



## SHORT RESEARCH ARTICLE

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**Special Collection:**  
Equity in Co-Production

# GeoTraductores: A Collaborative Initiative Democratizing Science Communication in Latin America

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### Key Points:

- GeoTraductores uses a collaborative model for science communication, engaging volunteers across organizations for efficient co-production
- Inclusive co-production promotes equity, enhancing accessibility to scientific knowledge for non-English speaking communities
- Our model aids early career researchers, improving their writing skills, positively impacting their professional trajectories

### Supporting Information:

Supporting Information may be found in the online version of this article.

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**Abstract** GeoTraductores is an collaborative initiative between Eos, Planeteando, and GeoLatinas that aims to provide Spanish-speaking communities access to current scientific findings. This goal is accomplished by translating science articles originally published in English on AGU's [Eos.org](https://eos.org), within their Science News magazine, into Spanish. This cross-organizational initiative has translated, edited, and published over 150 articles, breaking the language barrier for Spanish-speaking communities. Our experience since 2020 has allowed us to tailor an efficient co-production model, which starts with (a) the selection of articles of interest to translate, followed by (b) the translation, reviewing, and editing process by volunteers, and (c) the publication and social media dissemination of the translated article. The tangible impact of GeoTraductores is evident in the substantial surge of visitor traffic to the Eos website between 2020 and 2023, particularly from Latin American countries. Notably, increases exceeding 85% were observed in Colombia, Mexico, and Panama, with 20% or greater growth in Chile, Brazil, Costa Rica, Peru, and Ecuador, confirming the initiative's success in meeting a genuine need. This impact extends globally, with Spain experiencing a 40% increase in visitors. Our co-production model is possible thanks to the contribution of around 40 GeoTraductores, mainly women (85%), who are native Spanish speakers or bilingual (Spanish and English speaking). These early-career scientists, through their volunteer work, enhance their bilingual communication skills while breaking down language barriers in science communication. The Eos-Planeteando-GeoLatinas co-production model fosters science democratization for Latin America while promoting diversity, equity, and inclusion in Earth Sciences, one translation at a time.

**Plain Language Summary** GeoTraductores is an Eos, GeoLatinas, and Planeteando initiative based on co-production and volunteering to provide Spanish-speaking communities access to current scientific findings through translations. Within the Eos en Español project, this initiative translates science articles from English into Spanish. Between 2020 and 2023, GeoTraductores has translated, edited, and published over 150 articles, thus breaking down the language barrier for Spanish-speaking communities. We have developed an efficient co-production model that involves article selection, volunteering translation, review, editing, and publication as well as social media dissemination of the translated article. The impact of GeoTraductores is evident in the substantial surge of visitor traffic to the Eos website between 2020 and 2023, particularly from Latin American countries. For example, visits to the website from Colombia, Mexico, and Panama increased by over 85% and grew 20% or more in Chile, Brazil, Costa Rica, Peru, and Ecuador. This impact extends to Spain experiencing a 40% increase in visitors. This co-production model is possible thanks to the contribution of 40 GeoTraductores, mainly women (85%), who are native Spanish speakers or bilingual early-career scientists. The Eos-Planeteando-GeoLatinas co-production model fosters science democratization for Latin America while promoting diversity, equity, and inclusion in Earth Sciences, one translation at a time.

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## 1. Introduction

English is the dominant language used to communicate cutting-edge research and innovative models or technology within the worldwide scientific community (Tonkin, 2011). Consequently, the majority of information disseminated through Science Communication (*SciComm*) with the intent to bring science closer to the non-scientific population is presented in English, creating a language barrier for non-English-native audiences. Multilingual *SciComm* ensures that these communities can access scientific news, exchange new and potentially beneficial findings, and engage in research that could impact them or their communities in their native languages.

A deficiency in the dissemination of new or updated studies in a community's native language, especially regarding Earth Science-related topics, limits its capacity to make informed decisions in the face of local, regional, and global environmental issues (e.g., climate change) or non-climate-change-induced geologic hazards (e.g., volcanic eruptions, earthquakes, etc.). This lack of accessibility and inclusivity also hinders the creation of spaces in which non-English-speaking scientists and community members can contribute to the knowledge amassed by scientific research worldwide and make it adaptable to different situations (Amano et al., 2023; Carroll & Sironi, 2023). Consequently, to fulfill their purpose, *SciComm* and public engagement initiatives require improved accessibility to scientific knowledge through language translation.

One of the major roles of Science Communicators (*SciCommers*) is to propagate science by decoding technical and scientific information and presenting it to the broader population in plain language. *SciCommers* seek to facilitate access to this information and engage the general public through the use of audiovisual resources and tools on different platforms, including social media (e.g., Bultide, 2011). The majority of the projects and mainstream platforms that *SciCommers* depend on to extend their reach further are operated and funded by countries in the Global North whose primary language is English (e.g., Nature, Science News, Live Science, Horizon). However, there are independent bilingual and multilingual *SciComm* platforms of collective scientists and *SciCommers* (e.g., GeoLatinas Blog, Planeteando) that focus on bringing science content to non-English speaking individuals who are not reached by mainstream media. One such platform is Global Voices (2024), an international network of volunteer bloggers and translators around the globe. Another is [WorldWideScience.org](https://www.worldwidescience.org), a multilingual science gateway to access international databases and portals that facilitate the dissemination of scientific and technical information (Sanz-Gil, 2014); and [Eos.org](https://www.eos.org), the science news magazine published by the American Geophysical Union that currently offers a selection of its English articles translated into simplified Chinese, Spanish, French, Russian, Hindi, Portuguese, and Arabic. The latter exemplifies the efforts in translation into different languages, contributing to the democratization of science, that is, providing science news to readers of different languages. In this report, we define the democratization of science as the process of communicating science to the general public by breaking cultural and linguistic barriers facilitated by altruistic individuals and parties.

*GeoTraductores* is a volunteering initiative composed of mainly early-career geoscientists from GeoLatinas and Planeteando organizations partnered with the [Eos.org](https://www.eos.org) platform to participate in the *Eos en Español* project. In this report, we address the importance of technical translations and present the *GeoTraductores* initiative and its impact. First, a literature review addresses three aspects of *SciComm*: English as lingua franca, scientific translations, and our co-production model extension within volunteering collaborations. Then, we describe our co-production initiative, collaborative workflow, and the impacts on the Spanish-speaking audiences, volunteers, and organizations with collected data. Finally, we present our eight lessons learned with corrected actions and recommendations that can be used by other *SciComm* collectives in translating English articles into Spanish, or other languages, to bridge the language gap and increase public accessibility and engagement on Earth Science-related topics.

### 1.1. English as the Dominant Science Communication Language

The formal acknowledgment of English as the current *lingua franca* for global communication can be traced back to the historical influences of Anglo-Saxon civilizations during the Middle Ages, British colonialism during the XVIII and XIX centuries, and the current Western economic hegemony (e.g., Tonkin, 2011). During the Middle Ages through the early Renaissance, Latin served as the lingua franca for scientific discourse, later supplanted by the French until the Enlightenment period (Lindberg, 2010; Montgomery & Kumar, 2015). Consequently, the evolution of the lingua franca parallels our historical trajectory, significantly shaping global communication.

In academia, scientific neocolonialism is a term used to express the inequality of research activities in the Modern Era. Neocolonialism conveys the concept of colonial or parachute science—an extractivist practice from researchers of higher-income countries to investigate and extract data from non-native or lower-income countries without involving the local researchers and community (Odeny & Bosurgi, 2022; Stefanoudis et al., 2021). Murphy and Zhu (2012) connected academic neocolonialism to the journal ranking system dominated by Western Anglo-countries and the lack of attention received by non-English speaking researchers publishing their scientific findings in local journals. Hence, English is deeply intertwined with academic neocolonialism, forming a linguistic imperialism that confines knowledge transfer only to English-speaking audiences (Canagarajah & Said, 2011).

The prioritization of English in academic publications places non-native English-speaking researchers in a challenging position, necessitating proficiency or translation services to publish in high-ranked journals for visibility and recognition. Lazcano-Peña et al. (2019) highlighted this trend in a survey of 110 researchers from four Chilean universities, where publishing in English high-impact journals is not just an academic requirement but also a labor indicator. In contrast, the obligation for SciComm to the general public is notably absent from academic duties, depending solely on researchers' inclination and available time.

Across higher education institutions in Latin America, the academic settings mandate publication in high-impact English journals for global visibility and recognition, sidelining native language publications (e.g., Basilio, 2023b). This approach hampers knowledge transfer to other languages, hindering the timely application of scientific advancements to address local issues faced by communities (academia, industry, and governments) technologically (Johnson & Zentella, 2017). Consequently, the lack of emphasis on SciComm results in decreased accessibility to scientific information for the general public, adversely impacting decision-making processes concerning critical societal aspects like energy transition, climate change actions, and other vital aspects of our society.

## 1.2. Scientific Translation: Why and How?

There are an estimated 1.5 billion native and non-native English speakers around the globe (Statistics and Data, 2023). Although English is the most widely spoken language worldwide, nearly 81.5% of the world's population does not use it to communicate on a daily basis. The exclusive use of English in impactful scientific research and journals limits the dissemination of scientific information to more than three-quarters of Earth's habitants (e.g., Amano et al., 2023). Cutting-edge research, important information on climate change and policies, and other relevant issues often do not reach non-English-speaking populations at local and regional levels, even when it benefits their quality of life. Translating scientific information to other languages is one of the primary solutions to this problem. By creating SciComm multilingual platforms to fulfill this task, translations into Mandarin Chinese, Hindi, and Spanish (the three most spoken languages after English) would increase accessibility to science for at least an additional 1.7 billion people (Statistics and Data, 2023). Márquez and Porras (2020) proposed three approaches to achieve an effective multilingual SciComm: (a) multilingual translation for science accessibility, (b) training for STEM experts and Scicommers, and (c) promoting grassroots movements toward inclusivity. Ghidhaoui (2020) further suggests that another key aspect when translating scientific texts from English to other languages is recognizing the need for cultural contextualization, or interlinguistic translation. This is achieved when the translator adapts information by altering the literal translation of the text so that the audience understands the message's intention in their native language. This is also known as transcreation, which Díaz-Millón and Olvera-Lobo (2023) define as:

“...a type of translation characterized by the intra-/interlingual adaptation or re-interpretation of a message intended to suit a target audience, while conveying the same message, style, tone, images and emotions from the source language to the target language, paying special attention to the cultural characteristics of the target audience. This reinterpretation of the message may imply adaptations that move away from the original text to a greater or lesser extent to fit the original purpose, transmit the original message and overcome cultural barriers. For such reasons, it is present in persuasive and communicative contexts (p. 358).”

In addition to their own skill set and their cultural background, translators can use innovative technologies. For example, machine translation tools, like Google Translate and ChatGPT, can perform translations 10 times faster than professional translators, as noted by Van de Meer (2010). These tools can assist with reading and writing in

foreign languages and serve as post-editors for proofreading translations, ultimately enhancing learners' cross-cultural and cross-linguistic awareness, as demonstrated by Jiménez-Crespo in 2017. Hence, Artificial Intelligence (AI) can help scientists and SciComms translate first drafts more efficiently. However, such tools need to be used with good judgment (Steigerwald et al., 2022). Prates et al. (2020) found that the Google Translate tool is strongly biased in translating male pronouns from 12 languages, such as Hungarian, Chinese, French, using examples with female, male, and neutral pronouns, particularly so for STEM related translations. In addition, Amano et al. (2023) found that most non-English speaking researchers prefer to pay for translation services or use a third party as a language receptor editor rather than use machine translation tools. Nonetheless, AI tools can assist non-native English speakers in improving their language accuracy when translating into English. These tools can also support low-income countries that cannot afford translation services, as a step toward achieving equity in science (Berdejo-Espinola & Amano, 2023). Furthermore, some initiatives (i.e., Ted-translators) utilize computer aid technology as assistants to aid the translation process (Jiménez-Crespo, 2015). Steigerwald et al. (2022) highlighted that AI tools combined with collective efforts “*can transform a monolingual scientific hub into a multilingual scientific network*,” contributing to promoting multilingual spaces, which will decrease the degree of bias in global policy, management, and decision-making.

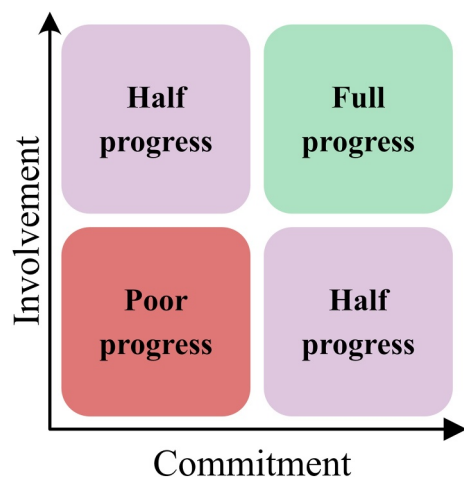
Regarding professional translation activities, the ISO 17100 (2015) guidelines describe technical translators as professionals hired to translate information, setting the quality of translation services standard to which professional translators adhere. Nonetheless, translators often need expertise in the diverse fields that benefit from language translation, especially in regards to STEM technical language. An article by Language Scientific (2019) distinguishes between these “technically competent” translators and technical translators who are also experts in their fields. They mention that translations carried out by non-expert technical translators have a higher risk of containing crucial mistakes that might endanger the overall message. In contrast, people who have studied distinct subjects for years are reasonably more suited to translate related work and ensure the dissemination of contextually correct information in STEM fields. In addition to professionals who dedicate their livelihoods to translating scientific information, many bilingual and multilingual scientists invest a considerable fraction of their time in translating information to disseminate their work (Jiménez-Crespo, 2017) through volunteering or as a hobby. This additional task often consumes part of their time and effort and is rarely rewarded, limiting the number of scientists willing to take on translation tasks as an extra responsibility (Lazcano-Peña et al., 2019). Bigger translation projects (e.g., books, Wikipedia pages, websites) are more likely to be pursued by collective initiatives based on collaboration and volunteer work, in which participants can choose to remain anonymous (Celis-Mendoza, 2019).

### 1.3. GeoTraductores Case Study

To volunteer is to be of service for the benefit of the public without having any obligation to do so. Many volunteers have altruistic motives: their humanitarian concerns drive them to act without remuneration; others offer their services in hopes of gaining experience, acquiring new skills, strengthening social skills, boosting self-esteem, or amplifying networking while working toward a noble cause (e.g., Asghar, 2015; Clary et al., 1998). Non-profit organizations, which depend on sources of external funding, tend to rely on volunteer work to achieve their missions when lacking the necessary resources to offer paid labor. However, they can further increase their access to resources by engaging in co-production, which is defined as the interaction between people and forms of knowledge pertaining to different research institutions (Chambers et al., 2021).

In the case of non-profit organizations, co-production can be used to counteract resource and tool limitations, which are essential for reaching the general public and fulfilling organizational objectives. The GeoTraductores co-production model exemplifies *Science as Capacity Building* (Akerlof et al., 2023), wherein community organizations partner to co-produce through their members in STEM-related initiatives and actively participate as representatives. This approach differs from traditional co-production models, which often involve communities with agency in content selection and decision-making (Fischer & Eastwood, 2016; Ostrom, 1996). The GeoTraductores co-production model consists of partnerships between different organizations and volunteers, where its members select and translate articles. Here, we acknowledge the extension of the conventional definition of co-production and are transparent about our singular model as a collaboration type.

Such collaborations as a basis for this co-production type can effectively address inequities by enhancing organizations' capabilities to promote the recognition and visibility of marginalized or underrepresented groups.



**Figure 1.** Volunteer progress tasks involvement versus commitment matrix (Modified from GeoLatinas & Navarro-Perez, 2022).

possesses a sense of ownership, responsibility, and support for the initiative's objectives. We enrich our skills by sharing knowledge and learning from each other's experiences. Conversely, equity in co-production within volunteering organizations can be challenging. After distributing tasks, the progress of each assigned task is up to the volunteers' time and effort. From our experience, if there is no encouragement, form of reward, or positive leadership, the progression in co-production decreases due to the lack of commitment of volunteers (Figure 1). The delayed deliverable tasks may enact a domino effect in postponing the final products in the co-production, and other volunteers may increase their workload to reach the committed deadline delivery, resulting in co-production inequity.

## 2. GeoTraductores: A Volunteer-Based Co-Production Initiative

The GeoTraductores initiative started in 2020 as a partnership and collaboration between Planeteando, GeoLatinas and Eos. This initiative makes SciComm accessible to Spanish speakers, primarily based in the USA and Latin America, by translating science articles from the [Eos.org](https://eos.org) platform within the *Eos en Español* project (<https://eos.org/eos-en-espanol>). In the first year, more than 40 articles translated into Spanish were published by Eos and Planeteando, and since then, over 150 SciComm articles have been made available in Spanish (Table S1). GeoLatinas and Planeteando provide translators, mainly early career scientists, an opportunity to translate scientific content while improving their English reading and comprehension skills. High-quality translations for the Spanish readership are ensured by Planeteando's editorial team, also part of GeoTraductores, while review and scheduling of the upload for the final articles is done by Eos, who provides their platform and social media channels to disseminate this exhaustive work.

GeoLatinas' experience in creating multilingual content goes back to its foundation. Since 2019, GeoLatinas has been creating multilingual social media content (in Spanish, English, and Portuguese) to amplify the careers of Latin American women in Earth and Planetary Sciences. In 2020, a focus was made on multilingual science and diversity content through the GeoLatinas Blog and other initiatives led by its members (Barragán-Montilla et al., 2023; Gómez Correa & Rosa Marín, 2020; Rosa Marín et al., 2020). GeoLatinas Blog published over 15 blog entries about science, diversity, and inclusion in English, Spanish, and Portuguese, channeling the growing interest of its members to work toward science accessibility and democratization in Latin America. This initiative assembled and trained a skilled team of editors and translators, who later joined the *GeoTraductores* initiative.

Originally conceived as a series of engaging videos, Planeteando aimed to demystify Earth Sciences by explaining its core concepts in Spanish, often utilizing elements of popular culture to capture and retain the attention of a diverse audience (Bastien-Olvera & Pilatowsky-Gruner, 2019). Over time, Planeteando expanded its scope and now includes a diverse team of natural scientists, social scientists, and artists. This team works together to produce a variety of projects ranging from podcasts and documentaries to film festivals and even geoscience-themed drag shows (Basilio, 2023a). Planeteando's forte lies in distilling complex socio-

While equity in the geosciences has seen progress through the establishment of organizations such as the AAPG Women's Network, Association for Women Geoscientists, Asian American and Pacific Islanders in Geosciences, AGQ (LGBTQ + affinity community of AGU), National Association of Black Geologists and Geophysicists (NABGG), GeoLatinas, Planeteando and many others, there remains a need for more collaborative spaces. These spaces can maximize the impact of diversity-focused initiatives by pooling resources and leveraging each other's strengths to address weaknesses or gaps in current efforts or resources within the field.

Using volunteers in non-profit organizations' co-production increases accountability (Tuurnas et al., 2016) since it amplifies the scaling up of ideas and enhances a high sense of belonging (de Wit et al., 2019), and the benefit and cost ratio increases in favor of gaining skills and experience (Chinman & Wandersman, 1999). Combined with proficient coordinators and positive leadership in Science as Capacity Building co-production types, these factors contribute to achieving an equitable balance and continuous improvement in volunteering collaborations. The GeoTraductores collaboration is based on co-leadership and peer mentorship, wherein each co-leader and volunteer

environmental concepts and challenges into accessible and engaging content for the general public. This approach has not only popularized scientific understanding but also positioned Planeteando as a pivotal voice in addressing the climate change crisis, particularly in Mexico, where it resonates deeply with the local socio-environmental narrative.

Eos is the century-old nonprofit news magazine published by AGU (the American Geophysical Union), whose mission is “to promote discovery in Earth and space sciences for the benefit of humanity.” The authors would like to recognize that most of Eos' news is produced by the Global North or from Western-Anglo SciComm projects and that this may unintentionally reinforce the power imbalances discussed previously through scientific colonialism. However, Eos's global bureaus and translation projects are actively working to decolonize their organizational structures by broadening readership by publishing news written by diverse science writers from various regions around the globe. In the mid-2010s, Eos began an aggressive initiative to broaden its international reach through greater recognition and coverage of Indigenous Peoples and Traditional Knowledges, the establishment of SciComm bureaus around the world (primarily the Global South) as well as translating articles, features, and research profiles to Spanish and Simplified Chinese. To date, the ongoing initiative has grown to include bureaus throughout Latin America, India, Africa, and Oceania, as well as translations available in Spanish, Simplified Chinese, French, Russian, Portuguese, Hindi, and Arabic. Furthermore, accessibility to Eos SciComm articles extends through its educational platform ENGAGE (<https://eos.org/engage>) for educators teaching primarily in high school and undergraduate science. For Spanish-translated articles, teachers have requested audio of the stories along with the articles. These educators primarily teach high school students in ESL (English as a second language) and Spanish classes. Eos currently enjoys a professional relationship with Planeteando and GeoLatinas, who continue to provide all Spanish translations for *Eos*, and as AGU's relationship with the organization has expanded to sponsorship of Planeteando's Fall School for early-career SciCommers.

The extensive efforts from GeoLatinas and Planeteando to make science available for non-English speaking audiences were later channeled through the *Tools of the Trade* series by the Nature Reviews Earth and Environment journal. Since 2022, GeoLatinas has been publishing short articles in this series in English and the author's mother tongue (Spanish or Portuguese). This joint effort marked the beginning of the *Tools of the Trade by GeoLatinas* collection. As for 2023, 13 articles about scientific methodologies used by GeoLatinas' early career scientists are available in this Nature journal in English, Spanish, and Portuguese, making an invaluable contribution to science accessibility and providing our members with the chance to create their own multilingual content and publish it in indexed journals (Nature, 2023).

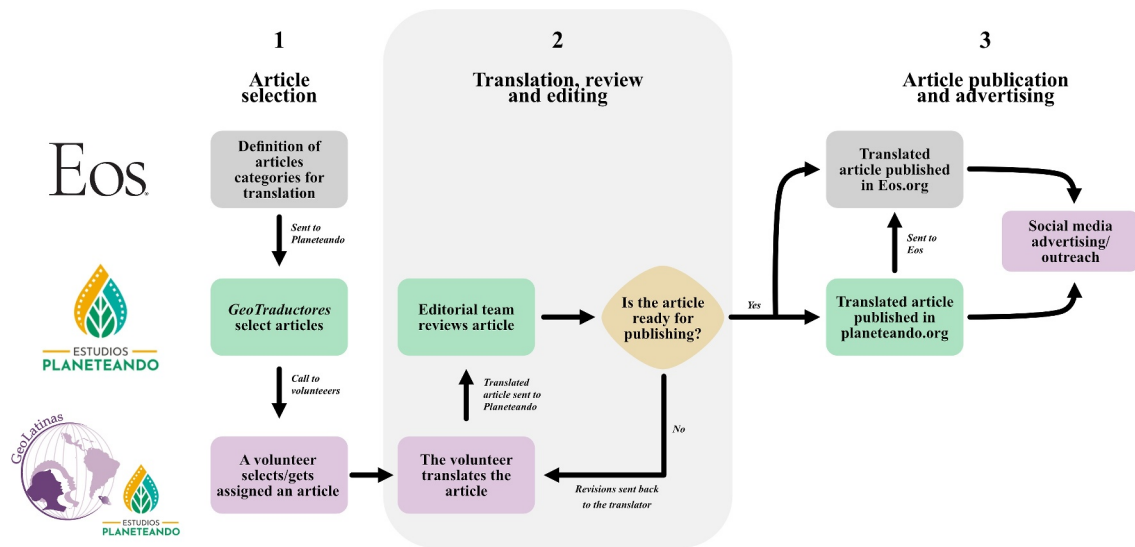
### 3. A Collaborative Workflow for SciComm Translations

GeoLatinas, Planeteando, and [Eos.org](https://eos.org) have overlapping interests that converged to create the GeoTraductores initiative. Before describing the collaborative workflow, we present a brief description of the mission and overall aim of each organization.

GeoLatinas is an online international member-driven organization with the mission to embrace, empower, and inspire Latinas to thrive in Earth and Planetary Sciences. Currently, we have around 1,300 members in over 56 countries worldwide. Our members are at different levels of their professional careers in academia (46%), industry (10%), government agencies (6%), and entrepreneurship (4%). We are a multicultural organization that embraces our Latin American heritage and communicates in English, Spanish, and Portuguese. Within science communication, GeoLatinas aims to close the cultural and linguistic gap between Latin American people and opportunities for career progression (Barragán-Montilla et al., 2023).

Planeteando is a scientific and social outreach project mainly focused on Earth and environmental sciences. They specialize in the entire process of audiovisual content creation, starting from researching and synthesizing the content, moving through the production stage, and finally, distributing the material. They also organize science fairs and a film festival and have their own blog where they publish original content in Spanish and the Eos translations. Planeteando aims to create spaces to learn and reflect from a social and environmental perspective (<https://planeteando.org/>).

Eos.org provides accessible content (not behind a paywall) to more than a quarter million readers every month. Articles and opinions focus on new developments in the Earth and space sciences as well as issues of interest to



**Figure 2.** GeoTraductores co-production workflow.

scientists and the science-interested public: climate change, communicating science, education and careers (<https://eos.org/>).

We divide our collaborative work into three main steps: (a) article selection, (b) translation, reviewing, and editing, (c) publication, and social media outreach (Figure 2). To facilitate the workflow between organizations, a standard template created by Eos is used with a specific order for each translation section.

In the first step (Figure 2), the GeoTraductores send a proposal to Planetando with the original Eos article they want to translate. Planetando corroborates that the selected article has yet to be, or is currently being, translated by another GeoTraductorx to approve the start of the translation. During this step, the selection of the article by the GeoTraductorx is a choice of their own. In this way, the GeoTraductorx can work on a topic they are an expert in or feel interested in. This allows all parties involved to ensure the GeoTraductorx would have sufficient technical knowledge to translate niche terms and sustain volunteer motivation (Figure 2) to complete a mostly volunteer translation. Moreover, it also enables a diversity of translated topics since the GeoTraductores come from a wide variety of fields with different interests. The range of articles does not only limit to their topics, but also their type, length and format. They vary from in-depth features, traditional news articles and short single-study profiles. Such diversity in the content accessibility caters to a broad audience, from the casual science-interested public to professional Earth and space scientists.

During the second step (Figure 2), the GeoTraductorx works independently on the translation. According to the collected data from a survey (Section 4.3), most of them follow three stages before sending the first draft of the text to the editor at Planetando:

- Read: Scan the article to understand the writer(s) message; deep reading to identify colloquial language or jargon, unknown words, and people genres.
- Translate: Start translating paragraph by paragraph and apply transcreation to culturally adapt some phrases that literal translation does not have the correct meaning in Spanish (i.e., deliver the writer(s) message correctly).
- Editing: Compare the original text with the translation to correct for inconsistencies; some GeoTraductores use AI tools such as Google Translator; and re-read throughout the text to secure high-quality translation.

Once Planetando receives the first draft, the job of the editor is to review and edit the translation to ensure the concepts and tone follow the intention of the original author(s). If any important corrections are needed, the draft is sent back to the GeoTraductorx for revision (Figure 2, step 2), with comments and suggested changes to help the GeoTraductorx improve their translation skills.

During the final step of the process (Figure 2, step 3), Planeteando publishes the final version of the translation at [planeteando.org](https://planeteando.org) and sends it for publication in Eos. The role of the Eos Editor is to accept the translated piece and prepare for publication at [Eos.org](https://eos.org). The editing process involves reviewing all present sections, adding metadata, placing images correctly, searching for and highlighting direct quotes, and adding the translator and partnership information. Once published, Eos, Planeteando, and the GeoLatinas visibility team share the articles on social media to broaden their reach. To acknowledge their work, GeoTraductores are also tagged in social media posts, allowing them to increase their visibility and build networks.

### 3.1. An Evolving Collaboration

The GeoTraductores initiative has been running for more than 3 years. During this period, we have made distinct efforts to keep it going and to involve more people in the project. The Planetando team made the first translations, soon joined by the GeoLatinas organization, increasing the number of GeoTraductores and the diversity of topics. GeoLatinas and Planeteando continue to call on for more volunteers to join this initiative. In the first 3 years of this initiative, these efforts have brought together nearly 40 GeoTraductores.

Despite the relatively large number of GeoTraductores and their enthusiasm, most of their involvement and commitment (Figure 1) was limited, because their workload did not allow for volunteer work. This is reflected in the percentage of translations each of them has contributed to the initiative. Nearly 42% of the 156 translations we have published in our first three and a half years have been made by two GeoTraductores, who lead the initiative in the GeoLatinas and Planeteando teams.

To encourage more volunteers and reduce the workload of the GeoTraductores who have contributed the most, Eos, Planeteando, and GeoLatinas ran a translation workshop in April 2022. Tips and feedback for translation and selection of articles were provided to the attendees to motivate the first translation work process as a final product. Once approved by the Editors, these translations were published in the *Eos en Español* project. Alongside the publication of their translation, we also provided a completion certificate. This new strategy fueled the initiative with new volunteers, demonstrating that implementing positive leadership and incenting strategies within a co-production like GeoTraductores can significantly enhance volunteer participation.

However, the momentum GeoTraductores gained following the workshop dwindled after a few months, leading to a reliance on a few volunteers. Fortunately, during the last quarter of this three-and-a-half year period, Eos allocated funds to start compensating GeoTraductores for their work, marking a new phase for our initiative. This change facilitated a new call offering incentive pay, to which approximately 26 GeoTraductores applied, with the majority being new volunteers. While keeping the same workflow, we noticed that (Figure 2), while previously GeoTraductores took 1–2 months to finish an article translation; however, with the introduction of incentive pay, the turnaround time improved to a week. This new incentive is projected to provide a more tangible benefit for the GeoTraductores, allowing them to invest more time in the project.

## 4. GeoTraductores Initiative Impact

### 4.1. Reaching the General Public

GeoTraductores has proven to be a valuable initiative to reach broader audiences in the Spanish-speaking world. From January 2020 to April 2023, analysis of the [Eos.org](https://eos.org) website revealed approximately 65,000 visitors engaging with the Spanish-translated articles. Notably, 20% of the total visits to translations were from users browsing in Spanish, a significant increase of 74% in overall Spanish browser traffic during this period. Interestingly, this 20% of visitors from browsers set to Spanish highlights the immense importance and the wide interest of these translated pieces within the Spanish-speaking community, since only fewer than 2% of the 3.2 million visits Eos has per year are from browsers set to Spanish. Because of GeoTraductores, the number of browsers set to Spanish went from only 4,000 to 13,000 during the years of the initiative. Over the analyzed period, Eos enjoyed a significant increase in traffic from different Latin American countries. The largest increase was detected from browsers with a location set in Colombia, showing a 161% increment of visitors. Interest in Mexico and Panama shows a rise in around 90% of readers. Traffic also increased by nearly 50% from browsers set in Peru, Ecuador, and Costa Rica. A smaller ~20% surge was also documented for Chile and Brazil. Outside Latin America, the amount of visitors from Spain also increased by 40%. We expect these numbers to continue increasing as more translations are published, with added focus on translating articles on topics relevant to Latin



America. This redirection is informed by analytics that show two of the top 5 most visited stories are those set in Colombia (Garzón & Flórez, 2021) and Mexico (O'Hanlon, 2021), with 3,687 and 14,849 visit respectively over the analyzed period, suggesting readers are interested in topics that are related to their current location.

#### 4.2. Diversity Insights in GeoTraductores

Almost 40 GeoTraductores have engaged in Spanish-English translations. While the majority are native Spanish speakers, a few are either native English speakers or grew up bilingual. The driving force behind the initiative predominantly consists of women, making up approximately 85% of the GeoTraductores. Our diverse cohort includes individuals from various nationalities, including Mexican, Chilean, Colombian, Venezuelan, Peruvian, Puerto Rican, Ecuadorian, and American backgrounds. The GeoTraductores predominantly consist of individuals in the early stages of their careers, encompassing postgraduate and undergraduate students as well as those in their initial professional roles. The initiative boasts a substantial representation of individuals who hail from low to middle-income households, including first-generation undergraduate and postgraduate students. Within the GeoTraductores a diverse range of expertise is present, spanning from applied geosciences to fundamental science research. The extensive range of themes in the translated articles mirrors the diverse cohort and the GeoTraductores' liberty to choose articles for translation.

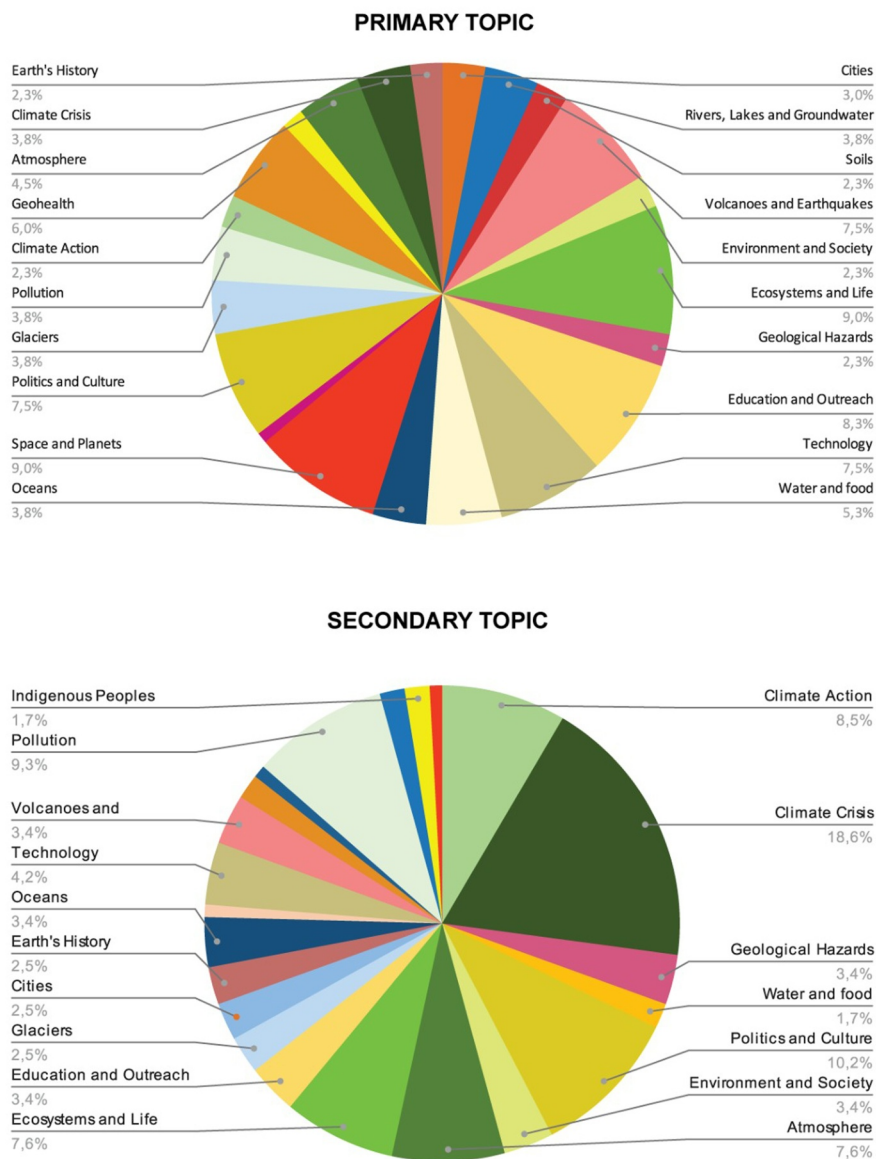
To analyze the distribution of topics of the translated articles, we used 23 categories (Figure 3) that broadly encompass their themes. We assigned a primary and a secondary theme to each piece according to their content. For example, if the article focuses on describing strategies to raise awareness of the volcano hazards, we assigned the primary theme to the "Education and Outreach" category, while the secondary topic would fall within the "Geological Hazards" category. The distribution of the primary theme revealed no significant bias toward a specific field (Figure 3), although the secondary topics show a slight preference toward pieces tackling climate issues (Figure 3), a pattern seen in Eos as a whole. Thus, the data show that our initiative brings diversity to the SciComm content we are sharing in Spanish.

#### 4.3. Advantages, Pitfalls, and Future Perspectives of the GeoTraductores Initiative

To obtain insights, opinions, demographics, and perspectives from the different actors participants involved in GeoTraductores, a survey was conducted among the organizations involved from July 24 to 8 August 2023. Seventeen participants answered, 12 as translator volunteers, four as the organizations' representatives, and two as editors. Our partnership representatives embraced the concept of *Equity in Co-production*, where each party shared equal participation and responsibility in crafting a final product. This collaborative effort was dedicated to disseminating science news in Earth and Planetary disciplines to Spanish audiences. To enhance our approach, we actively sought the perspectives of various stakeholders involved in the initiative. This reflective process delved into both the pitfalls and advantages of our workflow over the past years, paving the way for insightful future perspectives.

Survey participants identified diverse advantages to this initiative and its collaborative workflow, reflective of their role in the initiative. From the GeoTraductores and editors' perspective, the advantages are gaining English and translation skills, learning new scientific knowledge, enhancing collaboration and networking, contributing to the global Spanish-speaking community, and a flexible workload. The organizations' representatives expressed that among the benefits of this co-production are the flexibility and freedom of article selection, continuing knowledge transfer from scientific concepts, continuous improvement in identifying the subtle differences in how English and Spanish SciComm operate, providing opportunities to early geoscientists and postgraduate students to be involved in SciComm and reaching broader audiences.

Although most members of the initiative agree to its benefits, they have also pinpointed a few challenges encountered throughout the process. Some GeoTraductores expressed a lack of accountability from the initiative co-leaders as a disadvantage, which likely reflects the initiative's co-leader's limited time for volunteer work that as previously mentioned does not contribute to labor metrics. Another disadvantage expressed by GeoTraductores was that the absence of monetary compensation hampered their engagement. Likewise, the editors and organizations' representatives perceived a lack of motivation, accountability, and compensation from the volunteers. This produced a less consistent translation schedule amongst most GeoTraductores, placing a heavier workload on the initiative co-leaders to translate additional articles.



**Figure 3.** Plots showing the proportion of the primary and secondary topics of the translated articles.

These perspectives highlight that volunteering brings significant benefits but also comes with notable pitfalls. Nevertheless, there is room for improvement with regards to the drawbacks and solutions that can be implemented to help address them.

The road to financial compensation followed a somewhat familiar path for initiatives like GeoTraductores, which start as “labor of love” affinity projects and, through dedicated effort and valuable production, evolve into organizations capable of deftly manage fee and payment systems. For their part, Eos and AGU are acutely aware of the scientific community's far-too-common reliance on unpaid labor, especially from marginalized groups. Increasing the compensation, visibility, and opportunities to such groups aligns with AGU's mission, and thus, compensation was initially offered to Planeteando. As a fledgling business, Planeteando initially declined the offer. However, when GeoTraductores later indicated they were ready to begin a financial relationship and approached Eos for compensation, Eos promptly and enthusiastically offered a competitive compensation package.

Financial compensation has already led to an increase in commitment amongst the GeoTraductores. Our collective experience also provides more ideas for expanding and strengthening the co-production. For instance,

most of the GeoTraductores agree that beginner translators should receive formal training and that each organization can contribute to running an induction workshop or preparing online material, like video-tutorials or guides. The GeoTraductores also suggested that in replacement or lieu of payment, official certification also improves the involvement of volunteers, especially those in the earliest stages of their careers.

Our experience might also provide other insights into how collaborative initiatives work and the broader realm of translation. Although monetary or official recognition is important to increase the commitment of the collaborators, their primary drive to participate in the project is not necessarily that, as suggested by our survey, is their desire to contribute to Spanish-speaking audiences' knowledge of SciComm. The majority also said that increasing their translation skills (83%) and including this experience in their resume (75%) were strong reasons to join the initiative. The GeoTraductores have already experienced benefits from volunteering in this co-production. They shared that 50% gained visibility on LinkedIn and Twitter platforms when their translated piece was published. At least 25% found job opportunities due to volunteering. Some examples included working in an NSF-funded project creating bilingual content for social media, online interpreters, technical translators from English to Spanish and Portuguese, and translating Wikipedia pages.

The GeoTraductores have also perceived a need for SciComm to be delivered in their native language (Spanish). The majority agreed that it provides accessibility and awareness to the general public and increases community participation and language inclusivity. The rise in interest in the Spanish articles in Eos supports these observations. Our findings suggest a demand for scientific content in Spanish, which contrasts with the decrease in support of scientific publications in Spanish all across Latin America (Basilio, 2023b). Eos's most read articles indicate that the enthusiasm for Earth and Planetary sciences-related information is highly focused on topics that directly affect the general public or the people working in the field since three of the most popular translated articles tackle Climate Change (Wuebbles et al., 2021) or geohazard issues (O'Hanlon, 2021) but also problems of discrimination and bullying within the geoscientific community (Popp et al., 2021). Thus, English-Spanish technical translators are a valuable workforce for the upcoming world challenges.

Although AI translation tools might compensate for the lack of funds, especially in low-income countries or volunteers, the work of technical translators should not be overlooked. As we mentioned in Section 1.2, AI translation tools have several problems during translations. Thus, they need to be used carefully or as a resource, which the GeoTraductores agree on due to their experience. Therefore, promoting collaborative initiatives such as GeoTraductores in other languages, or more in Spanish, could help bring science to a broader audience and make it more useful for the general public. The workflow and the three-party partnership of GeoTraductores is a useful model to promote similar co-productions initiatives.

## 5. Lessons Learned From the GeoTraductores Initiative

The Project Management Institute (PMI, 2021, p. 242) defines a lesson learned as “*the knowledge gained during a project, which shows how project events were addressed or should be addressed in an efficient and effective manner.*” The importance of their identification is to define corrective actions or recommendations to correct mistakes and improve strengths. After analyzing the results from the survey (Section 4), we reflected on eight identified lessons learned during the three and a half years since this co-production began (Table 1). We identified five problems, assessed their impacts on the initiative's progress, and implemented the corrective actions to prevent it from happening again. We also identified three strengths as best practices that positively impact our initiative progress with recommendations to their consolidation. A total of 13 corrected actions and recommendations are proposed to boost our co-production; we will continue to enhance our working methods by investing in recruitment publicity and workshops for new volunteers, increasing the dissemination of our initiative via social media, fostering greater accountability among co-leaders, and pursuing ongoing incentives as forms of recognition.

## 6. Conclusions

In this report, we showcased our Science Communication (SciComm) co-production model, through the GeoTraductores initiative, which translates English to Spanish updated articles of the Eos.org platform on Earth sciences-related topics. GeoTraductores is a collaboration between Eos, GeoLatinas, and Planeteando, propelled by early-career scientist volunteers and co-led by experienced coordinators and editors. We outlined our collaborative model and discussed its impact on Spanish-speaking readership, volunteers, and partnered

**Table 1**  
*Identified Lessons Learned in the GeoTraductores Co-Production*

Problem	Impact	Corrective action
Beginner translators do not receive formal training	Loss of potential volunteers	<ul style="list-style-type: none"> <li>• Run periodic induction and translation workshops proper certification <ul style="list-style-type: none"> <li>• Prepare online material</li> </ul> </li> <li>• Expand the initiative to translate other SciComm-related products <ul style="list-style-type: none"> <li>• Increase recruitment calls</li> </ul> </li> </ul>
Lack of commitment and involvement from volunteers	Poor periodicity of translations from most of GeoTraductores creates a heavier workload for co-leaders in handling article translations	<ul style="list-style-type: none"> <li>• Increase volunteers' visibility and recognition on social media <ul style="list-style-type: none"> <li>• Seeking a continuous incentive as retribution</li> </ul> </li> </ul>
Lack of accountability from the co-leaders	Poor engagement and communication between co-leaders and GeoTraductores volunteers	<ul style="list-style-type: none"> <li>• Increase communication with volunteers by sending occasional updates about the initiative</li> <li>• Organize online edit-a-thons to gather volunteers in a limited time to increase translations and share experiences</li> </ul>
Lack of monetary compensation	Lack of compensation hampers volunteering	<ul style="list-style-type: none"> <li>• Grant an incentive pay for the <i>Eos en español</i> project participation. <ul style="list-style-type: none"> <li>• Apply for grants to sustain the initiative</li> </ul> </li> </ul>
The overuse of AI translation tools	Poor quality of translation pieces and lack of volunteer accountability	<ul style="list-style-type: none"> <li>• Include a section on AI translation tools and best practices in future workshops and online materials</li> </ul>
Strength	Impact	Recommendation
Volunteering co-production workflow.	Tailored SciComm translation strategy in which each partner contributes equally within their resources and capacity.	<ul style="list-style-type: none"> <li>• Annual review meeting of the co-production organizations for the GeoTraductores continuous improvement</li> </ul>
English-Spanish translation experience.	High outreach to Spanish-speaking audiences.	<ul style="list-style-type: none"> <li>• Organize regular check-ins with GeoTraductores to share experiences and mentorship beginners</li> <li>• Disseminate the translated articles within communities that might be interested in them (e.g. schools, policymakers, etc)</li> </ul>
International network in Earth-related topics.	Professional translations of Earth-related topics for <a href="https://eos.org">Eos.org</a> articles.	<ul style="list-style-type: none"> <li>• Increase recruitment calls to expand our volunteers</li> </ul>

organizations. We identified eight lessons learned from our workflow and provided 13 corrective actions and recommendations for ongoing improvement. We wish to extend an invitation to SciComm collectives from non-English speaking communities to contribute to the democratization of science by adopting our model and exploring alternative collaboration approaches. Specifically, we encourage collaboration within non-profit organizations focused on regions like Latin America to increase multilingual content and enhance SciComm efforts in those areas with a strategy toward decolonization.

The GeoTraductores initiative highlights the importance and influence that a STEM-related collaboration can have in disseminating knowledge to non-English speaking audiences. Our experience illustrates that distributing workload and roles among partnered organizations and volunteers facilitates the growth of our networks. These networks can promote regular SciComm translations, profoundly impacting communities reliant on informed decision-making, opinion formation, or policy development. The GeoTraductores experience underscores the need for technical expertise, prudent use of AI tools for translation, and continuous reflection to sustain volunteer engagement. Our evolving collaboration highlights and addresses challenges in co-production volunteering initiatives (Table 1).

Multilingual SciComm content broadens readership audiences and increases accessibility of information to linguistically marginalized communities. It leverages the language proficiency of multilingual scientists while simultaneously building and strengthening international information networks.

The GeoTraductores initiative strongly affirms the genuine need for non-English science content, particularly in regions such as Latin America and Spanish-speaking populations in the USA, where linguistic diversity is rich, but access to translated scientific literature remains limited. While our focus has been primarily on translating

content from Eos, especially news and stories focused and produced in the “Global North,” mainly in the USA, our translation efforts have also included articles focused and produced in the “Global South”, especially Latin America. As the number of journalists and scientists from Latin America writing for Eos increases, we expect that the number of translations on Latin American issues will also rise. Although GeoTraductores is trying to tackle the accessibility of science through the power of translations, it is essential to acknowledge and support the wealth of scientific knowledge produced in Latin America, much of it is published and preserved in platforms such as [SciELO.org](https://doi.org/10.1029/2023CSJ000070) and [RedALyC.org](https://doi.org/10.1029/2023CSJ000070) (e.g., Basilio, 2023b), index repositories focus on STEM publications in Latin America, the Caribbean, Spain and Portugal. Institutions worldwide should prioritize efforts to train and promote the consolidation of technical translators in various languages. By doing so, we can contribute to a more equitable distribution of scientific knowledge and address the linguistic barriers that hinder access to information in these regions—one translation at a time.

## Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

## Data Availability Statement

The authors confirm that the data supporting the survey findings are openly available from the University of Leeds Data Repository at <https://doi.org/10.5518/1450> (Navarro-Perez et al., 2024). The data used to report statistics on the [Eos.org](https://doi.org/10.5518/1450) website due to legal/commercial restrictions are not available. Finally, the list of all translated articles from the GeoTraductores initiatives up to the article submission is available in Supporting Information S1.

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