Research Article

ANALYSIS OF METEOROLOGICAL CONDITIONS OF ARIYALUR DISTRICT

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Abstract

The meteorological monitoring is essential for any air quality assessment, because it adds significant value to the air quality data. These data provide input to the air quality models, simulating the dispersion, transport and transformation of air pollutants etc. Meteorological parameters used in the air quality application include wind direction, wind speed, temperature, humidity, pressure and rainfall, which are called as primary variables. The meteorological parameters play an important role in the distribution of pollutants. Hence, the present detailed study of meteorological data for the climatological factors of Ariyalur. The period of five years during January 2011 to December 2015 and focused the effect of cement factory pollutants. It was noted that the data collected the variation in the temperature from January to December is not as very significant as it is a semi arid zone. The minimum temperature has not reduced less than 26 °C and the maximum has gone up till 40 °C. Such temperature has been noticed for the year 2011. Similar trend has been seen from 2011 to 2015, the minimum temperature noticed has been 20 °C and the maximum was only 40 °C. The collection of atmospheric temperature data along with rainfall, humidity have been reported to determine the quality of ecosystem from a meteorological point of view as these parameters play a vital role in the dispersion of pollutants from their origin.

Article History

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Key words: Meteorological data, Climatological factor, Pollutants and Ariyalur.

1. Introduction

The temporal changes of weather and the corresponding short - term changes in meteorology are the single largest factor which plays an important role in controlling changes in the magnitude and distribution of air quality conditions. In order to forecast air quality and develop effective emission control and personal protection strategies, it is important that the meteorological aspects of transport, diffusion and deposition be effectively characterized and subsequently predicted Walter et al. (2003). In a way, each sunny day is like a tiny season as the air goes through a daily cycle of warming and cooling. The air warms during the morning hours, as the sun gradually rises up in the sky, like spreading the blanket of heat energy over the gruel. The sun reaches its highest point around noon, after which it begins its slow journey towards the western horizon. It is around noon
when the earth’s surface receives the most intense solar rays. However, somewhat surprisingly noon time is usually not the warmest part of the day. Rather, the air continues to be heated, often reaching a maximum temperature later in the afternoon. In a year, March to June refers to the summer season in which the daily maximum temperature is 39.5 to 42.8 °C. The onset of monsoon brings relief to the region. During the northeast monsoon between October and December the mean daily maximum temperature varies from 33.3 to 36.7 °C. The coolest months are December, January and February when the minimum temperature drops to 15.6 °C. In the lower atmosphere, water is present everywhere. As a gas, water vapour molecules move about quite freely, mixing well with neighboring atoms and molecules. As a liquid, the water molecules are closer together, and bump each other. In the solid state (ice), the molecules arrange themselves in an orderly pattern with each molecules more are less locked into a rigid position, able to vibrate, but not able to move about freely.

The relative humidity is the ratio of the amount of water vapour actually present in the air compared to the maximum amount of water vapour required for saturation at the particular temperature and pressure. The relative humidity varies from 20 to 78 % in summer and from 40 to 97 % during the monsoon months. The area is dry during most part of the year. Humidity is high during the northeast monsoon period of October, November and December. The meteorological parameters play an important role in the distribution of pollutants. Hence, the present study aims at the detailed study of meteorological parameters, pollutant concentration and also their effect on the vegetation.

2. Materials and Methods

Rain fall

Rain gauge measures the precipitation in millimeter. The type of rain gauge used is standard rain gauge. It was kept away from trees and structures, so that the instrument is not damaged.

Atmospheric pressure

The atmospheric pressure was measured using the aneroid barometer. It has a light metal case with ring suspension. It has reliable sensor. These barometers are of great accuracy, easy to use and affordable.

Humidity

The humidity was measured using round type hygrometer. It was made up of light weight acrylic. Easily mountable, initially it was calibrated.

Wind direction recorder

It is operated mechanically without any power supply. The wind vane is an instrument used to measure the wind direction. It is mounted on a roof top about 10 mts above the ground away from building, trees and other objects which interfere with the wind direction. The wind vane used for the present investigation was Hydromat instrument and has been manufactured as per IS 5799; 1970.

Wind speed recorder

The wind speed was recorded using non mechanical Anemometer which records the number of revolution per minute electronically. This type of anemometer is less sensitive than the cup anemometer. Further using the same instrument the temperature was also recorded.

Construction of wind rose

The wind rose was constructed based on the meteorological data collected for 5 years as per software, www.environmentallake.com and version 5.9.0.

3. Results and Discussion

The meteorological parameters in the vicinity of cement plants were estimated for a period of 5 years starting from January 2011 to December 2015. The parameters analyzed include temperature, rainfall, rainy days, relative humidity, average wind speed and the
predominant wind direction. With the data obtained five wind rose have been constructed.

**Temperature**

The meteorological conditions of Ariyalur were assessed (Table – 1 to 5). During the year 2011, the maximum temperatures were recorded during May and June (39 °C) and a minimum has been recorded during September (26 °C). For the year 2012, highest temperature (39.8 °C) has been recorded during April and a minimum (21.2 °C) have been recorded during November. For the year 2013, similar higher temperature (39.1 °C) was recorded during April and the lower temperature around (24 °C) was recorded during September. The same trend has been noticed for the year 2014. A maximum of 40 °C was noticed during April and a minimum value has been noticed during October, (26.2 °C). But for the year 2015, the month of April and June has shown 39 °C as maximum and the month of November (20.8 °C) has shown the minimum temperature.

**Rainfall**

For the year 2011, the highest rainfall recorded was 5.1 mm during September and for about 3 months there has not been any rainfall recorded. But, for the whole year the number of rainy days was just 46 during 2011. During the year 2012, the highest rainfall recorded during October was 12 mm and a minimum of 0.03 mm was recorded during January 2013. For the year 2013, the number of rainy days was 62. During 2014, the month of November had a good spell of rain (15.5 mm) when compared with June, when the rain has been just 0.3 mm. Similarly, the number of rainy days was higher during September, October, and November 2014 (12 - 13 days). For the year 2015, lesser rainfall was noted similar to 2011 and 2012. It is 8.3 mm during September and a minimum was 0.3 mm during July 2015, and the number of rainy days recorded during 2015 was 59, similar to that of 2012.

**Relative humidity**

The relative humidity was found to be a maximum during the early hours of the day (92 %) in the month of November, and minimum value obtained was 54.8 % during June 2011 and this value correspond to the sun set period. For the year 2012, the same month of November has experienced high relative humidity of 96.2 % and during the hottest months of the year, April and May the value of about 55 % has been recorded. But for the year 2013, the highest relative humidity has been recorded during January (93.8 %) and the minimum was noticed during August and the value of 53.4 %. During 2014 and 2015 as for the previous years the relative humidity was higher in the month of November (91 – 92 %). Though there was a reduction of relative humidity during the hotter months, the humidity has not reduced more than 63 % during 2014 and not more than 56 % during 2015 respectively.

**Average wind speed**

As the wind speed is of high importance with respect to pollution, it was recorded continuously for 24 hours a day and the average has been represented at 8.30 am and 5.30 pm of every day. Finally, the monthly average has been in to consideration. The highest wind speed recorded was 29.8 km/h during July 2011, whereas the lowest value recorded was 11 km/h during November 2011. For the year 2012, the average wind speed was higher during June and July (29 km/h) and the minimum was during the month of December (12.2 km/h). Similar result has been noticed during the year 2013, and during 2014, the maximum wind speed of 29.2 km/h was noticed during July and a minimum has been noticed during August 2014 (11 km/h). Similarly, the average wind speed of 27.1 km/h was recorded during July 2015 and a low value has been recorded during October 2015 (14.7 %).

**Wind direction**

The predominant wind direction recorded during 2011 - 2015 happens to be north east and at times the dominant direction was ENE and toward west.
Table - 1: Meteorological conditions of Ariyalur, in the vicinity of a cement plant associated with wind - rose during January - December 2011

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature</th>
<th>Rainfall (24 hrs)</th>
<th>Rainy Days (24 hrs)</th>
<th>Relative humidity</th>
<th>Average wind speed (24hrs)</th>
<th>Predominant wind direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max °C</td>
<td>Min °C</td>
<td>(mm)</td>
<td>(mm)</td>
<td>08.30 hrs (%)</td>
<td>17.30 Hrs (%)</td>
</tr>
<tr>
<td>January</td>
<td>27.06</td>
<td>26.81</td>
<td>Nil</td>
<td>Nil</td>
<td>91.00</td>
<td>72.88</td>
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<tr>
<td>February</td>
<td>39.61</td>
<td>32.14</td>
<td>3.18</td>
<td>5</td>
<td>89.81</td>
<td>64.57</td>
</tr>
<tr>
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<td>27.59</td>
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<td>Nil</td>
<td>79.12</td>
<td>56.97</td>
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<tr>
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<td>31.64</td>
<td>Nil</td>
<td>Nil</td>
<td>75.61</td>
<td>58.17</td>
</tr>
<tr>
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<td>28.87</td>
<td>2.87</td>
<td>4</td>
<td>73.63</td>
<td>64.58</td>
</tr>
<tr>
<td>June</td>
<td>39.83</td>
<td>33.00</td>
<td>3.50</td>
<td>4</td>
<td>69.31</td>
<td>54.78</td>
</tr>
<tr>
<td>July</td>
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<td>28.41</td>
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<td>3</td>
<td>70.53</td>
<td>65.00</td>
</tr>
<tr>
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<td>3</td>
<td>86.14</td>
<td>75.60</td>
</tr>
<tr>
<td>September</td>
<td>35.17</td>
<td>26.00</td>
<td>5.13</td>
<td>7</td>
<td>82.19</td>
<td>79.37</td>
</tr>
<tr>
<td>October</td>
<td>33.61</td>
<td>29.33</td>
<td>4.53</td>
<td>11</td>
<td>86.19</td>
<td>80.11</td>
</tr>
<tr>
<td>November</td>
<td>32.11</td>
<td>28.11</td>
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<td>7</td>
<td>92.00</td>
<td>84.20</td>
</tr>
<tr>
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<td>29.19</td>
<td>0.35</td>
<td>2</td>
<td>86.00</td>
<td>81.81</td>
</tr>
</tbody>
</table>

Values are mean of total number of days of a month

Table - 2: Meteorological conditions of Ariyalur, in the vicinity of a cement plant associated with wind - rose during January - December 2012

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Max °C</td>
<td>Min °C</td>
<td>(mm)</td>
<td>(mm)</td>
<td>08.30hrs (%)</td>
<td>17.30 Hrs (%)</td>
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<tr>
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</tr>
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<td>95.30</td>
</tr>
<tr>
<td>September</td>
<td>33.49</td>
<td>29.11</td>
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<td>7</td>
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<td>89.09</td>
</tr>
<tr>
<td>October</td>
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<td>27.80</td>
<td>5.60</td>
<td>13</td>
<td>80.13</td>
<td>78.90</td>
</tr>
<tr>
<td>November</td>
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<td>21.16</td>
<td>7.52</td>
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<td>94.05</td>
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</tr>
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<td>0.32</td>
<td>2</td>
<td>72.09</td>
<td>67.80</td>
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</table>

Values are mean of total number of days of a month

Table – 3: Meteorological conditions of Ariyalur, in the vicinity of a cement plant associated with wind - rose during January - December 2013

<table>
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</thead>
<tbody>
<tr>
<td></td>
<td>Max °C</td>
<td>Min °C</td>
<td>(mm)</td>
<td>(mm)</td>
<td>08.30hrs (%)</td>
<td>17.30 Hrs (%)</td>
</tr>
<tr>
<td>January</td>
<td>29.14</td>
<td>26.01</td>
<td>0.03</td>
<td>1</td>
<td>93.81</td>
<td>90.11</td>
</tr>
<tr>
<td>February</td>
<td>38.08</td>
<td>36.70</td>
<td>Nil</td>
<td>Nil</td>
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<td>60.90</td>
</tr>
<tr>
<td>March</td>
<td>38.87</td>
<td>34.60</td>
<td>Nil</td>
<td>Nil</td>
<td>80.36</td>
<td>62.11</td>
</tr>
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<td>April</td>
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<td>June</td>
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<tr>
<td>July</td>
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<td>4</td>
<td>83.14</td>
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<tbody>
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<td></td>
<td>Max °C</td>
<td>Min °C</td>
<td>(mm)</td>
<td>(mm)</td>
<td>08.30hrs (%)</td>
<td>17.30 Hrs (%)</td>
</tr>
<tr>
<td>January</td>
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<tr>
<td>August</td>
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<td>4.33</td>
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<td>September</td>
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<td>15.54</td>
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<td>80.91</td>
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</tbody>
</table>

Values are mean of total number of days of a month

Table – 4: Meteorological conditions of Ariyalur, in the vicinity of a cement plant associated with wind - rose during January - December 2014

<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Max °C</td>
<td>Min °C</td>
<td>(mm)</td>
<td>(mm)</td>
<td>08.30hrs (%)</td>
<td>17.30 Hrs (%)</td>
</tr>
<tr>
<td>January</td>
<td>31.12</td>
<td>23.60</td>
<td>0.35</td>
<td>2</td>
<td>91.10</td>
<td>76.00</td>
</tr>
<tr>
<td>February</td>
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<td>24.18</td>
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<td>64.13</td>
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<td>2.60</td>
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<td>86.34</td>
<td>68.38</td>
</tr>
</tbody>
</table>

Values are mean of total number of days of a month

Table – 5: Meteorological conditions of Ariyalur, in the vicinity of a cement plant associated with wind - rose during January - December 2015

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With the acquired meteorological data, wind roses were constructed for the period of five years (2011 - 2015) (Figs.1 – 5).

Viswanadhan and Anil kumar (1986) have studied the dependency of the concentrations of pollutants, their dispersion and diffusion on the meteorological conditions such as temperature, wind velocity, mixing. They have reported unstable conditions during night time. They have also suggested lesser emission of pollutants during night time in the city of Cochin Rishbhmodi and Agrawal (1991) have studied the meteorological
data and the data has been utilized for the
construction of wind rose. From air pollution point
of view, wind direction and wind speed were
found to act as important parameters. Gujral et al.
(2001) have made a detailed study regarding the
meteorological parameters such as wind velocity,
wind direction, relative humidity and temperature
for an air polluting industry during Sep - 1998 to
Aug - 1999. On the basis of SPM concentration
recorded at all the monitoring size they have
stressed that the meteorological parameters
enhance the pollution potential of the given area.
Similarly Mohindru et al. (2002) has stressed the
importance of meteorological data collection to
discuss about the effect of air pollutants emitted
by the industrial activity. But they have concluded
that the micrometeorological parameters play an
important role on the environmental quality.
Along with such parameters the stack height has
also been found to pose an effect on the
distribution of pollutant concentrations (Sriram
and Gobalasamy, 2001). The authors have
suggested a rise in the ground level concentration
of the pollutants too.

4. References

Assessment of dispersion of ambient
suspended particulate matter and
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