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Scanning Doppler lidar applications for air quality monitoring

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Air quality is greatly affected by the sources of gaseous and particulate pollutants, but also by boundary layer dynamics. For instance, a very low mixing layer at the surface can trap emissions at the surface within a smaller volume resulting in higher pollutant concentrations – or it may keep high stack emission from reaching the surface. Additionally, chemical and physical processing of the emissions once in the atmosphere is influenced by turbulent properties of the boundary layer. Scanning Doppler lidars provide a tool for characterising the turbulent nature of the boundary layer and hence we have launched a new project called "Dispersion of air pollution in the boundary layer – new approach with scanning Doppler lidars", which utilises the network of five scanning Doppler lidars (HALO Photonics) operated by the Finnish Meteorological Institute in meteorologically and environmentally different locations in Finland.

Vertical wind speed and aerosol backscatter profiles obtained from a Doppler lidar can be used to determine the mixing level height, but only if the mixing layer top exceeds an instrument-specific lower limit, in our case 100 metres. However, low level scanning routines offer possibilities to further decrease this threshold. One of the aims of this project is to combine different scanning routines with vertically pointing measurements and thus decrease the lower threshold for detecting mixing layer height, preferable all the way down to the level of the instrument. On the other hand aerosol backscatter signal from low level scanning can be used to investigate the spatial distribution of particulate matter within the boundary layer. Preliminary comparison of in-situ measurements of PM10 mass concentrations and aerosol backscatter signal over the city of Helsinki indicate that the backscatter signal could be used to provide PM10 mapping over urban regions. The current status of method development for low level mixing height and PM10 mapping as well as subsequent results will be presented in the conference.