Understanding the Drivers of Urban Expansion
Case Study of Seville Province

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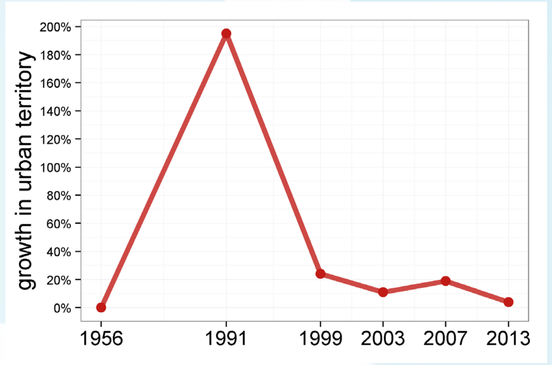
COMPLEX
Knowledge Based Climate Mitigation Systems for a Low Carbon Economy

Motivation

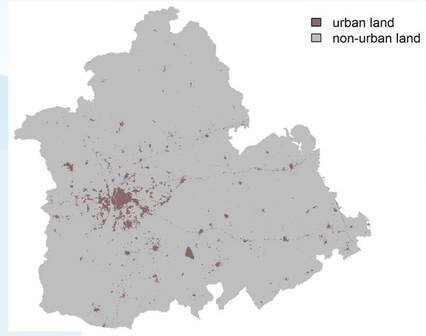
Urban development has accelerated across the globe in recent decades. Much new urbanization has not been concentrated in cities, but has occurred as dispersed, low density development outside of major centers but within their area of economic influence. Province of Seville (Spain) has experienced notable urban expansion in recent years and is subject of the case study.

- In Seville (and Spain) urban expansion has been especially acute since the restoration of democracy.
- The speed of development slowed down during the 2008 crisis.



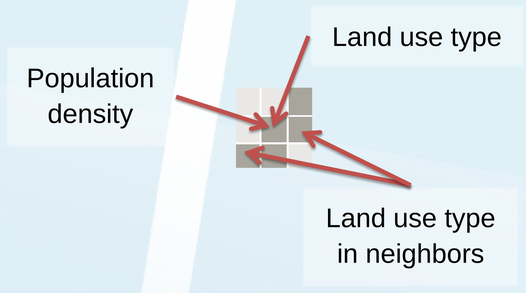
Map of Seville

- The territory is represented by a regular grid of cells
- We classify cells into two major categories:
  1 – urban land,
  0 – non-urban land (vegetation, wetlands, agricultural land and water)



Modelling concepts

- Spatial patterns in urban land development are linked with the level and type of economic activity.
- The types of land use in the neighboring cells are interconnected.
- We can detect and model the relationship between the type of land use and the level of economic activity at the scale of a single cell.



Data

- Population density at the lowest level of administrative division (census tracts called “sections”)
- Land use map with urban/non-urban land distribution
- Data on economic indicators in municipalities (the number of indicators was reduced from 13 initial indicators to 3 principal components, which explain 99% of total variance)
- Spatially explicit economic indicators (8 maps in total)

Statistical analysis and preliminary results

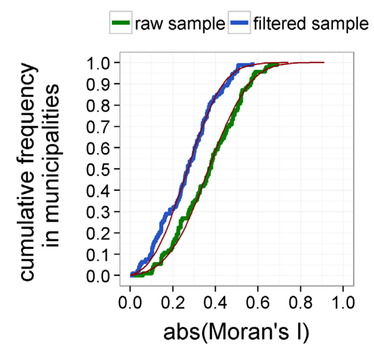
- Multiple regression of population density in the cell based on the type of land use in this cell, the type of the land use in the neighboring cells and economic indicators
- Cross validation in each municipality to verify significance of detected relationship between land use and economic development
- Spatial autocorrelation analysis. Spatial data has the tendency to be dependent. Characteristics at proximal locations are more similar than expected for randomly associated pairs of observations, which leads to unstable parameter estimates.

Regression residuals exhibit significant spatial autocorrelation overall and in most municipalities, e.g. in Dos Hermanas municipality with 107 thousand inhabitants.

Filtering and aggregation

- Although the data was collected at the lowest level of administrative division, it appears to be clustered. Some sections cover very large land areas, especially where human activity is very low due to difficult or undeveloped terrain.

Points, which represent undeveloped territory, are removed from the sample.
Filtering has reduced strength of spatial autocorrelation across municipalities, although significant dependence is still present.



- Next, multiple observations within a cluster are aggregated according to section by taking a summary of land use states (urban or non-urban) within each cell neighborhood. The resulting data points are from different sections and are thus regarded as independent (in the context of population density).

Future Work

- Removing spatial autocorrelation, if necessary this can be accomplished through rigorous analysis at the municipal level
- Projecting land-use patterns based on economic indicators (solving the inverse problem)

Acknowledgments

This work received support from the EU FP7 project COMPLEX (grant no. 308601)