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Carbonyl sulfide exchange in a temperate loblolly pine forest grown under ambient and elevated CO_2

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Abstract. Vegetation, soil and ecosystem level carbonyl sulfide (COS) exchange was observed at Duke Forest, a temperate loblolly pine forest, grown under ambient (Ring 1, R1) and elevated (Ring 2, R2) CO_2. During calm meteorological conditions, ambient COS mixing ratios at the top of the forest canopy followed a distinct diurnal pattern in both CO_2 growth regimes, with maximum COS mixing ratios during the day (R1=380±4 pptv and R2=373±3 pptv, daytime mean ± standard error) and minimums at night (R1=340±6 pptv and R2=346±5 pptv, nighttime mean ± standard error) reflecting a significant nighttime sink. Nocturnal vegetative uptake (−11 to −21 pmol $m^{-2}s^{-1}$, negative values indicate uptake from the atmosphere) dominated nighttime net ecosystem COS flux estimates (−10 to −30 pmol $m^{-2}s^{-1}$) in both CO_2 regimes. In comparison, soil uptake (−0.8 to −1.7 pmol m^{-2} s^{-1}) was a minor component of net ecosystem COS flux. In both CO_2 regimes, loblolly pine trees exhibited substantial COS consumption overnight (50% of daytime rates) that was independent of CO_2 assimilation. This suggests current estimates of the global vegetative COS sink, which assume that COS and CO_2 are consumed simultaneously, may need to be reevaluated. Ambient COS mixing ratios, species specific diurnal patterns of stomatal conductance, temperature and canopy position were the major factors influencing the vegetative COS flux at the branch level. While variability in branch level vegetative COS consumption measurements in ambient and enhanced CO_2 environments could not be attributed to CO_2 enrichment effects, estimates of net ecosystem COS flux based on ambient canopy mixing ratio measurements suggest less nighttime uptake of COS in R2, the CO_2 enriched environment.

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