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Biosphere-atmosphere exchange of reactive trace gases of tall vegetation canopies: the rôle of characteristic chemical, plant physiological, and turbulent time scales

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For reactive trace substances, vegetation canopies play a significant role as sources (e.g. VOC, HNO_2), as well as sinks (e.g. wet and dry deposition of oxidants (O_3, H_2O_2), reactive N-, S- and C-containing trace gases and aerosol particles). Particularly in (tall) canopies, the fate of these substances is determined by chemical, plant physiological, and turbulent transport processes. The ability of tall vegetation canopies to "trap" those reactive trace gases (and reaction products), which are biogenically emitted from the plants and/or by the soil below the canopies, became recently known to be an important (but up to now rarely investigated) aspect of atmospheric budgets of trace gases. For instance, a considerable part of soil emitted H_2O, NO_X or CO_2 can be (re-)absorbed before escaping the canopy layer into atmospheric surface and boundary layers, and finally into the free troposphere. Time scales for chemical reactions are in the order of seconds to hours and are consequently overlapping with the time scales for turbulence mixing and plant physiological processes within tall canopies. While there is fairly good knowledge on chemical and plant physiological time scales, characteristic in-canopy turbulent time scales are difficult to assess. This is due to

high roughness, decoupling effects and coherent structures which hamper classical description of the turbulent exchange. Diagnostic algorithms, referring to simplistic description of chemical, plant physiological, and turbulent processes will be used to elucidate the complex interactions. Emphasis will be given to the influence of different canopy structures on characteristic in-canopy turbulent time scales.