An optimized NOx emission inventory over East Asia, from PYVAR-CHIMERE inverse modeling tool constrained by OMI satellite observations

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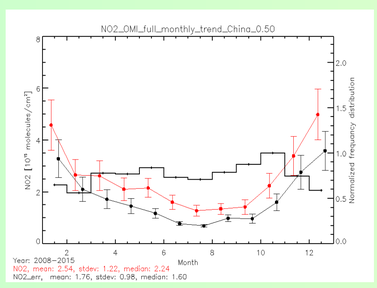
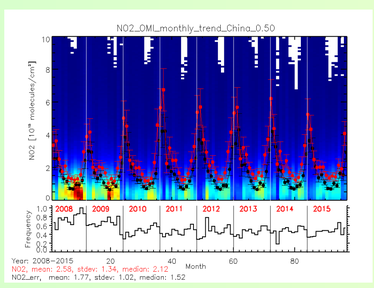
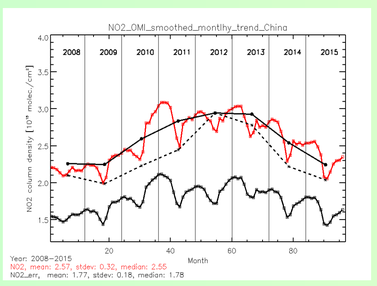
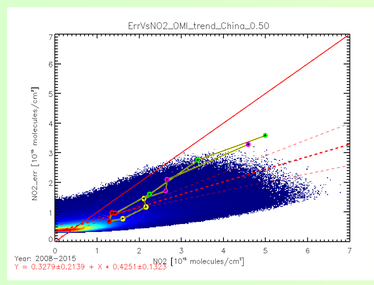
The aim of this work is to better quantify pollution precursor emissions (mainly NO_x and NMHCs), their spatio-temporal variability from the interannual to the sub-seasonal scale for the 2008-2017 period, and to evaluate the impact on pollutant variability and trends. We use the **PYVAR-CHIMERE inverse modeling tool**, based on the CHIMERE chemical transport model and a **4D variational assimilation scheme**, to derive optimized temporally resolved NO_X gridded emission inventories at continental scale (with a spatial resolution of 0.5 degrees) from **OMI satellite observations of NO_2** tropospheric columns. First results covering one year of simulations are presented and discussed. CHIMERE optimized concentrations will be compared to real concentrations of NO2 collected and provided by Berkeley Earth (http://www.berkeleyearth.org), from 1525 surface stations in China.

OMI NO2 over North China Plain







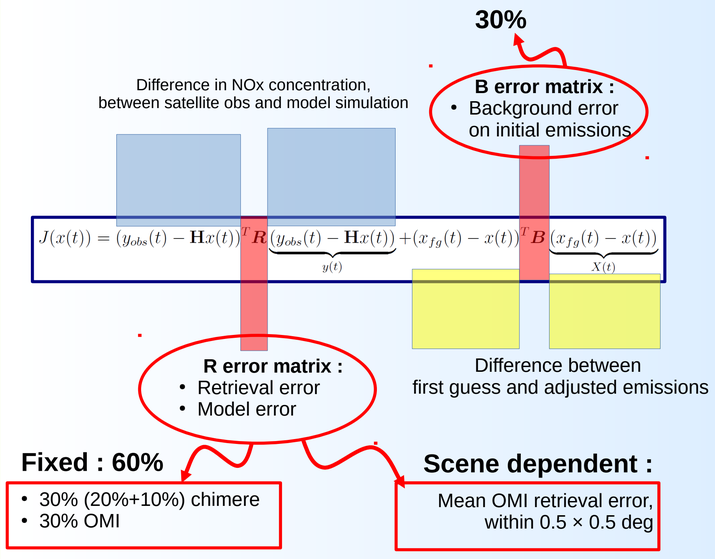


Tropospheric NO2 retrievals from **OMI (OZONE MONITORING INSTRUMENT)**, a UV/VIS nadir spectrometer onboard EOS-Aura (NASA). Ground pixel : 13×24 km² (nadir), up to 26×128 km².

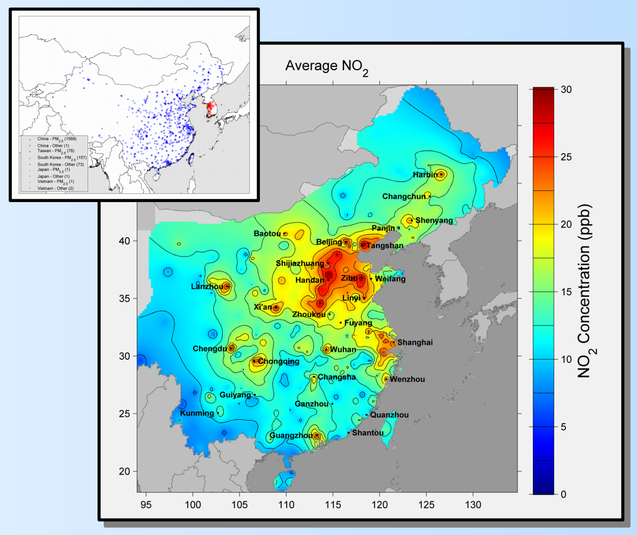
Tropospheric column density [10^{15} molecules/cm²] from the Duch OMI NO2 (DOMINO) data product v2.0 (2011).

Estimated average error (Boersma et al., 2011):
1.0 * 10^{15} molec./cm² + 25 %
1.51 * 10^{15} molec./cm² over China

PYVAR-CHIMERE

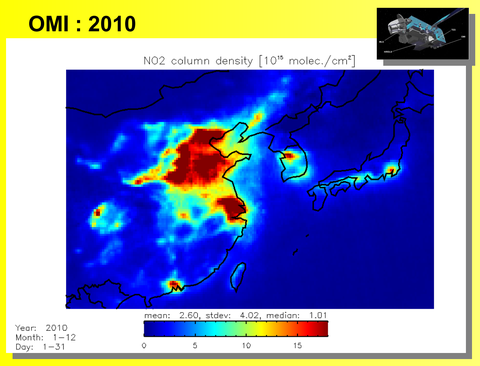


Surface NO2

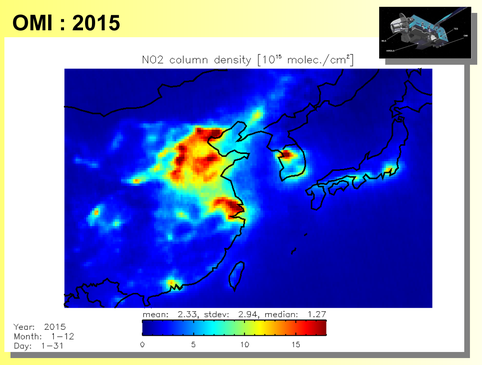


NO2 surface concentration, 2015 – 2016
http://www.berkeleyearth.org

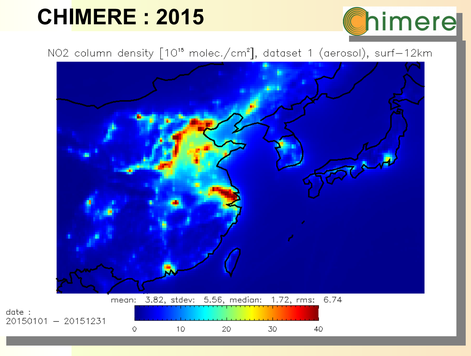
OMI : 2010



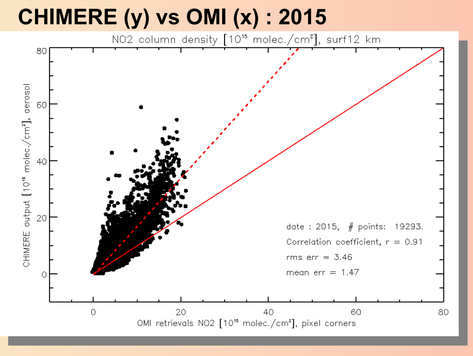
OMI : 2015



CHIMERE : 2015



CHIMERE (y) vs OMI (x) : 2015



CHIMERE overestimates observed NO2 concentrations :

→ **Old NOx inventory (EDGAR - HTAP 2010)**

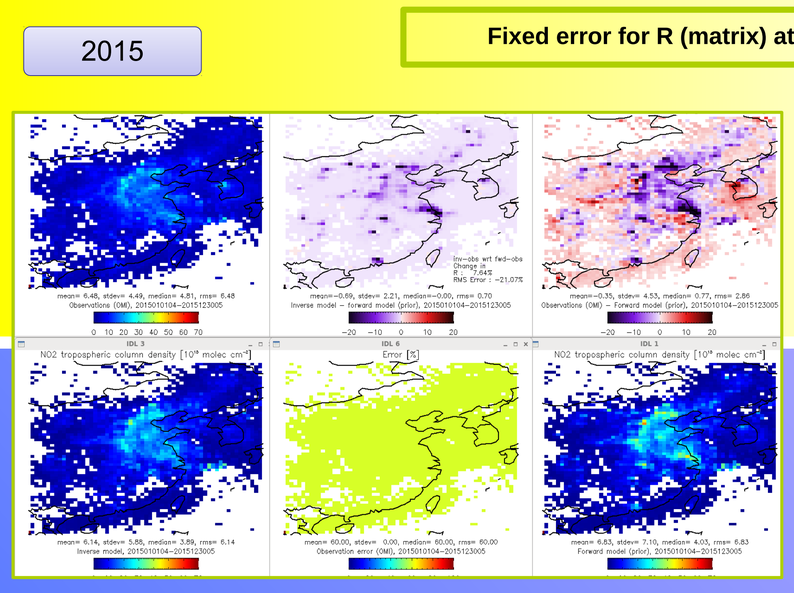
Main anthropocentric NOx emissions in China are from transport and coal-fired power plants : rapid implementation of air quality control regulations.

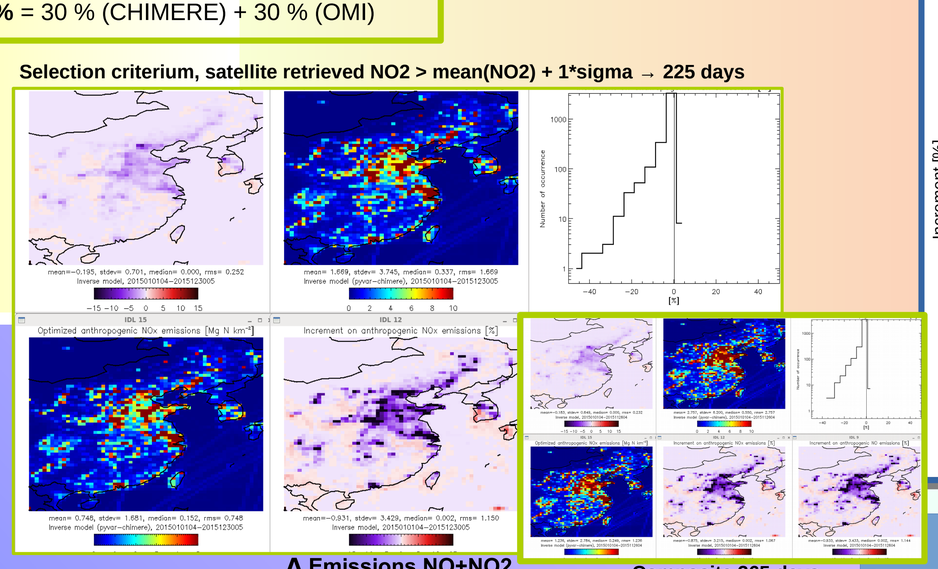
RESULTS : optimized emissions

2015

Fixed error for R (matrix) at 60 % = 30 % (CHIMERE) + 30 % (OMI)

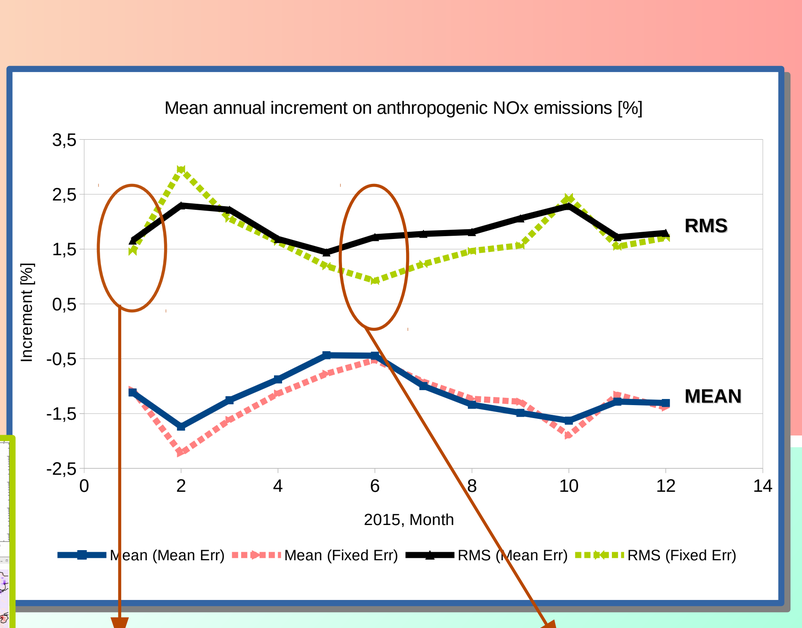
Selection criterium, satellite retrieved NO2 > mean(NO2) + 1*sigma → 225 days





Δ Emissions NO+NO2

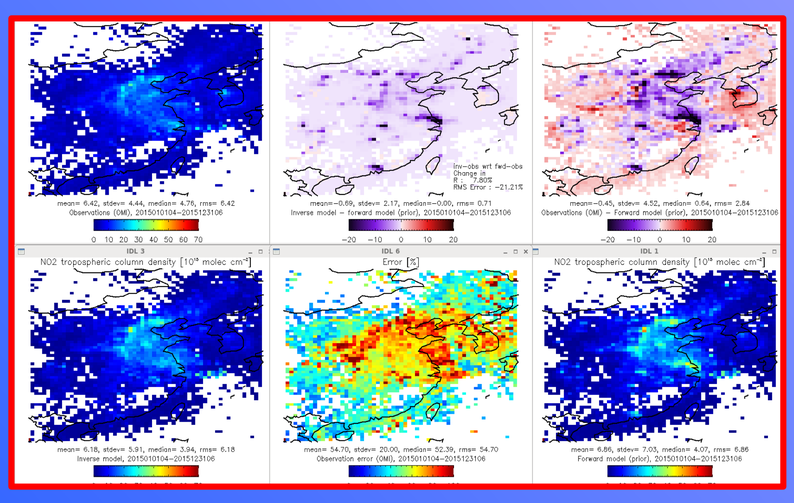
Composite 365 days

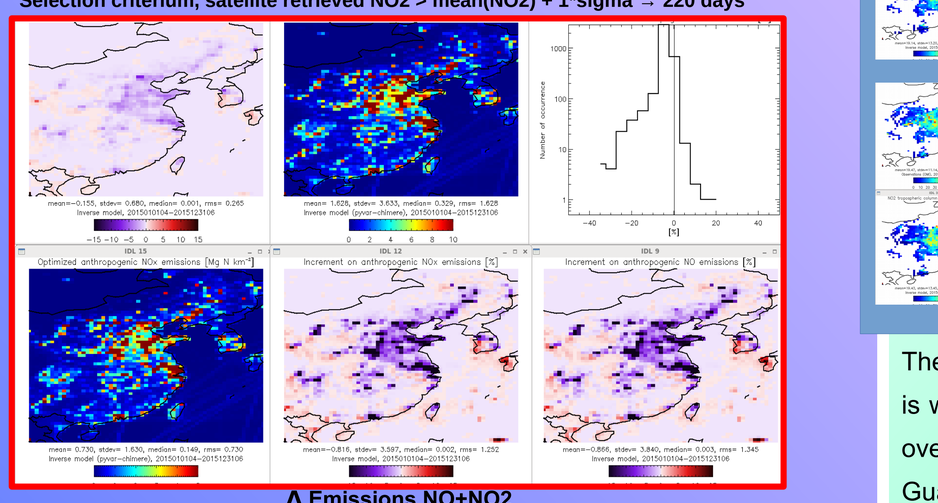


2015

Scene dependent error for R (matrix): Mean OMI retrieval error, within 0.5 × 0.5 deg

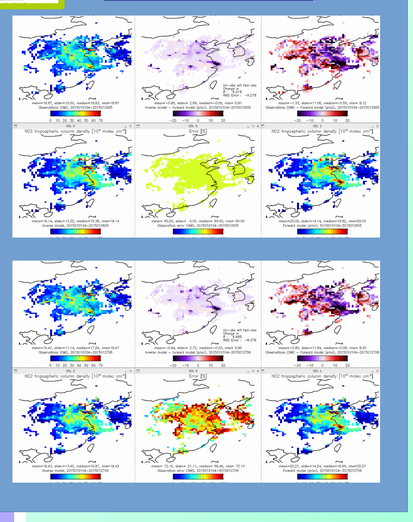
Selection criterium, satellite retrieved NO2 > mean(NO2) + 1*sigma → 220 days



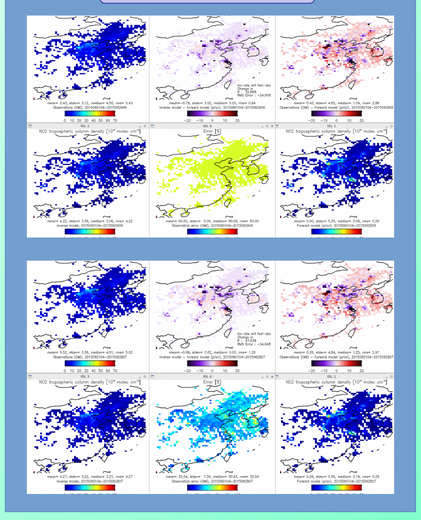


Δ Emissions NO+NO2

January



June



The annual average of NOx concentrations from optimized emissions is weaker (down to -15%) over the biggest cities of China, especially over Beijing region, Shanghai and Hangzhou (Yangtze River delta), Guangzhou and Hong-Kong (Pearl River delta) and slightly stronger over the East China Sea.