Climate Change Media Framing in Small Island States: A Comparative Analysis of Development Status Effects in Barbados and Singapore (2010–24)

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(Manuscript received 16 August 2025, in final form 2 October 2025, accepted 14 November 2025)

ABSTRACT: This study analyzes climate change coverage in the national newspapers of Barbados (*NationNews*) and Singapore (*The Straits Times*) from 2010 to 2024. Using natural language processing and sentiment analysis of 6278 articles, we examined coverage across six categories: physical phenomena, environmental impacts, mitigation, adaptation, policy, and economic dimensions. Results reveal distinct framing patterns reflecting each nation's context: Barbados's coverage emphasizes physical phenomena and adaptation strategies, while Singapore focuses on environmental impacts and mitigation measures. Both outlets show declining policy coverage over time and yet maintain unexpectedly positive sentiment. Despite facing similar climate threats, the contrasting media narratives reflect how development status and local vulnerabilities shape climate change communication, with implications for customized communication strategies in vulnerable island states.

KEYWORDS: Social Science; History; Classification

1. Introduction

The global climate crisis is one of the most pressing issues of the twenty-first century, having significant effects on ecosystems, economies, and societies around the world (Abbass et al. 2022; Dow and Downing 2011; Fletcher et al. 2024; Gilding 2012; Hoegh-Guldberg et al. 2019; Malhi et al. 2020). The role of the media in influencing public discourse has come under increased scrutiny as evidence links human-driven factors like carbon emissions and deforestation to climate change (Barkemeyer et al. 2017; IPCC 2023a; Lynas et al. 2021; McCarthy et al. 2001; Molder and Calice 2023; National Research Council 2001; Oreskes 2004; Perga et al. 2023; Shanahan 2009; Strauss et al. 2024).

Individual behaviors and policy decisions can be shaped by how the media portrays the problems, potential solutions, and urgency (Abroms and Maibach 2008; Gamson and Wolfsfeld 1993; McCombs and Valenzuela 2021). "The issues emphasized in news reports become the issues regarded as most important among the public. The agenda of the news media becomes, to a considerable degree, the agenda of the public" (McCombs and Valenzuela 2021, p. 2). When the news media stress certain urgent issues, they have a profound influence on public awareness and policy agendas, directing what people pay attention to, discuss, and often respond to. Climate change communication—especially through the mass media—is vital to increase public understanding and support for political action (Carvalho et al. 2017; Moser 2010; Nisbet 2009; Vu et al. 2019; Whitmarsh et al. 2013; Wibeck 2014). Comprehending the portrayal of climate change in various geographical areas reveals how media framing and public debate on environmental issues are influenced by development level and vulnerability to extreme weather.

The effects of framing—the way issues are presented, including the selection of concerns, the emphasis on particular features, and the interpretation of their significance—are debated in media studies on climate change (Badullovich et al. 2020; Entman 1993). These debates notwithstanding, scholars have called for increased examination of framings in different global contexts to improve climate communication. Global media outlets depict climate change from a variety of angles, frequently influenced by local circumstances (Boykoff 2011; Rebich-Hespanha et al. 2015).

Media framing of climate action differs greatly because climate action differs greatly throughout nations with varying degrees of development and resource capacities (Günay et al. 2021; Hase et al. 2021). Comparative examination of media narratives is crucial for effective climate communication strategies since reducing global emissions necessitates paying close attention to competing national climate change frameworks (Broadbent et al. 2016). There remains limited analysis of how development level influences media narratives within the specific context of small island states facing similar environmental vulnerabilities.

This study addresses how different development status shapes media framing of climate change among small island nations. Specifically, this study examines the media framing of two island states—Barbados (BB) and Singapore (SG):

1) How do BB and SG's media differ in their emphasis on climate change categories, given their contrasting development status as small island nations?
2) What temporal trends in category coverage emerge within each country, and how do these reflect their respective climate communication priorities?
3) How does sentiment toward climate change coverage vary between the two contexts, and what does this reveal about public discourse framing?

By presenting the first comprehensive comparative analysis of media framing between an island developing state (BB)

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DOI: 10.1175/WCAS-D-25-0116.1

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and an island developed nation (SG), this study contributes to the theory of climate communication by illuminating the ways in which infrastructure and economic capacity impact the ranking of climate themes in national media discourse.

2. Background

Comprehending the political and media environments of the two small island states offers essential context for analyzing their climate narratives. BB is a parliamentary democracy (Government of Barbados 2025) and a member of the Alliance of Small Island States (AOSIS) (AOSIS 2025). The *Nation Newspaper* (also known as *NationNews* online) serves as its main daily newspaper (Wikipedia 2025). With a small population of about 280 000, the country faces climate hazards that significantly impact its constituents (UNEP 2025). SG is also an AOSIS member (AOSIS 2025) and has a parliamentary democracy system, with a population of about 5 million (MFA 2025). *The Straits Times* of SG is among the leading daily English-language newspapers in the region (Encyclopedia Britannica 2025).

During 2010–24, both nations suffered severe climate change consequences. The International Disaster Database Emergency Events Database (EM-DAT), for instance, states that BB experienced a number of climate disasters, such as drought conditions from January to June 2010, Hurricane Tomas in October 2010, Hurricane Irma in September 2017, Hurricane Elsa in July 2021 that affected 3300 people and left 186 homeless, Tropical Storm Bret in June 2023 that affected 179 people, and Hurricane Beryl in July 2024 that affected 2500 people (EM-DAT 2024). The fact that Hurricane Elsa was the first hurricane to hit BB directly in more than 60 years made it especially noteworthy (Sandiford et al. 2024). SG, as a low-lying island, is facing serious effects of climate change. From 1993 to 2021, sea levels rose at a rate of 3.5 mm annually, with roughly 30% of the island situated less than 5 m MSL. From 1984 to 2022, temperatures rose by 0.24°C every decade, and a number of issues, including water resources, dengue, food security, and biodiversity, are being impacted by climate change (NCCS 2024). These disparate climate vulnerability patterns—acute disasters versus gradual environmental changes—offer important context for understanding media framing strategies in each country.

The two nations' approaches to climate change are different due to their respective economic situations. With a 2024 GDP per capita of about USD 25,365 (World Bank 2025a), BB faces an existential threat from climate change. For instance, it carried out the first debt-for-climate resilience exchange in history in December 2024, releasing cash for coastal protection, food security, and water to fill climate funding gaps and high national debt loads (Furness 2024).

In contrast, SG uses its significant domestic resources to combat climate change, with a GDP per capita of USD 90,674 in 2024 (World Bank 2025b). SG will spend about SGD $100 billion over the next century to defend the nation from rising sea levels, in contrast to BB, which is dependent on foreign assistance and debt reduction (Reuters 2019). Seagrass and coral reef restoration real-time sensor networks, designing sea barriers, elevating reclaimed land levels, and mangrove restoration are only a few of the numerous protection measures that the nation has invested in as part of its internal funding of its climate policy (Stellar Structures 2025). SG views climate action as a chance for technological innovation and regional impact, as evidenced by programs like the Green Plan 2030 and a 500 million U.S. dollars commitment for regional decarbonization (Singapore Government 2025; Reuters 2024).

The selection of BB and SG offers a theoretically sound comparison: Although both are small island nations vulnerable to climate change and sea level rise, their development paths within the small island state category differ significantly. Even if they share AOSIS membership and climate vulnerabilities, their disparate levels of development, political structures, and media landscapes offer an ideal natural experiment for studying how context influences climate discourse. Although SG's high-income status and sophisticated infrastructure set it apart from other small island developing nation profiles, it is nonetheless vulnerable to the same climate threats as other small islands. The analysis of how economic capacity affects climate discourse within the same broad category of climate-vulnerable nations is made possible by this comparison, which is especially useful because it separates the variable of development status while accounting for environmental similarities.

AOSIS is a recognized special category despite their variability, and their developmental peculiarities shed light on how economic capability influences climate debate. This study looks at how similar environmental constraints produce various media narratives depending on developmental context, addressing the existing shortage of knowledge regarding contextual factors in small island state climate communication.

3. Data and methods

Natural language processing (NLP) has been applied extensively in climate research to gain insights into climate change (Stede and Patz 2021). This technique can be used to examine climate themes in history, track climate plans or policies, map political and social discourses, detect drought impacts and misinformation, analyze public discourse on climate anxiety or sentiment, and develop susceptibility or decision support systems (Bahar et al. 2024; Bucur et al. 2024; Fu et al. 2023; Ibrohim et al. 2023; Jost et al. 2019; Meddeb et al. 2022; Mi and Zhan 2023; Rodrigues et al. 2021; Schaefer et al. 2023; Singh et al. 2024; Sodoge et al. 2023; Umamaheswaran et al. 2023). We applied NLP techniques in our data processing and analysis to observe climate change media framing patterns in both datasets.

a. Data collection

We collected climate change coverage from two national newspapers using systematic search procedures. Initial searches used the Boolean query "Barbados AND climate change" on the *NationNews* website (https://nationnews.com/), yielding 544 articles from 2010 to October 2024. For SG, we used identical search terms "Singapore AND climate change" on *The Straits*

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Times website (https://www.straitstimes.com/), which provided coverage from April 2015 onward.

To ensure temporal comparability, we supplemented SG data with LexisNexis Academic, one of the biggest newspaper databases (https://www.lexisnexis.com/en-us/professional/academic/nexis-uni.page) to retrieve articles from 2010 to March 2015 using identical search parameters. This dual-source approach ensures complete temporal coverage for comparative analysis.

The combined articles and their publication years are presented in Table 1. The datasets of BB *NationNews* and SG *Straits Times* were referred to as the "BB data" and "SG data," respectively.

Several factors may contribute to the significant discrepancy in article numbers (BB: 544; SG: 5,734): 1) SG's significantly larger population, media market, and greater content volume per issue in a developed economy; 2) disparities in archival policies and digital accessibility between the outlets; and 3) SG's role as a regional hub that generates more coverage of climate-related business and policy. The notable decline of SG articles from 258 in 2022 to 39 in 2023 and 33 in 2024 may be due to changes in editorial policy, a decreased emphasis on climate coverage, or adjustments in digital preservation procedures over the time we collected the data.

TABLE 1. The number of articles published in BB *NationNews* and SG *Straits Times* from 2010 to 2024.

Year	BB data	SG data
2010	22	205
2011	16	194
2012	28	149
2013	20	177
2014	41	234
2015	85	368
2016	60	445
2017	49	450
2018	31	578
2019	23	923
2020	24	715
2021	41	966
2022	42	258
2023	37	39
2024	25	33
Total	544	5734

b. *Data processing and normalization*

To analyze changes over time, we grouped articles by publication year for systematic comparison across the study period. Using the Natural Language Toolkit (NLTK) (Bird et al. 2009) and spaCy (Honnibal and Montani 2017), we processed and normalized the articles by removing stop words (such as "on" and "in") and punctuation marks, and lemmatization was applied to all the data. Word vectors of the datasets were created using the open-source NLP library Gensim (Rehurek and Sojka 2022) to observe semantic relationships and word proximity patterns between words.

Instead of using absolute counts, we employ proportional frequency calculations to allow for meaningful comparisons across datasets of varying sizes, normalizing all measurements by the total number of words in each dataset per year.

$$\text{Proportional frequency} = (\text{number of category terms in year})/(\text{total words in year}).$$

This normalization approach controls for differences in dataset size, absolute numerical volume, or imbalance and allows for a methodologically sound and meaningful comparison of emphasis patterns across the two media outlets while preserving the full scope of coverage from each source.

c. *Category term development*

Currently, there is no comprehensive taxonomic glossary based on category terms of climate change, such as physical phenomena, mitigation, and adaptation, even though these categories are frequently discussed in academic literature and climate-related news reports. To observe trends or changes in such categories, we developed a list of category terms for climate change by following these procedures:

(i) Bigram and trigram construction: While unigrams like "water," "sea," and "air" are commonly used in climate news reports, they can be highly ambiguous when extracted from context. Therefore, our approach focused on constructing bigram and trigram tables. We processed both the BB and SG datasets, resulting in a comprehensive list of bigrams and trigrams, such as "coral bleaching," "drinking water," and "sea level rise."

(ii) Glossary extraction: We extracted all terms from authoritative sources, including the IPCC glossary (IPCC 2023b), the *Dictionary of Environment and Ecology* (Collin 2004), and the National Weather Service's weather glossary (NWS 2024). After removing duplicates and normalizing the entries from these three glossaries, we compiled a term lexicon containing 8570 unique entries.

(iii) Matching bigrams and trigrams: We identified matches between the BB and SG bigrams and trigrams (from step i) and the unique entries from the lexicon (from step ii). By combining the top 300 matching bigrams and trigrams from both datasets and removing duplicate matches, we created a dictionary of the most frequently used terms in BB and SG datasets. We then manually reviewed each term for categorical relevance and removed those that were too ambiguous. For example, terms like "deep sea," "long term," "degree celsius," "high performance," "real time," "natural history," "southern hemisphere," "northern hemisphere," and "small scale" did not offer clear classification. These were removed. Several most frequent and distinct unigrams representing physical phenomena—hurricane, cyclone, drought, and storm—were manually added.

As a result, we developed six main categories with a total of 103 terms, each containing relevant terms for climate change, as shown below:

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- Physical climate phenomena (phenomena): climate change, coastal flooding, drought, etc.
- Environmental impacts (impacts): air pollution, carbon dioxide, coastal erosion, etc.
- Mitigation measures (mitigation): alternative energy, carbon neutral, carbon sequestration, etc.
- Adaptation, sustainability, and monitoring (adaptation): climate information; freshwater, sustainable agriculture, etc.
- Economic, urban, and social dimensions (economic): economic development, urban design, social cost, etc.
- Policy and governance responses (policy): action plan, emission standard, Kyoto Protocol, etc.

Monitoring activities (such as tide gauge) and natural indicators like coral reef are critical for enabling adaptation and sustainability in small island contexts. We classify them under adaptation_sustainability_monitoring. The full list of terms is available in the appendix.

Our main analytical strategy is to determine the proportional frequency of terms in each category in each dataset for each year of the study period. This allows us to compare the two media outlets' category focus patterns over time in a methodical manner.

d. Sentiment analysis

The computational identification and classification of opinions conveyed in a text is the focus of sentiment analysis, also known as opinion mining, a branch of NLP. Because of its capacity to evaluate enormous volumes of textual data from numerous sources, including social media, reviews, and news stories, it seeks to ascertain if the stated sentiment is positive, negative, or neutral (Pang and Lee 2008). Depending on the level of granularity needed, it can be carried out at different levels, such as document-level, sentence-level, or aspect-based analysis (Liu 2020).

Sentiment analysis has been extensively employed in climate change research scenarios (Bucur et al. 2024; Ibrohim et al. 2023). Using the Flair framework (Akbik et al. 2019), a package created by researchers at Humboldt University of Berlin, we implemented sentiment analysis at the document level, computing individual sentiment score for each news article within each respective year. We then calculated the average sentiment score for all articles within each year of the study period, producing annual sentiment trends for both the BB and SG datasets. This approach allows us to track changes in the overall tone of climate change coverage over time.

We used the Shapiro–Wilk test to examine the normality of sentiment score distributions prior to regression analysis and then employed linear regression to evaluate trends in sentiment scores over time for each publication.

4. Results and discussion

There are greater frequencies of phenomena coverage in BB coverage when compared to SG as shown in Fig. 1. These discrepancies most likely reflect BB's stronger awareness of climate phenomena, more direct immediacy, and greater climate concerns. More fluctuations can be seen in SG's coverage, which has shown noticeably rising trends in the last several years (2022–24). Significant discrepancies between the two news outlets' coverage of climatic events are revealed by the statistical test (Table 2). BB data continuously place a high priority on climate change as a frontline observer. This distinction emphasizes how media priorities when covering climate phenomena are influenced by local exposure and susceptibility.

However, there is no discernible rising or decreasing trend in the coverage of impacts in BB's media, which is significantly lower and more stable. On the other hand, SG's media consistently and prominently emphasize impacts, with a noticeable upward trend in recent years. In comparison with BB's coverage, SG's media statistically prioritizes reports on impacts.

These patterns are consistent with Entman's (1993) framing theory, which holds that media sources choose and highlight various facets of a single topic according to their audience's perceived relevance, an approach using framing to enable more focused and relevant communication to different audiences (Guenther et al. 2024; Stede et al. 2023). While SG's impact-focused strategy implies increased institutional capability for thorough environmental evaluation, BB's phenomenon-focused coverage highlights the urgent physical threats that small island developing governments face. These disparate trends are indicative of regional variations in the coverage and framing of climate change, as noted by Boykoff (2011), with research showing that climate change framing depends on broader social and political contexts (Badullovich et al. 2020; Vikström et al. 2023). However, alternative explanations that do not involve strategic framing might include disparities in journalist expertise, institutional source availability, or editorial resource allocation.

There are clear differences in the two media's coverage of the terms of mitigation. They both exhibit notable differences and growing variability. The coverage of BB's media is more sporadic and inconsistent, with a noticeable increase in 2022–24. With notable variances, SG's media sees considerable decline in recent 2023–24. These periodic changes in mitigation coverage are consistent with recent climate events. BB's increased mitigation coverage in 2022–24 relates to major hurricanes and tropical storms during this period, potentially driving discussions on mitigation measures.

The two news outlets' coverage of adaptation shows clear disparities: BB's media shows a relatively higher and more fluctuating focus on adaptation strategies, which probably reflects its more immediate climate vulnerabilities and localized adaptation needs, while SG consistently reports on the terms of this category in a low but stable manner, indicating a relatively smaller perceived urgency for immediate climate action.

There are similarities between the two media's coverage of the economic, urban, and social aspects of climate change. There is no statistically significant difference between the two news outlets' attention to these characteristics. As low as 0.014, SG exhibits a general declining tendency. BB exhibits greater variability, peaking in 2019 (0.056) and 2023 (0.057).

Highly sporadic or irregular reporting on the terms of policy is evident in BB's coverage, which may indicate an

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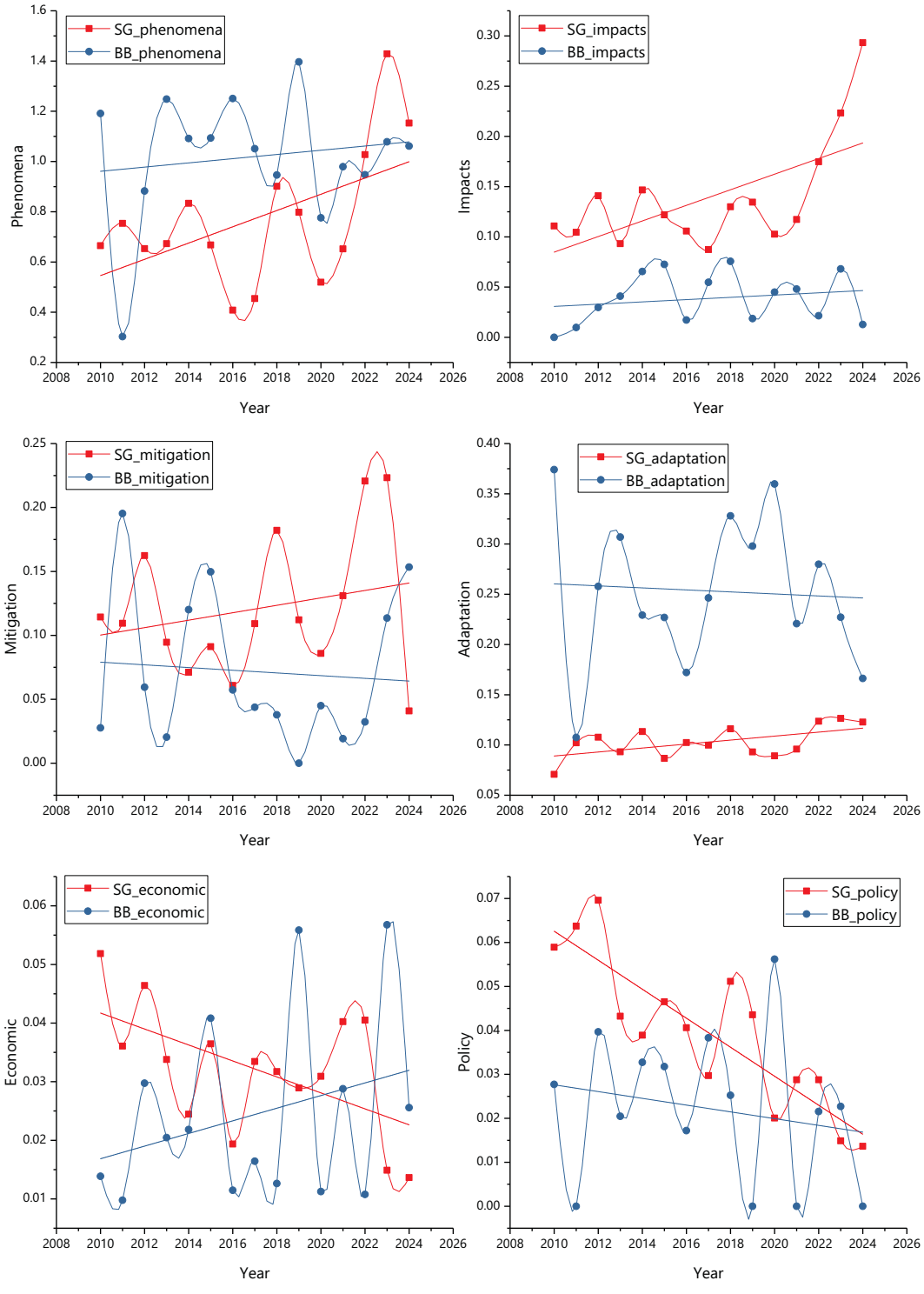

FIG. 1. Changes in category proportional frequency from 2010 to 2024.

opportunistic or reactive reporting pattern or reporting that is based on particular occurrences. The coverage of SG begins comparatively higher in 2010 (0.059) and progressively decreases until 2024 (0.014), when it reaches its lowest point. The emphasis on policy and governance responses in SG's reporting has been steadily and gradually declining over time, as evidenced by this long-term and obvious downward trend. The two series show significant difference.

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TABLE 2. Mann–Whitney tests of category proportional frequency. The significance level is at 0.05.

Category proportional frequency	*N*	Median	U	Z	*p*
SG_phenomena	15	0.673	48	−2.655	0.008
BB_phenomena	15	1.061			
SG_impacts	15	0.122	225	4.646	0.000
BB_impacts	15	0.041			
SG_mitigation	15	0.109	167	2.240	0.025
BB_mitigation	15	0.045			
SG_adaptation	15	0.102	6	−4.397	0.000
BB_adaptation	15	0.246			
SG_economic	15	0.033	160	1.949	0.051
BB_economic	15	0.020			
SG_policy	15	0.041	171	2.408	0.016
BB_policy	15	0.023			

The reduced policy coverage in both outlets runs counter to expectations from agenda-setting theory (McCombs and Valenzuela 2021), which forecasts consistent media attention to policy changes during times of growing climate urgency. Although it is impossible to pinpoint a single cause, these declines may be the result of a complex interaction of factors, such as a decline in the novelty or public interest in policy terminology, a shift toward phenomena-focused or impact-focused or alternative reporting, skepticism about the efficacy of policy mechanisms, increased awareness of how irrelevant some policies are to local outcomes, a preference for more approachable, narrative-driven climate stories, or changing journalistic approaches to climate communication.

This pattern could limit public awareness of viable policy instruments and lessen pressure on policymakers to take climate action, which would have serious implications for democratic climate governance.

Overall, BB's emphasis on physical climate phenomena and adaptation is in line with its immediate climate challenges as a small island developing state. As a developed city-state, SG, on the other hand, shows less urgency regarding adaptation and a wider focus on environmental impacts and mitigation. The results highlight important differences and similarities, providing information about how local settings influence climate narratives.

We performed sentiment analysis on the two datasets (Fig. 2). Graphically, BB's annual average sentiment score fluctuates more significantly, peaking in 2018 but showing notable declines in 2013 and 2023. In contrast, SG's sentiment is steadier, with a general upward trajectory until 2023. A divergence is observed in 2023: SG reaches its highest point, while BB's experiences a sharp decline, highlighting possible differences in climate reporting or public sentiment drivers.

It is unexpected that both media consistently display a positive tone in the annual average sentiment scores from 2010 to 2024 (ranging from −1 to 1), despite the datasets focusing on climate change, one of humanity's most formidable, threatening, and challenging crises. This pattern of positive sentiment persisted even during periods of severe climate events, such as Hurricane Elsa's direct impact on Barbados in 2021 and Hurricane Beryl in 2024.

FIG. 2. Annual sentiment scores for climate change coverage (2010–24). Sentiment scores range from −1 (most negative) to +1 (most positive).

The top 100 documents with the greatest sentiment scores were manually examined, and the results showed clear national priorities for positive climate coverage. The high-scoring articles from BB focused on regional cooperation and international diplomacy. They highlighted climate policy engagement ("Paris Agreement in focus," "PM Stuart to sign and ratify Paris Agreement"), renewable energy leadership ("Barbados can lead in renewable energy"), and collective regional frameworks ("Caribbean leaders launch plan to make region a climate-smart zone"), which reflected a small island state's strategy of leveraging international agreements and multilateral action for climate resilience.

In contrast, SG's most positive climate coverage concentrated on solution-oriented approaches and institutional innovations. These included green investment mechanisms ("Singapore to invest U.S. $2 billion in green funds to drive climate action"), financial sector sustainability ("New initiative launched to help financial sector be more sustainable"), and climate documentation and awareness campaigns ("Photo exhibition and documentary on Antarctica journey launched to showcase climate change"). These measures were in line with a developed city-state's approach to technological and financial innovation. With SG emphasizing institutional capacity and financial solutions and BB stressing diplomatic power and regional unity, these diverse factors imply that positive climate sentiment reflects each country's unique strategic positioning.

Statistically, the Shapiro–Wilk test for the sentiment scores of the two series indicates that both distributions are normal (SG: $p = 0.327$; BB: $p = 0.694$). Table 3 shows that there is strong evidence of relationship between time and sentiment scores for SG reports. They indicate a clear upward, more structured and predictable sentiment evolution in climate change reporting. But BB's media sentiment changes appear as more unpredictable, potentially event-driven sentiment

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TABLE 3. Regression analysis results for sentiment scores. The significance level is at 0.05.

Parameter	SG sentiment score	BB sentiment score
Slope	0.026	0.011
Slope_Standard_Error	0.007	0.011
Adjusted_R-Square	0.506	−0.005
p	0.002	0.353

variations. We use the analysis to describe systematic tendencies in sentiment evolution rather than to prove causation.

The very positive tone of both publications indicates that, rather than emphasizing disasters, climate journalism in these settings stresses opportunities, solutions, and agency. This corresponds with climate communication literature emphasizing constructive messaging that encourages salience and self-efficacy, rather than fear-based approaches which can weaken engagement (Boykoff 2011; O'Neill and Nicholson-Cole 2009; O'Neill et al. 2013; Sheppard 2012). Research indicates that nonthreatening, relatable imagery and solution-focused accounts promote positive emotions, self-efficacy, or proenvironmental behaviors, while disaster-focused representations may increase salience but reduce self-efficacy (Baden 2019; Carlson et al. 2020; Lorenzoni et al. 2007; O'Neill et al. 2013). Studies show that positive emotions from solution-oriented messaging increase readiness to act proenvironmentally and capture attention for climate action (Carlson et al. 2020; Chatelain et al. 2018). The observed reporting patterns may reflect broader trends in climate communication trainings toward such salience or efficacy-promoting strategies, although this study does not establish whether such frameworks directly shaped reporting practices in BB or SG media.

The divergent temporal trends highlight significant contextual variations: While SG's more predictable and structured sentiment evolution suggests systematic institutional confidence in technological and policy solutions, BB' event-driven variations may reflect the lived reality of immediate climate impacts—optimism around adaptation measures interspersed with concern during acute events.

Despite being small countries dealing with physical issues like sea level rise, BB and SG have very different economic systems and levels of development. We constructed word vector models based on unigrams for each of the two media to investigate the covered policy topics. The two corpora have been found to have different thematic emphases based on the distances between "policy" and its closest words (Fig. 3). Proximity indicates semantic similarity in word usage patterns.

The discussion in BB's media emphasizes the social, sustainable, and developmental facets of policy, reflecting immediate concerns regarding the effects on productive sectors, including fisheries, agriculture, and infrastructure. The following are key words related to policy: "social," "enhance," "promote," "sustainability," "fishery," "human," "agricultural," "infrastructure," and "productivity." These words emphasize developmental and community-oriented concerns, aligning with the socioeconomic and environmental challenges faced by BB,

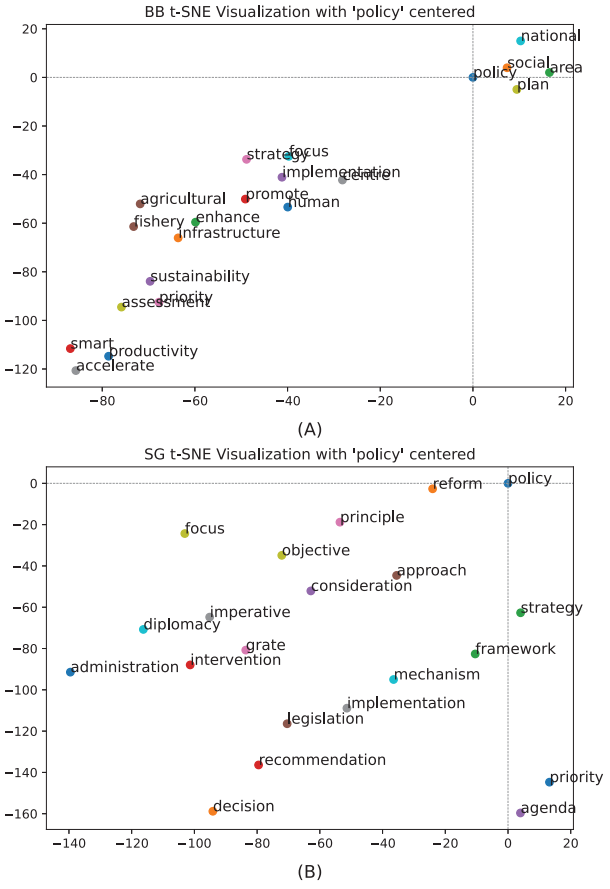

FIG. 3. The *t*-distributed stochastic neighbor embedding (*t*-SNE) visualization of policy and its closest words in word vector models of (a) BB and (b) SG datasets.

a small island developing state. The country's efforts to support sustainable growth in response to environmental vulnerabilities are highlighted by the focus on sustainability, social and economic development, and climate resilience.

The media in SG, on the other hand, places more emphasis on governance, institutional frameworks, and methodical approaches to policy. The following are key words associated with policy: "reform," "strategy," "legislation," "framework," "implementation," "objective," "agenda," and "diplomacy." These terms suggest a discourse centered on strategic and formal decision-making, indicating that SG may be less focused on immediate disaster response, allowing for a more governance-oriented climate discourse. The emphasis is on structured frameworks, strategic interventions, and institutional governance, highlighting the country's systematic and policy-driven approach to addressing challenges.

5. Conclusions

This comparative study shows that among small island states with comparable environmental vulnerabilities, development status has a significant impact on climate communication. Our analysis of 6278 articles demonstrates how institutional resources and

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economic capabilities result in different media framings: BB highlighted physical threats and community adaptability, while SG concentrated on governance structures and mitigation. Over time, both publications decreased their policy-related coverage, indicating changes in the priority of their communications.

Sentiment analysis shows that assumptions about climate journalism that are crisis-oriented are overstated. Both sources tended to be optimistic despite their vulnerabilities, with BB being more variable and SG being more consistent. Word vector results distinguish the outlets' approaches, with BB emphasizing community-oriented and developmental aspects of policy, while SG focused on institutional frameworks and governance structures.

Our study expands on framing theory beyond regional variation by emphasizing development status as a critical contextual component (Boykoff 2011). The findings have significant implications for climate communication and policy: Although regionally customized techniques might improve engagement, resource discrepancies may lead to different approaches to climate action. The decrease in policy-related coverage in both publications raises concerns about the public's ability to understand, evaluate, and support climate policy measures.

The generalizability of our results is constrained by several factors. Relying on a single English-language newspaper per nation limits representativeness, and the exclusion of multilingual content may omit alternative framings. The category term lists, while systematically developed, reflect our subjective topical boundaries. To provide a more complete picture of climate discourse, future studies should widen their scope to include additional AOSIS member states and wide-ranging data sources such as social media platforms.

Acknowledgments. We are deeply grateful to the anonymous reviewers and editor(s) whose insightful feedback and guidance significantly improved this work. The authors received no funding for this research. The authors declare that they have no competing interests. This study did not require ethics approval as it exclusively involved the analysis of publicly available newspaper articles. No human participants, personal data, or sensitive information were included in the research, and therefore, no ethical concerns were raised.

Data availability statement. The data analyzed in this study are publicly available from the *NationNews* website (https://nationnews.com) and the *Straits Times* website (https://www.straitstimes.com), as well as LexisNexis (https://www.lexisnexis.com). The software used for natural language processing and sentiment analysis—NLTK, spaCy, Gensim, and Flair—is open source and publicly available through their respective repositories as cited in the manuscript.

APPENDIX

Climate Change Category Terms Used in Analysis

```
climate_terms = {
  'physical_climate_phenomena': [
    'climate change', 'coastal flooding', 'cyclone', 'drought',
    'dry season',
    'el nino', 'extreme weather event', 'flash flood',
    'flooding', 'forest fire',
    'global warming', 'heat island', 'heat stress', 'hurricane',
    'marine heatwave',
    'natural disaster', 'sea level rise', 'storm', 'storm
    surge', 'tropical cyclone',
    'tropical storm', 'urban heat island'
  ],
  'environmental_impacts': [
    'air pollution', 'carbon dioxide', 'coastal erosion',
    'coral bleaching',
    'environmental degradation', 'environmental impact',
    'forest degradation',
    'greenhouse gas', 'habitat loss', 'ice sheet', 'mass ex-
    tinction', 'ocean acidification'
  ],
  'mitigation_measures': [
    'alternative energy', 'carbon neutral', 'carbon neu-
    trality', 'carbon sequestration',
    'carbon sink', 'carbon tax', 'energy conservation',
    'energy efficient',
    'environmentally friendly', 'fuel efficient', 'public
    transport', 'solar energy',
    'solar panel', 'solar power', 'sustainable energy',
    'wind farm', 'wind turbine'
  ],
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      sessment', 'impact study', 'land management',
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      assessment', 'risk management', 'sea wall', 'self
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}
```

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