



## **BOLD STATEMENTS in environmental and climate science communication**

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**Abstract.** Environmental and climate science communication often results in the production of appealing but, at times, inaccurate statements, i.e. "bold statements". Such statements are common in the media, however, in-cases, are used by scientists alike. We discuss the concept of such statements seeking to identify their origin and purpose, as well as the benefits and threats of such communication methods. By bringing bold statements in context to the paradigm of climate science communication we argue that their use is enforced by the urgent nature of climate change and that bold statements have been proven useful in raising public awareness and mobilizing the public toward positive climate action, as well as in accelerating law-/policy-making processes that follow scientific conclusions. On the other hand, we demonstrate three example cases of bold narratives in climate and environmental science communication, i.e. 1) An upcoming cooling of Europe due to the gulf stream collapsing, 2) a new island made out of garbage in the Pacific Ocean, and 3) an upcoming "apocalypse" due to bee extinction. Through those cases, we bring up concerns that using bold statements and sacrificing scientific accuracy in the shrine of public mobilization may backfire, as the use of bold statements encompasses risks by spreading misinformation, and can lead the public to confusion and inappropriate action.

### **1 Introduction**

Under pressure from the ongoing anthropogenic climate change (IPCC, 2021) and alarming environmental problems, the scientific community is urged to optimize methods of environmental and climate science communication, bridge the gap between scientists and the public through a common language (Reser and Bradley, 2020), and thus enhance understanding, engagement, and action beyond academia (Howarth et al., 2020). Over the last decades, communication of climate science, and especially on the field of climate change, has received ample attention evolving from a "metaphorical wild west" (Moser, 2016) to an estab-



20 lished field of its own. However, as in any, “outlaws”, “duels”, and wild debates still thrive in the field. Such is the controversial  
case of using bold (i.e. appealing but inaccurate) statements in communicating climate change and environmental problems.  
Acknowledging the complexity of science communication, i.e. communicating accurately while engaging and motivating the  
public at the same time, and without claiming expertise on the topic, we here bring up concerns that the use of bold statements  
from scientists sacrifices accuracy in the shrine of mobilization and outreach, leading, however, to misunderstandings and con-  
25 fusion.

This article posits that with the lure of communicating complex concepts, mobilizing the public, or even promoting their own  
work, climate scientists often oversimplify reality, neglect uncertainty, or overemphasize certain aspects of a concept, form-  
ing bold statements that are meant to provoke, shock, and therefore advertise rather than accurately inform. Such statements  
30 thrive in the media, as journalists would favor “click-bait” over more informative headlines in order to draw attention (Beleslin  
et al., 2017). In public literature, bold statements are also known to convey the so-called “fake news”. In contrast to legitimate  
news that provides substantial information and allows the reader to make their own conclusions, fake news provides minimal  
information to support a clear opinion (Rubin et al., 2015). Hereon, we argue that in addition to public media, the use of bold  
statements from scientists proliferates as well (Douglas, 2006), initiating a chain of inaccurate communication which finally  
35 leads to misinformation and misinterpretations in the public sphere.

To address the question “Why do scientists use bold statements, and what are the benefits and threats of such communi-  
cation methods?”, we present insights from climate science communication literature, and more specifically from the rapidly  
emerging field of climate change communication, and investigate which doctrines of the field breed the use of bold statements.  
40 Additionally, we aim to address what are the consequences of bold statement communication on legal and political stakehold-  
ers that carry the responsibility of deciding the planet’s climate future. Against this background, we discuss literature on the  
law-science interface investigating the consequences of using bold statements in this exchange.

To further illuminate the concept of bold statements in environmental and climate science communication we study three  
45 well-known example cases where such statements received ample attention. The first case study focuses on the narrative of  
the potential slowdown of the gulf stream and its effect on climate. While scientists disagree on whether the ocean current  
has weakened or not, an alarmist narrative has been projected by popular media, linking its slowdown to a potential new ice  
age. Though the narrative is based on some scientific findings, it fails to communicate the involved uncertainty and proposes  
an unlikely future dystopia. The second case study discusses the so-called Great Pacific Garbage Patch (GPGP), an area of  
50 converging currents in the Pacific Ocean leading to anomalously high garbage concentration. This accumulation area is often  
exaggerated by the media to be a “floating garbage island”, with lurking misinterpretations however, as in some cases, the term  
seems to have been perceived literally. The third case study draws from communication strategies of conservation biology, and  
through the paradigm of the honeybee, widely promoted by activists in the past decades, it shows how selective and simplified



communication or over-promotion of specific endangered species can lead to misinformation and inappropriate action.

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In this paper, we explore existing literature about climate science communication and bring the concept of bold statements, introduced above, in context to the paradigm of climate change communication (Section 2). We then discuss and evaluate the use of bold statements through the three characteristic case studies of bold statements introduced above (Sections 3.1-3.3). Here, we examine reasons for “communication going wrong”, motives for using bold statements, as well as potential implications of such communication strategies. Additionally, we briefly examine how bold statements may function in the science-policy interface and how their use could influence the law-making process (Section 4). Finally, we attempt to scale the pros and cons of bold statements in climate science communication by discussing their apparent motives and purposes, possible consequences, as well as potential ethical implications (Section 5).

## 65 **2 The origins of bold statements - Literature review on climate change communication**

The understanding of the community on science communication, and more specifically on communicating climate change, has been evolving forming doctrines as well as heating debates. The dominant view in the 1980s was the so-called “information deficit model” in which the public is seen as in need of education from experts (The Royal Society, 1985), and that enhanced public engagement of the scientists providing more information on climate change would per-se increase public understanding and consensus on the topic. The “information deficit model” sees non-experts as “empty vessels” that need to be filled with useful information in order to act rationally (Irwin and Wynne, 1996). However, the “information deficit model” was challenged by social scientists arguing that more information wouldn’t necessarily promote acceptance amongst the general public (Nerlich et al., 2010). Instead, promoting dialogue and contextual understanding over a one-way transition of information adds to more active engagement of the public (Ockwell et al., 2009), without resorting to controversial distinctions between experts and non-experts (Collins and Evans, 2007). Furthermore, it is suggested that apart from rational engaging the public to climate change, i.e. explaining the scientific basis of the problem, science communicators should make the issue appealing and interesting, thus aiming to engage the public through understanding, emotions and behavior alike (Ockwell et al., 2009; Nerlich et al., 2010).

80 Experimenting with the emotional engagement of the public, the media in the late 1990s adopted “alarmism” as a strategy in climate change communication. Public (bold) statements from experts underlying the catastrophic consequences of climate change were promoted, climate change was compared to a weapon of mass destruction, and a dystopian future was framed if no adequate action was to be taken (Carvalho and Burgess, 2005; Nerlich et al., 2010). Alarmism, as an attempt to mobilize through fear, is popular in many types of public communication (Altheide and Michalowski, 1999). Fear-appealing strategies aim to attract public attention by emphasizing the dangers of risky behaviors, thus increasing the likelihood of engagement to proposed counter-behaviors (Yzer et al., 2013). Such strategies still dominate the media, however, the use of alarmism in



90 climate change communication emerges as a highly controversial topic in the scientific literature (Chapman et al., 2017). Even though it is advocated that distress motivates attitude change and thus can be used to address climate change (Moffic, 2007), “alarmistic tactics” have been challenged as well, supporting that they might have the opposite of the intended effect (Witte and Allen, 2000). That is as evoking fear without proposing clear and manageable solutions could lead the public to apathy and denial, instead, literature seems to converge that alarmism and negative messaging can be constructive when become personal, scaled to the individual, and proposed in the context of “hope” underlying possible and effective counteractions (Howarth et al., 2020; Davidson and Kecinski, 2022).

95 If and how to communicate uncertainty bears another friction point amongst (climate) scientists. The shift from the “information deficit model” to more versatile engagement strategies calling for action brought focus to human motivation and what distracts from it. Here, uncertainty is found to be the “bone of contention” (Moser, 2016). At times of increasing consensus amongst scientists on anthropogenic climate change, emphasizing the inherent uncertainty of the climate system has been criticized as a cause of public “skepticism”, as uncertainty is often confused with ignorance from the public (Patt and We-  
100 ber, 2014; Morton et al., 2011). On the other hand, it is argued that communicating these uncertainties is important (Howarth et al., 2020) as it adds trust to the results through showing honesty (Gustafson and Rice, 2019, 2020), and can be important for decision-making on robust adaptation strategies (van Pelt et al., 2015). In an effort to settle the argument, Gustafson and Rice (2019, 2020) reviewed the effect of uncertainty in science communication distinguishing between different types of un-  
105 certainty. Their findings suggest that only the “consensus uncertainty” described as disagreement or conflict between scientists shows strong evidence of negative effects (reduced credibility, beliefs). In contrast, communicating the inherent uncertainty in science as knowledge gaps, error limitations, or possible future falsification has a null or positive effect as it adds credibility and trust to the results.

110 So what breeds bold statements in science communication? It can be argued that to an extent, some of the propositions of the post-“information deficit” agenda set the stage for bold statements. The call to make climate science appealing opens the way to communicate it in terms of marketing and grabbing attention on a topic becomes as important as accurately communicating it. The same holds for the call to the emotional engagement of the public which promotes fear-appealing strategies aiming to shock and control rather than inform (Altheide and Michalowski, 1999). Finally, the call for behavioral engagement urged for clear and confident messages that will re-program climate skepticism, tempting scientists to “bold” their findings instead of  
115 cautiously communicating them together with any inherent uncertainty. The above propositions i.e. to engage the public not only through understanding but through emotions and toward behavioral change, although controversial, consist of advances in climate science communication and it is those advantages that seem to provide an alibi in the use of bold statements. That being said, according to our review of climate change communication literature, it is the shifting objective of the field from informing to mobilizing that seems to have led to the proliferation of bold statements. Hence, it is the urgent nature of climate change  
120 that drives climate communication a step further communicating facts to attempting emotional and behavioral engagement,



opening this way the path for the use of bold statements.

But are the motives of scientists always unselfish when they revert to the use of bold statements? In an early study of scientific persuasion, Law and Williams (1982) state: “The title of a paper is obviously of great importance. In terms of the marketing metaphor, we may say that it constitutes a vital part of the packaging. It is designed to alert potential users, to persuade them that this is a valuable product, one with which they cannot do without”. More recently Moore (2020) provides advice on how to better communicate scientific results with click-bait titles that grab the attention of a time-poor readership, decorating an article that is more likely to be cited, or a funding application that is more likely to be granted. The above illuminates a different motive for scientific bold statements. It is unfortunate but undeniable, that the future academic career of any young scientist will depend on the visibility of their work (i.e. their citation index) as much as on its quality, if not more. Moreover, another decisive factor will lay on their capability to retrieve funds for their research by composing applications that will stand out among a plethora of others. That makes bold headlines, which are likely to impress, reach a larger audience, and remain memorable, a tempting alternative to more accurate but less vivid titles. Thus, it is argued that the promotion and advertisement motives fueling bold statements in the media can be met in the scientific literature as well. That, as outreach appears crucial for the "survival" of a scientist in an academic system that, at times, values quantity above quality (Olenick et al., 2019).

### 3 Case studies

#### 3.1 The Gulfstream and a new ice age

One example of a bold statement and alarmistic narrative in climate science communication is the potential slowdown of the Gulfstream, or more precisely, a slowdown of the Atlantic Meridional Overturning Circulation (AMOC), and its effect on climate. The AMOC (which includes the Gulfstream) is an important component of the Earth’s climate system and the global ocean circulation, as it brings warm water from the tropics northward in the Atlantic Ocean and colder polar waters southwards, hence regulating and stabilizing the climate in large parts of the Northern Hemisphere. The narrative of the bold statement is that global warming results in increased melting of ice in polar regions, leading to increased freshwater flow into the northern parts of the Atlantic Ocean that then slows down or completely collapses the northward flowing Gulfstream (Leiserowitz, 2004). This would, according to the narrative, then result in a severe drop in temperatures across the northern hemisphere. The first parts of this narrative are scientifically sound as a slowdown of the AMOC is both possible and likely within the 21st century, but the final consequences are more uncertain as the Northern Hemisphere will still warm due to global warming, and a complete collapse of the AMOC within the next century is unlikely (IPCC, 2021).

The scientific hypothesis that climate changes may result in changes in ocean circulation, which again can result in even stronger feedback on the climate, is not new (Stommel, 1961; Jackson et al., 2015). However, the idea was brought to the public’s attention when it was expressed in its most extreme form with the science-fiction movie “The Day After Tomorrow”



155 in 2004. Here, the AMOC collapses because of global warming, completely destabilizing Earth's climate and propelling the planet into a new ice age. The movie's plot is an exaggeration, and it is unlikely to happen, but can be perceived as plausible by an audience lacking background information. Since then, popular articles have been linking recent studies proposing a slowdown of the AMOC with the movie, and even if the exaggeration of the plot is sometimes mentioned, bold and sensational headlines underlining the upcoming dire consequences of an AMOC slowdown are used leading the public in to confusion on whether global warming or global cooling should be expected (Mooney, 2015; Letzter, 2017; Woodward, 2019).

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But what initiated this narrative? In recent years, there have been multiple influential papers arguing that we have already experienced a slowdown of the AMOC as a response to anthropogenic climate change. For example, using paleoclimate data as proxies for AMOC strength, it has been suggested that the AMOC has weakened since 1950 (e.g., Rahmstorf et al. (2015); Caesar et al. (2018); Thornalley et al. (2018); Caesar et al. (2021)). It has also been suggested that this decline is an indication or early warning of the potential collapse of the AMOC (Boers, 2021) that could then lead to a drop of temperature in the Northern Hemisphere, especially in northern Europe. However, the different paleoclimate records show large discrepancies, and thus their uncertainty is high and their relation to the AMOC is unclear (Kilbourne et al., 2022). Additionally, there are several studies based on direct observations that do not detect a slowdown or weakening of the AMOC (Worthington et al., 2021; Rossby et al., 2020; Fu et al., 2020; Fraser and Cunningham, 2021; Smedsrud et al., 2022), that as the time series, which are provided by observational arrays monitoring the AMOC strength, is too short to verify any significant trends (Lobelle et al., 2020). In other words, there is no scientific consensus on whether the AMOC is slowing down and at risk of collapsing. Nonetheless, climate models predict that a slowdown in the future is likely (Weijer et al., 2020), but this does not mean that a collapse of the AMOC is imminent and neither a temperature drop in the Northern Hemisphere (Shu et al., 2022). The collapse scenario is therefore categorized as "low probability, high impact" (IPCC, 2021).

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A debate among scientists as the one described above is a normal part of the scientific method and is necessary for advancing science. The main issue in communicating a potential AMOC decline has been the failure to communicate its uncertainties in the records and the likelihood of the different possible scenarios. Here it is the scientists' responsibility not to "use" the misconception of a spectacular but unlikely AMOC collapse and temperature drop to advertise their work and be clear on what are the more certain outcomes of climate change i.e that temperature will keep increasing with more greenhouse gas emissions (Amundsen, 2022). It is also important to highlight the complexity of the global climate system. The stories often provide a too simplistic view of the ocean circulation, for example, by not distinguishing between the wind-driven Gulf Stream and AMOC (Wunsch, 2004). This being said, the bold statements and the extreme exaggeration in "The Day After Tomorrow", have probably also had some positive effects - educating the public on the relationship between ocean circulation and climate and on the potential dangers of anthropogenic climate change (Leiserowitz, 2004). However, communicating AMOC decline outside of its uncertainty frame and proposing a plausible future dystopia related to an upcoming ice age has no real scientific basis and seems irresponsible in a period of global warming, as it can distract public opinion and promote climate skepticism.



### 3.2 A garbage island in the Pacific Ocean?

190 Another use of bold statements is found in the communication of plastic pollution, and specifically of the Great Pacific Garbage  
Patch (GPGP). The GPGP is an area of around 1.6 million square kilometers with an anomalously high plastic concentration  
between the Hawaiian Islands and North America (Lebreton et al., 2018). Because of the rotation of the winds and their interac-  
tion with the ocean, the ocean currents converge in this area and thus accumulate any floating substances, including garbage of  
human origin. The GPGP is often used as a symbol of the disastrous impact humans have on our planet's natural environment.  
195 A giant patch of garbage far away from any land in the middle of the Pacific Ocean is a perfect symbol to raise concerns about  
our plastic consumption, draw attention toward the problem of pollution, and promote a more sustainable lifestyle through  
emotional engagement. As if the formulation "garbage patch" is not already dramatic enough, the term "garbage island" has  
frequently been used. This vivid wording is even more shocking, is easier to grasp for the broad public, and may thus, more  
efficiently, initiate individual action to fight plastic pollution. However, regardless of if and how people take action after being  
200 approached with such a message, a misconception manifests in the public opinion and scientific literature, that there is an  
actual garbage island in the ocean, i.e. that the plastic concentration is so high that "floating plastic form a solid continental  
form, entirely made of garbage" (Lup et al., 2020). This is a misleading and wrong perception of the GPGP: In contrast to the  
illustration as a garbage island, the GPGP is an area of high garbage concentration. In its inner area, the plastic concentration  
is estimated to range from 1 to 100 kg km<sup>-3</sup> (Lebreton et al., 2018). Although this is an alarming number for such a remote  
205 place, it is by far not enough to form a compact mass of floating plastic.

In scientific literature, formulations like "garbage island" as a description of the GPGP are rather rare, however, enough to  
prove a misconception not limited to the public sphere, but infiltrating academia as well (Kazarian, 2006; Budnikov et al., 2012;  
Lup et al., 2020). Then, an unacquainted reader would have no reason not to believe this. However, most science communica-  
210 tion to a broad public audience does not happen through the scientific literature, but via the media. Here, the description of the  
GPGP as a garbage island can be found much more frequently. Online newspapers and other websites create sensational reports  
about new garbage islands taking over the oceans (The New York Times, 2009; Pacific Standard, 2018; Iberdrola; CNET, 2022;  
NBC News, 2021; FACTS, 2022). Some online articles even rely on the study from Lebreton et al. (2018), but misuse their  
findings by connecting them to a garbage island in the Pacific (Global Citizen, 2018; SurferToday; Allygate). Furthermore,  
215 a video published on YouTube by "BRIGHT SIDE", one of the most subscribed channels on the platform (BRIGHT SIDE,  
2018; Wikipedia, 2022), takes the bold statement one step further by stating "a new continent consisting entirely of garbage  
forms in the Pacific Ocean". The video shows a distorted version of Greenland centered around the position of the Hawaiian  
Islands with a skull in it. Such communication strategies aim to shock the audience and ultimately to financial benefits through  
click-baiting. At the same time, however, through exaggerating the GPGP to an island, they achieve wider communication of  
220 the problem and emotional engagement of the public motivating behavioral change.



225 But to which extent are scientists responsible for a bold statement that spreads mostly through mass media? An answer can be found in the linguistic gap between scientists and non-experts. In cases, some scientists tend to use such exaggerations or analogies to vividly communicate complex terms such as the GPGP to a broader audience, however, scientists should know that such methods can be deliberately garbled by journalists seeking to sell a story, or unconsciously misinterpreted by an audience missing critical background and be perceived literally. Such a case can be found in NBC News (2021). A co-author of a scientific study finding coastal species to establish within garbage patches in the ocean (Haram et al., 2021) says; "It's almost like a new island has emerged". Even if well intended, this wording is likely to be twisted, deliberately or not, and indeed later in the same article the term "islands of plastic" is used.

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No matter if scientists or media call the GPGP a garbage island for sensationalism or to raise awareness about plastic pollution, the power of such a statement is that it can reach a large audience and efficiently communicate the problem of plastic pollution, motivating behavioral change, and thus it can be considered as a good step forward. However, that comes with a serious drawback, such communication strategies spread heavy misinformation reaching millions of people. Nevertheless, technology now allows people to shake down the legend of the plastic island just by visiting platforms such as "Google Earth", where no floating island is to be found as the GPGP is not visible from space. What is then to be expected by such an individual that realizes the boldness of the statement, if not to lose faith in science? Additionally, even the minor reports of the GPGP in the scientific literature to be an actual garbage island illustrate another problem, a de-education that follows the spread of such statements. Now scholars feeding from appealing bold statements can create new, and in the absence of an adequate peer-review process, inaccurate knowledge. Overall, it is argued that bold statement communication can promote fake-science, and thus reduce scientific credibility.

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### 3.3 "Beepocalypse" and biodiversity loss

Bold statement communication can also be noted in outreach campaigns for biodiversity loss. Biodiversity loss due to climate change has become a major concern in regard to food security (Barnosky et al., 2011). Efforts have emerged since the 1980s with the development of conservation biology, which addresses conservation problems related to species, communities, and ecosystems perturbed by human activity (Soulé, 1985). Stories about specific species have historically helped to illustrate the problem but often simplify the complex situation and may move the focus of the public in the wrong direction. For example, in recent decades there has been brought disproportionally large focus on the so-called "charismatic megafauna", for example, polar bears, elephants, and pandas, increasing public awareness about their decreasing populations and vulnerability to human impacts. However, there is still little awareness about smaller, less "charismatic" and usually more specialized species that are sometimes even more exposed and vulnerable to environmental changes (Perfecto and Vandermeer, 2008; Shah and Parsons, 2019). It is, for example, much harder to create awareness and sympathy for plankton than polar bears, even though the plankton have a much larger ecological significance as they represent the foundation of the food chain. There are, however, some examples of small but still "charismatic" species that have received a lot of attention. We here focus on honeybees used

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as a symbol for the decrease in pollinators due to anthropogenic influences. The narrative builds on the fact that a decrease in pollinators causes problems for food production and general biodiversity, and urges the public to save the honeybees to avoid an apocalypse. We find, however, that such statements and selective communication of biodiversity loss can lead to inappropriate action as honeybees are not the only endangered pollinator, and as they act antagonistically to other pollinator species, 260  
disproportional increase in their population can lead to further biodiversity loss.

Many initiatives around bees have been established over the last years, such as the ‘Save the Bees initiative’ (Greenpeace) and the United Nations ‘World Bee Day’. The first use of the term “beepocalypse” appeared in the press in 2006 when US 265  
beekeepers started to notice a concerning increase in mortality in their managed honeybee colonies (Ingraham, 2015; VanEngelsdorp et al., 2008). Overall, there is widespread concern about the global decline in managed (Neumann and Carreck, 2010) as well as wild pollinators (Cameron et al., 2011; Zattara and Aizen, 2021). The managed European honeybee (*Apis mellifera*) is most often under the spotlight, as it is more studied and referred to, leaving other wild pollinators in the dark (Wood et al., 2020). However, this can be problematic as both wild bees and honeybees are negatively impacted by climate change, but in competing habitats, wild bees are additionally being threatened by high-density managed beekeeping (Hudewenz and Klein, 270  
2013, 2015; Henry and Rodet, 2018).

There is a general misconception among the public, vehiculated by bold statements, that honeybees are the only pollinators that need to be saved in order to avoid food production extinction (Balton, 2016; FDA, 2018; FAO, 2018; Parlee). However, more and more studies are now advertising and calling people to carefulness concerning the increasing enthusiasm of urban 275  
beekeeping when so many wild pollinators are threatened by extinction. That is because wild pollinators such as wild bees are threatened, among other environmental stress factors, by the diminution of food resources (Egerer and Kowarik, 2020). The increasing managed honeybee population could thus potentially have an overall negative impact as they act antagonistically to other species (Mallinger et al., 2017). In order to secure biodiversity and food production in the long term, a healthy population of a vast variety of pollinators is crucial (Zattara and Aizen, 2021). There are, for example, more than 20.000 different bee 280  
species, most of them specialized in pollinating different plants. Therefore, disproportional emphasis on restoring the managed honeybee can further promote biodiversity loss rather than counteract it.

Bees are important pollinators, but other pollinators such as flies, butterflies, and bats need as much attention as bees since biodiversity is key when it comes to tackling food production issues. Favoring one pollinator species over others will continue 285  
the trend of species declination (Potts et al., 2010). This is thus an example where a simplification, through the form of a bold statement (e.g. beepocalypse), has an overall negative impact on the problem. By communicating, or emphasizing only a part of the problem, or simplifying the problem (as by focusing on only one species when talking about pollination) the narrative might have been more harmful than helpful. This being said, it has not only done harm. The increased focus on bees and the importance of pollination in media has likely led to an increased engagement and knowledge about the important linkage in 290  
our ecosystem and the importance of biodiversity for human society. This engagement should be used further-on to tackle the



problem in a sustainable way. This just shows the fine balance of creating a good story and exciting narrative, but at the same time keeping accuracy and not simplifying too much.

#### 4 "Lost in translation" - bold statements in the law/policy making-science interface

295 Similar to the general public, law- and policy-makers constitute a consumer of scientific observations. Alongside other relevant factors (e.g. political, economic, and ethical), science communication becomes thus important for pertinent stakeholders (Montuschi, 2017), and bold statements may often influence respective decision-making processes. Science does not determine whether fossil fuel emissions shall be reduced or restricted, neither seeks to achieve any other normative commitments in response to climate change. This is to be done by law- and policy-makers, who will however depend inter alia on the factual  
300 background provided by scientific evidence to understand a natural phenomenon and act in response to it. Resorting to science can however be at times misleading - if not problematic- for legal and political actors when seeking to provide a solid basis of uncontroversial evidence which they can operate from.

Law (as well as policy-making) and science are often conceived of as two irreconcilable worlds due to the inherently different vocabulary, methods, and reasoning that the two systems employ (Green, 1990). To erase the vast conceptual distance  
305 between the two fields, there is a need for finding a common ground of communication (Woker, 2021). The way scientists seek to convey a message to a non-scientific audience that shapes law- and policy-making becomes thus of paramount importance in bridging the gap between these two fields. In this arduous task, tangibility and apprehension are significant, and at times even bold statements and generalizations may be helpful for enabling legal and political stakeholders to comprehend complex  
310 natural phenomena and act in response to changes occurring in the natural world. That however with the prerequisite that the main concepts, even though bolded, are still accurately communicated.

In this ledge of communication, bold statements have previously served as a threshold in bridging the law-science interface, and even alarmistic techniques, emotional invocation, and unclear evidence can at times be helpful demonstrating that the end  
315 justifies the means. For instance, in a 1988 statement, James Hansen, at the time director of the NASA Goddard Institute for Space Studies, bluntly declared before the US senate that "The greenhouse effect has been detected, and it is changing our climate now". Although Hansen's scenarios have now been verified as reasonable long-term projections (Hausfather et al., 2020), by the time, they were perceived as exaggerated and bold (McIntyre, 2009). Nevertheless, Hansen's statement was considered highly influential in bringing climate change into the public consciousness and shaping the rationale of respective  
320 policy-making discussions that followed in the US (Besel, 2013; Dunlap, 2013).

Nowadays, lawmakers and politicians strongly engage with natural scientists in high-level decision-making fora where bold statements are in principle avoided. Yet, bold statements with potentially negative implications have at times also pene-



325 trated such high-level fora as the Intergovernmental Panel on Climate Change (IPCC), which directly provides key findings to  
policy-makers. In its Fourth Assessment Report (IPCC, 2007), the IPCC's second working group, responsible for assessing the  
impacts, adaptation, and vulnerabilities related to climate change, quoted in its first version, though corrected afterwards, false  
and bold predictions on Himalayan glaciers disappearing by 2035 (Carrington, 2010). That bold statement was referenced to  
a grey literature source that was not previously cited by working group one which consists of climate scientists investigating  
the scientific basis of climate change. Such a proposition of glaciers disappearing by 2035 would seem erroneous, inaccurate,  
330 and bold to any expert, but it seemed plausible to non-climate scientists from working group two and thus, was included in a  
report that could be subsequently used by policymakers to develop mitigation strategies. Maybe more importantly, the event  
led to warranted criticism of the IPCC review process and challenged IPCC's overall credibility in informing policy-making  
processes (Schiermeier, 2010).

335 Whether bold or inaccurate statements positively impact the response of the political and legal public is something that has  
to be individually assessed in each case. Law- and policy-making succeed natural scientific observations and come to respond  
to emerging socioecological shifts. Law is criticized for responding slowly, reluctantly, and inconsistently to natural world  
changes (Sperling and Cooper, 2013), so science communication is crucial and at times simplifications and even bold state-  
ments may speed up formal processes, and, as long as they are accurate, lead toward preventive and proactive actions. However,  
340 as demonstrated by the aforementioned IPCC example, bold statements by the scientific community may generate risks, since  
policy-makers being non-experts in hard science cannot easily differentiate between plausible and non-realistic scenarios. Even  
though the responsibility to consult legitimate scientific sources rests with those drafting laws and policies, highly penetrative  
bold statements could be consumed and misinterpreted by anyone including policy-makers, thus scientists shall be mindful  
when using such communication techniques.

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## 5 Conclusions

Nowadays, bold statements are found all over the media aiming to increase the visibility of their content or else "click-baiting".  
We find that bold statements in climate and environmental science communication can serve the same purpose, however, are  
350 additionally enforced by the urgent nature of climate change as a problem that demands quick reflexes. Following that, com-  
munication efforts shifted attention from providing more information on climate change, to making the issue appealing, emo-  
tionally engaging, and seeking behavioral change of the public to battle climate change. That way, we propose that modern  
doctrines of climate science communication, even though controversial, provide an alibi for inaccurate communication and  
bold statements which can shock and therefore mobilize.

355 To investigate further the motives and possible consequences of bold statements in the public arena we discussed three cases  
of such statements. In the first case study, the controversial consequences of the gulf stream weakening leading to a future



temperature drop in the Northern Hemisphere are promoted out of their uncertainty frame. In that case, aspects of scientific evidence are cherry-picked due to their alarming consequences, failing to communicate though the (un)likelihood of the scenario, shifting attention from the more likely scenario of future global warming, and overall leading to public confusion. In the second case study, the GPGP, an area of high garbage concentration in the Pacific Ocean, is exaggerated to be a “floating garbage island”. That seems to have led to misunderstandings as the term have been perceived literally in cases, illustrating that such communication methods can promote fake-science. Finally, in the third case study, the problem of biodiversity loss due to reducing pollinator population is simplified to the problem of the threatened honeybee, urging to action to restore its population. However, such action can in some cases be inappropriate as honeybees act antagonistically to other pollinator species, leading that way to further biodiversity loss.

The above narratives have been brought to the public mainly by mass-media, however, scientists seeking funding, fame, or simply to bridge a linguistic gap, have also added to the spread of the bold statements. The three cases illustrate different types of bold statements. The first case is an example of communicating a concept without communicating the involved uncertainty or likelihood, the second case is about promotion through exaggeration, and the third case is about oversimplifying a concept to make it better understood. We show that in all three cases inaccurate communication through bold statements has had good impacts by engaging the public and increasing awareness, however, has resulted in confusion, misunderstandings, and inappropriate actions as well.

Overall, simplification is needed when communicating science to a wider audience, including policy and law-makers. In the same direction, exaggeration can efficiently engage the public and accelerate law-making processes toward mitigating climate change and environmental problems. However, the extent of “inaccuracy” needed to efficiently communicate a problem and bridge a linguistic gap needs to be considered carefully, and be scaled to the individual case, avoiding production of bold statements that could, non the less, generate risks.

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*Competing interests.* The authors declare that no competing interests are present in this work



## Ethical statement

This work addresses potential ethical implications of inaccurate scientific communication through bold statements by reviewing the available literature. Any referencing to "grey" literature is explicitly done with purpose to illustrate manifested misconceptions in the public sphere. Addressing a controversial topic, as bold statement communication is, we acknowledge that our  
390 interpretations are subjective, but the analysis is transparent and ethical, and has received ethical clearance from our research institutes.

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