

Constraining Emissions of CO₂ and co-emitted species in European cities

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In the European ICOS network the impact of fossil fuel CO₂ emissions is monitored at the continental scale by CO₂ and ¹⁴CO₂ measurements at so-called ICOS atmospheric class-one stations representing mainly background stations. However, the fossil fuel emissions are concentrated in urban and industrialised regions, and emission reduction policies are mostly made at the national scale. From the perspective of the emission reductions agreed upon in the Paris Agreement 2016, it is highly desirable to develop and test methods to apply an atmospheric monitoring technique for monitoring fossil fuel emissions from city scales up to regional and national scales. Methods based on CO₂ concentrations alone are not likely to work because the uncertainty of the CO₂ budget is often dominated by uncertainties in biogenic fluxes and variable background concentrations. ¹⁴CO₂ has already proven to be the most direct tracer for ffCO₂ emission. However, also for ¹⁴C-based ffCO₂ estimate challenges remain, mainly the choosing a suitable background for the investigated region and taking into account the ¹⁴C emissions from the nuclear industry. The budget is determined mainly by fossil fuel emissions, on the regional and national scale. Only the presence of nuclear power plants in the vicinity of the city region of interest may influence the budgets, assuming that cosmic production and disequilibrium fluxes from oceans and vegetation are negligible (Graven and Gruber 2011, Vogel et al. 2013, Bozhinova et al. 2014, Turnbull et al., 2014).

In RINGO (an ICOS-EU associated project), a method is being developed based on paired atmospheric stations where CO₂ and ¹⁴CO₂ will be sampled, where possible together with CO, NO_x, O₂ and Rn. The method will be tested for atmospheric station pairs in 3 city regions: Paris, Rotterdam and Heidelberg/Karlsruhe. The atmospheric sampling strategy and the setup of the model efforts is described. The use of extra tracers like CO, O₂ and Rn will be discussed. This presentation focusses on the discussions and decisions made in the project and the resulting detectability of anthropogenic emission signals.

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