

Climate news mediates extreme weather effects on climate change concern

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ARTICLE INFO

Dataset link: [10.7910/DVN/MOEYDD](https://doi.org/10.7910/DVN/MOEYDD)

Keywords:

Climate change concern
Extreme weather
News media
Issue attention
Mediation

ABSTRACT

As the severe impacts of climate change become increasingly apparent, concerns about climate-related issues have grown in recent years. The news media plays an important role in disseminating information about climate change and its consequences to the wider public and thus can influence public climate concern. Here, we investigate how extreme weather affects issue attention to climate change in the European online news media and how extreme weather and news coverage jointly shape changes in climate change concern. For the analysis, we combine 12 harmonized Eurobarometer survey waves, measuring public concerns about climate issues, with meteorological data and indices of environmental news coverage based on publications from 2481 media outlets in 200 regions of 22 European countries. Using fixed effects panel models, we estimate effects of temperature anomalies on climate news and climate concern and explore the role of the news media in explaining changes in concerns in response to temperature anomalies. The results indicate that unusually high temperatures exhibit a robust positive effect on media attention, especially when they overlap with other events that draw attention to the climate topic, such as major climate change conferences. We furthermore find evidence that the climate news in national outlets increases public concern about climate change and show that reporting by such outlets is likely to partly explain the effects of temperature anomalies on concerns. We do not find any significant effects of climate reporting in regional news outlets on climate concern. Our results suggest that the national news media partly mediates the effects of extreme weather on public climate change concern. The findings also highlight that focusing events strongly influence issue attention of the media, providing windows of opportunity to raise awareness about climate issues, while pointing to challenges in sustaining attention to related topics beyond short-lived news cycles.

1. Introduction

The impacts of climate change become increasingly visible worldwide, with extreme weather getting more frequent, prolonged and severe (Clarke et al., 2022). While extreme weather has directly palpable impacts that can influence climate concerns and the prioritization of climate policy in the affected regions, also their representation in the media can play an important role in influencing the public opinion (Sisco, 2021). Public support for climate action is essential for the implementation of both mitigation and adaptation measures, particularly in democratic systems where policy decisions are shaped by voter priorities. In this process, the news media serves as an important broker of information, linking scientific findings, political discourses, and public opinion (Tavares

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<https://doi.org/10.1016/j.crm.2026.100806>

Received 13 May 2025; Received in revised form 4 March 2026; Accepted 4 March 2026

Available online 6 March 2026

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et al., 2020; King et al., 2023). In the context of climate change, many individuals draw on media coverage to interpret climate-related events, making it an important factor in the social construction of climate change concern (Boykoff and Yulsman, 2013; Schäfer and Painter, 2020).

Previous research has demonstrated that extreme weather can affect public perceptions and increase concern regarding climate change and related issues such as energy (e.g., Brooks et al., 2014; Bergquist and Warshaw, 2019; Hoffmann et al., 2022). However, the mechanisms underlying these relationships are empirically not well established, including the role of the media in shaping these effects. Extreme weather influences individuals' firsthand experiences but climate change media coverage may be required to contextualize these events within broader climate change discussions. The information about extreme weather that is disseminated by the media could thus indirectly influence concerns, even among those who have not been directly affected.

In this paper, we explore the role of the news media in shaping public climate change concerns and examine the extent to which media coverage explains the relationship between extreme weather and concern. Understanding this mediation effect is critical for identifying the conditions under which extreme weather translates into sustained public engagement with climate issues. We furthermore consider how media reporting during extreme weather is affected by socio-political events, which can either direct attention to the climate topic or distract from it. As examples of such events, we explore the moderating role of UNFCCC Conferences of the Parties (COPs) and major sports events.

In our empirical design, in a first step, we analyze the effects of extreme weather, operationalized here with temperature anomalies, on the volume of climate reporting in the news media, considering also the role of other events that could focus attention on climate-related topics or crowd out attention to such topics. In a second step, we investigate the joint impact of temperature anomalies and climate news on climate change concern measured using Eurobarometer survey data, allowing us to estimate the extent to which news coverage mediates the effects of weather extremes.

The Eurobarometers are representative surveys that are conducted on a semi-annual basis in all countries of the European Union to collect data on public perceptions of various issues. Respondents are asked what they consider to be the two most important issues facing the European Union at the time of the interview. In their answers, respondents can name climate change as one issue, which we use as a basis to determine whether a person is concerned about the topic. For our analysis, we aggregate the Eurobarometer data to the sub-national regional level, constructing a panel on average climate change concerns covering 200 regions across 22 European countries from 2014 to 2019. We combine the concern data with information about the occurrence of temperature anomalies in the survey respondents' regions of residence prior to the interviews as well as media reporting about climate change in regional and national media outlets in the same time period. These data allow us to estimate longitudinal models to investigate how temperature anomalies influence the volume of climate news and to conduct a mediation analysis exploring the role of media in shaping the response of public concern to temperature anomalies.

Our study makes three key contributions to the literature. First, while prior research has examined the links between extreme weather, media attention, and climate concern separately, we integrate all three components into a single analytical framework (Fig. 2). In addition, focusing events are considered as moderators of the impact of extreme weather on media coverage. Second, our comprehensive panel dataset provides a unique basis for research on the drivers of public concerns about climate change, allowing us to assess sub-national differences in reporting and exposure to extreme weather. Our dataset includes media information derived from 1.2 million articles from 2481 online news sources, providing a broad perspective beyond large legacy media outlets such as The New York Times, which have been the focus of previous studies (e.g., Shanahan and Good, 2000; Eisensee and Strömberg, 2007; Liu et al., 2009; Tan and Weaver, 2009; Noailly et al., 2024). Third, we provide new insights into how different types of media outlets influence public perceptions of climate change by distinguishing between national and regional news sources. Our findings have implications for both climate communication strategies and policy-making, as they highlight the role of media in shaping public engagement with climate issues.

The remainder of the paper is structured as follows. Section 2 provides a review of the existing literature on extreme weather, media coverage, and environmental attitudes with a focus on climate change concern. Drawing on this review, we outline the hypotheses guiding our analysis. Section 3 describes the data, measurements, and methods employed in our study. Section 4 presents descriptive statistics on climate change media coverage and concern, along with the results of the regression models. Section 5 interprets these findings in light of the initial hypotheses. Section 6 addresses the study's limitations and considers their consequences for interpreting the results. Section 7 concludes.

2. Literature review and theoretical framework

A growing body of research explores the impact of extreme weather on environmental attitudes and behaviors. Most studies indicate that extreme weather has a short-term but positive effect on public climate concern (e.g., Egan and Mullin, 2012; Deryugina, 2013; Brooks et al., 2014; Bergquist and Warshaw, 2019; Howe et al., 2019). These effects extend beyond attitudes, influencing behaviors such as information-seeking (Lang, 2014; Osberghaus and Demski, 2019; Choi et al., 2020) and pro-environmental voting (Bromley-Trujillo et al., 2019; Hazlett and Mildenberger, 2020; Hoffmann et al., 2022; Bassetto et al., 2025). Possible mechanisms driving these effects include heightened emotional engagement, increased issue salience, and a reduced psychological distance to climate change, making the issue feel more immediate and personally relevant (Wang et al., 2019; Sisco, 2021). Furthermore, attribution of extreme weather to climate change, motivated reasoning, and issue attention in legacy and social media have been explored as moderators and mediators (Kirilenko et al., 2015; Pianta and Sisco, 2020; Sisco, 2021). However, portraying climate change as a proximate issue, for instance, by means of extreme weather, can yield mixed outcomes, with negative, neutral, and positive effects on pro-environmental attitudes and behavior depending on the context (Brügger et al., 2016).

Hypothesis 1. Extreme weather raises climate change concern.

Extreme weather can also play a role in setting the media agenda, defined as “the pattern of news coverage [...that] is a systematic compilation of the issues or topics presented to the public that identifies the degree of emphasis on these topics, [...often] in terms of their rank-order” (McCombs and Valenzuela, 2014). Agenda setting theory explains issue attention broadly with three factors: problem indicators, focusing events, and information feedback (Liu et al., 2009; Schäfer et al., 2013). First, problem indicators are information that highlights the factual importance of an issue. In the context of climate change, this includes long-term trends such as atmospheric greenhouse gas concentrations as well as short-term events such as the occurrence of extreme weather. Second, focusing events affect how widely an issue is disseminated and whether it stands out from the background noise of competing newsworthy material. For climate change, focusing events comprise, for instance, international conferences and treaties, civil society actions, and publications of major scientific reports (Lochner et al., 2024). Third, information feedback, generated by political actors, scientists, and advocacy groups, further amplifies or dampens media coverage.

Several studies have empirically investigated determinants of media attention to climate change and the environment. Early research already identified a positive impact of extreme weather on climate coverage in US newspapers and TV news (Ungar, 1999; Shanahan and Good, 2000). Also in the European context, climate change reporting of online news sources increases following periods of temperature anomalies (Pianta and Sisco, 2020). In Australian, German, and Indian print outlets, however, COPs as focusing events exhibit a stronger effect on climate change coverage than extreme weather as problem indicators (Schäfer et al., 2013; Lochner et al., 2024). Similarly, international focusing events and feedback through scientific publications have been found to positively affect issue attention of the New York Times (Liu et al., 2009). Media coverage depends also on economic context and elite cues, for instance statements by political organizations (Sampei and Aoyagi-Usui, 2009; Brulle et al., 2012; Carmichael and Brulle, 2018). Highlighting the role of competing newsworthy material, research suggests that news pressure from other exogenously determined events, like the Olympic Summer Games, significantly reduces US media coverage of natural disasters and consequently aid flows to the affected regions (Eisensee and Strömberg, 2007).

Hypothesis 2.1. Extreme weather increases climate change media coverage.**Hypothesis 2.2.** Socio-political focusing events drive media coverage of climate change.**Hypothesis 2.3.** The impact of extreme weather on climate change media coverage depends on exogenous focusing events.

Media attention affects what both decision-makers and their constituents see as a priority for policy-making at a given time (Tan and Weaver, 2009; McCombs and Valenzuela, 2014). Media coverage of climate change increases public climate concern in the USA, particularly among democrats (Brulle et al., 2012; Carmichael and Brulle, 2018). The reporting of local newspapers has also been found to influence the policy agenda of US states as measured by the number of introduced bills (Tan and Weaver, 2009). In terms of pro-environmental behavior of individuals, there is evidence that climate change-related media coverage can be linked to water saving (Quesnel and Ajami, 2017), donations to regions affected by extreme events (Chapman et al., 2023), green consumption (Trivedi et al., 2018), green investments (Noailly et al., 2024), and engagement in related Twitter discussions (King et al., 2023).

From the perspective of news consumption, patterns of media usage correlate with climate change concern, other environmental attitudes, behaviors, and preferences, as well as socio-demographics, forming distinct clusters that model a typology of individuals with regard to their engagement with climate change (Metag et al., 2017; Leiserowitz et al., 2021). Media usage influences problem awareness and behavioral intentions regarding climate change in Germany, although effects depend on pre-existing individual characteristics such as political interest and are mixed for different types of media (Arlt et al., 2011). Results of a meta-analysis indicate that media usage positively affects belief in anthropogenic climate change, with stronger effects of social than of traditional media (Bogert et al., 2024). Consumption of partisan news publications has been linked to the amplification of climate change opinions, resulting in polarization of attitudes in the USA (Bolin and Hamilton, 2018; Bolsen and Shapiro, 2018; Merry, 2024). In such settings, local media, e.g. weather news, tends to be more trusted across partisan divides than national media and may thus be more effective in fostering climate change belief and concern (Bloodhart et al., 2015; Andrews et al., 2023).

Hypothesis 3.1. Climate change media coverage increases climate change concern.**Hypothesis 3.2.** Climate change media coverage mediates the effect of extreme weather on climate change concern.**3. Data and methods**

Our empirical analysis is based on a panel of sub-national European NUTS regions with weekly frequency. The core dataset consists of harmonized Eurobarometer surveys, online news articles, and geo-referenced meteorological data which measure climate change concern, climate change media coverage, and temperature anomalies as instances of extreme weather. Table 1 summarizes the theoretical concepts in agenda setting theory as discussed in Section 2, their application to the research question, and their operationalization that is described in the following sections. Using these data, we estimate fixed effects models that control for region-year and season invariant factors. In all models, the continuous variables are scaled to unit variance given the standard deviation of the fixed effects residuals, resulting in standardized coefficients (Mummolo and Peterson, 2018).

Table 1

Summary of theoretical concepts, their application to the research question, and the corresponding operationalization. “Temperature anomaly” includes overall temperature anomalies, positive and negative temperature anomalies, warm and cold spell intensity, and warm and cold spell duration (Section 3.1.2).

Theoretical concept	Applied concept	Operationalization
Problem indicator	Extreme weather	Temperature anomaly
Focusing events	COPs and sports events	Event indicator
Issue attention	Climate change media coverage	Reports of online news media
Population outcome	Climate change concern	Prioritization as EU policy issue

3.1. Data and measurement

3.1.1. Climate change concern

We construct a measure of climate change concern from the Eurobarometer surveys 2014 to 2019. The Eurobarometers collect a repeated cross-section twice a year with a multi-stage, random sampling design on behalf of the European Commission. The sample consists of 620 469 individual respondents that reside in 200 regions of 22 countries. The climate change concern variable is based on the question “What do you think are the two most important issues facing the EU at the moment?”. Respondents are defined to be concerned if they indicate climate change as one of the two most important challenges for the EU, among a selection of other common policy domains, such as terrorism, unemployment, inflation, taxation, and immigration. Based on this information, we estimate the regional population share that is concerned about climate change using post-stratification weights.

3.1.2. Extreme weather

Different measures of unusually high and low temperatures are used to capture extreme weather. We focus on temperature anomalies because they tend to be attributed to climate change by both journalists and survey respondents due to the close connection to global warming, which is a precondition for any shifts in climate news coverage and public concern (Sisco, 2021). This is also reflected in the large overlap of concerns for climate change generally and global warming more specifically (Skogen et al., 2018). Beyond their salience with regard to climate change, temperature anomalies offer several methodological advantages. They vary quasi-randomly over time within a given region-year, reducing concerns about confounding with other local trends since the timing of temperature extremes is strictly exogenous to any socio-economic processes, news coverage, and regional attitudes (Dell et al., 2014; Hsiang, 2016). In contrast, other types of hazards, such as floods, are strongly affected by adaptation measures. Additionally, temperature is spatially extensive in contrast to more confined weather events, including wildfires and floods. Given that the Eurobarometer survey only provides respondents’ region of residence, not their exact location, this ensures that all respondents within a region are similarly affected by the event.

The raw data of the temperature variables are daily means from the ERA5-Land reanalysis (Hersbach et al., 2020). These 0.1° grids are aggregated to NUTS regions as their mean, weighted with the fraction each cell intersects with the region area. The measures are then defined based on the distribution of daily values in region i and calendar week $w(t)$ in the reference period 1981–2010 which characterizes the regional climate throughout the year.

The first measure is based on the long-run mean $\mu_{i,w(t)}^{81-10}$ and standard deviation $\sigma_{i,w(t)}^{81-10}$ of the regional temperature distribution. As a first step, standard scores are calculated as

$$T_{i,t}^{\text{anomaly}} = \frac{T_{i,t} - \mu_{i,w(t)}^{81-10}}{\sigma_{i,w(t)}^{81-10}} \tag{1}$$

and averaged for each week. A positive anomaly is defined as

$$T_{i,t}^{\text{anomaly,pos}} = \begin{cases} T_{i,t}^{\text{anomaly}}, & \text{if } T_{i,t}^{\text{anomaly}} > \sigma_{i,w(t)}^{81-10} \\ 0, & \text{otherwise} \end{cases} \tag{2}$$

and aggregated to 4-week rolling means. The 4-week time period is chosen for aggregation based on the results of distributed lags models that more flexibly model the effect of temperature anomalies on climate news over time (Appendix D.1.2). Figure A3 in Appendix A.3 describes the temporal aggregation and sequence of variables in more detail.

As alternative measures, warm (cold) spells are defined as at least three consecutive days with temperatures $T_{i,t}^{\text{spell}}$ that fall above (below) a the 95th (5th) percentile $T_{i,w(t)}^{p95}$ ($T_{i,w(t)}^{p5}$) (Perkins and Alexander, 2013). Spell severity measures the temperature in excess of the thresholds while duration captures the number of days defined as spell. The warm spell severity is defined as

$$T_{i,t}^{\text{excess,warm}} = \begin{cases} T_{i,t}^{\text{spell}} - T_{i,w(t)}^{p95}, & \text{if } T_{i,t}^{\text{spell}} > T_{i,w(t)}^{p95} \\ 0, & \text{otherwise} \end{cases} \tag{3}$$

and the cold spell severity as

$$T_{i,t}^{\text{excess,cold}} = \begin{cases} |T_{i,t}^{\text{spell}} - T_{i,w(t)}^{p5}|, & \text{if } T_{i,t}^{\text{spell}} < T_{i,w(t)}^{p5} \\ 0, & \text{otherwise} \end{cases} \tag{4}$$

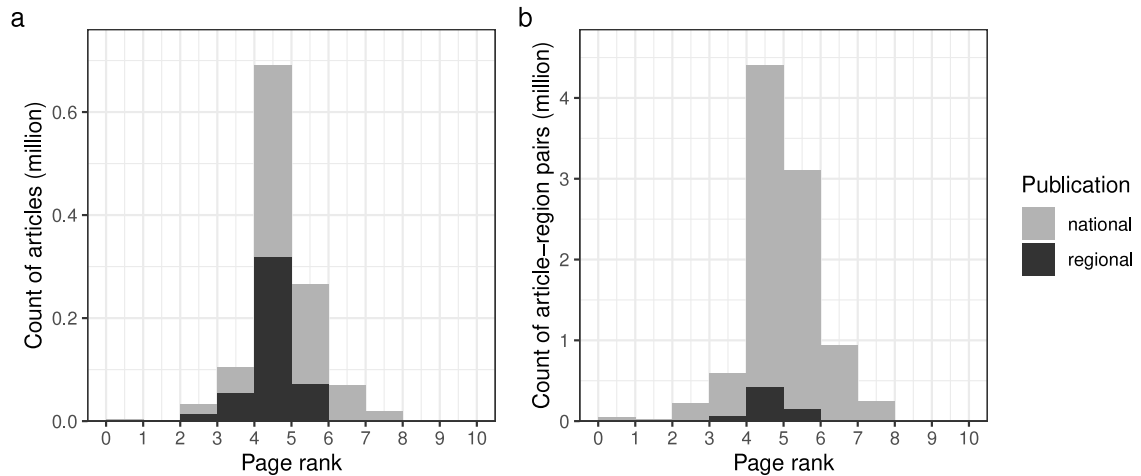


Fig. 1. Histograms of the page ranks distribution by type of publication. (a) shows counts of unique articles, (b) counts of articles as assigned to NUTS regions. The bars for regional and national sources are stacked.

so that higher values of both cold and warm spell measures indicate more extreme events. The daily values are then summed up to weekly values and averaged over rolling 4-week periods. Figure A1 in Appendix A.1 shows the yearly distribution of the different temperature measures.

3.1.3. Environmental media coverage

Data on news coverage is retrieved from the Europe Media Monitor (emm.newsbrief.eu) hosted by the Joint Research Centre of the European Commission. It provides a comprehensive overview of European media activity by collecting RSS feeds and clustering the retrieved articles thematically (Steinberger et al., 2009). We collect all articles in the categories Climate Action, Climate Change, Environment, Environmental Protection, Ecology, and Biodiversity that are published a given country, regardless of their language. We construct a measures of articles covering topics related to climate change (Climate Action, Climate Change), of articles covering other environmental topics (Environment, Environmental Protection, Ecology, and Biodiversity), and of energy topics (Renewable Energies, Alternative Energy). The index of climate news serves as the mediator in the following analysis, while the indices of environmental and energy news are used to control for related media coverage in additional specifications. The environment and energy indices exclude articles that are also tagged with climate change-related topics to separate the measures more clearly. We validate the assignment of topics by manually reviewing a random sample of articles (Appendix A.4).

We screened the sources for journalistic quality so only publications of newspapers, press agencies, and other online news outlets that are targeted at a general audience feed into the indices. 2 481 of the 3 910 unique sources in the raw data meet this criterion. Any press releases from companies, lobby organizations, non-governmental organizations, political organizations, government bodies, parliaments, academic organizations as well as special interest publications, for instance for particular professions or fake news, are removed and only included in the dataset to the extent that they were picked up by journalistic outlets. We analyze all articles published in journalistic outlets, including possible duplicates, since articles that were published several times by one outlet or across several outlets are also likely to have reached a larger audience. Thus duplicates can plausibly impact climate change concern each time they are published.

Each unique domain is then assigned one or more NUTS region codes corresponding to the Eurobarometer based on its news coverage. For larger publications with several subdomains for different sections, each section is attributed to the relevant regions. For instance, a regional section of a newspaper can be assigned to the respective region, while the general section is assigned to the whole country. We exclude a few sources that are not clearly associated with specific regions or countries (EU Agenda, EU Observer, Euractiv, EU Reporter, European Voice, Europolitics, Politico EU, EU Business, European Data Journalism, Neurope).

Based on these raw data, we create indices of environmental news coverage that are weighted with the importance of the source as approximated by the page rank of the respective website. The page rank p_s is a weight of each source s based on the hyperlink structure of the internet that assigns high scores to those pages with relatively many incoming links from highly ranked sites and relatively few outgoing links (Berkhin, 2005). The weights are provided by the Open Page Rank that is based on Common Crawl project, an open source database of web crawl data (DomCop, 2022). The Open Page Rank is scaled to a range from 0 to 10. Fig. 1 shows the distribution of page ranks over the included articles.

The measures distinguish between news outlets with a sub-national regional focus and those that target one or more countries as a whole. Separately for regional and national news, the weighted sum of articles published in region i at time t is calculated as $m_{i,t} = \sum_s n_{i,t,s} p_s$ and normalized as $m_{i,t}^{norm} = m_{i,t} / \sigma_i$ in order to account for the differences in regional variance of news density (Pianta and Sisco, 2020).

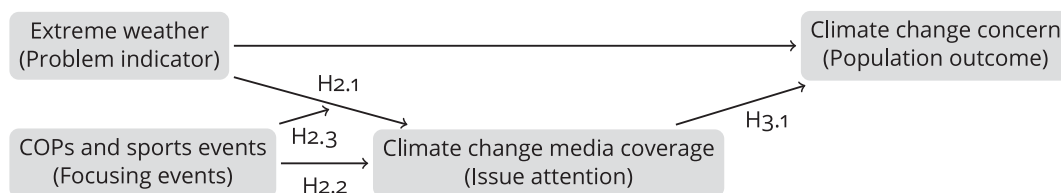


Fig. 2. Hypothetical relationship of concepts in agenda setting theory. Extreme weather as problem indicator influences population outcomes such as climate change concern both directly and indirectly through media coverage. Climate change media coverage that captures issue attention thus acts as a mediator in this framework. The extent to which a problem indicator translates into issue attention is affected by exogenous events that draw attention to related issues. Such focusing events thus are a moderator of the effect of problem indicators on issue attention. The labels on the arrows indicate the hypothesis that refers to the respective relationship.

3.1.4. Climate change information acquisition

Information acquisition is measured using Google web searches for climate change and global warming, translated to the regional languages based on the list provided by [Pianta and Sisco \(2020\)](#). Google trend regions are matched to the NUTS regions that are available in the Eurobarometer. For some small or sparsely populated regions, the overall or climate change-related search volume is too low so they cannot be included. This affects some regions in Sweden, Finland, Bulgaria and all regions in Romania. Data for the latter is retrieved for the whole country.

Google provides search interest as a percentage of the maximum search interest in a given time period if it exceeds an unknown minimum threshold. Since the API only provides monthly data for the whole period of analysis, we download daily data for each region-month separately and adjusted it for the monthly overall Google search interest 2014–2019 to make the values comparable over time ([Bewerunge, 2018](#)). The adjusted daily values are $\text{trend}_{i,t}^{\text{adj}} = \text{trend}_{i,t}^{\text{daily}} \times \text{trend}_{i,t}^{\text{monthly}} / 100$. To obtain the final index, the adjusted daily values are averaged for each NUTS region and week. Figure A2 in Appendix A.1 shows the levels of Google web search for climate change and global warming as time trends across regions and as regional averages 2014–2019.

3.1.5. Focusing events

Focusing events are operationalized using indicator variables of various event types that have been shown as relevant to the public perception of climate change in previous literature ([Eisensee and Strömberg, 2007](#); [Liu et al., 2009](#); [Schäfer et al., 2013](#); [Lochner et al., 2024](#)). A complete list of included events as shown in [Fig. 3](#) is provided in Table A4. They are included in the regressions grouped into the following event types: COPs, G7 summits, sports events, activism, and EU elections. Major sport events comprise Football World Cups, European Football Championships, and Olympic Summer Games. Four days are added before the start and after the end dates of each event to account for news attention in the weeks immediately before and after the events. Accordingly, events beginning Monday to Thursday are assumed to affect also news coverage in the previous week, while events ending Wednesday to Sunday are assumed to affect also the coverage of the following week.

3.2. Model specification

The empirical model considers two ways in which extreme weather can affect climate change concern ([Fig. 2](#)). First, weather as problem indicator for climate change can directly influence population outcomes such as climate change concerns in the affected regions. Alternatively, weather could draw media attention to climate change and other environmental topics as important political issues which in turn affects attitudes. Such an indirect effect could also influence those that were not immediately affected by the weather.

To analyze the relevance of the media in shaping climate change concerns in the aftermath of extreme weather, we first test whether extreme weather exerts a significant influence on related media coverage. Agenda setting theory suggests that the degree to which this is the case depends on focusing events that help extreme weather stand out from the background noise ([Liu et al., 2009](#)). Accordingly, focusing events could act as moderators and are introduced as interactions with extreme weather variables, allowing their effects on news coverage to vary. In a second step, we test whether increased media attention affects climate change concern and explains the relationship between weather and changes in concerns as a mediator.

Our empirical strategy is based on the framework for mediation analysis of [Baron and Kenny \(1986\)](#), which is operationalized with a linear structural equation model ([MacKinnon et al., 2007](#); [Imai et al., 2010b](#)). In this approach, the total effect of extreme weather on climate change concern is decomposed into a direct effect, capturing changes in concern that arise independently of media coverage, and an indirect effect that operates through shifts in climate-related news. Formally, the mediation framework consists of two linked equations. The mediator equation models the effect of extreme weather and its interaction with focusing events on the volume of climate change coverage in regional and national media outlets (Equation (5)). The outcome equation expresses climate change concern as a function of extreme weather and media coverage (Equation (6)). Estimating these equations jointly allows us to identify how much of the overall relationship between extreme weather and changes in concern is transmitted through media attention.

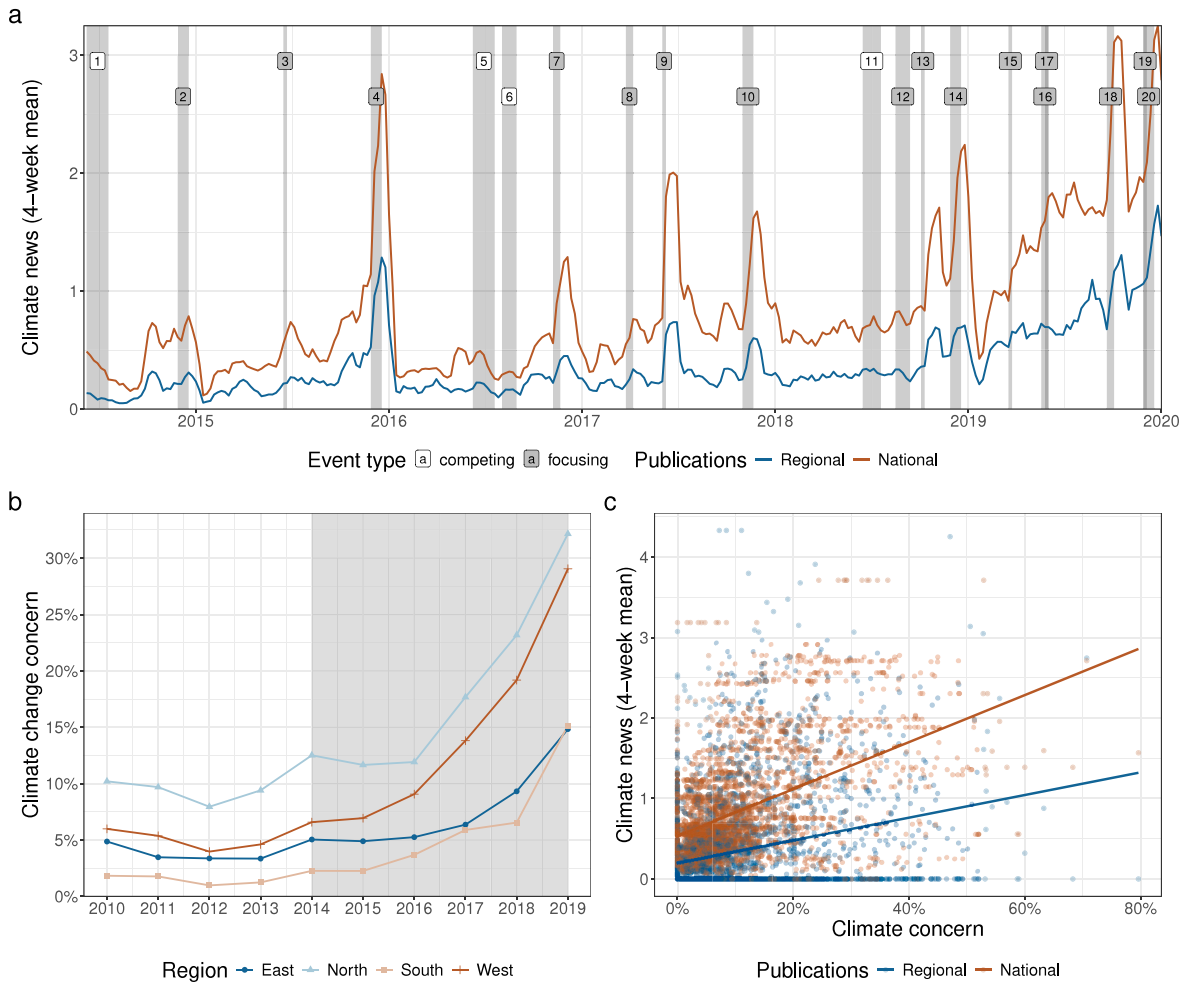


Fig. 3. Descriptive statistics of climate change news coverage and concern. **(a)** 4-week moving average of climate change news of regional and international news outlets. The highlighted events are (1) Football World Cup 2014, (2) Conference of the Parties 20, (3) Pope Francis’s encyclical letter on climate change and the environment, (4) Conference of the Parties 21, (5) European Football Championships 2016, (6) Olympic Summer Games 2016, (7) Conference of the Parties 22, (8) Trump undoes clean power plan, (9) USA announce withdrawal from Paris Agreement, (10) Conference of the Parties 23, (11) Football World Cup 2018, (12) Greta Thunberg’s school strike, (13) IPCC Special Report 15, (14) Conference of the Parties 24, (15) First Global Climate Strike, (16) European Parliament election 2019, (17) Second Global Climate Strike, (18) Global Week of Climate Action and UN Climate Action Summit, (19) Fourth Global Climate Strike, (20) Conference of the Parties 25 (Table A4). Event type “competing” includes sports events and event type “focusing” includes climate-related events. **(b)** Yearly average climate change concern in European macro-regions. The grey area indicates the period of analysis. **(c)** Scatter plot of the share of the regional population concerned with climate change as one of the two most important challenges for the EU and average climate news in the 4 previous weeks, including the week of the survey.

We thus estimate a structural equation model of the form

$$m_{i,t} = \beta w_{i,t} + \delta_{i,t} + \lambda_t + \eta_t + \varepsilon_{i,t} \tag{5}$$

$$y_{i,t} = \beta' w_{i,t} + \gamma m_{i,t} + \delta_{i,t} + \lambda_t + \eta_t + \varepsilon_{i,t} \tag{6}$$

where $y_{i,t}$ is the population share that is concerned about climate change in region i at time t , $m_{i,t}$ is the measure of news coverage acting as the mediator variable, and $w_{i,t}$ is the weather shock. $\delta_{i,t}$ are region-year fixed effects that control for any unobserved factors that vary on a region-year basis. This includes the average level of climate concern and news which could be affected by time trends such as general shifts in environmental attitudes or total news output. η_t are event fixed effects that include COPs, G7 summits, sports events, activism, and EU elections. λ_t are season fixed effects that capture the varying timing of measurement throughout the year. $\varepsilon_{i,t}$ is the idiosyncratic error. Accordingly, the specification exploits variation within region-years and seasons while unobserved heterogeneity of region-years and seasonality are absorbed by the included fixed effects.

The mediation effect is computed as the product of β and γ as implemented by Tingley et al. (2014). Causal interpretation of the mediated effect requires the sequential ignorability assumption to hold (Imai et al., 2010a,b). First, the treatment $w_{i,t}$ is assumed to be independent from the mediator $m_{i,t}$, and the outcome $y_{i,t}$, given pre-treatment covariates. Variation of temperature extremes within region-years can be considered to be random and independent of media coverage and concerns since temperatures cannot be influenced in the short term, plausibly satisfying this assumption (Dell et al., 2014; Hsiang, 2016). Second, sequential ignorability requires the independence of the mediator from the outcome, conditional on the observed treatment and other potential pre-treatment covariates. This means that media coverage is quasi-randomly assigned and independent of climate change concern, given the weather conditions and fixed effects.

4. Results

4.1. Trends in climate change reporting and concern

Attention of European online news media to climate change has trended upwards over the analyzed time period (Fig. 3a). The increase is more pronounced in national than in regional news outlets. The time series are characterized by several short-lived spikes in coverage that coincide with specific events such as COPs, particularly in national outlets (Table D12). Also other events such as the European Parliament election 2019, G7 summits, and school strikes positively correlate with issue attention. In contrast, sports events, such as Football World Cups, tend to decrease the coverage of climate topics.

Levels of climate change concern declined until 2012 in the aftermath of the global recession, stagnated in 2014 and 2015, and increased markedly since 2016 across Europe (Fig. 3b). Nevertheless, there are large differences in levels between regions, related to both structural and individual-level drivers (Peisker, 2023; Bassetto et al., 2025). In 2019, the share of concerned respondents converged around 15% in the Southern and Eastern European regions and around 30% in the Northern and Western European regions. Regional climate change concern correlates positively with the volume of climate news published in the previous weeks (Fig. 3c). This correlation with concerns is stronger for news in national outlets than for news in smaller regional outlets.

4.2. Warm spells increase media reporting about climate change

In fixed effects models, we regress climate news coverage in regional outlets and national outlets on measures of unusually high and low temperatures (Table D5). Warm spells consistently increase news coverage in both regional and national outlets while the effects of cold spells are insignificant across most definitions of temperature anomalies (Fig. 4). This indicates that the results do not rely on a specific definition of temperature anomalies. The finding is robust to various specification changes, including an alternative fixed effects structure with controls for spatio-temporal trends (Table D6), an alternative method to adjust the standard errors for spatial autocorrelation (Table D7), not weighting news articles by the page rank of their outlet (Table D8), variations in the threshold to define cold and warm spells (Table D9), controlling for lagged media coverage (Table D10), and the inclusion of distributed lags and leads (Figure D6). Figure B4 in Appendix B provides placebo tests with explanatory variables 10 000 times randomly resampled within region-years, indicating that the results are not artifacts of the fixed effects structure.

Temperature anomalies may not only affect the content provided by news outlets, but also information seeking behavior of the local residents (Lang, 2014; Sisco et al., 2017). Such behavior could correlate with media attention, biasing the estimated effect of climate news on concern. To approximate information acquisition, we construct indices of Google web search of climate change and global warming (Section 3.1.4). We find that temperature anomalies do not significantly affect search intensity (Table D11). While climate news in regional outlets have a moderate positive impact on regional searches, national climate news and coverage of other environmental topics do not influence this outcome.

4.3. Focusing events draw media attention

Agenda setting theory suggests that not only extreme weather as problem indicator, but also focusing events influence the topics of news coverage. We include COPs, other political summits, national and EU elections, and climate activism as events that could focus the attention on climate change-related topics. As example of events that compete for limited media attention, we consider major sports events. To explore the heterogeneity of temperature effects on media coverage, we add interactions of the temperature variables with COPs and sports events since they occur regularly with predetermined timing, making them exogenous to news coverage and extreme weather. In the following analyses, we focus on positive and negative temperature anomalies as measures of extreme weather.

We find that COPs, G7 summits, and climate activism increase climate change coverage, while sports events decrease it (Table D12). The effects of all event types are notably larger in national than in regional outlets that are by definition more focused on local events. The events also affect how temperature extremes are perceived (Fig. 5). The effects of positive temperature anomalies on news coverage of climate change is significantly larger during COPs, highlighting the important role these events play in drawing attention to climate change and vice versa. In contrast, the coverage of climate change due to such temperature extremes is not significantly affected by sport events. Both estimates control for possible seasonality of effect heterogeneity.

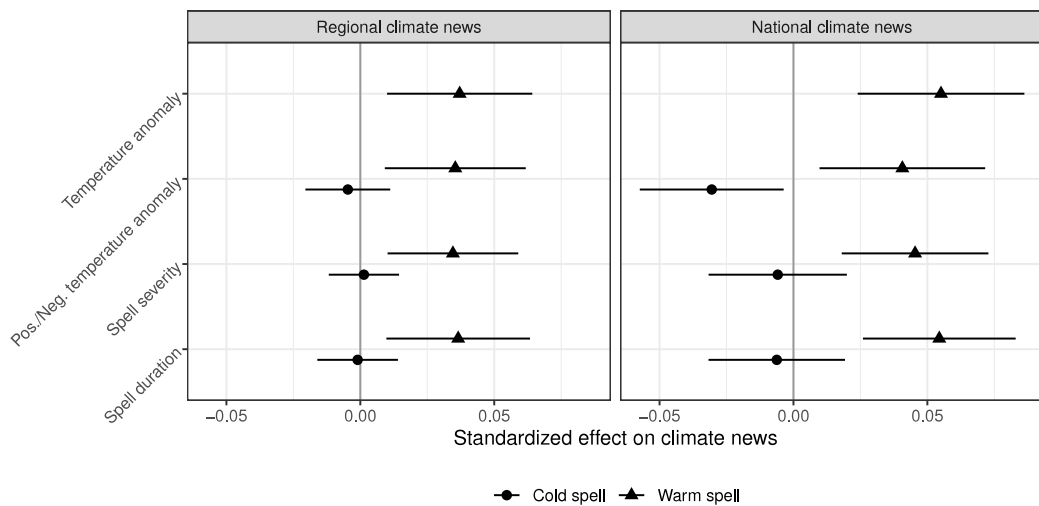


Fig. 4. Baseline effects on the climate news index of regional and national publications (Table D5). The dots indicate the point estimates, the lines 95% confidence intervals with standard errors clustered by country-year. Variables are standardized using the variance of the fixed effects residuals. Positive (negative) temperature anomalies are weeks that are at least 1 standard deviation above (below) the weekly average of the reference period 1981–2010. Warm (cold) spells are defined as at least three consecutive days above the 95th (below the 5th) percentile of the weekly distribution in the reference period. Severity refers to the temperature in excess of threshold during such spells while duration captures the number of days defined as warm and cold spells. News articles are weighted by the page rank of their outlet.

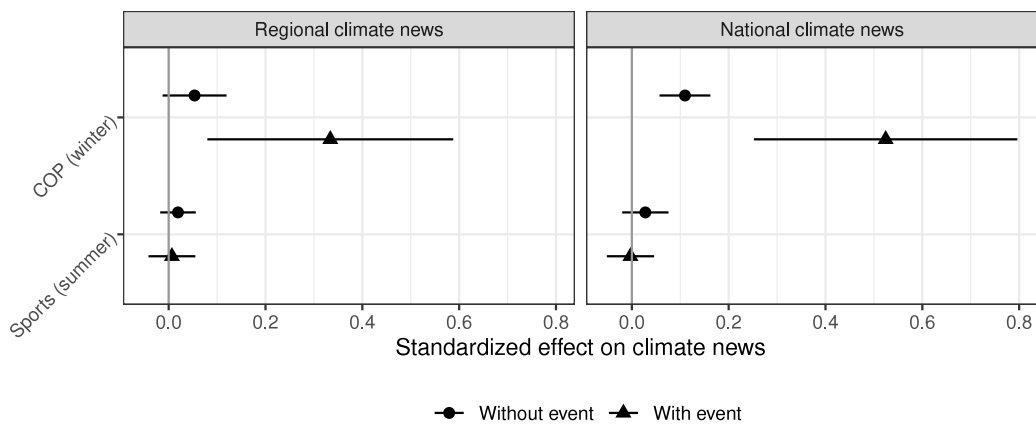


Fig. 5. Heterogeneous effects of positive temperature anomalies on news coverage of climate change. They represent the marginal effect of a 1 standard deviation increase in positive temperature anomalies, conditional on coincidence with COPs in winter and major sports events in summer (calculation of linear combinations based on Table D12, columns 1–2). Positive temperature anomalies are defined as weeks in which the temperature is at least 1 standard deviations above the weekly distribution in the reference period. The ranges indicate 95% confidence intervals based on standard errors clustered by country-years.

4.4. Media coverage increases concerns about climate change

Climate news stories from national sources have a sizable positive impact on concerns (Table 2, columns 5–7). This effect is robust to controls for related news indices (column 6), knowledge acquisition as measured by Google search intensity for climate change and global warming (column 7), and the control for spatio-temporal trends (Table D14). In contrast, climate change-related publications from regional sources do not significantly affect climate change concern. Figure B5 in Appendix B provides placebo tests with explanatory variables 10 000 times randomly resampled within region-years, indicating that the results are not artifacts of the fixed effects structure.

The effectiveness of climate news could increase or decrease with the level of coverage if a critical mass of coverage is needed to influence regional attitudes or audiences become saturated by too much coverage. To investigate such a non-linear impact of media coverage on climate concern, we include quadratic terms of the climate news indices (Table D15). We find that the effect

Table 2

Upper panel: Input models for the mediation analysis with treatment *T*, mediator *M*, and outcome *Y*. All variables except for climate change concerns are 4-week averages. Standard errors in parentheses are clustered by country-years. Lower panel: Mediation analysis with positive temperature anomalies as the treatment variable and national climate news as mediating variable (Tingley et al., 2014). The proportion mediated refers to the fraction of the total effect that is mediated by national climate news. In parentheses are bootstrapped 95% confidence intervals based on 10,000 resamples. In the sensitivity analysis, parameter values are reported at which the mediation effect would be zero (Appendix C).

	<i>M</i> : National climate news			<i>Y</i> : Climate change concern			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>T</i> : Pos. temperature anomaly	0.130 *	0.100	0.103	0.149 **	0.127 **	0.124 **	0.128 **
	(0.075)	(0.067)	(0.065)	(0.060)	(0.057)	(0.061)	(0.062)
Neg. temperature anomaly	-0.095 *	-0.082 *	-0.091 *	-0.077 **	-0.061 *	-0.060 *	-0.059 *
	(0.050)	(0.046)	(0.048)	(0.036)	(0.033)	(0.033)	(0.034)
<i>M</i> : National climate news					0.171 **	0.163 **	0.167 **
					(0.075)	(0.078)	(0.084)
Regional climate news		0.171 ***	0.167 ***			0.017	0.016
		(0.041)	(0.042)			(0.047)	(0.049)
National environmental news		0.240 ***	0.234 ***			0.025	0.014
		(0.063)	(0.061)			(0.057)	(0.058)
Regional environmental news		-0.066 *	-0.064 *			0.015	0.014
		(0.038)	(0.038)			(0.039)	(0.041)
National energy news		-0.028	-0.025			-0.030	-0.023
		(0.056)	(0.056)			(0.064)	(0.064)
Regional energy news		-0.008	-0.003			-0.026	-0.026
		(0.022)	(0.023)			(0.041)	(0.043)
Google web searches			0.071 ***				0.020
			(0.026)				(0.029)
Observations	2669	2669	2534	2669	2669	2669	2534
Region-year fixed effects (groups)	1159	1159	1104	1159	1159	1159	1104
Season fixed effects (groups)	4	4	4	4	4	4	4
Event type fixed effects (groups)	4	4	4	4	4	4	4
R ² (overall)	0.807	0.828	0.835	0.854	0.855	0.855	0.845
R ² (within)	0.064	0.165	0.181	0.020	0.029	0.030	0.030
Mediator model					(1)	(2)	(3)
Average mediation effect					0.022 ***	0.016 ***	0.017 ***
					(0.01, 0.03)	(0.01, 0.03)	(0.01, 0.03)
Average direct effect					0.127 ***	0.124 ***	0.128 ***
					(0.06, 0.2)	(0.06, 0.2)	(0.06, 0.2)
Total effect					0.149 ***	0.14 ***	0.145 ***
					(0.08, 0.22)	(0.07, 0.21)	(0.07, 0.22)
Proportion mediated					0.149 ***	0.116 ***	0.119 ***
					(0.07, 0.31)	(0.05, 0.26)	(0.05, 0.27)
Sensitivity analysis							
ρ					0.1	0.1	0.1
$R_M^{*2} R_Y^{*2}$					0.01	0.01	0.01
$\tilde{R}_M^2 \tilde{R}_Y^2$					0.0091	0.0081	0.0079

* $p < 0.1$.

** $p < 0.05$.

*** $p < 0.01$.

of national climate news is stronger at higher levels and insignificant at lower levels, suggesting that climate coverage requires a certain amount of volume to become effective (Figure D7a). The effect of regional climate news remains statistically insignificant across the range of observed values (Figure D7b). To stay in a single-mediator framework in the following analysis, we use a linear relationship as an approximation since the quadratic terms do not improve model fit as indicated by the adjusted R^2 (Table D15, column 2 & 4).

We find that positive temperature anomalies raise climate change concern in the affected regions while negative anomalies have a smaller negative effect (Table 2, columns 4–7). Consistent with a mediating role of climate news coverage, the coefficients of temperature anomalies are attenuated once climate news variables are included (columns 5–7). Coverage of other environmental topics does not significantly affect climate change concern. Since no Eurobarometer surveys were conducted during or immediately after COPs or major sports events, we cannot test how such events modulate these effects of media coverage.

Media attention to climate topics is not only driven by supply-side factors, i.e., newsworthy material, but also demand-side factors, i.e., the interests and attitudes of the audience. Plausibly, news outlets publishing in regions that experience an increase in climate concern could adjust their coverage to meet the interest of their readers, leading to endogeneity concerns (King et al., 2023). We find that climate change concern increases climate news in the following weeks only in regional, but not in national outlets (Table D13). This suggests that national outlets do not significantly respond to regional attitudes with regard to climate change, making it a suitable mediating variable.

4.5. Reporting as mediator of temperature impacts on concerns

Based on the models in Table 2, we infer the extent to which climate news could act as channel through which temperature extremes affect climate change concerns. Since only national, but not regional climate news are estimated to positively affect concerns (Table 2, columns 6–7), the following models focus on national news as mediator. Additionally, national news are not significantly affected by regional concerns (Table D13), strengthening the sequential ignorability assumption required for a causal interpretation of the mediation estimate. Appendix C provides a more detailed discussion of the assumptions and their plausibility based on a generic sensitivity analysis suggested by Imai et al. (2010a,b).

In Table 2, T indicates the treatment variable (positive temperature anomalies), M the mediator (national climate news), and Y the outcome (climate change concern) of the mediation model. The national climate news has a significant and sizable positive mediation effect. In the parsimonious specification, it is estimated that on average about 15% of the total effect of positive temperature anomalies on climate change concern can be attributed to national climate news (Table 2, column 5). The results remain robust to the inclusion of competing mediators. When controlling for other environmental news indices and information acquisition, the proportion mediated by climate news remains sizable and statistically significant (column 6–7). These findings are fully robust to an alternative specification that controls for spatio-temporal trends (Table D14).

5. Discussion

The findings indicate that positive temperature anomalies on average raise climate concern in the affected regions, corroborating results of previous studies (e.g. Deryugina, 2013; Brooks et al., 2014; Hoffmann et al., 2022). Negative temperature anomalies have a smaller effect regional concerns, indicating a non-linear relationship of temperature anomalies and concerns. This suggests that extreme weather that is readily attributed to climate change influences regional attitudes more strongly since unusually high temperatures are closely related to global warming, while unusually low temperatures are not a salient feature of climate change (Sisco, 2021). The results overall provide support for Hypothesis 1 that extreme weather increases climate concern with the qualification that positive temperature anomalies as examples of events associated with climate change have a stronger effect than negative anomalies.

Our results show that positive temperature anomalies also significantly increase climate change coverage in both regional and national news outlets, while negative anomalies do not consistently affect climate news. Accordingly, climate change attribution is likely to similarly act as a moderator for these effects in the context of Hypothesis 2.1 that extreme weather draws media attention to climate change. In columns 2–3 of Table 2, the coefficient of positive temperature anomalies becomes insignificant once controlling for related news indices. The data is subset to weeks with available survey data here which leads to a much smaller sample and less precise estimates compared to Fig. 4. Since media and weather are measured contemporaneously in Table 2, the other news indices could mediate and thus bias the temperature effects on national climate news in this specification (Appendix A.3).

As a second driver of climate change news coverage, we identify COPs, climate activism, and G7 summits as also suggested by the time series in Fig. 3a and previous research (e.g. Liu et al., 2009; Schäfer et al., 2013; Lochner et al., 2024). This lends support to Hypothesis 2.2 that socio-political focusing events draw media attention to climate change, particularly COPs in national news outlets. Conversely, competing events such as major sports tournaments reduce media attention to environmental topics by diverting journalistic resources and audience focus, highlighting the broader challenge of sustaining attention in an increasingly fast-paced media environment. Overall, the finding of an upward trend in climate news with event-driven surges in attention corroborates data from the USA and other countries (Schmidt et al., 2013; Metag et al., 2017; Bohr, 2020; Boykoff et al., 2024).

The temperature effect on news coverage is particularly pronounced during major climate-related events, such as COPs, which can amplify the salience of extreme weather in the climate change discourse (Liu et al., 2009). We can only partly confirm Hypothesis 2.3 that the effect of extreme temperature is moderated by focusing events since we find a sizable significant interaction of positive temperature anomalies only with COPs but not with sports events, implying that the type of event and its association with climate change are relevant for the interaction.

We find support for Hypothesis 3.1 that climate news increase climate concern with regard to reporting in national news outlets. Climate reporting in regional outlets, however, does not exhibit a similar effect. Accordingly, we cannot confirm previous results from the USA that regional news are particularly effective in raising climate concern in the European context (Bloodhart et al., 2015; Andrews et al., 2023). Several factors related to differences in audience reach, editorial framing, and the political salience of national versus local reporting may contribute to the stronger effects of national compared to regional publications. First, media consumption behavior differs between social strata and correlates with environmental attitudes and values. It is possible that larger, national outlets are more likely than regional ones to reach an audience which is not strongly concerned about climate change yet but also not ideologically opposed to it (Metag et al., 2017). Second, articles of national outlets also tend to be published on larger websites and across more regions, enhancing their visibility. While the median page rank of unique articles is only slightly higher in national than in regional news outlets (4.8 vs 4.5), the most widely read articles with page rank greater than 6 are almost exclusively from national sources (Fig. 1). Third, smaller regional publications may lack the resources and expertise to effectively report on complex scientific topics such as climate change, especially under financial pressure from declining subscription and advertising revenue (Boykoff and Yulsman, 2013; Schäfer and Painter, 2020; Andi, 2020). Fourth, mitigation-focused climate reporting, which requires engagement with high-level policy discussions, is more prevalent in national outlets, whereas adaptation measures, that are often framed as localized concerns, feature more prominently in regional sources (Gurwitt et al., 2017; Tavares et al., 2020).

The mediation model suggests that positive temperature anomalies raise public concerns about climate change both directly and indirectly. Directly, as they affect experiences in the region and indirectly as national media reporting increases popular climate change concern, linking temperature anomalies to attitudes. The evidence thus supports Hypothesis 3.2 that climate change news coverage in national-level media outlets acts as mediator between extreme weather and climate change concern. While the robustness tests and sensitivity analysis indicate that the mediation effect is not likely to be spurious, a causal interpretation requires that news coverage is independent of the concerns, given the treatment and control variables (Appendix C). Although the assumption cannot be directly tested, we provide suggestive evidence by regressing media coverage on past climate change concern. We find that regional climate change concern does not predict future coverage of climate issues in national outlets, while it increases climate news in regional outlets (Table D13).

6. Limitations

Despite the large number of news outlets and articles included in our data, the measurement of media attention has limitations which are important for the interpretation of the results. The data contain only articles that were published online, but not those that were published exclusively offline, e.g. through television, radio, or print. The results may thus not generalize to all possible media types and there may be differences in the impacts of online and offline media sources. Especially for regional news outlets, however, the internet has become an important medium to connect with their audience as physical distribution becomes economically less viable with declining subscriptions (Schulz, 2020). Also, younger age groups are more likely to consume online media making them more susceptible to their reporting (Andi, 2020; Robertson, 2022).

We only capture journalistic publications, while social media contents in response to temperature anomalies are not included in our data. However, a significant share of social media content about climate change is based on news as journalists increasingly disseminate their content through social media channels (Kirilenko et al., 2015; Schäfer and Painter, 2020). A randomized experiment showed a sizable, causal increase of social media posts in the week after publication of online news (King et al., 2023). Our estimated effects on concern therefore likely capture the such social media posts that derive directly or indirectly from the news items immediately after their publication. In additional models, we include a variable for Google searches for climate change to rule out that our media effects are driven by increased information seeking. All our results remain fully robust to this variation. Also chatbots based on large language models are increasingly used to acquire information that was previously sourced from news media and may influence attitudes and behaviors related to climate change (Hornsey et al., 2025; Bago et al., 2025). Overall, however, the news media remains the most important source of information about climate change despite the rise of alternative information channels (Ejaz et al., 2025).

Our data only capture the number of articles related to climate change and environmental issues so we do not observe the total publication output during a specific time period. Accordingly, we cannot measure the relative share of relevant reports published and the competing news pressure from other salient topics. This could lead to spurious trends in the descriptive statistics if, for instance, the upward trend of climate news is an artifact of an increase in the total output. Regardless, changes in total media output do not affect the validity of our regression results because the region-year fixed effects control for any unobserved changes in the output level. Furthermore, the data do not include information on the readership in each region-week, implying that we assume each article has an equal impact in each region it is assigned to. The media indices capture differences of impact between outlets through the global page rank of their respective website. While this might be a good approximation for small media outlets, differences in audience size between regions could introduce measurement error for larger outlets which are consumed in many regions.

Similarly, the trend of climate change concern could be influenced by changes in the Eurobarometer survey design. The trend question itself remained unchanged over time but the answer categories summarizing different policy domains have partly changed (Hoffmann et al., 2022). While “climate change” was available as answer category in all included survey waves, changing alternatives could have influenced the level of reported climate change concern. We flexibly control for changes in the level of concern, whether spurious or not, using region-year fixed effects to avoid bias in the estimated effects of temperature and news coverage on climate change concern.

7. Conclusion

Our results show that positive temperature anomalies substantially heighten media attention to climate change in both regional and national outlets. This response is influenced by COPs as focusing events that amplify coverage of temperature anomalies, especially in national media. Such events could provide windows of opportunity to connect extreme weather with the broader climate discourse, leading to a particularly strong rise in the volume of climate change coverage, for instance, if journalists take unusual temperatures as illustrations of abstract climate science concepts. We also find that positive temperature anomalies and climate reporting in national outlets increase public concern about climate change, whereas regional coverage has no significant effect on concerns. The mediation analysis suggests that part of the impact of positive temperature anomalies on climate concern can be attributed to increased national-level climate news.

The findings highlight the central role that international focusing events, particularly COPs, play in shaping climate change coverage. This could be related partly to non-governmental organizations strategically directing media attention to climate issues during such events (Schäfer, 2012). Notably, national news outlets appear more sensitive to these political events, whereas regional

sources prioritize more immediate local concerns. The reliance on focusing events, however, raises important questions about how climate communication can be sustained independently of periodic media cycles driven by large political or social events.

From a policy perspective, our findings suggest that reporting of national media outlets in the context of temperature anomalies could be effective in raising public concern and engagement. Scientists and advocacy groups could collaborate with journalists to ensure that extreme weather is framed in a way that highlights the role of climate change as a systematic issue rather than an isolated event. Periods, during which climate change is already high on the policy agenda, for example during COPs, offer time windows to engage with the public and raise awareness about the issue. The dominance of event-driven journalism in large outlets, however, also points to challenges and opportunities for effective climate change communication in smaller, regional news outlets beyond global focusing events. Additionally, strategies to counteract the crowding-out effect of competing media events, such as sports tournaments, could be explored by connecting climate topics to these events.

While our study focuses on the volume of climate coverage, future research could further examine the qualitative aspects of media representation. Narratives, visualizations, and frames, such as emphasizing scientific consensus, economic consequences, or moral responsibility, may interact to influence public concern in distinct ways (Wozniak et al., 2015; Dasandi et al., 2022; Thier and Lin, 2022). Beyond temperature anomalies, the study could be extended to other types of extreme weather that can differ in their effects on news coverage and climate change concern. Also the coverage of international extreme weather events and its effect on policy preferences warrants further investigation since many of the most severe climate change impacts are occurring in the Global South and are likely under-reported in Europe (Eisensee and Strömberg, 2007; Kalatzi Pantera et al., 2023). An accurate representation in the European media is thus important to raise awareness not only about local climate impacts but also about impacts occurring in those regions most affected by climate change.

CRedit authorship contribution statement

Jonas Peisker: Writing – original draft, Writing – review & editing, Visualization, Software, Methodology, Data curation, Conceptualization. **Roman Hoffmann:** Writing – review & editing, Methodology, Supervision, Conceptualization. **Raya Muttarak:** Writing – review & editing, Supervision.

Funding information

JP and RH gratefully acknowledge funding from the International Institute for Applied Systems Analysis, Austria and the National Member Organizations that support the institute. RH acknowledges funding by the European Union's Horizon Europe Programme under Grant Agreement No. 101094551 (SPES) and under Grant Agreement No. 101162653 (2C-RISK) supported by the European Research Council. RM acknowledges funding by the European Research Council under Grant Agreement No. 101002973 (POPCLIMA).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.crm.2026.100806>.

Data availability

Code and data is available in a public repository with DOI [10.7910/DVN/MOEYDD](https://doi.org/10.7910/DVN/MOEYDD).

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