# Political Weather: How experiencing climate change shapes our political lives

*PhD Defense*

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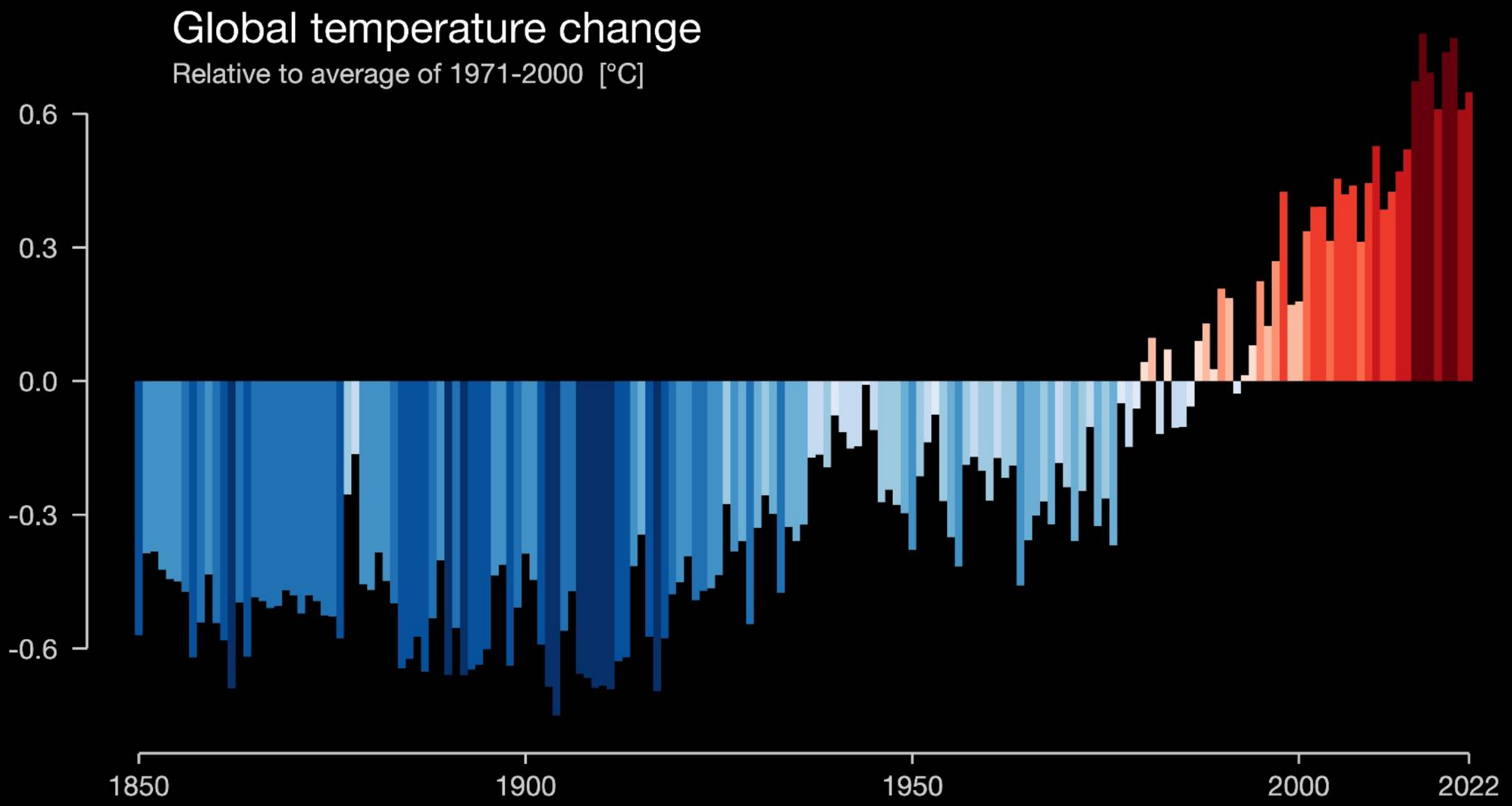
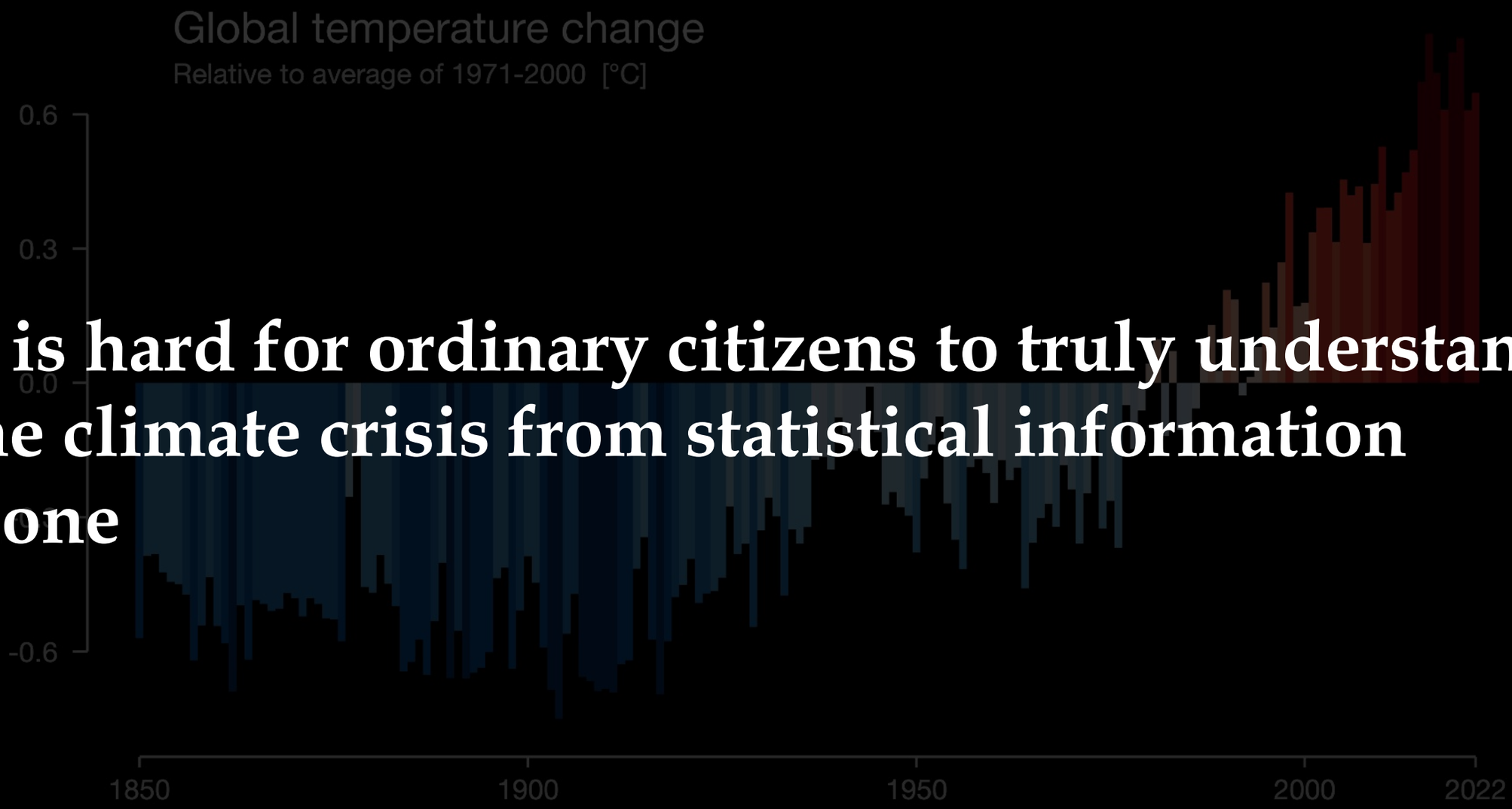
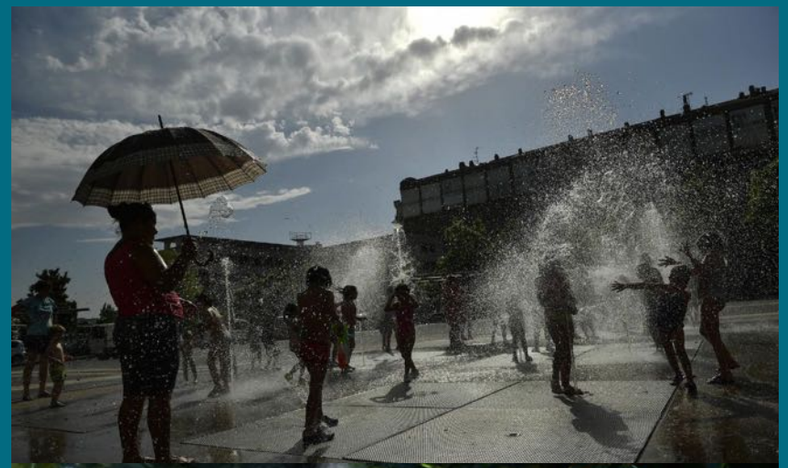
January 9, 2024

Let’s begin with a picture.


Global temperature change
Relative to average of 1971-2000 [°C]
0.6
0.3
0.0
-0.3
-0.6
1850
1900
1950
2000
2022



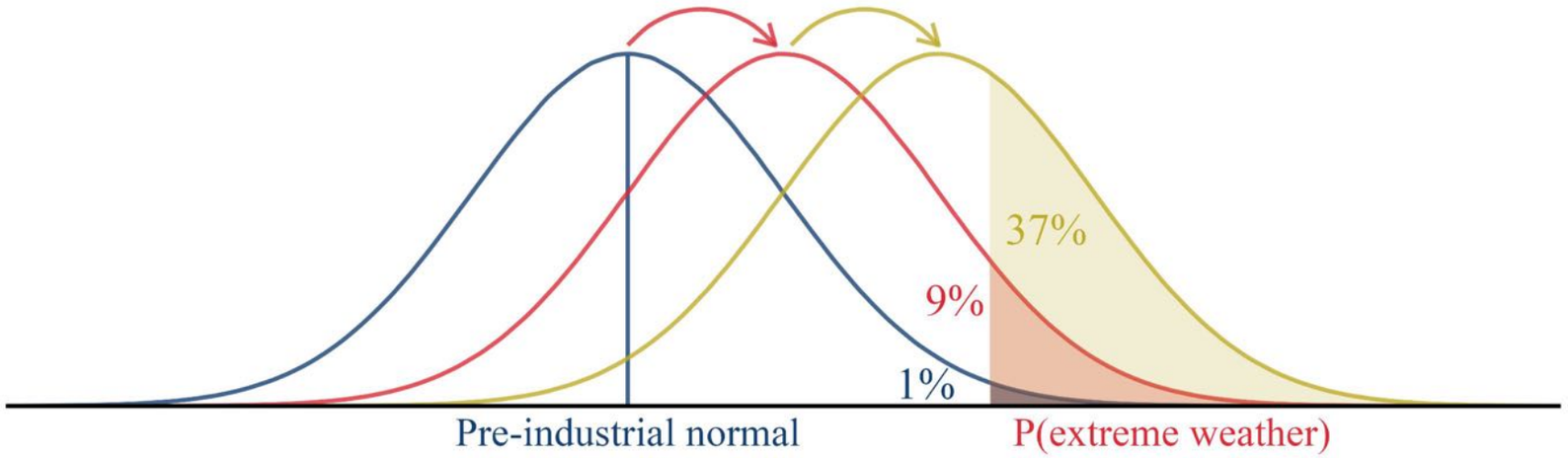

# It is hard for ordinary citizens to truly understand the climate crisis from statistical information alone

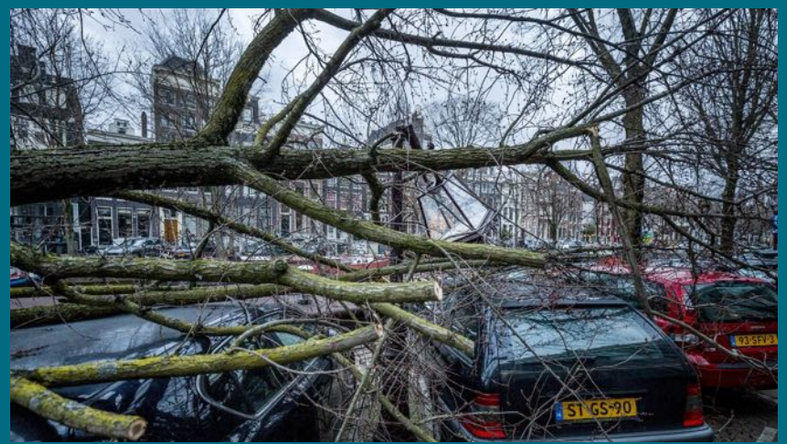



MISTING STATION


FURNACE CREEK VISITOR CENTER
130 °F
54 °C

# Climate change creates more extreme weather experiences




ST GS-90

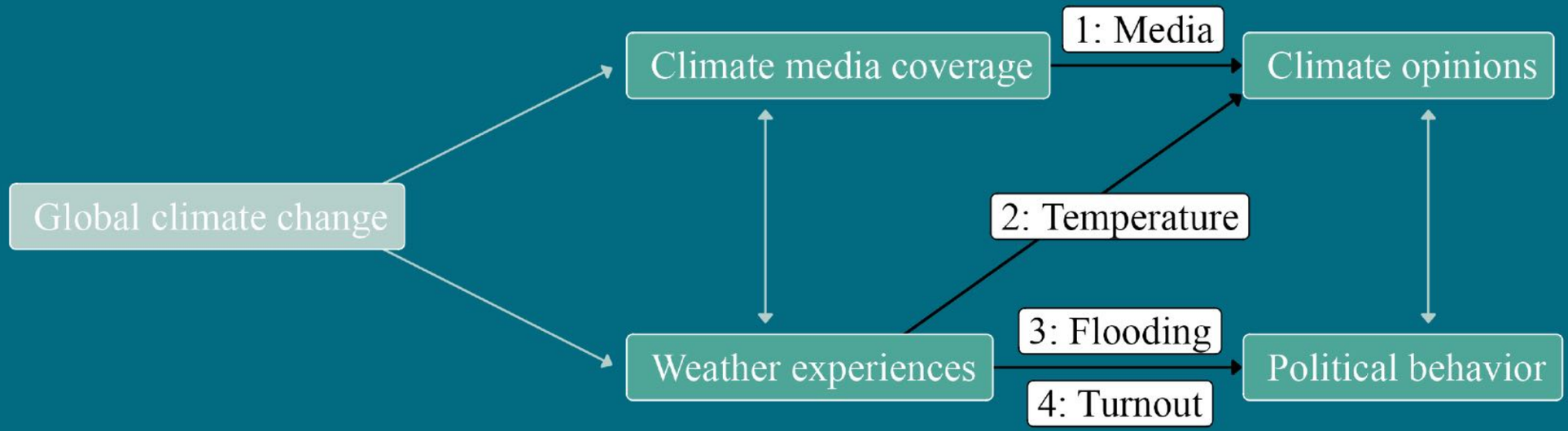
# Argument

- The green transition is too slow, and public support too low
- Voters increasingly experience climate change
- Weather affects everybody, and the personal relevance is clear
- Perhaps experience can cut through climate denialism and political polarization
- Voters are also influenced by traditional information sources: **media coverage**

# Research question

> **How are voters' climate opinions and behavior shaped by media coverage of climate change and personal weather experiences?**

- Empirical focus on voters in **Denmark**


Global climate change
Climate media coverage
1: Media
Climate opinions
2: Temperature
Weather experiences
3: Flooding
4: Turnout
Political behavior


# Article 1: Media

# Article 1: Media

- “Mass media influence on the rapid rise of climate change”
- Published in *International Journal of Public Opinion Research* (2022)

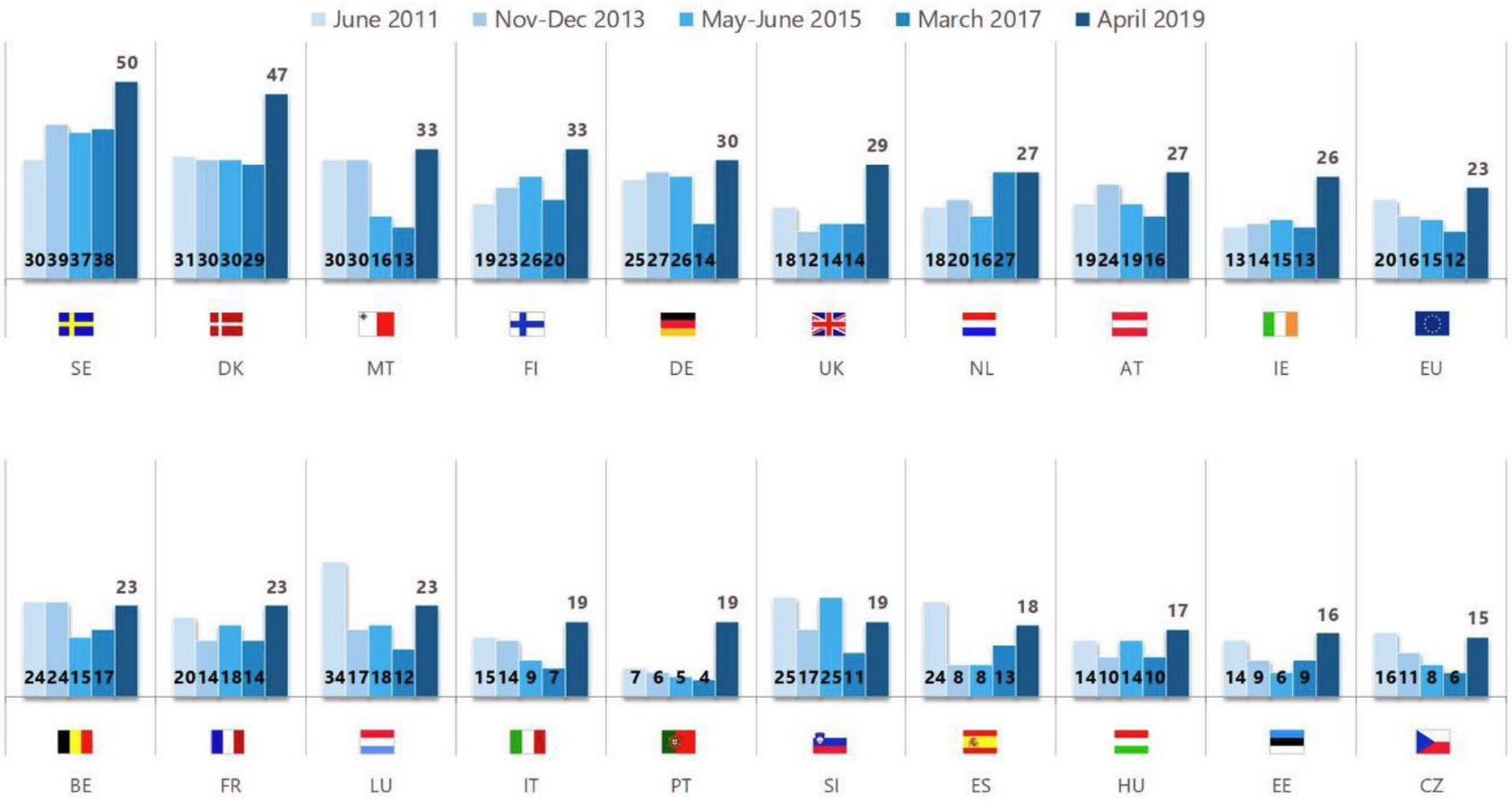
> **Does mass media coverage of climate change increase public salience?**

# Background

- Climate change became highly salient in 2019
- What happened?
- We need information to form opinions
- Did the mass media play a role?
- Despite fragmentation of media and audience

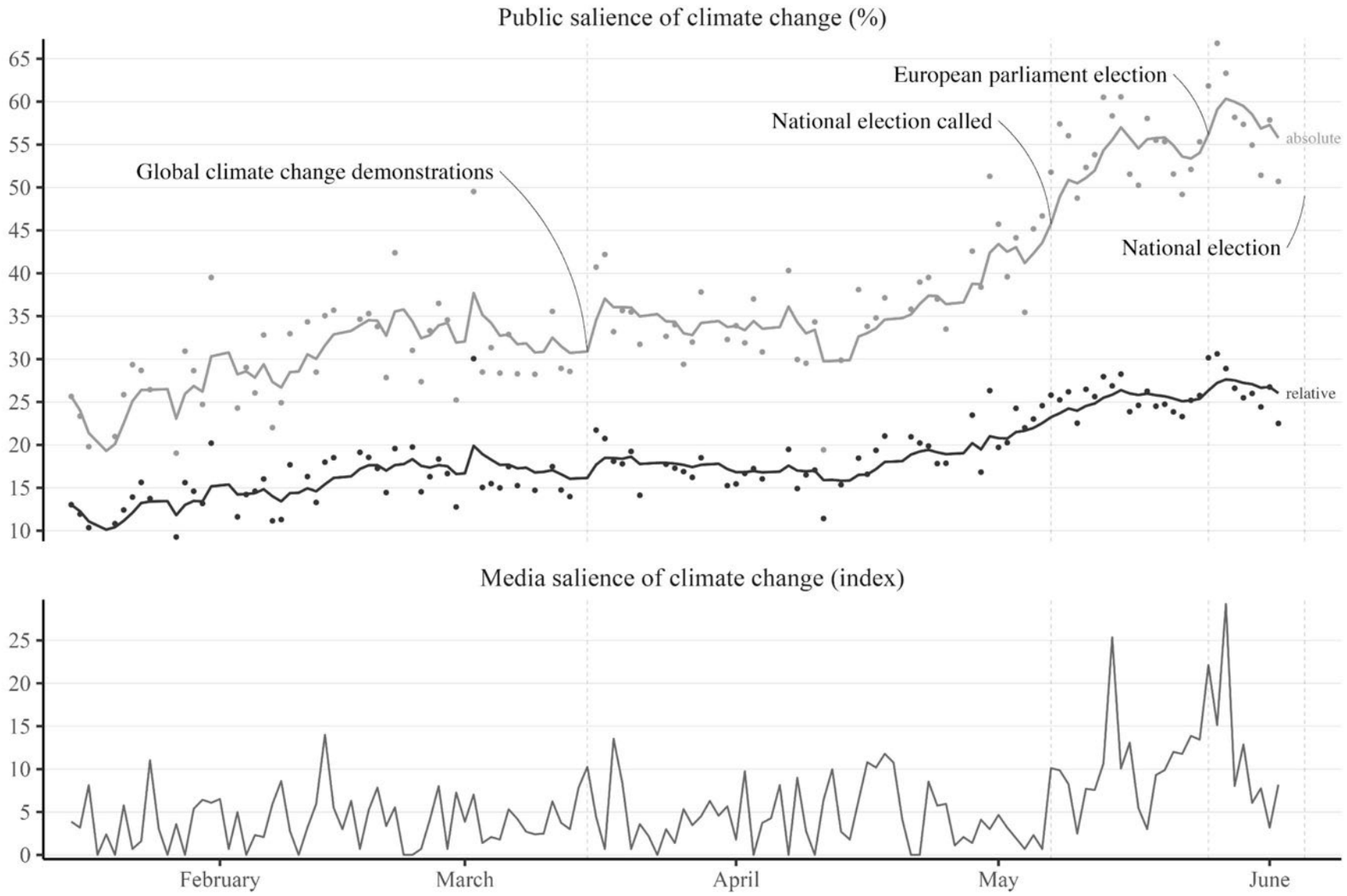
# Climate change's rapid rise in 2019

**QB1A** Which of the following do you consider to be the single most serious problem facing the world as a whole?
**(% - Climate change)**




© Kantar. (2019). Special Eurobarometer 490 Report: Climate Change. European Commission, Directorate-General for Climate Action.

# Climate change's rapid rise in 2019




- Spotting the connection is hard
- Statistical analysis is needed

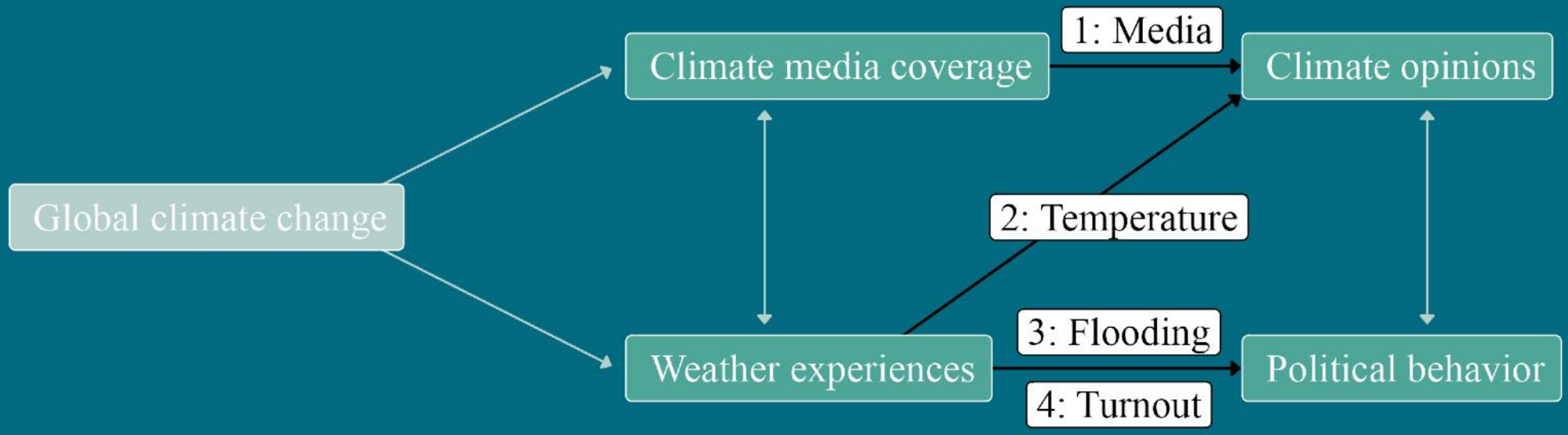
# Statistical results

- **Yes, the public responds to more media coverage**
- No sign of reverse causality
- When climate coverage increases by ~34*,
  public salience grows by 1 %-point
- Who is influenced?
- Age 18-29, 30-49, urban, women, Social Democrats (Section 8.7)

# A quick summary –

*Does mass media coverage of climate change increase public salience?*

- Yes, media climate coverage can drive public salience
- Concentrated among attentive citizens → limit of media influence
- “Real-world events” drive media coverage
- Major responsibility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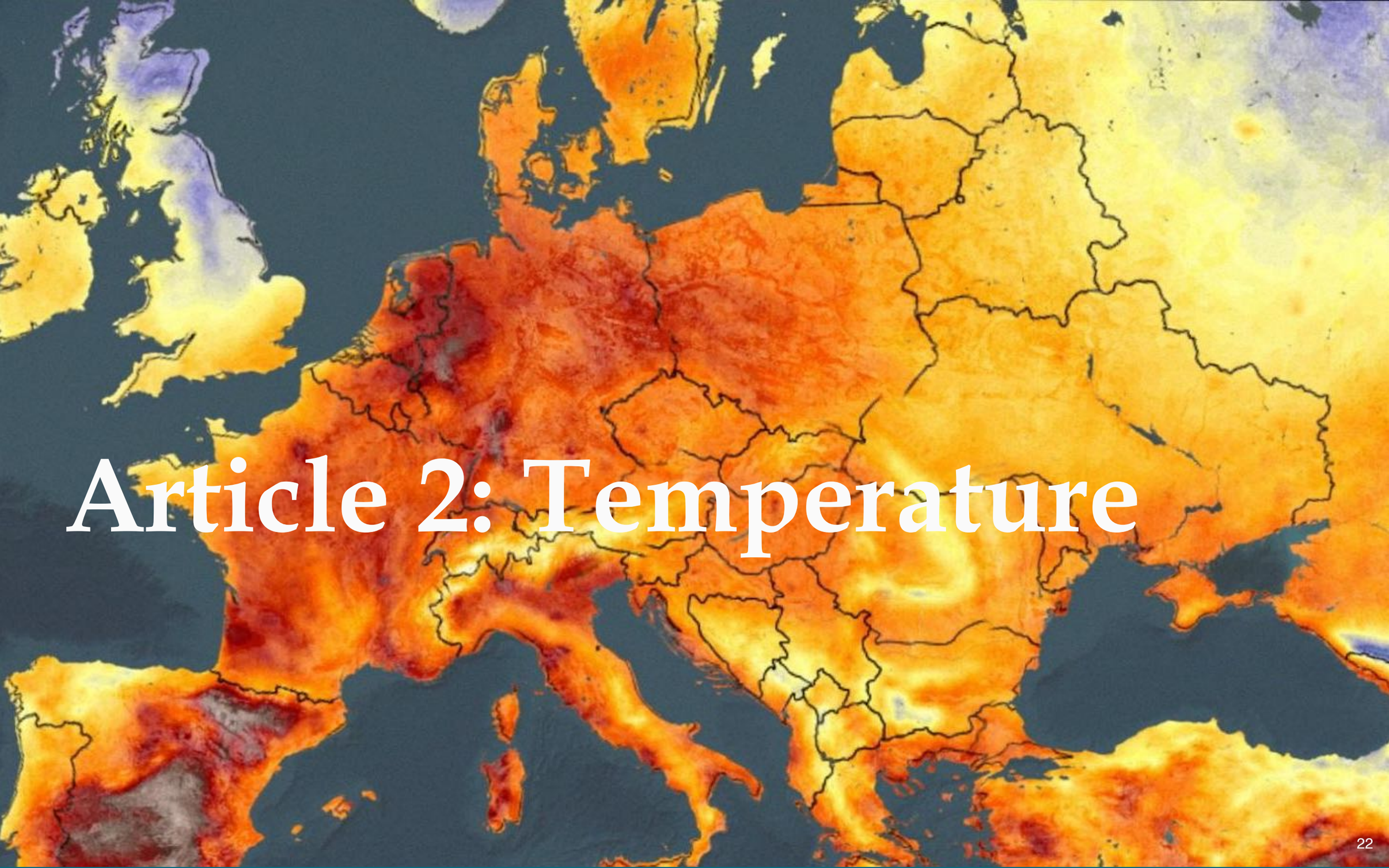


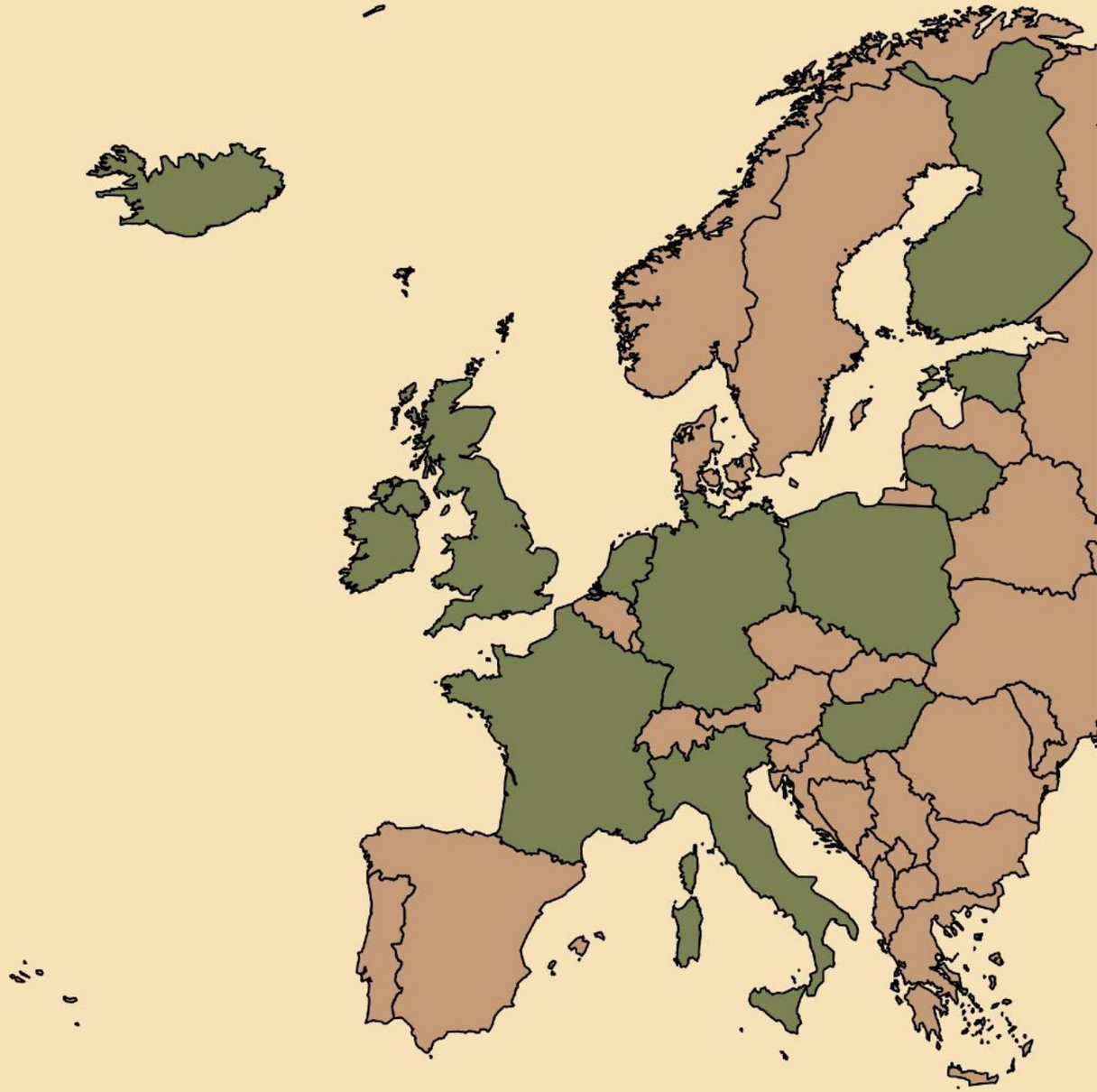
# Article 2: Temperature

# Article 2: Temperature

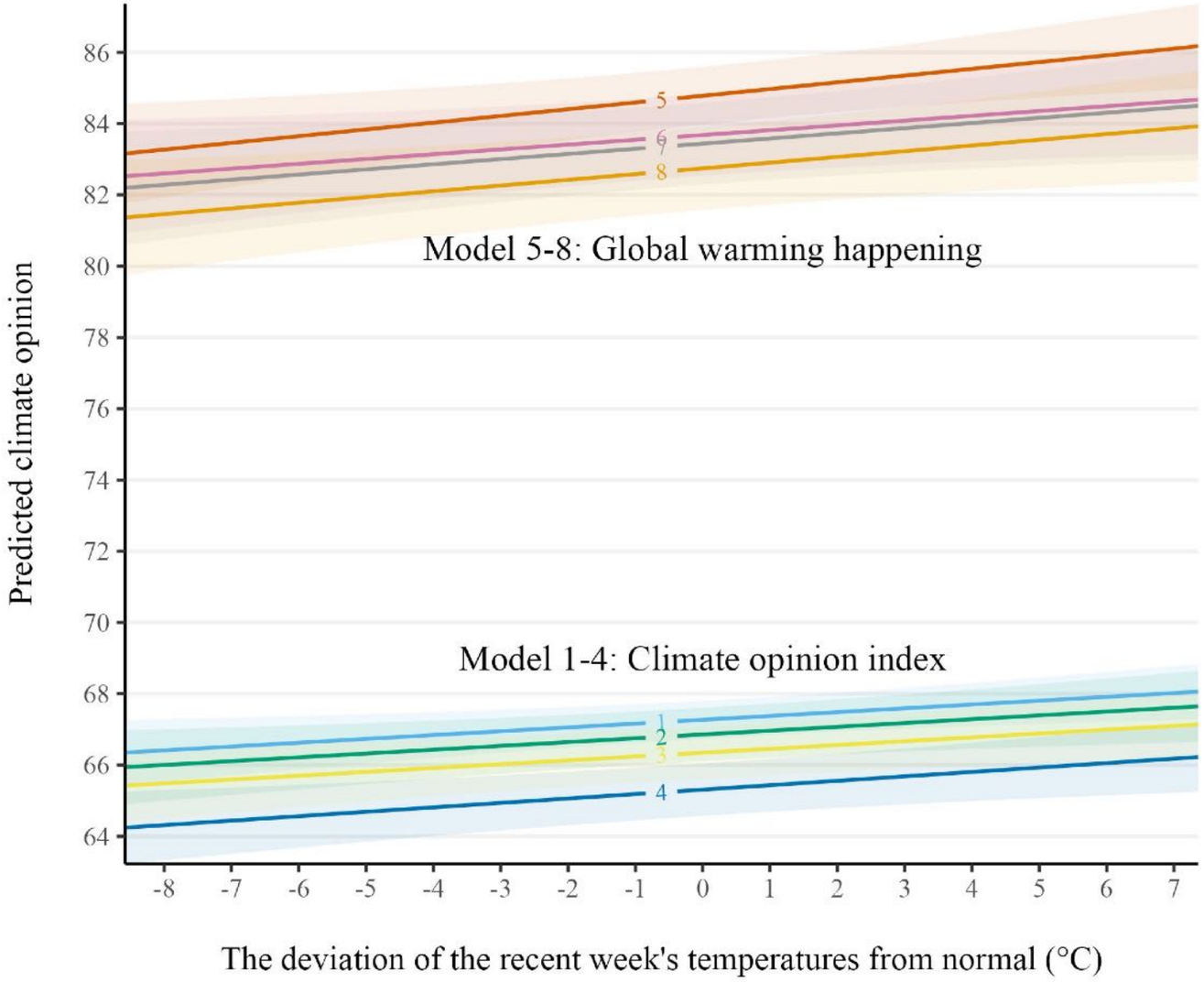
- "How weather experiences strengthen climate opinions in Europe"
- Published in *West European Politics* (2021)
- Extension of Egan & Mullin (2012)

## Does warmer weather make us more climate conscious?

- 12 European countries
- Climate opinions (index)
- Temperatures* in past 7 days

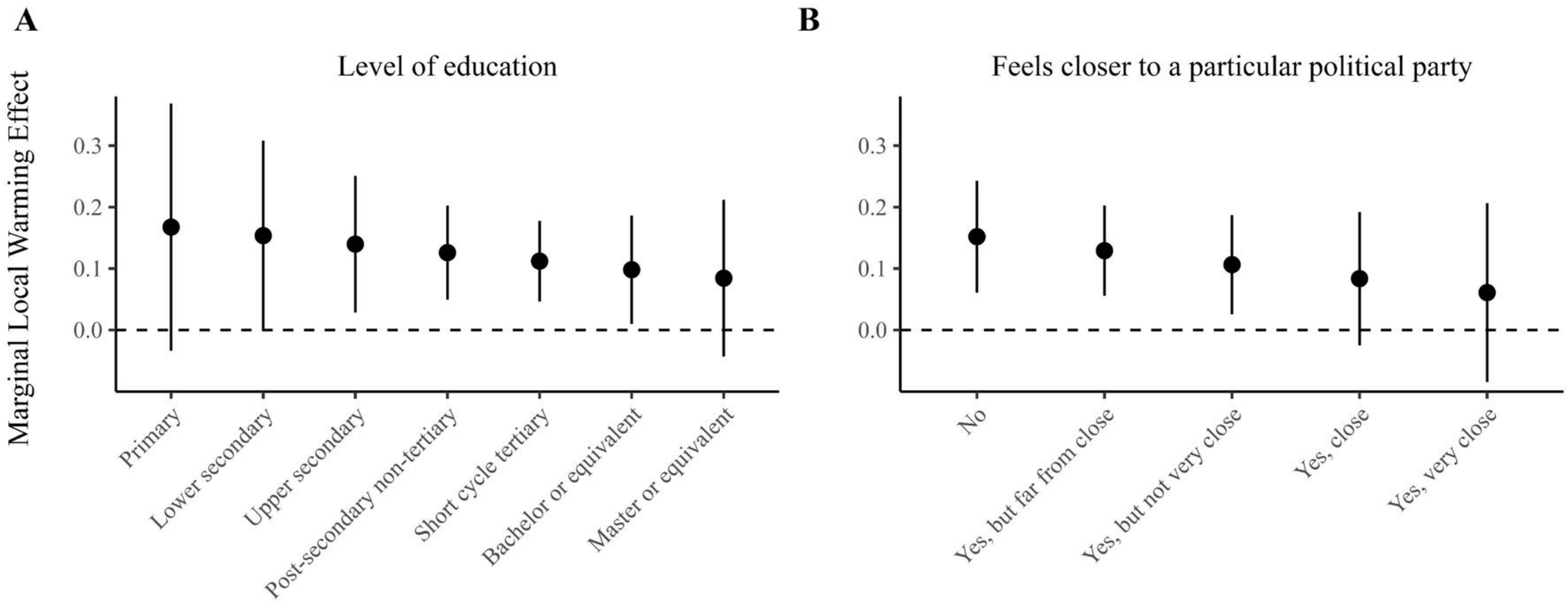


# Results

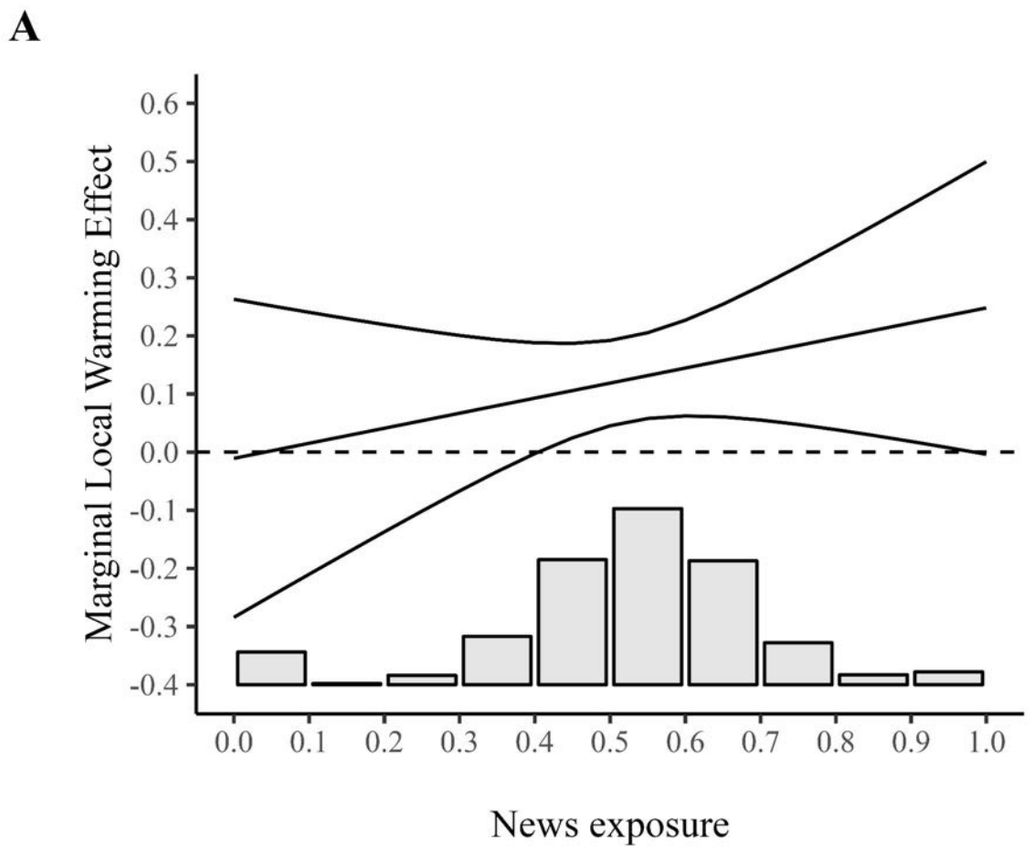



- Warmer-than-usual weather increase climate awareness
- 5°C temperature shift strengthens climate opinions by 0.5–1.0
- Small effect, but …

# Who is affected?



# Who is affected?

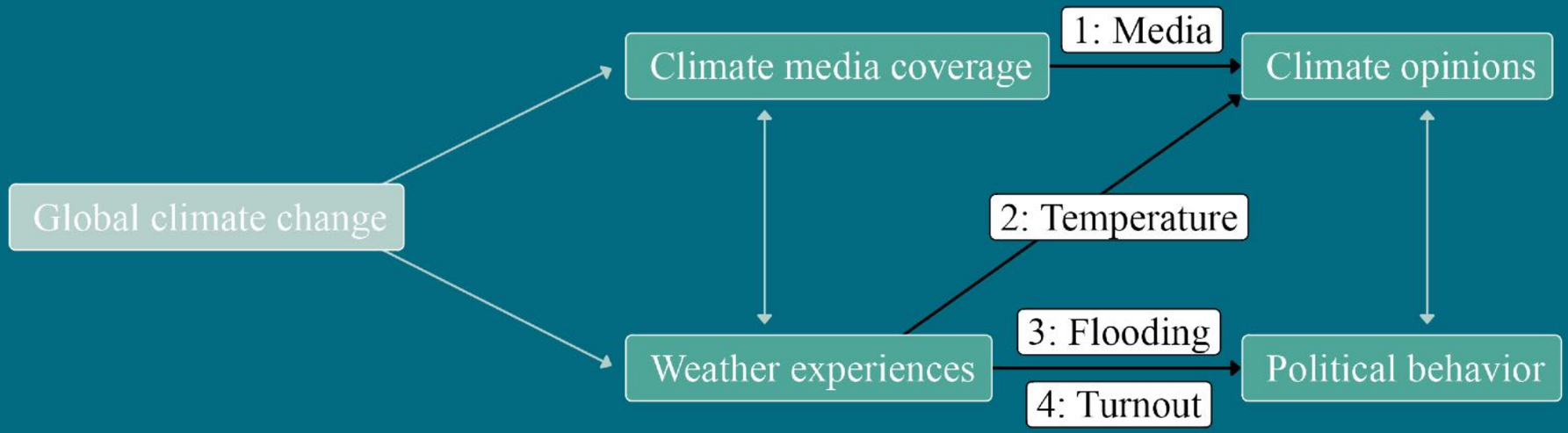



- Only suggestive evidence
- **Temperatures affect everybody**

# A quick summary –

*Does warmer weather make us more climate conscious?*

- Yes!
- Across 12 European countries
- Robust effect of warmer-than-normal temperatures
- Same for everyone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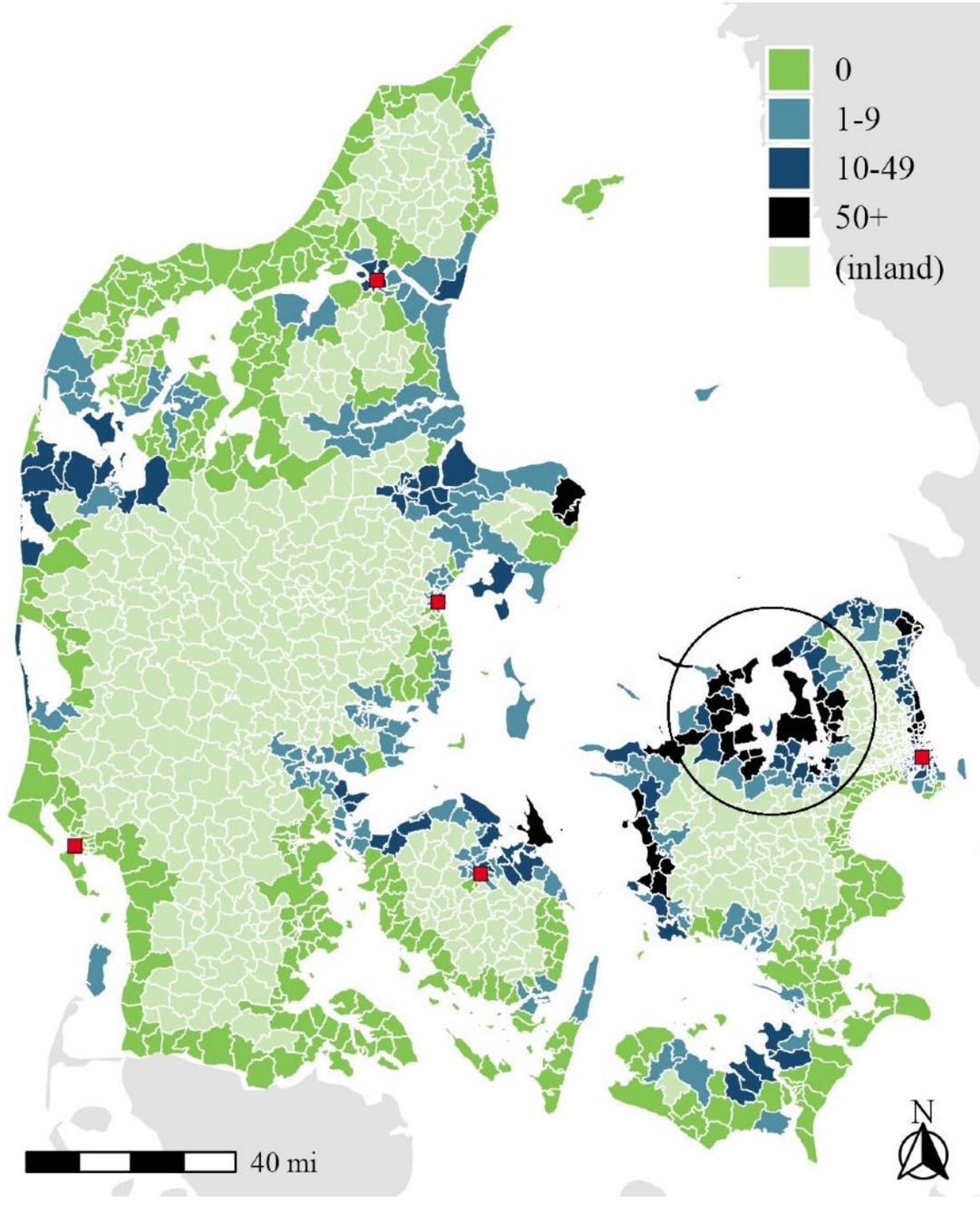
# Article 3: Flooding

# Article 3: Flooding

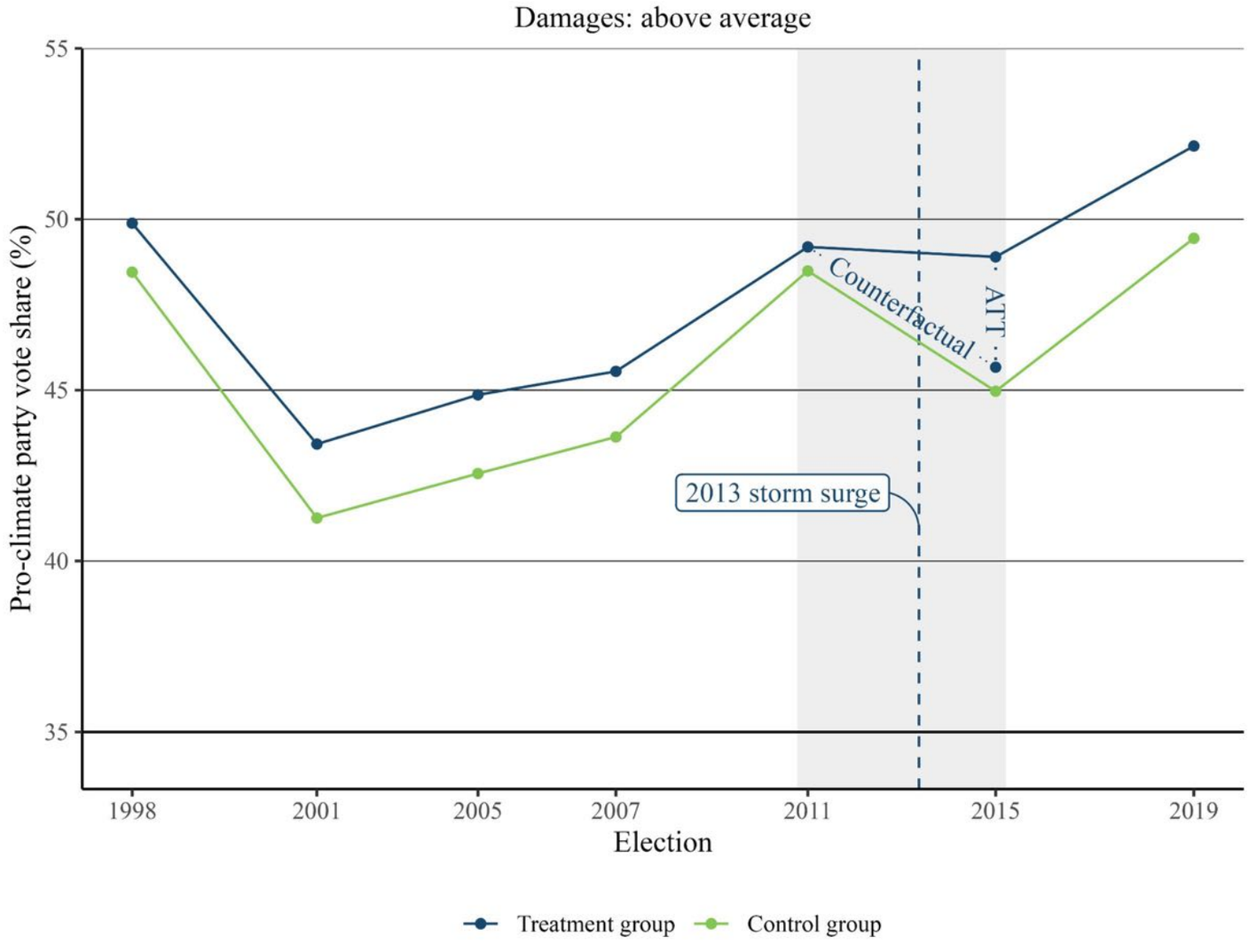
- “Pro-climate voting in response to local flooding”
- Unpublished manuscript (under review)

> **Does local flooding experience lead to pro-climate voting?**

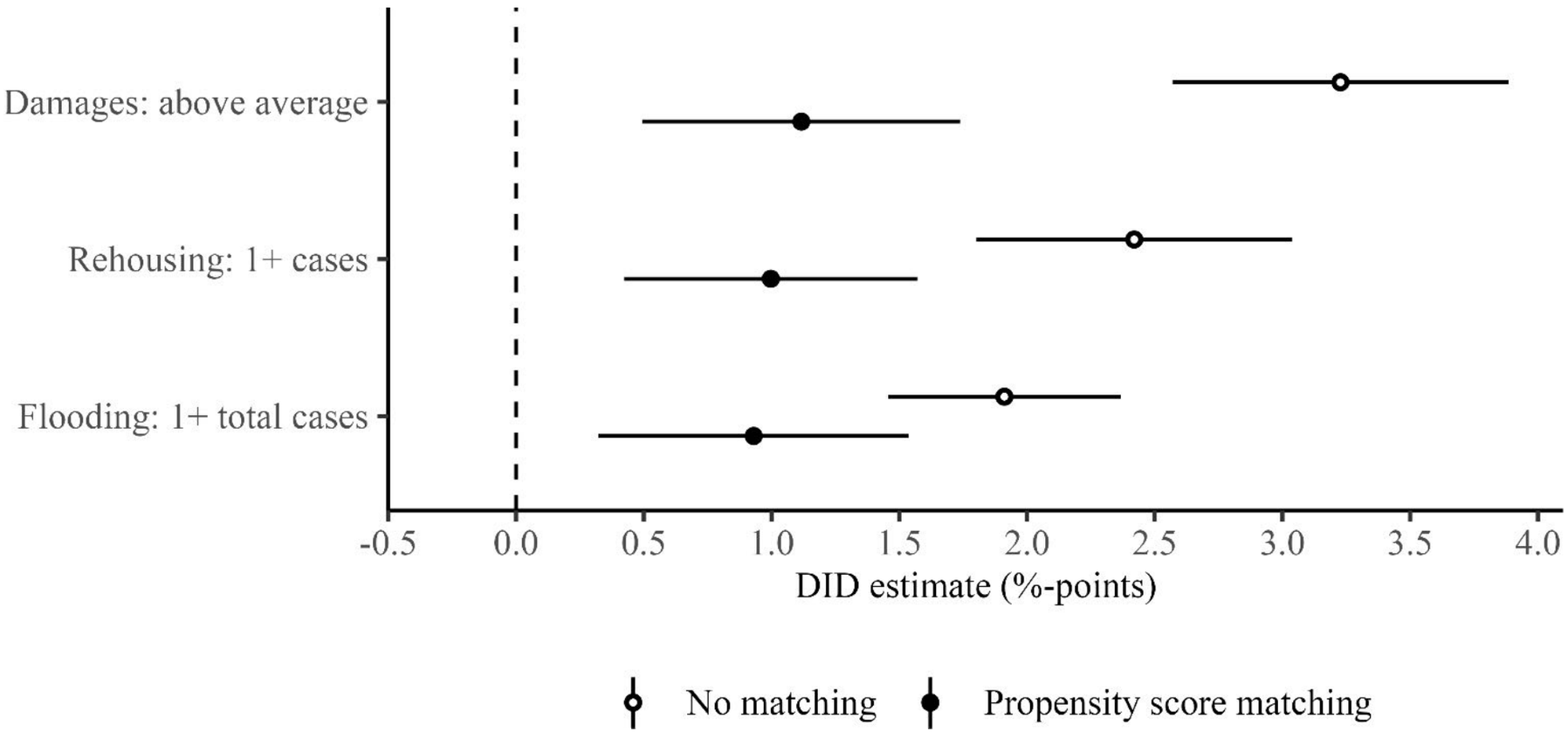
Flooding cases in the 2013 storm surge



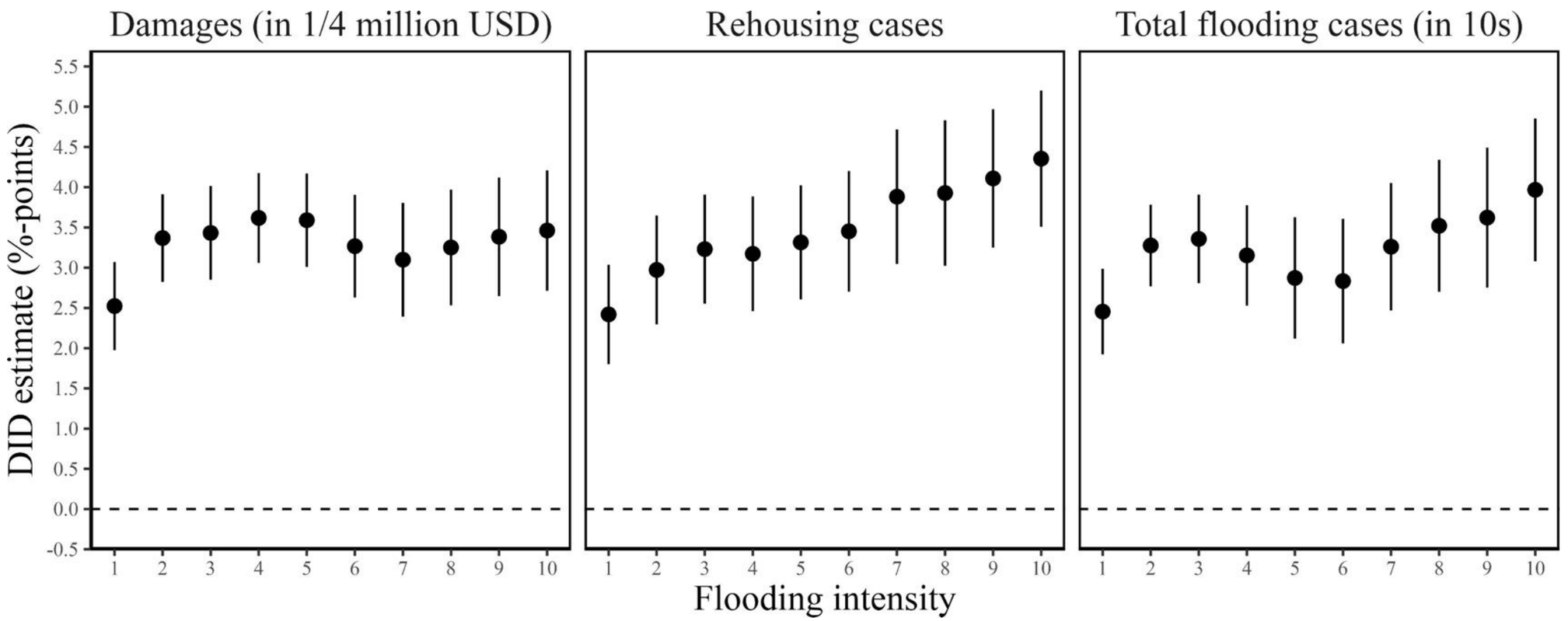
# Pro-climate voting



# Effect estimates



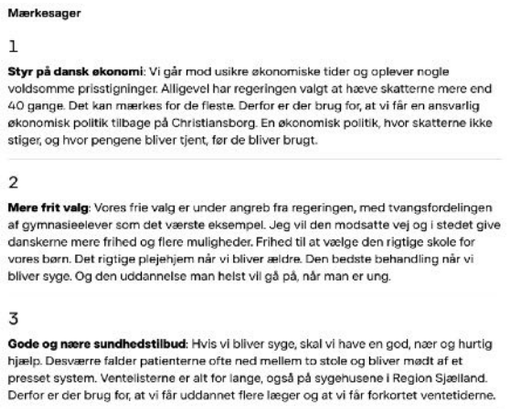
# Flooding intensity



# Part 2: Pro-climate candidates

- Polling advice application (kandidattest)
- What *key priorities* do candidates communicate about?
- Climate-related issues?





**Mærkesager**

1

**Styr på dansk økonomi**: Vi går mod usikre økonomiske tider og oplever nogle voldsomme prisstigninger. Alligevel har regeringen valgt at hæve skatterne mere end 40 gange. Det kan mærkes for de fleste. Derfor er der brug for, at vi får en ansvarlig økonomisk politik tilbage på Christiansborg. En økonomisk politik, hvor skatterne ikke stiger, og hvor pengene bliver tjent, før de bliver brugt.

2

**Mere frit valg**: Vores frie valg er under angreb fra regeringen, med tvangsfordelingen af gymnasieelever som det værste eksempel. Jeg vil den modsatte vej og i stedet give danskerne mere frihed og flere muligheder. Frihed til at vælge den rigtige skole for vores børn. Det rigtige plejehjem når vi bliver ældre. Den bedste behandling når vi bliver syge. Og den uddannelse man helst vil gå på, når man er ung.

3

**Gode og nære sundhedstilbud**: Hvis vi bliver syge, skal vi have en god, nær og hurtig hjælp. Desværre falder patienterne ofte ned mellem to stole og bliver mødt af et presset system. Ventelisterne er alt for lange, også på sygehusene i Region Sjælland. Derfor er der brug for, at vi får uddannet flere læger og at vi får forkortet ventetiderne.

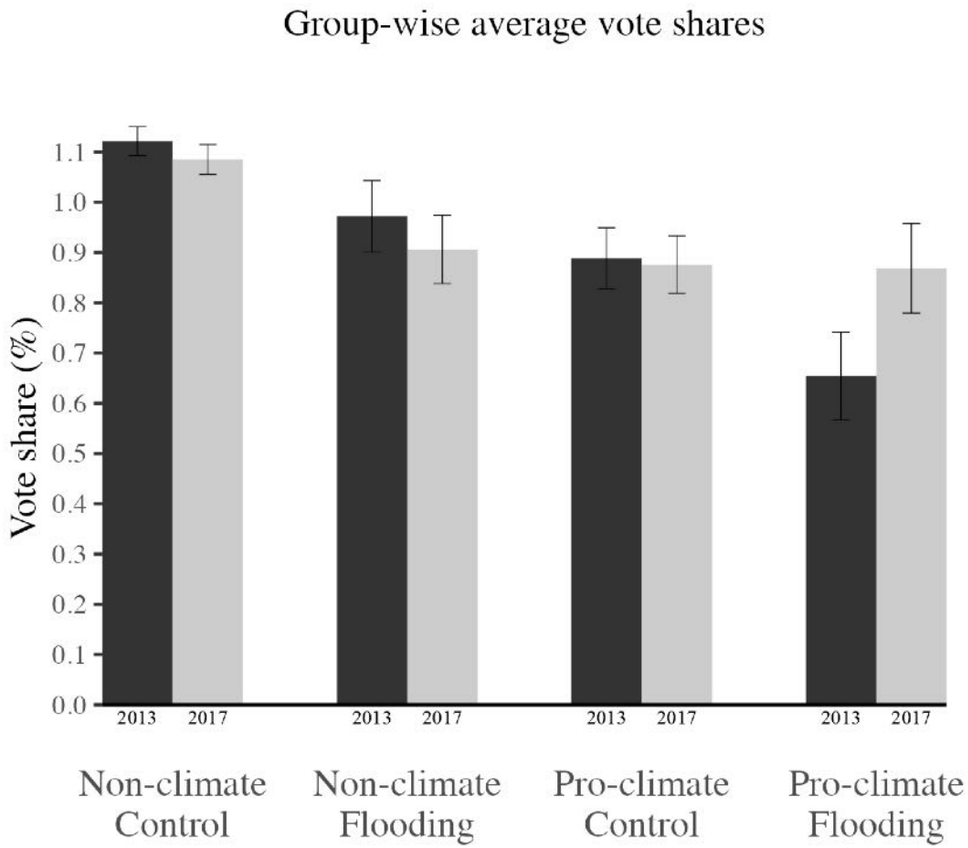
Altinget/DR

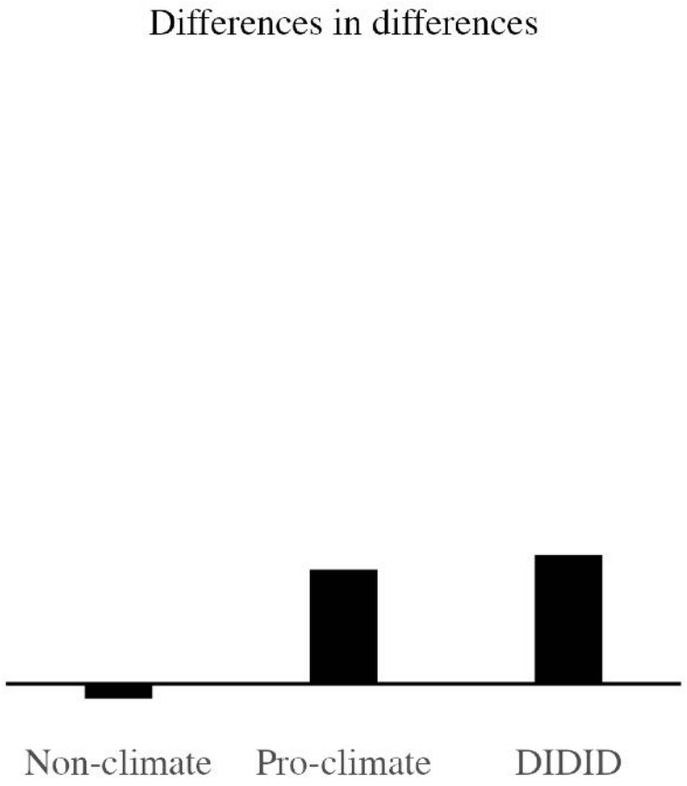
# Pro-climate candidates

*Storm surge protection. We are in high risk of flooding during storm surge. We experienced it in January, and we still have citizens living in temporary housing 10 months later. If we don't do something, large parts of the municipality will be flooded*

- Candidate from the Liberal Party (V)

# Analysis


Group-wise average vote shares
Vote share (%)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
2013
2017
Non-climate Control
Non-climate Flooding
Pro-climate Control
Pro-climate Flooding


Differences in differences
Non-climate
Pro-climate
DIDID

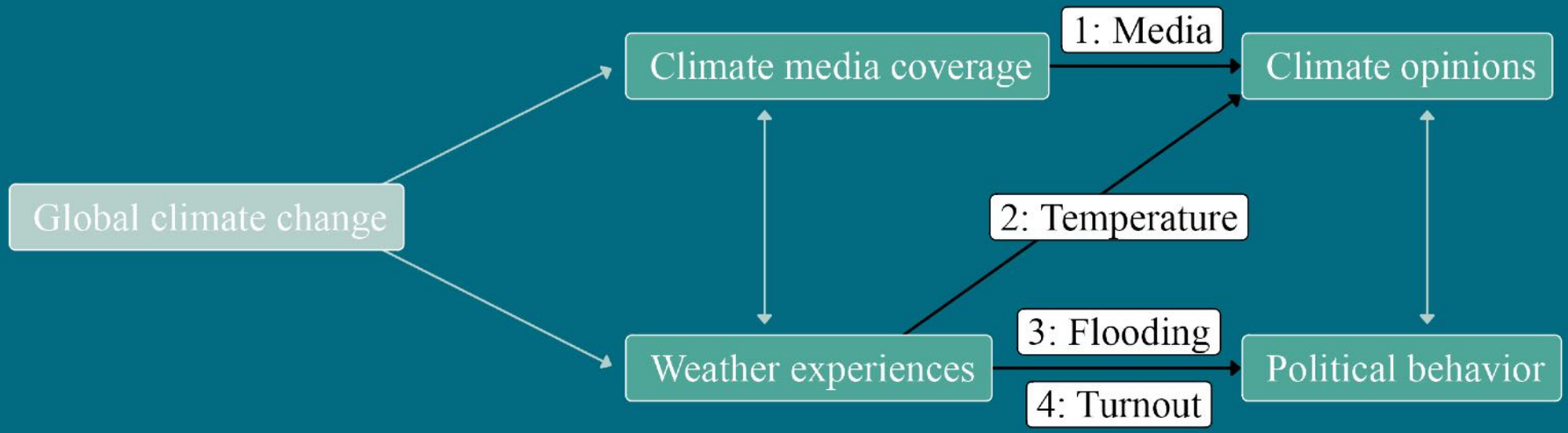
# Results

- **0.18-0.26 %-points** effect of flooding on candidate vote shares
- Median candidate: ~3 %-points higher election chances, if they are pro-climate

# A quick summary –

*Does local flooding experience lead to pro-climate voting?*

- Yes – parties and candidates
- ~1-3 %-points
- Climate-related issues become salient
- Salience translated into pro-climate vote using parties' *reputation* and candidates' *communication*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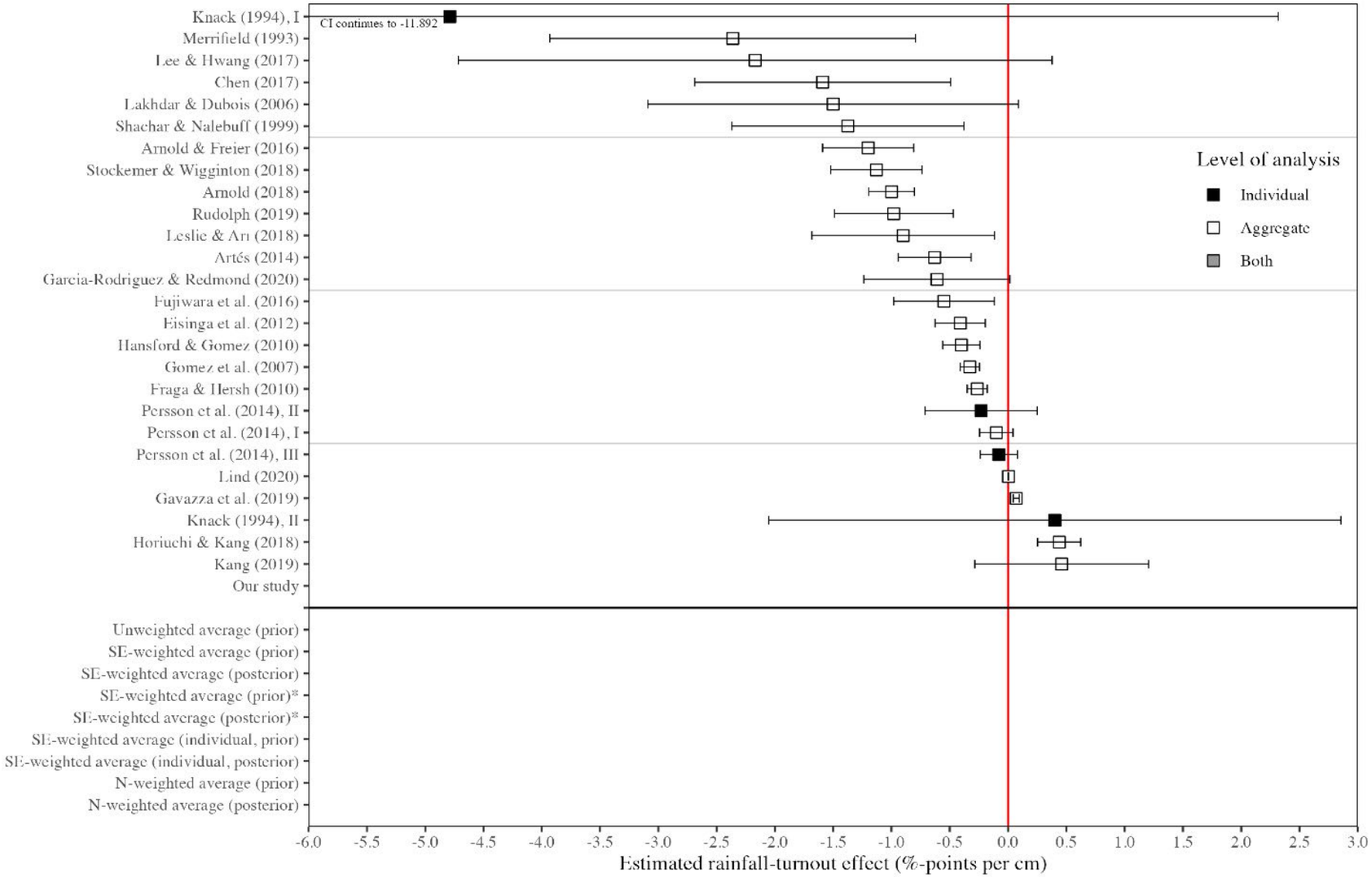
# Article 4: Turnout

# Article 4: Turnout

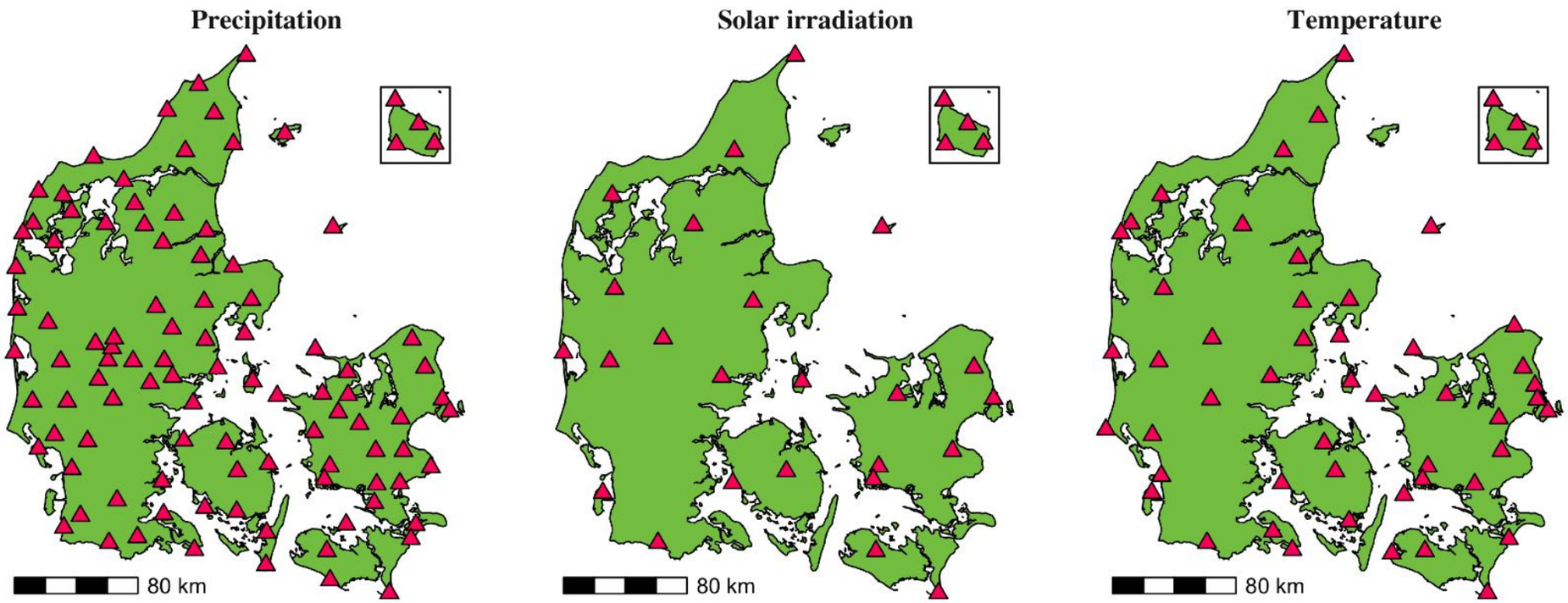

- “When the election rains out and how bad weather excludes marginal voters from turning out”
- Published in *Electoral Studies* (2023)
- Co-authored with Kasper M. Hansen

> **How does the weather affect electoral turnout?**

# Rainfall and turnout



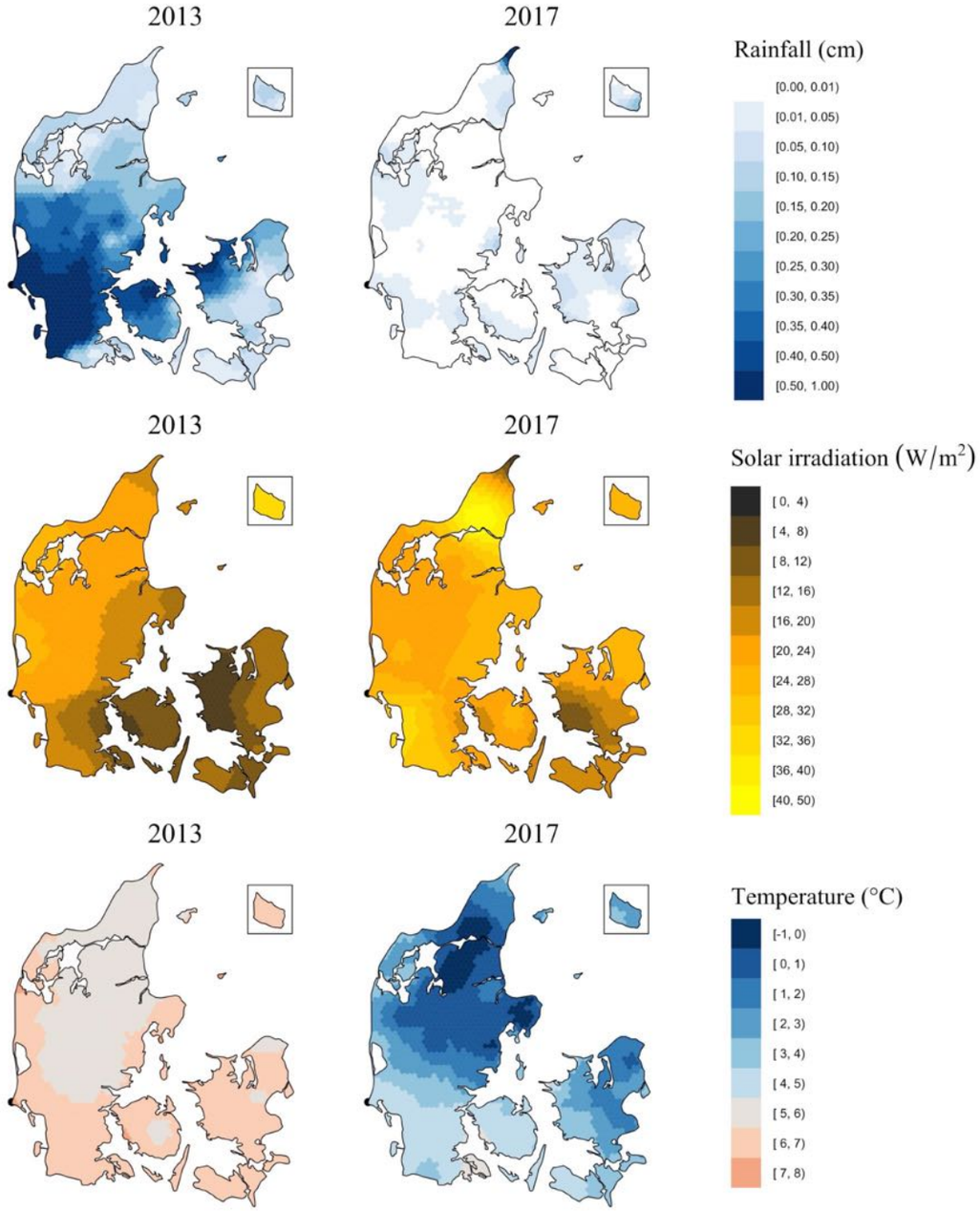
# Our study



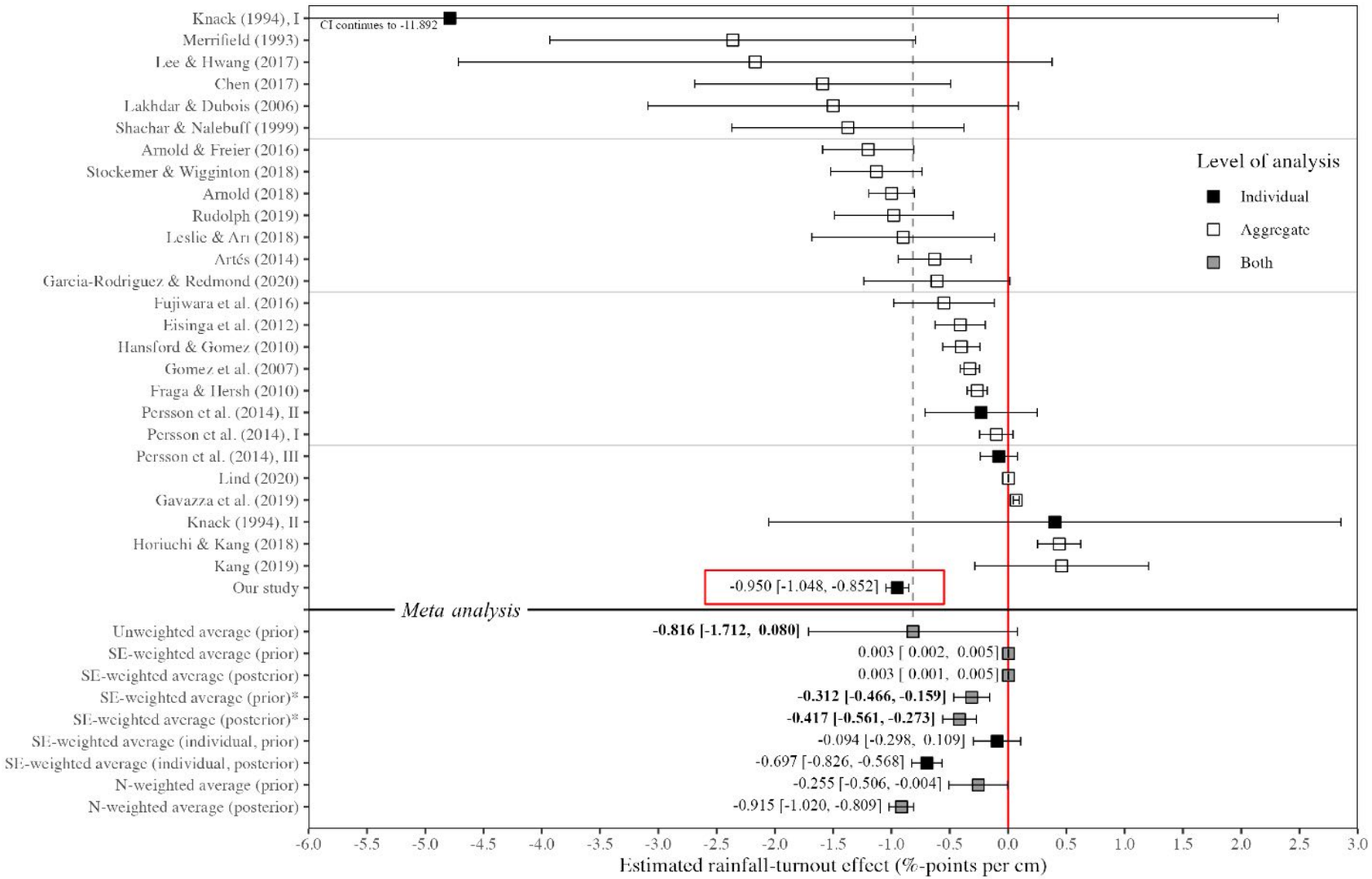

- Registry data on 4,459,145 eligible voters' turnout

# Election Day weather

- Turnout around 70%
  (2013: 72%, 2017: 71%)
- 30% don't vote
- **What role does the weather play?**

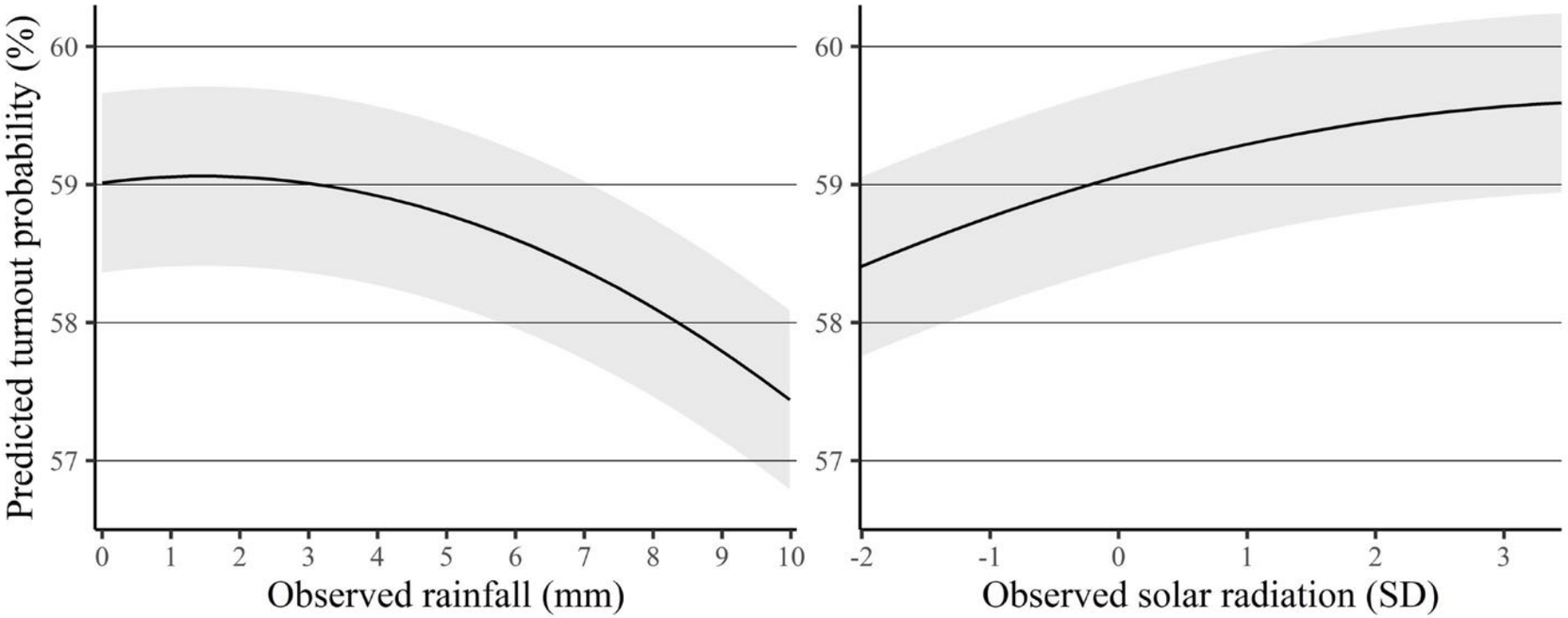


# Results



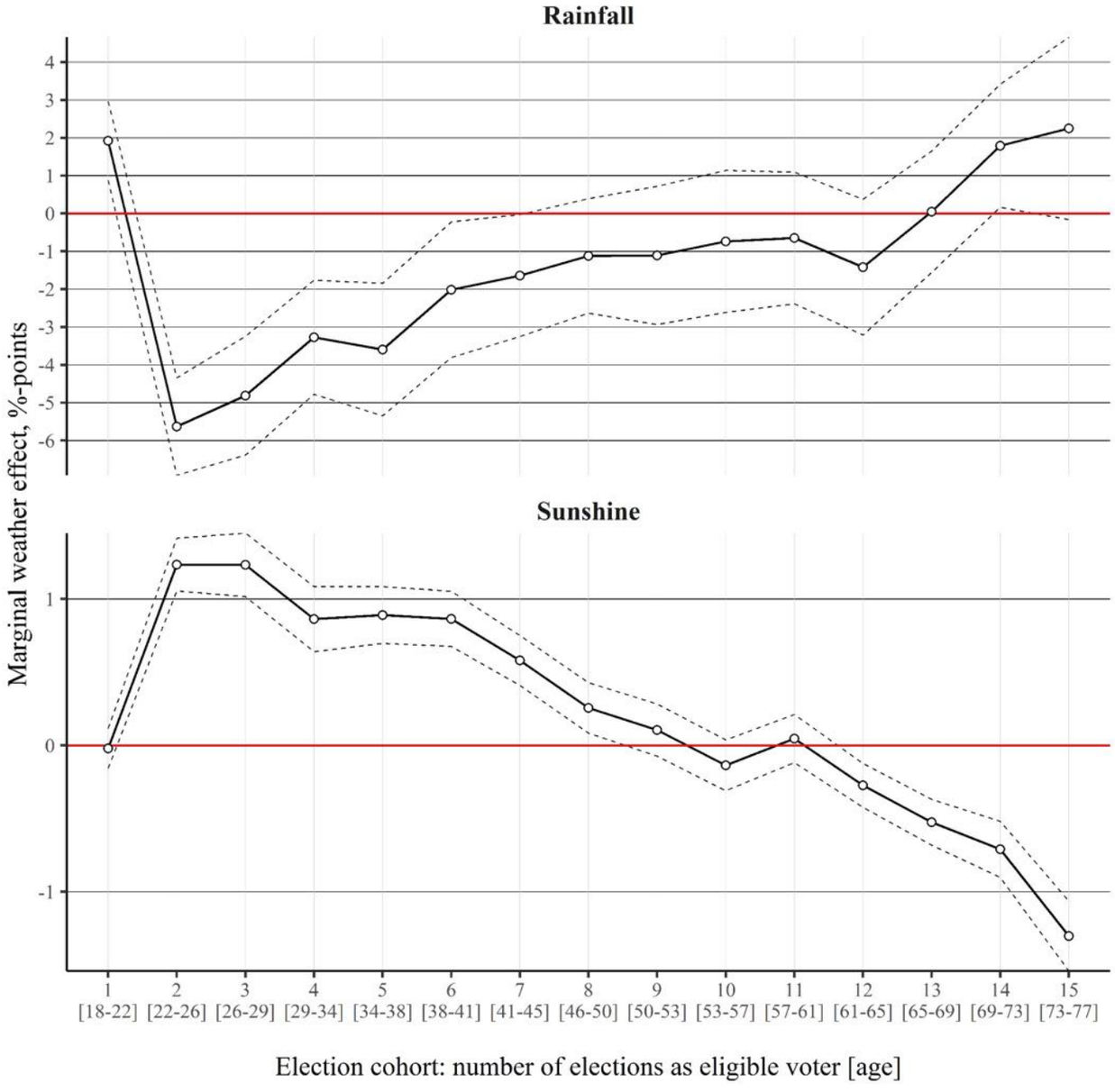

- Rainfall reduces P(voting) by almost **1 %-points** per cm

# Results




- Rainfall effect grows with more rainfall
- Sunshine increases turnout

# Who is susceptible to bad weather?




- Young voters!

# A quick summary –


*How does the weather affect electoral turnout?*

- Experienced weather shapes turnout
- Rainfall reduces turnout by 1 %-point per 1 cm
- Stronger effect of extreme weather
- Young voters most susceptible
- Implications for democratic representation
- … climate change?

# Conclusion

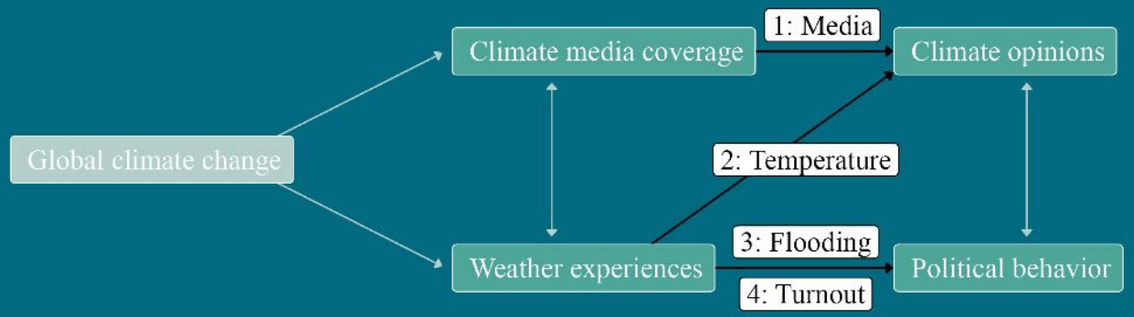

> Research Question: How are voters' climate opinions and behavior shaped by media coverage of climate change and personal weather experiences?

- Positive or "constructive" responses to climate change
- Climate change – a self-correcting problem?
- Responsibility of political elites
- "Political Weather"
- Everyday experiences

# THANK YOU!

# Overview

- Introduction → **Section 1**
- 1: Media → **Section 2.1**
  - Summary in **Section 2.6**
  - Supplementary material in **Section 8**
- 2: Temperature → **Section 3.1**
  - Summary in **Section 3.6**
  - Supplementary material in **Section 9**
- 3: Flooding → **Section 4.1**
  - Summary in **Section 4.12**
  - Supplementary material in **Section 10**
- 4: Turnout → **Section 5.1**
  - Summary in **Section 5.8**
  - Supplementary material in **Section 11**
- Conclusion → **Section 6**



# Supplementary material for Article 1: Media

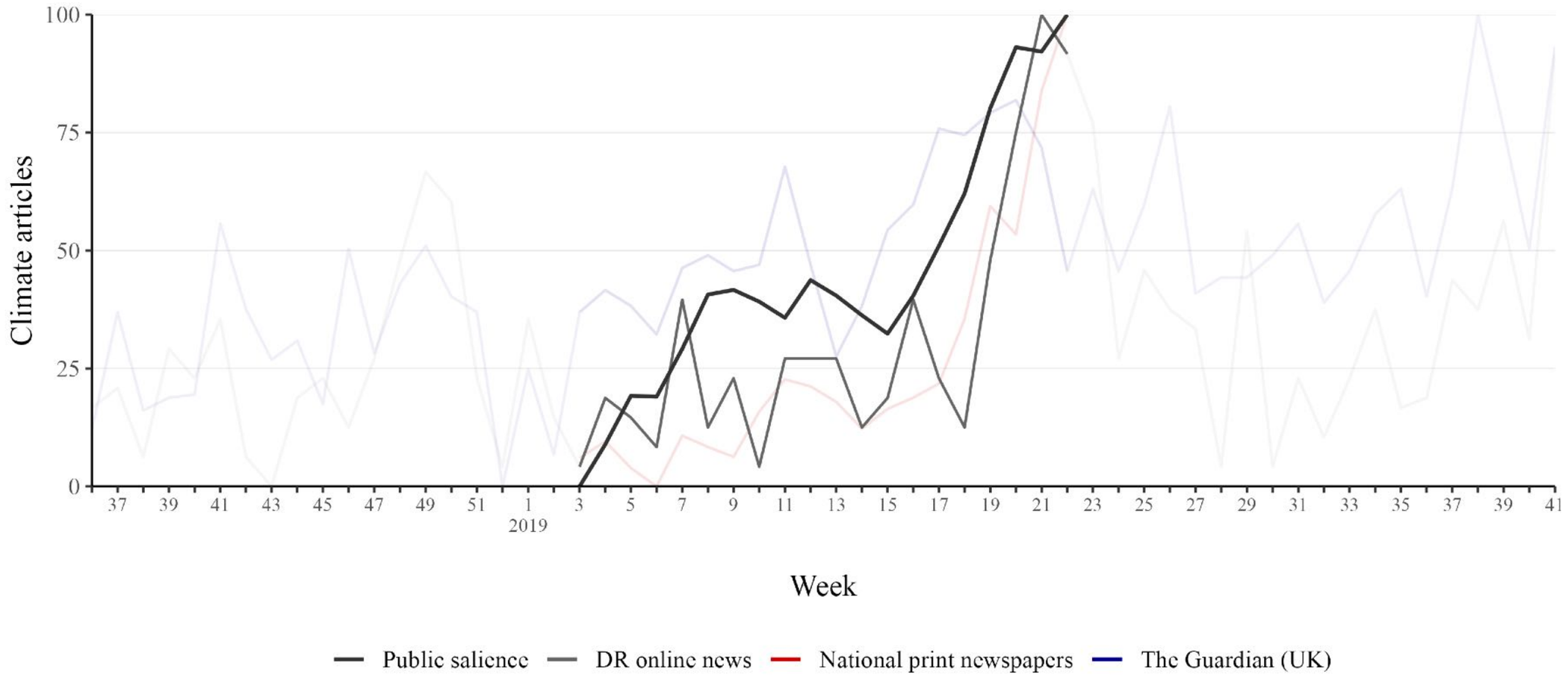
<**Summary** in *Section 2.6*, **overview** in *Section 7.1*>

# Measuring media coverage

"\bklima|global[e]?
opvarmning|co2|drivhuseffekt|drivhusgas|climate|global
warming"

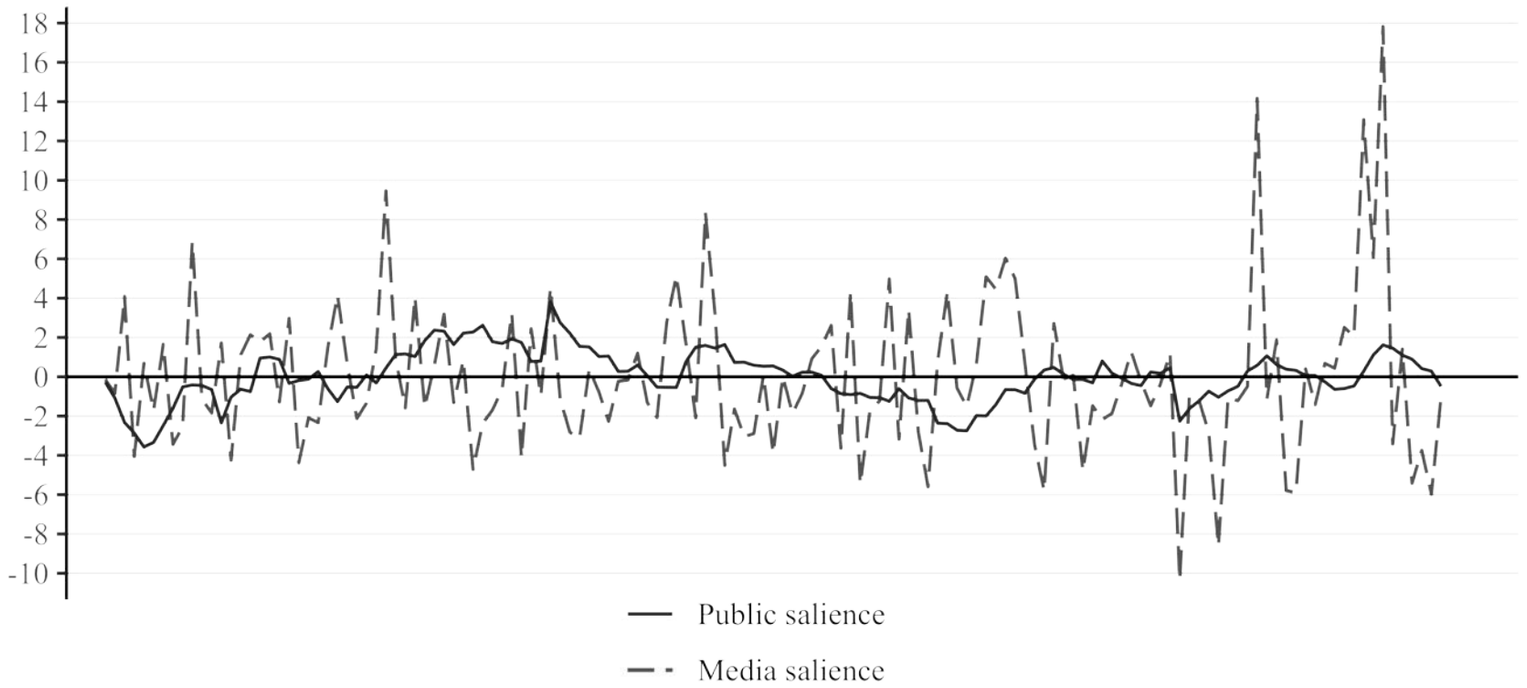
1. Natural log of the number of keyword hits (default)
2. Raw number of keyword hits
3. Square root of the number of keyword hits
4. Number of climate articles (1+ keyword hits)

# Weekly media coverage



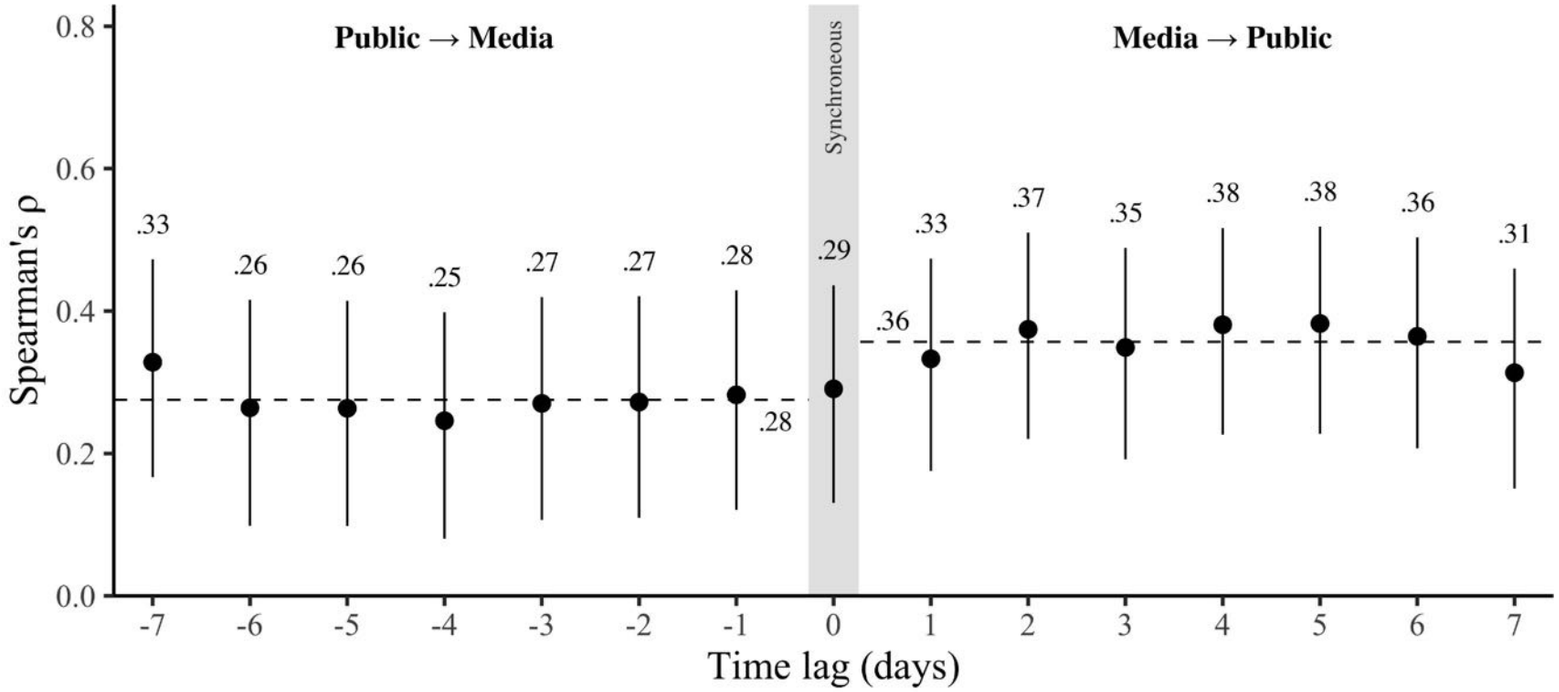
# Time series decomposition

*Residual variance = VAR model input*



# Statistical results

*Cross-lagged panel correlation*



# Statistical results

*Vector autoregression model*

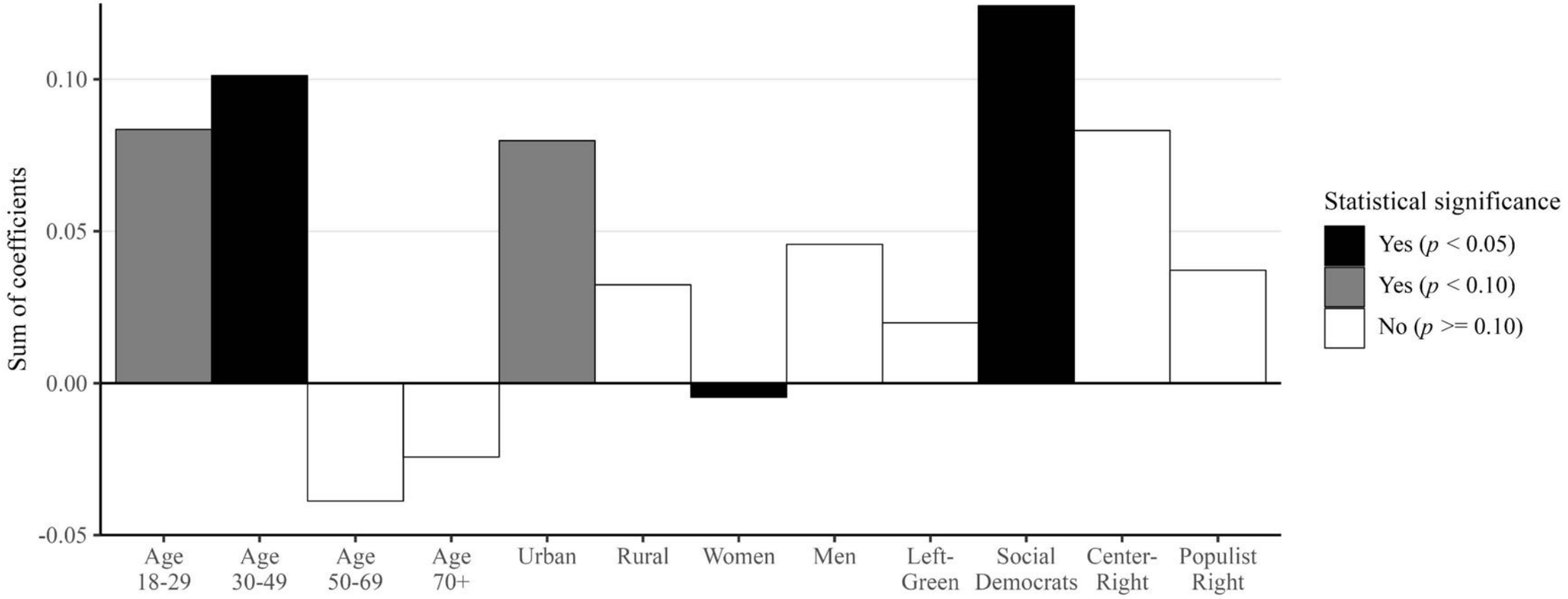
| Direction | N | No. of lags | Sum of coefficients | P | $R^2$ |
|---|---|---|---|---|---|
| Media-Public | 138 | 1 | 0.029 | 0.019** | 0.982 |
| Public-Media | 138 | 1 | -0.005 | 0.983 | 0.361 |

# Statistical results

*Vector autoregression model with varying lag order*

| Subgroup | N | No. of lags | Media to Public | | | Public to Media | | |
|---|---|---|---|---|---|---|---|---|
| | | | Sum of coefficients | P | $R^2$ | Sum of coefficients | P | $R^2$ |
| Full sample | 138 | 1 | 0.03 | 0.02 | 0.98 | 0.00 | 0.98 | 0.36 |
| | 137 | 2 | 0.03 | 0.07 | 0.98 | -0.17 | 0.17 | 0.39 |
| | 136 | 3 | 0.01 | 0.03 | 0.98 | -0.17 | 0.14 | 0.41 |
| | 135 | 4 | 0.04 | 0.01 | 0.98 | -0.20 | 0.32 | 0.41 |
| | 134 | 5 | 0.05 | 0.01 | 0.98 | -0.14 | 0.27 | 0.42 |
| | 133 | 6 | 0.04 | 0.01 | 0.98 | -0.10 | 0.20 | 0.42 |
| | 132 | 7 | 0.03 | 0.03 | 0.98 | -0.01 | 0.03 | 0.46 |

# Who is responsive to media climate coverage?




- Education: Age 30-49
- Immigration: Age 70+, rural, women, center-right (not populist right)

# Supplementary material for Article 2: Temperature

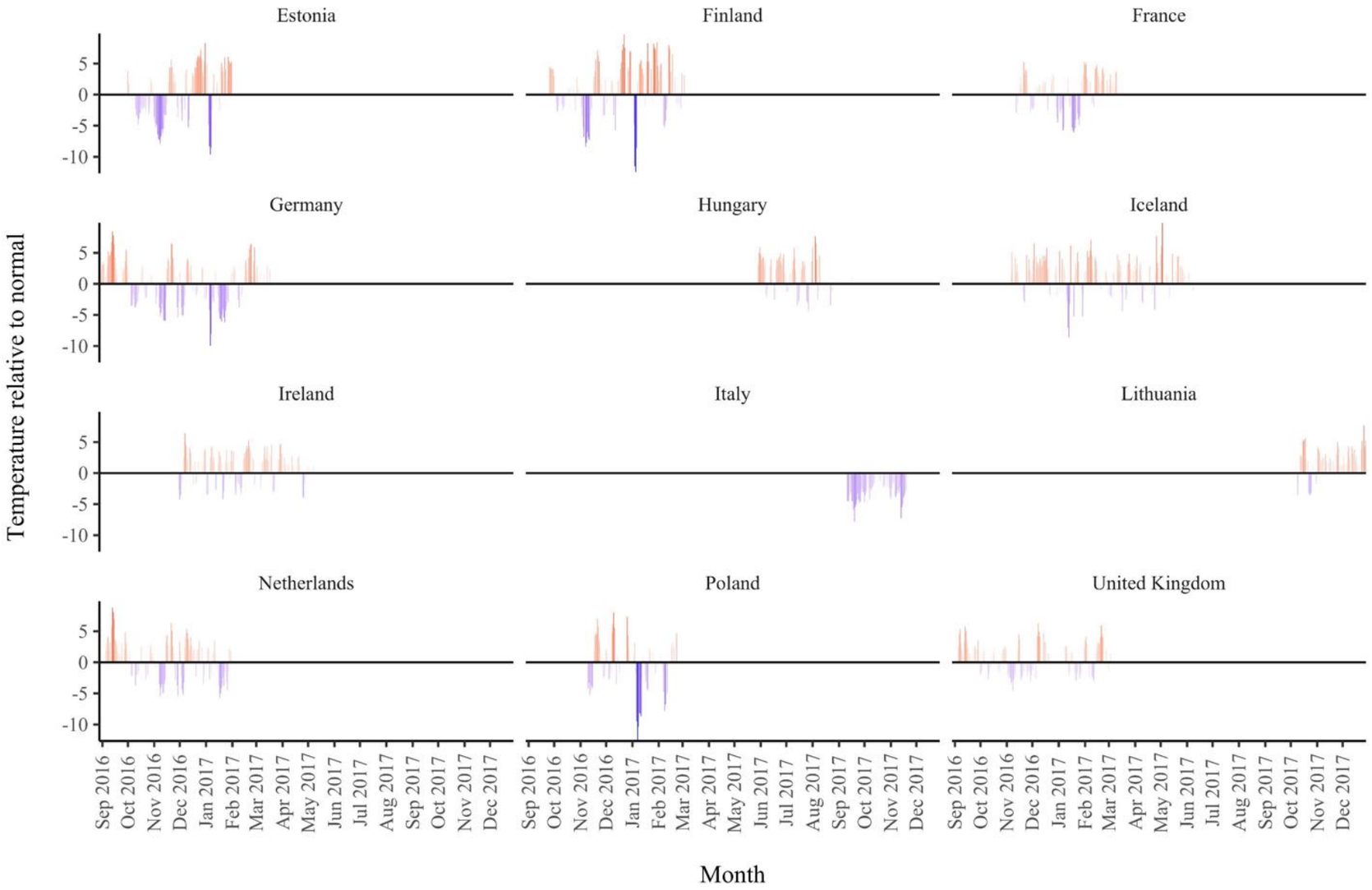
<**Summary** in *Section 3.6*, **overview** in *Section 7.1*>

# Temperature measure

$$temperature_{ct} = \frac{1}{7}\sum_{t-7}^{t-1} mean\ temperature_{ct} - normal\ temperature_{ct}$$

| Country | Average temperature variance | Number of weather stations |
|---|---|---|
| Austria | 6.4 | 6 |
| Switzerland | 5.3 | 10 |
| Russian Federation | 5.2 | 579 |
| Spain | 4.4 | 208 |
| Norway | 3.9 | 1370 |
| Sweden | 3.6 | 848 |
| Israel | 3.3 | 29 |
| Slovenia | 3.3 | 20 |
| Threshold | 3.0 | |
| Finland | 2.9 | 392 |
| France | 2.6 | 44 |
| Italy | 2.4 | 284 |
| Germany | 1.9 | 1076 |
| United Kingdom | 1.8 | 120 |
| Poland | 1.6 | 33 |
| Iceland | 1.5 | 9 |
| Hungary | 1.3 | 5 |
| Netherlands | 1.3 | 56 |
| Estonia | 1.2 | 27 |
| Lithuania | 1.2 | 13 |
| Ireland | 1.1 | 47 |

# Data collection



# Balance check

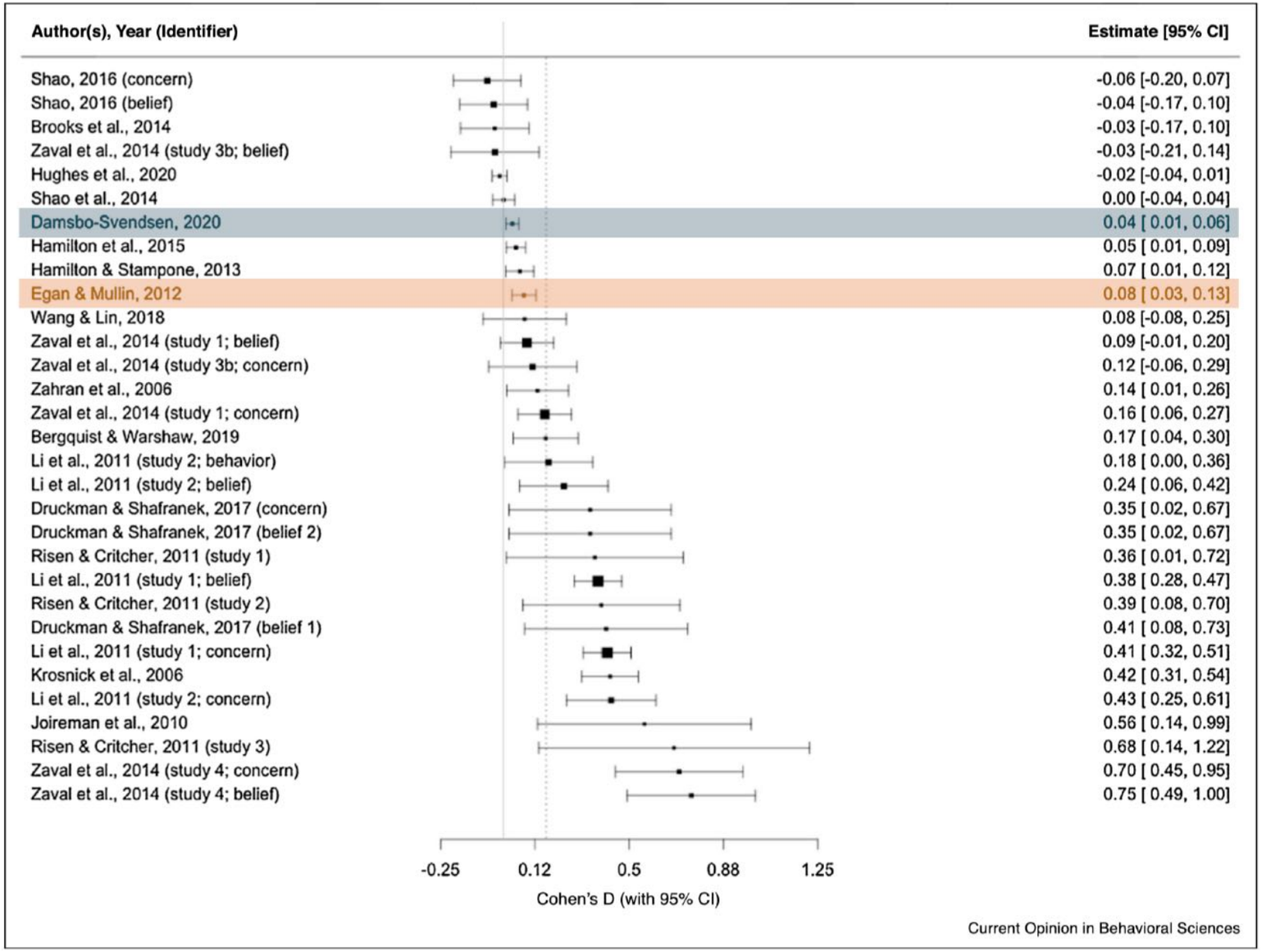
| | Temperature | |
|---|---|---|
| | (1) | (2) |
| Education | −0.01 (0.01) | −0.01 (0.01) |
| Age | 0.001 (0.001) | −0.0001 (0.001) |
| Gender (ref. = Male) | −0.01 (0.02) | 0.002 (0.02) |
| Income | −0.01* (0.01) | −0.01 (0.005) |
| Religiosity | 0.005 (0.01) | −0.005 (0.01) |
| Ethnic minority (ref. = No) | 0.05 (0.09) | 0.08 (0.09) |
| Ideology | 0.004 (0.01) | −0.0004 (0.004) |
| Party ID | −0.02 (0.01) | −0.02* (0.01) |
| Constant | 0.50*** (0.06) | −1.32* (0.80) |
| Month + day of week FEs | | + |
| Countries in sample | 12 | 12 |
| Observations | 16,905 | 16,905 |
| $R^2$ | 0.15 | 0.27 |

# OLS model

| | Climate opinion index | | | | Single climate change question | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 |
| Temperature | 0.11*** | 0.11*** | 0.11*** | 0.12*** | 0.19*** | 0.13 | 0.14* | 0.16** |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.07) | (0.09) | (0.08) | (0.08) |
| Ideology | | | | −0.82 | | | | −0.73 |
| | | | | (0.14) | | | | (0.10) |
| Party ID | | | | 1.26*** | | | | 0.85*** |
| | | | | (0.10) | | | | (0.19) |
| Constant | 67.27*** | 68.47*** | 62.73*** | 65.97*** | 84.78*** | 85.43*** | 80.66*** | 83.65*** |
| | (0.02) | (0.45) | (1.77) | (1.65) | (0.03) | (0.63) | (2.60) | (2.60) |
| Month and day of week fixed effects | | + | + | + | | + | + | + |
| Demographics controls | | | + | + | | | + | + |
| Countries in sample | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Observations | 23 966 | 23 966 | 23 415 | 22 850 | 23 966 | 23 966 | 23 415 | 22 850 |
| $R^2$ | 0.086 | 0.089 | 0.144 | 0.168 | 0.037 | 0.039 | 0.051 | 0.058 |

Note: All models are OLS regressions with country fixed effects and country-wise cluster-robust standard errors (in parentheses). Demographic controls include age, gender, education, income, religiosity and ethnic minority. The climate change index is composed of the single climate change question and five other items (see appendix). *p < .1; **p < 0.05; ***p < .01.

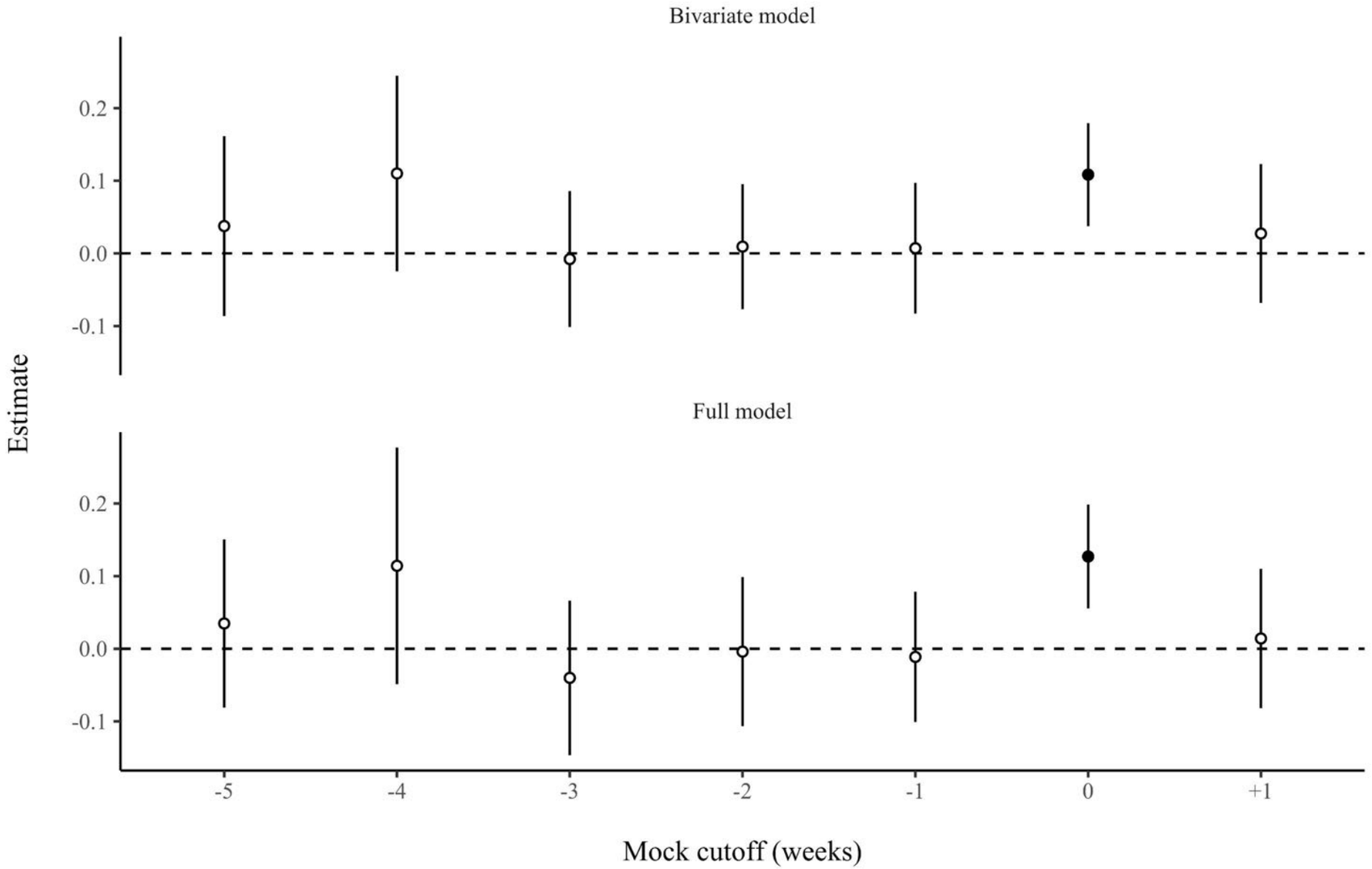
# Meta-analysis




© Sugerman et al. (2021). "Local warming is real: A meta-analysis of the effect of recent temperature on climate

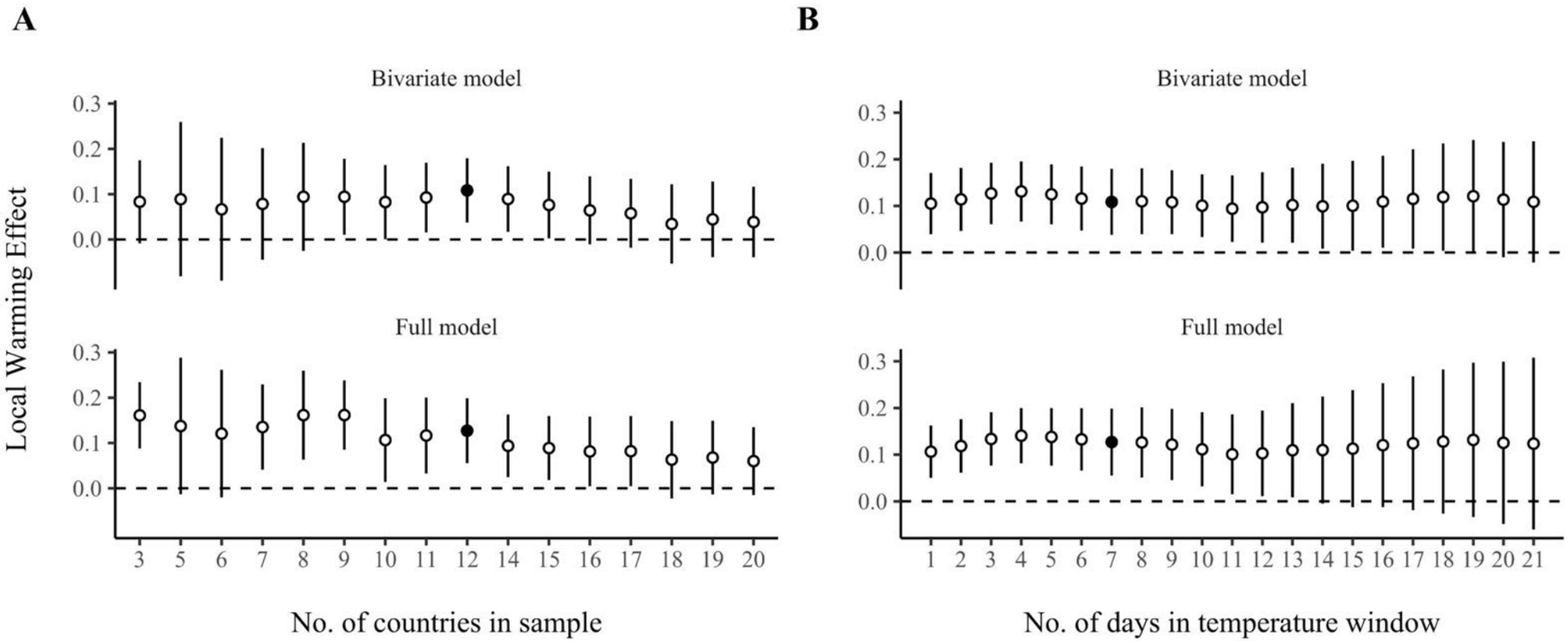
change beliefs."

# Placebo test

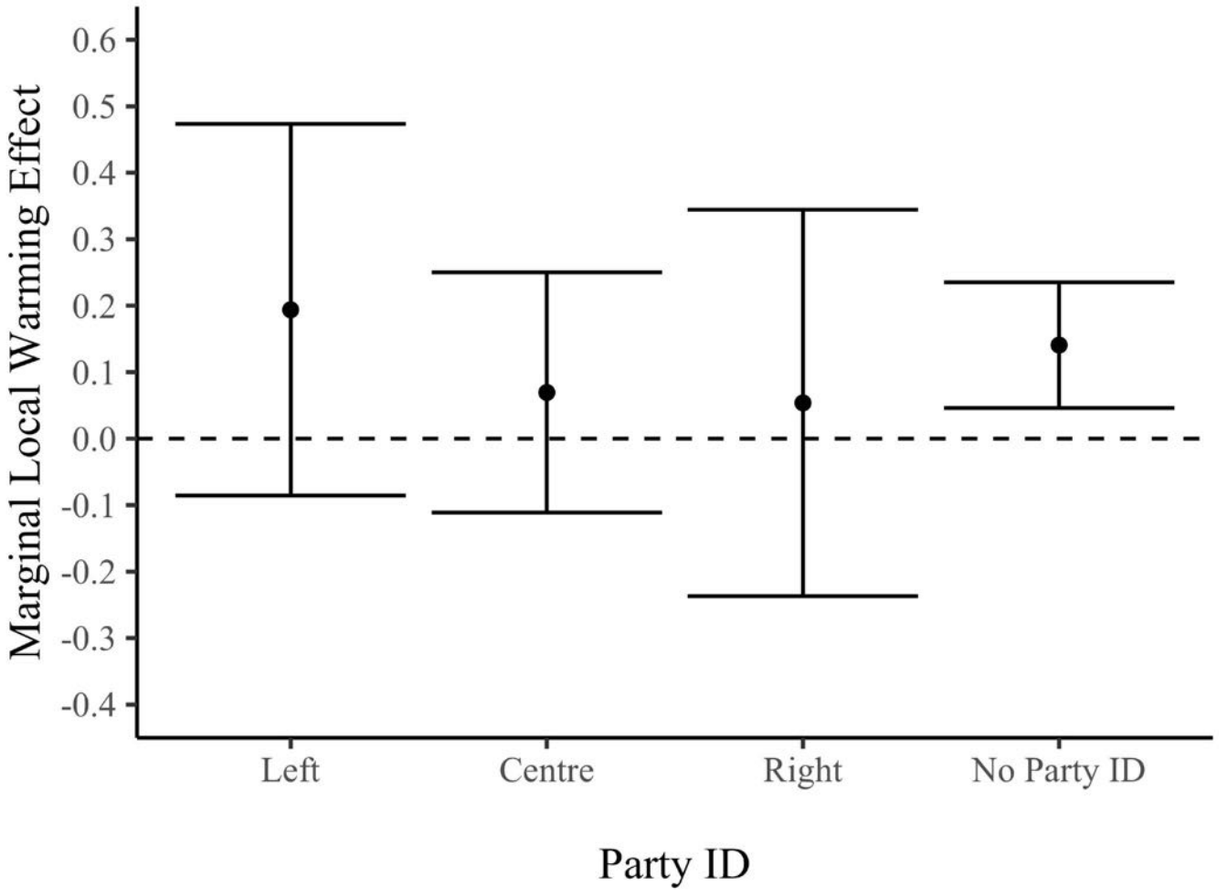


# Robustness checks

*Changing the sample size or 7-day temperature window*



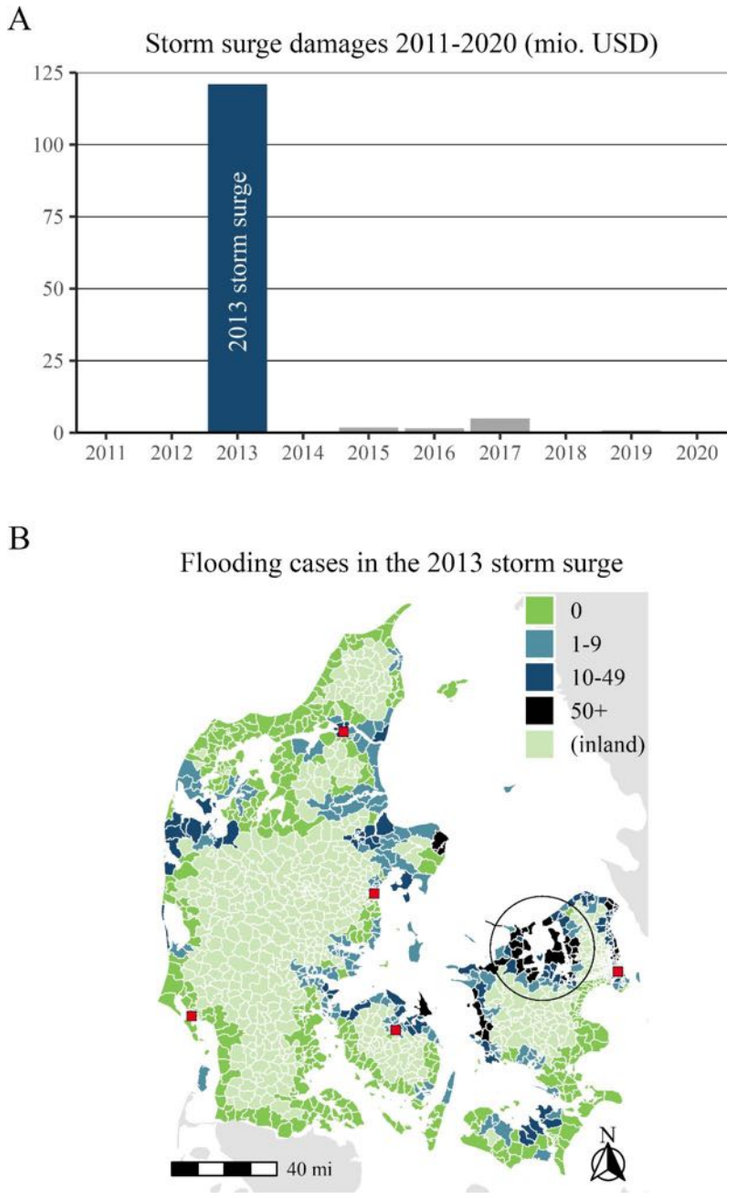
# Left-right party ID



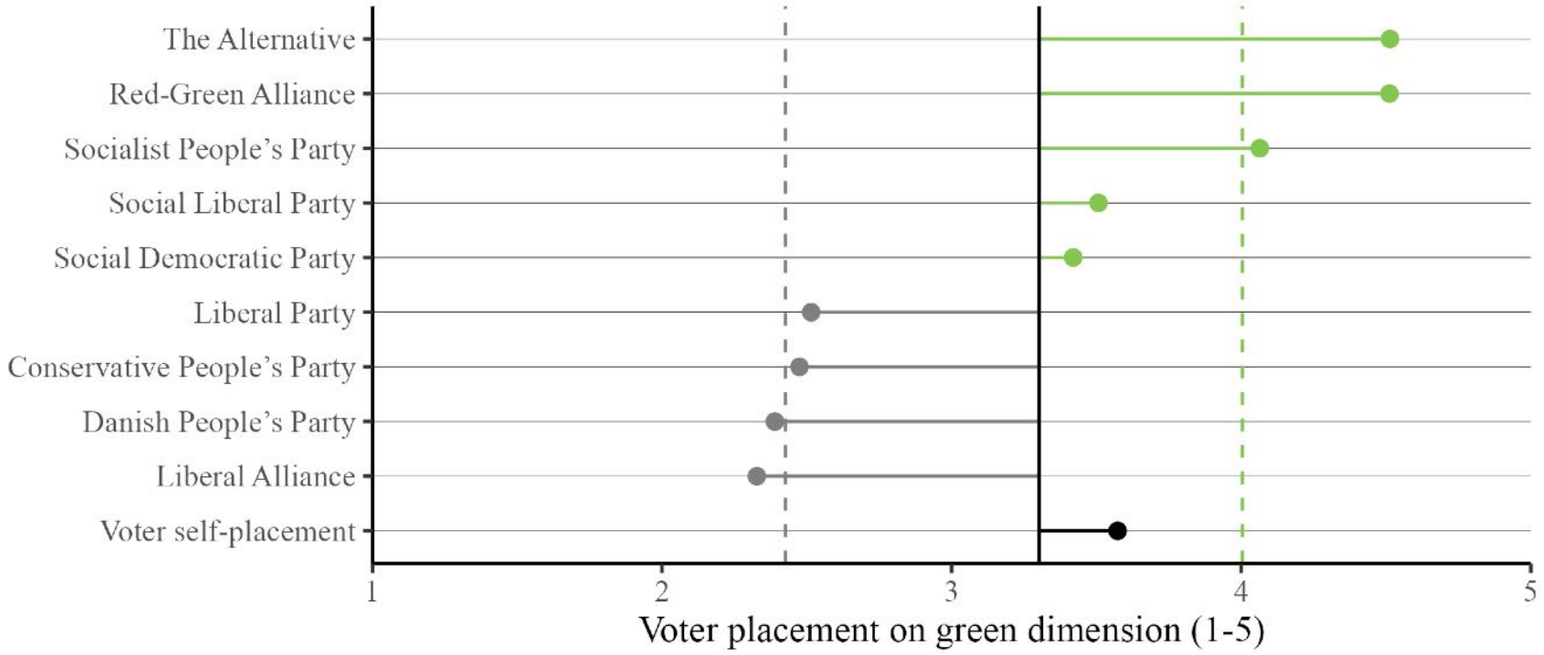
# Supplementary material for Article 3: Flooding

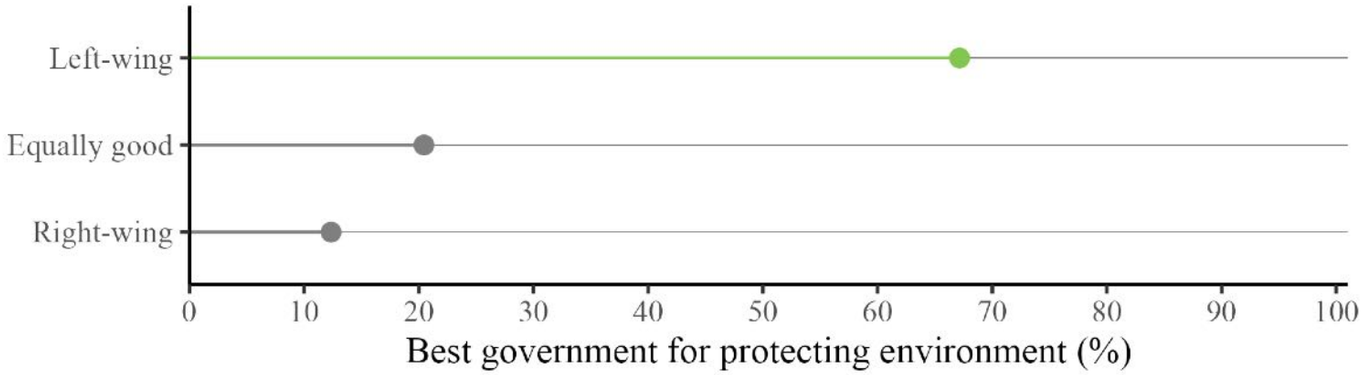
<**Summary** in *Section 4.12*, **overview** in *Section 7.1*>

# Storm surge timeline and map

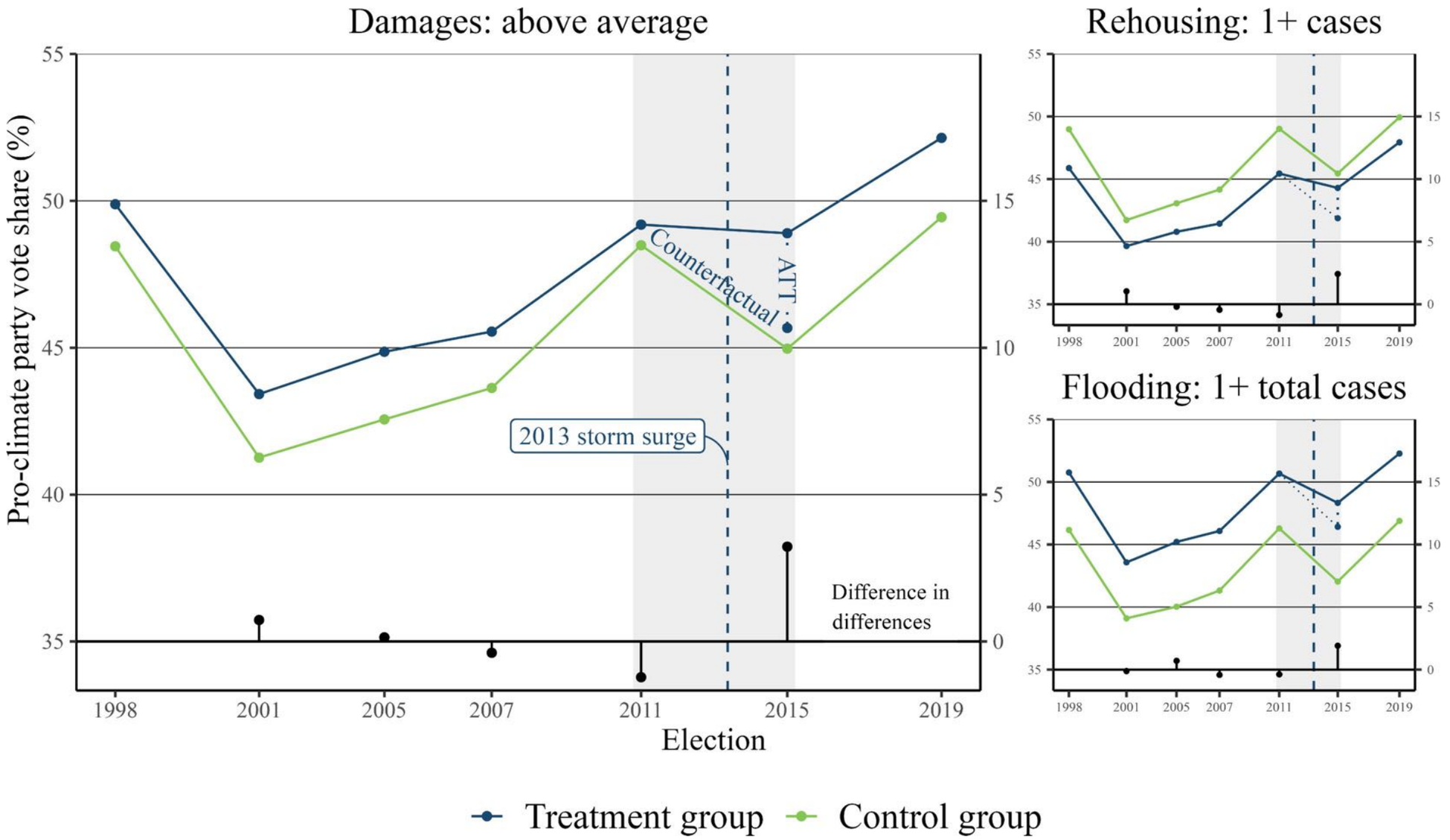


# Climate issue ownership

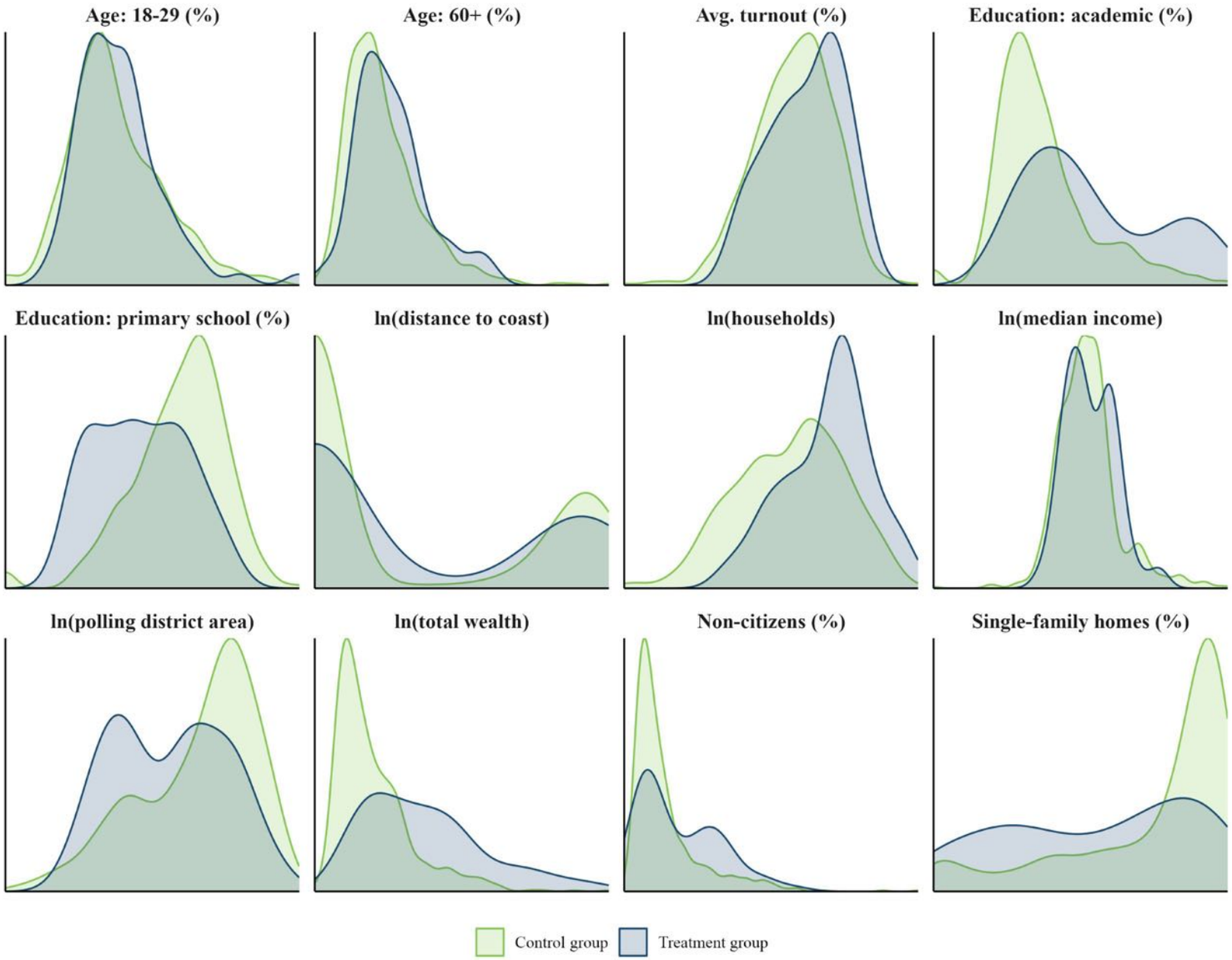


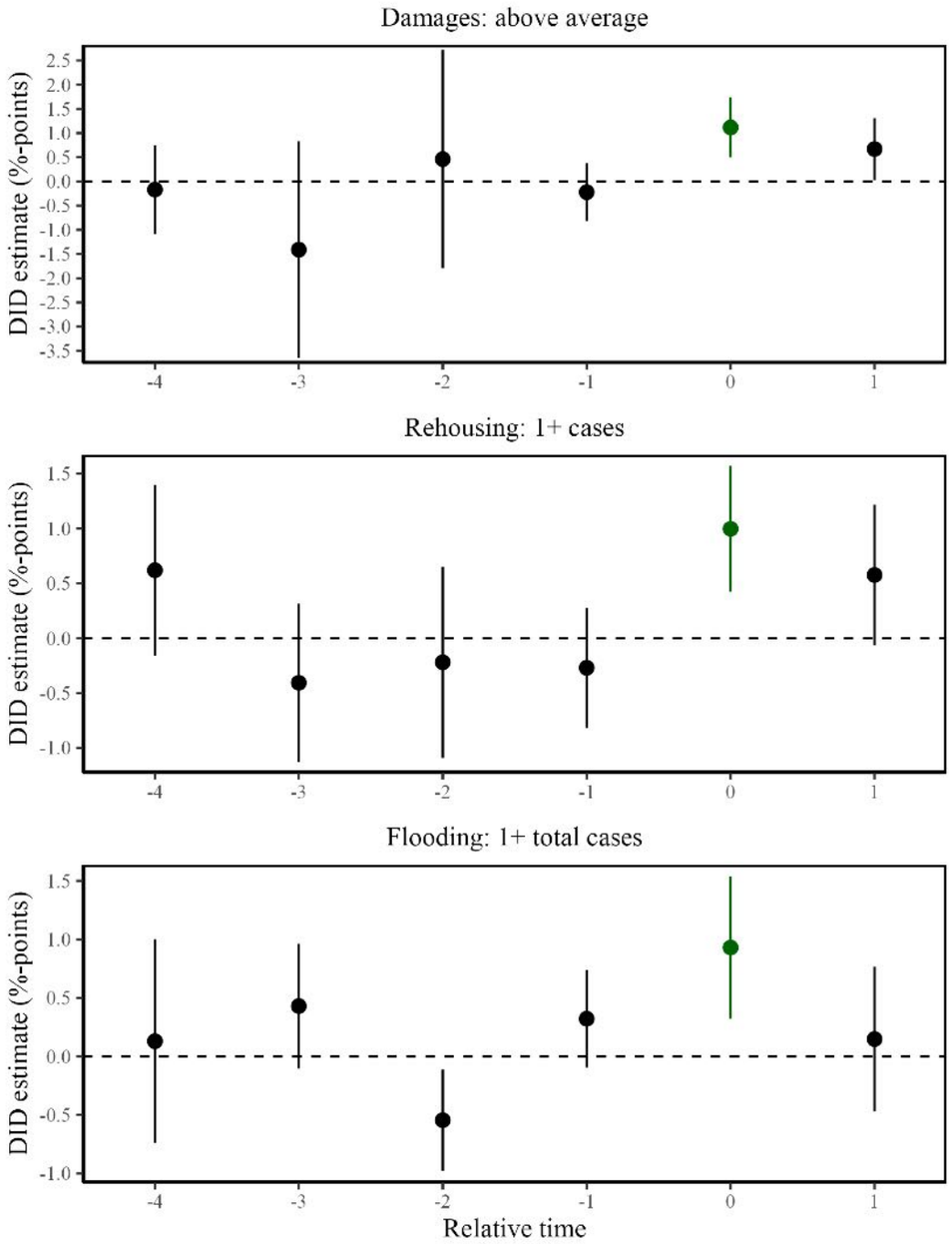
# Parallel trends



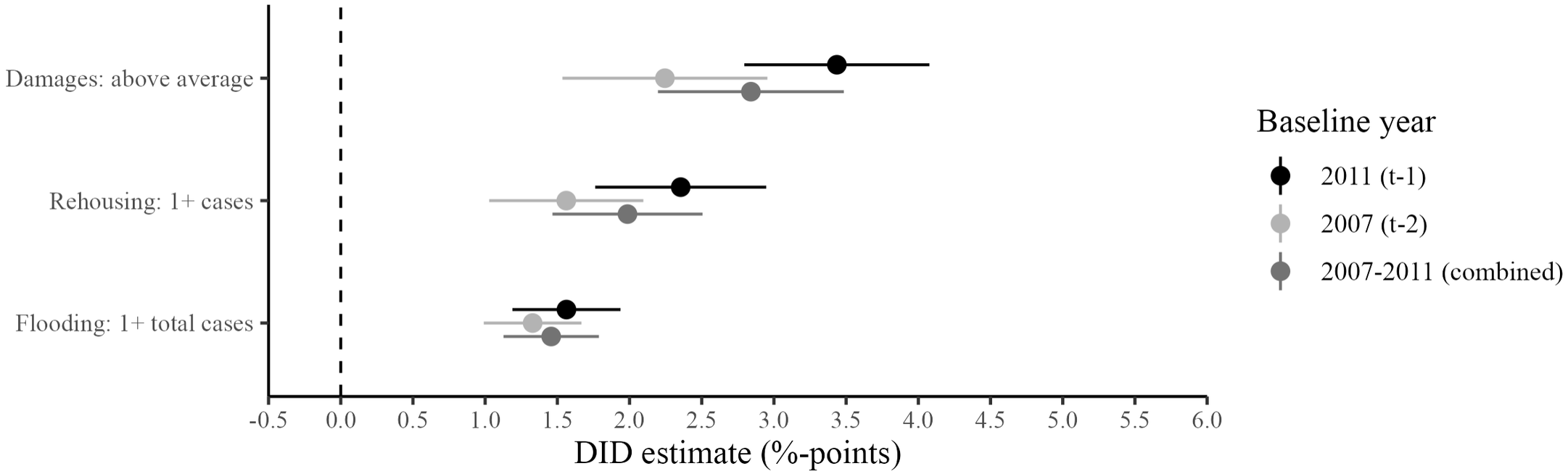
# Balance


Age: 18-29 (%)
Age: 60+ (%)
Avg. turnout (%)
Education: academic (%)
Education: primary school (%)
ln(distance to coast)
ln(households)
ln(median income)
ln(polling district area)
ln(total wealth)
Non-citizens (%)
Single-family homes (%)
Control group
Treatment group

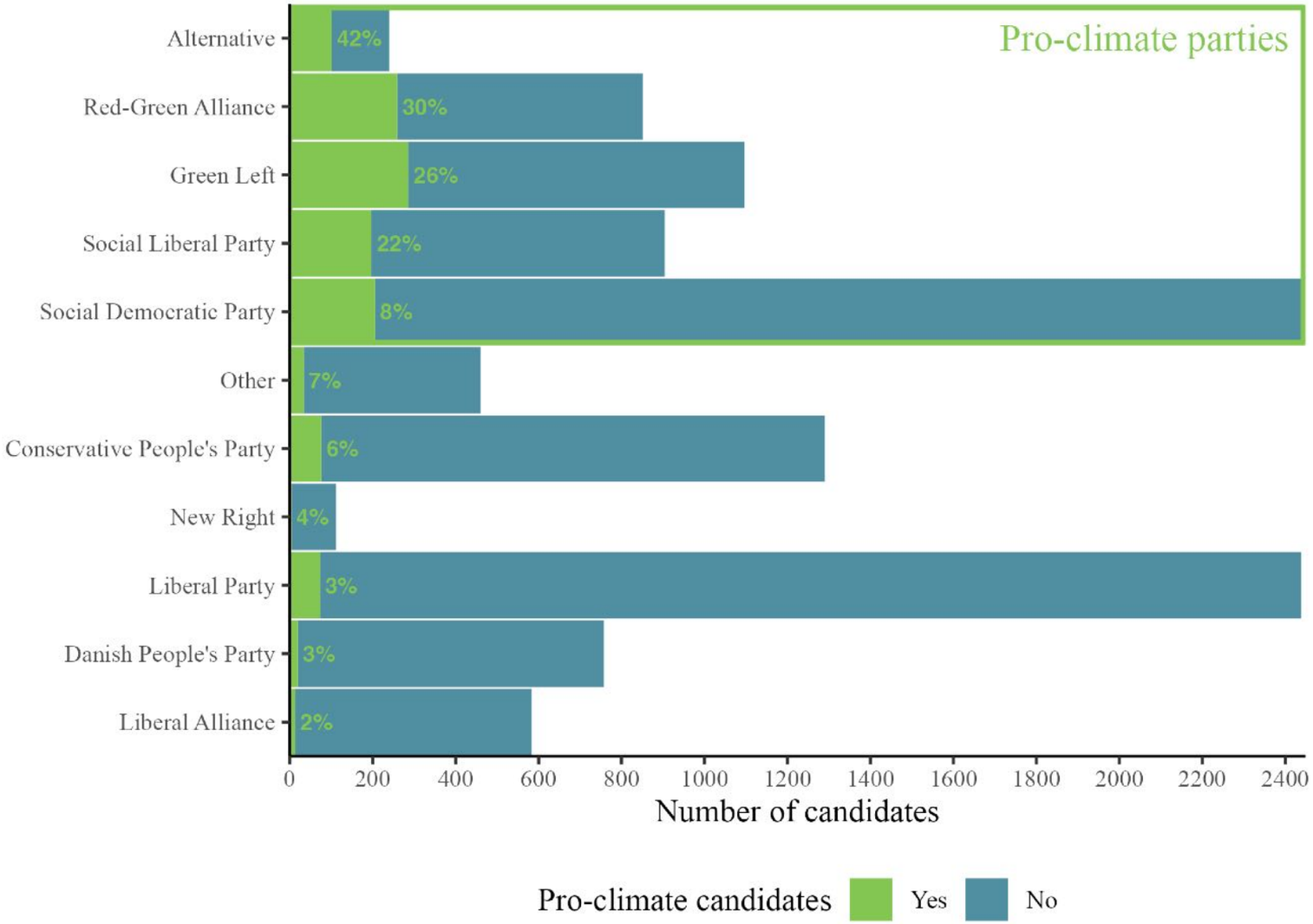
# Event study plot


Damages: above average
DID estimate (%-points)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4
-3
-2
-1
0
1
Rehousing: 1+ cases
DID estimate (%-points)
1.5
1.0
0.5
0.0
-0.5
-1.0
-4
-3
-2
-1
0
1
Flooding: 1+ total cases
DID estimate (%-points)
1.5
1.0
0.5
0.0
-0.5
-1.0
-4
-3
-2
-1
0
1
Relative time

# Full sample


Damages: above average
Rehousing: 1+ cases
Flooding: 1+ total cases
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
DID estimate (%-points)
Baseline year
2011 (t-1)
2007 (t-2)
2007-2011 (combined)

# Pro-climate parties



# Climate candidate keywords

| Keyword | Hits |
|---|---|
| \bklima | 874 |
| bæredygtighed | 344 |
| grøn[n]?[e]? omstilling | 285 |
| co2 | 245 |
| vedvarende energi | 206 |
| grøn[n]?[e]?[r]?[e]? kommun | 147 |
| grøn[n]?[e]? energi | 144 |
| grøn[n]?[e]? kommun | 126 |
| alternativ[e]? energi | 50 |
| fossil | 48 |
| oversvømme | 34 |
| grøn[n]?[e]? løsning | 31 |
| grøn[n]?[e]? løsning | 31 |
| grøn[n]?[e]? job | 29 |
| grøn[n]?[e]? arbejdsplads | 21 |
| kommunen[s]? grøn | 20 |
| kystsikring | 14 |
| global[e]? opvarmning | 13 |
| grøn[n]?[e]? virksomhed | 12 |
| grøn[n]?[e]? fremtid | 11 |
| c02 | 10 |
| ren[e]? energi | 10 |
| stormflod | 9 |
| drivhusgas | 5 |
| drivhuseffekt | 2 |
| climate | 0 |
| global warming | 0 |

# Additional pro-climate candidate examples

*Climate and environment. Put the planet over profits! My heart beats most for green issues because our future depends on it. Our ambition must be to become a self-sufficient, carbon neutral municipality. We can do that by improving energy efficiency in our buildings and incorporate climate and environment in every relevant proposal*

- Candidate from the Red-Green Alliance (Ø)

# Candidate data details

1. Begin with merged dataset (votes and survey): 11,774 candidates
2. Add vote tallies from each district and election: 194,039 rows (candidate-district-elections)
3. Merge with district flooding
4. Restrict to coastal districts:
    - 118,176 rows (candidate-district-elections)
    - 7,671 unique persons or 9,748 unique election-candidates
    - 2,077 (approx. 42%) run in both elections

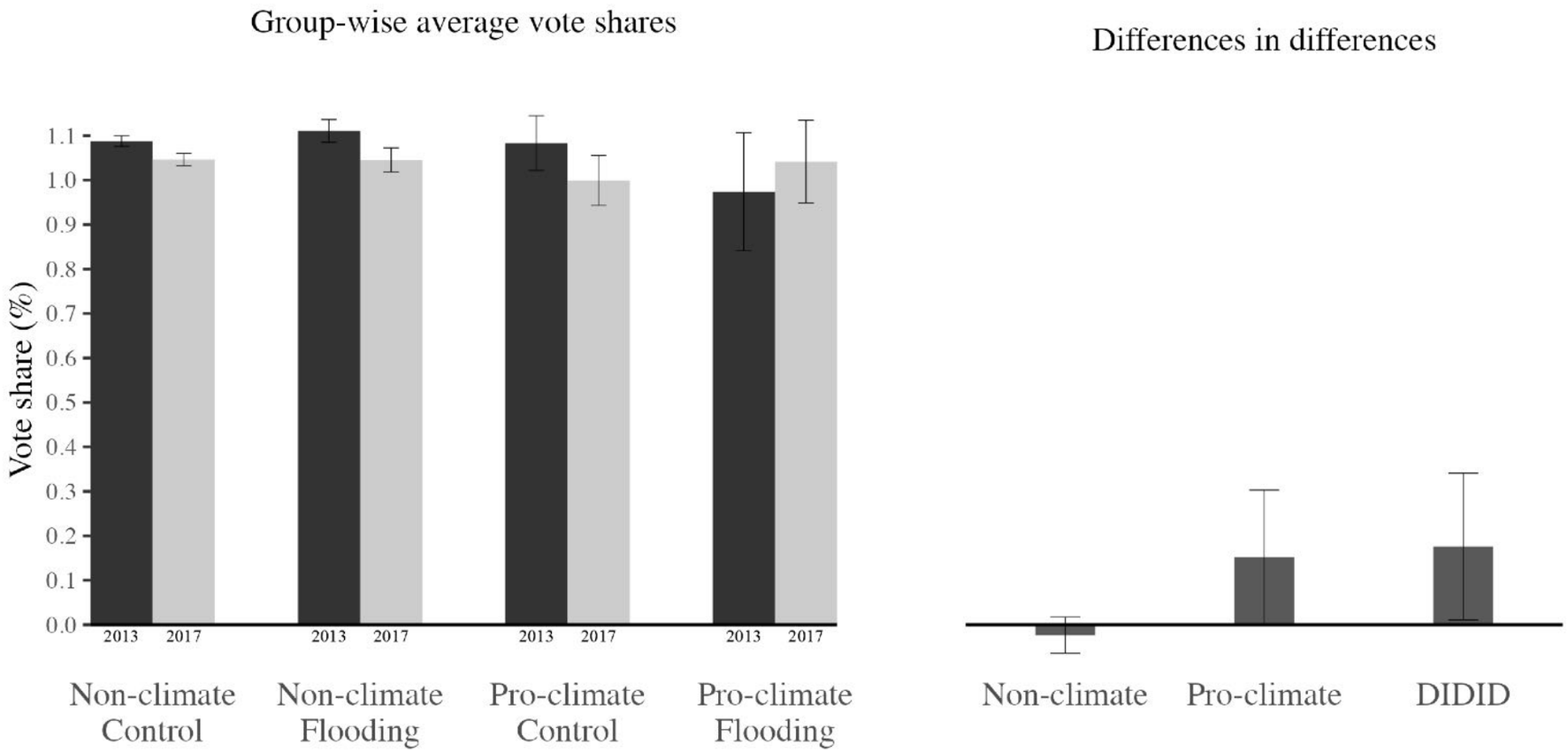
# OLS model

| | Candidate vote share (%) | | |
|---|---|---|---|
| | Model 1 | Model 2 | Model 3 |
| Flooding | 0.025. | 0.023 | 0.024 |
| | (0.015) | (0.014) | (0.014) |
| Post | −0.039*** | −0.041*** | 0.142*** |
| | (0.010) | (0.010) | (0.017) |
| Pro-climate | −0.235*** | −0.004 | −0.153. |
| | (0.033) | (0.034) | (0.081) |
| Flooding x Post | −0.042* | −0.024 | −0.055* |
| | (0.021) | (0.021) | (0.022) |
| Flooding x Pro-climate | −0.122 | −0.132 | 0.040 |
| | (0.083) | (0.082) | (0.068) |
| Pro-climate x Post | 0.001 | −0.043 | −0.016 |
| | (0.038) | (0.039) | (0.050) |
| Flooding x Post x Pro-climate (DIDID) | 0.262*** | 0.176* | 0.120. |
| | (0.072) | (0.084) | (0.062) |
| Municipality FEs | X | X | X |
| Party FEs | | X | |
| Candidate FEs | | | X |
| Observations | 118 176 | 118 176 | 118 176 |

$$Vote\ share_{itd} = \beta_1 Flooding_d + \beta_2 Post_t + \beta_3 Climate_{it} + \beta_4 Flooding \times Post_{td} + \beta_5 Flooding \times Climate_{itd} + \beta_6 Climate \times Post_{it} + \beta_7 Flooding \times Post \times Climate_{itd} + \alpha_m + \epsilon_{itd}$$

# DIDID plot

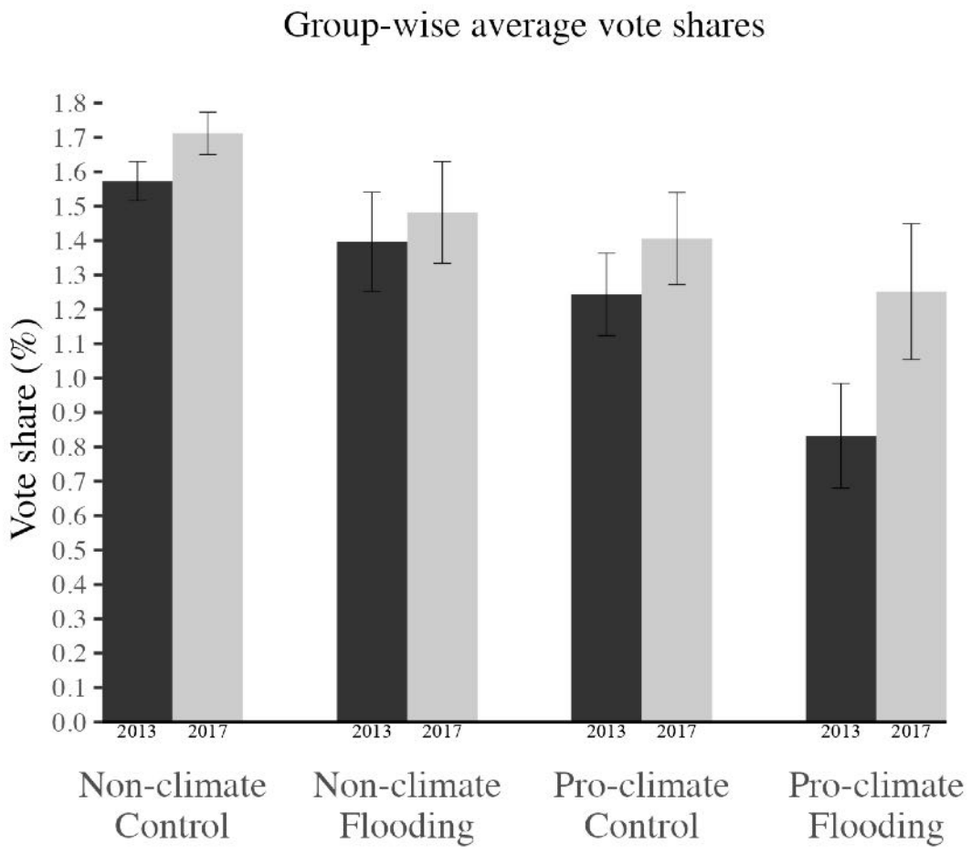
*Post-estimation*

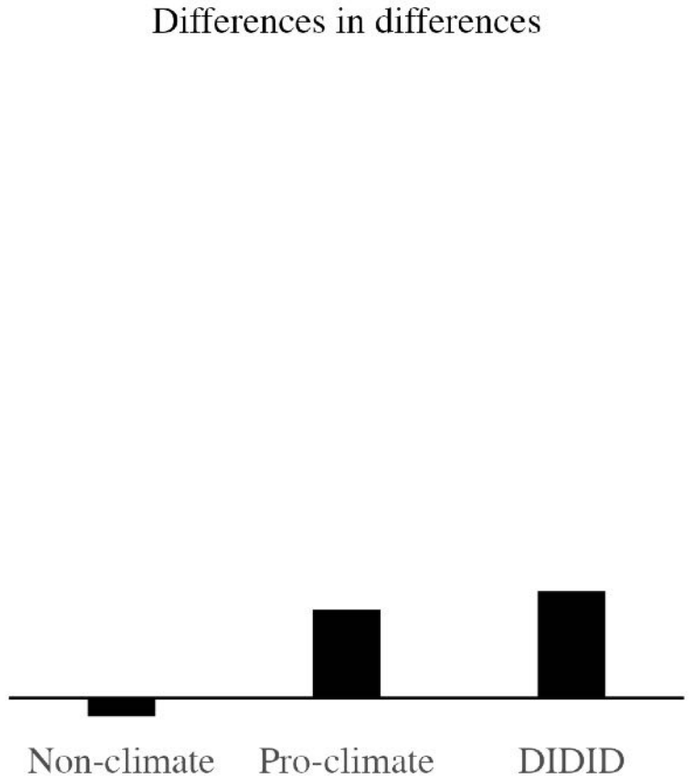



*Model 2 (municipality + party FEs)*

# DIDID plot

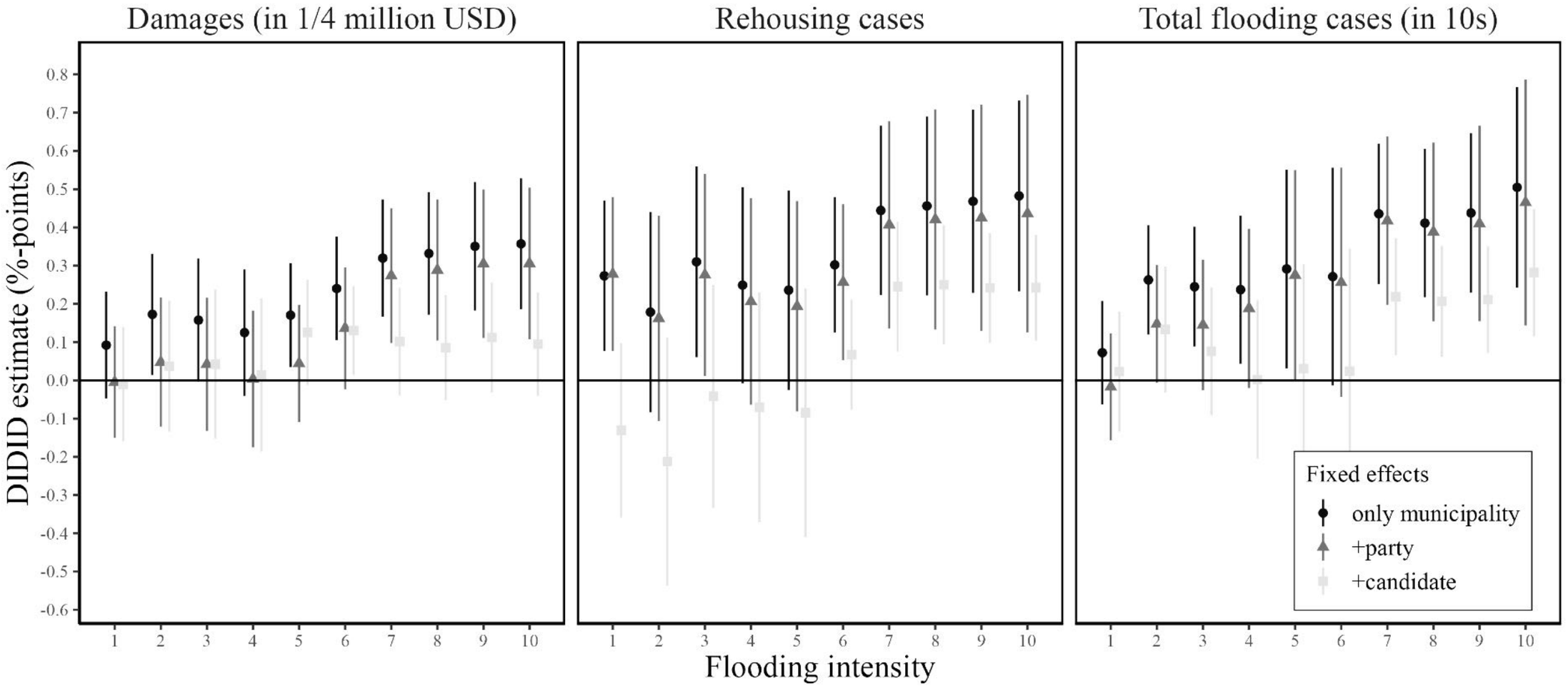
*Sample: 2,077 candidates running in both elections*



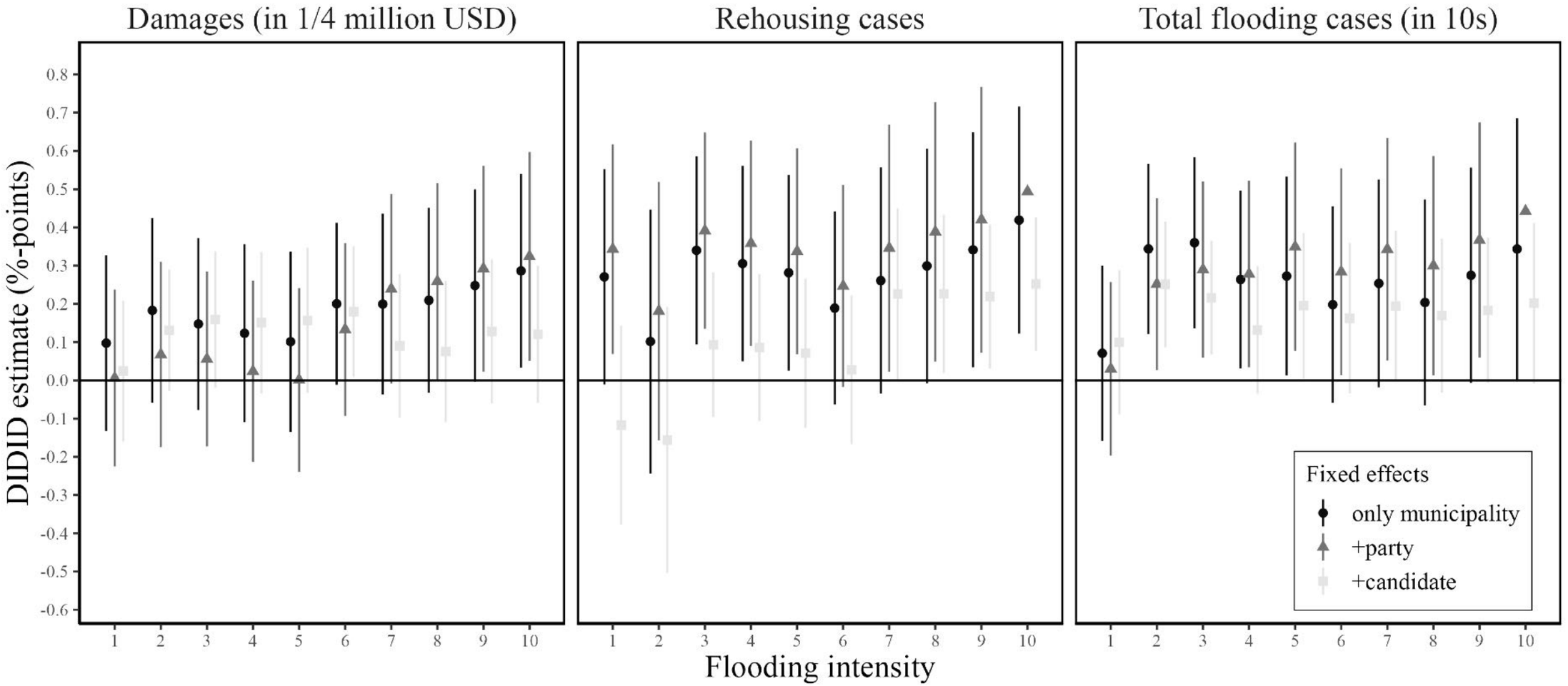
# DIDID coefficient plot

*Sample: All candidates*



# DIDID coefficient plot

*Sample: 2,077 candidates running in both elections*

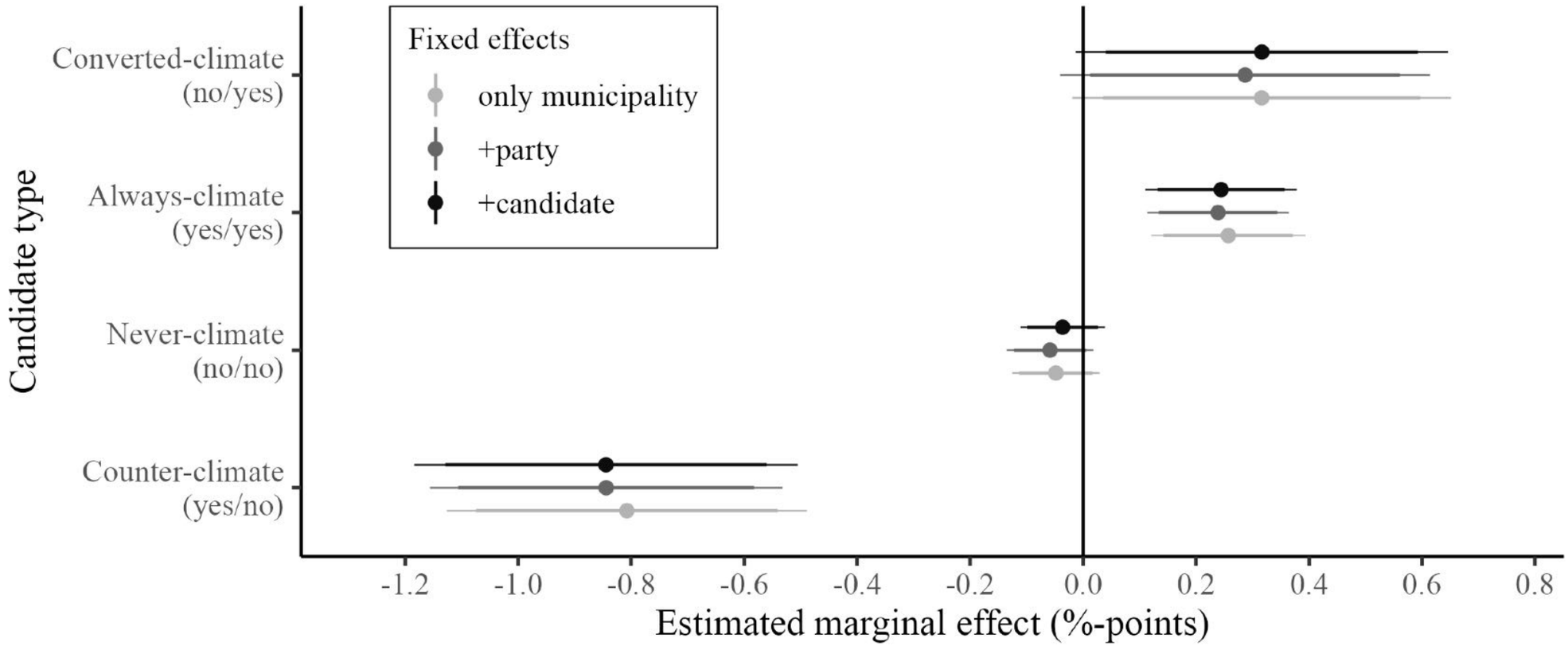


# Mechanism

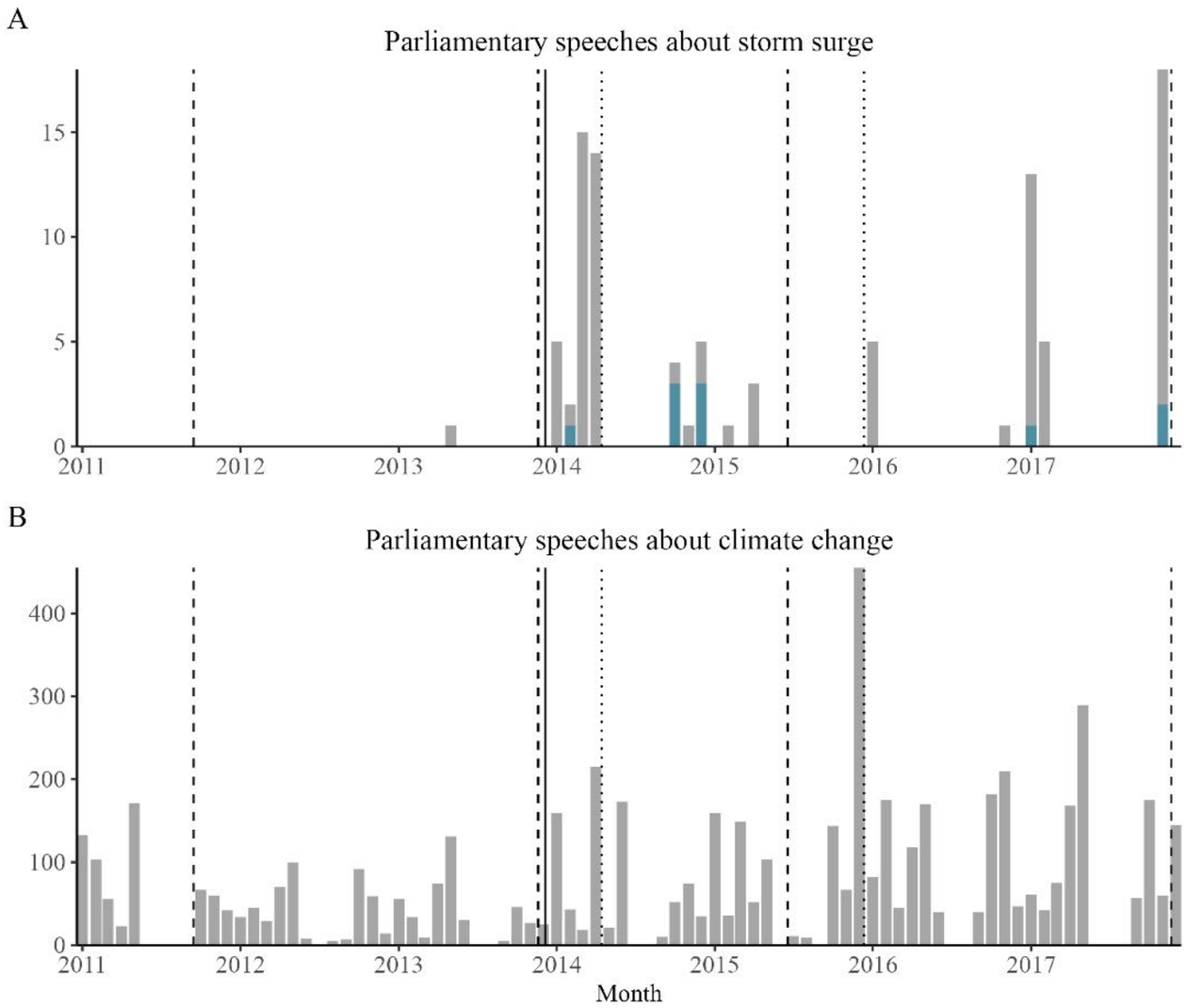
- Voters with flooding experience prefer pro-climate candidates
- Issue salience and candidate communication
- Not driven by **supply-side:**
  - converted climate candidates (Section 10.17)
  - party promotion of climate candidates
  - mobilization of new candidates
- Nor by overlap between pro-climate candidates and **incumbents** or **pro-welfare candidates**

# Candidates becoming pro-climate?

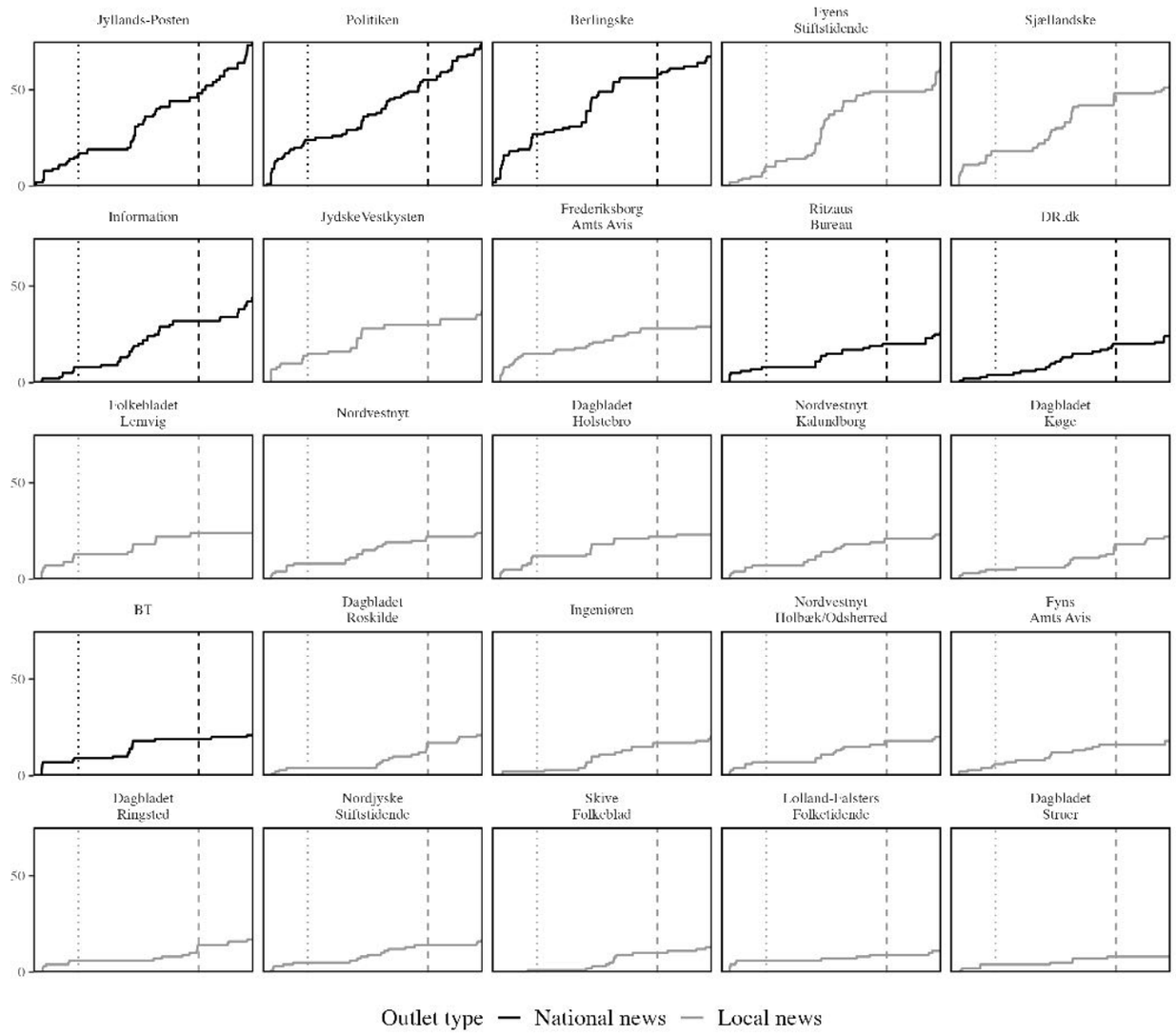
*Sample: 2,077 candidates running in both elections*



# Parliamentary speeches



# Media coverage



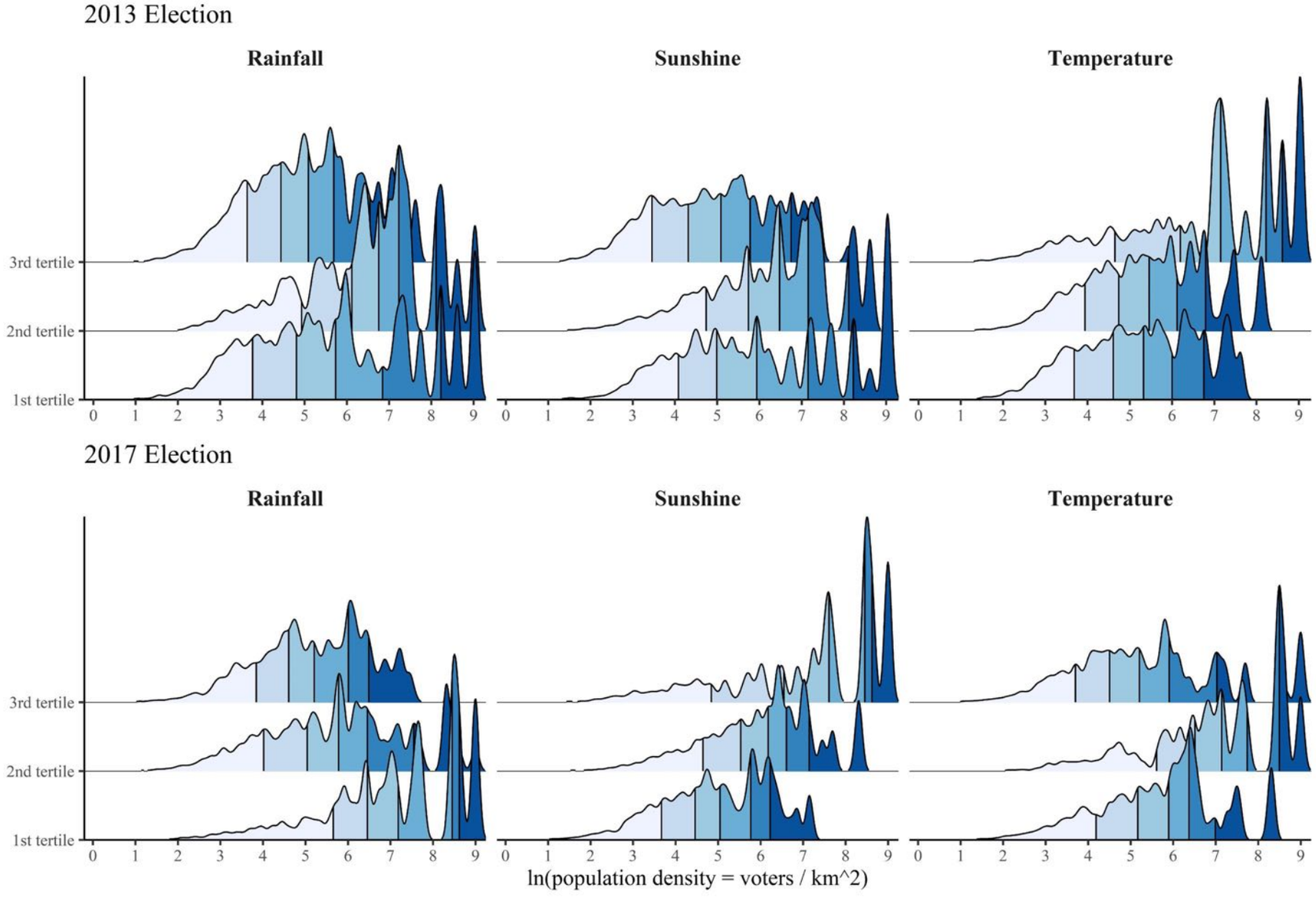
# Supplementary material for Article 4: Turnout

<**Summary** in *Section 5.8*, **overview** in *Section 7.1*>

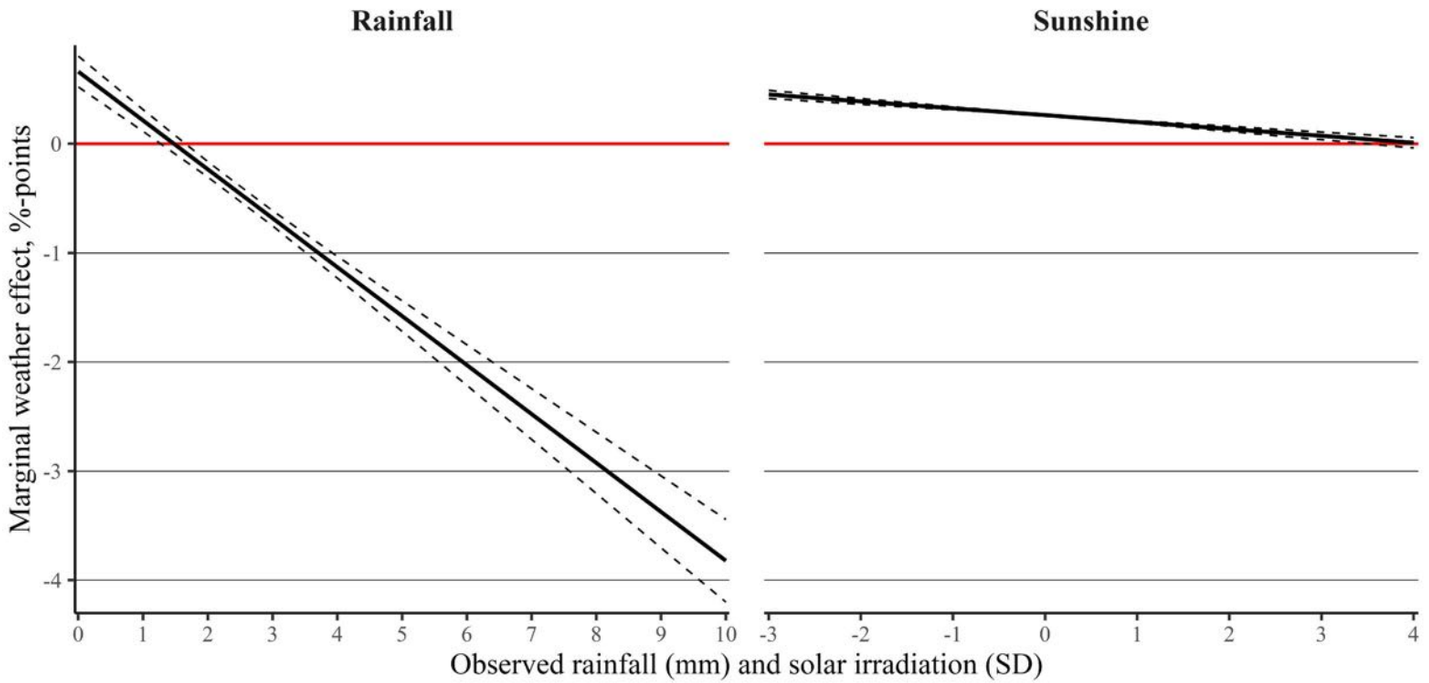
# Weather measures

$$Local\ weather_{vt} = \frac{\sum_{i}^{3} (Observation_{it} / Distance_{i}^{2})}{\sum_{i}^{3} (1 / Distance_{i}^{2})}$$

# Covariate balance: age, distance, and



# Non-linear weather effects



# Additional robustness checks

1. One weather variable at a time
2. No additional control variables: age, close to coast, local population density, gender, ln(population), non-western immigrant population share, closeness of election
3. Adding municipality fixed effects
4. Restricting to non-movers
5. Restricting to age 40-60
6. Excluding addresses with many residents
7. Using nearest weather station and limiting maximum distance
8. Placebo test with weather from 30/60 days before Election Day
9. A range of alternative standard errors
10. Logistic regression

# What's next?

1. **Conditions:** When and where do citizens respond constructively to climate experiences – why?
2. **Interaction:** How do personal weather experiences interact with elite communication?
3. **Psychology:** Learning about climate change or superficial use of heuristics?