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# Science to the service of policy: APICE action plan in Barcelona

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and Noemí Pérez

Venice, 8th November 2012  
APICE Final Conference



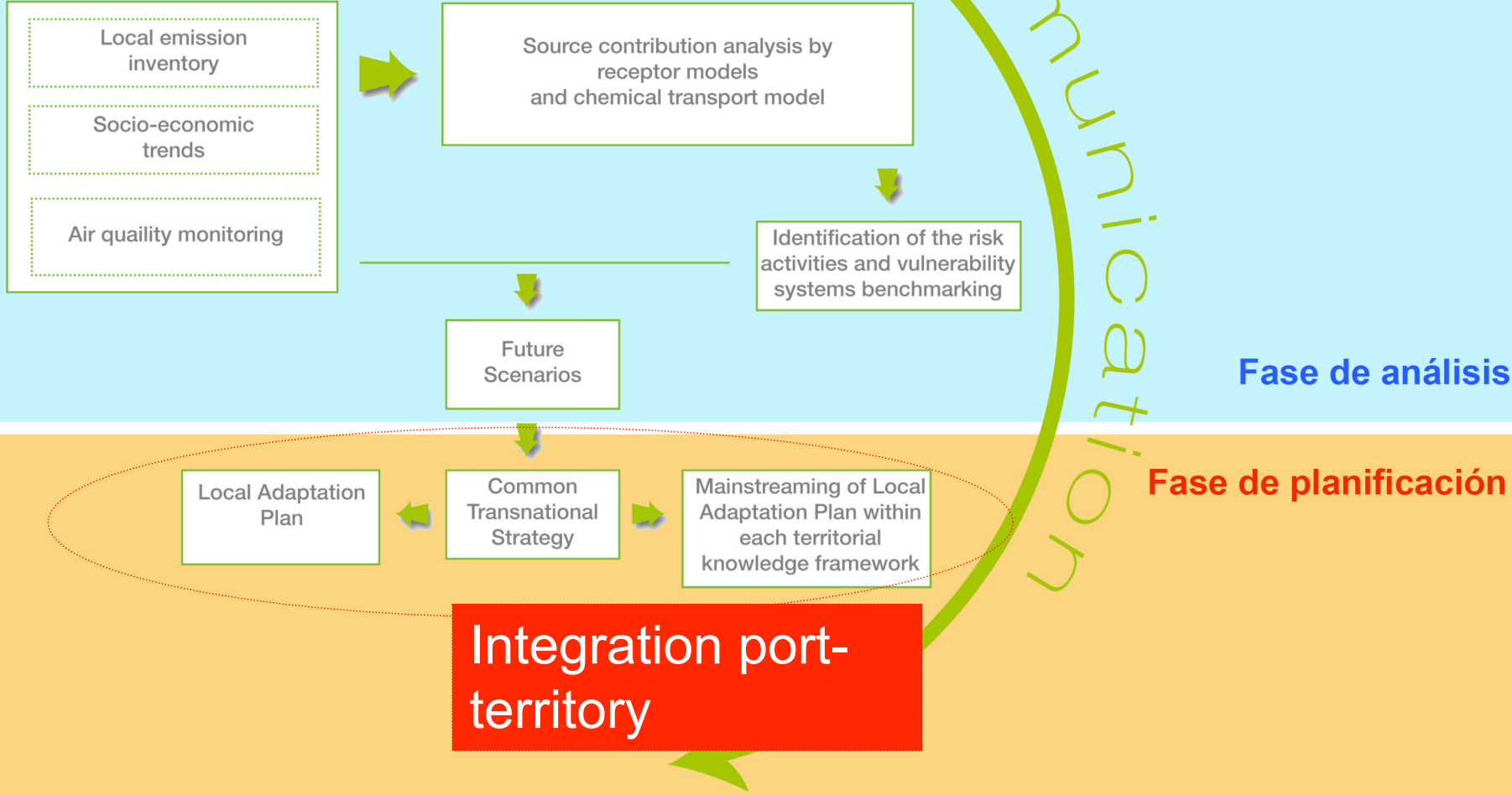
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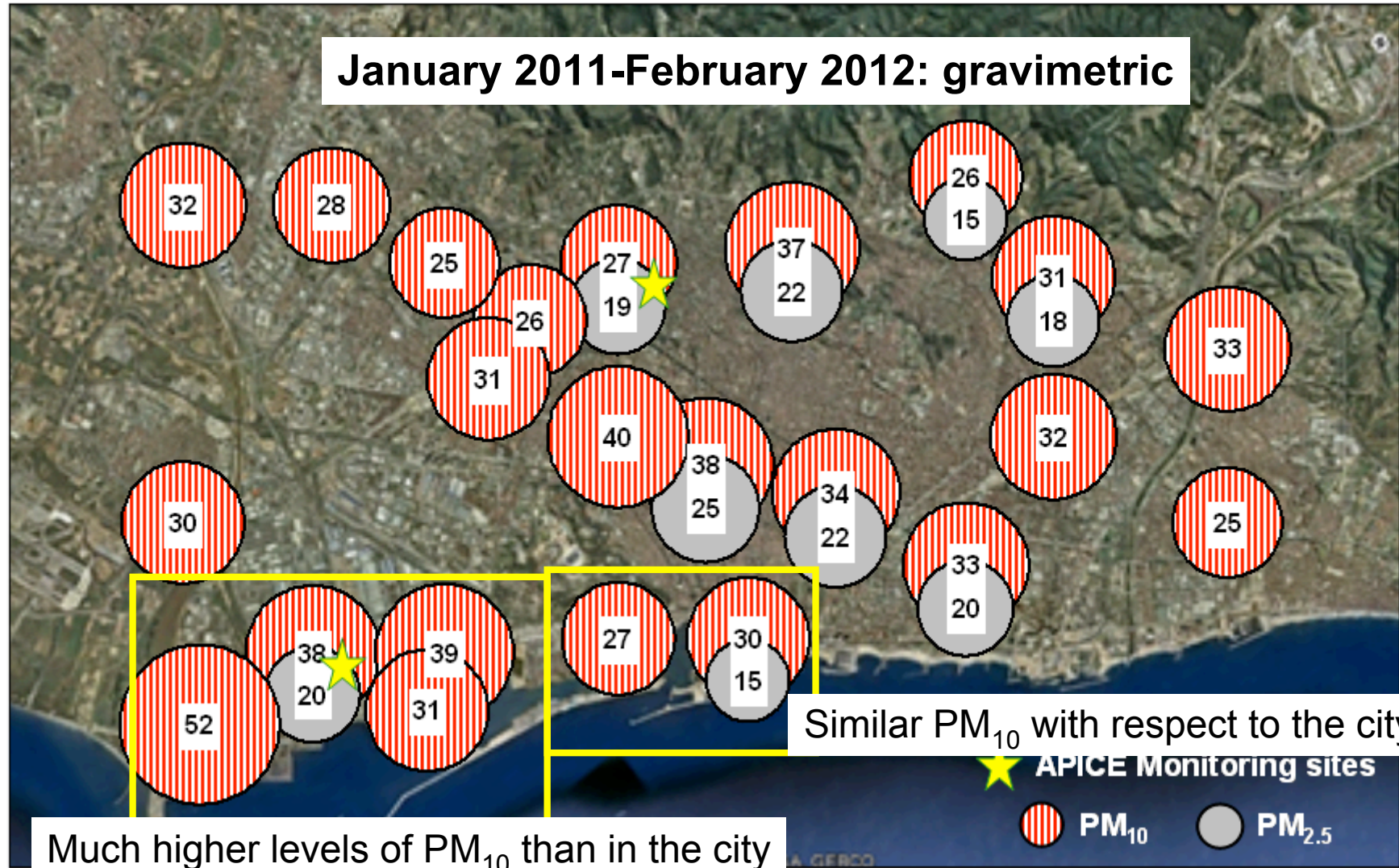


# APICE methodology

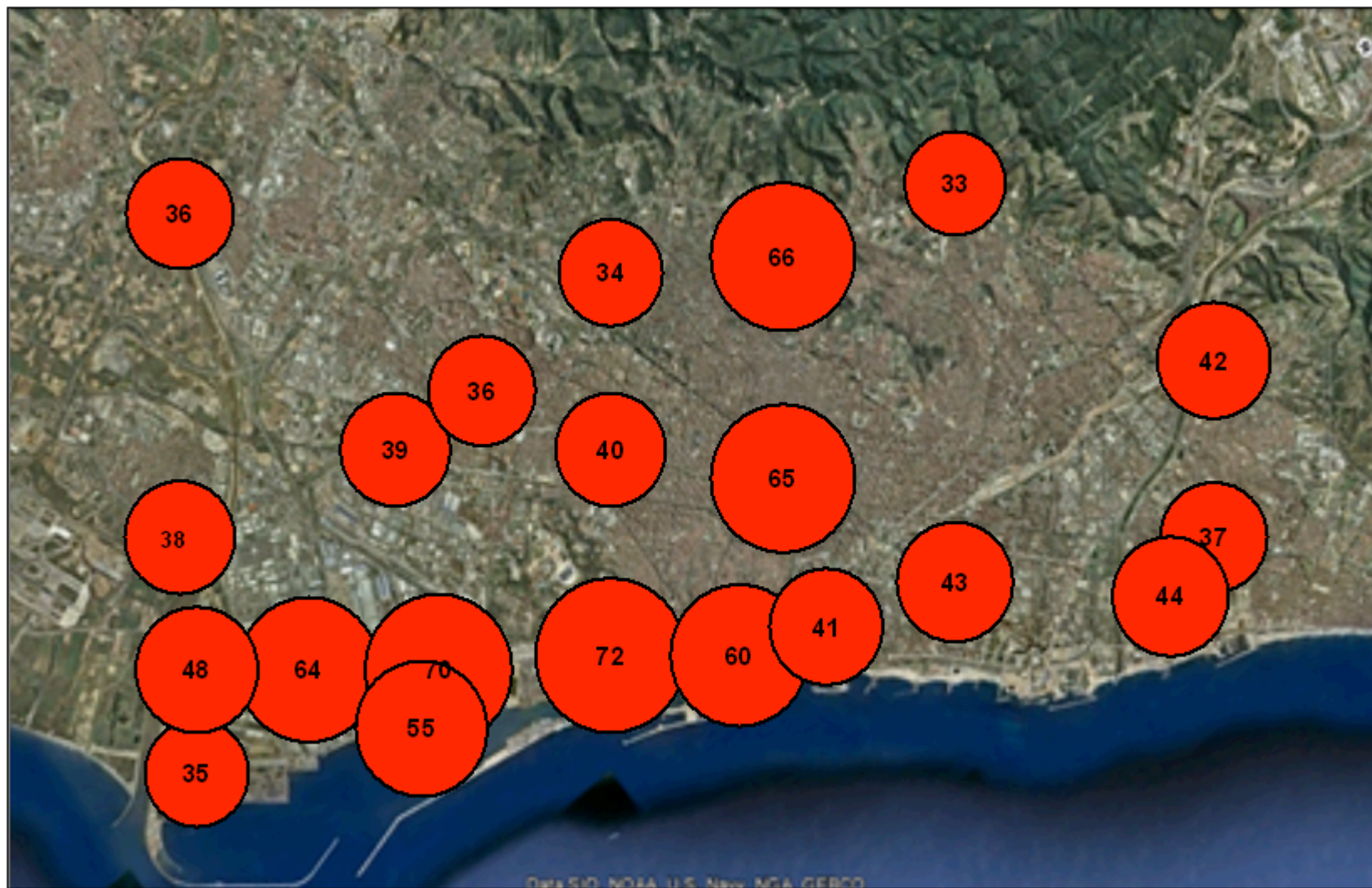


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# WP 4. Barcelona metropolis: PM



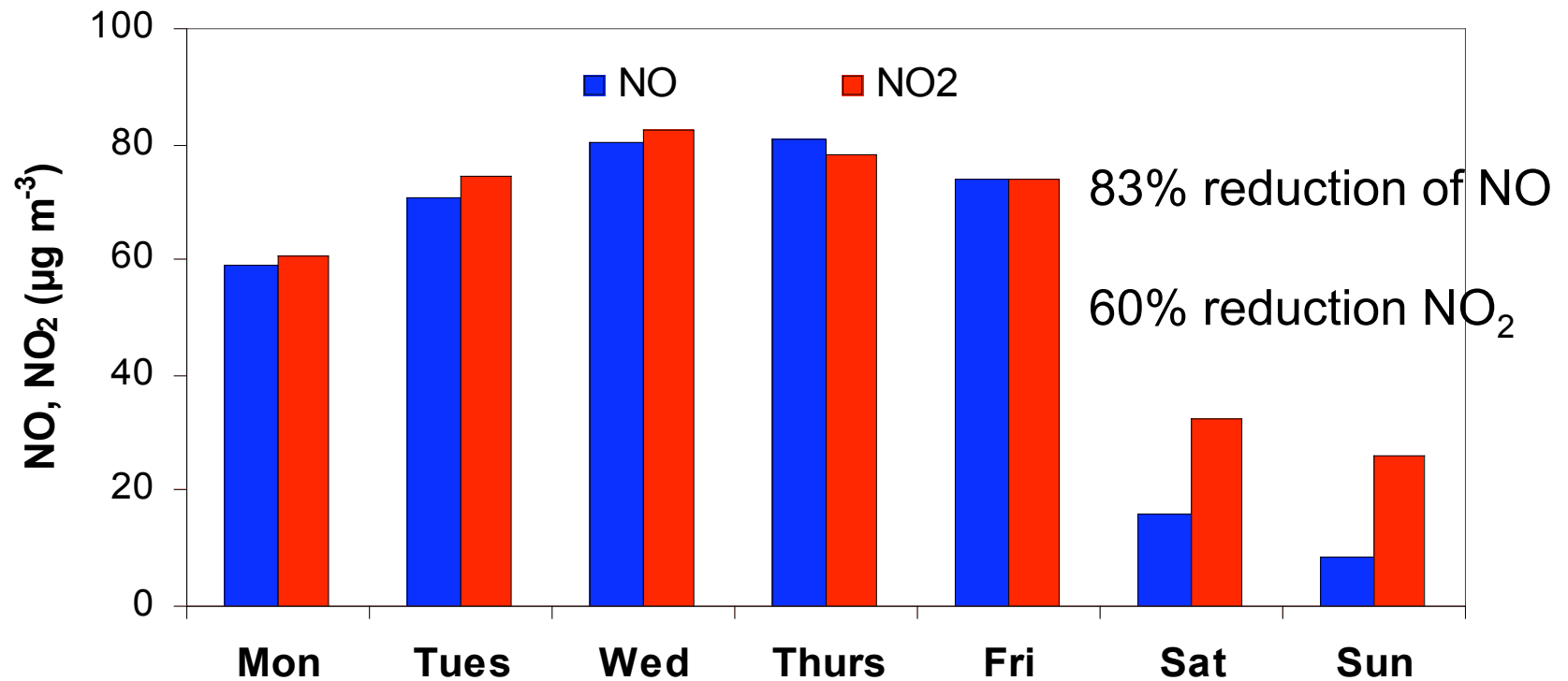
## WP 4. Barcelona metropolis: NO<sub>2</sub>



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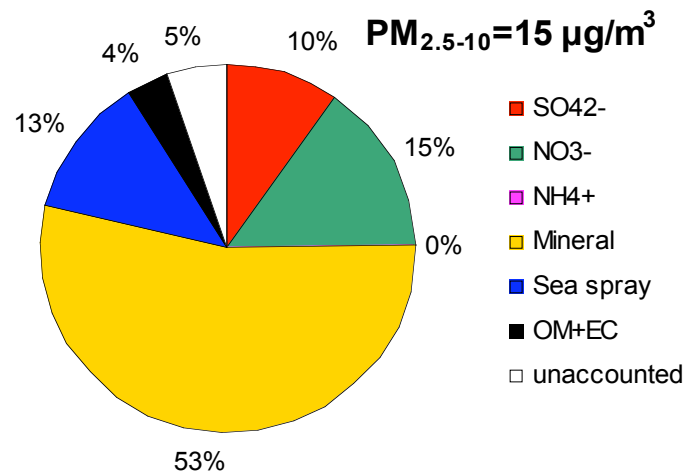
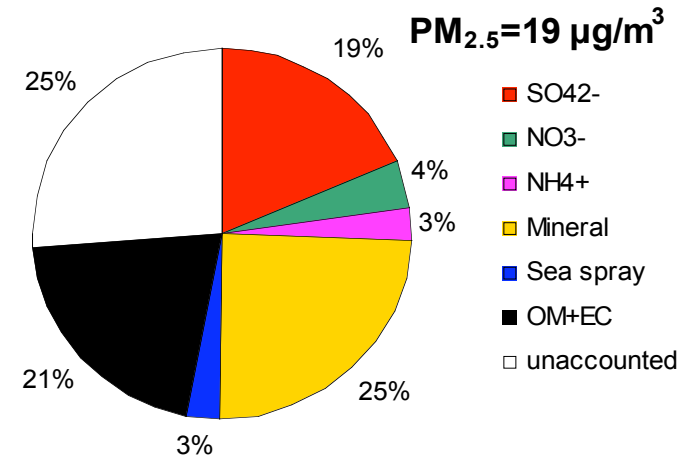
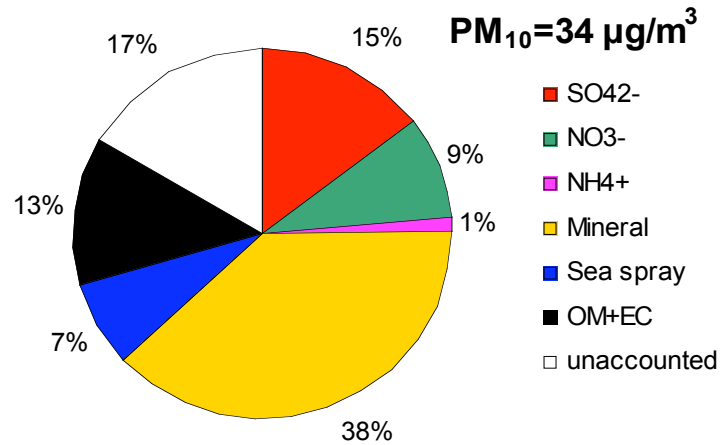
# WP 4. Barcelona Port: NO<sub>2</sub>

## March 2011-February 2012: real time monitoring

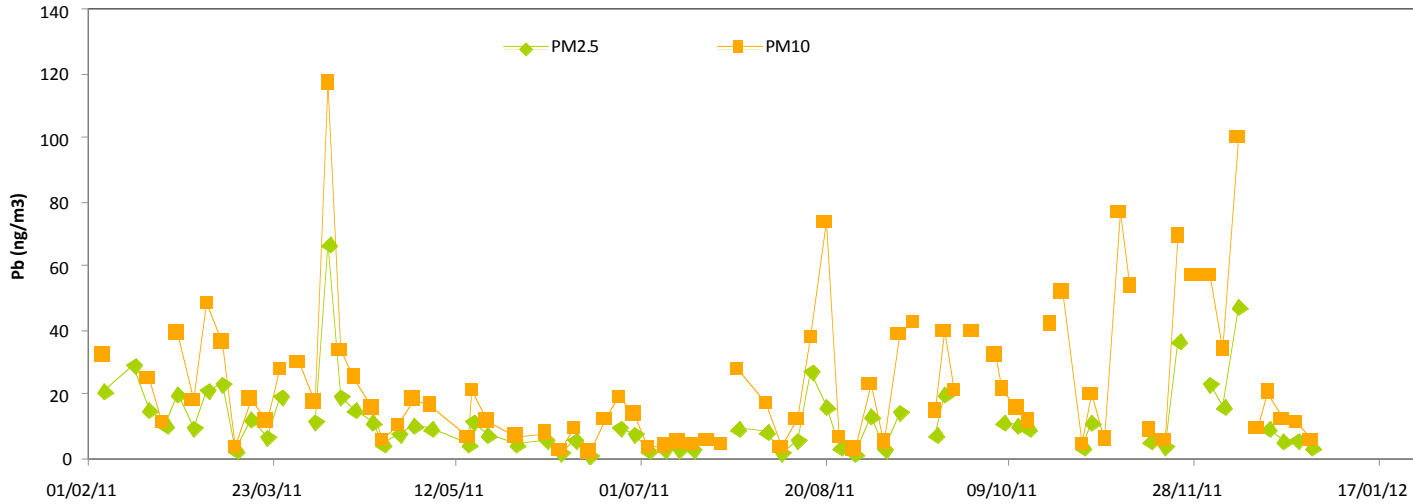


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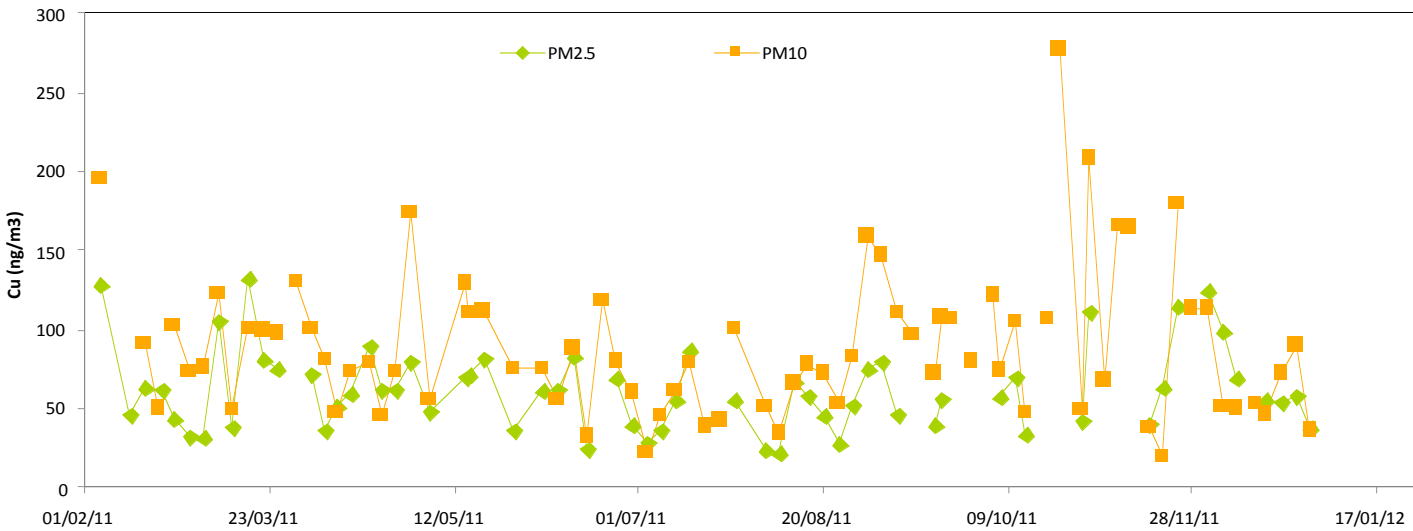
# WP 4. Chemical composition (Port): $PM_{10}$ - $PM_{2.5}$ - $PM_{2.5-10}$



# WP 4. Chemical composition (Port): PM<sub>10</sub>-PM<sub>2.5</sub>



industrial

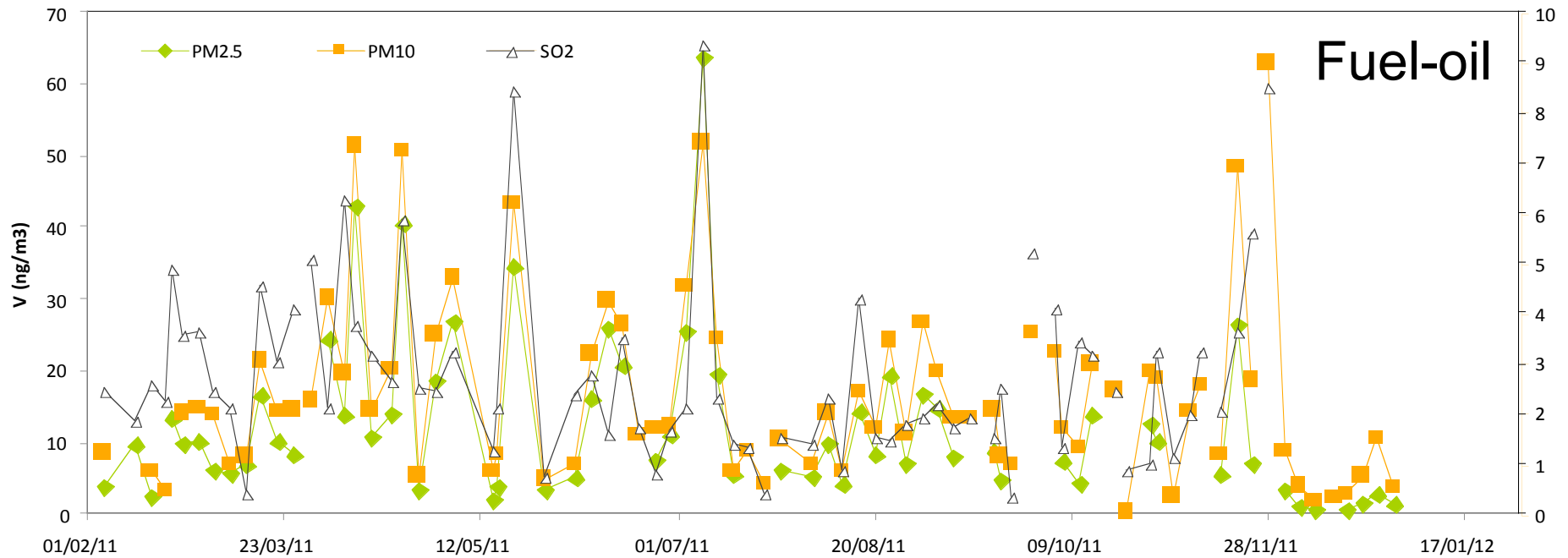


traffic



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# WP 4. Chemical composition (Port): PM<sub>10</sub>-PM<sub>2.5</sub>



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# IDAEA-CSIC: Source apportionment (PMF2)

Simultaneous PMF analysis with data from 2 measurement sites in Barcelona from February 2011 to January 2012:

- Port of Barcelona
- Urban background site (Palau Reial)

25 species selected

295 cases (including PM<sub>10</sub> and PM<sub>2.5</sub>)

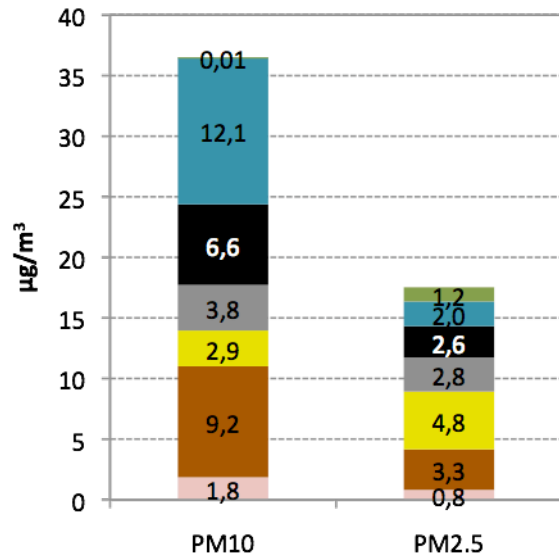
Best solution: 6 sources

- Industrial emissions (Mn, Zn, Cd, Pb, As, K)
- Mineral/road dust (Al, Ca, Fe, Mg, P, Ti, Mn, Cu, Zn, Sb, Sn, EC)
- Ammonium sulphate (NH<sub>4</sub><sup>+</sup>, SO<sub>4</sub><sup>2-</sup>)
- Fuel oil combustion (V, Ni, SO<sub>4</sub><sup>2-</sup>)
- Vehicle exhaust emissions (EC, OC, Fe, Cr, Cu, Zn, Sn, Sb)
- Aged sea spray + nitrate (Na, Mg, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>)



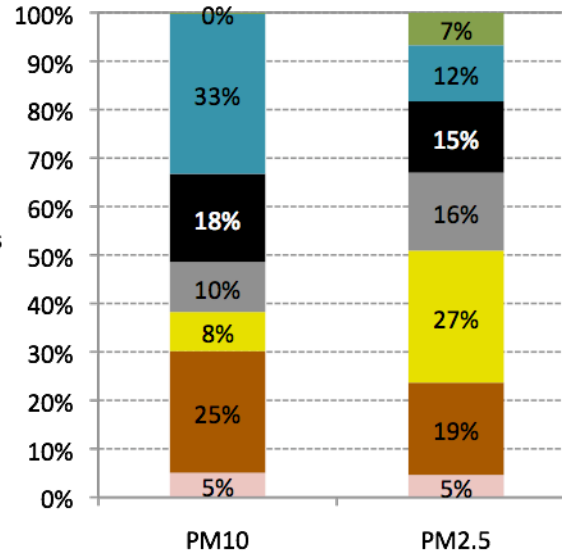
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# Source apportionment Port-City



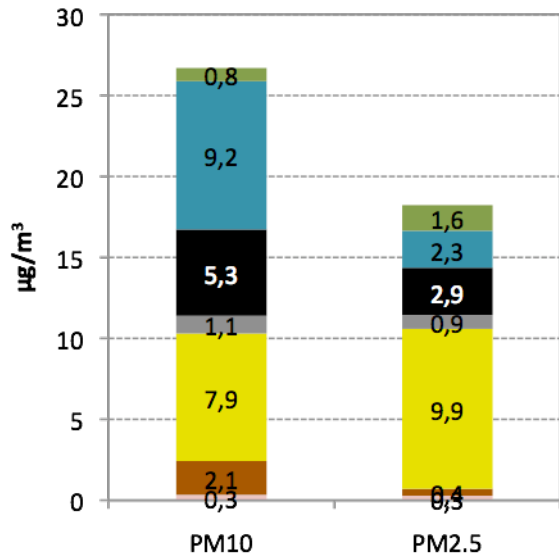
## Port BCN

- Unaccounted
- Aged sea spray + nitrate
- Vehicle exhaust emissions
- Fuel oil combustion
- Ammonium sulphate
- Mineral/road dust
- Industrial emissions



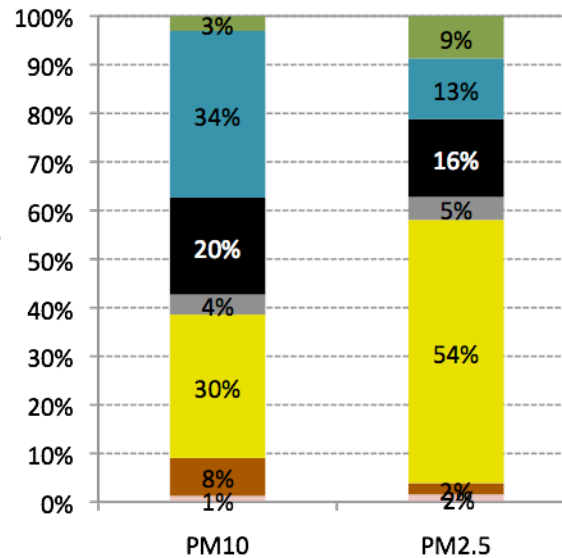
## Port BCN

- Unaccounted
- Aged sea spray + nitrate
- Vehicle exhaust emissions
- Fuel oil combustion
- Ammonium sulphate
- Mineral/road dust
- Industrial emissions



## Urban BCN

- Unaccounted
- Aged sea spray + nitrate
- Vehicle exhaust emissions
- Fuel oil combustion
- Ammonium sulphate
- Mineral/road dust
- Industrial emissions



## Urban BCN

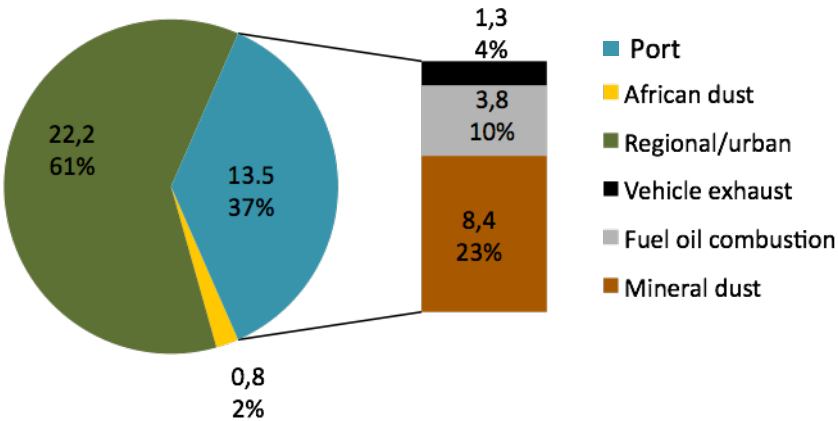
- Unaccounted
- Aged sea spray + nitrate
- Vehicle exhaust emissions
- Fuel oil combustion
- Ammonium sulphate
- Mineral/road dust
- Industrial emissions



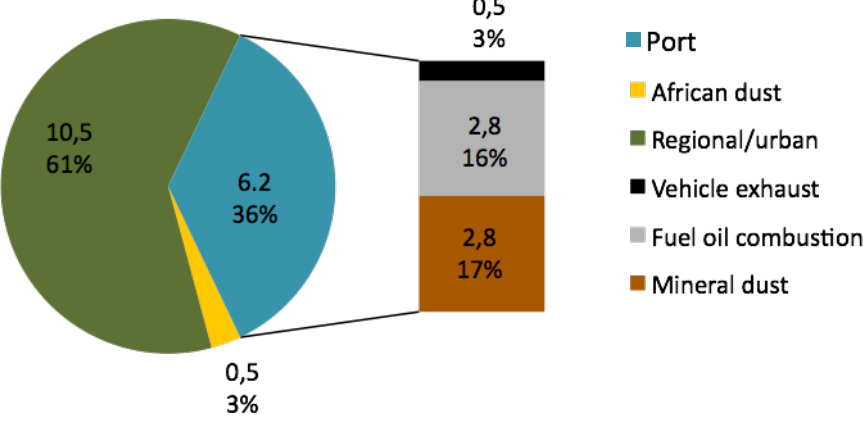
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# Contribution of port emissions to PM<sub>10</sub> and PM<sub>2.5</sub> at the port of Barcelona and the urban background

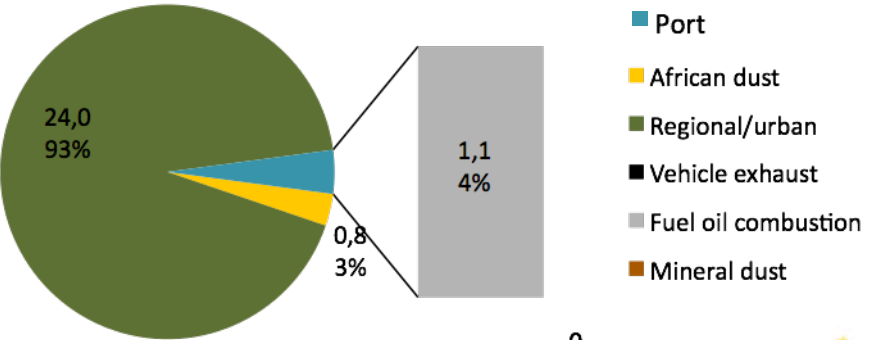
**Port BCN PM<sub>10</sub>**



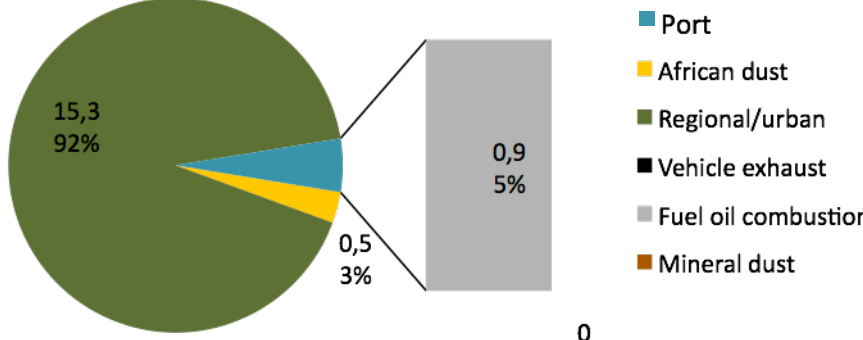
**Port BCN PM<sub>2.5</sub>**



**Urban BCN PM<sub>10</sub>**



**Urban BCN PM<sub>2.5</sub>**

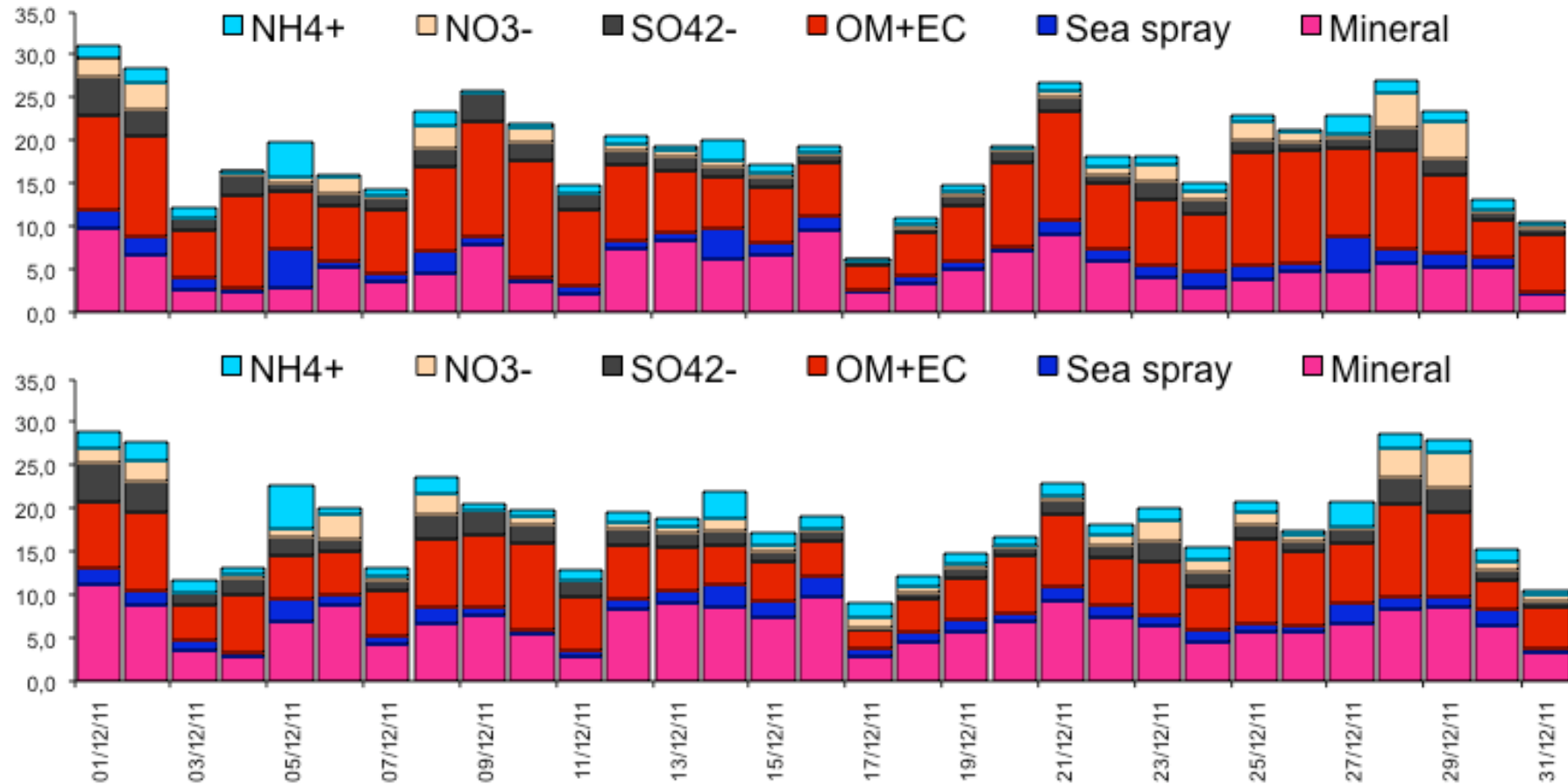


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0  
0%

# Comparison with CTM

## BCN-WTC Observations



Correlation coefficients (r):

NH4+: 0.925

SO42-: 0.894

Sea Spray: 0.849

NO3-: 0.923

OM+EC: 0.917

Mineral: 0.887

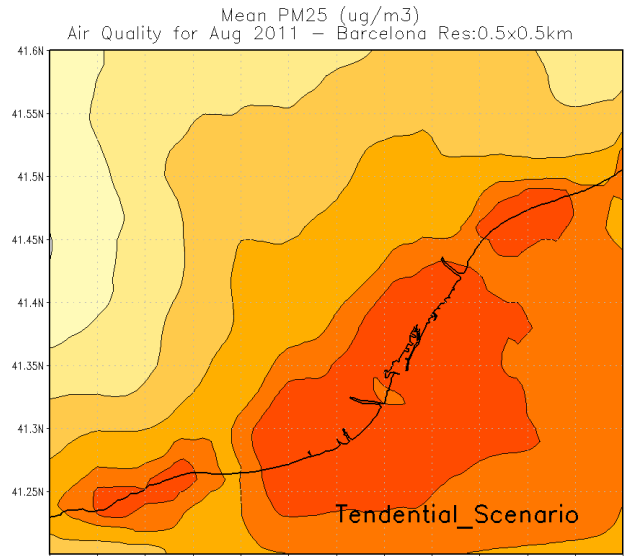
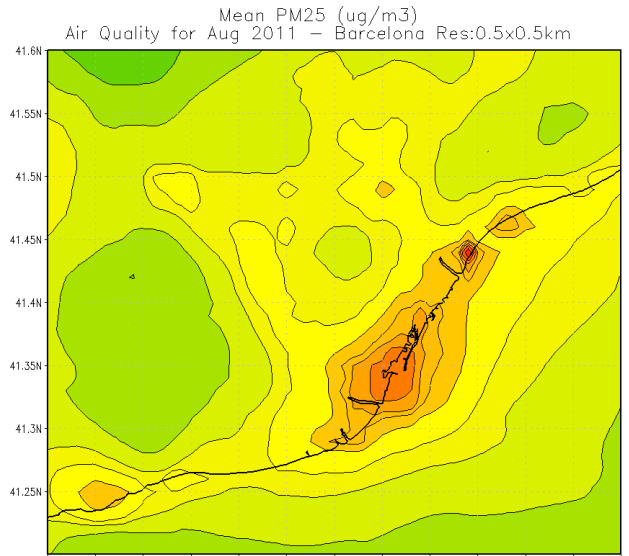
## BCN-Port Model



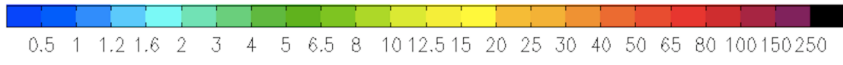
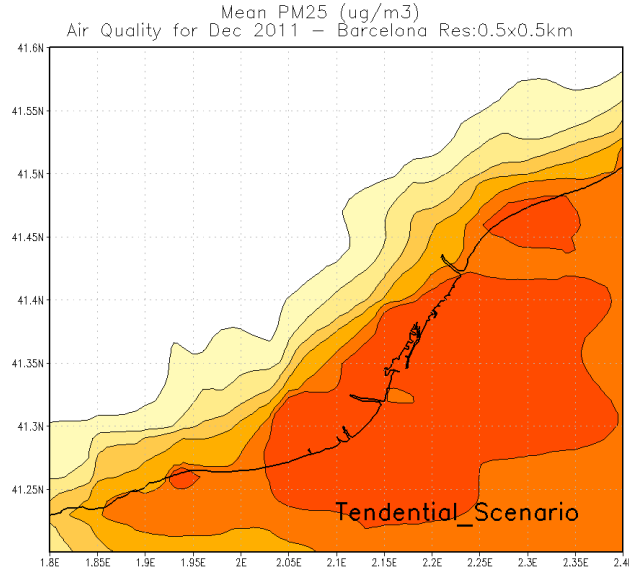
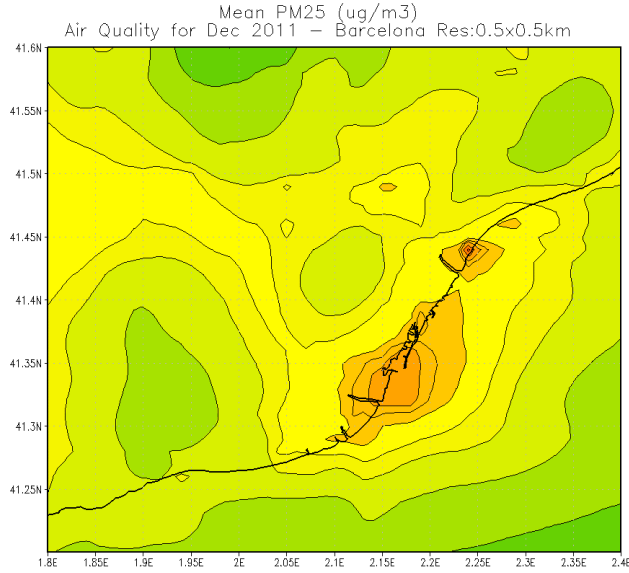
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# Tential scenario of emissions for the SNAP8 (including port) PM2.5, Future (2015) vs. Present

Summer

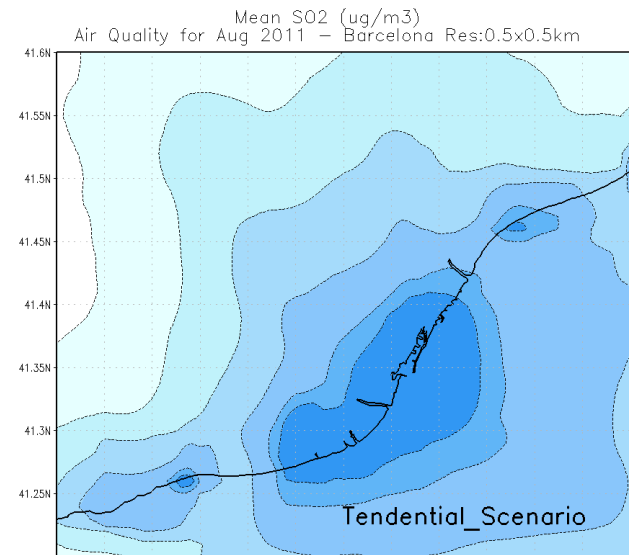
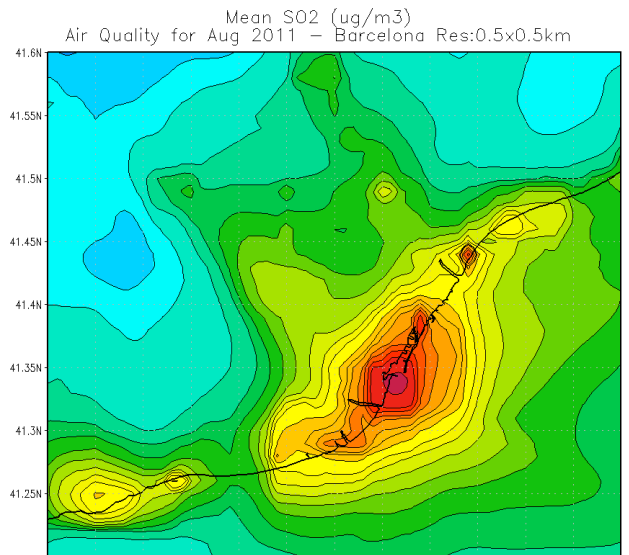


Winter

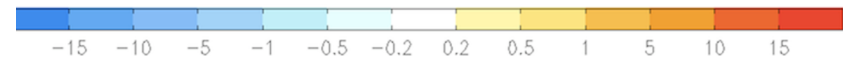
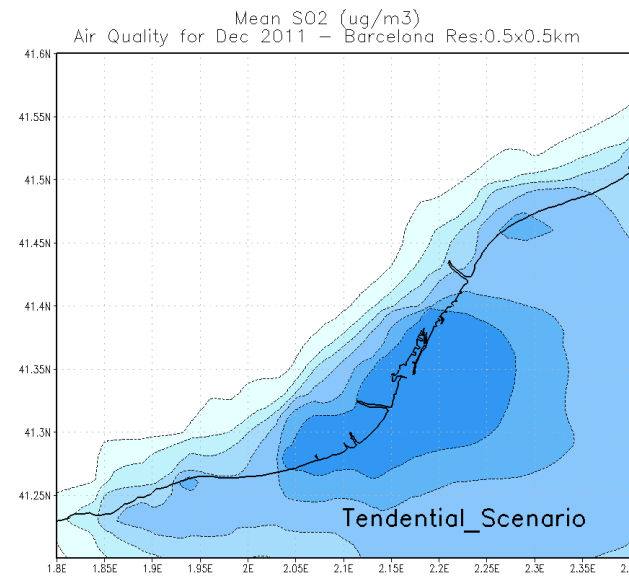
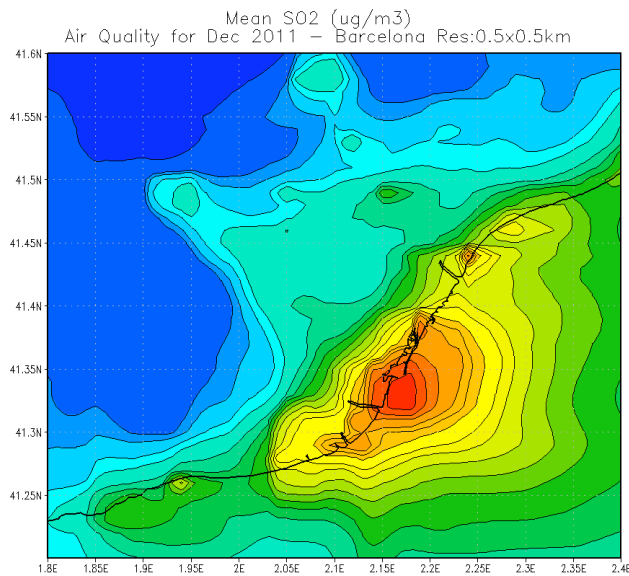


# Tendential scenario of emissions for SNAP 8 (including the port) Sulphur Dioxide, Future (2015) vs. Present

Summer

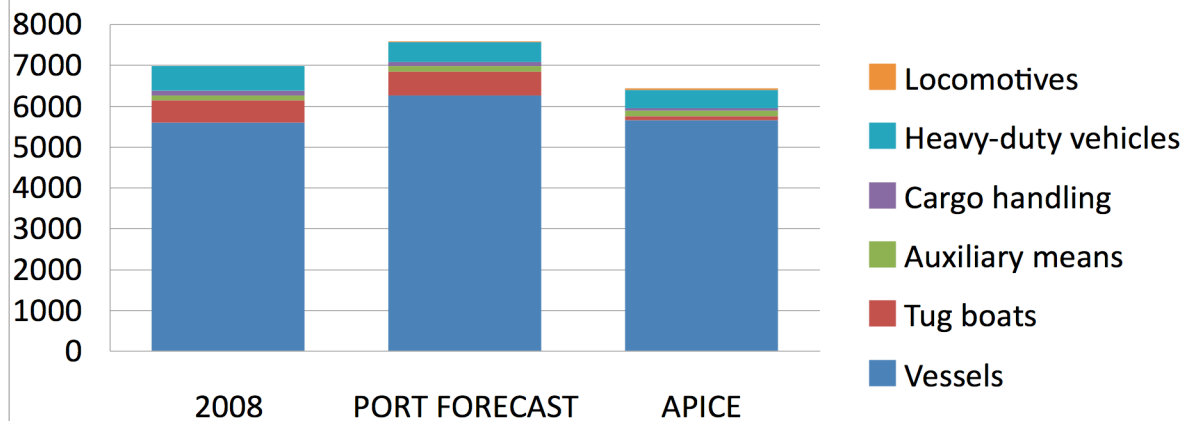


Winter



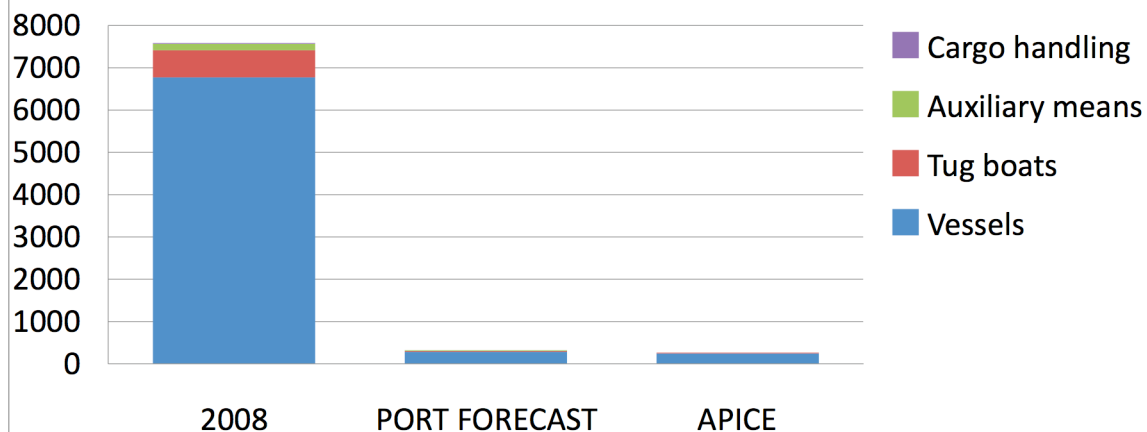
# Comparing scenarios: future trend and APICE plan

## NOx emissions induced by Port of Barcelona



**Emissions reduction at port with APICE:**  
**Nox: 8%**  
**PM10: 11%**  
**Sox: 96,5%**

## SOx emissions induced by Port of Barcelona



# Plan/Scenario APICE

1. Passengers ferries propelled by LNG
2. 50% tug boats with LNG
3. Cargo handling: electricity + NG
4. Land traffic (trucks and trains):
  - a) Ratio 85/15
  - b) Less time at port
  - c) Lower emission factors



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# APICE plan in Barcelona

## Assessment of criteria and actions (Delphi)

Emission source	Ranking	Measures
Ship emissions		<ol style="list-style-type: none"><li>1 Alternative fuel (LNG)</li><li>2 Manouvering - Change in fuel while manouvering</li><li>3 Hotelling - Shore power</li><li>Manouvering - Vessel speed reduction on approach or</li><li>4 departure from port</li><li>5 Hotelling - Reducing hoteling time</li><li>6 Air emissions inspection on board</li></ol>
Diesel powered equipment		<ol style="list-style-type: none"><li>1 Idle reduction programs</li><li>2 Accelerated fleet turnover</li><li>3 Natural gas conversion</li><li>4 Exhaust gas technologies (DOC, DPF, etc.)</li><li>5 Different fuels solutions (biodiesel, etc.)</li></ol>
Cargo handling equipment		<ol style="list-style-type: none"><li>1 Idle reduction programs</li><li>2 Alternative fuels</li><li>3 Accelerated fleet turnover</li><li>4 Retrofitting technologies</li><li>5 National non-road engine emission standards</li></ol>

# APICE plan in Barcelona

## Structure

### Emission source

Introduction to the emission source

Measure x.x.

State of the art

Description of the measure

Action x.x.y.

Action x.x.z.

Effect of the measure

Measure x.y

...



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Thanks for  
your attention



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