Moving fast without breaking things: The benefits of preprinting for CDR research

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This is a non-peer reviewed preprint submitted to EarthArXiv. The manuscript has been submitted to Communications Earth & Environment.

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Preface

Advocates of preprinting usually focus on its benefits to individual researchers — more feedback, citations, and visibility. We argue its greater value is collective: preprinting improves scientific coordination, which the carbon dioxide removal field needs in order to move fast without sacrificing rigor.

Introduction

Policy strategies increasingly rely on carbon dioxide removal (CDR) to meet global temperature targets. But ensuring that these strategies reflect the realistic potential of CDR requires a sound body of knowledge. As a result, CDR researchers are under a great deal of pressure to build up a large evidence base quickly.

Generating this knowledge quickly requires coordination. When scientists work alone, progress is slow. Coordination with other researchers — the process of sharing work and building on each other's insights — is essential for avoiding inefficiencies or proceeding too far down unpromising avenues of inquiry. But coordination doesn't just happen on its own, especially in a field that's highly interdisciplinary. It requires dedicated systems and a culture of participation.

Publishing in peer-reviewed journals is a widely adopted form of scientific coordination. However, the vast majority of papers do not appear for months, or even years, after submission. In CDR, where knowledge generation needs to keep up with the pace of policy conversations, the sluggish pace of peer review poses risks. Long delays between producing knowledge and sharing it weaken coordination and slow overall progress. The stakes are real, because if the research can't move fast enough, decision makers may commit resources to CDR approaches that the science doesn't support. The CDR field needs forms of coordination that facilitate rapid information sharing.

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The widespread adoption of preprinting could dramatically improve coordination in CDR. Preprints are papers that researchers share publicly before publishing them in a journal, and typically before peer review even begins. The usual case for preprinting focuses on individual benefits: more feedback, citations, media attention, and placement in high-impact journals.[1-4] These benefits are real, but they miss what matters most. In this piece, we argue that the stronger case for preprinting is collective: preprinting at scale can enhance scientific coordination, often in ways that individual researchers may not fully appreciate. CDR preprinting is just beginning to pick up, but adoption is currently too low for preprinting to play a meaningful coordination role. We believe the field can get there, but it takes a clear understanding of what's at stake, and a shared commitment to preprinting for the collective good.

Preprinting increases the speed and quality of scientific coordination

Scientific coordination, at its core, is about fighting the fragmentation of knowledge. Perhaps the most recognizable vehicles for coordination are workshops and conferences, which have a high density of exchanges that quickly propagate the latest findings. But convenings have limitations: they're infrequent, abstracts and talks compress the science, and most of the information sharing ends with the meeting itself. The rest of the time, coordination largely comes from reading, writing, and reacting to articles — a less direct, but more durable, form of information exchange. These articles most often take the form of peer-reviewed publications, but this doesn't need to be the only form of writing-based coordination. We see three main advantages that preprinting has over peer-reviewed publishing as a mode of coordination for CDR researchers.

First, widespread preprinting increases the cadence of coordination. Preprints make new results available to the research community ~5-15 months earlier than peer-reviewed articles.[1,5-7] That's roughly the duration of a research project itself, which means that preprints can double the rate of progress in the field, assuming that each research project leads to an improvement in at least one further study. If we imagine that each preprint improves more than one further study, then preprints could increase the rate of progress exponentially.

Second, preprints aren't just faster, they're timely. This increases the *quality* of coordination. In a young field like CDR, attention can move from one problem to the next pretty quickly, so contributions can have a bigger impact if they "strike while the iron's hot."[8] If a handful of labs are working on a problem right now, your contribution might matter more today than it would a year from now; once your paper is finally published, other researchers may have moved on. Furthermore, if anyone reaches out in response to your preprint, you'll probably have a more constructive conversation, since all the fussy details of your study are still top of mind.

In a field like CDR, these timeliness benefits can also strengthen researchers' ability to influence decision makers. We help run the preprint server CDRXIV,[9] and CDR researchers have told us that they post preprints in order to get their work out before the next workshop, funding round, or measurement protocol revision. Because they arrive at the right moment, those preprints spark richer conversations. They also allow decisionmakers to follow up with targeted questions, strengthening the scientific basis of their decisions. Preprints help this back-and-forth happen at the pace of science, not the pace of publishing.

Finally, preprints are publicly available works in progress, not "set in stone" publications. This may seem like a subtle distinction, but in our experience the "in progress" character of preprints is another way of improving the quality of coordination points. Whereas peer-review feedback is often formal and adversarial, preprint feedback can be more open-ended and collaborative. Without the pressure to comply with peer-review feedback simply to make a paper publishable, preprinting creates space for deeper engagement — one characterized by constructive dialogues rather than lengthy, one-off review documents. In this sense, it combines the informality of conference coordination with the durability of peer-reviewed publishing. Indeed, researchers in CDR and other fields report that preprinting has helped them form new collaborations.[10-12]

The important thing to recognize about these coordination benefits is that you may not always notice them. Receiving direct feedback is a visible form of coordination, but it's not the whole picture. Coordination doesn't require a dialogue. The researcher who adjusts their parameter after reading your preprint rarely tells you. The lab that builds on your experiment rather than duplicating it may not send you a thank-you. Yet those hidden course corrections are a vital part of scientific coordination. Preprinting improves the speed and quality of these coordination points, particularly when adoption reaches a sufficient scale.

Preprinting's "coordination effect" can scale quickly in CDR

If preprinting brings these coordination benefits, the question for CDR is whether the field can reach the scale of adoption at which those benefits kick in. Other fields show us that while widespread adoption is not guaranteed, it's far from unprecedented. Over the last century, preprinting has repeatedly shown up in young fields that are under pressure to make progress quickly. In the 1940s and 1950s, physicists privately circulated preprints to keep up with the proliferation of results made possible by the revolution of Feynman diagrams.[13,14] In the 1960s, the European Organization for Nuclear Research (CERN) adopted a public preprinting system so that researchers could better keep up with the fast pace of high-energy physics.[14] More recently, preprints played a key coordination role in the development of vaccines and policy for COVID-19.[15] All of these are examples of fields, like CDR, in which researchers needed to keep up with the evolving research landscape in order to best contribute to it.

CDR could be at its own inflection point. After hovering near zero for fifteen years, the share of CDR publications that first appeared as preprints began to climb steadily around 2020, reaching about 10 percent in 2024 (Fig. 1). The trend holds across CDR pathways and methods.[10]

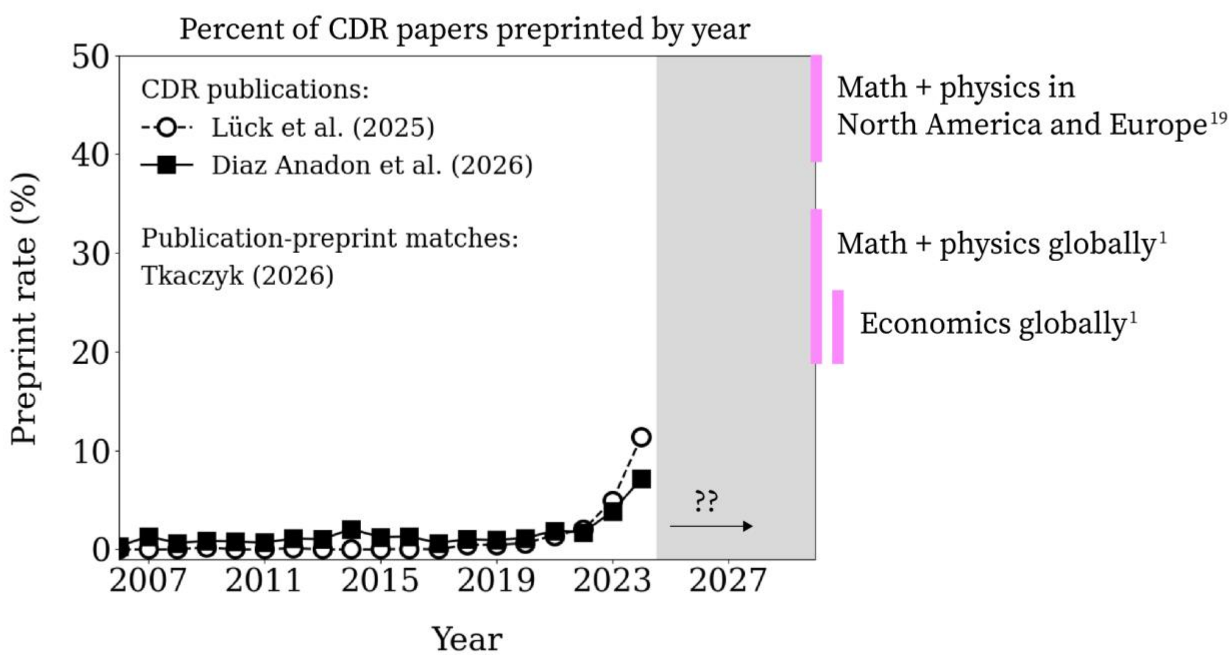

***Fig 1**: Percentage of CDR publications that first appeared as a preprint from 2006-2024. We cross-referenced lists of CDR publications[16,17] and preprints matched to their respective publications[18] to compute the preprinting rate over time. Preprinting rates hit an inflection point around 2020, and have risen rapidly since. Pink bars show preprinting rates in higher-adoption fields for reference.[1,19]*

However, 10 percent is still far from the 20-50 percent rates of preprinting that we see in fields like math, physics, and economics,[1,19] where preprints play a notable coordination role. How do we get there in CDR?

Ultimately, widespread adoption of preprinting requires a cultural shift. In CDR, that means reconceptualizing preprinting as a best practice for the field, rather than a question of the researcher's personal style or level of comfort with sharing their work early. As we noted above, one barrier to achieving this cultural shift is that not everyone who preprints feels a direct benefit from doing so. We've heard researchers describe preprinting as "shouting into the void" — posting work early and openly, but not receiving the useful feedback that preprinting proponents often promise. This reaction is understandable, but it also misses the most valuable aspect of preprinting. The real prize is a boost in scientific coordination at the field level. Coordination benefits are often diffuse, subtle, or even wholly undetectable from the perspective of a single preprint author. As such, shifting the culture towards preprinting requires that CDR researchers embrace the practice for the sake of the collective, not the individual.

Conclusion

Building a culture of preprinting isn't a given, but we're optimistic. Barriers to adoption are falling. Almost all journals that publish CDR papers now allow preprinting,[10] and a growing number of funders encourage (or even require) it.[4] Researchers who preprint overwhelmingly report that there are no negative consequences of doing so,[20] and as Paul Ginsparg, the founder of arXiv, observed, no community that has started to post preprints has stopped.[15] The needed cultural shift begins with researchers prioritizing preprinting's collective benefits. If you're a CDR researcher, we encourage you to read and write preprints, and to help normalize the practice in your network. Preprinting has boosted progress in other fields at crucial moments — it's time for it to play this role in CDR.

Acknowledgments

We are grateful for feedback that improved this manuscript from Freya Chay, Grayson Badgley, Sam Hindle, Jonathan Lambert, and Jesper Suhrhoff. We thank Sam Hindle for feedback on our survey questions. This work was supported in part by a grant from the Patrick J. McGovern Foundation (no specific grant number).

Author contributions

Tyler Kukla and Chris Allen conceptualized the article. Tyler conducted the preprint rate analysis, the preprint attitudes survey, and made the figure. Tyler and Chris wrote and edited all drafts of the text.

Competing interests

Tyler Kukla and Chris Allen help run CDRXIV, a preprint server for carbon dioxide removal research that is managed by CarbonPlan.

Data availability

Carbon dioxide removal publication data is from Lück et al. (2025) and Diaz Anadon et al. (2026).[16,17] Data matching those publications to preprints is from Tkaczyk (2026).[18] The code to read and analyze those datasets is publicly available at on Github, release version 1.0, under MIT license: https://github.com/carbonplan/cdr-preprint-rate-analysis/releases/tag/v1.0.[21] The data inputs and processed outputs are publicly available on Zenodo under CC BY 4.0 license at https://doi.org/10.5281/zenodo.21465070.[10]

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