Deriving anthropogenic CO2 emissions for combustion by application of the emission-ratio method to TROPOMI/S5P NO2 emission data.

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Anthropogenic CO₂ and NO₂ emissions from combustion processes usually have the same sources but different emission ratios. Because of their similar sources, combustion emissions of CO₂ and NO₂ are correlated in space and time. Or in other words: combustion emissions of NO₂ will generally be accompanied by CO₂ emissions, and vice versa.

This concept can be used for converting satellite-based emissions of NO₂ into CO₂ emissions by multiplying known emission ratios of CO₂ over NO₂ from established emission databases with satellite-derived NO₂ emissions.

As part of the H2020 CHE project (“CO₂ Human Emissions”) we have applied this method to TROPOMI/S5P NO₂ emission data and “bottom-up” emission databases from Dutch TNO. TROPOMI/S5P emissions using the inversion algorithm DECSO were derived for the Iberian Peninsula in Europe and an area over South America.

We find that, after accounting for naturally occurring soil NOₓ emissions, the spatial distribution of DECSO-TROPOMI based CO₂ emissions over the Iberian Peninsula and the South America region overall are very realistic, and within uncertainties CO₂ emissions budgets from both methods are not dissimilar.

We will also present and discuss some additional aspects and uncertainties of this ratio-method, including the influence of uncertainties in the TNO bottom-up emission database, like inter-country differences, and the relevance of applying emission ratios representative for the same time period as the TROPOMI/S5P measurements. We will also provide some recommendations for further improving this method.

Overall, at minimum this method appears to provide a “sanity check” for bottom-up (reported) CO₂ emissions, but potentially more than that, also evidenced by several new satellite mission proposals to combine direct measurements of CO₂ with direct measurements of NO₂ from the same satellite platform.

How to cite: de Laat, J. and van der A, R.: Deriving anthropogenic CO2 emissions for combustion