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Pro-environmental voting when climate change is made salient: Evidence from high-resolution flooding data

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Abstract

Experiencing events such as extreme heat, flooding, or wildfires may affect political preferences and voting patterns, but existing evidence is mixed. Further, although scientists attribute the increasing incidence and severity of these events to climate change, it is typically uncertain whether the public makes this connection and, therefore, the channel leading from extreme weather events to political outcomes remains unclear. Here we consider a setting in which this connection was made very salient. We use high-resolution flooding and building-level damage data to identify spatially finely disaggregated effects of a large flood in Germany on pro-environmental voting. The flood's destructiveness and temporal proximity to a general election entailed that media and politicians paid significant attention to the flood, drawing a connection to climate change. Our analysis shows that experiencing damage increases pro-environmental voting, suggesting that first-hand experiences of extreme weather events that are attributed to climate change affect political preferences.

1. Introduction

Significant political action is required to combat climate change [1]. Political action, in turn, requires public support [e.g. 2, 3]. Understanding the socio-economic and natural determinants of public support is therefore an important area of research at the intersection of social and natural sciences. One hypothesis put forward in this literature is that experiencing weather extremes first-hand may be particularly effective in changing public beliefs, attitudes, and actions in a pro-environmental direction [e.g. 4–7]. However, the existing literature does not provide a clear picture yet regarding the validity of this hypothesis. First, there is a large literature that investigates the effects of temperature extremes on climate-related beliefs. Howe et al. [8] review this literature in detail and conclude that the evidence in this area regarding an effect of extreme events on beliefs is mixed. For example, studying the U.S., Bergquist and Warshaw [9] find a moderate effect of temperature changes on concerns about climate change, while Brulle, Carmichael, and Jenkins [10] and Marquart-Pyatt et al. [4] find that weather extremes do not affect public opinion. Further, the evidence regarding the effects of hurricanes, wildfires, and floods on beliefs is also mixed. While, e.g., Sloggy et al. [11] find that

data are available at https://emergency.copernicus.eu/mapping/list-of-components/EMSR517. Data on buildings are available at https://www.openstreetmap.org. All online resources last accessed on September 7, 2022. Replication materials are available at https://doi.org/10.7910/DVN/EFHBNR.

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disasters (hurricanes, wildfires, and floods) in the U.S. affect perceptions regarding climate change, Lyons, Hasell, and Stroud [12] do not find a link between experiences with tornadoes, hurricanes, and flood events and beliefs. The literature also shows heterogeneous effects, such as Osberghaus and Fugger [13], who find that natural disaster experience confirms climate change beliefs in those who believed in climate change before the disaster, but has no effect on pre-disaster climate skeptics.

At the same time, focusing on the European case, results from the European Social Survey (ESS8, conducted during 2016–17) show that the vast majority of respondents believe in climate change and the role of humans in it, and the data show that most respondents expect negative impacts due to climate change [14]. Thus, while understanding the role of determinants of climate change perceptions is important, in a context in which the belief in climate change is already very high it seems more important to understand what determines climate action [15]. Yet, there is a much more limited number of studies that investigate the connection between extreme environmental events and environmental action. A handful of studies find associations between actual or perceived climate-related events and environment-related investments [16–18]. Finally, a few papers study the effect of climate experiences on climate action in the form of pro-environmental votes [19–23]. Some of these papers highlight important heterogeneous effects. In particular, the finding by Hazlett and Mildenberger [19] of an effect of wildfires on pro-environmental voting in the U.S. is driven by Democratic areas. Similarly, the effects of unusual weather found in Herrnstadt and Muehlegger [22] are strongest for (moderate) Democrats.

Two particular aspects make studying the effects of weather extremes on beliefs, attitudes, and actions challenging and may partly explain some of the differences in the results found in the literature: Firstly, the difficulties of spatially delineating the affected area, in particular when temperature extremes are considered. Secondly, individuals experiencing weather extremes may not necessarily attribute those to broader environmental changes.

In this study, we deal with these issues, analyzing the effects of being exposed to damage caused by a large flood that occurred in parts of Germany in July 2021 on support for the major pro-environmental party in Germany—the Green party—in the general election that took place ten weeks after the flood, in September 2021. This setting allows us to advance the literature in particular in two dimensions: First, unlike for heat waves or dry spells, the spatial extent of the primary effects of a flood, the flooded area and destroyed buildings, can be precisely delineated. In particular, we employ detailed, objectively, and consistently measured data on the spatial extent of the flood and the building-level impact of the flood, which are provided by the European Commission's COPERNICUS emergency management service (CEMS). CEMS compiles geospatial data based on satellite and aerial imagery in cases of natural disasters. These data distinguish between damaged buildings and affected buildings (possibly damaged, damaged, or destroyed). The available detail of the data is illustrated in Fig 1, using the example of one severely affected village. For our analysis, we aggregate these data to the municipality level (*Verbandsgemeinde*, which, at the median, has about 12,000 eligible voters and covers 97km^2 in Rhineland-Palatinate, the German state that we focus on). We merge information on buildings from *OpenStreetMap* to calculate the shares of damaged and affected buildings for each municipality. These finely disaggregated data allow us to identify whether and how immediate the experience needs to be to affect climate-related action, including through spatial spillovers.

Secondly, both the media and politicians, including the main candidates for the chancellorship, linked the flood to climate change, making this channel very salient for voters [cf. 24–28]. For example, Olaf Scholz, now Chancellor, stated that the flood "certainly also has something to do with the fact that climate change is progressing" [29]. The connection the public drew

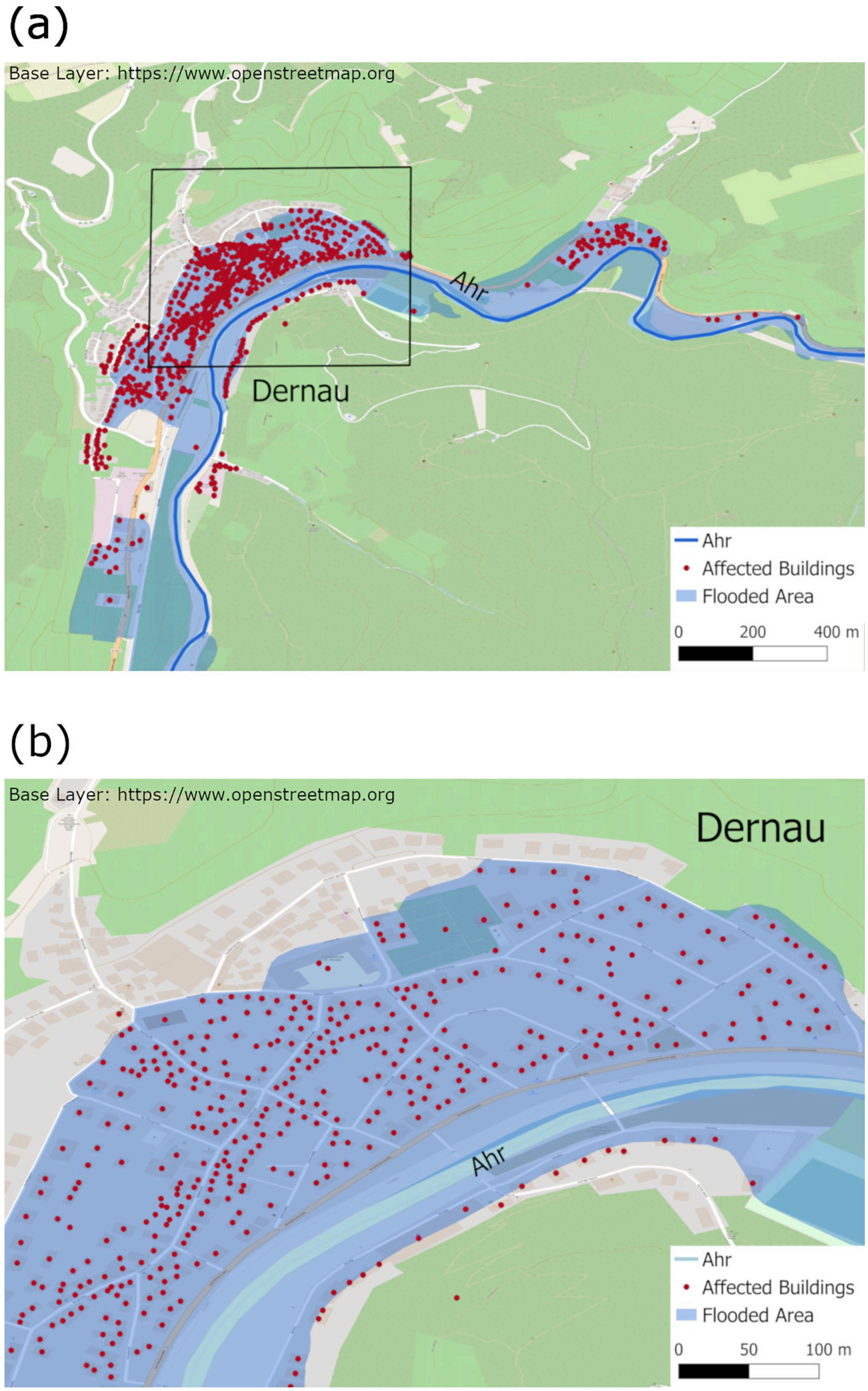

Fig 1. Illustration of CEMS data around the village Dernau. Subfigure (a) shows the full extent and Subfigure (b) zooms in. The maps depict the flooded area (in blue) and affected buildings (in red) for the community Dernau, which was severely hit by the Ahr flooding. *Source*: COPERNICUS emergency management service. Map is based on OpenStreetMap https://www.openstreetmap.org and OpenStreetMap Foundation, which is made available under the Open Database License https://opendatacommons.org/licenses/odbl/.

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Fig 2. Google trend for the search term *Climate Change (Klimawandel)* in Germany around July 15. *Source*: Google Trends (https://www.google.com/trends).

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between flood and climate change is also evidenced by the Google Trends index for the search term *Climate Change (Klimawandel)*, which spiked in the days immediately after the flood on July 15 as shown in Fig 2. Thus, our context allows us to make a strong case that the findings can be explained by a channel related to voters' concerns about climate change.

In addition, we note that treatment intensity and climate action-related outcomes are frequently self-reported [e.g. 8, 17, 30], while our analysis is based on objective measures of treatment (flooding extent and damage) and outcomes (vote shares). Finally, we exploit panel data involving four general election cycles (2009, 2013, 2017, 2021). Panel data allow us to use location-specific fixed effects in the econometric analysis, thus avoiding sources of bias that are due to location-specific fixed characteristics that are correlated with flooding and might at the same time explain pro-environmental voting.

The heavy rains in July 2021 caused flooding in several parts of Germany. Yet, the effects were most severe in Western states. In particular, out of 183 deaths directly associated with the flood, 134 occurred in the state of Rhineland-Palatinate. This state also incurred the largest economic damage [31]. Given the distribution of destruction caused by the flood, we focus our attention on Rhineland-Palatinate.

We find that experiencing the flood first-hand within one's municipality affects pro-environmental voting in statistically significant, yet moderate ways. Our setting strongly suggests voters' increased awareness of the implications of climate change as the channel that links the direct experience of the destruction caused by the flood to changes in voting patterns. However, these effects of the flood are limited to voters that live close to the flooding.

In parallel work, which we became aware of after the first draft of this paper was written, two other papers, by Garside and Zhai [32] and Hilbig and Riaz [33] also study the effect of the 2021 flood on election outcomes. In line with our findings, Garside and Zhai [32] also find moderate increases in the vote share of the Green party, in particular in the localities that were directly affected by the flooding. On the other hand, Hilbig and Riaz [33] find little evidence that exposure to flooding had an effect on Green party votes. However, it is important to note that these two papers are based on different empirical strategies. The main differences to those papers that matter for our results are due to the use of the above-mentioned CEMS data and to the level of spatial aggregation. Hilbig and Riaz [33] assign whole counties to either treatment or control, with counties assigned to one of three categories (not affected, weakly affected, highly affected, based on data from [34]), while the present paper considers a more disaggregated level, the municipality level (*Verbandsgemeinde*). In addition, the present paper uses the CEMS data to define more nuanced, continuous measures of treatment (the share of buildings affected and the share of area flooded). Garside and Zhai [32], on the other hand, have also used the CEMS data. However, they use these data to generate a dummy variable for whether a community was among the highly affected areas (more specifically, they consider the share of a community that was flooded according to CEMS data and define the 95% of communities with the largest CEMS flooding coverage as affected). Thus, they do not exploit the full variation that the CEMS data provides. A further difference in the use of data concerns the level of aggregation. Garside and Zhai [32] use the *Ortsgemeinde* as their unit of observation, which is a lower administrative unit than the *Verbandsgemeinde* that is our unit of observation. We use the latter because for most communities absentee ballots are aggregated to that level [35], and absentee ballots constitute a large share of all ballots (47% of all votes cast in the 2021 elections were absentee ballots [36]). In addition, their share increased in the flood-affected areas, which is partly due to the fact that the flood made voting in person more difficult. The flood destroyed buildings that previously were used as polling stations and, instead, mobile polling stations (e.g., in buses) were used, which made it more difficult to vote in person because they were placed only in selected locations [37]. This choice of aggregation at the municipality level also implies a different approach to estimating clustered standard errors in our paper. Besides these conceptual differences, our approach differs in several further dimensions. We use four election years in the estimation, which allows us to examine pre-trends, we weight regressions by the underlying votes cast to keep the municipality-level election data representative of the underlying individual votes, and we allow year fixed effects to vary at the county level, which ensures unbiased estimates when election trends vary across counties. We investigate the implications of using alternative definitions of treatment variables as well as other differences in the research design in S1 Text.

2. Data and methods

The CEMS flooding data contain, within a certain area of interest, information on the spatial extent of flooding and on building-level impact. Based on aerial and satellite imagery, CEMS experts classify building impact into three groups, distinguishing between possibly damaged, damaged, and destroyed buildings. Possibly damaged buildings show some characteristics of damaged buildings but the decision is less clear-cut due to poor image quality. Damaged buildings show slight to heavy damage, while destroyed buildings show very heavy damage to complete destruction. For our analysis, we group these measures as follows. *Buildings affected* refers to buildings from any of these three categories, while *buildings damaged* comprises damaged and destroyed buildings.

We calculate shares of buildings affected and of buildings damaged at the smallest administrative level, the community (*Ortsgemeinde*). For each community, we count the number of buildings affected and of buildings damaged and divide it by the total number of buildings, which can be obtained from OpenStreetMap. To quantify the extent of flooding, we calculate the shortest distance between a community's geographic centroid to the closest flooding event. We also calculate the share of area flooded for each community. The treatment variables thus measure the degree of exposure to the flood. Distance measures are positive when the distance to the nearest flooded location is positive, i.e., individuals are only indirectly affected. On the other hand, share of flooded area and share of buildings affected proxy the degree of direct local exposure (we can never be sure about an individual's direct exposure).

The dependent variable of interest is the local vote share of the pro-environment Green party. We obtained election outcomes of all major parties for the *Bundestag* elections in 2009, 2013, 2017, and 2021. In Germany, voters cast a candidate-specific (*Erststimme*) and a party vote (*Zweitstimme*). We analyze the latter as it determines the *Bundestag*'s party composition. The election data are provided at the more aggregate municipality level (*Verbandsgemeinde*). In order to match the spatial resolution of the election data, we need to calculate the measures of flooding and building impact at the municipality level as well. Hence, after initially determining flood exposure at the community level, we construct municipality-level averages of these exposures, weighted by the population of each community. While it is possible to directly calculate exposure measures at the municipality level, doing so would assume a constant number of individuals per building or per area within a municipality. When we instead use the exposure data at a smaller geographic level and weight by the population of that area, we only make such an assumption at the community level. S1 and S2 Tables provide summary statistics of the final dataset.

To estimate the effect of flooding on pro-environmental votes, we estimate difference-in-difference models of the following form.

$$Y_{m,t} = \beta D_{m,t} + \gamma_m + \gamma_{c(m),t} + \epsilon_{m,t} \quad (1)$$

$Y_{m,t}$ is the vote share of the Green party in municipality m in election year t. The coefficient of interest β captures the effect of flooding exposure $D_{m,t}$ on Green party votes. Flooding exposure $D_{m,t}$ in 2021 is measured in several alternative ways, as indicated above. Flooding exposure is set to zero for the years prior to 2021. The fixed municipality effect γ_m captures pre-2021 differences in voting behavior between municipalities. Fixed effects $\gamma_{c(m)t}$ allow time effects to vary at the county (*Landkreis*) level. We cluster standard errors at the municipality level.

A causal interpretation of β requires parallel trends in the absence of treatment. Event-study plots depicted in Fig 3 show no evidence of pre-trends for any of the exposure variables considered, lending support to this assumption and a causal interpretation of the estimates.

3. Results

We first study whether voters in Rhineland-Palatinate residing closer to the floods were more likely to cast a pro-environmental vote by voting for the Greens in 2021. Columns (1) and (2) of Table 1 indeed show significant effects of proximity of flooding on the Greens' vote share. Column (3) implies that living within 10 and 20km of flooding still led to higher Green party support. Furthermore, controlling for spillovers in this way almost doubles the estimated effect for voters living closer than 10km from the floods (as it changes the relevant comparison group). These effects are of substantial magnitude as 2.6 percentage points represent more than 30% of the average Green party vote share, and more than 20% of the average Green party vote share in 2021.

Distance to flooding is a coarse proxy of the extent of flooding and the actual damage. The CEMS data allow us to quantify these underlying measures of interest directly. Column (4) shows that a one percentage point increase in the share of area flooded led to a 0.22 percentage point increase in Green party votes. Columns (5) and (6) use the building-level data on affected and visibly damaged buildings. The (statistically significant) results suggest that buildings (the median damage share among affected municipalities is 9%) increases the Greens' vote share by about 0.48 percentage points, while going from zero to the maximum damage share (27%), leads to a 1.44 percentage points increase.

Column (3) of Table 1 shows that municipalities with a centroid 10 to 20km from the flooding also saw increases in Green party support, yet those were smaller than in municipalities closer to floods. To investigate spillovers further, we select in Table 2 the subset of municipalities without any affected buildings. As explanatory variables we consider shares of affected/damaged buildings in neighboring municipalities in buffers of 10 or 20km around the municipality of interest. To facilitate a comparison of coefficients, we normalize all explanatory variables, by dividing them by their respective standard deviation. We find that flooding in neighboring municipalities also significantly increased voters' Green party support in

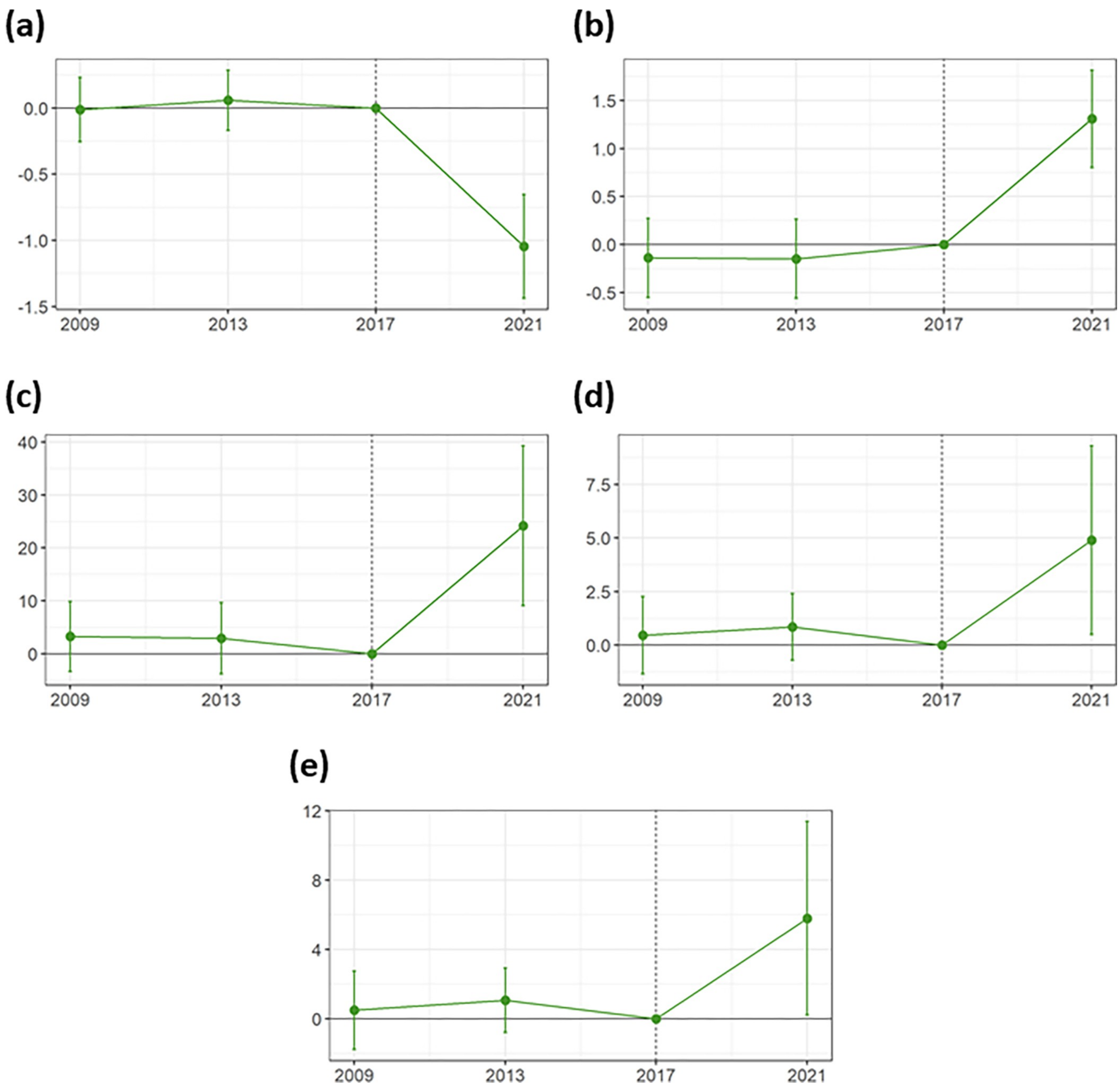

Fig 3. Event study for the percentage of votes for the Green party for five different measures of flooding exposure in Rhineland-Palatinate. Panel (a): Log distance from flooding. Panel (b): 0 to 10km from flooding. Panel (c): Share of area flooded. Panel (d): Share of buildings affected. Panel (e): Share of buildings damaged. Estimates are obtained from the regression $Y_{m,t} = \sum_{\tau\in\mathcal{T}} \beta_\tau \mathbb{1}\{t = \tau\} D_m + \gamma_m + \gamma_{c(m),t} + \epsilon_{m,t}$ where $\mathcal{T} = \{2009, 2013, 2021\}$. D_m is flooding exposure in 2021, and $\mathbb{1}\{\cdot\}$ is the indicator function. The index m refers to municipality, t to election year, and c to county. Error bars refer to 95% confidence intervals.

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municipalities that are not directly affected by the floods. Columns (2) and (4) show that these effects drop substantially when the flood occurs more than 10km away from a municipality's borders.

We repeat the analysis for different measures of flood exposure for all parties represented in the German *Bundestag*. Results are shown in Table 3. Each coefficient refers to a separate regression of the vote share of the party shown at the top of the table on the outcome shown in

Table 1. Flood-related determinants of votes for the Green party.

	Percentage of votes for Green Party					
	(1)	(2)	(3)	(4)	(5)	(6)
Log distance from flooding	**-1.06*****					
	(0.227)					
0 km–10 km from flooding		1.40***	2.63***			
		(0.322)	(0.542)			
10 km–20 km from flooding			1.42***			
			(0.501)			
Share of area flooded				22.2***		
				(6.98)		
Share of buildings affected					4.47***	
					(2.07)	
Share of buildings damaged						5.29**
						(2.63)
Dependent variable mean	8.518	8.518	8.518	8.518	8.518	8.518
Observations	564	564	564	564	564	564
Adjusted R^2	0.9854	0.9848	0.9855	0.9833	0.9832	0.9832
Within R^2	0.1467	0.1118	0.1535	0.0240	0.0193	0.0185
Municipality fixed effects	✓	✓	✓	✓	✓	✓
Year-County fixed effects	✓	✓	✓	✓	✓	✓

Regressions are weighted by the votes cast. The impact data distinguish between possibly damaged, damaged, and destroyed buildings. *Buildings affected* refers to buildings from any of these three categories, while *buildings damaged* comprises damaged and destroyed buildings. Standard errors are in parentheses and clustered at the municipality-level.

*p<0.1

**p<0.05

***p<0.01.

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rows on the left of the table. The only significant results are for the far-right AfD—which opposes climate protection measures—whose vote share fell substantially in 2021 in municipalities affected by flooding. This is consistent with voters across the political spectrum 216 moving towards parties more in support of climate actions.

The results so far were for the most affected state, Rhineland-Palatinate. We now add North-Rhine Westphalia to the analysis, which was the second most affected state in terms of human suffering and economic damage. Table 4 shows results for the effect of flood exposure on vote shares for North Rhine-Westphalia (NW) and for Rhineland-Palatinate (RP) and North Rhine-Westphalia jointly. These results confirm our prior findings, and results are comparable both when using data from North-Rhine Westphalia alone and when pooling data from Rhineland-Palatinate and North-Rhine Westphalia.

Above, we define treatment at the municipality level and use continuous treatment definitions. An alternative approach would be to assign whole counties to either treatment or control and using a coarser treatment definition, based on three damage categories, which is the approach that has been taken in parallel work [33]. S1 Text provides an analysis using this alternative definition of treatment. The analysis reported there reveals that our use of high-resolution data, which allows us to define treatment at the municipality level, is central to identifying treatment effects.

In a recent paper, Hazlett and Mildenberger [19] have shown that an effect of wildfires in California on pro-environmental voting is mostly due to the effects in Democratic-voting

Table 2. Analysis of spillovers.

	Percentage of votes for Green Party			
	(1)	(2)	(3)	(4)
Share of buildings affected 0 km–10 km (normalized)	0.823**	0.776**		
	(0.369)	(0.361)		
Share of buildings affected 10 km–20 km (normalized)		0.082		
		(0.148)		
Share of buildings damaged 0 km–10 km (normalized)			0.814**	0.756**
			(0.394)	(0.373)
Share of buildings damaged 10 km–20 km (normalized)				0.099
				(0.147)
Dependent variable mean	8.507	8.507	8.507	8.507
Observations	536	536	536	536
Adjusted R^2	0.9843	0.9842	0.9842	0.9842
Within R^2	0.0685	0.0709	0.0646	0.0682
Municipality fixed effects	✓	✓	✓	✓
Year-County fixed effects	✓	✓	✓	✓

Estimation only based on municipalities without affected buildings. The explanatory variables referring to buildings within 0 km–10 km or 10 km–20 km are defined as follows: For each municipality, we draw a buffer of 10 km–20 km around its outer boundaries. We then count the number of buildings affected inside these buffers and divide them by the total number of buildings in the respective buffers. Regressions are weighted by the votes cast. Standard errors are in parentheses and clustered at the municipality-level.

*p<0.1

**p<0.05

***p<0.01.

https://doi.org/10.1371/journal.pclm.0000219.t002

Table 3. Votes for other major parties.

	Percentage of votes for					Green Ideology Score
	CDU	SPD	FDP	AfD	Left	
	(1)	(2)	(3)	(4)	(5)	(6)
Share of area flooded	9.88	-1.21	-6.26	-23.4***	7.25	1.61***
	(12.0)	(9.92)	(3.88)	(6.87)	(5.09)	(0.508)
Share of buildings affected	2.24	-0.127	-1.36	-5.05***	1.30	0.319**
	(2.59)	(2.26)	(0.888)	(1.68)	(0.980)	(0.138)
Share of buildings damaged	2.79	-0.038	-1.69	-6.05***	1.60	0.383**
	(3.09)	(2.73)	(1.06)	(2.06)	(1.17)	(0.170)
Dependent variable mean	36.02	25.79	11.30	8.513	5.853	4.020
Observations	564	564	564	423	564	564
Municipality fixed effects	✓	✓	✓	✓	✓	✓
Year-County fixed effects	✓	✓	✓	✓	✓	✓

Each coefficient refers to a separate regression. Regressions are weighted by the votes cast. *Green Ideology Score* takes the percentage share of text in a political party manifesto from the year 2021 in favor of environmental protection [38] and weights this score by the vote share of each of the five parties. Standard errors are in parentheses and clustered at the municipality-level.

*p<0.1

**p<0.05

***p<0.01.

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Table 4. Votes for the Green party in North Rhine-Westphalia (NW) and Rhineland-Palatinate (RP).

	Percentage of votes for Green Party			
	NW		NW and RP	
	(1)	(2)	(3)	(4)
Share of area flooded	31.5**		26.7***	
	(15.8)		(8.52)	
Share of buildings affected		1.56***		1.65***
		(0.446)		(0.439)
Dependent variable mean	8.680	8.680	8.637	8.637
Observations	1,544	1,544	2,108	2,108
Adjusted R^2	0.9877	0.9878	0.9869	0.9869
Within R^2	0.0077	0.0124	0.0097	0.0122
Municipality fixed effects	✓	✓	✓	✓
Year-County fixed effects	✓	✓	✓	✓

The effect of the share of buildings damaged cannot be determined, as that information is only available for Rhineland-Palatinate. Regressions are weighted by the votes cast. Standard errors are in parentheses and clustered at the municipality-level.

*p<0.1

**p<0.05

***p<0.01.

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areas. Motivated by this finding, we also consider for our setting the heterogeneity of effects with respect to Green party vote share. Specifically, we use the median of the Green party vote shares in 2009 (the beginning of our study period) and define a Green party stronghold as a municipality with a vote share above the county's median. We find that the effect of direct exposure to the flood is larger in Green strongholds (see S3 Table). These results resonate with the finding of Hazlett and Mildenberger [19], in that they show that a pro-environmental inclination might be an important driver of the effects that we observe.

4. Discussion

Why does direct flood exposure increase the Green party share? Our hypothesis was that (a) the flood made people more concerned about climate change. Politicians and the media contributed to this and made the connection between the flood and climate change more salient. Further, we hypothesize that (b) the Green party is seen as the party that is most likely to deal with environmental issues. Alternatively, voting behavior could not be based on what a party does to fight climate change, but based on what a party has done in the immediate aftermath of the flood. There is a literature in political science that shows that indeed voters reward politicians for their role in preparing for a disaster or for post-disaster responses [39–42]. However, this could not explain the asymmetric response, with the Green party being the only one that gains vote share. At the time of the flood, in Rhineland-Palatinate, the Green party was in a governing coalition with the SPD and the FDP, while in North-Rhine Westphalia, CDU and FDP formed the governing coalition and the Greens were in the opposition.

Another concern is that the Green party is not the only party that represents pro-environmental values. To deal with this, we use the Manifesto Project Database [38] to assign a "Green ideology score" to each party, which allows us to see how voters shift towards a "Green ideology". The results shown in column 6 of Table 3 confirm that being directly affected by the flood on average increases the vote share of parties with pro-environmental values.

The Green vote share can increase because voters are switching to the Green party or because of higher turnout of (potential) Green voters. In results not shown here, we find that overall turnout is smaller in directly affected municipalities. Because overall turnout decreased more than the Green vote share increased in affected areas the absolute number of votes for the Green party decreased. However, without further assumption on how turnout affected different parties, it is, unfortunately, not possible to answer the question of whether switching or turnout differences explain the overall changes. Finally, our results do not allow us to identify the exact channel through which the flood leads to a larger share of pro-environmental votes.

Sisco [43] identifies three possible channels in the context of weather extremes, namely that weather extremes may elicit emotional responses, could increase the extent to which climate change is top of mind to the public, and might lessen the sense of (psychological) distance to climate impacts. As the discussion in the introduction makes clear, media attention and politicians' behavior suggests that the connection between the flood and climate change was made particularly salient in the case that we study. The increased salience may also be responsible for the desire of the population to seek more information (as illustrated by the increase in searches for terms related to climate change, see Fig 2). Thus, while we hypothesize that the circumstances have increased the salience of climate change-related policy issues, we cannot rule out that voting behavior was also affected by mediating channels, such as information seeking. However, in the absence of further data, 266 we cannot be certain about the degree to which each of the possible channels is at work.

5. Conclusion

A large flood in 2021 in Germany caused politicians and the media to discuss intensively the connection between this extreme weather event and climate change. Ten weeks later, a general election took place. Using building-level data to measure flood exposure, and exploiting panel data covering four election cycles to identify causal effects, we find that exposure to the flood caused a significant share of individuals to vote for the pro-environmental Greens. Unlike in other situations in which researchers study connections between extreme events and climate perceptions or climate action (including voting) having to assume that individuals make the connection between the event and climate change, we study a context in which the treatment (the flood) was closely tied to climate change by politicians and the media, making the connection to climate change very salient. Taken together, our findings strongly suggest that experiencing events that in the minds of voters are tied to climate change, affects voters' inclination to cast a pro-environmental vote. However, the difference between directly and not-directly affected areas is modest in size, with a maximum effect size of about 1.4 percentage points in the Greens' vote share (when going from zero to the maximum share of damaged buildings). There may be stronger effects that affect all voters to the same extent. Yet, identifying these is beyond what studies of this kind can achieve. Further, whether effects are short-lived, persistent, or even increasing over time, is an important area of future research.

Supporting information

S1 Table. Municipality-level election outcomes.
(DOCX)

S2 Table. Municipality-level flooding exposure.
(DOCX)

S3 Table. Heterogeneity with respect to Green strongholds.
(DOCX)

S4 Table. Alternative treatment definitions.
(DOCX)

S1 Text. Comparison to alternative treatment definitions.
(DOCX)

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