Imperial College London

UWS UNIVERSITY OF THE WEST of SCOTLAND

Air Quality v Athletes?

Development of decision support tools for the assessment of personal exposure to air pollution

Julien S Baker, Lon Kilgore & Andrew Hursthouse*

School of Science, University of the West of Scotland,

John Gulliver & Yang Wang

MRC-HPA Centre for Environment & Health,

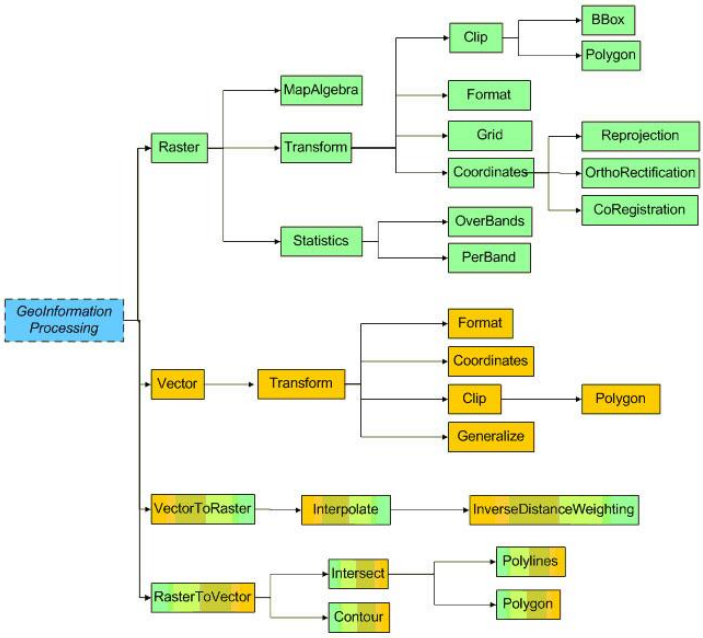
Faculty of Medicine, Imperial College London,

*Contact: andrew.hursthouse@uws.ac.uk

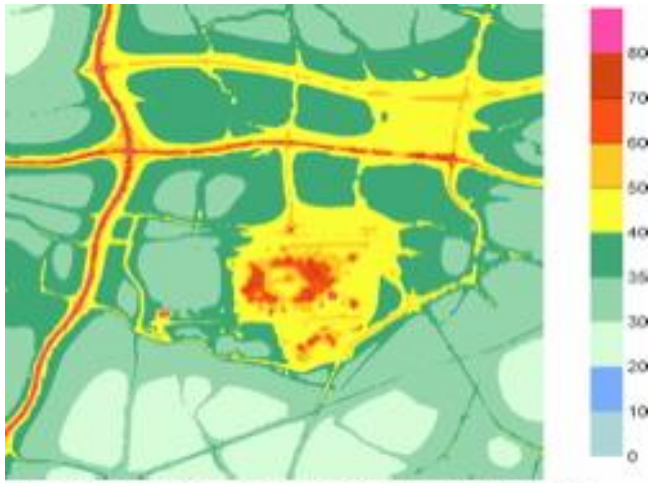
Background

- Concern over air quality and exercise with implications for the performance of athletes
- Increase in promotion of outdoor exercise to promote well being
- Uncertainty linking wide area air quality and personal exposure
- Developments in ICT now allow more refined personal exposure modelling

Development of personal exposure models

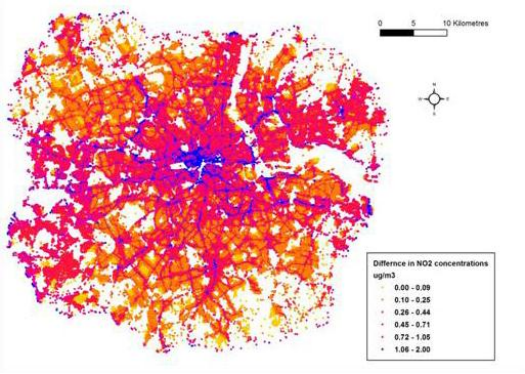


- Space-Time Exposure Model (STEMS) developed as part of GENESIS (**GEN**eric **E**uropean **S**ustainable **I**nformation **S**pace for environment) (FP7) 2008-2011 (IC/UWS partners)
  - Extract air quality data from current AQMs to high spatial (temporal) resolution ADMS-Urban; requires traffic flows and composition on 'major roads' and other sources summarised on a 1km grid (e.g. London Atmospheric Emissions Inventory)



Modelled NO_2 concentrations around Heathrow, 2002 base case (µg/m³)
[From "Adding Capacity at Heathrow Airport —Air Quality Studies for Heathrow", 2007]

Case study concept – route modelling & exposure assessment

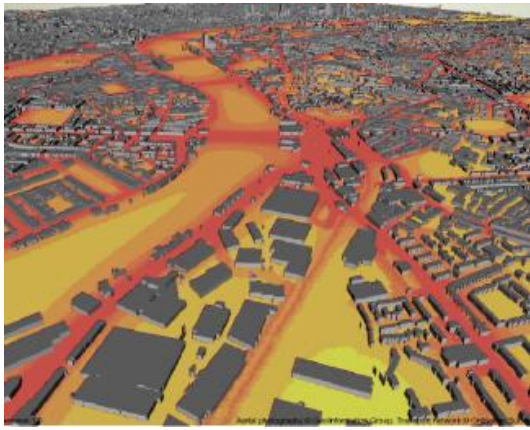


Recruit volunteers from athletics clubs

Obtain training running routes (space time data)

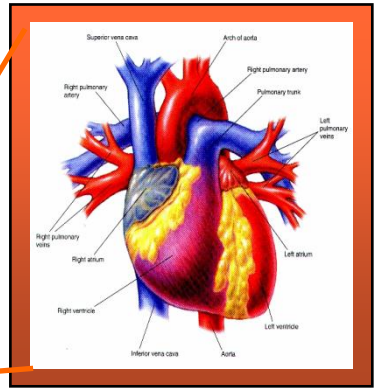
Intersect route data and air quality maps = exposure profile for individuals

Look at alternative routes and impact on potential exposure



Applications?

- Planning routes e.g. Games events, identifying low exposure areas .....public viewing locations....
- healthy lives; well being
  - STEMS currently being used for comparing address-based and personalised exposures in London (publication pending)
- Decision support intervention evidence base...?



GLASGOW 2014

LEGACY 2014
XX COMMONWEALTH GAMES
SCOTLAND

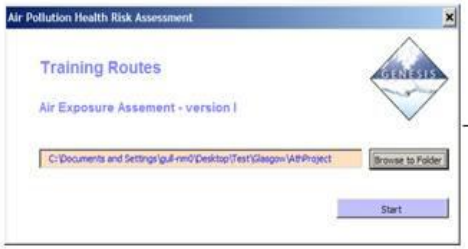
Pilot: DST Development Process

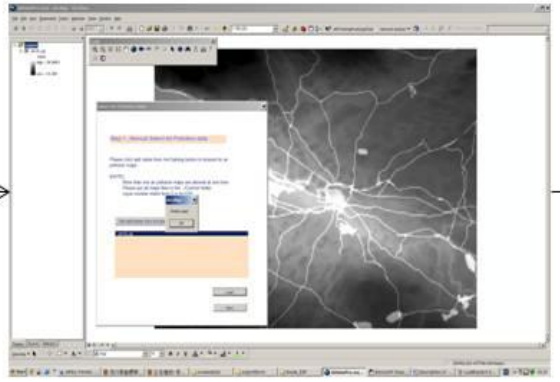
- Project December 2011 – May 2012
- the extension of open source personal air pollution exposure assessment software system
- investigate the integration of local air pollution surfaces and transport models for the Glasgow area
  - refine the tool for specific local application.
- Activities:
  - meeting with Air Quality team of Glasgow City Council and planning officers from Strathclyde Passenger Transport Executive.
  - Software development and GIS integration: Imperial College;
  - training assessment, BC monitoring: UWS.

Pilot: DST Functionality

- GIS ARCGIS9.3 – VBA programming
- Digital data – OS: Roads & digital terrain model (slope)
- Annual PM_{10} @ 100m pixel (UK 2001 EI)
    - Vinneau et al, 2010
- Not restricted to cities that have emissions inventories;
  - GB-wide NO_2 and PM_{10} surfaces for 2009 developed at Imperial using land use regression modelling (LUR) (100m spatial resolution) + a 10 m digital terrain model to adjust exposure (dose) due to gradient
  - 50m res model for NO_2 (2009) being developed

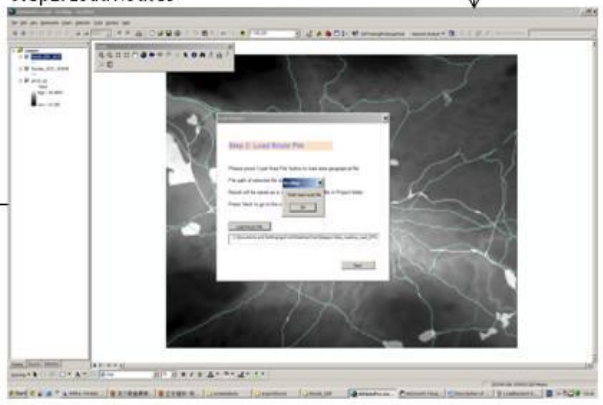
Pre-Process of extracting air concentration values to the transport network



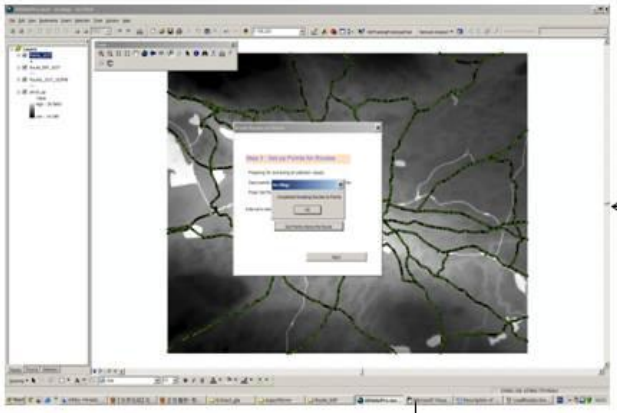


Step1: Load Air Concentration Data

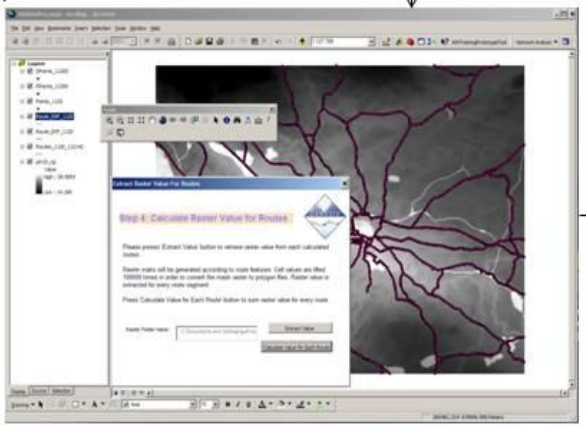
Step2: Load Routes



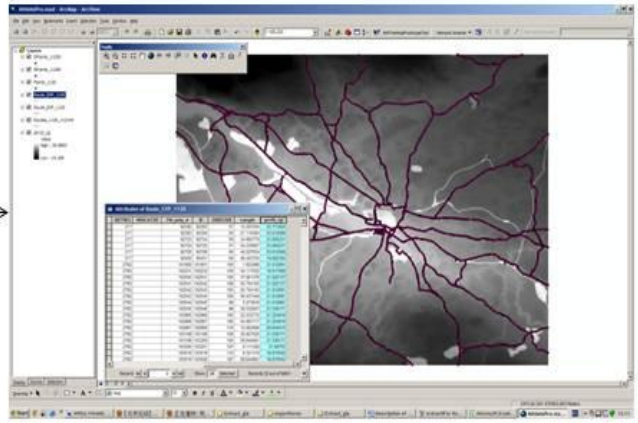
Step3: Break routes into points



Step4: Extract pollution value to points and sum to routes



Step5: Routes with exposure values



Training route selection

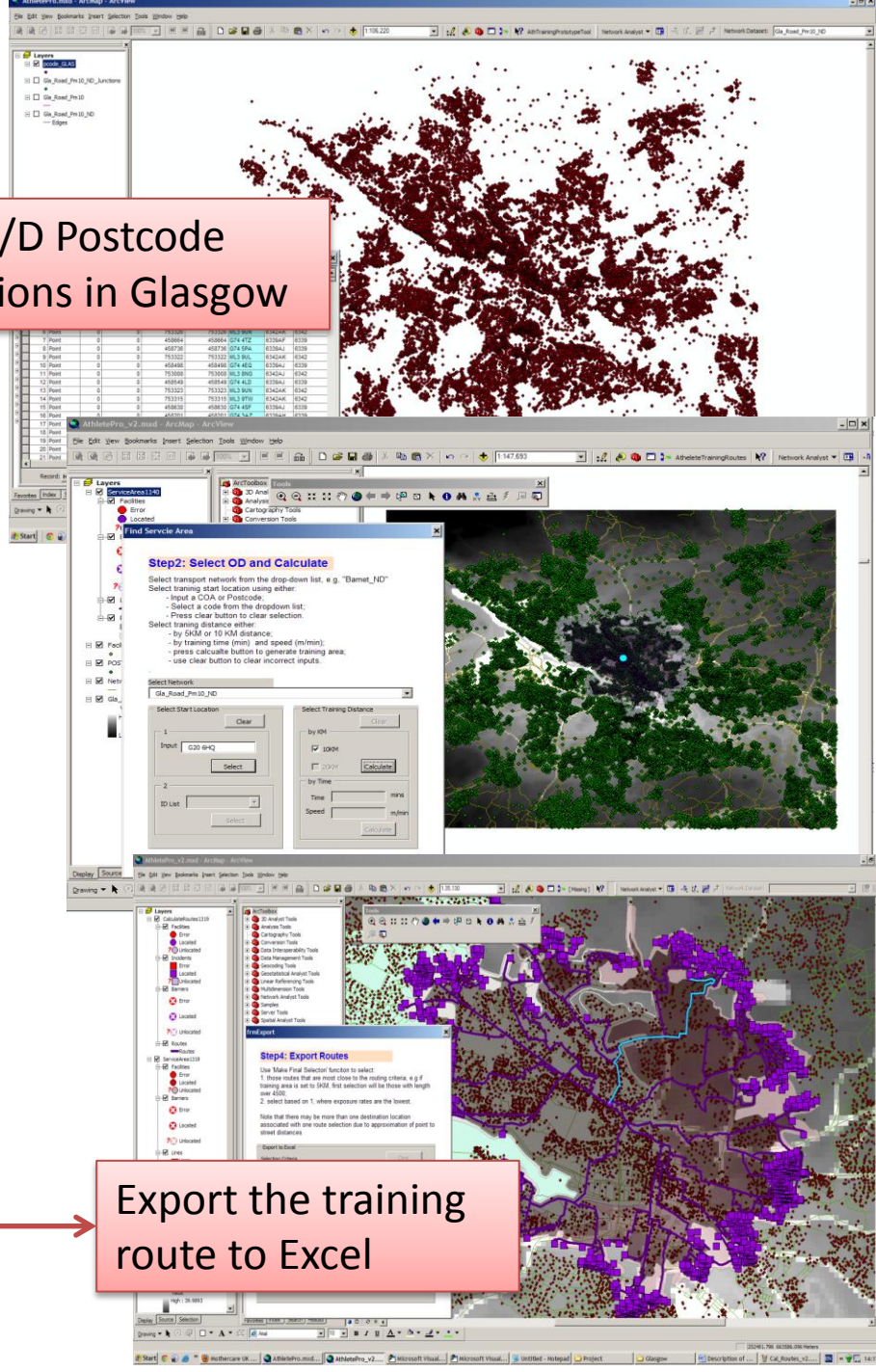
O/D Postcode locations in Glasgow

provide a start location by entering a postcode. The user is also asked to specify either a total length for the route (in this case 10km or 20km) or a total running time.

The transport network and air pollution surface are then automatically loaded into the project

the user to select one or more routes matching the selection criteria, ranked in ascending order of exposure scores

Export the training route to Excel



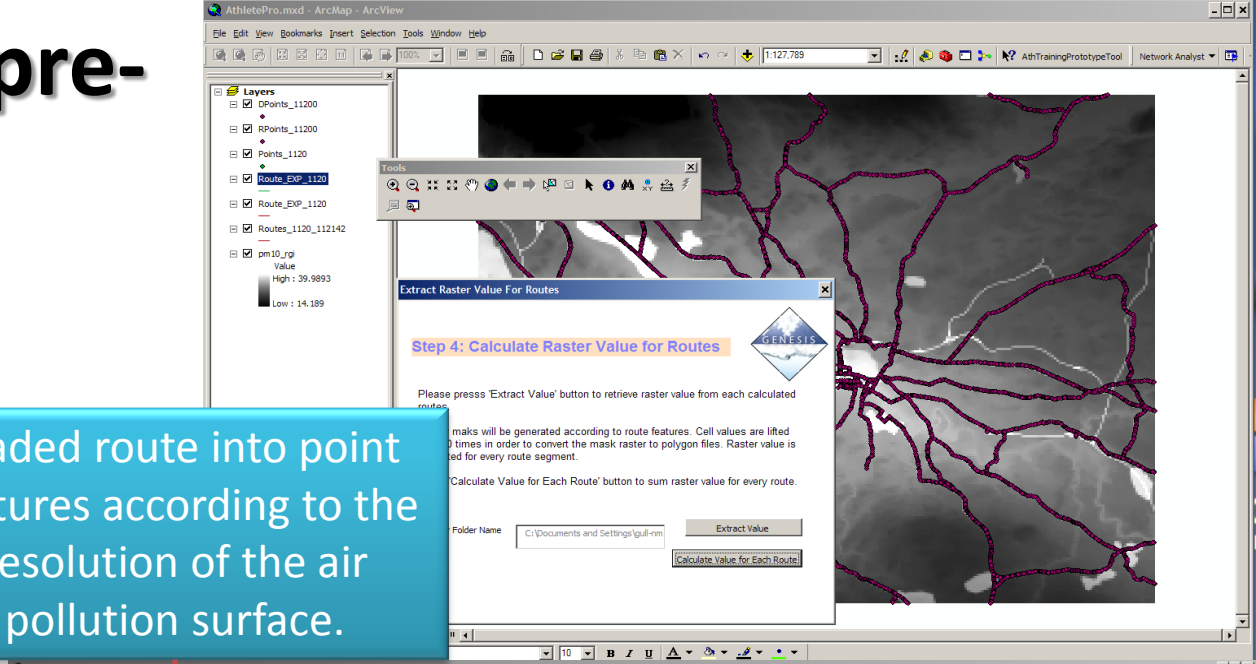
Exposure along pre-defined routes

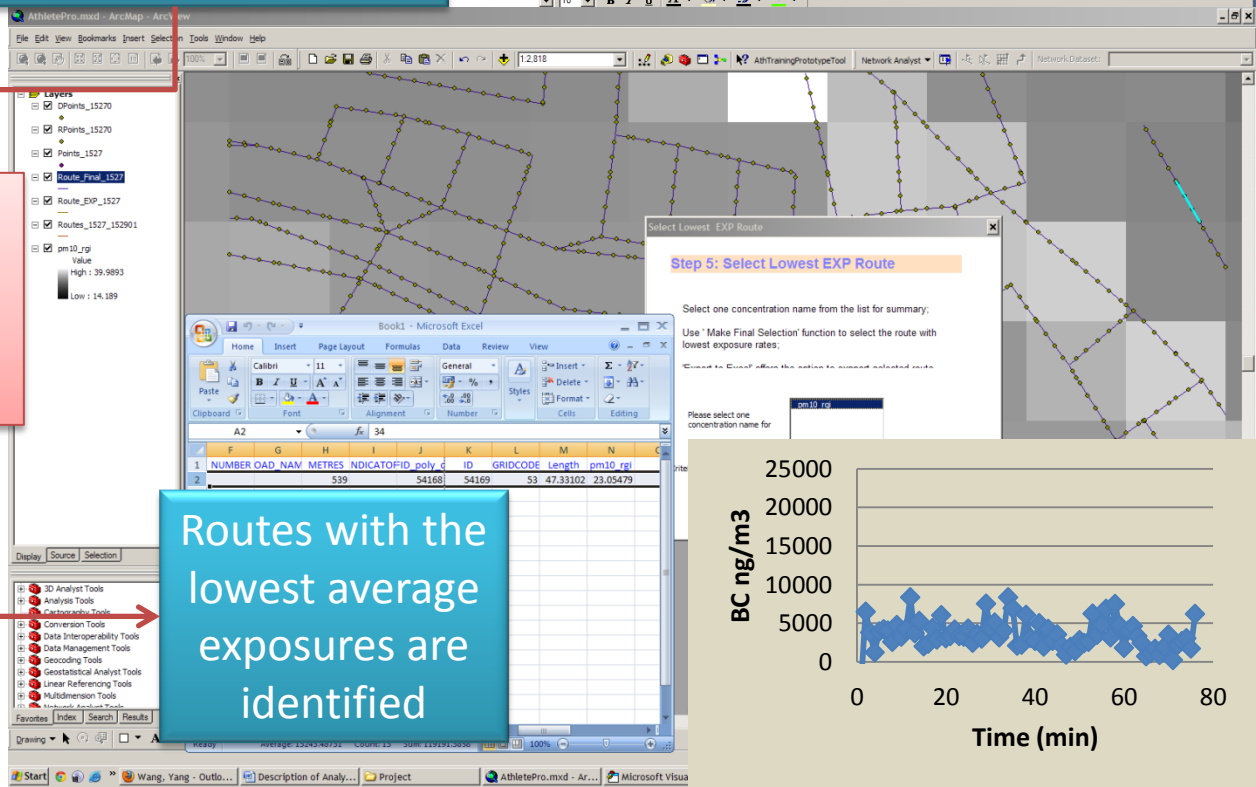
single route or small number of routes

loaded route into point features according to the resolution of the air pollution surface.

points created along the routes and intersect them with the air pollution surface to extract an exposure score for each point

Routes with the lowest average exposures are identified





Pilot: Exposure v performance data, N Glasgow

Garscube Harriers
Glasgow Running Club
Founded 1898...

CLUB MARK

Home | Latest News | History | Club Info | Calendar | Photos | Seniors | Young Athletes | Contacts | Archive

Welcome to Garscube Harriers

Whiteboard News

Congratulations to **Catriona Graves** who won the Under-17 Girls Inter-District cross country race at Holyrood Park, Edinburgh on Saturday January 5th.

The 2012 **Santa Race** (see picture on the left) attracted a large entry of 40 senior runners and 21 junior runners. With 24 helpers out there too there were 85 folk involved with the race. Congratulations to Ben Melby who won the Turkey in the senior race despite pushing a pram around the course and to Finlay Currie who won the junior handicap race with Ross Durnin posting the fastest junior time.

http://www.garscubeharriers.org.uk

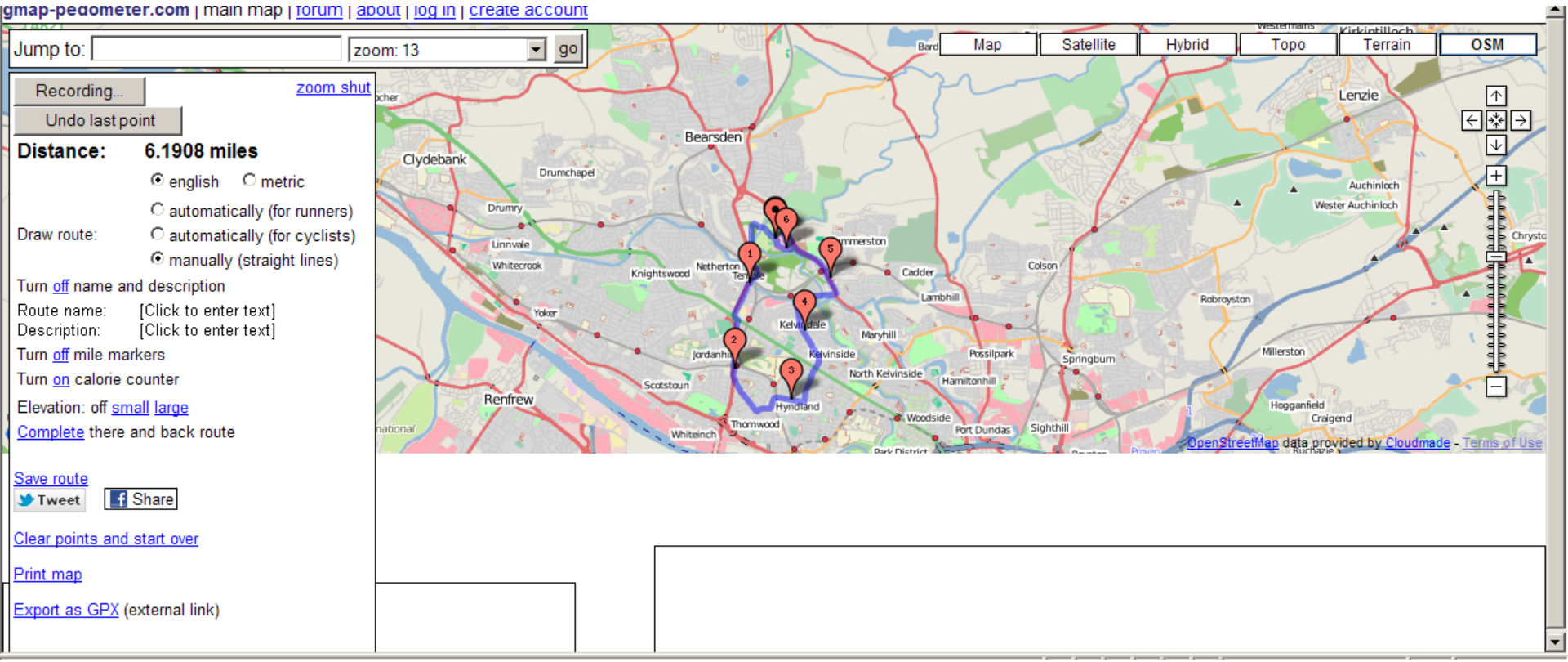
Recruitment & exposure : aims

- Recruitment a target of 20 elite (marathon) runners (50:50 M/F) through local running clubs
- participation in a series of training sessions (~ 1 hour duration)
- urban/rural air quality contrast.
- Participant consent form and health history questionnaire
- breath volume and heart rate before and after training sessions.
- Air quality exposure - Black Carbon as an indicator.
  - A real-time aerosol black carbon personal exposure (microAeth® Model AE51, 60 s integr.),
- local authority air quality monitoring station data PM_{10} levels http://www.scottishairquality.co.uk/




Training sessions

- 6 sessions February to April 2012 (5 full runner performance), 7-8pm from Garscube Sports Complex, N Glasgow.
- Route data and raw monitoring results collated
- biometric data collected before and after each session.
- 23 recruits, mean age 46.7 years, (11 x F; 12 x M).
- training for 11.8 years (av.) .
- mileage per week run 24.7 miles (av.) .
- 70% competitive runners,
- 7 completed all runs + full data!

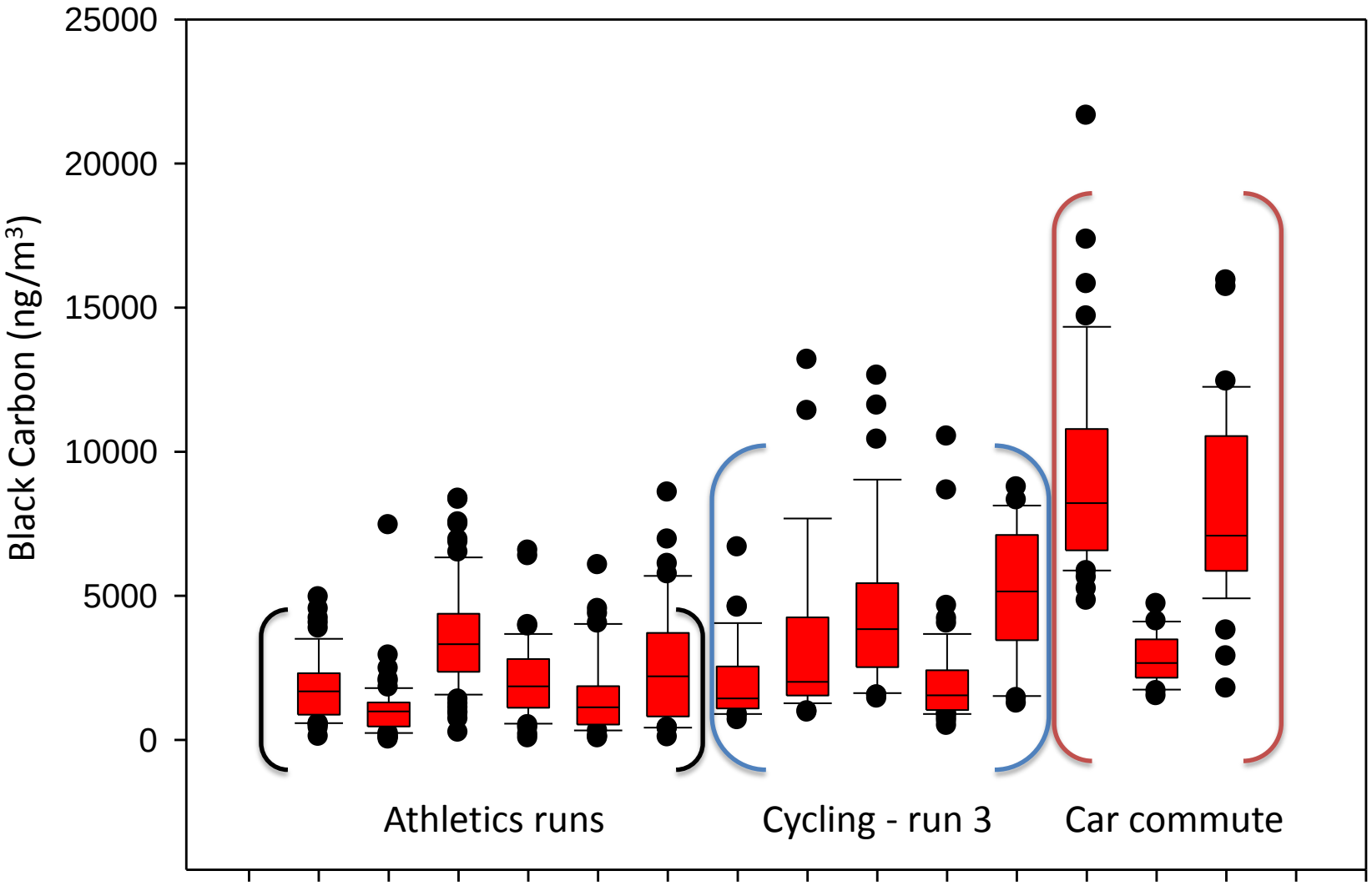


http://www.gmap-pedometer.com/?r=5300671

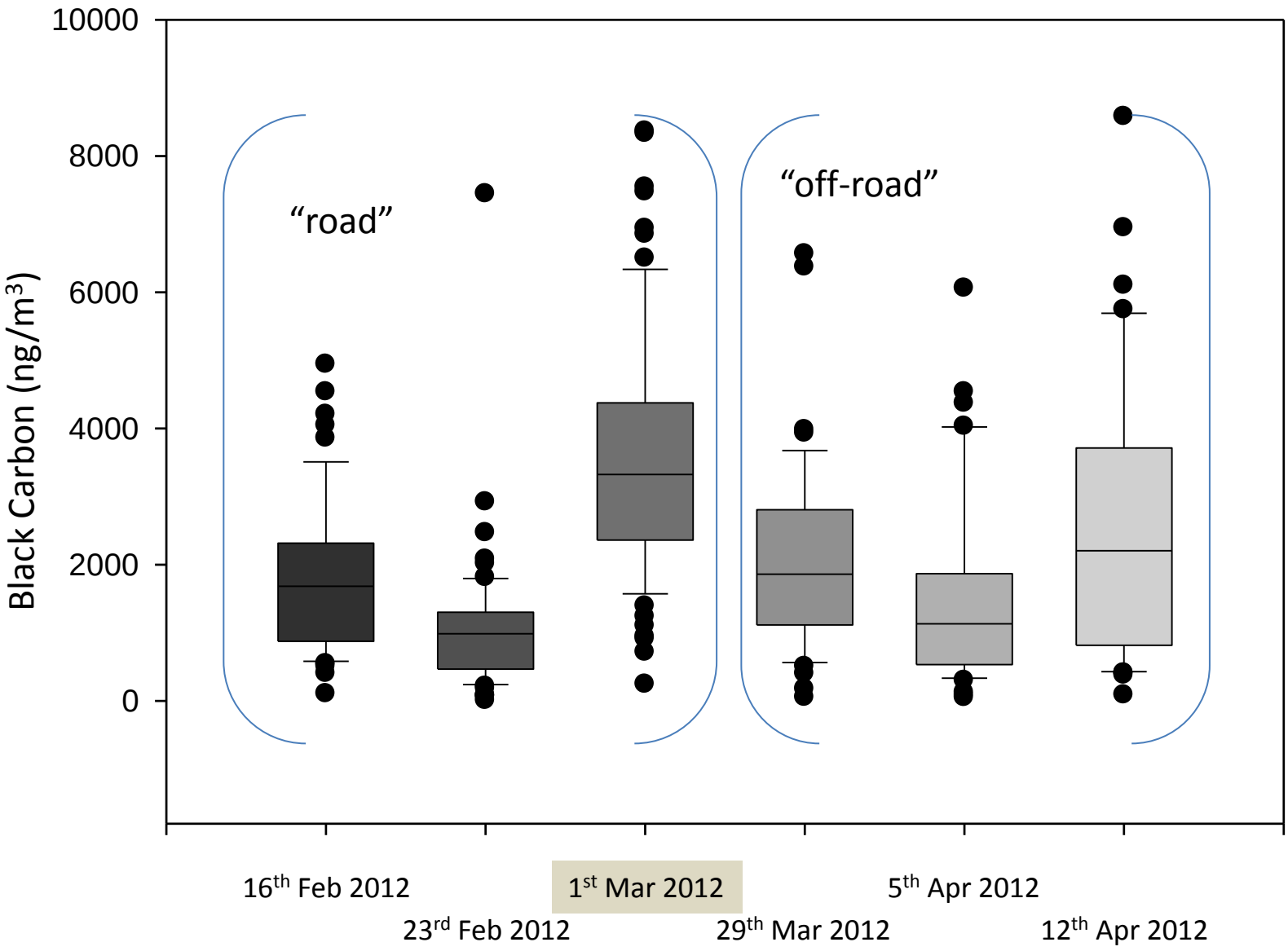
e.g. Run 1 = 16th feb 2012

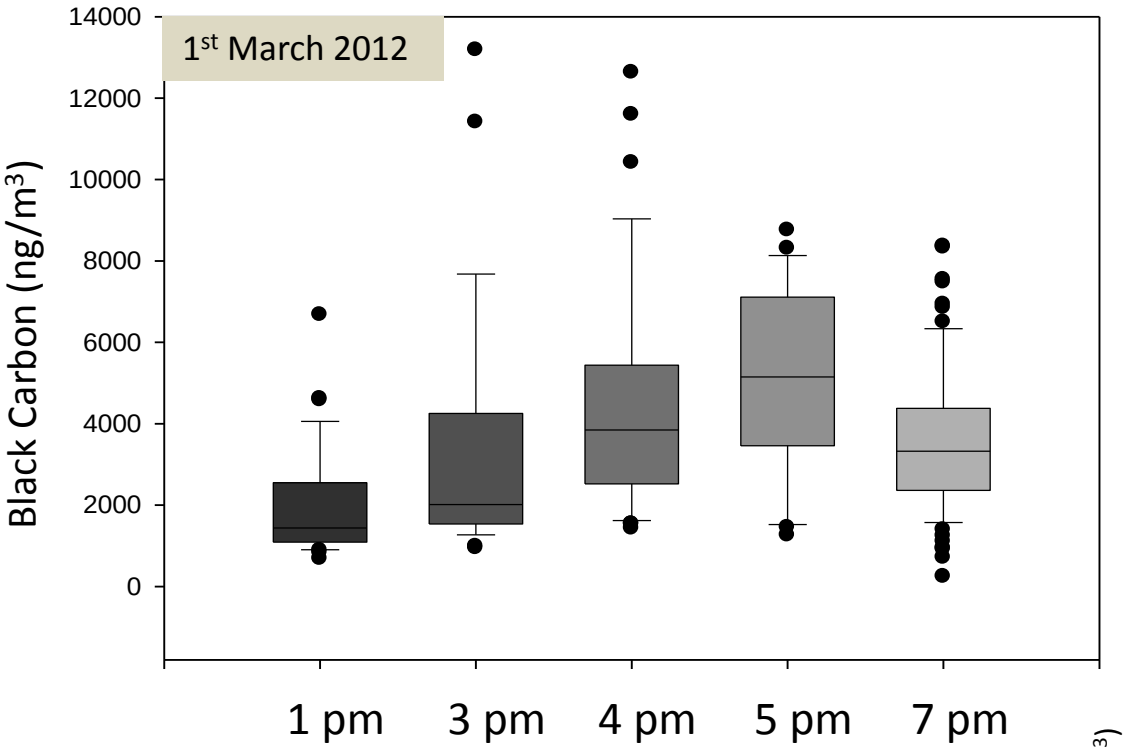
Exposure measurement

Data Summary Comparisons



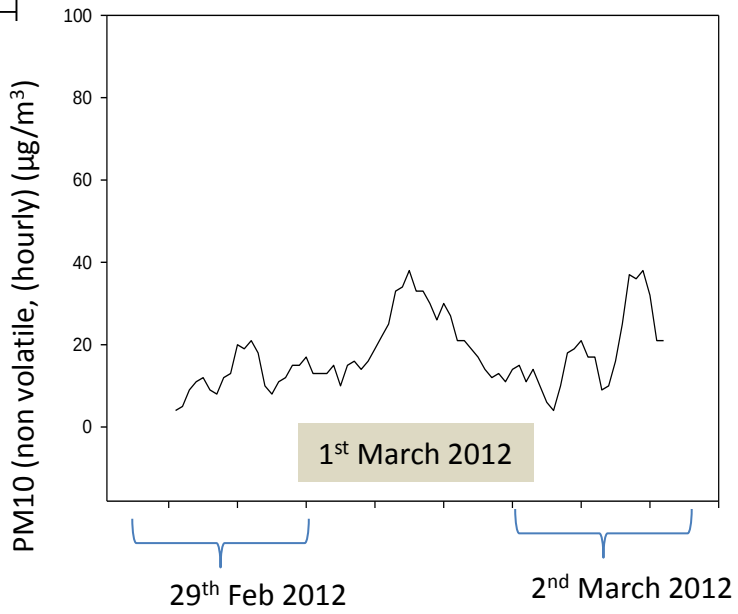
Athletics runs





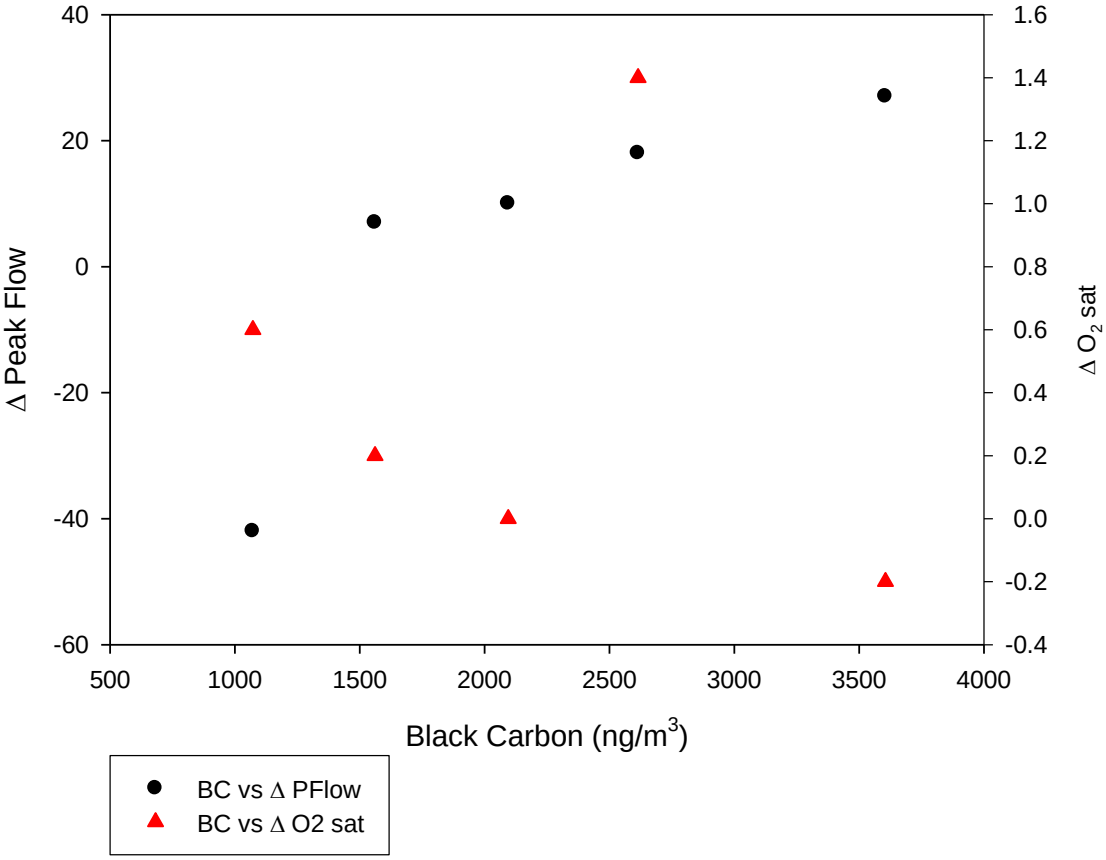
Black Carbon v PM10?

Broomhill, Glasgow (kerbside)



Effects on Performance?

- Peak Flow, O_2 Saturation v BC?
- Poor significance
- Limited data....
- But.....?



Conclusions and further work

- AQ Effects ?
- Development of modelling/exposure assessment tool – refined AQ surface
  - http://www.londonair.org.uk/LondonAir/Guide/Exercise.aspx
- Extend to other groups – emphasis on exposure contrast
- Other biomarker/assessment criteria
- Emission inventory and model integration

Acknowledgements

- SG – part funding pilot study
- Members of Garscube Harriers
- Dr Julie Thompson, UWS

- MRC-HPA Centre for Environment & Health, IC
- Institute for Clinical Exercise Science, UWS
- Institute for Biomedical & Environmental Health Research, UWS

Imperial College London

UWS UNIVERSITY OF THE WEST of SCOTLAND