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Analysis of the impact of biomass burning emissions on global ozone production in the upper troposphere with MOCAGE CTM and IAGOS airborne data.

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The UTLS (Upper Troposphere/Lower Stratosphere) is a key layer of the atmosphere as its chemical composition impacts both the troposphere and the stratosphere, and therefore plays a significant role in the climate system. Ozone at this altitude for instance plays a great role on surface temperature. Unlike in the stratosphere; it can be produced from the photolysis of precursors originating in the troposphere; mainly nitrous oxides (NO_x) and carbon monoxide (CO) at this pressure range. Biomass burning emissions in particular are likely to play a significant role in the quantities of these species in the upper troposphere and thus impacting ozone balance. This effect is investigated thanks to the global chemistry transport model MOCAGE. Because of the strong vertical gradients in this layer of the atmosphere, well resolved in-situ observation dataset are valuable for model evaluation. As of measurements used to validate MOCAGE results, IAGOS in-situ measurements from equipped commercial aircraft were chosen for their fine vertical resolution as well as their wide geographical coverage. Using both of these tools, upper tropospheric air composition is studied, with a focus on ozone precursors and production linked to biomass burning emissions.

Firstly is investigated the direct impact of biomass burning emissions on CO concentration in the upper troposphere, as it is both a good tracer of wildfire plumes in the atmosphere and it plays a role in the upper troposphere chemical balance. For this purpose MOCAGE simulations spanning over the year of 2013 where biomass burning emissions were turned on and off are compared to estimate a contribution to upper tropospheric CO. These simulations were validated using all the available data from the IAGOS database. It was found that biomass burning impacted CO levels globally, with the strongest enhancement happening above the most emitting areas (equatorial Africa and the Boreal forests). The importance of a fast vertical transport pathway above the fires was also highlighted with the possible occurrence of pyroconvection in addition to deep convection. Secondly, other chemical species related to ozone production were looked upon. Peroxyacetyl Nitrates (PAN) for instance were found to be impacted by biomass burning as it is a product of NO_x oxidation as well as the main "reservoir" specie for NO_x in the upper troposphere. Ultimately, ozone production resulting from biomass burning emissions is investigated, both in biomass burning plumes encountered by IAGOS aircraft, and on a more global scale using the MOCAGE simulations.

