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"Let them eat cake": drought, peasant uprisings, and demand for institutional change in the French Revolution

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Abstract
The paper studies whether a drought in 1788 affected the outbreak of peasant revolts during the French Revolution. I construct a community-level data set with information on local drought severity and peasant uprisings in 1789. Communities with severe drought conditions more often experienced peasant revolts against the feudal system. Then, I investigate a mechanism through which drought may have affected peasant revolts. Those more affected by the drought had higher demand for institutional change as expressed in the lists of grievances. The results provide evidence on specific ways in which the drought of 1788 impacted the French Revolution, a milestone in the democratization of Western Europe.

Keywords Democratization · Economic history · Weather shock

JEL classification N0 · Q0 · P0

1 Introduction

In 1788, a drought hit France and caused severe crop failure. Grain prices soared. A growing part of the population went hungry. At this point, France was already in deep financial, economic and political crisis, the result of numerous long- and medium-term developments in French politics, the French economy and society.[1] As a result, King Louis XVI had limited means to import grain from abroad or to quell public discontent using military means. While grain prices continued to rise, public discontent grew. It was the time of the year, the so-called lean season, when last year's harvest had been depleted, and before the new

[1] See Sect. 2.1 for a discussion of the long-term causes of the French Revolution.

The sentence "Let them eat cake" (fr. "Qu'ils mangent de la brioche") was attributed to Marie-Antoinette (1755–1793), wife of King Louis XVI, to illustrate the selfishness and ignorance of the French upper class. In reality, Jean-Jacques Rousseau wrote this sentence already in 1765 in *Confessions*: "At length I remembered the last resort of a great princess who, when told that the peasants had no bread, replied: "Then let them eat brioches."

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harvest was brought in. By summer 1789, open revolt against the feudal *Ancien Régime* had broken out. Several historians have hypothesized that the drought of 1788 and ensuing harvest failure affected the outbreak of revolts during the French Revolution (Le Roy Ladurie, 1971; Lefebvre, 1973; Neumann, 1977; Neumann & Dettwiller, 1990).

In this paper, I provide an econometric test of this hypothesis. I first examine whether the drought affected the French Revolution by impacting the outbreak of peasant revolts in the summer of 1789. Then, I investigate a mechanism through which this impact may have operated and that has so far been little documented, drought's impact on popular demand for institutional change.

For this purpose, I construct a canton-level data set for all 3500 French cantons with information on local drought severity in the growing season of 1788, on local peasant uprisings in the summer of 1789, and on local demand for institutional change as documented in the *cahiers de doléances* (lists of grievances) in May 1789 (i.e. this is *after* the drought but *before* the outbreak of the revolution).

In the first part of the analysis, I test whether peasants in areas more affected by the drought in 1788 were more likely to participate in uprisings. In the summer of 1789, shortly before the new harvest was to be brought in, famished peasants rose in revolt against their landlords. The peasants were enraged by the fact that they—many close to starvation—owed excessive taxes to their landlords. Their landlords, in contrast, were exempt from all taxation and also enjoyed numerous other political and economic privileges.[2] The peasants attacked their landlords' castles and burned charters enshrining these privileges. It is plausible that peasants more affected by the drought faced higher price increases and were more likely to rise in revolt against their landlords.

Using data on the exact locations of around 300 peasant revolts (Lefebvre, 1973), I show that areas with more severe drought were significantly more likely to experience peasant revolts.[3] I also show that the drought had a particularly large effect on early revolts from where protests spread to other parts of France.

Historical evidence documents that these peasant revolts mattered greatly for the course of the French Revolution. They were one of the factors that finally coerced the National Assembly in Paris into committing to comprehensive institutional reform. In August 1789, "[...] in an effort to appease the peasants and to forestall further rural disorders", the National Assembly formally abolished the feudal regime (Merriman, 2010, 447; Neely, 2008, 80).

Then, I investigate a possible mechanism through which the drought may have impacted the outbreak of revolts: the drought's impact on popular demand for institutional change. This demand is a key prerequisite for democratization (Acemoglu & Robinson, 2006, 2001; Lipset, 1959; Besley & Persson, 2019).[4] The drought may have affected the content of the lists of grievances, for example, if those more affected by the drought had better

[2] These privileges (*privilèges*) were a hallmark of the French feudal system.

[3] To measure drought, I obtain information on local growing-season temperature and precipitation from Luterbacher et al. (2004) and Pauling et al. (2006). These data have been reconstructed from instrumentally-measured weather records, historical sources, and geological archives such as tree ring series, ice core data and lake sediments.

[4] A recent strand of literature has set out to identify specific factors that influence this demand—such as previous experience with democracy at the individual, local, or national level (Fuchs-Schündeln & Schündeln, 2015; Giuliano & Nunn, 2013; Persson & Tabellini, 2009; Welzel, 2007); state indoctrination through education (Cantoni et al., 2017); and socialization during childhood (Sapiro, 2004).

information on the inadequacy of the existing regime to protect the common population from such calamities.

For this purpose, I use information from the *cahiers de doléances* (lists of grievances). These contain the results of a nationwide, locality-level survey, commissioned by King Louis XVI, on the French population's demands for change, including demands for institutional change. The survey was undertaken in the spring of 1789, this is after the drought but before the storming of the Bastille on July 14th, 1789, which is often viewed as the beginning of the revolution, in preparation of the Estates General.[5]

Using information on more than 1100 demands for institutional changes from more than 600 lists of grievances, I document that commoners in areas hit more severely by drought conditions had significantly higher demand for institutional change, e.g., for eliminating certain privileges of the nobility, for establishing free municipal elections, and for creating a free press. Demands were chosen that represent hallmarks of democracies: equal political and economic rights irrespective of class, equality before the law, the demand for elections, and for a free press. They represent a clear departure from the class-based, highly unequal *Ancien Régime*. During the French Revolution, growing demand for institutional change in general and the content of the lists of grievances in particular gave the representatives of the Third Estate at the Estates General in Paris, later at the National Assembly, a clear mandate to fight for more participatory institutions and a more equitable distribution of political and economic rights.[6]

The paper contributes to the literature examining the relationship between the drought of 1788 and the French Revolution (Le Roy Ladurie, 1971; Lefebvre, 1973; Neumann, 1977; Neumann & Dettwiller, 1990; Labrousse, 1939, 1944). It provides the first econometric test of the hypothesis that the drought influenced the French Revolution, the outbreak of peasant revolts and popular demand for institutional change in the lists of grievances. The paper shows that demand for institutional change, which had already developed very gradually over many decades, was further affected by this short-term event. In addition, I show that the effect of the drought was particularly large for the crucial first revolts that later-on spread across France.

It also contributes to work that uses information from the lists of grievances to gauge public sentiment before the Revolution, such as Hyslop (1936, 1968), Shapiro and Markoff (1998), and Johnson (2015). It also contributes to more recent literature addressing important questions in economics using rich French historical data from the French Revolution or from later time periods (Franck, 2016; Squicciarini & Voigtlaender, 2016; Franck & Michalopoulos, 2017; Squicciarini, 2020). This paper contributes to this literature by examining the role of a weather shock in an especially important moment in French history.

The paper also adds to work on the relevance of historical climatic and geographic conditions for human development. Galor and Özak (2016) show that pre-industrial agro-climatic characteristics shaped economic behaviour today. It is also related to papers examining the political impacts of shocks to geographical conditions, such as short-term weather shocks (Acemoglu et al., 2020; Dell, 2012; Brückner & Ciccone, 2011; Spoerer & Berger, 2001; Belloc et al., 2016; Zhang et al., 2006; Burke & Leigh, 2010; Miguel et al., 2004;

[5] The Estates General was an assembly of representatives of the three estates (the First Estate representing the clergy, the Second Estate representing the nobility, and the Third Estate representing all commoners) that met in Paris in May 1789 to debate ways out of the country's deep political and financial crisis.

[6] This is consistent with economic theory, where manifestations of demand for democracy by the disenfranchised increase incentives of the ruling elite to agree to institutional reform (Acemoglu & Robinson, 2001, 2006).

Burke et al., 2009; Bai & Kung, 2011; Chaney, 2013). Consistent with Acemoglu et al. (2001; 2006), this literature shows that such short-term shocks can have both short-term political impacts and long-term consequences for development if they appear at a pivotal moment in history. So far, this literature has focused on the impact of weather shocks on civil wars, uprisings, and other forms of violence.[7] This paper contributes to this strand of literature by documenting that the weather shock not only affected peasant uprisings but also demand for institutional change in the population. This could be interpreted as an additional channel through which an economic shock leads to political unrest. It may, for example, be a relevant mechanism underlying the relationship between weather shocks and democratic transitions documented in Brückner and Ciccone (2011).

Historians generally agree that both the peasant revolts and the demands for institutional change mattered greatly for developments during the French Revolution that had far-reaching consequences, e.g. the insistence of the Third Estate on political reform during the National Assembly and the abolition of the feudal system. Hence, this paper sheds light on one of the factors that shaped this landmark event in the democratization of Western Europe.

2 Historical background

2.1 Long-term causes of the French Revolution

In the 1780s, France was in deep economic and political crisis. After years of warfare and an exuberant lifestyle at the French court, France's financial resources were exhausted.[8] Unlike the English monarchy—the French monarchy lacked a financial institution such as the Bank of England from where it could have borrowed at lower interest rates (Norberg, 1994; Bossenga, 2011; Hoffman & Rosenthal, 2000). A related problem was the split of authorities over expenditures (the government) and taxation (the *Parlement de Paris*). Increased spending was not financed by increasing taxes but had to be financed by debt (White, 1995). The highly inefficient tax system exempted the rich and overburdened the poor. It was firmly in the hands of the nobility and did not generate sufficient income for the state.

When the French king sought to reform the rigid and inequitable tax system, which would have reduced the nobility's income from taxation, a lengthy dispute between the king and the French nobility ensued. The members of French nobility were not willing to agree to reform unless the king considerably increased their political power (Hoffman & Rosenthal, 2000)

One of the reasons for the inefficiency of the French tax system was that the right to raise taxes had been sold to individuals in return for short-term loans. Many powerful groups within the French society, especially the aristocracy and the church, had also been exempt from taxes in return for their loyalty, and their political and military support. In the French political tradition, these privileges were irrevocable. Each new king was accepted by the provincial nobility based on his promise to respect the existing privileges (Neely, 2008). In the long-term, the money that French kings had raised in return for tax

[7] Hsiang and Burke (2014) provide a useful overview.

[8] The wars include the War of the Austrian Succession (1740–48), the Seven Years'War (1756–63), and the American War of Independence (1775–1783).

exemptions and other privileges did not generate as much income as taxes. "Fiscal immunities, whether inherited or purchased, undermined French finances and put the king in the apparently ridiculous situation of taxing those who had nothing to tax. They also made it impossible for the Crown to reform the fiscal system and render it more equitable and more efficient," (Norberg, 1994).

The manifold privileges and tax exemptions did not only render the French tax system inefficient and unresponsive they also lead to a highly unequal distribution of the tax burden across the French population. The poorest part of the population paid taxes to the King and had feudal obligations toward their local landlords (Neely, 2008). This strained economic situation had been further aggravated in the 1780s by a crisis of the manufacturing sector. This crisis caused unemployment of textile workers and decreased tax revenues.

Finally, intellectual developments also played "an essential role in transforming a fiscal crisis into a revolution,"(Kaiser & Van Kley, 2010). New ways of thinking about political rights of all people influenced the behaviour of the Third Estate in the Estates-General.

2.2 Lists of grievances

By spring 1789, the French king Louis XVI was under immense political and economic pressure. To avert state bankruptcy he had to solve the stalemate with the French nobility over the reform of the tax system. In spring 1789, he felt forced to convene the Estates General. It was the first time since 1614. The Estates General was an assembly of representatives of the three estates (clergy, nobility, and commoners) with a purely consultatory function. The plan of both the king and the nobility was to win the clergy and commoners over to take their respective side.

In preparation of the Estates General, the King asked the nobility, the clergy, and the male tax-paying population of the Third Estate[9] to hold town hall meetings at the parish or town level, and to produce lists of grievances (*cahiers de doléances*) (Merriman, 2010, 443). These grievances could include any topic concerning all spheres of French public life. The estates then elected representatives at the *bailliage* (electoral-district) level who took these lists to the Estates General in Paris.[10] Starting in May 1789, representatives of all Estates advocated for these requests at the Estates General in Paris.

The lists of grievances are a unique historical source. An important question is how reliable they are and how their content can be interpreted. First of all, as researchers have pointed out, the lists of grievances are not reports on living conditions in France. Instead, they are an expression of the population's *sense* of these living conditions. For example, a demand to reduce a certain tax is not a measure of the actual tax burden but a measure of the population's sense that the tax burden was too high or unjust. This sense is exactly what I am interested in studying.

Assemblies were held to draw up the lists of grievances. It is thinkable that power dynamics at these assemblies influenced their content. Shapiro and Markoff (1998) find that the presence of outsiders at these assemblies, such as seigneurial representatives or lawyers, influenced the form but not the content of the lists. They also show that the lists of grievances were taken very seriously and produced with great care, despite the limited time availability. Shapiro and Markoff (1998) also find that more educated commoners or

[9] That is the male tax-paying population above 25 years of age.

[10] The lists were also summarized at the electoral district level. I include the original locality-level lists and lists at the electoral district.

commoners with more economic or political power exercised greater influence on the content of the lists compared to the uneducated and illiterate, even though the latter were also present at these assemblies (Hyslop, 1936, 1968). It is important to keep this in mind when interpreting results.

2.3 Peasant revolts

Hopes had been high among commoners that the Estates General would establish a more equitable and participatory political and economic system. Yet, the nobility and the king completely disregarded their demands for institutional reform and these hopes were soon disappointed. In July 1789, any sort of major political reform remained elusive, and frustration grew among the common population. Besides, there were rumours that the aristocracy planned to starve the rural communities into submission. Finally, the population was under enormous economic pressure due to the failed harvest of 1788 (Lefebvre, 1973). By the early summer of 1789, the rural population was at their most vulnerable because any reserves were depleted, the so-called lean season. "As the price of bread rose to its highest points [...], the interaction between subsistence problems and the stimulated popular awareness of politics became explosive," (Campbell, 2006, 32).

As mentioned before, a large part of the agricultural sector consisted of small peasant cultivators who lived just above self-sufficiency, with little in the way of a financial cushion. In July 1789, shortly after the storming of the Bastille, bread prices rose to new heights, and peasants organized armed protests against their landlords, against the heavy tax that they owed to them and the inequitable distribution of economic and political rights (Lefebvre, 1973, 118). The financial crisis limited the king's means to either appease or subdue these uprisings. No longer able to pay for grain imports and unable to pay military troops, the king could no longer rely on the two main strategies he had used in the past to avert social unrest.

By August 1789, the majority of the National Assembly, nobility, clergy, and the Third Estate alike, wished to restore public order. Many sympathized with the peasants' request to abolish both the peasants' feudal obligations and the nobles' economic and political privileges; others, whose properties were attacked, were willing to make concessions to limit further damage (Neely, 2008, 80). "On August 4, 1789, in an effort to appease the peasants and to forestall further rural disorders, the National Assembly formally abolished the "feudal regime," including seigneurial rights [and] renounced privilege, the fundamental organizing principle of French society," (Merriman, 2010, 447).

3 Data and variables

To examine whether the drought of 1788 impacted political outcomes in 1789, I construct a cross-section data set for 3,666 French cantons[11] with information on local drought exposure, on the outbreak of peasant revolts, on local demand for institutional change as expressed in the lists of grievances, and on control variables.

[11] The canton is a small administrative division of the French state, one level below the *département*. The 3,666 cantons in the data set are all cantons in mainland France. Other territories, e.g. Corsica and French overseas territories (*France d'outre-mer*) were excluded because most data were not available for these areas.

3.1 Drought in 1788

In historical contexts, drought has commonly been measured as deviation in precipitation from the long-term mean (Acemoglu et al., 2020; Dell, 2012) or as deviation in temperature from the long-term mean (Chambru, 2019). The European Drought Observatory (European Drought Observatory, 2012) defines drought as both a lack in precipitation or high temperature or a combination of both that leads to a lack in water supply.[12] Based on previous work and following this definition, I measure drought severity as deviations in local growing-season temperature and in precipitation in 1788 (from the long-term mean) and the interaction of the two variables. The interaction effect of temperature and precipitation on crop yields is well-documented (Leng et al., 2016; Matiu et al., 2017; Ray et al., 2015). I use deviations from local long-term means in temperature and precipitation as explanatory variables to capture the effect of the local weather shock rather than the effect of a canton having a warmer and drier climate in general.

I obtain information on temperature and precipitation in the growing season of 1788 from Luterbacher et al. (2004) and Pauling et al. (2006).[13] These are grid data with grid cells measuring about 50 by 50 kms. The data have been reconstructed by paleoclimatologists based on instrumentally-measured weather data, historical records, and geological archives, such as tree-ring series and ice cores from all over Europe. France was among the earliest adopters of weather stations and already had several in the second half of the 18th century (Garnier, 1974). Verification checks of the authors also show high predictive power for France in the 18th century (Pauling et al., 2006). These data are unique in their high geographical and temporal resolution and are regularly used including by Sequeira et al. (2020) and Tabellini (2020).

Following Dell (2012)'s definition of drought, I measure drought as the ratio of growing-season temperature in 1788 over the long-run growing-season temperature mean (1750 to 1800).[14] Deviations from the long-run precipitation mean in the growing season of 1788 are defined accordingly (see Eqs. 1 and 2). I exploit the fact that—while long-term average temperature and precipitation remain relatively stable over time—the deviation from long-term mean temperature and precipitation is exogenous.

$$Temperature_{cr} = \frac{Temperature_{1788}}{\frac{1}{51}\sum_{1800}^{1750} Temperature_t} \tag{1}$$

$$Precipitation_{cr} = \frac{Precipitation_{1788}}{\frac{1}{51}\sum_{1800}^{1750} Precipitation_t} \tag{2}$$

Table 1 shows summary statistics. Growing-season temperatures in 1788 were up by between 2.5 and 15 percent. Growing-season precipitation levels in 1788 were between 25

[12] High temperatures may lead to a lack in water supply by increasing evapotranspiration.

[13] The growing season is defined as the spring and summer season spanning the months March to August.

[14] Table 11 shows that results are robust to the use of other definitions of long-term temperature and precipitation.

percent below the long-term mean and 3 percent above the long-term mean. Probability of peasant revolt and higher demand for institutional change were higher in warmer areas. These outcomes were also higher where precipitation was higher. In Sect. 4, I will explore the contributions of each weather component and, importantly, of their interaction to outcomes. Figure 1 shows a map of the distribution of temperature and precipitation deviations in the growing season of 1788. Different parts of France were differently affected by the drought. Areas in central France and Eastern France were especially affected (in red and orange). Northwestern France was especially affected by low precipitation (in beige), whereas Southeastern France was especially affected by high temperatures (in yellow).

Table A.1 in the online Appendix shows local characteristics by how strongly a canton was affected by the drought. When comparing those most affected by the drought (with relatively warm and dry climate) to those less affected (with relatively cool and wet climate)[15] we see that population density is lower in more affected areas. Literacy is also lower. Population density is generally related to more popular unrest. A random correlation between severe drought conditions and population density is unlikely to be a concern for omitted variable bias here.

3.2 Peasant uprisings

To measure whether a canton experienced a peasant revolt in the summer of 1789, I collect data on the exact locations of 299 peasant revolts during the summer of 1789 using information from Lefebvre (1973, 4).[16] Based on place names, I identify geographic coordinates for each peasant revolt. I then create an indicator variable, *PeasantRevolt*, that is one if canton c in region r experienced a peasant revolt in 1789, 0 otherwise. Figure 1 provides a map of peasant revolts. They touched most parts of France, except for Brittany in northwest France. Panel 2 in Table 1 shows that the share of cantons that experienced a peasant revolt is higher among relatively warm cantons (with above-median growing-season temperature deviation) compared to relatively cool cantons (with below-median growing-season temperature deviation).

3.3 Lists of grievances

I collect information on demands for institutional change from the lists of grievances (*cahiers de doléances*). I base my analysis on one of the most comprehensive collections of lists of grievances compiled by the French Parliamentary Archives (Mavidal & Colombey, 1870). The French Parliamentary Archives are a chronologically-ordered edited collection of archival and published sources on the French Revolution. It was conceived in 1862 as a definitive record of parliamentary deliberations at the request of the French legislature. They started as a curatorial endeavour spearheaded by government archivists. It later became a scholarly project under the direction of leading historians. The French *Archives parlementaires* (Mavidal & Colombey, 1875, 1870) were an effort to parallel government publications in other countries such as the Journals of the House of Commons, the formal records of House of Commons business in the UK. They contain about 600 lists of grievances, including the name of the place where the list was produced, and the estate (nobility, clergy, Third Estate).

[15] Note that all cantons had above average temperature in the growing season of 1788.

[16] This constitutes the most comprehensive database on peasant revolts in France in the summer of 1789.

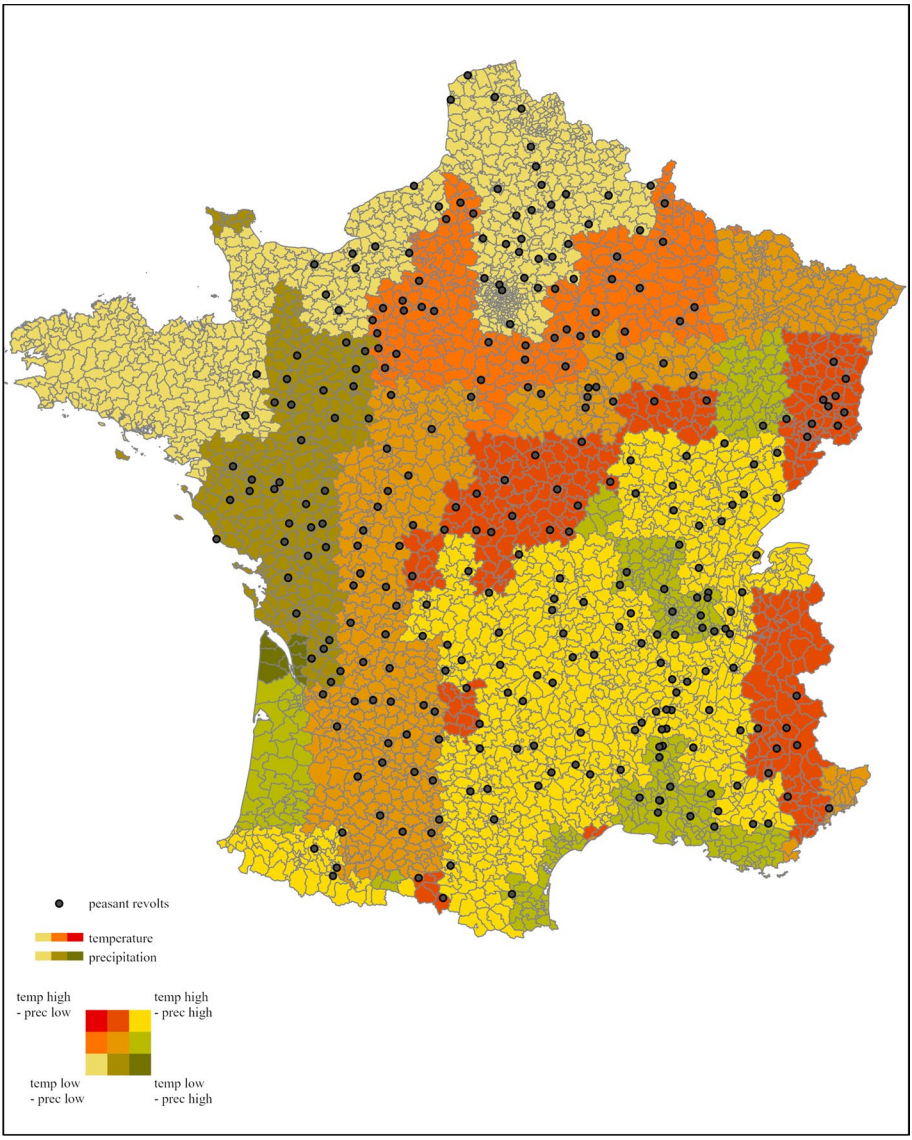

Fig. 1 Drought in the growing season of 1788 and peasant revolts. *Notes:* This map is a bivariate map of the geographic distribution of temperature and precipitation in the growing season of 1788 in France. Areas with high temperature and low precipitation are shown in red, areas with low temperatures and high precipitation are shown in green. Areas with low temprature and low precipitation are shown in yellow and areas with high temperature and high precipitation are shown in bright yellow. The map also shows the locations of peasant revolts in the summer of 1789

The Parliamentary Archives are accompanied by an index produced by government archivists. M. J. Mavidal, chief of protocol and of parliamentary publications, and E. Laurent, parliamentary librarian, oversaw the creation of the index that provides information not only on topics included but on specific demands (e.g. Topic: Freedom of press;

Table 1 Summary statistics

Weather variables	Mean	Min	Max				
(In deviations from the long-term mean:)							
Growing-season temperature in 1788	1.05	1.026	1.149				
Growing-season precipitation in 1788	0.894	0.752	1.037				
	All cantons						
	All	Hot areas	Cold areas	*p*-value difference	Wet areas	Dry areas	*p*-value difference
Number of observations	3666	1837	1829		1836	1830	
Mean							
Probability of peasant revolt	0.082	0.093	0.07	0.01**	0.087	0.077	0.26
Demands for institutional change	*Cantons with list of grievances*						
From lists of grievances	All	Hot areas	Cold areas		Wet areas	Dry areas	
Number of observations	608	300	308		304	304	
Mean							
No. of demands for institutional change	1.28	1.5	1.05	− 0.45***	1.507	1.046	0.46***
Type of demands							
Improve rights of the Third Estate	0.22	0.28	0.162	− 0.12***	0.289	0.151	0.14***

Table 1 (continued)

Demands for institutional change	*Cantons with list of grievances*						
From lists of grievances	All	Hot areas	Cold areas		Wet areas	Dry areas	
Free press	0.21	0.28	0.146	− 0.13***	0.273	0.148	0.13***
Introduce municipal elections	0.164	0.227	0.104	− 0.12***	0.237	0.092	0.14***
Abolish feudal privileges of the nobility	0.382	0.38	0.383	0.003	0.109	0.201	− 0.04***
Abolish *Lettres de cachet*	0.299	0.343	0.256	− 0.09**	0.345	0.253	0.9**

Notes: This table presents mean, minimum and maximum of the weather variables. The weather variables are: deviation in growing-season temperature in 1788 from the long-term mean and deviation in growing-season precipitation in 1788 from the long-term mean. Then, the table presents summary statistics for outcome variables: mean for all cantons (column 1), mean for cantons with above median growing-season temperature deviation (column 2; "hot areas"), and mean for all cantons with below median growing-season temperature deviation (column 3, "cold areas"), mean for all cantons with above median growing-season precipitation deviation (column 5, "wet areas"), mean for all cantons with below median growing-season precipitation deviation (column 3, "dry areas"). Columns 4 and 7 indicate the p-value of the difference in variables between the two subsample. Stars indicate significance levels

demand: demand to grant complete freedom of press; see Mavidal & Colombey, 1875). I identify all topics from the index that clearly demand more equal political and economic rights for its population. I only include topics when the exact demand related to this topic is also identified.[17]

Topics include a wide range of matters from local to national affairs touching virtually all spheres of public life: demands to repair local roads, to improve other local infrastructure (e.g., to relocate abattoirs), demands on religious practices (e.g., punish blasphemy in court), and how to deal with beggars and foundlings. I include a list of all topics in the index in Table A.3. Table A.4 in the online Appendix shows that the topics as identified in the index are very close to the original texts.[18]

I identify demands in five categories that demand to abolish or reform certain political institutions or to introduce more participatory institutions. The demands were chosen as they represent hallmarks of democratic systems today and mark a clear departure from the existing class-based *Ancien Régime*: the demand for political and economic equality, and equality before the law, the demand for elections, and for a free press.

(1) Political representation of commoners and access to all professions

The political and economic rights of the Third Estate (commoners) were minimal in pre-Revolutionary France. Certain lists of grievances demand the political representation of the Third Estate, and access to all professions. In particular, they demand that the number of representatives of the Third Estate, that represented 96 percent of the population, equals the number of both the representatives of the first (clergy) and of the second (nobility) estates at the Estates General.

(2) Demands for a free press

Under the *Ancien Régime*, all publications were under the scrutiny of royal censorship. Any publications with political content were strictly prohibited. The lists of grievances contain demands to establish a free press and to curtail or to end royal censorship.

(3) Election of municipal officers

Municipal officers were regularly appointed by the king or regional ruler, often in exchange for a considerable financial contribution. The appointee then had the right to collect taxes from the local population. In most cases, he took full advantage of this possibility by extracting taxes irrespective of the living conditions of the local population. The lists of grievances contain demands to appoint these municipal officers by election.

(4) Abolish feudal privileges of the nobility

Feudal privileges were the cornerstone of the French feudal system (*privilèges*). They enshrined the right of the nobility to be exempted from most taxes. They also enshrined the nobility's rights to levy taxes and to administer the law on their lands (*droit seigneurial*). The nobility further had the right to be judged by certain courts only effectively circumventing the justice system (*committimus*).[19] Feudal privileges enshrined the exclusion of commoners from all political and many economic activities.

(5) Abolish the king's right to issue *lettres de Cachet*

[17] If the index only included topics without further information it would be impossible to tell from the index alone whether a demand asks to grant or not to grant press freedom.

[18] I work with this collection of lists of grievances because the accompanying index allows identification of individual demands, e.g. "Demands for a free press without censorship." Alternative work, for example the classification of demands in the lists of grievances by Hyslop (1936, 1968) provide information on broader categories only, e.g. "Cahiers that were most strongly democratic." While the category name fits nicely with my research question, it is not clear which specific demands are included in this category.

[19] It was the nobility's way of circumventing the French justice system. As a result, it was virtually impossible for the common population to obtain justice.

In the *Ancien Régime*, the king had the right to issue *Lettres de Cachet*. These were letters, signed by the king, enforcing arbitrary decisions and judgments. They were often used to silence and imprison political adversaries without trial. There was no possibility to appeal against these letters, and they had become symbols of the king's unlimited political power.

I geo-reference the locations of all places for which a list of grievances is available, and identify among them all places with a demand in any of these categories. Based on this information, I create six variables: I define *Number of Demands for Institutional Change* as the number of demands described above. Then, I create five indicator variables, one for each demand. The indicator variable *political representation* takes a value of one for canton c if a location in canton c demanded better political representation of the Third Estate or access to all professions, and zero otherwise. The indicator variable for demands (2) to (5) are defined accordingly. Figure 2 presents the share of cantons with lists of grievances that demand any (1) or a specific type of institutional change (2 to 6). Almost 50 percent of cantons demand at least one institutional change. Almost forty percent demand the abolition of feudal privileges of the nobility. About 30 percent demand the abolition of the king's right to issue the *Lettres de Cachet*. 22 percent contain demands to improve the political representation of the Third Estate. 21 percent contain demands for press freedom, and about 16 percent demand the introduction of local municipal elections.

Table 1 shows that relatively warm cantons (with temperature deviations above the median) have a higher average number of demands for institutional change (1.3 compared to 0.9) compared to relatively cold cantons (with temperature deviations below the median). The share of cantons with individual demands for institutional change are higher among cantons with temperature deviation above median for four out of five demands.

Lists of grievances are available for 608 out of 3666 cantons. Figure 3 shows the geographic distribution of the lists of grievances. It appears relatively even across France, yet Table A.5 in the online Appendix shows that there are significant differences in a number of characteristics between cantons with and without lists of grievances. Population density is higher and distance to routes of communication is lower in cantons with a list of grievance compared to those without. This suggests that lists of grievances may have been more likely to survive or to be included in the collection if they are from more urbanised parts of France. It is thinkable that an estimated effect of the weather shock on demand for institutional change might be different in areas without a list. There are also two clusters around Paris and Aix-en-Provence. I therefore explore whether results are likely to differ by urbanisation in Sect. 4.2. Reassuringly, results are very similar.

3.4 Geographic and economic characteristics

I collect data on an array of factors that may have affected outcome variables. If these were also correlated with the weather variables, then excluding them would bias results. I include information on population density in 1789, routes of postal and other forms of communication in 1789, salt tax rates in 1789, literacy in the 17th century, whether a canton is located close to Paris in the Ile-de-France region, and seven region fixed effects based on the distribution of language groups within France that proxy for an array of sociocultural and economic characteristics.

More densely populated areas may have been more likely to experience peasant revolts, for example, because communication costs between peasants or citizens was lower. Historical evidence also suggests that towns were at higher risk of riots

(Lefebvre, 1973). In pre-industrial times, population density is also a useful proxy for an area's affluence. I collect information on population density in 1789 from Clout (1977). The measure is provided in seven categories: below 500 inhabitants per square league, between 500 and 750 inhabitants per square league, between 750 and 1000 inhabitants per square league etc., until above 1750 inhabitants per square league.

Cantons closer to routes of postal and other forms of communication may have received more information on the political situation which may have affected their political actions. It is defined as the distance to the closest postal route or other routes that could have facilitated communication: navigable rivers, canals, or well-paved roads. This variable is also an important control variable for a canton's economic situation. Relatively affluent areas are likely to be better connected than relatively poor ones. I digitize the map from Bonin and Langlois (1987) and compute each canton's distance to the closest route.

A canton's level of education may also have affected outcomes. For example, more educated inhabitants, for example, may have been more aware of the importance of institutions and may have been more likely to demand institutional changes in their list of grievances. I obtain information on literacy in 1690 from Clout (1977) (see Furet & Ozouf, 1977, for the underlying data by Maggiolo). This information is provided in ten literacy categories.

The high salt tax was a particularly important burden to French citizens before and during the French Revolution. In 1789, tax rates varied substantially across provinces within France. The highest tax rate applied to the northern center of France. Other provinces, such as Brittany, were exempt. These tax rates are reflected in the salt prices that are approximately thirty times higher in northern central France compared to Brittany. Likewise, regions with high salt taxes were also institutionally different. They belonged to the *Cinq Grosses Fermes* that were under direct management of the French Crown. Johnson (2015) shows that these regions were more in favour of market-enhancing national institutions and had stronger national sentiments. Whether or not citizens engaged in uprisings may have been affected by salt tax rates or by other institutional or cultural characteristics of salt tax regions. Therefore, I include a control variable on the salt tax rate in all specifications. I digitize information on the distribution of salt tax rates in 1789 from Shepherd (1926).

I add an indicator variable that is one if a canton is located within the Ile-de-France, the region around Paris. The special political status of the Ile-de-France as royal domain (as opposed to being subjected to a ruler from the nobility) and the proximity to Paris may have affected the area's general economic situation and political activity in 1789.

Finally, I include seven region fixed effects in all main specifications. I define seven regions based on the distribution of language groups in France: the region of the *Langues d'Oil* in northern France and the region of the *Langues d'Oc* in southern France, Brittany (Breton), the Savoy region in the East of France (Italian), the Basque region in the southwestern France, the Catalan region in southern France, and Alsace in Northeastern France (German). These languages were spoken by a majority of inhabitants in the corresponding region in 1789 and were an observable characteristic that proxy for an array of cultural, economic, and political characteristics.

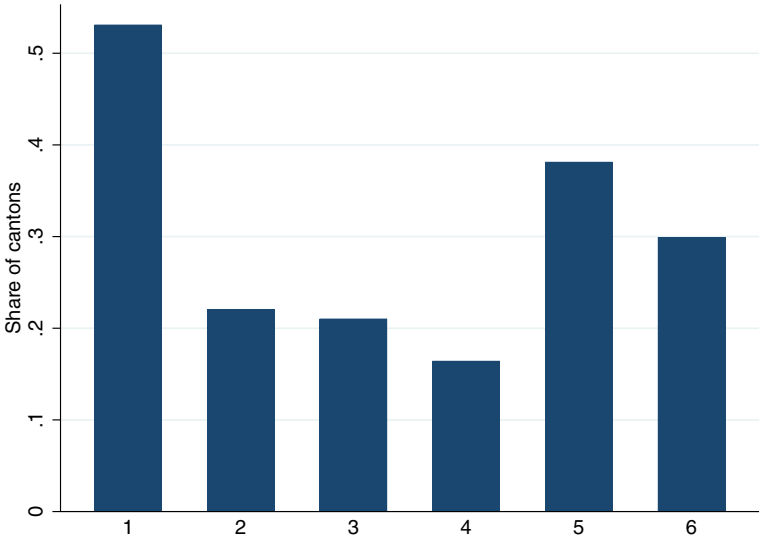

Fig. 2 Share of cantons with demands for institutional change. *Notes:* The graph shows the share of cantons for which a cahier exists (608 in total) that demand a specific institutional change. 1 = the share of cantons that demand at least one institutional change; 2 = the share of cantons that demand better political representation of the Third Estate and access to all professions; 3 = the share of cantons that demands a free press and the end of censorship; 4 = the share of cantons that demand the introduction of municipal elections; 5 = the share of cantons that demand to abolish feudal privileges of the nobility; 6 = the share of cantons that demand to abolish Lettres de Cachet

4 Empirical analysis and results

In this section, I examine the impact of drought in 1788 on two political outcomes: the outbreak of peasant revolts in the summer of 1789 and the demand for institutional change as expressed in the lists of grievances in the spring of 1789 in Sects. 4.1 and 4.2. Section 4.3 explores heterogeneous impacts of the drought in *Pays d'Élection* and *Pays d'État*.

4.1 Peasant uprisings

First, I examine the relationship between the drought of 1788 and peasant uprisings in the summer of 1789. To estimate whether the drought impacted the outbreak of peasant revolts I estimate the following equation:

$$\begin{aligned} PeasantRevolt_{cr} = \alpha + \beta Temperature_{cr} + \gamma Precipitation_{cr} \\ + \delta Temperature * Precipitation_{cr} \\ + RegionFE_r + X_{cr} + \epsilon_{cr} \end{aligned} \tag{3}$$

where $PeasantRevolt_{cr}$ is an indicator variable that is one for canton c if an uprising took place in this canton, and zero otherwise. Drought conditions are captured by the interaction of the two following weather variables: growing-season temperature (deviation of the growing-season temperature of 1788 from the long-term mean), and growing-season

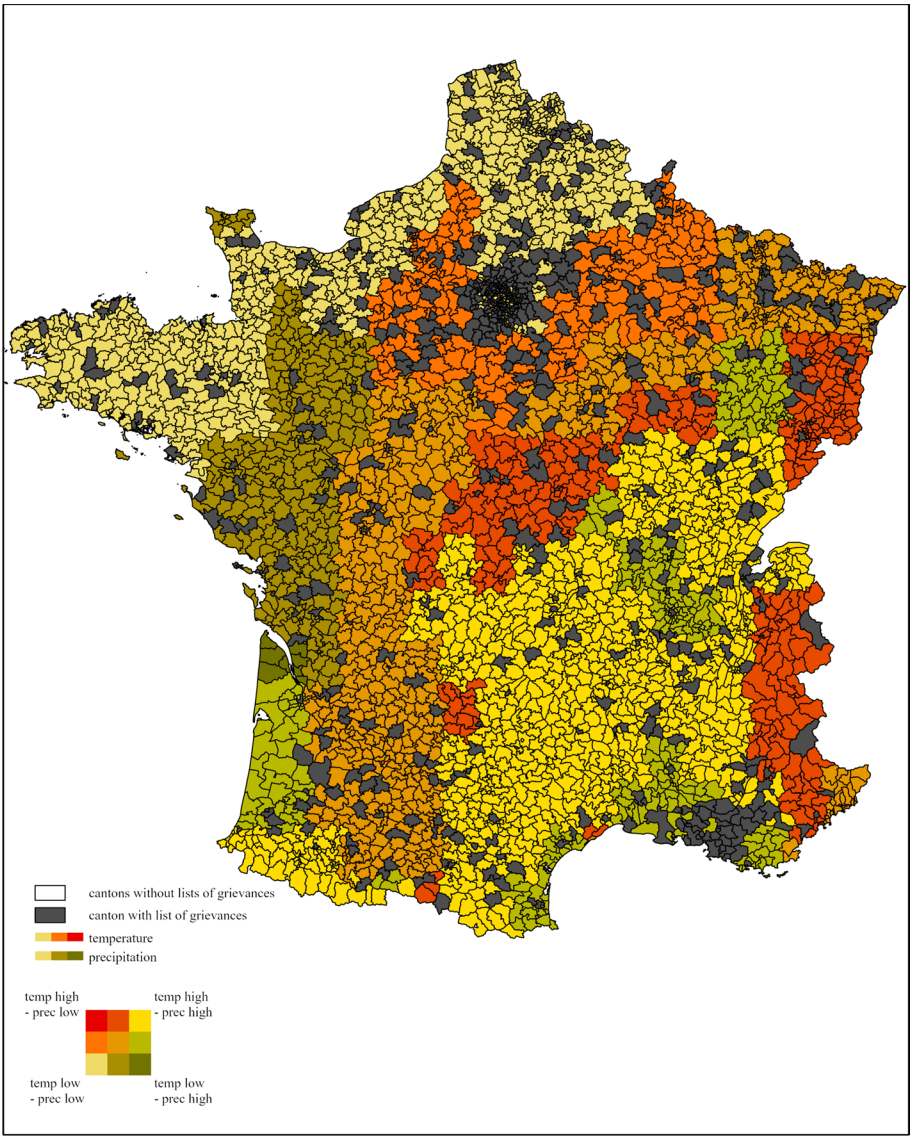

Fig. 3 Cantons with list of grievances. *Notes:* This map is a bivariate map of the geographic distribution of temperature and precipitation in the growing season of 1788 in France. Areas with high temperature and low precipitation are shown in red, areas with low temperatures and high precipitation are shown in green. Areas with low temprature and low precipitation are shown in yellow and areas with high temperature and high precipitation are shown in bright yellow. The map also shows cantons with a list of grievances in grey

precipitation (deviation of the growing-season precipitation of 1788 from the long-term mean, see Sect. 3.1). $RegionFE_r$ is a full set of region fixed effects; X_{cr} is a set of control variables (see Sect. 3.4 for a detailed description of control variables) and ϵ_{cr} is the error term. Standard errors are adjusted for 299 clusters at the grid level of the underlying temperature data set.

Table 2 Drought and peasant uprisings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Growing-season	24.62***	23.28***	28.67***	30.38***	30.59***	31.02***	31.86***	24.64***
Temperature	(4.892)	(5.125)	(5.697)	(5.677)	(5.864)	(5.768)	(5.996)	(5.658)
Growing-season	26.54***	25.19***	31.04***	32.76***	33.01***	33.59***	34.28***	26.84***
Precipitation	(5.387)	(5.603)	(6.164)	(6.126)	(6.358)	(6.235)	(6.478)	(6.141)
GS temperature*	− 25.38***	− 24.09***	− 29.59***	− 31.22***	− 31.47***	− 31.98***	− 32.71***	− 25.49***
GS precipitation	(5.158)	(5.356)	(5.874)	(5.841)	(6.066)	(5.955)	(6.189)	(5.873)
Control variables								
Regions FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pop. density			0.00**	0.00*	0.00*	0.00**	0.00*	0.00**
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Canton area				− 0.00	− 0.00	− 0.00	− 0.00**	− 0.00***
				(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Commun.					0.03	0.04	0.04	0.07
					(0.11)	(0.11)	(0.11)	(0.11)
Literacy						− 0.00	− 0.00	− 0.00
						(0.00)	(0.00)	(0.00)
Paris							− 0.06**	− 0.08***
							(0.03)	(0.03)
Salt tax								0.05***
								(0.01)
Marginal effect of increase in Temperature from p25 to p75								0.047***
Marginal effect of decrease in Precipitation from p75 to p25								− 0.006
Observations	3666	3666	3666	3666	3666	3666	3666	3666
R-squared	0.006	0.007	0.008	0.009	0.010	0.010	0.012	0.016

Table 2 (continued)

The table presents OLS estimates. Observations are at the canton level covering mainland France. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. Peasant Revolt is an indicator variable that is 1 if a canton experienced peasant revolt in the summer of 1789. Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

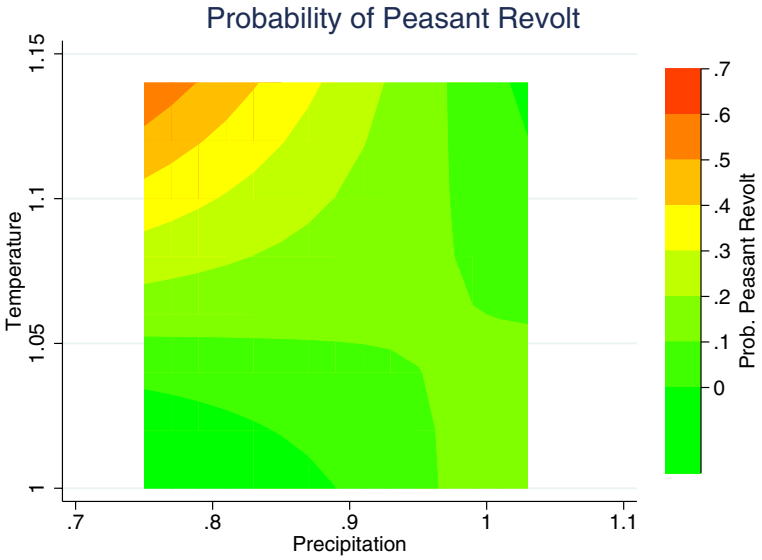

Fig. 4 Marginal effects of temperature and precipitation on peasant uprisings. *Notes:* This contour plot visualises the estimated marginal effects of growing-season temperature deviation and growing-season precipitation deviation on the probability of peasant revolts. Yellow and orange indicate higher effect sizes, green shades indicate lower effect sizes

I show results in Table 2. In column 1, I estimate the specification without any controls, and then introduce controls one by one. Results show a significant relationship between drought conditions in the growing season 1788 and the outbreak of peasant revolts. The coefficient sizes and significance levels remain similar with the introduction of the control variables.

Figure 4 depicts the relationship between temperature and precipitation and outcomes in a contour plot. The contour plot shows the predicted effect of temperature and precipitation on the outcome. It illustrates that the combination of high temperature deviations with low precipitation deviations predicts an increase in revolt incidence. The coefficients indicate that an increase in growing-season temperature from the 25th percentile (relatively cool) to the 75th percentile (relatively warm) where precipitation is low (at the 25th percentile) raises the probability of peasant revolt by 4.7 percentage points (an increase of 58 percent from the sample mean of 8 percent, significant at 1 percent). The marginal effect of a decrease in precipitation from the 75th percentile (relatively wet) to the 25th percentile (relatively dry) where temperature is high (at the 75th percentile) does not significantly affect the probability of revolt. This indicates that the effect I observe in the main results is mainly driven by the effect of temperature on revolt.

These results are consistent with historical evidence that link the outbreak of peasant revolts to the drought in 1788. The timing of the revolts in July is also consistent with a causal relationship between the two events because July is in the lean season, the time of the agricultural year when last year's resources are depleted and destitution and anxiety about the outcome of the coming harvest are on the rise. In 1789, anxiety was heightened by rumours that the aristocracy planned to quell any popular discontent and demands for reforms. Cantons most affected by the drought were more likely to face

higher prices, more destitution and anxiety and were therefore more likely to rise in revolt.

Consistent with the description of control variables in Sect. 3.4, signs on the coefficients of control variables show that areas with higher population density and those in smaller cantons are more likely to revolt.

Lefebvre (1973) describe that revolts first broke out in a small number of places and then spread from there all over France. The data on revolt outbreaks in Lefebvre (1973) include information on the relative timing of the revolt (the authors use symbols to indicate the locations of the first revolts and arrows to indicate the geographic spread of these revolts, see Figure A.1 in the online Appendix). In Table 3, I examine whether the drought had a role in triggering these early revolts. I create two indicator variables. $EarlyPeasantRevolt_{cr}$ is an indicator variable that is one for canton c if it experienced one of the 50 percent earliest revolts. $LatePeasantRevolt_{cr}$ is an indicator variable that is one for canton c if it experienced one of the 50 percent later revolts. I measure the timing of the revolt based on the number of arrows that lie between each revolt location and the closest location marked as "original revolt." Table 3 shows that the estimated effect of drought on early uprising is notably larger than its effect on later revolts.

The result that the drought impacted peasant uprisings is consistent with findings from other settings on the relationship between weather shocks and political violence (Dell, 2012; Spoerer & Berger, 2001; Belloc et al., 2016; Zhang et al., 2006; Brückner & Ciccone, 2011; Burke & Leigh, 2010; Miguel et al., 2004; Burke et al., 2009; Bai & Kung, 2011; Chaney, 2013) and with economic theory. Acemoglu and Robinson (2001, 2006) show that a negative economic shock increases the probability of revolt among the disenfranchised by decreasing opportunity costs of revolt.

Moreover, the revolts began in July, which is a crucial moment for peasants as this is typically the time when the resources from last year's harvests are exhausted and when the peasants have not yet collected the crops from this year. Peasants therefore have to buy cereals in high amounts at this time of the year. In areas where the drought of 1788 was harsher, peasants certainly faced higher prices in July and could more easily fear that the nobility would corner part of the harvests to come.

The peasant revolts were a significant event in the course of the French Revolution. They were one of the factors that finally—after months of discussions—coerced the political elite at the National Assembly into committing to comprehensive institutional reform, notably the abolition of the feudal system (see Sect. 2.3, Merriman, 2010, 447; Neely, 2008, 80).

4.2 The *Cahiers de Doléances* and demand for institutional change

Then, I analyze a possible mechanism through which the drought may have increased peasant revolt, that is the impact of the drought on demand for institutional change among commoners as expressed in the lists of grievances. Those more affected by the drought may have had better information on the inadequacy of existing institutions to avert the adverse consequences of such calamities and may therefore have had greater demand for institutional change.[20]

[20] Demands for institutional change in a broader set of areas captures a stronger will for more comprehensive institutional changes.

Table 3 Early peasant uprisings

	Peasant revolt (1)	Early peasant revolt (2)	Late peasant revolt (3)
Growing-season temperature	24.41***	16.40***	10.16**
	(5.622)	(5.517)	(4.405)
Growing-season precipitation	26.54***	18.32***	10.55**
	(6.093)	(6.023)	(4.834)
GS temperature* GS precipitation	− 25.20***	− 17.51***	− 9.914**
	(5.827)	(5.750)	(4.625)
Region fixed effects	Yes	Yes	Yes
Control variables	Yes	Yes	Yes
Observations	3666	3560	3473
R-squared	0.016	0.024	0.033

The table presents OLS estimates. Observations are at the canton level covering mainland France. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. Peasant Revolt is an indicator variable that is 1 if a canton experienced peasant revolt in the summer of 1789. 'Early Peasant Revolt' is an indicator variable that is 1 if a canton was among the 50 percent earliest places who experienced peasant revolt. 'Late Peasant Revolt' is an indicator variable that is 1 if a canton was among the 50 percent latest places who experienced peasant revolt. In column 2, I only include cantons in the sample with either early revolts or without revolts. In column 3, I only include cantons in the sample with either late revolt or without revolts. Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

I examine the relationship between drought and demands for institutional change in the lists of grievances by estimating the following specification:

$$\begin{aligned} Demands_{cr} = \alpha + \beta Temperature_{cr} + \gamma Precipitation_{cr} \\ + \delta Temperature * Precipitation_{cr} \\ + RegionFE_r + X_{cr} + \epsilon_{cr} \end{aligned} \tag{4}$$

where $Demands_{cr}$ represents six outcome variables. The first variable is the number of demands for institutional change in canton c. The other five indicator variables capture five types of demands for institutional change: (1) to improve the political representation of the Third Estate and grant access of commoners to all professions, (2) to establish a free press and end royal censorship, (3) to introduce municipal elections, (4) to abolish feudal privileges of the nobility, (5) to abolish the King's right to issue *Lettres de Cachet* (see Sect. 3.3 for a description of these demands). I include these demands because they represent hallmarks of a democratic system: elections in a specific context (the election of municipal officers), more equal rights regardless of rank (a better political representation of the Third Estate, the abolition of the political, economic, and judicial privileges of the nobility, and the abolition of the King's right to pass arbitrary judgment in the *Lettres de Cachet*) and

a free press. While these features alone do not constitute a democracy, their introduction constituted first steps towards a democratic system in France.

The indicator variable *Political Representation* takes a value of one for canton c if a location in canton c demanded better political representation of the Third Estate and access of commoners to all professions in their list of grievance, and zero otherwise. The indicator variable for demands 2) to 5) are defined accordingly. I base the analysis only on lists produced by the Third Estate. Except for the outcome variable, the specification is identical to specification 3 in Sect. 4.1.[21]

Column 1 of Table 4 shows a significant relationship between drought conditions and the number of demands for institutional change. Areas with more severe drought conditions listed more demands for democratic change in their lists of grievances. In Fig. 5, I visualize the estimated effects of temperature and precipitation deviations in a contour plot. It shows that the interaction between high temperature deviations and low precipitation deviations predicts a higher number of demands for institutional change to be included in the lists of grievances. This is consistent with results in the previous section showing that the drought increased peasant revolts. A smaller increase in the number of demands is also predicted for areas with high precipitation and low temperatures, which seems surprising. On the other hand, this could reflect the effects of a hail storm that hit France on July 13, 1788. Hail is a form of precipitation and is accompanied by low temperatures. While historians have argued that the effects of the hailstorm were much less detrimental than the effect of the drought (Le Roy Ladurie, 1971), it could explain why areas with relatively high precipitation and low temperatures saw a rise in demands for institutional change.

The coefficients in Table 4 indicate that an increase in growing-season temperature from the 25th percentile (relatively cool) to the 75th percentile (relatively warm) where precipitation is low (at the 25th percentile) is associated with an increase in demands by .4 demands (an increase of 32 percent from the sample mean of 1.28 demands significant at 10 percent). The marginal effect of a decrease in precipitation from the 75th percentile (relatively wet) to the 25th percentile (relatively dry) where temperature is high (at the 75th percentile) does not significantly affect the number of demands. Consistent with estimates in Sect. 2.3, this indicates that the effect of drought on the number of demands is driven by the effect of temperature on revolt.

I then examine the relationship between drought and the frequency of demands for change in different types of institutions. Results in Table 6 show that areas with more severe drought conditions had significantly higher demand for change in the political rights of the Third Estate, in particular for better political representation and access of commoners to all professions (column 1), for a free press (column 2) and for the introduction of elections at the municipal level (column 3). Demands for abolishing privileges of the nobility are also significantly more frequent in areas more affected by the drought. There is no significant effect of weather conditions on the king's right to issue *Lettres de Cachet*. These results are consistent with historical accounts that, in the spring of 1789, the common population blamed primarily the nobility, the excessive amounts of taxes that they owed to them, and their lack of political participatory rights, and not so much the king, for their dire economic situation.

[21] I estimate results at the electoral-district level as part of the lists were produced at that level in Sect. 5.4. Effect sizes are very similar to the one in my main specification. Significance level are somewhat lower, which is not surprising given the much lower number of observations.

Table 4 Drought and demands for institutional change from lists of grievances

	Total number of demands for institutional change							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Growing-season	252.0**	214.8*	308.8**	332.4***	315.0**	315.1**	331.1**	327.0**
Temperature	(107.1)	(113.5)	(122.4)	(124.1)	(128.5)	(128.9)	(127.7)	(132.2)
Growing-season	314.6***	273.1**	372.5***	397.0***	372.1**	372.2**	383.1***	379.0**
Precipitation	(119.9)	(126.5)	(135.9)	(137.6)	(143.3)	(144.0)	(142.0)	(145.8)
GS temperature*	− 297.0**	− 258.4**	− 352.4***	− 375.5***	− 351.7**	− 351.8**	− 364.7***	− 360.8**
GS precipitation	(114.5)	(121.1)	(129.8)	(131.5)	(136.9)	(137.5)	(135.6)	(139.5)
Control variables								
Region FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Population density			Yes	Yes	Yes	Yes	Yes	Yes
Canton area				Yes	Yes	Yes	Yes	Yes
Routes of commun.					Yes	Yes	Yes	Yes
Literacy in 1690						Yes	Yes	Yes
Paris							Yes	Yes
Great salt tax								Yes
Marginal effect of increase in temperature from p25 to p75								40.56*
Marginal effect of decrease in precipitation from p75 to p25								0.09
Observations	608	608	608	608	608	608	608	608
R-squared	0.040	0.051	0.058	0.061	0.065	0.065	0.095	0.095

The table presents OLS estimates. Observations are at the canton level covering mainland France. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. The dependent variable is the number of demands for institutional change included in the list of grievances in canton c. Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

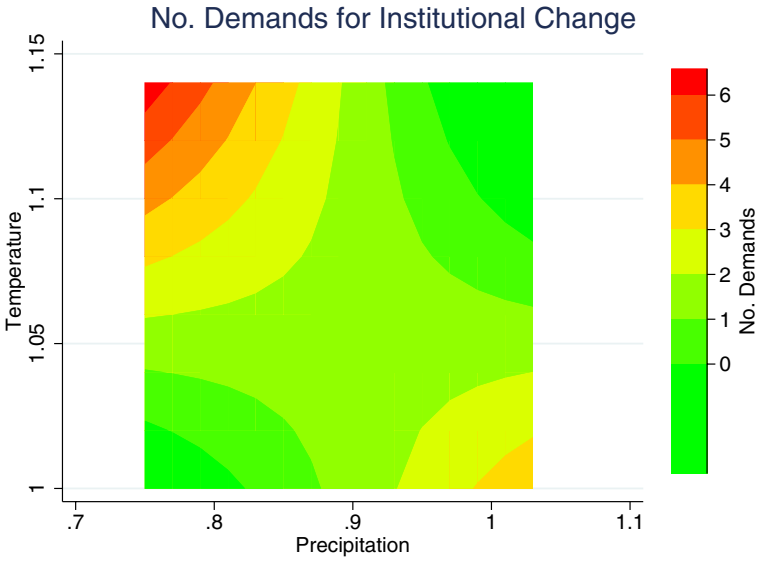

Fig. 5 Marginal effects of temperature and precipitation on demands for institutional change. *Notes:* This contour plot visualises the estimated marginal effects of growing-season temperature deviation and growing-season precipitation deviation on the number of demands for institutional change as expressed in the lists of grievances. Yellow to red shades indicate higher effect sizes, green shades indicate lower effect sizes

The question arises to what extent cantons with lists of grievances exist are comparable to the others. Summary statistics in Table A.5 in the online Appendix show that cantons with lists of grievances are on average more densely populated, they are located closer to routes of communication and a higher share of them is located in the French region of high salt taxes. These factors indicate that they might be on average economically stronger, more densely populated areas. How representative are these results for cantons without a list of grievance? Is it likely, for example, that the effects I estimate are smaller in less densely populated areas because the population there are less well informed of French politics? To explore this concern, I test whether the estimated effect differs when excluding what are likely the most urbanized cantons in the sample, cantons in the Paris and Aix-en-Provence region. In Table A.2 in the online Appendix, I show that point estimates and significance levels remain very similar and are somewhat higher when excluding all lists of grievances from these two regions.

These results provide evidence that the drought, possibly in combination with the hail storm, increased demand among French commoners for more participatory political institutions. This effect may have operated through an information channel: Those more affected by the drought had better information on the inadequacy of existing institutions to protect citizens from such calamities as the drought and its consequences.[22]

I further explore whether the drought affected demands at the intensive or extensive margin. In Table 5, I investigate whether the estimated effect stems from locations without

[22] Those more affected by the drought may in addition have had lower opportunity costs of contributing to the lists of grievances. The opportunity cost channel, however, is likely to be less relevant here because including demands for institutional reform in the lists of grievances was of low cost. It was not punishable by law nor are there any historical accounts of commoners being punished for including such demands in the lists of grievances.

Table 5 Drought and demands for institutional change from lists of grievances-binary specifications

	At least 1 demand	At least 2 demands	At least 3 demands	At least 4 demands	At least 5 demands
	(1)	(2)	(3)	(4)	(5)
Growing-season temperature	35.68	60.12	92.08**	99.80***	39.37**
	(38.12)	(36.75)	(38.10)	(29.11)	(16.33)
Growing-season precipitation	49.33	72.32*	105.6**	108.6***	43.14**
	(42.37)	(40.67)	(41.96)	(31.39)	(17.36)
GS temperature* GS precipitation	− 45.85	− 68.90*	− 101.2**	− 103.9***	− 40.99**
	(40.51)	(38.89)	(40.10)	(30.11)	(16.72)
Control variables	Yes	Yes	Yes	Yes	Yes
Observations	608	608	608	608	608
R-squared	0.033	0.078	0.106	0.123	0.045

The table presents OLS estimates. Observations are at the canton level covering mainland France. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. The dependent variables are binary variables that are one if a canton's list of grievance included at least one demand (column 1), two demands (column 2), etc. Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

demands including one or more demands or rather from locations with demands including more demands. Results indicate that the drought influenced the demands for institutional change at the extensive margin, i.e. locations that included one or two demands were more likely to include a second or third demand.

The content of the lists of grievances was an important contribution to the political developments in 1789. Later at the National Assembly, it gave the representatives of the Third Estate at the Estates General a clear mandate to fight for more participatory institutions and a more equitable distribution of political and economic rights.

4.3 Heterogeneous impacts of drought in Pays d'Élection and Pays d'État

The drought may have had an impact on peasant revolts and demand for institutional change through a number of channels. One possible channel was that the drought revealed to the population the inadequacy of political institutions to react to such calamities and to protect the population from its fallout. If this is true, then one might expect heterogeneous effects of drought on outcomes depending on the existing institutional set up. One marked institutional difference within France was the difference between regions belonging to the *Pays d'État* and to the *Pays d'Élection*. Taxes in the *Pays d'Élection* were high and they were under the direct authority of a royal representative. Taxes in the *Pays d'État* were generally lower and were under the authority of local landlords, usually the nobility. It is thinkable that the population in *Pays d'Élection* that faced higher taxes would be under higher economic strain already and hence respond more to the drought through revolt or by expressing higher demand for

Table 6 Demands for institutional change

	Institutions-Third Estate		Institutions-municipality	Institutions-nobility	Institutions-king
	Political representation	Free press	Introduce municipal elections	Abolish feudal privileges of the nobility	Abolish *Lettres de Cachet*
	(1)	(2)	(3)	(4)	(5)
Growing-season	76.76**	74.75**	98.17***	82.87**	− 5.511
temperature	(35.12)	(36.63)	(30.95)	(38.27)	(38.62)
Growing-season	90.06**	86.50**	109.4***	93.68**	− 0.617
precipitation	(38.52)	(39.92)	(33.67)	(41.62)	(42.08)
GS temperature*	− 85.33**	− 83.01**	− 103.8***	− 89.94**	1.318
GS precipitation	(36.80)	(38.31)	(32.25)	(39.84)	(40.34)
Regions fixed effects	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes
Observations	608	608	608	608	608
R-squared	0.067	0.119	0.112	0.035	0.055

The table presents OLS estimates. Observations are at the canton level covering mainland France. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. The dependent variable in column 1 is the number of demands for institutional change included in the list of grievances in canton c. The dependent variables in columns 2 to 6 are the demand for better political representation of the Third Estate (column 2), the demand for a free press and the end of censorship (column 3), the demand to introduce municipal elections (column 4), the demand to abolish feudal privileges of the nobility (column 5), and the demand to abolish the king's lettre de cachet (column 5). Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

Table 7 Heterogeneous effects of drought in *Pays d'État* and *Pays d'Élection*

	Total number of demands for institutional change			Peasant revolts		
	All	*Pays d'Élection*	*Pays d'État*	All	*Pays d'Élection*	*Pays d'État*
	(1)	(2)	(3)	(4)	(5)	(6)
Growing-season temperature	331.1**	46.65	585.2***	31.86***	25.82***	30.04***
	(127.7)	(232.9)	(147.3)	(5.996)	(8.931)	(9.424)
Growing-season precipitation	383.1***	76.90	681.8***	34.28***	29.56***	30.75***
	(142.0)	(250.8)	(165.0)	(6.478)	(9.944)	(10.24)
GS temperature* GS precipitation	− 364.7***	− 64.61	− 651.7***	− 32.71***	− 27.52***	− 29.59***
	(135.6)	(239.3)	(157.7)	(6.189)	(9.417)	(9.793)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	608	115	493	3,666	1,097	2,569
R-squared	0.095	0.214	0.094	0.012	0.031	0.015

The table presents OLS estimates. Observations are at the canton level covering mainland France. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. The dependent variable in columns 1 to 3 is the number of demands for institutional change included in the list of grievances in canton c. The dependent variable in columns 4 to 6 is Peasant Revolt, an indicator variable that is 1 if a canton experienced peasant revolt in the summer of 1789. See Sect. 4.3 for details on Pays d'Élection and Pays d'État. The specification contains the same control variables as in the main specification. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

institutional change. On the other hand, the *Pays d'Élection* were under centralized rule by the French king while the peasant revolts were especially directed against the ruling local nobility.

Table 7 examines this hypothesis. Interestingly, the population in the *Pays d'Élection* is more likely to react to the drought by demanding institutional change while the population in the *Pays d'État* is not. The probability of local revolt, in contrast, is about the same in *Pays d'Élection* and *Pays d'État* with a slightly larger effect in the *Pays d'État*. This chimes with the observation that peasant revolts were especially directed towards the local nobility. While taxes were especially high in the *Pays d'Élection* they were managed by royal representatives. This could explain why the population there was more likely to react through the lists of grievances that were directed to the King, rather than through revolts directed at the nobility.

5 Robustness

5.1 Accounting for spatial autocorrelation

In this section, I explore whether spatial autocorrelation in the error term may lead to the underestimation of the standard errors. Figure 1, for example, suggests that the weather variables may be spatially correlated. I test this formally using the Moran's I spatial autocorrelation index and find spatial autocorrelation in the location of peasant revolts, in the

Table 8 Accounting for spatial autocorrelation

	Main Specification	100 km	200 km	600 km	Main Specification	100 km	200 km	600 km	900 km
		Demands for institutional change				*Peasant revolt*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Growing-season	327.05**	327.0***	327.0***	327.0***	24.41***	24.41***	24.41***	24.41***	24.41***
temperature	(132.19)	(110.0)	(85.39)	(55.71)	(5.62)	(5.599)	(3.934)	(3.993)	(0.697)
Growing-season	379.03**	379.0***	379.0***	379.0***	26.54***	26.54***	26.54***	26.54***	26.54***
Precipitation	(145.80)	(120.2)	(101.1)	(57.25)	(6.09)	(6.071)	(3.965)	(3.742)	(0.815)
GS temperature*	− 360.76**	− 360.8***	− 360.8***	− 360.8***	− 25.20***	− 25.20***	− 25.20***	− 25.20***	− 25.20***
GS precipitation	(139.52)	(115.4)	(96.17)	(54.21)	(5.83)	(5.837)	(3.909)	(3.686)	(0.798)
Observations	608	608	608	608	3666	3666	3666	3666	3666
R-squared	0.09	0.095	0.095	0.095	0.02	0.016	0.016	0.016	0.016

The table presents OLS estimates. Observations are at the canton level covering mainland France. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. Peasant Revolt is an indicator variable that is 1 if a canton experienced peasant revolt in the summer of 1789. Demands for Institutional Change is the number of demands for institutional change included in the list of grievances in canton c. Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. In columns 1 and 5, robust standard errors are clustered at the grid level of the underlying temperature data. In columns 2 to 4 and 6 to 9, spatial correlation of the error term is assumed within 100, 200, 600 and (for the outcome peasant revolt) 900 km around each canton. Results assuming spatial autocorrrelation in the error term within 900 km for the outcome "Demands for institutional change" cannot be shown because the much smaller sample does not contain sufficient observations that far apart. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

temperature and precipitation (significant at the one percent level). There is no indication of spatial autocorrelation in the number of demands for institutional change. To examine whether spatial autocorrelation affects my results, I estimate the main specifications allowing for spatial dependence of errors across observations within up to 600 and 900 km using a recent implementation of the Conley correction in Table 8 (Colella et al., 2019).[23] The results hold in all specifications.[24]

5.2 Temperature and precipitation in later years

In this section, I present results of a placebo test and examine whether temperature and precipitation deviations in the years after the French Revolution predict the outbreak of peasant revolts in 1789 and demand for institutional change. In particular, I test whether temperature and precipitation deviations in the years 1790, 1810, 1830, 1850, 1870, and 1890 predict outcomes. For each specification, temperature and precipitation deviations from the long-term mean are defined as before (see Sect. 3.1 for a detailed definition of the weather variables).

Results in Tables 9 and 10 show the estimated effects of weather in 1790, 1810, 1830, 1850, 1870, and 1890 on the outbreak of peasant revolts and the number of demands for institutional change. The paper's main results for temperature and precipitation in 1788 are shown in column 1 to facilitate comparison. Except for the weather variables, the specifications are identical to the main specification. Results show that deviations in growing-season temperature and precipitation and winter temperature in years other than 1788 do not predict outcomes. The signs are insignificant and coefficients are small. One exception is the estimated relationship between temperature and precipitation in 1790 and demands for institutional change. Here the relationship is significant. One explanation for this could be that, because of the temporal proximity, certain large-scale determinants of the weather, such as atmospheric circulation patterns (Azores anticyclone, large-scale wind directions) were similar in 1788 and 1790. However, coefficients are relatively small and insignificant in all other years.[25]

5.3 Alternative long-term means

In the main specification, I define deviations in temperature and precipitation from the long-term mean. In the main specification, long-term temperature and precipitation is defined as temperature and precipitation between 1750 and 1800. In Table 11, I show that results are robust to the use of alternative long-term means, in particular the periods 1600 to 1800 and 1700 to 1800.

[23] With this approach, I follow prominent papers in the literature such as Sequeira et al. (2020), McGuirk and Nunn (2020), Ager et al. (2022), Caprettini and Voth (2022), Drelichman et al. (2021), Fouka and Voth (2022) and Ducruet et al. (2020).

[24] I cannot show results when assuming spatial autocorrrelation in the error term within 900 km for the outcome "Demands for institutional change" because the sample size is considerably smaller and does not contain sufficient observations that far apart. The entire French mainland territory only measures 950 (north to south) and 940 km (west to east) at its largest extent.

[25] The coefficient in column 4 of Table 10 is significant at 10 percent, but the sign of the coefficient is negative indicating that cooler, not warmer, temperatures in this year are weakly correlated with demands for institutional change.

Table 9 Placebo test for an effect of weather deviations in later years

	1788	1790	1810	1830	1850	1870	1890
	Peasant revolts						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Growing-season	24.64***	4.75	4.25	0.50	2.23	3.03	0.80
Temperature	(5.658)	(15.87)	(3.68)	(1.79)	(6.85)	(3.07)	(8.44)
Growing-season	26.84***	3.38	2.84	0.15	1.94	4.58	1.11
Precipitation	(6.141)	(16.04)	(3.79)	(2.06)	(5.56)	(4.48)	(6.03)
GS temperature*	− 25.49***	− 2.92	− 2.79	− 0.11	− 1.98	− 4.61	− 0.91
GS precipitation	(5.873)	(15.77)	(3.82)	(1.95)	(5.95)	(4.38)	(6.55)
Observations	3666	3666	3666	3666	3666	3666	3666
R-squared	0.016	0.02	0.02	0.01	0.01	0.01	0.02

The table presents placebo estimates. Estimates in column one show the main results to facilitate comparison. Columns 2 to 6 show results for the estimated relationship between weather in 1790, 1810, 1830, 1850, 1870, and 1890 and outcomes in 1789. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. Peasant Revolt is an indicator variable that is 1 if a canton experienced peasant revolt in the summer of 1789. Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

5.4 Drought and demands for institutional change at the electoral-district (bailliage) level

The collection of lists in the *Archives Parlementaires*, that I am using, contains both parish-level lists of grievances and bailliage-level lists of grievances. After the Estates General had been summoned and the invitation to submit *cahiers de doléances* had been issued, French commoners first produced lists of grievances at the parish level. At the electoral district (bailliage) level, parish lists were later summarized to produce the bailliage-level lists that were sent to the Estates General in Paris. I include both information from the parish-level and from the bailliage-level lists of grievances. I am especially interested in the parish-level lists because these contain the opinions of the common population, sometimes uneducated and illiterate, in an unaltered way.

One might be concerned that the fact that some lists of grievances were produced at the parish level while others were produced at the electoral district level might affect results for example because control variables are calculated at the canton level and not at the electoral district level. To address the concern, I construct a data set as in 4.2 but at the level of the historical electoral district (*bailliage*). For this purpose, I digitize a map of the French *bailliages* and associate the information from the lists of grievances and all control variables to these entities. I end up with 282 bailliages that have had a list. Table 12 shows results. Reassuringly, the effect sizes are very similar to the one in my main specification. Significance level are somewhat lower, which is not surprising given that the number of observations is less than half compared to the main specification.

Table 10 Placebo test for an effect of weather deviations in later years

	1788	1790	1810	1830	1850	1870	1890
	Demands for institutional change						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Growing-season	327.05**	760.11**	85.71	− 71.39*	− 11.11	11.87	203.50
Temperature	(132.19)	(303.78)	(56.38)	(43.20)	(82.06)	(56.45)	(180.67)
Growing-season	379.03**	772.81***	83.70	− 59.24	− 72.49	35.56	132.58
Precipitation	(145.80)	(297.11)	(58.68)	(45.97)	(75.28)	(81.29)	(127.07)
GS temperature*	− 360.76**	− 757.18**	− 83.96	56.41	80.43	− 36.44	− 141.17
GS precipitation	(139.52)	(292.97)	(58.83)	(43.98)	(80.19)	(79.50)	(137.55)
Observations	608	608	608	608	608	608	608
R-squared	0.09	0.09	0.08	0.09	0.10	0.09	0.10

The table presents placebo estimates. Estimates in column one show the main results to facilitate comparison. Columns 2 to 6 show results for the estimated relationship between weather in 1790, 1810, 1830, 1850, 1870, and 1890, and outcomes in 1789. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-term mean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. Demands for Institutional Change is the number of demands for institutional change included in the list of grievances in canton c. Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

6 Conclusion

The paper shows evidence that the drought of 1788 had political impacts during the French Revolution. Those more affected by the drought more often participated in peasant revolts against the feudal system. The drought was especially relevant to the outbreak of relatively early revolts that—historians have suggested—helped spark later revolts. I investigate a possible mechanism through which drought may have affected the outbreak of revolts: the drought's effect on popular demand for institutional change. I find that demand for institutional change, a key prerequisite for regime change, was higher in areas more affected by the drought. The results provide evidence on specific ways in which the drought impacted the French Revolution, a milestone in the democratization of Western Europe. They also contribute to our understanding of the political impacts of weather shocks.

It is also important to note, that the estimated effect of weather shocks on uprisings has to be interpreted as an effect *conditional* on underlying circumstances. Drought was a regularly occurring phenomenon (see Fig. 6). The same weather conditions may have had different effects if the underlying political, economic and social conditions in France had been different.[26]

[26] England, for example, was also affected by adverse weather conditions in the 1780 s. However, as England's economy depended less on agriculture and already had a more developed manufacturing sector the general population was less affected by these weather conditions.

Table 11 Alternative weather variables

	1750 to 1800	1600 to 1800	1700 to 1800	1750 to 1800	1600 to 1800	1700 to 1800
	Main specification	Peasant revolt		Main specification	Demands for institutional change	
	(1)	(2)	(3)	(4)	(5)	(6)
Growing-season	24.41***	17.72***	14.42***	327.05**	273.11**	353.76***
Temperature	(5.62)	(5.64)	(4.32)	(132.19)	(116.59)	(114.06)
Growing-season	26.54***	19.92***	15.85***	379.03**	315.31**	401.71***
Precipitation	(6.09)	(6.35)	(4.79)	(145.80)	(128.35)	(123.78)
GS temperature*	− 25.20***	− 18.25***	− 14.69***	− 360.76**	− 292.83**	− 377.36***
GS precipitation	(5.83)	(5.91)	(4.51)	(139.52)	(120.26)	(117.16)
Observations	3666	3666	3666	608	608	608
R-squared	0.02	0.02	0.02	0.09	0.09	0.10

The table presents OLS estimates. Observations are at the canton level covering mainland France. Growing-season temperature is the growing-season temperature deviation in 1788 from different long-term means: 1750 to 1800 (as in the main specification), 1600 to 1700 m, and 1700 to 1800. Peasant Revolt is an indicator variable that is 1 if a canton experienced peasant revolt in the summer of 1789. Demands for Institutional Change is the number of demands for institutional change included in the list of grievances in canton c. Control variables are population density, canton area, distance to closest road, whether a canton is subject to the great salt tax, literacy in 1690, whether a canton is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

Table 12 Drought and demands for institutional change at the electoral-district level

Total number of demands for institutional change							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Growing-season	274.8**	302.7**	375.3**	378.3**	369.1**	373.0**	290.1*
Temperature	(108.1)	(124.3)	(154.4)	(156.2)	(159.3)	(159.4)	(169.0)
Growing-season	307.3**	345.7**	424.7**	428.7**	417.3**	422.0**	338.8*
Precipitation	(121.4)	(141.2)	(173.2)	(176.2)	(180.1)	(180.1)	(188.0)
GS temperature*	− 294.5**	− 332.1**	− 406.8**	− 410.5**	− 400.0**	− 404.3**	− 323.3*
GS precipitation	(116.3)	(135.5)	(165.6)	(168.3)	(171.7)	(171.7)	(179.7)
Control variables							
Regions FE		Yes	Yes	Yes	Yes	Yes	Yes
Population density			Yes	Yes	Yes	Yes	Yes
Routes of commun				Yes	Yes	Yes	Yes
Literacy in 1690					Yes	Yes	Yes
Paris						Yes	Yes
Great salt tax							Yes
Observations	282	282	282	282	282	282	282
R-squared	0.015	0.043	0.045	0.046	0.046	0.055	0.063

The table presents OLS estimates. Observations are at the electoral district (bailliage) level. Growing-season temperature is the growing-season temperature deviation in 1788 from the long-termmean. It measures average growing-season temperature in 1788 (March to August) as a percentage of long-run average growing-season temperature. Growing-season precipitation is defined accordingly. GS temperature*GS precipitation is an interaction term of the two weather variables. The dependent variable is the number of demands for institutional change included in the list of grievances in canton c. Control variables are population density, distance to closest road, whether an electoral district is subject to the great salt tax, literacy in 1690, whether an electoral district is part of the Paris region Ile-de-France, and region fixed effects. See Sect. 3.4 for detailed information on control variables. Robust standard errors are clustered at the grid level of the underlying temperature data. Significance levels are indicated as *** for $p < 0.01$, ** for $p < 0.05$, * for $p < 0.1$

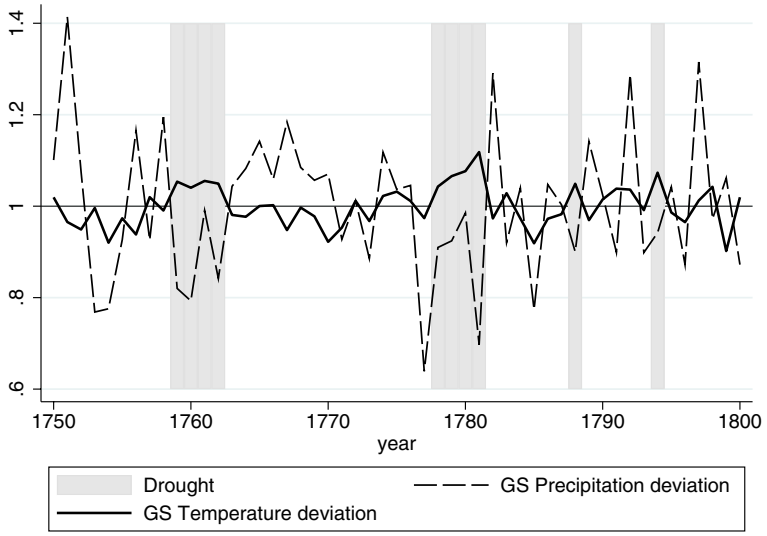

Fig. 6 Temperature and precipitation deviations over the long-run. *Notes:* The plot visualizes temperature and precipitation deviations over the period 1750 to 1800 in France

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