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The exchange of carbonyl sulfide between an urban ecosystem and the atmosphere

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During the past couple of years, carbonyl sulfide (COS), a trace gas present in the atmosphere at an average mole fraction of around 500 ppt, has received growing interest as a tracer for the gross uptake of carbon dioxide by plants (gross primary productivity, GPP). COS diffuses into plant leaves in a fashion very similar to CO_2, but in contrast to the latter is generally not emitted. Indeed it has been demonstrated that the leaf uptake of COS scales with the corresponding gross uptake of CO_2 and for a few selected ecosystems robust relationships between COS uptake and GPP have been found as well.

Here we report results from eddy covariance COS flux measurements above the city of Innsbruck (Austria) during summer/fall 2018. In urban environments, any CO_2 uptake by plants in green spaces is often dwarfed by concurrent anthropogenic CO_2 emissions, making it difficult to isolate the biogenic flux component. The aim of this study was to investigate whether COS could help disentangling the biotic CO_2 uptake from the large background of anthropogenic CO_2 emissions, an undertaking that to the best of our knowledge has not been attempted before. We hypothesised that the COS exchange would be smaller compared to productive terrestrial ecosystems, due to concurrent COS-consuming (plant and soil COS uptake) and COS-releasing (soil, burning of fossil fuel, unknown emission sources) processes.

Results show that COS fluxes were generally small and noisy. After appropriate averaging, however, a clear net uptake of COS could be observed in the morning and afternoon hours, while a peak of COS release was observed during midday hours. CO_2 was emitted from the urban ecosystem at high rates throughout the day, with a peak during the midday hours. These results will be discussed on the basis of a flux footprint analysis (fraction of built-up vs. green areas) and by using additional tracers for the burning of fossil fuels (e.g. concurrently measured carbon monoxide, benzol and toluol fluxes).