

# Climate Change Communication from Cities in the United States

Constantine Boussalis · Travis G. Coan · Mirya R. Holman

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**Abstract** Cities in the United States engage in action on climate change, even as the federal government remains resistant to comprehensive climate policy. While experts generally agree that local level adaptation and mitigation policies are critical to avoiding the worst climate impacts, the degree to which cities communicate climate change issues to their constituents has yet to be fully explored. In this article, we evaluate how U.S. cities communicate climate change related issues, problems, and policies. We use a computer-assisted approach to evaluate climate change efforts by cities by examining the full text of press releases of 82 large cities in the United States. We first identify who discusses climate change, finding that many large cities in the United States address climate change in their public communication. Second, we examine the content of these discussions. Many cities discuss weather-related concerns in conjunction with broad collaborative efforts to address global warming, while city-based policy discussions focus more on energy and transportation efforts. Third, we evaluate the local factors associated with these discussions. We find that the city's climate vulnerability is particularly influential in shaping the level and timing of climatic communication.

**Keywords** political communication · urban politics · climate change policy · climate vulnerability

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## 1 Introduction

When Donald Trump announced that the United States would be withdrawing from the Paris Climate Accords, the response from local governments was to reaffirm their policy commitment to addressing climate change (Mayors National Climate Action Agenda 2017).<sup>1</sup> For example, when President Trump tweeted “I was elected to represent Pittsburgh, not Paris,” Bill Peduto, Mayor of Pittsburgh, responded by tweeting the city “will follow the guidelines of the Paris Agreement.” In this paper, we show that these responses are a continuation of attention given to climate change by U.S. cities.

The literature on climate change policy often focuses on how local governments are engaging in robust action to address the negative effects of global warming. In the United States, research focuses on cities because they offer a path towards meaningful action on climate change, while the federal government remains inactive. Much of this research focuses on state level action (Bromley-Trujillo et al. 2016), case studies of key cities (McCormick 2016), or examines specific actions like joining the International Council on Local Environmental Initiatives (Krause 2011) or engaging in particular mitigation efforts (Reckien et al. 2014). We build on this scholarship with a rich new database of press releases from cities about climate change mitigation and adaptation efforts. In doing so, we measure the extent to which cities talk about climate change and how the issues are communicated over time.

We argue that evaluating city communication on climate change is central to understanding what governments are doing about climate change and why governments are ad-

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<sup>1</sup> The Mayors National Climate Action Agenda may be accessed at <http://www.climate-mayors.org/blog/>

addressing climate change in a public manner. Specifically, we address three central questions:

1. Which cities discuss climate change in their public communication?
2. When cities discuss climate change, which problems and solutions do they discuss?
3. Are these discussions related to climate vulnerability, extreme weather, economics or political factors?

In doing so, we use a new, large dataset of press releases from cities and employ a computational approach to identify climate change related discussions from city governments. This process allows us to examine not just which cities are engaged in climate change discussions, but also the content, focus, and timing of these discussions. We build on an innovative body of scholarship that uses text documents to evaluate the stances of political actors and institutions (e.g., [Grimmer and Stewart 2013a](#), [King et al. 2013](#), [Greene and O'Brien 2016](#)).

Which factors are associated with higher levels of climate related discussions? By estimating the probability that any city in our dataset will discuss climate change in any given month, we find that these climate-focused discussions are related to climate vulnerability, even when controlling for economic and political factors. And, while the city's political liberalness does shape the probability of climate discussions, vulnerability continues to matter, suggesting that cities may be able to overcome some of the partisan gridlock associated with climate change in the United States. Overall, our results suggest that cities are reacting to the challenges they face from climate change and engaging in entrepreneurial efforts to shape US climate policy.

## 2 Background

### 2.1 Urban climate vulnerability and an opportunity for action

The U.S. urban population has increased steadily over the last several centuries, with a significant majority of Americans living in cities and more than 80% living in Census classified urban areas. The residents of these urban areas are increasingly at risk from climatic changes: [Kjellstrom and McMichael \(2013\)](#) demonstrate that many cities in the United States are particularly vulnerable to climate change through a variety of direct, indirect, and systemic causes. This vulnerability relates to events like extreme weather, sea-level rise, and changing climate, but also is associated

with climate change as a multiplier effect, which increases health risks (i.e., [Bambrick et al. \(2011\)](#)).<sup>2</sup>

While cities are particularly vulnerable to climate change related effects, they also offer an opportunity for action that is unavailable or unlikely at the federal or state level in the United States. Indeed, the U.S. federal government is currently unwilling to address climate change ([Foran 2016](#)). In addition, geographic differences in ideology in the United States, with liberal urban areas and conservative rural areas ([Bui and Pearce 2016](#)), mean that cities offer a political environment where climate change action is not only accepted, but may be expected. For example, while the state of Louisiana's conservative population and heavy reliance on oil and gas revenues means an unwillingness to engage in climate change action, the liberal city of New Orleans is willing to engage in direct action.<sup>3</sup> Political leaders in these urban areas may also be more likely to use climate change as an issue in competitive elections ([Egan 2013](#)). Cities also have control over land-use, building standard, and zoning policies, which can shape both causes of and reactions to climate change. Finally, cities are largely unencumbered by international treaty negotiations that hamper international action ([Rosenzweig et al. 2010](#)).

Local efforts have the potential to be impactful, both in terms of how much cities contribute to climate change and their mitigation and adaptation activities. Cities and their residents are responsible for up to 70% of global greenhouse gas emissions ([Habitat 2011](#)). New York alone produced 49 million tons of carbon dioxide in 2014, which is one-fifth of the entire carbon production of France. Yet, this production of greenhouse gasses is not irreversible: cities have a wide range of policy options to shape overall emissions levels. For example, [Lutsey and Sperling \(2008\)](#) estimated that the realization of all sub-national initiatives could stabilize US emissions at 2010 levels by the year 2020. Further, cities have been successful in shrinking their carbon footprints: New York's 2014 rate of carbon production is a 13% reduction from 2005 rates.

### 2.2 Press releases and political communications from cities

Press releases are an important tool for measuring precisely what cities and their leaders wish to communicate with con-

<sup>2</sup> Our usage of the term "vulnerability" in this study corresponds mostly to the expected exposure of a given locale to future climate-related hazards. That is, we focus on the *external* and *biophysical* dimensions of vulnerability ([Füssel 2007](#)).

<sup>3</sup> See <https://www.nola.gov/mayor/press-releases/2016/20160425-pr-planning-tool-for-adapting-to-climate/>

stituents. They are used regularly to highlight positive aspects of governance and represent strategic decisions (Grimmer 2013a;b, Grimmer et al. 2012). Indeed, extant scholarship has called press releases “a nearly ideal source” (Grimmer 2013b, p. 8) of data for measuring how political actors communicate their priorities to constituents or “The Holy Grail” for “getting into the news” (Palser 2006, p. 90). They are also used to establish issue ownership in political campaigns (Vavreck 2009). What cities communicate via press releases thus offers an opportunity to examine credit claiming, constituent outreach, and efforts to spread information to news sources by local governments.

Press releases have been used successfully in the past to evaluate the policy priorities of U.S. Congressional representatives (Grimmer 2010). Press releases, moreover, have a multiplying effect—local news sources often pull sections of text directly from press releases when generating content, serving as “information subsidies” (Golitsynskiy 2013). Releases can also be used in agenda setting, candidate image management, and to influence both the amount and tone of coverage (Comrie 1997, Kiouisis et al. 2006, Waters et al. 2010). We thus argue that evaluating climate change communication from cities’ press releases represents an important — even ideal — measure of local government engagement on this issue.

### 3 Measuring city climate communication

#### 3.1 Data

In order to examine city level climate communication, we utilize press releases from a sample of major American cities.<sup>4</sup> We began with the fifty largest cities in the United States, as defined by the U.S. Census Bureau’s population estimates. Next, given our interest in the relationship between climate vulnerability and the policy agenda, we then added any city that appeared on three lists of climate vulnerable cities<sup>5</sup> and a matched set of thirty cities (based on population and % white) that did not appear on the lists. Some overlap occurred between the list of vulnerable cities, control set, and

<sup>4</sup> Replication materials are available at [https://github.com/traviscoan/city\\_climate\\_communication.git](https://github.com/traviscoan/city_climate_communication.git)

<sup>5</sup> The lists include 1) Climate Disruption Index (Weather.com), Cities That Could Disappear List (Huffington Post), or the Hallegatte Rankings (Hallegatte et al. 2013), which are based on projected sea level rise and storm surge risk. We also note how the Climate Disruption Index evaluates US cities (population > 200,000) according to vulnerability to sea level rise, extreme precipitation, drought, and heat, and average temperature and precipitation change. See <https://goo.gl/j4c61m> for methodology discussions and <https://goo.gl/X771Rn> for a response from climate scientists.

fifty largest cities, reducing the number of total cities to 82. We focus on large cities because major cities contribute a substantial share of overall US greenhouse gas emissions. Our sample account for roughly 17% of all US city greenhouse gas emissions.<sup>6</sup> Smaller cities also tend to suffer from issues of data availability for both climate vulnerability and control variables.<sup>7</sup> After identifying the set of U.S. cities to be studied, we developed software to harvest all available releases from each city’s website, producing 76,249 documents.

#### 3.2 Classifying climate change-related communication

Given the size of the overall press release corpus, manually identifying climate change related communication is unfeasible and thus we turn to *computer assisted* methods. Specifically, we rely on a supervised learning approach to classify city level climate communication, similar to that used by Genovese (2014).

The first step when using a supervised approach is to decide on suitable, manually annotated training and testing sets. There are a number of practical challenges to achieving this objective when using the press release corpus, yet the most significant challenge is the presence of considerable “class imbalance” between climate and non-climate related releases. Many issues demand communication from cities; discussions of climate change are likely to be relatively infrequent. As such, identifying a training set via a simple random sample is hopelessly inefficient.

We devised a simple sampling procedure that considers the likelihood of classifying false negatives (i.e., missing climate change press releases) and false positives (i.e., incorrectly classifying a non-relevant release as related to climate change) to overcome this challenge. First, consider the issue of false negatives: our goal is to minimize potential false negatives and thus identify the majority of press releases that *could* relate climate change. To do so, we constructed a climate-related keyword dictionary with the intention of including any relevant keyword. The keywords include terms directly related to *climate change* (including climate change, global warming, greenhouse, emissions, sea level rise, carbon dioxide, co2, climatic, climate resili\*, climate vulner\*, climate sci\*, and oc2), *weather* (including flood, hurricane, tornado, storm, drought, heat wave, and wildfire), *energy* (including renewable, solar, wind power,

<sup>6</sup> Specifically, our sample of 82 cities accounts for 982 million tCO2e/yr out of a total US city footprint of 6,232 million tCO2e/yr. See Jones and Kammen (2014) for more details.

<sup>7</sup> See Holman (2015) for a discussion of issues of data availability and reliability in smaller cities.

hydroelectric, green energy, biogas, and energy efficiency), and *transportation* (including hybrid vehic\*, electric vehic\*, fuel standard, and fuel cell). To ensure a comprehensive initial list of keywords, we cross-referenced our dictionary against a corpus of climate change material specific to U.S. cities. In the end, this process produced a set of 35 keywords, which were then used to identify 9,601 releases (12.59% of the corpus) potentially related to climate change. We provide detailed examples and a qualitative discussion of the *climate change*, *weather*, *energy*, and *transportation* categories in Appendix I.

By casting a wide net, false positives are likely, as the keywords used to identify relevant press releases have multiple meanings.<sup>8</sup> To address this issue, we trained a support vector machine (SVM) to classify climate-related discussion in the reduced set of 9,601 press releases. First, we randomly selected a set of documents ( $n = 697$ ) and an author manually coded whether they contained clear climate change content (see the appendix); 142 were climate change related, indicating a high level of false-positives. We then preprocessed the release text<sup>9</sup> and trained a linear SVM to identify the *true* climate change press releases. We then assessed the model's out-of-sample classification performance via 10-fold cross validation (e.g., Picard and Cook 1984). This method randomly segments the releases into 10 subsamples, where we use 90% for training and 10% to test out-of-sample performance. Cross-validation results indicate that the classifier is relatively accurate in distinguishing climate change related press releases from within the sample created from keywords, with an average F1 score of 0.81 (mean precision = 0.85 and mean recall = 0.77). Finally, we used the fitted model to project out to the 9,601 releases that had at least one of our climate change keywords, which reduces the sample to 2,849 climate-related releases.

#### 4 Who discusses climate change?

Which cities are more likely to discuss climate change in their press releases? We approach this question by using a sample of releases (January 2014 - February 2017 ( $n = 43,486$ )). We reduced the sample analyses because of the significant heterogeneity in temporal coverage of cities in our general sample, as typically only the releases of the current administration are made available online. Only three cities in our sample cover the entire 2000-2016 period (Lincoln,

NE; Boston, MA; Honolulu, HI), while 48.7% of the cities enter the dataset in 2014.

Figure 1 provides an overview of the cities in our sample, standardized by the number of releases. We can identify clear leaders in climate communication, such as Portland (OR) and San Diego (CA). Descriptively, those climate vulnerable cities (orange diamonds) tend to have a higher proportion of climate-relevant communication. Boston, New York, Chicago, and Pittsburgh are the cities with the highest absolute number of climate-relevant releases; see Appendix B for a list of the absolute counts by city.

In addition to variation by city in climate communication, we also observe temporal variation of climate discussion over the 2000-2017 period for cities with available press releases over time. The discussion by the Boston mayor's office tracks well with national and international newspaper coverage of climate change (e.g., Boykoff et al. 2015, Boussalis et al. 2016). Lincoln's discussions peak in 2011. Honolulu engages in a low-level of discussion over the entire time period, with a small decrease starting in 2015.

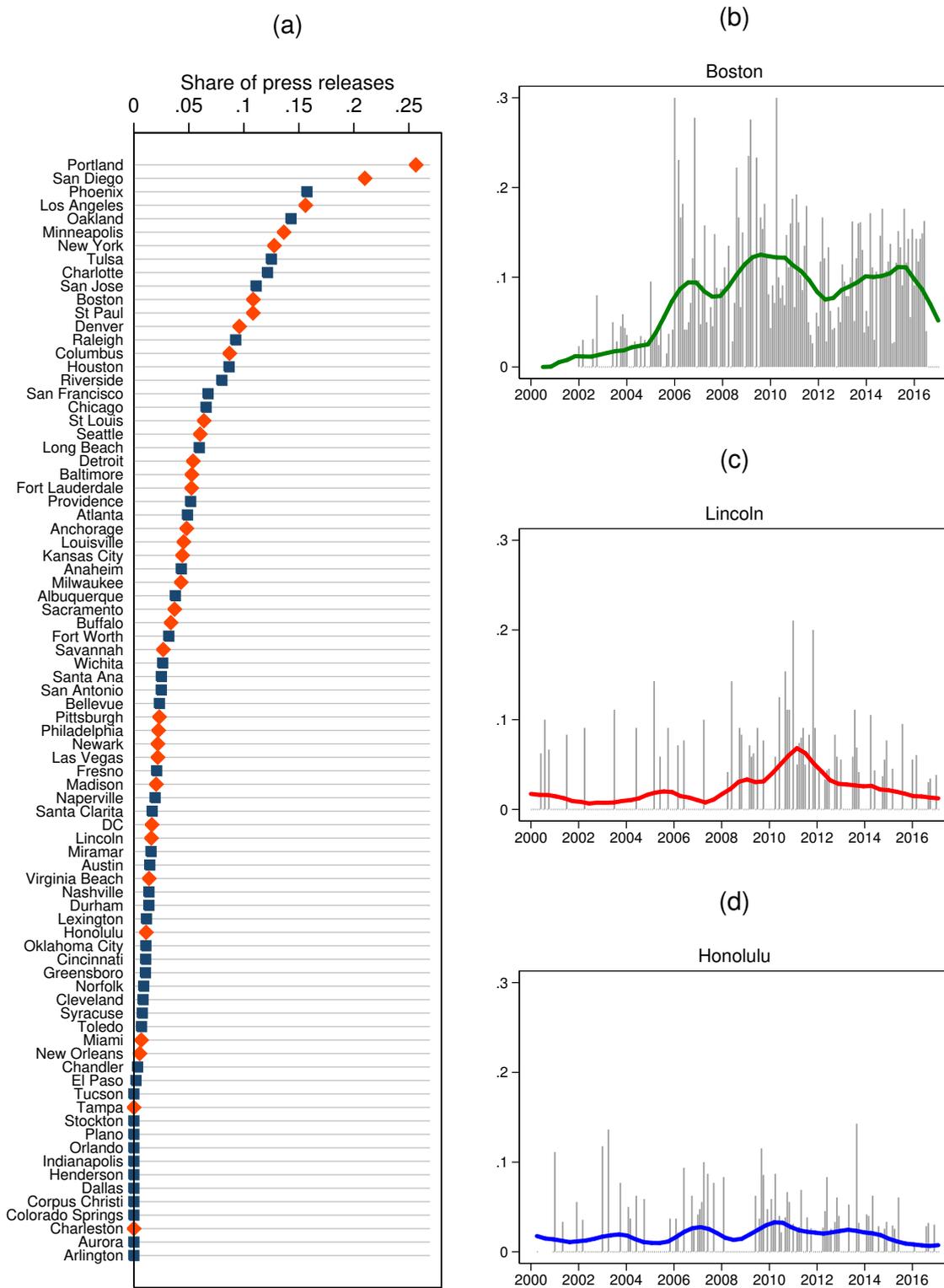
What about temporal variation across all the cities and press releases? As is clear in Figure 2, which provides aggregated press releases over time, vulnerability to climatic changes shapes levels of climate change discussions, with highly vulnerable cities discussing more climate-related themes than less vulnerable cities over time.

#### 5 How are cities discussing climate change?

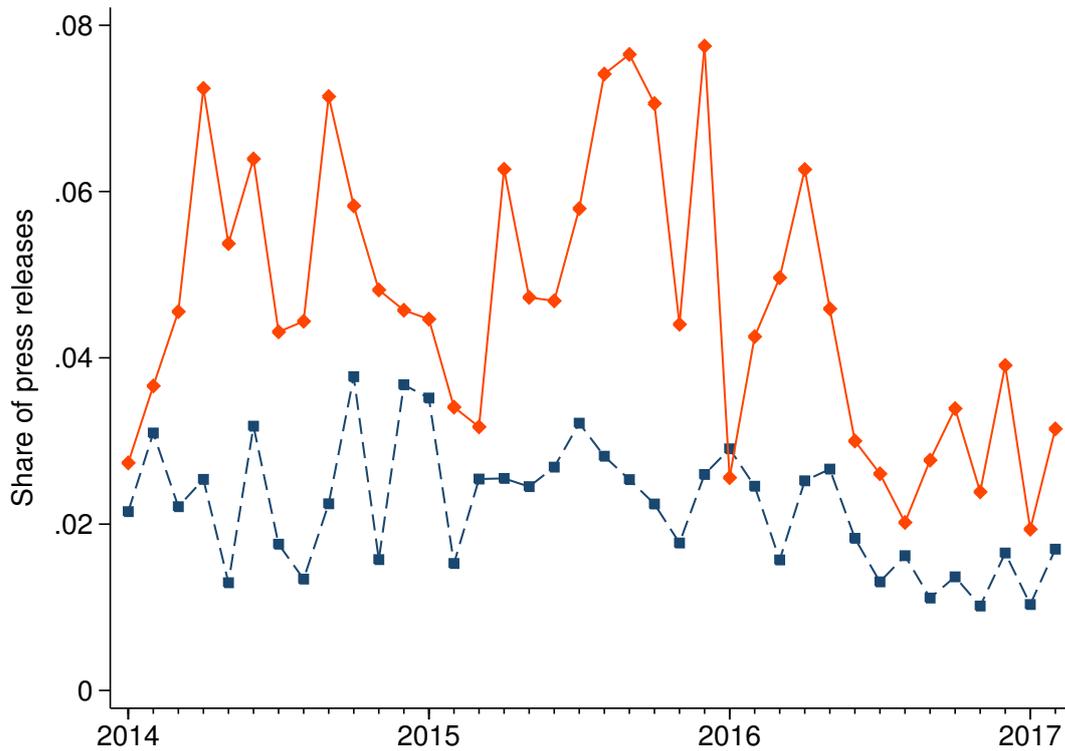
We next examine the content of these climate change discussions. In general, cities provide detailed and comprehensive information on efforts to mitigate or adapt to climate change. Press releases with energy keywords are the most common in our dataset (78.2%), following by climate change (40.1%). Within these topics, press releases also discussed weather (19.6%) and transportation (4.6%). Climate change and weather related press releases focus on adaptation, on broad approaches to address climate change, resiliency plans, and organizational or bureaucratic work to transform the city's approach to global warming. Alternatively, energy and transportation related press releases focus on specific policies or programs to change behavior or mitigate the effects of climate change. Please refer to the appendix for a detailed qualitative summary of the press release content.

<sup>8</sup> Consider the following reference to "energy" by New York City mayor Bill de Blasio (November 22, 2015), "Because we embraced wave after wave of immigrants who brought their *energy*..."

<sup>9</sup> Prior to training the model, we removed common "stop words," stemmed, and converted the raw tokens to term frequency-inverse document frequency (TF-IDF) features.



**Fig. 1:** Panel (a) displays the proportion of climate-related releases for 82 cities over the period 1/2014-2/2017. Cities with high climate change vulnerability = orange diamond, less vulnerable = a blue square. Panels (b) - (d) display the monthly proportion of classified releases over the 1/2000-2/2017 period for the cities of Boston (MA), Lincoln (NE), and Honolulu (HI), respectively, overlaid with local polynomial line to assist with interpretation.



**Fig. 2:** This plot displays the monthly share of classified press releases over the 1/2014-2/2017 period, by level of climate vulnerability. The orange (solid, diamond) series illustrates the climate-relevant communication of highly vulnerable cities, whereas the blue (dashed, square) series represents that of cities with lower vulnerability.

## 6 Does climate vulnerability predict city climate communication?

What climatic, political, economic and demographic factors explain variation of discussion of climate change by cities? To answer this question, we focus on the press releases of all our cities from January 2014 — February 2017.

### 6.1 Outcome and independent variables

Given that climate discussions may vary over time, we analyze two dependent variables of month-year discussions derived from the press releases identified in Section 3.2. First, we code *all climate-related discussion*—including direct mentions of climate change and energy, weather, and transportation topics related to climate change—as 1 for cities that published such a release in a given month-year and zero otherwise. Our second dependent variable, *explicit discussion of climate change*, is similarly coded as 1 for a city government that has released a statement that explicitly mentions “climate change” or “global warming” in a particular

month-year. Distinguishing between these is important because more conservative cities may utilize alternative framing strategies from those of liberal areas when talking about climate change.

We focus on a range of city level covariates that may help explain variation in whether a mayor’s office discusses climate change. To ease interpretation, we have standardized all our independent variables to have a mean of zero and a standard deviation of one, except if they are already a dichotomous variable. Full results are available in Appendix G. Summary information for all the variables is also available in Appendix F.

The main explanatory variable in our study is the *climate vulnerability* of a given city. This variable takes the value of 1 (“high vulnerability”) if the city has been listed on any of the climate vulnerable lists that we discuss in Section 3.1. Cities not found on any of these lists are coded as 0 (“low vulnerability”). We expect that cities with a high level of vulnerability will be more likely to communicate the issue in their press releases.

Climate change has become a hyper-politicized issue in the United States (Dunlap et al. 2016). Public opinion data show a growing divide across partisans on the issue of climate change (Bromley-Trujillo et al. 2014). A 2017 Gallup poll of Americans shows that while 90% of Democrats reported elevated levels of concern about climate change, only 36% of Republicans held the same view (Norman 2017). A wide gap in perceptions about climate change also exists among policymakers. An analysis of the 115th U.S. Congress reveals how 59% of House Republicans and 73% of Republican Senators publicly deny the existence of climate change, that humans are causing it, and/or that climate scientists overwhelmingly agree on these points (Koronowski 2017). Beyond climate change, more general attitudes about environmental protection have also been connected to partisanship, with Democratic areas being more likely to support environmental protection (Coan and Holman 2008). Mayors of cities in more liberal locales should be more likely to discuss climate change in their press releases. We proxy *citizen political ideology* with the county-level vote share for Barack Obama in the 2008 presidential election. We also include a measure of mayor partisanship in models with similar expectations.

We next examine the effect of climatic conditions on climate change communication by controlling for *local temperature anomaly*, measured as the monthly difference in city temperature to the 1901-1991 period average, based on data provided by the National Oceanic and Atmospheric Administration.<sup>10</sup> Li et al. (2011) posit that short-term weather effects may lead people to use local weather patterns as cues for understanding the more complex concept of global climate change. For example, there is a positive relationship between warm temperature anomalies and belief in climate change (e.g., Scruggs and Benegal 2012, Bohr 2017), though the evidence is mixed (see Marquart-Pyatt et al. 2014). In climate change discussions by governmental actors, the empirical findings on the effects of weather are mixed (Liu et al. 2009, Herrstadt and Muehlegger 2014). We hypothesize that *temperature anomalies* will push the issue of climate change up on the city's agenda and, holding other factors constant, will increase the likelihood that it is mentioned in press releases.

The economy of a city could also influence climate change discussions. Economic recessions may induce people to prioritize economic well-being over environmental security (e.g. Inglehart 1995, Guber 2003, Scruggs and Benegal 2012, Shum 2012, Coan and Holman 2008). Unemployment, for example, is negatively related with public concern for climate change (Kahn and Kotchen 2011, Brulle et al. 2012, Scruggs and Benegal 2012). We posit that this effect should trans-

late to the political agenda of a city. Therefore, cities will be less likely, holding other factors constant, to discuss climate change as *unemployment* increases. An alternative view is that cities often struggle financially, given the constraints of local government financing (Holman 2015). In our time period, the Obama administration made resources available to cities for climate change efforts. As such, it may be struggling cities who engage in climate activism because of the potential for external resources from the federal government. We use data from the 2014 Census to measure *unemployment* as the county-level percentage of the population (16 years+ and in the civilian labor force) who are unemployed.

Public opinion research has also investigated the effects of income on attitudes about climate change. Scruggs and Benegal (2012) find a negative effect of income on individual-level agreement with the scientific basis for global warming. In their model of American attitudes on the environment, however, Franzen and Vogl (2013) find a positive effect of income on concern for environmental issues, consistent with other research (e.g., Gelissen 2007, Coan and Holman 2008). In line with most research, we expect that a city's agenda will be more responsive to concerns about climate change in locales with higher incomes. We measure *income* as the county-level median household income, with data gathered from the 2014 U.S. Census.

The form of local government may also influence whether and how a city government discusses climate change. We consider the effect of either a mayor-council form of government, where the mayor has more independent power and authority, or a council-manager form of government, where the city manager (an appointed position) has more power. In the former, the mayor's preferences are more likely to translate into policy (Sharp et al. 2011). In the latter, leaders are insulated from political pressures and are less agile in policy formation (Lubell et al. 2009). We therefore expect that cities with the mayor-council form of government will be more likely to engage in climate change discussions.

Lastly, we control for the log of *total population* and the log of *press releases* in a given month-year, which serves to normalize the data. We expect that cities with larger populations (from the 2014 US Census) and more press releases will be more likely to mention the issue of climate change, holding other factors constant. Press release counts proxy local government professionalization.

## 6.2 Statistical methods

With the relevant variables in hand, the next step is to specify a model suitable for examining variation in climate dis-

<sup>10</sup> See Appendix E for a list of starting base periods.

cussion across cities and over time. The city press release data is inherently multilevel: cities are nested within state policy environments and are also grouped into months. To account for this structure, we employ a Bayesian random effects model that allows for cities to be hierarchically nested within states and cross classified with a month-year. We employ a logistic regression approach due to the binary nature of our outcome variables and incorporate random intercepts for state, city, and the month-year, thus partially pooling our estimates across relevant grouping variables. Further, to minimize the potential for over-fitting, we use regularizing priors in all models. See Appendix C for more information on our methods.

### 6.3 Results

Figure 3 (and a related table in Appendix G) provide estimates from the hierarchical logistic regression models for discussions of climate change in any particular month. Specifically, the plot displays the coefficients (log odds) based on mean posterior value, with the 50% and 95% credible intervals of the standardized covariates employed to explain the variation of our two dependent variables. Note that we report non-standardized coefficients for the dummy variables *climate vulnerability*, *mayor partisanship (Republican & Other)*, and *type of government*. Results for the *general climate change* dependent variable are displayed in blue circles, while those for *explicit discussion of climate change* are illustrated in red diamonds (see Appendix H for a comparison of model performance).

The empirical results generally fit our theoretical expectations. Our main explanatory variable, whether a city is highly vulnerable to the impacts of climate change, has a positive effect on the probability of a city government discussing climate change in general (log-odds = 0.729, 95% CI = [0.071, 1.401]) and climate change specifically (log-odds = 0.889, 95% CI = [0.004, 1.757]). Substantively, compared to a less vulnerable city, a highly vulnerable city is 13.8% more likely of generally discussing climate change in a given month-year, holding all other variables constant. The effect on climate-specific discussion is similarly pronounced: a highly vulnerable city is 3% more likely to discuss climate-specific matters in its press releases in a given month, compared to a less vulnerable city.

Our results also suggest a partisan effect on climate communication: the county-level vote for Barack Obama in the 2008 presidential election is positively related to general climate-related discussion (log-odds = 0.278, 95% CI = [-0.115, 0.681]), as well as climate-specific discussion (log-

odds = 0.544, 95% CI = [0.023, 1.121]). A locale with one standard deviation above the mean level of support for Obama in 2008 is 4% more likely to discuss climate change in general or 1.5% more likely to have climate-specific discussions, when compared to a locale that exhibited an average level of voter support for Obama. We find mixed evidence of a relationship between a mayor's partisanship and the likelihood of climate discussion in city press releases: no meaningful difference between cities with Republican and Democrat mayors emerges in the predicted probability of general climate-related discussions (log-odds = -0.234, 95% CI = [-1.1, 0.656]). However, Republican mayors are 1.2% less likely than their Democrat counterparts to release climate-specific statements (log-odds = -0.753, 95% CI = [-1.99, 0.464]). We find very little evidence of a difference between Democrat and independent/non-affiliated (other) mayors in the predicted probability of discussing climate change, either in general or specifically.

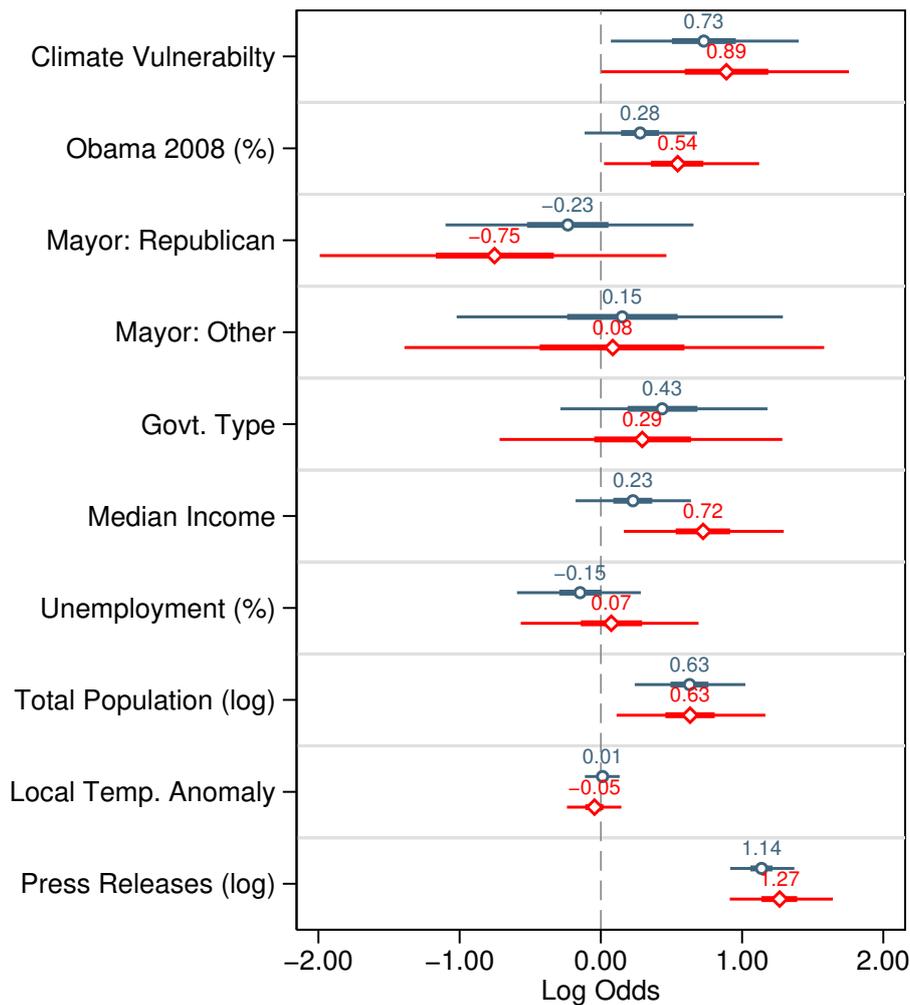
A mayor-council (versus a council-manager) form of government is associated with a higher likelihood of discussing climate change. Holding other variables constant, a mayor-council type of government is 7.6% more likely to discuss general climate change or 0.7% more likely discuss climate change specifically than its council-manager counterpart.

There is little evidence of a relationship between local temperature anomalies and climate change discussions. This result holds up to alternative specifications of the temperature variable. A non-linear (quadratic) specification of local temperature anomaly, used to control for both cold and hot extremes, also produces estimates that likely could include zero.

Moving on to the economic variables, we find somewhat mixed evidence: general climate discussions (log-odds = -0.147, 95% CI = [-0.594, 0.283]) decrease as unemployment rises, while it is very likely that there is no relationship between climate-specific discussions (log-odds = 0.074, 95% CI = [-0.567, 0.692]) and unemployment.

As expected, we find a positive effect of county-level median household income on the probability of general climate change content (log-odds = 0.227, 95% CI = [-0.179, 0.638]) and climate-specific discussion (log-odds = 0.724, 95% CI = [0.163, 1.295]). Compared to a county with an average median income, a standard deviation increase in income is associated with a 3.8% increase in discussions about climate change generally and 2.2% increase in climate change specific discussions.

Lastly, we find positive effects of logged population (log-odds = 0.628, 95% CI = [0.24, 1.023]) and the logged number of releases in a given month (log-odds = 1.138, 95% CI =



**Fig. 3:** Explaining variation of climate change discussions in press releases. This plot illustrates the results of the Bayesian hierarchical models described in Section 6.2. Standardized coefficients (log odds), 50% and 95% credible intervals are displayed for the *general climate change* dependent variable (top, blue, circle) and *explicit discussion of climate change* dependent variable (bottom, red, diamond). Note that regular coefficients are displayed for the dummy variables *climate vulnerability*, *mayor partisanship (Republican & Other)*, and *type of government*. A table of these results is available in Appendix G.

[0.916, 1.37]) on the probability that a city government will discuss general climate change issues or climate-specific issues (logged population: log-odds = 0.632, 95% CI = [0.111, 1.165], logged number of monthly press releases log-odds = 1.266, 95% CI = [0.913, 1.643]).

## 7 Discussion

Cities in the United States are vulnerable to climate change. In an environment where federal action to address climate change is increasingly unlikely, cities have the potential to drive climate change mitigation and adaptation in the United

States. Many cities have responded to this opportunity by engaging in a diverse set of actions, including such examples as New York City's establishment of an Office of Climate Resiliency. Yet, to date, we know very little about which city leaders communicate about climate change to their residents, the content of these communications, or the factors associated with increased discussions. To examine this gap, we build on existing research on public communication from other types of political offices (Grimmer and Stewart 2013b), state climate policy making (Bromley-Trujillo et al. 2016), and other climate-related scholarship on urban policy making (Sharp et al. 2011). Analyzing 76,249 press releases from 82 cities, we first engage in a robust process to identify all communication relating to climate change. We find that while

many cities engage in some discussion of climate change, several cities (Boston, New York, Chicago, and Pittsburgh) are, by far, the most frequent discussants in absolute terms and cities such as Portland and San Diego discussed climate-related themes more as a proportion of their total communication. Future research might evaluate whether there are substantive differences in how the most active cities discuss climate change as compared to those cities who only occasionally discuss the issue.

We then evaluate the content of these discussions through the use of keywords and find that cities discuss climate change and weather in the general frame of large-scale action and with a focus on cooperation with federal programs like the Clean Power Plan. Another major set of press releases focus on specific policies that cities have put into place, generally transportation and energy related press releases. For example, in Houston, a press release on solar panels notes the array “will reduce Houston’s carbon footprint.” Future research might evaluate how these discussions are framed, especially compared to how press releases discuss other policy issues.

Finally, we evaluate the factors associated with whether and when cities discuss climate change generally and specifically. Overwhelmingly, we find that highly climate vulnerable cities are more likely to talk about their global warming efforts. At the same time, we also find that many of the factors that have been shown to shape individual preferences for climate change action (such as income and partisanship) shape on a city’s climate change communications.

Our research provides a novel view of how climate change discussions occur in the urban arena. Cities are clearly communicating about climate change to the general public, but some cities are discussing climate change at a much higher rate. This discourse has the potential to shape public opinion about the need for climate action, the appropriate means of mitigation and adaptation, and the policies relating to climate change. Future research might compare climate discussions to actual policy actions: it may be that cities highlight the less controversial policies in public communication.

That we find a modest effect for the liberalness of the population and a weak effect for the mayor’s partisanship on these discussions—and a stronger effect for climate vulnerability—counter to extensive findings at the state and national level in the United States. As we discussed, US cities have far more liberal residents than suburban and rural areas. And it may be that absent the partisan rhetoric at the national level, voters are generally either ambivalent or supportive of climate action, which is consistent with many national polls on climate change.

Our data extends through February 2017, which is prior to President Trump’s announced intention to withdraw from the Paris Accord. As we noted at the beginning of the article, many cities have indicated they will remain in compliance with the Paris Accord. Future research could update our dataset with an additional set of recent press releases. This would allow an analysis of whether those cities who have been active on climate change prior to Trump’s withdrawal are more likely to commit to compliance with the Paris Accord.

Taken together, our results point to the need to evaluate climate action at all levels of government. The data we collected provide both depth and breadth to the discussions of urban government climate policy. The dataset would be improved by a comprehensive set of press releases over time from a broader set of cities. Fortunately, many cities are engaging in some discussions of climate change and other cities are aggressively pursuing a climate agenda. However, other cities—including some that appear frequently on climate vulnerable lists — are far less active. Future research might evaluate how political factors like elections, electoral competition, and issue ownership shape efforts to address climate change.

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