Listening to science? A proposal of historical periodization of the problem of climate change communication

¿Escuchar a la ciencia? Una propuesta de periodización histórica del problema de la comunicación del cambio climático

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ABSTRACT: This article reviews the evolution of the problem of climate change science communication from 1988 to 2022 to determine the current state of the question and to identify the rhetorical approaches most widely used to date. Methodologically, a distinction is first drawn between institutional milestones and rhetorical moments in discourses originating in science, politics, and the arts/media. A general corpus of 13,794 documents, including scientific literature, journalistic sources, and official reports, is then reviewed. The result is a proposal for a historical periodization with three periods: from 1988 to 2009, characterized by pragmatic communication needs; from 2010 to 2015, when the need to communicate climate change as a social fact emerged; and from 2016 to 2022 when climate change began to elicit specific political action on the international stage. The results reveal evidence of rhetorical connections in the discourses used by the different actors involved in socially shaping public knowledge of climate change. As to the conclusions, it is essential to explore hybrid formulas of epistemic authority and to conduct further research on a dialogic model of science communication that does not overlook the need to "listen to science", while also including the idea of a science that listens.

Keywords: climate change; historization; science communication; global warming; epistemic authority.

RESUMEN: Este artículo revisa la evolución del problema de la comunicación científica sobre el cambio climático desde 1988 hasta 2022, con el objetivo de determinar el estado actual de la cuestión e identificar los enfoques retóricos más ampliamente utilizados hasta la fecha. Metodológicamente, primero se establece una distinción entre hitos institucionales y momentos retóricos en discursos provenientes de la ciencia, la política y las artes/medios. Luego, se revisa un corpus general de 13,794 documentos, que incluye literatura científica, fuentes periodísticas e informes oficiales, lo que da lugar a una propuesta de periodización histórica en tres períodos: de 1988 a 2009, caracterizado por necesidades pragmáticas de comunicación; de 2010 a 2015, cuando surgió la necesidad de comunicar el cambio climático como un hecho social; y de 2016 a 2022, cuando el cambio climático comenzó a generar acciones políticas

específicas en el ámbito internacional. Los resultados revelan evidencia de conexiones retóricas en los discursos utilizados por los diferentes actores involucrados en la configuración social del conocimiento público sobre el cambio climático. En cuanto a las conclusiones, es esencial explorar fórmulas híbridas de autoridad epistémica y llevar a cabo más investigaciones sobre un modelo dialógico de comunicación científica que no ignore la necesidad de "escuchar a la ciencia", al mismo tiempo que incluya la idea de una ciencia que escucha.

Palabras clave: cambio climático; historización; comunicación de la ciencia; calentamiento global; autoridad epistémica.

1. Introduction

Global warming appeared on the cover of The New York Times in June 1988. Scientific alarm then jumps from specialised scientific circles to the wider social conversation.

More than three decades later, a prominent fracking executive who denies climate change is nominated by United States President as energy executive. At the same time, 2024 is confirmed by the European Copernicus Climate Change Service (C3S) to be the warmest year on record globally. This means that 2024 is as well the first calendar year that the average global temperature exceeded 1.5°C above its pre-industrial level.

The scientific alarm is not heeded, but the Earth temperature confirms it. Something is wrong with the need to listen to science. What has been done communicatively to prevent this problem? How have our efforts to prevent it evolved?

In 2019, almost 1,000 scientists signed a declaration endorsing civil disobedience as a necessary strategy to convey the severity of the climate and ecological emergency (DeSmog, 2019). Civil disobedience appears to be simply the latest attempt at getting society and political authorities worldwide to listen to science and act decisively. It also foregrounds the problem of how to communicate effectively the current ecological emergency.

The focus is placed here on this last issue, reviewing and systematizing current climate change communication as the failure to listen to science. The guiding premise of this piece of research is the huge importance attached to the critical awareness of rhetorical features in fostering a productive dialogue between radically different economic, political, and social actors. More precisely, the aim is to establish the problem's historical evolution with a view to gaining a deeper understanding of the discursive strategies used at different moments in time. It is believed here that it is possible to establish a periodization by identifying the points of origin (formulation of the problem) and shifts (reformulations of the problem), as well as the increase in and/or easing of tensions in the discourse (counter-formulations of the problem).

The research presented here reviews four decades of discursive production revolving around climate change in the fields of science, politics, and the arts/media, from 1988 to August 2022. Previous studies have shown that these are key areas of mediation that shape social perceptions of climate change as a scientific fact (Corner and Groves, 2014, p. 744; Doyle, 2011, p. 2). As to the methodological approach, this study takes the shape of a non-systematic review (Cameron et al., 2021, p. 83) of academic, press, and official sources involving several actors in the debate on climate change. Analytically speaking, a distinction is drawn between "rhetorical moments" (Calderwood, 2020) and "institutional milestones" as times when discursive agents such as political subjects of governance, activists, scientists, or academic publishers play mediating roles. Finally, a constructivist approach was taken as it was assumed that the way of understanding the current ecological and climate emergency prefigures the courses of action considered to tackle the problem.

First, a critical analysis is performed on the available scientific literature, identifying the perceived causes and epistemic premises that have shaped communication patterns affecting

public perception of climate change. This is followed by a description of the methods employed to identify rhetorical moments in both governance and climate change communication, as well as relevant institutional milestones. The results point to two important cut-off points in 2009-2010 and in 2015-2016, as well as to discursive shifts. All of this allows for formulating a working hypothesis and proposing a historical periodization of the problem of climate change science communication in the final section of this article. The main aim of such a proposal is to raise critical awareness of the stances currently taken in the debate on climate change communication.

2. Scientific literature review

During the first two decades of the 21st century, the specialist literature on communication and climate change included many descriptions of what does not work (ineffective communication). "We have failed to touch people's hearts," confesses Johan Rockström (2020, p. 370), joint director of the Potsdam Institute for Climate Impact Research (Germany). In fact, since becoming a topic of public concern, climate change communication has been perceived as a "problem" that remains both unresolved (Stamm, Clark and Eblacas, 2000, p. 219) and ineffectively addressed (Hassol, 2008, p. 106). Scientists, politicians, and a diverse range of experts seem to have been unable to communicate climate change impactfully (Howarth et al., 2020, p. 322). In addition, some believe that although facts have been reported, the need for an urgent response has not been adequately conveyed (Fraude et al, 2021). Others have emphasized that climate change communication addresses a topic that is extremely difficult to understand because it requires specialist knowledge that laypeople lack. It is also a long-term problem that transcends human lifetimes. It causes suffering that is most felt by those who least contribute to it and have the least resources to combat it (Sommer and Klöckner, 2021, p. 60).

In general, the literature on climate change communication highlights persistent challenges in conveying the urgency and significance of the issue. Despite decades of effort, experts have often focused on presenting scientific facts rather than inspiring actionable responses. This has led to ineffective communication and public disengagement. Barriers include the abstract, long-term nature of climate change, a lack of emotional resonance, and ideological resistance. The media's role has been critiqued for insufficient and depoliticized coverage, further exacerbating public apathy. While numerous studies examine these shortcomings, there remains limited exploration of the broader social, political, and epistemic dynamics shaping climate change communication strategies.

Virtually every academic paper on climate change communication published since 1988 has addressed these perceived problems, albeit from different perspectives. Corner and Groves (2014) have contended that we are at a communication impasse that cannot be broken solely by clearly presenting scientifically proven facts. It has also been suggested that an answer to the problem is not forthcoming because more coverage has been given to explaining the situation than to the different ways in which it can be tackled (Wirth et al., 2014). Furthermore, it seems that science and the media have been unable to communicate the urgent need to bring about changes (Hagen, 2016). Mitigation measures have also been apparently overlooked (Mitchell, Burch and Driscoll, 2016). In the literature on the topic, an apocalyptic approach has very frequently been taken to climate change. This which has led to a certain fatalism (Jackson, 2015) and has encouraged people to accept the idea that there is certain justice in "mother nature" taking revenge for the damage that has been caused to her (Skrimshire, 2014). Rather than inspiring people to act (Moser, 2016), this has resulted in a feeling of despondency because information on mitigating climate change does not seem to have been transmitted in such a way as to move people to action (Mitchell, Burch, and Driscoll, 2016).

The question of the epistemic premises of climate change communication has also received its fair share of attention. It has been claimed that they have been employed to promote strategies

mainly focusing on making the issue known to the public, stressing that knowledge does not raise awareness about the crisis (Kahan et al., 2012, p. 733-734). Some argue that information alone is insufficient to engage the public when there is a need to build on experience (Akerlof et al., 2013). For other authors, the rational approach is lacking because the values and prior beliefs of audiences serve to filter out information posing a threat to their ideological identity (Trevors et al., 2016). Yet others hold that abstract information is not sufficient because it leads to an analytical, second-hand experience, while creating a distant perception lacking in emotion (Burke, et al., 2018, p. 95-96). This was singled out as an unsuitable approach very early on (Weber, 2010). Notwithstanding these objections, the problem persists even when climate change communication employs figurative images (Duan et al., 2022). For his part, Hammond (2018, p. 3) has noted that the issue was successfully inserted into the media in the 2000s, but has long been regarded as being depoliticized.

Other studies have inquired into media coverage deficits and shortcomings (Bolsen and Shapiro, 2018; Boykof and Boykof, 2007). Indeed, quantitative content analyses conducted on Western media are the most widespread (Agin and Karlsson, 2021). Other analyses on different media sources (e.g. Albright et al., 2020) confirm the lack of information on climate change provided by healthcare services at a state and local level in the United States. The public perception of climate change is also a subject linked to communication practices that has attracted the attention of the research community (van der Linden, 2015a; 2015b). In the United States such link has been associated with political and media polarization (Bolsen and Shapiro, 2018), with authors emphasizing that, as late as 2019, a significant proportion of the population still did not see climate change as a personal risk (Ballew et al., 2019).

Academic reviews have been carried out in the field of climate change communication since 2015. The review performed by Agin and Karlsson (2021), possibly the most recent one, does not distinguish between environmental and climate change communication, even though one of the most influential papers in this respect highlighted the importance of this difference (Doyle, 2011). Yet, it has been impossible to encounter reviews exploring the conception and evolution of the topic examined here, namely, the social, political, and scientific problematization of climate change communication.

3. Methodology

As already noted, the intention here is to provide a structured overview of the historical evolution of the problem allegedly affecting the dissemination of climate change science information, to wit, the lack of listening, from 1988 to 2022.

This overview requires international observation coverage since the United Nations Framework Convention on Climate Change as early as 1992 states that 'its adverse effects are a common concern of humankind as a whole' and therefore requires a response from all states. Since the late 20th century, regulatory actions on climate factors by state, non-state, public and private actors have begun to intensify (Fariborz, 2011) and in many cases their interventions overlap inefficiently (Pattberg, 2010). Over time, it has come to be recognised that the problem of greenhouse gas emissions causing climate change is known to be addressed by stopping emissions. But, in contrast, the problem of global coordination to achieve such a halt has not been solved (Baraka, 2018). This forces us to take a look at the discourses worldwide.

To address that lack of listening with a global view, it was first necessary to identify institutional milestones and rhetorical moments regarding both governance and climate change communication. Our aim was to establish whether some of the latter might be considered as cut-off points marking the beginning or end of important historical periods in relation to the problem analyzed. This was achieved by reviewing the production of discourse in three social areas: science, politics, and the arts/media. Once a hypothesis about periodization had been

formulated, a narrative review was performed on the scientific literature on climate change communication to discern whether these periods displayed a convincing degree of internal continuity. The presence of sufficient distinctive features has also been considered with a view to validate or refute the working hypothesis, before substantiating a periodization proposal. It is important to stress that the whole process involved a constant looping back and forth from the data obtained in early reviews to the formulation of hypotheses to put forward a final periodization proposal.

A double-step review process was followed to obtain the initial data:

(1) Path mapping of the institution-building process of climate change governance with a view to identifying institutional milestones and rhetorical moments. Review guided by two questions: 1) which subjects of authority emerge in this process, and 2) which concepts, notions or argumentative items are installed in the public conversation. Method: non-systematic review (Cameron et al., 2021, p. 83) until saturation is reached. Corpus selected by snowball sampling technique (Noy, 2008) applied over journalistic reports and official documents released by bodies and institutions connected to climate change. The aim was to find items to start mapping the historical sequences of institutional milestones and rhetorical moments in climate change governance. This review provided an initial list lately completed with data from the second phase review (List 1 below).

(2) A narrative review with some methodology reported (SMR). This review falls into the second type of the three categories distinguished by Faggion et al (2017), which offers a hybrid review that combines systematic techniques to narrow down the corpus and narrative techniques to collect descriptions. This review has addressed only scientific literature on communication and climate change. With two phases, our review produced two different corpora: a general corpus for a quantitative review and a specific corpus for a narrative review. The first step involved running systematic searches on the Web of Science database, resulting in a general corpus of 13,794 publications for the quantitative review, from which a more restricted sub-corpus of 371 publications was retrieved for the narrative review. Searches were conducted during the first fortnight of August 2022. The main features of both are described below:

The corpus was built by running two searches with different combinations of search terms, starting with those identified in other studies (Calderwood, 2020; Anderegg and Goldsmith, 2014): "climate change" and "global warming". In both searches, one of these two expressions was combined with the term "communication", resulting in a corpus of 13,749 publications, of which 12,289 included "climate change" plus "communication" in their body text and 1,505, "global warming" plus "communication". This total corpus of publications was then filtered using diverse criteria: by year, by communication category, by type of publication (book, article, proceedings, etc.), by language, and by publication title. Thanks to this successive filtering, it was possible to obtain data (number of publications per filter category) that might have revealed differences between periods. Some of the filter criteria employed were of convenience or intentionally linked to the dates of milestones that had been previously identified during the historical review of climate change governance. This quantitative review provided an overview of the scientific production which was then used to research climate change communication in the period from 1988 to 2022 and might also help to identify possible dates for the periodization.

This corpus resulted from a narrative review whose aim was to characterize qualitatively different periods. A review using search terms appearing in the body text of publications does not mean that specific works on the communication issue in question will be identified. This is why it was decided to create a more specific corpus by using the same search terms but, on this occasion, for works that contained them in their title and abstract. This search yielded a sub-corpus of 382 texts, 368 and 14 from the "climate change" plus "communication" and the "global warming" plus "communication" searches, respectively. In this phase, a narrative bibliographical review was employed rather than a systematic one (Greenhalgh, Thorne, and

Malterud, 2018) because the idea was to gain a better understanding of a dynamic phenomenon. Following the guidelines for performing iteration reviews, further searches were run using new terms: mainly, previous works by authors, journal titles, historical events, and research centres and institutes. Consequently, the initial sub-corpus of 382 publications was broadened with other works useful for characterizing the periods, bringing the final number to 392.

These 392 papers have been explored based on a two-criteria guide: to locate new institutional and rhetorical landmarks on governance to complete our first list and to locate institutional milestones and rhetorical moments in the academic field for second list presented below.

In this narrative review we have proceeded by prioritising our objective of periodisation. We have therefore first looked for points of convergence between institutional and rhetorical moments. We have set time markers from these points. Then we have selected articles dealing with these milestones. We have then proceeded from these articles by means of a backward tracing technique through the sources the mention. In this way we noted the tracing of sustained lines of argument and interrupted lines (theoretical bases explicitly rejected in the texts).

We have extended the process to a point of logical saturation (Morse, 1995). Given that we have no prior periodisation, the first convergences we have detected have provided an initial structured overview, and evidence that consistent features of climate change communication research remain within each period. But the study could be refined with further exploration.

In short, our methodological set-up does therefore combine a two-step review process: first, identifying institutional milestones and rhetorical moments in climate change governance through a non-systematic review of academic and journalistic sources and, second, conducting a systematic review of climate change communication literature. In subsequent research stages, after identifying institutional milestones and rhetorical moments as potential cut-off points, a hypothesis is formulated for the periodization by cross-referencing the results from both initial searches to confirm whether there was any narrative continuity between the data included in each proposed period. Likewise, an attempt was made to identify any discontinuities that might have supported – or otherwise – the hypothesis, characterizing the periods both quantitatively and through a more narrative approach, which ultimately results in the historical periodization proposed in the final section of this article.

4. Institutional milestones and rhetorical moments for governance and climate change communication

With a history of permanent change, the intellectual understanding of the climate has increased under significant pressure from governmental, military, and corporate interests (Heymann, 2010, p. 587). All ways of understanding the climate are products shaped by the context in which they have been produced (Carey, 2012, p. 238), and all have given rise to different forms of social organization for managing them (Pfister, 2010, p. 29; Cox, 2010, p. 2; Hulme, 2009, p. xxviii-xxxiv). Changes in the climate have been observed and discussed since classical antiquity (Hulme, 2011; von Storch and Stehr, 2000). Yet, the concept of global warming, in relation to climate change induced by human activity, was coined by the geophysicist Wallace S. Broecker (Jouzel, 2020, p. 214) in 1975. Despite occasionally appearing in the press in 1977 (Wang, 2021, p. 31), it would not be publicly recognized as a global problem until the 1980s (Doyle 2011, p. 3). In no period of history, Heymann (2010, p. 593) notes, has there been a single, consistent understanding of the climate. Diversity has been the norm, and these different intellectual constructs have spawned separate and often divergent epistemic communities. In plain English, one could say that all of them have defined the problem according to their own interests.

Likewise, each and every approach to climate change has triggered different reactions (Doyle, 2011, p. 2). These responses have, in turn, become factors in the evolution of the problem

and its risks (Simpson et al., 2021), meaning that the phenomenon as an idea (discourse) is decisive in its material process (physical reality) (Lorenzoni and Whitmarsh, 2014, p. 703). The study presented here approaches climate change precisely as an idea. Each one of the agents participating in the social conversation on the climate crisis produces a discourse that interacts with the rest. As we have previously mentioned, the aim here is to periodize the emergence of discursive agents addressing climate change and the rhetorical moments, turning points in the formulation of the problem, and the narrative shifts produced by them. Each one of those discourses has its own social framework for understanding the problem of listening to science, and each framework is valuable because it introduces nuances when addressing the problem. Since the earliest analyses of the lack of listening to science, it has been evident that a change in values (Hoffman, 2012) is needed to combat this situation.

In 1988, the conversation on climate change, hitherto maintained exclusively in scientific circles, came into the public eye. There was a change in how it was communicated (Russill, 2008, p. 134). In June, the term appeared on the cover of The New York Times (UCS, 2015, p. 4). It was mentioned at the launch of the Intergovernmental Panel on Climate Change (hereinafter IPCC) at the United Nations conference in Toronto and, shortly afterwards, made its way into the discourse of the British Prime Minister. These are some of the reasons why scholars generally agree that 1988 was the year when the public climate change problem emerged (Jaspal and Nerlich, 2014, p. 123; Doyle, 2011, p. 17). A year later, climate change cropped up in the US President's discourse (Calderwood, 2020), while the major US fossil fuel corporations, including EXXON, Ford, and Chevron, created the Global Climate Coalition to intervene in the public debate with a view to calling the scientific discourse into question (Doyle, 2011, p. 14). It marked the beginning not only of the scientific and political discourse, but also of a war of words on climate change. The IPCC, the first body in history to mediate in the global discourse of climate change science, was tasked with regularly collating and summarizing the results of scientific research in that field. Rather than conducting its own research, it updates the state of the art in climate change to provide materials for the deliberation of governments (Dudman and Wit, 2021). It is, therefore, a key agent in the problematization addressed herein.

The report of the 1992 United Nations Conference on Environment and Development, the Rio Earth Summit, recognized the emergence of a communication problem: the need to open a debate on environmental issues beyond academia, initiating a dialogue with the citizenry and making it easier for them to participate in decision-making (Juárez-Bourke, 2018, p. 145). At this summit, two aspects with a bearing on the object of study here emerged: 1) the problematization of climate change communication; and 2) the emergence of the Conference of the Parties (hereinafter COP) as a new subject in global climate change political governance, destined to play a leading role in the collective definition of the problem. With the most highly regarded political discourse on climate change in the world, the COP is a body with different layers (voices), encompassing not only government representatives, but also specialists, experts, and civil society, although its final declarations are only signed by government representatives. This explains why the COP does not always speak with a single voice. In 2022, at the time of writing this article, the COP, which was first held in 1994, included 196 member countries.

The end of the 20th century marked the beginning of this new institutionalism, which would lead to a new flow of political activity, environmental diplomacy, and output of documents. In turn, this created significant needs for public communication at a time when specialist academic studies had yet to be performed on climate change communication. For a time, the actors involved met their communication challenges using solutions from other fields (political communication, advertising, corporate public relations, etc.) and/or their own intuition. Indeed, this first period would prove to be a breeding ground for cults of personality and leaders who would suggest creative solutions in a markedly authorial style. The example of Al Gore and his documentary An Inconvenient Truth (2006) illustrates this well.

The first challenge for researchers on climate change communication was to encounter practical solutions for improving the effectiveness of communication. This pragmatic goal would permeate the definition of the academic field of climate change communication from the outset. The following list details institutional milestones (M) and rhetorical moments (RM) as potential cut-off points in the historical development of global climate change governance:

Figure I. Institutional milestones and rhetorical moments in climate change governance

- 1988 – Creation of the IPCC (M).

- 1990 – First IPCC report (RM): anthropogenic change could not be unequivocally said to exist. (Doyle, 2011, p. 14).

- 1992 – Rio Summit (M), creation of the COP (M) and acknowledgement of the need to reduce emissions (Svampa, 2020, p. 111; Dunlap and McCraight, 2010, p. 244).

- 1994 – UN Framework Convention on Climate Change 1999 (M). The concept of climate justice is introduced (RM) (Newell, 2022).

- 1997 – Signing of the Kyoto Protocol (M) and (RM) the outlining of the instruments for cutting pollutant emissions.

- 2002 – Creation of the Transition Town movement in Ireland (M).

- 2005 – Change in the naming of the problem: the issue was not the time cycle but human health (RM) (Russill, 2008, p. 140).

- 2006 – Al Gore, *An Inconvenient Truth*. A communication strategy based on the information deficit model (Sakellari, 2015, p. 233-234). Linear model, explanatory, one-way approach, based on the presentation of rational information, data, and graphics (traditional classic model of science) (RM).

- 2007 – Fourth IPCC report (RM): the warming of the climate system was incontrovertible and there was evidence of it (Doyle, 2011, p.14).

- 2007 – Surge in online searches for "global warming" and "climate change" (Anderegg and Goldsmith, 2014).

- 2007 – Nobel Peace Prize awarded to the IPCC and Al Gore (M).

- 2009 – COP15 Copenhagen Summit, regarded as a failure of dialogue (Svampa, 2020, p. 112; Latour, 2010, p. 479). Ideological division and organization of protests in the wake of the summit (Todd, 2022).

- 2009 – Climategate: science discredited (Anderegg and Goldsmith, 2014; Maibach et al., 2012; Doyle, 2011, p. 13).

- 2010 – April, World People's Conference on Climate Change and the universal declaration of the Rights of Mother Earth, Tiquipaya (Bolivia) (RM). On December 21, Bolivia enacted the Law of the Rights of Mother Earth which recognized her as a rights-holder (RM).

- 2010 – Polly Higgins submitted a definition of ecocide to the United Nations Law Commission (RM).

- 2012 – "Move beyond data and models" (Hoffman, 2012, p. 34). Climate change was not a matter of science, but of cultural and ideological values, and what was approaching was a "culture war" (RM).

- 2015 – The Climate Change Coalition ceased activities (Brulle, 2021) (M).

- 2015 – COP21, Paris Summit (M), global agreement to combat climate change (which came into force in 2021), progress timetable for emission reduction (RM).

- 2015 – New formulation of the communication problem (RM): the Paris Agreement recognized shortcomings in dialogue in the heart of the COP and called for solutions to be explored (Mar et al., 2021, p. 5). Over time, this led to the inclusive process for facilitative dialogue, called the Talanoa Dialogue.

- 2016 – The Greens (Germany) included climate change in their manifesto (RM).

- 2017 – Launch of the Talanoa Dialogue platform, COP23 Bonn, whose political phase concluded at the 2018 COP24 Katowice (Poland).

- 2018 – Increased social mobilization, with new global subjects (M) – Fridays for Future, Extinction Rebellion – and globally significant rhetorical moments with widespread media coverage: listen to science.

- 2018 – COP24, Katowice (Poland), creation of the Paris Agreement Compliance Committee (M).

- 2019 – Call by Pope Francis to make ecocide a crime (RM).

- 2021 – 2015 Paris Agreement came into force.

- 2021 – Strengthening of regulations.

- 2021 – COP25, Glasgow. (RM) The testing of alternative communication methods in the Co-Creative Reflection and Dialogue Space (CCRDS) (Mar et al., 2021, p. 6).

- 2020 – Strengthening of political regulations in Europe.

- 2022 – Rejection in a referendum of the proposed Chilean Constitution which included the right to live in a pollution-free environment and the responsibility of the state to protect nature.

- 2022 – Summer of record temperatures in Europe.

In light of the above, several dates that could form the basis of a proposal for the cut-off points and periodization can be identified: 1988, which seems an indisputable point of departure in view of the scientific literature review; 2009-2010; and 2015-2016. The reason behind this choice of cut-off points is described in further detail below.

The transition from the first to the second decade of the new millennium –be it 2009 or 2010– has several points of departure and discontinuity as regards new discursive stances. COP15, which was held in Copenhagen in 2009, was viewed as a change in the political process that had got underway at the 1992 Rio Summit (Fernández Durán, 2010: 71). This summit failed to produce a legally binding agreement obliging the parties to follow a greenhouse gas emission reduction program (Svampa, 2020, p. 112; Pearce et al., 2015, p. 613; Doyle, 2011, p. 2; Latour, 2010, p. 479). All attempts to include civil society in the negotiations also ended in failure, with civic groups being marginalized and politically silenced. Partly due to this fact, the institutional rift between reformist and radical activism, which had been brewing since the 1980s, was clear to all by the end of the 2010s (Todd, 2022, p. 178). Climategate occurred in the same year as the Copenhagen summit, which further undermined scientific authority. A few months after COP15, a new international encounter of a radical nature was held in Bolivia from April 19-22, 2010. The World People's Conference on Climate Change and the Rights of Mother Earth was organized in Tiquipaya, on the outskirts of the city of Cochabamba. It responded to a call from Evo Morales, the then president of Bolivia, for a constitution that recognized Mother Earth as a rights-holder. This radical new turn in the tradition of constitutional law was a rhetorical moment that ushered in a novel understanding of the problem according to which the Earth

was a rights-holder in the discourse. On December 21, 2010, the Law of the Rights of Mother Earth was enacted in Bolivia (Vargas, 2012, p. 257).

The 2015 Paris Summit also represents a relevant rhetorical moment because: 1) it revealed a new aspect of the problematization, namely, the need for facilitative dialogue for change (Mar et al., 2021, p. 5), which meant shifting the focus from the message to the communication process itself; and 2) it gave centre stage to the action plan for combating climate change, involving a shift from the narrative of description to one of action. Various subsequent developments, such as the Talanoa Dialogue process, can be traced back to this change occurring at the 2015 Paris Summit.

With respect to climate change communication as an academic field, a clear discontinuity is also evident in the transition from the 2000s to the 2010s, which reinforces the decision to establish a cut-off point in 2009-2010. At the time, there was an increase in scientific production (Moser, 2016) questioning the epistemic assumptions of previous works (Lorenzoni and Whitmarsh, 2014, p. 704; Doyle, 2011, p. 13 ff.), with critical reviews that concluded that it was necessary to move forward from the information deficit model to the goal of critical engagement and inclusive dialogue (Pearce et al., 2015, p. 614). The call for a plurality of academic views on climate change was a constant during the first half of the 2010s. Academic interest (articles and research) and activities (conferences and forums) calling for other scientific fields to be included in the general dialogue also increased significantly over those five years (Carvalho et al., 2017; Dunlap and Brulle, 2015; Hoffman, 2012; Pfister, 2010). It was in the second half of the decade when the urgency of the response to global warming became a relevant aspect in the debate. As of 2015, journals focusing on the problem from a practical perspective – including Climate Services (2016) and Climate Action (2022) – began to appear. In this regard, the scientific approach seems to have coincided with the political shift originating at the 2015 Paris Summit, the testing of the Talanoa Dialogue process, and the wave of activism beginning in 2018. Specific institutional milestones and rhetorical moments regarding the academic field of climate change communication are listed as follows:

Figure 2. Institutional milestones and rhetorical moments in the academic field of climate change communication

- 2009 – Guide to *The Psychology of Climate Change Communication* – Columbia University, Center for Research on Environmental Decisions. (Wang, 2021, p. 32).

- 2009 – A group of scientists established the nine planetary boundaries (Rockström et al., 2009).

- 2010 – Publication of the first issue of *Wiley Interdisciplinary Reviews: Climate Change*.

- 2010 – Further progress in research on climate change communication (Wang, 2021, p. 33).

- 2011 – Launching of *Nature Climate Change* (albeit a continuation of *Nature Report: Climate Change* first published in 2007).

- 2011 – Identification of a new approach to climate history studies. It was necessary to bridge the gap between climate history and the history of culture, which had been previously studied separately (Pfister, 2010, p. 28).

- 2011– July Doyle, *Mediating Climate Change*. A turning point in the critical review of communication practices grounded on the scientific knowledge, on the linear model, and on considering climate change as an environmental phenomenon.

- 2012 – Appeals to focus on the cultural aspects of climate change and to include other academic fields in the scientific discourse on climate change, not only climate science but also, for example, social sciences (Hoffman, 2012).

- 2015 – Publication of the first issue of *Climate Change* (third most frequently mentioned journal in our general corpus).

- 2015 - Naomi Klein, *This Changes Everything*.

- 2015 – Shift in sociological interest (Islam and Kieu, 2021) and publication of Dunlap and Brulle's book calling for the inclusion of the social sciences in the study of climate change.

- 2016 – New approach to the problematization of climate change: the failure of science and the media to communicate the problem adequately not only led a deficient description of climate change but also concealed the urgent need to introduce systemic changes (Hagen, 2016; Hammond, 2018).

- 2016 – Publication of the first issue of *Climate Services* (practical approach).

- 2017 – Appeal for a change in the climate change communication research agenda to include the political sphere which was not being addressed by climate change communication practices (Carvalho et al., 2017).

- 2021 – Report entitled *Public Engagement for Net-Zero: A Literature Review*, released by the BCG Foundation and Lacoste.

- 2022 – First edition of *Climate Action* (practical approach).

5. Proposal for a historical periodization

After cross-referencing the institutional milestones from the two timelines discussed above, this provisional periodization hypothesis was found to be consistent.

(1) FROM 1988 TO 2009

This was a period in which a pragmatic necessity for communication emerged, but without the development of a specific field of study. There was a pressing need for a scientific characterization of climate change, which was seen as a scientific fact that had to be communicated.

Using the cut-off dates of the periodization proposal as a reference, several intentional searches were run on the general corpus. The goal was to ascertain whether the quantitative data, examined separately by period, confirmed the consistency of the proposed division. In the quantitative search, the term "climate change" prevailed over "global warming". Searches using the former yielded eight times more results than those employing the latter.

As already contended, 1988 seems to be a clear point of departure in relation to both the scientific and social discourse on climate change. In 2009 and 2010 there was a significant increase in the number of publications, indicating the possible conclusion of this initial stage. As a matter of fact, the first two notable increases in the overall number of publications occurred between 2009 (243) and 2010 (302), accounting for 59 new publications; and between 2010 (302) and 2011 (394), representing an increase of 92 publications. There was also a steady increase in the number of academic articles, especially between 2009 (164); and 2010 (223), and in review articles, from 2009 (9) to 2010 (17). It should also be noted that books on climate change communication began to appear in 2010. Similarly, as of 2010 the most notable increase in the number of climate change studies was registered in the field of communication, reaching third position behind environmental sciences and environmental studies.

From a more qualitative standpoint, the problem of communicating climate change was fraught with tension. A clear demand for pragmatic guidance, effective communication and the so-called "war of words" (Hoffman, 2015) topped the list. Consequently, the spotlight was placed on the message and the subject (Shome and Marx, 2009). The main challenge was to convince the

population of the existence of climate change, establishing persuasion as a primary goal (Pearce et al., 2015, p. 614-618). The hegemonic epistemic model used during this period pointed to an information deficit that should be remedied by implementing a positivist rationalist model of science, as well as through empirical evidence, data, and graphs. A paradigmatic example of this is Al Gore's documentary An Inconvenient Truth (2006). Other memorable films from this period focus their narratives on revealing, persuading and showing that the climate crisis is underway. The Day After Tomorrow (Roland Emmerich, 2004) pursues this goal through fiction, while The Age of Stupid (Fanny Armstrong, 2009) approaches it with a documentary aim.

In light of this, two approaches stood out in communication and climate change research during this period. One explored the perception of the problem from traditional social and cognitive psychology positions, with interpretations based on risk theory, behavioural change, and mental barriers, focusing on the psychological object and individual actions (Withmarsh, 2009; Leiserowitz, 2007; Lorenzoni et al., 2006). The other sought to describe the media coverage of the problem (mainly the presence of climate change in the media discourse and its news treatment). This became a popular focus of attention for research during this period (Boykoff and Boykoff, 2007; Moser and Dilling, 2007; Carvalho, 2005; Carvalho and Burgess, 2005; Antilla, 2005) and addressed issues such as gauging the coverage of climate change, studies of denial bias in editorial lines, and determining the balance between deniers and non-deniers. This type of research shed light on the positioning of sources and provided items for analysis in the study of the ideological and partisan polarization of discourse. Yet, it provided scant guidance for effective information-giving and distracted from theoretical research.

At the end of the period, Columbia University published The Psychology of Climate Change Communication, presented as the first guide expressly for scientists, journalists, educators, political aides, and the interested public (Shome and Marx, 2009). The delusion of coming up with a formula for conveying a perfect universal message (catering to all audiences) overshadowed discursive developments during this period. In response to this, some works offered rhetorical guidelines (Hassol, 2008; Hoffman, 2012). It is held here that a new period started in the 2010s because this premise was revised and fell into decline. The period ended in late 2009 with the publication of a work that would be crucial in the search for other approaches in the following decade: Why We Disagree about Climate Change. Understanding Controversy, Inaction and Opportunity (Hulme, 2009).

(2) FROM 2010 TO 2015

This period was marked by the emergence of an academic field specifically addressing the climate change communication problem. The call for making the scientific voice on climate change more plural grew stronger. A more interdisciplinary approach seemed to have been taken, turning climate change into a social fact that had to be communicated.

Quantitatively speaking, the aforementioned surge in academic production at the end of the previous period seems to corroborate the emergence of a new academic field concerned with climate change communication. At the end of the period, however, there was no noteworthy increase in general publications (from 85 in 2015 to 107 in 2016) or in academic articles (from 609 in 2015 to 684 in 2016). It warrants noting that review articles only started appearing regularly as of 2015.

At the beginning of the second half of the 2010s, climate change communication was recognized as a new academic field (Moser, 2016, p. 348), which had been developing since the 1970s (Hansen and Cox, 2015, p. 2). Concurrently, it was contended that sanctioned discourses on climate change had been limited to the physical and earth sciences, when those of experts from other fields should be taken into account (Castree, 2016, p. 731). The spotlight was no longer placed on the battle of words between deniers and non-deniers (Moser, 2010, p. 32).

The critical review of communication practices prior to 2010, which was a feature of this period, led to doubt being cast on the information deficit model, in line with Hume's work in 2009 (Moser, 2010; Doyle, 2011; Rayner and Minns, 2015, p. 3; Pearce et al., 2015, p. 614-615). Although authors like Rayner and Minns (2015, p. 12-14) acknowledged its utility in settings where there was scant social awareness of the problem. Despite being questioned, the information deficit model started to gain ground in this period, before prevailing in the following one (Cameron et al., 2021, p. 82).

The focus was still on how to convey the message to enhance its effectiveness, although alternatives to the rational, explanatory, data-based model were now being explored. It was not now a question of how to make climate change more understandable, but rather how to underscore its seriousness to engage the citizenry. In an attempt to provoke an emotional response from the public, there was a shift in communication practices toward artistic forms (Castree, 2016; Burke et al., 2018). Albeit with a restricted use, this line of artistic communication was not however new (Demos, 2020) and would last beyond 2015.

The most striking aspect is that in 2015 this approach produced a paradigmatic rhetorical moment in the art festival that was held simultaneously with the COP21 Summit in Paris (Tyszczuk and Smith, 2018; Sommer and Klöckner, 2021). Artistic pieces were implemented in more popular settings. ArtCOP21 connected hundreds of thousands of people to the climate challenge through an extensive global programme of over 550 major events. Installations, plays, exhibitions, concerts, performances, talks, conferences, workshops, family events and screenings – plus a whole range of people-power gatherings and demonstrations – took place right across Paris and in 54 countries worldwide (See https://www.capefarewell.com/artcop21/).

This drive for artistic practices aimed at merging awareness of climate change with the emotional experience of the crisis is also reflected in the emergence of a new literary subgenre: climate fiction.

> Climate change in literary studies, particularly in literary or critical theory, is also now being heralded as a discrete subfield of literary studies. This is more than just a matter of perception and of naming: there has been an actual increase in literary engagements with climate change, and literary scholars have been busy exploring both these texts and the concept of climate change as a cultural phenomenon (Johns-Putra, 2016, p. 266).

In 2007, the term "cli-fi" was coined (Goodbody and Johns-Putra, 2019, p. 230), and in 2015, as a result of the vibrant activity observed during this period, the first comprehensive and systematic work on climate fiction was published by Adam Trexler with the title Anthropocene Fictions: The Novel in a Time of Climate Change. (Trexler, 2015).

(3) FROM 2016 TO 2022

As a result of the Paris Agreement and the mobilizations of the following years, the focus of attention shifted to new epistemic forms and ideas in climate change communication practices. Climate change was now characterized as a political option that had to be communicated.

There was another noticeable increase in scientific production on the subject of communication and climate change from 2017 (705) to 2018 (880), as well as from 2018 to 2019 (1,080), and from 2018 to 2020 (1,231), indicating steady and sustained growth. The same applied to the number of scientific articles published on the topic, which registered an increase from 2017 (705) to 2018 (880), from 2018 to 2019 (1,080), and from 2018 to 2020 (1,231). By the same token, the number of review articles also increased significantly from 2018 (69) to 2019 (103). It is also worth noting that while the field of communication was still the third most important in relation to climate change, it had managed to close the gap with those in second and first place.

Qualitatively, the period starting in 2016 may reveal further divisions, but for now it ends in August 2022, when this paper was written. Its beginning coincided with the rolling out of a new global governance program agreed upon in Paris in 2015 (Paris Agreement). After this pledge

was set down on paper, protesters made a new demand: meet the pledge. This triggered a new wave of mobilizations, with new subjects, a new participant profile, and a new style. The narrative thread no longer had to do with confirming the anthropogenic nature, or otherwise, of climate change, but talked about taking action: listening to science and adopting urgent measures.

From the viewpoint of 2022, this period cannot yet be conclusively characterized, although it is indeed possible to recognize that new approaches were picking up steam:

- There was a clear shift toward dialogue-based communication practices (Mar et al., 2021, p. 6-7; Howarth et al., 2020, p. 324; Beuermann et al., 2020, p. 15-18). The focus was no longer on the message or how to make it more persuasive but rather on the communication relationship that discursive agents form with audiences. This approach viewed conversation as the preferred form of communication - Nichols et al. (2021). It posited that the monologue of science must be scaled back to recover the authority of the discourse of science.

- In conjunction with the above, the aim was not now so much to convey universal messages catering to all audiences, but to discover new ways of tailoring them to specific audiences (Cameron, Rockque, Penner and Mauro, 2021, p. 27-31), including very small ones like those participating in kitchen table conversations (Steele et al., 2021, p. 27-31) and the climate dinners promoted by Emory University in Atlanta (Crate and Nuttall, 2016, p. 362).

- The epistemic premise that behaviour is not a direct product of rational thinking, alongside the consolidation of cognitive dissonance theories and the tendency to avoid ambiguity (Cameron et al., 2021), prompted the exploration of indirect channels: appealing to feelings of belonging, identity, or control, instead of appealing to reasons or imperatives of environmental necessity.

- There was also an expansion in experimental approaches and hybrid artistic and performance forms: the climate crisis entered museums (Chao and Kompatsiaris, 2020) and performance art entered into scientific conferences (Juárez-Bourke, 2018).

- There was also an expansion of the idea that communicators of climate change should be hybrid, that they should be mixed: scientist, politician, and practitioner (Howarth et al., 2020, p. 323; Vincent et al., 2018, p. 76). Epistemic authority beyond the scientific realm was also explored (Dudman and Wit, 2021).

The relationship between individual identity and behaviour in response to the climate crisis emerges as a new communicative theme. This is evident in films that narrate diverse processes of subjectivation related to climate change, such as Spoor (Pokot, 2017, Agnieszka Holland), in which a former engineer retires to live in a small village in the Sudetes Mountains, and How to Blow Up a Pipeline (Daniel Goldhaver, 2022), where a group of environmentally conscious young people resort to acts of terrorism against industrial pipeline facilities. These are not narratives that merely describe the problem but instead focus on reflecting on the range of possible responses. Similarly, Evil Does Not Exist (Ryusuke Hamaguchi, 2023) explores this issue: a collective and local subjectivity which, through dialogue, is facing up to the defence of its ecosocial equilibrium. In short, the focus has shifted from the climate as an object that needs to be rationally explained to the poetic perspective on the existential implications of inhabiting the Earth. In different ways, all these narratives revolve around the question of how to respond and how to act.

Action-oriented communication prevailed (Bouman et al., 2020; Crate and Nuttall, 2016) over communication aimed at offering explanations. As a symptom and substantiation of the defining traits of this period, the last journal identified in the academic literature before concluding this

article was published in January 2020 and is called Climate Action. In the editorial of the first issue, Jale Tosun (2022) highlighted the ingredients of the formula proposed by the journal: dialogue + hybrid subject + transdisciplinarity focused on action.

6. Conclusion

The review performed in our study has confirmed several distinctive ways in which climate change communication has evolved since 1988. Observing the concurrence between institutional milestones and rhetorical moments has allowed us to notice turning points in the evolution of climate change communication strategies.

These institutional milestones and rhetorical moments in that evolution have therefore enabled us to craft a proposal for the periodization of climate change communication practice and research divided into three periods.

In the first period, from 1988 to 2009, the message was questioned and there was a consequent tendency to study the way in which it was elaborated to convey it in an explanatory fashion. In each period, a certain type of object of study, such as coverage, prevailed. Yet, the characterization that we propose indicates that this type of study was characteristic of the first historical period, when the speech war with denialism was at its peak. Although such studies have not completely disappeared, our periodization describes the new features that shaped the following periods.

Hence, the defining trait of the second period, from 2010 to 2015, was the recognition of a specialist climate change communication field and the performing of reviews in search of forms of communication that engaged more skeptical audiences with the climate crisis. The spotlight remained on the message and on eliciting emotions.

In the third period, from 2016 onwards, there was an important shift in interest from the message to the communication process itself.

Thus, in view of our periodization it is now possible to define a research agenda in line with the social system of climate change knowledge. We have also established criteria for assessing which research is still following routine practices from earlier periods and which is attuned to the current social conversation on climate change. This results from the intersection of the discourses of diverse agents (political, activist, media, artistic, etc.).

In the evolution that we have described, climate change communication has undergone several reorientations that, to our mind, pave the way for a future communication and climate change research agenda:

- Redefining the object: environment (nature) > climate change (biophysical earth system) > cultural change (system of life on Earth).

- Redefining the addressee: individual and lifestyle and consumption > socio-political structure and production model.

- Redefining the problematic aspects: the message and its characteristics > the type of communication relationship > from listening to science to science that must listen (Dudmann and Wit, 2021).

We have observed signs of a rationale linking the evolution of the academic discourse on communication and climate change to discourses from the spheres of politics, the media, and climate science. This rationale is merely noted herein. Sociology and anthropology have a theoretical tradition that may be applied to explain how this is taking shape in the field of climate change. Frequently, research on communication follows practices that are disconnected from the latest problems identified in climate change governance. We call for research that manages to connect this three-way dialogue to effectively serve the social objectives that academia must pursue.

7. Contribution

Task	Author 1	Author 2
Conceptualization	x	
Formal analysis	x	x
Project administration	x	
Investigation	x	
Methodology	x	
Data curation		x
Resources		x
Software	x	x
Supervision	x	x
Validation	x	x
Visualization	x	x
Writing – original draft	x	
Writing – review and editing		x

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