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Atmos. Chem. Phys., 10, 895-907, 2010

www.atmos-chem-phys.net/10/895/2010/

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What caused extreme ozone concentrations over Cotonou in December 2005?

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Abstract. This paper reports the first record of extreme ozone measurements in Africa. As part of the AMMA program, the ozone vertical profile recorded on 20 December over Cotonou presents exceptionally high ozone concentrations with up to 295 ppb at 1 km altitude. Retroplumes from the Flexpart model show that the air masses sampled at 1 km over Cotonou on this day came from the burning area situated north-east of Cotonou and passed over Lagos, Nigeria, which is highly impacted by urban pollution. We used the Master Mechanism box model to simulate the chemical composition of the plume during its transit.

We find that neither the biomass burning emissions of ozone precursors nor additional urban emissions from Lagos are high enough to simulate more than 120–150 ppb of ozone. The only way to reach almost 300 ppb of ozone within a few hours is to feed the air mass with large amounts of reactive VOCs as those recorded in the vicinity of petrochemical area. Sensitivity tests show that 250–600 ppb of VOCs combined with 35–80 ppb of NO_x allow the ozone concentrations to be higher than 250 ppb. Nigeria is the first African country with gas extraction and petrochemical industries, and petrochemical explosions frequently happen in the vicinity of Lagos. The hypothesis of a petrochemical explosion in this area is the most likely scenario which could explain the 295 ppb ozone maximum measured over Cotonou, downwind of Lagos.

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Citation: Minga, A., Thouret, V., Saunois, M., Delon, C., Serça, D., Mari, C., Sauvage, B., Mariscal, A., Leriche, M., and Cros, B.: What caused extreme ozone concentrations over Cotonou in December 2005?, Atmos. Chem. Phys., 10, 895-907, 2010. [Bibtex](#) [EndNote](#) [Reference Manager](#)

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