

TREND OF MICROMETEOROLOGICAL PARAMETERS DURING TSUNAMI ON THE EAST COAST OF INDIA

V.Kanakasabai and M.Rajendran

Department of Civil Engineering, Annamalai University
Annamalainagar-608 002, Tamilnadu, INDIA.
email : vkhdce@yahoo.com, raje69@yahoo.co.in

ABSTRACT

Tsunami, a large, breaking wave is generated by displacement of seafloor occurring during earthquakes. The Sumatra earthquake of December 26,2004 at 6:28:51 IST generated the deadliest Indian Ocean tsunami causing severe damage along the coast of Indian mainland. The micrometeorological parameters are measured continuously at Portonova on the East coast of India with the help of a 30 m height meteorological tower by the Department of Civil Engineering, Annamalai University. The parameters like wind speed, wind direction, temperature and solar radiation were recorded during the time of Tsunami also, This paper is aimed at processing the data to check whether there are any significant changes in the parameters due to the occurrence of Tsunami. The wind speeds measured at 10m, 17m and 30m heights show a decreasing trend for three days (25th, 26th, 27th December 2004). Likewise the temperature also show a decreasing trend on the day of Tsunami. The solar radiation was steadily increasing without any modulation on that day which was not on the previous day or the next day of Tsunami.

Introduction

Micrometeorology is an intimate study of physical phenomena taking place over limited regions of the surface of the earth and usually within the lowest layers of the atmosphere(Sutton.O.G). Motion of air in the Atmospheric Boundary Layer (ABL) mainly depends on some surface layer parameters like frictional velocity, surface roughness, surface heatflux, Monin-obukov length, etc. These parameters are derived from micrometeorological measurements of wind speed and temperature at different levels; solar radiation; etc. the Department of Civil Engineering, Annamalai University is routinely carrying out such measurements in the coastal town, Portonova, on the East coast of Tamilnadu State, India with a 30m high tower. The data pertaining to these parameters on the day of Tsunami as well as prior and after Tsunami are processed to check whether there are any significant changes in them due to the occurrence of Tsunami.

Study Area

Portonova is situated in Cuddalore district on the East coast of India in $11^{\circ}30'$ N Latitude and $79^{\circ}45'$ E Longitude. The Centre for Advanced Studies in Marine Biology of Annamalai University is located in this place. The coastal line is running straight from NNE to SSW direction. The 30m high meteorological tower is erected at about 750 m from the coast line of Bay of Bengal as depicted in Fig 1.

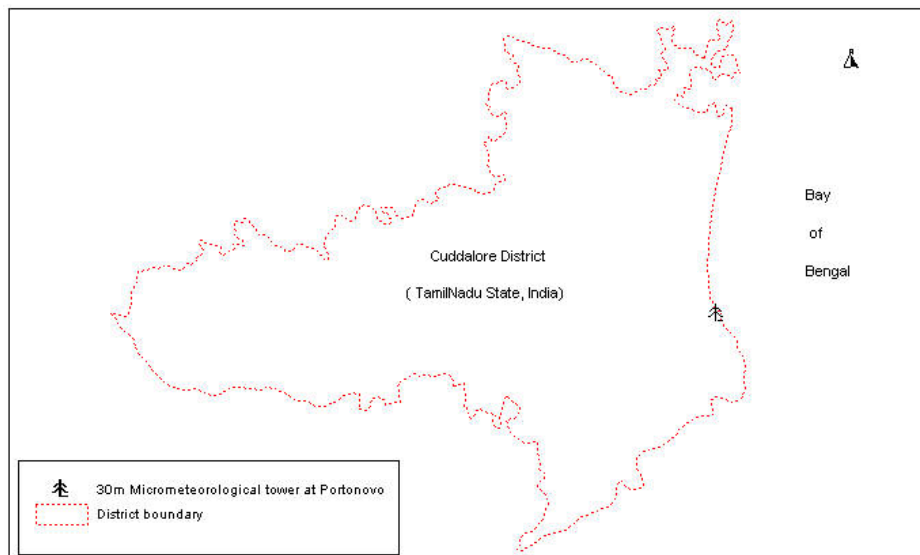


Fig.1 Study Area

Materials and Methods

A 30 m high tower (NRG make, USA) had been erected in the study area for recording micrometeorological parameters to study about ABL near the coast line. The tower was fitted with sensors to measure the mean wind speed and direction at heights of 10 m, 17 m and 30 m above the ground level. Two more sensors measuring temperature

and solar radiation were also mounted at 2m height as per the guideline (WMO 1983). The data were continuously logged, retrieved and processed periodically. Wind speed sensors fitted in the tower are 3-cup type anemometers (NRG make #40 type) with measuring range of 1 m/sec to 96 m/sec and accuracy of 0.1 m/sec. Wind direction sensors (#200 series NRG make) used in the experimental system are wind vanes with 1° accuracy of measurement. Temperature sensor used in the system is RTD type (NRG make #110s type) with 0.1° C accuracy of measurement. For incoming solar radiation measurement (Li-cor # L1-200 SA type) pyronometer is used with the range of measurement as 0 to 3000 W/m².

Data logging from these sensors has been carried out by 12 channel data logger (Symphonic type NRG make). This data logger is capable of taking samples at 2 seconds interval and averaging them into 10 minutes. A maximum, minimum and standard deviation are also worked out from this set of readings.

The experimentation for ABL study was initiated during the withdrawal of North East monsoon, that is in December 2004. While continuous measurement was in progress, Tsunami struck the East coast on the morning of 26th December 2004. 5 to 10 m high waves were striking the coast and in fact the tower was surrounded by water for a height of 0.75 m. After two days, the data recorded were transferred for investigation. The data pertaining to wind speed, temperature and solar radiation were given in Tables 1 to 5.

Table 1. Average Wind Speed at 10m height in m/sec.

Time	24-12-2004	25-12-2004	26-12-2004	27-12-2004	28-12-2004
8:30	5.8	3.0	4.6	3.2	7.8
8:40	5.7	4.8	4.8	3.0	7.6
8:50	6.3	4.2	4.1	3.1	8.0
9:00	5.8	4.5	3.8	3.0	7.9
9:10	7.4	5.6	4.6	3.3	7.5
9:20	7.5	5.9	4.7	3.3	7.9
9:30	6.5	5.9	5.9	4.5	8.0
9:40	7.1	4.5	4.9	5.4	7.3
9:50	7.4	5.3	5.9	4.8	8.0
10:00	7.6	5.2	5.8	4.6	7.2
10:10	7.1	5.6	6.0	4.2	7.2
10:20	7.0	6.7	5.9	3.9	7.5
10:30	7.7	6.5	5.3	3.4	7.6

Table 2. Average Wind Speed at 17m height in m/sec.

Time	24-12-2004	25-12-2004	26-12-2004	27-12-2004	28-12-2004
8:30	6.2	3.0	5.0	3.3	8.9
8:40	6.1	5.1	5.0	3.0	9.0
8:50	6.6	4.4	4.2	3.2	9.1
9:00	6.2	5.0	3.9	3.0	9.1
9:10	8.0	6.1	4.7	3.4	8.5
9:20	8.0	6.3	4.9	3.3	9.0
9:30	7.1	6.5	6.2	4.6	9.2
9:40	7.6	4.8	5.3	5.5	8.3
9:50	7.7	5.6	6.2	5.0	9.0
10:00	8.0	5.6	6.0	4.8	8.2
10:10	7.6	6.1	6.3	4.2	8.2
10:20	7.5	7.1	6.2	3.8	8.3
10:30	8.1	7.2	5.5	3.0	8.3

Table 3. Average Wind Speed at 30m height in m/sec.

Time	24-12-2004	25-12-2004	26-12-2004	27-12-2004	28-12-2004
8:30	6.7	3.6	5.6	3.9	9.4
8:40	6.5	5.4	5.4	3.6	9.4
8:50	7.0	4.8	4.6	3.8	9.7
9:00	6.7	5.4	4.5	3.8	9.5
9:10	8.4	6.6	5.1	3.8	8.7
9:20	8.4	6.8	5.3	3.9	9.4
9:30	7.3	6.9	6.5	5.1	9.5
9:40	8.0	5.4	5.7	5.9	8.6
9:50	8.0	6.1	6.5	5.5	9.3
10:00	8.4	6.0	6.4	5.4	8.6
10:10	7.8	6.4	6.7	4.9	8.6
10:20	7.7	7.7	6.6	4.4	8.6
10:30	8.4	7.6	5.9	3.7	8.8

Table 4. Temperature at 2m height in degree Celsius.

Time	25-12-2004	26-12-2004	27-12-2004
8:30	27.2	26.6	26.0
8:40	28.3	26.9	26.0
8:50	28.4	27.4	26.1
9:00	28.8	27.6	26.3
9:10	29.0	27.5	26.6
9:20	28.5	27.7	26.6
9:30	28.2	27.7	26.9
9:40	28.3	27.8	26.9
9:50	29.2	27.8	26.4
10:00	29.9	27.8	26.0
10:10	29.8	27.8	25.8
10:20	29.6	27.8	25.7
10:30	29.9	28.0	25.6

Table 5. Solar Radiation at 2m height in W/m².

Time	25-12-2004	26-12-2004	27-12-2004
8:30	505.2	501.1	132.3
8:40	617.2	531.8	169.9
8:50	581.9	565.2	187.9
9:00	589.1	597.1	231.5
9:10	549.4	626.9	211.1
9:20	249.7	656.5	207.0
9:30	247.2	680.9	243.4
9:40	374.3	705.8	207.6
9:50	777.5	728.6	168.7
10:00	746.0	751.6	142.3
10:10	637.6	770.7	163.6
10:20	744.0	787.6	194.1
10:30	813.0	799.4	161.0

Conclusions

After carefully analyzing the micrometeorological data recorded during Tsunami on the East coast of India, the following conclusions were arrived:

1. The wind speeds measured between 8.30 am and 10.00 am at 10m height were in the range of 5.8 to 7.9 m/sec, two days before and after Tsunami. But the wind speed show a decreasing trend of 3.0 to 6.7 m/sec for three days namely the day before Tsunami(25th December 2004) the day of Tsunami (26th December 2004) and the next day after Tsunami(27th December 2004).
2. The same trend was also seen for wind speed measured at 17m and 30m height. The trends depicted in Fig. 2, 3 and 4.
3. The temperature was decreased by one to three degrees on 26th and 27th December 2004. This can be better seen from Fig 5.
4. The solar radiation on 25th and 27th were with variations but on 26th December, it was steadily increasing, indicating that there was no cloud cover on that particular day(Fig 6.).

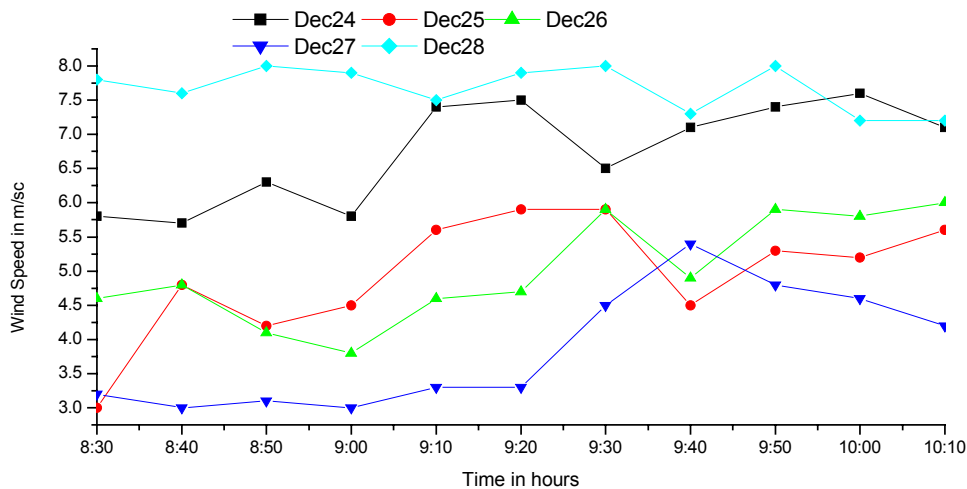


Fig.2 Ten meter Wind Speed Trend

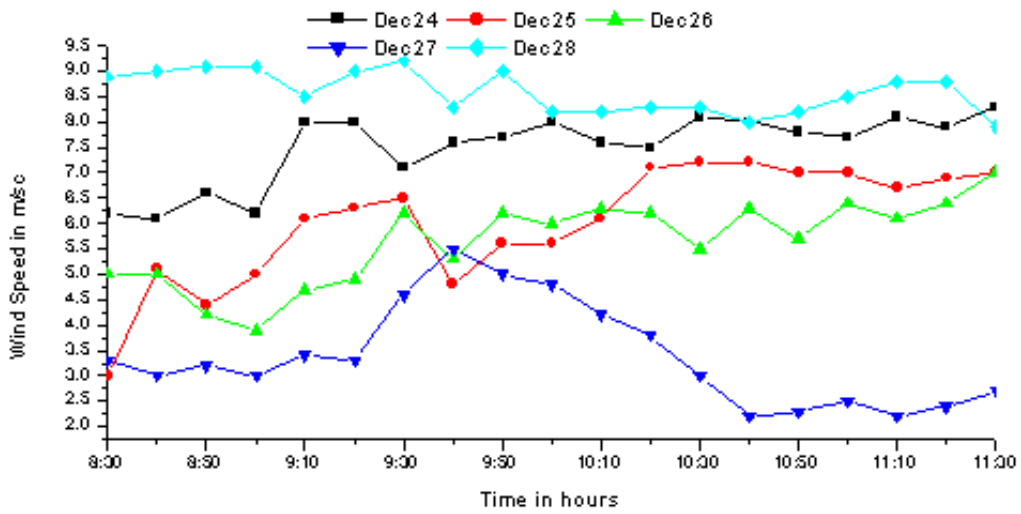


Fig.3 Seventeen metre wind speed Trend

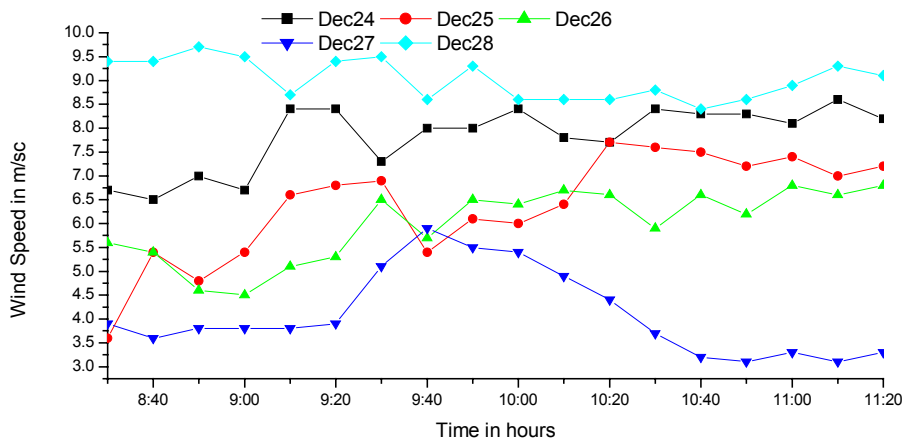


Fig.4 Thirty meter Wind Speed Trend

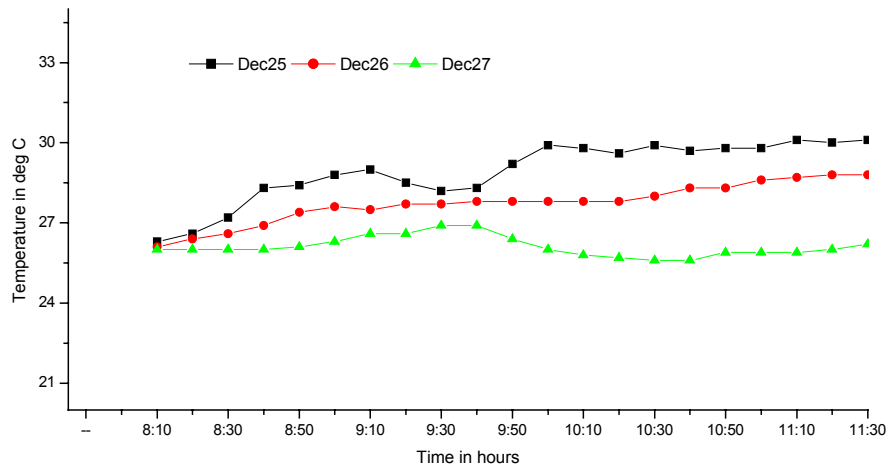


Fig.5 Temperature trend at 2m level

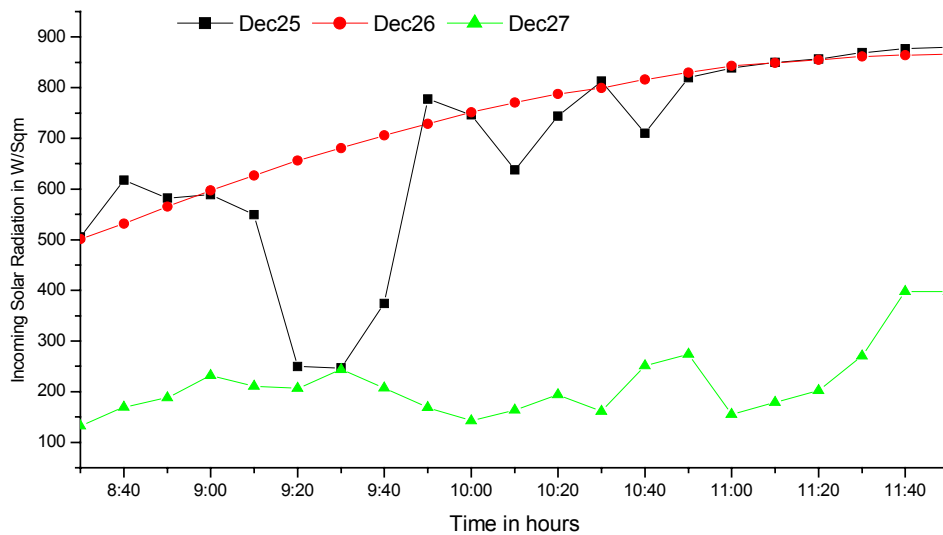


Fig.6 Solar Radiation Trend

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