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Determination of OH radical concentrations between 80-325 m over the Amazon rainforest using BVOC measurements

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The tropical rainforest is the largest source of VOCs to the global atmosphere ^[1], where they are oxidized primarily by the hydroxyl radical (OH) ^[2]. In-situ measurements of OH are rare, especially from tropical forests, but indirect OH estimates can be made using VOC concentrations measured from aircraft or towers. For this it is necessary to measure the vertical change in concentration of a specific VOC with a known OH rate coefficient, within a known reaction time. In this study volatile organic compounds (VOC) were measured on the Amazon Tall Tower Observatory (ATTO) from 3 heights (80, 150 and 325 m) above the Amazon rainforest with a PTR-TOF-MS 4000 (IONICON Analytik GmbH). Typically to estimate OH, the convective timescale of the boundary layer is taken as the approximate reaction time. However, here we have developed a new method to determine the vertical transport based on the dynamic time warping technique. Median averaged transport times from 80 m to 325 m ranged from 105 to 15 minutes with decreasing values throughout the day from 06:00 to 15:00 as thermal and shear driven convection increases. We apply this method to determine effective OH concentrations between 80-325 m using isoprene and its oxidation products (methyl vinyl ketone, methacrolein and ISOPOOH) and compare these empirically derived values to values from the large-eddy simulation DALES ^[3]. The timescales of turbulent mixing and OH chemistry are similar, so both govern the vertical change in concentration.

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