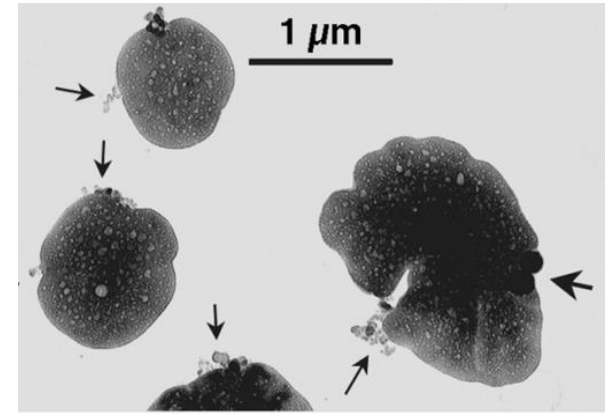




Modélisation de la pollution par le trafic à Bruxelles

Priscilla Declerck, Thierry de Vos, Billie Heene, Olivier Brasseur

Laboratoire qualité de l'air - Bruxelles Environnement



Introduction

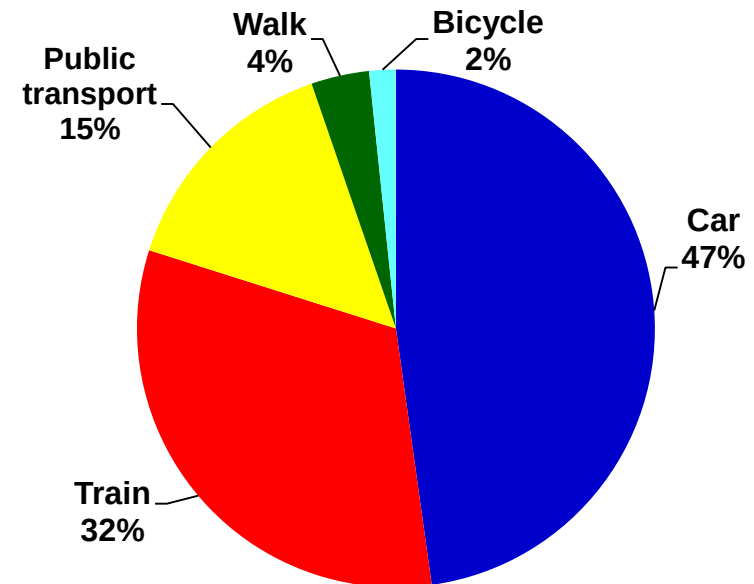


✓ The Brussels-Capital Region:

- A dense urban Region consisting of 19 municipalities
- Approximately 1.1 million inhabitants
- Population has grown fast over the last decade, and is still growing (+ 1.2%)
- Economic heart of Belgium – more than 370.000 commuters enter the city every day

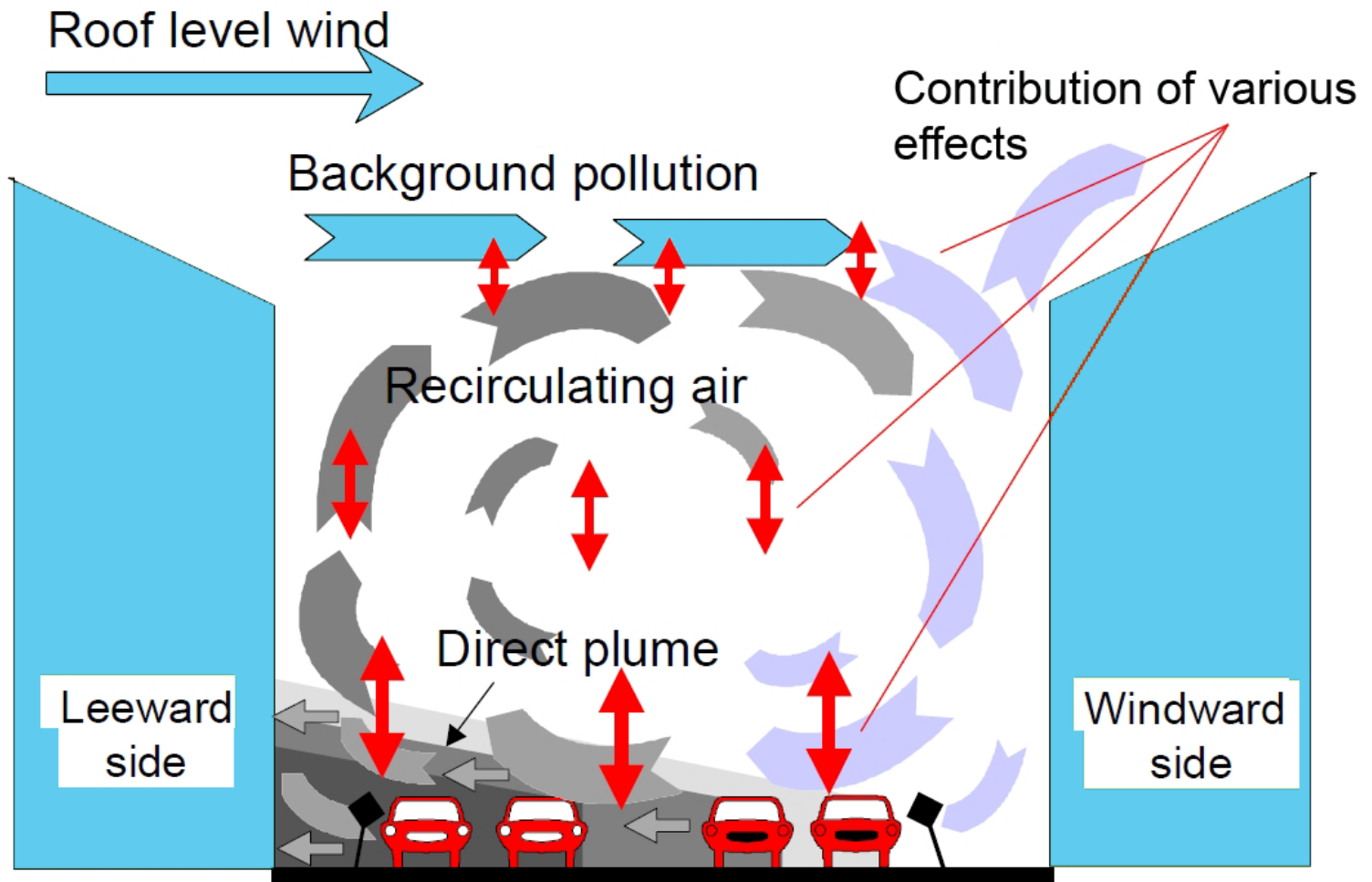
✓ Extremely dense transport network

- ⇒ Traffic related air pollution
- ⇒ Challenges concerning mobility



CANyon Street model for Black Carbon (CANS_{BC})

based on the approach of the Operational Street Pollution Model (OSPM)

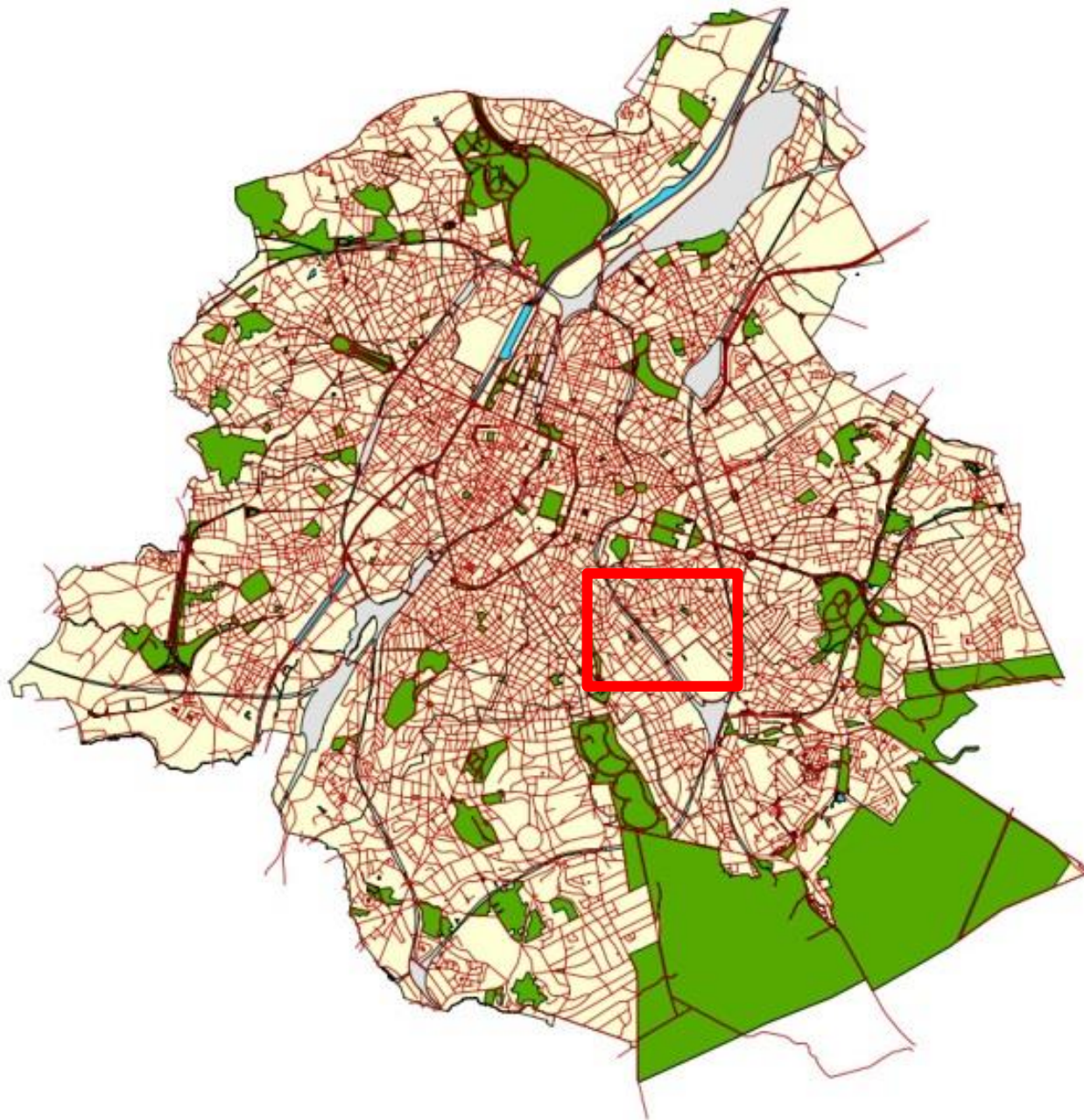


- ✓ CANS_{BC}: no chemical module
- ✓ Input data:
 - Meteorological data:
 - Wind direction
 - Wind velocity } @ a height of 30m (Molenbeek)
 - Urban background:
 - BC conc. from the urban background station of Uccle
 - Traffic emissions
 - Depending on vehicle countings
 - Temporal resolution of 15'
 - Vehicle speeds were kept constant



Direct validation: the Crown Street





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✓ AIMS

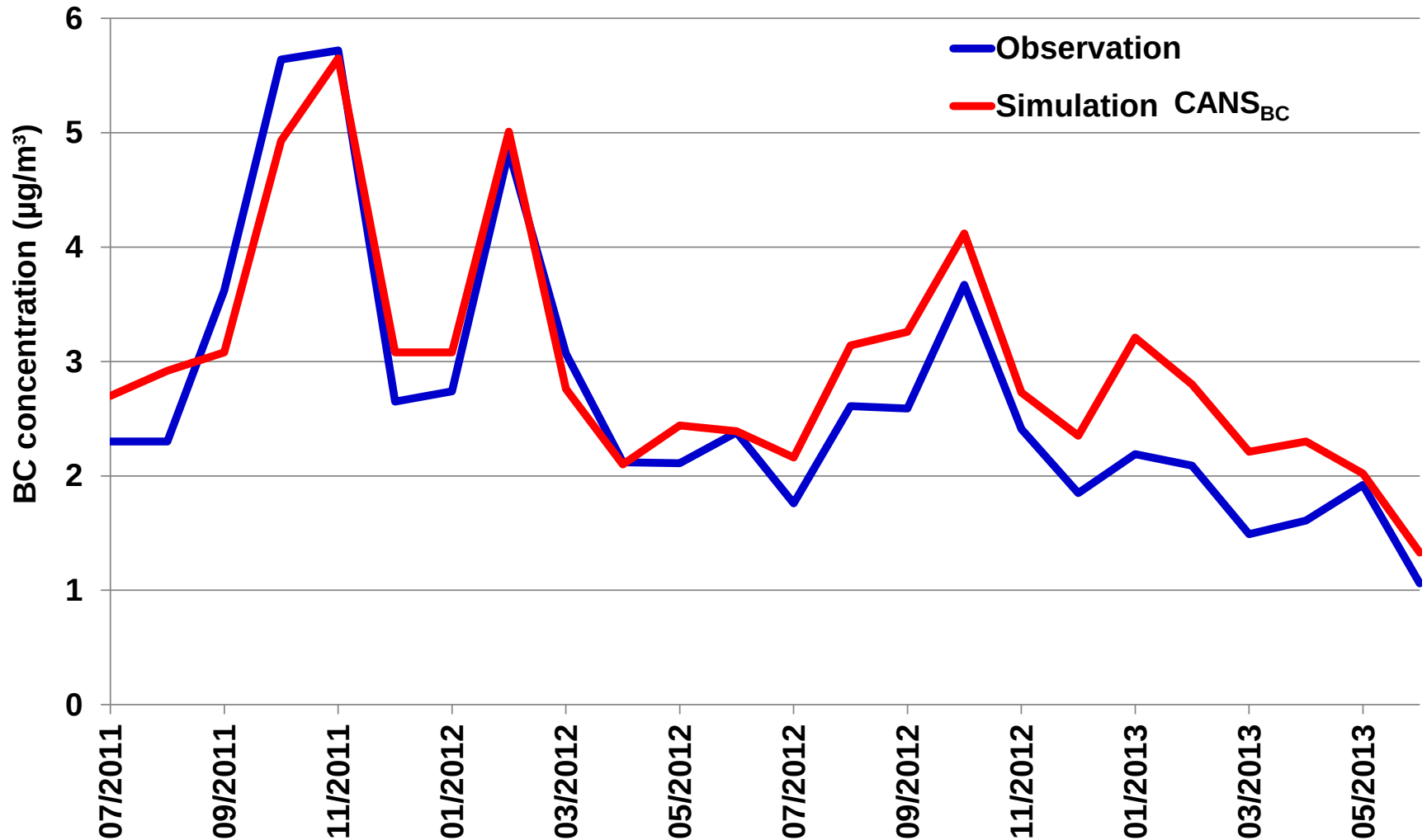
- Monthly evolution: variable meteorological conditions
- Half-hourly evolution: variable traffic emissions
- Sensitivity to the wind direction: capability of estimating the local contribution to BC concentrations

✓ Specifications

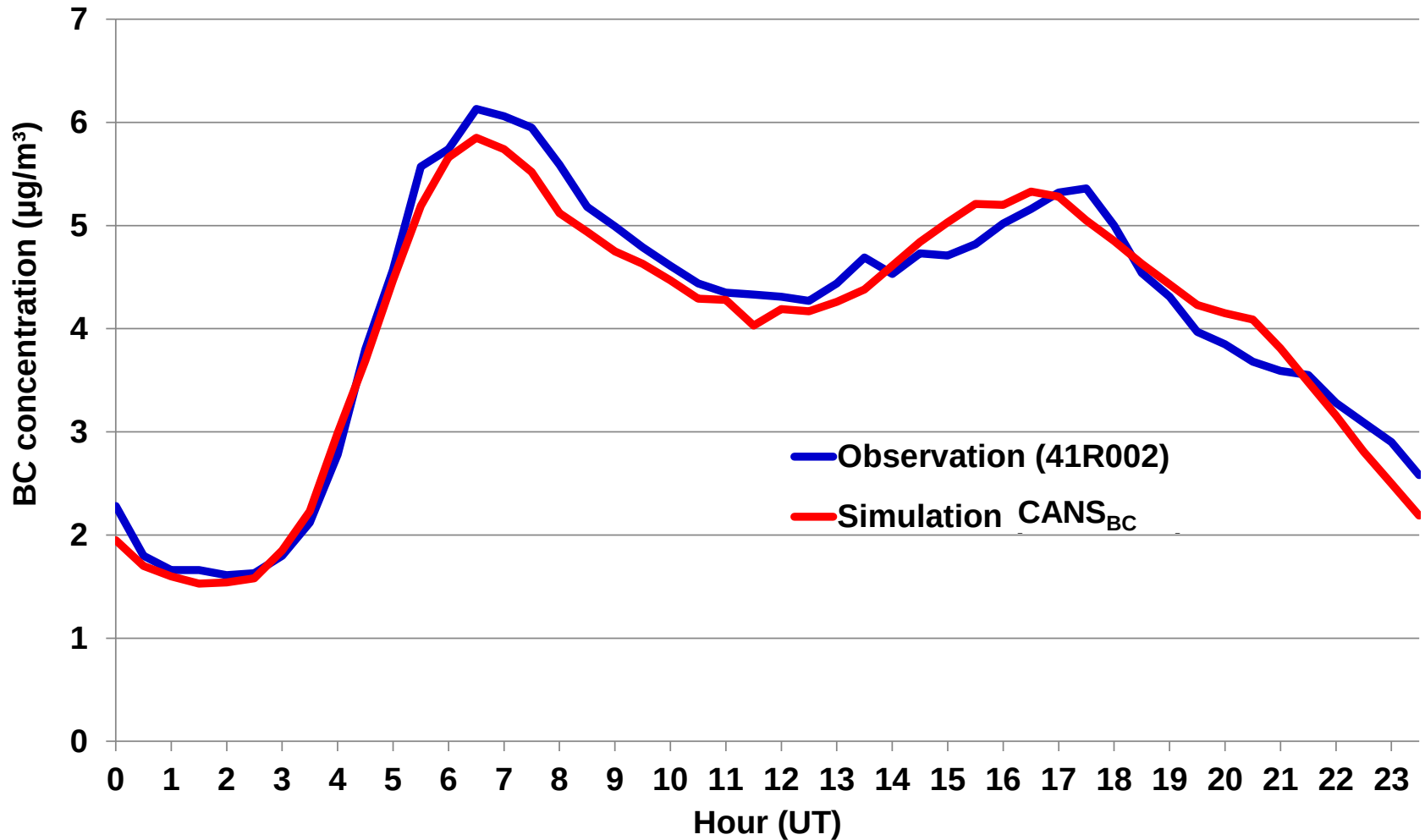
- Two years simulation period: 7/2011 – 6/2013
- Observed BC concentrations: fixed BC measurement station in the Crown Street
- Simulated BC concentrations: $CANS_{BC}$



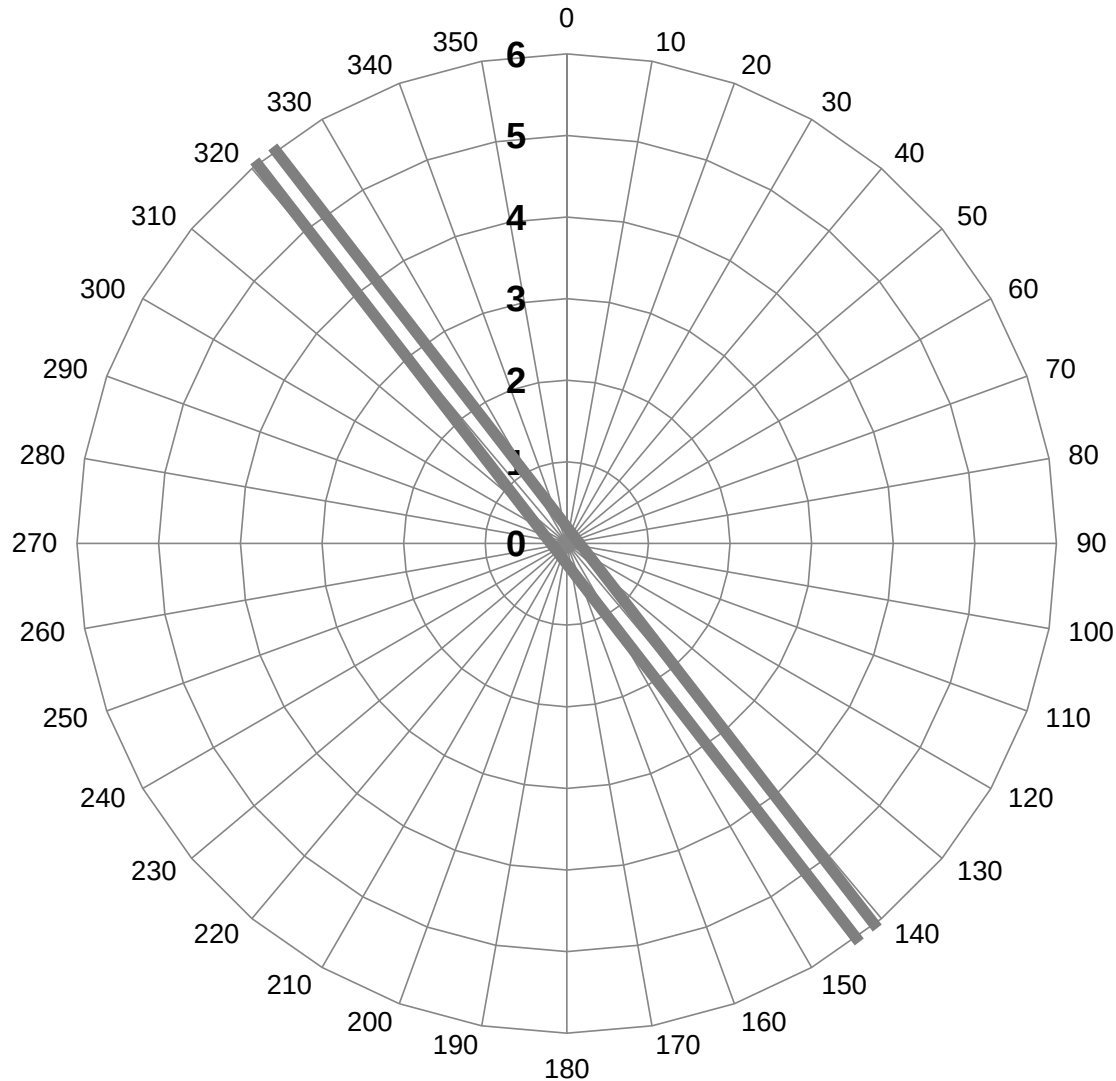
Monthly evolution



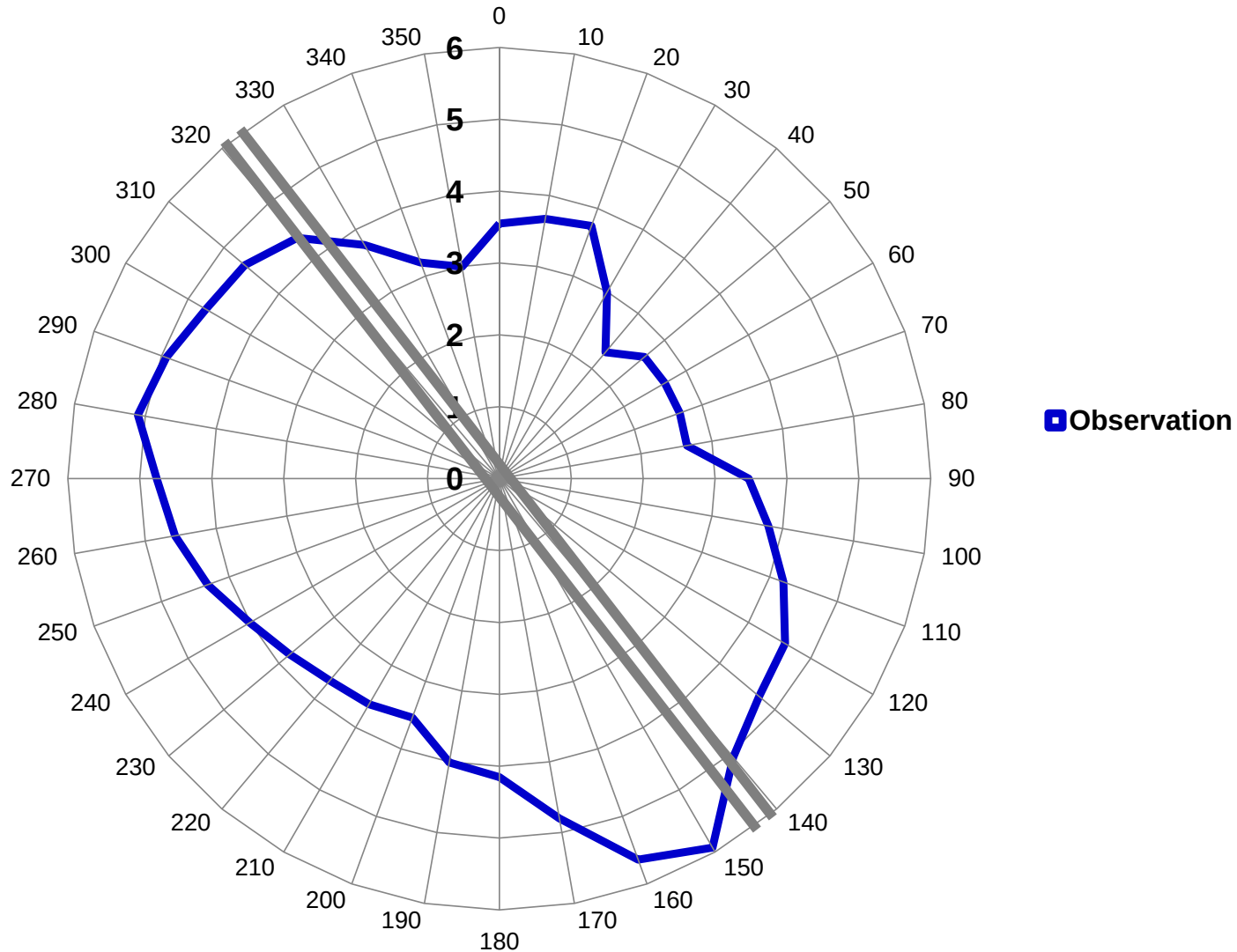
Diurnal evolution



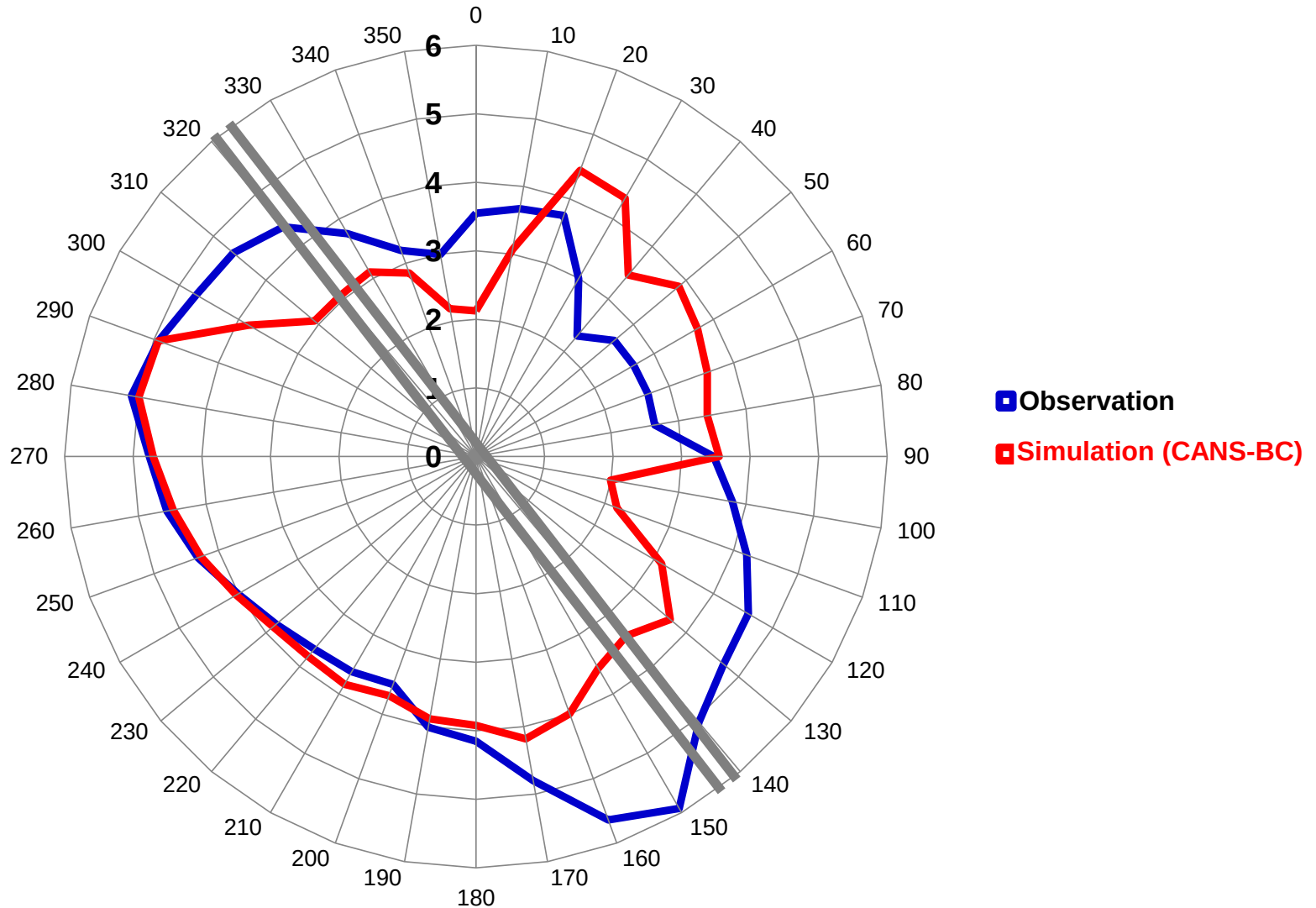
Sensitivity to wind direction



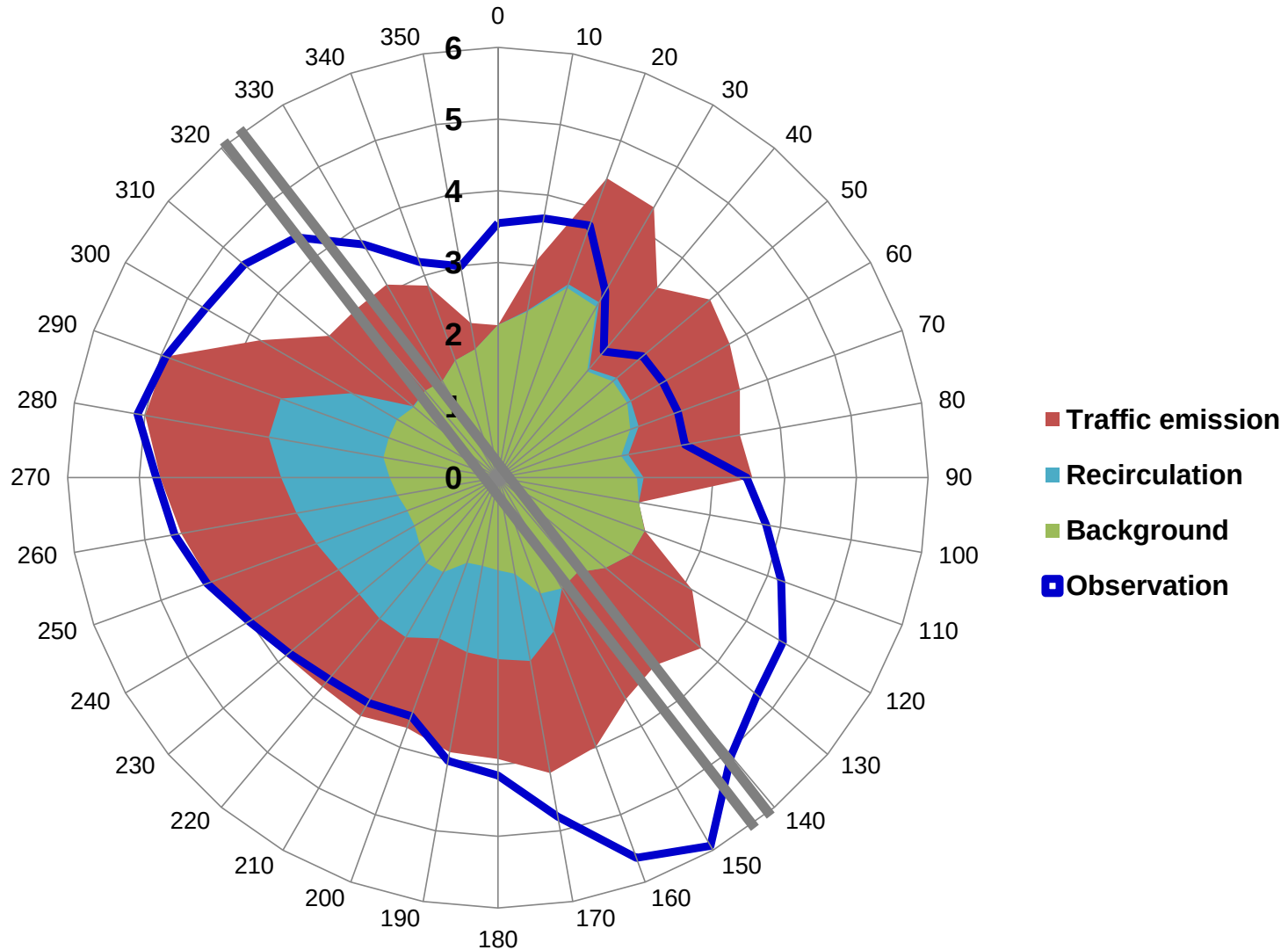
Sensitivity to wind direction



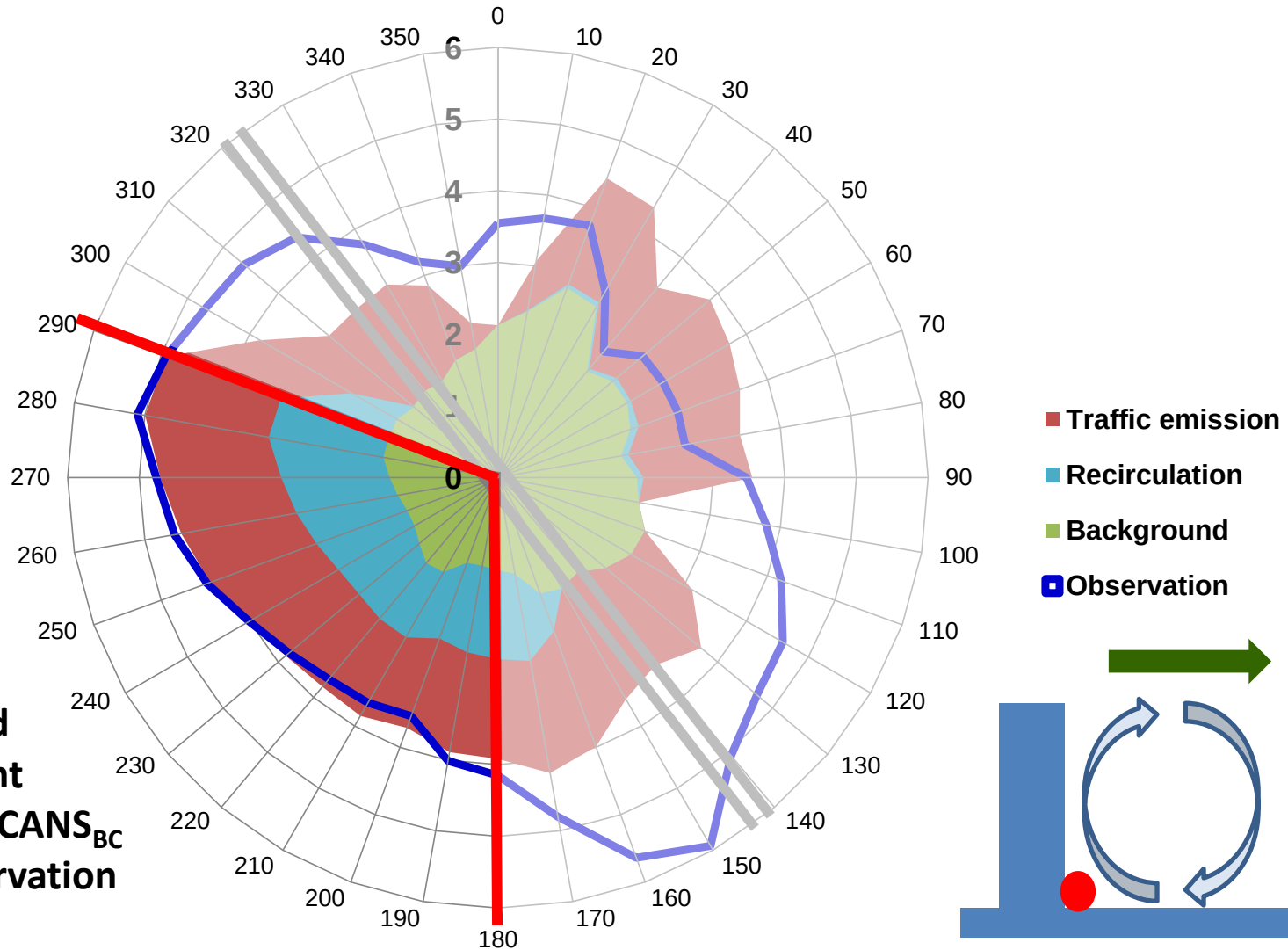
Sensitivity to wind direction



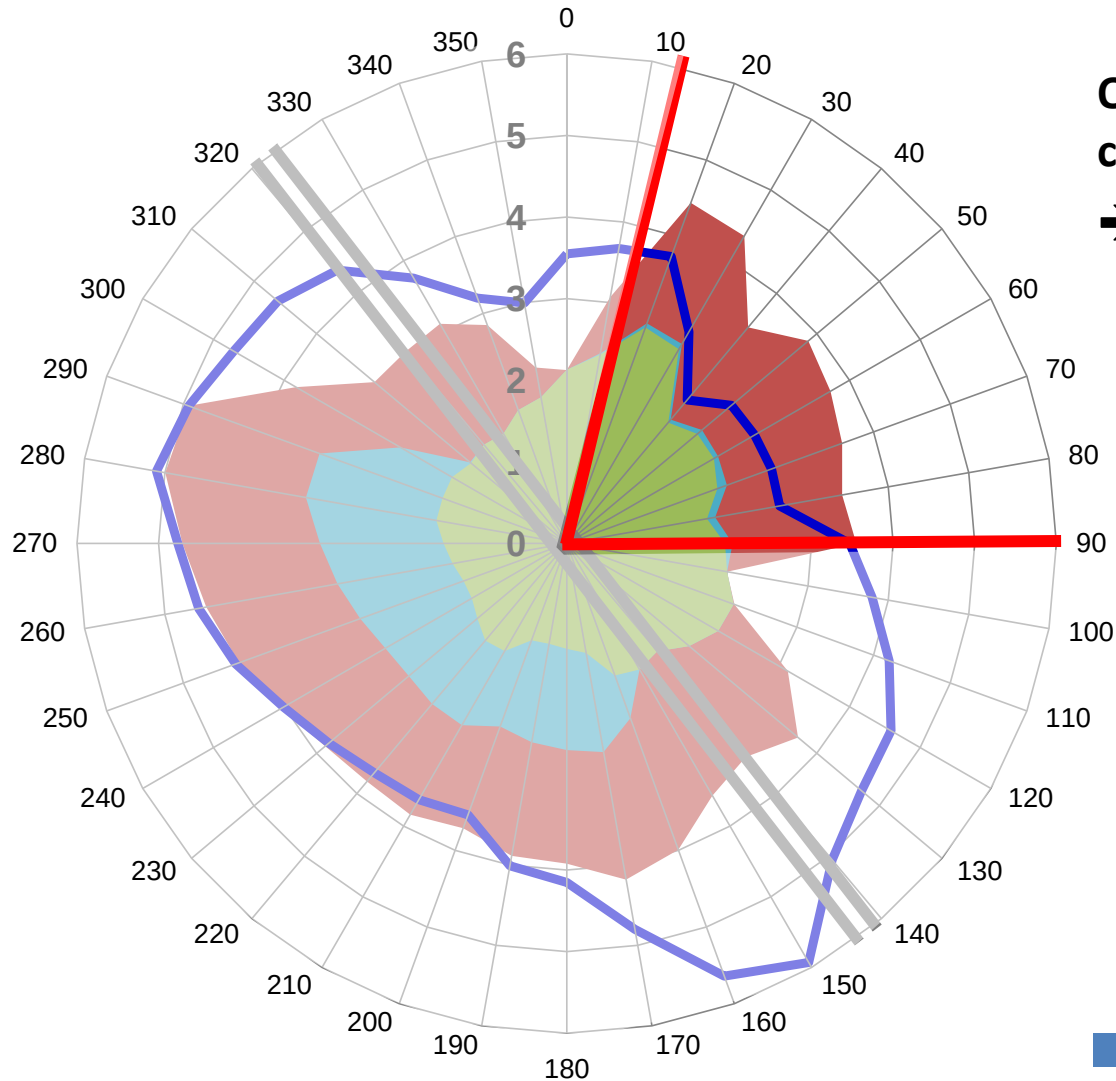
Sensitivity to wind direction



Sensitivity to wind direction



Sensitivity to wind direction



Overestimated BC concentrations

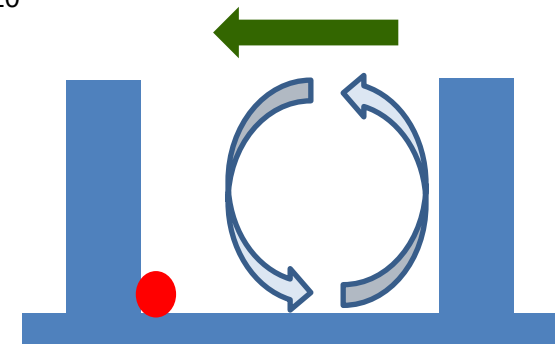
➔ **overestimated local contribution**

■ Traffic emission

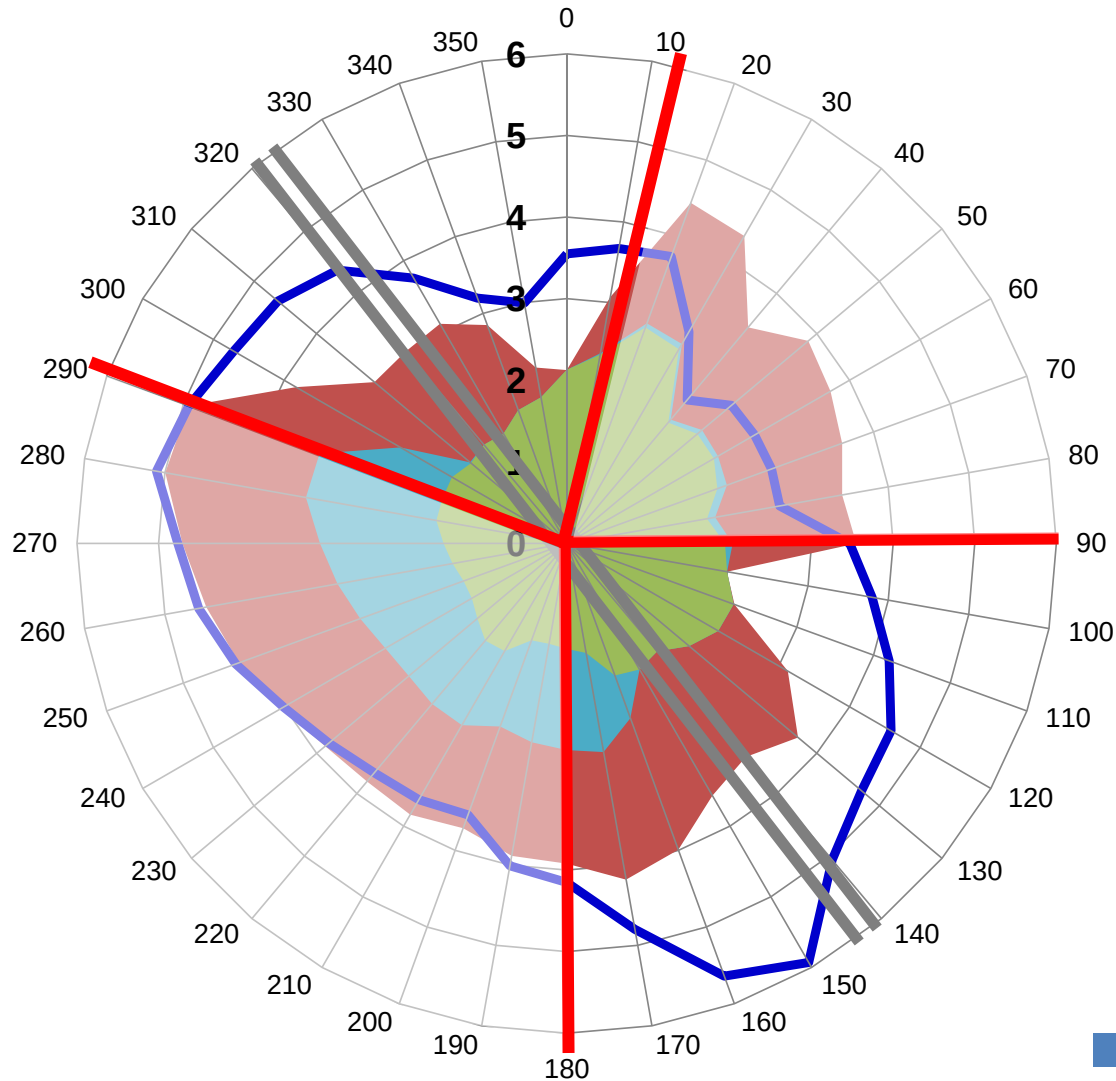
■ Recirculation

■ Background

■ Observation



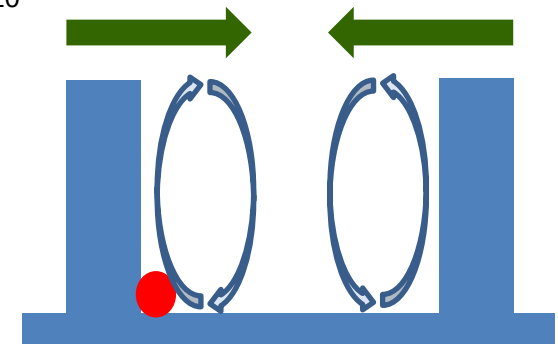
Sensitivity to wind direction



**Underestimated
BC concentrations**

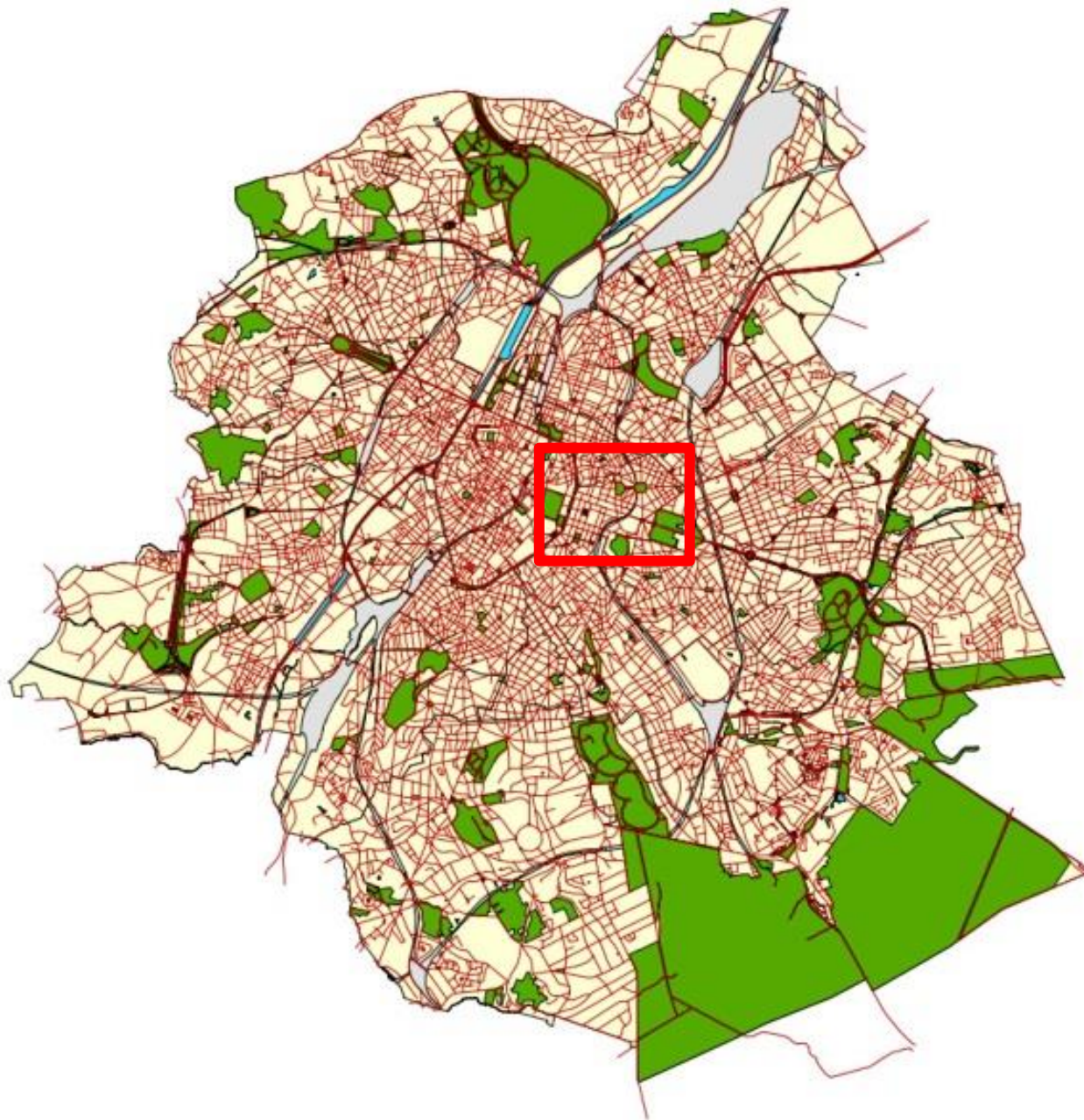
➔ **too weak
recirculation
and local
contribution?**

- Traffic emission
- Recirculation
- Background
- Observation



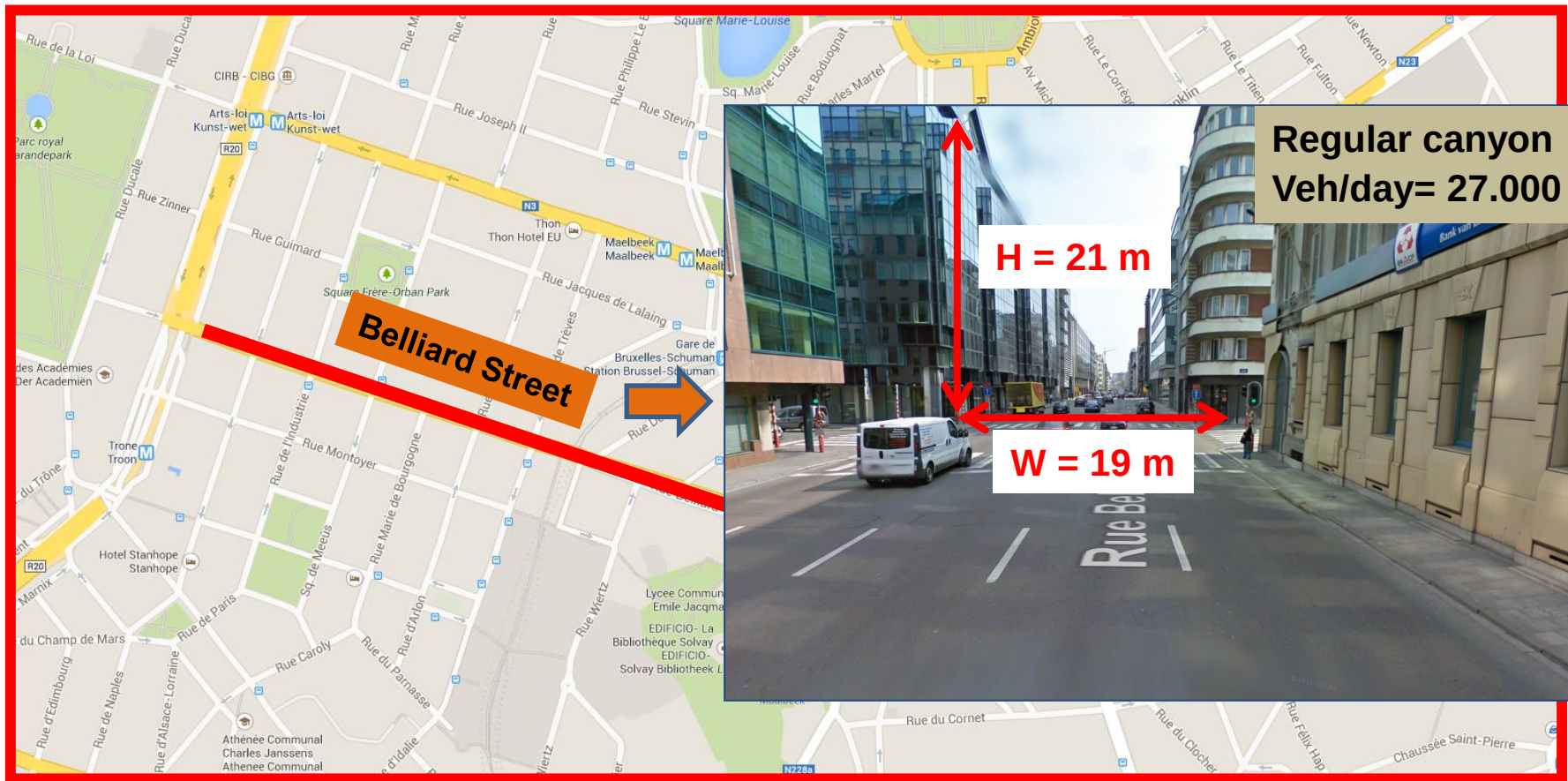
Indirect validation: the Belliard street





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✓ AIM

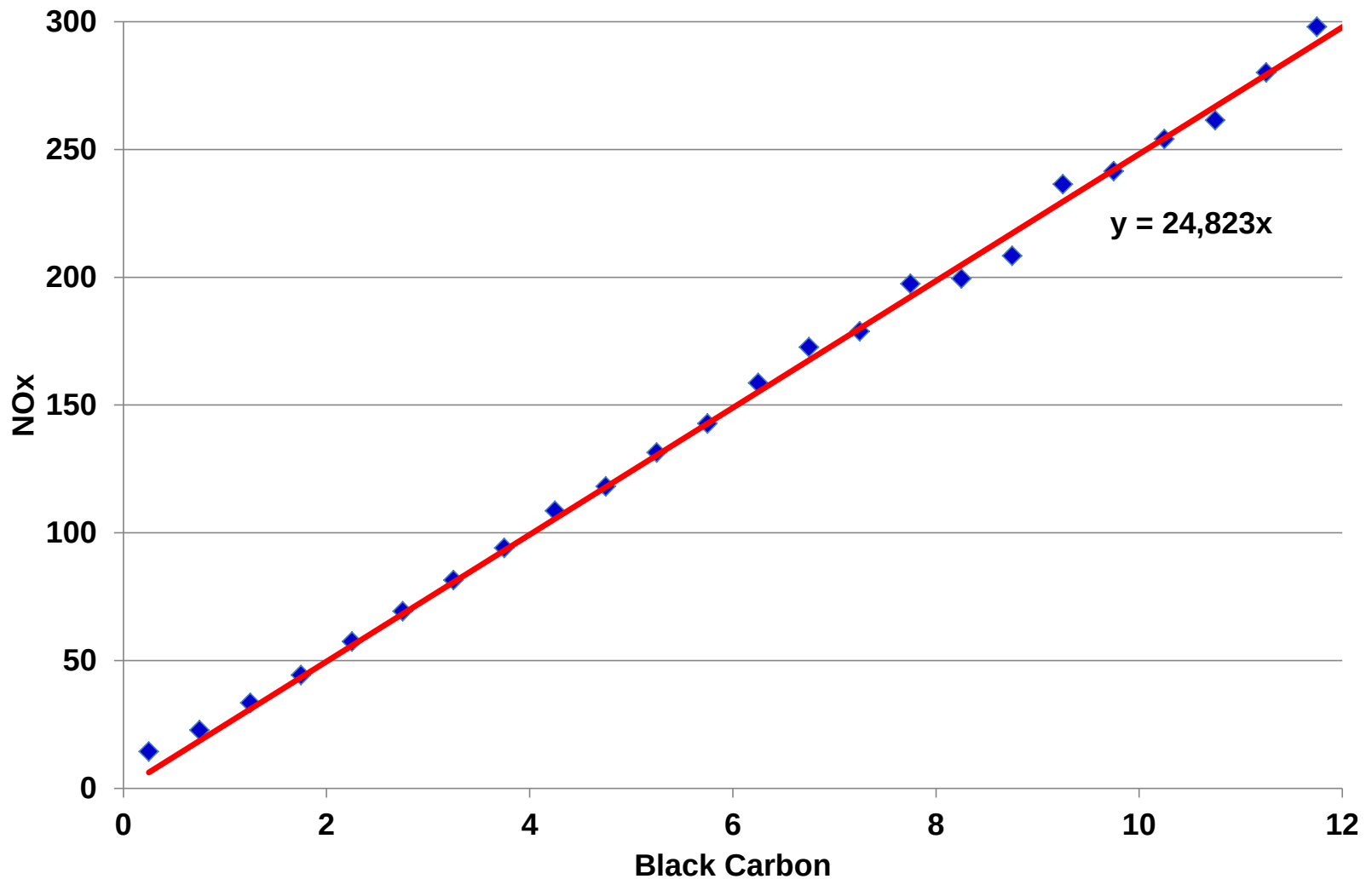
- Validate simulated BC concentrations based on the linear relation between BC and NOx

✓ Specifications

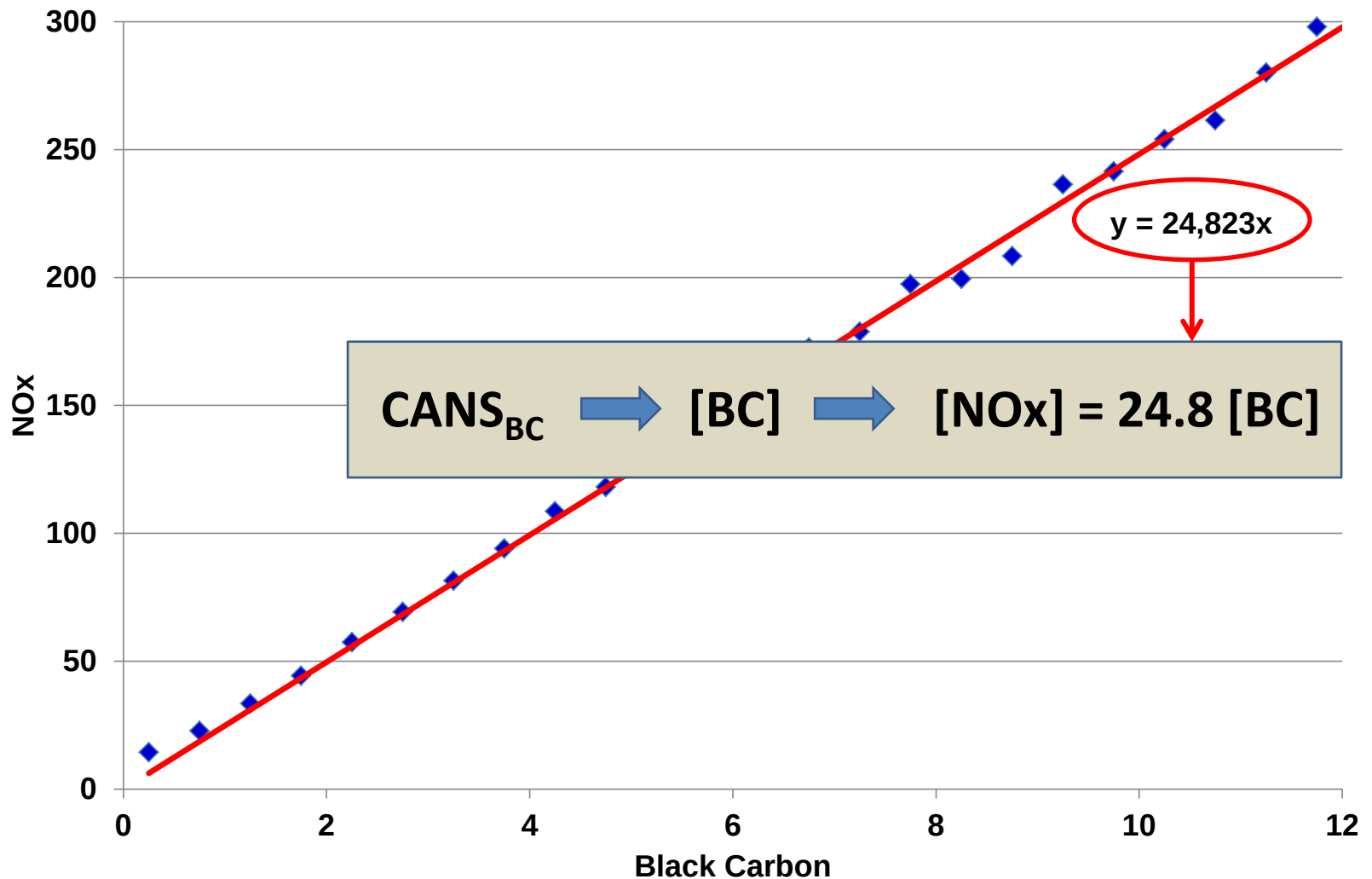
- Simulation period: 11/2012 – 6/2013
- Observed NOx concentrations: fixed NOx measurement station in the Belliard Street
- Simulated BC concentrations: $CANS_{BC}$



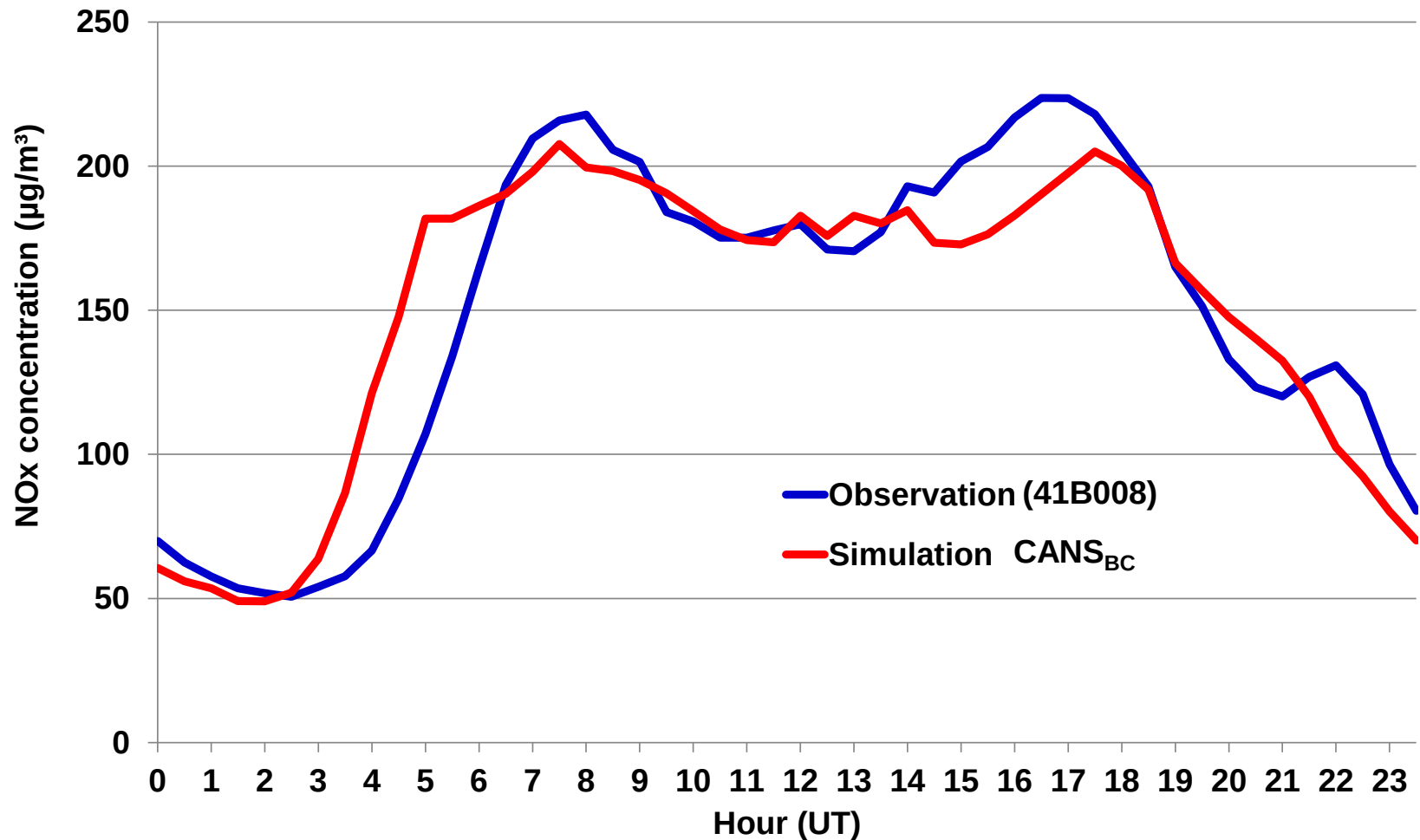
Relation between BC and NOx



Relation between BC and NOx

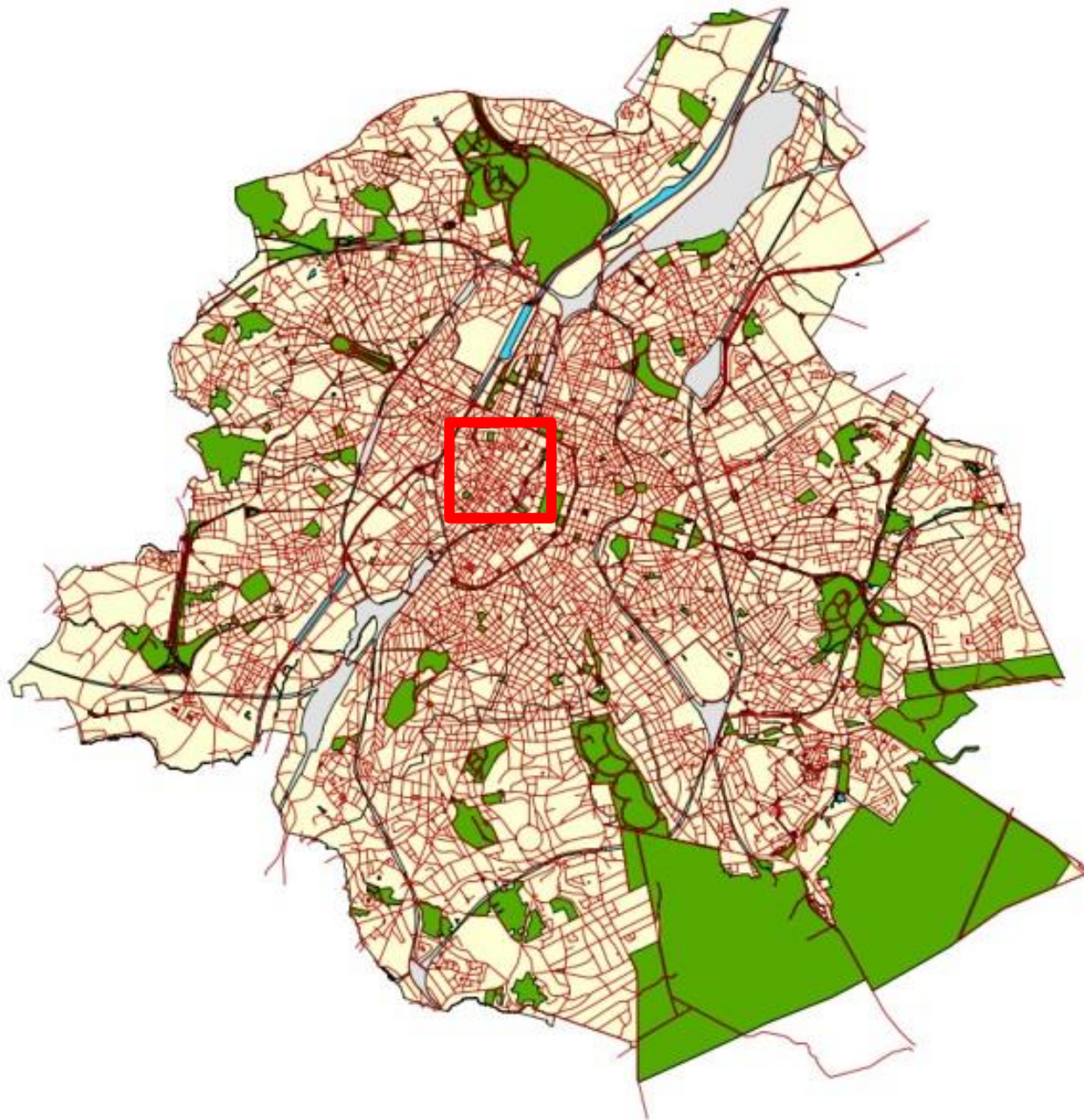


Diurnal evolution



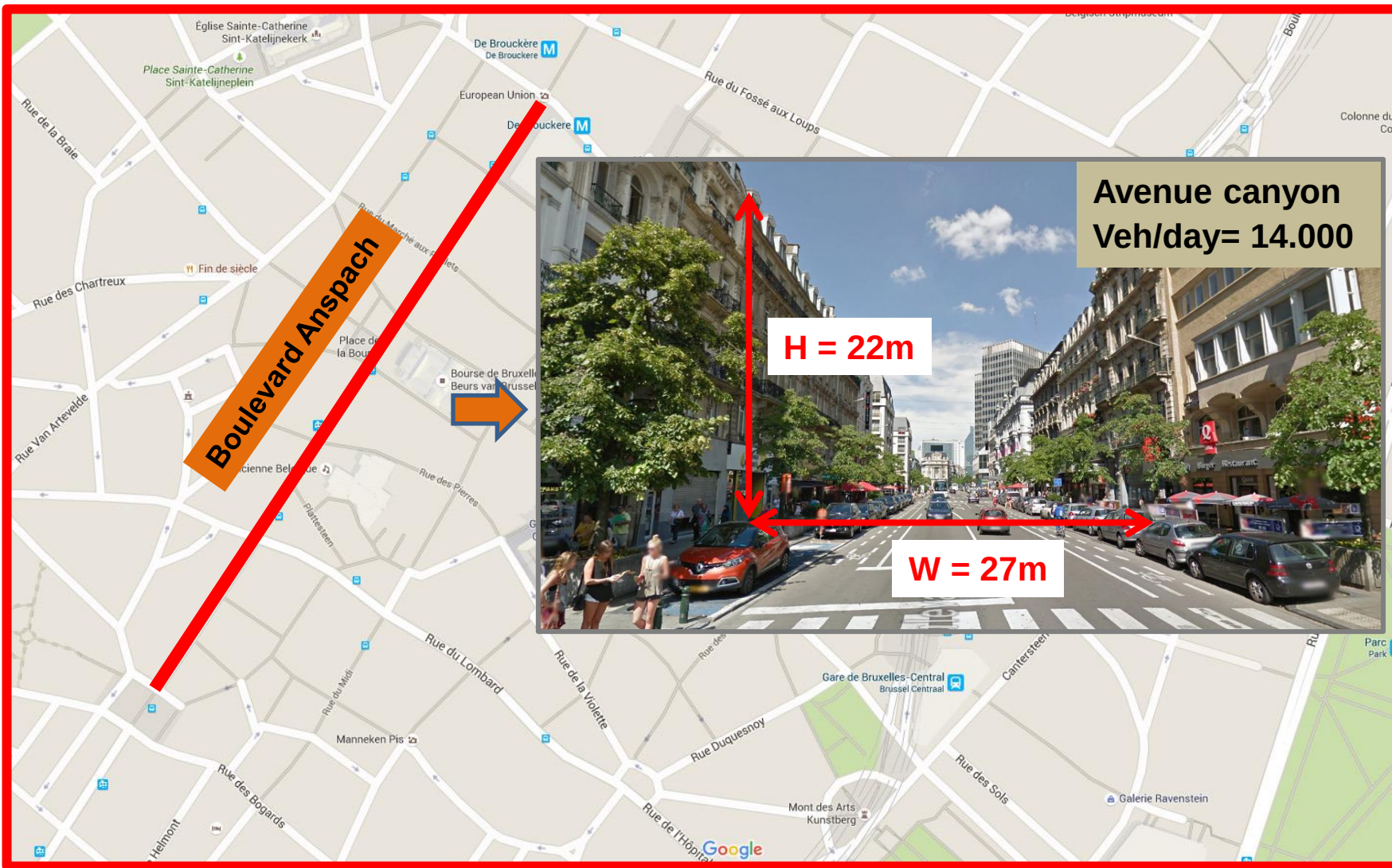
Direct validation: the Boulevard Anspach





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✓ AIMS

- Sidewalk: left vs right

✓ Specifications

- Simulation period: 18 days at rush hours (morning and evening)
- Observed BC concentrations: mobile BC measurement using AE51 aethalometer
- Simulated BC concentrations: $CANS_{BC}$



Sidewalk: left vs right

Spatial variations of BC concentrations along sidewalk

➡ Stop/start at traffic lights

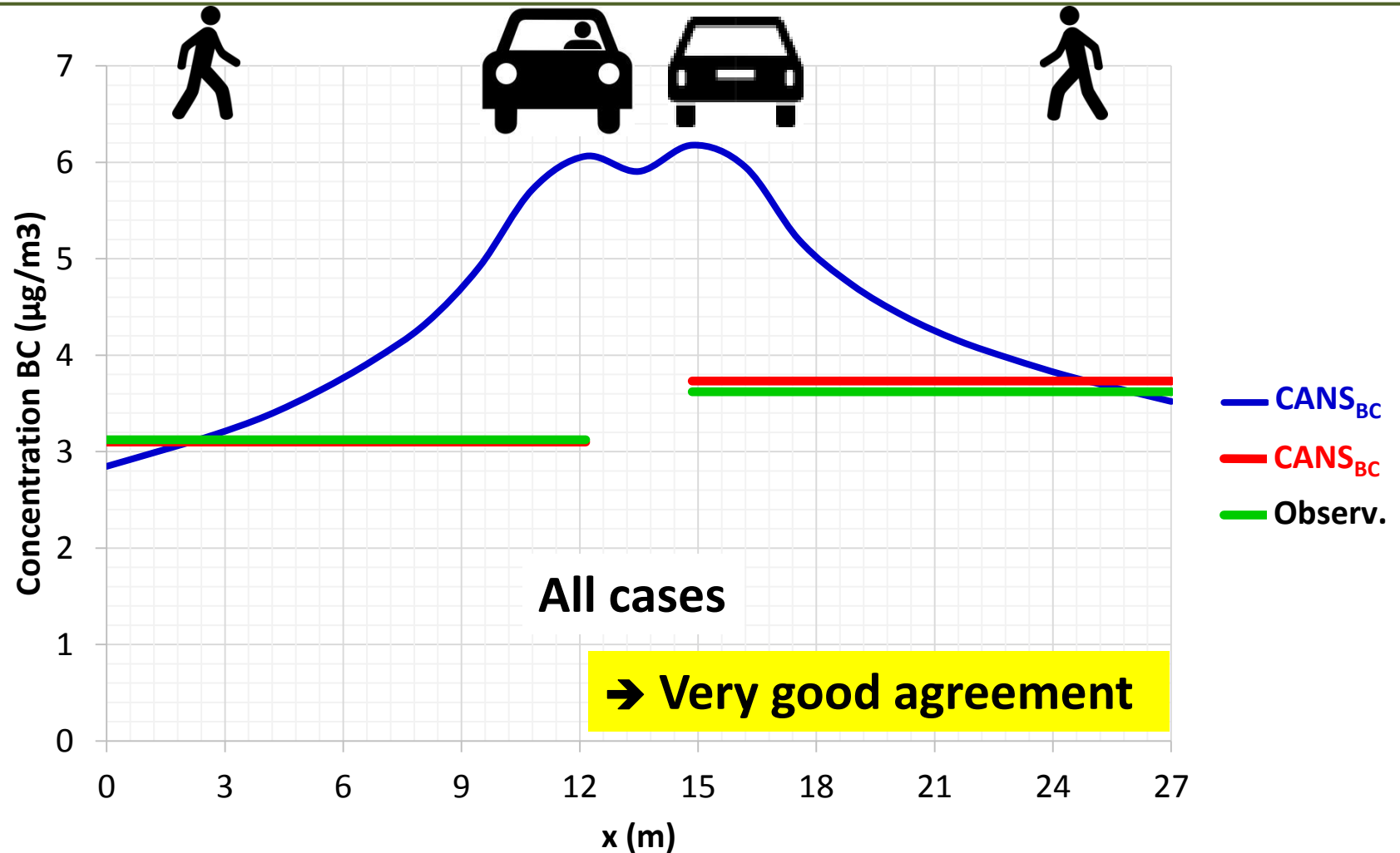


⬇
Consider
« averaged sidewalk »

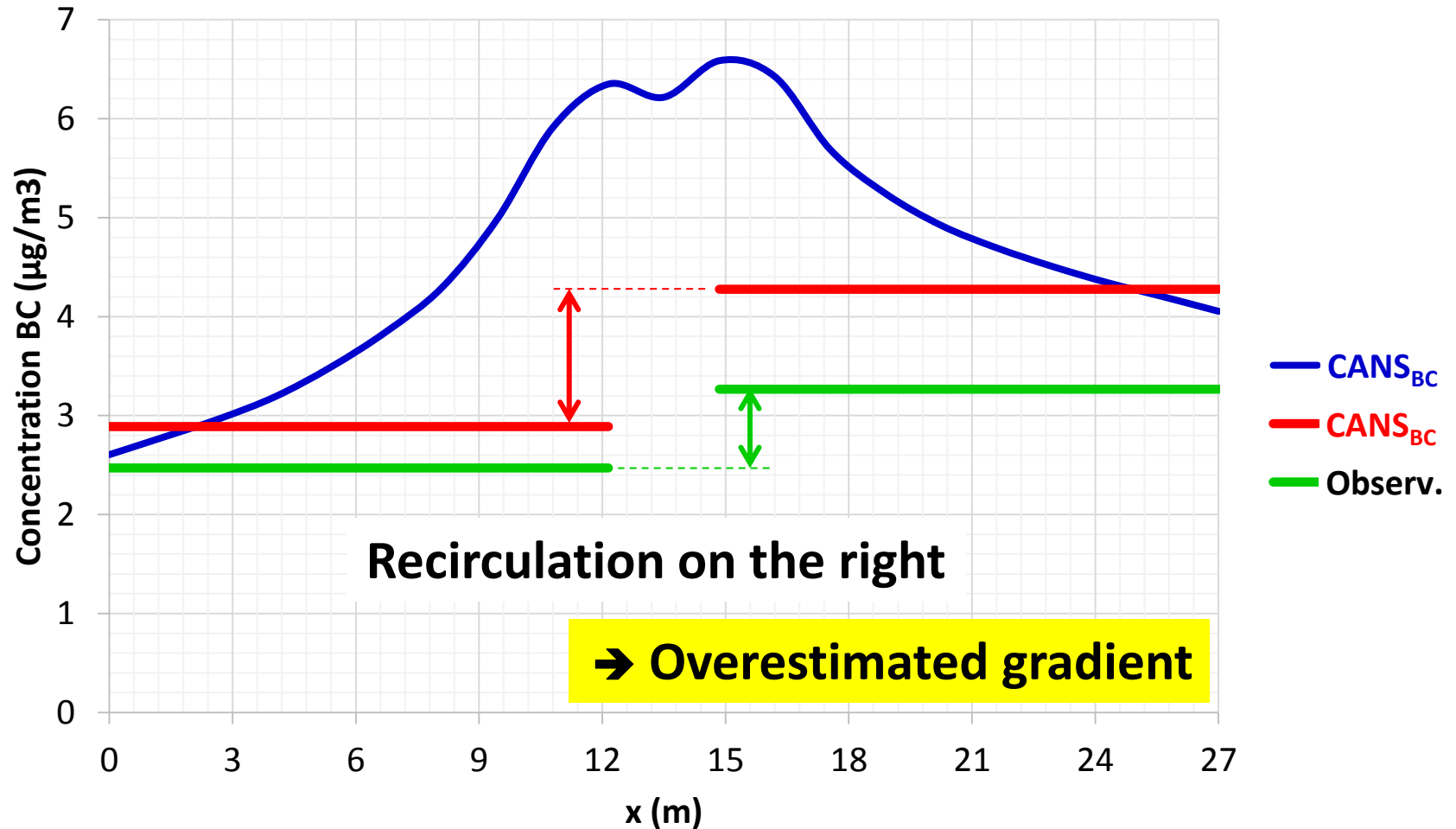
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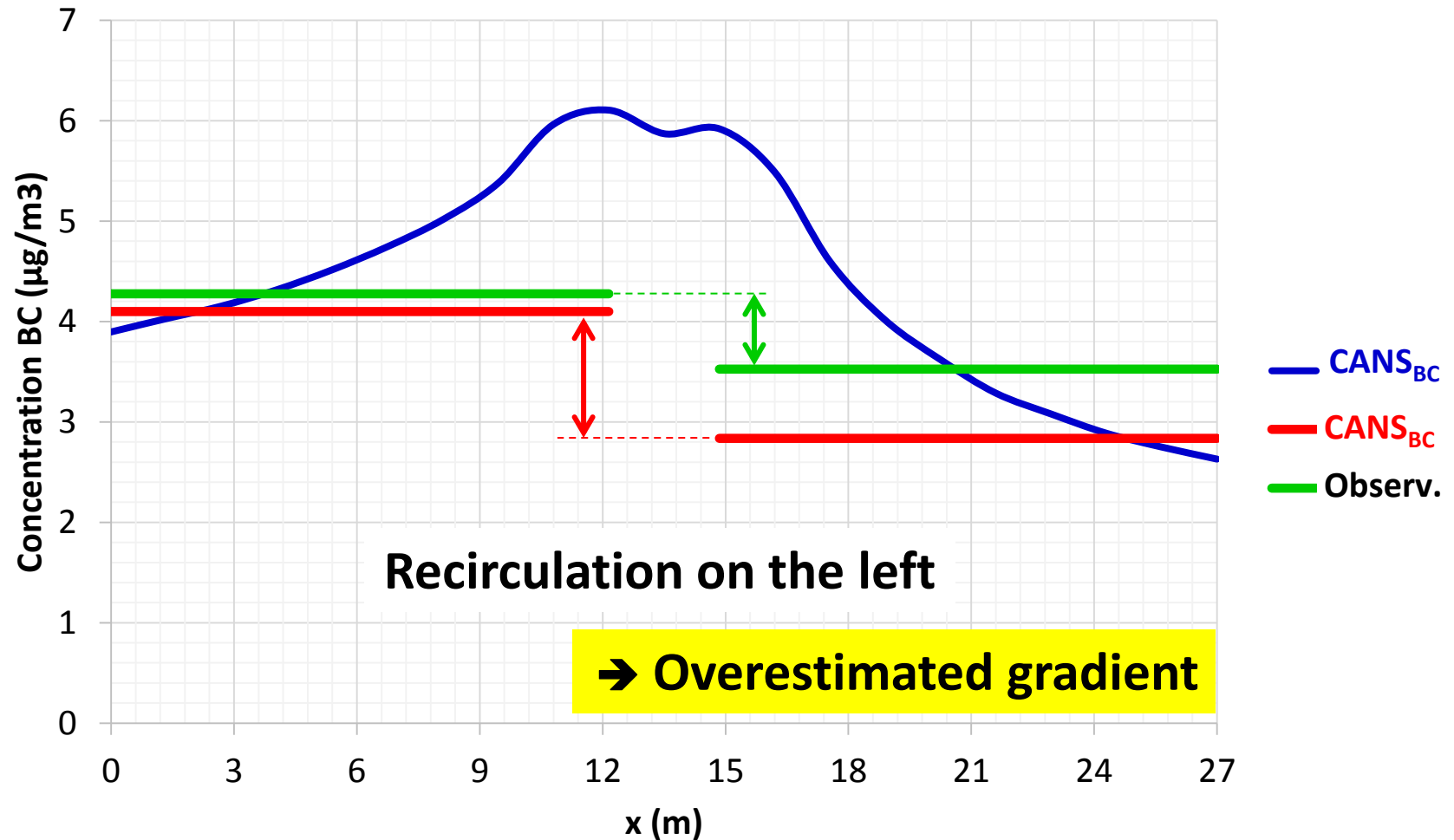
Sidewalk: left vs right



Sidewalk: left vs right



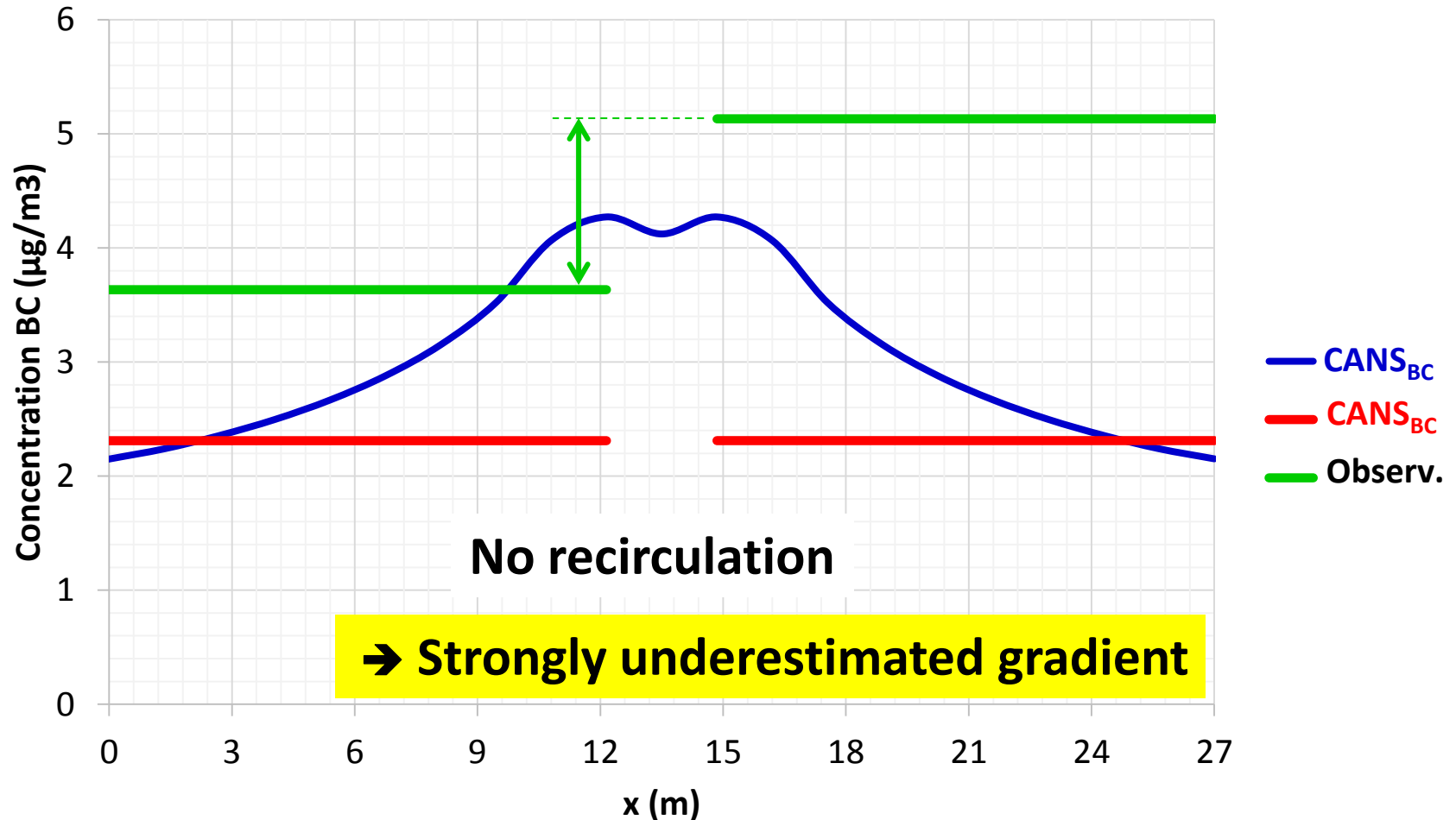
Sidewalk: left vs right



Recirculation on the left

→ Overestimated gradient

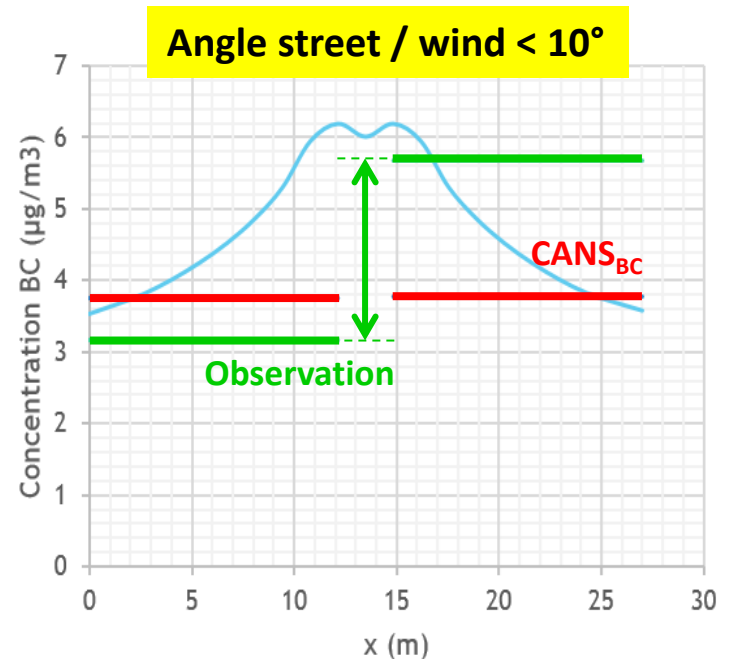
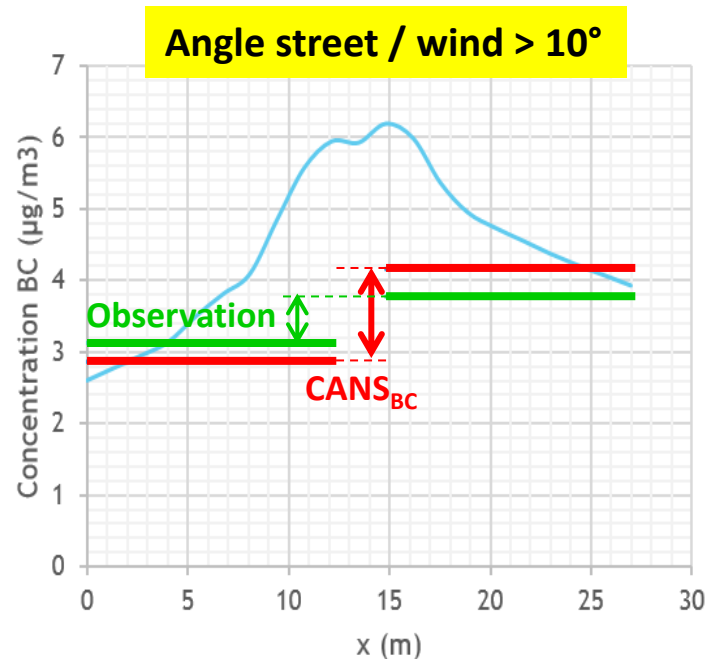
Sidewalk: left vs right



Sidewalk: left vs right

No recirculation if:

- Weak wind (< 2 m/s) : left/right gradient correctly simulated
- Wind direction close to street axis:



Conclusions



✓ Validation tests showed that CANS_{BC}:

- Performs well **at annual scale** in simulating average **monthly and diurnal BC evolutions**
 - ⇒ The model correctly handles:
 - the **meteorological conditions**
 - the variation in **traffic emissions**
- Is suitable to accurately simulate BC concentrations in canyon streets of the BCR if:
 - Accurate estimate of traffic emissions (counting, driving mode, emission factors, ...)
 - Vehicle speeds → turbulence generated by vehicles
- Able to simulate the **gradient of BC concentration between left and right sidewalks ...**
... but **improvements are needed** when the wind direction is close to the street axis.



Thank you for your attention

