Ambio 2019, 48:661–671
https://doi.org/10.1007/s13280-018-1096-x

RESEARCH ARTICLE

Climate change in Northern Russia through the prism of public perception

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Received: 9 February 2018 / Revised: 18 May 2018 / Accepted: 22 August 2018 / Published online: 11 September 2018

Abstract This article fills a major hole in the Western literature on climate change perceptions by reporting detailed data from Russia. While Northern Russia demonstrates high rates of climate change, regional adaptation policies are yet to be established. Complicating the problem, how the Russian public perceives climate change remains poorly known. This study synthesizes data from observations, modeling, and sociological surveys, and gives insight into the public perceptions of current and projected future changes in climate. Results indicate that, similar to what is found in the Western context, unusual weather patterns and single extreme events have a deeper impact than long-term climate change on public perceptions. The majority of the population considers climate and environmental changes locally, does not associate them with global drivers, and is not prepared to act on them. Accordingly, even the best designed climate policies cannot be implemented in Northern Russia, because there is no public demand for them. To address this situation, climate scientists should work to educate members of the public about basic scientific concepts so that they begin to demand better climate policies.

Keywords Adaptation policy · Climate change · Northern Russia · Public perception

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s13280-018-1096-x) contains supplementary material, which is available to authorized users.

INTRODUCTION

Extensive Western literature on climate change perceptions among the public shows that there is a complex relationship between the changes that are actually taking place in the climate and what individual members of the public perceive is happening. Describing the relationship between the changing climate and public perceptions requires detailed knowledge of the nature of climate change in various locations and understanding which characteristics of individuals are relevant in shaping their perceptions of the climate. The climate is changing in different ways in different geographies, meaning that correlating what is actually happening in a specific location with the perceptions of residents of that location requires detailed data on the climate changes and popular attitudes. Different groups within the population perceive these changes differently and these perceptions are affected by a wide variety of variables ranging from local weather events to personal characteristics, such as gender and level of education.

In the face of these challenges, the literature in Western countries is developing increasingly detailed portraits of public perceptions of climate change. While there is a growing body of Western writing on climate change in Russia, there it yet to be an examination of how the Russian public perceives climate change and how these perceptions relate to local measurements of climate change.

The purpose of this paper is to interrogate the best available data to better determine how the Russian case fits in with Western experience and the linkages between actual climate changes in Russia and public perceptions of these. The Russian case deserves more prominence in the broader international discussion because Russia occupies a significant portion of the Earth's landmass, its population lives in more extreme climate conditions, and many

climate impacts have already been observed there (Kattcov and Semenov 2014).

Research has long shown that citizens of different countries differ in terms of how they relate to their environment (Capstick et al. 2015; Lee et al. 2015; van der Linden 2015). Ingelhart in an examination of 43 countries, for example, demonstrated that citizens in countries with higher levels of pollution are more likely to express concern about the state of the environment (Ingelhart 1995). Cultural values also matter and citizens living in developed democracies with post-materialist values are also likely to support environmental protections. Even within countries there is considerable variation. In the U.S., for example, one study found that 63 percent of Americans believe global warming is happening, but there is considerable variation from county to county with the proportion of climate change believers ranging from 43 to 80% (Howe et al. 2015). The result is that each region has a different political climate for making climate change policy.

Much of the research published to date on climate change perceptions has focused on the U.S. and Western Europe, and many of the findings there have little relevance for Russia. For example, in the U.S. context, numerous analyses have found that political party affiliation and political ideologies are crucial in shaping an individual's attitude toward climate change (Marquart-Pyatt et al. 2014; Hornsey et al. 2016). Such distinctions are meaningless in Russia, where there are few stable political parties and most people have no significant attachment to them (Hale 2006). In the Russian context, personal networks and connections are more important than ideologies (Ledeneva 2013).

Other analyses show that direct personal experience with severe weather events makes people more likely to demonstrate high personal levels of concern about climate change and, for example, express a greater willingness to save energy to mitigate climate change (Spence et al. 2011). Likewise abnormally warm and abnormally cold temperatures are likely to increase concern about climate change among those living in the U.S (Egan and Mullin 2012; Brooks et al. 2014; Capstick et al. 2015). The most noticeable changes are increasingly hot summers (Hansen et al. 2012). One study of the U.S. found that climate change skeptics tend to live in areas that have experienced cooling rather than warming, further confirming that experiential learning shapes public perceptions (Kaufmann et al. 2017). This study also makes it clear that understanding the relationship between climate change perceptions and the reality of the local climate requires detailed knowledge about both climate data and the results of relevant surveys.

Worldwide, the level of educational attainment has been identified as the best predictor of concern about climate change (Lee et al. 2015). Nevertheless, the role of knowledge in attitudes toward climate change has been deeply contested, with some arguing that knowledge about climate change only has a limited impact on popular attitudes toward it. However, nuanced studies that break down different types of knowledge show that if people understand the causes of climate change they are much more likely to be concerned about it. In contrast, "higher levels of knowledge about the physical characteristics of climate change had either a negative or no significant effect on concern (Shi et al. 2016)."

MATERIALS AND METHODS

In the period 2016–2017 we conducted a survey to determine public perceptions of climate change in North-Western Russia (NWR) and in the Republic of Sakha–Yakutia (RSY). Besides the apparent distinctions in the climate regime, these regions differ in socio-economic development and population structure. Following (Anisimov et al. 2013), we analyzed patterns of climate change using regionalization based on the coherence of the temperature variations. We used daily and monthly air temperature and precipitation data from 744 Russian weather stations to gain insight into the long-term regional changes of the seasonal means and extremes. These data were compared with the public perception of modern climate change.

We developed a questionnaire asking respondents to make qualitative judgments about observed changes in the past 20–40 years and used responses as cognitive climate indicators, contrasting them against observational data. The questionnaire (in Russian) is accessible through our web-portal (Kokorev et al. 2017); a full English translation is given in the Electronic Supplementary Material (ESM) (Fig. S1) and is summarized here.

The first bloc of questions addresses cognitive indicators associated with the timing and duration of the seasons, changes in the seasonal temperature and precipitation, and notable weather conditions. We distinguish between the cold and warm seasons rather than winter and summer. In both regions the cold period lasts notably longer than the calendar winter, and people perceive it as a norm. We may thus question whether the duration of "winter" has changed, meaning that the cold period may have become shorter. There is a strict climatological definition of the cold and warm periods, which allows direct comparison of the people's perceptions with the observations. In the second bloc respondents evaluate the effect of climate change on the environment, professional activities, lifestyle, recreation, and wellbeing. Permafrost and vegetation have fundamental value for land use and wild life in the study regions, and we used them as the key indicators for

environmental changes. In the third bloc respondents evaluate the likelihood of climate-related disasters and preparedness to face climate challenges. The last bloc of questions collects basic demographic information including age, gender, education, professional position, marital status, social integration, and wellbeing of the participants.

We conducted the survey mostly through the internet, asking respondents to fill out the on-line questionnaire. We had to take energetic measures to publicize information about the survey so that it stood out against the background of the constant flow of economic and political news on the Russian internet. We mirrored the questionnaire at two dedicated web-portals and launched them at the beginning of the regional outreach campaigns in RSY and NWR in March and December 2016 respectively. During the time that we conducted the survey, the media published numerous interviews with us on national networks, there were televised debates on the topic with the participation of the St. Petersburg city government natural resource committee, and we organized a teleconference with Yakutia's parliamentary Committee on Natural Resource Use. In all these publications and programs, we distributed information about how to participate in the survey. In several cities of the Komi Republic and in Yakutia, we delivered public lectures about climate change and invited participants to take part in the survey. Additionally, we sent letters to elementary schools in several cities and villages in Yakutia asking parents of the students to take part in the survey. The Yakutia Ministry of Special Education distributed hard copy questionnaires to all of the schools in its jurisdiction throughout the republic and organized the return of the completed forms to Yakutsk, where the answers were uploaded in electronic format.

All of these unusual measures were necessary because conducting independent public opinion polls for scientific purposes is extremely difficult in contemporary Russia. The state monitors all social initiatives in which a political subtext is suspected and frequently intervenes to shut them down. Such activities were particularly frequent in the run up to the March 18, 2018 presidential election. In this environment, the last bloc of questions, which asked respondents for demographic data including their income, could be seen as an attempt to determine the level of dissatisfaction among the population about their standard of living and willingness to engage in protests.

The surveys gathered 1219 answers from respondents, including 849 in North-Western Russia and 370 in Sakha. Of these 142 were discarded (110 from the North-West and 32 from Sakha), since they either did not have full data or the respondents did not identify their place of residence. Several questions were confusing for the respondents and in several cases they did not provide answers. For example, in St. Petersburg some respondents were confused by questions addressing summer temperatures and sharp changes in temperature, in Murmansk—summer temperatures, in Syktyvkar—rain, and in Ukhta and Saskylakh—sharp changes in temperature.

In North-Western Russia, the majority of respondents were women (70%). The largest age cohort was from 30 to 44 years old (39.4%). Most of the participants in the poll had a higher education (85%): 53.7% were specialists, 17.2% held technical degrees. 80.1% had not moved for more than 20 years. In Sakha, 62% of those polled were women and 38% men; a plurality (35.9%) was between 30 and 44, but there were many young people from 18 to 29 as well. 62% had higher education, and 16% vocational education. 64.2% lived in urban settlements or a city. A plurality was specialists (41.3%) or held technical degree (23.7%). 11.3% were college students.

We examined the representativeness of the sample and made necessary corrections. To do this, for each city where we conducted the survey, we compared the sample to Russia's official 2010 census data about gender and age distributions among the population, level of education, family situation, and the length of residence in one place (Russian census 2010). We then set quotas for the sample so that by using the method of random selection in each category we eliminated the answers of some of the respondents to keep the differences between the Rosstat data and the sample at less than 5 percent. In NWR and RSY we removed 125 and 55 surveys respectively, leaving 614 and 281 surveys in the resulting representative sample. We removed the extra surveys from the overrepresented women, reduced the most overrepresented 30–44 age group, and reduced the number of surveys from respondents with higher education. Charts in Fig. 1 illustrate the structure of the resulting samples in NWR and RSY.

We conducted factor and cluster analyses of the surveys using IBM SPSS Statistics, v.23.0.0.0. Variables in the factor analysis are multiple choice items of a climate questionnaire. The data in this case consist of a N-way contingency table with answers to the items for a number of respondents. Factor analysis is used to aggregate larger number of N items, i.e., questions, many of which address similar features of climate change, into smaller number of independent n-factors. Cluster analysis is further used to discover taxon-like groups of cases in data, i.e., to identify groups of respondents, who similarly respond to given factors. These methods are used routinely in sociological studies and are detailed in (Collins and Lanza 2010).

RESULTS

The main cognitive indicators of climate change are presented in Fig. 2. Green and blue colored bars designate

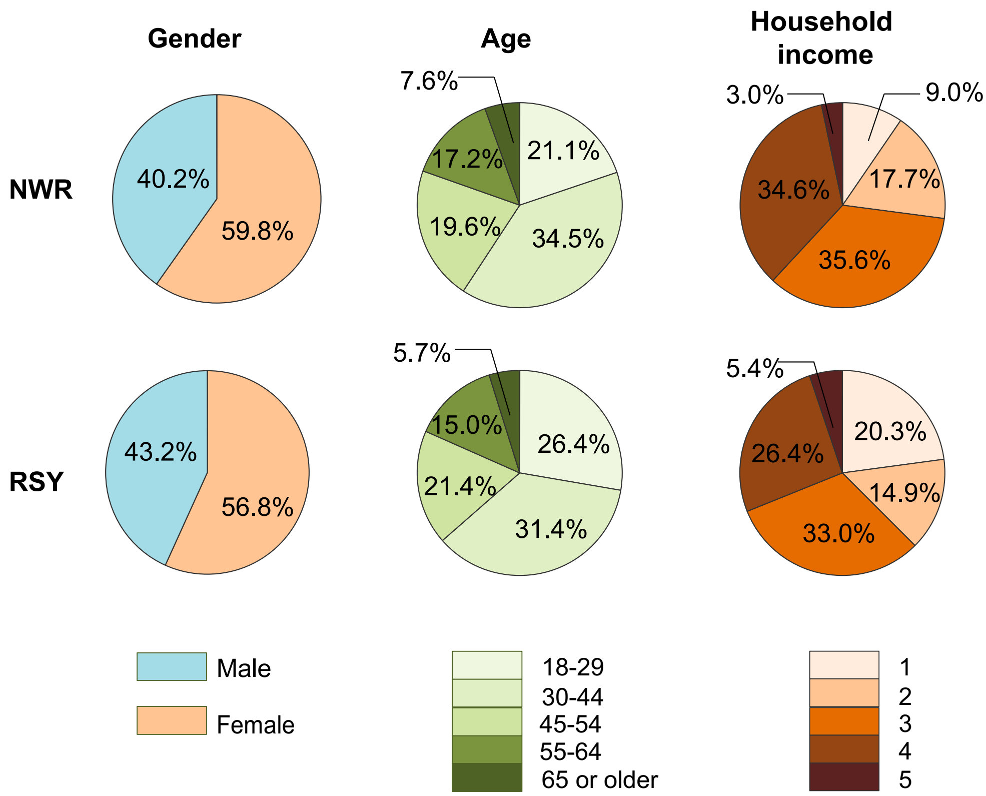

Fig. 1 Demographic structure of the sample in the study regions. Numbers 1,2,…5 designate low, lower middle, middle, upper middle, and high house-hold income of the respondents

results for NWR and RSY respectively. Responses which agree with the observations are marked with the darker colors. Figure 2 shows that of the cognitive climate indicators analyzed, the majority of the population has perceptions that correspond with observed values only in evaluating temperatures and the beginning of the cold season. In NWR, the majority similarly objectively perceived the end of the cold season. In RSY, they correctly see permafrost degradation. For all the remaining indicators, fewer than half of the respondents answered in ways that were confirmed by the observations.

Figure 3 gives insight into the actual climatic changes in the study regions. It illustrates regional trends for air temperature, precipitation, wind speed, and cloudiness for the calendar winter (DJF) and summer (JJA) over the 1976–2016 period. We also examined data at the beginning and end of the climatological cold and warm periods, the number of freezing/thawing temperature transitions, abrupt temperature changes by more than 5 °C day^{-1} and 10 °C day^{-1}. In Table 1 we layout selected observational data about changes in the climate for cities and settlements where we conducted surveys.

Sharp changes in temperature by more than 10 °C create strong tactile feelings. It is possible to notice the reduced amplitude of daily temperature change during winter everywhere except Saskylakh, Ambarchik, and Srednekolymsk in the high North of RSY. However, only a relatively small number of respondents noted such changes correctly.

Observations and modeling indicate that permafrost temperature has increased by 1 to 2 °C in Northern Russia in the past 35 years (Vaughan et al. 2013; Anisimov and Sherstukov 2016). The depth of seasonal thawing has increased by 0.05–0.10 m in NWR, by 0–0.05 m and 0.10–0.15 m, respectively, in central Sakha and east of the Kolyma lowland, and did not change in Western Sakha and between the Lena and Viliui rivers (Anisimov and Kokorev 2017). By themselves, permafrost changes might not be visible. Public opinion could see them through a cascade of consequences which include landscape and vegetation changes, the expansion of geomorphological processes leading to thermokarst, uneven ground subsidence and ponding. In cities and villages, changes increase risks to infrastructure built upon permafrost. When such effects start to become visible, society begins to consider the changes as a natural danger, and this is exactly what people in RSY noted in the survey.

We conducted factor and cluster analyses of the surveys. In both study regions, of the 15 interrelated questions analysis separated out four independent factors. The first

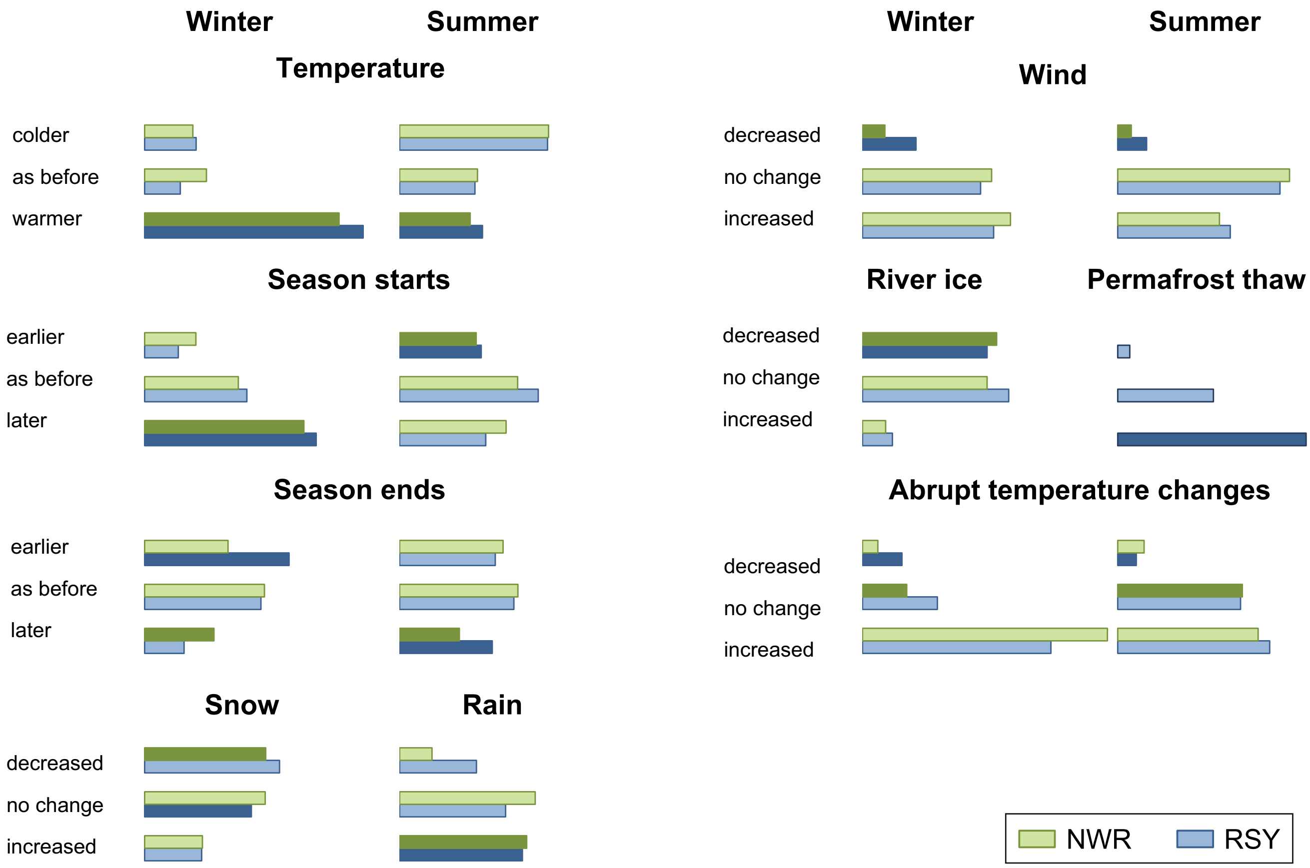

Fig. 2 Summary of the cognitive climate indicators in the North-West Russia (green bars) and in Yakutia (blue bars). Darker colors indicate responses confirmed by observations

and the second factors unite the cognitive indicators of climate change during the cold and warm seasons, such as the duration of the period, changes of the seasonal temperature, and precipitation. The third factor unites wind and abrupt temperature changes in all seasons. In NWR the fourth factor characterizes the timing of the seasons, in RSY—the thawing of the permafrost. Standard cluster analysis divided all respondents into three groups, according to their responses to the four factors. Each group draws its own picture of contemporary climate change, as summarized in Table 2. The highlighted cells indicate public perceptions confirmed by climate data.

Participants in the first group include the largest number of respondents from the Komi Republic in NWR, and from the cities of Lensk and the village Saskylakh in RSY. Their perception of climate change is rarely confirmed by the climate data. In their opinion, changes in most of the climate indicators are indeterminant (indicated as “0” in Table 2). At the same time, they express concerns that climate change leads to worsening conditions for work and leisure, with a rise in injuries and morbidity.

Respondents from the cities St. Petersburg and Novgorod in NWR, and Yakutsk in RSY dominate the second and third groups. They notice changes in the winter period, which are mostly confirmed by climate data. In both study regions respondents note a small increase in sickness and injuries. In their opinion, conditions for work and leisure worsened in the NWR and became better in RSY. Participants in the second and third groups differ in their evaluation of changes in rain in both regions, and also in winds and timing of the cold and warm seasons in NWR, and in summer temperature changes in RSY.

We analyzed how the gender, income, age, and education of the respondents affected their perception of climate change. To do this, in each of the examined demographic categories we determined the share of respondents whose opinions corresponded to the main climate change indicators. The results are presented in Fig. 4.

While internationally gender typically was not a factor (Hornsey et al. 2016), we found discernible gender differences in both study regions. In Yakutia a larger percent of men (81%) than women (71%) correctly noted changes in the temperature, duration, and timing of the cold period (factor 1, Fig. 4). Nuanced analysis shows that 49% of men and only 37% of women noted shortening of the ice period on rivers, possibly because these changes affect traditional

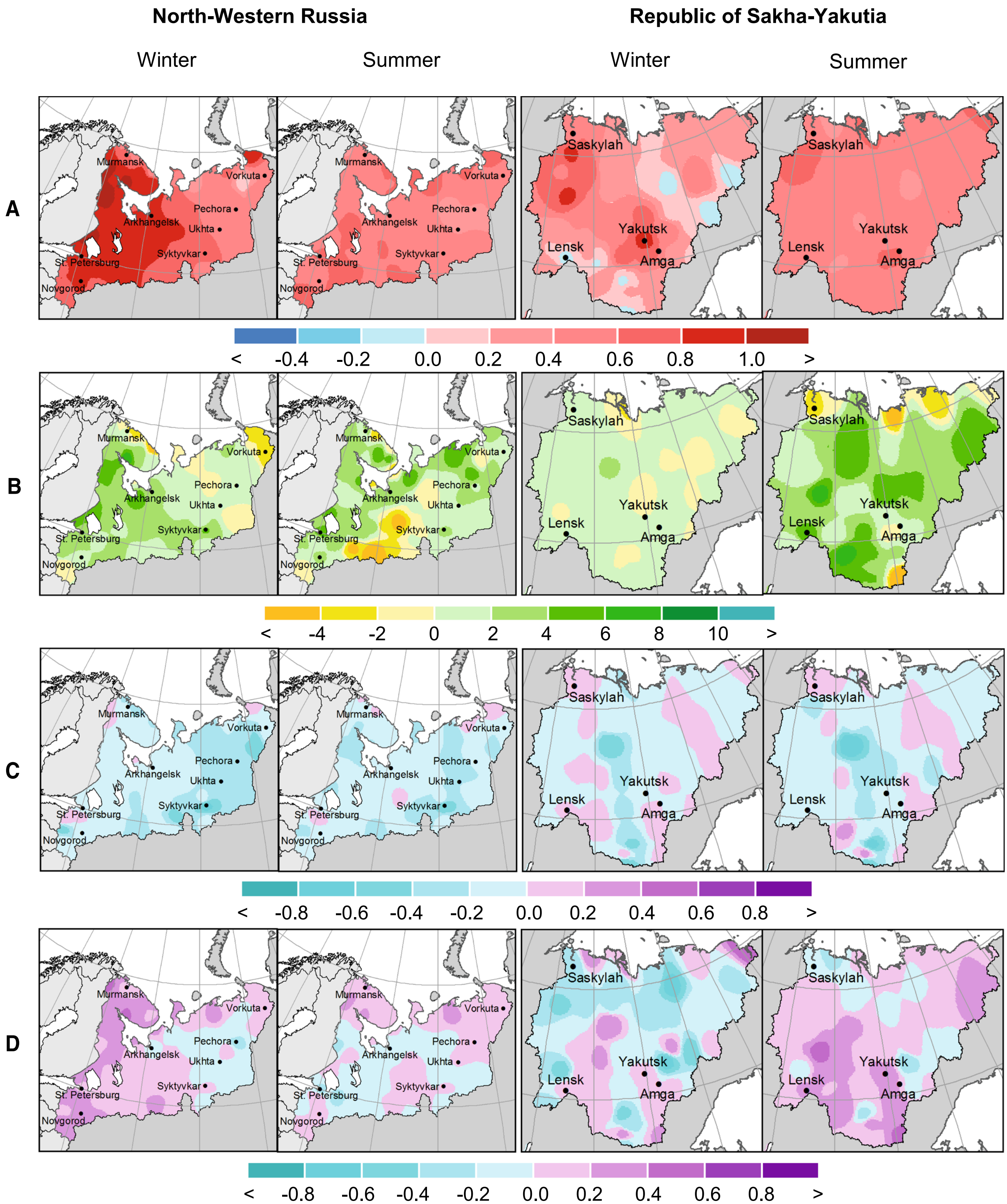

Fig. 3 Trends of climate parameters over the period 1976–2016 for the calendar winter (DJF) and summer (JJA) in NWR and RSY. **a** air temperature (°C 10 $year^{-1}$); **b** precipitation (mm $month^{-1}$10 $year^{-1}$); **c** wind speed (m s^{-1}10 $year^{-1}$); and **d**—cloudiness (n 10 $year^{-1}$)

Table 1 Changes in the duration of the cold (Δn_c, days) and warm (Δn_w, days) periods, seasonally-averaged air temperature (ΔT, °C), precipitation (ΔR, mm), and number of days with temperature changes by more than 10 °C day^{-1} (Δn_{T10}, day month^{-1}) in the selected cities of the study regions between the periods 2007–2016 and 1997–2006

Place	Cold period				Warm period			
	Δn_c	ΔT	Δn_{T10}	ΔR	Δn_w	ΔT	Δn_{T10}	ΔR
North-Western Russia								
Murmansk	−12	0.8	−1.7	10	8	−0.2	0.0	21
Arkhangelsk	−16	1.9	−3.1	4	3	0.3	0.1	28
Syktyvkar	−22	1.2	−1.3	12	3	0.5	0.0	36
St. Petersburg	−38	1.0	−1.6	21	13	0.0	0.0	−1
Novgorod	−32	0.7	−2.4	3	5	0.2	0.0	27
Republic Sakha-Yakutia								
Saskylakh	−17	0.8	4.9	6	13	1.7	0.0	26
Tiksi	−12	1.0	−0.5	12	13	1.6	−0.3	1
Verkhoyansk	−4	1.0	−2.2	−1	11	0.7	−0.1	13
Lensk	−10	1.2	−2.4	9	6	0.3	0.0	10
Yakutsk	−7	1.6	−0.2	0	6	0.7	0.0	19
Ust-Maia	−4	1.0	−1.4	2	−3	0.9	−0.1	21
Ambarchik	−12	2.4	1.8	−14	12	0.8	−0.4	20
Srednekolymsk	−10	1.5	0.7	13	4	1.0	0.0	15
Chulman	−14	0.8	−1.5	6	11	0.7	−0.1	68
Aldan	−6	0.4	−3.0	6	8	0.6	−0.1	78

male outdoor practices, such as hunting and winter fishing; At the same time a larger percent of women in RSY (57%) than men (45%) noted increased road icing, possibly because it increases injuries on sidewalks in the cities. In RSY a larger percent of women than man noted changes in the warm period, such as more frequent rains (44% women and 34% men), abrupt temperature changes (52% and 41%), and insect out-breaks (53% and 34%). Such changes have direct negative effect on recreational outdoor activities during the short warm season in Yakutia. In NWR more women than men noted that the cold season ends later (31% women and 17% men), winter winds are getting stronger (55% and 43%), there are more abrupt temperature changes (83% and 75%) and more diseases in winter (61% and 46%); summer starts later and ends earlier (40% women and 30% men), gets colder (52% and 44%), and more abrupt temperature changes in summer (54% and 39%).

Also clear is the correlation between correctly perceiving climate change across selected factors with the level of income and education of the respondents, while age differences are less pronounced (Fig. 4). As a rule, a larger share of the middle- and high-income population and the better educated people perceive climate change in the way it actually happens.

Climate perception index

We used results from the climate and sociological data analysis to construct the numerical Climate Perception Index (CPI). The CPI reflects the gap between the perceptions of the population and the objective climate indicators. The index is intended to assist climate adaptation planning among public officials by providing information

Table 2 Results of the factor and cluster analysis in the two study regions. Per cent indicates the share of respondents in each group. Perceptions confirmed by observations are highlighted in bold. Symbols "−","0", and "+" designate lower/earlier changes, no change, and higher/later changes, respectively

Factor	Cognitive climate indicators	Groups in NWR			Groups in RSY		
		1 30.9%	2 33.9%	3 35.2%	1 27.8%	2 28.5%	3 43.7%
1	Arrival of winter	0	**+**	**+**	0	**+**	**+**
	Temperature in winter	0	**+**	**+**	0	**+**	**+**
	Snow depth	+	**−**	**−**	**0**	**0**	−
	Road icing	**+**	0	**+**	0	**+**	**+**
	River ice period	0	**−**	**−**	0	**−**	**−**
2	Arrival of summer	+	+	0	0	0	0
	End of summer	−	0	−	−	**+**	**+**
	Temperature in summer	−	−	−	−	−	0
	Rain	**+**	0	**+**	**+**	**+**	0
3	Winds	+	0	+	+	+	+
	Abrupt temperature changes	+	+	+	+	+	+
4	Onset of spring	**+**	0	−	0	**−**	**−**
	Permafrost thawing	n/a	n/a	n/a	0	**+**	**+**

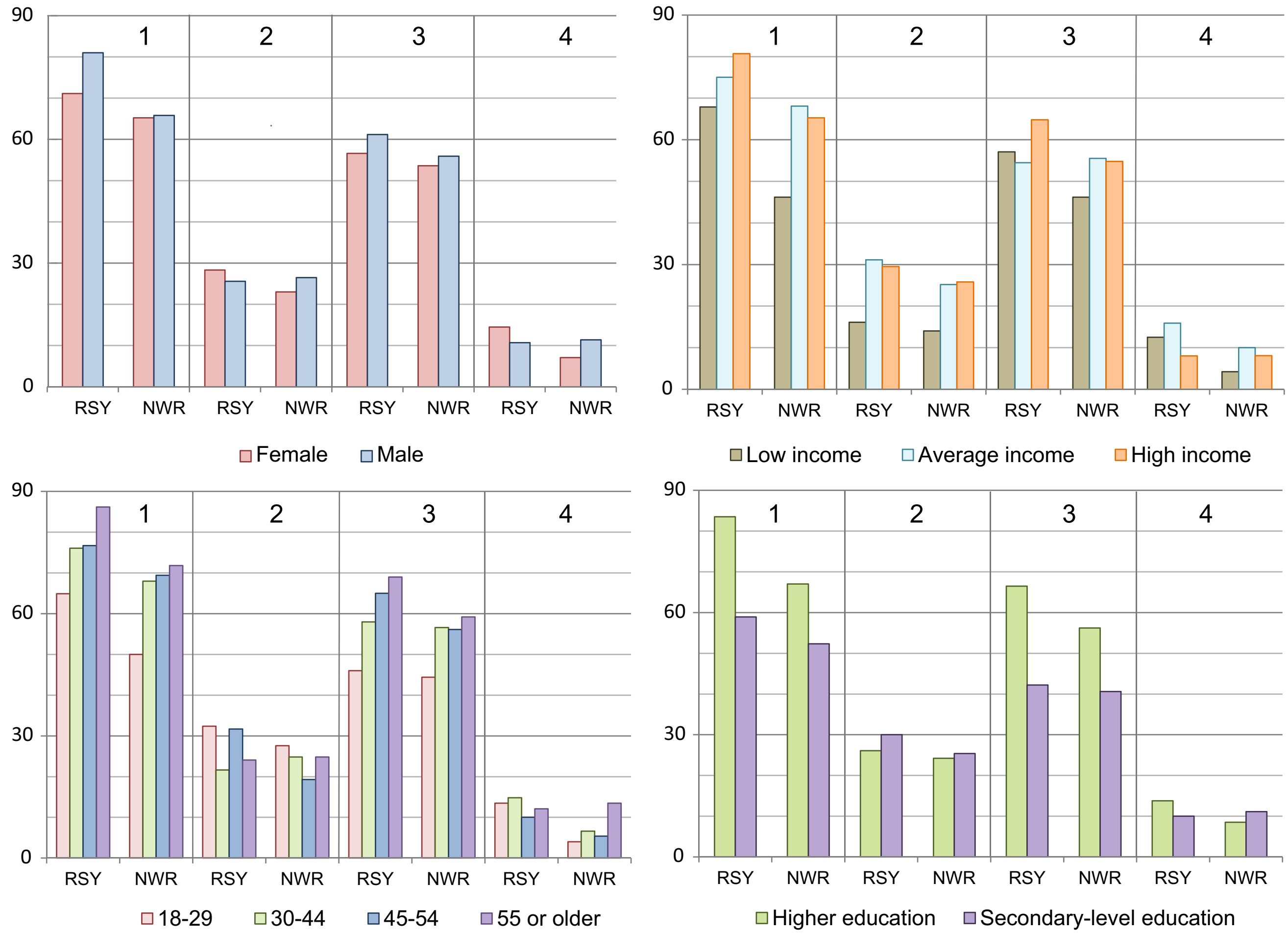

Fig. 4 Share of respondents (%) by sex, income, age, and education whose perception of climate change correspondents with observational data. Numbers on the panels indicate four independent factors of climate change

about the public awareness of, and preparedness for, climate change at the regional level. Using the index, Russian officials will know where members of the public are more or less likely to have a clear conception of how the climate is actually changing. Populations who understand what is happening around them will likely be more willing to accept science-based policy responses to climate change.

The CPI is defined by the following equation:

$$\mathrm{CPI} = \frac{1}{N}\sum_{i=1}^{N} \Delta I_i \times 100\%. \quad (1)$$

Here N is the total number of the paired cognitive and objective climate indicators; ΔI_i is the binary parameter, which is set to 1 if the public perception of the specific climate feature is confirmed by the objective observational data, and to 0 otherwise.

Among the indicators included in the CPI were temperature in the cold and warm periods, rainfall, the beginning and ending of the seasons, and abrupt weather changes. For each indicator we determined the percentage of all surveyed whose perception corresponded with the observed data. The CPI measures the average across the five indicators. Table 3 presents the data for the chosen cognitive indicators and for the CPI for cities of the NWR and RSY.

The data in the Table 3 show the low level of the CPI in all the researched regions with relatively small differences among the cities. A possible reason for these differences could be the different age structure and levels of income and education among the populations, as demonstrated in Fig. 4. The mature well-off social groups, particularly those living in the large cities of St. Petersburg, Murmansk, and Yakutsk, more adequately perceive climate change while the rest of the population is less informed regarding these questions either because of poor knowledge of the problem, or because they have to deal with more pressing economic problems.

Table 3 Summary of cognitive climate indicators and the climate perception index (CPI) for selected cities and settlements in North-Western Russia and Yakutia

Place	Climate indicators					
	Temperature		Rain	Season timing	Abrupt changes	CPI
	Winter	Summer				
North-Western Russia						
St. Petersburg	87.3	21.0	9.5	75.2	13.3	41.7
Novgorod	91.9	15.8	21.1	63.2	5.6	38.3
Arkhangelsk	77.1	32.4	6.1	52.9	8.8	36.1
Murmansk	71.4	46.2	15.4	66.7	15.4	43.9
Mean	85.2	23.7	11.6	68.4	11.2	40.0
North-Western Russia. Komi Republic						
Syktyvkar	56.4	29.5	12.8	42.5	9.4	29.3
Ukhta	25.0	23.1	15.4	69.2	8.3	27.2
Pechora	50.0	50.0	10.0	50.0	10.0	32.4
Vorkuta	81.8	18.2	11.1	54.5	11.1	33.2
Mean	55.7	29.5	12.7	44.9	9.4	30.5
*Sakha-Yakuti*a						
Yakutsk	89.3	32.8	32.0	66.1	15.6	52.5
Saskulakh	71.4	27.3	42.9	35.0	10.5	41.7
Amga	80.0	30.0	60.0	60.0	15.0	54.6
Lensk	46.2	7.7	61.5	7.7	7.7	29.6
Mean	83.0	29.9	38.6	57.6	14.4	44.7
Average over the studied regions						
All places	74.6	27.7	21.0	57.0	11.6	38.4

DISCUSSION

The Russian data agree with the Western observations in that for all respondents the main indicator of climate change was an increase in temperature during the cold period. Figure 1a shows this for all cities where the poll was conducted. Against the background of this sharp winter warming, the changes in other climate indicators were not as great and therefore many respondents did not notice them. The interaction of various factors also played a role. Thus, heavier precipitation and cloudiness (Fig. 1c, d) created the impression of a rainy and overcast summer. Possibly because of these conditions, the majority of respondents did not notice the increased summer temperatures in both regions.

Russians are like others around the world in that for them unusual weather patterns and single events seem to have greater effect on the public perception of climate change than the long-term trends. For example, on 18 March 2015 in Yakutsk there was a sudden thunderstorm when usually at this time of year the temperature consistently remains between − 10 and − 20 °C. Yet a month and a half later, when Yakutsk's continental climate delivers stable warm weather with temperatures above freezing, it began snowing. In both cases, there was ice throughout the city and it was difficult to use the streets and sidewalks, there were numerous accidents, and 179 people went to the emergency room, which is a record for Yakutsk. It is not surprising that against this background, the long-term trend of reduction in the daily temperature dynamic and the number of transitions across the freezing point has yet to make an impact on the public consciousness.

Generally speaking, the literature on climate change finds that people with higher levels of education tend to have a better sense of how the climate is changing. This observation only partially applies to Russia. As Fig. 4 shows, respondents with higher education are more aware of winter temperature increases and changes in the beginning and ending of the seasons. On other indicators, their opinions differ only insignificantly from respondents with less education. Knowledge about climate change does not always arouse concern among the respondents because in the northern regions of Russia climate change has a number of positive consequences (Anisimov 2016). Potential gains include less severe living conditions (Zolotokrylin et al. 2018) with a positive impact on human health (Mokhov et al. 2013); reduced demand for heating energy (Anisimov and Kokorev 2017); a longer ice-free period with direct implications for river and marine transportation in the Arctic, including the northern sea route (Stephenson 2017); better conditions for agriculture in many regions of Northern Eurasia (Porfiriev 2011), the northward shift of vegetation zones (Zhiltcova and Anisimov 2015), and increased bioproductivity (Anisimov et al. 2015).

Overall, Russians are not unique in the lack of a societal consensus toward climate change. Analyses of European publics have found high levels of indecisiveness regarding the danger climate change poses, which sources of climate change information to trust, and whether to support any mitigation or adaptation strategies (Hagen et al. 2016).

The Russian public is yet to associate cognitive indicators of climate change with global drivers. In our view, this situation reflects the intrinsic conflict between the global nature of climate change, and regional nature of climate change impacts. More studies are needed to better understand the links between cognitive climate indicators and global processes.

Against this background Russian policymakers have to account for the regional differences in climate adaptation so that the legislative measures they suggest win public support. Nearly all Russian federal ministries are charged with the task of developing climate adaptation measures with the Federal Service for Hydrometerology and Environmental Monitoring (Roshydromet) playing the key role in this work. This task has to be completed by December

2018 for further legislative actions. Many of the ministries, including Roshydromet, Ministry of Regional Economic Development, Ministry of Transportation, and several regional Ministries of Yakutia already use the Climate Perception Index in their planning as a cumulative metric characterizing the preparedness of the population to meet climate challenges and to implement new climate adaptation practices.

CONCLUSIONS

Our analysis shows that social perceptions of contemporary climate change in Russia are deeply ambiguous. The opinion of the respondents varies across many of the indicators, and those whose perceptions of the changes correspond with observed values are often in the minority. Climate change leads to risks and new opportunities, necessitating the development of climate adaptation policies. While such policies often have high costs, they can not advance without public support (Ingelhart 1995). Russian officials have a clear understanding that many stakeholders consider new legislative initiatives critically and with caution, and even an ideal adaptation strategy would fail if it contradicts public perceptions of the ongoing changes. The Climate Perception Index provides quantitative metrics for operational use in regional adaptation planning.

An analysis of the specific cognitive indicators making up the CPI shows the varying perception of climate change effects. Most significantly, the long-range series of observations indicates a reduction of abrupt weather changes, which practically does not register in the social consciousness. This outcome may be explained by low probability and high impact events, like the one in Yakutsk in 2015, when isolated unusual weather patterns influenced public opinion more than slow changes making up a trend. At the level of everyday consciousness, abrupt changes are associated with the need to change current modes of behavior for specific times of year, causing discomfort in daily lives ranging from the need to wear different clothes to limiting transportation options and raising questions about more frequent illness.

In Russia, even though local scientists have accurate measurements of changing climate patterns, the population does not have a clear conception of what is happening. The findings presented here suggest that only a minority of the Russians we surveyed in the north-west and Eastern Siberian regions of Russia correctly perceived the way that climate is changing in their local environment. As a result, there is little public demand for climate adaptation policies, and Russian policymakers will have difficulty adopting responses that address what is actually changing in the Russian context. According to the classic Western democratic model, public preferences are translated into policy through elections and lobbying policy makers. Although Russia is an authoritarian country, the political leaders generally try to adopt policies that have broad public backing (Treisman 2011). In the case of climate change, policy makers would have to take a leadership role and convince the public that the climate is changing the way it is in fact changing and then start adopting policies that prepare cities and villages for the new conditions that they will likely face in the near future.

In this sense scientists will have to make a much greater effort to educate the public about how the climate is changing before policy makers will be able to adopt appropriate responses. The fact that the climate changes are not linear and that Russia benefits in some ways from the changes makes this task all the more difficult.

Acknowledgements The study of the public perception of climate change in Northern Eurasia is supported by the Russian Science Foundation, Grant # 14-17-00037 to the State Hydrological Institute in St. Petersburg. Authors are thankful to colleagues in Syktyvkar (Anna Tscherbakova) and in Yakutsk (Yuriy Zhegusov) for the assistance in public surveying, and to Yelena Zhiltcova and Ksenia Shapovalova (State hydrological institute in St. Petersburg) for preparing figures and tables.

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