

Dear Louise Arnal,

Thank you very much for taking the time to review the article. I have carefully read all of your comments and believe they will help improve the article significantly. Below, I respond to each of the contributions you have made and add how each of the parts of the article that has been modified based on your suggestions would look like

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.

You are absolutely right when you say that you miss the hypothesis at the beginning of the article. As you say, we have added part of the hypothesis both in the abstract and in the introduction of the article to highlight the central aspect of this research, which is to show a model of scientific communication with specific characteristics.

So, in the abstract we have add: “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, teleconnections, and specialization) allow taking on the challenge. In this article we present a communication proposal existent in a newspaper published in Spain. We argue that this communication format represents a model to disseminate climate science, educate readers and even to make physical concepts such as the Jet Stream accessible. We believe that this format conforms to and complies with the enunciation of Article 12 of the Paris Agreement, which calls on the signatory countries to promote education and training on climate change”.

In the introduction we have add: “This communication format has a 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, teleconnections, 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 you suggest, we have included the example you mention 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 I 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, whose released energy was 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 shows besides the role of teleconnections in the global climatic system. 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.

Regarding the survey I have already added a copy to the paper where all the questions that were asked to the chosen population appear. In this case students from the three universities in Galicia. In any case I think it is important to mention that the survey has been conducted to support our claim that there is little knowledge about climate change and that traditional media are the preferred choice for information among the population, even among young people. The data that our study shows coincide with other work mentioned in the article. We simply wanted to provide some new and specific data on a part of the population of Galicia, which is where Weather Stories are published.

Regarding the method for analyzing the content of Weather Stories, no survey has been carried out. The article proposes a model and a practical example. Future research could try to analyze through experimentation the impact that this type of communication format has on a part of the population.

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, I 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.

As you propose we have unified items 7.1, 7.2 and 7.3 into one since they talk about the historical part of the current.

“7.1 A current with plenty of history

The communication model that we present is aimed for the readers’ scientific culture improvement and for their familiarisation with complex physical concepts, such as the Jet Stream. A good way of attaining this objective is by addressing its origin and functioning from a historical point of view. By explaining the jet stream history, we make sure that readers do not assimilate such physical concept as something abstract and unknown, but rather as a natural mechanism with its own history, which has even played a major role in certain historical events.

For example, its discovery is related to an important climatic event of the past. One of the natural mechanisms that intervenes in climate dynamics (Alan Buis, 2020) is intense volcanic eruptions, which inject sulphuric gases in the stratosphere and create an aerosol cloud that blocks sunlight, lowering temperatures and triggering a chain of events in global climate, some of them with catastrophic consequences (Jason Wolfe, 2000). Some of the most famous cataclysms in climate history are caused by a volcano. In 1883, one of the most intense

examples was registered. The Krakatoa volcano erupted in Indonesia and the explosion wiped out a large area of the island. The powerful 1883 eruption, whose released energy was 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 shows besides the role of teleconnections in the global climatic system. 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). This English scientific institution started one of the first public cooperation networks. Based on the data coming from all around the globe thanks to the telegraph, scientists suspected that something was moving the Krakatoa cloud across the planet. The depiction of the movement of that volcanic cloud produced the first map of the jet streams that circulate the Earth (David Kravets, 2010).

Besides, this air current played a crucial role in one of the most important historical events of the 20th century. The jet stream is a high-speed airflow situated around 8,000 metres of altitude, just below the tropopause, the boundary between the troposphere and the stratosphere. Winds go from west to east moving about the whole hemisphere at an average speed ranging between 150 and 400 kilometres per hour. The Jet Stream played a crucial role during World War II. In the 1930s, Japan was a great scientific power that kept the jet stream existence as a state secret (Rebecca Maksel, 2018). After the attack to the American naval fleet in Pearl Harbor, Japan thought it was the right moment to use the weapon of which nobody else knew. Hence, they decided to use the stream to attack the United States with balloons loaded with bombs. The goal was to start fires in the west part of the country (Xavier Fonseca, 2020a). (See figure 1)"

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 you suggest 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. 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 parts of the article you propose and we have delated “and that the media is the main source of public opinion information” because the consumption of news in the media is experimenting 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. (National Academy of Science, 2020)”

“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 (Emily L. Howell, 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 (NOAA, 2021)”

“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) (European Union, 2019)”

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).

“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 knowledge”

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

“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, teleconnections, and specialization) allow taking on the challenge of explain 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.

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 we survey show. As a result, the recipient the public is unable to accept it and this 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)

I suggest changing "harder" to "more catastrophic".

“In the last five years, the science discourse on climate change has become more catastrophic”

What are the limits set by the Paris Agreement? Please specify.

“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 (National Academy of Science, 2020)”

Please explain very briefly what the "Hot Earth" hypothesis consists of in the manuscript.

“The ‘Hothouse Earth’ hypothesis which explains that if warming continues at the current rate it could produce a cascade of events that can raise 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).”

This would be a good point to briefly introduce what the Jet Stream is.

“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 stream of winds that separate cold polar air from warm subtropical air in the north hemisphere. Knowing these physical concepts is vital to understanding how the global climate system works and the threat of climate change”

Suggest changing "the generation" to "one of the generations".

“This population group is very interesting because they are young, educated people who use several sources of information and who belong one of the generations that will mostly suffer the consequences of the increase in global temperature”

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 believe that, following the provisions backed by the 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. “

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.

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

"The effect wears off 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.

You are right. We have removed that reference

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.

This is very important and the term "field" has been changed to "forecast". In this part of the article it is explained 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 also compare the information.

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

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 survey to support this idea

Please briefly explain in the manuscript the 3 crisis points facing journalism.

The economic and model concepts have been removed because they have nothing to do with the main topic of the article.

“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, Ramón; Buslón, Nataly; López-Pan, Fernando; León, Bienvenido; López-Goñi, Ignacio; Erviti, María-Carmen, 2020)”

This paragraph is a repetition of many elements introduced in section 2. I suggest that it be revised to be more concise.

Based on your comment I have cut out some part, 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, Carlos, 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, Ramón; Buslón, Nataly; López-Pan, Fernando; León, Bienvenido; López-Goñi, Ignacio; Erviti, María-Carmen, 2020)

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 in more depth on the media crisis. In this part we just want to highlight the continuing importance of the traditional media, because Weather Stories is published in a newspaper.

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.

“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. 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)”

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 I mentioned at the beginning, 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, let it be noted again that the survey information is not the main focus of this article. As has been referenced there are many studies that point out that there is great concern about climate change but little knowledge.

"More than 40% believe", is this figure from the survey?

Yes

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

“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 a reliability, important to build public trust”

Where did the Filomena storm occur?

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

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

This sentence was deleted

“Furthermore, given that the population has a limited level of general scientific literacy and a low level of specific climate literacy, the content is presented with a simple language supported by some graphic material that facilitates the understanding of physical concepts”

Historical perspective further frames broader concepts in a locally relevant context for the audience.

“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 historical perspective additionally frames broader concepts in a locally relevant context for the public”

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

“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 that caused a mass migration of farming families to urban centers (Kelley et al., 2015) (Müller et al., 2016).”

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.

“The journalist from La Voz de Galicia Xavier Fonseca is the creator of this format and works with Department of Nonlinear Physics in the University of Santiago de Compostela, universities and research centers in Galicia, Spain and the rest of the world to produce information every day”

He suggests changing "air navigation" to "air traffic".

Here we talk about how airplanes take advantage of jet stream to save time and fuel. That is why we believe that the best way is air navigation.

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 added the different points of the Weather Stories format in both the abstract and the introduction, as we mentioned.

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".

“7.1 A current with plenty of history

The communication model that we present is aimed for the readers' scientific culture improvement and for their familiarisation with complex physical concepts, such as the Jet Stream. A good way of attaining this objective is by addressing its origin and functioning from a historical point of view. By explaining the jet stream history, we make sure that readers do not assimilate such physical concept as something abstract and unknown, but rather as a natural mechanism with its own history, which has even played a major role in certain historical events.

For example, its discovery is related to an important climatic event of the past. One of the natural mechanisms that intervenes in climate dynamics (Alan Buis, 2020) (Alan Buis, 2020) is intense volcanic eruptions, which inject sulphuric gases in the stratosphere and create an aerosol cloud that blocks sunlight, lowering temperatures and triggering a chain of events in global climate, some of them with catastrophic consequences (Jason Wolfe, 2000). Some of the most famous cataclysms in climate history are caused by a volcano. In 1883, one of the most intense examples was registered. The Krakatoa volcano erupted in Indonesia and the explosion wiped out a large area of the island. The powerful 1883 eruption, whose released energy was 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 shows besides the role of teleconnections in the global climatic system. 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). This English scientific institution started one of the first public cooperation networks. Based on the data coming from all around the globe thanks to the telegraph, scientists suspected that something was moving the Krakatoa cloud across the planet. The depiction of the movement of that volcanic cloud produced the first map of the jet streams that circulate the Earth (DAVID KRAVETS, 2010).

Besides, this air current played a crucial role in one of the most important historical events of the 20th century. The jet stream is a high-speed airflow situated around 8,000 metres of altitude, just below the tropopause, the boundary between the troposphere and the stratosphere. Winds go from west to east moving about the whole hemisphere at an average speed ranging between 150 and 400 kilometres per hour. The Jet Stream played a crucial role during World War II. In the 1930s, Japan was a great scientific power that kept the jet stream existence as a state secret (Rebecca Maksel, 2018). After the attack to the American naval fleet in Pearl Harbor, Japan thought it was the right moment to use the weapon of which nobody else knew. Hence, they

decided to use the stream to attack the United States with balloons loaded with bombs. The goal was to start fires in the west part of the country (Xavier Fonseca, 2020a). (See figure 1)”

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.

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

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

Done

Technical corrections:

"To advance learning" (without "in").

“To advance the learning of the science of climate change, in general, and of concepts such as the Jet Stream, in particular, specific scientific communication formats are required that can successfully tackle the difficult task of explaining such complex problems to the general public”.

The citation is not closed.

Done

"to assimilate" (without "to").

“For our ‘sapiens’ brain to assimilate climate change, providing a historic perspective may be of great help.”

"on the planet".

“The emphasis of this dissemination proposal is that all of these are events linked to jet stream changes, which serve as an example of the importance that the jet stream has on the planet.”