

Geosci. Commun. Discuss., author comment AC1  
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## Reply on RC1

Xavier Fonseca et al.

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Author comment on "A physical concept in the press: the case of the jet stream" by Xavier Fonseca et al., Geosci. Commun. Discuss., <https://doi.org/10.5194/gc-2021-34-AC1>, 2022

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Responses to reviewer 1 (Louise Arnal)

Thank you very much for taking the time to review the article. We have carefully addressed all of your comments and believe they will help improve the article significantly. Below, please find a point-by-point response to each of your comments and concerns.

**The manuscript needs a hypothesis testing methodology. Currently, you introduce a hypothesis only on page 6. I think it should be introduced right after stating the context. In addition, I think the elements you present that are part of your hypothesis (i.e., daily section, scientific dissemination, historical perspective, teleconnections, and specialization) should be introduced within the context of your paper, based on the broader literature. Here, you explain each element through the Weather Storues experience, which should be part of the results. Introducing these elements at the beginning of your manuscript would help readers understand what they are and why they are important. In your results, you can refer to these elements and show how Weather Stories fulfills those points.**

We agree with the reviewer in that a statement introducing the hypothesis at the beginning of the article is missing. We have now corrected this by mentioning the hypothesis both in the abstract and in the introduction of the article to highlight the central aspect of this research, which is to discuss a model of scientific communication with specific characteristics.

We have now modified the abstract by adding the elements of the paper's hypothesis:

"These specific formats of science communication should be included in the media because they are the main source for information on climate change and because their characteristics (daily section, scientific dissemination, historic perspective and specialization) allow taking on the challenge."

In the introduction we have added:

"This communication format has specific characteristics that make it possible to face the challenge of communicating the science of climate change to a non-specialist audience. These characteristics are daily section, scientific dissemination, historic perspective and

specialization. Our hypothesis is that it can be used as a model to bridge the existing gap between an increasing awareness of climate issues and the apparently stagnant knowledge on these natural phenomena. We illustrate our analysis with a particular example: how this communication format has brought up the dissemination of the *Jet Stream*”.

**It is also important that you explicitly mention how the examples you use in Section 7 tackle the elements you introduce in Section 6. E.g., "a volcanic cloud had covered the whole planet" (P9 L280-281) illustrates the importance of teleconnections.**

As the reviewer suggests, we have included the example about how the volcanic cloud that covered the sky after the explosion of the Krakatoa volcano illustrates the importance of teleconnections in the climate system. Also in the section explaining the influence of the jet stream on air navigation. Regarding sections 7.3 and 7.4 we believe that in the text itself it is clear that *Weather Stories* addresses the influence of the jet stream through scientific dissemination, teleconnections, and specialization.

“The powerful 1883 eruption, which released energy equivalent to a million atomic bombs, raised particles to the upper atmosphere and, in less than two months, a volcanic cloud had covered the whole planet. This kind of climatic events show the tight interrelations within the global climate system and the role of teleconnections. London’s Royal Society received numerous testimonies from people all over the world describing the effects of this phenomenon at distant locations from the eruption site (Fonseca, 2018)”

**The methodology section requires more information, for example regarding the dissemination method used for the survey, the exact questions asked as part of the survey, and the method used to "analyze the content of a model" (P5 L 141) to improve climate literacy. I suggest adding a copy of the survey to your manuscript for more clarity and transparency.**

As per the reviewer’s suggestion, we have added to the paper a copy of the survey including all the questions that were asked to the target population, in this case students from the three universities in Galicia.

Regarding the method for analyzing the content of *Weather Stories*, no survey has been carried out for this purpose. The article proposes a science communication model and illustrates it with a practical example. We believe that the analysis through experimentation of the impact that this type of communication format has on the population is beyond the scope of the present article and should be the subject of future research.

**In the results Section 5 you refer to information from the wider literature (e.g., P5 L152-154, see other instances throughout Section 5). These references to outside results should be included instead at the start of the manuscript when you introduce these points, or in a discussion section, to keep the results section**

**for your own study results only.**

As you propose, we have added a reference in the first part of the article to a study on climate literacy carried out outside Spain by Alliance Research. Their data is very much in line with what our survey shows, that there is very low literacy among the population in Europe and the United States. The data reinforces the need to create formats such as Weather Stories.

"Despite the climate urgency and the exponential increase of scientific evidence about its origin, behaviour and impact, we can still observe a severe lack of climate education in the public (Allianz Research, 2021)"

**Section 7 is presented as a mix of narratives (7.1 to 7.3) or contextualized narratives (i.e., why was a certain narrative selected for the readers, e.g., P10 L301-302). For more conciseness, I suggest using the same style throughout. I think contextualized narratives is more appropriate for this manuscript as it provides a more critical overview of the Weather Stories articles.**

Following the reviewer's suggestion we have now unified items 7.1, 7.2 and 7.3 into one subsection since they talk about historical aspects of the discovery of the current.

**It would be great if you could give us a more critical view of the future steps the community should take to address the current challenge of climate illiteracy. Please offer a reflection at the end of the manuscript and perhaps a couple of suggested future steps. Some examples of questions you might address are What would you like to see happen in the world/Spain to improve climate literacy in the future? Should other countries/regions in Spain adopt a similar concept to the one you present? What are some of the challenges of using the media as a dissemination format? Will you evaluate the impact of this dissemination to see if it works?**

As the reviewer requests, we have added a final comment in the conclusions section about possible future steps, such as trying to experimentally measure the impact Weather Stories can have:

"Approaching climate change from a dissemination point of view and not from an informational one is a necessary step that mass media must take in order to succeed in making the audience comprehend the nature of such an existential issue as global warming. We would like the media in Spain and the rest of the world to adopt specific scientific communication formats such as Weather Stories in order to be able to take on the challenge of explaining climate change to a non-specialized public with guarantees. We also believe that it would be wise to try to measure the impact that Weather Stories has on the public through experimentation. Our wish for the future would be that the media would become a valuable resource for the educational system. By combining education and information, it would be possible to successfully face the challenge of understanding climate change"

**The points you raise throughout the manuscript are excellent, but require more references to the literature in some parts. For example P1 L22-23 ("the scientific community has published several articles highlighting the urgency of the current situation", please cite some examples), P2 L34-43 (this paragraph requires more references to the literature on the lack of climate education in the general public,**

**people still don't know how the greenhouse effect works, and that the media is the main source of public opinion information), P2 L57-58 ("widely debated within the academic literature", please provide examples of articles), P8 L245-255 (the jet stream concept requires citations to relevant literature), and P14 L361-362 ("as shown by different surveys around the world", please refer the reader to some examples).**

References have been added in all of the parts of the article the reviewer suggests and we have deleted the remark referring "that the media is the main source of public opinion information" because the consumption of news in the media is experiencing a very important change, especially after the pandemic. In any case, it is important to highlight that La Voz de Galicia is published every day on paper, web and social networks (Twitter, Facebook, Instagram). In addition, our survey reveals that the analyzed population assures that the most consumed media is written and digital press and television and that the last time they were informed about climate change was through a journalist.

"During this time, the scientific community has published several articles highlighting the urgency of the current situation, while pointing out that the progressive increase of greenhouse gases may trigger a domino effect in the global climate system that would make it unstable and raise the Earth's average temperature beyond the limits established by the Paris Agreement which aims to prevent the increase in the average global temperature of the planet from exceeding 2°C compared to pre-industrial levels. "

"Despite the climate urgency and the exponential increase of scientific evidence about its origin, behaviour and impact, we can still observe a severe lack of climate education in the public (Allianz Research, 2021)"

"The effect that a wider knowledge about climate science may provoke on an individual is widely debated within the academic literature and has both supporters and detractors (Howell and Brossard, 2021)"

"The inclination of 23.5 degrees in Earth's rotation axis makes solar radiation to be intense in the equator and weak in the poles. To compensate for this energy imbalance, the planet has ocean and air currents that redistribute heat "

"In the last few years, the degree of concern and climate awareness has increased in society, as shown by different surveys all around the world, from Europe to the United States (Goldberg 2020 et al) "

#### **Specific comments:**

**P1 L13: Suggest changing "knowledge" to "climate literacy" to clarify that you are not referring to scientific knowledge but to the knowledge of the general public. (Same in P4 L104).**

The suggested changes have been made:

"As concerns about the climate crisis rise, climate literacy remains stagnant"

"This change of terminology seems to be aimed at raising the general public's awareness about the causes and effects of the problem; however, it does not entail an increase in climate literacy"

**P1 L16-17: Your characteristics allow you to take on what challenge - that of science communication? Please specify in the manuscript.**

Yes, we referred to the challenge of explaining the complexity of climate science. We have now specified it in the text:

"...allow taking on the challenge of explaining the complexity of climate science".

**Introduction: You only introduce why it is important for the public to understand climate change in section 2. I think this needs a line or two in the Introduction, as it is an important point that frames the rest of your paper.**

We agree. We have changed the following paragraph in the Introduction by adding a remark at the end explaining why it is important for the public to understand climate change :

A possible explanation for this deficit is that the climate change message is not being correctly transmitted by the media, which are the main source of public opinion information as our survey shows. As a result, the recipient the public is unable to accept it, which is a big problem because knowing the science and the impacts of climate change is the key to understanding how serious it is. (NOAA, 2009)

**P1 L22: I suggest changing "harder" to "more catastrophic".**

The suggested change has been made.

**P1 L25: What are the limits set by the Paris Agreement? Please specify.**

The limits, set in terms of temperature rise, are now specified:

"During this time, the scientific community has published several articles highlighting the urgency of the current situation, while pointing out that the progressive increase of greenhouse gases may trigger a domino effect in the global climate system that would make it unstable and raise the Earth's average temperature beyond the limits established by the Paris Agreement which aims to prevent the increase in the average global temperature of the planet from exceeding 2°C compared with pre-industrial levels (National Academy of Science, 2020)"

**P1 L 25: Please explain very briefly what the "Hot Earth" hypothesis consists of in the manuscript.**

"The 'Hothouse Earth' hypothesis, which establishes that if warming continues at the current rate it could produce a cascade of events that could increase the global average temperature above 3 degrees, appears to be a possible future as a result of a feedback process that would give rise to a previously unknown climate situation in human history (Steffen et al., 2018) (Xavier Fonseca, 2020b)."

**P2 L32-33: This would be a good point to briefly introduce what the Jet Stream is.**

We have now introduced the Jet Stream concept in the said paragraph:

"The supporters of this theory say that climate triggers a domino effect so that, when one of the tiles collapses, it may end up knocking down the others. These individual pieces may refer to unique ecosystems, such as the Amazon and the coral reefs, or to global climate regulation mechanisms, such as the thermohaline circulation (Caesar, L., McCarthy, G.D., Thornalley, D.J.R. et al., 2021: 4) and the Jet Stream, a high speed wind current in the upper troposphere that follows the separation between cold polar air from warm subtropical air in both hemispheres. Knowing these physical concepts is vital to

understanding how the global climate system works and the threat that climate change poses”

**P2 L46-47: Suggest changing "the generation" to "one of the generations".**

The change has been made.

**P3 L66: This hypothesis is not tested in your manuscript, please change the word, or provide a test for this hypothesis in your manuscript. I would suggest the latter since you already have a main hypothesis explored.**

We have now changed the word hypothesis. We prefer to focus on the effect of the media on climate literacy and leave the impact on policies, which may come (or not) as a follow up, for further work.

“We believe that, following the provisions backed by NOAA and the United Nations, the scientific literacy process is vital for boosting ambitious policies that guarantee the climate system’s stability and, therefore, for preventing a cascade effect of events that make the average temperature rise above the safety limits. ”

**P3 L68-69: Do you have a reference for this that you can add in the manuscript? I find this point surprising since academia is a center of learning.**

We have added another reference published by NOAA on the importance of climate literacy.

**P3 L73-74: "The effect vanishes soon" is an excellent point. However, you do not argue that this is not the case for the media. Please address this point in the manuscript.**

We have added the following remark to address the reviewer’s point:

“Education through the reading of a daily newspaper section as we propose here, resembles more the conventional method of study in scholar environments and may have a different impact, with a longer lasting imprint.”

**P3 L80: I find the idea of “social experience” fascinating, but I don’t quite understand what you mean by that. Since it is an important point, please provide a clear explanation of what this is in the manuscript.**

Please, see response to comment below

**- P3 L80-82: by "everyday testing within the meteorological field" do you mean that this experience is backed up by constant progress within the field of meteorology. Please clarify/rephrase.**

In this part of the article we explain that the content of the information can be checked every day against the weather forecast. The reader learns about meteorology and can put the learning into practice and compare the information with reality. This whole process is what we refer as “social experience”. So, the word "field" refers to a meteorological variable such as sea level pressure, wind, temperature, etc. We have changed “field” to "forecast", and “social experience” to “educational experience” to avoid confusion.

“Building on this idea, we argue that the scientific communication format presented in this article is actually inspired in an ‘educational experience’ created after a constant learning process with the added value provided by everyday testing against the meteorological forecast”

**P4 L106-107: Is there anything you can cite in the manuscript to support the claim that the greenhouse effect is not well understood by the public? I find this surprising since it is a concept that is taught in school.**

We cite a paper and also our own survey to support this idea. We have now added the sentence:

"Our survey reveals that half of the analyzed population does not recognize the greenhouse effect as the cause of the increase in global temperature."

**P4 L116-117: Please briefly explain in the manuscript the 3 crisis points facing journalism.**

We have decided to remove the mentions to the economic and model concepts because they have nothing to do with the main topic of the article. The paragraph reads now as:

"This fact has been ascertained during the Covid-19 pandemic. Mass media were considered one of the essential activities, since information is deemed to have the power to save lives. However, journalism faces today a confidence-wise crises (Rodrigo-Alsina, M. & Cerqueira, L., 2019). Credibility is being threatened in post-truth times, a concept understood as the circumstances in which 'objective facts have less influence on opinions and decisions than personal emotions and beliefs' (Wihbey and Ward 2016). A study conducted in Spain on the dissemination of information during the Covid-19 pandemic revealed that most of the fake news were spread through social media and WhatsApp (89.1 %), whereas that figure was of 4 % in press media (Salaverría et al., 2020)".

**P4 L113-127: This paragraph is a repetition of many elements introduced in section 2. I suggest that it be revised to be more concise.**

Based on the reviewer's comment we have cut out some part of the paragraph but keeping the essence of what is meant in those lines about the role of the media during the pandemic:

"Mass media also have a double leading role within the current climate emergency context (Maxwell T. Boykoff and J. Timmons Roberts, 2007), as main information and education source. We further support the importance of the media with quantitative data from our survey, which reveals that a high percentage of the analyzed population mostly relies on the press and TV news to obtain information about climate change, rather than from the academic literature. For these different reasons, we contend that, in order to study the general impact of the climate literacy process, it is vital to take into account the role of the media, which has not been always considered (Rosales López, 2009).

Indeed, in order to send a message of urgency, the press is the most efficient medium. This fact has been ascertained during the Covid-19 pandemic. Mass media were considered one of the essential activities, since information is deemed to have the power to save lives. However, journalism faces today a confidence-wise crises (Rodrigo-Alsina, M. & Cerqueira, L., 2019). Credibility is being threatened in post-truth times, a concept understood as the circumstances in which 'objective facts have less influence on opinions and decisions than personal emotions and beliefs' (Wihbey and Ward 2016). A study conducted in Spain on the dissemination of information during the Covid-19 pandemic revealed that most of the fake news were spread through social media and WhatsApp (89.1 %), whereas that figure was of 4 % in press media (Salaverría et al., 2020)

**P4 L120: Doesn't the percentage of fake news on social networks and Whatsapp also suggest a change in the source of information?**

Indeed, but I think this question should be addressed in another article on the media crisis in more depth. In this part we just want to highlight the continuing importance of the traditional media, because Weather Stories is published in a newspaper.

**P5 L135-137: For readers unfamiliar with the history of weather in Galicia, it would be useful to give an overview of the background of climate change in this region of Spain. For example, sea level rise, droughts, floods.... This context is very important to frame the survey results you mention below.**

We have now added the following paragraph, following the reviewer's suggestion:

"The quantitative study was conducted in the three universities based in Galicia is a region located in the northwest of the Iberian Peninsula. The average annual temperature in Galicia increased by 0.20 degrees per decade between 1961 and 2015. Between 1951 and 2017 there were nine episodes of drought. The absence of rain has a very important impact on this Spanish region because its economy and way of life depend on rainfall, which is usually very reliable. It is also the region of the entire Iberian Peninsula with the most kilometers of coastline and this makes it especially vulnerable to rising sea levels. (Xunta de Galicia, 2015)"

**P5 L156: You report that "quite a lot" and "very much" are the most selected responses by survey participants. However, readers do not know what choices were offered to participants and cannot judge the impact of this response. More examples in section 5. See my main comment on the methodology section above. As an example of why this is important, when mentioning the various sources of climate change information noted by survey participants, were options such as "a friend," "family," and "social networks" ones that participants could also choose?**

As mentioned earlier, a copy of the survey has been attached with the article as supplementary material where all the questions and answers can be seen. In any case, we note again that the survey information is not the main focus of this article. There are several other studies, as we reference in the paper, that point out that there is great concern about climate change but little knowledge on the subject.

**P6 L169: "More than 40% believe", is this figure from the survey?**

Yes, we have now specified it the text:

**"More than 40% of the surveyed individuals believe",**

**P6 L184: I would say that the daily provision of information also constitutes reliability, important in building public confidence.**

We have now added the suggested remark:

"Thus, by learning and contrasting day after day, this format helps establish a trust relationship between the medium and the reader. Finally, the daily provision of information additionally constitutes reliability, important to build public trust"

**P7 L201: Where did the Filomena storm occur?**

We have now added that Filomena affected Spain:

"A good example is the coverage of the storm Filomena that affected Spain in January 2021 (Xavier Fonseca, 2021a). The coverage started one week before most of Spain

collapsed blanketed in snow, and continued days after with the explanation of the origin of this extreme cold event, introducing physical concepts such as the 'Jet Stream' to explain it, while framing it within climate change (Xavier Fonseca, 2021b)"

**P7 L207: By "own personality" do you mean that it is a unique medium? Please rephrase the sentence.**

We have now deleted this sentence to avoid confusion. We just meant that the graphics' design is exclusive for Weather Stories and easily identifiable.

**P7 L209: The historic perspective further frames broader concepts in a locally relevant context for the audience.**

We have now added the suggested remark:

"The historic approach is the format's hallmark. This helps readers to understand the relevance that climate has had in the evolution of life on Earth, and Earth itself, as well as to understand that this influence can sometimes be unexpected. Also, the historic perspective additionally frames broader concepts in a locally relevant context for the public"

**P7 L217: "it can also be linked to a war such as the one in Syria", this requires further explanation in the manuscript.**

We have now added some explanation on Syria:

"Climate change is not only about hurricanes in the East Coast of the United States, heat waves in Europe and droughts in Africa, it can also be linked to a war like Syria's due to the drought that occurred between 2017 and 2010 causing a mass migration of farming families to urban centers (Kelley et al., 2015) (Müller et al., 2016)."

**P8 L235-243: To understand this paragraph readers need more information about Weather Stories, such as who contributes to it, how often issues are published, what is the range of topics. This could be introduced in more detail in the introduction section.**

We provide now extra information on Weather Stories at the end of the Introduction section, as per the reviewer's request:

"Weather stories are published every day in the newspaper La Voz de Galicia on the page that contains meteorological and maritime information. The format focuses on informing the public about the weather in Galicia and explaining from a scientific point of view the meteorological events that affect the community, but also topics related to the history of the climate and climate change. The journalist from La Voz de Galicia Xavier Fonseca is the creator and main contributor of this format and works with the Nonlinear Physics Group at the Physics Faculty of the University of Santiago de Compostela, universities and research centers in Galicia, Spain and the rest of the world to produce information every day. This communication format has specific characteristics that make it possible to face the challenge of communicating the science of climate change to a non-specialist audience. These characteristics are daily section, scientific dissemination, historic perspective and specialization. Our hypothesis is that it can be used as a model to bridge the existing gap between an increasing awareness of climate issues and the apparently stagnant knowledge on these natural phenomena. We illustrate our analysis with a particular example: how this communication format has brought up the dissemination of

the *Jet Stream*. "

**P8 L260: Suggests changing "air navigation" to "air circulation".**

Here we talk about how airplanes take advantage of the jet stream to save time and fuel. The proper term in this context is air navigation.

**P8 L262: The various viewpoints mentioned here are important but have not been introduced before. Please introduce this point earlier in the manuscript. Should it also be an additional element of the model introduced in section 6?**

We have now added the different viewpoints of the Weather Stories format (daily section, scientific dissemination, historic perspective and specialization) in both the abstract and the introduction.

**P9: Suggest moving sections 7.2 and 7.3 as subsections of 7.1, as they fit into the theme of "a stream with a lot of history".**

Following the reviewer's suggestion, we have now unified sections 7.1, 7.2 and 7.3 into one section about historic perspective on the Jet Stream.

**Section 7: These narratives are very interesting, but are presented somewhat arbitrarily. Please mention explicitly how they relate to the model elements introduced in section 6 (see the main comments section above). You could also report the dissemination/publication dates of each story, with links to these publications so that readers can read them if they are interested.**

Section 7 serves as a practical example of the Weather Stories science communication model. The dissemination of this physical concept brings together several points of the model such as historical perspective, science outreach, and specialization. Our opinion is that there is nothing arbitrary about this part. As for the links, in the article there are references to the articles published about the jet stream in *La Voz de Galicia* and in the bibliography as well.

**P14 L365: I suggest changing "often invisible" to "often invisible to the untrained eye" to emphasize that it is invisible if the person does not know what to look for.**

The suggested change has been made:

"The climate crisis, given its characteristics: global, slow and often invisible to the untrained eye, represents a challenge for the homo sapiens' brain ability"

**P14 L381: "Belenguer, 2003" should be introduced earlier in the manuscript if it is referred to in the conclusions.**

We have now included this reference at the beginning of section 6:5:

"This innovative collaboration between physicists and scientific journalists working together in the same research group makes it possible for the section's content to have all warranties of a thorough information and to respond to a demand by the scientific community, which requires more specialised communicators and a higher prominence in

public areas to debate about the environmental issue (Besley and Nisbet 2013, Belenguer, 2003)."

**Technical corrections:**

**P1 L13: "To advance learning" (without "in").**

**P2 L63: The citation is not closed.**

**P7 L215: "to assimilate" (without "to").**

**P12 L345:"on the planet".**

All the suggested corrections have been made .Thank you!

Please also note the supplement to this comment:

<https://gc.copernicus.org/preprints/gc-2021-34/gc-2021-34-AC1-supplement.pdf>