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Analysis and modelling of vertical exchanges induced by the convective systems of tropical latitudes : effects on tropospheric ozone

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In tropical regions, upward movements due to strong convective areas have been evidenced in the past but the stratosphere to troposphere exchanges studies linked to tropical convection, convective clouds, cyclones and inter-tropical convergence zone (ITCZ) are still limited.

The objective was to perform our knowledge on the exchanges dynamical mechanisms near to deep convection, and more particularly in the close vicinity of tropical cyclones by investigating the dynamical links between tropical convection and tropospheric ozone.

A climatological approach showed that the influence of the frequent occurrence of these convective systems on tropospheric ozone is double : an ozone enhancement in mid-troposphere and a decrease of ozone in high troposphere.

The analysis of a strong subsiding transfer on April 6, 1995 (300 ppbv at 10.5 km), following from the cyclone Marlene activity, occurring in the peripheral part of the cyclone, at approximately 1000 km of the centre of the cyclone, characterised the dynamical mechanisms of this stratosphere-troposphere exchange. The high levels ageostrophic circulation and associated divergence zones, and the contribution of the vertical wind shear to the stratosphere-troposphere exchange are very important contributions of the meso-scale modelling through MESO-NH.

The answer of the idealized model of tropical cyclone HURRICANE brought dynamical complements and generalized this study of mechanisms connecting cyclones and

dynamic exchanges between the atmospheric compartments. First, it allowed to better understand the effects of the vertical wind shear on the exchanges from the lower stratosphere to the upper troposphere. More, the air masses circulations associated to the tropical cyclones structure at the origin of both upward and downward dynamical exchanges showed by the climatological study have been materialized.

In an additional way to the Marlene case, three different synoptic situations where a strong interaction between convection, jet-front system and Rossby waves induce stratosphere-troposphere exchanges have been documented. Through this study, we performed our knowledge of the exchanges mechanisms between stratosphere and troposphere induced by the convection and tropical cyclones and we put in evidence the variability of the signatures observed on ozone, humidity and potential vorticity.