NEDUM SOCIOECONOMIC URBAN EXPANSION MODEL

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NEDUM-2D has been developed to model how the inhabitants choose to locate in a city, how policies can influence their choice, and what are the socio-economic effects associated to these policies.

It has been designed to create long-term scenarios for city expansion, based on scenarios describing future land-use and transport policies in the city, on demographic scenarios on the future total population, and on global "techno-economic" scenarios on future income, construction cost and transport cost evolution. These techno-economic scenarios can be produced through global general equilibrium prospective models, such as Imaclim-R developed in CIRED (Rozenberg et al. 2010) , or Markal/TIMES developed by IEA ETSAP . NEDUM-2D can therefore be seen as a tool to downscale at city scale global scenarios produced by such models.

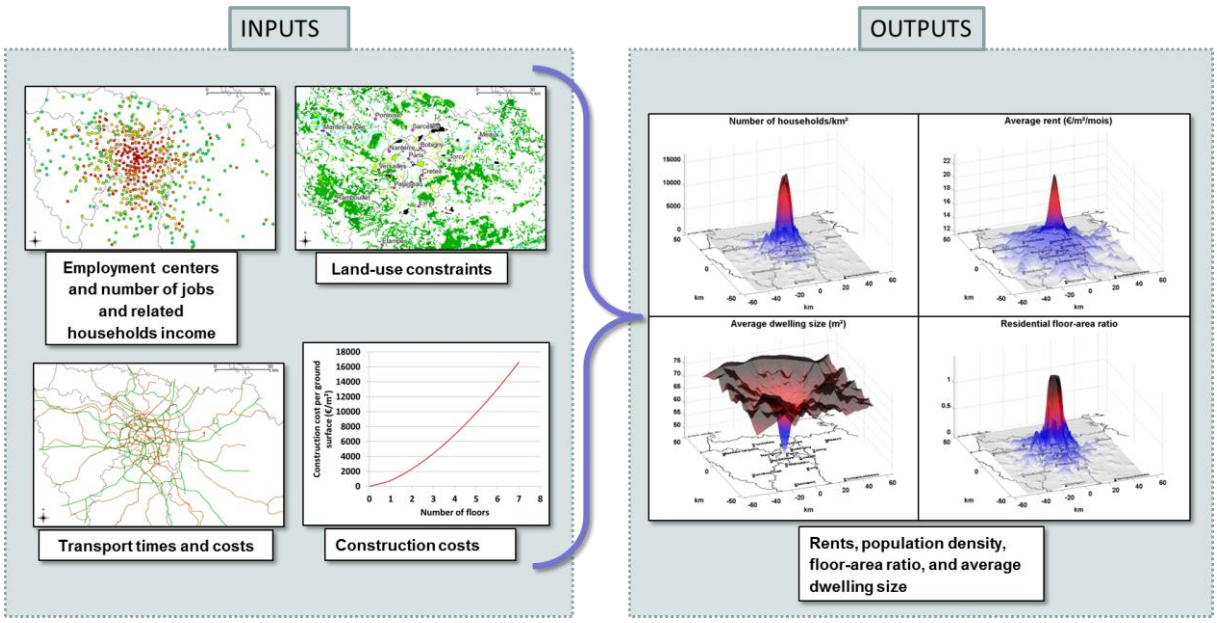

Figure 1 - Description of NEDUM-2D model

More precisely (V. Viguié, Hallegatte, et Rozenberg 2011; Vincent Viguié et Hallegatte 2012; V. Viguié 2012), NEDUM-2D simulates the spatial distribution of land and real estate values, dwelling sizes, population density, building height and density, and their evolution over time (Figure 1). It is a dynamic model which relies on the classical urban economics framework (Fujita 1989), but is able to capture the dynamics of urban systems, and the importance of inertia. To produce scenarios going until the end of the century, it uses only general and fundamental economic principles, which are likely to remain constant over the long term.

Three main mechanisms drive the model. First, we suppose that households choose their accommodation location and size by making a trade-off between the time and money they spend for transport (i.e. to commute to their jobs) and the real estate price level (or, equivalently, between the proximity to the city center and the housing surface they can afford).

Second, real estate developers choose to build more or less housing (i.e. larger or smaller building) at a specific location, depending on the local level of real estate prices. When these prices are low, developers tend to build low density buildings, and when these prices are high, they tend to build high density buildings.

Third, we suppose that various city characteristics do not change and adjust at the same speed. For instance, rents can change very quickly, whereas buildings characteristics evolve over a much longer timescale. Building depreciation is also very slow, leading to path dependency and lock-ins in city evolution.

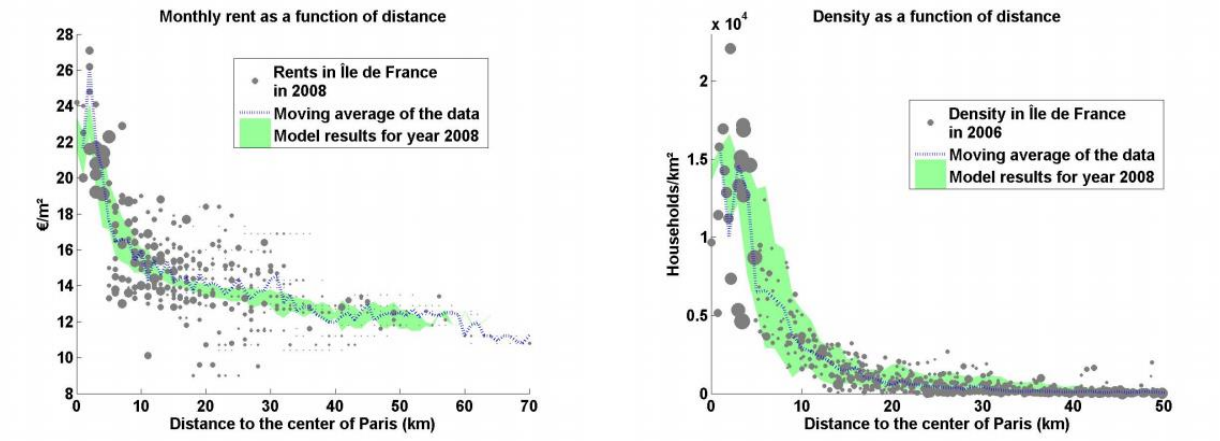

Figure 2: Comparison between actual Paris urban area structure and NEDUM simulation, for the same years.

Using these mechanisms, it is possible to determine the structure of the city from information on population size, households' income, transport network location, building construction costs and developers behavior parameters.

This model has been first calibrated on Paris urban area (Vincent Viguié et Hallegatte 2012). A validation of the model over the 1900–2010 period shows that the model reproduces the available data on the city's evolution fairly faithfully (Figure 2 and Figure 3), suggesting that the model captures the main determinants of city shape evolution. It also well reproduces the spatial distribution of dwelling size, population density, and rents in the urban area (V. Viguié, Hallegatte, et Rozenberg 2011; Vincent Viguié et Hallegatte 2012)

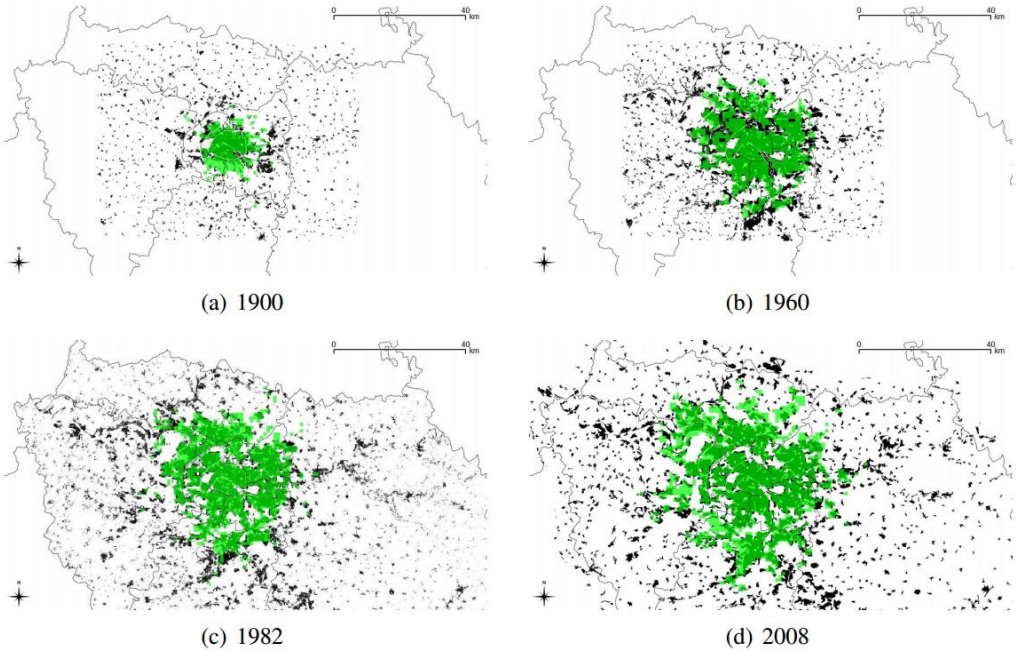

Figure 3: Simulated urbanized area compared to actual urbanized area. Actual urban area appears in black (Source: Corinne Land Cover and IAU), whereas model simulation appears in transparent green.

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