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Extracting value from scientific literature with scientometric methods and tools: a case study of permafrost and civil engineering

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We illustrate how the use of scientometric methods and tools can facilitate the scanning and interpretation of large volumes of scientific outputs and benefit the literature review of a scientific topic, reducing the cognitive burden to identify emerging trends and shifts in scientific interest. We rely on a corpus of publications about permafrost which proves to be a fast-growing and multifaceted object of study in the geosciences (16,267 references retrieved from Scopus and published since the 1970s) and undertake a scientometric approach to understand the knowledge about permafrost that has been produced and disseminated so far.

With the rise of digital technology and the increase in the amount of data available, scientometrics has benefited in its methods from text-mining and datavisualisation tools, thus enabling maps to be drawn up to visually represent the semantic space of a textual corpus (for example with networks representing graphically the proximity between strongly related terms) and to observe its dynamics over time.

We outline the benefits of 2 scientometric tools and a few of their specific functions: CiteSpace, for a structural analysis based on bibliographic data (e.g. co-citation networks to reveal underlying intellectual structures) and Cortex, for a lexicometric analysis based on terms extracted from metadata and press articles (e.g. co-occurrence networks to detect trends and transition patterns). First, we tackled the corpus in a global and objective way, without presupposing which fields have been involved. Then we focused on one particular field (civil engineering) to demonstrate how we can better feed these tools with terms extracted from a corpus of press articles mentioning construction and building issues.

In this longitudinal study, we use 3 units of analysis and evaluate their frequencies, shares and patterns of co-occurrences: disciplinary fields (retrieved via Scopus journal classification scheme), terms (automatically extracted from titles, abstracts and keywords and validated by similar extraction on media articles and expert review), geographical areas (automatically extracted with Name Entity Recognition function, and investigated both as a field of study and also as information about countries interested in any aspect of permafrost).

We can then show and explain the increasing share of publications about permafrost, the ever-growing number of disciplinary fields involved along with content fluctuations in the engineering field, the emergence of new associations between terms and in particular with "climate change",

and the significant impact of studies about the Qinghai-Tibet plateau.

The focus on civil engineering allows us to perform contrast analyses with other sub-corpus (about climate change or environmental sciences) and to identify the existing overlaps but mostly the gaps to be filled.

With this case study on permafrost, we show how scientometric tools can meet the need for objectivity in extensive literature reviews when fake news and climate scepticism are threats to science integrity and the sound dissemination of its results. Besides, we provide for more knowledge about the development of research on permafrost and initiate a particular focus on civil engineering issues providing evidence for future works.