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RESEARCH ARTICLE

FRACTAL DIMENSIONAL ANALYSIS OF OZONE IN TROPICAL REGION

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ABSTRACT

Climate change is the most studied concept in the world of research. Various new techniques like Neural Networks, learning Non-linear dynamic sand other sareused to predict climate change. Ozone activity may be major forcing of climate change. In this paper we use Ozone data as an indicat or of climate change and study it strend using Hurst's exponent method. The Fractal dimensional value of Ozone was calculate edtobe 1.1 foraperiod of365 days. This value of Ozone showsa "persistence" that is the future trendis more and more likely tofollowan established trend.

INTRODUCTION

The amount of Ozone in the atmosphere varies substantially from day to day. It also varies with season and latitude. Total columnar ozone over the Observing station, its temporal variations and vertical distribution are important basic data for studies on morphology and behavior of atmospheric ozone in different parts of the globe. Importance of monitoring of ozone level on a global basis has increased, in view of the recognition in the yearly seventies of the possibility of a long term global ozone depletion due to catalytic reactions in the stratosphere involving chemicals released by anthropogenic activities and its possible impact on the biosphere as well as the perturbation in the middle atmosphere radiation budget (Subbaraya and Lal[1]). The discovery of the Antarctic ozone hole in the mid-eighties by Joseph Farmen, Brian Gardiner and Jonathan Shanklin; a research group from the Britiesh Antarctic Survey highlighted the gravity of the Problem.

The diurnal variation of surface ozone has been studied by several workers like Kaushar Ali *et al*[2].over Himalayan region and Delhi, Satsangi *et al.*[3] at Agra and Kulshrestra *et al.*[4] at Delhi. However diurnal variation of total columnar ozone in india has been reported by comparatively fewer workers like Raj *et al.*[5] at Pune during 1998-2003 and Dani *et al.*[6] during BOBMEX-99.The study of variations in columnar ozone concentration at Tamilnadu has special significance, because it is located in the tropical region, where most of the ozone formed is due to the availability of the high dose of solar UV radiation. In view of these considerations, the diurnal variation of columnar ozone at Tropical region has been studied using total ozone mapping Spectrometer.

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CalculatingtheHurstexponent

To calculate the Hurst exponent, one must estimate the dependence of the rescaled range on the time span n of observation (7).A time series of full length N is divided in to a number of shorter time serie so length n=N,N/2,N/4,...The average ere scale drange is then calculated for each value of n. For a (partial) time series of length n, $X=X_1$, $X2...X_n$, there scale drange is calculated as follows:

1. Calculate the mean: m
2. Create a mean- adjusted series:$Y_t= X_t–m$ for t=1, 2….n
3. Calculate the cumulative deviate series Z;
4. Compute the range R;
5. Compute the Standard deviation S;
6. Calculate the rescaled range R (n) / S (n) and average over all the partial time series of length n. The Hurst exponent is estimated by fitting the power law to the data.

The Hurst exponent is related to the fractal dimension Dof the time series curves by formula (8) D=2-H If the fractal dimensions D for the time series is 1.5 there is no correlation between amplitude changes corresponding to two successive time intervals. There fore no trend in amplitude can be discovered from the time series and hence the processes unpredictable. However as the fractaldimensionsdecreasesto1, the process becomes more and more predictable as it exhibits "persistence", that is the future trend is more and more likely to follow an established trend (9). As the fractal dimension decreases from 1.5 to2, the process exhibits 'anitipersistence". That is adecrease in the amplitude of the processes more likely to lead to an increase in the future. Hence the predictability again in creases. However, we will be concerned only with persistence behavior since all geophysical time record analyzed till date (10) exhibit behavior.

Data and analysis

The ozone data is obtained for a period of Jan 2006-Dec 2006 downloaded from www.jwocky.gsfc.nasa.gov/teacher/ ozone_overhead_archive.html. The Hurst exponent value for the ozone data for 365 days was calculated using the above mentioned steps. The fractal dimension value obtained was D=1.1 for the ozone data. In a time series fore casting we would like to know that the series under study is predictable or not. If the time series is random the entire model designed based on it is expected to fail. The Hurst exponent value of ozone data for 365 days shows a more predictable trend**.** Thus the ozone data can be used as a tool to study the climate change.

Conclusion

In this paper we have analyzed the Hurst Exponent value of the ozone for a period of 365 days and was found to be 1.1. This suggests that the ozone has predictable nature which can be learnt by other techniques like neural network to benefit fore casting.

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