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► To cite this version:

| Olivier Pourret, Daniel Enrique Ibarra. The rise of preprints in Earth Sciences. 2023. hal-04040428

HAL Id: hal-04040428

<https://normandie-univ.hal.science/hal-04040428>

Preprint submitted on 22 Mar 2023

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**This paper is a non-peer reviewed preprint submitted to
EarthArXiv.**

The rise of preprints in Earth Sciences

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A research article's preprint is its initial draft shared online, which is frequently (but not always) done before submission to a journal and formal peer review. Preprint archiving may aid in the modernization of Earth Sciences publishing by removing obstacles to widespread scientific engagement and stumbling blocks to the development of an open and transparent research culture.

Preprint archiving services have existed since the 1960s, and thus are not a recent invention. A centralized online network called arXiv, pronounced "är kv" (from the Greek letter "chi"), was created in August 1991 to exchange physics preprints. For more than 30 years, arXiv has assisted the fields of physics, mathematics, and computer science, during which time the rate of scientific knowledge dissemination rapidly accelerated.

Preprints have recently gained popularity across a wider range of academic fields, including the Earth Sciences, including geochemistry, mineralogy and petrology, thanks to EarthArXiv (<https://eartharxiv.org>; Narock et al., 2019), ESSOAr that recently evolved in ESS Open Archive (<https://essopenarchive.org/>), and EGUsphere* (<https://egusphere.net>) (Figure 1).

*More than 20 years ago, EGU introduced the unique concept of open discussion and transparent peer review in which preprints were posted online; they now have a centralized preprint service EGUsphere.

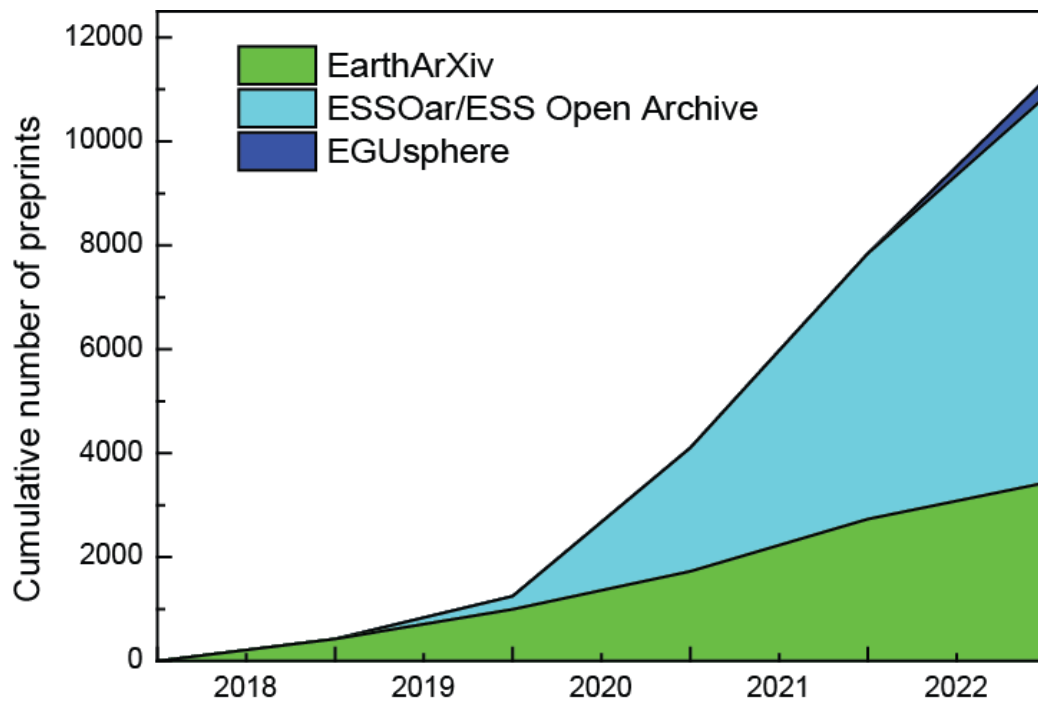


Figure 1. Cumulative numbers of preprints from EarthArXiv, ESS Open Archive and EGU sphere (data accessed on January 02 2023).

Some other regional preprint services also exist as well as more general ones (e.g. Irawan et al., 2022); a list can be found at <https://asapbio.org/preprint-servers> (Kirkham et al., 2020).

Preprints have numerous, well-established advantages for both researchers and the general audience (e.g., Bourne et al., 2017; Sarabipour et al., 2019; Pourret and Irawan, 2022).

Preprints, for instance, allow:

- The quick dissemination of research findings, which is important for time-sensitive studies (such as those conducted after natural disasters), for early-career researchers applying for jobs, or for any academic applying for grants or a promotion, given that journal-led peer review can take months or even years;

- Increased visibility and accessibility for research outputs due to the preprint's free uploading and viewing, especially for individuals who do not have access to paywalled journals or who have restricted access because of remote working (such as during lockdowns);
- Peer feedback that goes above and beyond what is offered through journal-led peer review, increasing the likelihood of collaboration through community input and discussion;
- Researchers to set priority (or a precedent) for their findings to reduce the possibility of being "scooped";
- Dismantling of silos that traditional journals sustain by exposing us to a wider range of research than we might otherwise encounter and providing a home for works that do not clearly have a traditional peer-review publication as their intended destination;
- Openness and transparency in research, with a focus on enhancing the overall standard, reliability, and reproducibility of findings.

Despite these benefits, some authors point out that preprints without peer review raise a host of issues that may vary by discipline and publication type (e.g. Meinert, 2020). In particular, they may come with a caveat that interpretations are subject to change and that they may or may not lead to actual peer reviewed publication. Pourret et al. (2020) pointed out that the increased dissemination effect has the potential to be used to promote non-reproducible scholarship or fake news and adds an extra potential burden on readers. Preprints may have some other disadvantages, including information overload, insufficient quality assurance, political influence, and outsized impact (e.g. Smart, 2022).

Based on policies collated on Sherpa Romeo (<https://v2.sherpa.ac.uk/romeo/>) of the Earth Sciences journals, a majority of those journals do accept manuscripts preprinted prior to or during submission.

Overall, preprints have played a crucial role in advancing science for the benefit of humanity during the pandemic, according to the medical and scientific communities as well as the general people (Besançon et al., 2021). They are now included in some major bibliographic databases. Even if not always allowed by some funding agencies (e.g. Australian Research Council, Lanati et al., 2021), preprints are now a recognized step in the publication of scientific research and will continue to be used. For example, preprints are now included in the flow chart publication of the open access platform of European funded projects Open Research Europe. Indeed, preprints are assisting in the modernization of our disciplines by reducing structural hurdles that prevent taxpayers, who frequently support knowledge development, from accessing science and knowledge, as well as by making research findings rapidly available to anybody who might benefit from them. The preprint landscape is moving fast, in early December 2022 *PLOS* announced in a [press release](#) partnership with *EarthArXiv*.

Additionally, *PLOS*, in partnership with *Dataseer*, has just released the first Open Science Indicators dataset, which uses large-scale Natural Language Processing to analyze published research articles to identify and track Open Science practices (Public Library of Science, 2022). The first three indicators included are: data sharing, code sharing, and preprint posting. Importantly, these metrics are not intended to rate or rank journals or publishers, but rather to set benchmarks, monitor changes over time, and better understand the research community's use of Open Science practices such as preprinting. Nevertheless, preprints are certainly here to stay!

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Appendix Cumulative number of preprints (data accessed on January 02 2023).

	2018	2019	2020	2021	2022
EarthArXiv	425	995	1726	2732	3429
ESSOar/ESS Open Archive	-	253	2376	5114	7436
EGUsphere	-	-	-	-	326