MACC

Monitoring Atmospheric Composition and Climate

Deliverable D_O-INT_3.8
Protocol for personal and microenvironment monitoring surveys

Lead Beneficiary

Imperial College London

Introduction

Monitoring of personal exposure with portable air pollution monitors will be undertaken in order to calibrate and validate the personal exposure model deployed in MACC. Additionally, a sequence of microenvironmental monitoring campaigns is planned in order to further investigate the differences between personal, indoor and outdoor levels of air pollution. Data on personal and microenvironmental exposures will be collected via bespoke monitoring campaigns taking place between March 2010 and December 2010 in London. A pilot monitoring campaign took place in November 2009 in order to test the monitoring equipment and define the procedures for data capture and retrieval. A minimum of five portable 'light scattering' air pollution monitors will be used (OSIRIS and Dustmate) with the support of additional monitoring equipment (DustTrak) to be confirmed if it can be made available.

The pilot campaign that took place in November 2009 demonstrated the need for monitoring with high temporal resolution with a maximum of 1 measurement per second for traffic microenvironments because of high fluctuations in the recorded pollution levels. Furthermore the possibility of inlet blockages by head wind in faster traffic environments (above walking speed) was noticed. In order to limit possible inlet blockages, a special mushroom shaped cap will be fitted on top of the inlets (and faced into the wind). The upper inlet under the cap will additionally be modified to divert the oncoming wind. Especially shaped baskets and bags were successfully tested for monitoring during walking and cycling. They prevent the monitor from shaking and movement, as well as provide a functional design with which they can be carried close by.

Personal Monitoring

Volunteers will be equipped with portable monitoring devices for a minimum of one day of exposure monitoring at a time, and repeated to total a couple of weeks of data per individual over the whole campaign. They will be asked to fill in a diary (10-minute resolution) in which they specify their locations (address etc.) against different periods during the day, as well as their general activities (sleeping, cooking, cleaning, travelling & mode of transport, etc). Data on routes will be captured either by GPS or by hand-drawn maps. Several individuals will carry monitors on the same day in order to capture variations across London on different routes and in different microenvironments at the same time.

The aim is to make a survey that includes at least 30 different individual routes per season (or grouped by similar meteorological condition). Both air pollution, as well as time-activity behaviour change between seasons. It is therefore important to consider possible implications for the model.

The results for each hour will be used to validate the same route modelled based on hourly pollution maps. Ideally the pollution maps for comparison are constructed especially for the day of monitoring, but averaging several days within one season may be necessary.

Continuous, daily microenvironmental monitoring

Microenvironmental monitoring will simultaneously take place with a second phase of personal monitoring. While one individual will collect data on their personal exposures, other monitors are placed in the different microenvironments that the individual occupies during the day (e.g. home-outdoors, home-indoors, work etc.). This will be repeated for different individuals on different days and in different seasons. This will allow data captured as personal exposures to be separated out and compared with concentrations captured in the different microenvironments, for different types of activity and different times of the day. Comparisons will also be made with data from fixed-site monitors as part of the London air quality network.

The diary filled in by the participants will additionally cover questions about the type of building (age, storey in which monitor is installed, room in which monitor is installed, type of cooker, possible influences of ETS etc).

Monitoring in transport microenvironments

Transport microenvironments require intense monitoring (see D_O-INT_3.7), especially as they frequently represent peak exposures. The following microenvironments will be monitored more intensely:

- Bicycle
- Pedestrian
- Car
- Bus

The model will be designed to calculate the microenvironmental exposure from the ambient. It is therefore important to obtain data on differences between the microenvironment and the surrounding ambient. All transport microenvironments will be compared to simultaneously monitored pollution levels on a bicycle. Choosing cycling as the mode to compare others against has several advantages:

1. Bicycles experience ambient air conditions and can therefore monitor the ambient surrounding of other traffic microenvironments.
2. Bicycles are able to keep up with other traffic modes (in central London traffic hardly ever exceeds 30km/h) and can cycle next to buses and cars.

3. They can alter the path they take in order to be closer to the target microenvironment (cycle through a park for a walking route; along the bus lane...).

Paired monitoring will take place for the following modes:

1. Walking and Cycling Campaign
2. Car (inside/ outside) and Cycling Campaign
3. Bus and Cycling Campaign

Walking and Cycling Campaign
A cycling and a walking volunteer will be equipped with portable monitors.

- Temporal Setting: about 1 hour (congruent with intervals used for the modelled exposure surfaces), repeated at least once
- Spatial Setting: circular route; both cyclist and walker repeats the rounds as often as necessary in order to complete the agreed amount of monitoring time

The results of the cycling and the walking sample will then be compared, as well as compared to the ambient levels at nearby fixed-site monitors.

Car and Cycling Campaign
One monitor will be fitted inside a car (in the middle) and one monitor will be fitted on the roof (with mushroom inlet) with a roof rack (a technique developed and tested by the Centre of Transport Studies, Imperial College London). Another monitor will be with a cyclist who will cycle close to the vehicle.
Special attention will be given to several possible confounders

1. Ventilation setting (needs to be homogeneous between repeated monitoring)
2. Differences between different types of cars (at least two different cars should be used)
3. Weather conditions (should be chosen homogeneous)
4. Cyclists will avoid constant influences of the monitoring car's exhaust.

- Temporal Setting: repeatedly for about one hour each time
- Spatial Setting: Different types of road (high traffic, low traffic) should be used in order to be able to detect possible lag times.

Bus and Cycling Campaign
One monitor will be inside the bus and one monitor will be with a cyclist outside (avoiding constant influence from the exhaust). Special considerations need to be made for buses, as

there are several factors that may influence the indoor levels and are hard to control for (additionally to the factors that were mentioned as influences for cars, s. a.), these include:

- Number of passengers
- Open windows
- Built of the bus
- Frequency of buses on the route (being stuck behind other buses)

Repeated monitoring will be necessary to get an understanding of the range of influences that these factors have on exposures.

Timeline

		10	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*
Personal Monitoring	Recruiting & Preparation	---									
	Spring Campaign		---	---							
	Summer Campaign				---	---	---				
	Winter Campaign									---	---
Stationary Microenvironmental Monitoring		---	---	---	---	---	---			---	---
Microenvironmental Monitoring	Preparation	---									
	Cycling & Walking		---								
	Car & Cycling					---					
	Bus & Cycling								---		

Project months 10 – 19 (March 2010 – Dec. 2010)