Land-use change effects on infectious disease transmission: the case of Chagas disease in Colombia

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Introduction. In 2012, the World Health Organization (WHO) defined the 2020 goals program for controlling the burden of morbidity of neglected tropical diseases (NTDs). One of them is Chagas disease, which is endemic in Latin America and is transmitted to humans by so-called kissing bugs. In the wild, kissing bugs associate with palm trees, implying that the rapidly expanding palm-oil economy of Colombia (the main producer of palm oil in Latin America) may strongly affect Chagas disease incidence. The aim of this project is to investigate which land-use characters best predict Chagas incidence in Colombia considering the expanding economy of oil-palm plantations.

Methodology. We have implemented a generalized linear model (GLM) for Chagas disease incidence prediction at the municipality level in Colombia. As explanatory variables we consider social factors (population density, percentage of population in rural areas, and unsatisfied basic needs), climatic factors (annual average temperature and precipitation), vector presence (incidence of seven kissing bug species), control efforts (previous fumigation), and land cover (landscape heterogeneity and habitat proximity). For analysing the spatial structure of land cover (oil-palm monocrops, forests, human settlements etc.), we quantify spatial variation by assessing the characteristic sizes of, and distances between, patches differing in land cover, using auto- and cross-correlation functions obtained via Fourier transforms (see figure below).

Results and Discussion. The explanatory variables have been gathered and processed for the 1062 municipalities located in the continental territory of Colombia. The GLM estimates suggest that the shorter is the distance between urban areas and habitats suitable for kissing bugs, the higher is the incidence of Chagas disease. On the other hand, the smaller is the size of human settlements, the lower is the disease incidence. While the first result is expected, the second result might highlight a problem with the local health system in rural areas.

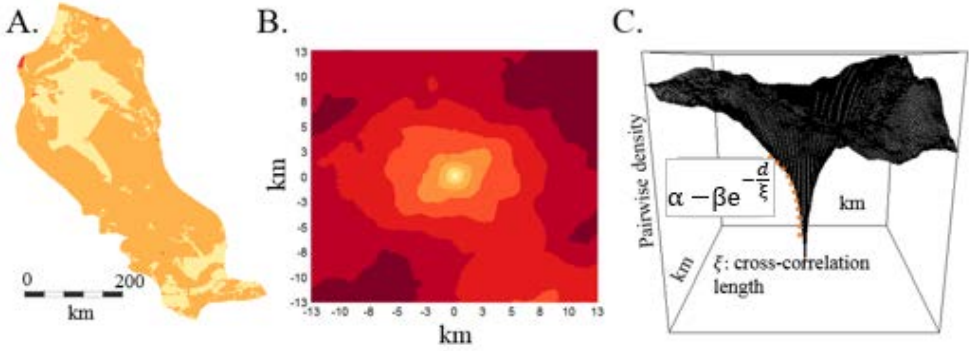

Figure. Cross-correlation example. *A. Villanueva municipality (yellow: high vector suitability, orange: low vector suitability, red: human settlements, area: 852 km^2). B. Cross-*

correlogram (low pairwise density: yellow, high: red). C. Cross-correlation function and definition of cross-correlation length.