

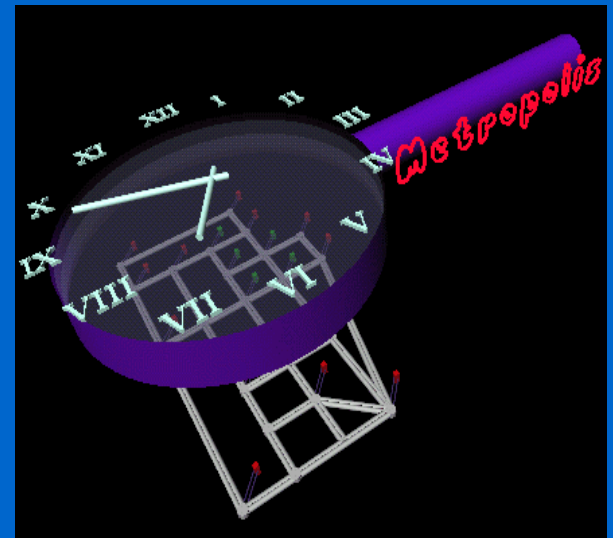
METROPOLIS: dynamic network models

EPFL Transport Economics

March, 11, 2024 2:00-4:00

André de Palma

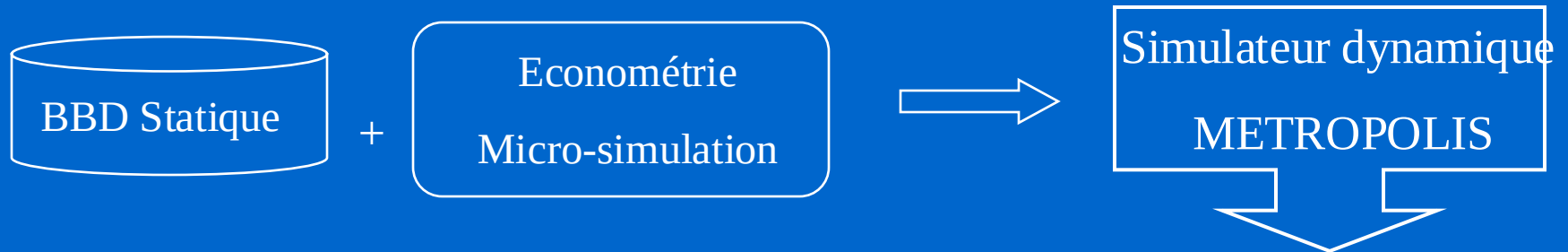
Cergy Paris Université



1. Introduction: why a Software?

2. TRAITS DE METROPOLIS

METROPOLIS in brief

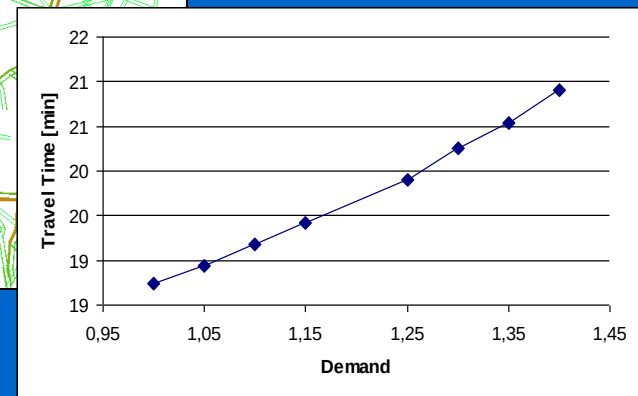


Sorties désagrégées

Simulations com... Edit Rank

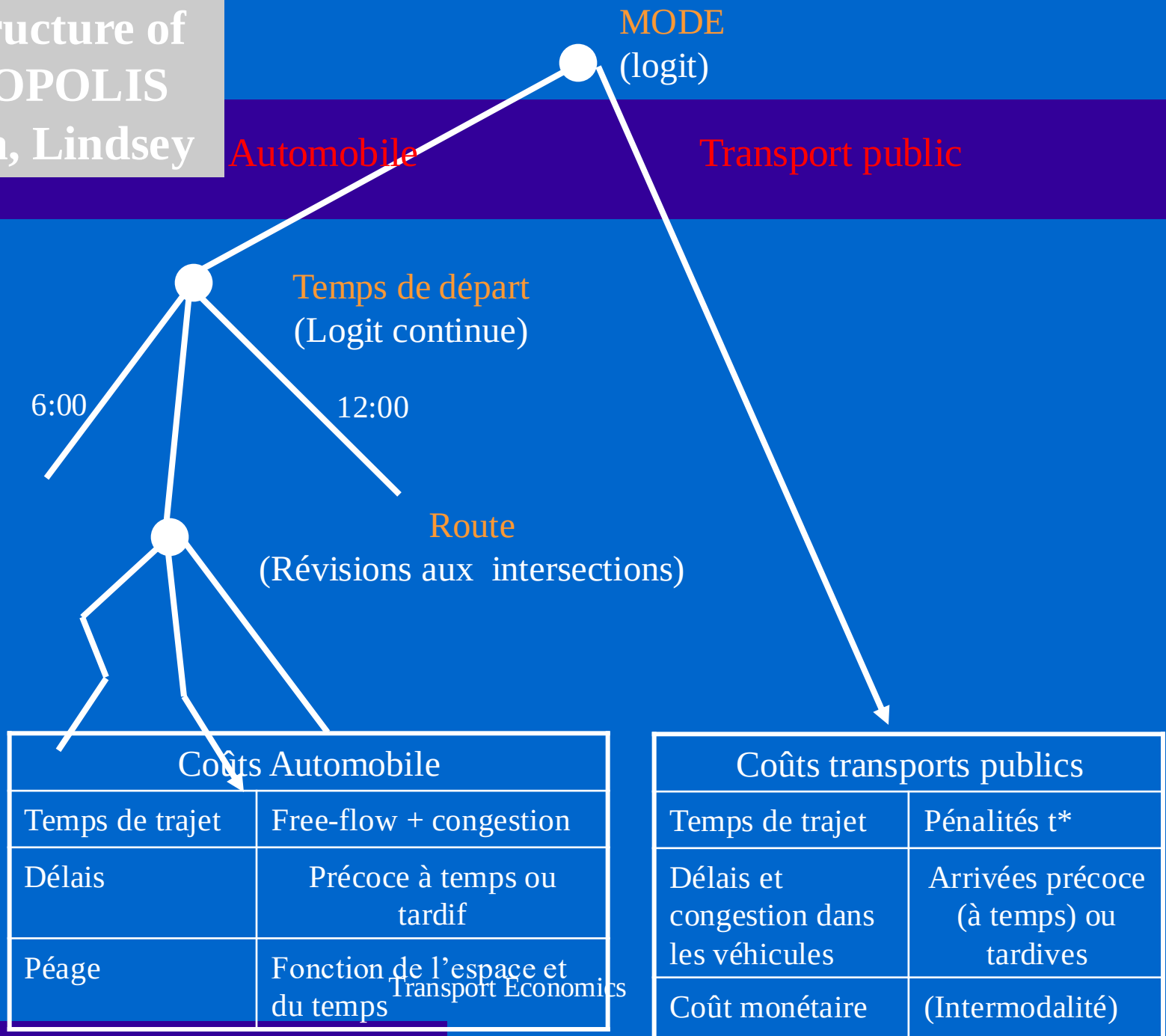
SiRefm1.80

stac:	0,30
time:	23,93
cost:	55,24
scost:	25,33
tt0cost:	23,70
late:	11,10
early:	36,16
earpop:	63,53
ontpop:	17,38
latpop:	19,09
period:	475,20
cong:	26,19
vehkm:	29,52
narcs:	16,64



Transport Economics

Basic structure of METROPOLIS de Palma, Lindsey



Departure time model

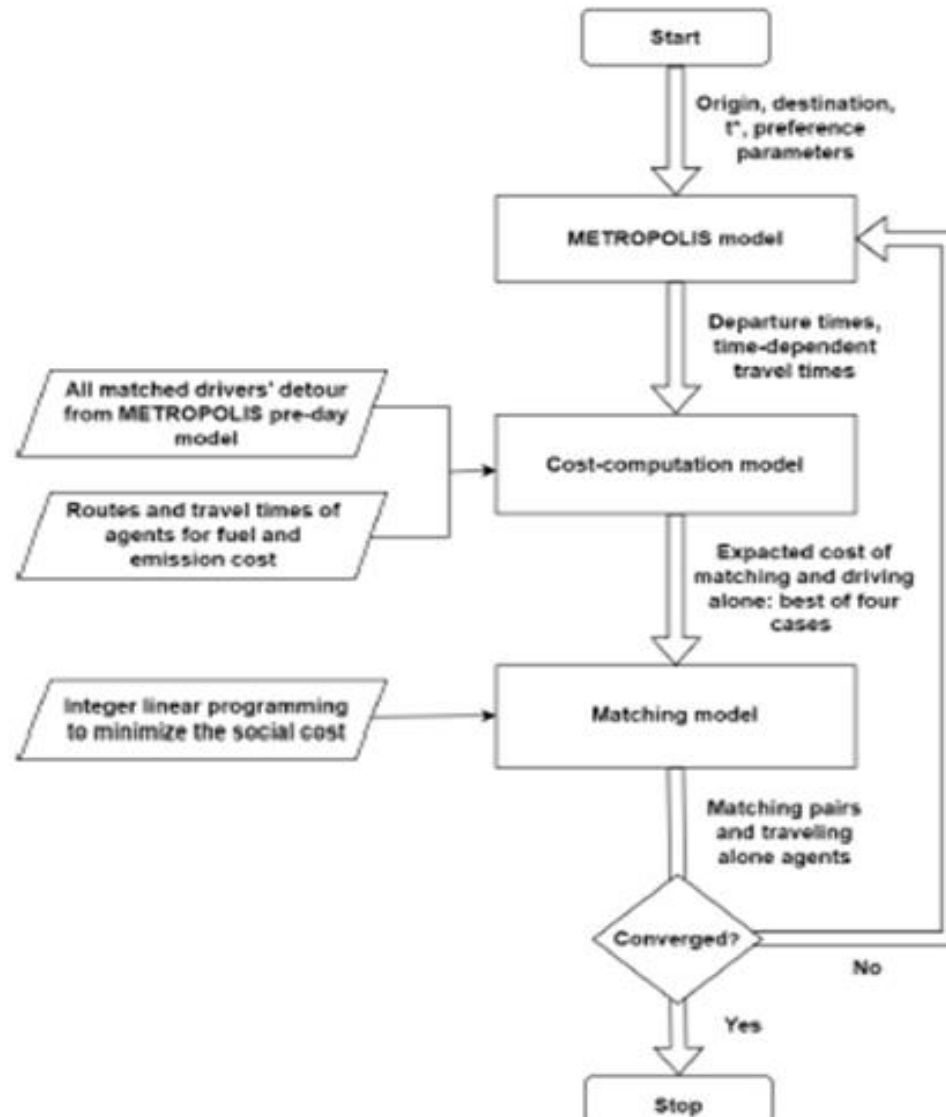
$$P_k(t) \Delta t = \frac{\exp\left(-C_k(t; t_k^*) / \mu\right)}{\int_{T_i}^{T_f} \exp\left(-C_k(\tau; t_k^*) / \mu\right) d\tau} \Delta t$$

Adjustment processes

MSE

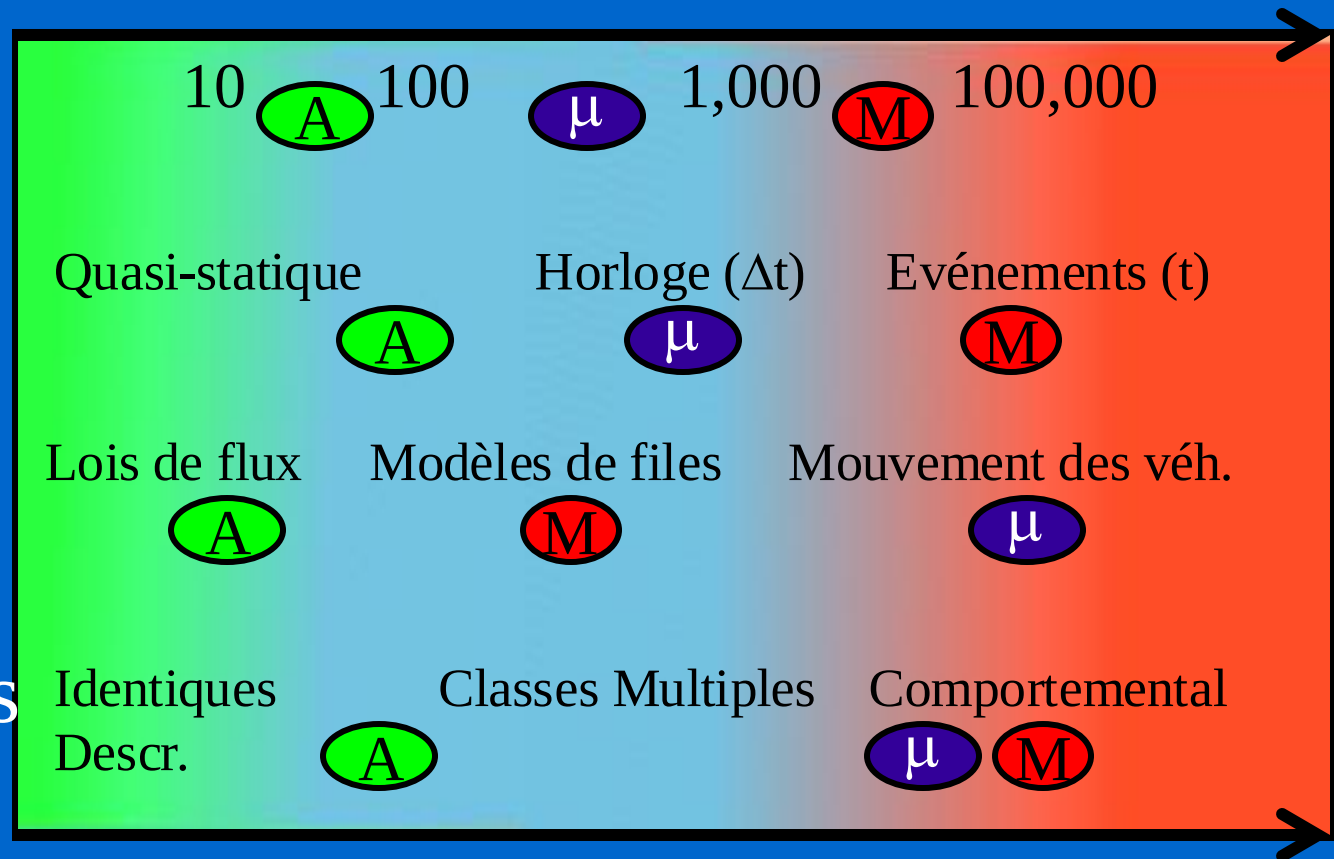
$$tt^H(t; \omega + 1) = \lambda tt^H(t, \omega) + (1 - \lambda) tt^O(t, \omega)$$

Architecture (with car pooling)



Typology of dynamic models

- Liens
- Temps de simulation
- Congestion
- Utilisateurs



Complexité

A Analytique

μ Micro-simulateurs
Transport Economics

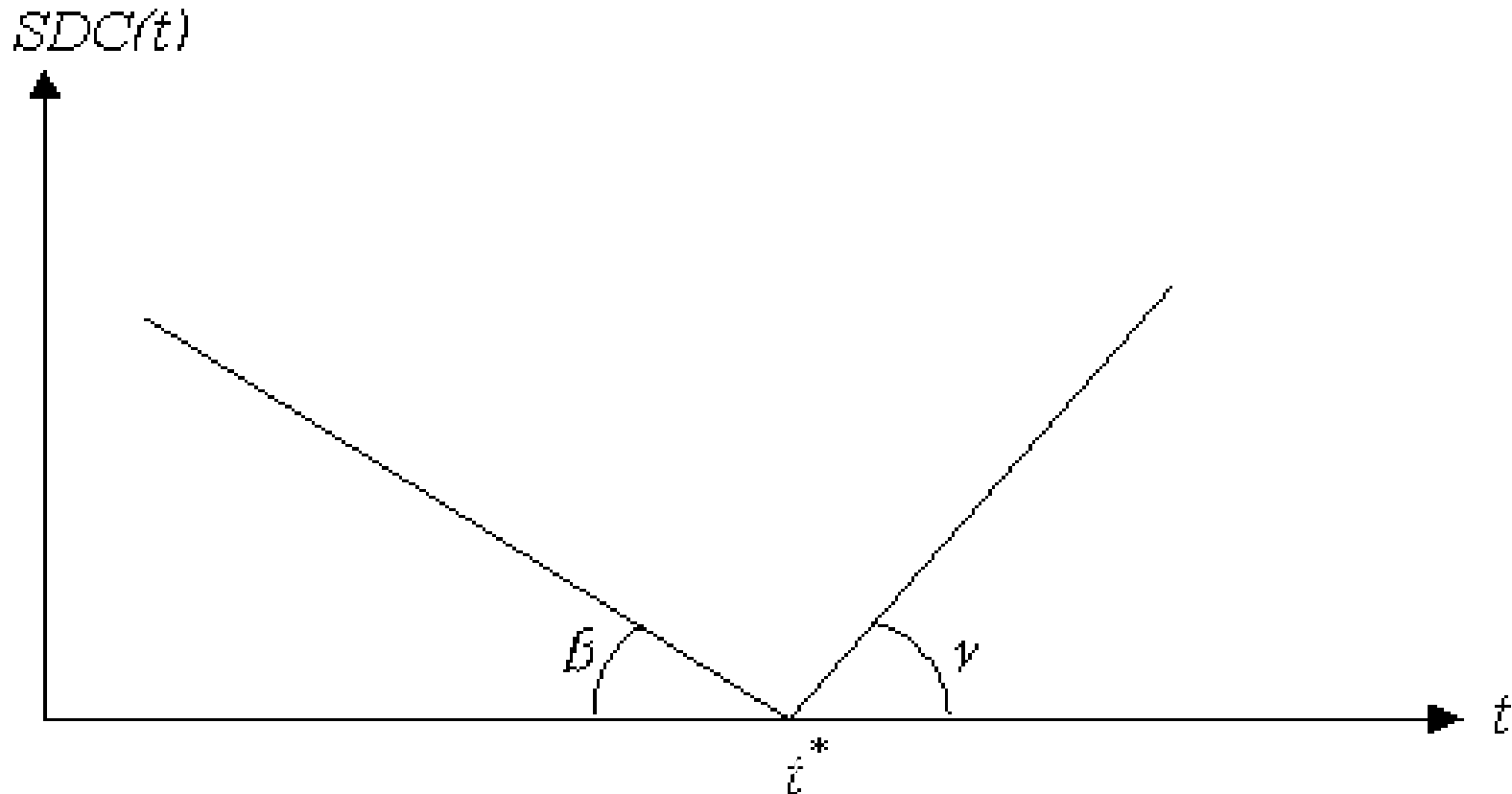
M METROPOLIS

Policy in dynamic models: discussion

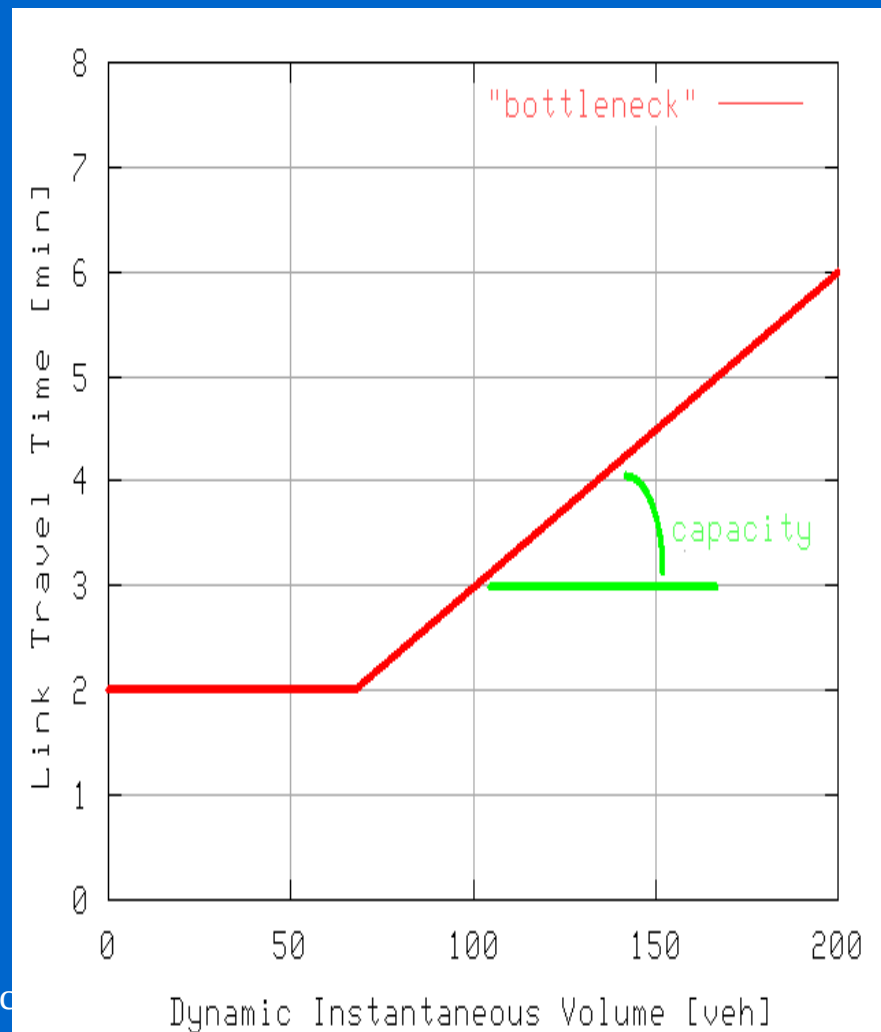
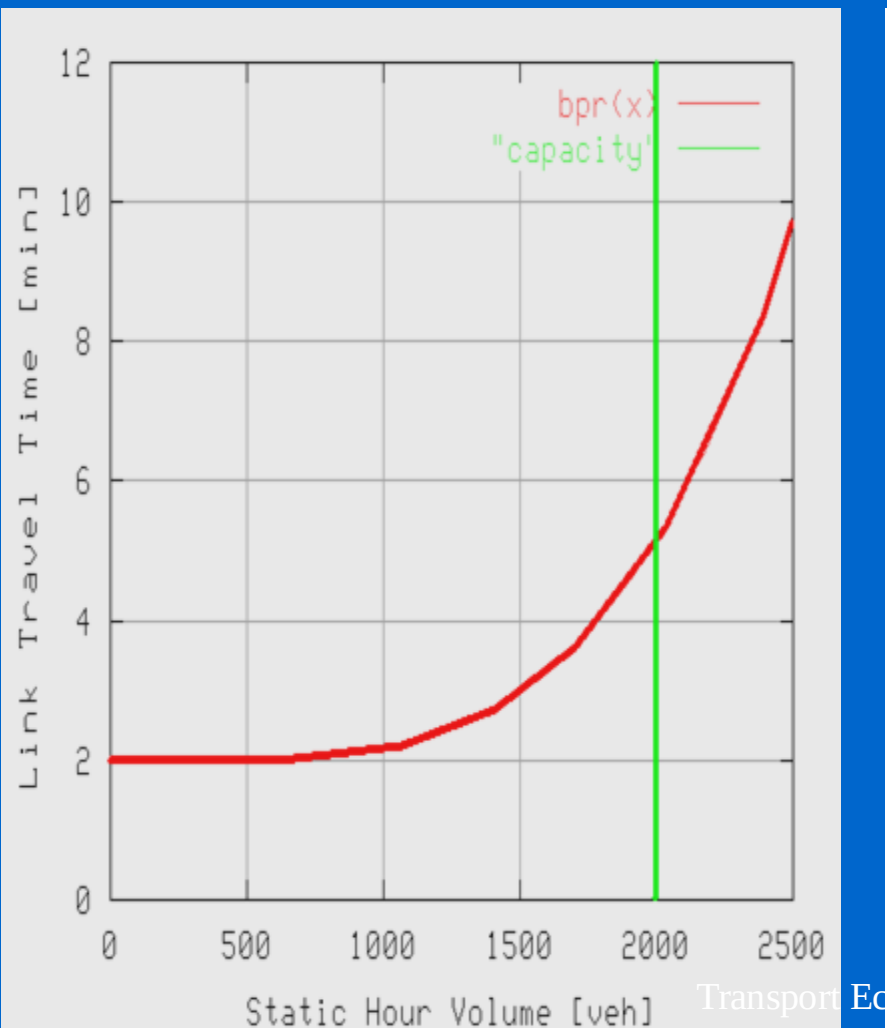
- Déplacement du pic: choix du temps de départ
- Horaires flexibles et décalés
- Impacts des incidents / accidents et ITS
- Modélisation de la journée entière: population synthétique
- Coût généralisé et coût de deshorage
- Asymétrie: matin et soir
- Tarification modulaire

Demand: cost function

- Coût des usagers: temps de trajet + coûts de deshorage

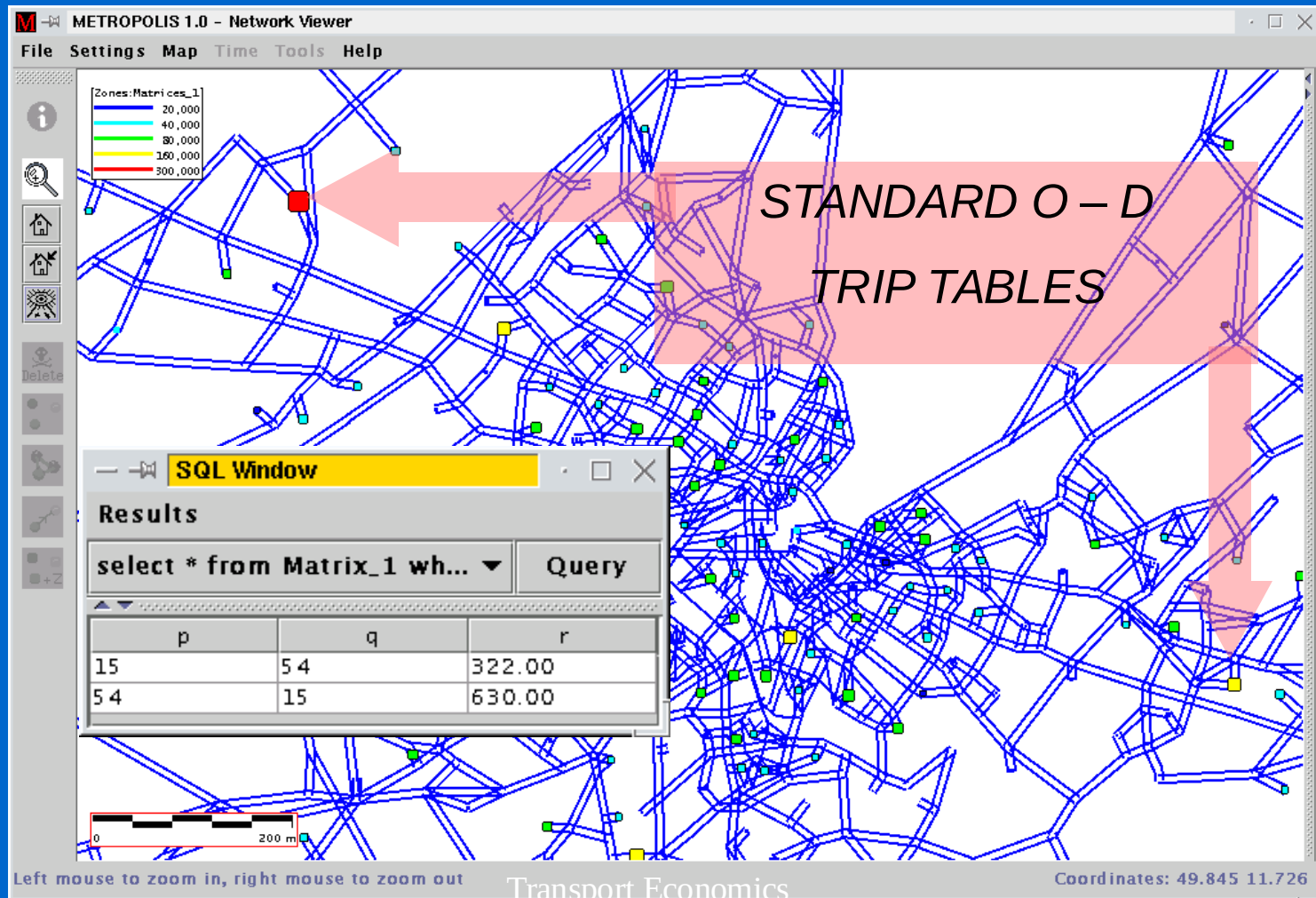


Congestion : static vs dynamic



3. INPUT DATA

O/D Matrix (static)



Static network

METROPOLIS 1.0 - Network Viewer

File Settings Map Time Tools Help

Links: capacity

- 400
- 800
- 1,200
- 1,600
- 2,000

0 200 m

Link info

Default

Name: unnamed

Origin: #441

Destination: #439

Type: 12

Length: 0.3 [km]

Lanes: 2

Max. speed: 35 [kph]

Lane capacity: 666.667 [vph]

Function: 2

UI1: 597.589

UI2: 0.52

UI3: 0

On map: capacity Value:666.667

Coordinates: 498.032 119.013

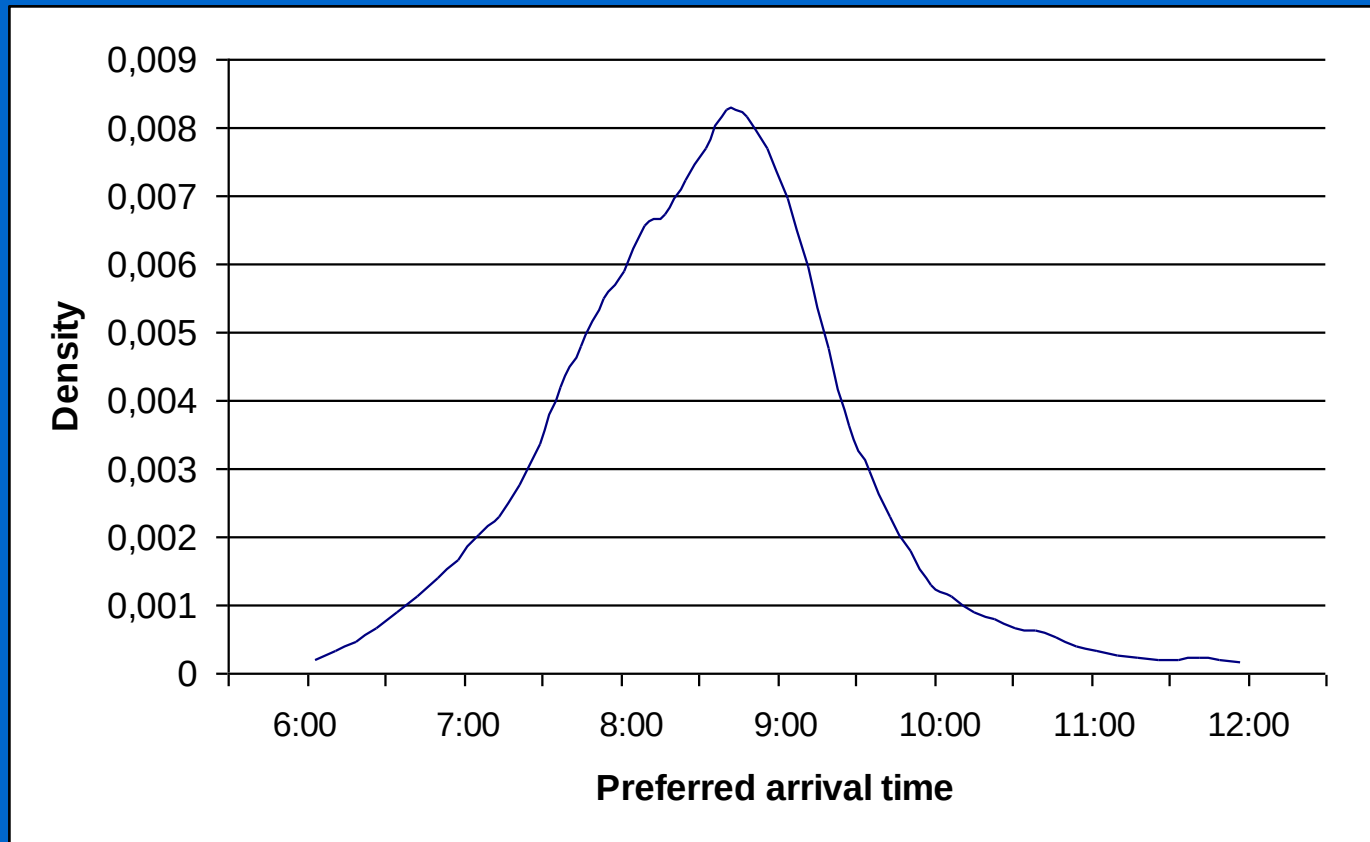
**Mandatory
link fields
(static data)**

**Optional
link fields**

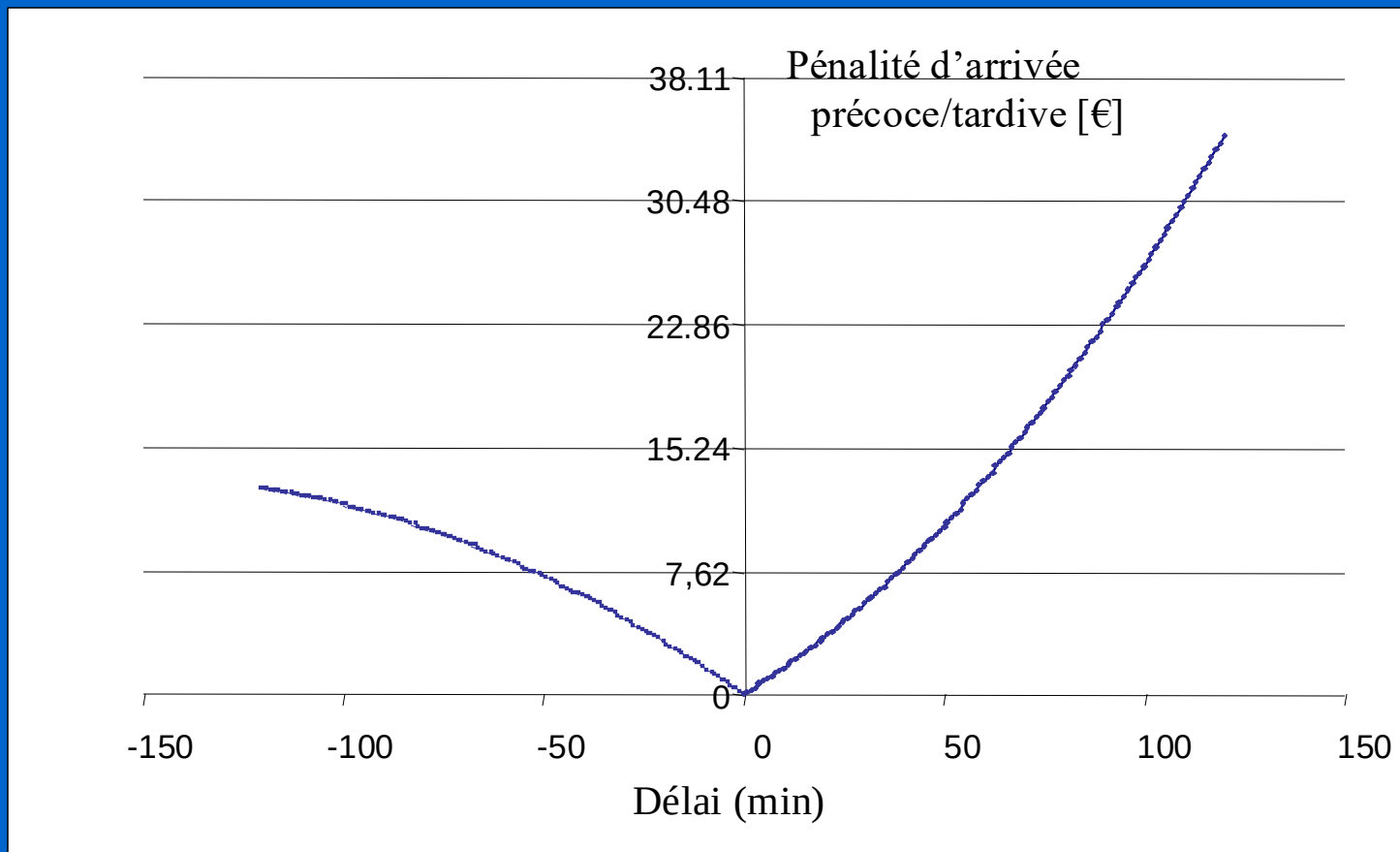
Left mouse gets information on node or link

Transport Economics

Density of desired arrival times at destination



Schedule delay costs

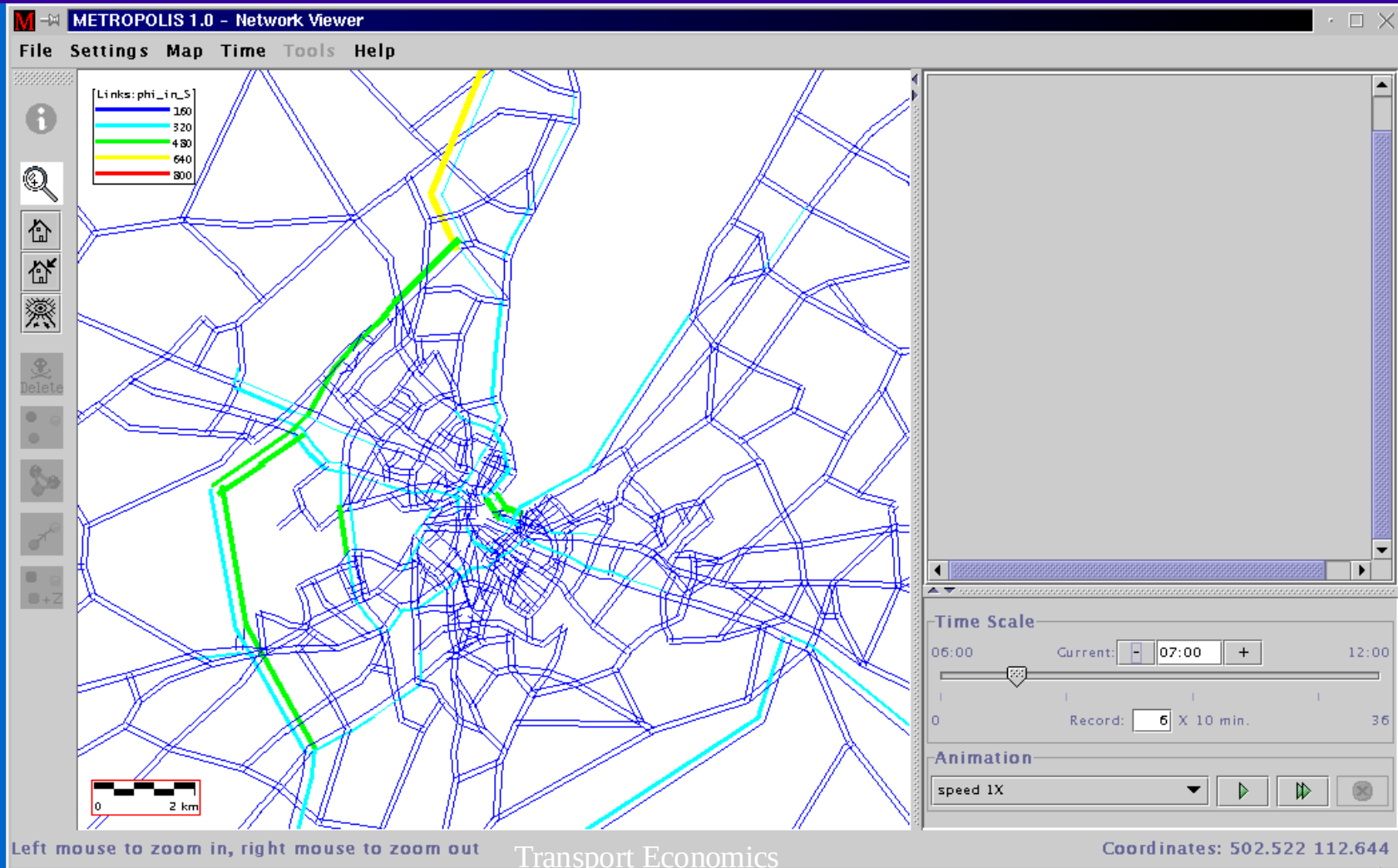


4. OUTPUT DATA

Aggregate indicators

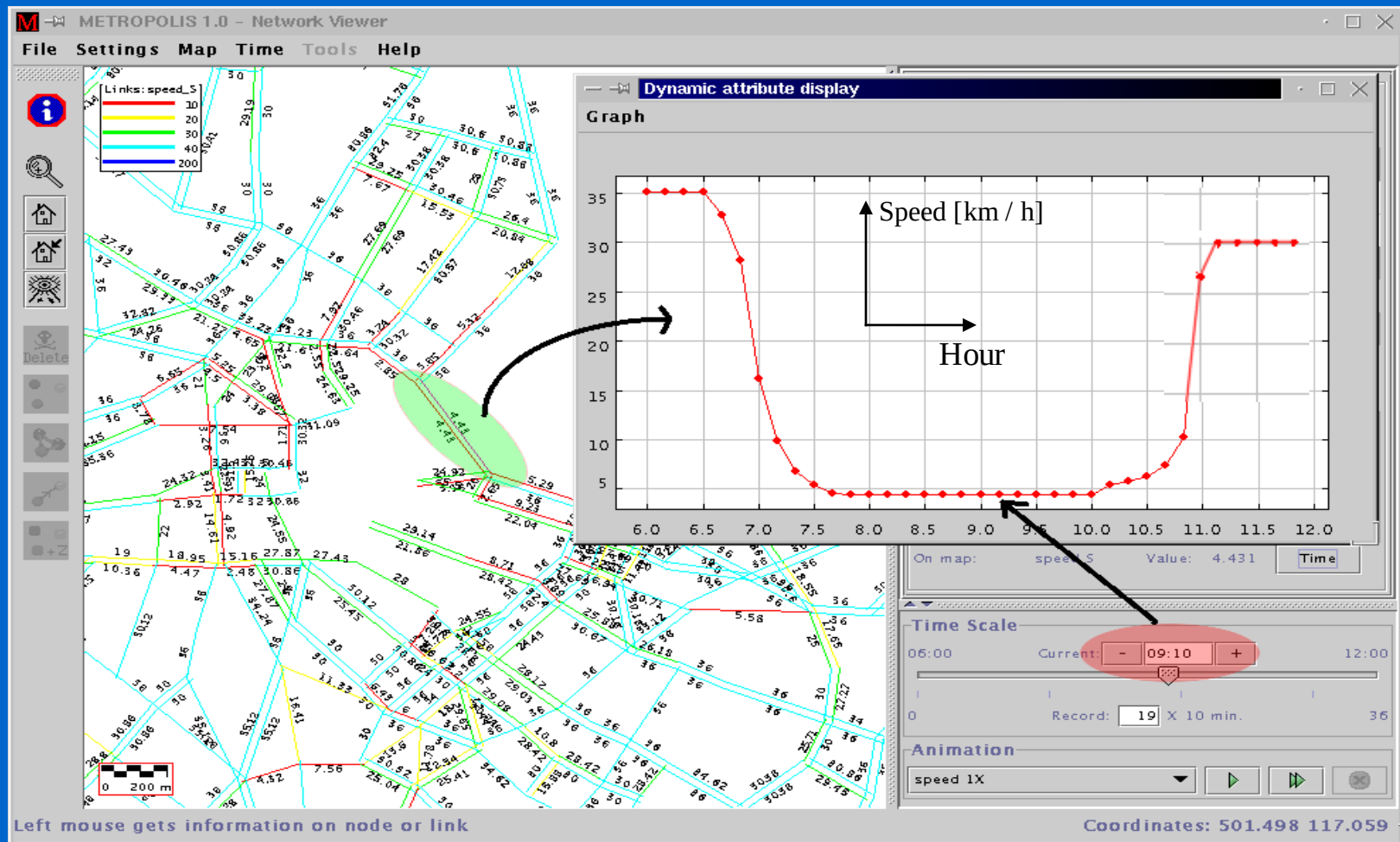
Modèle statique	Modèle dynamique	Unités
• Coût	• Coûts de deshorage • Coût constant	€
• Temps de trajet	• Délai moyen précoce • Délai moyen tardif	Minutes
	• Fraction en avance • Fraction en retard	%

Dynamic flow 7:00-9:00 am

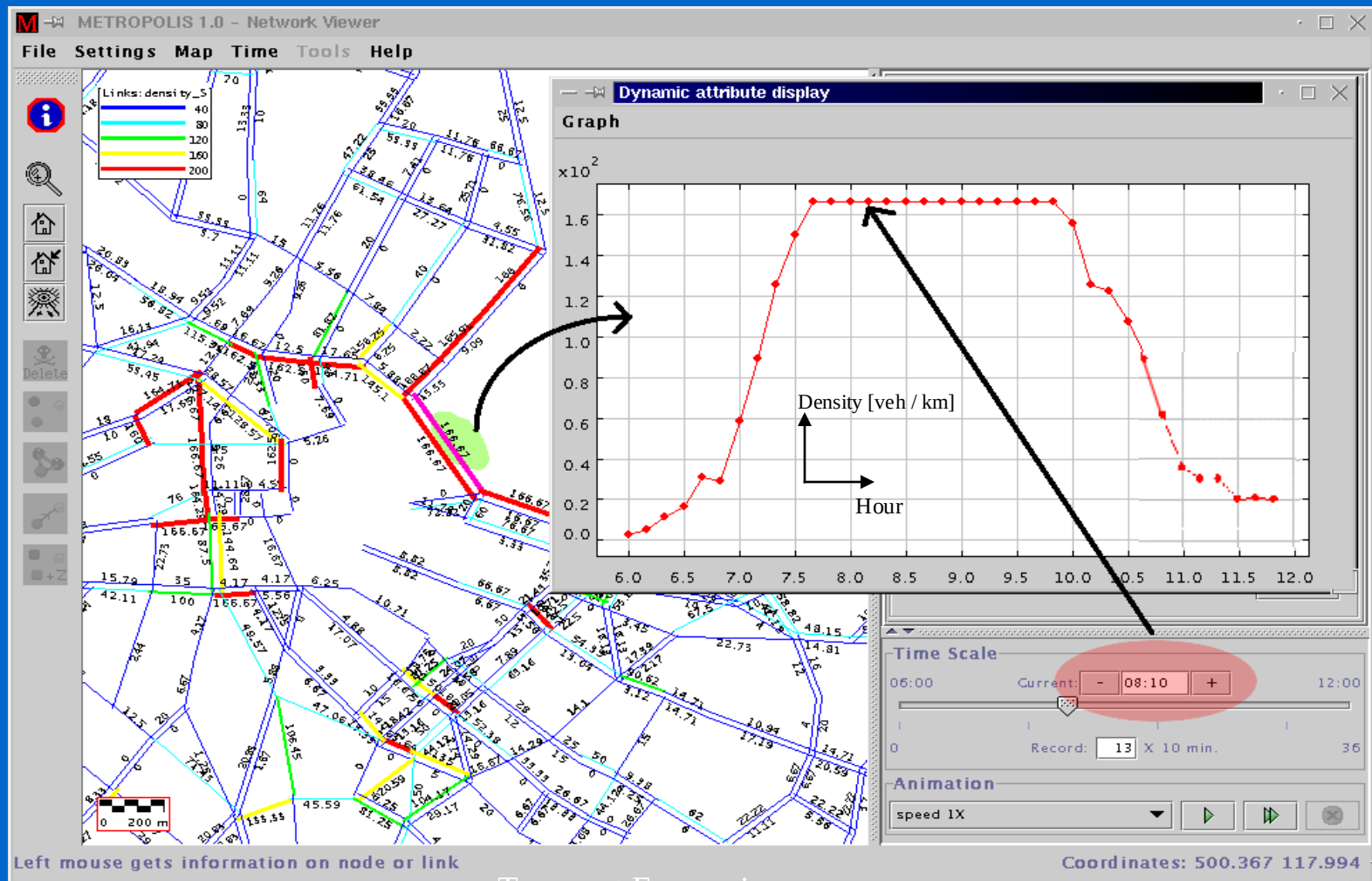


Model of Geneva, 1998.

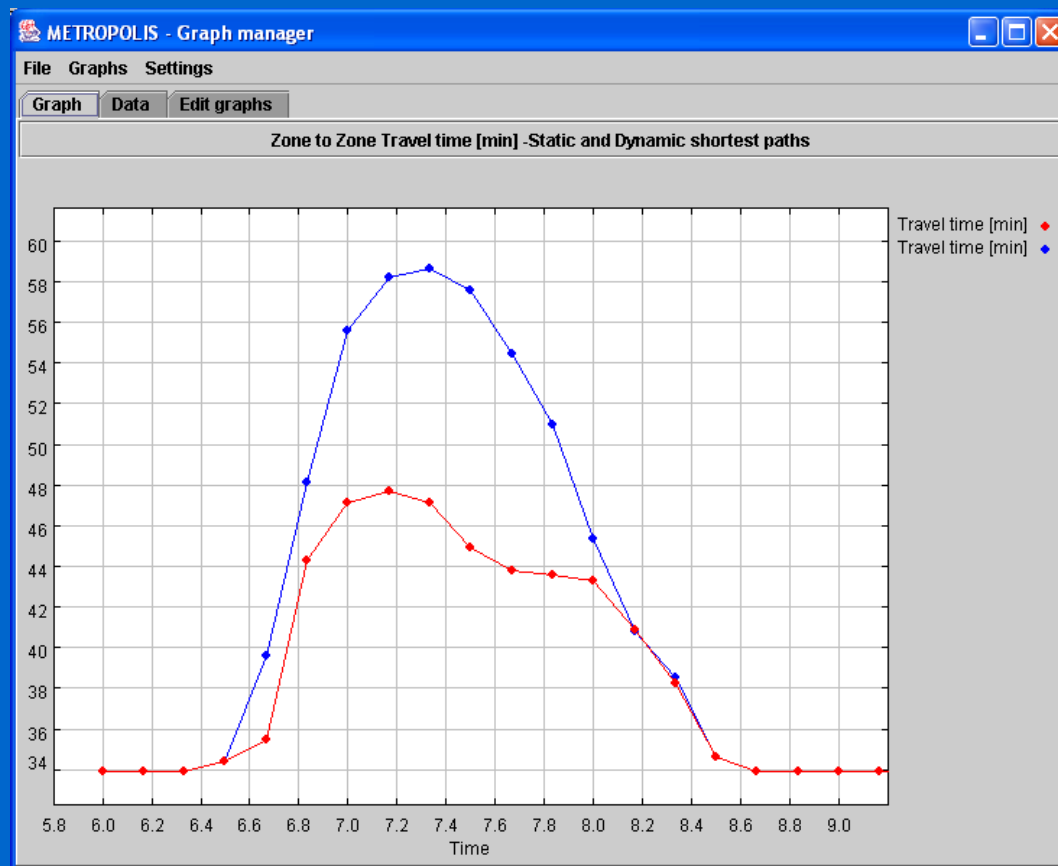
Time dependent speed



Time dependent density



Dynamic shortest path time



5. Simulations for Ile-de-France

Network of Ile-de-France

Caracteristiques	IAU	DREIF
Surface	12 000 km ²	
Population (1999)	Paris : 2 125 millions	
	Banlieue : 8 827 millions	
Longueur totale des routes et autoroutes	2 053 km	
N. de zones	525	1 305
N. de noeuds	4 666	16 682
N. of liens	17 957	39 854
Longueurs totale du réseaux codé k [km]	18 819	19 679
Index de capacité [veh*km/h] x1000	28 443	33 876
Vitesse moyenne à vide [km/h]	52	37

Additional econometric parameters

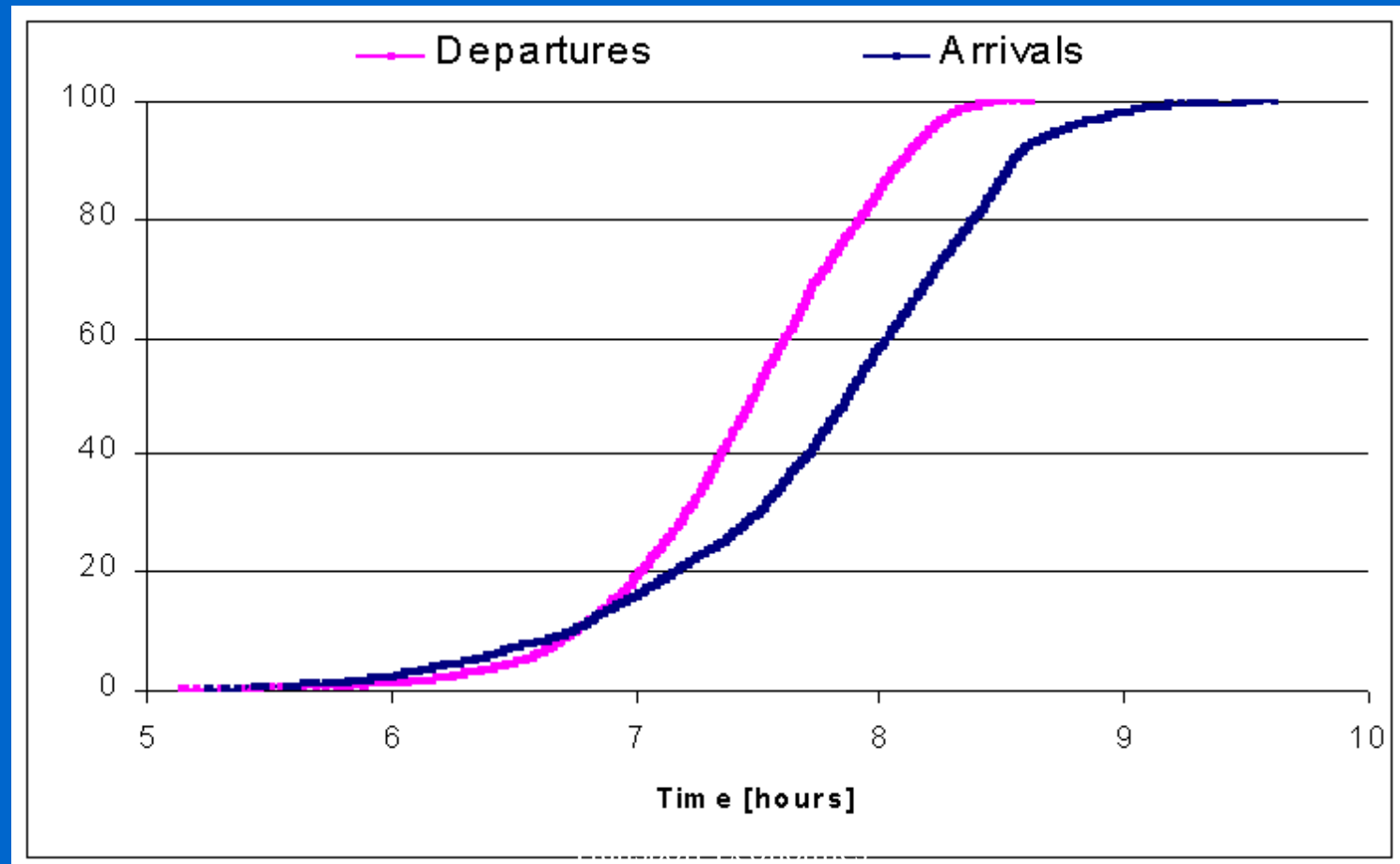
Segmentation de la demande	α [€/h]	β [€/h]	γ [€/h]	t^* [min]	$\sigma - t^*$ [min]	POP
Domicile / travail vers Paris et la proche banlieue	12,96	6,08	7,52	08:29	60	25%
Domicile / travail vers la banlieue lointaine	12,96	8,37	17,44	08:24	50	30%
Autres motifs	12,96	5,24	10,63	08:54	54	21%
				10:49	53	24%

Aggregated indicator

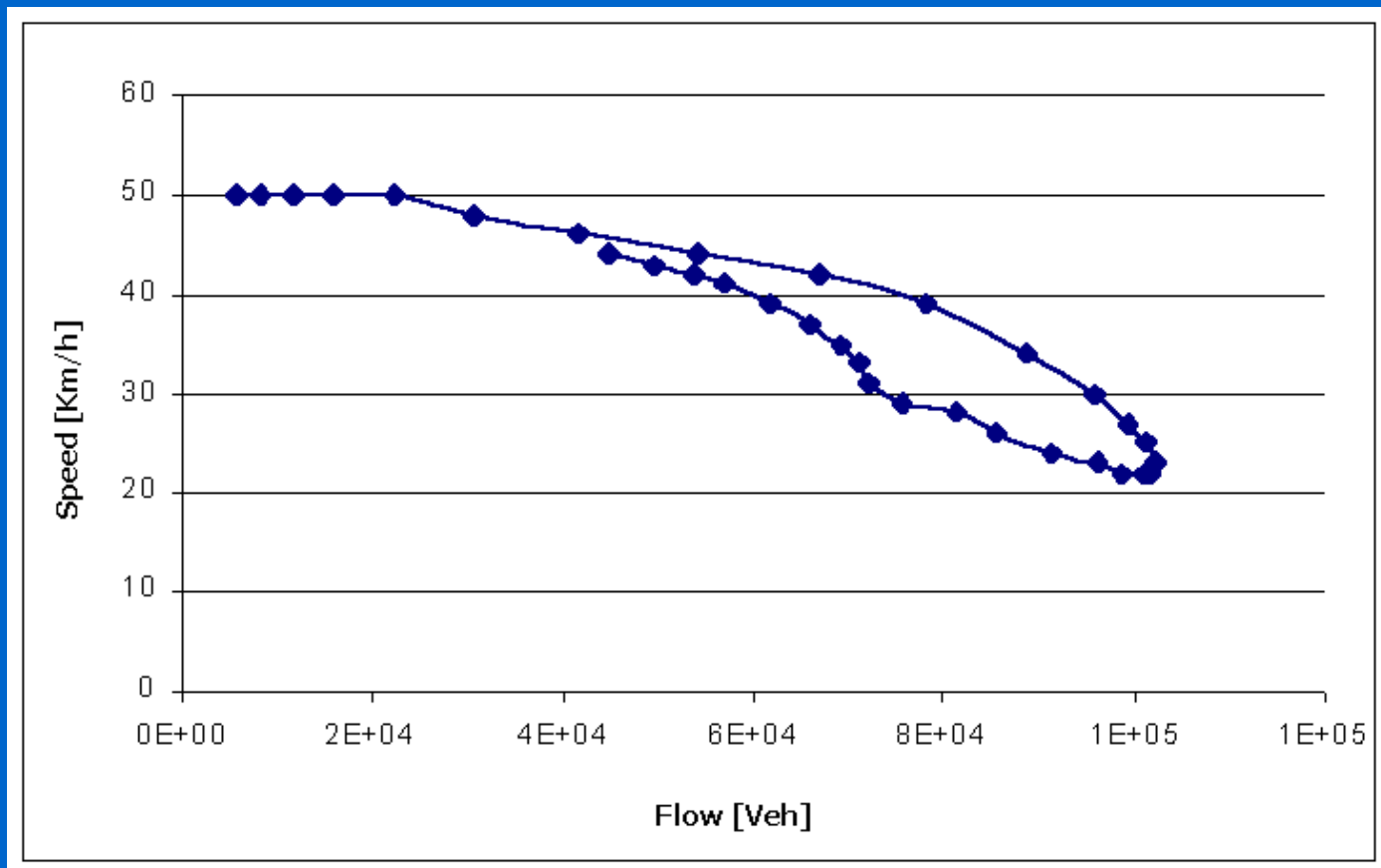
Scenario de référence	IAURIF 1	D
Temps de trajet [min]	32.50	
Délai précoce [min]	28.28	
Délais tardif [min]	19.07	
Fraction précoce [%]	47.25	
Fraction à temps [%]	19.60	
Fraction tardive [%]	33.15	
Coût total moyen [€]	9.47	
Coûts sans congestion [€]	5.26	
Temps d'attente [€]	1.76	
Coût de deshorage [€]	2.45	
Vitesse moyenne [km/h]	28.90	
Volume de déplacements [Ml véh.km]	63.70	
Distance moyenne parcourue [km]	17.51	
Nombre de liens empruntés par utilisateur	17.61	
Indice de congestion [%]	28.85	

Cumulative arrivals and departures

Dans Paris



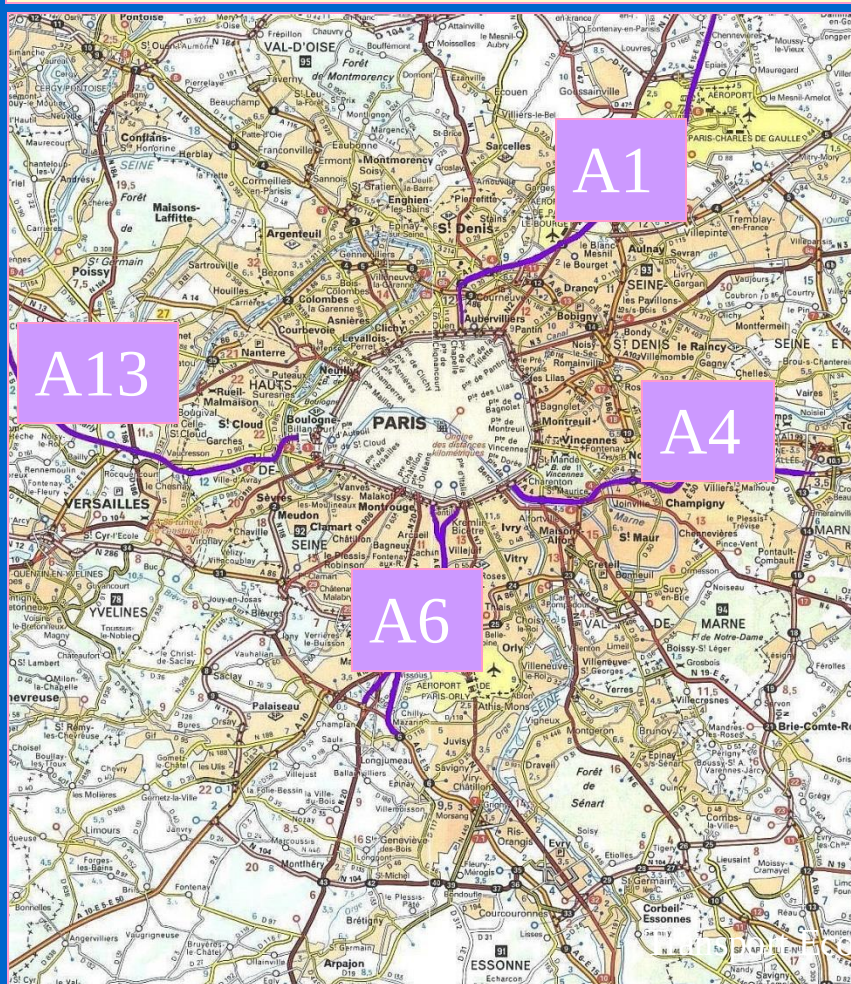
Hysteresis on Bd. Périphérique



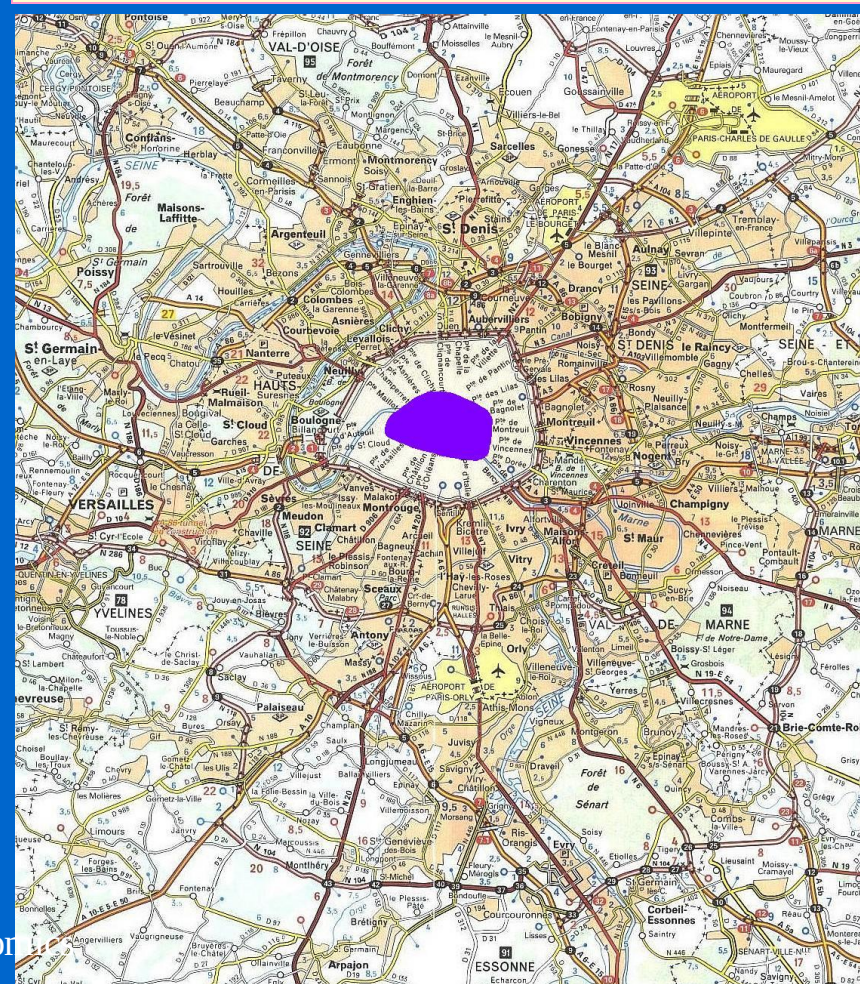
6. Road pricing policies

Radial and cordon pricing in IDF

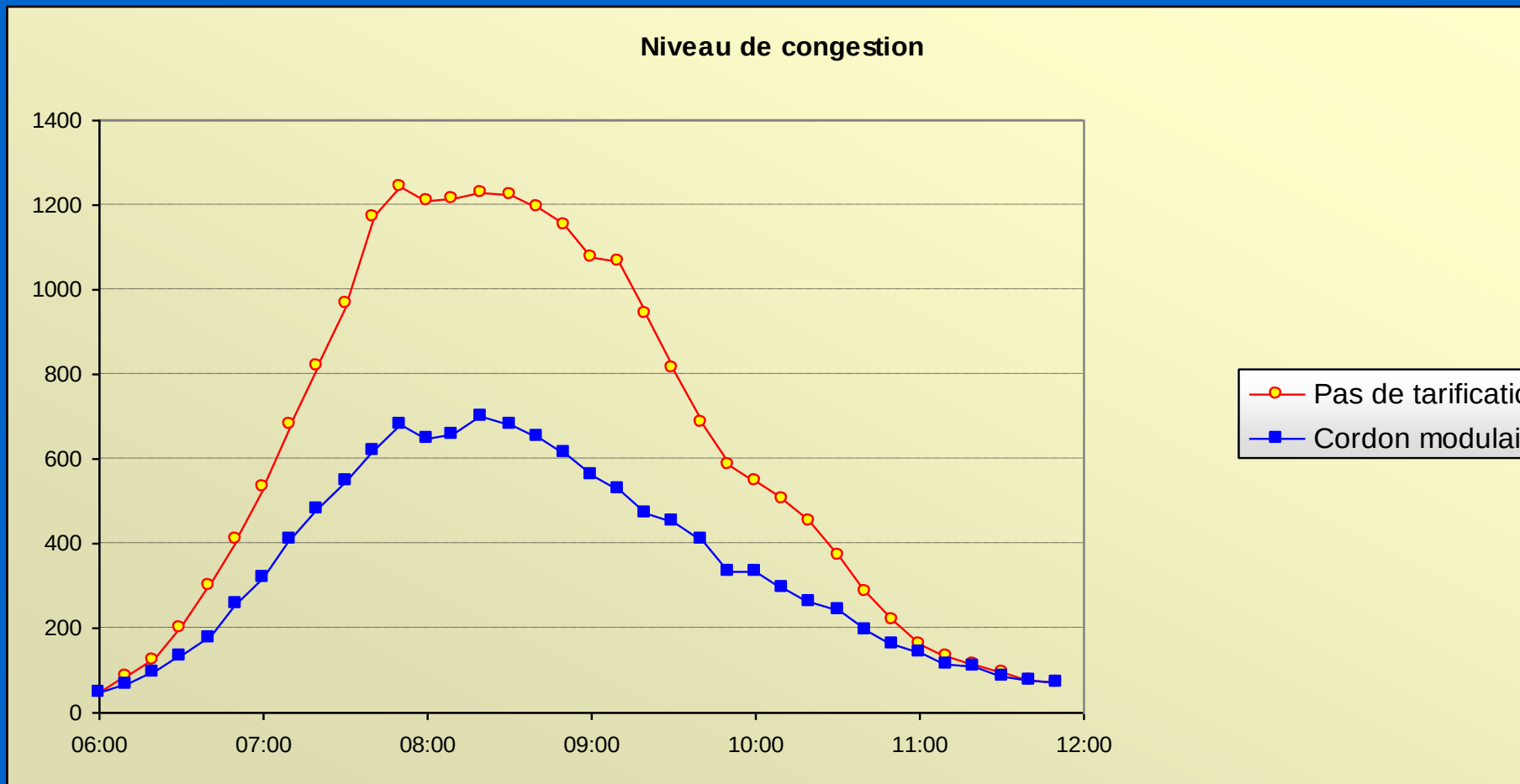
Tarification radiale



Tarification de cordon

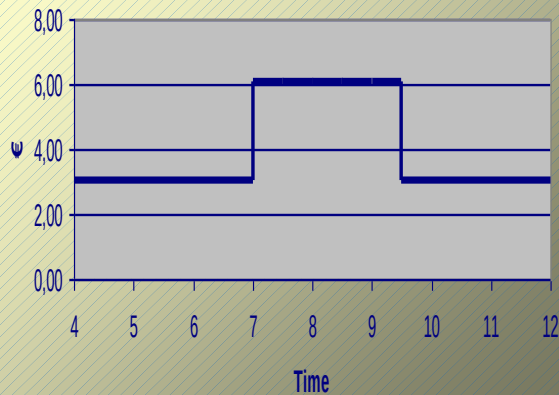


Peak spread

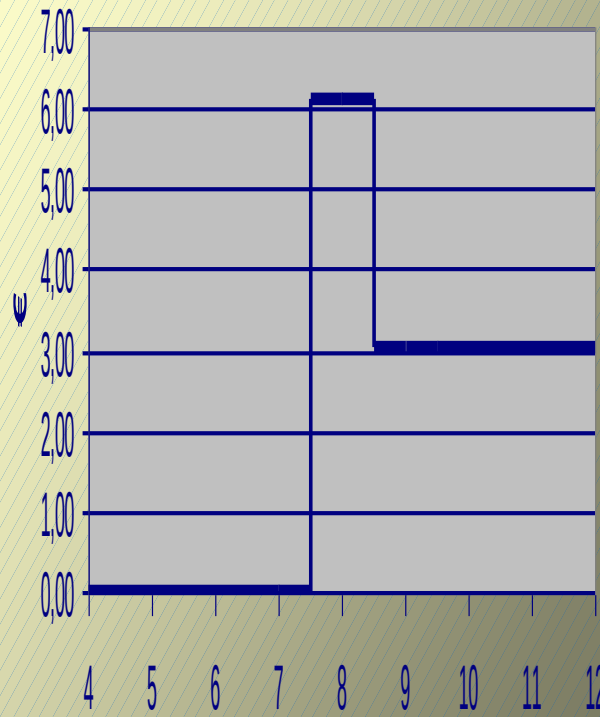


Different coarse tolls

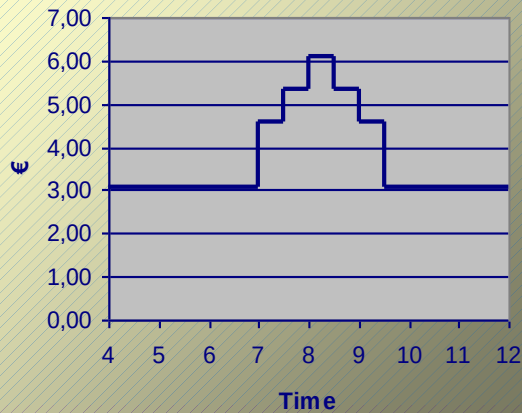
Modular Toll 1



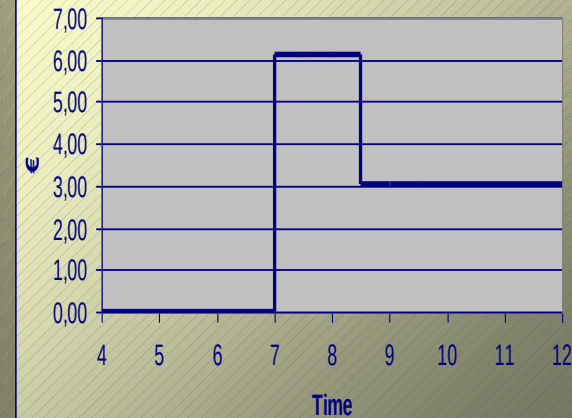
Modular Toll 3



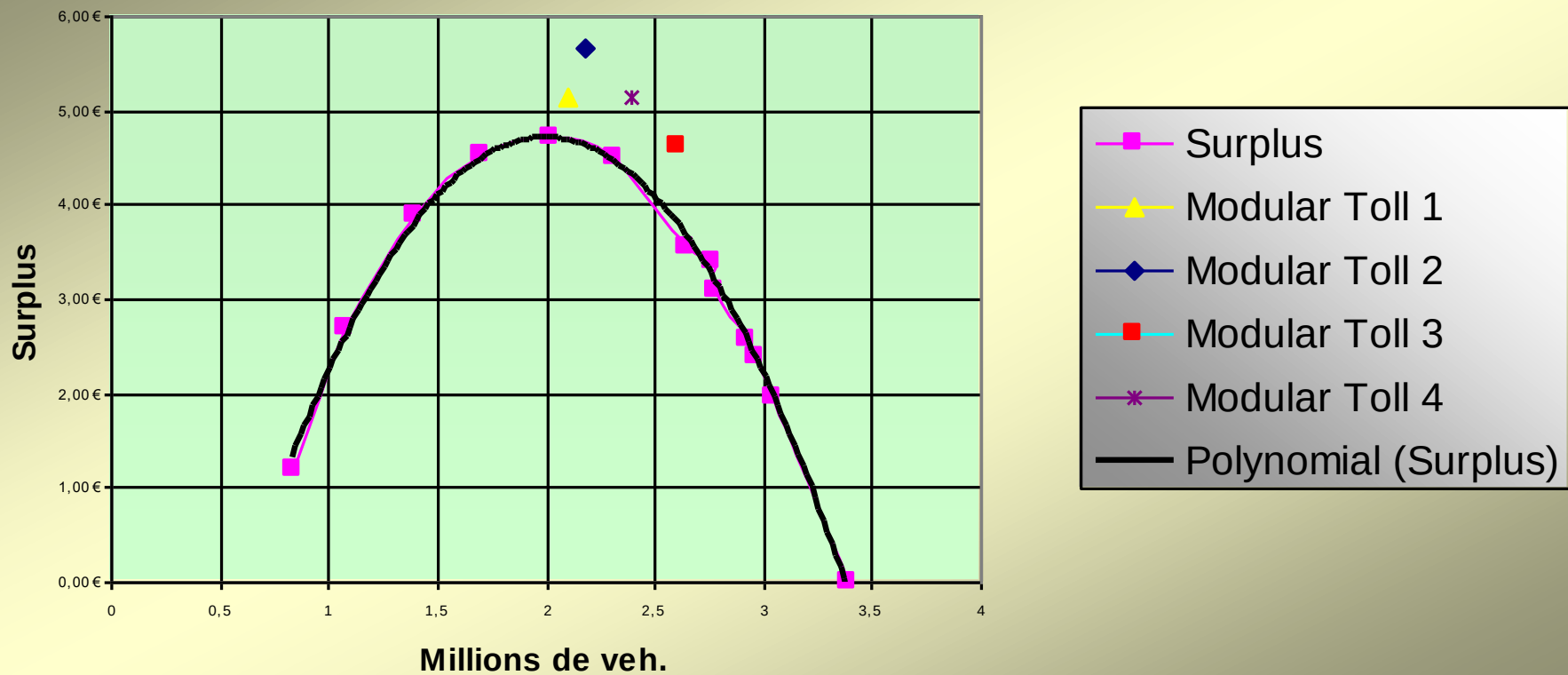
Modular Toll 2



Modular Toll 4



Efficiency of different toll regimes



8. On-going applications

- LUTI model: Integration with a land use model UrbanSim (N. Picard)
- Maintenance (R. Seshadri & R. Lindsey)
- Environment (N. Blond & R. Le Frioux)
- Car pooling (P. Stokkink, L. Javaudin & S. Ghosly)
- Coordination within HH (R. Lindsey and N. Picard)