



Estimation of anthropogenic CO₂ emissions from OMI NO₂ observations using chemistry transport modelling over Europe.

R. L. Curier, R. Kranenburg, M. Jozwicka, R. Timmermans, H. Denier van der Gon
TNO, Utrecht, The Netherlands

Theme:

Megacities...

& Climate Change (& how to monitor progress towards objectives...)

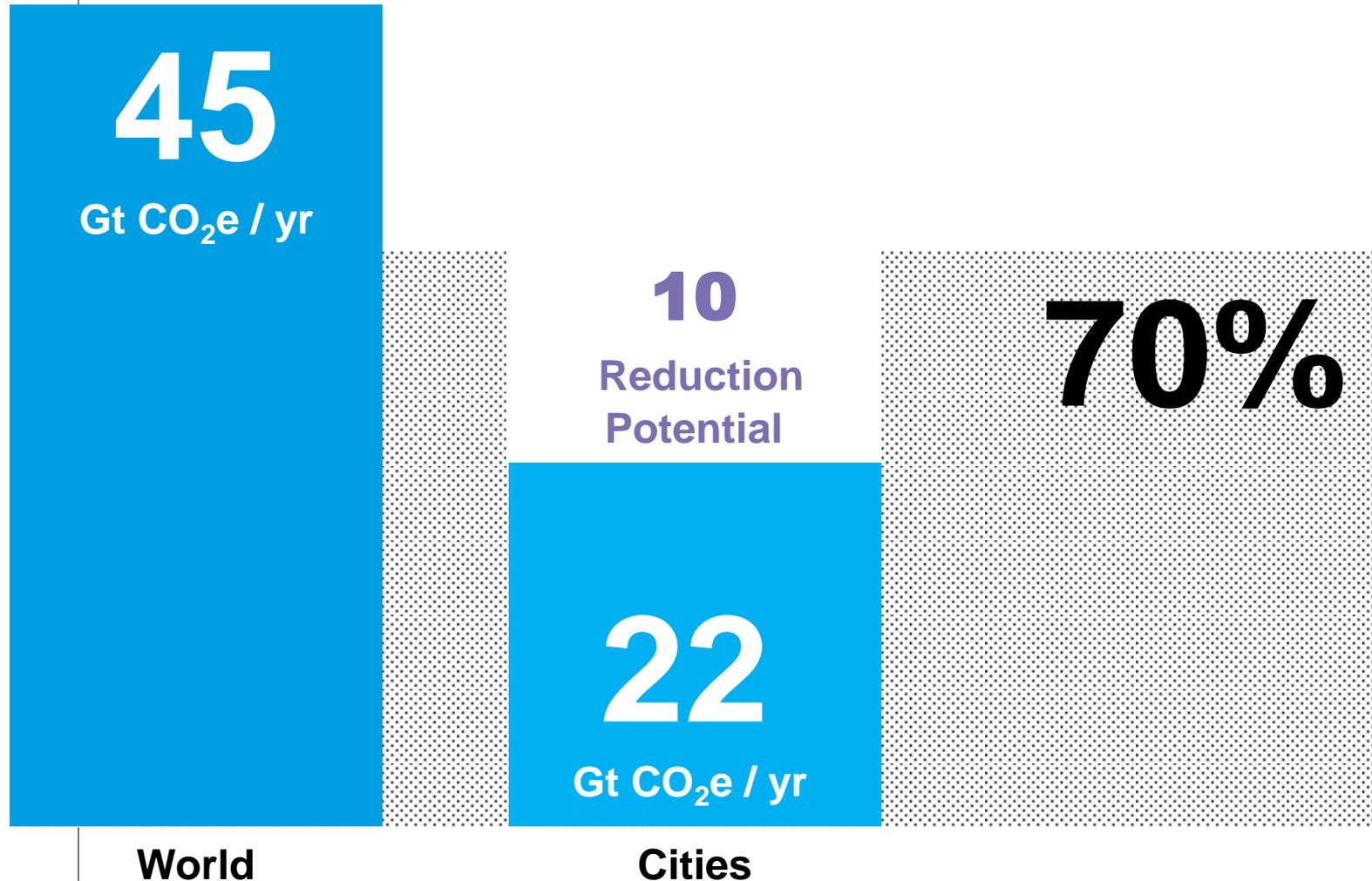


major advances and issues in the theme **Megacities and climate change**

- › CO₂ is the biggest contributor (60+ %) to global warming
- › Global CO₂ emissions are continuously growing at a pace of 2-3% per year, reaching a level in 2013 that is 60% above emissions in 1990.
- › To avoid dangerous climate change, action is needed...
- › **it needs to happen in cities...**



Cities account for 70% of global GHG emissions





major advances and issues in the theme **Megacities and climate change**

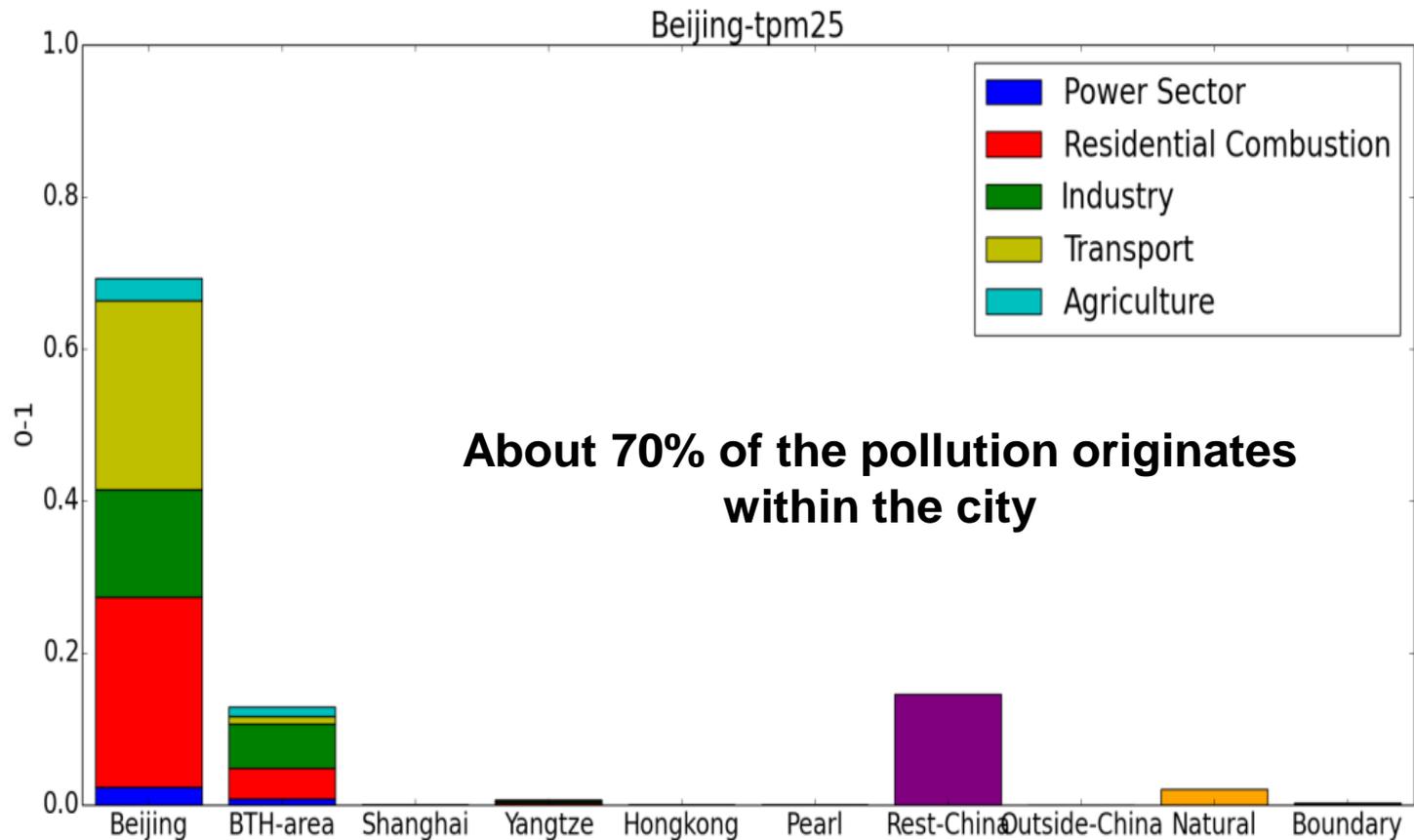
- › CO₂ is the biggest contributor (60+ %) to global warming
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Megacities and Air Pollution

- › Outdoor air pollution, mostly by PM_{2.5}, leads to 3.3 million premature deaths per year worldwide (Lelieveld et al., Nature, 2015)
- › Majority of global population lives in cities, action is needed... **it also needs to happen in cities...**
- › **Common denominator AP & CC : fossil fuel combustion**



What can cities do?



Poster Timmermans *et al.* –Source attribution of particulate matter in Chinese cities



This research: Can we quantify and monitor city CO₂ emissions using Satellite data?

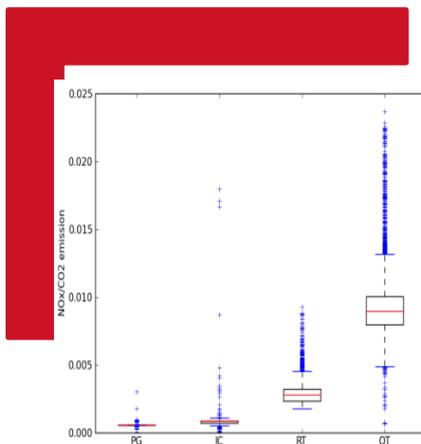
- › **Remote sensing of anthropogenic CO₂ is challenging.**
- › Anthropogenic CO₂ <<< than background – no high resolution Space observation yet
- › Combustion processes are important sources for CO₂ and NO_x.
- › NO₂ has a short lifetime and can be monitored with the OMI instrument

NO₂ is a suitable tracer for recently emitted anthropogenic CO₂.

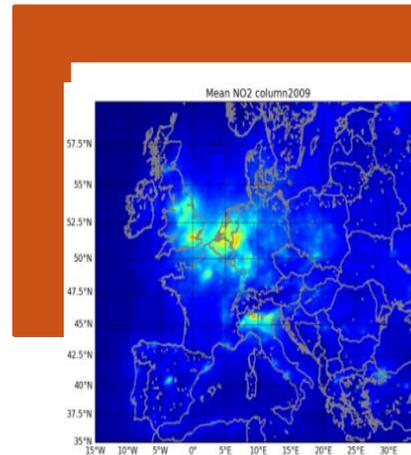


Methodology:

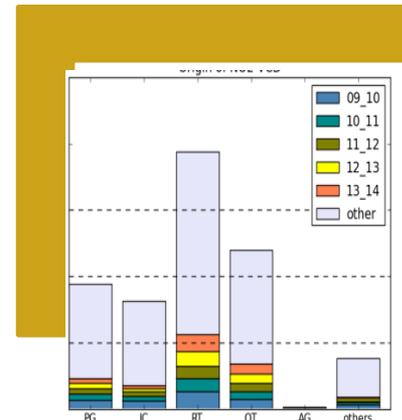
Reported NO_x/CO₂ ratio



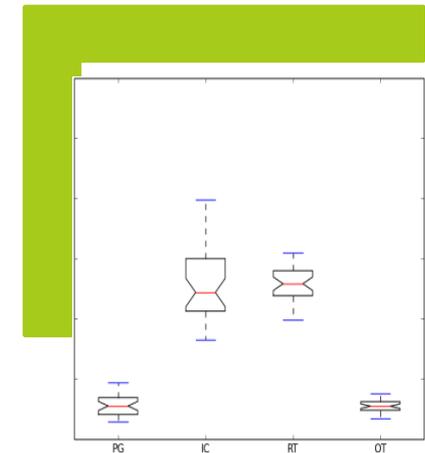
OMI NO₂ column



Source apportionment



Estimate CO₂ anthropogenic contribution

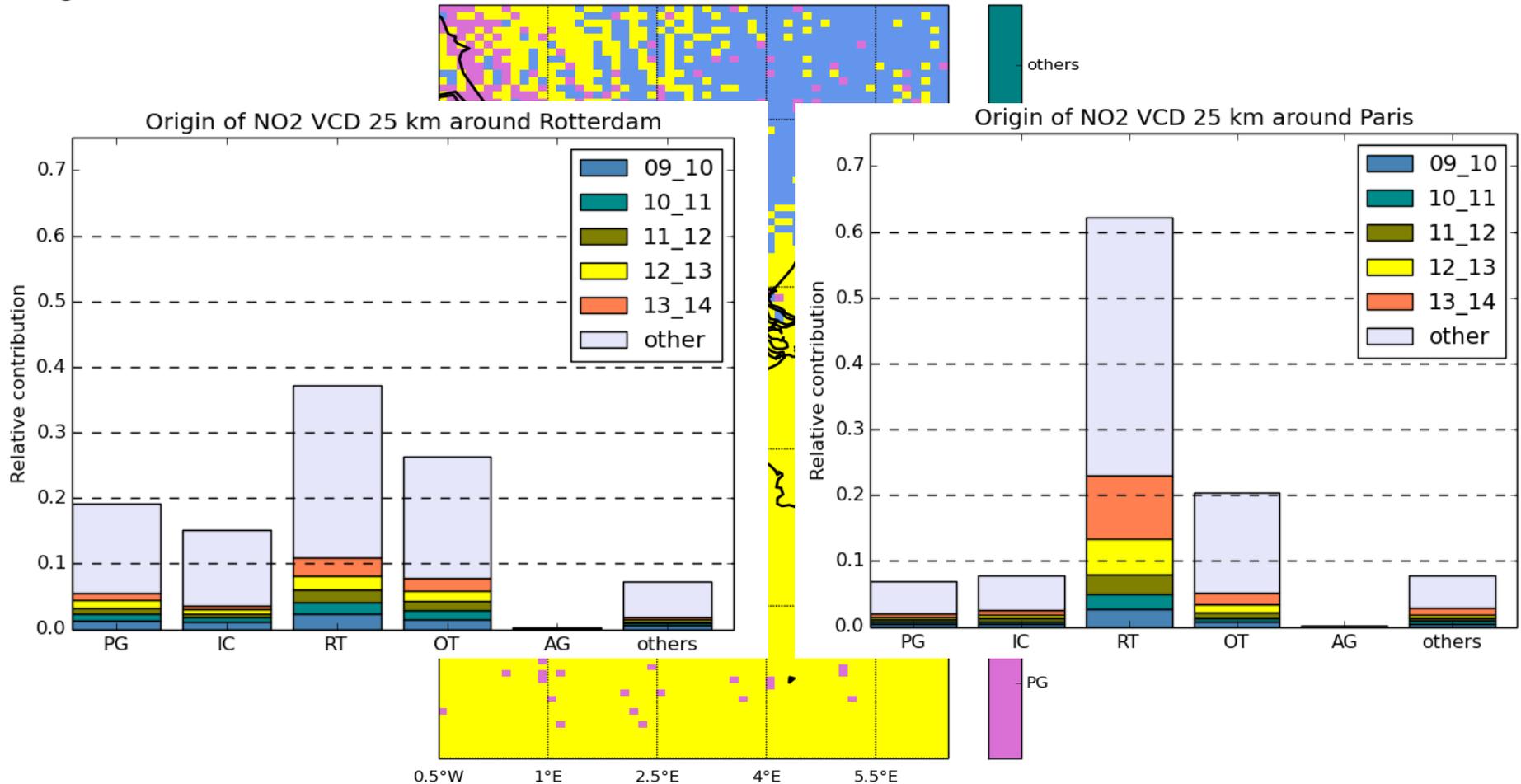


Combine LOTOS-EUROS CTM modelled NO₂ by source sector with monthly mean satellite observations to track and “label” the origin of NO₂ in the OMI NO₂ columns.

Next, combined with NO_x/CO₂ ratio by sector to derive co-emitted CO₂ by source type.



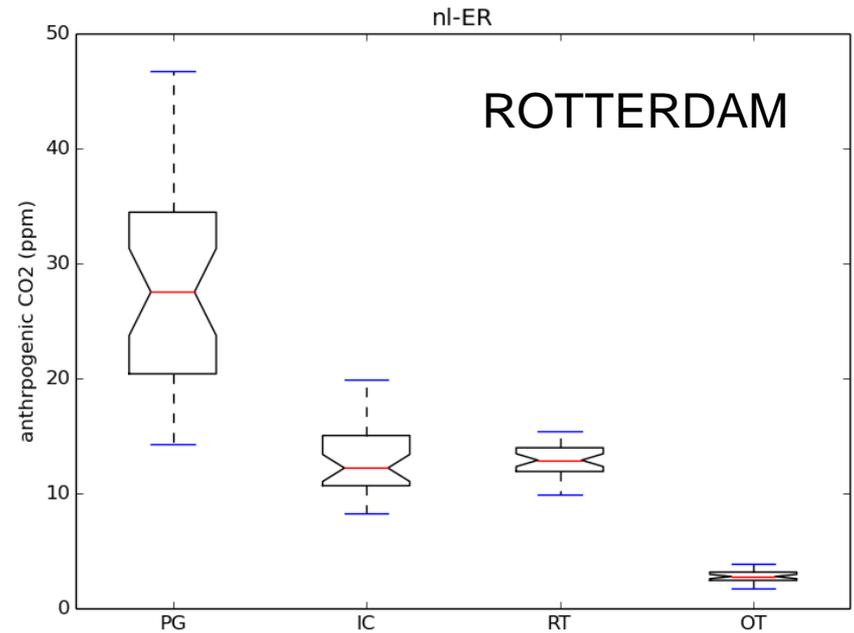
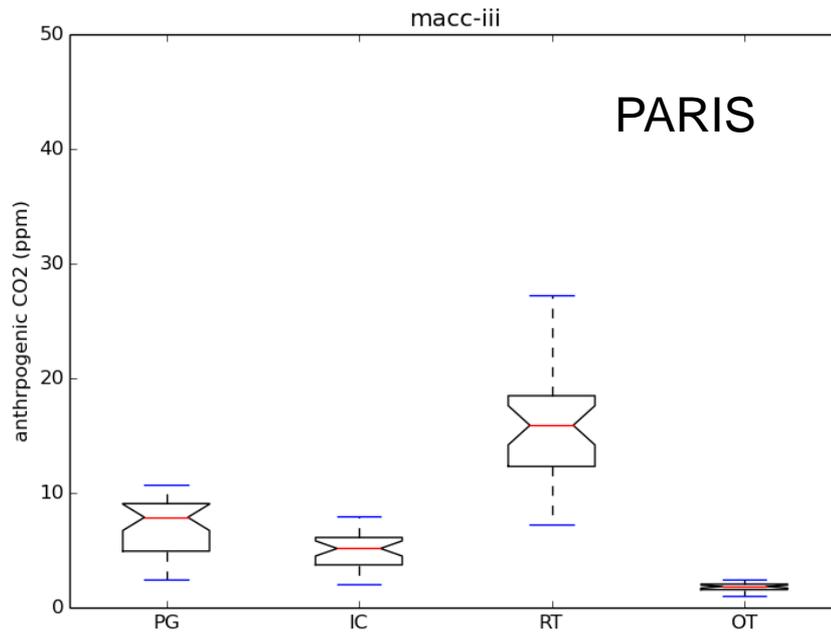
Contribution of various source sectors as function of the time of emission to the NO₂ column at OMI overpass across North Western Europe. PG: power generation, IC: industrial combustion, RT: road transport, OT: other transports, A: agriculture, O: other sectors.



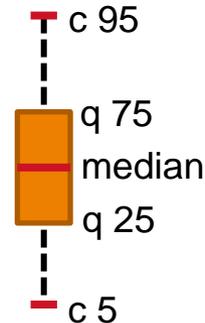


Estimate Anthropogenic CO₂

Assessing CO₂ surface concentration per source contribution (25 km domain)



PG = Power Generation
IC = Industrial combustion
RT = Road transport
OT = Other transport





Summary:

A pilot study has been performed to explore the possibility to develop a process which enable us to invert anthropogenic CO₂ contributions from OMI NO₂ imagery over both the Rotterdam and Paris areas.

The results are encouraging but remain to be validated.

Validation options:

- Inverted anthropogenic CO₂ contributions will be compared to measurements and direct simulations
- Comparison to other attempt to estimate anthropogenic CO₂ contributions.

Can this exercise be transported to other part of Europe or the world? Will the technology-specific ratios hold for other places?

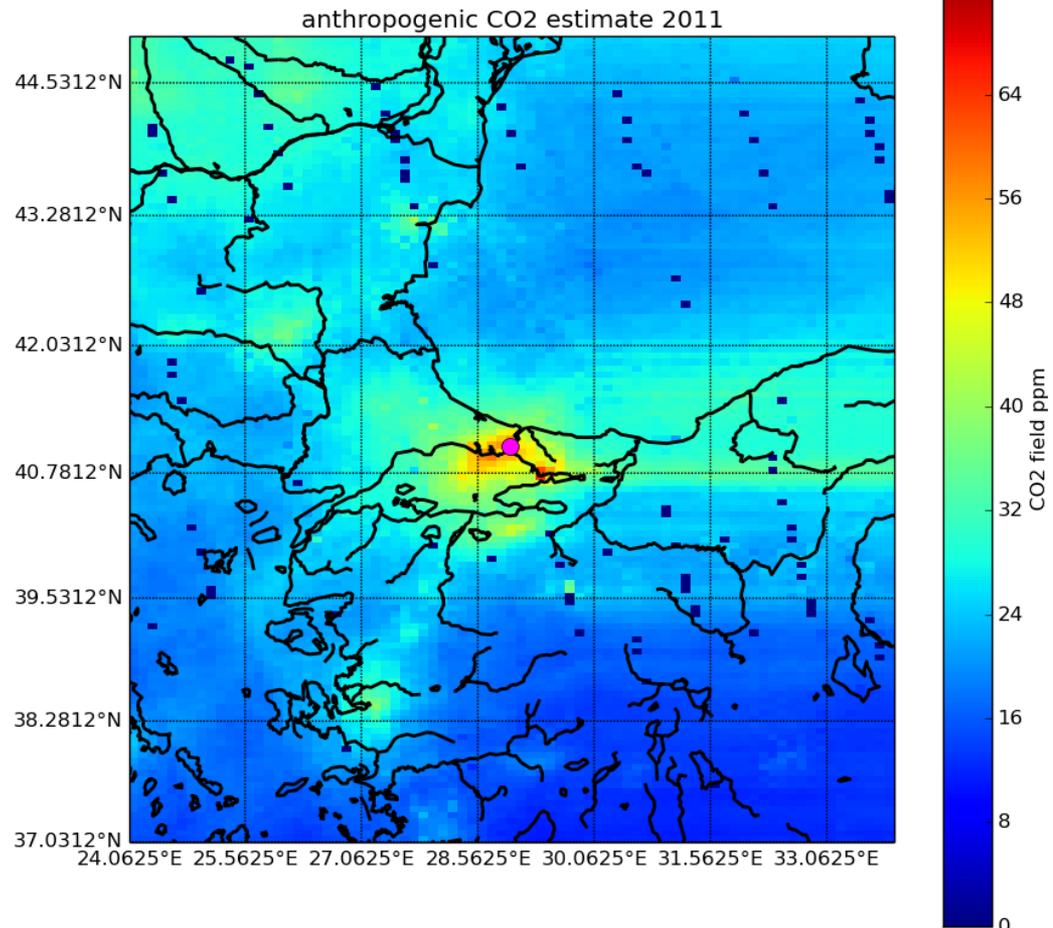
- test could be carried out for Istanbul and Beijing

First pilot focused on yearly mean but the goal is to assess the CO₂ emission from EO data at a finer time scale i.e. daily



The rationale: Test in a data rich environment – export to a data poor environment...

- › **Istanbul; an annual layer of ~30 ppm anthropogenic CO₂**
- › Using CO₂ : NO_x ratios from TNO-MACC_III
- › Pilot needs further study and validation
- › Sensitive to emission ratio's





Thank you for you attention



Contact:

Lyana.curier@tno.nl

hugo.deniervandergon@tno.nl

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