Maritime Integrated Approach in the Mediterranean Area

CAIMANs

Cruise and passenger ship Air quality Impact Mitigation ActioNs

Present emission comparison among the study areas

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Macro & Micro air pollution estimation

[ARPAV code (Pillon, Elvini) mainly based on EMEP/EEA, 2013]

- macropollutants (NOx, CO, NMVOC, SO_2, PM10/PM2.5)
- micropollutants (Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, HCB and PCB)

  by EMEP/EEA (2013) methodology based on two fuel classes (MDO/MGO and BFO) and ship gross tonnage
- CO_2 from fuel consumption by EMEP/EEA (2013) and IPCC (2006) emission factors
- Benzo(a)pirene: Cooper and Gustafsson (2004), EF bassi e Agrawall et al. (2010), EF elevati.

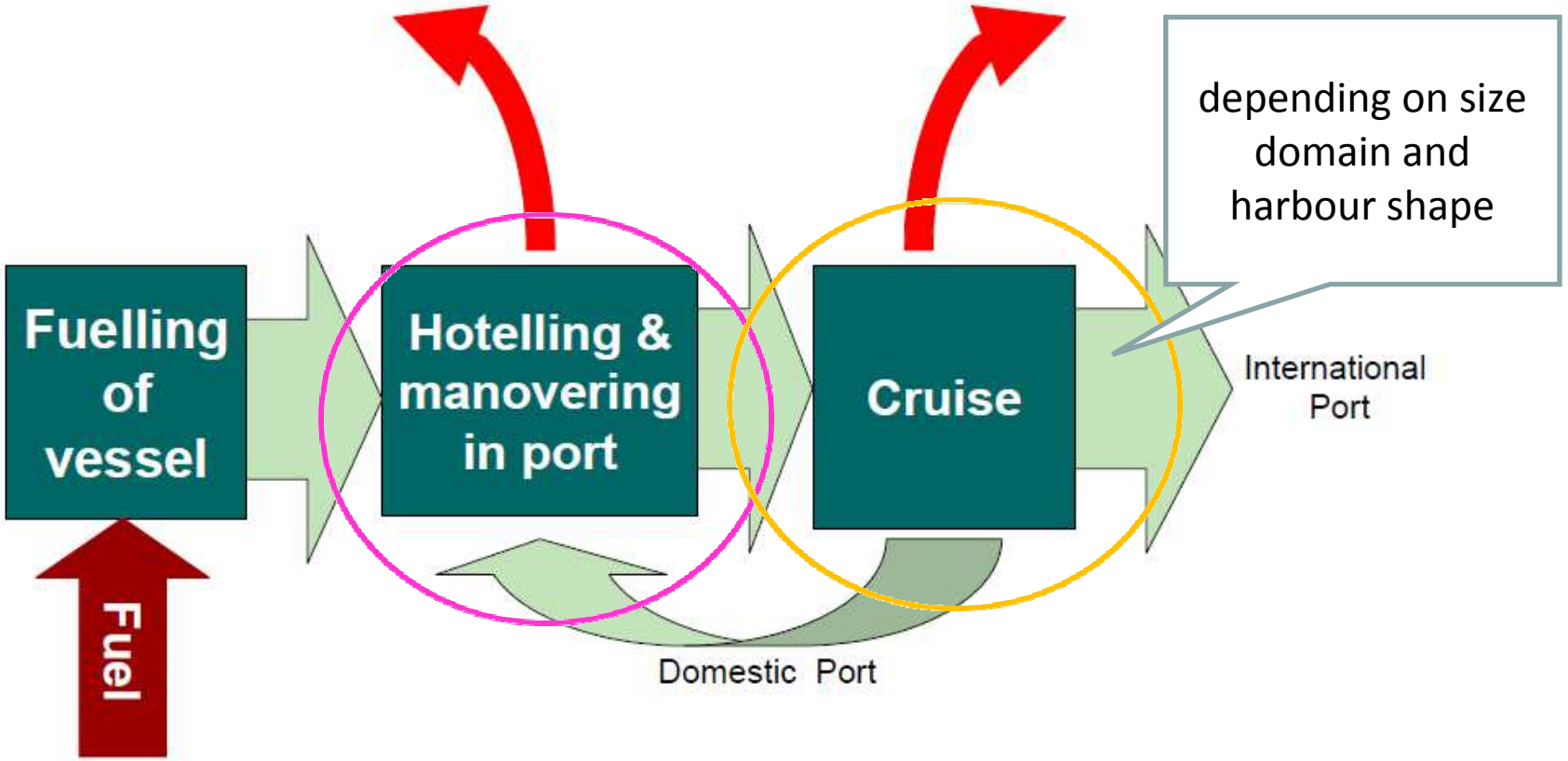
For present emissions (year 2013):

- Starting from the call registration db in the five harbour areas

For future scenarios:

- mid-term trend and development scenarios (year 2020 or 2025)
- Local or common mitigation hypothsis

EMEP/EEA air pollutant emission inventory guidebook 2013 approach

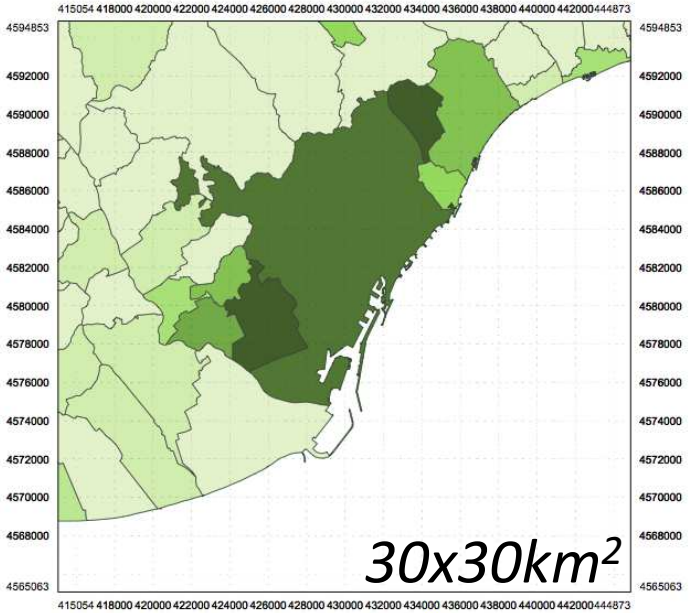


Bunker Fuel Oil (BFO) *and*

Marine Diesel Oil/Marine Gas Oil (MDO/MGO) *undistinguished*

Le studied areas

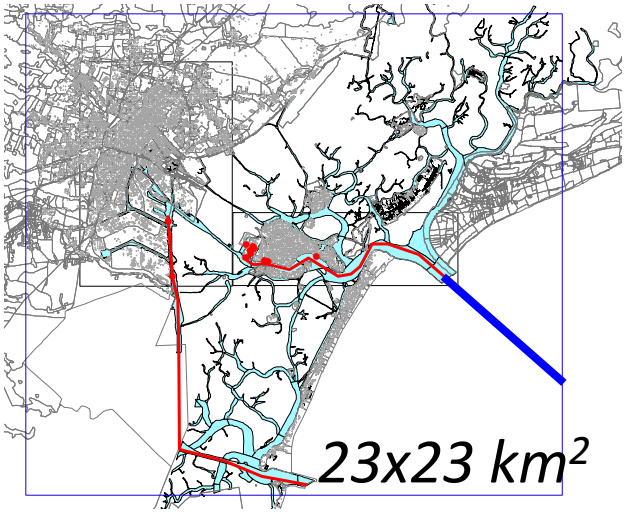
Barcelona



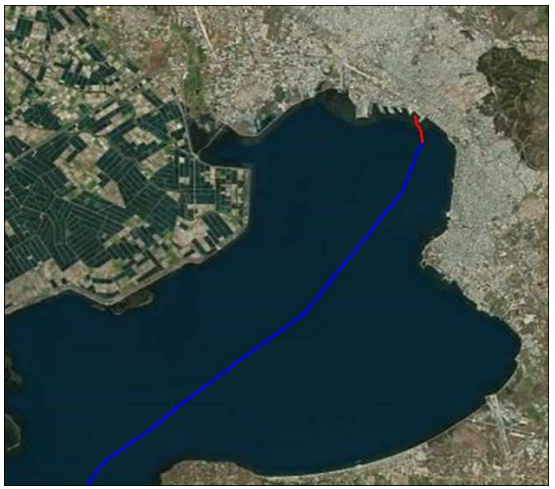
Marseilles

12x12km²

Venice



Thessaloniki



30x30km²

Genoa

10x10km²

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The CAIMANs tool for bottom up ship emissions

ARPAV implemented a BottomUpHarbour program, written in fortran 90 language, that handles ASCII text input and output files [Pillon,Elvini]

BottomUpHarbour Program

→ Engine type : GT, HSD, MSD, SSD, ST

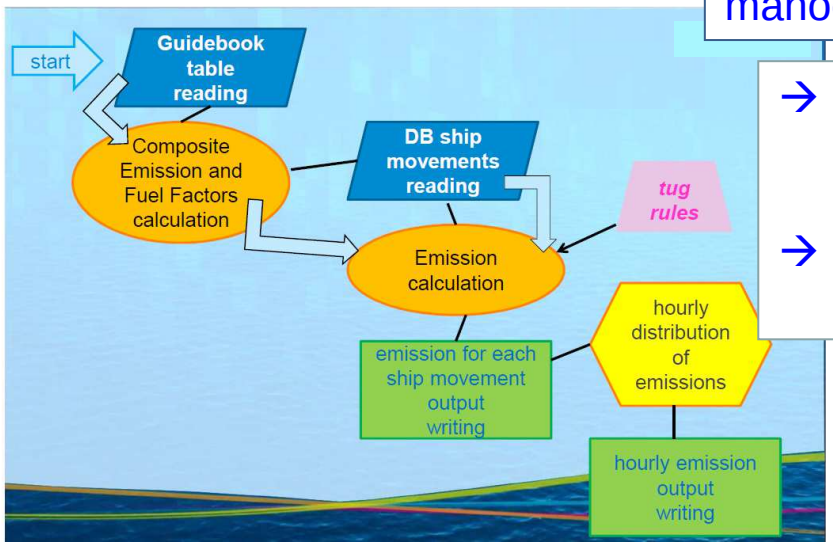
Main engine Auxiliary

→ Fuel type: **BFO, MDO/MGO**

→ **Fleet composition**

→ time spent in the different navigation phases: hotelling, manoeuvring and cruise

→ **scheduled or recorded arrivals and departures**



→ Tier3: NOx, NMVOC, PM, Fuel Consumption (EF in g/kWh)

→ Tier1: CO, SO_2, micropollutants (EF in (k)g/ton fuel)

→ **EMEP / EEA emission factors**

SOx Emission Factors – for current (2013) estimations

*20*S kg/ton fuel,*
where S is the fuel sulphur content in mass %

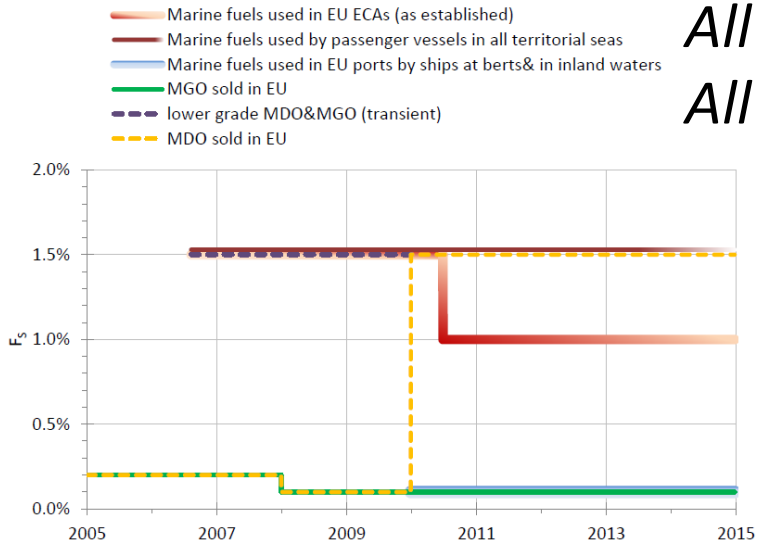


Figure 4. The maximum fuel sulphur content (F_S, in mass %) for marine fuels allowed in EU territ and EU inland waterways given by Directives 1999/32 and 2005/33/EC.

All passenger in territorial waters: 1.5%
All ships at berth (hotelling phase): 0.1%

As set by directive 2005/33/EC

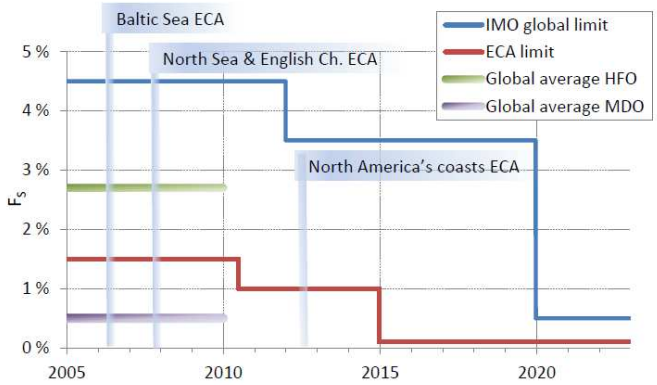
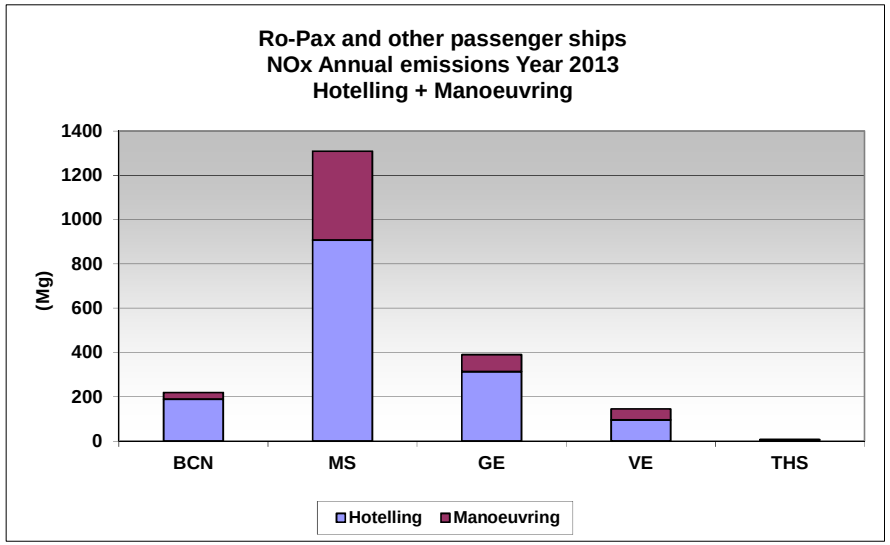
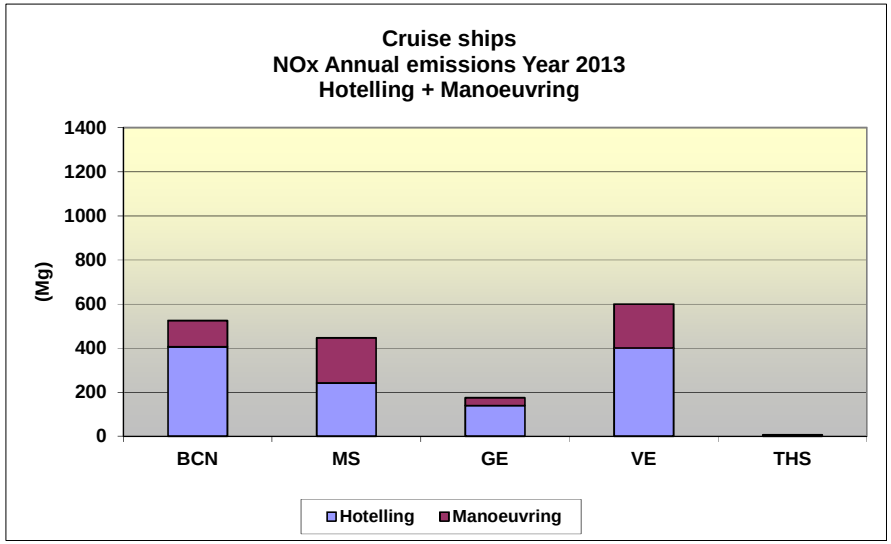


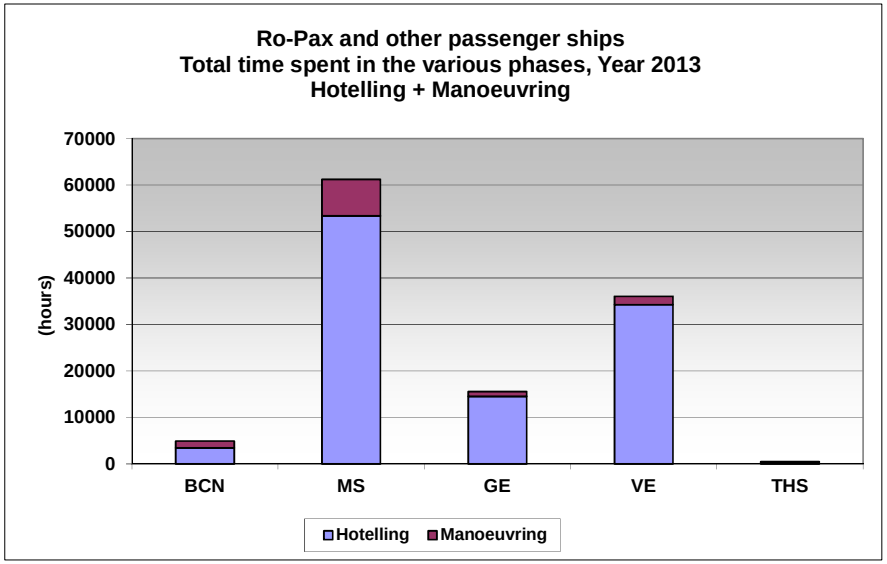
Figure 2. The maximum fuel sulphur content (F_S, in mass %) for marine fuels allowed globally and in Emission Control Areas (ECAs) given by IMO (years when different ECAs enter in force are shown) and the current average F_S of HFO and MDO used by the global fleet (average fuel composition from Endresen et al., 2005)

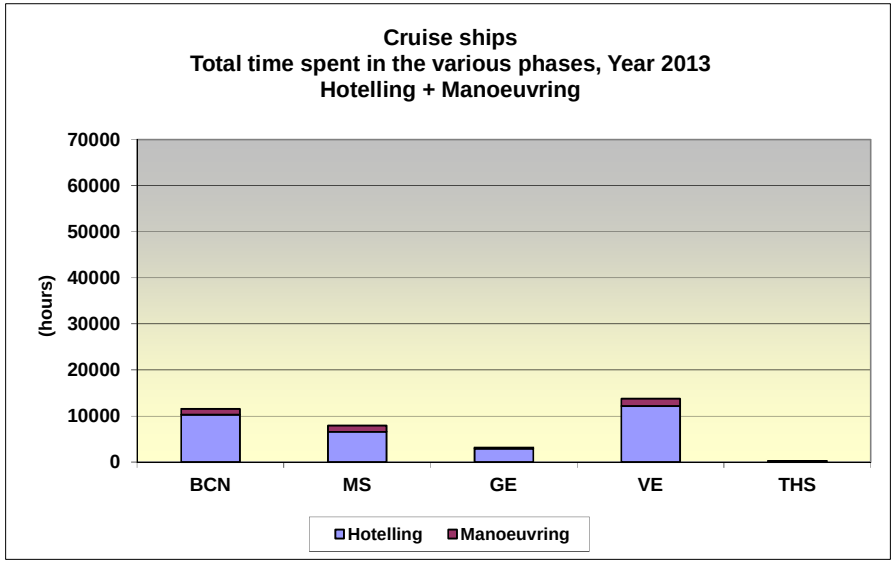
BFO: 2.7% as Global avarage fuel sold
MDO/MGO: 1% as upper limit

NOx emissions – Ro-Pax *vs* Cruise ships









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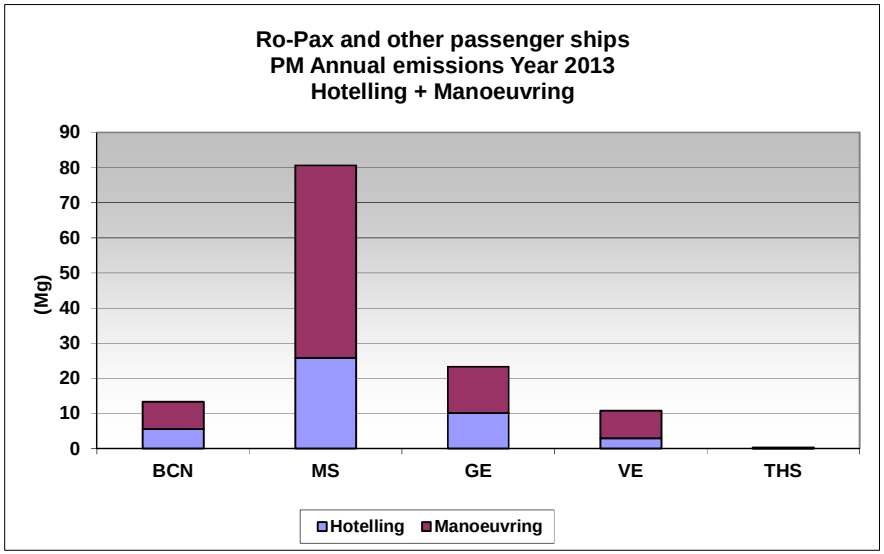
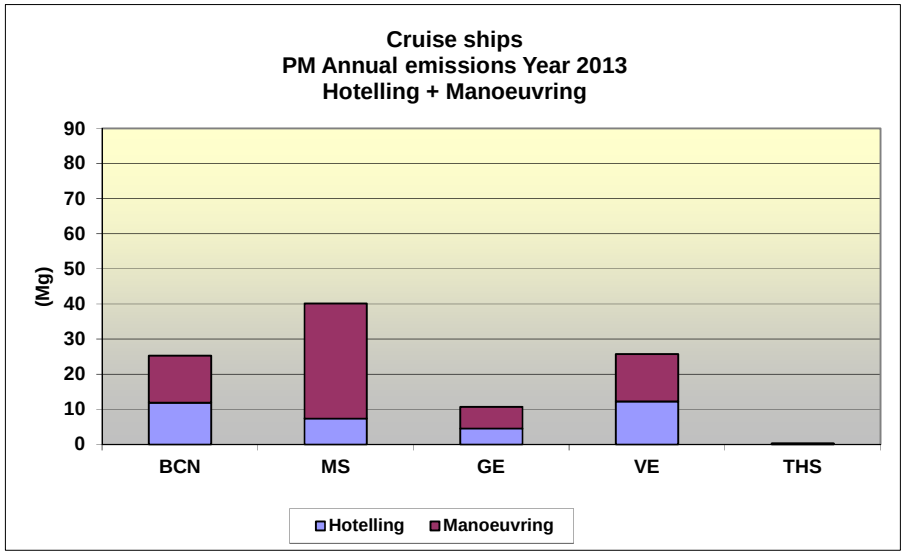
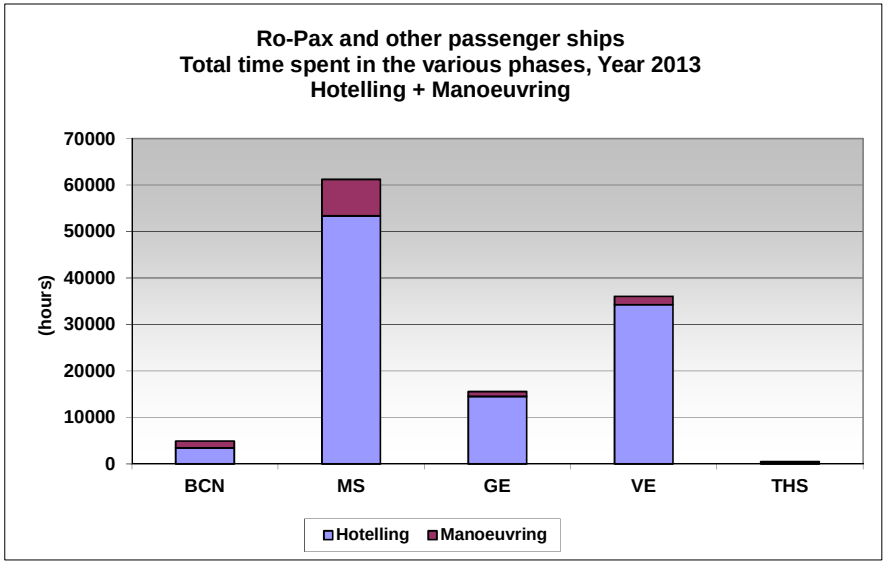
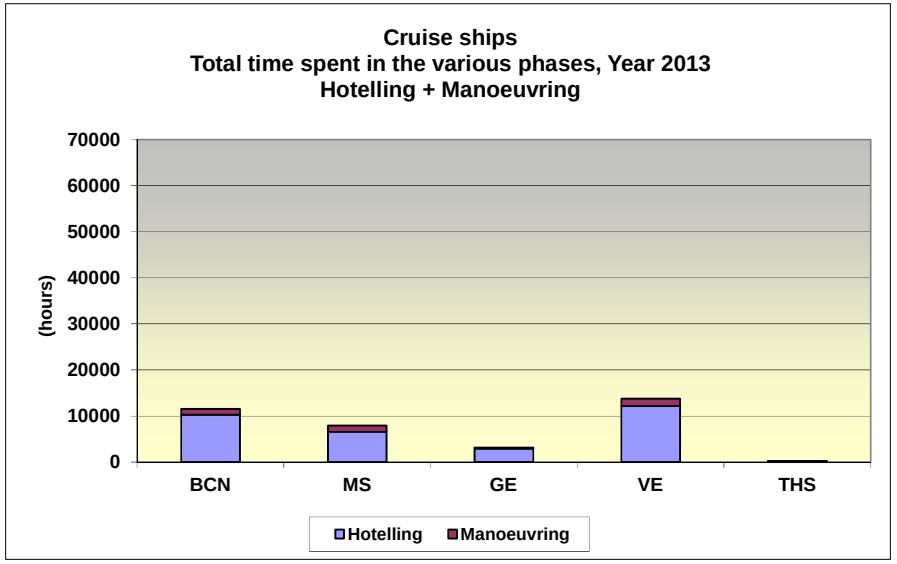
PM (PM10/PM2.5) emissions – Ro-Pax *vs* Cruise ships









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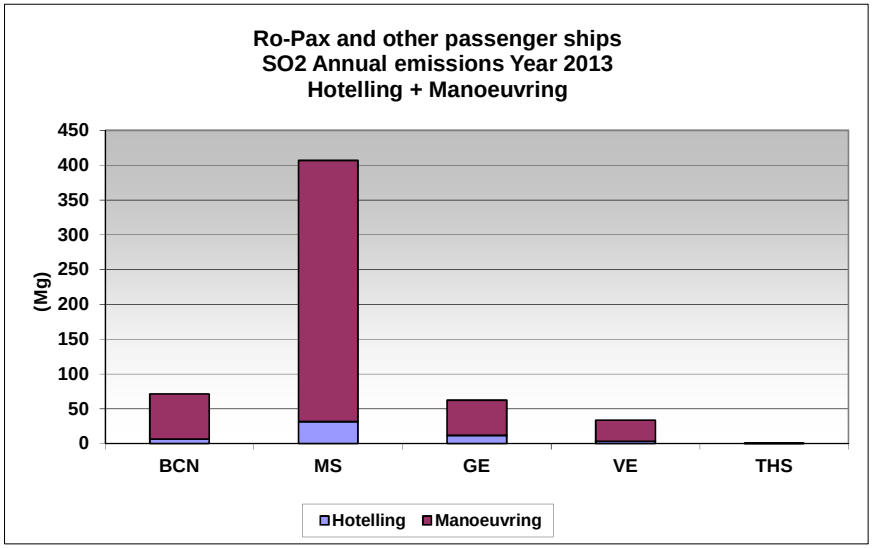
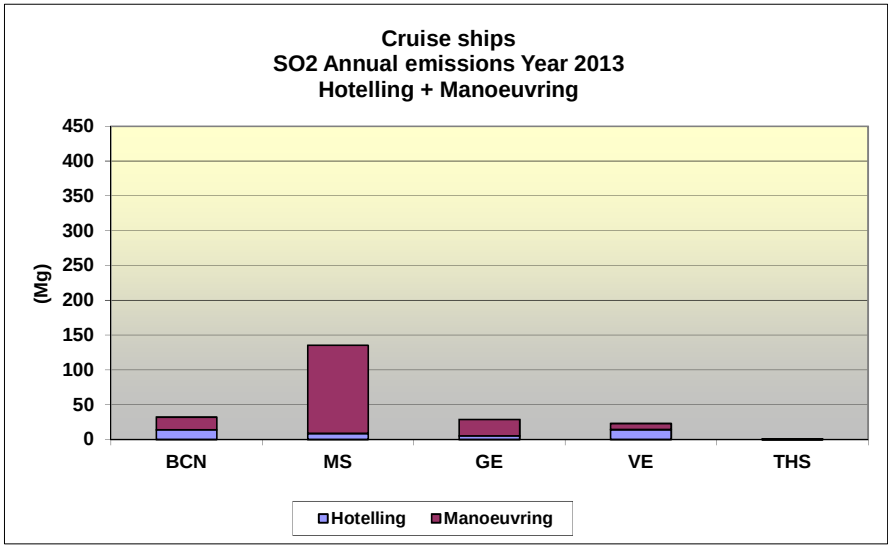
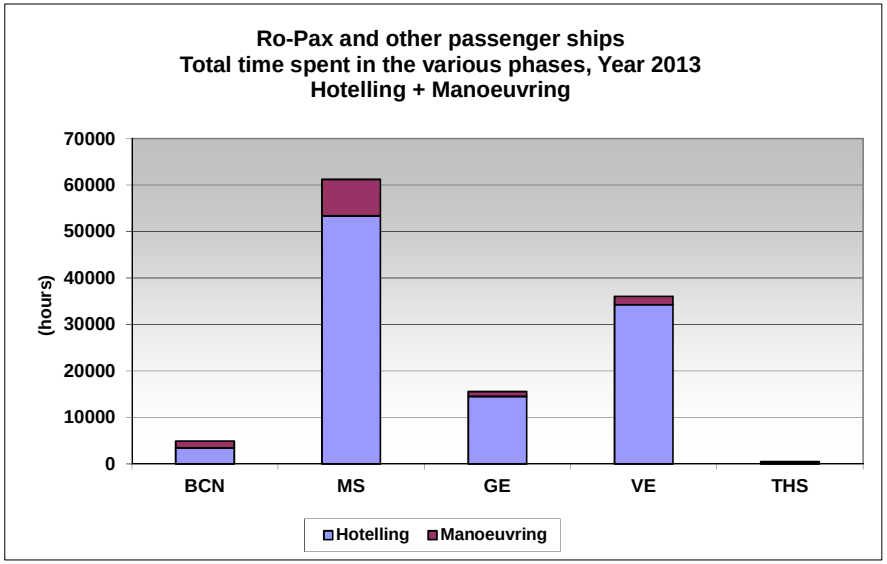
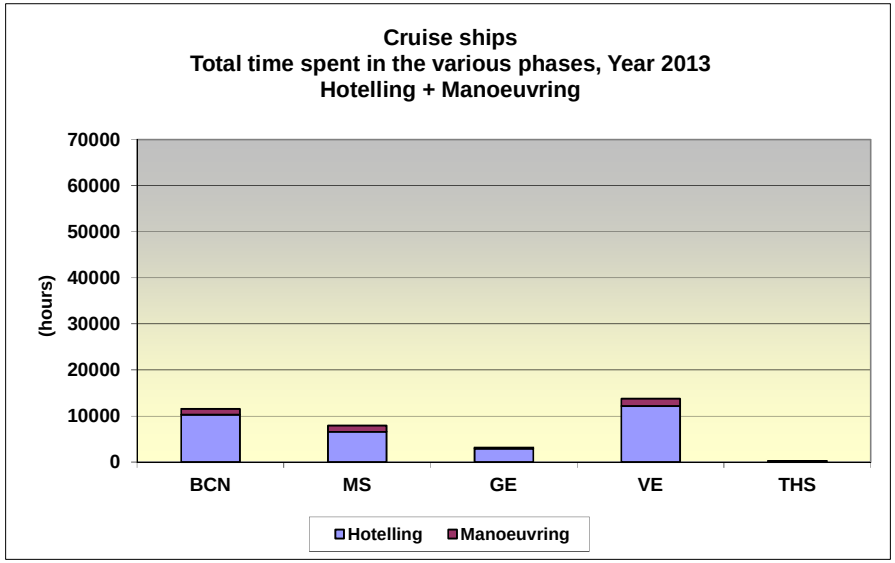
SO_2 emissions – Ro-Pax *vs* Cruise ships









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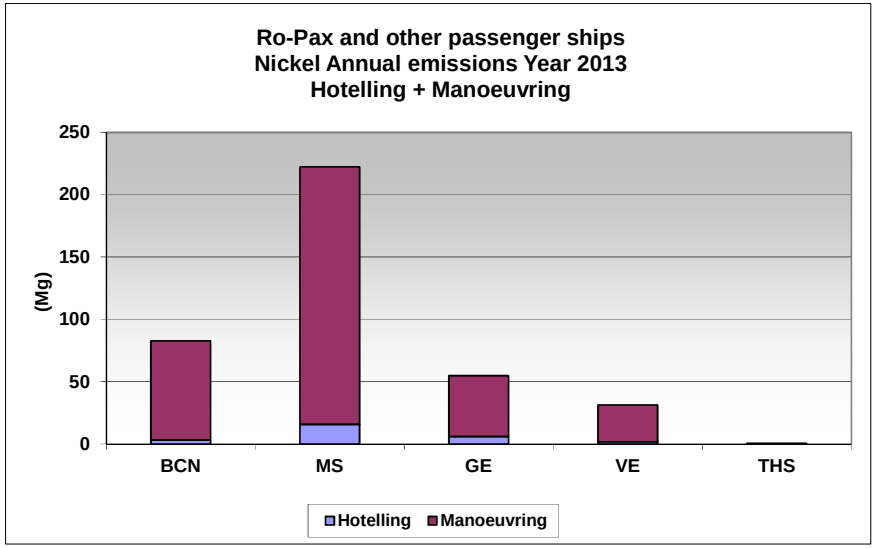
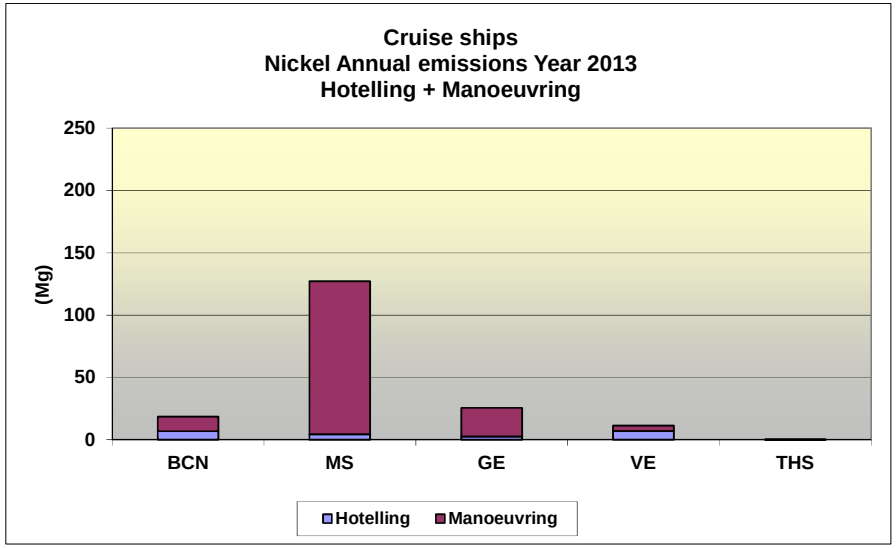
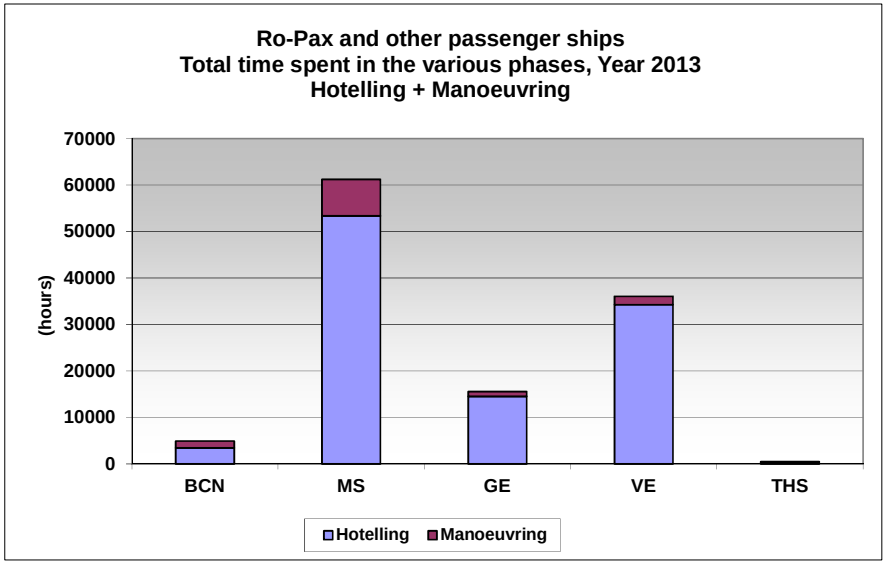
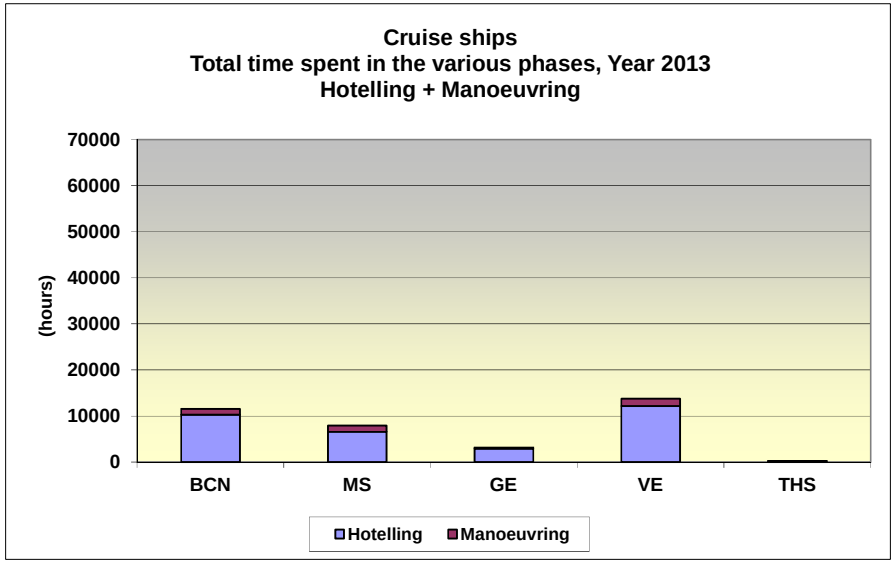
Nickel emissions – Ro-Pax *vs* Cruise ships









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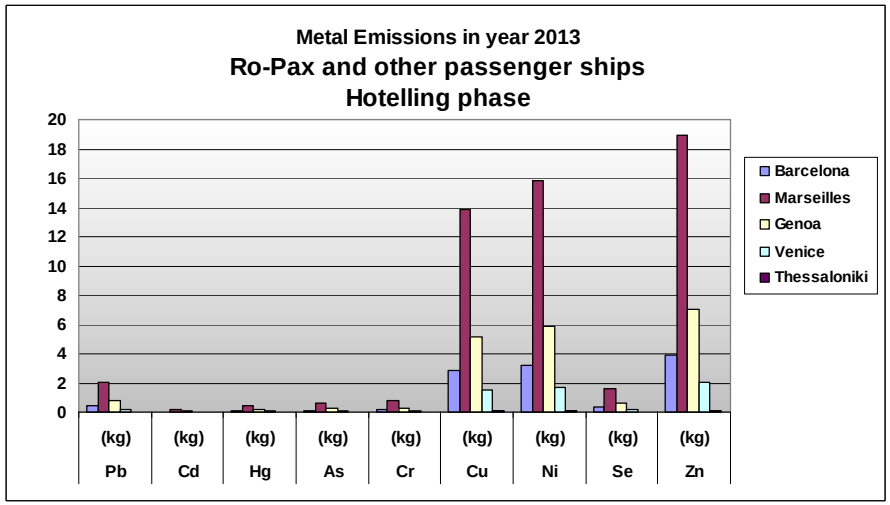
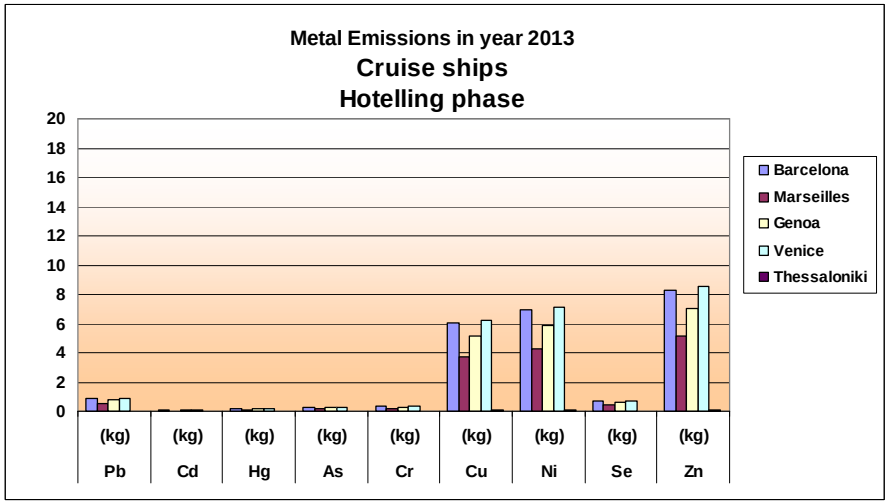
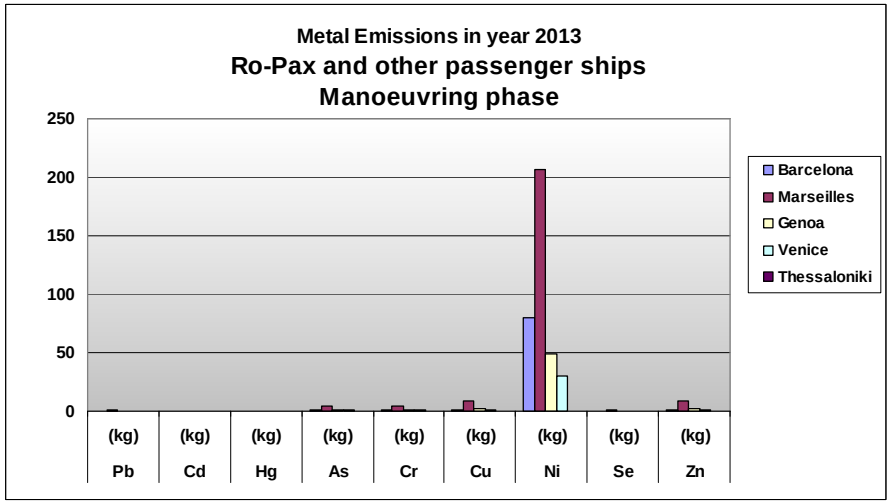
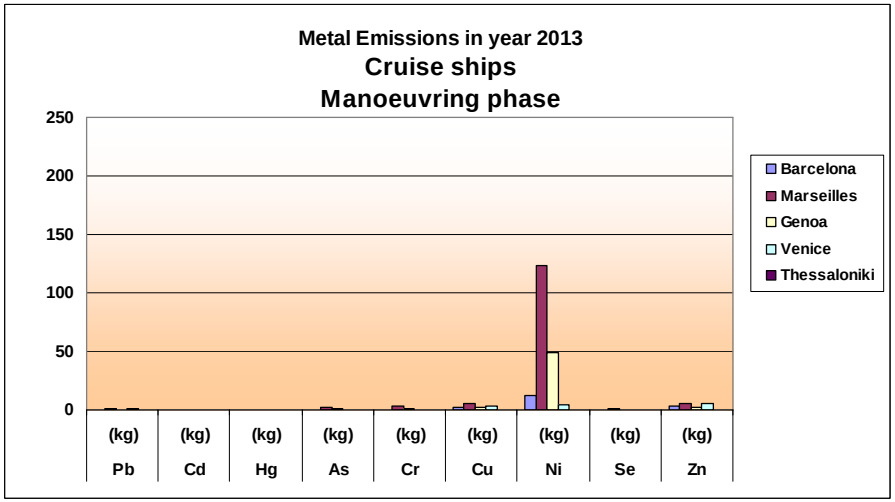
All metals emissions– Ro-Pax *vs* Cruise ships









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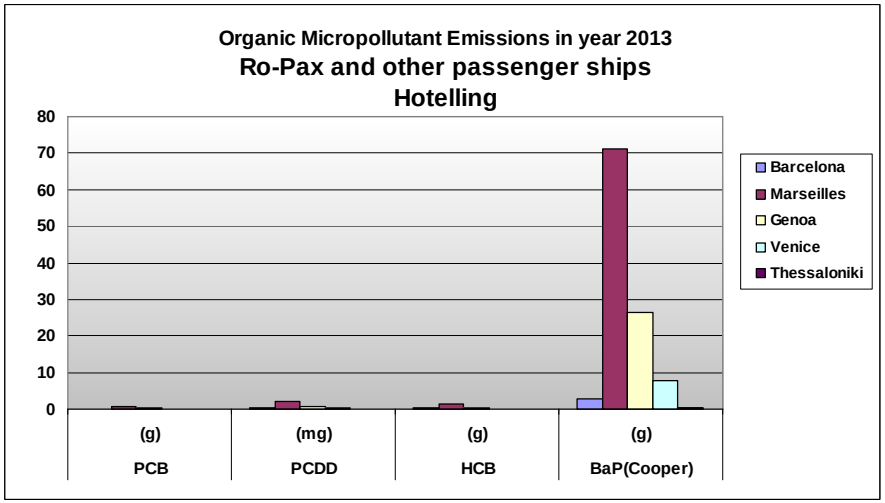
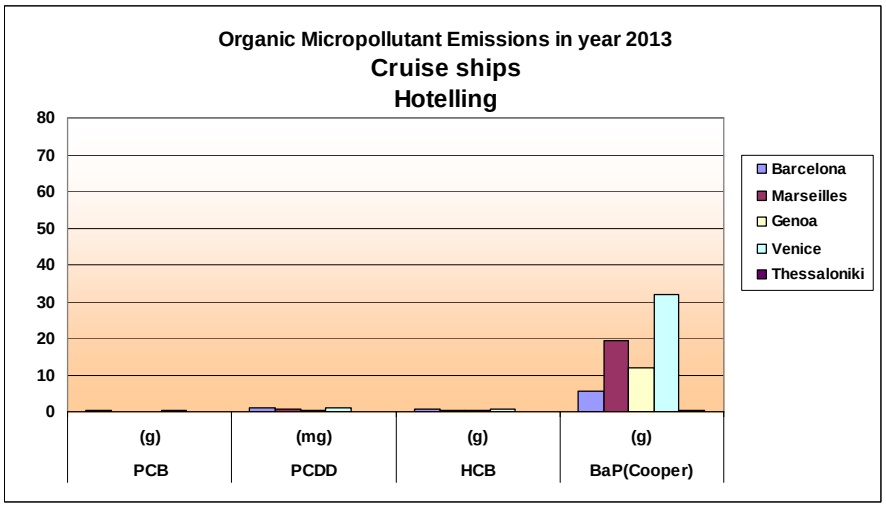
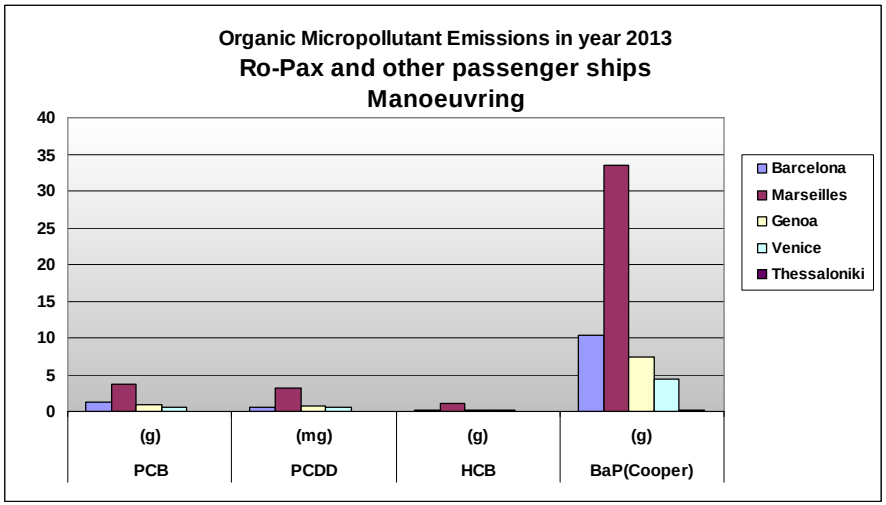
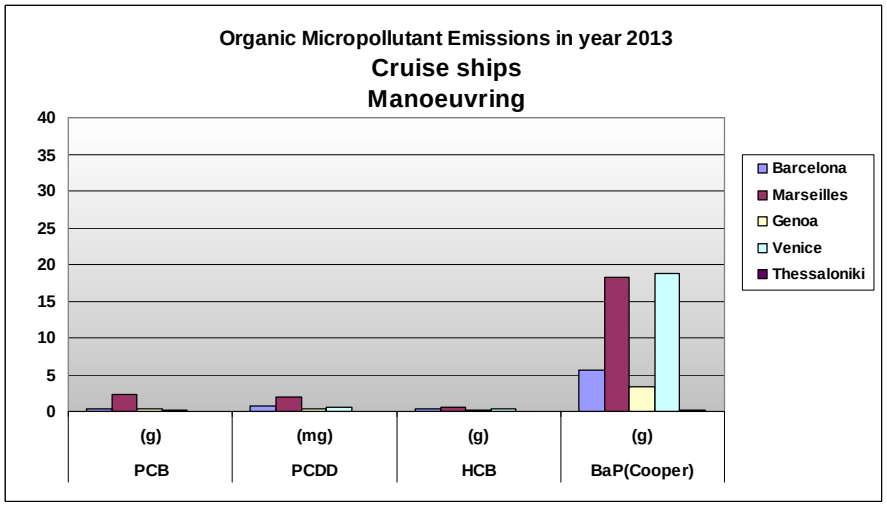
Organic micropollutant emissions – Ro-Pax *vs* Cruise ships









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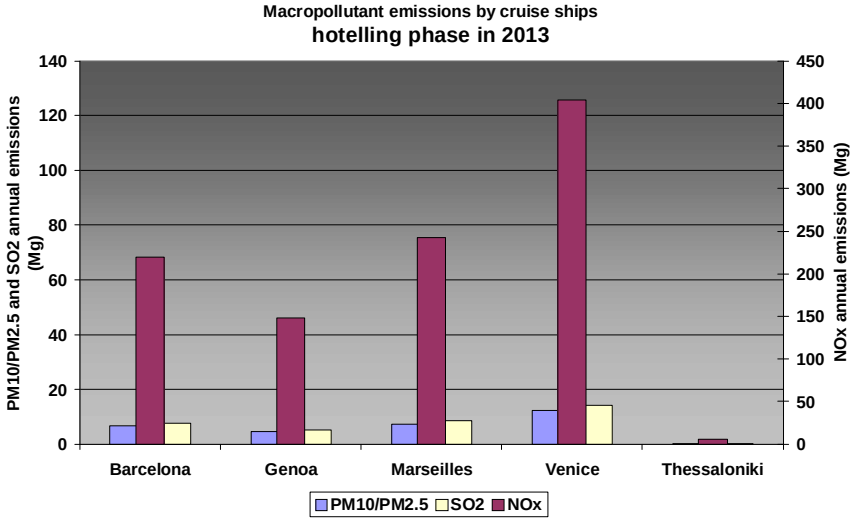
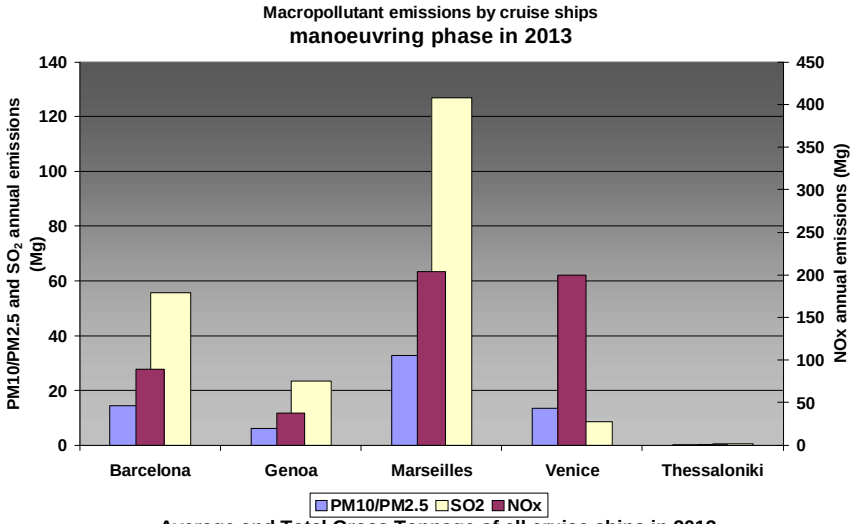
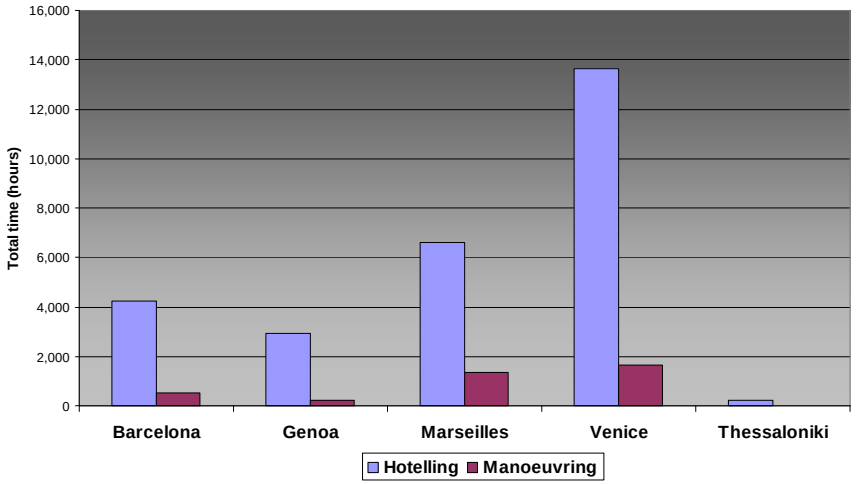
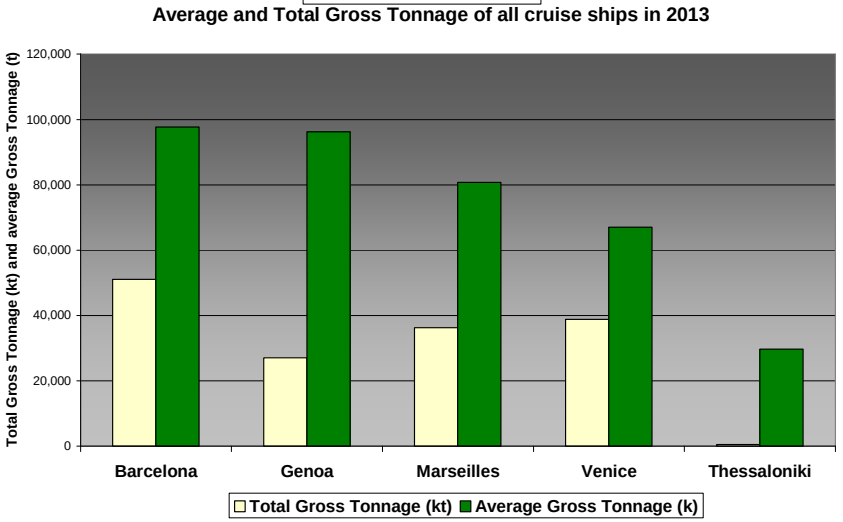
Focus on cruise ships – Macropollutant emissions









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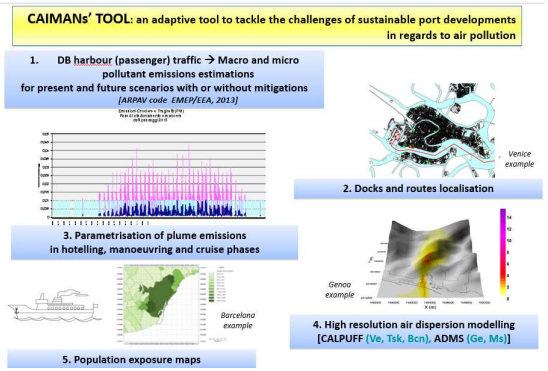
Conclusions of the emission estimation step



First step of the Air Quality Impact Assessment:
input for the air dispersion models.

High detailed information on passenger ship emissions hour by hour for the whole year 2013 based on the passenger ships movements recorded in each harbours.

Comparison among the 5 harbours of yearly emissions of ro-pax and cruise ships.

Comparison within each harbour of ro-pax emissions vs cruise ship emissions.

Focus of cruise ships:
Effect of different size (tonnage) on the emissios
Effect of the Blue Flag 2 Agreement in Venice for SO_2 and PM emissions in manoeuvring phase.

CAIMANs

Cruise and passenger ship Air quality Impact Mitigation ActioNs

Priority axis 2 Environment

Objective 3: Prevention of maritime risks and strengthening of maritime safety

http://www.medmaritimeprojects.eu/section/caimans

Lead Partner: Environmental Protection Agency of Veneto Region ARPAV – Padoa (IT)
www.arpa.veneto.it

Partners:

University of Genoa, Department of Physics (IT) www.labfisa.ge.infn.it
Aristotle University of Thessaloniki (GR) http://lap.physics.auth.gr
AIR PACA – Air quality observatory (FR) http://airpaca.org/
Spanish Research Council - Institute of Environmental Assessment & Water Research IDAEA (ES) http://www.idaea.csic.es/

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