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## Monitoring and studying GMRT antenna control parameters: I
## Wind Speed


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3 December 2012

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# Monitoring and studying GMRT antenna control parameters: I
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## Abstract

Several online control data monitoring tools are being developed for enabling (1) statistical study of antenna control parameters (2) study of individual antenna peculiarities over time and waveband (3) plotting tools to provide a quick way to detect a problem and thus enable its solution. In this note, we give details of the various tools that have been developed for recording and examining control data in the online control system. We also present a preliminary analysis of the results on the wind speed data which have been logged since August 2009 from the wind-meters installed on the GMRT antennas. From the data collected over the last three years, We find that the average wind speed over GMRT is between 20 to 10 kmph from April to August and less than 20 kmph in rest of the year. Moreover, the average speed shows two peaks; one in May/June and one in July/August. Correspondingly, the total number of hours when the wind speed crosses 40 kmph also shows two peaks - the maximum number of hours are recorded in May/June followed by a smaller number of hours recorded in August. The maximum wind speed recorded at GMRT has exceeded 40 kmph in all the months of the year. The maximum wind speed recoded in the monsoon moths was more than 60 kmph. In 2012, the wind speeds crossed 40 kmph for more than 40 hours in the months of May to August which is more than that noted in 2010 and 2011. The maximum wind speed recorded in the last three years was 84 kmph in March 2010. GMRT antennas are parked when the one minute average wind speeds exceed 40 kmph. The antennas have been designed to be able to withstand winds $\sim$ 133 kmph; and such wind speeds are expected once in about 50 years. More over since wind meters are installed on GMRT antennas, recording of data can help any long term study of wind speeds around GMRT by interested groups. This

exercise has enabled continuous recording of wind speeds and also quantifying the downtime of GMRT for science observations due to high winds.

## 1. Introduction

The GMRT consists of an array of 30 antennas. Each Antenna is 45 meter in diameter and 45 meter in height. The weight of each dish is about 80 tonnes and the counter-weight is about 40 tonnes. The design is based on what is being called the **`SMART'** concept - for **S**tretched **M**esh **A**ttached to **R**ope **T**russes. The dish has been made light-weight and of low solidity by replacing the conventional back-up structure by a series of rope trusses stretched between 16 parabolic frames made of tubular steel. The low-solidity design cuts down the wind forces by a large factor and is particularly suited to Indian conditions where there is no snowfall in the plains. The overall wind forces and the resulting torques for a 45-m GMRT dish are similar to those for a 22-m dish of conventional design, thus resulting in substantial savings in cost. GMRT is designed such that the tracking accuracy is 1 arc min when wind speed is less than 20 kmph. Dish can be operational when wind speed is less than 40 kmph. Antennas should be parked when one minute averaged wind speed on any antenna one crosses 40 kmph.

The individual GMRT antenna gets automatically parked when averaged wind speed for 3 seconds crosses 40 kmph. A real time wind speed recoding program always runs on the control machine. If one minute averaged value from any one antenna crosses 40 kmph all antennas have to be parked to avoid any damage possible either due to high winds or power failures caused by high winds. The program generates alarm for parking the antennas. Once parked due to high winds, all the antennas must remain parked till the instantaneous wind speed values for all of them show less than 35 kmph for 15 minutes continuously.

## 2. Web-based ONLINE data monitoring tools

Various online monitoring tools are developed to enable availability of limited control data for users outside GMRT and to study antenna control

parameters. This web based monitoring tools which have been implemented till now are:

a)The Subarray tracking status ('*ondisp*' ): Dynamic display of antenna tracking status and various antenna flags. The screen is refreshed every minute. Thus a user can study the antenna count/problems from anywhere.

b)Ondisplay history : To see the history of the subarray tracking status. This is particularly useful in tracking down antennas which are down for long periods due to the same reason. Also useful in studying the frequency with which brakes are applied/timeouts are recorded or any other problems with antenna tracking are recorded.

c)Feed Position System (FPS) : To see FPS (turret position) system status ie feed in focus and the position counts.

d)Antenna Pointing Offsets : Displays the antennas offsets recorded along elevation and azimuth axis every time the pointing procedure is done. Data have been recorded since 2009. Facility to generate plots is also provided. This is useful in studying the long term pointing behavior of antennas and identifying sudden changes in the pointing which might be due to mechanical problems. More information is given in Part II of this series.

e)Wind Speed : Displays the Wind speed data/plots and statistics from data that have been recorded since 2009. More details are given from the next section of this report.

f)Temperature: Daily plots of the temperature recorded in the antenna shell since 2009 are available. More details will be given in Part III of this series.

g)Servo data: Displays servo related data for debugigng servo problems. This was developed when the servo group needed to monitor antenna oscillations and provide the data since 2009.

h)Sensitivity using deflection data : The IF data from the optical fibre are recorded and estimated sensitivities from the deflection test are recorded. Plotting facility is also available.

i) Fringe data : This tool estimates the antenna gain using the calibrator data from the data files using rantsol. It then displays the estimated antenna gain amplitude. All the calibrator data since 2010 are available for the user to examine.

All these tools are the monitoring part of “control and monitoring software of GMRT”. To develop these tools, various software tools are used like JavaScript, PHP, Perl and Gnuplot . Tools to monitor more parameters are being added to this suite of programmes. In this report, we focus on the wind speed monitoring data and present some preliminary inferences from the data monitored so far.

## 3. Wind speed monitoring tools.

Web based monitoring and statistical tools are developed to study various parameters associated with the antenna such as the wind data. From each antenna base, a wind datapoint is recorded every 3-4 seconds in the ONLINE shared memory. This data is read by the data monitoring tool that has been developed by us. Each antenna has two wind meters and the maximum value from the two wind meters is considered as wind speed recorded by that antenna. To reduce the data size, the maximum value recorded in 3 minutes is considered as a one data record ( primary data reduction) and these values are stored in a wind data file. One can plot various wind parameters with respect to time. Various wind parameters are also displayed in tabulated form. Some times few antennas show sudden jumps (spikes) in the record, which are likely to be junk data. We have tried to remove these bad points by estimating a mean of recorded values and identifying the bad points. Perl, PHP and JavaScript, html and gnuplot are used to develop these utilities. We describe the various various plots and tables and present preliminary inferences.

**A) Daily Wind Speed Plots : Valley wind** (fig 1)**:** GMRT antennas are spread over 25 km region. The Y shaped array is roughly divided into four parts, Central Square(CSQ), East arm (E), West arm (W) and South arm (S). The maximum wind speed recorded by an antenna from each part is tabulated and plotted for a single day. This 24 hours plot shows the average and maximum wind speeds. Average wind speed value is calculate by taking the arithmetic mean of the available data records during the 24 hours period. One can see a daily plot by changing the date option (also year wise pdf files are available). **Indvidual Antenna Wind Speed (**fig 2)**:** One can plot the wind speed of a single antenna with time for a single day. **All Antenna Wind (**fig 3)**:** This plot shows all antenna plots on the same page. One can quickly look at the wind speed of all antennas on any day. All the data points used are obtained from the maximum value recorded in 3 minutes.

**B) Yearly wind speed plots. Gray plots** (fig 5 to 8) of each year. These plots show overall wind speed recorded for one year. **24 hour wind plots** throughout the year. **High wind plots** throughout the year.

**C) Statistical plots and Tables**. **Average** (fig 9) wind speed plots of each year, **Maximum** (fig 10) wind speed plot of each year and **Total time** (fig 11) for which the wind speed was above 40 kmph per year. The wind **Summary table** (table 1) shows the Average, Maximum and Total hours of wind speed crossing 40/50/60 kmph for a year, month and daily basis. While doing statistical calculations the maximum wind speed value from all the antennas is considered as a single record.

## 4. Wind speeds recorded at GMRT antennas since 2009

Wind speeds at GMRT remain high in the premonsoon and monsoon months which begins around May/June and continues till September. While the wind speeds during the day are $\sim$ 20 kmph in the monsoon months; they are typically $\sim$ 10 kmph in the rest of the months. In fig 12 to 16, the wind speeds recorded by the wind-meters on the 30 antennas on 1 December 2011 (non-monsoon), 21 January 2012 (non-monsoon), 5 July 2012 (monsoon), 1 August

2012 (monsoon) and 6 August 2012 (monsoon) are shown as examples. The wind speeds start climbing around 8am IST, peak from noon to 4pm IST and then gradually decline. This pattern is particularly observable in the plots from July and August. The average wind speed recorded at the GMRT antennas between 2009 to 2012 is shown in fig. 9. Average wind speeds exceeding 20 kmph are recorded from April to August, and the average wind speed is around <15 kmph in the rest of the months. In fig 10 the maximum speed recorded at the GMRT antennas between 2009 to 2012 is shown. In fig. 11, the total number of hours that recorded wind speeds exceeding 40 kmph is shown. As expected the months of April/May to August show higher frequency of high winds and has the largest number of hours when wind speeds exceeded 40 kmph . Table 1 shows the overall statistics of the wind speed from August 2009 to December 2012. The first column of this table indicates the time interval in months and years. The second show the averaged wind speed (kmph), the third column indicates maximum wind speed observed at GMRT, fourth column indicates the antenna which recorded the maximum wind speed, fifth column indicates the total number of hours for which the wind speed was above 40 kmph and the sixth and seventh indicates that for above 50 kmph and above 60 kmph respectively. There are a few antenna ( S04, S03) of GMRT where higher wind speeds are recorded due to terrain.

In GMRT Observing Cycle 22 (Apr to Sep 2012), about 60 hours of actual time scheduled for science observations was affected by high winds (average speed > 40 km/h). Table 2 indicates the list of proposals and the time lost due to high winds. When overheads are included, then the actual time which was unusable because of high winds was about 160 hours.

Fig. 5 to 8 shows dynamic spectra-type gray color plots where the color-coding indicates the wind speeds with the IST on the x-axis and the month of the year on the y-axis. Clearly the incidence of higher winds is larger for the months of May to August. Although this pattern of high wind speeds during the daytime continues throughout the year, the magnitude of the wind speeds are much lower. During the pre-monsoon months of April, May, high winds are recorded throughout the day and this kind of behavior also continues into June. Table 3 indicates the working status of the antenna wind meters. Table 4 to 7 indicates the month wise maximum wind speed values for all antennas. Table 8 to 11 Indicates the month wise averaged wind speed values for all antennas. All these data are presented for there interested in studying the wind conditions at GMRT.

## 5. Summary

In this note, we have presented preliminary results on the wind speeds encountered by GMRT antennas. GMRT antennas were constructed to withstand instantaneous wind speeds of 133 kmph . To protect the antennas from damage, the observatory policy is to park antennas when the wind speeds exceed 40 kmph over a minute duration. During the pre-monsoon/monsoon months, GMRT antennas regularly encounter stormy weather thus leading to the possibility of damage. The wind meters are installed at a certain height on the antennas. With these tools in place, it is now possible to monitor the wind speeds at GMRT and conduct statistical studies on the same. Moreover the data can also be used by other groups interested in wind studies. All the data are available online at (http://www.gmrt.ncra.tifr.res.in/~astrosupp/gmrtmon/wind/wind.php) for any interested person to download and use.

Ref. Tests on servo system of GMRT and some relations concerning wind loads, unbalanced load, frictional torques, motor currents and counter-torque bias ( Swarup, G, Joshi, B. C, Tapde, S. C, Nagarathnam, N. V, Vaidya, V. M, Barapatre, B. M)

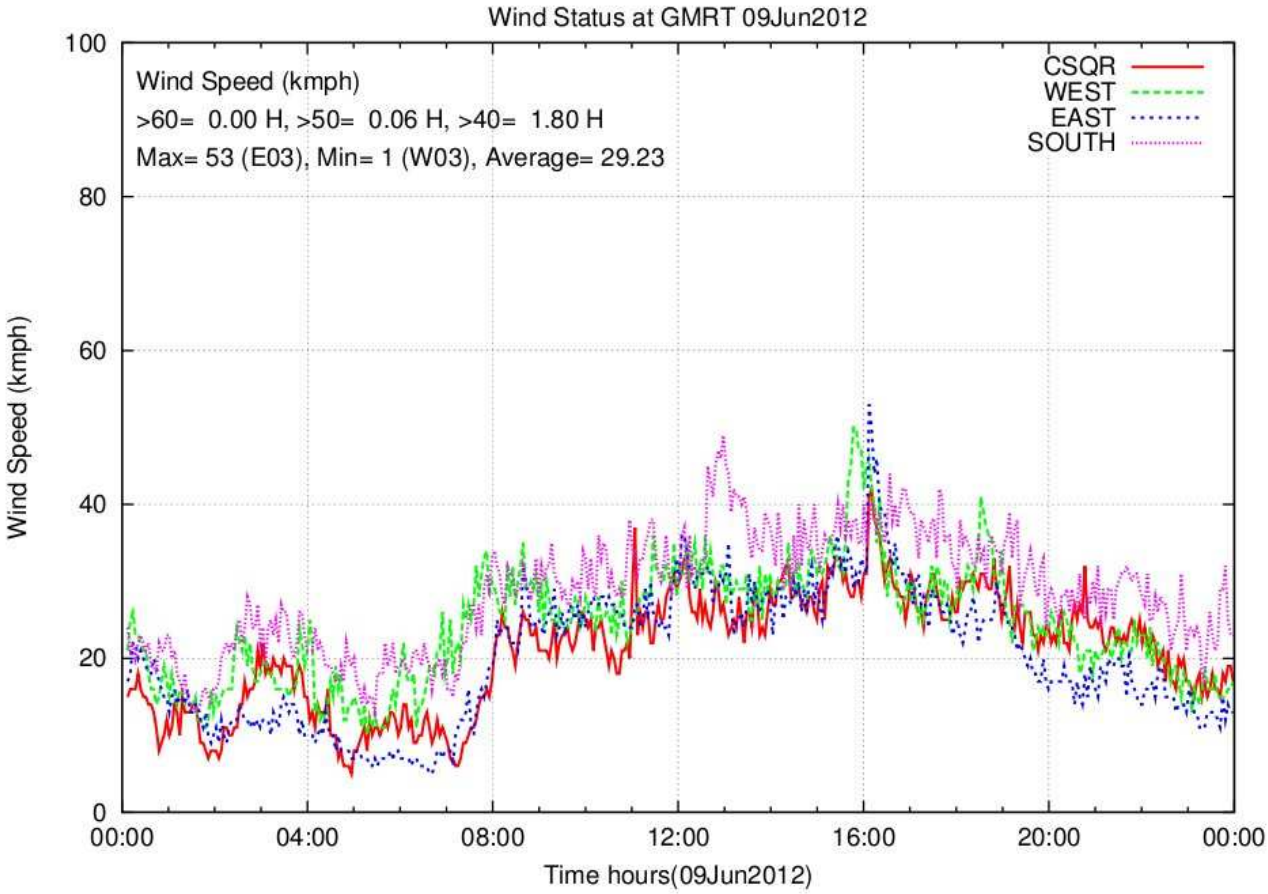


Fig 1. Daily Wind Plot (Valley Plot).

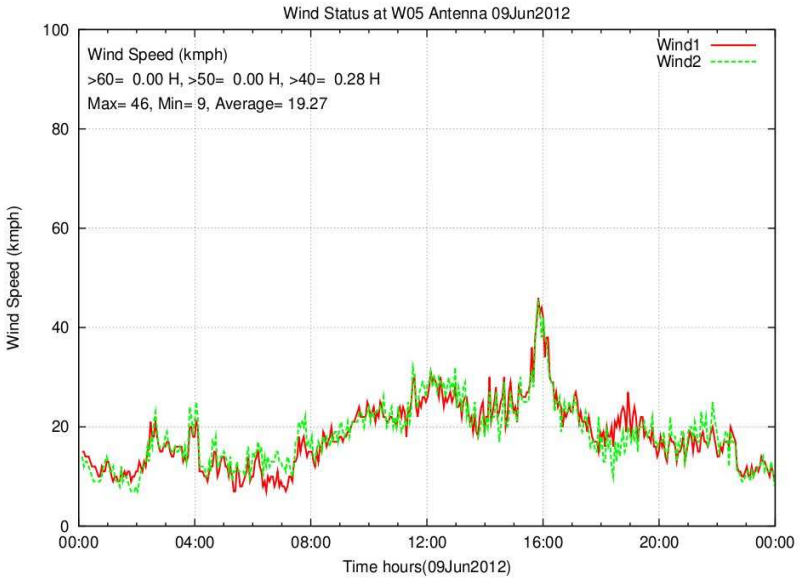


Fig 2. Daily Wind Plot (Single Antenna).

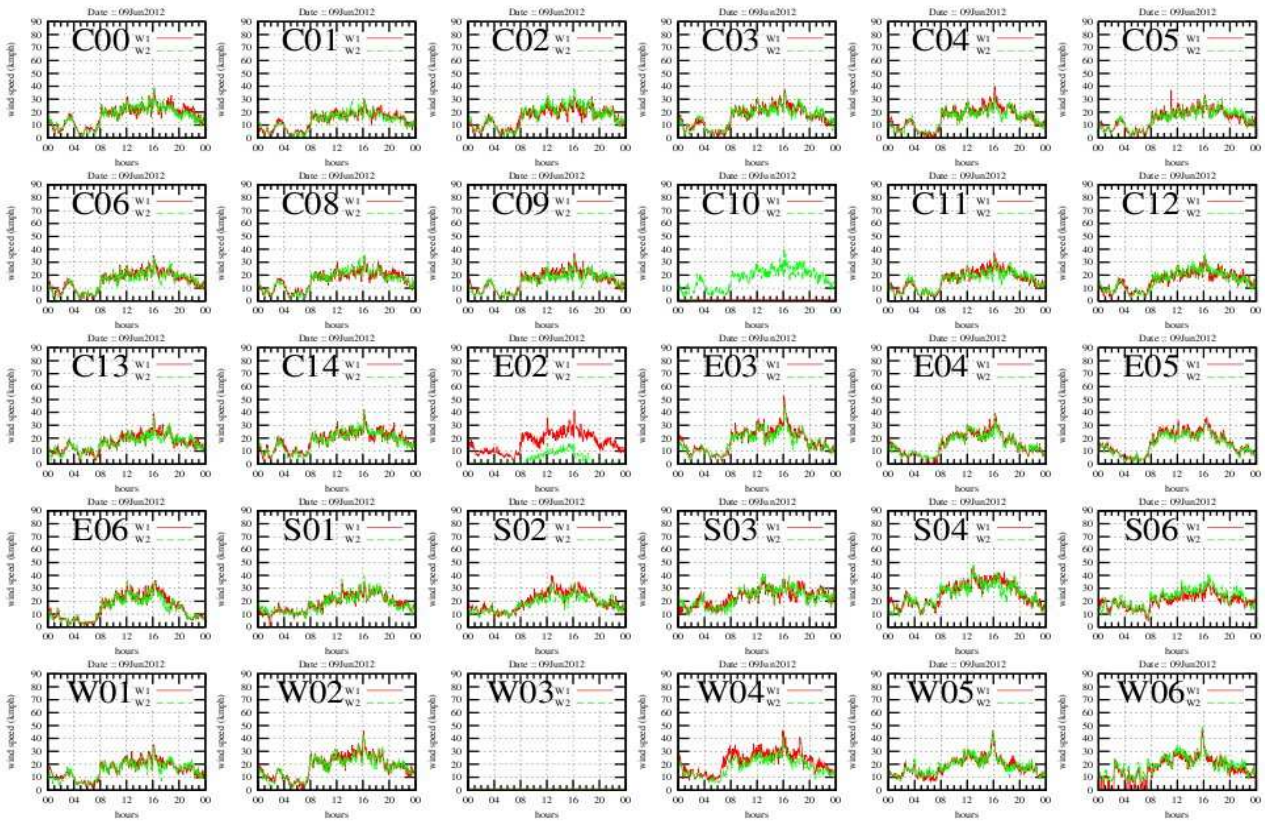


Fig 3. Daily Wind Plot (All antenna)

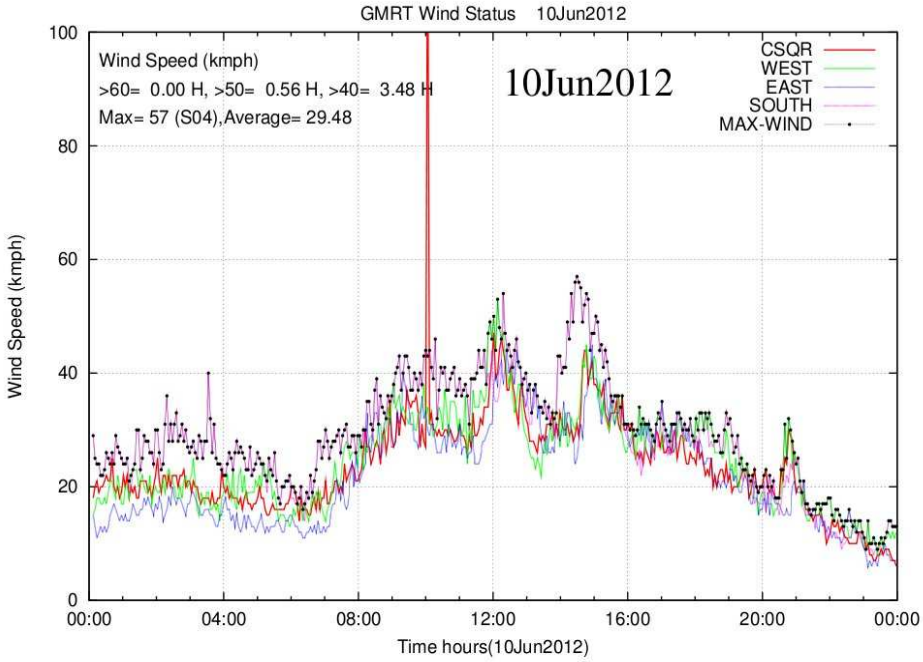


Fig 4. Bad Point (spikes) filtering.

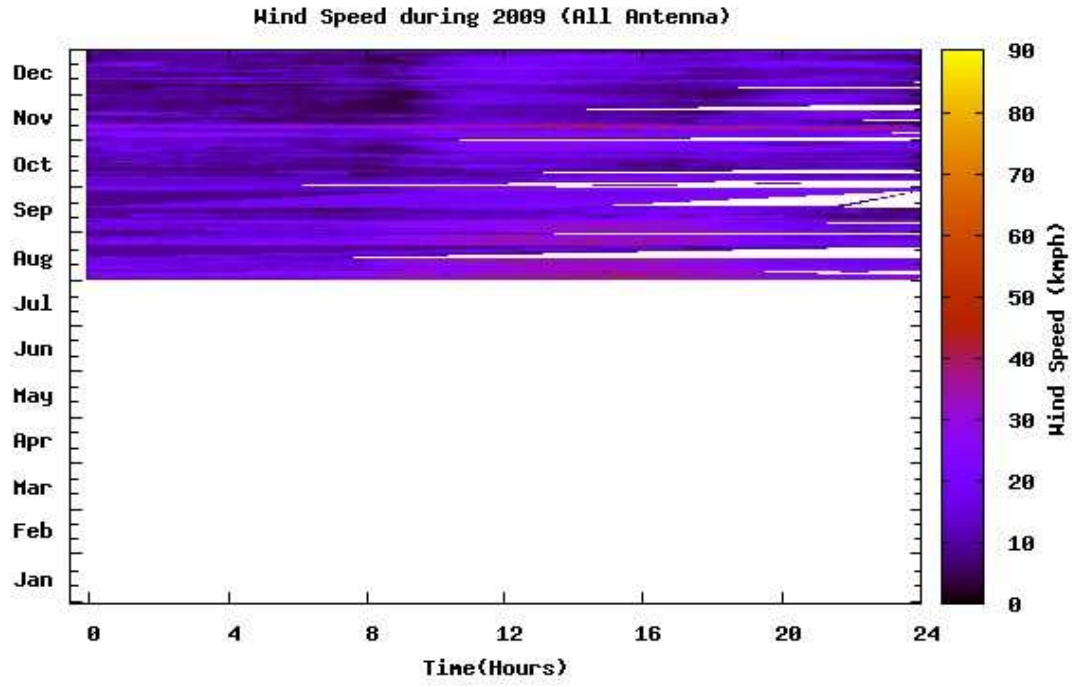


Fig. 5. Compact view of the wind speed in a year 2009 shown by a color wind speed plot. The x-axis denotes the time of the day and y-axis the month. The color coding shown on the right indicates the wind speed. White streaks in the plot indicate lack of data.

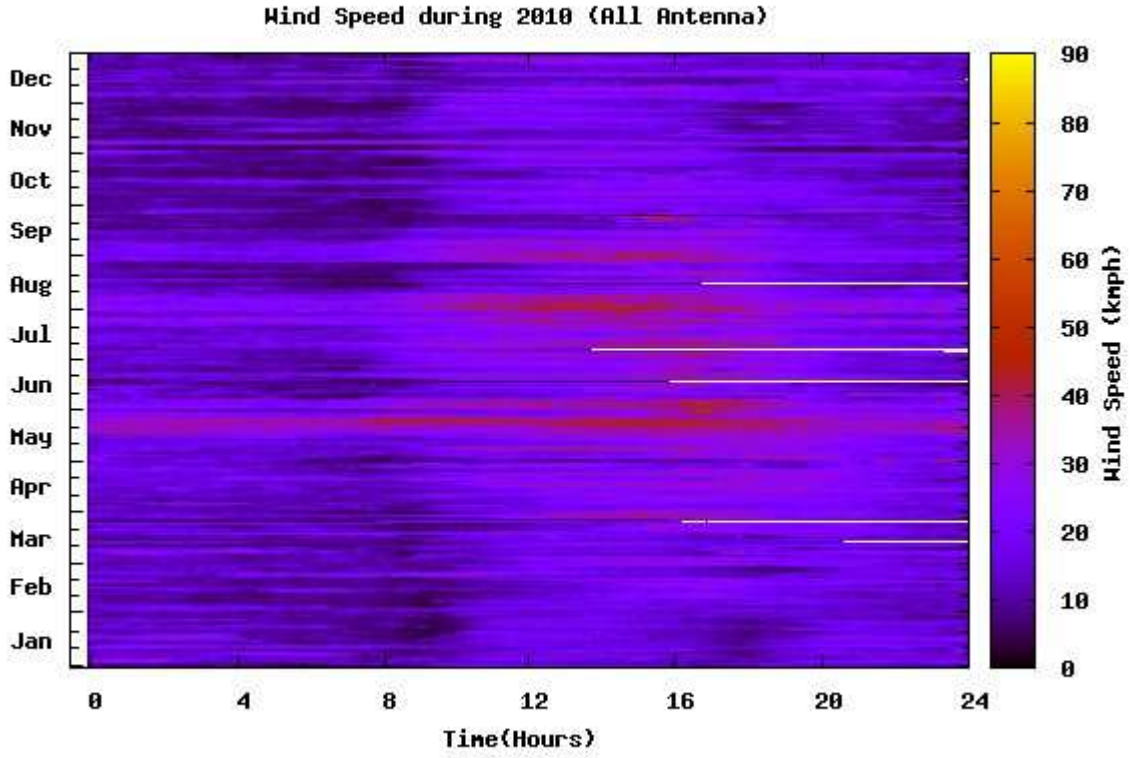


Fig. 6. Compact view of the wind speed in a year 2010 shown by a color wind speed plot. The x-axis denotes the time of the day and y-axis the month. The color coding shown on the right indicates the wind speed. White streaks in the plot indicate lack of data.

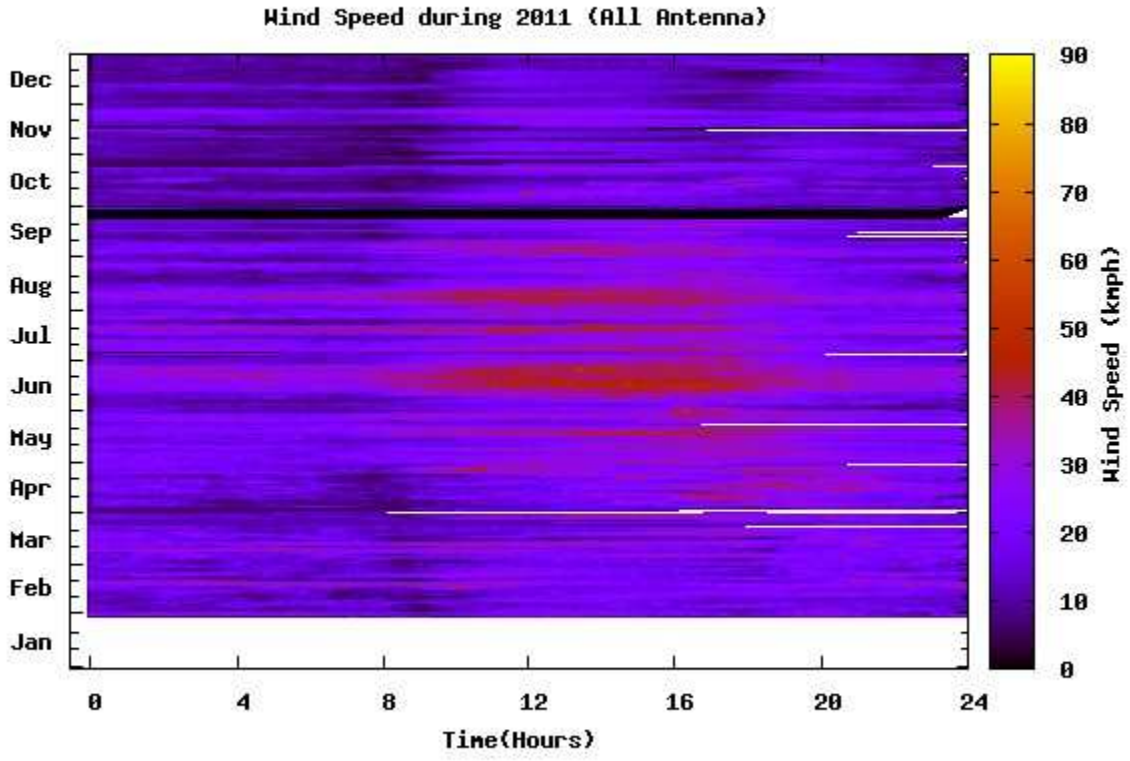


Fig. 7. Compact view of the wind speed in a year 2011 shown by a color wind speed plot. The x-axis denotes the time of the day and y-axis the month. The color coding shown on the right indicates the wind speed. White streaks in the plot indicate lack of data.

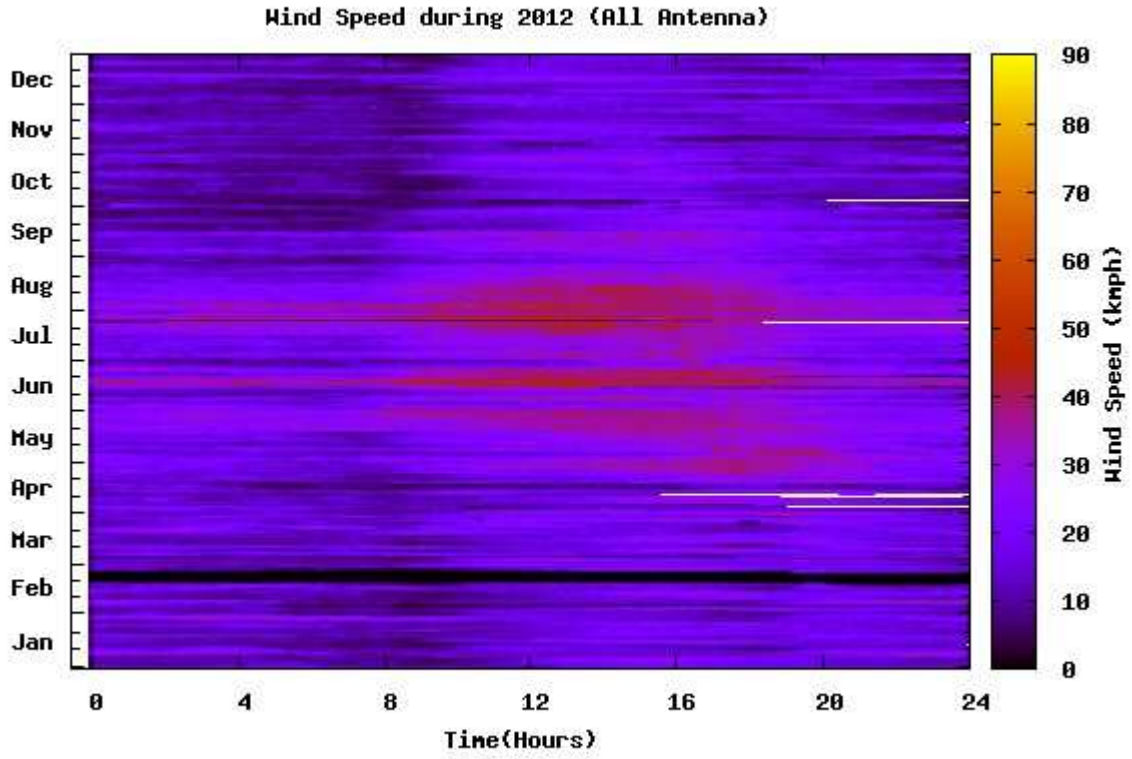


Fig. 8. Compact view of the wind speed in a year 2012 shown by a color wind speed plot. The x-axis denotes the time of the day and y-axis the month. The color coding shown on the right indicates the wind speed. White streaks in the plot indicate lack of data.

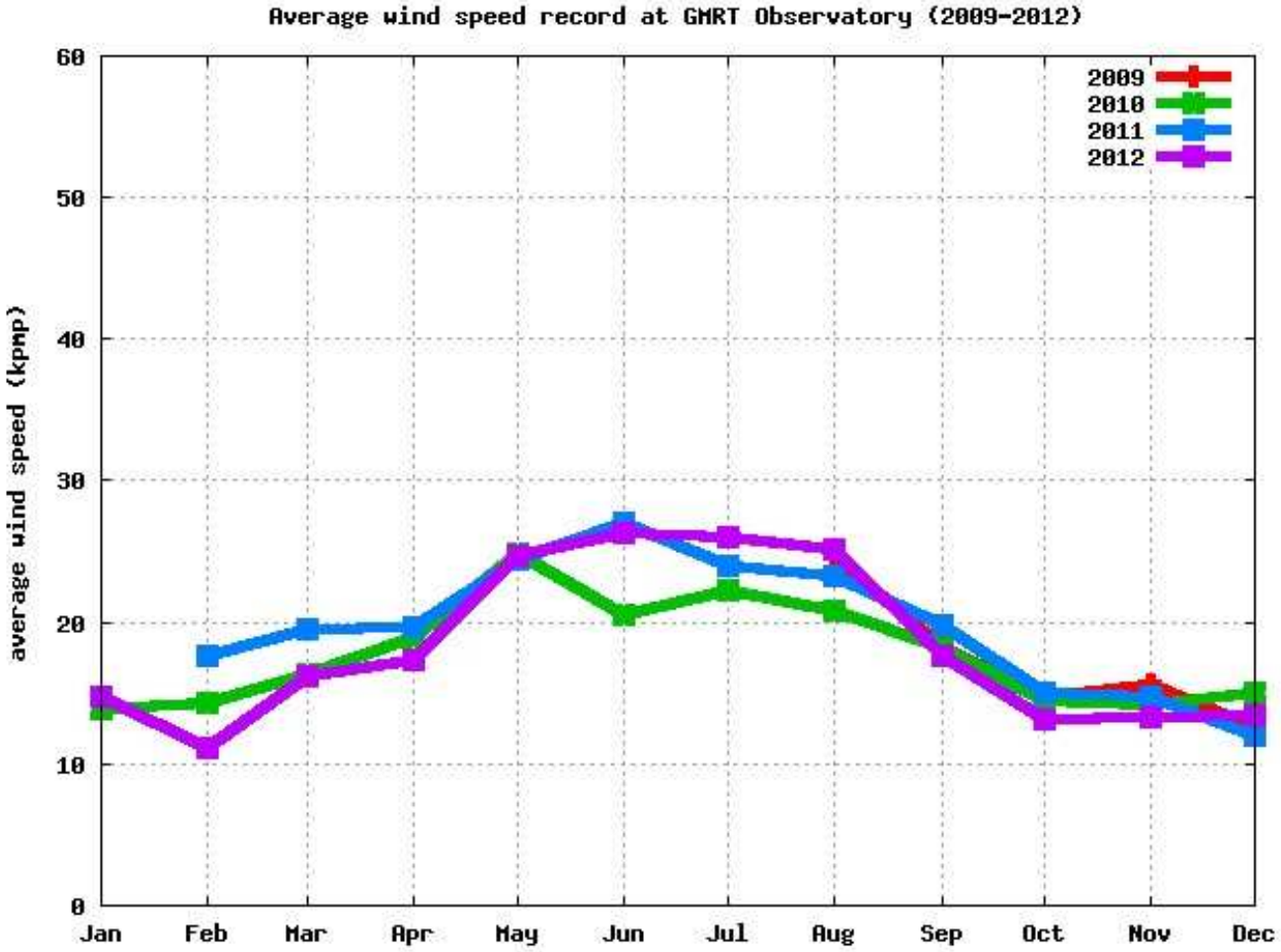


Fig. 9. Average wind speed kmph (2009 – 2012). Note the gradual rise in the wind speed around February/March and gradual decline in August/September. These values are obtained by averaging monthly data over the entire array.

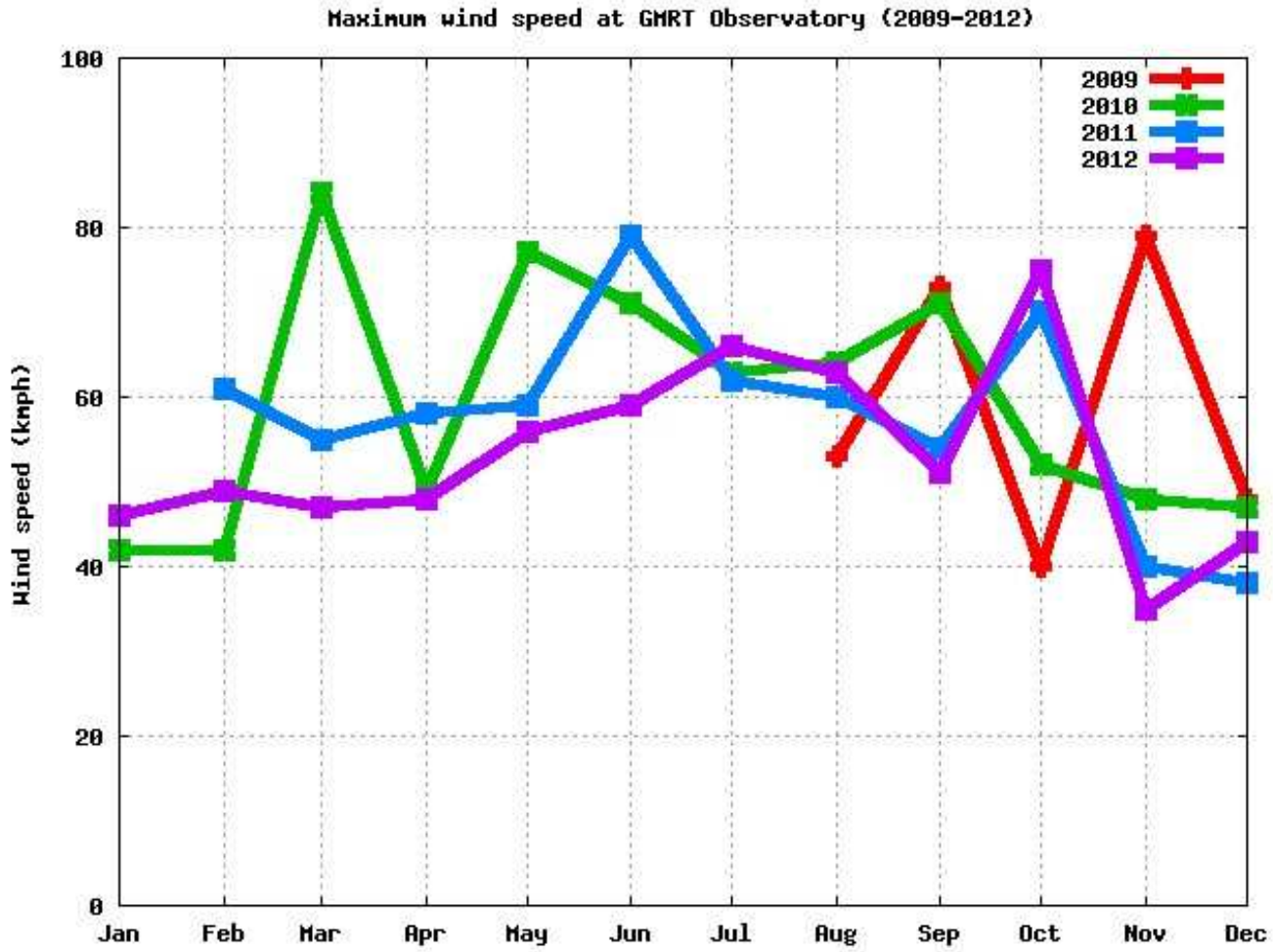


Fig. 10. Maximum wind speed kmph ( 2009 – 2012 ) recorded by any antenna in the GMRT array in a month is shown here. Note several peaks seen which are close to 80 kmph. While in 2010, the highest speed of 84 kmph was recorded in March, in 2009 GMRT recorded a similar speed in November. As seen in the figure, maximum speeds at the array are > 40 kmph throughout the year with a gradual rise which doubles the magnitude. Since occasionally a high value is wrongly recorded, to obtain this data, all the wind data had to be examined.

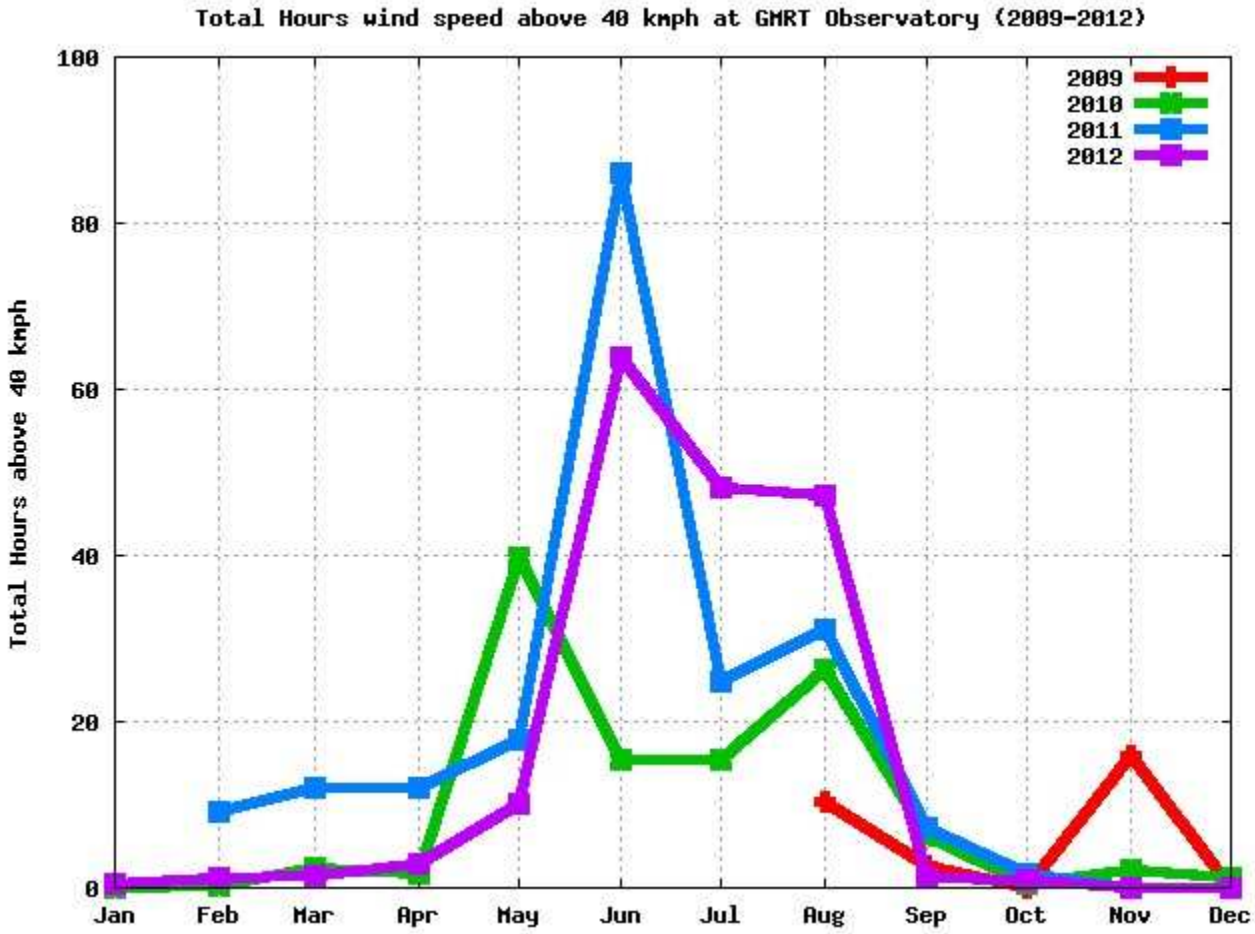


Fig. 11. Total hours for which wind speed was above 40 kmph (2009-2012). The distribution is double-peaked with the first peak in May/June and second peak in August. The small peak seen in November 2009 does not seem to be typical.

Table 1. Overall statistics (2009-2012)

| Duration | avg(kmph) | max(kmph) | max(Ant) | above-40(h) | above-50(h) | above-60(h) |
|---|---|---|---|---|---|---|
| Aug2009 | 24.71 | 53 | S04 | 10.44 | 0.17 | 0.00 |
| Sep2009 | 18.19 | 73 | E05 | 2.58 | 0.22 | 0.06 |
| Oct2009 | 14.68 | 40 | W05 | 0.00 | 0.00 | 0.00 |
| Nov2009 | 15.59 | 79 | S04 | 15.82 | 4.83 | 1.63 |
| Dec2009 | 12.58 | 48 | C00 | 0.06 | 0.00 | 0.00 |
| 2009 | 16.57 | 79 | S04 | 28.90 | 5.22 | 1.68 |
| Jan2010 | 13.89 | 42 | E06 | 0.06 | 0.00 | 0.00 |
| Feb2010 | 14.36 | 42 | S04 | 0.17 | 0.00 | 0.00 |
| Mar2010 | 16.36 | 84 | S04 | 2.30 | 0.17 | 0.11 |
| Apr2010 | 19.01 | 49 | S04 | 1.68 | 0.00 | 0.00 |
| May2010 | 24.90 | 77 | E05 | 39.67 | 2.75 | 0.67 |
| Jun2010 | 20.48 | 71 | S04 | 15.43 | 3.09 | 0.62 |
| Jul2010 | 22.33 | 63 | S04 | 15.43 | 0.45 | 0.06 |
| Aug2010 | 20.83 | 64 | S02 | 26.32 | 2.41 | 0.06 |
| Sep2010 | 18.16 | 71 | S04 | 6.23 | 1.07 | 0.11 |
| Oct2010 | 14.41 | 52 | S04 | 0.45 | 0.11 | 0.00 |
| Nov2010 | 14.20 | 48 | W05 | 2.24 | 0.00 | 0.00 |
| Dec2010 | 15.07 | 47 | S04 | 1.12 | 0.00 | 0.00 |
| 2010 | 17.84 | 84 | S04 | 111.10 | 10.04 | 1.63 |
| Jan2011 | 00.00 | 0 | NAN | 0.00 | 0.00 | 0.00 |
| Feb2011 | 17.59 | 61 | E05 | 9.26 | 1.35 | 0.06 |
| Mar2011 | 19.53 | 55 | E05 | 12.06 | 0.56 | 0.00 |
| Apr2011 | 19.65 | 58 | E05 | 11.95 | 1.35 | 0.00 |
| May2011 | 24.38 | 59 | S04 | 17.90 | 4.49 | 0.00 |
| Jun2011 | 26.97 | 79 | C00 | 85.96 | 9.43 | 0.34 |
| Jul2011 | 24.05 | 62 | S04 | 24.80 | 0.56 | 0.06 |
| Aug2011 | 23.25 | 60 | E03 | 31.20 | 2.92 | 0.00 |
| Sep2011 | 19.87 | 54 | S04 | 7.24 | 0.06 | 0.00 |
| Oct2011 | 15.06 | 70 | C11 | 1.63 | 0.39 | 0.28 |
| Nov2011 | 14.69 | 40 | W04 | 0.00 | 0.00 | 0.00 |
| Dec2011 | 12.02 | 38 | W04 | 0.00 | 0.00 | 0.00 |
| 2011 | 19.74 | 79 | C00 | 202.00 | 21.10 | 0.73 |
| Jan2012 | 14.77 | 46 | E06 | 0.39 | 0.00 | 0.00 |
| Feb2012 | 11.15 | 49 | E06 | 1.12 | 0.00 | 0.00 |
| Mar2012 | 16.14 | 47 | C11 | 1.46 | 0.00 | 0.00 |
| Apr2012 | 17.30 | 48 | W03 | 2.92 | 0.00 | 0.00 |
| May2012 | 24.76 | 56 | W03 | 10.21 | 0.28 | 0.00 |
| Jun2012 | 26.28 | 59 | S04 | 63.74 | 5.11 | 0.00 |
| Jul2012 | 26.01 | 66 | S04 | 48.20 | 4.15 | 0.28 |
| Aug2012 | 25.20 | 63 | S04 | 47.30 | 4.32 | 0.17 |
| Sep2012 | 17.64 | 51 | S04 | 1.23 | 0.06 | 0.00 |
| Oct2012 | 13.19 | 75 | S04 | 0.95 | 0.22 | 0.06 |
| Nov2012 | 13.30 | 35 | S04 | 0.00 | 0.00 | 0.00 |
| Dec2012 | 13.46 | 43 | S04 | 0.06 | 0.00 | 0.00 |
| 2012 | 18.30 | 75 | S04 | 177.59 | 14.14 | 0.50 |

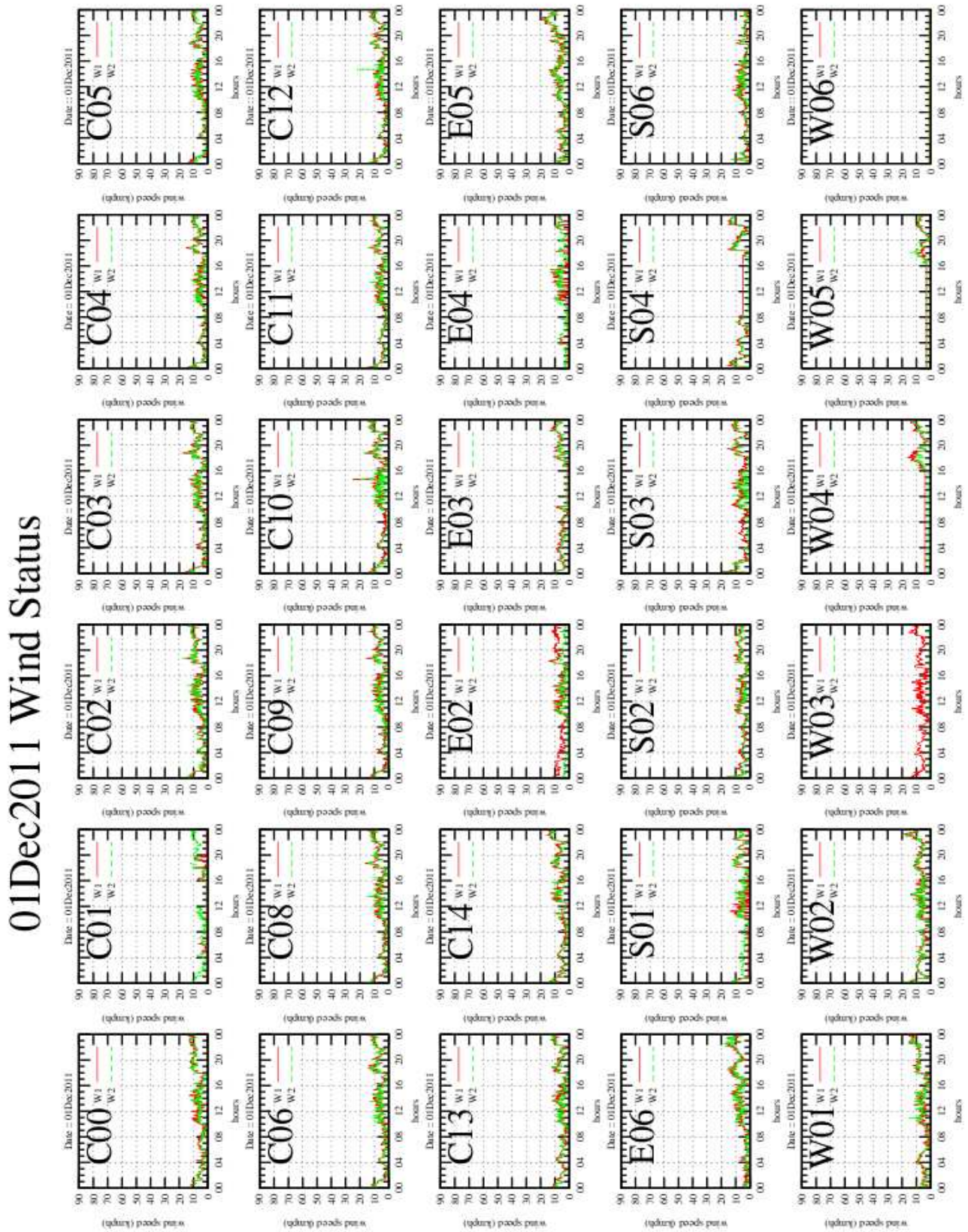


Fig. 12. Wind speeds recorded on all 30 antennas on 1 December 2011. Red and green are 2 wind meters

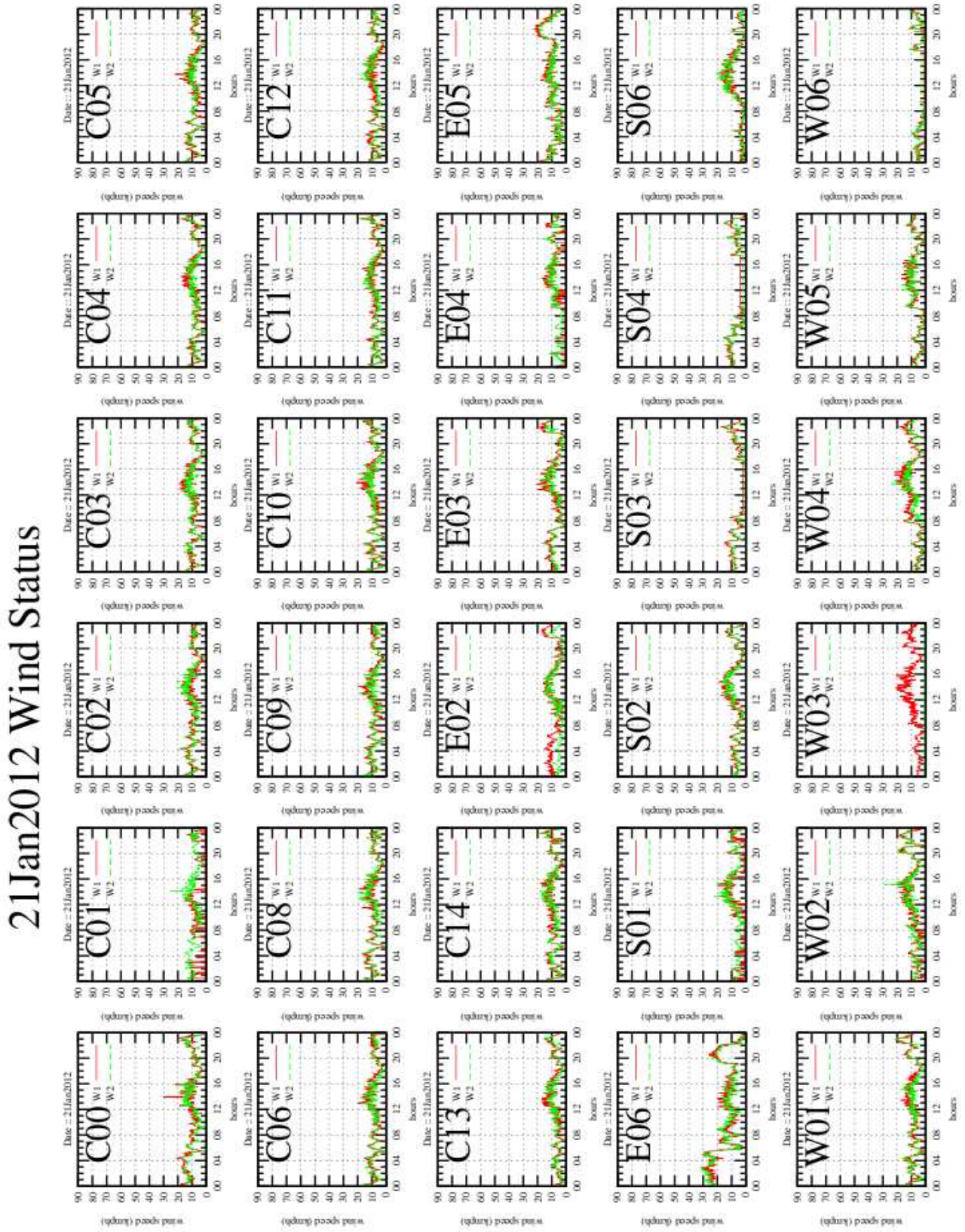


Fig. 13. Wind speeds recorded on 21Jan2012 by 30 ant. Red and green are 2 wind meters.

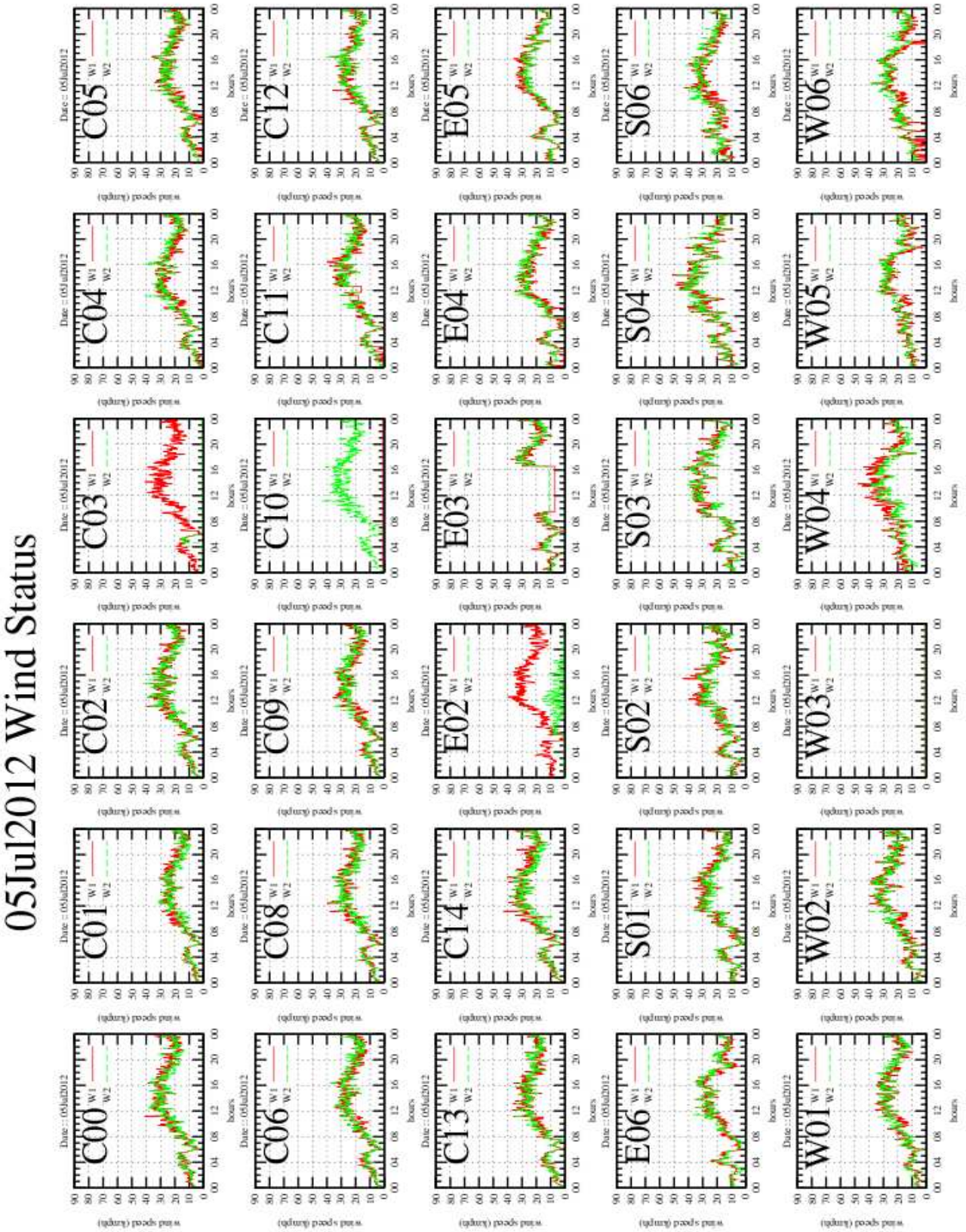


Fig. 14. Wind speeds recorded on 5 July 2012 by 30 ants. Red and green are – 2 wind meters

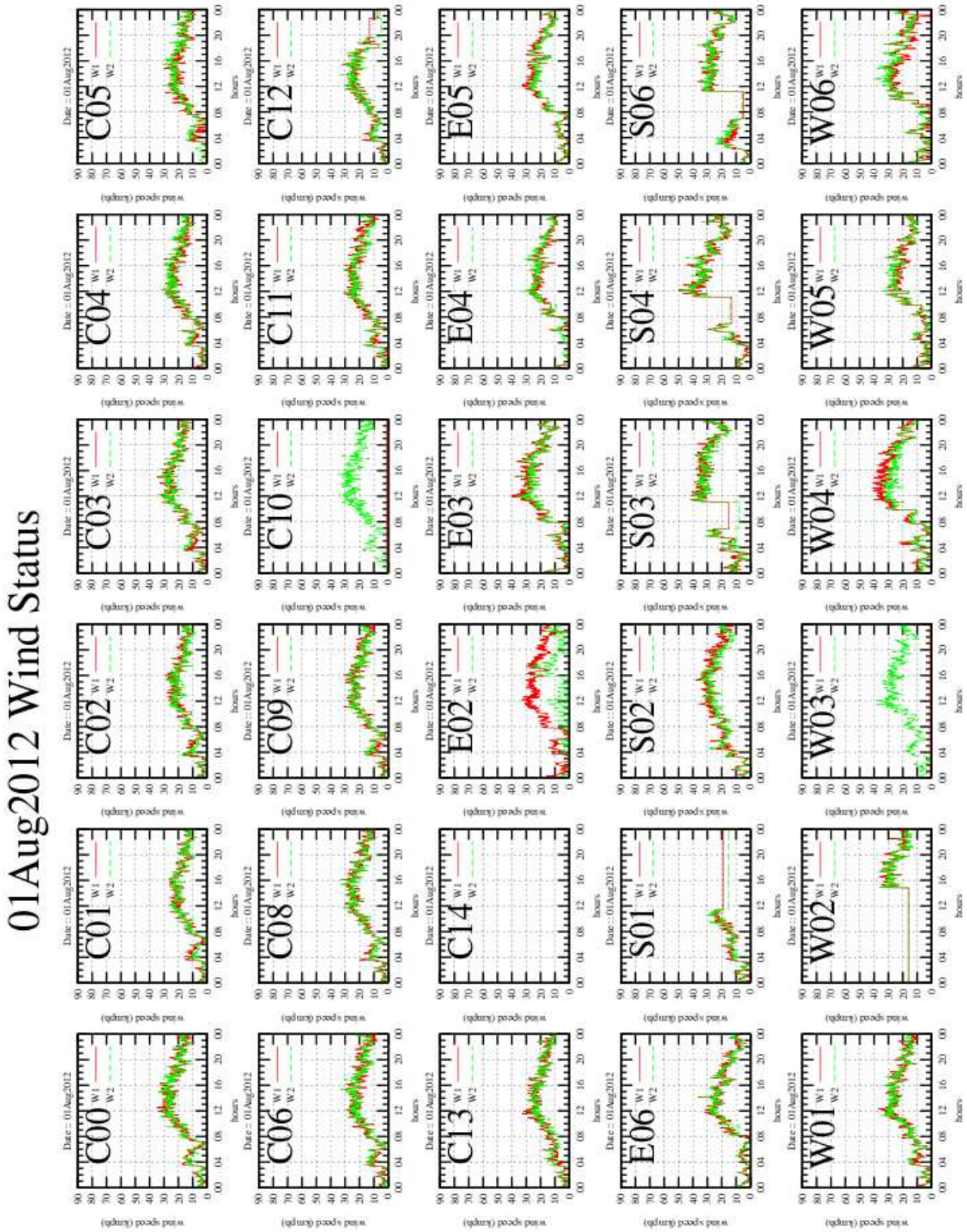


Fig. 15. Wind speeds recorded on 1 August 2012 by 30 ant. Red and green are two wind meters

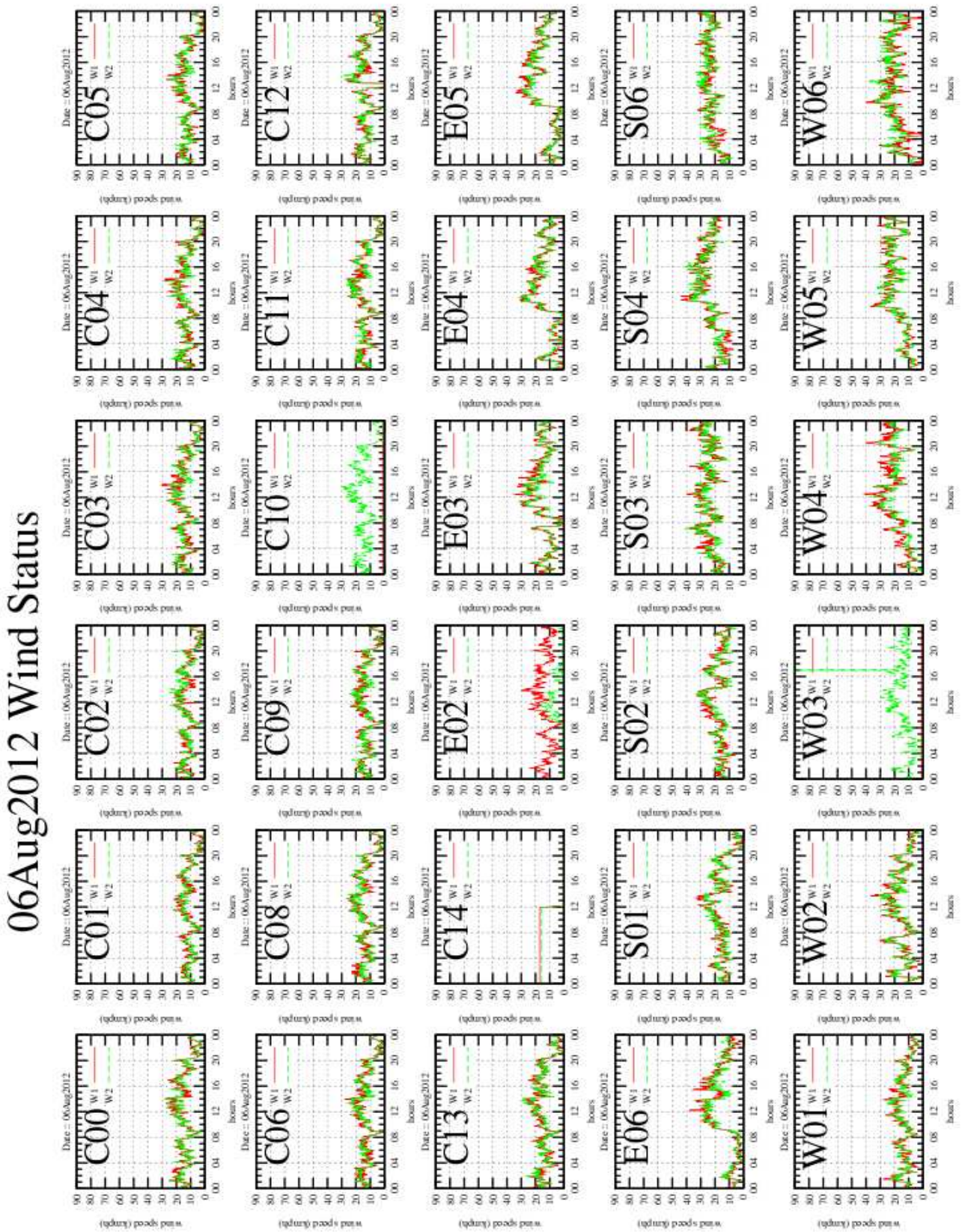


Fig. 16. Wind speeds recorded on 6Augst2012 by 30 ant. Green,red – two wind meters

Table 2. Time lost during GMRT Observing Cycle 22 due to high winds.

| Date | Project Code | Time lost (hours) |
|---|---|---|
| May 8, 2012 | 22_039 | 1.5 |
| Jun 2, 2012 | 22_036 | 3.0 |
| Jun 9, 2012 | 22_020 | 1.0 |
| Jun 10, 2012 | 22_002 | 4.0 |
| Jun 16, 2012 | 22_045 | 1.0 |
| Jun 16, 2012 | 22_046 | 1.0 |
| Jun 19, 2012 | 22_056 | 4.0 |
| Jun 21, 2012 | 22_066 | 1.0 |
| Jun 24, 2012 | 22_046 | 2.0 |
| Jun 26, 2012 | 22_056 | 0.5 |
| Jul 2, 2012 | 22_043 | 0.5 |
| Jul 7, 2012 | 22_013 | 0.5 |
| Jul 8, 2012 | 22_055 | 0.5 |
| Jul 15, 2012 | 22_055 | 0.5 |
| Jul 22, 2012 | 22_065 | 2.0 |
| Jul 22, 2012 | 22_013 | 1.5 |
| Jul 24, 2012 | 22_019 | 4.5 |
| Jul 27, 2012 | 22_019 | 6.0 |
| Jul 28, 2012 | 22_049 | 6.0 |
| Jul 29, 2012 | 22_055 | 2.0 |
| Jul 30, 2012 | 22_074 | 2.5 |
| Aug 3, 2012 | 22_064 | 3.5 |
| Aug 3, 2012 | 22_057 | 3.5 |
| Aug 4, 2012 | 22_057 | 3.0 |
| Aug 7, 2012 | 22_013 | 0.5 |
| Aug 14, 2012 | 12DT022 | 3.0 |
| Aug 14, 2012 | 22_074 | 1.5 |
| | | Total 60 hours |

Table 3. Working status of the wind meters ( each antenna has two wind-meters).

| Antenna | Jan 2010 ( 12 ant) | Jan 2011 (20 ant) | Jan 2012 (30 ant) | Jan 2013 (29 ant) |
|---|---|---|---|---|
| C00 | | | 2 | 2 |
| C01 | | 1 | 2 | |
| C02 | | | 2 | 2 |
| C03 | | | 2 | 2 |
| C04 | | 1 | 2 | 2 |
| C05 | | 2 | 2 | 2 |
| C06 | 1 | 2 | 2 | 2 |
| C08 | 1 | 2 | 2 | 2 |
| C09 | | 2 | 2 | 2 |
| C10 | 2 | 2 | 2 | 2 |
| C11 | | | 2 | 2 |
| C12 | | | 2 | 2 |
| C13 | | | 2 | 2 |
| C14 | | 1 | 2 | 2 |
| W01 | 1 | | 2 | 2 |
| W02 | 2 | 2 | 2 | 2 |
| W03 | | 1 | 1 | 2 |
| W04 | 1 | 1 | 2 | 2 |
| W05 | | 1 | 2 | 2 |
| W06 | | | 2 | 2 |
| E02 | | 1 | 2 | 2 |
| E03 | | | 2 | 2 |
| E04 | | 2 | 2 | 2 |
| E05 | 2 | 1 | 2 | 2 |
| E06 | 1 | 2 | 2 | 2 |
| S01 | | 1 | 2 | 2 |
| S02 | 1 | | 2 | 2 |
| S03 | 2 | 2 | 2 | 2 |
| S04 | 2 | 2 | 2 | 2 |
| S06 | 1 | 1 | 2 | 2 |

Table 4. Maximum wind speed (kmph)2009

| Antenna | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C00 | | | | | | | | 15 | 17 | 27 | 15 | 48 | 48 |
| C01 | | | | | | | | 43 | 37 | 34 | 76 | 19 | 76 |
| C02 | | | | | | | | 38 | 32 | 25 | 16 | 9 | 38 |
| C03 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| C04 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| C05 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| C06 | | | | | | | | 43 | 33 | 34 | 65 | 27 | 65 |
| C08 | | | | | | | | 48 | 38 | 38 | 64 | 29 | 64 |
| C09 | | | | | | | | 32 | 28 | 25 | 45 | 18 | 45 |
| C10 | | | | | | | | 35 | 29 | 26 | 58 | 27 | 58 |
| C11 | | | | | | | | 37 | 30 | 29 | 60 | 19 | 60 |
| C12 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| C13 | | | | | | | | 1 | 1 | 2 | 49 | 2 | 49 |
| C14 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| W01 | | | | | | | | 31 | 24 | 22 | 45 | 22 | 45 |
| W02 | | | | | | | | 45 | 37 | 35 | 51 | 32 | 51 |
| W03 | | | | | | | | 16 | 3 | 1 | 21 | 8 | 21 |
| W04 | | | | | | | | 48 | 48 | 39 | 54 | 31 | 54 |
| W05 | | | | | | | | 45 | 42 | 40 | 46 | 28 | 46 |
| W06 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| E02 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| E03 | | | | | | | | 23 | 4 | 1 | 9 | 2 | 23 |
| E04 | | | | | | | | 47 | 32 | 31 | 47 | 15 | 47 |
| E05 | | | | | | | | 45 | 73 | 34 | 66 | 31 | 73 |
| E06 | | | | | | | | 47 | 50 | 37 | 57 | 38 | 57 |
| S01 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| S02 | | | | | | | | 47 | 49 | 30 | 73 | 34 | 73 |
| S03 | | | | | | | | 49 | 56 | 35 | 61 | 32 | 61 |
| S04 | | | | | | | | 53 | 49 | 37 | 79 | 37 | 79 |
| S06 | | | | | | | | 38 | 38 | 32 | 40 | 28 | 40 |

Table 5. Maximum wind speed (kmph) 2010

| Antenna | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C00 | 36 | 20 | 38 | 38 | 26 | 30 | 26 | 15 | 24 | 13 | 15 | 24 | 38 |
| C01 | 1 | 17 | 15 | 2 | 1 | 38 | 1 | 1 | 1 | 1 | 37 | 25 | 38 |
| C02 | 4 | 10 | 22 | 28 | 41 | 31 | 4 | 11 | 25 | 26 | 29 | 14 | 41 |
| C03 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 3 |
| C04 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| C05 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 40 | 51 | 36 | 37 | 27 | 51 |
| C06 | 29 | 33 | 39 | 37 | 50 | 45 | 40 | 53 | 54 | 34 | 43 | 36 | 54 |
| C08 | 34 | 32 | 39 | 41 | 53 | 48 | 46 | 39 | 26 | 14 | 25 | 24 | 53 |
| C09 | 20 | 24 | 30 | 27 | 41 | 31 | 1 | 30 | 35 | 25 | 36 | 22 | 41 |
| C10 | 27 | 34 | 53 | 36 | 73 | 49 | 51 | 50 | 58 | 33 | 47 | 29 | 73 |
| C11 | 19 | 28 | 34 | 28 | 48 | 16 | 5 | 1 | 11 | 8 | 11 | 2 | 48 |
| C12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| C13 | 1 | 1 | 1 | 1 | 1 | 30 | 51 | 48 | 51 | 31 | 41 | 27 | 51 |
| C14 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| W01 | 19 | 24 | 27 | 24 | 55 | 45 | 1 | 29 | 28 | 29 | 34 | 24 | 55 |
| W02 | 34 | 34 | 64 | 49 | 68 | 51 | 49 | 48 | 43 | 38 | 40 | 37 | 68 |
| W03 | 2 | 1 | 3 | 3 | 14 | 52 | 49 | 49 | 59 | 40 | 41 | 29 | 59 |
| W04 | 33 | 37 | 46 | 44 | 50 | 55 | 53 | 56 | 49 | 44 | 46 | 39 | 56 |
| W05 | 35 | 33 | 38 | 38 | 52 | 57 | 50 | 42 | 19 | 2 | 48 | 25 | 57 |
| W06 | 1 | 1 | 1 | 1 | 51 | 53 | 43 | 51 | 34 | 31 | 38 | 25 | 53 |
| E02 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 36 | 40 | 32 | 33 | 33 | 40 |
| E03 | 1 | 12 | 9 | 8 | 51 | 62 | 47 | 54 | 60 | 40 | 48 | 35 | 62 |
| E04 | 12 | 24 | 21 | 16 | 33 | 29 | 51 | 45 | 36 | 31 | 40 | 26 | 51 |
| E05 | 36 | 35 | 36 | 39 | 77 | 66 | 51 | 52 | 51 | 51 | 41 | 46 | 77 |
| E06 | 42 | 40 | 44 | 41 | 75 | 61 | 47 | 48 | 52 | 37 | 45 | 38 | 75 |
| S01 | 1 | 1 | 1 | 2 | 33 | 48 | 47 | 47 | 37 | 32 | 45 | 26 | 48 |
| S02 | 27 | 36 | 49 | 34 | 57 | 49 | 40 | 64 | 37 | 31 | 32 | 28 | 64 |
| S03 | 36 | 40 | 41 | 48 | 56 | 58 | 52 | 49 | 60 | 38 | 37 | 29 | 60 |
| S04 | 33 | 42 | 84 | 49 | 53 | 71 | 63 | 58 | 71 | 52 | 44 | 47 | 84 |
| S06 | 33 | 35 | 37 | 39 | 38 | 38 | 38 | 39 | 38 | 32 | 36 | 31 | 39 |

Table 6. Maximum wind speed (kmph) 2011

| Antenna | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C00 | | 1 | 34 | 40 | 42 | 79 | 42 | 56 | 42 | 53 | 33 | 30 | 79 |
| C01 | | 24 | 33 | 34 | 39 | 46 | 37 | 49 | 33 | 44 | 31 | 25 | 49 |
| C02 | | 3 | 12 | 22 | 11 | 40 | 1 | 25 | 40 | 56 | 36 | 28 | 56 |
| C03 | | 1 | 35 | 1 | 1 | 1 | 1 | 48 | 40 | 50 | 33 | 29 | 50 |
| C04 | | 24 | 29 | 37 | 41 | 45 | 39 | 41 | 39 | 42 | 33 | 27 | 45 |
| C05 | | 24 | 33 | 34 | 38 | 64 | 35 | 44 | 34 | 44 | 31 | 30 | 64 |
| C06 | | 26 | 35 | 41 | 47 | 55 | 41 | 51 | 33 | 47 | 31 | 31 | 55 |
| C08 | | 33 | 41 | 37 | 39 | 48 | 1 | 50 | 36 | 46 | 36 | 26 | 50 |
| C09 | | 20 | 26 | 31 | 32 | 66 | 30 | 14 | 18 | 35 | 28 | 27 | 66 |
| C10 | | 37 | 39 | 39 | 45 | 63 | 45 | 54 | 39 | 53 | 33 | 29 | 63 |
| C11 | | 15 | 2 | 14 | 2 | 1 | 1 | 1 | 21 | 70 | 34 | 31 | 70 |
| C12 | | 1 | 1 | 1 | 1 | 41 | 40 | 47 | 40 | 49 | 30 | 28 | 49 |
| C13 | | 29 | 34 | 35 | 39 | 64 | 40 | 48 | 37 | 48 | 32 | 27 | 64 |
| C14 | | 30 | 37 | 39 | 44 | 53 | 44 | 51 | 42 | 50 | 34 | 32 | 53 |
| W01 | | 1 | 1 | 26 | 38 | 51 | 39 | 37 | 34 | 40 | 31 | 26 | 51 |
| W02 | | 38 | 38 | 42 | 50 | 69 | 43 | 48 | 41 | 55 | 36 | 33 | 69 |
| W03 | | 30 | 35 | 40 | 44 | 54 | 44 | 45 | 41 | 44 | 37 | 29 | 54 |
| W04 | | 34 | 42 | 51 | 51 | 54 | 48 | 49 | 46 | 50 | 40 | 38 | 54 |
| W05 | | 32 | 34 | 36 | 40 | 47 | 47 | 40 | 33 | 37 | 33 | 27 | 47 |
| W06 | | 25 | 31 | 36 | 57 | 50 | 47 | 46 | 32 | 25 | 25 | 25 | 57 |
| E02 | | 35 | 30 | 35 | 41 | 48 | 37 | 48 | 39 | 41 | 31 | 29 | 48 |
| E03 | | 31 | 40 | 42 | 46 | 58 | 49 | 60 | 46 | 44 | 38 | 30 | 60 |
| E04 | | 30 | 29 | 35 | 39 | 49 | 38 | 43 | 35 | 50 | 31 | 27 | 50 |
| E05 | | 61 | 55 | 58 | 48 | 55 | 45 | 57 | 47 | 67 | 31 | 27 | 67 |
| E06 | | 56 | 47 | 48 | 40 | 51 | 42 | 47 | 41 | 50 | 33 | 29 | 56 |
| S01 | | 28 | 31 | 36 | 39 | 52 | 44 | 45 | 40 | 40 | 33 | 29 | 52 |
| S02 | | 1 | 1 | 35 | 41 | 56 | 46 | 46 | 43 | 41 | 31 | 28 | 56 |
| S03 | | 33 | 49 | 47 | 53 | 60 | 52 | 56 | 44 | 45 | 36 | 26 | 60 |
| S04 | | 36 | 54 | 55 | 59 | 66 | 62 | 57 | 54 | 47 | 31 | 32 | 66 |
| S06 | | 31 | 37 | 38 | 38 | 39 | 39 | 39 | 38 | 38 | 35 | 29 | 39 |

Table 7. Maximum wind speed (kmph) 2012

| Antenna | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C00 | 33 | 43 | 41 | 37 | 48 | 48 | 50 | 46 | 37 | 32 | 32 | 29 | 50 |
| C01 | 30 | 26 | 37 | 47 | 39 | 37 | 40 | 37 | 29 | 21 | 7 | 3 | 47 |
| C02 | 31 | 30 | 38 | 40 | 44 | 46 | 45 | 39 | 41 | 29 | 28 | 29 | 46 |
| C03 | 29 | 45 | 41 | 44 | 51 | 46 | 48 | 47 | 45 | 52 | 26 | 23 | 52 |
| C04 | 26 | 29 | 39 | 41 | 50 | 42 | 49 | 40 | 35 | 32 | 26 | 24 | 50 |
| C05 | 31 | 27 | 34 | 33 | 40 | 41 | 40 | 44 | 34 | 28 | 23 | 23 | 44 |
| C06 | 27 | 28 | 35 | 37 | 45 | 42 | 47 | 40 | 37 | 28 | 27 | 23 | 47 |
| C08 | 32 | 30 | 36 | 36 | 47 | 46 | 44 | 46 | 35 | 35 | 30 | 25 | 47 |
| C09 | 26 | 29 | 35 | 36 | 44 | 43 | 42 | 41 | 35 | 29 | 27 | 26 | 44 |
| C10 | 34 | 31 | 40 | 38 | 37 | 49 | 47 | 46 | 34 | 36 | 29 | 28 | 49 |
| C11 | 32 | 29 | 47 | 38 | 45 | 43 | 42 | 43 | 33 | 35 | 29 | 26 | 47 |
| C12 | 27 | 28 | 35 | 38 | 43 | 44 | 47 | 43 | 39 | 32 | 25 | 26 | 47 |
| C13 | 27 | 29 | 34 | 35 | 46 | 44 | 42 | 42 | 39 | 32 | 27 | 26 | 46 |
| C14 | 31 | 33 | 40 | 43 | 47 | 53 | 45 | 39 | 42 | 35 | 29 | 28 | 53 |
| W01 | 29 | 27 | 34 | 38 | 47 | 43 | 45 | 41 | 33 | 34 | 26 | 25 | 47 |
| W02 | 42 | 38 | 39 | 44 | 50 | 50 | 53 | 46 | 35 | 49 | 34 | 40 | 53 |
| W03 | 32 | 37 | 36 | 48 | 56 | 1 | 54 | 45 | 36 | 43 | 31 | 30 | 56 |
| W04 | 33 | 41 | 41 | 41 | 47 | 55 | 65 | 51 | 40 | 44 | 32 | 33 | 65 |
| W05 | 27 | 30 | 34 | 38 | 42 | 48 | 50 | 49 | 34 | 42 | 20 | 24 | 50 |
| W06 | 30 | 32 | 40 | 40 | 48 | 55 | 54 | 56 | 35 | 52 | 27 | 26 | 56 |
| E02 | 33 | 28 | 37 | 35 | 39 | 42 | 53 | 42 | 43 | 34 | 25 | 23 | 53 |
| E03 | 36 | 34 | 39 | 40 | 47 | 59 | 57 | 47 | 42 | 35 | 30 | 29 | 59 |
| E04 | 27 | 38 | 30 | 40 | 42 | 43 | 49 | 40 | 36 | 32 | 29 | 26 | 49 |
| E05 | 32 | 32 | 33 | 39 | 48 | 45 | 46 | 43 | 41 | 37 | 28 | 32 | 48 |
| E06 | 46 | 49 | 46 | 42 | 56 | 49 | 48 | 41 | 38 | 41 | 32 | 33 | 56 |
| S01 | 31 | 28 | 36 | 36 | 48 | 52 | 43 | 44 | 37 | 40 | 27 | 26 | 52 |
| S02 | 28 | 30 | 33 | 40 | 46 | 49 | 45 | 45 | 35 | 38 | 28 | 29 | 49 |
| S03 | 38 | 31 | 45 | 48 | 54 | 53 | 56 | 54 | 41 | 43 | 29 | 30 | 56 |
| S04 | 37 | 40 | 41 | 40 | 54 | 59 | 66 | 63 | 51 | 75 | 35 | 43 | 75 |
| S06 | 36 | 32 | 33 | 30 | 40 | 49 | 65 | 45 | 39 | 32 | 32 | 32 | 65 |

Table 8. Average wind speed (kmph) 2009

| Antenna | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C00 | | | | | | | | .1 | .1 | .1 | .0 | .1 | .1 |
| C01 | | | | | | | | 8.9 | 3.6 | 2.2 | .7 | .0 | 2.6 |
| C02 | | | | | | | | 5.6 | 2.5 | .5 | .2 | .0 | 1.5 |
| C03 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| C04 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| C05 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| C06 | | | | | | | | 14.5 | 8.8 | 6.6 | 7.2 | 3.5 | 7.6 |
| C08 | | | | | | | | 16.3 | 8.6 | 2.3 | 6.0 | 3.6 | 6.8 |
| C09 | | | | | | | | 1.8 | 1.9 | 1.0 | .9 | .5 | 1.1 |
| C10 | | | | | | | | 11.6 | 7.6 | 6.2 | 6.9 | 6.1 | 7.5 |
| C11 | | | | | | | | 5.1 | 2.6 | .3 | 1.1 | .1 | 1.6 |
| C12 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| C13 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| C14 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| W01 | | | | | | | | 7.9 | 6.6 | 3.7 | 3.6 | 3.5 | 4.8 |
| W02 | | | | | | | | 16.9 | 11.8 | 9.5 | 9.6 | 7.3 | 10.6 |
| W03 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| W04 | | | | | | | | 18.8 | 14.1 | 8.0 | 8.9 | 7.2 | 10.8 |
| W05 | | | | | | | | 15.9 | 11.8 | 4.9 | 3.6 | .8 | 6.5 |
| W06 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| E02 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| E03 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| E04 | | | | | | | | 6.0 | 3.2 | .7 | .9 | .5 | 2.0 |
| E05 | | | | | | | | 14.5 | 9.3 | 8.9 | 8.9 | 7.4 | 9.5 |
| E06 | | | | | | | | 13.1 | 7.4 | 9.6 | 10.5 | 8.8 | 9.8 |
| S01 | | | | | | | | .0 | .0 | .0 | .0 | .0 | .0 |
| S02 | | | | | | | | 13.4 | 7.3 | 3.3 | 4.3 | 2.5 | 5.6 |
| S03 | | | | | | | | 17.4 | 10.6 | 5.7 | 6.2 | 4.7 | 8.3 |
| S04 | | | | | | | | 20.6 | 12.0 | 6.9 | 8.6 | 7.2 | 10.4 |
| S06 | | | | | | | | 18.6 | 12.4 | 6.3 | 6.6 | 6.0 | 9.3 |

Table 9. Average Wind speed (kmph) 2010

| Antenna | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C00 | .4 | .0 | .3 | .5 | .2 | .2 | .0 | .0 | .1 | .0 | .0 | .4 | .2 |
| C01 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | 5.2 | 5.5 | .9 |
| C02 | .0 | .1 | .2 | .4 | .9 | .3 | .0 | .5 | .6 | .4 | .4 | .1 | .3 |
| C03 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| C04 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| C05 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | 6.8 | 8.5 | 7.4 | 6.9 | 6.2 | 3.0 |
| C06 | 3.3 | .6 | 2.1 | 4.2 | 5.8 | 3.7 | 9.0 | 12.7 | 10.9 | 8.5 | 7.9 | 7.0 | 6.3 |
| C08 | 4.8 | 5.5 | 4.9 | 8.7 | 8.1 | 6.5 | 2.8 | 1.1 | .5 | .1 | .1 | 1.6 | 3.7 |
| C09 | .6 | .8 | 1.5 | 2.4 | 4.6 | .1 | .0 | 3.0 | 7.7 | 6.3 | 5.9 | 5.3 | 3.2 |
| C10 | 7.0 | 8.4 | 9.6 | 12.0 | 15.6 | 12.7 | 13.3 | 11.4 | 9.8 | 8.4 | 7.6 | 7.1 | 10.2 |
| C11 | .1 | .2 | .8 | .9 | 1.6 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .3 |
| C12 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| C13 | .0 | .0 | .0 | .0 | .0 | .4 | 13.3 | 11.2 | 9.1 | 6.0 | 5.0 | 2.1 | 3.9 |
| C14 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .0 |
| W01 | 1.1 | .6 | 1.9 | 2.4 | 5.3 | 1.4 | .0 | .2 | .2 | .4 | .5 | .1 | 1.2 |
| W02 | 8.1 | 9.2 | 10.6 | 13.4 | 18.0 | 13.5 | 14.4 | 13.7 | 11.3 | 9.5 | 8.6 | 7.8 | 11.5 |
| W03 | .0 | .0 | .0 | .0 | .0 | 9.7 | 14.4 | 13.9 | 10.1 | 8.9 | 8.1 | 7.3 | 6.0 |
| W04 | 7.5 | 9.1 | 10.5 | 13.2 | 19.0 | 11.2 | 16.2 | 15.5 | 12.5 | 9.8 | 8.8 | 7.8 | 11.8 |
| W05 | .8 | 2.0 | 3.7 | 7.6 | 14.8 | 7.3 | 8.0 | 1.3 | .0 | .0 | 5.8 | 5.9 | 4.8 |
| W06 | .0 | .0 | .0 | .0 | 11.0 | 7.7 | 5.2 | 4.8 | 2.8 | 1.7 | .8 | .3 | 2.9 |
| E02 | .0 | .0 | .0 | .0 | .0 | .0 | .0 | 6.0 | 9.7 | 7.3 | 7.0 | 6.5 | 3.1 |
| E03 | .0 | .0 | .0 | .0 | 5.4 | 12.8 | 9.9 | 8.3 | 7.4 | 4.0 | 3.9 | 2.2 | 4.5 |
| E04 | .4 | .3 | .1 | .0 | .0 | 2.6 | 10.6 | 10.0 | 8.2 | 7.4 | 6.9 | 6.3 | 4.4 |
| E05 | 7.3 | 8.7 | 9.8 | 11.7 | 17.4 | 12.4 | 12.5 | 12.0 | 10.1 | 9.4 | 8.3 | 12.4 | 11.0 |
| E06 | 10.4 | 9.6 | 10.4 | 13.0 | 15.7 | 11.1 | 10.5 | 10.8 | 9.5 | 8.9 | 9.9 | 8.6 | 10.7 |
| S01 | .0 | .0 | .0 | .0 | .0 | 6.9 | 12.7 | 11.5 | 9.2 | 7.1 | 7.2 | 6.2 | 5.1 |
| S02 | 2.6 | 3.0 | 4.5 | 5.0 | 7.3 | 3.4 | 3.4 | 6.4 | 3.1 | 1.6 | 1.5 | .5 | 3.5 |
| S03 | 4.9 | 6.0 | 7.2 | 9.0 | 14.4 | 12.0 | 14.8 | 13.1 | 10.5 | 6.6 | 6.4 | 5.2 | 9.2 |
| S04 | 7.5 | 8.8 | 8.9 | 11.4 | 18.1 | 14.6 | 17.0 | 16.4 | 12.7 | 9.2 | 8.6 | 7.4 | 11.7 |
| S06 | 6.0 | 6.7 | 6.7 | 8.4 | 14.9 | 13.0 | 17.2 | 15.4 | 10.0 | 5.9 | 6.8 | 6.2 | 9.8 |

Table 10. Average wind speed (kmph) 2011

| Antenna | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C00 | | .0 | 1.7 | 10.9 | 15.9 | 17.8 | 14.6 | 14.8 | 12.2 | 8.5 | 8.0 | 6.4 | 10.1 |
| C01 | | 6.2 | 6.8 | 8.6 | 12.7 | 13.9 | 11.3 | 12.7 | 9.5 | 6.2 | 6.6 | 5.3 | 9.1 |
| C02 | | .0 | .2 | .3 | .8 | 3.0 | .0 | .2 | 11.7 | 5.9 | 8.3 | 6.5 | 3.2 |
| C03 | | .0 | .5 | .0 | .0 | .0 | .0 | 8.8 | 11.6 | 7.8 | 7.8 | 6.2 | 3.8 |
| C04 | | 3.2 | 2.6 | 6.8 | 13.2 | 14.4 | 12.0 | 12.8 | 8.3 | 5.7 | 6.9 | 5.5 | 8.4 |
| C05 | | 7.3 | 7.7 | 4.3 | 13.0 | 14.2 | 11.5 | 11.7 | 9.1 | 5.7 | 6.6 | 5.5 | 8.8 |
| C06 | | 8.0 | 8.0 | 9.7 | 15.7 | 16.5 | 12.6 | 10.2 | 2.3 | 7.0 | 7.2 | 5.8 | 9.5 |
| C08 | | 7.7 | 8.0 | 9.2 | 14.4 | 9.8 | .0 | 11.7 | 10.8 | 7.5 | 7.4 | 5.8 | 8.4 |
| C09 | | 5.9 | 5.7 | 7.2 | 11.9 | 13.2 | 5.0 | .0 | .1 | 5.5 | 7.0 | 5.6 | 6.2 |
| C10 | | 8.3 | 8.9 | 10.3 | 16.0 | 17.5 | 14.4 | 14.6 | 11.2 | 5.7 | 7.8 | 6.5 | 11.0 |
| C11 | | .0 | .0 | .0 | .0 | .0 | .0 | .0 | .1 | 5.2 | 7.0 | 5.7 | 1.7 |
| C12 | | .0 | .0 | .0 | .0 | 4.5 | 13.2 | 12.4 | 10.6 | 5.1 | 7.4 | 5.8 | 5.3 |
| C13 | | .7 | 1.2 | 2.6 | 7.4 | 13.8 | 7.2 | 7.8 | 4.8 | 7.3 | 7.5 | 5.7 | 6.1 |
| C14 | | 8.2 | 8.9 | 10.3 | 15.8 | 17.7 | 14.6 | 14.7 | 10.3 | 3.4 | 5.0 | 6.7 | 10.5 |
| W01 | | .0 | .0 | .1 | 2.1 | 6.5 | 1.5 | .1 | 3.2 | 8.2 | 7.8 | 6.0 | 3.3 |
| W02 | | 9.3 | 10.0 | 11.1 | 17.9 | 18.0 | 15.3 | 15.4 | 11.7 | 9.4 | 9.9 | 7.3 | 12.3 |
| W03 | | 8.4 | 8.6 | 10.3 | 16.3 | 15.8 | 14.1 | 14.6 | 12.2 | 8.3 | 9.0 | 6.7 | 11.3 |
| W04 | | 9.3 | 9.8 | 11.9 | 19.1 | 18.9 | 16.3 | 16.2 | 14.2 | 9.3 | 9.0 | 7.0 | 12.8 |
| W05 | | 7.3 | 6.6 | 9.3 | 16.8 | 14.8 | 13.2 | 12.7 | 10.7 | 7.0 | 6.8 | 5.4 | 10.1 |
| W06 | | .9 | 2.3 | 4.7 | 14.7 | 12.1 | 8.0 | 4.9 | 2.1 | .5 | .2 | 2.4 | 4.9 |
| E02 | | 7.6 | 8.6 | 9.7 | 13.2 | 15.6 | 13.5 | 13.3 | 10.7 | 7.4 | 6.8 | 5.5 | 10.2 |
| E03 | | 2.9 | 2.6 | 3.9 | 8.2 | 10.4 | 6.8 | 7.6 | 4.8 | 7.8 | 7.4 | 5.9 | 6.3 |
| E04 | | 6.4 | 4.9 | 9.3 | 12.7 | 14.0 | 11.6 | 11.5 | 9.5 | 7.1 | 7.6 | 5.5 | 9.1 |
| E05 | | 15.0 | 15.9 | 14.6 | 15.4 | 16.5 | 13.3 | 13.0 | 11.0 | 9.0 | 9.7 | 7.2 | 12.7 |
| E06 | | 10.0 | 10.2 | 9.8 | 13.7 | 14.1 | 12.0 | 11.2 | 10.1 | 9.2 | 10.8 | 7.7 | 10.8 |
| S01 | | 7.2 | 6.8 | 9.0 | 13.8 | 16.0 | 13.8 | 13.0 | 7.9 | 4.4 | 8.2 | 5.9 | 9.7 |
| S02 | | .0 | .0 | 7.7 | 14.4 | 15.9 | 15.2 | 14.7 | 11.7 | 7.3 | 6.1 | 5.6 | 9.0 |
| S03 | | 6.1 | 6.5 | 9.2 | 13.9 | 20.5 | 17.7 | 16.5 | 13.2 | 8.1 | 7.6 | 4.3 | 11.3 |
| S04 | | 9.0 | 9.3 | 10.5 | 15.0 | 22.2 | 19.3 | 18.4 | 15.4 | 6.6 | 5.6 | 3.7 | 12.2 |
| S06 | | 7.0 | 6.2 | 8.8 | 12.7 | 19.3 | 18.4 | 16.9 | 14.9 | 5.9 | 6.7 | 5.4 | 11.1 |

Table 11. Average wind speed (kmph) 2012

| Antenna | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C00 | 8.6 | 6.4 | 9.6 | 10.3 | 16.0 | 17.1 | 16.0 | 14.6 | 9.2 | .3 | 3.5 | 7.0 | 9.9 |
| C01 | 7.1 | 5.2 | 7.8 | 7.7 | 12.1 | 13.3 | 12.0 | 10.9 | 8.4 | .2 | .0 | .0 | 7.1 |
| C02 | 8.4 | 6.3 | 7.5 | 8.7 | 14.9 | 16.9 | 13.0 | 12.4 | 8.5 | 5.9 | 6.6 | 6.2 | 9.6 |
| C03 | 8.0 | 6.0 | 9.1 | 10.4 | 16.1 | 16.8 | 14.8 | 14.2 | 6.6 | 5.0 | 5.5 | 5.6 | 9.8 |
| C04 | 7.1 | 5.3 | 8.0 | 9.3 | 14.6 | 15.2 | 13.9 | 13.0 | 9.6 | 5.4 | 6.3 | 6.1 | 9.5 |
| C05 | 7.1 | 5.2 | 7.3 | 8.3 | 13.1 | 14.9 | 13.5 | 12.3 | 8.0 | 4.8 | 5.5 | 5.1 | 8.8 |
| C06 | 7.3 | 5.5 | 8.1 | 9.3 | 14.1 | 15.2 | 13.9 | 13.0 | 9.5 | 6.0 | 6.7 | 5.8 | 9.5 |
| C08 | 7.5 | 5.5 | 7.9 | 6.9 | 14.4 | 15.8 | 14.9 | 13.7 | 10.0 | 5.8 | 6.4 | 5.5 | 9.6 |
| C09 | 7.1 | 5.5 | 8.1 | 9.2 | 14.1 | 15.4 | 14.1 | 13.2 | 9.4 | 5.5 | 6.6 | 5.6 | 9.5 |
| C10 | 7.9 | 5.6 | 9.0 | 5.6 | 2.0 | 12.1 | 14.8 | 13.4 | 9.4 | 5.9 | 7.3 | 7.1 | 8.4 |
| C11 | 6.5 | 5.3 | 7.9 | 8.8 | 14.8 | 15.6 | 14.5 | 13.6 | 9.5 | 6.1 | 6.8 | 6.0 | 9.6 |
| C12 | 7.2 | 5.4 | 8.1 | 9.3 | 14.5 | 15.8 | 14.6 | 13.5 | 9.9 | 6.4 | 6.6 | 6.2 | 9.8 |
| C13 | 6.9 | 5.2 | 8.0 | 8.9 | 14.6 | 15.9 | 15.0 | 14.0 | 9.7 | 6.5 | 6.5 | 6.3 | 9.8 |
| C14 | 8.2 | 6.2 | 8.7 | 8.8 | 16.5 | 18.1 | 4.2 | 4.8 | 10.5 | 7.3 | 7.7 | 7.3 | 9.0 |
| W01 | 8.0 | 5.8 | 5.4 | 9.3 | 15.6 | 15.4 | 14.3 | 13.3 | 9.9 | 6.4 | 7.2 | 7.1 | 9.8 |
| W02 | 9.0 | 6.7 | 10.0 | 11.2 | 17.9 | 17.5 | 13.9 | 15.0 | 9.4 | 7.0 | 8.7 | 7.5 | 11.2 |
| W03 | 8.1 | 5.4 | 7.1 | 6.7 | 1.1 | .0 | 12.7 | 13.8 | 8.0 | 4.7 | 6.3 | 4.7 | 6.6 |
| W04 | 9.0 | 6.6 | 10.1 | 11.4 | 19.4 | 20.1 | 17.2 | 16.5 | 11.8 | 7.5 | 7.9 | 7.6 | 12.1 |
| W05 | 7.2 | 5.3 | 7.1 | 9.3 | 18.4 | 15.7 | 14.2 | 15.4 | 8.6 | 5.1 | 3.7 | 5.5 | 9.7 |
| W06 | 5.1 | 4.8 | 8.0 | 10.4 | 20.1 | 19.1 | 17.2 | 16.1 | 9.9 | 5.2 | 5.6 | 5.4 | 10.6 |
| E02 | 7.4 | 5.5 | 8.0 | 9.1 | 14.8 | 15.5 | 13.7 | 13.4 | 9.9 | 5.0 | 4.7 | 4.6 | 9.3 |
| E03 | 7.5 | 5.8 | 7.9 | 10.1 | 16.5 | 16.9 | 13.8 | 14.6 | 8.9 | 5.2 | 6.5 | 6.5 | 10.0 |
| E04 | 6.9 | 5.3 | 8.0 | 8.2 | 13.8 | 13.9 | 12.0 | 11.6 | 6.3 | 4.4 | 5.7 | 6.1 | 8.5 |
| E05 | 9.1 | 6.8 | 10.3 | 11.4 | 15.6 | 14.9 | 12.8 | 12.5 | 8.9 | 8.2 | 8.4 | 7.1 | 10.5 |
| E06 | 9.8 | 7.5 | 10.5 | 10.5 | 15.0 | 14.4 | 11.9 | 12.3 | 7.7 | 8.4 | 8.5 | 9.1 | 10.5 |
| S01 | 6.8 | 5.2 | 6.5 | 6.2 | 12.0 | 15.0 | 16.4 | 12.7 | 10.4 | 6.5 | 6.5 | 1.9 | 8.9 |
| S02 | 6.9 | 5.0 | 7.8 | 9.3 | 15.0 | 17.3 | 17.0 | 16.3 | 10.4 | 6.8 | 6.3 | 6.1 | 10.4 |
| S03 | 4.8 | 4.7 | 7.8 | 9.9 | 15.4 | 20.7 | 20.8 | 19.3 | 11.6 | 6.9 | 7.0 | 6.7 | 11.3 |
| S04 | 5.8 | 6.2 | 8.5 | 9.0 | 18.0 | 20.2 | 21.5 | 20.9 | 13.7 | 7.9 | 7.9 | 7.6 | 12.3 |
| S06 | 6.4 | 4.1 | 3.7 | 3.3 | 8.5 | 17.8 | 19.3 | 17.4 | 7.0 | 3.2 | 5.7 | 6.2 | 8.6 |