This is an Accepted Manuscript of an article published by Taylor & Francis in International Journal of Sociology on 02 September 2025 available at https://doi.org/10.1080/00207659.2025.2552090

Exploring Clusters of Perceived Climate Change Risks and Impacts Across Countries with Different Exposure

Aistė Balžekienė[a]* and Audronė Telešienė[a]

[a] *Civil Society and Sustainability Research group, Kaunas University of Technology, Kaunas Lithuania*

*** email: aiste.balzekiene@ktu.lt*

Exploring Clusters of Perceived Climate Change Risks and Impacts Across Countries with Different Exposure

Abstract

Research has shown that, in many cases, variability in climate change risk perception tends to be greater within countries than between them. The aim of the article is to analyse how climate change risk perception is related to climate change impact perception among individuals across countries with different climate change risk exposure. We employ a data-driven analytical approach and identify within-country population clusters. Analysis is based on the International Social Survey Programme (ISSP) module "Environment IV" data. The countries are classified into three groups according to their exposure to climate change risks on the basis of the Global Climate Change Risk Index – high, medium and low. A two-step cluster analysis performed across the multi-country sample identified three clusters based on individual-level patterns of risk and impact perception, and of almost equal share. First cluster, "vigilant", is characterised by high risk perception and low impact perception; second cluster, "disquieted", displays high risk perception and high impact perception, and third cluster, "reluctant", has moderate risk and impact perception. Findings show that the distribution of clusters differs significantly between the three groups of countries, suggesting that climate change risk exposure influences the cognitive framing that links perceived risks and impacts among individuals.

Introduction

The scientific literature is rich in research on the impacts of climate change on human well-being and the need for large-scale adaptation (Collins et al., 2013; Kjellstrom & McMichael, 2013; Nascimento et al., 2022; Sen Roy, 2018) . When it comes to individuals and households, the focus is on lifestyle changes and solutions to reduce the carbon footprint of everyday decisions and to strengthen resilience. Climate modelling shows that the Paris Agreement will not be met in the forthcoming decades (Nascimento et al., 2022), so preparing populations to adapt to the adverse effects of climate change is crucial. Social research on public perceptions of climate change, its risks and preparedness for adaptation is considerable but still evolving (e.g. (Gonzalez & Sanchez, 2021; Linden, 2015; Vulturius et al., 2018), as are literature reviews (see for example Salas Reyes et al., 2021) and bibliometric analyses (Anjum & Aziz, 2025; Fan et al., 2022; Fu & Waltman, 2022). One important factor is how people perceive the risks of climate change (Wang et al., 2019; Gilbert & Lachlan, 2023). Published studies explain perceptions of climate change risk based on affective (e. g. Salas Reyes et al., 2021), cognitive (e. g. Xie et al., 2019), experiential (e. g. Lacroix et al., 2020), objective spatial (e. g. Grover et al., 2017), socio-structural factors (e. g. Echavarren et al., 2019), but the results are incomplete, geographically fragmented or inconsistent (Gilbert & Lachlan, 2023; Martin, 2023).

In looking for further ways to strengthen the theoretical toolbox for explaining the perception of climate change risks, it is important to note several typical methodological decisions in this field of research: data from a single country are usually used, and explanatory models are often applied to the population as a whole, without considering that populations are not homogeneous, but rather segmented, and that explanatory models may perform differently in different segments. That is, hypothetically, if socio-demographic variables explain risk perception in one segment well, they may be insignificant in another segment, because worldview variables may be stronger factors in that segment. When analysing the population as a whole, such differences are flattened out, possibly masking different mechanisms of perception formation. There is a lack of studies that look for naturally occurring (identified via data-driven analysis) segments based on climate change perception variables. Moreover, it is important to note that cross-national studies find the between-countries variability of climate change risk perception to be less than the within-country variability (Bostrom et al., 2012; Budescu et al., 2014; Weber, 2016), which further strengthens the case for comparative studies of population segments. The negative impacts of climate change are not evenly distributed globally. Scientific efforts to understand the different impacts of climate change on different countries have led to a ranking of countries according to their climate change exposure (Eckstein et al., 2021). Risk is defined in relation to threat exposure (Collins et al., 2013). Individual experiences of climate change adverse effects, and the ways that individuals make sense of these experiences, linking them to the climate change, is extremely important in understanding climate change risk perceptions (Broomell et al., 2015; Myers et al., 2013; Rudman et al., 2013; Spence et al., 2011; Weber, 2016).

To address the lack of climate change risk perception comparative studies of population segments, and the lack of research that connects risk perceptions to perceived climate change impacts, we perform cluster analysis with data from International Social Survey Programme (ISSP) Environment Surveys Wave IV (ISSP Research Group, 2023).

The paper aims to analyse how climate change risk perception is related to perception of local climate change impacts in countries with different climate change risk exposure. The following research questions are addressed in this article:

RQ1: What distinct clusters of individuals can be identified based on their perceptions of climate change risk and their perceived local impacts of climate change?

RQ2: Is the structure of the clusters significantly different among populations from high, medium and low climate change exposure countries?

RQ3: What are the differences across countries in the cluster structure?

The findings from this cluster analysis provide insights into how different segments of the population perceive the risks and local impacts of climate change, and how these are related to exposure to climate change risks. This can inform targeted communication strategies, policy development, and educational programs.

Conceptual framework

Climate change risk perception has been effectively conceptualized in models such as van der Linden's Climate Change Risk Perception Model (CCRPM), a seminal framework that integrates multiple social-psychological factors (Linden, 2015). Beyond the CCRPM, numerous other conceptual and measurement frameworks have been developed to capture the multidimensional nature of climate change perception. Among these, the scale proposed by Van Valkengoed and colleagues (Simis et al., 2016) is particularly relevant to the focus of this study, as it includes risk perception alongside perceived reality, causes, and consequences of climate change. While this scale provides a valuable measurement tool, we further rely on van der Linden's CCRPM because it aligns more closely with the structure of the representative survey data provided by the ISSP Environment module. According to Gilbert & Lachlan (2023), the CCRPM has explained nearly 50% of the variance in climate change risk perceptions in a number of Western countries, e. g. Canada (Lacroix et al., 2020), United Kingdom (van der Linden, 2015), Italy (Castellini et al., 2024) or the United States (Gilbert &

Lachlan, 2023). The CCRPM model integrates cognitive, experiential, socio-cultural, and socio-demographic factors.

Cognitive factors pertain to subjectively reported or objectively assessed knowledge about climate change causes, impacts and possible responses (van der Linden, 2015; Gilbert & Lachlan, 2023). Climate change knowledge plays an important role in shaping risk perception, with several studies suggesting that higher levels of knowledge are associated with increased concern about climate change (Castellini et al., 2024; Zobeidi et al., 2020). However, the relationship between knowledge and climate change risk perception is not straightforward. Research has also shown that knowledge alone does not consistently predict risk perception across all contexts, and its influence may depend on how knowledge is conceptualized or measured (van der Linden, 2015; Gilbert & Lachlan, 2023). This reflects broader insights from science communication research, which has critiqued the so-called "knowledge-deficit model" - the assumption that more information leads directly to greater concern or engagement (Simis et al., 2016).

Socio-cultural factors of the CCRPM include value orientations and descriptive and prescriptive social norms (van der Linden, 2015). Despite proof of significant impacts of social norms on climate change risk perception in some populations, e. g. in Italy (Castellini et al., 2024), generally these factors exhibit inconsistent impacts across different cultural contexts (Elshirbiny & Abrahamse, 2020). This inconsistency underscores the complex interplay between individual risk perceptions and broader societal influences. Among the factors within CCRPM, socio-demographic factors such as age, education and income level exhibit particularly mixed results in the literature. This does not imply that these factors are uniformly insignificant, but rather, that the evidence on the explanatory power of socio-demographic factors is mixed, with findings varying by context and variable. Some studies show that younger individuals, women and those with higher education exhibit greater climate change risk perception (e.g. Demski et al., 2017; Echavarren et al., 2019; Ergun et al., 2024; Paniello-Castillo et al., 2025). However, other studies have suggested that classical sociodemographic variables can't explain a significant share of variability in climate change risk perception (Brulle et al., 2012). At the same time, studies such as Sen Roy (2018) emphasise that gender plays a critical role in shaping lived experiences of climate change, particularly in the Global South, suggesting the need to be more sensitive and consider how such experiential inequalities may also influence perceived local impacts.

Experiential processing factors involve affect and personal experiences with climate change adverse effects, for example, extreme weather events (van der Linden, 2015). Affect has been shown to explain a larger variance in climate change risk perception compared to previous experiences with extreme weather events (Gilbert & Lachlan, 2023; Lacroix et al., 2020). Similarly, Castellini et al., (2024) have shown that affect and social norms explained more variance in risk perception than other variables in Italian population. This suggests that emotional responses to climate change related threats may drive perceptions of risk more strongly than individual experiences with climate change impacts, not negating experiential factors effects. There is evidence linking personal experiences of extreme weather effects to heightened risk perceptions(Broomell et al., 2015; Myers et al., 2013; Rudman et al., 2013; Spence et al., 2011; Weber, 2016). Experience with extreme weather events has been shown to be a significant predictor of climate change risk perception in Italy (Castellini et al., 2024) and Egypt (Elshirbiny & Abrahamse, 2020). But Brulle et al. (2012), using time-series analysis of U.S. public opinion data, found that weather extremes have no effect on aggregate public opinion. A recent narrative review by Sambrook et al. (2021) further highlights how the influence of personal experience is shaped by individuals' prior beliefs, emotional responses, and interpretative frameworks, helping to explain variation in how climate change impacts are perceived. The same holds for more recent research.

Gilbert & Lachlan (2023) has also discussed that results are inconsistent, probably depending not just on country cases, but also on the type of experience. For example, Lacroix et al. (2020) have found that direct exposure to forest fires and other types of extreme weather events was not a significant predictor of climate change risk perception in Canada. Interestingly, the study has shown that the indirect exposure (through media and conversations) was associated with stronger climate change risk perception in the beginning of their quasi-experiment (Lacroix et al., 2020). Brulle et al. (2012) have also proved that media coverage of climate change directly affects the level of public concern in U.S. Inconsistency can also be explained by the possibility of mediating the effect of experience on risk perception. An analysis by Ai et al. (2024) showed that party affiliation is an important mediating factor, and extreme weather experiences amplified the perceptions of climate change risk among individuals without party affiliations. This led them to suggest that the relationship between experiences and risk perception is not direct, but rather influenced by other cognitive frameworks, such as perceptions of causality (Ai et al., 2024).

A separate branch of research in the field of climate change risk perception looks at the importance of spatial factors. Several studies have explored this relationship, highlighting the importance of geographic proximity and local environmental conditions (Balžekienė et al., 2024; Jayakody et al., 2025; Raymond & Brown, 2011; Sikder & Mozumder, 2020). Geographical proximity to areas directly affected by climate change has been shown to increase climate change risk perception in Europe (Balžekienė et al., 2024), and in the U.S. population (Sikder & Mozumder, 2020). This relationship between proximity and perception helps account for why populations in countries facing higher climate risk exposure often report elevated levels of concern (Echavarren et al., 2019; Gartin et al., 2020; Grover et al., 2017). This variation depends, among many other factors, on specific climate-related hazards faced by each country. Multilevel analysis of climate change risk perception in multiple European populations has shown that variables related to natural hazards, like temperature increases or water deficit, can significantly explain climate change risk perceptions (Echavarren et al., 2019). Similarly, Grover et al., (2017) found that as objectively assessed risk increases, perceptions of climate change risk significantly rise among the U.S. population. To assess the extent to which countries are impacted by weather-related loss events such as storms, floods, and heatwaves, Germanwatch has developed the Global Climate Risk Index (CRI) (Eckstein et al., 2021). This index ranks countries based on their vulnerability and exposure to extreme weather events and serves as a convenient tool to conduct scientific comparative analyses (Grant et al., 2023; Halkos & Zisiadou, 2023).

These findings collectively underscore the multifaceted nature of climate change risk perception and the need for further advancing the explanatory research. We suggest combining country-level variables describing climate change risk exposure and individual-level variables defining climate change risk perception and perceived local impact of extreme weather events.

Materials and methods

Our article aims at exploring the clusters in the population that can be identified based on public risk perception of climate change and the perception of climate change impacts in the respondent's living place.

The objectives of the article are (1) to identify and explore distinct groups in the public based on the risk perception of climate change and perception of local impacts of extreme weather events and (2) to compare the structure of these groups in a set of counties with different levels of exposure to climate change. Therefore, we are using two different types of data: international survey data to capture subjective perceptions and the global climate change risk index to assess objective exposure levels for the grouping of countries with different exposure levels to climate change impacts.

Survey data analysis in this article is based on the International Social Survey Programme (ISSP, issp.org) module ISSP "Environment IV" 2020 (ISSP Research Group, 2023). The full data set includes 28 countries and 44100 respondents globally. The participation of countries in ISSP is funded by national funding bodies; therefore there is an uneven representation of countries from different geographical regions. Countries that participated in ISSP "Environment IV" module are: Australia (AU), Austria (AT), China (CN), Croatia (HR), Denmark (DK), Finland (FI), France (FR), Germany (DE), Hungary (HU), Iceland (IS), India (IN), Italy (IT), Japan (JP), Republic of Korea (KR), Lithuania (LT), New Zealand (NZ), Norway (NO), Philippines (PH), Russian Federation (RU), Slovakia (SK), Slovenia (SI), South Africa (ZA), Spain (ES), Sweden (SE), Switzerland (CH), Taiwan (TW), Thailand (TH), and United States of America (US). There is a low representation of countries from Africa and Latin America. Data was collected from 2019 to 2023. It is worth noting that data collection took longer than usual in ISSP due to COVID-19 restrictions on field data collection. In all countries, a probability sampling method was used. The universe for sampling was persons aged 18 years and older with a few exceptions. The data collection for representative samples was administered by national organisations in each country, responsible for ISSP implementation. Data collection mode varied country by country, and included mainly face-to-face interviews, with some exceptions. See detailed explanation of ISSP module "Environment" IV methodology, sampling strategy, data collection modes, list of organisations responsible for data collection and access to raw data in ISSP Research Group, 2023[1]. The map of participating countries is available at the ISSP webpage issp.org.

Since the ISSP's geographical coverage is uneven, our article aims to analyse mindset structures based not on differences between countries, but on the objective realities of individuals' exposure to climate change risks.

To be able to use data from all ISSP module "Environment" IV countries, we proposed to classify them based on the level of exposure to climate change risk for further analysis. There are different indicators to measure climate change risk and climate change mitigation and adaptation performance. For example, ND Gain index (Notre Dame Global Adaptation Index) measures countries' adaptive performance to climate change risk, and the Yale EPI index includes indicators on climate change mitigation performance. However, our objective is to categorise countries based on their exposure to climate change impacts, rather than on their adaptation efforts or climate performance levels, to be able to compare the mindsets of people living in different climate change risk exposure.

[1] https://www.gesis.org/en/issp/data-and-documentation/environment/2020

The Climate Risk Index (CRI, https://www.germanwatch.org/en/cri), published since 2006, is one of the longest-running annual climate impact-related indices. The CRI analyses climate-related extreme weather events degree of effect on countries. We have chosen Global Climate Change Risk Index, because it provides the cumulative risk index, based on data from a decade from 20 years period (2000 – 2019), thus we believe that this index is a comprehensive and reliable database to use for the country classification according to the climate risk exposure level. Countries from the ISSP sample are classified based on their exposure to climate change using the Global Climate Risk Index 2021 by German Watch (Eckstein et al., 2021). This index ranks countries based on the extent to which they have been affected by the impacts of climate-related extreme events. We are using the report from 2021, as it is closest in time to the field work of ISSP. In the Climate Risk Index (CRI) countries are classified into 5 groups, with values from 1 – highest risk group to 5 – lowest risk group. Few countries/ regions from ISSP sample did not have values in CRI. The data from the U.S. is missing from CRI, and the report does not explain why this data is missing. For our article, we needed to assign U.S. so one of the climate risk exposure group, to be able to make use of ISSP data from the U.S. We have decided to assign the U.S. to the same climate risk group as Canada and Mexico (group 4) The U.S. was placed in the same group as Canada and Mexico, based on the IPCC Sixth Assessment Report on North America (Intergovernmental Panel On Climate Change, 2023; Lucatello et al., 2022) which does not indicate that the U.S. faces significantly higher climate risk impacts compared to the other two countries.

Among the ISSP sample countries, none belonged to climate risk group 1, and only the Philippines was from risk group 2 in the Germanwatch risk index.

We admit that this is the limitation of the study, as countries from climate change risk groups 1 and 2 are underrepresented; however, this is caused by the ISSP coverage. Therefore, we joined the Philippines with the countries from group 3 for the creation of sub-samples of different exposure groups. Countries in the ISSP sample were divided into three groups of climate change exposure using the following rule (see Table 1):

1. High climate change risk: CRI groups 2 and 3
2. Medium climate change risk: CRI group 4
3. Low climate change risk: CRI group 5

Table 1. Grouping of countries by climate change risk for the analysis

	Climate change risk index 2000- 2019 (score) [1]	**Climate change risk group from Germanwatch**[2]	**Group for analysis**
PH-Philippines	18.17	2	1
AU-Australia	47.67	3	1
HR-Croatia	47	3	1
FR-France	41.67	3	1
DE-Germany	38.17	3	1
IN-India	38.5	3	1
IT-Italy	39	3	1
RU-Russia	48.5	3	1
ES-Spain	46.5	3	1

TH-Thailand	29.83	3	1
AT-Austria	56.5	4	2
CN-China	56.33	4	2
TW-Taiwan [3]	53.52	4	2
HU-Hungary	74	4	2
JP-Japan	64.83	4	2
KR-Korea (South)	85.17	4	2
NZ-New Zealand	85	4	2
SI-Slovenia	55	4	2
ZA-South Africa	76	4	2
CH-Switzerland	57.67	4	2
US-United States [4]	N/A	4	2
DK-Denmark	118	5	3
FI-Finland	153.5	5	3
IS-Iceland	168.5	5	3
LT-Lithuania	118.17	5	3
NO-Norway	137.5	5	3
SK-Slovakia	114.83	5	3
SE-Sweden	131.33	5	3

[1] Global Climate Risk index, https://www.germanwatch.org/en/19777 Lower value, higher climate change risk (p. 43-46)
[2] Global Climate Risk index (p.15) (1 – highest risk group; 5- lowest risk group)
[3] Value from the German watch of Chinese Taipei
[4] Germanwatch data is not available for the US.

Three groups of countries, classified by objective exposure to local climate change impacts, create three sub-samples for the analysis, with the highest share of respondents in the group with medium exposure to climate change risks (see Table 2).

Table 2. Structure of sub-samples by exposure to climate change risks

Exposure to climate risks	**N. of respondents**	**%**
High climate change risk	14763	33.5
Medium climate change risk	20587	46.7
Low climate change risk	8750	19.8
Total	**44100**	**100.0**

In this article, we use data data-driven approach and look for the internal structure of mental models that are not based on the country differences, but rather on cognitive variabilities in the populations with different exposure to climate change risks.

The general logic of data analysis in this article, in relation to research questions, is presented in Figure 1.

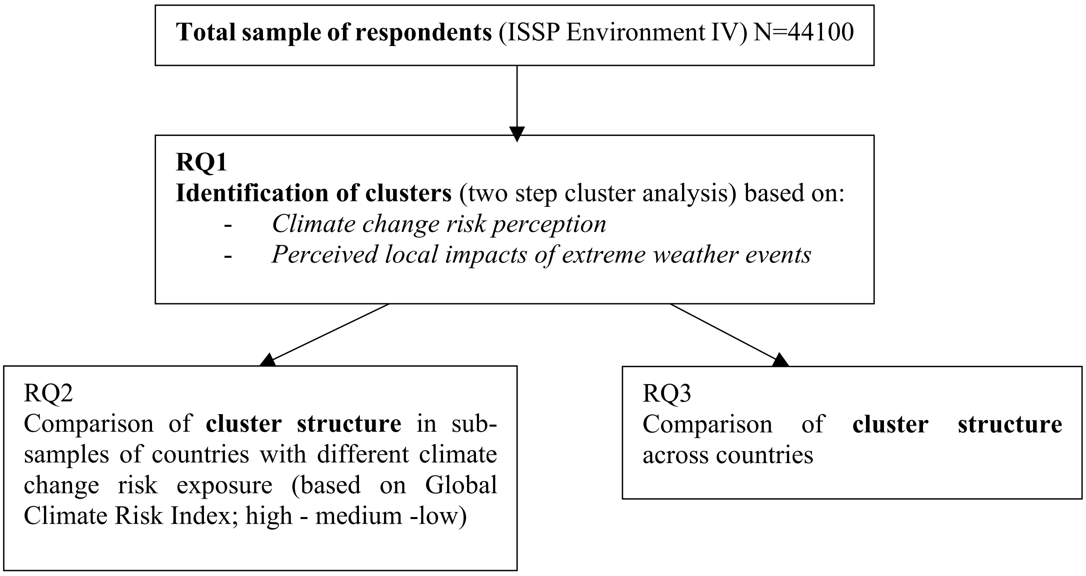


Figure 1. Logic of data analysis

The rationale behind the selection of variables for cluster analysis is the nexus of general risk perception of climate change and perceived local impacts of extreme weather events. We assume that these variables reveal distinct mental models encompassing general awareness and concerns, together with localised contexts of exposure to extreme weather events. Our methodological approach (see Figure 1) is to dissociate cluster analysis from country-level classification. Therefore, first we have run cluster analysis on the total ISSP sample of 44100 respondents to identify underlying mental models on risk perception–impact perception axis (RQ1). Furthermore, we analysed the cluster structure within three groups of respondents, each representing different levels of exposure to climate impacts. It is important to note that this analysis was conducted independently of the country level, as we used sub-samples based on exposure level (RQ2). And lastly, we examined the structure of the previously identified clusters at the country level to identify significant outliers and differences (RQ3).
We used the following variables from ISSP Environment IV for the cluster analysis in the ISSP sample:

Climate change risk perception
“A rise in world's temperature is (dangerous/ not dangerous) for environment”:
[1- extremely dangerous, ... , 5 – not dangerous at all]
This variable was recoded, so that higher value would mean higher risk perception. Values of recoded variable range from 1 – not dangerous at all, … , to 5 – extremely dangerous].

Climate change risk perception in the ISSP survey is measured using one item, which is a part of a set of items measuring risk perception of environmental issues. While it is common in survey research to use multi-item constructs, the use of a single item to measure climate change risk perception is widely accepted in academic literature, particularly in the international comparative surveys. For example, one item used for the analysis of climate change risk using ISSP data (Luís et al., 2018), World value survey (Martin, 2023), Eurobarometer survey (Ergun et al., 2024) and Gallup world poll (Knight, 2016).

Perceived local impact of extreme weather events
"Thinking about your neighbourhood, to what extent, if at all, was it affected by the following things over the last twelve months? Extreme weather events (such as severe storms, droughts, floods, heat waves, cold snaps, etc.)"

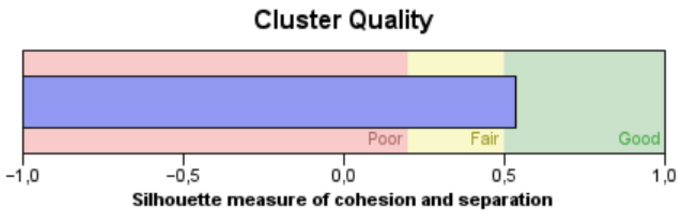
[1 – not at all, …, 5 – to a very great extent]

The ISSP questionnaire includes only a single variable to measure perceived local impacts of extreme weather events and does not distinguish between different types of events. As a result, respondents based their answers on their own understanding of the events relevant to their local areas. In our analysis, these variables are treated as interval-scale.

Two-step cluster analysis was performed using these two variables (*climate change risk perception* and *perceived local impact of extreme weather events*). Two-step cluster analysis used for large data sets allows the identification of groups of respondents that are similar by identified features and different from respondents in other groups (clusters). Two-step cluster analysis finds the most suitable number of clusters, and proposes data data-driven solution. Cluster analysis is suitable for exploratory data analysis. Two-step cluster analysis is used for both continuous and categorical variables, and this method is especially effective for uncovering patterns and relationships in complex datasets without requiring prior knowledge of the number of clusters (SPSS analysis, 2024). The variables used for the identification of clusters were treated as continuous and were normalised before conducting cluster analysis.

The results of two-step cluster analysis determined three clusters and indicated "good" quality according to the average silhouette (see Figure 2). The silhouette measure of cohesion and separation is of value of 0.5.

Figure 2. Cluster quality of two-step cluster analysis



Other characteristics of clusters are presented further in the results section.

Other statistical methods used in the article include descriptive statistics to present frequencies, means and standard deviations; chi-square tests, and post-hoc analysis of chi-square results using pairwise comparisons of with a Bonferroni correction to identify which specific groups are different from each other. Data analysis was conducted using SPSS 29.0 software.

Results

The analysis of key variables in this study revealed significant differences in the perception of climate change risks and the perceived local impacts of extreme weather events in the analysed countries (see Figures 3 and 4).

Climate change risk perception is considerably high in almost all countries in the sample. In all countries (except China), more than half of the respondents identify climate change as extremely dangerous or very dangerous to the environment. On the contrary, the local impact of extreme weather events in the neighbourhoods of respondents is not perceived as high in most countries. One interesting extreme is Taiwan, where climate change risk perception is highest compared to other countries; however, the perception of local impacts is low.

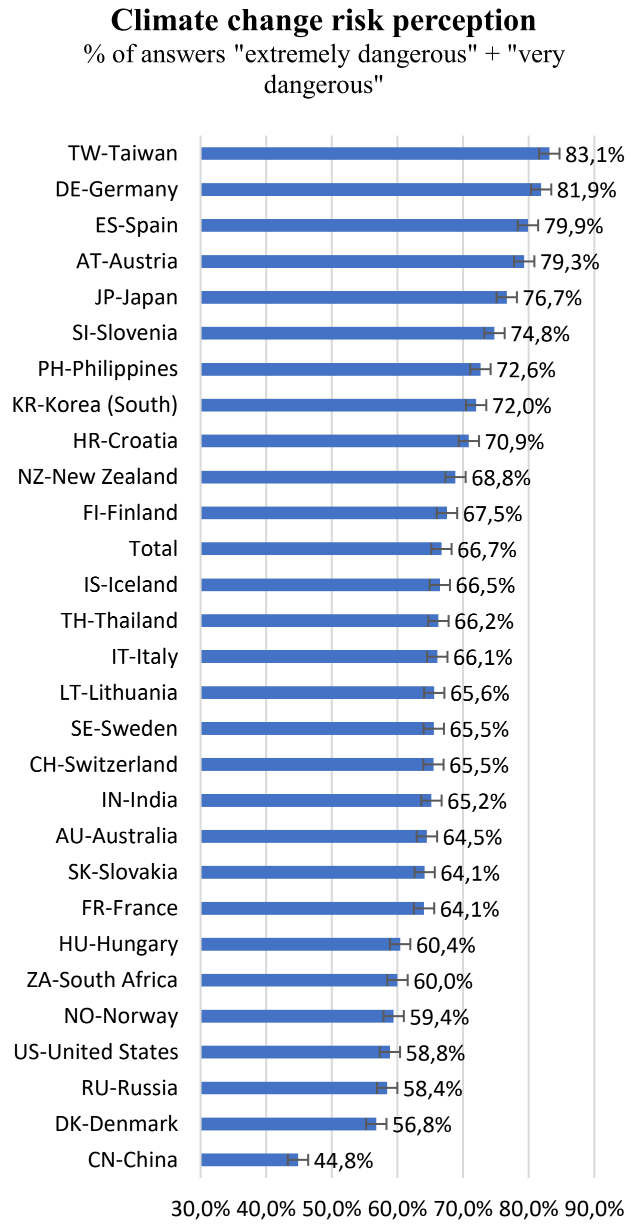


Figure 3. Answers to the question "*A rise in world's temperature is dangerous/ not dangerous to environment?". % of answers "Extremely dangerous" and "very dangerous*", ISSP Environment IV, N=44100.

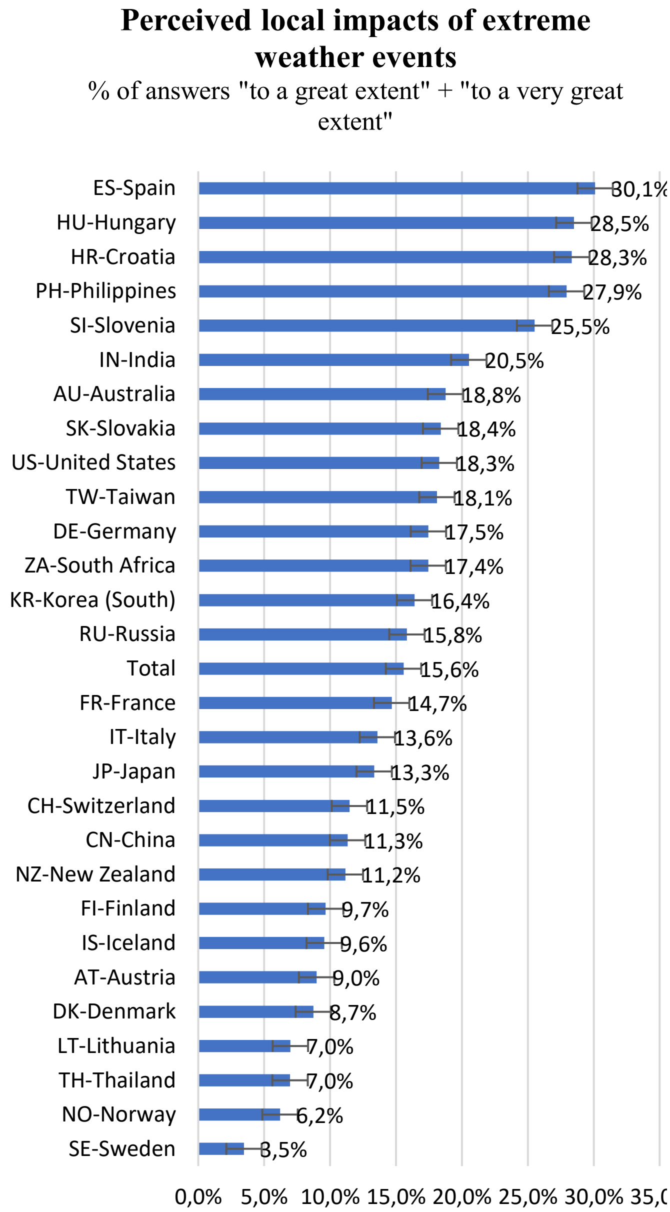


Figure 4. Answers to the question "*Thinking about your neighbourhood, to what extent, if at all, was it affected by the following things over the last twelve months?*". % of answers "to a great extent" and "to very great extent", ISSP Environment IV, N=44100.

Climate change risk perception in all sample has a mean of 3,9 (SD=0,97) (from 1 -not dangerous at all to 5 – extremely dangerous), and the mean of perceived local impacts of extreme weather events is 2,38 (SD=1,1) (from 1 – not at all to 5 – to a very great extent).

We will further discuss the results according to the research questions of the article.

RQ1: What distinct clusters of individuals can be identified based on their perceptions of climate change risk and their perceived local impacts of climate change?

Two-step cluster analysis was run on the full sample of 44100 respondents in order to understand what groups of population can be identified regardless of country dependency.

The distribution of three clusters divides the sample into almost equal three parts (see Table 3).

Table 3. Distribution of clusters within the sample.

Cluster	Percent	N. of respondents
1	35.1%	14 199
2	32.2%	13 077
3	32.7%	13 331
Missing		3493

Three clusters present different combinations of climate change risk perception and perceived local impacts, and cluster characteristics indicate significant differences in the centroids of clusters (see Figure 5). Conceptual labels for the clusters are proposed based on their internal characteristics.

Cluster 1 indicates a high level of climate change risk perception (M=4,43), but low perceived local impact of extreme weather events (M=1,57). This kind of set of attitudes might indicate global awareness of climate change. People in this cluster usually indicate that their neighbourhoods are not affected or are affected to a small extent by extreme weather events. Therefore, presumably, they did not have a high level of experience with the impacts, and their concern can be driven rather by indirect experience. We propose to name this cluster "*vigilant*", which means high alert, in order to avoid danger.

Cluster 2 includes people with very high climate change risk perception (M=4,48) and high perceived local impact of extreme weather events (M=3,51). This group of people is aware of climate change impacts from direct experience in their local neighbourhoods. This cluster can be called "*disquieted*", indicating anxiety, uneasiness with the situation.

Cluster 3 reflects the situation, when the impacts of climate change are perceived as already visible (medium score) (M=2,15), however, concern with climate change is not so high (M=2,15). The mean of climate change perception in this cluster is the lowest of all 3 clusters (almost two times lower). This cluster could be named "*reluctant*", indicating the gap between awareness and perceived experience of local impacts of climate change and a low level of concern in general with climate change.

Proposed names of clusters are used further in this article together with the numbers of clusters, as they help to distinguish among the main characteristics within the clusters.

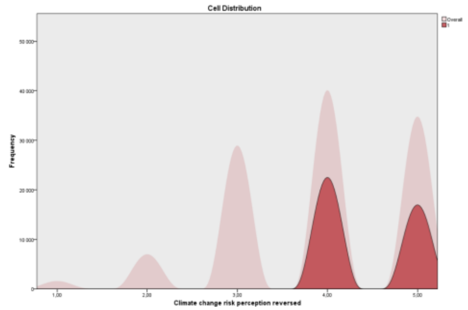
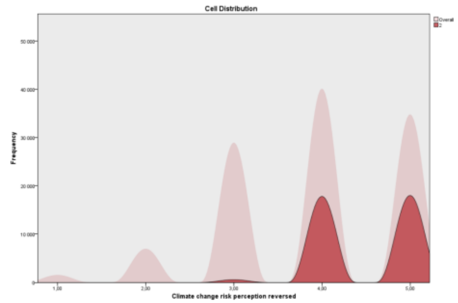
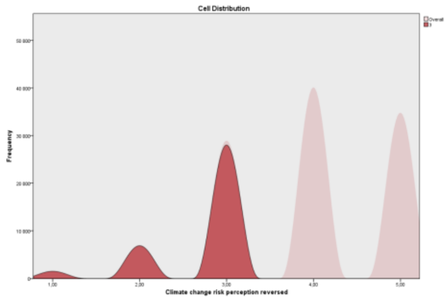
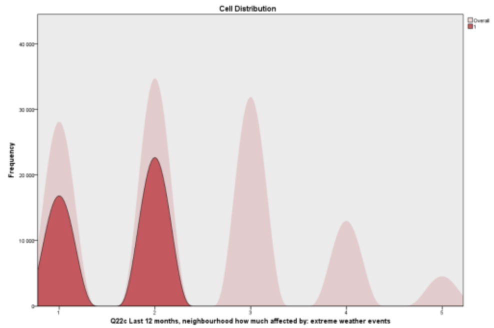
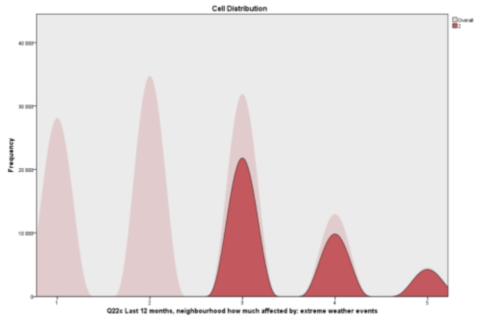
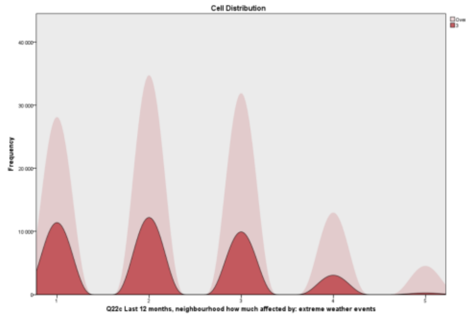
Cluster	1	2	3
Label	**“Vigilant”**	**“Disquieted”**	**“Reluctant”**
Description	High risk perception (M=4,43, SD=0,50), low perceived impact (M=1,57, SD=0,50)	High risk perception (M=4,48, SD=0,53), high perceived impact (M=3,51, SD=0,70)	Moderate risk perception (M=2,73, SD=0,53), moderate perceived impact (M=2,15, SD=0,98)
Size	35.0% (14199)	32.2% (13077)	32.8% (13331)
Inputs: climate change risk perception			
Inputs: perceived impact			

Figure 5 Labels and structure of clusters, ISSP Environment IV full sample. N=40607

RQ2: Is the structure of the clusters significantly different among populations from high, medium and low climate change exposure countries?

The second step in our analysis is to explore the cluster structure among sub-sets of samples from countries with different climate change exposure levels. Results reveal that there are significant differences in the distribution of clusters in different climate change exposure groups, X^2 (4, N=40534) = 303.7, p<0.01. Table 4 presents the distribution of respondents across different climate change exposure groups according to the three clusters identified in the previous step using the full sample and table 5 presents the results of post-hoc analysis of the chi-square test using pairwise comparisons of cluster distribution within different groups of countries.

Table 4. Distribution of respondents' clusters in the groups of countries with different climate change exposure levels, %

	Clusters			
Country group by climate change risk index	**1 „Vigilant“**	**2 „Disquieted“**	**3 „Reluctant“**	Total
High climate change risk countries	33,0%	37,4%	29,6%	100,0%
Medium climate change exposure countries	35,5%	30,9%	33,6%	100,0%
Low climate change exposure countries	37,7%	26,4%	35,9%	100,0%
Total sample	**35,1%**	**32,2%**	**32,7%**	**100,0%**

Larger	Smallest

Table 5. Post- hoc tests of Chi-square pair-wise comparisons of column proportions within the groups of countries of different climate change exposure*

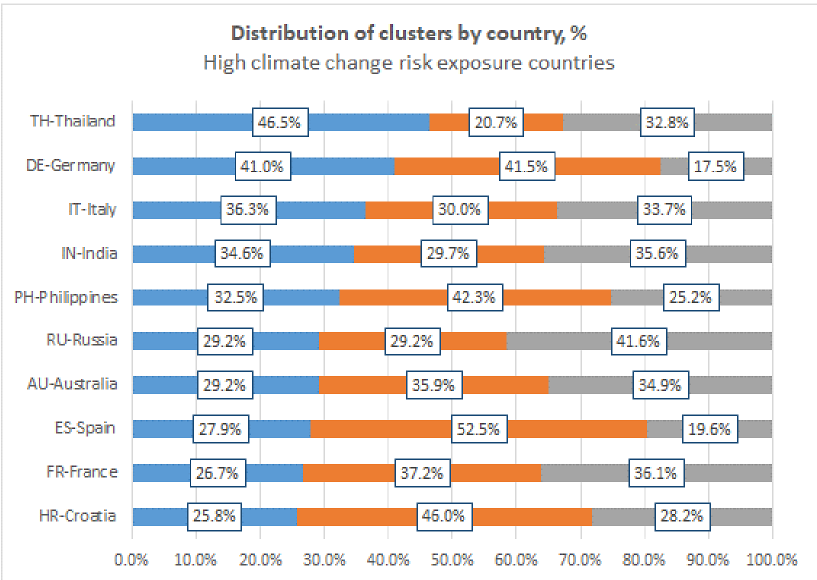
	Clusters		
Country group by climate change risk index	**A „Vigilant“**	**B „Disquieted“**	**C „Reluctant“**
High climate change exposure countries		A(,000) C(,000)	
Medium climate change exposure countries	B(,000)		B(,000)
Low climate change exposure countries	B(,000)		B(,000)

*Results are based on two-sided tests. For each significant pair, the key of the category with the smaller column proportion appears in the category with the larger column proportion. Significance level for upper case letters (A, B, C): ,05. Tests are adjusted for all pairwise comparisons within a row using the Bonferroni correction

The cluster structure in the country groups from different exposure levels shows significant differences in cluster distribution. In the group of countries with the highest level of climate change exposure, the largest cluster is cluster n. 2 ("*disquieted*"), with the highest values of climate change risk perception and perceived local impact compared to other clusters. However, there is still a significant gap in the perception of impacts with the objective exposure. The sizes of "vigilant: and "reluctant" are not significantly different. Among populations from the countries with medium and low climate change exposure, the cluster of "disquieted" is significantly smaller, compared to the share of the other two clusters. Post-hoc analysis (table 5) identifies that in both groups of medium and low climate change, the is a similar share of people falling into the "vigilant" and "reluctant" clusters.

RQ3: What are the differences across countries in the cluster structure?

There are visible differences in the cluster structure across different countries (see Figure 6). Among the high climate change risk exposure countries, Spain has the largest proportion of respondents in the cluster n. 2 "*disquieted*" (52,5%), while Thailand has the lowest (20,7%). This cluster signifies part of the population that is aware, concerned and alarmed. If the share of people with such an attitudinal structure is low, that could undermine the efforts of climate change adaptation and mitigation. From this group, Thailand has the highest share of people in cluster 1 (46,5%), which means low perception of local impacts, even though general risk perception is high.



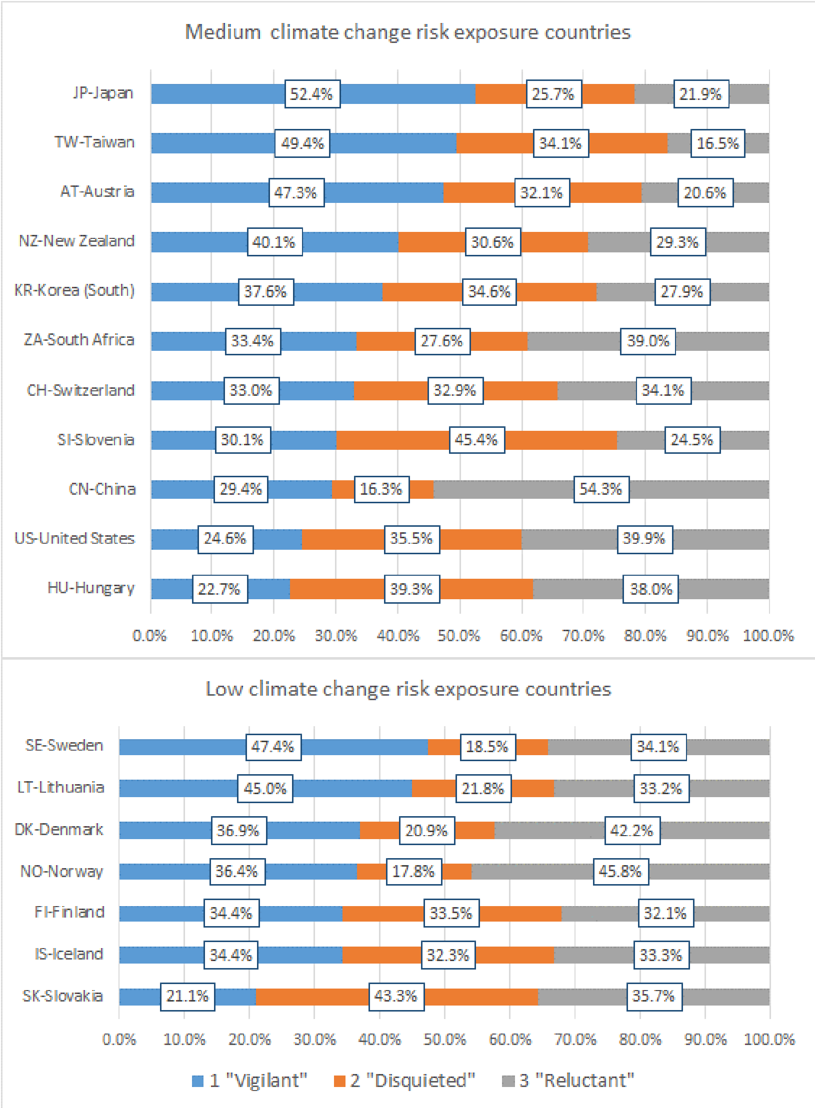


Figure 6. Cluster Distribution (%) in ISSP Environment IV Countries by climate change exposure Level

In countries with medium and low climate change exposure, the largest share of the population belongs to cluster 1 ("*vigilant*"), accounting for 35,5% and 37,7% respectively. This corresponds to the objective exposure level, which is low, but also signifies a high level of alert. The second largest cluster in both of these country groups is characterised by medium risk perception and medium to low perceived impact (cluster 3, "*reluctant*"), and both values are lowest compared to other clusters. Over one-third of the population belongs to this cluster (33,6% in medium exposure and 35,9% in low exposure countries), and this signifies possible gaps in awareness, especially in medium exposure countries. The largest differences in the medium climate change exposure countries (see Figure 6), is in the share of cluster 1 (high risk perception - low perceived impact). Around half of the population in Japan, Taiwan and Austria belong to this cluster, and lowest shares are in U.S. (24.6%) and Hungary (22.7%). There are also significant differences in the cluster distributions among the countries belonging to the low climate change exposure countries. Slovakia is an outlier, with 43,3% of the population belonging to cluster 2, which is characterised by high risk perception and high perceived impact. A counter-intuitive finding in this group of countries is that Denmark and Norway have the highest shares in the “reluctant” cluster (42,2% and 45,8% respectively) as quite often public in Scandinavia has revealed high levels of climate change concern.

Discussion and conclusions

This study aimed to identify individual-level perception profiles based on climate change risk perception and perceived local climate change impacts, using a data-driven, person-centred clustering approach across countries. This approach prioritises identifying patterns of co-occurring perceptions and focuses on within-country variation in how individuals perceive climate risks and local climate-related impacts. In the first stage of the analysis, we used the total sample of respondents from the ISSP Environment IV module to conduct a two-step cluster analysis, based on two indicators: climate change risk perception and perceived local impacts of extreme weather events in respondents’ neighbourhoods. This enabled us to uncover clusters of individuals that transcend national boundaries and reflect meaningful patterns at the individual level, rather than being driven by between-country differences. In the second stage, we examined whether these identified perception profiles, i.e., the population clusters, are distributed similarly across sub-sets of people from different levels of climate change exposure. And lastly, we explored the differences in cluster structure across the ISSP participating countries. While this comparison highlighted variation across country groups, our analysis remained at the individual level, as the clusters themselves were formed from individual responses.

Our study has some limitations related to the geographical coverage of the sample, missing values in cluster analysis and available variables for our research design. The available countries in the ISSP sample do not represent different climate change exposure country groups equally. None of the countries in the ISSP sample are from the Global Climate Change Risk Index's highest risk class. This means that segments of the population with the highest risk exposures are underrepresented in this analysis. Another limitation of this study is that during cluster analysis, the respondents with missing values in one or both variables that were used for clustering were removed from the final cluster structure. In total, 3493 respondents were not assigned to clusters, and that constitutes 7,9% of all sample. One more limitation of our study is related to the use of the survey variable of perception of impacts from extreme weather events. There are more observable impacts of climate change, yet their perceived presence has not been measured. The variable on perceived impacts from extreme weather events was the only available variable for analysis in the ISSP Environment IV survey module.

The first research question explored whether distinct clusters of individuals could be identified based on their perceptions of climate change risks and perceived local impacts of extreme weather events on local neighbourhoods. A two-step cluster analysis identified three groups of individuals, regardless of their country affiliation. The first group (Cluster 1) of respondents – labelled *vigilant* – exhibit high climate change risk perception but low perceived impacts of climate change on local neighbourhoods. This combination indicates that these individuals are highly aware of and concerned about climate change as a global risk but do not strongly perceive its direct effects in their immediate surroundings. They might be highly informed about climate change through media, education, or public discourse – referred to as indirect exposure (Lacroix et al., 2020) – but have not yet observed tangible local impacts, or are unable to relate the observable changes to the abstract and complex concept of climate change.

The second group (Cluster 2) of respondents – labelled *disquieted* – report high risk perception and high perceived impact of climate change on their local neighbourhoods. This group is disquieted by their direct experience with extreme weather events, which has been shown in previous research to significantly increase concern about climate change and strengthen risk perception (Spence et al., 2011; Castellini et al., 2024; Elshirbiny & Abrahamse, 2020). As noted by Sambrook et al. (2021), such experiences often interact with individuals' prior beliefs and emotional responses, shaping how climate change is perceived and internalised. While our study did not directly examine the role of prior beliefs or emotions, we acknowledge that these factors likely influence how individuals interpret local climate-related events and assess associated risks.

The third group (Cluster 3) of respondents – labelled *reluctant* – shows the lowest risk perception, yet somewhat average perceived impact of climate change on local neighbourhoods, and thus presents an intriguing paradox. This suggests that while they acknowledge the climate change induced changes in their surroundings, they do not necessarily link them to climate change or do not perceive them as a significant risk. This pattern may reflect what Sambrook et al. (2021) describe as selective interpretation, where prior beliefs or low emotional engagement lead individuals to downplay or disconnect observable local changes from broader climate change narratives; similarly, Weber (2016), drawing on a review of prior research, notes that without strong affective cues, individuals may struggle to perceive climate change as an urgent personal threat.

Our second research question examined whether the structure of the identified clusters differs in sub-samples from high, medium and low climate change risk exposure countries. Our findings highlight significant differences in cluster distribution across the groups of countries.

Disquieted – the ones with high risk perception and high perceived impact– make up the largest portion of respondents in the group of countries with high climate change risk exposure. This is natural and logical, given that the populations are exposed to the effects of climate change and then have a higher perception of both the impacts and the overall risk of climate change. This applies to 37.4% of the population in high-exposure countries.

Vigilant – the ones with high climate change risk perception yet lowest (compared to other clusters) perceived impacts, make up the larger proportion of respondents both in countries with medium, and in countries with low climate change risk exposure (35.5% and 37.7% respectively) than "disquieted". This might be more natural in the group of countries where risk exposure is low, i. e. climate change impacts are less frequent or less severe. It is more difficult to explain why the cluster of vigilant respondents is larger in countries with medium risk exposure. These are the countries that already witness the effects of climate change to a considerable extent, yet their populations remain inadequately aware (non-aware) of these impacts or unable to recognize them in their local neighbourhoods. It might be that climate change effects are distributed so, that the majority of residents live outside impacted areas. Some studies have shown that there is a discrepancy between the geographical distribution of population versus the distribution of areas affected by climate change and geographic distance decreases climate change risk perception (Sikder & Mozumder, 2020; Weber, 2016).

Another explanation might pertain to the discussion on the fractured links between direct experience and awareness of climate change (Lacroix et al., 2020; Ai et al, 2024). For example, residents may perceive droughts as a natural occurrence in their region, failing to recognise their increasing intensity and frequency over time, and therefore not attributing them to climate change. This could be due to attitudinal uncertainty and attribution scepticism (Haltinner &

Sarathchandra, 2021) where gradual or indirect changes are interpreted as part of natural variability rather than as indicators of broader and more complex climatic changes. On the other hand, the interpretation of environmental cues is heavily influenced by socio-cultural and cognitive factors (van der Linden, 2015). There is research showing that the relationship between experiences and risk perception is not direct, but rather influenced by other cognitive frameworks (Ai et al., 2024). Therefore, future research should explore the extent to which attribution ambiguity and scepticism affects public recognition of climate change impacts, particularly in regions with medium climate change risk exposure.

The third research question investigated differences in cluster structure across countries. Analysis confirmed that in countries with higher exposure to climate change risks, there are more residents exhibiting stronger perceptions of climate change impacts on their neighbourhoods. The results also confirmed that, with some exceptions, lower country exposure to climate change risks is associated with weaker perceptions of climate change impacts on local neighbourhoods. However, notable cases such as Thailand – where exposure is high, but perceived impact remains low, indicate that the relationship is not universal.

In countries with medium or low exposure to climate change risks, it is important to maintain climate change communication and ensure that the topic remains present in public discourse. This is because higher risk perception here is likely shaped not through direct experience but rather through indirect exposure. Indirect exposure occurs through media, education and everyday conversations about climate change. Lacroix et al. (2020) have also demonstrated that it has significant potential to influence risk perception in situations where residents lack experiential knowledge. In countries with medium or low exposure to climate change risks, it is crucial to further research the content of public discourse, to implement media monitoring studies and assess education programs.

Meanwhile, in high-exposure countries, a different approach is more important - linking personal experiences with the complex processes of climate change. This approach calls for domestication of climate change risks, and is particularly important in countries such as the Australia, Croatia, France, Germany, Italy, Philippines, Russia, Spain, and Thailand. The concept of domestication comes from risk communication studies and describes how global and abstract climate risks should be framed in ways that resonate with local contexts, cultural narratives, and everyday experiences (Olausson, 2014; Rabitz et al., 2021). Domesticated climate change discourses provide with local examples that serve as mental shortcuts - availability heuristics (Topolinski & Strack, 2015) - linking observable events in their local environment to the abstract topic of climate change. Further research is needed to examine how cognitive biases and psychological mechanisms, such as the availability heuristic, influence individuals' ability to connect local climate change impacts with climate change. Climate change communication domestication and availability heuristic heavily depends on socio-cultural contexts. Thus, another critical area for investigation is the impact of socio-cultural contexts in relation to climate change communication. These studies should be conducted in specific countries as case studies to highlight and empower contextual understanding, ensuring that locally relevant narratives, lived experiences, memories of past events, etc. are used to explain risk perceptions and develop more effective climate change communication strategies.

Our study also suggests that further research on climate change risk perception should rely more on analysing segmentation and testing explanatory models in different population segments, rather than testing such models on the population as a whole, assuming its homogeneity.

Acknowledgments

This article is based on projects, funded by the Research Council of Lithuania (LMTLT), agreement No S-MIP-22-26 (KLIM-KOM) and agreement No S-VIS-23-21 (SERENITY), implemented at Kaunas University of Technology.

The authors wish to thank the participants of the 2nd ISSP user conference, which took place on 4th of December, 2023, for their valuable comments on the paper.

Declaration of interest statement

Authors have no conflicts of interest to disclose

Data availability

Data is available for download at https://search.gesis.org/research_data/ZA7650

Lithuanian data set of ISSP "Environment IV" is available from Lithuanian Data Archive for SSH (LiDA): Telešienė et al., 2022 at https://hdl.handle.net/21.12137/RINOXY

References

Ai, X., Han, Z., & Zhang, Q. (2024). Extreme weather experience and climate change risk perceptions: The roles of partisanship and climate change cause attribution. *International Journal of Disaster Risk Reduction*, *108*, 104511. https://doi.org/10.1016/j.ijdrr.2024.104511

Anjum, G., & Aziz, M. (2025). Bibliometric analyses of climate psychology: Critical psychology and climate justice perspectives. *Frontiers in Psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1520937

Balžekienė, A., Echavarren, J. M., & Telešienė, A. (2024). The effect of proximity on risk perception: A systematic literature review. *Current Sociology*, 00113921241250047. https://doi.org/10.1177/00113921241250047

Bostrom, A., O'Connor, R. E., Böhm, G., Hanss, D., Bodi, O., Ekström, F., Halder, P., Jeschke, S., Mack, B., Qu, M., Rosentrater, L., Sandve, A., & Sælensminde, I. (2012). Causal thinking and support for climate change policies: International survey findings. *Global Environmental Change*, *22*(1), 210–222. https://doi.org/10.1016/j.gloenvcha.2011.09.012

Broomell, S. B., Budescu, D. V., & Por, H.-H. (2015). Personal experience with climate change predicts intentions to act. *Global Environmental Change*, *32*, 67–73. https://doi.org/10.1016/j.gloenvcha.2015.03.001

Brulle, R. J., Carmichael, J., & Jenkins, J. C. (2012). Shifting public opinion on climate change: An empirical assessment of factors influencing concern over climate change in the U.S., 2002–2010. *Climatic Change*, *114*(2), 169–188. https://doi.org/10.1007/s10584-012-0403-y

Budescu, D. V., Por, H.-H., Broomell, S. B., & Smithson, M. (2014). The interpretation of IPCC probabilistic statements around the world. *Nature Climate Change*, *4*(6), 508–512. https://doi.org/10.1038/nclimate2194

Castellini, G., Pinel, H., Acampora, M., Lucini, L., Barello, S., & Castiglioni, C. (2024). Understanding the role of hope in climate change risk perception: A cross-sectional study. *Journal of Risk Research*, *27*(7), 789–805. https://doi.org/10.1080/13669877.2024.2368207

Collins, T. W., Grineski, S. E., Ford, P., Aldouri, R., de Lourdes Romo Aguilar, M., Velázquez-Angulo, G., Fitzgerald, R., & Lu, D. (2013). Mapping vulnerability to climate change-related hazards: Children at risk in a US–Mexico border metropolis. *Population and Environment*, *34*(3), 313–337. https://doi.org/10.1007/s11111-012-0170-8

Demski, C., Capstick, S., Pidgeon, N., Sposato, R. G., & Spence, A. (2017). Experience of extreme weather affects climate change mitigation and adaptation responses. *Climatic Change*, *140*(2), 149–164. https://doi.org/10.1007/s10584-016-1837-4

Echavarren, J. M., Balžekienė, A., & Telešienė, A. (2019). Multilevel analysis of climate change risk perception in Europe: Natural hazards, political contexts and mediating individual effects. *Safety Science*, *120*, 813–823. https://doi.org/10.1016/j.ssci.2019.08.024

Eckstein, D., Künzel, V., & Schäfer, L. (2021). *The Global Climate Risk Index 2021*. Bonn: Germanwatch. https://bvearmb.do/handle/123456789/1306

Elshirbiny, H., & Abrahamse, W. (2020). Public risk perception of climate change in Egypt: A mixed methods study of predictors and implications. *Journal of Environmental Studies and Sciences*, *10*(3), 242–254. https://doi.org/10.1007/s13412-020-00617-6

Ergun, S. J., Karadeniz, Z. D., & Rivas, M. F. (2024). Climate change risk perception in Europe: Country-level factors and gender differences. *Humanities and Social Sciences Communications*, *11*(1), 1573. https://doi.org/10.1057/s41599-024-03761-4

Fan, J., Liu, G., Xia, Z., & Cai, S. (2022). A bibliometric analysis of climate change risk perception: Hot spots, trends and improvements. *Frontiers in Environmental Science*, *10*. https://doi.org/10.3389/fenvs.2022.917469

Fu, H.-Z., & Waltman, L. (2022). A large-scale bibliometric analysis of global climate change research between 2001 and 2018. *Climatic Change*, *170*(3), 36. https://doi.org/10.1007/s10584-022-03324-z

Gartin, M., Larson, K. L., Brewis, A., Stotts, R., Wutich, A., White, D., & du Bray, M. (2020). Climate Change as an Involuntary Exposure: A Comparative Risk Perception Study from Six Countries across the Global Development Gradient. *International Journal of Environmental Research and Public Health*, *17*(6), 1894. https://doi.org/10.3390/ijerph17061894

Gilbert, C., & Lachlan, K. (2023). The climate change risk perception model in the United States: A replication study. *Journal of Environmental Psychology*, *86*, 101969. https://doi.org/10.1016/j.jenvp.2023.101969

Gonzalez, J. B., & Sanchez, A. (2021, May). *What shapes climate change perceptions in Africa? A random forest approach*. arXiv. https://doi.org/10.48550/arXiv.2105.07867

Grant, R., Roy, S. S., Zablah, C. J., Aquino, P., Simpson, M., & Viala, P. (2023). Climate adaptation and resilience indices for the Caribbean region: An assessment of four leading indices. *Climate and Development*. https://doi.org/10.1080/17565529.2023.2282482

Grover, H., Brody, S. D., & Vedlitz, A. (2017). Understanding climate change risk perception in the USA. *International Journal of Global Warming*, *13*(2), 113–137. https://doi.org/10.1504/IJGW.2017.086280

Halkos, G., & Zisiadou, A. (2023). The Effects of Climate Change to Weather-Related Environmental Hazards: Interlinkages of Economic Factors and Climate Risk. *Journal of Risk and Financial Management*, *16*(5). https://doi.org/10.3390/jrfm16050264

Haltinner, K., & Sarathchandra, D. (2021). Considering attitudinal uncertainty in the climate change skepticism continuum. *Global Environmental Change*, *68*, 102243. https://doi.org/10.1016/j.gloenvcha.2021.102243

Intergovernmental Panel On Climate Change. (2023). *Climate Change 2021 – The Physical Science Basis: Working Group I Contribution to the Sixth Assessment Report of the IPCC* (1st ed.). Cambridge University Press. https://doi.org/10.1017/9781009157896

ISSP Research Group. (2023). *International Social Survey Programme: Environment IV - ISSP 2020. GESIS, Cologne. ZA7650 Data file Version 2.0.0,* [Dataset]. https://doi.org/10.4232/1.14153.

Jayakody, D. Y., Adams, V. M., Pecl, G. T., & Lester, E. (2025). My place is at risk: Spatial assessment of climate risk perceptions along the East Coast of Tasmania and related landscape value associations. *Regional Environmental Change*, *25*(3), 87. https://doi.org/10.1007/s10113-025-02400-1

Kjellstrom, T., & McMichael, A. J. (2013). Climate change threats to population health and well-being: The imperative of protective solutions that will last. *Global Health Action*, *6*(1), 20816. https://doi.org/10.3402/gha.v6i0.20816

Knight, K. W. (2016). Public awareness and perception of climate change: A quantitative cross-national study. *Environmental Sociology*, *February*, Article February. https://doi.org/10.1080/23251042.2015.1128055

Lacroix, K., Gifford, R., & Rush, J. (2020). Climate change beliefs shape the interpretation of forest fire events. *Climatic Change*, *159*(1), 103–120. https://doi.org/10.1007/s10584-019-02584-6

Linden, S. V. D. (2015). The social-psychological determinants of climate change risk perceptions: Towards a comprehensive model. *Journal of Environmental Psychology*, *41*, 112–124. https://doi.org/10.1016/j.jenvp.2014.11.012

Lucatello, S., Sánchez, R., Lucatello, S., & Sánchez, R. (2022). Climate Change in North America: Risks, Impacts, and Adaptation. A Reflection Based on the IPCC Report AR6 - 2022. *Revista Mexicana de Economía y Finanzas*, *17*(4). https://doi.org/10.21919/remef.v17i4.794

Luís, S., Vauclair, C.-M., & Lima, M. L. (2018). Raising awareness of climate change causes? Cross-national evidence for the normalization of societal risk perception of climate change. *Environmental Science & Policy*, *80*, 74–81. https://doi.org/10.1016/j.envsci.2017.11.015

Martin, C. (2023). Biospheric values as predictor of climate change risk perception: A multinational investigation. *Risk Analysis*, *43*(9), 1855–1870. https://doi.org/10.1111/risa.14083

Myers, T. A., Maibach, E. W., Roser-Renouf, C., Akerlof, K., & Leiserowitz, A. A. (2013). The relationship between personal experience and belief in the reality of global warming. *Nature Climate Change*, *3*(4), 343–347. https://doi.org/10.1038/nclimate1754

Nascimento, L., Kuramochi, T., & Höhne, N. (2022). The G20 emission projections to 2030 improved since the Paris Agreement, but only slightly. *Mitigation and Adaptation Strategies for Global Change*, *27*(6). https://doi.org/10.1007/s11027-022-10018-5

Olausson, U. (2014). The Diversified Nature of "Domesticated" News Discourse: The case of climate change in national news media. *Journalism Studies*, *15*(6), 711–725. https://doi.org/10.1080/1461670X.2013.837253

Paniello-Castillo, B., Döring, S., Dryhurst, S., Di Baldassarre, G., & Raffetti, E. (2025). Risk perception of climate change and global crises: Influences of socio-economic drivers and political orientations. *Humanities and Social Sciences Communications*, *12*(1), 967. https://doi.org/10.1057/s41599-025-05349-y

Rabitz, F., Telešienė, A., & Zolubienė, E. (2021). Topic modelling the news media representation of climate change. *Environmental Sociology*, *7*(3), 214–224. https://doi.org/10.1080/23251042.2020.1866281

Raymond, C. M., & Brown, G. (2011). Assessing spatial associations between perceptions of landscape value and climate change risk for use in climate change planning. *Climatic Change*, *104*(3), 653–678. https://doi.org/10.1007/s10584-010-9806-9

Rudman, L. A., McLean, M. C., & Bunzl, M. (2013). When Truth Is Personally Inconvenient, Attitudes Change: The Impact of Extreme Weather on Implicit Support for Green Politicians and Explicit Climate-Change Beliefs. *Psychological Science*, *24*(11), 2290–2296. https://doi.org/10.1177/0956797613492775

Salas Reyes, R., Nguyen, V. M., Schott, S., Berseth, V., Hutchen, J., Taylor, J., & Klenk, N. (2021). A Research Agenda for Affective Dimensions in Climate Change Risk Perception and Risk Communication. *Frontiers in Climate*, *3*, 751310. https://doi.org/10.3389/fclim.2021.751310

Sambrook, K., Konstantinidis, E., Russell, S., & Okan, Y. (2021). The Role of Personal Experience and Prior Beliefs in Shaping Climate Change Perceptions: A Narrative Review. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.669911

Sen Roy, S. (2018). *Linking Gender to Climate Change Impacts in the Global South*. Springer International Publishing. https://doi.org/10.1007/978-3-319-75777-3

Sikder, A. H. M. K., & Mozumder, P. (2020). Risk Perceptions and Adaptation to Climate Change and Sea-Level Rise: Insights from General Public Opinion Survey in Florida. *Journal of Water Resources Planning and Management*, *146*(3), Article 3. https://doi.org/10.1061/(asce)wr.1943-5452.0001156

Simis, M. J., Madden, H., Cacciatore, M. A., & Yeo, S. K. (2016). The lure of rationality: Why does the deficit model persist in science communication? *Public Understanding of Science*, *25*(4), 400–414. https://doi.org/10.1177/0963662516629749

Spence, A., Poortinga, W., Butler, C., & Pidgeon, N. F. (2011). Perceptions of climate change and willingness to save energy related to flood experience. *Nature Climate Change*, *1*(1), 46–49. https://doi.org/10.1038/nclimate1059

SPSS analysis. (2024, October 16). Two-step Cluster Analysis in SPSS - Explained, Performing, Report. *Statistical Analysis Services For Academic Researches*. https://spssanalysis.com/two-step-cluster-analysis-in-spss/

Telešienė, A., Balžekienė, A., Budžytė, A., & Zolubienė, E. (2022). *ISSP 2020: Environment IV, Lithuania, November 2022* (Version V2) [Dataset]. Lithuanian Data Archive for SSH (LiDA). https://hdl.handle.net/21.12137/RINOXY

Topolinski, S., & Strack, F. (2015). Heuristics in Social Cognition. In J. D. Wright (Ed.), *International Encyclopedia of the Social & Behavioral Sciences (Second Edition)* (pp. 825–828). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.24018-X

Vulturius, G., André, K., Swartling, Å. G., Brown, C., Rounsevell, M. D. A., & Blanco, V. (2018). The relative importance of subjective and structural factors for individual adaptation to climate change by forest owners in Sweden. *Regional Environmental Change*, *18*(2), 511–520. https://doi.org/10.1007/s10113-017-1218-1

Wang, S., Wang, J., Lin, S., & Li, J. (2019). Public perceptions and acceptance of nuclear energy in China: The role of public knowledge, perceived benefit, perceived risk and public engagement. *Energy Policy*, *126*, 352–360. https://doi.org/10.1016/j.enpol.2018.11.040

Weber, E. U. (2016). What shapes perceptions of climate change? New research since 2010. *Wiley Interdisciplinary Reviews: Climate Change*, *7*(1), Article 1. https://doi.org/10.1002/wcc.377

Xie, B., Brewer, M. B., Hayes, B. K., McDonald, R. I., & Newell, B. R. (2019). Predicting climate change risk perception and willingness to act. *JOURNAL OF ENVIRONMENTAL PSYCHOLOGY*, *65*, 101331. https://doi.org/10.1016/j.jenvp.2019.101331

Zobeidi, T., Yazdanpanah, M., & Bakhshi, A. (2020). Climate change risk perception among agriculture students: The role of knowledge, environmental attitude, and belief in happening. *Journal of Agricultural Science and Technology*, *22*(1), 43–55.