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Interlinkages between Climate Change Impacts, Public Attitudes, and Climate Action—Exploring Trends before and after the Paris Agreement in the EU

Patricia Nayna Schwerdtle [1,*], Edwige Cavan [2], Lukas Pilz [3], Silvio Daniele Oggioni [4], Arianna Crosta [5], Veranika Kaleyeva [6], Peshang Hama Karim [7], Filip Szarvas [8], Tobiasz Naryniecki [9] and Maximilian Jungmann [10]

1 Heidelberg Institute of Global Health, Faculty of Medicine, Heidelberg University, 69120 Heidelberg, Germany
2 History and Dynamics of English Speaking Spaces, HDEA, Sorbonne University, 60200 Paris, France
3 Institute of Environmental Physics, Faculty of Physics and Astronomy, Heidelberg University, 69120 Heidelberg, Germany
4 Department of Agricultural and Environmental Sciences, University of Milan, 20122 Milan, Italy
5 Department of Environmental Science and Policy, University of Milan, 20133 Milan, Italy
6 Institute of Urban and Regional Development, 03-728 Warsaw, Poland
7 The Discipline of Earth and Environmental Sciences, Doctoral School of Exact and Natural Sciences, University of Warsaw, 02-678 Warsaw, Poland
8 Institute for Environmental Studies, Faculty of Science, Charles University, 100 00 Prague, Czech Republic
9 Faculty of Psychology, University of Warsaw, 00-183 Warsaw, Poland
10 Heidelberg Center for the Environment, Heidelberg University, 69120 Heidelberg, Germany
* Correspondence: patricia.schwerdtle@uni-heidelberg.de

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Abstract: European member states have high emission reduction potential. They send a strong signal to the rest of the world with their action or inaction on climate change. Yet, within the EU, national-level climate policies (NLCP) lag behind the EU Commission's overall climate goals. Transparency of and accountability for climate action requires an integrative perspective. Here, insights from diverse research disciplines address the following questions: How are climate impacts, public attitudes, and climate policies changing over time, and what are the interlinkages? Using three databases (Germanwatch (CCPI), European Extreme Events Climate Index (E3CI), and Eurobarometer Public Opinion Survey, 27 European countries were compared for NLCP (mitigation), climate change impacts (heat/drought), and public attitudes towards climate change (cognition/affect/conation). Differences among groups before and after the Paris Agreement were evaluated with ANOVA tests; trends and geographical differences were analysed with linear models. NLCP did not improve after the Paris Agreement, even displaying some deterioration in the eastern macro-region. Conversely, public awareness towards climate change is improving, with concern being higher in northern compared with southern countries. Heat stress is significantly related to NLCP, with increases in heat stress corresponding to improved climate policy in the northern region while worsening it in the southern region. Under worsening climate impacts, public attitudes increasingly favour climate action. However, overall policy responses are inadequate, although differences occur at the macro-regional level. The results provide granular insights into a persistent knowledge–action gap.

Keywords: climate change; climate impacts; climate policy; mitigation; adaptation; climate action; public attitudes

1. Introduction

The European Union (EU) contributes significantly to global emissions, historically and currently. EU countries (EU-27) have been responsible for approximately 18% of global

carbon dioxide emissions since the industrial revolution, mainly produced by the four most polluting countries in the EU—Germany, France, Italy, and Poland [1].

The EU continues to contribute significantly to global warming, although awareness and concern about climate change are widespread in European societies [2]. Additionally, the EU is considered a global leader in political commitment towards climate action [3]. This evolution in public concern and responsible governance coincides with growing knowledge about the impacts of climate change [4] and the increasing viability and affordability of technology to make sustainable transitions [5]. It seems that the stage is set; however, climate action is slow and incremental rather than rapid and transformative [6,7]. While many states make commitments to climate action, we have not seen the scale and speed of transformation that is necessary to keep the planet well under 2 °C of warming [8]. While the accusation by climate activists and the public that effective policy (and climate action) lags behind climate change impacts is common, there is a need for more empirical evidence to support this claim. The difference between commitment and action is referred to as 'the knowledge–action gap' and has led to a new sub-field of climate science called 'climate action science' [9].

Diverse countries within the EU are expected to work together to achieve the aspirations of the European Green Deal—perhaps the biggest social and economic transformation in human history in such a short time. There is a lack of research examining the connections between domains and factors enabling and inhibiting climate action and comparing these relationships over time in the EU [10]. After the Paris Agreement, and with oversight from the United Nations Framework Convention on Climate Change (UNFCCC), we are generally seeing more transparency regarding climate action targets, yet there is a need for more transparency about the motivation of states in terms of why they set certain targets and take, or fail to take, certain actions. Increased transparency increases the likelihood of states being held accountable to their commitments, and enables policy diffusion and learning from others who are leading the way to accelerate transformative change towards decarbonised and resilient social and natural systems [11].

2. Literature Review

In a functioning liberal democracy, public attitudes supporting climate action should be reflected in ambitious and effective climate policy over time, but is this the case in the EU since the Paris Agreement? We conducted a targeted literature search to establish what is known about the relationships between climate impacts and public attitudes towards climate change and European climate policies. Most articles examined these relationships in isolation or pairs, yet we did not identify any studies investigating the nexus between these three domains over time in the EU. The following literature review first looks at trends within the three domains: climate impacts, climate policy, and public attitudes. Then we move on to explore the literature that covers bilateral relationships between these domains in the EU and, finally, the scarce research that explores the nexus between these three domains.

2.1. Climate Change Impacts—The Trends

The frequency and severity of climate and weather extreme events have increased over the years [12]. Events such as wildfires, extreme precipitation, and heat on land and in the ocean are more and more significant. The European Union is increasingly at risk of extreme climate events such as heat-related human mortality, marine and terrestrial ecosystem disruptions, water scarcity, losses in crop production, and risks to infrastructure [13].

2.2. Climate Change Policy—The Trends

The EU has pledged to achieve net-zero greenhouse gas (GHG) emissions by 2050. To do so, the governments of the European countries have committed themselves to climate change mitigation policies. Mitigation policies seek to prevent or reduce GHGs that cause climate change while climate change adaptation policies anticipate the adverse effects of

climate change and seek to minimise potential damages. Since the Kyoto Protocol in the early 2000s, climate policies have sustained the trend in emission reduction. Emissions have been driven down by national and EU-level climate policies targeting energy efficiency and increasing the use of renewable energy fields [14]. In general, progress has continued in the EU since the Paris Agreement, with emissions decreasing [15]. However, some disparities at the macro-regional level can be observed, with individual member states showing less support for climate policies [16]. Increasing the effort is required to reach the 2050 target [17]. A recent study showed that in order to meet the European Commission's objectives for renewable energy, the current progress of EU member states needs to double [18].

2.3. Public Attitudes towards Climate Change—The Trends

Studies show that the level of concern for climate change has increased in the EU since the Paris Agreement [19]. Jakučionytė-Skodienė and Liobikienė [20] show that on a 10-point scale, the average climate change concern in EU countries between 2015 and 2019 has increased from 7.24 to 7.86, and they hypothesise that the evolution could have been triggered by the discussions around the Paris Agreement, as well as by the movement against climate change and extreme weather events. Moreover, the study highlights the increased feeling of personal responsibility within the EU-27 since the Paris Agreement, which increased by 1.7 times between 2015 and 2019. Studies, however, demonstrate that concern for climate change is not uniform throughout Europe, with countries such as Portugal, Spain, and Germany showing a higher level of concern than Ireland or the Eastern European countries [21]. Given this disparity, it is important to study both components together at the EU level and at the regional level.

2.4. Climate Change Impacts and Public Attitudes towards Climate Change

Of the articles we identified in our searches, most investigated pairwise relationships between these two domains, such as the relationship between climate change impacts and public attitudes towards climate change. For example, Arıkan and Günay [22] tested whether perceived threats from climate change influence climate change concern and found that both the planetary threat and personal threat have substantive effects on climate change concern, with personal threat exerting a greater influence on climate change concern than the planetary threat, with a stronger effect in high-income countries than low-income ones.

2.5. Climate Change Impacts and Climate Change Policy

Another pairwise relationship examined in the literature is the dyad between climate change impacts and climate policies. Climate policy can include policies that mitigate emissions, adapt to climate change, or (ideally) do both. Aguiar et al. [23] examined 147 local adaptation strategies in Europe and found that the key triggers for policy action (adaptation) were the increasing frequency of extreme weather events as well as incentives via research projects and implementation of EU policies. This demonstrates a connection between climate change impacts and climate policy in the EU, with the main barriers to climate change adaptation policy being uncertainty, insufficient resources/capacity, and insufficient political commitment.

2.6. Public Attitudes towards Climate Change and Climate Change Policy

Other research has explored the relationship between public attitudes towards climate change and climate policy. Public concern about climate change is a crucial variable influencing public support for climate action [22]. Events that are understood to be impacts of climate change can shape human attitudes, understanding, and risk assessment of global environmental changes [24,25].

2.7. Few Papers Examined the Nexus between Climate Impacts, Public Attitudes, and Climate Policy

An exception is Pfeifer and Otto [26], who found that seasonal temperature changes influence climate change perception and can offer a window of opportunity for a more stringent climate change policy. Van Boven and Sherman [27] further explored the relationship between climate change impacts and attitudes and found that factors other than climate concerns were at play. They found that political ideology, individual differences, and political elite stances also influence public support for climate policy. Further, social norms drive elite influence and, despite a growing sense that climate change requires immediate action, elites can polarise the discourse and pose barriers to climate policy.

As we enter this critical decade for climate action, it is imperative to determine whether the EU's climate policies have improved since the Paris Agreement in 2015 and to better understand the relationships between these three domains that we postulate are important drivers of climate action.

In this study, we use the Climate Change Performance Index (CCPI) as an indicator of climate change policy. Here, climate change policy refers to the efforts conducted by governments to mitigate climate change, and it is used as a proxy for adaptation policy. Germanwatch developed the CCPI as a tool for increasing transparency in the international climate change policy [28]. Public attitudes are social attitudes towards climate change and climate action. For this study, we consider three aspects of these attitudes: public perception of the seriousness of climate change, the public's willingness to take personal action to address climate change, and whom the public sees as primarily responsible for tackling climate change, using the Eurobarometer survey on public opinions. Climate impacts are defined as a collection of indices that measure the extent to which countries are affected by different types of climate change-related hazards and the severity of such events. For this study, we include two hazards from the European Extreme Events Climate Index (E3CI): heat stress and drought stress.

We hypothesise that countries experiencing higher-range climate impacts perform better in terms of climate action (climate change policy) and that countries with societies that strongly prioritise climate action perform better in terms of climate action. Our research questions (RQ) at the EU and macro-regional level were firstly descriptive: How has climate policy been changing from before and after the Paris Agreement? How have public attitudes towards climate change been changing from before and after the Paris Agreement? How have climate impacts (drought and heat stress) been changing from before and after the Paris Agreement?

The next set of questions was more analytical:

- RQ1: Is there a relationship between drought/heat stress and climate policy? If so, what is the nature of the relationship?
- RQ2: Is there a relationship between public attitudes towards climate change and climate policy? If so, what is the nature of the relationship?

Figure 1 shows a conceptual map of the three domains and our two main research questions.

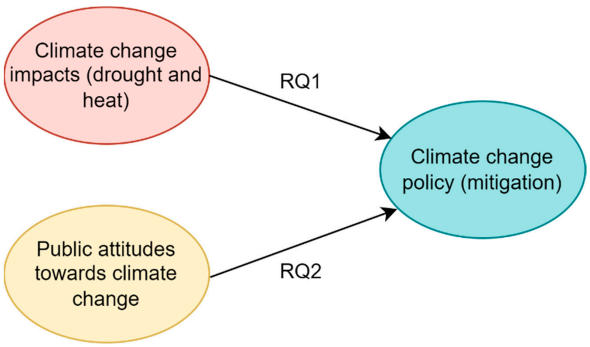

Figure 1. Conceptual map of three domains and two main research questions.

3. Methods

We used three reputable and validated databases to collate data and conduct a time series analysis on 27 European countries in terms of climate impacts, public awareness, and climate policy within the 2007–2021 timeframe. The databases are the European Extreme Events Climate Index (E3CI) [29], the Eurobarometer surveys [30–34], and the Germanwatch climate change performance index [28].

3.1. Climate Impacts

As an approximation of the environmental impact of climate change, we chose the 'heat stress' and 'drought stress' indicators from the E3CI database. These indicators are defined as the level of impact of different types of weather-induced hazards and the severity of such events in each European country. Heat and drought stress have been chosen since they are reliably and consistently linked to anthropogenic influences on the climate system in at least part of the study area of choice [12,35]. In the EU, heat stress is increasing consistently, and this phenomenon is ascribed with high confidence to climate change. Conversely, there is high confidence that hydrological, ecological, and agricultural drought stress is increasing in the Mediterranean, while ecological and agricultural droughts are increasing with lower confidence; this is also seen in western Europe [36,37]. The E3CI database was chosen because it is widely recognised in academia and because it directly reports a numerical value associated with the risk of specific classes of extreme events [29]. The calculation of the heat stress indicator is based on maximum temperature values, while the drought stress indicator is derived from the Standard Precipitation Index (SPI) [38]. The E3CI index covers the period 1981–2021 monthly and exploits the reanalysis of global climate data from ERA5 [39]. All E3CI values are previously standardised to be comparable and to allow for clear visualization of the risks associated with climate change. The use of different datasets such as the European Severe Weather Database [40], or more specific indices such as the Fire Weather Index [41] or the Extreme Wind Storm Catalogue (XWS) [42] was explored, but they were discarded due to the lack of data continuity over time or the complexity of relativizing the impact of extreme fire or wind events to the entire European continent. In our estimation, heat stress represents the best indicator to assess possible geographical differences in political responses while hinting at the presence of other driving factors, whereas a varying indicator such as drought might be useful in assessing the strength of the relationships between climate impacts and policy response.

3.2. Public Attitudes

These are social attitudes towards climate change and climate action. For this study, we consider three aspects of these attitudes: public perception of the seriousness of climate change, the public's willingness to take personal action to address climate change, and whom the public sees as primarily responsible for tackling climate change. We used data from the Eurobarometer survey on public opinions collected in 2011, 2014, 2017, 2019, and 2021, with resolution at the country level. The questions were selected for theoretical and practical purposes. Practically, data arising from these questions enabled comparisons at the macro-regional level in the periods selected and so were compatible with the other two domains (climate impacts and climate policy). Theoretically, in psychology, the three dimensions of public attitudes, represented by these questions, are widely considered to be the main components of the mind: cognition (what we think about the phenomena), affect (how we feel about the phenomena), and conation (how we act concerning phenomena) [43]. To explore the perceived seriousness of climate change (the cognition component), we used the national average answer to the question—"How serious a problem do you think climate change is at this moment?" Answers were ranked on a scale from 1 to 10, with "1" meaning it is "not at all a serious problem" and "10" meaning it is "an extremely serious problem". The feeling of personal responsibility for climate change (the affect component) in our study was represented by the question—"In your opinion, who within the EU is responsible for tackling climate change?" As an indicator, we used the percentage of responders who,

besides other options, answered "I personally" (am responsible). Thirdly, to quantify the individual action to fight climate change (the conation component) we used the question—"Have you personally taken any action to fight climate change over the past six months?" As an indicator, we used the percentage of responders who declared "yes".

3.3. Climate Change Policy

In this study, we focussed on national-level policies—not EU-level policies such as the Green Deal. We used the Climate Change Performance Index (CCPI) as an indicator of European countries' national climate policy. The CCPI analyses and compares the mitigation efforts of the 60 countries with the highest emissions (accounting for 90% of greenhouse gas emissions) plus the EU. National emissions targets are assessed as well as their implementation. Specifically, we used the fourth component of the CCPI, the climate policy-specific index. This index aims at covering recent developments in national climate policy, giving the same weight to both national and international commitments subscribed to by each state. Its components are derived from performance ratings of annual assessments by climate and energy policy experts. The index involves ranking the most important measures taken by governments on a scale of one to five. At the national level, experts measure the strengths and level of implementation of policies related to renewable energies, energy efficiency, as well as deforestation and ecosystem biodiversity. At the international level, the index measures the recent performance of each country in international conferences and multilateral negotiations.

In terms of temporal comparisons, we analysed the period from 2007 to 2022 and compared averages and trends before and after the Paris Agreement, which is considered an important turning point in the journey of climate action.

Geographically, we conducted the analysis for Europe using the regional breakdown of the UN Statistics Division. This classification divides Europe into four regions: Northern, Eastern, Western, and Southern Europe [23]. We also considered the differences in vulnerability to climate change that characterise the four regions, as shown in Table 1 by the ND Gain values for each country and the regional means. The Notre Dame Global Adaptation Initiative (ND-GAIN) created a country index that assesses risks exacerbated by climate change and translates that into the country's vulnerability to climate change. The Country Index uses 45 indicators to rank countries annually based on their level of vulnerability and their readiness to successfully implement adaptation solutions. The higher the index number (highest: 182), the more vulnerable the country is to climate change.

Table 1. Regions, Countries, and ND Gain Indices.

EU Region	Countries with Individual ND-GAIN Index	Regional ND Gain Mean
West (6)	France (16), Germany (8), Austria (7), Netherlands (17), Belgium (23), Luxemburg (12)	14
North (7)	Sweden (4), Denmark (5), Finland (2), Estonia (22), Latvia (35), Lithuania (28), Ireland (21)	17
South (8)	Croatia (55), Italy (33), Spain (26), Portugal (25), Slovenia (20), Greece (32), Cyprus (43), Malta (36)	34
East (6)	Bulgaria (54), Czechia (24), Hungary (50), Poland (28), Romania (74), Slovakia (45)	46

3.4. Analysis

All statistical analyses were carried out in R (version 4.0.5). ANOVA tests, followed by Tukey post hoc tests, were conducted to detect significant differences between groups of countries and to compare changes in parameters before and after the Paris Agreement (reference p-value = 0.05). The E3CI database of climate impacts was tested with linear models to assess whether it correctly represented the occurring trends for drought and heat stress within the EU. Linear models were also carried out to detect the significance of temporal trends, and to evaluate the effect of heat stress, drought stress, and the three questions from Eurobarometer surveys (cognition, affect, and conation) on the climate policies at the European level.

4. Results

Our analysis refuted the hypothesis that EU countries experiencing higher-range climate impacts and countries with societies that strongly prioritise climate action consistently perform better in their climate policies. There are macro-regional differences underlying these overarching findings in the EU. We present the results at the EU level and the macro-regional level. First, we describe the trends before and after the Paris Agreement concerning climate policy and public attitudes. Second, we analyse the relationships between the three domains.

4.1. PART A: Descriptive Overview of the Three Domains (Climate Change Policy, Public Attitudes, Climate Impacts) at the EU Level and the Macro-Regional Level

1. Climate Change Policies

There was no significant improvement in climate policy before and after the Paris Agreement at the EU and macro-regional level (p = 0.88, F = 0.02, df = 430) [2007–2015 period compared to 2016–2021]. This refers to countries' national climate policies across the EU, not EU level climate policies such as the EU Green Deal. However, eastern countries have significantly deteriorated their climate policies after the Paris Agreement ($p < 0.01$, F = 23.28, df = 94) (Figure 2).

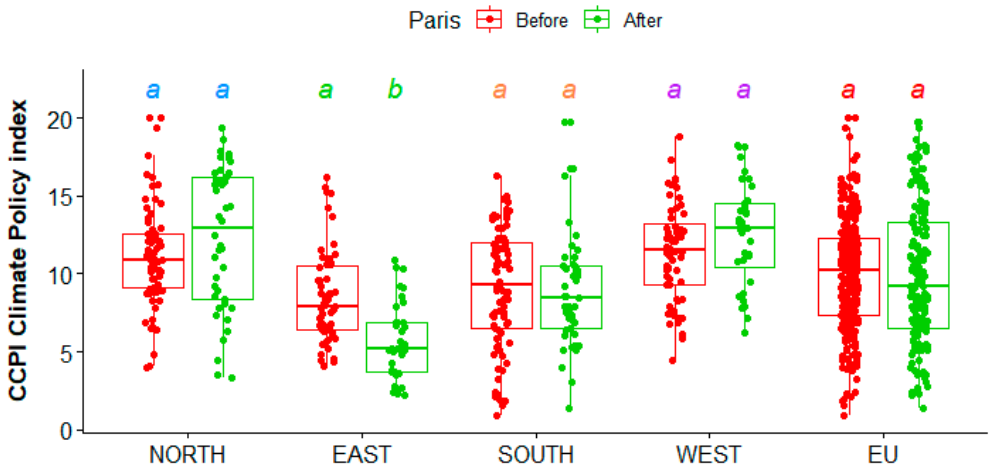

Figure 2. Climate policies have not improved since the Paris Agreement at the EU level or macro-regional level. Different letters (i.e.,—"a" and "b") depict significant differences between groups, while the same letters (i.e.,—"a" and "a") show no significant differences.

Figure 2 shows the Climate Policy index (CCPI) before and after the Paris Agreement at the EU and macro-regional levels. Different letters (i.e., "a" and "b") depict significant differences between groups, while the same letters (i.e., "a" and "a") show no significant differences.

2. Public attitudes regarding climate change

In terms of public attitudes, we asked how the three different components of public attitudes towards climate change (cognition, affect, and conation) have changed after the Paris Agreement at the EU and macro-regional levels. At the EU level, the perceived seriousness of climate change, individual action to fight climate change, and feeling of personal responsibility for climate change all significantly increased after the Paris Agreement ($p < 0.01$, F > 6.49, df = 132).

Figure 3 shows public attitudes about climate change at the EU level before and after the Paris Agreement. Different letters (i.e., "a" and "b") depict significant differences between groups, while the same letters (i.e., "a" and "a") show no significant differences.

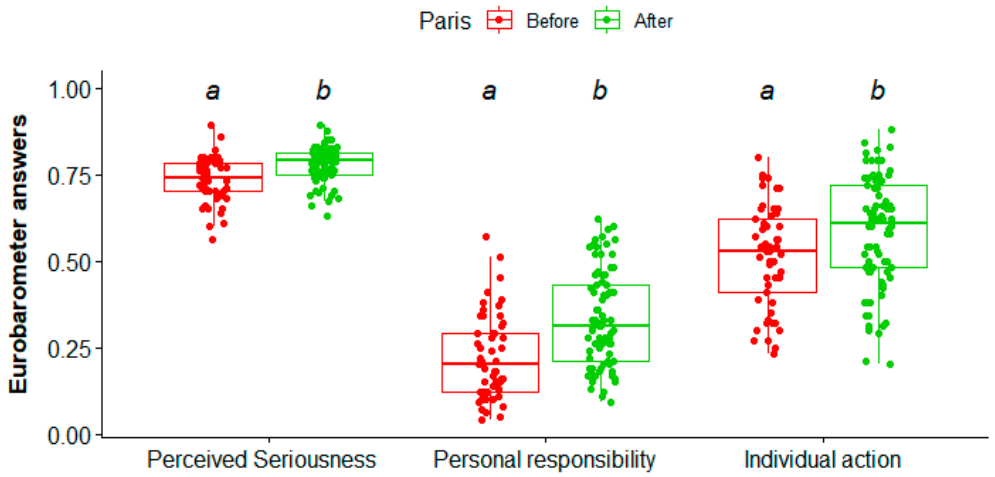

Figure 3. Public attitudes towards climate change increased EU-wide after the Paris Agreement. Different letters (i.e.,—"a" and "b") depict significant differences between groups, while the same letters (i.e.,—"a" and "a") show no significant differences.

At the macro-regional level, public attitudes towards climate change are not uniform within the EU. Significant differences were found in the perceived seriousness of climate change ($p < 0.01$, F = 18.96, df = 130), with southern European countries showing the highest concern ($p = 0.01$, $|t_{130}| > 3.096$) while northern European countries showed the lowest concern ($p < 0.01$, $t_{130} > 3.361$). The feeling of personal responsibility for climate change ($p < 0.01$, F = 20.48, df = 130) significantly differed among macro-regions, with northern and western countries expressing higher personal responsibility ($p < 0.01$, $|t_{130}| > 3.78$) than southern and eastern countries. Individual action to fight climate change was also heterogeneous in the EU ($p < 0.01$, F = 13.64, df = 130), with reported action taken less frequently in eastern European countries than in the other three macro-regions ($p < 0.01$, $|t_{130}| > 4.12$).

Figure 4 shows public attitudes about climate change at the macro-regional level. Different letters (i.e., "a" and "b") depict significant differences between groups, while the same letters (i.e., "a" and "a") show no significant differences between groups.

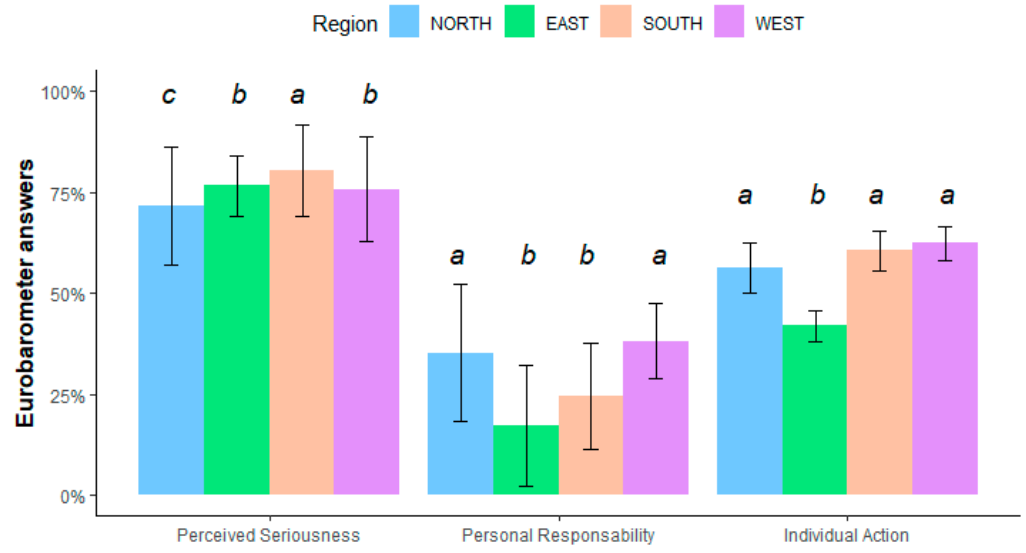

Figure 4. Public attitudes towards climate change did not increase uniformly at the macro-regional level. Different letters (i.e.,—"a", "b" and "c") depict significant differences between groups, while the same letters (i.e.,—"a" and "a") show no significant differences between groups.

After the Paris Agreement, the northern countries' sense of the perceived seriousness of climate change ($p < 0.01$, F = 15.34, df = 33) increased, as did those of the southern ($p = 0.04$, F = 4.55, df = 37), and western countries ($p < 0.01$, F = 14.30, df = 28). Eastern countries did not show any significant difference in this aspect. Similarly, the feeling of personal responsibility for climate change increased significantly after the Paris Agreement in all macro-regions except for the northern countries (East: $p < 0.01$, F = 13.13, df = 28; South: $p < 0.01$, F = 11.95, df = 37; West: $p < 0.01$, F = 21.37, df = 28). Concerning reported individual action to fight climate change, only western countries showed a significant increase following the Paris agreement ($p < 0.01$, F = 8.43, df = 28).

Table 2 summarises the findings concerning public attitudes towards climate change at the macro-regional level. The level of public concern about climate change varied across macro-regions, as did the evolution of these attitudes before and after the Paris Agreement. There was increased perceived seriousness in the northern, western, and southern regions with no increase in the eastern region. The highest concern was detected in the southern region and the lowest in the northern region. The feeling of personal responsibility increased in the northern, western, and southern regions but not in the eastern region. Higher responsibility was detected in the northern and western regions. Personal action taken over the past six months to fight climate change increased in the western and southern regions but not in the eastern and northern regions. The least action was taken in the eastern region. This heterogeneity within the EU justifies the value of further research on socio-economic regional differences and their potential impact on public attitudes towards climate change.

Table 2. Summary of public attitudes towards climate change in the EU.

Aspect of Attitudes	North	East	West	South
Perceived seriousness of climate change	Average level 2011–2021 LOWEST CONCERN	Average level 2011–2021 MEDIUM CONCERN	Average level 2011–2021 MEDIUM CONCERN	Average level 2011–2021 HIGHEST CONCERN
	Improvement after Paris agreement (2015): YES	Improvement after Paris agreement (2015): NO	Improvement after Paris agreement (2015): YES	Improvement after Paris agreement (2015): YES
Feeling of personal responsibility for tackling climate change	Average level 2011–2021 HIGHER RESPONSIBILITY	Average level 2011–2021 LOWER RESPONSIBILITY	Average level 2011–2021 HIGHER RESPONSIBILITY	Average level 2011–2021 LOWER RESPONSIBILITY
	Improvement after Paris agreement (2015): YES	Improvement after Paris agreement (2015): NO	Improvement after Paris agreement (2015): YES	Improvement after Paris agreement (2015): YES
Personal action taken over the past six month to fight climate change	Average level 2011–2021 MEDIUM ACTION	Average level 2011–2021 THE LEAST ACTION	Average level 2011–2021 MEDIUM ACTION	Average level 2011–2021 MEDIUM ACTION
	Improvement after Paris agreement (2015): NO	Improvement after Paris agreement (2015): NO	Improvement after Paris agreement (2015): YES	Improvement after Paris agreement (2015): YES

3. Climate impacts—E3CI

The E3CI database is coherent with the IPCC AR6 WG1 [12] and shows a significantly increased occurrence of heat stress all over the European Union (Figure S2). It is also consistent with the focal point for Italy as described in the IPCC AR6 WG2 in showing a significant increase in drought stress in the southern and western regions [13] (Figure S1).

4.2. PART B: Analysis of Multiple Domains at the EU Level Using Linear Models

4. Climate impacts and climate policies

Combining domains now, we looked at possible relationships between climate impacts and climate policies both at the EU and macro-regional levels. At both the EU and

macro-regional levels, the relationship between drought stress and climate policy is not significant (Figure 5).

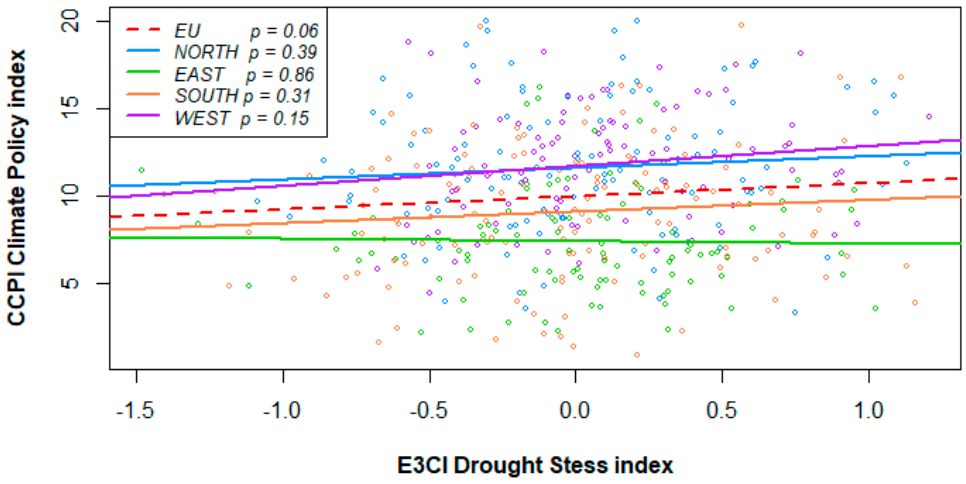

Figure 5. Drought stress and climate policy. Significant ($0.05 > p \geq 0.01$), highly significant ($p < 0.01$).

The same analysis was repeated to evaluate the relationship between heat stress and climate policy at the EU and macro-regional levels. At the EU level, the relationship between heat stress and climate policy is significant and negative ($p = 0.05$, F = 3.86, df = 430). In contrast, at the macro-regional level, the relationship is significant and positive for northern countries ($p < 0.01$, F = 9.85, df = 110) and significant and negative for southern countries ($p < 0.01$, F = 7.96, df = 126). Climate policies in western and eastern countries do not appear to be significantly correlated to heat stress (Figure 6).

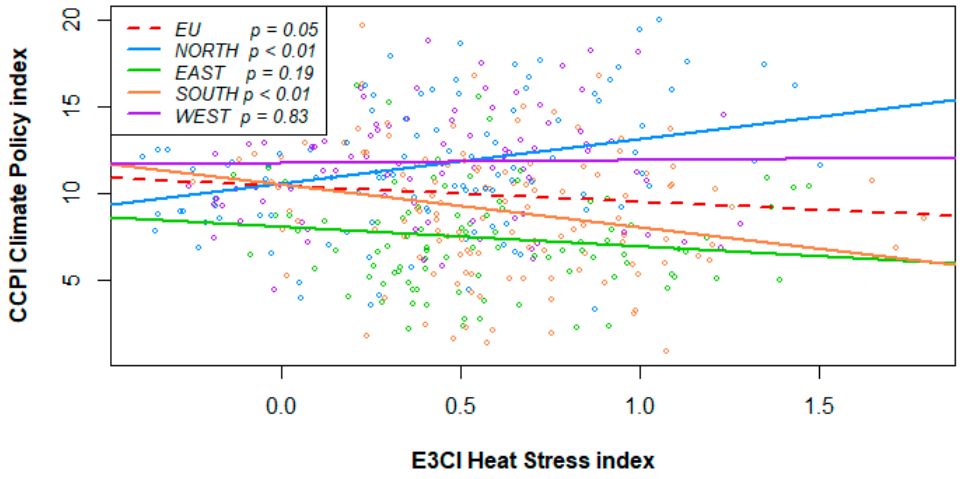

Figure 6. Heat stress and climate policy. Significant ($0.05 > p \geq 0.01$), highly significant ($p < 0.01$).

5. Public Attitudes and Climate Policies

Combining domains again, we looked at a possible relationship between the three components of public attitudes towards climate change and climate policies at the EU- and macro-regional levels.

According to our results, the perceived seriousness of climate change and climate policy are not significantly related to one another, both at the EU and macro-regional levels (Figure S3). In contrast, in terms of perceived personal responsibility for tackling climate change, at the EU level, the relationship with climate policy is positive and significant ($p < 0.01$, F = 29.30, df = 132). At the macro-regional level, only the western countries ($p = 0.01$, F = 6.82, df = 28) show a significant positive relationship between personal responsibility for climate change and climate policy. In the other regions, there is no

significant relationship between these variables. In terms of individual action to fight climate change, at the EU level, there is a positive and significant relationship with climate policy ($p < 0.01$, F = 18.15, df = 132). At the macro-regional level, no significant relationship was detected between individual action to fight climate change and climate policy.

Figures 7 and 8 show the linear regressions between climate policy (CCPI) and the Eurobarometer questions related to feelings of personal responsibility for climate change and individual action to fight climate change.

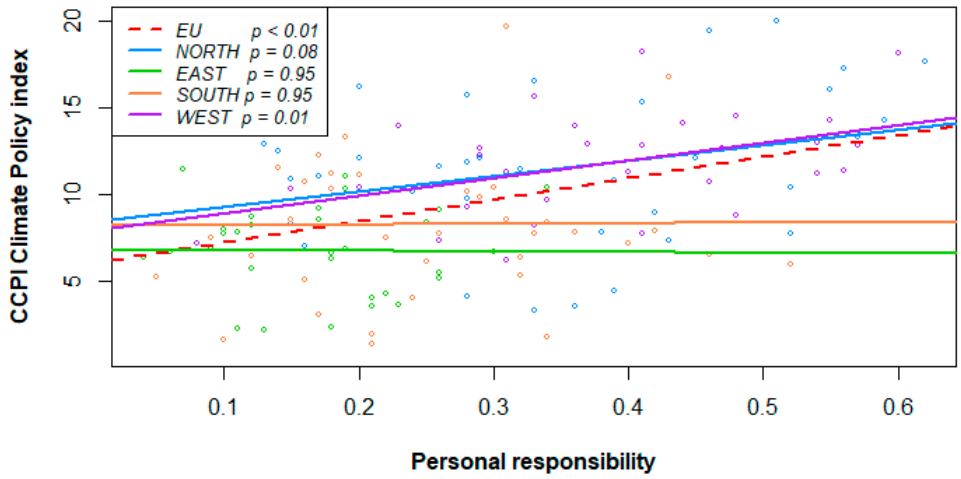

Figure 7. There is a positive relationship between the feeling of personal responsibility for climate change and climate policy at an EU level. Significant ($0.05 > p \geq 0.01$), highly significant ($p < 0.01$).

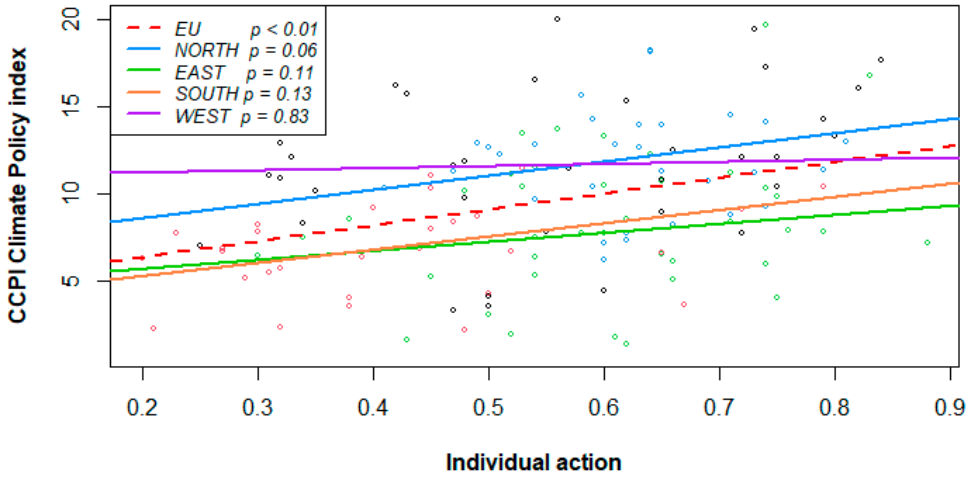

Figure 8. There is a positive relationship between individual action to fight climate change and climate policy at an EU level. Significant ($0.05 > p \geq 0.01$), highly significant ($p < 0.01$).

6. Discussion

While public concern about climate change is rising, and climate change impacts are worsening in the EU, climate change policy has not improved at a national level across the EU since the adoption of the Paris Agreement. In some EU member states, climate action performance is even decreasing. Unless deep reductions in greenhouse gas emissions occur in the coming years, global warming of 1.5 °C to 2 °C will be exceeded during the 21st century. A lack of performance on climate action could lead humanity to breach tipping points that would close the mitigation window forever and lead to devastating consequences for people worldwide, especially in those countries least responsible and most vulnerable [36,44,45]. The EU plays a pivotal role in trailblazing the way towards climate neutrality due to its comparatively strong economy and its influence on other

states through diplomatic relations, trade, and direct investments. It has therefore adopted the European Green Deal. Yet, it remains to be seen if this European policy will lead to significant climate action on the national level within the EU.

The first main finding of our study is that public awareness and concern about climate change is increasing, but climate change mitigation policies on the national level are lagging. There are several possible explanations for this, including the fact that democracies are known to be inclusive and to protect the rights of citizens, but slow to react to long-term threats. Policy development aside, major delays in implementation also exist since the results of climate policies take time to implement and to show an impact. However, the need for urgent and drastic action is an old call. Our study indicates that the opposite is happening: as climate change accelerates, climate policies on the national level within the EU have been stagnating since 2015 and, in some macro-regional areas, they are even worsening. Yet the concept of slow democracies still raises questions about how we can enhance the effectiveness of democracies in times of multiple crises and wicked problems while protecting the advantages of democracies for individuals and societal groups. The speed with which some democracies reacted with effective policies to the COVID-19 pandemic demonstrates that rapid responses are possible. A similar level of urgency needs to be applied to the climate crisis, which requires states to take less of a short-term approach to their political priority settings. Another condition for such change is appropriate public support towards parties who pledge and deliver good climate policy. Further research is required to uncover the barriers and enablers to developing effective climate policy and to reveal what other forces have an interest in maintaining this inertia, including lobbying from the fossil fuel industry. If renewable energy technology is available, affordable, and cost-effective, why is the implementation not scaled up accordingly? What policy barriers stand in the way? And which policy incentives could accelerate this transition?

The second main finding is that, despite rising climate change impacts in the EU (drought and heat), climate policy at the national level is not improving correspondingly. These findings support Peterson [46], who found no evidence of any increased ambition to mitigate climate change in the aftermath of extreme weather events. The nature of the insidious and slow-moving threat of climate change lends itself to delayed action and might be a partial explanation for this phenomenon. There is a need to make the emissions and policy inaction of states more visible to the public and for states to be held accountable for their inaction by, for example, attributing inaction to loss and damage and raising the question of liability. There have been precedents in the EU of various individuals, groups, and communities successfully holding governments accountable for their inaction on climate change. Examples are the landmark cases of Urgenda in the Netherlands [47] and Friends of the Environment in Ireland [48]. Both demonstrate how litigators and plaintiffs have compelled governments to implement more ambitious climate legislation to ensure compliance with the Paris Agreement. Such legal action could force a social tipping point that could accelerate a state's sense of responsibility and accountability. Furthermore, there is a need to look beyond historic emissions to current and future emissions in order to get a holistic picture of the sources, reduce finger-pointing, and enhance global solidarity. The spirit of "survival cosmopolitanism" was defined by Conversi [49] as the new global consciousness arising from the existential threat of climate change. Survival cosmopolitanism requires people to move beyond national boundaries and to combine multiple actions across nations in recognition that these very frontiers have become dangerous obstacles to the survival of nations [49].

Regional differences in the political response to heat stress may be due to the presence of different climate zones within the EU, each with its characteristic precipitation and temperature regime [50]. The extremes that societies are accustomed to may have a lower impact on their attitudes and responses. For example, given that heatwaves are usual in the Mediterranean, they may be less alarming to the public than in the northern countries [51]. This implies a need for tailored country-specific communication and political responses to climate change hazards to make the level of the threat and the costs of inaction clearer to

the public and policymakers. However, as Giordono et al. [52] have shown, multiple factors influence different policy responses elicited by extreme weather events; these include as institutional capacity, citizen's political stances on climate change, and the level and type of media attention. These diverse factors vary between countries; therefore, reasons for differing correlations between climate change impacts and climate policy are likely to be country-specific.

Diving a bit deeper into the findings regarding public attitudes, we did not find a significant relationship between the perceived seriousness of climate change and climate policy. However, the feeling of personal responsibility for climate change and individual action to fight climate change are positively correlated with climate policy. This means that as the sense of personal responsibility and personal action to tackle climate change reportedly increases, climate policy also improves. This supports the proposition that feelings and emotions about climate change play an important role in cognition and in motivating individuals to act [53,54], which has implications for public communication and advocacy efforts.

Public attitudes towards climate change are improving overall in the EU, which could be due, at least in part, to the increased integration of climate change (and the SDGs) into the curriculum at all levels in Europe [55,56] and increased coverage of climate change in the media [57]. This study found that public attitudes towards climate change are not increasing uniformly, with northern states being the least and southern states the most concerned. This may be related to the perceived capacity to adapt. If your perception is that your adaptive capacity is high (for example, your house is insured, your country's institutions will respond to disasters, etc.) then your level of concern may be lower, despite the threat-level perception being high. However, research by Le Coq and Paltseva [58] showed that eastern Europeans are, on average, less concerned about climate change than their western neighbours. This could also be due to less information about climate change and misinformation being more prominent in eastern EU countries [59], as was also found to be the case in the United States [60]. In contrast, our study shows that eastern countries score highly in their perceived seriousness of climate change, but lowest in their perceived personal responsibility for climate change and their reported individual action to tackle climate change. This highlights the importance of enhancing solidarity on the issue of climate change and avoiding any trends that might make this a 'left–right' or 'east–west' split issue. A just transition provides the foundations for such a response—greening the economy in a way that is inclusive and fair for all, creating decent work opportunities, and leaving no one behind.

Our results raise questions about the role that nationalism plays in these domains and interactions. Nationalism is an ideology that emphasises loyalty and allegiance to a nation or nation-state, placing those interests ahead of other individual or group interests, and it is currently recognised generally as the main ideological engine and legitimacy tool for political elites [61]. It is perhaps unsurprising that in the face of a collective crisis (such as climate change), where it is perceived that sacrifices need to be made in the interests of the common and cross-border collective good, national level policies will favour national interests ahead of collective (EU and global) interests. Indeed, climate change has been conceptualised as a 'tragedy of commons' on a global scale because nation-states, acting rationally in their own self-interest, act irrationally as a collective group by contributing to emissions that will lead to a collective disaster [62]. Yet as renewables become more efficient and cost-effective, and in the presence of a functional carbon market in the foreseeable future, the prioritisation of national interests may coincide with climate action since it will (and arguably already does) make economic sense to prioritise climate action. Alternatively, or additionally, as the public reaches a threshold of concern about climate change, a social tipping point may be reached whereby global climate action will be prioritised over the nations' self-interest and/or protectionism.

When it comes to environmental policies, we uncovered a gap between supranational European policies and national-level policies, and this may be partly explained by the ob-

stacle of nationalism, or resource nationalism. The relationships between nationalism and climate change have only recently been explored. Conversi [49] suggests two ways in which national narratives are being mobilised to make sense of climate action, including resource nationalism and green nationalism. Resource nationalism is the tendency of people and governments to assert control over natural resources located on their territory [49]. Green nationalism, or reflexive green nationalism (RGN), is an ideology critical of ecosystem destruction and supportive of the idea that the nation-state and its citizens have a special duty to protect the environment of their country [63]. Posocco and Watson [63] put forward several plausible claims based on the relationship between nationalism and climate change. First, climate change is undeniably a global phenomenon with national causes that are mainly caused by a small number of top polluting nation-states (the US, China, Russia, India, Japan and the EU28). Contrary to popular discourse, they put forward that the solution to climate change is local rather than global and depends on top polluters' ability to re-modernise and to develop RGN. Our study supports this view because it demonstrates that national-level policy is lagging behind EU policy, and if it does not advance significantly and urgently, the Paris Agreement goals will not be met. Additionally, the concept of RGN aligns with our findings of public concern about climate change increasing, with macro-regional differences. Conversi and Posocco [64] investigated case studies of exemplary nation-states that scored highest in the Environmental Performance Index (EPI) and CPPI, including some countries in our northern macro-region category (Norway, Sweden, Denmark) and some countries in our western macro-region category (Switzerland, Germany). These positive examples are in sharp contrast with the worst environmental offenders, such as the USA, Russia, Brazil China and India. The latter have long been run by economic regimes that place primary importance on some sort of resource nationalism that negatively affects both national and global populations [63]. Nationalism continues to play an important role in planning global energy transitions [49] and may explain the East/West and North/South divides that our study addresses. Updating these nation-states to more sustainable ideological forms is humanity's best shot at halting the climate crisis [63].

European states have high emission reduction potential, and they send a strong signal to the rest of the world with their action or inaction on climate change. This alludes to the literature on "exemplary ethical communities" and "exemplary national states", which are opposed to "top polluting nation states". Five factors have been identified to help explain why some countries have become exemplary in their action to combat climate change: (1) the development of a tradition of ecologism and environmentalism rooted in the long term; (2) the lock-in of green nationalism across society; (3) free and effective environmental movements; (4) inclusivity and welfare; and (5) a sense of national pride in environmental achievements [65]. Further research examining the evolution of these factors and how they can be bolstered in the EU has to potential to accelerate climate action in the years to come.

The climate crisis requires an urgent and radical coordination effort at the global level from one dominated by multilateral action to some form of synchronicity not seen previously [66]. This is the ideal; however, the world is still divided into nation-states, and these provide the foundation for all global institutions and agreements. Thus, a painful contradiction emerges—we need to move rapidly and radically to a better mechanism that can effectively face global crises. However, this world lends itself to slow and incremental change largely because nearly all states rest on the doctrine of nationalism. The nation-state is the dominant political reality of our time [67]. Indeed, existing nation-states are built around recently constructed boundaries largely based on oppositional politics, and thus they rarely lend themselves to the levels of coordination needed to tackle a global threat such as the climate emergency, which ignores all human-made boundaries.

There is no consensus in the research about determinants of public concern, beliefs, and other aspects of public attitudes towards climate change. While country-level factors such as wealth, climate adaptation preparedness, or fossil energy dependency may play a significant role [68,69], the individual-level drivers in one country do not always generalise to other national contexts [2]. Nevertheless, the disconnect between public awareness about

climate change and effective, ambitious, and expeditious climate policy at the national level in the EU is noteworthy and possibly an indicator of the health of our democracies.

7. Limitations

In terms of the limitations of this study, we considered several databases that best measure climate change impacts, public attitudes towards climate change, and climate policy. While we consider the selected databases the best available for this purpose, we do note their limitations. Next, we outline the limitations of the indicators within the databases and the limitations of the analysis.

Concerning indicators of climate impacts, our study is limited to two indicators for climate impacts: heat and drought stress, which are causally related to anthropogenic climate change with high confidence. However, while increasing temperatures are a good proxy for climate change across the whole EU, the consensus around drought is limited only to the southern region. Other parameters, e.g., precipitation, are attributed to climate change with lower confidence, or their confidence intervals differ across the examined European regions [36]. These decisions limit the comprehensiveness of a broader conceptualisation of climate change impacts. Therefore, the selection of indicators should be updated when considering other areas of the world.

Concerning indicators of climate change policy, the CCPI mainly looks at mitigation policy and less so at adaptation policy. The data are also at the national level and do not take into account supra-national level policy (EU policy including the Green Deal). This is a serious limitation as EU-level climate policy has been improving since the Paris Agreement [70] and may have a trickle-down effect on national-level policy in years to come. Moreover, it will be important to see if climate impact contributes to stronger adaptation policies at the national level and how mitigation and adaptation policies evolve together as the impact of climate change increases. Despite these limitations, the CCPI is still considered one of the main indicators of political performance in climate action [71].

Concerning indicators of public attitudes: Our analysis is limited to three questions to measure public attitudes towards climate change, although there are countless questions that could be asked to measure this domain. Our approach omits other important considerations such as the willingness to finance the transformation, i.e., the readiness to switch to more expensive but climate-friendly solutions, favouring subsidies to clean energy, or favouring additional taxation of polluting industries. Nevertheless, the questions selected produced data over the time period we needed and theoretically cover three important and comprehensive elements of attitudes: cognition, affect, and conation.

The major limitation of the statistical analysis is that we did not consider a highly probable lag effect between domains. For example, we can expect a lag between worsening climate impacts and changes to public attitudes and, subsequently, improved climate policy. However, the data resolution was too low to apply a lag time in the model [51]. Nonetheless, major patterns and trends between domains should be visible within the chosen time period, if present. Furthermore, the CCPI is structured to take into account the lag time between climate protection measures taken by governments and their impact on GHG emissions and energy use and production, avoiding the overlapping effects of previous policies on current scores [72].

The use of linear models may be considered too simple to give a holistic picture of what is considered a complex adaptive system: the climate, political and social systems. While our research makes assumptions by using linear models, public policies do not often evolve in a linear pattern [73], but rather evolve quickly after reaching a certain social tipping point [74]. A clear example of this mechanism in foreign policy is Sweden and Finland's request to join NATO following the invasion of Ukraine. Climate change policies do not seem to reach such tipping points after extreme climatic events related to climate change. However, momentum towards such social tipping points may be accelerated by the increased frequency and intensity of extreme climate-related events contributing towards strong shifts in the public opinion. This study aimed to uncover preliminary insights into

these systems; however, more complex statistical methods are required to build on this work. Further research may involve conducting a similar analysis with broader datasets or repeating the current study over time to see whether the relationships between these domains change. Indeed, as shown by our simplified model, geography appears to have effects on the chosen domains. A broader dataset, in terms of geographical areas, may be of use in determining if climatic events are related to increased awareness and, eventually, climate action. More insights about how this complex system works, how the different domains relate to each other, and outside factors are needed to check whether the a priori assumptions used to perform the analysis in this study are plausible. Other external factors, such as GDP, measures of economic inequity, democracy indices, and education level could be introduced into the model to assess what role they play in policy outcomes.

8. Conclusions

The impacts of climate change are worsening, and public attitudes towards climate action are changing. However, climate policies in European states are not gaining the necessary momentum to meet the level and urgency of the threat, nor are they an adequate response to the increased public awareness and concern. Complex causes likely underlie the gap we detected between supranational European policies and national-level policies, yet it may be explained, at least in part, by economic inequity in the EU, the health of democracies, and the obstacle of nationalism or resource nationalism that can be countered by green nationalism and survival cosmopolitanism. Yet even if climate policies could improve their effectiveness to meet the threat climate change presents, proper implementation of appropriate mitigation and adaptation measures would remain a challenge. This will have consequences for populations worldwide, especially the most vulnerable. Since European states have high emission reduction potential, they send a strong signal to the rest of the world with their action or inaction on climate change. There is a need to further examine the granularity of these disparities and the underlying causes for the observed discrepancies between different EU macro-regions. In general, the results of this study further strengthen the evidence of a persistent knowledge–action gap. Policies for the mitigation of and adaptation to the rapidly escalating climate crisis need to be implemented, translated into action, and evaluated for their effectiveness. Identifying barriers to, and enablers of, effective, ambitious, and expeditious climate policy is and will remain a challenge for interdisciplinary research in the years to come.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su15097542/s1, Table S1: Mean values of the chosen answers from Eurobarometer at EU macro-regions level. Figure S1: Drought is increasing at the EU level with macro-regional differences. Figure S2: Heat stress is increasing at the EU level and in all macro-regions. Figure S3: There is not significant relationship between the perceived seriousness of climate change and climate policy at an EU level.

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