Land Use Transportation Interaction Models

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http://www.spatialcomplexity.info/

Outline

- Preliminary Ideas:

  a. LUTI Models: A Little Bit of History, Graphics Interfaces

  b. Gravitation and Social Physics

  c. Spatial Interaction Modelling: Some Basic Ideas
- The Tyndall Model: Integrated Assessment
- SIMULACRA: ARCADIA and SCALE Projects
- Requirements: The Model Design: Models Flows: Physical Movements, Money & the Residential Model
- The Visual Template: The Desktop Model: Running It
- Building a Web-Based Model Interface
- Data Bases: Location, Interactions & Networks
- Current Challenges for Immediate Developments

Preliminary Ideas

a. LUTI Models: A Little Bit of History, Early Graphics

Early models: CATS 1955: The 1960s Models: large scale, aggregate data, policy led, suffered from all the problems of science in public policy that we now know

Largeness, remoteness from users, crude representation, limits on computation, poor links to policy

Lack of understanding of model outcomes

Statics versus dynamics – semi-dynamic models but most operational models predicated in terms of equilibrium and as we have seen, the most developed are structured in terms of a dynamic equilibrium

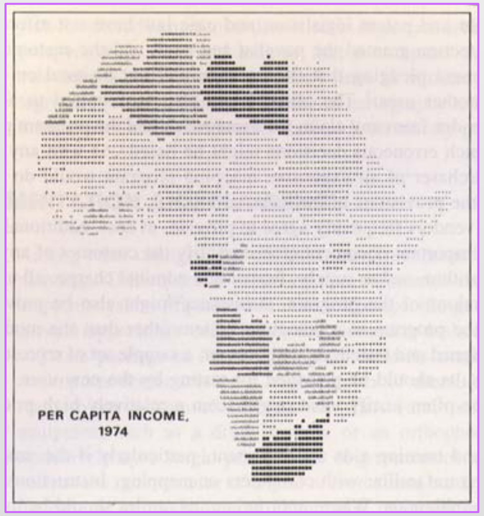
Disaggregation of sectoral activities

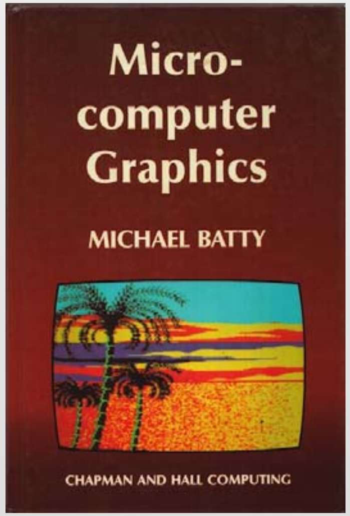
Early attempts at Visualisation: Traffic Flows in CATS, and Schmidt's model of the growth of East Lansing 1967

Harvard Lab: SYMAP – Symbol Mapping Systems, 1967-1970

Early cathode ray displays, 1960

Apart from some SYMAP applications, my own attempts began in the early 1980s with the Melbourne Model

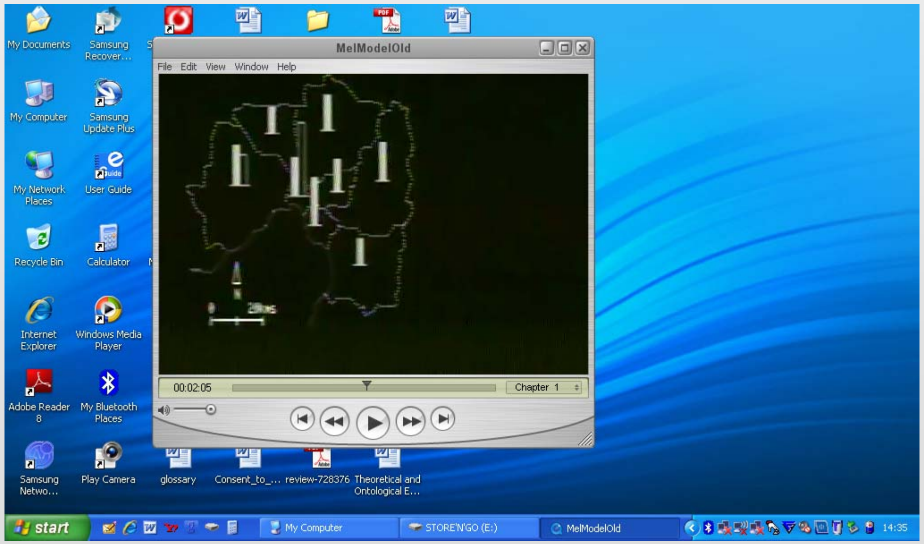





A PICTORIAL HISTORY
OF THE
EXPANSION OF THE
METROPOLITAN AREA


Lansing
File Edit View Window Help
1965
00:02:58

I worked on these models in the 1970s and published a book on them called Urban Modelling – you can get it online and if you go to my blog www.complexcity.info you can download it Our first foray into these large scale models and their visualisation was for Melbourne in 1982 and then development of a WATFor77 version in 1986. The Melbourne Version is primitive and not very nice to look at because we attached a video to the raster display device



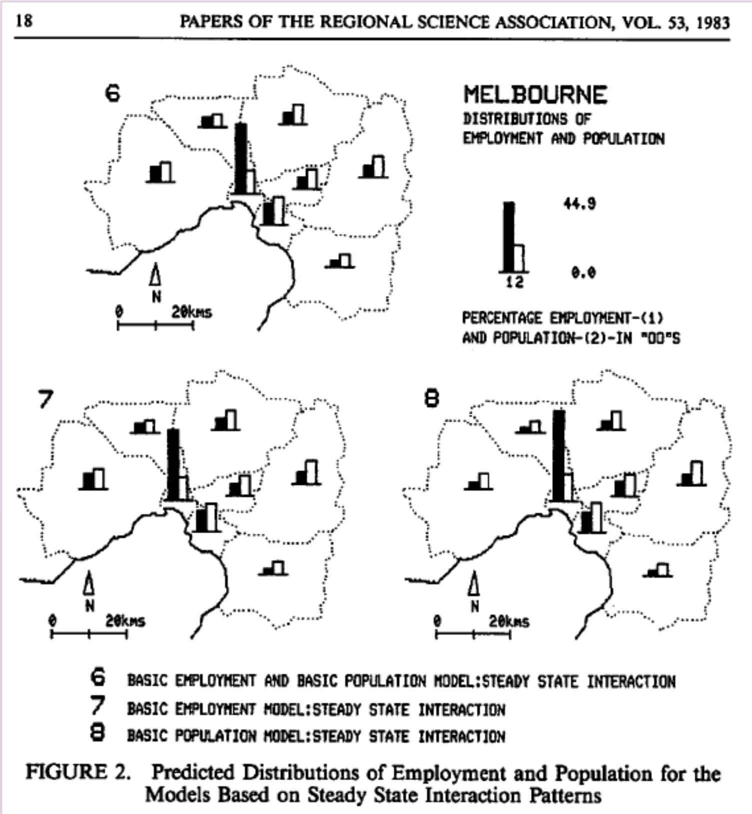


FIGURE 2. Predicted Distributions of Employment and Population for the Models Based on Steady State Interaction Patterns

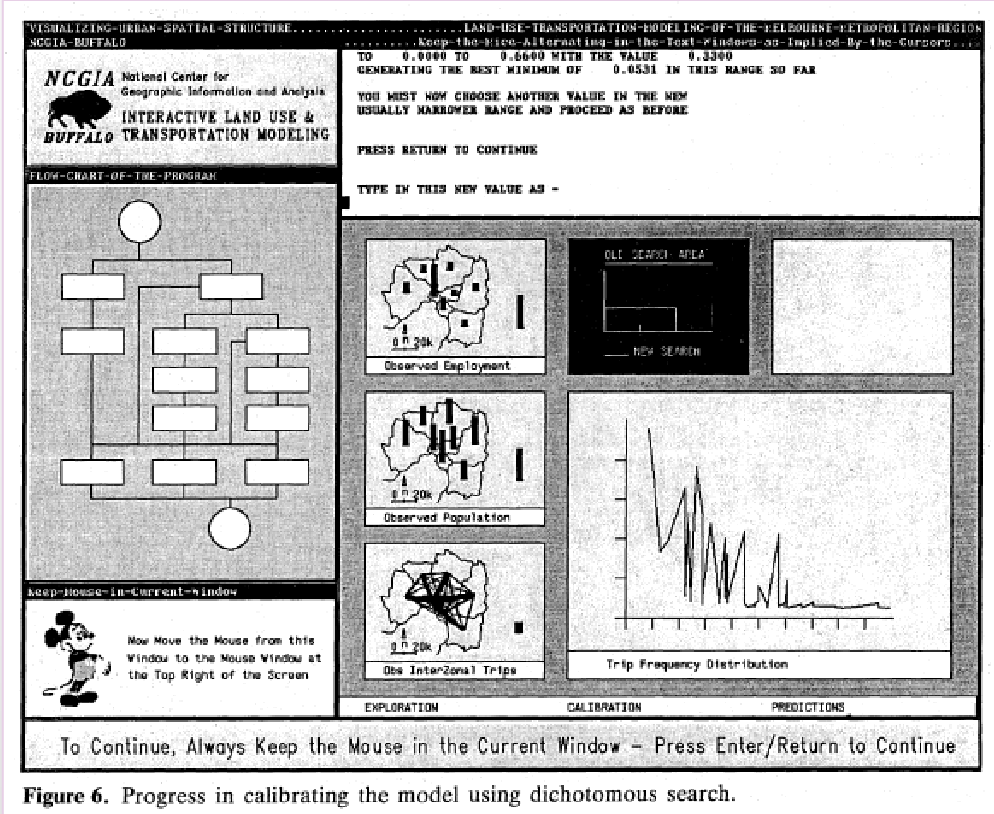


Figure 6. Progress in calibrating the model using dichotomous search.

From a VAX Terminal – A Raster 1982 | From a Sun Workstation – Simple Windows - 1991

At the risk of the talk getting longer, I will show the 1986 demo – as some of you may not have been alive in 1986. It still runs under DOS on this laptop

b. Gravitation and Social Physics

Let me begin to tell you how these models are built with a basic model of interaction- that was first articulated by Newton as his second law of motion – force is proportional to mass times acceleration

In more conventional terms relevant to this treatment, we might write the force between two bodies as

$$F_{12} \sim \frac{M_i M_j}{d_{ij}^2} = G \frac{M_i M_j}{d_{ij}^2}$$

There is a very long history of analogies between force and social interaction going back to Newton himself. There are many references in the books listed at the end of this talk

Let me immediately generalise this and say that we need to define many interactions – we break our system in to areas or points which we define as origins and destinations i and j

And then we measure the distance as in von Thunen not as distance per se but as travel cost or rather generalised cost c_{ij}

We also define the mass at the origins and destinations as O_i and D_j and we then write the conventional spatial interaction of gravity model as

$$T_{ij} \sim \frac{P_i P_j}{c_{ij}^2} = K \frac{P_i P_j}{c_{ij}^{\lambda}}$$

where K is now the 'gravitational' constant and λ a parameter

This is the model that has been used for years but in the late 1960s and 1970s various researchers cast it in a wider framework – deriving the model by setting up a series of constraints on its form which showed how it might be solved and produced various generating mechanisms that could generate consistent models

The *constraints logic* led to **consistent accounting**

The *generative logic* lead to analogies between **utility and entropy maximising** and opened a door that has not been much exploited to date between entropy, energy, urban forms physical morphology and economic structure

In particular the economic logic rather than the energy entropy logic was called choice theory, specifically discrete choice

Now to introduce all this, we need to define some more terms

We will refer to the size of volume of origins and destinations not as population P but as O_i and D_j assuming they are different from one another. We will also assume that the inverse square law on distance or travel cost does not apply and that whenever c_{ij} appears it will be parameterised with a value that varies which we call λ. Vito used a model like this in his first talk to take account of the weight on a link.

We will assume trips are as we have defined them as T_{ij} but we can also normalise trips by their total volume T to produce probabilities

$$p_{ij} = \frac{T_{ij}}{T} = \frac{T_{ij}}{\sum_{ij} T_{ij}}$$

Note that we use summation extensively in what follows

We must move quite quickly now so let me introduce the basic constraints on spatial interaction and then state various models

The constraints are usually specified as origin constraints and destination constraints as

$$O_i = \sum_j T_{ij}$$

$$D_j = \sum_i T_{ij}$$

And we can take our basic gravity model and make it subject to either or both of these constraints or not at all

So what we get are four possible models

Unconstrained

$$T_{ij} = KO_i D_j c_{ij}^{-\lambda}$$

Singly (Origin) Constrained so that the volume of trips at the origins is conserved

$$T_{ij} = A_i O_i D_j c_{ij}^{-\lambda}$$

Singly (Destination) Constrained so that the volume of trips at the destinations is conserved

$$T_{ij} = B_j O_i D_j c_{ij}^{-\lambda}$$

Doubly Constrained trip volumes at origin-destinations conserved

$$T_{ij} = A_i B_j O_i D_j c_{ij}^{-\lambda}$$

The first three are location models, the last is a traffic model

Ok, so what are these parameters that enable the constraints to me met – well they can be very easily produced by summing each model over the relevant subscripts – ie origins or destinations and then substituting & rearranging

I will do this but I will leave you to work through the algebra if you want to but it isn't necessary as I just want to impress the main ideas. Here are the factors which are sometimes called balancing factors

Unconstrained $K = T \Big/ \sum_i \sum_j O_i D_j c_{ij}^{-\lambda}$

Origin Constrained $A_i = 1 \Big/ \sum_j D_j c_{ij}^{-\lambda}$

Destination Constrained $B_j = 1 \Big/ \sum_i O_i c_{ij}^{-\lambda}$

Doubly Constrained $A_i = 1 \Big/ \sum_j B_j D_j c_{ij}^{-\lambda}$ $B_j = 1 \Big/ \sum_i A_i O_i c_{ij}^{-\lambda}$

Let me illustrate in two ways how we can build comprehensive models using this framework

If we say that residential location depends on not only travel cost but also on money available for housing we argue as before that

- The model is singly constrained – we know where people work and we want to find out where they live – so origins are workplaces and destinations are housing areas
- The model then lets us predict people in housing
- We argue that people will trade-off money for housing against transport cost

And we then set up the model as follows

Using the trip activity-volume form, we get

$$\sum_j T_{ij} = O_i$$

$$\sum_i \sum_j T_{ij} c_{ij} = C$$

$$\sum_i \sum_j T_{ij} R_j = R$$

leads to

$$T_{ij} = A_i O_i \exp(\vartheta R_j)\exp(-\lambda c_{ij})$$

Note that we now add a constraint on money available for housing (like rent) R_j. We can of course find out from this location model how many people live in destination housing zones, so again it is a distribution as well as a location model

$$P_j = \sum_i T_{ij}$$

We can extend this model in lots of ways and we will show some of these later. We also can think about disaggregating the model into different transport modes – let us call each mode k and then set up the model so that we can predict T_{ij}^{k} as follows

The model is singly (origin) constrained because we want to predicts how many people travel from work to home. Given we know how many people work at origins, and we want to predict what mode of transport k they travel on. Then

$$\sum_{j}\sum_{k} T_{ij}^{k} = O_i$$

$$\sum_{i}\sum_{j}\sum_{k} T_{ij}^{k} F_j = F$$

$$\sum_{i}\sum_{j} T_{ij}^{k} c_{ij}^{k} = C^k$$

And the model can be specified as

$$T_{ij}^{k} = O_i \frac{F_j \exp(-\lambda^k c_{ij}^k)}{\sum_j \sum_k F_j \exp(-\lambda^k c_{ij}^k)} = O_i \frac{F_j \exp(-\lambda^k c_{ij}^k)}{\sum_j F_j \sum_k \exp(-\lambda^k c_{ij}^k)}$$

Note that the mode split is a ratio of the competitive effects of each travel cost, that is

$$\frac{T_{ij}^{k}}{T_{ij}^{\ell}} = \frac{\exp(-\lambda^k c_{ij}^k)}{\exp(-\lambda^\ell c_{ij}^\ell)}$$

In short the model is not only distributing trips so that locations compete but also that modes compete BUT modes do not compete per se with locations

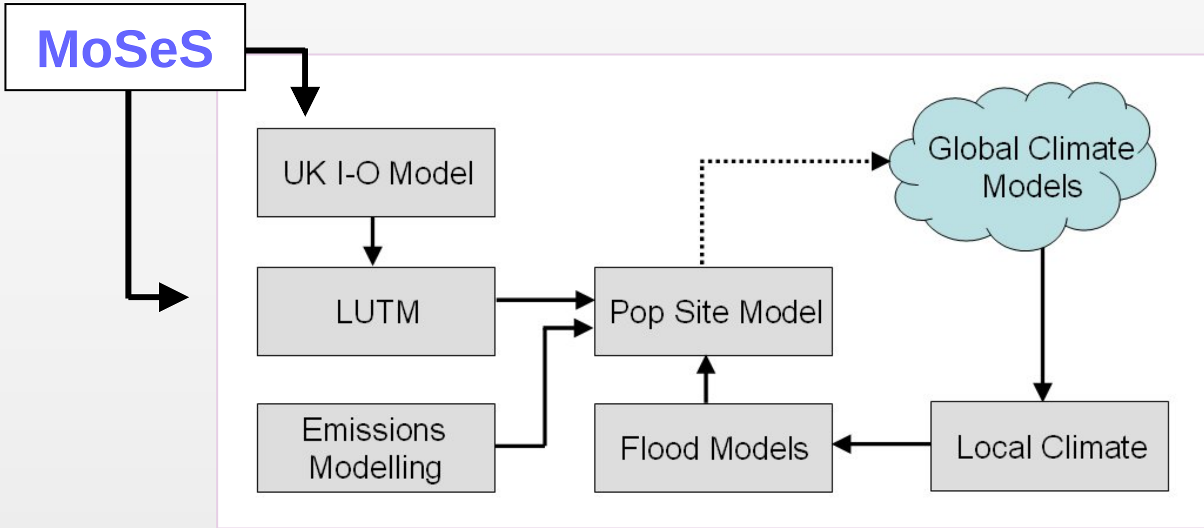
Now let us see how we can build this model for real

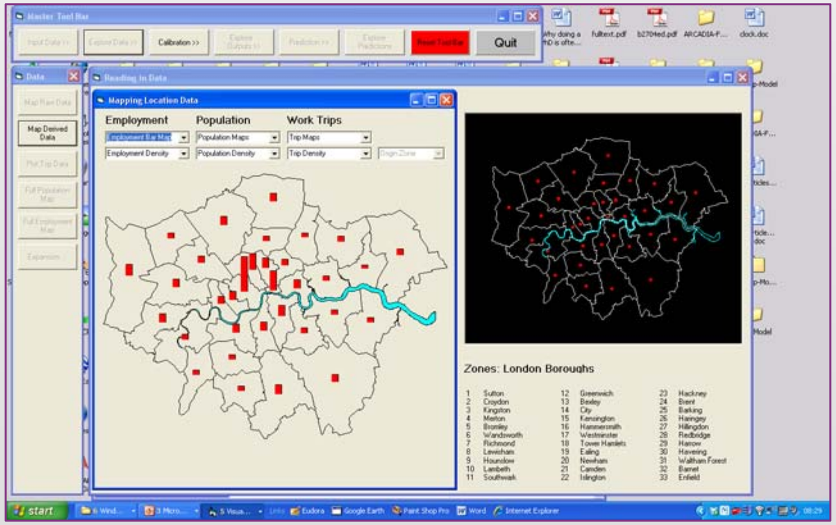
The Tyndall Model: Integrated Assessment of Climate Change in the London Region

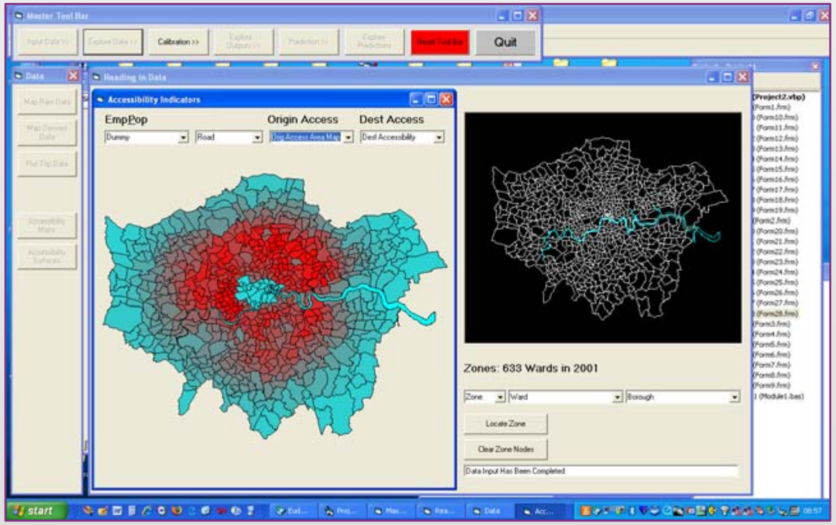
Our first model is a residential location model based on four modes but it is part of a much bigger project involving stringing different models together to look at integrated assessment of sea level rise and its impact on population in the London region. The reason why I have stressed visualisation as a key theme today is that one of our guiding principles in this modelling was to communicate the models as easily and as effectively as possible to our stakeholders

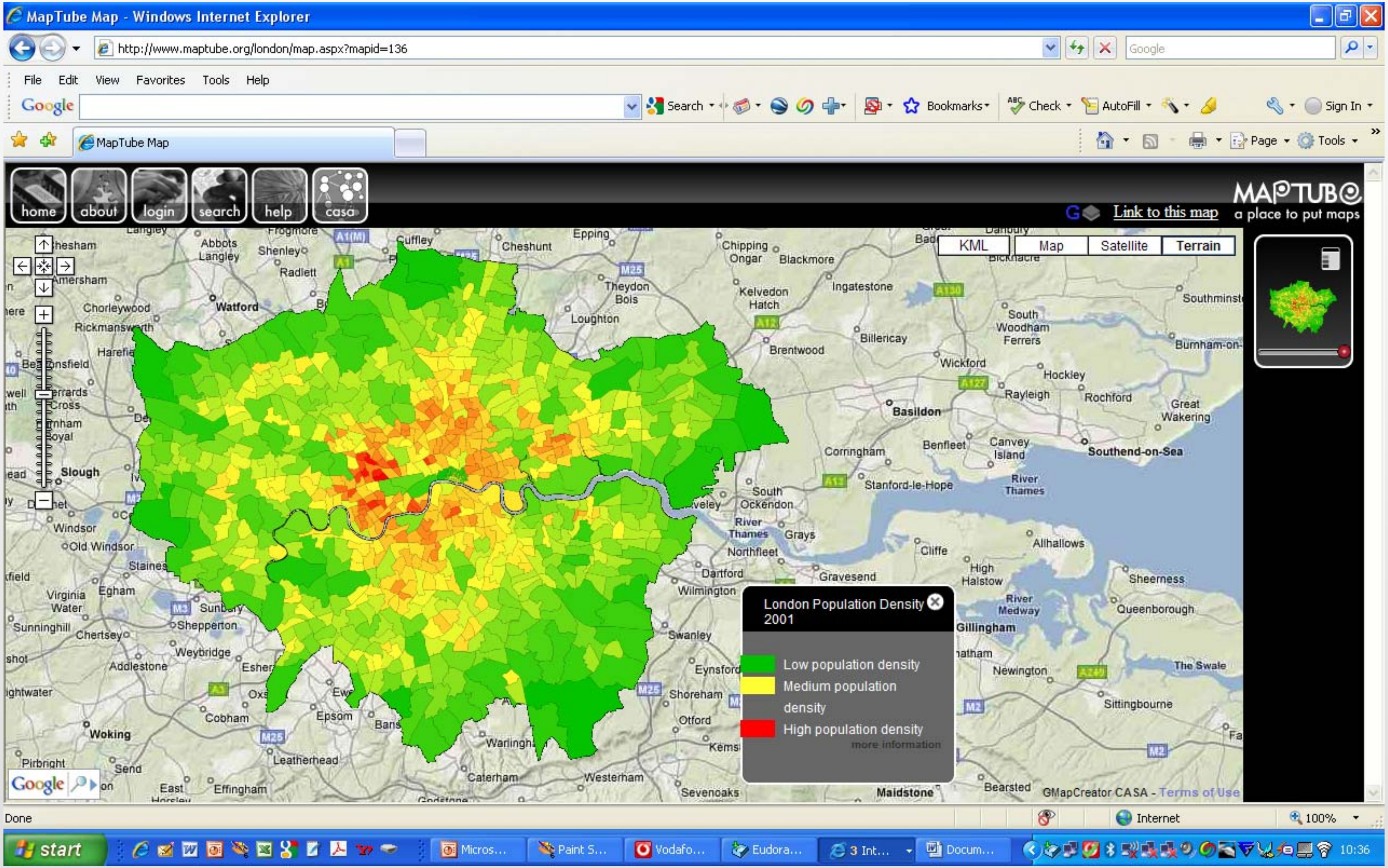
These were largely policy analysts and had some expertise in climate change problems and some knowledge of models of various kinds but not any one particular model

We also needed to communicate these ideas to other modellers, such as the flood modellers, the input-output, people etc.


MoSeS
UK I-O Model
LUTM
Emissions Modelling
Pop Site Model
Flood Models
Global Climate Models
Local Climate

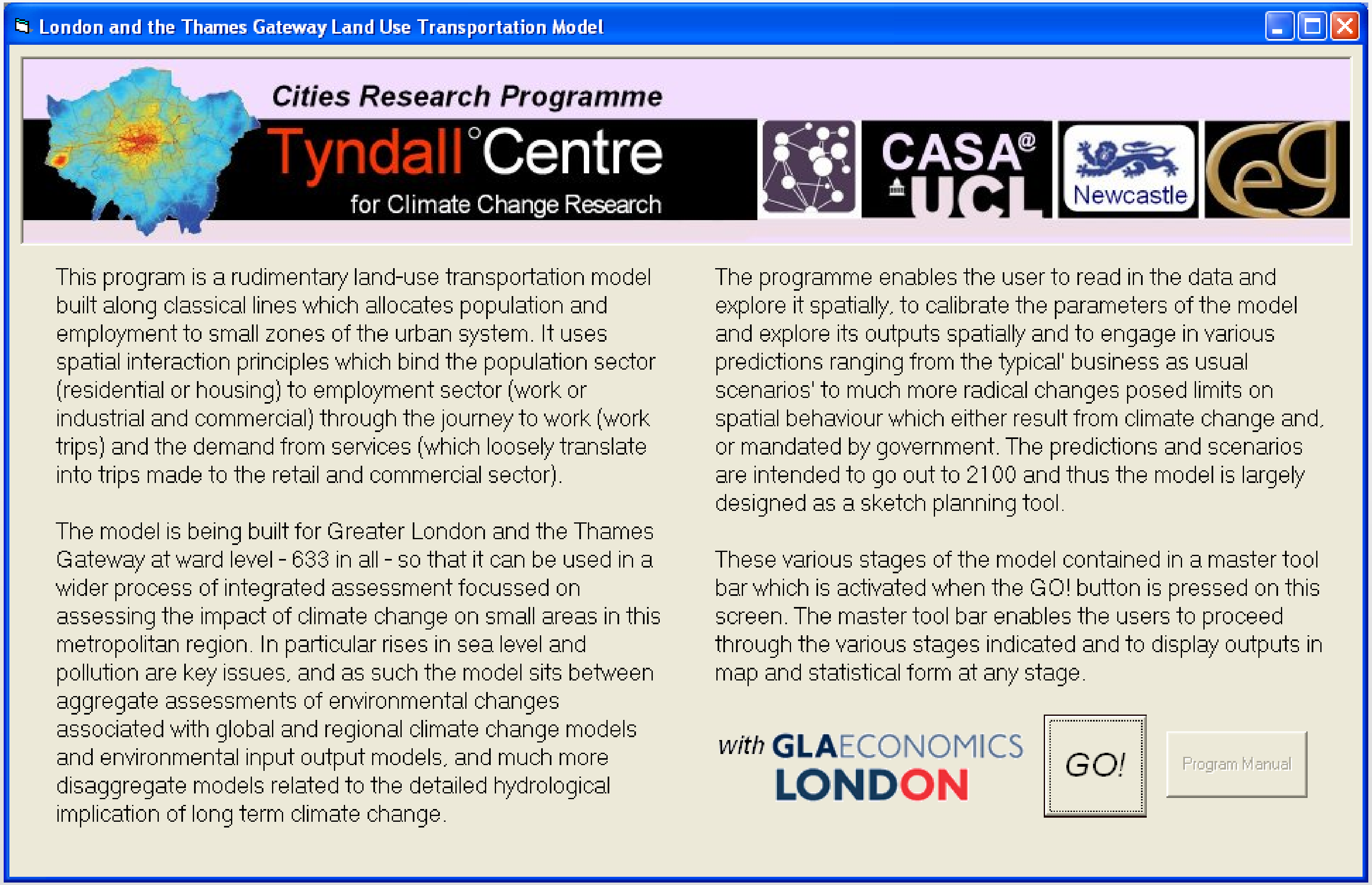

Quit
Mapping Location Data
Employment
Population
Work Trips
Zones: London Boroughs

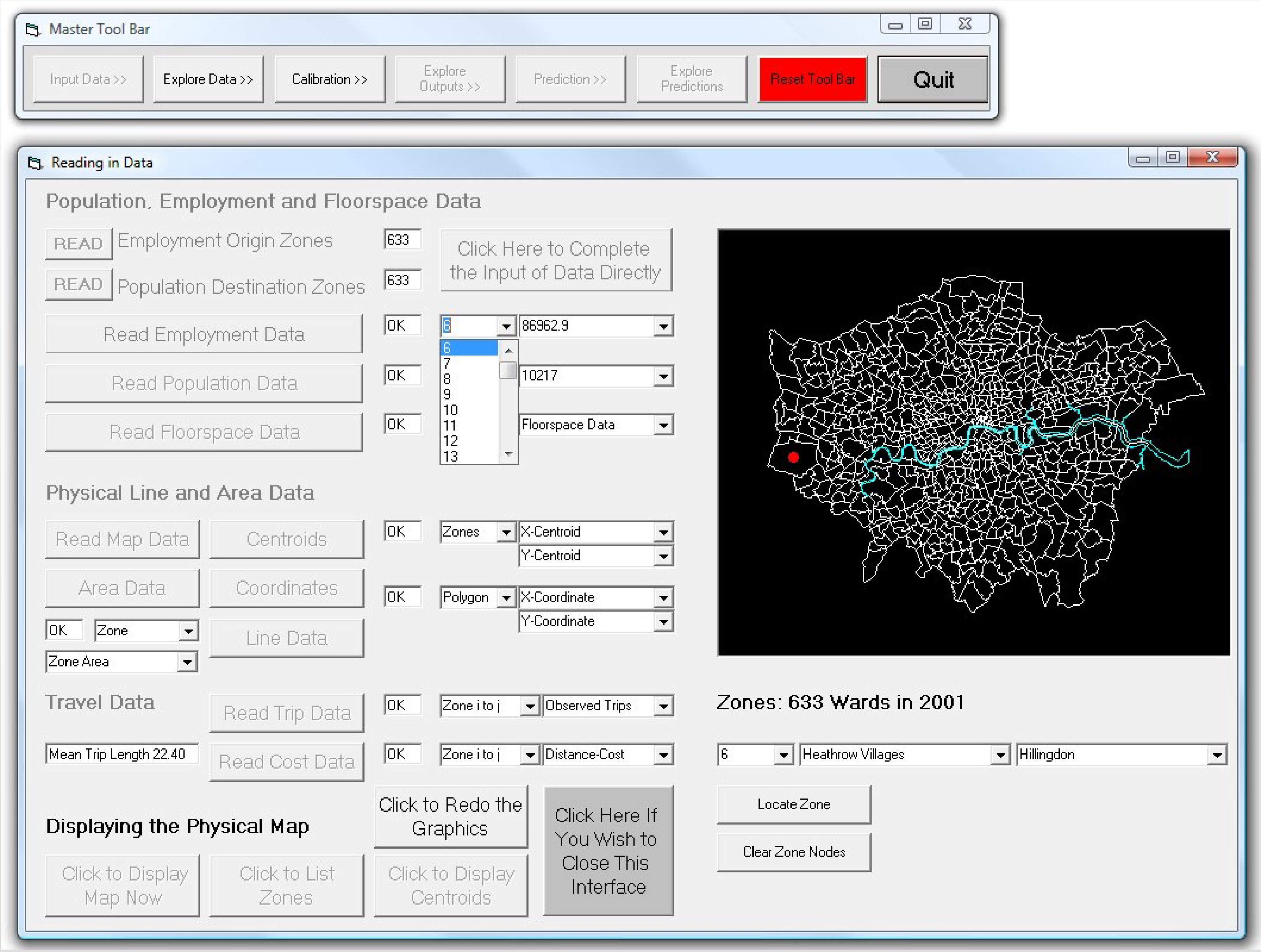

Quit
Accessibility Indicators
EmpPop
Origin Access
Dest Access
Zones: 633 Wards in 2001

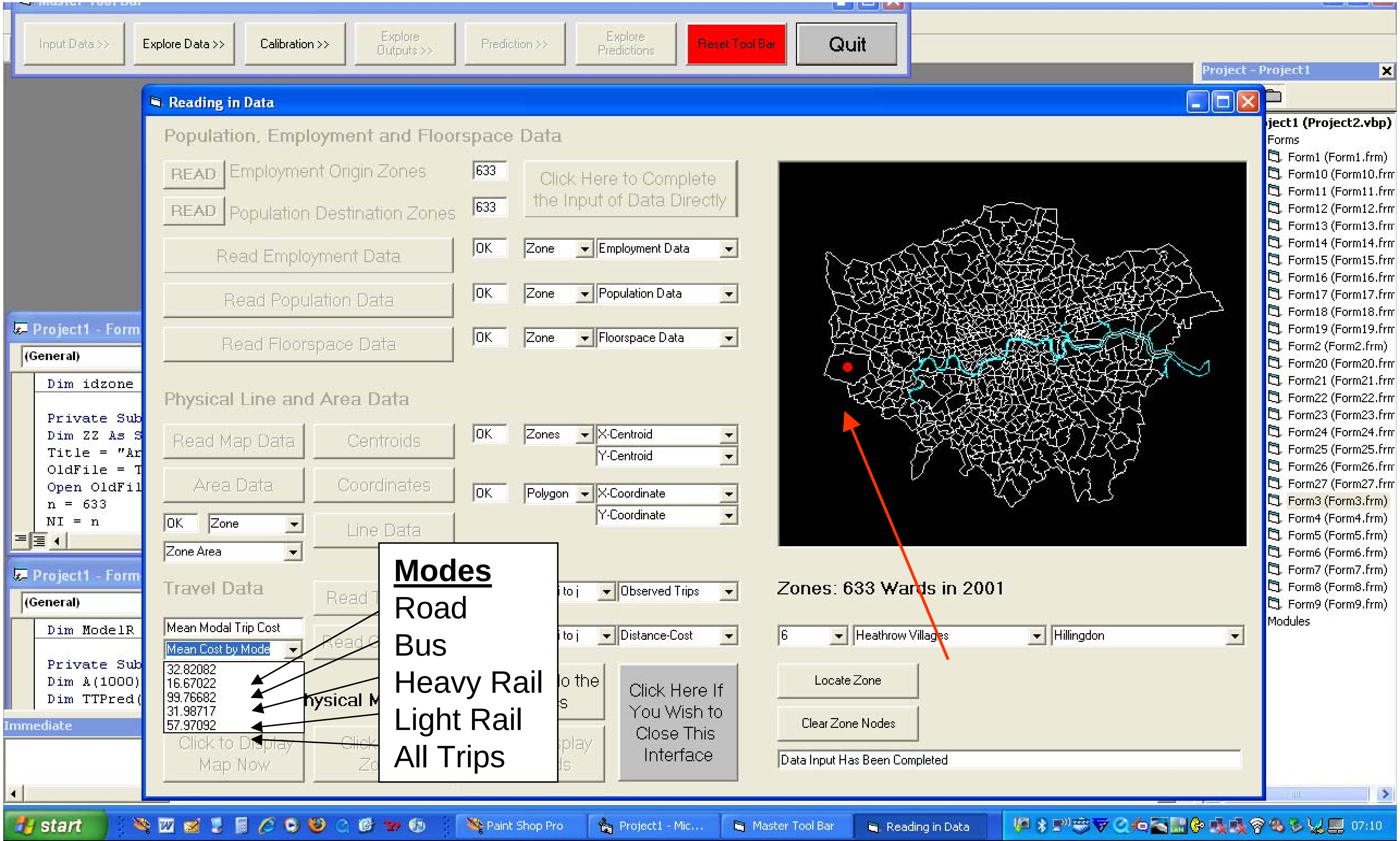


Go to www.maptube.org to see many maps of Greater London

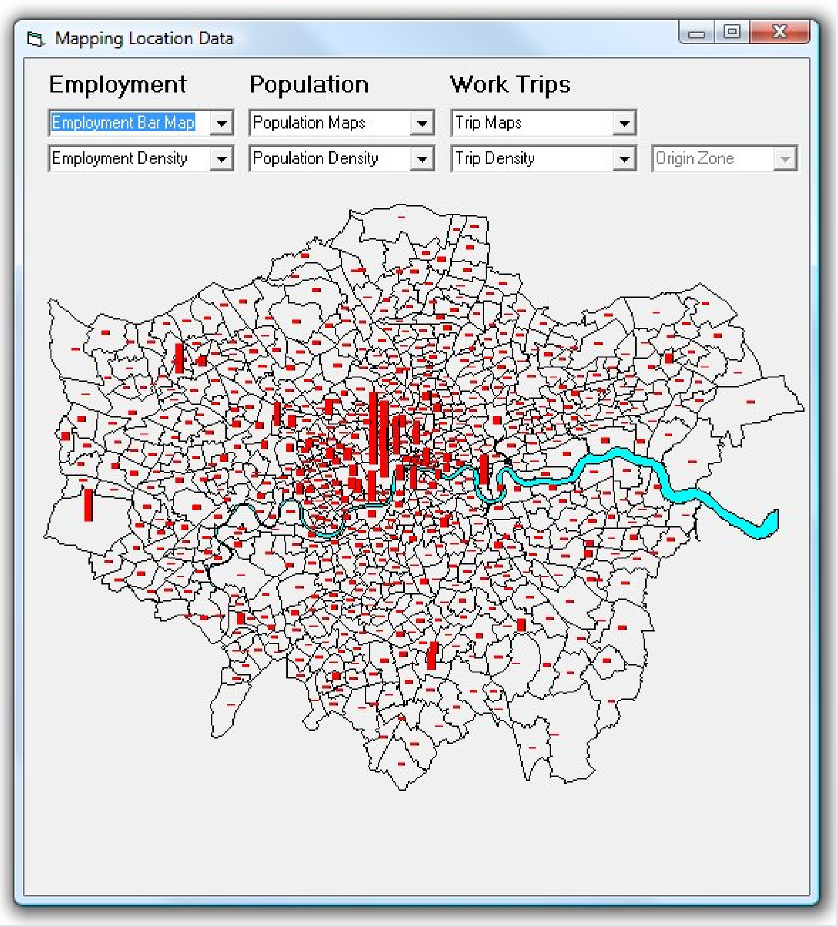
The Model Interface

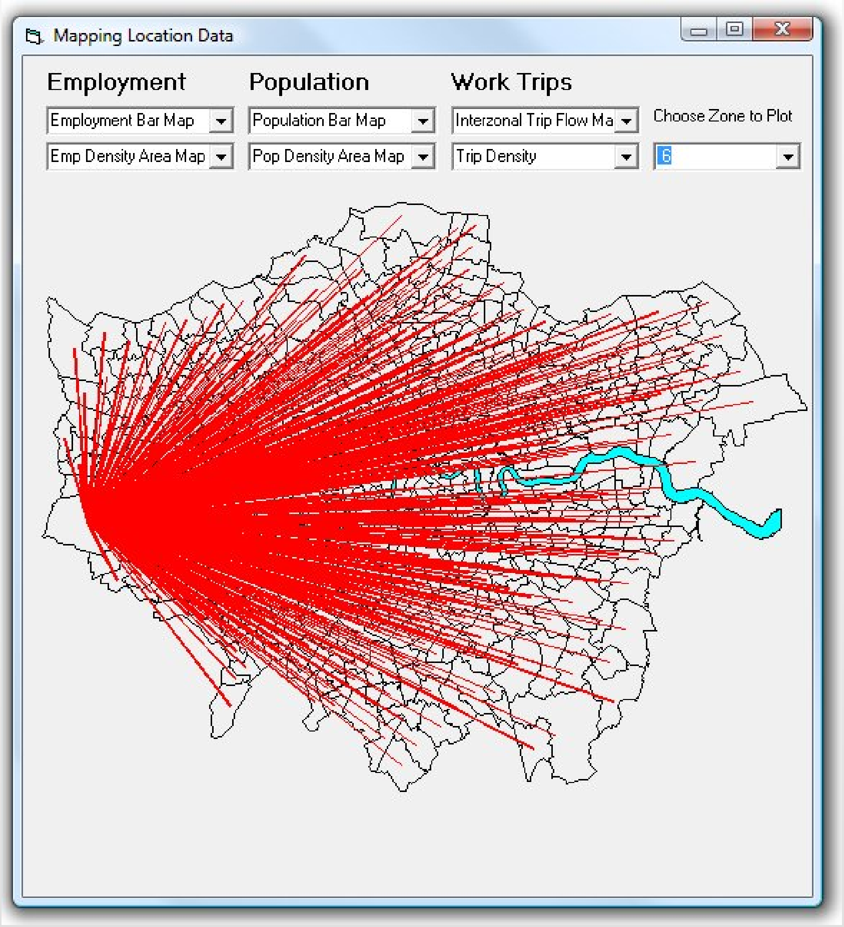


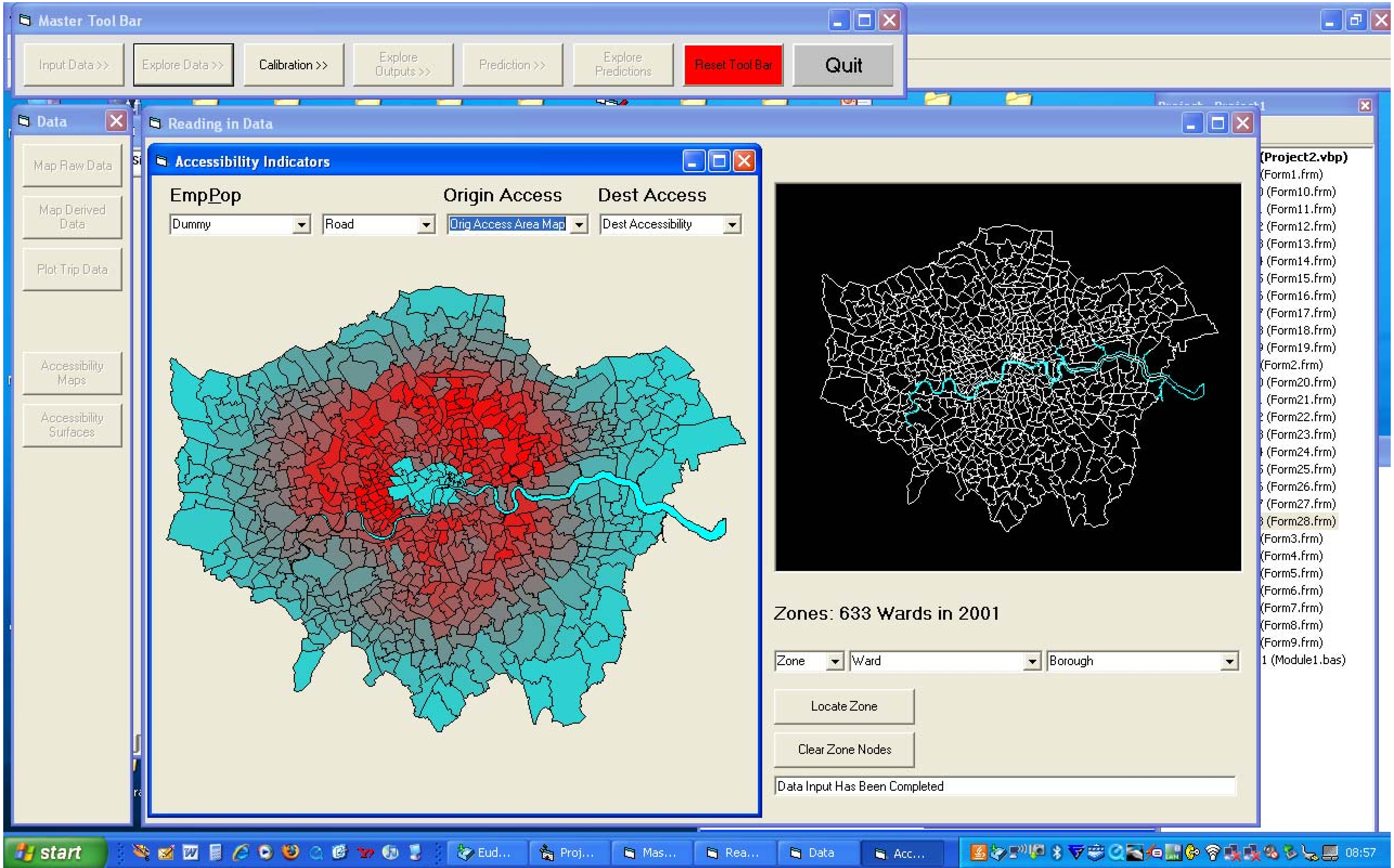

Master Tool Bar
Input Data >>
Explore Data >>
Calibration >>
Explore Outputs >>
Prediction >>
Explore Predictions
Reset Tool Bar
Quit
Reading in Data
Population, Employment and Floorspace Data
READ
Employment Origin Zones
633
READ
Population Destination Zones
633
Click Here to Complete the Input of Data Directly
Read Employment Data
OK
6
86962.9
Read Population Data
OK
10217
Read Floorspace Data
OK
Floorspace Data
6
7
8
9
10
11
12
13
Physical Line and Area Data
Read Map Data
Centroids
OK
Zones
X-Centroid
Y-Centroid
Area Data
Coordinates
OK
Polygon
X-Coordinate
Y-Coordinate
OK
Zone
Line Data
Zone Area
Travel Data
Read Trip Data
OK
Zone i to j
Observed Trips
Mean Trip Length 22.40
Read Cost Data
OK
Zone i to j
Distance-Cost
Displaying the Physical Map
Click to Redo the Graphics
Click Here If You Wish to Close This Interface
Click to Display Map Now
Click to List Zones
Click to Display Centroids
Zones: 633 Wards in 2001
6
Heathrow Villages
Hillingdon
Locate Zone
Clear Zone Nodes



Road: 38%; Bus: 12%: Heavy Rail: 12%: Light Rail 19%; Other (Walk, Bike, Fly): 19%


Mapping Location Data
Employment
Population
Work Trips
Employment Bar Map
Population Maps
Trip Maps
Employment Density
Population Density
Trip Density
Origin Zone


Mapping Location Data
Employment
Population
Work Trips
Choose Zone to Plot
Employment Bar Map
Population Bar Map
Interzonal Trip Flow Ma
Emp Density Area Map
Pop Density Area Map
Trip Density
6


Master Tool Bar
Input Data >>
Explore Data >>
Calibration >>
Explore Outputs >>
Prediction >>
Explore Predictions
Reset Tool Bar
Quit
Data
Map Raw Data
Map Derived Data
Plot Trip Data
Accessibility Maps
Accessibility Surfaces
Reading in Data
Accessibility Indicators
EmpPop
Origin Access
Dest Access
Dummy
Road
Orig Access Area Map
Dest Accessibility
Zones: 633 Wards in 2001
Zone
Ward
Borough
Locate Zone
Clear Zone Nodes
Data Input Has Been Completed
(Project2.vbp)
(Form1.frm)
(Form10.frm)
(Form11.frm)
(Form12.frm)
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(Form3.frm)
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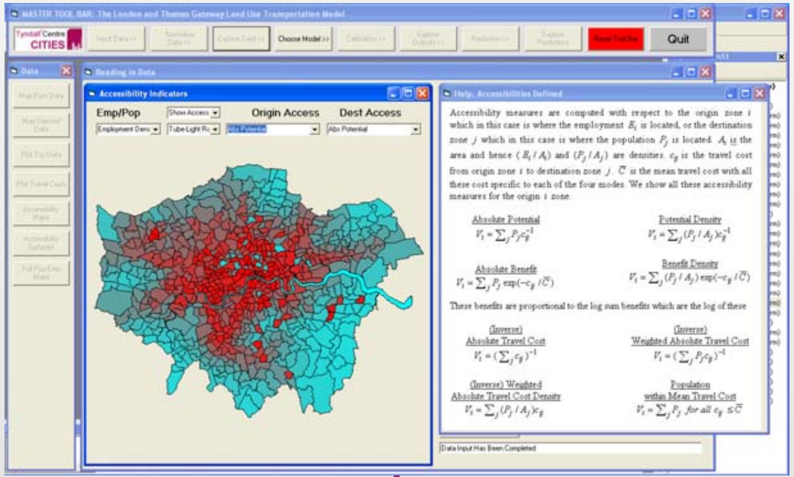
1 (Module1.bas)
start
Eud...
Proj...
Mas...
Rea...
Data
Acc...
08:57

Accessibility from the LUTM model

Many different accessibility measures, 8 in all



Help: Accessibilities Defined

Accessibility measures are computed with respect to the origin zone i which in this case is where the employment E_i is located, or the destination zone j which in this case is where the population P_j is located. A_i is the area and hence (E_i / A_i) and (P_j / A_j) are densities. c_{ij} is the travel cost from origin zone i to destination zone j. $\overline{C}$ is the mean travel cost with all these cost specific to each of the four modes. We show all these accessibility measures for the origin i zone.

Absolute Potential
$$V_i = \sum_j P_j c_{ij}^{-1}$$

Potential Density
$$V_i = \sum_j (P_j / A_j) c_{ij}^{-1}$$

Absolute Benefit
$$V_i = \sum_j P_j \exp(-c_{ij} / \overline{C})$$

Benefit Density
$$V_i = \sum_j (P_j / A_j) \exp(-c_{ij} / \overline{C})$$

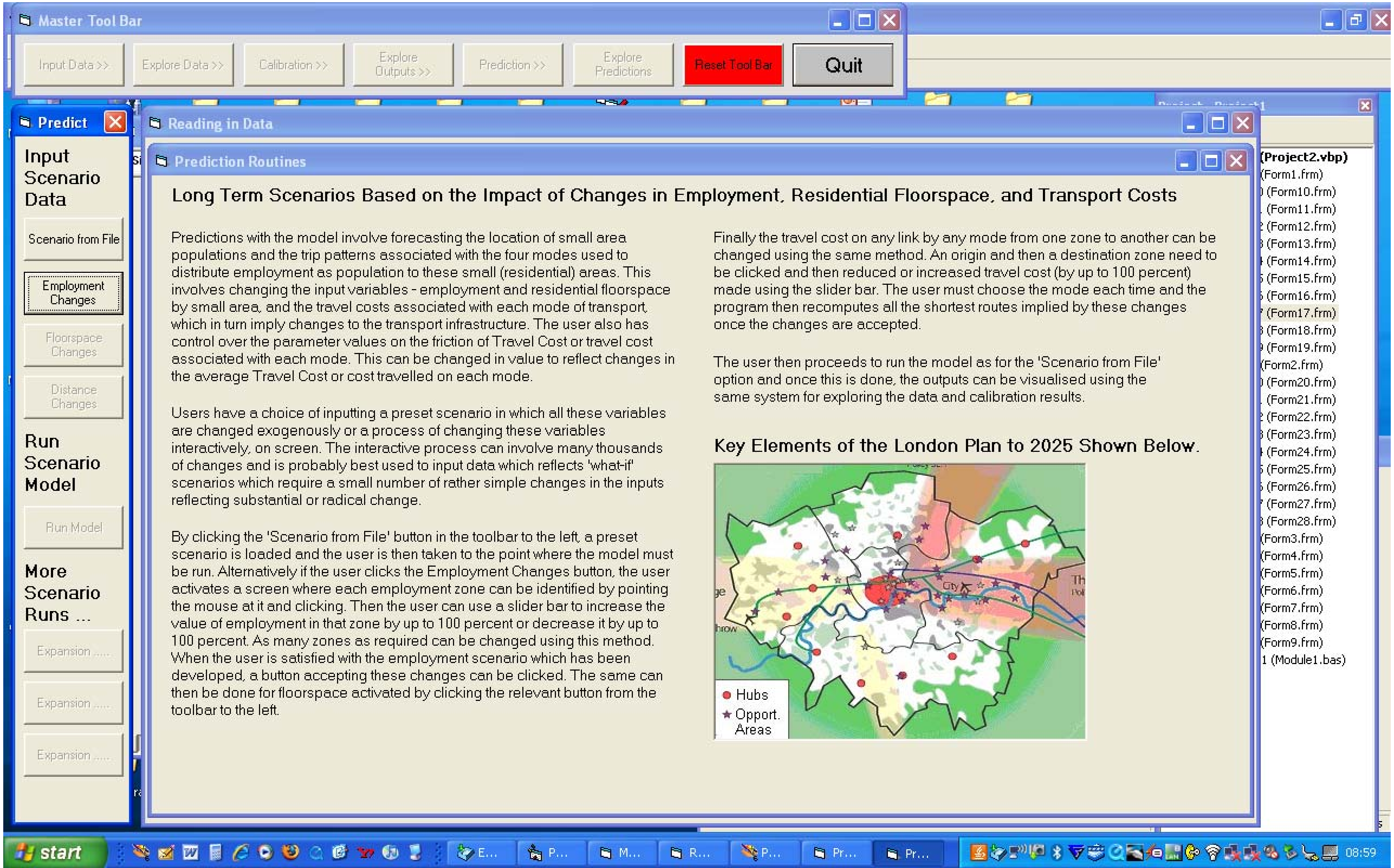
These benefits are proportional to the log sum benefits which are the log of these

(Inverse) Absolute Travel Cost
$$V_i = (\sum_j c_{ij})^{-1}$$

(Inverse) Weighted Absolute Travel Cost
$$V_i = (\sum_j P_j c_{ij})^{-1}$$

(Inverse) Weighted Absolute Travel Cost Density
$$V_i = \sum_j (P_j / A_j) c_{ij}$$

Population within Mean Travel Cost
$$V_i = \sum_j P_j \quad for\ all\ c_{ij} \leq \overline{C}$$


Master Tool Bar
Input Data >>
Explore Data >>
Calibration >>
Explore Outputs >>
Prediction >>
Explore Predictions
Reset Tool Bar
Quit
Predict
Input Scenario Data
Scenario from File
Employment Changes
Floorspace Changes
Distance Changes
Run Scenario Model
Run Model
More Scenario Runs ...
Expansion .....
Expansion .....
Expansion .....
Reading in Data
Prediction Routines
Long Term Scenarios Based on the Impact of Changes in Employment, Residential Floorspace, and Transport Costs
Predictions with the model involve forecasting the location of small area populations and the trip patterns associated with the four modes used to distribute employment as population to these small (residential) areas. This involves changing the input variables - employment and residential floorspace by small area, and the travel costs associated with each mode of transport, which in turn imply changes to the transport infrastructure. The user also has control over the parameter values on the friction of Travel Cost or travel cost associated with each mode. This can be changed in value to reflect changes in the average Travel Cost or cost travelled on each mode.
Users have a choice of inputting a preset scenario in which all these variables are changed exogenously or a process of changing these variables interactively, on screen. The interactive process can involve many thousands of changes and is probably best used to input data which reflects 'what-if' scenarios which require a small number of rather simple changes in the inputs reflecting substantial or radical change.
By clicking the 'Scenario from File' button in the toolbar to the left, a preset scenario is loaded and the user is then taken to the point where the model must be run. Alternatively if the user clicks the Employment Changes button, the user activates a screen where each employment zone can be identified by pointing the mouse at it and clicking. Then the user can use a slider bar to increase the value of employment in that zone by up to 100 percent or decrease it by up to 100 percent. As many zones as required can be changed using this method. When the user is satisfied with the employment scenario which has been developed, a button accepting these changes can be clicked. The same can then be done for floorspace activated by clicking the relevant button from the toolbar to the left.
Finally the travel cost on any link by any mode from one zone to another can be changed using the same method. An origin and then a destination zone need to be clicked and then reduced or increased travel cost (by up to 100 percent) made using the slider bar. The user must choose the mode each time and the program then recomputes all the shortest routes implied by these changes once the changes are accepted.
The user then proceeds to run the model as for the 'Scenario from File' option and once this is done, the outputs can be visualised using the same system for exploring the data and calibration results.
Key Elements of the London Plan to 2025 Shown Below.
Hubs
Opport. Areas
City
(Project2.vbp)
(Form1.frm)
(Form10.frm)
(Form11.frm)
(Form12.frm)
(Form13.frm)
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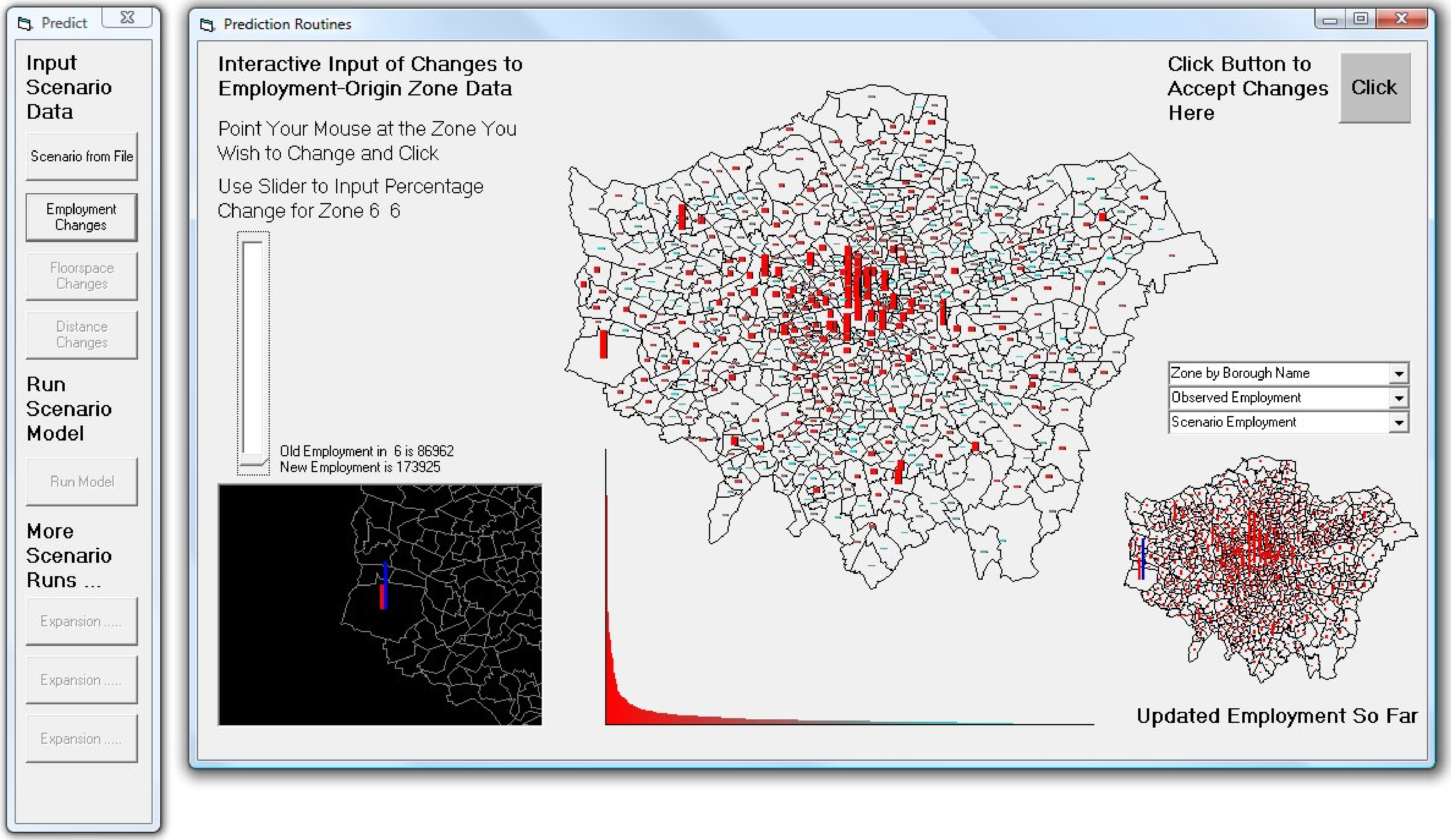
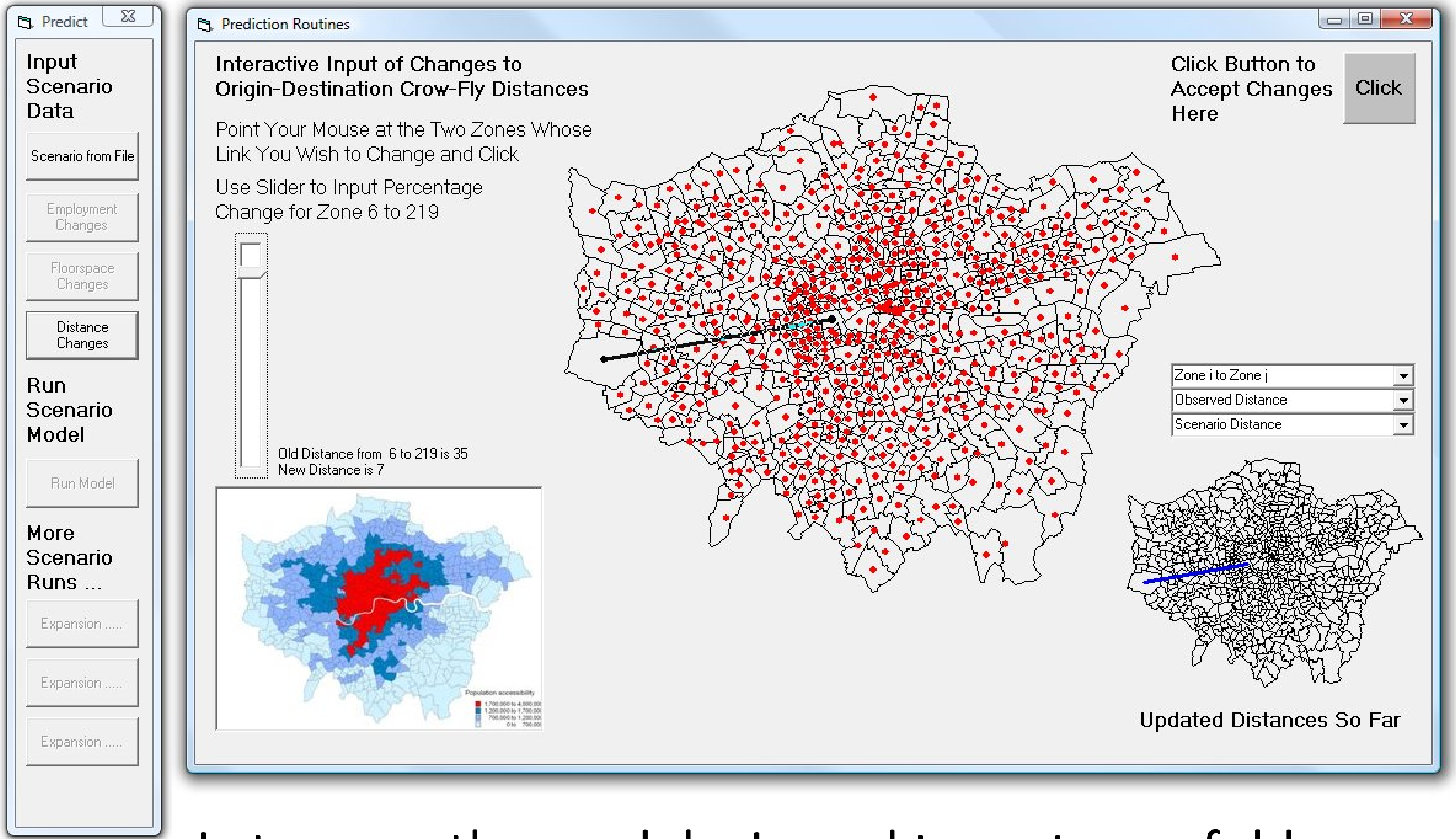
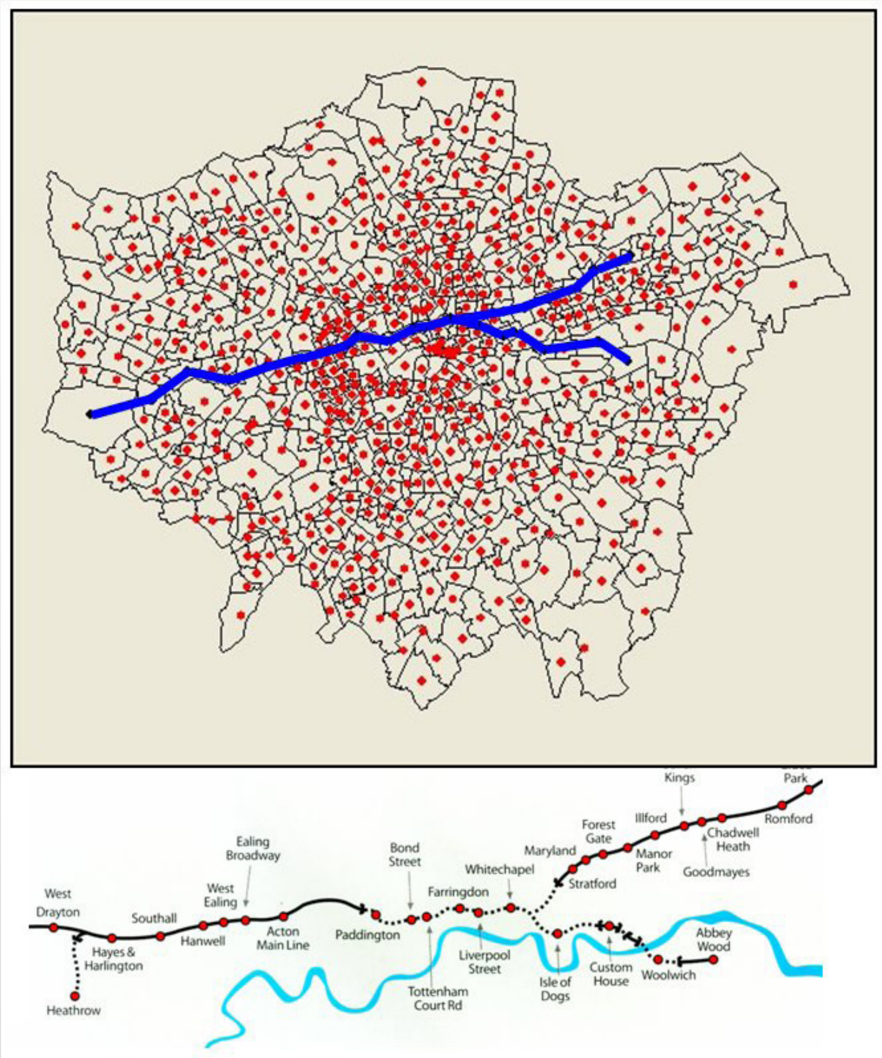
(Form6.frm)
(Form7.frm)
(Form8.frm)
(Form9.frm)
1 (Module1.bas)
start
08:59

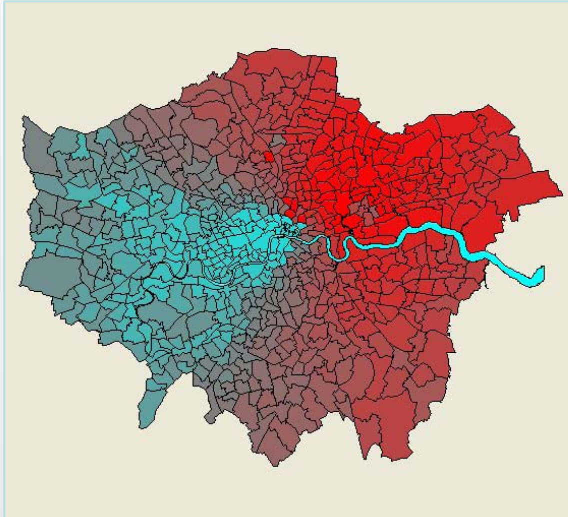

Predict
Input Scenario Data
Scenario from File
Employment Changes
Floorspace Changes
Distance Changes
Run Scenario Model
Run Model
More Scenario Runs ...
Expansion .....
Expansion .....
Expansion .....
Prediction Routines
Interactive Input of Changes to Employment-Origin Zone Data
Point Your Mouse at the Zone You Wish to Change and Click
Use Slider to Input Percentage Change for Zone 6 6
Old Employment in 6 is 86962
New Employment is 173925
Click Button to Accept Changes Here
Click
Zone by Borough Name
Observed Employment
Scenario Employment
Updated Employment So Far

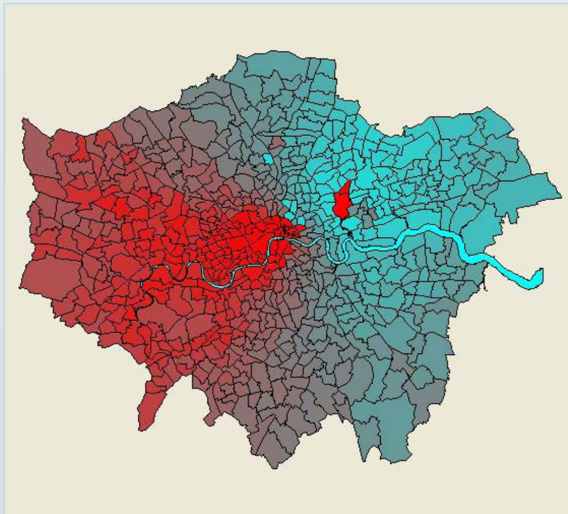


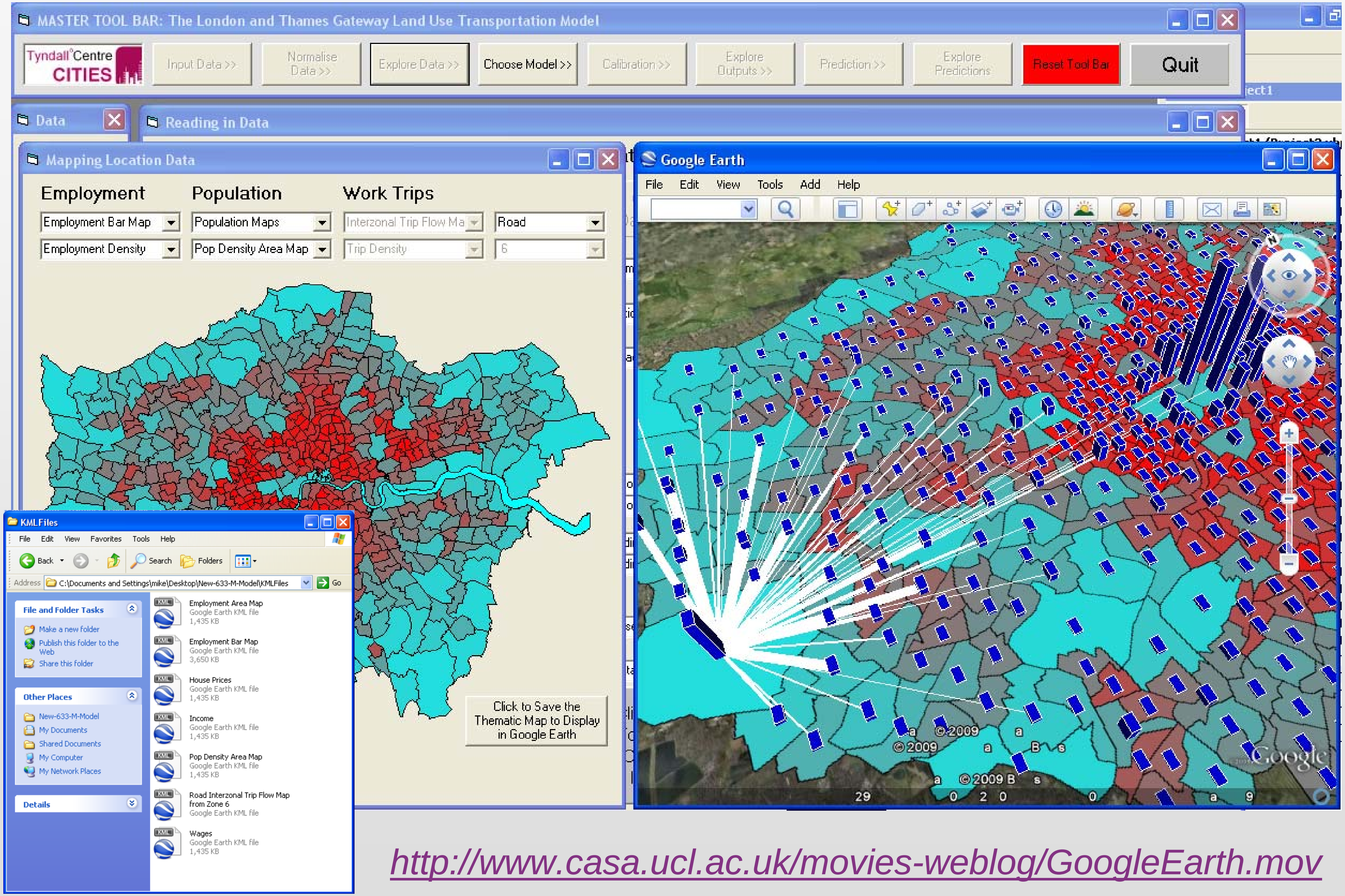
Let us ***run*** the model… I need to go to my folder…>>

Testing the impact of Cross Rail-1









http://www.casa.ucl.ac.uk/movies-weblog/GoogleEarth.mov

For a very old movie of all this go to our old web site
http://www.casa.ucl.ac.uk/transportmodel/transportmodel.asp

We need to re-track a bit now and for our full model we need to say something more about these kinds of spatial interaction models and how they can be extended

SIMULACRA: ARCADIA and SCALE Projects

SIMULACRA[1] is a generic set of models that we are building for a series of projects, first the ARCADIA project that is an extension of Tyndall, and then for another EPSRC Project called SCALE which deals with energy change in large cities

We are very keen on building a model framework in which we can develop many different variants, easily and quickly.

I think we are now in a position in this field where we can and should develop lots of variants, which test the robustness of any approach while at the same time, enabling models to be tuned to the problem in hand. But first let me sketch the integrated model – which involves coupling sectors

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[1]*SIMulation of Urban Landuse, And Commercial and Residential Activities*

Modular Modelling: Coupled Spatial Interaction

Now we have a module for one kind of interaction – consider stringing these together as more than one kind of spatial interaction

Classically we might model flows from home to work and home to shop but there are many more and in this sense, we can use these as building blocks for wider models. This is for next time too

What we will now do is illustrate how we might build such a structure taking a journey to work model from Employment to Population and then to Shopping which we structure as --

First we have the journey from work to home model as

$$T_{ij} = E_i \frac{F_j \exp(-\lambda c_{ij})}{\sum_j F_j \exp(-\lambda c_{ij})} \quad , \quad \sum_j T_{ij} = E_i$$

$$P_j = \alpha \sum_i T_{ij}$$

And then the demand from home to shop

$$S_{jm} = P_j \frac{W_m \exp(-\beta c_{jm})}{\sum_m W_m \exp(-\beta c_{jm})} \quad , \quad \sum_m S_{jm} = P_j$$

$$S_m = \sum_j S_{jm}$$

And there is a potential link back to employment from the retail sector $E_m = f(S_m)$

Ok so this is the model structure – iterative coupling of sectors to take account of simultaneity and we also want to be able to do the following:

- Alter and aggregate the zoning system quickly and easily, on the fly almost
- Alter by adding and deleting different model sectors, so for example running a model based on simply the retailing and other employment sectors without the residential and so on
- Subjecting the model to various kinds of physical constraints, at will and according to external policies
- Extending all sectors to not only predict endogenous activities but to also be subject to exogenous inputs of the same
- To interface the models easily and quickly with other sectoral models, demographic and more established transport models

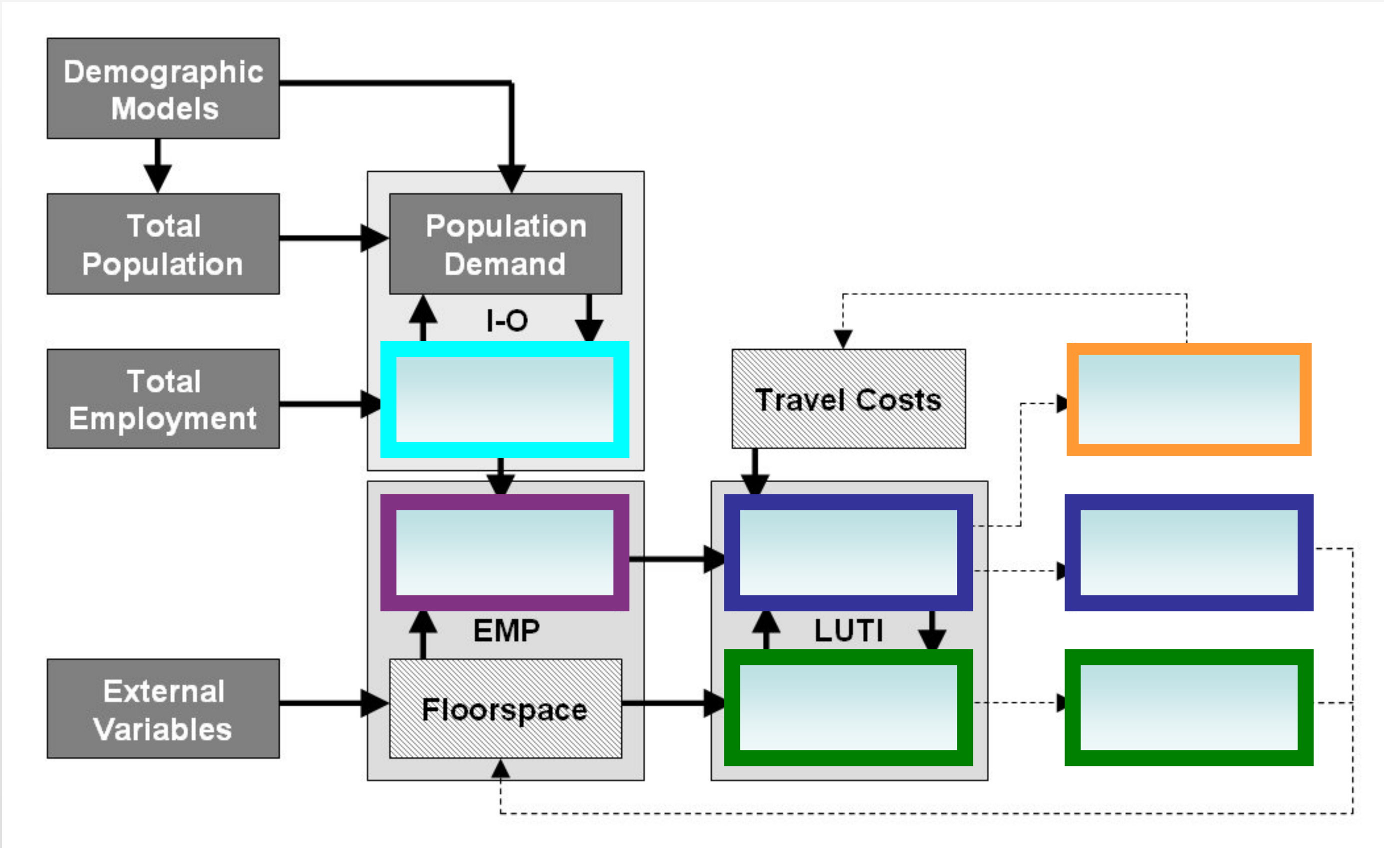
Requirements: The Model Design: Models Flows: Physical Movements, Money & the Residential Model

We will now show the current model to present the logic of our framework. Our model has now been scaled up massively to include the outer met area – 1767 zones (33 – 633 – 1767)

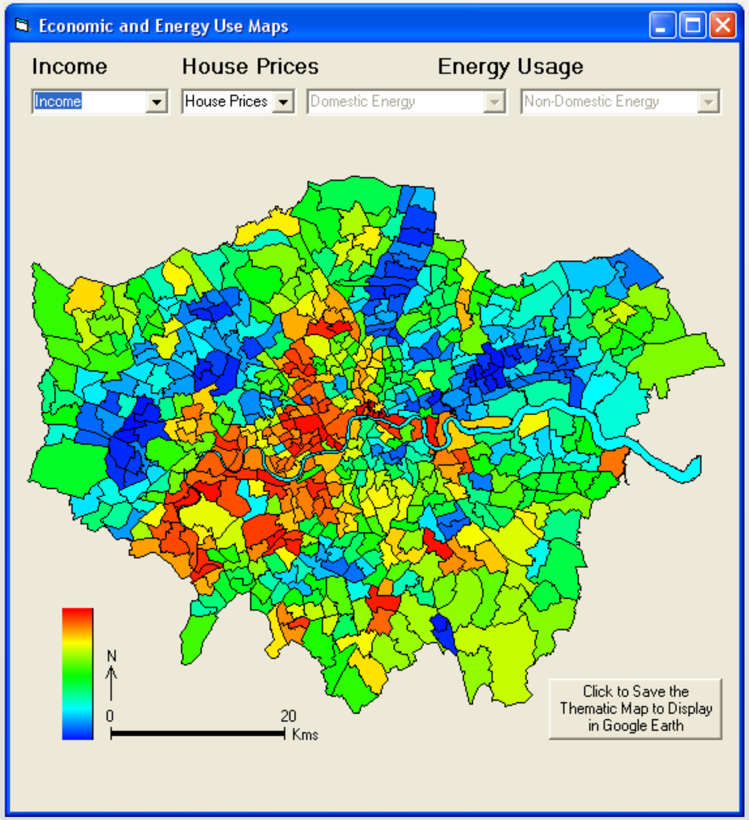
It is now a three sector model, not simply a residential location model as it includes internal employment location, retail location and residential location

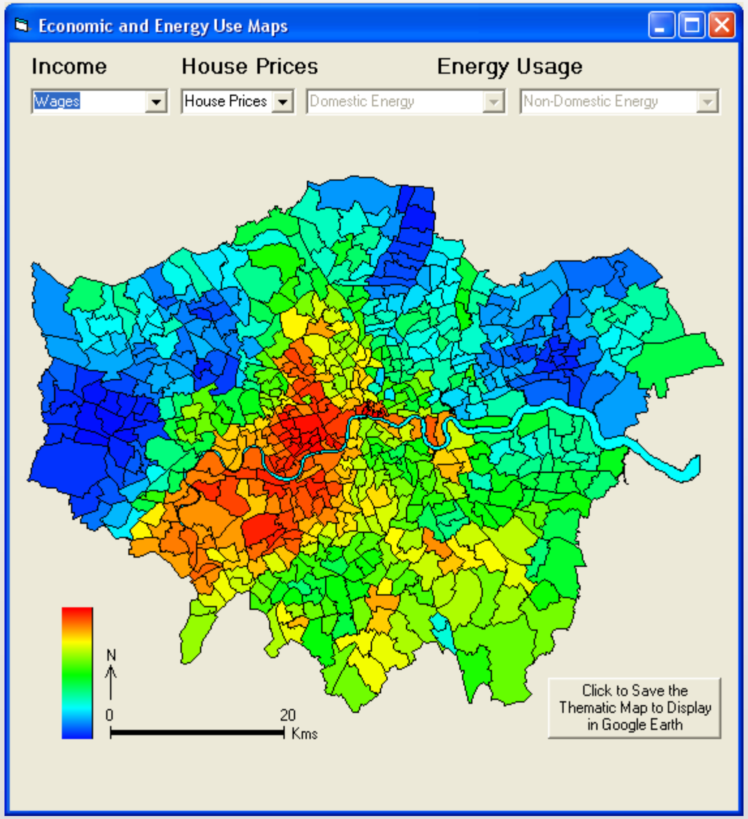
So far, we do not have modal split or any disaggregation of the sectors but we will have five modes and then probably 5 population categories and maybe 5 employment types in terms of occupations – in short the model will ultimately scale up to some 100 times the size of the current model

The Structure of SIMULACRA



I want to just show very briefly the sort of data that we have in the money sector that is driving this variant of the model and also state the residential location equation so you have some sense of what is going on





And the model is formalised as

with travel as a difference or variance σ^2 between these two sets of costs. Then, the system must satisfy the constraint

$$\sum_i \sum_j T_{ij} [(h_i + t_i) - (c_{ij} + \rho_j)]^2 = \sigma^2 \quad . \qquad (11)$$

The model that is generated from this constraint and which is the alternative residential location model in the current model variant is

$$T_{ij} = E_i \frac{A_j \exp(-\lambda [(h_i + t_i) - (c_{ij} + \rho_j)]^2}{\sum_j A_j \exp(-\lambda [(h_i + t_i) - (c_{ij} + \rho_j)]^2} \quad , \qquad (12)$$

which is subject to the usual origin constraint, generating population from equation (2) with (12) replacing equation (1).

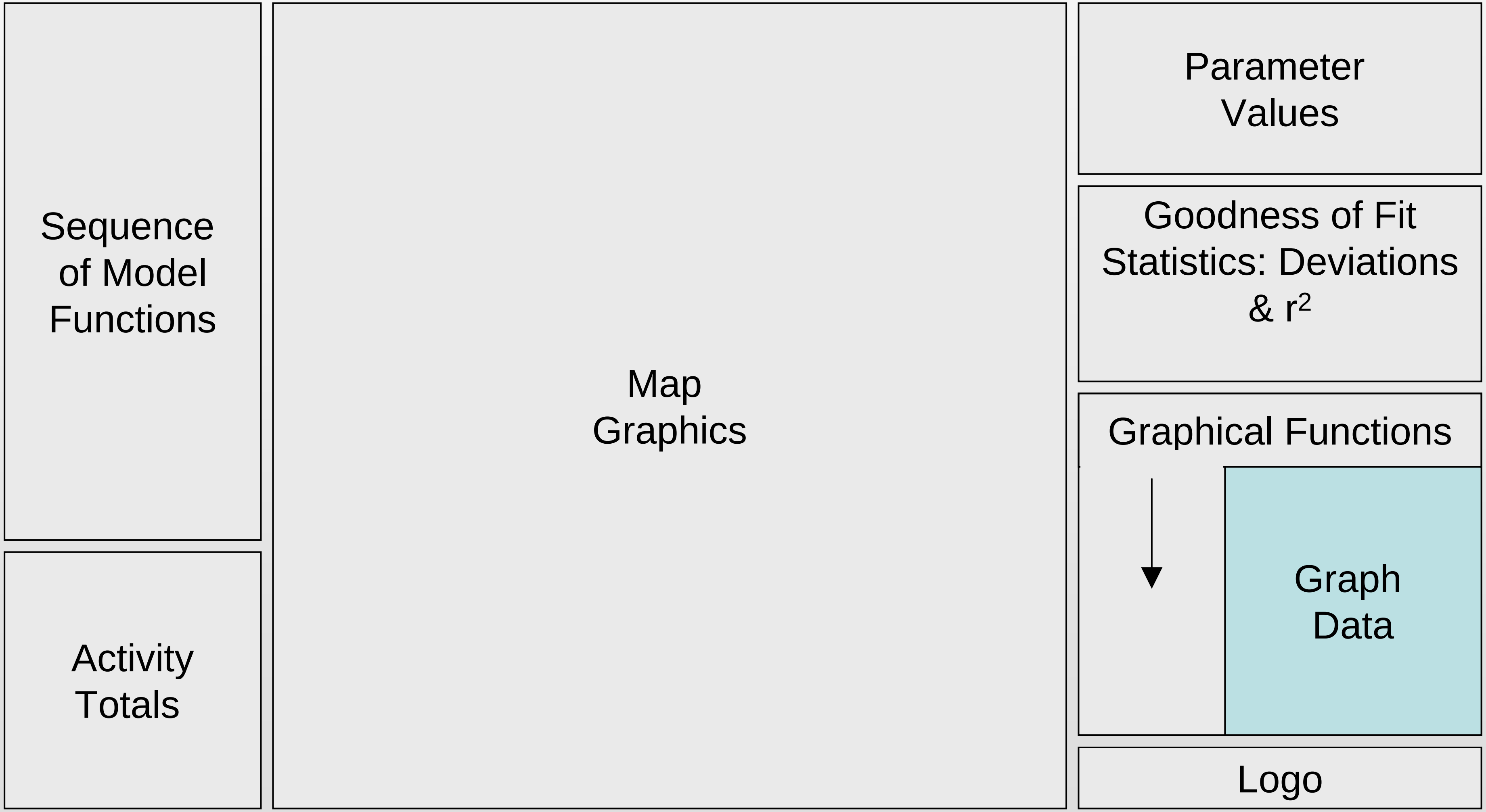
The Visual Template: The Desktop Model

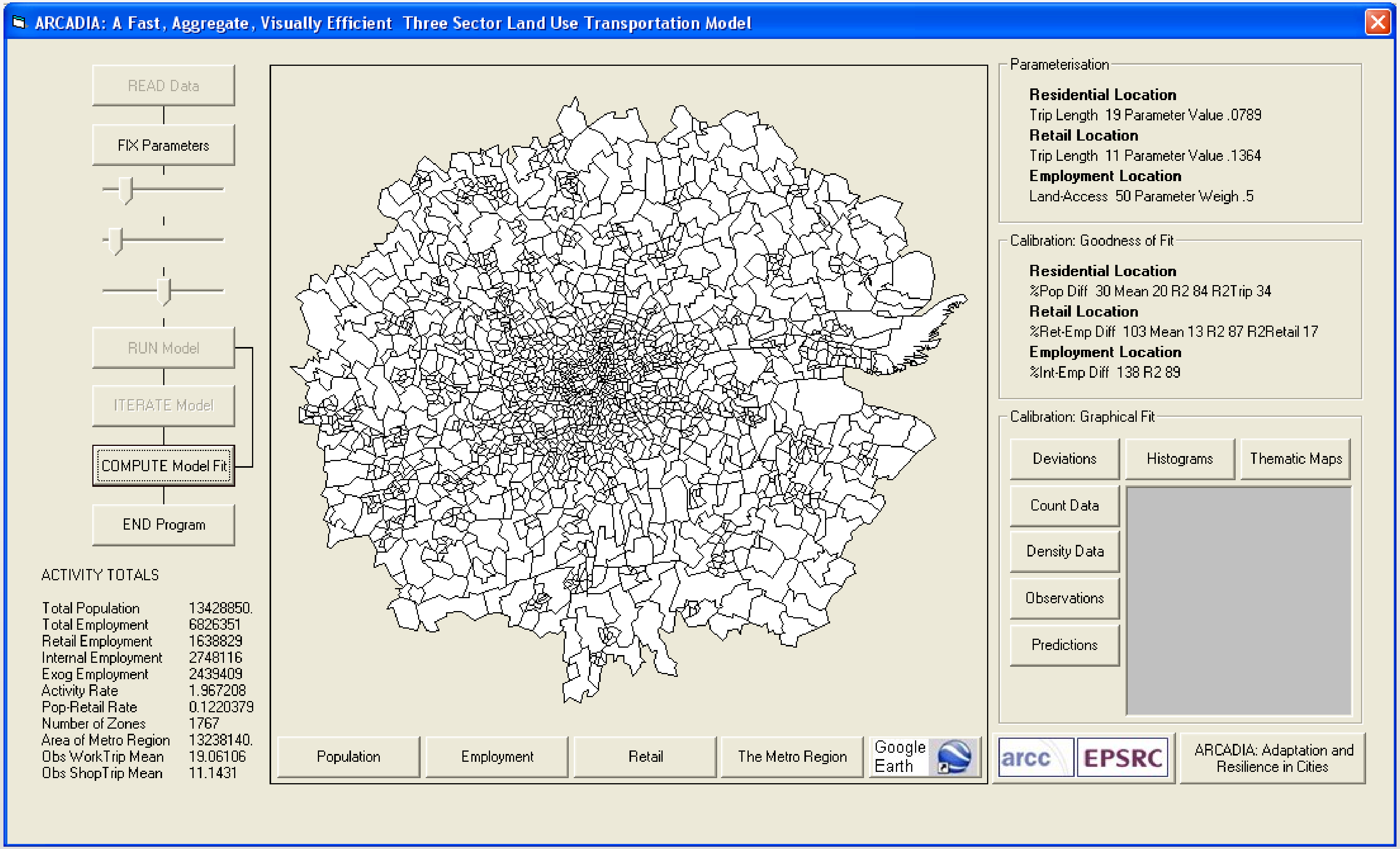
Ok – let me quickly tell you our strategy – we are building a fully fledged model using state of the art software and various web–based interfaces which is highly visual and will be as fast as possible

We are also building a mirror model on the desktop which is my contribution to the project and this is a one window minimal model which is for comparative purposes and to enable the bigger model to be tested

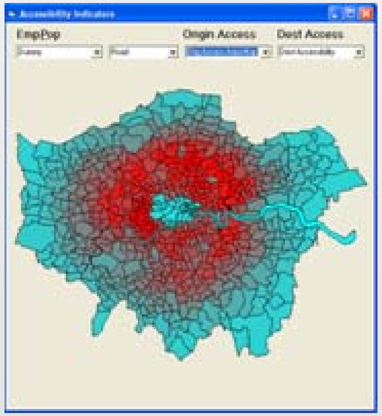
This is the model I will now show and then I will sketch the bigger application very briefly which Camilo in our group is developing

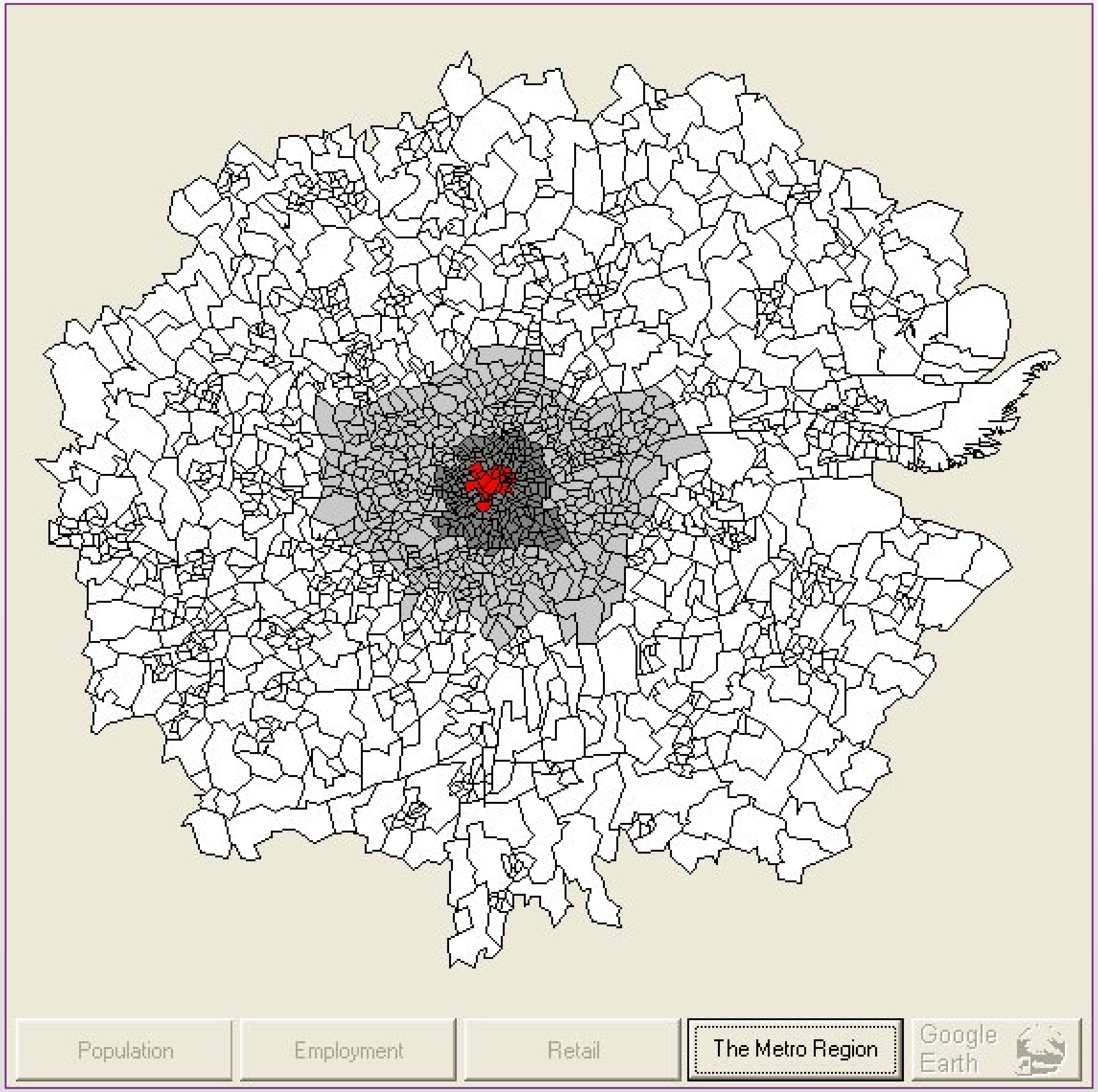
This is the order in which the operations take place



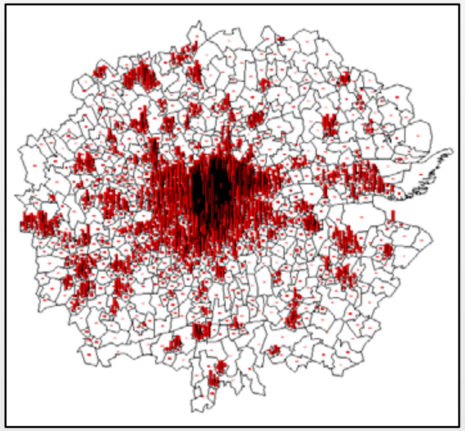

ARCADIA: A Fast, Aggregate, Visually Efficient Three Sector Land Use Transportation Model
READ Data
FIX Parameters
RUN Model
ITERATE Model
COMPUTE Model Fit
END Program
ACTIVITY TOTALS
Total Population 13428850.
Total Employment 6826351
Retail Employment 1638829
Internal Employment 2748116
Exog Employment 2439409
Activity Rate 1.967208
Pop-Retail Rate 0.1220379
Number of Zones 1767
Area of Metro Region 13238140.
Obs WorkTrip Mean 19.06106
Obs ShopTrip Mean 11.1431
Population
Employment
Retail
The Metro Region
Google Earth
Parameterisation
Residential Location
Trip Length 19 Parameter Value .0789
Retail Location
Trip Length 11 Parameter Value .1364
Employment Location
Land-Access 50 Parameter Weigh .5
Calibration: Goodness of Fit
Residential Location
%Pop Diff 30 Mean 20 R2 84 R2Trip 34
Retail Location
%Ret-Emp Diff 103 Mean 13 R2 87 R2Retail 17
Employment Location
%Int-Emp Diff 138 R2 89
Calibration: Graphical Fit
Deviations
Histograms
Thematic Maps
Count Data
Density Data
Observations
Predictions
arcc
EPSRC
ARCADIA: Adaptation and Resilience in Cities

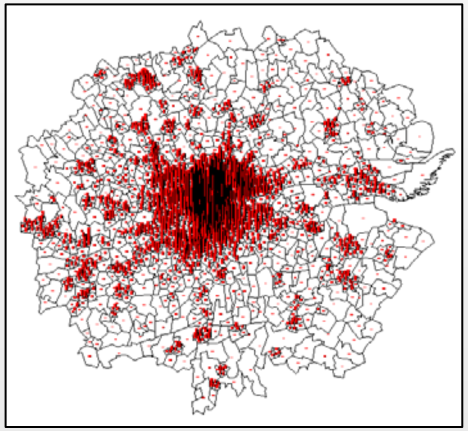

Employment
Population
Work Trips

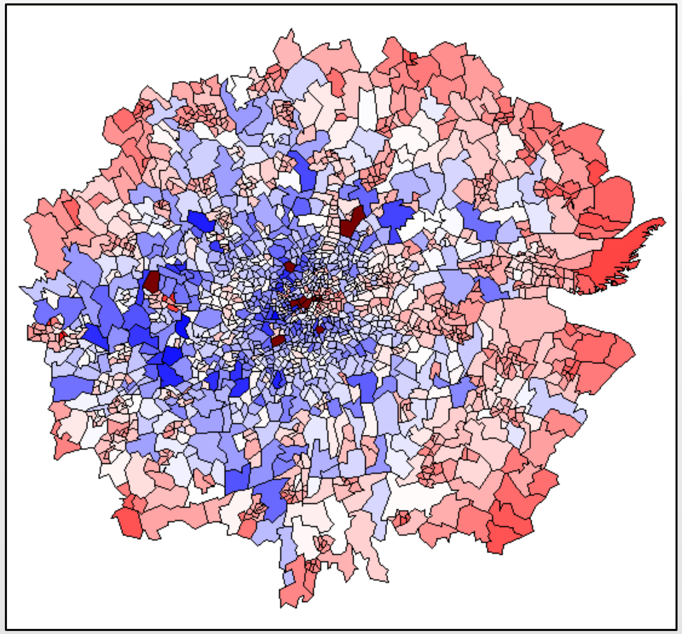

EmpPop
Origin Access
Dest Access

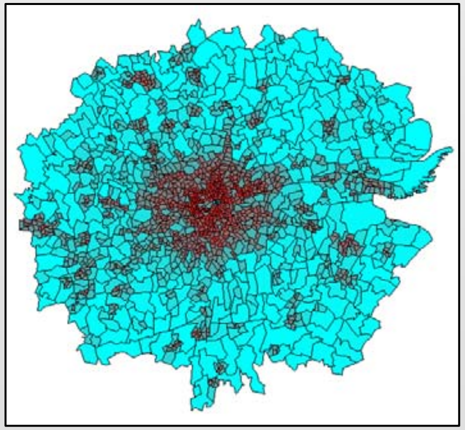

Population
Employment
Retail
The Metro Region
Google Earth

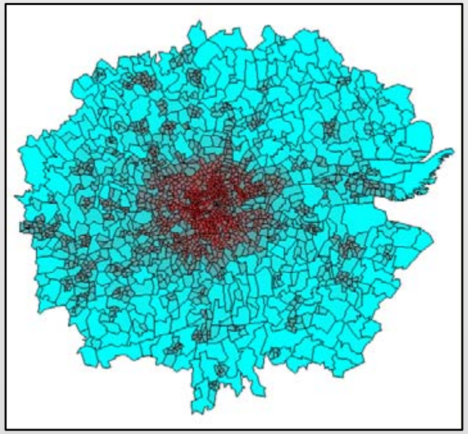
Here are some sample outputs – I will run the model as speed is important – here goes











RUN

The employment model has been built more recently and it much wider in scale than the current 1767 model – it has 3202 or so zones and this is largely because we need to capture locational change in the wider region.

The model is econometric based on predicting floorspace which in turn predicts employment. The two typical equations

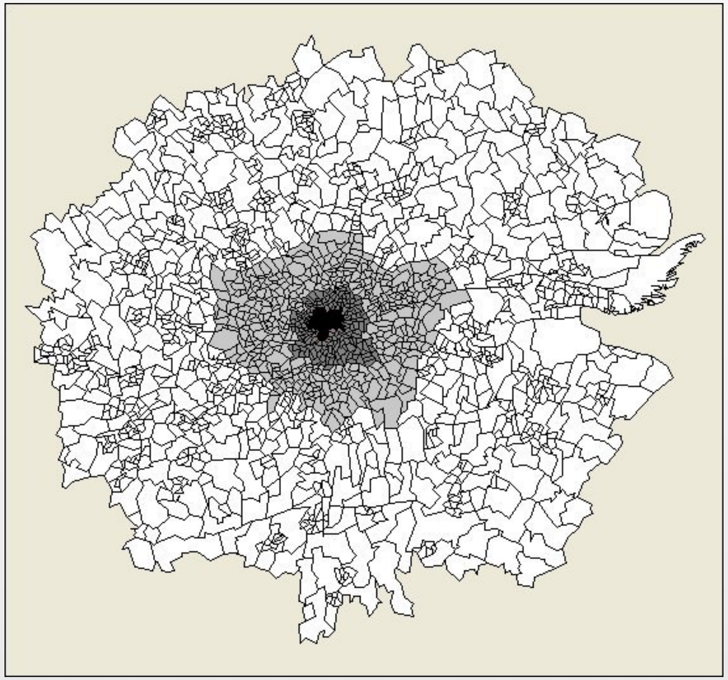
The models that have been fitted are variants of the generic structure that follows:

$$F_j^z = a_0 + \sum_{\substack{\ell=1,2,3 \\ \ell \neq z}} a_k F_j^\ell + a_4 B_j + a_5 D_j + a_6 A_j^z + a_7 T_j + a_8 G_j + \\ + a_9 H_j + a_{10} Q_j + a_{11} M_j + \sum_{\ell=1,2,3} s_\ell \delta_j^\ell + \sum_{\ell=1,2} f_\ell \delta_j^\ell \qquad (20)$$

similar to that for floorspace and we state it as

$$E_{jk} = b_0 + \sum_{z=1,2,3} b_k F_j^z + b_4 A_j^{PT} + b_5 A_j^R + b_6 M_j + b_7 J_j + b_8 H_j + b_9 h_j + b_{10} Q_j \qquad (21)$$

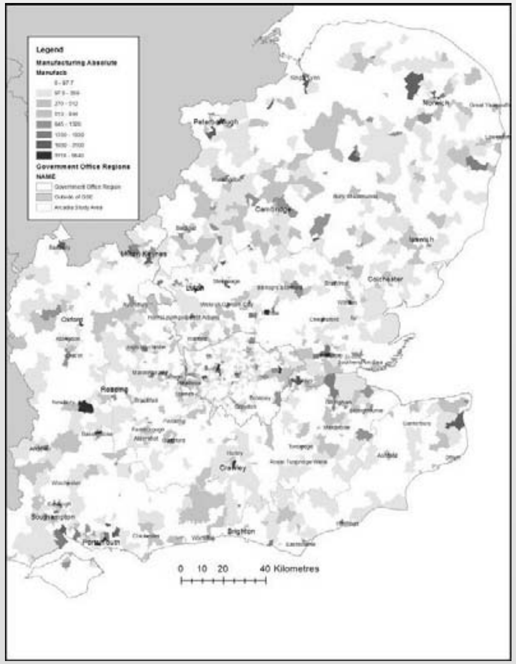

Regional Boundary
National Boundary
County Boundary
Regional Government Offices
Scotland
Berwick
North East
Newcastle
Carlisle
Teeside
North West
Yorkshire & the Humber
York
Barrow-in-Furness
Blackpool
Preston
Leeds
Hull
Merseyside
Liverpool
Manchester
Sheffield
East Midlands
East
Nott-ingham
Derby
Leicester
Norwich
Wales
Birmingham
West Midlands
Cambridge
Ipswich
Bedford
Gloucester
Oxford
Cardiff
Bristol
Reading
Basing-stoke
Guildford
Maidstone
Salisbury
South-ampton
South West
Bournemouth
Brighton
Exeter
Plymouth
Penzance
London
South East



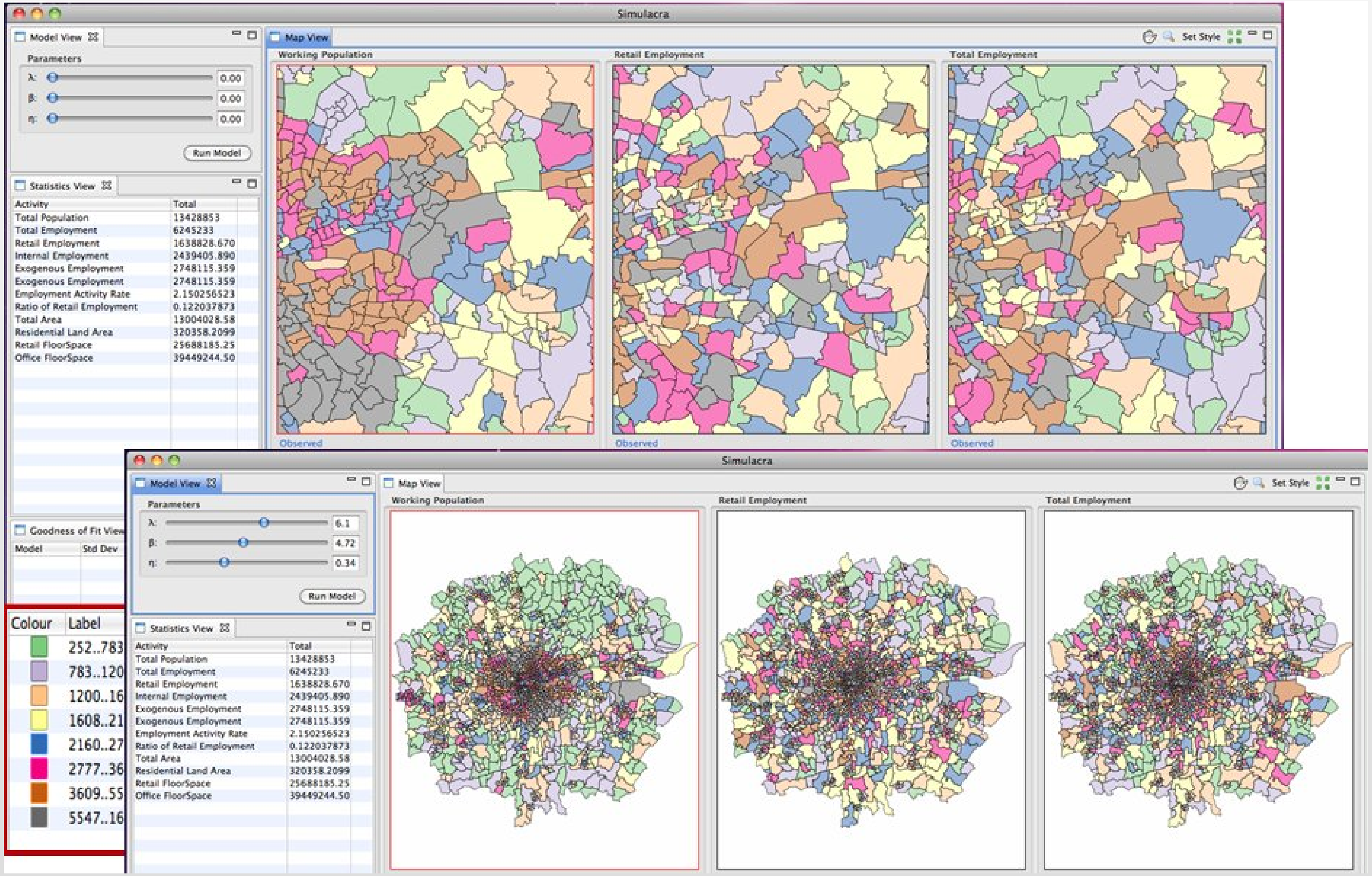

0 10 20 40 Kilometres

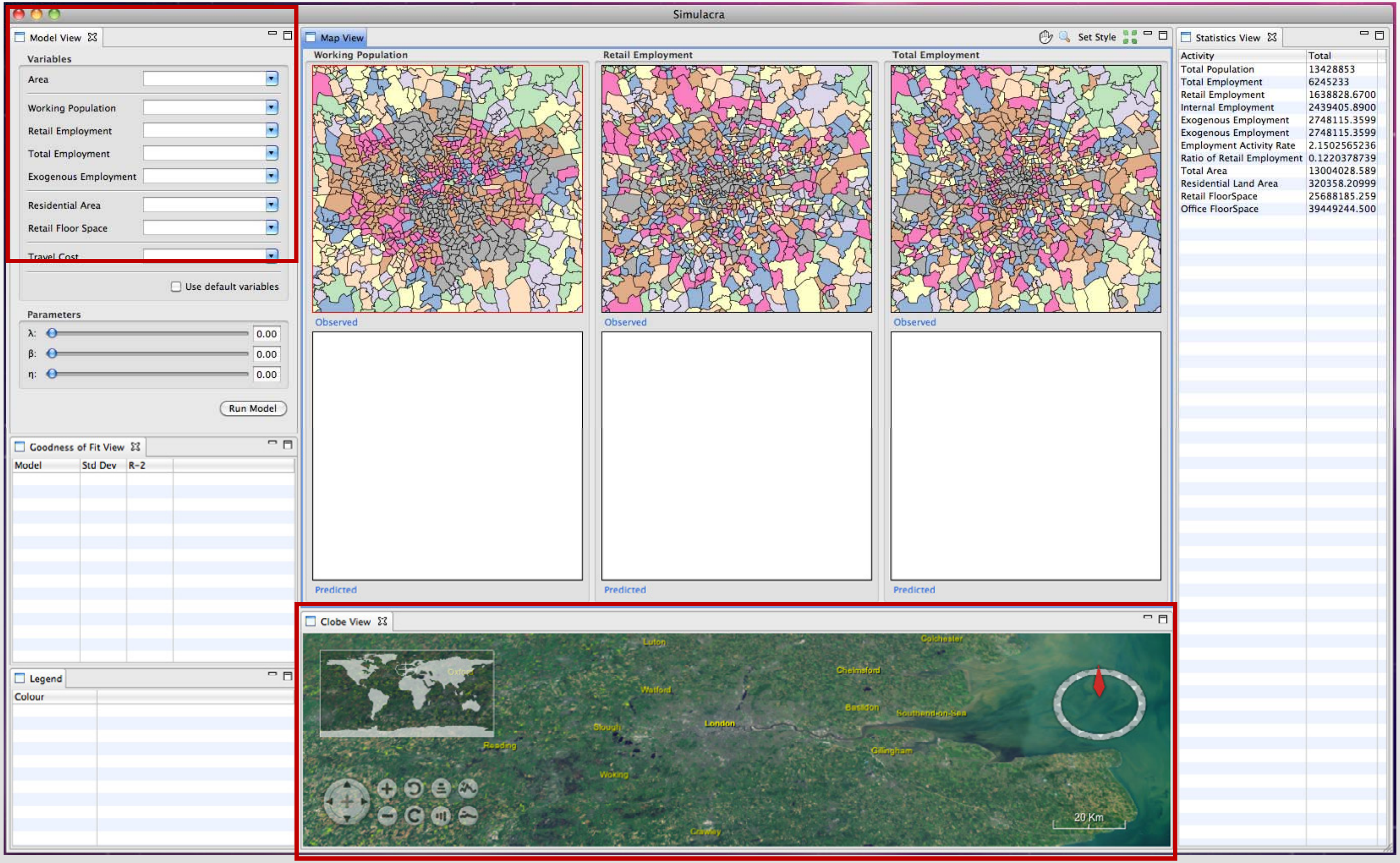

London
0 10 20 40 Kilometres


London
0 10 20 40 Kilometres

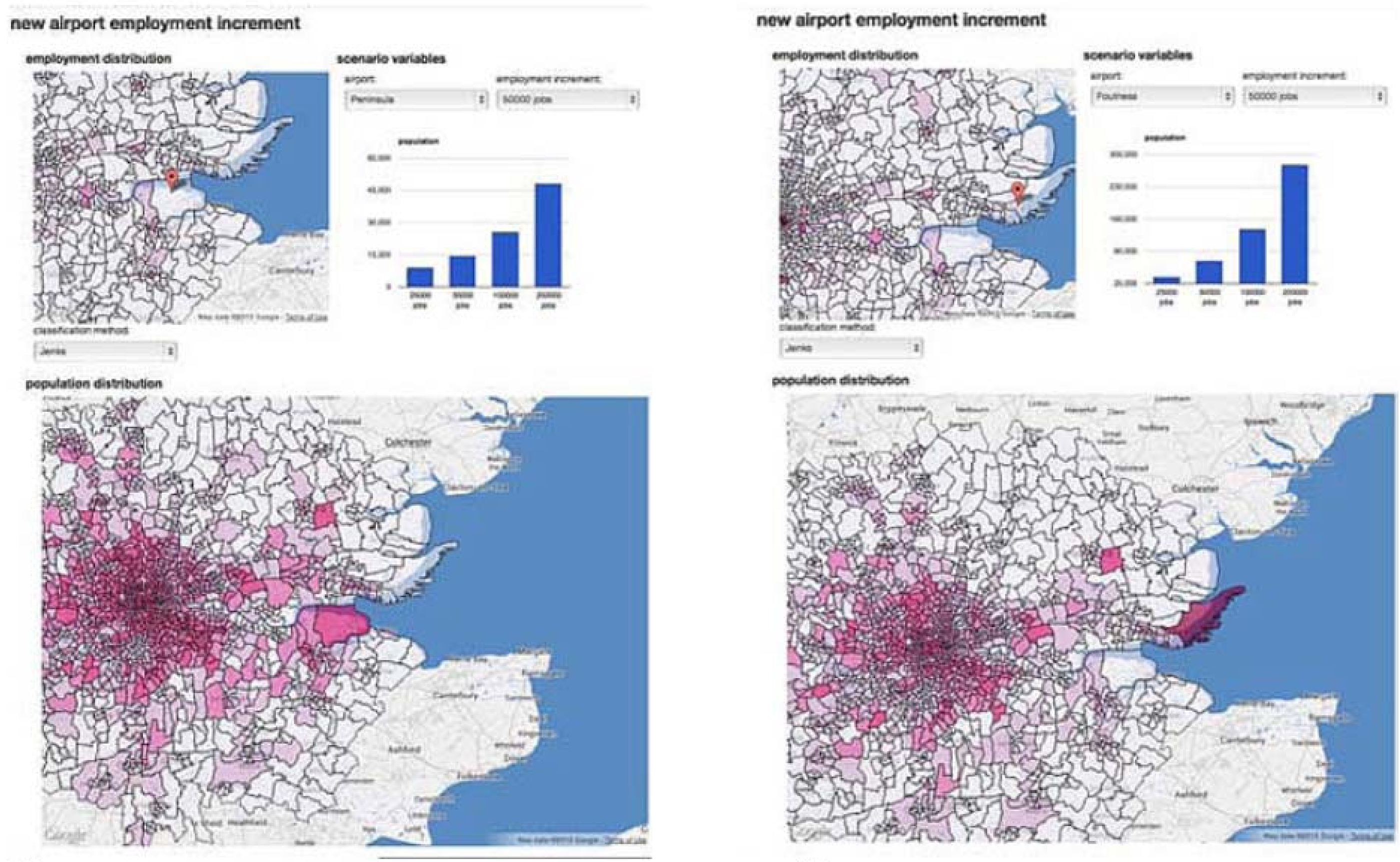

Legend
0 10 20 40 Kilometres

And here are some screen shots from the desktop version of the web based application – on Mac and PC




Simulacra
Model View
Variables
Area
Working Population
Retail Employment
Total Employment
Exogenous Employment
Residential Area
Retail Floor Space
Travel Cost
Use default variables
Parameters
λ: 0.00
β: 0.00
η: 0.00
Run Model
Goodness of Fit View
Model
Std Dev
R-2
Legend
Colour
Map View
Set Style
Working Population
Retail Employment
Total Employment
Observed
Predicted
Statistics View
Activity
Total
Total Population 13428853
Total Employment 6245233
Retail Employment 1638828.6700
Internal Employment 2439405.8900
Exogenous Employment 2748115.3599
Exogenous Employment 2748115.3599
Employment Activity Rate 2.1502565236
Ratio of Retail Employment 0.1220378739
Total Area 13004028.589
Residential Land Area 320358.20999
Retail FloorSpace 25688185.259
Office FloorSpace 39449244.500
Globe View
London
20 Km

And here are some examples of testing the impact of new airports on existing urban structure in the London region



(a) (b)

Figure 8. [In colour online.] Visualising the impacts of new employment on residential population in the vicinity of two proposed sites for a new London airport: (a) Isle of Grain, (b) Maplin Sands.

Data Bases: Location, Interactions & Networks

We have a big problem in getting the networks sorted out for the aggregate model as these networks are at a very fine scale

We need them to be at a coarser scale for the model as we need to do all the assignment and capacity checking at the level of the model

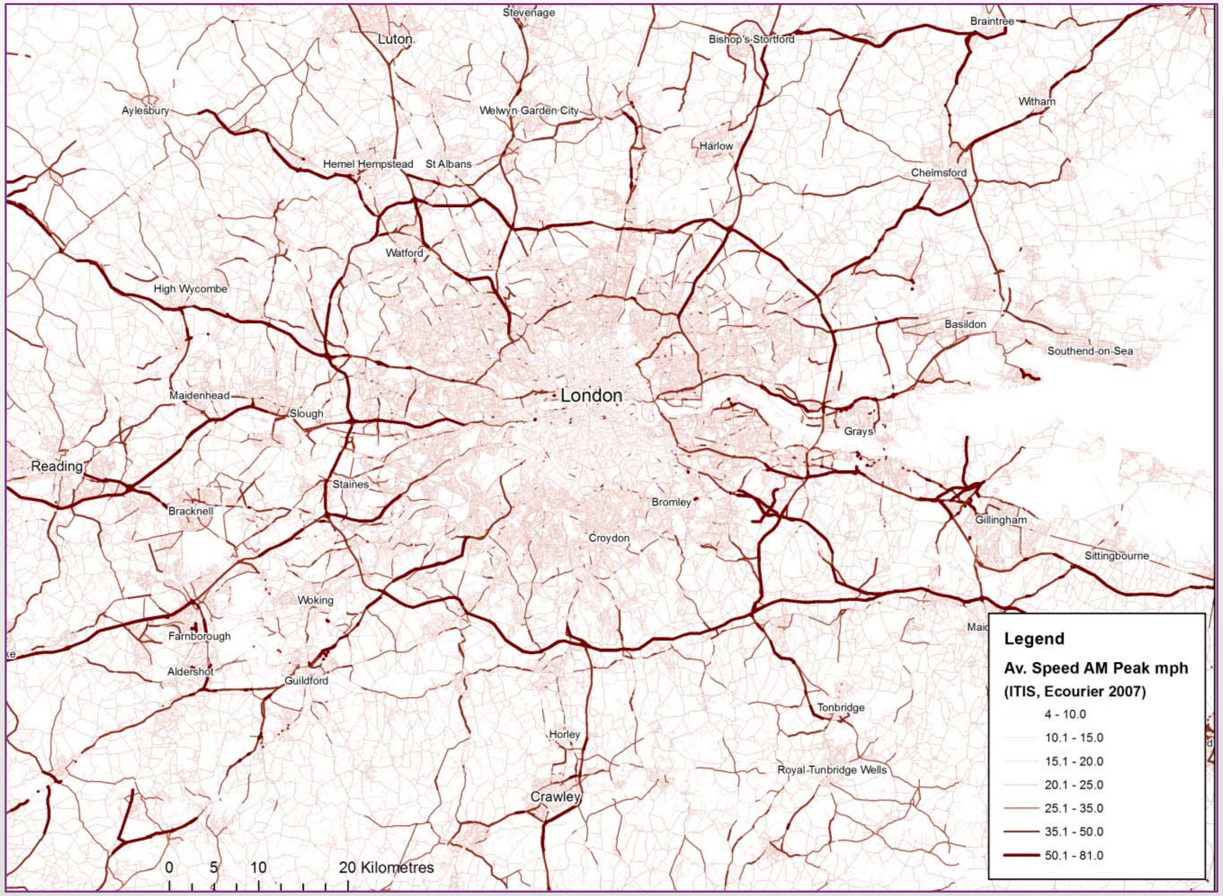
This is a long standing issue, we know, but we cannot afford to move down the local fine scale level to do the assignment of trips to the network because this would simply destroy our basic principle of accessibility of the model to users and also the speed requirements we need

We will show some of the detail we have by way of illustrating our work in progress.

Road Costs

Used GPS data for realistic road speeds across the South East. Sourced from ITIS and Ecourier.

Future improvements with dynamic consideration of congestion.

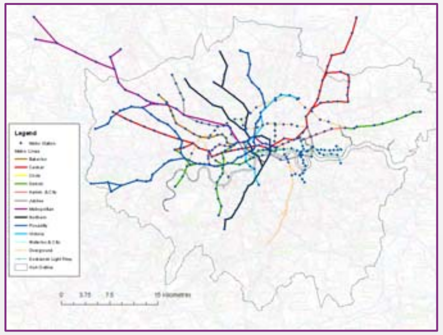


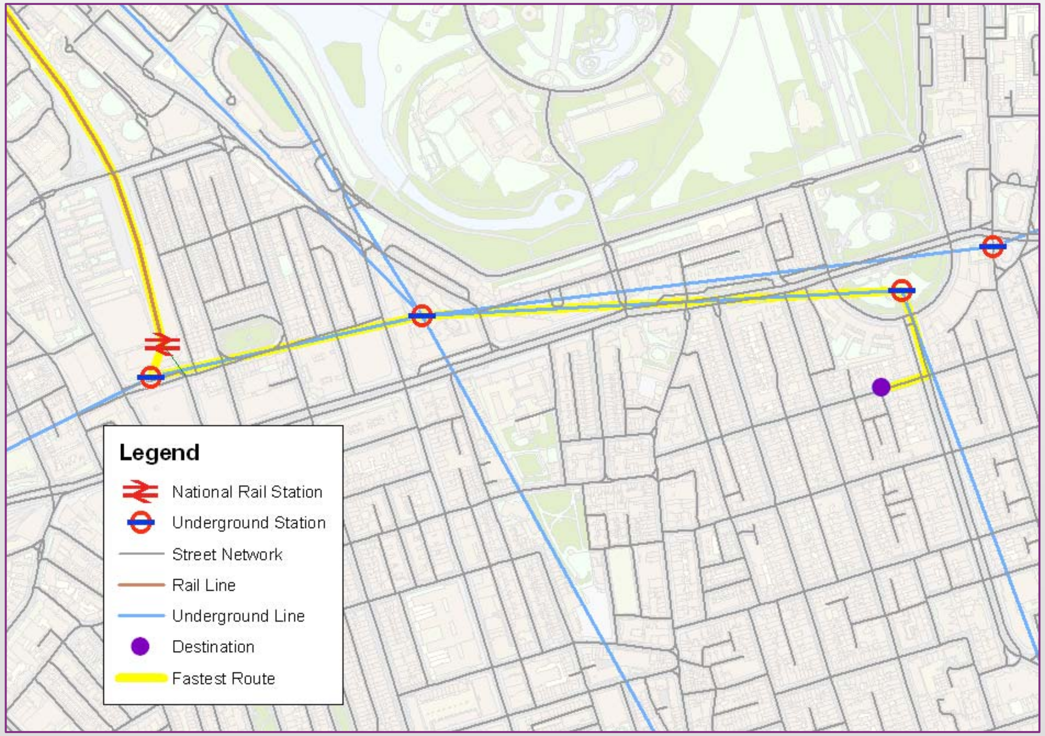
Public Transport Costs

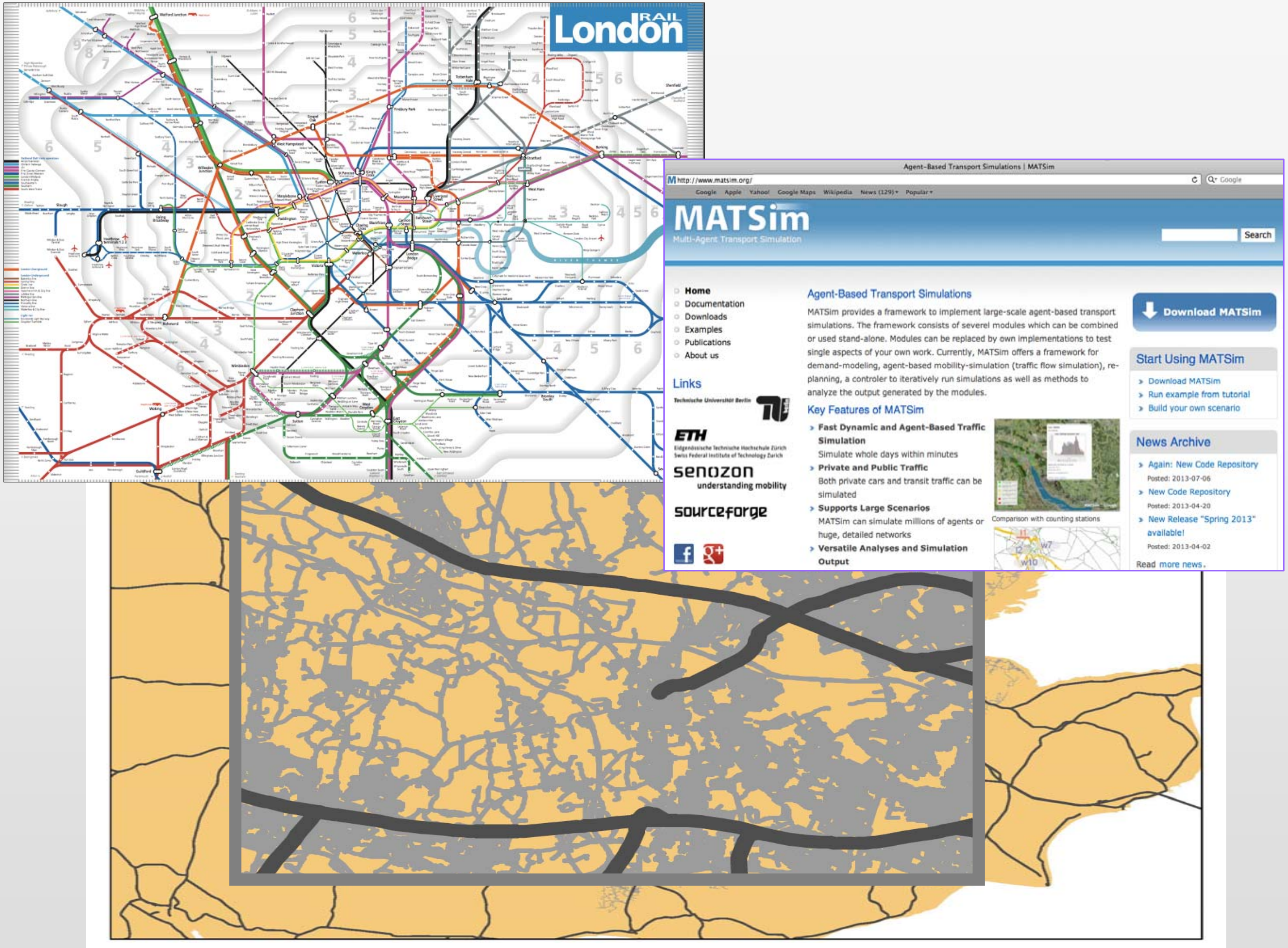
Based on network geometry and timetabled services. Initially using model presented by Duncan last term. Allows multi-modal PT trips.

TransXchange

Full UK PT timetable available in XML format. Could be used to automate process of generating PT networks.






London RAIL
Agent-Based Transport Simulations | MATSim
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Multi-Agent Transport Simulation
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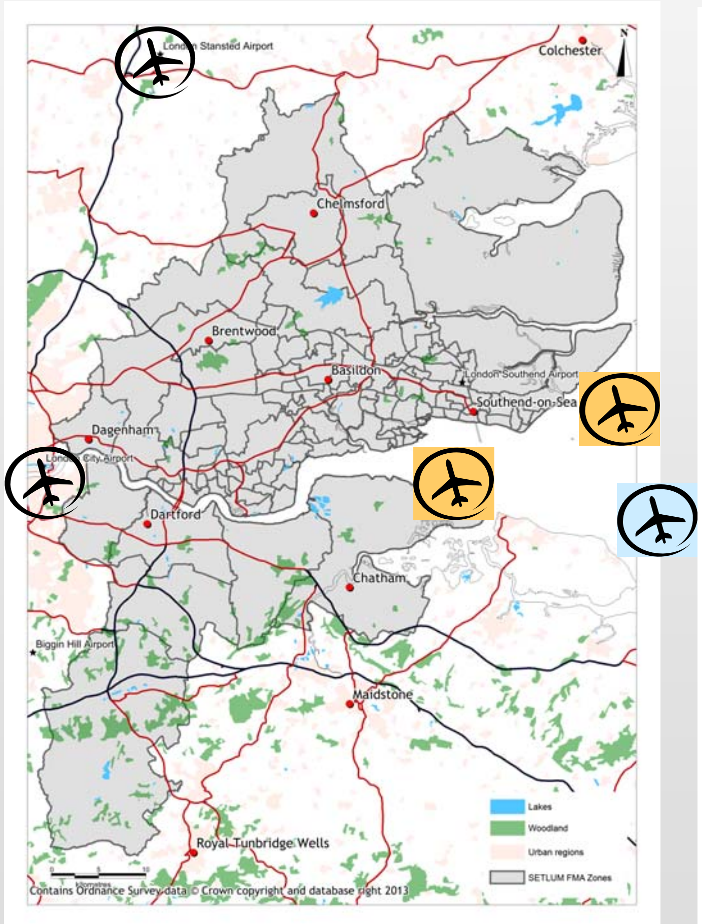
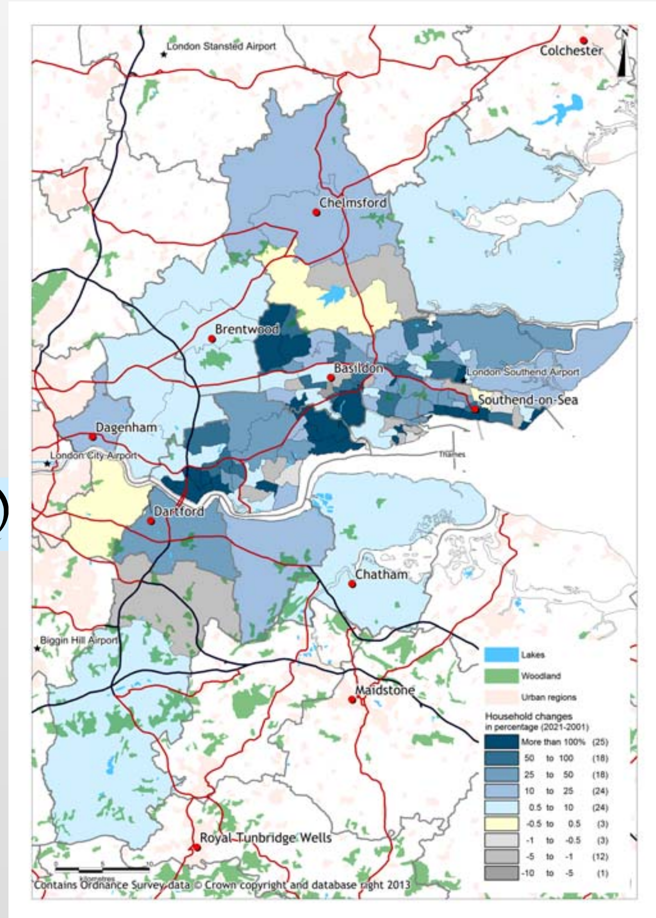
understanding mobility
sourceforge
Agent-Based Transport Simulations
MATSim provides a framework to implement large-scale agent-based transport simulations. The framework consists of severel modules which can be combined or used stand-alone. Modules can be replaced by own implementations to test single aspects of your own work. Currently, MATSim offers a framework for demand-modeling, agent-based mobility-simulation (traffic flow simulation), re-planning, a controler to iteratively run simulations as well as methods to analyze the output generated by the modules.
Key Features of MATSim
Fast Dynamic and Agent-Based Traffic Simulation
Simulate whole days within minutes
Private and Public Traffic
Both private cars and transit traffic can be simulated
Supports Large Scenarios
MATSim can simulate millions of agents or huge, detailed networks
Versatile Analyses and Simulation Output
Comparison with counting stations
Download MATSim
Start Using MATSim
Download MATSim
Run example from tutorial
Build your own scenario
News Archive
Again: New Code Repository
Posted: 2013-07-06
New Code Repository
Posted: 2013-04-20
New Release "Spring 2013" available!
Posted: 2013-04-02
Read more news.

And we are linking all this to Melanie Bosredon's Work is adding energy issues and data to the The DSC *SETLUM (South Essex Land Use Model)*





Key Challenges for Immediate Developments

- Speed of Models
- Quick and Effective Visualisation
- Running the Model with Users/Stakeholders
- Building a Residential Model Based on the Housing Market Cost, prices, travel and energy costs etc - The Wegener Principle
- Moving to a Semi-Dynamic Model with Inertia and Internal Migration
- A Local UK Dimension: Thinking of the Modelling Strategy as being Informed by National Data Bases such as Neighbourhood Statistics

Thanks

http://www.spatialcomplexity.info/
http://www.complexcity.info/
http://www.mechanicty.info/
http://blogs.casa.ucl.ac.uk/

http://www.casa.ucl.ac.uk/

Acknowledgements

Melanie Bosredon, Richard Milton, Pete Ferguson, Joan Serras, Camilo-Vargas-Ruiz
We are also working on these models with your own group here which leads the EU INSIGHT Project and EUNOIA which is led by NOMMON from Madrid

insight Innovative Policy Modelling and Governance Tools for Sustainable Post-Crisis Urban Development

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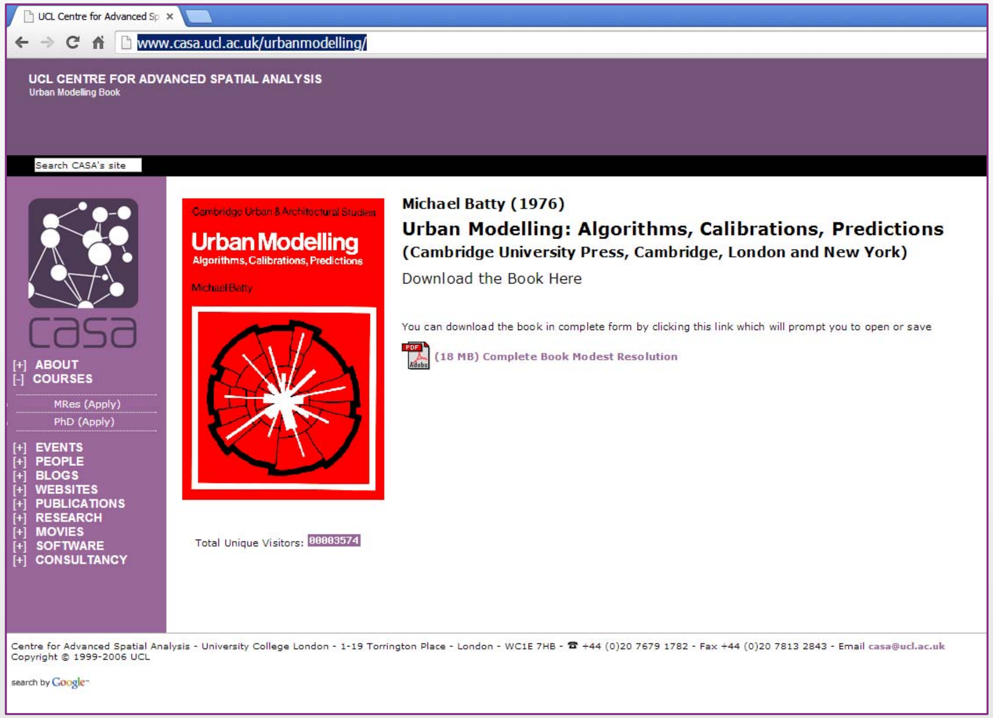

http://www.casa.ucl.ac.uk/urbanmodelling/

Environment and Planning B 2013 **40** 987 – 1002
SIMULACRA: fast land-use–transportation models for the rapid assessment of urban futures
Michael **Batty**, Camilo Vargas, Duncan Smith, Joan Serras, Jon Reades, Anders Johansson

Environment and Planning A 2013 **45** 532 – 552
Visually-Driven Urban Simulation: exploring fast and slow change in residential location
Michael **Batty**