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The anthropic risks, climate change and coronavirus pandemic (COVID-19)

A conceptual reflection on risk and disaster as a contribution to public perceptions[1]

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Abstract
Risks have always been present throughout human history, however, today are qualitatively different, as many of them are anthropic (human-made). The fact that people are exposed to dangers for which they have no decision-making capacity depended on knowledge they often do not have in order to decide on possible acceptable risks. The pandemic situation we face now brings light on human-made risks; came and lifted the veil, if there were any doubts, about the impact on the quality of life on the Planet, as consequence of human decisions and behaviour. Two types of human-made risks will be addressed: climate change and the pandemic caused by the coronavirus (SARS-CoV-2); reflecting on the exposure of structural vulnerabilities, these risks bring forth the importance of social capital and social networks in reducing vulnerabilities, the investment in science and its dissemination, and prevention, as preparedness for future risks, promoting resilience. Thus, governance relationships between States, economic models and resilient communities will also be addressed.

Keywords
Anthropic risks; Climate change; Coronaviruses; Resilient communities

Resumo
Os riscos sempre estiveram presentes ao longo da história da humanidade, porém, hoje são qualitativamente diferentes, pois muitos deles são antrópicos (de origem humana). O fato de as pessoas estarem expostas a perigos para os quais não têm capacidade de decisão depende do conhecimento que muitas vezes não possuem para decidir sobre os possíveis riscos aceitáveis. A situação de pandemia que enfrentamos agora traz luz sobre os riscos de origem humana; veio e levantou o véu, se dúvidas houvesse, sobre o impacto na qualidade de vida no Planeta, consequência das decisões e comportamentos humanos. Dois tipos de riscos de origem humana serão abordados: as mudanças climáticas e a pandemia causada

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pelo coronavírus (SARS-CoV-2); refletindo na exposição das vulnerabilidades estruturais, esses riscos trazem à tona a importância do capital social e das redes sociais na redução das vulnerabilidades, no investimento em ciência e sua disseminação, e na prevenção, como preparação para riscos futuros, promovendo resiliência. Assim, as relações de governança entre Estados, modelos económicos e comunidades resilientes também serão abordadas.

Palavras-chave
Riscos antrópicos; Alterações Climáticas; Coronavírus; Comunidades resilientes

Introduction

The World Economic Forum's 2020 Global Risks Report considered infectious diseases and pandemics, like COVID-19, as one of the top 10 risks in terms of impact over the next 10 years along with climate change – "while the world is grappling with the challenges of managing climate risks, it has been threatened with another major health crisis, the on-going pandemic due to COVID-19" (Appadurai, 2020).

Modern societies are facing the limits of their development models. Risk is currently given the same degree of importance as poverty in the 19th century and security in the 20th century. Since then, political confidence and legitimacy have been achieved through the progressive development of the Welfare State, based on control and security assumptions, through which both public and private institutions provide guarantees against risk in different dimensions of life, namely in public health, pensions, unemployment and sickness, and social assistance, among other welfare benefits.

The distinction between hazard, risk, and disaster is important because it illustrates the diversity of perspectives on how we recognize and assess environmental threats (hazards), what we do about them (dangers and risks), and how we respond to them after they occur (disasters) (Cutter et al., 2003). Luhmann (1993) pointed out, the difference between danger and risk is related to the fact that a danger is something to which people are exposed without having taken a decision, while risk is associated with the decision to take the risk. So, it is possible that people can be exposed to the consequences of decisions of some others else, like technical and political ones. And it is not uncommon today that decisions may have to be made under conditions of high uncertainty, or more precisely, as pointed by Kasperson (2009), "deep uncertainty"— where alternative approaches to risk analysis and management, and for coping with uncertainty, should be found, namely with regard to human behaviour which is also uncertain.

The combination of words: "risk, vulnerability and resilience" is quite common in this area of study. If vulnerability can be defined as an internal risk factor, vulnerability and resilience, both collective and individual, are key dimensions of the socio-psychological counterpart of the exposure of several stressor events, describing the degree to which a social context and individuals are susceptible to the short and medium-term effects to those events, and

describing also how such effects may be overcome and prevented (Cutter et al., 2003; 2008; Gonçalves & Possolo, 2010).

Cutter et al. (2008), using the model of disaster of places, suggests that social vulnerability is a multidimensional concept that helps to identify those characteristics and experiences of communities (and individuals) that allow them to respond to and recover from the consequences of disasters. And, in this sense, social vulnerability is not disconnected from resilience capabilities, such as: (i) robustness: ability to withstand stress without degradation or loss of function; (ii) redundancy: substitutability of elements, systems, and resources with respect to functional requirements; (iii) resourcefulness: ability to identify problems, to formulate priorities, and apply resources to achieve goals; (iv) rapidity: ability to address priorities and accomplish goals in a timely manner so as to contain losses and prevent future disruption.

Hence, resilience is defined as the capacity to achieve positive results on high risk situations, or maintain competencies under threats, or even face unexpected or low probability of occurrence events. It is a demonstration of manifested behaviour on social competence or success at meeting any particular tasks at a specific life stage after the exposure to those events. However, being resilient does not mean being non-vulnerable. The degree of vulnerability is determined by a combination of factors which include: (a) knowledge about hazard; (b) the conduct and behaviour of populations and infrastructure; (c) public policy and management; (d) organizational skills in all fields of disaster management; (e) a certain degree of uncertainty, both in nature and scientific knowledge, but also in the social system. Interpreting the multidimensional concept of vulnerability, Maskrey (1984) states that the vulnerability of a community is expressed through many factors: lack of awareness or knowledge of the behaviour of threats (cultural vulnerability); legal framework, regulatory and institutional counterproductive (institutional vulnerability); and disarticulation of social organization (social vulnerability).

Regarding the corona pandemic virus disaster, the repercussions are already visible in the economy, in politics, in health, in the supply of goods and in social security. No community will be spared from multiple and increasing damages if the trends remain unchanged, although the distribution of impacts is inevitably quite unequal, as it is associated with differences in vulnerability, thus having more implications for the most vulnerable geographies and particular social communities.

The issues of structuring inequality and social stratification of vulnerabilities were ignored in the first sociological studies which lead to the concept of disaster. It was the pressure of empirical data (unanticipated deductively) that brought evidence on inequality in the behaviour of populations on the peri-event and post-event. Bates et al. (1963) had already pointed out that the individuals belonging to the working classes in the case of Hurricane Audrey

suffered losses disproportionately highly in comparison to upper middle or upper class. Thus, several studies supported the assumption of stratified vulnerability based on: racial, ethnic, political power, gender stratification, demonstrating that disasters exacerbated pre-existing inequalities (Bates & Peacock, 2008; Oliver-Smith, 1996). Klinenberg, 2002) used a social autopsy approach in order to illustrate how a disproportionate number of victims of heat waves were mainly within the group of elders and African Americans. In essence, demonstrating how the social structure of a social context (Chicago, in the case) creates a distribution of victims also stratified by race, class, gender and age. In the case of Katrina and Rita hurricanes, people with extensive social networks were able to use them to accommodate family and friends outside the impact zones, converted their capital, providing resources during the period of non-operability or destruction of their home areas in New Orleans (Barnshaw & Trainor, 2007).

Indeed, if disasters provide evidence about the vulnerability of communities, cities and countries to danger and the severity of the impact on its economic performance and social welfare systems, then community resilience, based on social capital (Dynes, 2005; Gonçalves, 2015) and expert communication, as social support for crises situations, concern the ability to take deliberate, meaningful, collective action; proactive and reactive elements; fortifies against social concerns; creates potential to grow from a crisis (Gonçalves, 2015; Jewkes & Murcott, 2009; Kulig, 2000). Social support plays an important role in monitoring reactions to the impact of emerging, disruptive and eventually traumatic events, such as disasters resulting from pandemic events or climate change. People exposed to traumatic situations have a high risk of developing panic (Quarantelli, 1997), fear, trauma, even PTSD (post-traumatic stress disease) when social support is low (Gonçalves, 2015; McNally et al., 2003).

Another protective factor against exposure to trauma is related with preparation to deal with particular situations, becoming as an effect a variable of resilience (McNally et al., 2003). Training that people have undertaken before, preparing them for the peri and post events are crucial for information processing and for the development of more effective coping strategies since it reduces uncertainty in behaviours, increases the perceived control and allow for triggering and preparing appropriate answers to deal with emergent or cumulative disruptive situations (Shalev, 1996).

It is known that the factual consequence of the risks that lay people accept and/or are willing to take, are always blown up by social and cultural interpretations, depending on the prevalent values and interests, which are jointly related with perceptions, thus, with dominant social representations socially widespread and appropriated (Gonçalves, 2018; Wagner, 2021). People may feel predisposed to accept risks if they feel their objectives justify those risks. However, they can, at the same time, reject any chance of suffering damages if

they feel the risk is imposed upon them or if they feel it goes against their convictions and values (Slovic, 1992). Social support suggests that perceptions of support networks, both institutional and social ones, may play a crucial role in determining the degree to which individuals perceive risks, decide about them, and are willing to seek out and use social resources to decide about taken risks and to cope with them, which is a manifestation of resilience.

States and citizens face dangers and risks, the more systematically intensified the greater the vulnerability and uncertainty associated with decision-making processes (Beck, 2000; Wynne, 2002).

The arrival of the new coronavirus pandemic has left the whole world on alert about the impact of human actions on the Planet. In fact, we could see that the temperature and the greenhouse effect decrease during the lockdown times, around the world. Factories did not operate. Vehicle circulation decreased and therefore did not emit unbearable levels of CO_2 into the atmosphere, although methane emissions from agricultural activities and from animal feed were maintained. So, during the time that the world was in lockdown, the Earth has become, for a while, a more habitable place, reaching levels of gas emissions more compatible with the sustainability of the Planet, which should make us think about how we want to live on our Planet (Gonçalves & Bertolami, 2019; 2021a).

The implications on climate change and the Earth system caused by human occur on an unprecedented scale deviating from the reference conditions of the Holocene, placing us in an emerging geological epoch - the Anthropocene. This is a multidimensional problem that cannot be reduced to the classic geological terms - units of time and stratification. Societies developed and civilizational processes grew and fell in the course of the millennia that are inscribed in the Holocene (11,700 years), without significantly altering the fundamental character of the terrestrial system. However, and paradoxically, it is the sharpness of recent changes, namely the economic model adopted since the so called Great Acceleration – in the mid-1980s, with the start of the shift to Neoliberalism – that makes the Anthropocene functional as a geological unit with social consequences (Crutzen, 2002; Steffenn, et al., 2015; 2018; Crutzen & Stoermer, 2000; Steffen et al., 2007; Waters et al., 2016).

But what caused this extraordinary increase that is transforming the Planet's geology? The answer is clearly at a point of intersection of ethical, political, economic, technological development, and social change dimensions, having as a fundamental factor the way human action promotes risks on an increasingly larger scale, namely through increasingly rapid evolution of technology to the extent that it has been suggested that this response resides at the heart of the "technosphere"; this new terrestrial system in which humans can be seen as parasites of the biosphere (Flusser, 2011; Mendes, 2016; Latour, 2017).

The consequences of the coronavirus pandemic, paradoxically, are the inspiration for what will we are prepared to deal with to face the dangerous implications of changes on our Planet caused by climate change, and mere criticism of capitalism will not suffice. We need to imagine a feasible global systemic alternative where the human considers itself a part of the natural order and actively cooperates with it. And while the difference between human historical time and geological time has never concerned us, we must now reach an ethical understanding at the level of enduring species within the Planet equilibrium.

If we think within the framework of sustainable development and the resilience paradigm concept, we have to consider that climate change can be seen as the maximum exponent of world risk societies; not only increases disasters and catastrophes caused by natural phenomena, as also denote a sort of human actions that promote an increasing number of risks that can ultimately threaten human survival on the Planet. We also can envision and well understand how climate change can promote a number of diseases and infections, such as viruses, as well how the interaction between species can be compromised. It's a fact that continuous changes in the physical environment introduce imbalances in the terrestrial system and in the relationship between species. In the age of reflexive modernity, problems of nature are problems "of people", social problems (Beck, 2000) – "Nature is society and society is Nature."

Studies developed in the scientific community (Bertolami, 2018; Bertolami & Francisco, 2018; Bertolami & Francisco 2019a; Bertolami & Francisco, 2019b; Barbosa et al.,) suggests that a mathematical equation can allow for designing mitigation strategies, as well as risk assessment on the working of the Earth System (ES). Even more, a "Digital Contract for Earth System Restoration Mediated by a Planetary Boundary Exchange Unit", it is proposed, suggesting the development of global and local responsibility, in a word view as a common endeavour, to reduce risks and preserve life in the Planet (Bertolami & Francisco, 2021), with a focus on vulnerability social variables, communities resilience and economic models.

Within the development of a culture of risk, it would be possible to contribute to develop a model where the mitigation issue it is not only a task for governmental organisms and private specialized entities, but also it depends on the direct public perceptions and participation (Gonçalves, 2009; 2018), organizing their behaviour to face emergencies and crises that can affect communities (Gonçalves & Bertolami, 2020; 2021a).

Method

Thus, in the emergence of a new geological era, the Anthropocene – a multidimensional concept, which included more than geological units and global warming dimensions – we present an interdisciplinary theoretical reflection, between the dimensions of Sociology, with extension to Philosophy ones, and those of Physical Sciences, methodologically based on the evidence and a new reflexion of theoretical material previously prepared by the authors about anthropic risks we face now – climate changes and coronaviruses, within the frame of risk societies, disaster and resilient communities theories, under the scope of sustainable development (Gonçalves & Bertolami, 2019; 2020; 2021a; Bertolami, 2018; Bertolami & Francisco 2019b).

Climate change

In recent years, human action has been causing a change in the climate. In the context of the United Nations Framework Convention on Climate Change (UNFCCC), climate change is attributed directly or indirectly to human activity that alters the composition of the atmosphere and which is associated with natural climate variability, observed for long periods of time. The UNFCCC distinguishes between "climate variability" attributed to natural causes – internal to the Earth system in the Planetary system, that contribute to climate change – and "climate change" due to human activity by altering the composition of the atmosphere characterized by the unequivocal and continuous increase in the average temperature of the Earth's climate system, called global warming.

Global warming, science and actor networks

Global temperatures are expected to increase by 3 degrees Celsius or more towards the end of the century, twice the limit to avoid severe economic, social and environmental consequences. The years 2015-19 were the warmest on record, and also the most destructive of ecosystems that capture greenhouse gases. The impacts of human action on global warming will be predominantly negative. No scientific institution with a national or international reputation holds a dissenting opinion about the frequency and intensity of natural disasters that are consequently increasing. It became easily possible to perceive the catastrophic repercussion of man's action on the balance of the Planet with consequences for the human species, the relationship between species and social communities, since man depends on nature at all levels.

Since the IPCC (Intergovernmental Panel on Climate Change) was created in 1988, under the aegis of the World Meteorological Organization and the United Nations Environment Program, it has established itself as the main spokesperson

for scientific consensus and most respected world authority on global warming. Since 1990, it has published extensive periodic reports, which present the cutting edge knowledge about the warming of the Planet, and has been showing an evident trend – the growing reinforcement of the scientific consensus on climate change that was already emerging in the 1980s. Today, the scientific consensus on this matter is around 97-98%.

The main conclusions of the IPCC were: the warming of the Earth is unequivocal; human influence on the climate is notorious; the concentration of greenhouse gases in the atmosphere is increasing; surface temperatures rose by an average of 0.85°C (range from 0.65 to 1.06°C) from 1880 to 2012; each of the last three decades has surpassed the previous one in temperature levels; the oceans are consuming more than 90% of the energy of the climate system and a lot of carbon dioxide. However, as the ocean warms, it loses its ability to absorb carbon dioxide, which can accelerate atmospheric effects when it reaches saturation. The oceans will continue to acidify and warm up throughout the 21st century and beyond; sea level rose by about 19 cm between 1901 and 2010 due to the thermal rise in water; the elevation can reach more than 80 cm by 2100; the sea level will keep or rising after 2100; there will be significant impact not only in coastal regions, but in general and, correlatively, in society at several levels. Some consequences are already evident at present, such as, for instance, an increase in the trend of droughts and floods. If gas emissions (mainly carbon dioxide, but also methane) remain high and warming continues to increase, impacts can be cumulative and catastrophic. It is estimated that the average temperature may rise to 4.8°C by 2100.

To avoid the most pessimistic scenarios, reductions in emissions must be significant (as considered by Kyoto, Montreal and Paris Agreement protocols, among the various Environmental Agreements). However, some important changes in the Earth System may be irreversible for many centuries, even if emissions are halted now. Decisions made in the next two or three decades will be decisive and will have long-term effects.

Even before the negotiations that took place during the COP-15 in Copenhagen in December 2009, the national academies of science of the G8+5 nations published a Joint Declaration saying that "climate change and the use of renewable energy sources are challenges crucial for the future of humanity. The need for world leaders to agree on the reduction of emissions, necessary to combat the negative consequences of anthropogenic climate change, was emphasized". The statement quotes the 2007 IPCC Fourth Report, and states that "climate change is occurring even more rapidly than was estimated; global CO_2 emissions since 2000 have been higher than even the highest forecasts. The Arctic has been melting much faster than was envisaged, and sea level rise has become faster". Rio+20, that took place in June 2012, also called the United Nations Conference on Sustainable Development. It was one of the largest

events ever held by the UN and had the participation of more than 180 countries. It aimed to strengthen and ensure sustainable development among the countries involved. A widely discussed topic was the Green Economy – an economic growth combined with a reduction in the emission of polluting gases. In turn, the Paris Agreement is the last international commitment discussed among 195 countries with the aim of minimizing the consequences of global warming. It was adopted during the Conference of the Parties - COP21, in Paris, in 2015. It aimed strengthening the global response to the threat of climate change. It was approved by the 195 participating countries, which declared committed to reduce greenhouse gas emissions. The goal is to keep the Earth's average temperature below 2°C, in addition to efforts to limit the rise in temperature to 1.5°C above pre-industrial levels. Developed countries have also pledged to provide financial benefits to the poorest countries so that they can tackle climate change.

The increase in natural and technological disasters and even others disasters resulting from human action is intrinsically related to the increase in systemic risks. In this respect it is worth remembering and referring readers to the content of the Hyogo Framework, which was the global blueprint for disaster risk reduction efforts between 2005 and 2015. Its goal was to substantially reduce disaster losses by 2015 – in lives, and in the social, economic, and environmental assets of communities and countries. And consequently, the Sendai Declaration which was the successor instrument to the Hyogo Framework for Disaster Risk Reduction Action (2015-2030) based on prevention, via improving scientific investment on understanding anthropogenic impact; aiming to identify precursor signals and correlations to better prepare, anticipate and adapt, at a global level, but also at a local one, which concerns individual behaviour in communities.

Digital Contract for Earth System Restoration

A paradigm shift has occurred since the mid-twentieth century. Computational power has increased. It is possible to mobilize a vast amount of data and observations. And the continuous paradigm shift evolved. Nowadays, there are models that already simulate propositions for the preservation of the Planet.

The model "Digital Contract for Earth System Restoration Mediated by a Planetary Boundary Exchange Unit" (Bertolami & Francisco, 2021), calls for bottom-up processes, focused on global strategies with strengthening of resilient and participatory communities. The Digital Contract model of ES is strongly anchored on a solid body of evidence, showing that human activities are driving the ES towards a new state, usually referred to as Hothouse Earth, where its average temperature is necessarily higher than the one at the present and this

may have an irreversible impact on the regulatory ecosystems of the Planet, and unlikely to provide a sustainable future for humankind. It is proposed a new governance paradigm for managing the Earth System based on a digital contract inspired on block chain technology.

This proposal allows for radically decentralise procedures of controlling, maintaining and restoring ecosystems through a set of networks willing to engage in improving the operational conditions of local ecosystems in order to contribute to an optimal functioning of the Earth System. These procedures are aimed to improve local Planetary Boundary parameters so that they approach the optimal Holocene reference values, the so-called Safe Operating Space (SOS), via a reciprocal validation process and an exchange unit that internalises the state of the Earth System (Bertolami & Francisco, 2019b).

The model suggests mitigation strategies and risk assessment related to the profound transformations that we are witnessing through the changes on the climate, loss of biodiversity, destruction of ecosystems, pollution and so on are of such magnitude that there is a growing consensus, towards the need for urgent stewardship measures (Bertolami & Francisco, 2019a; 2019b; Rockström et al., 2009; Steffen et al., 2011; 2015).

A *Blockchain* Governance (BG) - a list of connected digital records, linked through a cryptographic key (Narayana et al., 2016), on the basis of the development of crypto currencies (the first of which was bit coin) - it is also proposed; to store the public nature of the information and built-in security and its insured trust. Within the model, BG allows for decentralised forms of ruling using elements that are somewhat different from the ones that characterise the usual models of representative democracy and direct democracy as those require centralised forms of State, governance, leadership and governmental institutions and organisations. In the open governance of the ES proposed by this model, the decisions concerning the blockchain evolution result from consultation of its users. The purpose is managing the Earth System blockchain to revert it back to Holocene-like conditions and drive it away from the Hothouse Earth scenario.

This Planetary Boundary Exchange Unit (PBEU or PB Coin) could provide the means for a community of concerned actors to voluntarily take action towards the maintenance or even the restoration of the several components of the ES within the frame of human rights and duties and in a kind of democracy that can lead the Planet as our Common House. Several assumptions are involved in this governance proposal. The first and most basic one is the existence of a demand for action leading to ES restoration in a time-scale short enough that it can mitigate the most destructive impacts of human activities. This means short-term, local and feasible actions. Furthermore, it is assumed that local actors can be progressively scaled up to engage into actions with wider spatial impacts. So, the setting up of the PB Coin and its exchange among the

members of the network requires an initial set of blocks that contains details on the conditions of the functional rules of the initial communities (Bertolami & Francisco, 2021).

Hence, social variables cannot fail to be part of models that seek to preserve the earth's balance with a focus on human resilience and the economic, health and labour, in short, political systems (Gonçalves & Bertolami, 2019; 2020; 2021a;b). And, to the extent that climate change may trigger disasters, both natural, as well as social, knowledge, and cultural actions that are intended to be effective, at public and social levels, will certainly depend on interdisciplinary collaborations, within an actor network interactions.

In this sense it continues to be designed interdisciplinary research, considering that resilience, in context, can only be increased through an ever greater social dissemination of scientific knowledge, for different social actors, contributing to perceptions anchored in the understanding of factors of necessary and sufficient knowledge for decisions and behaviours related with risks. Even because science and scientific uncertainty - an integral part of their method - should not be used, to justify insufficient political and economic measures; cause of structural social problems, result of economic policy, which are exposed in times of emergency and crisis, as is the case of climate change and the pandemic that we are going through (Gonçalves & Bertolami, 2021a;b). The concept of emergency is used here in the sense of a complex phenomenon or process, which emerge from a series of simple moments or actions, that leaves the routine and where the risk associated with danger for life is imminent. Therefore, in a world of complex systems, involving highly coupled human and natural systems, and multifaceted social, economic and political institutions, high levels of uncertainty challenge existing assessment methods and established procedures for decision-making and risk management (Kasperson, 2009), that must be an investment in communities resilient within the frame of eco-sociological systems (Gonçalves & Bertolami, 2019; 2021a;b).

COVID-19 and climate change

All species on Earth are interconnected in the web of life and humans cannot escape the result of this interconnected brunt. The stresses imposed by climate change on the wild ecological reservoirs housing various species including plants, insects and animals in multiple ways create a conductive environment for propagating infections within and among species, including humans. Another critical aspect is connected to the change in wildlife migration patterns observed across continents by the warming trend, which might lead to further release of novel viruses that can infect humans and their livestock and pets.

There is, also, an observed pattern in seasonal variations induced by increase in temperature across the globe; we see, effectively, the extension of the summer, longer and hotter summers, high humidity and direct sunlight can take a toll on human and other species health and air quality, and enhance the wildfire season, which also can have an indirect impact on the spread of pandemics. The shifting seasons of autumn and spring create ecological issues with spread of pollinators, changing growing seasons, and longer allergy seasons. Meanwhile, shorter and warmer winters allow for more pests to survive into the following season, increasing the odds of lower crop yields which impact food and nutritional security of people. Worsening food and nutritional security in turn impact human health adversely by altering the immune system. The sensitivity of human health related with aspects of weather and climate is well documented (Appadurai, 2020).

Climate impacts on health are largely observed in terms of its propensity to cause infections, heat stress and transmissible diseases; plus there are more insidious effects such as heightened blood pressure due to drinking water with higher than usual salt content, as has become common in coastal regions affected by saline water ingress.

Climate change is, in fact, one dimension of the Anthropocene era, which is more than just a matter of global warming. And the emergency health crises we face are more than a health issue, as they reveal our weaknesses and vulnerabilities that leave us exposed to risks and our lack of resilience at multiple levels.

It may not be easy to anticipate what measures must be taken in the future to mitigate risks of adverse health outcomes due to the uncertainty associated with climate change, however, we all are called upon to reflect and take responsibility in decisions, which brings us to man-social systems, the nature / culture dichotomy, as well as the “trade zones”, in a world of countless transactions of beings acting incessantly on each other (Latour, B., 2011, 2017).

For an effective perception of human action in climate change and other disasters as the COVID-19 pandemic, it is necessary to have a vision of the socioeconomic, cultural and political systems of the Planet as an integral part of disasters. This involves a whole network of actors (Law & Hassard, 1999; Latour, 2011), from scientists to policy makers, to enlighten everyone and above all the general public through for instance global Environmental Agreements. But also in local legislation and measures, with respective supervision that penalizes those responsible, either by action or by omission, and that, in turn, leads to the co-responsibility of each and every one as beings of the same Planet. And that means that we are able to share information and allow for the collaboration between States, namely in which concern early warning.

Learning from COVID-19: making it a window of opportunity for change

The economic and social costs of a pandemic like COVID-19 are increasing by the day with the spread of the infection. As became evident, from several scientific and media reports, not only it imposes huge infrastructure demands on healthcare systems, but also has substantial economic costs in terms of sickness-related absenteeism, disrupted work schedules and lost productivity under the lockdown conditions. And besides the business community, some professional services like the ones on the feeding surfaces, for example, worked harder than ever during the lockdown; this has a direct bearing on the livelihood of the poor and most vulnerable social contexts of society.

While direct costs are easily identifiable, indirect costs remain hidden. How should these be measured? How does one assess the cost of lost opportunities, and what are the economic gains of vaccination regarding avoided costs? Which target groups for vaccination would avoid higher costs? There are so many questions to grapple with. There are no definite answers so far and the uncertainties associated with the COVID-19 pandemic remain.

What is at stake is the quality of life and ultimately its extinction on Earth. We can, by our behaviour, lead to our own extinction even before shortening the gap of social inequalities. Knowing that we cannot "go back to former normality" – as we hear on the streets, now less deserted: nothing will ever be the same (!) - in a mixture of regret and hope, in the political capacities for protecting citizens, their work and physical and mental health; that there are changes that improve the quality of life and prevent damage resulting from situations like these. Hope for a change in lifestyles not so dependent on consumption of ostensible and unnecessary well-being products make countries not so dependent on some others, through certain products, such as fossil fuel, whose result has contributed to the increase in temperature and climate change that themselves increase disasters.

Often the decision-making-processes associated with risks show underlying relationships of uncertainty and trust; the risk may be related to the decision to trust someone in situations where it may later be proved that distrust would have been the most appropriate attitude - the lay public often says that it is easier to say who they do not trust than who to trust (Gonçalves, 2018).

Trust, associations and rules of reciprocity between groups and individuals, including belief systems and customs, represent the capital that gives visibility to social networks. Social and cultural capital, in the form of social networks can be converted into tangible resources for the survivors to a risk event. And these networks create close ties, through the identification with one's fellows, helping to reduce vulnerabilities (Gonçalves, 2015).

Politics will need to be driven by reformulation of economical thinking and income rights and a strong desire to wake up to the realities of a "new normal".

Social safety nets and associated policy measures beg for accountability and public confidence on health and climate considerations. The increase in public knowledge is one of the factors for reducing vulnerabilities, and social capital emerge as another protective factor to promote resilience, at global and local levels, of regions, of communities, as a resource embedded in social networks and social structure (Gonçalves, 2015; Aldrich, 2012), emphasize the production of "cultural capital" by group members (Bourdieu, 1986), and can be related to the importance of civic involvement in creating government policies (Putman, 2000).

Hence, science is an unequivocal key on both risks - pandemics and climate change. It portrays both as global emergencies that are expected to change the world for present and future generations. The scientific community has alerted the world about the alarming consequences of the impacts arising out of both threats.

The importance of scientific knowledge and public communication

The scientist in his dual condition of producer of knowledge and as citizen must promote scientific literacy in communities, being thus part of the solution.

If, on the one hand, the arguments of some scientists are rooted on the specificity of the scientific method, which guarantees the scientist's identity practice as an agent of scientific knowledge production, it follows that an established scientific fact only acquires this status in stages and, more often, after having completed three levels: the possible, the probable and the certain. An observation, a first experience will make it possible to formulate an hypothesis that will be of the order of the possible and, after other observations, or other experiences, after confirmation it will enter the domain of the probable or the very probable; most of the time they will take it for granted only after it has been verified by other peers; or rather, from the moment it was integrated into a coherent building of evidence.

On the other hand, all of this requires time and, above all, the spread of knowledge to other scientists and the diffusion of knowledge among policy makers to the general public, so that they are able to choose and to act when faced with such a decision, depending on the interpretation of results that are possible, probable, but not yet certain (Gonçalves, 2018; Gonçalves & Bertolami, 2020).

In countries such as USA and Brazil, scientists, nowadays, seek to demarcate themselves from political strategies, or from some pressure groups, recognizing the need to develop communication for audiences outside the scientific field, disseminating understandable knowledge and promoting behaviours of civic responsibility and defence of the common good. In this sense,

they defend, on the one hand, the responsibility of political decision makers and, on the other, the continuity of scientific research as a way of ensuring safety in the long term and preventing known risks and defending precautionary measures for risks that are not known (Gonçalves & Bertolami, 2020).

What seems radically new is the fact that, in the name of the Precautionary Principle, applied to risks that are not known and, therefore, cannot be prevented yet, there is a call for *accountability* in relation to non-real risks (in the sense of not verifiable at the present time, and may be anticipated in the present) and even totally unknown, opening a door to the notion of responsibility without fail (the burden of proof). In this sense, the precautionary hypothesis goes hand in hand with a new awareness of the duration of the causality of human actions. The Precautionary Principle invites the anticipation of what we do not even know, to take into account doubtful hypotheses, even simple assumptions, and science can be invoked in the name of (un)trust (Gonçalves, 2018).

Thus, better information through several means of communications, will allow citizens to understand what could be imaginary, potential and real risks and that the same risk may change in qualification depending on the state of individual and social knowledge. In this scenario of potential risks, the decision to take them into account must be in line with an individual and social acceptability, which is not independent of social representations, so, perceptions of the risk, since no reality, in fact, defines its contours. And in this measure move towards communities that are increasingly resilient to the dangers and risks to which they may be exposed.

The Road towards Sustainable Development

Progress towards sustainable development becomes more demanding in times of turbulence, crises and uncertainty. In 1973, the United Nations University established the Institute for Human Security and the Environment (UNU-EHS) to address risks and vulnerabilities, the consequences of complex, acute and latent environmental risks. Aiming to avoid that the concept of sustainable development become more of an adjective principle than a structural one, UNU-EHS developed vulnerability assessment methodologies as well as research on vulnerabilities associated with different impacts, arising from the impact of both natural phenomena, as well as of human action. The conditions of man-environment systems determine their sensitivity to any set of harmful exposures. In turn, the incorporation of differences in the resilience of different contexts has become a crucial element of analysis of man-environment systems.

According to UNU-ERHS, in order to preserve human security, the main priorities of a programme dedicated to such, should take into account: (i) Vulnerability assessment, resilience analysis, risk management and adaptation

strategies within the scope of interconnection of man-environment systems; (ii) Internal displacement and cross-border migration due to factors that affect climate change; (iii) Preparation, adaptation, response and recovery. In this context, resilience, in which social capital should be incorporated, emerges as an operational concept with the potential to promote more sustainable trajectories for political and planning processes. Because resilience reflects the ability of a system (a region, an economic activity, a city, a home) to absorb disturbances and reorganize itself without collapsing or considerably changing its identity, avoiding losing its main features; evaluate its potential to play a fundamental role, namely when crises, instability, uncertainty and complexity are interconnected factors in the characterization of a social context.

The characterization of the social impact of climate change in terms of systemic adaptation (interaction between man and the environment) requires some oriented actions and recommendations, that are essential to be used to evaluate, formulate and create a political plan, simultaneously, national and international, that ensure the sustainable development of our risky societies, where we are all called to reflection and joint responsibility in decisions, where the use of modern technology for the dissemination of scientific knowledge that impacts literacy of citizens is quite relevant, namely in which concern to spread and consolidate social representations of sustainability (Castro, 2015). In order to promote the sustainability of human societies, depending heavily on the environment, developing scientific interdisciplinary is very important to ensure a better understanding of our living environment, its balance and even its changes and human adaptive capacities. This is a question of communication and public perceptions (Gonçalves & Jesuíno, 2004) anchored on issues of social representations (Wagner, 2021) and policy of sustainability transitions (Castro, 2015).

Either we become resilient or we do destroy ourselves

The hope lies in that the economic models adopted, the capacity of governments and, above all, the commitment of scientific community, do inform citizens how to effectively use their citizenship and, through a constructive international cooperation, improve the quality of life on planet Earth, building resilient communities. Common values lead to shared world-views and, eventually, common fears. The choice of risks and how to live with them appears linked to acceptable risk, which is not independent of ethical dimensions, citizenship and human rights, since risk management, in a rule of law, always has a multidimensional character, including the right of being informed; once informed citizens become responsible for decisions concerning risks, evident in their behaviours.

Of course, those who have the knowledge have a social obligation to disseminate it, since the demand for collective security and future prevention is a social responsibility, avoiding that there is an individual detachment from large collective risks, considering them unacceptable, invoking political decisions in their reduction. In the current period characterized by dangers on an unprecedented scale, which expose the various social vulnerabilities, it becomes evident the need for different security systems, in the sense that society as a whole begins to be aware, in terms of insecurity, as a risk group, in which the Welfare State is a State that provides. For this reason, in the world of risk societies, both the quality of life and the production of knowledge cannot be mutually separated, in defence of preventive measures, which go through regulatory and inspection rules, and for the intervention of States.

The scientist, as a citizen, in great proximity to the lay public, share the same type of concerns, which is anchored in the movement that occurred in the scientific community, towards a greater investment in prevention and bridging the gap between individuals, communities, and the broader social structure to contextualize the exposure to dangers (Green, 1997; Gonçalves, 2018). In the role of specialist, the scientist represents those to consult in a factual logic; as a citizen, the scientist is an individual concerned with contributing to influence decisions, putting his knowledge at the service of society. Credibility criteria are now required - redistribution of the burden of proof, division of powers between producers and hazard assessor even public dispute over alternatives.

Credibility, acceptability, and trust are based on a process of creating discursive coalitions based on a shared definition of reality. So, where the Principle of Prevention applies for reducing known risks, Precaution is called for measures in the face of unknown consequences of unknown risks, and both have to do with political decisions, and with the mobilization of all stakeholders, the citizen, the representatives of local communities, the State itself.

Improving preventive capabilities comes with advancing knowledge and means of putting pressure on the demand for safety. Will decision-makers be able to take advantage of this paradoxical opportunity to realize that everyone must have the right to access knowledge, work and quality of life and opportunities to decide in an informed fashion? There must be a change in the format and distribution of time and working space? Should all work be paid? Should every citizen have the right to a minimum income that allows for her/his survival based on a rule of law? In other words, that are obligations to protect citizens, and therefore to invest in measures to identify groups of risk and to reduce them. Finally, we are talking about the consolidation of the Paradigm of Responsibility in the context of which a political, social and cultural economy of rights and duties is designed in terms of legal obligations – in which, the key concepts of ethics, education, historically situated politics, progress and utopias,

framed in the understanding of nature and its limits, aiming to move from suffering, and fear, to responsible hope (Jonas, 1997).

Based on liberal philosophy, it appeals to moral and ethical, as well as social pressure, and to the freedom and will of citizens. Thus, the obligations of the State will have to appeal to the rule of "not putting anyone in danger", implying an overlap of the forecast prevention/precaution on the State and on the benefit of the citizen. The culture of risk will have to be a cultural principle of society and it is up to the State to develop in a participatory strategy to help all those who suffer the consequences of risks and decisions taken in the name of their management. To prevent is not to explain. With better scientific performances, it seems possible to develop better diagnoses, as well as education and communication plans for different public spheres, politicians and the population in general, so to obtain a better national and international alert network about events that, although local, are multi-causal, and have transnational implications.

Conclusion

The dual-threat of COVID-19 and climate change has not only exposed numerous unequal structural vulnerabilities within our societies, especially in what concern emergency response, governance, early warning, disease forecast, and public health care, but has also illustrated (a) the lack of networks, both institutional and individual, that configure social capital as a tool to cope with disaster and uncertainty, and (b) the need for collective action and a paradigm shift in our approach to manage multiple crises and refers to uncertainty that needs knowledge, interdisciplinary and methodological innovation and public information to enable people to decide about acceptable risk.

The new coronaviruses is a good case study on errors to be avoided when planning to prevent the destruction of life on our Planet. Despite the cooperation of the World Health Organization (WHO), the information to the population is somewhat faulty, mainly due the delay and political interference. What saved lives at COVID-19 was, in fact, lockdown, and not cooperation between States and nations. Several countries have chosen independent paths, catering to their own resources and manufacturing interests. Although understandable, it is not at all a good way to deal with global threats to the Planet. And the same practices are happening in what concern climate change.

Around the world different countries adopt different policies and in many cases without respect for the Environmental Agreements. Fragmented and unequal responses to the threat of extinction of life on Earth are the recipe for delay and inaction, preventing options for alternative paths along the path of sustainable development. Paths can and must be implemented at local level, certainly, but with confidence in global aid measures. Without this confidence to

share information, nations work unilaterally, resulting in a loss of time, waste resources and an increase in the chances of failure. The comparison between the pandemic COVID-19 and the effects of climate change shows that events of low probability of occurrence, but with great, natural and social, consequences, are rarely considered with the anticipated seriousness, they are not given due prior importance and the necessary measures are not taken to prepare people to cope with.

Events that have a long time interval between occurrences, constitute threats that end up losing their emotional and representational value in the memory, both in politicians and in populations, in this way, the danger could turn into an abstract idea, "far from reality", and this can affect the way prevention is seen in political measures and decisions. Investment in preventive measures, can save lives, even in situations of uncertainty, thus prevention should be anchored in scientific research and in its communication. Above all, scientific discourse should be adequate to disseminate necessary and sufficient knowledge to the general public, even if it is necessary to transmit uncertainty in knowledge, transmitting the probabilities of occurrence and magnitude of consequences, with interdisciplinary being promoted to propose models that anticipate risks and, in this way, promote resilient behaviours.

Target investments in resilience-building measures, especially in health infrastructure, weather and disease forecast systems, addressing training and adaptive capacity needs at different scales are imperative. States should focus on improving vector control practices and personal protective measures and, also, to develop plans of mutual help in cases of emergence of general and transversal disruptive events. Politicians and policy makers need robust data to optimally allocate costs of preventative health care and climate resilience measures. There should be complete revamp on how we design and implement our social safety net systems. The social safety nets and associated policy measures ask for health and climate considerations in order to promote a sustainable development.

Apart from this, there is a lot to learn in what concerns behaviour issues, which means that we need to invest in public perceptions, and cultural norms that help manage emergencies and crises, considering the power of social capital and collective action for to cope with. So, even in times of social distance it is important to cultivate social ties though networks of social support institutionally conceived. Social ties should be related to political measures so to ensure trust, accountability and citizen knowledge for secure actions as citizen rights. Social ties impact our lives; they are agents of resilience reducing the risk impact of disasters, and through institutional ways connect people's knowledge and abilities, power, authority and trust.

And we should not mix up physical distancing with social distancing in time of crises. Social ties can be more important than ever in times of shock. This

must be a priority of governance. Communities with more links to their local authorities can better rely on new behavioural measures. Bridging ties, fortify social support and capital, help citizens share key information through the different community groups. And, those ties can provide critical information for future risk management, within the framework of disasters.

Thus, investments in science and technology, appropriate tools and approaches, and early warning systems are critical. Political decision will assume enormous importance in the context of both – the COVID-19 pandemic and climate change. Politics must be driven by compassion and a strong desire to wake up to the realities of a new normal. And the new normal must avoid the "normalization" of what is the possible now – using media for that – but give importance to public participation on what could be the "new normal".

The need for a public space arises to be created against the dangers and false security of a 'society conceived in the abstract'. The task now is to reconfigure the politician, and the politician's compass must include the ecological and its ethical dimension.

References

Aldrich, D. (2012). *Building Resilience*. The University of Chicago Press.

Appadurai, N. (2020). South Asia Confronts a Double Disaster: Cyclone and COVID-19. *World Resources Institute*. https://www.wri.org/blog/2020/05/south-asia-confronts-double-disaster-cyclone-and-covid-19.

Barbosa, M., Frederico F. & Orfeu, B. (2020). Towards a physically motivated planetary accounting framework, *The Anthropocene Review 7*(3): pp. 191-207. https://doi.org/10.1177/2053019620909659.

Barnshaw, J. & Joseph T. (2007). Race, Class, and Capital amidst the Hurricane Katrina Diaspora In: *The Sociology of Katrina: perspectives on a modern catastrophe* (pp. 91-105). USA: Rowan & Littlefield Publishers, Inc.

Bates, F., Charles F., Vernon, P., Robert, P. & Tracy, G. (1963). *The Social and Psychological Consequences of Natural Disaster*. Washington, D.C.: Natural Academy of Sciences, National Academy of Sciences, Natural Research Council.

Bates, F. & Walter P. (2008). *Living Conditions, Disasters and Development: An Approach to Cross-Cultural*. USA: University of Georgia Press.

Beck, U. (2000). Risk Society Revisited: Theory, Politics and Research Programmes. In B. Adam, U. Beck & J. van Loon (eds.),*The Risk Society and Beyond. Critical Issues for Social Theory* (pp. 211-229). London: Sage Publications.

Bertolami, O. (2018, dezembro 1). *A Humanidade no Antropoceno* [Online forum post]. Forum Demos. https://forumdemosnet.wordpress.com/2018/12/01/a-humanidade-no-antropoceno.

Bertolami, O. & Frederico, F. (2021). A digital contract for restoration of the Earth System mediated by a Planetary Boundary Exchange Unit. *The Anthropocene Review*, https://doi.org/10.1177/2053019620987270.

Bertolami, O., & Frederico, F. (2019b). A Physical Framework for the Earth System in the Anthropocene: Towards an Accountancy System. https://arxiv.org/pdf/1910.02467.pdf.

Bertolami, O. & Frederico, F. (2019a). A phase space description of the earth system in the anthropocene, EPL. *Europhysics Letters 127*(5) 59001. https://doi.org/10.1209/0295-5075/127/5900.

Bertolami, O. & Francisco, F. (2018). A physical framework for the earth system, Anthropocene equation and the great acceleration, *Global Planet. Change 169*: pp. 66-69. https://doi.org/10.1016/j.gloplacha.2018.07.006.

Bourdieu, P. (1986). The forms of Capital. In J. G. Richardson (Ed.), *Handbook of Theory and Research in the Sociology of Education* (pp. 241-258). Westport, Conn.: Greenwood Press.

Castro, P. (2015). Social representations of sustainability: Researching time, institution, conflict and communication. In G. Sammut, I. Andreouli, G. Gaskell & J. Valsiner (Eds.), The Cambridge Handbook of Social Representations (pp. 295-308). Cambridge: Cambridge University Press.

Crutzen, P. (2002). Geology of Mankind**.** *Nature 415*: p. 23. doi: 10.1038/415023a.

Crutzen, P. & Stoermer, E. (2000). The Anthropocene. *Global Change Newsletter 41*: pp. 17-18.

Cutter, S., Lindsay, B., Melissa, B., Christopher, B., Elijah, E., Eric, T. & Jennifer, W. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change 18*: pp. 598-606.

Cutter, S., Boruff, B. & Shirley, L. (2003). Social vulnerability to environmental hazards, *Social Science Quarterly 84*(2): pp. 241-261.

Dynes, R. (2005). Community Social Capital as the Primary Basis for Resilience. *University of Delaware, Disaster Research Center 344*: pp. 1-49.

Flusser, V. (2011). *Into the Universe of Technical Images.* Transl.: Nancy Roth. Minnesota: University of Minnesota Press.

Gonçalves, C. D. (2018). *Da Previsão à Prevenção. Risco Sísmico em Portugal Continental. Estilos de Pensamento nas Conceções e Percepções de Risco Sísmico*. S. l.: Novas Edições Acadêmicas.

Gonçalves, C. D. (2015). The importance of Social Capital facing the Unexpected (From Natural Hazards to Social Disaster) – A Style of Though. In I. Gil & C. Wulg (Orgs.) (2015). *Hazardous Future* (pp. 79-94). Berlin: De Gruyter.

Gonçalves, C. D. (2009). Da previsão à prevenção: risco sísmico em Portugal Continental. *Segurança em Protecção Civil, Revista de Planeamento e Gestão de Emergência*, *3*: pp. 13-21.

Gonçalves, C. D. & Bertolami, O. (2021b, junho 8). Muito mais resiliência, muito menos recuperação. *Público. Opinião*. https://www.publico.pt/2021/06/08/opiniao/opiniao/resiliencia-menos-recuperacao-1965529?access_token=8lvGJ0XRbsFdOWMw0nmGmS2bSlPxktN2TzApgqjUVrsdH8aE%2FWjhStOL8mcjmv%2Banpdxlnym7VHIBn%2BcUyor4g%3D%3D.

Gonçalves, C. D. & Bertolami, O. (2021a, março 11). Alterações Climáticas. Divulgação e Opinião. *Laboratório Criativo Umbuzeiro – Ciência no Ciberespaço/Universidade do Estado da Bahia – UNEB*. https://www.labcriatumbuzeiro.com/post/alterações-climáticas-divulgaçãoe-e-opinião.

Gonçalves, C. D. & Bertolami, O. (2020, junho 8). Pandemias, riscos, crises: a importância de investir em comunidades resilientes. *Público. Opinião*. https://www.publico.pt/2020/06/08/opiniao/opiniao/pandemias-riscos-crises-importancia-investir-comunidades-resilientes-1919871.

Gonçalves, C. D. & Bertolami, O. (2019). *A perceção pública das alterações climáticas*. Working paper. https://web.ist.utl.pt/orfeu.bertolami/Percepcao_Publica_1.pdf

Gonçalves, C. D. & Possolo, A. (2010). Social and Physical Aspects of Seismic Risk. In H. Kremers & A. Susini (Eds.), *Risk Models and Applications. Collected Papers* (pp. 49-77). Berlin: CODATA Germany.

Gonçalves, C.D. & Jesuíno, J. (2004). Cientistas e leigos: Uma questão de comunicação e cultura. *Revista Comunicação e Sociedade 6*: pp. 11-33.

Green, J. (1997). *Risk and Misfortune. The Social Construction of Accidents*. London: UCL Press.

Jewkes, R. & Murcott, A. (2009). Community representatives: Representing the community? *Social Science & Medicine 48*(7): pp. 843-858.

Jonas, H. (1997). *Le Principe Responsabilité. Une éthique pour la civilisation technologique*. Paris: Les éditions du CERF.

Kasperson, R. (2009). *Coping with deep uncertainty: Challenges for environmental assessment and decision-making*. *Uncertainty and Risk*. London: Earthscan.

Klinenberg, E. (2002). *Heat Wave: A Social Autopsy of Disaster in Chicago*. Chicago: University of Chicago Press.

Kulig, J. (2000). Community Resiliency: The Potential for Community Health Nursing Theory Development. *Public Health Nursing 17*(5): pp. 374-385.

Latour, B. (2017). *Facing Gaia: Eight Lectures on the New Climatic Regime*. Cambridge: Polity Press.

Latour, B. (2011). Networks, Societies, Spheres – Reflections of an Actor-Network Theorist – Keynote Lecture. *International Journal of Communication 5* (special issue edited by Manuel Castells): pp. 796-810

Law, J., & Hassard, J. (Eds). (1999). *Actor Network Theory and after*. Oxford: Blackwell Publishers.

Luhmann, N. (1993). *Risk: A Sociological Theory*. Berlin, New York: Walter de Gruyter.

Maskrey, A. (1984). Comunidad y desastres en América Latina: estrategias de intervención. In A. Lavell (Ed.), *Viviendo en Riesgo: Comunidades Vulnerables y Prevención de Desastres en América Latina* (pp. 25-58). Bogotá: La RED, Tercer Mundo Editores.

McNally, R., Bryant, R. & Ehlers, A. (2003). Does early psychological intervention promote recovery from posttraumatic stress? *Psychological Science in The Public Interest*, *4*: pp. 45-79.

Mendes, J. (2016). Tecnoética: uma disciplina filosófica para o século XXI. In: A. Manso & C. Martins (Orgs.), *Ensino da Filosofia em Portugal. Tradição e Actualidade da Formação* (pp. 35-45). Famalicão: Húmus.

Narayanan, A., Joseph B., Edward, F., Andrew, M. & Steven, G. (2016). *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*. Princeton: Princeton University Press.

Oliver-Smith, A. (1996). Anthropological Research on Hazards and Disasters. *Annual Review of Anthropology 25*: pp. 303-328.

Putnam, R. (2000). *Bowling Alone: Collapse and revival of the American Community*. New York: Simon & Schuster.

Quarantelli, E. (1997). Panic Behavior: Some Empirical Observations. In: C. Donald (Ed.), *Human Response to Tall Buildings* (pp. 336-350). Stroudsburg, PA: Dowden, Hutchison, and Ross, Inc.

Rockström, J., Will, S., Kevin, N., Asa, P., Stuart, C., Eric, L., Timothy, L., Marten, S., Carl, F., Schellnhuber, H.J., Bjorn, N., Cynthia, W., Terry, H., Sander, L., Rodhe, H., Sverker, S., Snyder, P., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R., Fabry, V., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. & Foley, J. (2009). Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society 14*(2): 32. [online] URL:http://www.ecologyandsociety.org/vol14/iss2/art32

Shalev, A. (1996). Stress versus traumatic stress from acute homeostatic reactions to chronic psychopathology. In B. A. van der Kolk, A. C. McFarlane, & L. Weisaeth (Eds.), *Traumatic stress: the effects of overwhelming experience on mind, body and society* (pp. 77-101). New York: The Guilford Press.

Slovic, P. (1992). Perception of Risk: Reflections on the Psychometric Paradigm. In S. Krimsky & D. Golding (eds.), *Social Theories of Risk* (pp. 117-152). Westport: Praeger.

Steffen, W., Asa, P., Lisa, D., Jan, Z., Mark, W., Richardson, K., Crumley, C., Crutzen, P., Folke, C., Gordon, L., Molina, M., Ramanathan, V., Rockström, J., Marten, S., Schellnhuber, H.J. & Uno, S. (2011). The Anthropocene: From Global Change to Planetary Stewardship. *Ambio 40*(7): pp. 739-761.

Steffen, W., Crutzen, P. & McNeil, J. (2007). The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature? *Ambio 36*(8): pp. 614-621.

Steffen, W., Richardson, K., Rockström, J., Cornell, S., Fetzer, I., Bennett, E., Biggs, R., Carpenter, S., Vries, W., Wit, C., Folke, C., Dieter, G., Heinke, J., Mace, G., Persson, L., Ramanathan, V., Reyers, B. & Sorlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science* 347(6223), 1259855-1-1259855-10.

Steffen, W., Rockström, J., Richardson, K., Lenton, T., Folke, C., Liverman, D., Summerhayes, C., Barnosky, A., Cornell, S., Crucifix, M., Donges, J., Fetzer, I., Lade, S., Scheffer, M., Winkelmann, R. & Schellnhuber, H.J. (2018). Trajectories of the earth system in the anthropocene. *Proceedings of the National Academy of Sciences of the United States of America*, *115*(33), pp. 8252-8259. https://doi.org/10.1073/pnas.1810141115

Waters, C. Zalasiewicz, J., Summerhayes, C., Barnosky, A., Poirier, C., Galuszka, A., Cearreta, A., Edgeworth, M., Ellis, E., Ellis, M., Jeandel, C., Leinfelder, R., McNeill, J.R., Richter, D., Steffen, W., Syvitski, J., Vidas, D., Wragreich, M., Williams, M., Zhisheng, A., Grinevald, J., Odada, E., Oreskes, N. & Wolfe, A. (2016). The Anthropocene is functionally and stratigraphically distinct from the Holocene. *Science 351*(6269) aad2622. https://doi.org/10.1126/science.aad2622

Wagner, W. (2021). Groups in contact: Meta-representations, interobjectivity, and cultural incompatibilities. *Journal of Theory of Social Behaviour 51*: pp. 2-21. https://doi.org/10.1111/jtsb.12259.

Wynne, B. (2002). Risk and Environment as Legitimatory Discourses of Technology: Reflexivity Inside Out? *Current Sociology 50*(3): pp. 459-477.