Climate Bones of Contention:
How Climate Variability Influences Territorial, Maritime, and River Interstate Conflicts

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Abstract: Conflict scholars examine the relationship between climate variability and conflict onset, with an emphasis on connections between precipitation and temperature shifts/shocks and intrastate violence. While empirical findings in this literature are mixed, we know less about how climate changes increase the risks for *interstate conflicts* between countries. This paper studies climate variability using the issue approach to world politics, connecting deviations and volatility in temperature and precipitation to the onset and militarization of diplomatic conflicts involving territorial, maritime, and river areas. We argue that climate variability increases interstate conflict risks by intensifying the salience and uncertainty of contested geopolitical areas. Analyses of issue claims in the Western Hemisphere and Europe (1901-2001) show that greater deviations and volatility in climate conditions increases risks for new diplomatic conflicts and militarization of ongoing issues and that chances for issue conflict are greatest for revisionist states (challengers). We confirm prior results that identify volatility in climate conditions as potentially dangerous steps to war.

A 2014 report from the Intergovernmental Panel on Climate Change (IPCC) identifies a variety of climate changes that will continue in the next century such as increases in land and ocean surface temperatures, greenhouse emissions, and weather and climate related disasters. Climate change will affect the quantity and variability of available freshwater, agricultural productivity, the frequency of natural disasters, coastal erosion, the seasonality of water runoff, land degradation, and countries' territorial and water borders (Hendrix and Glaser 2007; Busby 2008; Bauer 2011; Bernauer and Siegfried 2012).[1] These environmental shocks pose many risks to human and state security by increasing water scarcity, creating more environmental migrants and refugees, harming economic productivity, and raising risks for intrastate and interstate conflicts. While many scholarly studies seek to understand the relationship between natural disasters, climate changes, and *intrastate* violence (e.g. Burke et al 2008; Buhaug 2010), we know less about the connections between climate variability and *interstate* conflicts over land and water resources. Most interstate conflict research on this topic focuses on how climate change affects militarized interstate disputes in general (e.g. Stalley 2003; Gartzke 2012) or how shared water resources influence the risks for interstate conflict (e.g. Toset et al 2000; Hensel, Mitchell and

[1] *Climate change* involves long term changes in "mean conditions", such as increases in global temperatures, changes in annual precipitation, or rising sea levels, as well as changes in the intensity or frequency of natural disasters (e.g. floods, droughts, storms, heatwaves) (Barnett & Adger 2007: 640). *Climate variability* (Theisen 2019; Koubi 2019) captures short-term deviations of weather patterns from their long run means, with larger values indicating larger shocks (e.g. floods, droughts, heat waves).

Sowers 2006; Brochmann and Hensel 2009; Brochmann and Gleditsch 2012; Devlin and Hendrix 2014).

However, climate variability can be connected more explicitly to diplomatic issue claims involving territorial, maritime, and river areas given that the effects of climate shocks influence the salience and uncertainty of resource control for contested issues (e.g. water quantity/quality, fisheries stocks, agricultural viability of land). Issue scholars have shown that diplomatic issues higher in salience are more likely to experience militarized disputes and interstate wars (Hensel et al 2008), although the effects of climate variability have been mostly ignored in this literature. This paper considers whether climate variability in weather patterns influences interstate conflict using data from the Issue Correlates of War (ICOW) Project (Hensel et al 2008; Hensel and Mitchell 2017).[2]

We examine whether climate variability influences the onset and militarization of interstate diplomatic conflicts and whether those effects are similar across issues that involve sovereignty claims for land (territory) or water (maritime, river).[3] We focus on two theoretical mechanisms: *scarcity* (abundance) and *uncertainty* and we measure these concepts empirically through climate *deviation* (e.g. droughts/floods, heat waves/cold spells) and climate *volatility* (greater short-term variance in precipitation/temperature). We start with a set of dyads that could experience diplomatic conflicts (politically relevant dyads) and determine if deviations and volatility in climate variables increase the propensity for new diplomatic conflicts over land or water issues. For issue claims that occur, we also determine if precipitation and temperature deviations alter states' foreign policy decisions to militarize claims.

[2] For information about the ICOW project, see http://www.paulhensel.org/icow.html.
[3] The ICOW project has also collected data on identity claims, which could be affected differently by climate variability because they are high on intangible salience but low on tangible salience (Hensel and Mitchell 2017).

The topic is highly relevant because climate variability has increased over time. Figure 1A and 1B present systemic changes in climate conditions between 1900 and 2016.[4] We see that average temperatures and precipitation levels have increased, especially since 1960, and that countries are experiencing larger deviations from their long run means in more recent decades, especially for temperature. While scholars have shown that long run increases in global temperatures may be associated with fewer interstate conflicts (Gartzke 2012), we have less evidence about how climate variability influences conflict dynamics at a local, dyadic level. We illustrate our theoretical logic with diplomatic conflicts between Bolivia and Chile over the Mauri and Lauca rivers, showing that diplomatic and militarized interactions increased when these states experienced greater deviations from long-term precipitation means.

More generally, our analyses of issue claims in the Western Hemisphere and Europe (1900-2001) show that greater deviations and volatility in climate conditions increase risks for new diplomatic conflicts and that the risks of conflict are greatest for revisionist states (challengers). Our study makes several contributions to the existing literature on climate variability and conflict. First, we go beyond previous interstate studies that focus on higher levels of military engagement by also considering how diplomatic interactions at lower levels of hostility are influenced by climate variability. Second, our connection of climate issues and the issue approach to world politics allows us to think about scarcity and uncertainty through a new theoretical lens. Third, we show how precipitation and temperature deviations influence diplomatic issues collectively or separately. While the river literature has examined climate conditions, our results suggest that climate variability influences territorial and maritime issues also. Given that territorial issues are the most escalatory of all diplomatic issues, this is a

[4] This time series aggregates states' data on precipitation and temperatures collected by the Climate Research Unit at the University of East Anglia (2019).

potential concern for states' future security. Finally, by looking at challenger and target states in diplomatic exchanges more carefully, our study helps us understand whether climate variables are factors that push states into revisionist positions and whether challengers are more strongly affected by climate changes than targets.

Literature review

Conflict scholars examine how climate change and climate variability influence the risks for interstate and intrastate wars.[5] Global warming over the past few centuries has been associated with the decline of interstate warfare, reflecting the economic efficiencies that globalization creates relative to territorial conquest (Zhang et al 2006, 2007; Tol and Wagner 2010; Gartzke 2012). On the other hand, long-term changes in population and natural resources can spark interstate conflict as predicted by lateral pressure theorists (Choucri and North 1975). Dyadic studies show enhanced interstate conflict risks with greater population density (Stalley 2003) and higher water scarcity (Hensel et al 2006; Brochmann and Hensel 2009; Dinar 2009; Devlin and Hendrix 2014).[6] Social unrest (e.g. food riots) is negatively associated with long-term increases in average temperature, although the effects change over time through adaptation (De Juan and Wegenast 2019). Overall, the literature suggests a negative relationship between long-term climate change and conflict.

Other work focuses instead on how short-term climate variability influences the likelihood of conflict. Short-term climate triggers (e.g. droughts, floods, heatwaves) are

[5] For reviews of this literature, see Barnett and Adger (2007), Nordas and Gleditsch (2007), Salehyan (2008), Bernauer (2013), Theisen et al (2013), Burke et al (2015), Sakaguchi et al (2017), Theisen (2017), and Koubi (2019).
[6] However, river treaties with high levels of institutionalization can mitigate the risks caused by increased water scarcity (Tir and Stinnett 2012)

measured with deviations from panel specific precipitation or temperature means. Some studies find that climate variability increases intrastate conflict risks (Miguel et al 2004; Burke et al 2009, 2015; O'Loughlin et al 2012; Landis 2014; van Weezel 2019), while others find little to no relationship between short-term climate changes and armed conflict (Hendrix and Glaser 2007; Buhaug 2010; Theisen et al 2011; Koubi et al 2012; Klompe and Bulte 2013; Couttenier and Soubeyran 2014; Wischnath and Buhaug 2014). Curvilinear patterns also emerge with conflict occurring more often with floods or droughts than average rainfall (Hendrix and Salehyan 2012). Analyses of interstate conflicts suggest that militarized disputes are more likely for dyads experiencing increased volatility in precipitation or temperature (Devlin and Hendrix 2014). The disparate findings in this field depend greatly on methodological choices, temporal spans, and geographic units of analysis (Sakaguchi et al 2017; Koubi 2019).

Several causal mechanisms have been posited in the climate-conflict literature, but we focus on three related to our theory: agricultural productivity, seasonality, and water/resource scarcity.[7] *First*, climate variability can be a threat multiplier for violence by producing agricultural shocks that alter individuals' relative deprivation and opportunity costs for fighting (Theisen 2017: 211). Short term shocks in rainfall or temperatures can significantly reduce agricultural output and farmers' incomes (Zhang et al 2011), making it easier for rebel groups to recruit (Miguel et al 2004). A sudden decline in agricultural production also diminishes the government's ability to provide public goods (e.g. crop insurance) due to reduced tax revenues, increasing relative deprivation in society (Raleigh 2010; Devlin and Hendrix 2014; Nardulli et al. 2015). Countries more dependent on agricultural production face greater conflict risks in

[7] Other mechanisms that figure prominently in the civil war literature include state capacity (Detges 2016; Jones et al 2017), economic growth (e.g. Miguel et al 2004; Devit and Tol 2012; Koubi et al 2012; Raleigh et al 2014; Seter 2016) and migration (e.g. Barnett and Adger 2007; Bauer 2011; Caruso et al 2016).

response to climate shocks (Uexkull et al 2016). More broadly, climate variability generates uncertainty for land property rights (Gartzke 2012) and increases new claims to territory as environmental changes turn productive farmland into deserts and harm fishing and farming through intensified salinization of water supplies. Threats to agricultural production generate resource scarcities that encourage states to look outside their territories for additional land and resources.

Second, climate variability also influences seasonality conditions which can negatively impact water flows and agricultural growing seasons (Bernaeur and Siegfried 2012). Shifts in growing seasons and crop production influence the ability of insurgent groups to recruit fighters (Landis 2014). Climate change also increases the rate of glacial and snowpack melting which reduces water supplies during summer seasons and increases tensions in transnational river basins (Tir and Stinnett 2012). Seasonality changes generate more uncertainty about future water supplies for agriculture and fishing and thus create more property rights conflicts.

Finally, climate volatility influences the supply of important natural resources such as freshwater and raises uncertainty about future resource stocks (Homer-Dixon 1991; Gleick 1993; Hendrix and Glaser 2007; Raleigh and Urdal 2007). Militarized conflict is more likely in river basins as water scarcity increases (Brochmann and Hensel 2009), partly because climate variability makes it difficult for states to comply with the terms of river treaties (De Stefano et al 2012). The empirical and theoretical connections between climate change, climate variability, and conflict are well developed in the *intrastate conflict* literature, but we know less about the conditions under which climate factors make *interstate conflict* more likely. Our theory fills this gap by building upon the issue approach to world politics and connecting this general theory to climate variability through the mechanisms of scarcity (abundance) and uncertainty.

The issue approach and climate variability

International relations scholars often assume that conflict begins for a reason such as contestation of shared land borders, competition over important resources like oil, or the removal of other states' leaders. Yet many conventional theories of interstate warfare fail to consider how the issues at stake influence the onset and escalation of violence. The issue approach to world politics fills this lacunae by arguing that foreign policy is issue directed, that cooperative and conflictual foreign policy tools are substitutable means for issue-related ends, and that actors' preferences over such foreign policy options are driven by the salience that states attach to issues (Mansbach and Vasquez 1981; Diehl 1992; Hensel 2001; Hensel et al 2008). Issue scholars classify the *tangible* and *intangible* aspects of *issue salience* in diplomatic conflicts[8] and use this information to understand the onset of diplomatic claims and escalation of claims to militarized conflict. Issues that have high levels of intangible salience, such as territorial disputes involving sacred sites or historical homelands, are more likely to be settled through war than issues that involve mostly tangible stakes, such as fishing rights in EEZ areas or water quantity rights in cross-border rivers (Hensel and Mitchell 2005). However, higher values for both dimensions of issue salience are associated with more frequent militarized conflicts.[9] Many of China's maritime

[8] Hensel et al. (2008) present a typology of contentious issues identifying issues that typically have high or low values for tangible salience, based on tangible values of security, survival, and wealth, and for intangible salience, based on intangible values of culture/identity, equality/justice, independence, and status/prestige/influence. Territorial issues can involve both types of salience because land contains valuable resources and because historical claims or sacred sites increase the intangible value of the contested areas. Maritime and cross-border river claims are valued primarily for tangible salience such as fish, oil, and hydroelectric power generation. States less frequently attach psychological or historically significant attachments to maritime spaces or rivers. Identity claims have high intangible salience and low tangible salience.

[9] The ICOW dataset collects data on four types of diplomatic issues, identifying 843 dyadic *territorial* claims, 270 *maritime* claims, 143 *river* claims, and 157 *identity* claims through 2001 (Hensel and Mitchell 2017).

claims against its neighbors (e.g. Japan, Vietnam, Philippines) have high salience values and thus face high risks for militarization.

Figure 2 presents the general theoretical model for the issue approach. Stage 1 begins with an identification of dyads that could experience various types of diplomatic issue conflicts. For example, states that share land contiguous borders or cross-border rivers have more opportunities to start new diplomatic conflicts over territorial and river issues. Bolivia and Chile share a direct land border and multiple rivers (e.g. Mauri, Lauca, and Silala), thus they have potential for diplomatic conflicts over these issues. In stage 2, states with opportunities for issue claims start new diplomatic conflicts or maintain the issue status quo. States seeking to change the status quo (revisionists) are called *challengers*, while states defending the status quo are called *targets*. Chile challenged Bolivia's sovereignty claims over the Atacama Desert area starting in 1848, while Bolivia sought access to the sea and challenged Chile's territorial control of the area from 1884 on. Once an issue claim is underway, states can try to achieve their issue goals with military force, by negotiating peacefully, or by doing nothing. Chile went to war with Bolivia (and Peru) in the War of the Pacific (1879-1884) and won control of the contested territory. A maritime claim also arose after the war, with Bolivia contesting Chile's control of the port of Antofagasta and cutting off its access to the sea. The issue approach hypothesizes that militarized force is used occur more often by states to achieve issue related goals if the diplomatic issues are highly salient, if states have a history of militarizing the issues previously, and if there are many failed peaceful negotiations to resolve the claim (Hensel 2001; Hensel 2008). The issue approach’s focus on diplomatic claims allows for a better understanding of theoretical factors that encourage or deter militarized settlement. In the next section, we explain how climate variability can alter these diplomatic interactions.

General Effects of Climate Change on Diplomatic Conflicts and Militarization of Issue Claims

To understand how climate variability influences interstate conflict, we focus on two broad effects: 1) *scarcity (abundance)*, or increased competition for resources, and 2) *uncertainty*, or increased ambiguity about the stock or value of future resources. Climate variability alters the issue status quo by creating uncertainty about borders and resource rights, which can prompt new diplomatic conflicts or complicate existing claims. Resource scarcity changes the salience levels of existing diplomatic claims, which increases the potential for issue militarized conflict. Challenger (revisionist) states are more strongly affected by climate changes than target states because they typically do not have sovereign control over contested resources (e.g. downstream states in river basins).

First, climate variability can intensify competition for resources by increasing resource scarcity (e.g. droughts) or creating problematic resource abundance (e.g. flooding). The quantity and quality of freshwater can be changed by higher temperatures, creating greater rates of evaporation or increased water flows from mountain glacial melting (Bauer 2011; Bernauer and Siegfried 2012). Higher than average temperatures create more rainfall and snowmelt in the winter and contribute to winter flooding and summer droughts. Regions like the Middle East experience more diplomatic and militarized conflict over river basins relative to other regions due to greater water demands and fewer water supplies, especially as populations have grown (Hensel et al 2006). Climate variability can reduce the strategic and economic value of territory, maritime areas, and cross-border rivers. For example, areas that were once sustainable for agriculture become unusable due to desertification or intense droughts or flooding. Prior to the civil war, thousands of Syrians were displaced from agricultural areas due to drought (2006-2011) and many farmers lost livestock and land. Interstate tensions between Syria and Turkey were affected by these climate deviations, with Turkey moving troops into Syria's territory to attack Kurdish populations in 2019.

Potential revisionist actors are more affected by climate changes. Downstream states (e.g. Syria, Egypt, Jordan) experience greater water scarcity on average than upstream states and their environmental security is more negatively impacted when climate deviations occur. States experiencing a loss of productive fishing grounds in their coastal areas have incentives to take other states' resources. Thus, we may see more diplomatic conflicts between countries and the use of military force to defend issue goals if climate changes increase resource scarcity (abundance) for some states. Climate shocks can motivate states to contest the ownership of areas that are not experiencing this reduction in strategic value. If part of a state's territory becomes a desert, for example, it could see benefits in territorial conquest of neighboring areas that are more suitable for agriculture. Warmer temperatures and droughts exacerbate the problems of desertification by degrading the quality and quantity of soil and making it more difficult for dry land to return to productive farmland.

For an example of how climate variability influences the onset of diplomatic conflict through the mechanism of scarcity, consider the plot of Bolivia and Chile's precipitation deviation levels from 1901-1940 in Figure 3.[10] Bolivia initiated a diplomatic conflict against Chile in June 1921 protesting Chile's decision to divert water from the Mauri river through a contract with a local company that would use the water for irrigation. Eighteen years later, Bolivia protested Chile's decision to divert water from the Lauca river into the Rio Azapa valley. Prior to both claims, Bolivia experienced declining precipitation levels in water supplies. These short-term climate deviations reduced Bolivia's overall water scarcity, encouraging the country

[10] These values capture standardized deviations from each country's mean precipitation over the 1901-2001 time period.

to press its water quantity claims against Chile. In 1962, Bolivia cut off diplomatic relations with Chile and asked the Organization of American States to intervene in the claim, arguing that diverting water was an act of aggression (Tomasek 1967). The value of issue salience increased over time in the Lauca claim for Bolivia, as it came to see the water scarcity issue as more important to its national security. Based on the issue approach, such an increase in issue salience increases the probability of militarization. This case illustrates the expectations of our first hypothesis.

Hypothesis 1 (Scarcity (Abundance)): As temperature or precipitation deviations increase, interstate issue claims are more likely to be initiated and to be militarized.

Second, climate change can increase interstate conflict risks by increasing *uncertainty* about future resource stocks, especially when climate changes are highly volatile. "Climate change will likely affect levels of precipitation, with some countries growing more arid and others wetter. However, climate change will also result in increasing climactic variability: more frequent dry spells and flooding, more erratic rainfall patterns, and larger year-to-year variability in precipitation levels" (Devlin and Hendrix 2014: 28). A country could experience several years of general drought (deviation), but also experience more volatility in those years with greater winter floods and summer droughts compared to other drought-stricken states. Larger deviations from long term climate averages (e.g. a severe drought) and increased variance of short-term weather patterns (e.g. much higher and much lower average temperatures in the same year) create uncertainty in interstate relationships by altering the feasibility of status quo agreements and raising the stakes of contested issues. Agreements governing shared resources are more difficult to strike and maintain in times of climate uncertainty (Devlin and Hendrix 2014: 30) and few existing treaties include stipulations for variability management for droughts or floods (DeStefano et al 2012). Greater volatility in climate conditions also increases the salience of contested resources, as states secure control of resources to help minimize future drought situations. "Rapid change can lead to uncertainty about property rights or the disposition of resources, which in turn can lead to conflict" (Gartzke 2012: 180). We expect that diplomatic and militarized conflict is more likely when states experience greater volatility in mean temperatures/precipitation.

For an example of how climate variability influenced the onset of diplomatic conflict through the mechanism of uncertainty, consider Figure 3 and the plot of Bolivia and Chile's precipitation deviation levels from 1981-2001 in Figure 4. Bolivia experienced larger variance in its precipitation deviations prior to initiating a river claim against Chile in 1939 (Lauca River). Chile also experienced greater variance in precipitation deviations prior to initiating a river claim against Bolivia in December 1999.[11] Bolivia began to accept bids for water rights in the Silala river, which Chile claimed was an international river (and thus not under Bolivia's control). This followed Bolivia's implementation of tighter border controls and a new military outpost along the river in response to its perception that Chile was trying to divert water from the Silala. As both countries began to experience greater volatility in water supplies, they pressed diplomatic claims over shared river waters more intensely. Our general expectation is that we should observe a U-shaped relationship between climate volatility and interstate conflict given that large short-term shifts in precipitation or temperature can generate uncertainty.

Hypothesis 2 (Uncertainty): Higher volatility in temperature and precipitation deviations increases chances for interstate issue claim initiation and issue claim militarization.

Issue Specific Expectations for Climate Change

[11] Monthly variance for Chile's rainfall, for example, was much more volatile in the years close to 1999 compared to the variance in previous decades. Chile was experiencing some months with lots of rain and other months with very little rain and these patterns were more variable than in the past.

While we expect climate changes to influence all diplomatic interactions through the scarcity and uncertainty mechanisms, we also recognize that the mechanisms connecting climate variability and conflict may vary across diplomatic issues. In this section, we describe how climate variability influences territorial, maritime, and river issues distinctly.

First, sovereignty claims over territory can be influenced by climate change. Resource stocks and agricultural productivity of land can change because of global warming (e.g. desertification), which could lead to more revisionist behavior with respect to neighboring states' territories. Busby (2008: 477) notes that climate change creates direct homeland threats by altering the territorial border or waters of a country and by increasing transnational threats. Gartzke (2012) argues that rapid climate change increases uncertainty about property rights, which could lead declining powers to be more territorially revisionist. Guo's (2007) survey of more than 200 disputed areas since World War II finds support for this type of hostile lateral pressure, as resource scarcity at home prompts many states to make claims to neighboring states' territories. Precipitation changes can also change the course of rivers that may form the border between two countries, prompting the need for renegotiation of the boundary.

Second, river claims are also more likely to occur in the face of climate changes, something that pundits decades ago warned about when discussing the potential for water wars (Cooley 1984). Most militarized disputes that have occurred over river claims have taken place in the most water scarce region of the world, the Middle East (Hensel et al 2006). Increasing global temperatures affect water evaporation and rainfall patterns, altering water quantity and water quality in river basins (Bauer 2011). Many major river basins in the world are facing 25 to 50 percent reductions in average water flows by mid-century, creating serious water scarcity problems in the future (Eckstein 2009). States recognize these potential risks for future water scarcity when designing variability management clauses in river treaties (DeStefano et al 2012). Uncertainty in future water supplies increases the salience of river basins and can lead to revisionist behavior if future river flow variability starts to go beyond the bounds of existing models (Dinar el al 2015). A country like Egypt, for example, which is projected to face major water shortages in cities like Cairo in the future, may convert its behavior of verbal threats of force towards states on the Nile (e.g. Ethiopia) to militarized actions as uncertainty about its future water supplies grows. The river literature identifies a curvilinear relationship between water scarcity and cooperation (Dinar 2009), which implies that climate induced river conflict is most likely at very high or very low precipitation values. This fits with our second hypothesis about greater volatility making diplomatic and militarized conflict more likely.

Finally, maritime claims could also be influenced by climate change and variability. Warmer oceans increase scarcities in many fisheries stocks by changing migration patterns, increasing fish morality rates, and changing water acidity levels (Sumaila et al 2011). The issue approach shows that migratory fish stocks are the leading cause of militarized disputes for maritime claims (Nemeth et al 2014), thus climate changes exacerbate these risks. Increasing global temperatures are also making some areas of the ocean more accessible (e.g. Arctic, Northern Sea Route), which could create new diplomatic conflicts between states. Rising sea levels and increased coastal erosion will also have detrimental effects on existing baselines for maritime boundaries. This occurs because maritime baselines are "ambulatory" such that "if the baseline moves, the boundary moves" (Caron 2009: 9). Maritime claims around islands are much larger than claims around rocks[12] and rising sea levels will turn many islands into rocks. If an

[12] Article 121 of UNCLOS defines an island as a naturally formed area of land that is surrounded by water and above water at high tide, while a rock is a natural feature that is submerged under water at times and unable to sustain habitation or economic life (Schofield 2009, 23).

island had no maritime neighbors within 400nm, this could generate up to a 125,664nm^2 EEZ area; if the island were designated as a rock, EEZ claims around it would amount to only 452nm^2 (Schofield 2009). Some countries (e.g. Japan) spend a great deal of money to fortify "rocks" (e.g. Okinotorishima reef) with steel and concrete to help prevent further erosion and solidify EEZ claims around their "islands". Climate change creates uncertainties for maritime boundaries and could lead states to question the "fairness of past delimitation agreements with neighboring states" (Caron 2009: 13). Some island states could face existential threats as sea levels rise. Climate variability should have general effects on interstate conflict patterns, but the mechanisms by which it produces diplomatic conflicts may vary across issues.

Research design

We test our hypotheses by employing models of issue claim onset and militarization in the Western Hemisphere and Europe.[13] Given the temporal domain of the climate variables, we analyze ICOW diplomatic claims that occurred between 1901 and 2001. We utilize politically relevant directed-dyad years as the unit of analysis for the claim onset model because these pairs of states have the highest opportunities to make these issue claims (Figure 2).[14] Politically relevant dyads are defined as dyads that are either contiguous (through a land border or a water border up to 400 miles) or contain at least one major power.[15] We employ directed-dyads in order to give both dyadic partners the potential to initiate a claim as well as be targeted in a claim. We use the challenger vs. target distinction as coded by ICOW, but we allow each state in

[13] We selected regions for which territorial, maritime, and river claims are completely coded by ICOW. We also added Middle East river claims to our analyses given that it is the most water scarce freshwater region and our results are similar. Future analyses will expand our data to other regions covered by ICOW.
[14] We also replicate existing studies that use more specific opportunity selection rules such as states sharing river basins, coastal states in the same regions, or states sharing land borders. These results are discussed in the analysis section and included in the Appendix.
[15] Major powers are identified by the Correlates of War project; see http://www.correlatesofwar.org/data-sets/state-system-membership.

the opportunity group to be a potential challenger and a potential target. For the Western Hemisphere and Europe, these coding rules create 68,708 total observations for the issue onset model. To examine the conditions under which issue claims militarize, we utilize ICOW issue claim dyad years as the unit of analysis. This captures every year that a diplomatic claim is ongoing (e.g. 1939-1978 for the Bolivia-Chile Lauca river claim). For the militarization model, we have 6,152 total issue claim dyad observations in the two regions we analyze.

Our dependent variables are issue claim onset and militarized settlement attempts over issue claims as coded by ICOW. First, issue claim onset captures whether any new diplomatic issue claims (territory, river, or maritime) occur in a politically relevant directed dyad year. Issue onset is coded 1 if at least one issue claim was initiated by a potential challenger in a year and 0 otherwise. There are 168 issue claim onsets (0.24%). Second, militarization captures any militarized settlement attempts over a claimed issue between a pair of states. Specifically, militarization is coded 1 if at least one militarized dispute occurred over the issue in a year and 0 otherwise (Hensel et al. 2008).[16] There are 198 MIDs (3.2%).

To capture climate variability, we utilize information collected by the Climate Research Unit (CRU) at the University of East Anglia (2019) and derived from more than 4,000 weather stations around the world.[17] First, to test our scarcity (abundance) hypothesis, we follow existing literature (Hendrix and Salehyan 2012) to capture countries' standardized deviations in precipitation and temperature from their long run averages. We subtract each yearly observation from a country's long run mean (1900-2001) and then divide by the standard deviation of the country's time series. Positive deviations suggest the country is experiencing above average

[16] ICOW considers all possible militarized interstate disputes from the COW dataset and determines if the disputes involve the contested issues in the issue claim. Only those MIDs that are directly relevant to the issue claim are included.
[17] Version 4 of the dataset, http://catalogue.ceda.ac.uk/uuid/a5fc25a8153148b9872f24ab889f64a9.

precipitation (floods) or temperature (heat waves), whereas negative deviations suggest the country is experiencing below average precipitation (droughts) or temperatures (cold spells). For example, consider the first few values for these measures for the United States and Canada in Table 1; the complete time series are plotted in Figures 5a and 5b. In 1920, precipitation in the United States was above average (.402 deviations), but temperature was below average (-1.560 deviations). Compare this to Canada in 1920, which had below average precipitation and temperatures (-1.308 and -.685, respectively). As we see in Figures 5a/5b, the use of deviations helps to standardize climate effects across countries that have different means (e.g. Canada's average temperature is much lower than the United States' average temperature). Our theory implies a U-shaped relationship, with larger positive or negative deviations in climate variables being associated with more interstate conflict. We capture this by including squared terms for the standardized climate variables.

To test our uncertainty hypothesis, we add volatility variables to our models following Jones et al.'s (2017) approach. The volatility measure is a standardized variable that compares variance within a single year (using monthly data) to the variance for a country over all years, with larger values implying much more localized variance in precipitation and temperature compared to historical data. For example, prior to initiating the 1999 river claim against Bolivia, Chile experienced more monthly variation in rainfall compared to previous years. This generated more uncertainty for Chile about its future water quantity and increased the country's incentives to protect its transnational water supplies through diplomacy.

The dependent variables are binary therefore we use logistic regression with robust standard errors. We include other control variables used in previous issue approach research (Hensel et al 2008). First, using data from the COW project, we control for relative capabilities between the two dyad members by measuring the challenger's total share of dyadic CINC capabilities (military, economic, and demographic). Second, using data from the Polity IV Project, we include a variable for democratic dyad if both countries score six or higher on the aggregated polity scale. Third, we include the logged distance between the dyad members' capital cities. Finally, we control for the temporal dependence in the dependent variables using years since last issue onset (diplomatic peace years) and using years since last militarization (militarized peace years).[18] See Tables A1 and A2 for summary statistics and correlations.

Empirical findings

Testing Scarcity (Abundance) Hypothesis

We begin by evaluating evidence for the scarcity/abundance hypothesis, which posits that as temperature or precipitation deviations increase, interstate issue claims are more likely to be initiated (Table 2) and to be militarized (Table 3). First, we look at Table 2, Model 4 where we include all types of ICOW issues in the same model. Several climate deviation parameters for the challenger state are significant, while all climate parameters for the target state are insignificant, showing that revisionist states seeking to change the issue status quo are influenced more by climate variability than target states who are defending their existing claims to territorial, maritime, and river areas. Challenger temperature is negative and statistically significant, while challenger precipitation is insignificant. However, the squared term for the challenger state's precipitation deviation is positive and significant. To see the relationship more clearly, we plot the marginal effects for the potential challenger's climate variables in Figures 6 and 7.

[18] We also estimated models using time dummy variables, but we have too much separation in our dataset, causing us to lose over 35,000 observations with this estimation approach.

The results show support for the scarcity (abundance) hypothesis, but only for precipitation deviations. Figure 6 shows that when challenger states are experiencing droughts (negative deviations) or floods (positive deviations), they are more likely to initiate diplomatic conflicts. Scarcity or abundance of water can push states to make claims against neighboring states to defend/expand water resources or to seek more agriculturally productive land. The effect is substantively strong: going from a "normal year" (0 deviation) to a flood year (+2.5 deviation) is associated with a 73% increase in the probability of claim initiation (.0015 compared to .0026). The effect is even higher going from a normal year (0) to a drought year (-2.5 deviation): a 100% increase in the probability of initiation (.0015 compared to .003). These empirical patterns are driven primarily by conflicts involving territory (Model 1) and maritime (Model 3) issues.

Counter to our expectations, higher temperature deviations appear to decrease the probability of a state initiating diplomatic conflict (Table 2, Model 4). This suggests that states experiencing heatwaves are less likely to initiate diplomatic conflict, a finding that is consistent with other studies showing less interstate conflict in times of global warming (Gartzke 2012). Figure 7 shows the substantive effect of temperature deviations for potential challengers. Going from a normal year (0 deviation) to a heatwave year (+2.5 deviations) is associated with a 300% decrease in the probability of a challenge (.002 to .0005), while going from a normal year to a colder year (-2.5 deviations) is associated with a 33% decrease in the probability of a challenge.

Next (Table 3, Model 4 and Figures 8 and 9) we evaluate how the climate deviation variables relate to militarization of ongoing issue claims. First, we find that the challenger's precipitation deviations (and squared deviations) are positively and significantly related to militarized disputes. Figure 8 shows that the challenger's abundance of precipitation increases conflict risks more so than scarcity of rainfall. The probability of an issue militarizing when the challenger is experiencing normal levels of precipitation is .018 compared to .057 when experiencing floods (217% increase) and .016 when experiencing droughts (13% decrease). These effects are driven mostly by territorial conflicts (Table 3, Model 1) and suggest that excessive flooding creates incentives for leaders to capture contested territory with force. For example, Venezuela experienced significant rainfall amounts and greater precipitation volatility in 1998 in the year before initiating a militarized conflict against Guyana over contested resources in the Essequibo claim. Guyana had been seeking greater control of water (hydroelectric dams) and oil resources in the area, prompting a militarized response from Venezuela (the challenger).[19] On the other hand, militarized conflicts are more likely when the target state experiences large negative rainfall deviations or droughts (Figure 9). Climate change variables do not significantly influence militarization of maritime claims (Table 3, Model 3), which is interesting because over 1 in 4 maritime claims have at least one militarized dispute (Mitchell and Hensel 2017). This may reflect the fact that rising sea levels are going to be most detrimental for maritime boundary baselines, but that changes on this front have been accumulating only slowly to date.

Overall, our tests for hypothesis 1 reveal that climate variability influences diplomatic conflicts and issue militarization, but mostly for revisionist states and for countries experiencing larger variability in rainfall. Contrary to our expectations, higher deviations in annual temperatures are associated with lower risks for new geopolitical conflicts. Yet this reflects the general decline in territorial claims over time (Hensel and Mitchell 2017), with territorial claim cases dominating our analyses since we code onset only in the first year of an issue claim.

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[19] This October 1999 militarized dispute was followed in December by one of Venezuela's worst mudslides in history that killed 10,000-30,000 people. See http://news.bbc.co.uk/2/hi/8412249.stm.

Testing Uncertainty Hypothesis

The uncertainty hypothesis anticipates that greater short-term volatility in weather patterns increases the risks for diplomatic and militarized conflict. We add the volatility measure to our baseline models (5-8) for issue claim onset (Table 2) and militarization (Table 3). [20] The results support hypothesis 2, but only for temperature volatility. Greater monthly variance in temperatures significantly increases the likelihood of issue claim onset (all issues and maritime issues) and issue militarization (all issues and river issues). The risks for diplomatic conflict are three times higher for states with high (vs. average) temperature volatility as we see in Figure 10. Militarized conflict is 50% higher for states experiencing the highest volatility in monthly temperatures compared to states with average volatility. As we observed with our scarcity (abundance) tests, the effects are significant for challengers but not targets. While we see strong effects for challenger *precipitation* (squared) deviations on interstate conflict, these results show that *temperature* volatility for the challenger state also increases the risks for diplomatic and militarized conflict. More generally, climate variability acts as a conflict trigger for states seeking to change ownership of territorial or water resources.

Discussion

While politically relevant directed dyads create a comparable opportunity set across diplomatic issues, it is possible that these criteria include countries with few opportunities for issue claims. For example, river claim onset models (Brochmann and Hensel 2009) focus on states in shared river basins, while maritime claim occurrence models examine coastal states in the same region and major powers (Daniels and Mitchell 2017). We replicate our findings using previously published territorial, river, and maritime claim onset models Territorial claim onset is

[20] See Appendix Tables A8a-b for models that include all climate variables.

estimated for states sharing contiguous land borders in all regions (Table A5a). We find similar results; the squared term for challenger precipitation deviations is positive and significant. In the militarization model (Table A5b), squared deviations are also positive and significant for challenger precipitation and target temperature. Our uncertainty results are stronger when looking at all territorial claims globally and including only countries that share contiguous borders in the onset model.

For river claim onsets, we replicate Brochmann and Hensel (2009) in Tables A6a (claim onset), A6b (negotiation onset), and A6c (militarization). These models allow us to match climate conditions to upstream and downstream status in a river basin. We get stronger support for the scarcity (abundance) hypothesis in this restricted river basin dyad analysis, as higher levels of rainfall in the upstream state significantly reduce the chances for new diplomatic conflicts between riparian states. Finally, maritime claim occurrence (Table A7a) and militarization (A7b) is modeled using the Daniels and Mitchell (2017) dataset. Overall, climate variables have stronger effects in these models compared to our results.

Finally, we recognize the geographical and temporal limitations of our analyses. In the appendix (Tables A3a-b, A4a-b), we present models for our two regions separately. Our combined regional findings are very similar in the Americas, but somewhat weaker in Europe (especially for volatility). Yet our replication of territorial claims globally shows that our results are stronger when expanded to all geographic contexts. In terms of project's temporal limitations, climate variability has accelerated since the end of our data (2001) as we see in Figures 1a and 1b. Countries are experiencing greater climate deviations and volatility on average in the last twenty years, thus our results imply that the interstate conflict risks we identify may be increasing.

Conclusion

A recent report by the IPCC notes that land is a critical resource for addressing climate changes.[21] 500 million people live in areas that experience desertification and these areas are more likely to experience droughts, heat waves, and dust storms. Our project considers how greater exposure to extreme weather events (floods, droughts, etc.) and volatility in temperatures and precipitation influence the likelihood of interstate conflicts. Unlike previous research that focuses on civil conflicts or considers interstate conflicts at a relatively high level of escalation (e.g. militarized disputes or wars), our project shows how deviations and volatility in precipitation and temperatures affect diplomatic conflicts involving territorial, maritime, and river issues. Evidence supports our scarcity (abundance) and uncertainty hypotheses, especially for states that challenge issue status quos (e.g. states seeking to capture another state's territory, maritime fishing zone, or river water). Our results also show that weather patterns that deviate significantly from long run averages and generate larger short-term variances act as triggers for diplomatic and militarized conflicts. Bolivia and Chile are representative of a larger group of dyads that escalated tensions over land and river disputes when facing climate variability.

We connect climate variability to diplomatic conflicts over three geopolitical issues that are plausibly connected to shocks and volatility in rainfall and temperatures. But we can explore how climate factors influence interstate conflict over other diplomatic issues in future research. The ICOW project has compiled data on identity claims that capture interstate disagreements over the treatment of ethnic kin. While most environmental refugees stay in their home countries, we might see neighboring states initiate identity claims or provide military support to insurgents

[21] https://www.ipcc.ch/2019/08/08/land-is-a-critical-resource_srccl/

across the border if the government fails to respond adequately to disasters that affect shared ethnic kin (e.g. India in Bangladesh following the 1970 Bhola cyclone). Many militarized conflicts involve regime issues (e.g. seeking to remove a leader), thus we could also explore how climate variability influences countries' willingness to initiate regime claims.

Our research posits two causal mechanisms and explores how they might operate in territorial, maritime, and river conflicts, but we can do more in future research to test these mechanisms. We expect that climate variability can increase issue salience, but we have not explored the interactions between climate factors and issue salience. We identified several climate consequences that are more likely to provoke interstate disputes (e.g. decline in agricultural productivity, desertification, decreasing water supplies, lost fisheries' stocks) and future research could explore these intervening mechanisms empirically. We can also study how institutional agreements can help mitigate the negative consequences of climate change. River treaties are very common and often include provisions for addressing climate shocks to water quantities. Yet fewer treaties manage states' resource management in territorial and maritime issues. We can learn from the management practices of river basins, which have been very successful in reducing interstate militarized conflict, about how conflict can be minimized for other issues affected by climate variability.

Replication data
The dataset and do-files for the empirical analysis in this article, along with the Online appendix, can be found at http://www.prio.org/jpr/datasets and http://www.saramitchell.org/research.html.

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References
Barnett, Jon & W. Neil Adger (2007) Climate change, human security, and violent conflict. *Political Geography* 26(6): 639–655.
Bauer, Steffen (2011) Stormy weather: International security in the shadow of climate change. In Brauch H. et al. (eds) *Coping with Global Environmental Change, Disasters and Security, vol 5.* Springer, Berlin, Heidelberg.
Bernauer, Thomas (2013) Climate change politics. *Annual Review of Political Science* 16: 421–448.
Bernauer, Thomas & Tobias Siegfried (2012) Climate change and international water conflict in Central Asia. *Journal of Peace Research* 49(1): 227–239.
Brochmann, Marit & Nils Petter Gleditsch. (2012) "Shared rivers and conflict: A reconsideration. *Political Geography* 31(8): 519–527.
Brochmann, Marit & Paul R. Hensel. (2009) Peaceful management of international river claims. *International Negotiation* 14(2): 393–418.
Buhaug, Halvard. (2010) Climate not to blame for African civil wars. *Proceedings of the National Academy of Sciences in the United States of America* 107(88): 16477-16482.
Burke, Marshall B., Edward Miguel, Shanker Satyanath, John A. Dykema, & David B. Lobell. (2009) Warming increases the risk of civil war in Africa. *Proceedings of the National Academy of Sciences in the United States of America* 106: 20670–20674.
Burke, Marshall B., Solomon M. Hsiang, & Edward Miguel. (2015) Climate and conflict. *Annual Review of Economics* 7: 577–617.
Busby, Joshua W. (2008) Who cares about the weather? Climate change and U.S. national security. *Security Studies* 17(3): 468–504.
Caron, David D. (2009) *Climate Change, Sea Level Rise and the Coming Uncertainty in Oceanic Boundaries: A Proposal to Avoid Conflict*. Leiden, The Netherlands: Brill | Nijhoff.
Caruso, Raul, Ilaria Petrarca, & Roberto Ricciuti. (2016) Climate change, rice crops, and violence: Evidence from Indonesia. *Journal of Peace Research* 53(1): 66–83.
Choucri, Nazli, & Robert C. North. (1975) *Nations in Conflict: National Growth and International Violence*. San Francisco, CA: W. H. Freeman.
Couttenier, Mathieu & Raphael Soubeyran. (2014) Drought and civil war in sub-Saharan Africa. *The Economic Journal* 124(575): 201–244.
De Juan, Alexander & Tim Wegenast. (2020). Temperatures, food riots, and adaptation: A long-term historical analysis of England. *Journal of Peace Research 57*(2): 265–280.
De Stefano, Lucia, James Duncan, Shlomi Dinar, Kerstin Stahl, Kenneth M. Strzepek, & Aaron T. Wolf. (2012) Climate change and the institutional resilience of international river basins. *Journal of Peace Research* 49(1): 193–209.
Detges, Adrien. (2016) Local conditions of drought-related violence in sub-Saharan Africa: The role of road and water infrastructures. *Journal of Peace Research 53*(5), 696–710.

Devlin, Colleen, & Cullen S. Hendrix. (2014) Trends and triggers redux: Climate change, rainfall, and interstate conflict. *Political Geography* 43(November): 27–39.

Devitt, Conor, & Richard S. J. Tol. (2012) Civil war, climate change, and development: A scenario study for sub-Saharan Africa. *Journal of Peace Research* 49(1): 129–145.

Diehl, Paul F. (1992) What are they fighting for? The importance of issues in international conflict research. *Journal of Peace Research* 29(3): 333–344.

Dinar, Shlomi. (2009) Power asymmetry and negotiation in international river basins. *International Negotiation* 14(2): 329–360.

Eckstein, Gabriel E. (2009) Water scarcity, conflict, and security in a climate change world: Challenges and opportunities for international law and policy. *Wisconsin International Law Journal* 27: 409-460.

Gartzke, Erik. (2012) Could climate change precipitate peace? *Journal of Peace Research* 49(1): 177–192.

Gleick, Peter H. (1993) Water and conflict: Fresh water resources and international security. *International Security* 18(1): 79–112.

Guo, Rongxing. (2007) *Territorial Disputes and Resource Management: A Global Handbook*. Hauppauge, NY: Nova Science Publishers.

Hendrix, Cullen S. & Sarah M. Glaser. (2007) Trends and triggers: Climate, climate change and civil conflict in sub-Saharan Africa. *Political Geography* 26(August): 695–715.

Hendrix, Cullen S. & Idean Salehyan. (2012) Climate change, rainfall, and social conflict in Africa. *Journal of Peace Research* 49(1): 35–50.

Hensel, Paul R. (2001) Contentious issues and world politics: Territorial claims in the Americas, 1816-1992. *International Studies Quarterly* 45(1): 81–109.

Hensel, Paul R., & Sara McLaughlin Mitchell. (2005) Issue indivisibility and territorial claims. *GeoJournal* 64(4): 275–285.

Hensel, Paul R. & Sara McLaughlin Mitchell. (2017) From territorial claims to identity claims: The Issue Correlates of War (ICOW) project. *Conflict Management and Peace Science* 34(2): 126–140.

Hensel, Paul R. Sara McLaughlin Mitchell, & Thomas E. Sowers II. (2006) Conflict management of riparian disputes: A regional comparison of dispute resolution. *Political Geography* 25(4): 383–411.

Hensel, Paul R., Sara McLaughlin Mitchell, Thomas E. Sowers II, & Clayton L. Thyne. (2008) Bones of contention: Comparing territorial, maritime, and river issues. *Journal of Conflict Resolution* 52(1): 117–143.

Homer-Dixon, Thomas F. (1991) On the threshold: Environmental changes as causes of acute conflict. *International Security* 16(2): 76–116.

Jones, Benjamin T., Eleonora Mattiacci, & Bear F. Braumoeller. (2017). Food scarcity and state vulnerability: Unpacking the link between climate variability and violent unrest. *Journal of Peace Research* 54(3), 335–350.

Klomp, Jeroen, & Erwin Bulte. (2013) Climate change, weather shocks, and violent conflict: A critical look at the evidence. *Agricultural Economics* 44(s1): 63–78.

Koubi, Vally. (2019) Climate Change and Conflict. *Annual Review of Political Science* 22: 343-360.

Koubi, Vally, Thomas Bernauer, Anna Kalbhenn, & Gabriele Spilker. (2012) Climate variability, economic growth, and civil conflict. *Journal of Peace Research* 49(1): 113–127.

Landis, Steven T. (2014) Temperature seasonality and violent conflict: The inconsistencies of a warming plant. *Journal of Peace Research* 51(5): 603–618.
Mansbach, Richard & John Vasquez. (1981) *In Search of Theory: A New Paradigm for Global Politics.* New York, NY: Columbia University Press.
Miguel, Edward, Shanker Satyanath, & Ernest Sergenti. (2004) Economic shocks and civil conflict: An instrumental variables approach. *Journal of Political Economy* 112(4): 725–753.
Nemeth, Stephen C., Sara McLaughlin Mitchell, Elizabeth A. Nyman, and Paul R. Hensel. (2014) Ruling the sea: Managing maritime conflicts through UNCLOS and exclusive economic zones. *International Interactions* 40(5): 711-736.
Nordås, Ragnhild, & Nils Petter Gleditsch. (2007) Conflict change and conflict. *Political Geography* 26(6): 627–638.
O'Loughlin, John, Frank D. W. Witmer, Andrew M. Linke, Arlene Laing, Andrew Gettelman, & Jimy Dudhia. (2012) Climate variability and conflict risk in East Africa, 1990-2009. *Proceedings of the National Academy of Sciences in the United States of America* 109(45): 18344–18349.
Raleigh, Clionadh & Hendrik Urdal. (2007) Climate change, environmental degradation and armed conflict. *Political Geography* 26(6): 674–694.
Raleigh, Clionadh, Andrew Linke & John O'Loughlin. (2014) Extreme temperatures and violence. *Nature Climate Change* 4(January): 76–77.
Sakaguchi, Kendra, Anil Varughese, & Graeme Auld. (2017) Climate wars? A systematic review of empirical analyses on the links between climate change and violent conflict. *International Studies Review* 19(4): 622–645.
Salehyan, Idean. (2008) From climate change to conflict? No consensus yet. *Journal of Peace Research* 45(3): 315–326.
Seter, Hanne. (2016) Connecting climate variability and conflict: Implications for empirical testing. *Political Geography* 53(July): 1-9.
Schofield, Clive. (2009) The trouble with islands: The definition and role of islands and rocks in maritime boundary delimitation." In Seoung-Yong Hong & Jon M. Van Dyke (eds.), *Maritime Boundary Disputes, Settlement Processes, and the Law of the Sea*. Leiden, The Netherlands: Brill | Nijhoff.
Stalley, Phillip. (2003) Environmental scarcity and international conflict. *Conflict Management and Peace Science* 20(1): 33–58.
Sumaila, U. Rashid, William W.L. Cheung, Vicki Y.W. Lam, Daniel Pauly, and Samuel Herrick. (2011) Climate change impacts on the biophysics and economics of world fisheries. *Nature Climate Change* 1**:** 449–456.
Theisen, Ole Magnus. (2017) Climate change and violence: Insights from political science. *Current Climate Change Reports* 3(4): 210–221.
Theisen, Ole Magnus, Helge Holtermann & Halvard Buhaug. (2011) Climate wars? Assessing the claim that drought breeds conflict. *International Security* 36(3): 79–106.
Theisen, Ole Magnus, Nils Petter Gleditsch, & Halvard Buhaug. (2013) Is climate change a driver of armed conflict? *Climate Change* 117: 613–625.
Tir, Jaroslav, & Douglas M. Stinnett. (2012) Weathering climate change: Can institutions mitigate international water conflict? *Journal of Peace Research* 49(1): 211–225.
Tol, Richard S., & Sebastian Wagner. (2010) Climate change and violent conflict in Europe over the last millennium. *Climate Change* 99: 65–79.

Tomasek, Robert D. (1967) The Chilean-Bolivia Lauca River dispute and the OAS. *Journal of Inter-American Studies* 9(3): 351–366.
Toset, Hans Petter Wollebaek, Nils Petter Gleditsch, & Håvard Hegre. (2000) Shared rivers and interstate conflict. *Political Geography* 19(8): 971–996.
van Weezel, Stijn. (2019) On climate and conflict: Precipitation decline and communal conflict in Ethiopia and Kenya. *Journal of Peace Research* 56(4), 514–528.
Wischnath, Gerdis & Halvard Buhaug. (2014) On climate variability and civil war in Asia. *Climate Change* 122: 709–721.
Zhang, David, CY Jim, George Lin, Yuan-Qing He, James Wang, & Harry Lee. (2006) Climate change, wars, and dynastic cycles in China over the last millennium. *Climate Change* 76(3–4): 459–477.
Zhang, David, Peter Brecke, Harry Lee, Yuan-Qing He, & Jane Zhang. (2007) Global climate change, war, and population decline in recent human history. *Proceedings of the National Academy of Sciences in the United States of America* 104(49): 19214–19219.

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Table 1. Example of Climate Change Variables, USA and Canada.

State	Year	Precipitation (millimeters)	Standardized Precipitation	Temperature (degree Celsius)	Standardized Temperature
USA	1920	737.1	0.402	7.9	-1.560
USA	1921	687.5	-0.698	9.3	1.733
USA	1922	717.6	-0.031	8.5	-0.149
USA	1923	744.1	0.558	8.5	-0.149
USA	1924	654.4	-1.432	7.8	-1.796
…	…	…	…	…	…
CAN	1920	494.8	-1.308	-5.8	-0.685
CAN	1921	501.1	-0.980	-5.5	-0.255
CAN	1922	480.1	-2.074	-6.1	-1.116
CAN	1923	494.1	-1.345	-5.8	-0.685
CAN	1924	490.6	-1.527	-5.7	-0.542

Table 2. Effect of Climate Variability on Issue Claim Onset (PR dyads), 1901-2001.

	Standardized Precipitation and Temperature				Volatility			
	Model 1: Territory	Model 2: River	Model 3: Maritime	Model 4: All	Model 5: Territory	Model 6: River	Model 7: Maritime	Model 8: All
Potential Challenger								
Precipitation	-0.031	-0.224	0.078	-0.039				
	(0.130)	(0.199)	(0.109)	(0.084)				
Precipitation Squared	0.205***	0.038	0.124**	0.100**				
	(0.079)	(0.111)	(0.054)	(0.048)				
Temperature	-0.170	-0.194	-0.045	-0.205*				
	(0.187)	(0.292)	(0.190)	(0.112)				
Temperature Squared	-0.051	0.158	-0.521***	-0.119				
	(0.108)	(0.140)	(0.185)	(0.083)				
Precipitation Volatility					0.007	-0.251	0.081	-0.049
					(0.143)	(0.220)	(0.115)	(0.086)
Temperature Volatility					0.168	0.214	0.301**	0.233**
					(0.121)	(0.233)	(0.131)	(0.093)
Potential Target								
Precipitation	0.045	0.580**	-0.236*	-0.059				
	(0.188)	(0.286)	(0.131)	(0.097)				
Precipitation Squared	-0.296	-0.368*	-0.006	-0.100				
	(0.220)	(0.222)	(0.069)	(0.070)				
Temperature	-0.163	0.001	-0.007	0.011				
	(0.197)	(0.265)	(0.149)	(0.104)				
Temperature Squared	-0.098	0.125	0.013	0.044				
	(0.136)	(0.160)	(0.094)	(0.073)				
Precipitation Volatility					0.173	0.335	0.081	0.124
					(0.128)	(0.204)	(0.121)	(0.085)
Temperature Volatility					0.177	-0.075	-0.051	0.000
					(0.125)	(0.252)	(0.122)	(0.089)
Controls								
Relative Capability	-0.635*	-2.185***	0.808***	-0.086	-0.588*	-2.233***	0.804***	-0.101
	(0.357)	(0.704)	(0.308)	(0.218)	(0.341)	(0.665)	(0.301)	(0.209)
Democratic Dyad	0.087	1.166***	0.289	0.464***	0.006	1.130***	0.246	0.426**
	(0.287)	(0.380)	(0.250)	(0.165)	(0.291)	(0.369)	(0.250)	(0.166)
Distance	-0.277***	-0.503***	-0.109***	-0.217***	-0.273***	-0.505***	-0.109***	-0.216***
	(0.037)	(0.090)	(0.029)	(0.021)	(0.038)	(0.092)	(0.030)	(0.021)
Diplomatic Peace Year	-0.023***	-0.013	-0.007	-0.013***	-0.026***	-0.013*	-0.009**	-0.015***
	(0.007)	(0.008)	(0.004)	(0.003)	(0.008)	(0.007)	(0.004)	(0.003)
Constant	-4.808***	-5.596***	-6.176***	-4.606***	-4.886***	-5.427***	-6.349***	-4.591***
	(0.305)	(0.525)	(0.321)	(0.209)	(0.242)	(0.395)	(0.297)	(0.183)
Observations	64034	64034	64034	64034	64034	64034	64034	64034

Table 3. Effect of Climate Variability on Militarization (Claim Dyad Years), 1901-2001

	Standardized Precipitation and Temperature				Volatility			
	Model 1: Territory	Model 2: River	Model 3: Maritime	Model 4: All	Model 5: Territory	Model 6: River	Model 7: Maritime	Model 8: All
Challenger								
Precipitation	0.424***	0.193	0.087	0.262***				
	(0.126)	(0.936)	(0.119)	(0.082)				
Precipitation Squared	0.107*	0.155	0.063	0.087**				
	(0.058)	(0.401)	(0.084)	(0.044)				
Temperature	0.239	-0.972	0.049	0.127				
	(0.148)	(0.766)	(0.185)	(0.113)				
Temperature Squared	-0.006	0.423***	-0.019	-0.002				
	(0.077)	(0.140)	(0.086)	(0.052)				
Precipitation Volatility					0.058	0.524	0.056	0.058
					(0.109)	(0.355)	(0.116)	(0.078)
Temperature Volatility					0.146	1.235***	0.140	0.177**
					(0.117)	(0.412)	(0.136)	(0.089)
Target								
Precipitation	-0.286**	-1.093	-0.020	-0.177**				
	(0.127)	(0.787)	(0.121)	(0.082)				
Precipitation Squared	-0.008	0.008	-0.036	-0.013				
	(0.068)	(0.180)	(0.078)	(0.050)				
Temperature	-0.076	1.342	0.248	0.078				
	(0.146)	(0.818)	(0.188)	(0.104)				
Temperature Squared	0.018	0.119	0.003	0.041				
	(0.075)	(0.255)	(0.087)	(0.048)				
Precipitation Volatility					0.054	-0.023	0.016	0.034
					(0.103)	(0.360)	(0.130)	(0.077)
Temperature Volatility					0.148	-0.100	0.035	0.088
					(0.109)	(0.404)	(0.167)	(0.093)
Controls								
Relative Capability	0.716***	3.734**	0.104	0.534***	0.727***	2.343*	0.060	0.534***
	(0.251)	(1.697)	(0.339)	(0.187)	(0.237)	(1.246)	(0.326)	(0.182)
Democratic Dyad	-0.394	-1.632	0.042	-0.379**	-0.361	-0.044	0.152	-0.252
	(0.297)	(1.786)	(0.246)	(0.179)	(0.294)	(1.278)	(0.250)	(0.178)
Distance	-0.131***		0.007	-0.076***	-0.120***		0.007	-0.072***
	(0.036)		(0.033)	(0.022)	(0.035)		(0.033)	(0.021)
Mid Peace Year	-0.056***	-0.012	-0.041***	-0.048***	-0.058***	0.011	-0.040***	-0.048***
	(0.013)	(0.045)	(0.013)	(0.009)	(0.014)	(0.024)	(0.013)	(0.009)
Constant	-2.570***	-7.552***	-3.164***	-2.804***	-2.437***	-6.418***	-3.127***	-2.712***
	(0.234)	(1.058)	(0.359)	(0.183)	(0.211)	(0.956)	(0.306)	(0.161)
Observations	3085	420	2611	6134	3085	420	2611	6134

Figure 1a

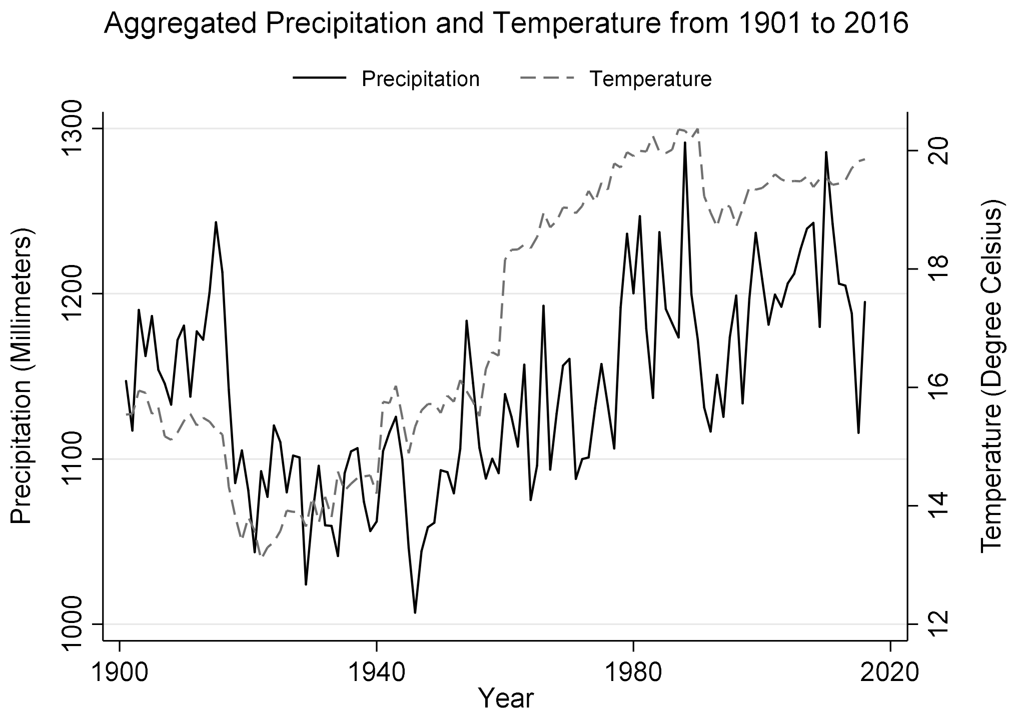


Figure 1b

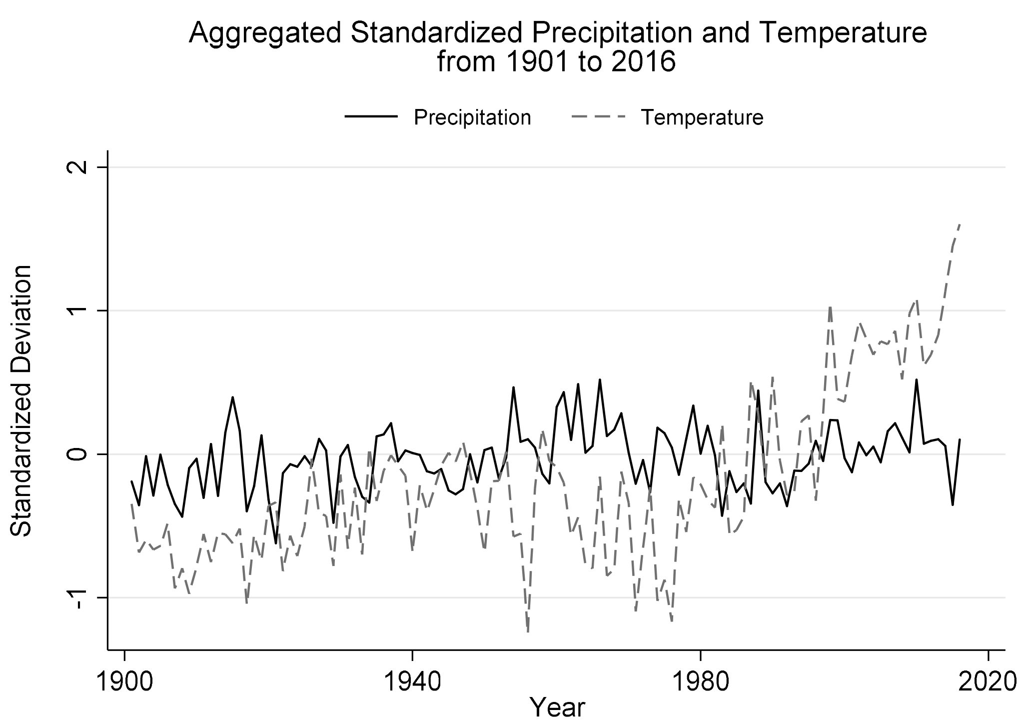


Figure 2: Issue Approach: Onset, Militarization, and Resolution of Diplomatic Conflicts.

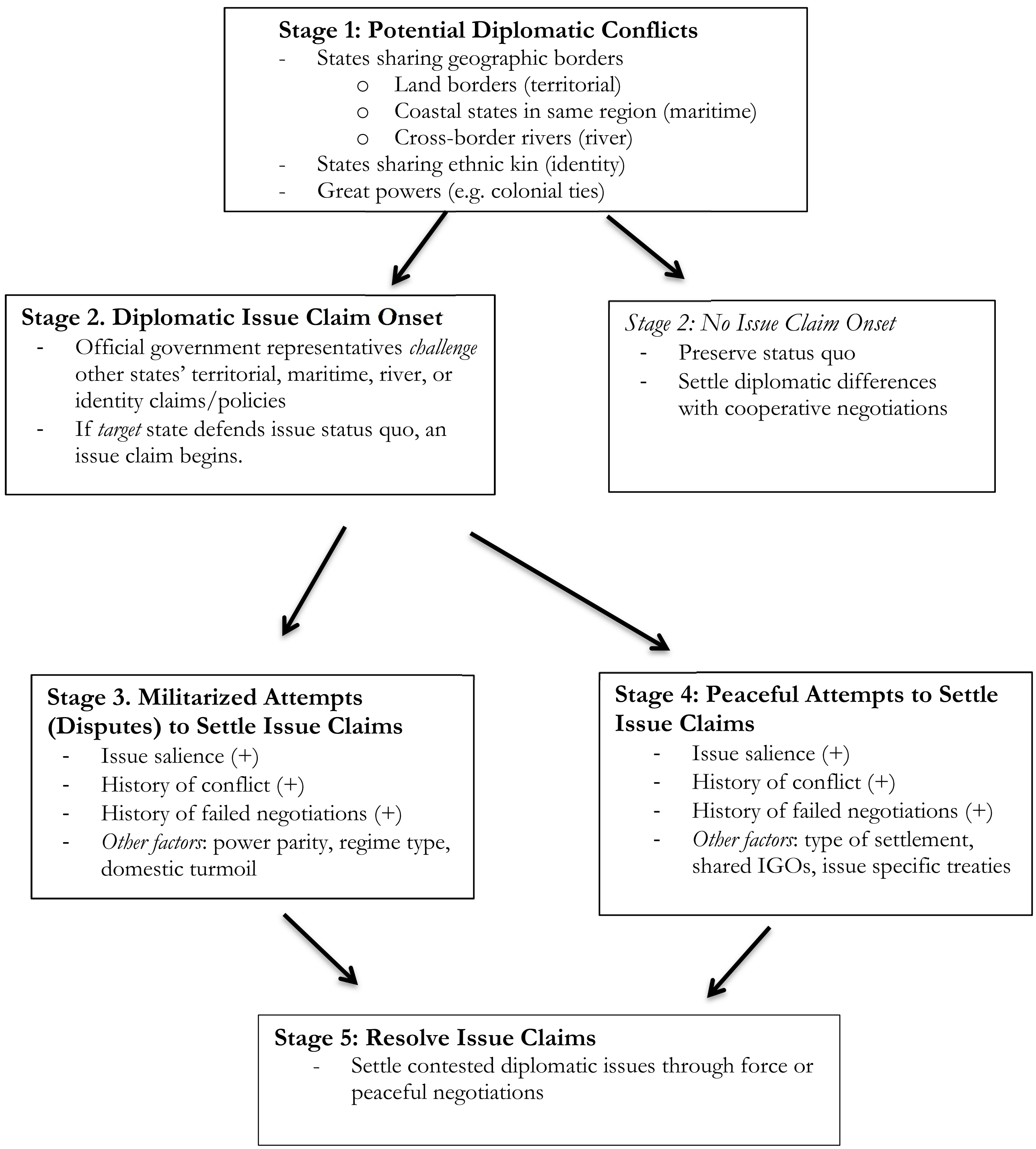
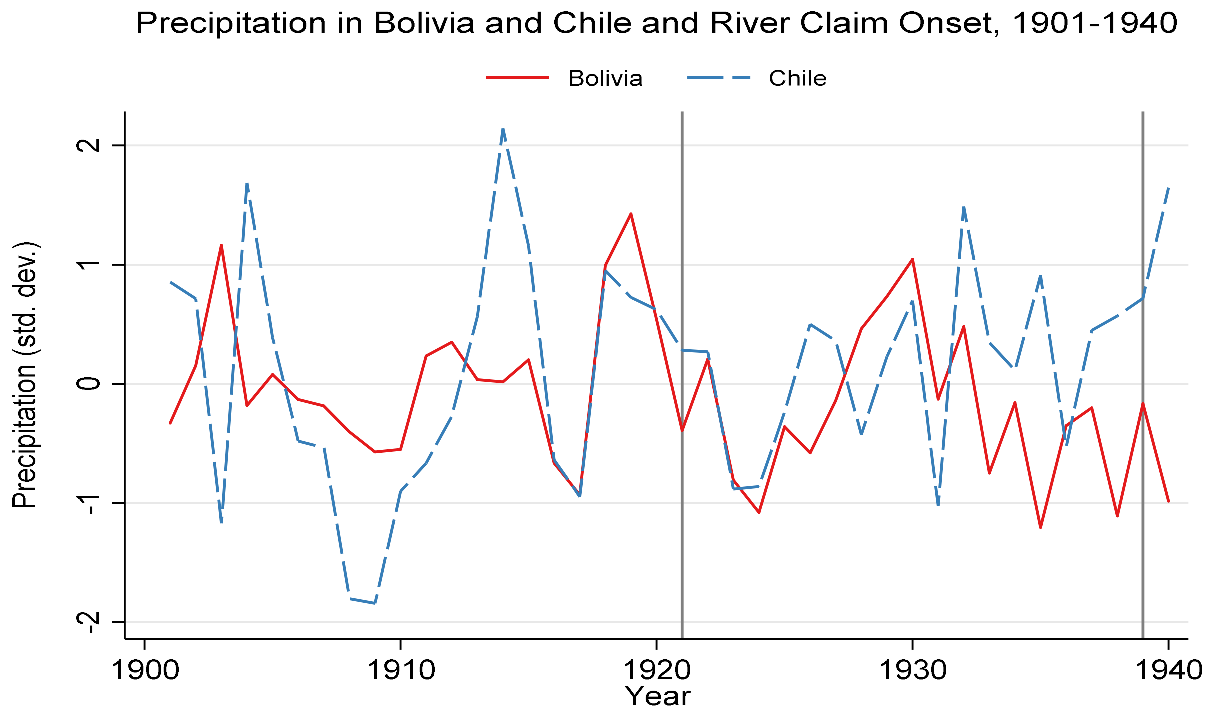


Figure 3



Precipitation in Bolivia and Chile and River Claim Onset, 1901-1940
Bolivia
Chile
Precipitation (std. dev.)
2
1
0
-1
-2
1900
1910
1920
1930
1940
Year

Figure 4

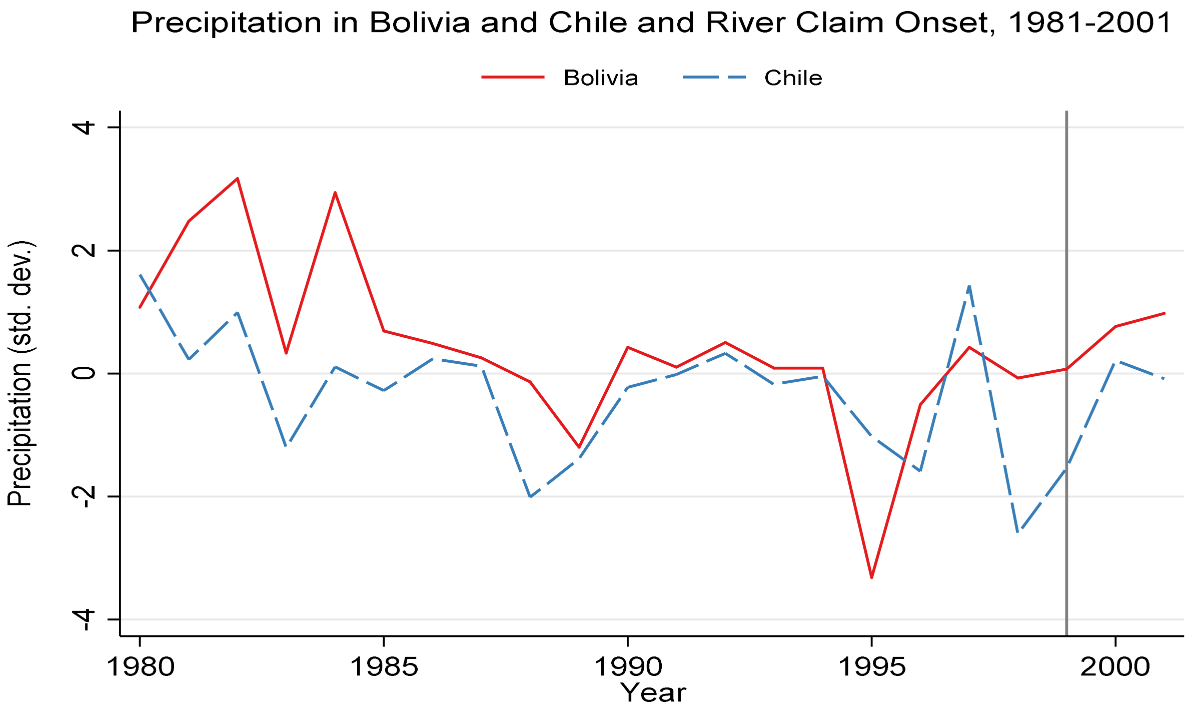

Precipitation in Bolivia and Chile and River Claim Onset, 1981-2001
Bolivia
Chile
Precipitation (std. dev.)
4
2
0
-2
-4
1980
1985
1990
1995
2000
Year

Figure 5a

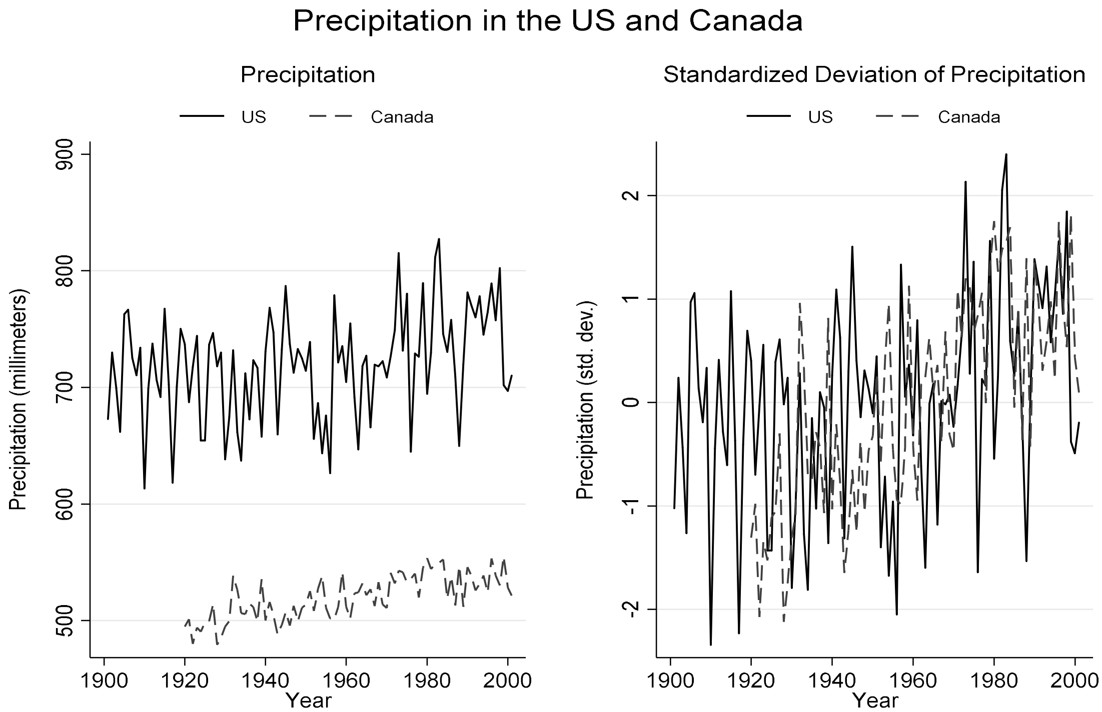


Figure 5b

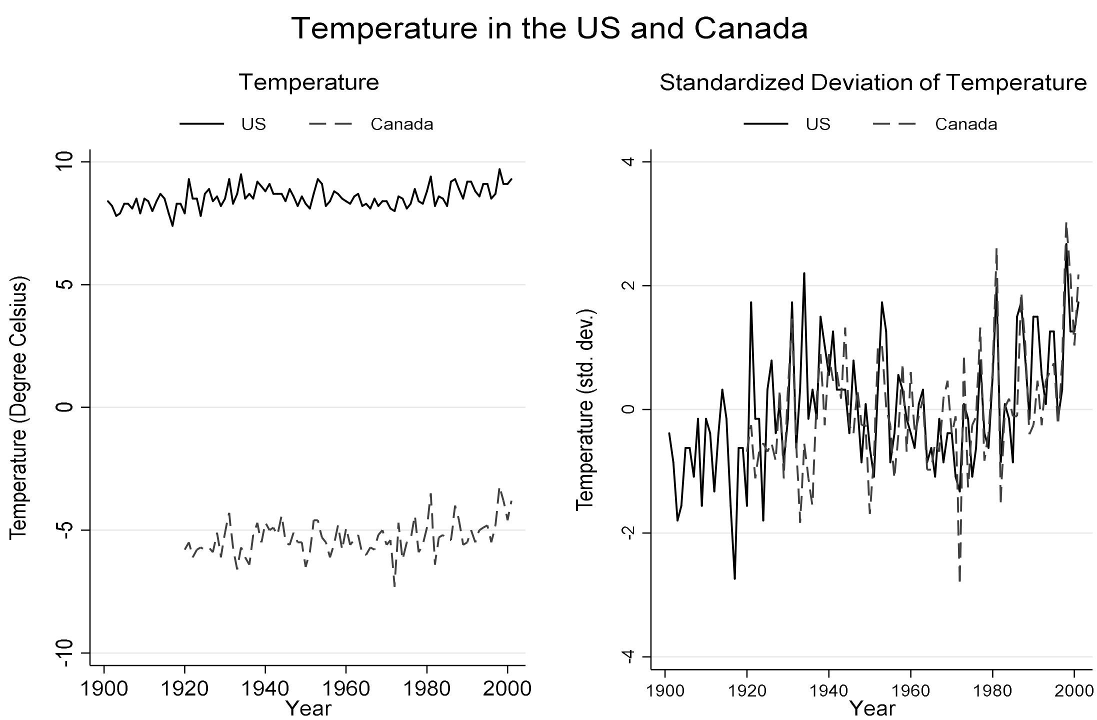
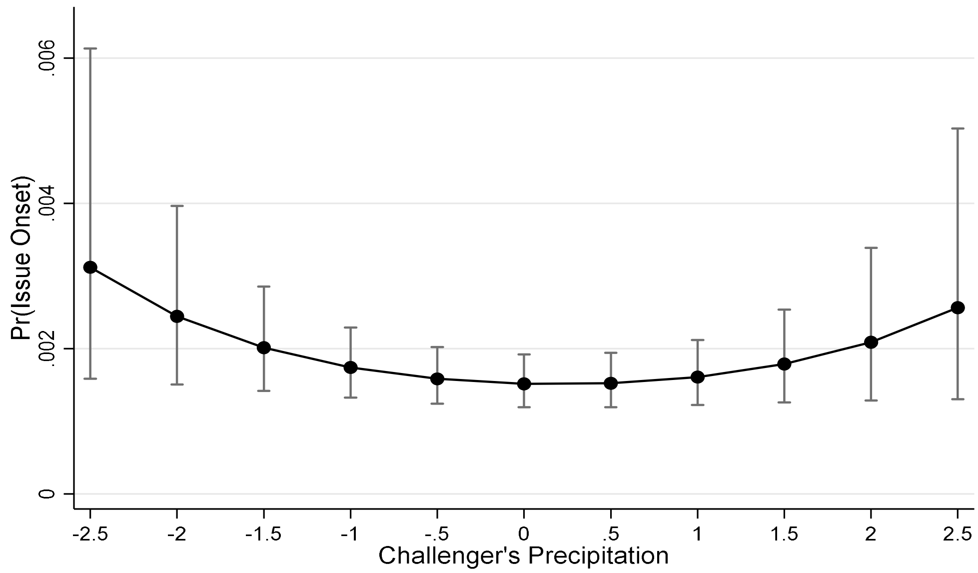
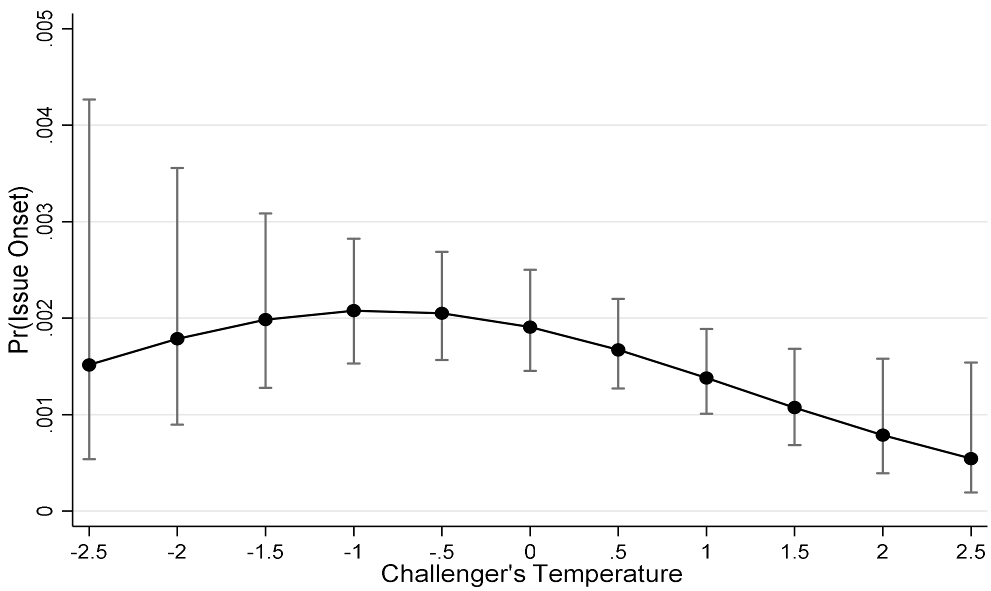


Figure 6. Challenger State's Precipitation on Probability of Issue Claim Onset.



Note: 95% Confidence Intervals reported.

Figure 7. Challenger State's Temperature on Probability of Issue Claim Onset.



Note: 95% Confidence Intervals reported.

Figure 8. Challenger's Precipitation on Probability of Issue Militarization.

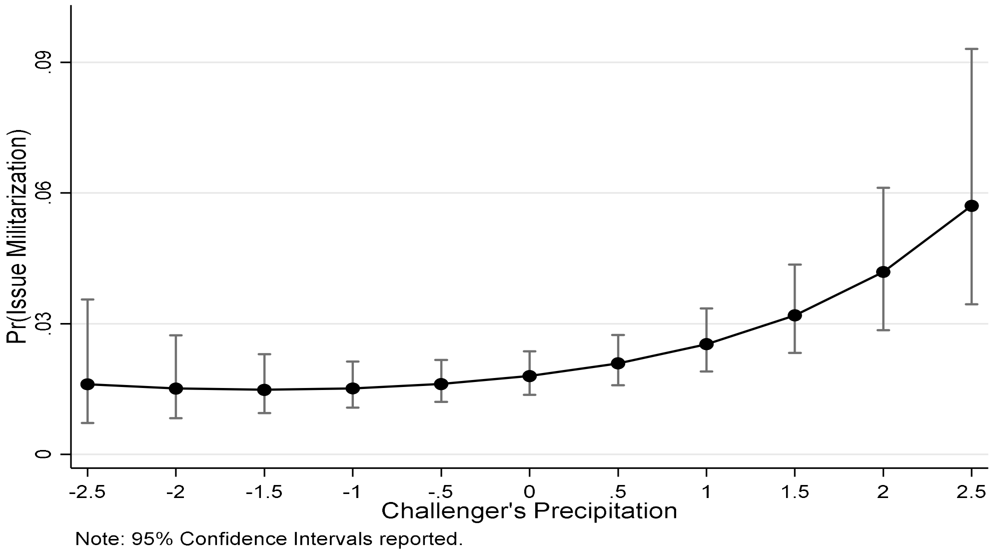


Figure 9. Target's Precipitation on Probability of Issue Militarization.

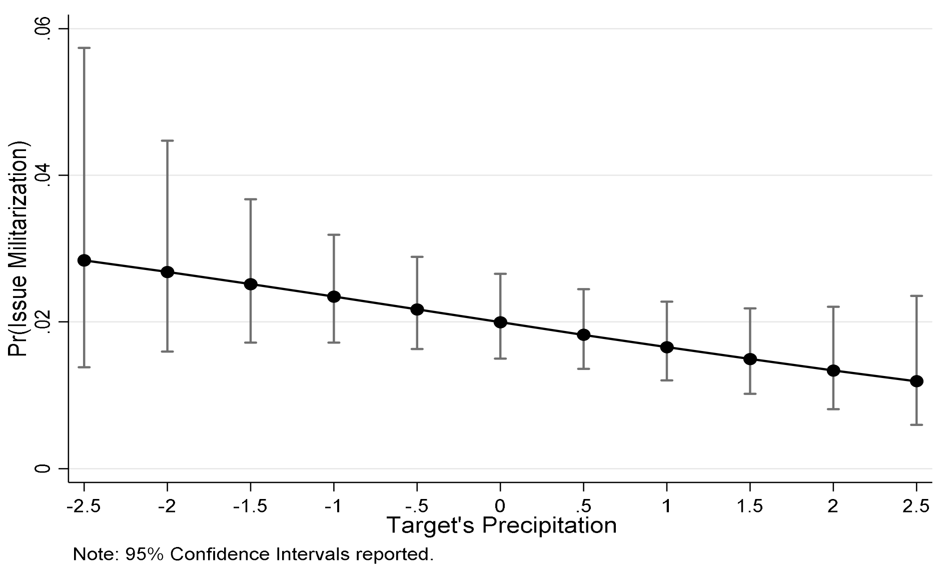


Figure 10. Challenger's Temperature Volatility on Probability of Issue Claim Onset.

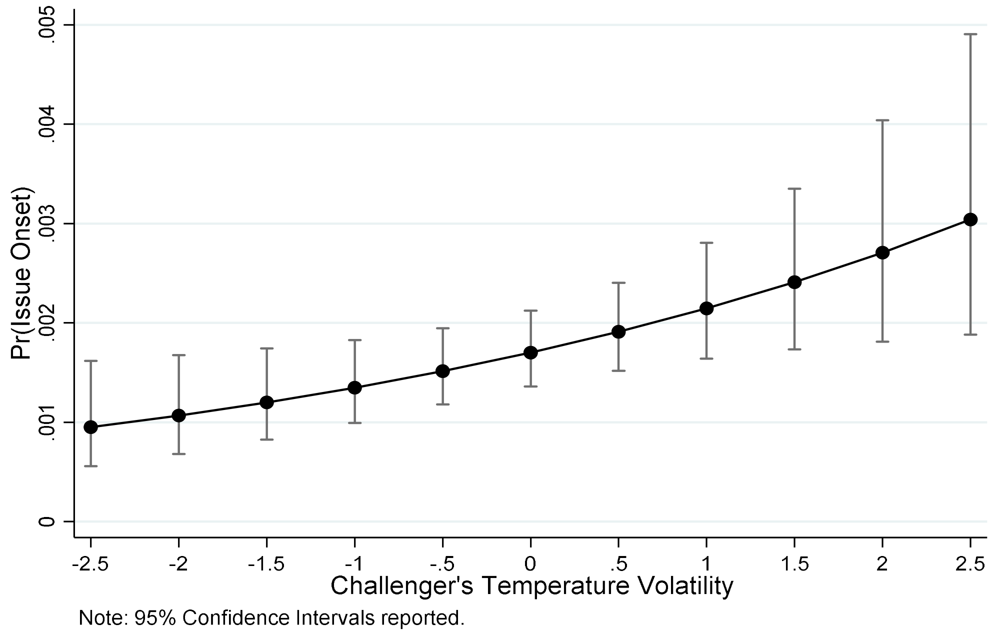


Figure 11. Challenger's Temperature Volatility on Probability of Issue Militarization.