FINNISH METEOROLOGICAL INSTITUTE

Ilmanlaadun kaukokartoitushavainnot Suomessa

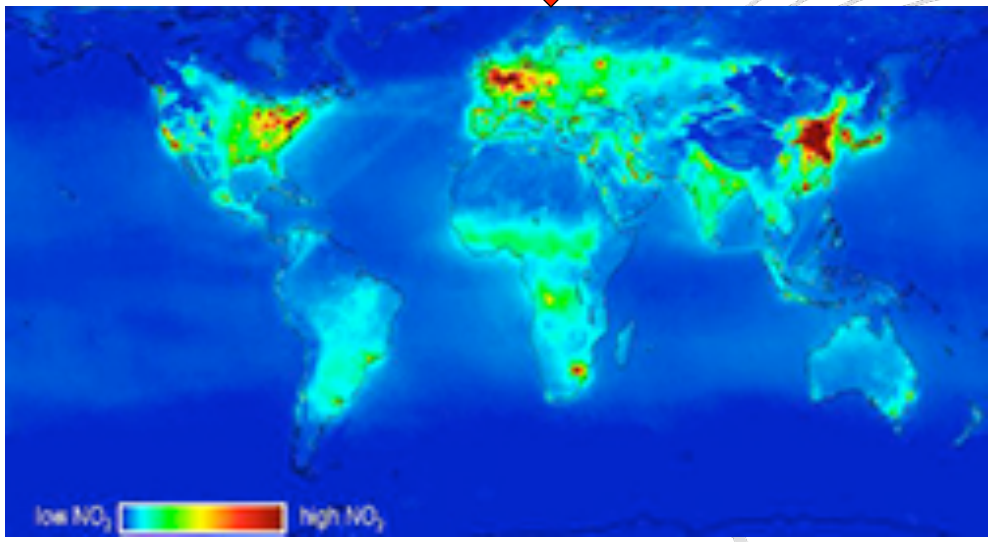
Iolanda Ialongo (FMI)
Email: iolanda.ialongo@fmi.fi
Hakkarainen, J. Jalkanen, J.-P., Johansson, L., Tamminen, J. (FMI),
Boersma, F. (KNMI), Krotkov, N. (NASA)

Outline

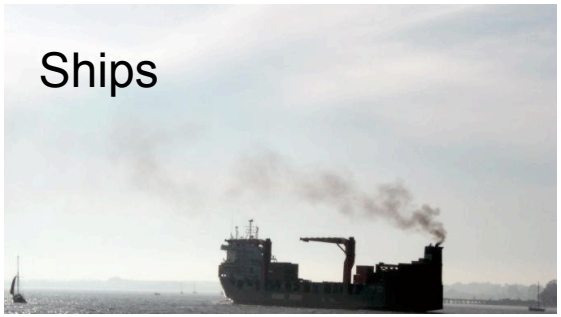
- Motivation
- OMI NO2 observations in Finland
- Applications
  - urban emission estimation
  - ship emissions monitoring

Motivation

OMI NO2



Sources

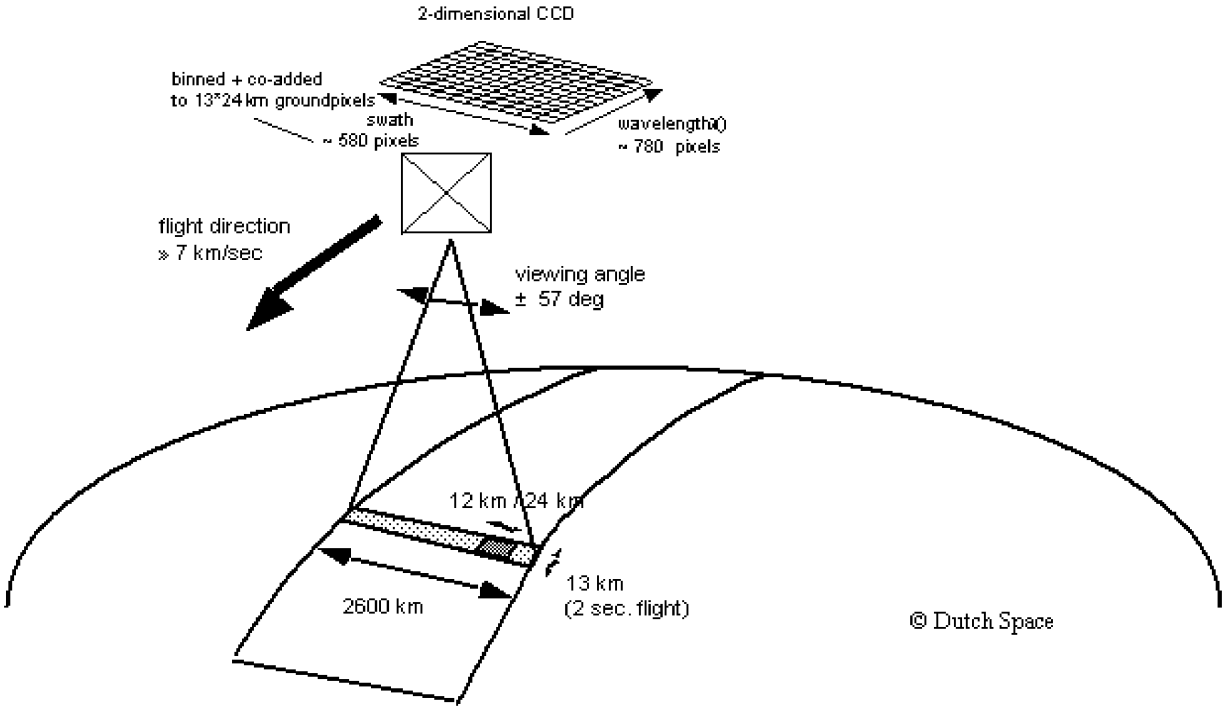


- Increasing interests in high latitude regions.
- Are satellite data applicable under critical situations (i.e. low solar angle, no illumination, signal close to the detection limit)?
- New emission regulation upcoming for shipping in Baltic Sea.

Ozone Monitoring Instrument

OMI

Products: O3, solar UV, NO_2, SO_2, aerosol and clouds.

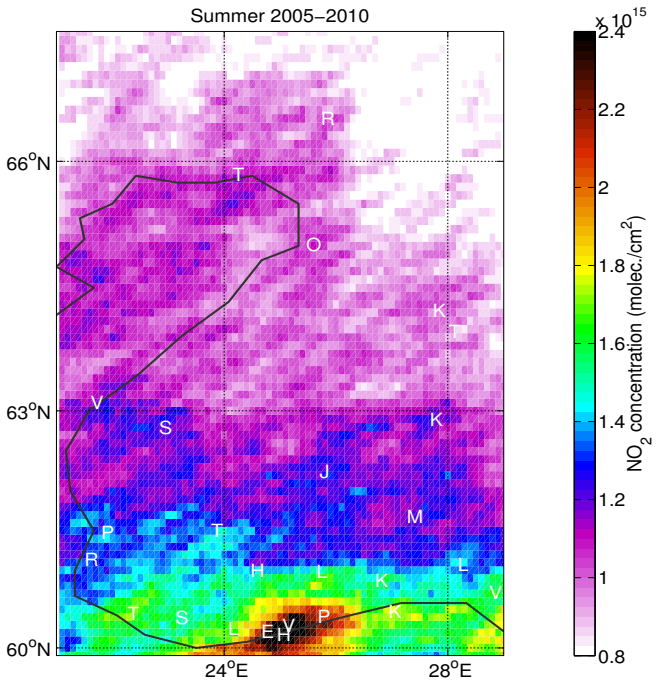


- Operational on **NASA EOS-AURA** satellite from July 2004
- Sun-Synchronous **polar orbit** (overpass: 13:45 LT– almost daily global coverage)
- **spatial resolution** 13km x 24km (nadir)

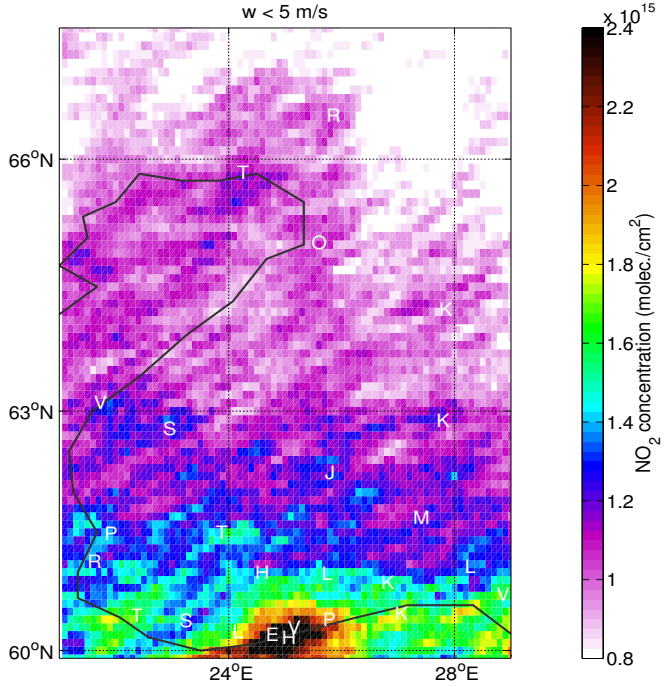
FINNISH METEOROLOGICAL INSTITUTE

NO2 sources identification in Finland

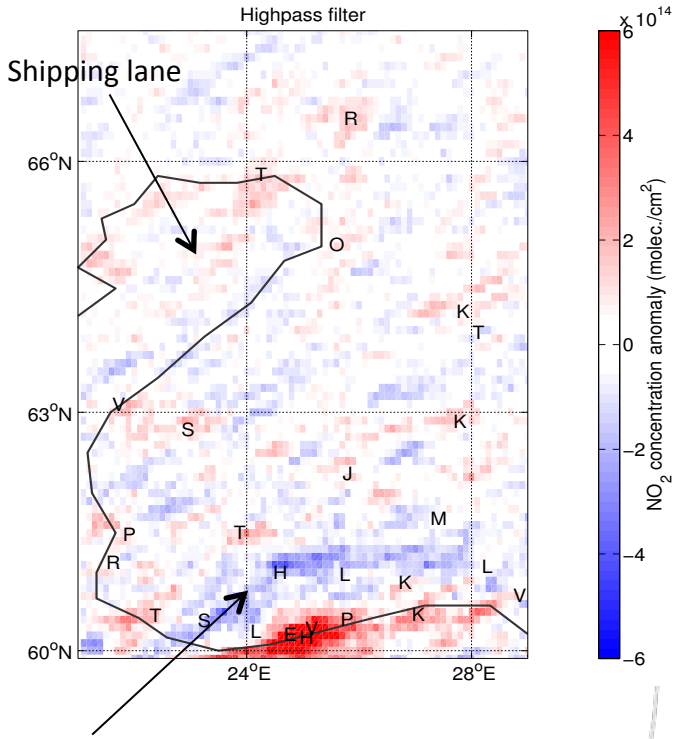
1. High resolution NO2 maps can be derived using multiple pixels averaging techniques.



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



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



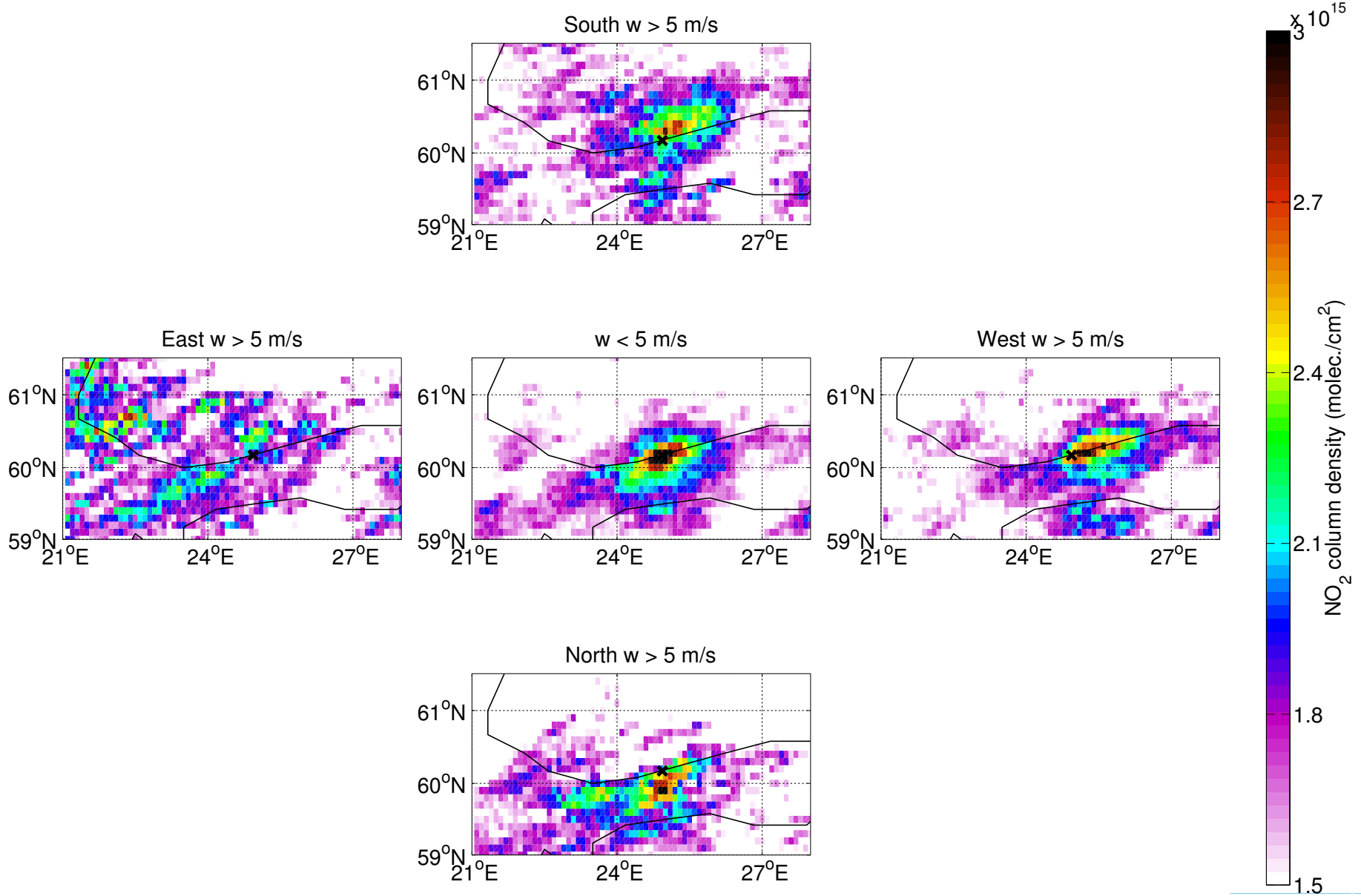
The main cities are marked by their initial

Some information can be lost removing the background

Red pixels indicate NO2 levels higher than the local background.

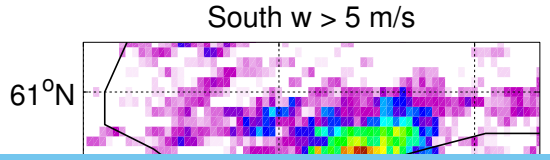
FINNISH METEOROLOGICAL INSTITUTE

OMI NO2 in Helsinki: effect of wind

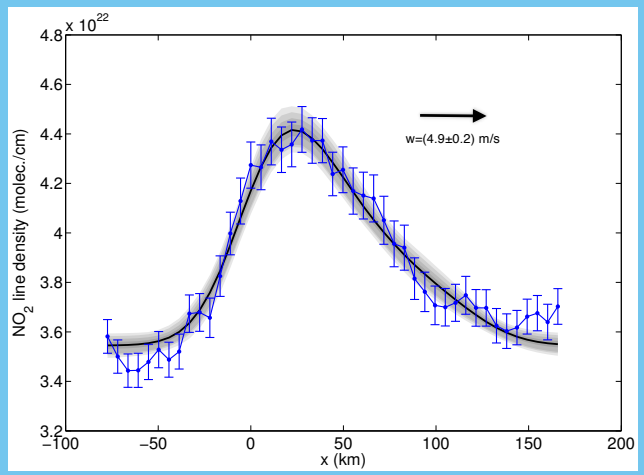


FINNISH METEOROLOGICAL INSTITUTE

OMI NO2 in Helsinki: effect of wind



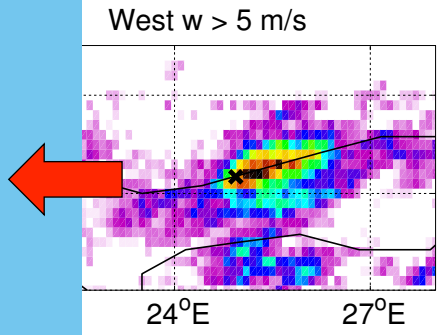
Fitting linear density

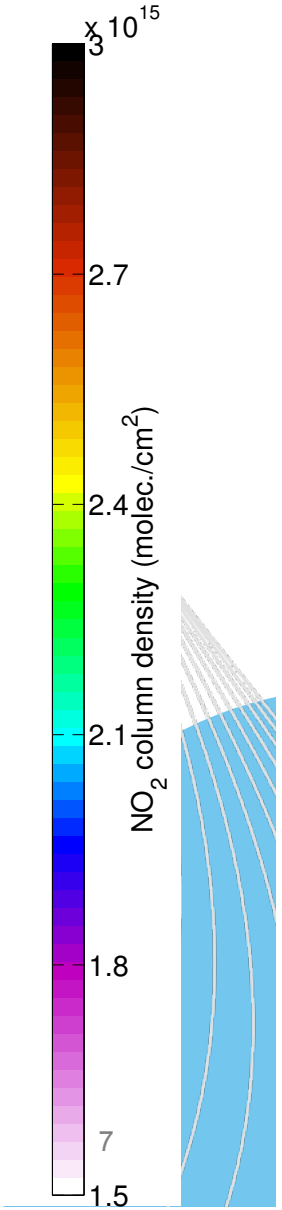


Fitting model $M(x) = E \cdot e \otimes G + B$

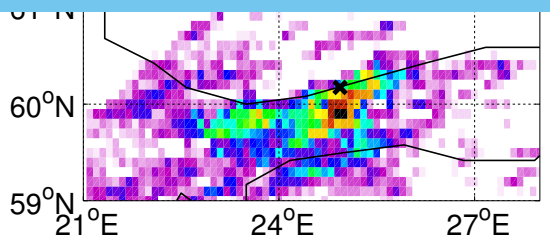
x distance from the city center
E burden parameter
e exponential function
with e-folding distance x_0
G Gaussian function
B background

***τ=x₀/w* lifetime**
(*w* = eastward mean wind speed)
E'=E/*τ* emission parameter

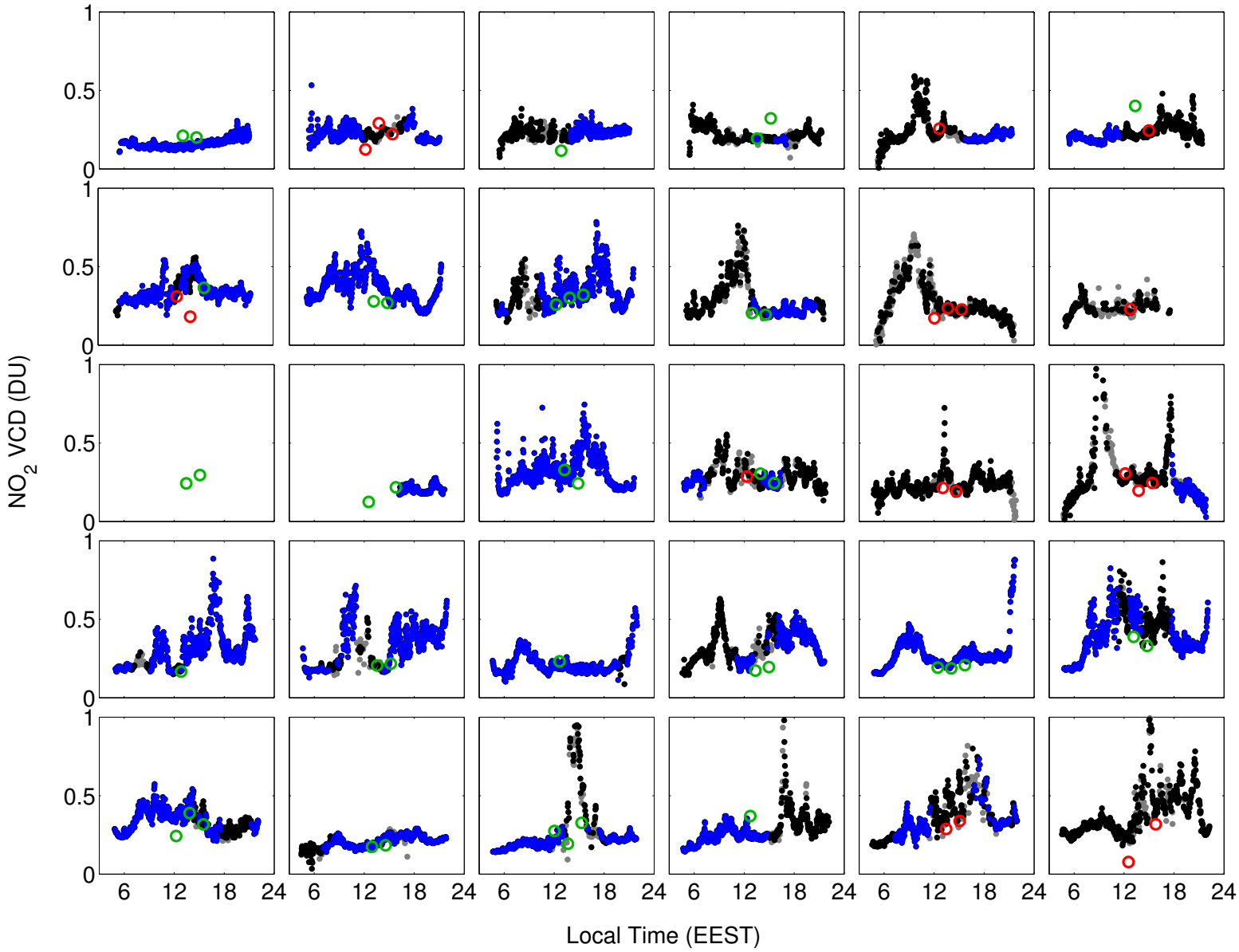




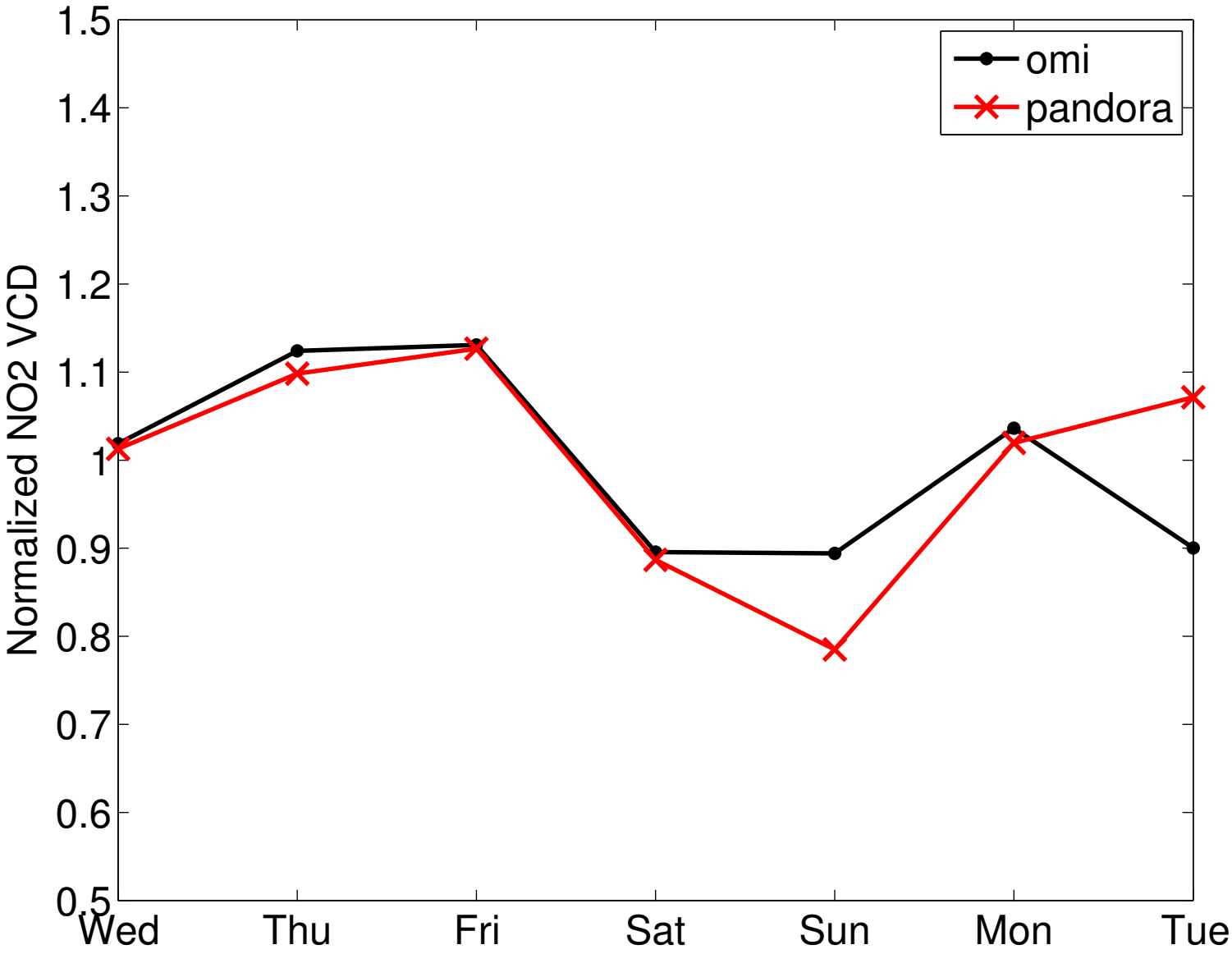
Life time: τ = (3.0 ± 0.5) h
Emission: E' = (1.5 ± 0.6) mol/s → EMEP database E' = (1.8 ± 0.3) mol/s



OMI NO2 validation in Helsinki

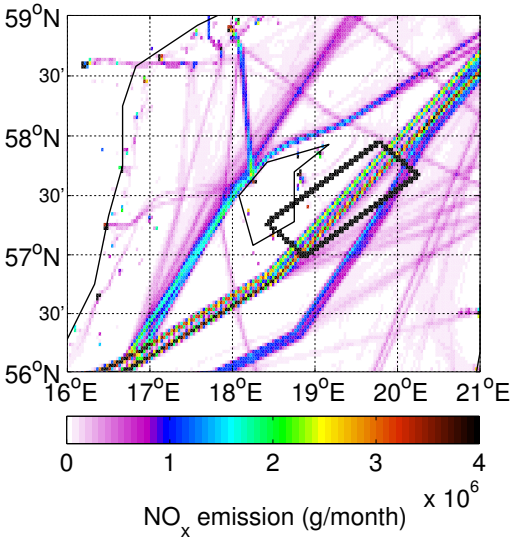


NO2 weekly cycle in Helsinki

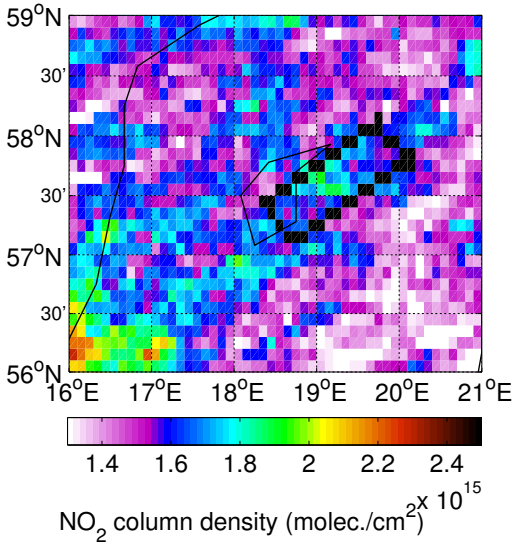


Ship emission over Baltic sea

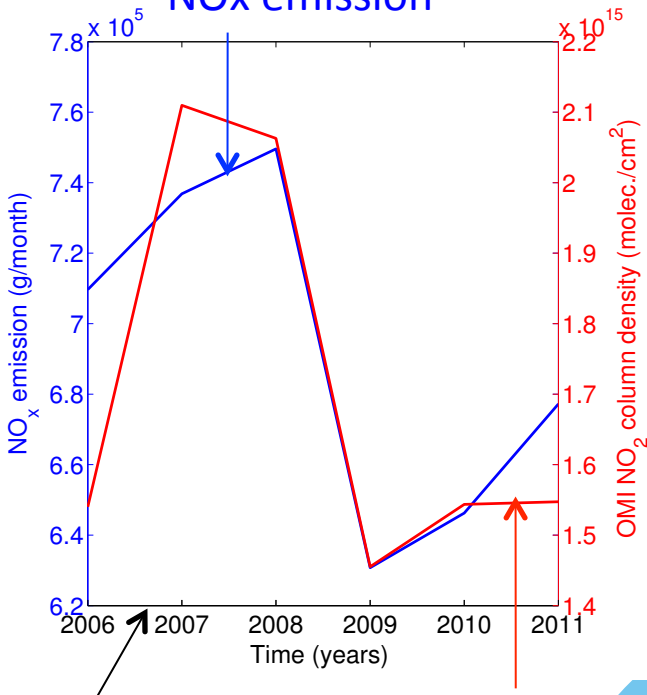
STEAM NOx emission



OMI NO2



NOx emission



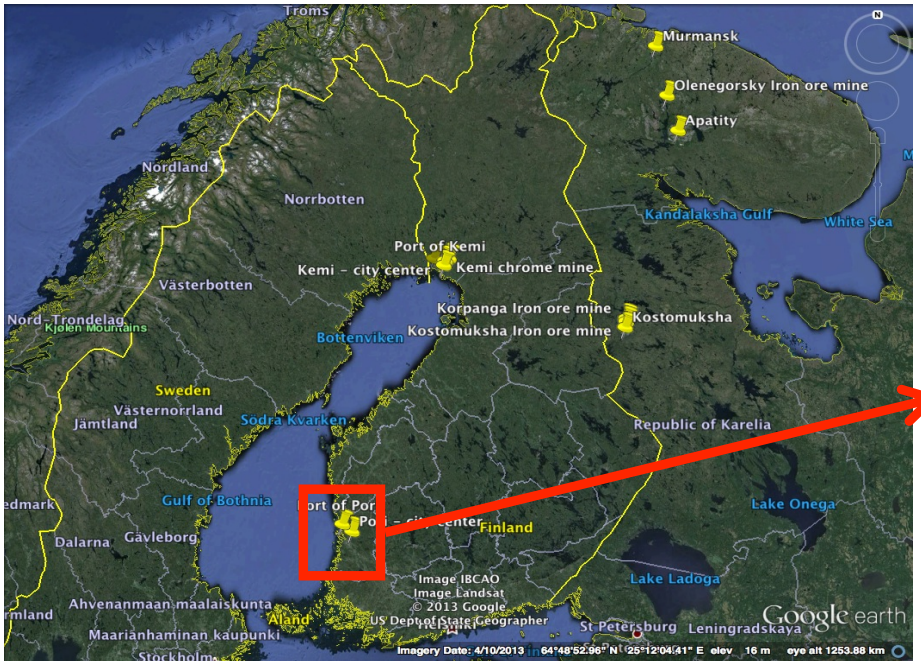
Both OMI NO2 and STEAM emissions show a decrease in 2009 (economical recession)

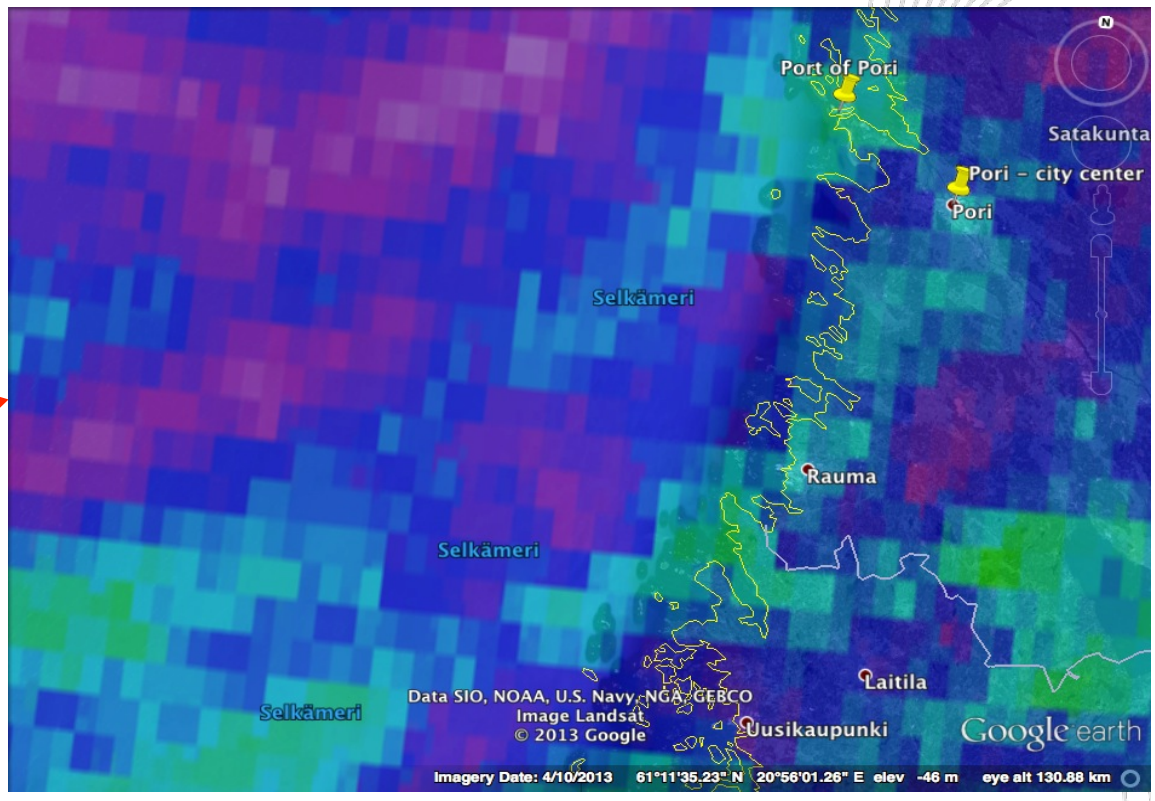
Jul-Aug averages within the black boxes

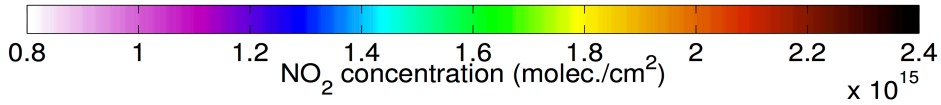
OMI NO2 tropospheric column

FINNISH METEOROLOGICAL INSTITUTE

Port cities in Finland: Pori



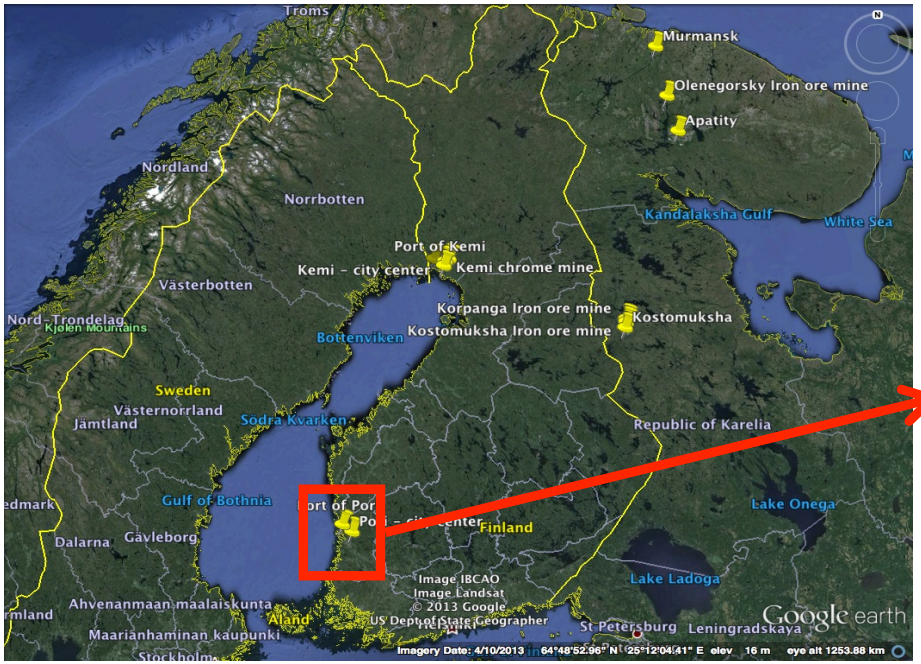


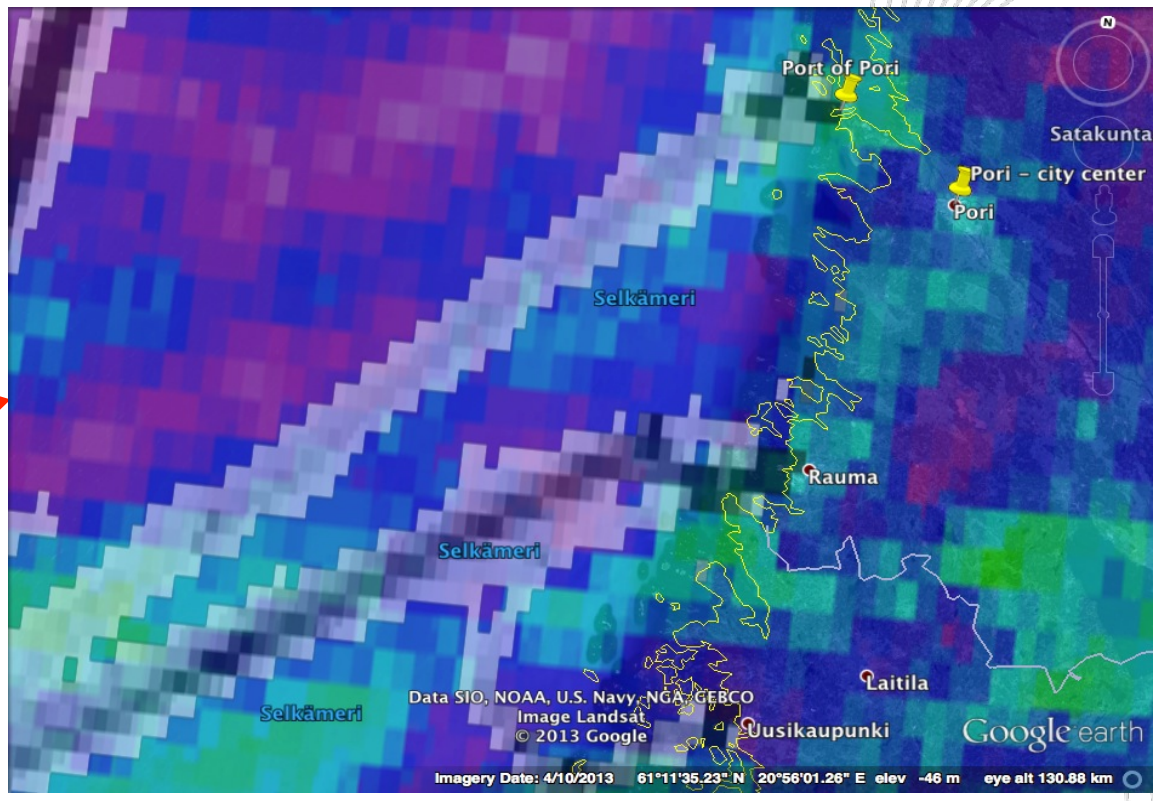


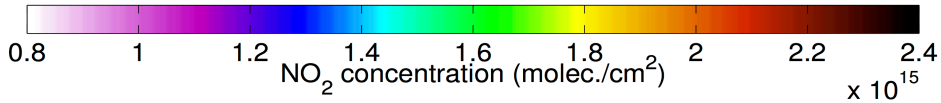
Pori port and city center

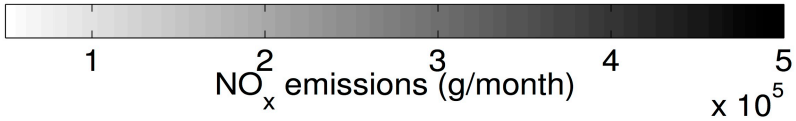
FINNISH METEOROLOGICAL INSTITUTE

Port cities in Finland: Pori





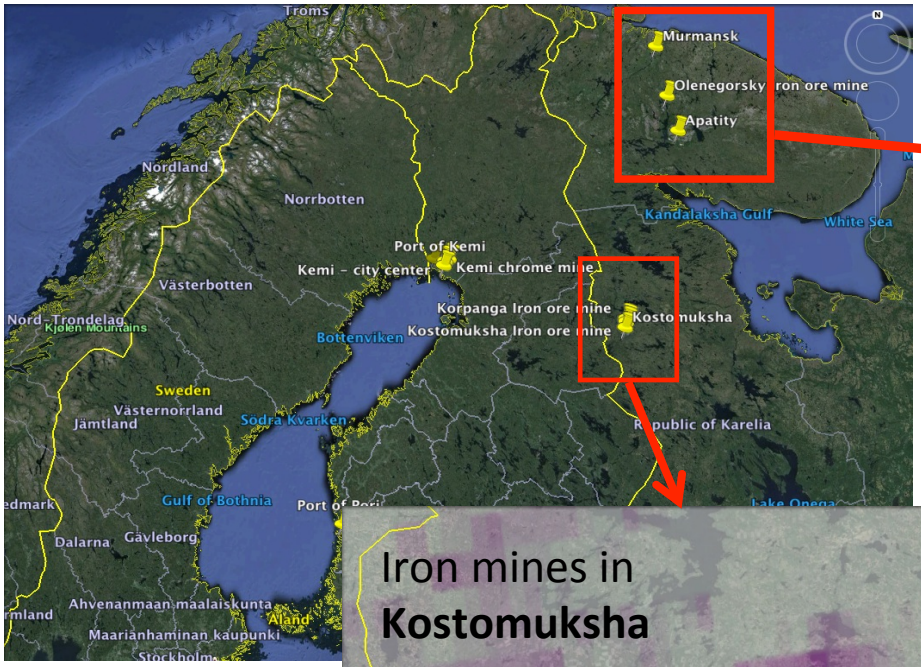


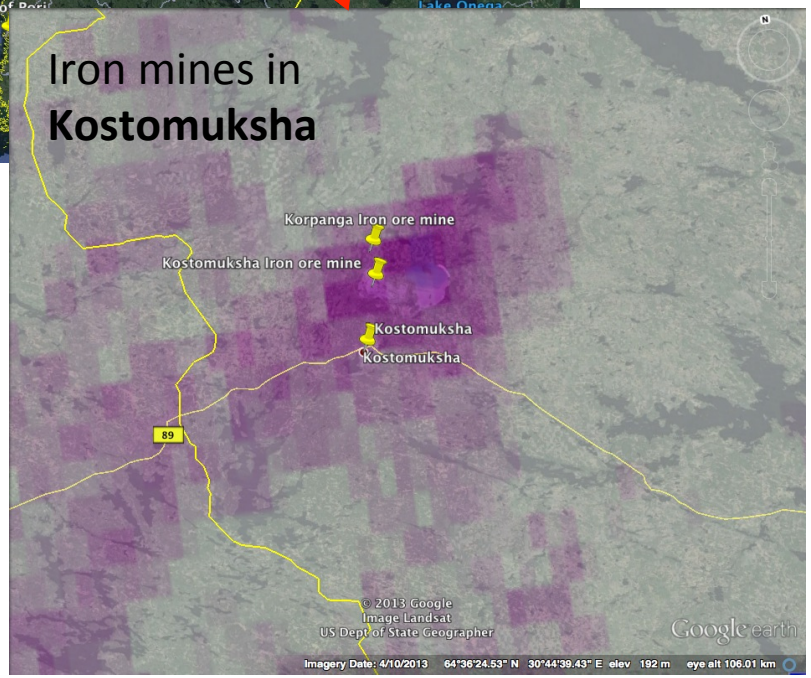


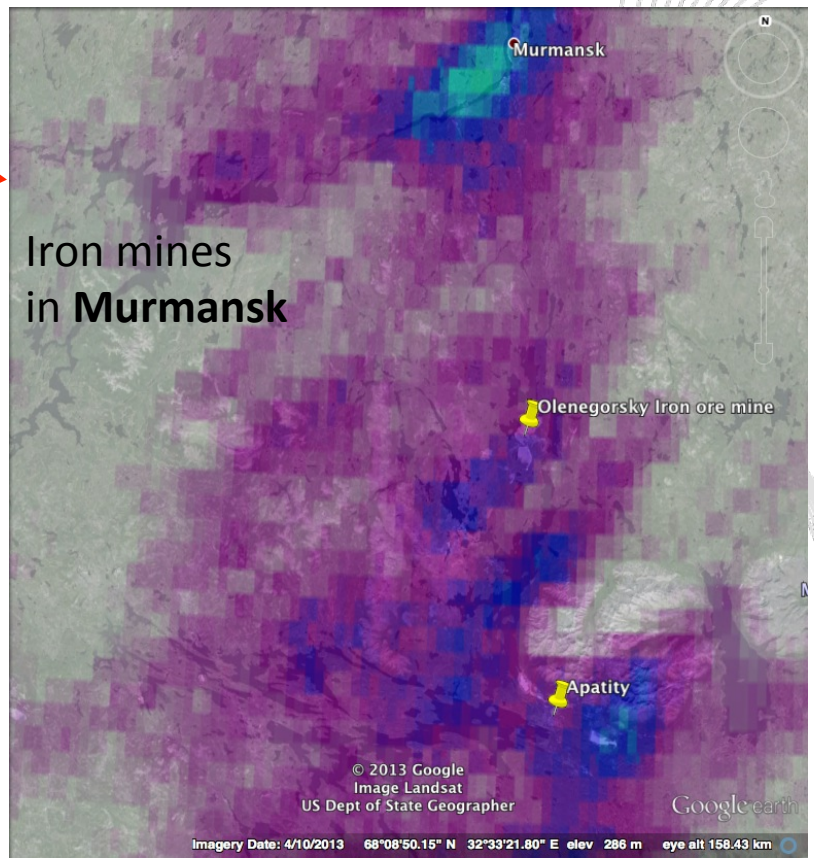
Pori port and city center
Overlap with STEAM ship emissions

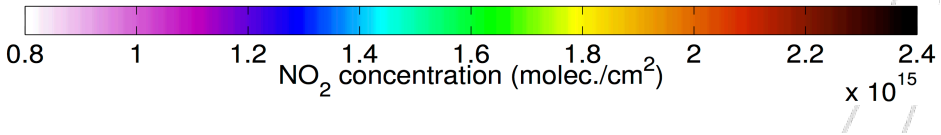
FINNISH METEOROLOGICAL INSTITUTE

Further applications: MINING









Thank you

Contact: iolanda ialongo@fmi.fi