Highway exhaust aerosols and their effects on alpine lichen populations

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Shortly after the oil crisis in the 1970's it was observed that incomplete combustion of fossil fuel resulted in thick grey-brown smog blankets covering the Salzach-valley in Salzburg, Austria (Hufnagel & Türk, 1998). The investigation of the net effect of airborne aerosol pollutants was studied with epiphytic lichen communities (Christ & Türk, 1981). Back then the most damaging component were SO_2^- and H_2S components resulting in loss of chlorophyll of the algal partner (Heber et al, 1994). With the gradual decrease of sulphur content in combustion fuel, NO_X and polycyclic aromatic HC components have taken over the chemical aspects of pollutant inventory. Being readily adsorbed by nano-particles, they provide the ideal agent to induce damage to lichen communities located near polluted areas, and in particular near high-traffic areas (Kasperowski & Frank, 1989). By investigating the particle inventory, it is possible to correlate epiphytic lichen polutations with nearby aerosol line-sources like the Highway E55 (Tauernautobahn) and to estimate the potential damage to the adjacent Bluntau-valley.

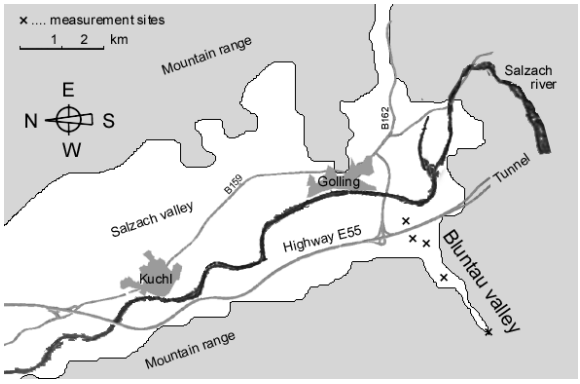

Figure 1. Topographical setting of the Bluntau-valley, highway and measurement sites.

SMPS-measurements were carried out repeatedly on several days during a six-month period. Measurement times were coordinated by taking into consideration the topography and the geographical orientation of the highway, i.e., the north-south orientation of the U-shaped Salzach-valley suggested to confine the monitoring window to the early morning or evening hours of bright, sunny days. Oscillatory motions of air masses occur perpendicularly to the valley's main orientation. The observed convective mass-flow of air driven by solar radiation and augmented by the western mountain range fit nicely with the documented surface wind data recorded on these days.

Since the morning measurements of the transect stretched from the westbound area across the highway to the eastbound area and beyond into the Bluntau-valley, the documented particle inventory confirms the translocating effect thereby exerting an additional stress-factor on lichen populations (fig.2).

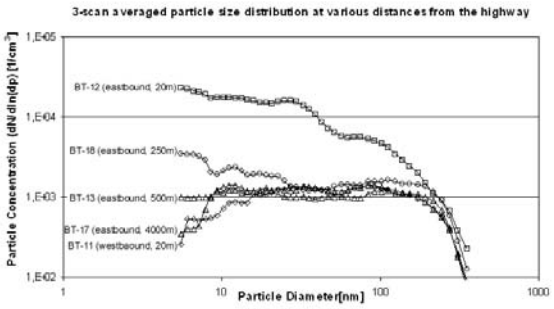

Figure 2. Size distributions of exhaust particles near Highway E55 (Tauernautobahn).

In conclusion, this investigation documents that particles from traffic emissions are translocated across the sound-protective barriers of the highway into the adjacent Bluntau-valley. This is obviously sufficient to negatively affect lichen populations as far as 500 m away from the high-traffic area and confirm biomonitoring investigations carried out almost 20 years ago (Kasperowski & Frank, 1989).

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