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The existence of a subculture of violence in the American South has long been considered a "social fact" (Cohn et al. 2004, p. 1652). Similarly, the existence of a link between temperature and violence has been postulated by laymen (Anderson 1989), and many researchers have investigated such a relationship (see Anderson 1989 for a review). Under a deterministic model, temperature is hypothesized to affect violent crime through two general pathways: routine activities, in that people will spend more time outdoors in pleasant weather and therefore have greater chances of engaging in interpersonal conflicts with each other (Rotton & Cohn 2003; Hipp et al. 2004); and psycho-physiology, in that aggression has been shown to increase under extreme temperatures (Anderson 1989).

There is more to weather than simply temperature, however: two locations can have similar temperatures but very different weather because of atmospheric conditions such as precipitation and humidity. Additionally, while the weather in a given location can change daily or even hourly, regions are characterized by their long-term climates. Because climate varies across the United States, this raises an important question about the so-called Southern subculture of violence: is it possible that what has been characterized as a geographic phenomenon is instead, or at least partially, an effect of climate on violence?

In the following sections, I begin by addressing the distinction between weather and climate. I then continue with a review of select studies in meteorological criminology. Finally, I report on the current state of geographic climate region definitions and the deficiencies therein.

Weather vs. Climate

The Intergovernmental Panel on Climate Change (IPCC) differentiates climate from weather in that climate describes the mean and variance of weather conditions (such as wind, precipitation,

and temperature), typically over a 30-year period (IPCC 2013). Climate, therefore, characterizes the long-term average weather of the region for which it is defined.

Few contemporary studies of violence, however, have extended long-term precipitation and temperature data to include other variables (such as windiness, cloudiness, daylight hours, humidity, and barometric pressure) that contribute to climate; the studies that have included such variables have suffered from numerous limitations.

Crime, Weather, and Climate

In testing the effects of routine activities and aggression on seasonal crime trends, Hipp et al. (2004) find that property crime rates are mainly influenced by routine activities but find mixed effects for violent crime rates, which results indicate are affected by both phenomena—implying two pathways between temperature and violence. Anderson & Anderson (1996) find that when controlling for an index created from temperature variables, the effect of southerness on homicide shrinks dramatically, even reaching nonsignificance when controlling for social variables; they conclude, however, that it is "implausible" that there is no effect of southerness on homicide (p. 750). Cohn (1990b), in a review of the literature on climate-related relationships with different types of crimes, surveys conflicting results of various studies that examine a possible link between heat and homicide; the author finds that "there is evidence of a long-term association of high-temperature climates with homicides" (p. 283). Rotton & Cohn (2003) conclude that at the national level, there is no link between average annual temperatures and homicide rates, but that at the state level, there emerges a U-shaped relationship between temperature and homicide, with higher homicide rates occurring at both temperature extremes.

The aforementioned studies, however, interpret the effects of temperature alone on homicide, neglecting to take into account such conditions as wind, precipitation, humidity, barometric pressure, cloud cover, and daylight hours. Here, I review three studies that leverage one or more additional atmospheric variables (but for a more complete overview, see Cohn 1990a).

Baylis (2015) uses geolocated tweets and daily weather data for each user's location to explore the effect of temperature and humidity on hedonic state, which is a one-dimensional scale that defines mood. The author implements a heat index, which essentially describes a complicated interaction between temperature and humidity, and finds that high heat-index levels are significantly and inversely correlated with hedonic state; put simply: high temperatures and high humidity combined result in bad moods. Additionally, the author reports that cloudiness also has a negative effect on mood. The study, however, suffers from three key limitations: First, the study is limited because it fails to report on interactions beyond heat index between weather conditions; the reader is left to wonder whether there could be, for example, an interactive effect of windiness and precipitation, on hedonic state. Second, because it is performed at the individual level and with daily meteorological data, the study fails to account for potential lagged effects of weather on mood. Third, and related to the second point, the study focuses on the effect of daily weather conditions, not the effect of climate. Despite these shortcomings, however, the study establishes effects of both humidity and cloudiness on mood: while the author does not investigate a link between daily weather and violence or other crime, the findings that heat index and cloudiness are inversely correlated with hedonic state suggest that such conditions may be further correlated with aggression and crimes that stem from negative mood.

In an estimation of the effects of changing climate (operationalized with temperature and precipitation anomalies) on a variety of types of crimes, Mares (2013) corrects for seasonal effects and finds no significant effect of either precipitation or precipitation anomaly on homicide (but does find that homicide is significantly affected by expected temperature). The study, however, is based on data for a single city—St. Louis, Missouri—and furthermore does not account for any possible interactions between temperature and precipitation, nor does it consider additional meteorological conditions. Nevertheless, the author provides a theoretical basis for the inclusion of precipitation, stating that it may counteract the positive effects of temperature on crime via both the aggression (by lowering temperatures) and routine activities (by discouraging people from venturing outside) pathways to crime.

Using twelve months of daily meteorological and crime data from the city of Mashhad, Iran, Talaei et al. (2014) find no evidence of an effect of temperature, humidity, or barometric pressure on homicide. The study, however, appears to be fraught with numerous methodological issues: Not only was the incidence of homicide so low (homicides ranged from 0–3 per day) as to render the lack of a relationship questionable, but there is also a concern that analyses at the daily level are excessively fine-grained and therefore unsuitable for capturing lagged correlations or medium- to long-term trends. Additionally, this investigation operationalizes the independent variables not continuously but categorically, splitting the full range of each variable into four sub-ranges and assessing the correlation between types of day and homicide. Despite using both temperature and humidity variables, the study does not consider any interactions (either multiplicative or via a heat index) between the two conditions. Furthermore, it is not clear how homicide is operationalized; the authors give both a daily range (0–3) and an average daily range (0.17 ± 0.45), but analyses are done using the latter term, the definition for which is nebulous. Given the multiple concerns about the robustness of the research undertaken therein, the study makes at best a tenuous contribution to the literature on the possible relationship between weather and homicide. That it failed to establish links between the three conditions measured and homicide is not reliably indicative that no such links exist.

Beyond establishing the existence of a relationship between temperature and crime (though its shape and the exact causal mechanism have not been conclusively identified), the corpus of meteorological criminology does not offer much in the way of firm conclusions. Because of varying definitions of weather and climate, disparate units of analysis, and inconsistent study periods, different studies have reached contradictory results (Cohn 1990a & 1990b). The research undertaken herein aims to advance the literature not only by operationalizing climate holistically but also by using such operationalization to classify geographic climate regions in the United States. As they are currently defined, such climate regions are insufficient for research needs in the social sciences.

Geographic Climate Regions

The National Oceanic and Atmospheric Administration (NOAA) has defined nine distinct geographic climate regions in the contiguous United States, as displayed in Figure 1 below. It is not clear, however, what data or methods were used to define such regions, which are drawn on state lines. That state lines sometimes correspond to geographic features but are largely socially constructed suggests such regions may be somewhat arbitrary and overly simplistic. Additionally, the regions do not allow discontiguous areas to have the same climate; this is in contrast to what is arguably the most widely used geographic climate model, the Köppen–Geiger climate classification system.

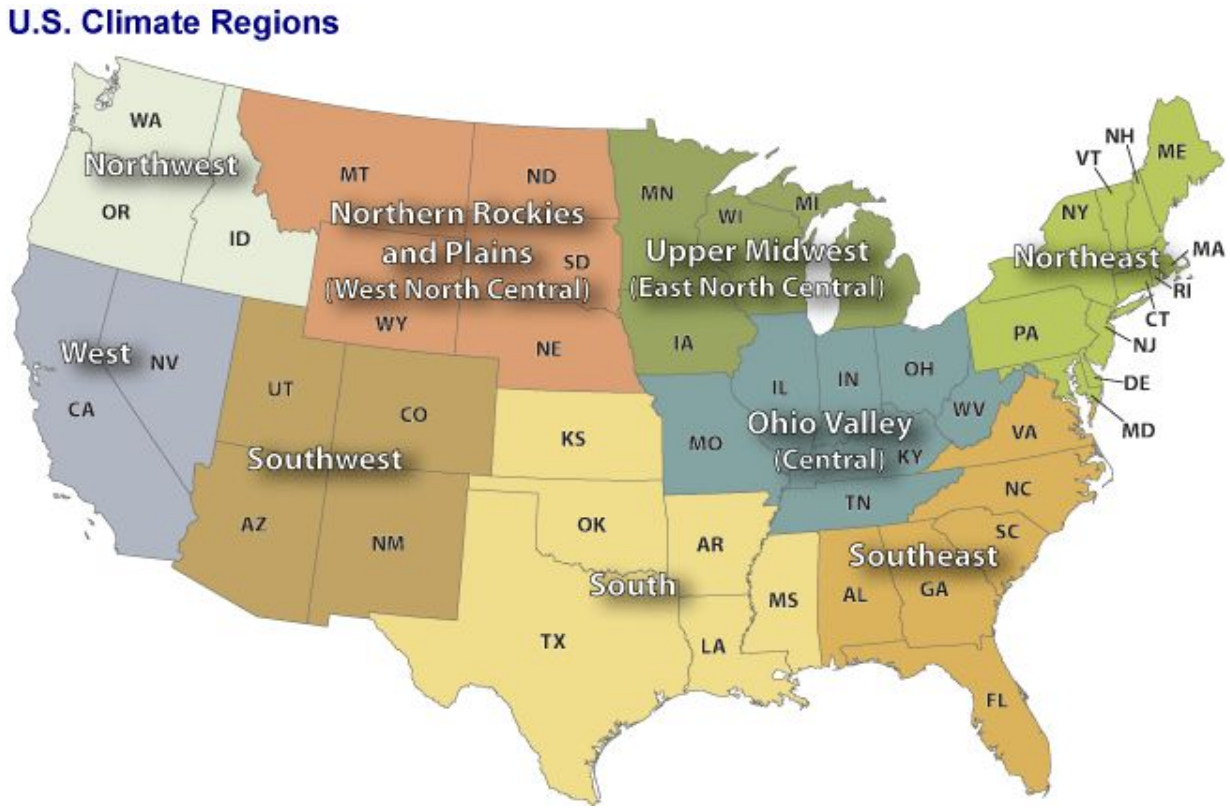

Figure 1: Geographic climate regions for the contiguous United States (NOAA, N.d.).

Dating to the year 1900, the Köppen–Geiger climate classification system has undergone numerous extensions and changes in the interim. A recent update by Peel et al. (2007a) is based on temperature and precipitation; the United States portion of the world map is displayed in Figure 2

below. The Peel update shows two important features, namely that the boundaries of the historical South roughly map to a single climate region and that climate regions can be discontiguous, unlike in the NOAA model in Figure 1. While the Peel update is based on "the whole period of record" (Ibid., p. 1634) for weather stations (nearly 12,400 precipitation stations and over 4,800 temperature stations), this actually raises concerns that the model is too robust to climate trends (Ibid., p. 1635–1636). Furthermore, the Peel update is drawn using only on precipitation and temperature data and does not take into account daylight hours, humidity, windiness, cloudiness, or barometric pressure.

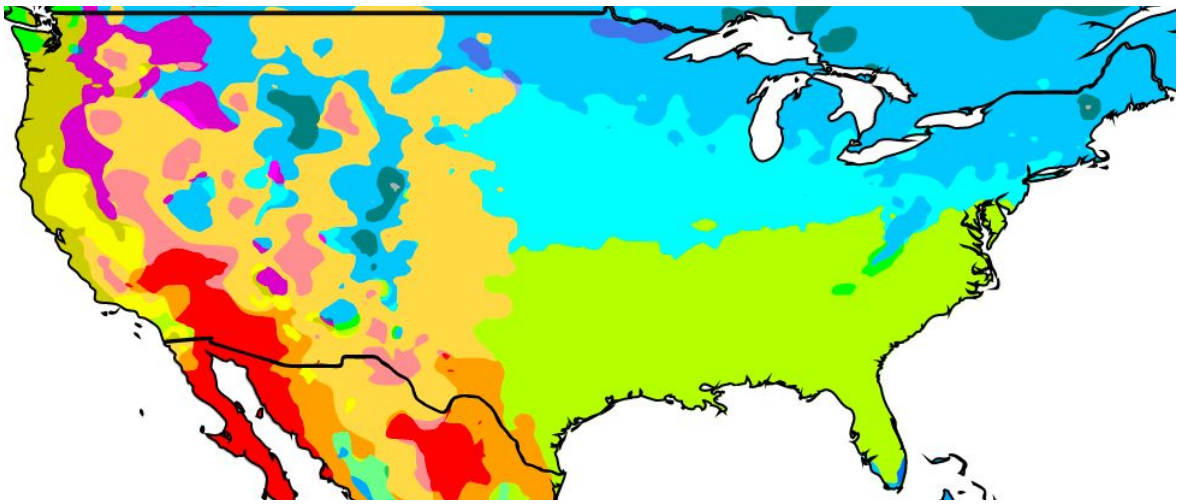

Figure 2: Peel update to the Köppen–Geiger climate classification system (contiguous United States); different colors represent different climate types (Peel et al. 2007b).

Given these deficiencies, neither the NOAA model nor the Peel model is ideal for climate-related research in the social sciences, especially with regard to investigating whether a climate effect has been misattributed to a regional subculture of violence in the historical South. I therefore operationalize climate using 30 years of monthly data on temperature, precipitation, daylight hours, humidity, wind, cloud cover, and atmospheric pressure. With climate defined holistically, I take a machine-learning approach to classifying climate regions within the contiguous United States. Such regions may prove useful in advancing social-science research.

References

Anderson, Craig A. 1989. "Temperature and Aggression: Ubiquitous Effects of Heat on Occurrence of Human Violence." *Psychological Bulletin* 106:1 (74–96). doi.org/10.1037//0033-2909.106.1.74

Anderson, Craig A., & Kathryn B. Anderson. 1996. "Violent Crime Rate Studies in Philosophical Context: A Destructive Testing Approach to Heat and Southern Culture of Violence Effects." *Journal of Personality and Social Psychology* 70:4 (740–756). doi.org/10.1037/0022-3514.70.4.740

Baylis, Patrick. 2015. "Temperature and Temperament: Evidence from a Billion Tweets." Energy Institute at Haas School of Business, University of California at Berkeley. ei.haas.berkeley.edu/research/papers/WP265.pdf

Cohn, Ellen G. 1990a. "Weather and Crime." *British Journal of Criminology* 30:1 (51–64). doi.org/10.1093/oxfordjournals.bjc.a047980

Cohn, Ellen G. 1990b. "Weather and Violent Crime: A Reply to Perry and Simpson, 1987." *Environment and Behavior* 22:2 (280–294). doi.org/10.1177/0013916590222006

Cohn, Ellen G., James Rotton, Amy G. Peterson, & Deborah B. Tarr. 2004. "Temperature, City Size, and the Southern Subculture of Violence: Support for the Social Escape/Avoidance (SEA) Theory." *Journal of Applied Psychology* 34:8 (1652–1674). doi.org/10.1111/j.1559-1816.2004.tb02792.x

Hipp, John R., Daniel J. Bauer, Patrick J. Curran, & Kenneth A. Bollen. 2004. "Crimes of Opportunity of Crimes of Emotion? Testing Two Explanations of Seasonal Change in Crime." *Social Forces* 82:4 (1333–1372). doi.org/10.1353/sof.2004.0074

Intergovernmental Panel on Climate Change (IPCC). 2013. "Annex III: Glossary." *Climate Change 2013: The Physical Science Basis.* ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_AnnexIII_FINAL.pdf

National Oceanic & Atmospheric Administration (NOAA). N.d. "U.S. Climate Regions." ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php

Peel, M. C., B. L. Finlayson, & T. A. McMahon. 2007a. "Updated World Map of the Köppen-Geiger Climate Classification." *Hydrology and Earth System Sciences* 11:5 (1633–1644). doi.org/10.5194/hess-11-1633-2007

Peel, M. C., B. L. Finlayson, & T. A. McMahon. 2007b. "World Koppen Classification." commons.wikimedia.org/wiki/File:World_Koppen_Classification_(with_authors).svg

Rotton, James, & Ellen G. Cohn. 2003. "Global Warming and U.S. Crime Rates: An Application of Routine Activity Theory." *Environment & Behavior* 35:6 (802–825). doi.org/10.1177/0013916503255565

Talaei, Ali, Arya Hedjazi, Amir Rezaei Ardani, Mohammad Reza Fayyazi Bordbar, & Andisheh Talaei. 2014. "The Relationship between Meteorological Conditions and Homicide, Suicide, Rage, and Psychiatric Hospitalization." *Journal of Forensic Sciences* 59:5 (1397–1402). doi.org/10.1111/1556-4029.12471