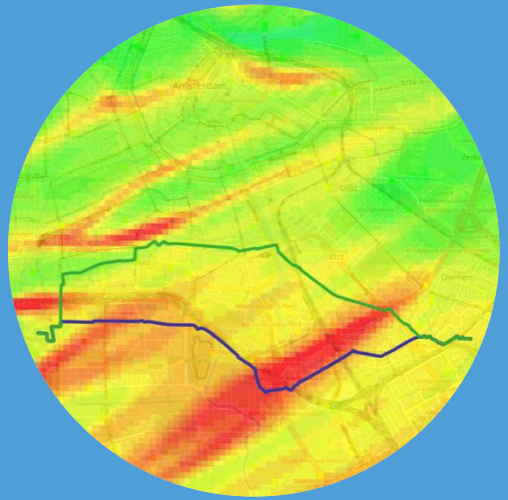
Healthy Urban Route Planner

A Route Planner with a special impedance

2 November 2017, Corné Vreugdenhil



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Project Info

- Stimulus Project 2016 (AMS-Institute)

- Parties:
  - Meteorology & Air Quality, WUR
  - Geo-Information and Remote Sensing, WUR
  - GGD Amsterdam
  - Fietsersbond Amsterdam

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GGD Amsterdam

Fietsersbond
Afdeling Amsterdam

The problem


DIGITALE KRANT
SERVIC
Vrij. Onverveerd
Het Parool
HOME
AMSTERDAM
STADSGIDS
Amsterdam meest vervuilde stad van Nederland

Route alternatives

Let's build a route planner for citizens to find a more healthy route!

	Route 1a	Route 1b	Route 2a	Route 2b
7h	62%	112%	65%	68%
8h	100%	144%	100%	98%
9h	109%	145%	106%	94%
10h	88%	117%	80%	71%
16h	111%	156%	103%	98%
17h	131%	195%	133%	131%
18h	137%	216%	141%	145%
19h	144%	217%	144%	151%

Project Overview

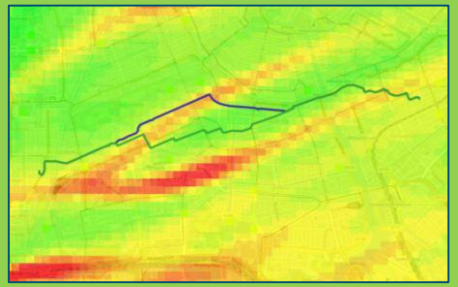
Mapping Air Quality Sources

Air quality source maps

Weather Research and Forecasting –Chemistry model

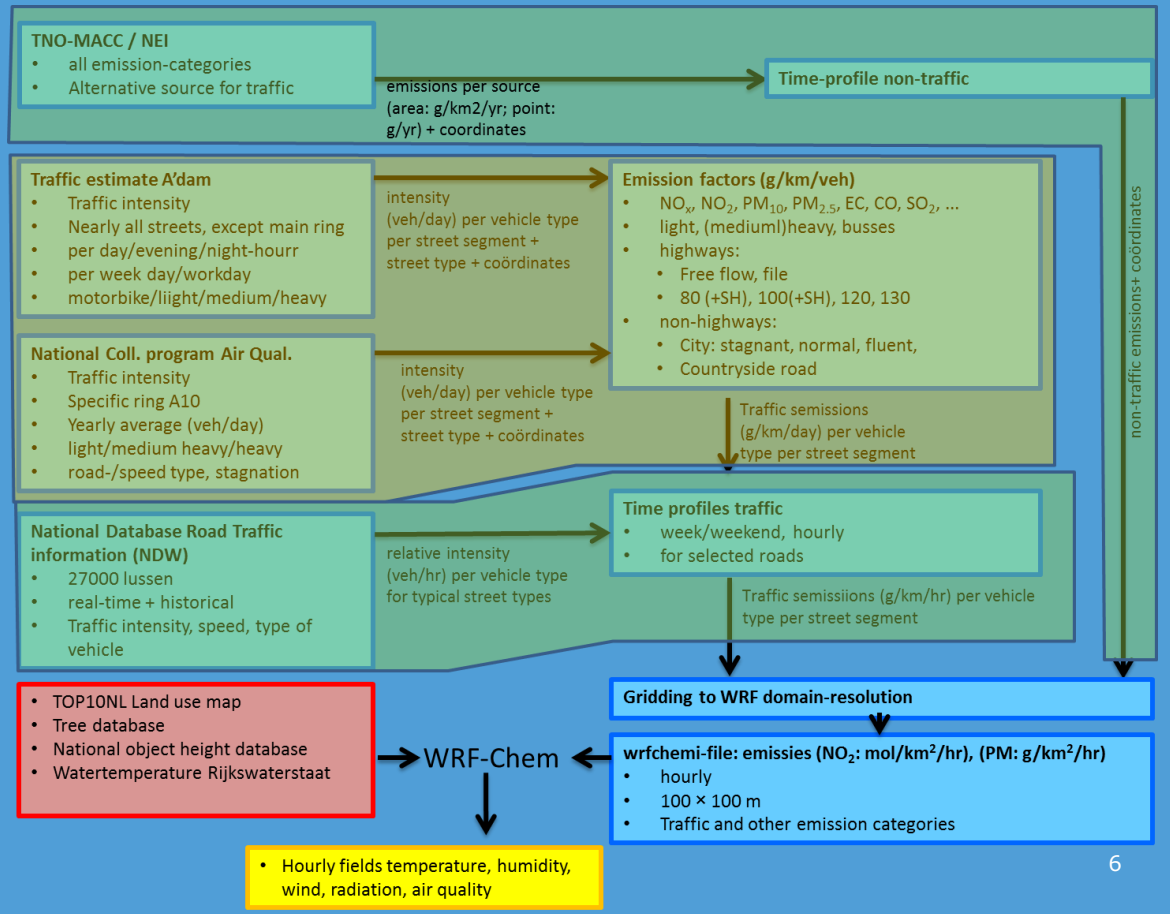
Daily air quality and heat maps

Route Planner Development



Mapping Air Quality Sources

- Emissions from Traffic: Observed traffic intensities (road counting loops)
- Non-traffic emissions: TNO-MACC / NEI



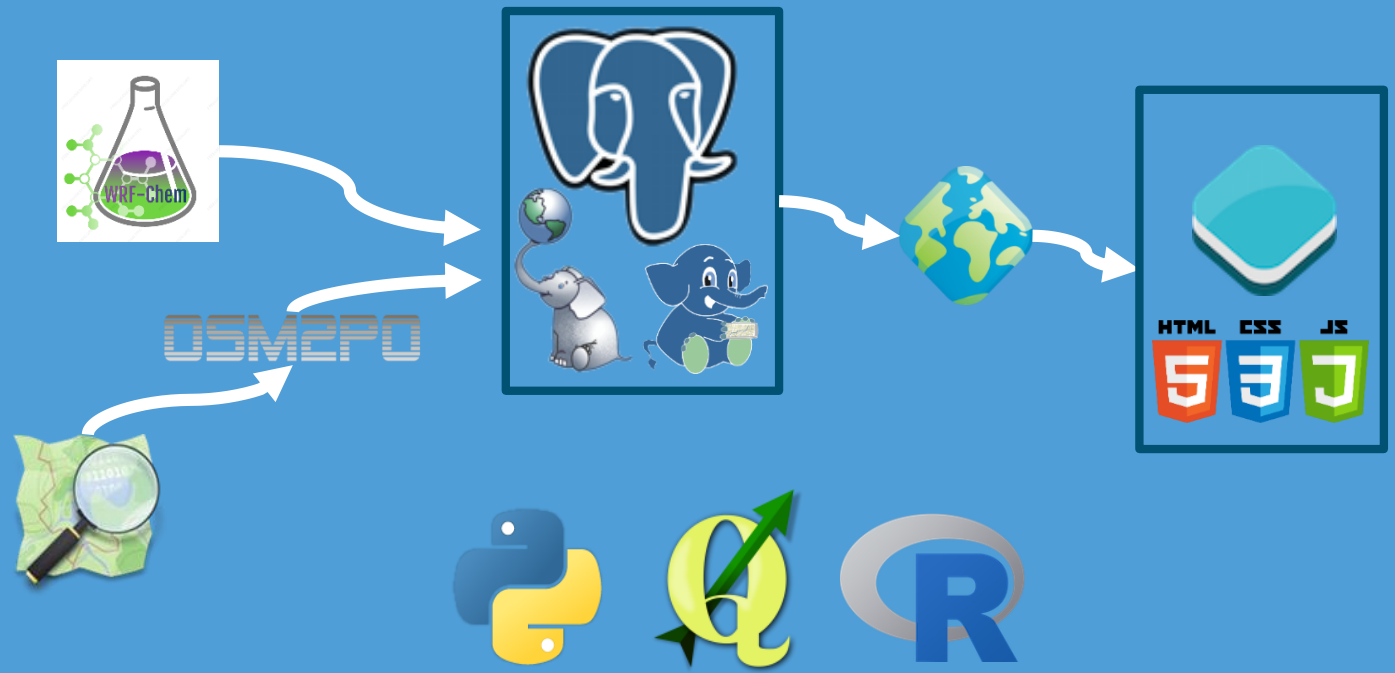
Weather Forecasting

WRF-Chem model: (Weather Research and Forecasting)

- Atmosphere and air quality model
- Includes urban canopy model and emissions
- Applied for Amsterdam, **hourly maps** with **100 m resolution**
- Atmospheric variables, amongst others **temperature** and **Nox concentration**

Route Planner Development

- Open source data & software based

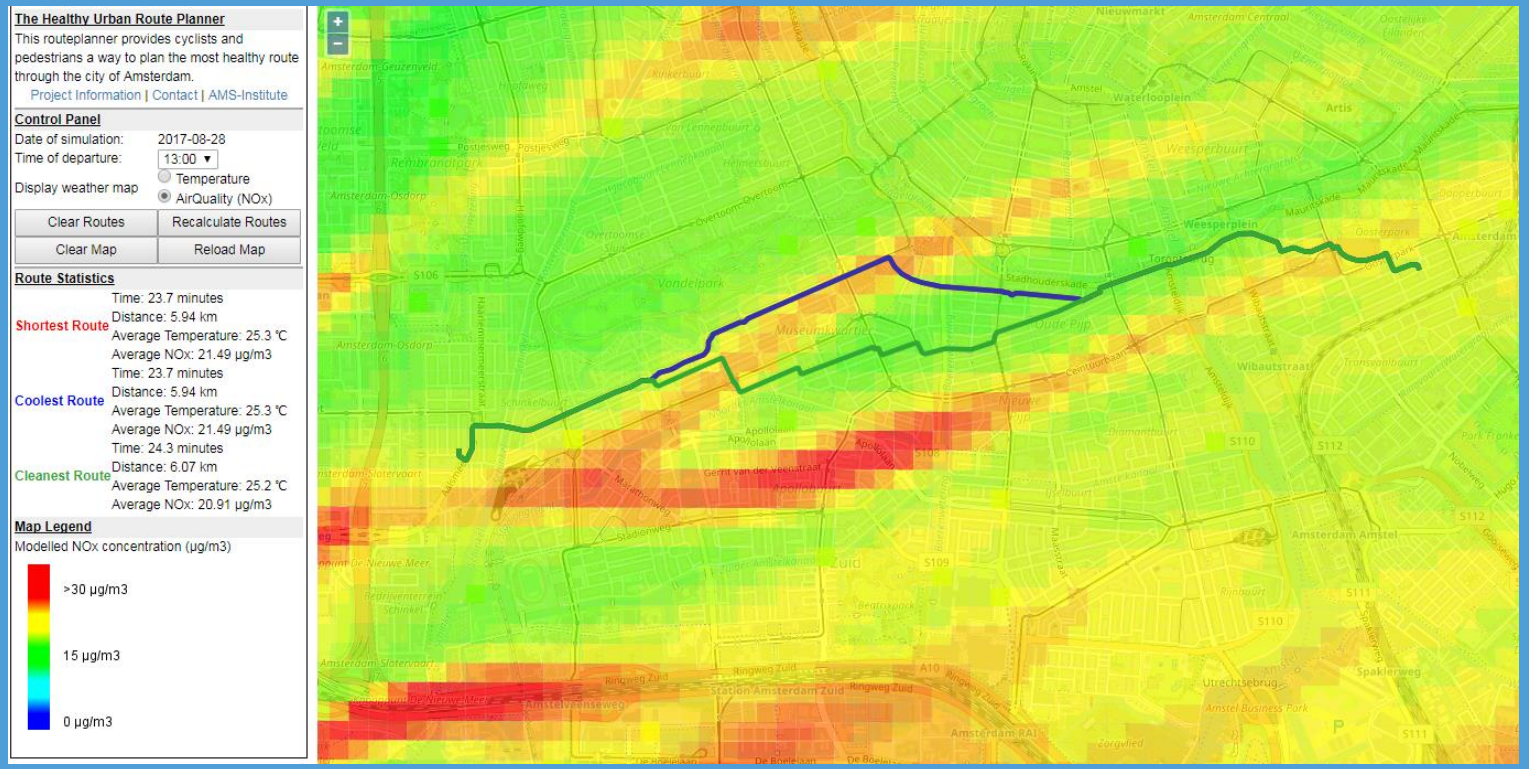


Route Planner Development

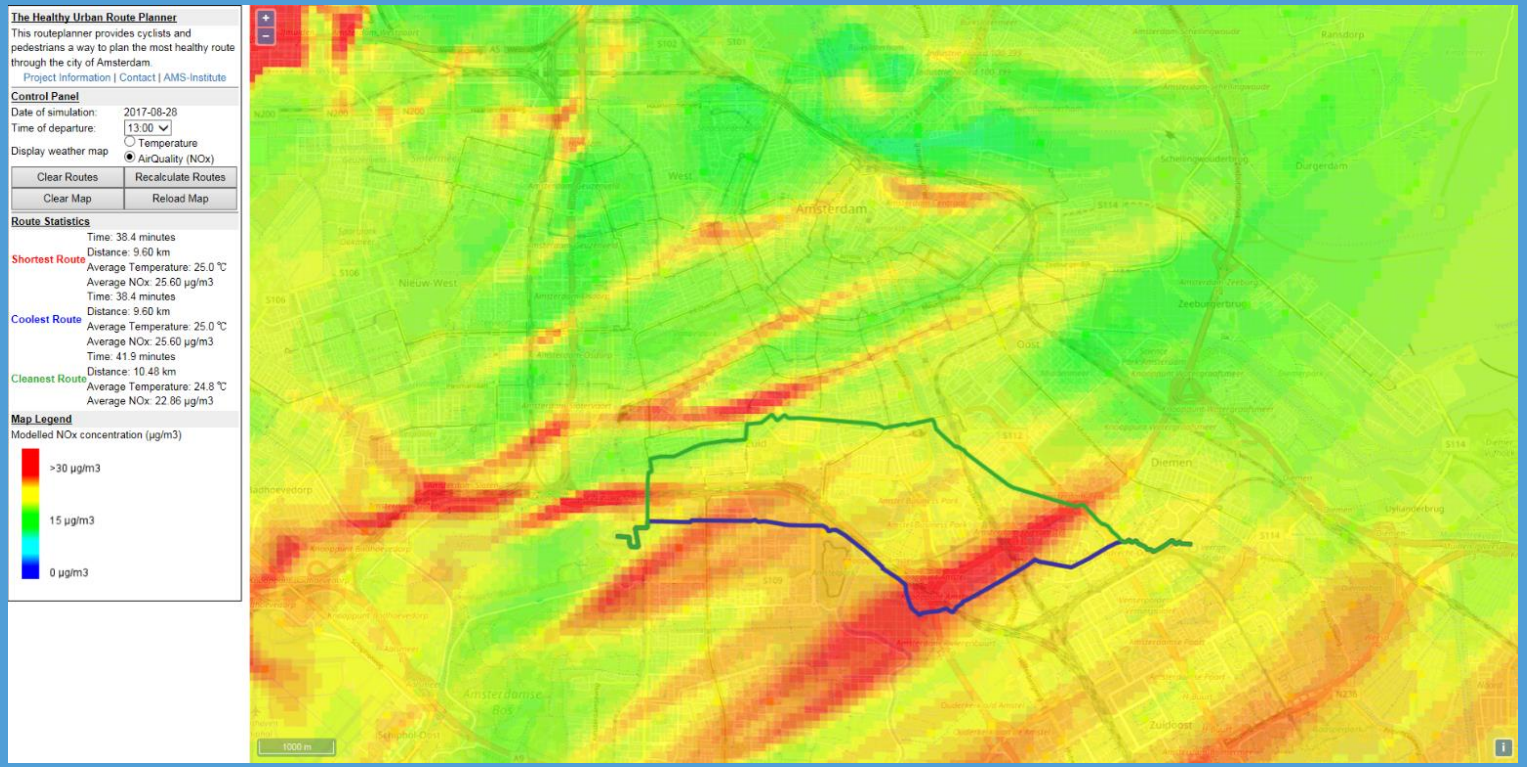
- Open source data & software based
- Routing algorithm: Traditional Dijkstra with adapted cost-definition
    - Time dependent impedance variable (simulation day & hours)
    - Impedance = weather variable * length of segment

        - Weather variable =
            - Temperature (Coolest Route) or,
            - NOx concentration (Cleanest Route)

HURP – the web application



HURP – the web application

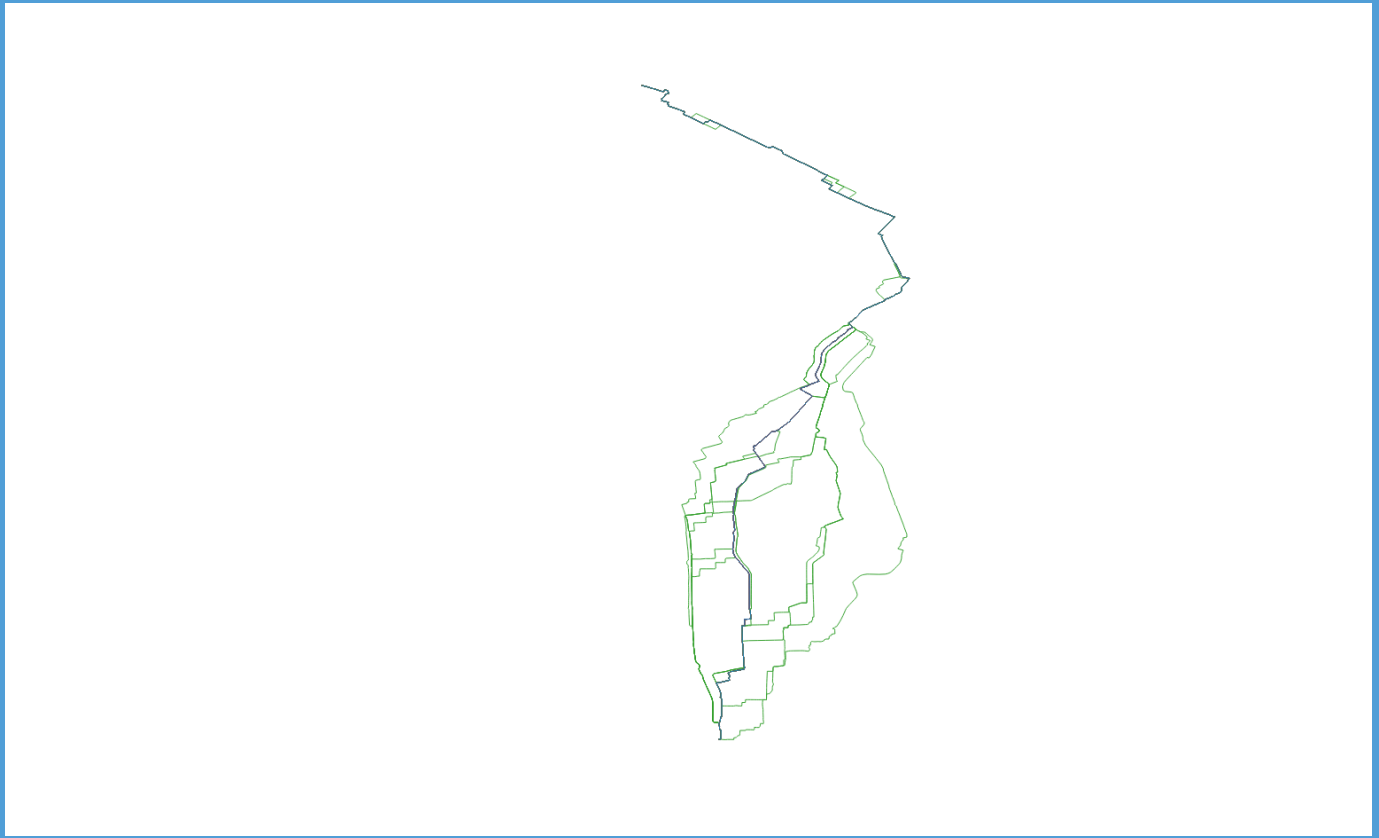


Monte Carlo analysis on HURP

- 1 begin-end
- 1 simhour
- 3 route types

Monte Carlo analysis on HURP

- 1 begin-end
- 24 simhours
- 3 route types

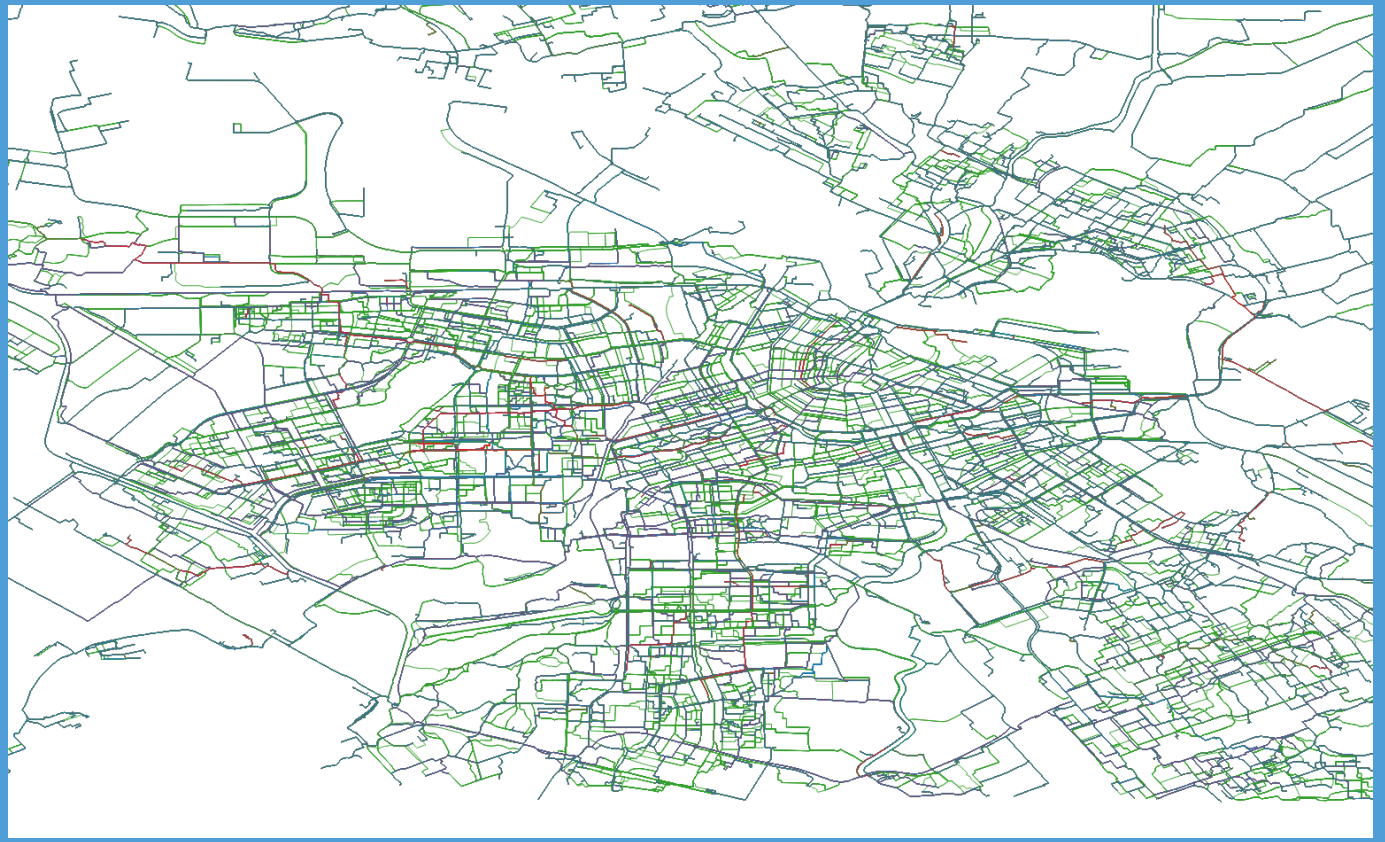


Monte Carlo analysis on HURP

- 10 begin-end
- 24 simhours
- 3 route types

Monte Carlo analysis on HURP

- 1000 begin-end pairs
- 24 simhours
- 3 route types



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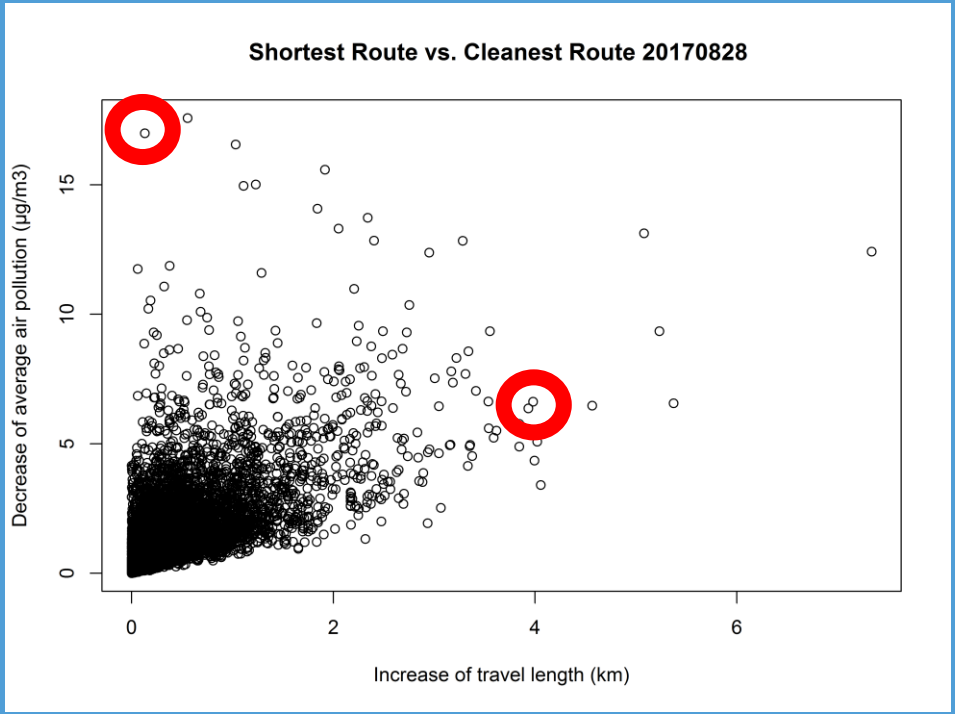
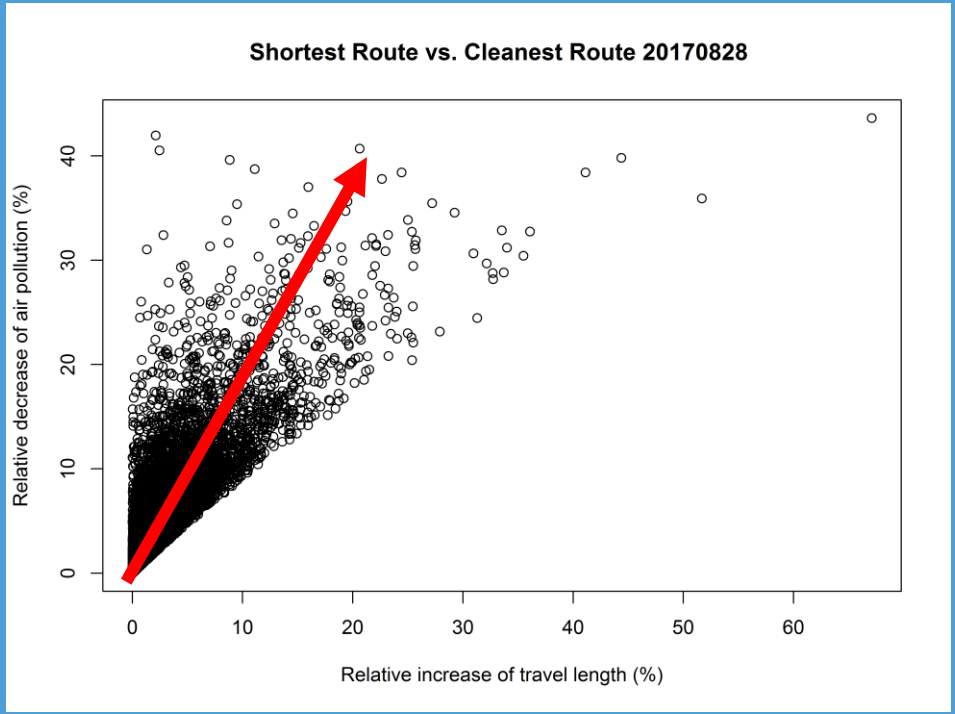
Results of Monte Carlo Analysis
Air pollution





Results of Monte Carlo Analysis
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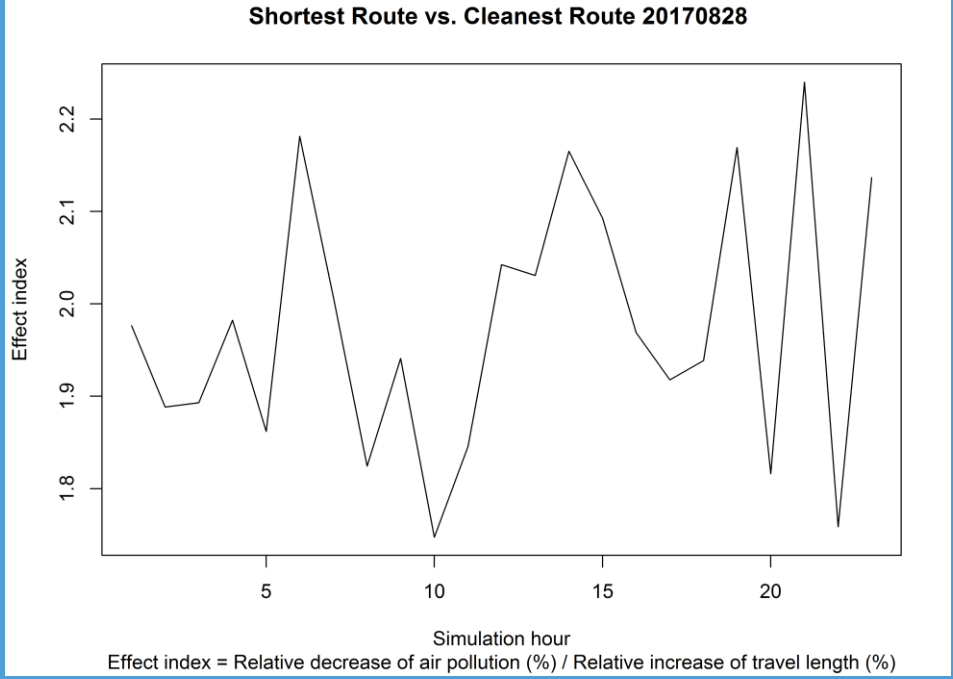
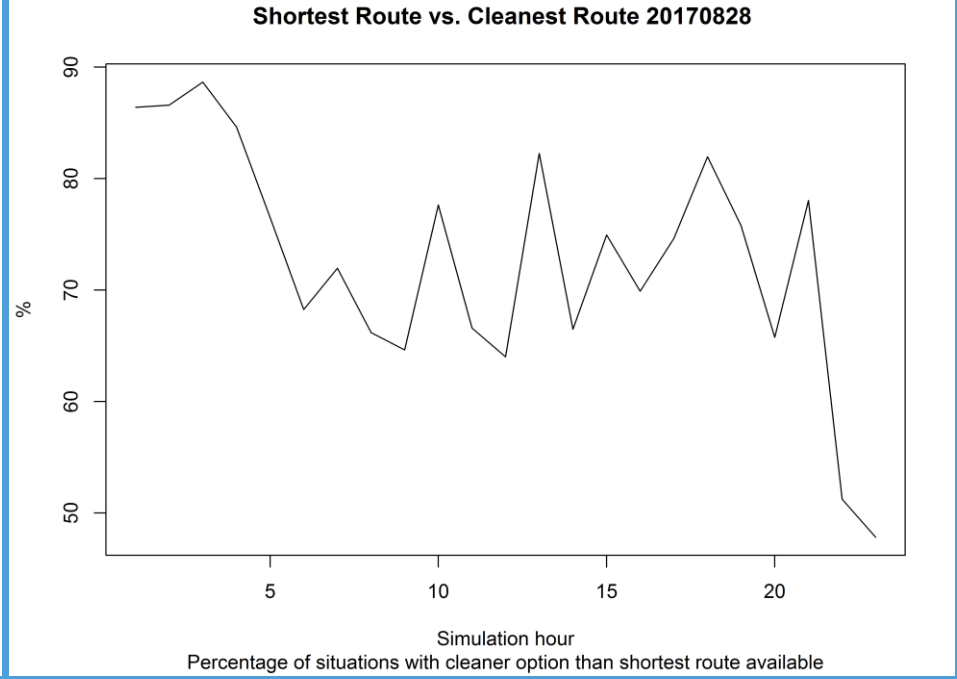
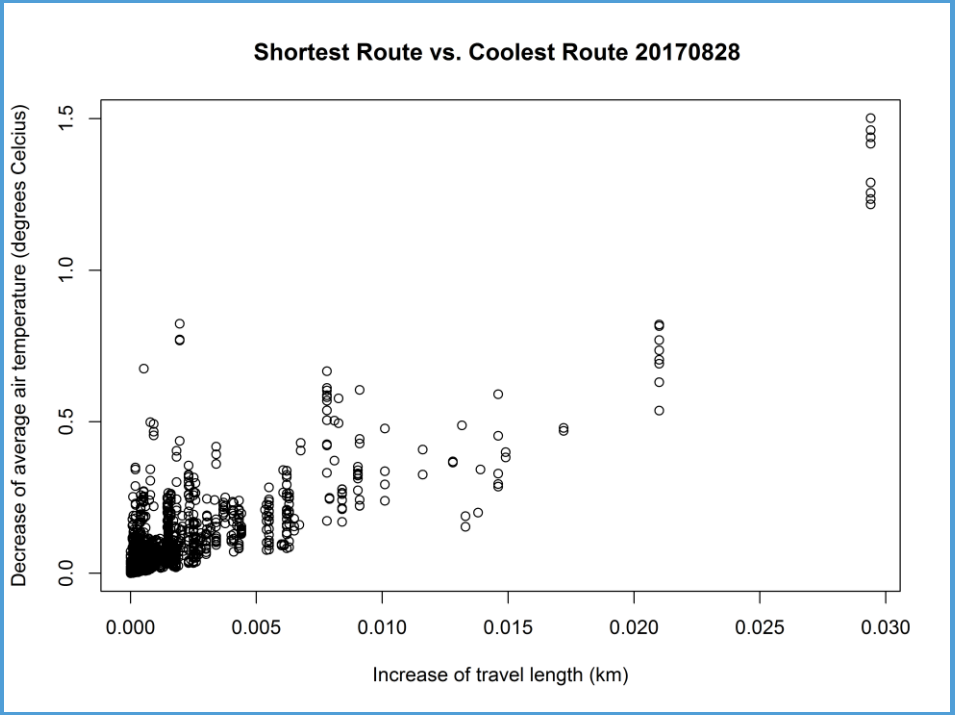


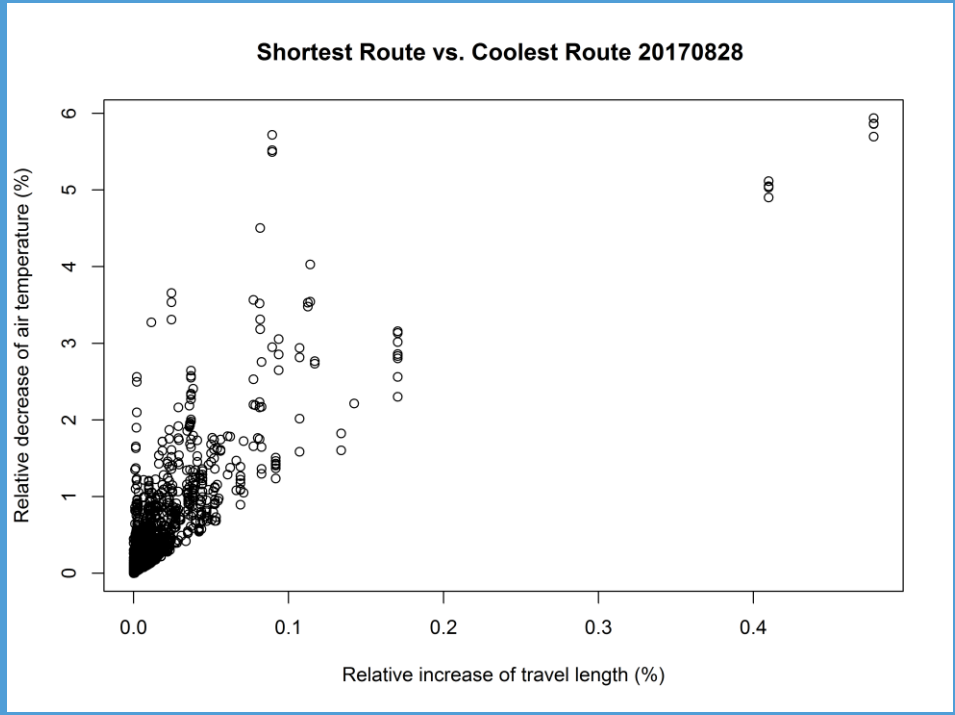
Effect index = Relative decrease of air pollution (%) / Relative increase of travel length (%)



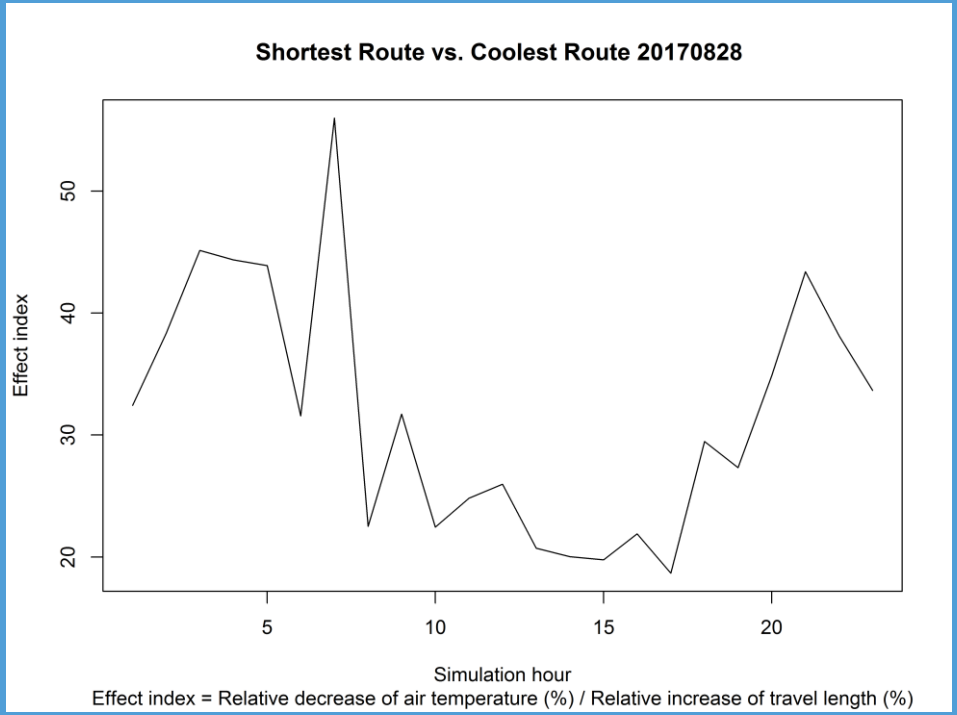
Percentage of situations with cleaner option than shortest route available

Results of Monte Carlo Analysis Temperature

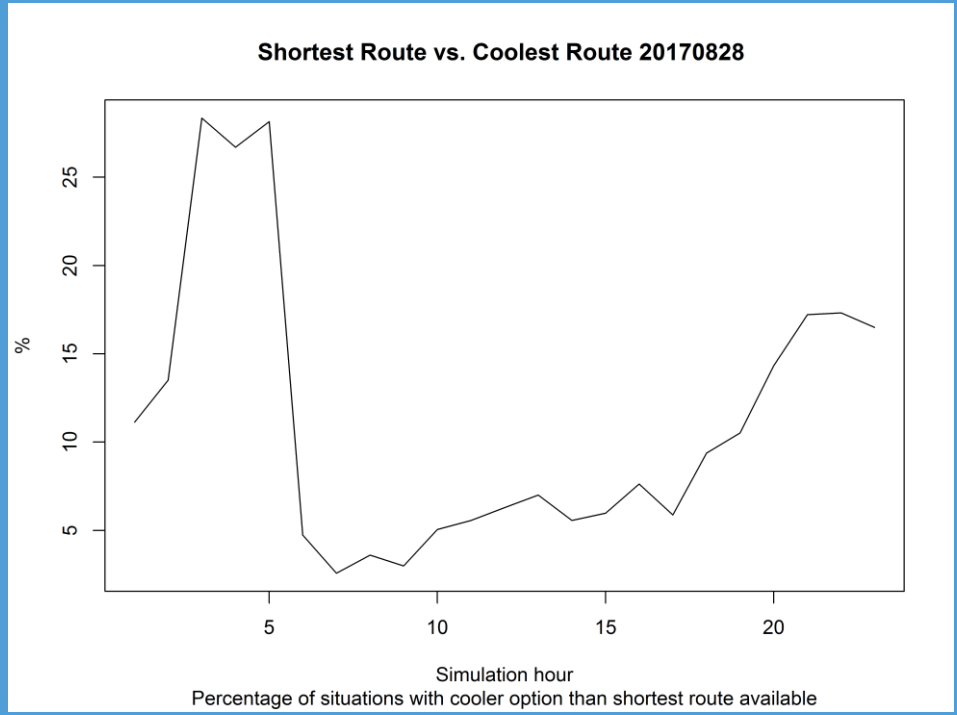




Results of Monte Carlo Analysis
Temperature



Effect index = Relative decrease of air temperature (%) / Relative increase of travel length (%)

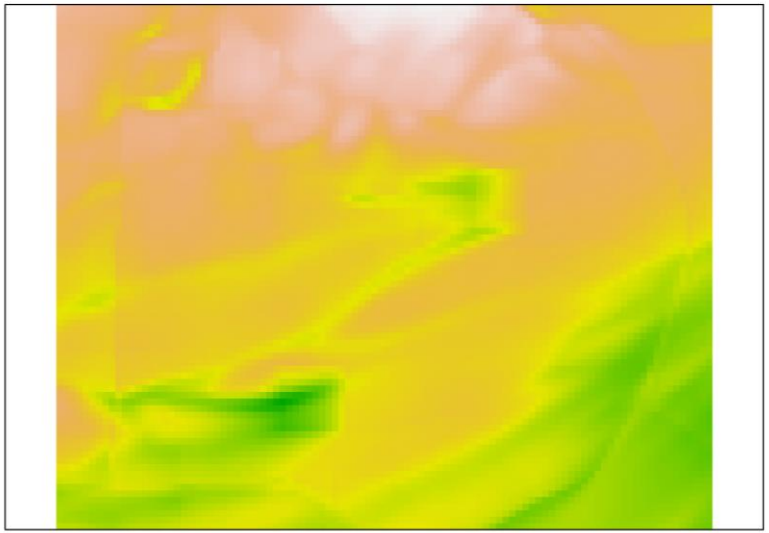


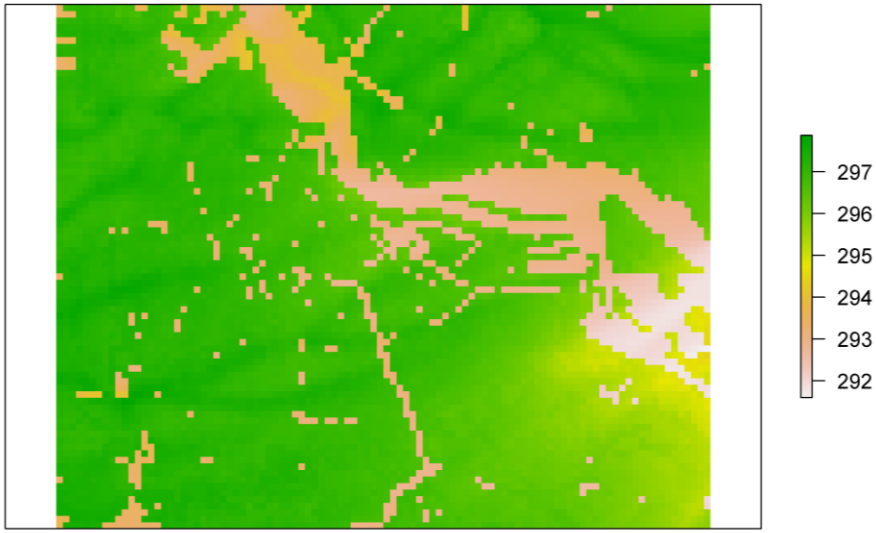
Percentage of situations with cooler option than shortest route available

Preliminary results

- NOx concentration:
  - ~ 70 % of cases a ‘cleaner’ alternative
- Temperature:
  - Only ~10-20 % of cases a ‘cooler’ alternative found
  - Larger effect, but rarely a cooler alternative

Larger influence due to larger spatial variability?





Discussion

Image from: http://www.gizmodo.co.uk/2016/07/diesel-chuggers-and-pre-2005-cars-facing-extra-london-air-pollution-charges/