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TROPOSPHERIC OZONE PREVISIBILITY THROUGH THE ARTIFICIAL NEURAL NETWORK TECHNIQUE: COMPARATIVE STUDY FOR THE METROPOLITAN AREA OF SÃO PAULO.

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EXTENDED ABSTRACT

The main objective of this research was to study the previsibility of the tropospheric ozone in the Metropolitan Area of São Paulo through Artificial Neural Networks technique. The variables considered in the study were: Air temperature, global solar radiation, relative humidity, wind velocity and direction, mixing height, cloud coverage, atmospheric pressure and ozone concentration. Meteorological parameters and atmospheric pollutants data were collected from the monitoring stations of the São Paulo State Environmental Protection Agency (Cetesb) and from the Climatological Station of the Institute of Astronomy, Geophysics and Atmospheric Sciences (IAGCA).

This research is associated in the extent of the project of Research in Public Politics: *'Desenvolvimento de Tecnologia para Previsão de Ozônio na Baixa Atmosfera'* (FAPESP-São Paulo Science Foundation, Process: 98/14157-7), coordinated by Prof. Dr. Roberto Guardani of the Department of Chemical Engineering of the Polytechnic School of USP, that had as objective the development of a model based on artificial neural networks for forecasting concentrations of tropospheric ozone in RMSP, which was implemented by the CETESB.

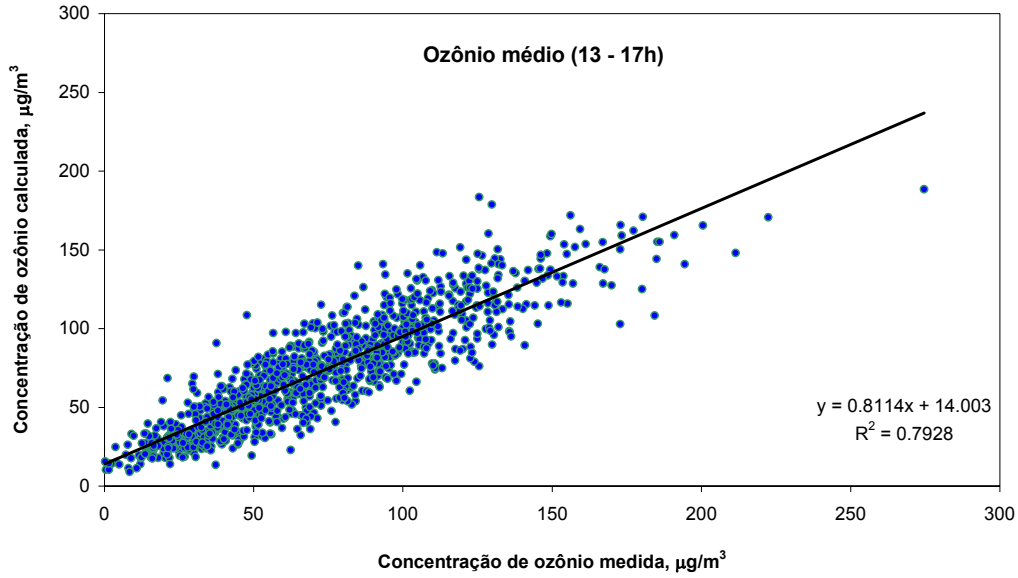
The air quality station used as the reference in this study was the one in the Ibirapuera Park, for being the one that presents larger incidence of high concentrations of

ozone, and also, for being representative of the ozone behavior in the RMSP. For that reason, the model development for forecast ozone formation with base in the data of the Ibirapuera station can make possible to foresee the behavior in other several places along the city, except for those close places (less than 50 m) of roads with dense traffic, where there are usually smaller indexes of ozone.

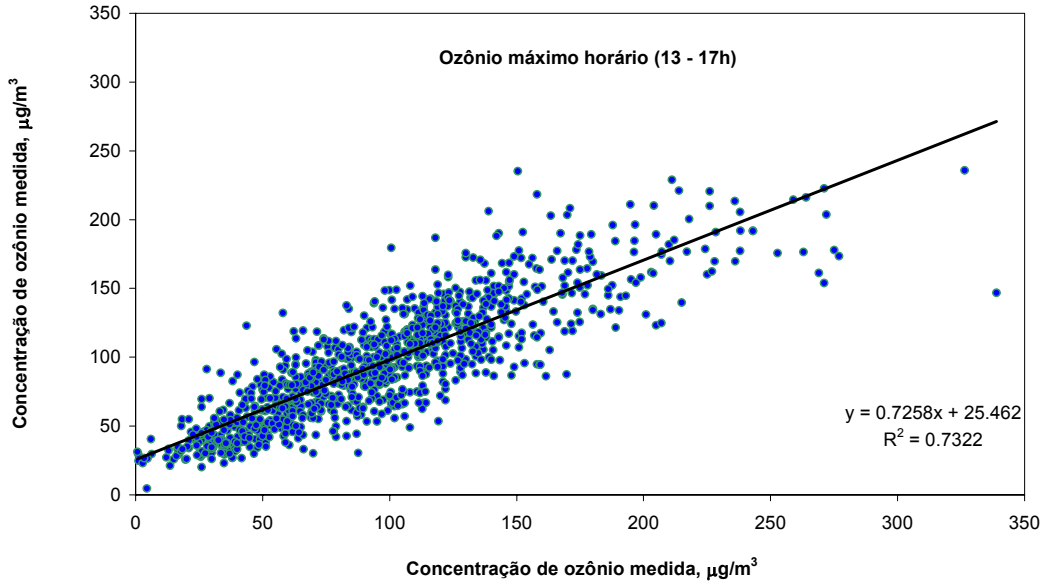
All data set refers to the period between 1999 and 2004. From the selected data were obtained representative averages for the morning, from 7 am to 12 am, and for the afternoon, from 1 pm to 5 pm. The meteorological parameters were used as inputs of the artificial neural network, in agreement with each configuration selected for adjustment. The outputs were average and maximum ozone for the afternoon period.

The artificial neural networks theory has globally been applied as a new and efficient tool to work with complex phenomena. A general reference on artificial neural networks can be found in DAYHOFF (1990). His application in the treatment of data is especially relevant in situations that present non-linearity, due to the capacity of such models to recognize a pattern in a process without the need of application of the physical and chemical laws that govern the system. Due to the characteristic complexity involved in the atmospheric modelling of concentrations of ozone, with a number of factors of different natures acting in the system, the use of a model of artificial neural networks represents a valid tool for the study of tendencies of levels of ozone concentrations (GUARDANI et al., 1999).

The main obtained results can be appraised in the pictures 1 and 2 which presents comparisons among the values calculated by the neural network and the measured ones for the concentrations of average and maximum ozone for the afternoon.



Picture 1: Comparison among calculated values and measured ones for the average ozone concentration (data from the learning-set).



Picture 2: Comparison among calculated values and measured ones for the maximum ozone concentration (data from the learning-set).

The method demonstrates to be functional, but susceptible to the quality of the meteorological forecast inserted as input. The concentrations of medium ozone for the period of the afternoon are foreseen better by the model, although the estimates of maximum ozone are also adapted. The dispersion of the results is larger when the concentrations of ozone are high, due to smaller frequency with such events are registered, therefore, less representative in the training process of the neural network. The result motivated the consideration of two confidence intervals for the output of the model: ozone concentrations between 0 and 100 $\mu g/m^3$ and concentrations above 100 $\mu g/m^3$.