Monitoring black carbon concentrations with mobile devices in the city of Liège

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Context

For a city of 200 000 inhabitants (around 500 000 with its suburbs) Liège (Wallonia, Belgium) has a small share of public transport (mainly diesel buses for urban transport), high share of car use and low share of cycling, with consequences for population exposure to traffic pollutants and quality of life. Liège and Walloon authorities presently strive to correct errors of past decades (kind of urban highways), re-build streetcar lines (stripped away 50 years ago)[1], foster bicycle use[1], give back riverbanks and green areas to pedestrians, etc.

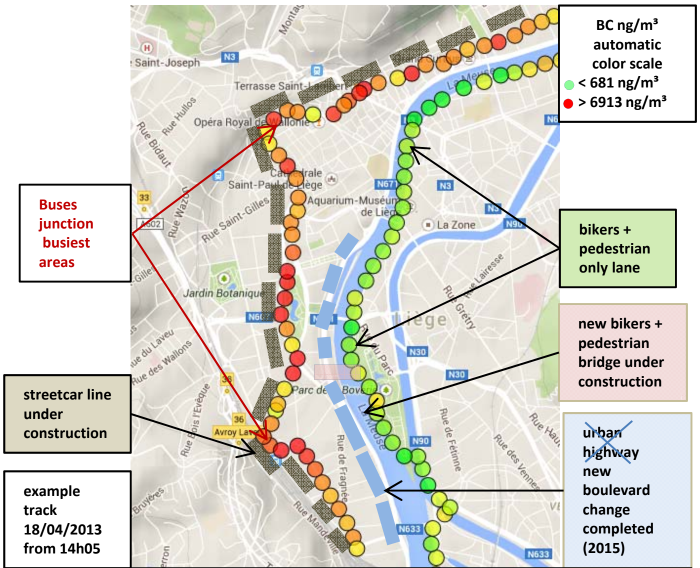


Fig. 1. Georefrenced PostSQL/PostGis database and interface developped for ExTraCar

ISSeP's ExTraCar project (2014-2016) focuses on Black Carbon (BC) because this pollutant is linked to the most toxic components of PM2.5[2]. BC is a chemically inert pollutant and is a more sensitive traffic pressure indicator than the (presently) regulated pollutants.

Materials and methods

The BC analyser that we use is the AE51 of AethLabs, it is highly portable (281 g) and battery operated (keeps running around 8h). The GPS is a DG 200 of Global-Sat, it records tracks (data downloaded afterwards, sends no signal) is also highly portable (40g) and records up to 24 h. Six device sets (GPS + BC analyser) are available.

Six tracks (loops) covering the territory of Liège were designed. Several cycling operators follow different tracks simultaneously, mostly during the morning and evening rush hours on schooldays. The operators cycles the loop 3 or 4 times during a measurement sessions, which enables to represent the spatial distribution of BC concentration for that time window.

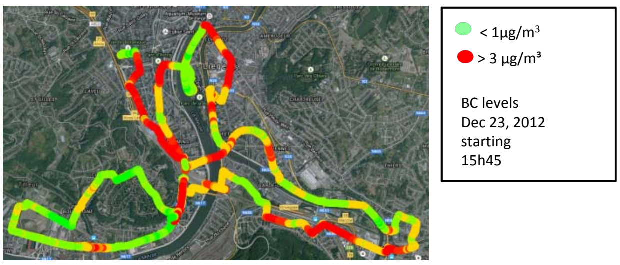


Fig. 2. Simultaneous measurements for 3 of the 6 loops

Data processing

GPS tracks

An automated procedure is developed to correct GPS data for loss of signal or device error (track of lane, across a block, etc.). This is of great importance in order to aggregate results for a same track and get representative results ; recorded tracks must be projected (forced towards) the theoretical ones.

BC results

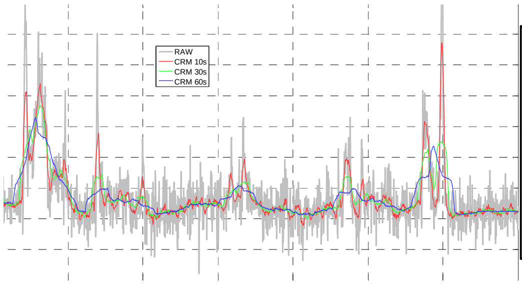


Fig 3 Various data processing for BC (1s) results
A 60 s centered rolling median of BC analyser 1 s values is currently used. This choice is subject to revision.

Meteorological representativeness of observations set

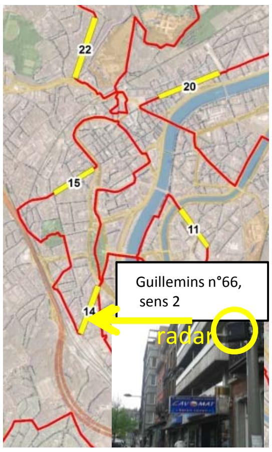
	Morning rush hour						Evening rush hour						Intermediate hours					
Stability classes	**Stable [G-E]**		**Neutral [D]**		**Unstable [C-A]**		**Stable [G-E]**		**Neutral [D]**		**Unstable [C-A]**		**Stable [G-E]**		**Neutral [D]**		**Unstable [C-A]**	
Status	Goal	Now	Goal	Nowl	Goal	Now	Goal	Now	Goal	Now	Goal	Now	Goal	Now	Goal	Now	Goal	Now
Chênée	10	8	10	0	10	0	10	4	10	10	10	0	/	0	/	4	/	0

Table 1. To assess the temporal distribution of BC concentrations, the set of observations must be representative of the various pollutants dispersion condition. For each measurement on a loop, this is recorded and the status of the data set is checked against a representativeness objective.

Modelling urban background concentrations and at street level

The regional model Austal 2000[3] will be used to generate background concentrations, at least for wintertime. Measurement from at least one station of the automatic network (AE22 from Magee scientific) are available for the North tip of the study area. Domestic heating emissions were obtained from an inventory made at AwAC and then disaggregated to get a higher spatial resolution. For tailpipe exhaust data, we refer to recent BC studies in Flanders[4].

At street level, the $CANS_{BC}$ model from O. Brasseur[5] will be used. This package relies on the same equations as OSPM[6]. Six street sections were chosen to this end with various orientations and H:W ratios.



We use traffic counts figures from three sources: our manual and radar data, as well as data recorded for a noise study in 2012.

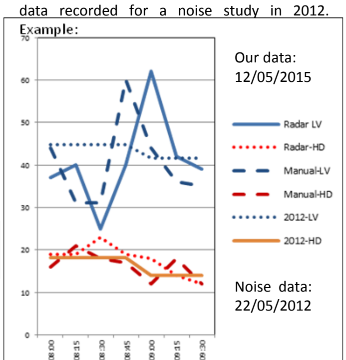


Fig 4. Count data consistency check
nb: hourly resolution for 2012 noise study data

References

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