Geographical modelling of happiness and well-being using population surveys and remote sensing data

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What is happiness? Can it be measured?

Human perceptions of happiness vary and depend on a wide range of factors

What is the good life for man? The question of what is a full and rich life cannot be answered for an individual in abstraction from the society in which he lives

(Aristotle, *Nicomachean Ethics*)

Can happiness be measured?

Happiness is subjective and no objective theory about the ordinary concept of happiness has the slightest plausibility

(Sumner, 1996)

General Health Questionnaire (1)
Have you recently:

- Been able to concentrate on whatever you are doing?
- Lost much sleep over worry?
- Felt that you are playing a useful part in things?
- Felt capable of making decisions about things?
- Felt constantly under strain?
- Felt you could not overcome your difficulties?

General Health Questionnaire (2) Have you recently:

- Been able to enjoy your normal day-to-day activities?
- Been able to face up to your problems?
- Been feeling unhappy or depressed?
- Been losing confidence in yourself?
- Been thinking of yourself as a worthless person?
- Been feeling reasonably happy all things considered?

General happiness Self Completion (4)
Question Number and Text KS1L :
Have you recently....been feeling reasonably happy, all things considered?

Value Label	%
More so than usual 1	13.2
Same as usual 2	72.8
Less so than usual 3	11.8
Much less than usual 4	2.2

Source: The British Household Panel Survey, 1991

Happiness in different activities (after Lavard. 2005)

	Happiness (index)	Average hours per day
Sex	4.7	0.2
Socialising after work	4.1	1.1
Dinner	4.0	0.8
Relaxing	3.9	2.2
Lunch	3.9	0.6
Exercising	3.8	0.2
Praying	3.8	0.5
Socialising at work	3.8	1.1
Watching TV	3.6	2.2
Phone at home	3.5	0.9
Napping	3.3	0.9
Cooking	3.2	1.1
Shopping	3.2	0.4
Computer at home	3.1	0.5
Housework	3.0	1.1
Childcare	3.0	1.1
Evening commute	2.8	0.6
Working	2.7	6.9
Morning commute	2.0	0.4

Note: Based on Day Reconstruction Study. Average happiness is net affect.

Happiness in different activities (after Layard, 2005)

Interacting with:	Average happiness
Friends	3.3
Parents/relatives	3
Spouse	2.8
My children	2.7
Co-workers	2.6
Clients/customers etc	2.4
Alone	2.2
Boss	2

Factors and variables linked to subjective happiness (individual level studies)

- Age
- Education
- Social Class
- Income
- Marital status/relationships
- Employment
- Leisure
- Religion
- Health
- Life events and activities

Life-events and happiness

- BHPS: **What has happened to you (or your family) which has stood out as important?**
- 145,408 major life events recorded between 1992-1995

Ballas, D., Dorling, D. (2007) Measuring the impact of major life events upon happiness, *International Journal of Epidemiology*, 36, 1244-1252. doi:10.1093/ije/dym182

Life Event	Coefficient	P value
RELATIONSHIPS (MINE ENDING 36,43)	**-0.178**	**0.00**
DEATH (PARENT, 45)	**-0.166**	**0.00**
HEALTHPARENT (1-9)	**-0.139**	**0.00**
DEATH (OTHER 45)	**-0.137**	**0.00**
EMPLOYMENT JOB LOSS 24	**-0.129**	**0.00**
HEALTH MINE (1-9)	**-0.117**	**0.00**
DEATH (FAMILY 45)	**-0.098**	**0.00**
HEALTH PARTNER (1-9)	**-0.092**	**0.00**
HEALTH CHILD (1-9)	**-0.084**	**0.00**
HEALTH OTHER (1-9)	**-0.073**	**0.00**
EDUCATION CHILD (12-19)	-0.029	0.12
EMPLOYMENT OTHER (23,26-29)	-0.028	0.13
OTHER EVENT (10-11;32-34;37-39;90-95)	-0.026	0.14
NOTHING IMPORTANT HAPPENED	-0.022	0.11
RELATIONSHIPS (WITH PET 54 AND SUBJECT)	-0.020	0.44
FINANCE (OTHER 60-69;73-79)	-0.019	0.27
RELATIONSHIPS FAMILY (46-53;55-59)	-0.014	0.39

Life Event	Coefficient	P value
RELATIONSHIPS (FAMILY 35. 41-42)	0.002	0.91
LEISURE (OUR HOLIDAY 30)	0.010	0.61
MOVING HOME (44;80-81)	0.013	0.46
EDUCATION OTHER (12-19)	0.024	0.27
FINANCE (CAR 70)	0.027	0.22
LEISURE (MY HOLIDAY 30)	0.029	0.07
PREGNANCY (OTHER 40)	0.031	0.56
PREGNANCY (FAMILY 40)	0.034	0.09
RELATIONSHIPS (CHILD'S STARTING 35, 42)	0.037	0.10
EMPLOYMENT JOB CHANGE (20-21)	0.040	0.02
LEISURE (OTHER 30-31)	0.043	0.02
EDUCATION MINE(12-19)	0.052	0.00
PREGNANCY (CHILD'S 40)	0.053	0.01
PREGNANCY (MINE 40)	**0.084**	**0.00**
FINANCE (HOUSE 71)	**0.097**	**0.00**
EMPLOYMENT JOB GAIN 22	**0.097**	**0.00**
RELATIONSHIPS (MINE STARTING 35. 42)	**0.160**	**0.00**

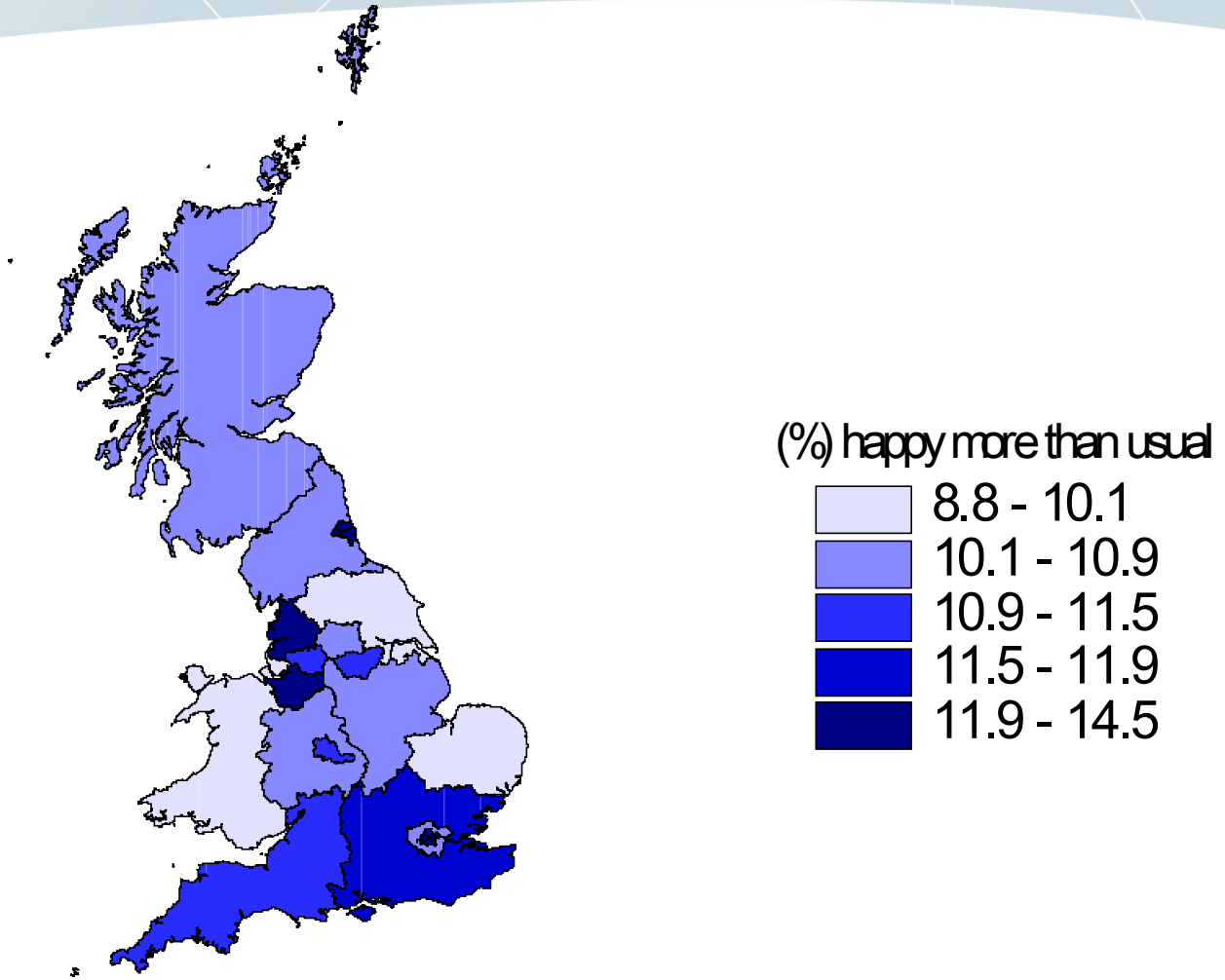
Geographies of happiness in Britain

Region / Metropolitan Area * GHQ: general happiness Crosstabulation

% within Region / Metropolitan Area

		GHQ: general happiness						
		Missing or wild	Proxy respondent	More than usual	Same as usual	Less so	Much less	Total
Region / Metropolitan Area	Inner London	4.5%	4.3%	**14.4%**	66.7%	7.7%	2.4%	100.0%
	Outer London	2.8%	5.7%	10.6%	68.6%	10.2%	2.1%	100.0%
	R. of South East	2.2%	5.0%	11.9%	70.2%	9.1%	1.6%	100.0%
	South West	1.7%	3.5%	11.3%	74.1%	8.0%	1.4%	100.0%
	East Anglia	2.1%	1.3%	10.0%	77.4%	8.5%	.8%	100.0%
	East Midlands	2.2%	1.4%	10.9%	76.0%	8.3%	1.3%	100.0%
	West Midlands Conurbation	6.6%	4.6%	11.5%	66.0%	9.9%	1.3%	100.0%
	R. of West Midlands	.8%	2.2%	10.7%	73.7%	10.7%	2.0%	100.0%
	Greater Manchester	1.0%	2.6%	11.1%	75.2%	7.7%	2.4%	100.0%
	Merseyside	.4%	4.7%	9.9%	75.5%	8.6%	.9%	100.0%
	R. of North West	1.3%	4.0%	14.5%	70.7%	8.1%	1.3%	100.0%
	South Yorkshire	1.0%	1.7%	11.3%	71.0%	13.3%	1.7%	100.0%
	West Yorkshire	2.7%	2.7%	10.7%	73.9%	8.5%	1.4%	100.0%
	R. of Yorks & Humberside	1.2%	5.5%	10.1%	76.5%	5.5%	1.2%	100.0%
	Tyne & Wear	.4%	3.8%	**14.0%**	72.7%	6.8%	2.3%	100.0%
	R. of North	1.8%	2.3%	10.8%	72.3%	11.5%	1.5%	100.0%
	Wales	3.9%	1.5%	8.8%	70.9%	12.6%	2.3%	100.0%
	Scotland	1.8%	2.3%	10.8%	74.0%	9.9%	1.3%	100.0%
Total		2.2%	3.4%	11.3%	72.2%	9.2%	1.6%	100.0%

Source: The British Household Panel Survey, 1991


(%) happy more than usual
8.8 - 10.1
10.1 - 10.9
10.9 - 11.5
11.5 - 11.9
11.9 - 14.5

Multi-level modelling and spatial microsimulation

1991 & 2001 Census of UK population:

- 100% coverage
- fine geographical detail
- small area data available only in tabular format with limited variables to preserve confidentiality

British Household Panel Survey:

- sample size: more than 5,000 households
- annual surveys since 1991
- individual data
- more variables than census
- coarse geography
- household attrition

Modelling happiness and well-being: multilevel (Ballas and Tranmer, 2007)

1. "Null model" – extent of variation
2. Socio-economic variables and health – random intercepts
3. Social context – interaction variables

Building geographical simulation models of happiness for "what-if" public policy analysis

Source: http://simcity.ea.com/

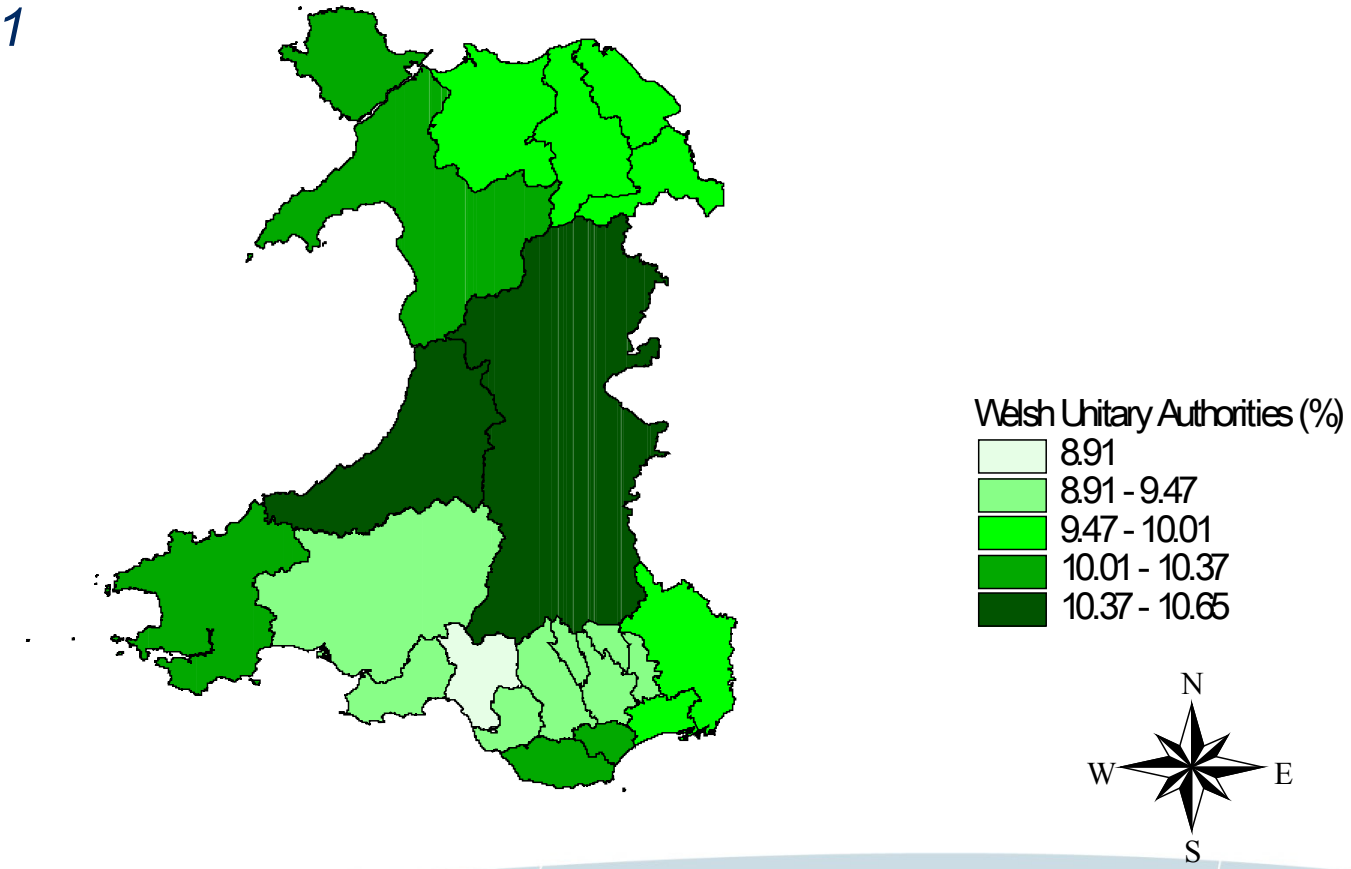
What is microsimulation

PERSON	AHID	PID	AAGE12	SEX	AJBSTAT	…	AHLLT	AQFVOC	ATENURE	AJLSEG	…
1	1000209	10002251	91	2	4	…	1	1	6	9	…
2	1000381	10004491	28	1	3	…	2	0	7	-8	…
3	1000381	10004521	26	1	3	…	2	0	7	-8	…
4	1000667	10007857	58	2	2	…	2	1	7	-8	…
5	1001221	10014578	54	2	1	…	2	0	2	-8	…
6	1001221	10014608	57	1	2	…	2	1	2	-8	…
7	1001418	10016813	36	1	1	…	2	1	3	-8	…
8	1001418	10016848	32	2	-7	…	2	-7	3	-7	…
9	1001418	10016872	10	1	-8	…	-8	-8	3	-8	…
10	1001507	10017933	49	2	1	…	2	0	2	-8	…
11	1001507	10017968	46	1	2	…	2	0	2	-8	…
12	1001507	10017992	12	2	-8	…	-8	-8	2	-8	…

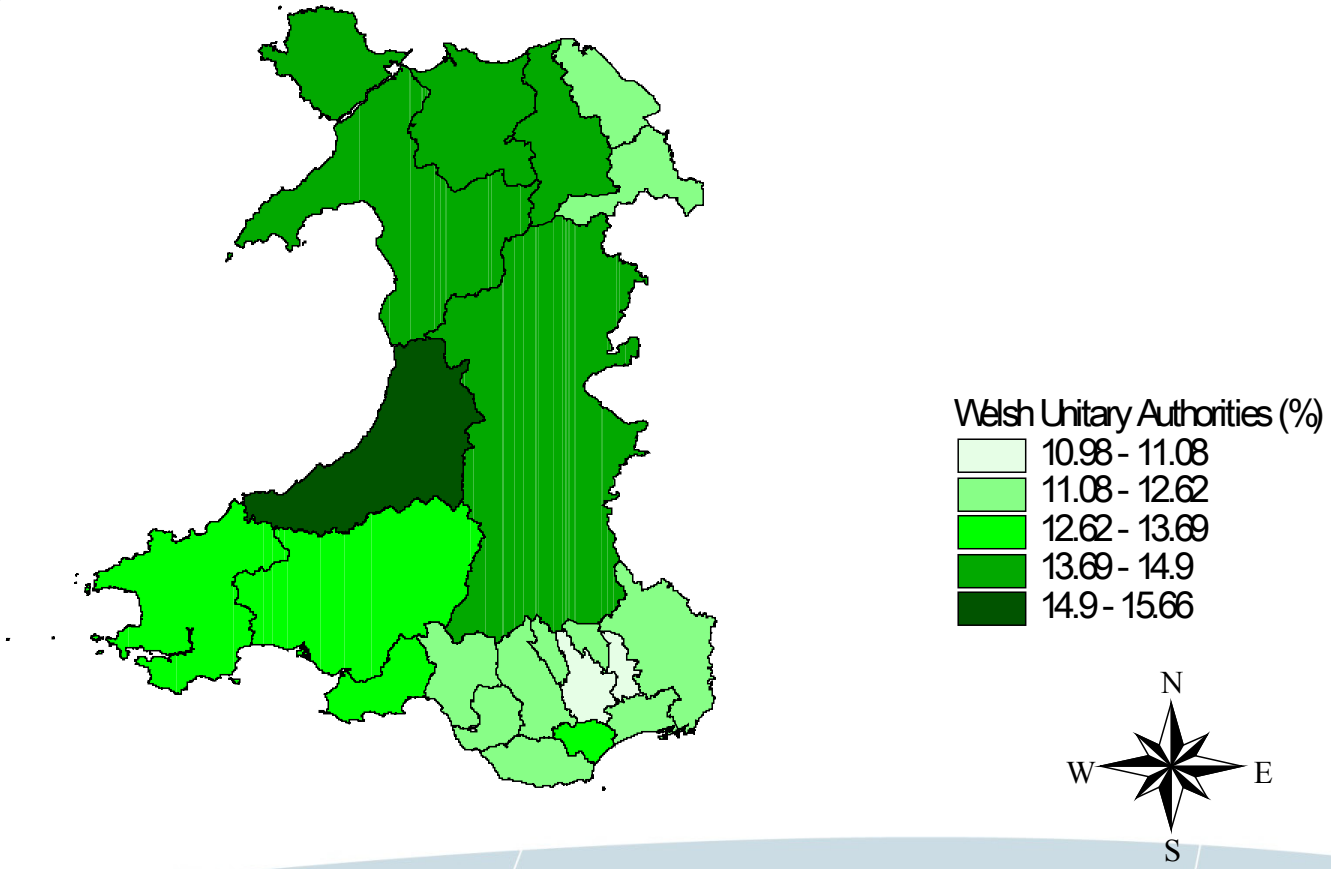
Tenure and car ownership example

	Household car ownership characteristics			Household tenure characteristics		
	1 car	2+ cars	No car	Owner-occupier	LA/HA rented	Other
Simulation	27	24	49	39	17	44
Census	50	20	30	60	10	30
Absolute error	23	4	19	21	7	14

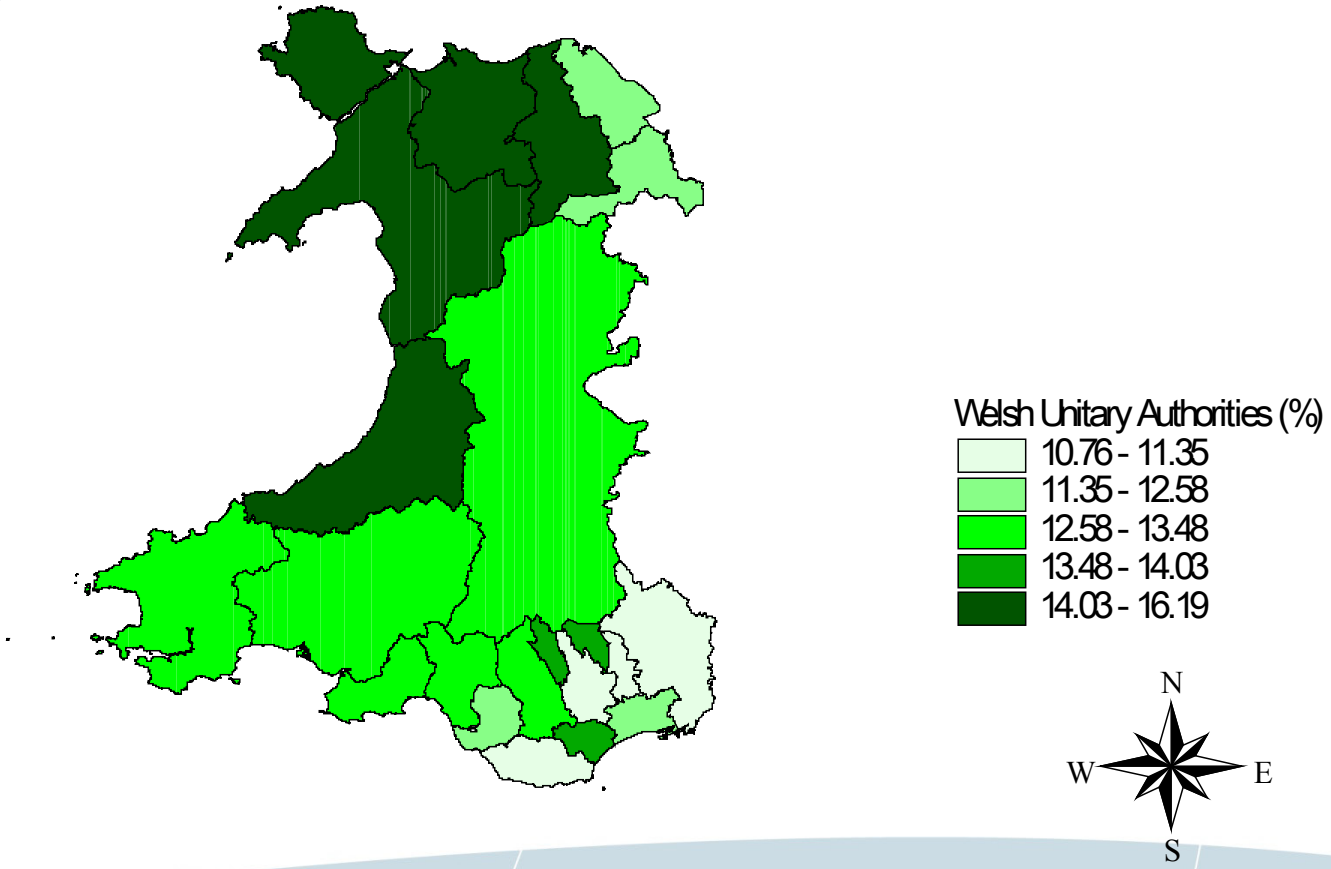
Estimated geography of happiness in Wales *(%) happy more than usual, 1991*



Estimated geography of happiness in Wales *(%) happy more than usual, 2011*



Estimated geography of happiness in Wales *(%) happy more than usual, 2021*



Combining spatial microsimulation model outputs with remote sensing data

Spatial microsimulation output:

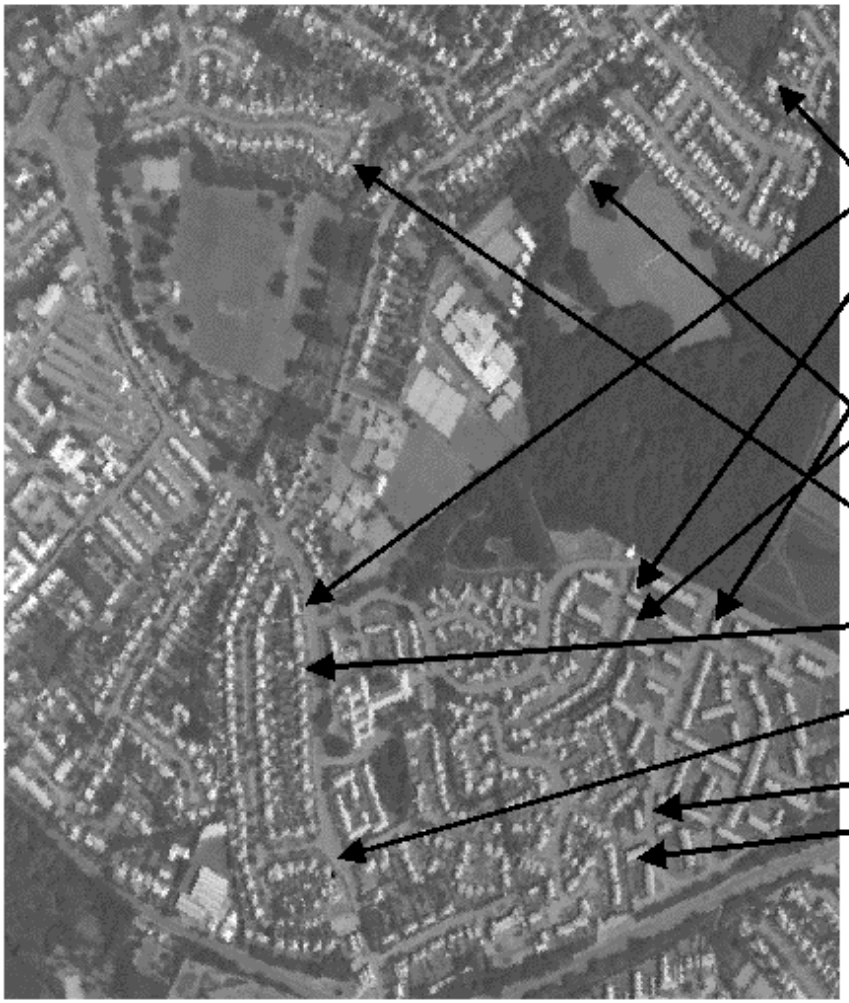
- No. of residents in household (as a proxy to house size)
- House type
- Number of cars (as a proxy to house size)
- Number of rooms in household space (as a proxy to house size)

Remotely sensed data:

- land use
- property size
- house type

"visibility" data

Remotely Sensed data



Microsimulation model output

Household ID	HHSPTYPE	ED-CODE	TENURE	.	.	.
108604	Detached	08DAFX33	Rented from Local Authority / NT E+W	.	.	.
178913	Terraced	08DAFX33	Rented from Local Authority / NT E+W	.	.	.
23459	Semi-detached	08DAFX33	Rented from Local Authority / NT E+W	.	.	.
152890	Detached	08DAFX33	Owner Occupied outright	.	.	.
24005	Semi-detached	08DAFX33	Owner Occupied buying	.	.	.
67443	Semi-detached	08DAFX33	Rent private furnished	.	.	.
201538	Detached	08DAFX33	Owner Occupied outright	.	.	.
150226	Terraced	08DAFX33	Rent private unfurnished	.	.	.
5336	Detached	08DAFX33	Rent private furnished	.	.	.
9217	Semi-detached	08DAFX33	Rent private furnished	.	.	.
180156	Semi-detached	08DAFX33	Rent private furnished	.	.	.
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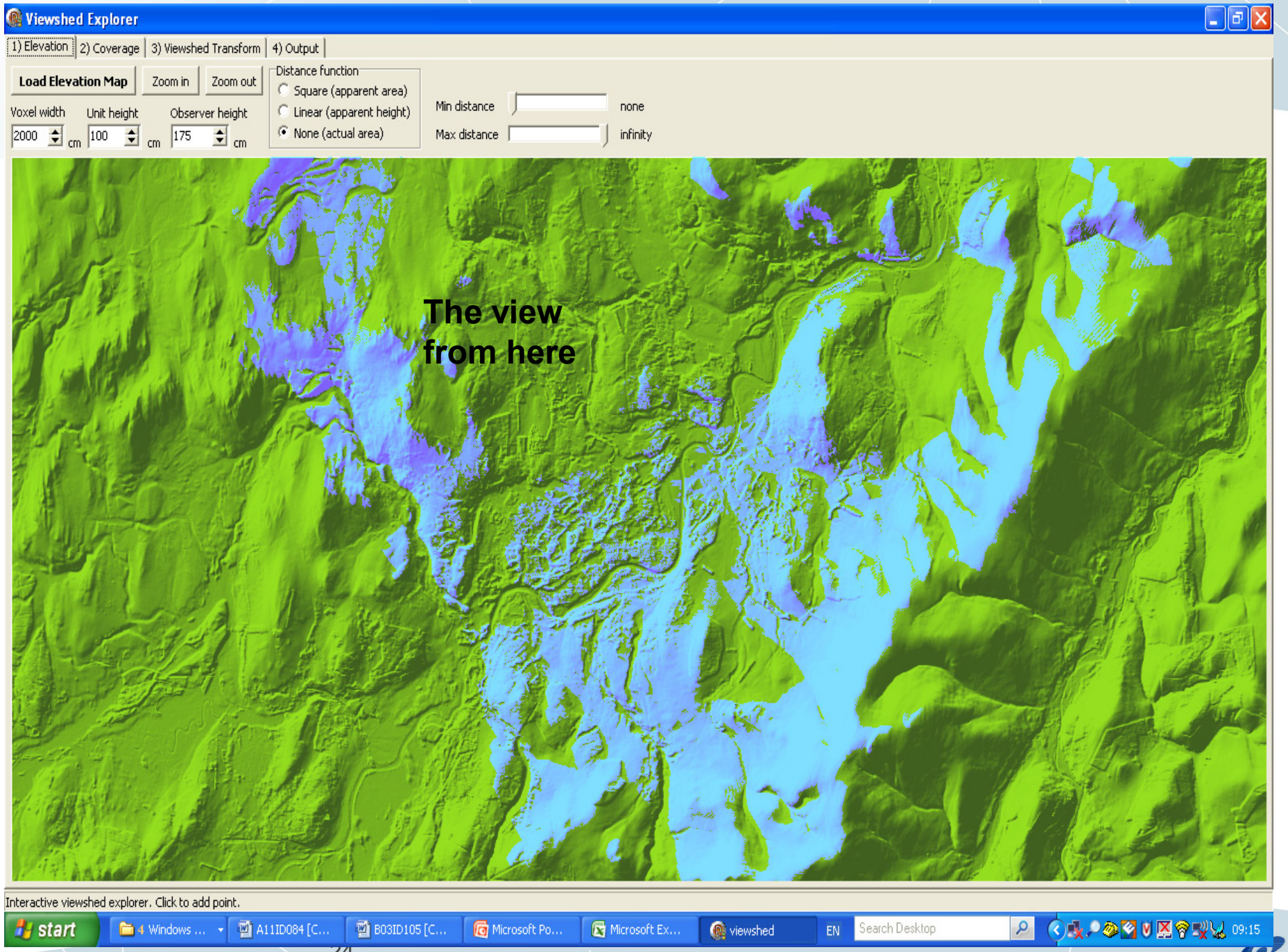
Viewshed Explorer
1) Elevation
2) Coverage
3) Viewshed Transform
4) Output
Load Elevation Map
Zoom in
Zoom out
Distance function
Square (apparent area)
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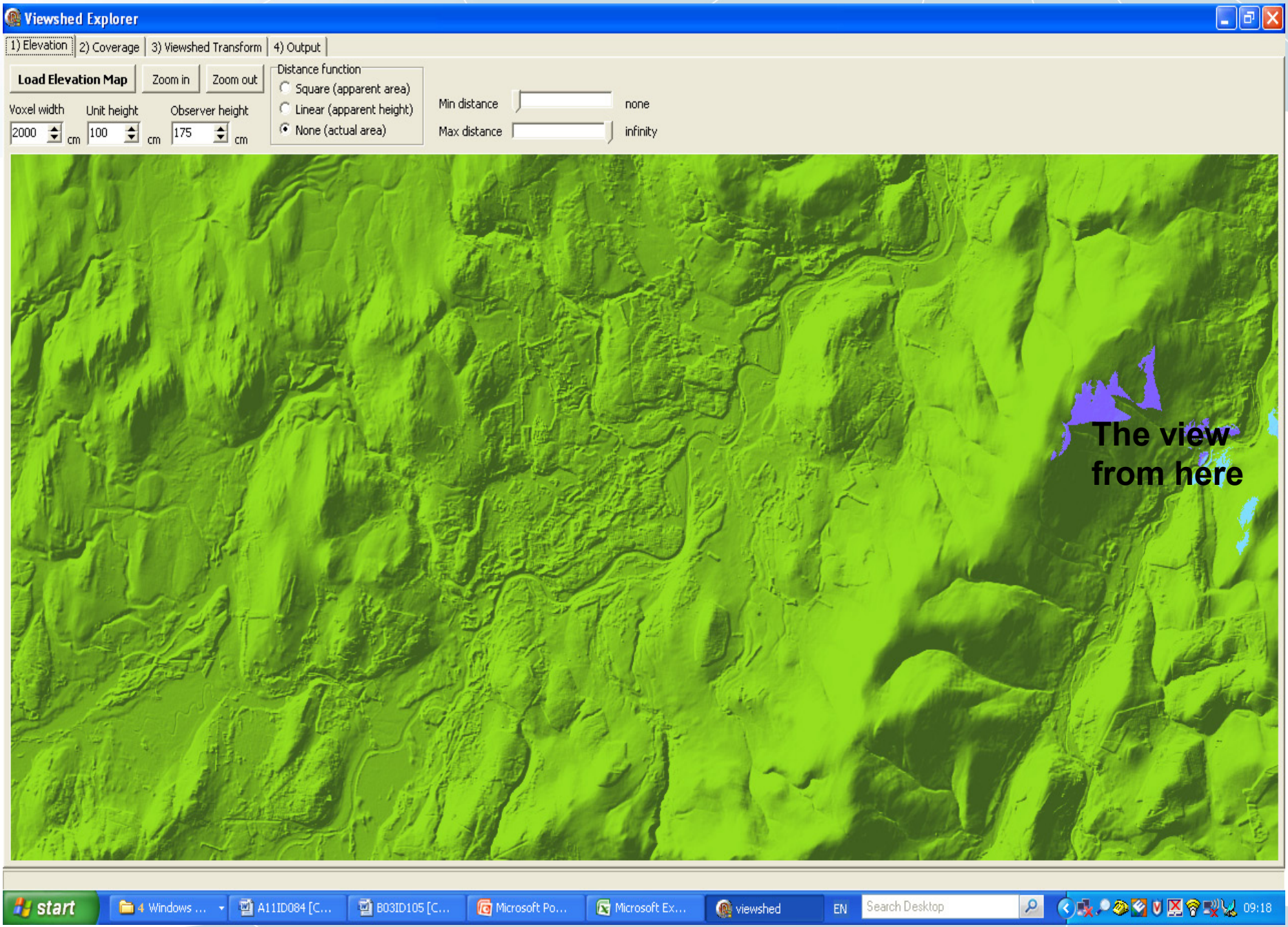
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Conclusions

- Towards a new framework for the combination of remotely sensed data with secondary and simulated data sets in order to provide a powerful database for the geographical analysis of subjective happiness and well-being, building on a rapidly growing body of inter-disciplinary research in this field
- Policy implications:

  - analysis of local policy outcomes

  - inform local debates on issues such as green-spaces and the geographical allocation and extent of geographical features that may be affecting happiness and local well-being.
- potential for calibration and for dynamic modelling of populations.
- Adding “environmental variables” to spatial microsimulation models and “human geography” variables to remote sensing data