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ADVANCED REVIEW

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Russia in a changing climate

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Abstract

Climate change will shape the future of Russia, and vice versa, regardless of who rules in the Kremlin. The world's largest country is warming faster than Earth as a whole, occupies more than half the Arctic Ocean coastline, and is waging a carbon-intensive war while increasingly isolated from the international community and its efforts to reduce greenhouse gas emissions. Officially, the Russian government argues that, as a major exporter of hydrocarbons, Russia benefits from maintaining global reliance on fossil fuels and from climate change itself, because warming may increase the extent and quality of its arable land, open a new year-round Arctic sea route, and make its harsh climate more livable. Drawing on the collective expertise of a large group of Russia-focused social scientists and a comprehensive literature review, we challenge this narrative. We find that

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Russia suffers from a variety of impacts due to climate change and is poorly prepared to adapt to these impacts. The literature review reveals that the fates of Russia's hydrocarbon-dependent economy, centralized political system, and climate-impacted population are intertwined and that research is needed on this evolving interrelationship, as global temperatures rise and the international economy decarbonizes in response.

This article is categorized under:

Policy and Governance > National Climate Change Policy

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KEYWORDS

adaptation, agriculture, Arctic, authoritarianism, civil society, climate change, disaster, flooding, forestry, fossil fuels, health, mitigation, Russia, Ukraine, urban, wildfire

1 | INTRODUCTION

Climate change will shape the future of Russia, and vice versa, regardless of who rules in the Kremlin. The world's largest country is warming faster than Earth as a whole, occupies more than half the Arctic Ocean coastline, and is waging a carbon-intensive war while increasingly isolated from the international community and its efforts to mitigate greenhouse gas emissions. Officially, the Russian government argues that, as a major exporter of hydrocarbons, Russia benefits from maintaining global reliance on fossil fuels and from climate change itself, because warming may increase the extent and quality of its arable land, open a new year-round Arctic sea route, and make its harsh climate more livable (Etkind, 2023; Gustafson, 2021; Lustgarten, 2020).

In this review, we draw on the collective expertise of a large group of Russia-focused social scientists and a large and growing body of literature to challenge the narrative that Russia will benefit from the continued use of fossil fuels and the associated rise in temperatures. We integrate the siloed research to assess the impacts of climate change on Russia and Russia's adaptation, or preparedness for managing these impacts. We identify the gaps in research about vulnerabilities and adaptations to reduce vulnerability.

Russia already faces disruptions from thawing permafrost; more frequent and intense fires, floods, and other disasters; threats to its agricultural and forestry economy and water resources; and negative health impacts of climate change. Impending disruptions include the high cost of adapting Russia's northerly urban environments to warmer temperatures and the challenges of responding to population flows. Russia's Central Asian neighbors may face even more serious climate change impacts due to water scarcity and limited economic opportunities that could instigate political instability on Russia's borders (Schatz, 2011; Zakhirova, 2013).

We argue that Russia is ill-prepared to address the current and impending crises. Russia's official scientific institutions are actively analyzing climate change and its impacts on the country and recommending adaptations, but they have limited influence. Civil society organizations that possess critical knowledge and expertise regarding the climate crisis are ignored or treated with increasing hostility by the Putin regime, making climate mitigation and adaptation efforts unlikely. Russian elites currently lack political commitment to a carbon-neutral economy and international cooperation. Top-ranked officials barely acknowledge the climate crisis, let alone fund key agencies or foster intra- and inter-governmental cooperation. Even in regions most affected by climate change, the authorities pay almost no attention to the costs of thawing permafrost and rising sea level.

Russian government inaction is unfortunate because, while shifting away from a hydrocarbon-based economy and a highly monopolized energy sector will certainly pose short-term costs for Russia, the longer-term benefits for both Russia and the world are real and potentially liberating. Hydrocarbon exporters and their allies have dominated elite politics and the Russian state, centralizing power, marginalizing civil society, and stifling political debate. Decarbonization would mean demonopolization of the energy sector and a shift in the balance of political power. Russia has scientific and industrial strengths in nuclear power, hydrogen, and other energy alternatives (Henderson &

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Mitrova, 2020), and these, as well as potential strengths outside the energy sector, could become its niche in the post-carbon economy and allow Russia to rejoin international efforts to fight climate change and to enjoy the benefits of winning that fight.

2 | CLIMATE CHANGE IMPACTS

Natural and human systems in Russia, as elsewhere in the world, are being altered by climate change. The alterations in Russia, however, are often unique, thanks to its distinct geographic profile (Figure 1).

2.1 | Agriculture, forestry, and water resources

The effects of climate change on Russian agriculture and forestry and especially its main commodity crop, wheat, vary by region and, in the aggregate, are unclear. Technological advances and increased production in currently unsuitable areas might offset declines in traditionally productive regions (Alcamo et al., 2007; Di Paola et al., 2018; Svetlov et al., 2019), or they might not (Belyaeva & Bokusheva, 2018; Ivanova et al., 2020; Pavlova et al., 2019). Challenges include vulnerable distribution systems and increasingly frequent disastrous climate events, such as drought and fires (Alcamo et al., 2007; Dronin & Kirilenko, 2011; Ksenofontov & Polzikov, 2020). Southeast European Russia, including the Lower Volga Basin and the North Caucasus, historically among the most productive regions, is projected to experience the most persistent droughts, which will lower yields and may disrupt interregional grain distribution (Dronin & Kirilenko, 2011; Katsova, 2022). Climate impacts on Russian agriculture are consequential for both domestic and global food security, given the country's status as a major exporter of grain to low- and middle-income countries in Africa and the Middle East (Wegren, 2022). Russia nevertheless continues its commitment to industrial agriculture and its associated greenhouse gases, thus promoting a vicious circle of climate change, projected declines in crop yields, and carbon-emitting farming practices (Wegren, 2022).

The effects of climate change on water resources also vary by region, with northern rivers generally projected to run higher and southern rivers lower. Scientists are monitoring river flow levels (Frolova et al., 2022; Gel'fan et al., 2022;

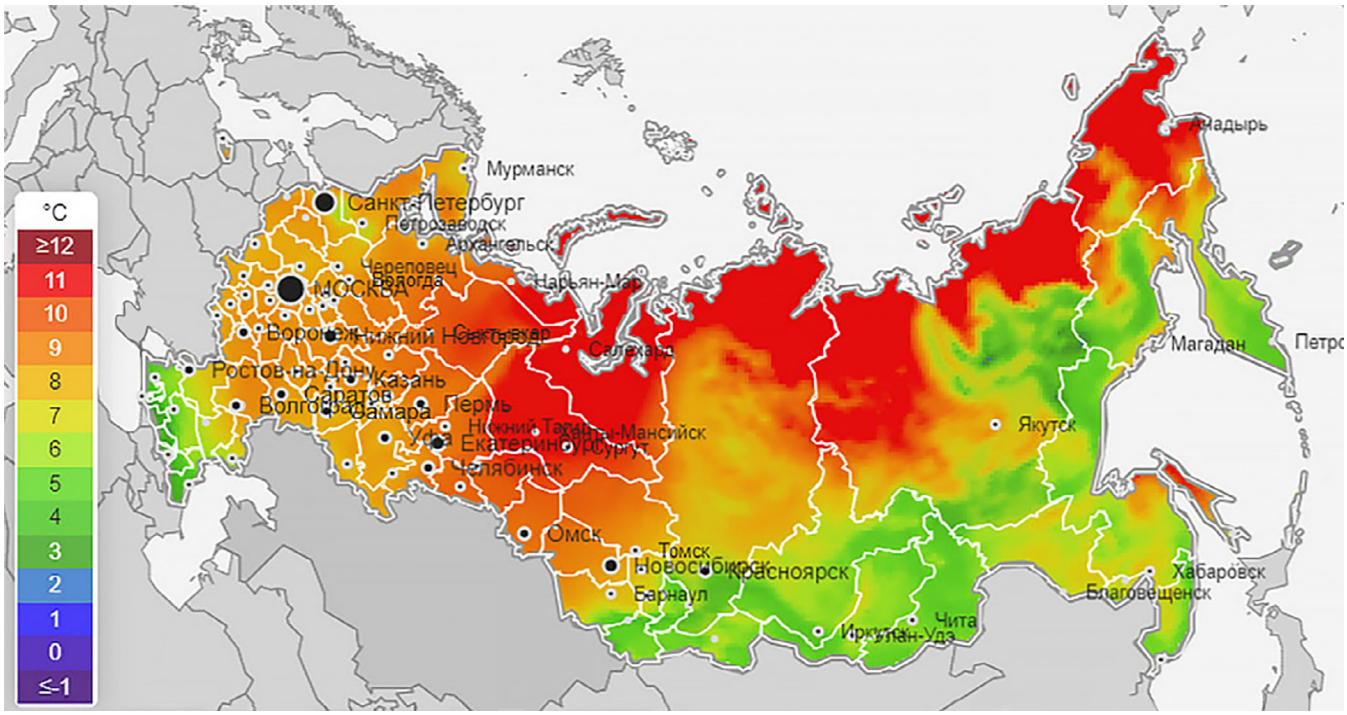

FIGURE 1 Projected increases in average winter temperature by 2090–2099 across the Russian Federation. *Source*: Climate Center of *Rosgidromet* (edited to exclude the forcibly annexed Crimea).

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Kalugin, 2022a, 2022b), lake-water quality (Matveeva et al., 2022; Moiseenko et al., 2013), algal blooms (Namsaraev et al., 2020), wetlands (Robarts et al., 2013), and groundwater recharge (Grinevskiy et al., 2021), but data, models, and conclusions are currently imprecise.

Climate change is exacerbating the water and agricultural problems created by Russia's war in Ukraine. The arid Crimea has been relying on limited local water sources since shortly after Russia's 2014 illegal seizure and annexation, when Ukraine blocked the North Crimea Canal that had been supplying 70%–85% of Crimea's water. As the hostilities and climate change continued, agricultural output and vegetation shrank, air pollution and industrial accidents increased, and the Russian government lost billions of dollars (Vynogradova, 2020). With decreased rainfall and higher temperatures causing polluted and drying local reservoirs, Russia blew up the North Crimea Canal blockage 2 days after the February 24, 2022, invasion and set its sights on the Ukrainian province of Kherson, partly to control the canal (Rutland, 2022; Troianovski, 2021). On June 6, 2023, Russia exploded and destroyed the Kakhovka dam, controlled by Russia since February 2022, and drained the Kakhovka reservoir. Without the water from the reservoir, Crimea is projected to become a desert (Nikolashvili, 2020).

2.2 | Human health

Climate change has already resulted in increased mortality from heat waves and wildfires, including 55,000 deaths in 2010 (Shaposhnikov, 2014) that disproportionately affected Russians 65 years and older, foreshadowing heightened challenges as Russia's population ages (Hansl et al., 2015), especially in southern Russia where many vulnerable older Russians move (Grigorieva & Revich, 2021). Climate-induced flooding has brought infectious disease, as in Lensk, Yakutia, in 2001 when flooding of the Lena River overwhelmed sewage pumping stations and wastewater treatment facilities, infecting 39,000 people in 59 communities with hepatitis A (Revich, 2008). Thawing permafrost introduces new public health threats from revival of several "zombie viruses" (Alempic et al., 2022) and has already allowed anthrax spores to leach to the surface, infecting 2500 reindeer and 36 humans in the Yamalo-Nenets Autonomous Okrug in 2016 (Revich et al., 2022). Thawing permafrost has also damaged the foundations of buildings providing health care and other vital social services (Revich, 2020a; Savilov et al., 2020). Rising temperatures are altering habitats, migratory patterns, and ecosystems, resulting in wider distribution of tick-borne encephalitis and mosquito-transmitted West Nile fever and in population and health decline of animals traditionally hunted by indigenous people who then shift to modern diets and suffer associated chronic diseases (Revich et al., 2019).

2.3 | Disasters

Globally, higher temperatures reduce humidity and therefore increase risk of fire and drought. Accordingly, in Russia forest fires have become more frequent, extensive, and costly, and fire season is longer (Kirillina et al., 2020). The fires contribute to greenhouse gas emissions in a pernicious feedback loop and affect soil, crop productivity, air quality, and public health. Burning Arctic peatlands are a particularly pernicious and distinctly Russian environmental problem (Witze, 2020). Siberia, like Europe and North America, experienced massive heatwaves in 3 of 4 years since 2020. Even prior to these extreme events, droughts and fire have been disturbing the carbon balance of Siberian forests, challenging the region's persistence as a carbon sink (Fan et al., 2023). The southern and eastern "bread basket" territories of European Russia, historically prone to severe summer droughts, are projected to experience further decreases in precipitation (Cook et al., 2020; Dronin & Kirilenko, 2011).

Thawing permafrost is leading to increased flooding, landslides, and hazardous subsidence of ground supporting existing infrastructure. Some Russian cities in high-latitude regions report infrastructure damage from thawing permafrost and soil instability for up to 80% of buildings and for pipelines, as evidenced by the 2020 Norilsk diesel spill (Hjort et al., 2022). Flooding in Russia also results from rapid snowmelt, rising rivers, storm surge, and ice jams that first elevate water levels in the upstream segment of a river and, upon release, flow downstream at high velocity, the latter causing the previously mentioned catastrophic 2001 Lena River flood and its 8 deaths and damage to 20,000 properties, 26 schools, 7 health care facilities, and public utilities and transportation infrastructure (Anisimov & Kokorev, 2017). Flash flooding from climate-magnified heavy precipitation near the Black Sea caused similar damage in 2012 in Krymsk, where 156 people died and 29,000 lost property (Otto, 2015; TASS, 2014).

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2.4 | Urban life

Russian cities, including Moscow and St. Petersburg, are experiencing the urban heat island effect and warming significantly faster than surrounding areas (Katsova, 2022). Climate change thus reduces demand for heating and may improve hydropower generation due to shortened ice periods and increased winter runoff during maximum energy demand (Anisimov & Kokorev, 2017). However, climate change also increases flood losses and demand for air conditioning, reduces the lifespan of buildings, expedites the deterioration of city heating systems, and increases risks for power lines, support towers, and road safety (Anisimov & Kokorev, 2017; Katsova, 2022). In some cities, greater precipitation and reduced capacity of small rivers to absorb excess precipitation overwhelms sewage infrastructure (Pavlovskii, 2013).

Other climate change impacts vary across Russian cities by geography and urban economies. Changes in snowfall and therefore demand for snow removal vary by region (Anisimov & Kokorev, 2017). Coastal cities like St. Petersburg and Vladivostok will suffer the most from rising sea levels, storm surges, and flooding, although the extensive St. Petersburg dam, completed in 2011, was designed to withstand up to 5 meters of sea level rise and thus protect some settlements against floods for the next 100 years (Kozin, 2019). Russia's main warm water port on the Black Sea, Novorossiysk, is similarly vulnerable to rising waters, which threaten freight and petroleum shipments. Siberian cities such as Novosibirsk, Krasnoyarsk, and Yakutsk now regularly contend with extensive wildfires (Kharuk et al., 2021). More than other Russian cities, those that depend on fossil fuel production, such as Salekhard, Khanty-Mansiisk, and Tyumen, are vulnerable to health impacts from temperature increases, as well as economic impacts from post-carbon transition.

Russia's northern cities face billions of dollars in damage to residential and commercial infrastructure from permafrost thaw (Streletskiy et al., 2019), especially because the Russian permafrost area houses large cities, such as Vorkuta, Yakutsk, and Norilsk, with large apartment buildings and heavy-built industrial facilities (Hjort et al., 2022). Foundation support has reduced by up to 45% in some locations, including 15%–20% reductions in Salekhard, Noviy Urengoy, and Nadym, and 20%–30% losses in bearing capacity are projected for Salekhard, Norilsk, Yakutsk, and Anadyr (Hjort et al., 2022). The usability of Arctic ice roads is also reduced (Anisimov & Kokorev, 2017).

2.5 | Migration

Although historically climate has motivated internal migration in Russia (Vakulenko, 2019), warming temperatures may not serve as pull factors to Russia's east and north, given limitations in urban development, transportation infrastructure, and soil quality, distance from Moscow and western Russia, and ineffective financial and policy inducements (Parfenova et al., 2019; Streletskiy et al., 2019; Wang et al., 2019), as well as the still colder-than-average climate. Except for Yamalo-Nenets Autonomous Okrug and Krasnoyarsk Krai, most Arctic regions are experiencing outmigration unlinked to climate change (Katsova, 2022; Khoreva et al., 2018). In addition, between 2010 and 2021, nearly 150,000 Russians were internally displaced, mostly by floods or fires, which creates short-term challenges for the Russian state different from long-term migration (Katsova, 2022). Projections for future migration suggest a continued minor role for climate change as a motivating factor (Fantazzini et al., 2021; Karachurina & Mkrtchyan, 2022; Sardadvar & Vakulenko, 2020).

International migration to Russia from Central Asia and the South Caucasus has been motivated by higher wages but could be influenced by climate change in the future, with the World Bank estimating that Russia could soon see 3.7 million climate migrants from Central Asia, Eastern Europe, and elsewhere, almost 2% of Russia's population (Clement et al., 2021). Migrants may come from poor communities in the aftermath of disasters (Sagynbekova, 2021) or because of push factors that include environmental conditions (Blondin, 2019). Outmigration from Russia is currently propelled not by climate change but by Russia's war in Ukraine.

2.6 | Industry

Given Russia's currently hydrocarbon-driven economy, assessments of industry under climate change typically focus on mixed energy impacts. Russian power plants will likely experience a net decline in demand for heat (Klimenko, Fedotova, et al., 2018; Klimenko, Klimenko, et al., 2018), and permafrost thaw presents opportunities for extraction and transport. However, thawing also jeopardizes 45% of hydrocarbon extraction fields in the Russian Arctic (Hjort

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et al., 2022); sea shore erosion threatens ports; fires pose risk to oil and gas infrastructure, and frequent atmospheric events cause faster corrosion of required metals (Katsova, 2022). Still, the state prioritizes large resource extraction projects (Moe, 2020), which increases carbon emissions in a positive feedback loop of melting Arctic ice and fossil fuel use. The state also continues to prioritize coal exports, especially to Asia (Martus & Fortescue, 2022).

The renewable sector has not been promoted in Russia; projects are often only for show (Koch & Tynkkynen, 2021). Low hydrocarbon prices, long distances from potential renewable sources to population centers, and high renewable energy costs driven by localization requirements hinder clean energy development and diversification (Henderson & Mitrova, 2020). Renewables thus make up just 2% of primary energy production. Hydropower accounts for most of that energy and 17% of electricity production. With 9% of the world's hydropower reserves, Russia could invest in new hydropower projects, especially in Siberia and the Far East, but instead focuses on the development of nuclear power stations (Bogoviz et al., 2020).

The energy sector in Russia accounts for half of federal budget revenues, and carbon-intensive industries such as metallurgy, fertilizer production, and chemicals account for 10% of GDP (Makarov et al., 2020). Decarbonization commitments by Russia's European trading partners following the 2019 Paris Agreement will thus negatively affect the Russian economy and social welfare (Makarov et al., 2020). After the 2022 full-scale invasion, the EU cut imports of Russian gas to 20% of prewar levels and accelerated the phasing in of their carbon border adjustment mechanism, which will dramatically increase the price of many carbon-intensive products imported from Russia (Kirkegaard, 2023).

Russia's political and industrial leaders have tended to downplay or deny climate change or argue that Russia is already a bastion against greenhouse gas accumulation (Godzimirski, 2022; Korppoo, 2022; Tynkkynen & Tynkkynen, 2018). Some Russian corporations have felt pressure from shareholders, lenders, and customers, predominantly international, to present a green face, but substantive change has been minimal (Kitade, 2021; Martus, 2018; Molchanova et al., 2020). While corporate behavior seemed on the brink of changing in 2021 in response to the EU's potential carbon tax on imports and the realization of potential economic benefits for Russia in a green transition, Western sanctions following Russia's invasion of Ukraine sidelined green endeavors in favor of desperate searches for alternative energy export markets (Babaeva, 2022; Galaktionov, 2022; Morozov, 2020).

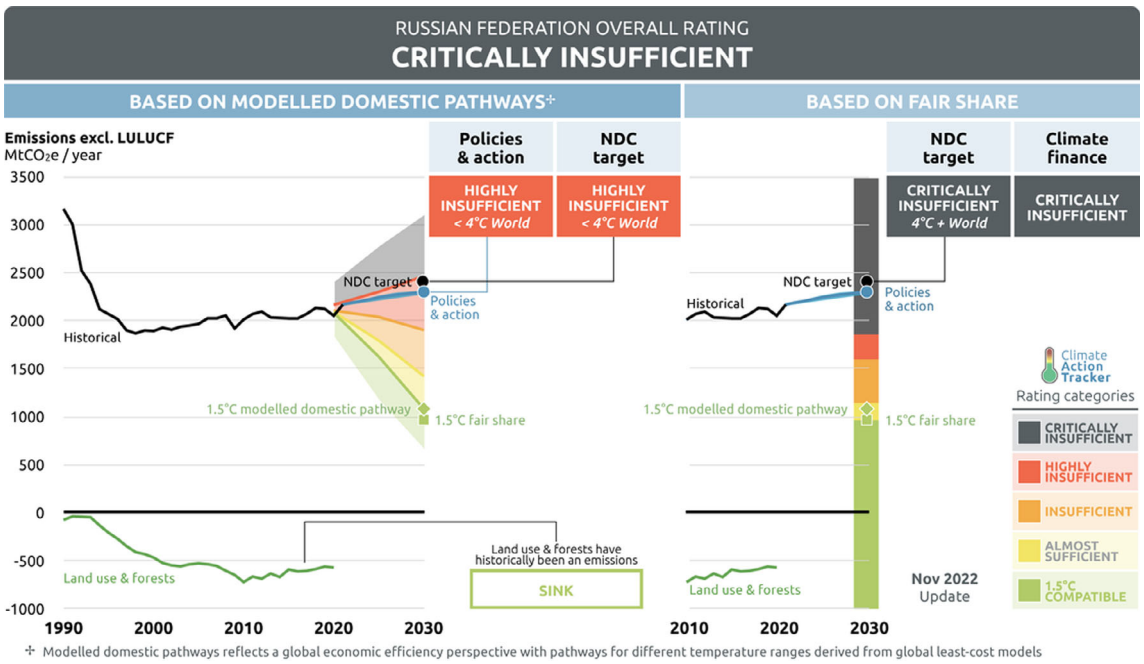

FIGURE 2 Carbon Action Tracker (CAT) rates the Russian Federation's climate targets, policies, and finance as "Critically insufficient" and inconsistent with the Paris Agreement's 1.5°C temperature limit. Among the reasons for CAT's low ratings are Russia's lack of policy commitment to curb emissions, Russia's unsubstantiated claim that by 2050 its forests would take up twice as much carbon as they do today, and Russia's failure to account for the impact of its enormous Siberian wildfires in recent years. They conclude that "If all countries were to follow Russia's approach, warming could reach over 3°C and up to 4°C."

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3 | CLIMATE CHANGE POLITICS

Russia matches its unique geographic profile with an equally unique political profile. Of the world's petrostates, it alone claims former superpower status with renewed imperial aspirations that depend critically on retaining global dependence on fossil fuels. These characteristics define its approach to domestic and international climate politics (Figure 2).

3.1 | Climate leadership deficit

Given that the Russian state owns or controls most Russian energy companies and is dependent on oil and gas income, state and corporate interests blend, and a desire to continue the production and sale of fossil fuels drives government inaction on climate change. No top political official champions a climate agenda; those in the highest positions of power demonstrate silence or denial (Box 1).

As of 2009, Russia has a Climate Doctrine that declares climate change to be a "policy priority for Russia." The resulting 2011 Comprehensive Plan charged federal ministries, led by the Ministry for Natural Resources and the Environment (MNRE), to report on 65 planned measures, 30 of which were declared completed by 2018 (Government of Russia, 2011; President of Russia, 2009). However, the magnitude of substantive progress is unclear, and the key governmental body named responsible for monitoring the Climate Doctrine, the MNRE, itself does not include climate action in its mission. The MNRE's Federal Service for Hydrometeorology and Environmental Monitoring (*Rosgidromet*) provides key expertise in climate change monitoring and forecasts and regularly produces comprehensive assessments—and warnings—of the detrimental impact of climate change on Russia (see Table 1.) However, scientific agencies rank low in the Russian government hierarchy and have little policy influence (Korppoo, 2016). The narrow coalition of experts that successfully lobbied for the Climate Doctrine and other climate action included civil servants, academics, NGO leaders, and corporate representatives but no representatives of the federal government and, even at its peak influence, was unsuccessful in promoting ambitious emission reduction goals or mitigation policies (Kokorin & Korppoo, 2013).

Also as of 2009, Russia has an advisor to the president on climate, a position first held by Aleksander Bedritskii, who advocated for stronger climate policy. In 2018, he was replaced by Ruslan (Abubakar) Edelgeriev, former Chechnya prime minister, who headed the intra-governmental working group on climate change and sustainable development but otherwise had limited climate-related experience (RBK, 2018). More powerful than the presidential advisor on climate is Deputy Prime Minister Viktoria Abramchenko, who oversees several state programs dealing with

BOX 1 Who controls the fossil fuel industry in Russia?

The fossil fuel industry in Russia is the single most important component of the Russian economy, contributing a quarter of GDP, nearly half of government budget revenues, and more than half of exports (Gerasimchuk & Oharenko, 2019). After the collapse of the USSR, the most valuable parts of the fossil fuel sector were privatized in highly politicized and often corrupt processes. Since the accession of Vladimir Putin to the Russian presidency, the state has increasingly drawn these assets under its control, either directly or through proxy ownership by oligarchs and businesspeople close to state officials.

The fossil fuel company, Gazprom, which is the largest natural gas company in the world and produces nearly 70% of natural gas in Russia, is majority state-owned (Organisation for Economic Co-operation and Development, 2020). In the more decentralized petroleum production industry, the company Rosneft produces 40% of Russian oil and 8% of its gas (Rosneft, 2023). Rosneft has officially been state-owned only since 2020, but it has effectively been state-controlled through its CEO Igor Sechin, a close Putin ally, since 2012 (Russia Monitor, 2020).

Ownership in the sector often involves networks of holding companies that limit the transparency of the industry and allow informal political networks to exercise enormous influence. This kind of ownership has been a hallmark of Russian economic organization over the last 30 years and largely explains the Russian state's reluctance to address climate change through decarbonization.

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TABLE 1 Russian government assessments of climate impacts on the territory of the Russian Federation.

Types of impact[a]	Description	Benefits	Drawbacks
Accelerated warming of annual temperatures	In 2020, the mean annual temperature in Russia was 3.2°C higher than the long-term average between 1961 and 1990.	Shifting of climatic zones north, increasing habitability, and opening up new locations for agricultural production	Forest fires; desertification; increase in insect-borne diseases; stress on water resources; species vulnerability; loss of work-days due to higher temperatures; increased health emergencies
Precipitation	Increased precipitation occurs throughout the year and for all seasons and is higher than average global precipitation levels.	No benefits identified	Increased risk of flooding; ice instability on rivers serving as winter roads; faster corrosion and destruction of metals used in construction of oil and gas infrastructure
Increased soil temperatures and thawing of permafrost	In Russia's permafrost zone, annual minimum soil temperature at a depth of 0.8 m is increasing more than 0.4–0.8°C every 10 years.	Increasing soil productivity (dependent on adaptivity to the new climate regime)	Infrastructure failure (e.g., cracking in buildings, railways, roads, oil wells); release of methane stored in permafrost; increased risk of novel infectious diseases; increased construction costs
Extreme temperatures	Heat waves (three consecutive days of temperatures above 32°C) were more common in European Russia in the period between 2006 and 2010 in comparison to 2001–2005.	Decreased incidence of ice crusts, which limit food sources for livestock and other animals	Increased incidence of drought, tornados, heat waves, and excess deaths, typhoons, freezing rain
Sea level rise	Fluctuations in the sea levels for Russia's Arctic coast have been higher than mean long-term levels.	No benefits identified	Increased coastal flooding and erosion, particularly in the Arctic; shoreline erosion will threaten ports
Decrease in Arctic sea ice extent	By the end of the cold season in the period 2004–2018, average ice thickness in the Russian Arctic seas decreased by about 40 cm (from 153 to 117 cm) compared to 1997–2003.	Opening of Northern Sea Route; access to natural resources in the Arctic	Habitat loss and change for Arctic animal species; increased human activity in sensitive environments (e.g., increased traffic on Arctic seas); loss of livelihood for indigenous populations

[a]Impacts are described in the Third Assessment Report, commissioned by the Russian government's Ministry for Natural Resources and the Environment (MNRE), written and released by its Federal Service for Hydrometeorology and Environmental Monitoring (*Rosgidromet*): http://cc.voeikovmgo.ru/images/dokumenty/2022/od3.pdf. Not all observed changes are reported in the table.

environmental protection, agriculture and forestry development, water resources protection, and a national project, "Ecology," that boasts a 4041 billion ruble budget (approximately $53 billion), but climate action is not among her responsibilities, and in her other capacities, she works with leaders of resource-extracting companies, such as Gazprom and Lukoil, and governors of resource-extracting regions. In 2020, Energy Deputy Minister Pavel Sorokin argued that big fossil fuel extraction projects need to be pushed through during the limited "window of opportunity" of the next two decades (Russian Federation Ministry of Energy, 2020). In 2021, the Ministry of Foreign Affairs recommended funding studies promoting "alternative" viewpoints on climate change that "would not necessarily imply abandoning fossil fuels" (Dobrovidova, 2021).

In Russia's legislature, no faction embraces a climate action agenda (Semenov, 2021). Parties that run on environmental platforms perform poorly in elections, and prominent legislators have pitched climate denial, including former Just Russia leader Sergei Mironov, who has lectured about "the total fraud" of climate change being "a trap for Russia" set by the West and has lobbied the Russian president against joining international agreements (Mironov, 2020). The lower chamber, the State Duma, has a Committee for Ecology, Natural Resources, and Environmental Protection; a similarly titled committee in the upper chamber, the Federation Council, ceased to exist in 2011 (Federation

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Council, 2011). Through powerful lobbies, the energy, mining, industrial, and agricultural interests, which have substantial stakes in climate policy, play a greater role in legislation than the Duma committee (Chaisty, 2013).

Russia's Academy of Sciences (RAS), the institution that provides scientific expertise behind policy-making, expresses climate denial on its official website: "Rumors about the climate catastrophe are somewhat exaggerated" (Russian Academy of Sciences, 2021). Although some institutions such as the Institute for Oceanic Science and Institute for Biology accept the science of climate change, climate-denying RAS members serve on state-led working groups and commissions. Climate advocacy from nongovernmental organizations has limited impact on the policy process.

3.2 | Adaptation planning

In recent years, Russian federal and regional policymakers have paid some attention to climate change adaptation, as seen in 2019's "National Plan of Measures for the First Step in Adapting to Climate Change by 2022," which envisions developing sectoral and regional adaptation plans (Government of Russia, 2019), and 2020's "Strategy for the Development of the Russian Federation Arctic Zone and Providing National Security through 2035" (President of Russia, 2020). *Rosgidromet* has been at the forefront of providing climate information to private sector actors and the public.

In June 2022, based on climate risk assessments and the recommendations of the Ministry of Economic Development, the Russian government approved 10 plans to adapt to climate change in the following sectors: transport, fuel and energy, construction and housing, agriculture and fishing, environmental management, healthcare, the Arctic, civil defense and emergency situations, industry and trade, and sanitation and public health. Regional plans have been developed for Belgorod, Volgograd, Vologda, Kemerovo, Kursk, Penza, and the illegally annexed Crimea, and these address local extreme weather events, agricultural vulnerabilities, water scarcity, and other local impacts. Plans for the other 77 regions and the annexed Sevastopol are still in development (TASS, 2022).

While these documents represent acknowledgment of the vulnerability of Russia's population to climate change, they simultaneously seek to capitalize on the perceived advantages of climate change, including greater access to Arctic waterways, expansion of agriculturally viable land, possible increase in the "productivity" of boreal forests, and lower heating energy costs during winters (Government of Russia, 2019). Moreover, adaptation financing and implementation are limited (Moe et al., 2022).

3.3 | Adaptation deficits

Adaptation to reduce Russia's vulnerabilities is thus currently minimal (Moe et al., 2022). The Russian government subsidizes crop insurance, but many agricultural producers consider premiums too high, only an estimated 5% of crops and livestock are insured, and some growers rely on federal aid when crops fail (Dronin & Kirilenko, 2011; Nechaev et al., 2021). In the short term, increased federal food reserves can reduce food stress during years of grain shortage but will be insufficient for more drastic climate change in the next 50 years, suggesting the necessity of greater interregional exchange to minimize food crises and matching crop varieties to the local climate, landscape, and soils (Dronin & Kirilenko, 2011). Since 2018, the Russian government has ramped up investment in technologies to develop locally adapted seeds for the main Russian field crops (wheat, barley, sugar beets, potatoes), though the main political rationale is national food security, not climate adaptation (Dobrovidova, 2019).

Two key public health warning and action plans exist, one created by the World Health Organization European Office, Russian Ministry of Health, and Arkhangelsk regional government in 2011/2012, and the other in the city of Moscow immediately following the 2010 heat wave. However, investment, implementation, and replication across Russia are uncertain (Revich, 2020a, 2020b, 2021). A sectoral plan published by the Ministry of Health in June 2022 acknowledged current and potential health impacts, but its goals are generic and unlikely to spur national, regional, or local action (Ministry of Health of the Russian Federation, 2021).

Russian officials receive public support for demonstrating competence in disaster management (Lazarev et al., 2014) but have few incentives to enact preventive measures, which provide fewer political benefits.

Most Russian cities lack strategic policy instruments, governance capacity, and political and fiscal autonomy to adapt to climate change. Historically, Russia's urban infrastructure and public transportation tend to be poor quality, energy inefficient, and poorly maintained, with urban adaptation to climate change not prioritized, and Russia's war in Ukraine further reduces the priority of adaptation. Moscow prepared an action plan to achieve carbon neutrality by 2060, but its formal adoption, let alone implementation, is uncertain. St. Petersburg prepared declarations such as "Environmental

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Policy-2030" and includes a climate adaptation section in its most recent City Strategic Plan but has no city-wide action plan. Other major metropolitan areas rarely incorporate climate change in strategic planning. For example, Ekaterinburg with its 1.5 million inhabitants does not have any climate-related strategy; the Dutch architecture agency MLA+ involved in the city's master-plan development mentions the issue only once. City environmental departments focus mostly on parks and recreation and rarely coordinate with the more important planning and transportation agencies.

Cities in Russia's permafrost areas have perhaps the greatest unmet adaptation needs, with special difficulties for engineering design and construction imposed by uncertain climate models and potentially high capital expenditures and operational expenses (Hjort et al., 2022). Historical infrastructure damage in Russia's permafrost areas resulted from poor maintenance (Hjort et al., 2022), suggesting Russia's inability or unwillingness to address the additional complexities of climate change. After the 2001 Lena River flood, authorities quickly rebuilt the destroyed city of Lensk in the same vulnerable floodplain location at 400 times the cost of preventive measures (Anisimov & Kokorev, 2017).

In October 2021, Russian Deputy Prime Minister Viktoria Abramchenko acknowledged the "inevitable emergence of 'climate migrants'" and the need to adapt to climate change accordingly (TASS, 2021). However, migration is not mentioned in adaptation planning, nor has climate-induced migration emerged as a policy agenda item or in public discussion.

3.4 | International relations

Russia has failed to assess the specific negative impacts of climate change on national security (Kochtcheeva, 2022). Defense and military budgets are threatened by an unreformed energy sector and the consequent declining Russian economy as the green energy transition progresses (Godzimirski, 2022). Geopolitical leverage provided by fossil fuel energy exports is threatened as previously dependent countries diversify energy sources (Henderson & Mitrova, 2020).

Instead, the Kremlin focuses on the positive aspects of a melting Arctic: The Northern Sea Route (NSR) opened in 2012, due to the lowest concentration of Arctic sea ice ever observed, and is seen as a key factor in reestablishing Russia's great power status (Kjellén, 2022; Moe, 2020). Russia has re-militarized the Arctic with new military installations on the western Arctic archipelagos and has thereby enclosed the Barents Sea at the western end of the NSR (Kjellén, 2022) (Box 2).

The Russian Federation has participated routinely in international climate diplomacy since the 1990s and was instrumental in bringing the Kyoto Protocol into force (Henry & Sundstrom, 2007; Makarov et al., 2020). Nevertheless, Russia has avoided meaningful commitments to reduce greenhouse gas emissions, using a 1990 baseline—prior to the post-Soviet economic crisis—and maximally accounting for forest carbon sequestration in national emissions budgets. At 2021's COP 26 meeting, Russia updated its 2030 target to 30% reduction below 1990s levels, which effectively

BOX 2 Russia and the Arctic

The Arctic is warming four times faster than the rest of the planet and provides an alarming indicator of the impacts of climate change (Rantanen et al., 2022). Since 1996, the Arctic Council, an international body uniting all of the Arctic countries, worked collaboratively to address a variety of environmental issues in the far north. Russia's 2022 full-scale invasion of Ukraine during its 2-year chairmanship led to the suspension of Arctic Council activities until Norway took over in May 2023. Council activities are slowly resuming, although Russia's role in future collaborative Arctic governance remains in question.

Russia's (non)cooperation is consequential. Russian territory makes up approximately half of the Arctic, and the Arctic is a central component of Russia's planning for its future. Russia sees the Arctic as a resource-rich zone, and President Vladimir Putin is counting on extracting the region's oil and natural gas resources to further the country's economic growth. Putin has also accelerated the militarization of the Russia Arctic, claiming the country faces threats from the West. The invasion of Ukraine led Finland and Sweden to seek to join the North Atlantic Treaty Organization (NATO), meaning that Russia now faces a united bloc in the Arctic. Putin's energy and military plans often run counter to the desires of the Indigenous people who have lived in the Russian Arctic for millennia. These groups have little voice in defining Russia's Arctic policy.

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requires no actual cuts to current emissions. Russia also pledged to achieve carbon neutrality by 2060 but with few details on implementation. Notably, President Putin did not attend COP 26 or COP 27, although Russia sent delegations to those conferences and will likely continue to do so.

Should Russia try to rejoin the global community and cast itself as a responsible international actor, it might do so via multilateral climate change and adaptation efforts, especially those involving easily achievable goals that do not threaten growth (Closson, 2019; Kendall-Taylor & Townsend, 2022; Kochtcheeva, 2022). Motivations for such engagement include potential revenue generation in the Arctic (Buchanan, 2023), a need for international economic reintegration (Henderson & Mitrova, 2020), and reputation concerns for Russia's "great power" status that, with the right incentives, could manifest as "green leader" discourse (Tynkkynen, 2020). However, these very motivations might raise concerns in the international community about the sincerity of Russia's climate commitments and inspire demands for Russia's more aggressive emissions reduction as a condition of future international engagement (Figure 3).

3.5 | War

Russia's full-scale invasion of Ukraine has brought devastation not only to Ukraine but to the global climate from increased military emissions—potentially several million extra tons of carbon dioxide equivalent (tCO_2e) directly (e.g., military operations that include explosions, fires, aircraft fuel, production and distribution of weapons, and more) and indirectly (e.g., methane leakage from the Nord Stream 1 and 2 pipelines and Ukraine's ultimate reconstruction) (Bennhold & Tankersley, 2022; Michaelowa et al., 2022). Seven months of Russia's aggression in 2022 resulted in at least 100 million additional tCO_2e, an amount equivalent to or higher than those of The Netherlands during that same period (de Klerk et al., 2022). In addition to military emissions from Russia, boosted military spending by the United States and Western Europe to assist Ukraine or maintain a strong presence in the region may result in emissions above levels promised in their commitments to the Paris Agreement. Although Russia has never played a leading role in international climate negotiations, its war and pariah status diminish its incentives for future cooperation and thus create uncertainty for future negotiations (Overland, 2022). The war also disrupts energy markets and diverts attention from dialogue on climate change.

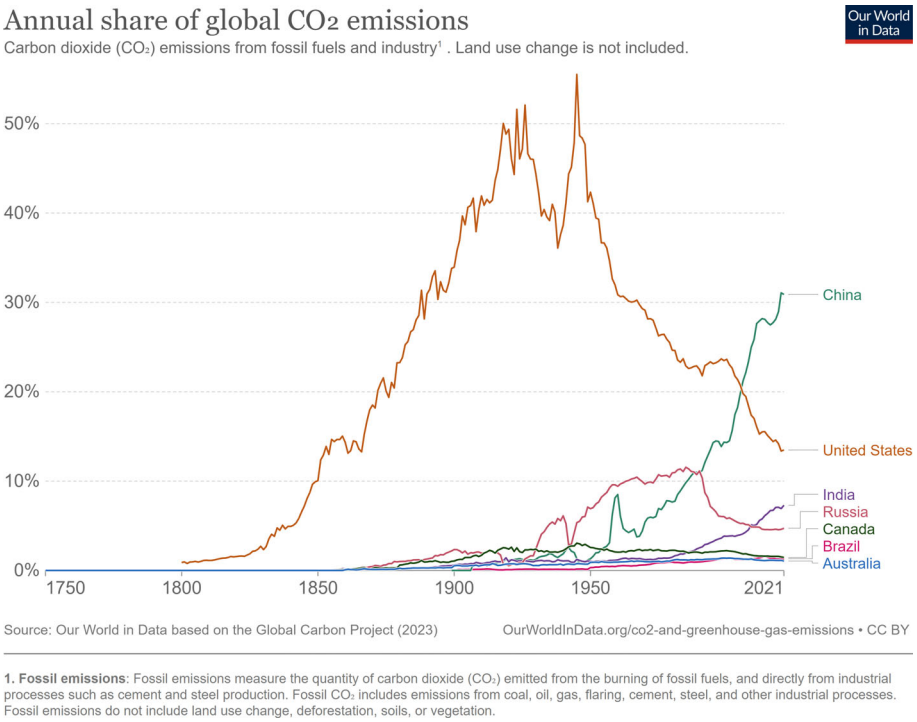

FIGURE 3 Although Russia's annual CO_2 emissions declined dramatically after 1990, those reductions were a direct result of economic collapse following the dissolution of the Soviet Union and not attributable to deliberate climate policies. Once Russia's economy stabilized, emissions again began to increase and are projected to continue to rise, given current policies.

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The combined impact of Russia's war and climate change reverberates throughout the Earth system. The war is interrupting global biodiversity conservation efforts and thus harming climate change mitigation, given that Russia has more carbon-sequestering forest and peatlands in need of protection than any other country (Gallo-Cajiao et al., 2023). In 2022, 20% of all Ukrainian nature conservation areas had also been affected (United Nations Environment Programme (UNEP), 2022). Military activities have caused the release of toxic industrial chemicals and hazardous waste, thus polluting air and already limited water supplies (UNEP, 2022), and the food-importing countries of the global south are suffering from the war's disruption to Ukraine's provision of staple crops and fertilizer, causing an additional 47 million people to face acute hunger (UNEP, 2022, 27). The precise environmental impact of the June 2023 destruction of the Kakhovka dam and hydroelectric power plant is unclear as of this writing, but the catastrophic flooding is sure to exacerbate climate impacts of water scarcity, food scarcity, biodiversity loss, and human morbidity and mortality and to magnify the carbon-intensive demands of rebuilding Ukraine.

Amidst this devastation, the war has generated some push for decreasing emissions. The spike in oil and natural gas prices led the European Commission to resolve to end the EU's dependence on Russian fossil fuels, improve energy conservation measures, and accelerate the transition to renewable energy sources, even if temporarily increasing the use of coal (Plumer, 2022). In May 2023, the International Energy Agency (IEA) named the war in Ukraine as one factor behind increasing investment in renewables globally over the last 5 years (International Energy Agency, 2023). However, the potential for emissions reductions has so far not been realized. Western sanctions have limited Russia's pool of customers for its oil exports, as well as its negotiating power and revenue, but the quantity of oil exports has rebounded to pre-war levels thanks to buyers in China and India (Cooban, 2023). Western sanctions have been more effective in decreasing natural gas production in Russia by 20%, and the warm 2022/2023 winter decreased demand, but the EU maintained its natural gas access with imports from Algeria and Norway, and a future cold winter could again increase demand (Meduza, 2023) (Figure 3).

3.6 | Civil society

Although Russians regularly cite environmental pollution as a main problem facing the country, they are relatively unconcerned about climate change and do not see it as an urgent government priority (Ashe & Poberezhskaya, 2022; Kurbanov & Prokhoda, 2019). Russian citizens largely agree with Russian policymakers that foreign policy interests and conspiracy drive international climate diplomacy more than environmental concerns (Korppoo, 2020). Some Russian elites see international climate policy as a "Western-led hegemonic project" threatening Russian sovereignty (Tynkkynen & Tynkkynen, 2018), a position more persuasive with citizens following the February 2022 invasion of Ukraine and Russian government charges that Ukraine is a puppet of NATO. Newspapers reiterate state claims about the economic benefits of international climate negotiations or the warmer Arctic (Poberezhskaya, 2018).

Although at least 10% of all protests in Russia have had an environmental component, such as local pollution, forest fires, or flooding, connections to climate change are rarely made (Lankina, 2018). Moreover, while the Russian state sometimes offers concessions to protesters, local authorities typically follow corporate interests or central government instructions (Demchuk et al., 2022). Russian corporations sometimes inadvertently satisfy activists when trying to meet international certification or social responsibility requirements (Newell & Henry, 2016), but Russian state and corporate dependence on fossil fuel revenue drives policy (Lassila & Siddi, 2021). Russia's invasion of Ukraine has increased pressure on activists, leading the most visible to flee (Ebel, 2022) and making domestic climate-related protests even less likely. As of spring 2023, 42 environmental organizations were listed as "foreign agents" (Inoteka, 2023), and Greenpeace and World Wildlife Fund (WWF) became "undesirable organizations" and shut down operations in Russia. At the same time, new activist initiatives have emerged, such as Earth Touches Everyone, and the invasion has prompted transnational collaboration to monitor the war's climate impacts, such as the Ukraine War Environmental Consequences Work Group (UWEC).

4 | CONCLUSION: IMPLICATIONS FOR FUTURE RESEARCH

Russia stands to be transformed by climate change. While leaders currently downplay or ignore the need to mitigate and adapt, they cannot do so much longer. To understand how Russia's government might shift from marginalization to prioritization of climate change, research is needed on the distinctly political dimensions of Russia in a changing climate.

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For example, Russia's fields, forests, and waterways experience vulnerabilities that must be addressed through social, legal, economic, and political processes. Recommended policies include water management (Volosukhin et al., 2022) and forest and wildfire management in light of water changes (Shvidenko & Schepaschenko, 2013). Research on the feasibility of passing and implementing these policies, as well as cross-regional variation in policies and actual agricultural, forest, and water adaptations, is critical.

Similarly, in an increasingly repressive Russian political and social climate, research is needed on the decision processes surrounding the development and implementation of public health warning and action plans. Also crucial are rigorous assessments of climate-related health challenges, particularly for key vulnerable groups such as children and Indigenous peoples of the north (Revich, 2008) and in interaction with anticipated demographic shifts.

The Russian and international scientific literature on disasters is burgeoning, but much is either region-specific or concerned with spatial patterns, rather than the political, institutional, and social context of disaster management and alleviation. For example, numerous studies clarify the legal aspects of the government's fire response, with forest legislation under the joint jurisdiction of the Russian Federation and its subjects and governed by the Forest Code of the Russian Federation. These studies describe the insufficient federal subsidies to regions, reduction of forest protection staff from 200,000 to 20,000, and transfer of some forest protection to ineffective private entities (Narita et al., 2021), including "service Cossacks" and other state-affiliated civil society groups called upon to respond to disasters and provide "ecological service" (Godovova, 2012). However, research is needed on the effectiveness of state and private institutions devoted to disaster response, such as fire-fighting, flood alleviation, or management of permafrost thawing.

Research is also needed on the institutions and available funding for various types of disaster prevention and post-disaster relief, decision-making surrounding funding distribution, the distribution of mortality and property losses across the vast country, and whether the task of reducing climate-related risk in construction is even on the political agenda. Although Russia's political system is highly centralized, disaster management is fundamentally a local issue, and there are significant regional disparities in economies, administrative capacity, and favoritism from Moscow. The fate of neglected regions is unclear, as is the cumulative pressure of disasters on public resources, the Russian economy, and the Russian state and whether the unequal distribution of the costs of climate change may trigger demands for political change.

Hazard assessments in permafrost regions have increased substantially and have identified northwestern parts of the Ural Mountains and northwest and central Siberia as having high hazard potential (Hjort et al., 2022). However, similar risk assessments for infrastructure and related economic costs are fewer (Hjort et al., 2022) but urgent. For 2020–2050, the costs of maintaining road infrastructure as permafrost degrades range from US $7–14 billion (422–865 billion RUB), and the costs of residential housing replacement range from US $0.5–0.6 billion (30–36 billion RUB) annually (Hjort et al., 2022).

Infrastructure questions are urgent outside permafrost regions as well. Cross-regional and cross-city research could helpfully compare vulnerabilities, adaptations, and the adjustments of regional and urban budgets and governance to adaptation needs.

In terms of Russian public opinion, research is needed on potential drivers of attitudes toward climate policy action, including local environmentalism (Anisimov & Orttung, 2019) and political and psychological factors such as conspiracy thinking that casts climate action as a Western attack on Russian identity and interests (Levada Center, 2021). However, Russia's war against Ukraine and heightened anti-Western propaganda suggest continued difficulty in shifting public opinion, should research-informed interventions even be possible. Research is also needed on potential drivers of climate activism. Framing climate change as an international justice struggle does not seem to resonate with the Russian public; frames around a special Russian responsibility for forests and the Arctic appear to hold more promise (Laruelle, 2012). Again, however, Russia's attack in Ukraine is likely the primary driver, reducing climate activism by minimizing the opportunity for protest in general.

The fates of Russia's hydrocarbon-dependent economy, centralized political system, and climate-impacted population are intertwined. Research is needed on this evolving interrelationship, as global temperatures rise and the international economy decarbonizes in response. Russia requires, but does not have, a comprehensive development strategy that accounts for the global post-Paris Agreement energy transition and its corresponding reduction in Russian hydrocarbon exports and GDP growth (Makarov et al., 2020). A burning question is whether Russia could diversify its economy and be powered by innovations in nuclear energy, hydrogen technologies, other economic niches such as reforestation or wind energy; investments in manufacturing, services, and agriculture and food production; or human capital investments in education, health, and better-functioning government (Henderson & Mitrova, 2020; Makarov, 2022; Makarov et al., 2020). If such innovations and investments fail to materialize, what are the implications for the country, the global climate, and international security?

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The authors have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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REFERENCES

Alcamo, J., Flörke, M., & Märker, M. (2007). Future long-term changes in global water resources driven by socio-economic and climatic changes. *Hydrological Sciences Journal*, *52*(2), 247–275. https://doi.org/10.1623/hysj.52.2.247

Alempic, J.-M., Lartigue, A., Goncharov, A. E., Grosse, G., Strauss, J., Tikhonov, A. N., Fedorov, A. N., Poirot, O., Legendre, M., Santini, S., Abergel, C., & Claverie, J.-M. (2022). An update on eukaryotic viruses revived from ancient permafrost. *BioRxiv*, Preprint. https://doi.org/10.1101/2022.11.10.515937v1

Anisimov, O., & Kokorev, V. (2017). Cities of the Russian north in the context of climate change. In R. Orttung (Ed.), *Sustaining Russia's Arctic cities: Resource politics, migration, and climate change*. Berghahan Books.

Anisimov, O., & Orttung, R. W. (2019). Climate change in Northern Russia through the prism of public perception. *Ambio*, *48*(6), 661–671. https://doi.org/10.1007/s13280-018-1096-x

Ashe, T., & Poberezhskaya, M. (2022). Russian climate scepticism: An understudied case. *Climatic Change*, *172*(41). https://doi.org/10.1007/s10584-022-03390-3

Babaeva, R. (2022). Zachem rossiiskie korporatsii stremitsia byt' 'zelenym [Why Russian corporations try to be 'green']. *RBK*. Retrieved from https://trends.rbc.ru/trends/green/cmrm/636cfe429a7947a52ca1808a

Belyaeva, M., & Bokusheva, R. (2018). Will climate change benefit or hurt Russian grain production? A statistical evidence from a panel approach. *Climatic Change*, *149*, 205–217.

Bennhold, K., & Tankersley, J. (2022). Ukraine war's latest victim? The fight against climate change. *New York Times*. Retrieved from https://www.nytimes.com/2022/06/26/world/europe/g7-summit-ukraine-war-climate-change.html

Blondin, S. (2019). Environmental migrations in Central Asia: A multifaceted approach to the issue. *Central Asian Survey*, *38*(2), 275–292.

Bogoviz, A. V., Lobova, S. V., & Alekseev, A. N. (2020). Current state and future prospects of hydro energy in Russia. *International Journal of Energy Economics and Policy*, *10*(3), 482–488. https://www.econjournals.com/index.php/ijeep/article/view/8968

Buchanan, E. (2023). *Red Arctic: Russian strategy under Putin*. Brookings Institution Press.

Chaisty, P. (2013). The preponderance and effects of sectoral ties in the State Duma. *Europe-Asia Studies*, *65*(4), 717–736.

Clement, V., Rigaud, K. K., de Sherbinin, A., Jones, B., Adamo, S., Schewe, J., Sadiq, N., & Shabahat, E. (2021). *Groundswell Part 2: Acting on internal climate migration*. The World Bank.

Closson, S. (2019). The impacts of climate change on Russian Arctic security. In R. E. Kanet (Ed.), *Routledge handbook of Russian security* (pp. 299–308). Routledge.

Cooban, A. (2023). Russia's oil exports are back to pre-war levels. CNN. Retrieved from https://www.cnn.com/2023/04/14/energy/russia-oil-exports-iea-report/index.html

Cook, E. R., Solomina, O., & Matskovsky, V. (2020). The European Russia Drought Atlas (1400–2016 CE). *Climate Dynamics*, *54*, 2317–2335. https://doi.org/10.1007/s00382-019-05115-2

de Klerk, L., Shmurak, A., Gassan-Ade, O., Shlapak, M., Tomliak, K., & Korthuis, A. (2022). Climate Damage Caused by Russia's War in Ukraine." Initiative on GHG accounting of war. Retrieved from https://climatefocus.com/wp-content/uploads/2022/11/ClimateDamageinUkraine.pdf

Demchuk, A. L., Mišić, M., Obydenkova, A., & Tosun, J. (2022). Environmental conflict management: A comparative cross-cultural perspective of China and Russia. *Post-Communist Economies*, *34*(7), 871–893. https://doi.org/10.1080/14631377.2021.1943915

Di Paola, A., Caporaso, L., Paola, F. D., Bombelli, A., Vasenev, I., Nesterova, O. V., Castaldi, S., & Valentini, R. (2018). The expansion of wheat thermal suitability of Russia in response to climate change. *Land Use Policy*, *78*, 70–77.

Dobrovidova, O. (2019). Russia joins in global gene-editing Bonanza. *Nature*, *569*, 319–320.

Dobrovidova, O. (2021). Russian climate scientists upset by ministry's call for 'alternative' research. *Science*. https://doi.org/10.1126/science.abj9306

Dronin, N., & Kirilenko, A. (2011). Climate change, food stress, and security in Russia. *Regional Environmental Change*, *11*, 167–178. https://doi.org/10.1007/s10113-010-0165-x

Ebel, F. (2022, November 5). Russia strips climate advocate of citizenship. *The Washington Post*. Retrieved from https://www.washingtonpost.com/world/2022/11/05/russia-climate-makichyan-citizenship/

Etkind, A. (2023). *Russia against modernity*. Polity.

Fan, L., Wigneron, J.-P., Ciais, P., Chave, J., Brandt, M., Sitch, S., Yue, C., Bastos, A., Li, X., Qin, Y., Yuan, W., Schepaschenko, D., Mukhortova, L., Li, X., Liu, X., Wang, M., Frappart, F., Xiao, X., Chen, J., … Fensholt, R. (2023). Siberian carbon sink reduced by forest disturbances. *Nature Geoscience*, *16*(1), 56–62. https://doi.org/10.1038/s41561-022-01087-x

Fantazzini, D., Pushchelenko, J., Mironenkov, A., & Kurbatskii, A. (2021). Forecasting internal migration in Russia using Google Trends: Evidence from Moscow and Saint Petersburg. *Forecast*, *3*(4), 774–803.

Federation Council. (2011). Komitet Soveta Federatsii po Prirodnym Resursam i Okhrane Okryzhaiushchei Sredy [Federation Council Committee on Natural Resources and Protecting the Environment]. Retrieved from http://council.gov.ru/services/reference/9767/s

Frolova, N. L., Magritskii, D. V., Kireeva, M. B., Grigor'ev, V. I., Gel'fan, A. N., Sazanov, A. A., & Shevchenko, A. I. (2022). Stok rek Rossii pri Proiskhodiashchikh i prognoziruemykh izmeneniiakh klimata: Obzor publikatsii. 1. Otsenka izmenenii vodnogo rezhima rek Rossii po dannym nabliudenii [Stock of Russian rivers under the existing and predicted climage changes: Summary of publications. 1. Evaluation of the water regime of Russian rivers by observational data]. *Vodnye Resursy*, *49*(3), 251–269.

Galaktionov, I. (2022). Kak rossiiskaia neft' prokladyvaey dorogu v Aziiu [How Russian oil paves a road to Asia]. BKS Ekspress. Retrieved from https://bcs-express.ru/novosti-i-analitika/kak-rossiiskaia-neft-prokladyvaet-dorogu-v-aziiu

17577799, 2024, 2, Downloaded from https://wires.onlinelibrary.wiley.com/doi/10.1002/wcc.872 by Uppsala University Library, Wiley Online Library on [04/07/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Gallo-Cajiao, E., Dolšak, N., Prakash, A., Mundkur, T., Harris, P. G., Mitchell, R. B., Davidson, N., Hansen, B., Woodworth, B. K., Fuller, R. A., Price, M., Petkov, N., Mauerhofer, V., Morrison, T. H., Watson, J. E. M., Chowdhury, S. U., Zöckler, C., Widerberg, O., Yong, D. L., … Biggs, D. (2023). Implications of Russia's invasion of Ukraine for the governance of biodiversity conservation. *Frontiers in Conservation Science*, *4*, 989019. https://doi.org/10.3389/fcosc.2023.989019

Gel'fan, A. N., Gusev, E. M., Kalugin, A. S., Krylenko, I. N., Motovilov, I. G., Nasonova, O. N., Millionshchikova, T. D., & Frolova, N. L. (2022). Stok rek Rossii pri Proiskhodiashchikh i prognoziruemykh izmeneniiakh klimata: Obzor publikatsii. 2. Vilianie izmeneniia klimata na vodnyi rezhim rek Rossii v XXI veke [Stock of Russian rivers under existing and predicted climate changes: Summary of publications 2. The influence of climate on the water regime of Russian rivers in the 21st century]. *Vodnye Resursy*, *49*(3), 270–285.

Gerasimchuk, I., & Oharenko, Y. (2019). *Beyond fossil fuels: Fiscal transition in BRICS. Case study: Russia*. International Institute for Sustainable Development.

Godovova, E. (2012). Vzaimodeistvie Organov Gosudarstvennoi Vlast Orenburgskoi Oblasti S Kazachestvom [Cooperation of the state agencies of Orenburg Oblast with the Cossacks]. Orenburg: Pressa.

Godzimirski, J. M. (2022). Energy, climate change and security: The Russian strategic conundrum. *Journal of Eurasian Studies*, *13*(1), 16–31.

Government of Russia. (2011). Order from April 25, 2011 730-r on the confirmation of an integrated plan for realizing the climate doctrine of The Russian Federation through 2000. Retrieved from https://docs.cntd.ru/document/902275850

Government of Russia. (2019). National Action Plan for Adaptation to Climate Change to 2022 (Order No. 3183-R). Retrieved from http://government.ru/news/38739/

Grigorieva, E. A., & Revich, B. A. (2021). Health risks to the Russian population from temperature extremes at the beginning of the XXI century. *Atmosphere*, *12*(10) https://www.mdpi.com/2073-4433/12/10/1331

Grinevskiy, S. O., Pozdniakov, S. P., & Dedulina, E. A. (2021). Regional-scale model analysis of climate change's impact on the water budget of the critical zone and groundwater recharge in the European Part of Russia. *Water International*, *13*(428). https://doi.org/10.3390/w13040428

Gustafson, T. (2021). *Klimat: Russia in the age of climate change*. Harvard University Press.

Hansl, B., Levin, V., & Shaw, W. (2015). *Searching for a new silver age in Russia: The drivers and impacts of population aging*. World Bank Group.

Henderson, J., & Mitrova, T. (2020). Implications of the global energy transition. In M. Hafner & S. Tagliapietre (Eds.), *The geopolitics of the global energy transition* (pp. 93–114). Springer.

Henry, L. A., & Sundstrom, L. M. (2007). Russia and the Kyoto protocol: Seeking an alignment of interests and image. *Global Environmental Politics*, *7*, 47–69. https://doi.org/10.1162/glep.2007.7.4.47

Hjort, J., Streletskiy, D., Doré, G., Wu, Q., Bjella, K., & Luoto, M. (2022). Impacts of permafrost degradation on infrastructure. *Nature Reviews*, *3*, 24–38. https://doi.org/10.1038/s43017-021-00247-8

Inoteka. (2023). All Russia. Retrieved from https://inoteka.io/ino/foreign-agents-en

International Energy Agency. (2023). *World energy investment 2023*. International Energy Agency.

Ivanova, S. V., Kessel, S. T., Espinoza, M., McLean, M. F., O'Neill, C., Landry, J., Hussey, N. E., Williams, R. Vagle, S., & Fisk, A. T. (2020). Shipping alters the movement and behavior of Arctic cod (Boreogadus saida), a keystone fish in Arctic marine ecosystems. *Ecological Applications*, *30*(3), e02050. https://doi.org/10.1002/eap.2050

Kalugin, A. S. (2022a). Climate change attribution in the Lena and Selenga River runoff: An evaluation based on the earth system and regional hydrological models. *Water*, *14*(1), 118 Retrieved from https://www.iwp.ru/science/publications/kalugin-a-s-climate-change-attribution-in-the-lena-and-selenga-river-runoff-an-evaluation-based-on-t/

Kalugin, A. S. (2022b). Future climate-driven runoff change in the large river basins in Eastern Siberia and the Far East using process-based hydrological models. *Water*, *14*(4), 609 Retrieved from https://www.iwp.ru/science/publications/kalugin-a-s-future-climate-driven-runoff-change-in-the-large-river-basins-in-eastern-siberia-and-the/

Karachurina, L., & Mkrtchyan, N. (2022). Internal migration and population concentration in Russia: Age-specific patterns. *GeoJournal*, *87*(6), 4741–4762.

Katsova, V. M. (2022). Tretii otsenochnyi doklad ob izmeneniiakx i ikh posledstviiakh na territorii Rossiiskoi Federatsii [Third summary document on changes and their consequences on the territory of the Russian Federation]. St. Petersburg: Rosgidromet.

Kendall-Taylor, A., & Townsend, J. (2022). *Russia in the Arctic: Gauging how Russia's invasion of Ukraine will Alter regional dynamics*. Center for a New American Security.

Kharuk, V. I., Ponomarev, E. I., Ivanova, G. A., Dvinskaya, M. L., Coogan, S. C. P., & Flannigan, M. D. (2021). Wildfires in the Siberian taiga. *Ambio*, *50*(11), 1953–1974. https://doi.org/10.1007/s13280-020-01490-x

Khoreva, O. G., Konchakov, R., Leonard, C. S., Tamitskiy, A., & Zaikov, K. (2018). Attracting skilled labour to the North: Migration loss and policy implications across Russia's diverse Arctic regions. *Polar Record*, *54*(5–6), 324–338.

Kirillina, K., Shvetsov, E. G., Protopopova, V. V., Thiesmeyer, L., & Yan, W. (2020). Consideration of anthropogenic factors in boreal forest fire regime changes during rapid socioeconomic development: Case study of forestry districts with increasing burnt area in the Sakha Republic, Russia. *Environmental Research Letters*, *15*, 035009.

Kirkegaard, J. F. (2023). *Russia's invasion of Ukraine has cemented the European Union's commitment to carbon pricing*. Peterson Institute for International Economics.

Kitade, D. (2021). *Russia's climate change measures entering a transitional period*. Retrieved from https://www.mitsui.com/mgssi/en/report/detail/__icsFiles/afieldfile/2021/12/08/2111e_kitade_e.pdf

17577799, 2024, 2, Downloaded from https://wires.onlinelibrary.wiley.com/doi/10.1002/wcc.872 by Uppsala University Library, Wiley Online Library on [04/07/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Kjellén, J. (2022). The Russian Northern fleet and the (re)militarisation of the Arctic. *Arctic Review on Law and Politics*, *13*, 34–52.
Klimenko, V. V., Fedotova, E. V., & Tereshin, A. G. (2018). Vulnerability of the Russian power industry to climate change. *Energy and Buildings*, *142*, 1010–1022.
Klimenko, V. V., Klimenko, A. V., Tereshin, A. G., & Fedotova, E. V. (2018). Impact of climate change on energy production, distribution, & consumption in Russia. *Thermal Engineering*, *65*(5), 247–257. https://doi.org/10.1134/S0040601518050051.pdf
Koch, N., & Tynkkynen, V.-P. (2021). The geopolitics of renewables in Kazakhstan and Russia. *Geopolitics*, *26*(2), 521–540.
Kochtcheeva, L. V. (2022). Foreign policy, national interests, and environmental positioning: Russia's post Paris climate change actions, discourse, and engagement. *Problems of Post-Communism*, *69*(4–5), 423–435.
Kokorin, A., & Korppoo, A. (2013). Russia's post-Kyoto climate policy. Real action or merely window-dressing? FNI Climate Policy Perspectives 10. Lysaker, Norway: Fridtjof Nansen Institute.
Korppoo, A. (2016). Who is driving Russian climate policy? Applying and adjusting veto players theory to a non-democracy. *International Environmental Agreements: Politics, Law and Economics*, *16*(5), 639–653.
Korppoo, A. (2020). Domestic frames on Russia's role in international climate diplomacy. *Climate Policy*, *20*(1), 109–123.
Korppoo, A. (2022). Russian discourses on benefits and threats from international climate diplomacy. *Climatic Change*, *170*(3), 1–24. https://doi.org/10.1007/s10584-021-03299-3
Kozin, D. (2019). St. Petersburg's Dam is holding back the floods, for now. *The Moscow* Times. Retrieved from https://www.themoscowtimes.com/2019/02/21/st-petersburgs-dam-is-holding-back-floods-for-now-a64066
Ksenofontov, M. Y., & Polzikov, D. A. (2020). On the issue of the impact of climate change on the development of Russian agriculture in the long term. *Studies on Russian Economic Development*, *31*(3), 304–311.
Kurbanov, A. R., & Prokhoda, V. A. (2019). Ecological culture: An empirical projection (attitudes of Russians towards climate change). *Monitoring of Public Opinion: Economic and Social Changes*, *4*, 347–370.
Lankina, T. (2018). Lankina Russian protest event dataset. Retrieved from http://eprints.lse.ac.uk/90298/
Laruelle, M. (2012). Larger, higher, farther north... geographical metanarratives of the nation in Russia. *Eurasian Geography and Economics*, *53*(5), 557–574.
Lassila, J., & Siddi, M. (2021). *Russia meets climate change: The domestic politicization of environmental issues and external pressure to decarbonize*. Retrieved from Helsinki: https://www.fiia.fi/en/publication/russia-meets-climate-change
Lazarev, E., Sobolev, A., Soboleva, I. V., & Sokolov, B. (2014). Trial by fire: A natural disaster's impact on support for the authorities in rural Russia. *World Politics*, *66*(4), 641–668.
Levada Center. (2021). Mnenie rossiiskikh ekspertov o global'nykh izmeneniiakh klimata i sopriazhennykh protsessakh [The opinion of Russian experts on global climate changes and accompanying processes]. Retrieved from Berlin: https://libmod.de/en/russia_other_perspective_climate_change/
Lustgarten, A. (2020). How Russia wins the climate crisis. *New York Times*. Retrieved from https://www.nytimes.com/interactive/2020/12/16/magazine/russia-climate-migration-crisis.html
Makarov, I. (2022). Does resource abundance require special approaches to climate policies? The case of Russia. *Climatic Change*, *170*(3). https://doi.org/10.1007/s10584-021-03280-0
Makarov, I., Chen, H., & Paltsev, S. (2020). Impacts of climate change policies worldwide on the Russian economy. *Climate Policy*, *20*(10), 1242–1256. https://doi.org/10.1080/14693062.2020.1781047
Martus, E. (2018). Russian industry responses to climate change: The case of the metals and mining sector. *Climate Policy*, *19*(1), 1–13. https://core.ac.uk/download/pdf/155777039.pdf
Martus, E., & Fortescue, S. (2022). Russian coal in a changing climate: Risks and opportunities for industry and government. *Climatic Change*, *173*. https://doi.org/10.1007/s10584-022-03420-0
Matveeva, V. A., Alekseenko, A. V., Karthe, D., & Puzanov, A. V. (2022). Manganese pollution in mining-influenced rivers and lakes: Current state and forecast under climate change in the Russian Arctic. *Water*, *14*, 1091. https://doi.org/10.3390/w14071091
Meduza. (2023). *A year ago Russia began to agressively refuse to deliver gas to Europe. As a result, who suffered more?* Meduza. Retrieved from https://meduza.io/feature/2023/06/02/god-nazad-rossiya-nachala-stremitelno-sokraschat-postavki-svoego-gaza-v-evropu-kto-zhe-v-itoge-postradal-bolshe-evrosoyuz-ili-gazprom
Michaelowa, A., Koch, T., Charro, D., & Gameros, C. (2022). *Military and conflict-related emissions: Kyoto to glasgow and beyond*. Retrieved from Hamburg: https://thefivepercentcampaign.files.wordpress.com/2022/06/military-emissions_final.pdf
Ministry of Health of the Russian Federation. (2021). Plan adaptatsii k izmeneniiam klimata [Plan for the adapation to climate change].
Mironov, S. (2020, April 28, 2020). Online-lektsiia "Global'noe izmenenie klimata: politicheskie i nauchnye aspekty [Online lecture by Sergey Mironov "Global Climate Change: political and scientific aspects]. Retrieved from https://spravedlivo.ru/10243810
Moe, A. (2020). A new Russian policy for the Northern Sea route? State interests, key stakeholders and economic opportunities in changing times. *The Polar Journal*, *10*, 209–227.
Moe, A., Lamazhapov, E., & Anisimov, O. (2022). Russia's expanding adaptation agenda and its limitations. *Climate Policy.*, *23*, 184–198. https://doi.org/10.1080/14693062.2022.2107981
Moiseenko, T. I., Skjelkvåle, B. L., Gashkina, N. A., Shalabodov, A. D., & Khoroshavin, V. Y. (2013). Water chemistry in small lakes along a transect from boreal to arid ecoregions in European Russia: Effects of air pollution and climate change. *Applied Geochemistry*, *28*, 69–79.
Molchanova, T. K., Yashalova, N. N., & Ruban, D. A. (2020). Environmental concerns of Russian businesses: Top company missions and climate change agenda. *Climate Change*, *8*(56) Retrieved from https://mdpi-res.com/climate/climate-08-00056/article_deploy/climate-08-00056.pdf?version=158678

17577799, 2024, 2, Downloaded from https://wires.onlinelibrary.wiley.com/doi/10.1002/wcc.872 by Uppsala University Library, Wiley Online Library on [04/07/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Morozov, M. (2020). Transgranichnyi uglerodnyi nalog v ES: Vyzov rossiiiskoi ekonomike [Transborder coal tax in the EU: A challenge for the Russian economy]. EKONS. Retrieved from https://econs.online/articles/opinions/transgranichnyy-uglerodnyy-nalog-v-es-vyzov-rossiyskoy-economike/

Namsaraev, Z., Melnikova, A., Komova, A., Ivanov, V., Rudenko, A., & Ivanov, E. (2020). Algal bloom occurrence and effects in Russia. *Water*, *12*(285). https://doi.org/10.3390/w12010285

Narita, D., Gavrilyeva, T., & Isaev, A. (2021). Impacts and management of forest fires in the republic of Sakha, Russia: A local perspective for a global problem. *Polar Science*, *27*, 100573. https://doi.org/10.1016/j.polar.2020.100573

Nechaev, V. I., Saifetdinova, N. R., Khoruzhy, L. I., & Mikhaylushkin, P. V. (2021). The formation of crop insurance tariffs with state support in the Russia. In A. V. Bogoviz (Ed.), *The challenge of sustainability in agricultural systems: Lecture notes in networks and systems* (Vol. 205, pp. 577–586). Springer.

Newell, J. P., & Henry, L. A. (2016). The state of environmental protection in The Russian Federation: A review of the post-soviet era. *Eurasian Geography and Economics*, *57*(6), 779–801.

Nikolashvili, E. (2020). *Without water: Occupied crimea turning into a desert*. Unian Information Agency Retrieved from https://www.unian.info/economics/without-water-occupied-crimea-turning-into-a-desert-11163674.html

Organisation for Economic Co-operation and Development. (2020). *Fossil fuel support country note*. OECD.

Otto, F. E. L. (2015). Attribution of extreme weather. *Nature Geoscience*, *8*(8), 581–582. https://doi.org/10.1038/ngeo2484

Overland, I. (2022). Russia's invasion of Ukraine: Consequences for global decarbonization. *Russian Analytical Digest*, *284*, 2–5. https://doi.org/10.3929/ethz-b-000550755

Parfenova, E., Tchebakova, N., & Soja, A. (2019). Assessing landscape potential for human sustainability and 'attractiveness' across Asian Russia in a warmer 21st century. *Environmental Research Letters*, *14*(6), 065004.

Pavlova, V., Shkolnik, I., Pikaleva, A., Efimov, S., Karachenkova, A., & Kattsov, V. (2019). Future changes in spring wheat yield in the European Russia as inferred from a large ensemble of high-resolution climate projections. *Environmental Research Letters*, *14*, 034010.

Pavlovskii, A. A. (2013). O livnevykh zatopleniiakh nekotorykh territorii Sankt-Peterburga pri sovremennykh klimata [About storm flooding of some territories of St. Petersburg under the modern climate]. *Obshchestvo. Sreda. Razvitie [Society. Environment. Development]*, *2*(27), 251–256.

Plumer, B. (2022). War in Ukraine likely to speed, not slow, shift to clean energy, I.E.A. says. *New York Times*. Retrieved from https://www.nytimes.com/2022/10/27/climate/global-clean-energy-iea.html

Poberezhskaya, M. (2018). Traditional media and climate change in Russia. In M. Poberezhskaya & T. Ashe (Eds.), *Climate change discourse in Russia* (pp. 64–79). Routledge.

President of Russia. (2009). Utverzhdena Klimaticheskaia doktrina Rossiiskoi Federatsii [Climate Doctrine of the Russian Federation Confirmed]. Retrieved from http://kremlin.ru/events/president/news/6365

President of Russia. (2020). Strategy for the development of the Russian Federation Arctic zone and providing National Security through 2035. Retrieved from http://www.kremlin.ru/acts/bank/45972

Rantanen, M., Karpechko, A. Y., Lipponen, A., Nordling, K., Hyvärinen, O., Ruosteenoja, K., Vihma, T., & Laaksonen, A. (2022). The Arctic has warmed nearly four times faster than the globe since 1979. *Communications Earth & Environment*, *3*(168), 168. https://doi.org/10.1038/s43247-022-00498-3

RBK. (2018). Stavshii sovetnikom Putina glava pravitel'stva Chechni zaimetsia klimatom [Becoming an advisor to Putin, the Chechen prime minister changes the climate]. RBK. Retrieved from https://www.rbc.ru/rbcfreenews/5b2ce81d9a79470100b9329d

Revich, B. A. (2008). *Climate change impact on public health in the Russian Arctic*. United Nations in the Russian Federation.

Revich, B. A. (2020a). Riski zdorov'ya naseleniya pri izmenenii klimata Arkticheskogo makroregiona [Health risks to the population due to climate change in the Arctic macroregion]. Retrieved from Moscow: https://ecfor.ru/publication/zdorove-naseleniya-pri-izmenenii-klimata-arkticheskogo-makroregiona/

Revich, B. A. (2020b). Rossiyskiy i mezhdunarodnyy opyt razrabotki planov deystviy po zashchitye naseleniya ot klimaticheskikh riskov [-Russian and international experience in developing action plans for protecting the population from climate risks]. *Gigiena i Sanitariya*, *99*(2), 176–181.

Revich, B. A. (2021). Izmeneniye klimata v Rossii—Problemy obshchestvennogo zdorov'ya [Climate change in Russia—Problems for society's health]. *Obshchestvennoye Zdorovye*, *1*(4), 5–14. Retrieved from https://ph.elpub.ru/jour/article/view/31

Revich, B. A., Eliseev, D. O., & Shaposhnikov, D. A. (2022). Risks for public health and social infrastructure in Russian Arctic under climate change and permafrost degradation. *Atmosphere*, *13*(4), 532. https://www.mdpi.com/2073-4433/13/4/532

Revich, B. A., Maleyev, V. V., & Smirnova, M. D. (2019). *Izmeneniye Klimata i Zdorov'ye: Otstenka, Indikatory, Prognozy [Climate change and health: Evaluation, indicators, predictions]*. Institute of Economic Forecasting, Russian Academy of Sciences.

Robarts, R. D., Zhulidov, A. V., & Pavlov, D. F. (2013). The state of knowledge about wetlands and their future under aspects of global climate change: The situation in Russia. *Aquatic Sciences*, *75*, 27–38. https://doi.org/10.1007/s00027-011-0230-7

Rosneft. (2023). Rosneft at a glance. Retrieved from https://www.rosneft.com/about/Rosneft_today/

Russia Monitor. (2020). Russia's rosneft has new ownership structure but same CEO. Russia Monitor. Retrieved from https://warsawinstitute.org/russia-rosneft-has-new-ownership-structure-but-same-ceo/

Russian Academy of Sciences. (2021, October 14, 2021). Slukhi o klimaticheskoi katastrofe neskol'ko preuvelicheny—uchenye RAN [Rumors about a climate catastrophe are somewhat exaggerated]. Retrieved from https://www.ras.ru/news/shownews.aspx?id=3bea1f39-a680-4a2a-97b2-f7102cf955b9#content

17577799, 2024, 2, Downloaded from https://wires.onlinelibrary.wiley.com/doi/10.1002/wcc.872 by Uppsala University Library, Wiley Online Library on [04/07/2024]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Russian Federation Ministry of Energy. (2020). Pavel Sorokin: 'My vidim vozmozhnosti dlia sushchestvennogo povysheniia effektivnosti dobychi za schet ispol'zovaniia massiva dannykh' [We see the possibility for a significant increase in production effectiveness using big data. Retrieved from https://minenergo.gov.ru/node/19640

Rutland, P. (2022). Why crimea is the key to the Ukraine war. Responsible statecraft. Retrieved from https://responsiblestatecraft.org/2022/10/18/why-crimea-is-the-key-to-the-ukraine-war/

Sagynbekova, L. (2021). *The impact of climate change induced and environmental challenges on migration dynamics in rural Kyrgyzstan*. OSCE Academy.

Sardadvar, S., & Vakulenko, E. (2020). Estimating and interpreting internal migration flows in Russia by accounting for network effects. *Socio-Economic Planning Sciences*, *69*, 100685.

Savilov, Y. D., Briko, N. I., & Kolesnikov, S. I. (2020). Epidemiologicheskiye aspekty ekologicheskikh problem sovremennosti [Epidemiological aspects of contemporary ecological problems]. *Gigiena i Sanitariya*, *99*(2), 134–139. https://www.rjhas.ru/jour/article/view/198/0

Schatz, E. (2011). Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. In D. Moran (Ed.), *Climate change and national security: A country-level analysis* (pp. 129–139). Georgetown University Press.

Semenov, A. (2021). Russian political forces meet climate change. Commentary. Retrieved from https://www.csis.org/analysis/russian-political-forces-meet-climate-change

Shaposhnikov, D. (2014). Mortality related to air pollution with the Moscow heat wave and wildfire of 2010. *Epidemiology*, *25*(3), 359–364. https://doi.org/10.1097/EDE.0000000000000090

Shvidenko, A. Z., & Schepaschenko, D. G. (2013). Climate change and wildfires in Russia. *Contemporary Problems of Ecology*, *6*(7), 683–692.

Streletskiy, D. A., Suter, L. J., Shiklomanov, N. I., Porfiriev, B. N., & Eliseev, D. O. (2019). Assessment of climate change impacts on buildings, structures and infrastructure in the Russian regions on permafrost. *Environmental Research Letters*, *14*, 025003. https://doi.org/10.1088/1748-9326/aaf5e6

Svetlov, N. M., Siptits, S. O., Romanenko, I. A., & Evdokimova, N. E. (2019). The effect of climate change on the location of branches of agriculture in Russia. *Studies on Russian Economic Development*, *30*(4), 406–418.

TASS. (2014). Navodnenie v Krymske 6-7 iiulia 2012 goda. Dos'e [Flood in Krymske July 6–7, 2012]. Retrieved from https://tass.ru/info/1298613

TASS. (2021). Abramchenko schitaet, chto migratsiia iz-za izmeneniia klimata v Rossii neizbezhna [Abrochenko thinks that climate migration is inevitable in Russia]. Retrieved from https://tass.ru/obschestvo/12649977

TASS. (2022). Pravitel'stvo utverdilo otraslevye plany adaptatsii k izmeneniiam klimata [The Government confirmed sectoral adaptation plans for adapting to climate changes]. Retrieved from https://tass.ru/ekonomika/15028057

Troianovski, A. (2021). Where Ukrainians are preparing for all-out war with Russia. *New York Times*.

Tynkkynen, V.-P. (2020). Could Russia embrace an energy transition? *Current History*, *119*(819), 270–274.

Tynkkynen, V.-P., & Tynkkynen, N. (2018). Climate denial revisited: (Re)contextualising Russian public discourse on climate change during Putin 2.0. *Europe-Asia Studies*, *70*(7), 1103–1120.

United Nations Environment Programme (UNEP). (2022). The Environmental Impact of the Ukraine Conflict: A Preliminary Review. Nairobi: United Nations Environment Programme.

Vakulenko, E. (2019). Motives for internal migration in Russia: What has changed in recent years? *Applied Econometrics*, *55*, 113–138.

Volosukhin, V. A., Bandurin, M. A., & Prikhod'ko, I. A. (2022). Izmenenie klimata: Prichiny, riski dlia vodokhoziaistvennogo kompleksa Krasnodarskogo kraia [Climate change: Causes, risks for water system of Krasnodar Krai]. *Prirodoobustroistvo*, *4*, 50–56. Retrieved from https://www.elibrary.ru/item.asp?id=49615924

Vynogradova, P. (2020). Backgrounder: The water crisis in crimea. Geopolitical monitor. Retrieved from https://www.geopoliticalmonitor.com/backgrounder-the-water-crisis-in-crimea/

Wang, L., Huang, J., Cai, H., Liu, H., Lu, J., & Yang, L. (2019). A study of the socioeconomic factors influencing migration in Russia. *Sustainability*, *11*(6), 1650.

Wegren, S. K. (2022). The impact of climate change on Russian agriculture and implications for global food security. *Highlights of Sustainability*, *1*, 188–201.

Witze, A. (2020). The Arctic is burning like never before—And that's bad news for climate change. *Nature*, *585*, 336–337.

Zakhirova, L. (2013). The international politics of water security in Central Asia. *Europe–Asia Studies*, *65*(10), 1994–2013.

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