Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 6, 1585-1598, 2006
www.atmos-chem-phys.net/6/1585/2006/

Modelling study of the impact of deep convection on the UTLS air composition – Part 2: Ozone budget in the TTL

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Abstract. In this second part of a series of two papers which aim to study the local impact of deep convection on the chemical composition of the Upper Troposphere and Lower Stratosphere (UTLS), we focus on ozone simulation results using a mesoscale model that includes on-line chemistry. A severe convective system observed on 8 February 2001 at Bauru, Brazil, is studied. This unorganised convective system is composed of several convective cells that interact with each other. We show that there is an increase in the ozone concentration in the tropical transitional layer (TTL) in the model during this event, which is compatible with ozone sonde observations from Bauru during the 2004 convective season. The model horizontal variability of ozone in this layer is comparable with the variability of the ozone sonde observations in the same area. The calculation of the ozone budget in the TTL during a 24 h period in the area of the convective system shows that the ozone behaviour in this layer is mainly driven by dynamics. The horizontal flux at a specific time is the main contribution in the budget, since it drives the sign and the magnitude of the total ozone flux. However, when averaged over the 24 h period, the horizontal flux is smaller than the vertical fluxes, and leads to a net decrease of ozone molecule number of 23%. The upward motions at the bottom of the TTL, related to the convection activity is the main contributor to the budget over the 24h period since it can explain 70% of the total ozone increase in the TTL, while the chemical ozone production inside the TTL is estimated to be 29% of the ozone increase, if NO_x production by lightning (LNO_x) is taken into account. It is shown that downward motion at the tropopause induced by gravity waves generated by deep convection is non negligible in the TTL ozone budget, since it represents 24% of the ozone increase. The flux analysis shows the importance of the vertical contributions during the life time of the convective event (about 8 h). The TTL ozone is driven out of the domain horizontally by the convective outflow during this period, limiting the ozone increase in this layer.

Final Revised Paper (PDF, 488 KB) Discussion Paper (ACPD)

Citation: Rivière, E. D., Marécal, V., Larsen, N., and Cautenet, S.: Modelling study of the impact of deep convection on the UTLS air composition – Part 2: Ozone budget in the TTL, Atmos. Chem. Phys., 6, 1585-1598, 2006. Bibtex EndNote Reference Manager