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# Disenfranchised by Climate Change

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CLIMATE  CENTRAL

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# Disenfranchised by Climate Change

Climate change affects everything, including the right to vote—a foundational and core right in democracies. Wicked weather increasingly threatens the exercise of that right by making it harder for people to register to vote, to get to the polls, and to have their ballots counted. And in 2024, already a record-breaking year for global average temperature, more than 80 countries—home to more than half the world’s population—are holding nationwide elections.<sup>1</sup>

Deliberate attacks on electoral integrity abound, ranging from disinformation campaigns to potential for violence, challenging the capacity of societies to manage elections. But one set of risks is growing even without nefarious intent: that posed by extreme weather events. Those risks will continue to increase as climate change worsens a panoply of extreme weather events such as heat waves, wildfires, hurricanes, deluges, and floods.

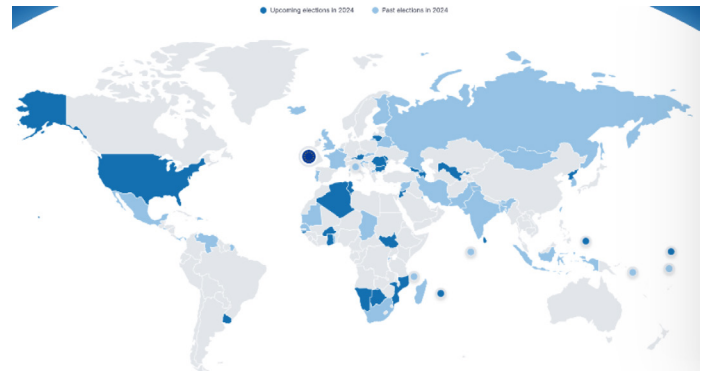


Figure 1. Upcoming (dark blue) and past (light blue) national elections in 2024. Credit: International Institute for Democracy and Electoral Assistance

## Disasters make it harder to vote

Weather-related disasters can affect the full range of election-related activities. If voters—or poll workers—cannot reach the registration office or polling place due to flooding, heat, or another disaster, votes may never be cast or counted.

Consider election day. Voting should not imperil human health. But standing in hours-long lines outdoors on a very hot day can do just that, causing heat stroke and even death. Extreme heat takes an exceptionally large toll on older people, young children, and pregnant women<sup>2</sup>. It is also dangerous for those with certain pre-existing medical conditions such as heart disease<sup>3</sup>. Wildfire smoke poses similar risks, as even short-term exposure can be harmful to people with asthma, diabetes, and heart or lung disease<sup>4</sup>. Torrential rains lead to flash floods that can be lethal to those caught in them: as the U.S. National Weather Service puts it, “Turn around, don’t drown”.<sup>5</sup>

Voters facing extreme heat, wildfire smoke, or a deluge may choose not to venture outside on election day. If they do decide to travel to the polls, they may discover that fire or flooding has blocked roads and that power outages have occurred.

In the wake of disasters, election officials may find themselves with a shortage of suitable polling places or discover that ballots cannot be delivered because roads or bridges are washed out. Power outages may occur, making it impossible to continue with voting for days or weeks. Ballot collection boxes may get destroyed by wildfires and/or floods. The upheaval caused by climate-driven disasters may even open opportunities for electoral mischief with officials distracted by rapidly evolving crises.

Those disruptions do not disappear when heat waves break, storms abate, floodwaters recede, or fires subside. Voters displaced by a disaster may have lost identification needed to register or cast a ballot. More immediate tasks, like finding food, housing, and schools for their children, may—by necessity—take precedence over casting a ballot. Displacement

<sup>1</sup> International Institute for Democracy and Electoral Assistance (International IDEA), “The 2024 Global Elections Super-cycle,” August 15, 2024, <https://www.idea.int/initiatives/the-2024-global-elections-supercycle> International IDEA notes that 74 national elections have been or are scheduled to be held in 2024; this tally counts the number of national elections, rather than the number of countries holding nationwide elections (some jurisdictions hold separate elections for presidential vs legislative posts), and does not separately include countries that participated in the EU Parliamentary elections in June 2024. Including the EU nations (without double-counting them) takes the total to approximately 84 countries.

<sup>2</sup> “Extreme Heat and Your Health.” U.S. Centers for Disease Control and Prevention, June 21, 2024. [https://www.cdc.gov/extreme-heat/about/index.html#cdc\\_environmental\\_basics\\_risk-who-is-at-increased-risk](https://www.cdc.gov/extreme-heat/about/index.html#cdc_environmental_basics_risk-who-is-at-increased-risk)

<sup>3</sup> “Extreme Heat and Your Health.” U.S. Centers for Disease Control and Prevention.

<sup>4</sup> California Office of Environmental Health Hazard Assessment, California Air Resources Board, U.S. Centers for Disease Control and Prevention, U.S. Forest Service, and U.S. Environmental Protection Agency. “Wildfire Smoke: A Guide for Public Health Officials,” August 2019. <https://www.airnow.gov/sites/default/files/2021-05/wildfire-smoke-guide-revised-2019.pdf>. Chap 1-2.

<sup>5</sup> “Turn around Don’t Drown,” U.S. National Weather Service, July 25, 2024, <https://www.weather.gov/safety/flood-turn-around-dont-drown>.

**Regardless of whether one's vote determines the outcome of an election, individuals who are unable to vote because of climate-driven extreme weather lose a fundamental human right within a democracy.**

may also leave voters far from their assigned polling places for lengthy periods if their homes remain uninhabitable. Even for voters who are not displaced, road closures and other transportation disruptions can make it impossible to reach the polls for weeks or months at a stretch. When such disruptions affect less-affluent regions disproportionately or are repaired less quickly, climate-driven extreme weather may impact not only the rights of those voters, but also election outcomes.

Extreme weather events and their aftermath may also interrupt campaigning. For example, an outdoor rally held in extreme heat can threaten the health of the candidate, staff, and supporters, and floods can hinder the ability to travel to campaign venues. Likewise, these events can make it harder for successful candidates to reach the halls of government, particularly for rural representatives in countries with limited transportation infrastructure.

Some events may affect vast numbers of voters, but many will have more localized impacts. Yet, the disenfranchisement of even a few voters can make a profound difference in election outcomes, including ones with global repercussions. Though not weather-related, the United States provides a memorable reminder that a small number of votes can have big consequences: a mere 537 votes in Florida determined the presidency in the 2000 election.

Regardless of whether one's vote determines the outcome of an election, individuals who are unable to vote because of climate-driven extreme weather lose a fundamental human right within a democracy.

## Climate change and extreme weather trends

Understanding the connection between climate change and elections requires a basic understanding of the climate problem. Beginning in the mid-1800s with the start of the Industrial Revolution, the burning of fossil fuel by humans, primarily for energy, has released carbon dioxide that forms a blanket of heat-trapping gases in the global atmosphere. Some heat-trapping gases, most notably carbon dioxide (CO<sub>2</sub>), remain in the atmosphere for centuries; indeed, much of the CO<sub>2</sub> released by the earliest Model T automobiles is still warming the planet today. Other gases have a shorter life in the atmosphere but cause substantially more heating while there: in particular, over a 20-year period, methane traps heat over 80 times more effectively than CO<sub>2</sub>. Carbon levels in the atmosphere are now 50% higher than in pre-industrial times<sup>6</sup>—and indeed far above those for the past 800,000 years.

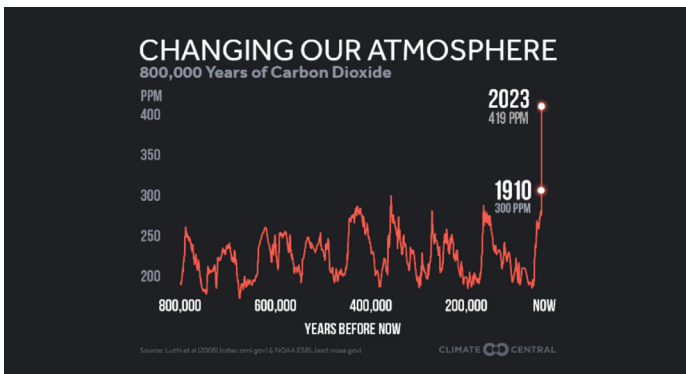


Figure 2. Credit: Climate Central<sup>7</sup>

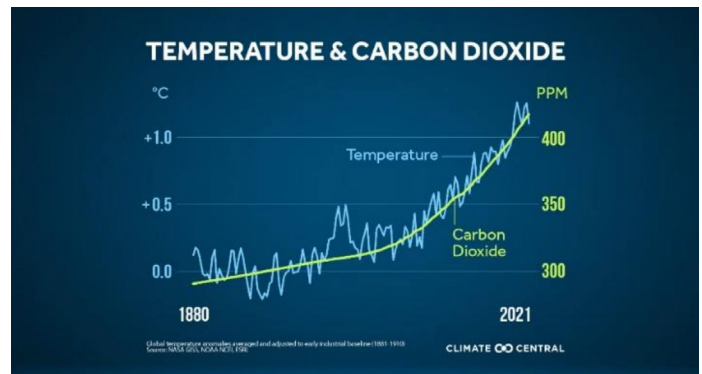


Figure 3. Credit: Climate Central<sup>8</sup>

<sup>6</sup> National Oceanic and Atmospheric Administration, "Carbon Dioxide Now More than 50% Higher than Pre-Industrial Levels," June 3, 2022, <https://www.noaa.gov/news-release/carbon-dioxide-now-more-than-50-higher-than-pre-industrial-levels>.

<sup>7</sup> Data from Luthi et al., "High-resolution carbon dioxide concentration record 650,000-800,000 years before present" (2008) <https://www.nature.com/articles/nature06949>; and "Climate Change: Atmospheric Carbon Dioxide," National Oceanographic and Atmospheric Administration, April 9, 2024. <https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide>.

<sup>8</sup> "Peak CO<sub>2</sub> & Heat-trapping Emissions." Climate Central, May 4, 2022. <https://www.climatecentral.org/climate-matters/peak-co2-heat-trapping-emissions>.

As more carbon pollution has accumulated, global average temperatures have climbed. The past 10 years brought the hottest decade in recorded history; each of the 12 months between July 2023 and June of 2024 was the hottest of those months in recorded history; and the two hottest individual days in recorded history occurred in July 2024.<sup>9</sup>

With higher temperatures come more extreme weather events to plague the globe.<sup>11</sup> Droughts and heat waves extend for longer. Hurricanes and cyclones intensify faster and carry more moisture. “Rain bombs” explode from the sky and cause inland and coastal flooding. Wildfires burn hotter—even creating their own weather—and rapidly scorch large swaths of land covered with drier vegetation. Meanwhile, the new temperature extremes drive accelerating sea-level rise that worsens coastal flooding and erosion.

In 2015, the nations of the world adopted the Paris Agreement, which aims to avoid catastrophic climate change by limiting multi-year warming to “well below” 2 degrees Celsius (3.6 Fahrenheit), and preferably to under 1.5 C (2.7 F).<sup>12</sup> But the world is not on track toward these goals. For the 12-month period through June 2024, global average temperatures climbed to 1.64 C (2.95 F) above pre-industrial levels.<sup>13</sup> According to recent analyses, under existing policies, by 2100, global average temperatures could rise to 2.7 C (4.9 F) degrees above pre-industrial times.<sup>14</sup> Multiple analyses show that every tenth of a degree of warming dramatically worsens the ensuing impacts.<sup>15</sup>

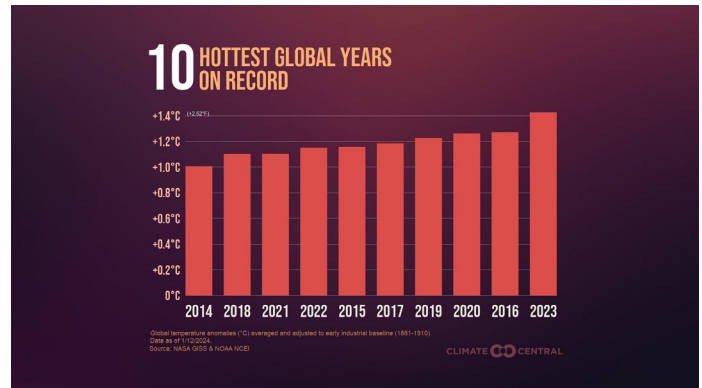


Figure 4. Credit: Climate Central<sup>10</sup>

Climate change has also shrunk the time between disasters. In the 1980s, disasters that caused a billion dollars or more in losses struck about every two to three months, on average, in the United States. Today, that time has shriveled to an average of every two weeks.<sup>16</sup> Other countries have similarly had to contend with shortened times between disasters.

With more frequent and close-in-time disasters, people struggle to prepare and respond. There is less time to recover. Emergency managers and government leaders grow weary. Supplies dwindle. People get displaced. Damaged government buildings close. Stress levels soar. Monies run short. Crime goes up. The fallout from disasters, ranging from wildfire smoke to the spread of pathogens and mosquitos in wetter conditions, harm people’s health. These and other factors make conducting—and voting in—elections a lot harder.

Even as climate impacts accelerate, advances in scientific knowledge and computing power have given rise to a new discipline: climate change attribution science.<sup>17</sup> Using observations, computer models, and statistical methods, researchers can quantify whether, and to what extent, human-caused climate change altered the likelihood of specific weather events. The climate fingerprint on elections is increasingly obvious – and quantifiable.

## Climate Change Is Already Affecting Elections

In just the past five years, extreme weather struck in over a dozen countries around election time, according to data compiled by the International Institute for Democracy and Election Assistance (International IDEA).<sup>18</sup>

<sup>9</sup> “New Record Daily Global Average Temperature Reached in July 2024.” Copernicus Climate Change Service, July 25, 2024. <https://climate.copernicus.eu/new-record-daily-global-average-temperature-reached-july-2024>.

<sup>10</sup> “2023: Earth’s Hottest Year on Record.” Climate Central, Jan. 12, 2024. <https://www.climatecentral.org/climate-matters/2023-earths-hottest-year-on-record>.

<sup>11</sup> “Extreme Weather and Climate Change,” NASA, undated. <https://science.nasa.gov/climate-change/extreme-weather>.

<sup>12</sup> United Nations Framework Convention on Climate Change. The Paris Agreement. Paris: UNFCCC, 2015. <https://unfccc.int/process-and-meetings/the-paris-agreement>.

<sup>13</sup> Copernicus Climate Change Service, “Surface Air Temperature for June 2024,” <https://climate.copernicus.eu/surface-air-temperature-june-2024>.

<sup>14</sup> Climate Action Tracker, “2100 Warming Projections: Emissions and expected warming based on pledges and current policies,” December 2023, <https://climateactiontracker.org/global/temperatures>.

<sup>15</sup> Intergovernmental Panel on Climate Change (IPCC), “Impacts of 1.5°C Global Warming on Natural and Human Systems.” Chapter. In Global Warming of 1.5°C: IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-Industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty, 175–312. Cambridge: Cambridge University Press, 2022. <https://www.ipcc.ch/report/sr15/chapter-3-impacts-of-1-5oc-global-warming-on-natural-and-human-systems>.

<sup>16</sup> Climate Central, “Billion-Dollar Disaster Seasons,” January 17, 2024. <https://www.climatecentral.org/climate-matters/billion-dollar-disaster-seasons-2024>. Data adjusted for inflation.

<sup>17</sup> “Attribution of Extreme Weather Events in the Context of Climate Change - New Report,” National Academies, March 11, 2016. <https://www.nationalacademies.org/news/2016/03/attribution-of-extreme-weather-events-in-the-context-of-climate-change-new-report>.

<sup>18</sup> “The Impact of Natural Hazards on Elections.” International Institute for Democracy and Electoral Assistance (International IDEA), Asplund, E (editor) June 25, 2024. <https://www.idea.int/news-media/multimedia-reports/impact-natural-hazards-elections>. International IDEA includes earthquakes in their tally; those have been excluded here.

For example, in the United States, Hurricane Ian hit Florida just six weeks before the November 8 midterm election in 2022. The storm caused massive damage to numerous polling locations as well as other infrastructure in portions of the state, affecting more than 12% of the registered Florida electorate.<sup>19</sup> Scientists calculated that rainfall from Hurricane Ian was 18% wetter than it would have been absent climate change.<sup>20</sup>

Similarly, Pakistan's massive floods in 2022 prompted officials to delay local elections.<sup>21</sup> The floods also displaced nearly eight million people, some of whom were unable to access national identity cards. As a result, they were unable to register or vote.<sup>22</sup> Floodwaters rendered many polling places inoperable or inaccessible. The World Weather Attribution, an international scientific consortium, calculated that climate change likely made the extreme precipitation that caused the floods 50% more intense.<sup>23</sup>

**Between January and July 2024, 63 cities that are home to nearly 160 million people around the globe experienced a week or more of abnormal temperatures in the four weeks leading up to their election day—temperatures that human-caused climate change made at least five times more likely.**

A prime example of the impacts of heat comes from this spring's elections in India, the world's most populous democracy, which held elections in seven geographically focused phases between April 19 and June 1, 2024. During much of that period, human-caused climate change made extreme heat in portions of the country at least fivefold more likely, according to the Climate Shift Index.<sup>24</sup> News reports indicate that at least 77 people died from the extreme heat during the final ten days of voting, including 33 poll workers. Climate-change-driven extreme heat also led to hospitalizations of people attending campaign rallies later in June in Arizona and Nevada in the southwestern US.<sup>26</sup>

India and the United States are not alone in experiencing abnormal heat during election season this year. Of the 60 countries that held nationwide elections between January and July 2024 and for which temperature data are available<sup>27</sup>, half experienced at least a week of climate-driven abnormal temperatures in the four weeks leading up to their election day.<sup>28</sup> For 75 cities in those countries, such heat occurred for at least half of the days in that month—and for 56 of those cities, the heat persisted for more than three weeks. Sixty-three cities experienced a week or more of abnormal heat that was at least

five times more likely because of human-caused climate change. These 63 cities are home to a total of nearly 160 million people in nations around the globe including Chad, the Dominican Republic, India, Indonesia, Mexico, Russia, Rwanda, the Solomon Islands, Togo, and Venezuela. For 29 cities, the temperature was at least 5 degrees C (9 degrees F) above normal.

## Towards climate-resilient elections

To plan and prepare for more frequent and ferocious climate-driven weather events and their potential impacts, election officials need to understand the trajectory of climate change and its range of impacts.

<sup>19</sup> "Voter Registration - By County and Party," Division of Elections - Florida Department of State, July 31, 2024, <https://dos.fl.gov/elections/data-statistics/voter-registration-statistics/voter-registration-reports/voter-registration-by-county-and-party>.

<sup>20</sup> Reed, Kevin A., and Michael F. Wehner. "Real-Time Attribution of the Influence of Climate Change on Extreme Weather Events: A Storyline Case Study of Hurricane Ian Rainfall." Environmental Research: Climate 2, no. 4 (October 2023): 043001. <https://doi.org/10.1088/2752-5295/acfd4e>.

<sup>21</sup> "Pakistan's election body postpones local polls in Karachi over 'weather conditions,'" Arab News, Aug. 24, 2022. <https://arab.news/wu49d>.

<sup>22</sup> Election Commission of Pakistan. "How To Register." <https://ecp.gov.pk/voter-awareness/how-to-register>. See also Web Desk. "Elections 2024 Pakistan: How to Cast Your Vote?" ARY NEWS, February 8, 2024. <https://arynews.tv/election-2024-step-by-step-guide-to-cast-your-vote>; see also Memon, Naseer. Assessment of the Adverse Impacts of Floods on Electoral Participation, 2023. <https://www.cpd-pakistan.org/wp-content/uploads/2024/01/Assessment-of-the-Adverse-Impacts-of-Floods-on-Electoral-Participation.pdf>.

<sup>23</sup> World Weather Attribution. "Climate Change Likely Increased Extreme Monsoon Rainfall, Flooding Highly Vulnerable Communities in Pakistan," September 14, 2022. <https://www.worldweatherattribution.org/climate-change-likely-increased-extreme-monsoon-rainfall-flooding-highly-vulnerable-communities-in-pakistan>.

<sup>24</sup> See Appendix for description of the Climate Shift Index and its methodology.

<sup>25</sup> Mitra, Esha. "India Heat: Dozens Killed by Extreme Temperatures as Polls Close in World's Largest Election." CNN, June 3, 2024. <https://www.cnn.com/2024/06/02/india/india-heatwave-poll-worker-deaths-intl-hnk/index.html>.

<sup>26</sup> Climate Central, "Climate change influencing severe heat in Southwest U.S.," June 11, 2024. [www.climatecentral.org/climate-shift-index-alert/climate-shift-index-alert-southwest-june-2024](http://www.climatecentral.org/climate-shift-index-alert/climate-shift-index-alert-southwest-june-2024).

<sup>27</sup> These 60 nations include 42 that held national-level elections between January 1 and July 31, 2024 (see "The 2024 Global Elections Super-cycle," International Institute for Democracy and Electoral Assistance (International IDEA), <https://www.idea.int/initiatives/the-2024-global-elections-supercycle>), except for two nations for which data are not available in the global temperature dataset (Tuvalu and Maldives). The other 20 are European Union nations that voted in EU parliamentary elections on June 6, 2024, but did not hold other nationwide elections during this period.

<sup>28</sup> Analysis from the Climate Shift Index. See Appendix for methodology and details.



To date, however, the climate-driven threat to voting has not yet appeared on the radar of most government officials, even though the U.S. Election Assistance Commission has concluded that “advance planning minimizes the disruption and aids in a quick recovery while preserving the security and integrity of the election.”<sup>29</sup>

Although no plan can address all contingencies, increased focus on physical risks from climate change can fortify the capacity to mount an appropriate response. Improved election planning will require that officials understand the risks that will increasingly be posed by climate-worsened disasters in their jurisdictions. Training regarding current and projected climate impacts—notably on the likelihood of more intense and more frequent extreme weather events—will enable officials to design climate-resilient elections, considering factors ranging from the timing of elections to the printing of ballots. Meteorologists and climate scientists can play key roles in providing such training.

A growing array of tools provides election officials (and other stakeholders) with data on climate-related risks. For example, Climate Central has created the Coastal Risk Screening Tool,<sup>30</sup> a free interactive online tool that incorporates the world’s most accurate global elevation dataset<sup>31</sup> to provide maps of future flood risk for coastal communities in every coastal nation. Tools like this could assist election officials in selecting less risky polling stations. Along with backup power sources, measures like these can help counter weather disruptions.

Similarly, climate data can help inform the timing of elections (where allowed by constitutional constraints), to avoid scheduling votes during periods when extreme heat events or severe tropical storms are most likely to occur.

More generally, providing greater flexibility in how and where people vote will better protect the right to vote as climate change accelerates. Experts on electoral processes recommend measures like allowing same-day voter registration (i.e., allowing voters to register and cast ballots in a single process),<sup>32</sup> creating online systems that enable voters to update their addresses more easily after displacement,<sup>33</sup> and allowing for temporary address changes to facilitate voting.<sup>34</sup>

Some systems already in place have enabled robust responses when weather-related disaster strikes. For example, devastating wildfires broke out across several Colorado counties in October 2020, just weeks before the November presidential election. Thousands of Coloradans were forced to evacuate their homes, sometimes with little notice.<sup>35</sup> As one media outlet noted, “Late-season fires in the high country are forcing elections officials to evacuate ballots alongside humans,” with sheriff’s deputies escorting bipartisan election judges to retrieve ballots from a drop box located in an evacuation zone.<sup>36</sup>

Former Colorado election official Jocelyn Bucaro describes Colorado’s voting procedures that provided multiple mechanisms for those displaced voters to cast their ballots.<sup>37</sup>

“Under Colorado’s election laws, every active registered voter is automatically mailed a ballot for each election approximately three weeks before Election Day. Voters have multiple options for returning their mail ballots, including by mail, at drop boxes located around their county, at in-person voting centers, and even at ballot drop boxes located anywhere in the state. Voters who need to register to vote or prefer to vote in person can vote at any voting center in their county. Vote centers open roughly two weeks before every general election. In the event that a voter has lost or not received their ballot and cannot get to an in-person voting site, they can use an electronic voting option. This option, which is also available to military and overseas voters and voters who are blind or have print disabilities, enables voters to receive, mark, and return their ballot online through a web portal hosted by the Secretary of State.

<sup>29</sup> “6 Tips for Contingency and Disaster Planning.” U.S. Election Assistance Commission, October 2014. [https://www.eac.gov/sites/default/files/eac\\_assets/1/28/EAC\\_6TipsForContingencyandDisaster-Planning\\_508\\_HiRes.pdf](https://www.eac.gov/sites/default/files/eac_assets/1/28/EAC_6TipsForContingencyandDisaster-Planning_508_HiRes.pdf).

<sup>30</sup> “Sea Level Rise and Coastal Flood Risk Maps—a Global Screening Tool,” Climate Central, <https://coastal.climatecentral.org>.

<sup>31</sup> Kulp, Scott A., and Benjamin H. Strauss. “CoastalDEM v3.0: Improving Fully Global Coastal Elevation Predictions through a Convolutional Neural Network and Multi-Source DEM Fusion.” Climate Central Scientific Report. Climate Central, February 2024. [https://24975331.fs1.hubspotusercontent-eu1.net/hubfs/24975331/CoastalDEM\\_3\\_Scientific\\_White\\_Paper\\_Mar2024-1.pdf](https://24975331.fs1.hubspotusercontent-eu1.net/hubfs/24975331/CoastalDEM_3_Scientific_White_Paper_Mar2024-1.pdf).

<sup>32</sup> Shapiro, Walter. “Election Day Registration Could Cut Through Many of the Arguments in the Voting Wars,” Brennan Center for Justice, October 16, 2018. <https://www.brennancenter.org/our-work/analysis-opinion/election-day-registration-could-cut-through-many-arguments-voting-wars>.

<sup>33</sup> Jennifer L. Clark. “An Essential Element of Emergency Preparedness: Modernizing Our Voter Registration System.” Brennan Center for Justice, October 21, 2016. <https://www.brennancenter.org/our-work/analysis-opinion/essential-element-emergency-preparedness-modernizing-our-voter>.

<sup>34</sup> International IDEA, “The Impact of Natural Hazards on Elections,” June 25, 2024. <https://www.idea.int/news-media/multimedia-reports/impact-natural-hazards-elections>.

<sup>35</sup> Jones, Corey H., Kevin J. Beaty, Michael Elizabeth Sakas, Hart Van Denburg, Nathaniel Minor, and Esteban L. Hernandez. “We Are In Defensive Mode”: Grand County’s Fast-Growing East Troublesome Fire Prompts More Evacuations.” Colorado Public Radio News, October 22, 2020. <https://www.cpr.org/2020/10/22/grand-county-braces-for-another-large-growth-day-for-the-east-troublesome-fire>.

<sup>36</sup> Kenney, Andrew. “Grand Lake Ballots Rescued From East Troublesome Fire Evacuation Zone.” Colorado Public Radio, October 22, 2020. <https://www.cpr.org/2020/10/22/grand-lake-ballots-rescued-from-east-troublesome-fire-evacuation-zone>.

<sup>37</sup> Bucaro, Jocelyn, personal communication via email to Climate Central, July 11, 2024.

In the wake of evacuations, the Colorado Secretary of State and local elections offices conducted a broad public messaging campaign to inform affected voters about the available options, including that they could bring their voted mail ballot to any drop box or vote center in the state, or utilize online options when needed.”

More generally, climate-resilient election procedures do not need to be invented from scratch. Already, many nations provide at least some form of “special voting arrangements”—essentially anything other than in-person voting on election day at the voter’s default polling station—for at least some voters.<sup>38</sup> Data for 204 countries compiled in 2021 by the International Institute for Democracy and Electoral Assistance indicate that various countries use a range of approaches.<sup>39</sup>

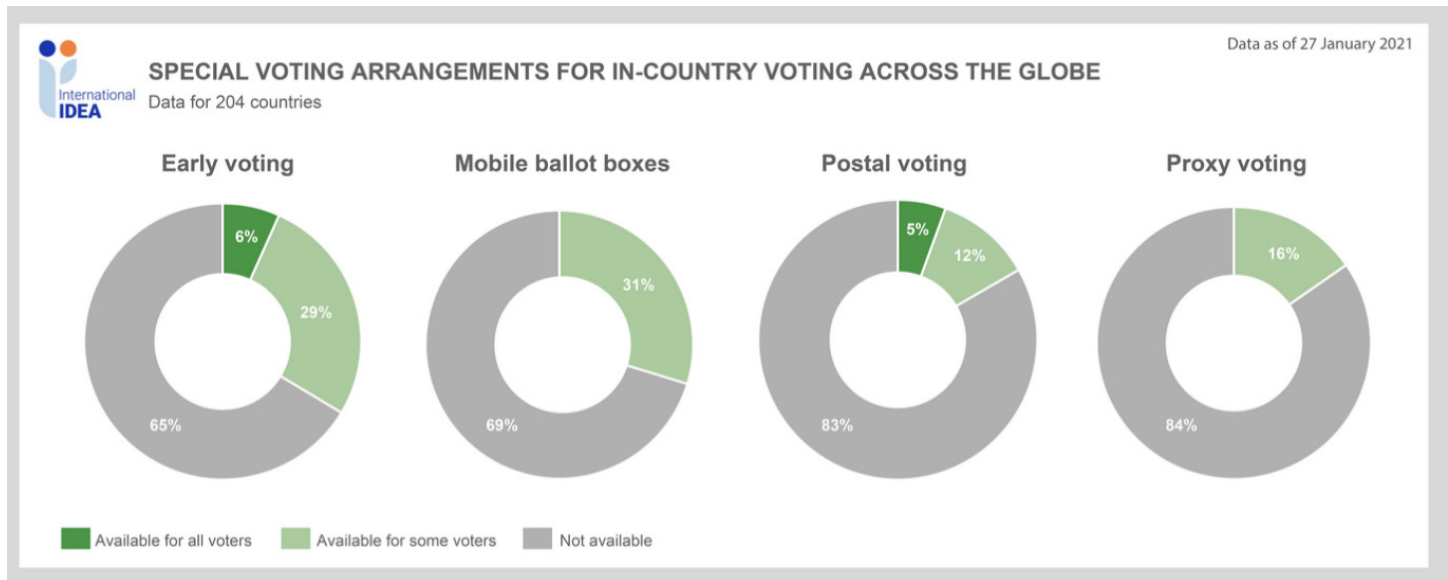


Figure 5. Credit: International Institute for Democracy and Electoral Assistance.<sup>40</sup>

In the United States, the ease of voting during non-emergency circumstances varies considerably among states.<sup>41</sup> Most states now provide options to vote prior to election day, via in-person and/or vote-by-mail options.<sup>42</sup> As of 2024, 37 states and Washington, DC allow both options, while another 10 allow early in-person voting but require an eligible reason to vote by mail. Only four states—Alabama, Mississippi, New Hampshire and (as a result of litigation) Delaware—lack options for voting prior to election day.<sup>43</sup>

Growing numbers of voters utilize pre-election-day options: in 2000, 14% of ballots were cast prior to election day, a number that increased to 50% in 2023 (with a Covid-prompted spike of 69% in 2020).<sup>44</sup> Additional options could further enhance resiliency in emergency situations. In the United States, supporters of mobile voting note that this approach places the ballot directly into the hands of voters through technology they carry with them, even in emergencies.<sup>45</sup> Where internet connectivity is available post-disaster, mobile voting reduces the burden on election officials to scramble to find usable polling places, replace poll workers who may themselves be displaced, or identify how to get mail ballots to (and back from) displaced voters. Ensuring ballot integrity is obviously crucial, including effective measures so that only eligible voters can vote, that ballots are cast and counted as the voter intended, that voter privacy is protected, and that any threat is detectable and addressable. In Estonia, internet-based voting has been available since 2005, with more than 50% of votes cast online in 2023.<sup>46</sup> The nation has implemented multiple cybersecurity measures within its electronic voting

<sup>38</sup> “Special Voting Arrangements,” International Institute for Democracy and Electoral Assistance, <https://www.idea.int/data-tools/tools/special-voting-arrangements>.

<sup>39</sup> “Special Voting Arrangements,” International IDEA.

<sup>40</sup> “Special Voting Arrangements,” International IDEA.

<sup>41</sup> “Cost of Voting Index,” <https://costofvotingindex.com>. The Index provides a relative ranking for all 50 U.S. states, taking into account factors such as ease of registration, access to early voting, and number of election-day polling stations.

<sup>42</sup> Yoder, Kyle, April Tan, and Stefan Martinez-Ruiz. “The Expansion of Voting Before Election Day, 2000–2024.” The Center for Election Innovation & Research, July 2024. <https://electioninnovation.org/research/expansion-voting-before-election-day>.

<sup>43</sup> Yoder, Tan, and Martinez-Ruiz, “The Expansion of Voting Before Election Day, 2000–2024.”

<sup>44</sup> Yoder, Tan, and Martinez-Ruiz, “The Expansion of Voting Before Election Day, 2000–2024.”

<sup>45</sup> “Removing Barriers to the Ballot Box: The Case for Mobile Voting.” Mobile Voting, April 24, 2023. <https://mobilevoting.org/updates/removing-barriers-to-the-ballot-box-the-case-for-mobile-voting-2>.

<sup>46</sup> Mac Dougall, David. “How I-Voting Came of Age in Estonia with Record Election Ballots.” Euronews, March 8, 2023. <https://www.euronews.com/next/2023/03/08/estonia-election-i-voting-comes-of-age-in-the-worlds-digital-republic-with-record-ballots>.



system, including ballot verification that uses a smartphone application to confirm the candidate for whom the vote was cast.<sup>47</sup>

Some changes to existing election methods may well require pre-disaster administrative and legislative action. The National Conference of State Legislatures (NCSL) notes that while at least 45 U.S. states have statutes that deal with Election Day emergencies, “there is little consistency between states on what events would be covered and exactly what plans will be followed in each emergency.”<sup>48</sup> NCSL also notes that state legislators “can consider asking for a review of existing statutory and regulatory guidance to identify any gaps,” listing 10 particular topics. These range from emergencies during the run-up to an election, deadline extensions, alternative methods for producing ballots, and ways to protect ballots from hazardous conditions.

But even with all the advanced planning in the world, including the expansion of the time and means of registration and voting, climate change will drive unforeseeable events—increasingly so as temperatures continue to rise and extreme-weather events multiply and intensify. To respond, election officials may need additional emergency powers to adjust election procedures—and funding to implement those adjustments. Some jurisdictions authorize postponement of elections under emergency situations.<sup>49</sup> But while weather disasters may sometimes warrant postponing an election or making other major process changes close to Election Day, ad hoc approaches can undermine voter confidence in an election’s legitimacy. The threat of mischief increases the imperative to pre-define the parameters and grounds for such extraordinary measures.

Election officials should also consider how they can robustly communicate details to voters about how and where to vote. Polling officials should also receive communications regarding changes to their duties. Social media, radio, television announcements, and even bullhorns in areas lacking connectivity can assist in informing the public. Civil society can also lend a hand, mobilizing volunteers to get the word out, by for example operating nonpartisan hotlines such as the Lawyers Committee on Human Rights’ Election Protection Hotline in the United States.<sup>50</sup> Such hotlines can help quickly disseminate updated information—assuming that electrical power is available to power computer and communications equipment.

## Conclusion

The right to vote constitutes the central pillar of democracy. But increasing levels of carbon pollution bring climate extremes that erode that pillar. Climate-driven disruptions have already caused election officials to scramble, adjusting procedures on the fly. With worsening extremes ahead, ad hoc responses lend themselves to actual or perceived political manipulation. Yet countries have proven slow to focus on the increased risk to election integrity brought by climate change. Building more resilient election infrastructure and introducing greater flexibility in how and where people register and vote can buffer the harm posed to the voting process.

Every voter should have the ability to cast their vote and have that vote be counted—regardless of the weather. Without advance planning, protecting that right becomes more tenuous on a rapidly warming planet whose atmosphere does not negotiate, cannot be bribed, and always bats last.

**Without advance planning, protecting that right becomes more tenuous on a rapidly warming planet whose atmosphere does not negotiate, cannot be bribed, and always bats last.**

<sup>47</sup> Mackisack, Daniel. “The Front Lines of Digital Democracy – Securing i-Voting in Estonia.” Democracy Technologies, July 5, 2023. <https://democracy-technologies.org/voting/front-lines-digital-democracy-i-voting-in-estonia>.

<sup>48</sup> “Election Emergencies.” National Conference of State Legislatures, April 2, 2024. <https://www.ncsl.org/elections-and-campaigns/election-emergencies>.

<sup>49</sup> Garrett, Sam, Karen L. Shanton, and Sarah J. Eckman. “COVID-19 and Other Election Emergencies: Frequently Asked Questions and Recent Policy Developments.” Congressional Research Service, July 16, 2020. <https://crsreports.congress.gov/product/pdf/R/R46455>.

<sup>50</sup> “Election Protection,” Lawyers’ Committee for Civil Rights Under Law, <https://www.lawyerscommittee.org/project/election-protection>.

## Appendix

### Attribution Analysis Methodology: The Climate Shift Index

Except where otherwise noted, the attribution data in this report were generated using Climate Central's Climate Shift Index (CSI). CSI quantifies the local influence of climate change on daily temperatures around the world, showing the extent to which human-caused climate change has shifted the frequency of daily temperatures for a particular location and time of year.

CSI levels 1 to 5 indicate conditions that are increasingly likely in today's climate. A CSI level of 1 means that climate change is detectable (technically, the temperature is at least 1.5x more likely). CSI levels 2 and higher correspond with the multipliers (2 = at least 2x more likely, 3 = at least 3x more likely, etc.). The CSI scale is currently capped at level 5, which means that a CSI of 5 includes higher values and thus should be read as at least 5. CSI level 5 events would be very difficult to encounter in a world without climate change — not impossible, but extremely unlikely.

Additional details on CSI and the peer-reviewed attribution science on which it is based are available at [www.climatecentral.org/climate-shift-index](http://www.climatecentral.org/climate-shift-index). A map-based interface, updated daily, is available at [csi.climatecentral.org](http://csi.climatecentral.org).

### Selection of Timeframe

We focused our analysis on the four weeks prior to Election Day on the ground that this period is likely to capture the greatest intensity of activity including campaigning and early voting, as well as Election-Day voting. We focused on Elections Days that occurred between January 1, 2024 and July 31, 2024, in order to present timely results for this global elections "Super-cycle" year (a term coined by the International Institute for Democracy and Electoral Assistance).

### Selection of Countries and Cities

To identify the "fingerprint" of climate change in the month prior to nationwide elections during the first seven months of 2024, we first compiled a list of the 60 countries met both of two criteria: they held one or more nationwide election between January and July 2024, and temperature data are available from the ERA5 global temperature dataset that is used in CSI. Data on countries holding national-level elections during this timeframe were sourced chiefly from "The 2024 Global Elections Super-cycle," International Institute for Democracy and Electoral Assistance, <https://www.idea.int/initiatives/the-2024-global-elections-supercycle>. Two countries were then excluded due to lack of ERA5 data, namely Tuvalu and Maldives. Because International IDEA's tally focuses on the number of elections rather than the number of countries holding elections, we separately included the 20 countries that participated in the EU Parliamentary elections in June 2024 but that did not otherwise hold national elections during January-July 2024. We did not double-count any countries that held more than one nationwide election during this time-frame (either due to the EU Parliamentary elections, or because they held separate Presidential and legislative national elections). We then used CSI to quantify the fingerprint of climate change for those 6 countries.

In addition, we selected a list of cities within those countries that either have more than one million inhabitants, are a national capital, or are sub-national administrative capitals of the seven largest countries. We used the Simple maps World Cities Database, which draws from a variety of different sources to build the list of cities and population estimates, such as the NGA, the US Geological Survey, the U.S. Census Bureau, and others. <https://simplemaps.com/data/world-cities>

For each city, we found the CSI and temperature anomaly time series from the nearest 0.25° grid cell on land. We then computed the mean temperature and the number of days with CSI greater than or equal to 2 or 5, meaning that human-caused climate change made the temperature for that location during that four-week period either two or five times more likely that would otherwise have been the case.

				Number of days in the 4 weeks prior to election day at/above...	
City	Country	Population	Election Date	Climate Shift Index of 2	Climate Shift Index of 2
N'Djamena	Chad	1,092,066	5/6/24	27	26
Mutsamudu	Comoros	30,000	1/14/24	23	20
Moroni	Comoros	17,267	1/14/24	22	18
Zagreb	Croatia	767,131	4/17/24	19	8
Santo Domingo	Dominican Republic	1,128,678	5/19/24	24	21
San Salvador	El Salvador	316,090	2/4/24	23	18
Tallinn	Estonia	614,561	6/6/24	23	9
Helsinki	Finland	1,360,075	6/6/24	25	4
Bengaluru	India	15,386,000	4/19/24	23	7
Srinagar	India	1,180,570	4/19/24	16	2
Pimpri-Chinchwad	India	1,727,692	4/19/24	17	0
Chennai	India	12,395,000	4/19/24	21	0
Pune	India	8,231,000	4/19/24	17	0
Visakhapatnam	India	2,035,922	4/19/24	27	16
Kavaratti	India	11,473	4/19/24	28	27
Panaji	India	40,017	4/19/24	26	10
Port Blair	India	100,608	4/19/24	27	24
Shillong	India	143,229	4/19/24	19	0
Bhubaneswar	India	837,737	4/19/24	21	8
Thiruvananthapuram	India	743,691	4/19/24	28	25
Aizawl	India	293,416	4/19/24	14	1
Depok	Indonesia	2,123,349	2/14/24	23	19
Jakarta	Indonesia	33,756,000	2/14/24	23	19
Surabaya	Indonesia	6,998,000	2/14/24	27	27
Medan	Indonesia	3,632,000	2/14/24	28	28
Malang	Indonesia	2,795,209	2/14/24	27	25
Bekasi	Indonesia	2,590,257	2/14/24	25	20
Bekasi Kota	Indonesia	2,381,053	2/14/24	25	20
Tangerang	Indonesia	2,237,006	2/14/24	23	19
Semarang	Indonesia	1,621,384	2/14/24	28	27
Sangereng	Indonesia	1,378,466	2/14/24	23	19
Bogor	Indonesia	1,127,408	2/14/24	23	19
Cilacap	Indonesia	1,174,964	2/14/24	24	18
Batam Centre	Indonesia	1,196,396	2/14/24	26	19
Sumedang	Indonesia	1,240,000	2/14/24	28	26
Palembang	Indonesia	1,535,952	2/14/24	20	14
Bandar Lampung	Indonesia	1,166,761	2/14/24	23	18
Bagam	Indonesia	1,269,820	2/14/24	26	19
Esfahan	Iran	2,219,343	6/28/24	18	5
Tabriz	Iran	1,558,693	6/28/24	17	7
Ahvaz	Iran	1,184,788	6/28/24	24	13
Shiraz	Iran	1,565,572	6/28/24	17	11
Riga	Latvia	920,643	6/6/24	19	0
Monterrey	Mexico	5,341,171	6/2/24	28	23
Morelia	Mexico	1,011,704	6/2/24	28	28
Leon de los Aldama	Mexico	1,579,803	6/2/24	28	27

				Number of days in the 4 weeks prior to election day at/above...	
City	Country	Population	Election Date	Climate Shift Index of 2	Climate Shift Index of 2
Ciudad Nezahualcoyotl	Mexico	1,072,676	6/2/24	28	26
Mexico City	Mexico	21,804,000	6/2/24	28	27
Zapopan	Mexico	1,476,491	6/2/24	25	21
Puebla	Mexico	1,576,259	6/2/24	28	28
Ecatepec	Mexico	1,929,926	6/2/24	28	26
Guadalajara	Mexico	5,525,000	6/2/24	27	21
Nezahualcoyotl	Mexico	1,077,208	6/2/24	28	26
Skopje	North Macedonia	526,502	4/24/24	18	4
Panama City	Panama	1,500,189	5/5/24	24	19
Murmansk	Russia	267,422	3/15/24	17	0
Kaliningrad	Russia	498,260	3/15/24	17	11
Kigali	Rwanda	1,518,632	7/15/24	28	27
Bratislava	Slovakia	475,503	3/23/24	16	3
Honiara	Solomon Islands	84,520	4/17/24	28	24
Soweto	South Africa	1,271,628	5/29/24	23	9
Bloemfontein	South Africa	256,185	5/29/24	16	0
Johannesburg	South Africa	8,500,000	5/29/24	23	6
Pretoria	South Africa	741,651	5/29/24	21	2
Stockholm	Sweden	2,121,000	6/6/24	16	0
Damascus	Syria	2,584,771	7/15/24	21	12
Aleppo	Syria	2,003,671	7/15/24	25	11
Lome	Togo	33,000	4/29/24	25	24
Sokode	Togo	113,000	4/29/24	20	14
Maracaibo	Venezuela	1,551,539	7/28/24	24	16
Valencia	Venezuela	1,484,430	7/28/24	28	28
Barquisimeto	Venezuela	1,059,092	7/28/24	28	28
Caracas	Venezuela	2,245,744	7/28/24	28	27
San Cristobal	Venezuela	1,015,623	7/28/24	18	11