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Ozone production in the upper troposphere over West Africa: sensitivity to non-methane hydrocarbons under convective conditions

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Tropical deep convection is an efficient pathway of transporting up to the upper troposphere (UT) trace gas species such as volatile organic compounds (VOC). However, the impact of convective transport on UT composition and chemistry is still poorly characterized.
The chemical impact of convection on the tropical UT over West Africa was studied during the AMMA Special Observation Period in August 2006 (SOP 2a2). Experimental strategy consisted in sampling at altitudes between 0 and 12 km downwind of Mesoscale Convective Systems (MCS) and at cloud base on-board the two French aircrafts, the ATR-42 and the French Falcon-20.

Previous work pointed out that tropical deep convection in West Africa is efficient and is responsible with fast transport of VOC into the UT even the most reactive (isoprene) in less than one hour (Bechara et al., 2009). Here, we have investigated the impact of VOC precursors on ozone production. For that purpose, box modelling was implemented with the Master Chemical Mechanism scheme to simulate ozone variability in the upper troposphere downwind convection. The model is initialized with observed trace gases concentrations (NMHC, NOx, NOy, CO...) collected during the AMMA SOP 2a2 airborne campaign.

Results show a positive ozone production several days downwind convective clouds at an average rate of 4 ppb/day. They confirm that UT ozone production is sensitive to NOx. Surprisingly, the sensitivity of NMHC initial concentrations on ozone production is negative. Indeed, an increase in NMHC favours PAN (peroxyacetyl nitrate) formation and thus decreases ozone production. The implication on ozone budget in the upper troposphere is crucial.