ROAD TRANSPORT EMISSIONS AND THE EFFECT OF DIESELIZATION OF PASSENGER CARS ON THE AIR QUALITY OF THE GREATER ATHENS AREA (GAA), GREECE

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Objectives

- Estimate road emissions in Greece and the Greater Athens Area (GAA)
- Examine the current state of air quality above the GAA based solely on road traffic emissions.
- Study the potential benefits of replacing gasoline Passenger Cars (PCs) with diesel PCs since the ban on movement for PCs with diesel engines was cancelled by greek authorities.

Methodology

- In the European Union the EMEP/CORINAIR methodology is applied for compiling emission inventories.
- *Code:* COPERT IV was applied to calculate the annual total emissions from the road transport sector.

  Country: Greece

  Period: 2006-2010

Vehicle class (passenger cars, light duty vehicles, heavy duty vehicles, urban buses and coaches and two wheelers)

Fuel type (gasoline, diesel, LPG, CNG)

Cylinder capacity (<1.4lt, 1.4-2.0lt, >2.0lt for passenger cars, <3.5t or >3.5t for commercial vehicles)

Engine Technology (PRE ECE, ECE 15/00-01, EURO 1, EURO 2, etc.)

Methodology

Input data

- Fleet composition data
- Speed for three main road types (urban, rural, highway)
- Mean annual mileage driven from each vehicle
- Share of annual driven condition from each vehicle class to these road types
- Minimum and maximum monthly mean temperature for Greece
- Annual fuel consumption for each fuel type

Output data

- Emissions in tonnes/year for pollutants:

  CO, VOCs, NOx, $PM_{2.5}$, PM_{10}, CO_2, NMVOCs, CH_4, NH_3 and heavy metals

- Period: 2006 to 2010

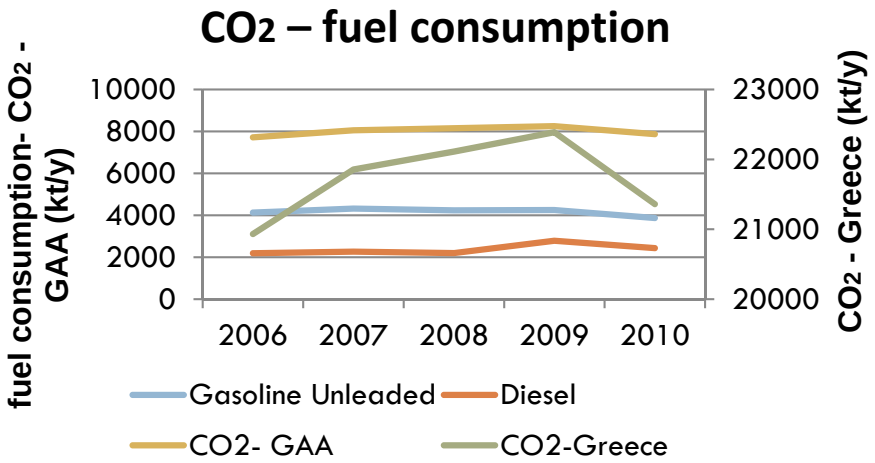
Methodology – fleet composition

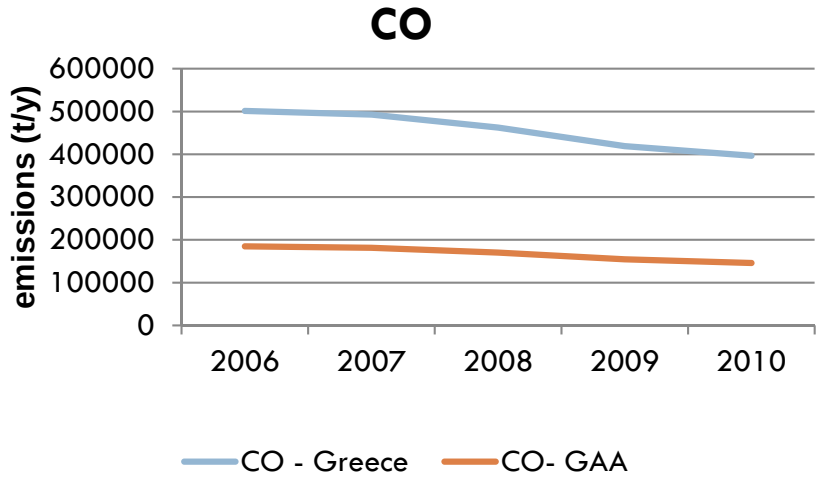
The yearly fleet composition at national level

population	2006	2007	2008	2009	2010
PCs total	4610282	4798530	5016210	5131960	5216873
Light Commercial Vehicles	991234	1016906	1040892	1046397	1056963
Heavy Duty Trucks	228555	238939	248466	255866	261170
Buses	26938	27102	27186	27324	27311
Two wheelers	1179719	1295217	2768607	1448851	1499133

- PCs' fleet increases continuously but this increase was smaller the last two years due to the econimical crisis.
- New registrations were fewer with a tend to smaller engine cylinder capacity (< 1.4 lt).
- Many old cars were dropped.

Results – Annual total emissions

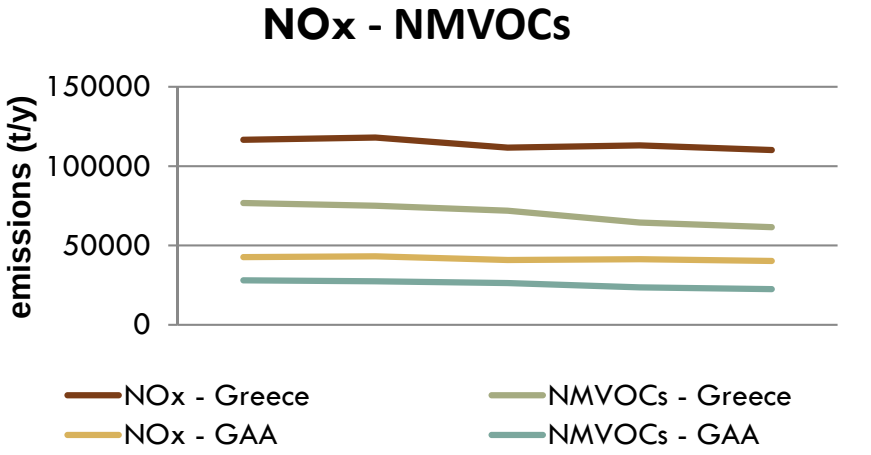


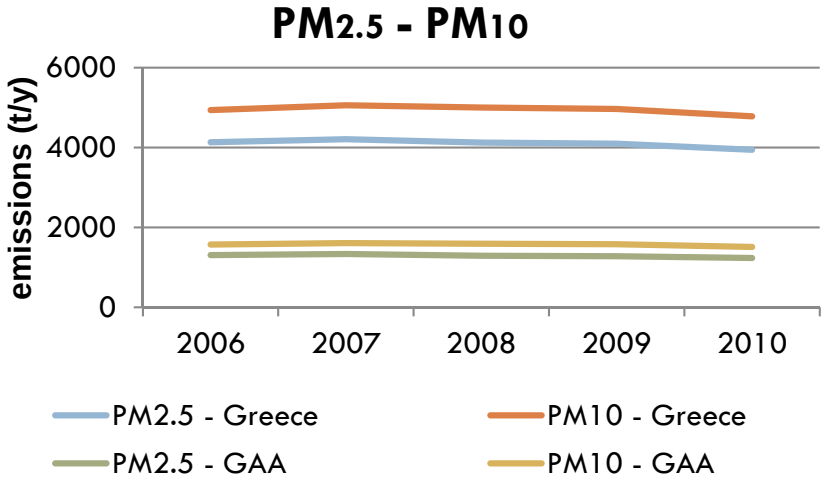


•The CO_2 emissions were related to the annual fuel consumption presenting an increase for the first 3 years while in 2010 a decrease of 4.6% was observed for CO_2 coupled with a 8.9% reduction in gasoline consumption and 12.5% in diesel consumption.

• The continuous decrease in CO emissions reflects the import of new engine anti-pollution technologies. Especially from 2008 to 2009 when EURO 5 and 6 passenger cars entered the Greek market the decrease was 9.4%.

Results – Annual total emissions





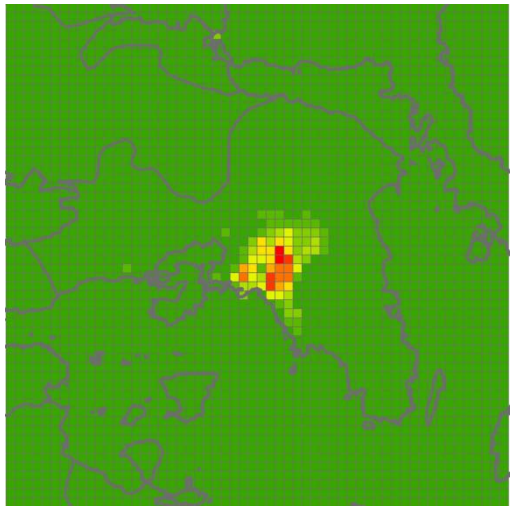
- The continuous decrease in NMVOCs emissions reflects the import of new engine anti-pollution technologies. Especially from 2008 to 2009 when EURO 5 and 6 passenger cars entered the Greek market the decrease was 10.3% for NMVOCs.
- NOx emissions remained rather stable.

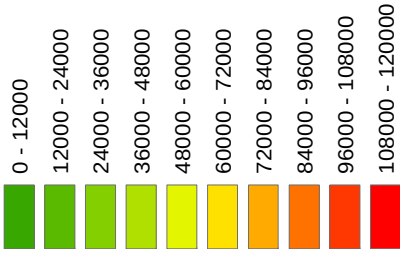
- $PM_{2.5}$ and PM_{10} remained rather stable with a slight decrease in 2010 (3.7% for both pollutants).

Almost 1/3 of national total values is emitted at the GAA

Results- spatial allocation of annual emissions to gridded form

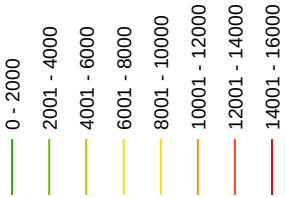
Urban emissions





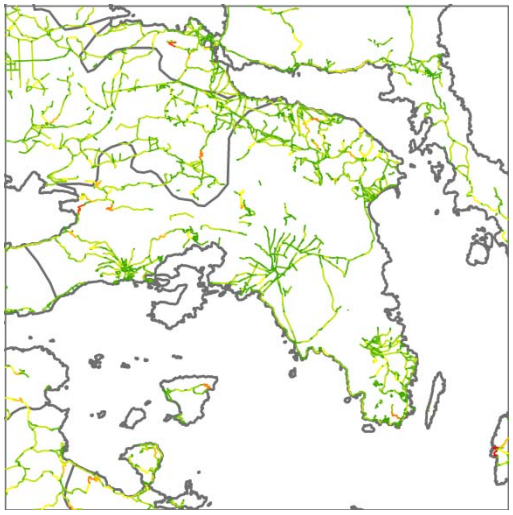
Proxy value: population data

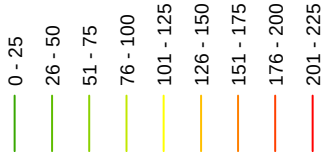
Highways emissions



Proxy value: road traffic flow data

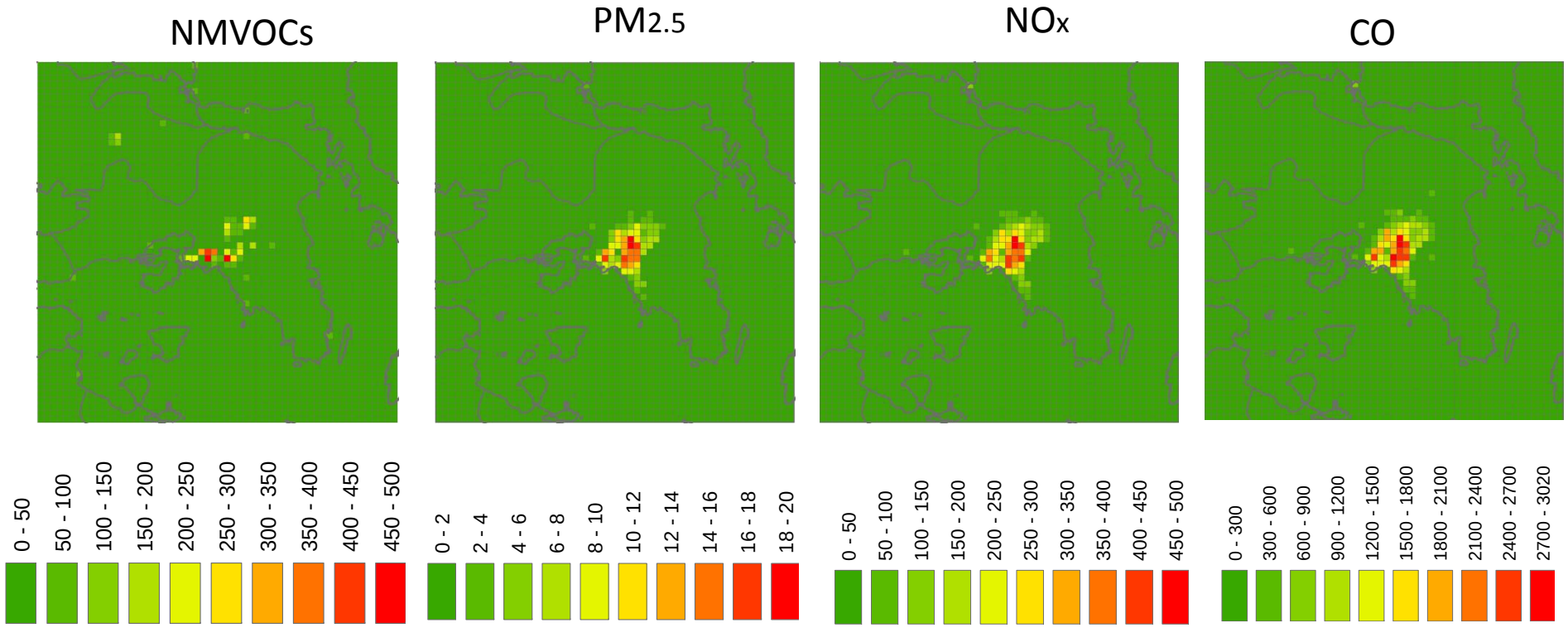
Rural emissions





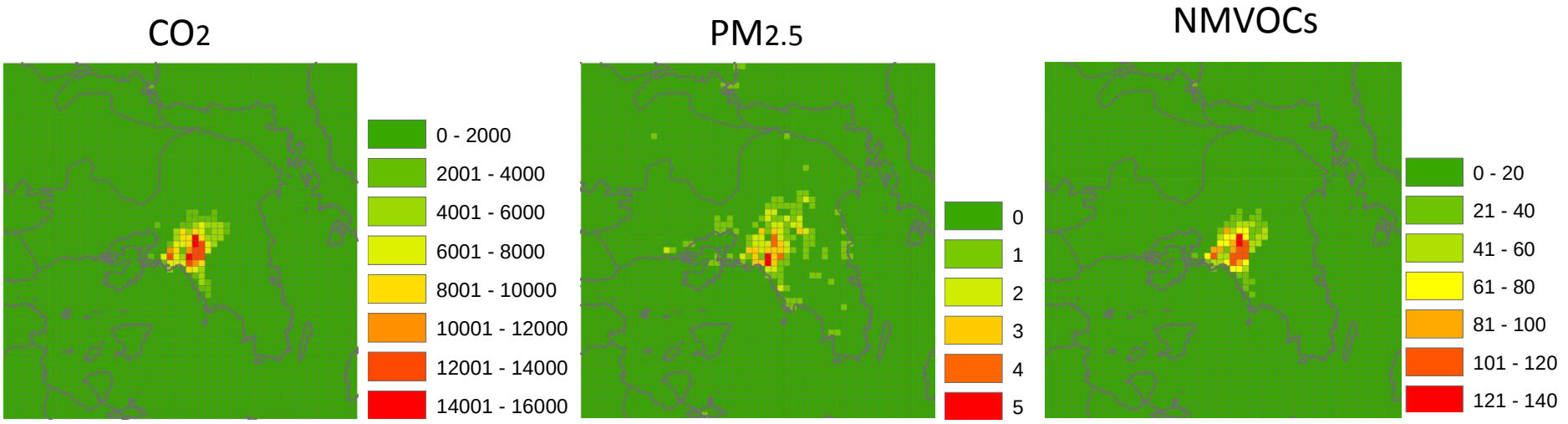
Proxy value: road length

Results- Urban emissions



Emissions of pollutants NMVOCs, $PM_{2.5}$, NOx and CO are located at the urban area of the GAA. This is because these cells represent high population densities.

Results- Differences in gridded emissions (2006-2010)



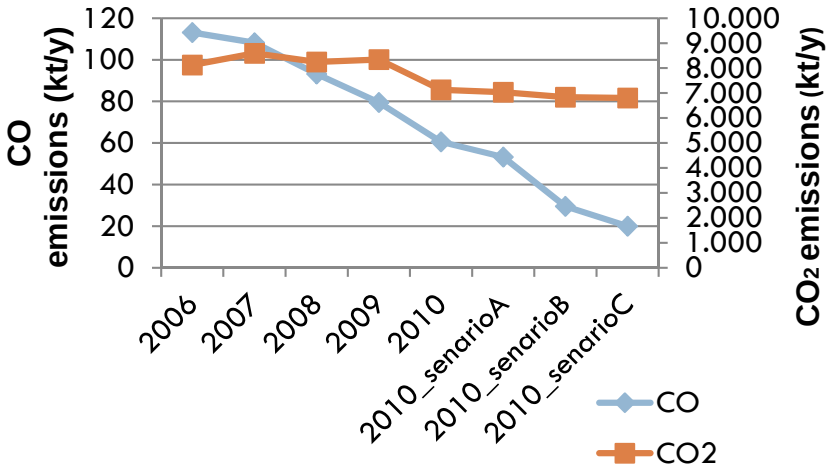
- Emissions decreased above the GAA.
- The maximum reduction was 10% for CO_2 emissions and 20% for $PM_{2.5}$ and NMVOCs emissions respectively.

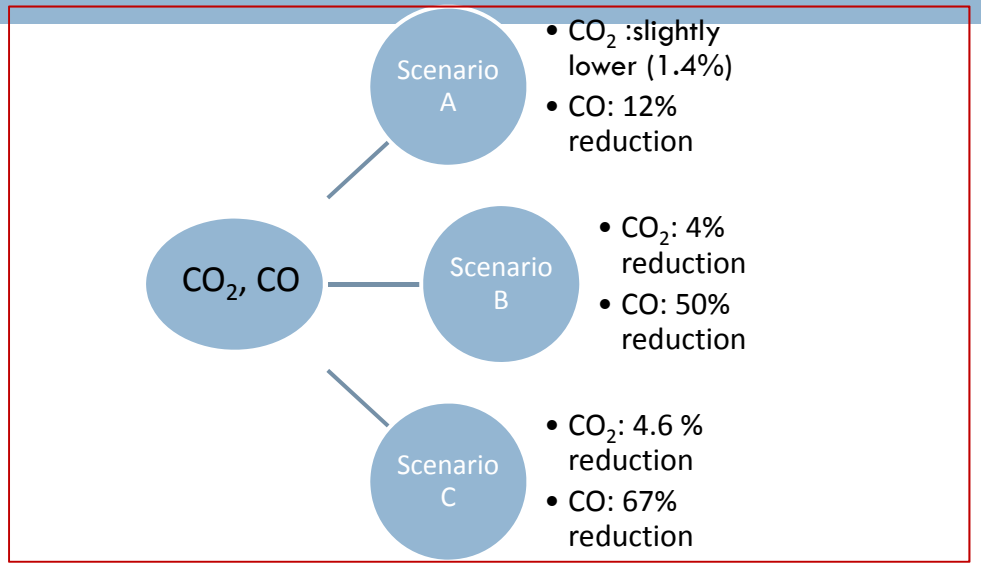
Dieselization - Methodology

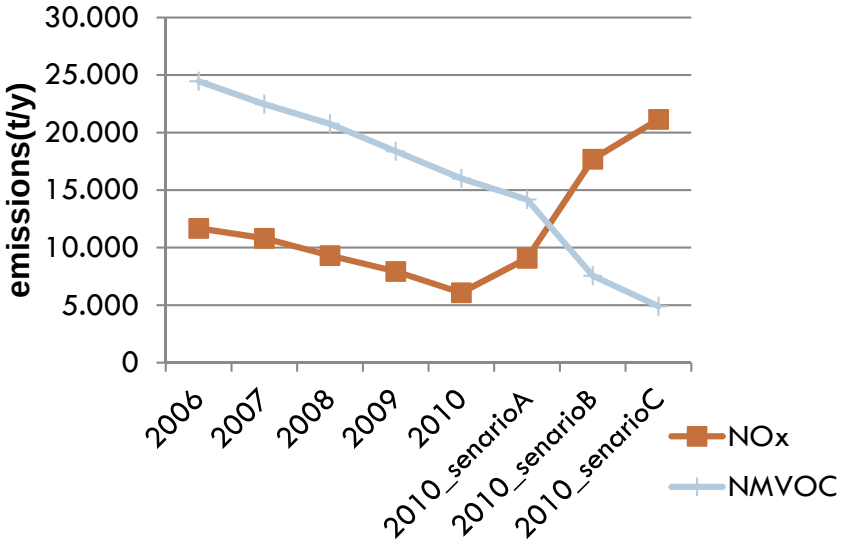
- ***Base year :*** 2006
- ***Scenario A***: 70% of new passenger cars registrations were considered to be diesel vehicles.
- ***Scenario B***: scenario A and 50% of gasoline passenger cars were replaced by diesel vehicles with cylinder capacity < 1.4 lt.
- ***Scenario C***: scenario A and 70% gasoline passenger cars were replaced by diesel vehicles with cylinder capacity < 1.4 lt.

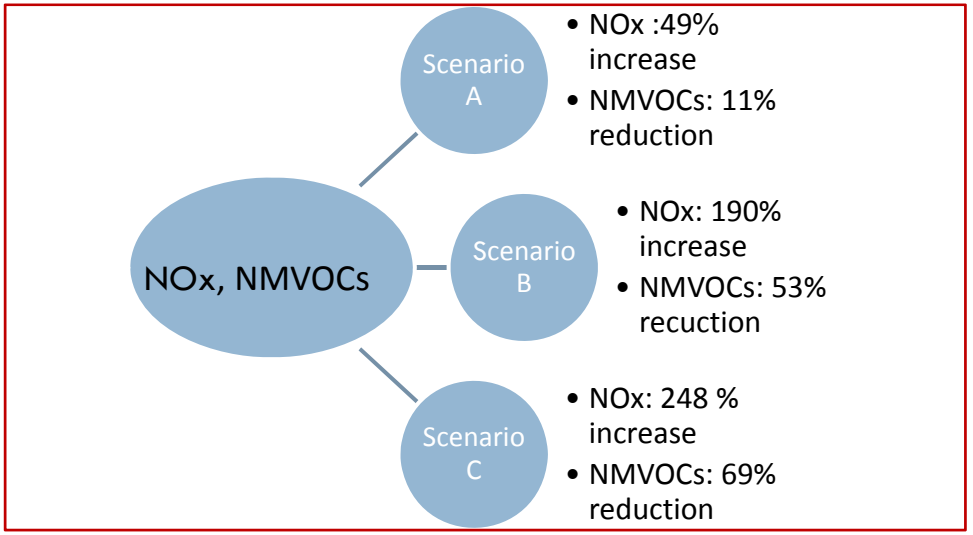
	2006	2007	2008	2009	2010	Scenario A	Scenario B	Scenario C
total PCs	4610282	4798530	5016210	5131960	5216873	5216873	5216873	5216873
gasoline PCs	4550856	4735631	4945897	5059189	5140712	4376596	2188300	1312980
diesel PCs	58354	60651	65659	66359	68618	832734	3021030	3896350

Dieselization – National PCs Emissions

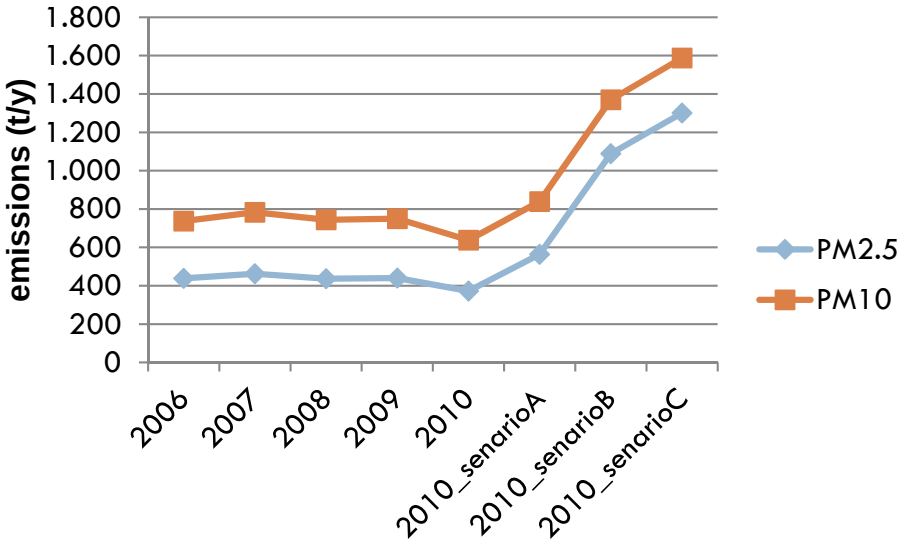


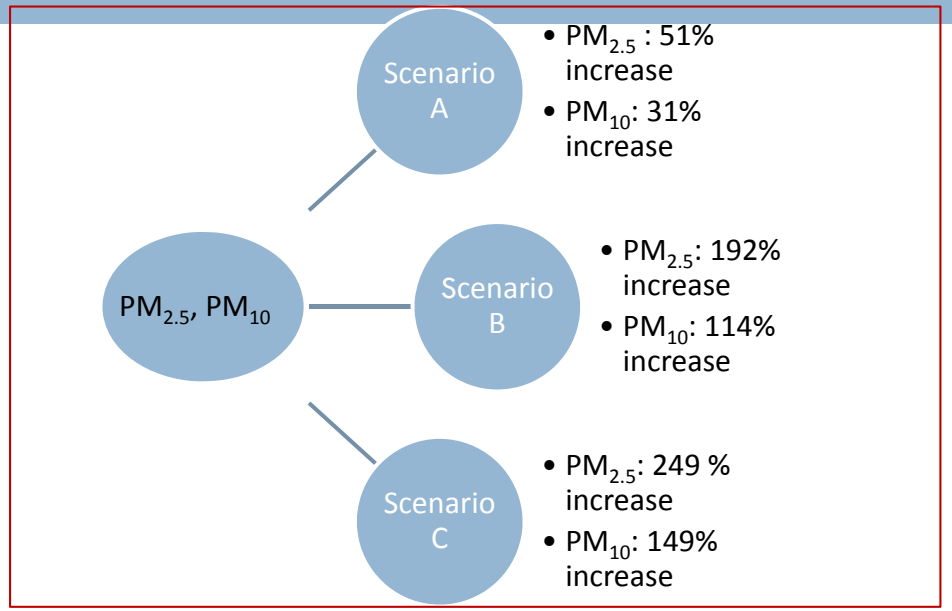






Dieselization – National PCs Emissions

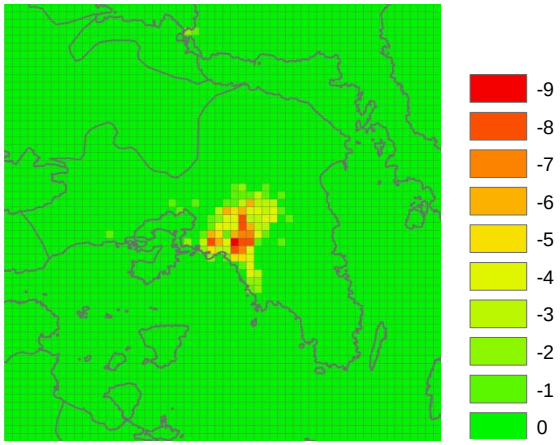




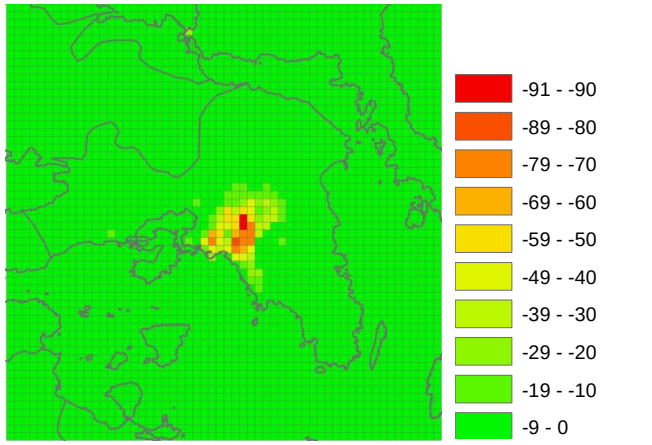
Generally, the replacemant of gasoline PCs with ones using diesel fuel had both negative (PM, NOx) and positve effects (NMVOCs, CO_2, CO) on pollutants emissions.

Results – Difference in emissions (2010 – 2010_scenarioC)

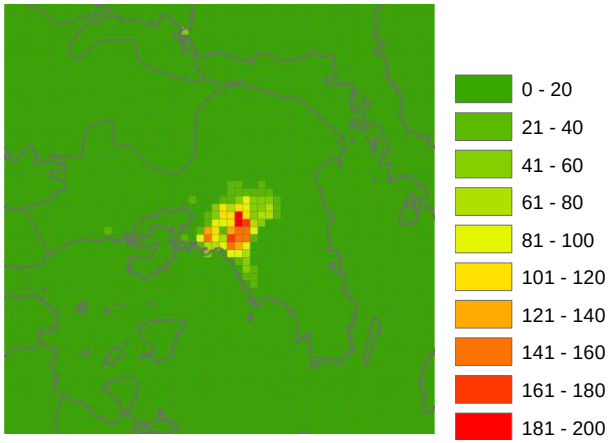
$PM_{2.5}$



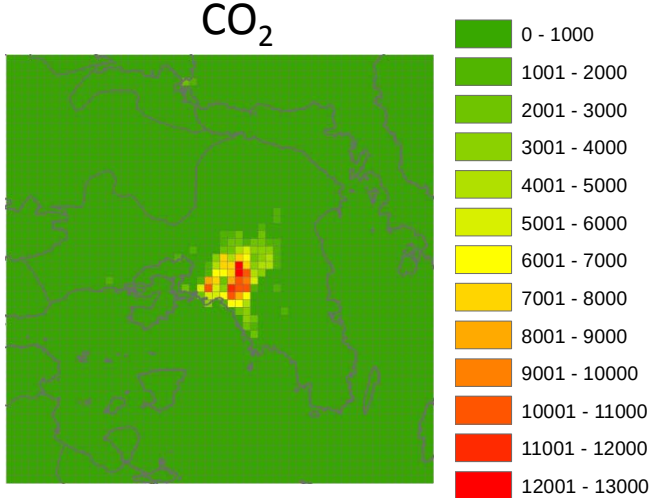
NOx



NMVOC



CO_2



- The negative effects of dieselisation in $PM_{2.5}$ and NOx emissions are obvious at the top two figures since the emissions incresed above tha GAA.
- Dieselisation affected positively NMVOCs and CO_2 emissions causing an important reduction.

Conclusions - 1

- CO_2 emissions are related to fuel consumption and in fact decreased in 2010.
- **PM and NOx emissions remained rather stable.**
- A decrease in CO and NMVOCs emissions took place after 2009 due to the import of new engine anti-pollution technologies.
- **When diesel penetration among passenger cars fleet reached 70% the benefit in CO_2 emissions was 4.6% in 2010 for Greece and 9% for the Greater Athens Area.**
- On the other hand dieselization had negative effects on NOx and particles emissions which increased quite considerably (248% increase both in NOx and $PM_{2.5}$ emissions respectively from 2010 till 2010_scenarioC for the GAA).

Conclusions - 2

- **Concluding, dieselization has different impacts on pollutants emissions which should not be neglected in order to make proper policy decisions.**

- Further work to complete the new emission inventory at national level and for the G.A.A. will shed light on the contribution of all sources to the pollutant levels.

- **Moreover, modeling of the pollutants' dispersion and chemical transformations will be possible, leading to the assessment of different mitigation strategies on the local and regional air quality.**

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THANK YOU !!!