Wildfire Smoke and Voting Behavior in the United States[*]

February 13, 2026

Abstract

Does wildfire smoke exposure shift political behavior? I exploit the quasi-random spatial dispersion of wildfire smoke plumes—driven by wind patterns rather than local conditions—to estimate the effect of smoke-derived $PM_{2.5}$ on county-level presidential voting. Using daily county-level wildfire smoke $PM_{2.5}$ estimates (Childs et al., 2022) merged with presidential election returns across four election cycles (2008–2020), I find that higher pre-election smoke exposure increases the Democratic two-party vote share and decreases the incumbent party's vote share. A 10 μg/m^3 increase in mean smoke $PM_{2.5}$ over the 60 days before the election is associated with a 0.9 percentage point increase in the Democratic vote share. The incumbent punishment effect is roughly four times larger. Effects are present across the partisan spectrum but somewhat stronger in Democratic-leaning counties. These results extend findings on fire proximity (Hazlett and Mildenberger, 2020) and general air pollution (Bellani et al., 2024) to a nationally representative setting where treatment assignment is plausibly exogenous.

JEL: D72, Q54   *Keywords:* Wildfire smoke, voting behavior, air pollution, climate salience

1 Introduction

Wildfires are among the most visible and rapidly growing consequences of climate change in the United States. Between 2006 and 2020, wildfire smoke affected every region of the country, with dramatic intensification in the final years of the sample. A growing literature investigates whether environmental shocks alter political behavior: Hazlett and Mildenberger

---

(2020) find that proximity to California wildfires increases pro-environment voting, but only in already-Democratic areas; Bellani et al. (2024) show that PM_{10} pollution on election day shifts German voters against the incumbent; and Gomez et al. (2007) demonstrate that rain suppresses voter turnout.

This paper bridges these strands by using *wildfire-specific* smoke $PM_{2.5}$ as a treatment variable across the entire continental United States. Relative to fire perimeter proximity, smoke exposure offers three advantages as a research design. First, the direction and extent of smoke plumes are determined by wind patterns, not by local community characteristics, providing a plausibly exogenous source of variation. Second, smoke affects vastly more people than fire itself—entire states experience smoke events while only a narrow band of communities live near fire perimeters. Third, smoke isolates the experiential and health channel from the property destruction and displacement that accompany direct fire exposure.

2   Data

Wildfire smoke $PM_{2.5}$.   I use daily county-level estimates of wildfire-attributed $PM_{2.5}$ from Childs et al. (2022), covering all U.S. counties from January 2006 through December 2020. These estimates use NOAA Hazard Mapping System satellite smoke plume classifications combined with machine learning to separate wildfire-derived $PM_{2.5}$ from background pollution. The data are available at Harvard Dataverse (doi:10.7910/DVN/DJVMTV).

Election returns.   County-level presidential election returns for 2000–2024 come from the MIT Election Data + Science Lab (MIT Election Data + Science Lab, 2024). I use the two-party vote share (Democratic votes / [Democratic + Republican votes]) as the primary outcome.

Analysis sample.   The overlap of smoke data (2006–2020) and presidential elections yields four election cycles: 2008, 2012, 2016, and 2020. After merging on county FIPS codes, the analysis sample contains 12,429 county-election observations spanning 3,108 counties.

Smoke exposure measures.   For each county and election, I aggregate daily smoke $PM_{2.5}$ over pre-election windows: 7, 30, 60, and 90 days before election day, plus the full fire season (June 1 to election day). The primary treatment variable is the mean daily smoke $PM_{2.5}$ in the 60 days before the election.

3 Empirical Strategy

I estimate two-way fixed effects models of the form:

$$Y_{ct} = \alpha_c + \gamma_t + \beta \cdot \text{SmokePM}_{ct} + \varepsilon_{ct} \qquad (1)$$

where Y_{ct} is the outcome in county c in election year t, α_c are county fixed effects absorbing all time-invariant county characteristics, γ_t are election-year fixed effects absorbing national swings, and SmokePM_{ct} is the mean wildfire smoke $\text{PM}_{2.5}$ in the pre-election window. Standard errors are clustered by county.

The identifying assumption is that, conditional on county and year fixed effects, variation in wildfire smoke exposure is uncorrelated with unobserved determinants of voting. This is plausible because smoke plume direction and dispersion are driven by atmospheric conditions—primarily wind patterns—rather than by the political or demographic characteristics of downwind communities.

4 Results

4.1 Main Results

Table 1 presents the main estimates. Column (1) shows that a 1 μg/m^3 increase in mean smoke $\text{PM}_{2.5}$ over the 60 days before the election increases the Democratic two-party vote share by 0.087 percentage points ($p < 0.001$). At the sample mean of 2.7 μg/m^3, this implies that moving from zero smoke to mean exposure shifts the Democratic vote share by roughly 0.24 percentage points. A county experiencing the 2020 Western fire season levels of smoke ($\sim$40 μg/m^3) would see a shift of approximately 3.5 percentage points.

Column (2) shows that the incumbent punishment effect is substantially larger: a 1 μg/m^3 increase reduces the incumbent party's vote share by 0.40 percentage points. This is consistent with the negative-affect mechanism identified by Bellani et al. (2024) in the German context—smoke makes voters feel worse, and they punish the party in power regardless of its partisan identity.

4.2 Heterogeneity by Prior Partisanship

Table 2 splits the sample by terciles of lagged Democratic vote share. The pro-Democratic shift from smoke is present in all three groups, with a somewhat larger effect in D-leaning counties (0.082 pp) than in R-leaning counties (0.066 pp). Unlike Hazlett and Mildenberger

Table 1: Effect of Wildfire Smoke on Voting Outcomes

	(1) DEM Vote Share	(2) Incumbent Vote Share	(3) Log Total Votes
Mean Smoke PM$_{2.5}$ (60d)	0.00087***	−0.00399***	0.00242***
	(0.00009)	(0.00044)	(0.00018)
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	12,429	12,429	12,429
R^2 (within)	−0.007	−0.024	0.070

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$. Standard errors clustered by county.

(2020), who find effects *only* in Democratic areas for fire proximity, I find that smoke exposure moves all county types toward the Democrats, though the effect is modestly larger where pro-environment attitudes are presumably more prevalent.

Table 2: Heterogeneity by Prior Partisanship

	R-Leaning	Swing	D-Leaning
Mean Smoke PM$_{2.5}$ (60d)	0.00066***	0.00049***	0.00082***
	(0.00021)	(0.00014)	(0.00013)
Observations	4,144	4,141	4,143

*** $p < 0.01$. County and year FE. SEs clustered by county.

4.3 Temporal Dynamics

Figure 1 plots the estimated effect of mean smoke PM$_{2.5}$ on Democratic vote share across different pre-election windows. The effect is statistically significant at all windows, with the largest point estimate at the 30-day window. This suggests that smoke exposure in the weeks most proximate to the election has the greatest electoral impact, consistent with a salience or recency mechanism.

4.4 Geographic Variation in Smoke Exposure

Figure 2 displays county-level mean smoke PM$_{2.5}$ in the 30 days before each election. The maps illustrate both the geographic scope and temporal variation that identify the main estimates: 2016 saw minimal pre-election smoke nationwide, while 2020 produced extreme exposure across the Western states following the historic August–September fire season.

Figure 1: Effect of smoke PM$_{2.5}$ on Democratic vote share by pre-election window length. Points are coefficient estimates from separate TWFE regressions; bars are 95% confidence intervals.

Figure 2: Pre-election wildfire smoke exposure by county, 30-day window before election day.

5 Discussion

Three mechanisms could drive these results. First, a *salience* channel: smoke makes climate change tangible, increasing the weight voters place on environmental issues and benefiting the party perceived as more pro-environment (Hazlett and Mildenberger, 2020; Kahn, 2007). Second, a *negative affect* channel: smoke degrades well-being and mood, and voters punish incumbents for experienced discomfort regardless of policy responsibility (Bellani et al., 2024; Healy and Malhotra, 2010). Third, a *disruption* channel: smoke could differentially suppress turnout among certain voter groups (Gomez et al., 2007; Burke et al., 2022).

The data are more consistent with the first two mechanisms than the third. The pro-Democratic shift points toward salience, while the larger anti-incumbent effect points toward negative affect. The positive turnout coefficient (Column 3 of Table 1) is surprising and may reflect confounding from 2020's historically high turnout; this result should be interpreted cautiously.

Limitations. This proof of concept has several limitations that subsequent work should address. The analysis covers only four presidential elections. The turnout measure (log total votes) is a crude proxy without a proper population denominator. County-level aggregation may mask within-county heterogeneity. And the negative within-R^2 values in some specifications suggest that the smoke variable alone explains limited within-county variation after absorbing fixed effects, underscoring that these are small effects on a noisy outcome.

6 Conclusion

Wildfire smoke exposure shifts votes toward the Democratic Party and against the incumbent, with effects that are statistically significant, present across the partisan spectrum, and strongest in the weeks immediately preceding the election. These preliminary results suggest that wildfire smoke—which is plausibly exogenous and affects a far larger population than fire proximity—offers a compelling research design for studying how environmental experience shapes political behavior.

References

Bellani, L., Ceolotto, S., Elsner, B., and Pestel, N. (2024). The effect of air pollution on voting behavior. *Proceedings of the National Academy of Sciences*, 121(18):e2309868121.

Burke, M., Driscoll, A., Heft-Neal, S., Xue, J., Burney, J., and Wara, M. (2022). Exposures and behavioural responses to wildfire smoke. *Nature Human Behaviour*, 6(10):1351–1361.

Childs, M. L., Li, J. S., Wen, J., Heft-Neal, S., Drber, A., and Burke, M. (2022). Daily local-level estimates of ambient wildfire smoke PM2.5 for the contiguous US. *Environmental Science & Technology*, 56(19):13607–13621.

Gomez, B. T., Hansford, T. G., and Krause, G. A. (2007). Weather, turnout, and voting: Is weather a natural experiment? *The Journal of Politics*, 69(3):649–663.

Hazlett, C. and Mildenberger, M. (2020). Wildfire exposure increases pro-environment voting within Democratic but not Republican areas. *American Political Science Review*, 114(4):1359–1365.

Healy, A. and Malhotra, N. (2010). Myopic voters and natural disaster policy. *American Political Science Review*, 104(3):387–406.

Kahn, M. E. (2007). Voting for the environment: Environmental voters and environmental voting. *Journal of Public Economics*, 91(9):1609–1619.

MIT Election Data + Science Lab (2024). County presidential election returns 2000–2024. Harvard Dataverse.