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Medium-range mid-tropospheric transport of ozone and precursors over Africa: two numerical case studies in dry and wet seasons

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Abstract. A meso-scale model was used to understand and describe the dynamical processes driving high ozone concentrations observed during both dry and monsoon season in monthly climatologies profiles over Lagos (Nigeria, 6.6° N, 3.3° E), obtained with the MOZAIC airborne measurements (ozone and carbon monoxide). This study focuses on ozone enhancements observed in the upper-part of the lower troposphere, around 3000 m. Two individual cases have been selected in the MOZAIC dataset as being representative of the climatological ozone enhancements, to be simulated and analyzed with on-line Lagrangian backtracking of air masses.

This study points out the role of baroclinic low-level circulations present in the Inter Tropical Front (ITF) area. Two low-level thermal cells around a zonal axis and below 2000 m, in mirror symmetry to each other with respect to equator, form near 20° E and around 5° N and 5° S during the (northern hemisphere) dry and wet seasons respectively. They are caused by surface gradients – the warm dry surface being located poleward of the ITF and the cooler wet surface equatorward of the ITF.

A convergence line exists between the poleward low-level branch of each thermal cell and the equatorward low-level branch of the Hadley cell. Our main conclusion is to point out this line as a preferred location for fire products – among them ozone precursors – to be uplifted and injected into the lower free troposphere.

The free tropospheric transport that occurs then depends on the hemisphere and season. In the NH dry season, the AEJ allows transport of ozone and precursors westward to Lagos. In the NH monsoon (wet) season, fire products are transported from the southern hemisphere to Lagos by the southeasterly trade that surmounts the monsoon layer. Additionally ozone precursors uplifted by wet convection in the ITCZ can also mix to the ones uplifted by the baroclinic cell and be advected up to Lagos by the trade flow.

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