WIND MONITORING STUDY AT RAMAGIRI, ANANTAPUR DISTRICT IN ANHRA PRADESH
(10.05.2018 to 12.08.2018)

Interim Report

Prepared for

M/s. Solar Energy Corporation of India Limited (SECI),
New Delhi

Wind Resource Assessmentand Offshore Unit
National Institute of Wind Energy
(Formerly “Centre for Wind Energy Technology”)
Chennai-600 100

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Executive Summary

M/s. Solar Energy Corporation of India Limited (SECI), New Delhi vide their e-mail dated 13.03.2018 has requested National Institute of Wind Energy (Formerly "Centre for Wind Energy Technology"), Chennai to establish "Wind Montoring study at Ramagiri, Anantapur district in Andhra Pradesh" at 100m height.. A proposal based on MNRE guidelines was prepared by NIWE and sent to M/s. Solar Energy Corporation of India Limited (SECI), New Delhi and subsequently, they made necessary payment on 16.04.2018.

The aim of this project is to ascertain the wind power potential of Ramagiri site.The Wind Monitoring Station at Ramagiri, Anantapur district in Andhra Pradeshwas installed by NIWE officials on 10.05.2018.

In this Interim report, the first part describes the site description and instrumentation of the Wind Monitoring station at Ramagiri. Second part gives data analysis report and graphical form.

The data logger used is AmmonitMeteo40L, that can collect the time series data for wind speed, direction, temperature and pressure. The logger was programmed to store data average, standard deviation, etc. from anemometer, wind vane, temperature and pressure sensor. 10 minutes averaging interval has been chosen. Theinstrumentation make/model of anemometer is Thies First Class , Wind vane model is Thies compact TMR, Pressure sensor AB100 and Temperature sensor is TPC 1.S/6-ME

DDG & Group Head - (WRA& O)

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WIND MONITORING STUDY AT RAMAGIRI, ANANTAPUR DISTRICT IN ANDHRA PRADESH
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1. Introduction

M/s. Solar Energy Corporation of India Limited (SECI), New Delhi vide their e-mail dated 13.03.2018 has requested National Institute of Wind Energy (Formerly "Centre for Wind Energy Technology"), Chennai to establish "Wind Montoring study at Ramagiri, Anantapur district in Andhra Pradesh" at 100m height. A proposal based on MNRE guidelines was prepared by NIWE and sent to M/s. Solar Energy Corporation of India Limited (SECI), New Delhi and subsequently, they made necessary payment on 16.04.2018.

NIWE has successfully commissioned 100m tall lattice guyed mast through outside agency in the presence of NIWE officials at Ramagiri site. And also NIWE team has installed sensors on the met mast at multi-levels along with automatic data logger on 10.05.2018.

2. Site Description

The site at Ramagiri was visited by NIWE official along with the representatives of M/s. Solar Energy Corporation of India Limited (SECI), New Delhi on 11.04.2018 & 12.04.2018. The geographical co-ordinates and elevation of the site is found as follows.

Latitude : $14^{o}19'$ 42.20"N

Longitude : $77^{o}30'$ 41.82"E

Elevation : 535m AMSL

The site is situated at 2.16km North of Ramagiri, 3.61km South of Muthuvakuntla and accessible through NH7.

Location map is given in Figure. 1

Figure 1. The Region of Interest is shown in green color

3. Instrumentation

The data logger used is Ammonite Meteo 40L, that can collect the time series data for wind speed, direction, temperature, pressure. The data logger was programmed to store average, standard deviation, etc. from anemometer, wind vane, temperature and pressure sensor.10 minutes averaging interval has been chosen. The Instrumentation make/model of anemometer is Thies First Class, Wind vane is Thies Compact TMR, Pressure sensor is AB 100 and Temperature sensor is TPC 1.S/6-ME.

Certified copy of Calibration Certificates dated 16.01.2017 (Sl. No.: 03132693 – 100m North, Sl. No.: 03132695-80m, Sl. No.: 03132696-50m, Sl. No.: 03132697-10m), 15.01.2017 (Sl. No.: 03132694 -100m South) for anemometers, 30.11.2017 (Sl.No. B 120405 – 5m) for pressure sensor and 12.12.2017 (SL.No. 117611-10m) for Temperature sensor (attached)

4. Wind data analysis

a. Data collection.

The Wind Monitoring Station was commissioned at the site in the month of 10.05.2018. The data is collected from data logger. The wind speed data of 100m North, 100m South, 80m, 50m and 10m levels for the period from 10.05.2018 to 12.08.2018 is used for the present analysis.

b. Availability of data in percentage for a given period.

Availability of data is 99% for the period of measurement. The data has been analyzed and details of the results in graphical mode are presented in this report.

c. Data Analysis

The month wise mean wind speed, wind power density, percentage frequency distributions of wind speed at 100m North, 100m South, 80m, 50m and 10m levels for the period from 10.05.2018 to 12.08.2018 have been given below. Also, the air density values calculated at the station are based on measured temperature and pressure data.

Table 1. Summary of month wise wind characteristics

Station : Ramagiri
Latitude : 14° 19' 42.20" N
Longitude : 77° 30' 41.82" E
Elevation : 535m AMSL

Based on data 10.05.2018 to 12.08.2018

Month	Temperature (°C)	Pressure (mb)	Air Density (kg/m³)*	100m North AGL		100m South AGL		80m AGL		50m AGL		10m AGL	
				WS (m/s)	WPD (W/m²)	WS (m/s)	WPD (W/m²)	WS (m/s)	WPD (W/m²)	WS (m/s)	WPD (W/m²)	WS (m/s)	WPD (W/m²)
May-18	28.88	950.26	1.097	5.06	132.84	5.04	130.78	4.85	115.49	4.52	91.60	3.62	45.65
Jun-18	26.65	950.11	1.105	8.51	423.58	8.46	417.08	8.23	388.07	7.83	340.87	6.40	190.35
Jul-18	25.73	950.45	1.108	9.73	590.37	9.70	584.45	9.49	551.55	9.15	500.09	7.57	288.29
Aug-18	25.28	951.94	1.112	11.15	832.78	11.12	827.27	10.91	782.85	10.55	713.11	8.79	414.82

Mast Height: 100m *Air density is based on Measured Temperature and Pressure data

WS : Wind Speed
WPD : Wind Power Density
AMSL:Above Mean Sea Level

Note:1% data missing

Table 2. Percentage Frequency Distribution

WS(m/s)	May-18	Jun-18	Jul-18	Aug-18
0--0.25	0.0	0.0	0.0	0.0
0.25--0.75	0.1	0.0	0.0	0.0
0.75--1.25	1.7	0.0	0.0	0.0
1.25--1.75	4.5	0.1	0.0	0.0
1.75--2.25	5.3	0.1	0.0	0.0
2.25--2.75	6.5	0.3	0.1	0.0
2.75--3.25	6.8	1.1	0.3	0.0
3.25--3.75	8.3	1.4	0.4	0.0
3.75--4.25	8.5	1.9	0.7	0.0
4.25--4.75	9.7	2.2	0.9	0.0
4.75--5.25	8.8	2.8	1.2	0.0
5.25--5.75	7.3	3.5	1.6	0.0
5.75--6.25	5.7	3.8	1.7	0.6
6.25--6.75	5.0	4.9	2.1	0.5
6.75--7.25	4.0	7.0	3.3	1.0
7.25--7.75	3.6	8.1	5.2	1.4
7.75--8.25	2.5	7.9	5.6	3.2
8.25--8.75	2.0	8.1	7.1	3.5
8.75--9.25	2.1	8.4	8.8	4.9
9.25--9.75	2.3	7.5	10.0	6.1
9.75--10.25	1.5	7.1	9.5	9.0
10.25--10.75	1.3	5.9	9.0	9.7
10.75--11.25	0.7	5.5	8.4	9.9
11.25--11.75	0.4	3.3	6.5	13.1
11.75--12.25	0.5	2.4	5.4	10.8
12.25--12.75	0.3	2.3	4.1	8.7
12.75--13.25	0.2	1.6	2.9	5.2
13.25--13.75	0.1	1.1	1.9	4.6
13.75--14.25	0.1	0.6	1.2	3.2
14.25--14.75	0.1	0.4	0.9	2.3
14.75--15.25	0.1	0.1	0.3	1.2
15.25--15.75	0.0	0.1	0.2	0.8
15.75--16.25	0.1	0.1	0.2	0.2
16.25--16.75	0.1	0.0	0.1	0.0
16.75--17.25	0.0	0.0	0.1	0.1
>17.25	0.1	0.0	0.0	0.0

Sensor Height: 100m North

Based on data 10.05.2018 to 12.08.2018

0.5 extends from 0 to 0.549
0.25--0.75 extends from 0.25 to 0.749

Table 3. Percentage Frequency Distribution

WS(m/s)	May-18	Jun-18	Jul-18	Aug-18
0--0.25	0.0	0.0	0.0	0.0
0.25--0.75	0.2	0.0	0.0	0.0
0.75--1.25	1.8	0.0	0.0	0.0
1.25--1.75	4.4	0.1	0.0	0.0
1.75--2.25	5.3	0.1	0.0	0.0
2.25--2.75	6.6	0.3	0.0	0.0
2.75--3.25	7.2	1.2	0.0	0.0
3.25--3.75	8.0	1.4	0.0	0.0
3.75--4.25	8.4	2.0	0.0	0.0
4.25--4.75	9.4	2.3	0.0	0.0
4.75--5.25	8.9	2.8	0.0	0.0
5.25--5.75	7.4	3.4	0.0	0.0
5.75--6.25	6.1	4.0	0.0	0.8
6.25--6.75	5.0	5.1	0.0	0.5
6.75--7.25	4.0	7.2	0.0	1.0
7.25--7.75	3.5	8.0	0.1	1.7
7.75--8.25	2.3	8.1	0.1	2.8
8.25--8.75	2.2	8.0	0.1	3.7
8.75--9.25	2.1	8.5	0.1	4.6
9.25--9.75	2.1	7.3	0.1	7.0
9.75--10.25	1.7	7.4	0.1	8.7
10.25--10.75	1.0	5.6	0.1	9.3
10.75--11.25	0.8	5.3	0.1	10.5
11.25--11.75	0.4	3.1	0.1	12.8
11.75--12.25	0.5	2.5	0.1	10.4
12.25--12.75	0.2	2.3	0.0	9.3
12.75--13.25	0.1	1.5	0.0	5.1
13.25--13.75	0.1	1.0	0.0	4.3
13.75--14.25	0.1	0.7	0.0	3.1
14.25--14.75	0.1	0.3	0.0	2.3
14.75--15.25	0.1	0.1	0.0	1.3
15.25--15.75	0.0	0.1	0.0	0.6
15.75--16.25	0.1	0.1	0.0	0.2
16.25--16.75	0.1	0.0	0.0	0.0
16.75--17.25	0.0	0.0	0.0	0.1
>17.25	0.1	0.0	0.0	0.0

Sensor Height: 100m South

Based on data 10.05.2018 to 12.08.2018

0.5 extends from 0 to 0.549
0.25--0.75 extends from 0.25 to 0.749

Table 4. Percentage Frequency Distribution

WS(m/s)	May-18	Jun-18	Jul-18	Aug-18
0--0.25	0.0	0.0	0.0	0.0
0.25--0.75	0.1	0.0	0.0	0.0
0.75--1.25	1.8	0.1	0.0	0.0
1.25--1.75	4.1	0.1	0.0	0.0
1.75--2.25	5.9	0.1	0.0	0.0
2.25--2.75	6.9	0.5	0.1	0.0
2.75--3.25	7.9	1.4	0.3	0.0
3.25--3.75	8.5	1.6	0.6	0.0
3.75--4.25	9.3	2.0	0.8	0.0
4.25--4.75	10.1	2.6	1.3	0.0
4.75--5.25	8.8	3.2	1.3	0.0
5.25--5.75	7.3	3.9	1.7	0.0
5.75--6.25	5.9	4.4	1.8	0.4
6.25--6.75	4.5	5.8	3.1	0.3
6.75--7.25	4.2	7.9	4.1	0.4
7.25--7.75	2.9	7.9	5.2	0.9
7.75--8.25	2.0	8.5	5.9	1.3
8.25--8.75	2.1	8.3	7.9	1.6
8.75--9.25	2.3	8.0	10.0	2.1
9.25--9.75	1.9	7.6	9.5	2.7
9.75--10.25	0.9	6.2	9.5	3.6
10.25--10.75	0.9	5.0	8.6	3.9
10.75--11.25	0.4	4.6	8.2	4.3
11.25--11.75	0.4	2.8	5.9	4.8
11.75--12.25	0.3	2.5	4.3	3.9
12.25--12.75	0.1	1.9	3.6	3.0
12.75--13.25	0.1	1.2	2.3	1.7
13.25--13.75	0.1	1.0	1.7	1.5
13.75--14.25	0.1	0.4	0.9	0.9
14.25--14.75	0.0	0.2	0.6	0.7
14.75--15.25	0.1	0.1	0.3	0.4
15.25--15.75	0.0	0.1	0.2	0.2
15.75--16.25	0.1	0.0	0.1	0.0
16.25--16.75	0.1	0.0	0.1	0.0
16.75--17.25	0.0	0.0	0.0	0.0
>17.25	0.0	0.0	0.0	0.0

Sensor Height: 80m Based on data 10.05.2018 to 12.08.2018

0.5 extends from 0 to 0.549
0.25--0.75 extends from 0.25 to 0.749

Table 5. Percentage Frequency Distribution

WS(m/s)	May-18	Jun-18	Jul-18	Aug-18
0--0.25	0.0	0.0	0.0	0.0
0.25--0.75	0.2	0.0	0.0	0.0
0.75--1.25	1.9	0.2	0.0	0.0
1.25--1.75	4.3	0.1	0.0	0.0
1.75--2.25	6.5	0.2	0.0	0.0
2.25--2.75	8.5	0.6	0.2	0.0
2.75--3.25	8.3	1.8	0.5	0.0
3.25--3.75	10.1	2.0	0.8	0.0
3.75--4.25	10.6	2.4	1.3	0.0
4.25--4.75	10.3	3.2	1.4	0.0
4.75--5.25	8.5	4.2	1.5	0.2
5.25--5.75	7.4	4.5	2.2	1.0
5.75--6.25	5.6	5.7	3.1	0.5
6.25--6.75	4.2	7.6	3.4	1.3
6.75--7.25	2.9	8.5	4.6	1.9
7.25--7.75	2.0	7.2	5.0	3.0
7.75--8.25	2.4	8.8	7.2	3.2
8.25--8.75	1.7	8.1	8.8	5.3
8.75--9.25	1.7	7.6	10.1	6.4
9.25--9.75	0.9	6.2	9.5	8.0
9.75--10.25	0.5	5.1	9.1	9.8
10.25--10.75	0.4	4.9	8.5	11.3
10.75--11.25	0.4	3.0	6.4	12.0
11.25--11.75	0.1	2.5	5.3	12.0
11.75--12.25	0.1	2.0	4.0	8.3
12.25--12.75	0.1	1.5	2.5	4.5
12.75--13.25	0.0	1.1	1.8	4.6
13.25--13.75	0.1	0.5	1.4	3.2
13.75--14.25	0.0	0.1	0.6	1.7
14.25--14.75	0.0	0.1	0.3	1.0
14.75--15.25	0.1	0.1	0.2	0.8
15.25--15.75	0.1	0.0	0.2	0.1
15.75--16.25	0.0	0.1	0.1	0.1
16.25--16.75	0.0	0.0	0.0	0.0
16.75--17.25	0.1	0.0	0.0	0.0
>17.25	0.0	0.0	0.0	0.0

Sensor Height: 50m Based on data 10.05.2018 to 12.08.2018

0.5 extends from 0 to 0.549
0.25--0.75 extends from 0.25 to 0.749

Table 6. Percentage Frequency Distribution

WS(m/s)	May-18	Jun-18	Jul-18	Aug-18
0--0.25	0.1	0.0	0.0	0.0
0.25--0.75	0.3	0.1	0.0	0.0
0.75--1.25	0.5	0.2	0.0	0.0
1.25--1.75	0.7	0.3	0.2	0.0
1.75--2.25	0.9	1.2	0.3	0.0
2.25--2.75	1.1	2.2	0.7	0.0
2.75--3.25	1.4	3.1	1.4	0.0
3.25--3.75	1.6	3.4	1.5	0.1
3.75--4.25	1.8	5.1	2.3	0.5
4.25--4.75	2.0	6.0	3.1	0.8
4.75--5.25	2.2	7.6	3.4	1.3
5.25--5.75	2.4	8.2	4.4	2.5
5.75--6.25	2.6	9.4	5.3	2.2
6.25--6.75	2.8	9.3	7.3	3.6
6.75--7.25	3.0	9.7	9.8	5.4
7.25--7.75	3.2	8.4	11.0	7.4
7.75--8.25	3.4	7.0	11.2	9.3
8.25--8.75	3.6	5.8	10.7	11.7
8.75--9.25	3.9	4.3	8.7	14.5
9.25--9.75	4.1	3.0	6.6	13.7
9.75--10.25	4.3	2.4	4.9	10.8
10.25--10.75	4.5	1.5	2.8	6.0
10.75--11.25	4.7	1.0	2.1	4.2
11.25--11.75	4.9	0.3	1.3	3.4
11.75--12.25	5.1	0.2	0.4	1.7
12.25--12.75	5.3	0.1	0.3	0.7
12.75--13.25	5.5	0.0	0.2	0.1
13.25--13.75	5.7	0.0	0.1	0.1
13.75--14.25	5.9	0.0	0.0	0.0
14.25--14.75	6.1	0.0	0.0	0.0
14.75--15.25	6.4	0.0	0.0	0.0
15.25--15.75	0.0	0.0	0.0	0.0
15.75--16.25	0.0	0.0	0.0	0.0
16.25--16.75	0.0	0.0	0.0	0.0
16.75--17.25	0.0	0.0	0.0	0.0
>17.25	0.0	0.0	0.0	0.0

Sensor Height: 10m Based on data 10.05.2018 to 12.08.2018

0.5 extends from 0 to 0.549
0.25--0.75 extends from 0.25 to 0.749

5. Summary of Ramagiri data set in Graphical form

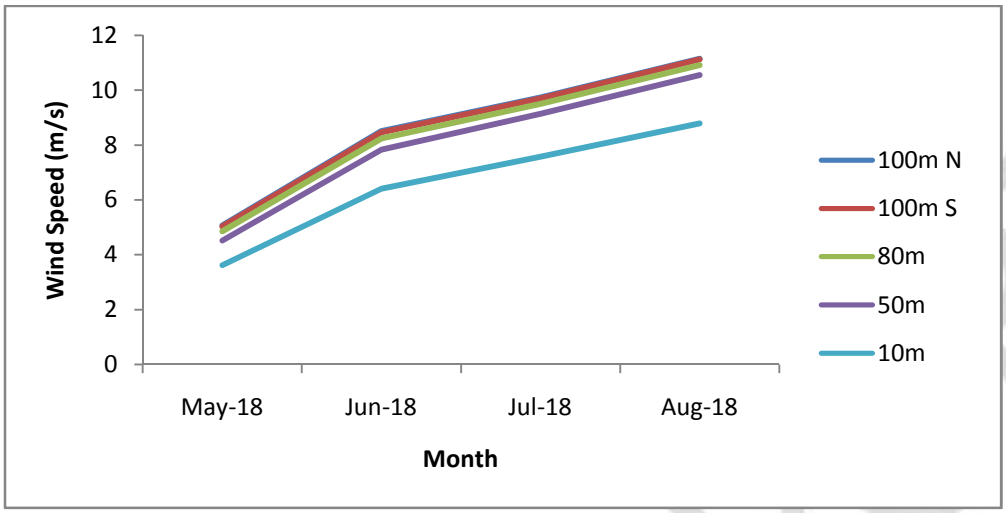

Figure 2. Monthly Mean Wind Speed

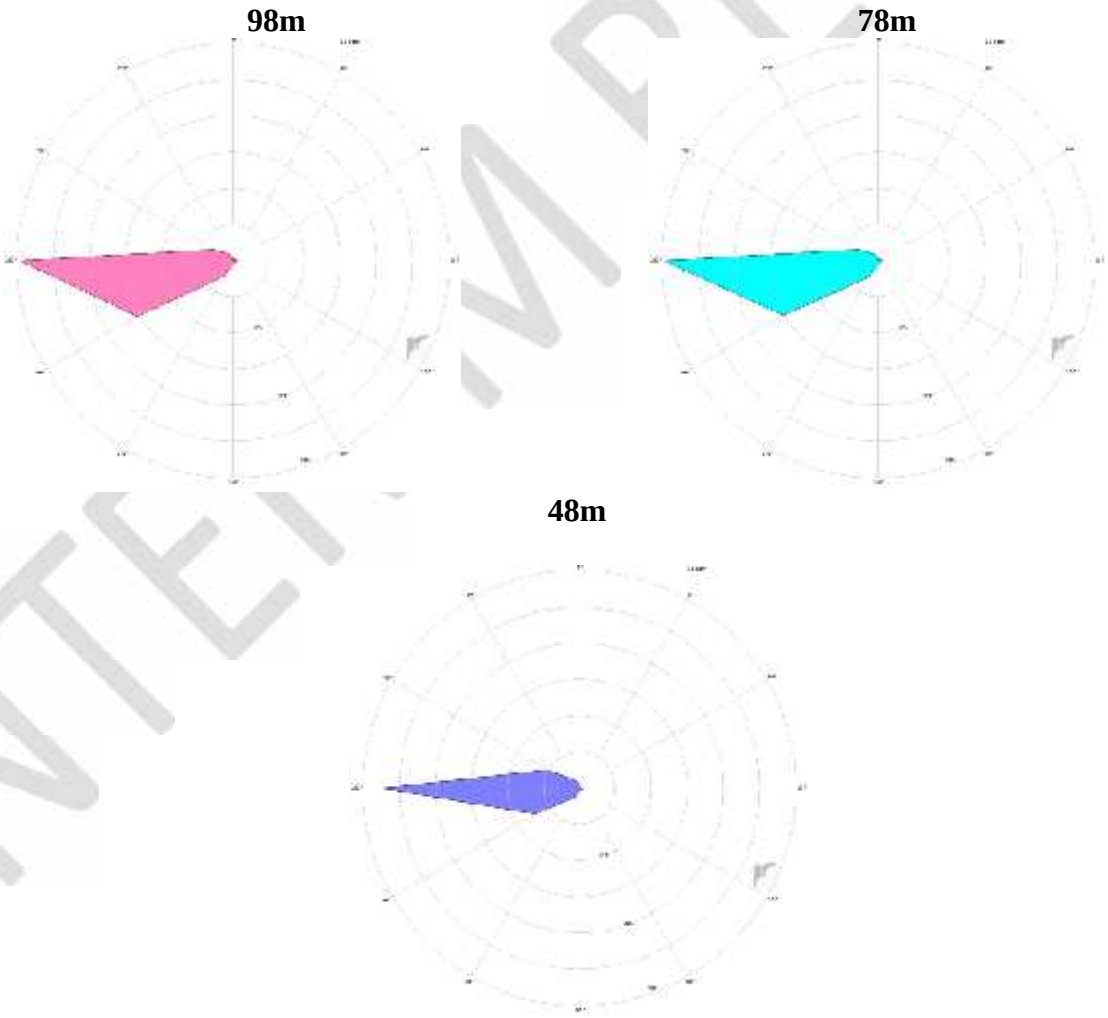

Figure 3. Wind Frequency Rose for Ramagiri

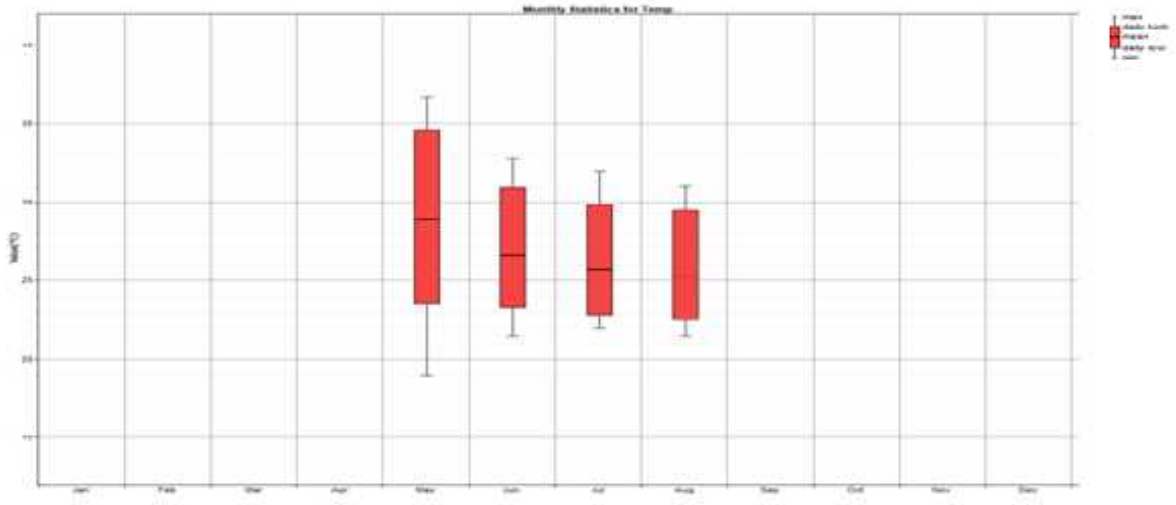

Figure 4 Temperature Profile for Ramagiri

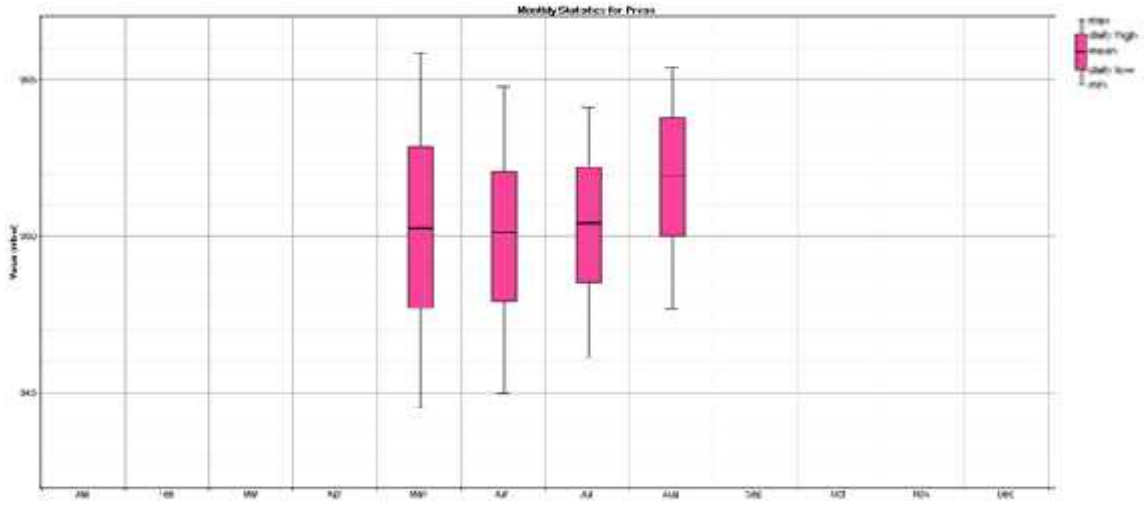

Figure 5 Pressure Profile for Ramagiri

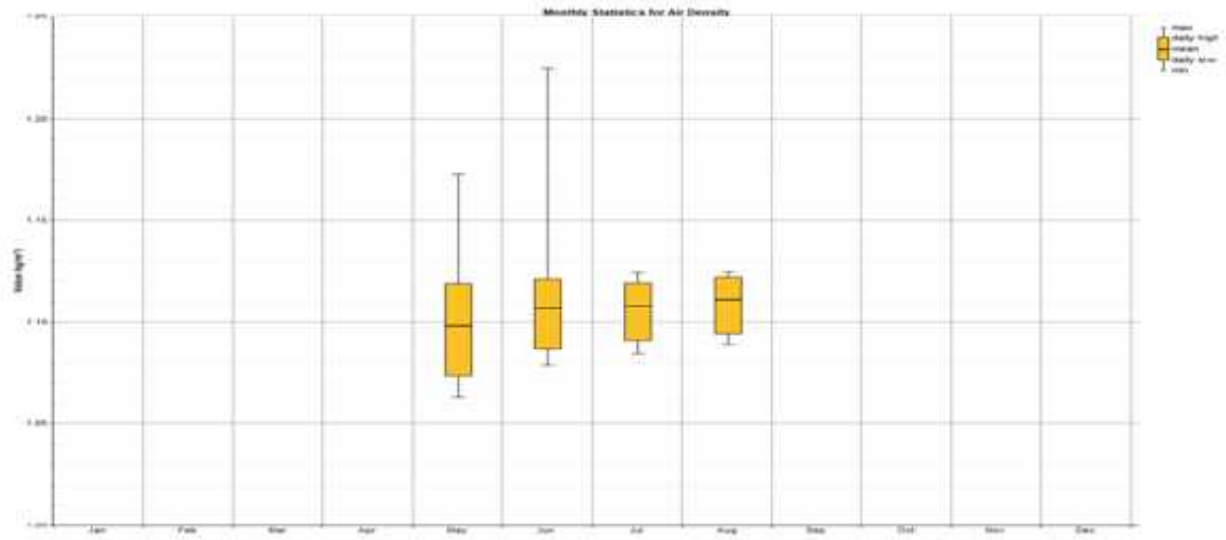

Figure 6 Air Density Profile for Ramagiri

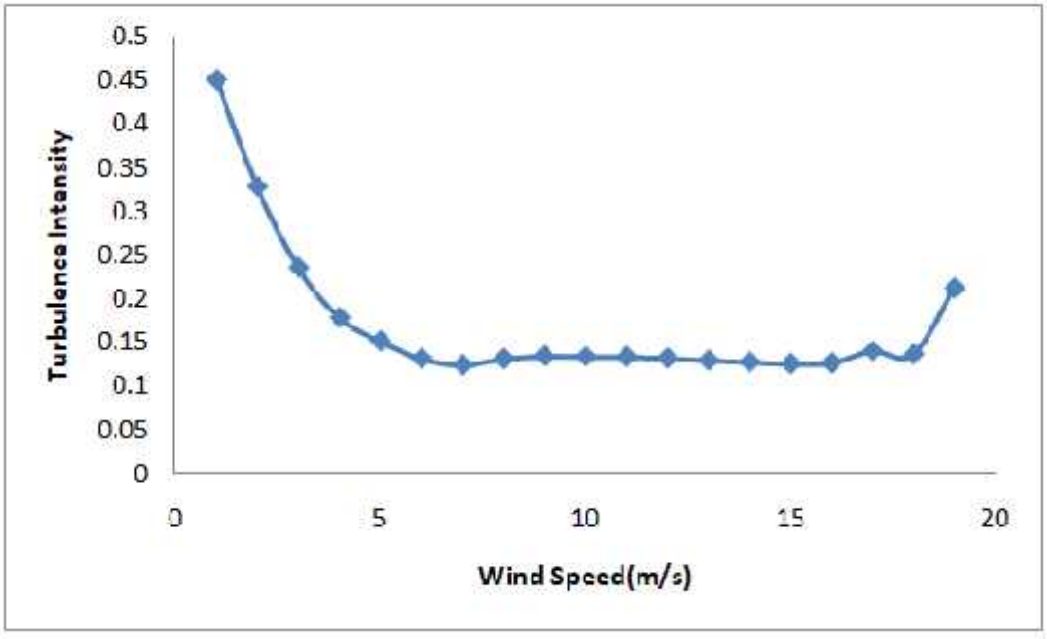

Figure 7 Turbulence Intensity for Ramgiri at 100m North