Climate Impacts and Political Survival: Effects of Drought & Precipitation

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Oleg Smirnov[1], Martin C. Steinwand[1*], Tingyin Xiao[2], Minghua Zhang[2]

[1]Department of Political Science, Stony Brook University, Stony Brook, NY 11794, USA.
[2]School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY 11794, USA.
**Correspondence to: martin.steinwand@stonybrook.edu*
The authors are listed alphabetically. T.X., M.Z., and O.S. generated the climate data. O.S. and M.S. performed data analysis and wrote the paper.

Abstract

We explore how the political survival of leaders in different political regimes is affected by drought and precipitation flooding, which are the two major anticipated impacts of anthropogenic climate change. Using geo-referenced climate data for the entire world and the years 1950 to 2010, we investigate whether democracies are better able to withstand the pressures arising from the economic and social disruptions associated with extreme climate than other institutional arrangements. We find that high precipitation, but not drought, increases political turnover in non-democratic regimes, both utilizing existing regime mechanisms and through irregular exit. Leaders of democratic nations appear not to be affected by extreme weather events. We find that economic development has no comparable conditioning effect for the consequences of extreme weather events on political survival.

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As severe consequences of anthropogenic climate change for human societies become a near certainty (IPCC, 2013, 2014), adaptation to changed environmental conditions becomes a necessity for affected societies. The need to pay for disaster preparedness and impact adaptation raises issues of the socialization of private costs, and some societies will have to deal with resettlement pressures (Black et al., 2011; McLeman & Smit, 2006; Perch-Nielsen, Bättig, & Imboden, 2008). Climate change therefore puts a variety of pressures on political systems that are yet little understood. One important predicted change in weather patterns is an increase extreme weather events. The Intergovernmental Panel on Climate Change provides reliable evidence that individual regions are beginning to experience more intense and longer droughts and more extreme precipitation events (IPCC, 2014). How governments handle extreme drought and precipitation events provides a window into how political systems are able to deal with political pressures arising from meteorological phenomena that will become more frequent and pronounced as a consequence of climate change. To study these responses, in this article we explore how *drought*, based on the degree and duration of dry atmospheric conditions (Mishra & Singh, 2010; Palmer, 1965; Svoboda et al., 2002; Vicente-Serrano, Beguería, & López-Moreno, 2009), and *precipitation flooding*, due to heavy rain (Brakenridge, 2014; Dankers et al., 2014; Hirabayashi et al., 2013; Vörösmarty et al., 2013), affect the survival of political leaders in office. Removal from office is the strongest political sanction that leaders face for unsatisfactory performance in office. Though only some crises caused by drought or flooding will results in this ultimate political punishment, the focus on removal allows us to hold different institutional, geographic and cultural contexts constant. We therefore can study the political consequence of extreme weather events across countries and isolate the effects of important political and economic variables. In particular, we are interested in whether democratic institutions make leaders more sensitive to the adaption pressures of climate change than their authoritarian counterparts. Also, we would like to know whether wealthier countries are better to able to deal with these political pressures than poorer societies.

Climate change threatens human well-being in the long run through its predicted effects on water resources, crop yields, rising sea levels, and changes to entire ecosystems, including the accelerated extinction of species (IPCC, 2014). Increasingly frequent extreme weather events are of more immediate concern. The Intergovernmental Panel on Climate Change (IPCC, 2014) notes that "impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones, and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability" (p. 6) There is substantial uncertainty about the regional distribution of the projected climate change impacts. Some countries will see large increases in drought or precipitation driven flooding in a relatively short time. Empirically, drought affects the largest number of people relative to other natural disasters (Mishra & Singh, 2010). Between 1992 and 2001, drought and flooding were, respectively, the number 1 and 2 causes of deaths caused by natural disasters.[1] Understanding the political consequences of extreme weather events therefore needs to have high priority.

We concentrate on wealth and political regime type because there is a wide consensus that natural disasters have worse effects on populations in developing countries (IPCC, 2014; Kahn, 2005), largely because their governments lack the financial means and institutional capacity to prepare for extreme events. This suggests that wealth and regime type play an especially crucial role for adapting to greater climate volatility in developing countries. Existing

[1] 277,574 deaths due to drought and 96,507 deaths due to flooding, followed by earthquakes (77,756) and storms (60,447) (Dilley, 2005).

works also show important effects of political regime type on disaster preparedness. For example, Flores & Smith (2013) establish that democratic governments get politically punished for natural disasters if they result in a high number of casualties, whereas non-democratic leaders face more protests over natural disasters independent of casualty rates. The authors argue that this difference in the political risks associated with extreme weather events induce democratic governments to invest in disasters preparedness, but not their non-democratic counterparts.

Not all natural disasters are alike. Intuitively, there should be a connection between the scope and speed with which a disaster unfolds and its political consequences. Several small and slowly occurring changes to the environment might result in constituents paying little attention because the salience of these changes is low. Even if the changes are noticed, constituents might prefer not to take political action because the relative costs of doing so are too high. Eventually, the consequences of a slowly unfolding environmental disaster might become too severe to be ignored. But even in this scenario assigning accountability to the government is not straight-forward if policies were implemented a long time ago by past incumbents. In contrast, quickly occurring disasters that produce high numbers of casualties and other costs pass the threshold for political action more easily. Leader survival therefore might be more sensitive to sudden-onset natural disasters compared to those that arise slowly. The political effects of different crises trajectories remain poorly understood (an extensive literature search only resulted in colloquial references to abstract concepts, such as the `boiling frog’ analogy, for delayed reactions to climate change). Our work breaks new grounds in this regard, by comparing the effects of drought, a longitudinal phenomenon that increases in severity as precipitation stays below average for several months, years or even decades, to precipitation flooding, which happens quickly and with little or no forewarning.

Droughts and floods also differ in other ways. Poor countries tend to have larger agricultural sectors. In these countries, drought can have severe consequences as it leads to repeated crop failures and dwindling of live stocks (Kelley, Mohtadi, Cane, Seager, & Kushnir, 2015; Mavromatis, 2007; Reyna, 2010; Svoboda et al., 2002). In contrast, in industrialized economies drought will cause inconveniences, such as limitations on water use for lawn maintenance and the like, but short of catastrophic conditions in which drinking water supplies are not guaranteed, the impact on the economy will be relatively small. Flooding tends to be geographically more limited than drought, and therefore has less potential to disrupt agricultural production. However, there are exceptions to this rule. For example, the devastating floods in Pakistan in 2010 submerged about 20 percent of the entire country, and imposed high costs in terms of human live and economic output.[2] Industrialized economies should be less susceptible to the effects of floods overall. But exceptionally large events can also do severe damage. The floods in Thailand in 2011 affected two thirds of the country. The resulting stop in industrial activity interrupted the global supply chain for some automobile parts and computer hard drives, that were exclusively produced in Thailand and could not be sourced elsewhere.[3]

Our choice of leader survival as key dependent variable follows a burgeoning literature that has used leader survival as a measure of political success in a wide variety of fields such as international conflict research (Chiozza & Goemans, 2004), the political economy of

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[2] Source: Radio New Zealand News, accessed on May 26, 2015 at http://www.radionz.co.nz/news/world/54885/pakistan-floods-seen-as-massive-economic-challenge-imf

[3] Various news sources, accessed on May 26, 2015 at http://www.bbc.com/news/business-15285149 ; http://www.nytimes.com/2011/11/07/business/global/07iht-floods07.html?_r=0

development (Bueno de Mesquita & Smith, 2009), and foreign aid decision making (Licht, 2010), among others. We contribute to this literature by providing a fine-grained analysis of how extreme weather events affect leader survival in different economic and political regimes. Important previous work in this vein is Flores & Smith (2013), who relate natural disaster response to leader survival. The authors focus on the impacts of natural disasters, such as the numbers of killed and displaced people. We choose a different strategy, by directly measuring meteorological events. Our approach has the advantage of accounting for all droughts and floods, regardless of whether they produce casualties or not. This eliminates an important source of selection bias, since casualty numbers and disaster responses are correlated with political regime type and wealth. It also helps to avoid problems with inconsistencies in the quality of data reporting.[4] In addition, in future work our measures of drought (the Standardized Precipitation-Evapotranspiration Index, or SPEI, (Vicente-Serrano et al., 2009)) and precipitation flooding (Harris, Jones, Osborn, & Lister, 2014) can be used to predict future climatic impacts based on temperature and precipitation projections of climate models for various emissions scenarios (Taylor, Stouffer, & Meehl, 2011).

[4] Flores & Smith rely on the Emergency Events Database (EM-DAT), which reports population impacts based on information provided by UN agencies, non-governmental organization, insurance companies, research institutes and press agencies (D. Guha-Sapir, R. Below, & Hoyois, 2015). The accuracy of the impacts data – such as the number of people killed, displaced, or requiring emergency assistance – depends on the quality of global monitoring and reporting of the relevant disasters.

Our paper also answers calls for increased scrutiny of the political processes that accompany adaptation efforts to climate change.[5] Javeline (2014) notes that adaptation is “fundamentally political“ (p. 1) as protection measures affect constituents unevenly and therefore have redistributional consequences. By focusing on political survival we explore how extreme weather phenomena affect the most basic incentive mechanism common to leaders in all political regimes across time and space. If drought and flooding constitute a threat to the political survival of incumbents, the political benefits of adapting to such natural disasters might outweigh the costs. On the other hand, if leaders are relatively immune to political fallout from extreme weather events, they have little incentive to implement adaptation measures.

Finally, our work speaks to the growing literature on climate change and violent domestic conflict (Buhaug, 2010; Hsiang, Burke, & Miguel, 2013; Kelley et al., 2015; Solow, 2013). Although leader survival and conflict are conceptually separate, the removal of a leader from office can contribute to the destabilization of the existing political regime, especially if regular institutional rules are violated in the process.

In the remainder of this article, we first introduce our argument about the effects of flooding and drought on leader survival in more detail. We then discuss our data and methodology. Next we present the results of the empirical analysis and discuss political implications of extreme weather events in the 21st century. We conclude with a discussion of the implications of our findings for future research on climate adaptation.

[5] By convention, adaptation refers to measures that deal with the consequences of climate change, whereas mitigation aims to curb or halt the process of climate change itself. See e.g. NASA, “Responding to Climate Change”, accessed on March 5, 2016 at http://climate.nasa.gov/solutions/adaptation-mitigation/.

CLIMATE IMPACTS, POLITICAL REGIME AND LEADER SURVIVAL

A basic insight from the study of electoral politics is that voters can influence leader actions by holding them responsible retrospectively for policy outcomes (Ferejohn, 1986). This motivates the study of political leader survival in the aftermath of extreme weather events. Pioneering work by Achen and Bartels (2004) shows that American voters punish incumbents for spells of drought at the ballot box. This suggests a straightforward logic of how extreme weather events are connected to climate change adaptation. Those leaders who are more susceptible to suffer politically from flooding and drought should be more willing to invest political capital into adaptation measures that alleviate the consequences of increasingly frequent extreme weather events. We focus on a number of factors that we believe are central for moderating this relationship. They are political regime type, the wealth of the affected society, and the speed at which meteorological disasters unfold.

Beginning with regime type, a hallmark that sets apart democratic from non-democratic regimes is that democratic leaders lose elections and voluntarily give up power (Przeworski et al. 2000). In contrast, leader removal in non-democratic regimes can follow a variety of patterns, that may involve elections (e.g. in one-party states or other illiberal electoral regimes), may follow publicly known rules (e.g., the Chinese Communist Party changes its leadership every 10 years), or are a function of private machinations among ruling elites (prominent examples include the frequent changes of government figureheads under Argentina's military junta from 1976-1982, and the choice of Communist Party leaders in the Soviet Union). The literature on leader survival differentiates between regular and irregular means of removal from office, but these modes of removal mean vastly different things in different political regimes.

Leaders in non-democratic regimes survive in office longer than their democratic counterparts (Bueno de Mesquita et al. 2003). This is not surprising, because regular removal from office for democratic leaders involves elections or term limits, whereas regular removal in non-democratic regimes involves rules that are meant to ensure the ongoing hold on power of the ruling elites. (Chiozza & Goemans, 2004). Removal from office in both democracies and non-democracies counts as irregular if it happens in a manner that violates existing rules. However, non-democratic rulers are much more likely to be removed in an irregular manner than their democratic counterparts (Goemans 2008). Together, these trends give rise to intuitive patterns. Democratic leaders are removed from office more frequently and by regular means, whereas non-democratic rulers hang on longer, but tend to exit in a non-regular fashion.

What implications do these patterns have for how sensitive rulers in different regimes are to the effects of extreme weather events? The answer is not straightforward. On the one hand, democratic leaders are held accountable by the electorate in frequent elections and therefore face consistent pressures to accommodate constituent concerns. This suggests that constituents unhappy with how a democratic leader handles the fallout from an extreme weather event should try to remove the leader through regular channels. However, large crises can trigger irregular removal of leaders in democracies as well. Especially in democracies that have not crossed a certain income threshold, political instability can lead to reversal to non-democratic rule (Przeworski et al, 2000).

In contrast, in non-democracies leaders are shielded against the threat of electoral loss. However, losing an election pales in comparison to the personal consequences that typically come with irregular removal from office. Goemans (2008) shows that fully 80% of leaders that are removed in irregular fashion face punishment, ranging from exile to execution. Since non-democratic leaders are more likely to be removed in an irregular manner, this threat of punishment should make them susceptible to pressures arising from extreme weather events as well. However, it is important to keep in mind that irregular removal is not the only way how non-democratic leaders can lose office. Some non-democratic regimes have regular mechanisms to exchange leaders while maintaining the regime's power base, such as swapping figureheads in a military junta. In the presence of political pressures, it might be preferable for the regime to change leaders through such regular channels to prevent the greater dangers of irregular removal and regime failure.

This discussion shows that both democratic and non-democratic leaders are at risk of removal from office in reaction to extreme weather events. Though we have some mild priors how susceptible different regimes are, those predictions are not definite. For democratic leaders the risk of regular removal might be greater than irregular removal, but we cannot rule out the latter. For non-democratic leaders the reverse holds, but the differences are likely even smaller, since the threat of irregular removal looms large. Ultimately, whether democratic or non-democratic leaders are better positioned to thwart threats to their tenure from extreme weather events is an empirical question. We differentiate in our analysis between both regime types and allow for both, regular and irregular channels of removal, but do not take an explicit stance in our theoretical prediction:

H1: Extreme weather events increase the risk of regular and irregular removal from office.

A second variable that moderates the impact of drought and flooding on leader survival is wealth. There are at least two connections. Governments in wealthier countries tend to have greater capacity to implement policy changes. One reason for this is that they rely less on patronage but on broader winning coalitions and public accountability (Bueno de Mesquita, Smith, Siverson, & Morrow, 2003). There also is evidence that good institutions are a prerequisite for growth (Acemoglu, Johnson, & Robinson, 2001), providing a reversed explanation for why wealthier countries tend to be better governed. Irrespective of the actual direction of the causal arrow between government capacity and wealth, governments of wealthier countries should be better at dealing with the effects of extreme weather events, isolating leaders in these countries more from political fallout.

The second connection between wealth and leader survival stems from the ability to use money to pay off important constituent groups. There is broad-based evidence that non-democratic leaders who have access to outside funding use it to isolate themselves from political unrest, for example if they receive foreign aid (Bueno de Mesquita & Smith, 2009; Licht, 2010; Morrison, 2009) or oil revenue (Ross, 2001). [6]

While the two connections affect different parts of the causal pathways leading from extreme weather events to leader survival, both point to the same observational outcome. Leaders in wealthier societies should be better able to resist political pressures from extreme climate events either because of better advance preparation and adaptation efforts, or because they can use money to buy support of important constituent groups in the aftermath of disaster. We summarize this discussion in Hypothesis #2.

H2: Leaders in wealthier societies are less at risk from regular or irregular removal following extreme weather events than those in poorer societies.

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[6] Some exceptions exist. For example, non-democratic leaders can exploit donor preferences for political stability to trade higher political risk for greater rent extraction (Steinwand, 2014).

We investigate a third major dimension along which political responses to extreme weather events are likely to vary. Natural disasters differ in how they unfold over time, ranging from brief sudden-onset events like the proverbial lightning `bolt from the blue', to events that are long-lasting and characterized by slowly unfolding consequences, such as the slow spread of an invasive species or changes to regional precipitation patterns brought on by deforestation. The political reactions of affected populations are likely to differ with temporal dynamics. Unexpected, fast moving, and costly events are difficult to ignore. They potentially impose high costs in terms of life and property, require an immediate disaster response and are therefore of great salience. In comparison, slow moving and long-lasting processes impose fewer costs in the short run, and might not require immediate intervention. This might translate into lower political pressure emanating from affected populations and in turn delay government reactions. As we mention in the introduction, despite the intuitive appeal of these two prototypical scenarios, the literature seems to have paid no attention to differences in how disasters unfold. We attempt to capture both scenarios by looking at extreme weather events that fall on either side of the fast/slow divide. Precipitation flooding often occurs without much forewarning and can destroy the livelihoods of affected populations within a single day. Drought on the other hand results from rain (or snow) falls staying below long-term averages for months, years, or even decades. We expect the political responses to flooding and drought to vary according to the logic laid out above:

H3: Both precipitation flooding and drought increase the risk of regular and irregular removal from office, both flooding more so than drought.

DATA

Political Leader Survival

To examine the relationship between climatological variables and the amount of time political leaders spend in the office we use the Archigos data set, version 4.0 (Goemans, Gleditsch, & Chiozza, 2009). Specifically, we focus on the number of days a leader spent in office and the type of exit. Given the climate and control variables data availability (see details below), we restrict our analysis to the period of 1950 – 2010.

According to Goemans et al. (2009): “Leaders can lose office in 1) a regular manner, according to the prevailing rules, provisions, conventions and norms of the country, 2) an irregular manner, 3) through direct removal by another state, and 4) as a result of a natural death, under which we include illness or suicide.” (p. 273) During the period that we study (1950-2010), Archigos reports a total of 1506 political leaders across all nations in the world including:

991 (65.8%) leaders who lost power through the regular exits,

252 (16.7%) losing power through irregular exits,

103 (6.8%) losing power through all other types of exits (e.g., natural death),

160 (10.6%) leaders still in power.

We restrict our analysis to regular and irregular types of exit (treating other types of exit as competing events, see discussion below), as well as to leaders still in power, comprising over 90% of all cases.

Climatological Variables

The two climate impacts that we examine here are drought and precipitation flooding. Climatological data—such as a drought index or monthly precipitation—are typically in the form of a gridded time-series dataset across the global area. A common resolution of 0.5° longitude and 0.5° latitude translates into a 720 by 360 grid. In order to transform the climate data to be compatible with political variables, we create annual national measures of drought and precipitation, and match the climate data with national boundaries GIS data (Bhaduri, Bright, Coleman, & Urban, 2007). For all grid cells that belong to a given country, we calculate the average climatological value for a given month. Then we create two annual measures of a climatic impact: (a) based on the monthly mean, and (b) based on the monthly maximum.

We model drought using the Standardized Precipitation-Evapotranspiration Index (SPEI), which is a drought index that is based on precipitation and temperature data (Vicente-Serrano et al., 2009)[7]. The SPEI time-scales can vary between 1 and 48 months. Here we explore common SPEI-12 month and SPEI-24 month measures, representing drought conditions in a given location in the past 12 and 24 months, respectively. The complete SPEI gridded time-series are publicly available at < http://sac.csic.es/spei/database.html>. Since only the negative values of the SPEI represent drought (positive values represent above-average precipitation), we define a Drought Index variable as $DI = -SPEI$ for $SPEI < 0$ and $DI = 0$ for $SPEI > 0$ (see Table 1 below for descriptive statistics).

[7] SPEI calculation uses the monthly difference between precipitation and potential evapotranspiration (PET). This difference between precipitation and PET describes the water balance of the soil (Thornthwaite, 1948). Although other drought indices are based on water balance—such as the Palmer drought severity index (PDSI) (Palmer, 1965)—SPEI is more convenient to calculate and can represent different time scales. At longer timescales (e.g., 12 months), the SPEI has been shown to correlate with the self-calibrating PDSI for a set of observatories with different climate characteristics, located in different parts of the world (Vicente-Serrano et al., 2009).

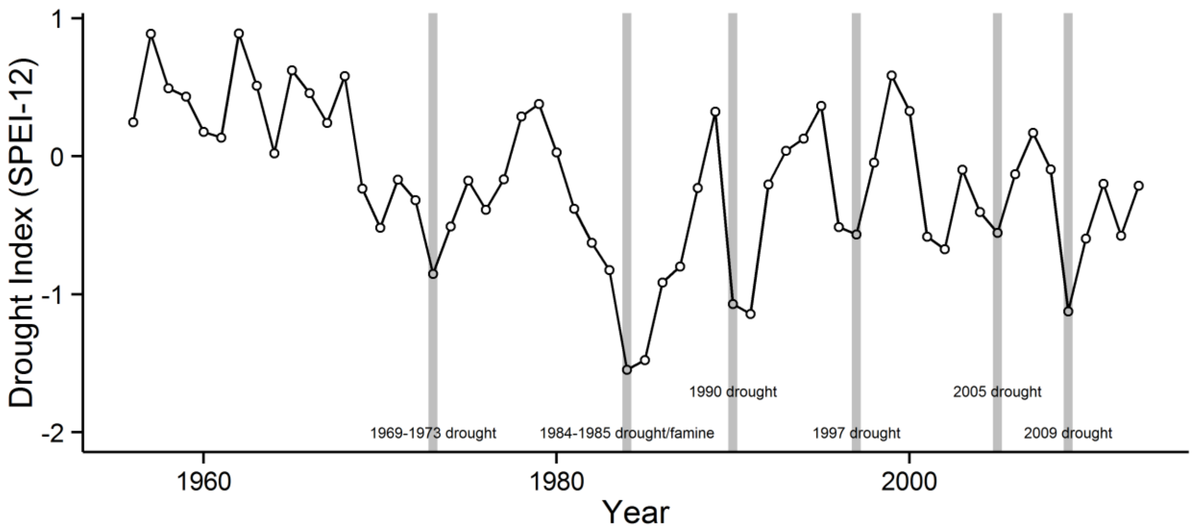
Figure 1(a) shows an example of the SPEI index for Sudan, along with six major droughts that affected the country since its independence in 1956. The graph is based on the SPEI-12 monthly mean.

[Figure 1 about here]

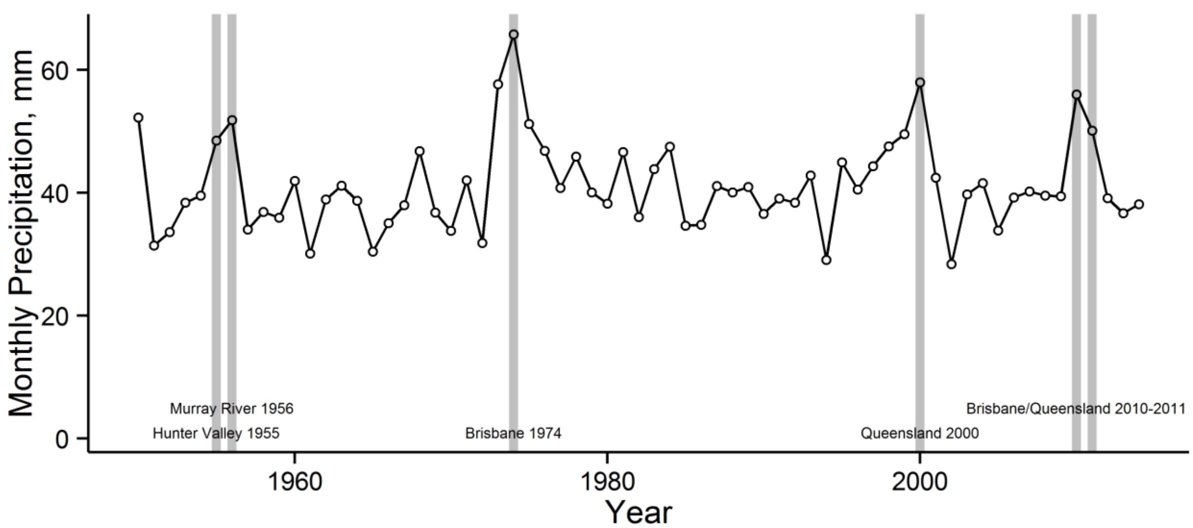
As expected the lowest SPEI values are recorded for the period of 1984-1985 (1984: SPEI = -1.55; 1985: SPEI = -1.48) when Sudan was affected by devastating drought and resulting famine (Reyna, 2010).

FIGURE 1. (a) SPEI-12 and droughts in Sudan. (b) Precipitation and major floods in Australia.

(a)



(b)



For precipitation, we use the state-of the-art monthly precipitation data from the Climatic Research Unit dataset (Harris et al., 2014), which is the gridded time-series dataset with high resolution (0.5° latitude x 0.5° longitude grid cells) across the global land areas excluding Antarctica. The unit of the precipitation data is millimeter per month. Figure 1(b) shows the mean precipitation values for Australia and the biggest floods affecting the country during 1950-2014 (Deo, Byun, Adamowski, & Kim, 2015). Similar to our measure of drought, there is a close correspondence between the physical measure of the climatic phenomenon (drought index, millimeters of precipitation) and the climate impact affecting humans (extreme droughts/famine and devastating floods). As the figure illustrates, despite the fact that both Sudan and Australia are large countries, the climate measure based on grid cell means is an accurate measure of national impacts, even if only a part of the country is affected (e.g., floods in Australia).

Table 1 shows the descriptive statistics of the key variables used in the statistical analysis. The unit of analysis is leader-years. The total time a political leader spent in the office—that is, the survival time—is measured by the total number of days, ranging from 1 to 17901 for the period of the study (1950-2010). Leaders' age at the time of the exit ranges from 17 years to 93 years. For the regular and irregular exit variables, the year when a leader loses power is coded as 1, and 0 otherwise.

[Table 1 about here]

TABLE 1. Descriptive Statistics.

	N	Mean	St. Dev.	Min	Max	Pct.-5th	Pct.-50th	Pct.-95th
Leader variables								
Year born	8,017	1,928	19.09	1,873	1,974	1,893	1,929	1,956
Age at the time of exit	8,017	56.98	11.37	17	93	39	57	76
Regular exit dummy	8,017	0.124	0.329	0	1	0	0	1
Irregular exit dummy	8,017	0.0314	0.174	0	1	0	0	0
Days in the office	8,017	2,327	2,705	1	17,901	108	1,374	8,377
National variables								
Polity score	8,017	11.57	7.385	0	20	1	14	20
Territory (grid cells)	8,017	14,077	39,140	16	430,134	227	3,155	40,704
Log territory	8,017	8.103	1.716	2.773	12.97	5.425	8.057	10.61
GDP per capita	8,017	7,841	9,537	160.9	65,879	563.2	3,803	28,775
Log GDP per capita	8,017	1.355	1.247	-1.827	4.188	-0.574	1.336	3.359
Population (M)	8,017	35.32	121.2	0.221	1,360	0.905	8.014	121.8
Log population	8,017	2.189	1.464	-1.510	7.215	-0.0998	2.081	4.803
Climatic variables								
SPEI – 12	8,017	-0.0170	0.604	-2.063	2.211	-1.010	-0.0102	0.997
Drought – 12	8,017	0.244	0.360	0	2.063	0	0.0102	1.010
Precipitation (mean)	8,017	94.38	62.43	1.616	326.2	10.24	84.21	218.8
Precipitation (max)	8,017	210.2	138.6	3.210	1,151	38.07	183.0	479.1

Note: Each case represents one leader-year. The drought-12 measure is based on the negative values of SPEI-12, which represent drought conditions (D-12 = SPEI-12 * -1 for SPEI-12 < 0). The Polity score is based on Polity2 (Polity score = Polity2 + 10). Precipitation (mean) is based on the mean value for a given year based on monthly observations. Precipitation (max) is equal to the maximum observed precipitation value observed in any of the 12 months.

MODEL

To examine the impact of droughts and flooding on either regular or irregular exit, we need to estimate the cumulative incidence of political exit as a function of these two competing risks (and other ways of losing office). A political leader may lose power in a regular fashion, for example through elections. However, the same leader also always faces the risk of losing office due to irregular removal by means of impeachment, coup, assassination, and so on. Since the two events prevent each other from occurring and we can only observe either a regular or an irregular exit, we need to treat the two types of exit as competing events. In this case, a competing-risks regression model (Fine & Gray, 1999) is preferred to the classical proportional hazards model (Cox, 1972). The competing-risks model is most commonly used in medical research since patients' deaths may have different causes (Satagopan et al., 2004; Wolbers et al., 2014). We also treat other forms of exit (through natural death, etc.) as competing risks.

In our model, the risk of exit form office is specified as a function of (1) the drought index, (2) precipitation, (3) a political leader's age, (4) the national population (United Nations, 2013), (5) GDP per capita (Heston, Summers, & Aten, 2012), (6) regime type based on the Polity measure (Mashall, Gurr, & Jaggers, 2014), and (7) the size of the territory derived from the LandScan grid (Bhaduri et al., 2007).

We estimate the cumulative incidence function following Fine and Gray (1999):

(1) $$\mathrm{CIF}_1(t) = 1 - \exp\left\{-\overline{H}_1(t)\right\}$$

where

(2) $\overline{H}_1(t) = \int_0^t \overline{h}_1(t)\,dt$ is the cumulative subhazard for failure of type 1 (e.g., regular exit)

with $\overline{h}_1(t)$ defined as the hazard for the event 1 (StataCorp, 2015, pp. 156-157).

The measure of drought used in the statistical models shown below is based on the SPEI-12 (Vicente-Serrano et al., 2009), representing drought conditions in the country in the previous 12 months (as illustrated in Figure 1(a)). We also tested alternative measures of drought based on 24, 36, and 48 month drought conditions and found substantively similar results.

For the measure of precipitation (Harris et al., 2014), we explore a two-by-two set of possibilities: (a) monthly mean precipitation in a given year, or the maximum precipitation observed in any of the 12 months in a year, and (b) precipitation describing the current or the previous year conditions. Unlike drought, flooding impacts may be short-term and more intense. In addition to using the monthly maximum values observed in a given year, we also examine a measure based on the mean. Longer-term measures of climate impacts are potentially more robust and a leader's exit may occur earlier than an extreme weather event (albeit in the same calendar year). Furthermore, we examine political exit using the current year precipitation measures and a one-year lagged version. For example, it is possible that floods have a more immediate impact on irregular political removal (eg via coups and revolutions) in the current year while political processes that unfold through regular channels are slower, leading to floods having a greater impact on regular removal (eg via elections) after a one-year time lag.

To make interpretation of coefficients more intuitive in the regression tables, we transformed the political regime (Polity) variable from the [-10; 10] range to the [0; 20] range by simply adding 10 units. Values below 5 represent roughly authoritarian regimes; values above 15 represent democracies; values between 5 and 15 describe anocracies (Mashall et al., 2014).

RESULTS

Regular Exit

First, we examine the relationship between the climatic variables and regular political exit, with all other types of exit modelled as the competing risk. In Table 2, we show estimates for the cumulative incidence of regular exit. These results are based on precipitation measures that employ a one-year lag. The estimates without the lag are substantively the same, but are estimated with more uncertainty (see Table A1 in the Appendix). Model 1 is based on mean monthly precipitation per year; Model 2 uses the observed precipitation maximum in any of the 12 months in a year; Models 3 and 4 include interactions of precipitation and the Polity [0-20] score.

[Table 2 about here]

Beginning with precipitation, we find that flooding increases the risk of regular removal from office, as coefficients are positive. This effect is statistically significant for monthly means (model 1) but is estimated with less precision for the measure based on maximum observed precipitation (model 2). Adding the interaction with regime type shows that the effect of flooding varies widely between democracies and non-democracies. For both measures (models 3 & 4), moving toward more democracy reduces the impact of precipitation on the risk of leader removal (negative interaction term). In a reversal to models 1 and 2, now maximum observed precipitation produces highly statistically significant coefficients, and the monthly means model has greater uncertainty.

TABLE 2. Regular Political Exit and Historical Climate Impacts (1950 - 2010), Annual Lag Models.

	(1)	(2)	(3)	(4)
Drought (12 months)	0.08407 (0.10164)	0.07459 (0.10152)	0.08156 (0.10180)	0.06906 (0.10167)
Precipitation (lag, monthly mean)	0.00106** (0.00054)		0.00319** (0.00159)	
Precipitation (lag, monthly max)		0.00041 (0.00027)		**0.00181*** (0.00066)**
Precipitation (lag, monthly mean) x Polity			-0.00014 (0.00009)	
Precipitation (lag, monthly max) x Polity				**-0.00010** (0.00004)**
Polity	0.09383*** (0.00819)	0.09417*** (0.00817)	0.10779*** (0.01266)	0.11680*** (0.01254)
Log Population	0.07792*** (0.02933)	0.07631*** (0.02950)	0.07802*** (0.02926)	0.07628*** (0.02947)
Log GDP per capita	0.10941*** (0.03475)	0.11279*** (0.03587)	0.10723*** (0.03488)	0.10340*** (0.03610)
Log Territory (grid cells)	-0.05124** (0.02361)	-0.04806* (0.02478)	-0.05127** (0.02357)	-0.05032** (0.02484)
Leader's Age (years)	0.01323*** (0.00328)	0.01305*** (0.00328)	0.01322*** (0.00328)	0.01331*** (0.00329)
Observations	7,967	7,967	7,967	7,967
Subjects	1,495	1,495	1,495	1,495
Failed	981	981	981	981
Competing	354	354	354	354
Censored	160	160	160	160

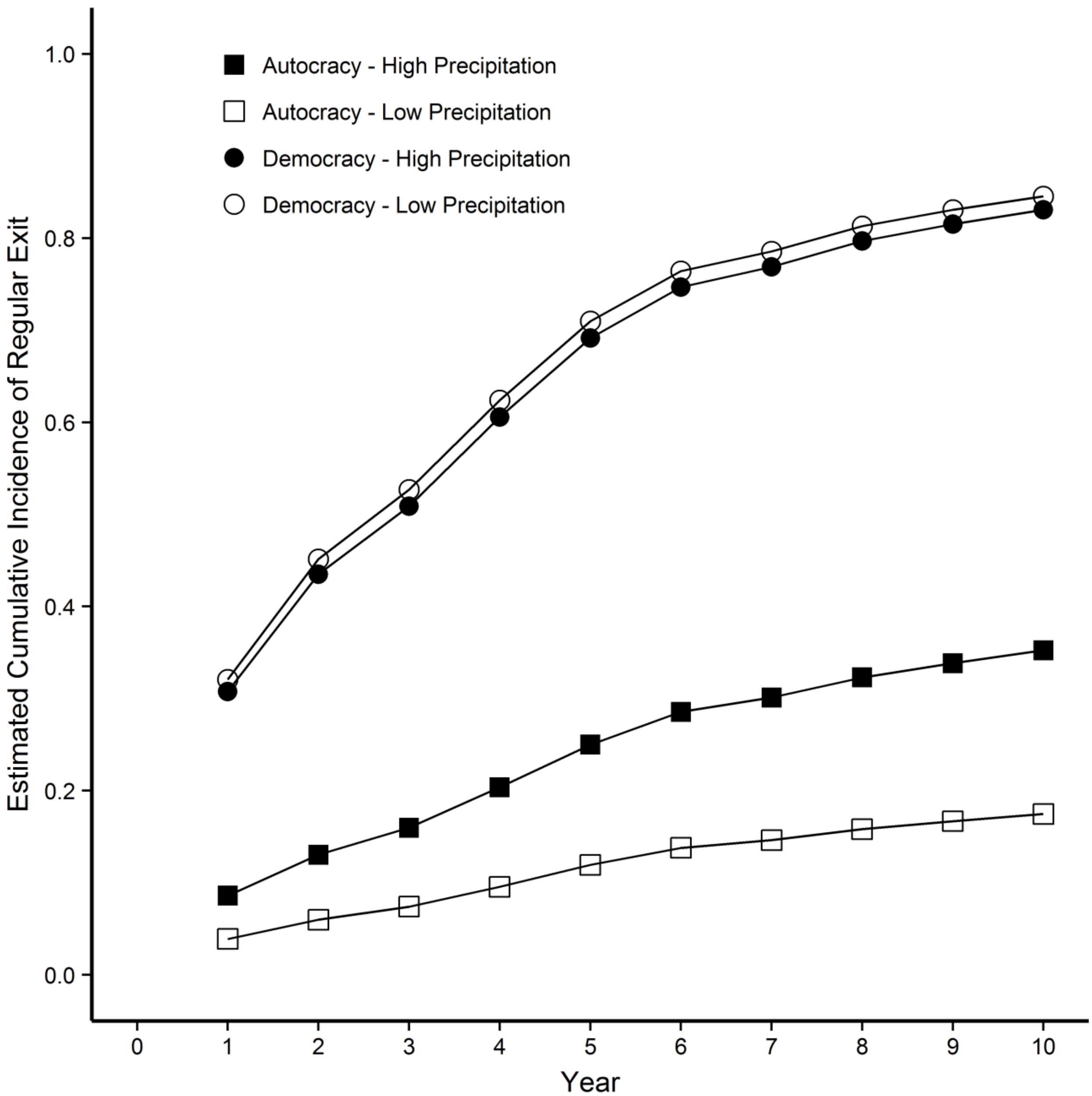
Note: Competing-risks regression with robust standard errors in parentheses (adjusted for 1495 clusters in leader id); *** p < 0.01, ** p < 0.05, * p < 0.1.

To evaluate the substantive effect of flooding and regime type on leader removal, we look at the predicted cumulative incidence of regular removal over time (Figure 2, based on model 4). The cumulative incidence function (CIF) provides the probability that the event of interest happened prior to a given time. For example, the CIF evaluated at 4 years gives the probability that a leader lost office in a regular fashion prior to finishing his 4th year in office.[8] Two things stand out. First, in line with well-established findings, democratic leaders have a higher probability of losing power via regular exit than their non-democratic counterparts. This is no surprise since regular elections and term limits are a hallmark of democracy. Second, consistent with our hypothesis #1, democratic leaders are much less affected by flooding precipitation than authoritarian leaders.

[Figure 2 about here]

[8] The CIF is the appropriate quantity of interest for competing risk models. Standard survival functions are not well defined because the event of interest depends on the covariates both directly and indirectly, through the effect of the covariates on competing events (Fine & Gray 1999, Scheike & Zhang 2011).

FIGURE 2. Regular Exit for Autocracy and Democracy under Low and High Precipitation.



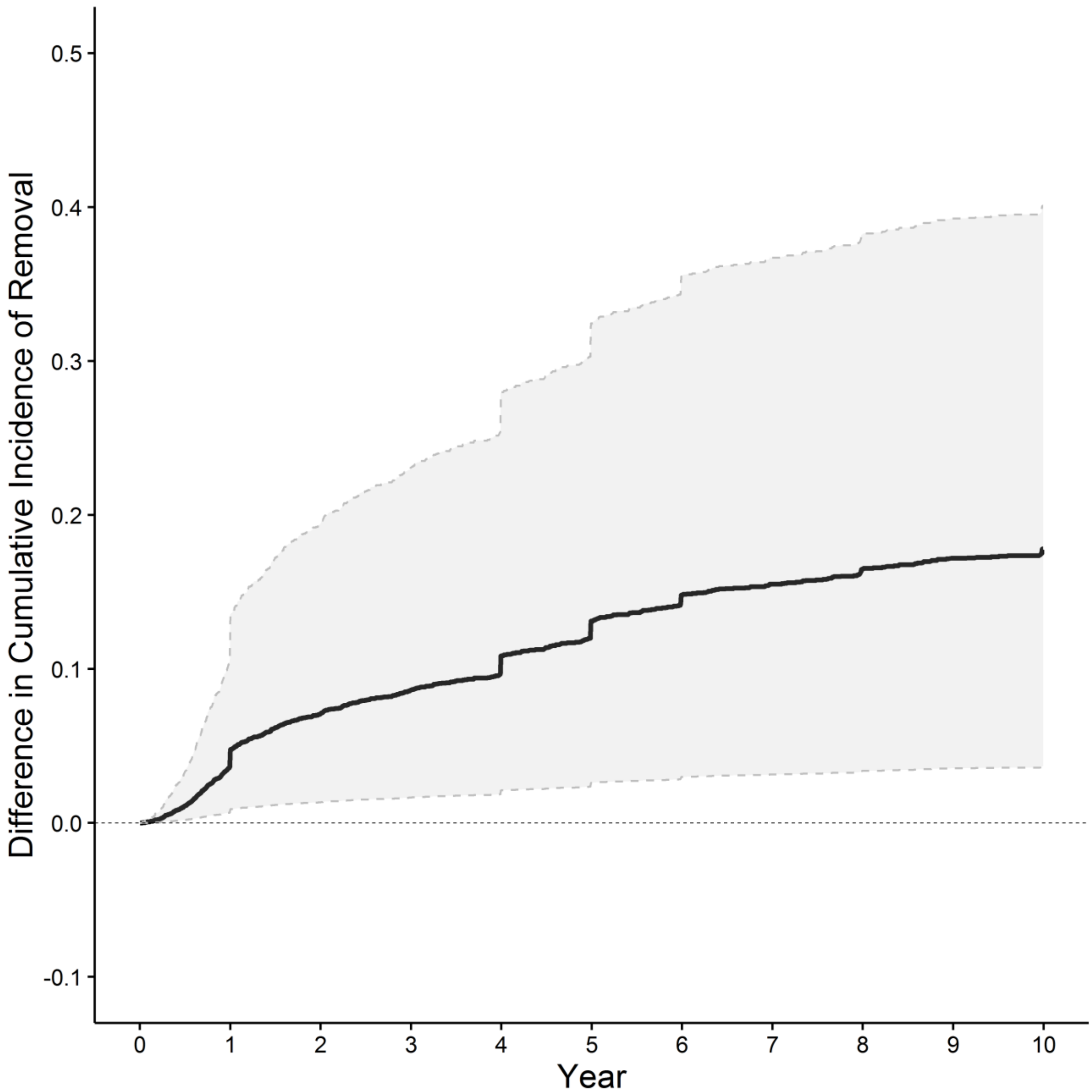
Note: The figure is based on Table 2 – Model 4.

For democratic leaders, the risk of removal from office over time is virtually indistinguishable with and without flood conditions (empty and filled circles). In contrast, non-democratic leaders start with a much lower baseline risk of losing office (empty squares). Flooding not only is associated with a higher likelihood of regular exit (filled squares), this effect also increases over time. For example, for a fully authoritarian leader (Polity = 0) who is four years in power, flooding increases the cumulative incidence of regular exit from 9.6% (5th percentile of precipitation variable) to 20.4% (95th percentile of precipitation). That means that non-democratic leaders are approximately two times more likely to lose power under high precipitation than lower precipitation. For a democratic leader (Polity = 20) after four years in power, the cumulative incidence of regular exit actually slightly decreases from 62.4% under normal conditions (5th percentile of precipitation) to 60.6% if there is flooding (95th percentile of precipitation).

Evaluating the uncertainty with which these effects are estimated is not straightforward. Gray (1988) describes a formal test for differences in CIFs, but the test does not allow for incorporating covariates. As alternative we turn to a parametric bootstrap procedure that relies on re-sampling from the sampling distribution. Figure 3 shows the difference in the cumulative incidence for non-democracies with and without precipitation and provides a 95 percent confidence band. The confidence band does not contain the origin, establishing that in autocracies the effect of precipitation on regular removal from office is statistically significant.

[Figure 3 about here]

FIGURE 3. Difference in the cumulative incidence of regular exit for non-democracies with and without precipitation.



Note: Shaded regions represent 95% confidence intervals.

Next we look at drought. In all models that we examine, the effects of drought point toward an increased risk of losing office, but the effect sizes are too small to reliably distinguish them from zero throughout. This is regardless of whether we use a version of the SPEI index that looks back 12, 24, 36 or 40 months. It appears that the slow-moving development of drought conditions produces less political pressure than the rapid and often drastic events associated with flooding. This pattern lends support to our Hypothesis 3.

In a next step we repeat the analysis of the effects of flooding and drought on regular removal from exit, but this time we include interactions with GDP per capita. We find no evidence that a country's wealth moderates the effects of drought or flooding on leader survival in a significant manner (hypothesis 2). We report full results in Table A3 in the appendix.

For a discussion of the control variables we return to Table 2. All of the controls have strongly significant effects that are consistent across specifications. More populous and wealthier countries experience more regular leader turnover, whereas countries with larger territory experience less. The risk of regular removal from office also increases with age of the leader.

Irregular Exit

We now examine the relationship between the climatic variables and irregular political exit, with regular exit modelled as the competing risk. Table 3 reports estimates for the cumulative incidence of irregular exit. In contrast to regular exit, the best fitting models with this dependent variable are based on the precipitation measures without the annual lag. The lagged version produces substantively identical estimates, but recovers parameters with less statistical certainty (see Table A2 in the Appendix). We explore these differences in more detail below.

TABLE 3. Irregular Political Exit and Historical Climate Impacts (1950 - 2010), No Annual Lag Models.

	(1)	(2)	(3)	(4)
Drought (12 months)	0.12348	0.10694	0.13782	0.10975
	(0.17866)	(0.17805)	(0.17940)	(0.17836)
Precipitation (monthly mean)	0.00027		**0.00280***	
	(0.00111)		**(0.00169)**	
Precipitation (monthly max)		-0.00018		0.00001
		(0.00049)		(0.00067)
Precipitation (monthly mean) x Polity			**-0.00035****	
			(0.00017)	
Precipitation (monthly max) x Polity				-0.00003
				(0.00007)
Polity	-0.12728***	-0.12667***	-0.09190***	-0.11949***
	(0.01151)	(0.01130)	(0.02002)	(0.02022)
Log Population	-0.06935	-0.06908	-0.06636	-0.06771
	(0.05714)	(0.05735)	(0.05713)	(0.05783)
Log GDP per capita	-0.44958***	-0.45628***	-0.45960***	-0.46085***
	(0.06263)	(0.06367)	(0.06376)	(0.06541)
Log Territory (grid cells)	0.04571	0.03369	0.05221	0.03382
	(0.05694)	(0.05818)	(0.05707)	(0.05817)
Leader's Age (years)	0.01736***	0.01767***	0.01698***	0.01774***
	(0.00624)	(0.00625)	(0.00623)	(0.00626)
Observations	8,017	8,017	8,017	8,017
Subjects	1506	1506	1506	1506
Failed	252	252	252	252
Competing	1094	1094	1094	1094
Censored	160	160	160	160

Note: Competing-risks regression with robust standard errors in parentheses (adjusted for 1495 clusters in leader id); *** p < 0.01, ** p < 0.05, * p < 0.1.

The analysis of irregular exit largely confirms the patterns that we found for regular exit. As before, the effect of drought is consistently in the direction that we expected, but the effects are too small to reach statistical significance. Again, conditioning the precipitation variables on GDP per capita has no effect (see full results in table A3 in the appendix). Most importantly, as was the case for regular exit, precipitation significantly increases the risk of losing office, lending more support to hypothesis 1. This effect is more pronounced for leaders in authoritarian regimes. Thus, once again, authoritarian leaders are more vulnerable to climate impacts than democratic leaders. In addition, looking at the pronounced impact of flooding in conjunction with the more moderate effect of drought provides further evidence that fast-moving weather events are more political consequential than slow-moving events (hypothesis 3). However, as we will see below, the effect of flooding on the cumulative incidence of irregular removal from office stays below conventional levels of statistical significance. The data therefore provide only qualified support for a systematic relationship between flooding and irregular removal from office.

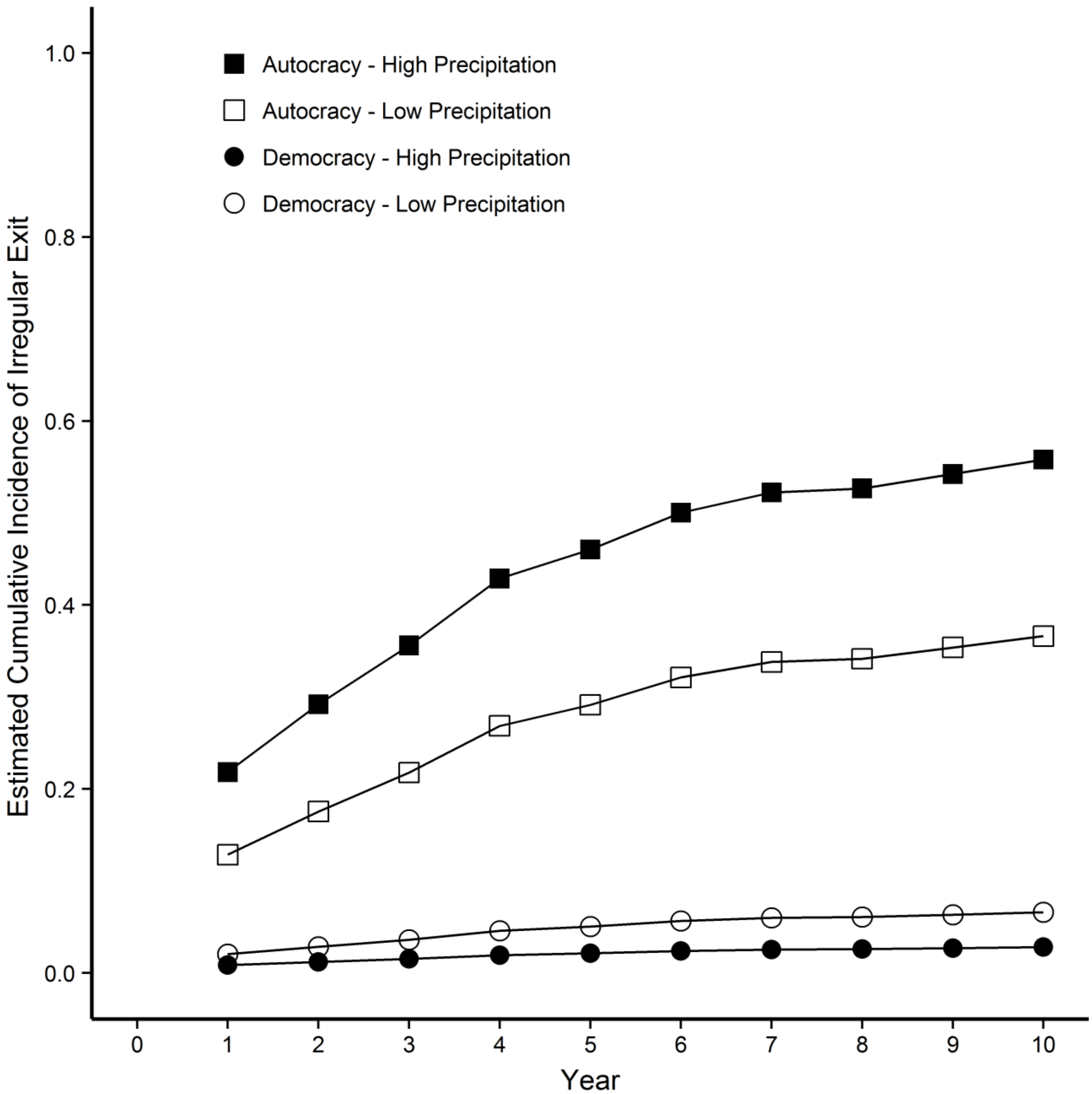
There are some differences between regular and irregular exit concerning the best fitting model. For regular exit, the most discernable patterns arose when we used a one-year lag for the precipitation variable and monthly mean precipitation per year (as opposed to maximum monthly precipitation in a given year). For irregular exit, this backward looking specification is associated with less statistical certainty. Instead, we recover the most significant estimates when we use same-year values of precipitation based on monthly means. One possible explanation for this difference is that irregular exits (such as coups) tend to be more spontaneous. Therefore, any crisis or weakness caused or exacerbated by flooding may have immediate consequences for authoritarian leaders. There are also concerns about temporal ordering, i.e. a situation in which the leader loses power early in the year while flooding takes place later in the same year. We don't think the results are driven by this, because the results for mean annual precipitation per year are more significant than those based on maximum precipitation in any of the 12 months in a year. The former measure will on average be less affected by temporal ordering problems because it smoothes participation patterns over the span of the entire year.[9]

We return to substantive effects of flooding on irregular removal from office. As was the case with regular exit, flooding substantively increases the risk of irregular exit for authoritarian leaders, but not for democrats. In contrast to regular exit, Figure 4 shows that authoritarian leaders start from a much higher baseline risk of irregular removal from office than democratic leaders. For example, for an authoritarian leader (Polity = 0) after four years in power, the cumulative incidence of irregular removal is a remarkably high 26.9% without flooding (5th percentile of precipitation variable, empty squares). With flooding, this number jumps to 42.9% (95th percentile of precipitation variable, solid squares), an increase in the cumulative risk of irregular removal of 60%. For democratic leaders (Polity = 20), the cumulative incidence of irregular exit after four years in office is only 4.6% (empty circles). As with regular exit, flooding actually reduces this risk, to less than 1.9% with high precipitation (solid circles).

[Figure 4 about here]

[9] We should also note that because of the exogeneity of our precipitation based measure, the chance that the observed patterns are simply a random product of reversed sequential ordering, i.e. floods by chance clustering in years after irregular removal from office, seems exceedingly small.

FIGURE 4. Irregular Exit for Autocracy and Democracy under Low and High Precipitation.



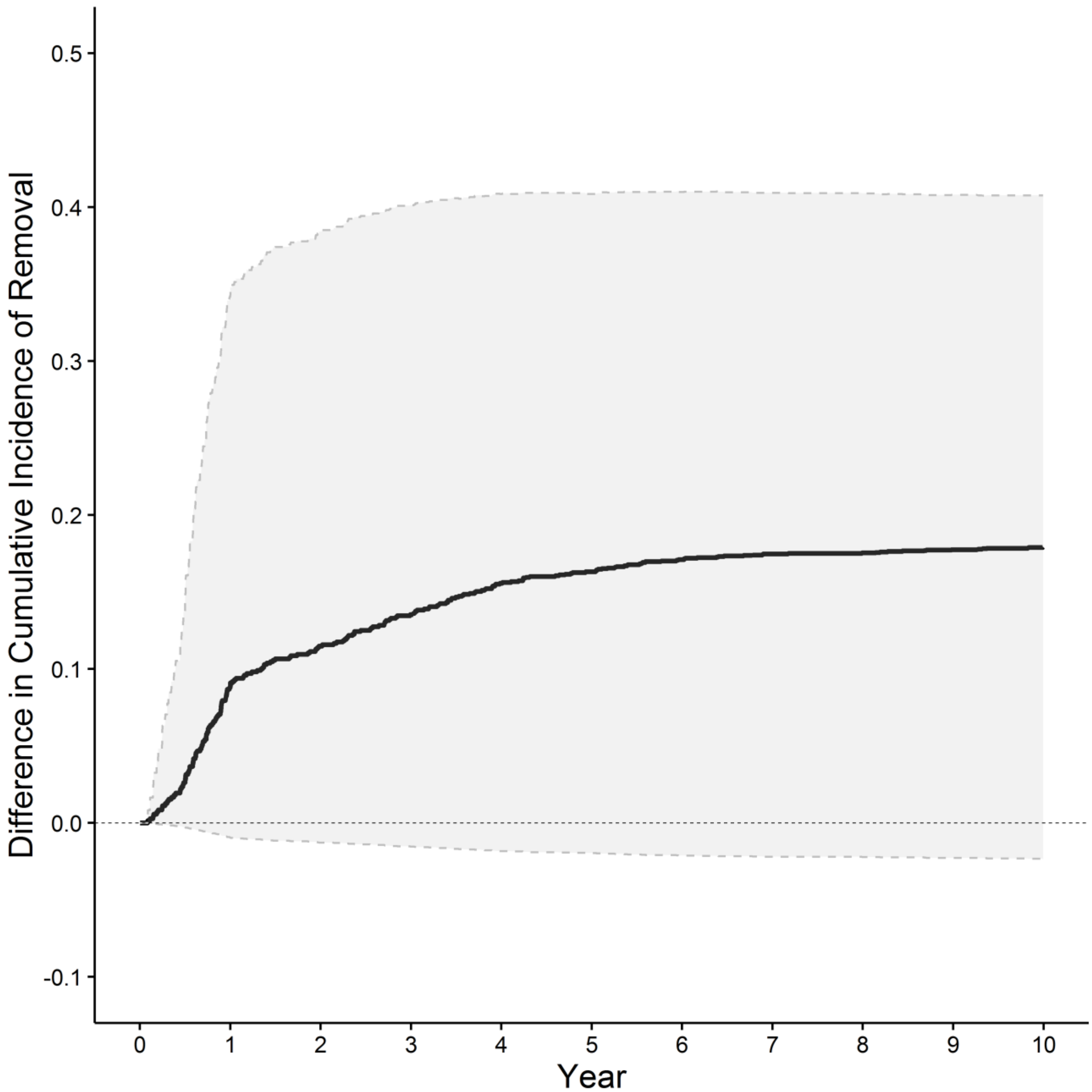
Note: The figure is based on Table 3 – Model 3.

Despite remarkably large effect sizes for autocratic leaders, there is too much uncertainty to recover these effects at standard levels of statistical significance. Figure 5 plots the difference in the cumulative incidence of irregular removal with and without flooding. The 95 percent confidence band contains the origin throughout (the effect is significant roughly at the 10 percent level). The reason for this uncertainty is likely the relative scarcity of irregular removal from office for autocrats. Of 1506 leaders in the analysis, only 252 were removed in an irregular manner (compared to 1094 who lost office in other ways). Only 134 of these where autocrats (polity $\leq$ 5). Since flooding is just one of many potential causes that can lead to leader removal, this is a very small sample. Given this shortcoming it is quite remarkable that we are in fact able to recover a large effect of flooding on irregular exit, albeit at a low level of statistical significance.

[Figure 5 about here]

In the discussion so far, we dichotomized the difference between democratic and non-democratic leaders. In Figures 6 and 7 we summarize the substantive effects of flooding across the entire range of the polity variable and for both types of exit. As before, effect sizes are based on calculating the difference in the cumulative incidence of removal from office comparing the 5th and 95th percentiles of the precipitation variable.

FIGURE 5. Difference in the cumulative incidence of irregular exit for non-democracies with and without precipitation.



Note: Shaded regions represent 95% confidence intervals.

Looking at irregular exit first (Figure 6), we observe that precipitation has a substantial effect only for leaders in countries with the lowest polity scores (up to 19 percentage points for fully autocratic leaders). For countries in the conceptual gray area between full autocracy and full democracy (Polity scores between 5 and 15, sometimes called anocracies), flooding has no discernable effect. In full democracies, the substantive effect of flooding is small but negative, meaning that precipitation actually reduces the probability irregular removal from office. However, in line with our discussion above, the point estimates fail to reach the 5 percent level of statistical significance throughout the range of the polity variable, thus providing only modest evidence for these effects.

[Figure 6 about here]

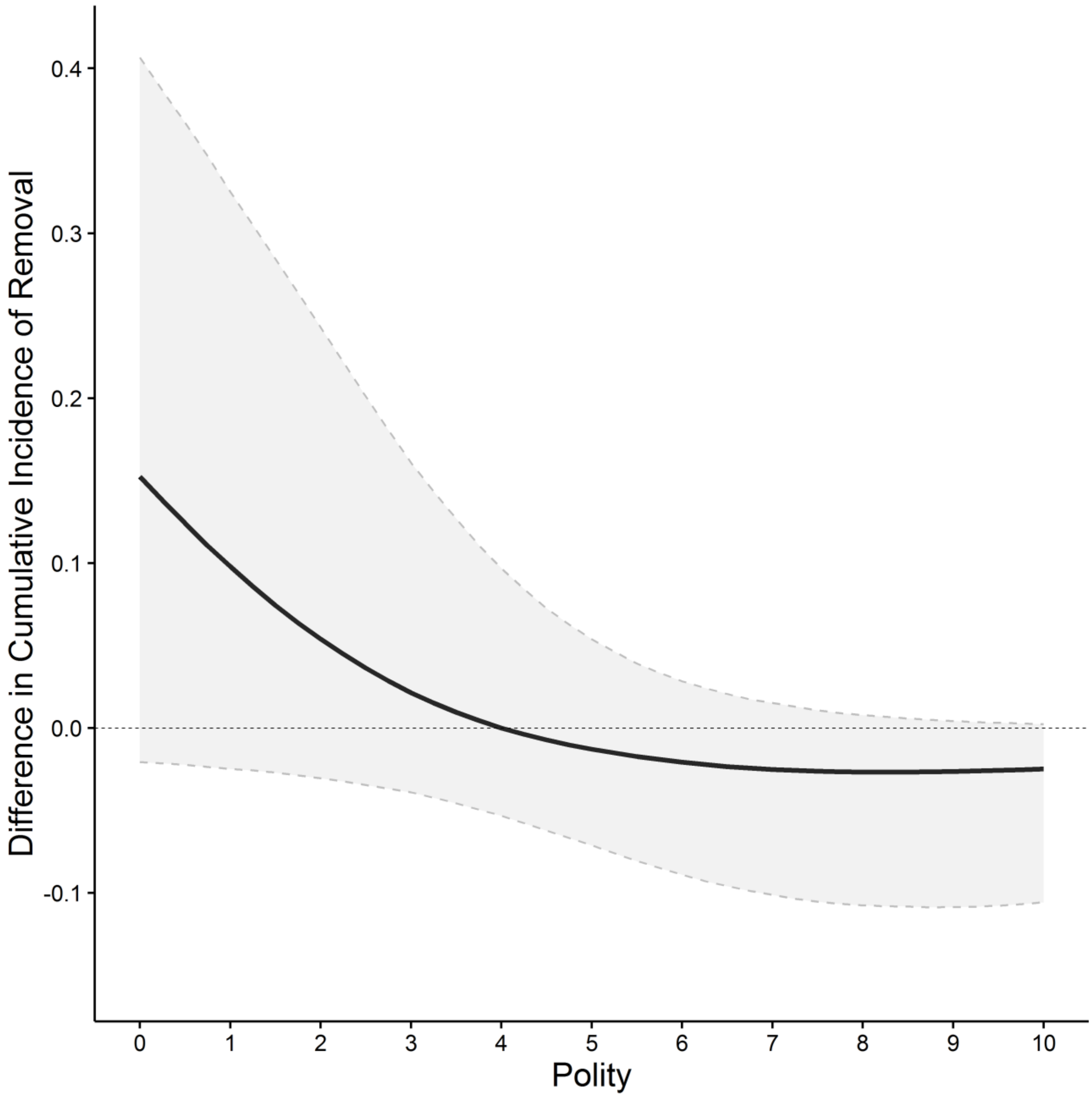
In marked contrast, flooding has a substantive and statistically significant effect on regular removal from office across a large part of the polity range, including full autocracies and anocracies (Figure 7). Only the political survival of fully democratic rulers is not affected by flooding in a statistically discernable manner. Autocracies experience the largest effects, with precipitation increasing the risk of losing office by about 12 percentage points.

[Figure 7 about here]

DISCUSSION

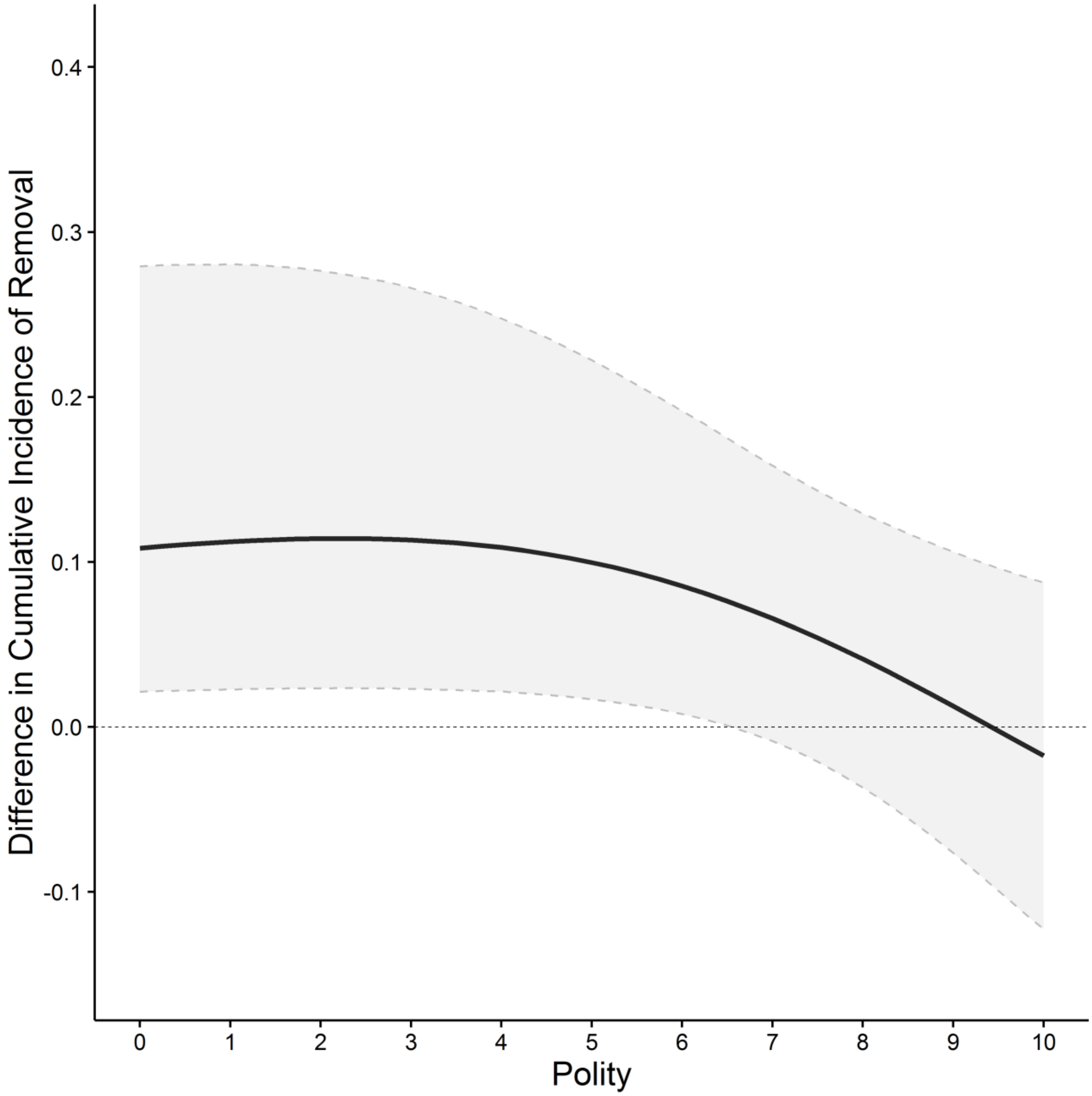
In this paper, we examined the political feedback from drought and precipitation flooding on leader survival. We find that flooding increases the risk of losing office for authoritarian—but not democratic—leaders. However, the effect is statistically significant only for the regular type of political exit. Irregular exit also appears to be more likely due to flooding precipitation but the coefficient is not statistically significant given the relatively small number of relevant cases.

FIGURE 6. Difference in the cumulative incidence of irregular exit with and without precipitation after four years in the office.



Note: Shaded regions represent 95% confidence intervals.

FIGURE 7. Difference in the cumulative incidence of regular exit with and without precipitation after four years in the office.



Note: Shaded regions represent 95% confidence intervals.

Unlike the effect of flooding precipitation, the effect of drought is insignificant across a variety of statistical models that we examined (although the coefficient is consistently positive). One possible explanation for this is that drought unfolds over long time periods, and it is difficult to predict at which point the consequences are severe enough for citizens to start blaming the government. It is also possible that the effects of drought are too diffuse, both in time and in space, to elicit a more forceful political reaction. Future research could usefully look at sub-national variation in political sentiment to relate drought to waning of political support for the incumbent government.

This differential effect of flooding, depending on the regime type, has potentially important implications for the future study of reactions to climate change and political pressures for adaptation. As first step to understanding these, how do we explain the greater effect of flooding on autocratic leaders? Since we control for wealth in our analysis, the democracy variable does not simply proxy for development and state capacity. In fact, unlike the political regime variable (Polity), the GDP per capita does not have a significant interaction with climate impacts when predicting political exit.

As regular leader turnover in democracies often implies a political realignment and a change of the winning coalition, democratic leaders might face greater incentives to avoid even comparatively small political risks associated with flooding. This is in line with the existing evidence that democracies have a greater interest in disaster preparedness and suggests more successful efforts to adapt to the challenges of climate change.

For the regular exit in a non-democratic regime, one possible interpretation of the finding is that some autocratic leaders attempt to anticipate pressures for irregular removal in the wake of catastrophe and try to thwart such negative political consequences. Using regular provisions of the existing institutional structure to change leadership in the face of popular pressures might be a preferable route than political upheaval that carries the risk of irregular removal from office. In autocratic regimes leader change by regular institutional venues mostly means that power remains in the hands of an inner governing circle (the `winning coalition' (Bueno de Mesquita et al., 2003)), whereas the figure head of government is exchanged. Leader change therefore might be a viable option that can help preserve the regime in power despite popular pressures. Prior research (Flores & Smith, 2013) argued that non-democratic governments invest less in disaster prevention because they are less sensitive to the political costs of high human casualty numbers. Our findings suggest that preparation might also be lacking because political pressures from flooding are effectively dealt with by changes in leadership, keeping existing institutional structures untouched.

From a policy perspective, our results are important because precipitation flooding is expected to increase in the 21st century under *both* optimistic and pessimistic climate scenarios; certainly more so under the business-as-usual path leading to abrupt climate change (Dankers et al., 2014; Hirabayashi & Kanae, 2009; Hirabayashi et al., 2013; IPCC, 2013; Kleinen & Petschel-Held, 2007). An increase in the incidence and severity of flooding will put greater pressures on leaders in democratic nations to find adaptation strategies or risk losing power. Even more dramatic will be the impact of floods on autocratic leaders. Our model predicts high leader turnover, but the consequences of this for the stability of autocratic regimes are hard to predict. It is possible that under greater stress the ability to vent political pressures through regular leader exchanges diminishes, and political instability results.

APPENDIX

TABLE A1. Regular Political Exit and Historical Climate Impacts (1950 - 2010), No Annual Lag Models

	(1)	(2)	(3)	(4)
Drought (12 months)	0.09124	0.07151	0.09033	0.06821
	(0.10096)	(0.10014)	(0.10102)	(0.10020)
Precipitation (monthly mean)	0.00110**		0.00225	
	(0.00053)		(0.00155)	
Precipitation (monthly max)		0.00029		0.00113*
		(0.00027)		(0.00068)
Precipitation (monthly mean)			-0.00007	
x Polity			(0.00009)	
Precipitation (monthly max)				-0.00006
x Polity				(0.00004)
Polity	0.09337***	0.09384***	0.10079***	0.10694***
	(0.00815)	(0.00811)	(0.01215)	(0.01230)
Log Population	0.08095***	0.08072***	0.08101***	0.08071***
	(0.02914)	(0.02930)	(0.02909)	(0.02925)
Log GDP per capita	0.11011***	0.10812***	0.10915***	0.10317***
	(0.03458)	(0.03557)	(0.03464)	(0.03567)
Log Territory (grid cells)	-0.05296**	-0.05397**	-0.05291**	-0.05509**
	(0.02351)	(0.02462)	(0.02348)	(0.02464)
Leader’s Age (years)	0.01282***	0.01265***	0.01283***	0.01284***
	(0.00326)	(0.00326)	(0.00326)	(0.00327)
Observations	8,017	8,017	8,017	8,017
Subjects	1,506	1,506	1,506	1,506
Failed	991	991	991	991
Competing	355	355	355	355
Censored	160	160	160	160

Note: Competing-risks regression with robust standard errors in parentheses (adjusted for 1495 clusters in leader id); *** p < 0.01, ** p < 0.05, * p < 0.1.

TABLE A2. Irregular Political Exit and Historical Climate Impacts (1950 - 2010), Annual Lag Models				
	(1)	(2)	(3)	(4)
Drought (12 months)	0.11987	0.10774	0.12853	0.10832
	(0.17854)	(0.17723)	(0.17920)	(0.17747)
Precipitation (lag, monthly mean)	0.00013		0.00238	
	(0.00110)		(0.00167)	
Precipitation (lag, monthly max)		-0.00016		0.00012
		(0.00051)		(0.00069)
Precipitation (lag, monthly mean) x Polity			-0.00031*	
			(0.00017)	
Precipitation (lag, monthly max) x Polity				-0.00004
				(0.00007)
Polity	-0.12671***	-0.12630***	-0.09476***	-0.11577***
	(0.01151)	(0.01133)	(0.02020)	(0.02026)
Log Population	-0.07009	-0.06965	-0.06716	-0.06785
	(0.05734)	(0.05752)	(0.05732)	(0.05795)
Log GDP per capita	-0.45341***	-0.45879***	-0.46262***	-0.46538***
	(0.06254)	(0.06382)	(0.06364)	(0.06542)
Log Territory (grid cells)	0.04442	0.03508	0.04971	0.03554
	(0.05708)	(0.05882)	(0.05713)	(0.05879)
Leader's Age (years)	0.01778***	0.01801***	0.01743***	0.01812***
	(0.00622)	(0.00624)	(0.00621)	(0.00624)
Observations	7,967	7,967	7,967	7,967
Subjects	1,495	1,495	1,495	1,495
Failed	251	251	251	251
Competing	1,084	1,084	1,084	1,084
Censored	160	160	160	160

Note: Competing-risks regression with robust standard errors in parentheses (adjusted for 1495 clusters in leader id); *** p < 0.01, ** p < 0.05, * p < 0.1.

TABLE A3. Interactions: Precipitation and GDP per Capita

	Regular Exit				Irregular Exit			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Drought (12 months)	0.0843 (0.1016)	0.0738 (0.1016)	0.0939 (0.1009)	0.0738 (0.1000)	0.1199 (0.1785)	0.1089 (0.1771)	0.1233 (0.1785)	0.1098 (0.1777)
Log GDPPC	0.1049* (0.0613)	0.1392** (0.0583)	0.0573 (0.0615)	0.0775 (0.0576)	-0.5065*** (0.1067)	-0.5294*** (0.1089)	-0.5017*** (0.1058)	-0.5295*** (0.1080)
Precipitation (mean, lag)	0.0010 (0.0010)				-0.0003 (0.0013)			
Precipitation (mean, lag) x Log GDPPC	0.0000 (0.0005)				0.0006 (0.0009)			
Precipitation (max, lag)		0.0006 (0.0004)				-0.0004 (0.0006)		
Precipitation (max, lag) x Log GDPPC		-0.0001 (0.0002)				0.0003 (0.0004)		
Precipitation (mean, no lag)			0.0002 (0.0010)				-0.0001 (0.0013)	
Precipitation (mean, no lag) x Log GDPPC			0.0005 (0.0005)				0.0006 (0.0009)	
Precipitation (max, no lag)				0.0001 (0.0004)				-0.0004 (0.0006)
Precipitation (max, no lag) x Log GDPPC				0.0001 (0.0002)				0.0003 (0.0004)
Polity	0.0938*** (0.0082)	0.0940*** (0.0082)	0.0936*** (0.0082)	0.0941*** (0.0081)	-0.1267*** (0.0115)	-0.1257*** (0.0114)	-0.1272*** (0.0115)	-0.1260*** (0.0114)
Log Population	0.0778*** (0.0293)	0.0764*** (0.0295)	0.0797*** (0.0292)	0.0806*** (0.0293)	-0.0682 (0.0575)	-0.0676 (0.0577)	-0.0675 (0.0574)	-0.0668 (0.0575)
Log Territory (grid cells)	-0.0511** (0.0237)	-0.0494** (0.0249)	-0.0510** (0.0236)	-0.0525** (0.0247)	0.0406 (0.0578)	0.0333 (0.0591)	0.0418 (0.0576)	0.0312 (0.0584)
Leader’s Age (years)	0.0132*** (0.0033)	0.0131*** (0.0033)	0.0129*** (0.0033)	0.0126*** (0.0033)	0.0179*** (0.0062)	0.0181*** (0.0063)	0.0175*** (0.0062)	0.0177*** (0.0063)
Observations	7,967	7,967	8,017	8,017	7,967	7,967	8,017	8,017
Subjects	1,495	1,495	1,506	1,506	1,495	1,495	1506	1506
Failed	981	981	991	991	251	251	252	252
Competing	354	354	355	355	1,084	1,084	1094	1094
Censored	160	160	160	160	160	160	160	160

Note: Competing-risks regression with robust standard errors in parentheses (adjusted for 1495 clusters in leader id); *** p < 0.01, ** p < 0.05, * p < 0.1.

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