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PROPENSITY TO CYCLE TOOL

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The Propensity to Cycle Tool

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UNIVERSITY OF WESTMINSTER

UNIVERSITY OF LEEDS

Department for Transport

History of PCT

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PROPENSITY TO CYCLE TOOL

History

- The Propensity to Cycle Tool (PCT) was created to support cycle infrastructure planning in England and Wales.
- Developed by academic team for DfT with additional research and policy funding
- Open source code base, free to use website, and data downloads
- Initially just for commuting, now includes travel to school
- Launched 2017 with major updates in 2018 / 2019

Use of the PCT

- Features in national guidance on cycling within England and Wales.
- Recorded use by 81 organisations
- The tool has been used both for providing an assessment of baseline cycling conditions in an area, as well as for visualising the potential.
- Used in all regions of England, particularly the south east, south west, the West Midlands and parts of the East of England.
- Most common usage is infrastructure planning, to support the preparation of Local Cycling and Walking Infrastructure Plans (LCWIPs).
- Has been used in 15 successful funding bids, 11 for the Transforming Cities Fund and 4 for the Access Fund for Sustainable travel.

The planning problem

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Where to build cycling infrastructure?

- Where it is easy to build?
- Where there are lots of current cyclists?
- Where there are lots of ***potential*** cyclists?

Where there is high potential?

Where there is high potential

The PCT approach

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PCT methods overview

Census 2011 origin-destination data :

- Travel to work, by mode by sex
- Middle super output area (now also LSOA)
- Distance & hilliness from CycleStreets

Home zone	Work zone	No. Com-muters	No. Cycle	No. Walk	No. Drive	No. Other	Distance (km)	Hilliness (%)
E02002361	E02002362	7	1	0	4	2	0.5	0.3
E02002361	E02002363	38	0	4	24	10	0.9	0.8
E02002361	E02002364	15	1	0	10	4	1.4	0.6
E02002361	E02002366	29	1	10	11	7	2.1	1.4

PCT methods overview

Census 2011 origin-destination data :
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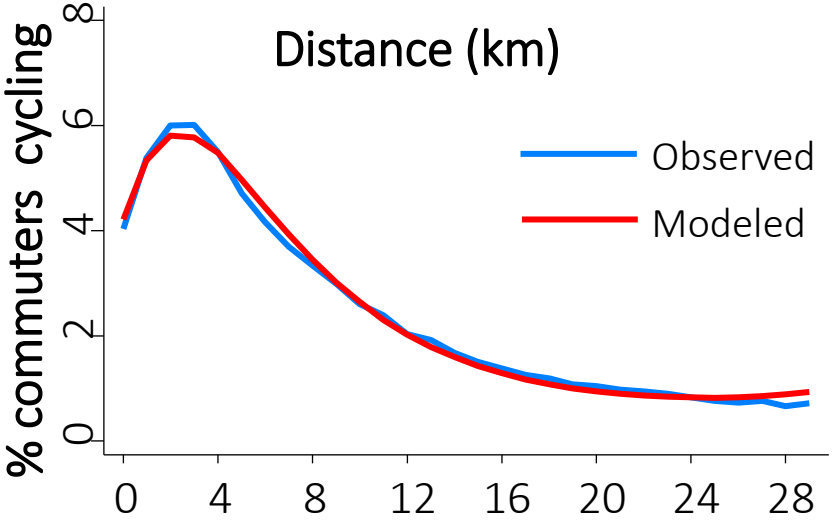
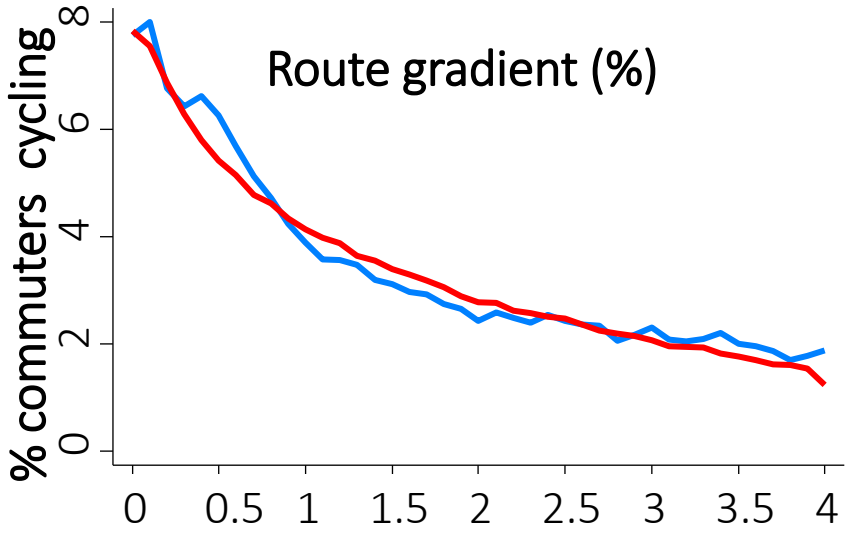
- Middle super output area (/ LSOA)
- Distance & hilliness from CycleStreets

↓

Model current propensity to cycle, as a function of distance and hilliness





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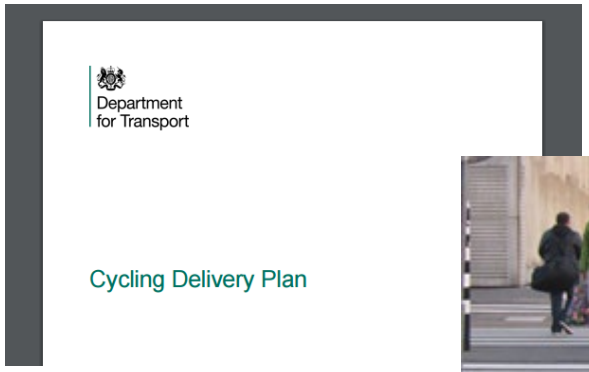
Model cycling uptake, health & carbon impacts in four scenarios

1. Government target
2. Gender equality
3. Go Dutch
4. Ebikes

} *UK, Dutch & Swiss travel surveys*



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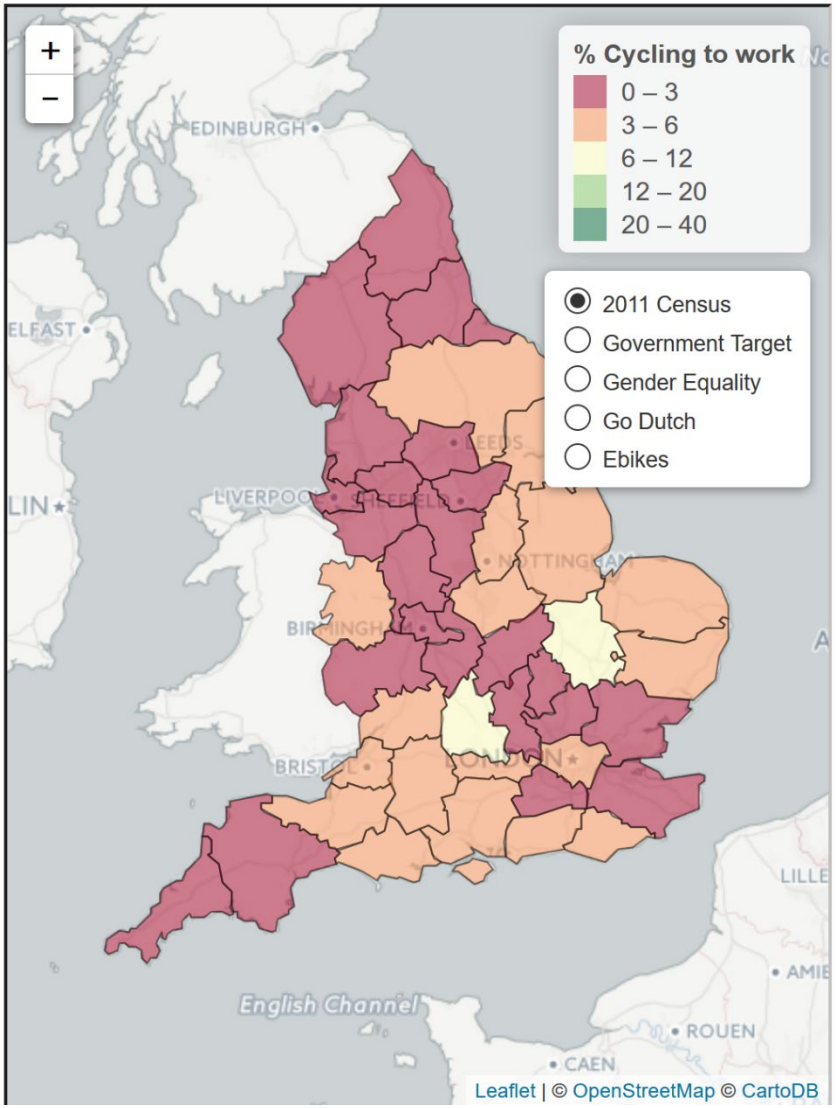
UK, Dutch & Swiss travel surveys

↓

Online visualisation: **www.pct.bike**



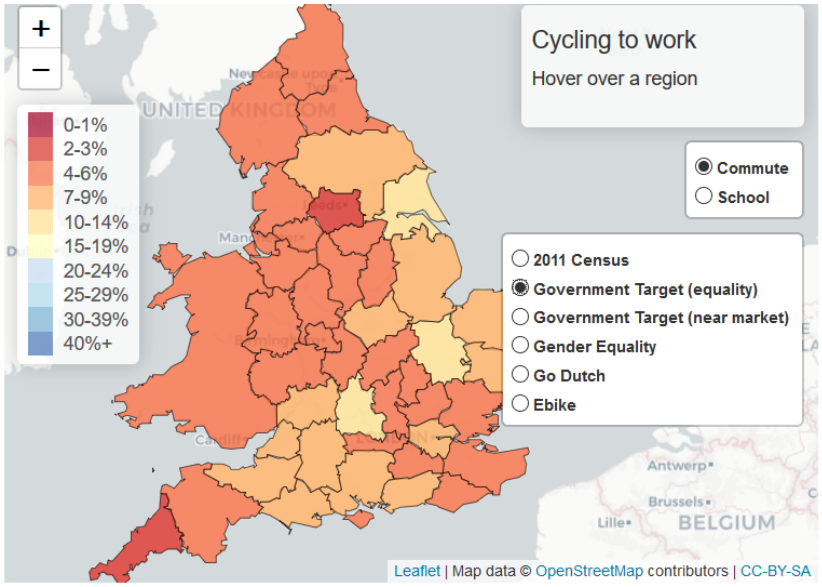
Scenarios

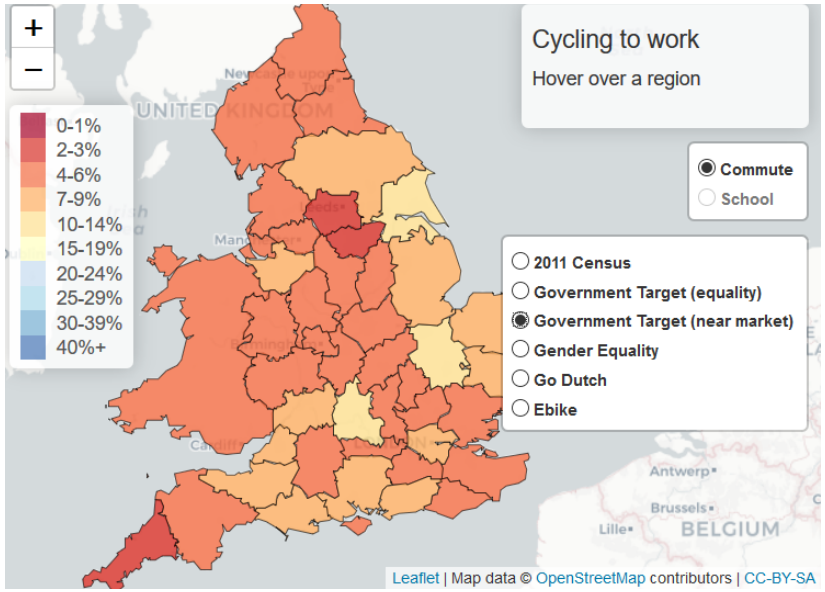
- Estimates cycling potential under scenarios for areas and along routes for the whole of England and Wales.
- Cycling potential calculated based on distance and hilliness
- Scenarios based on hypothetical ‘what if’ including ‘Go Dutch’ and ‘E-bikes’
- Other scenarios: ‘Gender Equity’ and ‘Government Target’

Why scenarios?

- Transport models do not deal well with walking and cycling
- Models highly calibrated on current behaviour are not well suited to consider step changes in behaviour
- Scenarios can show how a future might look like re size & spatial distribution of benefits, then we work out how to get there
- The PCT is agnostic on behaviour change but one social science approach is practice theory, where for a practice to succeed it needs the right combination of – stuff, - skills, and –meanings
- In much of England cycling requires a lot of stuff, high skills, and has meanings that put many people off

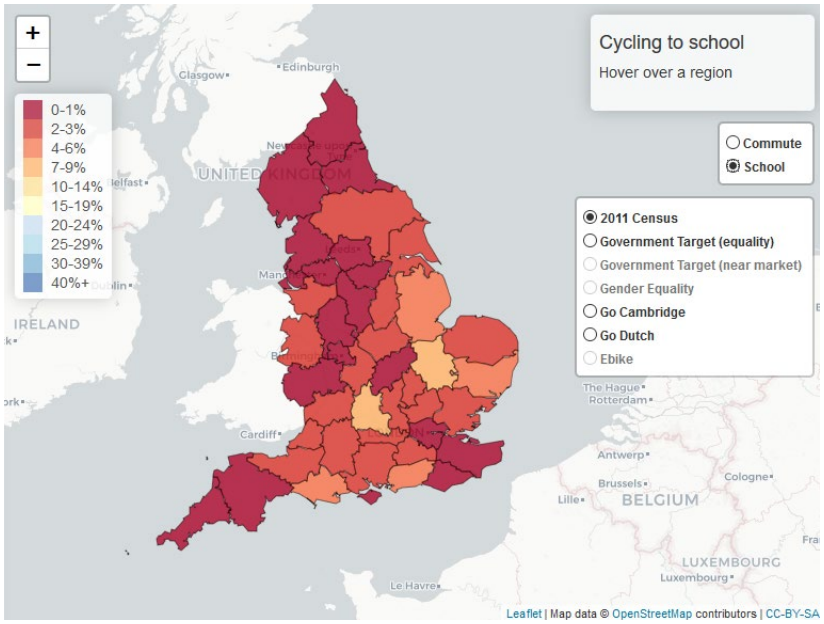
New: Government Target (near market) scenario

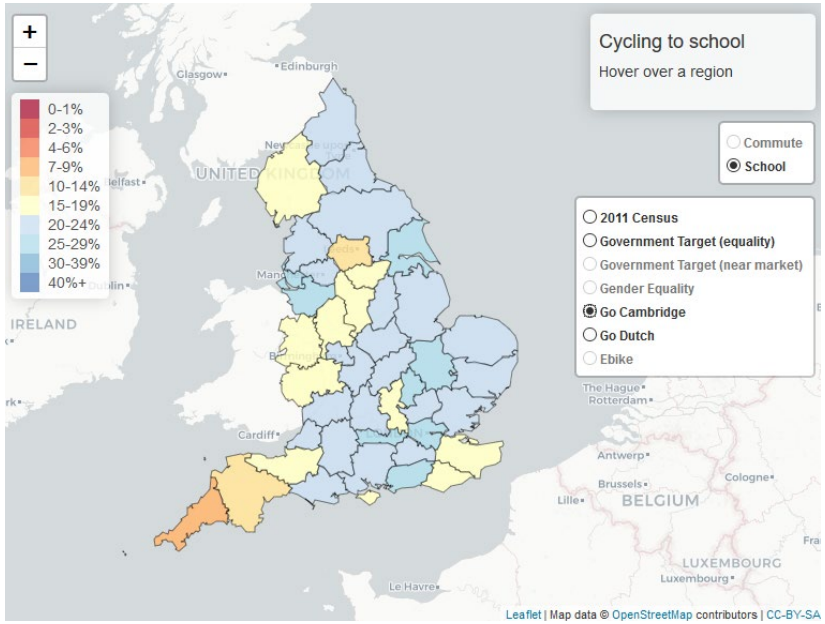




The first Government Target scenario has been renamed as Government Target (equality) to distinguish the two.

New: Schools Layer (and new ‘Go Cambridge’ scenario)

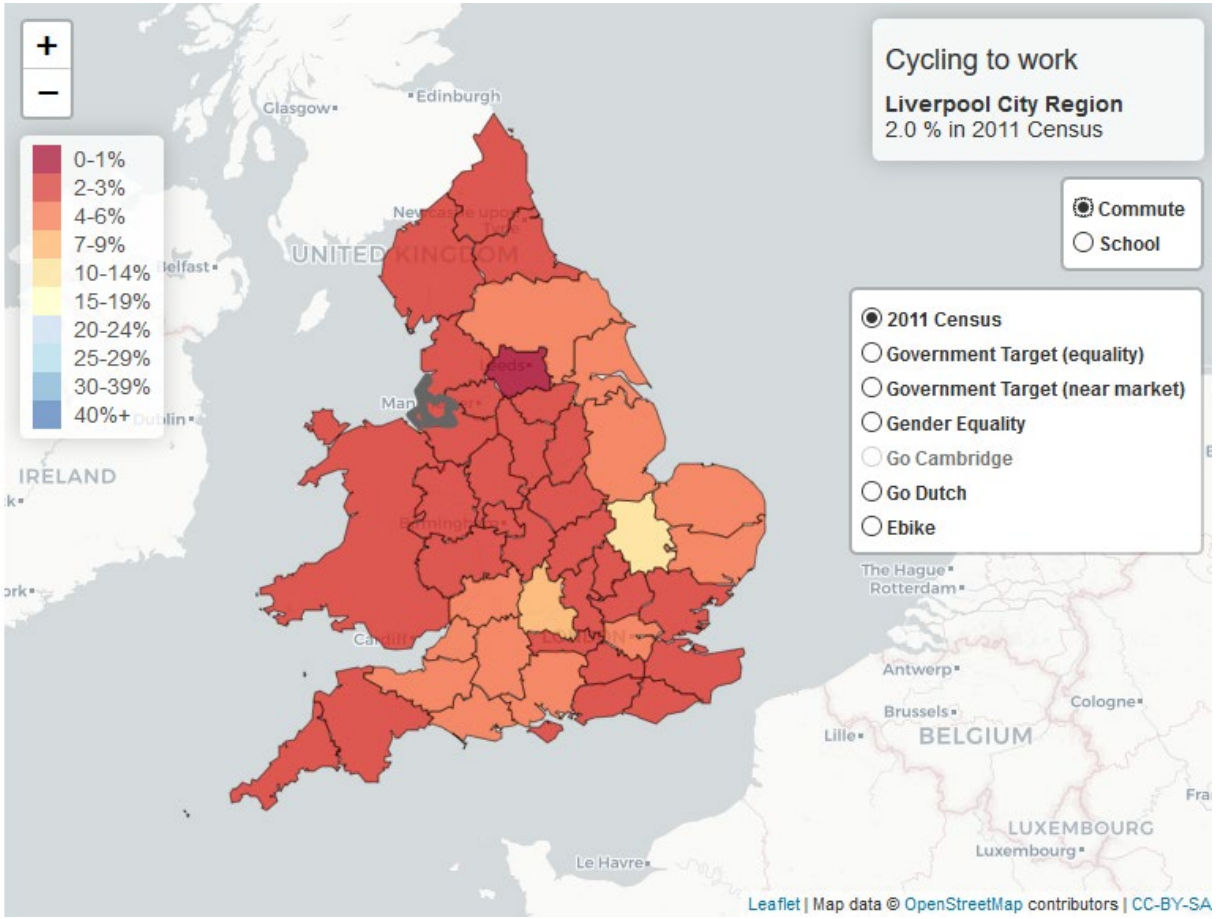




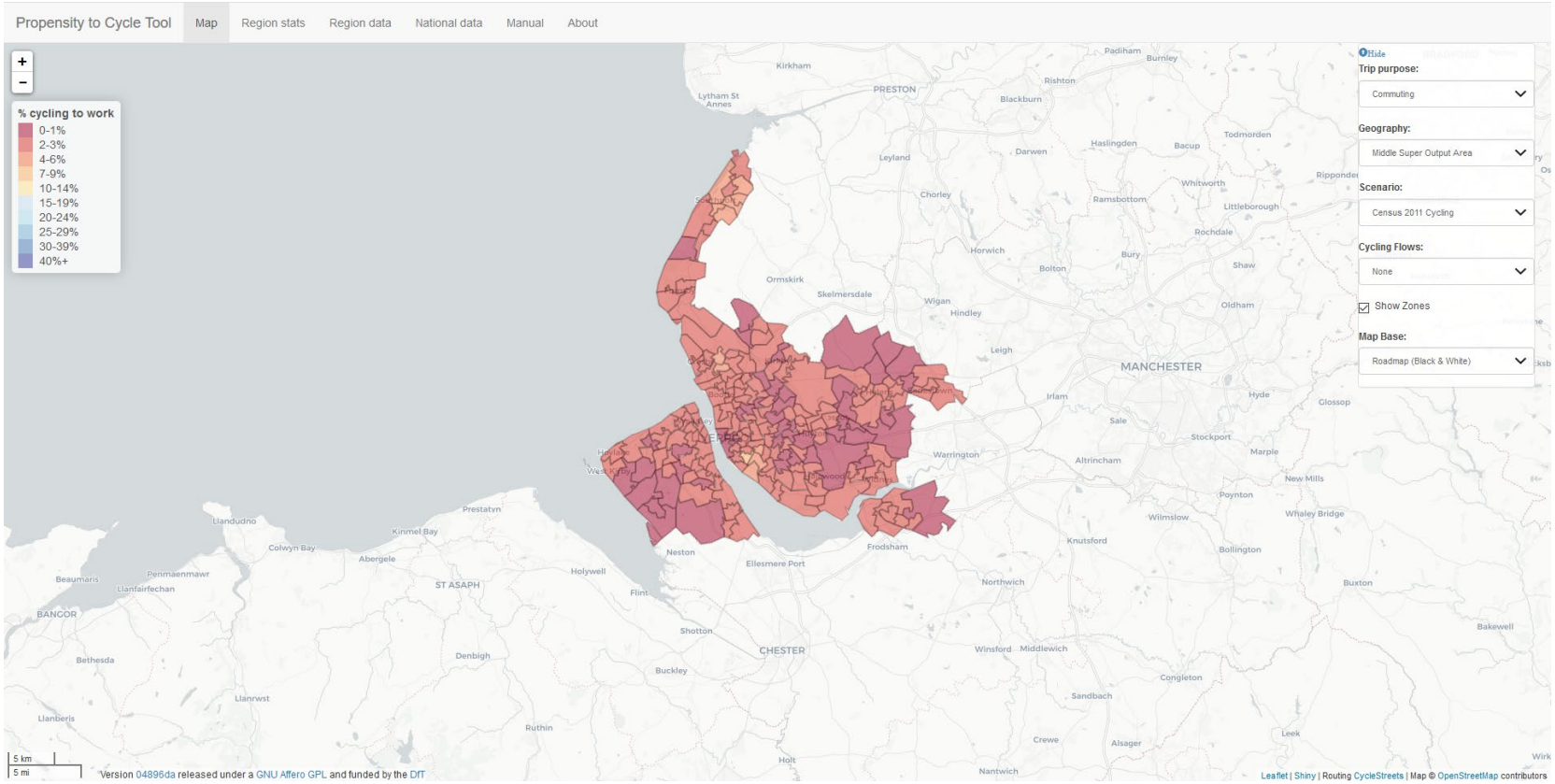
Using the PCT

- Three basic ways:
  - Interface – requires only a web browser
  - Using the data downloads – requires e.g. Excel (for non-geographical data), e.g. QGIS (for geographical data)
  - Reproducing and modifying the code base – coding skills required

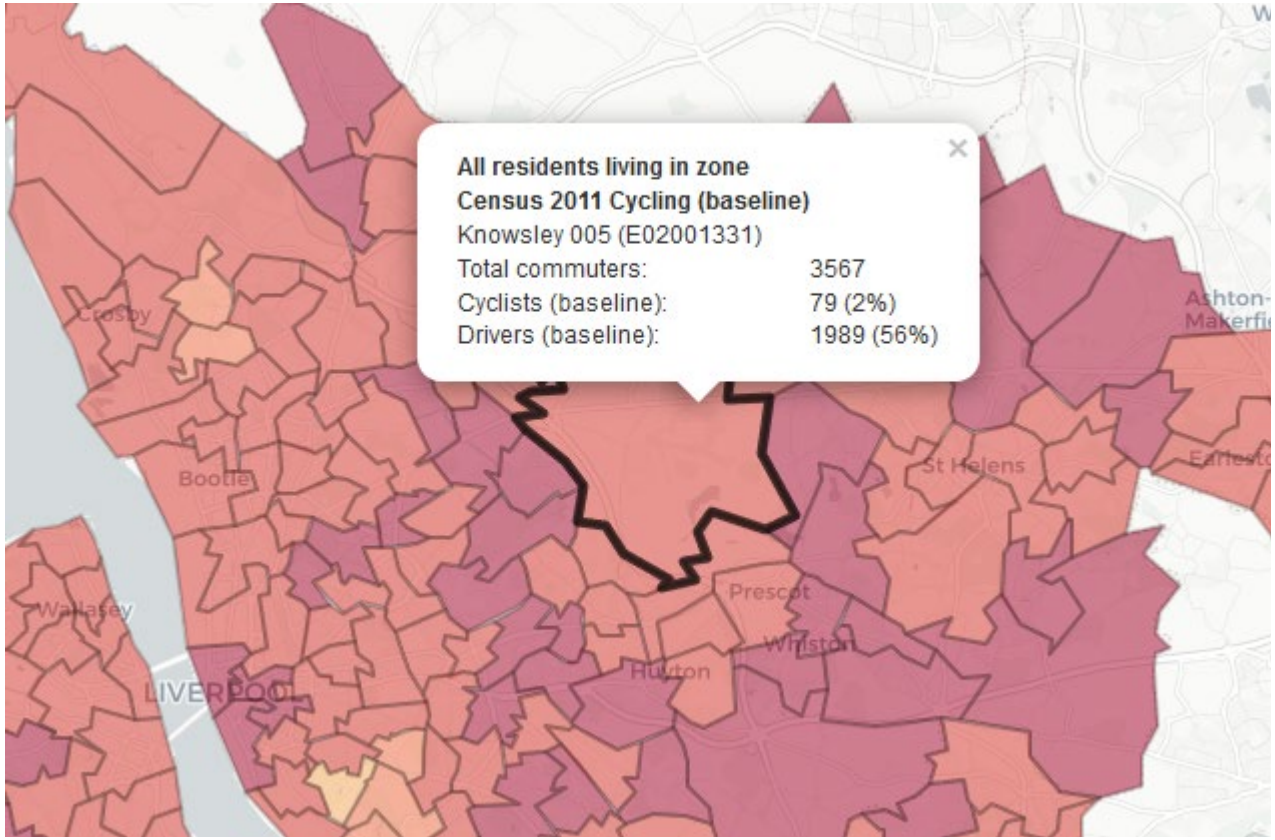
The PCT interface



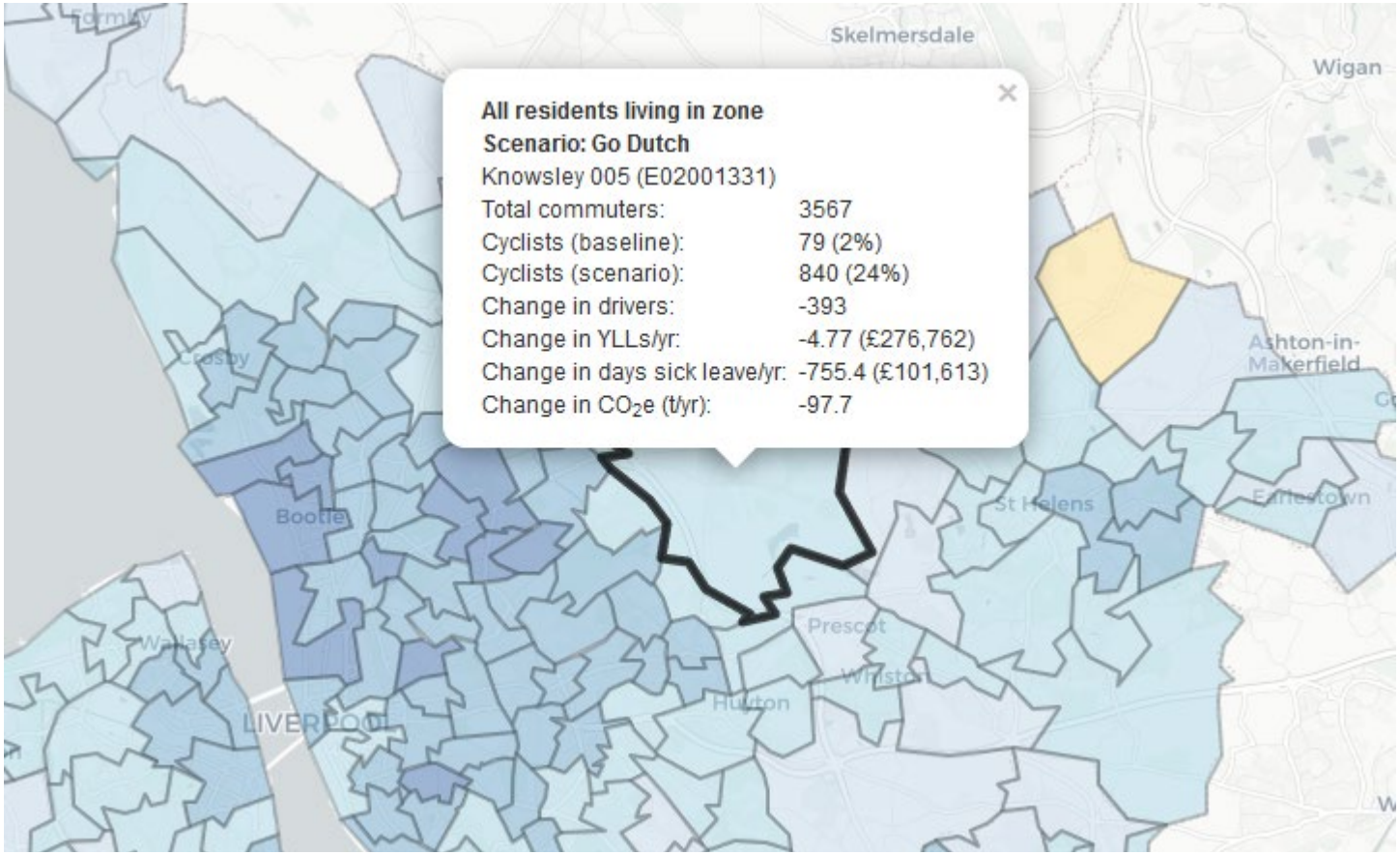
The PCT for Liverpool City Region



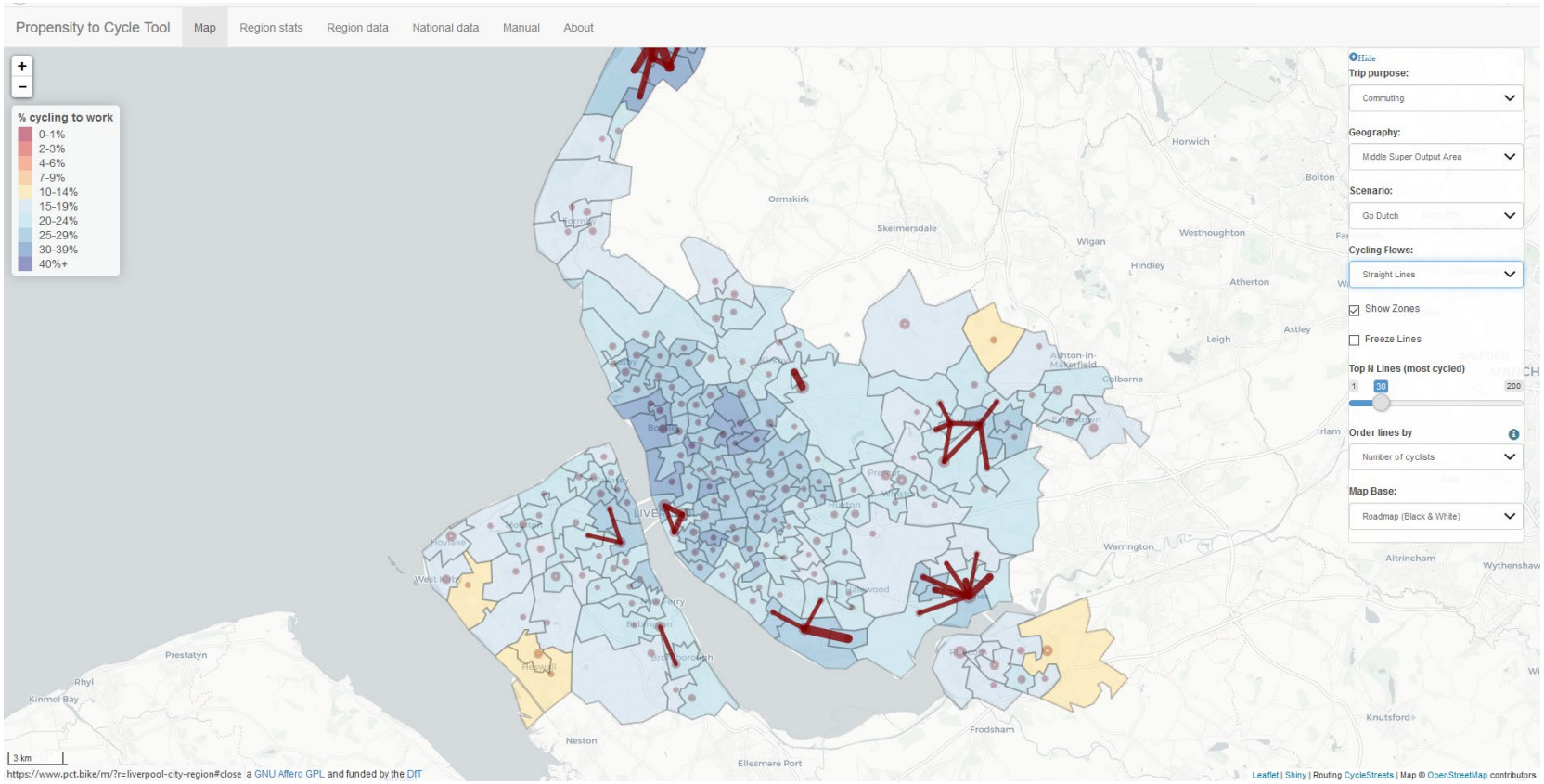
Click area for more information



Scenario-based information



Top N lines feature



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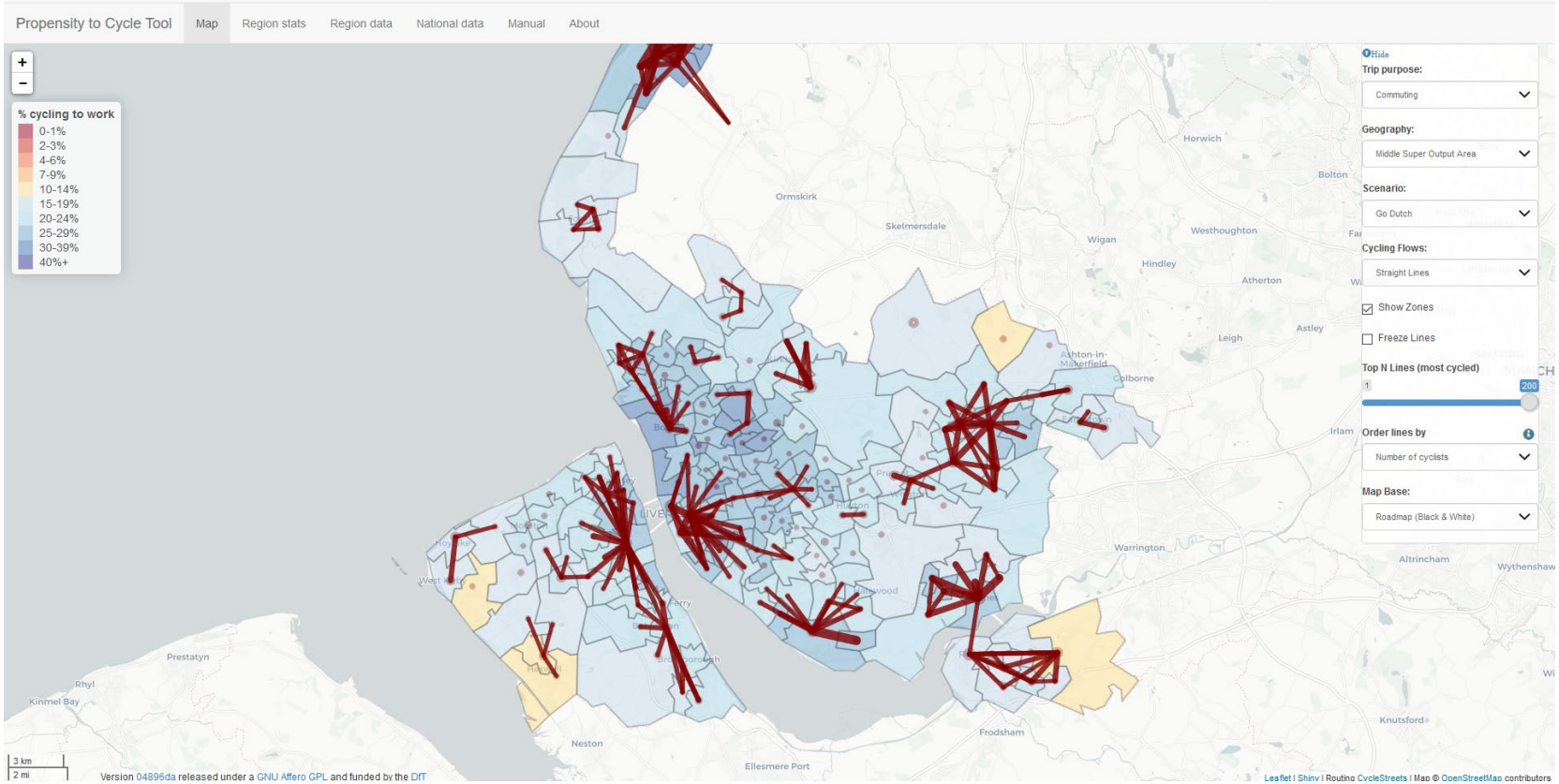
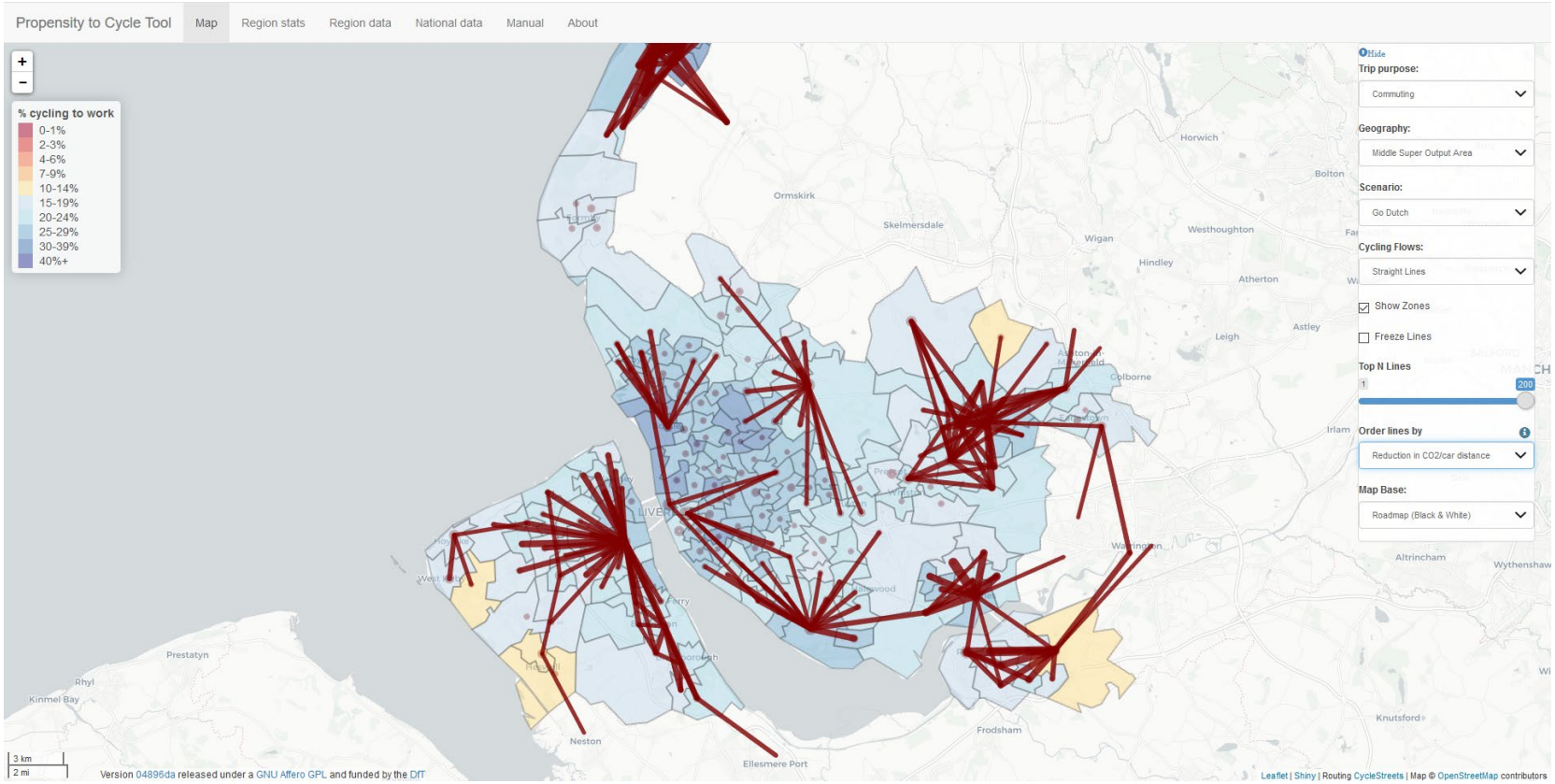
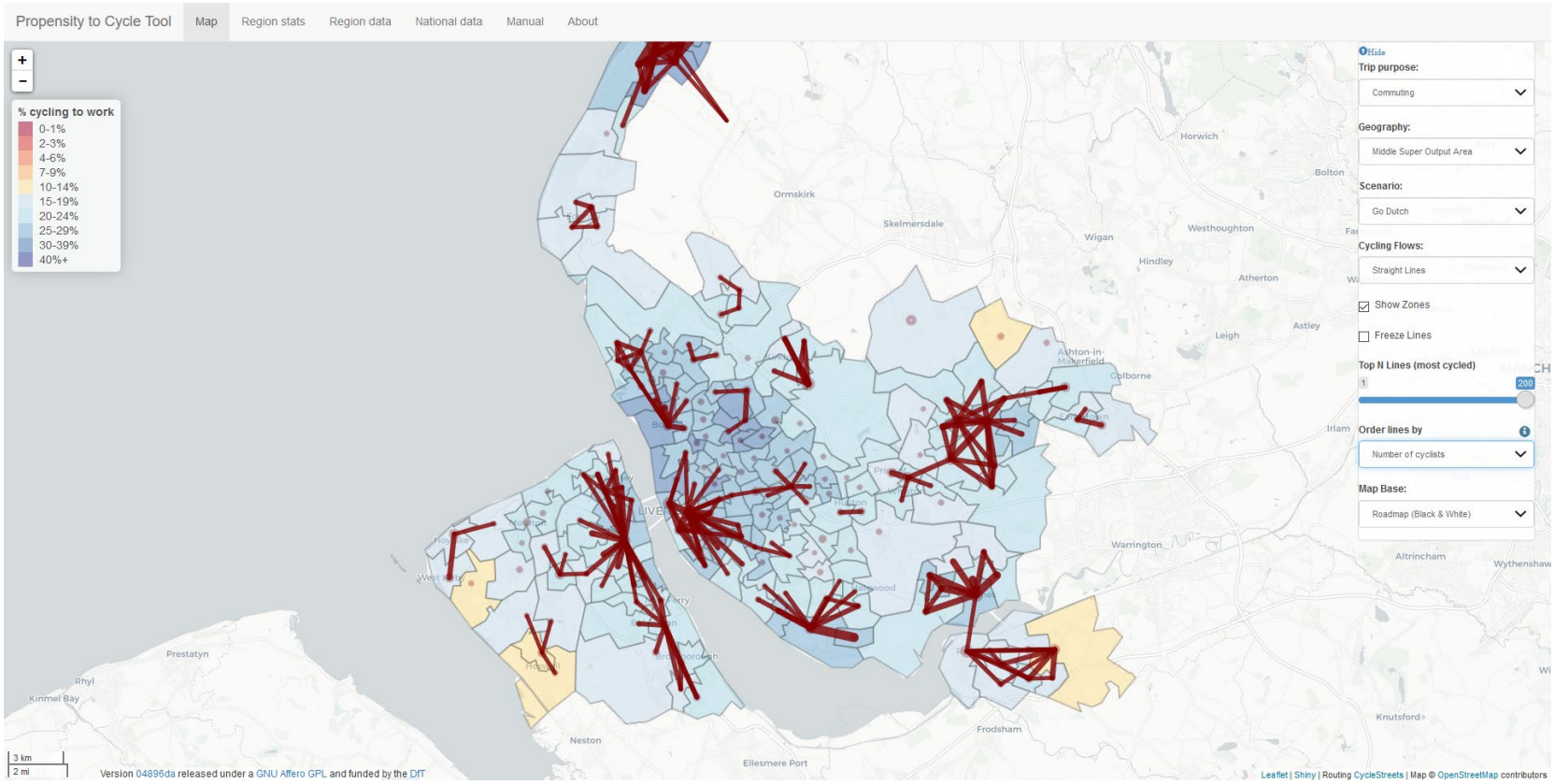


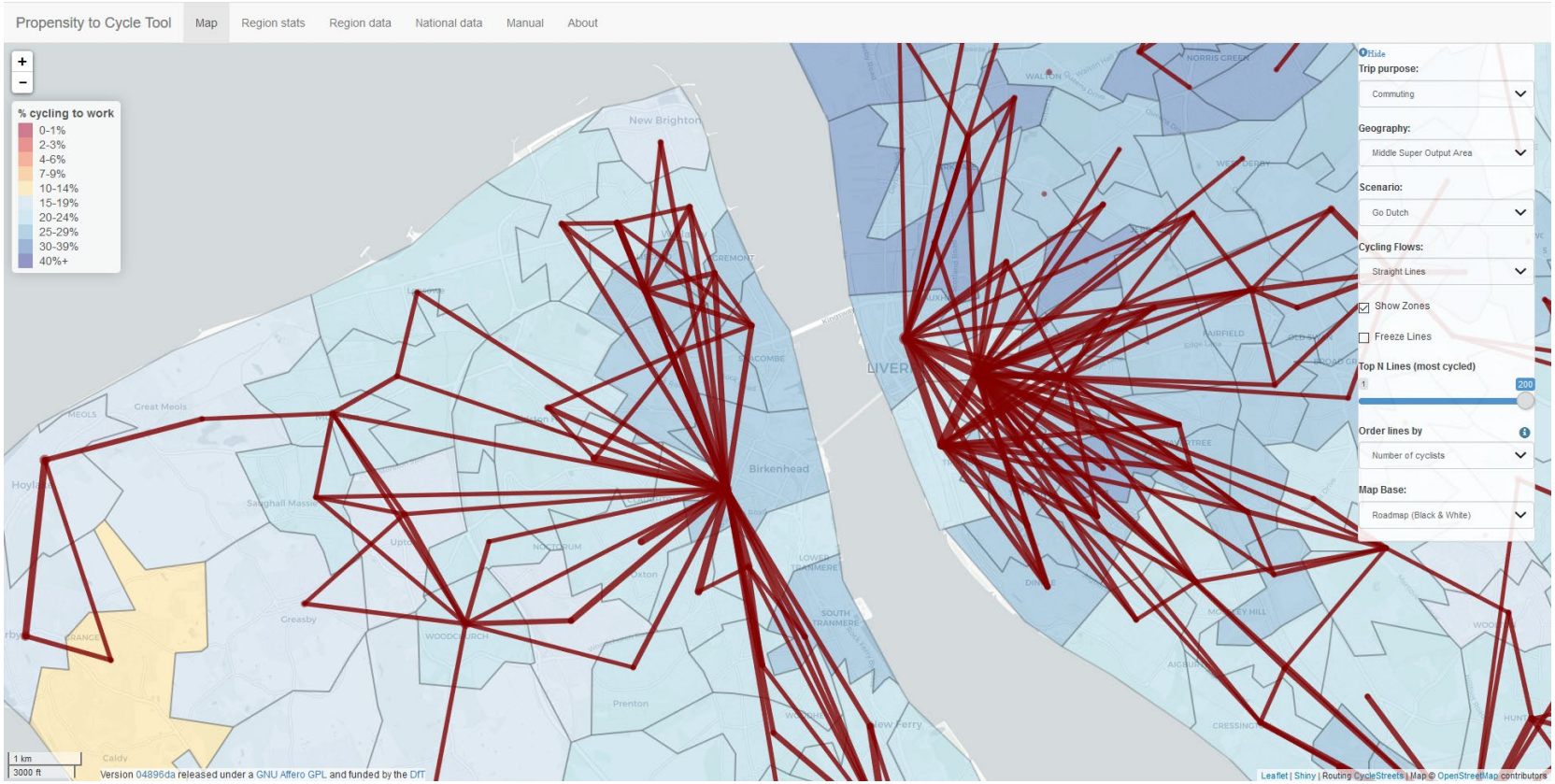
Order lines by: reduction in CO_2



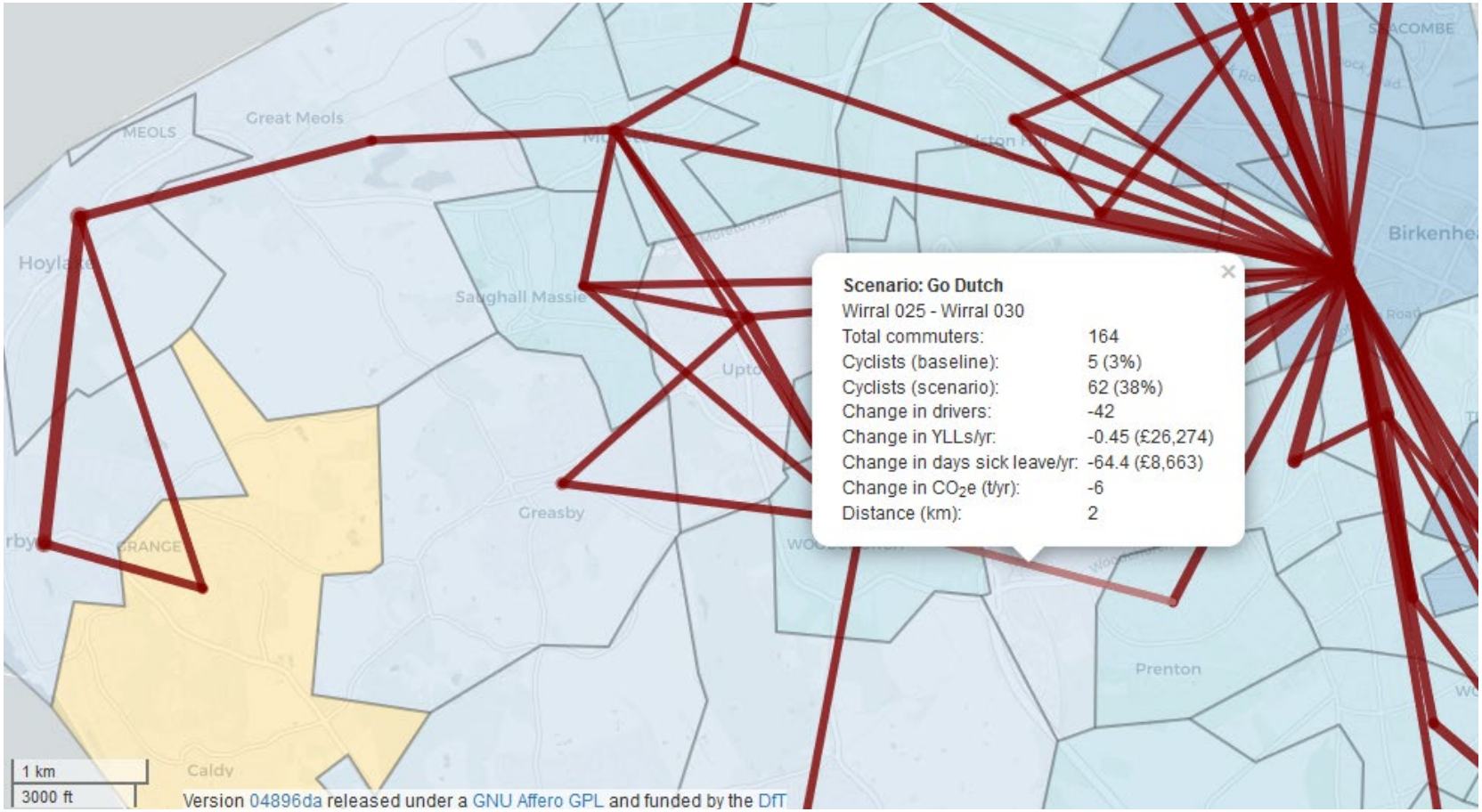
Order lines by: number of cyclists



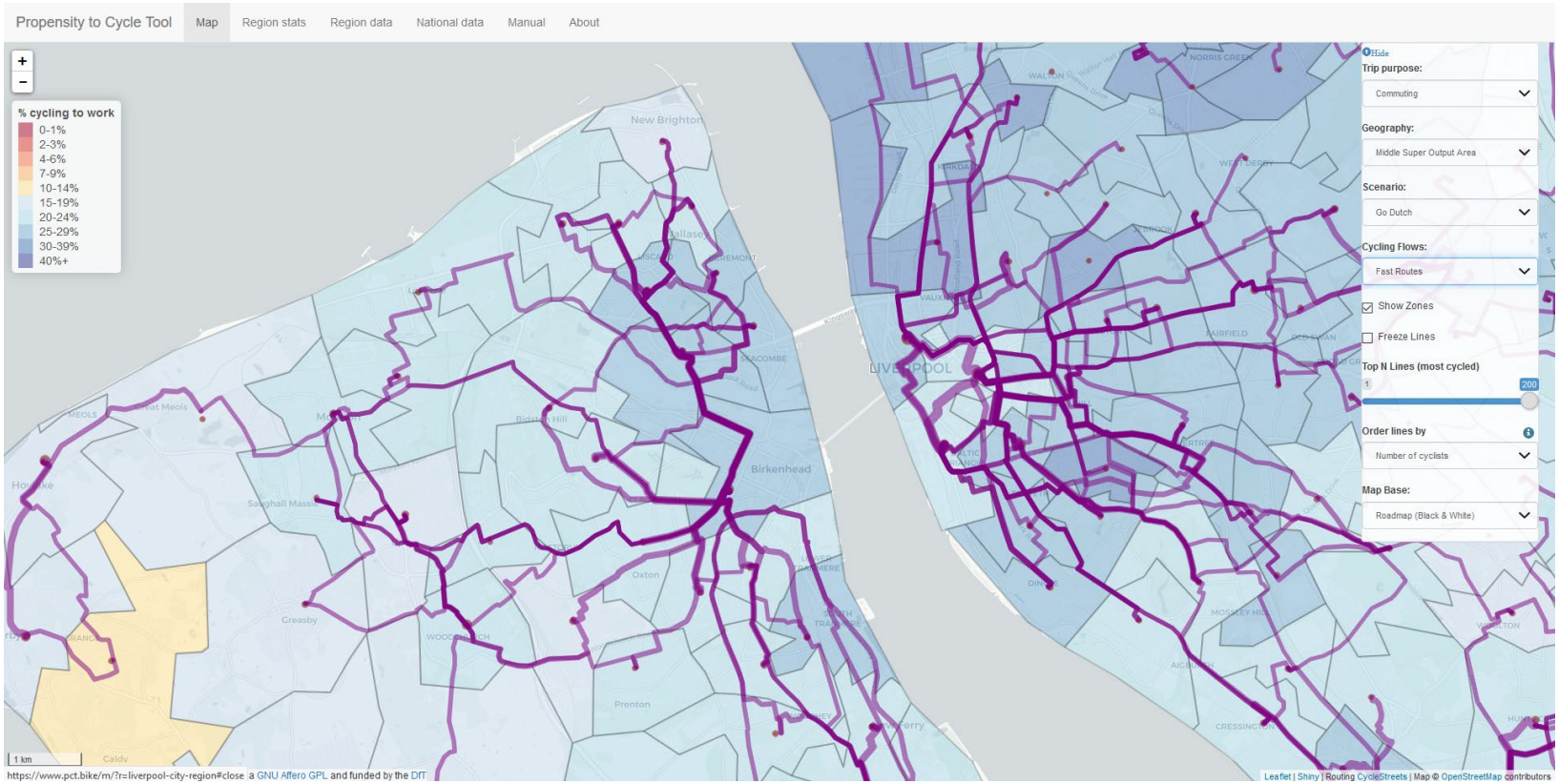
Zooming to Liverpool/Birkenhead



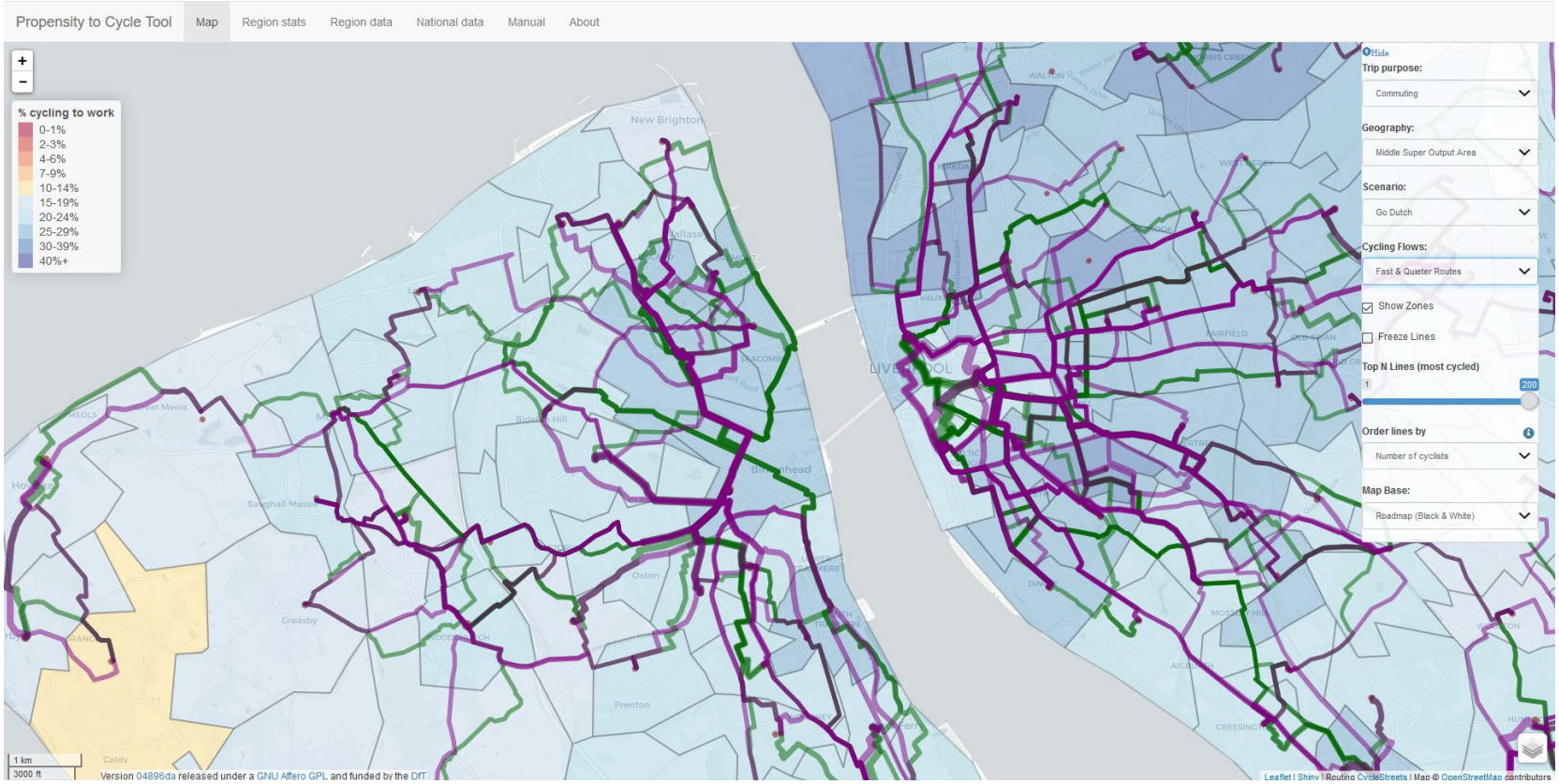
Line-based information



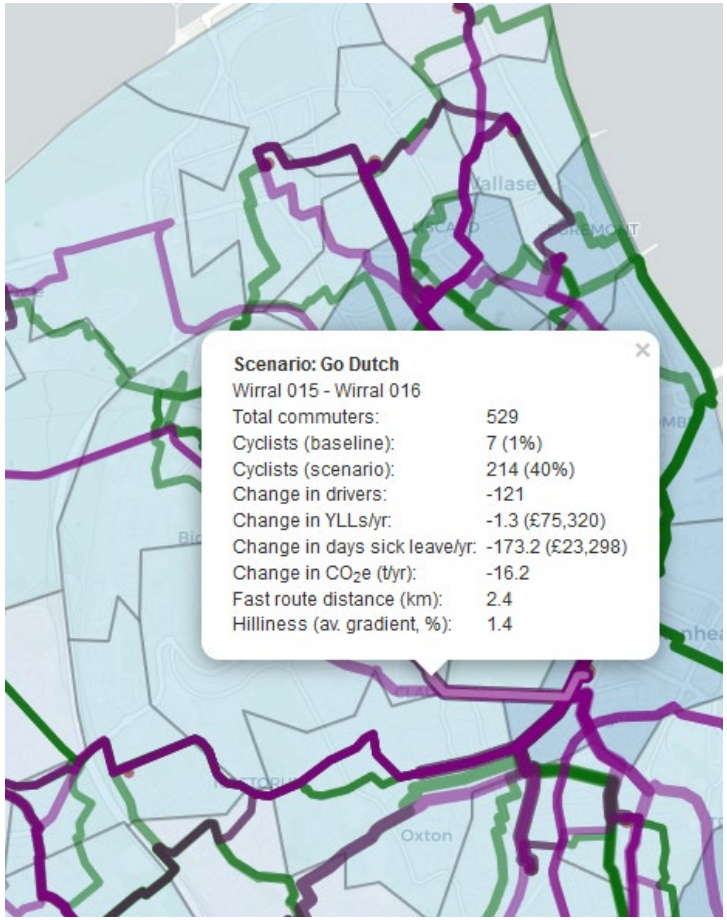
Fast Routes

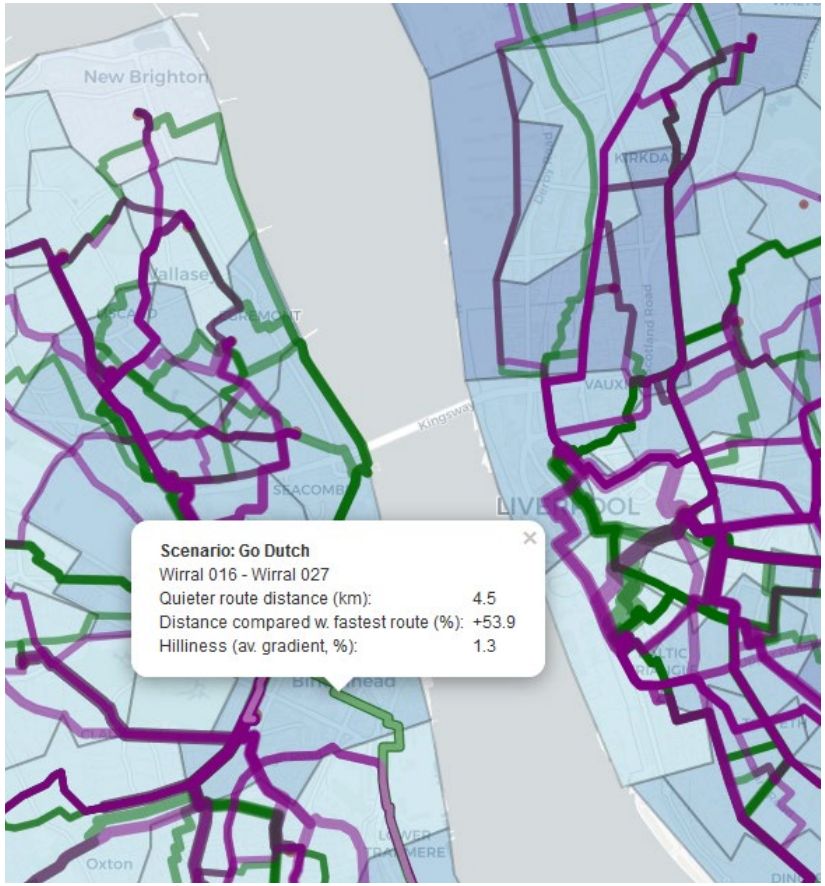

Propensity to Cycle Tool
Map
Region stats
Region data
National data
Manual
About
% cycling to work
0-1%
2-3%
4-6%
7-9%
10-14%
15-19%
20-24%
25-29%
30-39%
40%+
Trip purpose:
Commuting
Geography:
Middle Super Output Area
Scenario:
Go Dutch
Cycling Flows:
Fast Routes
Show Zones
Freeze Lines
Top N Lines (most cycled)
Order lines by
Number of cyclists
Map Base:
Roadmap (Black & White)
New Brighton
Birkenhead
LIVERPOOL
Oxton
Prenton
Greasby
1 km
https://www.pct.bike/m/?r=liverpool-city-region#close a GNU Affero GPL and funded by the DfT
Leaflet | Shiny | Routing CycleStreets | Map © OpenStreetMap contributors

Fast and Quieter Routes

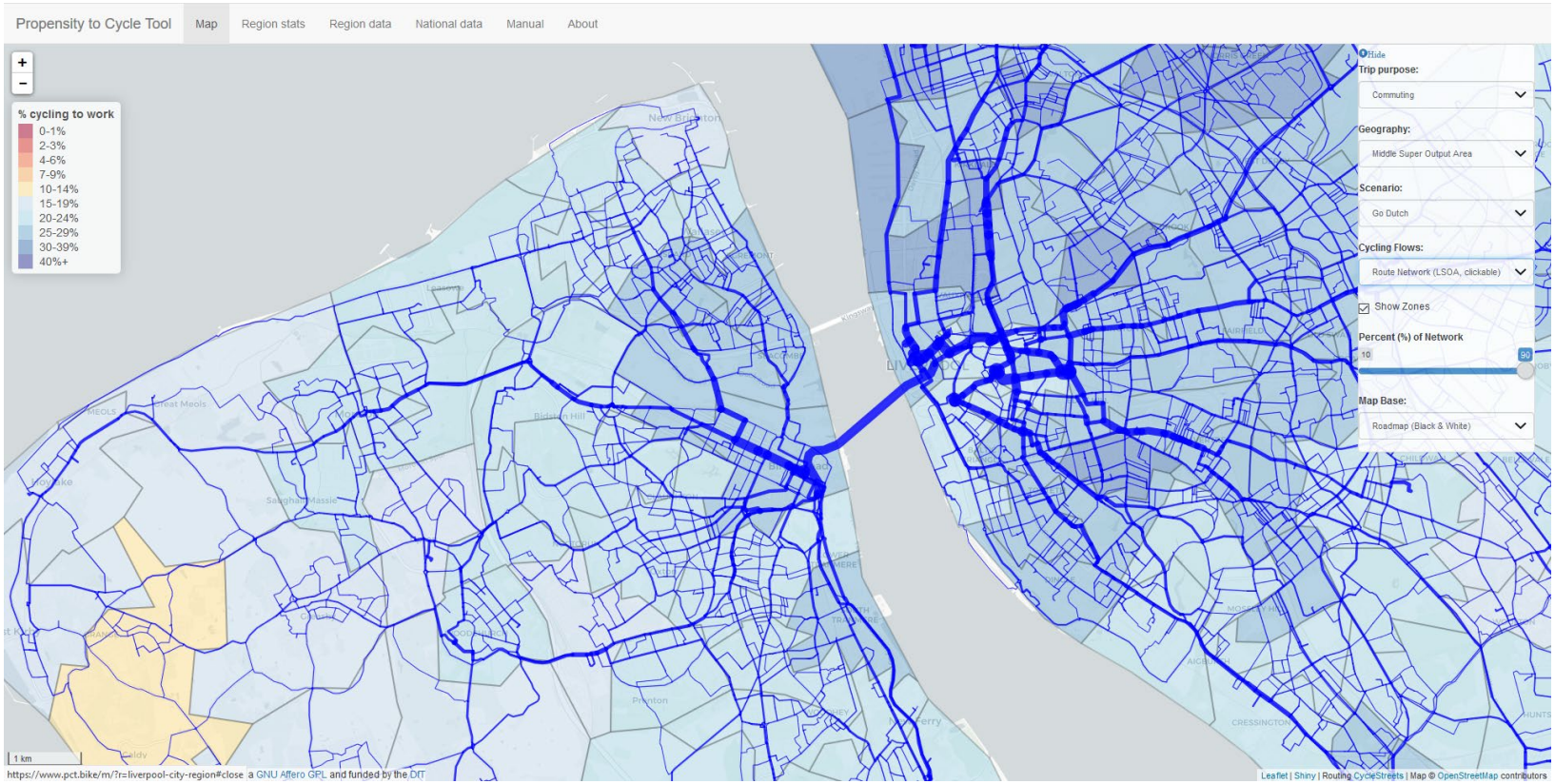


Fast/Quieter Routes Popups

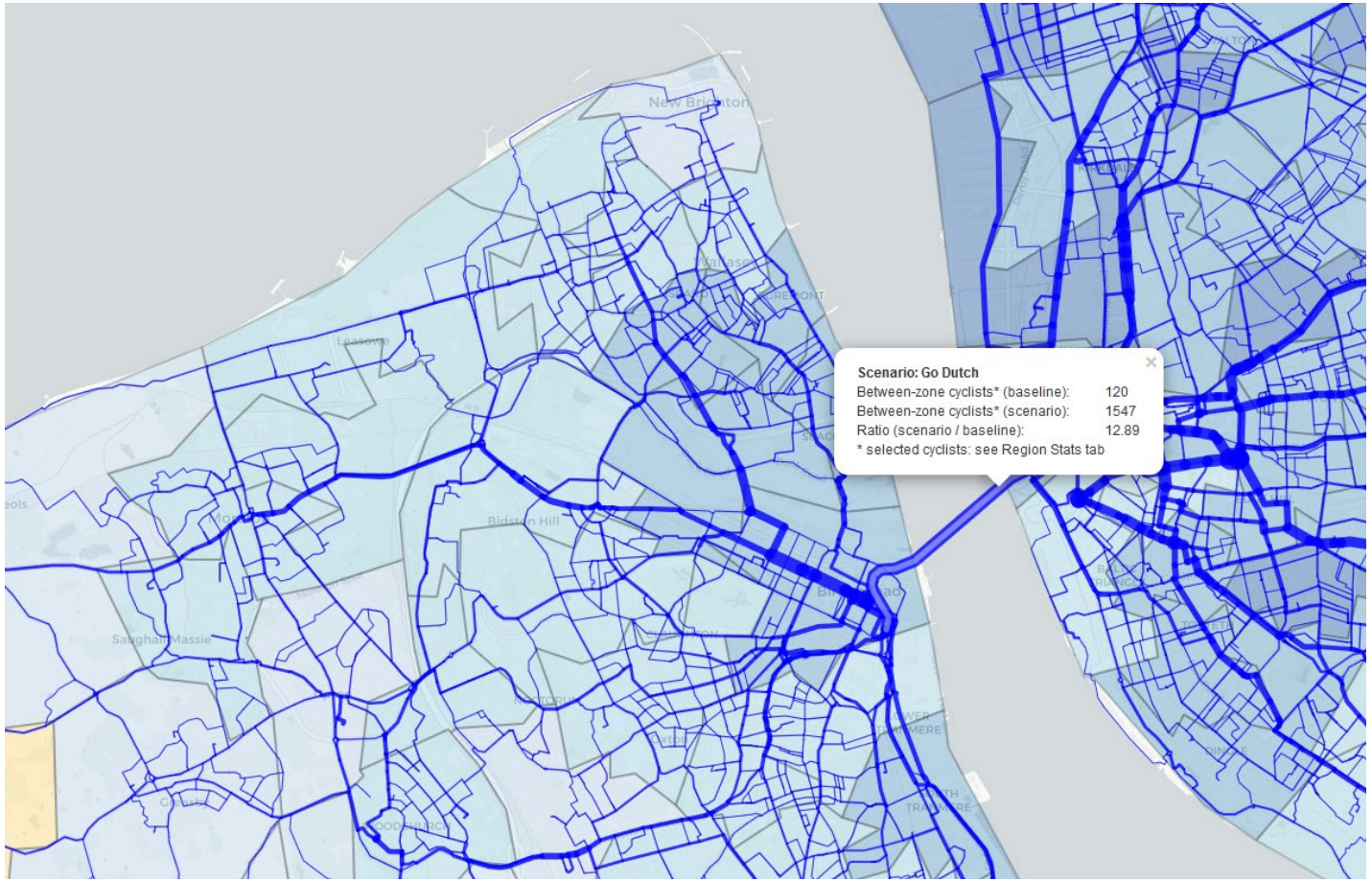




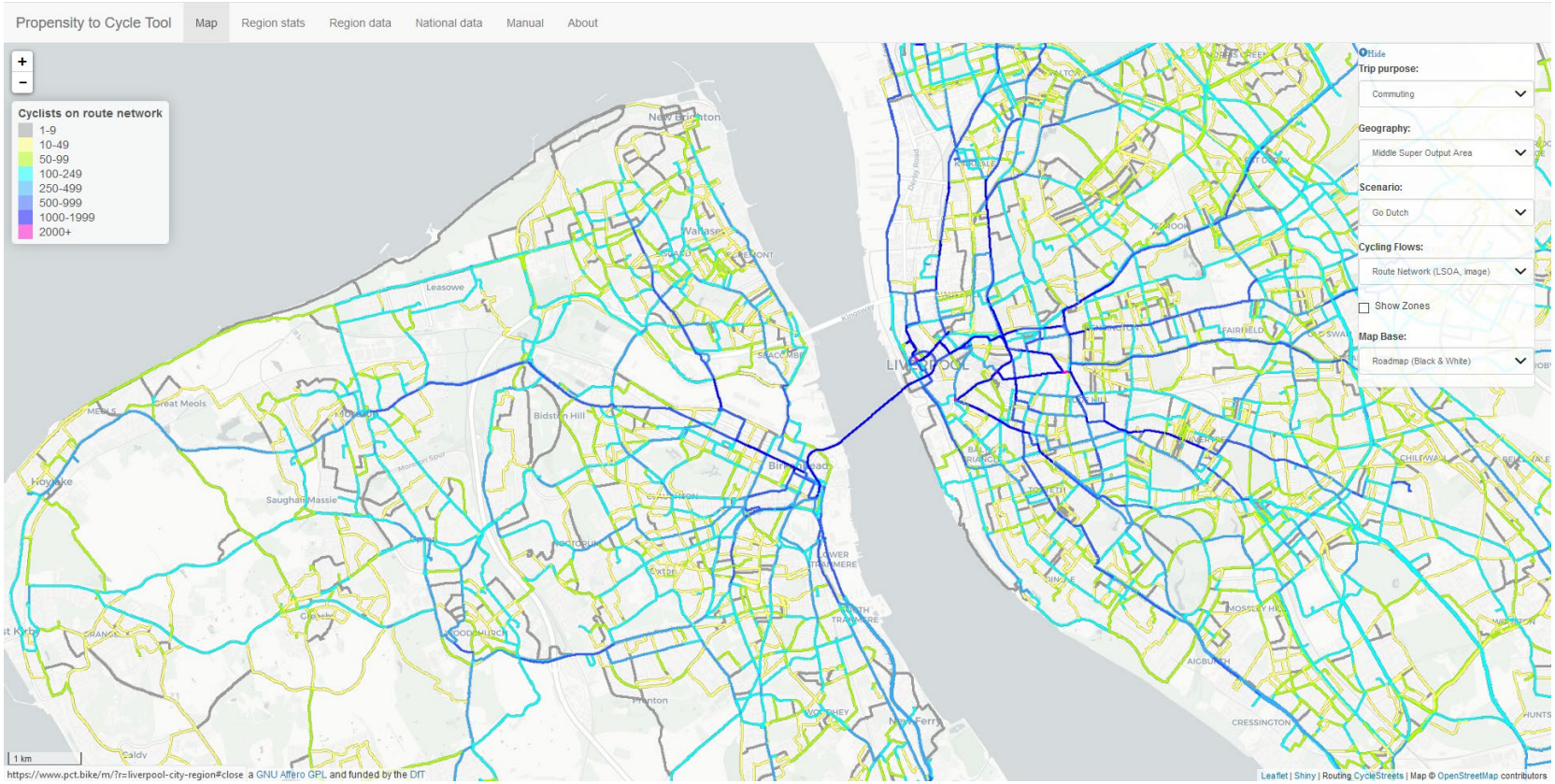
Route Network: **aggregating all** flows (c.f. **showing** the **top N**)



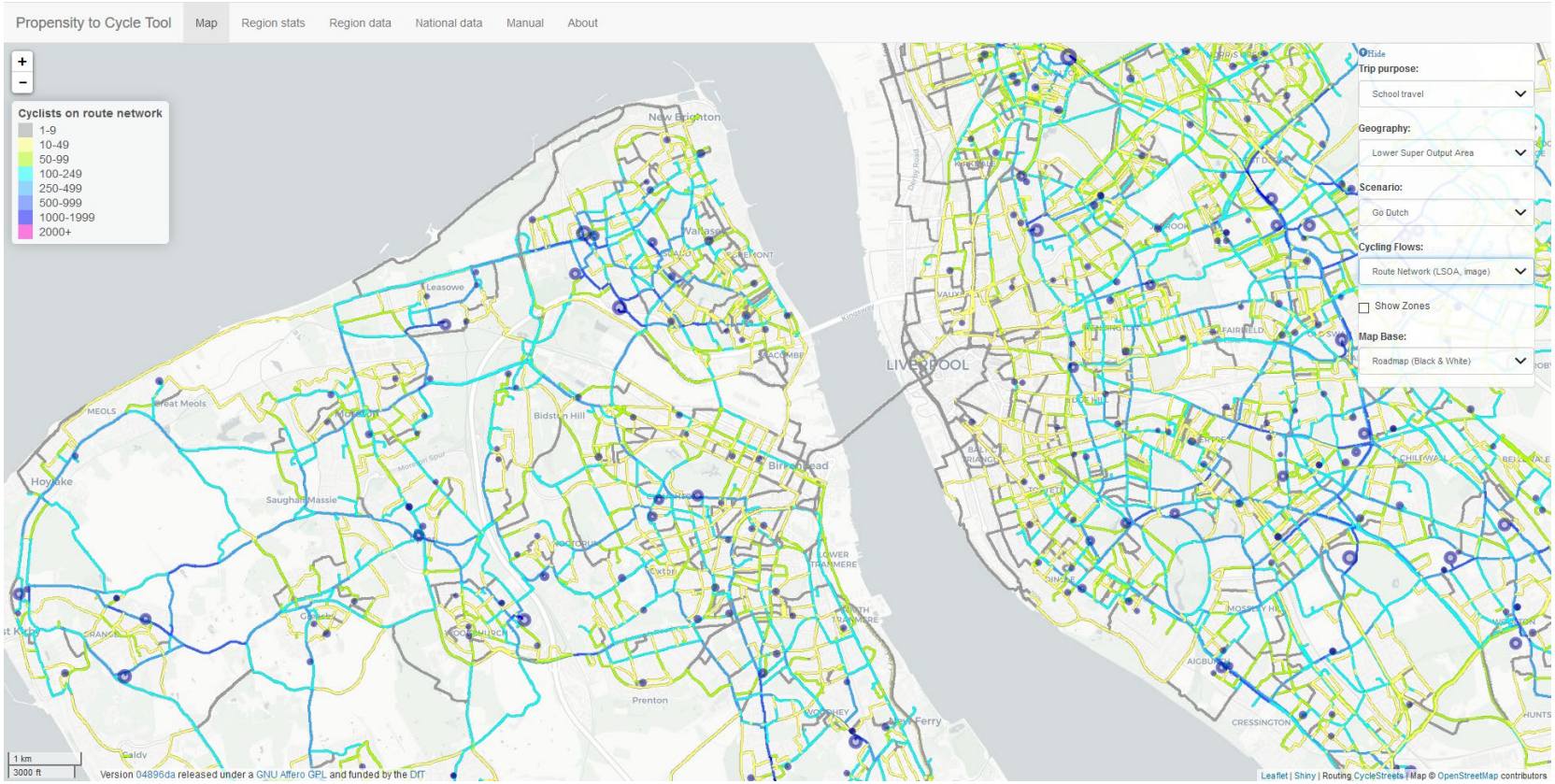
Route Network: segment info



Route network: raster image



Compare Go Dutch: Schools Layer



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Why use data downloads?

- The ability to create bespoke visualisations (e.g. showing areas by where health benefit is greater)
- Bespoke aggregation of uptake (e.g. within districts rather than a region)
- Bespoke benefits calculations including for UK Transport Appraisal Guidance (e.g. along a main road where major infrastructure is planned)
- Combination with other datasets (e.g. childhood obesity levels, injury data, existing bike infrastructure)

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PCT Health Impacts

Physical activity in PCT

- An important reason for increasing cycling it to increase physical activity
- People who walk or cycle have improved metabolic health and a reduced risk of premature mortality.
- The PCT estimates the change in physical activity from changes to cycling, e-bikes, & walking
- The PCT uses an improved version of the UK Transport Appraisal Guidance for health and health economic impacts. This was originally based on the WHO HEAT tool for walking & cycling
- The PCT includes both benefits from reductions in premature mortality (years of life gained) and from reduced sickness absence.

Intensity of activity

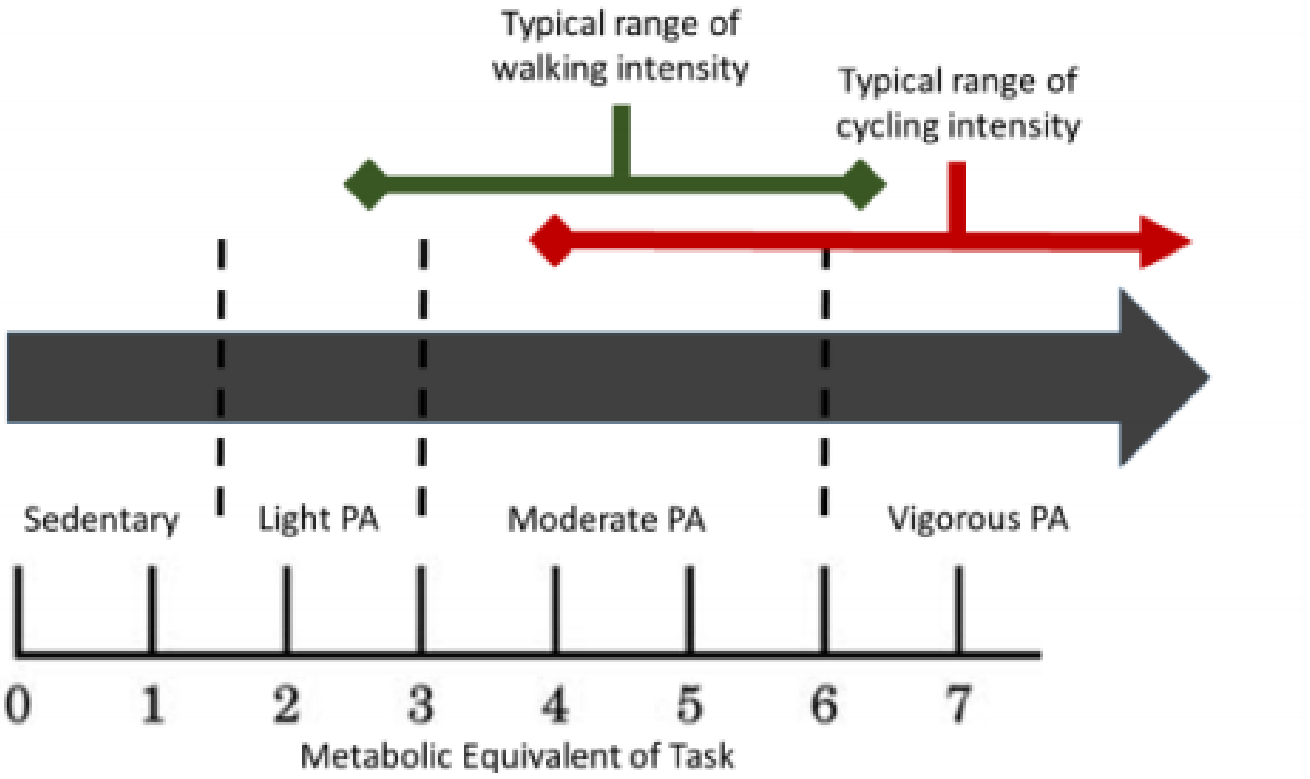
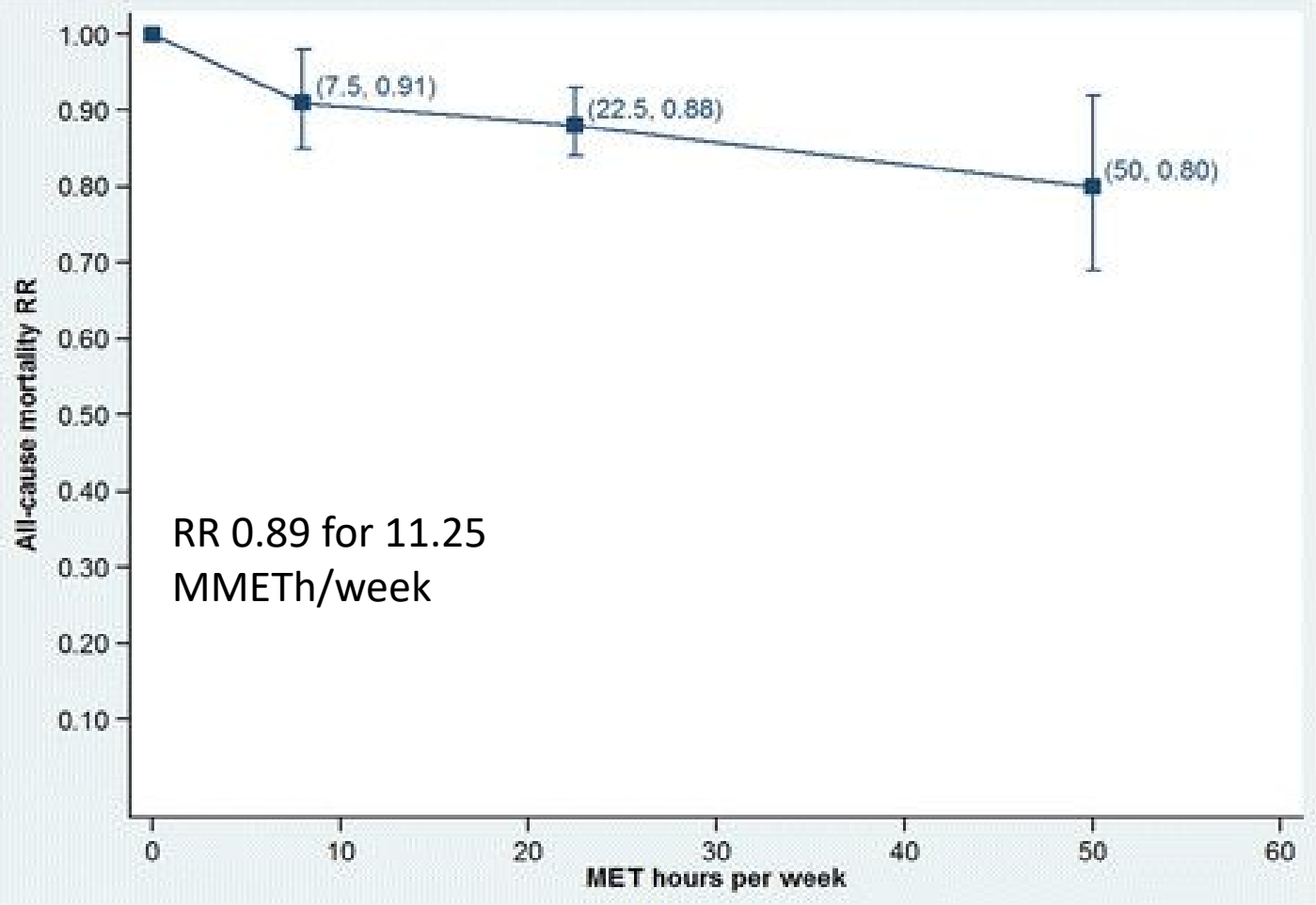


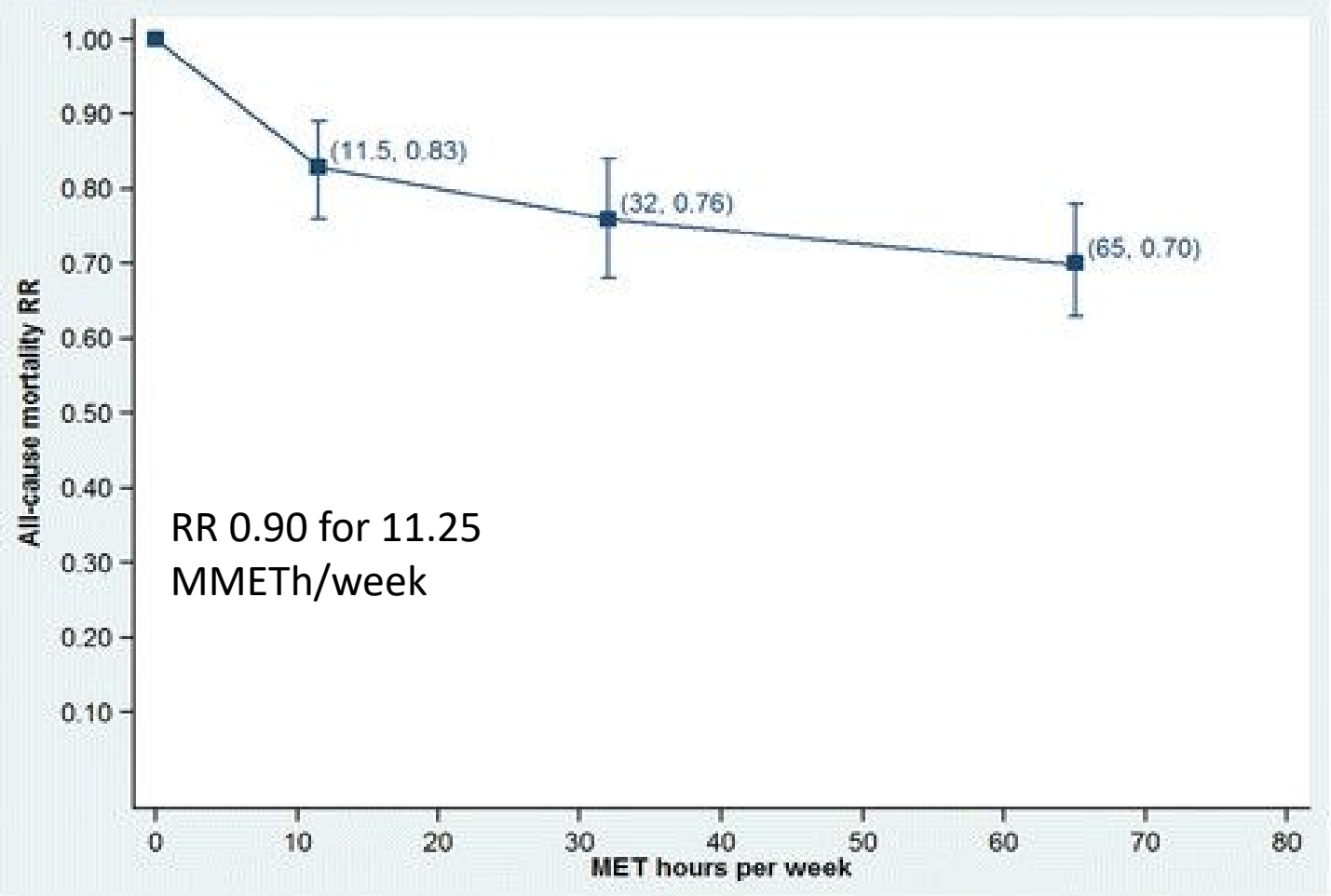
Figure 1. Illustration of walking and cycling as moderate to vigorous physical activities. Note ranges given are indicative and intensity will vary by pace, terrain, fitness, and many other factors. Ranges are estimates, based on the 2011 Compendium of Physical Activities. [11]

HEAT Walking



Kelly et al. 2013 IJBNPA

HEAT Cycling



RR 0.90 for 11.25 MMETh/week

Kelly et al. 2013 IJBNPA

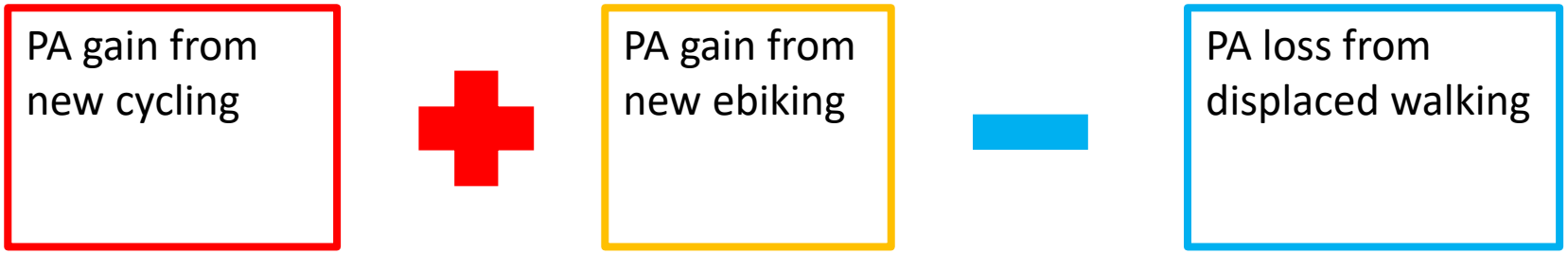
E-bikes

- Ebikes are not specifically covered in HEAT Cycling but enable faster travel and require less energy from the rider than traditional bikes.

- We therefore estimated new speeds and intensity values for this mode, giving a smaller benefit for every minute spent using ebikes than conventional cycles.

Physical activity in PCT

- An important reason for increasing cycling is to increase physical activity
- The PCT estimates the change in physical activity from changes to cycling, ebiking & walking



Applying the RRs

- The risk of death varies by local authority and sex & increases rapidly with age.
- Thus we use age and sex-specific mortality rates for each local authority in England and Wales.
- We assign a mortality rate based on each individual's age and sex, rather than the average of commuter cyclists in local authority
- Calculated using data published by the Office for National Statistics on deaths and the mid-year population for each local authority in England
- The monetary value of the mortality impact uses 'value of a statistical life' Department for Transport (£1,888,675 2017 money).

Replacing walking

- For a trip of a given distance, walking involves more physical activity than cycling.
- This means for a flow the observed health benefits can be negative if a high proportion of new cyclists previously walked, e.g. in very short trips
  - These may have particularly high cycling potential!
  - Is option to select on health gain instead of number of cyclists
- Example of where modelling at the individual level gives more accurate results: captures that people who currently walk are younger, which reduces the health cost of the switch from walking to cycling.

Physical activity in PCT

- Outcomes:
  - Number of deaths from all-cause mortality
  - Years of life lost (new)
  - Sickness absence (new)
- Methods are those developed for DfT TAG, extended to allow for ebikes and hilliness

Estimating hilliness impacts

Power required by a cyclist to move

= Road resistance + Wind Resistance + Gravity

- Road resistance = Coefficient of Rolling Resistance * Weight * Ground Speed
- Wind resistance = Coefficient of Air Resistance * Body Surface Area * (Barometric Pressure/Air Temp) * $AirVelocity^2$ * Ground Speed
- Gravity = Gravity *Weight * Sine of Angle of Incline * Ground Speed

- Plus assumptions about % time stationary, extra effort needed to accelerate, effort for downhill cycling/ebiking.
- Hills take more effort as harder work and longer duration.
- Mixture of working from first principles and trying to reach plausible and compatible overall averages.

Results: impact of using hilliness

		Health gain per commuter	
	Hilliness quintile	**Old results**	**New results**
least hilly	1	13.1	11.4
	2	10.2	10.0
	3	7.3	8.0
	4	6.1	7.2
most hilly	5	4.0	5.1

Results hilliness

- Using our existing model hilly areas already tend to have lower cycling potential than less hilly areas
- However, our new approach means that we can represent that the physical activity energy expenditure is higher

Sickness absence calculation

- We estimated the economic value of reduced sickness absence using a similar approach to mortality.
- Average hours of sickness absence are a function of sickness absence rate and total working hours. These vary by sex, age and region.
- We calculated age and sex-specific average annual hours of sickness absence for regions in England and for Wales
    - Ranging from 8.2 hours/year for men aged 16-24 in the East Midlands to 69.9 hours/year for men aged 50-64 in Wales.

Summary

- The PCT is a widely used policy tool for estimating travel to work and travel to school cycling potential in England and Wales
- Cycling potential is calculated for hypothetical ‘what if’ scenarios
- The PCT has a sophisticated microsimulation model for estimating health & health economic impacts
- Massive cycling potential in England and Wales, with corresponding large carbon and massive health benefits (around £2 billion per year from commuting alone).
- While current cycle commuting in England and Wales is highly skewed women and non-white people tend to make more ‘cyclable’ commute trips.
- Whose trips you prioritise depends on goal (health, carbon, equality)

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Thanks for listening

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CEDAR Centre for Diet and Activity Research
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Department for Transport