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Approaching geospatial trustworthiness with graph algorithms and maps

Markus Jobst [a,b]*, José Pablo Ceballos Cantú [c], Florian Twaroch [b], Georg Gartner [a]

[a] *Research Group Cartography, Vienna University of Technology, markus@jobstmedia.at, georg.gartner@tuwien.ac.at*
[b] *Federal Office of Metrology and Surveying, florian.twaroch@bev.gv.at*
[c] *WIGeoGIS, josepablo.91@gmail.com*

* Corresponding author

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Abstract:

An increasing amount of geospatial data, -services and applications on the Internet support the analysis, evaluation and communication of spatially related issues. Different legal frameworks enhance findability, availability, interoperability and reusability (FAIR principles) of spatial data as well as maps. The combination of fundamental spatial data themes with thematic content and its geo-analytics seems to be a key solution for many problem areas, especially for a number of indicators in the United Nations sustainable development goals (SDG). On one hand the aggregation of geoinformation with statistical data forms the fundament for automated analytical procedures, e.g. using methods of machine learning, artificial intelligence or spatial semantic reasoning. On the other hand a precise communication of new insights, the transmission of geospatial knowledge, and its inherited qualities of the automated procedures used, characterizes these kind of modern maps.

One key principle in terms of information communication technologies (ICT) is the service-oriented architecture, which supports fully automated procedures in data integration and map-production workflows. These workflows start with the selection of data, wrangling into useful information, processing and cartographic preparation in order to support knowledge flows from the machine to users. The overall aim of these modern map production focuses on fully automated workflows, without human intervention. In the end, the resulting map product shall completely fulfil the user needs of successful information transmission and knowledge expansion. This vision seems to be feasible: large language models for text, speech to text, generative scripting (programming languages) and generative AI for speech to image show that these models successfully work and digitalisation is moving to a next dimension. Generative AI for maps, often mentioned as GeoAI, MapAI or similar, is in development. Main questions concern on one hand the requirements and structures, which are needed to formalize cartographic language and the description of space. On the other hand, beyond the implementation of LLMs for map creation, the question arises, how to establish trustful map products and how to make the creation and content of the map transparent in order to support trust at the consumer side?!

We follow the idea that the description of space, as it is done with maps, could establish a foundational topographic ontology. This foundational topographic ontology is basically used in different information domains to georeference data and to establish a geospatial semantic information space or knowledge fundament. By abstracting the topographic ontology into a discrete description of space (rasterized representation of space), changes during time and multidimensional cubes can be established. This discrete description of space also allows for a more powerful embedding of graph algorithms within the data structures, which furthermore enables the processing of "trust" and transparency for data quality.

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This contribution thematizes the topic of trustworthiness in maps, as they could be generated by generative AI. We will introduce the model of a foundational topographic ontology, the discretization of space and exemplify a possible use of graph algorithms to calculate trust. Approaches of Earth Observation as well as GeoAI/MapAI will be taken into account comparatively. Future perspectives and basic requirements for the cartographic and geospatial knowledge sharing domain will be discussed.

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