2.038 The effects of canopy mixing on fluxes and vertical concentration gradient of VOCs above a forest canopy.

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Abstract:

Fluxes of biogenic Volatile Organic Compounds from forest ecosystems account for over three-quarters of the hydrocarbons annually released to the atmosphere. The atmospheric reactions of these compounds affect the composition, chemistry and oxidative capacity of the troposphere on all time and spatial scales. They are well-documented precursors of ozone and aerosol as well as a source of reactive nitrogen to remote regions. In spite of recent advances in our understanding of their reactions across a spectrum of NOx regimes, models are often still unable to reconcile simulated concentrations and fluxes of bVOCs with those measured in and above forest canopies, particularly in regions where NOx concentrations are moderate (~1-2 ppbv). We apply the FORCAsT (FORest Canopy Atmosphere Transfer) canopy exchange model to a rural mixed deciduous forest site in the northern mid-latitudes where NOx mixing ratios are typically around this level. We explore the canopy processes controlling exchanges of isoprene and its oxidation products methyl vinyl ketone and methacrolein between the forest canopy and the atmosphere. While isoprene fluxes are always positive, bi-directional exchange of methyl vinyl ketone and methacrolein has been observed at many sites. Furthermore, the chemical lifetime of isoprene is of a similar order to the canopy retention time making vertical exchange processes important. We conclude that for such species understanding and better accounting for turbulent mixing is as important as chemistry in determining canopy-top fluxes.