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SEASONAL VARIATION OF AOD AND CONCENTRATED WEIGHTED TRAJECTORY ANALYSIS OVER EAST INDIA (KHARAGPUR)

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Abstract- Aerosol optical depth (AOD) measurement done with MICROTOPS II Sunphotometer carried out East Indian region Kharagpur (KGP) one year duration data collected every hourly in day time (jun2013-may2014) for the source region identification. The seasonal comparison shown that high AOD shown in the summer (April, May) with higher AOD (0.75 ± 0.12) and low AOD in Monsoon (0.50 ± 0.18) (June, July, August, September).other seasons are Twinter, winter, NE monsoon, Tsummer AOD values will be (0.57 ± 0.23), (0.67 ± 0.16), (0.63 ± 0.16), (0.69 ± 0.16), respectively. The second objective is the concentrated weighted trajectories (CWT) analysis to potential source regions based on the 7-day back trajectory calculation from HYSPLIT model at the surface level and elevated level trajectories considered. this study we observed that the central India is the source region for monsoon season at surface level trajectories the winter season follows the IGP is source region and the summer has the two paths of sources were one is from IGP and coastal region. The pollutants are dispersed based on the wind direction.

Keywords: CWT analysis, HYSPLIT back trajectory, AOD

1. INTRODUCTION

The aerosol covers a wide range of materials that remain suspended in the atmosphere for a long time. As the suspension takes place in the gaseous medium, aerosol refers to small solid and liquid matter in the atmosphere, these are distinguished from dust in which larger piece of solid material approximately 20μm dia or greater that settles out of the atmosphere by gravitation. [7] the nuclei (,0.1μm dia) and accumulation (0.1-2μm dia) modes comprise the fine particles while particles of size (2.0μm dia) consist these are arises from different sources road dust, soil, probably arises from anthropogenic activity .these aerosol contained in atmosphere scattering and absorbing takes place solar radiation reflecting towards the space[1,4]. The vehicular exhausts are major sources of fine particles in the atmosphere. Radioactive impacts and atmosphere forcing study based on aerosol characteristics and its strength. These particles can be homogeneous or heterogeneous in their structure atmosphere particles contain organic and in organic components elements may be derived from both natural and manmade sources [9]. Aerosols can be transported over long distances affecting air quality and climate on global scale [3]. Aerosol measurements can also use as tracers to study how the earth atmosphere moves. The aerosol changes their characteristics very slowly, they are much better traces for atmospheric motion than chemical species. Aerosol have been used to study the dynamics of polar regions, the metrological changes such as inversion heights inversion strengths location and wind direction the concentration also change the time and space. One of the main difficulties in air pollution management is to be determine the quantitative relationship between ambient air quality and pollutant sources. The identification of [6] aerosol sources and estimate the contributions to PM10 and trace elements concentration at receptor location. Many countries the weekly variation in concentration of atmosphere aerosol and metrological variables in urban areas has been reported as evidence of anthropogenic influence on the weather system. This study shows seasonal variation and potential source regions using source-receptor method. To identify potential pollution sources, several trajectory statistics techniques were developed. Flow Climatology, Potential Source Contribution Function (PSC) [5] and Concentration Weighted Trajectory (CWT) [8] are some examples of these techniques. Among all, PSCF was primarily concerned and CWT analysis we are used in this study.

2. SAMPLE LOCATION AND METHODOLOGY

2.1 Sample Site

The aerosol optical properties carried over the East Indian location semiurban (KHARAGPUR) the station located in east IGP (Indo-Gangetic Plain) region. Kolkata (22.57 o N, 88.42 o E) is the capital city of west Bengal and industrially developed area in East Indian regions. The Kharagpur (22.19 o N, 87.419 o E) region distance from kolkata is 138.5 km via NH16 an important industrial town in Paschim Medinipur district of West Bengal, and residential area and small factories located.

2.2 Sample Collection

The aerosol optical properties using MICROTOP-II sun photometer 12 m elevation from ground. at top of roof

building civil department (IIT kharagpur) every hourly readings are recorded at every day in day time these are the ground based measurements carried over the both the location. The trajectory calculation from HYSPLIT model with NOAA (National Oceanic and Atmospheric Administration) metrological conditions of air mass parcel arriving at receptor location unit interval (end point) moving time and space collected every day data files (https://ready.arl.noaa.gov/hypub-bin/trajtype.pl?runtype=archive). MICROTOPS II is used for ground based measurement. It is a hand held multichannel Solar Light Microprocessor-controlled total ozone portable spectrometer having five wavelength bands centred on 380, 440, 500, 870 and 1020 nm. The sunphotometer works by measuring solar radiation intensity reaching surfaces at specified wavelength bands and calculates corresponding optical depths by knowing the respective radiation intensities at TOA.

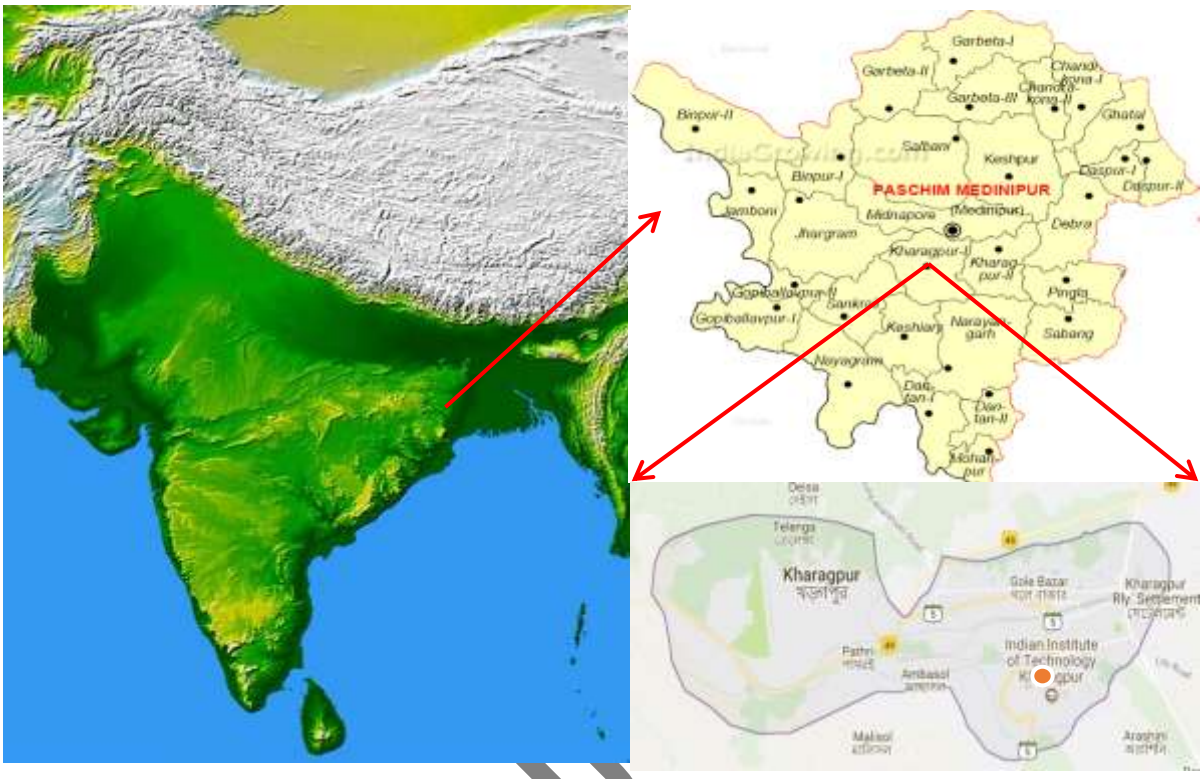

Fig. 2.1 Study Map and Sample Collection at Dot Point (IIT Kharagpur)

2.3 CWT Analysis

Potential source regions can be identified the using CWT analysis. The CWT analysis run using TrajStat free software with back trajectory from HYSPLIT. TrajStat as an external process to calculate cluster trajectories, and the trajectories could be converted to Geographic Information System line shape file. Cluster analysis function is in the software. Measurement data could be added to the corresponding trajectories, so the trajectories could be selected according to the measurement data. The software also could do PSCF (Potential Source Contribution Function) and CWT (Concentration Weighted Trajectory) analysis which is useful to identify pollution sources spatially for long-term transform of particles in environment air quality measurement. Concentration of each grid and its measured concentration with each trajectory calculated based on below equation

$$C_{ij} = \frac{\sum_{l=1}^{M} C_l \tau_{ijl}}{\sum_{l=1}^{M} \tau_{ijl}}$$

Here C ij represents average weighted concentrations in the grid cell, Cl is the measured AOD at the receptor location associated with the trajectory l,τ ij is number of trajectory end points in the grid cell (i, j) associated with the concentration of sample, and M is number of samples that have trajectory end points in grid cell (i, j) [10].CWT analysis gives the high potential regions, weight function is multiplied into the CWT value. Sand and dust storm (SDS) pathways and sources could be identified using trajectory statistics methods. Following is the steps to implement in the model given below step by step

In the CWT analysis below steps are followed in finding the potential regions

- Add required station information (latitude, longitude) into the project (HYSPLIT).
- Calculate 7-day back trajectories during data measurement period.
- Convert end point files to .tgs files. Then join group .tgs files to one file.
- Convert .tgs file to trajectory line shape file(GIS viewer) and add the shape file into the

project(Trajstat).

- Show press profile of the trajectories.
- Add measurement (AOD) data into the trajectories.
- Create grid polygon shape layers of PSCF and CWT.
- Run the CWT analysis and its weighs (depends on residence time).

3. RESULTS AND DISCUSSION

3.1 Seasonal Variability Of AOD Over The East Indian Locations

Seasonal variability of AOD over the East Indian locations Fig. 3.1 shows the seasonal day variation (500nm) (a) KHARAGPUR (jun2013-may2014) , Monsoon season (June, July ,August ,September) has the low AOD with higher deviation taking place day to day compare to summer season(April, May) has the high AOD with low variation taking place. the seasonal day AOD and in this analysis we deduct the high AOD values (Hazy days above 1) because of the higher AOD vale show that AEROSOL contact with clouds (cloud condensation nuclei) then it shows the higher value here over study is AEROSOL (single scattering albedo)present in Atmosphere with dry condition .

Ground based measurement are done at the location according to [2] seasonal variation study. Monthly variation of AOD were seen that the KGP location has low AOD in August (0.39 ± 0.10) and high in April (0.78 ± 0.09). this fig shows that increase in AOD from June (monsoon) to May (Summer) because of in the monsoon wet deposition tacking place to rainfall in the summer season particles will be equally distributed through over the atmosphere layers and particles settled by dry deposition

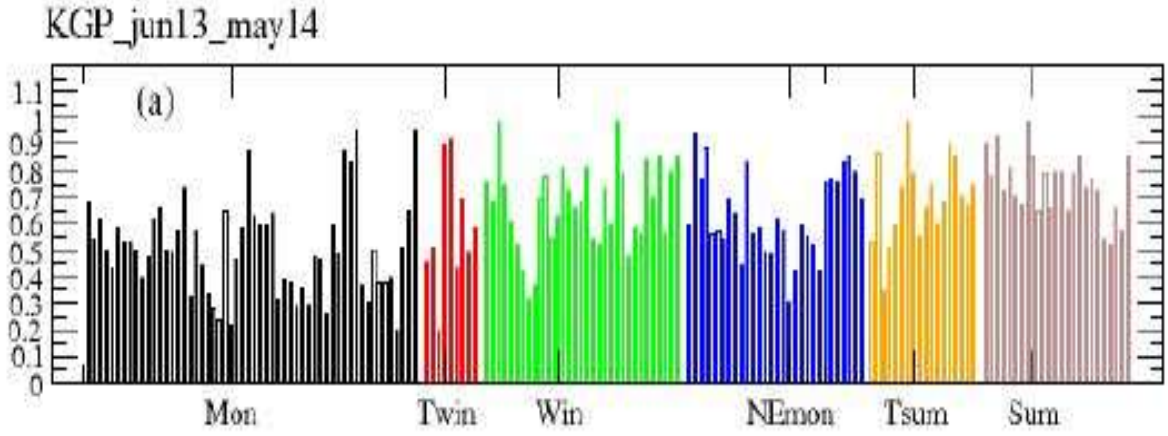

Fig. 3.1 Seasonal Daily Variations Over (a) KHARAGPUR

the number density remains high during night till it morning up to 10:00h and reduce to a low value during noon hours .the night time aerosol number density is 2-3 times larger than that during noon hours and increase in 4-5 times that of daytime these variation due to change in source strength, transport process and change in boundary layer parameters. The major source at kharagpur as the anthropogenic sources and biomass burning from field ,burning of wood and Agricultural works, etc. the other regions transport of aerosols due to wind pattern cause the temporal changes From the period of study we calculated that the Mean seasonal AOD with standard deviation seen the sub-urban(KGP) location AOD values. the summer (April, May) with higher AOD (0.75 ± 0.12) and low AOD in Monsoon (0.50 ± 0.18) (June, July, August, September).other seasons are Twinter, Winter, NE monsoon, Tsummer AOD values will be (0.57 ± 0.23) ,0.67 ± 0.16, 0.63 ± 0.16, 0.69 ± 0.16, respectively.

The AOD values gradually increase from Monsoon to summer season at the location but in winter at KGP as dominating the NEmonsoon.

3.2 CWT Analysis and Potential Source Regions

In this study receptor location considered as located east IGP region the 7-days back trajectory calculations from hysplit model. Potential source regions can be find out using CWT analysis with measured concentration at receptor location .here columnar AOD is taking for finding the source regions and its transport path ways. Seasonal variation due to changing its metrological conditions are dominating in which layer and those source regions calculated in this study the period will be divided in six seasons Monson(jun-sep), Twinter(oct), winter(nov-dec), NE monsoon(jan-feb), Tsummer(mar), Summer(apr-may) The CWT analysis is the simple trajectory calculation is that it can quantify the path ways the weights have been given to each of the trajectories arriving at the receptor site on the basis of mean value of the measured aerosol parameter (AOD here) each grid point gets a weighted value obtained by averaging the data measured at the receptor location and the associated trajectory crosses the grid cell and its residence time bases grid concentration can be find out from the CWT analysis.

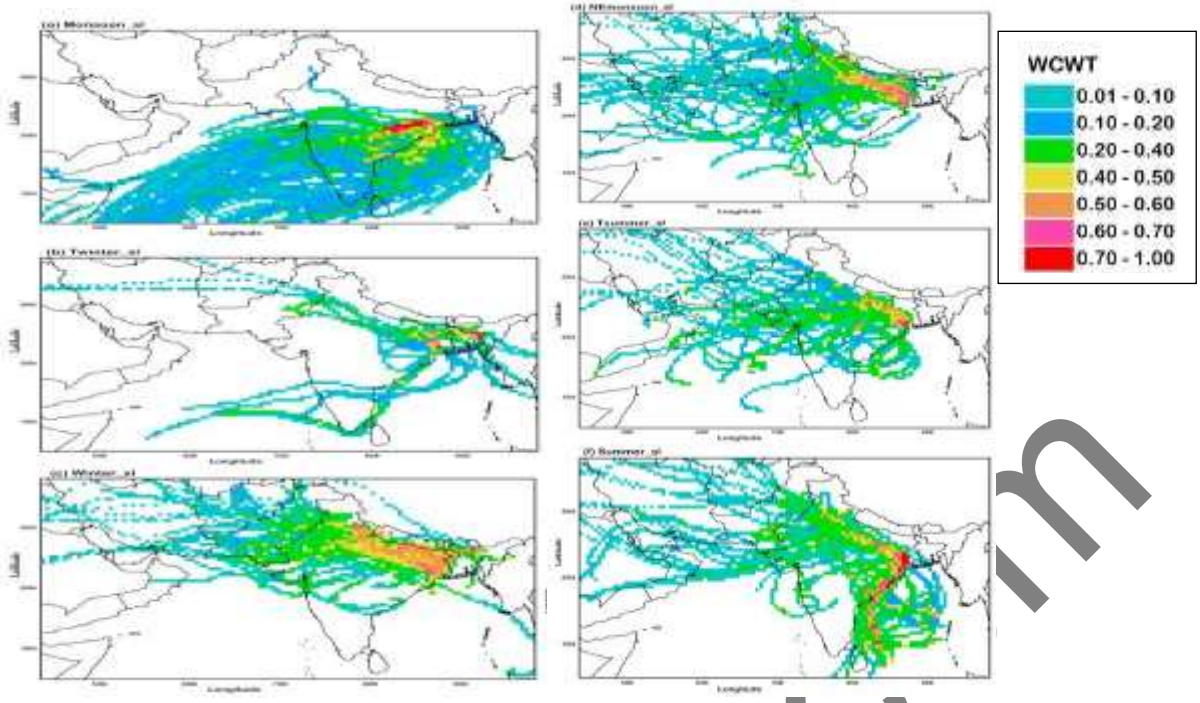

Fig. 3.2 Seasonal Variation of Potential Source Regions

From below fig shows that surface layer CWT analysis for the KGP site and its weights concentration from this we can says that Monsoon season Arabian basin has low significance(0.03-0.20) advection at the receptor location and high significant advection (0.70) from central India at KGP regions. The local regions are source region at KGP in Monsoon season.in Twinter season path region is change from central India to East Indian regions .IGP region is potential region at KGP. The IGP region is high significance effect at KGP. The trajectory are low significance arriving from NWI (North West India) in Winter season The trajectory path way will be continues from Winter to NE monsoon at KGP from we can the IGP region is potential region at KGP has the two path ways one from IGP and other one is coastal region of Bay of Bengal.

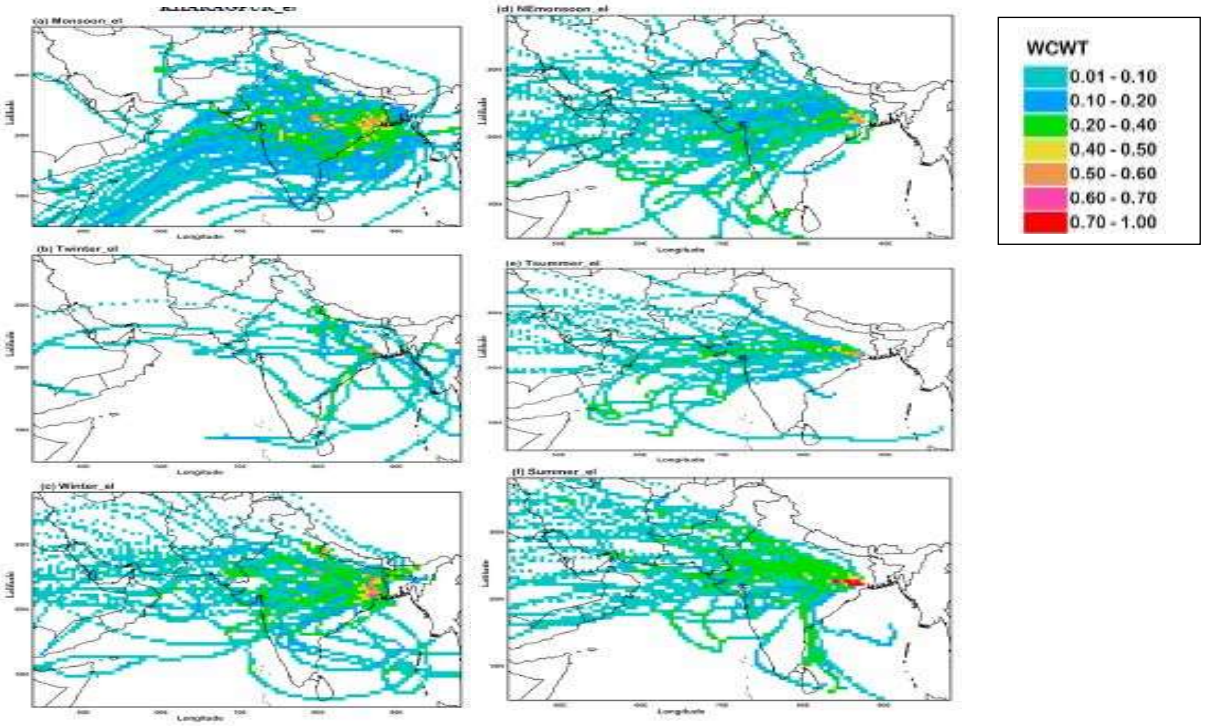

Fig. 3.4 Elevated layer WCWT for [el levels]

Summer season with high significance potential regions located in that coastal regions. Here we seen that summer season two path ways but in that coastal region is more dominating at KGP location with high significance (0.65-0.70) at receptor location

The Elevated layer (1000m, 5000m) trajectory are will advection taking from more distance compare to surface layer. These are with low significance (0.03-0.10). In Monsoon season at KGP location has potential regions are central India. From these fig 5 we say that other season like winter, NEmonsoon, Tsummer and summer seasons trajectories are arriving at the receptor location from African regions with low significance. Summer season clearly we see the high significance regions at KGP has the central India From these analysis we can say that the surface layer is more advection layer at the receptor locations the elevated layers has the long range transport with low significance source region.

CONCULISION

A comparison of ground based AOD measurements using hand held Microtops II sun photometer between KGP reveals that seasonal AOD values are high during summer season and low during Monsoon season. Spectral mean AOD values showed the seasonal variability in columnar aerosols was largely associated with the corresponding variability in finer aerosols. The CWT analysis used for identification of potential source regions at receptor location based on 7-days back trajectory calculation. The CWT analysis at surface layer shows IGP region as the main potential source during winter and NE monsoon season at the location. Whereas during Monsoon to summer there is a change in the transport path way from IGP region to coastal regions (Bay of Bengal and Indian Ocean). CWT analysis at elevated layers shows long range transportation of particles from African regions with a low significance during all the seasons under study.

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