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Diffusivity and enzymatic activity control the exchange of Carbonyl Sulfide (COS) between soils and the atmosphere

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Carbonyl sulfide (COS) is one of the most abundant and stable reduced sulfur trace gases found in the atmosphere, which is involved in stratospheric aerosol production and the ozone cycle. COS has a variety of natural and anthropogenic sources but is well balanced by sinks as vegetation and soils. Since the sink strength of soils is poorly understood, it is important to characterize the controlling parameters. Therefore, soil samples were investigated for their exchange of COS with the atmosphere under controlled ambient conditions. Arable soils from different places around the world are parameterized in relation to the ambient COS concentration, temperature and soil water content (WC). Based on our data exhibiting a clear and sharp optimum for the COS deposition velocity, we discuss the soil WC as an important biological and physical parameter. Beside ambient concentration and soil WC, soil structure and enzymatic activity seem to control the direction as well as the magnitude of the flux between soils and the atmosphere. The matching optima for different soils in relation to water-filled pore space (WFPS) suggest that the uptake of COS depends on the diffusivity dominated by WFPS, a parameter depending on soil WC and structure. Since carbonic anhydrase (CA) has been identified as the controlling enzyme for COS uptake in soil, we modified the method of Wilbur and Anderson (1948) in order to investigate the enzymatic activity in soils. Based on this technique we could qualitatively identify the activity of CA in our soil samples.