

# Ports and their influence on local air pollution and public health

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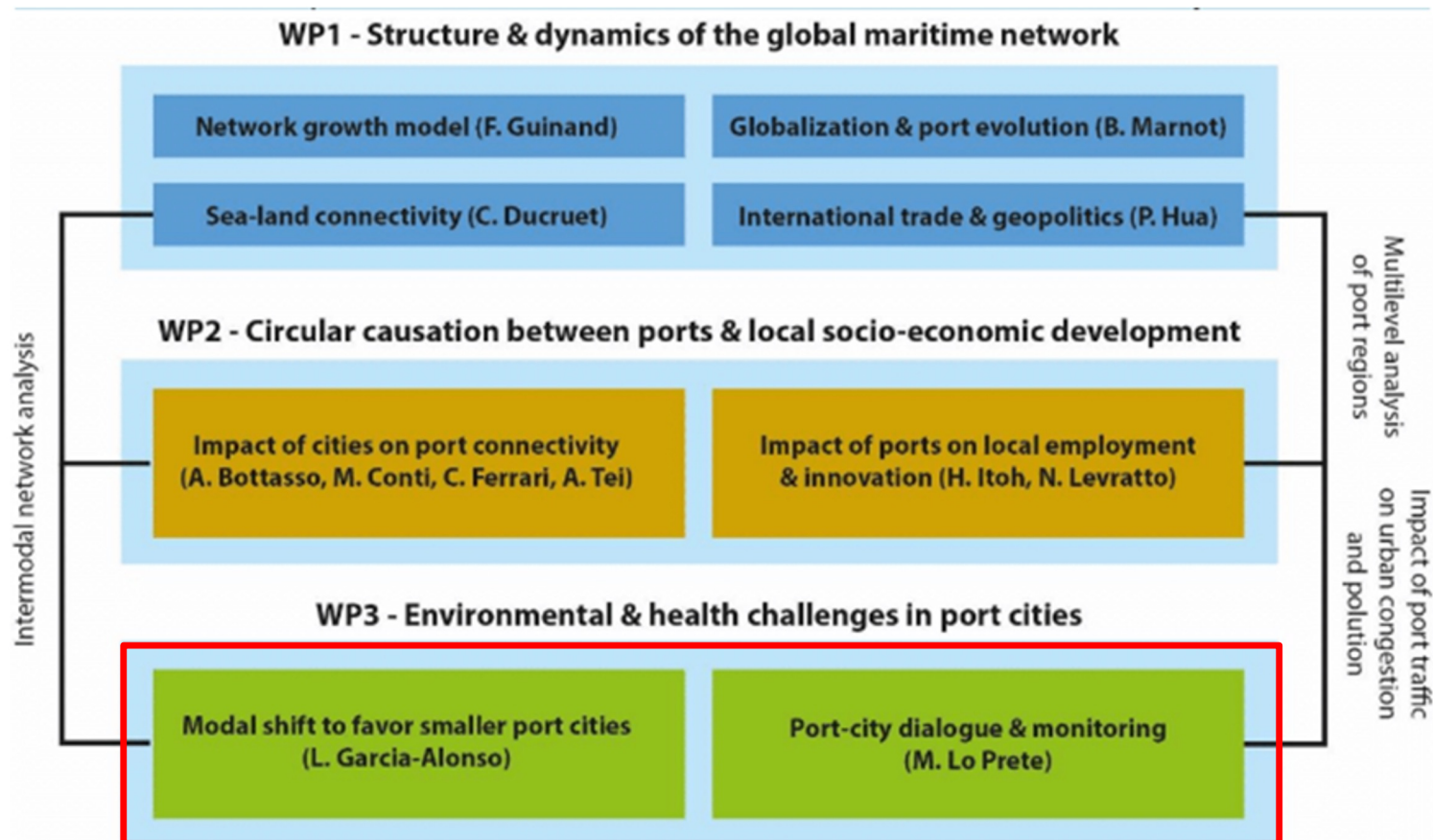
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# Origins of this research

- Work for the World Health Organisation (WHO) on environment and health in European port cities, 2020-2022 (unpublished)
- ANR-funded research project hosted at EconomiX, 2023-2026





# The ANR project 'MAGNETICS' 2023-2026



# Background and research question

- Literature: numerous analyses of shipping and port pollution
  - Increasing number of analyses about urban sustainability
  - Only a handful of papers deal explicitly with ports and health
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- Today's presentation: is having port(s) detrimental to the environmental and health conditions of cities and regions?

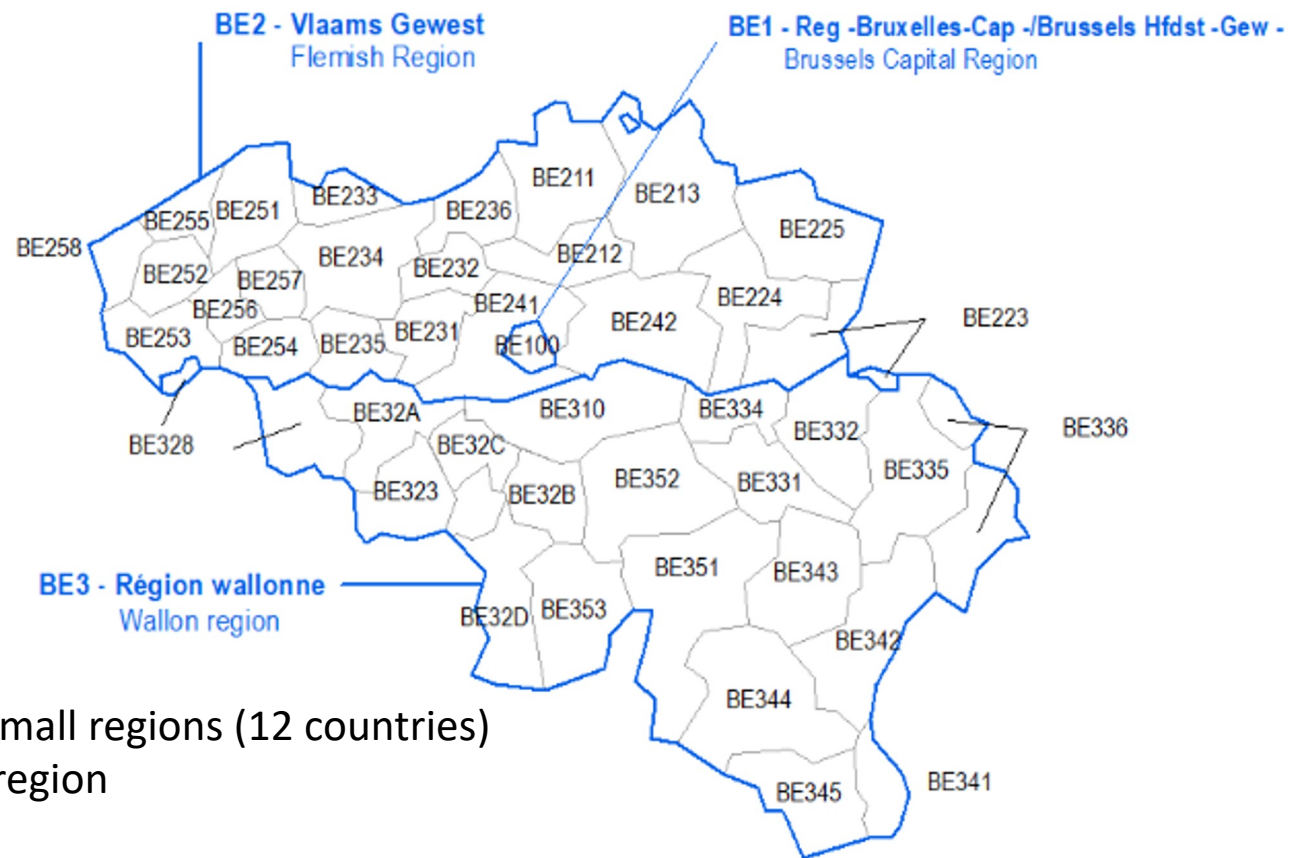
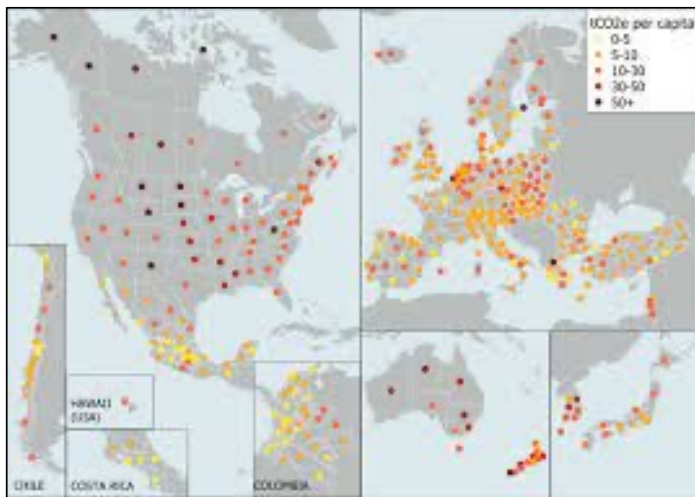
| Characteristics            | Environmental studies  | Health studies   |
|----------------------------|---|---|
| Specialization             | Transport studies (operations research, social sciences) and environmental sciences                       | Medical sciences (e.g. public health epidemiology), interdisciplinary   |
| Methodology                | Measurement and mapping of pollutions considered as health risks  | Cohort studies; model-based analyses; correlation between population exposure to hazards and health; often cross-sectional or ecological design |
| Data and monitoring        | Pollutions and emissions from different sources, geocoding  | Hospital admissions, premature deaths, diseases, socioeconomic status, gender, age, habits  |
| Comparability and timeline | Cross-comparisons, static   | Monographs, time series   |
| Decision support           | Technical and/or organizational solutions, policy implications  | Limited discussion on actors and governance   |
| Health impacts             | Health impacts sometimes implicit but mostly not directly discussed                                       | Health impacts explicit   |

*one common point: studies usually done at the intra-urban level / lack of systematic, quantitative, international analyses*

# A handful of studies on seaports & health

- Civitavecchia (Bauleo et al., 2019) : people living in areas with higher concentrations of PM<sub>10</sub> or NO<sub>x</sub> are younger and have a lower socioeconomic status than in less polluted areas; residents near the port have higher mortality from all cancers and neurological diseases,
- Brindisi (Gianicolo et al., 2013) : health risks (i.e., unplanned hospital admissions) increase for people living under prevailing winds carrying PM<sub>10</sub> and NO<sub>2</sub> and coming from port and industrial areas;
- Taranto (Vigotti et al., 2014) : the district most affected by the port and steelworks (i.e., young age, low socioeconomic status, high deprivation index, and highest SO<sub>2</sub> mean concentration) locates at distance from the port due to topography;
- Eight Mediterranean cities (Viana et al., 2020) : shipping causes fewer premature deaths than vehicular traffic, though emissions from both remained comparable in magnitude;
- U.S. ports (Gillingham and Huang, 2021) : air pollution from U.S. ports affects health outcomes but differ by race, as respiratory hospital visits, heart-related visits, and psychiatric visits are three times higher for Black people than for whites.


# Two levels of analysis: small and large regions



- Study area: OECD countries
- Study period: 2001-2018
- Nearly 5,000 ports
- 245 large regions (26 countries) & 164 small regions (12 countries)
- Merger of ports belonging to the same region
- Collection of « natural data » via GIS

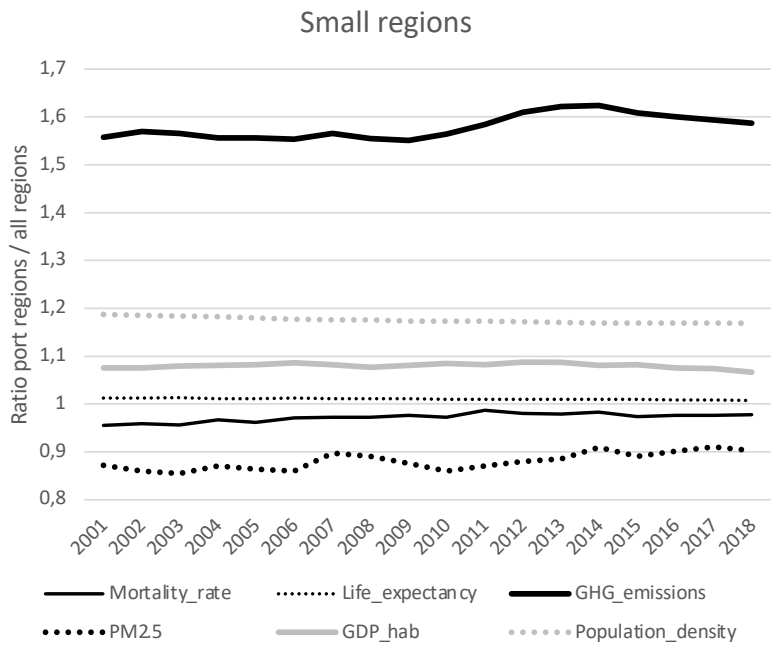
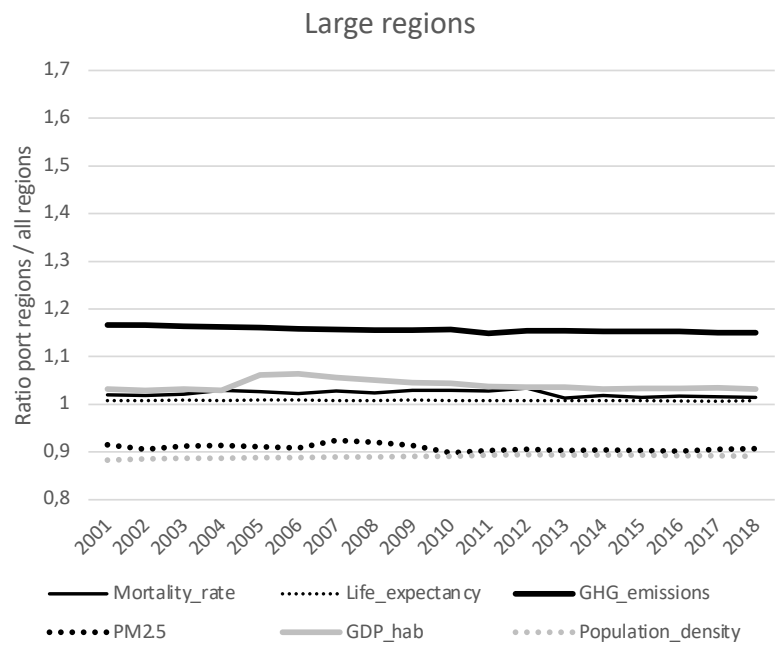
# Database: OECD territorial data + the Lloyd's List


| Category       | Variable  | Description  |
|----------------|---|--|
| Port traffic   | Total vessel traffic  | Gross tonnage (GRT) (LN)   |
|                | Containers, liquid bulks, passengers & vehicles, solid bulks                      | % in regional total  |
|                | Average ship turnaround time  | Average number of days spent by vessels in ports                         |
|                | Port dummy  | 0/1  |
|                | Emission Control Area (ECA)   | 0/1  |
| Geography      | Wind speed  | Knots  |
|                | Precipitations  | 0.01 inches  |
|                | Temperature   | Fahrenheit   |
| Pollution      | Particulate matter (PM <sub>2.5</sub> ) emissions                                 | Average level experienced by the population ( $\mu\text{m}/\text{m}^3$ ) |
|                | Total CO <sub>2</sub> equivalent emissions  | Metric tons (LN)   |
|                | CO <sub>2</sub> equivalent emissions by source (transport, industry)              | % in total emissions   |
| Health         | Mortality rate  | No. deaths per 1,000 people  |
|                | Mortality rate by cause (respiratory system, circulatory system, transport)       | % in total deaths  |
|                | Life expectancy at birth  | No. years  |
| Socio-economic | Gross Domestic Product (GDP) per capita   | \$US per inhabitant (LN)   |
|                | Population density  | No. inhabitants per km <sup>2</sup> (LN)                                 |
|                | Employment in manufacturing, heavy industries & energy, transport & accommodation | % in regional total  |

 *Data changed to location quotients to avoid the country bias*

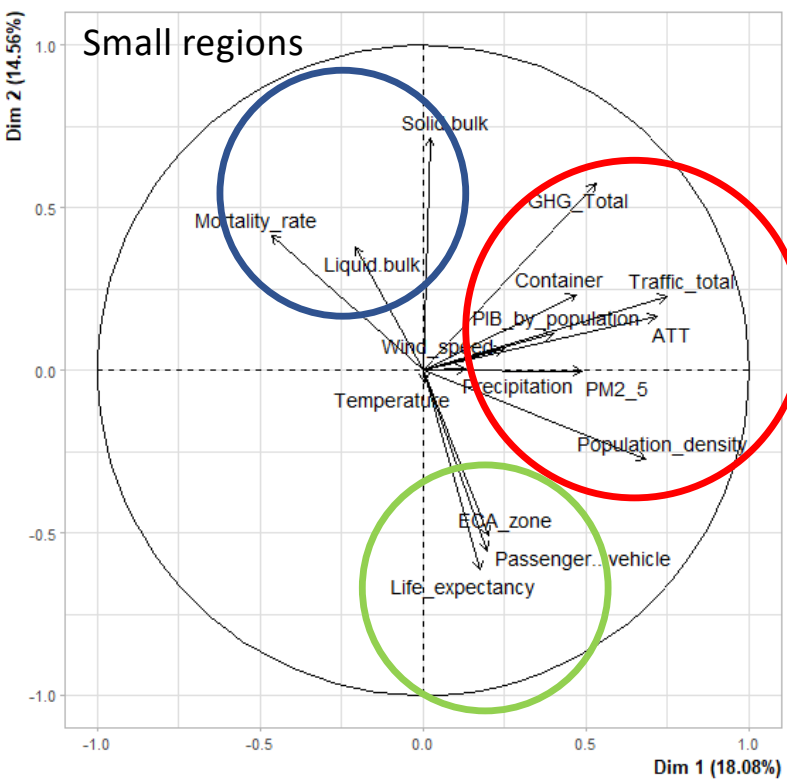
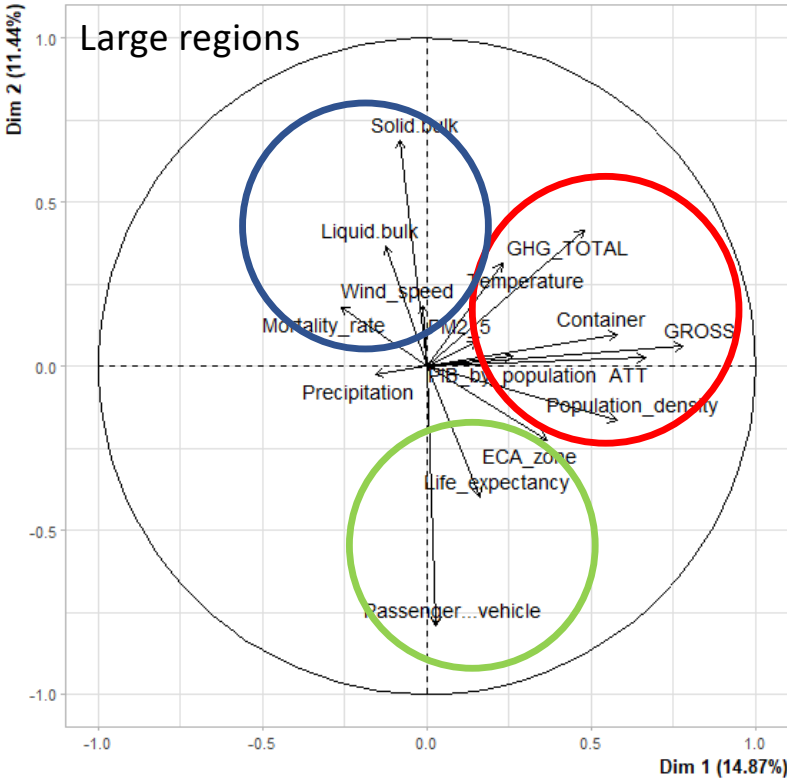


# Port regions are more polluted by GHG...



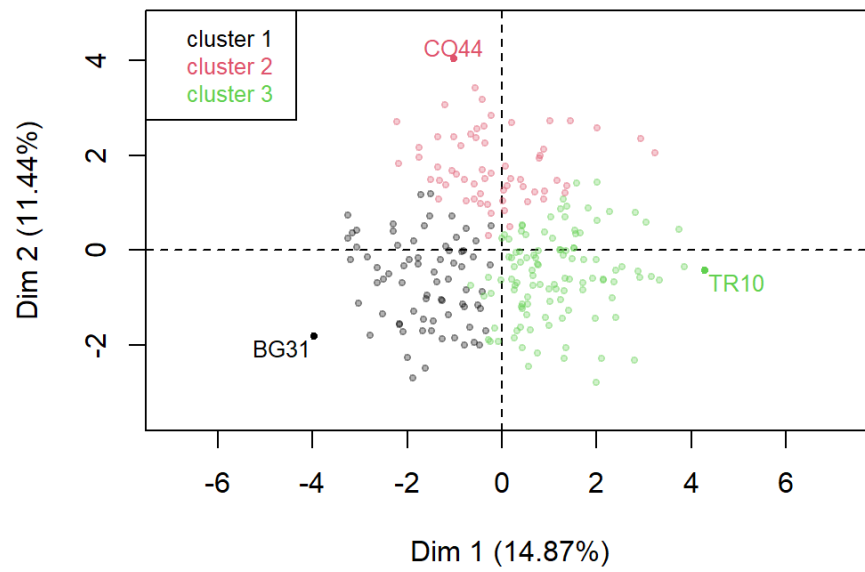
 *Richer and more densely populated (busier)*

# Factor analysis: two main trends

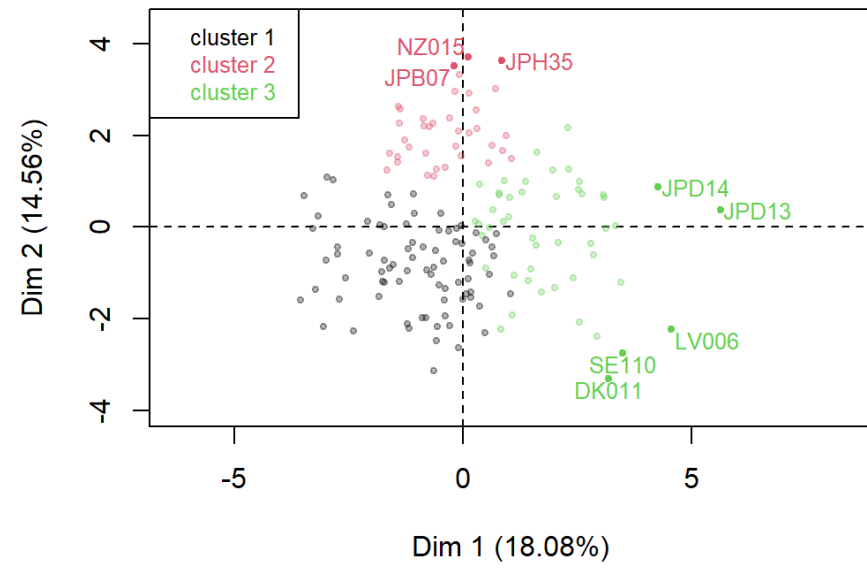


○ Specialization effect    
 ○ Size effect    
 ○ Other effect?

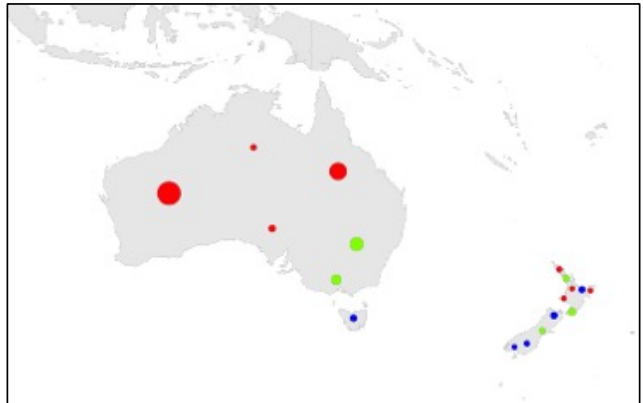
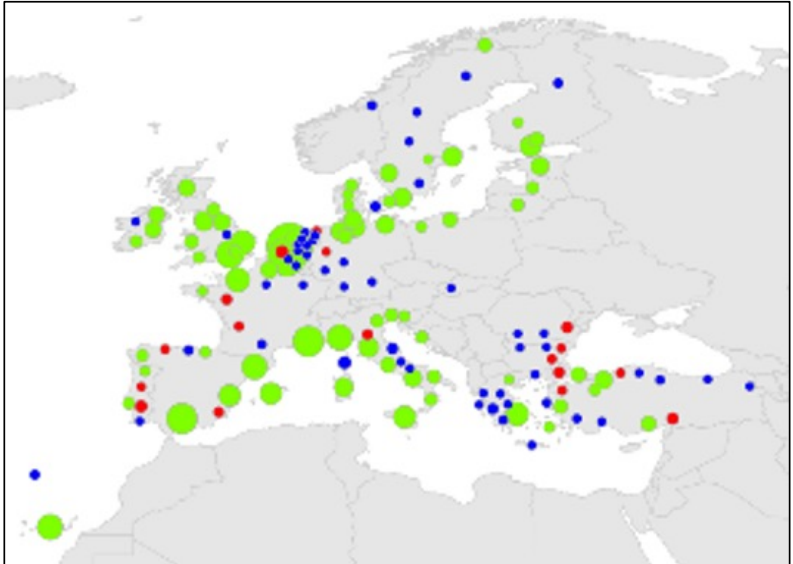
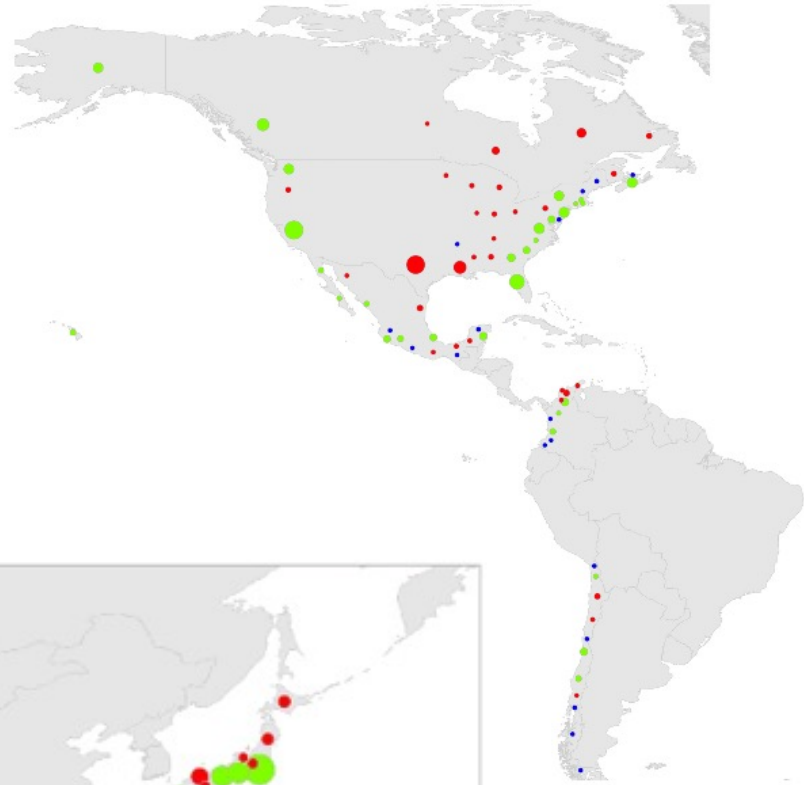
Large regions



Small regions

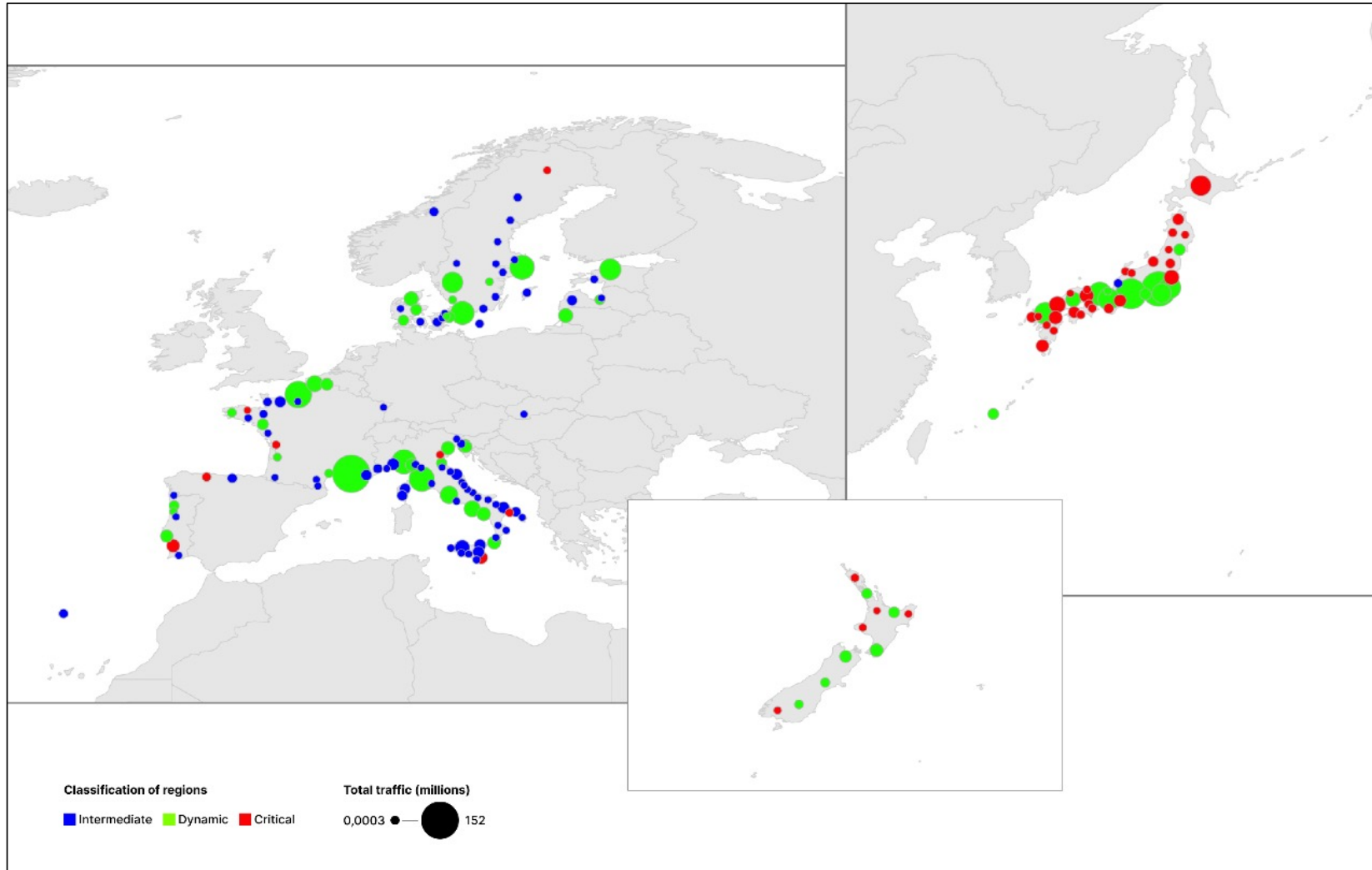


|                     | Large regions        |                           |                       | Small regions        |                           |                       |
|---------------------|----------------------|---------------------------|-----------------------|----------------------|---------------------------|-----------------------|
|                     | Dynamic port regions | Intermediate port regions | Critical port regions | Dynamic port regions | Intermediate port regions | Critical port regions |
| GHG_emissions       | 3.31                 | 2.35                      | <b>3.60</b>           | 2.28                 | 1.38                      | <b>2.57</b>           |
| PM2.5               | 0.94                 | 0.92                      | <b>0.95</b>           | <b>1.01</b>          | 0.87                      | 0.94                  |
| Mortality_rate      | 0.99                 | 1.06                      | <b>1.09</b>           | 0.99                 | 1.09                      | <b>1.22</b>           |
| Life_expectancy     | <b>1.00</b>          | 1.00                      | 0.98                  | <b>1.00</b>          | 0.99                      | 0.98                  |
| Density_population  | <b>1.14</b>          | 0.65                      | 0.69                  | <b>1.01</b>          | 0.40                      | 0.28                  |
| GDP_capita          | 1.00                 | 0.85                      | <b>1.02</b>           | <b>1.02</b>          | 0.79                      | 0.97                  |
| Total_traffic       | <b>17.64</b>         | 13.27                     | 16.29                 | <b>17.01</b>         | 13.60                     | 15.61                 |
| Containers          | <b>24.95</b>         | 6.31                      | 9.48                  | <b>22.45</b>         | 1.58                      | 9.96                  |
| Liquid_bulks        | 12.64                | 16.57                     | <b>27.24</b>          | 12.33                | 14.25                     | <b>24.05</b>          |
| Passengers_vehicles | <b>49.16</b>         | 43.60                     | 12.29                 | 47.64                | <b>51.56</b>              | 21.93                 |
| Solid_bulks         | 7.99                 | 8.50                      | <b>41.76</b>          | 9.04                 | 3.62                      | <b>34.01</b>          |
| ATT                 | <b>12.74</b>         | 7.22                      | 10.49                 | <b>11.50</b>         | 6.71                      | 8.41                  |
| ECA_zone            | <b>0.46</b>          | 0.27                      | 0.20                  | <b>0.32</b>          | 0.28                      | 0.05                  |
| Wind_speed          | 1.00                 | 0.93                      | <b>1.13</b>           | <b>1.21</b>          | 1.06                      | 1.04                  |
| Precipitations      | 0.91                 | <b>1.14</b>               | 0.96                  | <b>1.25</b>          | 0.90                      | 0.90                  |
| Temperature         | 1.01                 | 0.96                      | <b>1.06</b>           | 1.01                 | <b>1.02</b>               | 1.00                  |



**Classification of regions**  
 ■ Intermediate ■ Dynamic ■ Critical

**Total traffic (millions)**  
 0,001 ● 310



# Port impact on pollution and health

## Pollution

- The port dummy has a significant and positive influence on GHG
- But not for PM2.5 : this pollution is de facto lower on the coast due to winds (significant and negative influence of wind speed on PM2.5)
- Higher temperatures foster pollution

## Health

- port dummy has a significant and positive influence on mortality but only for large regions
- PM2.5 lowers the life expectancy

# Traffic impact on pollution and health

## Pollution

- Total traffic: significant and positive effect on GHG emissions
- As well as ship turnaround time
- Negative effect of belonging to an ECA zone
- Solid bulks increase GHG emissions; liquid bulks and passenger traffic increase PM2.5

## Health

- Total traffic increases mortality for all regions, but lowers life expectancy for small regions only
- Average ship turnaround time increases mortality and decreases life expectancy



*Thanks for your attention !!*

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