



AI-Enhanced Climate Communication and Public Engagement: A Conceptual Framework for Responsible Environmental Messaging

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ABSTRACT

Climate change communication faces persistent challenges, including psychological distance, political polarization, misinformation, public disengagement, and difficulty translating scientific evidence into meaningful public action. Artificial intelligence offers new possibilities for climate communication by supporting audience segmentation, message personalization, climate visualization, misinformation detection, and automated public engagement. However, AI-enhanced climate communication also raises ethical concerns related to transparency, manipulation, data privacy, algorithmic bias, and unequal access to trustworthy climate information. This conceptual article examines how AI can reshape climate communication and public engagement in digital society. Drawing on climate communication research, science communication, AI ethics, algorithmic accountability, and machine learning for climate action, the article proposes a three-dimensional framework: personalized climate meaning-making, algorithmic climate visibility, and responsible public engagement. Personalized climate meaning-making refers to the use of AI to adapt climate messages to audience values, local contexts, and perceived relevance. Algorithmic climate visibility refers to the ways AI and platform algorithms shape which climate narratives become publicly visible. Responsible public engagement refers to the ethical governance of AI-supported communication practices so that persuasion does not become manipulation. The article argues that AI should not be treated as a simple solution to climate communication problems but as a socio-technical tool that must be guided by transparency, equity, trust, and democratic participation.

1. Introduction

Climate change communication has long faced the challenge of translating complex scientific evidence into public understanding, concern, and action. Although the scientific consensus on anthropogenic climate change is strong, public engagement has often been limited by psychological distance, political identity, uncertainty, and competing media narratives (Moser, 2010; van der Linden et al., 2015). These challenges indicate that climate communication is not only a matter of

providing more scientific information but also a process of meaning-making, trust-building, and social engagement.

Research in science communication has shown that the deficit model, which assumes that public disagreement results mainly from lack of knowledge, is insufficient for explaining public responses to complex scientific issues. Nisbet and Scheufele (2009) argue that science communication must pay greater attention to values, framing, media systems, and public participation. This insight is especially important for climate change because people interpret climate information through cultural, political, and emotional contexts (Nisbet & Scheufele, 2009; Moser, 2010).

Artificial intelligence is increasingly relevant to this communication environment. AI systems can analyze audience data, detect patterns in public opinion, personalize messages, generate visualizations, monitor misinformation, and support climate-related decision-making. Machine learning has also been identified as a potentially useful tool for climate mitigation and adaptation, including energy systems, transportation, agriculture, disaster management, and climate modeling (Rolnick et al., 2022). These technical capacities create new possibilities for climate communication but also require careful social and ethical evaluation.

This article examines AI-enhanced climate communication as a socio-technical communication practice. It argues that AI should not be understood simply as a tool for increasing message efficiency. Instead, AI must be examined as a system that can shape public attention, personalize persuasion, influence trust, and reorganize climate visibility in digital environments (Gillespie, 2014; Diakopoulos, 2015).

The purpose of this article is to propose a conceptual framework for responsible AI-enhanced climate communication. The framework is organized around three dimensions: personalized climate meaning-making, algorithmic climate visibility, and responsible public engagement. These dimensions help explain how AI can support climate communication while also identifying the ethical risks of data-driven environmental persuasion (Floridi et al., 2018; Kitchin, 2017).

2. Literature Review

Climate Communication and Public Engagement

Climate communication research emphasizes that effective public engagement requires more than the transmission of scientific facts. Moser (2010) notes that climate change communication involves major challenges because climate change is complex, long-term, global, and often perceived as distant from everyday life. This makes it difficult for many publics to connect scientific information with personal experience and local action (Moser, 2010).

van der Linden et al. (2015) argue that public engagement with climate change can be improved by reducing psychological distance, using social norms, highlighting effective actions, and communicating in ways that connect with people's values. Their work is important because it shows that climate communication must be psychologically and socially grounded rather than purely informational (van der Linden et al., 2015).

Fear-based communication has also been widely discussed in climate communication. O'Neill and Nicholson-Cole (2009) found that fear-based visual representations may attract attention but are

often ineffective for motivating sustained public engagement. This suggests that climate messages should not rely only on catastrophic imagery but should also support agency, efficacy, and meaningful action (O'Neill & Nicholson-Cole, 2009).

Corner and Clarke (2017) further emphasize the importance of values-based and participatory approaches to climate engagement. Rather than treating publics as passive recipients of expert information, climate communication should connect with people's identities, communities, and everyday concerns. This approach is important for AI-enhanced communication because personalization should support public agency rather than merely optimize persuasion (Corner & Clarke, 2017).

AI, Machine Learning, and Climate Action

Artificial intelligence and machine learning have been increasingly discussed as tools for climate action. Rolnick et al. (2022) identify multiple areas in which machine learning can support climate mitigation and adaptation, including energy forecasting, transportation optimization, precision agriculture, disaster response, climate modeling, and carbon monitoring. Their work demonstrates that AI can support climate action across technical and social systems (Rolnick et al., 2022).

Although much AI-climate research focuses on technical applications, communication is also central to climate action. Climate models, risk forecasts, carbon data, adaptation recommendations, and sustainability information must be communicated to policymakers, communities, organizations, and publics. Without effective communication, even accurate climate knowledge may fail to influence decision-making (Moser, 2010; Rolnick et al., 2022).

AI can support climate communication by translating complex climate data into accessible formats. For example, AI-supported visualization tools may help people understand local climate risks, while language systems may help simplify technical information for different audiences. However, such tools must be carefully designed because simplification can also lead to distortion, overconfidence, or loss of uncertainty information (Kitchin, 2017; Diakopoulos, 2015).

AI may also support climate misinformation monitoring. Digital platforms contain competing climate narratives, including scientific information, political messaging, denialist claims, and misleading interpretations. Algorithmic systems can help identify patterns of misinformation, but they may also create new risks if automated moderation lacks transparency or if platform algorithms amplify engagement-driven climate controversy (Gillespie, 2014; Kitchin, 2017).

Algorithmic Visibility and Environmental Communication

Environmental communication increasingly occurs in platform environments where visibility is shaped by algorithmic systems. Gillespie (2014) argues that algorithms play a key role in determining relevance and visibility in digital culture. In climate communication, this means that public exposure to climate messages may depend not only on scientific accuracy or communicative quality but also on platform ranking, recommendation, and engagement systems (Gillespie, 2014).

Algorithmic visibility matters because climate communication competes with many other forms of public attention. A climate message may be accurate and socially important but still fail to reach audiences if it is not prioritized by platform systems. Conversely, emotionally charged or polarizing

climate content may become more visible if it generates engagement (Gillespie, 2014; Kitchin, 2017).

Diakopoulos (2015) argues that algorithmic accountability is necessary when computational systems shape public knowledge and power. This argument is relevant to climate communication because algorithms may influence which climate risks, solutions, actors, and controversies become visible to publics. If platform systems amplify misleading or polarizing climate narratives, they may affect democratic deliberation and public policy support (Diakopoulos, 2015).

Kitchin (2017) further argues that algorithms should be studied as socio-technical systems embedded in institutional, political, and economic contexts. For climate communication, this means that AI systems cannot be evaluated only by technical performance. Researchers must also examine their data sources, design assumptions, commercial incentives, and social consequences (Kitchin, 2017).

Ethics of AI-Enhanced Climate Communication

The ethical use of AI in climate communication requires careful attention to transparency, autonomy, fairness, privacy, and public trust. Floridi et al. (2018) propose an ethical framework for a good AI society based on principles such as beneficence, non-maleficence, autonomy, justice, and explicability. These principles are highly relevant to AI-enhanced climate communication because climate messaging may influence public beliefs, policy preferences, and behavioral choices (Floridi et al., 2018).

Personalized climate communication may be useful if it helps people understand local risks and relevant solutions. However, personalization may also become ethically problematic if it uses data-driven profiling to manipulate emotions, exploit vulnerabilities, or target audiences without meaningful consent. Therefore, AI-enhanced climate communication must distinguish between supportive personalization and manipulative microtargeting (Floridi et al., 2018; Kitchin, 2017).

Trust is another ethical issue. Climate communication depends on credible sources, transparent evidence, and public confidence in institutions. If AI-generated climate messages are not clearly disclosed, publics may become uncertain about authorship, accountability, and reliability. This may weaken rather than strengthen trust in climate communication (Diakopoulos, 2015; Nisbet & Scheufele, 2009).

Ethical climate communication must also consider equity. AI systems may perform better for high-resource languages, digitally active groups, or populations with more available data. If AI-enhanced climate communication fails to reach marginalized communities, it may reproduce existing inequalities in climate risk awareness and adaptation capacity (Floridi et al., 2018; Corner & Clarke, 2017).

3. A Conceptual Framework for AI-Enhanced Climate Communication

This article proposes a three-dimensional framework for responsible AI-enhanced climate communication: personalized climate meaning-making, algorithmic climate visibility, and responsible public engagement. These dimensions are interconnected because climate

communication involves both message design and the broader digital systems through which messages circulate (Moser, 2010; Gillespie, 2014).

Personalized Climate Meaning-Making

Personalized climate meaning-making refers to the use of AI to adapt climate communication to audience values, local contexts, knowledge levels, and perceived relevance. This dimension responds to the challenge that climate change is often perceived as distant, abstract, and difficult to connect with everyday life (Moser, 2010; van der Linden et al., 2015).

AI can support personalized meaning-making by helping communicators understand different audience concerns. For example, one community may be most concerned about flooding, another about heatwaves, and another about energy costs. AI-assisted analysis can help identify these concerns and support messages that connect climate change with local experience and practical action (Rolnick et al., 2022; van der Linden et al., 2015).

However, personalization must be guided by ethical limits. Climate communication should not simply optimize emotional response or behavioral compliance. It should help publics understand risks, evaluate evidence, and participate in collective decision-making. Personalization should therefore support agency and informed engagement rather than replace deliberation with behavioral targeting (Floridi et al., 2018; Corner & Clarke, 2017).

This means that AI-enhanced climate messages should communicate both relevance and uncertainty. Climate risks can be localized and made meaningful, but communicators must avoid overstating certainty or simplifying complex relationships. Responsible personalization requires balancing accessibility with scientific integrity (Moser, 2010; Kitchin, 2017).

Algorithmic Climate Visibility

Algorithmic climate visibility refers to the ways AI systems and platform algorithms shape which climate messages become visible, prominent, and influential. In digital media environments, climate communication is not distributed evenly. It is filtered through recommendation systems, search rankings, social media feeds, and advertising infrastructures (Gillespie, 2014; Diakopoulos, 2015).

This dimension matters because visibility affects public understanding. If platform algorithms prioritize conflict, outrage, or sensationalism, climate communication may become polarized or distorted. If credible climate information is less visible than misleading content, public engagement may be weakened despite the availability of accurate knowledge (Gillespie, 2014; Kitchin, 2017).

AI can potentially improve climate visibility by helping identify misinformation, recommend credible sources, and connect users with locally relevant information. However, these interventions require transparent governance. Publics should be able to understand how climate information is ranked, recommended, or moderated, especially when platform systems influence democratic debate and policy support (Diakopoulos, 2015; Floridi et al., 2018).

Algorithmic climate visibility should therefore be treated as a public communication issue rather than a purely technical issue. Climate communicators, platforms, policymakers, and researchers

need to examine how algorithms shape attention, credibility, and participation in climate discourse (Gillespie, 2014; Nisbet & Scheufele, 2009).

Responsible Public Engagement

Responsible public engagement refers to the ethical use of AI to support public understanding, dialogue, and collective action on climate change. Public engagement should not be reduced to message exposure, click-through rates, or behavioral nudges. It should involve meaningful communication that respects public autonomy, diversity, and democratic participation (Corner & Clarke, 2017; Nisbet & Scheufele, 2009).

AI can support engagement by helping communicators identify audience questions, respond to concerns, translate scientific concepts, and create interactive climate tools. For example, AI-assisted chatbots or visualization systems may help publics explore local climate scenarios and adaptation options. Yet these tools must be transparent about their data sources, limitations, and uncertainty (Rolnick et al., 2022; Diakopoulos, 2015).

Responsible engagement also requires avoiding excessive fear appeals. O'Neill and Nicholson-Cole (2009) show that fear-based climate representations may capture attention but can undermine deeper engagement. AI systems that optimize for emotional intensity may therefore amplify alarming content without supporting agency or constructive action (O'Neill & Nicholson-Cole, 2009; van der Linden et al., 2015).

Finally, responsible public engagement requires inclusion. Climate change affects communities unequally, and climate communication should not privilege only digitally visible or high-literacy audiences. AI-enhanced communication should be evaluated for fairness, accessibility, language diversity, and cultural relevance (Floridi et al., 2018; Corner & Clarke, 2017).

4. Discussion

AI as a Communication Support System, Not a Substitute for Public Dialogue

AI can strengthen climate communication by processing large amounts of information, identifying audience needs, generating accessible explanations, and supporting interactive engagement. However, AI should not be treated as a substitute for public dialogue, democratic participation, or institutional responsibility (Nisbet & Scheufele, 2009; Floridi et al., 2018).

Climate communication involves values, trade-offs, uncertainty, and collective decision-making. These cannot be fully resolved through automated personalization or optimized messaging. AI may help structure communication, but publics must still be able to question, interpret, deliberate, and participate in climate decisions (Corner & Clarke, 2017; Moser, 2010).

This distinction is important because AI-enhanced communication can easily become instrumental. If success is measured only by engagement metrics or behavioral outcomes, communicators may prioritize persuasion over understanding. Responsible climate communication should instead support informed agency and collective capacity (van der Linden et al., 2015; Nisbet & Scheufele, 2009).

Therefore, AI should be integrated into climate communication as a support system for better explanation, inclusion, and responsiveness. Its role should be bounded by transparency, human oversight, and public accountability (Diakopoulos, 2015; Floridi et al., 2018).

The Risk of Data-Driven Manipulation

One of the major risks of AI-enhanced climate communication is data-driven manipulation. AI systems can segment audiences, infer concerns, and generate messages optimized for emotional or behavioral response. While these capacities may improve relevance, they may also be used to exploit psychological vulnerabilities or intensify polarization (Kitchin, 2017; Floridi et al., 2018).

Climate communication should avoid manipulative personalization because climate change requires public trust and collective legitimacy. If audiences believe that climate messages are secretly microtargeted or emotionally engineered, trust in communicators and institutions may decline. This would be counterproductive for long-term climate engagement (Moser, 2010; Diakopoulos, 2015).

Transparent personalization may offer a more responsible alternative. Communicators can explain why certain information is locally relevant, what data are used, and how audiences can access broader context. This approach supports relevance without hiding the communicative process (Floridi et al., 2018; van der Linden et al., 2015).

Data-driven climate communication should also respect privacy. Audience segmentation, platform analytics, and personalized messaging may involve personal or behavioral data. Ethical AI climate communication must ensure that such data practices are proportionate, explainable, and aligned with public interest rather than commercial or political manipulation (Kitchin, 2017; Floridi et al., 2018).

From Awareness to Agency

A persistent challenge in climate communication is moving from awareness to agency. Many people may know that climate change is serious but still feel powerless, distant, or uncertain about what to do. Communication must therefore support efficacy and collective action rather than only communicate risk (van der Linden et al., 2015; O'Neill & Nicholson-Cole, 2009).

AI can support agency by connecting climate information with practical options. For example, AI-supported tools may help users understand household energy choices, local adaptation plans, transportation alternatives, or community-level climate risks. Such tools can make climate action more concrete and personally meaningful (Rolnick et al., 2022; Moser, 2010).

However, agency should not be reduced to individual consumer behavior. Climate change is a structural problem requiring policy, institutional change, and collective action. Climate communication should therefore avoid placing responsibility only on individuals and instead connect personal action with social and political participation (Corner & Clarke, 2017; Nisbet & Scheufele, 2009).

AI-enhanced climate communication should therefore be designed to strengthen both personal and collective efficacy. It should help people understand not only what climate change means for them

but also how communities, institutions, and societies can respond together (van der Linden et al., 2015; Corner & Clarke, 2017).

5. Future Research Directions

Future research should examine how audiences respond to AI-generated and AI-personalized climate messages. Experimental studies could compare human-written, AI-assisted, and AI-generated climate messages in terms of trust, perceived credibility, emotional response, policy support, and behavioral intention (Moser, 2010; van der Linden et al., 2015).

Researchers should also examine AI disclosure in climate communication. Studies could test whether audiences evaluate climate messages differently when they know that AI was used to generate, personalize, or recommend the content. This would help clarify how transparency affects trust in AI-enhanced environmental communication (Diakopoulos, 2015; Floridi et al., 2018).

Platform studies are also needed to examine algorithmic climate visibility. Researchers could analyze how search engines, social media feeds, recommendation systems, and advertising platforms shape exposure to climate information, misinformation, and solution-oriented messages (Gillespie, 2014; Kitchin, 2017).

Qualitative research could explore how climate communicators, journalists, NGOs, educators, and public agencies use AI tools in practice. Interviews and case studies could reveal how practitioners negotiate accuracy, personalization, uncertainty, emotional framing, and ethical responsibility (Corner & Clarke, 2017; Nisbet & Scheufele, 2009).

Finally, future research should examine equity in AI-enhanced climate communication. Scholars should investigate whether AI tools serve diverse publics across language, region, class, age, and digital access. This is especially important because climate vulnerability and communication access are often unequally distributed (Floridi et al., 2018; Moser, 2010).

6. Conclusion

Artificial intelligence creates new possibilities for climate communication by supporting personalization, visualization, misinformation detection, audience analysis, and interactive engagement. These capacities may help communicators address persistent challenges such as psychological distance, information overload, and public disengagement (Rolnick et al., 2022; van der Linden et al., 2015).

However, AI-enhanced climate communication also creates ethical and communicative risks. Personalization may become manipulation, algorithmic visibility may distort public attention, and automated communication may weaken trust if it lacks transparency and accountability. Climate communication therefore requires responsible AI governance rather than technological optimism (Diakopoulos, 2015; Floridi et al., 2018).

This article proposed a conceptual framework based on personalized climate meaning-making, algorithmic climate visibility, and responsible public engagement. These dimensions show that AI can support climate communication only when it is guided by scientific integrity, public trust, equity, and democratic participation (Moser, 2010; Corner & Clarke, 2017).

For the Journal of AI Communication and Society, this topic is significant because it connects artificial intelligence with environmental communication, public engagement, platform governance, and social responsibility. As climate communication increasingly occurs in AI-mediated digital environments, future research must examine not only how AI can communicate climate change more effectively, but also how it can do so responsibly and democratically (Nisbet & Scheufele, 2009; Kitchin, 2017).

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