

What facilitates public engagement? A study on communication actors and agenda-setting in climate communication

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Abstract

Purpose – This study aims to explore how communication actors and topic attributes shape climate discourse on Chinese social media, aiming to reveal prevailing issue agendas, actor–topic preferences, misinformation patterns and their influence on public engagement.

Design/methodology/approach – Drawing on Second-Level Agenda-Setting Theory and the Public Engagement with Science (PES) framework, the study analyzes 24,690 climate-related posts collected from Weibo. Latent Dirichlet Allocation was used to extract thematic categories, while content coding identified communicator types. Regression analysis and chi-square tests were used to examine how thematic salience and actor identity influence engagement metrics (likes, reposts, comments) and misinformation patterns.

Findings – The findings reveal a hybrid climate agenda structured around international relations, domestic policy and technological development, reflecting the integration of climate discourse into broader national priorities. Public users dominate content production and account for the vast majority of climate misinformation. Engagement patterns vary systematically across actor–topic combinations: politically and risk-oriented themes elicit stronger public responses, while non-governmental organizations (NGOs) and corporations outperform traditional institutional actors in generating engagement.

Originality/value – This study advances climate communication research by explicitly integrating Second-Level Agenda-Setting Theory with the PES framework to link agenda attributes to observable engagement behaviors in a non-Western, state-regulated digital environment. Methodologically, it demonstrates the value of combining scalable computational topic modeling with engagement metrics to analyze large-scale social media discourse. Substantively, the findings offer actionable insights for communicators, platform managers and policymakers seeking to enhance public engagement and address climate misinformation in collectivist and policy-centered media systems.

Keywords Climate communication, Online public engagement, Second-Level Agenda-Setting Theory, LDA, Misinformation

Paper type Research paper

Introduction

Climate change is widely recognized as a pressing global challenge. The 29th Conference of the Parties (COP29) reaffirmed this urgency by highlighting persistent gaps in governance



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(Nature, 2024), public health (Mulcahy and Smith, 2024) and climate finance (Jiang *et al.*, 2025). Addressing this crisis demands not only scientific and policy solutions but also active public engagement (Kovacheva *et al.*, 2022; Kumpu, 2022). Effective communication plays a critical role in building public awareness, fostering trust in science and mobilizing collective action (Weingart *et al.*, 2021), processes that increasingly unfold within digital media environments.

In the digital age, social media has reshaped the landscape of climate communication. Digital platforms enable a diverse array of actors, including government agencies, news outlets, Non-Governmental Organizations (NGOs), scientists and the general public, to participate directly in climate discourse (e.g. Hopke and Hestres, 2018; J. Kim and Kim, 2024). This shift reflects the paradigm of Public Engagement with Science (PES), which emphasizes two-way interaction over one-way dissemination (Irwin, 2014). Furthermore, engagement affordances lower participation thresholds, allowing users to actively respond to and shape climate narratives (Taddicken and Krämer, 2021; Tenenboim, 2022), thereby potentially bridging gaps between science and society (León *et al.*, 2021). However, the digital media environment simultaneously introduces structural risks. Online discussions frequently devolve into echo chambers, reinforcing confirmation biases and limiting exposure to diverse perspectives (Kanthawala and Maddox, 2022; Thorson, 2016). Such environments further facilitate the rapid spread of misinformation, thereby undermining the quality of informed public discourse (Scheufele and Krause, 2019).

Despite increasing attention to digital engagement, understanding what drives online publics to interact with climate content remains underexplored (Davies *et al.*, 2024). Existing research has identified several influential factors, including communicator identity and content attributes (Faehnrich, 2021). For instance, misalignment between institutional communication agendas and public expectations (Boczkowski and Mitchelstein, 2013), while professional communicators often hesitate to pursue participatory strategies because of limited audience responsiveness, institutional constraints and reputational concerns (Biermann *et al.*, 2025). At the content level, topics emphasizing health risks or climate impacts tend to increase engagement (Wibeck, 2014). However, much of this scholarship remains grounded in Western democratic contexts, leaving the cross-cultural and political embeddedness of online public engagement insufficiently examined (Irwin, 2014; Weingart *et al.*, 2021).

This gap in generalizability is particularly salient in the Chinese context, where climate communication unfolds within distinctive institutional, cultural and civic conditions. At the policy level, climate governance in China is embedded in a centralized and strategic framework that integrates climate action into broader national development agendas, such as low-carbon development, energy restructuring, efficiency enhancement and the “30–60” carbon targets (Chen *et al.*, 2025). This framework shapes not only policy priorities but also how climate issues are communicated and perceived by the public. Regarding the media landscape, although the system is state-led, digital platforms such as Weibo have created large-scale arenas for public discussion, engaging hundreds of millions of users (Yang and Stoddart, 2021). This unique coexistence of institutional governance and expansive digital participation represents a fundamental departure from Western social media environments. Notably, while public awareness of climate change has increased, actual public engagement has notably declined (Cai *et al.*, 2024). This divergence highlights the need to examine engagement dynamics within China’s distinctive media and governance context.

This study integrates Second-Level Agenda-Setting theory, which highlights the salience of issue attributes, with the PES framework, which emphasizes the roles of diverse communication actors. Together, these perspectives provide a complementary lens for

examining how thematic agendas and communicator identities jointly shape online public engagement in the Chinese social media context. Specifically, the study addresses four research questions. First, to establish a baseline of the digital climate discourse, we draw on both frameworks to map the landscape of topic attributes and communication actors: (RQ1) What are the dominant topic attributes and communication actors in China's online climate discourse? Second, to discern the specific agenda priorities of these participants, we examine the topic attribute preferences exhibited by different types of communication actors: (RQ2) What topic preferences are exhibited by different types of communication actors in China's online climate discourse? Third, given the critical implications of misinformation for climate communication and effective PES, we investigate the relationship between communication actors and the dissemination of climate misinformation: (RQ3) What types of communication actors are more likely to be associated with the dissemination of climate misinformation? Finally, synthesizing the core elements of both theories to explain engagement outcomes, we explore the joint influence of communication actors and topic attributes: (RQ4) How do communication actors and topic attributes influence online public engagement?

Rooted in China's distinctive media ecology, this study advances empirical understanding of online climate discourse, extending the cultural applicability of PES research. By integrating Second-Level Agenda-Setting theory with the PES framework, it provides a multidimensional framework for interpreting agenda dynamics and offers practical implications for optimizing online public engagement.

Theoretical framework

Public Engagement with Science and climate communication actors

PES has historically evolved through three distinct paradigms: the deficit model, which assumes the public lacks scientific knowledge; the dialogue model, which promotes two-way communication; and the participatory model, which involves the public in knowledge production and decision-making (Metcalf, 2019; Weingart et al., 2021). In the context of climate change, communication is increasingly understood as a process of meaning-making rather than mere fact transmission (Kumpu, 2022), which has driven a broader shift toward participatory and engagement-oriented approaches (Metcalf, 2019; Wibeck, 2014).

In the digital era, science communication has become increasingly pluralized, encompassing a heterogeneous constellation of actors ranging from scientists and official institutions to key opinion leaders, lay publics and even anti-science voices (Faehrich, 2021). While prior research has examined how these actors shape climate discourse (e.g. Busch Nicolaisen, 2022; Newman, 2017; Walter and Brüggemann, 2020), the majority of scholarship has focused on Western platforms such as Twitter and Instagram (e.g. Hopke and Hestres, 2018; J. Kim and Kim, 2024), leaving the actor dynamics within non-Western, state-led media ecologies largely underexplored.

In the Chinese context, the operationalization of PES actors is best captured by the "5 + 1" framework proposed by the China Climate Communication Project Center. This framework identifies six key actor categories: government, media, NGOs, corporations, think tanks and the public (Zheng et al., 2021). These categories represent a conceptual continuum of PES paradigms, ranging from the state-led mobilization characteristic of government and official media to the bottom-up, identity-driven discourse of the public. Although existing studies have examined specific groups like scientists in isolation (e.g. Cyranoski, 2017; Jia et al., 2017), a systematic assessment of how this full spectrum of actors collectively influences participatory responsiveness remains absent.

Second-level agenda setting in climate communication

Second-Level Agenda-Setting Theory shifts the analytical focus from object salience, or what to think about, to attribute salience or how to think about it (McCombs *et al.*, 1997; Wanta *et al.*, 2004). Rather than merely highlighting issues, media information emphasize specific substantive attributes and affective attributes that shape public interpretation (McCombs, 2005). While affective attributes concern the emotional tone, substantive attributes refer to the specific traits, arguments or cognitive facets used to describe an issue. This framework provides a measurable approach to examining how particular features of an issue gain salience in public perception (S.-H. Kim *et al.*, 2002; Weaver, 2007).

In the context of climate communication, substantive attributes serve as critical drivers of public interpretation. These attributes function as “topic agendas” that determine how the multifaceted challenge of climate change is deconstructed for the public (Ji, Lu, *et al.*, 2024). Prior scholarship indicates that the selection of specific attributes significantly influences audience response. For instance, framing climate change through localized impacts, health risks or economic consequences can heighten personal relevance and behavioral intentions (Soroka, 2002; Wibeck, 2014).

Online public engagement on social media

Online public engagement is fundamentally shaped by the participatory affordances of social media platforms. These technical features serve as structural forces that lower the threshold for participation by enabling frictionless interactions (Taddicken and Krämer, 2021). Within this environment, visible user metrics such as liking, sharing and commenting serve as behavioral proxies for PES ideals.

Liking represents a form of affective engagement. It is a low-effort response that typically signals emotional alignment with content (Jacobsen and Beer, 2021). Alhabash and McAlister (2015) further conceptualize likes as a mechanism of affective evaluation within persuasive processes. In contrast, sharing or reposting is expressive in nature. Bene (2017) characterizes this action as a public signaling act often driven by identity expression or stance-taking. In the specific context of Chinese social media, likes and reposts also function as indicators of affective amplification and are frequently used to evaluate government communication performance under platform-driven logics (Lu and Pan, 2021). Finally, commenting is typically associated with deliberative engagement, involving cognitive elaboration, interpersonal deliberation and discursive identity construction (Tenenboim, 2022). Rather than viewing these behaviors as discrete categories, scholars suggest they form a continuum of engagement (Ksiazek *et al.*, 2016). This spectrum ranges from basic exposure and affective responses to expressive dissemination and deeper cognitive involvement through deliberation.

Censorship and algorithms on Chinese social media platforms

In China, online engagement unfolds within a platform environment shaped by censorship and algorithmic distribution. Internet censorship operates through policy, social norms and technical control (Roberts, 2018). It functions through a dual mechanism that combines repression, which suppresses undesirable speech, with production, which promotes state-sanctioned narratives such as “positive energy.” This apparatus has evolved through three technical stages: initially relying on the “Great Firewall” for automated keyword filtering, advancing to a hybrid model incorporating human review to catch nuances such as satire and, finally, adopting proactive discursive manipulation by state-sponsored commentators (He *et al.*, 2024). Together, these mechanisms restrict critical expressions while encouraging content aligned with government objectives. However, even such a stringent regulatory

environment cannot entirely eradicate misinformation. Climate misinformation persists within this ecosystem because it often masquerades as legitimate scientific debate or manifests as subtle “discourses of climate delay” (Lamb *et al.*, 2020). Unlike overt forms of scientific denial or skepticism, these complex narratives often evade keyword-based blocking and manual scrutiny. Once this content slips through the censorship net, its circulation is accelerated by the interplay of participatory affordances and algorithmic mechanisms.

Algorithms further structure what users encounter. Global debates reflect two perspectives: some scholars highlight the risks of “filter bubbles” and “echo chambers” (Nguyen, 2020; Pariser, 2011), whereas others argue that recommendation systems can diversify information exposure (Möller *et al.*, 2018). In the Chinese context, however, algorithmic logic is distinct, intertwining commercial imperatives with state ideology (Meng, 2021). Rather than simply fragmenting audiences, recent studies suggest that Chinese algorithms may produce a “popular science cocoon” (Su *et al.*, 2024). In this model, recommendation systems may prompt otherwise apathetic users to encounter scientific information, thereby potentially broadening public awareness of climate issues.

These dynamics demonstrate that online engagement in China is not simply the result of individual agency but is conditioned by structural forces that simultaneously constrain expression and shape opportunities for knowledge acquisition, situating it within a distinctive socio-political context.

Theoretical synthesis

Synthesizing the perspectives outlined above, this study proposes a conceptual framework to examine climate communication within China’s digital ecology (Figure 1). This integration provides a structured lens for examining how different types of communication actors emphasize specific topic attributes when engaging in climate discourse. Importantly, these communicative practices are embedded within a state-regulated digital environment characterized by the interaction of censorship and algorithmic mechanisms. Online public engagement is operationalized through three behavioral indicators: likes, reposts and comments. By linking actor types and topic attributes to these engagement metrics, this study aims to reveal the drivers of participatory responsiveness within China’s specific digital landscape.

Methodology

Research design

This study uses a computational quantitative framework to examine the interplay between communication actors, topic attributes and online public engagement within China’s climate discourse. By integrating computational topic modeling with inferential statistics, the research design allows for a simultaneous analysis of agenda construction and behavioral engagement dynamics. All data were retrieved from publicly accessible social media sources, strictly adhering to ethical standards for digital research.

Data collection and filtering

Data were collected from the Chinese social media platform Weibo using Python-based scraping tools. Posts published between July 1 and December 31, 2024, were retrieved using 12 climate-related keywords, yielding an initial sample of 94,661 posts.

A multi-stage filtering procedure was applied to ensure content relevance and analytical quality. First, low-information posts were excluded based on term frequency-inverse document frequency (TF-IDF) thresholds. Second, manual screening removed posts

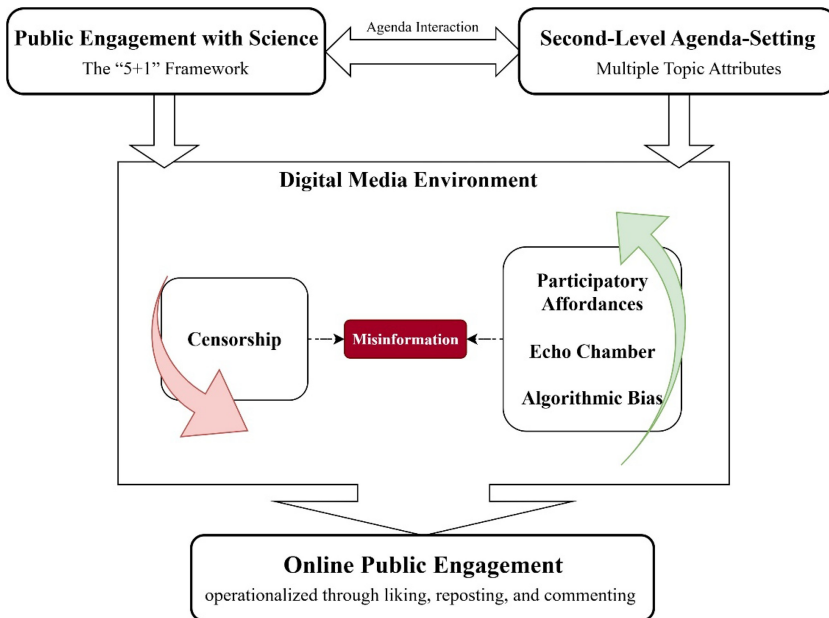


Figure 1. Conceptual diagram

Source: Authors' own work

containing only hashtags, emojis or off-topic content. The final data set included 24,690 valid posts. Each post record contained full text, user nickname and engagement metrics, which were used for actor classification, topic modeling and behavioral analysis. Full details of the filtering process are provided in Supplementary Material 1.

Variable operationalization and coding

Online public engagement was operationalized using three behavioral indicators commonly adopted in prior research: *Reposts*, *Comments* and *Likes*. These variables were treated as count-based outcome measures in the regression models and were directly extracted from the metadata of each Weibo post.

Communication actors were coded based on the CCCPC's "5 + 1" framework, classifying accounts into:

- Government
- Media
- NGOs
- Corporations
- Think Tanks
- Public
- An additional others was created for uncategorizable actors such as intergovernmental organizations.

Classification was performed manually by two independent coders using user nicknames, profile descriptions and verification badges. Inter-coder reliability was high (Cohen's Kappa = 0.972).

Topic attributes were derived through a two-stage process. First, LDA modeling was applied to extract second-level subtopics. To determine the optimal number of topics, sensitivity checks were conducted by training models with topic numbers ranging from 20 to 100. The results indicated that models within the 55–65 topic range yielded the highest and most stable coherence scores while maintaining low perplexity. From this optimal range, the 56-topic model (Coherence = 0.562, Perplexity = 0.0001) was selected because it offered superior semantic distinctiveness and interpretability for the research context.

Second, these 56 subtopics were manually aggregated into eight first-level thematic categories. This aggregation followed an iterative refinement process aimed at ensuring both theoretical consistency and contextual fit. Specifically, an initial first-level codebook was adapted from prior research (Ji *et al.*, 2024). Building on this framework, the coding scheme was systematically refined through category merging, boundary clarification and conceptual redefinition to maximize semantic coherence and minimize overlap across categories. This process resulted in a finalized first-level codebook comprising eight analytically distinct topic categories. To ensure reliability, two independent coders categorized the 56 subtopics based on the finalized codebook. Inter-coder reliability was robust (Cohen's Kappa = 0.829), and any discrepancies were resolved through discussion with a third researcher. Detailed LDA coherence and perplexity diagnostics, along with the manual coding scheme used to aggregate subtopics, are provided in Supplementary Material 2.

Veracity distinguishes accurate information from misinformation. Given the difficulty of inferring intent in digital contexts (Treen *et al.*, 2020), this study adopts a content-based definition. Following Chu *et al.* (2023, p. 847), misinformation refers to “information contrary to the current available epistemic consensus of the scientific community without considering its uncertainty and deliberate intentions.” It thus encompasses skepticism, contrarianism, denial, conspiracy theories and other forms of climate misinformation that undermine scientific consensus regardless of motive. Based on this definition, posts were coded as either (0) *Accurate Information* or (1) *Misinformation*, aligned with the IPCC's six assessment reports (AR1–AR6). Two trained coders applied this scheme after calibration, achieving high inter-rater reliability (Cohen's Kappa = 0.989).

Analytical strategy

To address the research questions, a multi-stage analytical strategy was implemented using Python. First, descriptive statistics were used to map the agenda landscape. Second, chi-square tests assessed the associations between actor types, topic preferences and the prevalence of misinformation. Finally, Negative Binomial Regression was identified as the primary estimation method, given the highly skewed and over-dispersed distribution of the social media engagement metrics. Independence checks for dependent variables (VIF < 1.33, Tolerance > 0.75) and multicollinearity diagnostics for predictors (VIF < 1.53, Tolerance > 0.66) confirmed the statistical independence of all variables, supporting the decision to model each engagement metric separately. Complete descriptive statistics and diagnostic details are provided in Supplementary Material 3. Model selection was guided by Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) metrics comparisons between nested models (actor-only, topic-only and full model). Additionally, to assess the sensitivity of the results to distributional assumptions, Poisson regression models were estimated as a robustness check against the Negative Binomial specifications.

Results

Descriptive analysis

Figure 2 visualizes the hierarchical taxonomy of the 56 subtopics derived from LDA modeling. These themes include diverse areas such as International Cooperation and Carbon Emissions to highlight the semantic granularity of discourse. The figure maps these subtopics to the eight first-level categories presented in Table 1 to structure the analysis.

Table 1 summarizes the sample distribution across communication actors, topic attributes and information veracity. The *Public* emerged as the dominant voice (50.567%, $n = 12,485$),

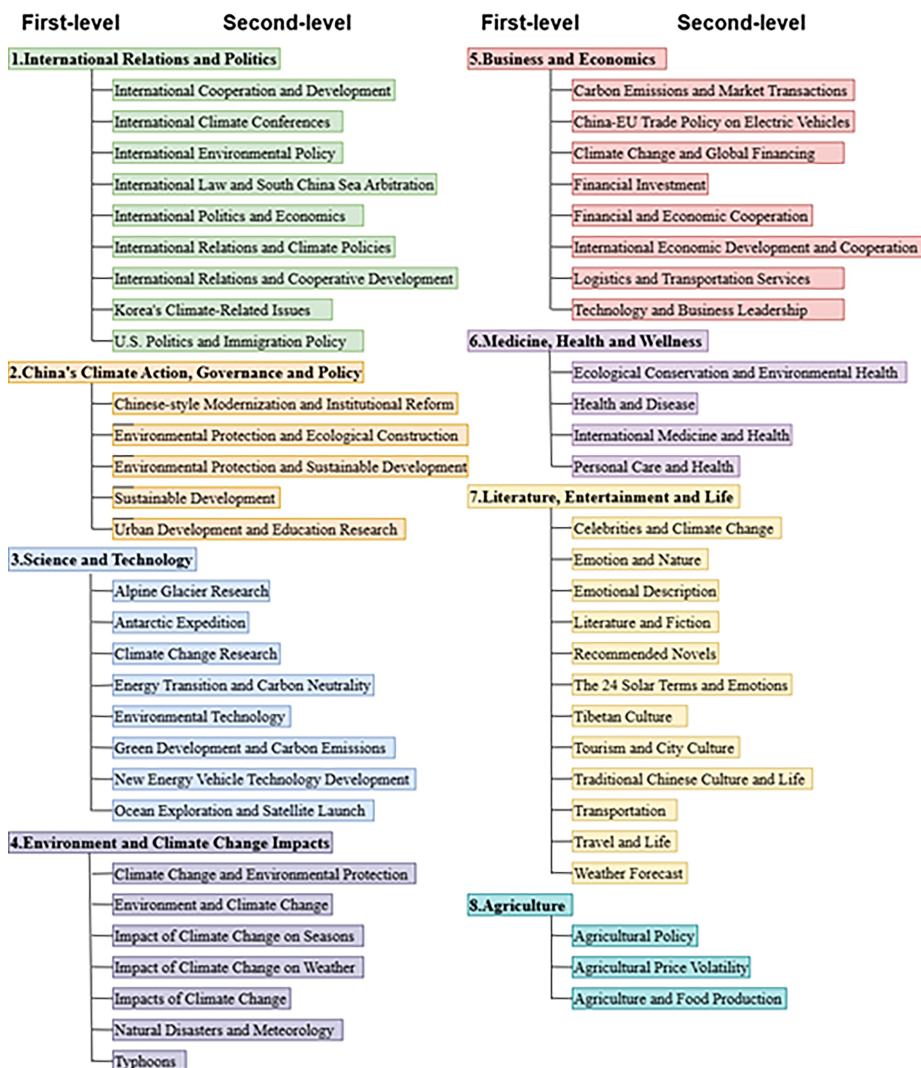


Figure 2. Hierarchical structure of first-level and second-level topics identified through LDA modeling

Source: Authors' own work

Table 1. Distribution of data set

Variables	N	%
<i>Communication actors</i>		
Government	3,903	15.808
Media	5,341	21.632
NGO	1,075	4.354
Corporation	780	3.159
Think tank	436	1.766
Public	12,485	50.567
Others	670	2.714
<i>Topic attributes</i>		
Topic1: International Relations and Politics	5,904	23.913
Topic2: China's Climate Action, Governance and Policy	5,370	21.750
Topic3: Science and Technology	4,925	19.947
Topic4: Environment and Climate Change Impacts	3,027	12.260
Topic5: Business and Economics	2,753	11.150
Topic6: Medicine, Health and Wellness	1,038	4.204
Topic7: Literature, Entertainment and Life	978	3.961
Topic8: Agriculture	695	2.815
<i>Information veracity</i>		
Accurate information	23,921	96.885
Misinformation	769	3.115

Source(s): Authors' own work

followed by *Media* (21.632%) and *Government* (15.808%), while other institutional actors played a peripheral role. Thematically, the agenda was concentrated on *Topic1: International Relations and Politics* (23.913%, $n = 5,904$), *Topic2: China's Climate Action, Governance and Policy* (21.750%) and *Topic3: Science and Technology* (19.947%), which collectively accounted for nearly two-thirds of the posts. The remaining five categories appeared significantly less frequently. Notably, the discourse was overwhelmingly accurate (96.885%), with *Misinformation* constituting only a marginal fraction (3.115%, $n = 769$) of the total volume.

Figure 3 presents a heatmap of average engagement levels across communication actors and topic attributes. A preliminary inspection reveals that likes consistently exceeded reposts and comments, indicating that low-effort engagement dominated climate-related interactions on Chinese social media. Visually, distinct engagement “hotspots” emerged. *NGOs* posts addressing environmental impact discussions (*Topic 4*) and *Corporations* posts focusing on science and technology (*Topic 3*) attracted the highest levels of engagement across all three metrics. In contrast, *Think Tanks* generated relatively limited interaction regardless of topic, appearing as consistent “cold spots” that suggest a lower capacity for public mobilization. These descriptive patterns highlight systematic differences in engagement potential across actor–topic combinations, which are further examined using multivariate regression analyses in the following section.

Chi-square analysis

A chi-square test of independence revealed a statistically significant association between communication actor type and topic category, $\chi^2(42) = 1452.672$, $p < 0.001$, with a small effect size (Cramér's $V = 0.099$). These results indicate that different actor

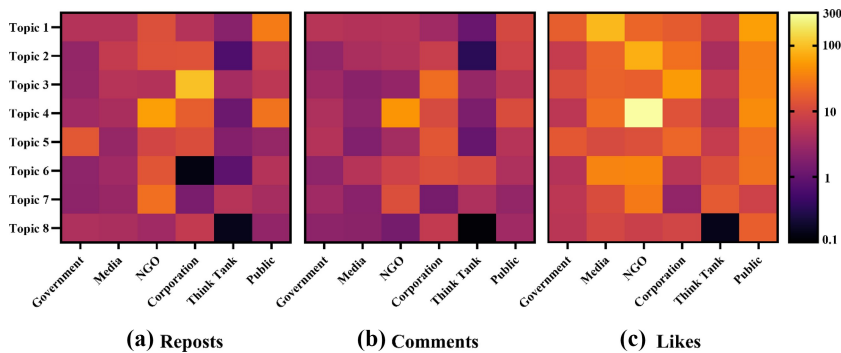


Figure 3. Heatmap of average engagement levels across communication actors and topic attributes
Source: Authors' own work

types tend to emphasize different topics within climate change discourse on Chinese social media.

Figure 4 further illustrates the distinct thematic profiles of different communication actors. Adjusted residuals from the chi-square analysis reveal systematic deviations from expected topic distributions. *Government, Media and Think Tanks* overemphasized *Topic 1: International Relations and Politics*, whereas *NGOs* exhibited a pronounced specialization

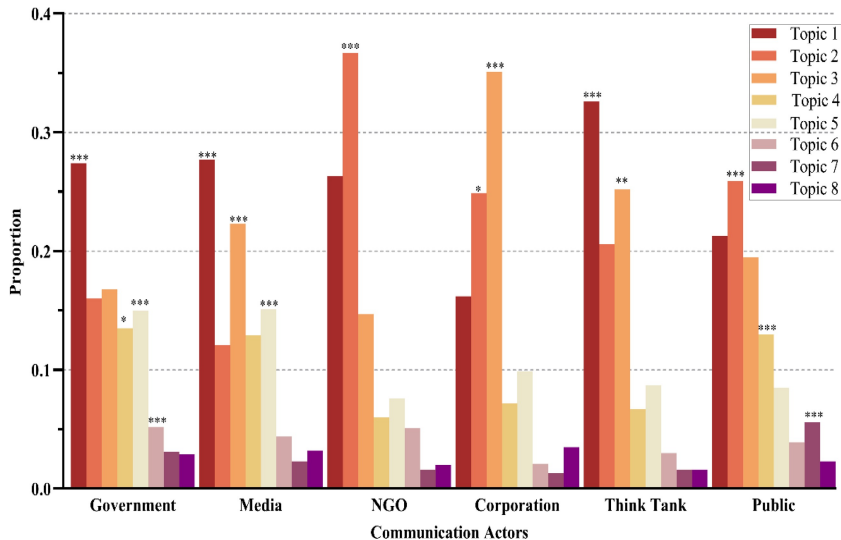


Figure 4. Distribution of topic attributes across communication actors

Note: Bars represent the proportion of each topic within each communication actor category. Asterisks indicate statistically significant positive associations based on adjusted standardized residuals (AR):

* $p < 0.05$ (AR > 1.96), ** $p < 0.01$ (AR > 2.58) and *** $p < 0.001$ (AR > 3.29)

Source: Authors' own work

in *Topic 2: China's Climate Action, Governance and Policy*. *Corporations* were significantly more likely to focus on *Topic 3: Science and Technology*. Although *Public* users displayed a comparatively diversified topic distribution, they significantly overrepresented governance-related content (*Topic 2*), environmental impact discussions (*Topic 4*) and lifestyle-oriented narratives (*Topic 7*) relative to expected frequencies. In contrast, lifestyle- and agriculture-related topics remained marginal among institutional actors, indicating their limited salience within climate communication on Chinese social media.

Regarding information veracity, a significant distributional difference was observed across actor types [$\chi^2(6) = 755.682, p < 0.001$, Cramér's $V = 0.175$]. Notably, misinformation was identified almost exclusively within content generated by the *Public* ($n = 764$), accounting for 6.117% of their total posts, whereas institutional actors remained largely accurate. Detailed crosstabulations examining (a) topic attributes by communication actor type and (b) misinformation occurrence by communication actor type are provided in Supplementary Material 4.

Negative binomial regression analysis

Tables 2 present the negative binomial regression results for reposts, comments and likes. The findings demonstrate that both communication actors and topic attributes exerted statistically significant effects on public engagement across all three models (all Wald χ^2 tests $p < 0.001$).

Compared to the *Public* baseline, non-institutional actors demonstrated superior engagement capacity. *Corporations* achieved the highest increase in information diffusion, boosting reposts by 396% and comments by 113%, although their effect on likes was non-significant ($p = 0.267$). *NGOs* emerged as the primary driver of affective engagement, eliciting the highest increase in likes (+69%) while also securing significant gains in reposts (+29%). In contrast, *Government* and *Media* were associated with significantly lower engagement levels across most models, with *Think Tanks* consistently ranking lowest.

Regarding topic attributes, macro-political and environmental narratives proved most resonant. *Topic 1: International Relations and Politics* consistently generated the strongest response across all metrics, particularly for likes (+337%) and reposts (+288%). *Topic 4: Environment and Climate Change Impacts* followed closely, driving substantial increases in reposts (+268%) and comments (+174%). *Topics 2, 3, 5 and 6* yielded moderate gains. In contrast, *Topic 7* was associated with weaker or non-significant engagement outcomes.

Figure 5 visually confirms the consistency of these actor and topic effects across reposts, comments and likes, with 33 of the 36 predictors reaching statistical significance.

Robustness checks

To assess the robustness of the findings, alternative model specifications and distributional assumptions were examined. Comparisons across nested models indicated that the existing models consistently achieved lower AIC and BIC values than Actor-only and Topic-only models across all engagement outcomes. In addition, Poisson regression models estimated using identical specifications produced substantively consistent results with Negative Binomial models in terms of effect direction and statistical significance, supporting the robustness of the reported actor and topic effects. Detailed results of the robustness checks are provided in Supplementary Material 5.

Table 2. Results of negative binomial regression model for engagement metrics

Variables	Coef (B)	Std. Error	Exp(B)	95% CI (ExpB)	p-value
<i>Reposts</i>					
Government	-0.768	0.020	0.464	[0.446, 0.483]	0.000
Media	-0.866	0.018	0.421	[0.406, 0.436]	0.000
NGO	0.257	0.033	1.293	[1.211, 1.380]	0.000
Corporation	1.602	0.038	4.963	[4.610, 5.344]	0.000
Think tank	-1.676	0.059	0.187	[0.167, 0.210]	0.000
Public (ref.)	—	—	1.000	—	—
Topic 1	1.355	0.047	3.875	[3.531, 4.254]	0.000
Topic 2	0.437	0.048	1.548	[1.409, 1.700]	0.000
Topic 3	0.456	0.048	1.578	[1.436, 1.733]	0.000
Topic 4	1.303	0.049	3.680	[3.341, 4.051]	0.000
Topic 5	0.663	0.050	1.940	[1.760, 2.140]	0.000
Topic 6	0.102	0.058	1.107	[0.989, 1.238]	0.078
Topic 7	-0.157	0.058	0.855	[0.762, 0.958]	0.007
Topic 8 (Ref.)	—	—	1.000	—	—
<i>Comments</i>					
Government	-0.627	0.021	0.535	[0.513, 0.557]	0.000
Media	-0.866	0.019	0.421	[0.406, 0.437]	0.000
NGO	-0.114	0.034	0.892	[0.835, 0.954]	0.001
Corporation	0.756	0.038	2.130	[1.975, 2.298]	0.000
Think tank	-1.434	0.061	0.238	[0.212, 0.268]	0.000
Public (ref.)	—	—	1.000	—	—
Topic 1	0.956	0.049	2.600	[2.360, 2.863]	0.000
Topic 2	0.702	0.050	2.017	[1.829, 2.222]	0.000
Topic 3	0.435	0.050	1.545	[1.401, 1.704]	0.000
Topic 4	1.007	0.051	2.739	[2.478, 3.028]	0.000
Topic 5	0.428	0.052	1.534	[1.386, 1.699]	0.000
Topic 6	0.574	0.059	1.774	[1.581, 1.992]	0.000
Topic 7	-0.090	0.060	0.914	[0.812, 1.030]	0.138
Topic 8 (Ref.)	—	—	1.000	—	—
<i>Likes</i>					
Government	-1.194	0.019	0.303	[0.291, 0.315]	0.000
Media	-0.219	0.017	0.803	[0.777, 0.830]	0.000
NGO	0.5237	0.032	1.688	[1.585, 1.798]	0.000
Corporation	-0.042	0.038	0.959	[0.890, 1.032]	0.267
Think tank	-1.800	0.053	0.165	[0.149, 0.183]	0.000
Public (ref.)	—	—	1.000	—	—
Topic 1	1.475	0.044	4.372	[4.010, 4.764]	0.000
Topic 2	0.732	0.044	2.080	[1.906, 2.268]	0.000
Topic 3	0.761	0.044	2.139	[1.962, 2.333]	0.000
Topic 4	0.893	0.046	2.442	[2.233, 2.672]	0.000
Topic 5	0.526	0.046	1.691	[1.546, 1.853]	0.000
Topic 6	0.616	0.053	1.852	[1.669, 2.054]	0.000
Topic 7	-0.363	0.054	0.695	[0.625, 0.773]	0.000
Topic 8 (Ref.)	—	—	1.000	—	—

Note(s): Reference categories are Public for Communication Actors and Topic 8 (Agriculture) for Topic Attributes. Exp (B) represents IRR. All models use robust standard errors. Across all three models, communication actor type and topic attribute were jointly significant predictors of engagement (all $p < 0.001$)

Source(s): Authors' own work

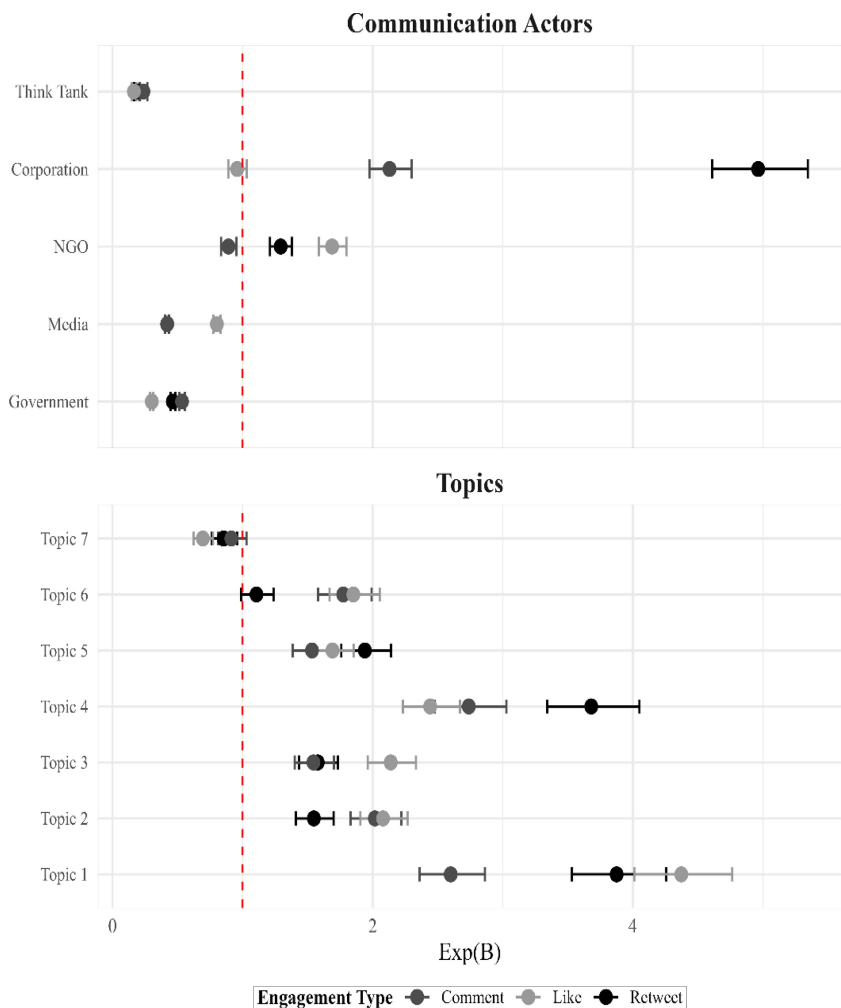


Figure 5. IRRs for communication actors and topics across engagement models

Source: Authors' own work

Discussion

Agenda structure and actor differentiation in China's climate discourse

Drawing on Second-Level Agenda-Setting Theory, this study reveals a structurally differentiated climate discourse on Chinese social media shaped by the intersection of state-centered agenda alignment and broad public participation. Rather than focusing on lifestyle-oriented or individualized environmental practices, climate narratives are predominantly organized around macro-political, governance and technological frames. This pattern reflects the institutional embedding of climate change within China's national priorities, where climate communication operates primarily as a collective and politically salient discourse.

While public users dominate the volume of climate-related posts, institutional actors exhibit more specialized agenda orientations. Government, media and think tanks tended to emphasize international relations, reinforcing a top-down narrative that positions China as both a climate leader and technological innovator. NGOs and public users, by comparison, placed relatively greater weight on domestic policy discussions, reflecting a more civic-oriented agenda centered on national concerns. Corporations focused mainly on technological themes, consistent with commercial interests in innovation and green growth.

Public-centered origins of climate misinformation

Although climate misinformation constitutes only a minor fraction of the overall discourse, it is overwhelmingly generated by public users, underscoring their critical role in shaping the epistemic environment. Despite China's strict media regulations and content moderation, misinformation continues to circulate in user-generated spaces that operate beyond institutional gatekeeping. This finding aligns with prior scholarship noting that even limited exposure can significantly distort public understanding (Scheufele and Krause, 2019; Van Der Linden *et al.*, 2017), particularly in high-volume digital ecosystems such as Chinese social media (Chu *et al.*, 2023). Consequently, a structural asymmetry emerges while credible narratives are largely curated by institutional actors, misinformation is diffused from the grassroots. Addressing this imbalance calls not only for top-down regulatory efforts but also user-focused strategies such as strengthening science communication, enhancing media literacy and fostering a more resilient information environment.

Drivers of online engagement: topic salience and communicator effects

Online public engagement with climate discourse in China is shaped by the combined effects of topic salience, communicator identity and a broader normative environment operating within a state-regulated algorithmic system.

Regression results revealed that topics related to international politics and climate change impacts consistently generate higher engagement across all behavioral indicators. These patterns are partly attributable to the timing of major global events, such as the 2024 US presidential election, marked by renewed climate skepticism from Donald Trump (Isidore and Matt Egan, 2025) and the convening of COP29. Together, these events intensified narratives of international contestation (Liu and Huang, 2023) and climate nationalism (Liu, 2015), amplifying public responsiveness to geopolitically framed climate topics. In contrast, lifestyle, culture and agriculture-related topics elicited consistently weaker engagement. This pattern aligns with prior research indicating that, within China's government-driven communication system, climate engagement is closely linked to policy dissemination, collective orientations and perceived national relevance (Qin and Jiang, 2025). In such a collectivist and policy-centered environment, topics framed around international responsibility and environmental risks are more likely to resonate with platform users and stimulate engagement through shared norms of collective action.

Significant disparities also emerged across communicator types. Institutional authority does not automatically translate into higher engagement. Government and media actors, despite their visibility, continue to rely on broadcast-style communication that underutilizes interactive affordances, resulting in comparatively limited public response (Lee and VanDyke, 2015). Similarly, think tanks remained peripheral, with limited visibility despite policy support for "new-type think tanks" since 2013 (Liu, 2021). A key challenge for authoritative institutions lies in reconciling professional authority with platform-native communication styles that prioritize interactivity and relatability. These findings underscore

the imperative for institutional communicators to evolve beyond traditional broadcasting models by integrating credibility with participatory strategies (Junsheng *et al.*, 2019).

By contrast, corporations and NGOs consistently outperformed institutional senders in driving engagement. Corporations excelled at generating affective and expressive responses, leveraging digital platforms to shape climate narratives while enhancing brand legitimacy (León *et al.*, 2021). NGOs, despite limited output, achieved strong engagement performance, likely because of high public trust and issue alignment. However, their marginal institutional position continues to constrain broader agenda-setting influence (PR Newswire, 2024). Notably, public users emerged as key drivers of engagement across all metrics. This finding challenges prior assumptions about public epistemic deference and participatory uncertainty (Nicolaisen, 2022), while affirming evidence of a structural shift toward more decentralized participation on Chinese platforms (Yang and Stoddart, 2021).

Taken together, these findings suggest that enhancing engagement potential in China's digital climate discourse requires strategically aligning with platform affordances and algorithmic dynamics to effectively navigate and amplify impact within a normatively bounded and state-regulated sphere.

Policy implications and strategic interventions

Based on the empirical findings, this study proposes several targeted intervention strategies to improve the quality and effectiveness of climate communication on Chinese social media.

First, implement public-targeted misinformation intervention programs. Given that climate misinformation in China is predominantly generated and circulated by public users, intervention strategies should not only introduce foundational knowledge about climate science denial through structured online courses (Cook, 2016) but also incorporate game-based inoculation and prebunking approaches (Cook *et al.*, 2023). These methods train the public to recognize specific rhetorical tactics used in climate contrarianism, offering a proactive defense against subtle reverse discourses that traditional fact-checking often overlooks.

Second, leverage corporate influence for "Sci-Tech" climate campaigns. To address the low volume of corporate discourse, platforms should encourage enterprises to launch dedicated science popularization initiatives. By integrating green innovation with public education, corporations can utilize their high engagement capacity to achieve a synergy between commercial objectives and public welfare, thereby simultaneously boosting public participation and corporate social responsibility.

Third, establish cross-sector digital collaboration mechanisms. To bridge the gap between authority and resonance, government and media accounts should provide authoritative endorsements to enhance the visibility of NGOs and think tanks. At the same time, institutional actors may benefit from adopting the interactive communication styles demonstrated by NGOs, thereby mitigating the diminishing returns of broadcast-oriented messaging and improving audience responsiveness.

Fourth, policymakers can enhance public engagement by prioritizing climate narratives that activate collective relevance and shared national concerns. Specifically, institutionalizing regular public-facing briefings on international climate agendas can situate climate change within broader narratives of national responsibility and global participation. At the same time, mainstreaming environmental risk communication that links climate impacts to public welfare, ecological security and everyday safety may further strengthen issue salience and motivate engagement within China's policy-centered communication context.

Contributions and limitations

Theoretically, this study extends climate communication research by integrating Second-Level Agenda-Setting Theory with the PES framework in a state-regulated media context. By applying scalable computational methods to map discourse structures and engagement behaviors, the study provides a replicable pathway for examining similar contexts.

Practically, the findings provide insights for policymakers, digital platform regulators and science communicators. The strong public responsiveness to climate geopolitics and environmental risk narratives highlights strategic entry points for fostering collective engagement in policy-centered contexts. At the same time, the predominance of misinformation from public users underscores the need for proactive interventions that go beyond fact-checking, such as prebunking-based climate literacy programs. Furthermore, recognizing the participation potential of NGOs and corporations highlights opportunities to diversify communicative leadership in China's digital climate governance.

Nonetheless, several limitations warrant consideration. First, this study analyzed only textual content, excluding multimodal elements such as images and videos, which are highly influential in climate discourse by shaping emotional responses, visual framing and risk perceptions. Given the growing prominence of visual and video-based content on social media platforms, especially in the circulation of climate-related narratives and misinformation, future research should incorporate multimodal data to better capture the full communicative dynamics of online climate discourse. Second, engagement was measured solely through behavioral metrics. These indicators reflect observable behaviors but cannot capture cognitive or affective engagement or users' underlying motivations. Future research should triangulate engagement metrics with qualitative approaches, such as interviews or surveys, to gain deeper insight into the cognitive and motivational processes driving online engagement.

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Supplementary material

The supplementary material for this article can be found online.

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