

Place-based attributes predict community membership in a social network

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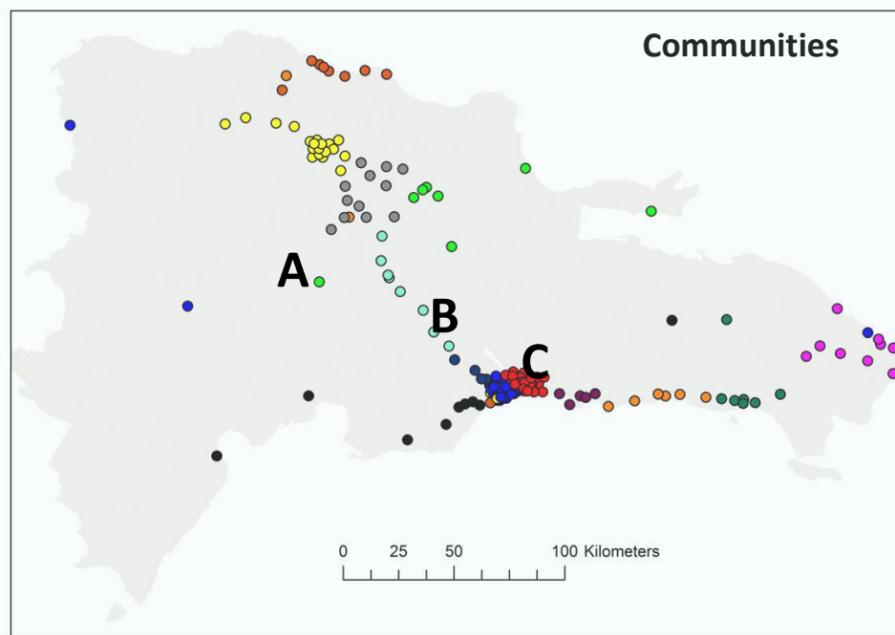
Large-scale social networks, representing connectivity between human populations, can be organized into communities of closely-connected nodes. Because connectivity, including disease transmission and human movement, is higher within than between communities, community membership in social networks has broad implications for science and policy.

I N T R O D U C T I O N

Social attributes of individual people, such as ethnicity, determine community membership in networks of individuals. Whether place-based attributes, such as land use, can explain communities in large scale networks remains unknown.

The ability to predict community membership in large-scale social networks would lead to applications such as predictive maps of disease for entire countries. Our goal is to use place based attributes to predict community membership in a large-scale social network of cell phone call flow in the Dominican Republic.

M E T H O D S + R E S U L T S

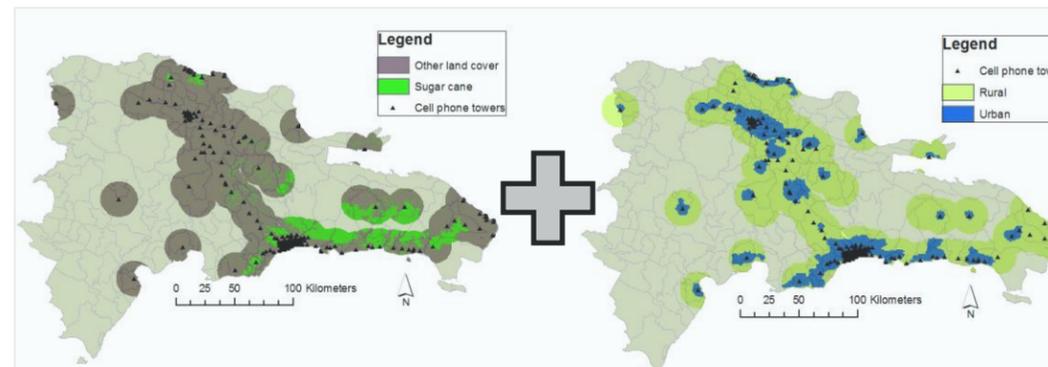


Location of cell phone towers and community membership. Each tower is represented by a dot and each community is represented by a different color. Letters correspond to photos of tower locations to the left.

We constructed a network from call flow between 177 cell phone towers in the Dominican Republic and detected communities in the network using a modularity algorithm. This algorithm revealed 12 distinct communities (shown above). Several communities, such as the east and west halves of Santo Domingo (red and blue dots), show distinct boundaries.

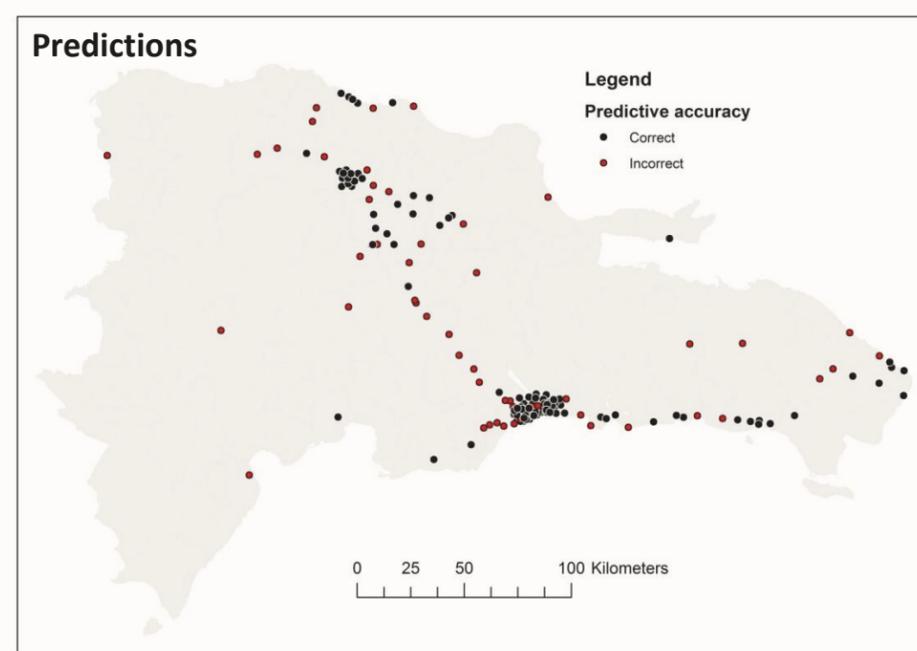


Each cell phone tower is embedded in a unique geographic context, for example, a rural farming community (A), a highway truck stop (B) and slums in the capital city (C). We quantified geographic context for each tower using four place based attributes: sugar cane production, a wealth index, distance to airport, and urbanization.



We used a linear discriminant analysis (LDA) to predict community membership from linear combinations of the four place-based attributes. The figure above represents this process for two attributes: sugar cane production and urbanization.

C O N C L U S I O N S



Predictive accuracy of LDA for community membership of cell phone towers. The color of each dot shows whether the tower's community membership was predicted correctly (black) or incorrectly (red). We were able to successfully predict community membership for >70% of cell phone towers using place-based attributes related to social, economic and ecological context. Consequently, the potential to extrapolate community membership across wide regions not covered by mobile phone towers exists.

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