BICYCLE BASED AIR POLLUTION MONITORING

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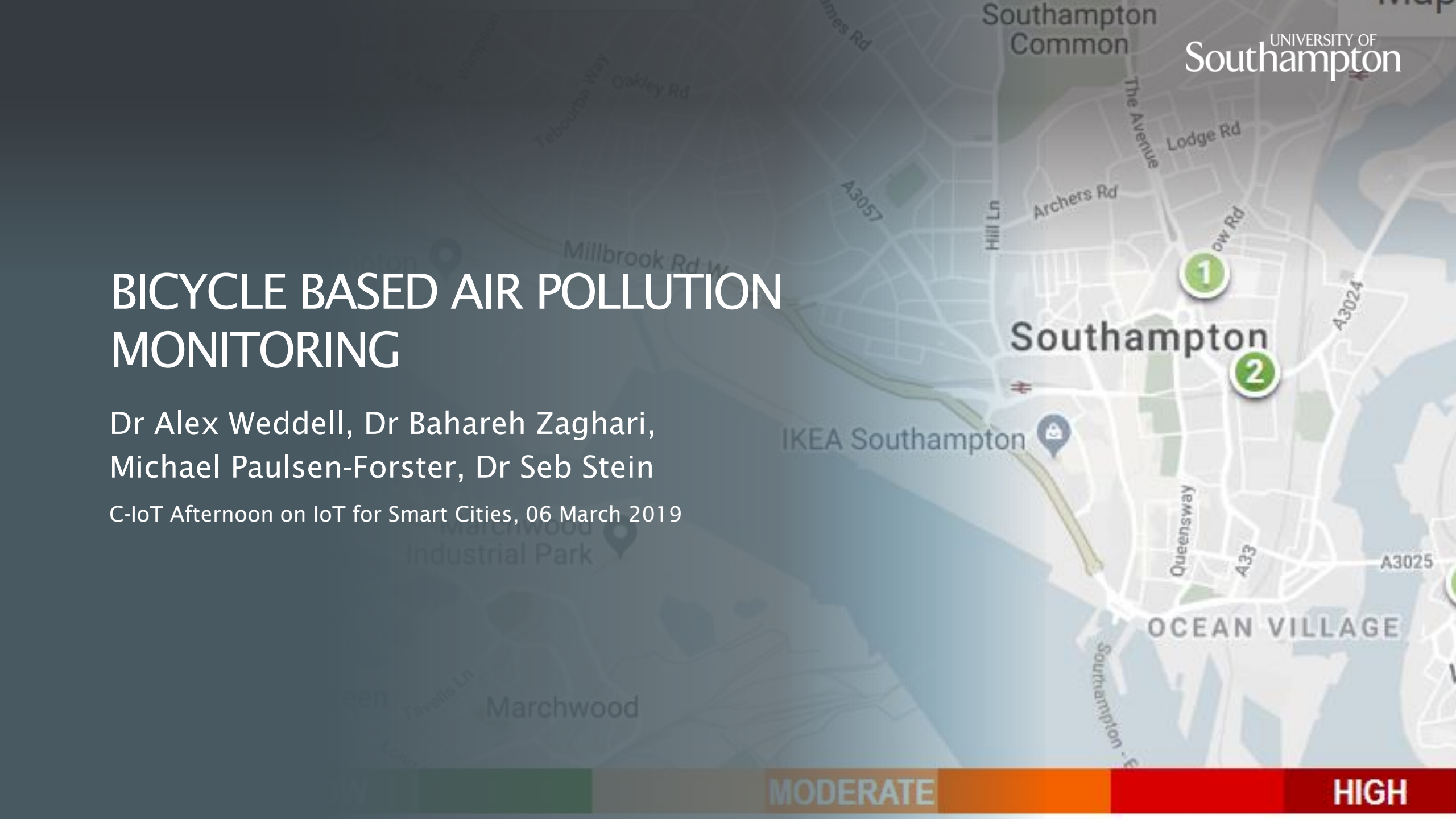
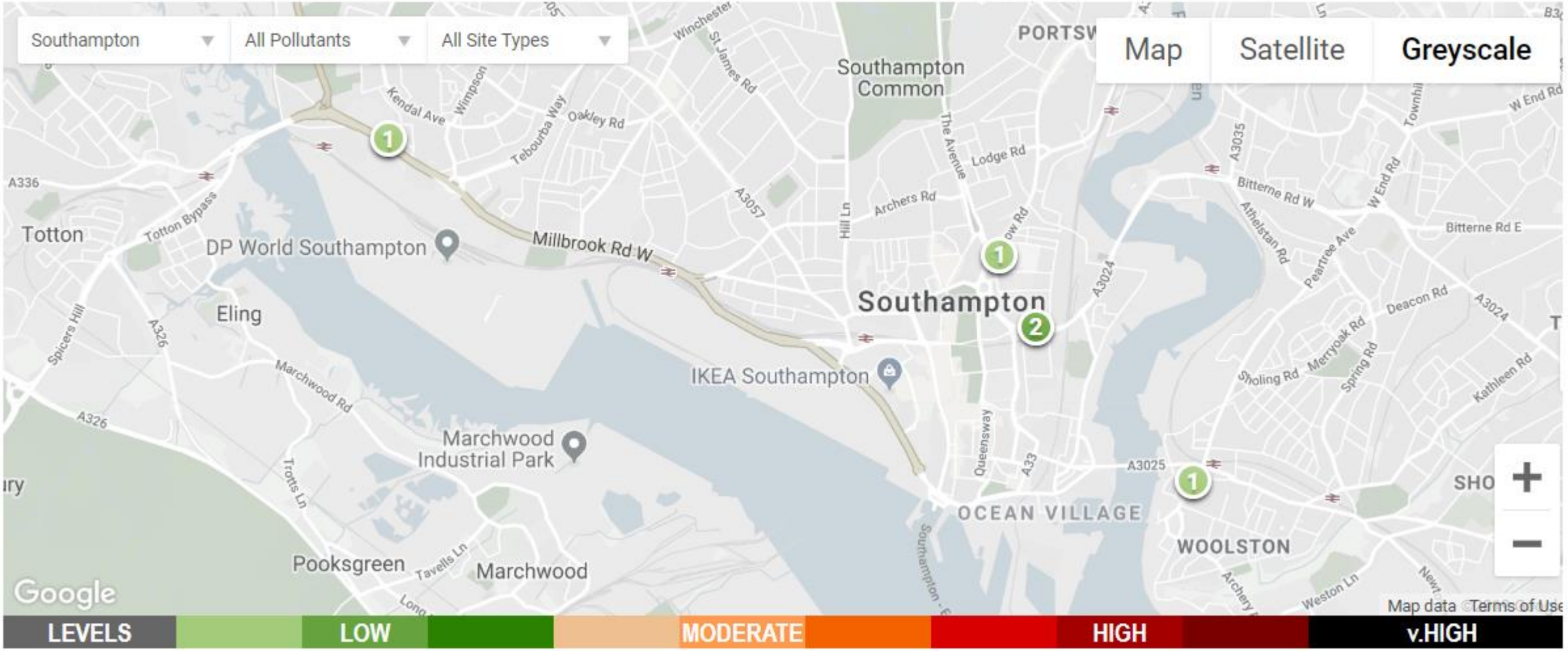


EXISTING AIR QUALITY MONITORING

- Southampton City Council only has four automatic air pollution monitors:
  - Six Dials, St Marys (NO_2, PM10, PM2.5, Ozone, Sulphur Dioxide, Benzene)
  - Onslow Road, Bevois Valley (NO_2)
  - Victoria Road, Woolston (NO_2)
  - Redbridge Road, Redbridge (NO_2, PM10)
- Plus around 60 NO_2 diffusion tubes around the city

Image Credit: The Naked Scientists, Google StreetView

EXISTING AIR QUALITY MONITORING



http://southampton.my-air.uk/

THE PROBLEM

- Automatic air pollution monitoring is expensive
  - Sparsely distributed sites, poor spatial resolution
- Other fixed techniques, e.g. diffusion tubes, give poor temporal resolution
  - Left in place for several weeks, analysed in lab, give an overall concentration level
  - Unreliable indicator of a person's realistic exposure to pollutant

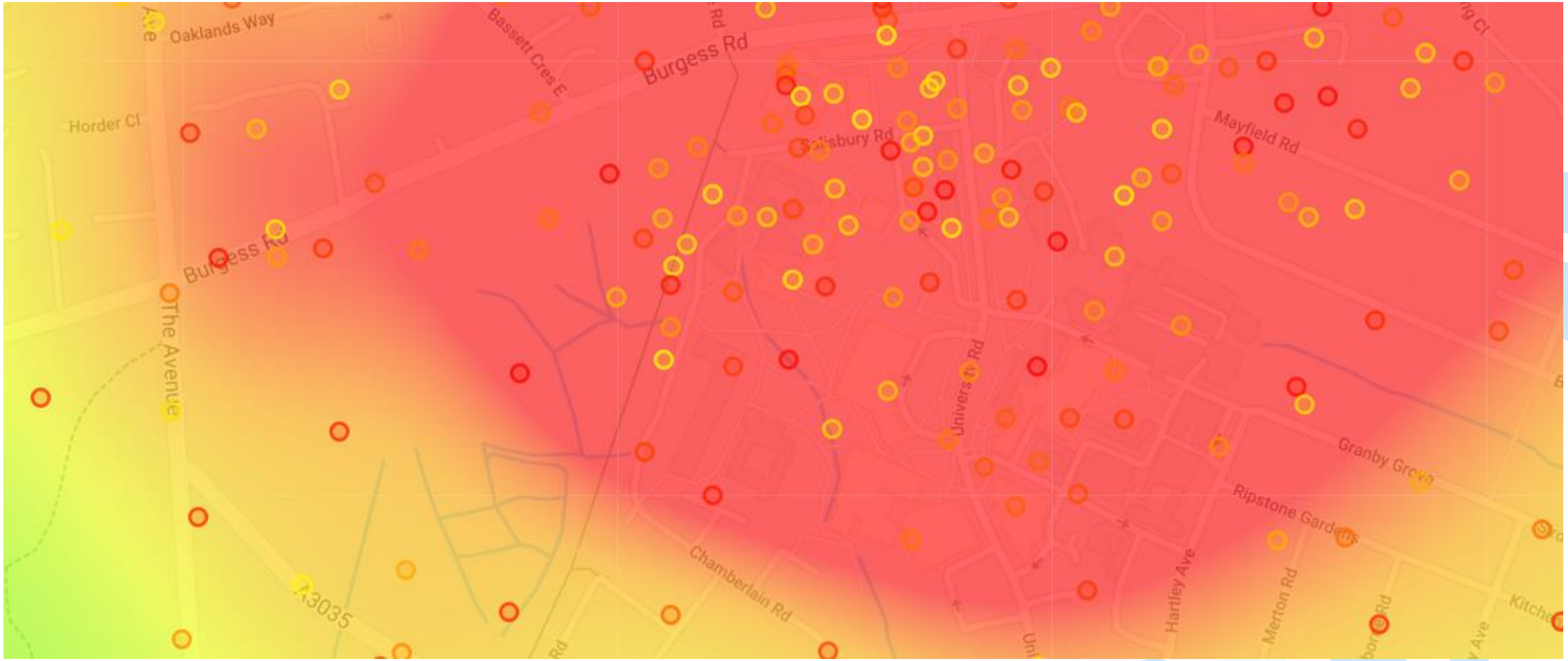
Image Credit: The Naked Scientists, Google StreetView

THE SOLUTION?

- Engage **citizens** to collect pollution data during their daily activities
- Develop a low-cost, open-source pollution data collection platform
- Include pollution sensors on moving platforms – bicycles etc.
- Build up a detailed pollution picture – enhanced temporal/spatial resolution (though the need for cheap devices means compromises on precision/accuracy)
- Incentivise cyclists to take certain routes to collect data…

Image Credit: Allan McKenzie/Swpix.com

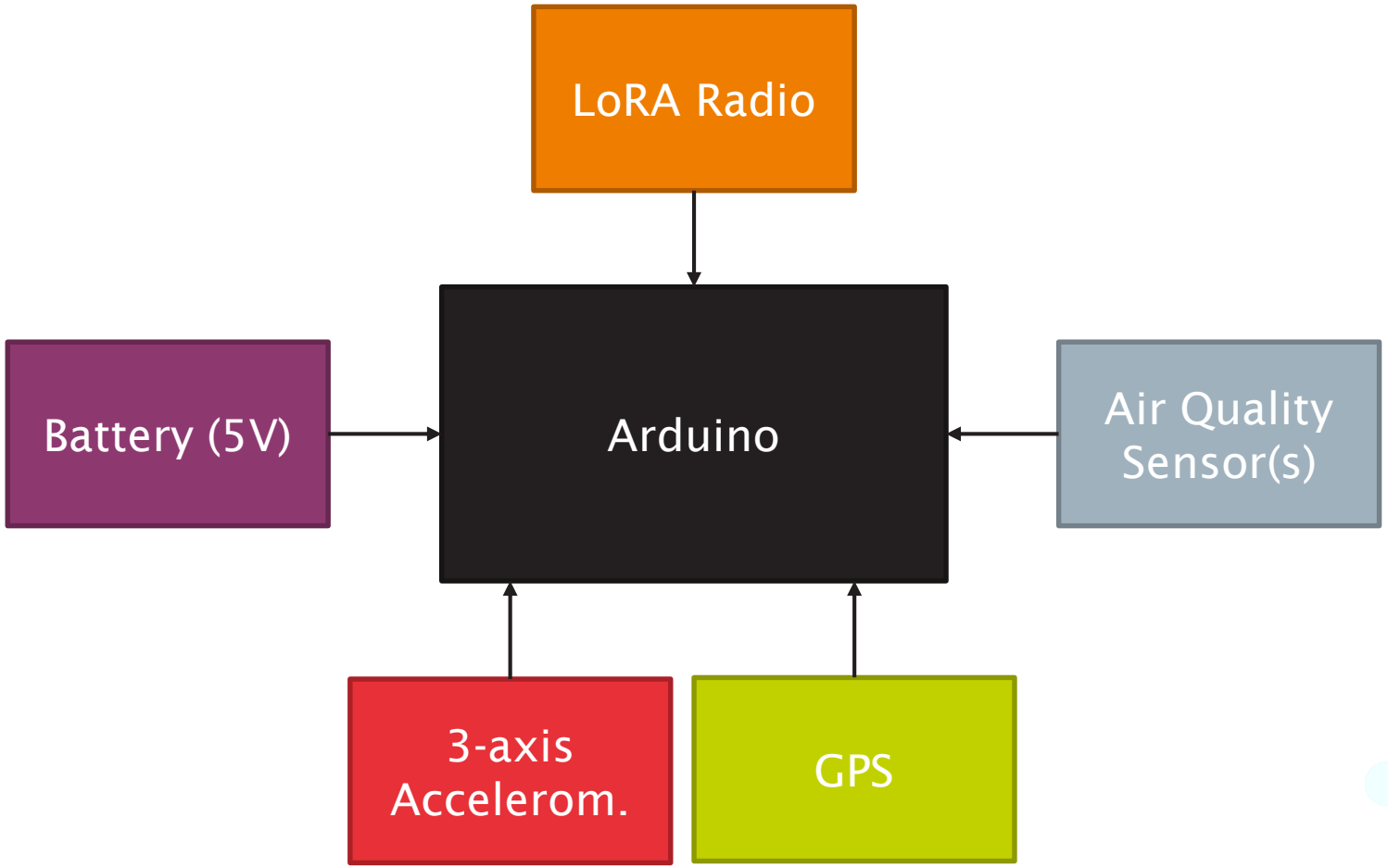
VISUALISING POLLUTION DATA



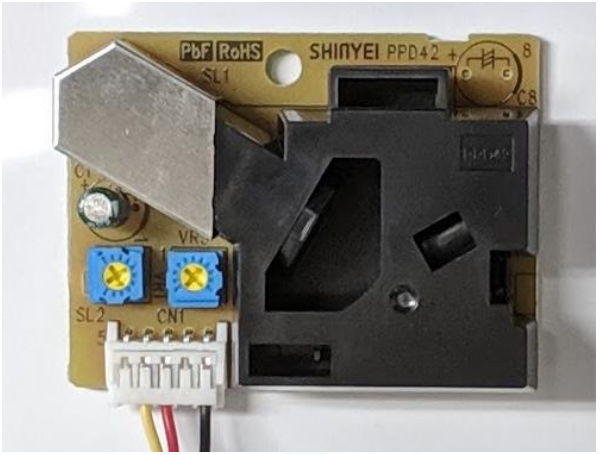
https://airpoll.co.uk/

PROTOTYPE SENSOR SYSTEM

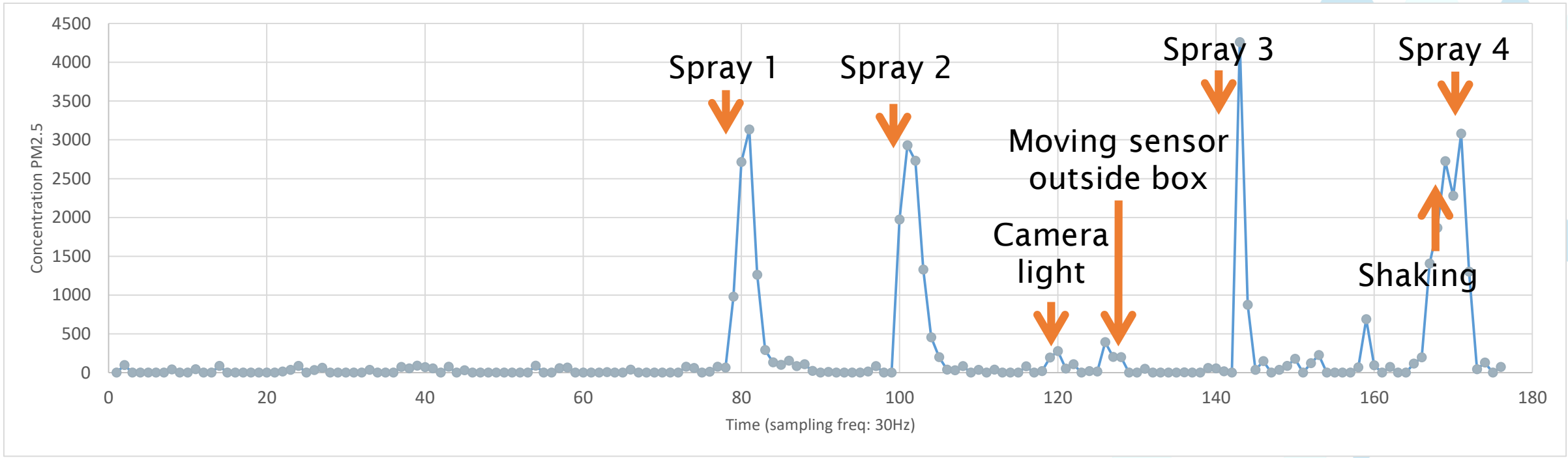
- Arduino Due, 3-axis accelerometer, GPS, LoRA radio + sensor(s)



EVALUATING SENSOR PERFORMANCE



- Testing of a very low-cost particulate sensor, using an aerosol
- Cross-sensitivity to shaking/vibration and light a particular concern!



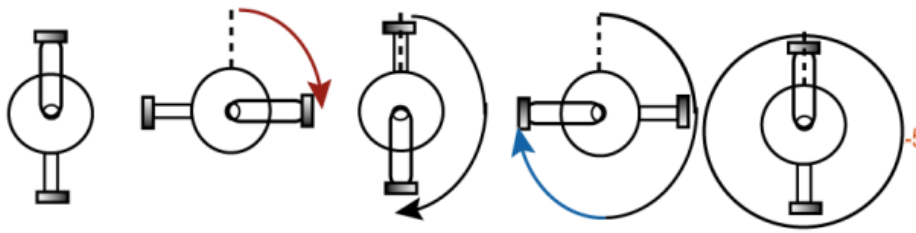
- Now evaluating alternative particulate sensors – Sensirion SPS30/Plantower

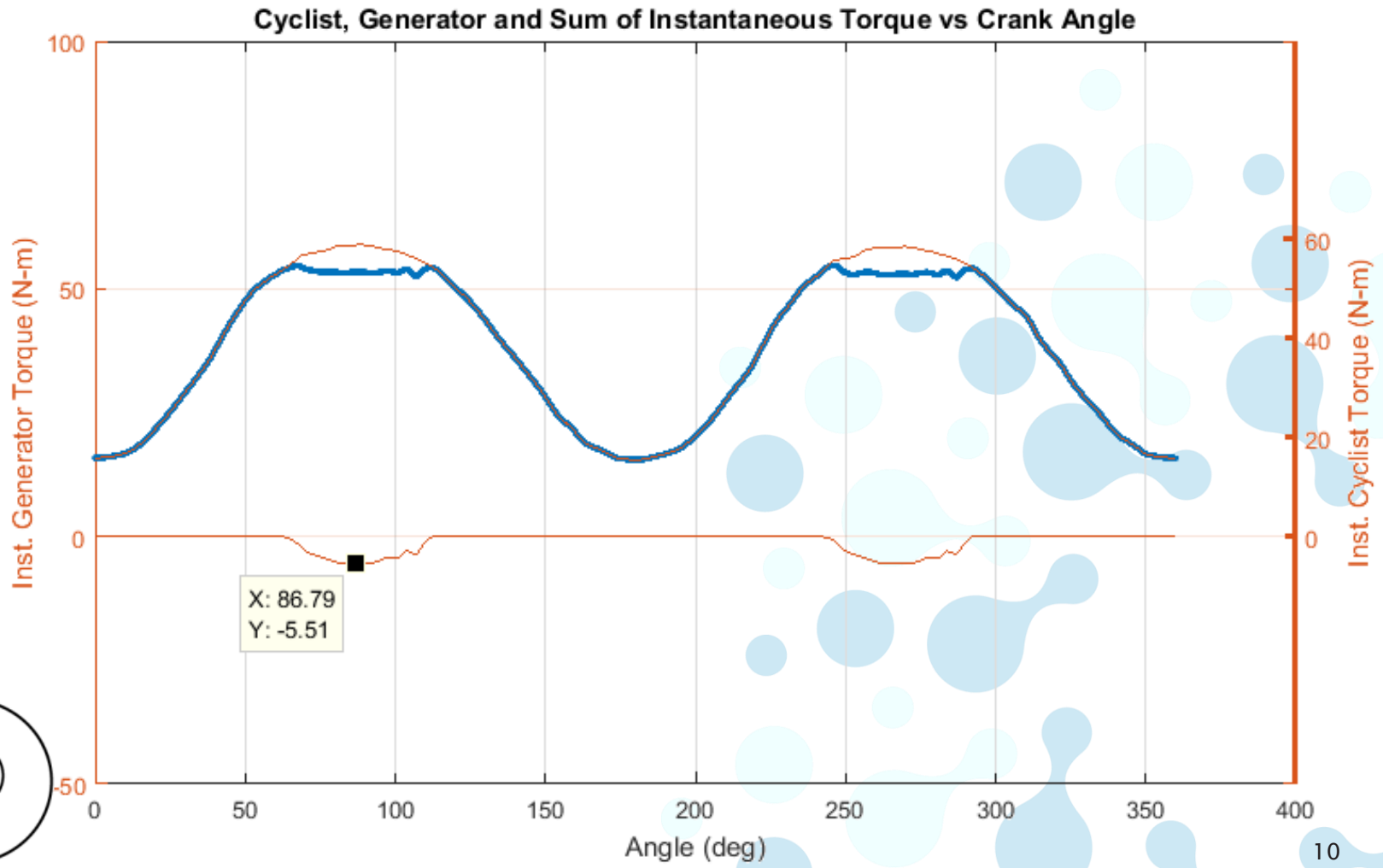
OUTSTANDING CHALLENGES

- Ethics and Safety
  - Recommending cycle routes – safety implications?
  - Tracking of bikes/users – real-time location data
- Power, Sensing and Packaging
  - Smarter sensing? At present, sensor runs on fixed duty-cycle. Could be smarter
  - Weatherproofing and security
  - Limited power supply - energy harvesting from cycle motion…

TOWARDS A SELF-POWERED DEVICE

- Switched-reluctance generator – harvesting from pedal motion
- Opportunistic harvesting, can be modulated with crank angle (minimal discomfort to cyclist)
- Can also be used as a **motor** for intelligent assistive cycling





YOUR QUESTIONS

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