Climate Change, Event Geography and Regional Impacts: Evidence from Professional Cycling

Abstract

This paper examines how climate change affects the geography of professional road cycling events in France. Using an original dataset combining annual climate indicators and the historical distribution of stage starts and finishes for the Tour de France, Paris–Nice, Paris–Roubaix, and the Critérium du Dauphiné between 2000 and 2025, the study evaluates whether long-term climatic conditions or short-term temperature extremes influence the selection of host cities. Descriptive analyses reveal a clear upward trend in average and maximum temperatures, alongside an intensification of heatwave episodes. However, cross-sectional regressions show that long-term climate variables do not explain the spatial distribution of starts and finishes, which remains strongly shaped by historical, institutional, and logistical factors. Poisson models confirm that annual temperature variations and extreme heat events have not yet significantly altered the geography of major races. These findings suggest that, while climate change is already transforming the environmental context of professional cycling, it has not yet reconfigured the territorial structure of events. Nevertheless, the increasing frequency of extreme temperatures poses significant challenges for local authorities, organizers, and tourism stakeholders. They will increasingly need to integrate climate adaptation into event planning, infrastructure investment, and territorial development strategies.

Keywords: climate change, professional cycling events, regional adaptation, tourism impacts, territorial resilience

G08 – Climate Change and Natural Hazards: Spatial Incidence and Impacts

1. Introduction

Climate change is one of the main contemporary drivers of territorial transformation, affecting environmental conditions, economic dynamics, and social practices (IPCC, 2021). Among the activities particularly exposed are outdoor sporting events, whose organization is closely linked to weather conditions and the capacity of territories to manage climate risks (Mallen & Adams, 2017; Périard et al., 2021). While the literature has largely focused on the impacts of climate on winter sports (Steiger et al., 2019), mega-events (Mallen & Chard, 2012 ; Toohey and Taylor, 2019), and recreational sports (Scott et al., 2019), research on professional cycling competitions is comparatively limited, although recent studies are beginning to address the effects of environmental conditions such as cold temperatures on athlete performance (Riera et al., 2021).

Road cycling has a major distinguishing feature: the geography of the races is intrinsically linked to the territories they traverse. Stage towns play a central role in the sporting spectacle, the media coverage of the landscapes, and the generation of local economic benefits (Preuss, 2007; Fourie & Santana-Gallego, 2011). In this context, rising temperatures, intensifying heat waves, and increased weather variability could alter the organization of races and even influence the selection of host cities. Research in sports physiology shows that extreme temperatures significantly affect cyclists' performance and safety (Nybo et al., 2014; Racinais et al., 2015), while research in the geography of sport highlights the dependence of cycling events on appropriate territorial infrastructure and effective local governance (Bale, 2002; Higham & Hinch, 2018).

However, no study has yet systematically analyzed the effect of climate change on the geography of major professional cycling races. This work fills this gap by using a unique dataset combining historical routes of the main French races (Tour de France, Paris–Nice, Paris–Roubaix, Critérium du Dauphiné), detailed annual climate series, and territorial information. Through an econometric approach combining cross-sectional and panel data models, the objective is to assess whether climatic conditions—average or extreme—influence the probability of a city hosting a start or finish, and to identify the territorial implications of these dynamics.

The results show that average, minimum, and maximum temperatures do not explain the spatial distribution of the stages, confirming that the geography of French cycling remains largely structured by historical, institutional, and logistical factors. However, the increasing frequency of extreme weather events suggests growing risks for the future organization of races, opening up important perspectives for territorial policies, sports governance, and adaptation strategies for local stakeholders. The remainder of this article is structured as follows: Section 1 presents the data; Section 3 outlines the methodology; Section 4 provides the results which are discussed in Section 5; and Section 6 concludes.

2. Data

For the period 2000-2025, we use a panel data set based on the start/finish city of the four main professional cycling races held in France (Tour de France, Paris-Nice, Paris-Roubaix, and Critérium du Dauphiné), enriched with annual climate data. Each row corresponds to a combination of "race – city – city role (start/finish)," with contextual variables (region, climate type) and a time series of temperatures. The two dependent variables are the number of starts (*NbDepart*) and the number of finishes (*NbArriv*) of professional races in the city. Thirty-three cities were selected for the study period (Annecy, Avignon, Bagnères-de-Luchon, Bayonne, Belfort, Bordeaux, Brest, Briançon, Caen, Cannes, Chambéry, Col d'Eze, Compiègne, Gap, Grenoble, Lyon, Mandelieu-la-Napoule, Manosque, Marseille, Metz, Montpellier, Nantes, Nevers, Nice, Paris, Pau, Perpignan, Roubaix, Saint-Etienne, Toulon, Toulouse, Valence, and Vergèze). Graphs 1 and 2 show the number of starts and finishes for each city. Ten cities simultaneously recorded more than 40 starts and finishes (Bagnères-de-Luchon, Bordeaux, Gap, Marseille, Metz, Nice, Paris, Pau, Roubaix, and Saint-Etienne).

Figure 1. Number of finishes per town

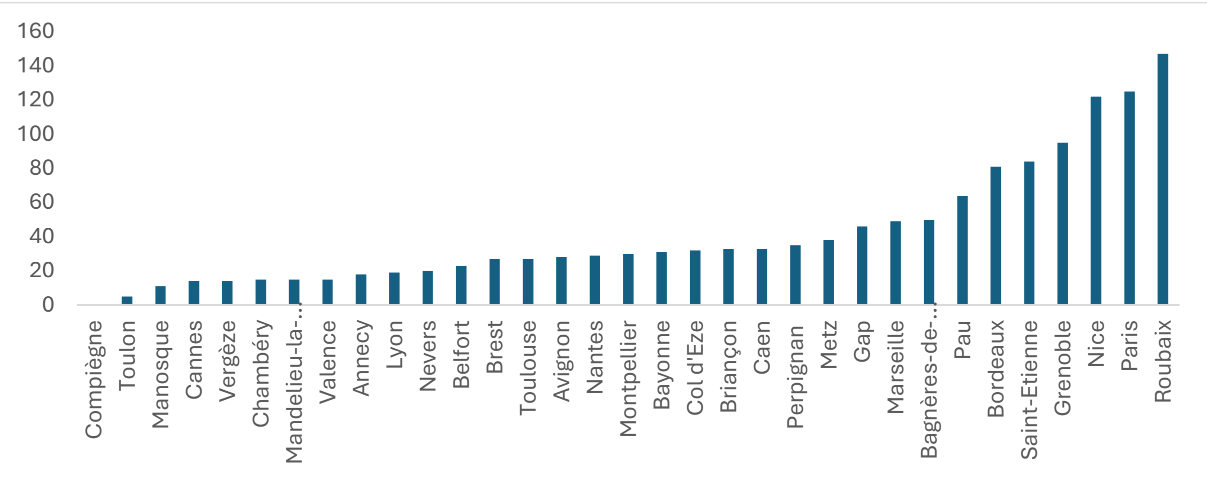
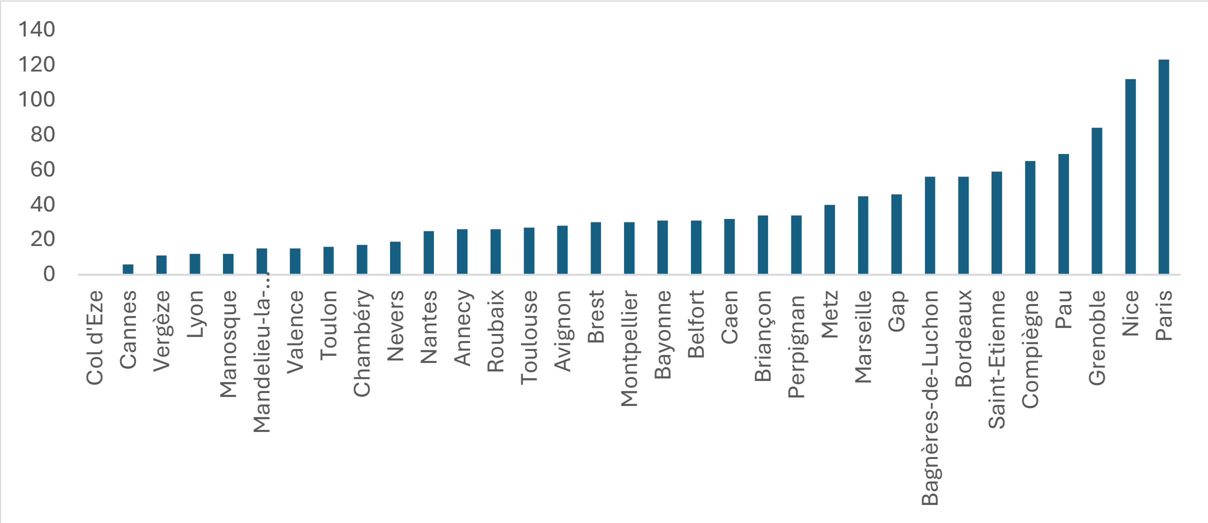


Figure 2. Number of starts per town



The independent climate variables are of three types and are continuous in degrees Celsius, declining annually from 2000 to 2025: average annual temperatures (*AverageTemp2000, ..., AverageTemp2025*), minimum annual temperatures (*TempMin2000, ..., TempMin2025*), and maximum annual temperatures (*TempMax2000, ..., TempMax2025*). Figure 3 shows the trend in average temperatures. They are increasing steadily, with a rise of approximately 1.3°C over 25 years. Figure 4 indicates that maximum temperatures show an even more pronounced trend, with heat waves becoming more intense. However, Figure 5 shows a weaker trend in minimum temperatures. Colder winters are becoming less frequent, with extreme minimum temperatures (-15° to -20°C) no longer observed after 2012. Two qualitative variables are used: the administrative region (Brittany, Burgundy, Grand Est, Hauts-de-France, Île-de-France, Nouvelle-Aquitaine, PACA, Occitanie, etc.) and the type of climate (Altered oceanic, Mediterranean, Mountain, Oceanic, and Semi-continental).

Figure 3. Trend of temperature averages

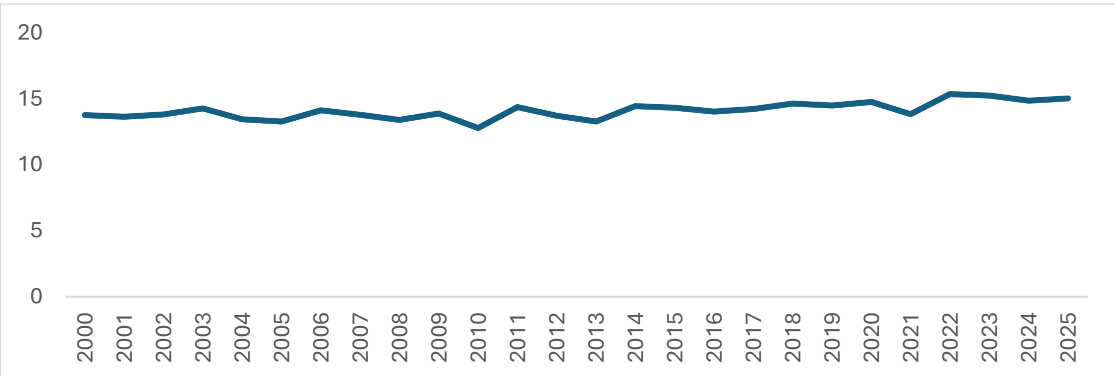


Figure 4. Trend of maximum temperatures

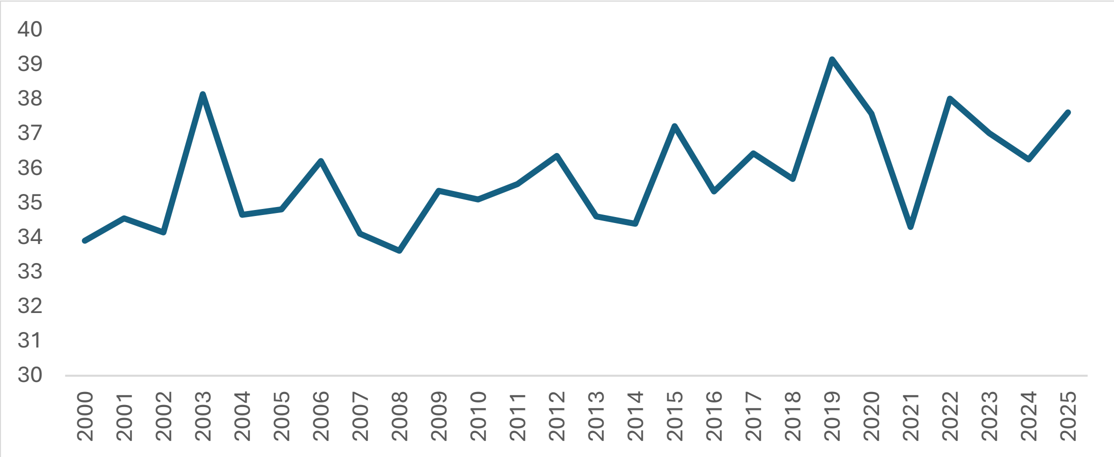


Figure 5. Trend of minimum temperatures

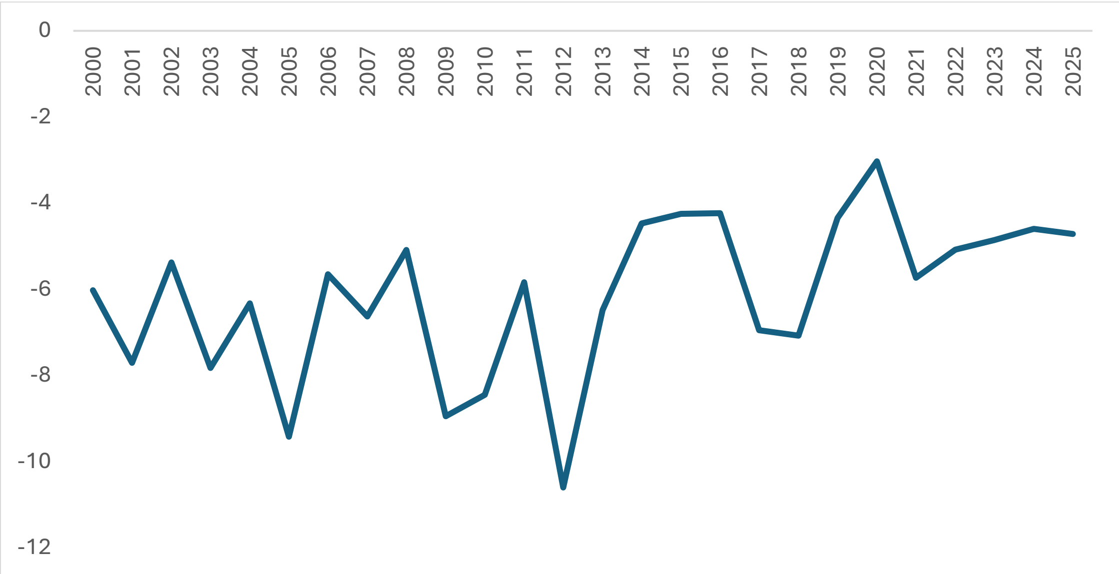


Table 1 presents the descriptive statistics of the database. Regarding the dependent variables, *NbDepart* shows a slightly skewed distribution. The maximum is observed in cities very central to the cycling calendar (Grenoble, Nice, Paris). The skewness is positive, indicating a high number of starts in a few cities. The slightly negative kurtosis indicates a distribution that is slightly flatter than normal. The Jarque-Bera test fails to reject the null of normality. The majority of cities host between 10 and 40 starts, while a small number play a disproportionate role. *NbArrival* shows leptokurtic skewness with a strong concentration around very high extreme value. The maximum of 123 is reached in Roubaix, the historic finish of Paris-Roubaix. The Jarque-Bera test rejects normality. Finishes are therefore more concentrated than starts, reflecting the structure of the cycling calendar. Indeed, some cities are emblematic finish points (Nice, Paris, Roubaix), creating extreme values.

Regarding climatic variables, descriptive statistics show highly varied distributions depending on whether they represent averages, minimums, or maximums. *AverageTemp* exhibits positive skewness and shows strong spatial heterogeneity, with Mediterranean cities being warmer than Alpine or continental cities. The overall average across all cities and years lies in an intermediate zone, with a median close to this average. Skewness is very high, indicating that the distribution is pulled upwards by the warmest cities (Marseille, Nice, and Perpignan). Kurtosis is also very high, showing a very sharp distribution with frequent extreme values. *TempMin* indicates extreme values of -20.2 °C (Grenoble, 2005) and 3.4 °C (Nice, 2022). Skewness is sometimes negative (very cold years), sometimes positive (milder years). Kurtosis close to zero indicates a distribution relatively close to normal. Minimum temperatures reflect regional differences more than global climate trends. *TempMax* is a more revealing variable of climate change. Annual averages vary between 33.6 °C (2000) and 39.1 °C (2019). Extreme values regularly exceed 40 °C, with an absolute maximum of 44.3 °C (2019). Skewness is often negative, meaning that extreme values are on the hot side. Kurtosis is positive and often very high, indicating a leptokurtic distribution with frequent extreme values. Maximum temperatures show an intensification of heat waves, consistent with national observations. These extremes can influence the location of cycling stages, particularly in summer.

Table 1. Descriptive statistics

	Nb_arrival	Nb_departure	AverageTemp	TempMin	TempMax
Minimum	0	0	13.3	-20.2	25.2
Maximum	123	71	15.4	3.4	44.3
Mean	33.54	30.05	[13.3->15.4]	[-10.6->-3.03]	[33.614->39.151]
Median	27	28		[610.6->-3.1]	[33.8->39.5]
Kurtosis	2.904	-0.14	[16->25]	[-1.137->-0.048]	[-1.251->9.780]
Skewness	1.739	0.577	[3.5->4.7]	[-0.617->1.019]	[-2.318->0.539]
Jarque-Bera test	0.000	0.316	0.000	0.000	0.000

3. Methodology

3.1. Cross-sectional model: multiple regression

The objective is to explain differences in cycling centrality between cities by their long-term climatic characteristics and their regional or climatic affiliation. For each city i, the total number of starts $NbDepart_i$ and the total number of finishes $NbArriv_i$ over the period are defined as dependent variables. The explanatory climatic variables are constructed as averages over the period: the average temperature $Aver\bar{age}Temp_i$, the average minimum temperature $Tem\bar{p}M\imath n_i$ the average maximum temperature $Tem\bar{p}Max_i$. Extreme indicators are introduced, such as the number of years in which the annual maximum temperature exceeds a given threshold (40°C), to capture exposure to heat waves. In addition to these continuous variables, there are indicator variables for climate type (Mediterranean, oceanic, mountain, etc.) and for administrative region, which allow for controlling non-climatic structural effects (infrastructure, cycling tradition, accessibility, etc.). The basic model can be written, for the dependent variable $Y_i \in \{NbDepart_i, NbArriv_i\}$, as follows in the equation (1):

$$Y_i = \beta_0 + \beta_1 Aver\bar{age}Temp_i + \beta_2 Tem\bar{p}M\imath n_i + \beta_3 Tem\bar{p}Max_i + \gamma' Climat_i + \delta' Region_i + \varepsilon_i \quad (1)$$

The coefficients $\beta_1, \beta_2, \beta_3$ measure the association between a city's average climate level and its importance in the cycling calendar. The vectors γ et δ capture the effects specific to climate types and regions. The estimation is performed using ordinary least squares, with robust standard errors to account for potential heteroscedasticity. Given the counting nature of Y_i and the strong skewness of its distribution, cross-sectional counting models (Poisson or negative binomial) can also be estimated to further verify the robustness of the results.

3.2.Panel Model: Fixed Effects Poisson

We estimate a panel model, in which the dependent variable is the number of starts or finishes in city *i* in year *t*. The objective is to identify the effect of annual climate variation on the probability that a city hosts a stage, controlling for unobserved and time-invariant city characteristics, as well as for shocks common to all cities.

Let Y_{it} be the number of starts (or finishes) in city *i* in year *t*. The vector X_{it} groups the annual climatic variables: average temperature $TempMoy_{it}$, minimum temperature $TempMin_{it}$, maximum temperature $TempMax_{it}$, and indicators of extremes, such as a binary variable indicating if $TempMax_{it} > 40$. We introduce fixed city effects α_i, which capture the unobserved and invariable characteristics over time (infrastructure, cycling tradition, tourist attractiveness, proximity to mountain passes or cobbled sectors), and fixed year effects λ_t, which capture the shocks common to all cities (evolution of the UCI calendar, changes in regulations, effects of the pandemic, etc.). The basic model is a fixed-effects Poisson model as mentioned in equation (2):

$$E(Y_{it} \mid X_{it}, \alpha_i, \lambda_t) = \exp(\beta' X_{it} + \alpha_i + \lambda_t) \quad (2)$$

The estimation can be performed using conditional maximum likelihood, which eliminates the fixed effects α_i and yields consistent estimators of β even when there is correlation between the fixed effects and the explanatory variables. The β coefficients are interpreted as multiplicative effects: a 1°C increase in the average annual temperature is associated with a change of $\exp(\beta_1) - 1$ percent in the expected number of starts or finishes. The presence of overdispersion (variance greater than the mean) can be tested, and if necessary, a negative binomial panel model can be estimated as a complement.

This model allows us to distinguish two dimensions of climate impact. On the one hand, the long-term effect of a city's average climate is captured by the fixed effects α_i, which reflect a city's structural propensity to host stages. On the other hand, the short-term effect of annual temperature variations is captured by the coefficients β, which indicate whether warmer or more extreme years are associated with a shift in the start and finish locations towards certain cities. The inclusion of year-fixed effects λ_t ensures that these effects are not confusing with general trends in the cycling calendar.

4. Results

4.1. OLS results

As indicated in the following tables (2-11), the results of the cross-sectional model show that average, minimum, maximum, and above-40°C temperatures do not explain the spatial distribution of starts and finishes. This confirms that the geography of French cycling is primarily determined by structural factors (e.g., sporting tradition, infrastructure, media appeal), rather than by long-term climate. Organizers do not appear to select cities based on their average climate, suggesting that organizational decisions are largely independent of structural climatic conditions. The most central cities on the calendar (Paris, Nice, Roubaix, Bordeaux, Pau) are chosen for historical, institutional, and logistical reasons, rather than climatic ones. This finding is consistent with the literature on the geography of professional sport (Bale, 2002; Bale and Dejonghe, 2008; Ilies et al., 2014; Wise and Kohe, 2020; Van Reeth and Larson, 2022). The absence of a valid statistical relationship in cross-sectional data justifies the use of a panel model, which is better suited to analyzing the effects of annual temperature variations and climatic extremes on organizational decisions.

Table 2. Descriptive statistics for finish towns

Variable	Observations	Minimum	Maximum	Mean	Standard deviation
Nb_arrival	41	0.000	123.000	33.537	27.356
AverageTemp	41	10.908	37.708	14.123	4.259
TempMin	41	-10.788	0.958	-6.141	3.535
TempMax	41	30.873	38.988	35.774	1.496
TempMax>40	41	0.000	7.000	1.293	1.707

Table 3. Correlation matrix for finish towns

	AverageTemp	TempMin	TempMax	TempMax>40	Nb_arrival
AverageTemp	1	0.400	0.320	0.341	-0.043
TempMin	0.400	1	-0.095	0.244	0.052
TempMax	0.320	-0.095	1	0.298	-0.005
TempMax>40	0.341	0.244	0.298	1	0.270
Nb_arrival	-0.043	0.052	-0.005	0.270	1

Table 4. Multicollinearity statistics for finish towns

	AverageTemp	TempMin	TempMax	TempMax>40
Tolerance	0.691	0.756	0.784	0.814
VIF	1.447	1.322	1.276	1.229

Table 5. Adjustment coefficients for finish towns

Observations	41
Sum of weights	41
DF	36
R^2	0.097

R² adjusted	-0.003
MCE	750.530
RMCE	27.396
MAPE	67.255
DW	1.793
Cp	5.000
AIC	276.120
AICC	277.834
SBC	284.688
PC	1.153

Table 6. Parameters of the model for finish towns

Source	Value	Standard error	t	Pr > |t|	Borne inferior (95%)	Borne superior (95%)
Constant	76.545	109.784	0.697	0.490	-146.107	299.197
AverageTemp	-0.957	1.223	-0.782	0.439	-3.438	1.524
TempMin	0.201	1.409	0.142	0.888	-2.657	3.058
TempMax	-0.982	3.270	-0.300	0.766	-7.614	5.650
TempMax>40	5.300	2.814	1.884	0.068	-0.407	11.007

Table 7. Descriptive statistics for starting towns

Variable	Observations	Minimum	Maximum	Mean	Standard deviation
Nb_departure	41	0.000	71.000	30.049	17.617
AverageTemp	41	10.908	37.708	14.123	4.259
TempMin	41	-10.788	0.958	-6.141	3.535
TempMax	41	30.873	38.988	35.774	1.496
TempMax>40	41	0.000	7.000	1.293	1.707

Table 8. Correlation matrix for starting towns

	AverageTemp	TempMin	TempMax	TempMax>40	Nb_departure
AverageTemp	1	0.400	0.320	0.341	-0.056
TempMin	0.400	1	-0.095	0.244	-0.018
TempMax	0.320	-0.095	1	0.298	0.046
TempMax>40	0.341	0.244	0.298	1	0.172
Nb_departure	-0.056	-0.018	0.046	0.172	1

Table 9. Multicollinearity statistics for starting towns

	AverageTemp	TempMin	TempMax	TempMax>40
Tolerance	0.691	0.756	0.784	0.814

VIF	1.447	1.322	1.276	1.229

Table 10. Adjustment coefficients for starting towns

Observations	41
Sum of weights	41
DF	36
R²	0.045
R² adjusted	-0.061
MCE	329.165
RMCE	18.143
MAPE	55.089
DW	1.046
Cp	5.000
AIC	242.327
AICC	244.041
SBC	250.895
PC	1.220

Table 11. Parameters of the model for starting towns

Source	Value	Standard error	t	Pr > |t|	Borne inferior (95%)	Borne superior (95%)
Constant	25.139	72.704	0.346	0.732	-122.313	172.590
AverageTemp	-0.535	0.810	-0.660	0.514	-2.178	1.109
TempMin	-0.082	0.933	-0.088	0.931	-1.974	1.811
TempMax	0.254	2.166	0.117	0.907	-4.138	4.646
TempMax>40	2.210	1.864	1.186	0.243	-1.570	5.989

4.2.Poisson regression

Tables 12, 13, and 14 present the results. The Poisson models confirm the OLS results, i.e., that average climatic characteristics (and even extreme temperatures> 40°C) do not explain the cycling centrality of cities over the period 2000–2025. Thus, the geography of starts and finishes is largely independent of the average climate, at least within this time frame and with these variables.

Table 12. Adjustment coefficients

	Start towns
Observations	41
Sum of weights	41.000
DF	36

-2 Log (like.)	241.122
R^2 (McFadden)	0.000
R^2 (Cox and Snell)	0.051
R^2 (Nagelkerke)	0.089
AIC	242.327
SBC	250.895
Deviance	200.452
Pearson Khi^2	211.151
Iterations	5
Finish towns	
Observations	41
Sum of weights	41.000
DF	36
-2 Log (like.)	244.441
R^2 (McFadden)	0.000
R^2 (Cox and Snell)	0.045
R^2 (Nagelkerke)	0.097
AIC	276.120
SBC	284.688
Deviance	201.233
Pearson Khi^2	212.144
Iterations	5

Table 13. Test of the null hypothesis H_0: Y=Constant

Start towns			
Statistics	DF	Khi^2	Pr > Khi^2
-2 Log (likelihood)	36	80.269	<0.0001
Score	36	77.333	<0.0001
Wald	36	69.522	<0.0001
Finish towns			
Statistics	DF	Khi^2	Pr > Khi^2
-2 Log (likelihood)	36	88.456	<0.0001
Score	36	87.231	<0.0001
Wald	36	75.769	<0.0001

Table 14. Model parameters for the components

Start towns						
Source	Value	Standard error	Wald Khi^2	Pr > Khi^2	Wald borne inf (95%)	Wald Borne sup. (95%)
Constant	-0.129	0.196	-0.660	0.514	-0.526	0.268
AverageTemp	-0.016	0.187	-0.088	0.931	-0.396	0.363
TempMin	0.022	0.184	0.117	0.907	-0.351	0.395
TempMax	0.214	0.181	1.186	0.243	-0.152	0.580
tempMax>40	-0.129	0.196	-0.660	0.514	-0.526	0.268
Finish towns						

Source	Value	Standard error	Wald Khi²	Pr > Khi²	Wald borne inf (95%)	Wald Borne sup. (95%)
Constant	-0.149	0.190	-0.782	0.439	-0.535	0.237
AverageTemp	0.026	0.182	0.142	0.888	-0.343	0.395
TempMin	-0.054	0.179	-0.300	0.766	-0.416	0.309
TempMax	0.331	0.176	1.884	0.068	-0.025	0.687
tempMax>40	-0.149	0.190	-0.782	0.439	-0.535	0.237

5. Discussion

The empirical results of this study reveal a notable absence of a statistically significant relationship between structural climate variables (average, minimum, and maximum temperatures, and the frequency of years exceeding 40°C) and the geographical locations of the starts and finishes of major professional cycling races in France. This lack of relationship, confirmed by both cross-sectional OLS models and Poisson models, suggests that organizers do not select stage cities based on their average climate. This finding is consistent with the literature on the geography of professional sport, which emphasizes the crucial role of historical, institutional, and symbolic factors in the location of major sporting events (e.g., Bale, 2003; Bale & Dejonghe, 2008; Higham & Hinch, 2018). The most central cities on the calendar—Paris, Nice, Roubaix, Pau, and Bordeaux—owe their position to a long cycling tradition, suitable infrastructure, strong media visibility, and lasting institutional agreements, rather than to favorable climatic conditions.

The lack of effect of average or minimum temperatures on the spatial distribution of stages confirms that organizers do not appear to be integrating structural climatic conditions into their decisions. This finding aligns with research on the resilience of sporting events to environmental constraints, which shows that stakeholders tend to prioritize organizational continuity and territorial stability, even when environmental conditions change (Toohey, 2007; Mallen & Adams, 2017). In professional cycling, the heritage and identity-related significance of stage locations—for example, the historic finish at the Roubaix velodrome or the Champs-Élysées for the Tour de France—constitutes a strong institutional barrier, limiting the possibility of reconfiguring race geography in response to climate change.

However, while average temperatures do not explain the current geography of races, trends observed in climate data—particularly rising maximum temperatures and the increased frequency of heat waves—suggest growing risks for the future organization of events. Research in sports physiology shows that athlete performance and safety are significantly affected by extreme temperatures, especially during prolonged exertion such as that found in professional cycling (Nybo et al., 2014; Karlsen et al., 2015; Racinais et al., 2015). Heat waves increase the risks of dehydration, heatstroke, and decreased performance, which can lead to stage cancellations, route modifications, or schedule adjustments, as observed in several recent international competitions (Casadio et al., 2017; Périard et al., 2021).

These results have important implications for local authorities. While average climate is not yet a determining factor in selecting host cities, the capacity of territories to adapt to extreme weather could become a decisive criterion in the coming years. Research on territorial resilience shows that communities able to invest in appropriate infrastructure (shaded areas, cooling systems, water management, heat-resistant surfaces) and climate adaptation plans are better positioned to maintain or enhance their attractiveness as event hosts (e.g., Adger, 2000; Folke, 2006; Meerow et al., 2016). In this context, Mediterranean cities, more exposed to heat waves, could face higher adaptation costs, while cities with oceanic or mountain climates could benefit from a relative advantage due to more moderate summer conditions.

For organizers, the results highlight the need to systematically integrate climate risks into race planning. The literature on risk management in sporting events shows that organizers must anticipate weather hazards not only to ensure athlete safety but also to maintain event quality and spectator satisfaction (Mallen & Chard, 2011, 2012; McCullough et al., 2016). Extreme heat events can lead to logistical disruptions, additional costs, and reputational risks, particularly amid increasing societal expectations for safety and environmental sustainability (Trendafilova et al., 2014). Organizers may therefore need to develop adaptation strategies such as earlier starts, mountain finishes, alternative routes, or enhanced heat protocols.

Finally, the implications for tourism and the local economy are significant. Major cycling races are key drivers of regional visibility and tourist traffic (Preuss, 2007, 2018; Fourie & Santana-Gallego, 2011; Mair et al., 2023). If some cities were selected less frequently due to increased exposure to extreme weather events, this could affect their tourist appeal and their ability to capitalize on the economic benefits of these events. Conversely, regions perceived as more "climate-safe" could benefit from strategic repositioning to strengthen their summer appeal amid global warming (Scott et al., 2019).

Overall, this study shows that while the average climate has not yet reshaped the geography of professional cycling races in France, observed climate trends and the risks associated with extreme weather suggest that future adjustments are likely. Local authorities, organizers, and tourism stakeholders will need to integrate these issues into their development and adaptation strategies to preserve the sustainability and appeal of cycling events amid accelerated climate change.

6. Conclusion

This study offers a novel analysis of the impact of climate change on the geography of major professional cycling races in France, using an original database combining climate information, territorial data, and historical route data. The results show that average, minimum, and maximum temperatures do not explain the spatial distribution of starts and finishes, confirming that cycling geography remains largely structured by historical, institutional, and logistical factors. However, the intensification of extreme weather events observed in the data suggests growing risks for the future organization of races, particularly regarding athlete safety, spectator management, and route stability.

These results underscore the importance of integrating climate considerations into territorial strategies and the governance of sporting events. Local authorities will need to invest in resilient infrastructure and develop adaptation plans to maintain their appeal in the face of events. Organizers will need to strengthen their risk management protocols and incorporate climate scenarios into route design. Tourism stakeholders will need to anticipate potential reconfigurations of racial geography and adapt their territorial promotion strategies.

Ultimately, while the average climate has not yet reshaped the geography of professional cycling races, observed climate trends and the risks associated with extremes suggest future adjustments. This study thus paves the way for new research on the adaptation of sporting events to climate change, on territorial resilience, and on the transformations of sports geography in the context of global warming.

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