Blame it on the Weather

Seasonality in Interstate Conflict*

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Abstract

Historically, fighting is widely believed to follow the seasons, tending to begin or increase in spring or summer and decline or terminate in the fall and winter. While not a new subject, the seasonality of conflict has received relatively little careful systematic study. I find significant annual variation in the advent or termination of wars. However, the overall relationship between conflict and seasonal climate change is more complex. Given that climate varies both temporally and geographically, it is possible to adjust the location of at least some contests, in effect changing the weather, rather than waiting for the weather to change. I offer an explanation of the cyclicality of wars and the relocation of other disputes. States tend to shift the *location* of modest contests and non-territorial disputes with the seasons. In the northern hemisphere, disputes occur an average of 556 kilometers (345 miles) farther south in winter than in summer. Wars and territorial disputes that are difficult to relocate geographically tend to exhibit more seasonal variation in onset and termination. The presence of both temporal and spatial cyclicality implies that the effects of climate change may vary for conflicts of different types and intensities.

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1 Introduction

Chroniclers and military practitioners have long discerned a seasonal pattern in the tide of war. Conflict is perceived to rise with the temperature, beginning or increasing in spring and summer and ending or declining with cooler weather. Yet, despite a broad consensus among observers, considerable controversy exists over the precise nature of this relationship. Indeed, there is only limited systematic evidence that such a seasonal cycle in conflict onset or termination exists.

There are also reasons to question the theoretical linkage between climate and conflict. In particular, bargaining theories of war cast doubt on the sufficiency of explanations for conflict that rely on variation in the opportunity or willingness of states to fight (Fearon 1995). Factors that influence the probability of war can typically be folded into the bargaining positions of competitors, altering settlements as much or more than these conditions affect the probability of war. However, temporary advantages in fighting are much more difficult to negotiate over, as states cannot credibly commit to honor agreements once advantages abate. Since the effects of seasonal climate change are necessarily temporary, states will have difficulty forging bargains that address seasonal advantages or disadvantages. Thus, states could conceivably vary seasonally in their propensity to fight.

This study begins by evaluating the conventional wisdom that nations fight more at certain times of the year. To the degree that seasonal weather patterns are unavoidable and more-or-less uniformly influence the ability of opponents to exercise force, warfare should vary with the seasons. Yet, not all contests or combatants are equal. States could engage in geographic substitution, altering the location of contests to avoid the worst effects of weather. Smaller disputes and those involving policy or regime issues, rather than territory, are easiest to relocate and thus least likely to wax and wane in frequency or intensity with the seasons. Wars and territorial disputes should exhibit greater seasonal shifts in onset or termination, since these contests are much more difficult to relocate. The effects of the seasons on conflict may also reflect strategic interaction. For example, seasonal climate patterns should be less apparent where nations are differentially affected by the weather — such as when disputants are located at different latitudes — since one side stands to benefit in relative terms from continuing to prosecute a contest across varying climatic conditions.

As expected, patterns of conflict for the most intense contests mirror seasonal temperature variation; war onset increases in spring and summer and declines in fall and winter. This pattern changes for more minor militarized disputes, however, where the seasonal pattern in conflict behavior occurs in terms of location rather than frequency. In the northern hemisphere, countries experience militarized disputes an average of 556 kilometers (345 miles) farther south in winter than in summer. This geographic variation also appears to be localized to non-territorial conflict. As suggested by the substitution argument, the onset and termination of territorial contests varies tends to vary temporally, rather than latitudinally. Disputes involving distant nations are somewhat less likely to exhibit either temporal or spatial variation, as the strategic incentives for competitors to capitalize on an opponent's military distress rule out compromise on either the location or timing of conflict. Finally, while some argue that seasonal variation in conflict behavior should decline as technological innovation increases the ability of armies to combat the effects of climate, I find no evidence that this is the case in comparing wars in the nineteenth and twentieth centuries.

The results also suggest a nuanced relationship between climate and conflict more generally. Global warming may matter more for where nations fight, than for when or whether conflict occurs. Climate change may impact the timing of relatively rare interstate warfare, leading to a "flattening out" of seasonal conflict patterns with milder winters and longer summers. A warmer climate could also move conflict away from the poles, as it becomes harder to fight at lower latitudes in the summer and more feasible to continue contests nearer the poles in winter months. Thus, seasonal variation in conflict behavior may decline with global warming, even if temperature volatility increases.

2 Literature: the Seasonality of Conflict

The weather has long been considered a central determinant of the success or failure of military campaigns. General George Patton famously prayed for clear skies to aid allied forces in the Battle of the Bulge. George Washington, in his letter to the Continental Congress on December 23, 1776, writes that "three or four days bad weather would prove our destruction."[1] Invasions by both land and sea have been defeated by storms or the arrival of winter. Seasonal variation in temperature and precipitation has dictated the timing of deployments and tactical or strategic withdrawals. The

[1] Letter available at: `http://memory.loc.gov/cgi-bin/query/r?ammem/mgw:@field(DOCID+@lit(gw100200))`.

more predictable the effects of weather, the more it matters in terms of grand strategy and the less in terms of tactics. Poor weather delayed the Allied Normandy invasions until June 6, 1944, even while planning for the invasion had been predicated on expectations that early summer was one of the few periods during which weather in the English Channel was relatively benign.

Cyclical patterns have also been identified in a variety of allied conflict processes. For example, researchers have found seasonal patterns in incidents of domestic violence in Merseyside in England (Farrell & Pease 1994), in 'woman damage' cases in Sierra Leone (Mokuwa, et al. 2011) and in crime statistics from the Canadian Arctic (Condon 1982). The peaks of seasonal cycles can vary with development, climate, and region. In Afghanistan and in other cold pastoral regions, the peak season for familial and tribal feuding is in the spring, after the snows have melted but before agricultural labor takes over as a mutual priority among competing groups (Dennys & Zaman 2009).

Perhaps because it is widely believed to exist, few studies actually evaluate the relationship between seasonal climate change and international conflict. J. David Singer and Melvin Small explore the empirical question of a seasonal cycle in war and peace, a natural outgrowth of their larger data collection effort and the focus on the war-month as a unit of analysis. "To some degree, our data support the common folklore ... Of the 93 wars, 64 began in either spring or autumn and only 29 in summer and winter" (Singer & Small 1970, page 150-151). Singer and Small also note that "this pattern does not change much over time." They do not find any seasonal pattern when it comes to war termination, however. Nor can they say whether seasonal variation is attributable to weather or other causes. "Before we can attest with certainty to the proposition that weather and climate weigh heavily with the decision-maker, we must compare similar sets of crises, which did and did not terminate in war, with specific seasonal variables" (Singer & Small 1970, page 151).

Where Singer and Small adopt an inductive approach, identifying seasonal covariates of war, Geoffrey Blainey (1973) is keenly interested in the theoretical origins of connections between climate and conflict. In data on forty-four wars occurring north of the tropic of Cancer between 1840 and 1938, Blainey reports that a majority began between April and July, supporting the conventional wisdom of a spring campaign season. Blainey appears initially to embrace the notion that climate represents opportunity. "Why was war more likely to begin in the warmer months? It is clear that spring and summer favored the invader" (Blainey 1973, page 99). However, he makes an even more direct and extensive appeal for a willingness explanation. Good weather causes nations to become optimistic about their prospects in war. This optimism leads to hubris. The seasonal cycle of conflict, Blainey argues, can be traced to fluctuations in national expectations for success.

While it might be that nations, and humans, tend to see things more cheerfully in springtime, it is not immediately clear that this argument is either necessary or sufficient to motivate seasonal fluctuations in conflict. To begin with, optimism as an argument is redundant if in fact good weather favors the offense as Blainey also suggests. It is not optimistic to perceive an advantage where one actually exists. Blainey's argument about seasonal misperception is thus weakened to the degree that the tenor of opinion simply follows fact. Nor does seasonally-induced optimism seem to have yielded consensus among contemporaries about how annual cycles of climate change were destined to influence the advent of major military contests. Blainey notes that European officials, anticipating war in the wake of the Agadir crisis of 1911, drew different conclusions about how weather would affect the onset of the great continental contest that broke out three years later.

> Although advisors might disagree in naming the season which seemed most likely to produce war, they believed that weather was one of those factors which influenced decisions to go to war (Blainey 1973, page 97).

Why would officials of nations impelled to war through seasonal enthusiasms find it so difficult to identify parallel motivations in other states? While blindness is always a possible explanation, it seems easier to imagine that tendencies of this type would be widely recognized, just as individuals involved in auto accidents have come to expect anger from the driver of the other vehicle,[2] or patients at a dental office are braced for discomfort. If nations can anticipate a seasonal rhythm of war-proneness, then it is possible that these same states can take steps to counter seasonal cycles of opportunity or willingness. Much as soldiers in all armies for ages have practiced the "stand to" at dawn to counteract opportune conditions for the assault, armies on the defensive could greet spring with heightened vigilance and preparedness. The effects of a seasonal pattern of war and peace will

[2]The issue is so endemic that many U.S. states have adopted the "no fault" approach to insurance/litigation in which it is no longer necessary to identify who was at blame in an accident, lessening the motives to argue onsite.

be less apparent if nations recognize this pattern and counter it through defense or deterrence.

Yet, there remain strong reasons to suppose that countermeasures, while no doubt enacted, are insufficient to entirely cancel the advantages of attacking with the benefit of good weather. Mobility is a force multiplier and immobility conversely weakens armies, particularly in the offense. The balance of power is not very important if an attacker is unable to advance or feed and supply its combat forces. Even for modern armies, mud, snow, rain or cold can do more damage than enemy artillery. Swollen rivers and impassible roads may do more to deter than unassailable redoubts. Weather can have such a tremendous effect on a nation's ability to project power that it is often better to suffer the loss of strategic surprise and attack at predictable periods in the year, rather than to invite the grinding or prohibitive effects of harsh climatic conditions (Winters 1998).[3]

If weather is a good reason to stay home, at least for portions of the year, it still does not follow that patterns of conflict will exhibit the seasonal cyclicality associated with varying state-level motives to fight. War is a strategic process involving the interaction of actors' motives. Seasonal incentives could simply be folded into the diplomatic negotiations that typically precede, accompany and often prevent the onset of war. One of the more important innovations in the study of international conflict in recent decades has been the insight that most factors thought to be associated with war initiation or victory are actually more appropriately thought of as components of leverage in bargaining (Fearon 1995).[4] Warfare is costly for both winners and losers. Given a deadweight loss from fighting, bargains will often exist that potential combatants prefer to actually having to fight. War is then redundant unless something obstructs effective bargaining (war often ends with bargains that could have been forged before fighting began). Theories of war are thus explanations for what prevents states from identifying or agreeing to war-preventing agreements. While being more likely to win, for example, might appear to make a state eager to attack, enemy advantages could also make opponents eager for compromise, mitigating the effect of military or political advantage on the probability that states fight. At least some of the effects of weather on conflict could be negotiated away, to the degree that effects are predictable and to the extent that

[3]This is not to say that individual commanders fail to find it expedient to attack when least expected. Perhaps the most famous example in Western military tradition is Washington's attack on Trenton on Christmas Day, 1776.

[4]Interestingly, this insight is preceded and approximated by Blainey (1973) himself.

bargains can be forged that represent the likely consequences of fighting before fighting occurs.

The problem with bargaining over the weather is that climatic conditions change. Advantages to an attacker that materialize in the spring or summer will fade in the fall and winter, leaving an attacker unable to prosecute an offensive with the same vigor anticipated previously. To the degree that the effects of climate on conflict are predictable and transitory, prospective targets have an incentive to drag out negotiations, delaying war until the weather turns and an attacker must choose between fighting without seasonal advantages, or waiting until good weather returns. Even if opponents are able to forge bargains that incorporate an attacker's seasonal advantage, the temptation will be for the target to "claw back" concessions once the campaign season has passed.

This inability to commit to bargains over the effects of seasonal climate change on conflict falls into a broader pattern of bargaining problems involving temptations for the disadvantaged party to renege on agreements when disadvantages are temporary or advantages ephemeral. Nations that are inherently stronger or better motivated to fight can demand, and expect to receive, lasting concessions from opponents. Even the advantages of surprise can be the basis for negotiations, as Fearon (1995) points out in discussing preemptive versus preventative war. It is not the presence of advantage, or even of incentives to strike first with force that matter for bargaining failure, but the mutability of advantages that prevents effective negotiation (Gartzke 2006, Slantchev 2010).

Where bargaining theory implies the need for considerable skepticism about the effects of relatively static contributors to victory such as military capabilities or resolve (Gartzke 2009), it is much more willing to entertain the impact of dynamic, particularly transient, factors such as climate on the advent of war and peace. Deals made over the weather are not durable because the weather changes. To the degree that these changes are both inevitable and predictable, they make bargains temporary and suspect. In fact, seasonal weather patterns have an important additional value as determinants of the timing of interstate contests. One of the more difficult aspects of international relations is identifying *when* states are likely to fight each other. Theories of war have generally shied away from making predictions about timing because this appears inherently more difficult than identifying factors that make competitors "ripe" for war. Given their nature, seasonal climate patterns lend themselves directly to theorizing about the timing of interstate contests.

3 Theory: Seasons of Conflict

Not only does traditional military lore and experience suggest that states should prefer to fight in the spring or summer, but the "the state of the art" in conflict theory embraces the notion that seasonal cycles of offensive advantage are particularly likely to precipitate violent contests because they are resistant to diplomatic bargaining. Since it is common knowledge that seasonal advantages in fighting must be temporary, potential attackers cannot threaten force with equal enthusiasm or credibility year round, while the targets of aggression cannot credibly promise to honor agreements made when a potential attacker is at the height of its power with equal felicity when the campaign season has passed. These insights lead to the expectation that the probability of conflict will vary with seasonal advantages to the attacker. For reasons explained below, I expect that the effect of this seasonal variation in conflict propensity will be most obvious for wars and other major contests.

Hypothesis 1 *Wars and major disputes are expected to vary seasonally, beginning or increasing in the spring and summer and terminating or decreasing in the fall and winter.*[5]

If advantages for the offense or defense shift with the seasons, it still does not follow that researchers will be able to observe a corresponding pattern of conflict behavior under all, or even most cirsumstances. Many aspects of social choice are obscured by the tendency for individuals, leaders and groups to respond strategically to opportunities or challenges. If fighting in winter is particularly difficult or ineffective in some places, it may be possible to fight somewhere else. Moving to lower/higher latitudes can have much the same effect as waiting for warmer/cooler periods in the annual calendar. Given this relationship, normal human impatience, and the inherent mobility of military forces, climate may have a much larger effect on the location of some contests than on the timing of these same disputes. Put another way, nations can be expected to design contests to take advantage of the effects of location in mitigating extremes of temperature, where possible. Rather than wait out the seasons, nations may substitute other locations as the venue for contests.

The question then becomes under which conditions conflict is likely to vary seasonally versus varying latitudinally. Two variables seem to be most relevant. First, size matters. Larger contests

[5]This effect may be accentuated in cooler climates, where nations are most deterred by the coldest weather.

are most likely to resist the temptation to relocate. Wars and other major disputes are costly acts, designed to maximize damage on an opponent. Most major contests involve contiguous states, so that moving the location of the dispute is far from simple. As Hypothesis 1 above implies, wars and major disputes should be most prone to seasonal variation in the frequency of contests. In contrast, minor disputes are by their nature bounded in terms of scale and scope. The exact location of these disputes is open to manipulation by a number of factors, including perhaps by seasonal weather cycles. Minor militarized disputes are the most likely to demonstrate geographic substitution, shifting the location of contests to compensate for the effects of annual weather patterns.

Hypothesis 2 *Minor militarized disputes are expected to vary their location with the seasons, occurring at higher latitudes in the summer and at lower latitudes in the winter.*

The second variable affecting the choice of where or when to fight involves the type of issue at stake in the contest. Nations contending over territory will often be compelled to fight at a given location, generally in some proximity to the disputed territory. To the degree that territorial conflict limits the ability of states to alter the location of the contest, the effects of seasonal weather patterns are more likely to be felt in determining the timing of the onset or termination of a dispute. Non-territorial conflicts, on the other hand, are often punitive actions designed to compel leaders to adopt or alter policies. As such, the location of a dispute is largely instrumental and could be replaced by another location, provided that the chosen location maximizes advantages for the attacker and damage to the enemy. Non-territorial disputes are disproportionately likely to exhibit seasonal displacement in location, minimizing the effects of weather on the frequency of contests.

Hypothesis 3 *The onset or termination of territorial disputes should tend to vary with the season.*

Hypothesis 4 *The average latitude of non-territorial disputes should tend to vary with the season.*

While fair weather fighting sounds appealing in a decision-theoretic framework, states in conflict may have varying incentives to respond to the weather by stopping or relocating disputes. Nations may fight *because* an opponent is inconvenienced by climate. After all, the purpose of war in large part is to cause harm to one's adversary. If an enemy does not prefer fighting in the cold or hot, then beginning or extending a conflict through the extreme season may not be a bad idea. Given the strongly zero-sum nature of military contests, nations may prefer fighting year-round, unless both sides are roughly equally affected by uncongenial climactic conditions. Seasonal patterns of conflict may be affected by the *relative* willingness of nations to fight throughout the year. As Harold Winters puts it, writing on weather and war, “in combat an environmental advantage for one side always means some degree of misfortune for the other” (Winters 1998, page 1).

Contests between nations that differ in their acclimation to a region might reflect less seasonal variation in weather patterns, since climate is more likely to advantage one nation or faction over the other. Thus, conflict involving two nations that are geographically distant should be less likely to exhibit seasonal variation than conflict between close neighbors. Examples include Napoleon and Hitler’s invasions of Russia, where intense winter fighting advantaged indigenous forces.

Hypothesis 5 *Seasonal variation in dispute onset or termination should decrease with distance.*

The effects of seasonal climate change could be affected by whether a dispute is reciprocated. Some disputes are one-sided, while others involve active participation by parties on both sides. Reciprocated disputes tend to be larger and more established, making them more difficult to relocate. Reciprocated disputes should thus be more affected by seasonal climate patterns than non-reciprocated disputes, exhibiting in particular less variation in the onset date of conflict.

Hypothesis 6 *Seasonal variation in onset or termination should be lower for reciprocated disputes.*

There is also a countervailing force to the implied size effect of reciprocation that should be particularly relevant for dispute termination. Non-reciprocated disputes can end at any time with the autonomous decision of the initiator — implying that they should be particularly responsive to the weather. Reciprocated contests, on the other hand, often require that all parties agree in order for a dispute to end, leading relative advantages of weather to prolong some contests. Since the effects of size (enhancing seasonal differences) and strategic interaction (diminishing differences) should work against each other in dispute termination, I expect to observe less variation in the timing of terminations of reciprocated and non-reciprocated disputes than for dispute onset.

The timing of contests may also be affected by changes in the vulnerability of armies to the weather. Blainey (1973) reasons that technological change has increased the ability of nations to sustain military operations in difficult climatic conditions, lengthening the campaign season and making year-round warfare more practical. If technological progress has lessened the inhibiting effect of seasonal climate variation, then one would expect to see that the relationship outlined by Hypothesis 1 is more noticeable in the nineteenth century, say, than in the twentieth century. Evidence of a diminishing seasonal pattern could also reflect rising average annual global temperatures, though it is difficult to disentangle technology from secular climatic change (Gartzke 2012).

Hypothesis 7 *Seasonal variation in dispute onset or termination should decrease over time.*

Information about the effects of seasonal temperature variation on the timing or location of militarized contests could prove informative in a variety of ways. One particular area of uncertainty involves the effects of global warming on war and peace.[6] There is growing concern that climate change will lead to a rise in international tensions. Barnett & Adger (2007), for example, argue that "direct and indirect impacts of climate change on human security may in turn increase the risk of violent conflict" (page 639). If the frequency of contests increases with seasonal warming, then it follows that global warming will likely lead to an increase in interstate disputes. If instead seasonal patterns do not co-vary with conflict, then climate change cannot be interpreted as necessarily pernicious, at least in terms of war and peace. Differences between conflict patterns at different dispute intensities, as suggested by the hypotheses should lead to a mix of these two tendencies.[7]

[6] A small but growing body of empirical research has begun to debate the validity of indications of climate-induced conflict, especially at the intra-state level. Burke, et al. (2009) provide evidence of significant increases in civil conflict associated with warmer annual temperatures in sub-Saharan Africa. However, these claims have been severely criticized by other studies (Nordås & Gleditsch 2007; Buhaug et al. 2010; Buhaug 2010). See also, Sutton, et al. (2010) for a critique specific to Burke et al. (2009). For a reply, see Burke, et al. (2010).

[7] Research identifies connections between climate and war over very long periods of human history. For example, Zhang, et al. (2007) show that global *cooling* is associated with a variety of harmful social effects including population decline and war in a period covering five hundred years from the early fifteenth century. Similarly, Tol & Wagner (2010) use data on warfare in Europe over a period of roughly half a millennium to show that the results of an earlier study by Zhang and a different set of collaborators (Zhang, Jim, Lin, He, Wang & Lee 2006) are robust.

4 The Effects of Seasonal Climate Change on Interstate Conflict

This section explores the empirical basis for the propositions outlined above. I use the annual cycle to represent seasonal climate variation, generally in the northern hemisphere where the bulk of interstate violence has occurred. I apply this variation to examine whether conflict varies in terms of frequency across the year. I also examine whether disputes are displaced to higher latitudes by variations in seasonal climate. I use both ordinary least squares when examining the latitude of disputes as the dependent variable, and negative binomial logit when assessing counts of conflict behavior as the dependent variable. After discussing the data for the analysis, I review the results.

The basic idea of seasonality in warfare embraces both the onset and termination of contests and a cycle of dispute intensity in ongoing disputes. Information in the conflict data I use here do not directly reflect the ebb and flow of campaign seasons in continuing conflicts. As such, my analysis almost certainly underestimates the overall impact of weather on warfare. Since the intent here is not to provide precise information about scale, but rather to assess hypotheses about cause, risk of type II errors (rejecting hypotheses drawn from "true" theories) may be dispelled if and when significant relationships are identified. Thus, I next seek to identify these relationships.

4.1 Data

Data for this study come from several sources. I have sought to identify and use conventional variables and model specifications in order to increase external validity and inter-comparability.

The most widely used source of data on interstate conflict are the Correlates of War (COW) Militarized Interstate Dispute dataset (MIDs) (Gochman and Maoz 1984; Jones, et al. 1996; Ghosn, et al. 2004). MIDs consist of all militarized threats, displays, or uses of force (and sometimes war) involving members of the international community, as identified by COW in the period 1816 to 2000. These data include the day, month and year of each MID initiation and termination. The dates for disputes are converted into days of the year by calculating the number of days for each month in the start or termination date, plus the number of days indicated for this event. Thus, a dispute that begins on February 4th, 1988 would create a day of the year value of $31 + 4 = 35$. In addition, Braithwaite (2010) geo-codes the location of all MIDs, allowing me to use these data to identify the latitude associated with each dispute. While the exact locations of contests may be debated, it is unlikely that Braithwaite coded locations with any intended favor for my hypotheses.

The Composite Indicator of National Capabilities (CINC) from COW measures the national material capabilities of each state every year in terms of military personnel and expenditures, iron or steel production and coal or oil consumption, and total and urban population (Correlates of War Project 2005). While various controversies exist about how best to measure power, CINC scores themselves are the most widely operationalized indicator of national capabilities. National capabilities could influence both dispute onset and termination, as well as the feasibility of relocating disputes, making it important to consider national capabilities in assessing climate and conflict.

COW also offers data on alliance status (Small & Singer 1990, Gibler & Sarkees 2004). Alliances are thought to influence dispute behavior and also capabilities, making it important to address the effects of alliances on the propensity and possibly also the timing of militarized contests. I code a dichotomous variable representing the presence or absence of a dyadic alliance or of a defense pact.

Regime type data comes from the Polity IV project (Gurr et al. 1989, Marshall & Jaggers 2002). Polity data consist of two eleven point indexes. DEMOC measures three institutional attributes of democracy: popular suffrage, constraints on the executive, and civil liberties. AUTOC codes restrictions on political participation. The indexes are routinely combined into an ordinal measure.

Contiguous states are far more likely to fight each other (Diehl 1985, Hensel 2000). In addition, a separate effect of proximity can be shown to be related to the distance between countries (Vasquez 1995). While the theoretical implications of proximity and contiguity have yet to be fully worked out (Senese 2005, Reed & Chiba 2010), there is reason to suspect that including both variables is necessary to properly assess the effects of seasonal climate change on conflict, particularly in relation to the relocation of disputes. Also, since distance is one of the variables called for by the hypotheses, including both distance and contiguity serves as a tougher empirical test.

In some regressions I use a measure of economic development to control for the impact of variable development levels across the sample. Per capita energy consumption correlates very highly with GDP per capita (c.f., Burkhart & Lewis-Beck 1994) and has the added value of actually measuring consumption of carbon emitting fuels. I use per capita energy consumption in all temporal tests.

I include several variables that represent system-level factors that might confound the analysis. *# Countries* is a count of the number of internationally recognized nation states by year. The number of countries in the world grows tremendously as a result of decolonization and other processes. *# Great Powers* captures some of the effect of system structure on tendencies to fight during different seasons or different latitudes. I also include dyadic major power status in some models in order to identify and differentiate the effects of major power status within a dyad from the more indirect impact of having a certain number of major powers in the international system.

4.2 Results

Early attempts to examine the seasonality of conflict focused on monthly variation in the frequency of wars. Figure 1 depicts the relationship between the month of the year and the number of MID wars. Each data point indicates the number of MID wars for a given month, averaged across most of the nineteenth and all of the twentieth centuries. A blue line represents the fractional-polynomial curve fit to these data, with the grey shaded region indicating the 95% confidence interval around the estimated function. Figure 1 thus supports early studies such as Blainey (1973) and Singer & Small (1970) and also Hypothesis 1; the probability of war increases throughout the spring and early summer, rising to a peak in July and declining thereafter through the fall and winter months.

Use of the month as the unit of analysis is problematic given variation in the length of different months.[8] In its place, I use the day as the unit of analysis below. Figure 2 represents the number of MID wars to occur in a given day of the year during the period 1816 to 2000 for the northern hemisphere. An equivalent plot of MIDs per day for the southern hemisphere reveals essentially the same relationship, so it is not reported here.[9] The shape created by the red polynomial curve is again that of a mild parabola, concave to the origin. Yet, given a rare event, considerable volatility exists in the time-series; there are days of the year in which as many as seventeen wars have begun, though the modal number of wars beginning on a given day of the year is zero.

The day of the year also poses a challenge for this analysis. Figure 3 tallies the number of MID onsets per day of the month for the 1816-2000 period. As the histogram illustrates, the day

[8] There is also ambiguity in how dates are recorded. Some versions of these data contain dates that do not exist.
[9] The difference in seasonal cycles between northern and southern hemispheres requires that I separate these results.

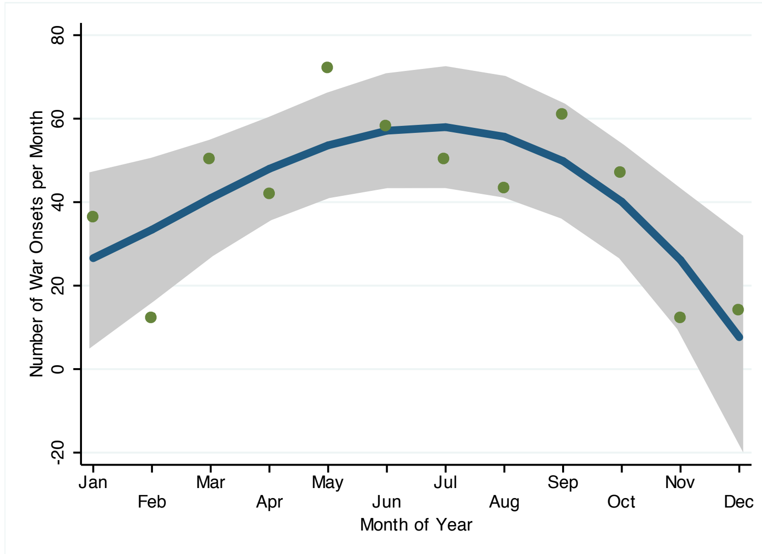

Figure 1: MID War Onsets per Month (Northern Hemisphere)

in which disputes are initiated is more-or-less random with the exception of the first day of each month, when disputes are roughly 4.5 times as likely to occur. The opposite pattern occurs for the ending day of disputes. Terminations are much more likely in the last few days of the month, depending on the length of the month. In order to save space, I do not report these results here.

Obviously, it is not an accident that the very beginning of the month is far more dispute prone. The question is whether one should believe that nations begin disputes disproportionately on the first of each month, or whether the anomaly is an artifact of Correlates of War coding criteria. While I was not able to document an official COW coding rule that would have led to this result, informal conversations with several members of the project suggests that the first of each month was used where a definitive starting day for a dispute was unavailable or controversial. Coding exact dates in every case is of course preferred, but use of the first of each month as the default category does not appear to interfere with the analysis here. In every test below, I also conducted the analysis while omitting data from the first (onset) or last few days (termination) of each month. Results are generally equivalent, and never contradicted the results for the hypotheses reported here.

Returning to the analysis of MIDs by the date, Figure 4 looks at all MID onsets. The red parabolic curve is now much flatter, indicating that militarized disputes are about as likely to

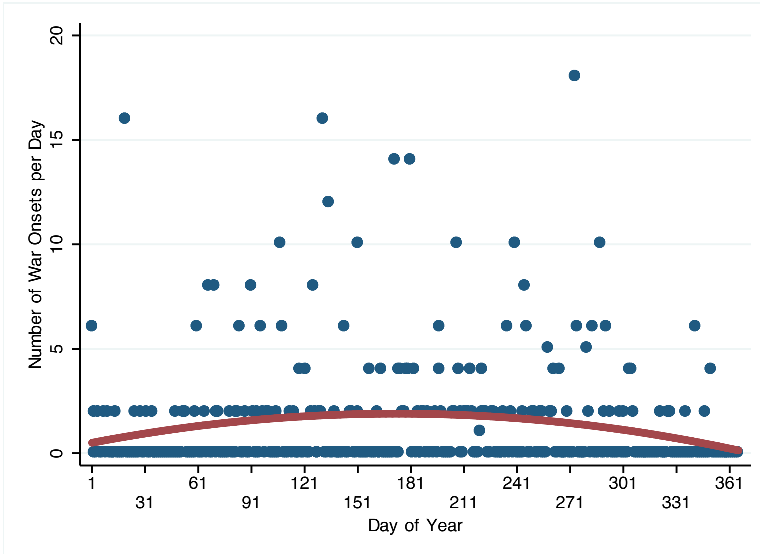

Figure 2: War Onsets per Day (Northern Hemisphere)

occur at any point in the year. This non-relationship is even more pronounced for minor disputes, as the sample of all MIDs depicted here also includes wars and fatal MIDs. So, Figure 4 appears to support the claim that minor MIDs experience little or no seasonal variation in dispute frequency.

Even a seasonal assignment of start dates should yield a similar frequency of MIDs in January and February as in November and December. The line plotted in Figure 4, however, trends downward slightly. Again, at least part of the apparent annual downward trend in MIDs can be explained by how these data are coded. Lacking certainty about starting dates for disputes, coders must exercise some discretion or apply a protocol. The standard appears to have been to "front load" the timing of disputes when dates were not obtainable. This effect can be seen even more clearly in Figure 5, which lists the termination dates of militarized disputes.[10] Here again there is no discernible seasonal variation in frequency, but the number of terminations rises steadily throughout the year, so that there are more terminations at the end of the year than at the beginning.

The relationship between MIDs generally and the probability of fighting in different parts of the year seems to be much less variable than that found for MID wars. To verify whether this is so, I next examine these relationships using multivariate statistical analysis. Table 1 provides six regressions

[10]Though not critical for the analysis here, the dates of MID terminations seem more tenuous than onsets.

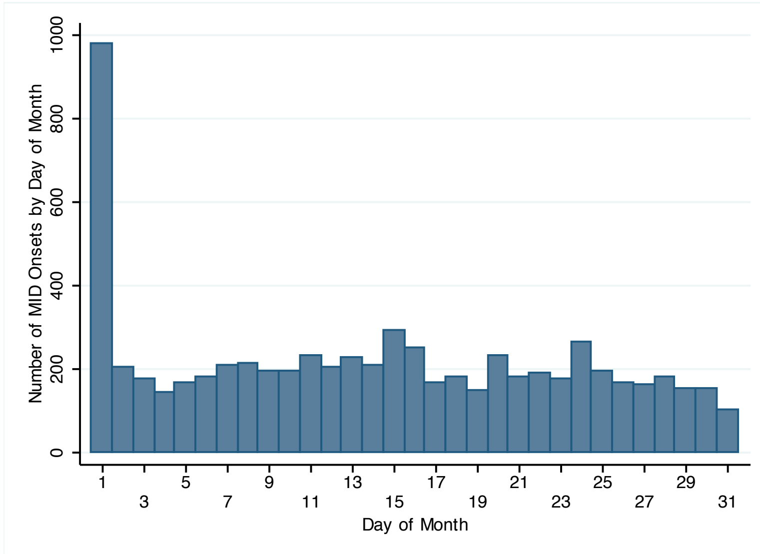

Figure 3: MID Onsets by Day of Month

of the relationship between the frequency and timing of different samples of MIDs occurring in the northern hemisphere.[11] The negative binomial estimator is used to accommodate a count dependent variable. Conventional control variables seem mostly irrelevant in analyzing the timing of disputes. For this reason, and to simplify the initial model specifications (Achen 2005, Clarke 2005, Ray 2005), all six regressions in Table 1 are kept quite simple, including only the day of the year that a MID occurs, the square of this variable to capture predicted non-linearities as well as an intercept.

The first three models in Table 1 focus on war onset. Model 1.1 contains all militarized dispute onsets, Model 1.2 includes fatal MID onsets, while Model 1.3 limits the sample to MID wars. The last three models in Table 2 assess termination. Model 1.4 again focuses on wars, but uses the day of the year and its square to predict terminations of major conflicts. Models 1.5 and 1.6 examine terminations of fatal MIDs and all MIDs, respectively. As should be clear from the results, the relationship between the timing and frequency of conflict depends on the intensity of the fighting. Minor disputes reveal no seasonal variation in the onset or termination of conflict, while wars and fatal MIDs demonstrate precisely this sort of pattern. Neither *Day of Year* variable is statistically significant in Model 1.1. In contrast, Models 1.2 and 1.3 report that fatal MIDs and particularly

[11] Roughly 90% of MIDs occur north of the equator. Results are equivalent for MIDs in the southern hemisphere.

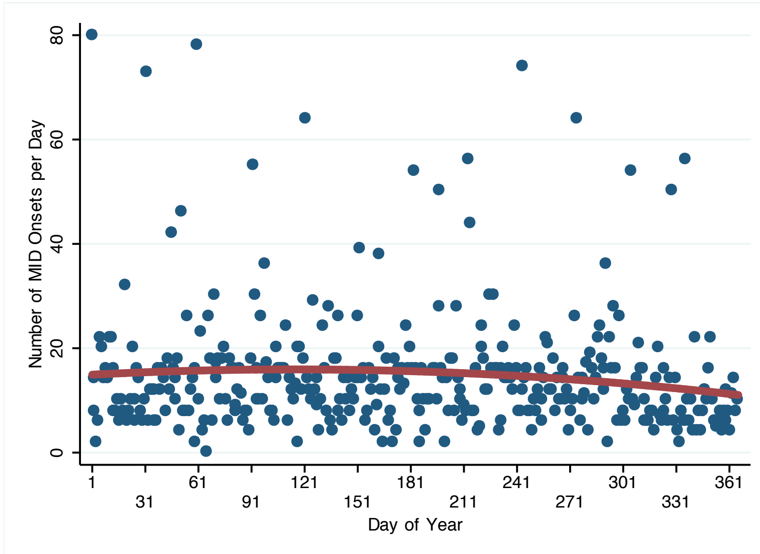

Figure 4: MID Onsets per Day (Northern Hemisphere)

MID wars are increasingly likely to begin in the spring or summer, with declining conflict propensity in the fall and winter, the very same pattern of conflict behavior as outlined by Hypothesis 1.

Results for Models 1.4 through 1.6 mirror those of the first three regressions in Table 1, with a few notable exceptions. As with war onset in Model 1.3, the termination of MID wars (Model 1.4) rises in the early days of the year and descends late in the annual cycle. However, this relationship is only significant at more modest thresholds, perhaps because of the limited number of war terminations. The pattern is more strongly borne out for fatal MIDs (Model 1.5). Finally, Model 1.6 reveals that MID terminations do not generally vary with the seasons, just as with onsets generally. Note that the "All MIDs" sample in Model 1.1 includes a minority of wars and major disputes, which while benevolent for this analysis is not precisely the sample anticipated by Hypothesis 2. Model 1.6 includes only those MIDs that do not involve fatalities, thus focusing more closely on minor MIDs. A relationship thus exists between the seasons and the frequency with which nations fight, but only for relatively intense forms of fighting. Minor militarized disputes generally fail to exhibit seasonal variation, at least not in terms of dispute onset or termination.

I next examine whether seasonal climate change affects where nations fight. In contrast to the effect of seasonality on the timing of contests, evidence for a seasonal effect of climate on the

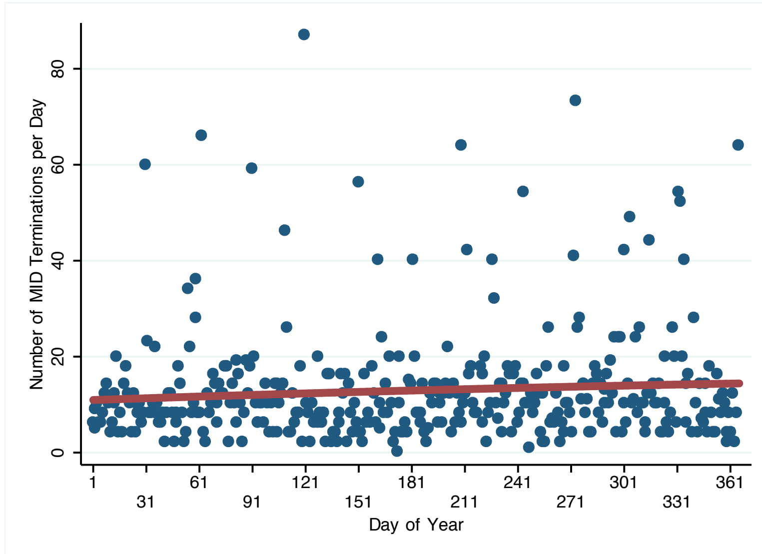

Figure 5: MID Terminations per Day (Northern Hemisphere)

location of contests involves using directed dyads as the unit of observation. Each dispute occurs at some place on the globe. I use data from Braithwaite (2009) that identifies the latitude (i.e., degrees north or south of the equator) of each MID. The key independent variable is now the start date of each dispute. I also include the quadratic (square) term for the start date to allow for the expected non-linear relationship between date and location. Each regression also includes a series of other variables to address alternative explanations and to control for various confounding factors.

Model 2.1 is a basic representation of the relationship between the date of MID onset and the latitude at which contests occur. I include both linear and quadratic (squared) terms for the day of the year, as outlined by Hypothesis 2. The linear date term is positive, suggesting that the location of disputes moves farther north in the spring and summer. The second, quadratic date term is negative, revealing a growing tendency for disputes to move farther south as time progresses toward the end of the year, in the fall and winter. While this pattern persists in all regressions of location on the time of year for the all disputes sample, it is important to note that the pattern is not repeated among wars and more intense disputes. Model 1.2 reports the effect of seasonal variation on the latitude of wars for the same regression specification as used in Model 1.1. Some caution is called for in comparing the results from these first two regressions in Table 2, given the

Table 1: Predicting the Timing of MIDs by the Day of Year, and by Year,
(Day of Year Observations, Negative Binomial Regression, MID onsets 1816–2000)

	Onset			Termination		
Model:	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
D.V.:	All MIDs	Fatal MIDs	MID Wars	MID Wars	Fatal MIDs	Non-fatal MIDs
Variable	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
Day of Year	0.00147	0.00832 ***	0.0141 ***	0.0149 **	0.0157 ****	0.00110
	(0.00178)	(0.00278)	(0.00486)	(0.00577)	(0.00439)	(0.00179)
Day of Year^2	-0.000006	-0.00003 ****	-0.00004 ****	-0.00003 *	-0.00003 **	-0.000001
	(0.000005)	(0.000008)	(0.00001)	(0.00002)	(0.00001)	(0.000005)
Intercept	2.690 ****	0.456 *	-0.446	-0.890 *	-1.077 ***	2.394 ****
	(0.152)	(0.203)	(0.406)	(0.409)	(0.370)	(0.135)
$\ln(\alpha)$	-1.045 ****	0.490 **	1.327 ****	2.072 ****	0.673 ****	-0.749 ****
	(0.117)	(0.153)	(0.139)	(0.142)	(0.152)	(0.101)
N	365	365	365	364	364	364
Log-likelihood	-1288.10	-650.65	-524.58	-463.89	-633.28	-1267.81
$\chi^2_{(2)}$	6.49	27.21	13.42	8.84	28.66	2.91

Significance levels : * : 5% ** : 1% *** : 0.5% **** : 0.1%

disparity in sample sizes. However, the lack of a significant effect for the two *Day of Year* variables for the war regression is at least consistent with the prediction of Hypothesis 2. There is no seasonal variation in the latitude of MID wars, as opposed to the frequency of these major contests.[12]

Along with the two date variables, I include two year variables with an equivalent specification. Each year variable is modestly statistically significant in opposite directions. I also examined models with a single year variable, though this was generally not significant. Together, these two findings suggest that the effect of history on the location of disputes is also non-monotonic. A possible explanation for the non-linear effect of the year is that initially development led European states to project power ever closer to the equator, forcing the median latitude of disputes farther south as the nineteenth century progressed. Later, after World War II, this process reversed itself, leading decolonizing European powers to appear to be fighting farther north with the passage of time. It is important to note, however, that none of this alters the impact of seasonal variation on conflict.

[12]By itself, the linear *Day of Year* variable is not statistically significant in any regression reported in Table 2. Regressions of wars or fatal disputes on the location of contests are omitted to save space (available from the author).

Table 2: The Effect of Seasonal Change on the Latitude of Militarized Interstate Disputes (Directed Dyad Year Observations, OLS using STATA, MID location data 1816–2000)

	— Onset	—	—	Termination	Territorial	Non-terr.
Model:	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)
D.V.: Latitude	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Variable	(S.E.)	(S.E.)	(S.E.)	(S.E.)	(S.E.)	(S.E.)
Day of Year	0.0492 ****	0.0640	0.0538 ****	0.0510 ***	0.0176	0.0461 ****
	(0.0137)	(0.0409)	(0.0148)	(0.0163)	(0.0203)	(0.0142)
Day of Year^2	-0.00013 ****	-0.00017	-0.00014 ****	-0.00011 **	-0.00004	-0.00012 ***
	(0.00004)	(0.0001)	(0.00004)	(0.00004)	(0.00005)	(0.00004)
Year	-5.552 *	-16.61 *	-5.519 *	-5.308 *	-5.128	-6.026 *
	(2.330)	(7.639)	(2.484)	(2.284)	(3.931)	(2.360)
Year^2	0.00148 *	0.00441 *	0.00146 *	0.00141 *	0.00138	0.00160 *
	(0.0006)	(0.0020)	(0.0007)	(0.0006)	(0.0010)	(0.0006)
CINC$_A$			26.45 ****	30.20 ****	55.87 ****	29.89 ****
			(6.183)	(5.900)	(12.01)	(6.199)
CINC$_B$			26.35 ****	30.09 ****	55.82 ****	29.80 ****
			(6.207)	(5.918)	(11.99)	(6.219)
CINC$_{A \times B}$			10.97	35.35	-125.3	16.93
			(69.46)	(65.20)	(154.1)	(66.27)
Alliance (dummy)			-1.497	-1.276	5.003 ***	-1.522
			(1.287)	(1.235)	(1.681)	(1.323)
Democracy$_A$			0.384 ***	0.247 *	0.392 *	0.287 *
			(0.126)	(0.122)	(0.188)	(0.126)
Democracy$_B$			0.381 ***	0.244 *	0.391 *	0.285 *
			(0.125)	(0.121)	(0.189)	(0.125)
Dem$_{A \times B}$			0.00736	0.0207	-0.0112	0.0112
			(0.0273)	(0.0265)	(0.0373)	(0.0278)
Contiguity			1.544 ****	1.518 ****	2.665 ****	1.500 ****
			(0.241)	(0.229)	(0.438)	(0.242)
Distance			-0.371 ***	-0.426 ****	-0.230	-0.440 ****
			(0.118)	(0.114)	(0.215)	(0.120)
# States	-0.198 ***	-0.483 **	-0.171 **	-0.181 ***	-0.265 ***	-0.194 ***
	(0.0634)	(0.180)	(0.0667)	(0.0606)	(0.0907)	(0.0628)
# Great Powers	1.878 ****	1.080	2.003 ****	1.820 ****	1.539 *	1.943 ****
	(0.409)	(0.966)	(0.416)	(0.396)	(0.600)	(0.410)
Intercept	5229.6 *	15698.9 *	5222.1 *	4993.8 *	4776.9	5674.5 *
	(2180.7)	(7187.9)	(2324.2)	(2137.3)	(3701.0)	(2207.2)
N	5368	497	4420	5141	1376	4845

Significance levels : $*$: 5% $**$: 1% $***$: 0.5% $****$: 0.1%

Model 2.3 adds additional control variables to confirm the robustness of the basic relationship. The model introduces a series of security-related variables, including *Defense Pact*, monadic and dyadic capabilities scores, and contiguity and distance. I also add monadic and dyadic measures of regime type. The two interaction terms (between CINC scores and among democracy variables) are not statistically significant in this or in subsequent regressions in Table 2. Alliance status is also insignificant in this and most of the remaining models, with one important exception. States' monadic material capabilities are statistically significant and positive in all models in Table 2. Monadic democracy is generally associated with disputes at higher latitudes, which is not surprising given the geographic concentration of democracy for much of modern history (Gleditsch 2003). Contiguous states tend to have more northerly contests, or perhaps more northerly states have more contiguous neighbors, so that contiguity appears to affect latitude when in fact contiguity pre-disposes states to fight regardless of latitude. Distance also decreases the latitude of contests, though it is not clear whether this is consistent with or simply orthogonal to Hypothesis 7. Model 2.3 also removes all onsets occurring on the first of each month. Results with and without data on initial (in the case of onsets) or final (terminations) days of the month are essentially the same.

Before moving on to discuss the remaining regressions in Table 2, it may prove informative to plot the effects of *Day of Year* and its quadratic on dispute propensity. Figure 6 plots the relationship from Model 2.3 in Table 2. Seasonal variation in conflict behavior is expressed in terms of the day of year (the x axis on the graph represents percentiles, rather than days). On average, interstate MIDs in the northern hemisphere occur farther north in summer months and farther south in the cooler portions of the year. While not a dramatic effect, the change is significant and substantively meaningful. The average contest in July occurs at approximately 28° 30' north latitude, while in January the same contest occurs at about 23° 30' north latitude, or approximately 556 kilometers or 345 miles farther south. Note also that variation in where disputes occur is slightly higher in the summer months. States have a bit more "latitude" in where they fight when average temperatures climb, which suggests in turn that it may become slightly more difficult to predict the likely location of militarized contests as average temperatures on the earth grow warmer.

Model 2.4 further modifies the analysis by examining the effect of termination dates on the

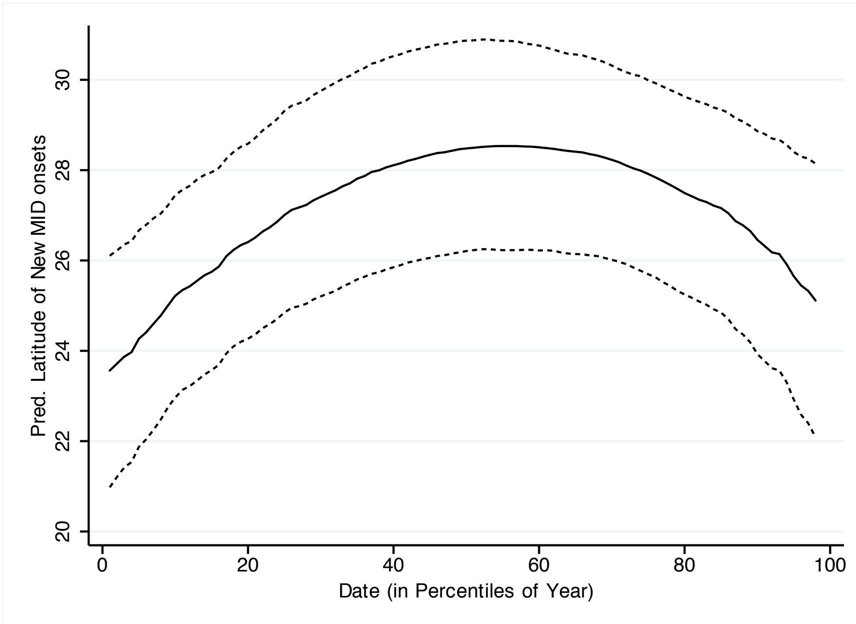

Figure 6: Latitude Predicted By Season in the Northern Hemisphere

latitude of disputes. Rather than demonstrating a direct causal relationship, it is most likely that termination dates correlate in a non-linear manner with the location of contests because they correlate with onsets. MIDs tend to be brief and are bound to end not long after they begin, particularly when dealing with the minor disputes that are most prone to relocate geographically in response to seasonal variations in weather patterns. Still, these results support Hypothesis 2.

The last two regressions in Table 2 compare the effects of the seasons on territorial versus non-territorial disputes. Hypotheses 3 and 4 differentiate the effects of seasonal climate change on the location and frequency of these two pretexts for conflict. As suggested by the hypotheses, territorial disputes appear unresponsive to the potential to relocate contests latitudinally in response to evolving weather conditions. In contrast, non-territorial disputes seem to be highly responsive to seasonal variation, displacing these disputes in a highly significant and predictable pattern.

Testing Hypotheses 5 through 7 involves identifying the effects of distance, reciprocity and time on the date of disputes. In each model in Table 3, the dependent variable is coded by subtracting the date of the onset or termination of a dispute from the mean value for the date variable, and then taking the absolute value of this difference. Large values thus constitute more substantial departures from the expectation of the respective date variable. The dependent variable in Model 3.1 is thus equal to $Abs\,(\bar{x} - x)$, where x is the onset date of each dispute, and $\bar{x}$ is the mean (expected) value of x. I further delimit the sample by again dropping the first day of each month in order to avoid biasing upward the apparent dispersion in these data. As predicted by Hypothesis 5, distance tends to diminish seasonal conflict variation. Increasing the space between the capitals or major cities of two nations increases the average discrepancy between actual and mean dates for the onset of disputes. In other words, *Distance* has the effect of "flattening" the peaks in any annual cycle of conflict. The march of time is also associated with a trend toward a flatter trajectory in seasonal conflict onset. Hypothesis 7 thus also appears to be supported by these findings.

Model 3.2 adds a number of security-related variables, none of which demonstrate statistical significance. Of greater interest, however, if the effect of reciprocal conflict on the timing of disputes. *Reciprocated* is a variable coding the presence or absence of mutual militarized violence in a dispute. As the results of Model 3.2 reveal, reciprocated disputes exhibit significantly less variation in start dates. As predicted by Hypothesis 6, fighting on both sides leads onsets to cluster more closely around dates in the mid-year. Conversely, non-reciprocated disputes, as less intense and more flexible contests, allow initiators greater freedom in the timing of the onset of militarized disputes.

Model 3.3 further assesses the robustness of the basic findings by including additional control variables. While the monadic and dyadic democracy variables in particular are statistically significant, they do not alter the estimated relationships between distance, reciprocal conflict, year and deviations in the timing of disputes. Distance tends to increase the dispersion of onset dates around the mean value; as states are separated by greater distance, they are less able to agree to adjust the timing of contests seasonally, preferring instead to fight throughout the year. As I have suggested, this may reflect intensified comparative advantage associated with fighting year round, since seasonal cycles of conflict depend on competitors mutually preferring to avoid bad weather.

Reciprocation of disputes, in contrast, leads to increasing seasonality in conflict patterns. This is most likely the result of reciprocal disputes being larger and more difficult to relocate. Finally, the notion that warfare is becoming less seasonal over time appears to be borne out in these analyses. The year variable is positive and highly statistically significant. Nations appear increasingly less

Table 3: The Effect of Distance on the Timing of Militarized Interstate Disputes
(Directed Dyad Year Observations, OLS using STATA, MID location data 1816–2000)

	— ——— Onset ——— —			— - Termination - —	
Model:	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)
D.V.: $Abs(day - \overline{day})$ **Variable**	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
Distance	0.0019 ****	0.0023 ****	0.0023 ****	-0.0009 **	-0.0043 ****
	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0009)
Reciprocated		-5.261 ****	-3.750 ***	-3.188 *	
		(1.405)	(1.335)	(1.405)	
Year	0.183 ****	0.170 ****	0.124 ****	-0.0452	-0.289 *
	(0.0394)	(0.0392)	(0.0355)	(0.0404)	(0.132)
Contiguity		0.674	0.343	-0.337	-0.404
		(0.537)	(0.486)	(0.465)	(1.417)
CINC_A		-15.35	2.177	46.24 ****	206.5 ****
		(14.32)	(17.30)	(13.54)	(63.99)
CINC_B		-14.54	3.164	46.03 ****	202.8 ***
		(14.30)	(17.28)	(13.52)	(64.09)
$\text{CINC}_A \times {}_B$		-257.7	-350.7 *	-412.9 **	-1469.2 ***
		(156.5)	(159.4)	(152.0)	(504.3)
Alliance		-0.676	-2.627	0.329	-28.34 ****
		(1.980)	(1.774)	(2.074)	(7.667)
Democracy_A			-1.148 ****		-1.107
			(0.293)		(1.107)
Democracy_B			-1.157 ****		-1.052
			(0.293)		(1.111)
$\text{Dem}_A \times {}_B$			0.338 ****		0.251
			(0.0520)		(0.261)
Development_A			-0.152		-0.0188
			(0.182)		(1.953)
Development_B			-0.154		-0.0437
			(0.182)		(1.951)
$\text{Dev}_A \times \text{Dev}_B$			-0.0211		0.431
			(0.0131)		(0.668)
Major Power			-3.876		-23.21 ***
			(2.155)		(7.441)
# States	-0.117 ****	-0.134 ****	-0.113 ****	0.121 ****	0.553 ***
	(0.0292)	(0.0297)	(0.0283)	(0.0295)	(0.179)
# Great Powers	1.997 **	1.386 *	0.938	0.535	11.41 ****
	(0.644)	(0.659)	(0.644)	(0.654)	(2.990)
Intercept	-268.9 ****	-237.8 ****	-139.5 *	163.4 *	538.7 *
	(74.25)	(73.81)	(66.29)	(76.12)	(234.9)
N	5716	5630	6346	5708	420

Significance levels : $*$: 5% $**$: 1% $***$: 0.5% $****$: 0.1%

constrained by annual climatic cycles, preferring or being better able to fight in all four seasons.

Models 3.4 and 3.5 assess the effects of an equivalent set of independent variables on deviations in the termination dates of disputes. Results for dispute termination are generally weaker than for deviations in onset. In particular, note the coefficient on the *Distance* variable changes sign. Distant disputants tend to experience less variation in the termination dates of their contests than do more proximate combatants. This effect is most pronounced in Model 3.5, where the sample is limited to MID war terminations. If advantaged states tend to pick the timing of the onset of contests, while losers decide when wars end, then disparate familiarity with local climates should encourage an increase in variation in the date disputes begin and a reduction in variation in when they end, as indeed is the case here. Results for reciprocation in Model 3.4 do not change sign from those in previous models. However, the significance threshold is much lower. Reciprocated disputes tend to end in the summer more often than non-reciprocated disputes. This weakening of the relationship, however, reflects the contrasting forces of larger dispute size and strategic interaction, as discussed in the paragraph following Hypothesis 6 above. The *Reciprocated* variable cannot be included in Model 3.5, since this only includes war terminations, which by definition involve reciprocated dispute relationships. Results for the time variable are also weaker and more equivocal in the termination regressions. In contrast to onset, the passage of time seems to draw terminations toward the seasonal mean, rather than dispersing dates as occurs for dispute onset.

5 Conclusion

The results reported here suggest contrasting effects of seasonal factors on the timing and location of contests. Seasonal climate change has little or no impact on when nations experience relatively minor militarized disputes. This could result either because initiators pay little attention to seasonal factors in determining the timing of minor disputes, or because mobile contests are more readily relocated to locations with more moderate climatic conditions. Evidence of a latitudinal shift in the location of disputes corresponding to seasonal climate change strongly suggests that the latter argument is more nearly correct. The effects of seasonal climate change are much more pronounced for larger (fatal) disputes and wars. Combatants in large military contests appear to make a considerable effort to begin or terminate disputes at times that avoid the worst effects of weather.

While minor disputes are not connected to annual climate cycles through the frequency of dispute onset or termination, they do exhibit a corresponding seasonal shift in the location (latitude) of such contests. As the analysis here seems to indicate, fighting moves to higher latitudes in the summer, and lower latitudes during winter months, at least in the northern hemisphere. This novel finding contradicts conventional wisdom about the effect of seasonality in conflict, while at the same time reconciling previous speculation and analysis with evidence of a seasonal cycle cycle for less mobil wars and territorial disputes. Wars, fatal disputes and territorial contests tend to remain in place, beginning and ending with the seasons, but not relocating with the weather.

Additional implications of the substitutability of location for climate and the commitment problem nature of seasonal advantage also appear in the analysis. More distant dyads tend toward year-round conflict initiation, probably because at least one state perceives itself to be relatively advantaged by extremes of climate. Nations cannot agree on the timing of dispute onsets or terminations when seasonal weather cycles influence the balance of power. At the same time, reciprocal disputes increase the seasonality of dispute onsets in particular and to a lesser extent terminations. This is most likely reflects the greater size and intensity of reciprocal disputes, making it more difficult to relocate such contests geographically. Finally, technology appears to be lessening the seasonality of conflict. The dispersion of beginning and ending dates for militarized contests is increasing with the passage of time. We can no longer blame the timing of contests on the weather, as modernity increases the capacity of nations to field effective military forces year round.

Before closing, it may be useful to extend some implications of this analysis to the future. Global warming promises to increase average annual temperatures, raising both seasonal lows and highs. Modest increases in temperature should tend to flatten out seasonal cycles of dispute onset and termination, much as we already observe in the effects of technological change. Together, these forces should tend to reduce or even eliminate the seasonality of conflict for major disputes, territorial disputes, and wars. The effects of climate change on minor disputes is more difficult to evaluate. Shifts in the location of contests are driven by seasonal patterns of conflict. If nations no longer need to curtail dispute behavior because of the weather, then there may be no reason to alter the location of more mobile disputes. However, at least some of the relocation of minor contests can be interpreted as resulting from seasonal temperature highs, rather than lows. If disputants are moving to higher latitudes in the summer — rather than simply relocating to avoid winter weather — then rising temperatures may compensate at lower latitudes for what is being reduced in more temperate regions. Global warming could see a shift in summer contests farther north, affecting major population centers and economic networks in the northern hemisphere.

At the same time, the most dramatic effects of climate change on interstate conflict may have less to do with seasonal cycles in the location of contests than with the overall average. Global warming is gradually melting the permanent ice caps at the poles. We have already observed a move by the key naval powers of northern Europe, North America, and Asia to explore and exploit the Arctic. The potential for year-round combat in regions previously enclosed by impassible ice should tend to dramatically shift the locus of contests to higher latitudes. Regions once devoid of dispute behavior may serve as significant venues for future disputes.

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