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Tracing the Emergent Field of Digital Environmental and Climate Activism Research: A Mixed-Methods Systematic Literature Review

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ABSTRACT

Following Fridays for Future's transnational mobilization, research into digital environmental and climate activism has rapidly grown. We contribute to the solidification of this emerging field through a mixed-methods systematic literature review. We quantitatively analyze 138 peer-reviewed articles regarding their theories, methodologies, and empirical focus. To identify research trajectories and emerging fields of interest, we add an in-depth qualitative analysis of influential publications. Research interest has grown rapidly and shifted from various areas of environmental grievance towards climate change as the primary focus. The field is driven by theories of framing, connective action, and (in)visibility. It is methodologically diverse, but geographically biased towards the West. Popular approaches include ethnographic case studies and Twitter studies, while other platforms receive limited attention. We diagnose a need for more comparative and relational approaches going beyond individual cases, countries, and platforms.

Climate change and environmental deterioration have been characterized as a key "planetary issue" of our time (Castells, 2008). Despite the issue's overwhelming importance, the field of climate change has long been criticized as elitist and characterized as a discourse which does not reflect the views and voices of the broader citizenry (Beck, 2010). Yet, recent years have seen the emergence of digitally networked, grassroots, transnational protest movements like Fridays for Future (FFF) or Extinction Rebellion.

These new climate movements rely on digital media as an organizing tool where they blend collective and connective action (Bennett & Segerberg, 2013) and produce complex scalar arrangements by "connecting local action to global processes" (Boulianne et al., 2020, pp. 208–209). Their proliferation has sparked academic interest and digital environmental/climate activism emerged as a field of inquiry. We therefore start out from the assumption that the recent observation of a dearth of research on climate activism (Agin & Karlsson, 2021) may no longer be true. Because the proliferation of digital media has shifted the theories (e.g. Bennett & Segerberg, 2011, 2013) as well as methods and data (cf. Neumayer & Rossi, 2016) used to investigate social movements, and the way these movements constitute themselves, *digital* environmental/climate activism, specifically, is a promising focus for our investigation. Through a mixed-methods systematic literature review, this study contributes to the definition and clarification of the field.

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We ask: *Which theories, methodologies, and empirical foci (in terms of geography, platforms, and actors) characterize the field of digital environmental/climate activism research? How did the field evolve?*

We quantitatively describe a corpus of 138 articles from leading English-language peer-reviewed journals. Informed by the same research question, for a subsection of the most influential papers, we conduct a qualitative analysis to synthesize their theoretical, methodological, and empirical contributions, and point out emerging research trajectories. While surveying English-language journals does not enable us to characterize the complete field of digital environmental/climate activism, focusing on these prestigious publications in the scientific *lingua franca* (Wolters, 2015) draws attention to the widely-read orthodoxy of the field. Because this focus is common in related literature reviews (e.g. Agin & Karlsson, 2021; Dhaher & Gümüş, 2022; Özkula et al., 2022), it enables a characterization of similarities and differences to research on climate change communication and digital activism, in general.

Our findings reveal a growing body of work on digital environmental/climate activism. More than one third of papers in our corpus were published in 2021 and the first half of 2022. There is a growing interest in youth activism, which coincides with a shift from environmental activism around specific local/national events to global climate movements. The field is characterized by a greater diversity of theories, methods, and empirical cases than previous reviews suggest. Yet, it is in need of theoretical synthesis, as well as more comparative and relational research designs.

Prior work

To our knowledge, ours is the first systematic review of digital environmental/climate activism research. However, earlier reviews of both climate communication, and digital activism research informed our expectations and approach. Surveying these studies has shown that most characterize the field through the dimensions of theories, methods, and empirical foci. The latter often includes geographical contexts, media or platforms, as well as actors under study. We mirror these aspects in our research, to enable comparisons to prior reviews and because they facilitate an overview of core aspects of empirical research studies.

The state of environmental and climate communication research

Several recent systematizations of environmental (Comfort & Park, 2018) or climate communication research (Agin & Karlsson, 2021; Dhaher & Gümüş, 2022 Pearce et al., 2018; Schäfer & Schlichting, 2014) exist. Despite different sampling approaches and time periods, all of these studies come to similar assessments.

Studies show an "increasing prominence and consolidation" (Hansen, 2011, p. 9) of environmental and climate communication over time. Since the 1970s, the field has shifted from studying a variety of environmental issues to climate change communication (Comfort & Park, 2018). Investigating 407 peer-reviewed articles from 1993 to 2018, Agin and Karlsson (2021) find that 62% have been published since 2014. Dhaher and Gümüş (2022) find 2020, the final year of their data collection, to be the preliminary peak in research.

This growth only partially coincides with a diversification of theories, methods, and empirical subjects. In terms of theories, the field is dominated by communication scholarship (Agin & Karlsson, 2021). Framing emerges as the dominant paradigm (Agin & Karlsson, 2021; Dhaher & Gümüş, 2022; Hansen, 2011). Dhaher and Gümüş (2022) conclude that many studies lack a theoretical framework. They call for a focus on the linkages between local and global to address the spatial complexities of climate change.

Methodologically, the field exhibits "a certain amount of conservatism" (Agin & Karlsson, 2021, p. 443), with a focus on content analyses and surveys (Agin & Karlsson, 2021; Comfort & Park, 2018; Dhaher & Gümüş, 2022). Quantitative and qualitative approaches are roughly balanced,

while mixed-methods designs are rare (Comfort & Park, 2018; Dhaher & Gümüş, 2022; Schäfer & Schlichting, 2014). Social media studies on climate change tend to use large datasets and quantitative, text-based approaches (Pearce et al., 2018).

Research is dominated by cases from North American and Western European countries (Agin & Karlsson, 2021; Comfort & Park, 2018; Dhaher & Gümüş, 2022; Schäfer & Schlichting, 2014). Although Schäfer and Schlichting (2014) find evidence of geographical diversification over time, Asian, African, and South American countries remain marginal. Studies investigate the countries most responsible for climate change, rather than those most vulnerable to its impacts (Schäfer & Schlichting, 2014, p. 154).

Research is focused on mass media and journalistic actors (Agin & Karlsson, 2021; Comfort & Park, 2018; Dhaher & Gümüş, 2022; Schäfer & Schlichting, 2014). Research on non-news media is growing, but remains scarce (Agin & Karlsson, 2021; Dhaher & Gümüş, 2022; Schäfer & Schlichting, 2014). Social media-centric papers are overwhelmingly concerned with Twitter, with minimal interest in Facebook and YouTube, and a lack of other platforms (Pearce et al., 2018).

Environmental communication research is therefore characterized as geographically narrow and primarily concerned with professional newsmakers. Studies outside of this area are also comparatively poorly cited (Agin & Karlsson, 2021). Activist communication is of marginal interest (Agin & Karlsson, 2021, p. 44).

The state of digital activism research

The second relevant research area for our study is digital activism. Neumayer and Rossi (2016) analyze prominent articles on protest and new media between 2000 and 2014 regarding media types, geographical foci, types of activism, and methodology. Özkula et al. (2022) tackle the question of data types and methodological approaches in digital activism research. To our knowledge, no reviews of theoretical approaches in digital activism research exist.

In terms of methodology, Neumayer and Rossi (2016) diagnose a decline in both theoretical papers and qualitative methods from 2007 onwards. With the increasing importance of digital data, quantitative approaches, especially social network analysis, become more common (p. 9). Mixed-methods papers are rare. This point is only partially corroborated by Özkula et al.'s (2022) survey of digital activism research methodologies from 2011 to 2018. They observe a decline in studies with exclusively traditional (as opposed to digital) data sources. However, many studies combine digital and non-digital data, and although computational approaches play a significant role, semi-structured interviews are the most common method (p. 9).

Similar to climate communication, a geographical bias towards North America and Europe exists (Neumayer & Rossi, 2016, p. 8). After 2008, a geographical diversification can be observed, with more studies focusing on the Middle East, Iran, and China (p. 7). International and multi-country studies are rare.

Regarding platforms, scholarship has increasingly moved from descriptions of larger media ecologies towards studies of specific platforms, especially Twitter and Facebook (Neumayer & Rossi, 2016; Özkula et al., 2022), which is criticized as potentially obscuring activist practices (Neumayer & Rossi, 2016, p. 7). The growth of single-platform studies coincides with a move towards studying digital forms of activism (e.g. networked activism), rather than activist engagement around specific issues (Neumayer & Rossi, 2016). Özkula and colleagues (2022) identify three archetypes of digital activism studies. Two of them are single-platform studies, focusing on Twitter hashtags and Facebook pages. The third type includes holistic approaches, spanning multiple sites and methods, and often using ethnographic approaches (p. 13).

Aim and contribution

While we have substantial knowledge in the field of climate change communication, knowledge of *digital* climate change communication and digital activism research is limited. Recent reviews

suggest that digital communication and activism are marginal subjects in environmental communication. However, even recent reviews (Agin & Karlsson, 2021; Dhaher & Gümüş, 2022) do not cover the last few years. The resulting gap may obscure crucial developments in the field of digital environmental/climate activism research. Current reviews suggest that climate communication research as well as digital activism research are theoretically and methodologically limited and conservative, feature strong geographical biases and focus on newspapers and Twitter as "easy data" (Özkula et al., 2022, p. 1). Yet, these features may not hold true for the intersection of digital environmental/climate activism research as an interdisciplinary field. Finally, existing reviews mostly take an exclusively quantitative approach to the literature. We believe that adding "flesh on the bare bones" (Kriesi et al., 2021, p. 10) via a mixed-methods review can identify trajectories in the literature.

Data and methods

We conducted a mixed-methods systematic literature review of social-scientific research on digital activism around environmentalism and climate change.[1] While quantitative literature reviews can describe a field, qualitative ones aim for theory-building and knowledge generation (Finfgeld-Connett & Johnson, 2013, p. 197). In a mixed-methods review, we aim for a middle-ground solution. We quantitatively describe and qualitatively synthesize the literature, similar to Suominen and Hajikhani (2021).

We limit our analysis to peer-reviewed articles written in English and published in journals listed in the Social Sciences Citation Index (SSCI). Hence, we cannot characterize the full breadth of research but capture the widely read, prestigious orthodoxy of the field. We conducted a four-step data collection and analysis process.

Step 1: data retrieval

To identify relevant publications, we tested several combinations of keywords. Each potential search string captured the three dimensions of our research object – (1) climate or the environment, (2) activism, and (3) digital or social media – , but varied in the search terms per dimension. Similar to Özkula et al. (2022, p. 6), the aim of testing multiple search strings was to identify a maximum number of relevant publications, while minimizing noise. For example, on the one hand, we found that adding "social movement" or "protest" to the activism dimension discovered additional relevant publications, but added little noise. On the other hand, including the names of specific social media platforms added very few new publications, but implicitly privileged some platforms over others, which is why we refrained. Finally, we used the following Boolean string:

> (climate OR "global warming" OR environment*) AND (activis* OR "social movement" OR protest OR "contentious politics") AND ("social media" OR "social network*" OR "digital media" OR "online media")

We collected data through Web of Science (WoS), identifying articles with a combination of these keywords in the title, abstract, or keywords. We filtered results by date up to 30 June 2022. This yielded an initial set of 440 papers, which were further screened.

Step 2: final data selection

Final inclusion was based on a manual review of each article's abstract and, if necessary, content to assess whether it fit the aforementioned inclusion criteria. 10% of the articles were screened jointly by both authors. The rest were screened by one author, and borderline cases were discussed. As we aimed for a broad view of the field, we included papers even if the aforementioned three dimensions were peripheral in the analysis (cf. Schäfer & Schlichting, 2014). The final dataset consisted of 138 papers.

Step 3: quantitative analysis

We used a mostly standardized codebook to capture theoretical, methodological, and empirical aspects of the full corpus. The codebook was adapted from Agin and Karlsson (2021) and can be found in the online appendix (Footnote 1). One author and a student assistant jointly coded 20% of the material for training purposes. Afterward, a reliability test was conducted ($n = 30$). Table 1 provides an overview of variables and reliability coefficients. One author coded the remainder of the material.

Step 4: qualitative analysis

For the in-depth qualitative analysis, we chose a subsection of our corpus to analyze the most influential contributions. We focused on the most cited papers, which highlight interests and trends in the field (Comfort & Park, 2018, p. 867). Focusing on widely cited papers tends to exclude recently published ones. To circumvent this, we separated papers published in the last two years (2021, 2022). We selected the 20 most cited papers from before 2021, and the five most cited papers for 2021 and 2022, each. 30 papers are well above the minimum sample size for different qualitative content analysis strategies (cf. Sim et al., 2018). Choosing papers from before 2020 and the last two years, separately, ensures the inclusion of recent papers, which have not yet reached their readership fully, while papers published before 2021 had a chance to be included in the most-cited papers. Lastly, our sample proportion of 20 to 10 approximately reflects the proportion of papers published in the last two years in the entire corpus (56 out of 138).

As shown in Figure 1, we incorporated a deductive and inductive coding process to synthesize research trajectories. Mayring (2014, p. 104) suggests combining deductive and inductive methods

Table 1. List of variables.

| Variable	Short description	Krippendorff's α
Year	Year of publication	NA
Citations Google	Number of citations on Google Scholar	NA
Citations Web of Science	Number of citations on Web of Science	NA
Discipline	First author's discipline	0.91
Country case	Country which was studied or where data was collected	0.89
Scope	Spatial scope of the activist point of contention, from locally focused to transnational	0.79
Theoretical outlook	Description of main theoretical approach or concepts	String variable
Method	Main methodological approach	0.82
Analytical paradigm	Paradigm of data analysis (i.e. quantitative, qualitative, computational)	0.87
Actors	Description of activist actors	String variable
Platform	Digital platform on which activism occurs	0.8
Activism object	Main object of activism (climate activism vs. other forms of environmental activism)	0.8
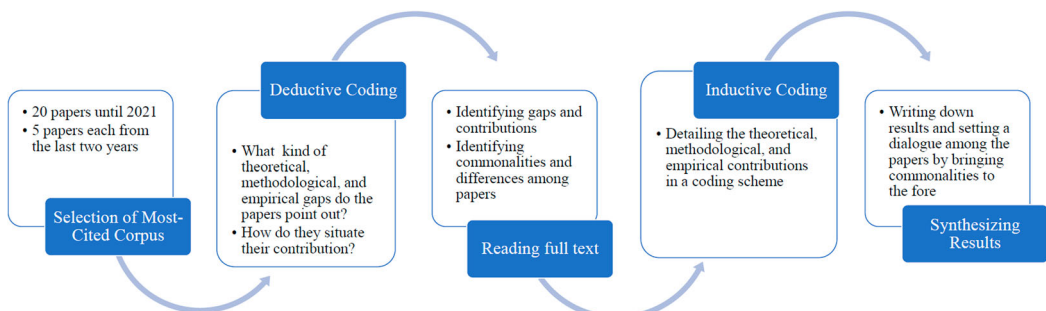
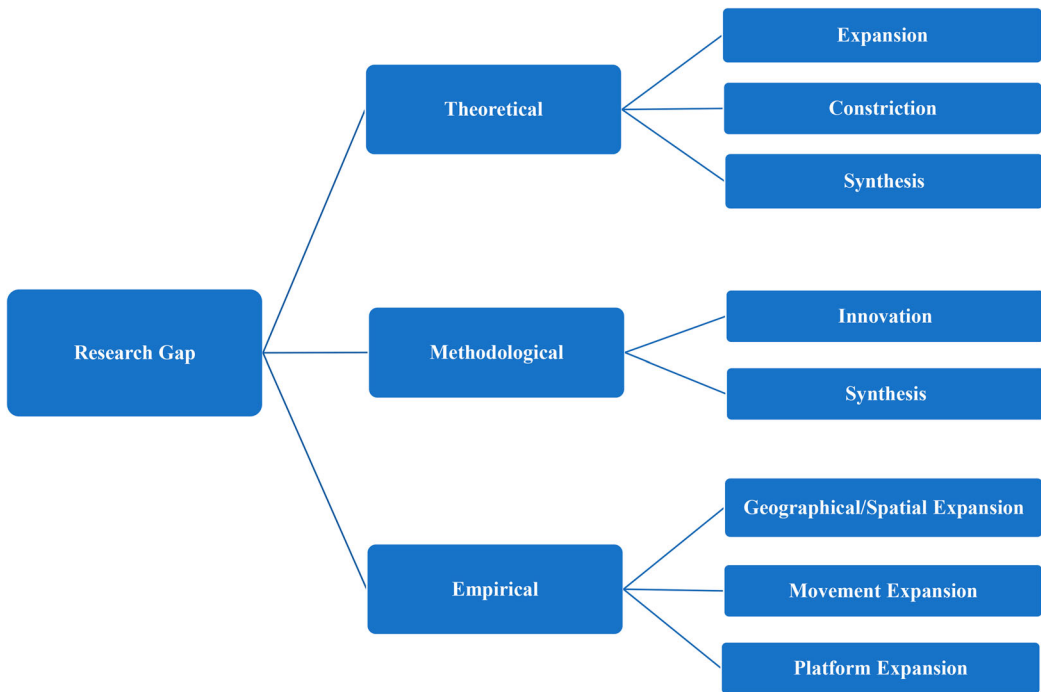**Figure 1.** Qualitative coding process.

Figure 2. Final qualitative coding scheme.

for qualitative content analysis. On the one hand, deductive category assignment informed by experience and theory allows the researcher to structure the coding process. On the other hand, inductive category formation is a complementary procedure, which allows more precise categorization and enables the diversification of deductively derived categories. We used our knowledge of the academic domain to derive theory, method, and empirical foci as aspects that are addressed in most academic papers and usually defined as research gaps to which papers aim to contribute. Further, our research question informed deductive category assignment. For inductive category formation, we focused on variations in the papers' contributions to these dimensions. For instance, a paper might suggest a theoretical contribution by bringing new dimensions to the theory, hence expanding its application. Therefore, we inductively derived more specific sub-categories within each dimension to specify the papers' contribution. We detected different types of contributions in all three dimensions and added new categories every time a new aspect emerged. The resulting coding scheme is demonstrated in Figure 2.[2]

Results

Our data reveals a growing interest in digital environmental/climate activism. Figure 3 shows the overall trendline, as well as separate trends for publications about climate vs. other forms of environmental activism.[3] While the first paper was published in 2009, research activity remained marginal until 2014. The first increase focused almost exclusively on non-climate-related digital environmental activism. A second sharp increase began in 2020. It was driven by an emerging focus on climate activism. Overall, 38.4% of papers were published in the past 1.5 years. In the presentation of further results, we focus on a cross-sectional description. A longitudinal analysis of key quantitative variables, which can be found in the online appendix (Footnote 1), revealed few clear trends. Where temporal patterns emerged, we briefly point them out.
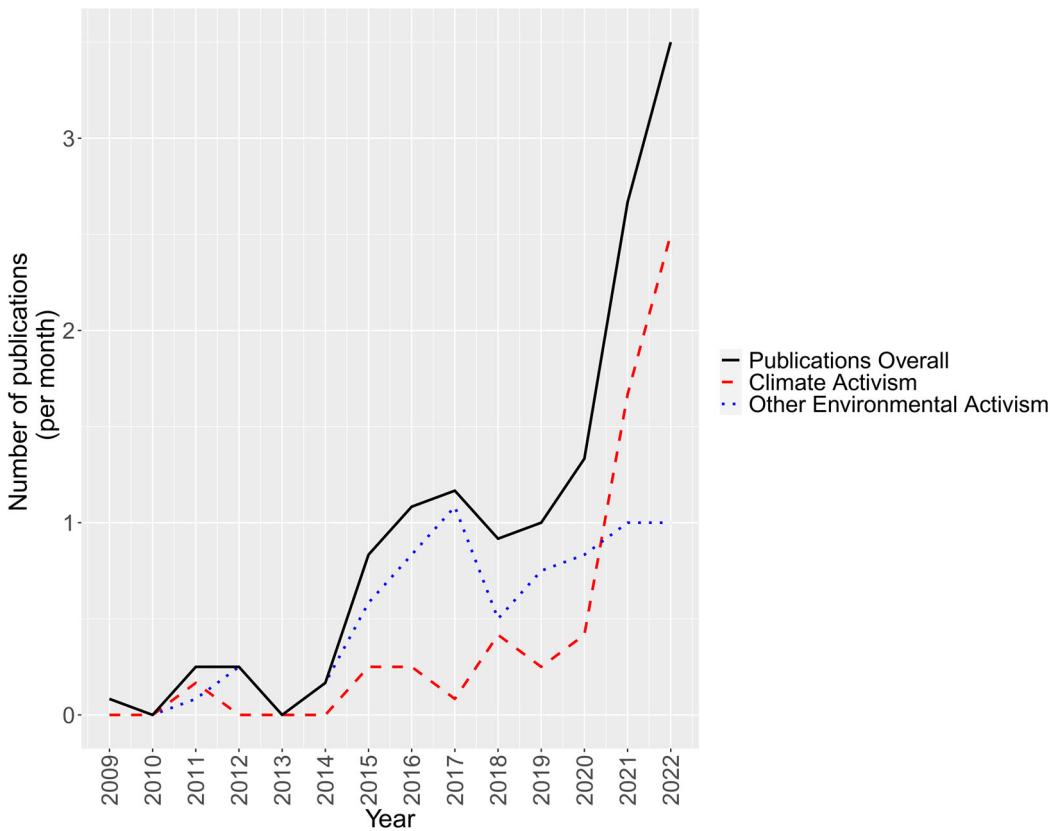
Figure 3. Research interest in digital environmental/climate activism over time. *Note: Results from full corpus (n = 138 papers).*

Stated research gaps

The in-depth analysis of stated research gaps in the most influential works reveals how recent scholarship seeks to shape the field theoretically, methodologically, and empirically. Theoretical contributions are foregrounded in sixteen out of the thirty most cited papers. They are defined in three ways: expanding the theory by bringing new aspects to light, constricting an old theory by pointing out its inadequacy for explaining a phenomenon, or synthesizing two or more theories by highlighting connections.

Fewer papers situate their contributions in methodology. Only seven papers aim for a methodological innovation or synthesis. Many contributions stem from network analysis. Empirically, new geographies (such as China or Chile), are brought into focus, as well as new platforms and emerging movements, such as FFF. A few recent studies focus on the global-local axis, uncovering how a global problem like climate change is locally addressed. These empirical expansions of research to new movements and spaces together with a rising number of publications in recent years signal a growing field of digital environmental/climate activism.

Below, we dive deeper into theories, methods, and empirical substance by discussing the results of the quantitative and qualitative analyses together. We synthesize findings for each aspect by first describing a variable quantitatively, based on the full corpus, then deepening the discussion through the qualitative analysis of 30 influential papers. To guide readers throughout the results, we refer to our *in-depth analysis* and *quantitative analysis* whenever the source of results changes.

Research fields, theories and concepts

In the *quantitative analysis,* coding theoretical fields and key concepts was challenging, given the diversity of theoretical schools and concepts. Like Agin and Karlsson (2021), we use a combination of disciplinary contexts and a string variable for key theories and concepts to characterize theoretical approaches in the complete corpus. Table 2 shows the most prominent disciplines, as well as their visibility in terms of citations. The field is dominated by communication scholarship (39.1%), with other disciplines, such as political science or sociology, following at a large distance. The dominance of communication scholarship has been stable over time (see Online Appendix).

The outsized role of communication studies is reflected in the field's key theories and concepts. As has previously been described for climate communication broadly (Agin & Karlsson, 2021; Dhaher & Gümüş, 2022; Hansen, 2011), framing is the most prominent theoretical paradigm in digital environmental/climate activism studies. To characterize the specificity of digital activism, Bennett and Segerberg's (2013) connective action approach is frequently invoked. Other common approaches to the study of online activism include hashtag activism, network theory, and counterpublics. Traditional notions from social movement research, such as collective identity, collective action, or contentious politics are also used. A number of concepts related to the spatiality of digital environmental/climate activism, such as transnationalization or glocalization, emerge.

The *in-depth analysis* reveals two clusters of theoretical approaches in the most influential papers. The centrality of Bennett and Segerberg's (2011, 2013) work on *connective action* is emphasized by the qualitative analysis. Their theory, which shifts from a collective action frame (rigid, centralized movement structures with ideological homogeneity) towards a connective action approach (allowing loose connections between people with different ideological convictions), inspired many studies.

Most papers utilize Bennett and Segerberg's (2011, 2013) connective action and personalization of activism approach in a cursory fashion, citing it as a reason for focusing on digital media in activism research. Fewer papers engage with the approach more substantively. Hopke (2015), and Hodges and Stocking (2016) bring it together with collective action theories of social movements, analyzing the flow between online and offline activism and the formation of collective identity through social media activism. Marchi and Clark (2021) exert the connective action approach in their concept of connective journalism to highlight the effectiveness of social media for local community activism.

While these papers synthesize connective action with other theories (hence being classified as theory-synthesizing papers), Leong et al. (2019, pp. 173–174) suggest expanding the application of connective action. Their extension looks not only at "periods of rupture" – intensified digital activism – but also "periods of abeyance" – low levels of activism – for sustaining collective identity.

A comparison of publications before and after the introduction of connective action highlights its field-changing role. Ackland and O'Neil (2011) investigate the role of digital media in collective identity formation by relying on traditional social movement theories, situating their contribution as an expansion of the collective identity approach. Such exclusive reference to collective identity is not present in later publications, even in those built on traditional approaches such as political opportunity structures (e.g. Vasi et al., 2015).

Table 2. Main research disciplines.

Discipline	% of articles	Citations	
		M	SD
Media & Communication	39.1	18.57	22.73
Political Science	10.9	52.60	112.81
Sociology	10.9	37.47	59.19
Business & Economics	8.7	18.88	21.41
Geography	5.8	16.63	17.72
Environmental Studies	4.3	65.75	128.82
Education	4.3	16.83	22.98
Others or multiple	15.9	15.61	35.06

Note: Results from full corpus (n = 138 papers)

The second theoretical cluster of papers is related to (in)visibility and surveillance. Uldam (2018) refers to Thompson's (2005) concept of mediated visibility for analyzing corporate surveillance practices on social media. In suggesting the theory's expansion to corporations, she nuances the visibility provided by social media as a disadvantage as much as an advantage. In another paper, Uldam (2016) engages with the same conceptual framework in synthesis with the notions of (post)-political and fantasy. Lester and Hutchins (2012) also utilize Thompson's concept of mediated visibility, expanding it to analyze activists' preference to stay invisible in order to gain negotiation power with governments and companies. DeLuca et al. (2016) position their contribution in defining the role of social media in surveillance and the uniqueness of Chinese civil society's circumvention of surveillance.

Beyond these clusters, other theoretical contributions reflect a diversity of theories, including constructivist approaches (Karahan & Roehrig, 2015), theories pointing to the unique blend of youth activism and social media (Belotti et al., 2022), a synthesis of a serial activism approach with a community-of-practice framework (Wang et al., 2021), and communication flow theories (Hilbert et al., 2017).

Methodological approaches

Methodologically, the *quantitative analysis* reveals the field's preference for multi-method and tri-angulation studies (Table 3). Almost 40% of papers use more than one method. Many align with what Özkula et al. (2022, p. 13) characterize as "holistic approaches" in digital activism studies: qualitative, in-depth case studies, which draw on a host of different materials and approaches. Among these multi-method studies, most combine content analysis with surveys/interviews (35.2%), followed by combinations of content and network analyses (31.5%).

For single-method studies, the most common approach is content analysis (34.1%), followed distantly by surveys/interviews (12.3%), and network analysis (5.8%). Network analyses are more popular than these numbers suggest, however, as they are frequently combined with content analyses. Methodological approaches largely remain stable over time (see Online Appendix).

The prominence of network analyses becomes clear in the *in-depth analysis*, where all but one of the influential papers aiming at methodological innovation propose network analysis. The three earliest papers in the influential corpus, Sullivan and Xie (2009), Ackland and O'Neil (2011), and Bennett and Segerberg (2011), all apply computational methods to reveal hyperlink networks among environmental activist organizations. Wonneberger et al. (2021) suggest an application of semantic and social network analysis to hashtag activism on Twitter. In addition to the dominance of network analysis, the application of computational methods/digital data is common in these highly cited contributions.

Other methodological contributions in the influential paper corpus strive for methodological synthesis. They often also suggest empirical expansion to new platforms. Hautea et al. (2021) use

Table 3. Methodological approaches.

Methodology	% of articles	Citations	
		M	SD
Triangulation/multiple	39.1	28.89	64.42
Content analysis	34.1	21.37	36.38
Surveys/interviews	12.3	12.18	23.29
Network analysis	5.8	64.94	113.94
Experiments	0.7	6.5	NA
Observations	0.7	1.5	NA
Others	2.2	26.33	29.54
None/not identifiable	5.1	24.93	20.55

Note: Results from full corpus (n = 138 papers)

TikTok data and put forward the inclusion of visual data in content analysis. Williams et al. (2015) extend network analysis to community building and polarization on Twitter.

In the *quantitative analysis*, to further characterize methodological orthodoxy, we coded whether studies took a predominantly quantitative, qualitative, computational, or mixed-methods paradigm (Table 4). Most studies follow a qualitative paradigm (39.9%). Mixed-methods studies (21%), quantitative (17.4%), and computational approaches (16.7%) are almost equally prevalent. Among mixed-methods studies, combinations of quantitative and qualitative analyses are most common (48.3%), followed by combinations of computational and qualitative analyses (27.6%). Over time, a slight decrease in the share of qualitative and mixed-methods studies can be observed, while computational approaches become more popular (see Online Appendix).

Empirical foci

Finally, we characterize the empirical subjects in digital environmental/climate activism research, focusing on geography, platforms, and actors.

Geography and spatiality

We analyze two dimensions of geography: countries and the geographical scope of the analysis. The *quantitative analysis* reveals that studies focus on 49 different countries (including within multi-country studies). Figure 4 shows a map of these countries. There is a dominance of English-speaking countries, with the US (15.2%), UK (10.9%), Australia (6.5%), and Canada (5.1%) all being frequently studied. One aberration from this pattern pertains to China, which is studied in an equal number of digital environmental/climate activism papers as the US (15.2%).

On the other end of the spectrum, there is little research related to South America (5.1% total, covering four different countries), Africa (5.1% total, covering six different countries), and South Asia (4.3% total, covering three different countries).

Only 6.5% of papers include data from more than one country. Yet, 22.5% of papers do not specify any geographical focus. These include hashtag or topical studies on social media, which do not require researchers to geographically delineate their case for data collection. While no clear trends in terms of geographical regions can be observed over time, multi-country and transnational studies become more popular (see Online Appendix).

The *in-depth analysis* of the most influential papers reveals that several aim at geographical expansion by applying existing theories or methods to under-studied contexts/countries: Dauvergne (2017) deals with the effectiveness of brand-focused activism in the context of Malaysia and Indonesia. Hilbert et al. (2017) and Scherman et al. (2015) look at environmental communication in Chile. Sullivan and Xie (2009), and DeLuca et al. (2016) expand research to China, while Lester and Hutchins (2012) investigate anti-forestry activism in Tasmania.

For the geographical scope of cases (Table 5), the *quantitative analysis* shows that despite the spatial complexity of environmental issues and digital communication, the national territory remains the primary reference point (35.5% of papers). Local or sub-national cases are almost

Table 4. Analytical paradigms.

Analytical approach	% of articles	Citations	
		M	SD
(Predominantly) qualitative	39.9	15.51	19.35
Mixed-methods/multiple	21.0	35.31	81.92
(Predominantly) quantitative	17.4	21.85	37.59
(Predominantly) computational	16.7	42.46	80.95
None/not identifiable	5.1	24.93	20.55

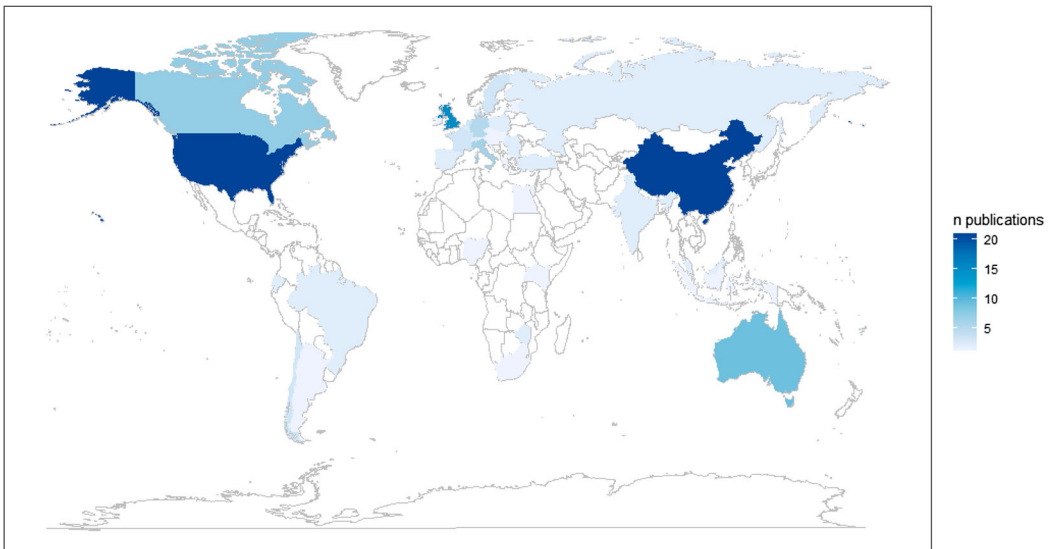Note: Results from full corpus (n = 138 papers)

Figure 4. Studied cases by country (including multi-country studies). *Note: Results from full corpus (n = 138 papers).*

equally prominent (30.4%), while studies that include cross-border communication are rarer (22.5%). Their share increases over time, however (see Online Appendix).

The *in-depth analysis* reveals that several papers problematize spatiality by referring to the interplay of the local-global axis. Boulianne et al. (2020) and Belotti et al. (2022) ask how social media activism, which enables young people to reach a global audience, affects offline and local mobilization. Boulianne et al. (2020) argue for the uniqueness of social media in connecting a global movement and its local mobilizations. The local-global axis is also uncovered by Vasi et al. (2015), who discuss how the screening of an anti-fracking documentary affected local mobilizations and how its popularity in the digital sphere influenced anti-fracking awareness globally. Hodges and Stocking (2016) suggest that local and global movements use social media in different ways. They call for expanding research towards the local-global axis because digital platforms' ability to make local mobilization globally visible marks a shift in digital environmental/climate activism.

Platforms

In terms of platforms and media (Table 6), the *quantitative analysis* shows that the most prevalent type of study investigates more than one platform (26.8%), often within qualitative case studies (cf. Özkula et al., 2022). The most prominent platform for single-platform investigations is Twitter (23.9%). It is followed distantly by Facebook (7.2%), organizational websites (5.1%), Weibo (2.9%), mass media websites (2.2%), as well as Instagram, TikTok, YouTube, and WeChat (1.4% each). 17.4% of papers do not focus on a specific platform, but study social media in general. This category captures a diverse array of papers, including experimental set-ups on fictional platforms as well as papers whose reporting does not

Table 5. Geographical scope of cases.

Geographical scope	% of articles	Citations	
		M	SD
National scope	35.5	18.83	27.01
Local/sub-national scope	30.4	28.85	71.97
Transnational scope	22.5	22.05	34.57
Other or no identifiable scope	11.6	45.94	85.45

Note: Results from full corpus (n = 138 papers)

enable the identification of specific data sources. The diversity of platforms under study grows slightly over time, but multi-platform studies become rarer (see Online Appendix).

As revealed by the *in-depth analysis*, influential papers often bring new platforms or new platform features into research in relation to platform affordances. Basch et al. (2022) and Hautea et al. (2021) analyze TikTok in relation to its unique features. Hautea et al. (2021) point out Tik-Tok's "architecture of affordance" for spreading ambivalent messages due to its design for mimicking previously created content in a humorous and obscure way. Basch et al. (2022) discuss the platform's uniqueness in conveying climate change content to young people. DeLuca et al. (2016) connect platform expansion and geographical expansion, focusing on the platform designs of Weibo and WeChat that enable activists to overcome Chinese government surveillance.

Actors

When it came to understanding actors in digital environmental/climate activism research, in the *quantitative analysis,* we encountered similar challenges to the coding of theories and concepts. The diversity and number of unanticipated categories were too great for standardized coding. We used open descriptions to capture the most important actors.

Overall, these descriptions demonstrate a strong focus on the role of politically engaged individuals. Around half of all papers focus on individual actors, ranging from YouTube commenters and TikTok users to news readers and conservation photographers. One emerging field of interest is the role of youths, young adults, and students. Many studies also focus on social movements. The most prominent example is the FFF movement, which was studied in at least 14 papers. Other frequently studied movements include anti-pipeline protests, anti-fracking protests, the People's Climate March, and Extinction Rebellion.

The *in-depth analysis* further emphasizes the dominance of Fridays for Future. Five out of seven papers with a movement expansion aspect are related to FFF, and six out of seven were published between 2020 and 2022. Three of these papers, Sorce (2022), Jung et al. (2020), and Molder et al. (2022), focus on the "Greta effect" (Sorce, 2022, p. 18); respectively focusing on Greta Thunberg's influence on the formation of collective identity among FFF activists, Twitter users' engagement with her personally, and her framing of climate activism on Instagram. Belotti et al. (2022) analyze FFF Rome, investigating young activists' flow between online and offline activism. Boulianne et al. (2020) analyze a global strike-day mobilization on Twitter and its effect on local mobilizations.

In comparison to the focus on individuals and new social movements, established environmental and/or non-governmental organizations play a minor role in the body of research surveyed in the

Table 6. Studied platforms and media.

Platform or medium	% of articles	Citations	
		M	SD
Multi-platform studies	26.8	29.00	37.23
Twitter	23.9	29.83	63.58
Social media in general	17.4	16.08	21.01
Facebook	7.2	14.10	14.02
Organizational websites	5.1	99.29	162.23
Weibo	2.9	12.50	18.41
Mass media websites	2.2	21.33	18.35
Instagram	1.4	1.25	1.77
TikTok	1.4	17.50	15.56
YouTube	1.4	22.50	24.04
WeChat	1.4	1.00	1.41
Others	2.9	7.75	6.59
None/not identifiable	5.8	5.44	7.63

Note: Results from full corpus (n = 138 papers)

quantitative analysis. One exception is research on Chinese digital environmentalism, where organizations are frequently studied. Moreover, few studies tackle questions around the interplay of different stakeholders in environmental activism.

Discussion

In this mixed-methods systematic literature review, we highlighted the theories, methods, and empirical foci of studies in the field of digital environmental/climate activism. We identified peer-reviewed papers from the social sciences, and quantitatively analyzed 138 relevant papers. The 30 most influential papers were chosen for further in-depth qualitative analysis to synthesize commonalities and research trajectories in a field-defining sub-section of the corpus.

In contrast to previous research that found activism to be marginal in climate change communication research (Agin & Karlsson, 2021), our review of digital environmental/climate activism research reveals a new, rapidly expanding field; more than one-third of papers were published in the last two years. Fridays for Future being among the most studied movement actors lends credence to the idea of the global school strike movement leading to a rise in research interest. It aligns with a thematic shift from environmental activism related to local grievances to climate change activism that demands institutional action against this global problem. These findings show that academic knowledge production is responsive to the outside world, and reflects social, political, and ecological developments.

This review fills a crucial gap in mapping digital activism research through the assessment of theoretical approaches. Previous reviews on climate change communication research identify framing as the dominant theoretical approach (Agin & Karlsson, 2021; Dhaher & Gümüş, 2022; Hansen, 2011), which our findings corroborate. Furthermore, our results highlight the centrality of Bennett and Segerberg's (2011, 2013) connective action theory. Digital activism emerges as a burgeoning field at the intersection of digital communication research and social movement studies, as the connective action approach focuses on the uniqueness of digitally-mediated forms of mobilization.

Methodologically, similar to Özkula and colleagues' (2022) findings on the importance of holistic approaches in digital activism studies, triangulation/multi-method papers are prominent in our corpus. There is a balance between qualitative and quantitative approaches when taking computational and conventional quantitative methods together. Mixed-methods studies play a much more prominent role in digital environmental/climate activism research than previous work (Dhaher & Gümüş, 2022; Neumayer & Rossi, 2016; Schäfer & Schlichting, 2014) suggest. The focus on the most cited publications highlighted the outsized attention paid to network-analytical approaches. As network studies dominate the influential literature, the method's role in the field is likely to grow.

Despite general tendencies towards certain theoretical and methodological approaches, theoretically and methodologically, the field of digital environmental/climate activism is diverse and expanding. This is less true for empirical focus areas.

Geographically, we confirm an imbalance towards the West, especially the Anglo-Saxon world (Agin & Karlsson, 2021; Dhaher & Gümüş, 2022; Schäfer & Schlichting, 2014), with certain exceptions. Our data highlights China as one of the dominant locations for digital environmental activism research. Most of the studies in question focus on NGO activities with a local environmental focus. Moreover, China's importance in the field still perpetuates a focus on the countries that are most responsible for climate change rather than those most affected (cf. Schäfer & Schlichting, 2014). Research tends to focus on the national or subnational/local level. Yet, a large and growing body of work has no geographical/spatial focus and analyses general social media discourses.

In terms of the most researched social media platforms, our findings corroborate a focus on Twitter (Neumayer & Rossi, 2016; Özkula et al., 2022). However, they also diverge from previous studies in two significant ways. First, Facebook is not as popular as Özkula et al. (2022) suggest. This may be related to a general decrease in Facebook usage. Second, unlike Neumayer and Rossi (2016),

but in line with Özkula et al. (2022), we find multi-platform studies to be the most common form of research on digital environmental/climate activism.

Identifying actors and types of activism turned out to be methodologically challenging because many studies focus on a diverse array of individual actors as activists. Such studies take any form of discursive engagement with a contentious topic on social media as a form of activism. This has become a common theoretical and analytical choice, which is not sufficiently discussed. It is also mirrored in the popularity of Bennett and Segerberg's (2011, 2013) theory of personalized forms of activism.

Some limitations of our research provide important context when interpreting these findings. We included only peer-reviewed, English-language articles, which were listed on Web of Science. This data collection strategy identifies influential work. However, it does not capture the entire body of work on digital environmental/climate activism research. Relying on a single database can lead to some sources being missed (Agin & Karlsson, 2021). Influential non-peer-reviewed articles, such as book chapters, may exist and show slightly different trends. Moreover, some of our findings might be the result of our selected data. Specifically, focusing on English-language papers may partly explain the overrepresentation of English-speaking countries. This limits the generalizability of our results and is reflective of power asymmetries embedded in the academy broadly (cf. Wolters, 2015). The recency of most publications in our corpus is clearly driven by the focus on *digital* activism. Future reviews could be extended through the inclusion of non-digital forms of environmental/climate activism to cover a longer time period.

Despite these limitations, we are able to characterize digital environmental/climate activism research as a fast-growing and theoretically and methodologically diverse field, with less diversity of empirical cases. Besides filling the gaps in terms of geography, platforms, and movements, several aspects require further attention. First, comparative studies that go beyond a single movement, platform, or country are needed to understand the specificity vs. commonalities of digital environmental/climate movements. Relatedly, relational approaches will be valuable for unveiling connections and entanglements between different movements, countries, and local struggles. The growing interest in network studies so far has remained limited to studying social networks among actors or organizations. Investigations of discursive as well as social connections between different sites of environmental/climate contention are needed.

An astounding gap lies in the field's inattention to the substantive demands of environmental/climate movements, in terms of highlighting specific problem definitions or policy solutions. Even studies that employ content analysis often lack engagement with what climate activists communicate. Climate policy frames are treated as pre-given, and only activists' employment of such frames is analyzed. The dearth of substantive analysis of activist demands obscures the ways in which new frames and policy proposals are suggested.

Altogether, our review paints the picture of a highly dynamic, emerging field of research, which will benefit from further integrative endeavors to connect disciplines and their theoretical and methodological strengths, as well as knowledge on specific countries, platforms, or movements.

Notes

1. The dataset, quantitative codebook, and qualitative coding scheme can be found in the online appendix: https://osf.io/c8tdm/?view_only=a7acf207d35a4563a9cf30a407475c1c
2. The coding scheme does not exclusively locate each paper in one category. Papers could be located in more than one of the deductive general categories (theoretical, methodological, or empirical contributions). Within these categories, papers were exclusively assigned to one inductive sub-category.
3. As we only included data for the first six months of 2022, we normalized the number of publications per year by dividing them by the number of months included.

Author note

The authors contributed equally to this work.

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