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Does **biodiesel** use affect the **urban air quality**?

Porto urban area - case study

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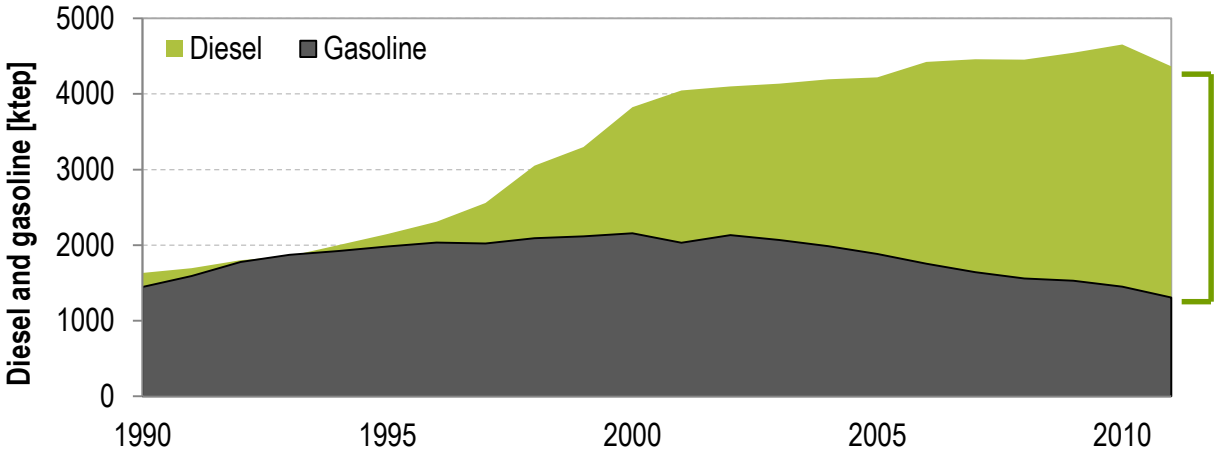
Why biodiesel?

Kyoto Protocol | ECCP | RoadMap2050	RED	CAFE
Climate Change	Energy	Air quality

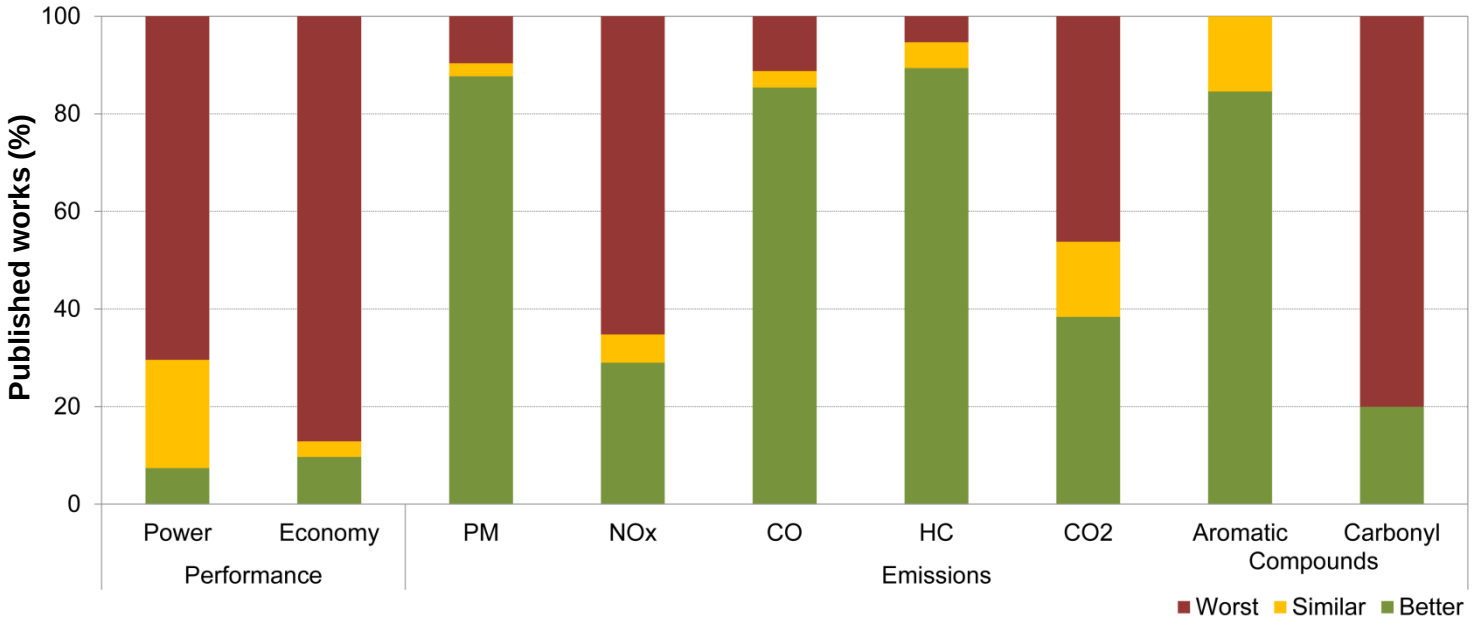
- **Reduction of GHG** emissions
- Reduction of the external energy dependence
- Reduction of **air pollution** levels: effects on **human health**



Biodiesel

Exhaust gases emissions

Due to **molecular structure** of biodiesel fuels, namely their **O_2 content** (10-12% higher than diesel), blend fuels with **small content of biodiesel (≤ 30%v/v)** in place of petroleum diesel can help in controlling air pollution, generating **lower exhaust gases emissions**, without significantly damaging engine power and economy.



B20 with higher combustion efficiency and lower emissions than diesel and other blends

Emission scenarios

REFerence scenario — **No biodiesel** is used as fuel by road transports

B20 scenario — Diesel engines fuelled with diesel blended with **20% of biodiesel** (B20).

Regulated pollutants

- CO
- NMVOC
- PM10
- PM2.5
- NO
- NO_2

Non-regulated pollutants

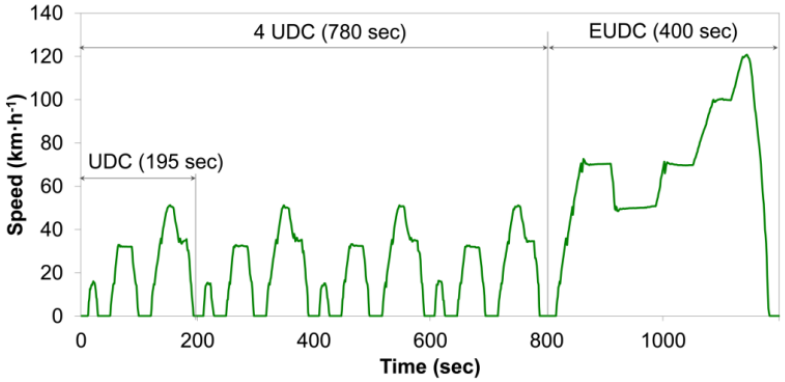
- Acrolein
- Formaldehyde
- Acetaldehyde
- Benzene

Emission scenarios

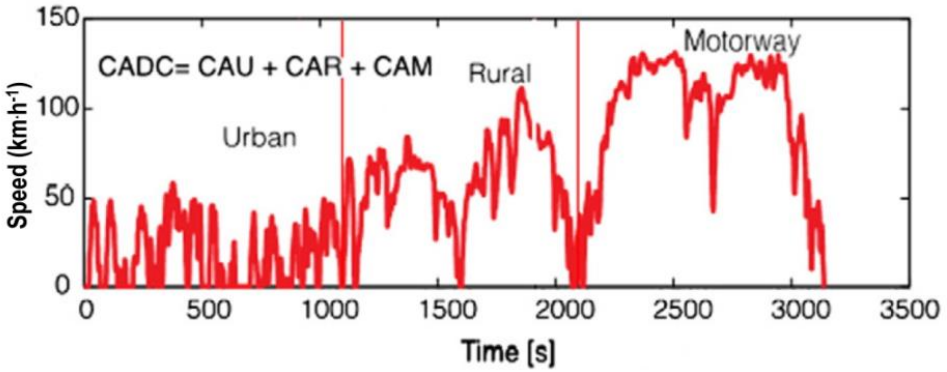
emission factors

REF EMEP/EEA air pollutant emission inventory guidebook 2009 and ARTEMIS methodology

B20 Bakeas et al., (2011)
Di et al., (2009)
Karavalakis et al. (2011)
Lopes et al. (2014)



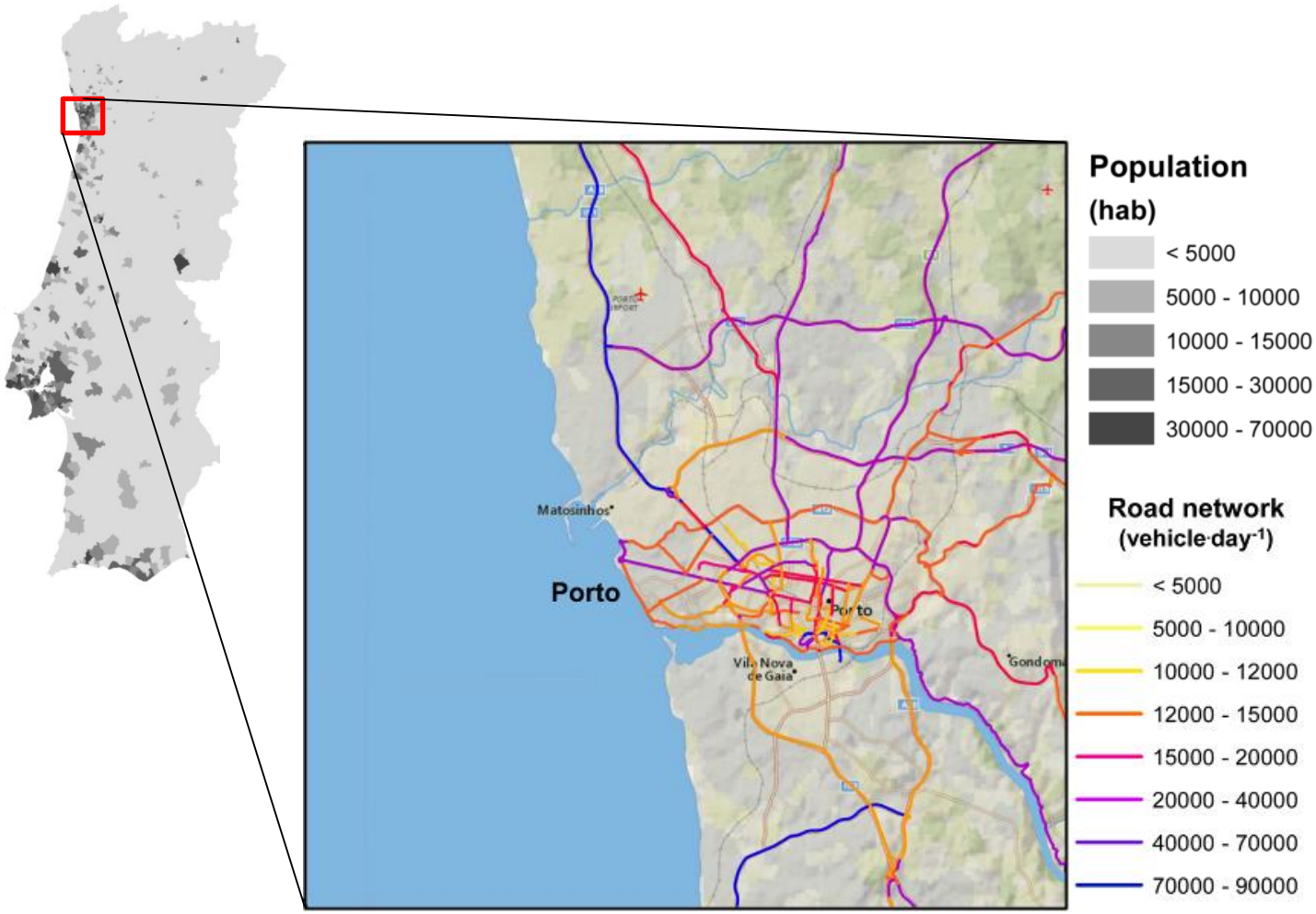
New European Driving Cycle



Common ARTEMIS Driving Cycle

EURO 4 and EURO 5

Porto urban area



Emission scenarios

TREM-HAP

TRansport Emission Model for line Sources – Hazardous Air Pollutant

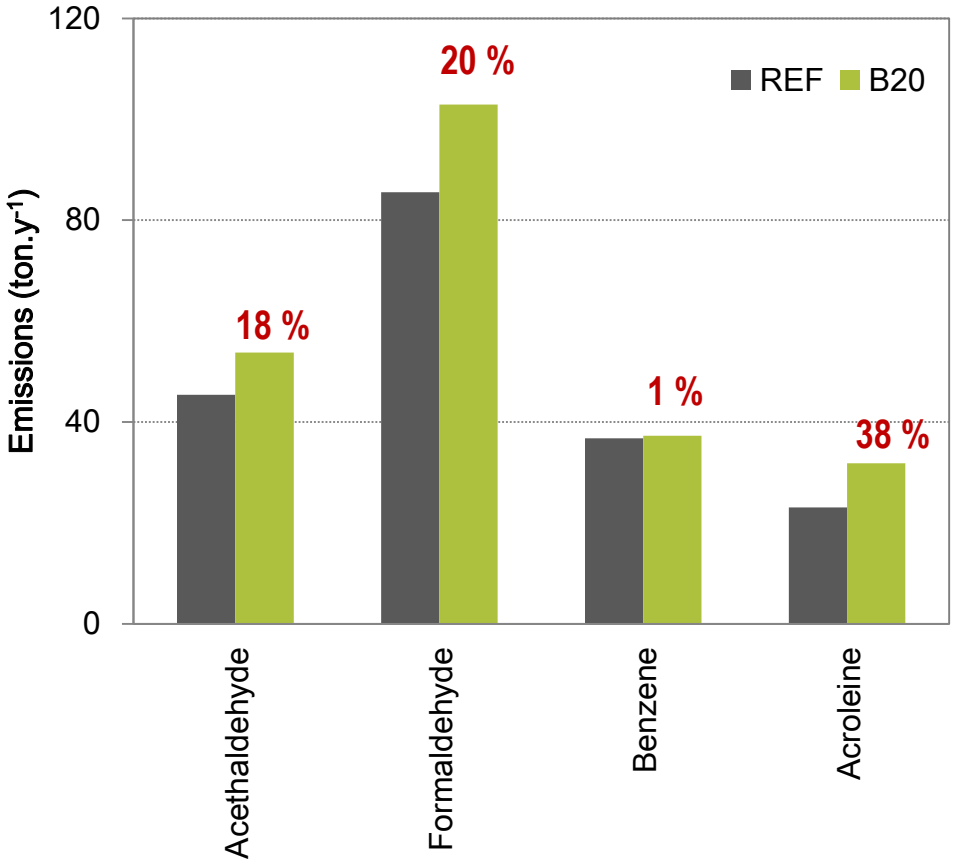
Input data
Total number of vehicles per road
Road type
Road length
Vehicle fleet distribution by categories
Vehicle fleet distribution by classes
Vehicle average speed
Ambient temperature
Fuel properties
Number of vehicles under cold engine

Total exhaust emission for each road

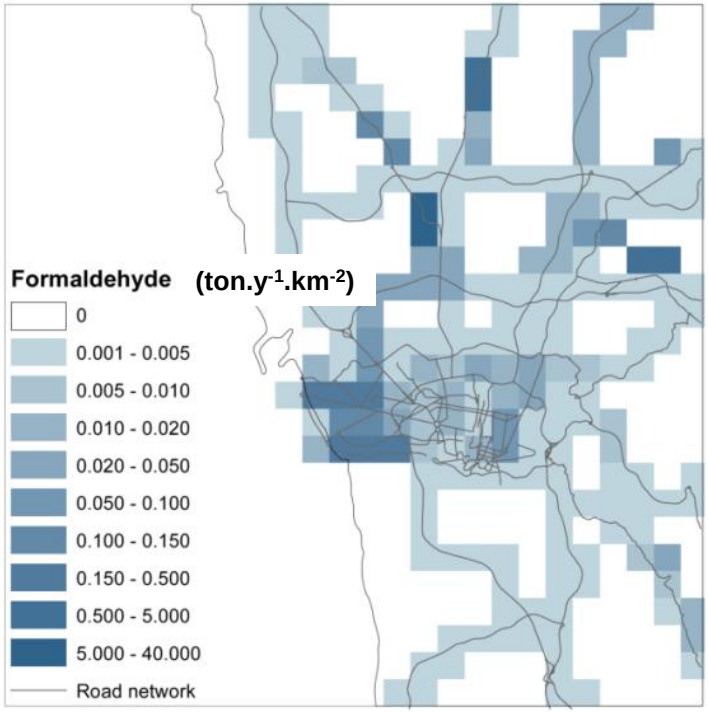
Emission scenarios

results

Non-regulated pollutans



Fomaldehyde emissions (REF)



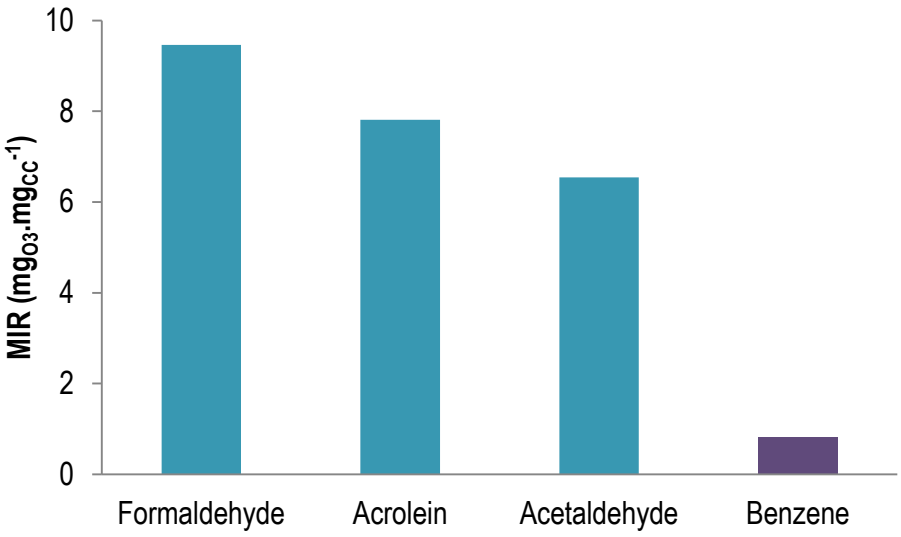
Increse of human exposure to **toxic** and **carcinogenic** pollutants

Emission scenarios

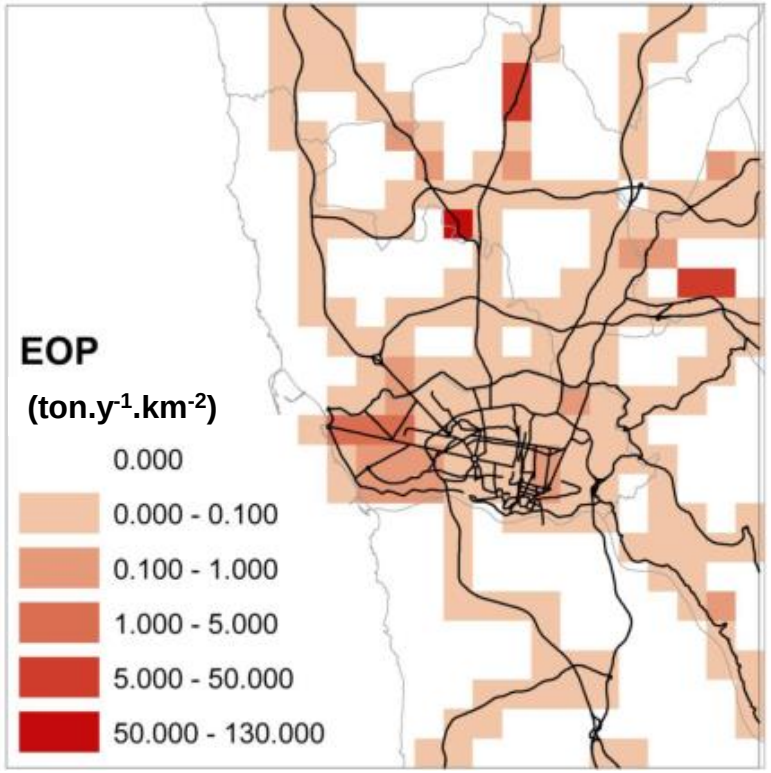
results: non-regulated pollutants

Aldehydes contribute to O_3 formation !!

Maximum incremental reactivity



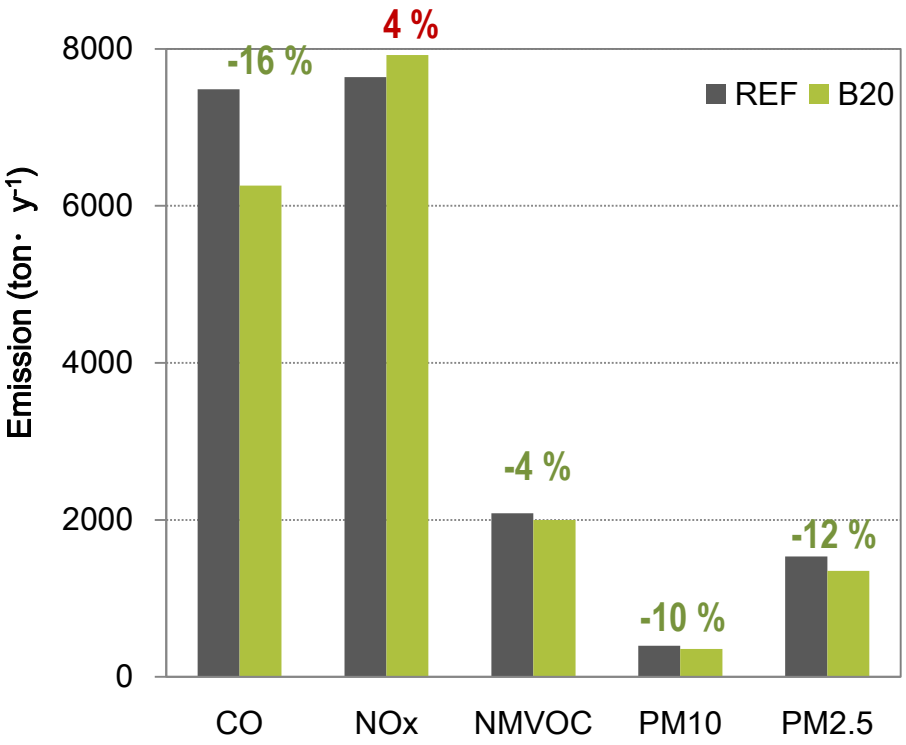
B20-REF Equivalent Ozone Production



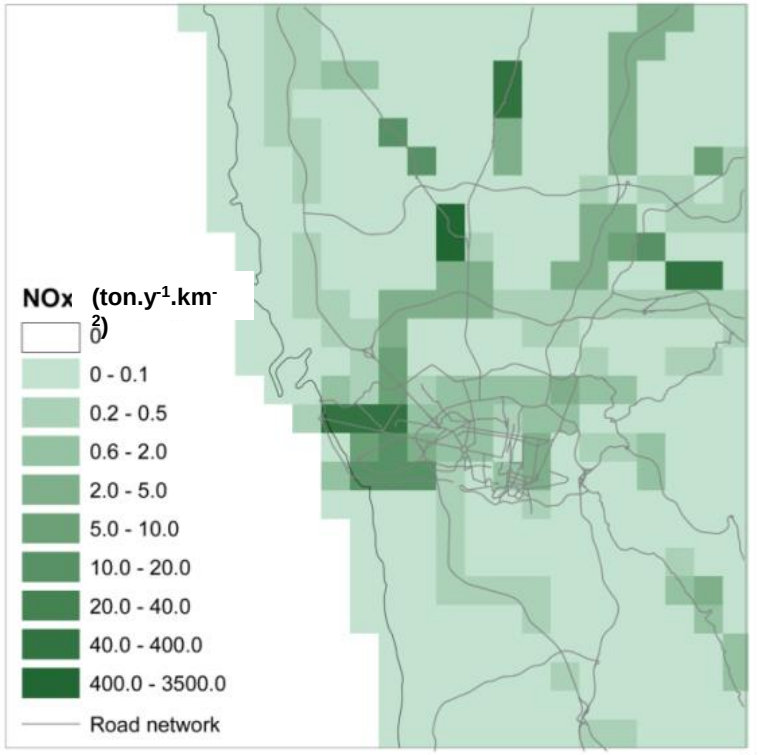
Emission scenarios

results

Regulated pollutans



NOx emissions (REF)

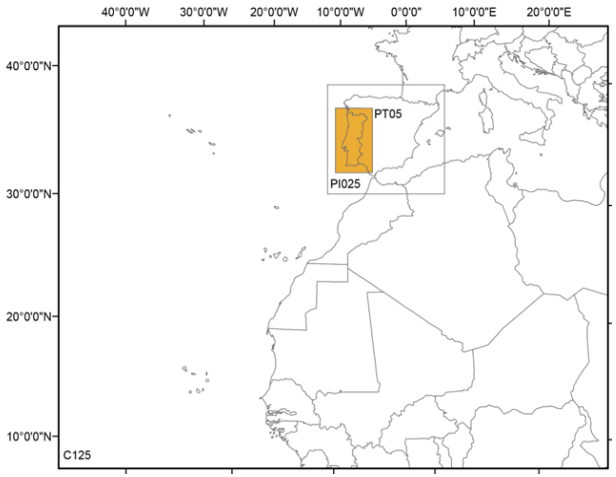


How far does this affect the urban air quality?

Air quality modelling system

WRF-EURAD

Meteorology: 2012



$5 \times 5 km^2$

$1 \times 1\ km^2$

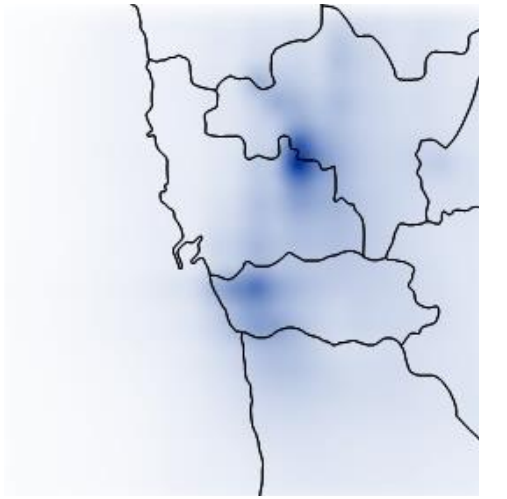
Impacts on air quality

B20 – REF

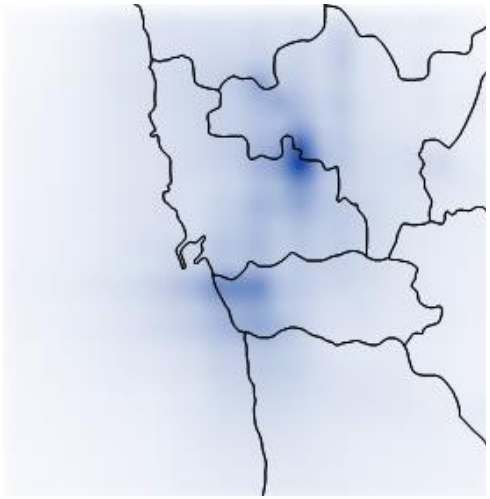
CO

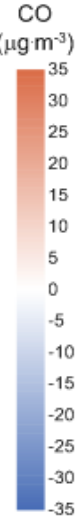
B20-REF

Summer mean

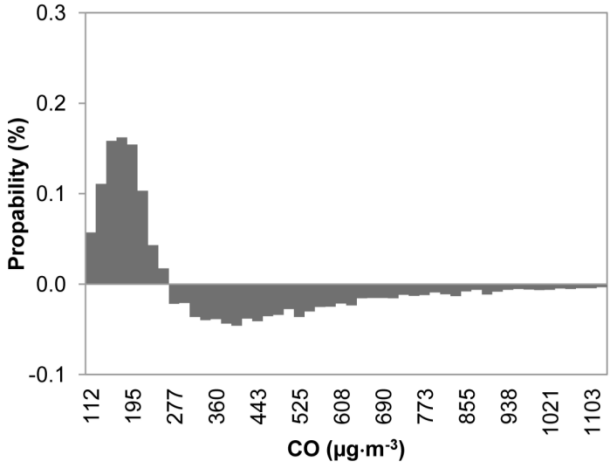


Winter mean





2012 hourly mean concentration



Impacts on air quality

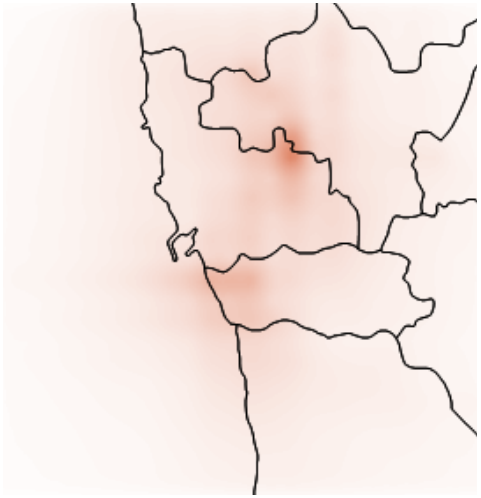
B20 – REF

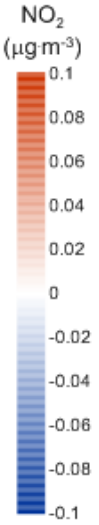
NO_2

B20-REF

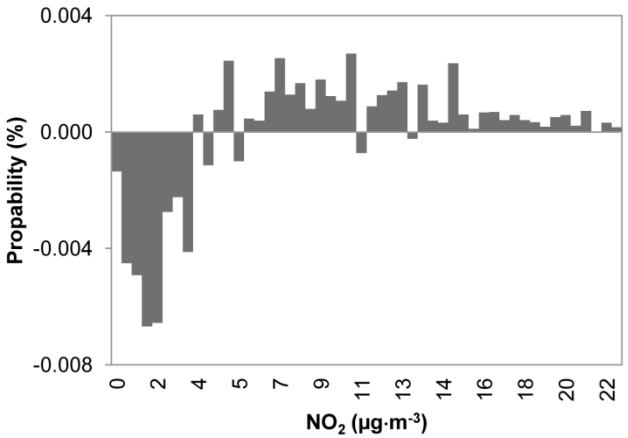
Summer mean

Winter mean





2012 hourly mean concentration



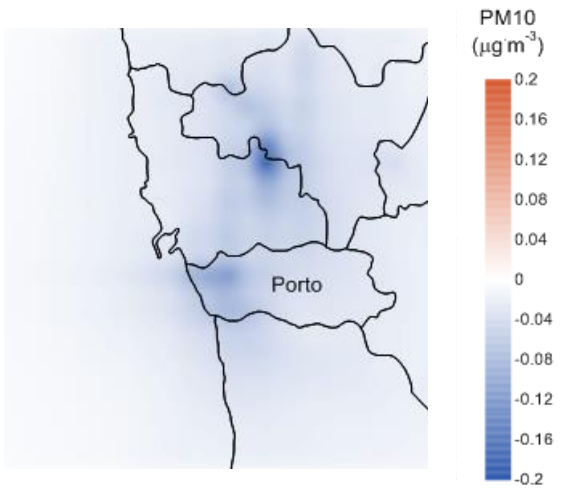
Impacts on air quality

B20 – REF

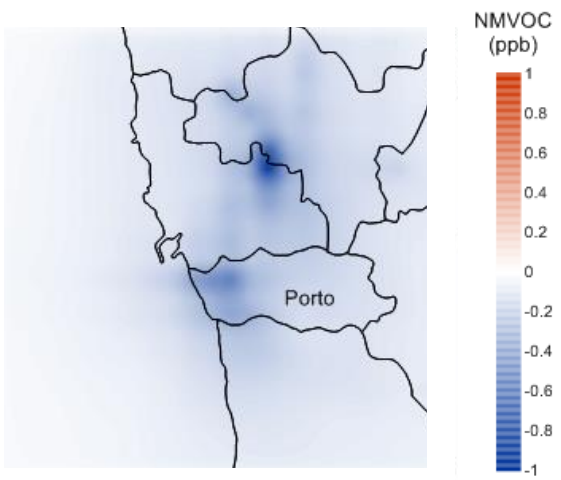
Annual mean

B20-REF

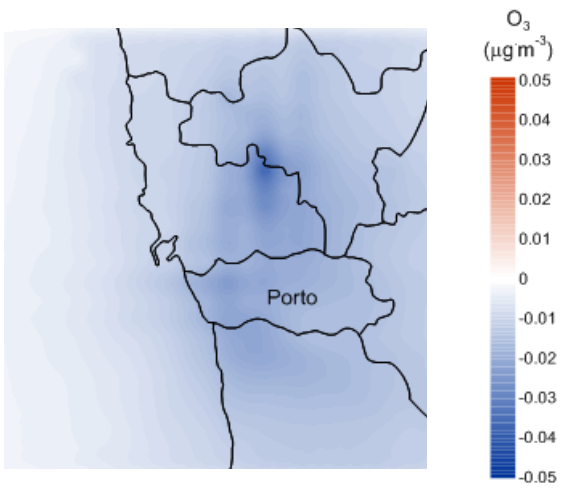
PM10



NMVOC



O_3



Final remarks

- The use of a B20 fuel allows a **reduction** on **PM10, PM2.5, total NMVOC** and **CO** emissions over the Porto urban area

- These variations in emission have a **positive effect**, although small, on **urban air quality**

- Significant increase on **acrolein, formaldehyde, acetaldehyde and benzene** emissions were estimated, potentiating tropospheric **O_3 formation**

- In spite of an estimated increase of **human exposure** to aldehyde, there are other and more hazardous compounds which emissions may decrease with B20 use

- **B20 is lesser injurious** for human health than diesel, helping on urban air quality improvement

The VOC effects on regional and urban air quality should be studies more deeply, in the future.

Thanks for your attention!

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