



An integrated micro-simulation modeling framework to measure and predict emissions and dynamic exposure

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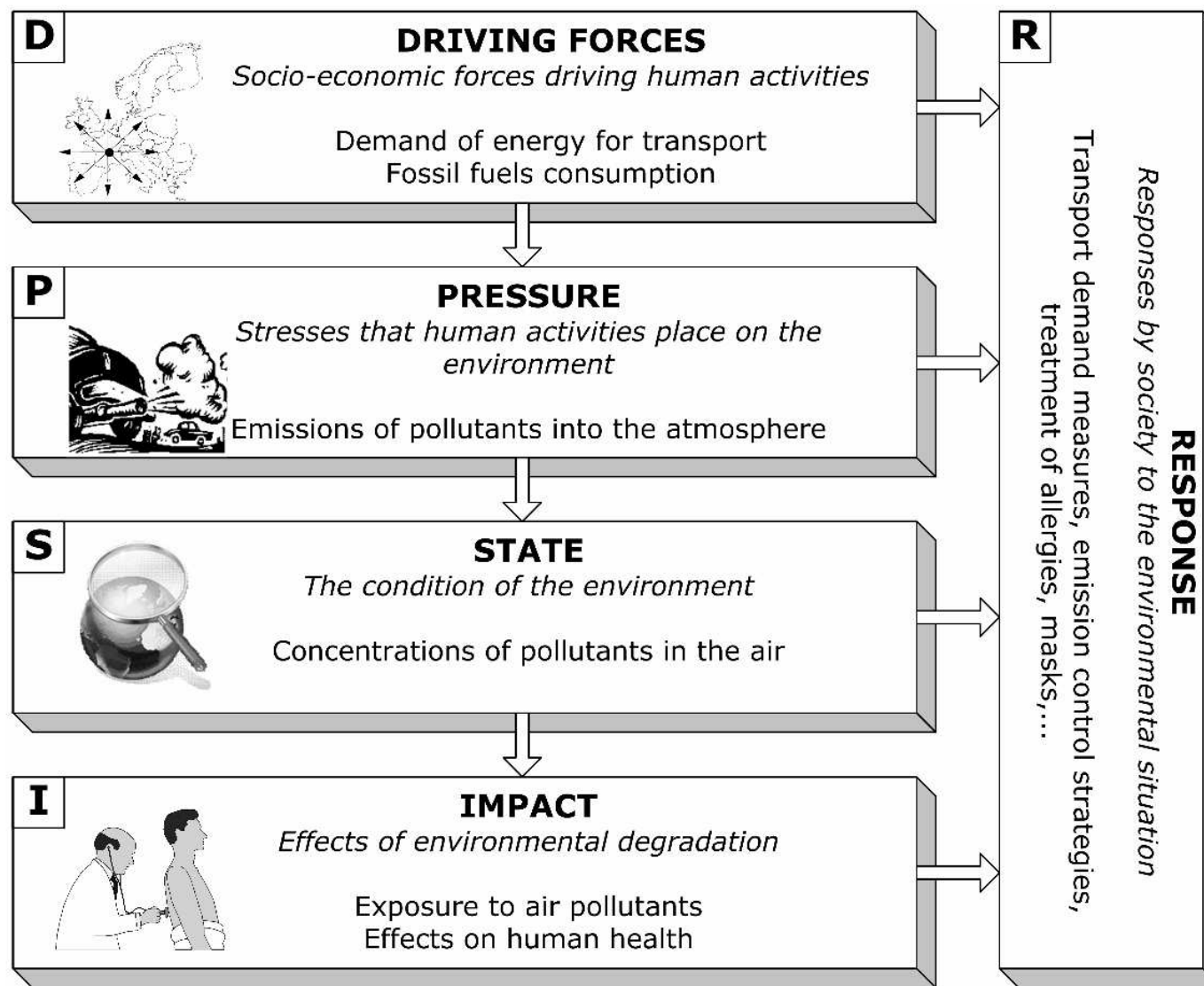
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Introduction

DPSIR Framework

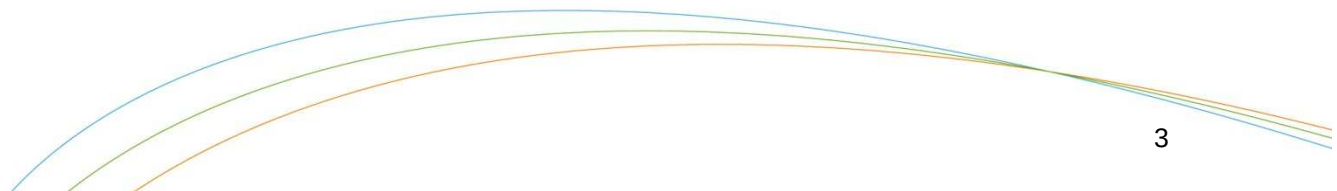




Introduction

Integrated micro-simulation framework

- » Integrated framework involves DPSIR compartments
 - » Emissions resulting from passenger car trips estimated using an activity-based model (**D,P**)
 - » Pollutant concentrations estimated by converting activity-based emissions into ambient pollutant concentrations (**S**)
 - » Population exposure estimated using time series location information from an activity-based model and estimated concentrations (**I**)





Introduction

Classic calculation of air pollution exposure

- » Just combining two sets of data:
 - » Exposure = concentrations*population
 - » Or: concentration weighted by population
- » High resolution concentrations
 - » Derived from measurements or air quality modeling
 - » Outdoor
 - » Averaged (cfr. air quality standards)
- » Statistical population data
 - » Address based
 - » Static (annual)
 - » Poor resolution / Quality



Introduction

Activity-based (AB) transportation models

- » Activity-based transportation models
 - » Predict which activities, where, when, for how long, with whom, transport mode(s) involved
 - » 5 typifying characteristics (McNally, 2000)
 - » travel derived from activity participation
 - » sequences of travel behavior, rather than individual trips
 - » household and other social structures
 - » spatial, temporal, transportation and interpersonal interdependencies constraints
 - » scheduling of activities in space and time
 - » main features of 'new' models (Davidson et al., 2007)
 - » activity-based platform
 - » tour-based structure
 - » micro-simulation modeling techniques

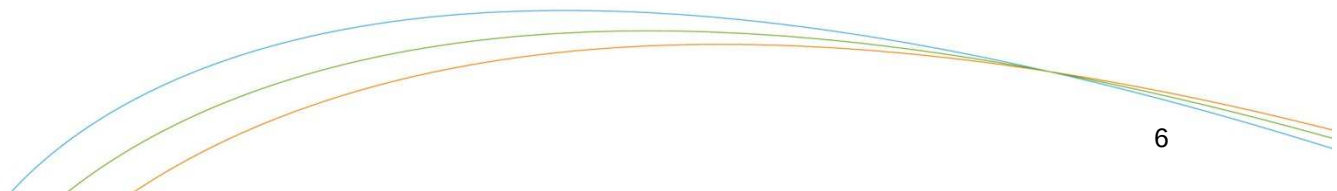


Introduction

Operational activity-based transportation models

- » Recent applications (for complete list see Henson et al. 2009)
 - » ADAPTS, ALBATROSS, CEMDAP, CenterSIM, FAMOS, FEATHERS, HAPP, Illute, Jakarta Model, MatSIM, MERLIN, PUMA, SMASH, TASHA, Tel Aviv Model

Henson, K.M., Goulias, K.G., and Golledge, R.G. 2009. An assessment of activity-based modeling and simulation for applications in operational studies, disaster preparedness, and homeland security. *Transportation Letters: The International Journal of Transportation Research*, **1**(1), 19-39.

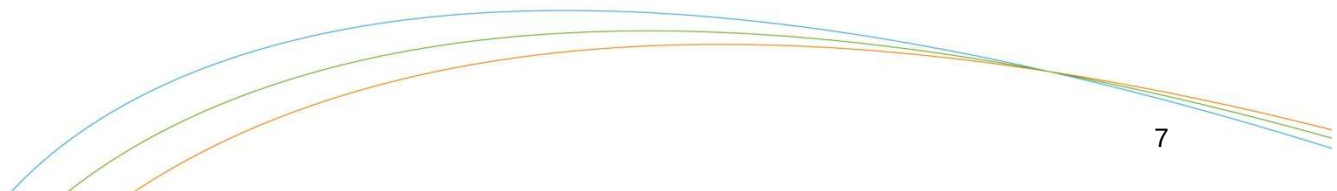




Introduction

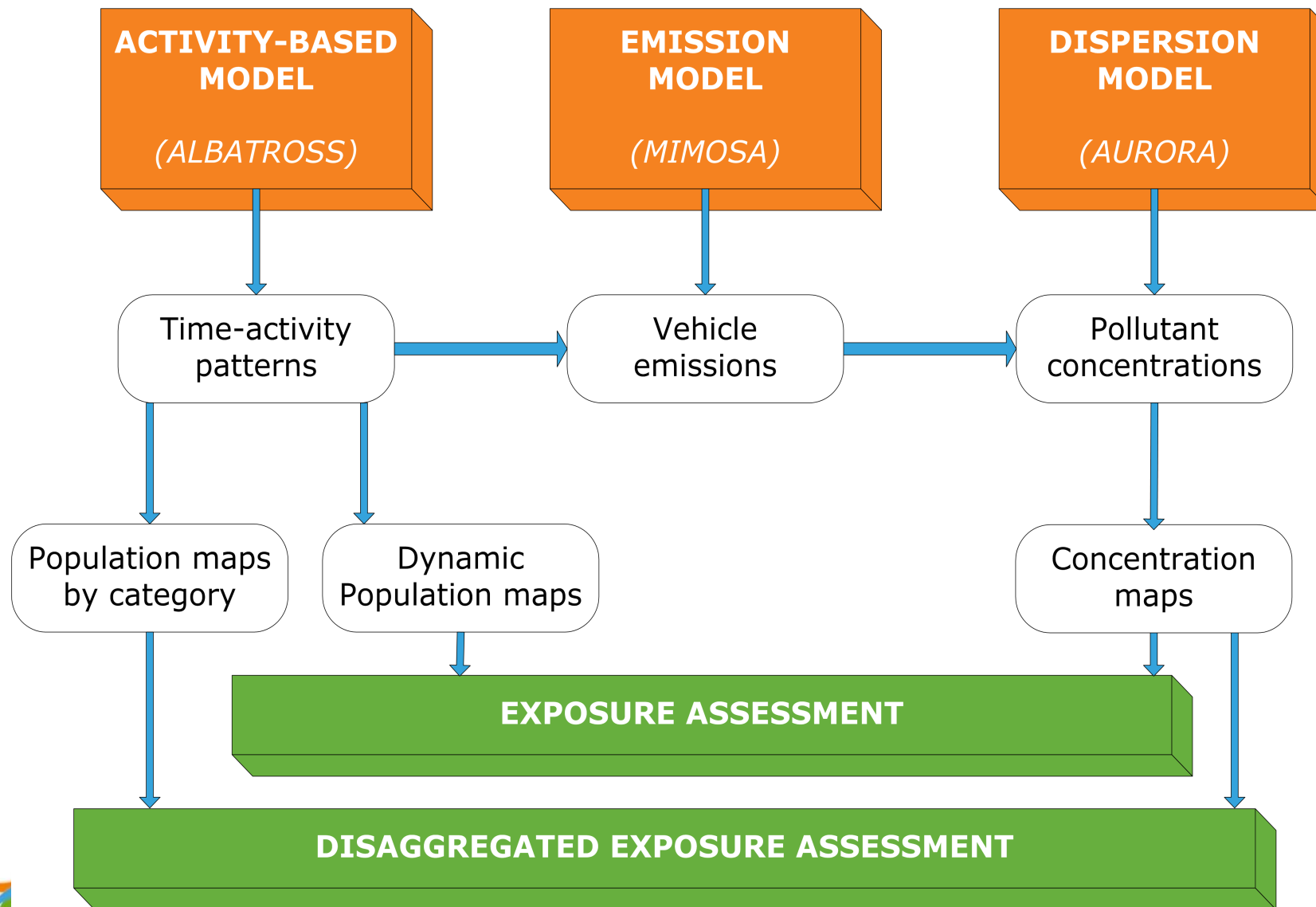
Advantages AB-transportation models

- » Transportation information
 - » Cold starts (tour-based model structure)
 - » Relevant variables for vehicle emission analysis
 - » VMT, travel mode and occupancy rates for auto modes, travel by time of day and time/location of starts
- » Temporal travel and emission analysis
 - » Not hourly counts or peak hour predictions
 - » But entire activity-travel agendas → local and temporal variations
- » Activity-based policy measures
 - » Improved evaluation of TDMs such as e.g. telecommuting
 - » Ability to consider secondary effects of TCMs
- » Exposure assessment:
 - » Dynamic exposure (people moving during day)
 - » Disaggregated exposure analysis (subgroups)



Methodology:

The Activity-Based model chain

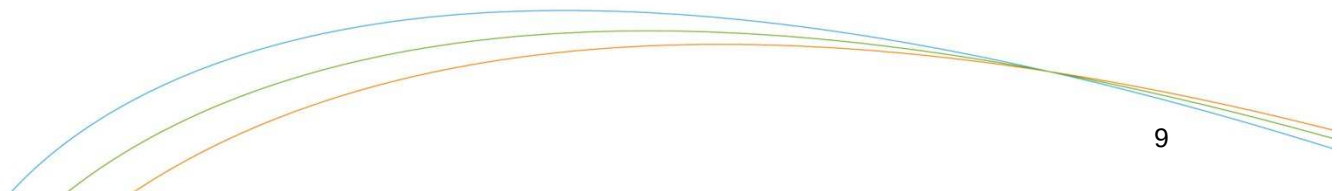




Methodology

Linking ALBATROSS and MIMOSA (1)

- » ALBATROSS
 - » Activity-based transportation model developed at TU/e
 - » Computational process model relying on decision rules
 - » CHAID
 - » Parametric action decision trees
 - » Spatial unit: 4-position postcode area
(Netherlands: +/- 4000 4PCA's, 16 million residents)
 - » Output: activity-patterns for a synthetic population
- » MIMOSA
 - » Macroscopic emission model
 - » Applies mainly COPERT emission functions
 - » Conversion of vehicle distances into emissions by means of emission factors





Methodology

Linking ALBATROSS and MIMOSA (2)

- » Simulation activity-patterns
 - » ALBATROSS
 - » Synthetic population of 30% of the Dutch population
- » Extraction from O/D information from activity schedules
 - » 1308 'LMS subzones'
 - » O/D information on car trips
 - » Calculation of trip matrices (O/D matrix x sample fraction)
- » Assignment of trip matrices to the Dutch road network
 - » 'All-or-nothing' traffic assignment
 - » TRANSCAD
- » Traffic flow information on hourly basis per traffic link
- » Conversion into emissions by applying emission factor approach
 - » Estimated traffic flows
 - » Speed (average speed assumed to be constant during the day)



Methodology

Validation of vehicle emissions

» Total vehicle emissions for the year 2000

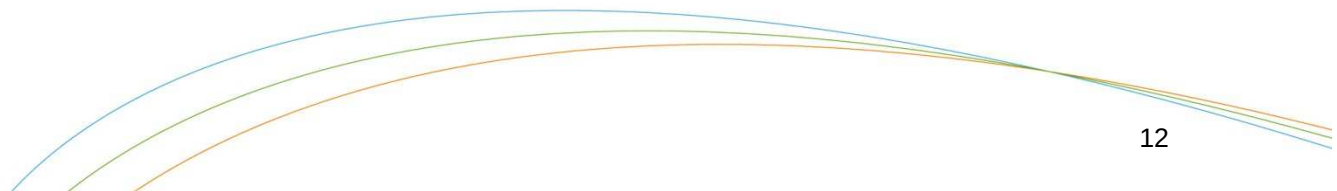
Emissions (10 ⁶ kg)	CO ₂	NO _x	VOC	SO ₂	PM
Modelled results	19292.25	70.21	43.97	1.59	2.97
Reported results	17346.00	60.10	40.35	1.26	2.88
Rel. difference (%)	11.22	16.71	8.98	26.30	3.21



Methodology

Linking ALBATROSS and MIMOSA with AURORA (1)

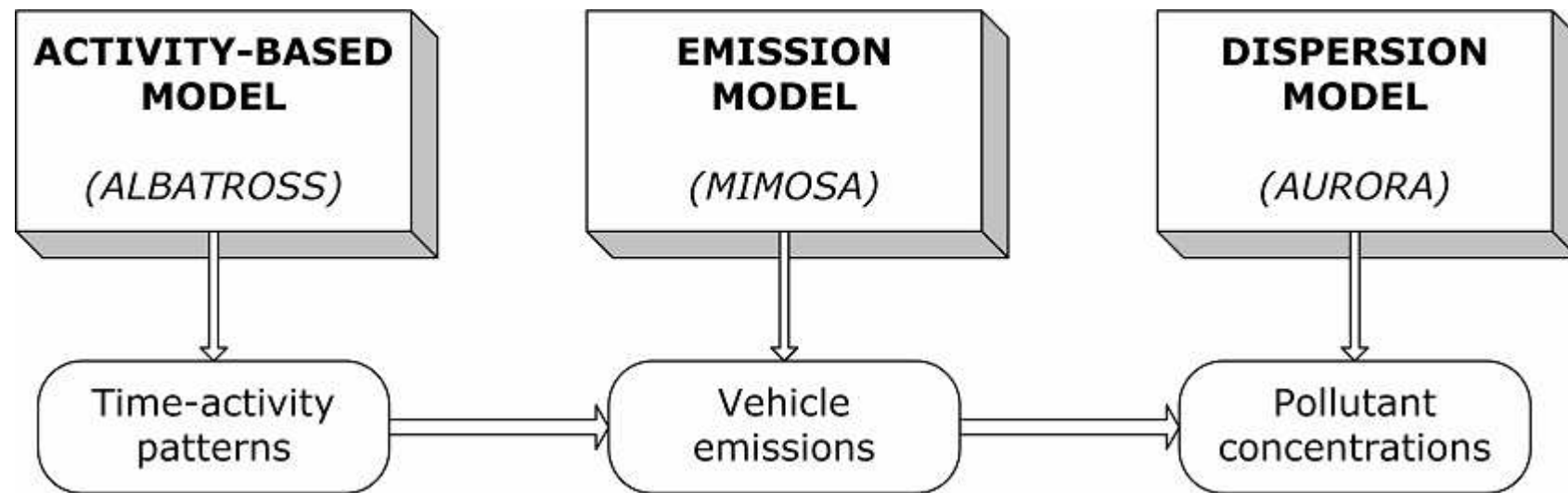
- » AURORA (**A**ir quality modeling in **U**rban **R**egions using an **O**ptimal **R**esolution **A**pproach)
 - » 3-dimensional model of the atmosphere
 - » assess how air pollutants
 - » are transported and mixed in the air
 - » undergo chemical reactions
 - » generate secondary pollutants
 - » ...
 - » Outcome: 3-dimensional concentration fields (up to 20 km altitude)
 - » 3 by 3 km resolution





Methodology

Linking ALBATROSS and MIMOSA with AURORA (2)

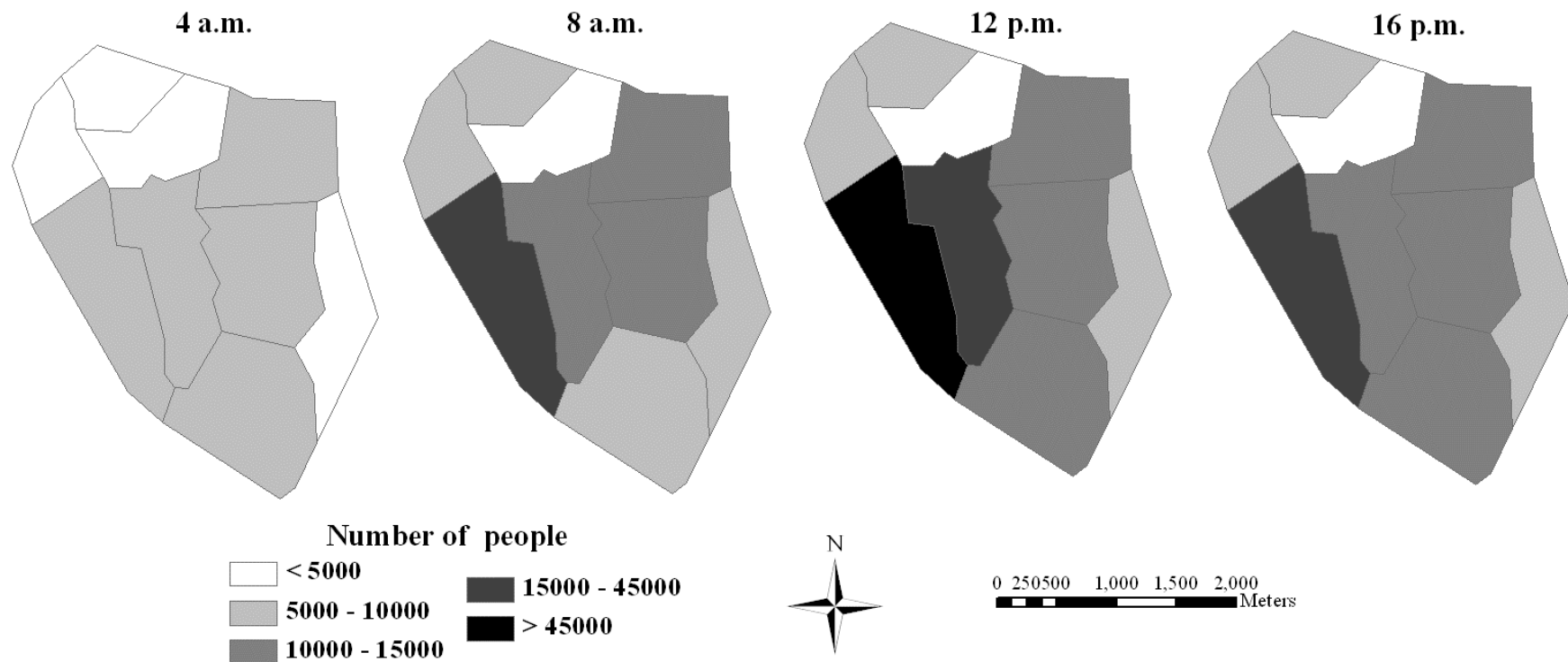




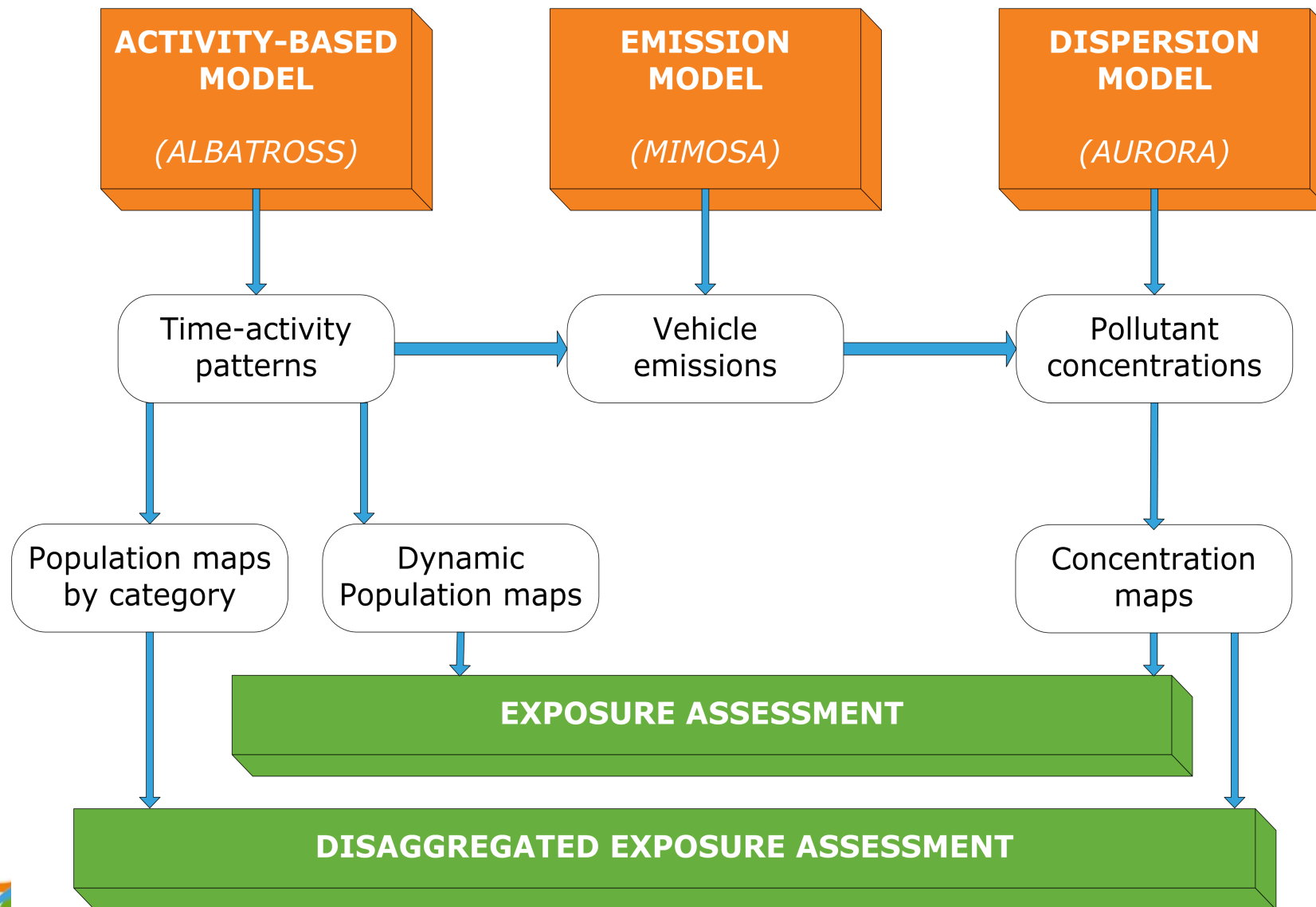
Static vs dynamic

People move from one place to another

Jobs are more likely located in urban areas
(Utrecht urban area (The Netherlands))

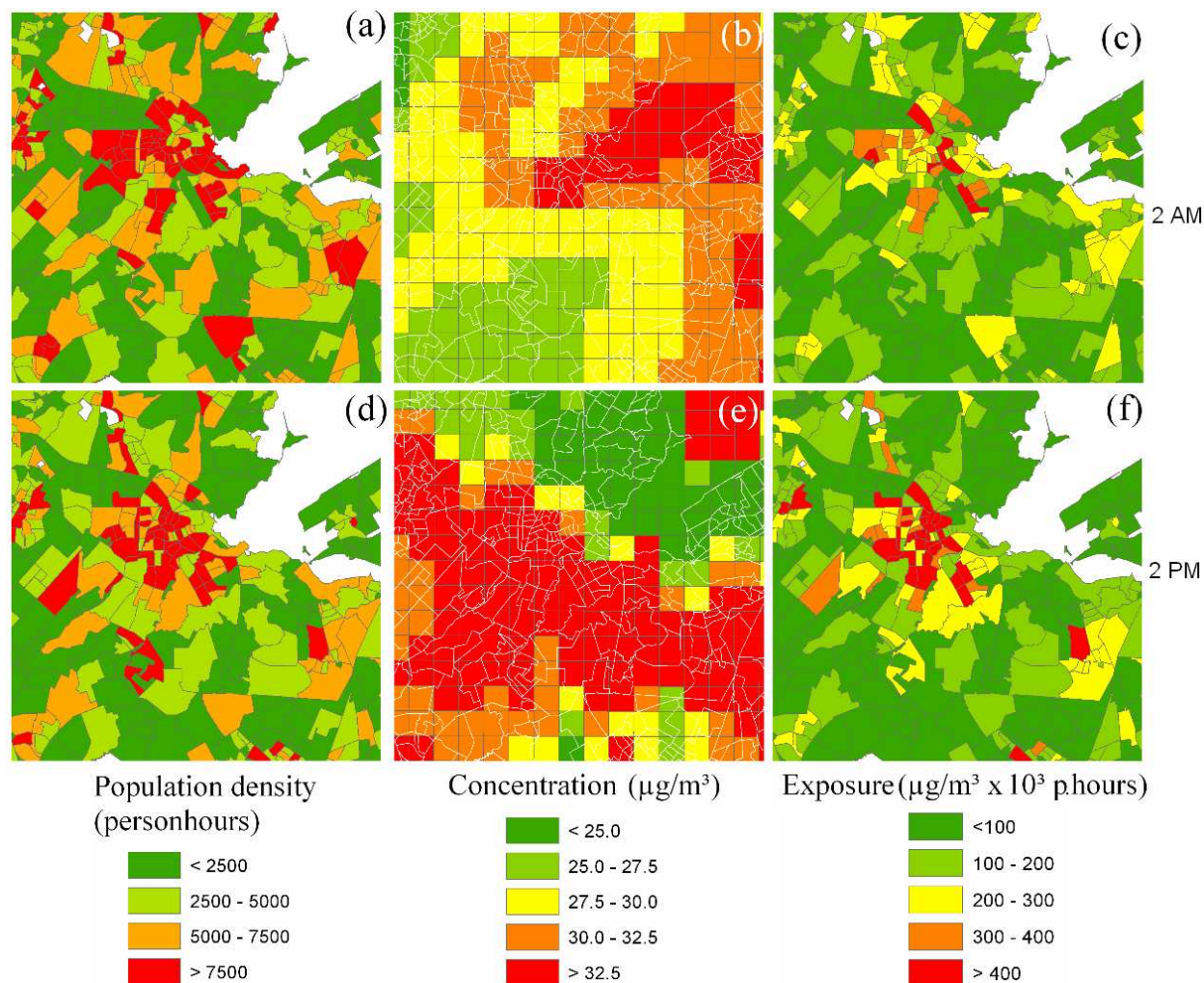


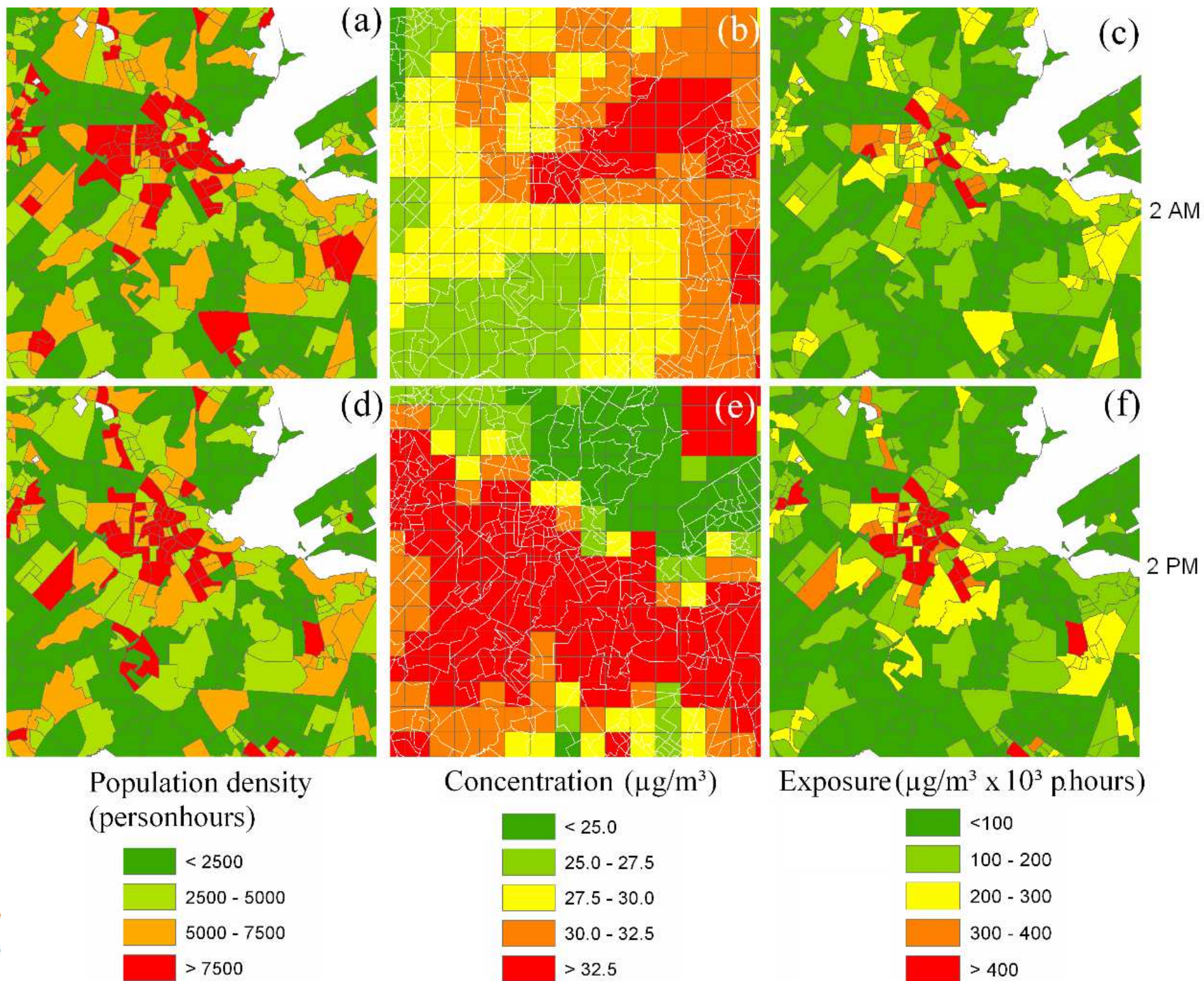
Disaggregated exposure assessment





Total NO₂ exposure assessment Amsterdam



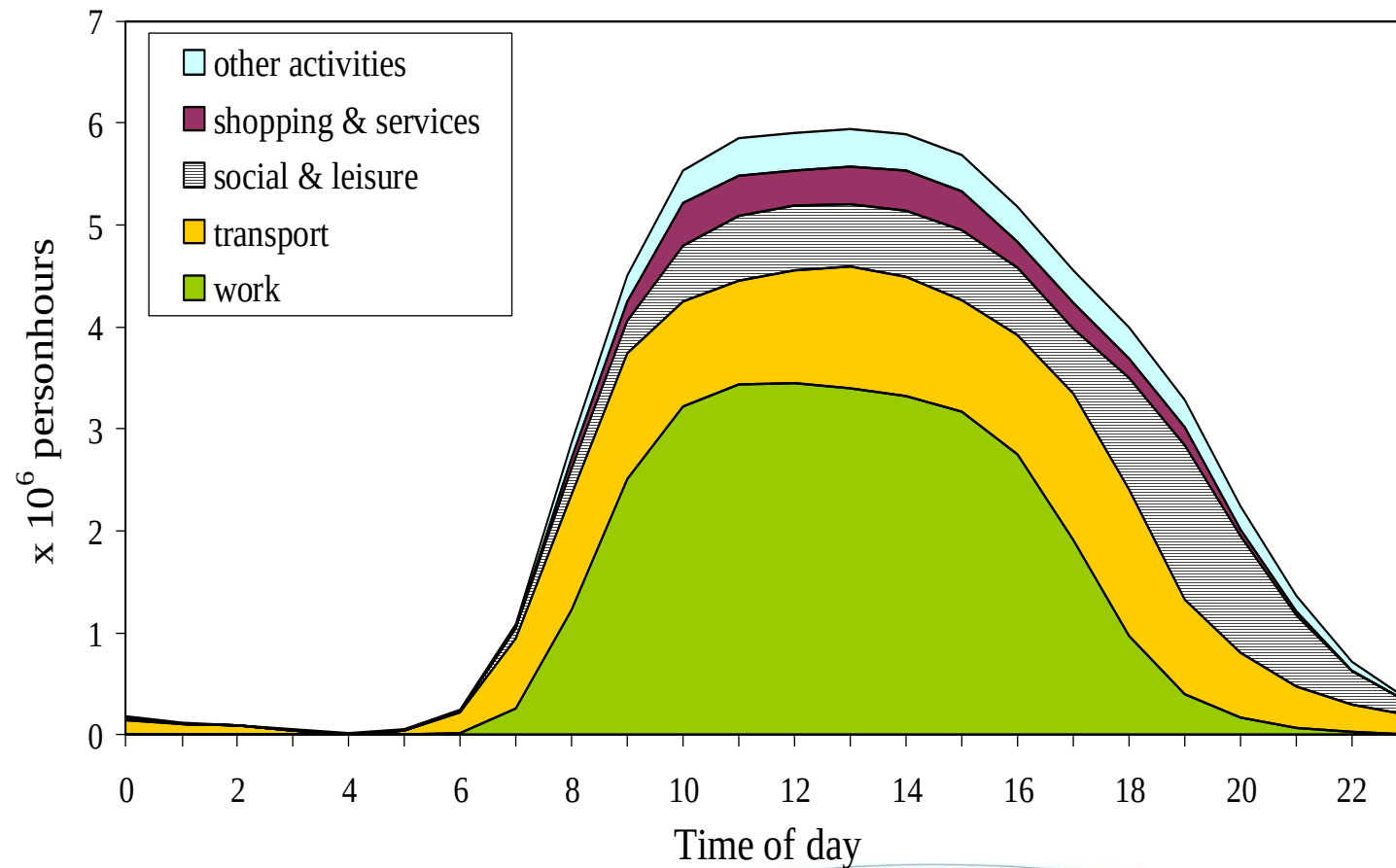




Disaggregated exposure assessment

Disaggregation by activity type

Likely important differences between working people and unemployed
(for both work and transport activities)

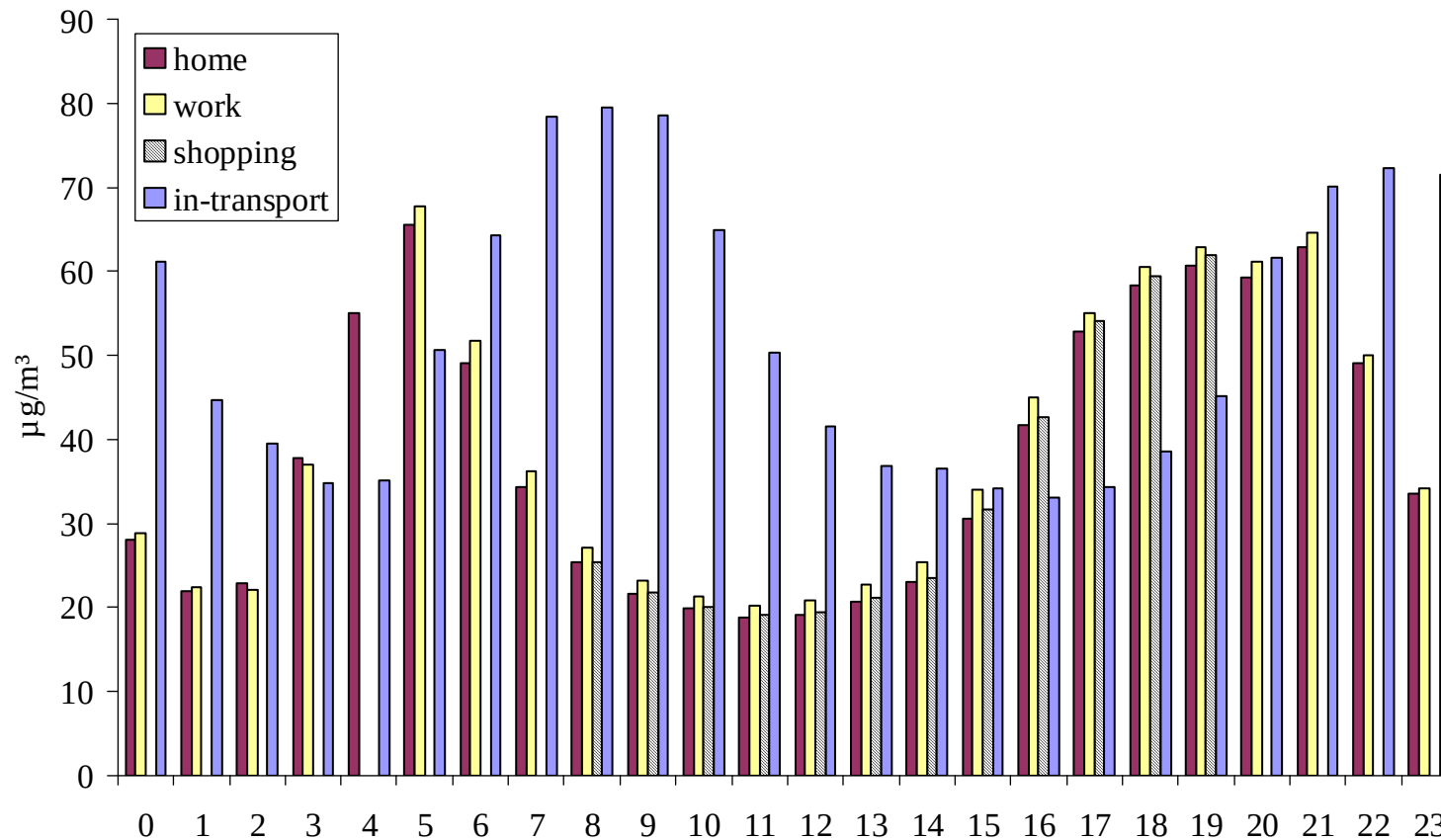




Disaggregated exposure assessment

Disaggregation by activity type

NO₂ concentrations in The Netherlands are on average somewhat lower in residential areas vs. other areas.

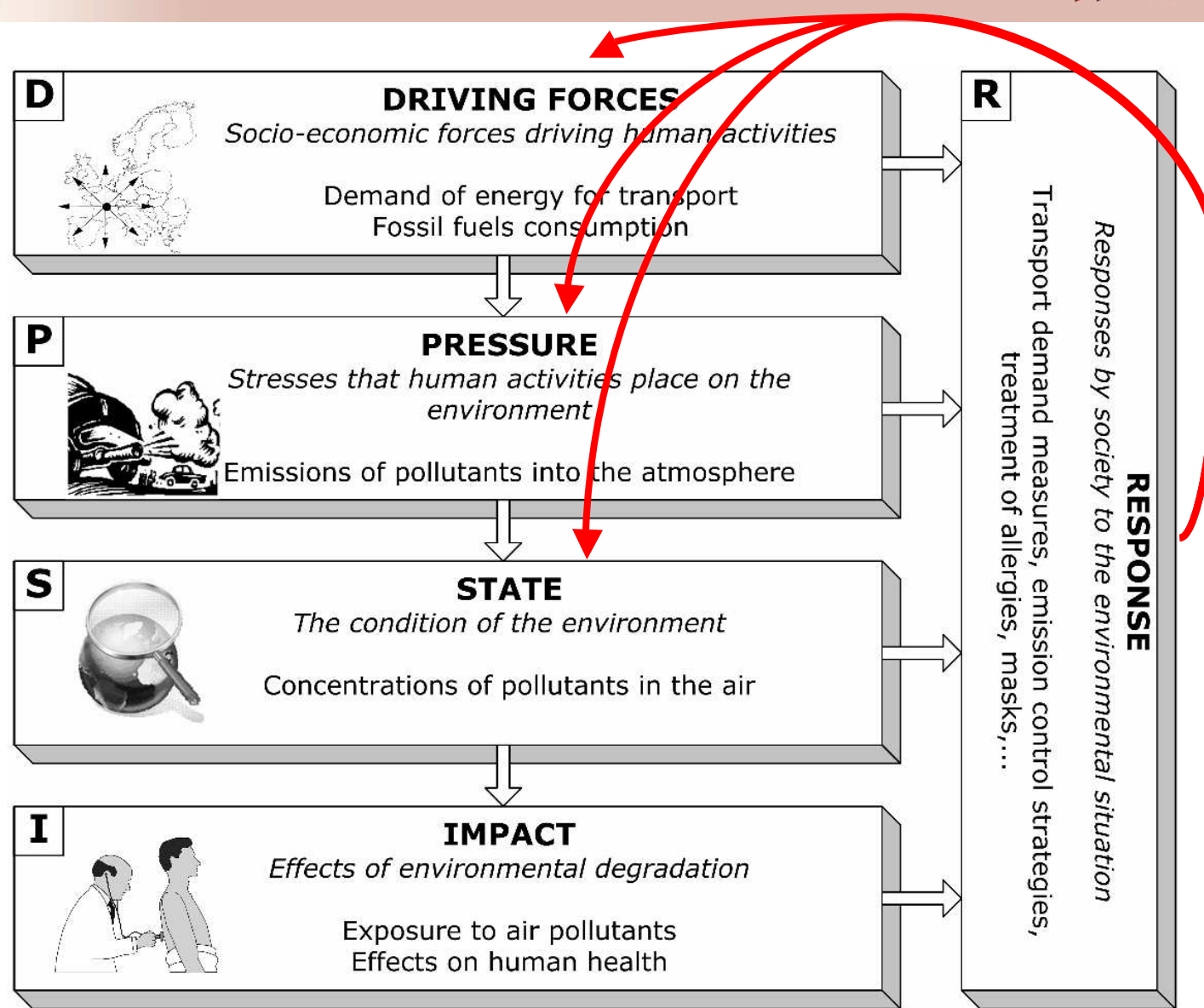




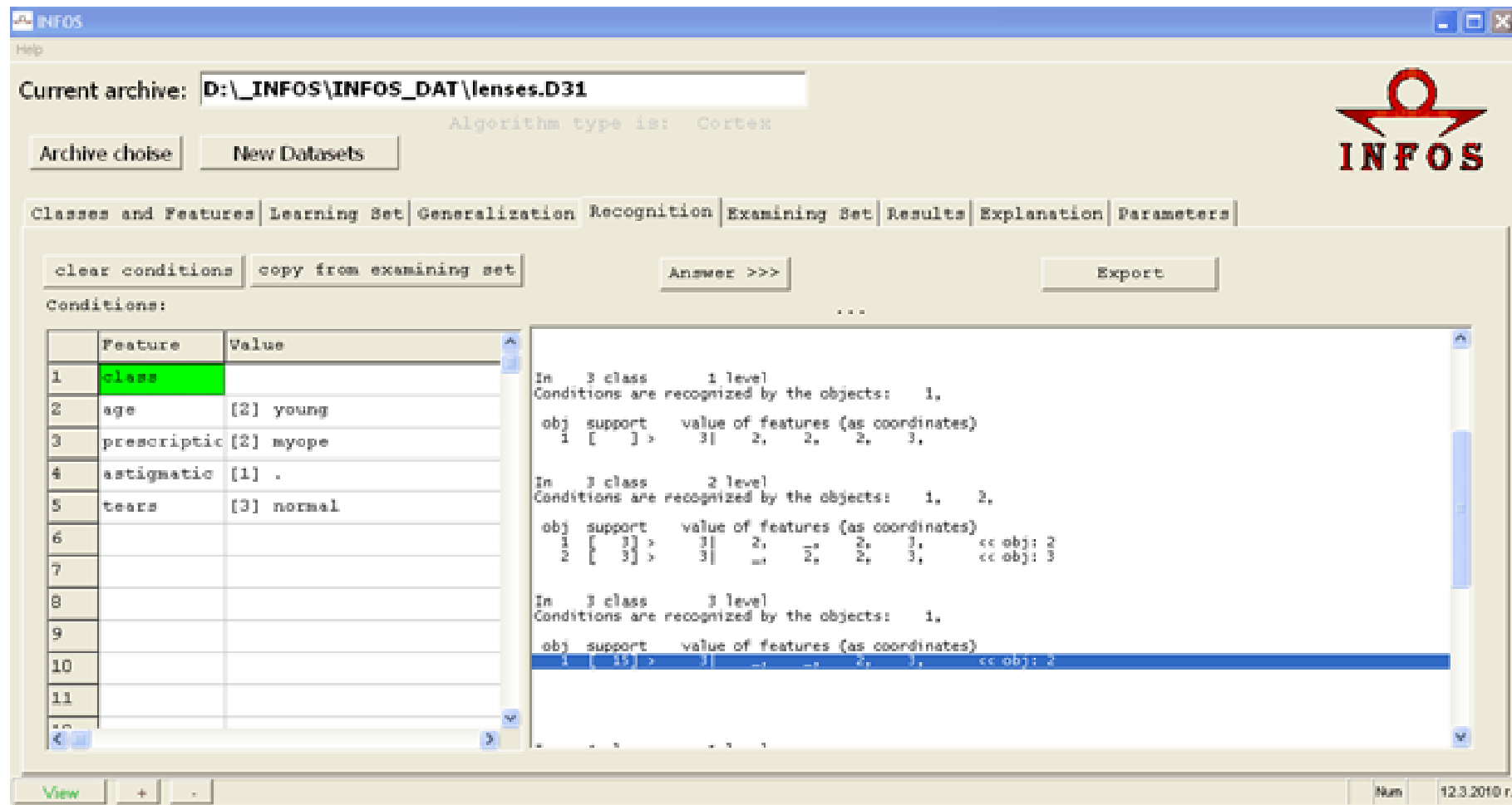
Conclusions

- » Activity Based traffic models can be used to model exposure of different income groups
- » Results can be used to devise more efficient exposure reduction policies aimed at specific population subgroups, activities, areas, ...
- » It is remarkable that a difference between SEC's can be found at the resolution used for these AQ calculations (3x3 kms)
- » Higher resolution calculations (1x1 km) will determine whether scale matters
- » Results should be analyzed further to establish causes for the observed differences

Disaggregation of nation-wide dynamic population exposure estimates in The Netherlands: Applications of activity-based transport models
Beckx et al., 2009. Atmospheric Environment (1-9) Available online at
<http://dx.doi.org/10.1016/j.atmosenv.2009.07.035>



Intelligent System “INFOS”



INFOS

Current archive: D:_INFOS\INFOS_DAT\lenses.D31

Algorithm type is: Cortex

Archive choice New Datasets

Classes and Features Learning Set Generalization Recognition Examining Set Results Explanation Parameters

clear conditions copy from examining set Answer >>> Export

Conditions:

	Feature	Value
1	class	
2	age	[2] young
3	prescriptic	[2] myope
4	astigmatic	[1] .
5	tears	[3] normal
6		
7		
8		
9		
10		
11		

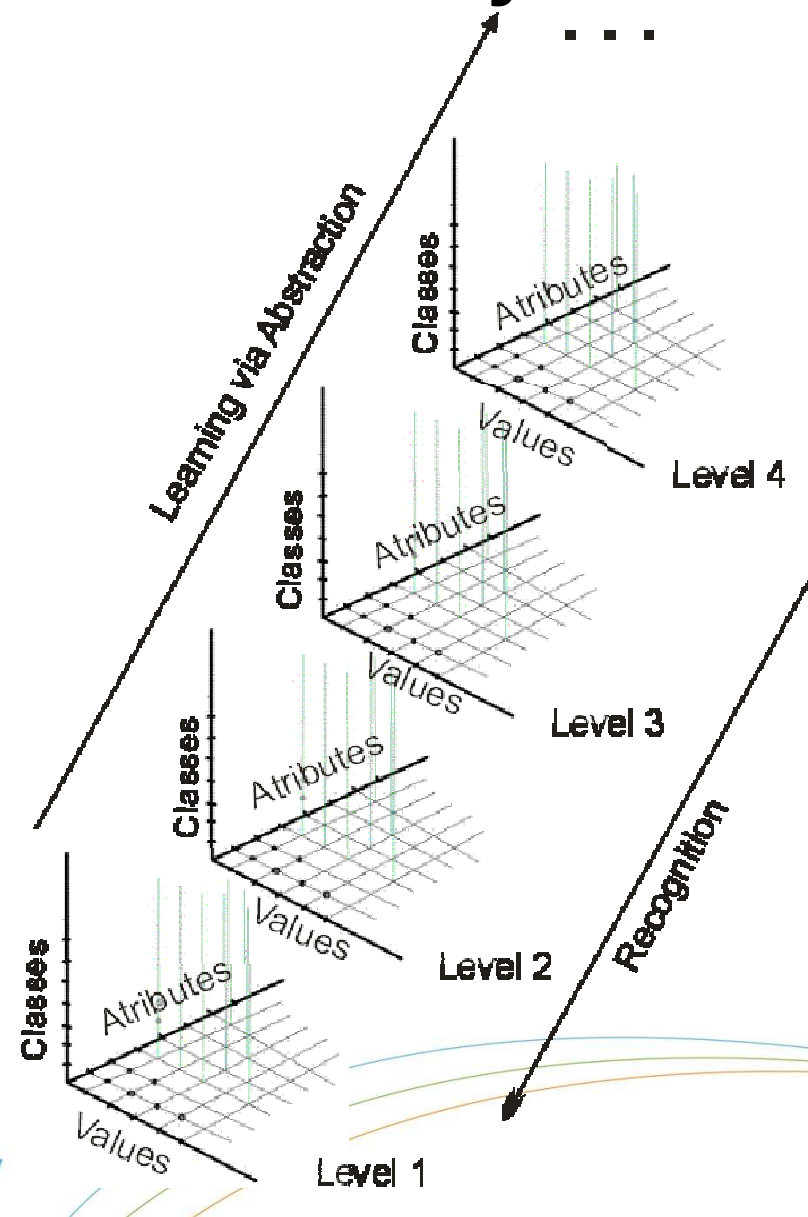
In 3 class 1 level
Conditions are recognized by the objects: 1,
obj support value of features (as coordinates)
1 [] > 3| 2, 2, 2, 3,

In 3 class 2 level
Conditions are recognized by the objects: 1, 2,
obj support value of features (as coordinates)
2 [] > 3| 2, 2, 2, 3, << obj: 2
3 [] > 3| 2, 2, 2, 3, << obj: 3

In 3 class 3 level
Conditions are recognized by the objects: 1,
obj support value of features (as coordinates)
1 [] > 3| 2, 2, 2, 3, << obj: 2

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INFOS Memory Structure



INFOS Parameters

INFOS

Help

Current archive: D:_INFOS\INFOS_DAT\lenses.D31

Algorithm type is: Cortex

Archive choice New Datasets

Classes and Features Learning Set Generalization Recognition Examining Set Results Explanation Parameters

ver. 1.3 / 11.03.2010

Support for generalization at: Minimum number of significant features values at:

level 1	2	level 1	2	Processing with absorption ☒
level 2	2	level 2	1	
level 3	2	level 3	1	
level 4	1	level 4	1	
high levels	1	high levels	1	

Тази група параметри показват, кои обобщения ще се считат за значими (ще се запазят в следващото ниво) при генерирането им от обектите в по-долното ниво. Броят на запазените е обща на база всички елементи. За всеки клас броят се редуцира в зависимост от процентното участие на обектите на класа спрямо всички обекти, но не е по-малка от 2.

Тази група параметри показват, кои обобщения ще се считат за значими (ще се запазят в следващото ниво) при генерирането им от обектите в по-долното ниво. Броят на запазените атрибути (сяс стойност различна от "1") варира за всички класове. Тя не може да бъде по-малка от 1.

Expanded path and filename to output program: C:\Program Files\Microsoft Office\OFFICE11\WINWORD.EXE

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Thank you for your attention

