Comparative measurements of the vertical profiles of black carbon size distributions and mixing fraction in air masses downwind of Mexico City and Asia

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The impact of black carbon (BC) on radiative processes, heterogeneous chemistry and health of ecosystems is sensitive to the characteristics of the soot, i.e. the number and mass concentration as a function of size and the amount of non-light absorbing material on the BC particles. The Droplet Measurement Technology (DMT) Single Particle Soot Photometer (SP-2), is the only instrument capable of measuring these characteristics and does so on a particle by particle basis in the diameter range from 150 to 800 nm.

In March and April, 2006, The SP-2 was one of a very large complement of instruments mounted in the NCAR C-130 for measuring particle and gas properties during the Megacity Impact on the Regional and Global Environment (MIRAGE) project and the Intercontinental Transport Experiment (INTEX-B). Vertical and horizontal profiles were made during MIRAGE within an approximately 200 km radius of Mexico City from March 3 to 31. The INTEX-B measurements were made from April 17 to May 15 and covered an area west of Seattle within approximately 800 km radius.

During MIRAGE, EC particles make up 10 - 15 % of the total particle number concentration and 25 - 35% of the particle mass concentration at distances up to 200 km from the city center of Mexico. The INTEX-B measurements show a more variable percentage that ranged from 5 to 20% by number and mass in this same size range.

The size distributed mass of EC in the Mexico City air mass has a mode at 400 nm and more than 10% of the mass is in diameters larger than 700 nm. The relative shape of the size distribution does not shift significantly to larger sizes as total concentration or distance from Mexico City increases - suggesting that coagulation is not a major source of EC particle growth. However, the particles further from the center of Mexico City had thicker layers of non-light absorbing material.

The results of these studies will be useful for generating better estimates of BC lifetime and in calculating the impact of BC on regional and global radiative fluxes and heating rates.