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Vertical profiles of ozone, VOCs, and meteorological parameters from the low boundary layer of a polluted megacity

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A clear understanding of the evolution of air pollutants at different heights of the boundary layer is an important issue to improve the air quality assessment of polluted cities. However, measurements to characterize the lowest few hundred of meters of the atmosphere over urban areas are scarce. In this context, the vertical distributions of ozone and 13 volatile organic compounds (VOCs) in the lower atmosphere of Mexico City were investigated.

A tethered balloon was used to obtain detailed profiles of those chemical species and meteorological parameters during nighttime, the morning and some hours after mid-day. Ozone concentrations were measured up to 1000 m above ground level by an electrochemical sonde, while VOCs were sampled in canisters up to 200 m of height in intervals of 50 m with a Teflon tube attached to the balloon's rope and connected to a diaphragm pump at the ground. The VOCs were analyzed by GC-FID and they included ethane, propane, propylene, butane, acetylene, pentane, hexane, heptane, benzene, octane, toluene, nonane and o-xylene. These VOCs were selected to be representative of the VOC burden of the atmosphere of Mexico City. In total 104 profiles between 500 and 1000 m height and 46 profiles up to 200 m were measured over 28 selected days during the dry months (November to April) of the years 2000-2004.

The analysis presented in this work focus on the description of the evolution of the vertical distributions of ozone and VOCs as function of the boundary layer development over Mexico City. The atmospheric stability is determined through vertical profiles of

the potential temperature and profiles of a modified bulk Richardson number. Special emphasis is given to the contribution of the residual ozone aloft the nocturnal boundary layer to the ground level ozone enhancement during the morning transition, as well as to the release of VOCs trapped in the stable nocturnal surface layer during the same transition period, when the inversion layer evolves and break-ups as the land and air warm-up. These vertical measurements will help to understand better the transport, mixing and chemical processes that determine the fate of the urban ozone, and will provide valuable information to evaluate actual air quality models.