Implementing policies today for the cities of tomorrow

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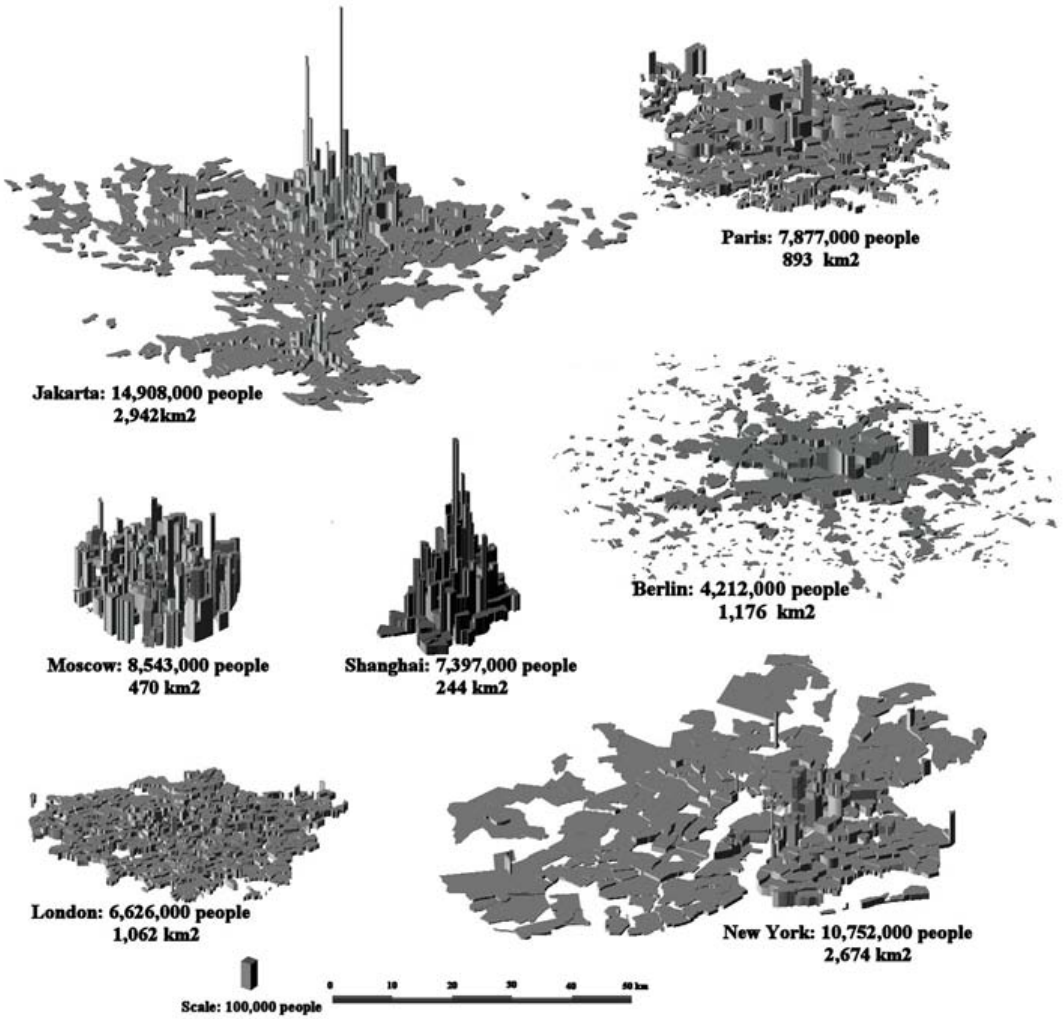
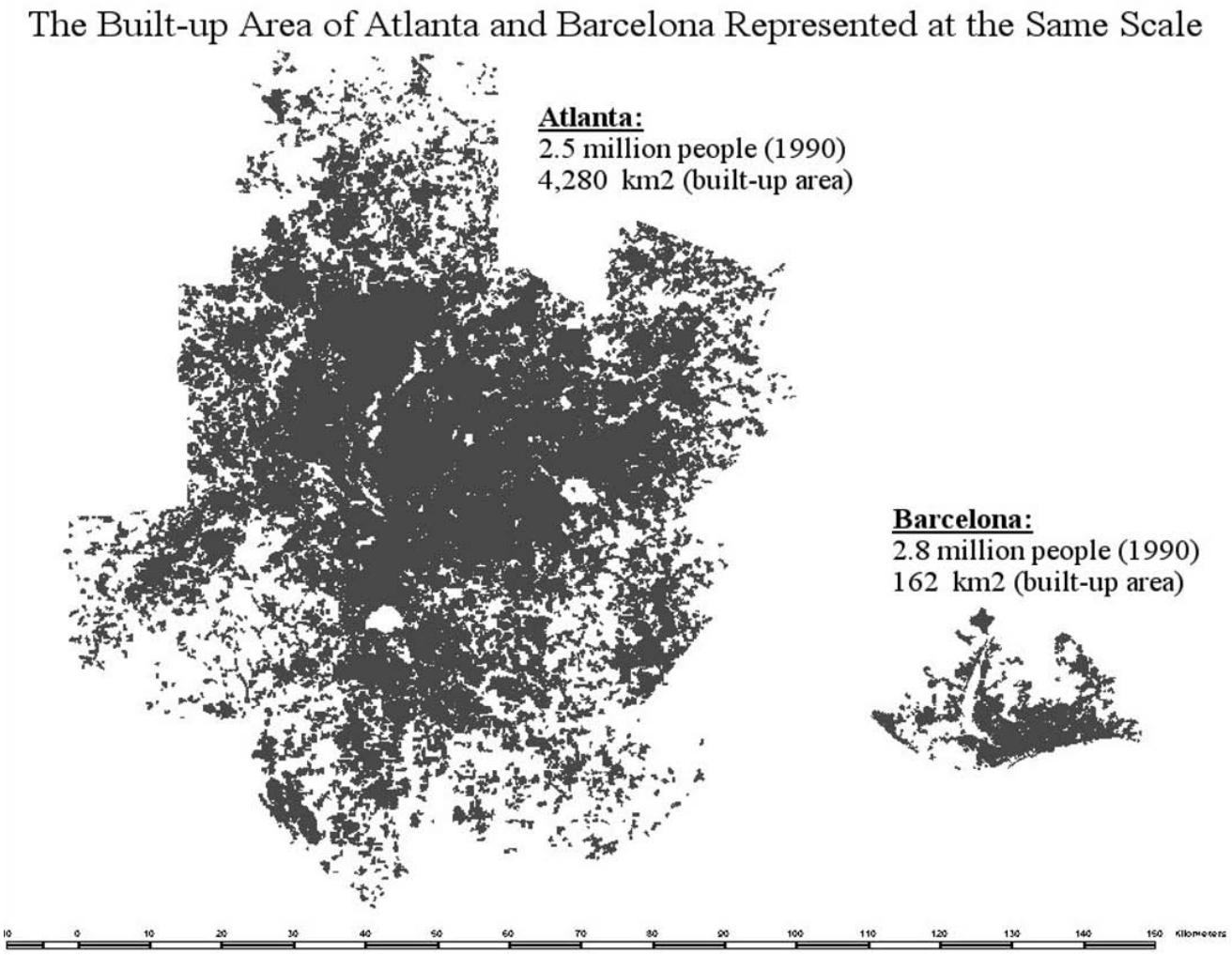
Introduction : Urban forms…

Spatial distribution of population in 7 major metropolis represented at the same scale (1990)



Source : Alain Bertaud

Urban forms matter for greenhouse gas emissions…



Lower emissions in Barcelona because of:

1 - Shorter travel distance;

2 – Easier use of public transport:

Barcelona has 99 km of metro line.

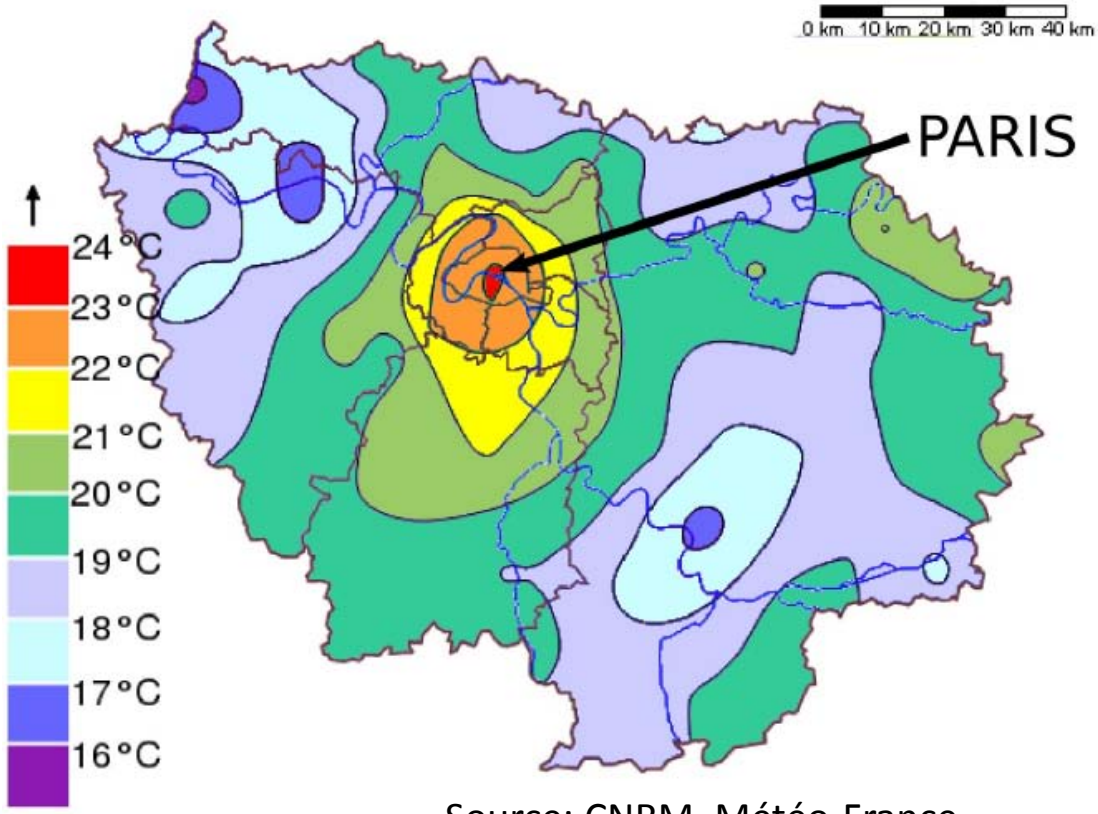
To provide the same accessibility to metro in Atlanta, 3400 km would be necessary.

Source: Alain Bertaud

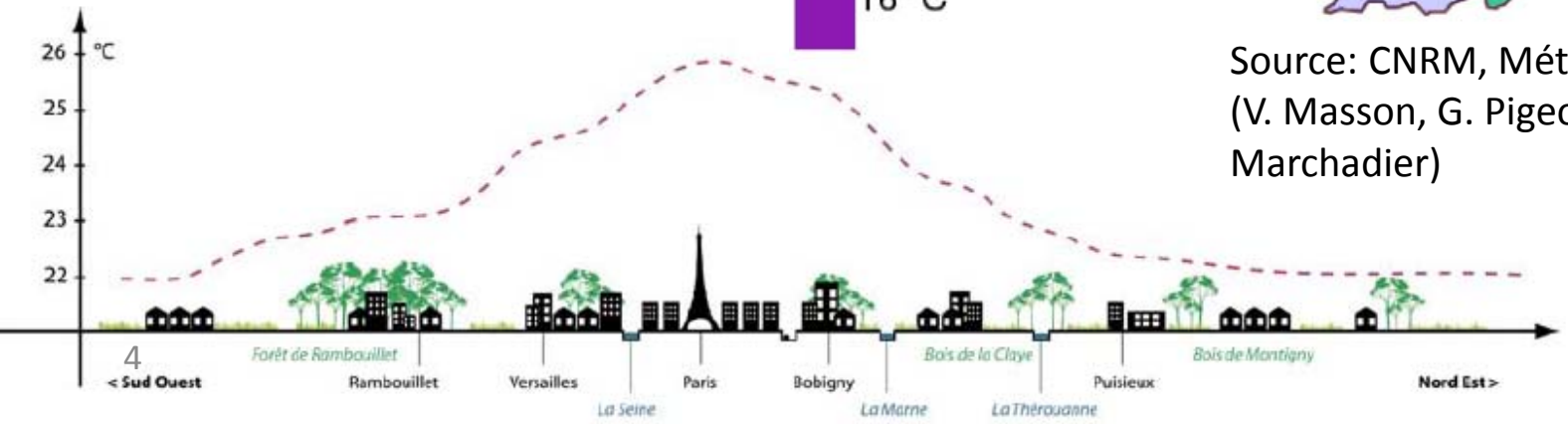
Urban forms matter for climate-change vulnerability…

Temperatures are higher in cities than in rural areas, especially at night.

Example of the 2003 heat wave.



Source: CNRM, Météo-France
(V. Masson, G. Pigeon, A. Lemonsu, C. Marchadier)



Adapting cities leads to specific issues

- **Urban forms matter for greenhouse gas emissions**
  - Transport, housing, …
- **Urban forms matter for climate-change vulnerability**
  - Urban heat island
  - Urbanization in flooding prone areas…

- **Urban forms matter for many other policy objectives, e.g., related to social and spatial inequalities, competitiveness...**

- **Urban forms cannot change rapidly, so we already need to take into account current and future constraints**
  - Unprecedented need to anticipate future constraints and objectives and to act with no delay

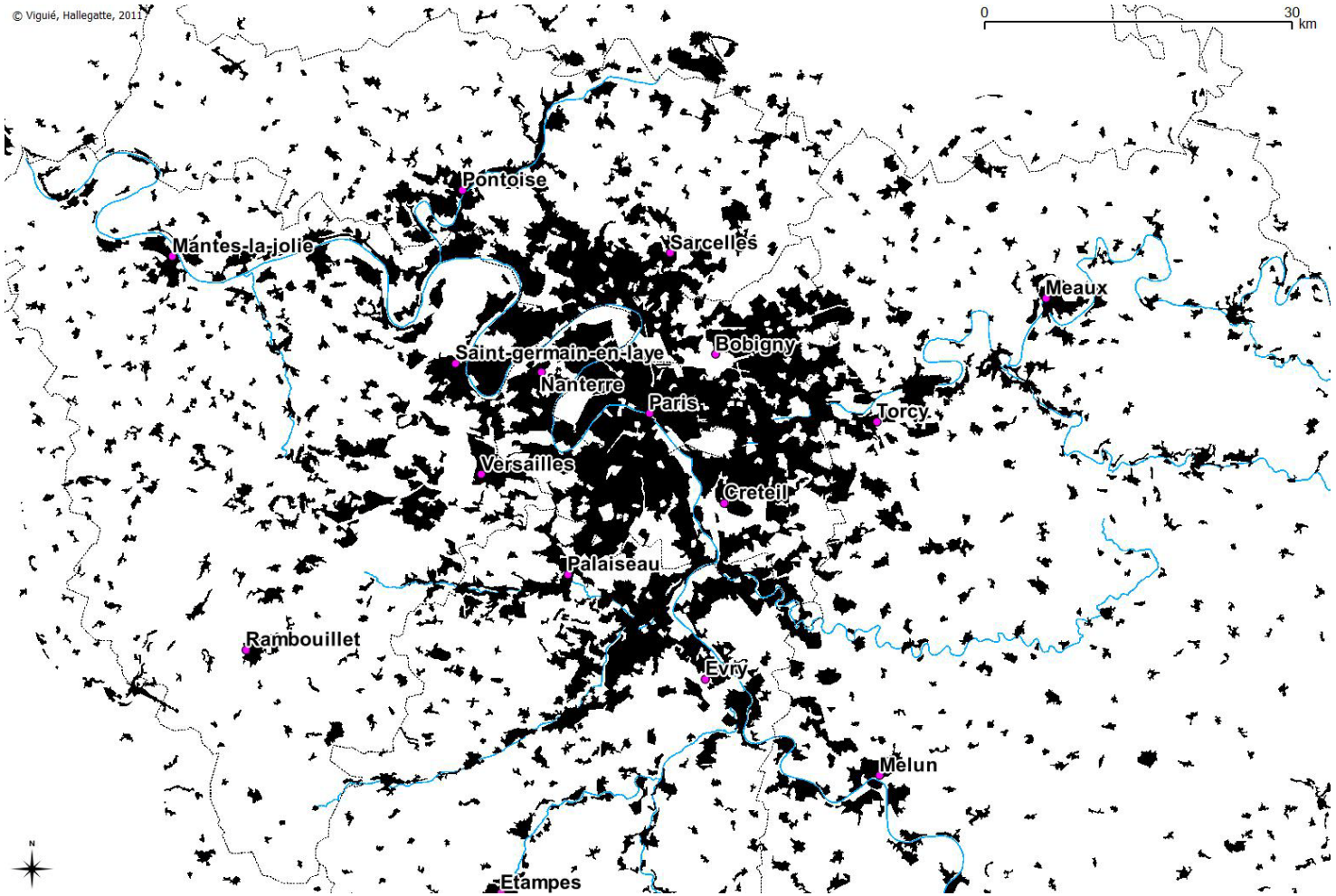
Modelling urban form?

- Standard urban economics modelling *(Alonso 1964, Mills 1967, Muth 1969)*

- **3 mechanisms :**
  1. Households' tradeoff:
     - Lower transportation costs and shorter commuting time when living close to the city center, and
     - Larger dwellings and lower rent in remote areas
  2. Investors optimize the housing density as a function of rents and construction costs
  3. Different evolution timescales for rents, population density, buildings etc.

- Simplifying hypotheses :
  - All households have the same income.
  - One trip per day towards the city center.
  - One city center

Paris, 2006


© Viguié, Hallegatte, 2011
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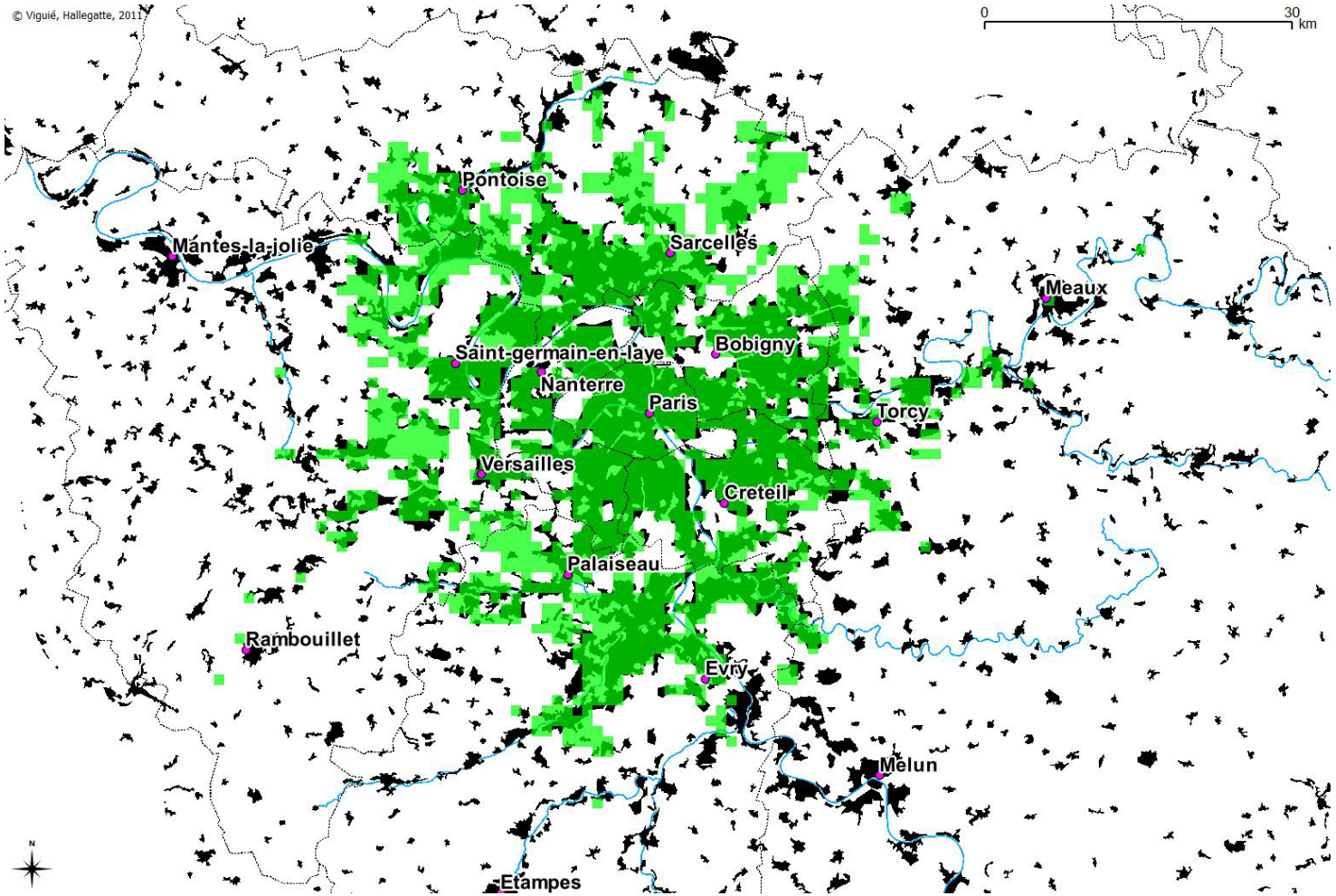
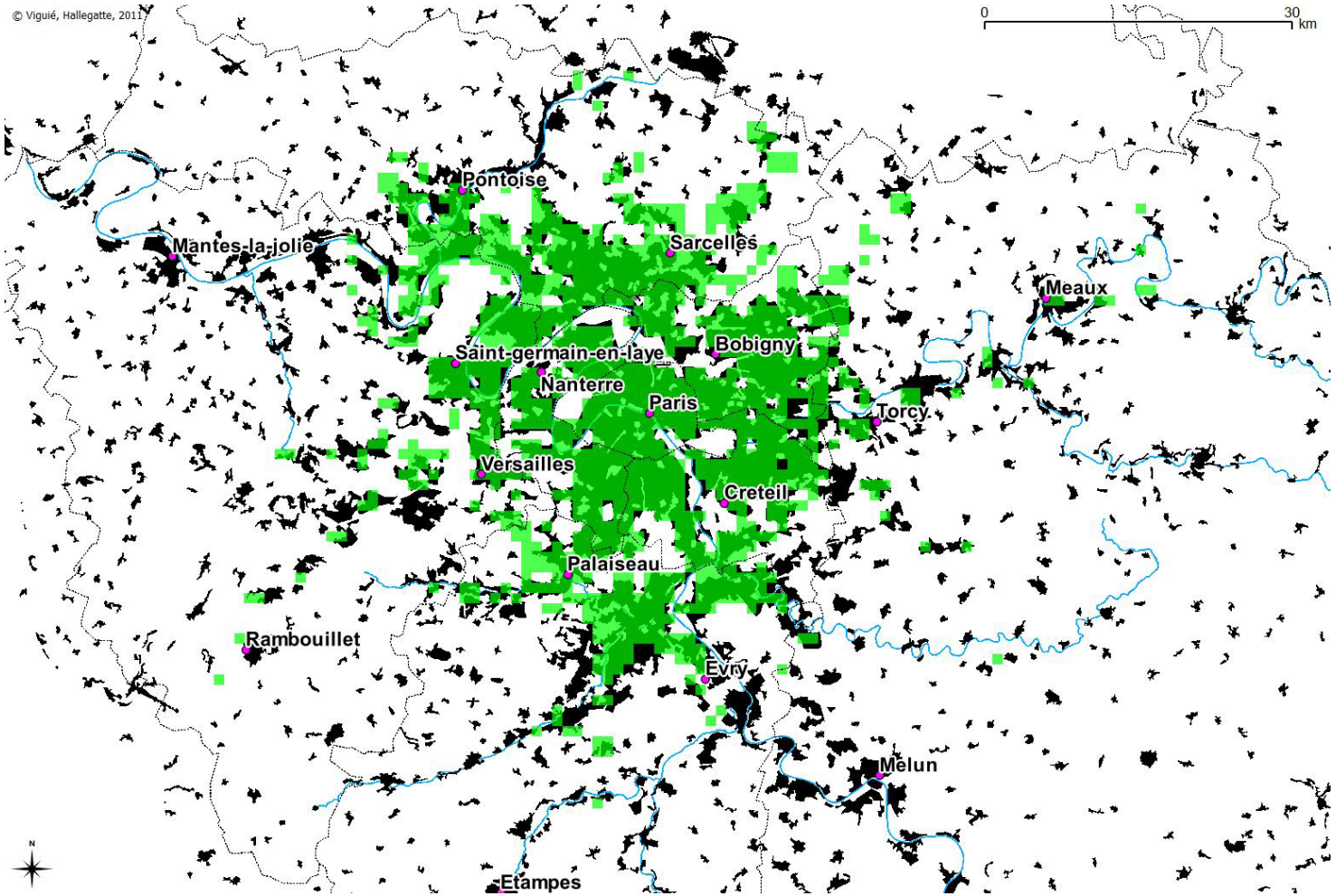
30
km
Pontoise
Mantes-la-jolie
Sarcelles
Meaux
Bobigny
Saint-germain-en-laye
Nanterre
Paris
Torcy
Versailles
Creteil
Palaiseau
Rambouillet
Evry
Melun
Etampes

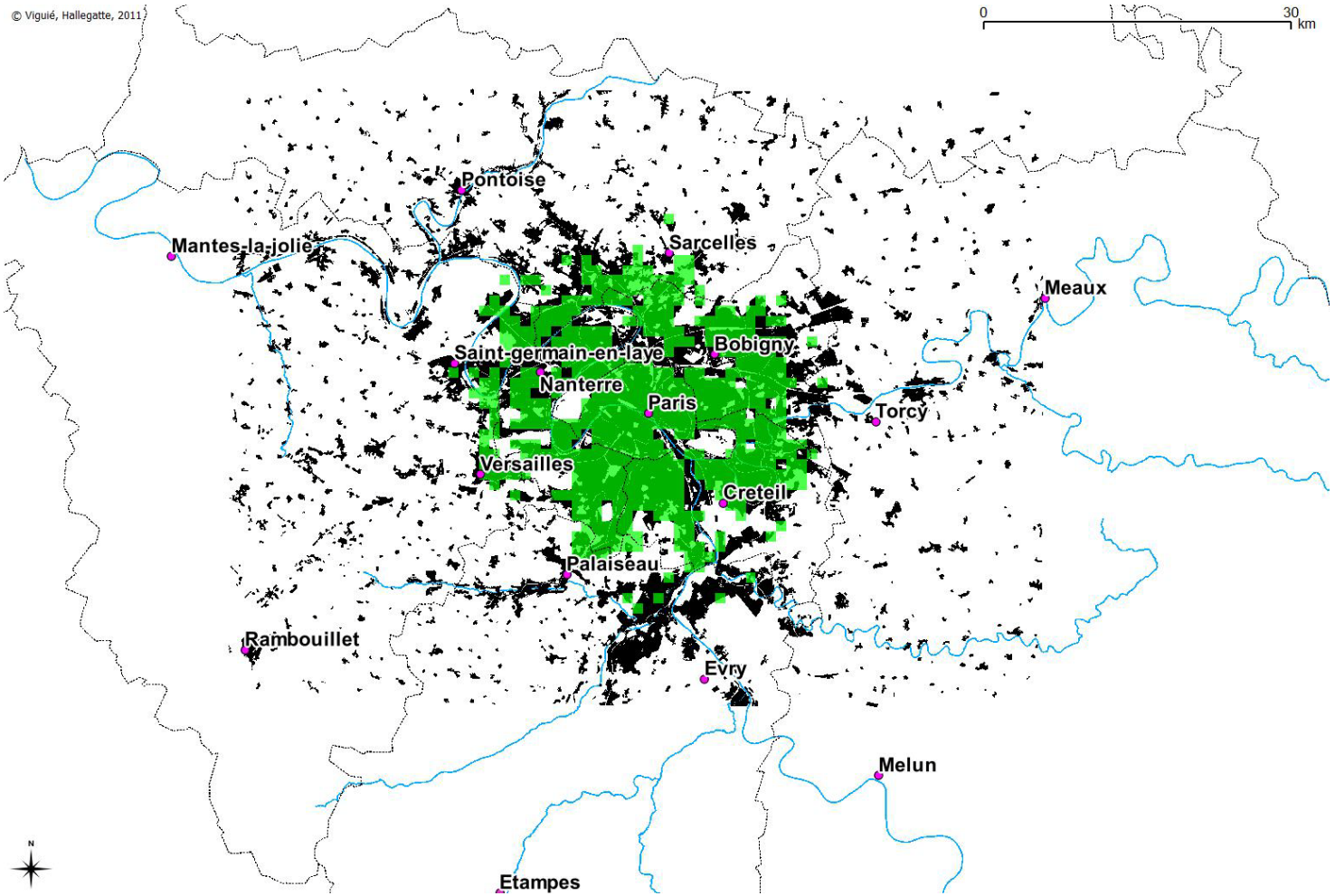
Model results : Paris, 2006



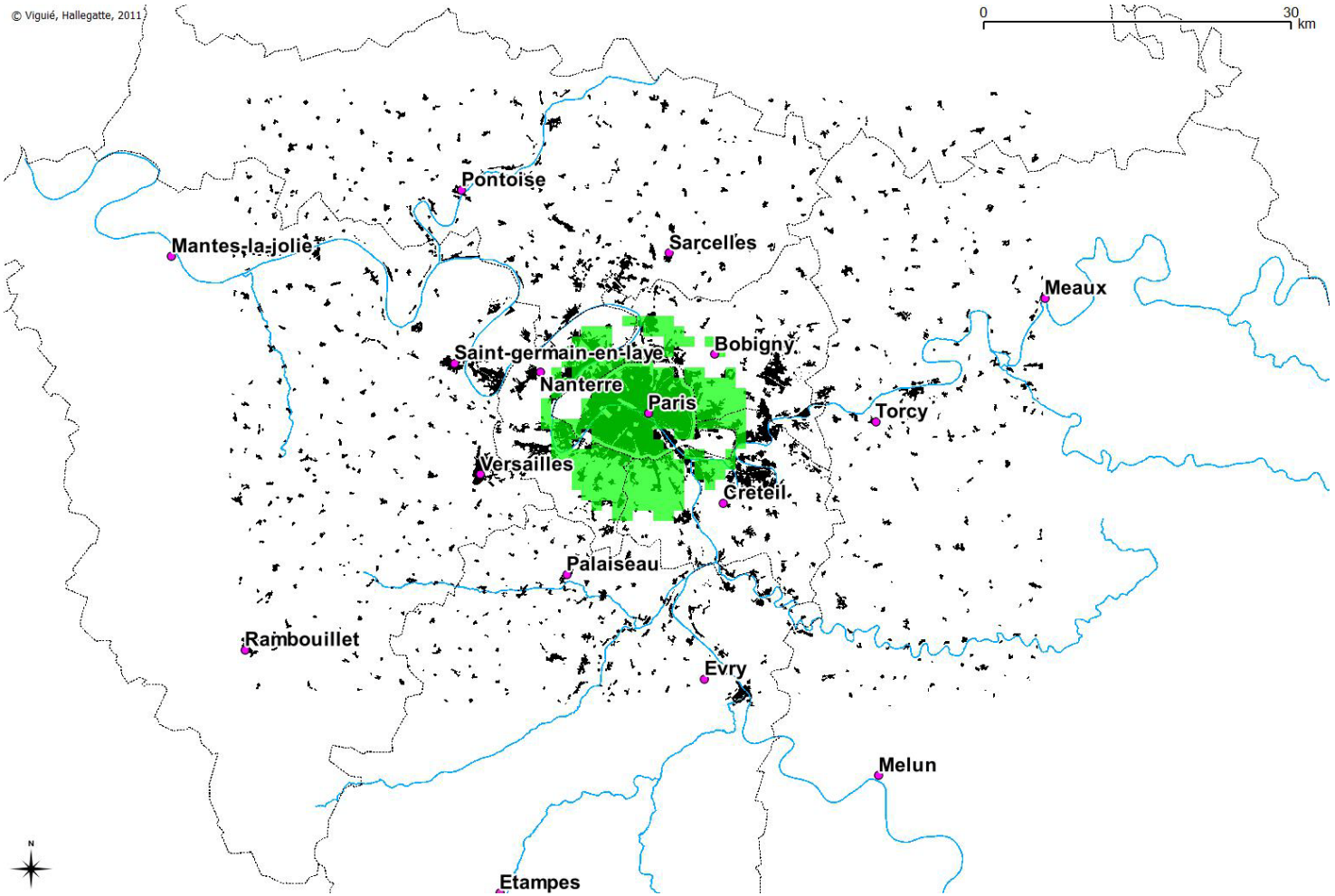
Model results : Paris, 1990



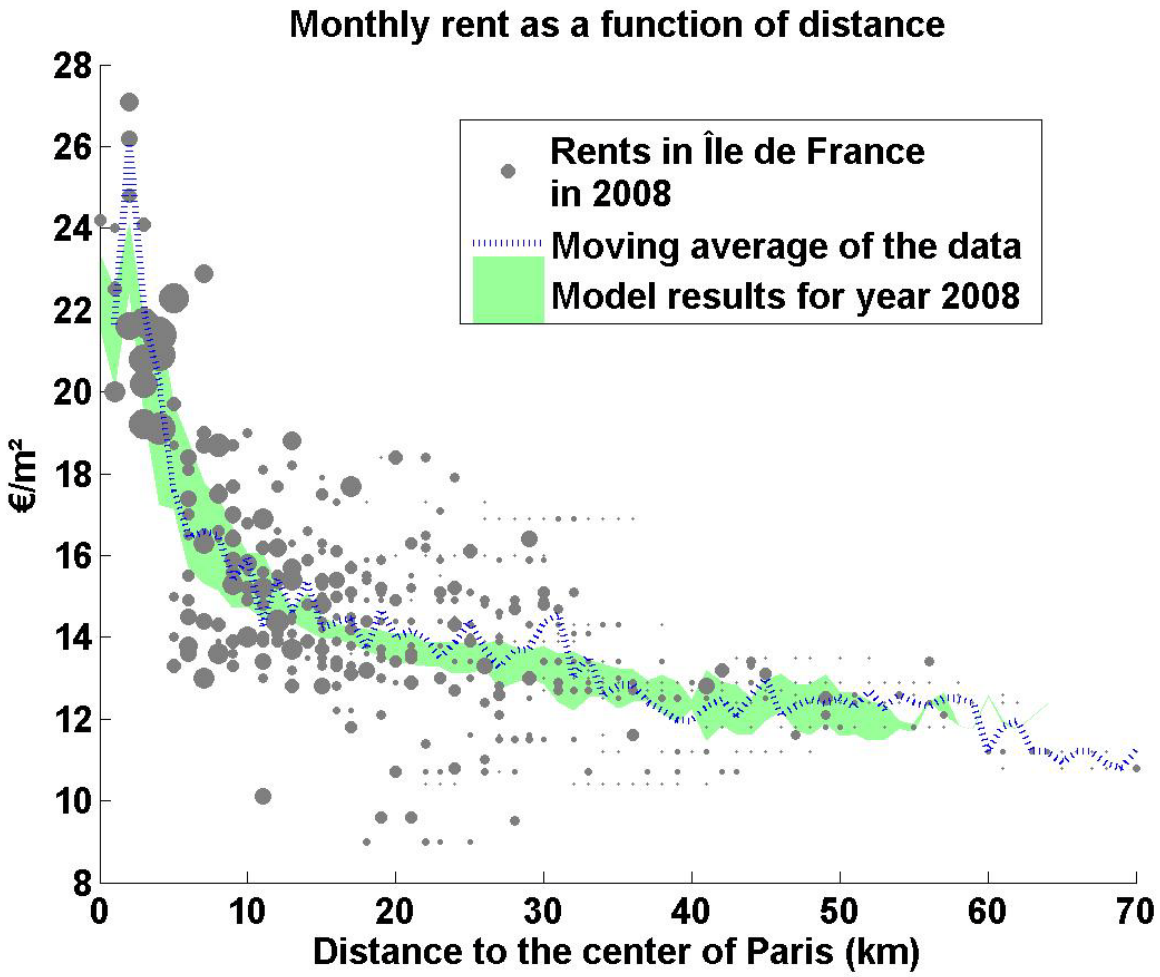
Model results : Paris, 1960



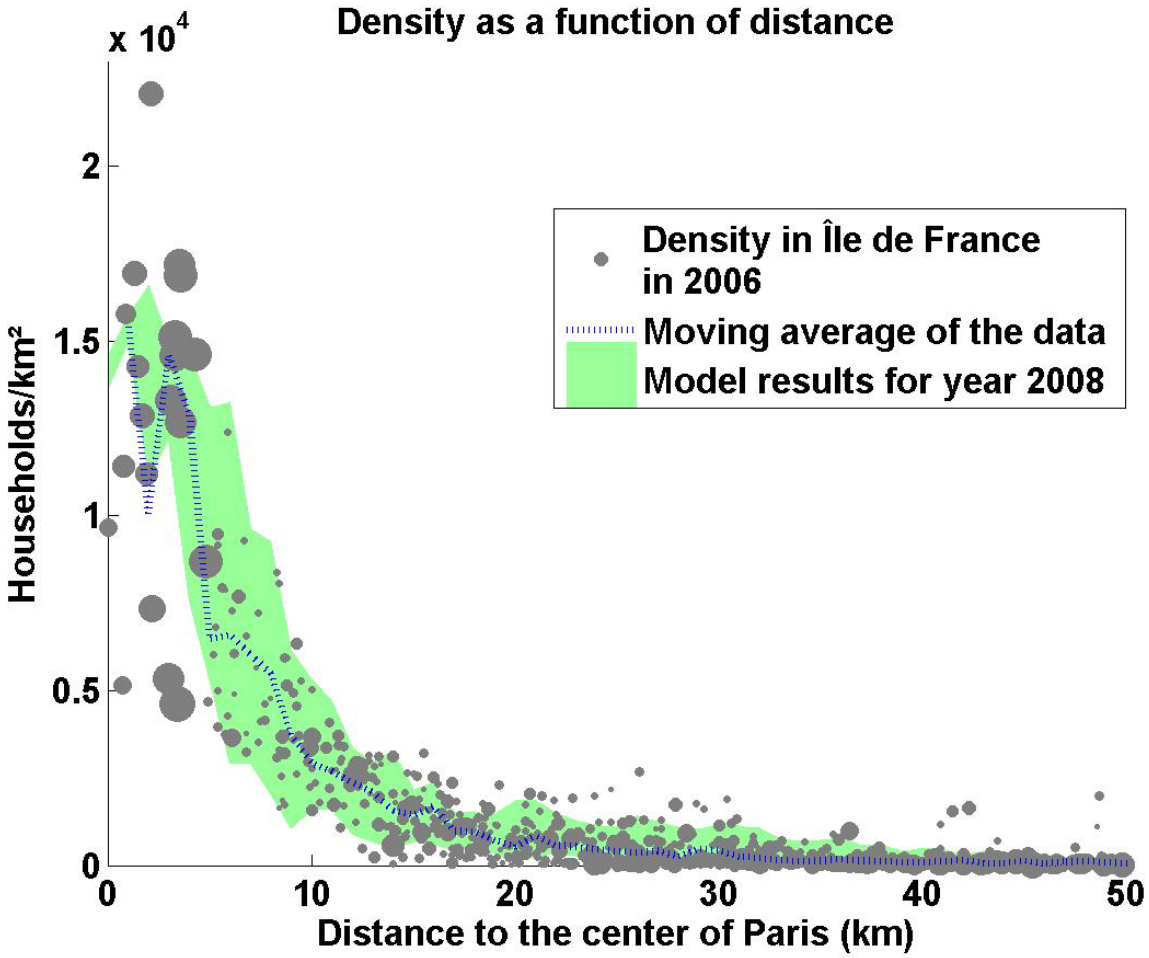
Model results : Paris, 1900



Model results



Model results



2010-2100 SCENARIOS

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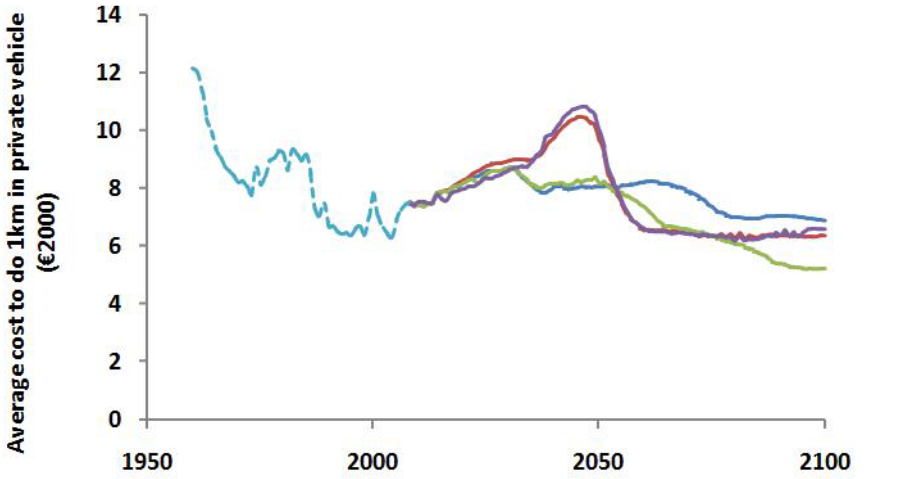
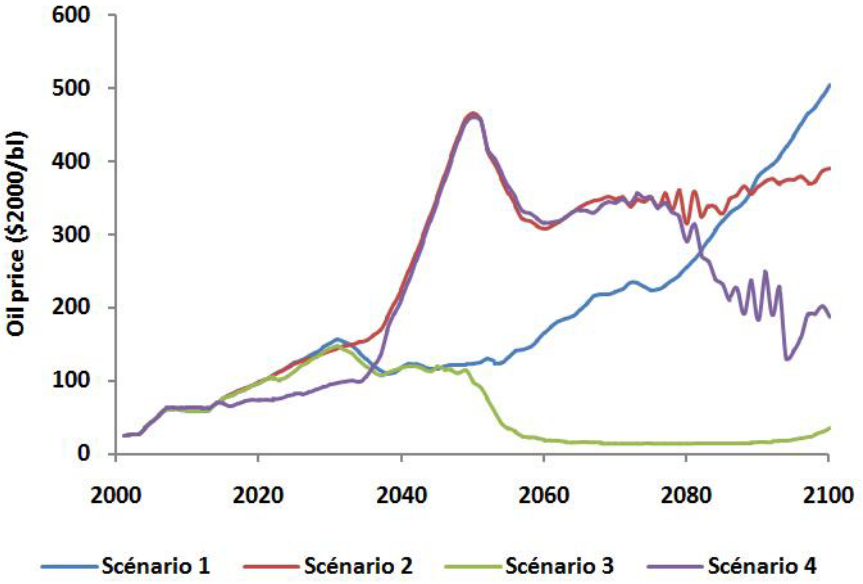
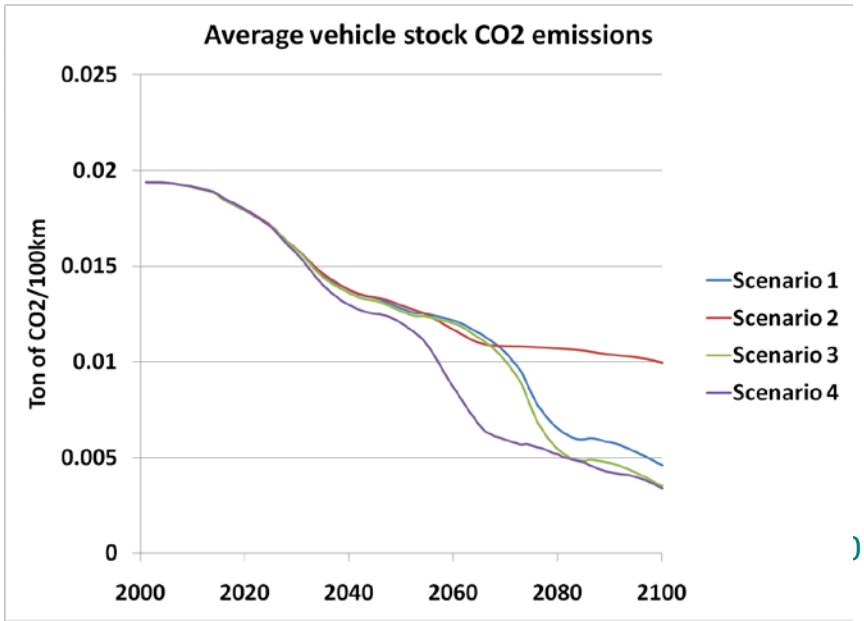
Main hypotheses

- 4 world scenarios :
  - Tensions on fossil fuel markets
  - Ambitions of world climate policies.

Techo-economic scenario from the ImaclimR model
Exemple: private vehicle cost and oil prices

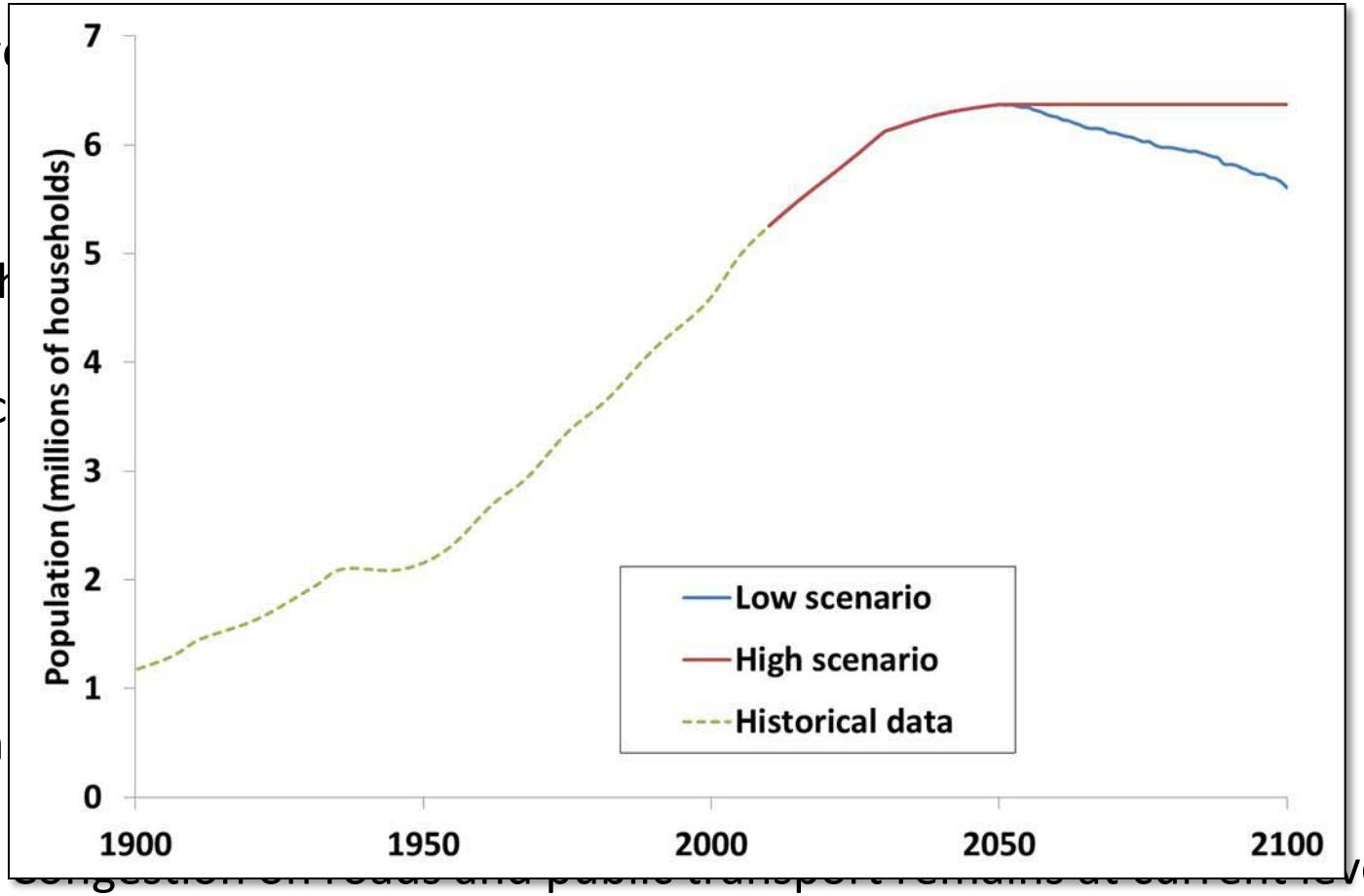




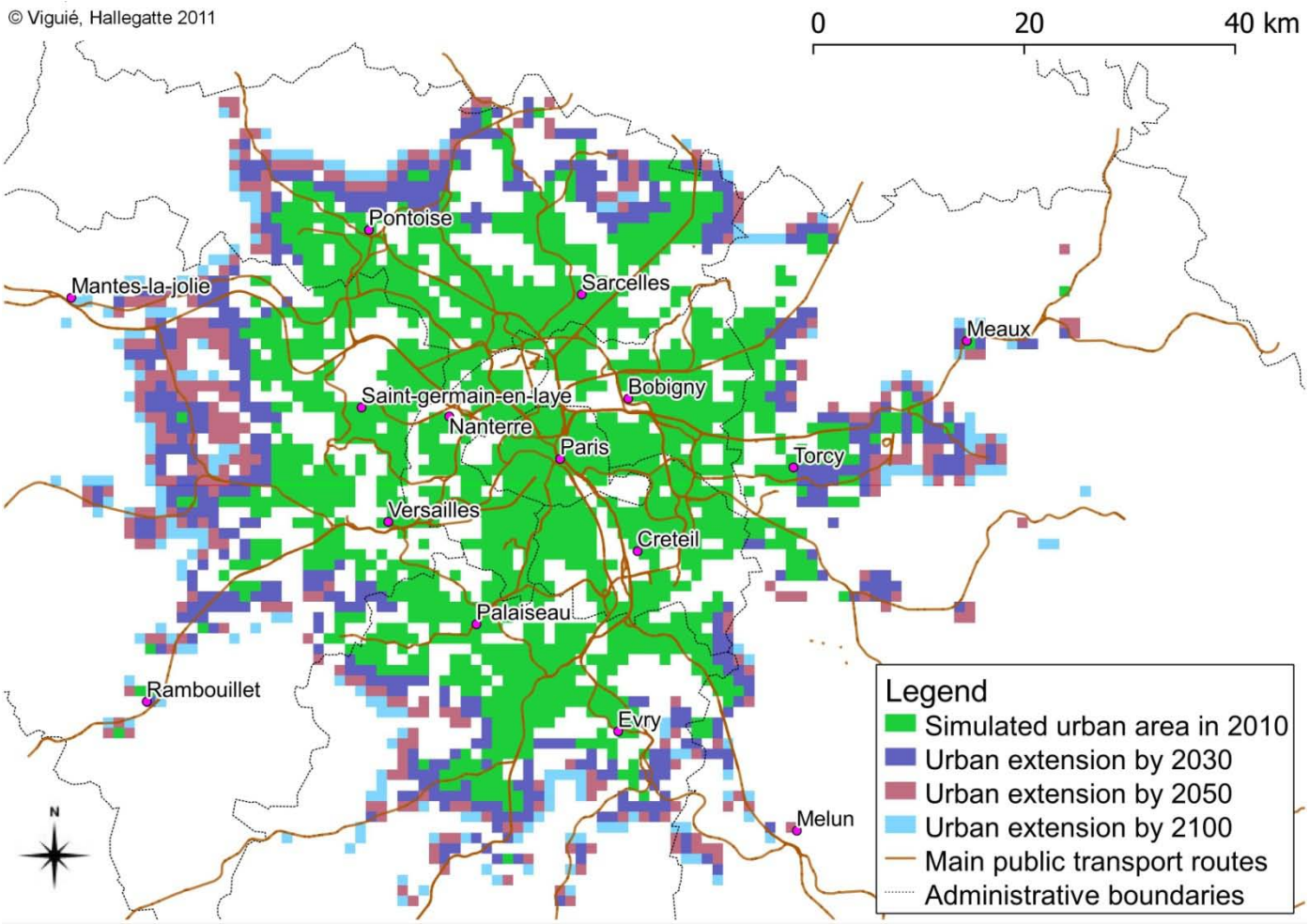


Main hypotheses

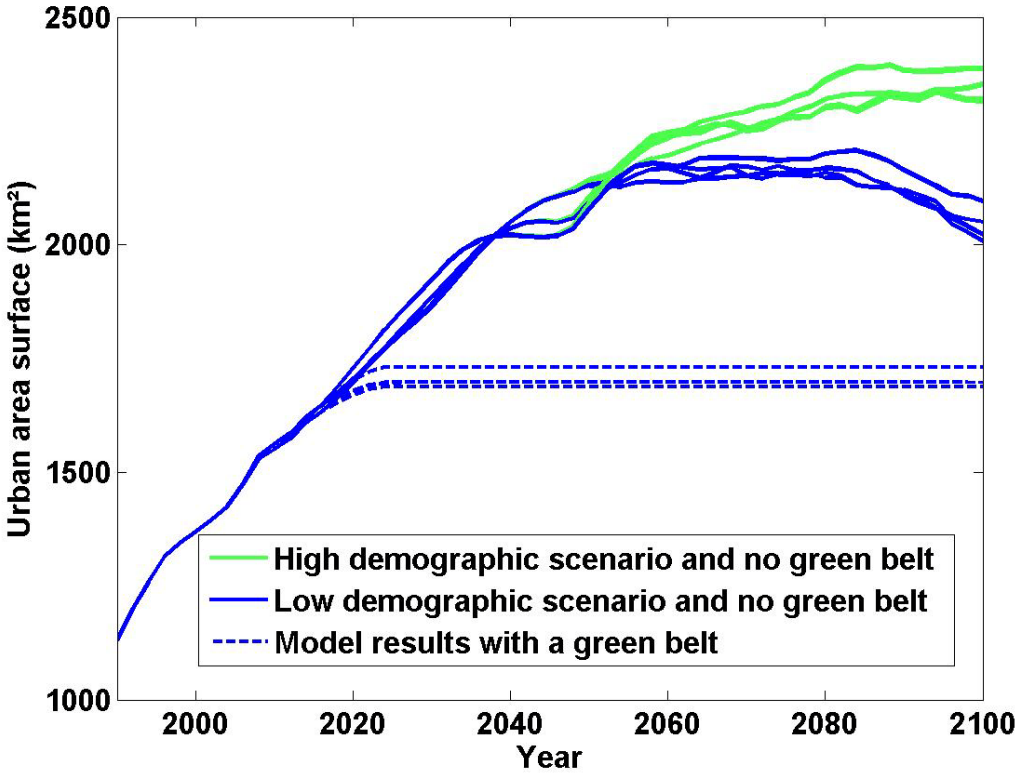
- 4 w
  - ➤
  - ➤
- High
- 4 sc
  - ➤
  - ➤
  - ➤
  - ➤
- Sim
  - ➤
  - ➤ Congestion on roads and public transport remains at current levels



Example of Paris urban area extension prospective scenario (high demographic scenario+scenario1)



Paris built area extension – Urban sprawl

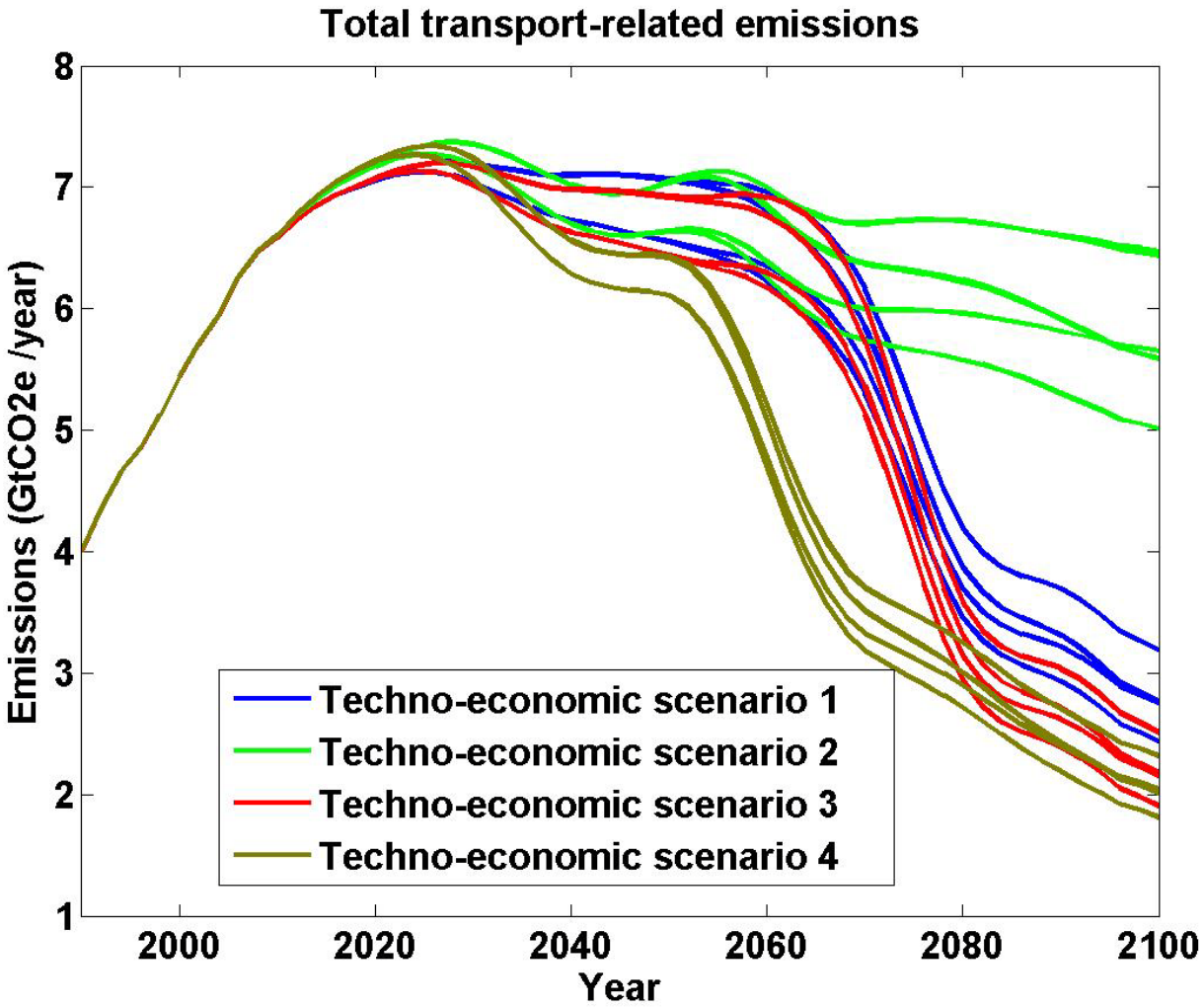


Urbanized area extension continues if the population keeps growing

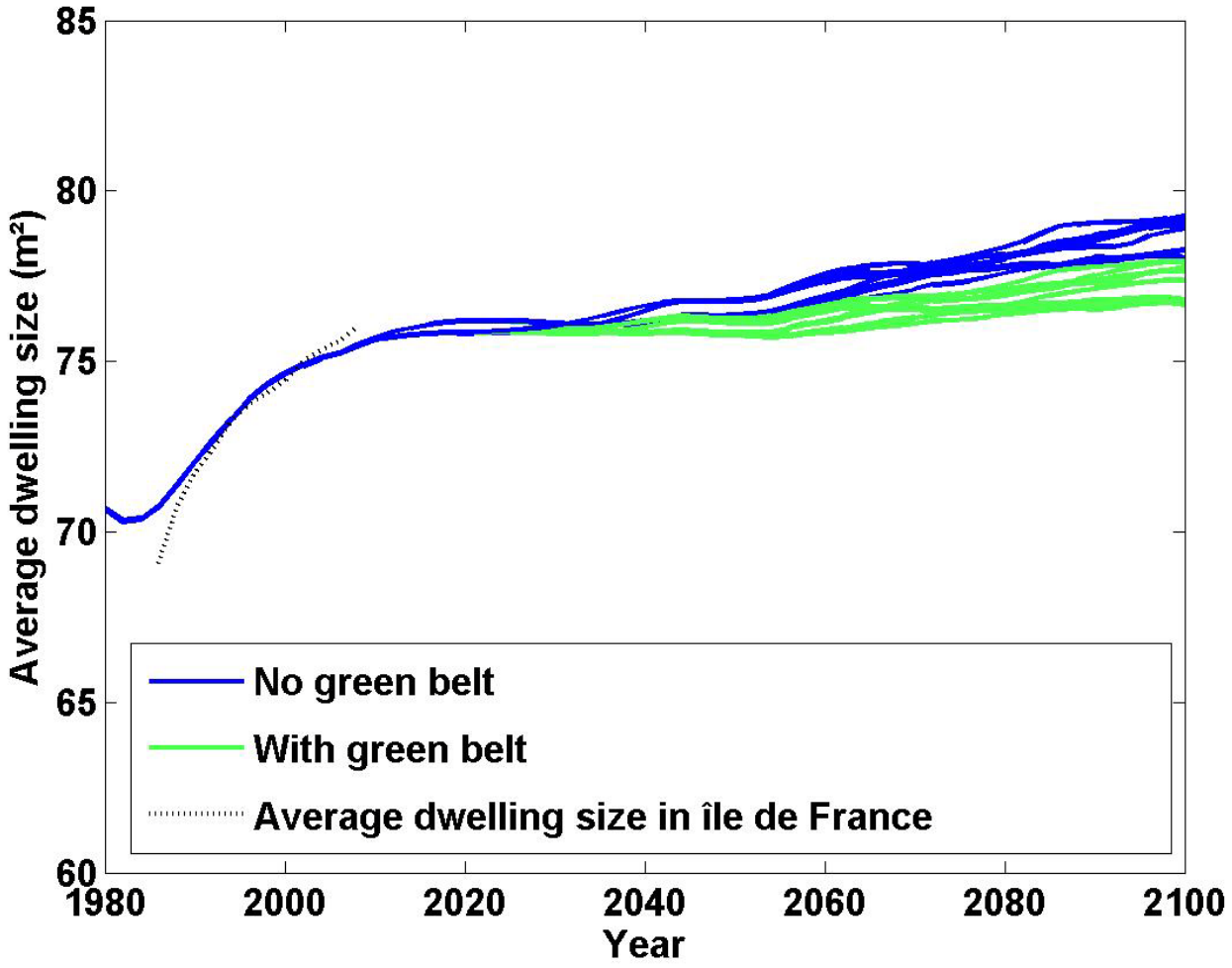
Slow decrease in the other case

Small impact of technology and fuel prices scenarios.
Only local policies can control urban sprawl.

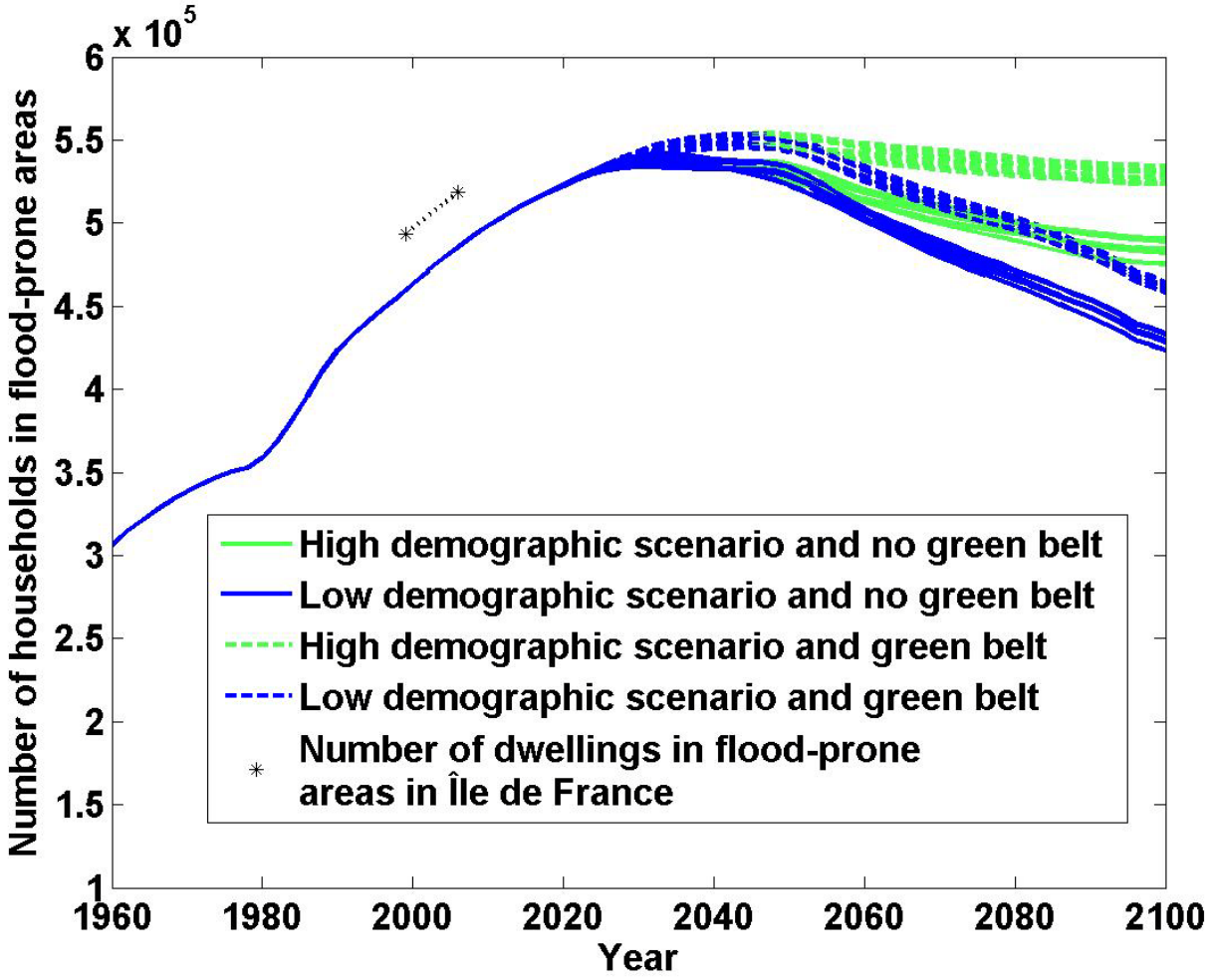
Input for mitigation policy analysis: Example: transport-related emissions in Paris



Dwelling size increase

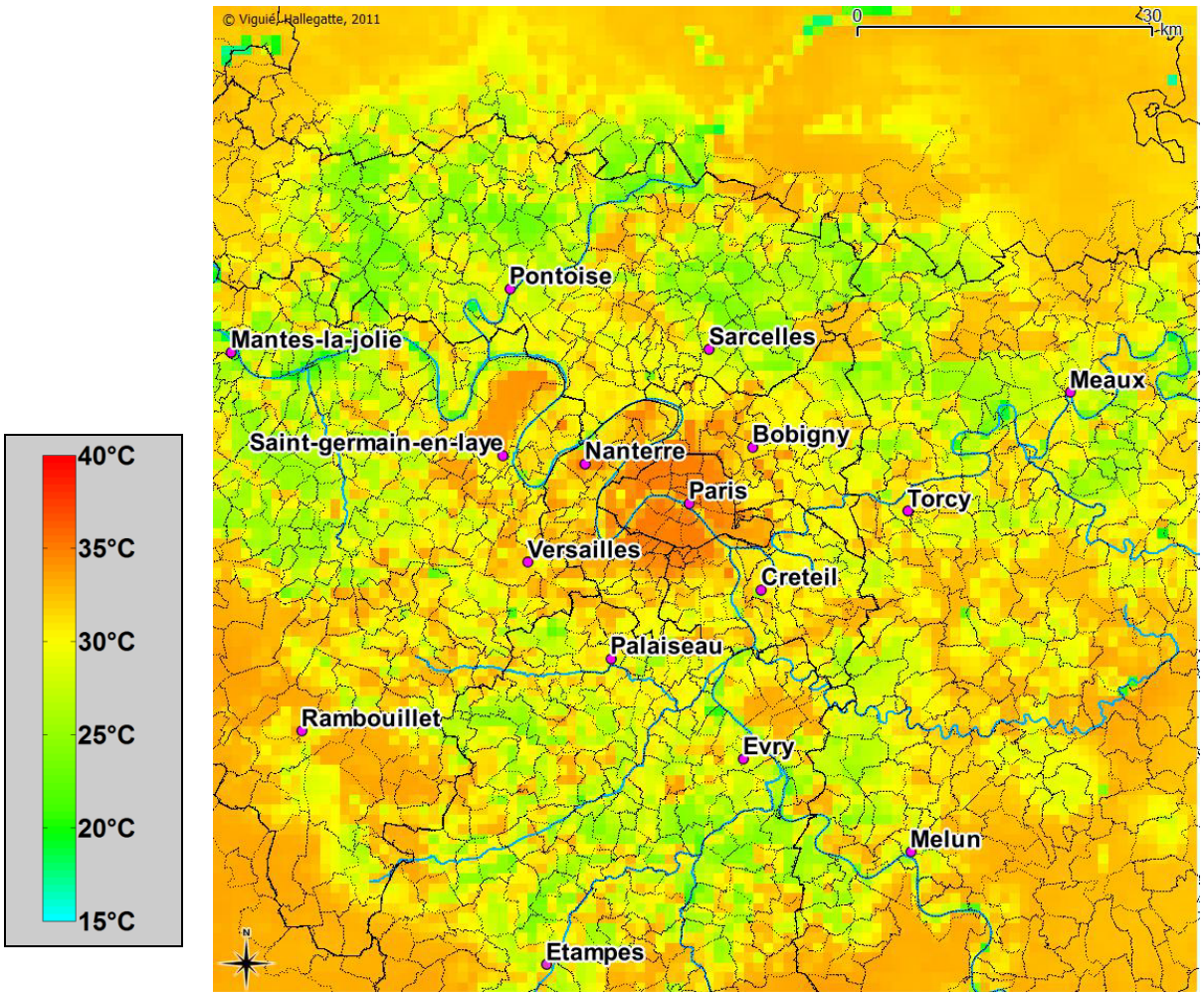


Input for adaptation policy analysis: Example: population exposed to floods and green belt



A green belt to control urban sprawl has a negative impact on flood risks

Example: Heat island effect in 2100 in this scenario



Air temperature, 2m above ground, at 19:00 UTC

After a day representative of august 2003 heatwave days

(work in progress)

Source: CNRM, Météo-France (V. Masson, G. Pigeon, A. Lemonsu, C. Marchadier, A. Beaulant)

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A few insights…

- Urban sprawl will continue and accelerate, even in a strong peak oil scenario. Only local policies can control urban sprawl.

- Transport-related emissions are found to decrease after 2030 in our scenarios, because of technological change and increased prices.

- Mitigation, adaptation, and other environmental objectives interact. For instance, a Green Belt to reduce transport and urban sprawl may increase flood risks or high-temperature vulnerability.

- **Urban economic models and urban-scale long term scenarios provide useful insights into mitigation and adaptation policies.**

APPLICATION IN WUHAN

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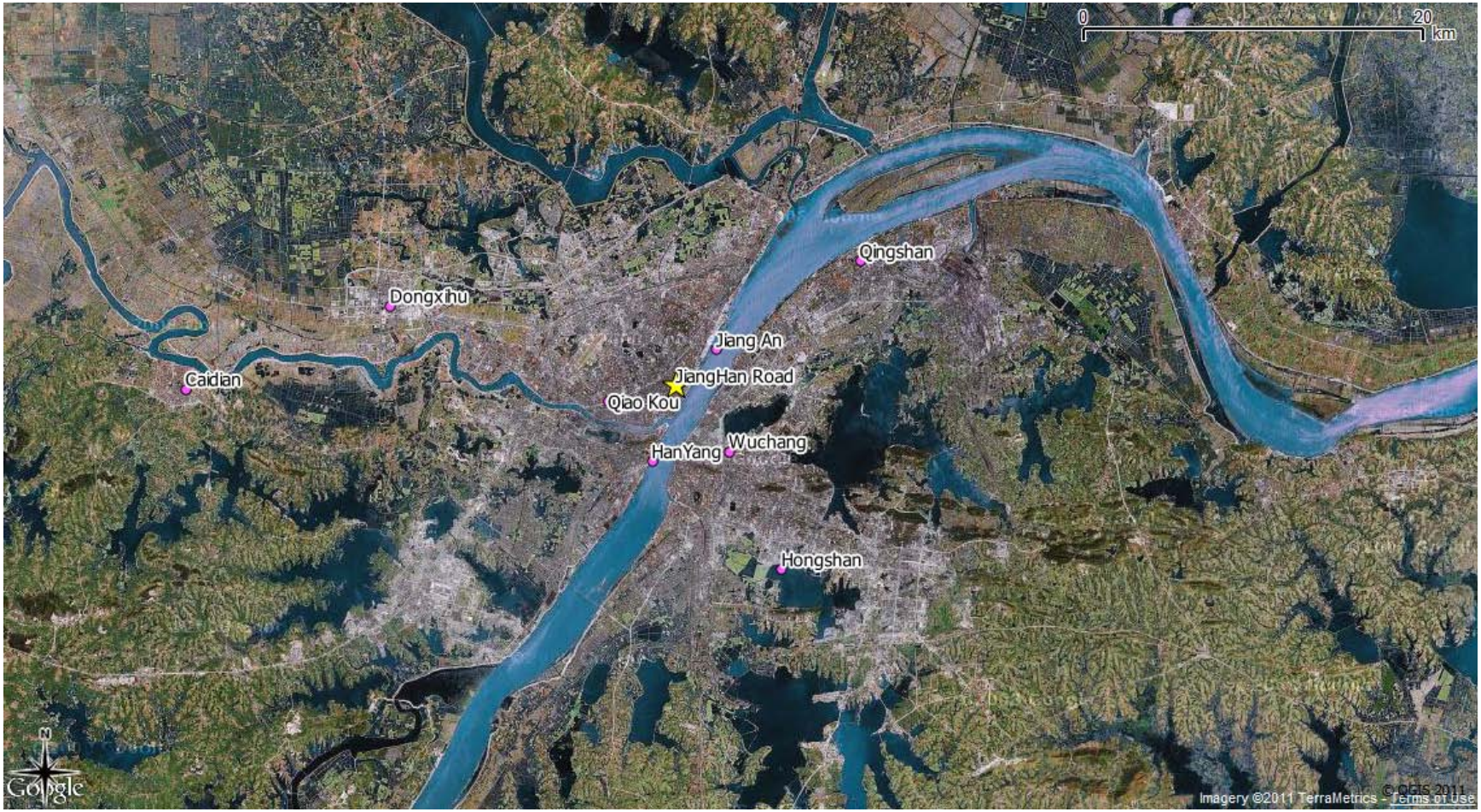
Wuhan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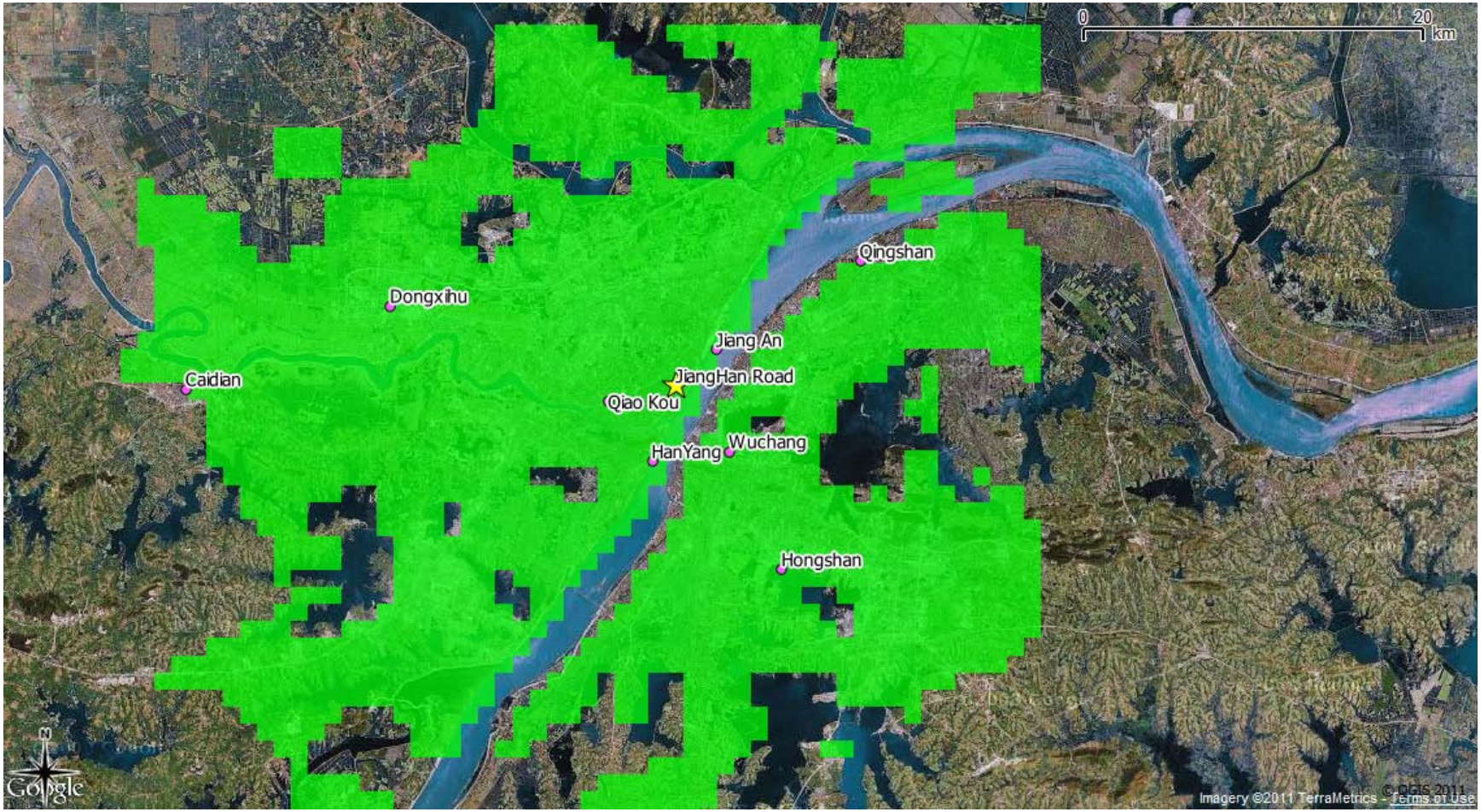
Wuhan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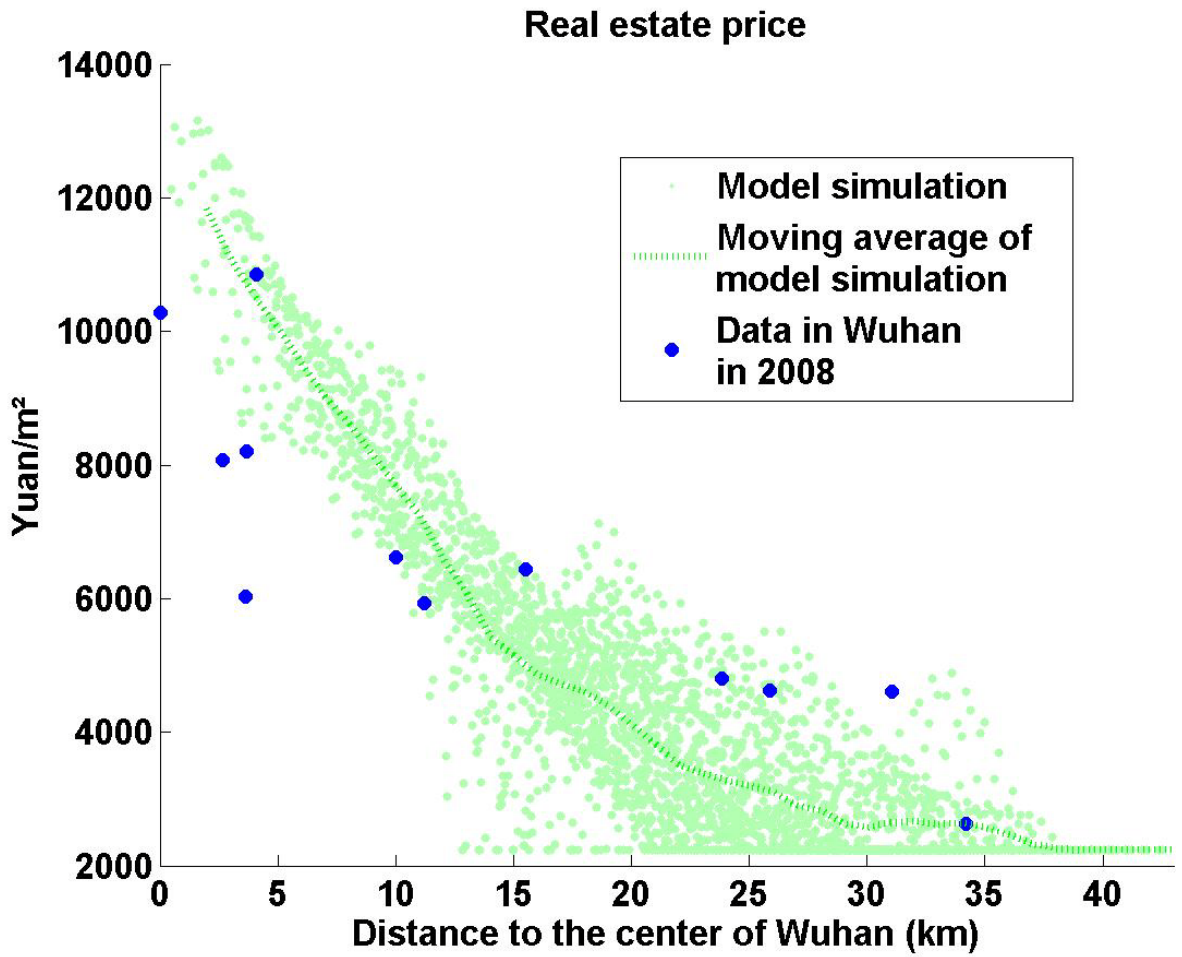
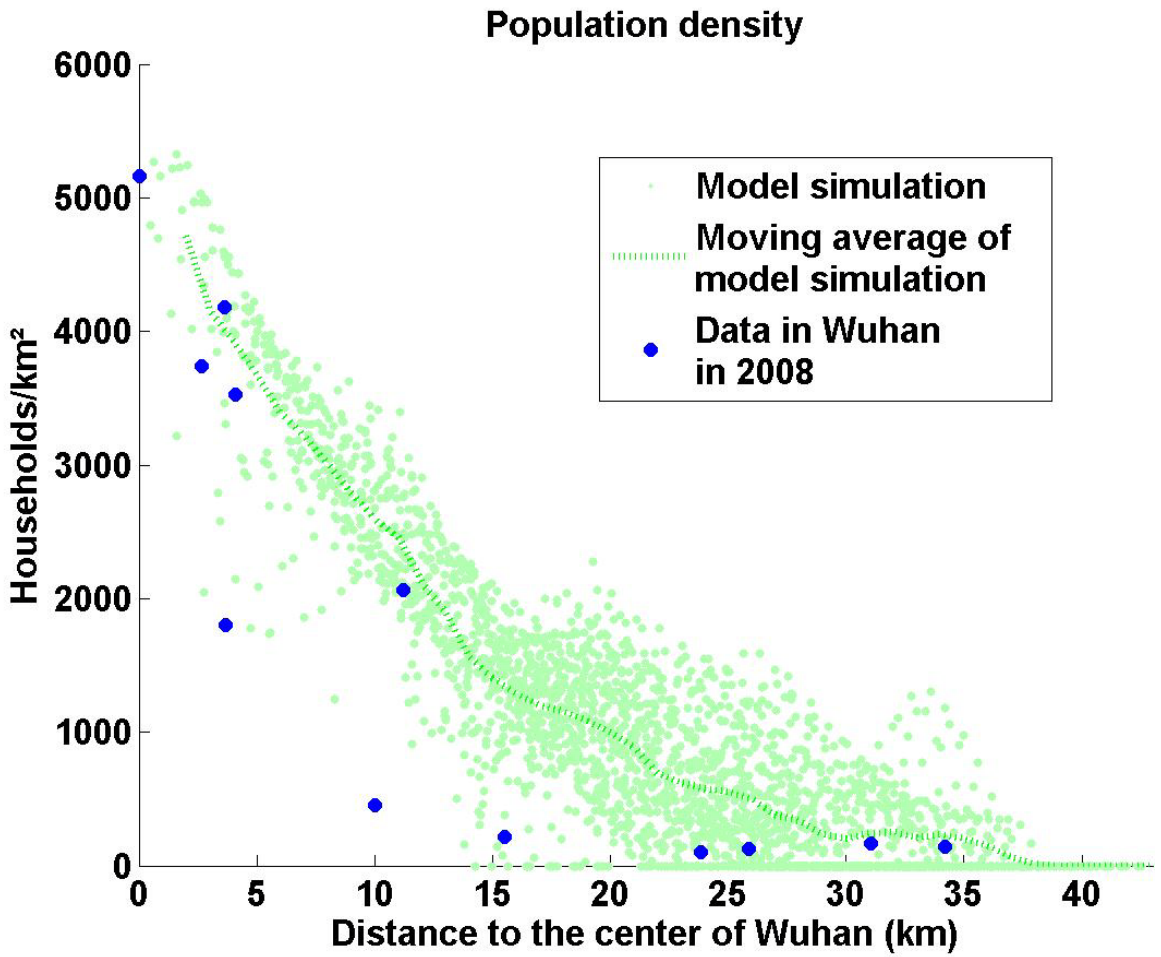
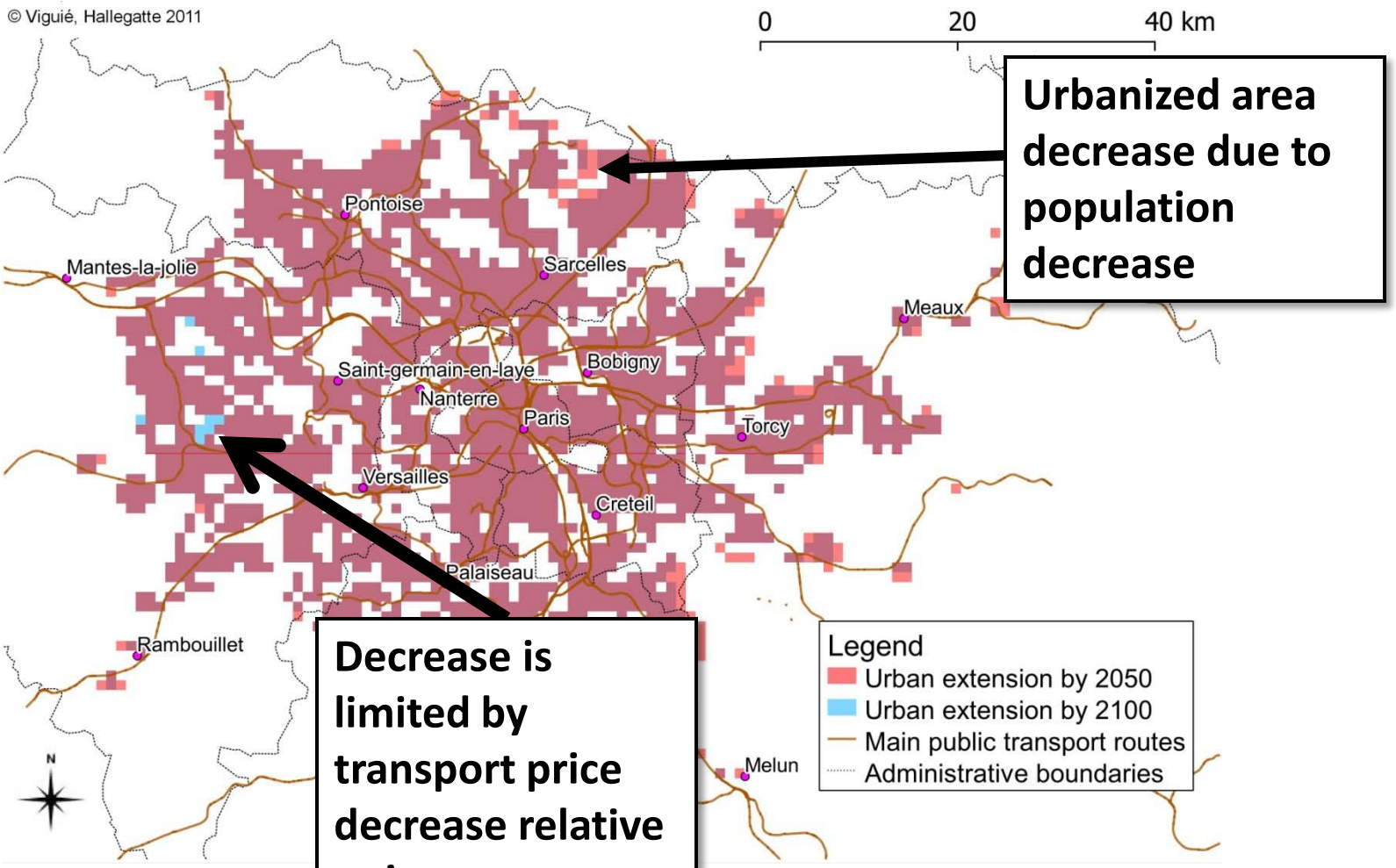
Real estate prices



Population density

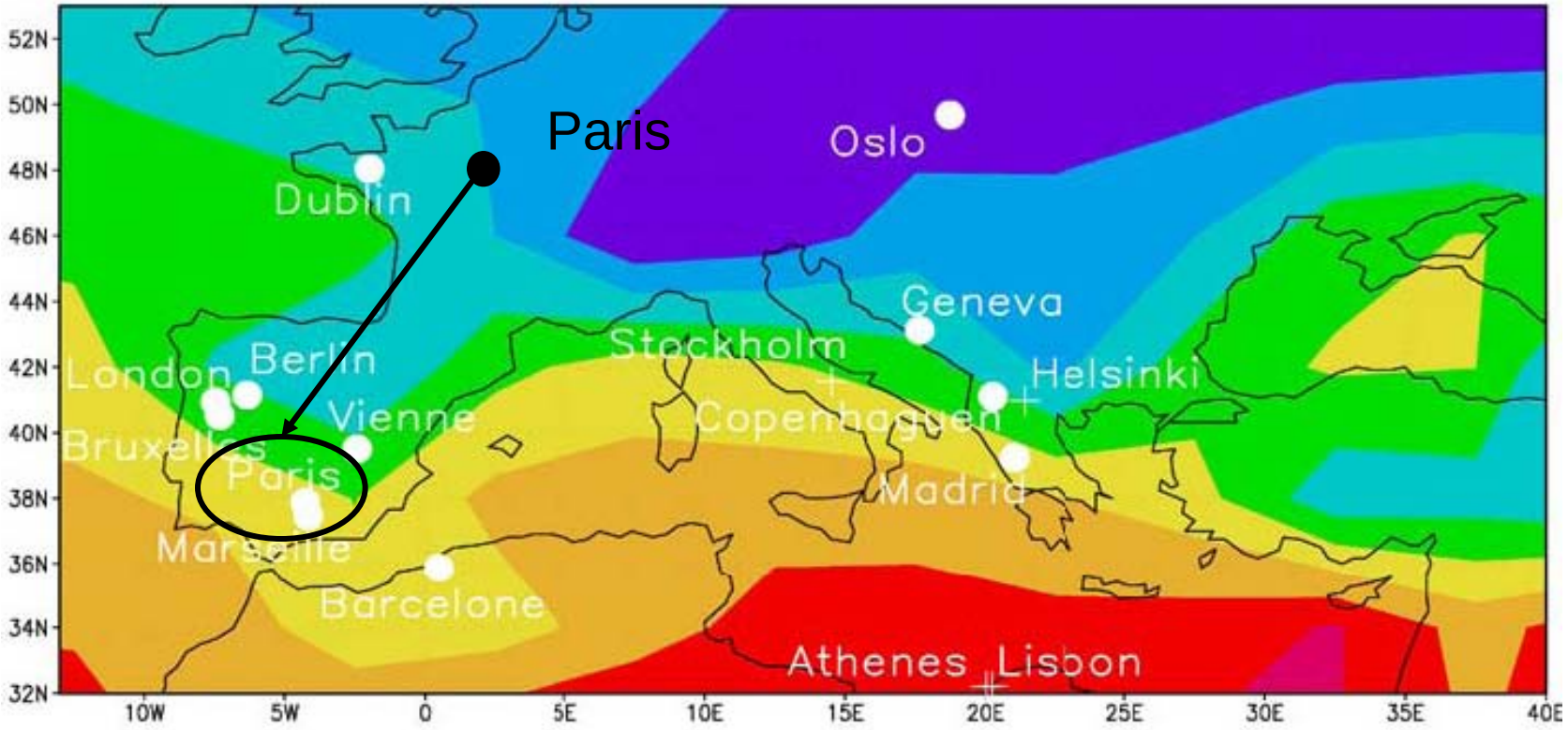


Scenario1 + low demographic scenario



Input for adaptation policy analysis: Adapting to high temperature and air conditioning

HadRM3 climate model, SRES A2 emission scenario

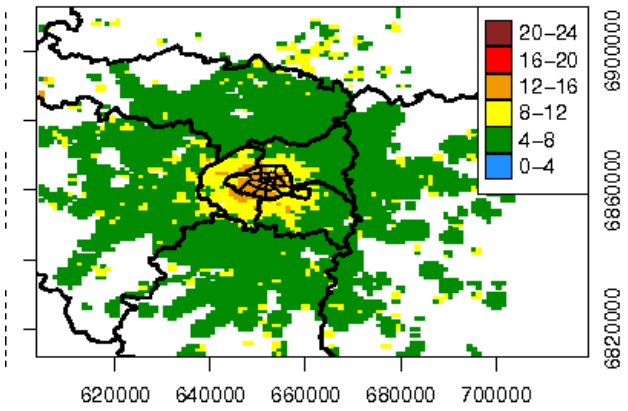


Hallegatte, Ambrosi, Hourcade, 2008.

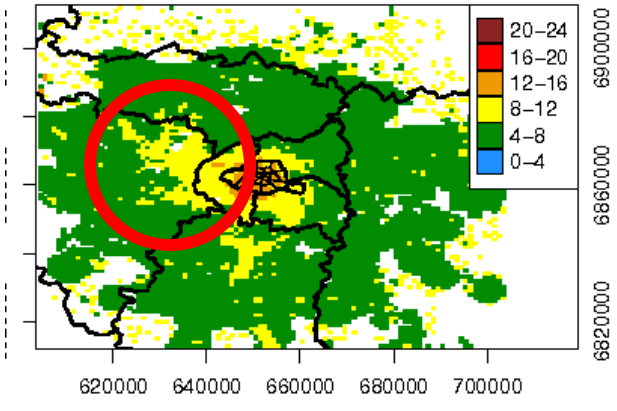
Input for adaptation policy analysis: Adapting to high temperature and air conditioning

Vulnerability to the 2003 heat wave, depending on urban forms and the use of AC.
Heat stess (outdoor, shadow) in number of hours.

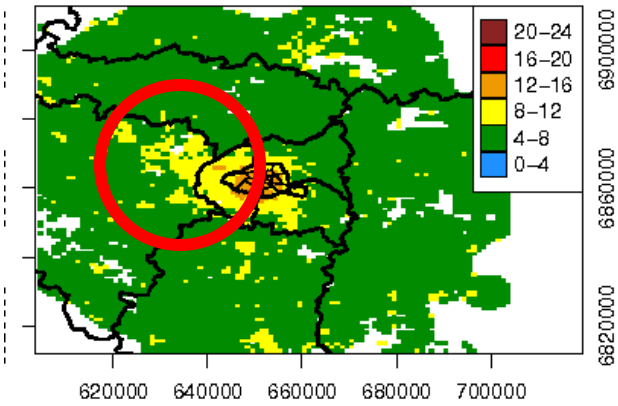
Current Paris



AC high-density scenario



AC low-density scenario



A high-density city appears more vulnerable to heat wave than a low-density city.

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