

Summarising public transport information with travel time maps

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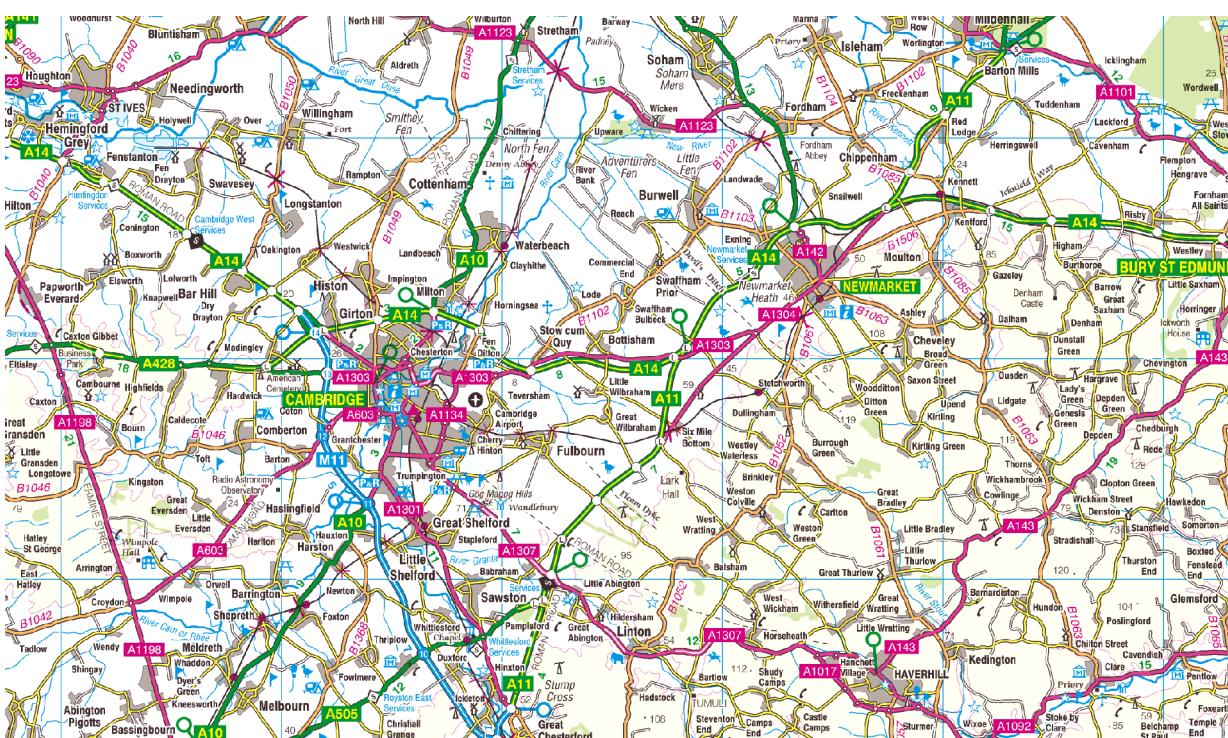
MONDAYS TO FRIDAYS

King

Bus route number	41	40		41	40		41	40		41	40	
	LE	CT		LE	CT		LE	CT		LE	CT	
Hunstanton Bus Station	d	1114 1148		1214 1248			1314 1348			1414 1448		
Sandringham Norwich Gates	d	1141		1241			1341			1441		
Sandringham Visitor Centre	d	1143		1243			1343			1443		
King's Lynn Bus Station	a	1210 1240		1310 1340			1410 1440			1510 1540		
King's Lynn	d	1256		1356			1456			1556		
Watlington	d	1303		1403			1503			1603		
Downham Market	d	1309		1409			1509			1609		
Littleport	d	1318		1418			1518			1618		
Ely	d	1326 1338 1353		1426 1440 1453			1526 1538 1553	1607		1626 1636 1653		
Waterbeach	d	1335		1435			1535			1616		
Cambridge	a	1344 1354 1408		1444 1457 1508			1544 1555 1608	1623		1644 1653 1708		
London Liverpool Street	e a	1513	1541	1613	1643	1713	1745			1815	1847	
London King's Cross	e a	1433	1507	1533	1608	1633	1705	1732		1735	1805	

CT - Central Trains service

LE - 'one' service



Why?

- Real-world questions:
 - Where can I go on holiday?
 - Where should I live / look for a job / ...?
- Show how to derive extra value from existing timetable services

Mapping travel times

- Complicated: travel time is a function of origin, destination, time of travel, mode
- Simplify by considering travel to or from a particular point (via public transport)
- Exploit existing journey-planning resources (e.g. Transport Direct)
- Naturally incorporate waiting time and service frequency effects
- Assumptions...

First example: rail travel

- Fairly easy to compute travel time between rail stations
 - We use an off-the-shelf application called “RailPlanner” (from Travel InfoSystems), driven by some custom software
 - RailPlanner is based on code developed by/for the German railways
 - Same code seems to be used for, e.g., www.nationalrail.co.uk journey planner
 - Compute travel times from one station to the ~2,800 others in a few minutes

RailPlanner

File Edit Search Locations Extras Options Help

New Print Find Return Earlier Later Direct Options Arr/Dep Taxi Map NetMap Tube

From:	Cambridge	Dep Location	Arr Location <th>L...</th> <th>Dep</th> <th>Arr</th> <th>Dur</th> <th>Modes</th>	L...	Dep	Arr	Dur	Modes
To:	Penzance	Cambridge	Penzance	3	07:59	17:05	09:06	
Via:		Cambridge	Penzance	8	08:15	17:05	08:50	
Depart	Tue, Mar 28, 2006	Cambridge	Penzance	2	10:04	19:02	08:58	

By Time Interval Matches

From: 07:00 Matches 3 To: 23:59 Interval 03:00

Journey Details Availability

Tuesday 28/03 Cambridge to Penzance

	Cambridge	Change time 5 mins
	Depart 07:59	Dest: Birmingham New Street Central Trains
	Arrive 10:42	
	Birmingham New Street	Change time 12 mins Spare time 18 mins
	Depart 11:12	Dest: Plymouth Virgin Trains
	Arrive 13:45	1
	Exeter St Davids	Change time 6 mins Spare time 17 mins
	Depart 14:08	Dest: Penzance First Great Western
	Arrive 17:05	1
	Penzance	Change time 5 mins

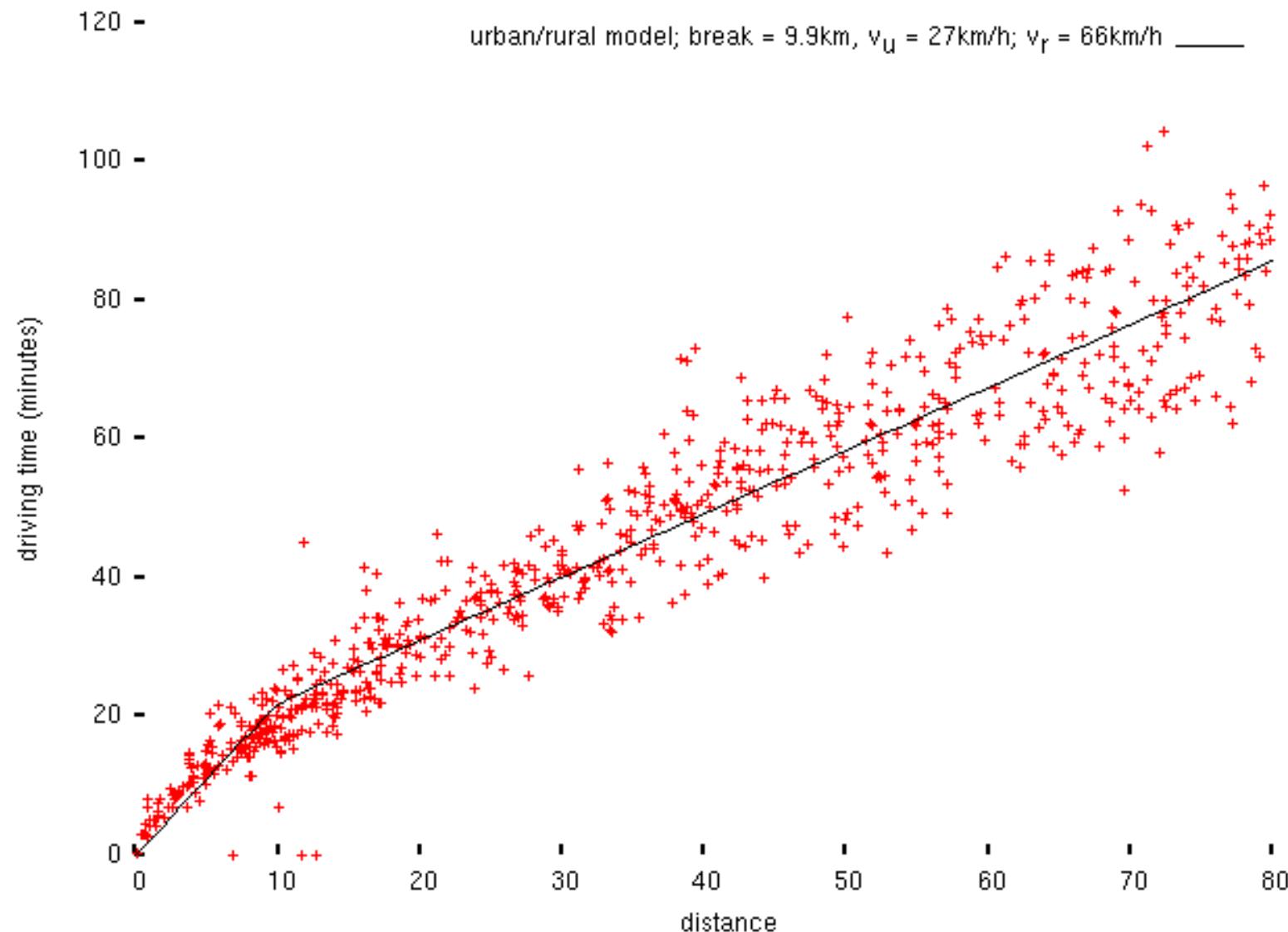
Total Journey duration 9 hrs 6 mins. 3 legs.

Ready

Rail travel model

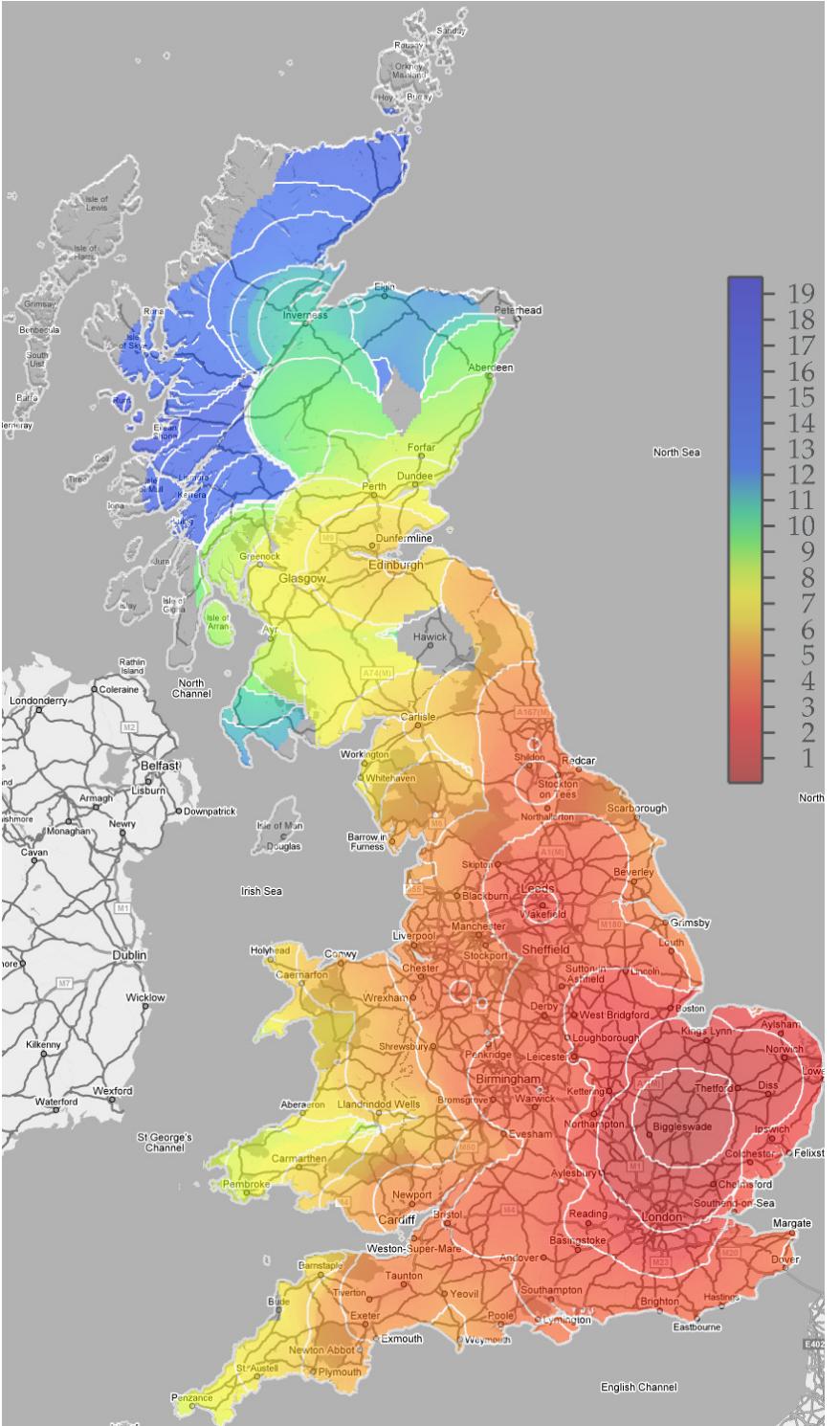
- Most journeys are not made to and from rail stations
- Need to estimate travel times between arbitrary origins and destinations
- Assume that user will travel to a station near their destination and then continue by taxi, up to a certain distance (one hour's travel), picking the quickest journey under that constraint
- Smoothing kernel analogue, but not linear

- Assume two-part driving/taxi model (urban/rural motivation: most train stations are in towns)
- Sample journeys using off-the-shelf route planning software (“TravelManager GB”)
- Fit piecewise linear model with unknown break point to give journey time function for *cross-country* journeys
 - Within ~10km: 27km/h
 - Outside ~10km: 66km/h
 - Ignore traffic(!)



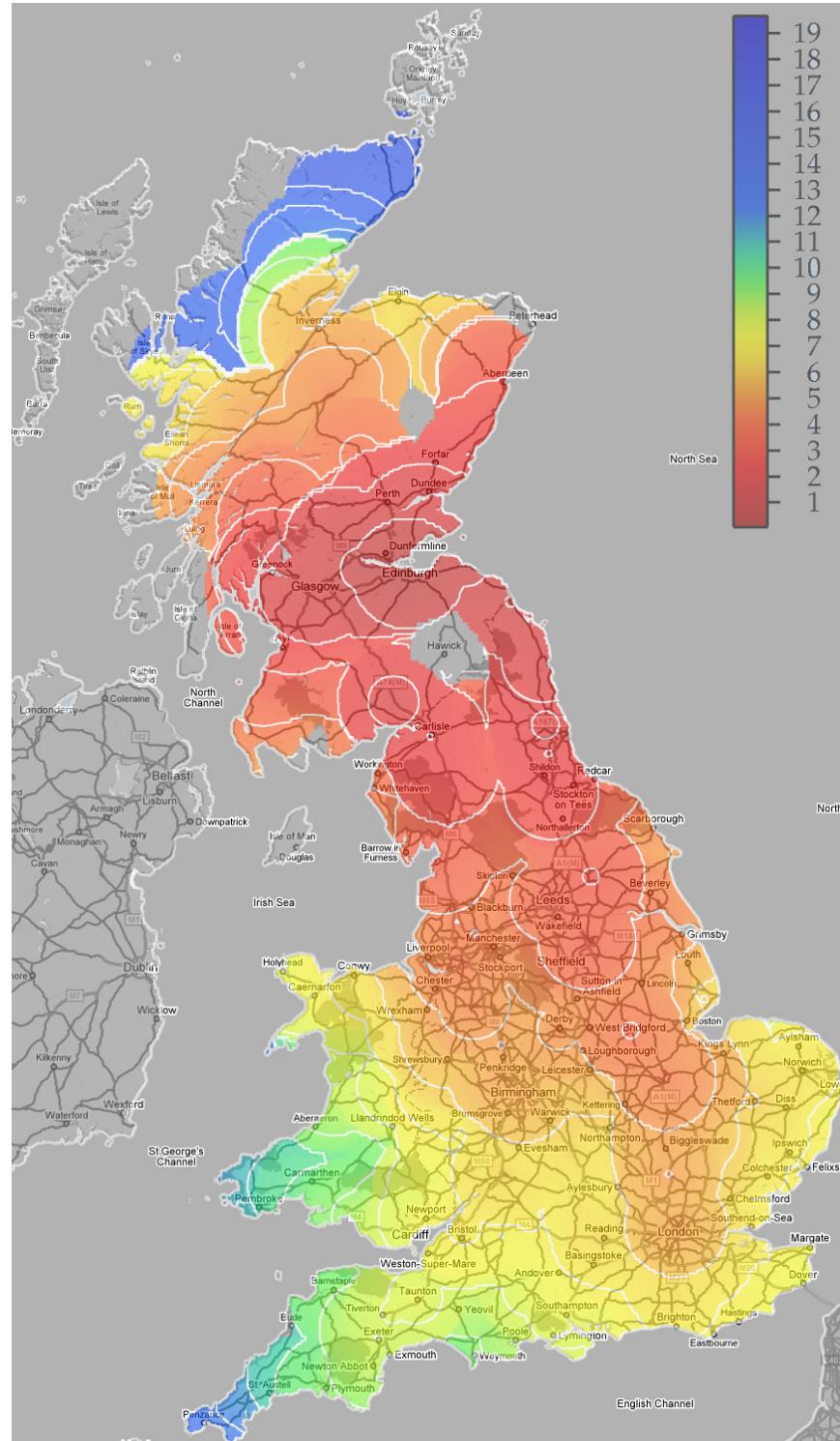
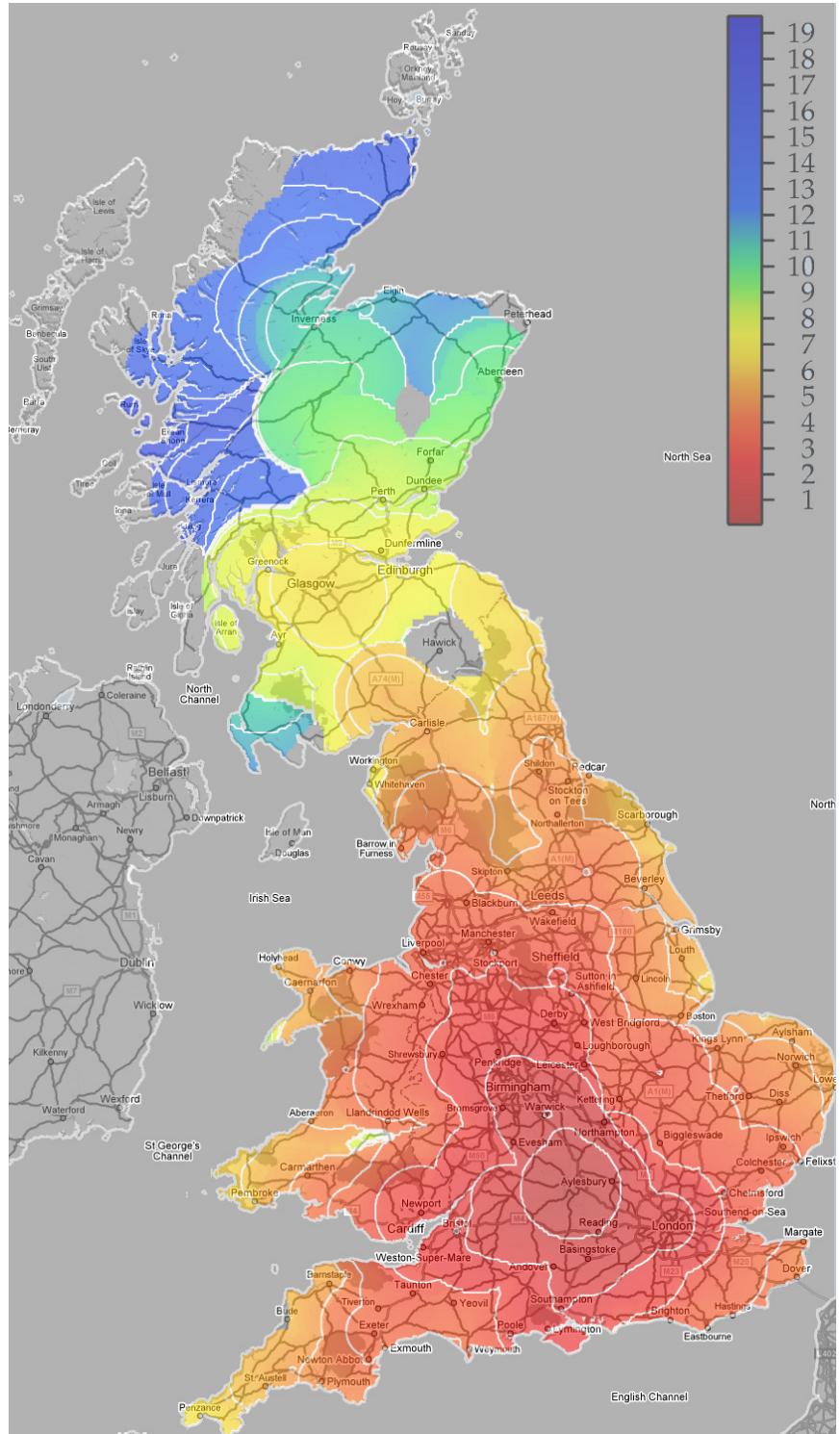
Rail travel model

- Specific example is slightly contrived
- Start at Cambridge station at 0700h on a weekday
- How far can you go, and how long will it take you?
 - It'd be nice to add, "... and how much would it cost?", but rail ticketing is too complicated for that



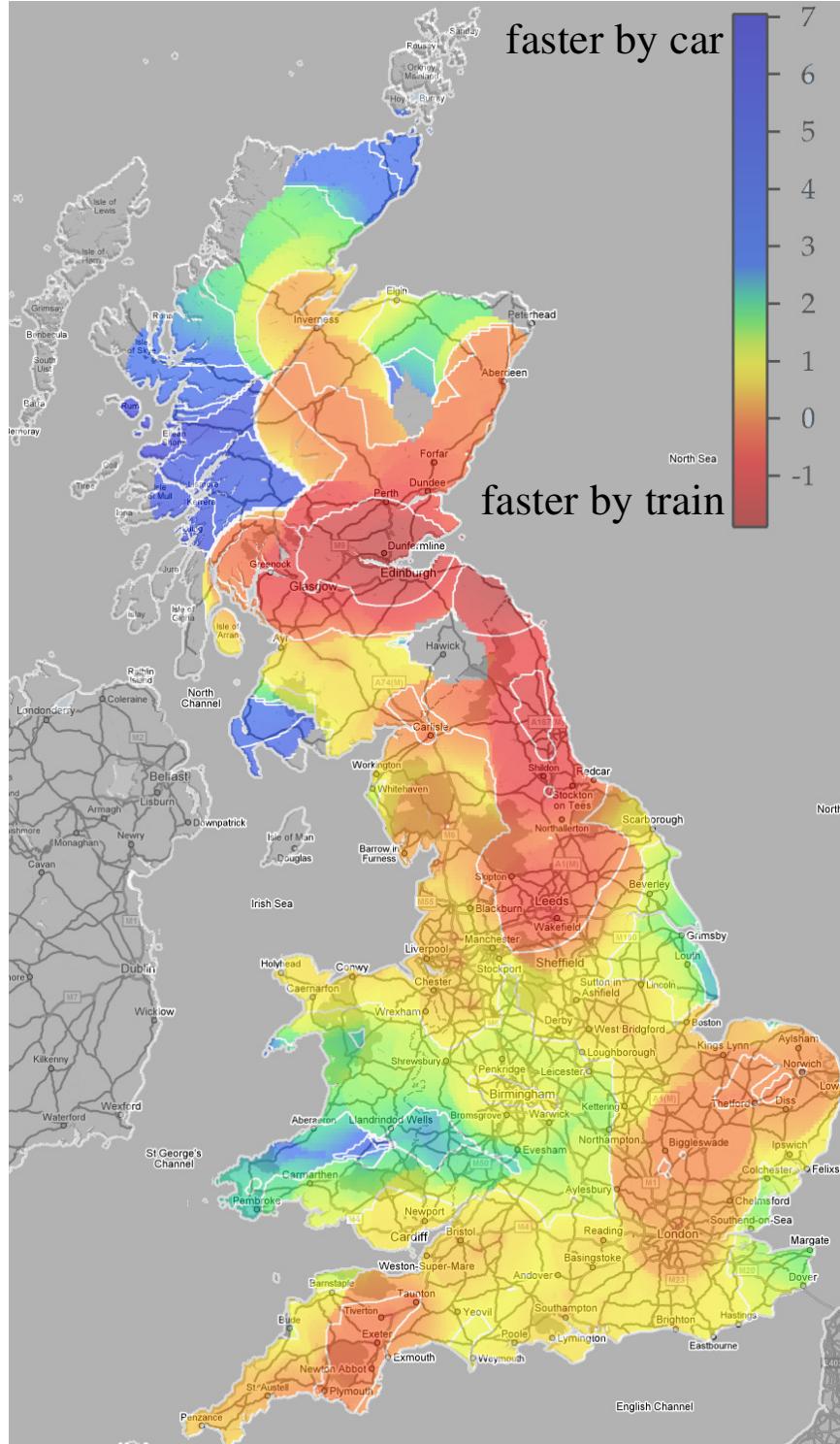
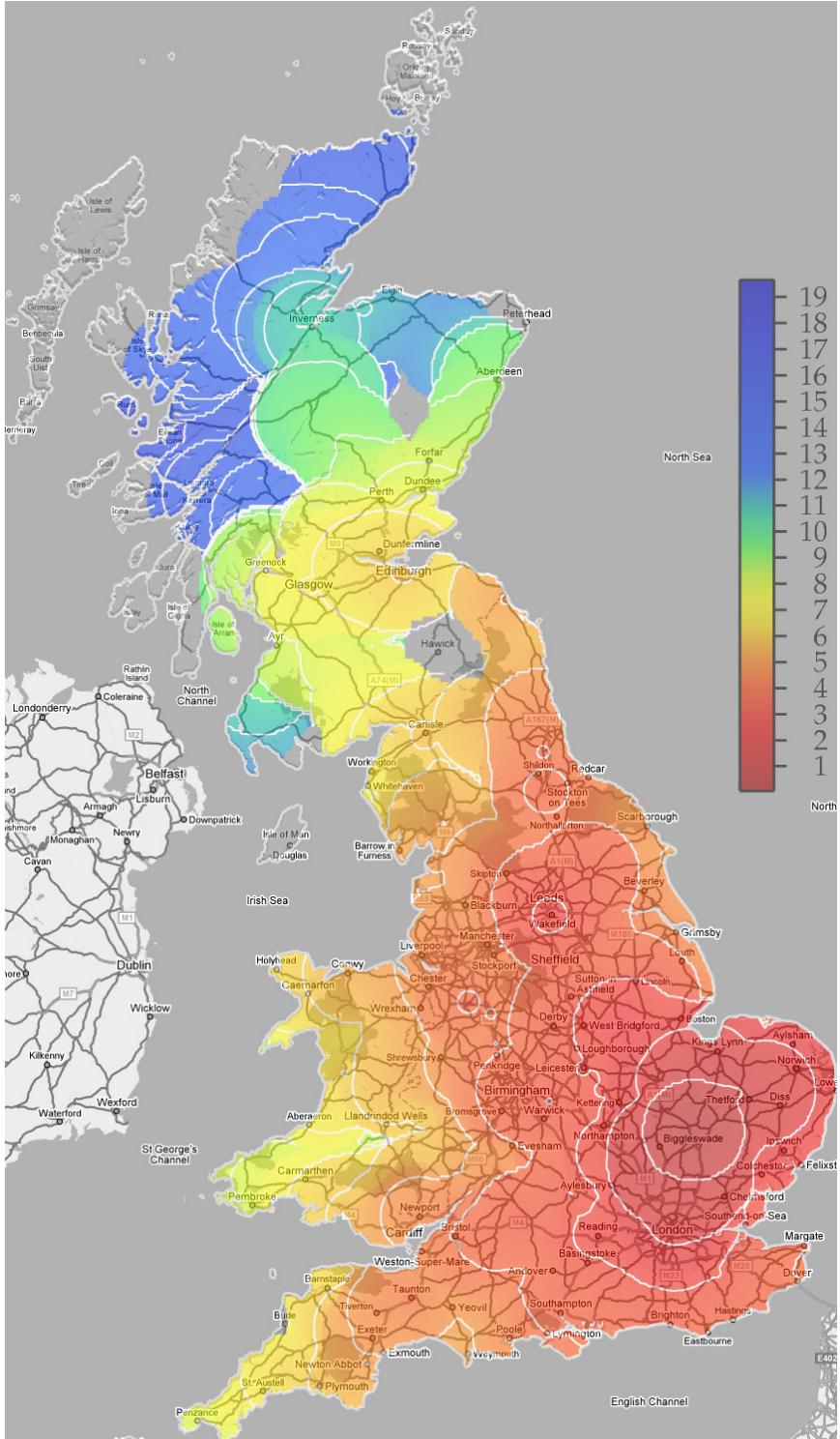
contours at 1h intervals

Other starting locations...



Modal comparison

- Since we have a road travel model (even though it isn't very good) we can compare the two modes
- This shouldn't be taken very seriously
 - Really need to add a proper distance model and account for traffic
- Nevertheless, interesting...



Future work: Improving the driving model

- Presently we assume the road network is uniform and isotropic, which is obviously wrong
 - Many of the circular structures in the maps are a result of this
- Fix this using (commercial) route-planning software
 - Problem here is doing the calculations sufficiently quickly to be useful
- Traffic

Pause for breath

Second example: Regional public transport

- Exploit www.transportdirect.info to infer travel times by *any* public transport mode within a much smaller domain (10–40km)
- Answer a slightly more realistic question, too:
- How early do you have to leave the house to get to work at 0900h?

Regional model

- Journey consists of walking to an exchange point (bus stop, station, etc.), joining a service, then walking to a destination
- More complex than the rail example
 - There are thousands of bus stops in any region of reasonable size
 - No common naming scheme for exchange points
 - (Ab)using TransportDirect in this way brings its own challenges



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coach



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To

Address/postcode

Leave

16 May 2006 07 00

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Public transport

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Place



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A101 : Closure at Limehouse

- A82 : Closure at Milton
- M61 : Accident Northbound at Manchester
- M32 : Closure outbound at J2
- A12 : Closure at Danbury
- M6 : Restriction Northbound at J31
- A590 : Closure at Farleton
- A65 : Closure at Kirkby Lonsdale
- M73 : Restriction both ways at J2
- A40 : Closure at Eynsham
- A2 : Closure at Chatham

Status at: Mon 15 May 2006 21:30

Tips and tools



Add Transport Direct to your website for free



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Latest...

For information changes to public services on [Buses](#) Monday 29th May

Thanks for visiting

Thank you for visiting Transport Direct - Britain's no 1 source of information on travel and public transport. Please let us know what you think by [contacting us](#).

Planning a day out



Plan a day trip to [London](#) with our new [Day trips](#) feature. The Door-to-door planner has lots of ideas for where to go and things to see.

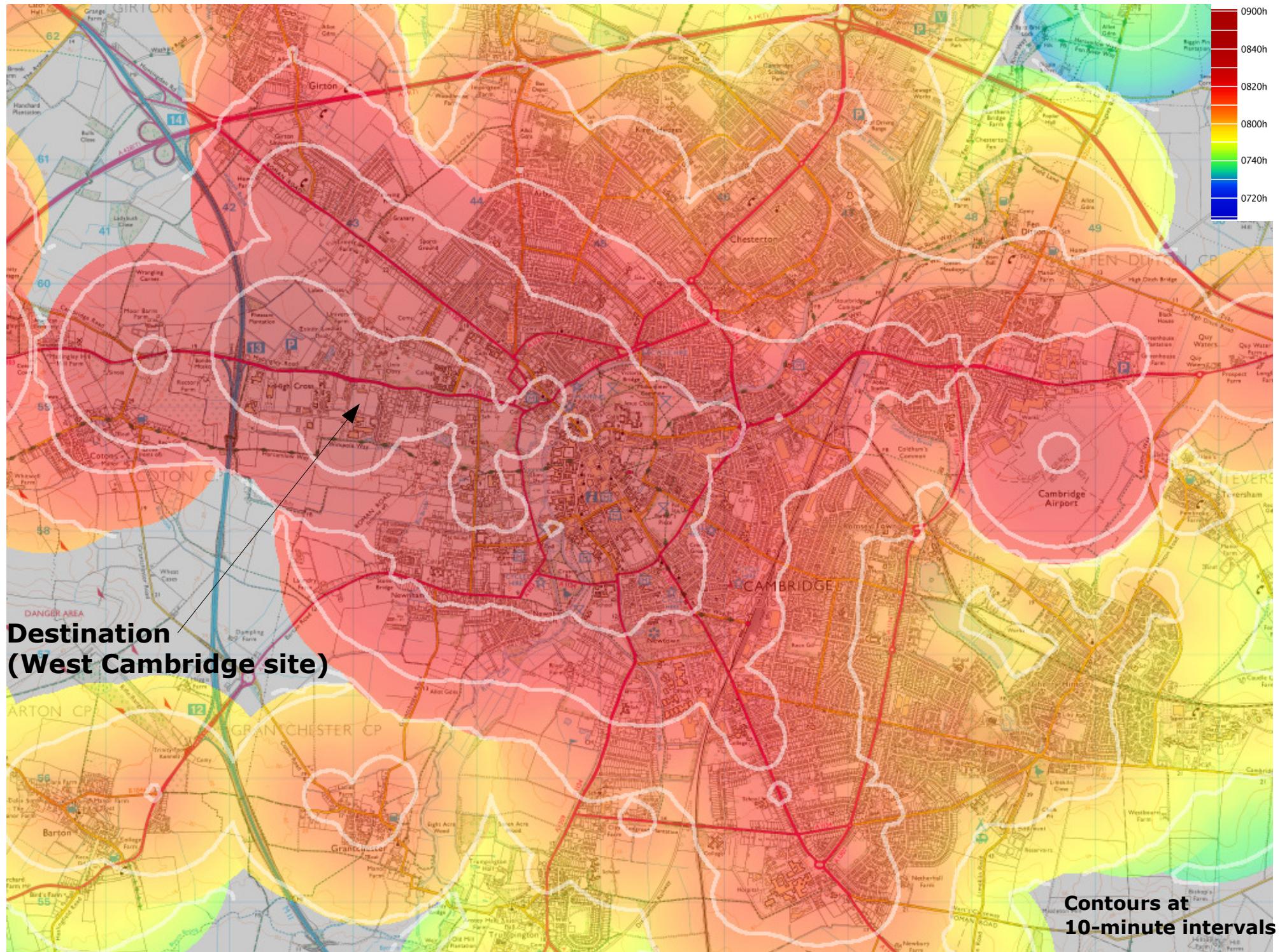
Free tools

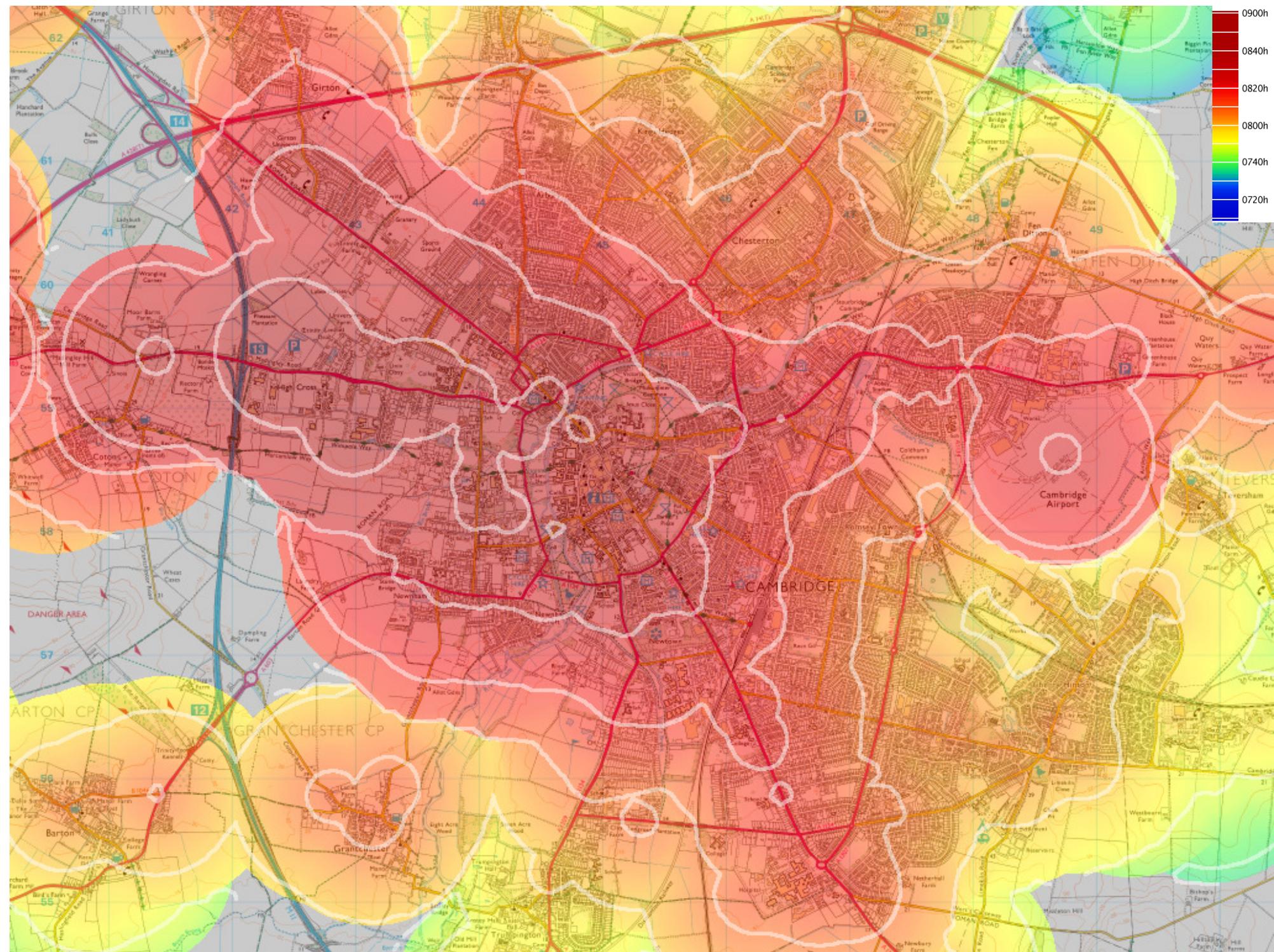


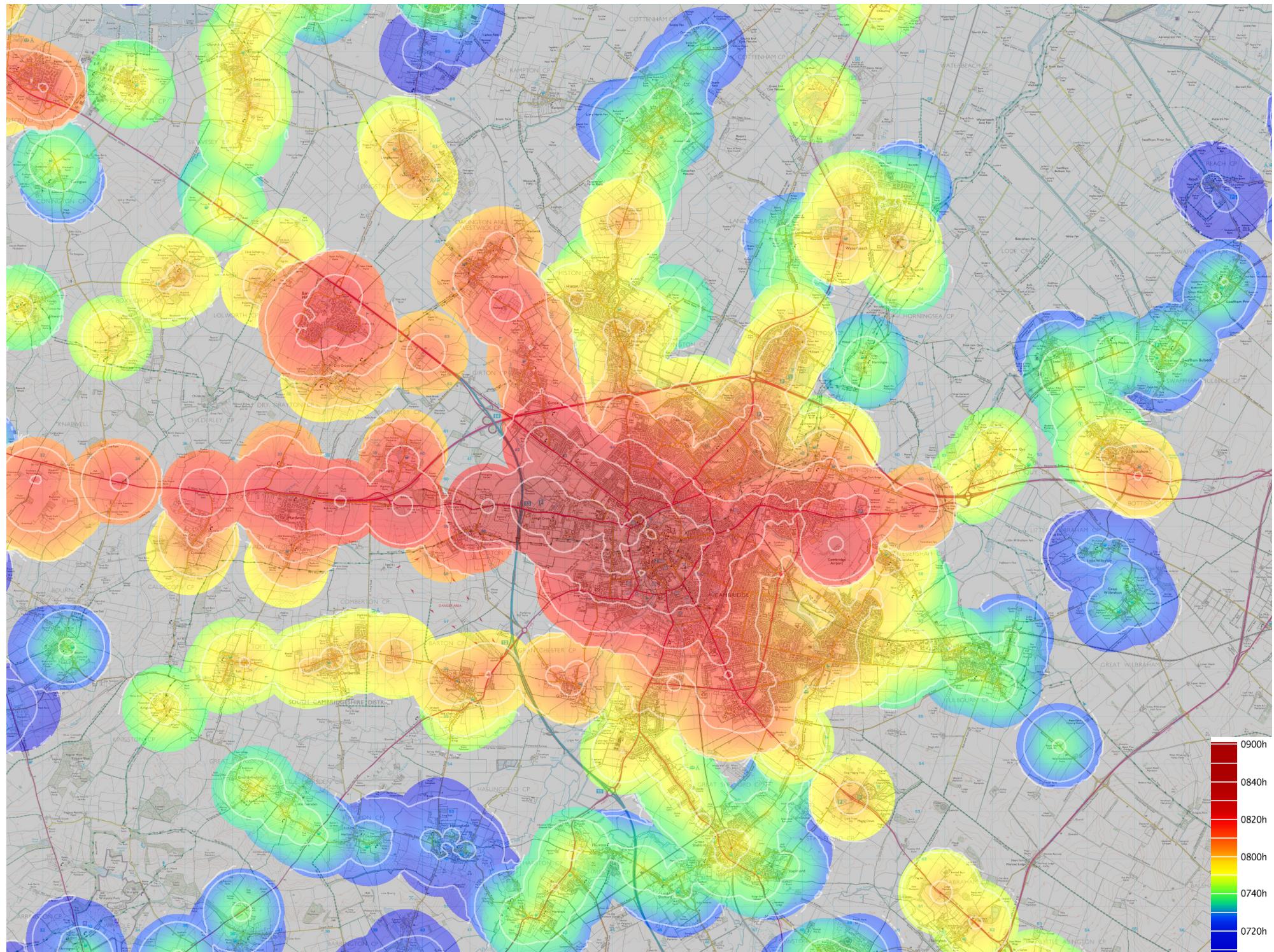
Get directions to [London](#)

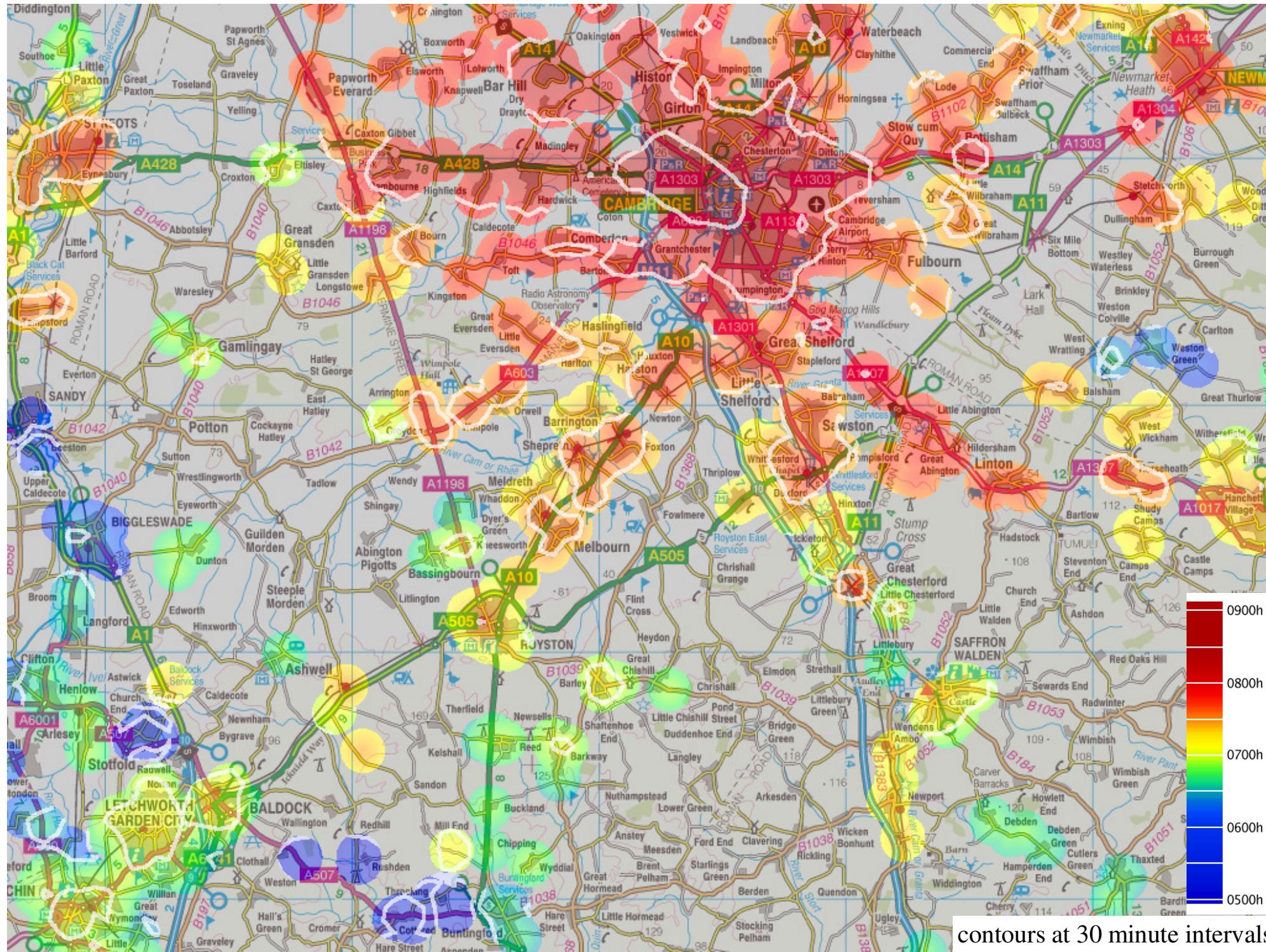
Regional model

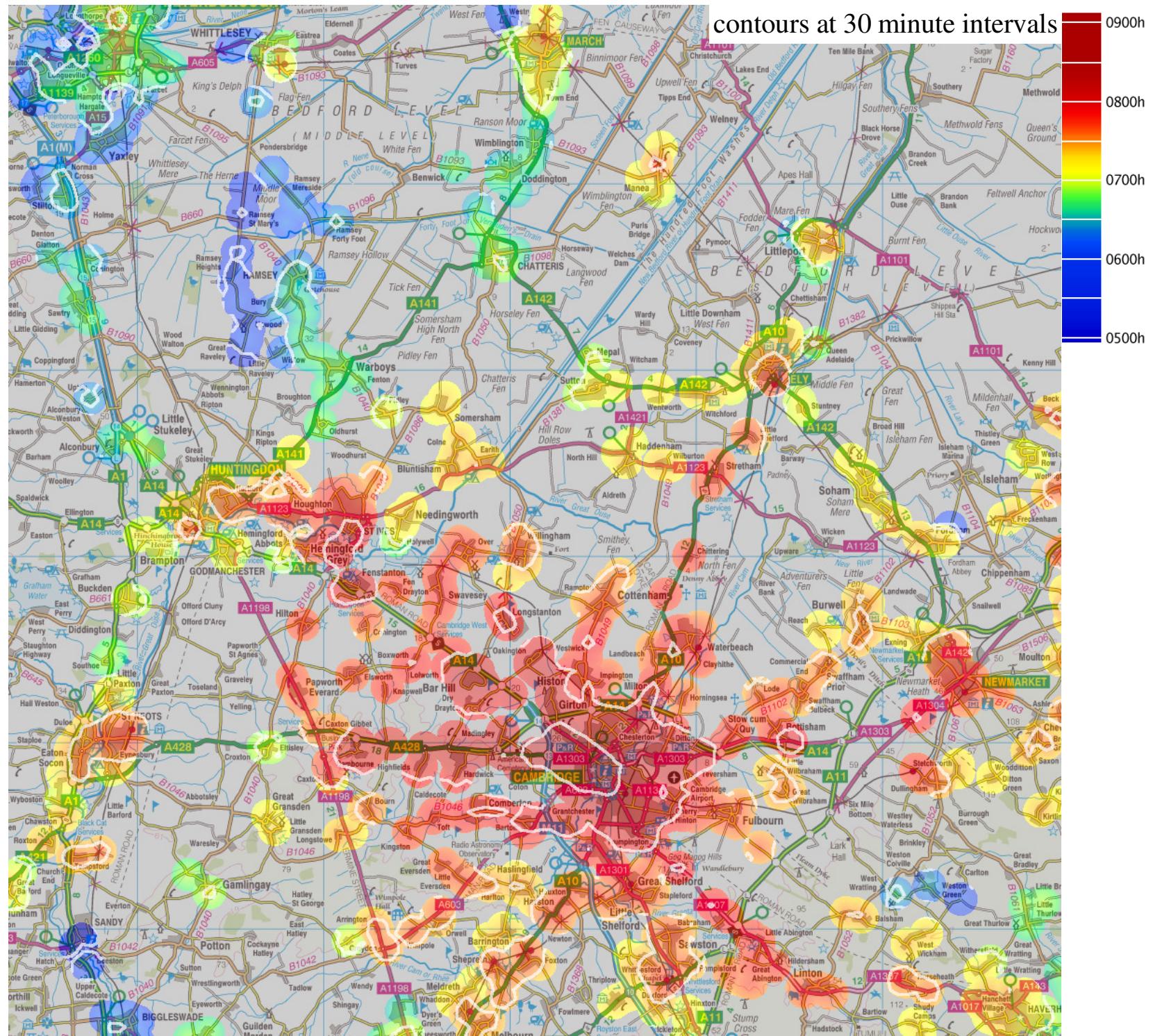
- Method is very simple
- Destination is specified as a postcode
- Iterate over bus stops, rail stations etc.
 - Find the closest postcode to each
 - Ask TransportDirect for the latest journey from that postcode to the destination
- Infer journey times for places other than bus stops using a simple walking model (1ms^{-1} , max walking time 15 minutes)
 - This matches TransportDirect's own model





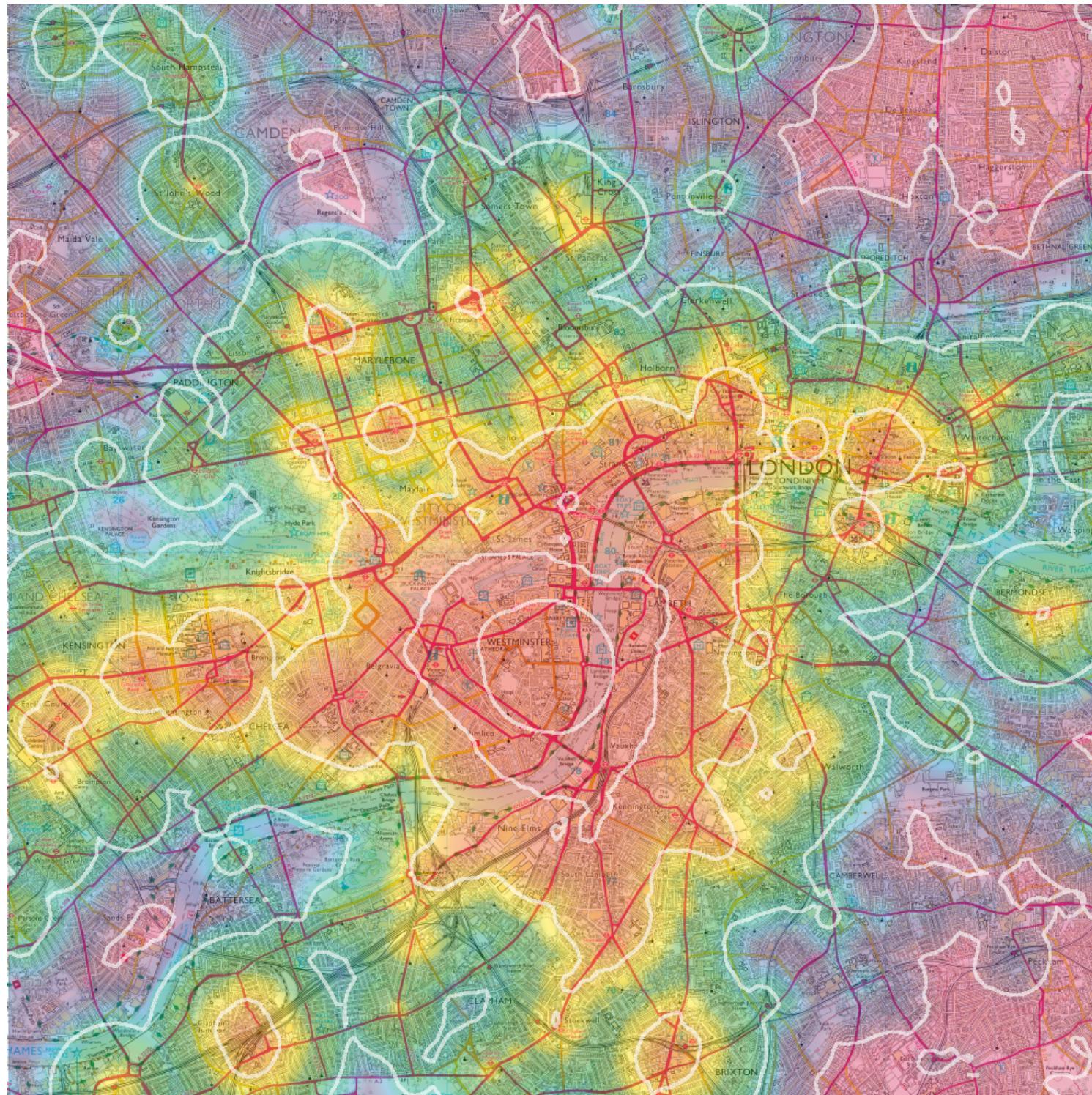






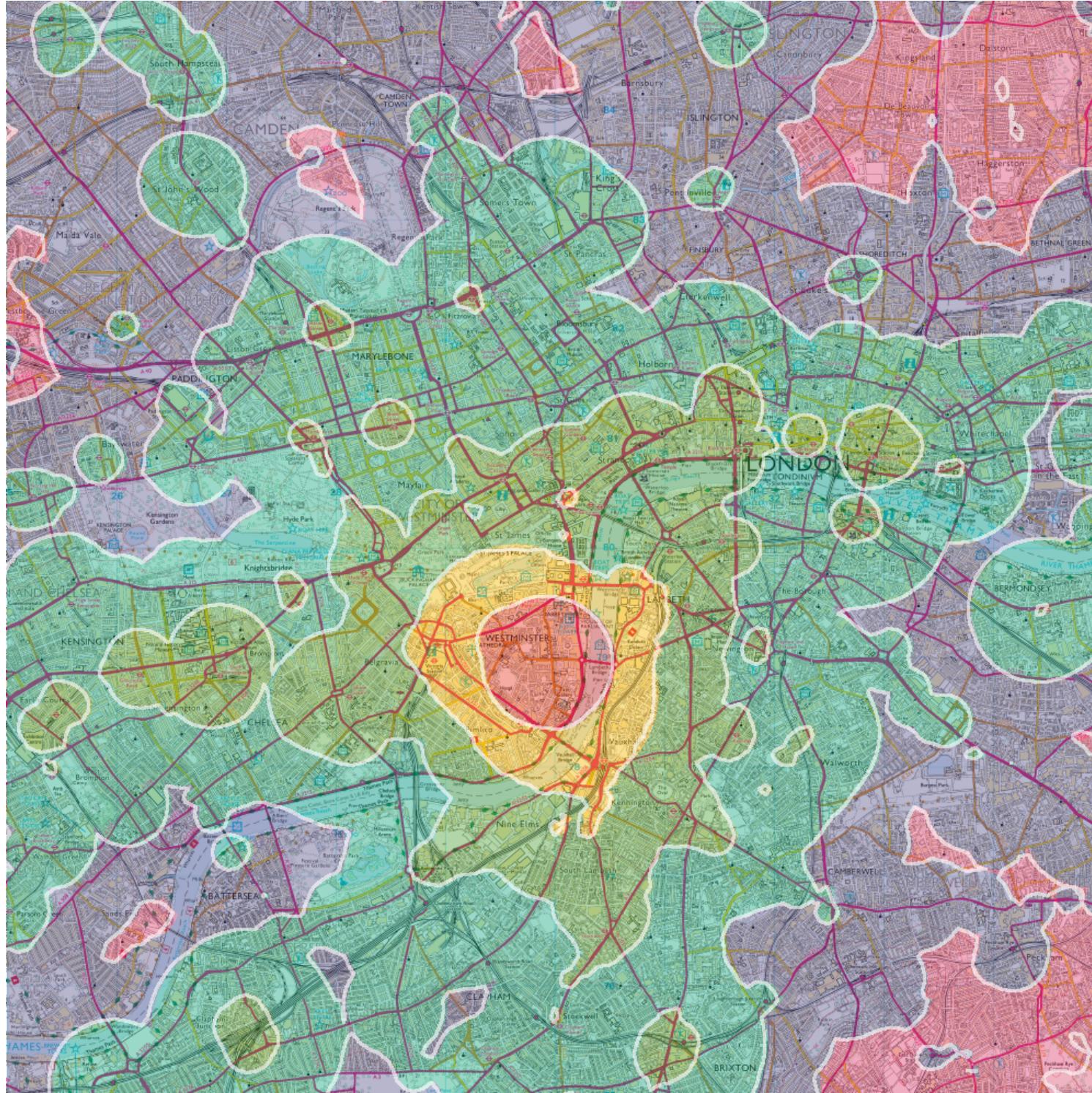
Extending the regional model to London

- Here we use Transport for London's timetable service at www.tfl.gov.uk
- Much faster than TransportDirect, though it seems to be based on the same underlying technology
- How early do you have to leave the house to get to work at the DfT?

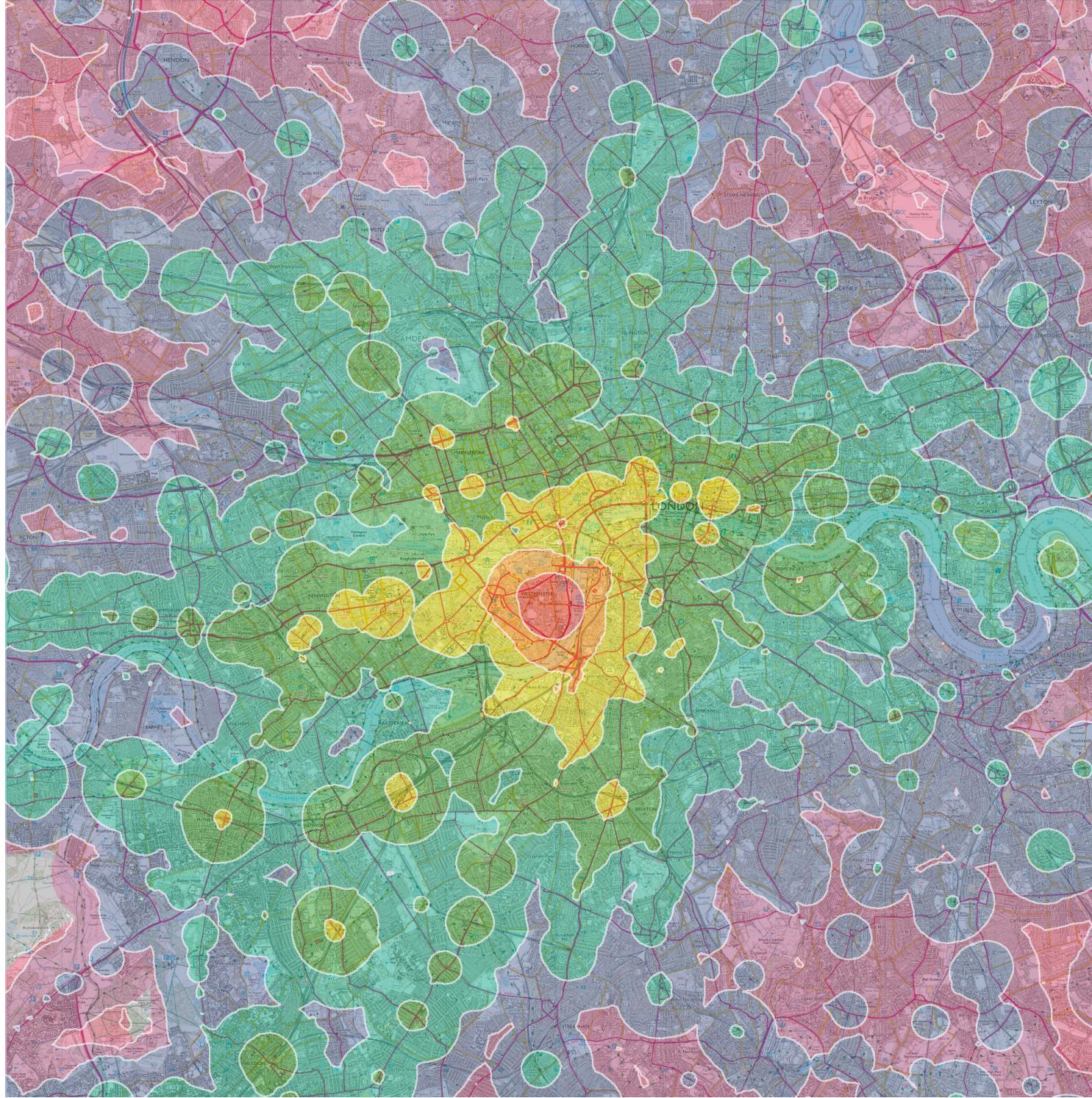


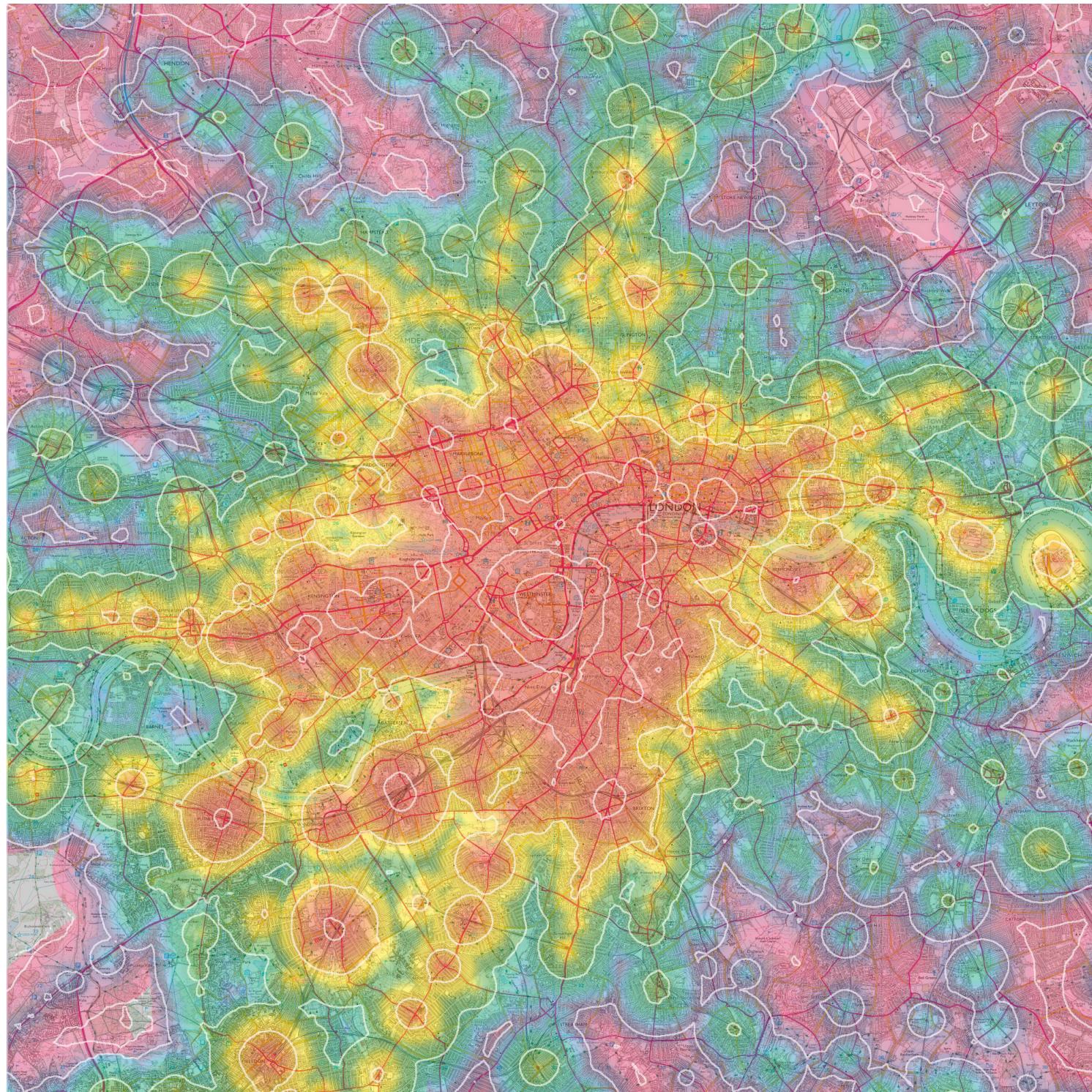
0900h
0840h
0820h
0800h

contours at 10-minute intervals

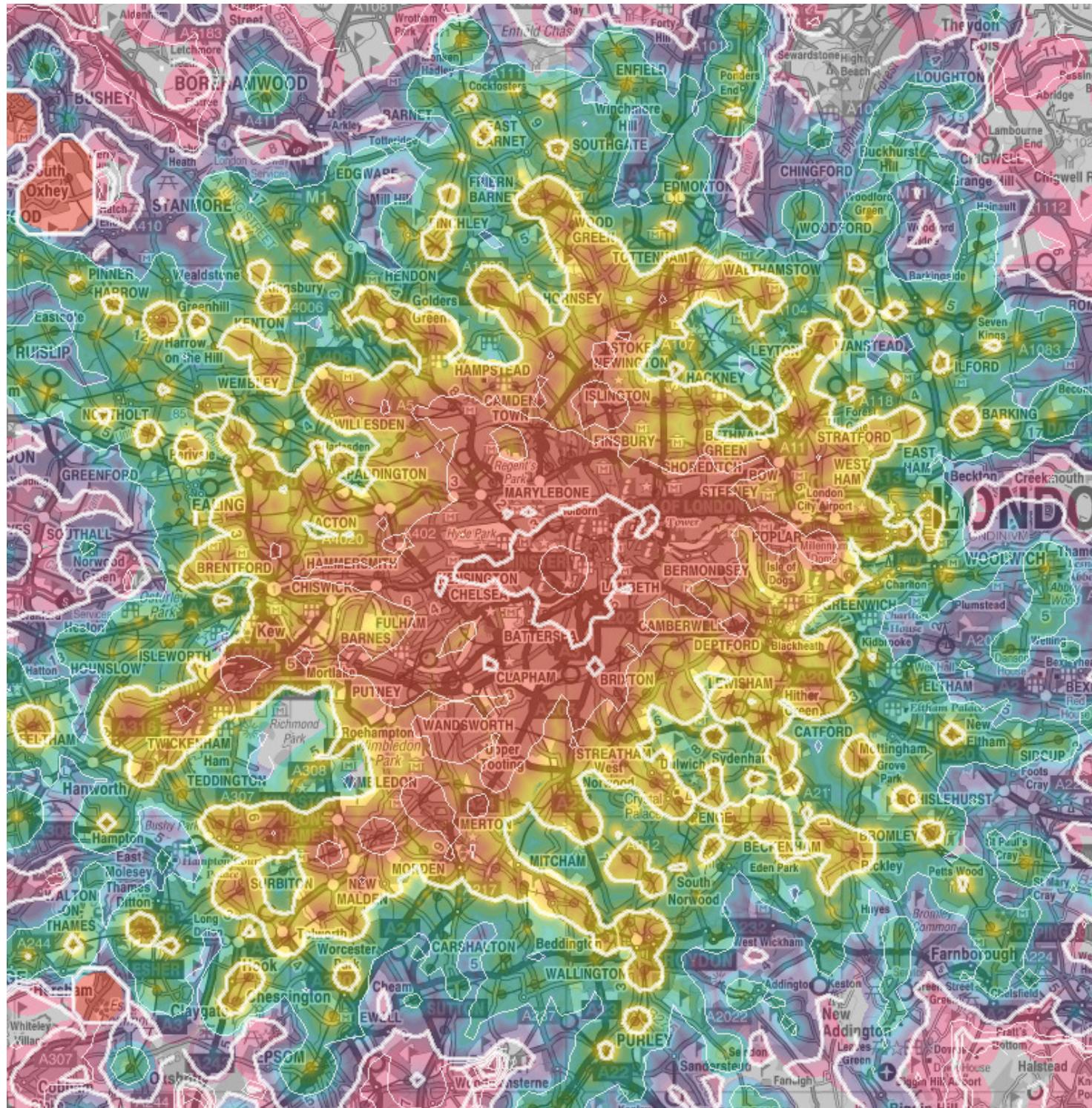


contours at 10-minute intervals





0900h
0840h
0820h
0800h
0740h



0900h
0830h
0800h
0730h
0700h

Technical notes

- Data are all derived from published sources
 - RailPlanner application
 - TransportDirect journey planning website
 - Transport for London website
- Automatic extraction of data using custom software
 - Written in C under Windows for RailPlanner
 - Otherwise perl and WWW::Mechanize
- Custom mapping
 - For national-scale maps: GMT (Generic Mapping Tools) from SOEST, University of Hawaii
 - Local scale mapping using custom software developed for this project
 - In both cases desktop GIS software would also have sufficed