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The application of artificial neural networks for discrete wavelength retrievals of atmospheric nitrogen dioxide in urban environments

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Research at the University of Leicester is being conducted to investigate the feasibility of using a technique of discrete wavelength sunlight spectroscopy to derive concentrations of the pollutant nitrogen dioxide from a satellite platform. This technique has the potential to enable very light and compact instrumentation, and may as a result provide abundant air quality data over (and within) urban environments which will be of significant value to users and policy makers.

To perform the discrete wavelength retrieval a back propagation multi-layered perceptron artificial neural network (ANN) has been developed to retrieve atmospheric slant columns of nitrogen dioxide from simulated measurements. The ANN approach enables retrievals to be performed much faster than other retrieval methods, which is a particularly useful feature in instances where a large quantity of retrievals is required, for example in a near real time operational information system based on discrete wavelength satellite and insitu measurements. To generate the required training data for the ANN to understand the necessary relationships the radiative transfer model SCIATRAN was run to provide millions of spectral intensities and slant column concentrations. To realistically portray urban air quality in the training data the radiative transfer model was fed atmospheric profile and aerosol data from modeled air quality forecasts to enable assimilation of the atmospheric composition of a typical urban environment.

The supercomputer at the University of Leicester (ALICE) has been utilised extensively in the network training process, and investigations into the ANN's ability to retrieve nitrogen dioxide from unseen test data of simulated concentrations will be presented.