Questions for discussion

- Consistency between co-emitted species.
  How important is this and how do we ensure consistency?

- Consistency of vegetation maps used. Use of vegetation maps in various models.

- Cconnection between emissions and models.
  Can we improve the "interface" between produced emissions
  and what models require?

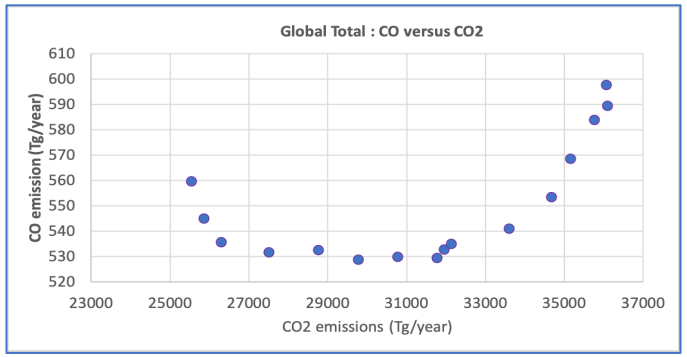
- Emissions that are not covered. Are we missing important elements?

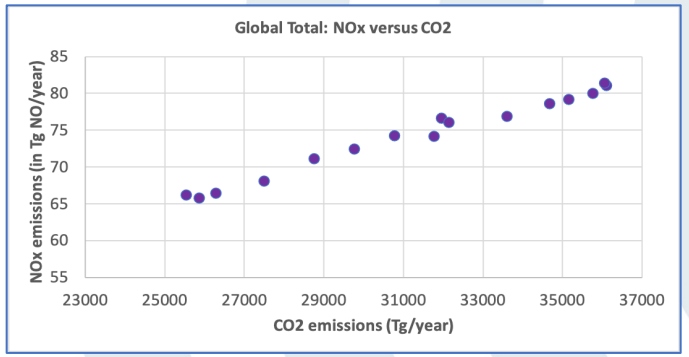
Co-emitted species: need studies for sectors and countries

How can we use information on co-emitted species to infer CO2/CH4 emissions?
Some examples in WP2 and WP5 already discussed yesterday

Are the emissions of some species well correlated?
Example using EDGAR5 emissions for CO2, CO and NOx

CO versus CO2
All sectors
→ No correlation

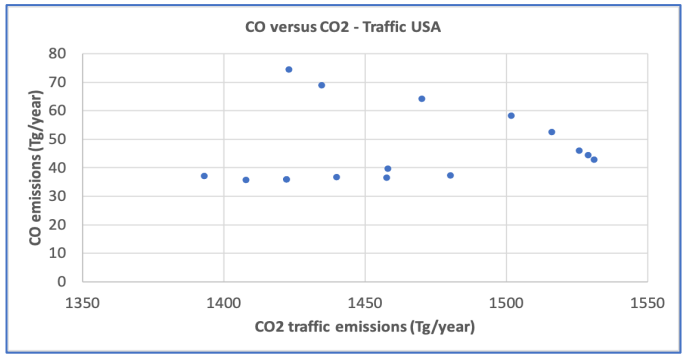


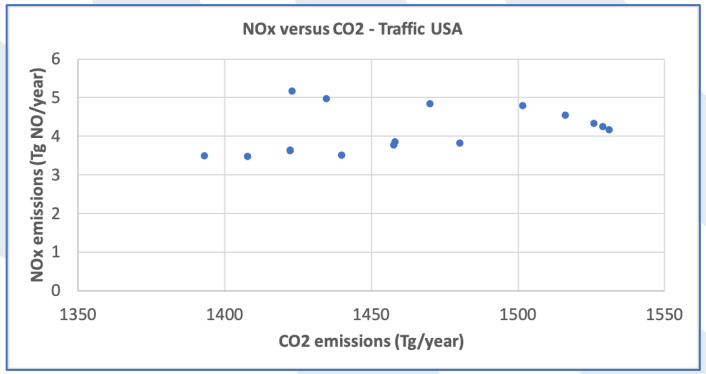


NOx versus
CO2

All sectors → Looks rather correlated

CO versus CO2
Traffic USA
→ No correlation





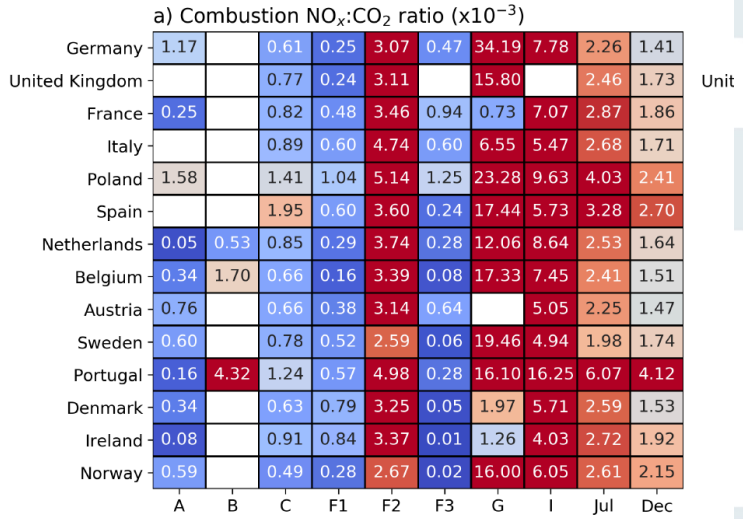
NOx versus
CO2
Traffic USA
All sectors
→ Not correlated

Needs a lot of work: no correlation on a global or country basis does not mean that there is no correlation on small scale or for sub-sectors. Technological changes need also to be taken into account accurately

Co-emitted species: need studies for sectors and countries

A few publications discussing co-emitted species:

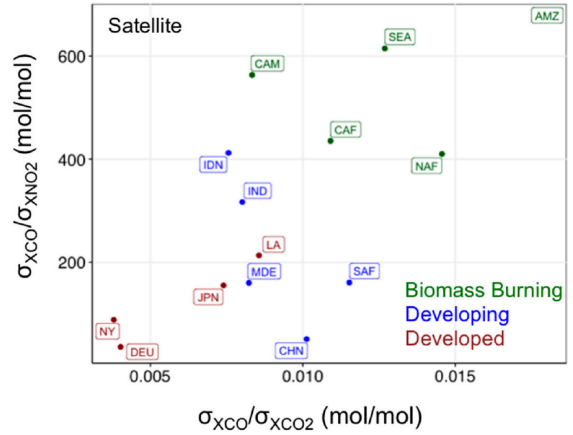
Sadiq et al., ACP, 2021: Understanding the influence of combustion on atmospheric CO2 over Europe by using satellite observations of CO2 and reactive trace gases



Zheng et al, Sciences Advances, 2021: Satellite-based estimates of decline and rebound in China's CO_2 emissions during COVID-19 pandemic

Reuter et al., ACP, 2019: Towards monitoring localized CO2 emissions from space: co-located regional CO2 and NO2 enhancements observed by the OCO-2 and S5P sate

Silva and Arellano, Remote Sensing, 2107: Characterizing Regional-Scale Combustion Using Satellite Retrievals of CO, NO2 and CO2.
This paper considers both anthropogenic and fire emissions



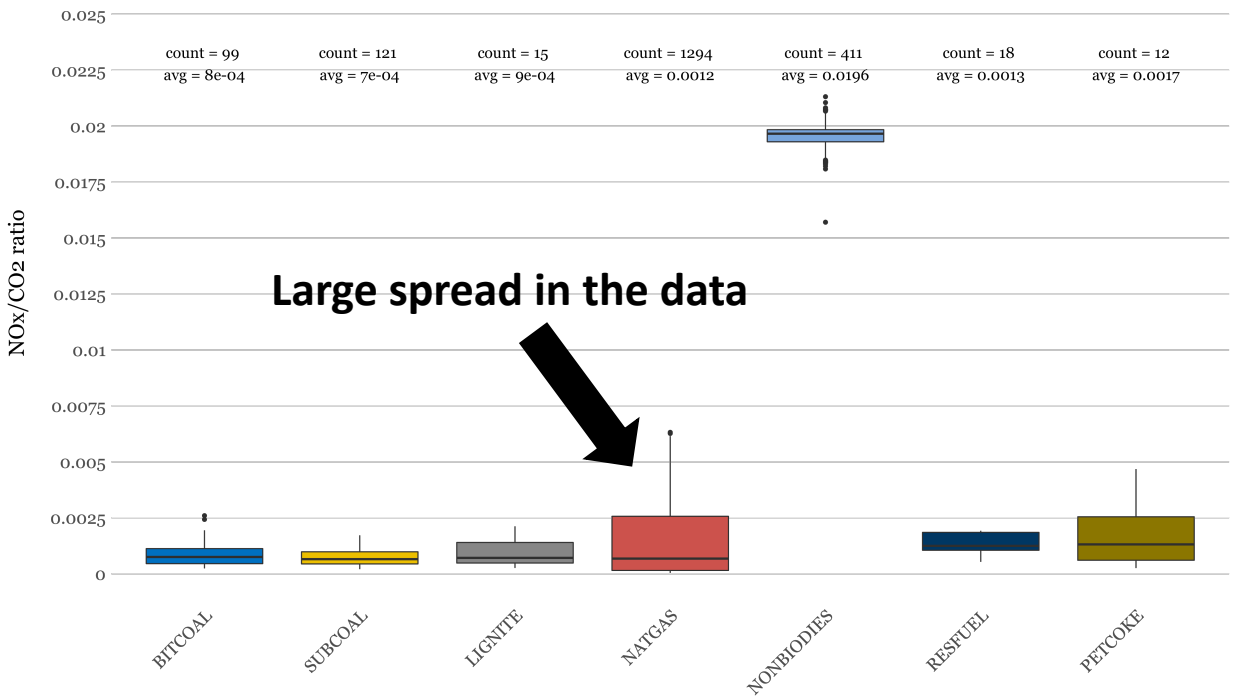
And several other papers….

Consistency between co-emitted species

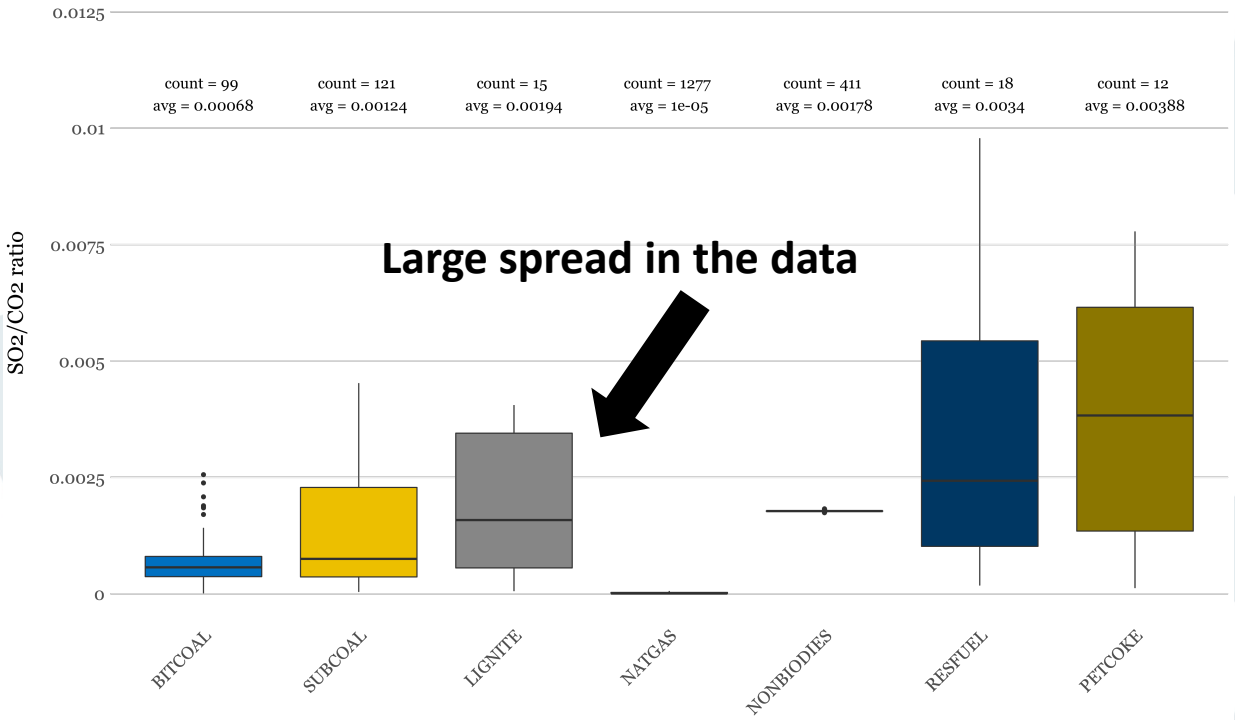
Global non-EU CoCO2 power plant point source database:

- Emissions for co-emitted species (e.g., NOx, SO2) estimated using average emission ratios per fuel type derived from approx. 2,000 USA power plants
- Information on the spread of the ratios could be provided for uncertainty estimates

NO_x/CO_2 emission ratios



SO_2/CO_2 emission ratios



Vegetation maps

Which vegetation maps are used in CoCO2? Are the datasets used in CoCO2 and CAMS consistent, for example for the emissions from fires (GFAS) and the natural emissions of BVOCs (CAMS-GLOB-BIO)

Are the currently available vegetation maps consistent?

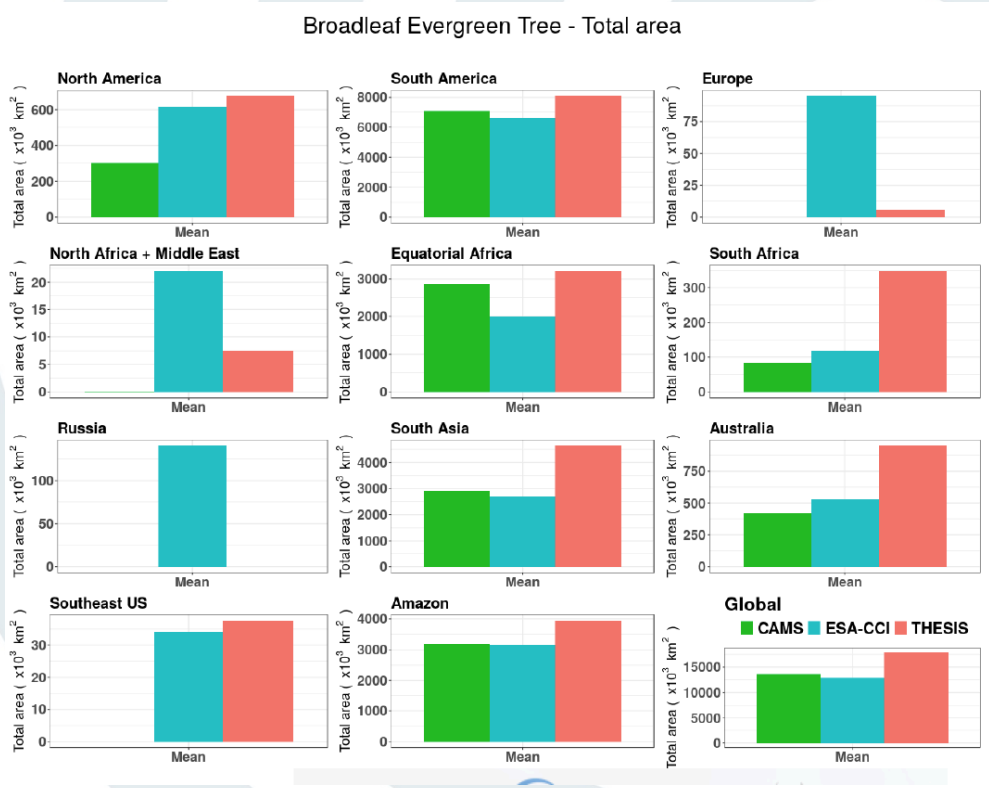
Work done within the CAMS project on emissions and in Sindelarova et al. (ESSD, 2021): differences between several vegetation datasets.

Other studies:

Liu et al., IJRS 2018: Comparison of country-level cropland areas between ESA-CCI land cover maps and FAOSTAT data

Paper by Hua et al. (Remote Sensing, 2018): Spatial Consistency Assessments for Global Land-Cover Datasets: A Comparison among GLC2000, CCI LC, MCD12, GLOBCOVER and GLCNMO

And others…



Connection between emissions and models

Prior information

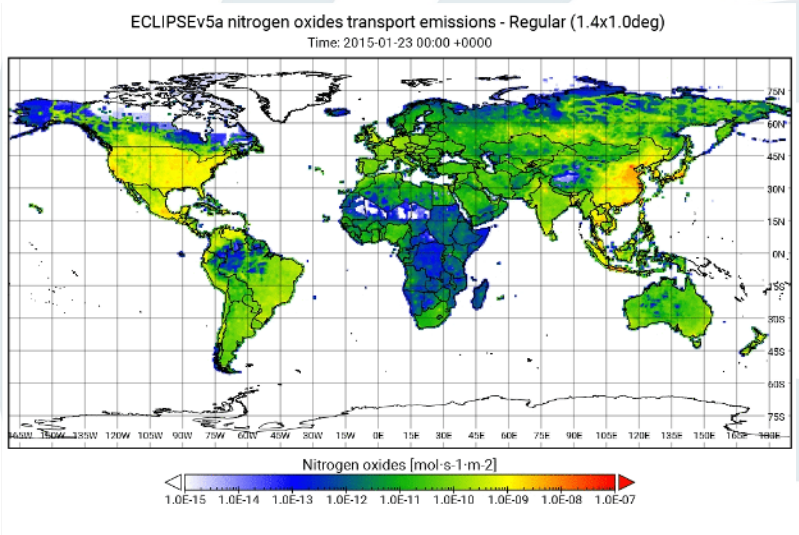
- Annual/monthly gridded emissions

Atmosphere Monitoring Service · EDGAR · Convention on Long-range Transboundary Air Pollution emep · ECLIPSE

- **Temporal profiles**
- **Vertical profiles**
- Speciation profiles (e.g. NOx to NO / NO2)

Processing

Emission input for models



Offline emission processing systems

- HERMESv3 (Guevara et al. 2019)
- SMOKE (Baek and Seppanen, 2018)

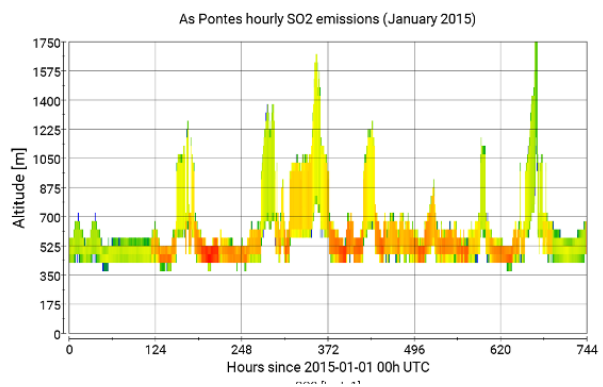
Online emission processing systems

- HEMCO 3.0 (Lin et al., 2021) – implemented in GEOS-Chem, NASA GEOS, NOAA UFS models
- Jähn et al. (2020) – implemented in COSMO-GHG and COSMOART
- + several in-house processing systems...

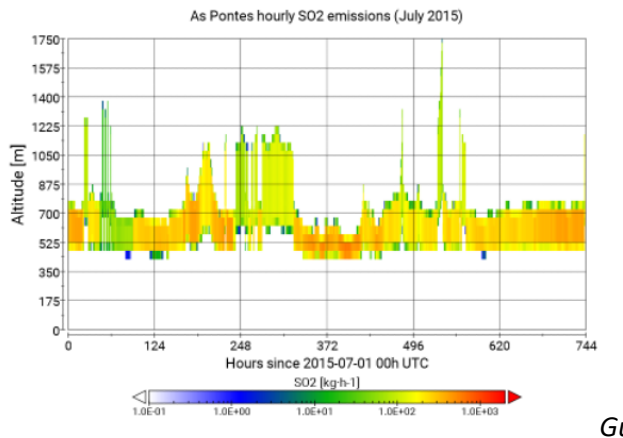
Connection between emissions and models

- Vertical/Temporal profiles typically provided per sector…
- But more detailed profiles are needed to take into account effects of e.g. different sociodemographic patterns, climatological/meteorological conditions, stack properties

Vertical distribution for As Ponter power plant (January 2015)

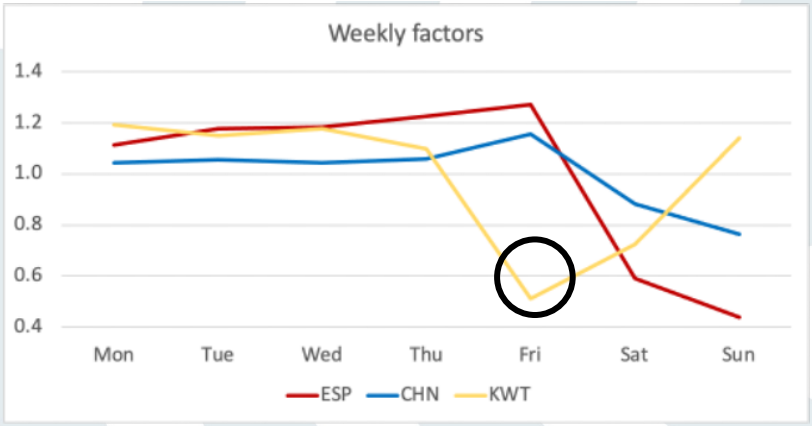


Vertical distribution for As Ponter power plant (July 2015)

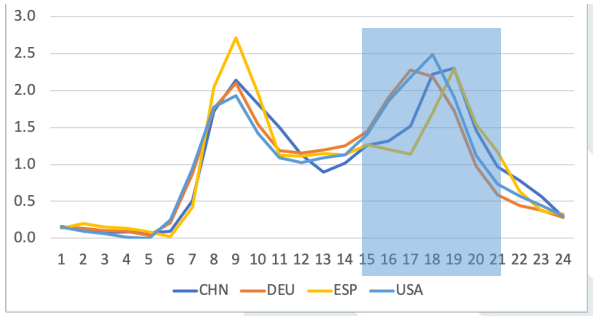


Guevara et al., (2020)

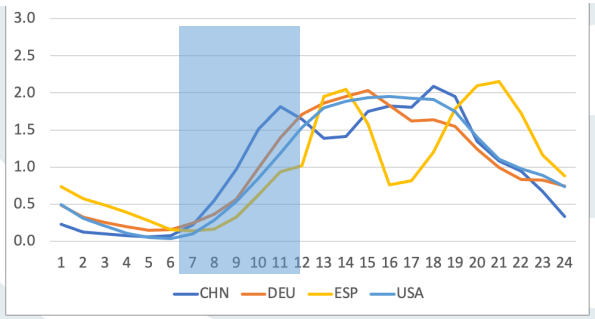
Weekly factors road traffic



Hourly factors road traffic (weekdays)



Hourly factors road traffic (Saturdays)



Connection between emissions and models

- The level of detail of the vertical/temporal profiles (e.g. country-dependent, point source-dependent) is directly linked to the level of flexibility of the emission pre-processing system
- Meteorological parametrisations (e.g., plume rise calculation) → Can be provided off line for past years, but need to be implemented online for forecasting purposes
- Are all these details in the emissions needed? (not all current models can use them)
- Which topic should be made a priority? – or where do we have more room for improvement in the models? Which links to….
- How we quantify the impact of using more detailed temporal/vertical profiles? (sometimes measurements to evaluate these aspects are scarce)