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Section C

Comparing lung deposition of ultrafine particles caused by fireworks and traffic

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Comparing lung deposition of ultrafine particles caused by fireworks and traffic

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Every year New Years celebrations are carried out across the world by individuals as well as official organizations involving fireworks, creating concern about an estimated intense particle load in densely populated areas.

This campaign investigated the size distribution of aerosols in the range below 1 µm, comparing its influence on lung deposition. Sampling sites were located in the downtown area of Salzburg, Austria, measuring New Years fireworks particle load and burden of traffic exhaust during a typical work day under winter weather conditions.

Most environmental monitoring campaigns rely on measuring PM_1, $PM_{2.5}$ or PM_{10}. This does not reflect the actual impact on humans, as depositions vary widely depending on the particle size distribution and the amount of ultrafine particles. Although PM_{10} seemed to be correlated with trends in ultrafine particles, it did not provide enough evidence that ultrafine particle behavior can be considered simply as a fraction of PM_{10} (Rosenbohm *et al.*, 2005).

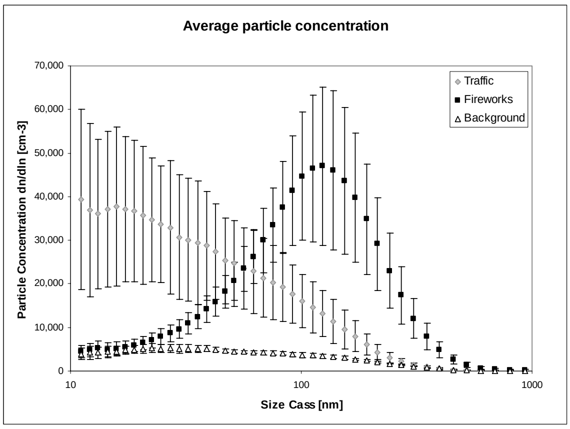

Figure 1. Particle size distribution averages comparing fireworks, traffic exhaust and a background value.

The sampled nano-particle inventory shows a great difference in its distribution. We found that the main burden in ultrafine particles originated from traffic exhaust. Although both fireworks and traffic show a similar total particle concentration of 78,790 [N/cm^3] (fireworks) and 75,518 [N/cm^3] (traffic) respectively, traffic creates significantly more particles below 100 nm with a broadened distribution within that range. Fireworks particles fingerprint peak past the 100 nm range. This difference in distribution is of great influence for the deposition in the human lungs.

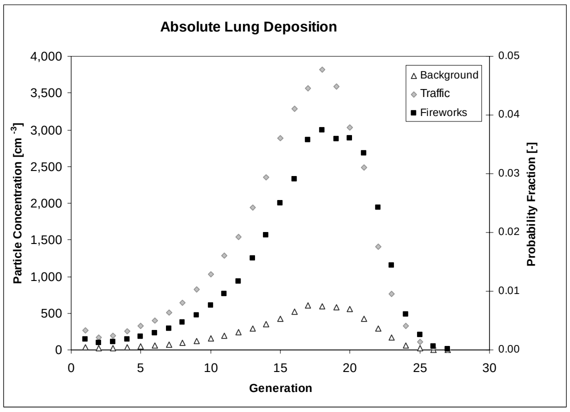

Figure 2. Modeled lung deposition patterns using the Monte Carlo code IDEAL. Plotted are simulations for fireworks, traffic and background measurements.

We used the gathered data on size distribution in the stochastic lung deposition model developed by Koblinger & Hofmann (1990), which shows distinct lung depositions past the 15th generation. Figure 2 shows a distinct higher particle deposition from traffic exhaust in this alveolar region. Deposition here is associated with increased cardio-circulatory problems, as the immune system is the primary organ to remove entrapped particles (Donaldson *et al.*, 1988).

Although fireworks increase PM_{10} (Barman *et al.*, 2008), this study found a less heavy impact on human lung deposition from fireworks versus average downtown traffic.

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