Climate change denial theories, skeptical arguments, and the role of science communication

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Climate change, also commonly referred to as global warming, is increasingly becoming the most pressing challenge to our planet. This issue is exceedingly complex, primarily due to continuous human emissions of greenhouse gases into the atmosphere, resulting in significant consequences that affect every facet of the environment, society, and the global economy.

While the majority of climate scientists unanimously agree that human activities are exacerbating climate change, there remains a faction within society that is skeptical or outright denies this reality. The debate surrounding global warming revolves around determining whether this phenomenon is indeed occurring and the extent of its severity. Questions also persist regarding the causes of climate change, as well as whether and how to implement mitigation measures.

This paper examines the causes and significance of climate change denial, as well as the role of climate change science communication, emphasizing the critical importance of addressing this issue for the benefit of our planet and future generations.

The existence of climate change denialism

Climate change denialism, also known as climate change denial or "climate change denialism," involves the rejection of scientific evidence or the doubt cast upon conclusions without sufficient basis. Naturally, proponents of this theory are at odds with the scientific consensus on climate change. Climate change deniers assert the climate change crisis is a hoax or a scam. They propagate conspiracy theories, suggesting that the climate change crisis has been fabricated or, at the very least, exaggerated by interest groups seeking to control political and economic power (Goldenberg, 2010; Readfearn, 2015).

Climate change deniers have also alleged that scientists have manipulated information and violated ethical standards in their research endeavors. This is an effective strategy aimed at undermining trust in scientific efforts, as well as in the results and credibility of scientists themselves.

One notable scandal, known as "ClimateGate," occurred in 2009 at the University of East Anglia's Climate Research Unit (CRU). This incident unfolded after a hacker breached and stole CRU's emails, subsequently disseminating them across various websites ahead of the Copenhagen Climate Summit, or the 2009 United Nations Climate Change Conference (Goertzel, 2010). Climate change skeptics accused Professor Phil Jones and his colleagues of manipulating data and research materials related to climate. In contrast, CRU supporters argued that the email hack and selective quoting were discriminatory and aimed at discrediting scientific evidence on climate change (McKie, 2019). Despite eight investigative committees reviewing these allegations and publishing reports, no evidence of fraud or wrongdoing has been found. Nevertheless, skepticism about climate change persists and is challenging to be eliminated (DHNS, 2010).

The primary "weapons" used by climate change deniers to attack the credibility of scientific research include allegations of data manipulation and claims of breaches of scientific review principles. Specifically:

- *Allegations of research data manipulation*: Climate change deniers often make claims about the creation of misleading research data within the environmental field. They use errors in research data to argue that climate change studies are untrustworthy. In 2002, the Cooler Heads Coalition published an article supporting the conspiracy theory advanced by the Lavoisier Group, asserting that hundreds of climate scientists had distorted their findings to support the climate change theory, aiming to protect their research funding (Dunlap & Jacques, 2013). In 2007, John Coleman, the founder of a US television weather channel, wrote on his personal blog that global warming is the biggest hoax in history (The Telegraph Foreign Staff, 2007). Many who share this perspective continually make similar allegations, suggesting that climate change research receives substantial government funding to manipulate science (Uscinski et al., 2017).
- *Allegations of violations of scientific peer review principles in climate change research*: Climate change deniers often argue that scientific articles on climate science have been distorted due to scientists attempting to suppress dissenting views. In 1996, Frederick Seitz, an American physicist, wrote an article in the Wall Street Journal criticizing the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) while also raising suspicions of corruption in the report's peer review process (Seitz, 1996).

Denying the role of humans in climate change

Those who hold the viewpoint denying humans' impacts on climate change acknowledge climate change and global warming but deny that humans are the cause of this crisis. They present unverifiable data on Earth's temperature changes from hundreds or even thousands

of years ago to support their stance (see Figure 1). According to them, the Earth's warming and climate change are natural cyclical phenomena that have occurred over thousands of years and are unrelated to human activities or the greenhouse effect.

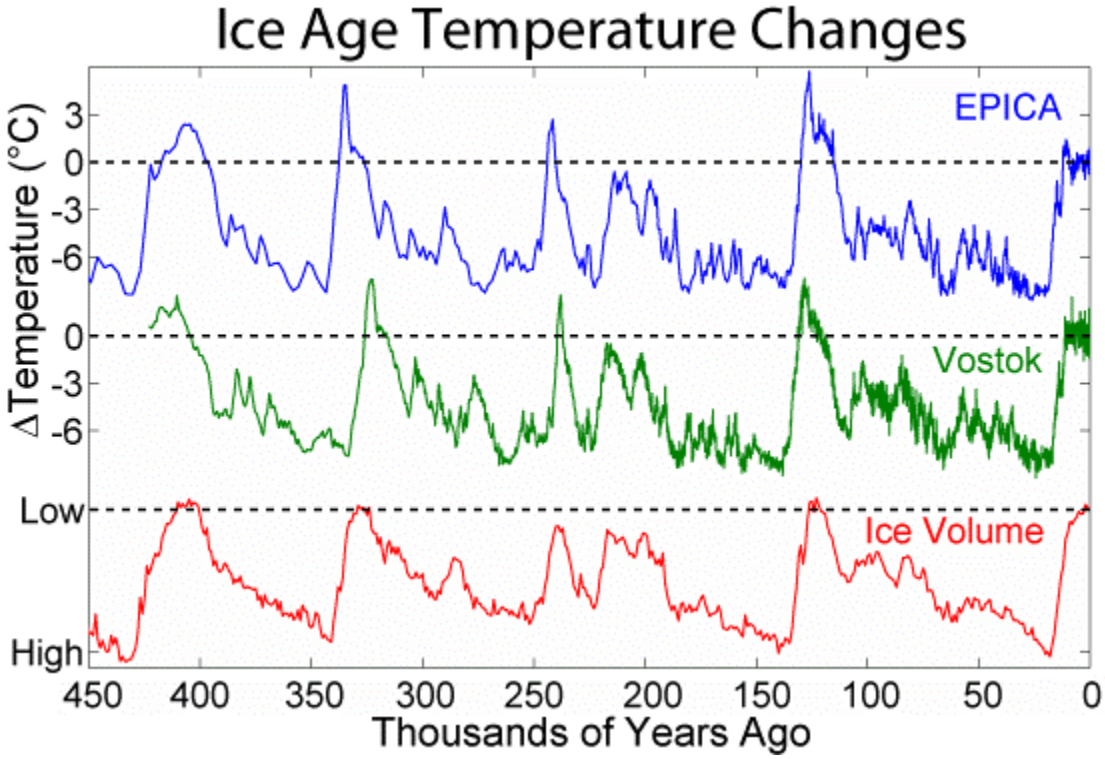


Figure 1: A graph of Earth's temperature over thousands of years shared by the deniers (source: Social Media)

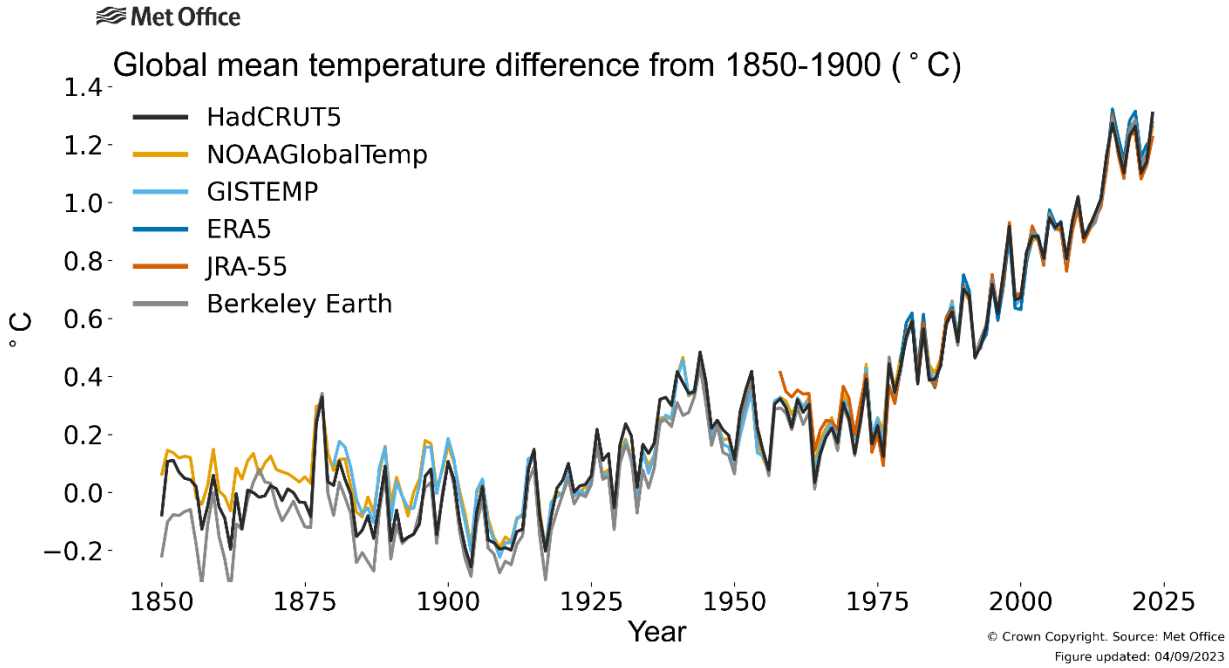
Conspiracy theories underlying this denial suggest that interest groups may be aiming to control global politics, capitalize on investments in clean energy, or even shift blame onto countries like China for the purpose of creating competition (Douglas & Sutton, 2015; Wong, 2016). William M. Gray, head of the Tropical Meteorology Project at Colorado State University's Department of Atmospheric Sciences, emphasized in 2006 that global warming had become a significant political issue with no other major adversary since the end of the Cold War. He argued that its goal might be to generate political influence, attempt to establish a global government, and control the populace (Achenbach, 2006). Before this argument, he had even claimed that scientists endorsed the scientific consensus on climate change because they were worried about losing their grant funding (Gray, 2000).

According to a 2017 study, approximately 40% of Americans believe in conspiracy theories and deny climate change (Uscinski & Olivella, 2017). The rate of belief and shifts in views on climate change also do not significantly differ across political parties (Deeg et al., 2019).

The impact of climate change and the human role

Although doubts about the reality of climate change still exist in some scientific literature, strong consensus within the scientific community suggests that global surface temperatures have increased in recent decades (Cook et al., 2013; Cook et al., 2016; Earth Science Communications Team, 2023). Some studies even indicate a consensus of up to 99% and 100% on human-induced global warming (Lynas et al., 2021; Powell, 2017). This phenomenon is primarily attributed to greenhouse gas emissions from human activities. Climate change is causing a range of increasingly severe effects on the environment. Desert areas are expanding, heatwaves and wildfires are becoming more common, and the Arctic is experiencing rapid warming, leading to the melting of polar ice caps and sea ice retreat (Liu & Xue, 2020; Thomas & Nigam, 2018; Turco et al., 2023). Higher temperatures also result in more powerful storms, droughts, and other extreme weather events (Masson-Delmotte et al., 2021). Rapid environmental changes in mountainous regions, coral reefs, and the Arctic have forced many species to change behavior, migrate, or face extinction (Ellis et al., 2019; Fretwell et al., 2023; Roffler et al., 2023; Román-Palacios & Wiens, 2020)[20]. Even if there is success in mitigating future warming, some impacts will persist for centuries, including ocean warming, ocean acidification, and sea-level rise (Masson-Delmotte et al., 2018).

There is an increasing body of evidence that shows that over the past 15 years, the world has experienced a faster rate of warming than in the 1970s (Met Office Hadley Centre, n.d.). Notably, this period also marks the beginning of the industrial era of human civilization. Data collected from various sources and scientific organizations consistently support this consensus and alignment of information (Met Office Hadley Centre, n.d.).



Global mean temperature from various organizations (Retrived from Met Office Hadley Centre (n.d.) under Open Government License: https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/)

New data from the National Snow and Ice Data Center (NSIDC) continues to show that Antarctic sea ice levels in mid-September 2023 reached their lowest historical levels (Biino, 2023).

Why climate change denial theories persist and flourish

The denial of climate change's existence can stem from various reasons, including lack of information, outdated knowledge, conservative thinking, resistance to new information, or fear of economic and political repercussions. However, it also indicates that the communication and persuasion efforts within the community regarding the climate change crisis have not reached their optimal level. There is a shared responsibility and significant role for various stakeholders in improving this situation:

Scientists

Scientists play a crucial role in researching, gathering factual information, and warning about the climate change crisis and its impacts on the planet and humanity. However, the voices of scientists often do not resonate widely in society, and scientific research is often presented in a dry, complex, and inaccessible manner to the majority of people. Moreover, scientists themselves have not been proactive and "sincere" in communicating scientific information related to climate change. This contributes to a disconnection with other parts of society and may express a sense of instructing rather than informing and persuading others.

As a result, the effectiveness of communicating scientific information is low. Much of the communication of scientific information about climate change appears to be left to the science communication sector, the media, and even social activists. Therefore, scientific information is vulnerable to being miscommunicated by science communicators, the press, and even social activists, which creates room for climate change denial groups to capitalize on and cast doubt on the accuracy of scientific information.

Social activists and the media

Environmental activists and the media are crucial in conveying information to the general public. However, there have been instances where some environmental activists have crossed the line, engaging in inappropriate, offensive, and even illegal actions to garner attention and turn environmental issues into "media sensations" rather than presenting persuasive arguments. These instances include art vandalism, road blockage, private property vandalism, etc. These actions can lead to backlash and change the perspectives of environmental supporters.

Some environmental activists, although passionate, sometimes reflect perceptual limitations in presenting their views through arguments that may not be sufficiently persuasive or logically sound. Many environmental activists tend to exaggerate threats to capture public attention. They issue warnings and predict catastrophes based solely on intuition rather than scientific evidence.

For example, in June 2018, climate activist Greta Thunberg posted an urgent tweet warning that a leading climate scientist had predicted that climate change would wipe out humanity within five years unless we stopped using fossil fuels (Forbes, 2023). However, after five years, reality has shown that humanity still exists without signs of extinction, leading to ridicule from the community. Such inaccurate warnings can be more harmful than beneficial to environmental protection efforts, similar to the boy who cried "wolf" in the fable, making the community lose trust in genuine environmental threats and serious scientists.

Political Leaders and National Governments

Political leaders and national governments face a significant responsibility in addressing the climate change crisis. However, even within leadership and national governments, there is a divergence in perceptions of climate change and its impacts, leading to differences in approaches to this issue.

Some leaders even embrace climate change denialism. For instance, on July 28, 2003, U.S. Senator James Inhofe questioned, "With all of the hysteria, all of the fear, all of the phony science, could it be that man-made global warming is the greatest hoax ever perpetrated on the American people?" (Harman, 2014). Recently, Florida Governor Ron DeSantis even rejected $350 million in federal funds aimed at tackling climate change (Otten, 2023).

Many other leaders are pressured by political and corporate interests, especially major industrial conglomerates, and therefore, they do not implement strong measures to address climate change. For example, in 2017, while serving as President of the United States, Donald Trump withdrew the U.S. from the Paris Agreement, an accord established with hopes of mitigating global warming. He argued that this agreement would "undermine" the U.S. economy and leave the U.S. "at a permanent disadvantage" (Chakraborty, 2017)

Emission-producing corporations

Climate change opposition, in many cases, is related to the actions of corporations responsible for greenhouse gas emissions. Greenpeace's 'Exxon Secrets' investigative project provided evidence indicating that corporations like Koch Industries and ExxonMobil may be behind the funding of climate change denial groups (Monbiot, 2006). A survey conducted by the Royal Society of the United Kingdom in 2005 also revealed that ExxonMobil distributed $2.9 million to 39 groups with "a distorted view of the science behind climate change and a complete lack of evidence" (Adam, 2008).

Final Remarks

Despite disagreements over technical aspects or approaches to climate change models and data, consensus within the scientific community is increasingly robust and affirms that climate change is occurring, and it has and will continue to have serious, even existential, impacts on the environment and life on Earth. Denial and rejection do not help address this issue but rather exacerbate the situation (Douglas et al., 2019), increasing risks and consequences beyond salvage.

To address climate change, we need global consensus and consistent action, and this can only be achieved with reliable scientific information and guidance. Therefore, scientists need to engage in conveying information along with science communicators and the media to enhance the clarity and credibility of information. Environmental activists need to conduct appropriate communication campaigns and use scientific information in a trustworthy, appropriate manner to avoid becoming targets of denialists. Simultaneously, governments should promote policies and measures to mitigate the impacts of climate change while highlighting the scientific basis behind each crucial decision.

Clearly, facing an issue that threatens the planet's existence, cooperation, and determined action are not only necessary but also a prerequisite. Logically, trust can only be built on reliable scientific information to ensure this process becomes a reality. Thus, the communication process and methods of scientific communication also need to be equally trusted and, therefore, require adequate investment.

Establishing a dedicated scientific communication sector for climate change issues is necessary due to the complexity and interdisciplinarity of the problem. Furthermore, the trend of open science needs to be promoted and encouraged further because it not only enhances the credibility and persuasiveness of scientific information but also makes scientists more humble (Besançon et al., 2021; Vuong, 2017, 2020). Transparent disclosure of scientific costs will also help demonstrate that scientific efforts have been made and refute allegations of corruption and political involvement in scientific results (Vuong, 2018).

The social sciences and humanities have not received sufficient attention as a valuable approach to supporting the resolution of the climate change issue, even though human actions predominantly cause the severity of the situation. Specifically, if the current eco-deficit culture within society is not replaced by an eco-surplus cultural values, the implementation of climate change mitigation policies, programs, and actions will become more challenging, potentially fostering and sustaining climate change denial and resistance (Nguyen & Jones, 2022). Promoting or maintaining sustainable development initiatives, such as the semiconducting principle of monetary and environmental values exchange, will be exceptionally challenging when a significant portion of the population still does not believe that climate change is caused by human activities (Vuong, 2021).

The evidence of human-induced climate change is clear and has achieved near-universal consensus among scientists. Perhaps it is time to stop seeking answers to "Who is to blame?" and focus on the question, "Will we ever stop claiming nature as our own?" (Vuong, 2023).

References

Achenbach, J. (2006). *The tempest*. The Washington Post. Retrieved October 23 from https://www.washingtonpost.com/wp-dyn/content/article/2006/05/23/AR2006052301305_pf.html

Adam, D. (2008). *Exxon to cut funding to climate change denial groups*. The Guardian. Retrieved October 23 from https://www.theguardian.com/environment/2008/may/28/climatechange.fossilfuels

Besançon, L., Peiffer-Smadja, N., Segalas, C., Jiang, H., Masuzzo, P., Smout, C., . . . Leyrat, C. (2021). Open science saves lives: lessons from the COVID-19 pandemic. *BMC Medical Research Methodology*, *21*(1), 1-18. https://doi.org/10.1186/s12874-021-01304-y

Biino, M. (2023). *Sea-ice levels in Antarctica at a 'mind-blowing' historic low*. Insider. Retrieved September 20 from https://www.businessinsider.com/sea-ice-levels-in-antarctica-reached-a-new-historic-low-2023-9

Chakraborty, B. (2017). *Paris Agreement on climate change: US withdraws as Trump calls it 'unfair'*. Fox News. Retrieved October 23 from https://www.foxnews.com/politics/paris-agreement-on-climate-change-us-withdraws-as-trump-calls-it-unfair

Cook, J., Nuccitelli, D., Green, S. A., Richardson, M., Winkler, B., Painting, R., . . . Skuce, A. (2013). Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters*, *8*(2), 024024. https://doi.org/10.1088/1748-9326/8/2/024024

Cook, J., Oreskes, N., Doran, P. T., Anderegg, W. R., Verheggen, B., Maibach, E. W., . . . Green, S. A. (2016). Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*, *11*(4), 048002. https://doi.org/10.1088/1748-9326/11/4/048002

Deeg, K. S., Leiserowitz, A., Maibach, E., Kotcher, J., & Marlon, J. (2019). *Who is changing their mind about global warming and why?* (Yale Program on Climate Change Communication., Issue. https://climatecommunication.yale.edu/publications/who-is-changing-their-mind-about-global-warming-and-why/

DHNS. (2010). *UK 'Climategate' inquiry largely clears scientists*. Deccan Herald. Retrieved October 23 from https://www.deccanherald.com/content/61233/uk-climategate-inquiry-largely-clears.html

Douglas, K. M., & Sutton, R. M. (2015). Climate change: Why the conspiracy theories are dangerous. *Bulletin of the Atomic Scientists*, *71*(2), 98-106. https://doi.org/10.1177/0096340215571908

Douglas, K. M., Uscinski, J. E., Sutton, R. M., Cichocka, A., Nefes, T., Ang, C. S., & Deravi, F. (2019). Understanding conspiracy theories. *Political Psychology*, *40*, 3-35. https://doi.org/10.1111/pops.12568

Dunlap, R. E., & Jacques, P. J. (2013). Climate change denial books and conservative think tanks: Exploring the connection. *American Behavioral Scientist*, *57*(6), 699-731. https://doi.org/10.1177/0002764213477096

Earth Science Communications Team. (2023). *How do we know climate change is real?* NASA's Jet Propulsion Laboratory and California Institute of Technology. Retrieved October 23 from https://climate.nasa.gov/evidence/

Ellis, J. I., Jamil, T., Anlauf, H., Coker, D. J., Curdia, J., Hewitt, J., . . . Hariprasad, D. (2019). Multiple stressor effects on coral reef ecosystems. *Global Change Biology*, *25*(12), 4131-4146. https://doi.org/10.1111/gcb.14819

Forbes, S. (2023). *The case of Greta Thunberg's deleted tweet — What alarmists need to hear*. Forbes. Retrieved October 23 from https://www.forbes.com/sites/steveforbes/2023/07/14/the-case-of-greta-thunbergs-deleted-tweet---what-alarmists-need-to-hear/?sh=49ab5ecb145c

Fretwell, P. T., Boutet, A., & Ratcliffe, N. (2023). Record low 2022 Antarctic sea ice led to catastrophic breeding failure of emperor penguins. *Communications Earth and Environment*, *4*(1), 273. https://doi.org/10.1038/s43247-023-00927-x

Goertzel, T. (2010). Conspiracy theories in science: Conspiracy theories that target specific research can have serious consequences for public health and environmental policies. *EMBO Reports*, *11*(7), 493-499. https://doi.org/10.1038/embor.2010.84

Goldenberg, S. (2010). *US Senate's top climate sceptic accused of waging 'McCarthyite witch-hunt'*. The Guardian. Retrieved October 22 from https://www.theguardian.com/environment/2010/mar/01/inhofe-climate-mccarthyite

Gray, W. M. (2000). *Get off warming bandwagon*. BBC News. Retrieved October 23 from http://news.bbc.co.uk/2/hi/in_depth/sci_tech/2000/climate_change/1023334.stm

Harman, G. (2014). *New argument from climate change deniers: global warming is a good thing*. The Guardian. Retrieved October 23 from https://www.theguardian.com/sustainable-business/blog/environment-climate-change-denier-global-warming

Liu, Y., & Xue, Y. (2020). Expansion of the Sahara Desert and shrinking of frozen land of the Arctic. *Scientific Reports*, *10*(1), 4109. https://doi.org/10.1038/s41598-020-61085-0

Lynas, M., Houlton, B. Z., & Perry, S. (2021). Greater than 99% consensus on human caused climate change in the peer-reviewed scientific literature. *Environmental Research Letters*, *16*(11), 114005. https://doi.org/10.1088/1748-9326/ac2966

Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S. L., Péan, C., Berger, S., . . . Gomis, M. J. C. o. w. g. I. t. t. s. a. r. o. t. i. p. o. c. c. (2021). *Climate change 2021: the physical science basis* (Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change, Issue. https://www.ipcc.ch/report/ar6/wg1/

Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P. R., . . . Pidcock, R. (2018). *Global warming of 1.5 C*. https://www.ipcc.ch/sr15/

McKie, R. (2019). *Climategate 10 years on: what lessons have we learned?* The Guardian. Retrieved October 23 from https://www.theguardian.com/theobserver/2019/nov/09/climategate-10-years-on-what-lessons-have-we-learned

Met Office Hadley Centre. (n.d.). *Global temperature*. Met Office Hadley Centre. Retrieved October 23 from https://climate.metoffice.cloud/temperature.html

Monbiot, G. (2006). *The denial industry*. The Guardian. Retrieved October 23 from https://www.theguardian.com/environment/2006/sep/19/ethicalliving.g2

Nguyen, M.-H., & Jones, T. E. (2022). Building eco-surplus culture among urban residents as a novel strategy to improve finance for conservation in protected areas. *Humanities & Social Sciences Communications*, *9*, 426. https://doi.org/10.1057/s41599-022-01441-9

Otten, T. (2023). *DeSantis rejected $350 million in climate funding before hurricane Idalia*. The New Republic. Retrieved October 23 from https://newrepublic.com/post/175301/desantis-rejected-350-million-climate-funding-florida-hurricane-idalia

Powell, J. (2017). Scientists reach 100% consensus on anthropogenic global warming. *Bulletin of Science, Technology and Society*, *37*(4), 183-184. https://doi.org/10.1177/0270467619886266

Readfearn, G. (2015). *Doubt over climate science is a product with an industry behind it*. The Guardian. Retrieved October 22 from https://www.theguardian.com/environment/planet-oz/2015/mar/05/doubt-over-climate-science-is-a-product-with-an-industry-behind-it

Roffler, G. H., Eriksson, C. E., Allen, J. M., & Levi, T. (2023). Recovery of a marine keystone predator transforms terrestrial predator–prey dynamics. *Proceedings of the National Academy of Sciences*, *120*(5), e2209037120. https://doi.org/10.1073/pnas.2209037120

Román-Palacios, C., & Wiens, J. J. (2020). Recent responses to climate change reveal the drivers of species extinction and survival. *Proceedings of the National Academy of Sciences*, *117*(8), 4211-4217. https://doi.org/10.1073/pnas.1913007117

Seitz, F. (1996). *A major deception on global warming*. The Wall Street Journal. Retrieved October 23 from https://www.wsj.com/articles/SB834512411338954000

The Telegraph Foreign Staff. (2007). *Weather Channel boss calls global warming 'the greatest scam in history'*. The Telegraph. Retrieved October 23 from https://www.telegraph.co.uk/news/earth/earthnews/3313785/Weather-Channel-boss-calls-global-warming-the-greatest-scam-in-history.html

Thomas, N., & Nigam, S. (2018). Twentieth-century climate change over Africa: Seasonal hydroclimate trends and Sahara Desert expansion. *Journal of Climate*, *31*(9), 3349-3370. https://doi.org/10.1175/JCLI-D-17-0187.1

Turco, M., Abatzoglou, J. T., Herrera, S., Zhuang, Y., Jerez, S., Lucas, D. D., . . . Cvijanovic, I. (2023). Anthropogenic climate change impacts exacerbate summer forest fires in California. *Proceedings of the National Academy of Sciences*, *120*(25), e2213815120. https://doi.org/10.1073/pnas.2213815120

Uscinski, J. E., Douglas, K., & Lewandowsky, S. (2017). Climate change conspiracy theories. In *Oxford research encyclopedia of climate science*. https://doi.org/10.1093/acrefore/9780190228620.013.328

Uscinski, J. E., & Olivella, S. (2017). The conditional effect of conspiracy thinking on attitudes toward climate change. *Research and Politics*, *4*(4), 2053168017743105. https://doi.org/10.1177/2053168017743105

Vuong, Q.-H. (2017, 12/20). Open data, open review and open dialogue in making social sciences plausible. *Scientific Data Updates*. http://blogs.nature.com/scientificdata/2017/12/12/authors-corner-open-data-open-review-and-open-dialogue-in-making-social-sciences-plausible/

Vuong, Q.-H. (2018). The (ir)rational consideration of the cost of science in transition economies. *Nature Human Behaviour*, *2*, 5. https://doi.org/10.1038/s41562-017-0281-4

Vuong, Q.-H. (2020). Reform retractions to make them more transparent. *Nature*, *582*, 149. https://doi.org/10.1038/d41586-020-01694-x

Vuong, Q.-H. (2021). The semiconducting principle of monetary and environmental values exchange. *Economics and Business Letters*, *10*(3), 284-290. https://doi.org/10.17811/ebl.10.3.2021.284-290

Vuong, Q.-H. (2023). *Meandering sobriety*. https://www.amazon.com/dp/B0C2TXNX6L/

Wong, E. (2016). *Trump has called climate change a Chinese hoax. Beijing says it is anything but.* The New York Times. Retrieved October 23 from https://www.nytimes.com/2016/11/19/world/asia/china-trump-climate-change.html