



**Assessment of ship traffic emission impact
on air quality in the port cities.**

Examples of St.Petersburg and Tallinn.

**City of St.Peterburg,
Head of department for state
regulation in the field of environment
protection**

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A new environmental policy of St.Petersburg by the year 2030 was approved by the city Government 18 June 2013

Prevention of ambient air pollution and reduction
of negative impact on the ambient air are the
first priorities declared by the document.



Air quality is one of the most sensitive aspects of environment protection in St.Petersburg

2500 companies had more then 4500 valid environmental permits for air emission in 2011.

Industrial sources emit about 450 compounds.

About 1700 thousand vehicle were registered in St.Petersburg in 2011.

24 584 ships visited cargo and passenger ports of St.Petersburg in 2011.



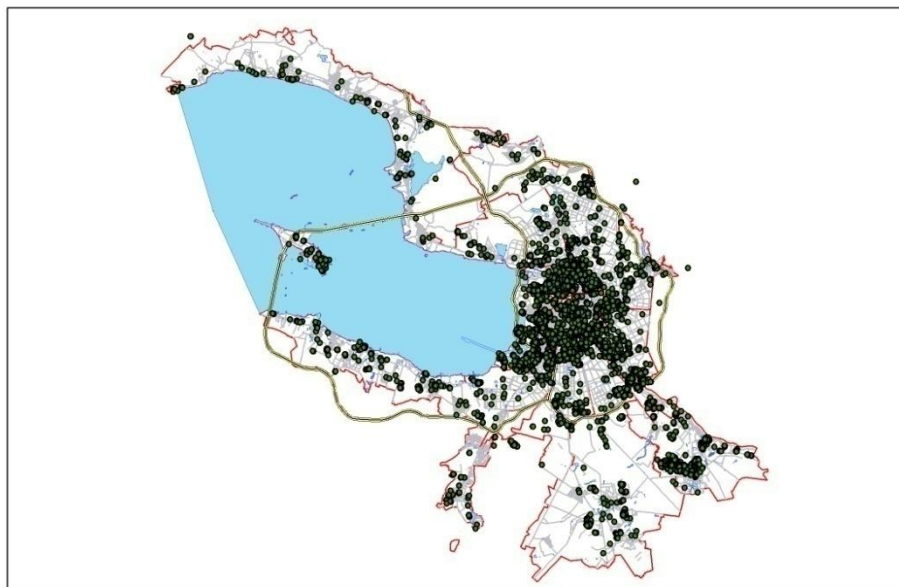
Emission sources database by the end of 2011

Industrial emission sources

25344 sources
134024 ton/year

Transport emission sources

1437 road sections
67245 ton/year



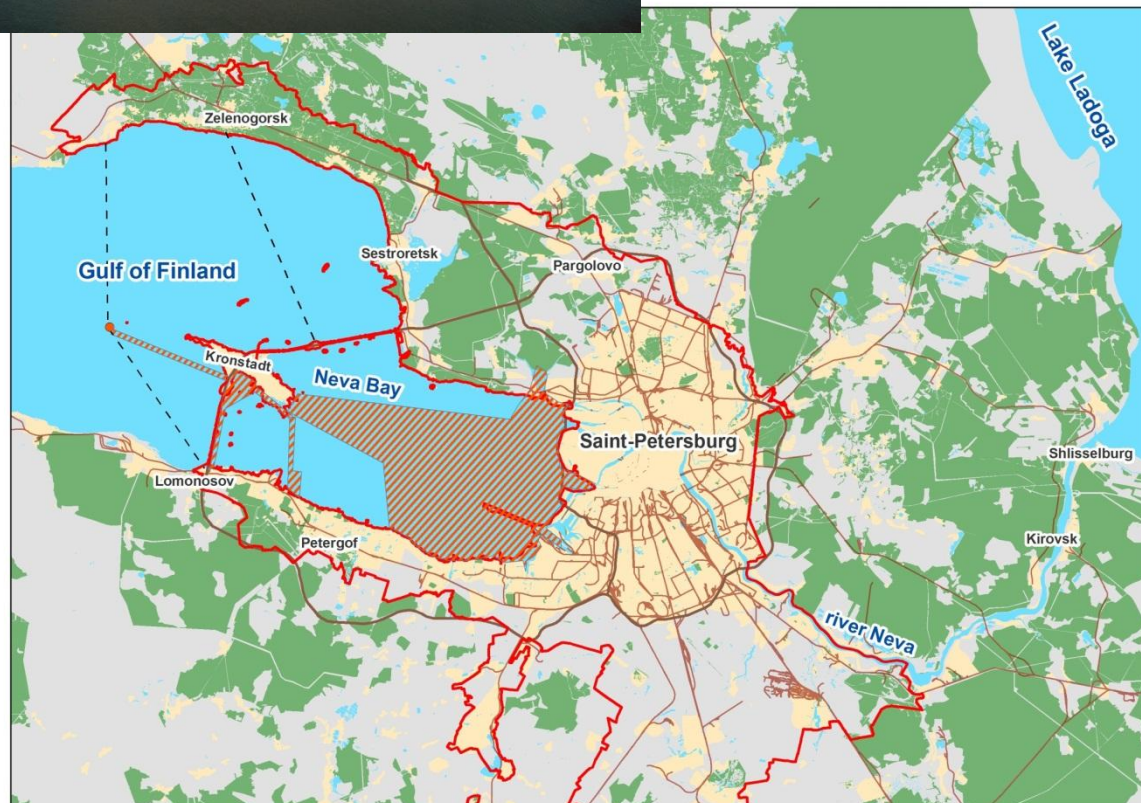
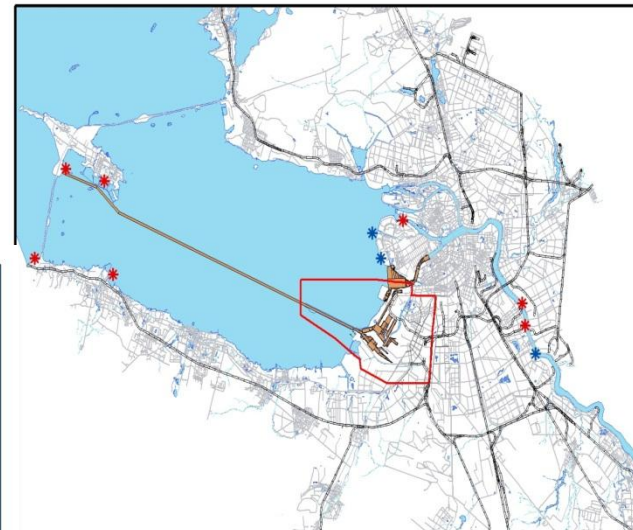
**11% of people complaints
in St.Peterburg are related
to air quality.**



Water areas with intensive ship traffic in St.Petersburg.



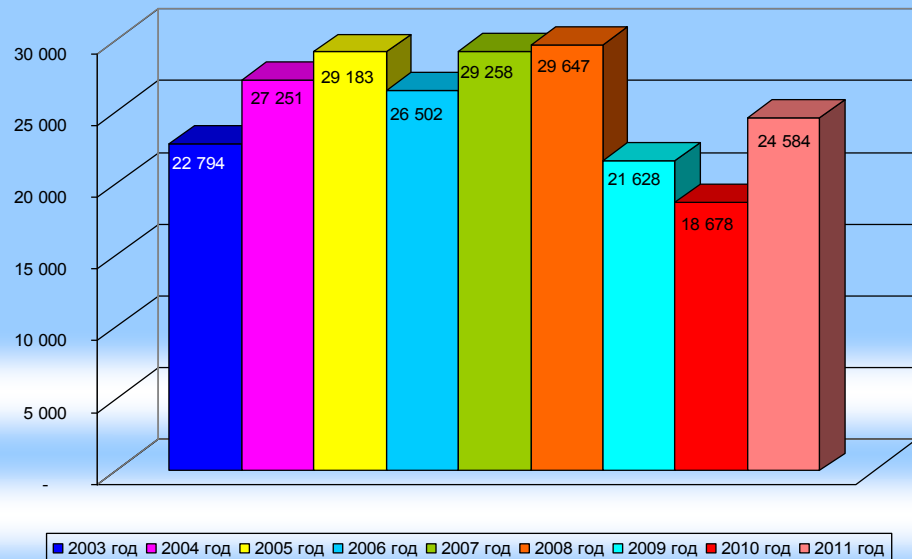
Preliminary data on ship emission sources within the border of St.Petersburg





Ship traffic intensity in the Sea port of St. Petersburg between 2003 - 2011

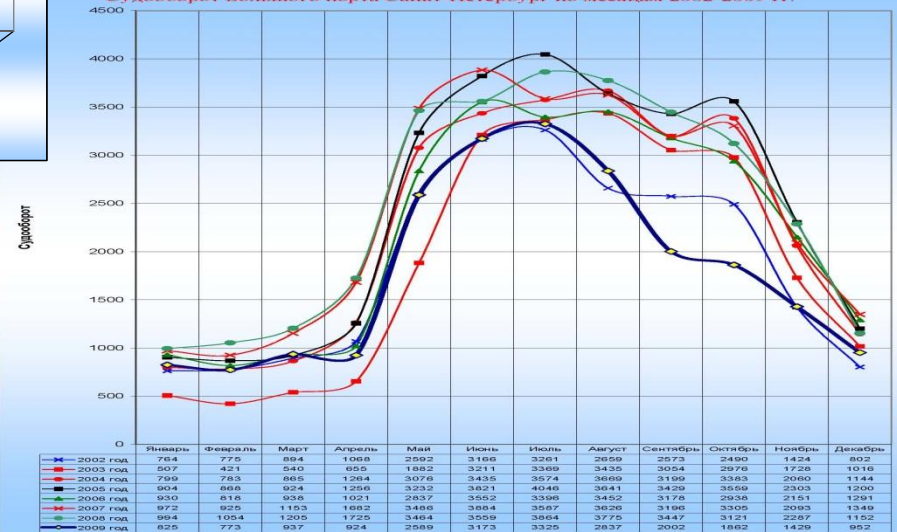
Годовой грузооборот 2003-2011 г.



20-30 thousands ships
annually call the Sea
cargo port of SPb

70-80% of ships come to
the Sea port in the period
from May to October.

Судоборот Большого порта Санкт-Петербург по месяцам 2002-2009 гг.





Sea passenger ships:

2008 - 362 ships,

2009 - 337 ships,

2010 - 430 ships,

2011 - 659 ships



River cruisers:

2009 - 785 ships,

2010 - 771 ships,

2011 - 1548 ships

River class cargo ships:

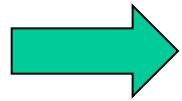
2008 - 7 493 ships,

2009 - 6 919 ships,

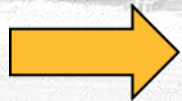
2010 - 8 869 ships,

2011 – 7 022 ships





Traditionally ship emission inventory was based on fuel consumed by ships in the region.



New methodology takes into account:

- **ship type and type of its energy unit**
- **power of main or auxiliary engine which provides regime of ship movement**
- **fuel type**
- **emission factors**



Methodology of calculation of the mass of pollutants, emitted to the ambient air of St.Petersburg by ship traffic (Decree of the Committee for nature use, environmental protection and ecological safety of St.Peterburg 05.06.2012 N 102-p).



Calculation of emissions of the individual ship

Mass of the pollutant emitted to the air by one ship calling St.Petersburg area is:

$$M_i = P \cdot e_i \cdot T$$

- *P (kWt) – power consumption needed for the certain regime of propulsion;*

- ***e_i (g/kWt-h) – emission factor of the pollutant i ;***

- *T (hour) – time of the ship motion.*



Assessment of vessels by tonnage.

- 1. Vessels have tonnage less then 1000 t**
- 2. Vessels have tonnage within the range of 1000-3000 t**
- 3. Vessels have tonnage within the range of 3000-5000 t**
- 4. Vessels have tonnage within the range of 5000-15000 t**
- 5. Vessels have tonnage within the range of 15000-50000 t**
- 6. Vessels have tonnage within higher then 50000 t**





1). Passage of vessels via the Access Channel.

Access Channel runs from the town of Kronstadt (navigation gates of the rim highway) up to direct entrance into the port's inner water area. Each vessel's passage time was assumed to be equal to 2.5 hours, given the speed of 10 knots (approximately 20 km/hr).

2). Mooring (shifting) of vessels in the port's water area.

The time of each mooring operation was assumed to be equal to 30 min., given that the vessels of less than 5 000 t do not use harbour tugs for mooring.

Vessels of 5 000 to 50 000 t use for mooring (shifting) 2 harbour tugs each.

Vessels of over 50 000 t use for mooring (shifting) 3 harbour tugs each.

3). Vessels berthed in the port.

The average port quay berthing time for all types of vessels was assumed to be equal to 36 hours. Ships use auxiliary engines idling at the berths.



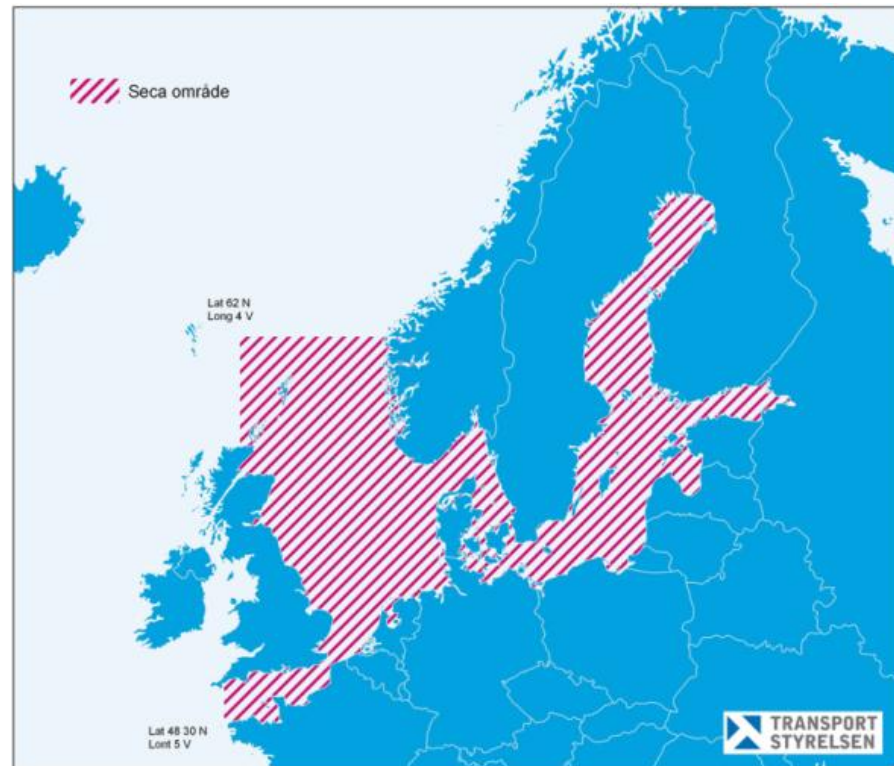
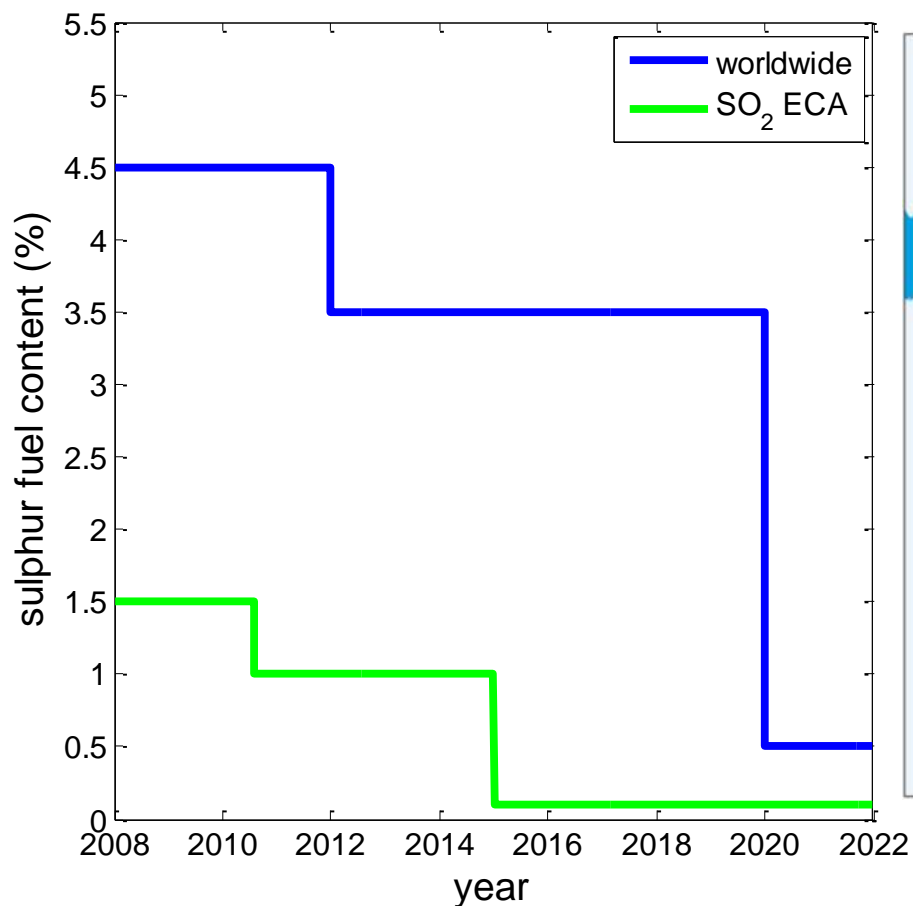
Sulfur content in fuel

1,0 % sulfur concentration in fuel used by 30%
of ships.

0,17 % sulfur concentration in diesel used by
70% of ships.



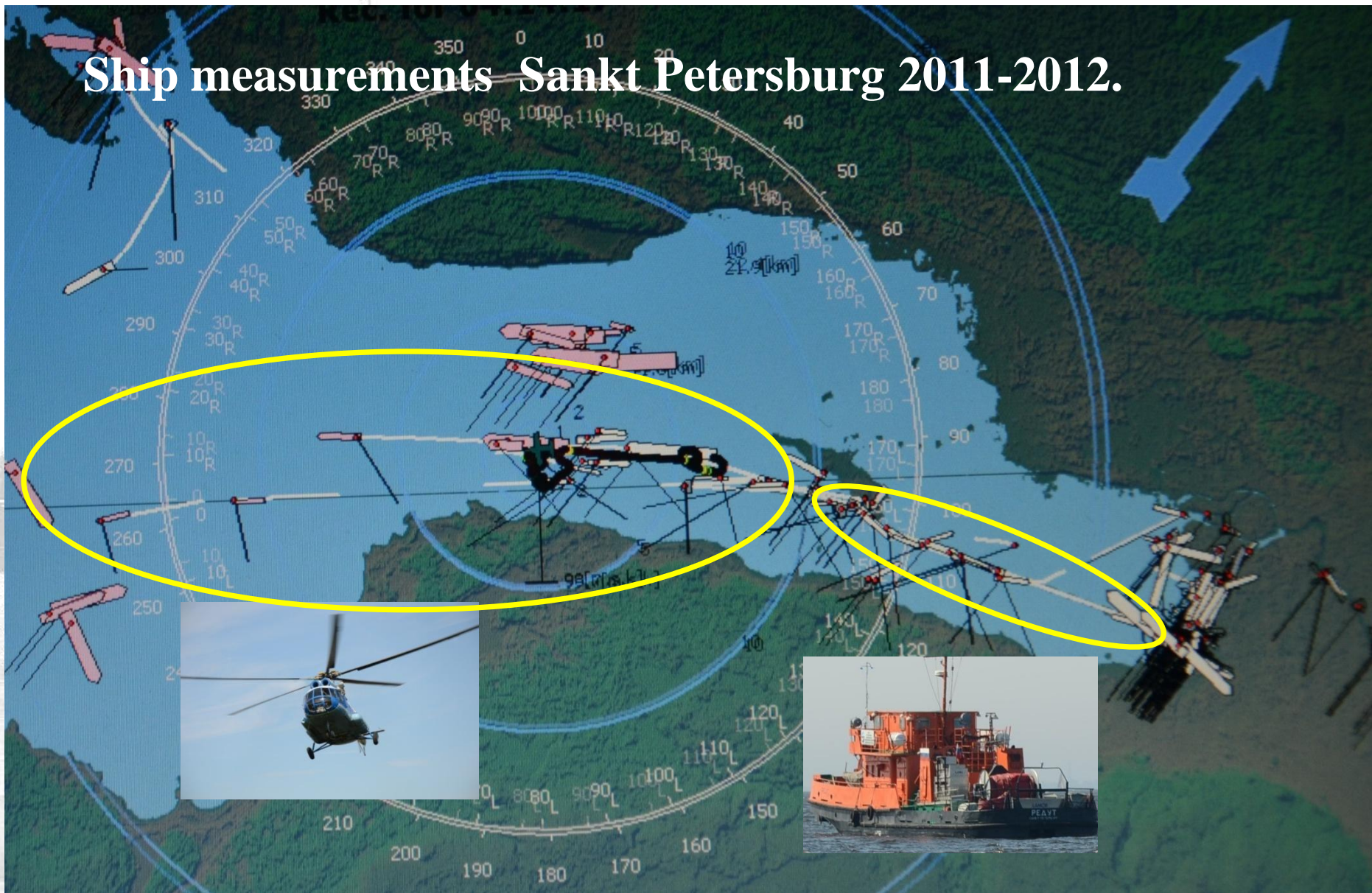
Limit of **sulfur fuel content** for ships (IMO, MARPOL Annex VI) and EU directive 2012/33/EU



Sulfur Emission Control Area

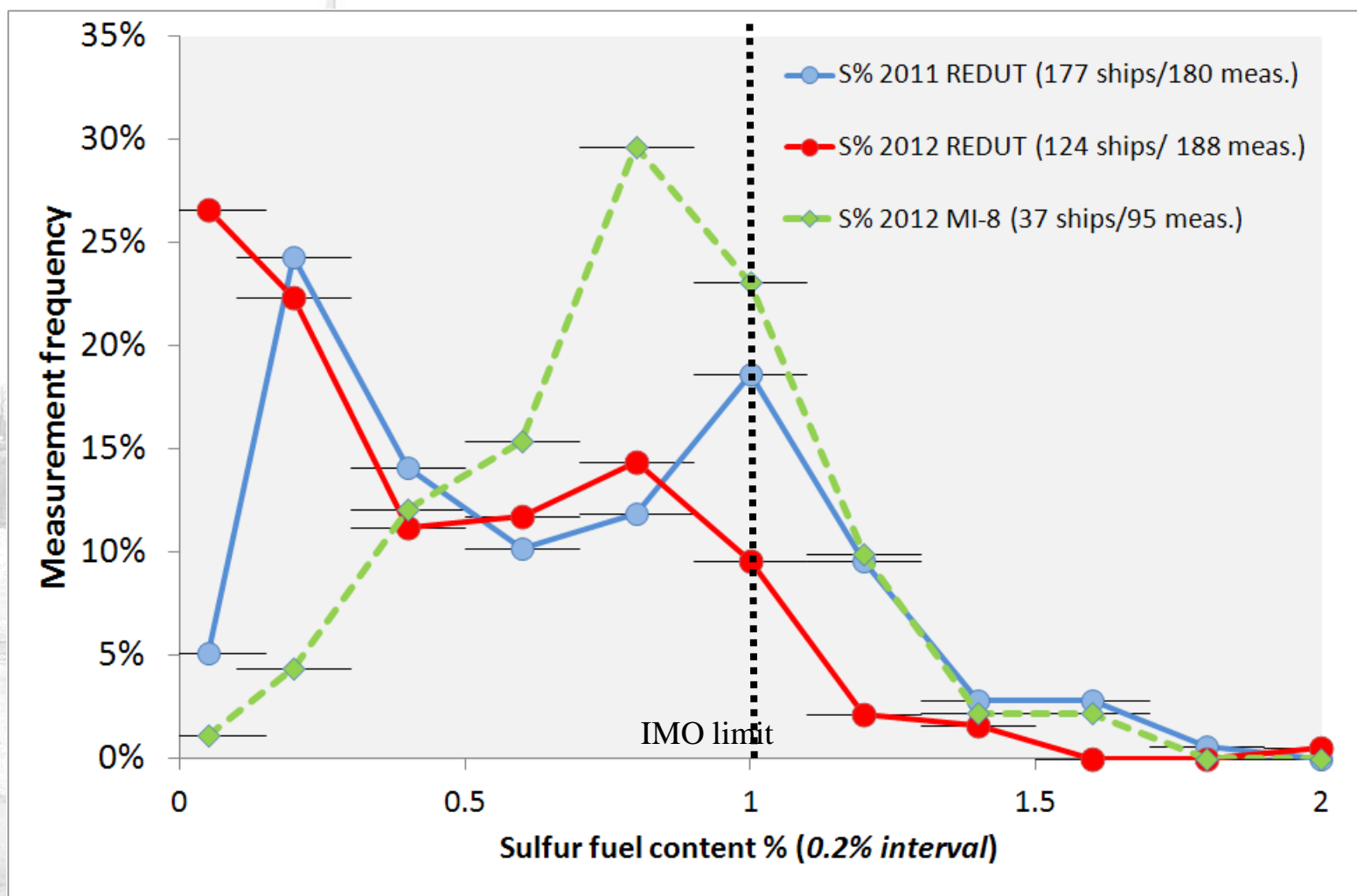


Ship measurements Sankt Petersburg 2011-2012.





Sulfur fuel content for ships in Neva bay and Gulf of Finland 2011 and 2012 measured from M/S Redut and MI-8 helicopter





Contribution of the different emission sources to total emissions in St.Petersburg in thousand tons

Industrial emissions	Car traffic emissions	Ship traffic emissions	Emissions from railway transport
134	67	14	3



Total emission of ship traffic in St. Petersburg area (tonnes per year).

Pollutant	Sea ships	River cargo ships	River cruis ers	Local river boats	Total
NO_x	7 502	692	273	1 163	9 630
CO	1 619	256	82.3	796	2 753
CH	310	56.7	20.5	140.8	528
C	303	57.9	17.0	92.0	470
SO₂	485	66.8	5.3	45.9	603



Annual emissions of selected ports in Finland (t/y)

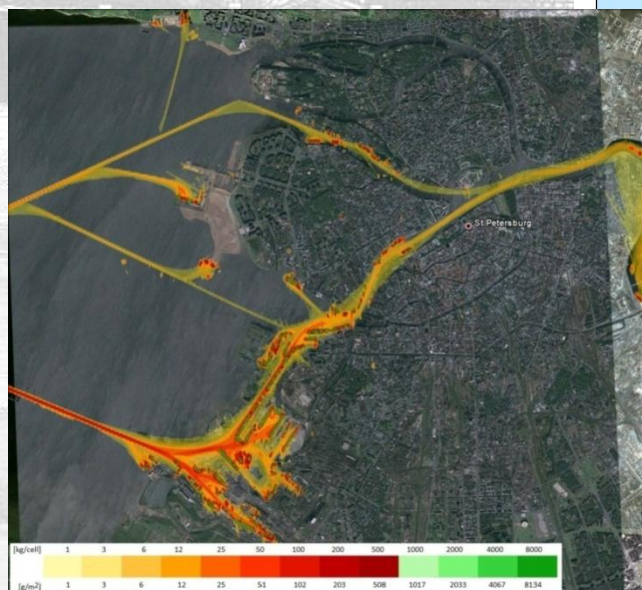
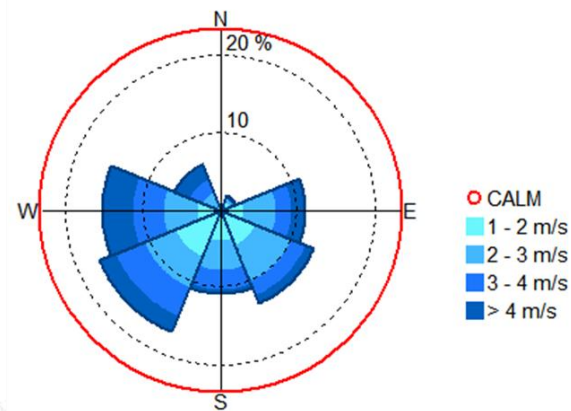
Ports	Nitrogen oxides (NO _x)	Sulphur dioxide (SO ₂)
Helsinki	1 763	190
Turku	694	81
Mariehamn	751	93
<i>All Ports in Finland</i>	<i>7 030</i>	<i>723</i>
<i>St.Petersburg</i>	<i>9 630</i>	<i>603</i>

Emission data for the ports of Finland 2009



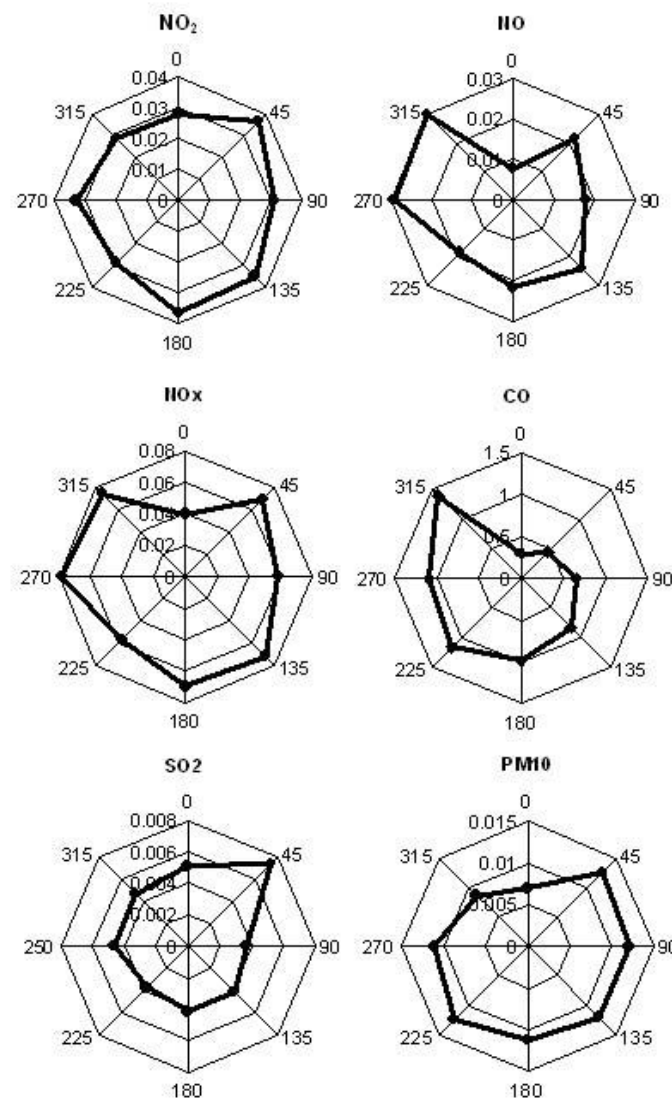
Automatic measuring station in the vicinity of the Sea port of St.Petersburg

Wind Rose, St. Petersburg 20.6. – 13.11.2011



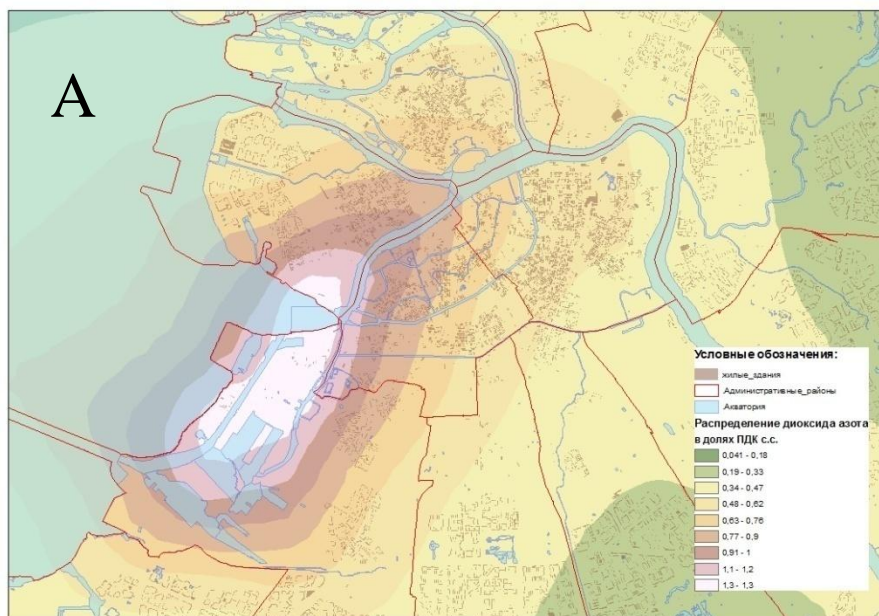


Diagrams of pollutants concentrations measured in the vicinity to the Sea port of St.Petersburg (mg/m³).

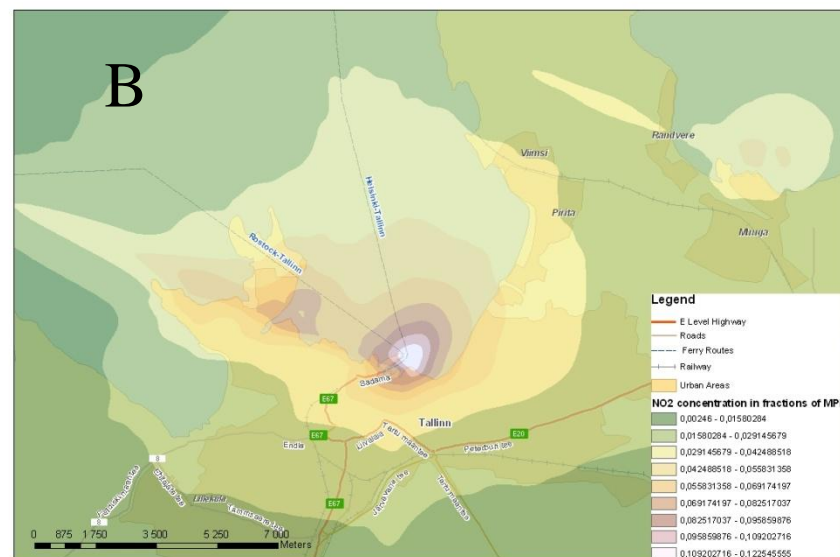




Dispersion of NO₂ emitted by ship traffic in St.Petersburg A and Tallinn B.



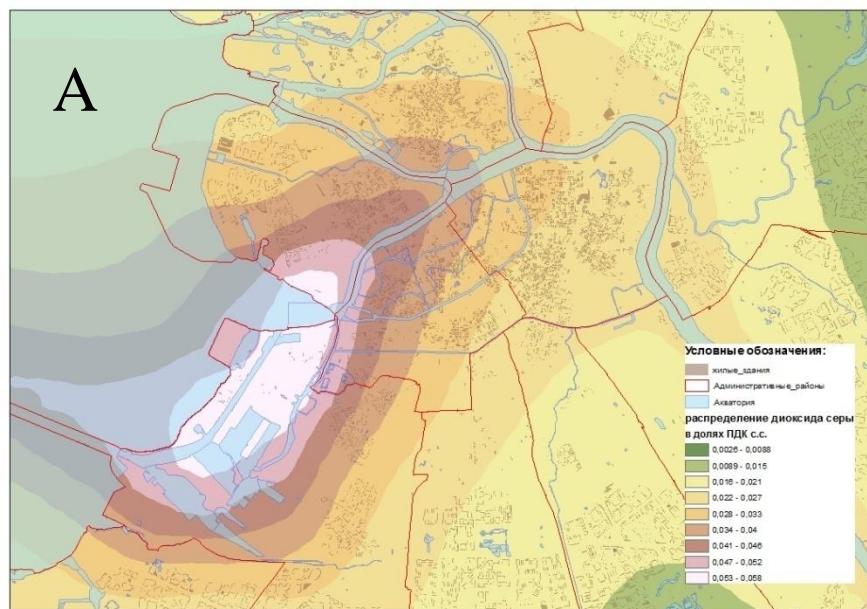
maximum = 52 $\mu\text{g}/\text{m}^3$



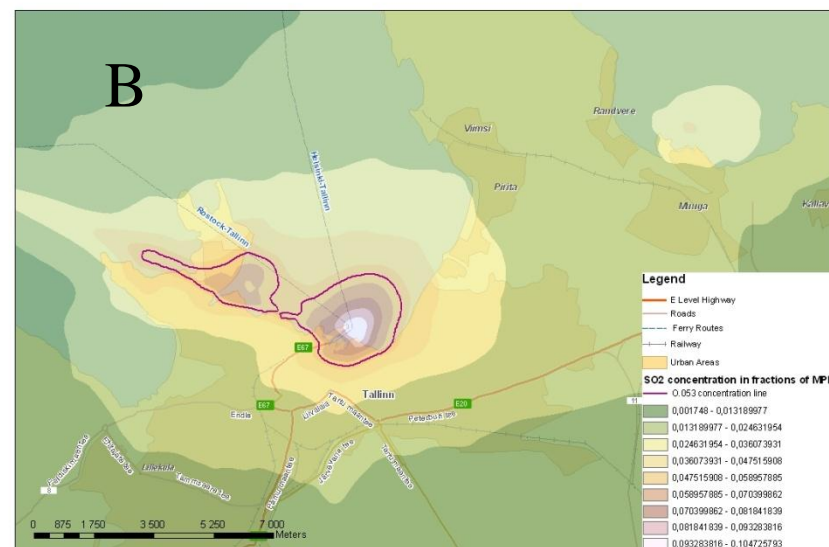
maximum = 4 $\mu\text{g}/\text{m}^3$



Dispersion of SO₂ emitted by ship traffic in St.Petersburg A and Tallinn B.



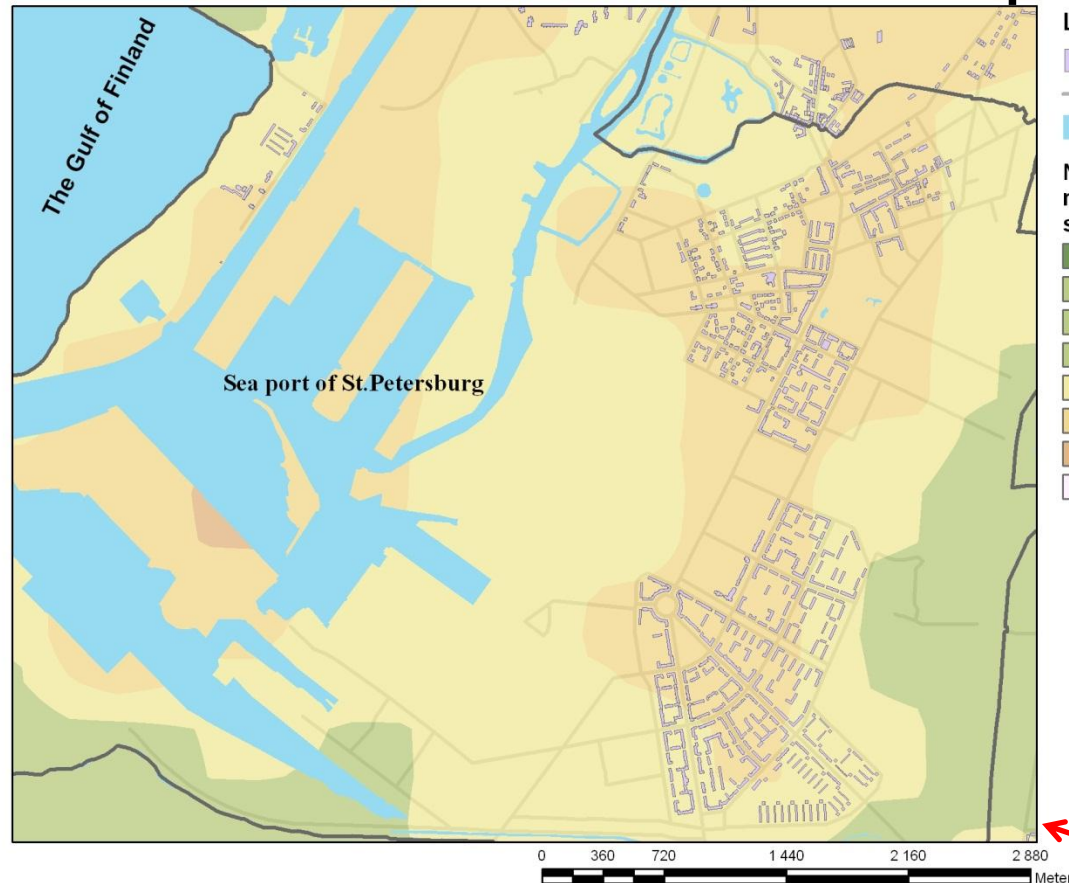
maximum = 2.9 $\mu\text{g}/\text{m}^3$



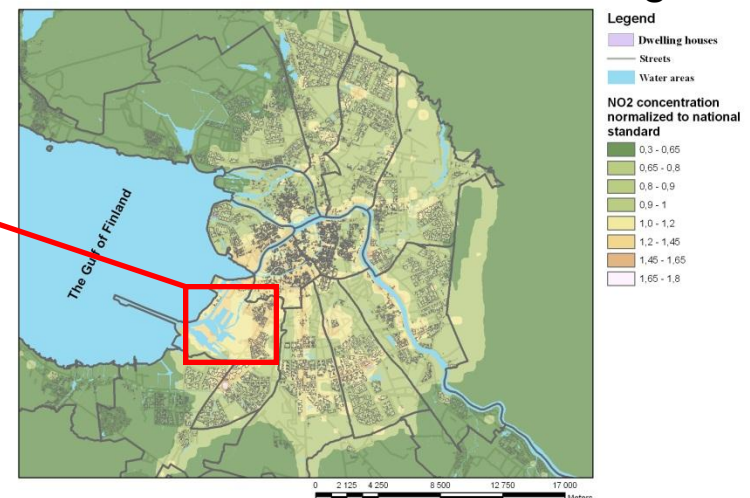
maximum = 5 $\mu\text{g}/\text{m}^3$



St.Petersburg city population exposed to NO₂ emitted by ships calling the Sea port.



NO₂ annual average concentration in St.Petersburg.



91.5 thousand people live in 576 houses located within the area with high NO₂ concentration.



Outcomes

- Ship traffic is identified as the third important source of emissions in St.Petersburg.
- The ship emission inventory methodology developed in St. Petersburg provides reliable annual average emission data.
- The methodology of the ship emission inventory developed in St. Petersburg has to be improved in order to provide short-term emission.
- Remarkable contribution of ship traffic in CO and NO_x pollution of the city area is indicated. SO₂ and PM₁₀ impact is negligible.
- As far as Sea Port of St.Peterbusrg is located nearby the city centers about 100 thousand people are exposed to the emissions.
- International cooperation is powerful tool for reduction of the negative impact of ship emissions.
- Monitoring of the environmental effectiveness of the new international regulations enacted in the Baltic sea has to be done.



Thank you !

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