Development of an ANN–based air pollution forecasting system with explicit knowledge through sensitivity analysis

**Introduction**

* For near surface emissions, surface winds determine transport/dispersion of pollutants
* Atmospheric stability determines extent to which pollutants dispersed vertically
* Deterministic vs. statistic
  + Rely on fluid dynamic and chemical transformation models, limited by requirement of detailed knowledge of source parameters
  + Use measurements of emission rates, meteorological parameters, etc. to develop linear/nonlinear functions, limited by inability to provide dispersion mechanisms
* ANN models capture nonlinear behavior of atmospheric processes, used widely for prediction, function approximation and pattern classification
* Purpose of study is to determine effect of different meteorological parameters on pollutant concentrations to construct an ANN model based on pattern recognition
  + Forecasted NO2 concentrations

**Methods**

* Site in Auckland, New Zealand chosen due to complex mixture of traffic, home heating, and industrial emissions
* One year of data chosen for training, two weeks for testing
* Used sensitivity analysis, which provides extra knowledge on response of the network to meteorological and emission parameter changes
* Three linear models developed on the same data set
  + One w/inputs of time scales
  + One with time scales, wind speed, and wind direction
  + One with time scales and all meteorological inputs
* Evaluated by: Mean Bias (MB), Root Mean Square Error (RMSE), coefficient of determination (R2), and index of agreement (IA)

**Results**

* Clear inverse relationship between NO2 concentrations and wind speed
* NO2 linearly related to solar radiation and relative humidity
  + Other graphics shown in attached figures
* Hidden layers = 37
  + Genetic optimization took longest, but got most accurate results
* From sensitivity analysis, wind speed, wind direction, and hour of the day show greatest sensitivity, as shown in attached figures
* Wind speed plays most important role and shows strong inverse relationship
  + When removed, show most drastic change
* Six models w/ removed variables, results shown in attached figures
* Models perform worst in spring and best in autumn

**Conclusion**

* Surface winds found to be most influential parameter
* Future research includes k-means clustering

**Citation**

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**Purpose**

I will be using this research on my background research paper, as well as to supplement the background information section of my final research paper. This is the main paper on which I will base my research on. It describes very well the methods used to run an artificial neural network.