



Ilmanlaadun kaukokartoitusvainiot Suomessa

Iolanda Ialongo (FMI)

Email: iolanda.ialongo@fmi.fi

Hakkarainen, J., Jalkanen, J.-P., Johansson, L., Tamminen, J. (FMI),
Boersma, F. (KNMI), Krotkov, N. (NASA)



Outline

- Motivation
- OMI NO₂ observations in Finland
- Applications
 - urban emission estimation
 - ship emissions monitoring



Motivation

Sources

Forest fires



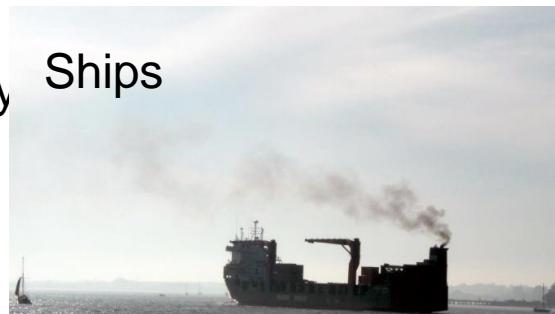
Car traffic



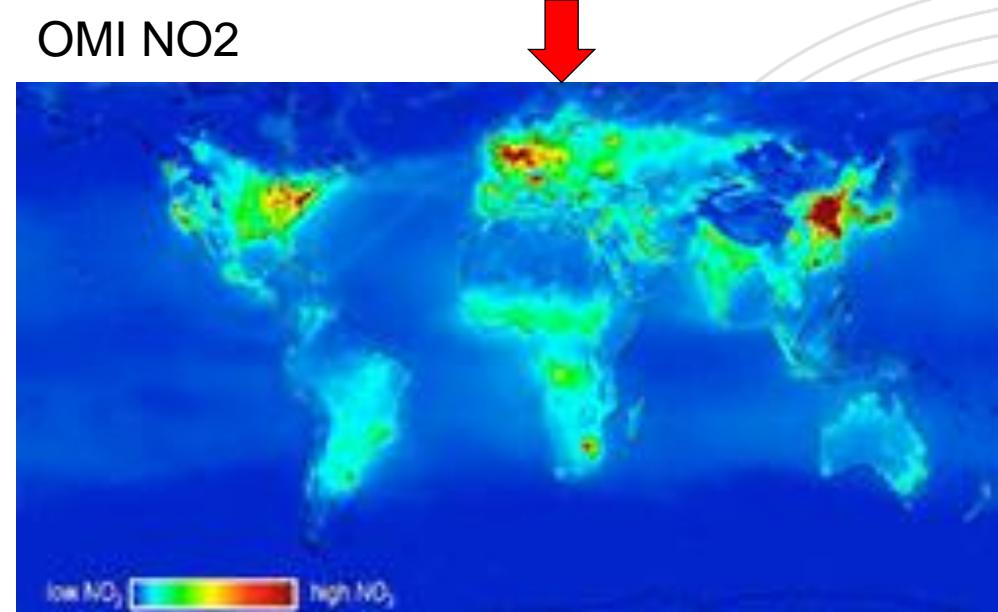
Industry/power plants/extraction activity



Ships



OMI NO₂

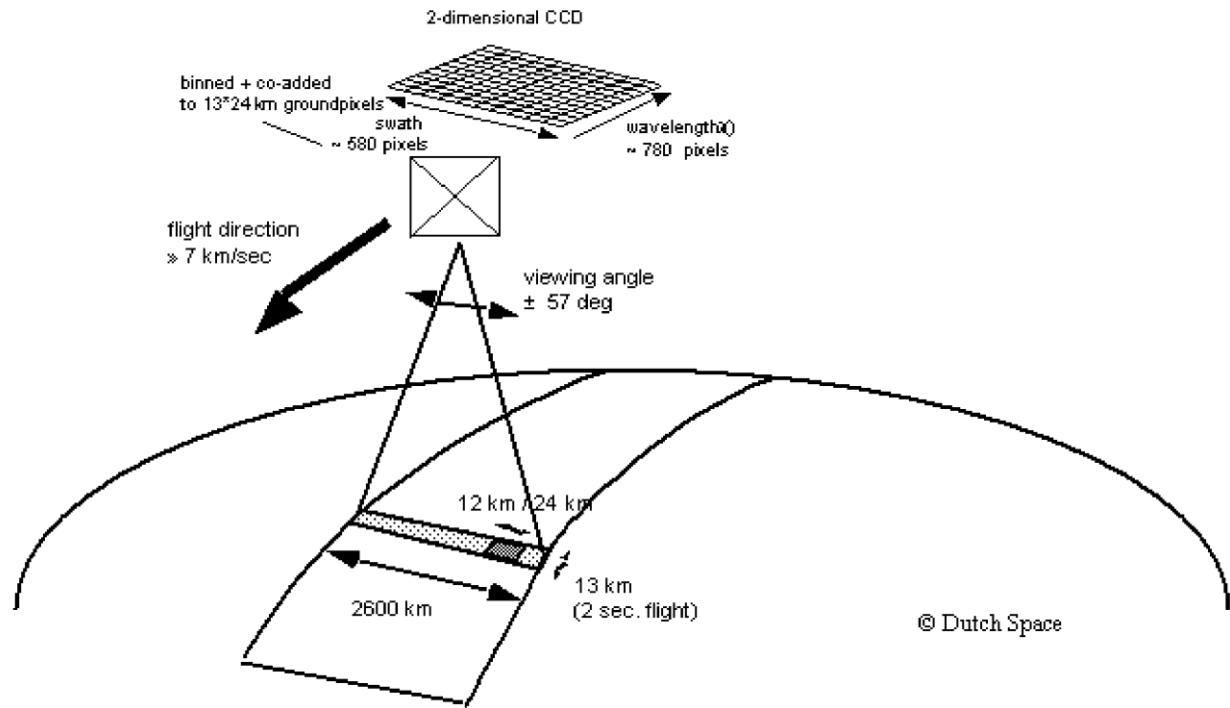


- Increasing interests in high latitude regions.
- Are satellite data applicable under critical situations (i.e. low solar angle, no illumination, signal close to the detection limit)?
- New emission regulation upcoming for shipping in Baltic Sea.



Ozone Monitoring Instrument

Products: O₃, solar UV, **NO₂**, SO₂, aerosol and clouds.

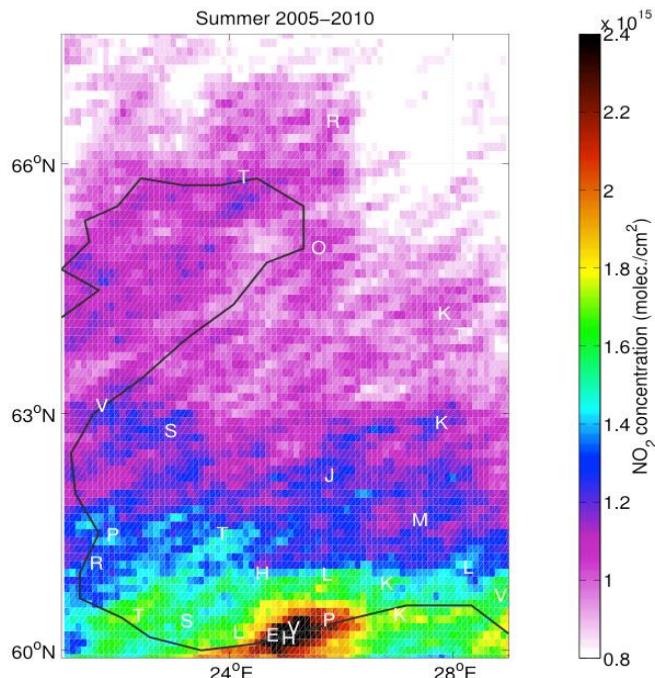


- Operational on **NASA EOS-AURA** satellite from July 2004
- Sun-Synchronous **polar orbit** (overpass: 13:45 LT – almost daily global coverage)
- **spatial resolution** 13km x 24km (nadir)



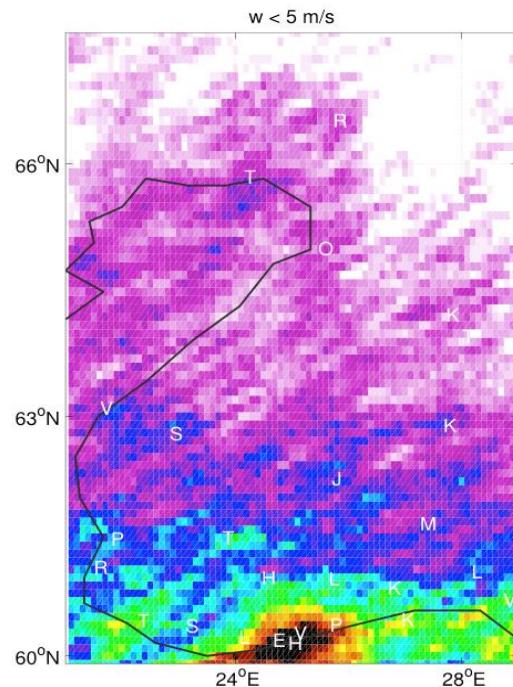
NO₂ sources identification in Finland

1. High resolution NO₂ maps can be derived using multiple pixels averaging techniques.



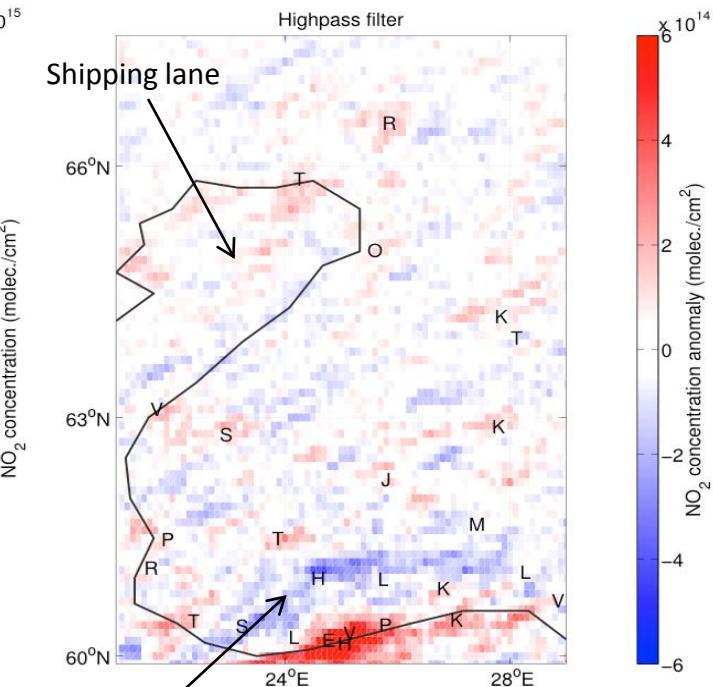
The main cities are marked by their initial

2. Considering only weak wind conditions, helps in detecting the NO₂ sources



Some information can be lost removing the background

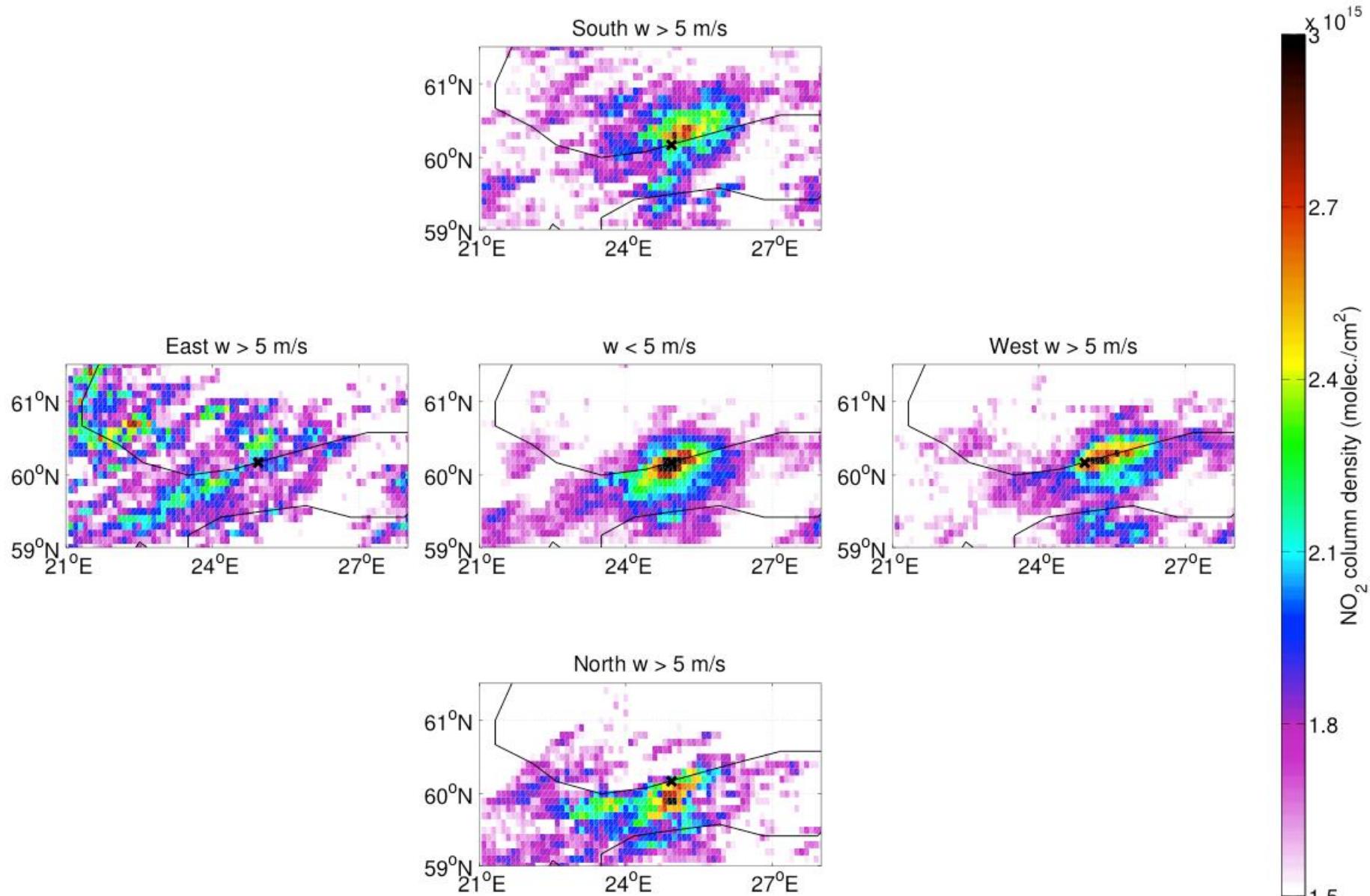
3. Subtracting the local background from the NO₂ values, further enhances the NO₂ signal.



Red pixels indicate NO₂ levels higher than the local background.



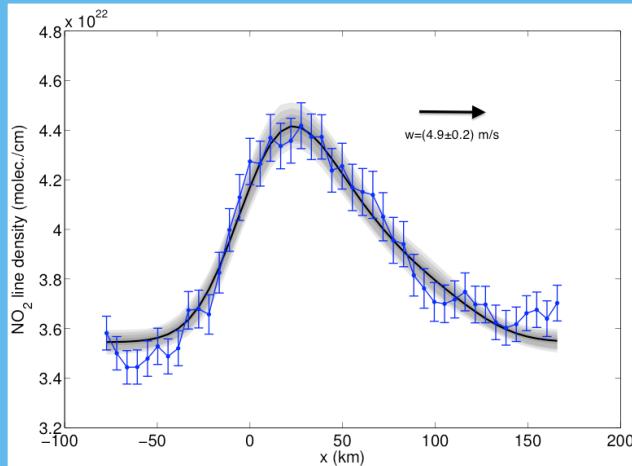
OMI NO₂ in Helsinki: effect of wind





OMI NO₂ in Helsinki: effect of wind

Fitting linear density



Fitting model $M(x) = E \cdot e \otimes G + B$

x distance from the city center

E burden parameter

e exponential function
with e-folding distance x_0

G Gaussian function

B background

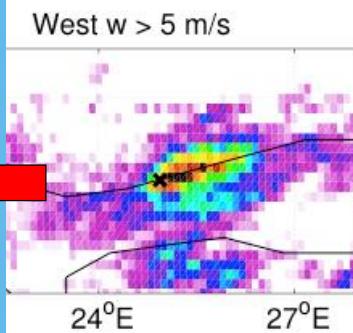
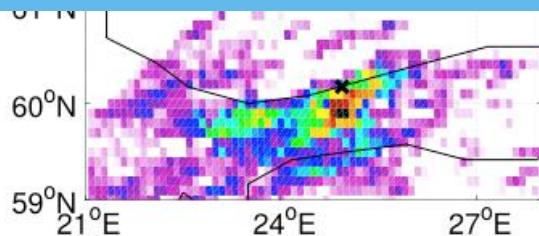
$\tau = x_0/w$ lifetime

(w = eastward mean wind speed)

$E' = E/\tau$ emission parameter

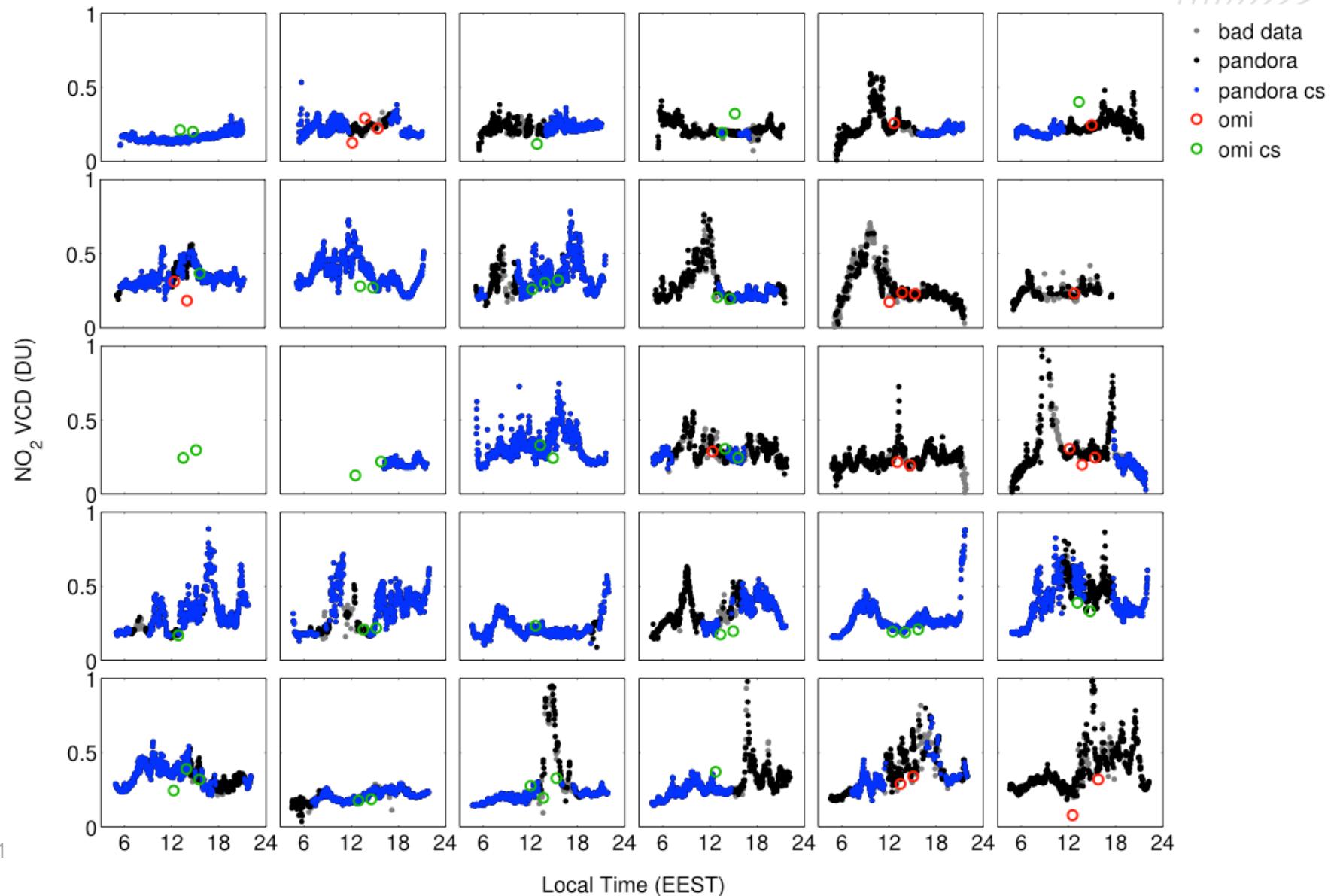
Life time: $\tau = (3.0 \pm 0.5) \text{ h}$

Emission: $E' = (1.5 \pm 0.6) \text{ mol/s} \rightarrow \text{EMEP database } E' = (1.8 \pm 0.3) \text{ mol/s}$



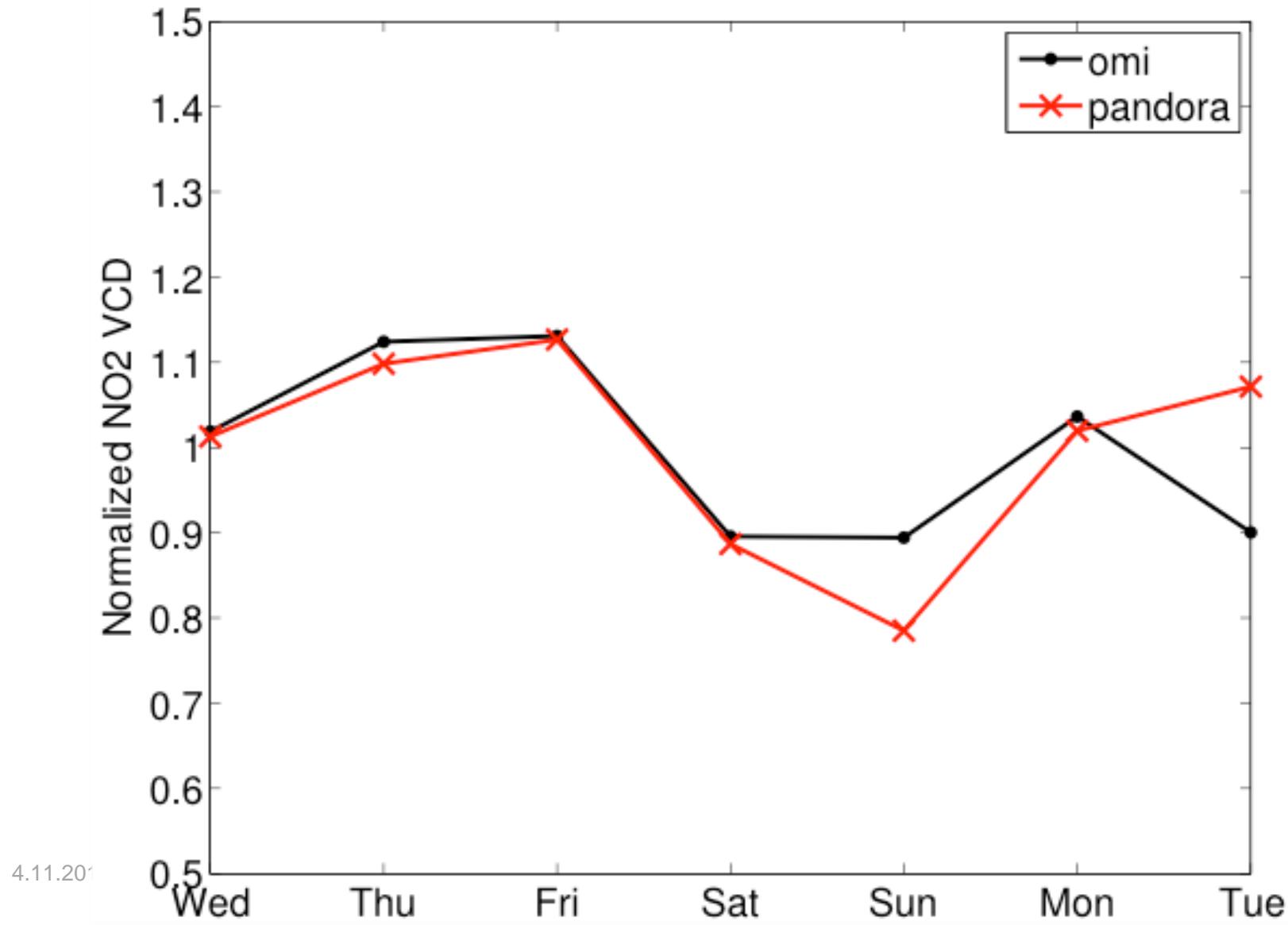


OMI NO₂ validation in Helsinki





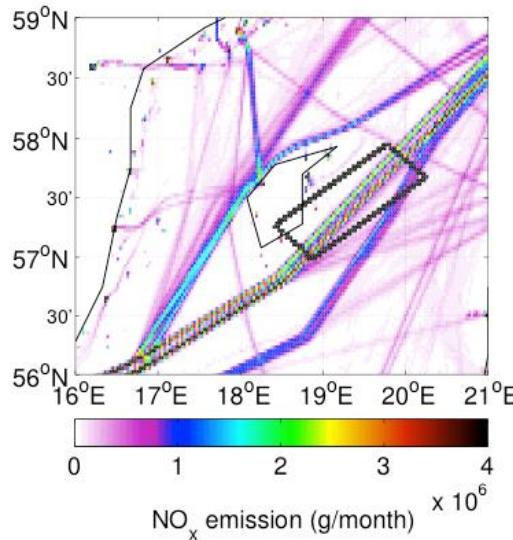
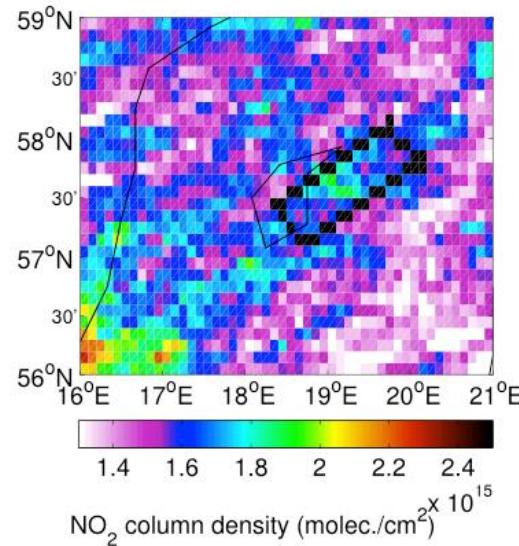
NO₂ weekly cycle in Helsinki



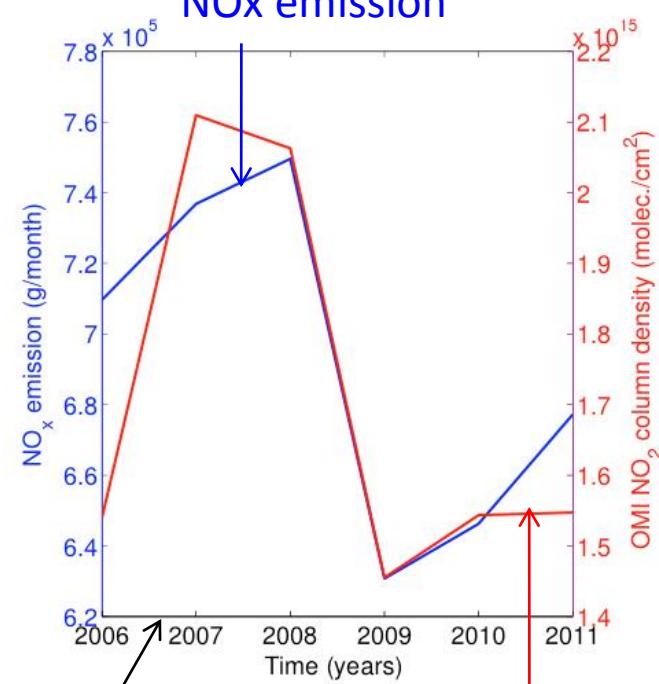


Ship emission over Baltic sea

STEAM NOx emission

OMI NO₂

NOx emission



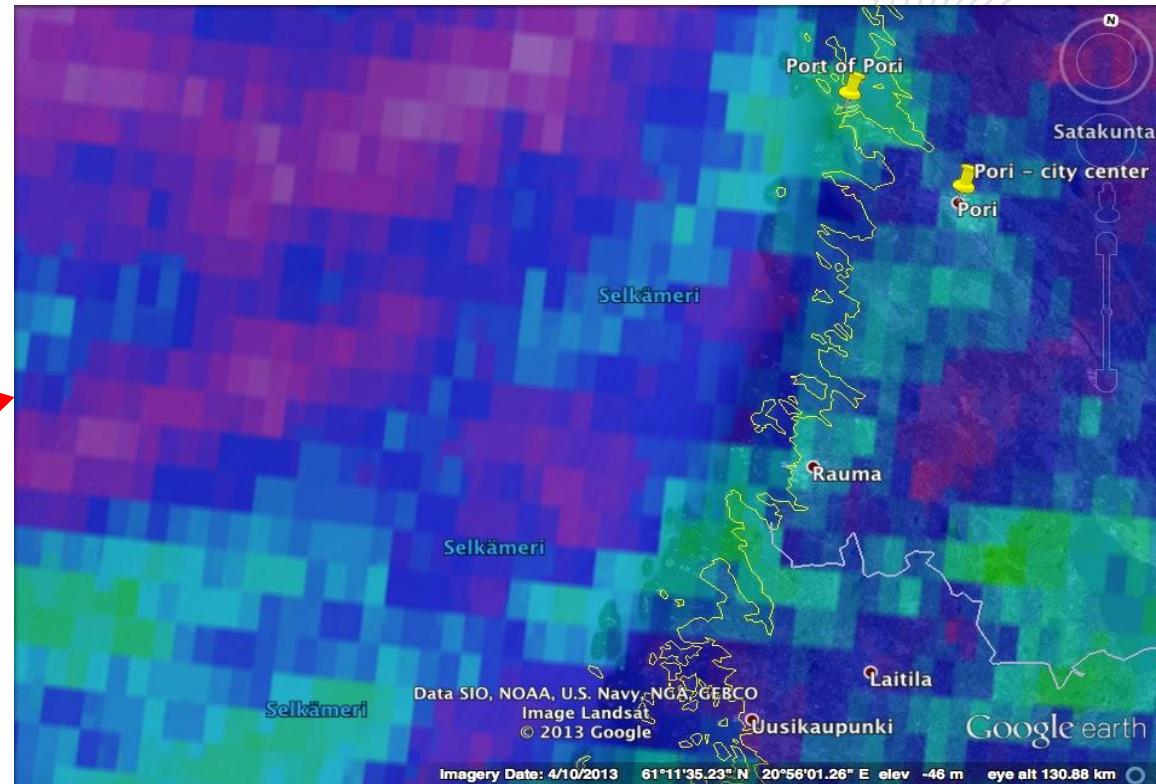
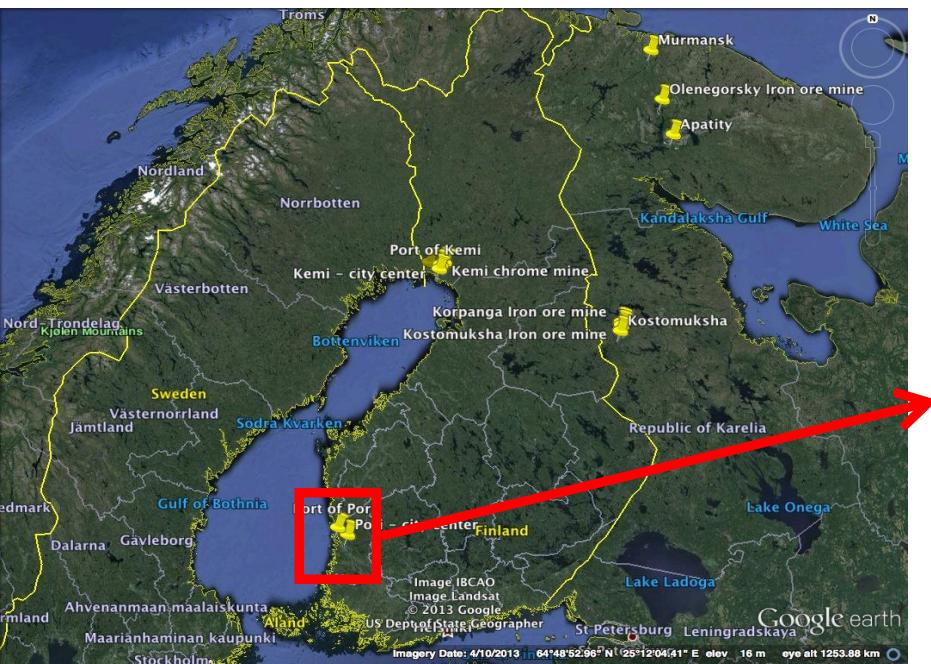
Both OMI NO₂ and STEAM emissions show a decrease in 2009 (economical recession)

Jul-Aug averages within
the black boxes

OMI NO₂
tropospheric
column



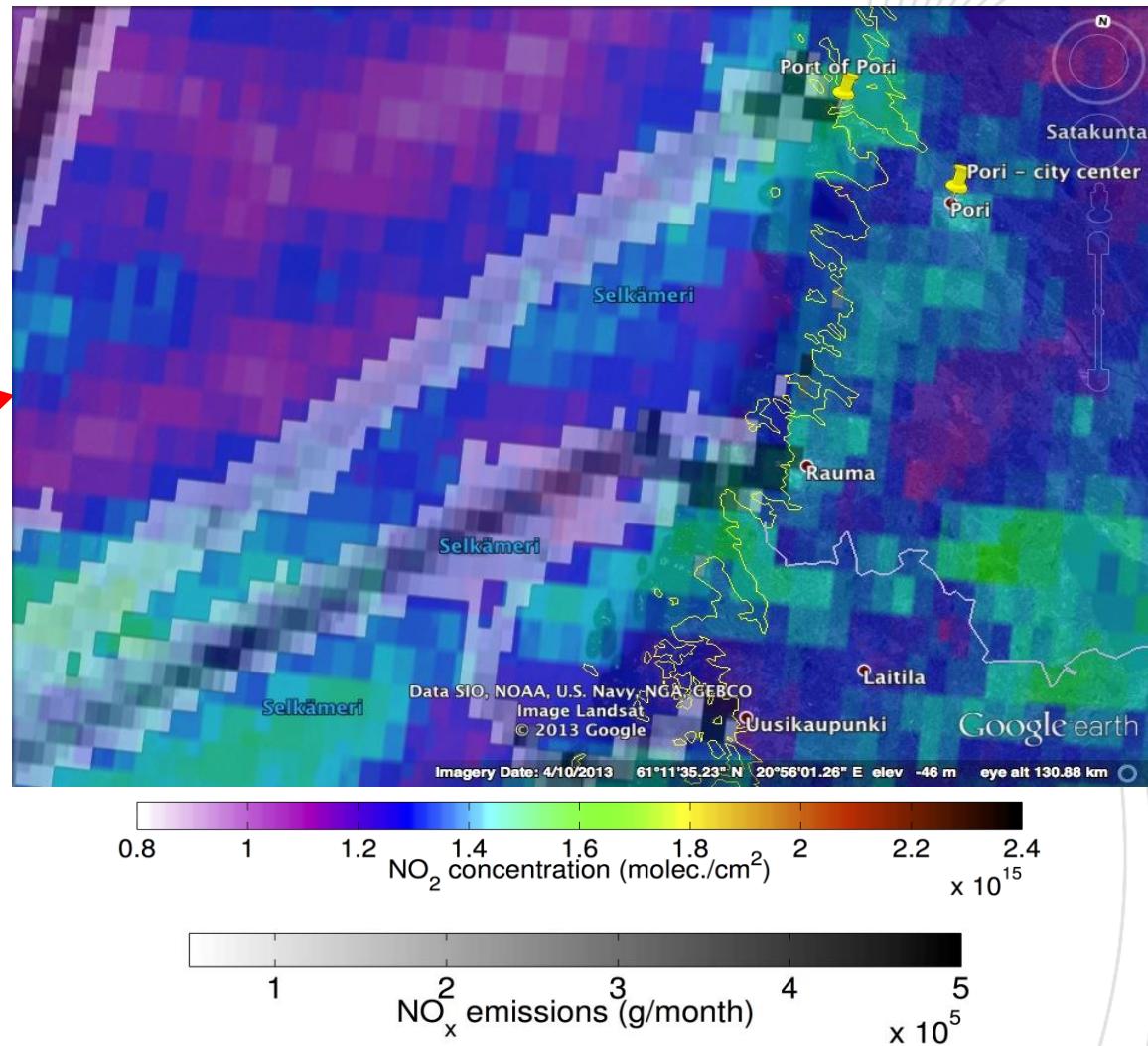
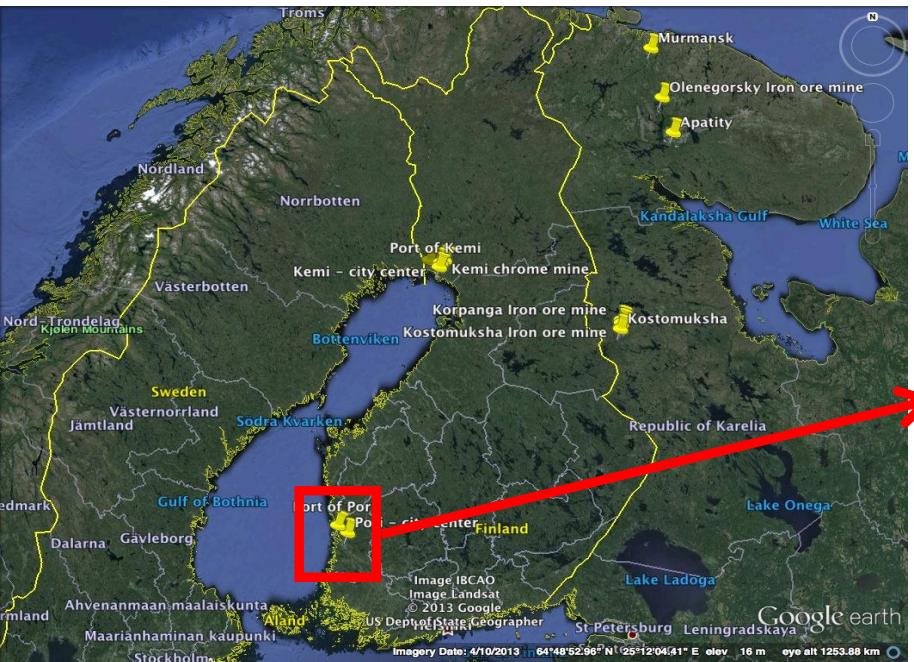
Port cities in Finland: Pori



Pori port and city center



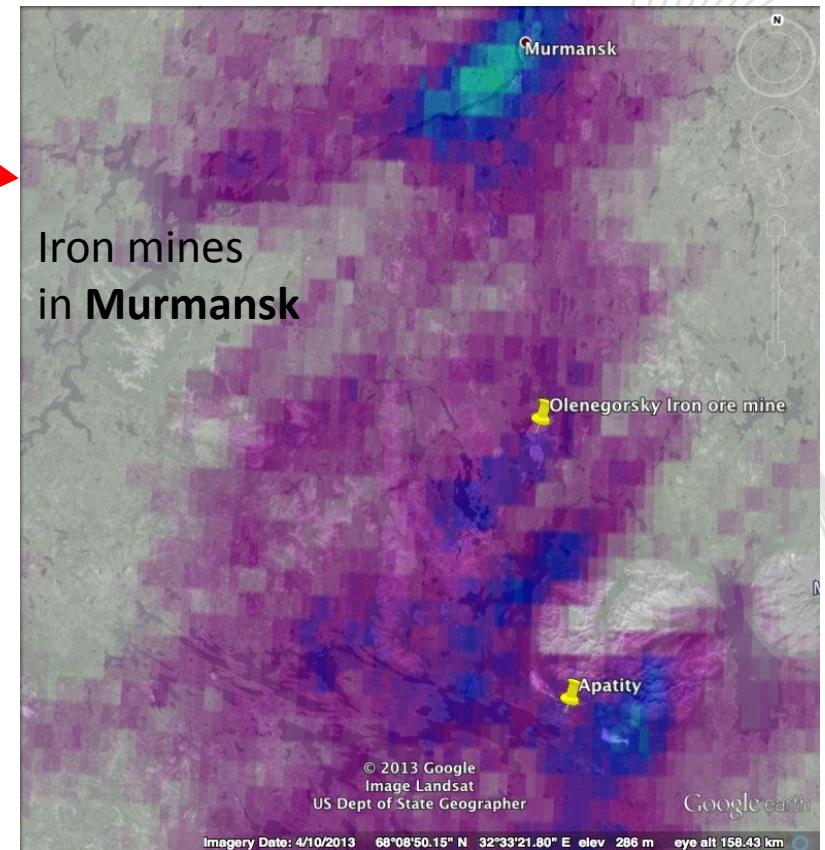
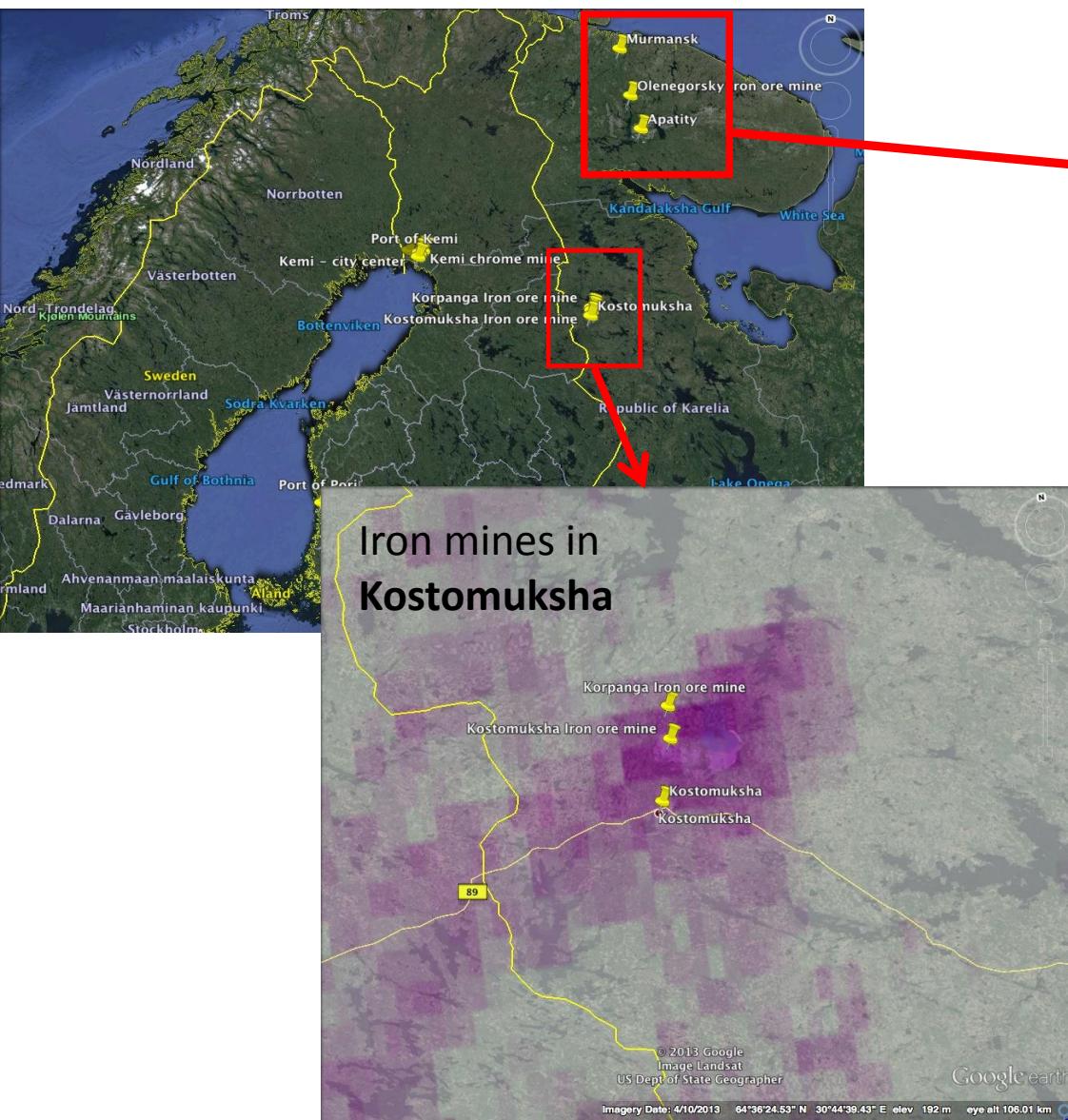
Port cities in Finland: Pori



Pori port and city center
Overlap with STEAM ship emissions



Further applications: MINING





Thank you

Contact: **iolanda.ialongo@fmi.fi**