Building an Open Dataset of Ubiquitous Map Images for Cartographic Research: Practices and Prospects

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Abstract:

With the fast development of web technologies and open data initiatives, a massive amount of map images has become assessable through the internet. For instance, USGS provides an open portal for browsing and downloading historical topographic map images; open access geo-journal publications contain thematic map images of scientific findings; weather agencies publish map-based predictions of typhoon events; and map enthusiasts upload their map work onto social media to participate annual marathon of map-design. The ubiquity of map-making activities across different social sectors and professional demographics has created ubiquitous map images across the internet, which has forged a valuable resource for cartographic research and geospatial applications.

However, these ubiquitous map images often exhibit varying cartographic designs and thematic topics. This non-uniform feature raises both research and application challenges. Some researchers have proposed computational methods to extract useful information from map images (e.g., topic mining). These efforts, to some extent, ease the searching of such non-structured geospatial media but often fail to examine the cartographic properties of the ubiquitous map images, such as layout design, symbol design, and completeness of map features.

Motivated by the ever-thriving data-driven research, we aim to investigate the collective characteristics of the open access map sources by building an open dataset of ubiquitous map images. First, we review related work of developing map datasets for varying purposes and identify the key features, e.g., map use, map theme, map source, and auxiliary data. Second, we illustrate the practical needs and technical feasibility of establishing hierarchical tag semantics to facilitate cartographic research. In particular, we discuss the unique challenges in fulling such cartographic-oriented tagging tasks by comparing them with the tagging tasks in other domains, such as object detection and semantic segmentation in computer vision and robotics. Third, we illustrate the promising added value of the open map image dataset by enriching them with auxiliary data, such as eye-tracking data and online questionnaires.

Furthermore, we outline the research opportunities that have been brought forth by the ubiquitous map image dataset and review some preliminary dataset-enabled research tasks, such as map image interpretation and balance assessment. In the end, we demonstrate the possibility of using the dataset to revisit some of the fundamental research problems in cartography.

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