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Melting Science: Russian Climate Change Research in the Global Context

Alexey Zheleznov[1], Ekaterina Dyachenko[2], Maxim Dmitriev[3] and Katerina Guba[4]

[1] azheleznov@eu.spb.ru, [2] edyachenko@eu.spb.ru, [3] mdmitriev@eu.spb.ru, [4] kguba@eu.spb.ru
European University at St. Petersburg, Center for Institutional Analysis of Science & Education, Gagarinskaya st. 6/1 A, St. Petersburg (Russia)

Abstract

In this paper we wanted to assess the rapidly growing contribution of Russian scientists to global climate change studies. Our study examines publication patterns and citation impact across national and international journals, based on Scopus data for this area from 2010 to 2023. The analysis highlights shifts in the dissemination of Russian climate-related outputs, reflecting a transition from dominance by national mainstream journals to a more diverse landscape by 2022. Despite Russia's geopolitical isolation and reduced collaboration with the Western academic community, significant contributions to global climate change research persist in recent years. Approximately 90% of citations for Russian-authored articles originate from international journals. Our findings suggest that Russian journals continue to primarily serve the ex-Soviet research community, limiting their broader recognition. The study raises critical questions about the visibility and integration of Russian science in global research agendas. By investigating the interplay between external factors and scientific output, the findings shed light on the evolving role of Russian researchers in addressing pressing global challenges. This scientometric exploration offers insights into how academic isolation influences the structure and impact of national scientific contributions in the context of climate change, with broader implications for the global research ecosystem. A major freezing by western academic community has complicated a national science melting without a potential western diplomatic thaw with Russia as hundreds of regional researchers still prefer national journals.

Introduction

Our research explores Russian climate change science, emphasizing the importance of enabling prospective research to support global sustainability. The climate crisis has catalyzed interdisciplinary scientific efforts worldwide and fostered prominent initiatives promoting international cooperation. In response to the political freezing Russia might reflect on its Soviet-era experience on national self-sufficiency, leveraging existing scientific expertise and human capital (Krasnyak, 2018). Notably, every second Russian author in leading regional journals in Physics and Astronomy has also published at least one article or review in any of the Nature Index journals, that cannot be attributed only to 'low scientific quality' research (Veretennik & Yudkevich, 2023). Despite a Post-Soviet thaw, many Russian scientists continued to prioritize poorly visible local journals, but the rise of the international citation of Russian science has been tied to collaborative publications written directly in English and published in the major international journals (Kirchik et al., 2012). The Western academic community was quite outspoken on breaking academic relationships with Russian universities (Wit & Altbach, 2024). The current wide isolation of Russia's scholars has unfolded an ever-growing crisis that concerns global changes in the Arctic, in particular (Rees & Büntgen, 2024).

The purpose of this research is to examine the international visibility of the Russian climate-related output in both international and national journals from 2010 to 2023. Taking into account the huge variety of known environmental processes on Russia's climate change and the legacy of various academic groups, plenty of Russian researchers are still working in their labs at the time of the ongoing conflict. Notable experts (Oldfield & Poberezhskaya, 2023) warn that the increasing isolation of Russian science from the international community risks deflecting attention away from critical debates in geoengineering and climate modification, thereby alienating this rich scientific tradition at a critical juncture.

As the volume of climate change research grows, scientometric studies have expanded, providing an opportunity to understand a range of issues regarding new knowledge, including the productivity of specific countries and regions such as Central Asia (Vakulchuk et al., 2023). Prior research highlights that papers authored by ecologists from countries where English is a national language attract significantly more citations than those from non-native English speaking countries (Leimu & Koricheva, 2005).

The broad research question quiding this study is: What are the citation patterns of Russian climate change publications, and what do they tell about Russia's integration into global research on this hot topic?

Rather than offering a single assessment, this study aims to present a comprehensive picture that would help us understand whether Russia plays a prominent role in global warming studies. This can help to guess how climate-related sciences would be melted by a significant deterioration in the ties between Russian scientists and the science of Western countries.

The field of climate change research is highly heterogeneous. Russia possesses about 40% of the Arctic region and data obtained by polar scientists are an important element in understanding the rapid changes in global climate. Thus, interdisciplinary cooperation in climate research is a significant element for a deeper and more accurate understanding of climate change. Some works are products of international collaborations, while others are authored by Russian scientists only. To answer the research question we analyzed not just averaged indicators for this diverse flow of publications, but also its constituent parts separately. We believe this approach allowed us to obtain a citation pattern of Russian climatic research.

Material and methods

The metadata for scientific publications authored by Russian researchers were collected from Elsevier's Scopus bibliometric database over a 14-year period, spanning from 2010 at the end of 2023 (last accessed on 27.02.2024). The period was selected due to a significant increase in the volume of publications in this field during these years, and, more important, to the introduction of the so-called "mega-grants" governmental program in 2010, which aimed to establish research laboratories led by prominent scientists. Many representatives of the Russian diaspora, as well as leading domestic scientists, were awarded for their climate change-related projects.

Our search strategy expands upon broader bibliometric approaches, which often rely on standardized keyword-based queries (Fu & Waltman, 2022). However, such general approaches may oversimplify the complexity of climate-related research by overlooking regional terminologies and specific environmental factors relevant to a country's climatic characteristics. To address this limitation, we retrieved scholarly outputs, including papers published in 13 relevant international and national journals as well as those identified using a set of 179 important keywords and expressions[1]. Four types of publications were selected: articles, reviews, letters, and notes. A country restriction was applied — at least one author must have at least one affiliation in Russia.

To better understand relevant details, we categorized research journals into five distinct groups based on their audience orientation:

- International mainstream: the top-100 most influential journals cited by policy documents from the Overton database (Bornmann et al., 2022). These journals serve as key platforms for global scientific discourse and policy-relevant research in general.
- Low quality: journals that were either discontinued from the Scopus database or flagged by 'Beall's List' due to concerns about their editorial practices.
- Russian mainstream: national journals that publish predominantly in English, either as original publications or as translated editions of Russian-language articles.
- Russian non-mainstream: other national journals, often publishing in Russian.
- International non-mainstream: other journals that are neither in the top-tier international category nor classified as low-quality.

Results

Publication Output

Our strategy identified 21556 Russian-authored articles on the topic of climate change. As shown on Figure 1, the annual publication output of Russian authors grew rapidly from 2012. In 2010, Russian authors published 656 papers, and the dataset reveals a remarkable fourfold increase by the end of the period. Figure 1 illustrates the publication's dynamics across different journal categories. Notably, half of these publications are strongly associated with Russian journals.

1 The search query is presented online: https://github.com/OdSt/CLIMATE/blob/master/query.txt

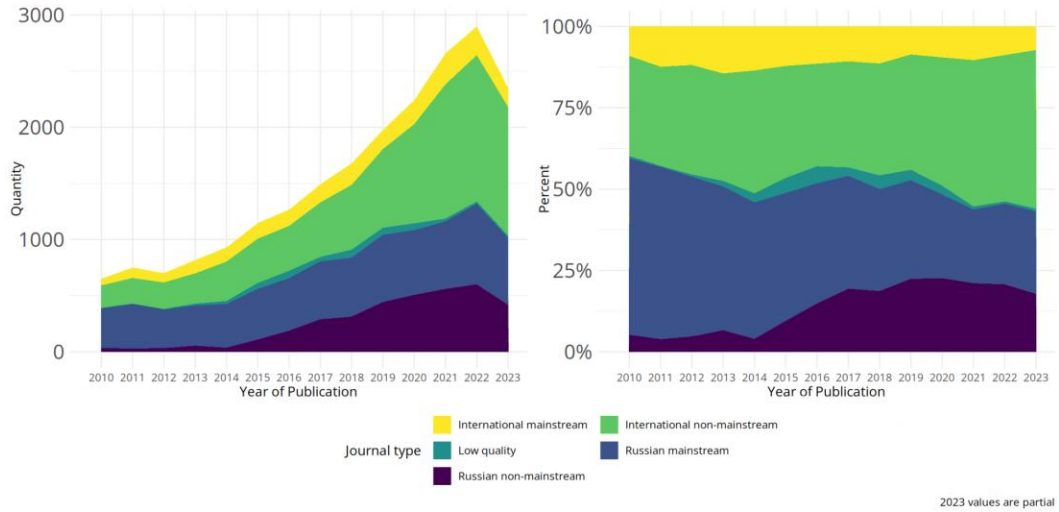

Figure 1. Origin of climate change-related publications by Russian researchers.

Between 2010 and 2014, Russian mainstream journals were the predominant platform for publication, averaging 369 articles annually, which accounted for 48.5% of the total number of articles during this period. After 2014, the share of other types of journals increased (Figure 1b). For instance, while in 2010 Russian non-mainstream journals published 5% of the total number of publications in that year, in 2022 they took up 20%. Another growing trend was demonstrated by the group of international non-mainstream journals. In 2010, this group had 30% of the total number of publications that year, but in 2022, there was already a 45% share. In the group of mainstream international journals, the share of publications remained virtually unchanged and averaged 10%.

Citations

Table 1 shows that different segments of the publication flow of Russian authors are quite different in terms of how many citations they receive and where these recognition come from. We wanted to find out whether the articles in each segment are important to the international community. We put five segments of the publication flow to the rows 2-6 of the Table. Columns from C to G show from which journals citations to Russian articles come from.

We see that the vast majority of citations of Russian articles - about 90% - is received by papers in international journals, not Russian ones. Papers in Russian journals present about half of the publication set, but attract only 11% of citations. Russian papers in international mainstream journals account only for 10% of the publication set, but attract 33% of the citations.

Articles from low quality journals receive not so many citations. Still, when one calculates the citation per paper ratio, it will be higher for low-level journals than for Russian journals (rows 5 and 6). We can confirm previous estimations (Kirchik et al., 2012) that papers in Russian journals (even those published in English) do not attract much attention. Many of these journals publish predominantly the authors from local academic communities.

We have identified that the origin of citations for each category come mostly from journals within the same set. It is interesting to look at the group of papers in Russian journals in English (Russian mainstream journals, line 5). Many of them are translated journals, i.e. they accept manuscripts in Russian and then translate them into English. This significant expenditure of publishing resources serves the goal of making the articles visible to an international audience. Do they achieve this goal according to the citation data? It seems that in general, they do not. The average number of citations of an article in a Russian journal in English is 1.4 over a 3-year window, and this is almost as high as for articles in Russian-language journals - 1.1. For comparison, articles in international journals gain on average 8.1 citations, in high-level international journals - 18.5.

Moreover, 70% of citations to Russian journals originate from Russian journals, indicating that translating articles into English does not significantly enhance their recognition by an international audience.

Several factors may contribute to this citation disadvantage. Lack of journal visibility could be one of them. Russian authors may also be inclined to publish the most interesting results in foreign journals. Another critical factor could be that Russian journals publish few articles created by international teams.

Table 1. Distribution of citations of Russian authors' publications by journal groups.

Papers in	*A) N of Russian papers*	*B) All citations in 3-year window*	*C) Citations from international mainstream journals*	D) Citations from international non-mainstream journals	E) Citations from low-level journals	F) Citations from Russian mainstream journals	G) Citations from Russian non-mainstream journals
All journals	**21556**	**123527**	**25211**	**83098**	**1342**	**9085**	**4656**
International mainstream journals	2197	40602	**14070**	25124	165	830	395
International non-mainstream journals	8385	68376	10510	**53187**	492	2653	1423
Low-level journals	468	980	21	399	**496**	17	46
Russian mainstream journals	6894	9611	531	3321	135	**4871**	749
Russian non-mainstream journals	3612	3958	79	1067	54	714	**2043**

Discussions

This paper has provided a broad overview of the contribution of 25528 Russia-affiliated scientists to global climate change studies. Our findings demonstrate the significant difference in the visibility and impact of papers across five different

groups of journals. Russian scientists, firstly, are actively involved in the study of global perspectives, and secondly, develop a number of locally important issues. Despite long-standing limitations such as insufficient computer capacity, the Russian scientific community has a long history of research on climate modeling and international cooperation in this area (Doose, 2022; Semenov et al., 2024). During freezing times of the Cold War competitions, world-class collaborations on glaciers and sea ice paradoxically melted the Iron Curtain and opened valuable links (Lajus & Sörlin, 2014). We looked at the size of the author teams in each group of the papers, and found that the biggest are those teams that produce internationally co-authored papers in international mainstream journals (median size is 8). Russian-only teams have a median of 3-4 members.

Christine Musselin (2024) describes how world-class researchers strategically navigate between solo and co-authored works, as well as between national and international publication venues. We observe comparable outliers among leading Russian climate scientists. For instance, climate modeler Evgeny M. Volodin has published high-impact solo-authored papers in international mainstream journals (Geophysical Research Letters, 2021; Environmental Research Letters, 2013) while also co-authoring widely cited articles in national mainstream journals (e.g., Izvestiya, Atmospheric and Oceanic Physics, 2010; Russian Journal of Numerical Analysis and Mathematical Modelling, 2018). This dual strategy suggests that top Russian researchers recognize the need to engage both domestic and global audiences, but structural constraints may still limit their international influence.

The broader geopolitical context has increasingly shaped the trajectory of Russian climate change sciences. While current climate mitigation actions are often driven by concerns of economic competitiveness, energy efficiency, and security interests (Kochtcheeva, 2022), the internationally recognized research teams and climate models still serve as vital foundations for climate sciences in Russia. Some scholars argue that Western countries should explore targeted climate policy incentives to sustain engagement with Russian researchers, given the global urgency of climate action (Moe et al., 2023).

If current trends persist, Russian science may face increasing fragmentation, with potential consequences for both national and global climate change research. The context of our study is the deteriorating relations between Russia and most Western countries. This is already affecting and will continue to affect how Russia participates in global climate science.

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