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Atmospheric impact of sesquiterpenes in the Amazon rainforest

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Sesquiterpenes ($C_{15}H_{24}$) are highly reactive biogenic volatile organic compounds playing an important role in atmospheric chemistry. Once emitted from the Earth's surface, primarily by vegetation, they are rapidly oxidized to semivolatile oxygenated organic species that can lead to secondary organic aerosols (SOA) that influence climate. In the pristine Amazon rainforest environment oxidation of sesquiterpenes is initiated by OH and ozone.

We measured sesquiterpenes in March 2018 (wet season) and November 2018 (dry season) from central Amazonia, at the remote field site ATTO (Amazonian Tall Tower Observatory), Brazil. Samples were collected on adsorbent filled tubes equipped with ozone scrubbers at different heights above the forest canopy ; every three hours for two weeks at 80m and 150m (wet season) and every hour for three days at 80m, 150m and 320m (dry season). Samples were then analysed in the laboratory with a TD-GC-TOF-MS (Thermodesorption-Gas Chromatographer-Time Of Flight-Mass Spectrometer, Markes International). Simultaneous measurements of ozone and meteorological parameters were made at the nearby INSTANT tower. Identification of the chromatographic peaks was achieved by injection of standard molecules and by matching literature mass spectra. Quantification of the chemical compounds was achieved by injection of a standard mixture containing terpenes.The most abundant sesquiterpene measured at ATTO is (-)-α-copaene. Its diel profile varies with photosynthetically active radiation (PAR) and temperature, suggesting the canopy to be the main emission source. Interestingly, other identified sesquiterpenes show a consistent mirrored cycle, with their concentration being higher by night than by day. These varied mostly with RH suggesting the soil to be the main source of the emissions. Air samples taken at the ground are qualitatively and quantitatively different to those collected at different altitudes from the tower. Sesquiterpenes show a common maximum at sunrise (5 :00-7 :00 local time, UTC-4h) coincident with a strong decrease in ozone concentration (>50% decrease on average during the dry season). The strongest effect is registered during the dry season, when sesquiterpenes and ozone concentrations are highest and ozone loss is largest. The atmospheric impact of the measured sesquiterpenes will be discussed including ozone reactivity contributions and OH generation.