

Aerosolizirani črni ogljik - uspešnost omejevanja virov onesnaženja zraka

Griša Močnik, A. Gregorič, I. Ježek, N. Marchand, J.L. Jaffrezo, J. Alard, J.L. Bescombes, F. Chevrier, L. Drinovec

Black Carbon and Particulate Matter



≠



- BC – primary
- BC – direct to sources

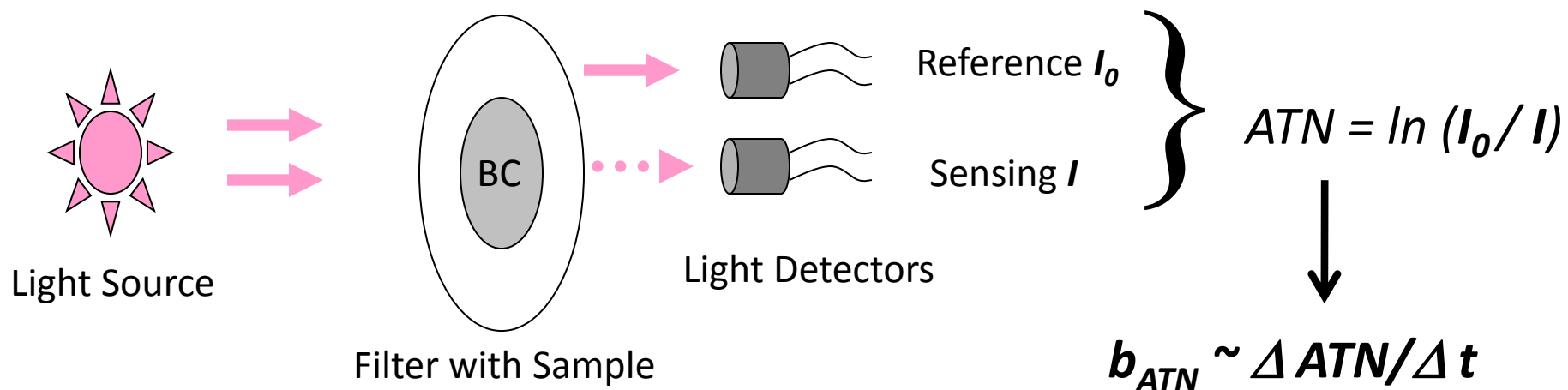
- PM dominated by secondary
- well mixed

Domestic heating with wood

- visible source of air pollution
- not so „easy“ to control
- difficult to regulate



Optical measurement of Black Carbon: Aethalometer™



- Collect sample **continuously**.
- ***Optical attenuation*** $\sim$ change in ATN. Convert to **absorption**.
- Measure optical absorption **continuously** : $\lambda = 370$ to 950 nm.
- Convert ***optical absorption*** to ***concentration of BC***:

$$BC(t) = b(t) / \sigma$$

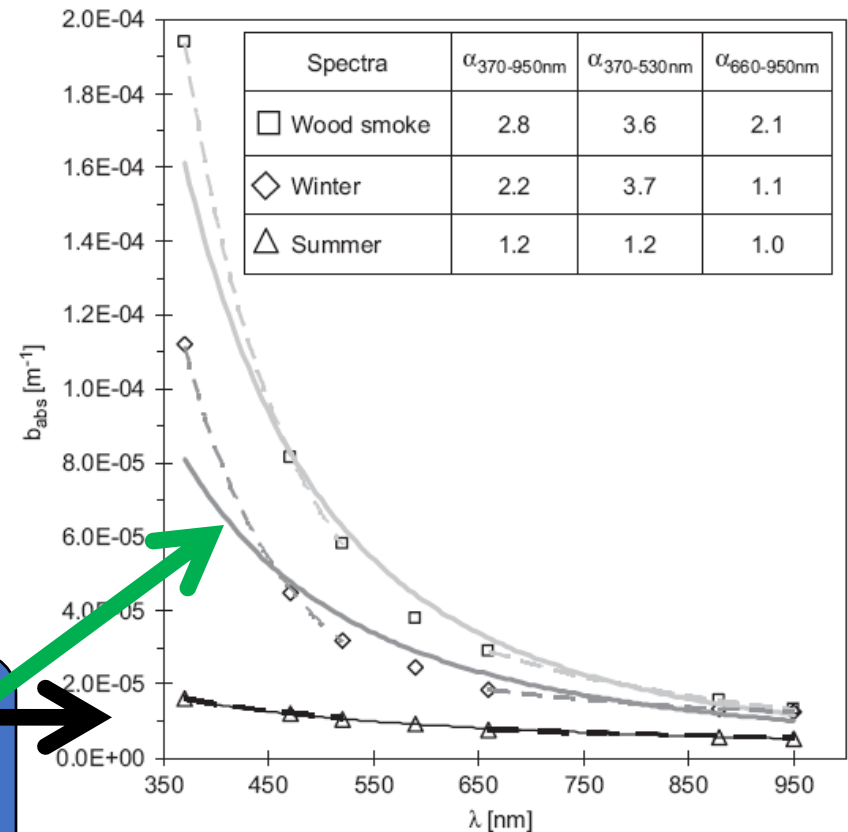
- Real-time data: **minutes**
 - *Dynamical, real-time measurement, updated each period*

Biomass-smoke vs. diesel - 7λ

- measure attenuation with the Aethalometer
- absorption coefficient - b_{abs}
- for pure black carbon: $b_{abs} \sim 1/\lambda$
- generalize **Angstrom exponent**:
 $b_{abs} \sim 1/\lambda^\alpha$

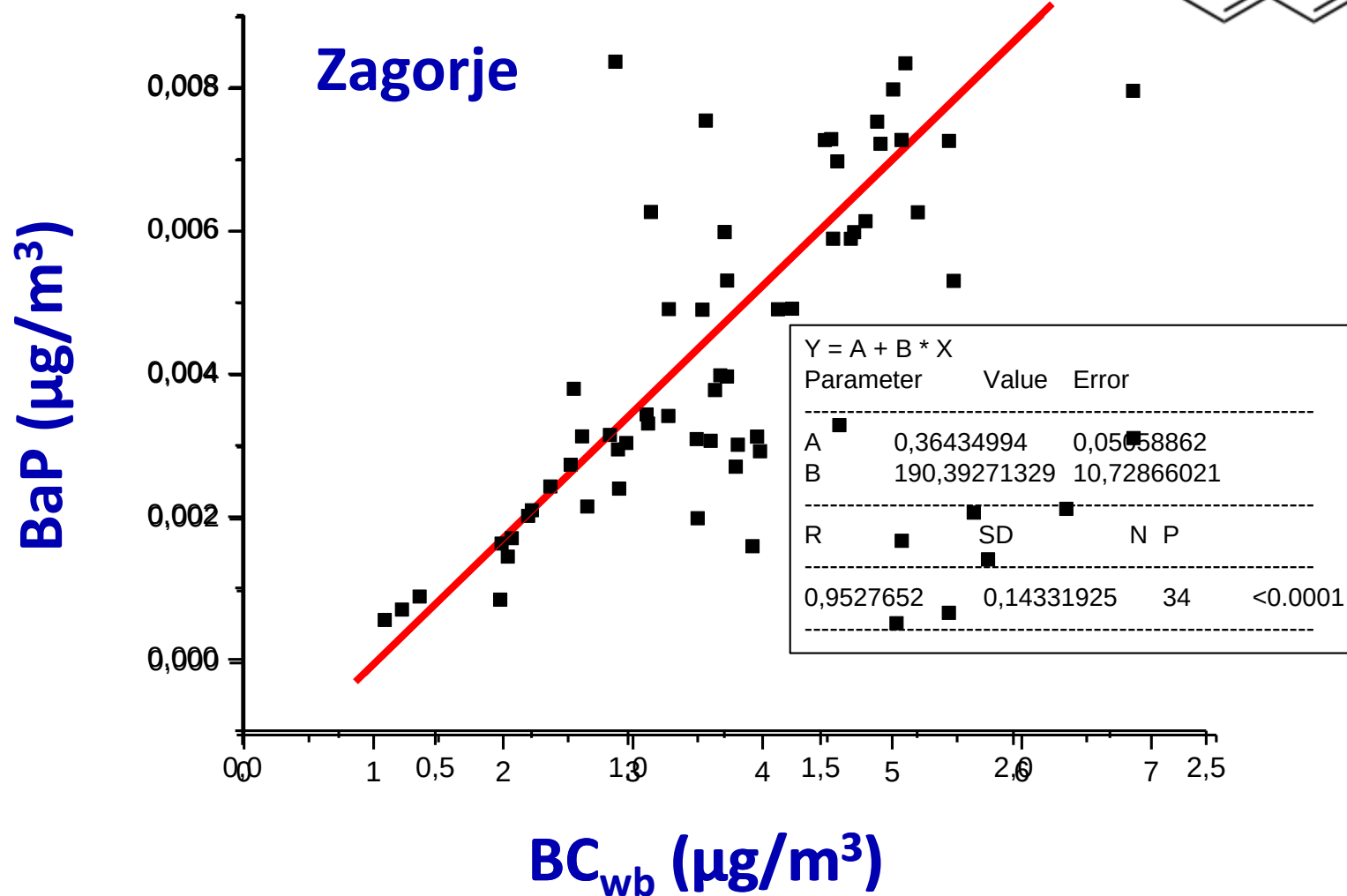
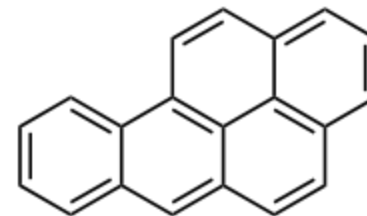
diesel: $\alpha \approx 1$

biomass-smoke: $\alpha \approx 2$ and higher



J. Sandradewi et al., A study of wood burning and traffic aerosols in an Alpine valley using a multi-wavelength Aethalometer, Atmospheric Environment (2008) 101–112

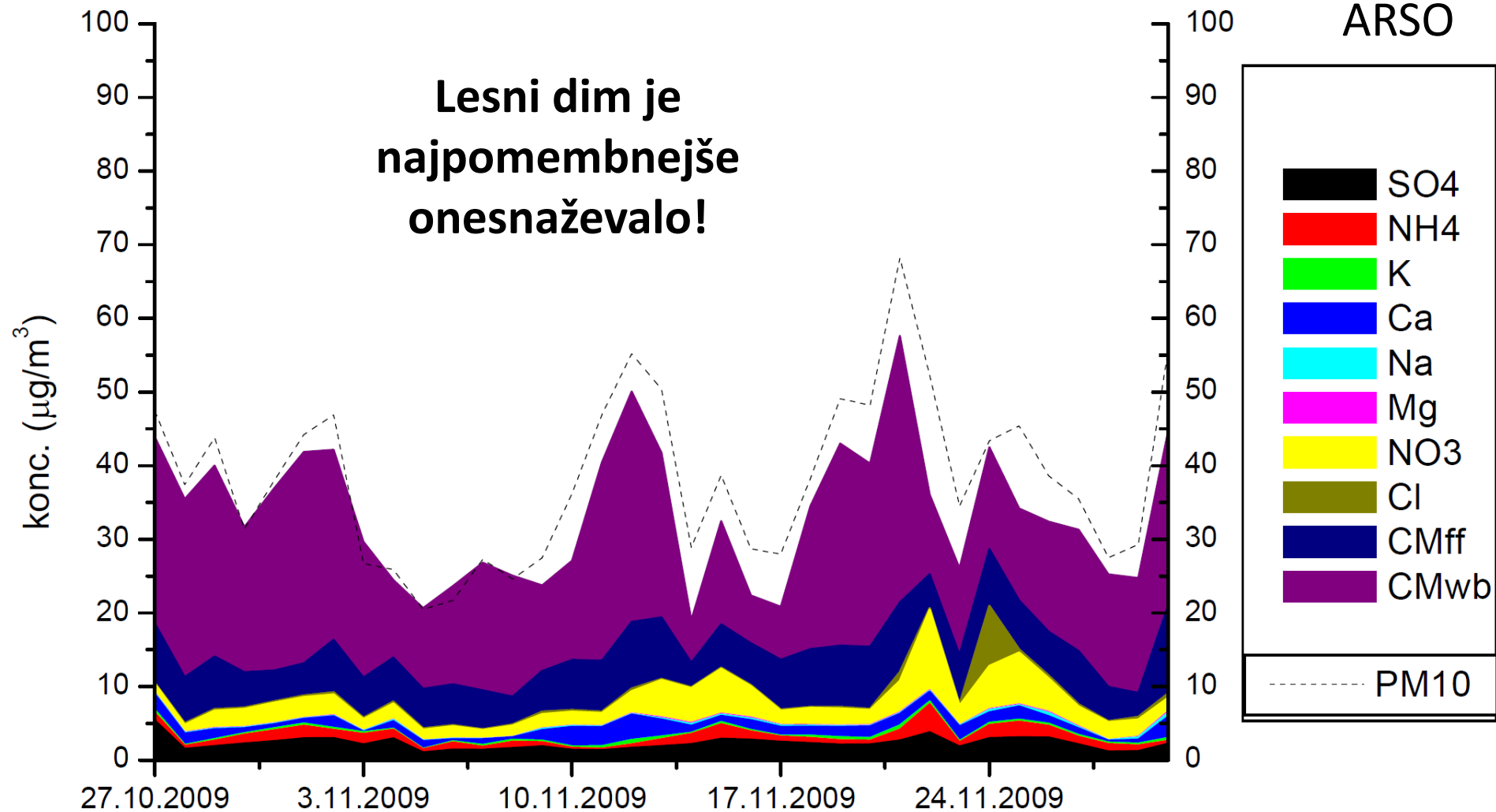
PAH – what is the source?

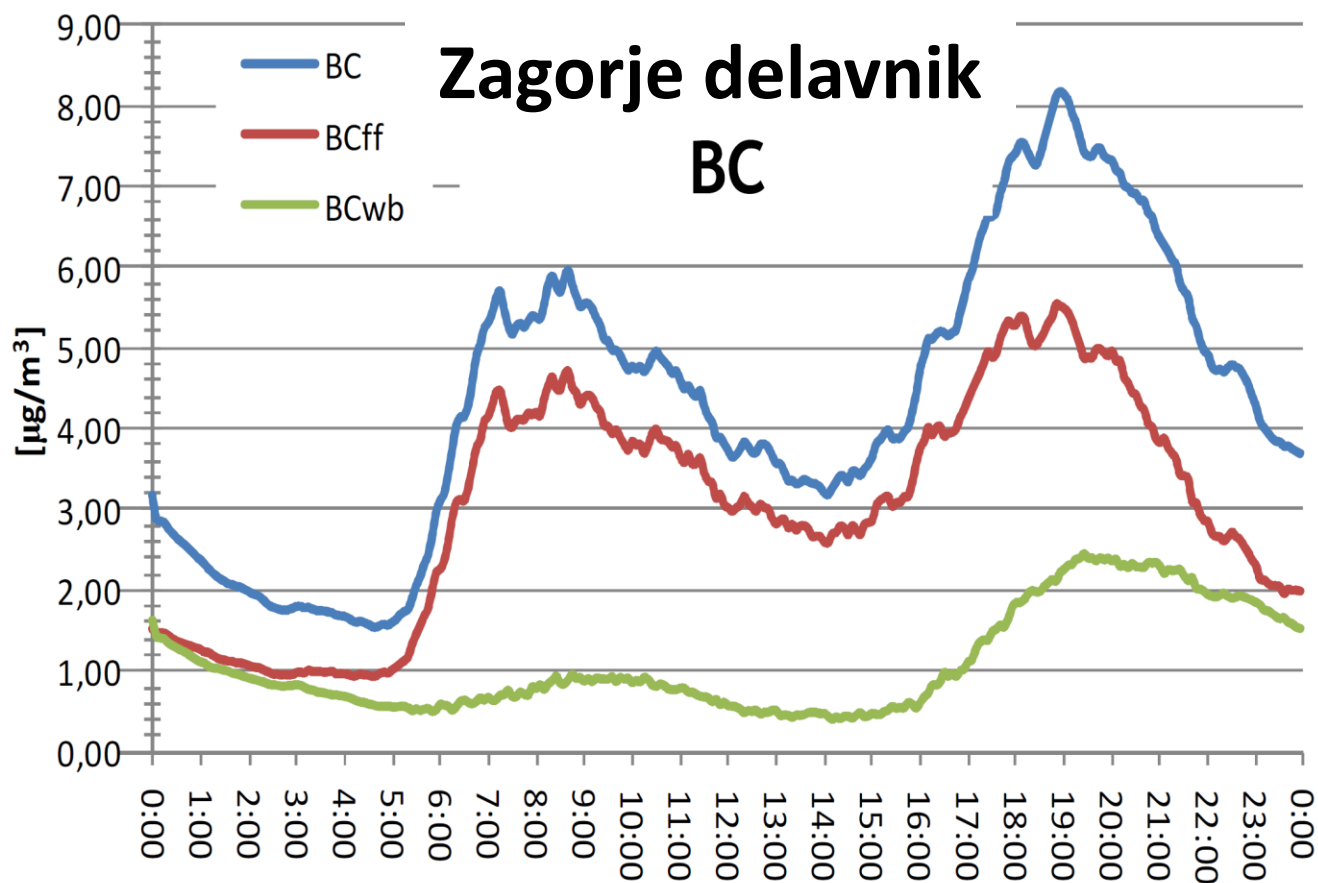


BaP by GC-MS - EARS

ARSO

**Lesni dim je
najpomembnejše
onesnaževalo!**



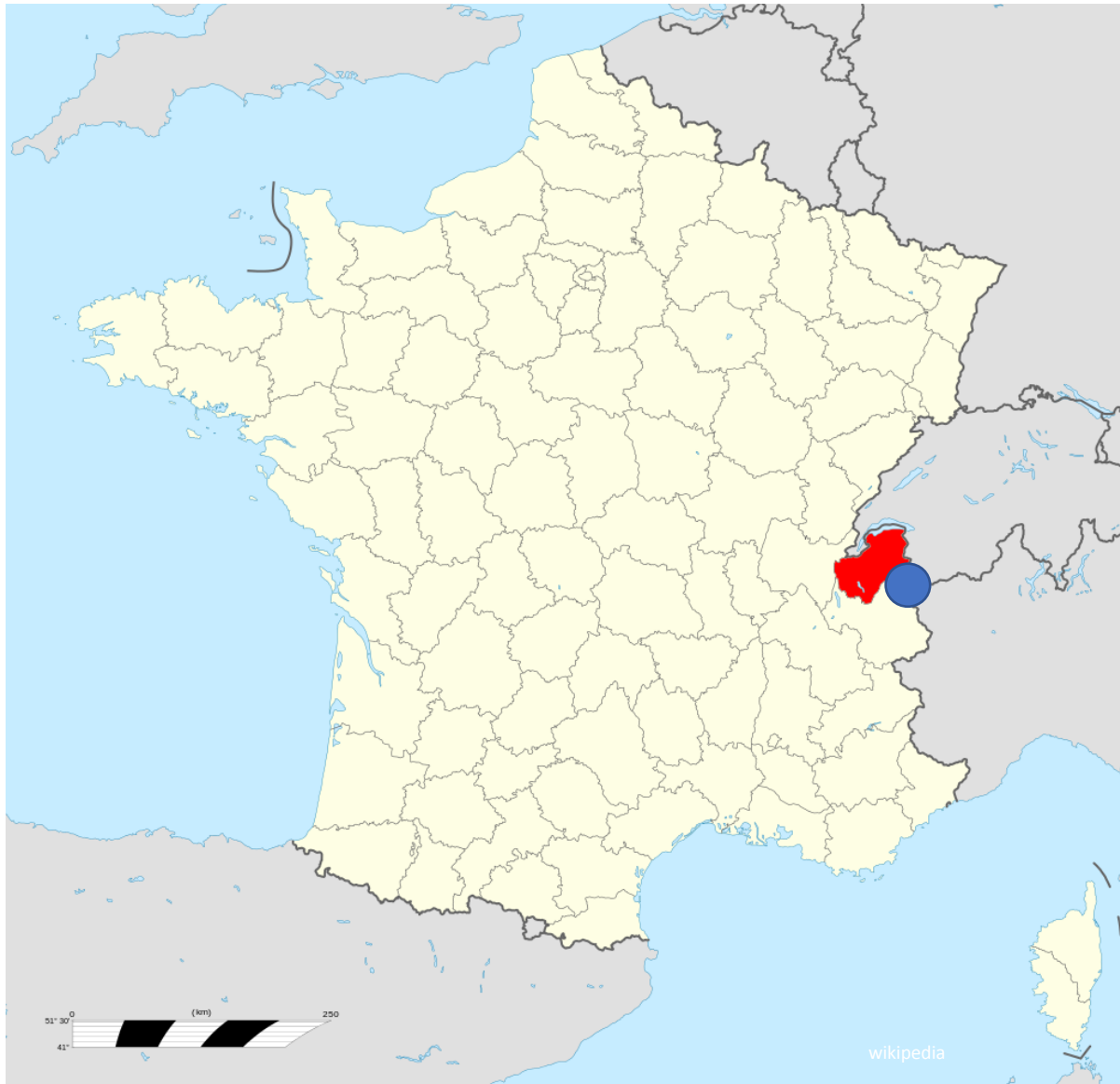


promet

73%

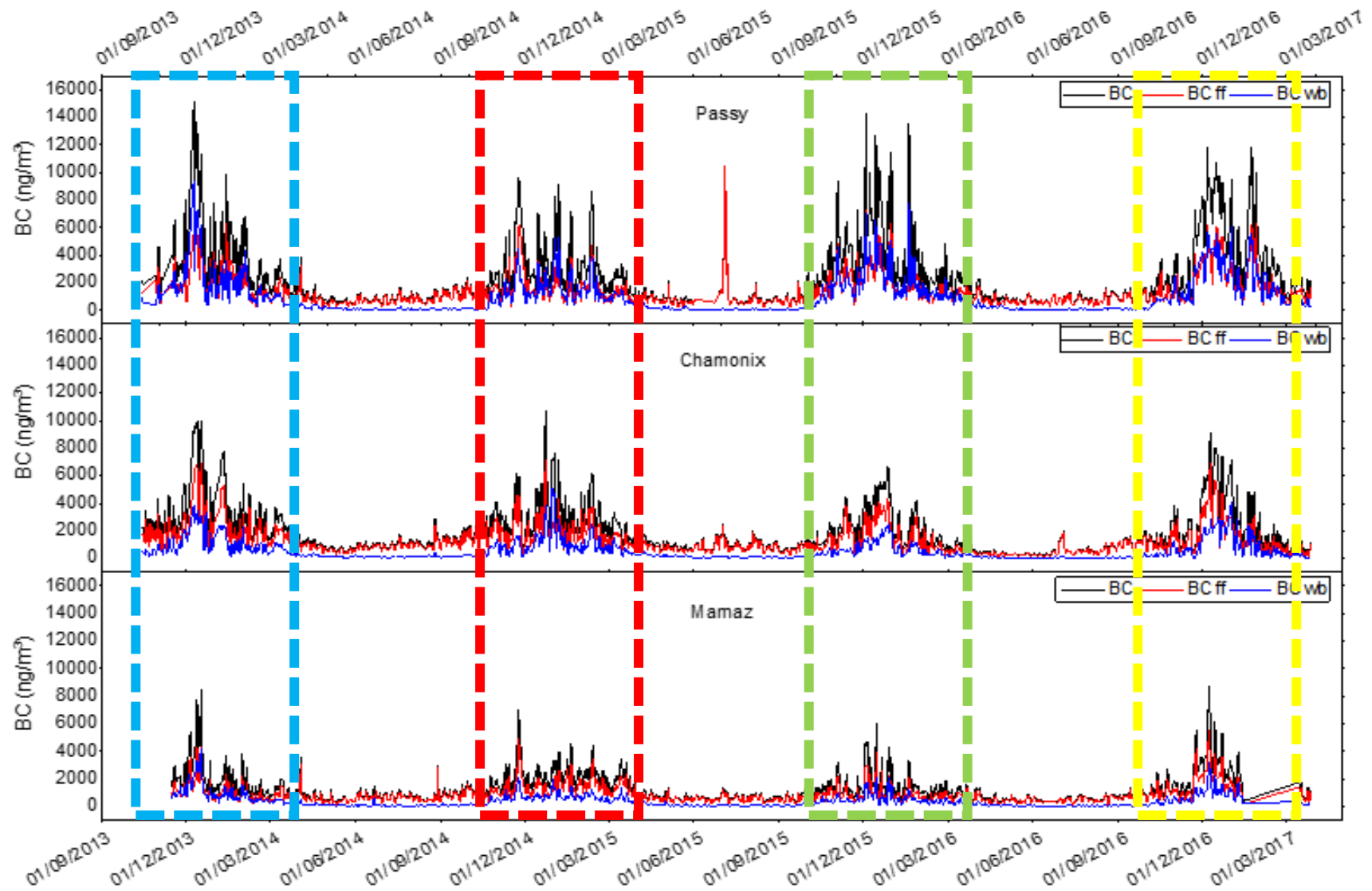
**kurjenje
lesa**

Vallée d'Arve, France – 7000 stoves!

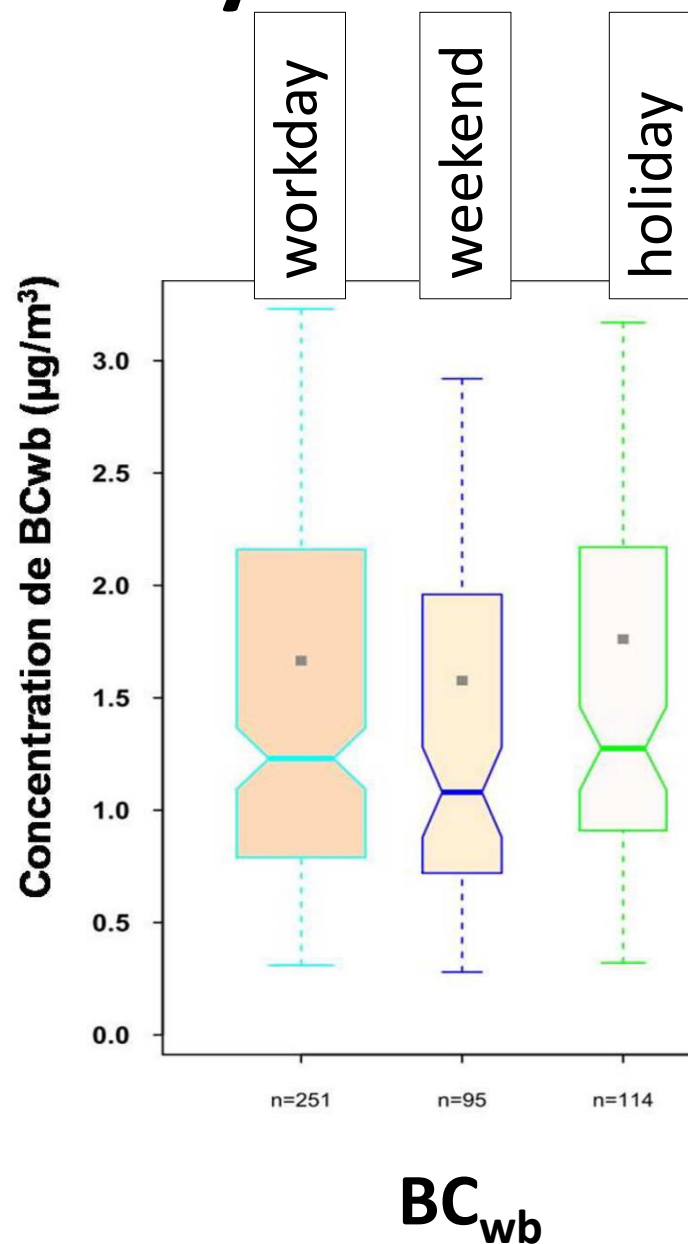
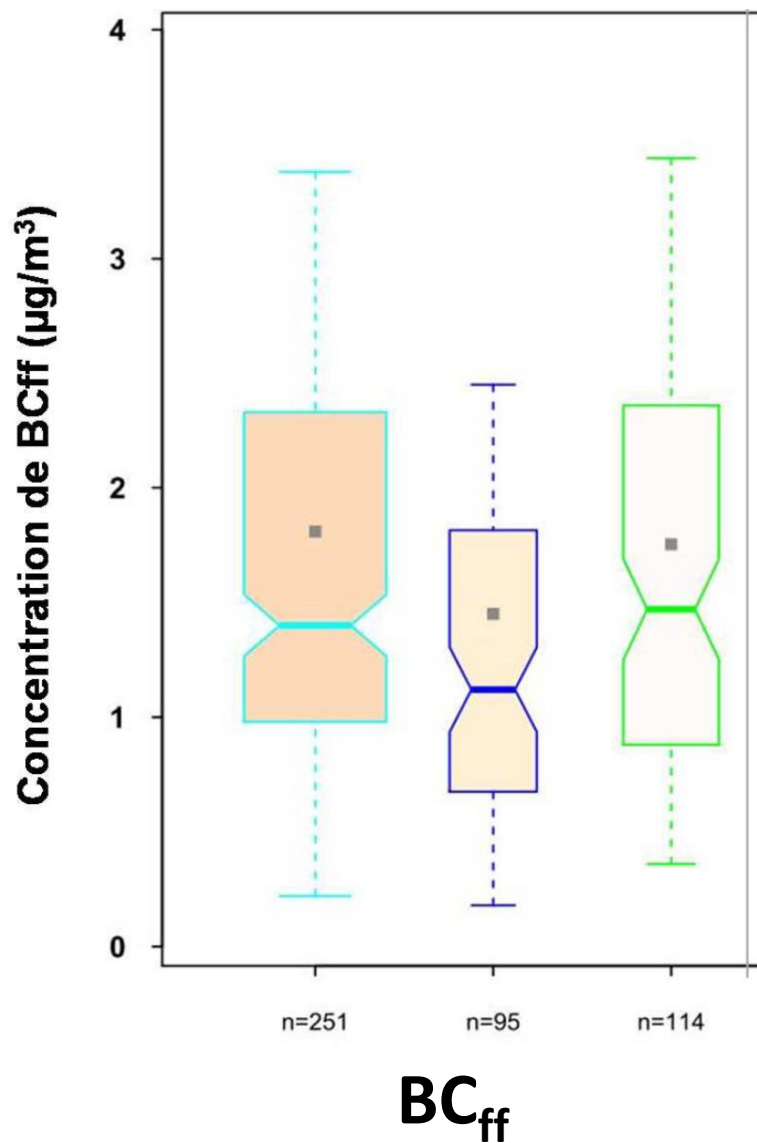


Vallée d'Arve, France

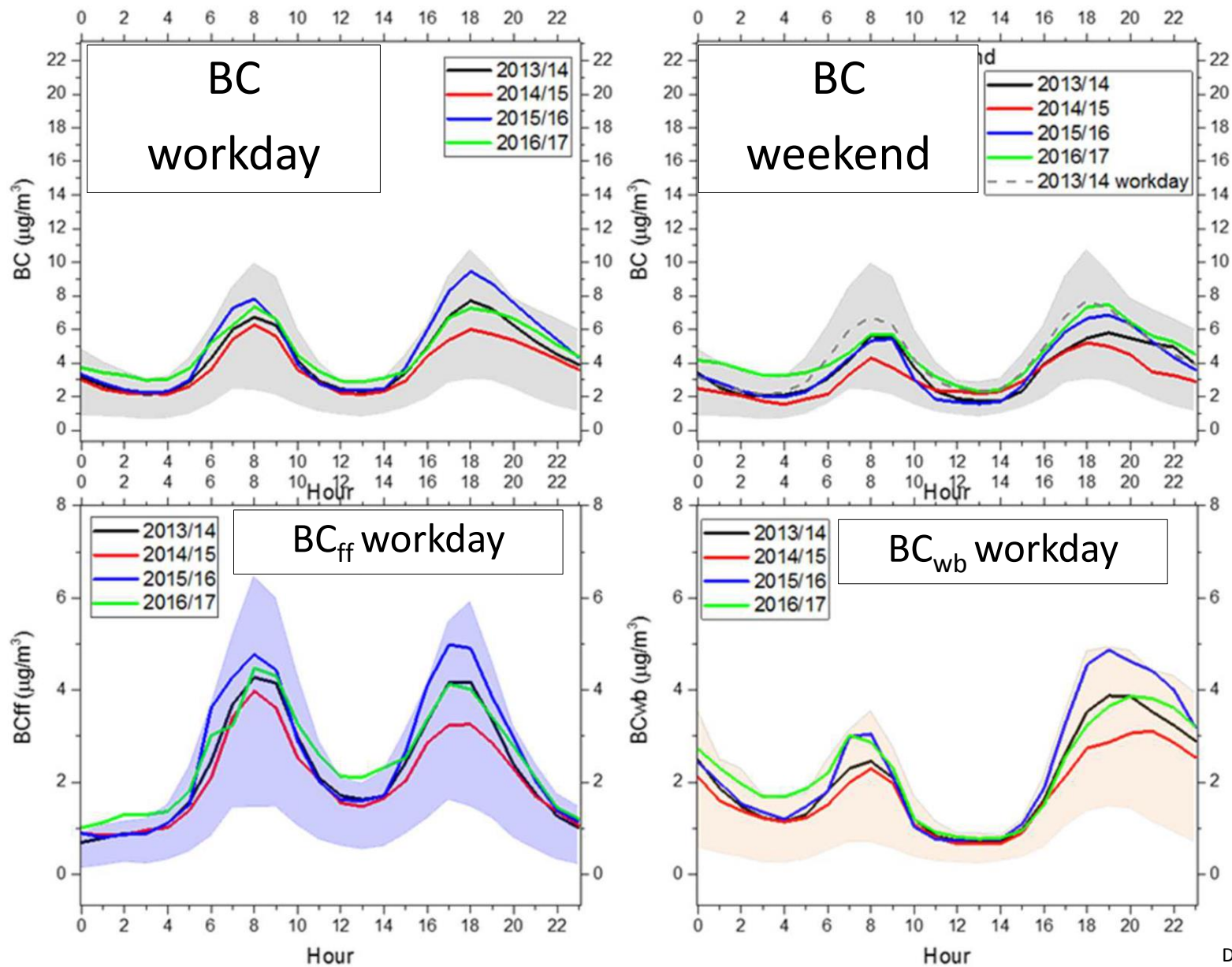
Nov – Mar



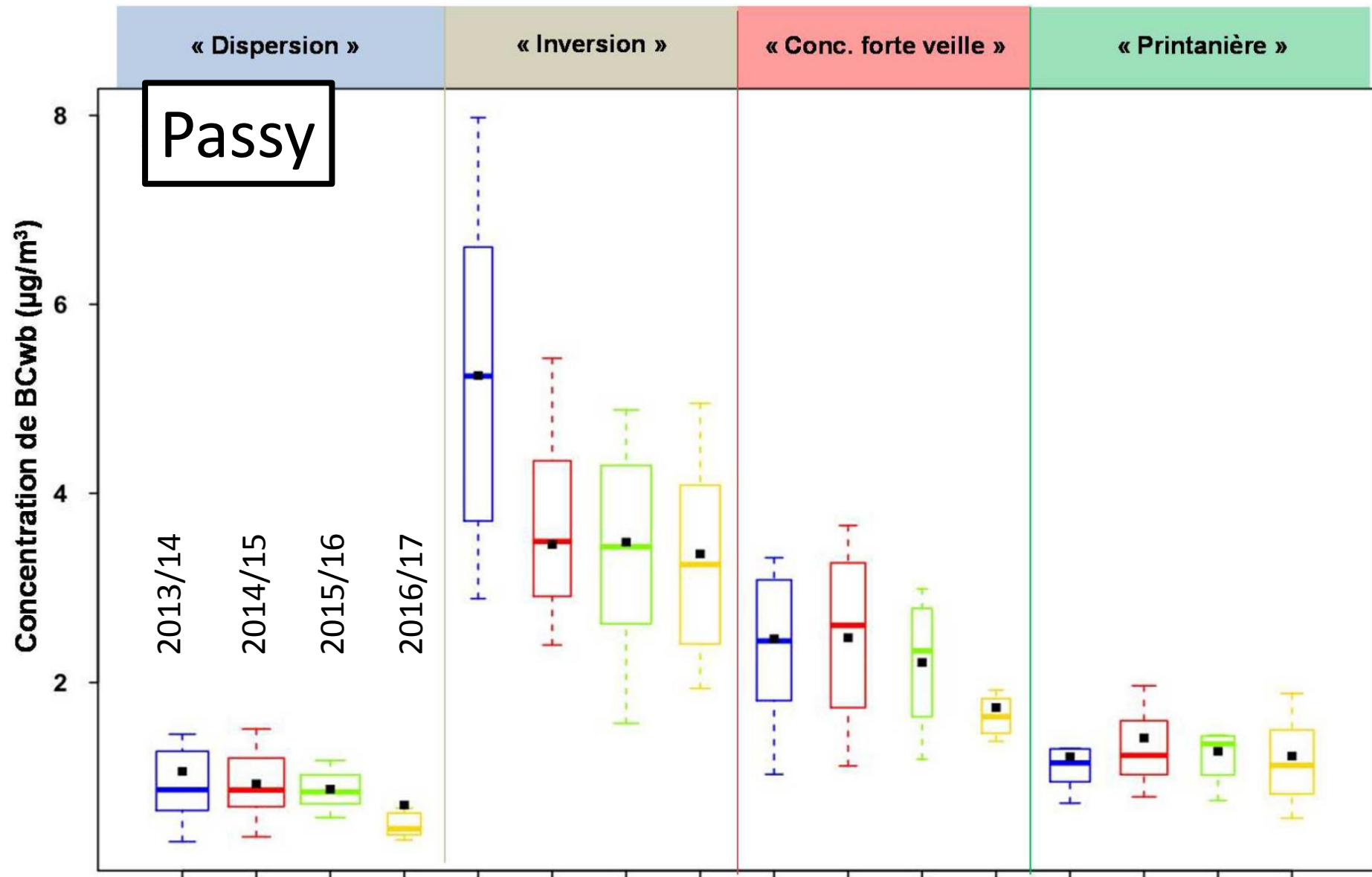
Vallée d'Arve, France - Passy



Vallée d'Arve, France - Passy

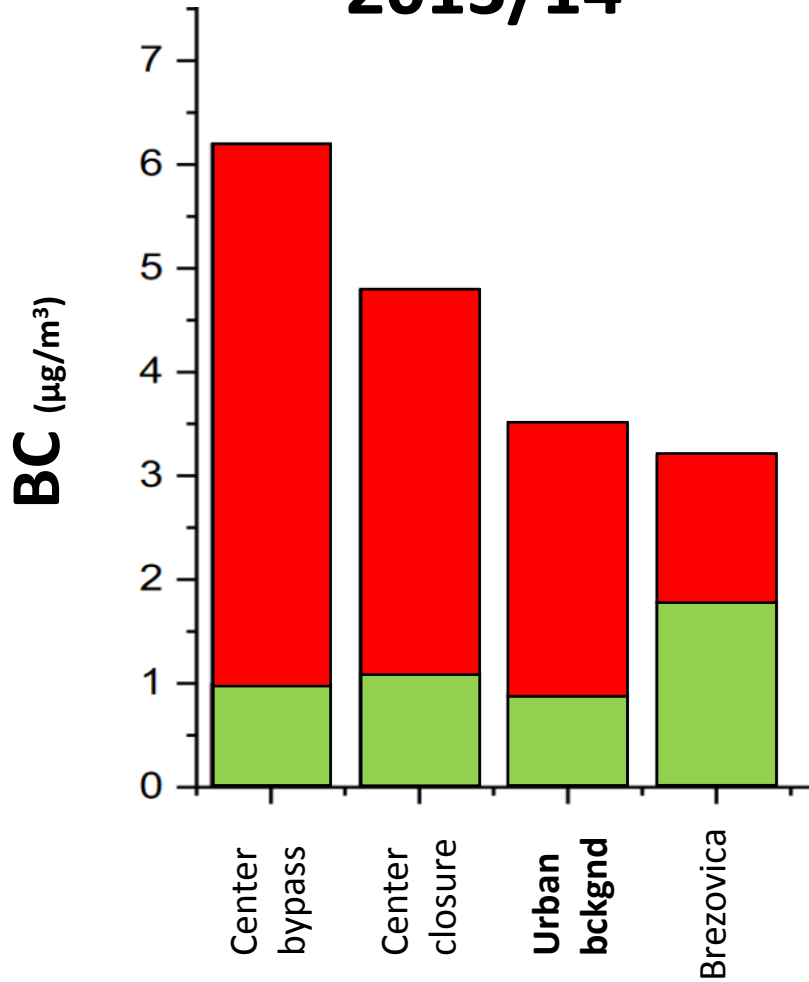


BC_{wb} Nov – Mar

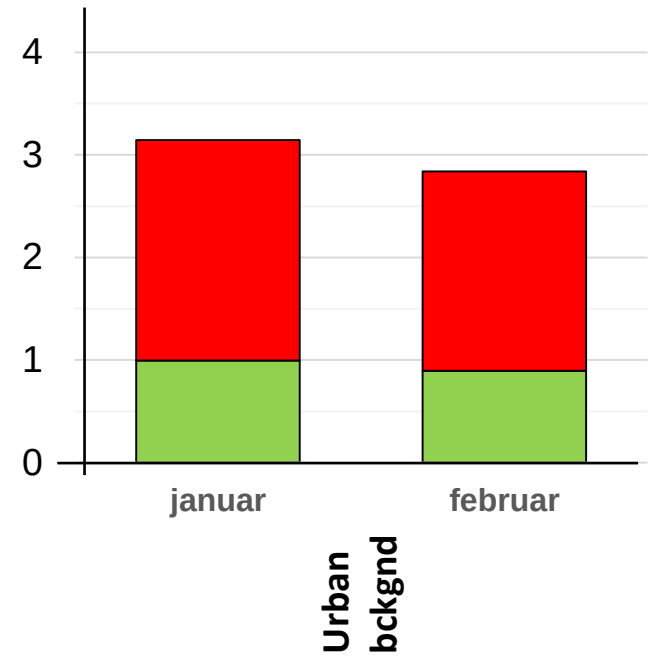


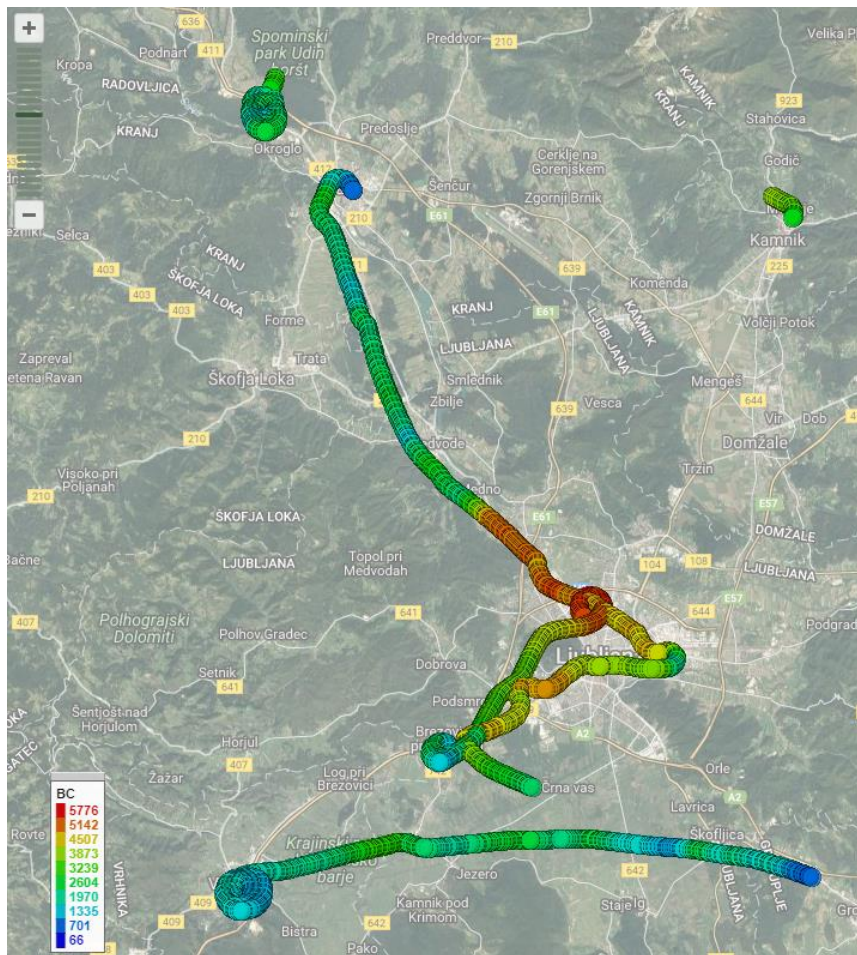
Ljubljana

2013/14

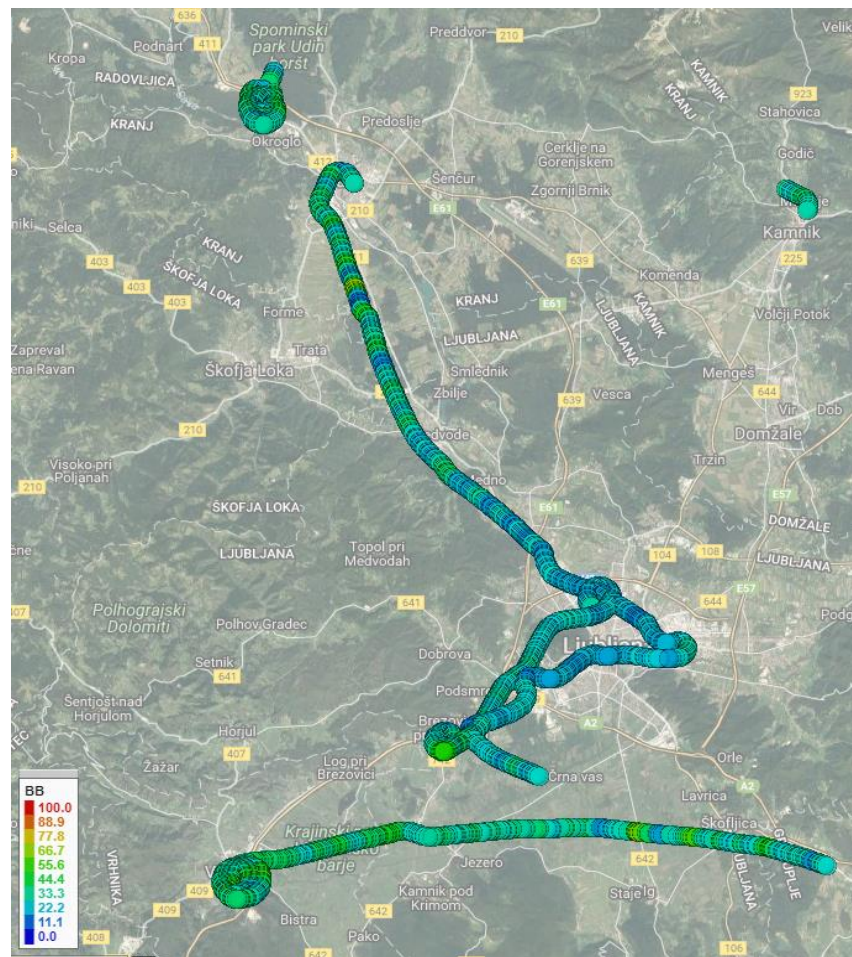
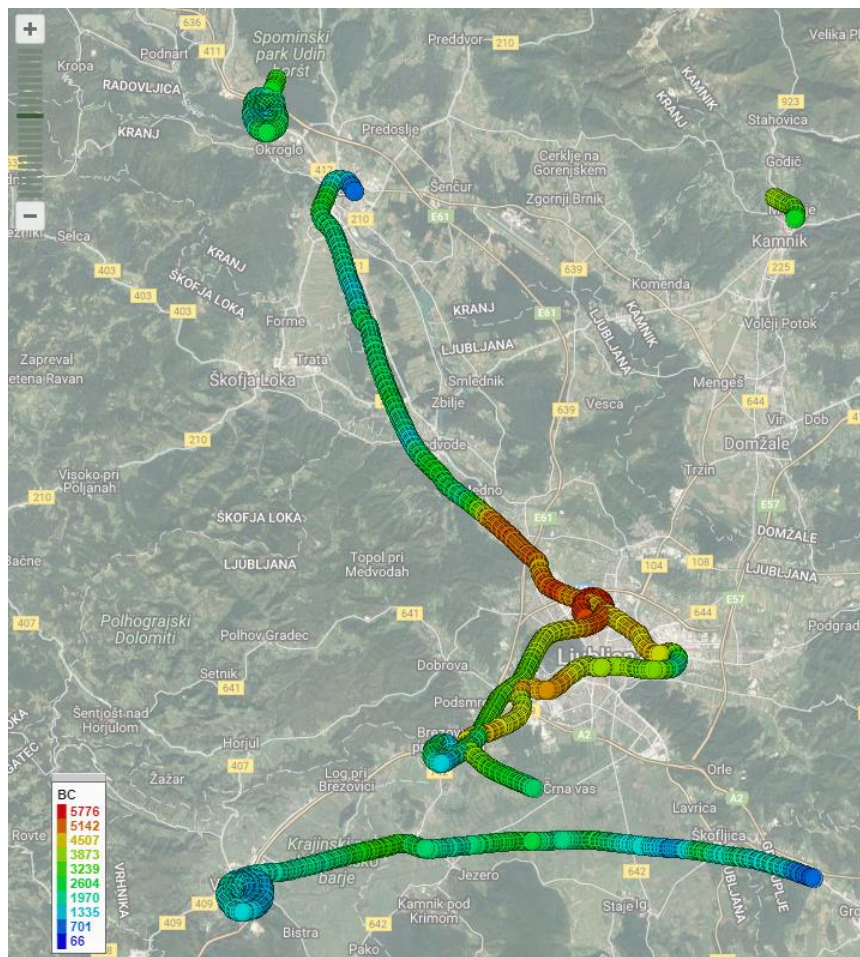


2018

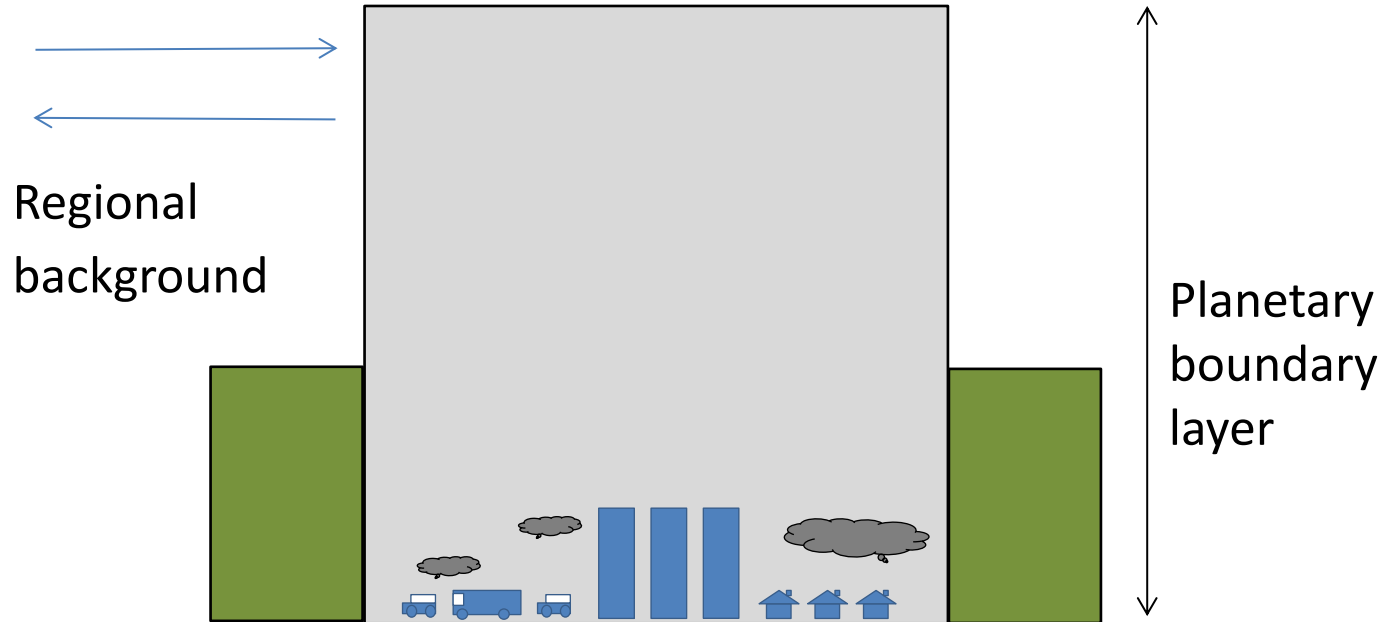




- nižje koncentracije v centru mesta
- najbolj onesnaženi predeli: Bežigrad, Šiška in Vič



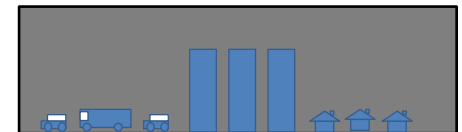
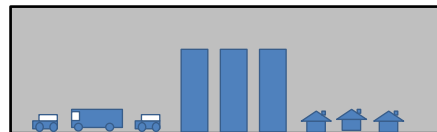
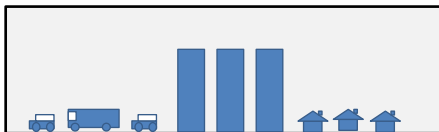
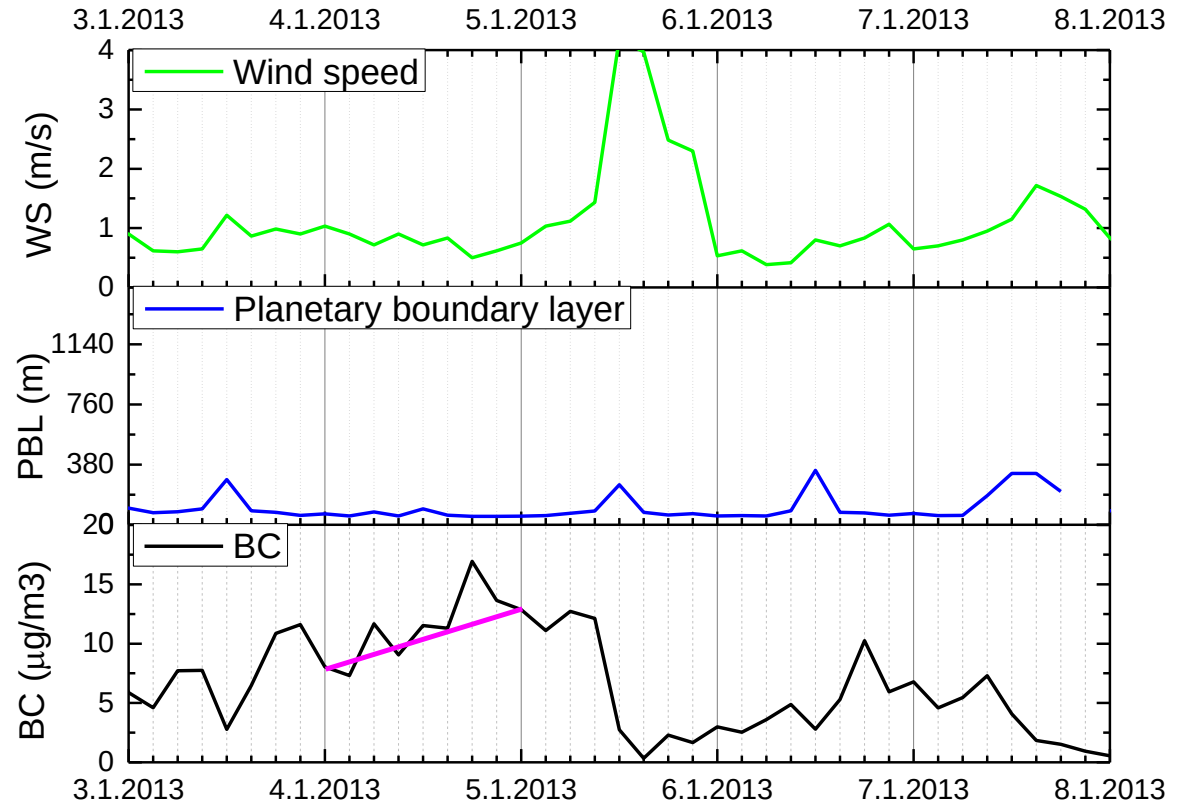
Production of black carbon - model



Assumptions:

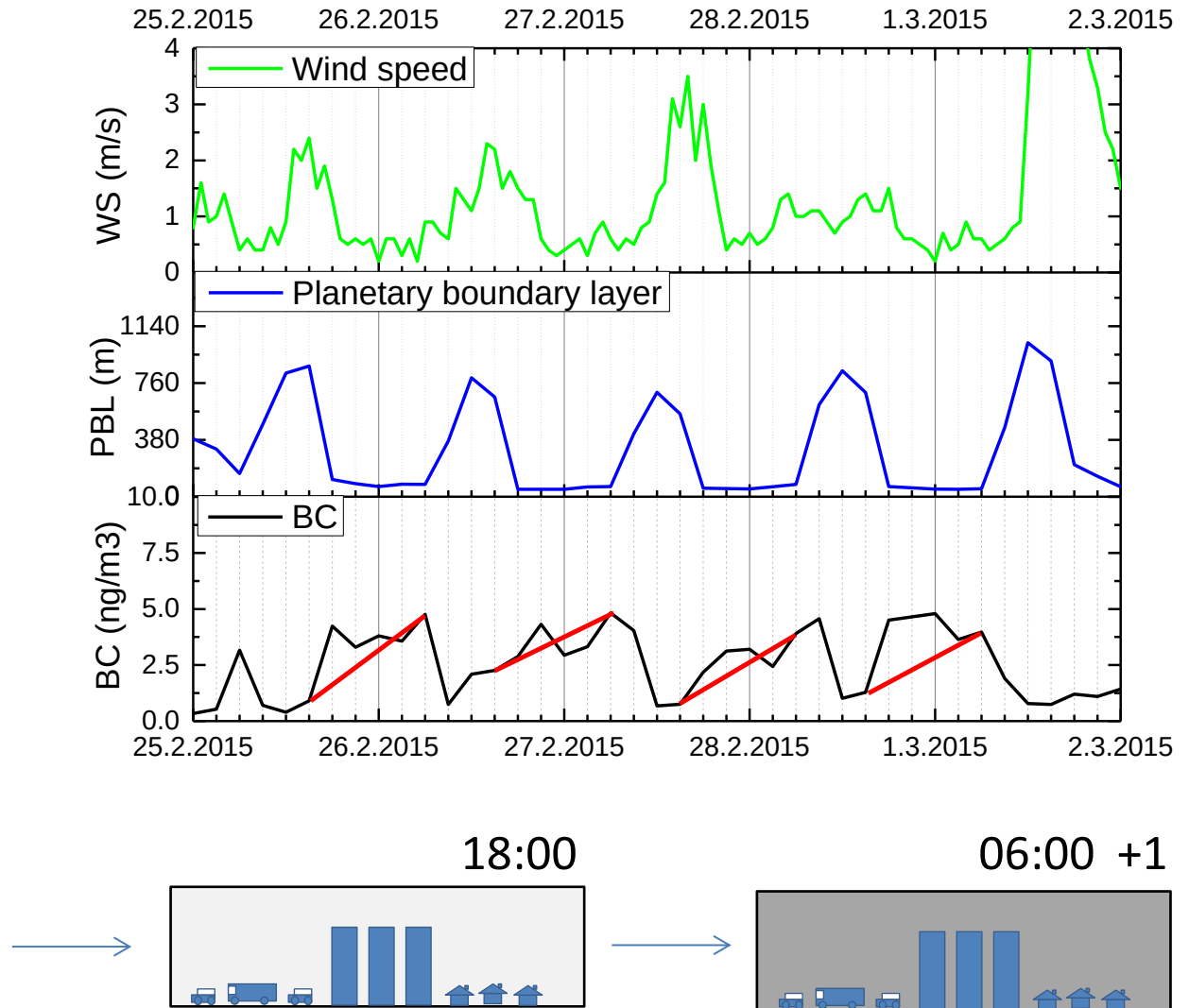
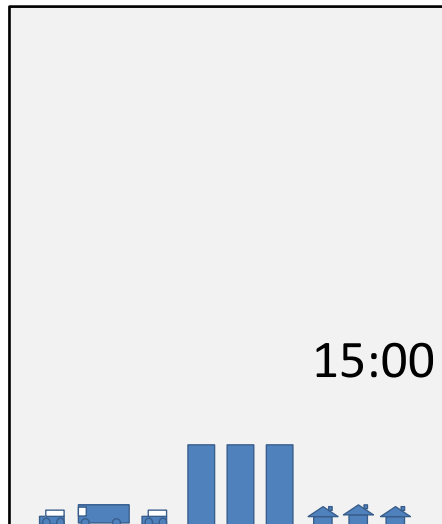
- Black carbon is produced by traffic and biomass burning
- Emissions are contained inside the basin when PBL is lower than surrounding hills

Production of black carbon: Non-convective days

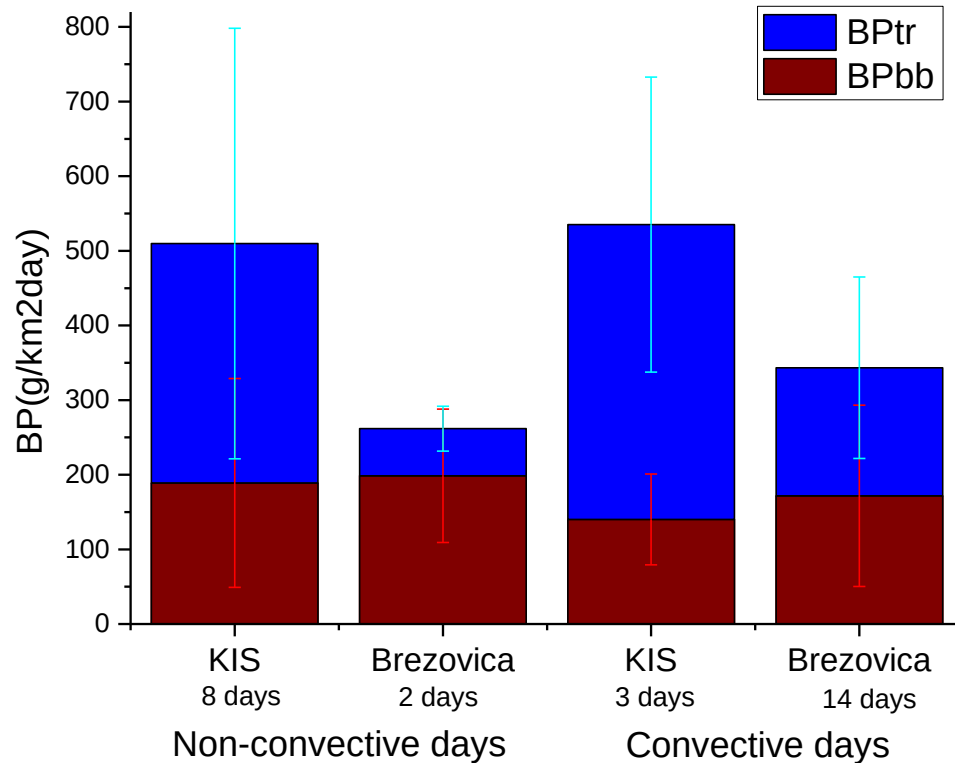


Production of black carbon

Convective days



Production of black carbon- Results



Black carbon production
(surface density):

$$BP = (dBC/dt) * PBL$$

- Different approaches give similar results

Global BP=25 g/km²day
(Bond et al., 2007)

- Biomass burning production is homogeneous
- Traffic emissions are heterogeneous

Sklepi

- **BC –kvantifikacija učinkovitosti ukrepov**
- **določanje virov**
- **vloga vremena**
- **dolgotrajne meritve**
- **produkcija**
- **detektivka**

Hvala!

grisa.mocnik@ijs.si

Quantification

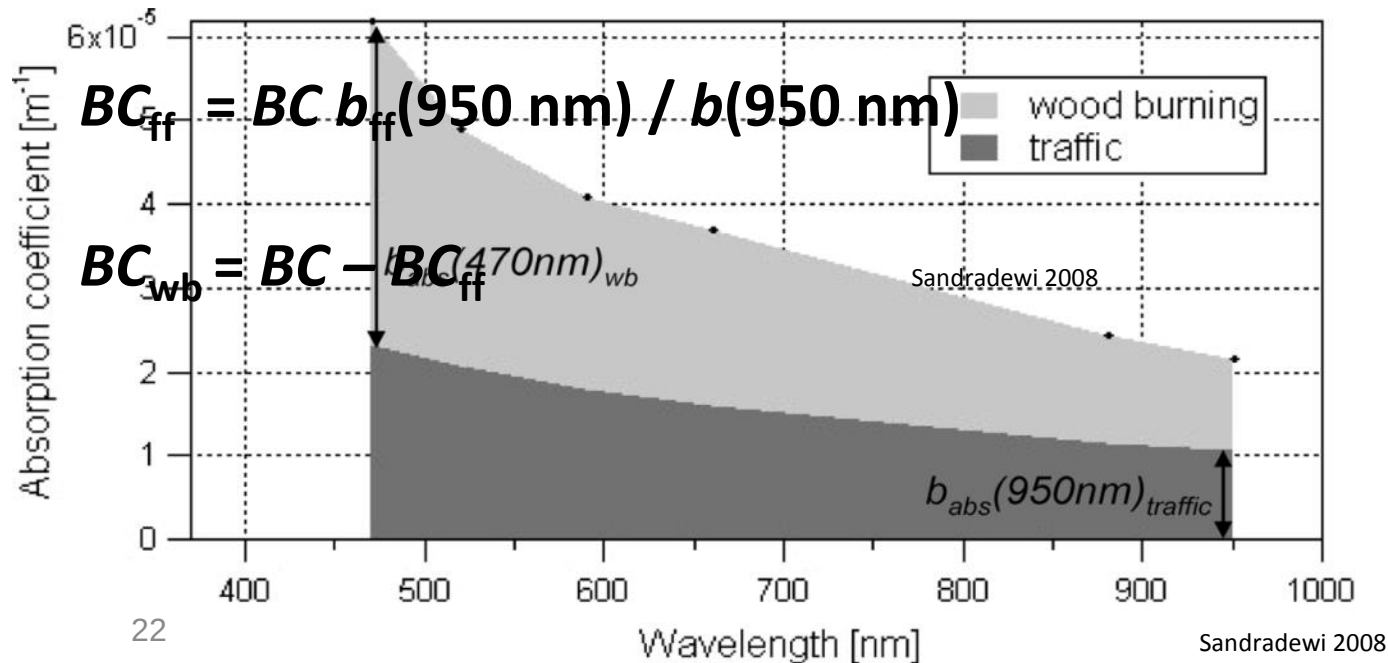
$$b(\lambda) = b_{wb}(\lambda, \text{wood}) + b_{ff}(\lambda, \text{fossil}) \quad \lambda = 470 \text{ nm}, 950 \text{ nm}$$

$$b_i(470 \text{ nm}) / b_i(950 \text{ nm}) = (470 \text{ nm} / 950 \text{ nm})^{-\alpha}$$

$$\alpha = 1,0 \pm 0,1 \text{ (fossil)} \quad \text{Bond \& Bergstrom 2004}$$

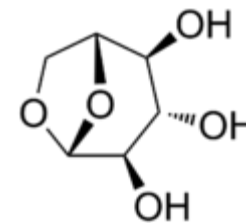
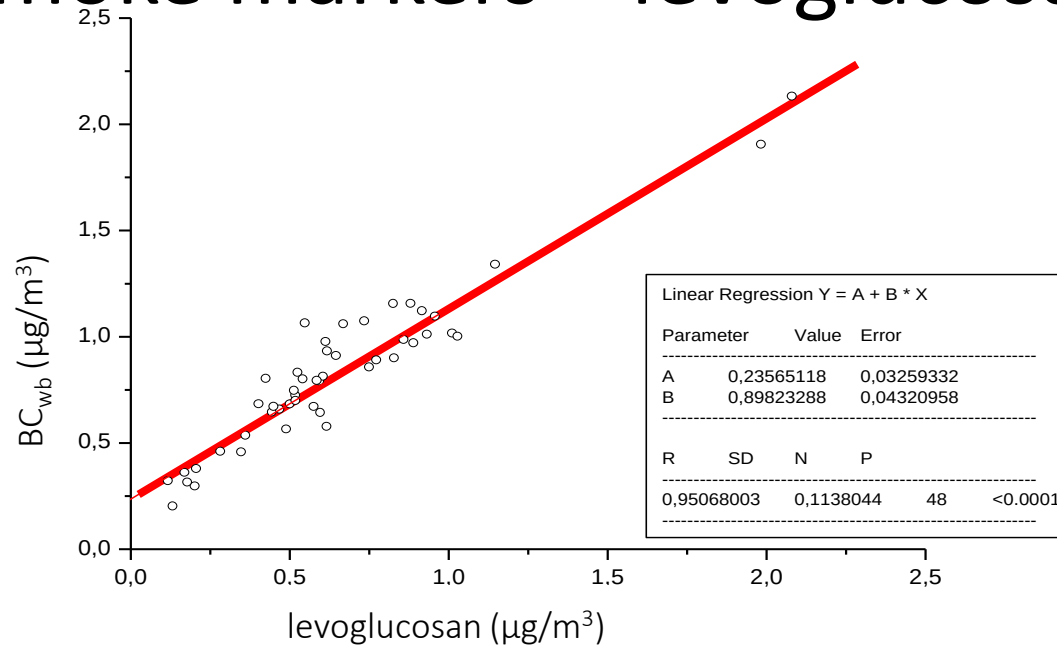
$$\alpha = 2,0 - 0,5 / +1,0 \text{ (wood)} \quad \text{Kirchstetter 2004,}$$

Day 2006,
Lewis 2008

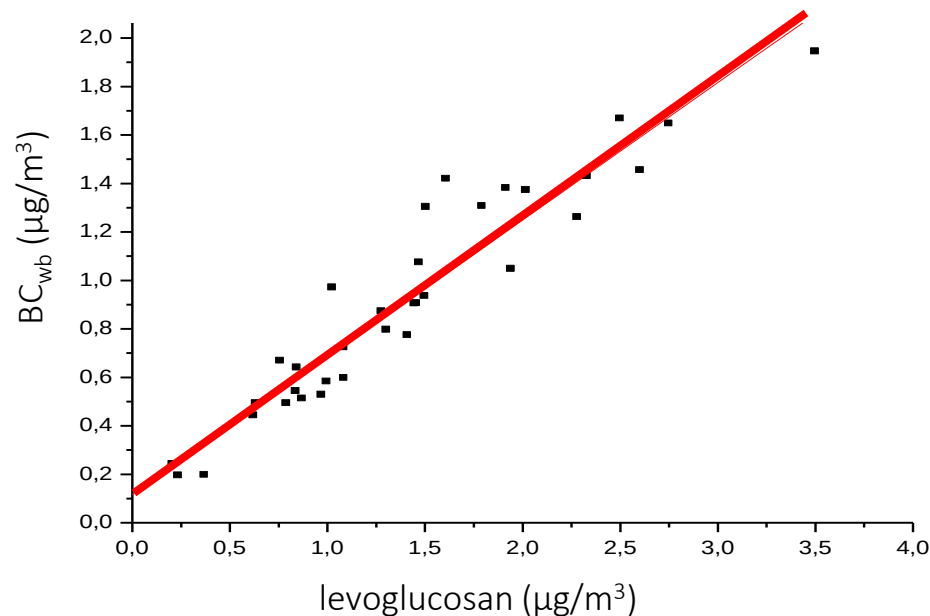


Wood-smoke markers – levoglucosan

Nova Gorica

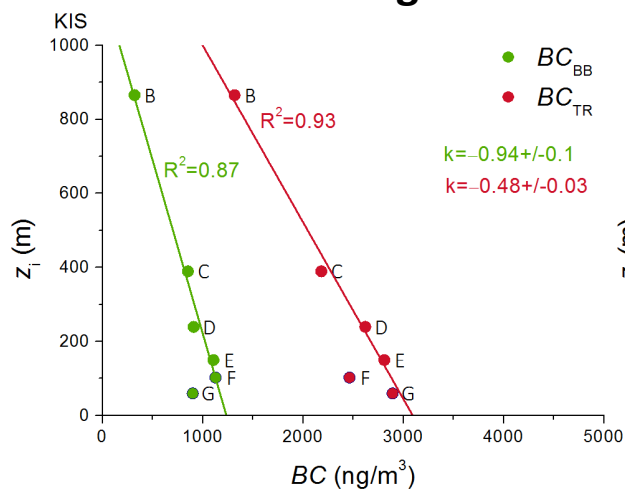


Zagorje

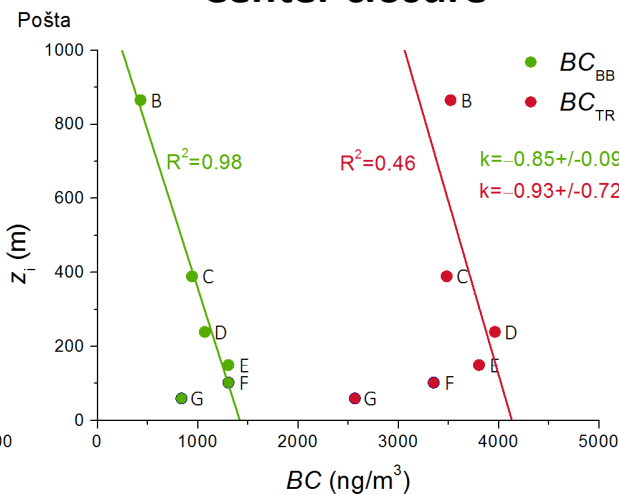


Levoglucosan - ion
chromat. EARS

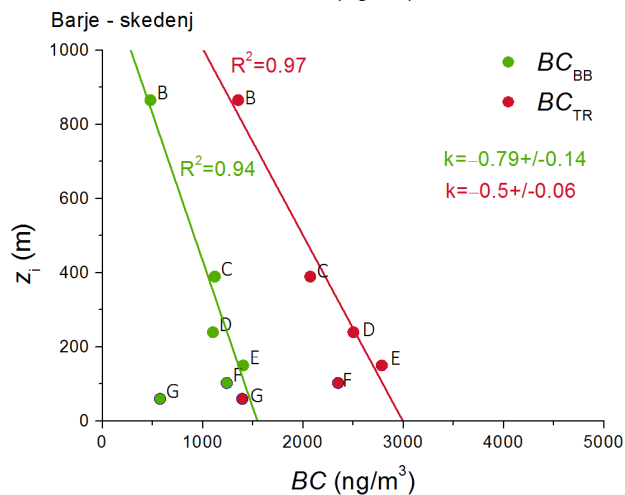
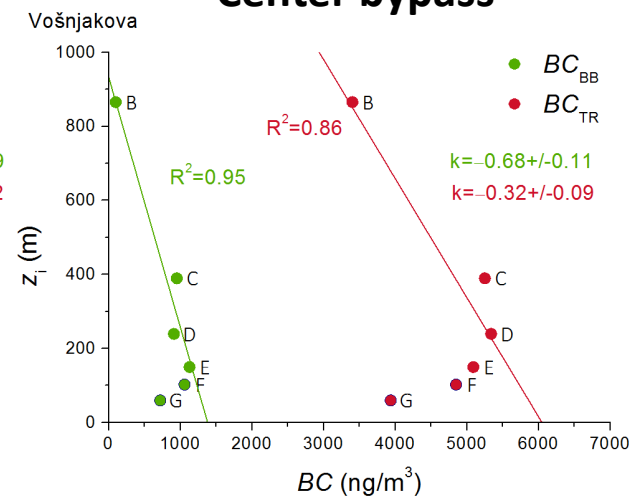
Urban background



Center closure



Center bypass



HWY-2

