropriate speed in response to the pressure to address each problem... and to try to implement an acceleration and deceleration policy appropriate to the problem and requirement' (Reisch 2015: 6). Not only are the timing of the Earth system process, and the temporalities of the people

involved diverse and sometimes contradictory, but change itself is not continuous: 'How the expected impacts will play out at regional or human scales is irreducibly difficult to predict, let alone how these geophysical changes will interact in complex feedbacks with economic, political and cultural responses, as yet unknown' (Garrard 2019: 4).

In this respect, paying attention to synchronicities (i.e., meaningful coincidences) and seizing the 'kairos', or propitious momentum for action, should be favoured, even if this means altering predetermined plans (Gault 1995; Reisch 2015). 'In kairological time planning is inconceivable. Those dwelling in kairological time cannot determine in advance the right time to do this or that. They await the unknown future and prepare to respond to it ... It is the human response from the possibilities which emerge from the future that actually yield the present' (Gault 1995: 156). Virtuous political tipping points can be activated but only if alternatives to 'business-as-usual' have been properly debated and prepared in terms of desirability, content, technology and infrastructure. In an analytical perspective, the challenge is to 'unpack the black box of time' and 'expose the temporalities embedded within knowledge practices in a manner that incorporates the tempo, timing and rhythmicity of change' (Lockie 2014: 101). Studying the implications and limitations of the temporalities embedded in these environmental policies (including policy mix and techniques) designed to render Earth system processes governable may be a last fruitful avenue for future research.

6. CONCLUSION

Developing a critical analysis of the temporality embodied in Earth system processes is key to understanding the constraints we face when tackling Earth system governance and thinking about new transformative pathways to tackle mounting socioecological degradations. The bounded hybridity between the biophysical and sociocultural realms is worth more sustained attention. In this paper, I have underlined the current mismatch between the specific temporality of the biophysical realm and the temporality of the dominant sociopolitical conventions (sociocultural realms). As Lockie and Wong put it (2018: 346), 'While we have come a long way in developing more sophisticated technologies, techniques and devices to make the multiple temporalities of ecosystems processes more visible than ever, we have not yet adequately grappled with the challenge of synchronising these newly visible ecological temporalities with the multiple temporalities of the social'.

The argument at the core of this paper was that addressing the unique temporal features of Earth system processes would require, among other things, a critical assessment of how temporality has been shaped and operationalised in policymaking, especially through the concept of sustainable development.

What we need is not only a great transformation *in* time but, maybe even more importantly, a great transformation *of* time (Reisch 2015). The uniqueness of the temporality of Earth system processes deeply transforms our time horizon and the pace of change. Contrary to the debate opposing behavioural to structural change, these transformations will impact both subjectivities and institutions. We are not starting from scratch. Many utopian proposals in the social sciences literature, as well as concrete experiments and practices, whether recent or well-established, involve a deep transformation of our subjective and institutional relationships to temporality.

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