Paris Case Study with a special focus on Grand Paris project

Kiarash Motamedi, Nathalie Picard, UCP

SustainCity Conference on Integrated Land-Use and Transport Simulation

Thursday 18 April 2013

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Outline of the presentation

▸ Motivation, Paris region and GUA

▸ Grand paris project and scenarios

▸ Estimation: models and results

▸ Simulations results

▸ Conclusion and future developments

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Motivation for Sustaincity project and UrbanSimE

▸ Develop a tool perfectly suited to the European context
▸ Economic modeling consistent with:
  ▸ Political constraints
    ▸ Strong price regulation in dwelling rental market
    ▸ Constraints limiting urban development
  ▸ Consequences on markets
    ▸ Partial segmentation in real estate market
    ▸ No attempt to model market clearing
  ▸ Data availability
▸ Past experience with grid cell version
  ▸ Relevant size for alternative locations depends on models and variables (and on available data)
  ▸ No future for grid cell version in Europe (data, history, policy)
▸ General philosophy: adapt the model to data availability, political constraints and market structures, no the reverse

SustainCity
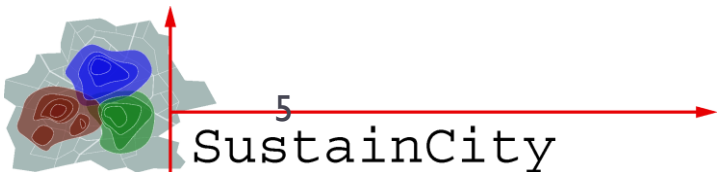
UNIVERSITÉ
de Cergy-Pontoise
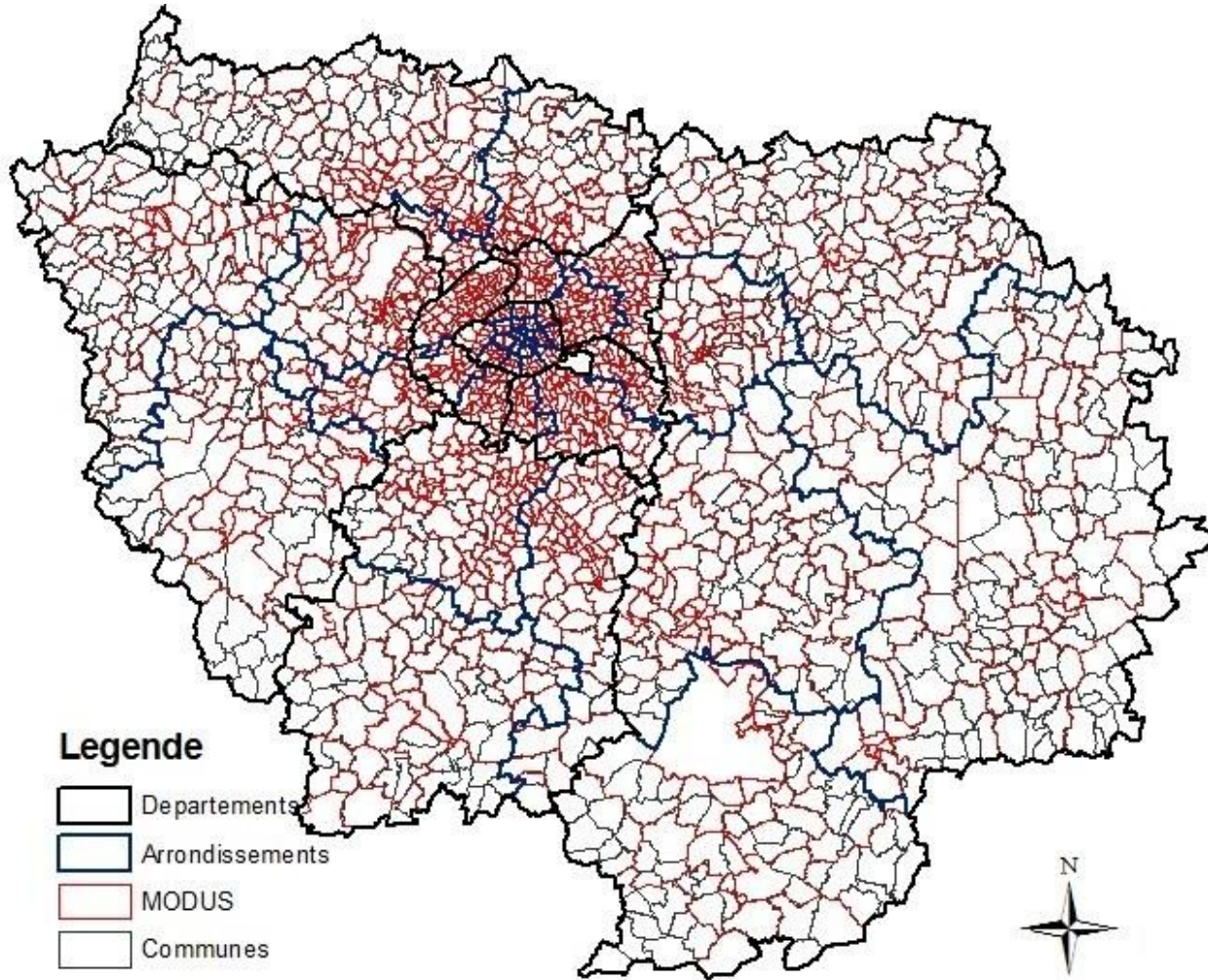
Grand Paris: Zoning

▸ 8 Départements

▸ 44 Arrondissements

▸ 1289 Zones MODUS

▸ ou 1300 Communes

Zonage de travail RELU-TRAN

▸ 11 CDT

▸ 50 Zones

Legende
- Departements
- Arrondissements
- MODUS
- Communes

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Grand Paris project and Scenarios

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

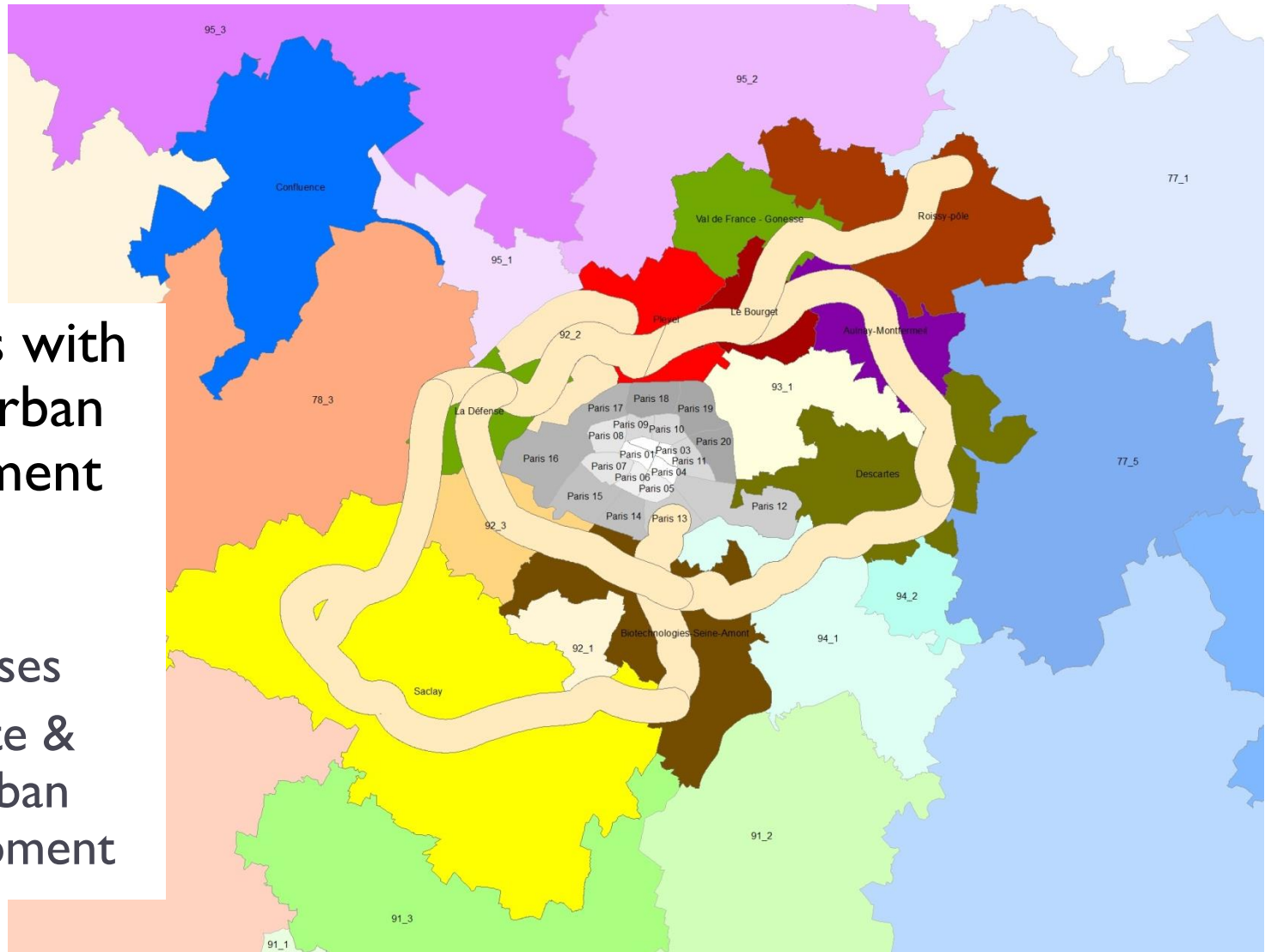# Grand Paris transport Project

- 160 km automatic Metro lines (145 km new lines)
- 75 stations
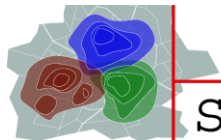- ~30 billion Euros budget
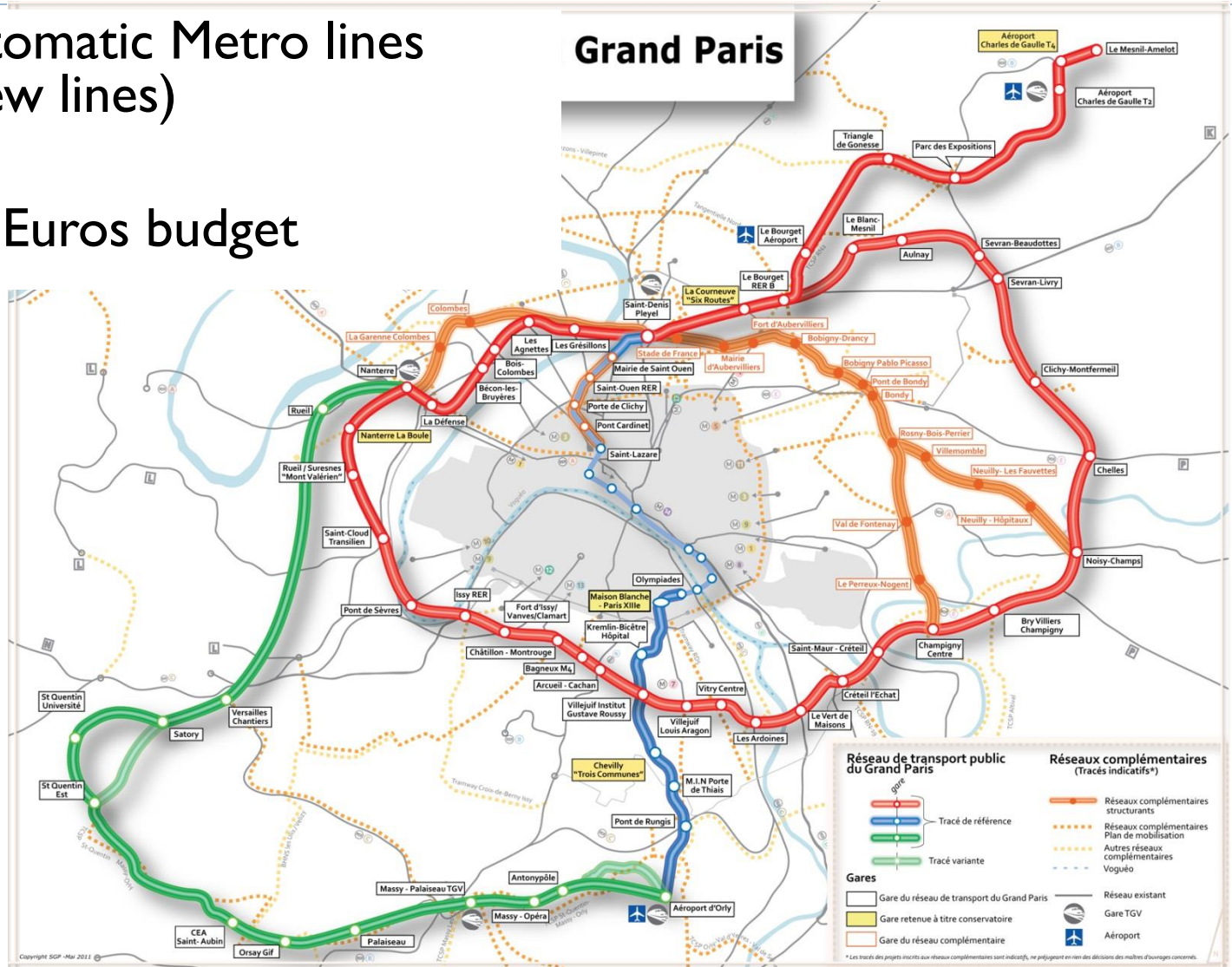
Grand Paris transport and urban development Project

- ▶ 10 zones with special urban development policies
  - ▶ Attract businesses
  - ▶ Promote & ease urban development

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Objectives of Grand Paris project

▶ Improve the region's attractiveness and competitiveness with respect to other great Metropolitan areas like London.

▶ Create specialized business zones to increase productivity

▶ Densification of close suburbs

  ▶ Control urban sprawl

  ▶ Reduce real estate market pressure in Paris city

  ▶ Improve social welfare and equity

▶ Global projections (compared to BAU scenario):

  ▶ Attract 140 to 380 thousand new jobs in the region by 2035

  ▶ Increase the population by 80 to 180 thousand

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Grand Paris Scenarios

- 4 scenarios simulated:
  - S0 (BAU): No GP infrastructure, No increase in regional attractiveness
  - S1: GP infrastructure, No increase in regional attractiveness
  - S2: GP infrastructure; Lower attractiveness gain projection
  - S3: GP infrastructure; Higher attractiveness gain projection
- Two interaction modes with transportation models:
  - MODUS: no feedback, update on 2009, 2025, 2035
  - METROPOLIS: Feedback each 3 years
- Simulated period: 1999 to 2035, extension to 2050 with fixed Population, Employment and Transportation data
  - ➔ Measure long run effects

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Data

- Commune = basic GUA ➔ data collected and modeled at commune level for all models :
  - General (exhaustive) Population Census RGP 1999 and New Census (yearly from 2006; partial sample, ex post weighting)
  - Land use data (MOS 1999, 2003 & 2008)
  - « Cote annuelle des valeurs vénales immobilières et foncières » : Callon 1998: real estate prices, by tenure and type
  - Enquêtes régionales emplois (ERE 1997 et 2001): employment
  - Transport variables from METROPOLIS & MODUS transport models

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Observed and projected population
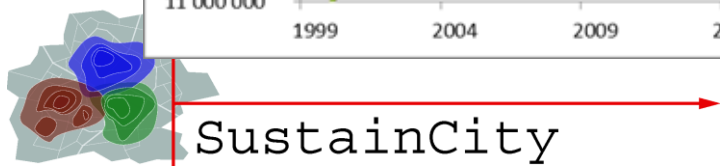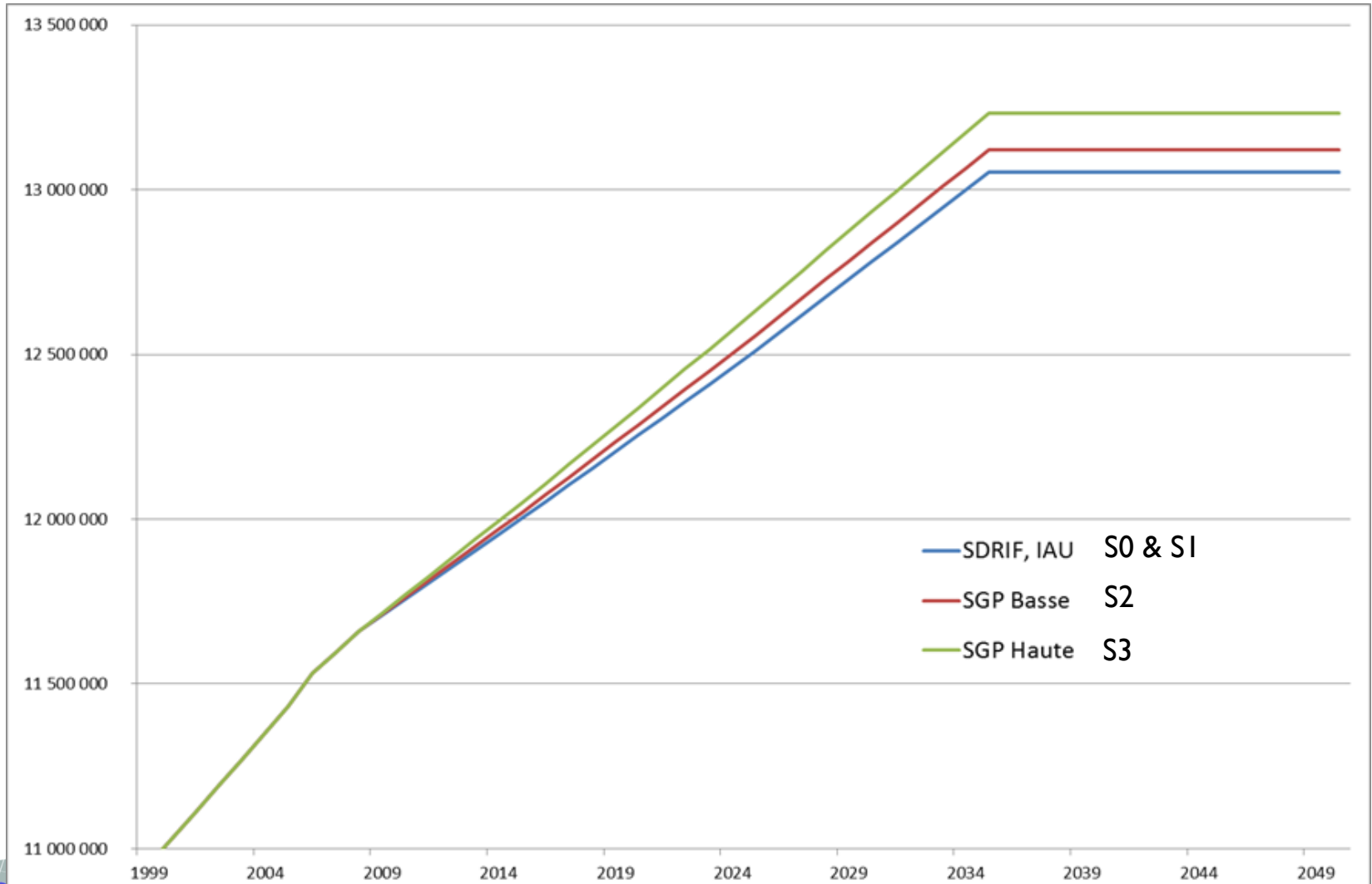
Observed and projected employment

Total number of jobs

Lower S2
Higher S3
SDRIF S0 & S1

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Estimation: models and results

SustainCity

UNIVERSITÉ
de Cergy-Pontoise
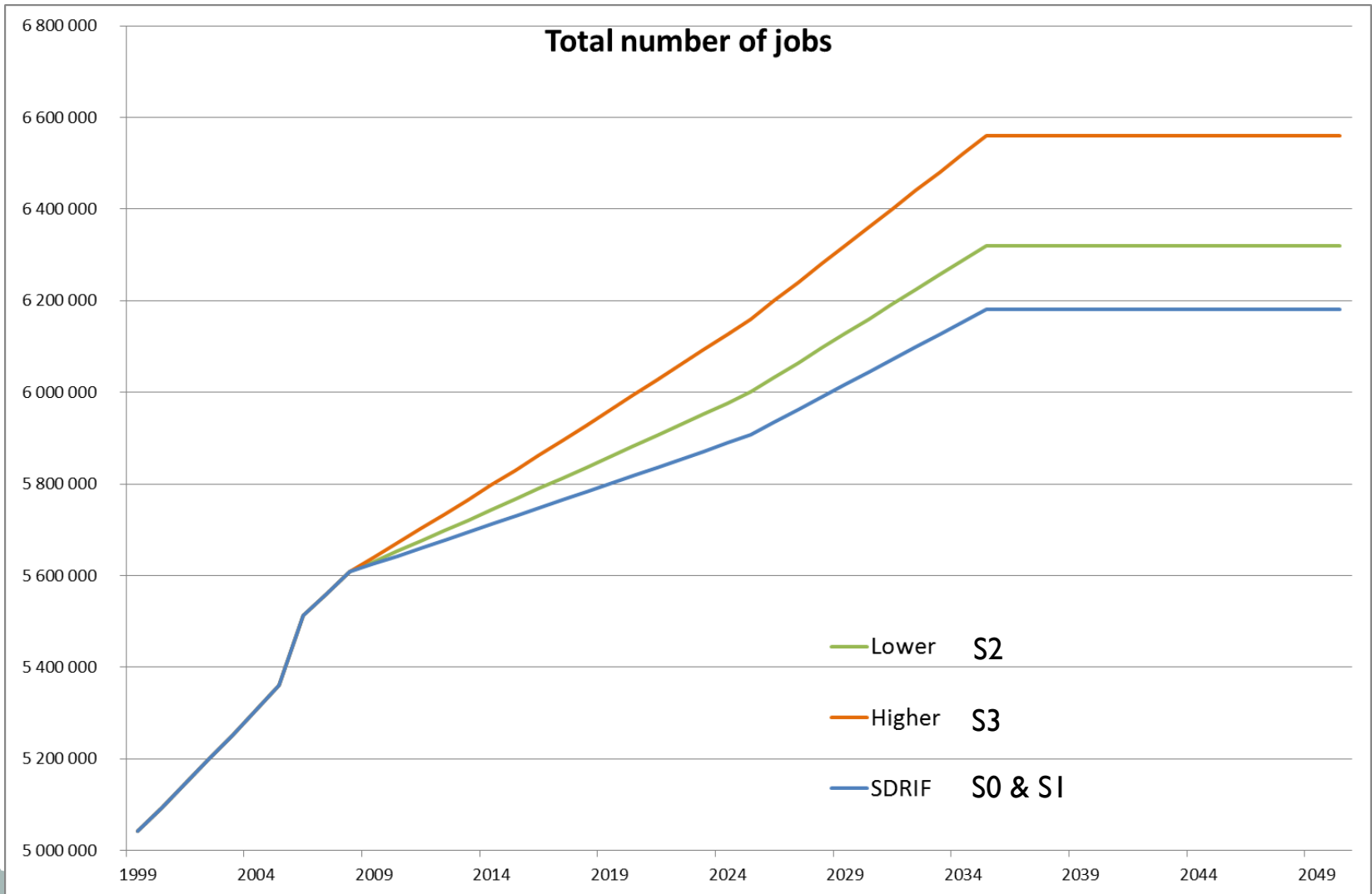
Real estate prices

Variable	Rent, Flat	Buy, Flat	Rent, House	Buy, House	Offices
Constant	4.27129	9.45813	4.40606	9.67391	7.71961
Paris dummy	-0.27555	0.03969			0.20013
Close suburbs dummy	0.123	0.1461	0.12211	0.12004	0.23247
La Défense dummy					0.40643
« Ville nouvelle » dummy					0.06795
Housing tax rate (tenant)	-0.00391		-0.00482		
Housing tax rate (owner)		-0.00207		-0.00226	
Tax rate on labour force					-0.01541
% dwellings built <1915	0.34734	0.38984	0.51977	0.69014	0.72731
% recent dwellings	0.14361	0.4453	-0.02944	-0.04573	-0.23414
Average tt using PT	-0.11559	-0.28128	-0.07547	-0.28918	-0.25611
# métro/tramway stations	0.00686	0.00441			0.02045
Population density	0.00621	0.00218	0.00894	0.00901	0.00755
% HH head over >55	0.3028	0.3977	0.12115	0.10098	
% poor HH	-0.61381	-1.27228	-0.51412	-1.31656	-0.69666

Significance level: <1% ; 1-5%; 5-10%; NS

SustainCity

UNIVERSITÉ de Cergy-Pontoise

Relocation rate, by household type

Yearly rate	1	2	3	4	5	6+
House, owner	4,94%	5,73%	7,06%	7,73%	7,50%	7,32%
Flat, owner	7,13%	6,35%	7,72%	6,60%	6,49%	7,68%
House, tenant	22,20%	24,99%	25,51%	25,41%	23,21%	18,86%
Flat, tenant	19,18%	17,33%	15,08%	12,29%	11,65%	8,67%
All together	13,98%	11,15%	11,60%	10,35%	10,19%	8,85%
Cum. rate, 9 years	1	2	3	4	5	6+
House, owner	32,32%	35,71%	44,78%	57,93%	58,33%	52,90%
Flat, owner	41,46%	36,28%	49,73%	56,48%	58,08%	53,09%
House, tenant	74,18%	76,31%	80,92%	85,55%	85,34%	78,86%
Flat, tenant	62,79%	59,85%	65,09%	67,22%	64,18%	54,83%

Globally: relocation rate decreasing in HH size; by far larger for tenants than owners for a given size, and type; larger for houses than flats for tenants, reversed for tenants in small households only

SustainCity

UNIVERSITÉ
de Cergy-Pontoise
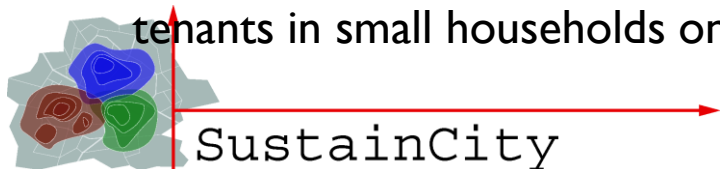
Localisation choice model by tenure and dwelling type

- Separate estimates for:
  - Owners/tenants
  - House/flat
- Heterogeneity of preferences, depending on:
  - Number of HH members (1/2/3/4+)
  - Children (<= 16 ans)
  - Nationality of HHH (French/foreign)
  - HHH age (<35; 35-55; >55)
  - Education of HHH (Primairy, Middle school, high school, University)
  - Per capita income (3 categories; equivalence scale=$\sqrt{n}$)
- Local amenities crossed with HH characteristics

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Variables used in HH Location choice model

Amenity	Var	*Size	* Child	* Foreign.	* Income	* Educ	* Age
Price (log)					X		X
Paris, Near suburbs	X						
Distance to Highway	X,3						
Noise	X						
HH size		X					
HHH age							X
HH income					X		
Same département	X					X	
% foreigners				X	X	X	
% land surf. parks & gardens	X	X					
% land surf. Forest		X	X		X		
% land surf. lakes		X	X		X		

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Variables used in HH Location choice model

Amenity	Var	*Size	* Child	* Foreign.	* Income	* Educ	* Age
% land surf. Educ. Facilities			X				
% commune urban revit. pl			X				
Density	X						
# railway stations					X		
# subway stations					X		
TT PT					X		
TT PC					X		
Housing tax rate (tenant)					X		
Housing tax rate (owner)					X		
% blue collars					X	X	
% employees					X	X	
% intermediates					X	X	
% inactive population					X	X	

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Residential location: overall results

- Goodness of fit measure
  - Pseudo-R² larger➜less random choice,
    - HH really choose where to buy a house
    - Rent a flat anywhere

	House, owner (1)	Flat, owner (2)	House, tenant (3)	Flat, tenant (4)
Observations	54736	72066	32820	429733
Pseudo-R²	0.2903	0.2413	0.2522	0.2073

SustainCity

UNIVERSITÉ de Cergy-Pontoise

Firmography:
goodness of fit measure, by sector

	1	2	3	4	5	6	7	8	9	10	11
Firms death											
# firms	185	30 887	22 844	69 095	8 745	10 099	8 366	52 567	42 150	25 036	13 329
# jobs	2 137	666 569	218 635	635 265	243 316	248 074	74 094	937 295	336 979	675 758	581 866
Pseudo R²	0,9999	0,6597	0,2478	0,221	0,9912	0,7904	0,4917	0,4469	0,3966	0,6622	0,9736
Variation in log number of jobs (final number/fraction)											
R² final #	0,9934	0,9724	0,9783	0,9541	0,9436	0,9352	0,9864	0,9675	0,9246	0,9862	0,9893
R² fraction	0,2957	0,0765	0,0390	0,0808	0,1562	0,1057	0,1072	0,0906	0,1038	0,0690	0,0400
Localisation des établissements											
Pseudo R²		0,0727	0,1394	0,0490	0,0622	0,0588	0,0622	0,0447	0,0727	0,0656	0,0452

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

METROPOLIS Interaction

‣ ## UrbanSim -> METROPOLIS:

  ‣ 8 trip purposes, Captives and Non Captives distinguished

  ‣ Compute aggregate matrices based on 2001 trip generation factors

    ‣ Trip generation in function of Population, Active population, Total employments, Employments in education sector and in personal services

  ‣ Simultaneous Trip distribution – Mode choice based on Logit

    ‣ Utility in function of Euclidian distance, congested travel time, parking availability index (density at destination)

  ‣ Matrix equilibration by a Fratar algorithm

‣ ## METROPOLIS -> UrbanSim
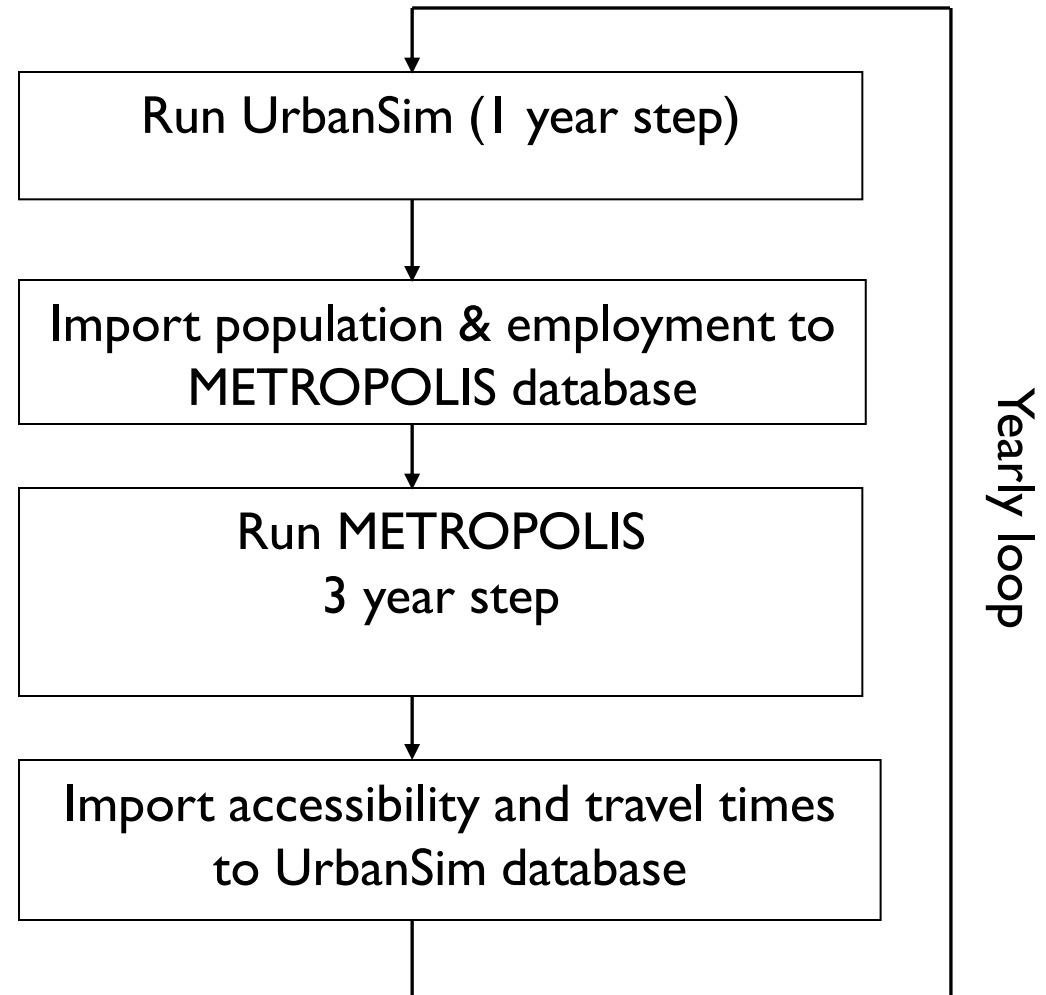
  ‣ Average travel time & departure time choice logsum per O-D

  ‣ Compute all O-Ds travel time by post assignment

  ‣ Average travel time by origins and destinations

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Simulation results

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

UrbanSimM & Grand Paris

- UrbanSim run each year
- Accessibility computed by METROPOLIS
- Calibration
  - Starting year : 1999
  - Target year: 2006
- Simulation
  - Starting year : 2006
  - Simulation period: 2006 to 2035

```
┌─────────────────────────────────┐
│    Run UrbanSim (1 year step)    │
└─────────────────────────────────┘
                │
┌─────────────────────────────────┐
│  Import population & employment to │
│      METROPOLIS database         │
└─────────────────────────────────┘
                │
┌─────────────────────────────────┐
│         Run METROPOLIS           │
│          3 year step             │
└─────────────────────────────────┘
                │
┌─────────────────────────────────┐
│  Import accessibility and travel times │
│      to UrbanSim database        │
└─────────────────────────────────┘
```

Yearly loop

SustainCity

UNIVERSITÉ de Cergy-Pontoise

Simulation results: predicted change over time (Employment)

Part de Paris et des CDTs dans l'évolution de l'emploi

Legend:
- CDT - Tendanciel
- Paris - Tendanciel
- Paris + CDT - Tendanciel
- CDT - Scen. 0
- Paris - Scen. 0
- Paris + CDT - Scen. 0
- CDT - Scen. 1
- Paris - Scen. 1
- Paris + CDT - Scen. 1
- CDT - Scen. 2
- Paris - Scen. 2
- Paris + CDT - Scen. 2

SustainCity

UNIVERSITÉ
de Cergy-Pontoise
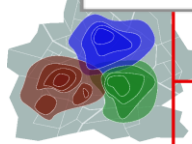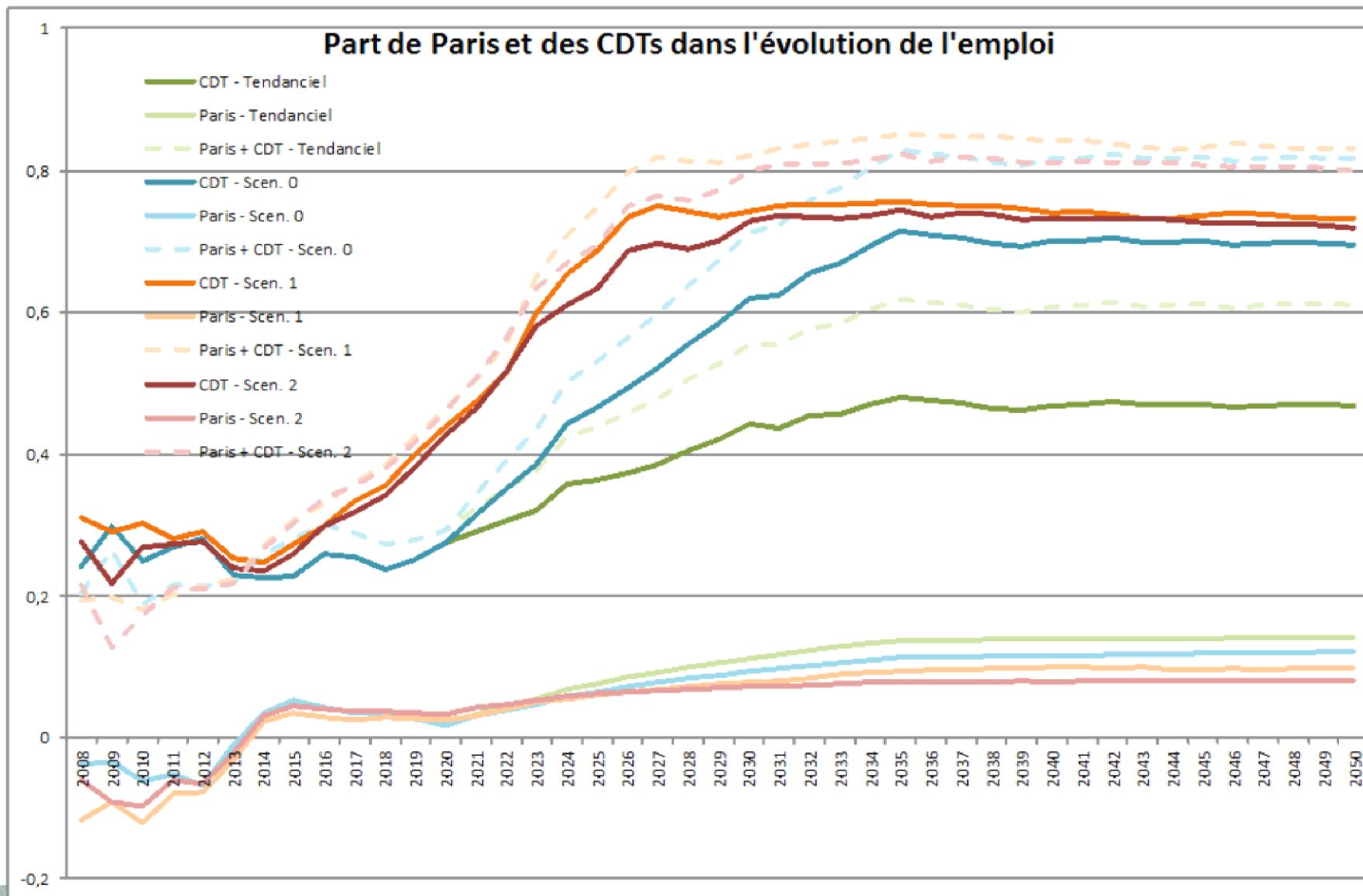
Simulation results: predicted change over time (Population)

Part de Paris et des CDTs dans l'évolution de population

Legend:
- CDT - Tendanciel
- Paris - Tendanciel
- Paris + CDT - Tendanciel
- CDT - Scen. 0
- Paris - Scen. 0
- Paris + CDT - Scen. 0
- CDT - Scen. 1
- Paris - Scen. 1
- Paris + CDT - Scen. 1
- CDT - Scen. 2
- Paris - Scen. 2
- Paris + CDT - Scen. 2

SustainCity

UNIVERSITÉ
de Cergy-Pontoise
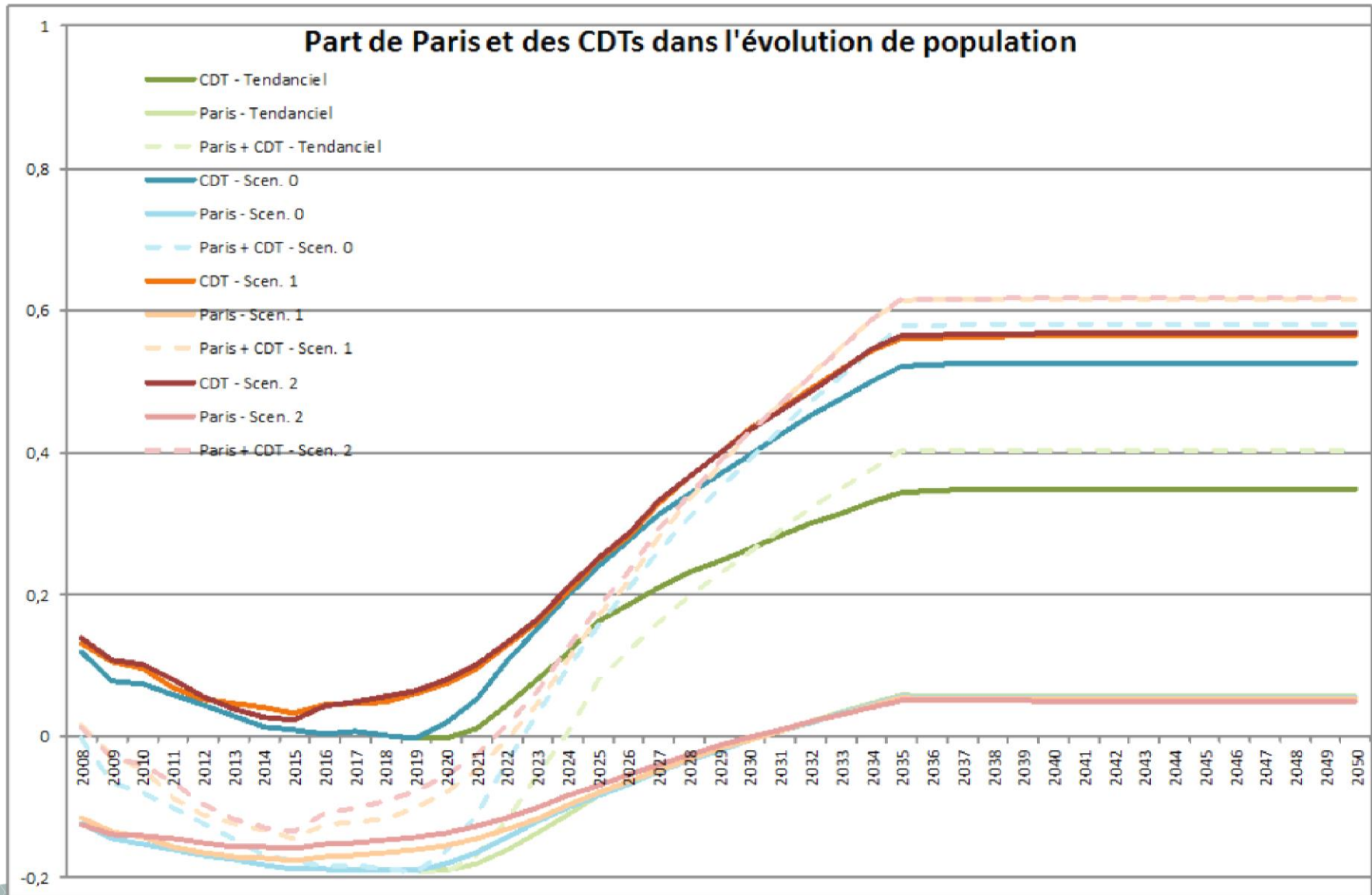
Evolution of population, 2005 to 2035

Grand Paris Zone	Ref	Low	High	Ref	Low	High	DRIEA
	MODUS			METROPOLIS			
Aulnay-Montfermeil	24 520	50 713	62 984	23 780	47 548	58 101	96 084
Biotechnologies Seine-Amont	102 944	189 674	201 449	98 645	175 079	184 985	206 145
Confluence	69 250	53 539	56 835	65 128	51 075	54 058	49 525
Descartes	50 716	81 431	90 419	49 337	77 875	86 034	104 132
La Défense	59 184	87 880	98 661	56 339	78 514	83 531	98 487
Le Bourget	19 397	100 785	103 950	18 778	87 449	89 014	102 000
Pleyel	77 382	140 666	147 605	72 249	123 706	128 930	102 666
Roissy-pôle	31 224	33 099	35 155	28 965	30 560	32 291	58 033
Saclay	104 834	191 810	200 257	100 040	175 761	182 764	223 313
Val de France - Gonesse	17 934	17 723	19 421	17 356	17 159	18 744	5 559
Paris	94 436	90 699	91 801	93 229	89 586	90 661	141 042
CDT	557 385	947 320	1 016 736	530 616	864 725	918 453	1 045 945
Other communes	948 488	649 379	683 164	976 463	733 087	782 588	613 017
Total region	1 600 309	1 687 398	1 791 701	1 600 309	1 687 398	1 791 701	1 800 004

SustainCity

Evolution of # of jobs, 2005 to 2035

Grand Paris Zone	Ref	Low	High	Ref	Low	High	DRIEA
	MODUS			METROPOLIS			
Aulnay-Montfermeil	2 390	19 650	22 052	2 381	19 021	21 260	23 019
Biotechnologies Sei.	77 924	93 887	135 201	75 856	90 885	128 976	144 836
Confluence	28 856	27 629	29 517	28 296	27 116	28 931	17 885
Descartes	40 688	72 798	83 037	39 719	69 696	79 001	84 246
La Défense	99 167	152 368	159 963	96 097	139 625	143 918	146 794
Le Bourget	15 644	46 839	54 501	15 092	42 416	49 640	60 000
Pleyel	58 299	90 651	99 985	55 980	85 043	93 163	115 489
Roissy-pôle	29 639	89 876	140 951	29 014	84 130	126 819	170 841
Saclay	35 521	125 465	150 095	35 187	121 294	144 125	159 019
Val de France – Gon.	6 041	7 186	18 009	5 963	7 075	17 315	14 189
Paris	112 918	91 083	94 982	112 138	90 575	94 430	74 339
CDT	394 169	726 349	893 311	383 584	686 302	833 149	936 318
Other communes	292 947	141 848	212 270	304 312	182 403	272 985	189 342
Total region	800 034	959 280	1 200 563	800 034	959 280	1 200 563	1 199 999

SustainCity

Net evolution of office prices 2005 to 2035

Grand Paris Zone	Ref	Low	High	Effect low	Effect high
Aulnay-Montfermeil	-1.28%	13.42%	15.33%	14.89%	16.83%
Biotechnologies Seine-Amont	15.07%	20.11%	31.52%	4.38%	14.30%
Confluence	-0.93%	1.71%	4.42%	2.67%	5.40%
Descartes	2.09%	10.51%	14.18%	8.25%	11.84%
La Défense	5.99%	26.25%	37.86%	19.11%	30.06%
Le Bourget	0.77%	14.32%	19.25%	13.45%	18.34%
Pleyel	27.16%	73.55%	76.99%	36.49%	39.19%
Roissy-pôle	2.65%	17.51%	37.73%	14.48%	34.18%
Saclay	0.22%	16.98%	20.29%	16.72%	20.02%
Val de France - Gonesse	-5.31%	-3.19%	4.33%	2.24%	10.18%
Paris	35.38%	27.68%	29.02%	-5.69%	-4.70%
Others	-3.52%	-1.63%	1.13%	1.96%	4.83%

SustainCity

UNIVERSITÉ de Cergy-Pontoise

Net evolution of flat prices 2005 to 2035

Grand Paris Zone	Ref	Low	High	Effect low	Effect high
Aulnay-Montfermeil	-7.82%	-0.74%	1.25%	7.69%	9.85%
Biotechnologies Seine-Amont	-3.77%	2.43%	2.22%	6.44%	6.22%
Confluence	2.30%	-1.94%	-1.87%	-4.15%	-4.08%
Descartes	-2.80%	-0.77%	1.46%	2.09%	4.38%
La Défense	-1.96%	1.92%	2.91%	3.96%	4.97%
Le Bourget	-15.41%	-2.43%	-1.80%	15.34%	16.09%
Pleyel	-10.88%	-2.88%	-3.34%	8.98%	8.46%
Roissy-pôle	1.33%	0.92%	3.88%	-0.40%	2.52%
Saclay	-8.12%	-0.33%	-0.22%	8.48%	8.60%
Val de France - Gonesse	-1.99%	-2.35%	-1.59%	-0.37%	0.40%
Paris	-6.81%	-7.63%	-10.04%	-0.88%	-3.47%
Others	6.66%	3.80%	4.27%	-2.68%	-2.24%

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Conclusions

▸ Possibility to implement a rich and realistic UrbanSIM model in Ile-de-France and simulate the effects of a major transportation infrastructure project

▸ Take into account the Europeen (French) specificities of real-estate and job markets, and urban development

  ▸ Imperfect real estate and job markets

  ▸ Legal constraints and regulations

▸ Richness of the estimated models to take into account the heterogeneity of preferences

  ▸ Possibility to determine the winners and loosers of any reform or large project

▸ Interaction with other models to:

  ▸ Improve the macroeconomic assumptions

  ▸ Compute the economic benefits (agglomeration effects, etc.)

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Ongoing and future developements planned in Paris case study

▸ Integration of demography module
  ▸ Endogenous HH formation and evolution
▸ Dynamics of location choices
▸ Nested choices of tenure status, dwelling type, residential and job location
▸ Capacity constraints
▸ Borrowing constraints
▸ Explicit modelling of affordable housing
  ▸ Strong capacity constraints
▸ Computation of indicators to measure
  ▸ inequalities, social mixity and household welfare

SustainCity

UNIVERSITÉ
de Cergy-Pontoise

Future developments in Paris case study

▸ **Modeling interactions within households**
  ▸ Joint modeling of residential and professionnal location
  ▸ Individual-specific travel time to actual job or accessibility to potential jobs
  ▸ Collective decisions: diverging preferences and constraints for location, and bargaining power

▸ **Match between labor supply and demand**
  ▸ Worker chooses workplace depending on actual home-job travel time
    ▸ Improved OD matrix beyond 4-step model
  ▸ Aggregate demand by establishment
    ▸ Better models and predicts aggregation of jobs
    ▸ agglomeration effects
  ▸ Explicit modeling of stakeholders

▸ **Interactions with ot integration of a CGE model**

SustainCity

UNIVERSITÉ
de Cergy-Pontoise