Comparison of regressive and neural network models to study total ozone trend over Indian stations

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In last two decades a number of studies have been carried out throughout the world to understand the impact of human activities on ozone using satellite and ground based data. The most common tool to determine ozone trend is linear regression model which include various periodicities like solar cycle, biennial oscillation, ENSO cycle. Various researchers have determined trend over Indian stations. In this research work we have shown neural network as another tool to determine trend and a comparison between the linear regressive models and neural network shows good agreement.

Monthly mean Dobson and TOMS data for the period 1980 to 2003 is used over three stations namely Delhi, Kodaikanal and Pune. The following trend models are developed and used in this study.

1. A time series regressive model [kundu & Jain, 1993] is used to obtain trend from TOMS and Dobson spectrophotometer.

O3(t) = a + bt + a1sin(2p(t-p1)/6) + a2sin(2p(t-p2)/12) + a3sin(2p(t-p3)/26) + a4sin(2p(t-p4)/132) + a5 sin(2p(t-p5)/264)

where O3(t), t=1,2,Ě,T denotes the time series of ozone, t time in month, a the intercept, b the trend coefficient and g the terms involving amplitude and phase of 6-month, annual, biennial, 11 and 22 years cycles.

2. Another time series regressive model O3(t) = a + b.t + e. ENSO(t) + d.QBO + g.Solar Where t is time in month, a the intercept, b trend coefficient, e, d, g are the coefficients for ENSO (El Nino Southern Oscillation), quassi-biennial oscillation and 11-years solar cycle.

3. A neural network software Qnet obtained from Vesta Service Inc. (USA) based on back-propagation technique is used to find trend. Total ozone is taken as output parameter and parameters like day, various periodicities such as biennial, 11-year and 22 solar cycles, ENSO cycle are taken as input variables. The model has only one hidden layer. The hidden layer processes the data nodes using Sigmoid function as a transfer function.

Reference: Kundu N and M Jain, Total ozone trend over low latitude stations, Geophysical Research Letter, 20, 2881-2883, 1993.