

8 Working Paper

Air Quality Monitoring

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Air Quality Monitoring

Sapphire to Woolgoolga Pacific Highway Upgrade

Roads & Traffic Authority

*9 August 2007
Reference 1093.28/
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Appendix A Environmental Report – Ambient Air Monitoring Sapphire to Woolgoolga

1. Introduction

As part of the Environmental Assessment process for the proposed upgrade of the Pacific Highway between Sapphire and Woolgoolga (the Proposal), an air quality monitoring station was established at Korora. Air quality monitoring has been undertaken to provide air quality data for a typical section of dual carriageway on the Pacific Highway in or adjacent to a regional centre. The monitoring has been undertaken more to provide additional information to the community regarding air quality rather than being motivated by standard assessment practice or by apparent air quality issues in the area.

The monitoring station was located approximately 0.5 km from the southern extent of the Proposal, on the northern side of the Korora Rural Fire Service shed, approximately 20m from the western edge of the existing four lane dual carriageway Pacific Highway (refer **Figure 1**). To the west of the monitoring station site is the Korora Nature Reserve, while to the east is the Pacific Highway, Korora Public School and adjacent residential areas.

The sign posted speed limit for the Pacific Highway adjacent to the monitoring site is 100 km/h. While the 2006 annual average daily traffic volume on this section of the highway is approximately 20,500 vehicles per day (veh/day), the period of air quality monitoring at Korora included the 2005/06 Christmas and New Year holidays when traffic volumes were substantially higher than annual average daily traffic volumes. The monitoring equipment is located at a point on the highway where there is a climbing gradient of 5.2% from north to south (ie southbound lanes are climbing).

The Korora monitoring station was established to provide data on air quality adjacent to the Pacific Highway. The air quality monitoring site at Korora is understood to be the first such installation for air quality data collection for a Pacific Highway upgrade project. The monitoring station was equipped to monitor the following air quality and meteorological parameters:

- Carbon monoxide (CO)
- Oxides of Nitrogen (NO_x)
- Nitrogen Dioxide (NO₂)
- Nitrogen monoxide (NO)
- Particulate matter (fine particles 10 micrometres (µm) or less in size) (PM₁₀)
- Particulate matter (fine particles 2.5 micrometres (µm) or less in size) (PM_{2.5})
- Wind speed
- Wind direction
- Air temperature
- Relative humidity

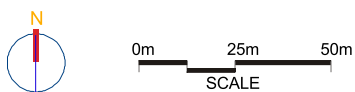
Due to the proximity of the monitoring site to the Pacific Highway, the concentrations of air quality parameters measured include traffic emissions. Therefore, the concentrations detected are likely to be higher than the background levels for the local area and will give a conservative indication of the air quality experienced on the NSW north coast.

Monitoring was undertaken at the site between 14 October 2005 and 31 January 2006. Specific details of the monitoring station are provided in Appendix A.



Legend

- ★ Air quality monitoring site



Source: Aerial photography (Dwyer & Assoc. May 2005)

Figure 1

Air Quality Monitoring Site

2. Summary of Results

This section provides a brief summary of the results of the data collected over the monitoring period, with the full results presented in Appendix A.

In setting air quality goals for NSW, the Department of Environment and Climate Change (DECC), incorporating the Environment Protection Authority (EPA), has looked to the air quality standards outlined by the *National Environment Protection Council of Australia*, which are part of the National Environment Protection Measures (NEPMs). Three of the parameters measured at the Korora monitoring site are outlined in the NEPM for ambient air quality. These parameters are identified in Table 1 on the following page, as is an advisory reporting standard for PM_{2.5}. The DECC's assessment goals are numerically equivalent to the NEPM goals, but do not allow for any exceedances.

There are no NEPM goals for the parameters NO and NO_x. Key results for the Korora monitoring station were as follows:

- The maximum 8-hour average CO concentration was 0.3 mg/m³, compared with the NEPM goal of 10 mg/m³. The 8-hour average CO data is shown in Section 2.5 of Appendix A.
- The maximum 1-hour average NO₂ concentration was 69.6 µg/m³ compared with the NEPM goal of 246 µg/m³. The 1-hour average NO₂ data is shown in Section 2.6 of Appendix A.
- The maximum 24-hour average PM₁₀ and PM_{2.5} concentrations were 37.8 µg/m³ and 15.4 µg/m³ compared with the NEPM goals of 50 µg/m³ and 25 µg/m³ respectively. 24-hour average PM₁₀ and PM_{2.5} data is shown in Section 3.5 and Section 3.6 of Appendix A respectively.

Table 1: National Environment Protection Measure for Ambient Air Quality

Pollutant	Averaging Period	NEPM Goals		Korora Monitoring Results		
		Maximum Concentration	Goal within 10 years (Maximum Allowable Exceedence)	Maximum Recorded Concentration	Recorded 90 th percentile Concentration	Average Recorded Concentration
National Standards and Goals for Ambient Air Quality						
CO	8 hrs	9.0 ppm (10 mg/m ³)	1 day a year	0.2 ppm (0.3 mg/m ³)	0.07 ppm (0.08 mg/m ³)	0.03 ppm (0.04 mg/m ³)
NO ₂	1 hr	0.12 ppm (246 µg/m ³)	1 day a year	0.037 ppm (69.6 µg/m ³)	0.010 ppm (18.81 µg/m ³)	0.004 ppm (9.2 µg/m ³)
Particles as PM ₁₀	1 day	50 µg/m ³	5 days a year	37.8 µg/m ³	29.8 µg/m ³	20.3 µg/m ³
Advisory Reporting Goals						
Particles as PM _{2.5}	1 day	25 µg/m ³	Goal is to gather sufficient data nationally to facilitate a review of the goal	15.4 µg/m ³	10.8 µg/m ³	7.7 µg/m ³

3. Conclusions

The purpose of the monitoring station at Korora was to establish the level of current emissions due to traffic on the Pacific Highway to ensure that air quality close to the road is satisfactory and that the Proposal would not have a significant impact on ambient air quality.

The monitoring station was set up to monitor a likely “worst case” situation, with the station being close (20m) to the western edge of a four lane section of highway with a significant climbing grade (5.2 percent) and was conducted over the peak traffic (November, December, January) Christmas holiday period.

The results of the Korora monitoring station indicate that immediately adjacent to the highway, peak readings, and the commonly used 90th percentile readings, of the regulated emissions (CO, NO₂ and PM₁₀) were all considerably less than the limits specified in the National Environment Protection Measure. Consequently, the recorded air quality at the Korora monitoring station was considerably better than the air quality goals specified in the National Environment Protection Measure.

The non-regulated PM 2.5 was also measured. The levels of PM 2.5 peaked at 15.4 ug/m³ against a possible National Environment Protection Measure goal of 25ug/m³. The 90th percentile reading was 10.8 µg/m³.

The highest emission readings generally occurred during holiday periods or at night. On occasions these higher readings could have been due to traffic on the dirt access track next to the monitoring station, activity around the Rural Fire Service shed or to bush fires.

The National Environment Protection Measure goals are actually ambient air quality goals that are intended to be applied at locations away from the influence of significant emission sources. Dispersion would reduce the pollutant levels significantly as the distance from the road increases. For example, levels 100 metres from the road would be closer to ambient levels and would be around half of the levels recorded at the monitoring station.

As the Proposal is predicted to carry less vehicle traffic than at Korora (volumes reduce with distance north from Coffs Harbour), and have a lower grade than the Korora stretch of highway (maximum grade to be 4 percent), it is anticipated that during operation, the Proposal would also comply with the National Environment Protection Measure goals.

Construction air quality impacts are predictable and can be adequately addressed through standard good practice mitigation measures which would be outlined in the Air Quality Management Plan which would form part of the Construction Environmental Management Plan (CEMP) for the Proposal.

Appendix A

Environmental Report – Ambient Air Monitoring Sapphire to
Woolgoolga

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**Korora Air Quality Monitoring Paper
Sapphire to Woolgoolga Pacific Highway
Upgrade
NSW Roads and Traffic Authority**

7 March 2007
Reference 109328GE



Revision 2



NATA Accredited Laboratory - Connell Wagner
Number: 4669

The following parameters are included in the scope of accreditation.

Air monitoring parameters – carbon monoxide; light scattering; nitrogen oxides; ozone; particulates-
PM₁₀, total suspended; sulfur dioxide

Meteorological parameters and Radiation – global, net; rainfall; relative humidity; temperature; wind
direction; wind speed – horizontal.

Prepared by:

A handwritten signature in black ink, appearing to read "MM", followed by a period.

Michelle Manditch.

Checked by:

A handwritten signature in black ink, appearing to read "M. Stewartson", followed by a period.

Maurice Stewartson

NATA Signatory/ Air Monitoring:

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Maurice Stewartson.

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1. Introduction

1.1 Korora

Technical features of the Monitoring Station include:

- Availability is total instrument availability less time taken by nightly zero/span checks of 1 hour and any other calibrations or maintenance.
- All data is in Eastern Standard Time.
- Sample head height is 4.5 meters.
- Anemometer mast height is 10 meters.
- The site is situated in a urban region, grid reference (MGA Zone 56):

Easting – 512570

Northing – 6653105

This site meets:

AM-3: AS3580.2.1 and 2.2 Preparation of reference test atmospheres

AM-6: AS3580.7.1 Determination of carbon monoxide - Direct reading instrument method.

AM-12: AS3580.5.1 Determination of oxides of nitrogen - Chemiluminescence method.

AM-1: AS 2922 Ambient Air-Guide for the siting of sampling units.

AM-4 USEPA (1987) EPA 450/4-87-013 On-site meteorological program guidance for regulatory modelling applications.

2. Carbon Monoxide and Oxides of Nitrogen Summaries

2.1 Korora October 2005 Summary

Sapphire Woolgoolga: Korora

October 2005

	CO ppm	NO ₂ ppm	NO _x ppm	NO ppm
% Sampling Time	26	26		
Daily 1 Hour Averages				
Monthly Average	0.024	0.005	0.007	0.002
90 th Percentile Value:	0.055	0.010	0.016	0.007
Max Value 1 Hour:	0.323	0.029	0.059	0.042
Min Value 1 Hour:	0.002	0.001	0.000	0.000
Max Value 24 Hour:		0.008	0.013	0.005
NEPM Goals				
1 Hour Exceedances:		0		
8 Hour Exceedances:	0			
% of Time Exceeded:		NIL		
No. of Days Exceeded:		NIL		

NEPM Goals
 Nitrogen Dioxide (NO₂)
 1 hour 0.12 ppm
 1 year 0.03 ppm
 Carbon monoxide (CO)
 8 hours 9.0 ppm

2.2 Korora November 2005 Summary

Sapphire Woolgoolga: Korora

November 2005

	CO ppm	NO ₂ ppm	NO _x ppm	NO ppm
% Sampling Time	96	96		
Daily 1 Hour Averages				
Monthly Average	0.025	0.004	0.007	0.003
90 th Percentile Value:	0.054	0.009	0.016	0.007
Max Value 1 Hour:	0.372	0.017	0.041	0.029
Min Value 1 Hour:	0.001	0.000	0.000	0.000
Max Value 24 Hour:		0.008	0.015	0.007
NEPM Goals				
1 Hour Exceedances:		0		
8 Hour Exceedances:	0			
% of Time Exceeded:		NIL		
No. of Days Exceeded:		NIL		

NEPM Goals
 Nitrogen Dioxide (NO₂)
 1 hour 0.12 ppm
 1 year 0.03 ppm
 Carbon monoxide (CO)
 8 hours 9.0 ppm

2.3 Korora December 2005 Summary

Sapphire Woolgoolga: Korora

December 2005

	CO ppm	NO ₂ ppm	NOx ppm	NO ppm
% Sampling Time	96	96		
Daily 1 Hour Averages				
Monthly Average	0.037	0.005	0.007	0.002
90 th Percentile Value:	0.083	0.010	0.016	0.007
Max Value 1 Hour:	0.500	0.037	0.055	0.031
Min Value 1 Hour:	0.002	0.000	0.000	0.000
Max Value 24 Hour:		0.010	0.012	0.004
NEPM Goals				
1 Hour Exceedances:		0		
8 Hour Exceedances:	0			
% of Time Exceeded:		NIL		
No. of Days Exceeded:		NIL		

NEPM Goals
 Nitrogen Dioxide (NO₂)
 1 hour 0.12 ppm
 1 year 0.03 ppm
 Carbon monoxide (CO)
 8 hours 9.0 ppm

2.4 Korora January 2006 Summary

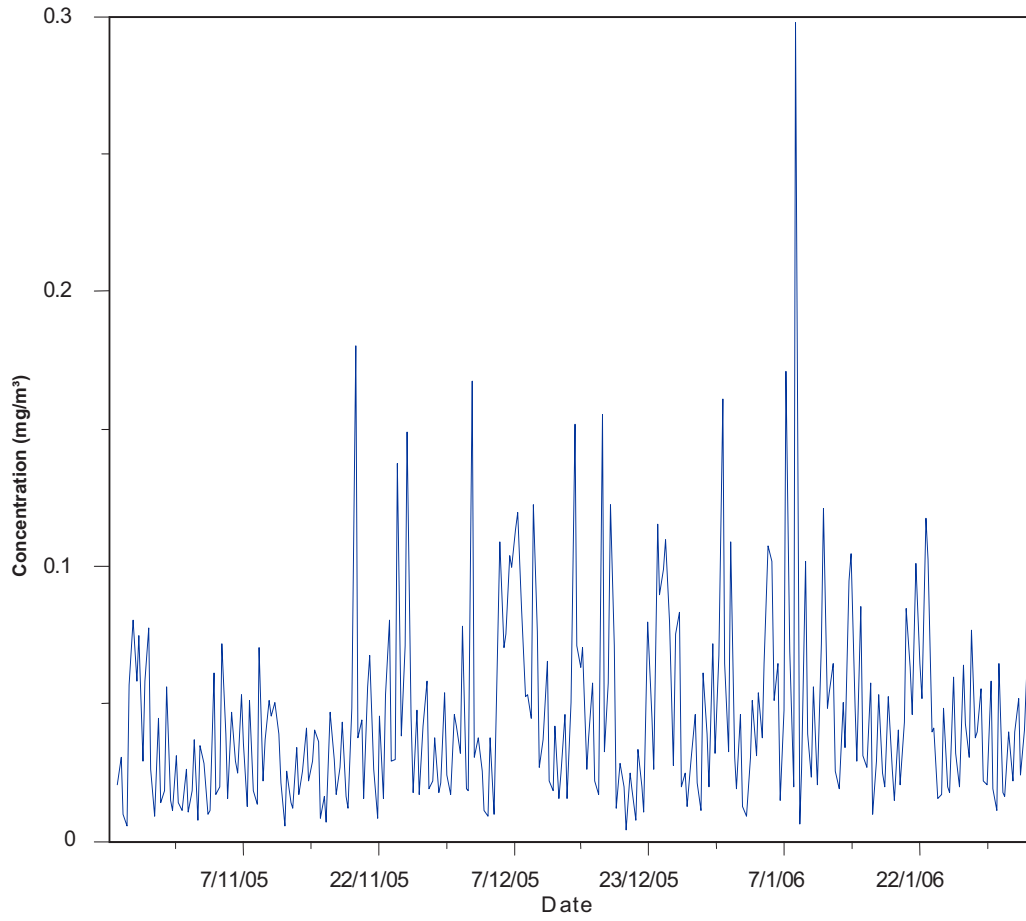
Sapphire Woolgoolga: Korora

January 2006

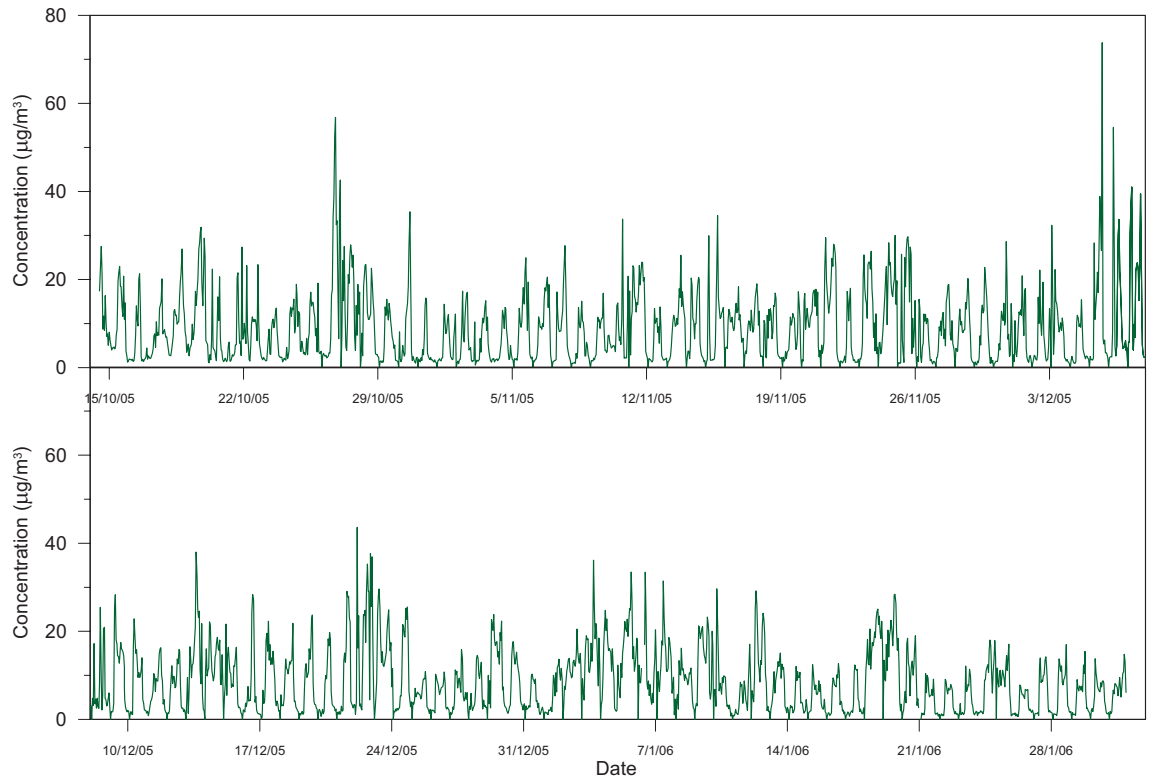
	CO ppm	NO ₂ ppm	NO _x ppm	NO ppm
% Sampling Time	95	95		
Daily 1 Hour Averages				
Monthly Average	0.035	0.004	0.008	0.004
90 th Percentile Value:	0.069	0.009	0.018	0.010
Max Value 1 Hour:	1.003	0.017	0.044	0.034
Min Value 1 Hour:	0.002	0.000	0.000	0.000
Max Value 24 Hour:		0.009	0.020	0.011
NEPM Goals				
1 Hour Exceedances:		0		
8 Hour Exceedances:	0			
% of Time Exceeded:		NIL		
No. of Days Exceeded:		NIL		

NEPM Goals
 Nitrogen Dioxide (NO₂)
 1 hour 0.12 ppm
 1 year 0.03 ppm
 Carbon monoxide (CO)
 8 hours 9.0 ppm

2.5 8-hour average CO concentrations October 2005 to January 2006



2.6 1-hour average NO₂ concentrations October 2005 to January 2006



3. PM10 and PM2.5 monthly summary

3.1 October 2005

Date	Wind Speed m/s	Wind Direction deg	Sigma Theta deg	PM10 µg/m ³	PM2.5 µg/m ³
1/10/2005					
2/10/2005					
3/10/2005					
4/10/2005					
5/10/2005					
6/10/2005					
7/10/2005					
8/10/2005					
9/10/2005					
10/10/2005					
11/10/2005					
12/10/2005					
13/10/2005					
14/10/2005					
15/10/2005					
16/10/2005					
17/10/2005					
18/10/2005					
19/10/2005					
20/10/2005					
21/10/2005					
22/10/2005					
23/10/2005					
24/10/2005					
25/10/2005					
26/10/2005	0.9	324	34	23	10
27/10/2005	0.3	349	42	23	10
28/10/2005	0.4	135	41	27	10
29/10/2005	1.4	22	27	21	8
30/10/2005	0.6	358	44	19	7
31/10/2005	0.6	334	35	15	5

3.2 November 2005

Date	Wind Speed m/s	Wind Direction deg	Sigma Theta deg	PM10 $\mu\text{g}/\text{m}^3$	PM2.5 $\mu\text{g}/\text{m}^3$
1/11/2005	0.9	15	33	17	6
2/11/2005	1.1	10	33	18	6
3/11/2005	1.7	10	34	18	6
4/11/2005	1.2	6	43	18	8
5/11/2005	0.2	96	35	18	8
6/11/2005	1.0	173	49	15	5
7/11/2005	0.5	61	29	19	6
8/11/2005	1.0	12	31	16	6
9/11/2005	1.3	11	40	17	6
10/11/2005	1.2	351	42	20	8
11/11/2005	0.7	142	44	31	9
12/11/2005	1.2	14	27	21	7
13/11/2005	0.9	165	47	20	8
14/11/2005	0.4	73	40	17	7
15/11/2005	0.4	238	39	17	8
16/11/2005	2.3	185	53	31	8
17/11/2005	1.5	191	53	15	6
18/11/2005	0.1	71	38	9	4
19/11/2005	1.0	23	44	24	15
20/11/2005	0.8	162	45	28	13
21/11/2005	0.5	152	46	17	8
22/11/2005	0.6	350	31	16	7
23/11/2005	0.3	139	42	14	7
24/11/2005	0.5	136	48	14	6
25/11/2005	0.1	238	37	8	5
26/11/2005	0.8	17	40	13	5
27/11/2005	0.4	17	44	12	5
28/11/2005	0.9	171	52	16	6
29/11/2005	0.7	356	29	14	6
30/11/2005	1.2	4	40	17	7

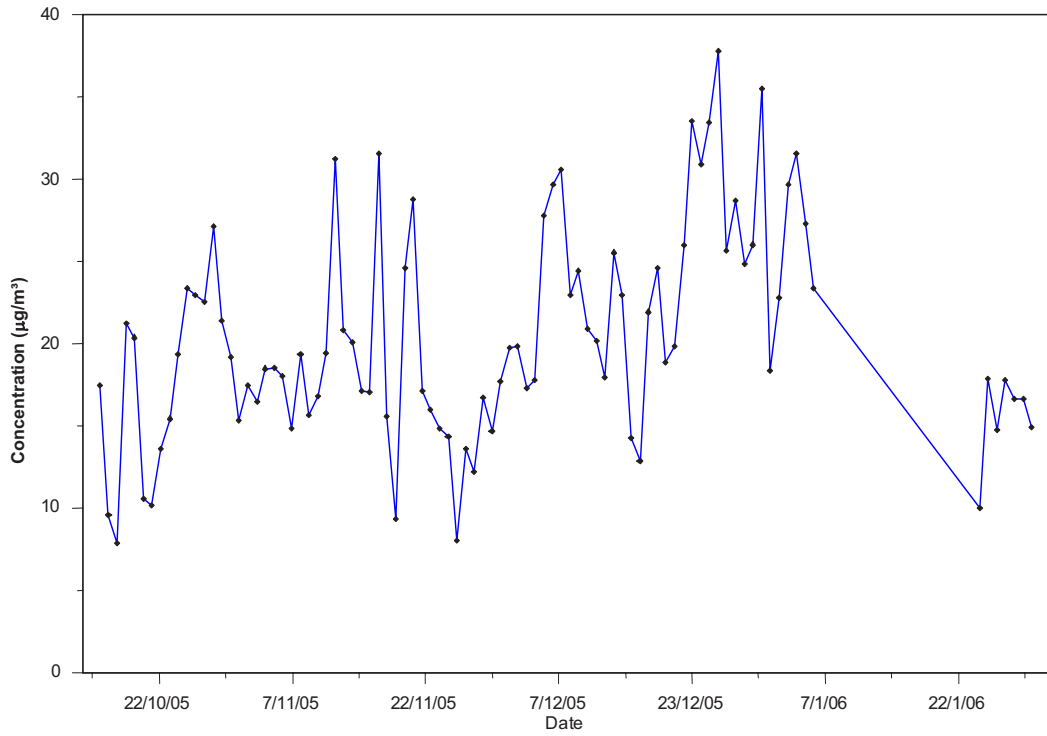
3.3 December 2005

Date	Wind Speed m/s	Wind Direction deg	Sigma Theta deg	PM10 µg/m ³	PM2.5 µg/m ³
1/12/2005	1.2	11	35	20	8
2/12/2005	1.1	348	36	20	6
3/12/2005	0.4	67	33	16	5
4/12/2005	0.5	9	27	17	5
5/12/2005	0.4	31	27	26	8
6/12/2005	0.6	338	33	28	11
7/12/2005	0.4	337	44	31	14
8/12/2005	0.4	301	42	22	7
9/12/2005	0.6	172	34	24	9
10/12/2005	0.4	41	20	20	9
11/12/2005	0.5	151	51	20	8
12/12/2005	0.4	138	42	18	7
13/12/2005	0.3	38	39	25	11
14/12/2005	1.6	177	47	22	10
15/12/2005	0.6	73	43	14	6
16/12/2005	0.4	314	44	13	6
17/12/2005	0.5	34	31	21	6
18/12/2005	0.4	150	34	23	8
19/12/2005	0.1	156	32	17	6
20/12/2005	0.8	11	23	19	8
21/12/2005	0.4	12	30	25	9
22/12/2005	0.0	71	41	33	13
23/12/2005	0.5	98	40	31	14
24/12/2005	0.6	338	34	32	11
25/12/2005	1.1	157	38	37	12
26/12/2005	0.8	53	26	26	10
27/12/2005	1.4	28	31	28	11
28/12/2005	0.8	3	40	23	6
29/12/2005	0.5	58	41	26	9
30/12/2005	1.7	30	37		8
31/12/2005	2.1	17	37	18	7

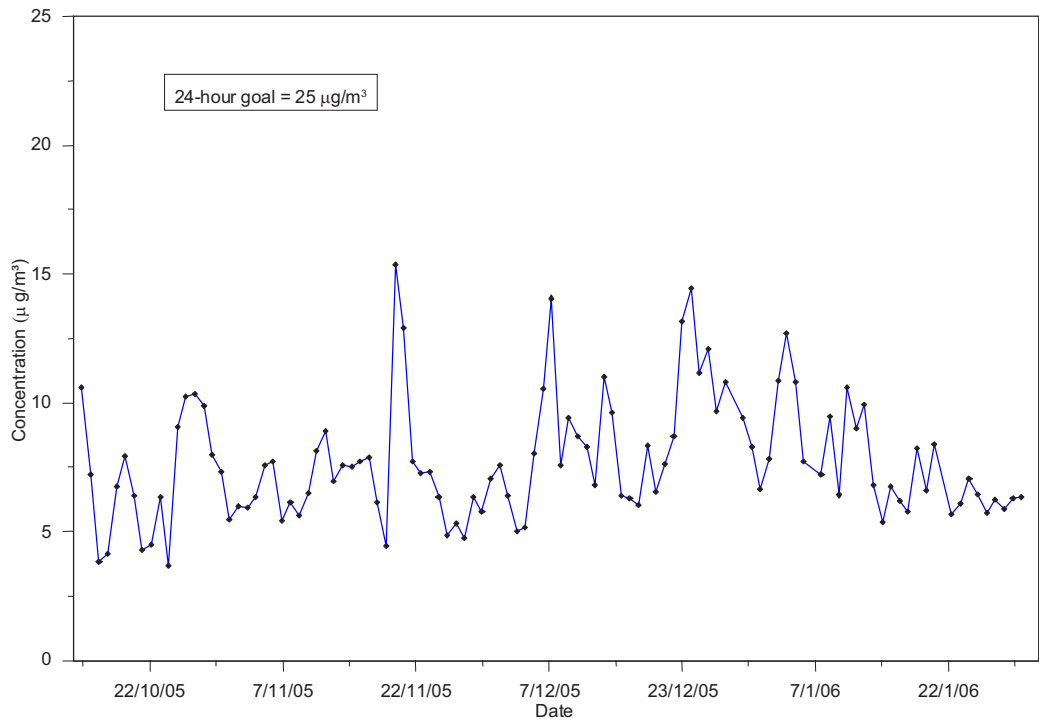
3.4 January 2006

Date	Wind Speed m/s	Wind Direction deg	Sigma Theta deg	PM10 µg/m ³	PM2.5 µg/m ³
1/01/2006	1.0	11	42	23	8
2/01/2006	1.0	165	43	30	11
3/01/2006	0.4	130	42	31	13
4/01/2006	0.7	186	47	27	11
5/01/2006	0.5	129	46	22	8
6/01/2006	0.5	176	52		2
7/01/2006	0.8	135	44		7
8/01/2006	1.0	155	50		9
9/01/2006	0.6	150	44		6
10/01/2006	1.5	23	36		9
11/01/2006	1.2	11	41		9
12/01/2006	0.5	159	49		10
13/01/2006	0.6	32	36		7
14/01/2006	0.7	24	33		5
15/01/2006	0.7	37	24		7
16/01/2006	1.1	22	28		6
17/01/2006	0.8	348	36		6
18/01/2006	0.9	177	51		8
19/01/2006	0.5	176	49		7
20/01/2006	0.1	64	40		8
21/01/2006	0.7	26	20		7
22/01/2006	0.6	29	24		6
23/01/2006	1.3	21	39		6
24/01/2006	1.0	30	39	9	7
25/01/2006	0.4	201	48	17	6
26/01/2006	0.5	47	25	14	6
27/01/2006	0.7	27	29	18	6
28/01/2006	0.3	32	26	17	6
29/01/2006	0.2	116	33	17	6
30/01/2006	0.3	121	41	15	6
31/01/2006	0.5	160	41	17	7

3.5 24-hour average PM₁₀ concentrations October 2005 to January 2006

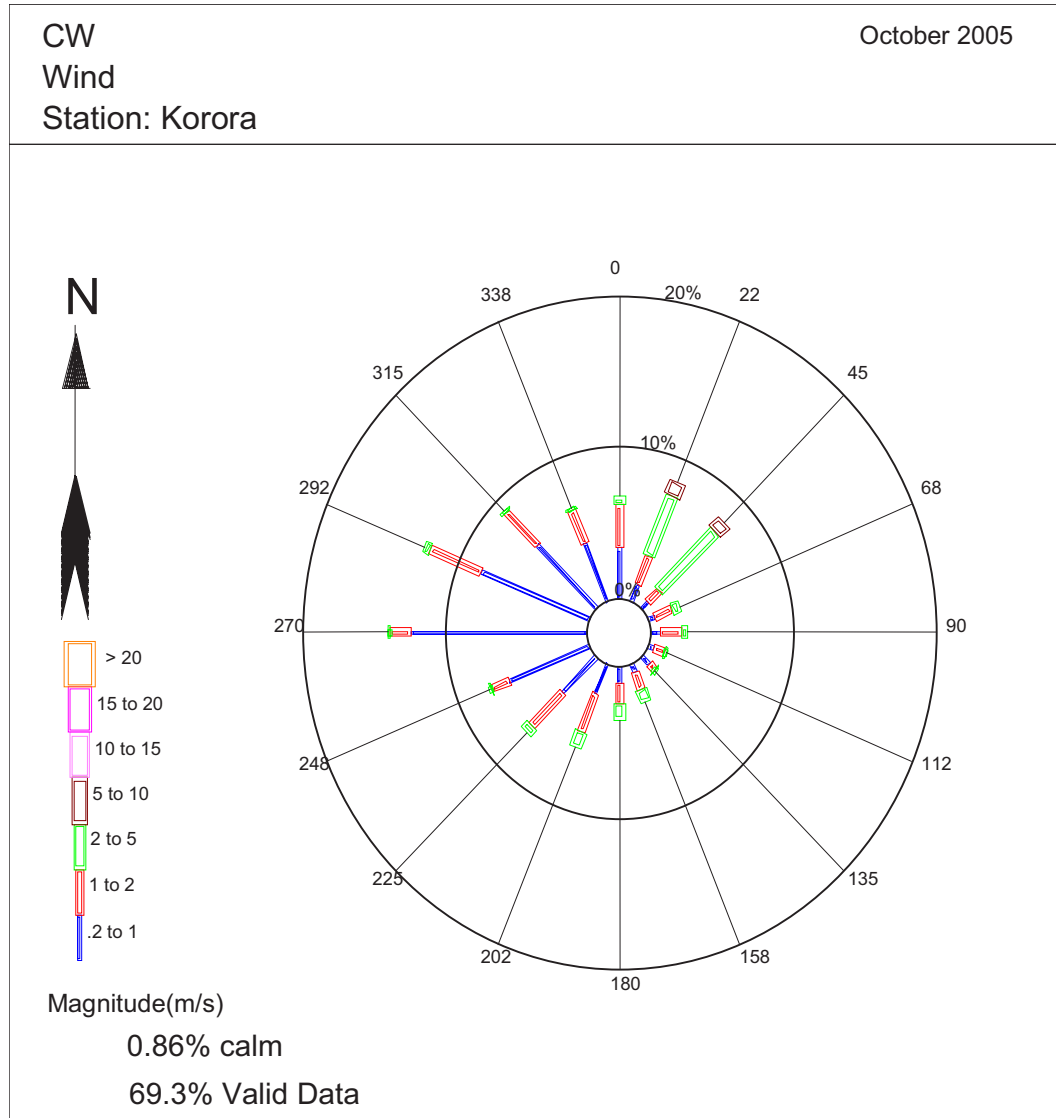


3.6 24-hour average PM_{2.5} concentrations October 2005 to January 2006

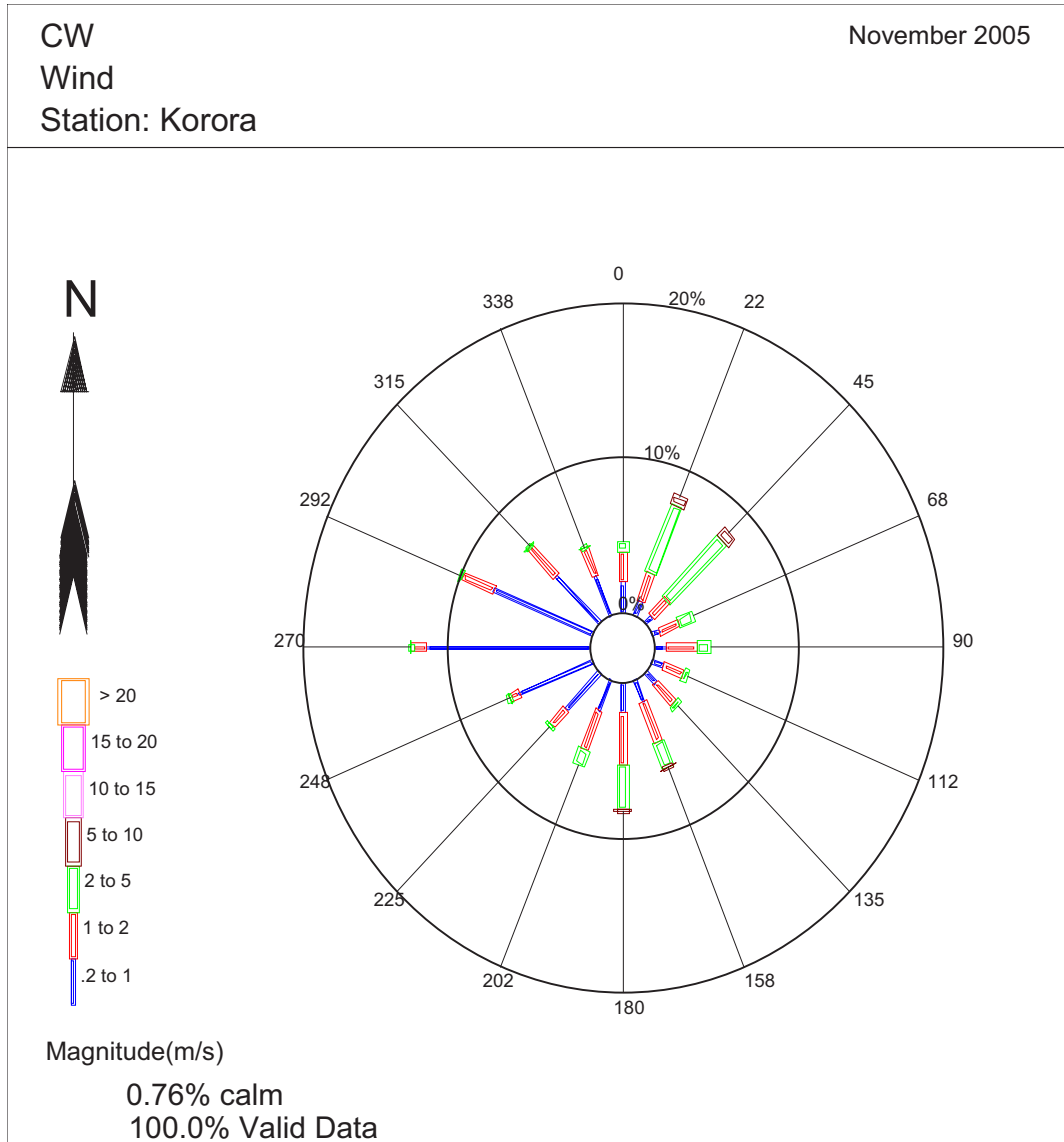


4. Climatic graphs

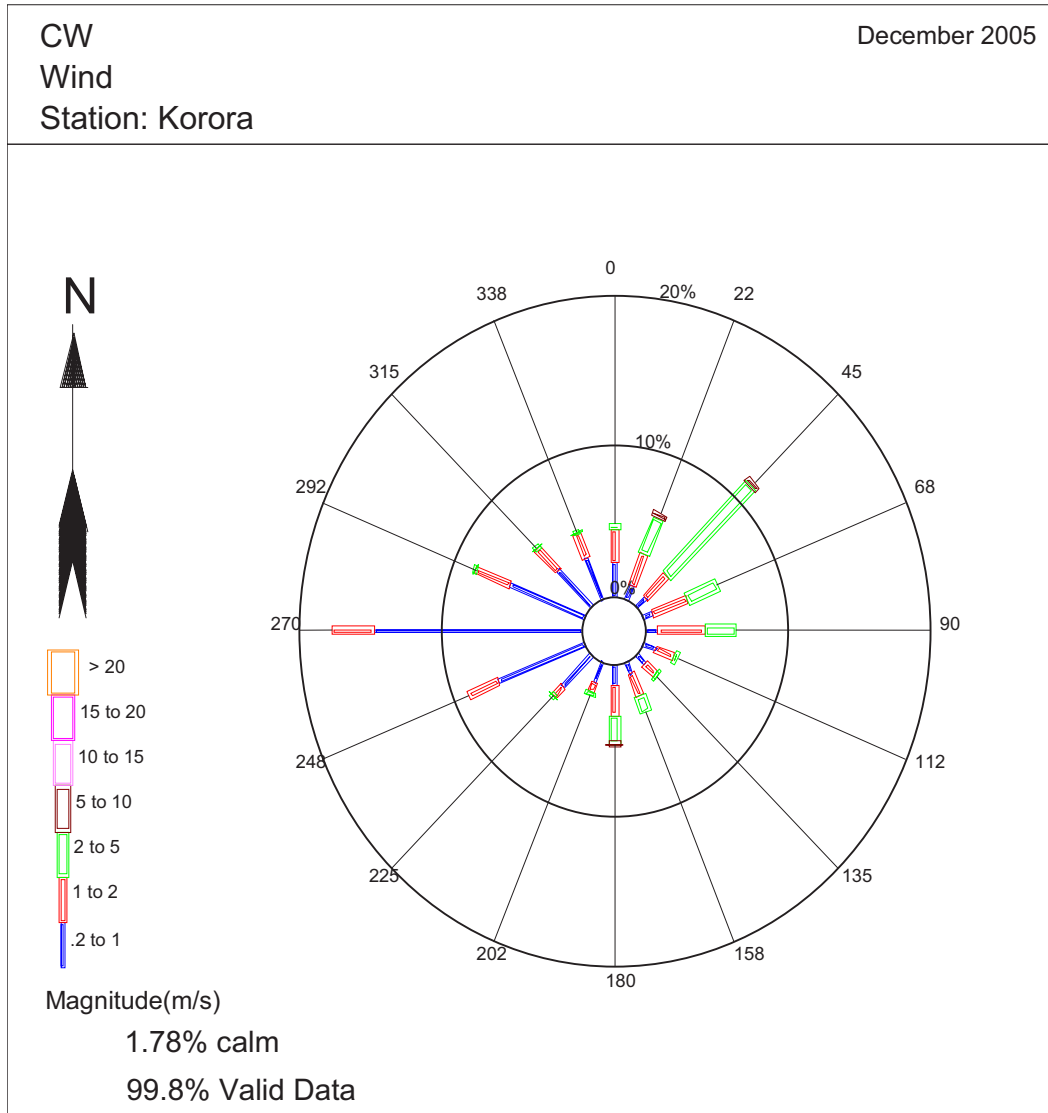
4.1 October 2005 Windrose



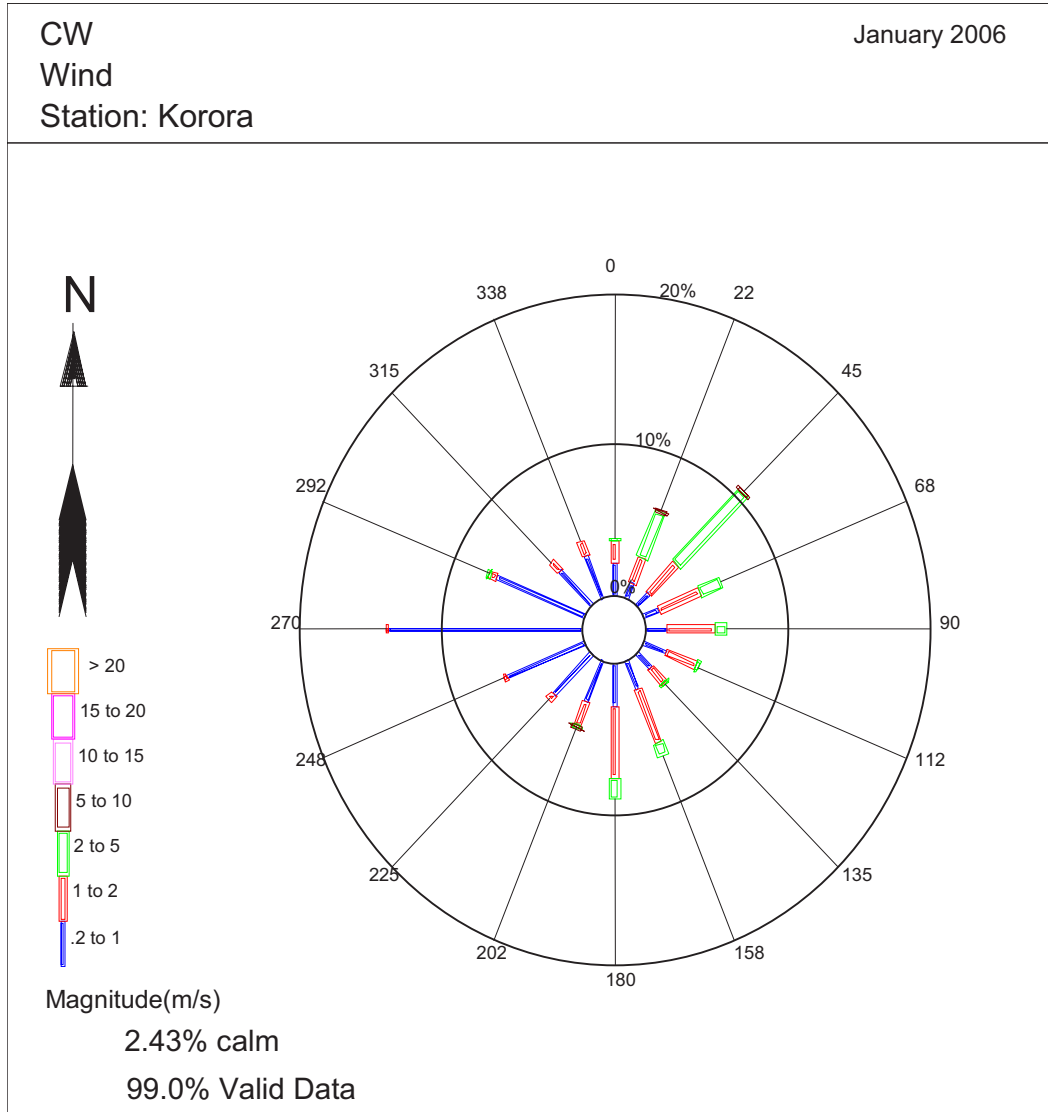
4.2 November 2005 Windrose



4.3 December 2005 windrose

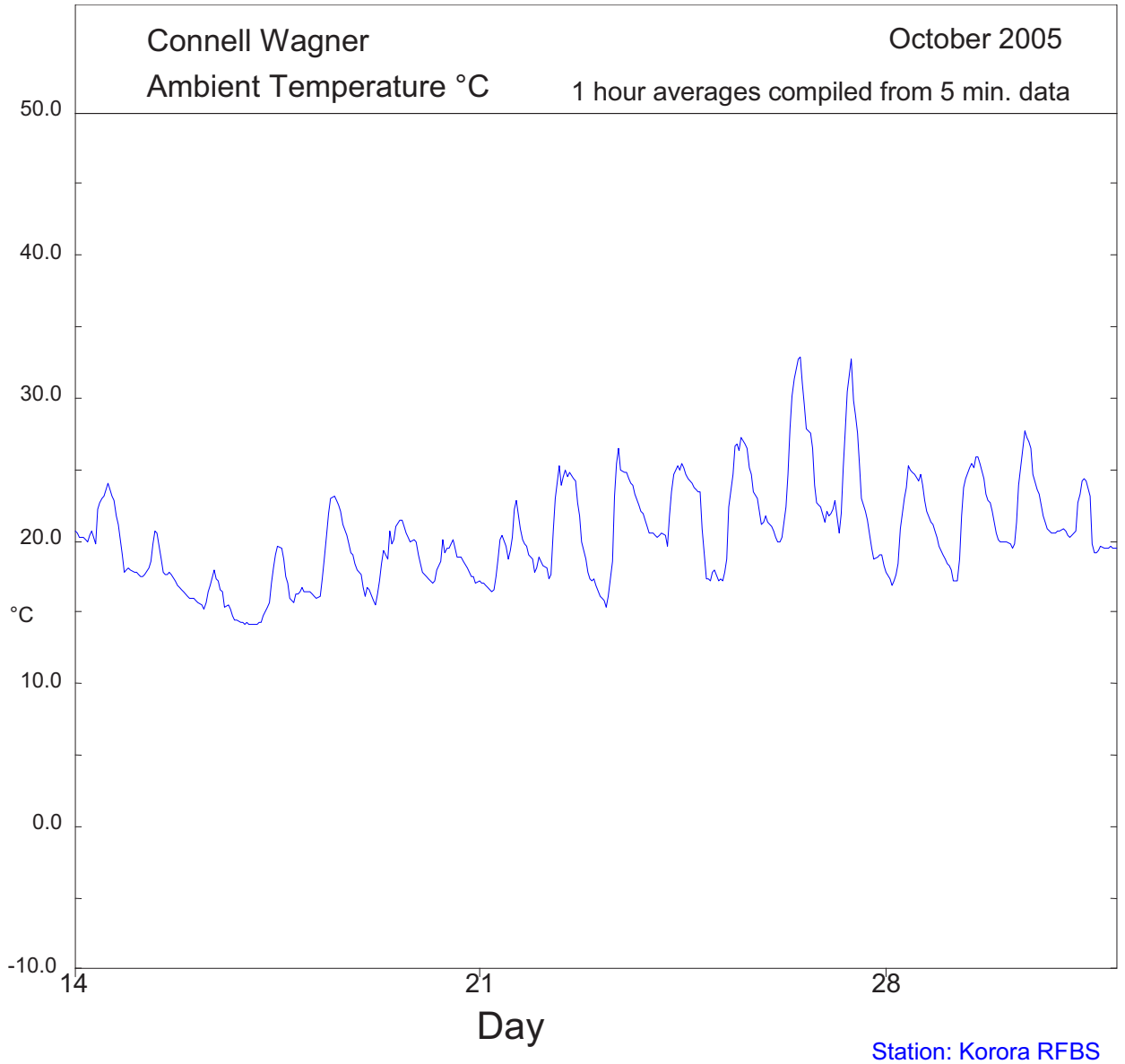


4.4 January 2006 windrose

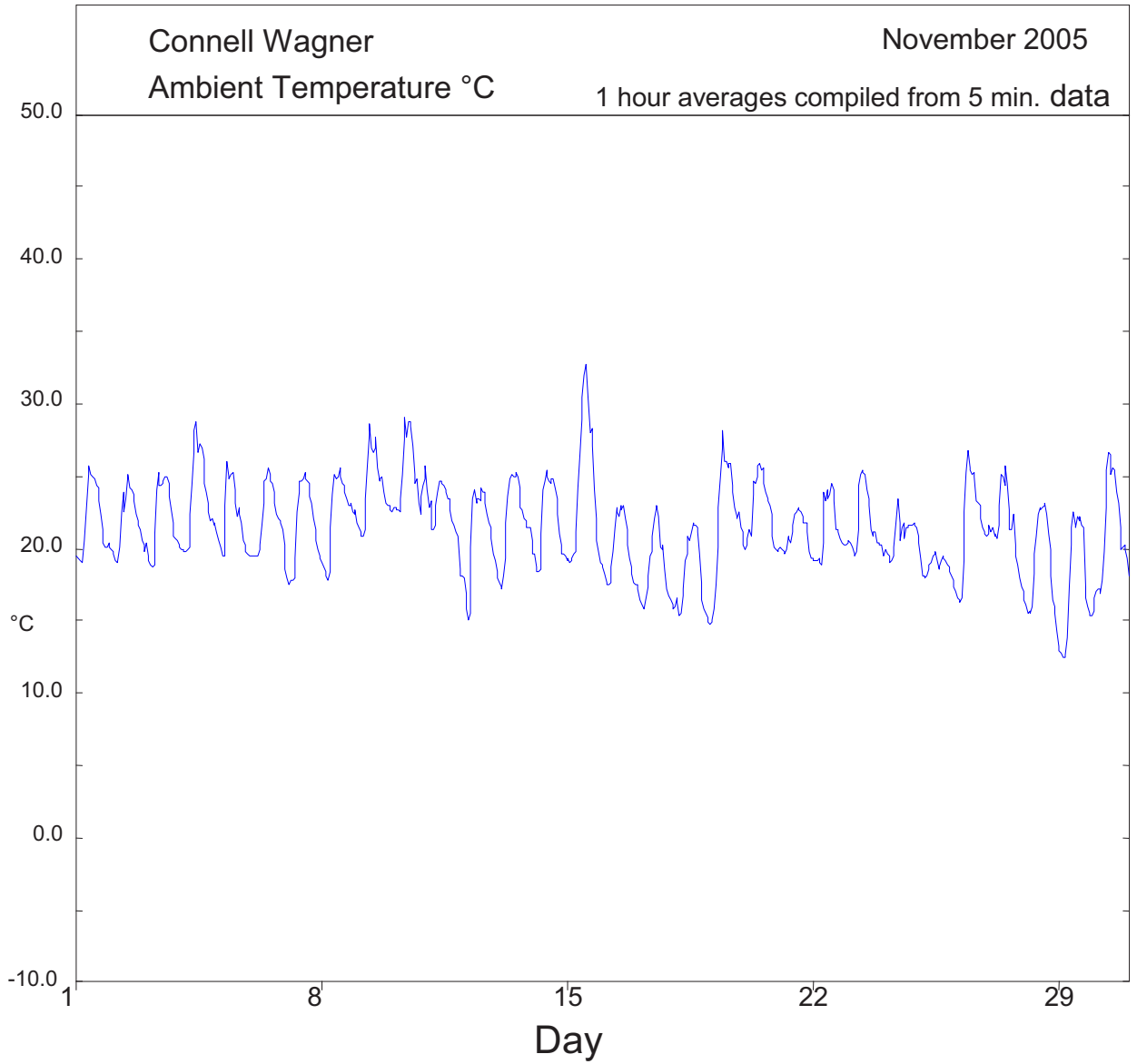


5. Temperature Graphs

5.1 October 2005 Temperature Graph

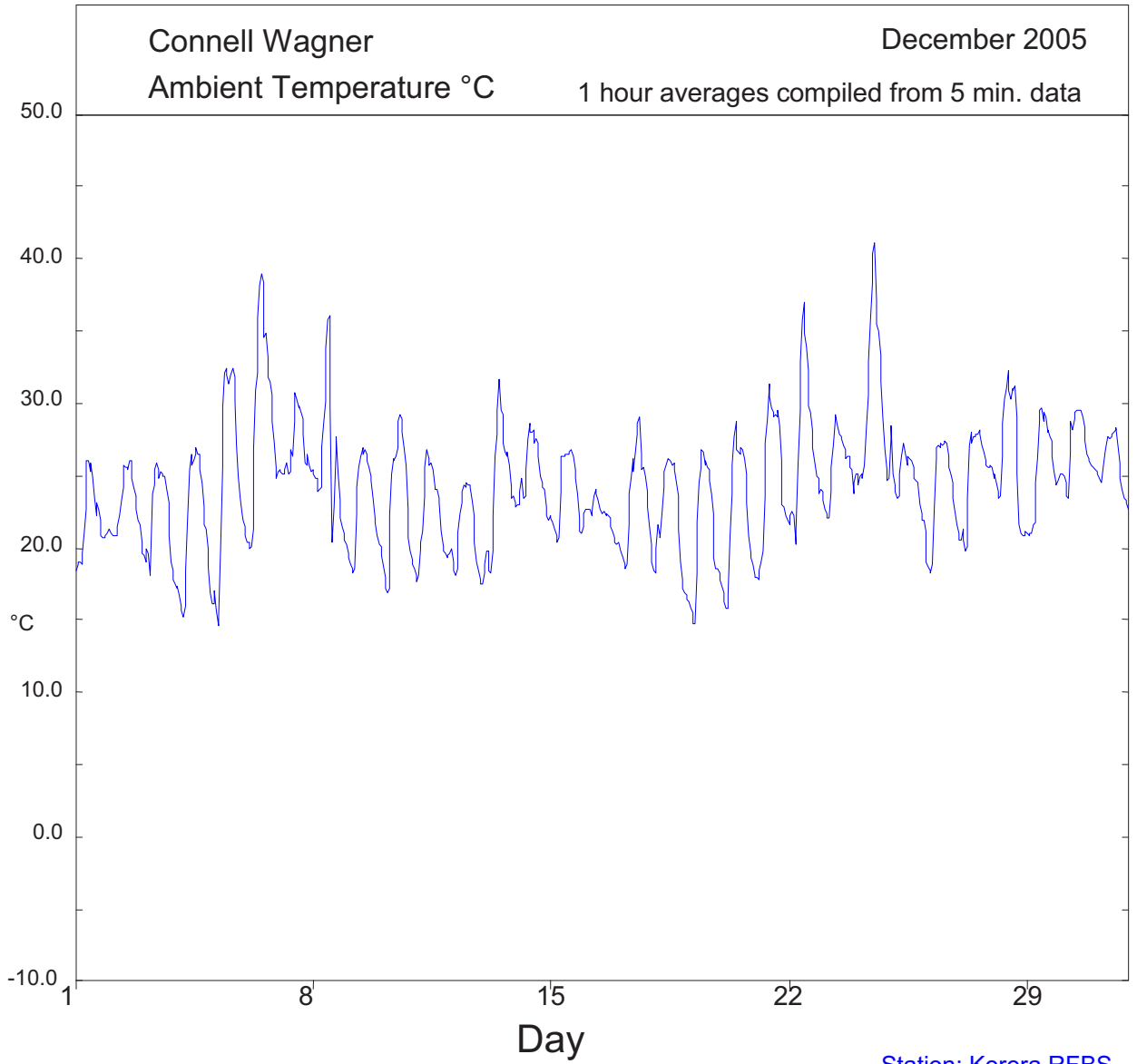


5.2 November 2005 temperature graph

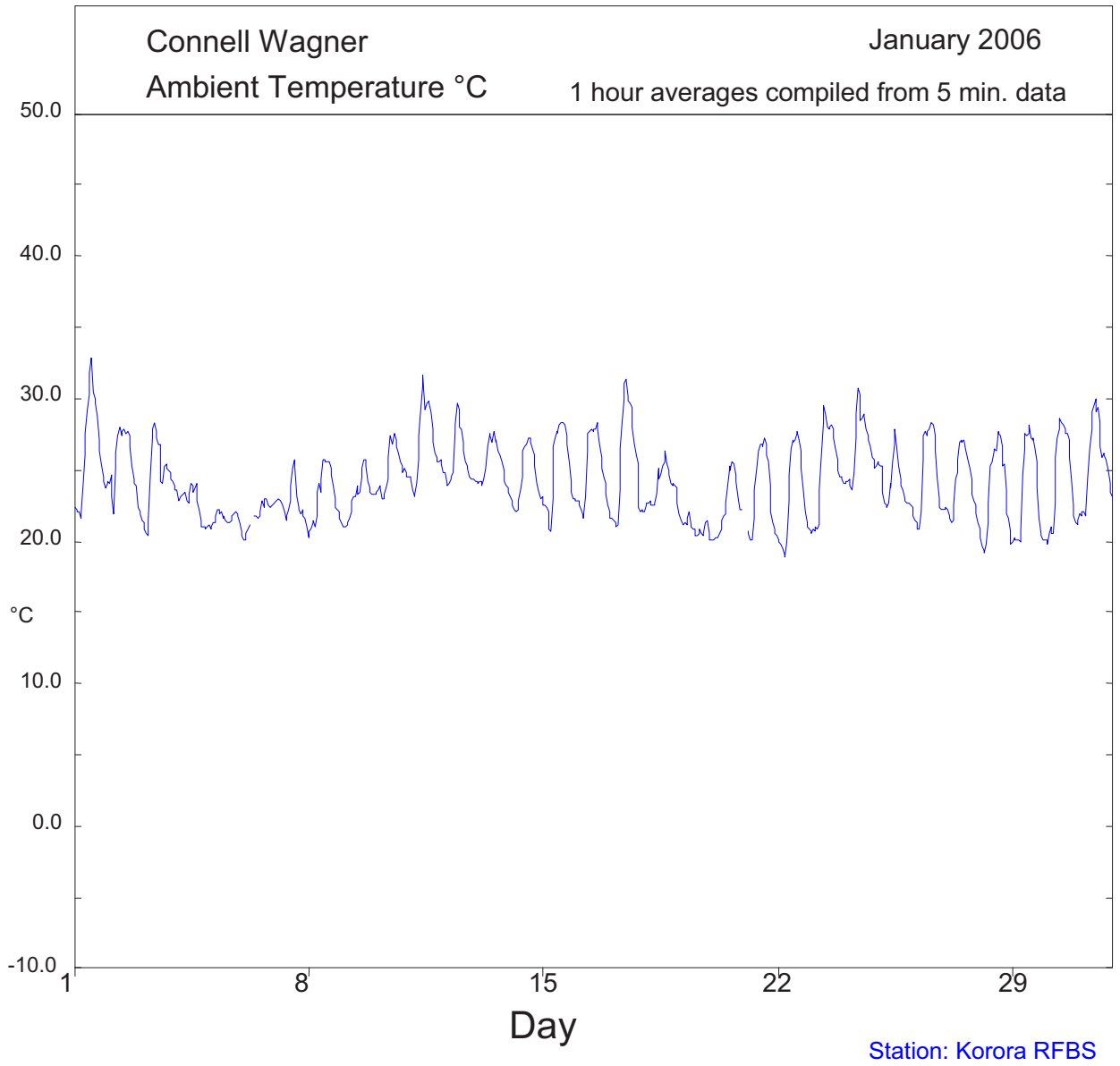


Station: Korora RFBS

5.3 December 2005 temperature graph

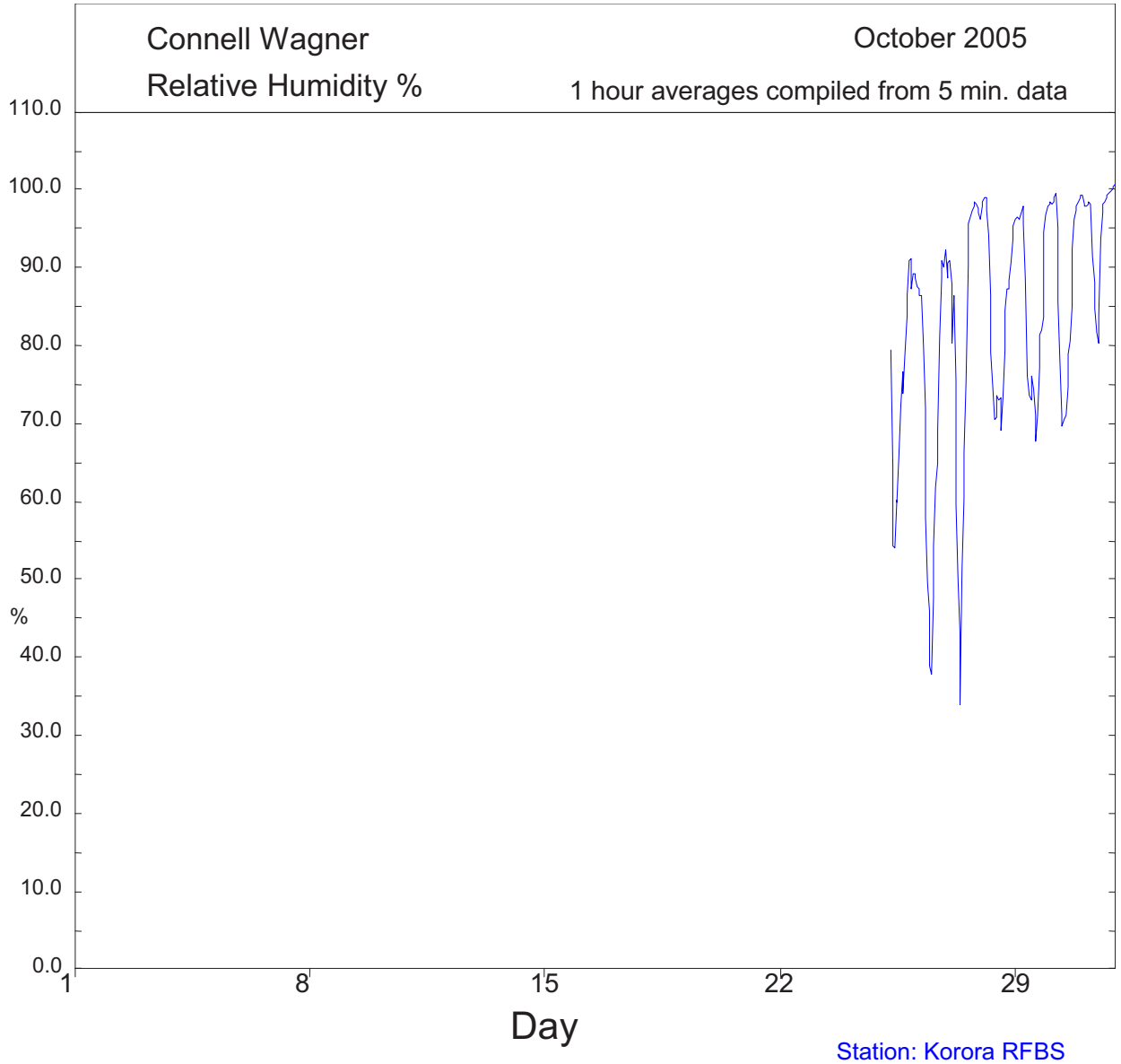


5.4 January 2006 temperature graph

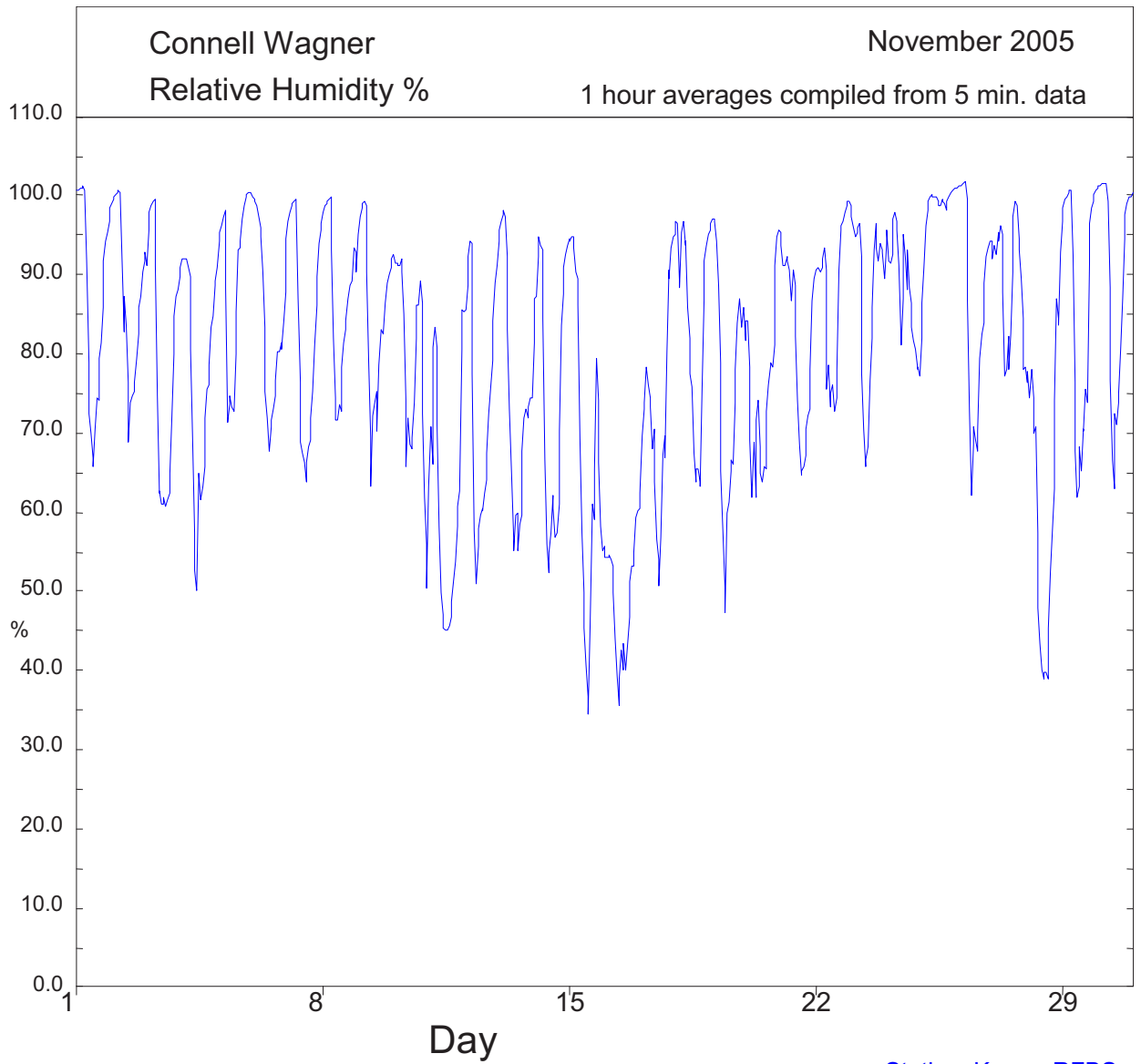


6. Relative Humidity Graphs

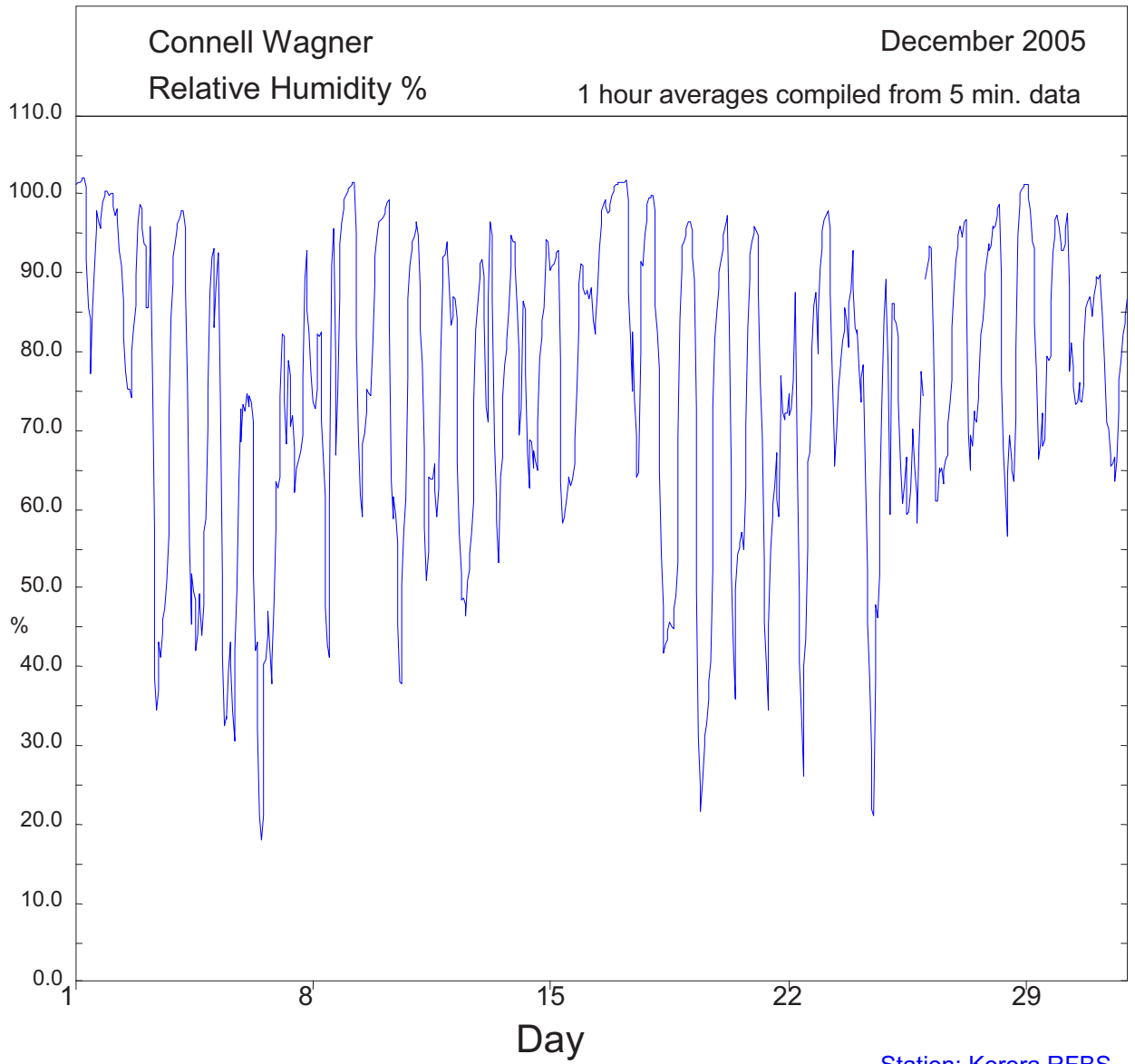
6.1 October 2005 relative humidity graph



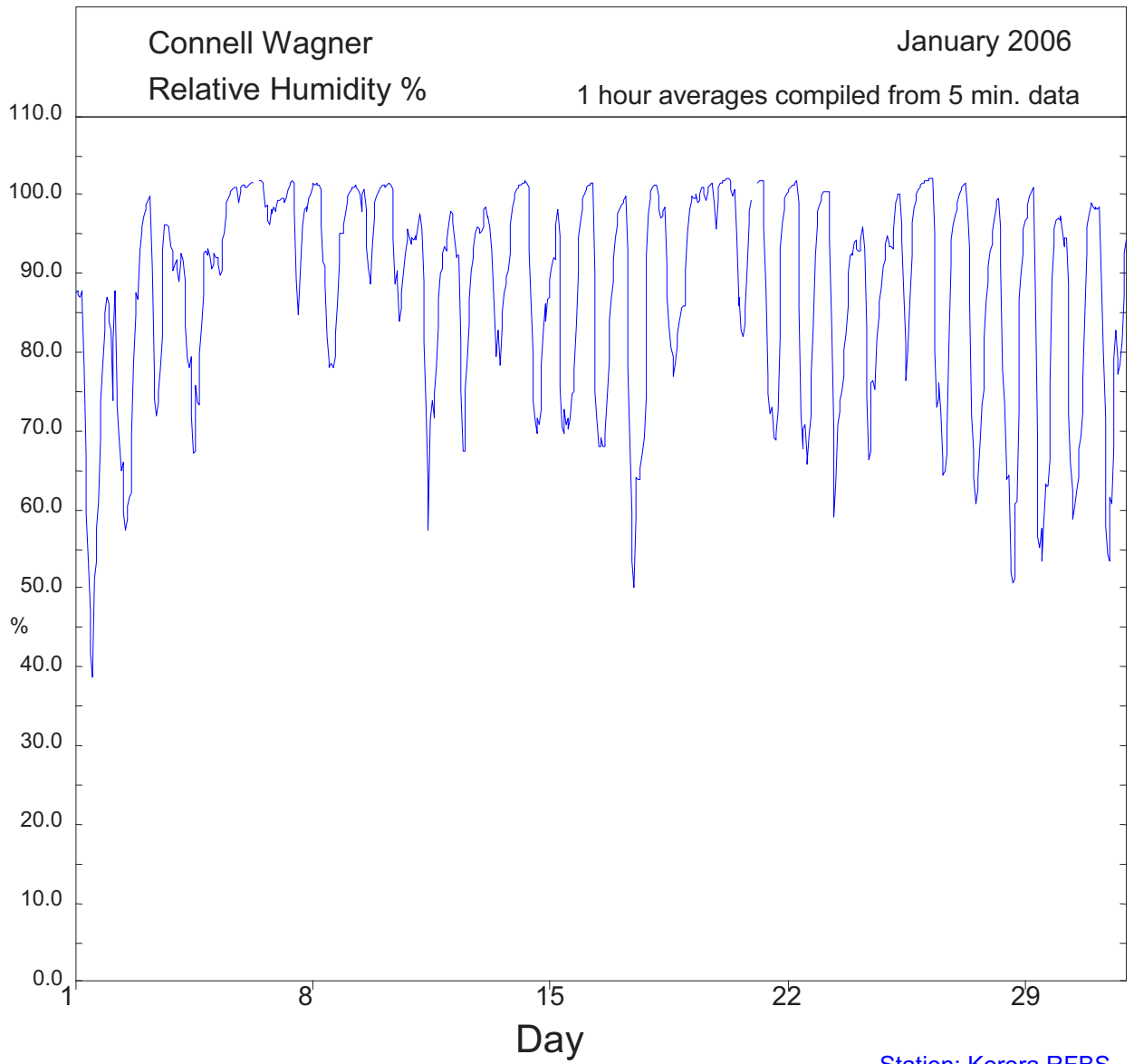
6.2 November 2005 relative humidity



6.3 December 2005 relative humidity



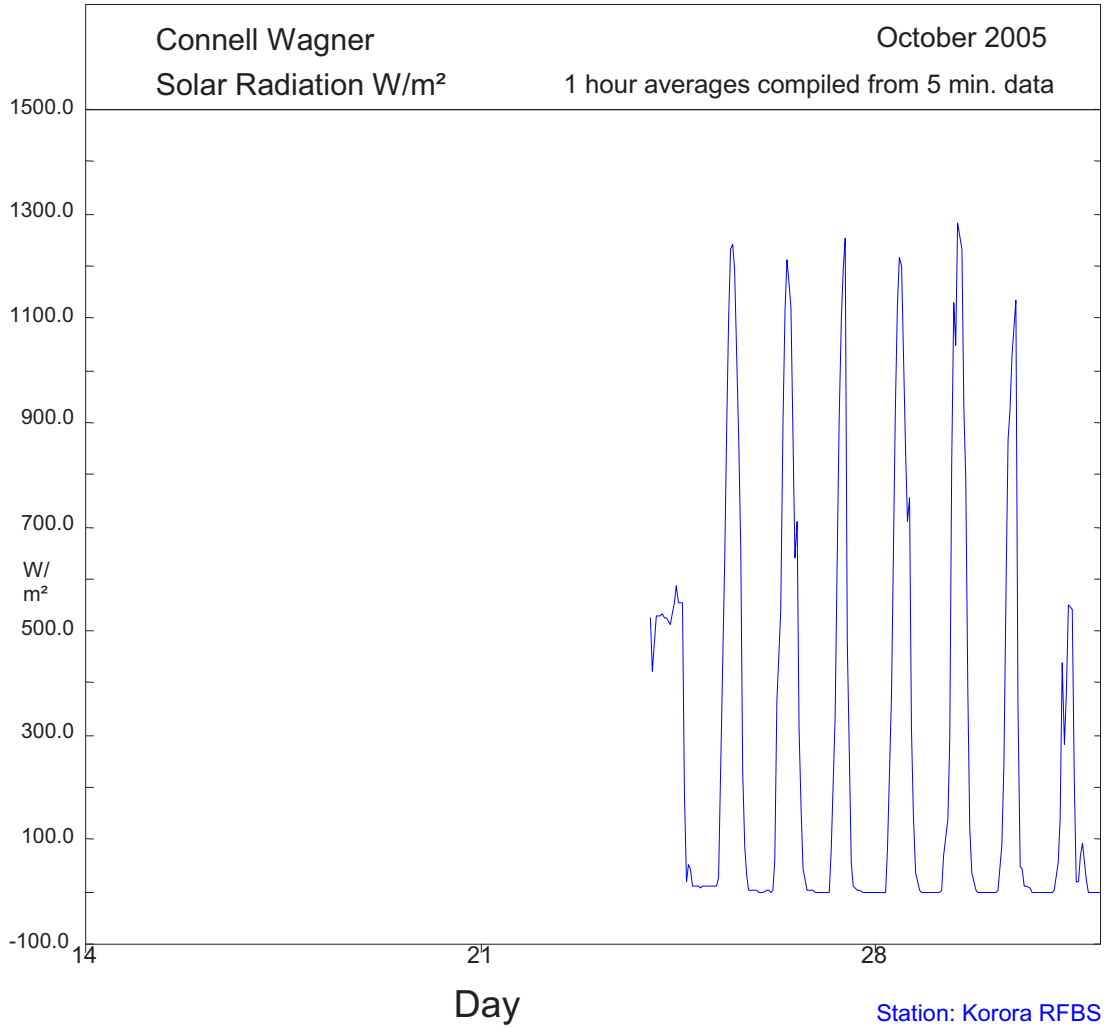
6.4 January 2006 relative humidity



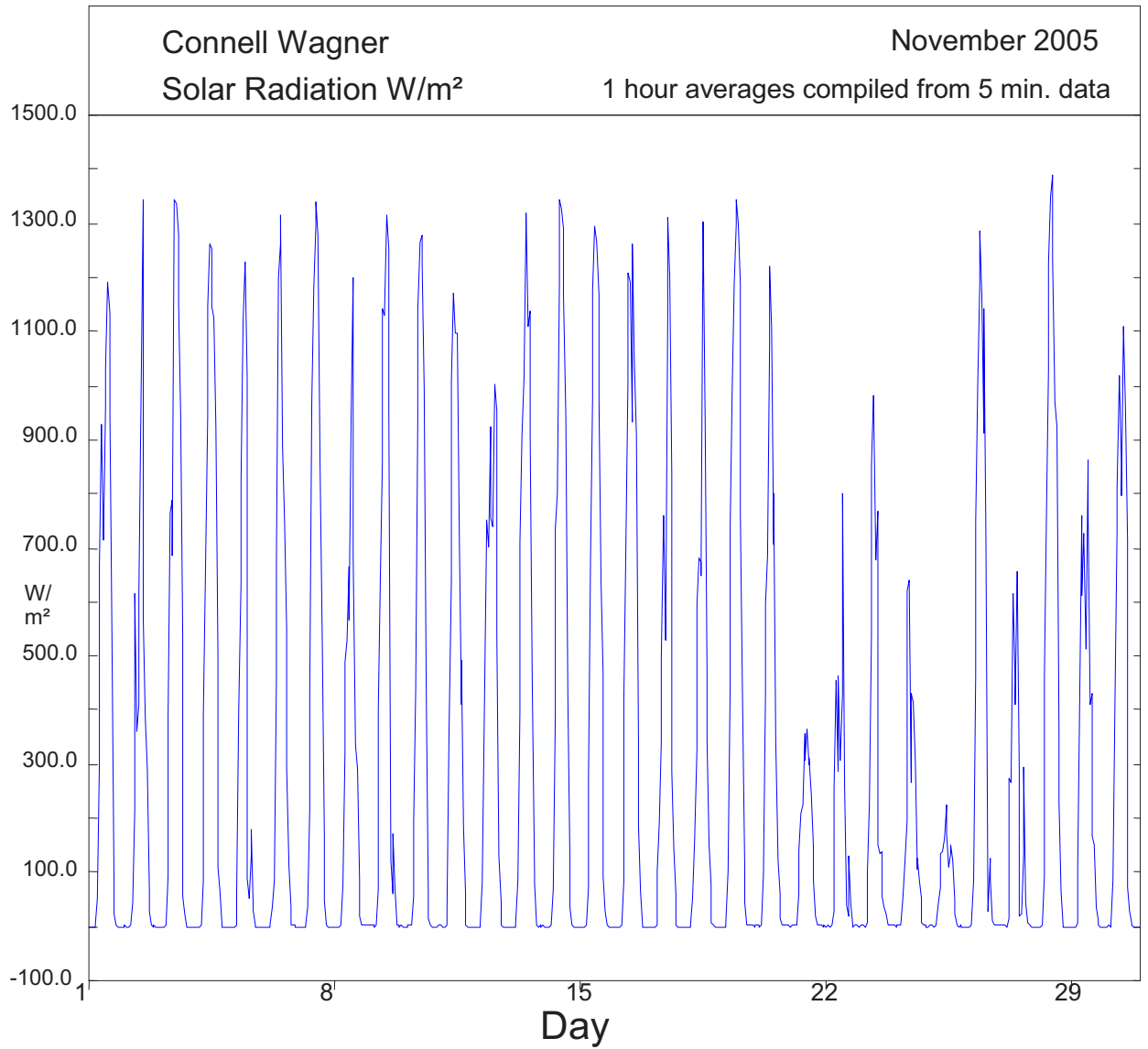
Station: Korora RFBS

7. Solar Radiation Graphs

7.1 October 2005 solar radiation graph

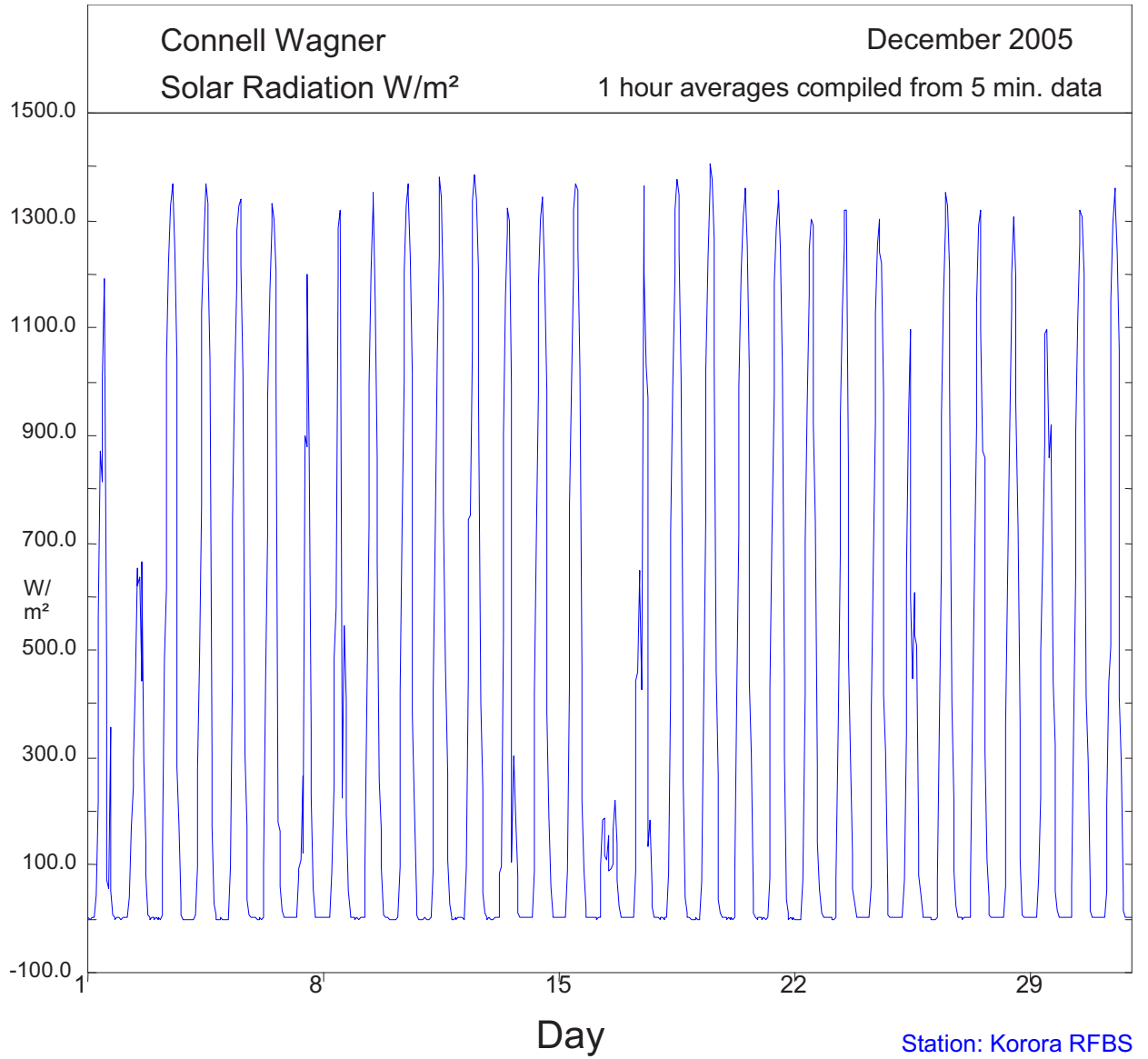


7.2 November 2005 solar radiation graph

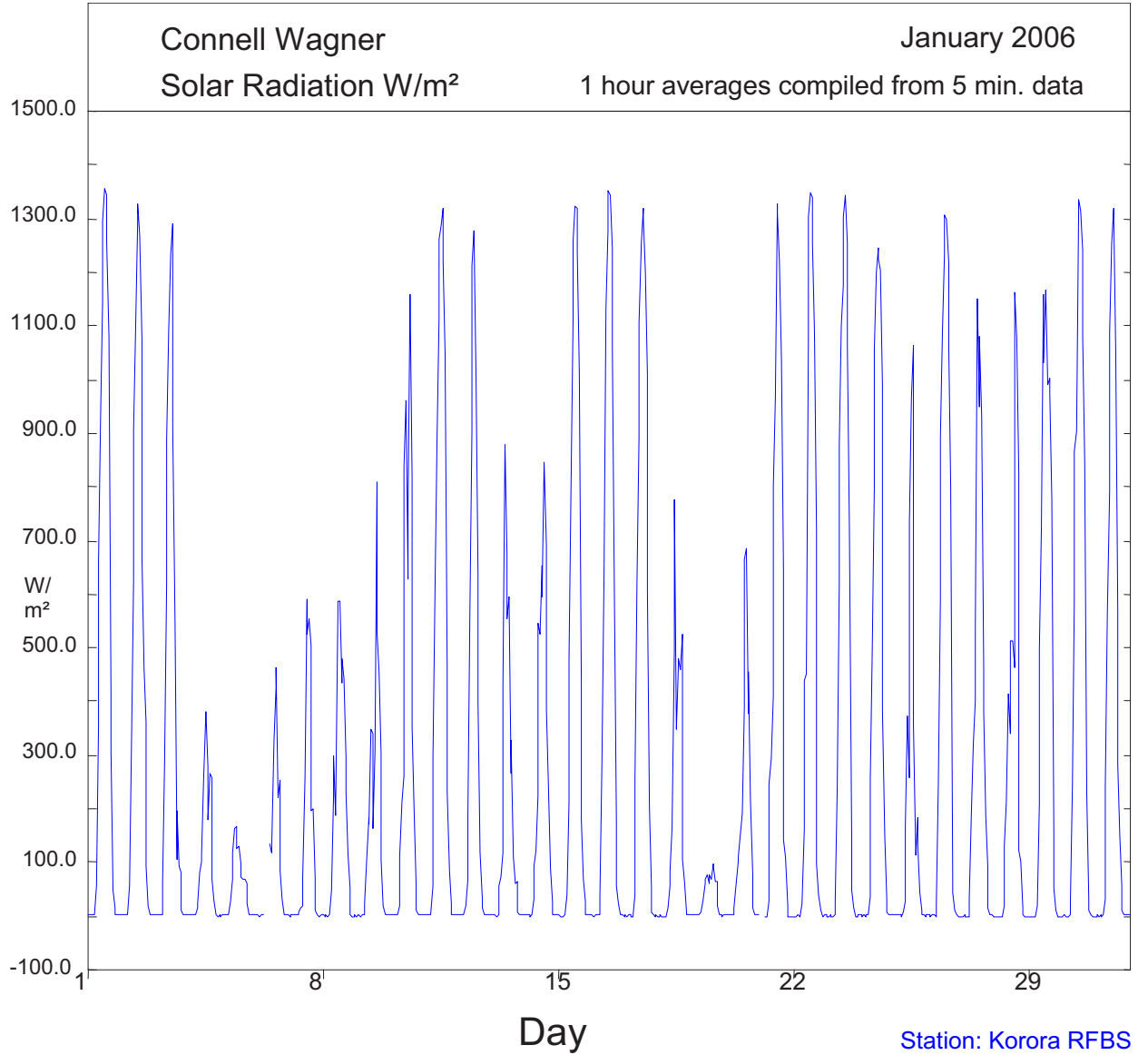


Station: Korora RFBS

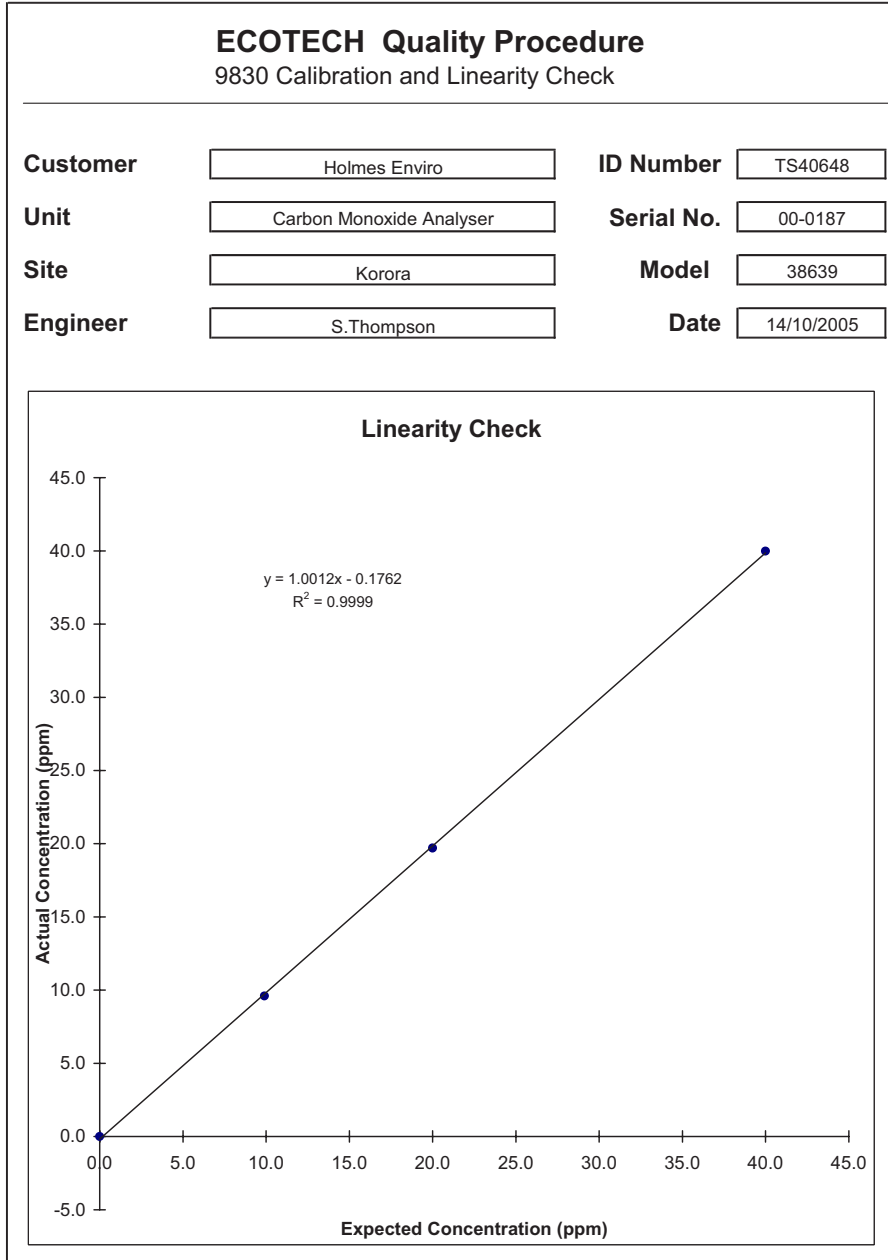
7.3 December 2005 solar radiation graph



7.4 January 2006 solar radiation graph



8. Calibration Graphs



Connell Wagner PPI Calibration and Linearity Check

Customer	Holmes enviro	ID Number	40699
Unit	Nitrogen Oxides Analyser	Serial No.	00-0040
Site	Korora	Model	9841
Engineer	S.THOMPSON	Date	14/10/2005

