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On observationally based surface flux estimates using the 222Radon-tracer approach: new methodologies and application to CO_2 emissions in Bern, Switzerland

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The 222Radon-tracer method is a powerful tool to estimate local and regional surface emissions of (e.g.) greenhouse gases. Here we demonstrate that in practice, the method as it is commonly used, produces inaccurate results because of non-homogeneously spread emission sources and we propose a different approach to account for this. We have applied the new methodology to ambient observations of CO_2 and 222Radon to estimate CO_2 surface emissions for the region of Bern, Switzerland. Furthermore, by applying the same methodology to combined measurements of CO_2 and $\delta(O_2/N2)$ we are able to discriminate between the main emission sources influencing our observations on seasonal and daily timescales.
Mean net CO_2 emissions based on two years of observations are estimated at: (8.3 $\pm$ 3.3) kt km-2 a-1 in summer/spring and (9.4 $\pm$ 4.4) kt km-2 a-1 in winter/autumn. Observed oxidative ratios indicate a dominant biospheric source in summer/spring and fossil fuel combustion processes in winter/autumn, specifically related to natural gas usage.