Extracting Land Use from Historical Maps Using Machine Learning: The Emergence and Disappearance of Cities in France

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 Abstract :
We study the evolution of urbanization in France over 250 years using information extracted from historical maps.

In a first part, we use machine learning technics to extract land use information from historical military maps of the whole France around 1860. A detailed 200-meter x 200-meter gridded data set is produced for entire country. Land uses are obtained from Random Forest algorithms, first applied to the 4-meter by 4-meter pixels of the raw maps to extract built-up. The classification of other land uses (forests, crops, pastures, vineyards, water) is based on a Quickshift aggregation of the raw information into superpixels to which a second set of Random Forest algorithms is applied. The accuracy of the classification is very high.

In a second part, we use both built-up and population information on the 200-meter x 200-meter grid to delineate cities at three points in time, 1760, 1860 and 2015. We describe the process of urbanization in France over 250 years. In particular, we document the increasing urban share for population and land and the evolution of cities, those that lose urban status, those that emerge, and those that remain. We also describe the evolution of urban concentration, both within- and between-city. Over time, population concentrates in much fewer but larger cities and the population size dispersion among surviving cities increases. Within-city population and building density gradients from centre to periphery are shown to decline over time.