Integrating EO-based data into vulnerability assessments

Case study and reflection on urban health research

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ABSTRACT

Assessing the vulnerability of individuals, to a disease for example, results in the identification of factors which may contribute to an increase in damages, such as, in case of an exposure to an illness, morbidity or mortality. Such an assessment often proves to be a challenging task due to the suspected factors not always being direct, causal, or easily measurable. Moreover, these assessments can be limited by insufficient knowledge or data. Conducting empirical research on case studies, be it at a local scale, in a southern country, in an urban setting, or on a sensitive topic, requires careful selection of adequate methods or models appropriate to the given situation.

In the past two decades the use and the combination of remote sensing and socioeconomic data layers in geographic information system (GIS) has, therefore, appeared as a solution to understanding and assessing vulnerability to environmental hazards. Indeed, the civilian Earth observation satellites have been in use since the 1960s and, with the development and democratization of GIS and satellite imagery, large amounts of information from increasingly diversified sources have become available. However, data integration presents common issues and needs an appropriate approach to overcome difficulties such as the choice of common scale or the use of proxy to characterize a phenomenon.

Through a comprehensive exploration of these challenges, we illustrate the interest of using an exploratory spatial data analysis (ESDA) approach as a facilitator of the data science process in a study of urban malaria. Still rarely applied in developing countries, ESDA approach is defined not only as a research approach but also as a means to test strong assumptions - in our case concerning global health issues. It has led us to examine from different angles the social and spatial determinants of malaria infection as well as to enhance our understanding of interactions between its three components (human hosts, vectors, and parasites).

Several streams of quantitative information were collected, both directly and indirectly related to the study of malaria. More specifically, multi-temporal satellite imagery, census data, and results from social and health surveys have been integrated into a GIS. The use of statistical and geostatistical analysis has revealed a pattern of risk of infection in Dakar. Links have been established between social attributes (census data), landscapes, and environmental attributes (specific features extracted from satellite imagery). A strong link between exposure (which results in a bigger parasite reservoir in marginalized areas) and social vulnerability of individuals (which substantially increases the risk of malaria infection) has been outlined.

Lastly, beyond the results of the study on urban malaria, this research has allowed us to revive the debate on the key questions raised since the development and democratization of GIS and satellite imagery: Is it possible to identify social features remotely through the use the EO? How far can EO contribute to characterize social processes?