

Methodological Issues in the Combined use of GPS, GIS and Accelerometry in Research on Greenspace and Physical Activity with Adolescents

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Green space

Natural environments in urban settings

Quantity and proximity linked to higher levels of physical activity in adults and adolescents

Leisure time use of green space and its relationship to physical activity

Method

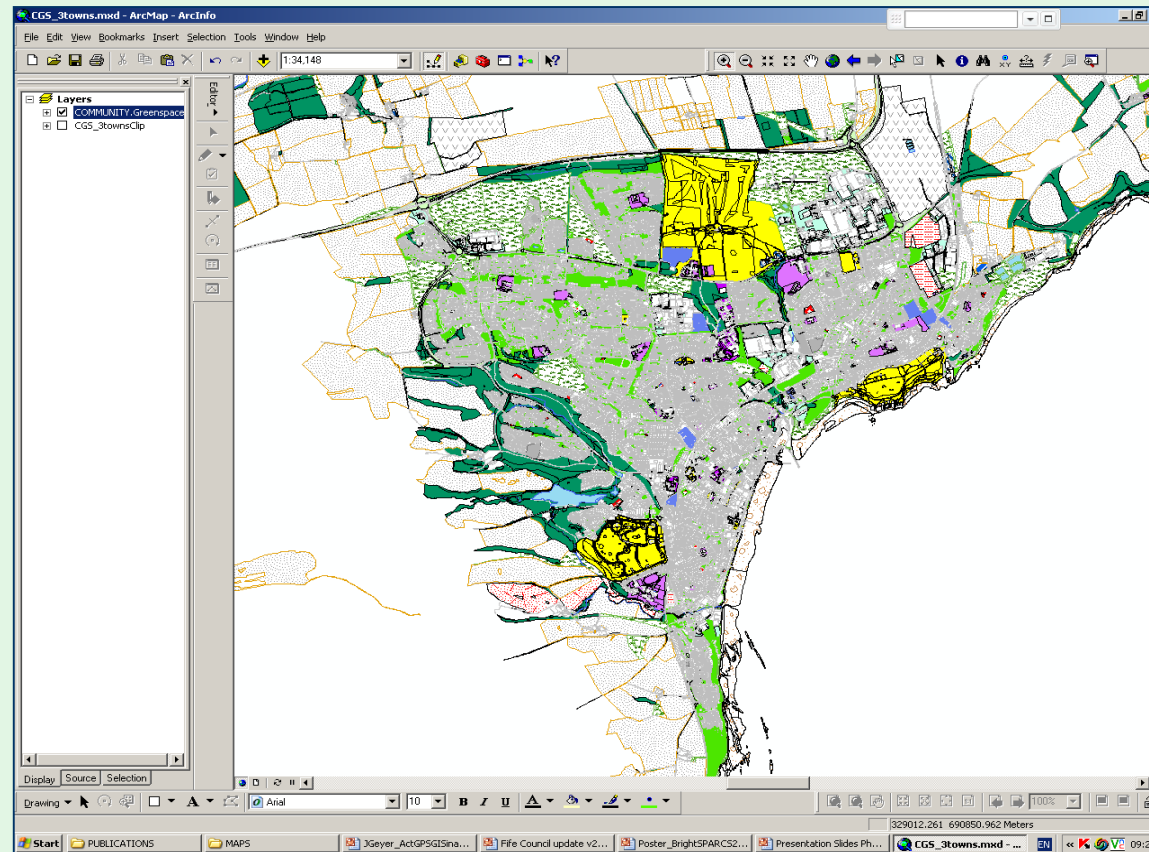
- 35 adolescent girls and boys aged 13 and 15 years from 3 towns in Fife, Scotland
- Monitoring of physical activity using Actigraph AM7164 uniaxial accelerometers – 30s epoch, all waking hours
- Tracking of geospatial behaviour with Blackberry 8900 GPS enabled mobile phones using GPSlogger* - 30s epoch, kept with them at all times

* Sourced from macberry.com

- Fife Council GIS green space layer – used to assign green space land use code to GPS location data



GPS enabled
Blackberry



Experiences - Fieldwork

Data Loss

- GPSlogger and fiddling fingers!
- Applock

Acceptability

- Incentive
- Acceptable look
- Primarily a phone
- Familiarity with recharging
- Large memory – 1GB, >16,000 recordings

- Dash to volunteer
- Approval of phone
- Good variety of volunteers

Limitations

- Separate to accelerometer and not attached to body
- Expense limits sample size

Experiences - Data processing and analysis

- Using GIS data to characterise GPS data from phones
- Missing data and imputation

Microsoft Excel - V28A11_example of merged.xls

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	ID	Longitude	Latitude	newdatetime	Day	timeperiod	weekend	LU_CODE	Distance	CPS	Missing	Adjacent		
260	2,435	-3.43913600000	56.04362600000	16-Jun-2010 16:09:30	16	3	0	6.21	0.00	0	0	0		
261	2,436	-3.43922800000	56.04358100000	16-Jun-2010 16:10:00	16	3	0	6.21	0.00	0	0	0		
262	2,437	-3.43925000000	56.04353700000	16-Jun-2010 16:10:30	16	3	0	6.21	1.92	0	0	0		
263	2,438	-3.43930700000	56.04339600000	16-Jun-2010 16:11:00	16	3	0	6.21	0.03	3	0	1		
264				16-Jun-2010 16:11:30	16	3	0			339	1	0		
265	2,439	-3.43938000000	56.04354000000	16-Jun-2010 16:12:00	16	3	0	6.21	0.78	1,025	0	1		
266	2,441	-3.43921400000	56.04343400000	16-Jun-2010 16:12:30	16	3	0	6.21	0.00	11	0	0		
267	2,442	-3.43936000000	56.04341500000	16-Jun-2010 16:13:00	16	3	0	6.21	1.02	1	0	0		
268	2,443	-3.43936200000	56.04338100000	16-Jun-2010 16:13:30	16	3	0	6.21	0.00	431	0	1		
269				16-Jun-2010 16:14:00	16	3	0			125	1	0		
270	2,444	-3.43953300000	56.04350800000	16-Jun-2010 16:14:30	16	3	0	6.21	0.40	0	0	1		
271	2,445	-3.43925100000	56.04358300000	16-Jun-2010 16:15:00	16	3	0	6.21	0.00	0	0	1		
272				16-Jun-2010 16:15:30	16	3	0			0	1	0		
273				16-Jun-2010 16:16:00	16	3	0			0	1	0		
274				16-Jun-2010 16:16:30	16	3	0			0	1	0		
275				16-Jun-2010 16:17:00	16	3	0			0	1	0		
276				16-Jun-2010 16:17:30	16	3	0			0	1	0		
277				16-Jun-2010 16:18:00	16	3	0			0	1	0		
278	2,446	-3.43913900000	56.04329400000	16-Jun-2010 16:18:30	16	3	0	6.21	0.00	0	0	1		
279	2,447	-3.43939200000	56.04350700000	16-Jun-2010 16:19:00	16	3	0	6.21	2.01	0	0	0		
280	2,448	-3.43927900000	56.04343700000	16-Jun-2010 16:19:30	16	3	0	6.21	0.00	0	0	0		
281	2,449	-3.43930600000	56.04345300000	16-Jun-2010 16:20:00	16	3	0	6.21	0.00	0	0	0		
282	2,450	-3.43934100000	56.04344300000	16-Jun-2010 16:20:30	16	3	0	6.21	0.00	0	0	0		
283	2,451	-3.43920400000	56.04341500000	16-Jun-2010 16:21:00	16	3	0	6.21	0.00	0	0	0		
284	2,452	-3.43924700000	56.04329900000	16-Jun-2010 16:21:30	16	3	0	6.21	0.00	0	0	0		

Joining GIS with GPS

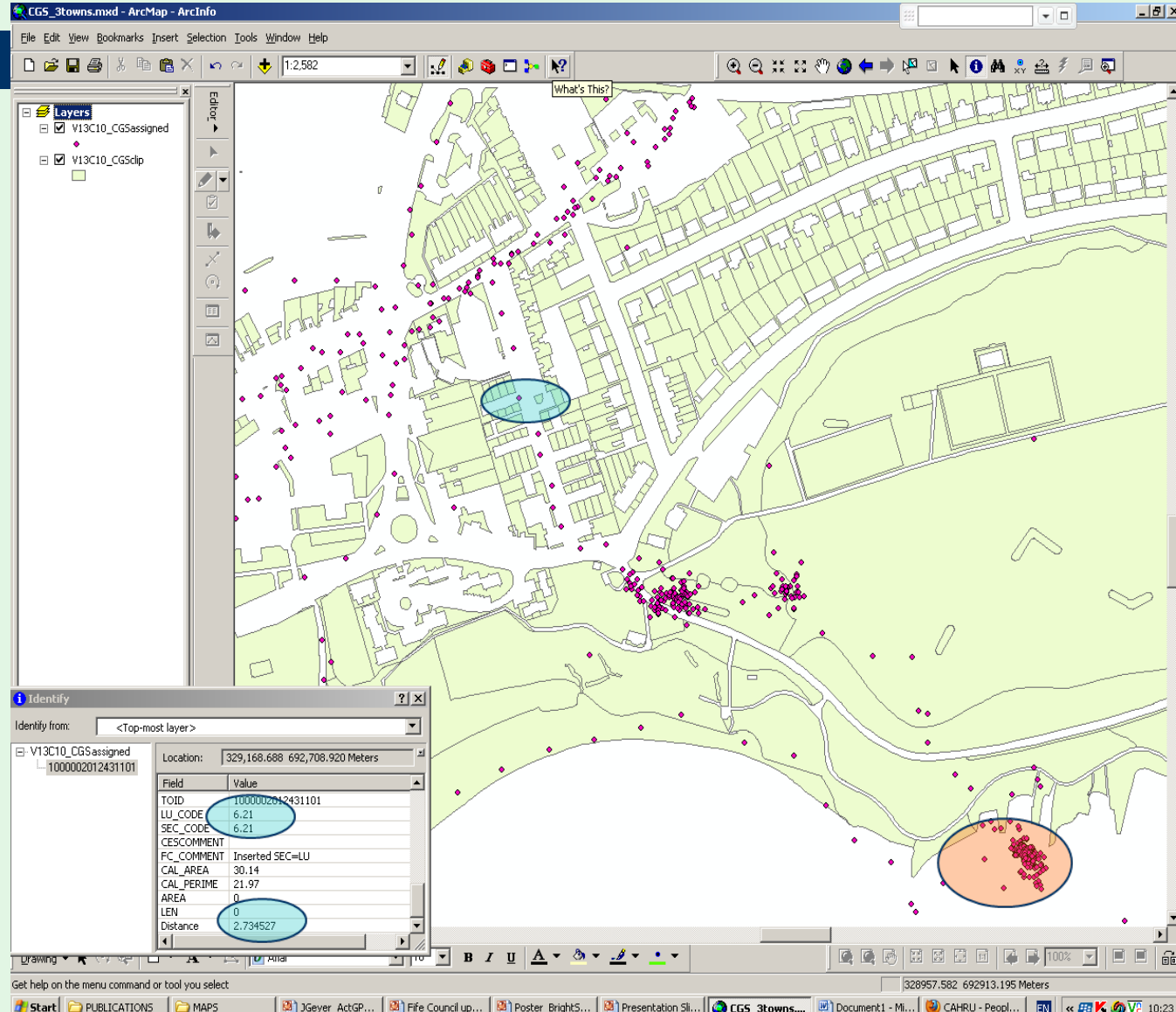
- A GS code was assigned to all GPS data with a distance value

Non-GS

*(Home/street/shops)
assigned a GS code –
usually a garden*

*Requirement to post
process to reclassify
and exclusion of
garden exposure*

- Beach erroneously treated as non green space



Missing Data and Imputation

- Amount of missing data extremely variable between individuals ranging from 98.6% to 8.3% (includes low quality participants)
- Exclusion of days where actigraph data >30mins unexplained gap or GPS >60 mins gap – possible non-compliance
- Total percentage missing data for aggregate dataset was 25% (before imputation)
- Pattern of missing data – frequency of durations, reasonable to impute?
- Imputation – if bounded by same code and within 35m of each other then impute based on last known land use coding
- Is it reasonable to assume missing data is non-GS?
 - proportion of boundary pairs that are in GS
 - probability that longer missing sections are bounded by nonGS
- 15% of bounding GPS points were GS coded

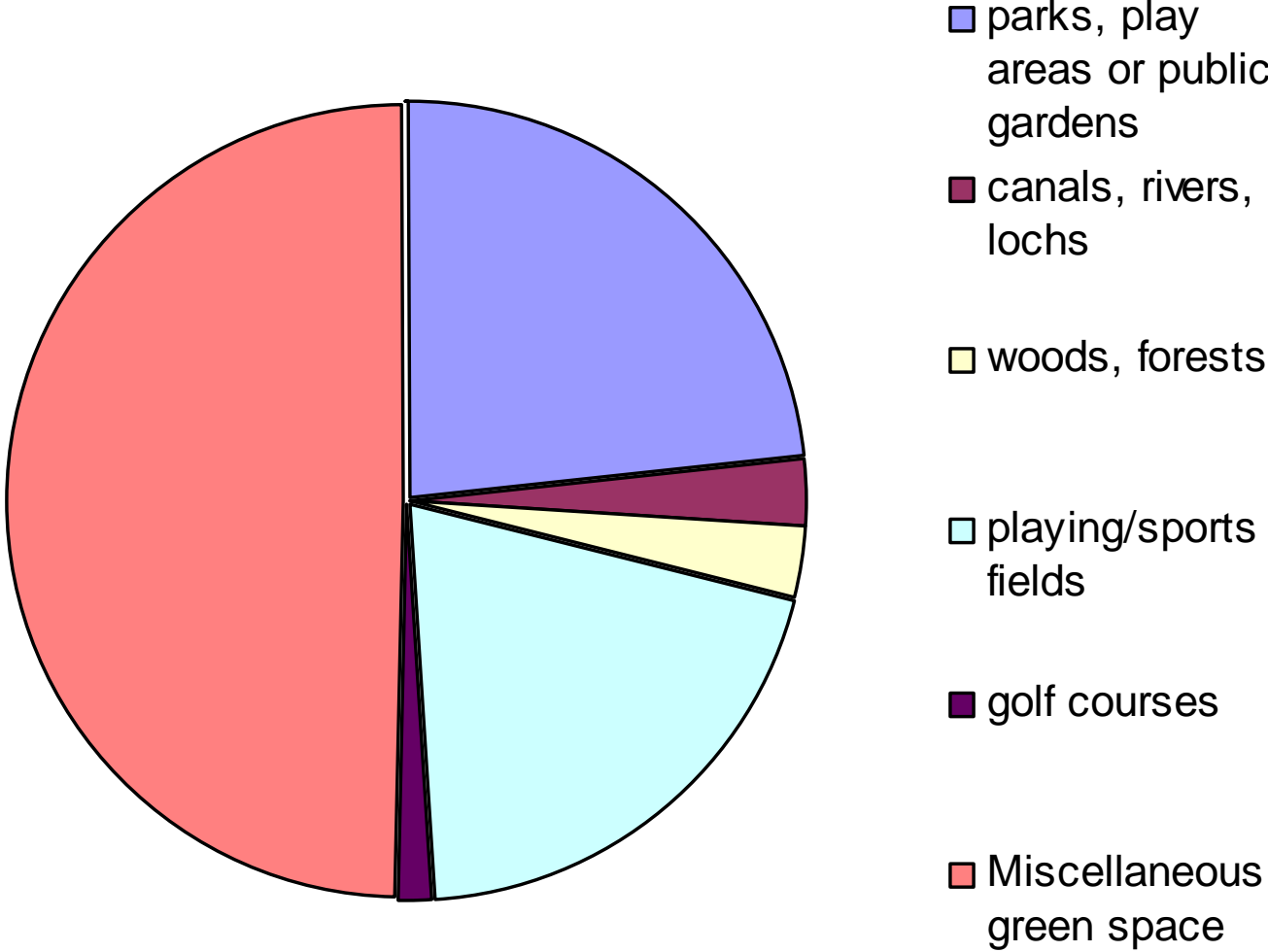
Conclusions

- Exciting method with great appeal to adolescents
- Promising level of detail and accuracy for researchers
- Fieldwork and data handling challenging
- Caution required in reliance on results from this method

Compliance

- Recharging
- Keeping Blackberry with them at all times
 - Signal loss: signal obstruction or switched off
 - Signal in the home: participant at home or left unit behind
- Requirement for additional information – balance with burden
 - Interviews
 - Live tracking battery information
 - Survey sent daily to phones

**Local GS use during non-school time (summer term)
by a group of urban teenagers aged 13 and 15 years in
Fife, Scotland**



Local GS use during non-school time (during summer term time) by a group of urban teenagers aged 13 and 15 years in Fife, Scotland

	Average mins in GS	Average mins of PA level 1 in GS [equivalent to 750cpm cut off]	Average mins of PA level 2 in GS [equivalent to 2000cpm cut off]	Average mins of PA level 3 in GS [equivalent to 3500cpm cutoff]
per school day	56	28	18	9
Range	none to >3 hours			
per weekend day	94	32	21	12
Range	33 to >4 hours			

**Based on aggregate dataset before imputation

Aim

- Investigate green space use and physical activity in green space by adolescents during their leisure (non-school) time

Questions

- How much do adolescents in Scotland use greenspace during their leisure time?
- How active are they in green space?
- What contribution does green space make to leisure time physical activity?

Details of aggregate dataset

Days of “complete” data	No. of adolescents
1	4
2	10
3	4
4	1
5	2

Adolescent group	Number in aggregate sample
S2	12
S4	9
Girls	10
Boys	11

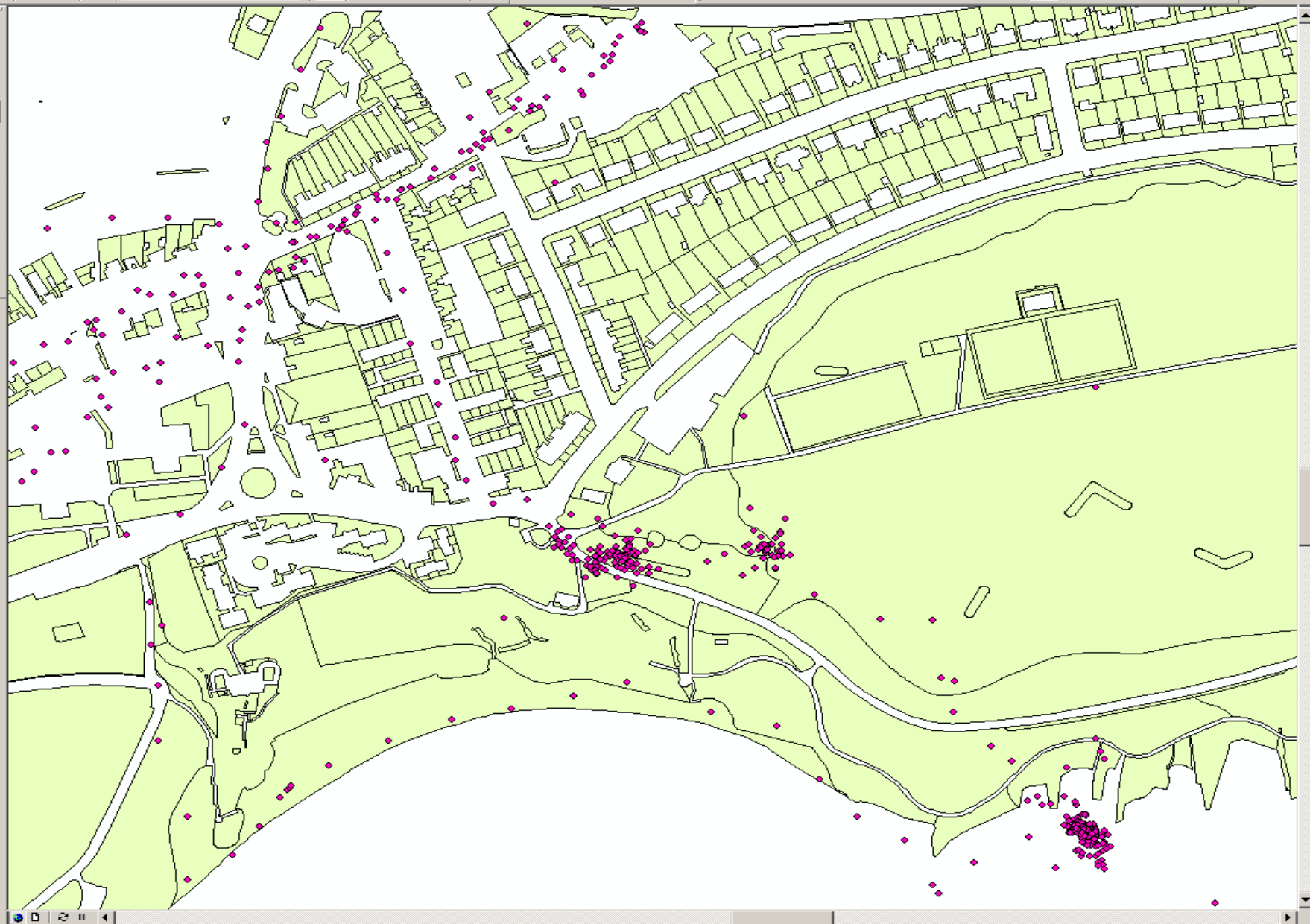
Dataset so far consists of 50 “complete” days including weekdays and weekends from 21 participants

Layers

- V13C10_CG5assi
- V13C10_CG5clip
 - <all other val
 - LU_CODE
 - 6.1
 - 6.21
 - 6.22
 - 6.23
 - 6.31
 - 6.32
 - 6.4
 - 6.51
 - 6.52
 - 6.53
 - 6.54
 - 6.6
 - 6.71
 - 6.72
 - 6.73
 - 6.81
 - 6.82
 - 6.83
 - 6.84

Display
Source Selection

Editor

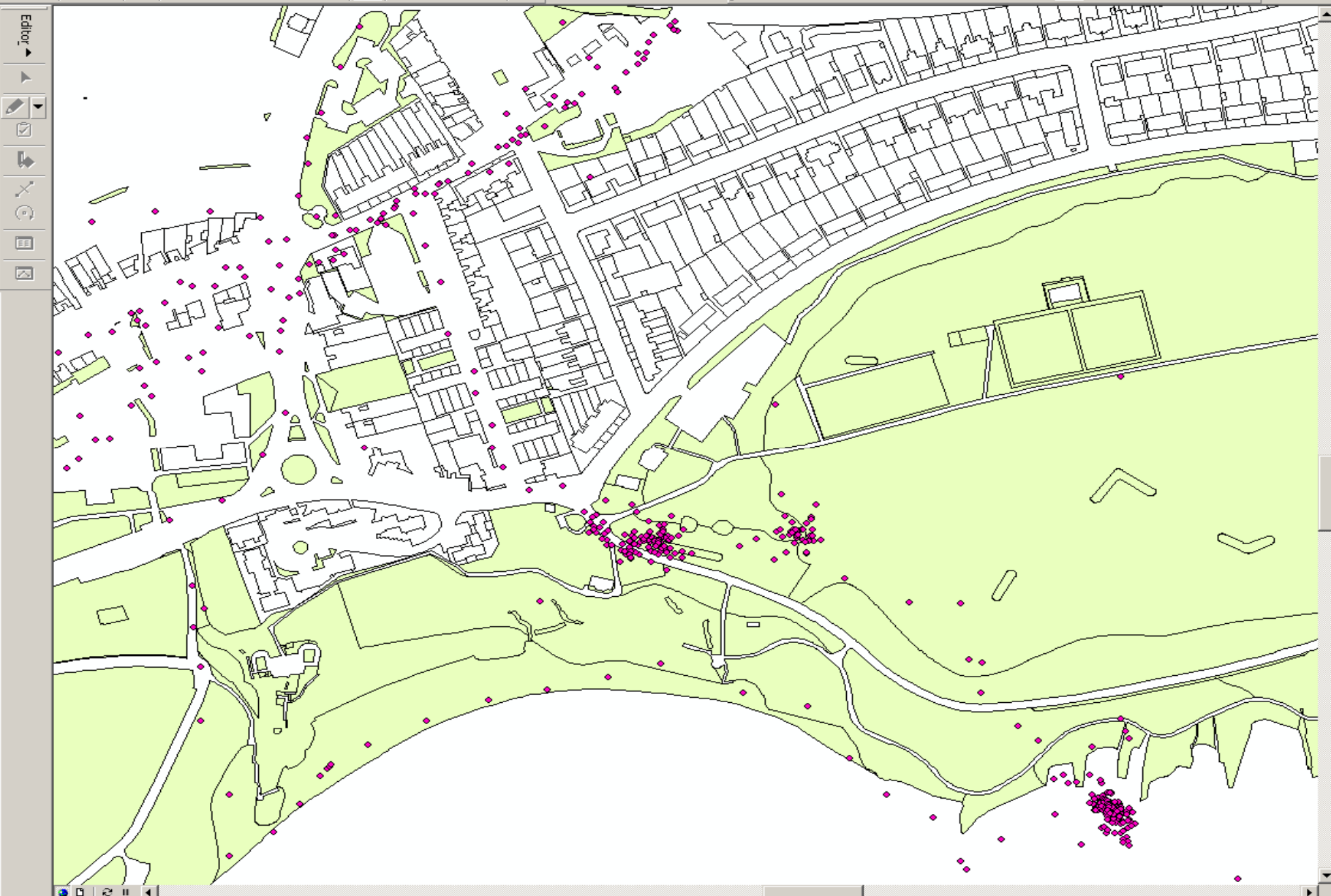


Layers

- V13C10_CG5assi
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 - 6.31
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 - 6.51
 - 6.52
 - 6.53
 - 6.54
 - 6.6
 - 6.71
 - 6.72
 - 6.73
 - 6.81
 - 6.82
 - 6.83
 - 6.84

Display

Source Selection



Experiences – Data management and analysis

Overview

1. GPS data trimmed in SPSS to leave only leisure time
2. **In ArcGIS clipped non-local trips and joined to green space layer**
3. In SPSS merged with leisure time actigraph data using date & time
4. Created aggregate file
5. **Quality check of actigraph and GPS data**

Layers

- V94C21_CG5clip
- V94C21_GPSprojec

Display Source Selection

Editor

Edit Task

