# The challenges of public communication of sciences in climate mutation

## *Os desafios de comunicação pública das ciências na mutação climática*

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**ABSTRACT**

This study addresses the challenges of public communication of sciences in climate mutation based on Bruno Latour's reflections. This text (1) discusses disinformation and climate denialism; (2) focuses on the importance of working on public communication of sciences by explaining research processes and their controversies; (3) debates why it is necessary to overcome the myth of objective knowledge and to ground the production and communication of different types of knowledge; (4) addresses the intrinsic relationship between science, discourse, and representation; and (5) presents educational-communicative practices that offer clues to face these challenges epistemologically and empirically.

**Keywords:** climate denialism; public communication of sciences; climate education.

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**RESUMO**

Este ensaio problematiza os desafios de comunicação pública das ciências na mutação climática a partir do pensamento de Bruno Latour. O texto está dividido em cinco partes: (1) discute a desinformação e o negacionismo climático; (2) foca na importância de se trabalhar a comunicação pública das ciências iluminando os processos de pesquisa e suas controvérsias; (3) debate por que é preciso superar o mito do conhecimento objetivo e aterrar a produção e a comunicação dos diversos saberes; (4) aborda a relação intrínseca entre ciência, discurso e representação; (5) apresenta práticas educomunicativas que oferecem pistas para enfrentar epistemológica e empiricamente esses desafios.

**Palavras-chave:** Negacionismo climático, comunicação pública das ciências, educação climática

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# A

## The challenges of public communication of sciences in climate mutation

ONE OF THE MOST eminent minds in political ecology and the anthropology of science, Bruno Latour, passed away on October 9, 2022. This essay is a simple posthumous tribute, highlighting the contributions of his reflections to public communication of sciences in the context of climate mutation.

The central problem addressed in the article is disinformation and climate denialism. Articulating discussions already worked on by Latour throughout his work (such as the need to overcome the myth of objective knowledge, to ground the production and communication of diverse knowledge, and the intrinsic relationship between science, discourse, and representation), this essay presents educational-communicative practices that offer clues for epistemologically and empirically facing the challenges of working on the public communication of sciences by shedding light on research processes and their controversies.

In methodological terms, this essay is based on a bibliographical review of Bruno Latour's work, seeking to identify his key contributions to the field of public communication of sciences in the context of climate mutation and to establish parallels with recent research on climate and scientific denialism in general, as well as in dialogue with other authors, such as Hans Jonas and Byung-Chul Han. The reflections presented here expand on points discussed in the international webinar "Communicating Climate Emergency. A challenge to science, human rights and democracy"[1] and dialog with the results of the study on climate education practices carried out in Brazil from 2016 to 2021, which was conducted by the Brazilian Fund for Environmental Education (FunBEA) with funding from the Institute for Climate and Society (iCS)[2].

### DISINFORMATION IS A PHENOMENON OF POST-POLITICS (NOT POST-TRUTH)

During the 27th Conference of the Parties to the Framework Convention on Climate Change, COP27, in November 2022 in Egypt, Climate Action Against Disinformation released the results of a survey carried out in six countries[3], which sought to measure the damage caused by fake news to people's perception of the environment. Brazil was part of the study, which indicated that 40% of people here believe that fossil fuels are clean energy; 44% believe that climate change[4] is not caused by human activity; 29% say that scientists disagree on the causes of climate change; 24% say that global temperature records are unreliable; and 15% do not believe that fossil fuel production can cause medical problems for those living near extraction sites (Preite, 2022).

[1] The author took part in this seminar as a guest speaker. It was organized by the Universidade Estadual de Campinas (Unicamp) and brought together scientists, professionals, and activists from different countries from June 20 to 24, 2022. All the presentations are available at *Direitos Humanos Unicamp* (2022).

[2] The author coordinated this study alongside Rachel Trajber and Semíramis Biasoli. It culminated in the participatory drafting of the *Diretrizes de Educação Ambiental Climática* (2023).

[3] From October 18 to 21, 2022, the study listened virtually to Brazilians, Australians, Indians, Germans, Britons, and Americans over the age of 18. The survey was based in Brazil by the Observatório do Clima, and the margin of error is ±2.9%.

[4] Here we use the term climate mutation or New Climatic Regime instead of more usual expressions such as global warming, climate change, climate crisis, climate emergency or climate collapse, based on the recognition that the changes we are currently experiencing are long-lasting and, in part, irreversible (Latour, 2020).

The idea of the active production of ignorance was popularized in the study published in 2011 by Robert N. Proctor on the actions of the tobacco industry (Latour, 2020). It should come as no surprise, then, that when it comes to fossil fuels and their central role in climate change, the economic interests of the oil industry are also defended with an intense, billion-dollar disinformation campaign of climate denialism:

> For a clarifying episode that is not metaphoric in the least: Exxon-Mobil, in the early 1990s, knowing full well what it was doing, after publishing excellent scientific articles on the dangers of climate change, chose to invest massively in frenetic extraction of oil and at the same time in an equally frenetic campaign to proclaim the non-existence of the threat. (Latour, 2020, p. 29)

Nevertheless, recent data shows that 90% of the Brazilians interviewed in the survey conducted by Yale University's Climate Change Communication Program are convinced that the average temperature has been rising for the last 150 years, will rise even more in the future and that, as a result, the world's climate will be altered. These results place Brazil among the countries with the highest percentage of the population aware of the existence of climate change, close to Hungary (96%), Portugal (95%) and Costa Rica (94%), which lead the ranking, and far from those where this rate is lower: Laos (67%), Haiti (67%) and Bangladesh (70%) (Leiserowitz et al, 2022)[5].

When the question is about the causes of climate change, however, the Brazilian figures (following an international trend) become less encouraging. Only 53% of respondents in Brazil say that the causes are mainly human, a figure close to the countries that obtained the highest percentage on this question (Spain, 65%; Sweden, 61% and Taiwan, 60%) and far from those where the degree of misinformation on the subject is appalling (Indonesia, 18% and Yemen, 21%). This data is consistent with the perception that the Brazilians who took part in the survey have about their own knowledge of climate change: 13% said they know a lot; 52% that they know a moderate amount; 30% that they know little; and 5% have never heard of the subject (Leiserowitz et al, 2022).

Generally speaking, the comparative table of data collected by the Yale Climate Change Communication Program shows that while the so-called developed countries tend to be more aware of and recognize the climate emergency, in the so-called undeveloped countries, on the other hand, the effects of this problem tend to be perceived as closer and more urgent. And this seems to confirm what the movements mobilized around the so-called Climate Justice are denouncing: that the consequences of climate mutation, although they affect practically

[5] This survey was conducted in partnership with an arm of big tech Meta called "Data for Good" and was carried out with Facebook users. The aim was to measure public knowledge about climate change and the beliefs, attitudes, political preferences, and behavior linked to the issue. The sample consisted of 108,946 active users of the platform over the age of 18. Responses were collected from 192 countries and territories around the world between March 25 and April 14, 2022 (Leiserowitz et al, 2022).

the entire world population, affect more seriously precisely those peoples and communities in situations of greater socioeconomic vulnerability.

There is an intrinsic relationship between rising inequality, deregulation, and climate denialism, which is clarified by Bruno Latour (2020) in his last book published during his lifetime, "Down to Earth: Politics in the New Climatic Regime." For the author, these three phenomena are symptoms of the same historical situation: the ruling classes have concluded that there is no longer enough room on Earth for everyone and have stopped pretending that history is leading to a common horizon:

> The hypothesis is that we can understand nothing about the politics of the last 50 years if we do not put the question of climate change and its denial front and center. Without the idea that we have entered into a New Climatic Regime, we cannot understand the explosion of inequalities, the scope of deregulation, the critique of globalization, or, most importantly, the panicky desire to return to the old protections of the nation-state – a desire that is identified, quite inaccurately, with the "rise of populism." (Latour, 2020, pp. 10-11)

Latour launches the hypothesis (political fiction, as he calls it) that the messages on ecological mutation delivered since the 1980s by activists, artists and scientists have been heard by the elites. But, having heard the warning, they took the cruel and cynical stance of further defending their own interests and seeking only their own salvation (even if only for a few generations). And for this very reason, even to avoid making this perversity explicit and generating revolt, they began to publicly deny the problem vehemently. Latour compared the conduct of the political-economic elites to that of the owner of the *Titanic*, who used one of the few boats available to save himself from the shipwreck and abandoned the crew and lower class passengers on the sinking ship – making sure to leave the orchestra playing beforehand, to delay the awareness of the tragedy and the inevitable angry reaction of the abandoned:

> If the hypothesis is correct, all this is part of a single phenomenon: the elites have been so thoroughly convinced that there would be no future life for everyone that they have decided to get rid of all the burdens of solidarity as fast as possible – hence deregulation; they have decided that a sort of gilded fortress would have to be built for those (a small percentage) who would be able to make it through – hence the explosion of inequalities; and they have decided that, to conceal the crass selfishness of such a flight out of the shared world, they would have to reject

> absolutely the threat at the origin of this headlong flight – hence the denial of climate change. (Latour, 2020, pp. 28-29)

Also in 2022, the National Institute of Science and Technology in Public Communication of Science and Technology (INCT-CPCT) coordinated the research "*Confiança na ciência no Brasil em tempos de pandemia*," with support from the National Council for Scientific and Technological Development (CNPq) and the Carlos Chagas Filho Foundation for Research Support of the State of Rio de Janeiro (Faperj). During the COVID-19 pandemic, the media visibility of scientists and the circulation of scientific articles, many of which had not even gone through the peer review process, increased considerably. On the other hand, the traffic of false or deliberately distorted information about the disease, the supposed treatments and the risks of the vaccines also increased. The aim of this study was to measure the impact of this information disorder on Brazilians' self-declared trust in science (Massarani et al, 2022).

One of the results is that 68.9% of those interviewed said they trusted or trusted very much in science. This figure represents a large majority of respondents, but is lower than that found in other surveys carried out in previous years. The comparison, however, should be made with caution, because the methods and questions were not the same[6].

Evidence that the disinformation that has circulated intensely during the pandemic has affected (upwards or downwards) Brazilians' trust in science can be better identified in the answer to the question of whether or not it has been altered during the COVID-19 pandemic:

> …only a third of people (32.9%) say that the pandemic has left their confidence unchanged. For the rest, the pandemic was the period of a change in attitudes towards science. The majority of respondents say that their trust in science has increased a lot or increased (55.6%) and for 10.1% it has decreased. The majority of those who say that their confidence has increased are young, female, with a university or postgraduate degree and an income between two and five times the minimum wage. (Massarani et al, 2022, p. 11, free translation)

The fact that 3 out of 10 Brazilians openly distrust the sciences should not surprise us. After all, it would be unreasonable to expect the majority of the population, abandoned by the elites and betrayed by the promises of Modernity, to "have the confidence of a Louis Pasteur or a Marie Curie in scientific facts!" (Latour, 2020, p. 33). And this is not due to what has become recurrent in journalism to call "post-truth," but much more to this triangulation between

[6] The INCT-CPCT research used the survey technique, collecting data through personal and individual home interviews. 2,069 people aged 16 or over were interviewed between August and October 2022, distributed among Brazilian municipalities of all sizes, in order to ensure regional dispersion and representativeness. The margin of error is 2.2%, with a 95% confidence interval (Massarani et al, 2022).

climate denialism, the explosion of inequalities and deregulation, which Latour has called post-politics:

> When journalists talk about "post-truth" politics, they do so very lightly. They do not stress the reason why some have decided to keep on engaging in politics while voluntarily abandoning the link to the truth that (rightly!) terrified them. Nor do they stress the reason why ordinary people have decided – and rightly so, in their case too – not to believe in anything any longer. Given what their leaders have already tried to make them swallow, it is understandable that they are suspicious of everything and don't want to listen anymore. (Latour, 2020, p. 35).

If the abandonment of the common world generates a general distrust of the facts, it is therefore necessary to rebuild the collectivities in connection. And in public communication of sciences, this means that scientists need to get off their pedestals and science communicators need to open up the black boxes of scientific practice. This is what we will deal with in the following sections.

## IT IS NECESSARY TO COMMUNICATE FACTS AND DEEDS

Bruno Latour (1993) observed that the paradox of scientific knowledge is that, despite being fabricated, it is also solid: there is a certain ambiguity between fact and deed, a relationship of dependence and at the same time opposition between science and research, which is not usually handled well by communication. In general, the so-called diffusion or dissemination of science only shines a light on the results (the cooled and solidified part of science). Meanwhile, most of the scientists' attention is devoted to what is not yet (and may never be) considered fact: the scientific process, i.e., research.

The result is that, communicated in this way, sciences and technologies become fetishes, concepts that we naturalize as black boxes (Latour, 2000)[7]. As Hans Jonas also observed with regard to technical and scientific progress and its increasing specialization, the collective heritage of knowledge tends to increase to the same extent that individual understanding of the world becomes increasingly fragmented: ". . . his accumulated knowledge becomes increasingly esoteric, less comprehensible to laypeople, and thus excludes most of our contemporaries from its observation" (Jonas, 2006, p. 270, free translation).

[7] The word black box is used by cyberneticians whenever a piece of machinery or a set of commands is too complex for us to know how they are used (input and output), not how they actually work (Latour, 2000).

The way to minimize this gap is not by trying to make every citizen a scientist – not least because there are different fields of research, and even for scientists in a given area, the knowledge that comes from other disciplines can seem enigmatic. Moreover, it's increasingly difficult to provide a broad

generalist education that gives an overview of all (or most) of the scientific facts involved in the techniques and equipment we depend on in our daily lives. Such breadth would even be a risk, since the inevitable overload of data implicit in it could cause saturation and exhaustion (Han, 2017a) and lead to Information Fatigue Syndrome (IFS), with a loss of analytical capacity and responsibility (Han, 2018).

Enrique Leff said, in his talk at the aforementioned webinar "Communicating the Climate Emergency: A challenge to science, human rights and democracy," that in view of the complexity of the causes and consequences of climate change, in order for people not to feel paralyzed, it is not enough to simply popularize the findings of climate science, it is necessary to open Pandora's Box[8]. One way to deal with this challenge would be to communicate facts and deeds, in other words, to explain the theories and methodologies that support scientific knowledge.

[8] Greek mythology deals with Pandora's Box as the one in which the gods keep all the world's ills – such as war and disease – but also the gift of hope.

The bet is that, little by little, the wider public will begin to understand that doubt is part of doing science, and climate deniers (and scientists in general) will no longer be able to use scientific controversies as a discrediting factor, as they do today. The so-called climate skeptics rely on the illusory demand for objectivity, as if there were a single yardstick to judge all the ways of verifying the truth. And so they apply the "double-click test" to climate scientists, saying in an accusatory tone: since you have data that you obviously transform, then you manipulate it.

The term "double click test" was used by Bruno Latour in a lecture given on August 9, 2012, at the Food and Agriculture Organization of the United Nations (FAO), broadcast by IPTV USP, to illustrate the demand for "information without transformation." It is linked to the transparency fetish worked on by Byung-Chul Han (2017a, 2017b, 2018), the anxiety exacerbated by digital culture that makes us want to find ready and objective answers to any and all questions on the internet, with just two clicks of the mouse. As this is an unrealistic claim, the frustration resulting from this attempt contributes to not only the sciences, but also religions and politics, increasingly being perceived as liars and manipulators.

Journalism, as a reductive language, also relies on the social expectation that it "contains the essential predicate of truth" (Chaparro, 2007, p. 11, free translation). Traditional journalism has historically tended to present itself as objective, capable of "observing the facts in their material reality, and without deformations resulting from the individual perspective of the observer" (Chaparro, 2007, p. 12, free translation). Journalistic facts would be understood for what they are, not for what they might be worth or mean.

It is no surprise, then, that journalistic coverage of the sciences generally eclipses achievements and presents facts as objective maxims. Research tends to be presented based on the (often decontextualized) clipping of part of its results, usually those most easily communicated through headlines.

But news – like everything else in general – cannot stand up to the double-click test either (and is being discredited as well). Journalistic facts are worth what they mean, they only gain meaning from their context (Noblat, 2007). Proof of this is that even newspaper writing manuals that advocate objectivity teach reporters to "start the news with what is most important" (Chaparro, 2007, p. 12, free translation).

Part of the campaign that seeks to discredit journalists comes precisely from the importance of journalism for democracy. What is at risk is the factual truth itself, i.e., "the truthful and verifiable account of what happened, and it structures nothing less than politics itself" (Bucci, 2022, p. 8, free translation). Along these lines, the "Fake Free Amazon" project from March to September 2022 mapped the main disseminators of disinformation in the region and identified hyper-partisan websites that present themselves as journalistic: Portal Novo Norte (TO), Terra Brasil Notícias (RN), and Vista Pátria (RJ). All three have in common the fact that they have received public funding and eclipse the socioenvironmental agenda not only with out-of-context data, but with the suppression of these themes, which represented less than 10% of the 206 pieces of content published by them in the period (Intervozes, 2023).

Therefore, communicating facts and deeds that explain climate mutation is a mission that journalists also need to take on. And not just so that we have better news about the issue, but also more news, since the gap is twofold: quality and quantity of coverage. When asked how often they hear about climate change in their daily lives (for example, on TV, in newspapers, on social media or in conversations with family and friends), 27 % of Brazilians say they hear about it at least once a week, 20% at least once a month, 29% a few times a year; 8% once a year or less; 5% never, 9% do not know, and 2% did not answer. Internationally, the scenario is not so different: in Sweden and Germany, where the population most often says they hear about it, the percentage of those who say it happens at least once a week is no more than 66% (Leiserowitz et al, 2022)[9].

[9] The countries with the lowest rates of respondents who hear about climate change at least once a week are Yemen (7%), Algeria and Cambodia (both 9%) (Leiserowitz et al, 2022).

Therefore, communicating the sciences in the context of climate education requires didacticism, but taking care not to fall prey to the fetish of transparency. As Byung-Chul Han (2017b) teaches us, transparency becomes a trap when it is linked to simplification, superficiality, pornography, commercialization, and homogenization – it is ultimately a systemic compulsion of the current stage of capitalism. But in concrete reality we cannot be transparent (in the sense of fully

disclosing ourselves) even with ourselves, let alone in social and interpersonal relationships: and this impermeability, far from being a problem, is a necessary condition for our health (spiritual, psychic, social): "It has been proven that a greater amount of information does not necessarily lead to better decisions. *Intuition*, for example, transcends the information available and follows its own logic" (Han, 2017b, pp. 16-17, free translation).

Communicating facts and deeds also requires dealing with different temporalities and scales, establishing the proclaimed local-global relationship. But here again, the purely Cartesian approach can lead to a misleading perception of totality, which needs to be overcome: ". . . one cannot pass from the Local to the Global by moving through a series of interlocking scales, as in the illusory impression of zooming that we can get from Google Earth" (Latour, 2020, p. 112).

This antizoom perspective is a central aspect of the actor-network theory developed by Bruno Latour. In order to understand the different scales and temporalities imbricated in a given reality, including in the production of scientific knowledge, it is necessary to follow the actors and describe the phenomena and relationships that constitute it:

> Whatever label we use, we are always attempting to retie the Gordian knot by crisscrossing, as often as we have to, the divide that separates exact knowledge and the exercise of power - let us say nature and culture. Hybrids ourselves, installed lopsidedly within scientific institutions, half engineers and half philosophers, 'tiers instruits' without having sought the role, we have chosen to follow the imbroglios wherever they take us. To shuttle back and forth, we rely on the notion of translation, or network. More supple than the notion of system, more historical than the notion of structure, more empirical than the notion of complexity, the idea of network is the Ariadne's thread of these interwoven stories. (Latour, 1993, p. 3)

The concept of sociotechnological networks developed by Latour (1993) helps us to understand that the multiplicity of ways of validating truth has nothing to do with relativism, but rather with relationism. In other words, it is not possible to (re)cognize scientific practice with the modern tweezers of the object-subject. Climatologists, for example, cannot say anything about the climate without the artifacts of theory and the apparatus of the laboratory:

> To speak in popular terms about a subject that has been dealt with largely in learned discourse, we might compare scientific facts to frozen fish: the cold chain that keeps them fresh must not be interrupted, however briefly. The universal in networks produces the same effects as the absolute universal, but it no longer has the same

> fantastic causes. It is possible to verify gravitation 'everywhere', but at the price of the relative extension of the networks for measuring and interpreting. The air's spring can be verified everywhere, provided that one hooks up to an air pump that spreads little by little throughout Europe owing to the multiple transformations of the experimenters. Try to verify the tiniest fact, the most trivial law, the humblest constant, without subscribing to the multiple metrological networks, to laboratories and instruments. (Latour, 1993, p. 119)

Latour (2020, p. 113) stated that "each of the beings that participate in the composition of a dwelling place has *its own way of* identifying what is local and what is global and of defining its entanglement with the others." Boaventura de Souza Santos also drew attention to the irrationality of the claim to universality, and pointed out that "the more global the problem, the more local and more multi-local the solutions must be" (Santos, 1999, p. 111, free translation). Therefore, we need to question the traditional division between center and periphery and recognize that the world increasingly works from the notions of circuit and border (Canclíni, 2015).

## REFUSING TO ENTER PLATO'S CAVE

In his book *Politics of Nature: How to Bring the Sciences Into Democracy*, Bruno Latour (2004) calls on us not to enter Plato's cave, breaking with the view inherited from Greek philosophy that there is an incompatibility between the world of men (human laws) and truths not made by the hands of men (laws of nature). This bicameralism (a break between things as they are – ontology – and the representations we make of them – epistemology – is what historically explains the view of science as one that presents indisputable facts and therefore, with its authority, puts an end to public discussion.

In Greek myth, the philosopher was the savior, the bridge between the world of truth and the social world. This sage, however, was murdered by the horde of ignoramuses, the uneducated and angry society. With Modernity and the appreciation of rationalism, scientists gained prestige and power.

Control of instruments and theory has become the power to define reality not just for experts, but for the general public. On the surface, this is democratic, because there is potentially the possibility of anyone having access to knowledge and technology. In reality, however, this access is restricted to a few:

> The rationality of public decision making must appear to be scientific. Hence intellectuals with a scientific style (including economists *par excellence)* have

> come to be seen as leading authorities, indeed the possessors and purveyors of practical wisdom. There has been a universal assumption (however superficial and laced with cynicism) that scientific expertise is the crucial component of decision making, whether concerning Nature or society[10]. (Funtowicz & Ravetz, 2000, p. 27, free translation)

[10] In the original: La racionalidad de la toma de decisiones públicas debe parecer ser científica; y por lo tanto los científicos sociales y humanos (en especial los economistas) han llegado a ser vistos como autoridades conductoras. Se supone universalmente (por acrítica y superficial que esta suposición sea) que el experto científico es el componente crucial en la toma de decisiones, tanto en lo que concierne a la naturaleza como a la sociedad.

The spell, however, as we discussed in the previous section, is being used against the sorcerer. And it was precisely the climate deniers who, with their disinformation campaigns, "have thus been clever enough to turn ordinary philosophy of science against their adversaries" (Latour, 2014, p. 27). With their criticism that the climate sciences were not objective, they illuminated the inseparability of the nature/culture binomial and the intrinsic relationship between description and prescription:

> We owe to the astute Republican strategist Frank Luntz, a psychosociologist and unrivalled rhetorician, the celebrated inventor of the expression "climate change" in the place of "global warming," the best formulation of this profound philosophy: the *description* of the facts is so dangerously close to the *prescription* of a policy that, to put a stop to the challenges addressed to the industrial way of life, one has to cast doubt on the facts themselves. (Latour, 2014 , p. 25)

The findings of climatologists on anthropocentric climate change have an obvious moral and political charge, which most of these scientists are not prepared to deal with: "What is to be done, indeed, in the face of 'inconvenient truths' if you possess only the right of uttering them with a mechanical voice and without adding any recommendation to them? You will remain paralyzed" (Latour, 2014, p. 28).

Despite this difficulty, part of the contribution of climate scientists goes beyond the mission of informing: it is about alarming, moving, setting in motion, taking sides in a war. Proof of this is that the Intergovernmental Panel on Climate Change (IPCC) was awarded the Nobel Peace Prize rather than the prize in physics or chemistry (Latour, 2020a).

The quality of information and problem-solving strategies are the two central points for most scientific methodologies. And both require dealing with of science now encompasses the management of irreducible uncertainties in knowledge and in ethics (Funtowicz & Ravetz, 2000). Publicly, however, these uncertainties tend not to be debated.

Since climate science deals with multi-scalar phenomena, with long duration of impacts and high complexity and variability, it tends to rely on mathematical

models and computer simulations that generate exact numbers in order to produce confidence. In their book *La ciencia posnormal: ciencia con la gente*, Silvio Funtowicz and Jerome Ravetz (2000) criticized this artificial hyper-precision with a joke: an attendant at a natural science museum was heard telling schoolchildren that a particular dinosaur bone was 56,000,012 years old. And when the children ask how he knew so precisely, the teacher promptly starts explaining about carbon-14 dating, but the museum attendant interrupts her and says that he has been working at the museum for 12 years and, when he joined, he took a training course in which he was told that the bone was 56 million years old.

Similarly, the false division between nature and culture is based on supposed certainties, when the sciences are basically dealing with probabilities. Latour denounces the authoritarianism implicit in the belief that facts stand on their own, "without a shared world, without institutions, without a public life, and that it would suffice to put the ignorant folk back in an old-style classroom with a blackboard and in-class exercises, for reason to triumph at last" (Latour, 2020, pp. 35-36): "When one calls upon 'nature' this way, it is almost always because one wants to explain yet again to dunces, within the virtual walls of a classroom, what they are going to end being forced to understand" (Latour, 2020a, p. 352, free translation).

One example the author has experienced of how to publicly acknowledge uncertainties is something that frightens – and even offends – many scientists: it happened in Manaus (AM) in 2004, when she was working as a correspondent for the then Radiobrás – now Empresa Brasil de Comunicação (EBC) – in the northern region[11]. Her office was in the Amazon Protection System (Sipam), a complex that also housed employees from various other federal agencies, including a group of climatologists responsible for a public climate forecasting service. There were dozens of Sipam satellite communication terminals scattered around various isolated locations in the Brazilian Amazon, where there were no other means of remote communication (such as telephone, internet, or radio). Radiobrás's management was keen to use this communication network to produce content for Rádio Nacional da Amazônia. The author then held a meeting with the team of climatologists and proposed that they do a daily radio program on climate forecasting. And she came up with the idea of making this forecast interactive: from Sipam, a scientist or the reporter herself would call one of the isolated locations and talk to a resident, asking, for example, if it had actually rained there the previous day, as predicted. And if the answer was no, then the scientist could take the opportunity to detail why the forecast had been rainy (i.e. give more details of what factors influence the rainfall) and also

[11] She was then the only professional of this federal public communications company – which also owns Rádio Nacional da Amazônia – who actually lived in the Amazon region.

explain that the forecast has a margin of error and a scale limit (i.e. it does not always hit the exact spot where the rain will or will not fall). Scientists were so horrified by the suggestion, promptly shouting that dynamics would discredit climatology, that the proposal was shelved.

Some scientists believe that to step down from the pedestal of certainty is to have their authority questioned, because their legitimacy has been built on the ideal of distancing. Modern scientific knowledge is based on the subject-object dichotomy, on the dictum that "*to know is to know from the outside*"[12] (Latour, 2020, p. 84). Galileo's discovery that the Earth revolves around the Sun in the midst of other planets contributed to the distanced perspective that the sciences adopted: "The fact that one can gain access to remote sites *from* the earth becomes the *duty* to gain access to the earth *from remote sites*." (Latour, 2020, p. 83).

[12]Italics kept from the original passage; a feature often used by Latour to highlight key ideas throughout his books.

The photograph of planet Earth taken by NASA in the 1960s has become a symbol of the emergence of the environmental issue, of the risk society; a metaphor on which the purposely vague discourse of sustainable development is based, that humanity shares a planet with limited resources and needs to come together to use them well (Hajer, 1995). Bruno Latour invites us to land, but not on the unified mother ship, but on Earth:

> It is obvious that the question of the sciences is central we are to survey the Terrestrial. Without the sciences, what would we know of the New Climatic Regime? And how could we forget that sciences have become the privileged target of the climate change deniers? / But we still need to know how to grasp them. If we swallow the usual epistemology whole, we shall find ourselves again prisoners of a conception of "nature" that is impossible to politicize since it has been invented precisely to limit human action thanks to an appeal to the laws of objective nature that cannot be questioned.(Latour, 2020, p. 80)

Latour says that he stopped using the term Gaia because many people appropriated it as if it contained a unidirectional intentionality ("Gaia, mother earth"). This understanding of totality is a mistake, since it is multiplicity in connection that characterizes the thinking of James Lovelock, his main influence in conceiving the Terrestrial:

> If the composition of the air we breathe depends on living beings, the atmosphere is no longer simply the environment in which living beings are located and in which they evolve; it is, in part, a result of their actions. In other words, there are not organisms on one side and an environment on the other, but a co-production by both. Agencies are redistributed. (Latour, 2020, p. 93).

In all the disputes taking place in the New Climatic Regime, the sciences play a decisive role. We therefore need to value them without believing too strongly in their metaphysics:

> It is impossible to understand what is happening to us without turning to the sciences – the sciences have been the first to sound the alarm. And yet, to understand them, it is impossible to settle for the image offered by the old epistemology; the sciences are now and will remain from now on so intermingled with the entire culture that we need to turn to the humanities to understand how they really function. (Latour, 2017, p. 4)

However, it is not a question of giving up rationality. But to direct it towards the Earthly, not the Global, making explicit the political nature of scientific practice:

> How can this difference in orientation be defined? The two poles are almost the same, except that the Globe grasps all things from *far away*, as if they were *external* to the social world and completely *indifferent* to human concerns. The Terrestrial grasps the same structures from *up close*, as *internal* to the collectivities and *sensitive* to human actions, to which they *react* swiftly. Two very different versions of the way for these very scientists to have their feet on the ground, as it were.(Latour, 2020, p. 82).

In other words, to land is to immerse oneself in the folds of the Terrestrial, without giving up the "moderns' major innovation: the separability of a nature that no one has constructed – transcendence – and the freedom of maneuver of a society that is of our own making – immanence" (Latour, 1993, p. 140).

## IMBRICATING ONESELF IN THE TERRAINS OF LIFE

The Earth is not the all-encompassing Global, so big that we cannot grasp it, nor is it the Local of illusorily self-sufficient borders and identities. It is made up of collectives in connection, who need to get to know which are their terrains of life or, in other words, which are the actors (human and more than human) on whom they depend and with whom they need to establish diplomatic relations. Landing, in this sense, is a movement that must reconcile two apparently contradictory processes, that of attachment and that of globalization: "The soil allows us to attach ourselves; the world allows detachment. Attachment allows us to get away from the illusion of a Great Outside; detachment allows us to escape the illusion of borders" (Latour, 2020, p. 112).

And the way to do this is through description: "How could we act politically without having inventoried, surveyed, measured, centimeter by centimeter, being by being, person by person, the stuff that makes up the Earth for us?" (Latour, 2020, p. 113). A process of recognition and analysis that should no longer take place in terms of production systems (based on the notions of freedom and mechanism, with a central role for human beings), but rather generation systems (based on the notions of dependence and genesis, with a distributed role for human beings):

> Caught up in a system of production, humans are alone in having the capacity to revolt – always too late; caught up in a system of engendering, *many other protestors* can make themselves heard – before the catastrophe. In the latter system, not only points of view but also points of *life* proliferate. (Latour, 2020, p. 107).

The contradiction between the system of production and the system of engendering is "not simply a matter of economics but rather of civilization itself" (Latour, 2020, p. 108). In line with Bruno Latour, an author who influences her[13], the award-winning Brazilian journalist and writer Eliane Brum, in her most recent work, *Banzeiro* Òkòtó - *uma viagem à Amazônia Centro do mundo*, stated that "living in the ruins, among ruins, ruining myself too, I understood that nothing changes, nor does the forest have a chance of continuing to exist, as long as people – all people, not just human people – are treated as leftovers" (Brum, 2021, p. 251, free translation). And, in another passage, she added:

> It is not possible to tackle the climate crisis with the same thinking that generated the climate crisis. The future depends on our ability to radically transform the way our species views itself and what it calls nature. To do this, we need to generate not only other knowledge, but also another structure of thought and even another language. (Brum, 2021, p. 343, free translation)

Thinking from the point of view of systems of engendering also means shifting the notion of past and future: we are now looking for the connection (what is or is not taken into account), rather than objectivity. There is no longer the arrow of modernist time, the ideas of linear progress and tradition as a return to the past no longer make sense: "It is the sorting that makes the times, not the times that make the sorting" (Latour, 1993, p. 76). The various temporalities, the provisional result of the connection between beings, therefore, coexist in what we call the present:

[13] The author is a supporter of Sumaúma, a trilingual news agency based in Altamira (PA), and took part in a virtual meeting with Eliane Brum's team on December 16, 2022, when she confirmed that Latour's work is one of her influences in thinking about the Amazon and the socioenvironmental issue in general.

> I may use an electric drill, but I also use a hammer. The former is thirty-five years old, the latter hundreds of thousands. Will you see me as a DIY expert 'of contrasts' because I mix up gestures from different times? Would I be an ethnographic curiosity? On the contrary: show me an activity that is homogeneous from the point of view of the modern time. Some of my genes are 500 million years old, others 3 million, others 100,000 years, and my habits range in age from a few days to several thousand years. (Latour, 1993, p. 75)

To exist, produce knowledge, and communicate it from the Earth, recognizing oneself as part of engendering systems, is to try to answer the following questions avoided by Modernity: "Who or what is speaking? Who or what is acting?" (Latour, 2017, p. 67). The modern doubt of double representation (do scientists betray or translate nature? Politicians betray or translate the people?) is one and the same. In the New Constitution (or Parliament necessary for the New Climatic Regime), mediation is brought to the fore, but not to solve the enigma (because the pure thing does not exist: science without society, politics without objects), but as a way of reactivating democracy (Latour, 1994).

From 2011 to 2013, Latour coordinated the *Gaïa Global Circus* project at the *Chartreuse de Villeneuve-lès-Avignon*, in which students from various disciplines simulated a climate conference in which the delegates were countries as much as "forest," "oceans," "lands," "indigenous peoples," "cities," "non-governmental organizations," "international organizations," "economic powers," "stranded petroleum assets," etc. And scientists were part of the delegates, in a dispersed way (and not gathered together and separated from the others, as at the Climate COP) (Latour, 2017).

Latour's inspiration was the National Water Authority, which has existed in the Netherlands since the 13th century, and which speaks on behalf of the rivers and seas, which is essential for a country built on dikes. In California, on the other hand, he regrets that there is no similar representation mechanism, despite farmers in the Central Valley depending on the waters of the aquifer, which are being overexploited:

> The fiction resides not in giving water a voice but in believing that *one could get along without* representing it *by a human voice* capable of making itself understood by other humans. The error does not lie in claiming to represent nonhumans; we do that in any case all the time when we talk about rivers, voyages, the future, the past, States, the Law, or God. The error would lie in believing it possible to take such interests into account without a human who embodies, *personifies*, *authorizes*, *represents* their interests. (Latour, 2017, p. 425)

Doing Science imbricated in the thousand turns of the Earth is ultimately an exercise in representation. And that increasingly requires scientists to improve their senses of perception of the various actors, as Aílton Krenak (2019, p. 15, free translation) reminds us:

> I read a story about a European researcher in the early 20th century who was in the United States and arrived in a Hopi territory. He had asked someone from the village to facilitate his meeting with an elder he wanted to interview. When he went to meet her, she was standing near a rock. The researcher waited until he said: 'She's not going to talk to me, is she?' To which his facilitator replied: 'She's talking to her sister.' 'But it's a rock.' And the fellow said: 'What's the problem?'

However, representation, which is so necessary for democracy, encounters obstacles in contemporary Western societies marked by digitalization and the cult of exposure, in which humans and more than humans tend to be objectified:

> Today, the world is not a theater where actions and feelings are *represented* and *read*, but a *market* where intimacies are exposed, sold, and consumed. The theater is a place of *representation*, while the market is a place of *exposure*. Thus, theatrical *representation* is currently giving way to pornographic exposure (Han, 2017b, p. 80, free translation).

In Western or Westernized societies, the "people of the commodity" (Kopenawa & Albert , 2019) are not shy about putting ancestral objects, animal bones and fetuses on display, for example. Something that infuriated Yanomami thinker Davi Kopenawa the first time he was in Paris and was taken by his hosts to visit a museum. Wisely sensing that description and prescription go hand in hand, he then asked himself:

> After all, after seeing all the things in that museum, I ended up wondering if the Whites hadn't already started acquiring so many of our things just because we Yanomami are starting to disappear too. Why do they keep asking us for our baskets, bows, and feather ornaments while the miners and farmers invade our land? Do they want to get these things in anticipation of our death? Will they then want to take our bones back to their towns? Once we're dead, will we be displayed in the same way, in glass cases in some museum? That's what it all made me think (Kopenawa & Albert, 2019, p. 429, free translation).

The Terrestrial invites us to take action, to "turn this mercantile house back into a home, a party house, where life is really worth living" (Han, 2017a, p. 128).

To do this, we need to go beyond scandalous and spectacular indignation at climate collapse:

> The society of indignation is a society of scandal. It has no *contenance*, no composure. Disobedience, hysteria, and rebellion – which are characteristic of the waves of indignation – allow for no discreet and factual communication, no *dialog*, no *discourse*. (Han, 2018, p. 22, free translation)

Fleeting indignation disperses without generating movement. We therefore need to find and tell stories that help us postpone the end of worlds:

> Our time specializes in creating absences: of the meaning of living in society, of the very meaning of the experience of life. This generates a great deal of intolerance towards those who are still capable of experiencing the pleasure of being alive, of dancing, of singing. And there are many small constellations of people scattered around the world who dance, sing, and make it rain. The kind of zombie humanity we are being called upon to join cannot tolerate such pleasure, such enjoyment of life. So they preach the end of the world as a way of making us give up on our own dreams. And my provocation about postponing the end of the world is precisely that we can always tell one more story. If we can do that, we will be postponing the end. (Krenak, 2019, p. 19, free translation)

A challenge for public communication of sciences in the New Climatic Regime, therefore, is to produce narratives that generate discourse and action. And one way to do this may be to move from Nature to the Terrestrial, from the Global-Local to the terrains of life: "Have you noticed that the emotions involved are not the same when you're asked to defend nature – you yawn, you're bored – as when you're asked to defend your territory – now you're wide awake, suddenly mobilized? (Latour, 2020, p. 17).

## FINAL CONSIDERATIONS: CLUES OFFERED BY EDUCOMMUNICATION

So far, this essay has achieved four of its five objectives. Based on Bruno Latour's thinking and in dialog with recent research on climate and science denialism in general and with other authors such as Han Jonas and Byung-Chul Han, it has been possible to: (1) discuss disinformation and climate denialism; (2) focus on the importance of working on the public communication of science by illuminating research processes and their controversies; (3) debate why it is necessary to overcome the myth of objective knowledge and ground the

production and communication of diverse types of knowledge; and (4) address the intrinsic relationship between science, discourse and representation. In these final remarks, it remains to present educational-communicative practices that offer clues for epistemologically and empirically confronting the challenges of public communication of sciences in the context of climate mutation.

In Brazil, there is a certain historical distance between environmental education and climate science (Jacobi et al, 2011; WWF-Brazil & Instituto Ecoar, 2009). In so-called climate education, "a content-based reading tends to predominate, as a transfer of meanings of techno-scientific potential, with a list of tips and practical suggestions of a behavioral, simplistic, reductionist, and decontextualized nature" (Tamaio, 2010, p. 46, free translation).

This assessment also appears in the international literature on the subject, which points out that environmental education campaigns related to climate change are marked by the belief that, in order to change habits and behaviors, efficient and objective communication is needed. This view is based on short-term pragmatic thinking, which continues to treat recipients as automatic decipherers or as simple means to achieve a certain end (Brulle, 2010; Nerlich et al., 2009).

Bruno Latour (2004, p. 351) taught us, however, that "Ecological crises, as we have interpreted them, present themselves as generalized revolts of the means: no entity – whale, river, climate, earthworm, tree, calf, cow, pig, brood – agrees any longer to be treated 'simply as a means' but insists on being treated 'always also as an end.'" For this reason, public communication of sciences is increasingly being urged to adopt a dialogical, critical, and collaborative stance, which finds its theoretical basis and methodological support in what is known as socioenvironmental educational-communication (Brianezi & Gattás, 2022).

A good example of climate education that values scientific knowledge as a process, in an educational-communicative way, is the Climate Mural. It was created by Frenchman Cédric Ringenbach, from the French National Centre for Scientific Research, in 2015, from the exercise of asking his trainees to place graphics from the IPCC reports and relate them. In 2018, the Mural became an association and was licensed under *Creative Commons*, free for non-commercial use. In the game, which has an online and printed version, for children and adults (in two levels: intermediate and advanced), the participants position 42 cards containing images and key data from the 6 reports already published by the IPCC, in a dialogical way, looking for the connection between them.

The positioning of each card and the dialog generated from the construction of the mural are mediated by a facilitator. In Brazil, there are almost 100

Climate Mural facilitators and more than 3,000 people who have taken part in building murals, making us the second country outside Europe with the most editions[14]. These figures are directly related to the Virtual Climate Learning Journeys – *Jornadas pelo Clima*, created by Climate Reality Brasil manager[15], Renata Moraes, at the end of 2020, and which by the end of 2022 had already completed 33 classes, with 577 micro-projects written and 739 certified participants.

*Jornadas pelo Clima* (Climate Journeys) has been certified by the Banco do Brasil Foundation as a social technology and listed in the UN Resource Library as a reference in the education sector[16]. Each day consists of 5 weekly synchronous meetings of 3 hours each, with a playful and interactive perspective. And between them, the exchange between participants continues via WhatsApp group – and there are missions to complete, which seek to bring climate knowledge closer to each person's life. Each person is encouraged to draw up a micro-project to put some of what they have learned into action.

In October 2022, Climate Reality Brasil sent out an online questionnaire to people who had completed the Jornadas pelo Clima, and received 67 responses. Of those respondents, only 29% actually carried out all or part of their micro-project. Despite the low number, the actions generated are significant, among them: the virtual library of open educational resources on climate education (*Climateca*) created by the SP Climate Coalition[17], and the inclusion of climate education in the curriculum of public schools in Rio de Janeiro (Municipal Law No. 7.523/2022), the result of mobilization promoted by the RJ Climate Coalition.

Climate mutation is multiplying "tangled objects" (Latour, 2004) that remind us that we have moved from the world of objective certainties to that of probabilities, requiring us to open up and relate to different black boxes of scientific knowledge. Educational-communicative experiences such as the Climate Mural and Climate Journeys, from different perspectives and actors, seem to make dialog a strategy for translating and, above all, appropriating scientific knowledge by audiences and collectives mobilized in favor of their livelihoods in the context of the New Climatic Regime.

[14]Data from December 2022 systematized by Climate Reality Brazil and made available to the author because she is part of Climate Reality's international network of climate leaders and the national network of *Jornadas pelo Clima* facilitators.

[15]In 2016, the Brazilian Climate Center (CBC), created by Alfredo Sirkis (who died in 2020), began representing The Climate Reality Project in Brazil, created 10 years earlier in the United States by Al Gore. In August and September 2022, the international organization held its annual virtual climate leadership training focused on Brazil, in Portuguese, with 7,000 people registered, 3,000 of whom completed the training.

[16]More information is available at (Journey for Climate, 2022).

[17]Constantly updated (Climateca, n.d.).

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