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Understanding the origin and composition of air in the Upper Troposphere from MOCAGE CTM and IAGOS airborne data : a focus on biomass burning

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The Upper Troposphere/Lower Stratosphere (UTLS) is a key layer of the atmosphere when it comes to understanding exchanges of air affecting tropospheric and stratospheric composition. It also plays an important role on the Earth's radiative budget, and is a source of uncertainties when it comes to studying climate. Modelling its chemical composition is challenging because of the multiple chemical and physical processes at stakes, but also because of the difficulty to validate the results with global and well resolved observations. Satellites data lack vertical resolution and in-situ ozone soundings lack global coverage. As a complementary dataset, the IAGOS European research infrastructure; which relies on equipped commercial airplanes; provides in-situ measurements with high vertical resolution in the UTLS and a wide geographical coverage. Using both IAGOS measurements and outputs from MOCAGE CTM, upper tropospheric air composition and origin is studied, and more specifically the contribution of biomass burning events.
First is assessed the potential of the IAGOS database to validate outputs from MOCAGE, with a focus on Carbon Monoxide (CO) and Ozone (O_3). A reference simulation is carried out using the chemistry transport model MOCAGE, for 2013, a recent year with the largest number of validated IAGOS measurements. Indeed, IAGOS allowed us to study how well the model represents air composition of the UTLS by comparing its results to multiple flights, as well as some vertical profiles in the upper troposphere for well sampled regions. This kind of comparisons is very useful for a global evaluation. But in order to isolate the contribution of biomass burning, we need to be able to select part of the measurements.
For this purpose, the recently developed SOFT-IO tool is used, providing CO source attribution thanks to the Lagrangian model FLEXAPRT coupled to emissions inventories. After locating positive CO anomalies attributed to biomass burning, we then evaluate the model performance for these specific events. Biomass burning emissions are studied, as well as the way they are injected into the atmosphere in the model. A new parametrisation for injection profiles has been developed thanks to the latest inventories products such as GFAS mean altitude of maximum injection. After validating this new method, a study is conducted to assess the influence of biomass burning to the upper troposphere composition, on CO, but also on the production of related species like O_3.