

Putting Science on the Map: Spatio-Temporal Metadata for Scientific Article Discovery

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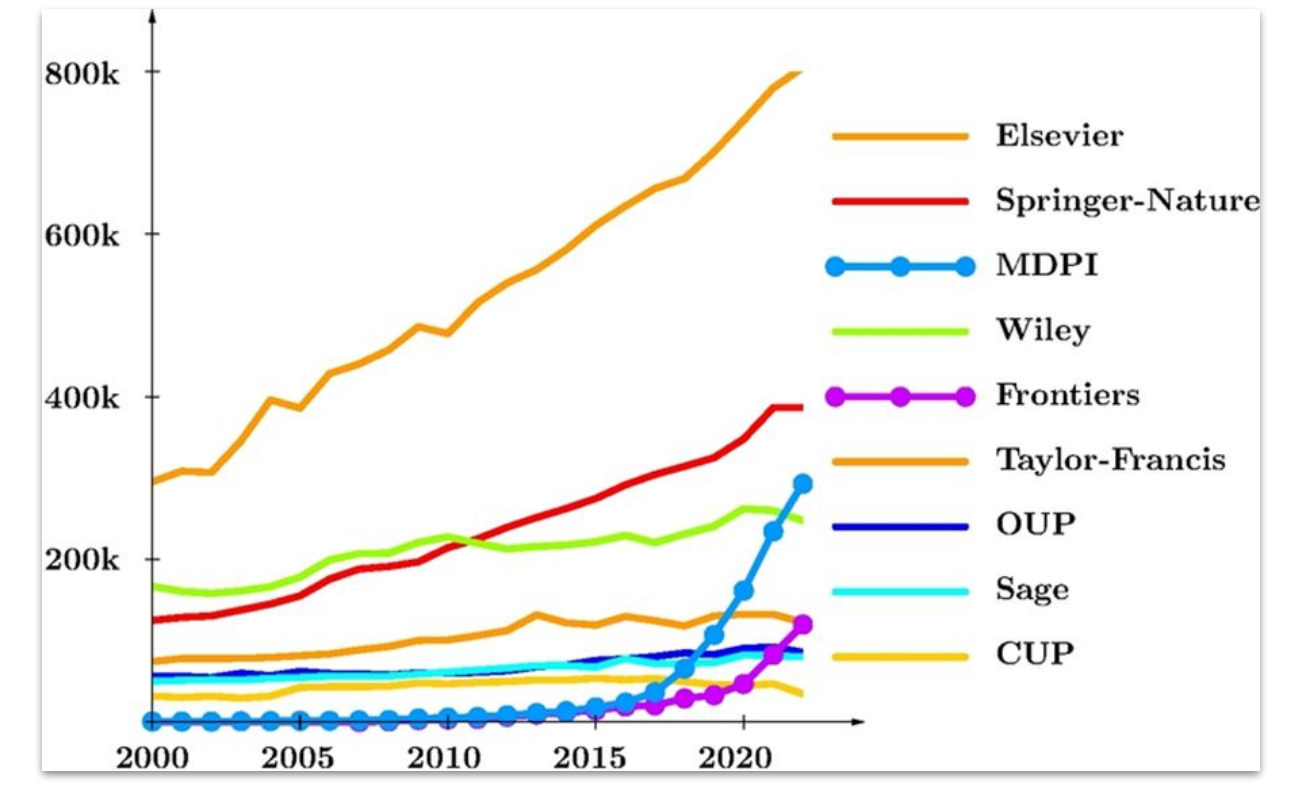
The rapid growth of scientific publications has made the discovery of relevant literature increasingly challenging. While current approaches rely mainly on keyword search, citation chaining, editorial curation, and author-based retrieval, the spatial and temporal dimensions of research – the “where” and “when” of a scientific article – remain largely underexploited. This work showcases existing tools for integrating spatio-temporal metadata into scholarly publishing, sketches a novel framework for automated enrichment, and emphasises the potential of such metadata throughout the research data management (RDM) cycle.

Finding scientific articles today

- Status Quo
- General web searches (e.g., Google Scholar, OpenAlex)
 - Discipline specific portals or AI agents
 - Personal recommendations (e.g., via social media)

- Based On
- Search terms (title, abstracts, keywords, full text)
 - Citation chaining
 - Editorial curation (e.g., topical journals, special issues)
 - Known authors, groups, and affiliations

- Challenge
- Increasing number of scientific articles
 - Need for novel ways to discover relevant works



Hanson, Mark A., Pablo Gómez Barreiro, Paolo Crosetto, et Dan Brockington. « The strain on scientific publishing ». Quantitative Science Studies, 8 novembre 2024, 1-21. <https://doi.org/10.48550/arXiv.2309.15884> <https://www.oivridscience.fr/excessive-growth-in-the-number-of-scientific-publications/>

Now this, as a model, has advantages and disadvantages. For example, discrepancies between the model and the actual situation might be used as a measure of the perceived suitability of a site for occupation. More cogently, a major disadvantage is that it ignores the premise **“everything is related to everything else.”** The geographical interpretation of this premise should be that population growth at place A depends not only on the previous population at place A but also on the population of all other places.

Tobler, W. R. (1970). A Computer Movie Simulating Urban Growth in the Detroit Region. Economic Geography, 46, 234–240. <https://doi.org/10.2307/143141>

Game Changer: Spatio-Temporal Metadata

- Almost all research has a spatial and temporal component
- “where” and “when” of a scientific article

Status Quo: Date of publication & authors’ affiliations

- Gap:
- Spatio-temporal context about the content is hidden, e.g., as place names or coordinates in full text, supplementary materials, visualisations, or data values
 - Not available as human- and machine-readable metadata

- Spatio-temporal metadata as unbiased basis for discovering research work

What's next?

Definition: Spatio-temporal extent

- Spatial extent: Author affiliation vs. place of birth/residence of study participant vs. study area
 - Temporal extent: Publication date vs. study period ≠ reference period
 - Format of storing spatio-temporal metadata for scientific articles
- Definition of spatio-temporal extent will be re-used in framework (e.g., prompts)

Extraction: Framework for automated extraction of spatio-temporal extent from full text

Semi-automated process supporting authors + facilitates extraction for published articles

- Benchmarking multiple approaches for extraction
 - Named Entity Recognition (NER) for text extraction
 - Optical Character Recognition (OCR) for map extraction
 - Large Language Models (LLMs) for full-document reasoning
- Specification & Interoperability
 - Storage in accordance with existing (or yet-to-be-defined) metadata standards
 - AI-Readiness
- Proof of concept implementation delivering interoperable spatio-temporal metadata

Discovery: Academic database enriched with spatio-temporal metadata for scientific articles

So that spatio-temporal metadata can help to find relevant works, they need to be available in an adequate amount.

- Application of framework in academic database
 1. Suggestion Mode
 - geoMetadata plugins/OPTIMAP
 2. Automatic Mode
 - Small scale vs. large scale
 - Applied in Knowledge Graphs like NFDI4Earth’s KnowledgeHub
 - OpenAlex & OpenAIRE
- Discovery
 - Integration in discovery portals like OPTIMAP & NFDI4Earth’s OneStop4All



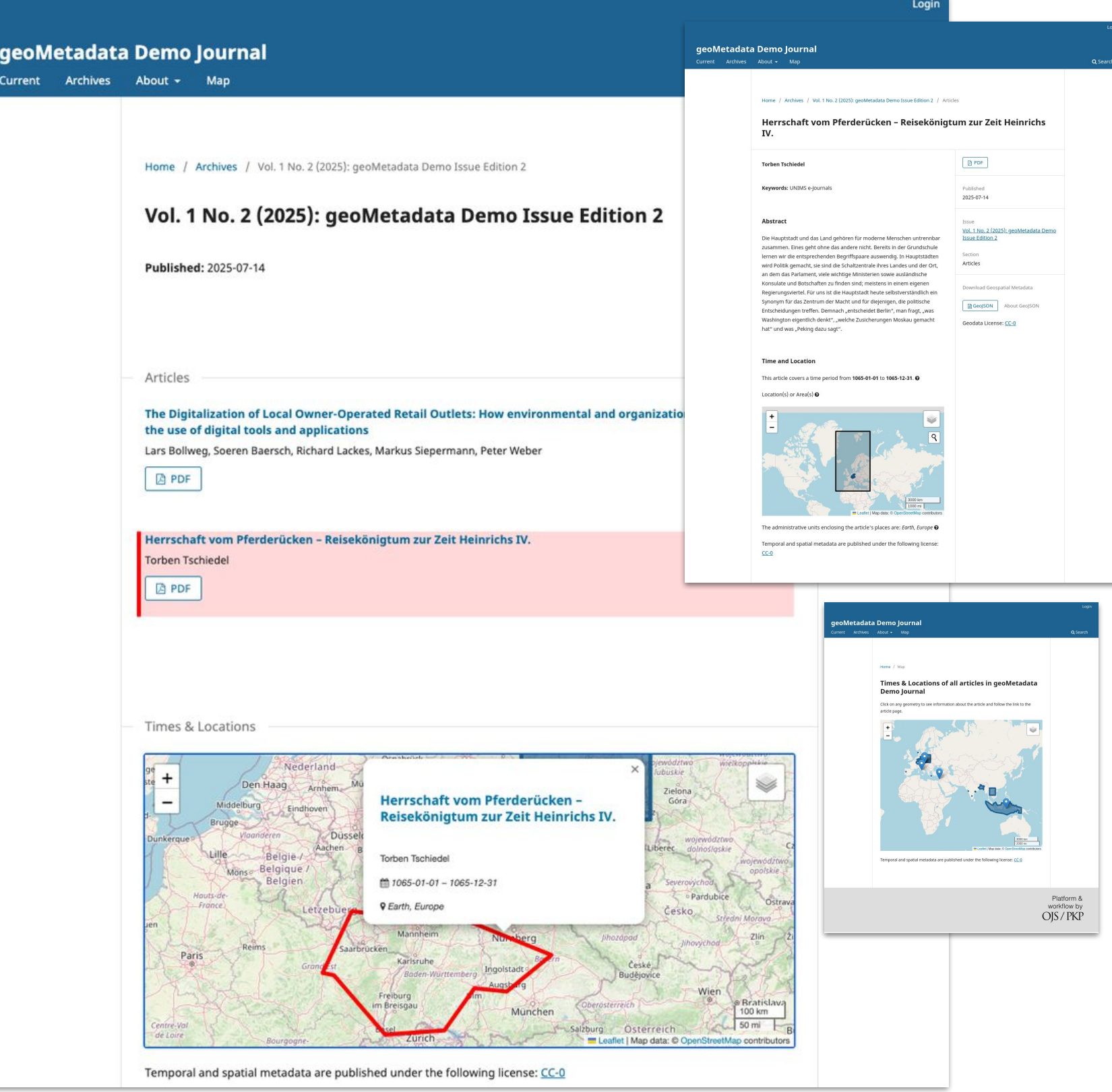
What tools are already out there?

Collect Metadata The geoMetadata plugins for Open Journal Systems (OJS) and Janeway, two leading scholarly publishing platforms, integrate machine-readable spatio-temporal metadata into publishing workflows and enable map-based discovery of scientific articles.

Find Outputs OPTIMAP is an open, map-based platform that aggregates spatio-temporal metadata from multiple journals and implements crowdsourcing to georeference and temporally annotate articles lacking such metadata.

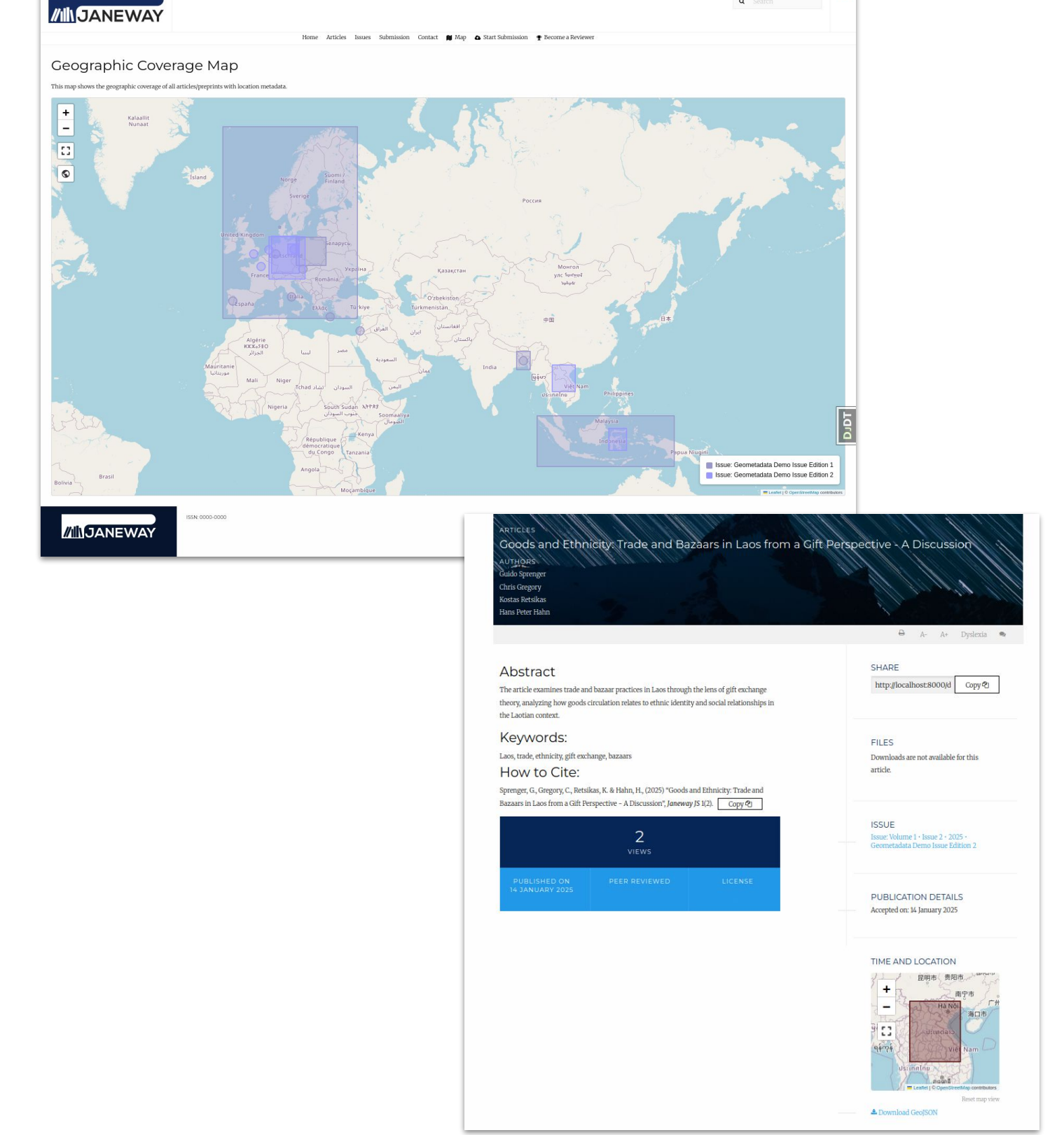
geoMetadata OJS Plugin

<https://github.com/TIBHannover/geoMetadata>
<https://service.tib.eu/komet/ojs330/index.php/gmdj/>



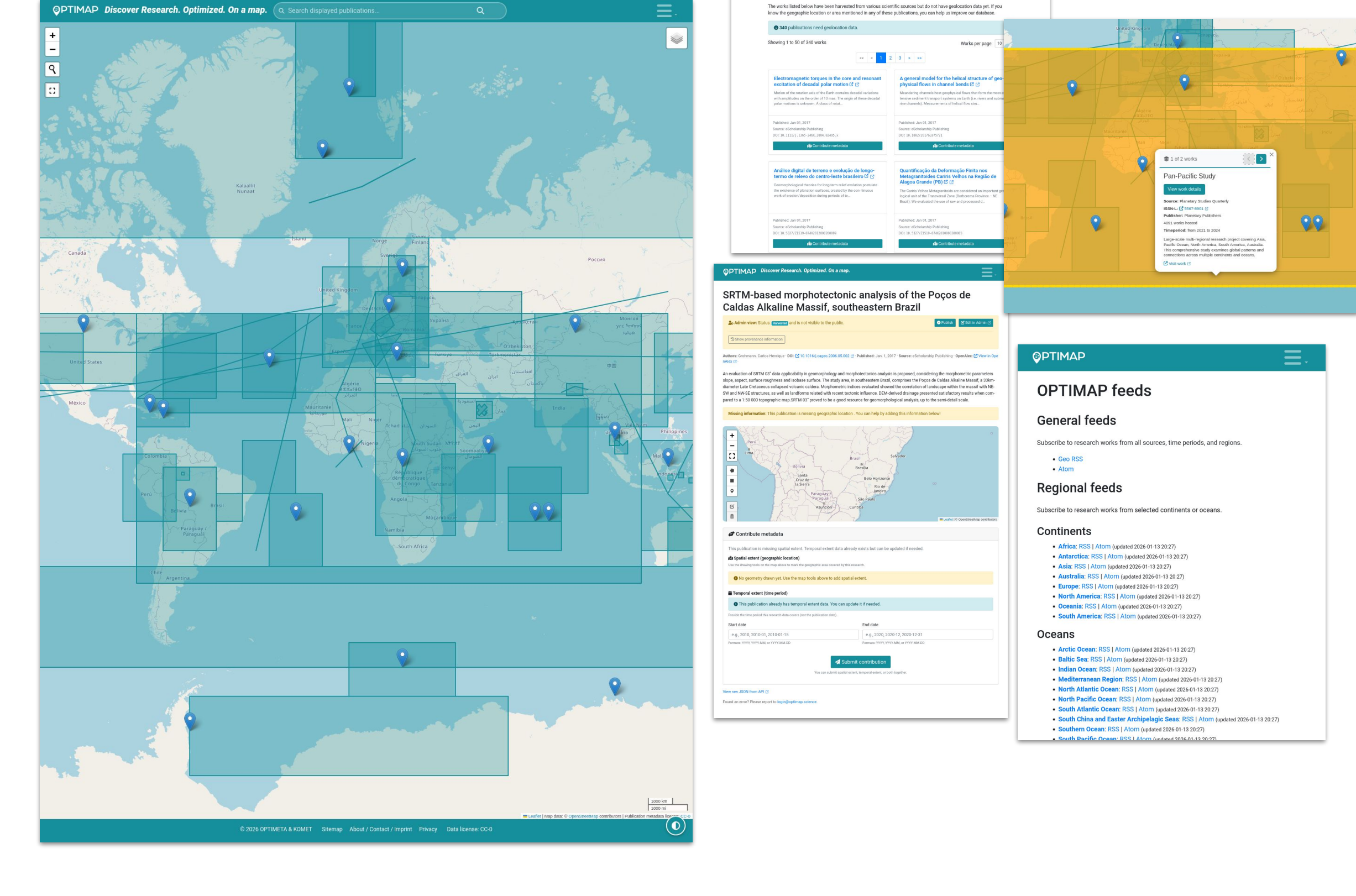
geoMetadata Janeway Plugin

https://github.com/GeoinformationSystems/janeway_geometadata



OPTIMAP

<https://github.com/GeoinformationSystems/optimap>
<https://optimap.geo.tu-dresden.de>



Unlocking the spatial and temporal context of research work opens new ways to discover, connect, navigate, and evaluate scientific knowledge.

Projects



Reference

Niers, T. and Nüst, D.: Putting Science on the Map: Spatio-Temporal Metadata for Scientific Article Discovery. EGU General Assembly 2026, Vienna, Austria, 3–8 May 2026, EGU26-21334, <https://doi.org/10.5194/egusphere-equ26-21334>, 2026.

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