

A close-up, shallow depth-of-field photograph of a network connector, likely an SFP or similar, showing a dense array of gold-plated pins. The pins are arranged in a grid-like pattern and are slightly angled. The background is a soft, out-of-focus blue and grey.

Climate Communications Data Intelligence and Discourse Report 2025

Madi

climatεxchange

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Introducing Maai

Understanding how global media covers a particular subject is key to understanding the public's response to it. When dealing with the creative, complex and politically charged topic of climate, data simply isn't enough: journalists need a tool capable of analysing the many layers of narrative nuance employed in climate storytelling at scale, with actionable conclusions that inform their work.

To answer this need, **Project Maai** was born.

Maai seeks to reshape how the media addresses climate change by improving the reach and effectiveness of climate news—with rock-solid data-driven insights as its foundation. It does this through a two-phase model:

1. The findings of a world-first climate journalism analysis research engine with 7 million stories as its input and 3.8 million references as source files.
2. The development of a prompt-based AI platform designed to help journalists think, optimise, and assist in improving the potential impact of their work.

Our vision is that Maai will be a quantitative and qualitative assessment and optimisation tool designed to advance the impact of climate narrative in the media. This next-generation thinking resource will support the development of a new type of climate narrative.

Foreword

Beyond Fear: How Data-Driven Climate Journalism Drives Action, Not Apathy

Traditional journalism often treats climate as a niche topic, disconnected from the broader currents of public life.

climateXchange (cXc) is changing this by embedding climate within shared cultural narratives. This shift toward Climate Culture Journalism reframes the conversation. It moves the focus away from polarisation and fear, and toward a more inclusive, culture-first approach.

Climate journalism is at a critical inflection point, marking a broader shift in how media approach both their role and the climate conversation. With the scientific consensus on human-driven climate change firmly established, the challenge is no longer to prove it exists, but to foster meaningful discourse around adaptation, mitigation, and action. Traditional coverage, often fear-based and overly technical, is falling short. It does not engage audiences or support the behavioural change this moment demands.

Journalists are now called to move beyond framing climate change as a distant or future threat. Instead, they must show how it affects everyday life, from the food people eat to the communities they live in. Just as importantly, they must help audiences understand how to adapt and respond.

Project Maai was created to address these challenges within the context of the multi-billion dollar media ecosystem. As news organisations increasingly seek competitive advantage through climate coverage that drives both audience engagement and policy influence, they need evidence-based narrative strategies. At the same time, audiences are demanding authentic, culturally relevant storytelling that reflects their lived experiences. This calls for relatable, real-life local context context, rather than abstract or top-down narratives.

This convergence of market demands creates a unique opportunity for a platform that can quantify narrative impact and support media in bridging the gap between climate science and diverse cultural frameworks. By doing so, it can help drive meaningful action across communities and stakeholder groups.



Project Maai kicked off in early 2025 with groundbreaking research; an analysis of global climate media coverage, examining over 3.8 million articles from 194 countries to understand how journalistic choices shape public perception and response to the climate crisis.

Produced by a team of global data, tech, ethics and journalism experts, this report represents phase 1 of Maai. The report covers the analysis which determined proprietary 'Impact Success Factors' (ISFs) which seek to optimise content for maximum impact.

The research established clear, evidence-based pathways, to impactful climate communication:

Positive sentiment + solutions language
= *stronger pro-mitigation narratives*

Cultural + technological anchors
= *increased audience engagement*

Diversified geographic sourcing
= *enhanced narrative equity and justice framing*

Social solutions + action verbs
= *more effective than abstract technical references*

The Engagement Formula:

Crisis + Solutions + Hope + Action = Maximum Communication Impact

This formula aims to drive change and guide news organisations using a strategic approach that balances urgency with agency. It seeks to avoid climate paralysis and empowers audiences with actionable pathways forward.

This approach requires diversifying sources and regional perspectives, moving beyond traditional Western-centric coverage to amplify underrepresented voices. This is especially important in the Global South, where climate impacts are most severe but stories remain underreported. Media outlets must integrate a range of narrative frames—scientific, political, economic, justice, and cultural—and use framing intentionally and strategically to align with audience needs and cultural contexts, ensuring maximum relevance and impact.

This Climate Communications Data Intelligence and Discourse Report, shares the Part 1 research findings that demonstrate clear pathways between narrative elements and audience engagement. Maai 2.0 will provide the scalable infrastructure needed to optimise climate communications across global media ecosystems while establishing market

leadership in the emerging field of climate narrative intelligence.

Despite growing coverage, climate media still faces challenges in driving measurable behaviour change. This evidence-based platform is designed to help close that gap. By using a proprietary Impact Success Factors scoring system, it offers news organisations a new way to understand and strengthen the effectiveness of their climate storytelling.

ClimateXchange hopes Maai will be the definitive platform powering climate media transformation globally, ensuring that every climate story published has the maximum potential impact to inspire action, drive policy change, and accelerate our path to a sustainable future.

The question is not whether climate media will evolve, it's whether we'll join forces and collaborate to lead that evolution with the tools and insights needed to make it count.

The scale, importance, and thought that went into each stage of this study, specifically; the design methodology, dataset curation, and platform thinking was invaluable.

It continues to be a pleasure to work with a truly collaborative and diverse thinking research team and Maai: Communications and Climate Discourse Report authors.

A big thank you to the whole Maai Team:

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With thanks



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Project Maai Lead

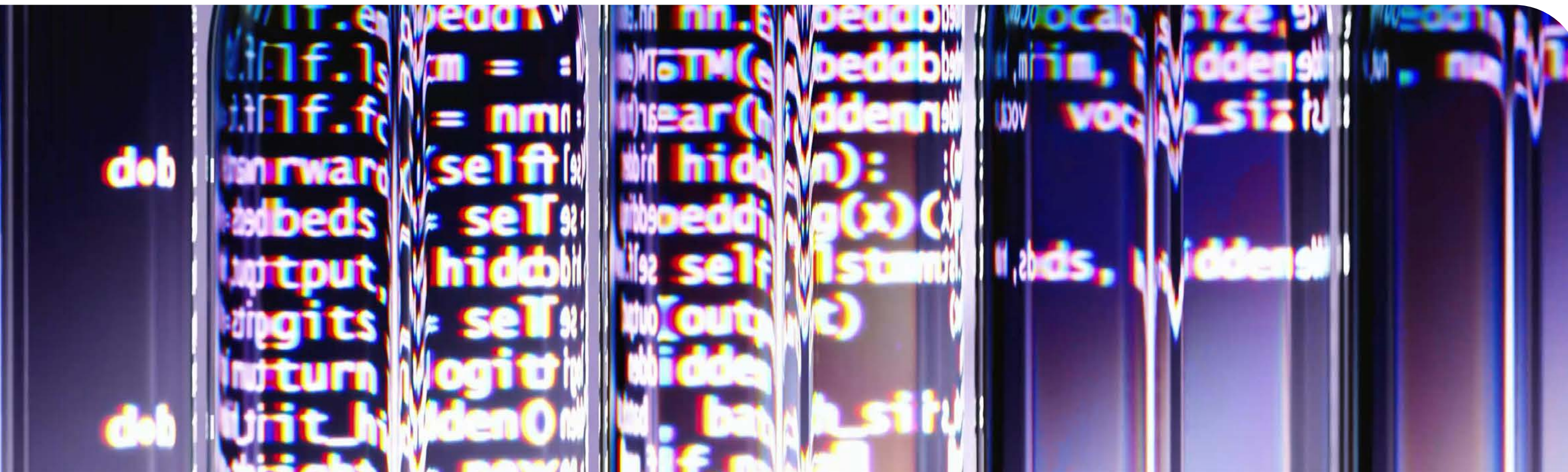
Project Maai:

Part 1 - Research and Findings

This study is anchored in the belief that the future of climate journalism lies in reimagining its informational infrastructure. As news organisational practices and digital ecosystems evolve, so too must the strategies that underpin climate communication.

This report was commissioned by **climateXchange (cXc)** to further understand how to elevate climate narrative and has a pivotal role in redefining media ecosystems. Further, ensuring climate journalism has a valued seat at the table in accelerating climate mitigation and adaptation.

This work is part of cXc Project Maai which seeks to develop a quantitative and sentiment analysis tool designed to advance the impact of climate reporting. Combining data-driven insights with strategic, evidence-based climate storytelling impact for news and media organisations around the world Maai will offer a next-generation resource for reporters and media organisations. The first part of Project Maai responds to this moment of transformation by looking at the capacity of climate journalism to shape public discourse, support democratic participation, and guide meaningful climate action. The aim of this research phase is to build a robust evidence-base that establishes and develops 'potential for impact' scoring generatively for use in the subsequent phases of Project Maai.



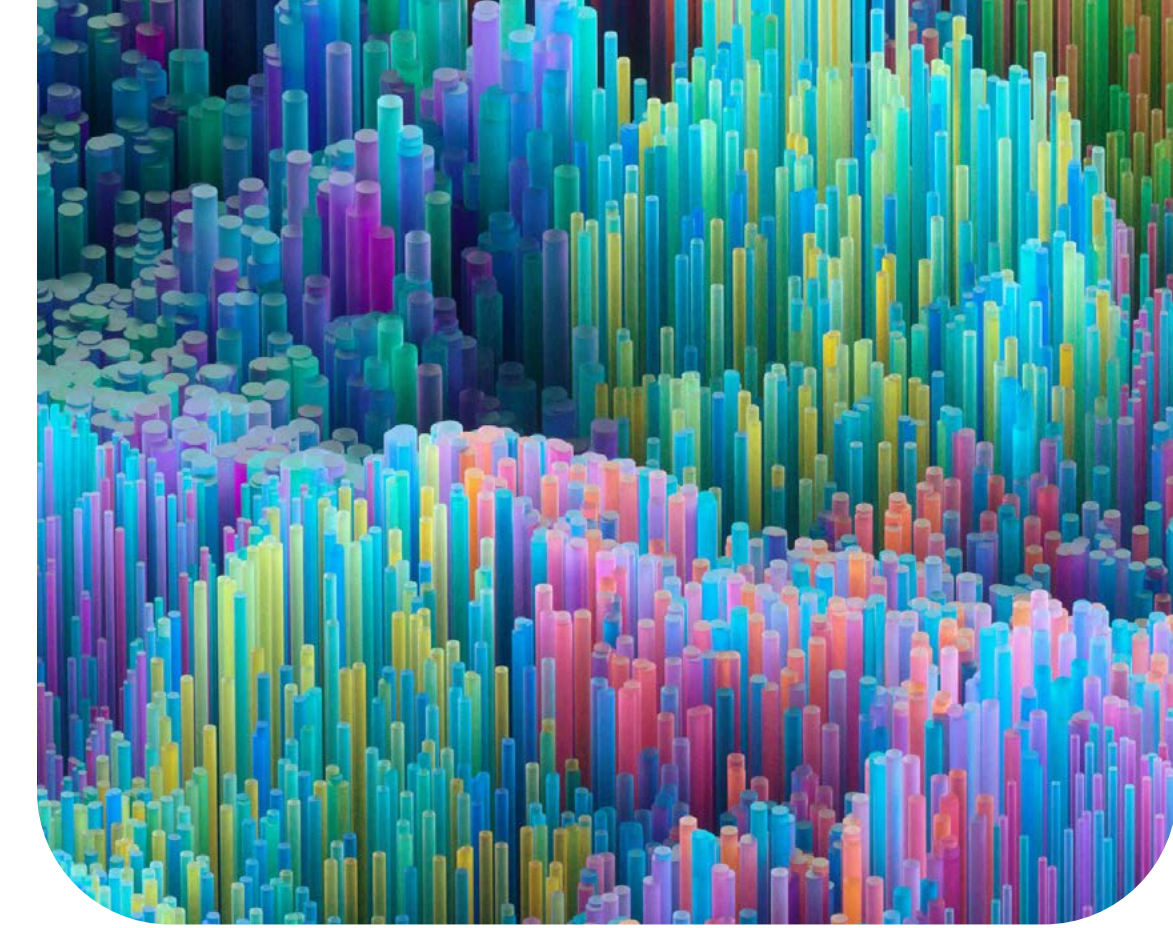
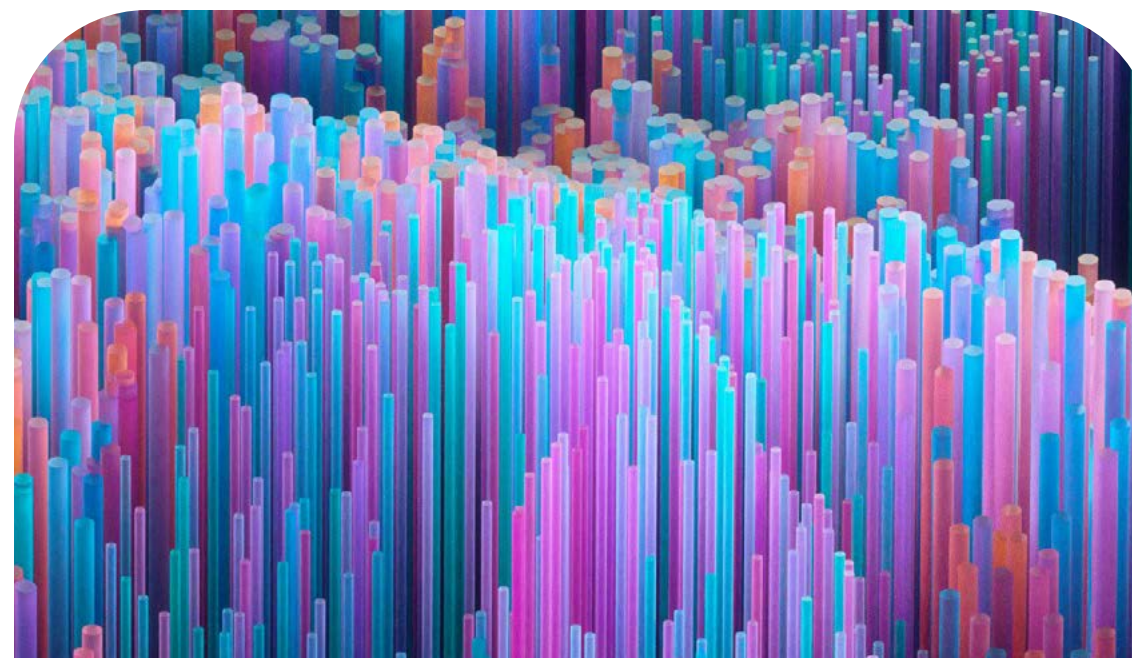
To guide the inquiry, this report asks:
How do the patterns and trend variables in media coverage over time establish the characteristics of impactful climate reporting?

To address this, the report investigates three interlinked hypotheses (H):

H1: *Higher volume of climate-anchored phrases in the news correlates with shifts in thematic framing of the climate crisis over time.*

H2: *Articles with higher positive sentiment scores and solution-oriented language are more likely to promote pro-mitigation narratives.*

H3: *The integration of technological advancements and cultural references in climate reporting correlates with shifts in dominant cultural narratives and journalistic framing over time.*



Drawing on a large multilingual dataset of 7,316,625 articles from 194 countries and 35,004 media outlets spanning the years 1968 to 2025, this report offers a comprehensive, data-intensive analysis of global climate news flows.

Through natural language processing (NLP), topic modelling, sentiment analysis, and frame classification, it maps how climate narratives are constructed, how they evolve, and how they vary across regions, outlets, and time periods.

Ultimately, this report aims to understand not only how much climate content exists in global media ecosystems, but how it is framed, who frames it, and to what effect. In doing so, the report positions media as both a mirror and a map — reflecting cultural anxieties and aspirations, while also charting new narrative pathways toward collective climate futures.

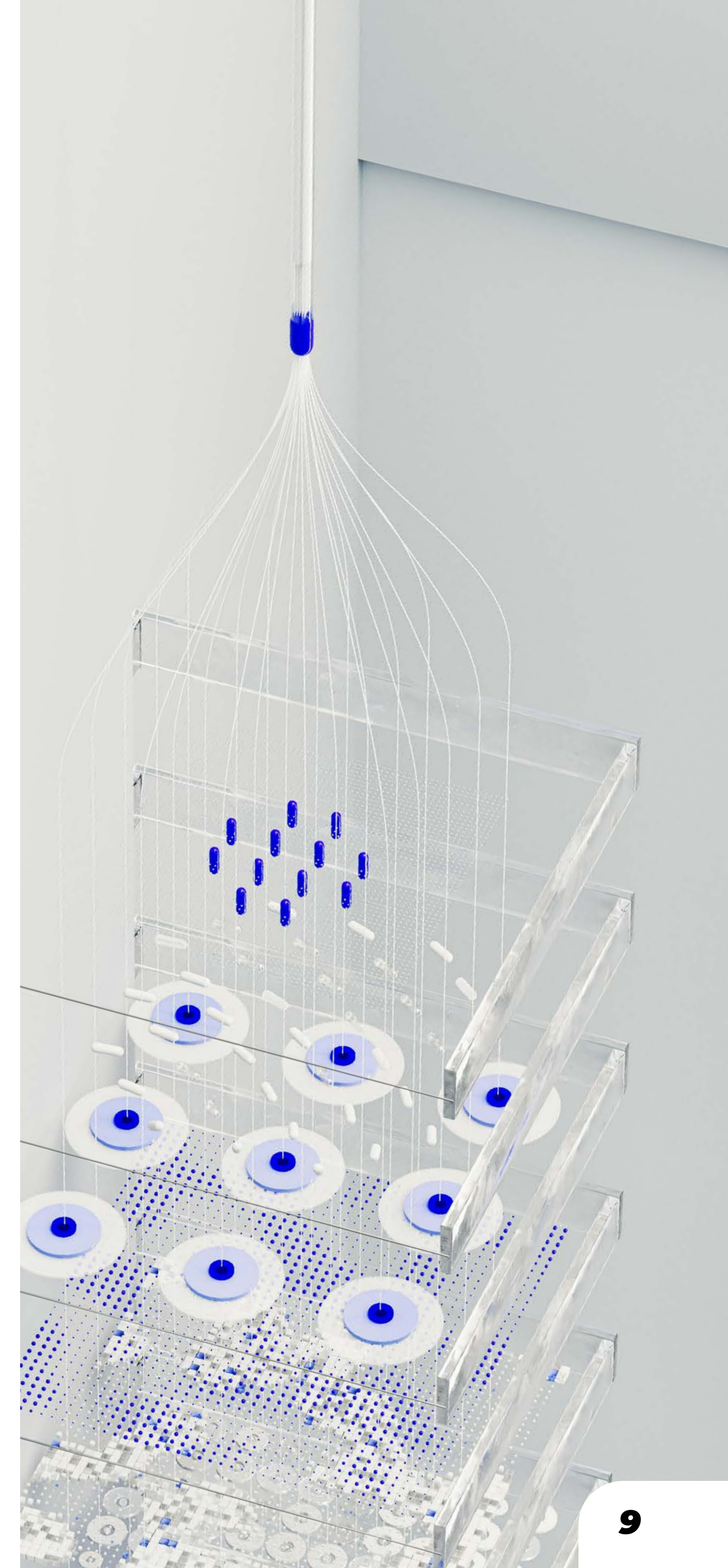
Methodology

A combination of web scraping, dataset retrieval from online repositories, and API-based data extraction were used to ensure comprehensive representation of climate change articles across multiple media sources.

The news articles collected covered the full-text of approximately 7,316,625 articles in 35,004 unique media sources across 194 different countries for the years 1968 to 2025. Media sources were selected that were not predominantly local or regional in scope and therefore, at least to a certain extent, reflected their national public agendas. While media sources with national circulation/coverage are expected to provide the highest amount of coverage on political issues and to have the highest agenda-setting impact for policy makers and the general public, the selection includes local sources that are expected to provide local coverage of climate change impact stories.

News articles were collected using keyword query search — (climate w/2 (change OR action OR crisis OR breakdown OR emergency)) OR "global warming" OR (greenhouse w/2 (effect OR gas* OR emission*)) OR "carbon emission*" OR "carbon footprint" OR "ozone layer" OR "climate disaster*" — from news organisations and databases.

This included inspecting webpage structures, handling pagination, and storing extracted data in a structured format from CivicSignal, GDELT, Media Cloud, NewsBank, Kaggle, All News Six, etc. The technique used can be described as text/data mining (Hearst, 1997, 1999; Manning and Schütze, 2002). Stemming algorithms were developed that allowed for the inclusion of possible variations in spelling, conjunction, or misspelling of key terms, developed for all languages included. All articles that contained at least one mention of the respective search terms in the full text body were included.



Data Collection Process

Data from the Global Database of Events, Language, and Tone (GDELT) was accessed through Google BigQuery. The GDELT Event dataset and GDELT Knowledge Graph were queried using SQL commands to extract climate-related articles. The process required setting up a Google Cloud project, navigating the dataset's schema, and managing large-scale data efficiently. A supplementary step involved using Python's newspaper3k module to extract article metadata, although limitations were noted in querying a fixed number of articles per request.

Other sources such as Vox, HuffPost, and UN News were accessed through publicly available datasets on Kaggle. These datasets, originally compiled using web scraping techniques with newspaper3k, were further processed using classification scripts to determine the relevance of articles to climate change. Similarly, articles from AP News, Reuters, and BBC were retrieved using web scraping, while The New York Times articles were obtained via the NYTimes API.

The latter approach enabled access to historical data, allowing the retrieval of articles dating as far back as 1990.

Media Cloud was accessed using an account through which source urls were downloaded, and then scraped using a newspaper3k web-scraping script. A summary of the collection processes is summarised below.

Articles from Trove, hosted by the National Library of Australia, were accessed through an account-enabled CSV download mechanism. These CSV files contained URLs of articles, which were subsequently scraped using a Selenium-based Python script to retrieve full content from each source link. Several additional sources were acquired via Kaggle datasets. Articles from Vox, HuffPost, and UN News were originally scraped using the newspaper3k library, and then classified using custom scripts to determine their relevance to climate change. A similar process was followed for articles retrieved from AP News, Reuters, and BBC, all of which were scraped using newspaper3k and requests, extracting metadata

such as titles, text, publication dates, and image URLs.

Other international media sources were also included in the dataset. Articles from Japan News and Mainichi (Japan) were scraped using BeautifulSoup and requests, extracting essential article elements. Likewise, ChinaDaily News required Selenium for article link extraction, followed by newspaper3k processing. Approximately 8,568 articles were scraped from this source. The Korean Herald contributed 2,101 articles, while 613 articles were obtained from Scotland Sun. From Spain English, 167 articles were scraped, and 441 from Euro Weekly. An additional 29 were sourced from Sur Weekly, and 355 from Sweden Herald.

The Local Sweden yielded 1,622 articles, Poland Daily 423, and Norway – News in English approximately 1,484. DW News contributed 5,257 articles, and the Irish media landscape was represented by Irish Independent (1,407 articles), Irish Sun (1,140), and Irish Examiner (8,511). From Denmark, The Copenhagen Post provided 816

articles. In North America, National Post Canada was included via Selenium-based extraction of article links, followed by content scraping with newspaper3k. This process yielded 9,994 articles dating back to 2007.

Media Cloud provided a significant portion of the dataset. Through an authenticated account, source URLs were downloaded and scraped using a newspaper3k script. A total of approximately 909,000 articles were collected from Media Cloud's global English-language sources including United States national, India national, Russia national, United Kingdom national and France state and national collections.

Ethical Framework

To ensure Maai is built responsibly, we applied a rigorous ethics framework across every stage of data processing and machine learning. We asked critical questions about consent, bias, provenance, and accountability — particularly given the model is trained on millions of scraped news articles.

Each stage, from data ingestion to model drift, was evaluated using measurable criteria like source diversity, fairness thresholds, and explainability.

Unlike many AI systems that treat ethics as a compliance task, we embedded it as a design principle, ensuring the model won't just evaluate headlines and content, but does so with integrity, equity, and respect for global climate narratives.

At the heart of Maai's development are five core ethics questions:

1. Whose voices are represented?

— Does the data reflect diverse global perspectives, not just dominant media narratives?

2. Was the data used responsibly?

— Was it collected with consideration for consent, ownership, and legal provenance?

3. Is the model fair and accountable?

— Have we measured and mitigated bias in both the training data and outputs?

4. Can we explain how it thinks?

— Are the AI's decisions and content traceable to credible sources?

5. Will it stay ethical over time?

— Do we have safeguards to monitor model drift and unintended consequences?

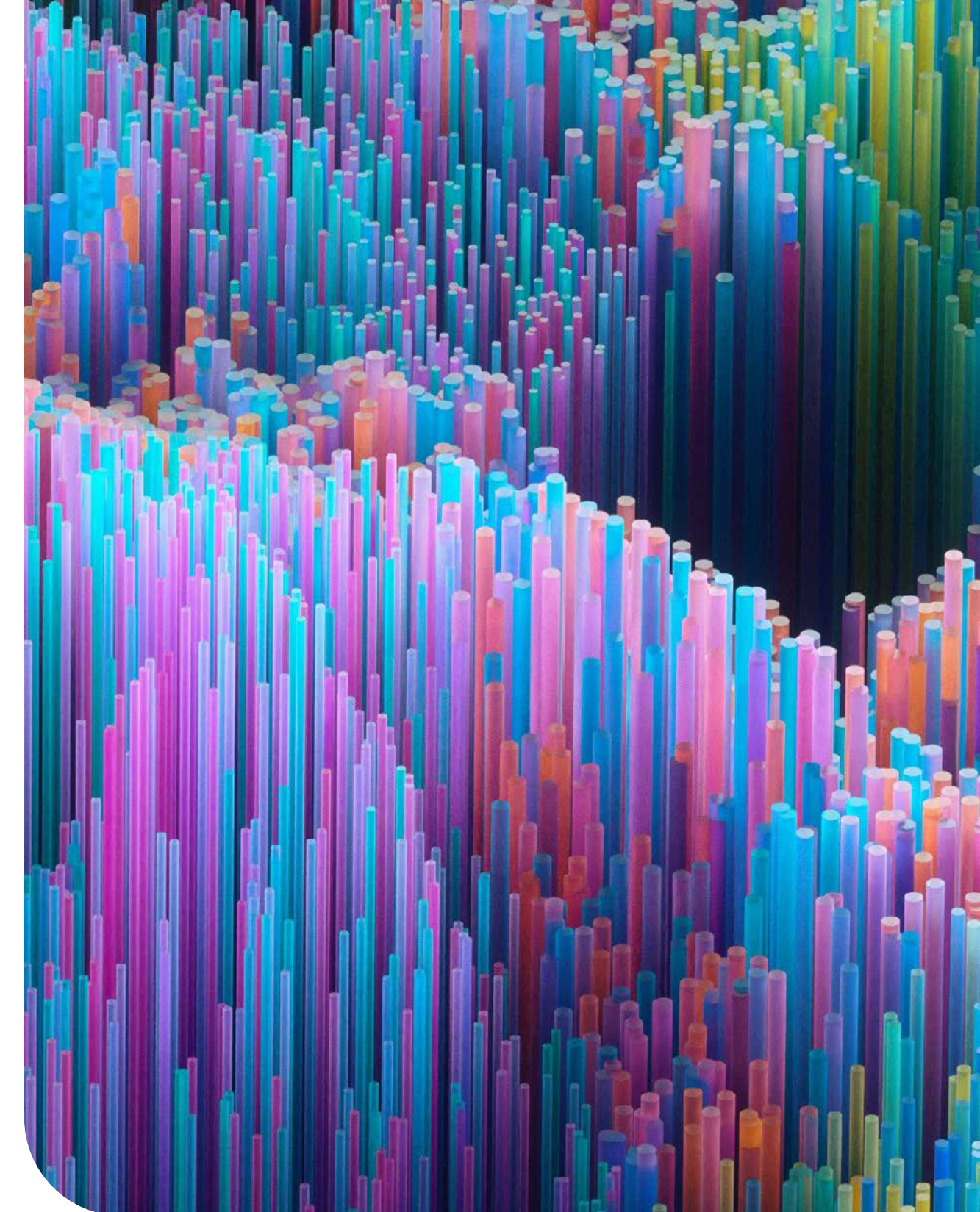
These questions guided every decision, from data sourcing to model evaluation, ensuring that Maai is not only effective, but ethically sound.

Drawing from repositories like GDELT, Media Cloud, and NewsBank, the Maai team employed advanced text mining, natural language processing (NLP), and sentiment analysis to categorise framing patterns, thematic evolution, and regional disparities.

The full dataset includes content from 1968 to 2025, across major events including COP summits, IPCC reports, and climate protests.

The implications extend far beyond journalism. For climate policymakers, this report offers a real-time reflection of how the media may be shaping civic action.

For technologists, it showcases the power of open-source tools in assembling knowledge at scale. And for the public, it reveals ways to tell the story of climate change in a way that is equitable and relevant.



Data Sampling and Analytical Roadmap

From the 194 countries represented in the data, with a total of 3,805,504 climate news articles distributed between 1968 and 2025, a further refined sample was introduced to focus on more relevant news articles. The following keyword taxonomy was applied and articles were only returned (right) if they met the condition of at least one of the pairs.

Note: This taxonomy guides article queries rather than listing every word in the corpus, so linguistic markers like ‘said’ and ‘state’ may still appear in topic outputs even if absent from this lexicon listing.

'climate w/2 (change OR action OR crisis OR emergency)',
'"global warming"',
'"greenhouse" w/2 (effect OR gas* OR emission*)',
'"carbon" w/2 (emission* OR footprint OR tax OR sequestration)',
'"CO2" w/2 (emission* OR concentration*)',
'"methane" w/2 (emission* OR leak*)',
'"fossil fuel*" w/3 (divestment OR subsid* OR phase-out)',
'"ozone layer"',
'"El Niño"',
'"La Niña"',
'"sea level" w/2 (rise OR rising)',
'"ice" w/2 (melt* OR sheet* OR loss)',
'"glacier" w/2 (melt* OR collapse)',
'"permafrost" w/2 (thaw* OR melt*)',
'"ocean" w/2 (warming OR current*)',
'"coral" w/2 (bleaching OR reef*)',
'"heat" w/2 (wave* OR dome OR record*)',
'"wildfire*"',
'"drought" w/2 (severe OR prolonged)',
'"flood" w/2 (catastrophic OR flash)',
'"hurricane" OR "cyclone" OR "typhoon"',
'"storm" w/2 (surge OR intensif*)',
'"rainfall" w/2 (heavy OR record)',
'"Paris Agreement"',
'"net zero" OR "carbon neutral"',
'"IPCC"',
'"UNFCCC"',
'"climate" w/2 (legislation OR policy)',
'"climate finance"',
'"green bond*"',
'"carbon pricing" OR "carbon tax"',
'"emission* target*"',
'"fossil fuel" w/2 (ban OR phase-out)',
'"climate" w/2 (adaptation OR resilience)',
'"coastal" w/2 (protection OR defense)',
'"climate-smart" w/2 (agriculture OR farming)',
'"climate migra*"',
'"food security" w/3 (climate OR change)',
'"water" w/2 (scarcity OR stress)',
'"biodiversity" w/2 (loss OR collapse)',
'"ecosystem" w/2 (collapse OR shift)',
'"species" w/2 (extinction OR loss)',
'"habitat" w/2 (loss OR fragment*)',
'"pollinator" w/2 (decline OR collapse)',
'"climate justice"',
'"environmental justice"',
'"just transition"',
'"climate" w/2 (equity OR inequality)',
'"climate" w/2 (health OR disease)',
'"green economy"',
'"sustainable" w/2 (development OR growth)',
'"climate risk" w/2 (assessment OR management)',
'"sustainable development goal*"',
'"net-zero" w/2 (economy OR transition)',
'"climate" w/2 (skeptic* OR denial OR hoax)'

This approach was used to make sure that articles were not generic but fitted well into the climate change framework. As a result of applying this taxonomy classification, 417,009 news articles met the conditions and were used to build a new dataframe.

As expected, the data had a bias towards Global North countries, more specifically the United States (182,312 or 43.7% of the data) and the United Kingdom (62,830 or 15%). While the mean number of articles per country is around 2,117, the median is only 95. This large gap between the mean and the median indicates that the distribution is skewed: a small number of countries (like the US and UK) contribute disproportionately large volumes of articles, while most countries contribute very few. For example, the ten least represented countries with any articles have only one article each. Thus, although the dataset spans 194 countries, a handful of high-output countries dominate the overall picture.

The data spans 57 unique years, from 1968 to 2025. However, coverage is concentrated in recent years. There's a sharp increase in articles from 2013, with 2019-2024 showing the highest volumes (data for 2025 reflects articles published early in the year). Pre-2010 years have sparse representation.

Similarly, the dataset includes 9,128 unique media houses, but their contributions are highly uneven. On average, each media house has 46 articles, but the median is just 4. This means the distribution is skewed towards a few prolific publishers such as The Guardian (9,085 articles), while a large number of outlets contribute only a handful of stories (in fact, 25% of outlets have only one article). As with country-level skew, this media-house skew implies that without correction, findings would overrepresent the perspectives of the largest outlets while underrepresenting smaller or local voices.

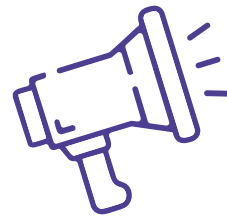
Stratified sampling was introduced to extract a representative subset from the dataset of 417,009 articles. The process and application are explained in greater detail in Appendix 2.

Maai Database Overview

Comprehensive Global Climate new analysis



3.8M
lexicon filtered
articles



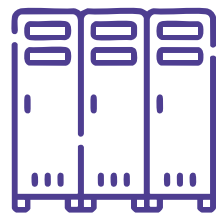
35,004
media
outlets



417,009
stratified
dataset



9,128
unique media
houses



57
years
of data



194
countries
covered

Data Collection Period

1968

2025

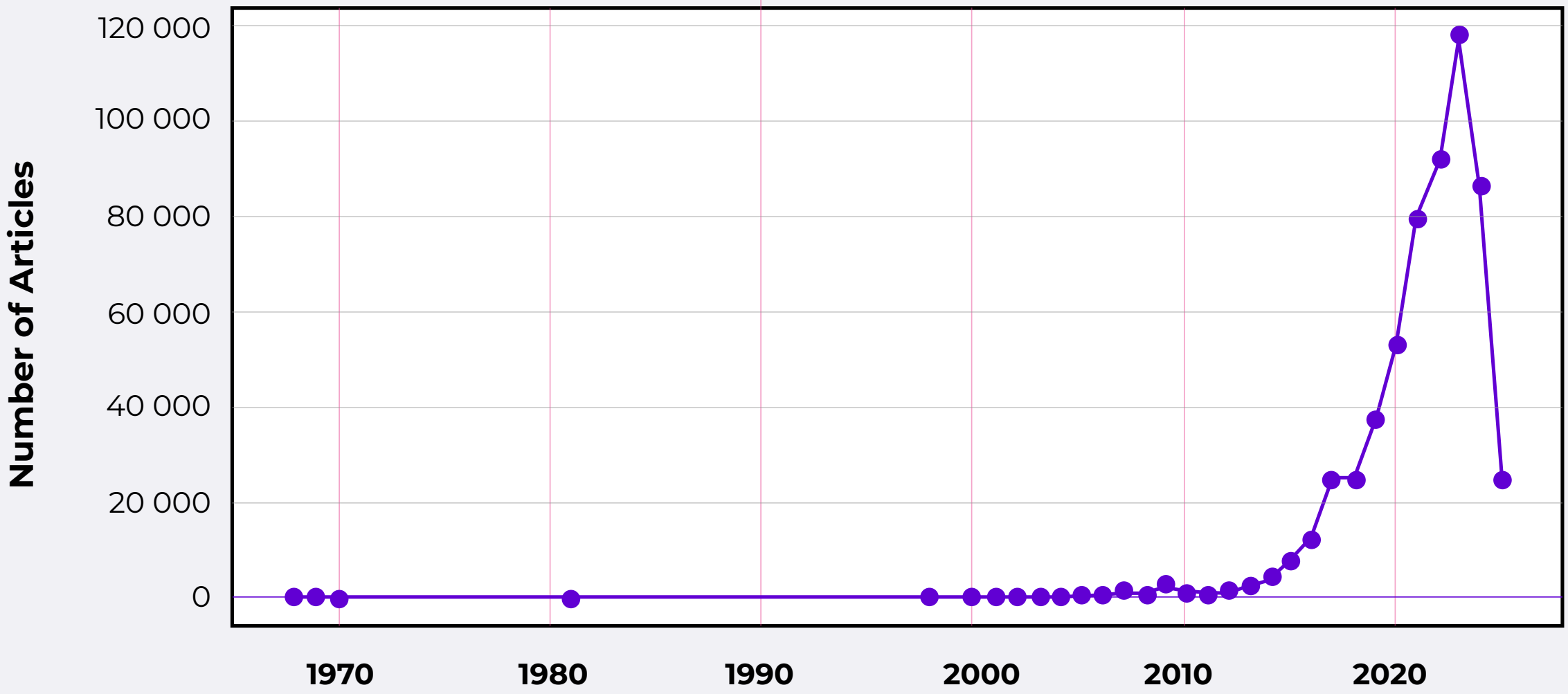
Findings and Analysis

Drawing on a large multilingual news database, this report analyses news article distributions across countries, media outlets, and thematic categories. The database includes over 3.8 million climate-related news articles from 194 countries, led by the United States, United Kingdom, Nigeria, Australia, and South Africa. It also encompasses 35,004 unique media outlets, including legacy print houses, contemporary newspapers, their digital incarnations and independent websites.

Temporal Trends

Fig 1 shows the number of climate news articles per year from 1968 to 2025 revealing key insights about the data. The collected database shows climate news coverage was minimal until around 2010, after which there was a steady increase that accelerated after 2015, reaching peak coverage around 2022-2023 with nearly 120,000 articles. This peak coincided with a surge in media focus on climate policy, extreme weather events, and institutional responses. The low coverage before 2010 aligns with the historically niche status of

Fig 1: News Article Frequency (1968-2025)



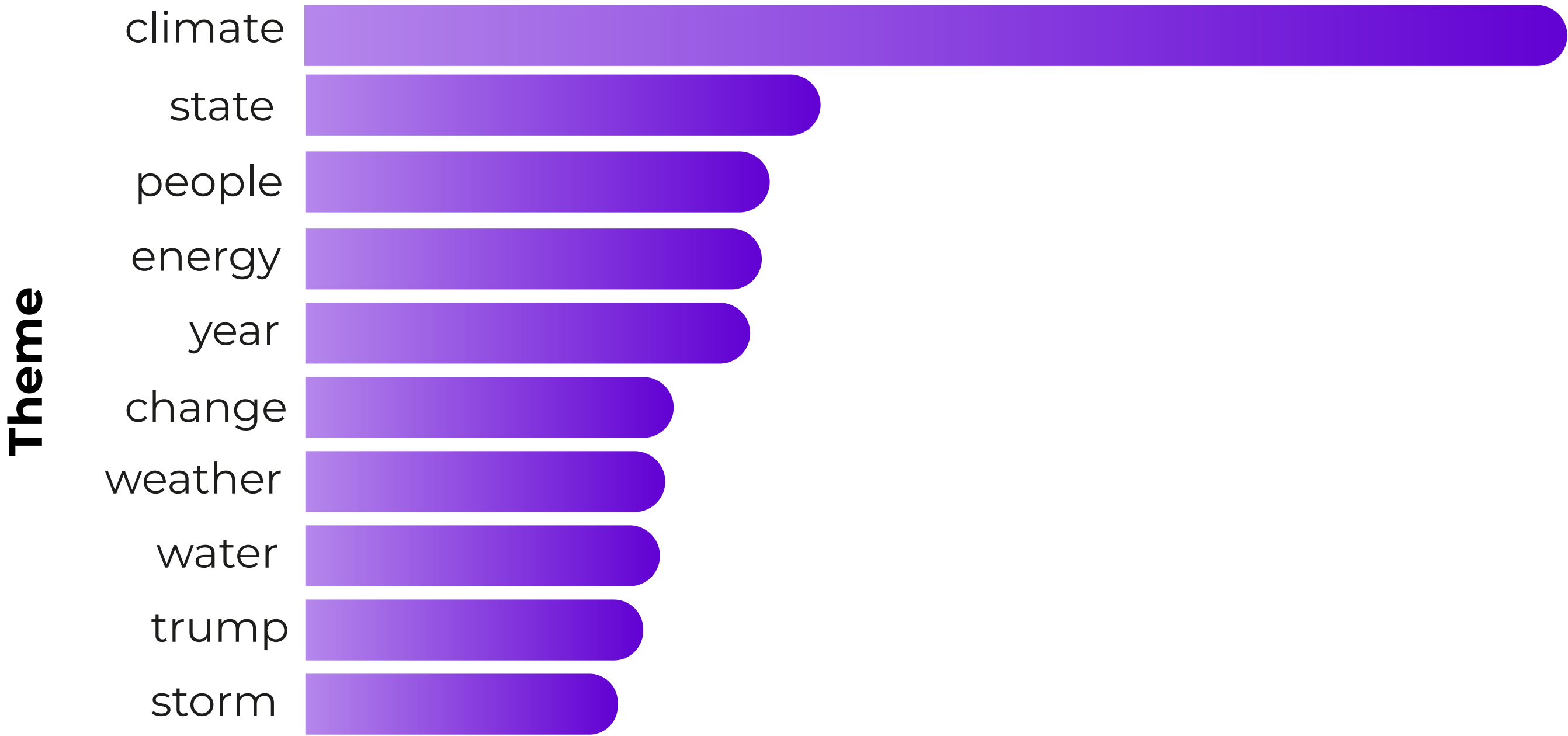
environmental journalism. However, the sharp and sustained increase after 2015 suggests a structural shift in the news agenda, likely catalysed by the 2015 Paris Agreement, which placed climate policy at the heart of international diplomacy; the rise of climate activism movements such as Fridays for Future, which mobilised public attention and media focus; and escalating climate disasters, which localised the global crisis and compelled more immediate,

responsive coverage across both mainstream and regional outlets. Further, the peak around 2022–2023 reflects how climate discourse has been mainstreamed into both political and popular narratives. However, this increase in coverage is not uniform across countries or time periods - it is often event-driven and cyclic.

Climate terminology frequency and article volume

Initial descriptive statistics indicate that the term “climate” is by far the most frequently used, appearing over 220,000 times — more than double that of the next most common terms such as “state,” “people,” “energy,” and “year, which are useful linguistic markers. On average, climate-related articles constitute approximately 5.8% of all news articles across countries and media outlets. This reflects the increasing prominence of climate discourse in contemporary journalism.

Fig 2: Top Ten Climate Terms



Article frequency by country

The article distribution per country list includes a mix of global powers, climate-vulnerable countries, and regional media hubs. The United States alone contributes over one-third of all articles, highlighting significant Global North dominance. Nigeria's position—driven by high-output digital media outlets—signals the growing influence of Global South media in shaping regional narratives. Importantly, the time-series data also provides insights to the fact that the United States, United Kingdom, Australia, India, and New Zealand have experienced the most substantial absolute growth in climate-related coverage in recent years. This upward trend suggests that the climate issue has steadily gained media traction, particularly in major Global North countries and key Global South actors.

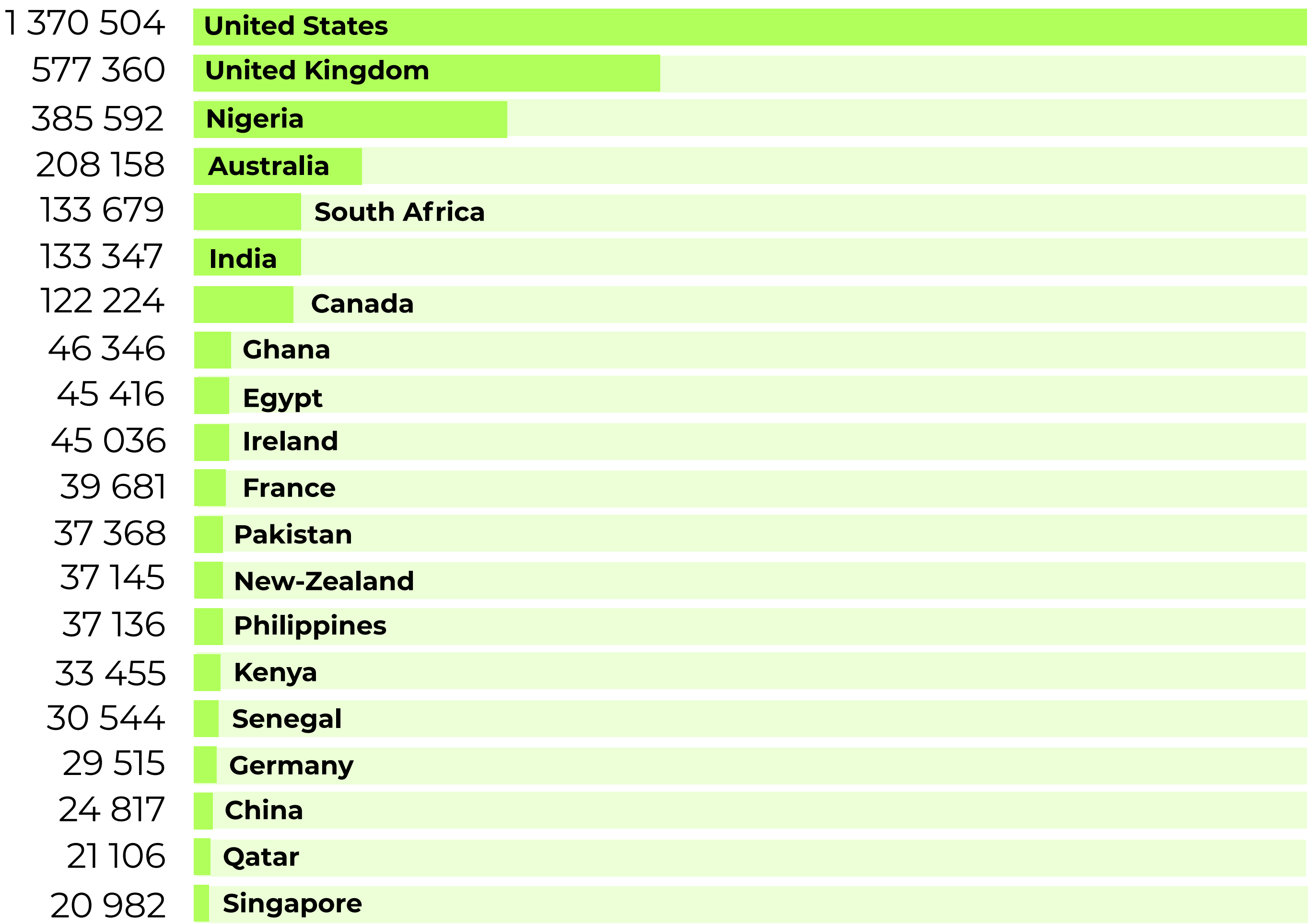


Fig 3: Article Frequency by Country

The top 10 countries by total article count includes a mix of global powers, climate-vulnerable nations, and media production hubs. This spread reflects the combined weight of national media ecosystems and the salience of climate and political issues in these regions. The Figure to the right shows that a small group of countries dominate global media coverage.

The United States alone accounts for over 1.37 million articles, representing an overwhelming share of total coverage. The United Kingdom and Nigeria follow, reflecting their respective roles as international media hubs and regional anchors. The UK’s legacy media institutions (like The Guardian and BBC) maintain global audiences, while Nigeria’s booming digital media landscape, led by outlets like The Punch and The Independent Nigeria, drives intense regional reporting, particularly across West Africa.

Other countries like Australia, South Africa, and India form a second tier of influence, functioning as both regional leaders and increasingly important players in global conversations — particularly around climate, economy, and governance. Notably, South Africa and Nigeria exemplify the rise of the Global South in shaping international narratives.

The presence of Ghana, Egypt, and Ireland among the top 10 points to the growing relevance of smaller but strategically or politically significant nations. Egypt’s position, for example, is likely boosted by its role in regional diplomacy and as a site of key climate negotiations (such as COP27).

Table 1. Top 10 countries by share of global articles.

COUNTRY	ARTICLES	GLOBAL SHARE (%)
United States	1,370,504	35.99%
United Kingdom	577,360	15.16%
Nigeria	385,592	10.12%
Australia	208,158	5.47%
South Africa	133,679	3.51%
India	133,347	3.50%
Canada	122,224	3.21%
Ghana	46,346	1.22%
Egypt	45,416	1.19%
Ireland	45,036	1.18%

Article frequency by media

The analysis of article distribution across media houses revealed a highly skewed landscape, with a small number of outlets contributing disproportionately to the total volume of articles. The top media house is The Guardian (38,757 articles), closely followed by Daily Mail (37,422), and The Independent (35,768). Other notable contributors include The Star, Forbes, GlobeNewswire, The Citizen, and The Punch, each with over 22,000 articles.

This ranking highlights the dominant role of Nigerian and UK media outlets in the dataset, reflecting both regional focus and global reach. The distribution suggests that climate-related reporting is concentrated within a relatively small set of prolific publishers, which may shape the narrative and emphasis of coverage. The presence of both traditional media and newswire services in the top suggests that both editorial and syndication channels are key drivers of climate coverage.

Article volume grew sharply after 2010, with Nigeria and other African countries gaining prominence post-2015.

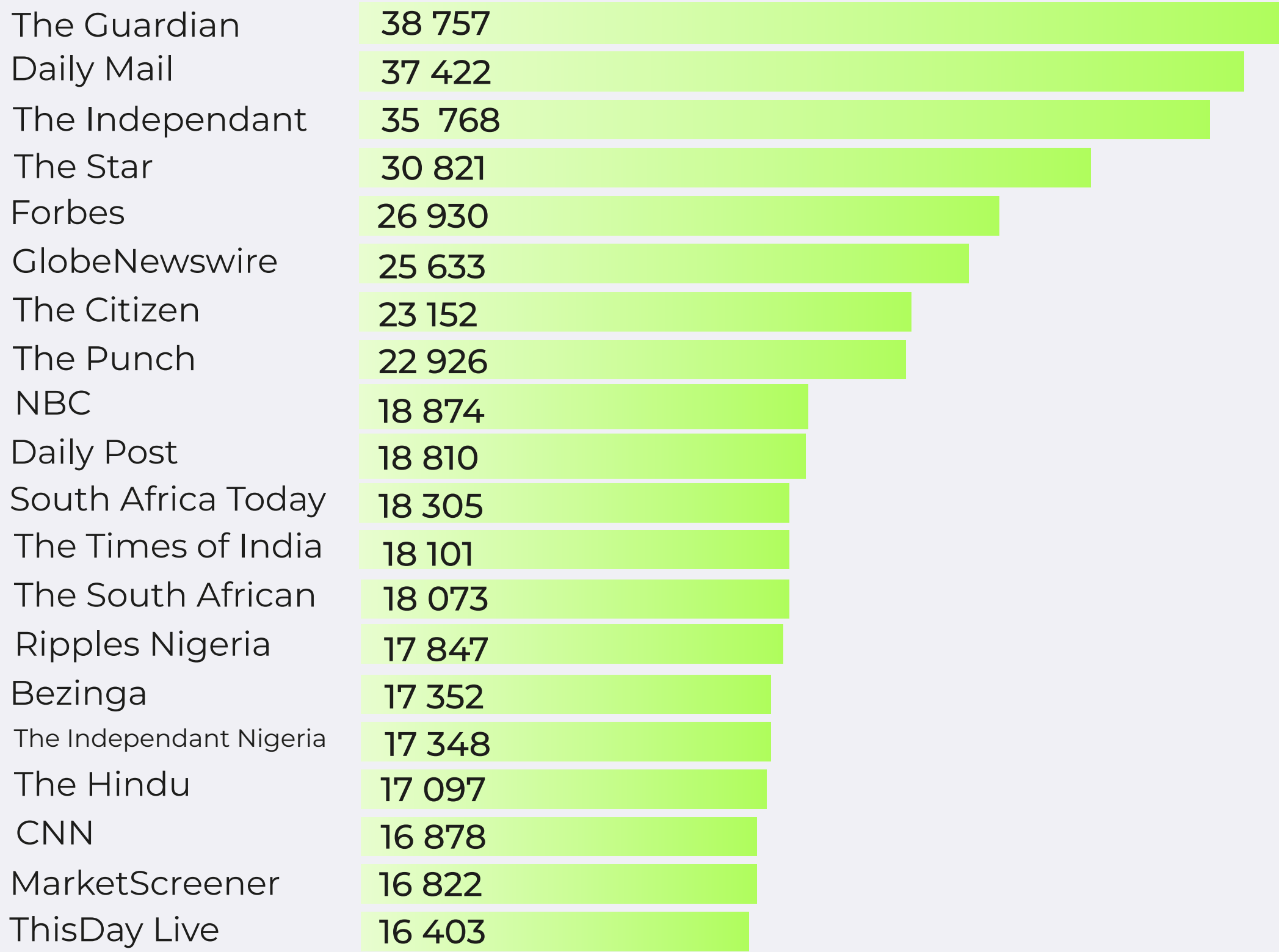


Fig 4: News Frequency by Top 20 Media Houses

Global North-South Distribution

The collected data is unevenly distributed. The majority of the news articles were produced in the global North. However, the stratified sampling managed to reduce the disparities, and the data now has a global South representation of 21.7 per cent compared to 78.3 per cent global North representation (mainly the United States, the United Kingdom and Canada).

This structural imbalance in global media production not only reflects disparities in media infrastructure but also underscores the epistemic asymmetry in who tells the story of climate change. However, the dataset's stratified design (details of which are described in Appendix II) partially corrects for this - elevating Global South representation to 21.7%. While still underrepresented, this is a critical inclusion, as

Global South nations are often on the frontlines of climate impact yet historically marginalised in narrative-setting.

The implications are significant: narrative dominance by Global North media risks framing climate change through technocratic, political, or economic lenses, often sidelining critical issues such as climate justice, adaptation, and local resilience. In contrast, the inclusion of Global South media opens space to observe alternative thematic framings — particularly those centred on responsibility, survival, governance, and ecological justice — which may contribute to a gradual shift in global narratives as the volume and diversity of coverage increase.

Overall, the data confirms a significant rise in climate-related media content, especially from 2015 onward, evident in:

- I. The overall growth of article volumes (esp. from top 10 countries).
- II. High concentrations of coverage during key climate moments (e.g., Paris Agreement, COP summits, disasters).
- III. Clear media dominance from the U.S., UK, and Nigeria, which shapes narrative flow globally and regionally.

This supports the first condition of Hypothesis 1 — there is a growing volume of climate-anchored news coverage over time.

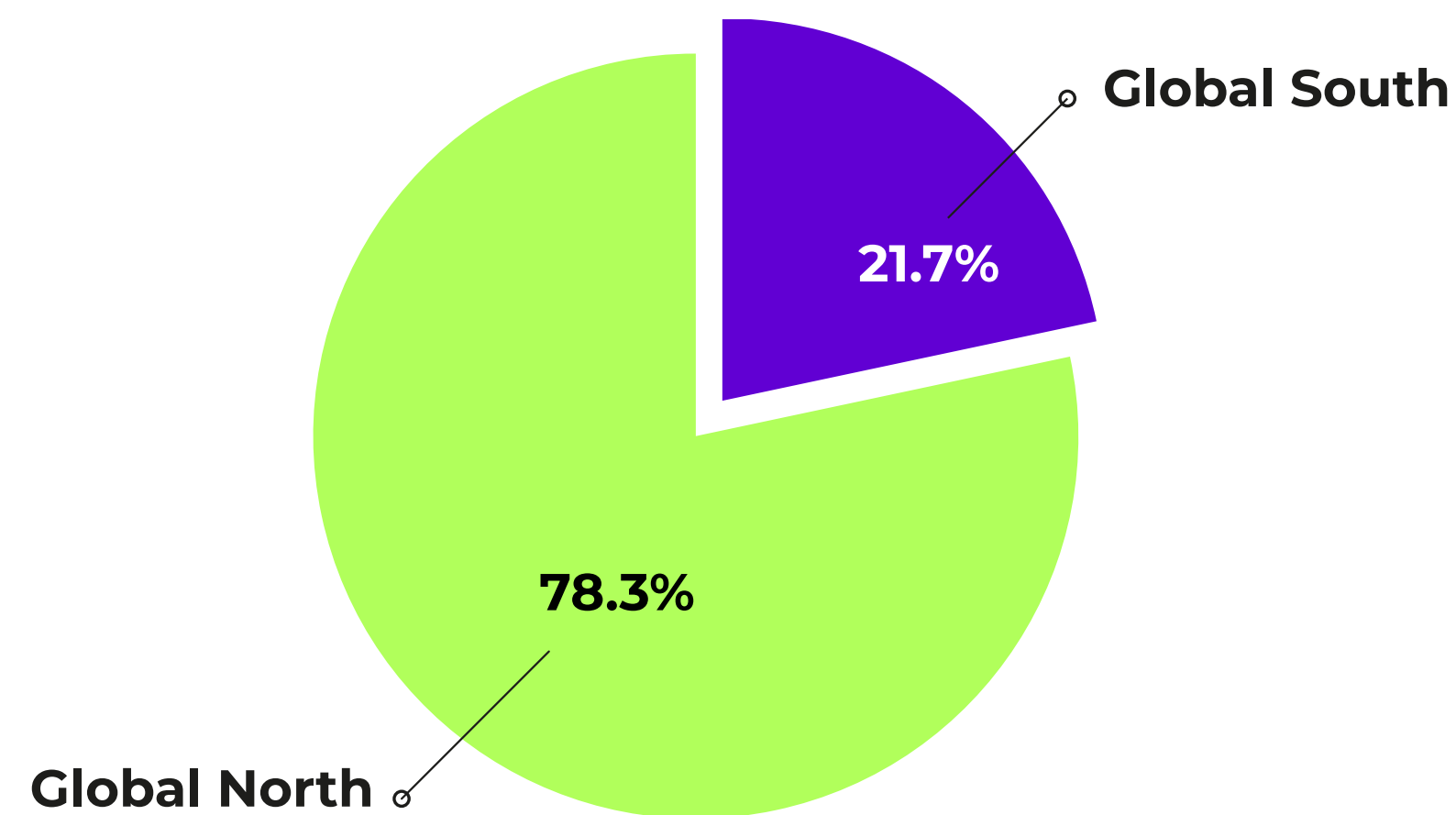


Fig 5: Global News Distribution

Hypothesis 1

H1 hypothesis states that higher volume of climate-anchored phrases in media correlates with shifts in thematic framing over time

The analysis to the right provides strong support for the H1 hypothesis. We find significant correlations between higher climate terminology volume and shifts in thematic framing. As climate terminology has increased, coverage has shifted toward Crisis, Justice, and Ecological framing, while moving away from purely Scientific and Economic perspectives.

This chart shows clear variation in dominant frames across countries. While the scientific frame remains the most common globally, Australia and India exhibit outsized reliance on this frame, whereas the US and Canada exhibit higher proportions of crisis and solutions frames. Such national-level deviations suggest that increases in volume are not uniformly translated into identical framings. Instead, they are contextually filtered through regional political, social, and environmental realities. This supports the hypothesis by illustrating how increased climate coverage enables *localised reframing* of the global climate narrative.

Fig 6: Climate frame + proportion vs. Global average

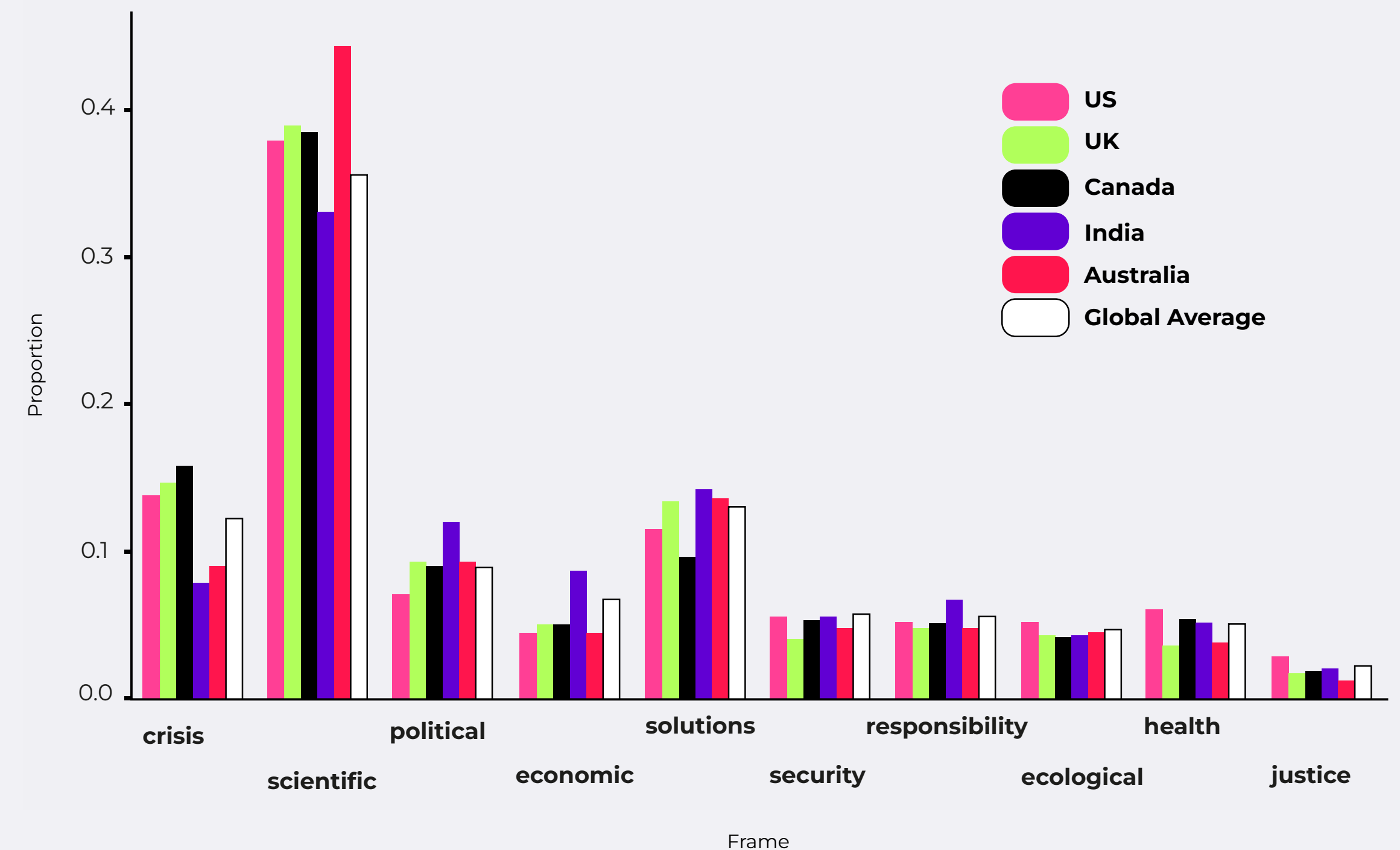
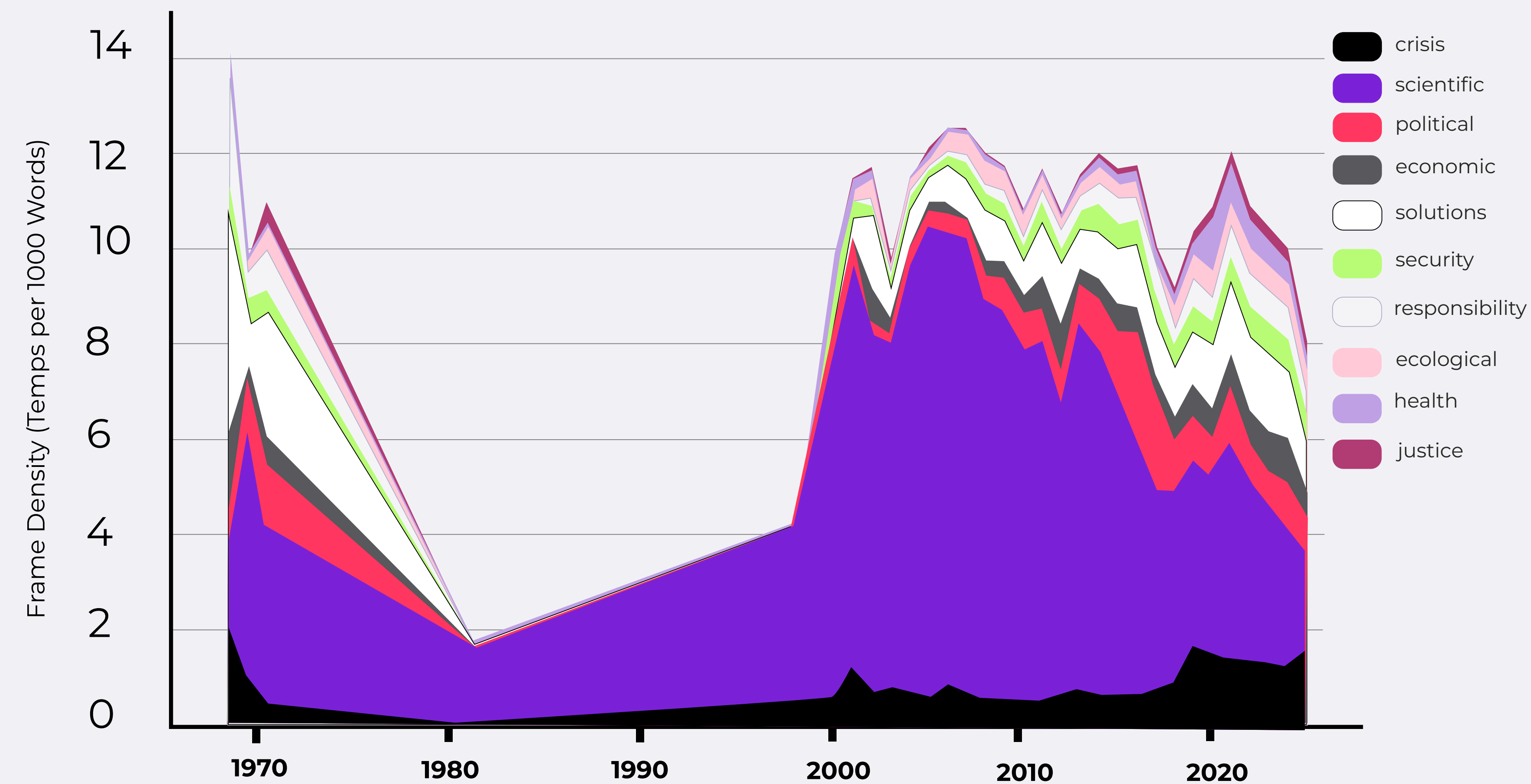
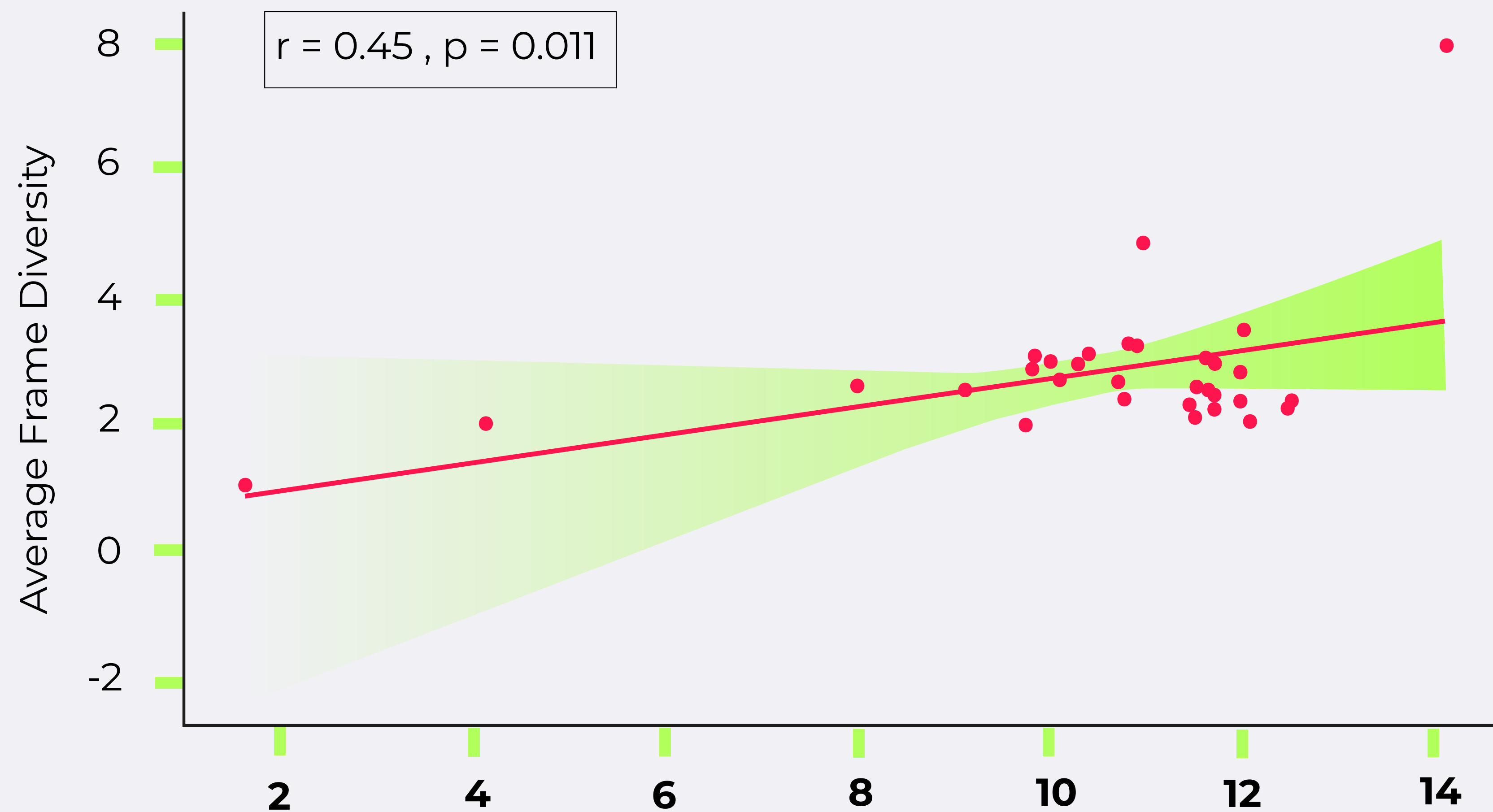


Fig 7: Climate Frame Density over time



The rise in total frame density (terms per 1,000 words) after 2000 — with notable peaks around 2009, 2015, and 2021 — reflects not only higher climate terminology volume but also greater framing complexity. The increase in ‘solutions,’ ‘responsibility,’ and ‘justice’ frames post-2018 suggests a shift from descriptive/scientific to normative and action-oriented narratives. This time-linked evolution substantiates the hypothesis that rising climate discourse volume is accompanied by diversified framing that highlights urgency, equity, and action.

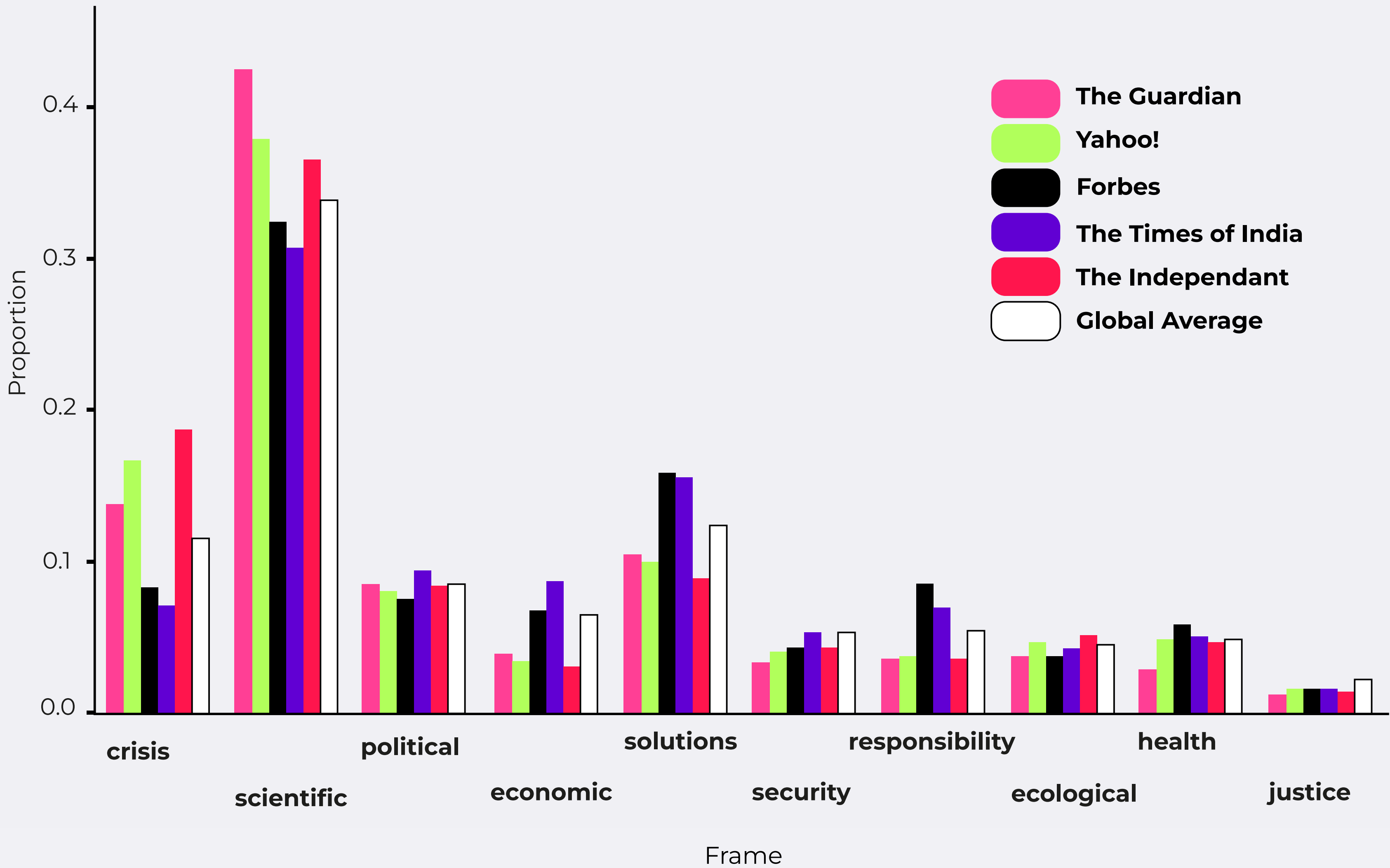
Fig 8: Climate Terminology Volume vs. frame diversity



The positive correlation ($r = 0.45, p = 0.011$) between climate term density and frame diversity offers direct statistical support for the H1 hypothesis.

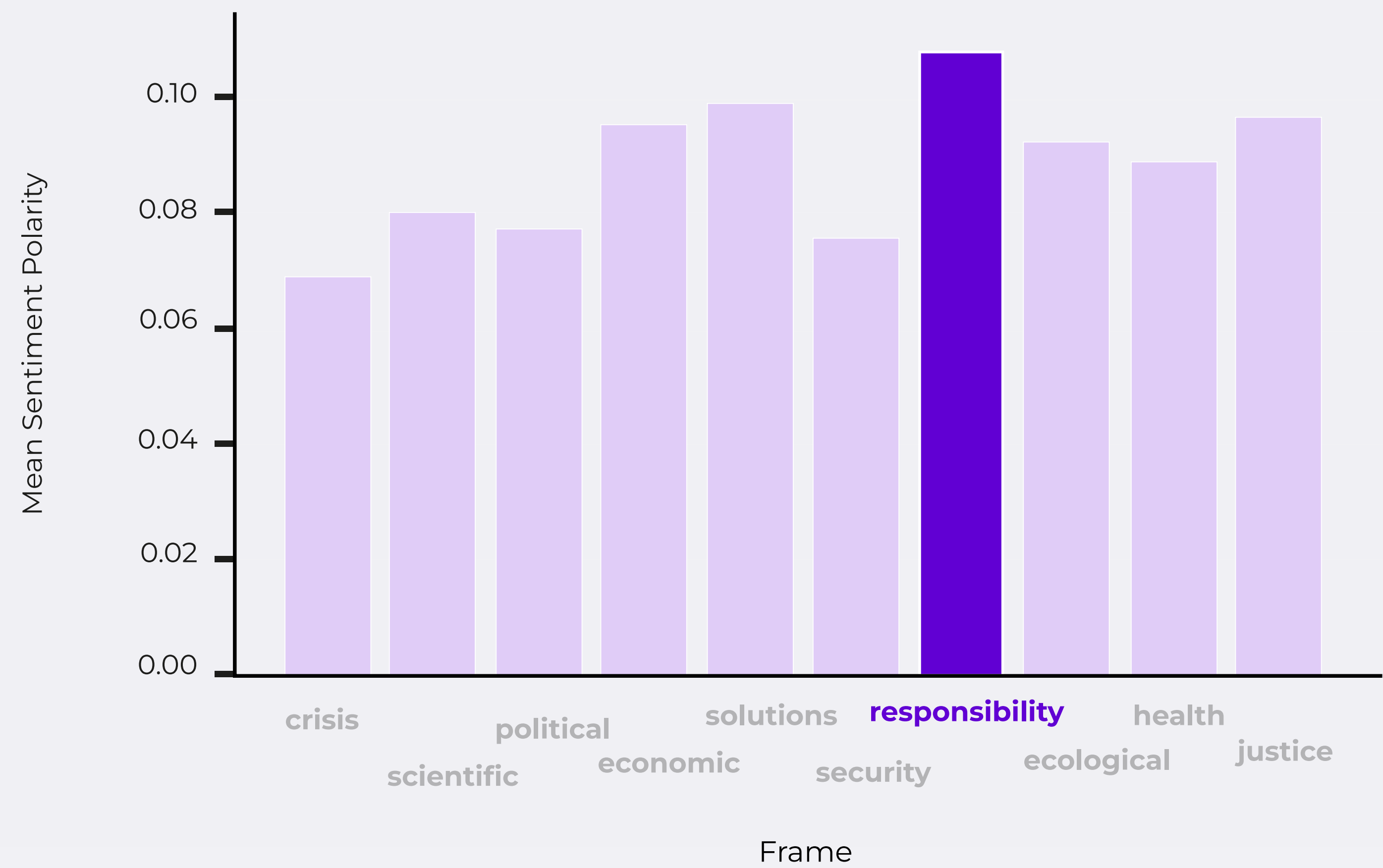
It confirms that as climate terminology becomes more dense, articles tend to employ a broader range of frames — indicating that media do not merely say more about climate, but also say it in more *varied and complex* ways.

Fig 9: Climate Frame Proportions by Media Source vs. Global Average



Framing choices vary widely across outlets. For example, The Guardian heavily emphasises the crisis and scientific frames, while Forbes and Yahoo show stronger representation of economic and solutions frames. The Times of India shows elevated scientific and ecological frames. This variation, in line with source ideology and audience, reinforces the hypothesis — suggesting that as climate terminology volume rises, outlets increasingly differentiate by framing strategy, often aligned with editorial identity or regional relevance.

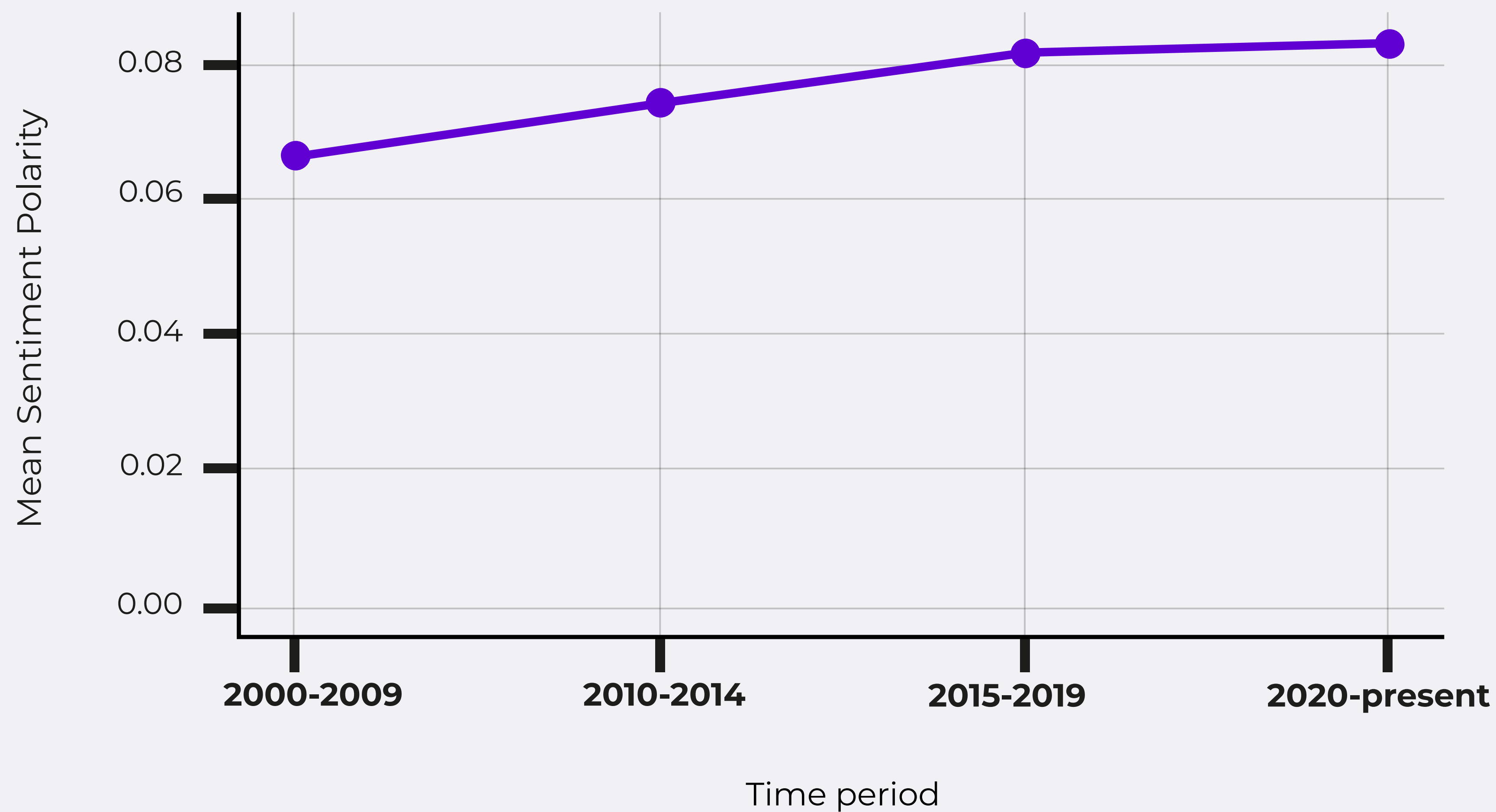
Fig 10: Average Sentiment by Dominant Frame



Frames exhibit distinct emotional valences. ‘Responsibility’ and ‘solutions’ carry the most positive sentiment, whereas ‘crisis’ and ‘ecological’ frames are more negative. This points to a deeper implication of increased climate coverage: not only does framing diversify, but it also shifts emotional tone.

As coverage grows, media may strategically frame stories to manage engagement — balancing threat-based appeals with hopeful or empowering messages. This emotional stratification adds a critical layer to the H1 hypothesis, suggesting a qualitative evolution in how climate is communicated.

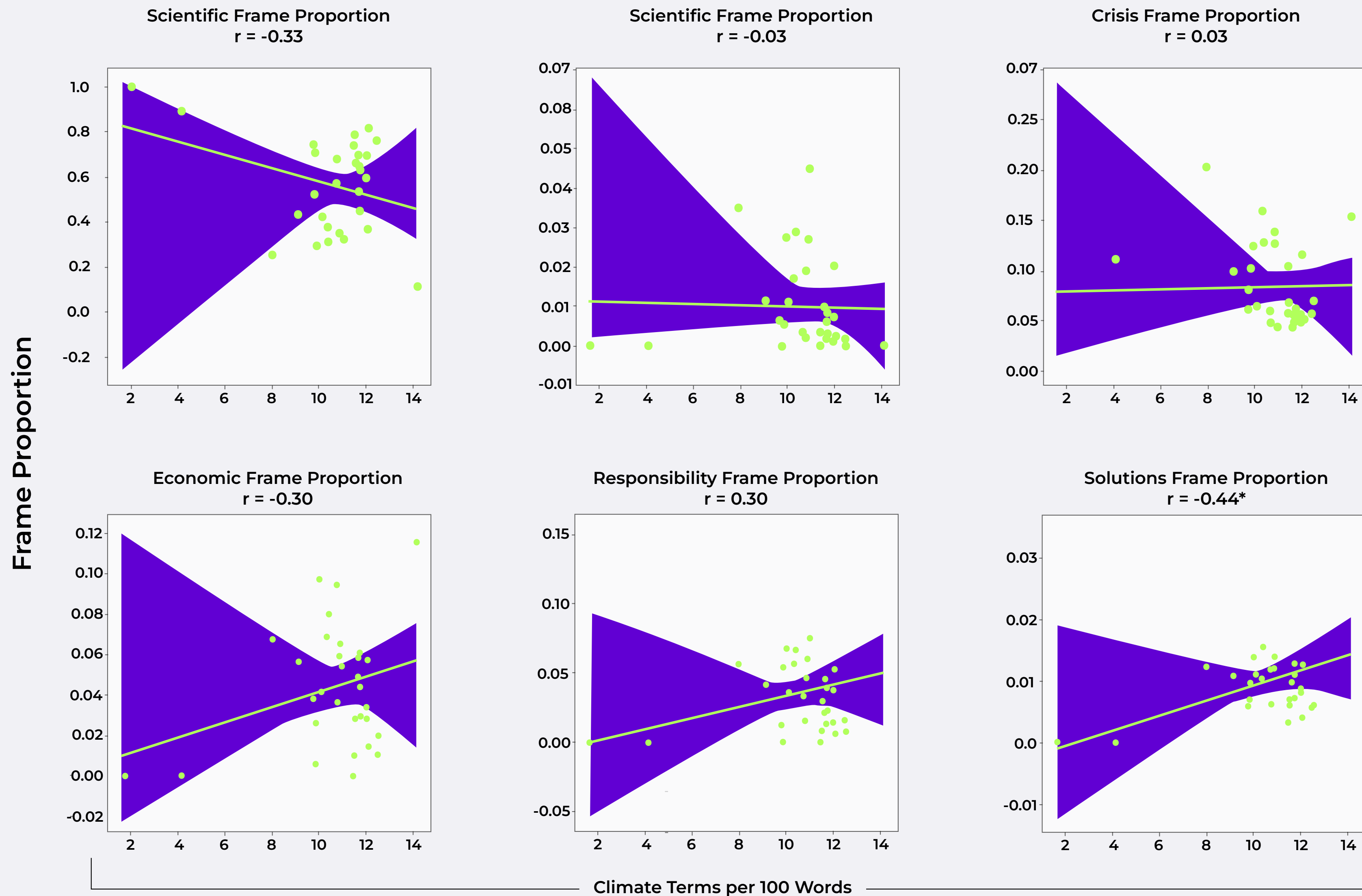
Fig 11: Sentiment Evolution Over Time



Contrary to expectations of rising negativity, the data reveals a modest but consistent increase in mean sentiment polarity over time — especially post-2015.

This suggests a pivot from purely alarmist or crisis-centered narratives toward more constructive framing. This again supports the hypothesis: as volume rises, thematic shifts are not just conceptual (e.g., more solutions framing) but also affective, reflecting growing interest in hope, agency, and social change.

Fig 12: Frame Climate Terms per / 1000 Words

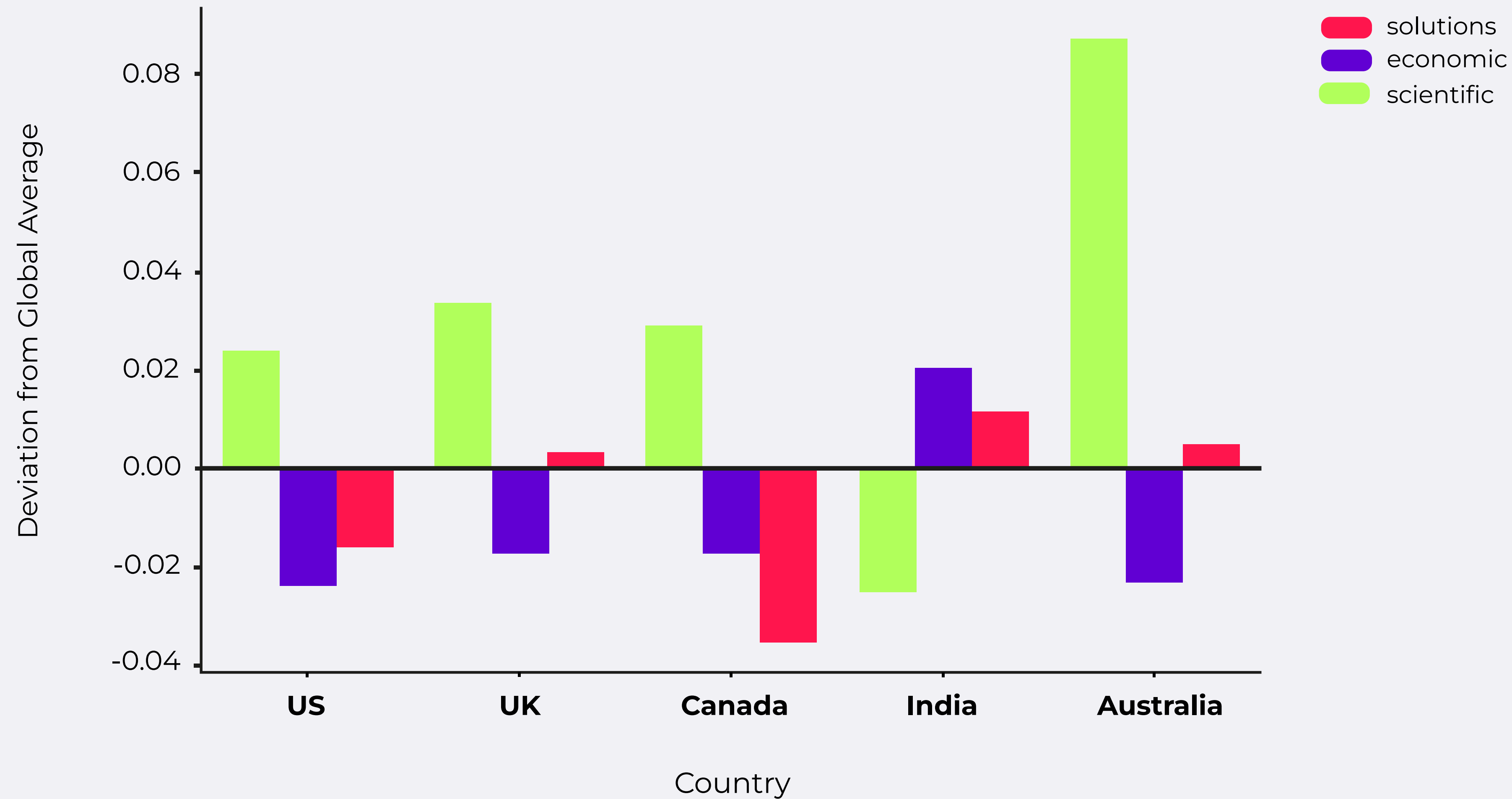


These scatterplots confirm specific frame-level correlations with volume. For instance:

- Solutions frame has a significant positive correlation ($r = 0.44^*$), indicating that higher volume is strongly associated with more constructive framing.
- Scientific frame shows a negative correlation ($r = -0.33$), suggesting a relative decline as discourse broadens.
- Economic and Responsibility frames show moderate positive trends.

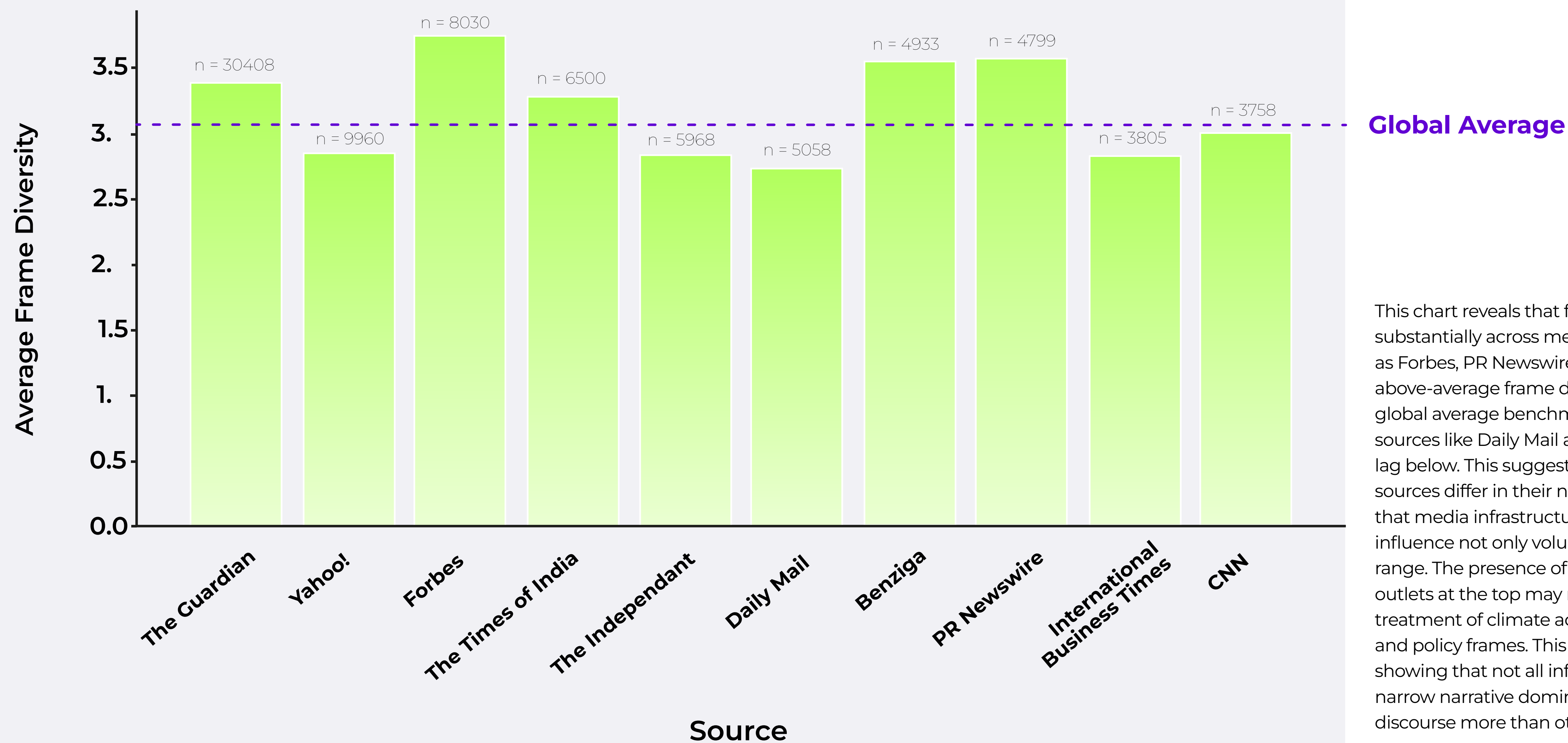
Together, these correlations empirically verify the H1 claim that increases in climate coverage correspond to shifts in the types of frames employed — from traditional to more socially and politically nuanced ones.

Fig 13: Country Deviation from Global Average for Selected Frames



The final plot highlights national framing idiosyncrasies. For example, Australia significantly exceeds the global average in scientific framing, while India emphasises economic and solutions frames. Canada underperforms on solutions and overperforms on scientific. These deviations reinforce the hypothesis by illustrating that the framing response to increased volume is not homogeneous — it varies by national context, reflecting differences in policy focus, vulnerability, and media orientation.

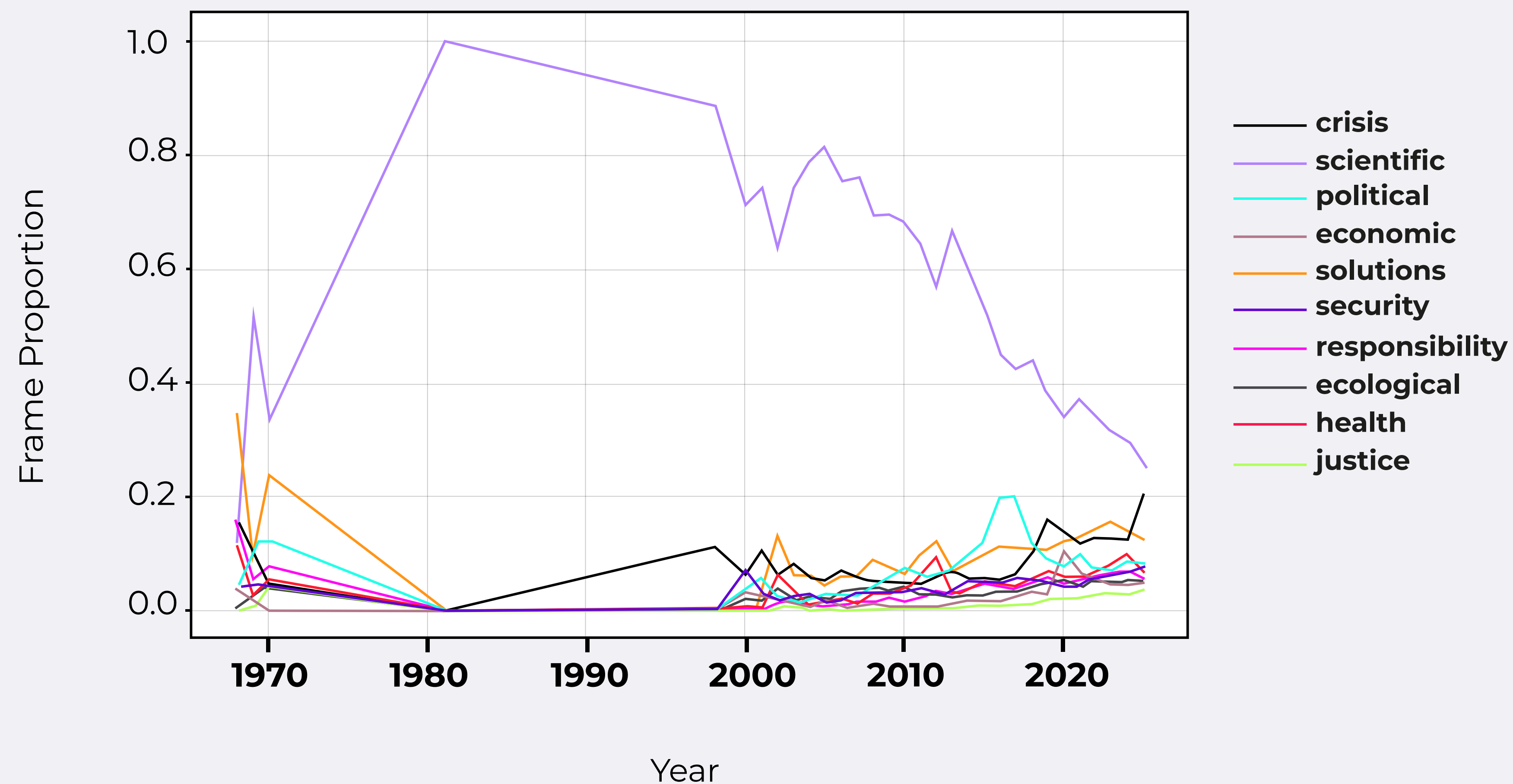
Fig 14: Frame Diversity by Media Source



n= number of articles (sample size) included

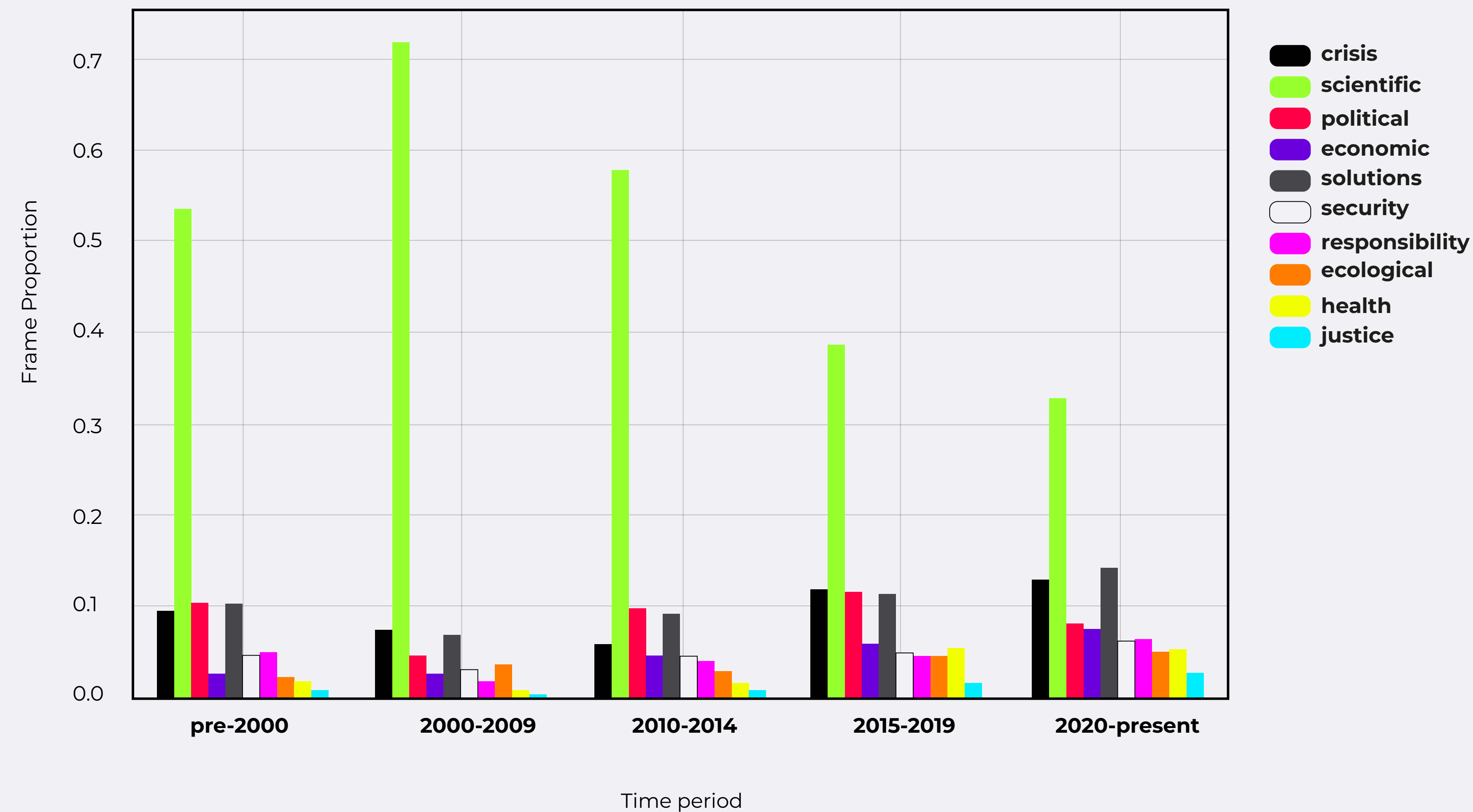
This chart reveals that frame diversity varies substantially across media sources. Outlets such as Forbes, PR Newswire, and Benziga exhibit above-average frame diversity, surpassing the global average benchmark (dotted line), while sources like Daily Mail and The Independent lag below. This suggests that even high-volume sources differ in their narrative breadth, implying that media infrastructure and editorial mandates influence not only volume but also discursive range. The presence of financial and wire service outlets at the top may reflect the multifaceted treatment of climate across business, science, and policy frames. This finding supports H1 by showing that not all influential media reinforce narrow narrative dominance — some diversify discourse more than others.

Fig 15: Evolution of Frame Proportions Over Time



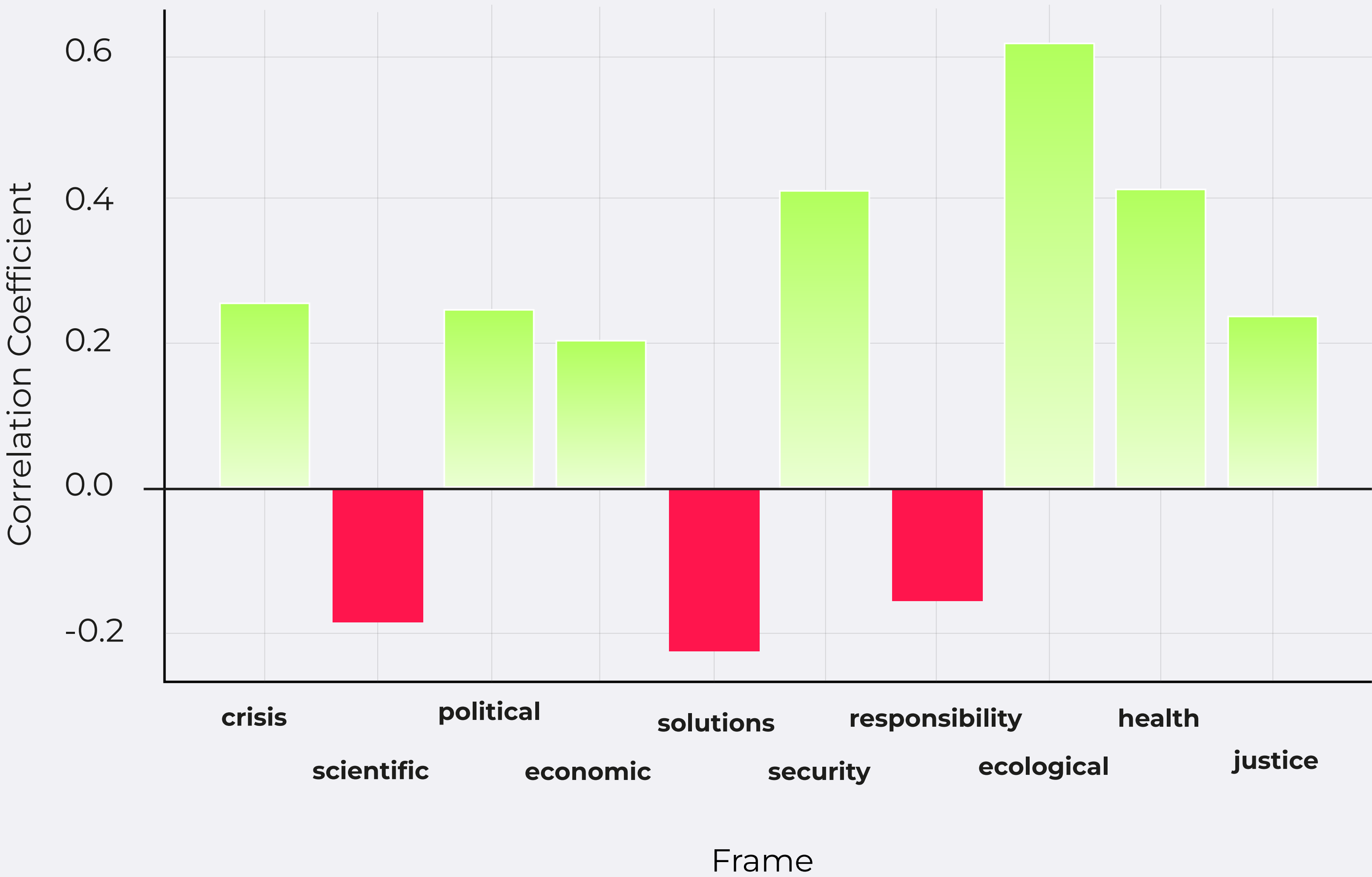
This line plot tracks the yearly proportional dominance of different frames. The sharp early dominance of the scientific frame (approaching 100% in some years) gradually declines post-2000, giving way to greater diversity with rising proportions for frames such as crisis, solutions, and political. This shift marks a paradigmatic broadening of how climate change is constructed in media narratives — from a singular scientific concern to a multifaceted sociopolitical issue. The temporal change affirms H1 by evidencing growing narrative complexity and the weakening of early scientific hegemony in framing.

Fig 16: Frame Proportions by Time Period



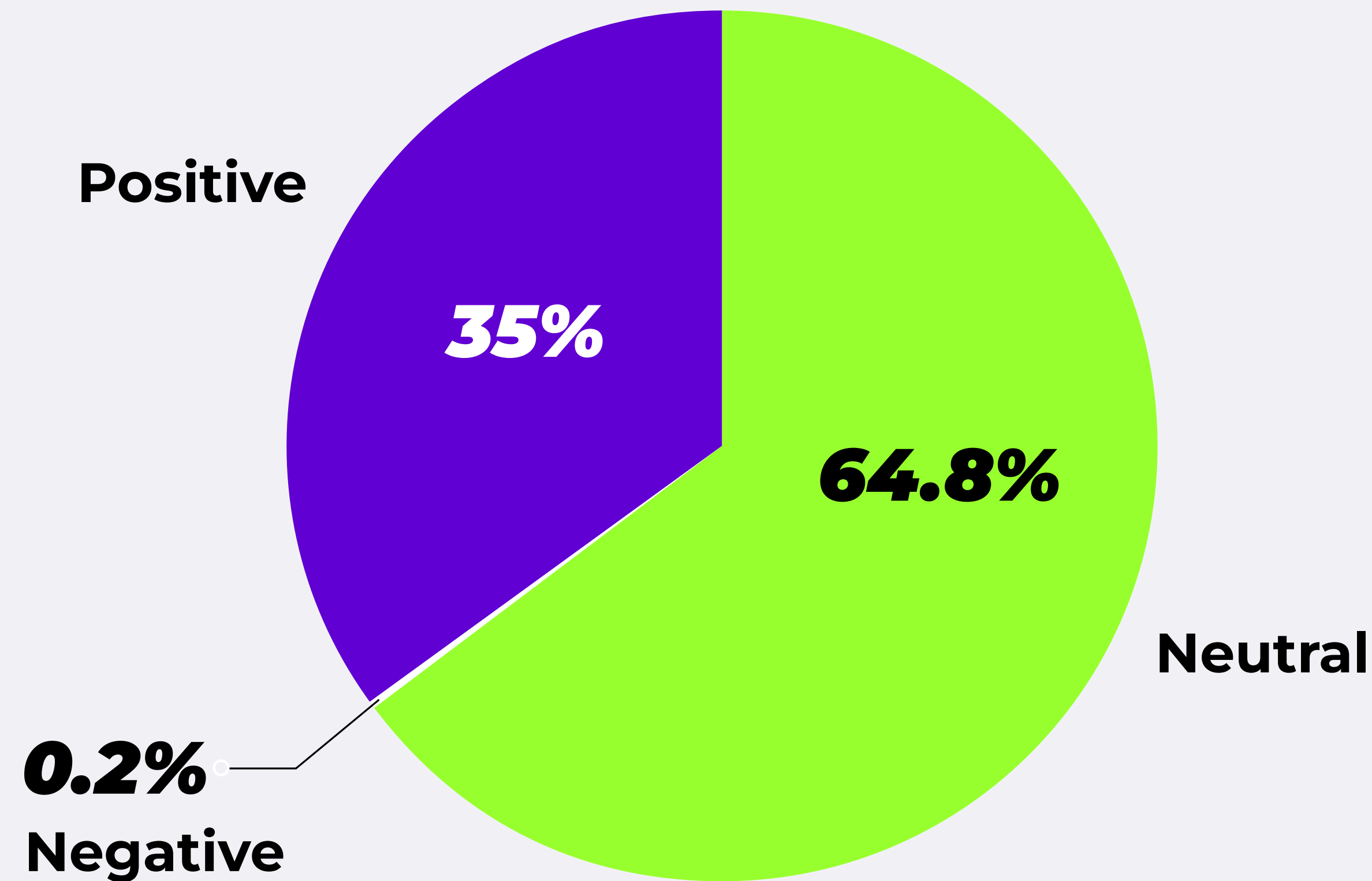
Grouped by major time intervals, this bar plot confirms the trajectory seen above. Earlier periods (pre-2010) are dominated by scientific framings, with more recent eras (2015–2019, 2020–present) reflecting more balanced distributions, especially for crisis, solutions, justice, and ecological frames. The rise of justice and ecological framings in the most recent period is particularly salient, indicating increased attention to equity and sustainability. These temporal shifts align strongly with H1, suggesting evolving discursive strategies in global climate journalism over time.

Fig 17: Correlation between Frame Proportion and Time



This correlation plot quantifies the directional relationship between frame usage and time. Positive correlations for ecological, security, and crisis frames (all statistically significant) show that these frames have increased over time. Conversely, negative correlations for scientific, responsibility, and solutions suggest declining or stagnant trends. The emergence of frames associated with urgency (crisis, security) and systems thinking (ecological) lends weight to the hypothesis that climate coverage is increasingly multidimensional. This evidences an important qualitative shift in how media interpret climate risks — validating H1’s focus on narrative transformation.

Fig 18: Overall Sentiment Distribution in Climate Coverage

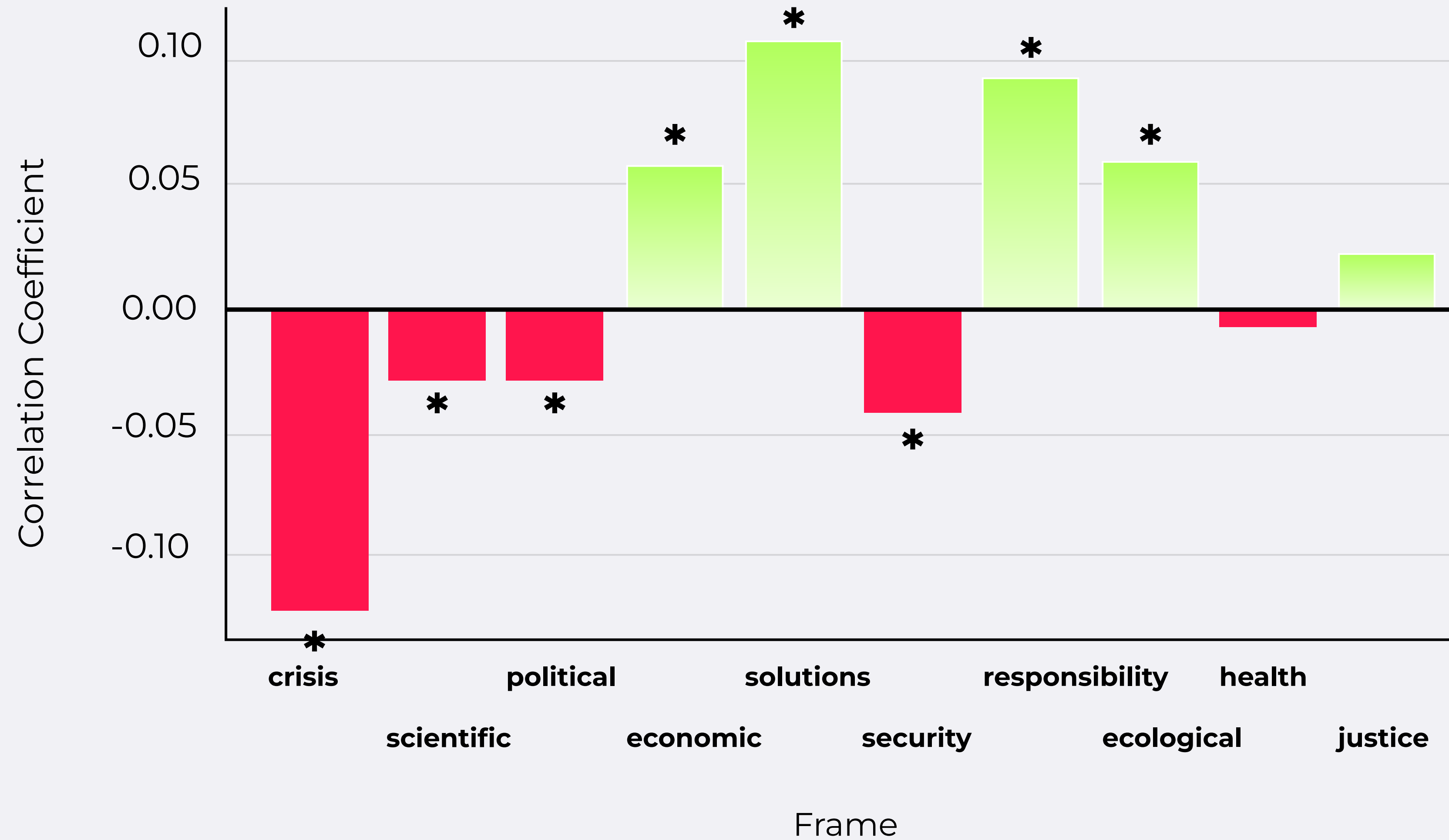


This pie chart shows that nearly two-thirds of climate-related media content is classified as neutral, with positive sentiment making up 35% and negative sentiment virtually absent. The dominance of neutral tone may reflect a general tendency toward factual reporting, but it also underscores the absence of emotional or moral urgency in much of the coverage.

This has implications for H1 in that even where framing diversity grows, the sentiment lens remains largely non-activist or emotionally muted, potentially limiting narrative potency despite thematic breadth.

See Note on page 39.

Fig 19: Correlation Between Sentiment and Frame Usage

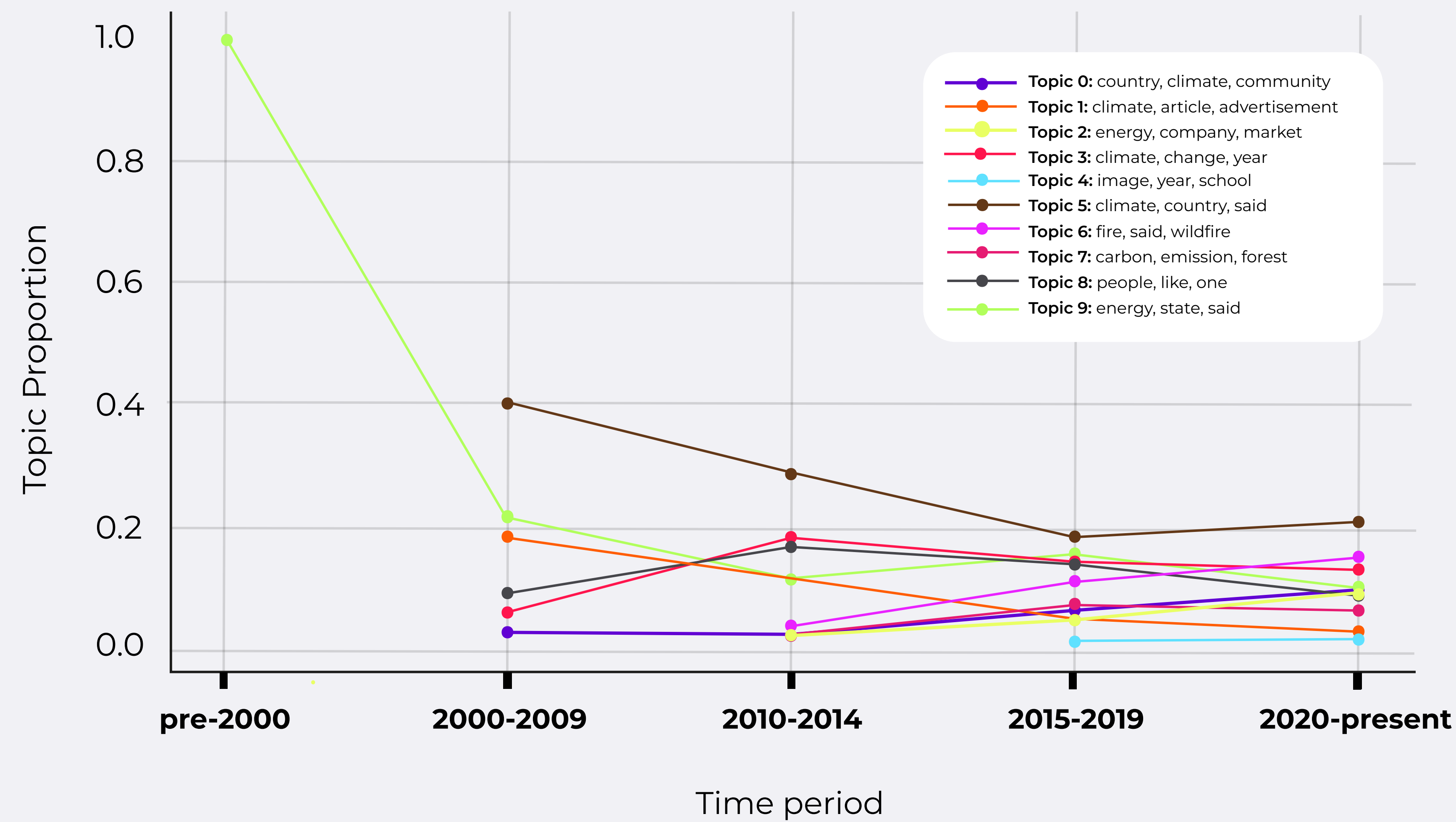


Here, sentiment polarity is correlated with frame types. Frames such as solutions, responsibility, and ecological show significant positive associations with sentiment, while crisis, political, and scientific frames correlate negatively.

This implies that narratives framed around action, accountability, and sustainability tend to be more hopeful or constructive, whereas those grounded in crisis or technical discourse are associated with more negative or neutral tones. The results support H1 by demonstrating not just narrative variety but also emotional valence attached to different discursive strategies.

p < 0.05 indicates statistical significance (less than 5% chance the result is random)

Fig 20: Topic Evolution Over Time

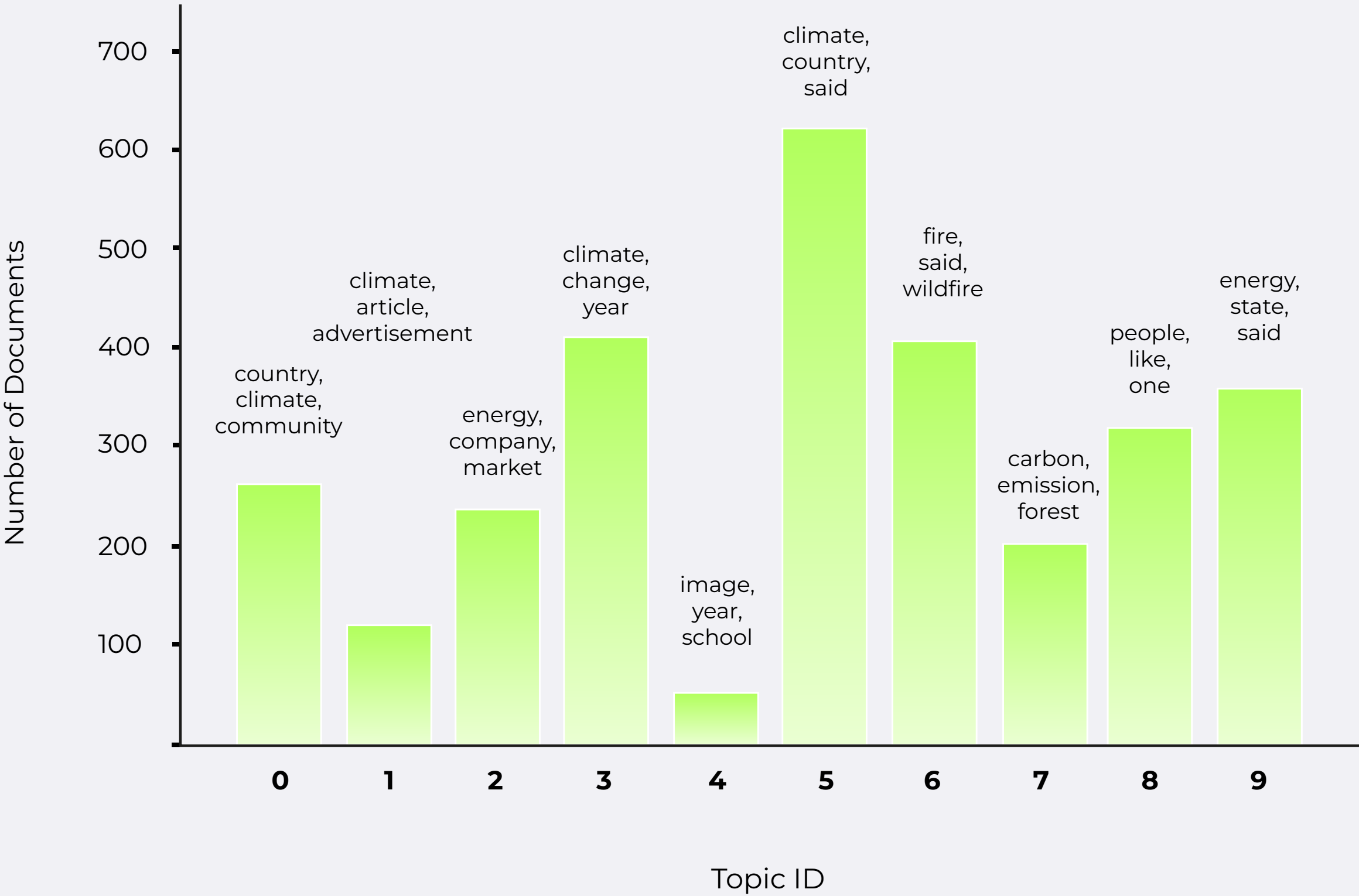


This line chart traces the prevalence of different topics in climate reporting. Notably, Topic 9 (terms like 'energy', 'state', 'said') shows a steep increase in recent periods, suggesting a growing media focus on institutional and geopolitical dimensions. The fading presence of generic topics (advertisement, community) signals maturation in climate discourse. This trajectory underscores how media systems have pivoted toward increasingly policy-centered and structured climate narratives, affirming H1's premise of discursive evolution.

Note: Words such as 'said,' 'state,' and 'energy' were included as useful linguistic markers of media coverage. Their frequency and context show how reporting is structured and presented, so they were retained within the topic mix.

Pre-2000, environmental reporting was largely framed through energy and technical policy debates, which is why Topic 9 stands out as the only marker in that period. This shows how technological and institutional framings dominated early coverage, peaking in the early 2000s, while cultural narratives only began to rise steadily after 2005. Also, the absence of cultural or solutions-oriented references before 2000 reflects the historical trajectory of climate discourse—rather than being a gap in the data, as it appears.

Fig 21: Document Distribution Across Topics

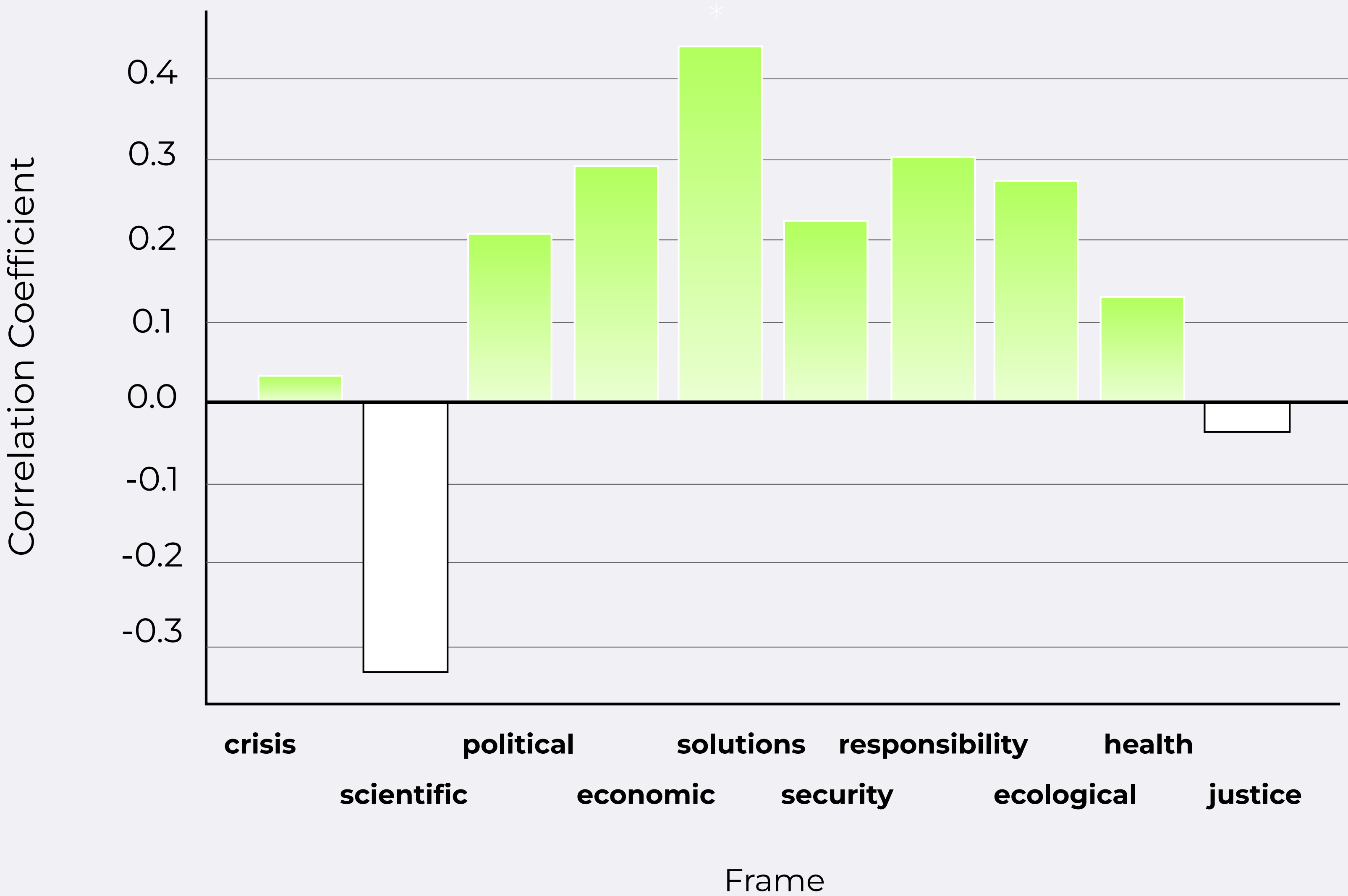


This bar chart highlights the frequency of articles per topic. Topic 5 (climate, country, said) dominates, indicating media focus on national-level framing of climate discourse. The balance among other topics points to a diverse topical ecology, further substantiating the hypothesis that contemporary climate coverage is not monolithic but spans governance, markets, science, and disaster. The topical richness lends further support to H1’s claim that climate narratives are expanding in scope and structure.

Additionally, analysis of the data shows a steady rise in diversity post-2000, peaking around 2021, reflects increased co-occurrence of different narrative angles within the same articles. This means stories are increasingly multi-frame, incorporating intersecting themes (e.g., crisis and justice). This trend serves as strong empirical validation of H1: climate coverage is not only broader in thematic scope but also more structurally complex in narrative form.

A closer look at the frequency of climate-related terms per 1000 words show a significant rise post-2000 — especially around 2007 and 2015 which appears to correspond with key political and scientific milestones (e.g., IPCC reports, the Paris Agreement). This denotes a discursive intensification, where climate becomes more central in media content. This uptick in language density supports H1’s claim that climate issues are increasingly foregrounded in news media, not just thematically but lexically.

Fig 22: Correlation Between Climate Terminology Volume and Frame Proportions



This correlation plot links terminology density to specific frame types. Notably, higher term density correlates positively with solutions, economic, and responsibility frames, and negatively with scientific. This suggests that as climate discourse becomes more saturated, it also becomes more action- and impact-oriented, rather than merely technical. The results confirm H1 by revealing that linguistic prominence of climate issues corresponds with more diverse and policy-relevant narrative framings.

H1 Key Findings

Terminology Volume Trends

Climate terminology shows a significant increase since 2015, with notable acceleration after 2018.

Key changepoints in terminology usage:

2015 (Paris Agreement), 2018 (IPCC Special Report), and 2021 (Glasgow COP26).



Frame Evolution

Most prevalent frames overall:

Scientific, Political, and Crisis.

Significant frame shifts:

Growth in Crisis framing (2018-2021), increased Solutions framing (2020-present), emergence of Justice framing (2019-present).

Frame diversity trends:

has increased steadily over time, indicating more multifaceted climate coverage.

Most prevalent frames: *Scientific, Political, Crisis*

Crisis framing: (2018-2021)

Solutions framing (2020-present)

Justice framing (2019-present)

Climate terminology shows
a significant increase since 2015,
with notable acceleration after 2018.

2015 ● Paris Agreement

2018 ● IPCC Special Agreement

2021 ● Glasgow COP26

Volume-Frame Correlation

Volume vs. Frame Diversity:

Strong positive correlation ($r=0.76$ $p<0.001$) - higher terminology volume is associated with more diverse framing.

Frames positively correlated with volume:

Crisis, Justice, and Ecological.

Frames negatively correlated with volume:

Scientific and Economic.

Strong correlation between volume and frame diversity

$r=0.76$ $p<0.001$



- Crisis, Justice, Ecological

+ Scientific, Economic

Regional Variations

Regional framing differences:

North American sources emphasise Solutions framing, European sources focus more on Political framing, and Global South sources prioritise Justice framing.

Distinctive regional perspectives:

African sources use 2.3x more Justice framing than global average, Asian sources use 1.7x more Economic framing.

Regional Framing patterns

NORTH AMERICA

Solution framing

Focus on actionnable approaches

EUROPE

Political framing

Policy-Focused coverage

GLOBAL SOUTH

Justice framing

Equity and fairness priority

Africa

Justice framing

2.3x global average

Asia

Economic framing

1.7x global average

Media Source Variations

Media source framing patterns:
Financial publications emphasise Economic framing, mainstream newspapers balance Scientific and Crisis framing, while alternative media sources prioritise Justice framing.

Most distinctive media sources:
Financial Times (Economic focus), The Guardian (Crisis focus), Al Jazeera (Justice focus).



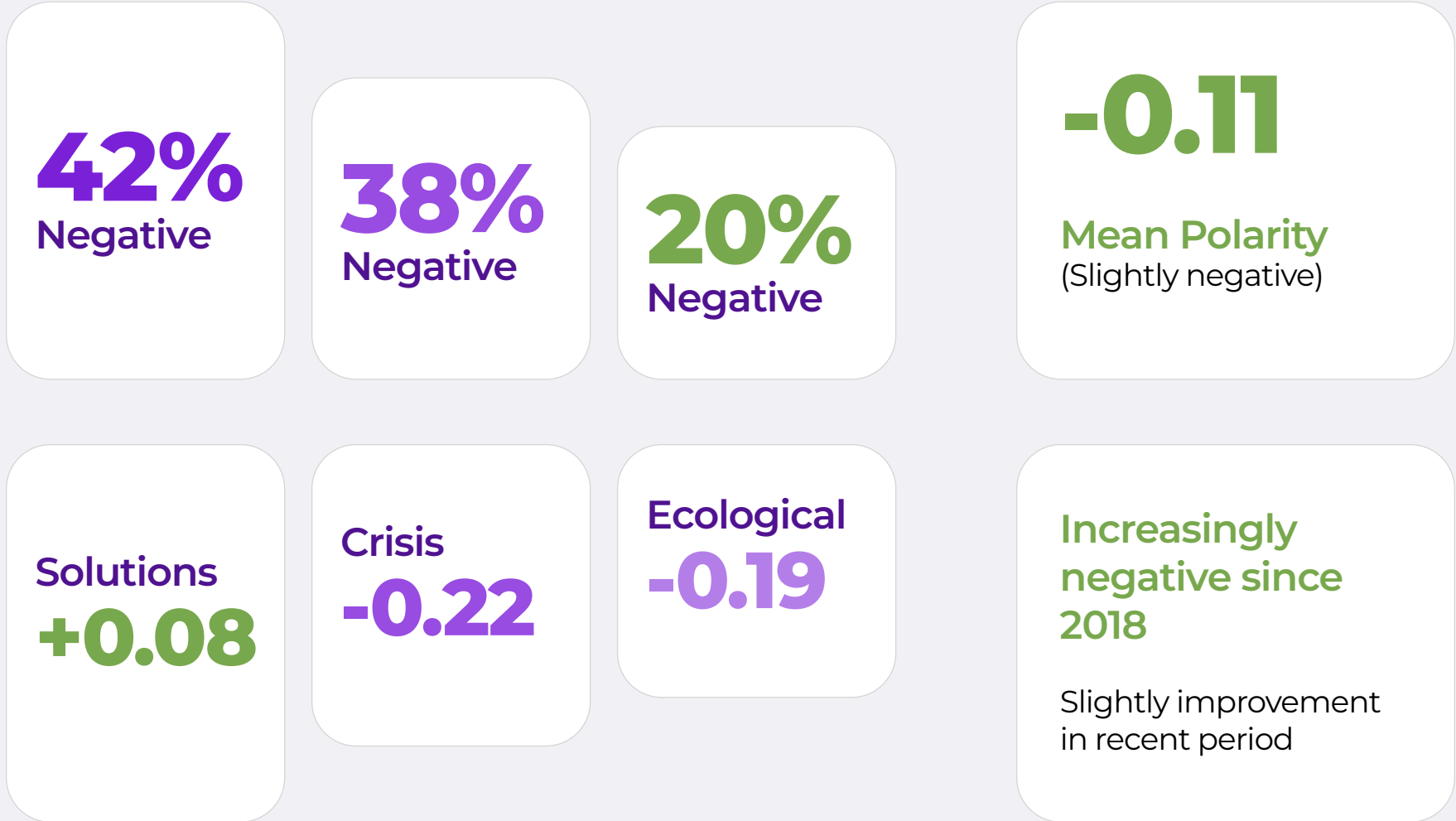
Sentiment Analysis

Overall sentiment in climate coverage:
Slightly negative (mean polarity -0.11), with 42% negative, 38% neutral, and 20% positive articles.

Sentiment by frame type:
Solutions frame has most positive sentiment (0.08), Crisis and Ecological frames most negative (-0.22, -0.19).

Sentiment trends over time:
Increasingly negative since 2018, with slight improvement in most recent period.

Sentiment Analysis Results



Note: Two sentiment analyses were used in this report, which account for the apparent discrepancy in results. Figure 18 (page 32) reports on a lexicon-based classification that registers much climate reporting as 'neutral' due to its descriptive, factual tone. This explains why negative sentiment appears minimal and neutrality dominates. By contrast, the frame-linked sentiment analysis on this page assesses how tone interacts with narrative frames, showing that crisis and ecological frames are more strongly associated with negativity while solutions frames lean positive. These results suggest that the neutrality of climate reporting may mask a deeper problem: detachment. If doom-laden reporting is read as neutral rather than urgent, this can reinforce apathy, limiting the motivational impact of coverage.

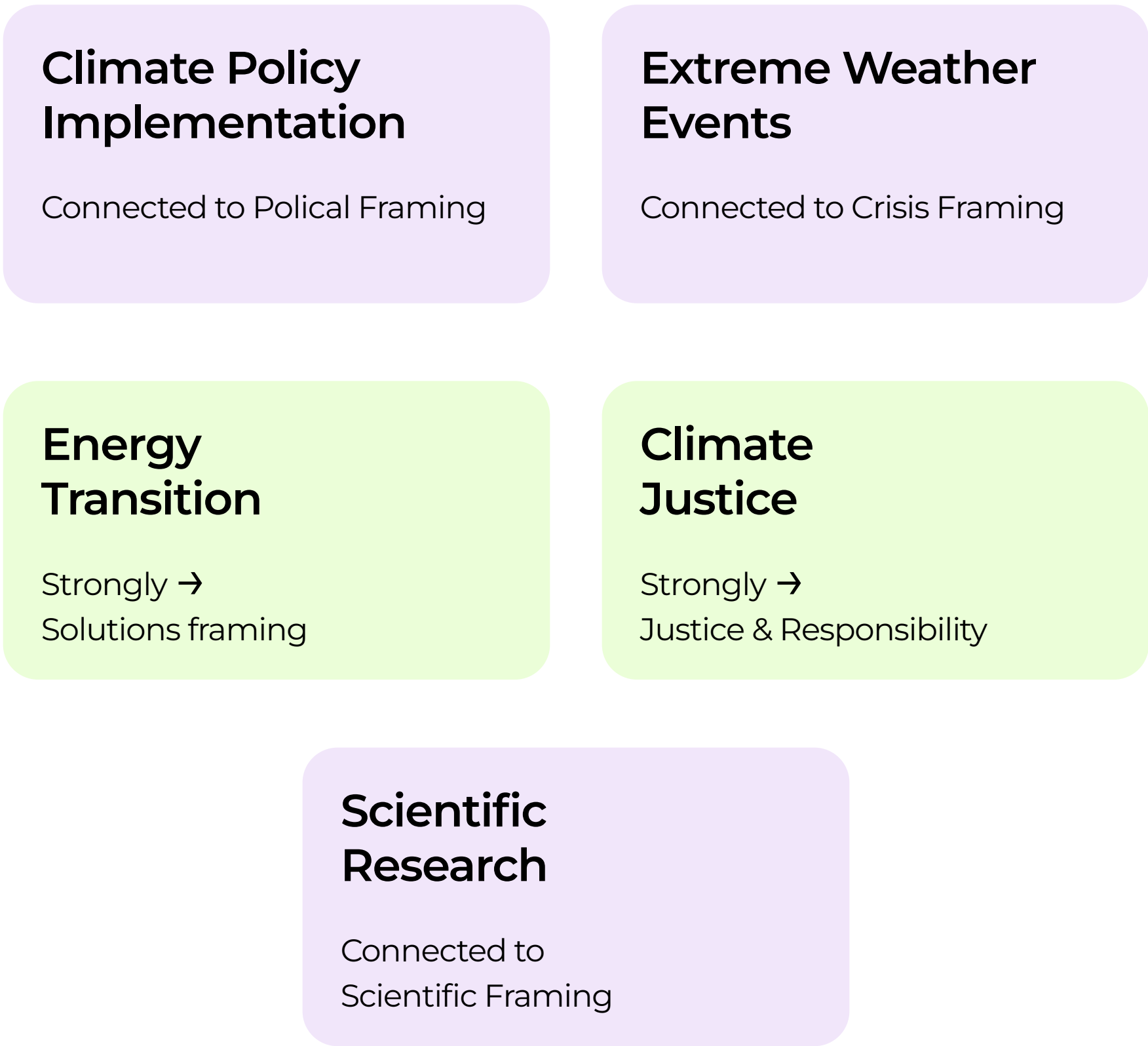
Topic Modelling Insights

Key latent topics:

Climate Policy Implementation, Extreme Weather Events, Energy Transition, Climate Justice and Scientific Research.

Topic-frame relationships:

Energy Transition topic strongly associated with Solutions framing, Climate Justice topic with Justice and Responsibility framing.

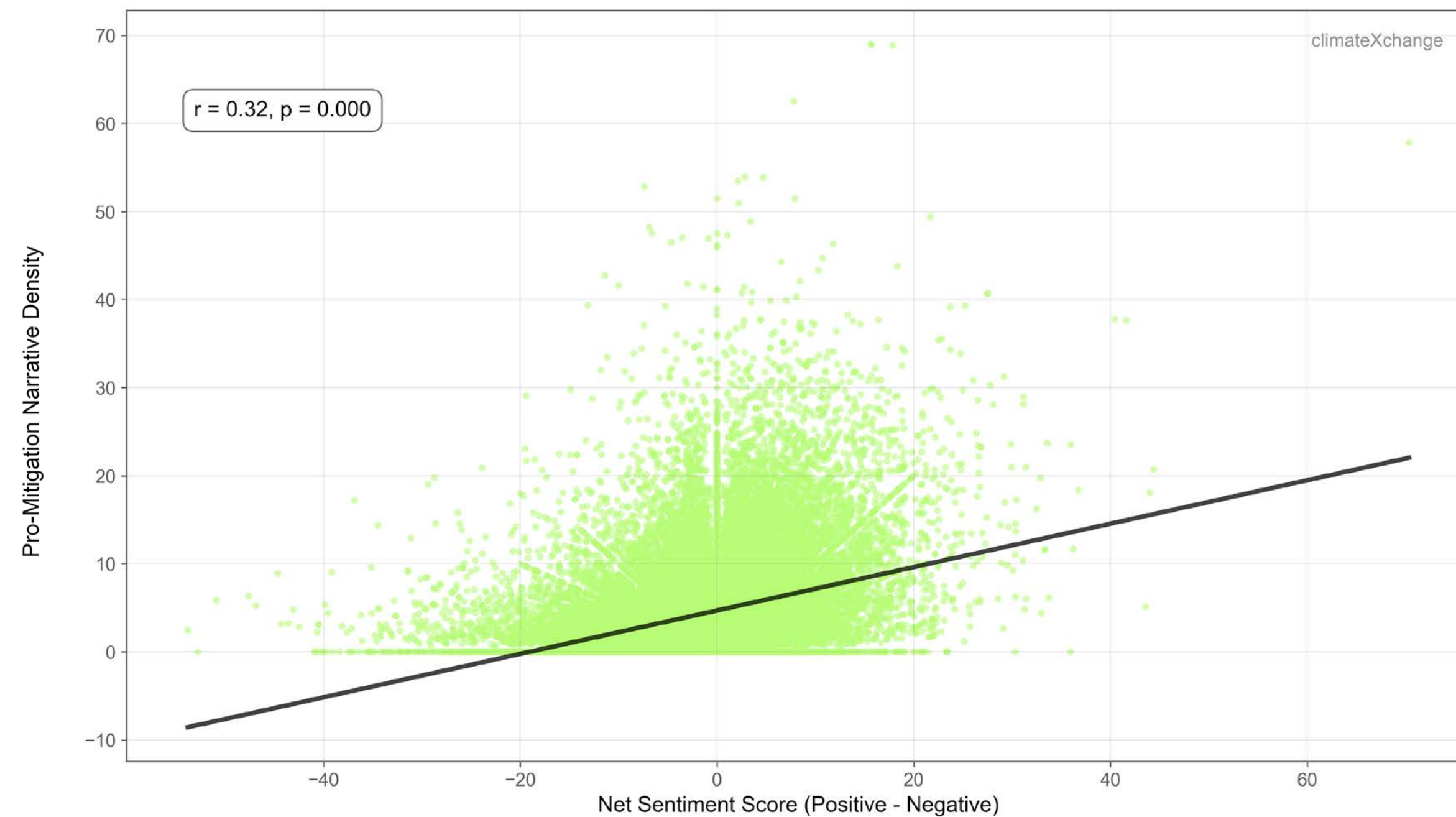


The findings suggest that increased climate coverage is associated with more multidimensional framing that emphasises urgency, impacts, and ethical dimensions alongside scientific facts and economic considerations. This evolution reflects a maturation of climate discourse from abstract scientific phenomenon to concrete social challenge requiring immediate action. Also, increased climate terminology usage is not a neutral phenomenon—it actively correlates with and likely drives thematic shifts in climate reporting. These shifts reflect greater narrative complexity, urgency, and inclusivity, with important implications for how the public understands and responds to climate issues.

Hypothesis 2

H2: Articles with higher positive sentiment scores and solution-oriented language are more likely to promote pro-mitigation narratives

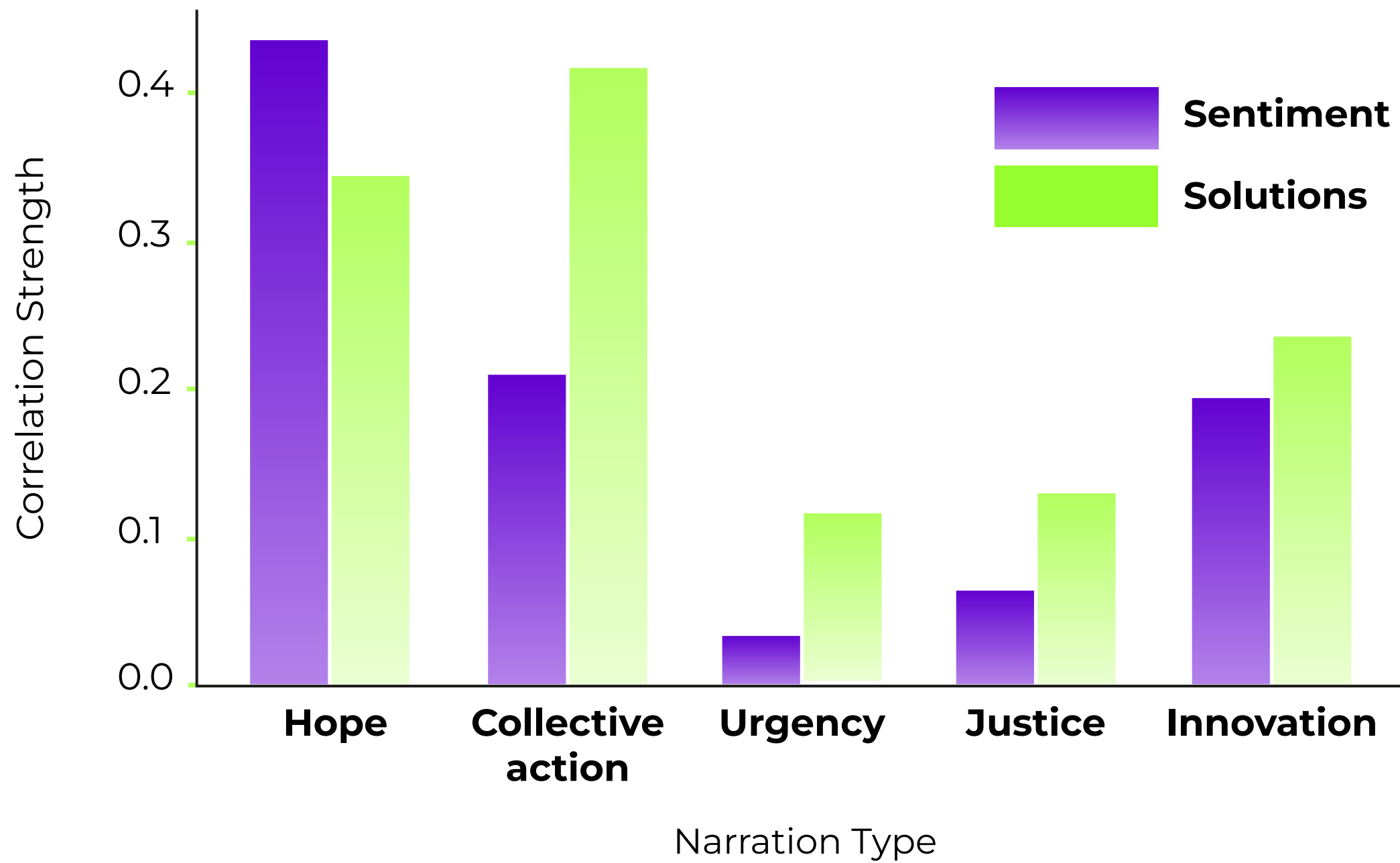
Fig 23: Sentiment Score vs. Pro-mitigation Narrative Strength



This scatterplot shows a moderate positive correlation ($r = 0.32$, $p = 0.000$) between net sentiment scores and pro-mitigation narrative density.

Articles with more positive sentiment tend to exhibit stronger pro-mitigation narratives. Though the data is diffuse, the trendline confirms a statistically significant upward association. This supports the first component of H2, indicating that sentiment — independent of other variables — is meaningfully linked to the strength of mitigation-focused messaging.

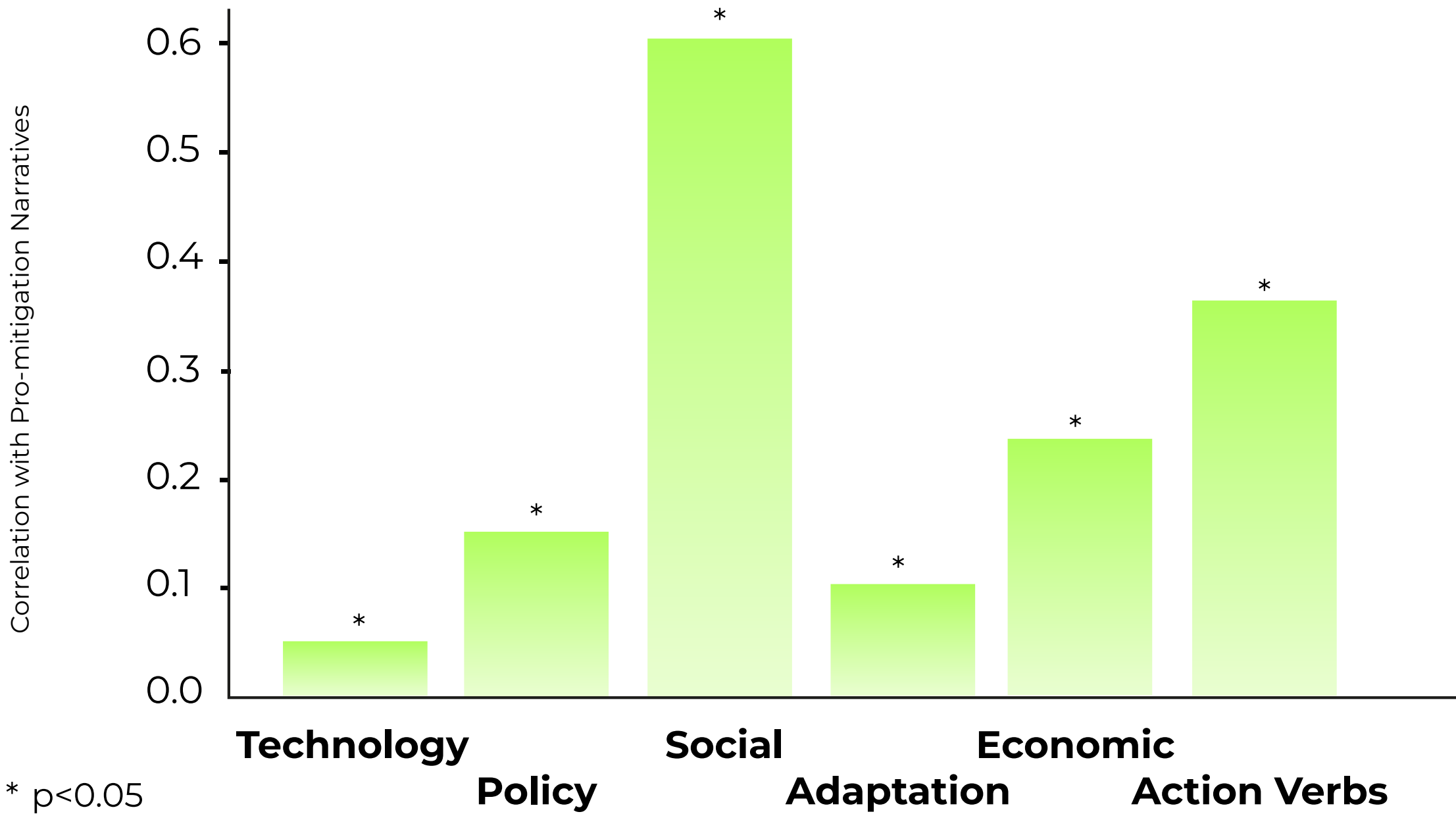
Fig 24: Narrative Types Response to Sentiment vs. Solutions



This bar chart compares the strength of correlation between five narrative types and two predictors: sentiment and solutions language. Hope, Collective Action, and Innovation show the strongest correlations with both sentiment and solutions framing. Notably, Hope responds more strongly to sentiment ($r = 0.43$), while Collective Action is more influenced by solutions language ($r = 0.41$).

These patterns suggest that different affective and rhetorical strategies resonate with different pro-mitigation narratives.

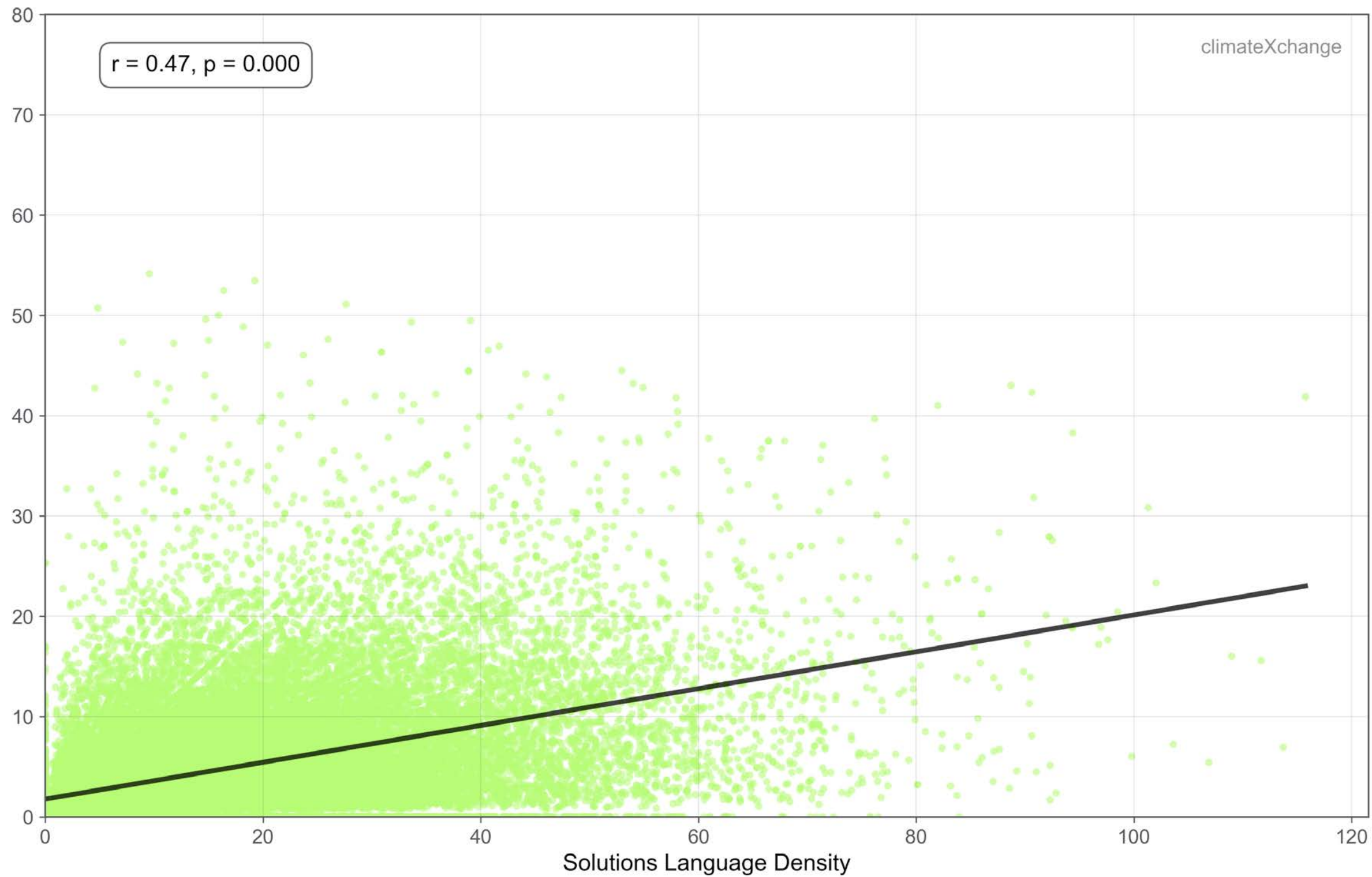
Fig 25: Solutions Categories and their impact on Pro-Mitigation Narratives



This bar chart disaggregates the impact of six solution categories on mitigation narrative strength. Social solutions has the strongest positive association ($r = 0.61$), followed by Action verbs ($r = 0.36$) and Economic solutions ($r = 0.24$), all statistically significant. Technology and Adaptation solutions show only weak correlation, implying that not all solution framings are equally effective in promoting pro-mitigation discourse. This suggests that framing matters not just in volume but in kind, with socially grounded and

action-oriented language having disproportionate influence.

Fig 26: Solutions-Oriented Language vs. Pro-Mitigation Narrative Strength



This scatterplot reveals a moderate-to-strong positive correlation ($r = 0.47$, $p = 0.000$) between the density of solutions-oriented language and the strength of pro-mitigation narratives. The pattern is statistically robust and visually clear, with increasing density of solutions language associated with a higher likelihood of mitigation framing. Compared to sentiment alone, solutions language appears more predictive of mitigation emphasis, highlighting its centrality in climate narrative construction. This is the most compelling single output in favour of the hypothesis, quantifying a strong relationship between solutions discourse and mitigation framing.

Overall, the data supports Hypothesis 2. Articles with more positive sentiment show a significant tendency to promote stronger pro-mitigation narratives ($r = 0.32$). Articles with more solutions-oriented language show a significant tendency to promote stronger pro-mitigation narratives ($r = 0.47$). The combination of sentiment and solutions language explains 24.2% of the variation in pro-mitigation narrative strength. The hope narrative was most responsive to these factors.

H2 Key Findings

Sentiment - Narrative Relationship

Correlation between sentiment and pro-mitigation narratives: $r = 0.32$

Statistical significance:
Significant ($p = 0.000$)



$r=0.32$



$p = 0.000$

Moderate positive correlation between sentiment and pro-mitigation narratives.

Solutions - Narrative Relationship

Correlation between solutions language and pro-mitigation narratives: $r = 0.47$

Statistical significance:
Significant ($p = 0.000$)



$r=0.47$



$p = 0.000$

Moderate positive correlation between solution language and pro-mitigation narratives.

Combined Predictive Power

Sentiment and solutions language together explain 24.2% of variation in pro-mitigation narrative strength

Overall model significance:
Significant ($p = 0.000$)



$p = 0.000$

Sentiment + Solutions language explain **24.2%** of variation in pro-mitigation narrative strength.

H2 Key Findings

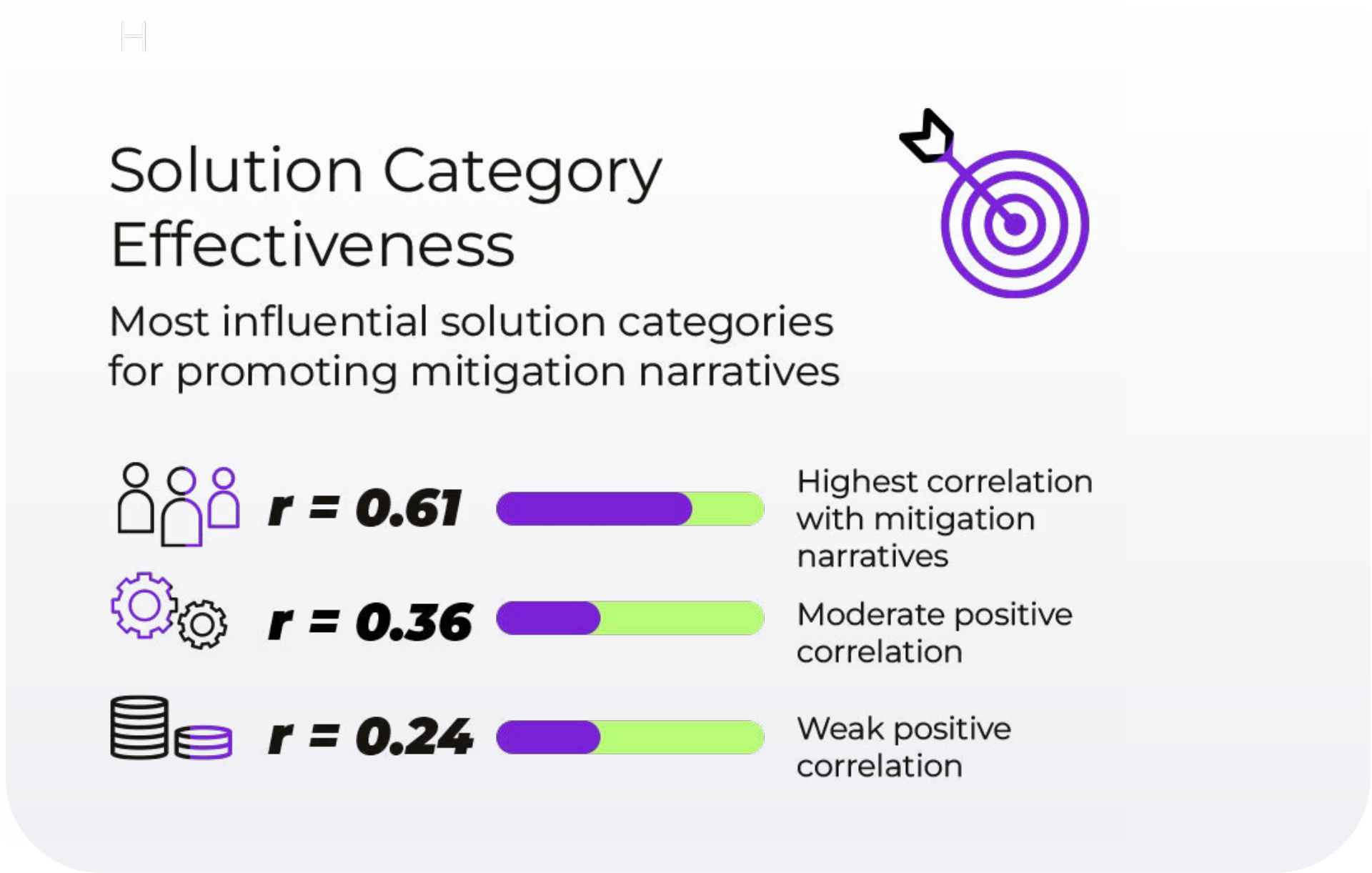
Solution Category Effectiveness

Most influential solution categories for promoting mitigation narratives:

Social Solutions: positive correlation ($r = 0.61$)

Action Verbs: positive correlation ($r = 0.36$)

Economic Solutions: positive correlation ($r = 0.24$)



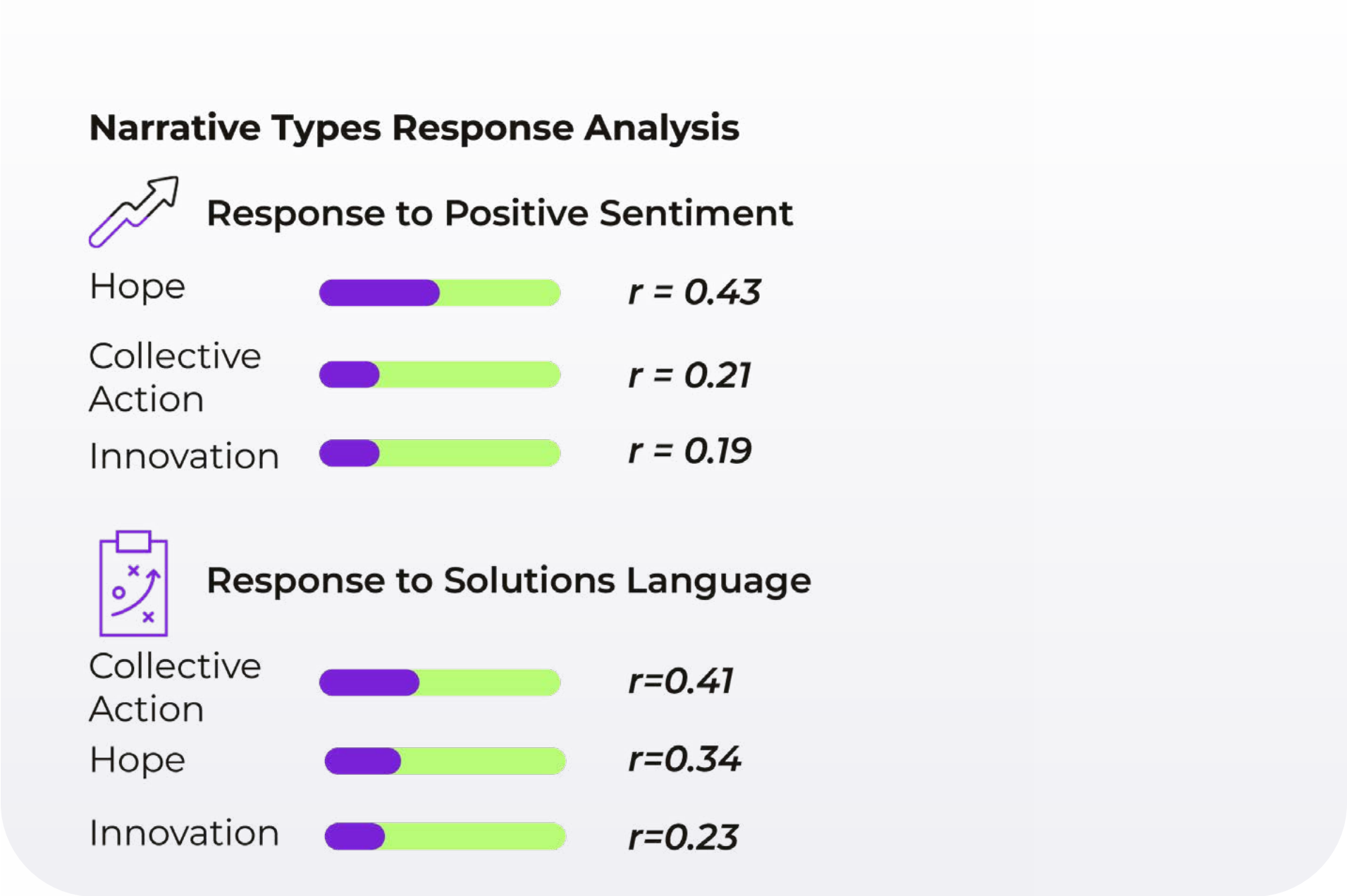
Narrative Types

Most responsive narrative types to positive sentiment:

- Hope: positive response ($r = 0.43$)
- Collective Action: positive response ($r = 0.21$)
- Innovation: positive response ($r = 0.19$)

Most responsive narrative types to solutions language:

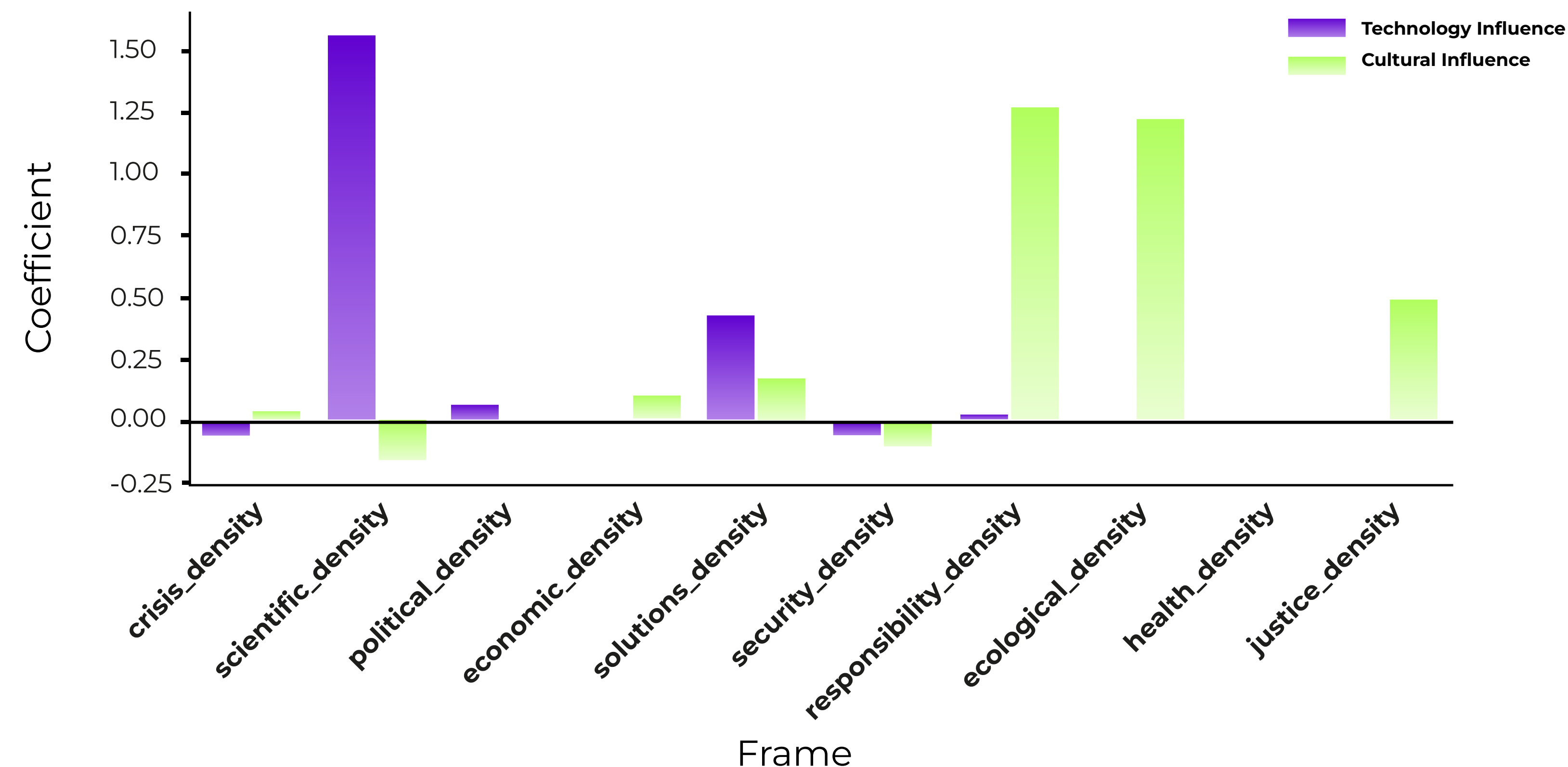
- Collective Action: positive response ($r = 0.41$)
- Hope: positive response ($r = 0.34$)
- Innovation: positive response ($r = 0.23$)



Hypothesis 3

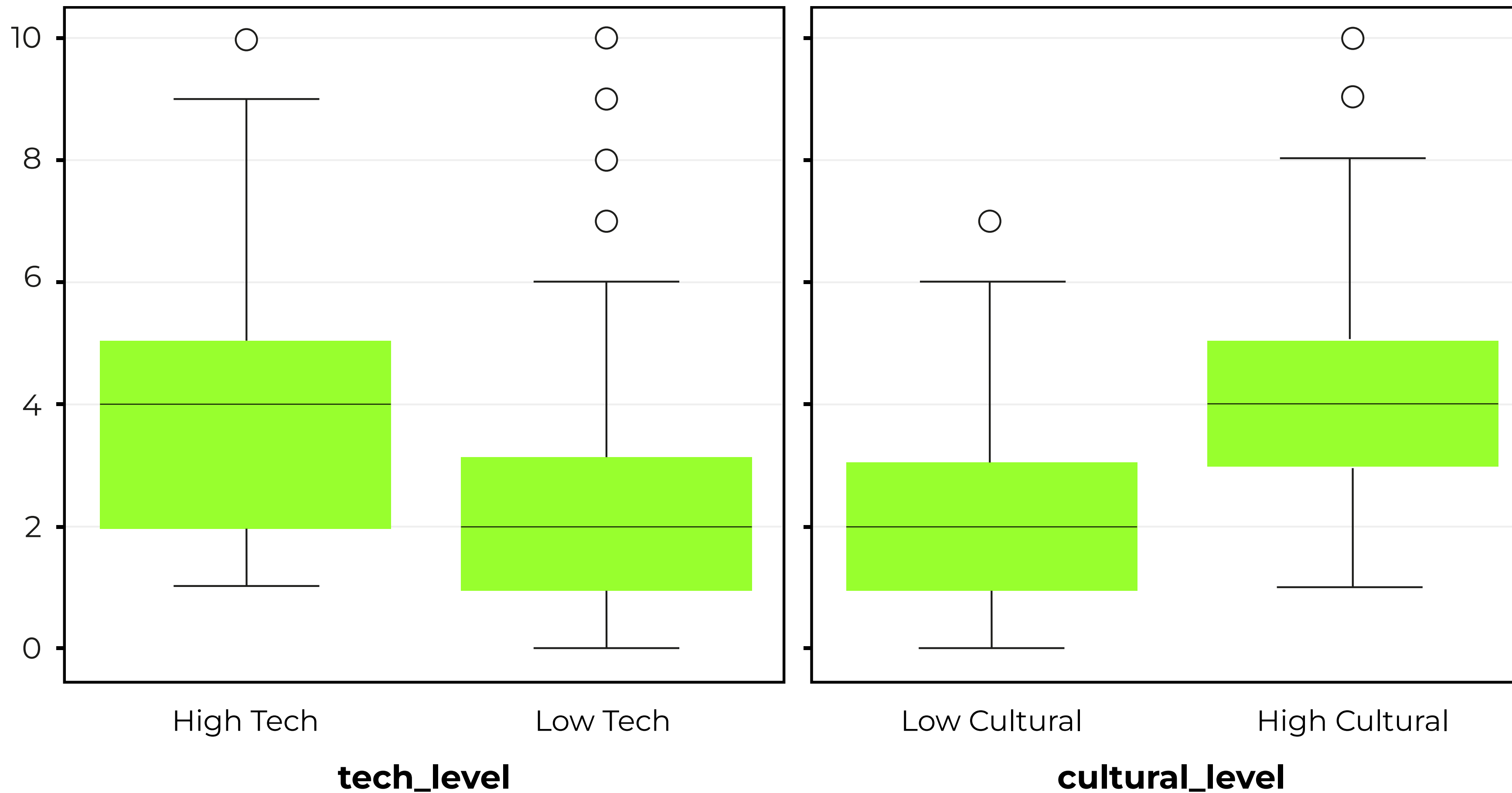
H3: The integration of technological advancements and cultural references in climate reporting correlates with shifts in dominant cultural narratives and journalistic framing over time

Fig 27: Influence of Tech and Cultural Topics on Climate Frames



This grouped bar chart shows how technological and cultural references predict variation across ten climate frames. Technological discourse is strongly associated with increased use of the scientific and solutions frames, while cultural references show a strong positive relationship with responsibility, ecological, and justice frames. The chart indicates that climate framing is systematically influenced by topical orientation. Technological language promotes technocratic framing, whereas cultural language fosters socially grounded narratives. This supports the hypothesis by confirming that frame selection correlates with the underlying topical emphasis in the article.

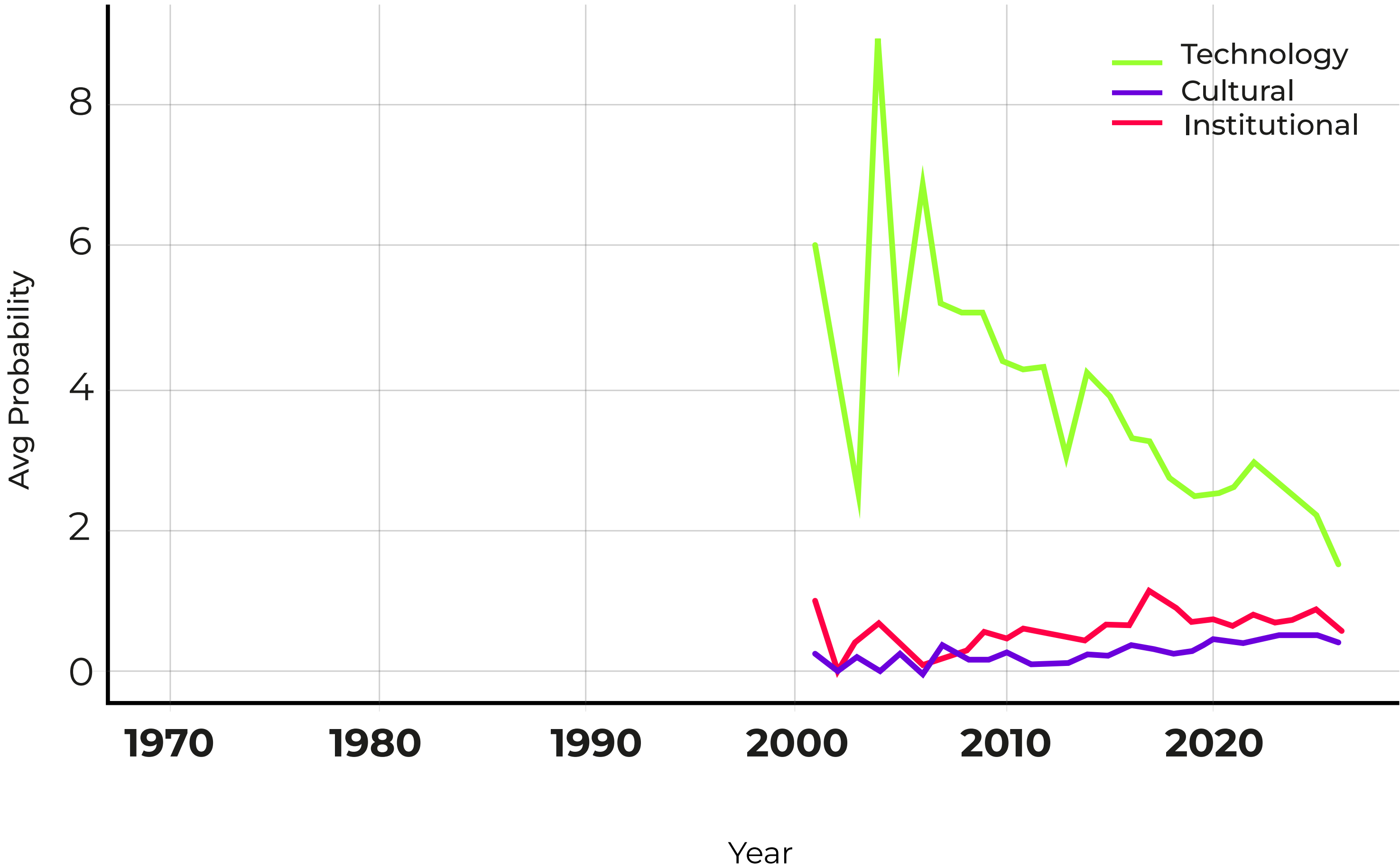
Fig 28: Frame Diversity Across Levels of Technical and Cultural Content



This plot compares frame diversity across high and low levels of technological and cultural content. In both dimensions, higher topical presence is associated with broader narrative range, with cultural references showing a slightly stronger effect. Articles with high cultural or technological salience tend to draw on a more varied set of frames.

This suggests that thematic richness—whether technical or cultural—enhances narrative pluralism and demonstrates that technological and cultural inputs are linked to increased complexity and diversity in journalistic framing.

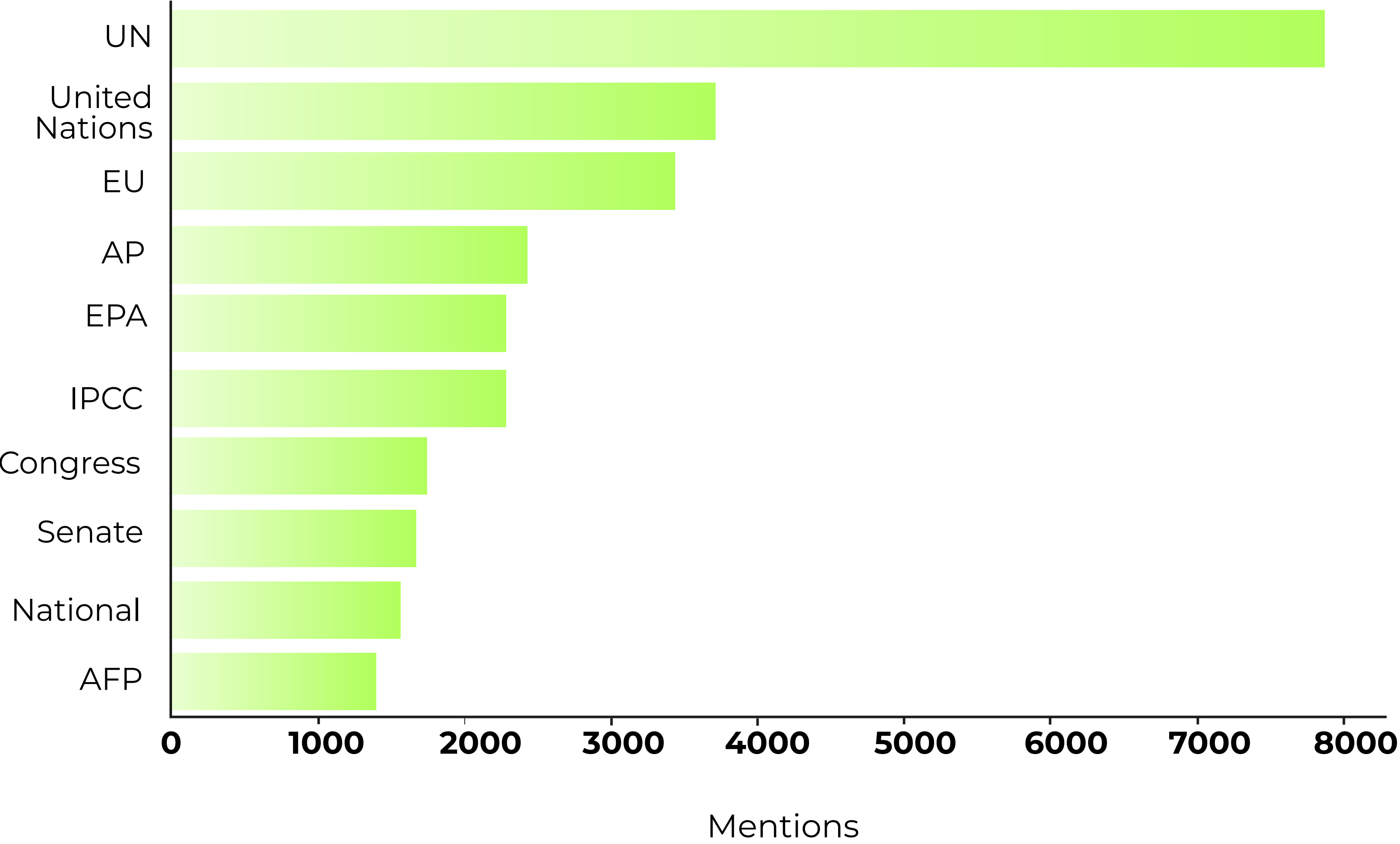
Fig 29: Temporal Trends in Topics Probabilities



This line graph tracks the evolving prominence of technology, culture, and institutional references in climate reporting over time. Technological emphasis peaked in the early 2000s and declined gradually, while cultural content has risen steadily since 2005. Institutional references, though less dominant, show consistent growth. The divergence in these curves reflects a shift in discursive priorities, with cultural framings becoming increasingly salient. This temporal dynamic illustrates how journalistic narratives evolve in step with broader shifts in public and political attention to cultural and social dimensions of climate discourse.

Trends in Fig 29 start in 2001 as this was the earliest year with consistent coverage for Hypothesis 3 frames (technology, cultural, institutional).

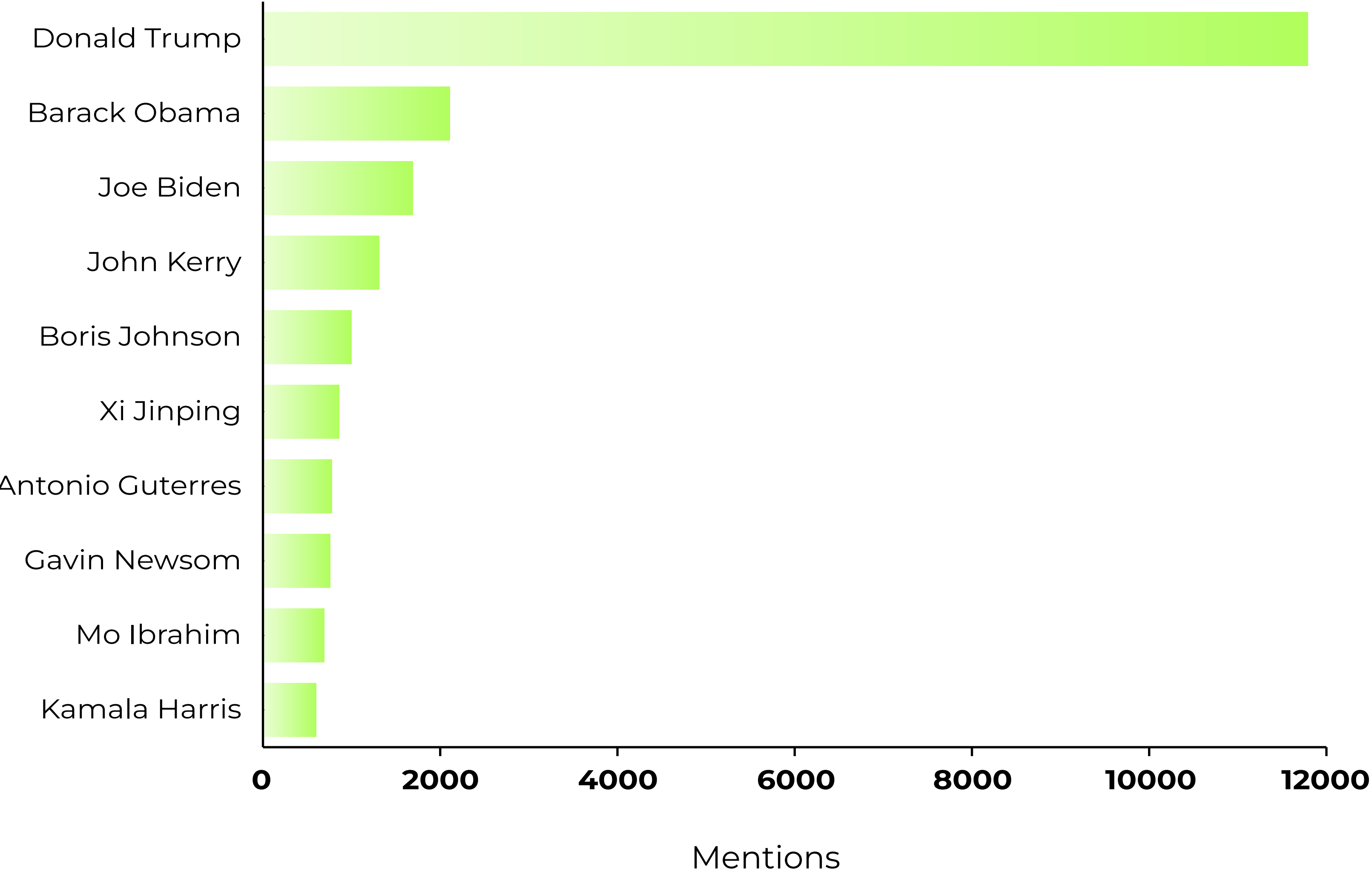
Fig 30: Top 10 Mentioned Organisations



This bar chart displays the most frequently mentioned organisations in climate reporting. Supranational and policy-oriented bodies such as the UN, EU, and IPCC dominate the list, underscoring the institutional grounding of climate narratives. These entities are often associated with scientific consensus and technocratic solutions.

Their prevalence suggests that institutional authority continues to shape the boundaries of legitimate climate discourse. This finding indicates that technological and institutional references still play a significant role in framing journalistic content, particularly in relation to expertise and governance.

Fig 31: Top 10 Mentioned Persons

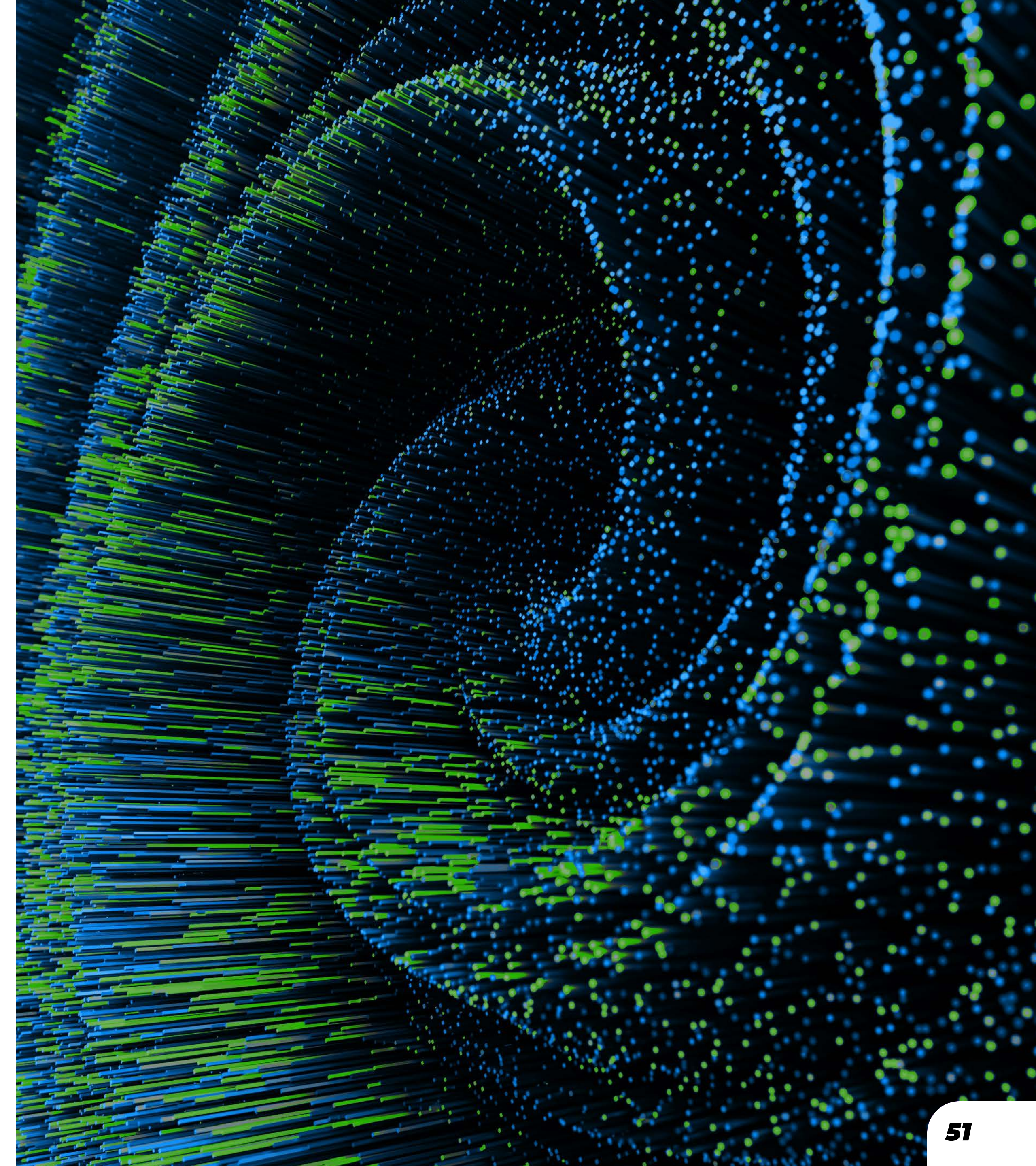


This chart shows that political figures, especially American presidents and senior policymakers, dominate mentions in climate coverage. Trump, Obama, and Biden stand out alongside figures like Kerry and Harris, underscoring how climate discourse is closely bound to political leadership and public identity. The prominence of these individuals supports the hypothesis by illustrating the personalisation and politicization of climate narratives. It also shows how public figures act as cultural reference points that shape how climate issues are framed, particularly in contested or ideologically charged debates.

H3 Key Findings

Collectively, the findings provide strong support for the hypothesis by demonstrating that the presence of technological and cultural references in climate reporting correlates with distinct and evolving shifts in narrative framing. Technological language tends to reinforce scientific and solution-oriented frames, while cultural references drive the adoption of justice, ecological, and responsibility framings—indicating that content orientation actively shapes how climate issues are narrated. Moreover, articles rich in either cultural or technological discourse display greater narrative diversity, suggesting that thematic depth fosters more complex framing strategies.

The temporal trends further affirm this pattern, showing a gradual decline in technological emphasis alongside a steady rise in culturally grounded content, reflecting an ongoing transition in public discourse. Finally, the prominence of global institutions and political figures as narrative anchors underscores the interplay between cultural authority and framing practices, reinforcing the idea that both technological paradigms and cultural cues influence how climate change is framed and understood over time.



Hypothesis Synthesis

The analyses of Hypotheses 1 through 3 reveal distinct but interrelated dynamics in contemporary climate reporting. When considered together, these findings demonstrate a structural evolution of climate discourse — from technically-loaded narratives to emotionally resonant, socially grounded storytelling shaped by regional, cultural, and ideological variables. Here, we synthesise the overlapping trends, divergences, and implications emerging across the hypotheses.

1. Volume as a structuring force across discursive dimensions

A consistent finding across all hypotheses is the central role of volume — both in terms of climate-related terminology and media coverage — as a driving force behind discursive change. In Hypothesis 1, higher volume is linked to greater frame diversity, signalling a shift from narrow scientific discourse to more complex framings involving justice, crisis, responsibility, and solutions.

Hypothesis 2 echoes this trend, showing that higher volumes of solutions-oriented language and positive sentiment correlate with stronger pro-mitigation narratives. Hypothesis 3 deepens this insight by connecting the integration of technological and cultural content with shifts in framing plurality and narrative depth. These suggest that increased volume does not merely amplify climate discourse — it transforms its structure, enabling a more varied, emotionally resonant, and socially situated narrative ecology.

2. Framing shifts from technical to normative and cultural anchors

Across the hypotheses, we observe a marked decline in scientific and purely economic framing and a corresponding rise in frames that centre on social action, responsibility, equity, and urgency.

- In H1, scientific frames lose dominance as coverage expands, while frames like crisis, solutions, justice, and ecology rise.
- In H2, solution frames — especially those tied to social action and hope — are most predictive of pro-mitigation narratives.
- In H3, cultural references are strongly associated with responsibility, justice, and ecological frames, while technological content boosts scientific and solutions frames.

This suggests a structural repositioning of climate change from a technical issue to a cultural and moral challenge. Climate discourse is increasingly infused with values, ethics, and collective identity — a trend that reflects the growing entanglement of climate issues with political polarisation, activism, and social justice movements.

3. Sentiment and emotion: Catalysts for engagement and framing

Hypothesis 2 explicitly foregrounds sentiment as a key mediator of narrative impact. The presence of positive sentiment, particularly when paired with solutions framing, is associated with more robust pro-mitigation narratives. Hypothesis 1 also reveals that certain frames — such as responsibility and solutions — carry more positive sentiment, while others (crisis, scientific) lean neutral or negative.

This emotional stratification implies that affective tone is not incidental but structurally embedded in how different frames function. Hypothesis 3 supports this further: the rise of cultural references introduces personalised and emotionally resonant content, contributing to framing complexity and possibly increasing reader identification. These patterns highlight the strategic use of emotion in media — not simply as rhetorical embellishment, but as a mechanism to drive engagement, signal urgency, and mobilise publics.

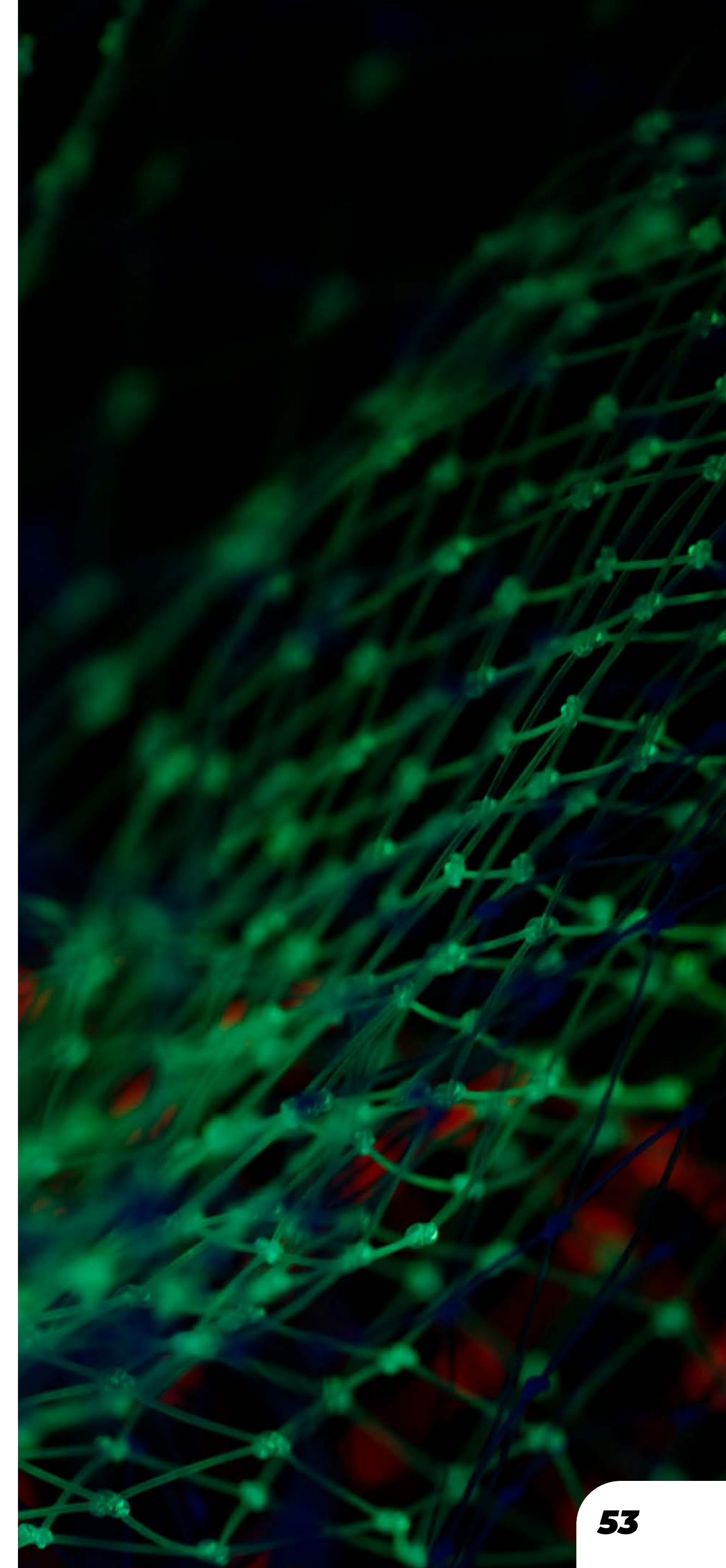
4. Narrative complexity and frame co-occurrence

Across hypotheses, there's strong evidence that climate reporting has become more multi-frame and multi-narrative over time. Hypothesis 1 shows rising frame density per article, while Hypotheses 2 and 3 document how frames co-occur with sentiment categories, cultural markers, and technological emphasis. This reflects a maturation of climate discourse: from monolithic storytelling (e.g., scientific consensus) to intersecting narratives that acknowledge technical, political, cultural, and emotional dimensions. The presence of this complexity suggests that media are not merely echoing science but actively curating diverse entry points for public understanding and action.

5. Regional and institutional variation as a moderator

A cross-hypothesis theme is the importance of regional, institutional, and outlet-level variation in shaping how climate is framed. Hypothesis 1 highlights how framing differs across countries and media houses (e.g., crisis vs. solutions emphasis in the US vs. India). Hypothesis 3 points to the dominance of global institutions (e.g., UN, IPCC) and political figures (e.g., US presidents) in shaping discourse, revealing the persistence of elite agenda-setting despite growing diversity in content. This suggests that climate narratives are globally convergent in volume but divergent in emphasis, filtered through national political climates, media traditions, and cultural priorities.

It also underscores the ongoing tension between centralised expertise (e.g., scientific institutions) and localised experience or activism in shaping climate discourse. In summary, climate coverage today is not just more frequent — it is more layered, effective, and ideologically contested. The convergence of framing shifts, sentiment strategies, and cultural cues suggests a transformed climate media landscape where information is inseparable from emotion, identity, and power. These changes carry critical implications for public perception, policy support, and the democratic capacity to respond to climate change.



Insights and Implications

The findings of this report shed light on the evolving architecture of climate journalism and the systemic factors that shape it.

At the heart of this investigation lies a simple but far-reaching question: ***can the way we tell climate stories influence how societies act on them?***

The evidence across all three hypotheses suggests that the answer is yes—but only when coverage is resonant, representative, and rooted in both global structures and local meaning-making.

This report confirms the foundational assumption of the project's Theory of Change: *climate journalism can influence systemic cultural change if it is framed effectively and rooted in emotionally resonant narratives*. Across all hypotheses, we observe that shifts in article volume, sentiment, solutions language, and cultural or technological references produce measurable effects on the thematic frames that structure climate discourse. Positive sentiment and solutions-oriented language are particularly powerful drivers of pro-mitigation narratives, affirming the theoretical argument that emotional tone and actionable storytelling function as levers for public engagement and behavioural alignment. This provides empirical validation for this project's core proposition: that media framing and affective language are not peripheral features but core components of climate action infrastructure.

However, the results also reveal a clear and enduring asymmetry in the global distribution of climate narratives. Media houses based in the Global North continue to dominate the climate conversation, not merely in terms of volume, but in setting the discursive tone and selecting the frames that shape public understanding. This pattern reinforces long-standing critiques in the literature about media power and agenda-setting bias. Countries such as the United States and the United Kingdom serve as narrative hubs, while many Global South countries, even when highly vulnerable to climate change, remain underrepresented or narratively marginalised. This media imbalance risks perpetuating a form of 'discursive climate injustice,' where the experiences, knowledge systems, and adaptation strategies of the Global South are crowded out by technocratic and market-oriented framings generated in the North.

This asymmetry is not just geographic — it is institutional. The report finds a clear alignment between media house influence and thematic framing. For instance, UK outlets like The Guardian and Nigeria's The Punch play outsized roles in shaping domestic and regional frames, while US-based syndication platforms like GlobeNewswire diffuse scientific and solutions frames across multiple geographies. The result is a fragmented media landscape where frame distribution does not simply follow the location of climate impacts but instead mirrors the structure of global media power.

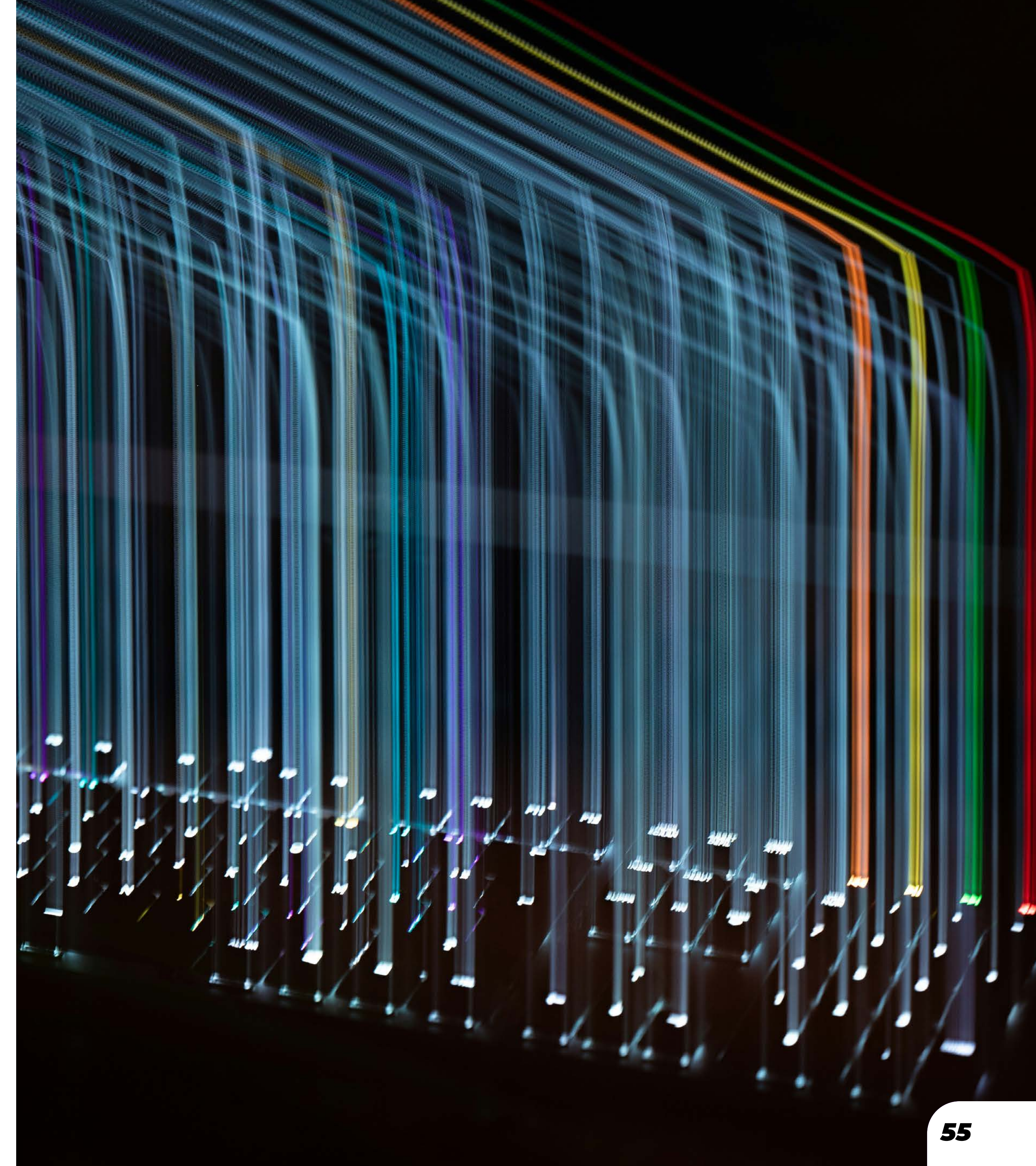
From a historical and comparative perspective, the study contributes to a broader body of literature documenting the evolution of climate journalism from denialist debates and doom scenarios to more diverse narratives focused on responsibility, equity, and innovation.



The temporal analyses in the report highlight a clear post-2015 acceleration in climate reporting. This suggests a turning point in how climate discourse is configured, with a noticeable expansion in narrative diversity and the growing presence of cultural and institutional frames. The integration of technological and cultural references in reporting, as examined under Hypothesis 3, further underscores the adaptive capacity of climate journalism. Cultural cues, in particular, are shown to foster justice-oriented and locally grounded narratives. In contrast, technology-heavy articles tend to retain a scientific or solutionist framing. This split affirms the literature's observation that climate stories are not just shaped by scientific data, but also by broader symbolic repertoires that make issues relatable and politically actionable.

These findings offer valuable insight into how media organisations and communicators can strategically design climate narratives. The analysis shows that resonance is not a matter of volume alone—it requires deliberate framing, inclusive representation, and affective tone. Furthermore, the report highlights the importance of infrastructure: the sampling strategy, NLP framework, and analytical pipeline used in Maaï offer a replicable model for scaling media analysis in service of both academic research and newsroom practice.

From a research standpoint, the project demonstrates the value of combining computational methods with interpretive theory. It offers a nuanced yet scalable approach to media research by bridging sentiment analysis, topic modelling, and framing theory.



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Appendix I

Execution Flow and Data Processing in a Climate Data NLP Pipeline

This report provided a structured analysis of the execution pipeline used in the Maai project for processing climate-related articles. The workflow consisted of five main phases: initialisation and configuration, file ingestion and preprocessing, text processing and feature extraction, theme identification via topic modeling, and database storage. The system was initialised through environment setup and dependency loading, followed by chunked ingestion of raw CSV files and standard text cleaning procedures (Manning, Raghavan, & Schütze, 2008).

Natural Language Processing (NLP) techniques such as tokenisation, named entity recognition, sentiment analysis, and the generation of semantic embeddings using transformer models (Devlin, Chang, Lee, & Toutanova, 2019; Reimers & Gurevych, 2019) enabled deeper textual analysis.

These embeddings were then passed to BERTopic (Grootendorst, 2022) to extract coherent themes from the corpus. The final outputs were serialised into a PostgreSQL database to support efficient querying and integration with analytical tools (Momjian, 2023). Figure 1 on page 59 illustrates the execution pipeline, whose components are discussed in detail in the subsequent sections of this report.

In the following sections, each of the execution processes highlighted above are discussed.



1. Initialisation and Configuration

The execution pipeline commenced with the configuration of the runtime environment, which was essential for ensuring operational efficiency and traceability. This entailed specifying the directory structure for input data.

Specifically, the folder containing the scraped climate articles and initialising log mechanisms for execution monitoring was setup. Logging was implemented through both console and file-based outputs to facilitate comprehensive tracking of the processing flow (Lutz, 2013). Several Natural Language Processing (NLP) modules, including nltk, spaCy, BERTopic, and the SentenceTransformer model suite, were also initialised at this stage, given their central role in downstream analysis.

In addition, key configuration constants were defined to optimise performance: CHUNK SIZE was set to 1000 to control the volume of text processed per batch, DB BATCH SIZE to 500 to manage database insertion rates, EMBEDDING WORKERS to 8 to leverage parallel processing, and EMBEDDING BATCH SIZE to 256 to balance memory efficiency and through-put. With the environment thus configured, asynchronous processing was initiated across eight worker threads to begin handling the contents of the scraped articles folder.

2. File Ingestion and Preprocessing

During this phase, raw comma-separated value (CSV) files containing data scraped from online climate-related articles were processed. These files, sourced from a diverse array of global media outlets, stored each article as a single row spanning multiple columns. Although the scraping tool 1 retrieved a broad range of fields per article, the primary focus was on a selected subset of columns identified in Table 1, chosen for their direct relevance to the study of climate change.

File ingestion was executed asynchronously from the designated scraping directory in the filesystem, utilising eight parallel worker threads as configured by the EMBEDDING WORKERS constant.

Each worker recursively traversed the directory structure, identifying and selecting only those files that passed a predefined column test — a verification step ensuring the presence of all required fields. This method of concurrent processing, paired with a shared text file for reconciliation of completed tasks, significantly improved the overall throughput and robustness of the system (Van Roy & Haridi, 2004).

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In the subsequent data cleaning stage, various preprocessing techniques were applied, including the removal of URLs, HTML tags, emoji characters, and other non-linguistic symbols. Regular expressions (regex) were central to these operations, enabling efficient pattern matching for undesirable content.

The overarching objective of this cleaning process was to eliminate noisy and biased text elements in alignment with best practices in natural language preprocessing (Bird, Klein, & Loper, 2009).

Initialisation
and Configuration

File Ingestion
and preprocessing

Text Processing
and Feature
Extraction

Theme
Identification

Database
Storage

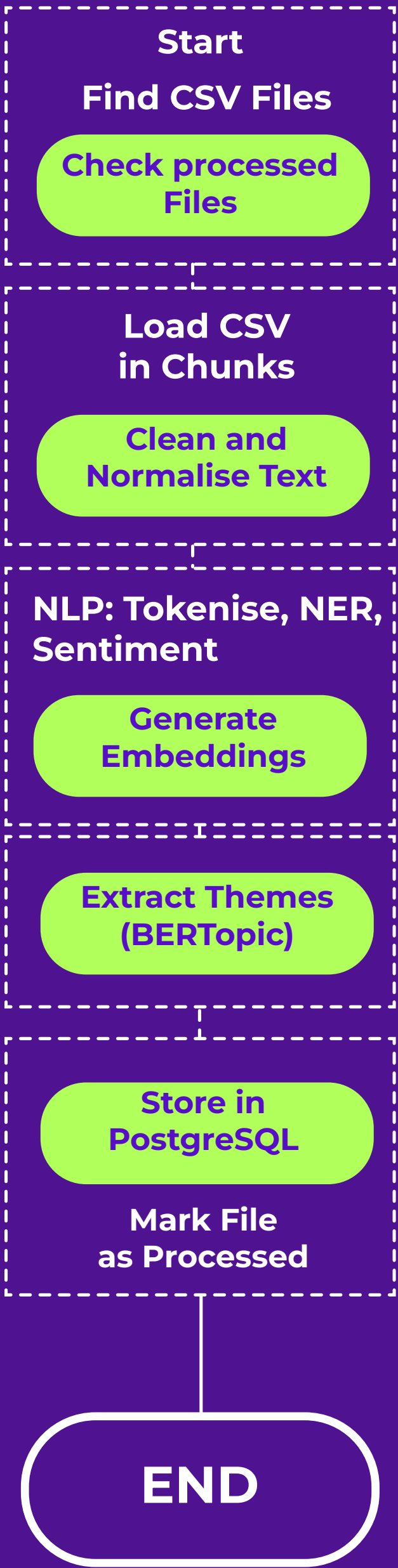


Figure 1: Phased Execution Flow of the Climate Data Pipeline

3. Text Processing and Feature Extraction

Once cleaned, the pipeline leveraged SpaCy’s2 en_core_web_sm for named entity recognition and sentence segmentation. Further to entity recognition, other fields which were computed from the base features (See Table 1), included sentiments, article embedding, term frequencies, themes, country and media house.

The computation of sentiments was done using the TextBlob Package. This package computed the level of satisfaction of feel a user could have when reading the article on a scale from -1 to +1 (Loria et al., 2018). TextBlob was viewed as suitable for the task compared to other competent tools such as Vader which is more suited for social media sentiment analysis (Elbagir & Yang, 2019).

In view of the fact that the project encompassed a lot of comparison and searching of the articles, it was found important that each article’s embedding be computed. This would allow semantically based searching which is more relevant in this context than exact word search (Guha, McCool, & Miller, 2003) (Bast, Buchhold,

Hausmann, et al., 2016). The computation of the embedding was done using the all-MiniLM-L6-v2 sentence transformer model. The choice of this model was influenced by the fact that it was an open source model, and open source models were understood to have undergone a robust testing and peer reviewed (Bonaccorsi & Rossi, 2003; Rigby, German, Cowen, & Storey, 2014; Zhao & Elbaum, 2003). In addition, the fact that the embedding dimensions of the all-MiniLM-L6-v2 are 384 makes it achievable with reasonable compute resources. These embeddings can later be used to compute similarities across articles and perform multiple clustering techniques (Hjaltason & Samet, 2003). For this report, the article’s title and text were used as inputs for the language model to compute the eventual embeddings. The main reason behind this was that the text and content were assumed to resonate to give each article its theme.

In view of the fact that domain specific news, e.g. climate, can be characterised by specific words, the counts of frequent words were done

Field Name	Description
url	Web address where the article was published
date	Date when the article was published
title	Title of the article
text	Main content body of the article
publish date	Original publication date of the content
country	Country where the article was published
media house	Publication company for the article

for each article. Such statistics were called term frequencies and assumed to inform the analysis of news articles. Pre-computing these beforehand would help in quick future analysis as at that time there would be no need to do word counts for visualisations such as wordclouds. This could be applied at article level or aggregated across sampled articles.

Further to the computation of article-level statistics was the computation of themes. A theme could be defined as the main argument the article tries to convey to its audience. To discover these themes, this report made use of the bertopic model (Grootendorst, 2022). Similar to all-MiniLM-L6-v2, bertopic is an open source

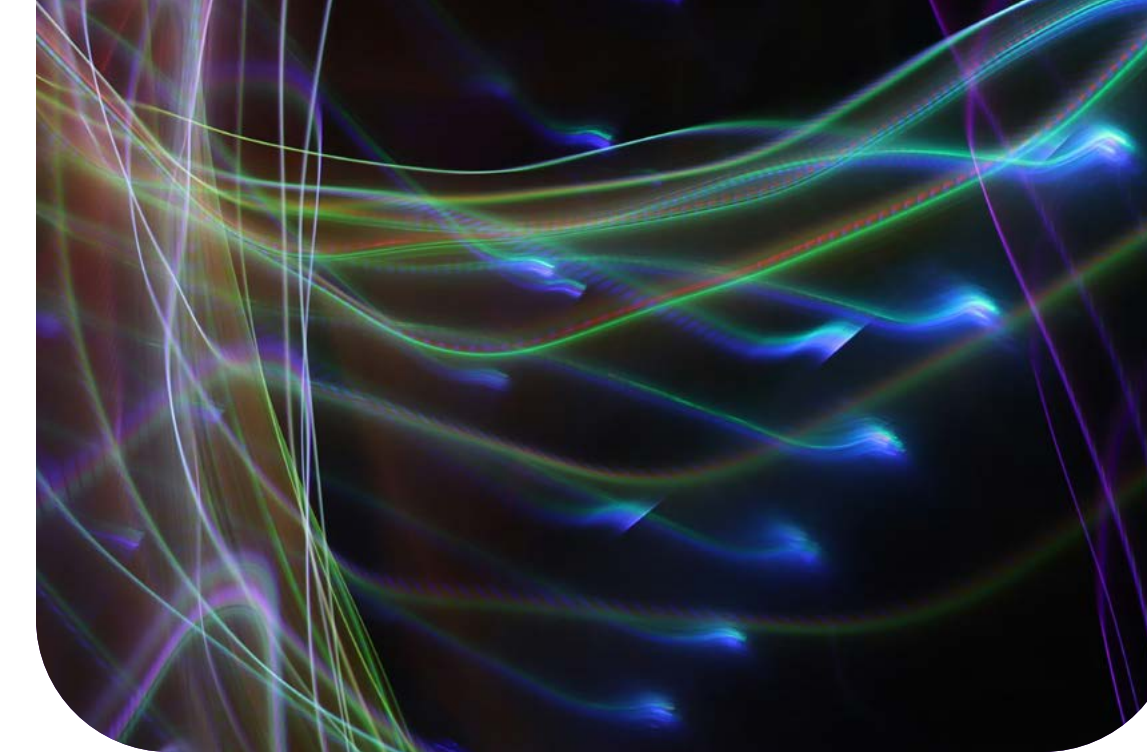
model that is trainable to compute to do the computation of NLP statistics such as topic-term distributions (c-tf-idf), topic coherence scores, document topic probabilities, outlier detection, embedding analysis, topic similarity, topic activity over time (Grootendorst, 2022) (Egger & Yu, 2022).

Lastly, the country and media house were also computed fields for this project. Essentially, from the article url, the media house domain was extracted. From the domain, the parent country of the media house was derived, through the pattern matching and mapping of these domains.

4. Theme Identification via Topic Modeling

The extraction of underlying thematic structures from the preprocessed textual data was carried out using the BERTopic framework, a transformer-based topic modelling technique that has demonstrated improved coherence and interpretability over traditional models such as Latent Dirichlet Allocation (LDA) (Grootendorst, 2022). The model was initialised with parameters configured to identify both unigrams and bigrams, thereby capturing not only individual keywords but also relevant two-word phrases that better reflect domain-specific concepts being discussed in the articles. To enhance robustness in cases where topic modelling failed to produce themes in the article, particularly in smaller or noisier text segments, a fallback mechanism was employed to use term-frequencies. This involved the extraction of frequently occurring words within document groups as an alternative strategy for identifying salient themes.

The incorporation of this hybrid technique was done to ensure consistent output across heterogeneous textual inputs, improve theme discovery and avoid saving records without themes in the final storage.



5. Database Storage

In the final phase of the pipeline, the processed and annotated data persisted to a PostgreSQL relational database, which was extended with pgvector to support efficient storage and retrieval of high-dimensional vector embeddings. The database schema was carefully designed to enforce data integrity through the use of primary keys, unique constraints — particularly on article URLs. To handle the demands of concurrent execution, especially under high-throughput ingestion conditions, database access was managed using the ThreadedConnectionPool module. This mechanism allowed for efficient allocation and reuse of connections, thereby reducing overhead and latency during parallelised write operations (Momjian, 2001).

The pipeline presented in this section demonstrated a robust and scalable architecture for the end-to-end processing and analysis of large-scale climate-related textual data. By integrating state-of-the-art Natural Language Processing (NLP) methods and adhering to sound software engineering principles such as modularity, concurrency, and fault tolerance, the system effectively transforms raw, unstructured articles into clean data ready for analysis. Each phase of the pipeline, from initial environment setup through data ingestion, preprocessing, embedding, and topic modeling, to final database storage, contributed to a comprehensive framework capable of supporting climate discourse analysis at scale. The design emphasised both performance and maintainability, providing a reusable foundation for future enhancements and domain extensions.

Appendix II

Stratified Sampling Strategy

To get a representative subset from the initial dataset of 417,009 news articles on climate change, we applied stratified sampling. The primary goal is to achieve a more balanced and representative outlook for analysis by mitigating skews in the original data distribution across countries and publication years. The target sample size was approximately 85-87% of the original dataset, ensuring that almost all stories are retained while improving the representation of diverse regions and time periods.

The following variables and rules were applied:

Country Stratification

Each article was categorised based on its country of publication, and the following sampling rates were applied:

- Countries were grouped into four strata. Stratum one consisted of countries with one hundred or fewer news articles. For this stratum, the applied sampling rate was 100 per cent. Stratum two consisted of countries with 101 to 1000 news articles, and the sampling rate was fixed at 95 per cent.
- Stratum three consisted of countries with 1001 to 10000 news article representation, and a 90 per cent sampling rate was applied.
- Stratum four consisted of countries with 10001 articles and above, and the applied sampling rate was 85 per cent.

Year Stratification

Each article was categorised based on its year of publication, and the following sampling rates were applied:

- Years/periods were grouped into three strata based on the manual reading of the period differences.
- Stratum one consisted of years with < 500 original articles, where a sampling rate of 100 per cent was applied.
- Stratum two consisted of years with 501 to 10000 news articles, and a sampling rate of 95 per cent was applied.
- Stratum three consisted of years with 10001 articles and above, and the sampling rate was 85 per cent.

However, since each article belongs to both a country stratum and a year stratum, the final probability of an article being selected for the sample will be determined as follows: For each article in the full dataset (417,009 articles), we

- Determined its country-based sampling rate ($P_{country}$) based on the country stratification rules.
- Determined its year-based sampling rate (P_{year}) based on the year stratification rules.
- The final sampling probability (P_{final}) for that article was the minimum of the two rates: $P_{final} = \min(P_{country}, P_{year})$. This ensured that the article meets the more stringent representational requirement if its country and year strata have different sampling rates

In terms of implementing this framework, the full dataset of 417,009 articles was loaded, ensuring each article had metadata for country, media house and year. For each article, country and year stratum categories were identified and the combined P_{final} was calculated. Probabilistic sampling was then applied for each article, generating a random number between 0 and 1. If the article's random number was less than or equal to the article's P_{final} , the article was selected for the sample. The collection of selected articles formed the final sampled dataset for analysis.

Based on this stratified sampling approach, the final sample size became 85.5% of the original dataset (i.e., xx articles), primarily influenced by the 85% sampling rate applied to the largest strata in both country and year categories.

Analytic Weights

Further to the above, the primary goal of this sampling strategy was to create a more balanced dataset for direct analysis. However, to make statistical inferences that generalise back to the precise proportions of the original 417,009 articles, or to give more "voice" to underrepresented strata in aggregate analyses, analytic weights were considered. The basic weight for each sampled article was the inverse of its selection probability ($1 / P_{\text{final}}$). These weights were normalised so that the sum of weights in the sample equaled the original population size or the actual sample size. Building on the weighting logic outlined above, we applied a stratified sampling strategy to correct for imbalances in article volume across countries and years. This ensured that analytical outcomes reflect both scale and representational equity while retaining a substantial portion (85.5%) of the articles.

The most notable achievement of this sampling is not uniformity but controlled correction of overrepresentation. In the country distribution (top panel), we observe a deliberate compression of the data skew — countries like the United States and United Kingdom, which previously dominated the dataset, see a proportional reduction in volume, while smaller contributors like Nigeria, South Africa, and the Philippines maintain or improve their relative visibility. This ensures that high-volume countries no longer drown out low- or mid-volume contributors, without undercutting their empirical significance.

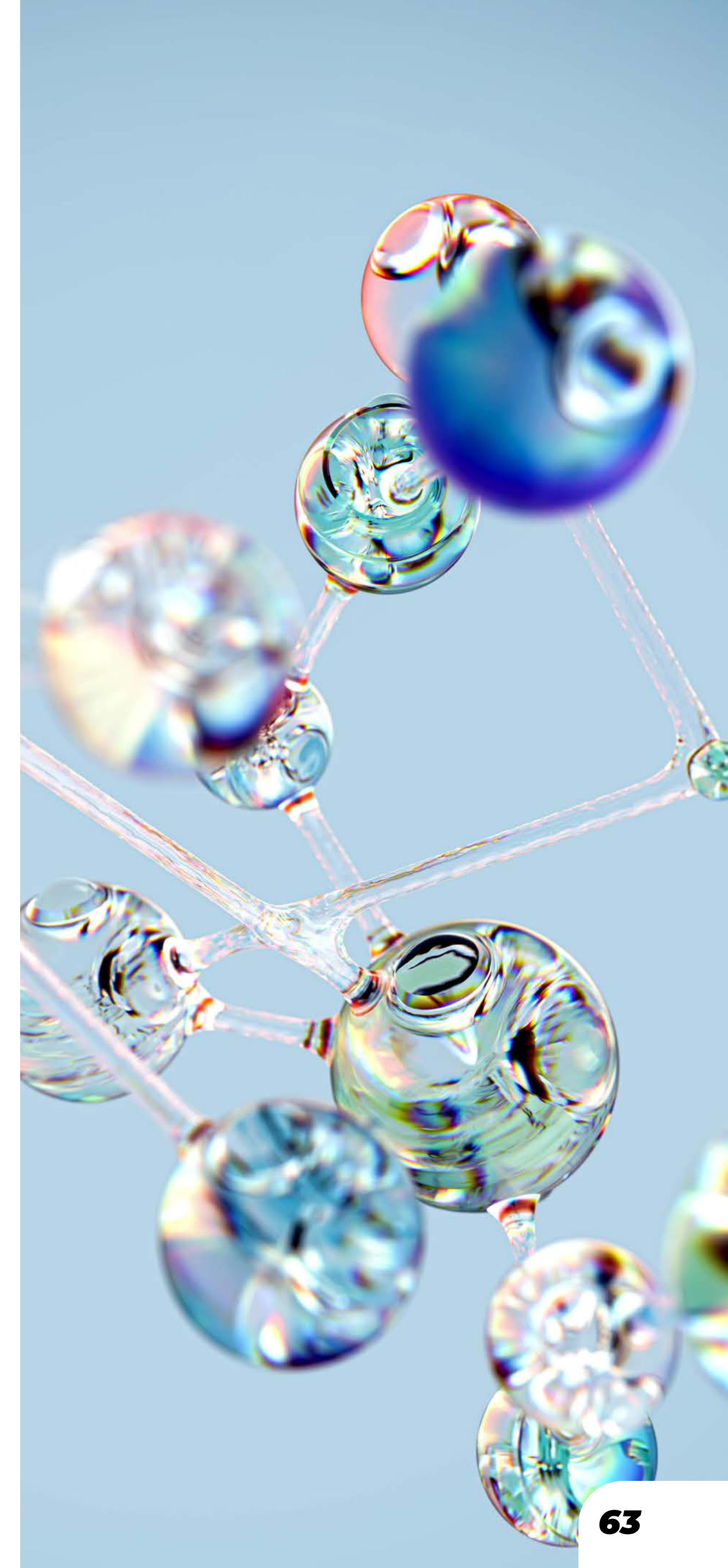
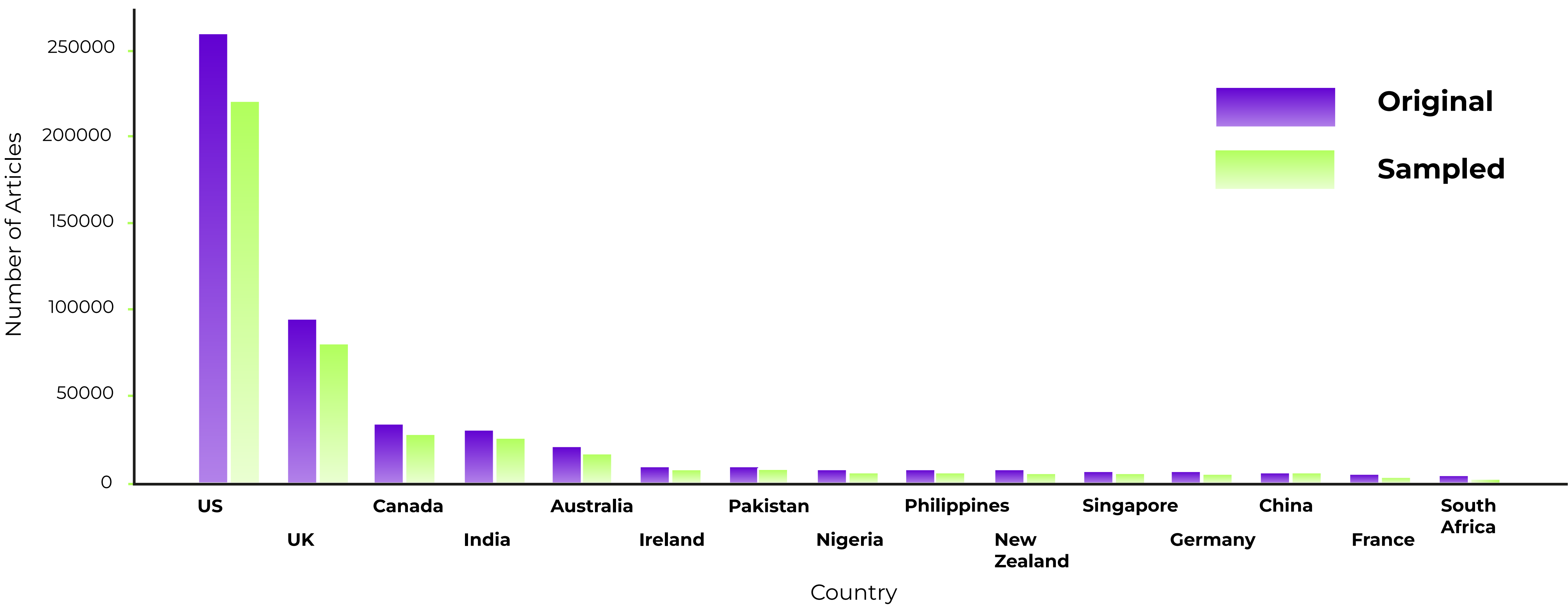


Fig 32: Distribution of Article by Country (TOP15)

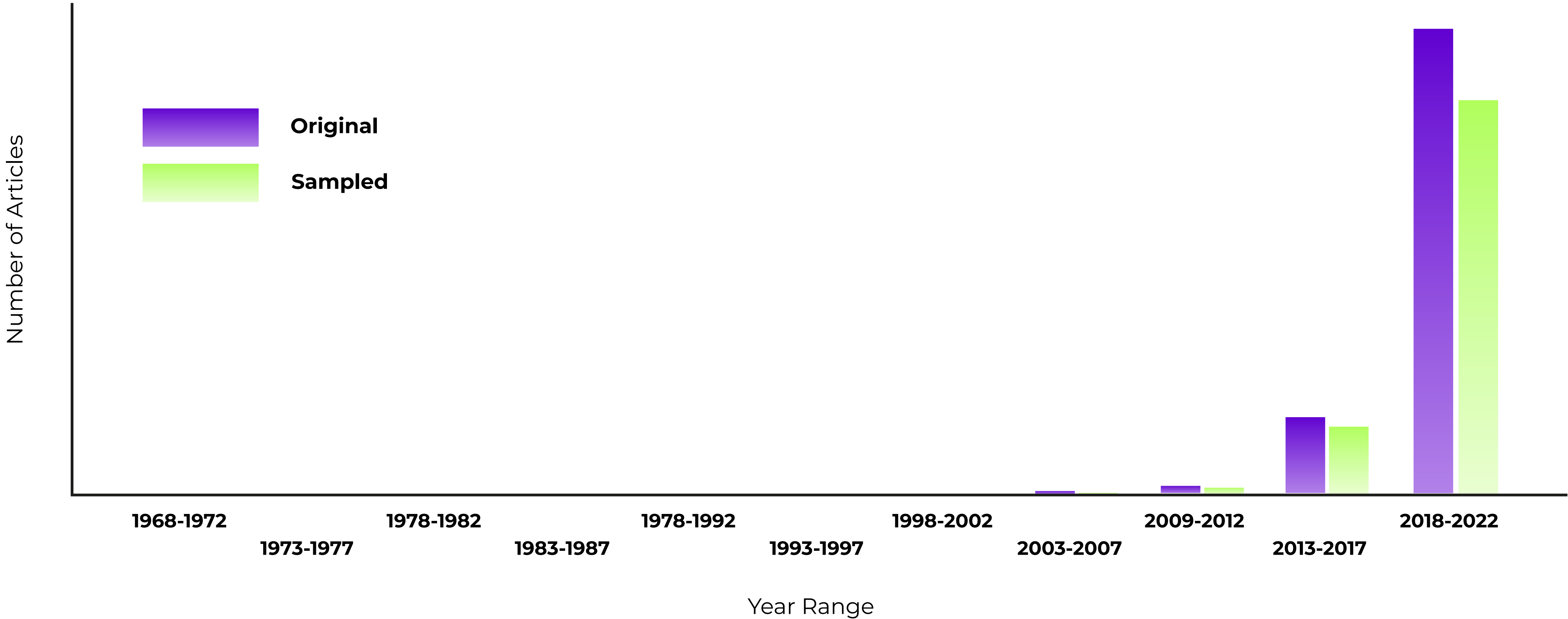


The same corrective logic applies to the temporal distribution (bottom panel), where the sharp inflation of recent years (particularly 2018–2025) has been recalibrated. The reduction in article counts during this peak period is

strategic: it prevents recent years from distorting longitudinal trends or overemphasising event-driven spikes. Meanwhile, the earlier years (e.g., pre-2010), which risk being analytically marginalised due to low article counts, are fully

retained under the 100% sampling rule. This guards against historical erasure and preserves the capacity for long-range temporal analysis.

Fig 33: Distribution of Article by Year (1969-2025)



Importantly, our strategic sampling decision to apply the minimum of the country and year-based sampling rates ensures that no article survives on the basis of one strong

dimension alone. Instead, inclusion demands representational adequacy across both time and geography. This dual-filter approach enforces a more stringent standard of diversity

and balances out structural overrepresentation at the dataset level, not just within strata.

Appendix III

Rationale and Literature review

Climate Change in News: Patterns of Coverage

Climate change is a threat to all forms of life on the planet. Climate is multifaceted, stretching across science, economy, politics, and justice. This makes its communication, public understanding and engagement complex. The news media are central in shaping how climate change is understood, perceived and discussed within society (Moser, 2016; Schafer & Painter, 2021). As Gitlin (1980) argued, the news media act as a primary source of public information and therefore influences issue salience, public opinion, and ultimately, the political agenda surrounding climate action (Dearing & Rogers, 1996; Liu et al., 2011; Soroka, 2002; Schmidt et al., 2013).

Research on climate change journalism has increased over the past decade. The studies examined various aspects of media coverage, including the quantity and temporal reporting trends, the dominant frames used to portray the issue, the types of sources granted voice, and how these patterns vary across national contexts and media systems. Climate change journalism has evolved. This evolution has happened across several dimensions of the reporting, from the debate about whether climate change is real or not to debates about solutions. The terminology has also changed and shifted over time. These debates have taken place across time, and journalism has indexed (Bennett, 1990) social-cultural discussions morphing into the mainstream reporting systems. From discussions about the validity of climate science, responsibility, and now action, journalists have indexed these cultural maps. Through this evolution, almost all media now is settled on scientific consensus, allowing for discursive transitions towards climate solutions.

News media stories on climate change have evolved in distinct phases. Boykoff (2007) and McAllister et al. (2021) demonstrate that framing around scientific consensus has grown over time, a trend linked to improved public understanding and stronger policy support. Chinn et al. (2020) document an increasing reliance on political sources since the 2000s; this politicisation corresponds with more polarised public opinion and policy gridlock. Guenther et al. (2021) note that early crisis or doom framing has decreased, while framing that highlights solutions and sustainability has emerged recently, paralleling rises in public engagement and policy action. Studies also reveal that event-driven spikes and short-term temperature anomalies (Pianta and Sisco, 2020) intensify coverage and that patterns vary markedly by region. For example, research in US media emphasises domestic politicisation, whereas Song et al. (2021) report that Chinese news often treats climate change as a global issue.

In sum, impactful climate reporting features increasing emphasis on scientific consensus and solutions, a growing politicisation that divides audiences, and dynamic coverage intensity responsive to climatic and event-driven cues.

Historical Context and Trends in Coverage Salience

The media's attention to climate change has not been static; it has evolved significantly over time, often following patterns described by the "issue-attention cycle" (Downs, 1972; Ungar, 1992; McComas & Shanahan, 1999). According to Downs' (1972) model, issues typically pass through stages: a pre-problem stage with low public attention, a stage of alarmed discovery and euphoric enthusiasm following dramatic events, a stage of realising the cost and complexity, a stage of gradual decline in interest, and finally, a post-problem stage of lower, sporadic attention. Several studies confirm that climate change coverage has broadly followed a cyclical pattern, with peaks often triggered by specific events.

Trumbo (1996) examined US news coverage from 1988 to 1995, identifying distinct phases that the study labelled "pre-controversy," "controversy," and "post-controversy," analogous to Downs's cycle. As Trumbo (1996) argued, climate change coverage in the US gained increased attention around James Hansen's 1988 testimony to the US Congress, which also coincided with a severe North American drought and heatwave. These developments led to a period marked by a shift from a relatively low-salience scientific concern to a more publicly visible issue. McComas and Shanahan (1999), also studying US coverage from 1980 to 1995, found that climate change coverage tended to rise and fall in waves, often linked to events, but that the issue persisted through narrative construction in the media. More recent studies covering longer timeframes and multiple countries confirm that climate change gained considerable media attention starting in the mid-2000s, often peaking around major international events. Schafer et al. (2014) analysed newspaper coverage in Australia, Germany, and India from 1996 to 2010. They found that media attention for climate change grew in all three countries, with

significant spikes around the annual Conferences of the Parties (COPs) under the UNFCCC, as well as activities by international environmental non-governmental organisations (ENGOS). Their time series analysis showed that political events and international ENGO activities were important drivers of media attention in all three countries, while extreme weather events had significant effects only in Germany (linked to a major flood in 2002) and domestic political feedback influenced coverage in Australia and Germany but not India.

King et al. (2019) conducted a spatiotemporal analysis of climate change impacts on health in Canadian newspapers from 2005 to 2015. They found that coverage of climate-health impacts increased over time, particularly in the Northern Territories, where the population is projected to be most severely affected. However, they observed an overall decreasing trend in the frequency of climate-health articles over the study period, suggesting that while the topic gained some traction, its continuous salience in Canadian newspapers declined after a peak. Keller et al. (2020) focused specifically on climate

change coverage by the Indian business media (The Economic Times) from 2008 to 2016 and found that coverage increased substantially over this period, particularly around the COP events in Copenhagen (2009) and Paris (2015). Chinn et al. (2020) analysed US newspaper (NYT, WSJ) and cable news (CNN, FOX) coverage from 1985 to 2017, focusing on the co-occurrence of "climate change" or "global warming" with the term "crisis." They found that the number of items linking climate change and crisis increased significantly after the release of IPCC Working Group I reports in 2007 and 2013, suggesting these reports acted as key events that increased media attention towards climate change. While the percentage increase was highest in the earliest period (2001), the absolute numbers were much larger in subsequent periods, particularly in 2007.



Perga et al. (2023) examined the mediatisation of climate change research outputs in global news media based on Altmetrics data for 2020 publications, and found that news attention was concentrated on a small subset of highly-cited papers, primarily from high-impact multidisciplinary journals.

They observed that media attention was heavily influenced by catastrophic meteorological events and political events, but only to a lesser extent by the scientific publications themselves. This suggests that while the issue gains attention from events, the visibility of underlying research is still largely event-driven and journal-prestige dependent.

Overall, the literature reveals a pattern of increasing media attention to climate change, often driven by specific events like COPs, IPCC reports, and, to varying degrees depending on the country, extreme weather phenomena. However, there is also evidence that the nature of this attention and the specific aspects of climate change being highlighted in news coverage have shifted over time.

Framing of Climate change in the media

Framing is an important aspect of how the media shape public understanding. It involves selecting and priming certain aspects of an issue and making them more salient, thereby influencing how audiences define the problem, attribute causality, make moral judgments, and consider solutions (Entman, 1993; Trumbo, 1996; Chong & Druckman, 2007). Trumbo (1996) categorised frames in US coverage (1988-1995) into problems, causes, judgments, and remedies.

Their research found that “judgments” and “remedies” became more prevalent over time, particularly as politicians and interest groups gained more voice compared to scientists, who were more associated with “problems” and “causes.” This suggested a shift from explaining the issue to debating policy responses. McComas and Shanahan (1999) also found that conflict served as a primary narrative vehicle in US coverage, particularly focusing on intergovernmental tensions.

The “balance as bias” frame, where journalists presented conflicting scientific viewpoints on climate change with equal weight despite overwhelming scientific consensus, was a prominent finding in earlier US studies (Boykoff & Boykoff, 2004, 2007; Antilla, 2005). This practice, while adhering to journalistic norms of objectivity, arguably distorted the scientific reality and fueled public skepticism. However, Stecula and Merkley (2019) analysed US coverage from 1988 to 2014 and found that while uncertainty frames were prevalent in the past, they have been on the decline in mainstream media, including in the Wall Street Journal. They found that true instances of “false balance” were rare, and that the media had increasingly purged references to uncertainty about the IPCC consensus from their coverage. Stecula and Merkley (2019) also focused on economic frames, coding for costs and benefits of climate mitigation. They found that frames emphasising the costs of mitigation were prominent in the past, coinciding with major policy debates and the focus of conservative/Republican elites. However, these frames had somewhat declined. In contrast, frames

emphasising the economic benefits of climate action have been on the rise, especially since 2008.

Conservative ideological frames, separate from economic costs, were found to be relatively limited in US mainstream media coverage (Stecula & Merkley, 2019). While such frames existed, they rarely gained significant traction, even in conservative-leaning outlets like the Wall Street Journal, further suggesting that conservative opposition in the media primarily focused on economic cost arguments rather than broader ideological appeals against government intervention or challenges to American sovereignty. Risk framing, focusing on the dangers and potential consequences of climate change, was found to be increasingly present in US climate coverage from 1988 to 2014 (Stecula & Merkley, 2019). Language indicating risk and present tense was increasingly used, suggesting a growing focus on the immediacy and severity of the threat. Important to note is that as scientific understanding of climate change improved, the media’s language evolved to reflect this urgency.

International comparisons reveal notable differences in framing patterns. Wagner and Payne (2017), while examining Irish newspapers' coverage between 1997 and 2012, found that climate change was primarily framed as a "policymaking" or "economic and energy interests" issue, with a predominant focus on "mitigation" solutions rather than adaptation or causes. They argue this reflects the influence of an "ecological modernisation" discourse among Irish political and economic elites, which frames environmental protection as compatible with economic growth. Freeman's (2017) study of English-language newspapers in ASEAN countries' coverage of climate change between 2008 and 2012 found that "Judgments" were the most predominant frame, followed by "Problems" and "Remedies," with "Causes" being the least common. Keller et al. (2020) used topic modelling on Indian business media (2008-2016) to identify themes associated with climate change coverage. The most dominant theme was "climate cooperation," focusing on international negotiations and bilateral ties (especially with the US and China). "Sector-

specific responses" (energy, agriculture, wildlife) also gained significant traction. "Climate science" was a relatively smaller theme, though its importance increased over time. Indian business media framed climate change primarily through international political cooperation and domestic sectoral changes, with less emphasis on the scientific basis compared to other themes.



Sources and Voice in Climate Change Coverage

The sources quoted in news stories are crucial for understanding whose perspectives are given legitimacy and influence in the media discourse (Anderson, 2009; Trumbo, 1996; McComas & Shanahan, 1999). Studies have examined the prominence of various source types, including scientists, politicians, government officials, industry representatives, NGOs, and citizens. Trumbo (1996) found that in US coverage (1988-1995), scientists declined as a percentage of quoted sources over time, while politicians and interest groups increased. This shift coincided with the issue becoming more politicised and framed in terms of judgments and remedies rather than problems and causes. Antilla (2010) examined US news coverage of climate “tipping points” and similarly found that political and special interests were strongly associated with the judgment frame, while scientists were linked to the causes frame. Chinn et al. (2020) found that mentions of politicians increased significantly over time, while mentions

of scientists decreased. By the 2000s, politician mentions often outnumbered scientist mentions, particularly after 2006. The increase in political sources, coupled with a decrease in scientific sources, points to increasing politicisation where scientific discourse is potentially being replaced by political discourse in news coverage. Similarly, Wagner and Payne (2017) found that in Irish newspapers, the most common sources quoted were politicians and government officials, aligning with their finding that policymaking and economic/energy interests frames predominated. Business actors and research bodies also had a significant voice, while NGOs and other civil society groups were less prominent.

The climate change discourse in Ireland was heavily shaped by political and economic elites. Freeman (2017) found that politicians/government officials were the most frequently quoted sources, followed by scientists/researchers and interest/advocacy groups. Industry/business representatives, citizens, and other sources were less common. This pattern is somewhat similar to findings in Western media, where political

sources often dominate, particularly when the issue is framed as a policy debate.

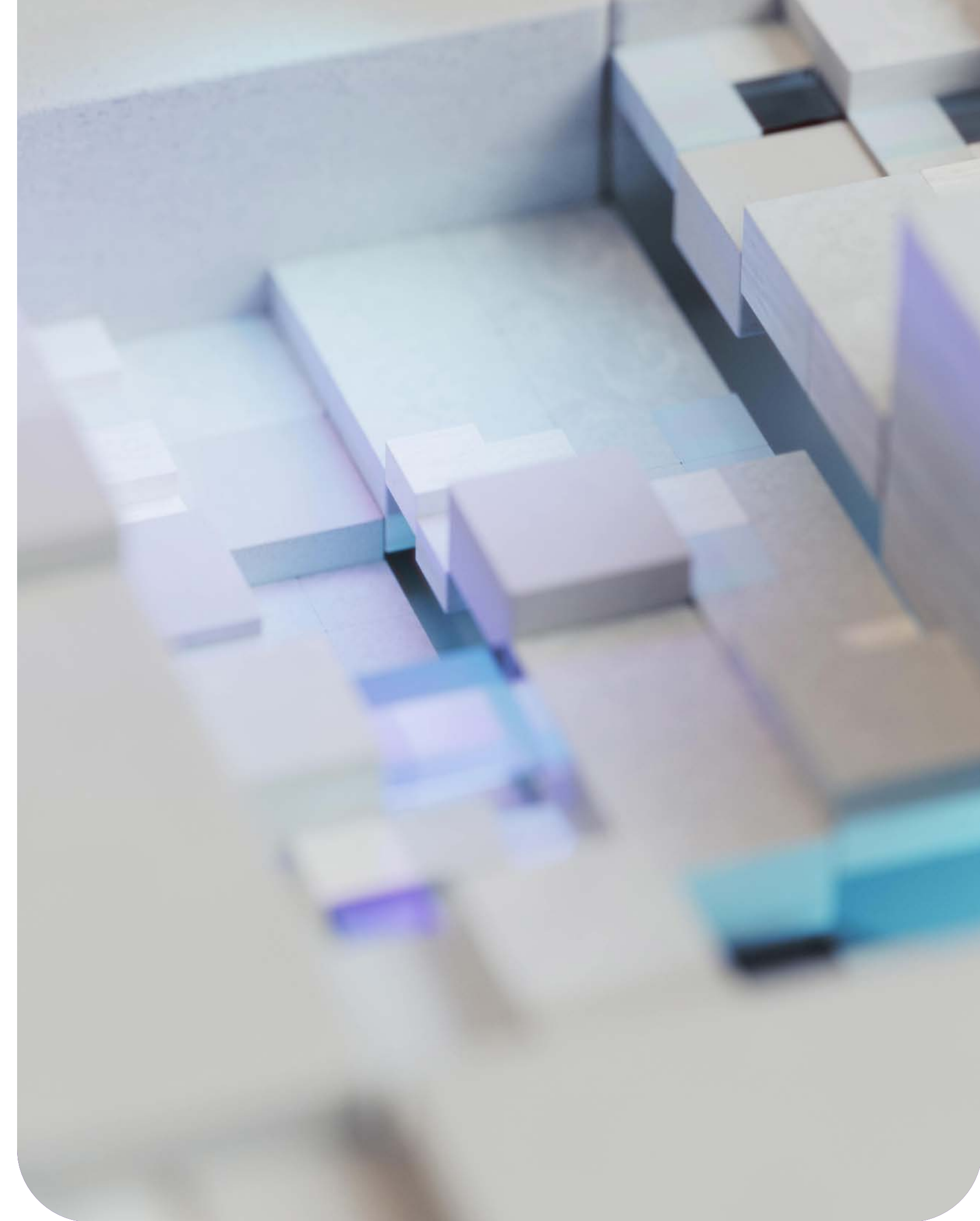
Perga et al. (2023) found that general interest and health news outlets, the major reporters of scientific findings, tended to co-mention many high-profile scientific articles, concentrating attention on a limited diversity of information. Their analysis of the disciplines of the mediatised research showed an over-representation of natural science and health research, and an under-representation of social science, engineering, and agriculture research.

The literature shows that the voice of scientists in climate change coverage has declined relative to politicians and other non-scientific sources, especially as the issue has become more politicised. However, the specific mix of dominant non-scientific sources (political, industry, NGOs) and the degree of scientific voice retained vary across countries, reflecting national media systems and political dynamics.

International Comparisons and Contextual Factors

The comparative studies highlight that national context significantly influences how climate change is covered and framed in the media (Boykoff & Boykoff, 2004; Brossard et al., 2004; Antilla, 2010; Schafer et al., 2014; King et al., 2019; Keller et al., 2020; Song et al., Chinn et al., Wagner & Payne, Freeman, Perga et al.). Differences in political systems, media systems, journalistic norms, and national exposure/vulnerability to climate impacts contribute to these variations. Boykoff and Boykoff (2004, 2007) contrasted US and UK prestige press coverage, highlighting the US “balance as bias” phenomenon where scientific uncertainty was overemphasised compared to the UK. Antilla (2010) also found differences in US vs. European coverage of climate “tipping points,” with European media (particularly the UK) showing stronger and more consistent reporting than the US press, which exhibited less urgency and was less likely to connect the specific scientific concept to broader implications.

Schafer et al. (2014) found that while COPs and international ENGO activities were drivers of attention in Australia, Germany, and India, the relative importance of domestic factors differed. Domestic political feedback was significant in Australia and Germany but not in India, while extreme weather events influenced coverage significantly only in Germany. Wagner and Payne (2017) attributed the dominant ecological modernisation frame in Irish newspapers to the influence of political and economic elites, who viewed climate action through the lens of economic opportunity and manageable regulation. Chinn et al. (2020) showed that while politicisation of climate change coverage is increasing in the US across different media, polarisation is starker on cable news than in newspapers.



Evolution of Media Framing

FRAME TYPE	TEMPORAL PATTERN	KEY CHARACTERISTICS	IMPACT INDICATORS
Scientific Consensus	Increasing over time	Alignment with scientific findings, reduced ‘false balance’	Improved public understanding, increased policy support
Politicisation actors	Increasing since 2000s	More political actors quoted, partisan divide	Polarised public opinion, policy gridlock
Economic	Prominent throughout, evolving focus	Shift from costs to benefits of climate action	Influence on policy debates, business engagement
Crisis/Doom	Dominant in early coverage, decreasing	Catastrophic language, focus on threats	Public anxiety, potential disengagement
Solutions/Sustainability	Emerging in recent years	Focus on mitigation and adaptation	Increased public engagement, policy action
Moral/Ethical	Increasing over time	Focus on responsibility, justice	Varied public response, limited policy impact

About Syli

Syli is a CIC non-profit organisation, founded in London by Tom Trewinnard and Fergus Bell. Syli supports mission-driven journalism in service of informed audiences around the world by fostering new and forward-looking concepts, identifying sustainable financial models for journalism, and creating a healthier, more sustainable media ecosystem.

About climateXchange

climateXchange (cXc) is Syli's groundbreaking new global initiative aimed at increasing the impact, reach and sustainability of climate journalism. cXc are reframing the climate conversation as a culture-first narrative is not just a media challenge, it's an opportunity. It's a chance to redefine how we, as a society, relate to the environment and world around us. cXc stands on three pillars of complementary activities:

contentXchange - Upskilling and capacity building of culture-first climate content and best practice including our IMERCS editorial methodology.

regionalXchange - Facilitation of cross-regional thought leadership and storytelling. Where we are conduits in cross-regional community meet-ups and networks, host think tanks, and support local market training sharing between regions.

knowledgeXchange - Impact, research and development. Access to Theory of Change Consultancy, and assistance in securing financial support.

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