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A social-sensing approach to monitoring human-biodiversity interactions in urban environments

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Abstract:

Given the increasing anthropogenic pressures on biodiversity in urban areas, monitoring human-biodiversity interactions is of paramount importance for the sustainable development of urban environments. The implications are manifold since it enables the formulation of strategies that effectively balance the needs and demands of human populations with the preservation and conservation of biodiversity within urban areas. Overall, a more comprehensive understanding of human-biodiversity interactions is crucial for ensuring that the benefits of biodiversity are equitably distributed and can lead to the development of more habitable, sustainable, and resilient urban environments. Geosocial media data offer opportunities to quantify human-biodiversity interaction and track how people interact with and perceive different species and habitats in urban environments. The complexity and variability of this data source require, however, innovative efficient methods of data analysis to extract meaningful insights cost-effectively. We propose a social-sensing approach to revealing and monitoring the interactions between people and urban biodiversity by employing unsupervised text mining techniques and geospatial analysis on geosocial media data.

The overarching research objective of this study is to facilitate the identification of specific wildlife-related information in geosocial media and to quantify and track spatial and temporal patterns of human-biodiversity interactions in urban areas. This study builds upon a methodology that draws on the semantic similarity of word2vec embeddings (Mikolov et al., 2013) for the unsupervised classification of geosocial media textual metadata (Gugulica and Burghardt, 2023). The methodology was developed and applied to quantify indicators of cultural ecosystem services flow in urban green spaces. Similarly, we used unsupervised text classification to classify and identify Flickr and Instagram geotagged posts related to wildlife observations and photography. In addition, part-of-speech tagging, and semantic similarity calculation were subsequently employed to label and filter the nouns used in textual annotations for the identification of specific biodiversity elements such as various species of plants, animals, and microorganisms as well as types of habitats. To visualize the information extracted, we created so-called TagMaps, which are spatial word cloud representations of textual information retrieved from geosocial media (Dunkel, 2015) (Figure 1). Some preliminary results show that human-biodiversity interactions are highly localized and occur as hotspots mainly in urban parks, nature reserves, and protected areas. Furthermore, habitats of certain animal and plant species were revealed, and we could gain insights into the local fauna and flora that social media users observe, interact with, and value.

Ongoing work focuses on integrating data from further social networks, such as Twitter and iNaturalist, to improve the validity and representativity of the results. Additionally, we will conduct spatial-temporal analysis of geosocial media data to test the hypothesis that geotagged social media data can be used as an additional source to track changes in local biodiversity. By analyzing data from different periods, we could potentially assess the impacts of management and conservation policies on local biodiversity and detect any declines or changes in the distribution of species. Furthermore, spatial-temporal analysis of geosocial media data could be used to spot the introduction of invasive species in specific geographic areas and track the spread of these species over time. By this means, we address the need to devise automated strategies to discover valuable biodiversity-related data from alternative sources, which can be used to enrich and expand existing databases.

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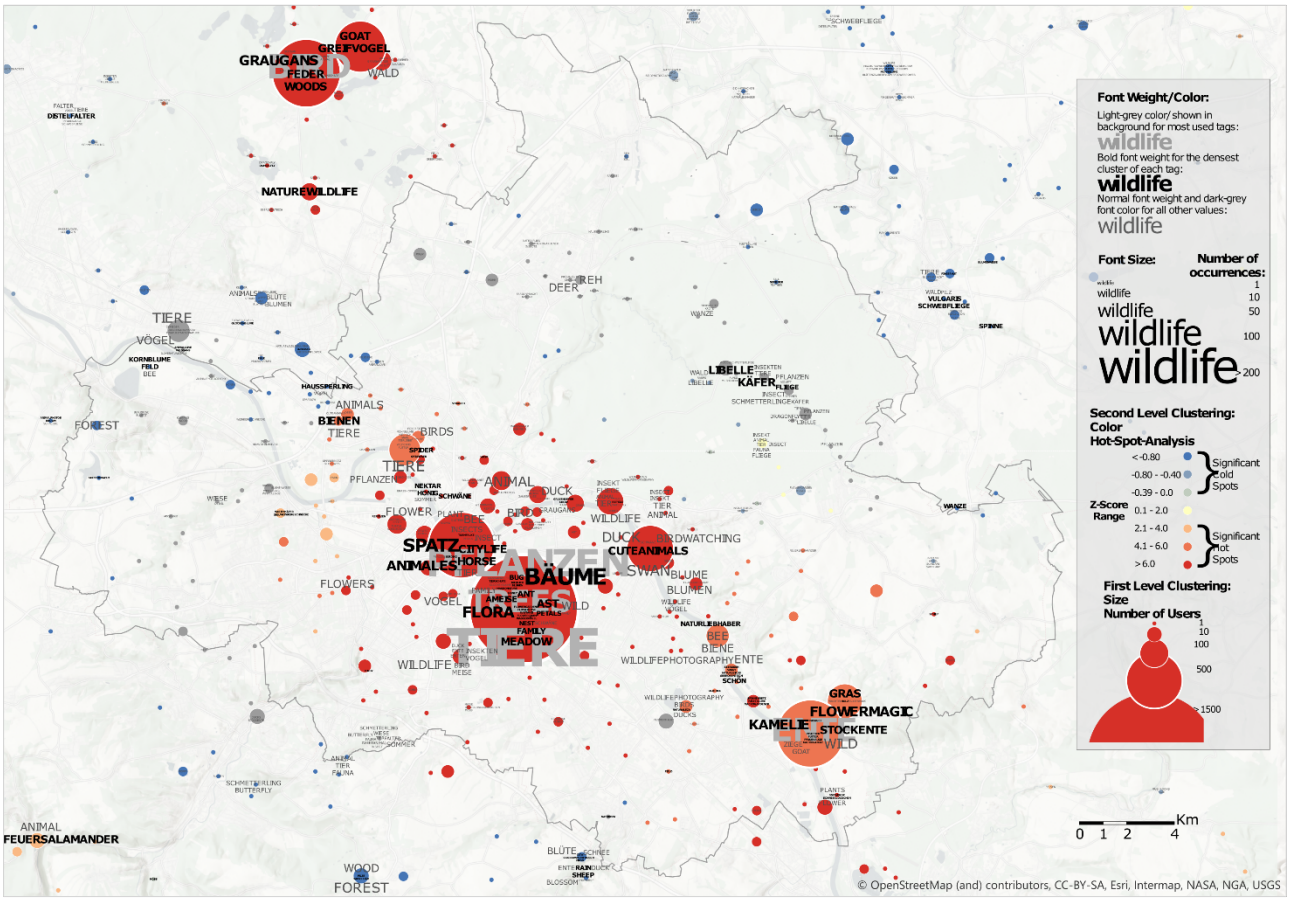

Figure 1. Biodiversity observations on geosocial media in the city of Dresden, Germany.

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