

Validation of a global bottom-up point source catalogue with satellite-based emissions

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Background, motivation & objective

- The CORSO project provides specific developments and guidance for the implementation of the European CO₂ emission Monitoring and Verification Support capacity within the Copernicus programme
- The importance of high-quality prior data, including the correct geolocation of large industrial point sources, was recently stressed by a European Commission policy brief written by its CO₂ Taskforce
- To this end, CORSO is developing a bottom-up global catalogue of CO₂ emissions and co-emitted species (i.e. NO_x, SO_x, CO and CH₄) from power, cement and iron/steel plants for the reference year 2021
- To reduce the uncertainty linked to these estimates, top-down emission products derived from the TROPOMI instrument on the Copernicus Sentinel-5P satellite have been produced for validation purposes

Methodology

Bottom-up estimates

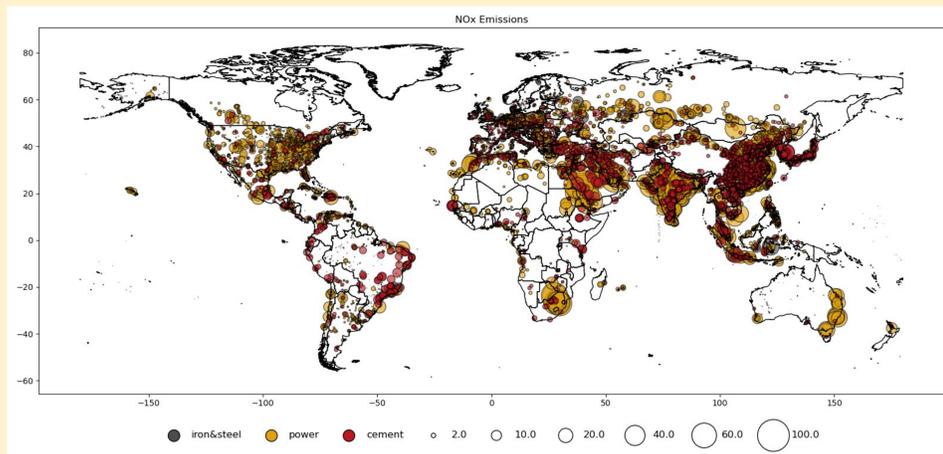


Figure 1: Plant-level annual NO_x emissions (kt/year) reported by the CORSO global point source database for the year 2021. The database consist of a mosaic of European and a non-European estimates, based on the integrated Industrial Reporting Database, the Global Energy Monitor trackers, IEA World Energy Balances and the Emissions and Generation Resource Integrated Database, among others¹.

Top-down estimates

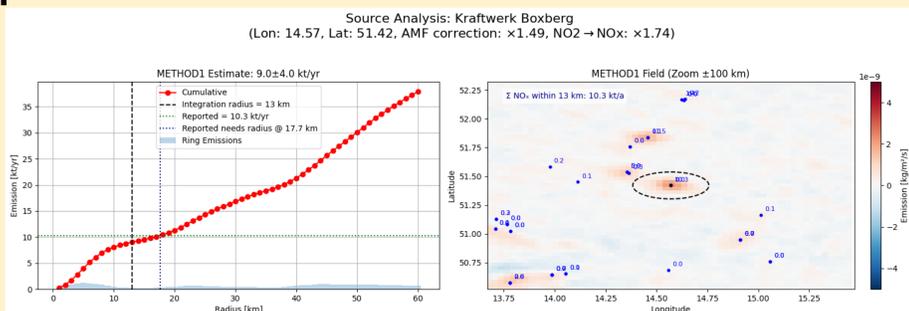


Figure 2: TROPOMI-based annual NO_x emissions for a power plant using the divergence method². Integration radius defined by checking the curvature of the radial profiles and select the point that maximally contains the source without including the next one

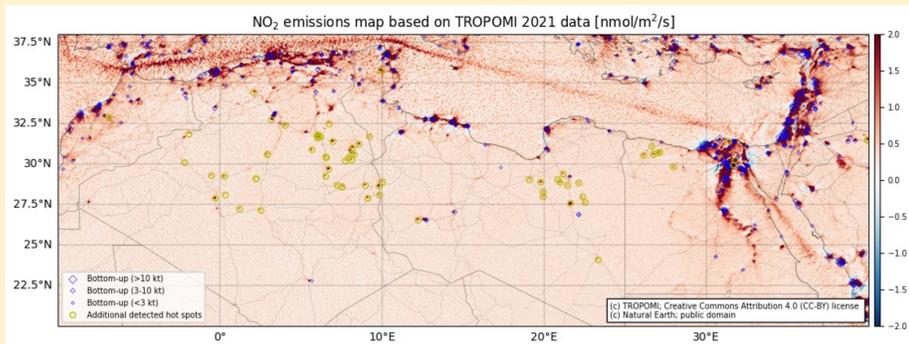


Figure 3: TROPOMI-based NO₂ hotspot locations against locations of industrial point sources as reported by the CORSO bottom-up catalogue in Northern Africa

Conclusions

- Good agreement between bottom-up and TROPOMI-based NO_x estimates in EU and USA, where bottom-up emissions are based on Industrial facility reporting programmes, as well as in countries dominated by coal-fired power plants (e.g., South Africa, India, Australia).
- Largest discrepancies between bottom-up and TROPOMI-based NO_x estimates are found in developing countries dominated by gas and oil-fired power plants due to lack of facility level information (e.g., fuel usage in dual fuel power plants), as well as in plants located nearby large urban areas, where TROPOMI NO₂ plumes may get mixed with other sources.
- As a result of the intercomparison, we addressed misallocations, the inclusion of missing facilities and the refinement of the estimation methodologies in the CORSO bottom-up dataset, demonstrating the added value of integrating bottom-up and top-down emission estimation methodologies
- Future developments will focus on the inclusion of missing large point sources detected by TROPOMI observations (e.g., refineries and mining facilities)

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Intercomparison results

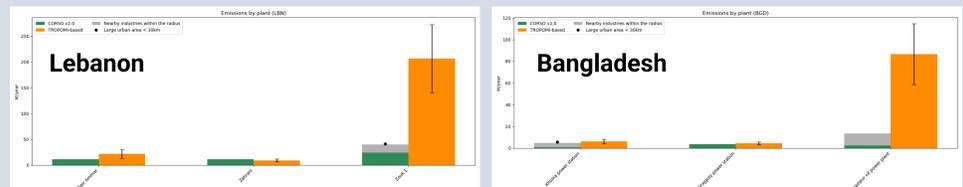
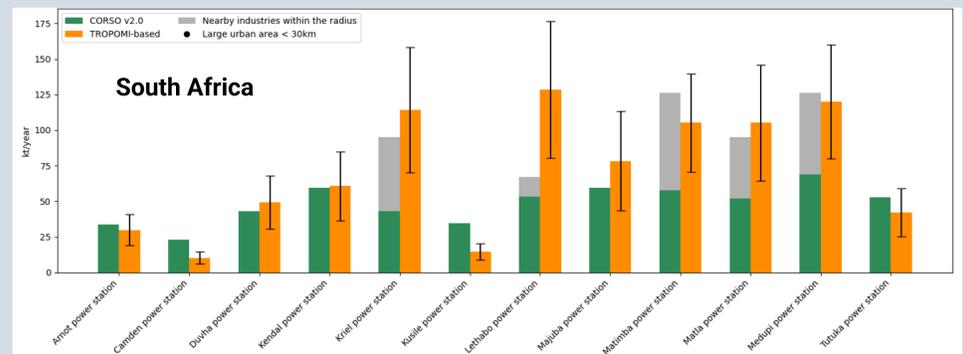
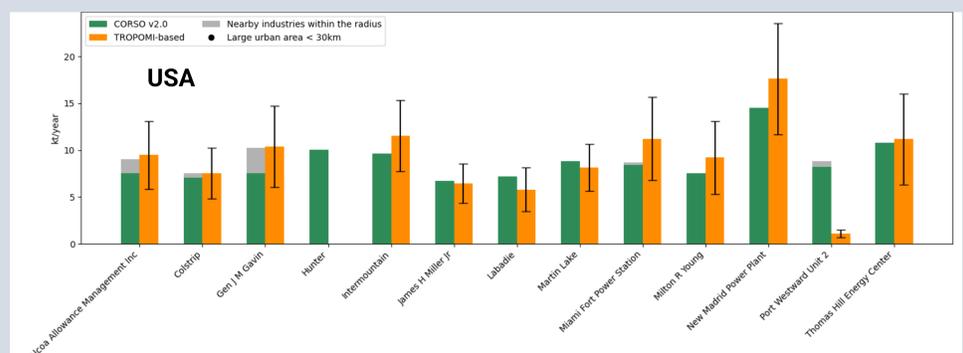
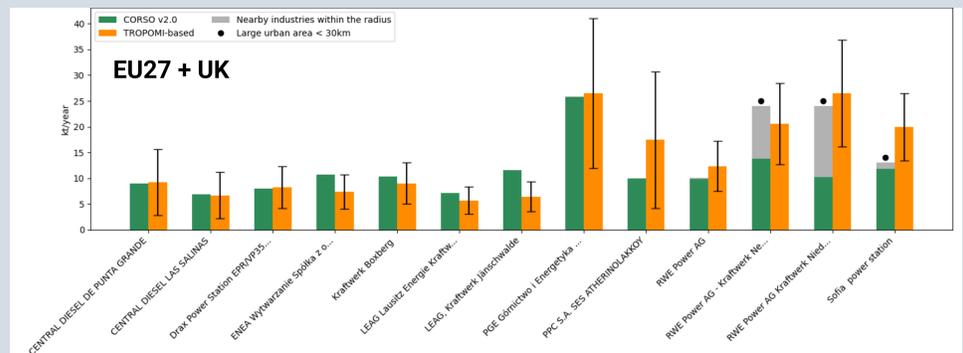


Figure 4: Comparison between plant-level annual NO_x emissions estimated by the CORSO bottom-up catalogue and derived from TROPOMI for selected countries

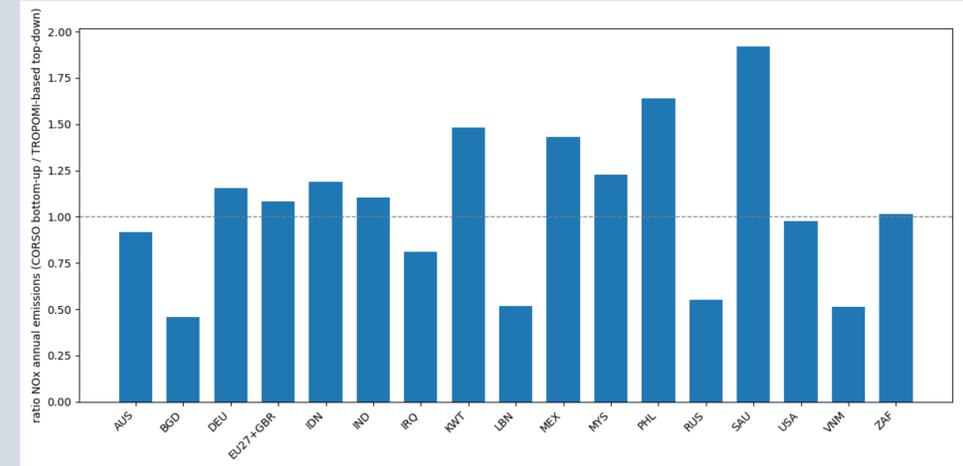


Figure 5: Ratio between NO_x bottom-up and top-down emissions at the country level. Ratios were computed considering the median of plant-level ratios per country

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