REFERENCE

Ang, A. H-S, and Tang, W. H., Probability Concepts in Engineering Planning and Design Volume II : Decision, Risk, and Reliability, John Willey & Sons, Inc., (1984)

Atkinson, D. G., et al., Improvement of the EPA Industrial Source Complex Dispersion Model, J. of Applied Met., 36 (1996): 1088 – 1095

Beyer, W. H., CRC Standard Mathematical Tables, 24th Edition, Cleveland, the Chemical Rubber Company, (1976): 600 – 602

Blackman, A. et al., The Benefits and Costs of Informal Sector Pollution Control: Mexican Brick Kilns, Resources for the Future, (2000): 1 – 25

Bowers, J. F., et al., Test of the Industrial Source Complex (ISC) Dispersion Model at the Armco, Middletown, Ohio Steel Mill, EPA-450/4-82-006, USEPA, RTP, NC, (1982)

Calvert, S., and Englund, H. M., Handbook of Air Pollution Technology, A Wiley-Interscience Publication, (1984)

Chan, T. L. et al., Monte Carlo simulation of nitrogen oxides dispersion from a vehicular exhaust plume and its sensitivity studies, Atmospheric Environment, 35 (2001): 6117 – 6127

de Nevers, N., Air Pollution Control Engineering, International Ed., McGraw-Hill, (1995): 20 – 21

Doran, J. C., and Horst, T. W., An evaluation of Gaussian plume-depletion models with dual-tracer field measurements, Atmospheric Environment, 19 (1985): 939 – 951

Godbole, V., and Naperkoski, G. J., An Operational Evaluation of the Industrial Source Complex Model, Conference on Applications of Air Pollution Meteorology, American Meteorological Society, (1984): 70 – 75

Golder, D., Relations among stability parameters in the surface layer, Boundary-Layer Meteor., 3 (1972): 47 – 58

Hanna, S. R. et al., Monte Carlo Estimates of Uncertainties in Predictions by a Photochemical Grid Model (UAM-IV) Due to Uncertainties in Input Variables, Atmospheric Environment, 32 (1998): 3619 – 3628

Hao, J. et al., A study of the emission and concentration distribution of vehicular pollutants in the urban area of Beijing, Atmospheric Environment, 34 (2000): 453 – 465

Harrison, R. M., and Perry, R., Handbook of Air Pollution Analysis, 2nd Ed., Chapman and Hall Publishers, Inc., (1977)

Himmelblau, D. M., and Bischoff, K B., Process Analysis and Simulation: Deterministic Systems, John Willey & Sons, Inc., (1968)

Hyde, P., Air Quality Modeling of Elevated Particulates Concentrations in Tucson in 1999, (2001): 2 – 15

Komhyr, W. D., Operations Handbook – Ozone observations with a Dobson Spectrophotometer, (1980): 94 – 96

Koracin, D. et al., PM_{10} Dispersion Modeling for Treasure Valley, Idaho, J. Air & Waste Manage. Assoc., 50 (2000): 1335 – 1344

Kumar, A. et al., Performance of an Industrial Source Complex Model: Predicting Long-Term Concentrations in an Urban Area, Environmental Progress, 18 (1999): 93 – 100

Kyriakidis, P. C. et al., Stochastic modeling of atmospheric pollution: a spatial time-series frame work. Part I: methodology, Atmospheric Environment, 35 (2001), 2331 – 2337

Kyriakidis, P. C. et al., Stochastic modeling of atmospheric pollution: a spatial time-series frame work. Part II: application to monitoring monthly sulfate deposition over Europe, Atmospheric Environment, 35 (2001), 2339 – 2348

Lorber, M. et al., Testing the USA EPA's ISCST-Version 3 model on dioxins: a comparison of predicted and observed air and soil concentrations, Atmospheric Environment, 34 (2000): 3995 – 4010

Mazzeo, N. A., and Venegas, L. E., Practical use of the ISCST3 model to select monitoring site locations for air pollution control, Int. J. Environmental and Pollution, 14 (2000): 246 – 259

Meechumna, P. et al., Research Project on Environmental Management to Solve Dust Pollution Problem from Stone Mining Areas and Processing Plants around Tambol Nah Pra Larn and its Vicinity in Saraburi Province, Final report submitted by Faculty of Engineering, Chulalongkorn University to Department of Mineral Resources, Ministry of Industry, (1999): 4-1, 7-44, xxii-11 - xxii-24

Moore, G. E., and Londergan, R. J., Sampled Monte Carlo uncertainty analysis for photochemical grid models, Atmospheric Environment, 35 (2001): 4863 – 4876

Riswadkar, R. M., and Kumar, A., Evaluation of the Industrial Source Complex Short Term Model in a Large-scale Multiple Source Region for Different Stability Classes, Environmental Monitoring and Assessment, 33 (1994): 19 – 32

Schnelle, K. B., Jr., and Dey, P. R., Atmospheric Dispersion Modeling Compliance Guide, McGraw-Hill, (1999): 5 – 13

Schulman, L. L., et al., Evaluation of the Proposed Downwash Modifications to the Industrial Source Complex Model, Environmental Research and Technology, Inc., P-B810-012, Boston, MA (1985)

Schwede, D. B., Sensitivity of the Industrial Source Complex Model to Input, Deposition Parameters, J. of Applied Met., 36 (1996): 1096 – 1105

Tanthapanichakoon, W., Ph.D. Dissertation, University of Texas at Austin, Texas, (1978)

Taylor, R. K, Evaluation of ISCST3 Dispersion Model Performance Using Actual Emissions Data and Ambient Monitoring Data for a Large Chemical Manufacturing Facility Located in North Carolina, Air & Waste Assoc., (1996): 2 – 10

Turner, D. B., Workbook of Atmospheric Dispersion Estimates: An Introduction to Dispersion Modeling, Lewis Publishers, (1994)

U.S. EPA, Appendix W to Part 51: Guideline on air quality models, (1999): 410 – 411

U.S. EPA, User's Guide for the Industrial Source Complex (ISC3) Dispersion Models Volume II – Description of Model Algorithms, (1995)

Wanitchbuncha, K., SPSS for Windows for Data Analysis, 1st Ed., CK & S Photo Studio, Inc., (2000)

Wark, K., and Warner, C. F., Air Pollution: Its Origin and Control, 2nd Ed., Harper & Row Publishers, Inc., (1981)

Williamson, S. J., Fundamentals of Air Pollution, Addison-Wesley Publishing Co., (1973)

Winiwater, W., and Rypdal, K., Assessing the uncertainty associated with national greenhouse gas emission inventories: a case study for Austria, Atmospheric Environment, 35 (2001): 5425 – 5440

Zannetti, P., Air Pollution Modelling : Theories, Computational Methods and Available Software, Van Nostrand Reinhold, (1990): 42 – 75

APPENDICES

APPENDIX A

CALCULATION OF SOLAR ELEVATION ANGLE

The sine of the solar elevation angle, sin α, is given by

$$\sin\alpha = \sin\phi \sin K_d + \cos\phi \cos K_d \cos H_A$$

Where:

$$H_A = \left(\frac{\pi}{12}\right)(\tau - E_m) - \lambda$$

$$E_m = 12.0 + 0.12357 \sin(D) - 0.004289 \cos(D) + 0.153809 \sin(2D) + 0.060783 \cos(2D)$$

$$D = (d-1)\left(\frac{360}{365.242}\right)\left(\frac{\pi}{180}\right)$$

$$K_d = \sin^{-1}\left[0.39784989 \sin\left(\frac{\pi \sigma_A}{180}\right)\right]$$

$$\sigma_A = 279.9348 + D\left(\frac{180}{\pi}\right) + 1.914827 \sin(D)$$

Where:

ϕ is the latitude (radians)

λ is the longitude (radians)

d is the Julian day

τ is the time of day (hours GMT)

An Example:

Saraburi Province is at 14.8° latitude and 100.61° longitude. It is 7 hours earlier than GMT. Calculation of the solar elevation angle at 10:00 AM on December 31, 2001, is as followings:

Calculations:

d = 365

τ = 17:00 GMT

D = 6.2618

E_m = 12.047

H_A = -0.4593

σ_A = 638.59

K_d = 0.4043

$$\sin\upsilon = \sin(0.2583)\ \sin(0.4043) + \cos(0.2583)\cos(0.4043)\cos(-0.4593)$$

$$= 0.8972$$

υ = 1.1135 radians or 63.80°

APPENDIX B

CALCULATION OF EMISSION RATE

B.1 Emission Factor of Stone Processing Operations

Emission factors provided by U.S. EPA. for filterable PM and PM_{10} emissions from crushed stone processing operations are presented in Tables B 1.1. This emission factor is employed to calculate PM_{10} emission rate in this study. However, the U.S.EPA Ap-42 document has not been concluded and indicated emission factors in some cases. Consequently, present study used some of the developed emission factors for Saburi stone processing provided by Meechumna, P. et al. as shown in Table B 1.2.

Table B.1.1 Emission factors for crushed stone processing operations[a] (kg/ton)

Source [b]	Total Particulate Matter	EMISSION FACTOR RATING	Total PM-10 [c]	EMISSION FACTOR RATING
Screening (SCC 3-05-020-02,-03)	— [d]		0.0076 [e]	C
Screening (controlled) (SCC 3-05-020-02-03)	— [d]		0.00042 [e]	C
Primary crushing (SCC 3-05-020-01)	0.00035[f]	E	ND [g]	
Secondary crushing (SCC 3-05-020-02)	ND		ND [g]	
Tertiary crushing (SCC 3-05-020-03)	— [d]		0.0012 [h]	C
Primary crushing (controlled) (SCC 3-05-020-01)	ND		ND [g]	
Secondary crushing (controlled) (SCC 3-05-020-02)	ND		ND [g]	
Tertiary crushing (controlled) (SCC 3-05-020-03)	— [d]		0.00029 [h]	C
Fines crushing j (SCC 3-05-020-05)	— [d]		0.0075	E
Fines crushing (controlled)j (SCC 3-05-020-05)	— [d]		0.0010	E
Fines screening j (SCC 3-05-020-21)	— [d]		0.036	E
Fines screening (controlled)j (SCC 3-05-020-21)	— [d]		0.0011	E
Conveyor transfer point k (SCC 3-05-020-06)	— [d]		0.00072	D

Table B.1.1 Emission factors for crushed stone processing operations[a] (kg/ton) (Cont.)

Source [b]	Total Particulate Matter	EMISSION FACTOR RATING	Total PM-10 [c]	EMISSION FACTOR RATING
Truck unloading: fragmented stone m (SCC 3-05-020-31)	ND		8.0×10^{-6}	E
Truck loading—conveyor: crushed stone n (SCC 3-05-020-32)	ND		5.0×10^{-5}	E
Wet drilling: unfragmented stone m (SCC 3-05-020-10)	ND		4.0×10^{-5}	E

[a] Emission factors represent uncontrolled emissions unless noted. Emission factors in kg/Mg of material throughput, SCC = Source Classification Code. ND = no data.

[b] Controlled sources (with wet suppression) are those that are part of the processing plant that employs current wet suppression technology similar to the study group. The moisture content of the study group without wet suppression systems operating (uncontrolled) ranged from 0.21 to 1.3 percent and the same facilities operating wet suppression systems (controlled) ranged from 0.55 to 2.88 percent. Due to carry over or the small amount of moisture required, it has been shown that each source, with the exception of crushers, does not need to employ direct water sprays. Although the moisture content was the only variable measured, other process features may have as much influence on emissions from a given source. Visual observations from each source under normal operating conditions are probably the best indicator of which emission factor is most appropriate. Plants that employ sub-standard control measures as indicated by visual observations should use the uncontrolled factor with an appropriate control efficiency that best reflects the effectiveness of the controls employed.

[c] Although total suspended particulate (TSP) is not a measurable property from a process, some states may require estimates of TSP emissions. No data are available to make these estimates. However, relative ratios in AP-42 Sections 13.2.2 and 13.2.4 indicate that TSP emission factors may be estimated by multiplying PM-10 by 2.1.

[d] Emission factors for total particulate are not presented pending a re-evaluation of the EPA Method 201a test data and/or results of emission testing. This re-evaluation is expected to be completed by July 1995.

[e] References 9, 11, 15-16.

[f] Reference 1.

[g] No data available, but emission factors for PM-10 emission factors for tertiary crushing can be used as an upper limit for primary or secondary crushing.

[h] References 10-11, 15-16.

[j] Reference 12.

[k] References 13-14.

Table B.1.2 Emission factors of PM_{10} for crushed stone processing operations[a] (kg/ton) used in the present study.

Source [b]	PM_{10} (kg/ton)
Truck Unloaded	0.0008***
Primary Crushing	0.00017
Secondary Crushing	0.000045
Tertiary Crushing	0.0012***
Screening	0.0076***
Fine Screening	0.036***
Conveyor Transfer	0.00072***
Truck Loading	0.00005***
Total	0.05275

** It is noted that conveyor transfers are about 10 points in a stone crushing plant.

*** US EPA's Emission Factor

B.2 Calculation of PM_{10} emissions from stone processing operations

The PM_{10} emission rate from stone crushing plants can be estimated by the following correlation.

$$\text{Emission Rate (kg/hr)} = \text{Emission Factor} \times \text{Plant Capacity} \qquad \text{(B.2.1)}$$

An Example:

The total capacity of Silapanai plant is 140 ton/hr, the emission factors of PM_{10} for crushed stone processing operations (kg/ton) is 0.05275 kg/ton, thus, the approximated emission rate of Silapanai plant is:

Calculations:

$$\begin{aligned} \text{Emission Rate} &= 0.05275 \text{ (kg / ton)} \times 140 \text{ (ton / hr)} \\ &= 7.39 \text{ kg / hr} \\ &= 2.05 \text{ g / s} \end{aligned}$$

Table B.2.1 PM_{10} emissions from stone crushing plants for uncontrolled emissions

No.	Plant	Capacity (ton/hr)	PM_{10} Emission Rate (kg/hr)
1	Silapanai	140	7.39
2	Kaewrtanadee1	180	9.50
3	Kaewrtanadee2	180	9.50
4	Rong Mo Hin Pong Taywin	290	15.30
5	Sila Sin Sap 2	430	22.68
6	S. Sila Thong Saraburi 1	320	16.88
7	S. Sila Thong Saraburi 2	230	12.13
8	Saraburi Benjapon	180	9.50
9	Silacharoenkit	180	9.50
10	Sila Boonsupa	180	9.50
11	Sila Mas	290	15.30
12	Sila A. Ratanachai 2	180	9.50
13	Dow Na Pra Laan	150	7.91
14	Na Pra Laan	430	22.68
15	Pornpit Sila 1	430	22.68
16	Saraburi Bhubha Thai	180	9.50
17	Sila Thepnorasingha	290	15.30
18	Sila Permpoon	160	8.44
19	Sila Srivilai	180	9.50
20	Boon Thai Sila	150	7.91
21	Siripatana	500	26.38
22	Sin Chai	450	23.74
23	Pra Bath	580	30.60

24	Cement Thai	250	13.19
25	Sila Lertchit 3	150	7.91
26	Krai Sin	600	31.65
27	Mekrarat	430	22.68
28	Silathip Saraburi	60	3.17
29	Silachai	330	17.41
30	Sila Maharat	180	9.50
31	Tanaworapong	150	7.91
32	Niyomchai	180	9.50
33	Sahasilapuempoon	150	7.91
34	Sila Sai Cret	440	23.21
35	Sila Sumpan	430	22.68
36	Sila Thaworn	150	7.91
37	Sahakanookchot	360	18.99
38	Saha Udomsila	180	9.50
39	Pitaksin	430	22.68
40	Sila Koong Kao Keaw	430	22.68
41	Surin Aomya Chemical 1	180	9.50
42	Palitapan Hin Klet Thai2	320	16.88
43	Sila Tawee Srap	300	15.83
44	Saraburi Chemical Line	130	6.86
45	Sila Chaicharoen	300	15.83
46	Saraburi Cement1	300	15.83
47	Sanont	150	7.91
48	Sahapongnarapan	180	9.50

APPENDIX C

SAMPLED PROBABILITY PLOTS OF METEOROLOGICAL INPUTS

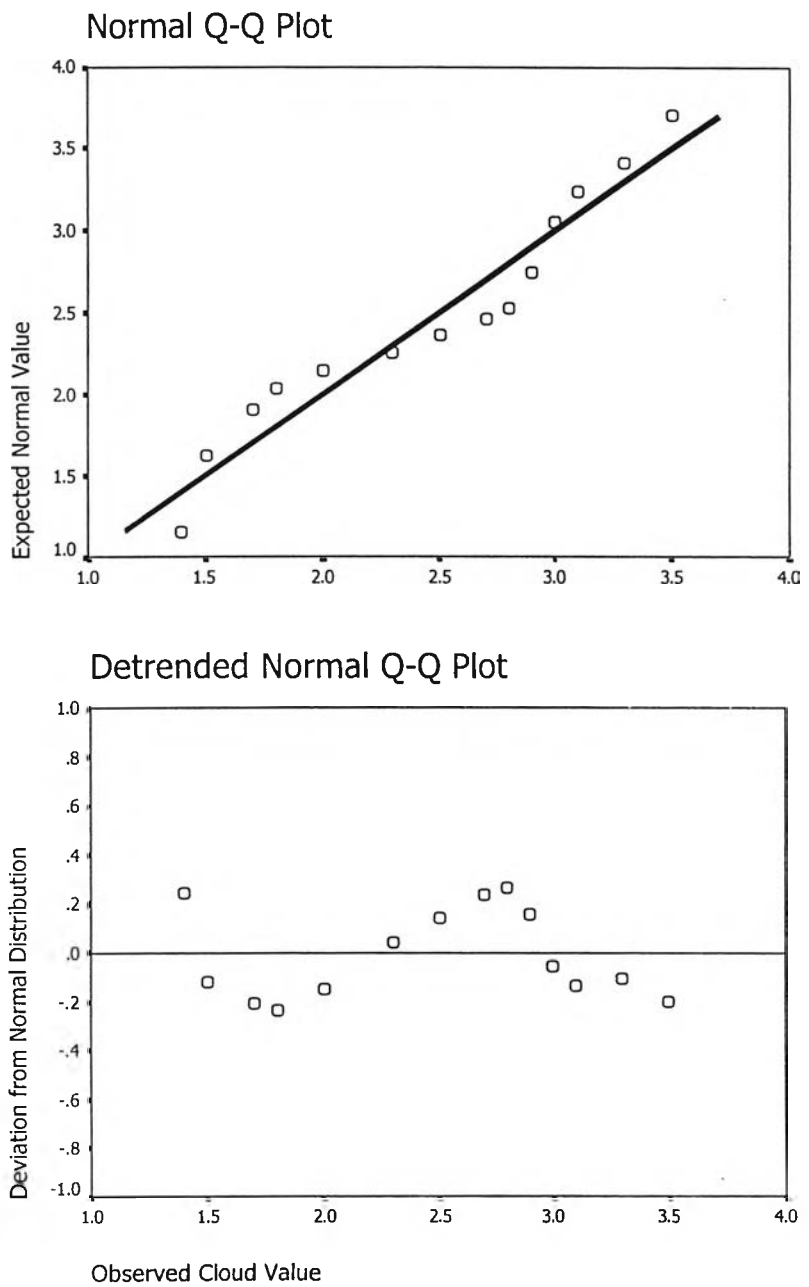


Figure C.1 **(a)** Comparison of normal Q-Q probability distribution plot and detrended plot with historical cloudiness data at 1:00 A.M. for January of 1983 – 2000.

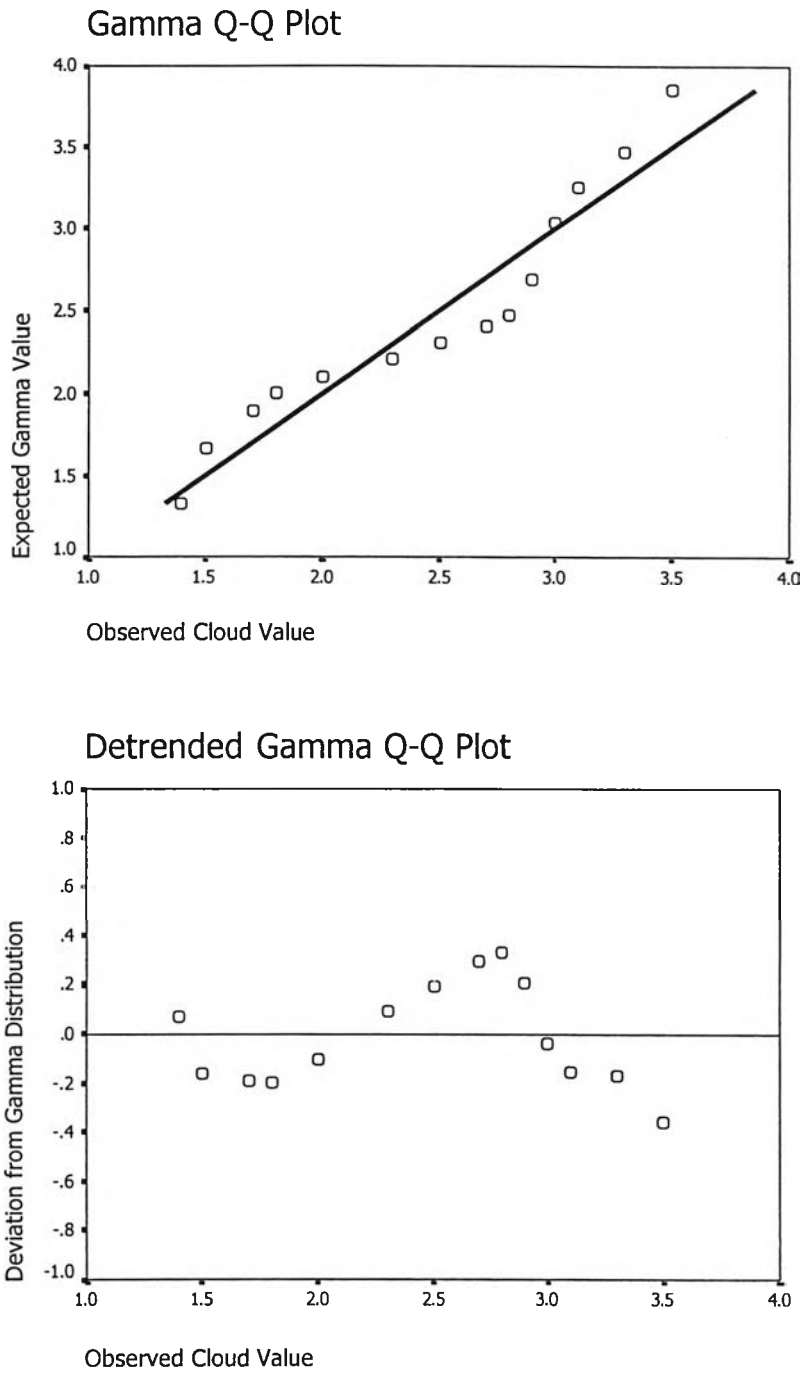


Figure C.1 (b) Comparison of gamma Q-Q probability distribution plot and detrended plot with historical cloudiness data at 1:00 A.M. for January of 1983 – 2000.

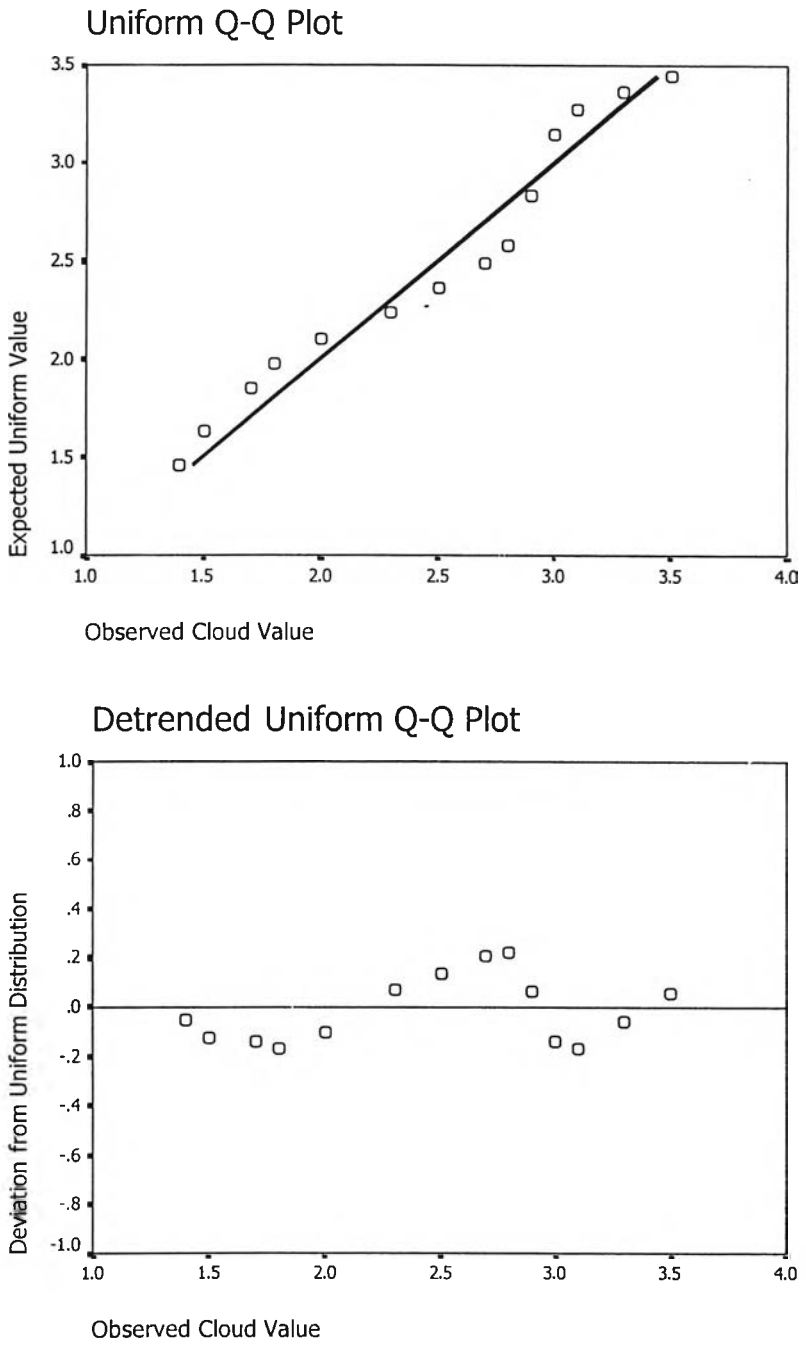


Figure C.1 **(c)** Comparison of uniform Q-Q probability distribution plot and detrended plot with historical cloudiness data at 1:00 A.M. for January of 1983 – 2000.

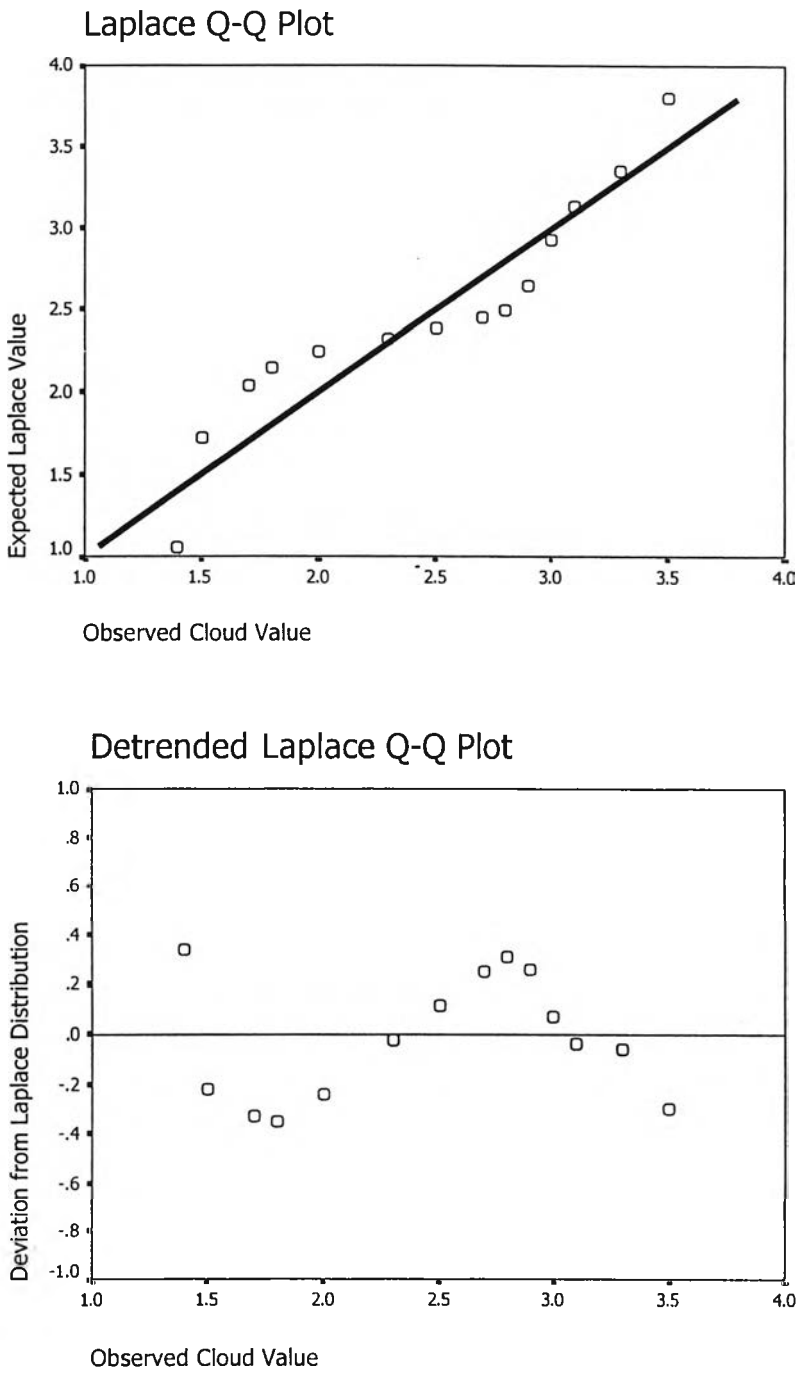


Figure C.1 (d) Comparison of Laplace Q-Q probability distribution plot and detrended plot with historical cloudiness data at 1:00 A.M. for January of 1983 – 2000.

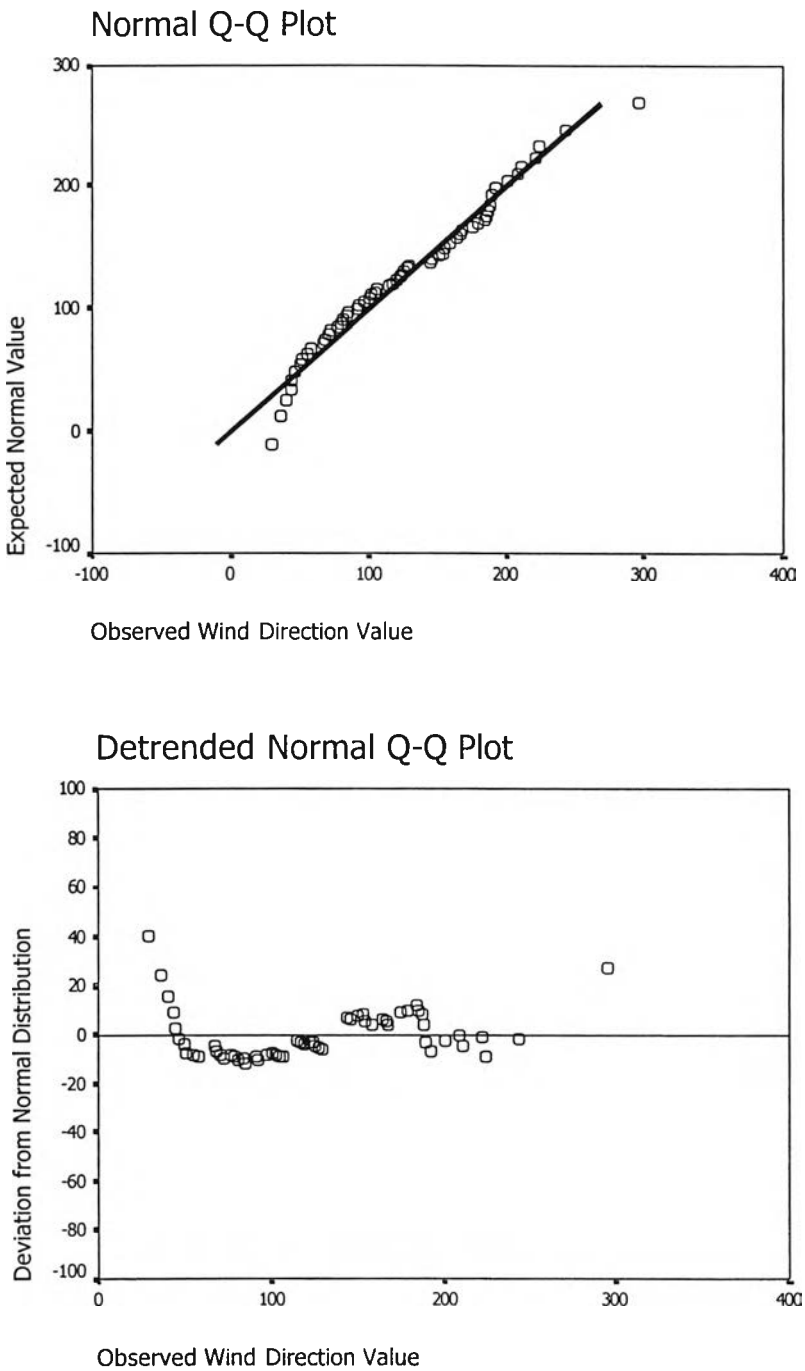


Figure C.2 (a) Comparison of normal Q-Q probability distribution plot and detrended plot with historical wind direction data at 1:00 A.M. for January of 1995 – 2000.

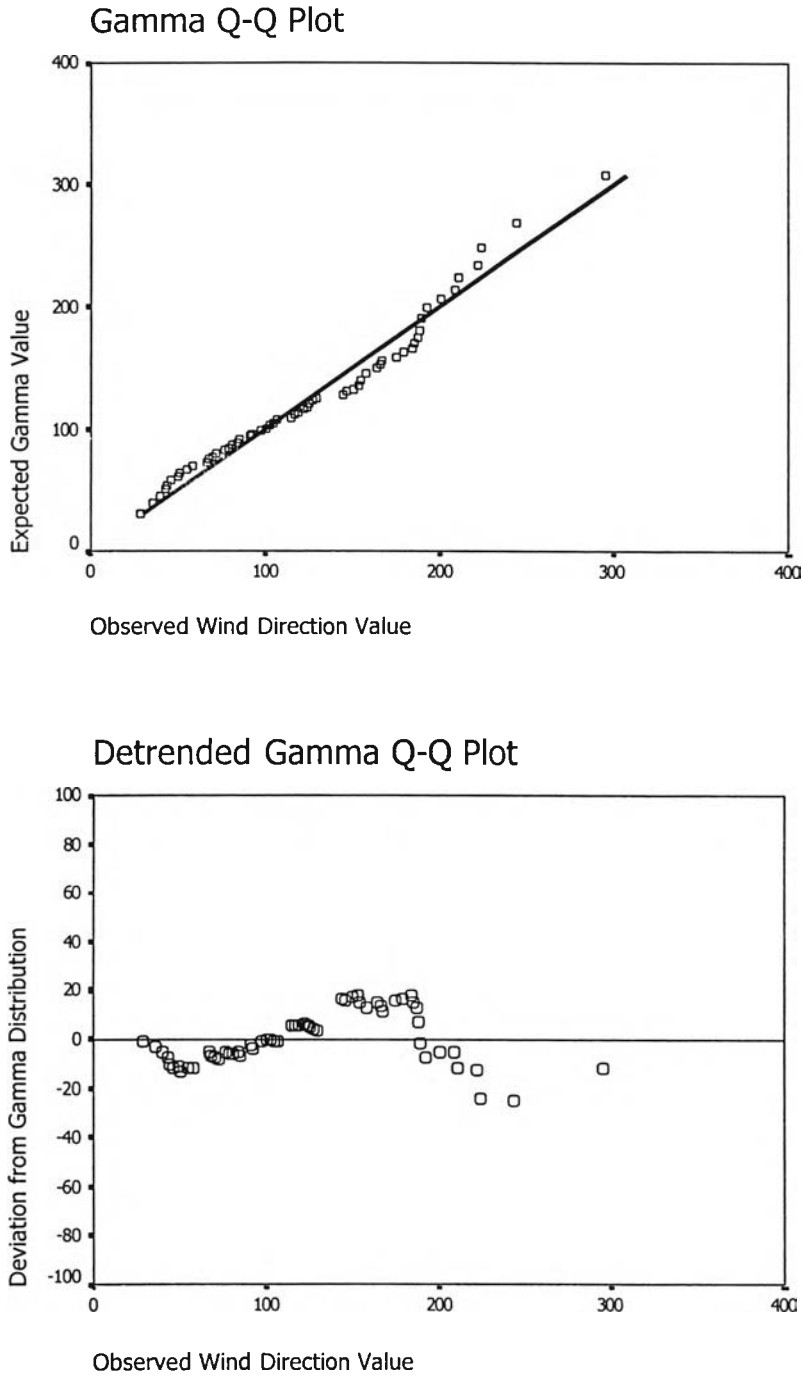


Figure C.2 (b) Comparison of gamma Q-Q probability distribution plot and detrended plot with historical wind direction data at 1:00 A.M. for January of 1995 – 2000.

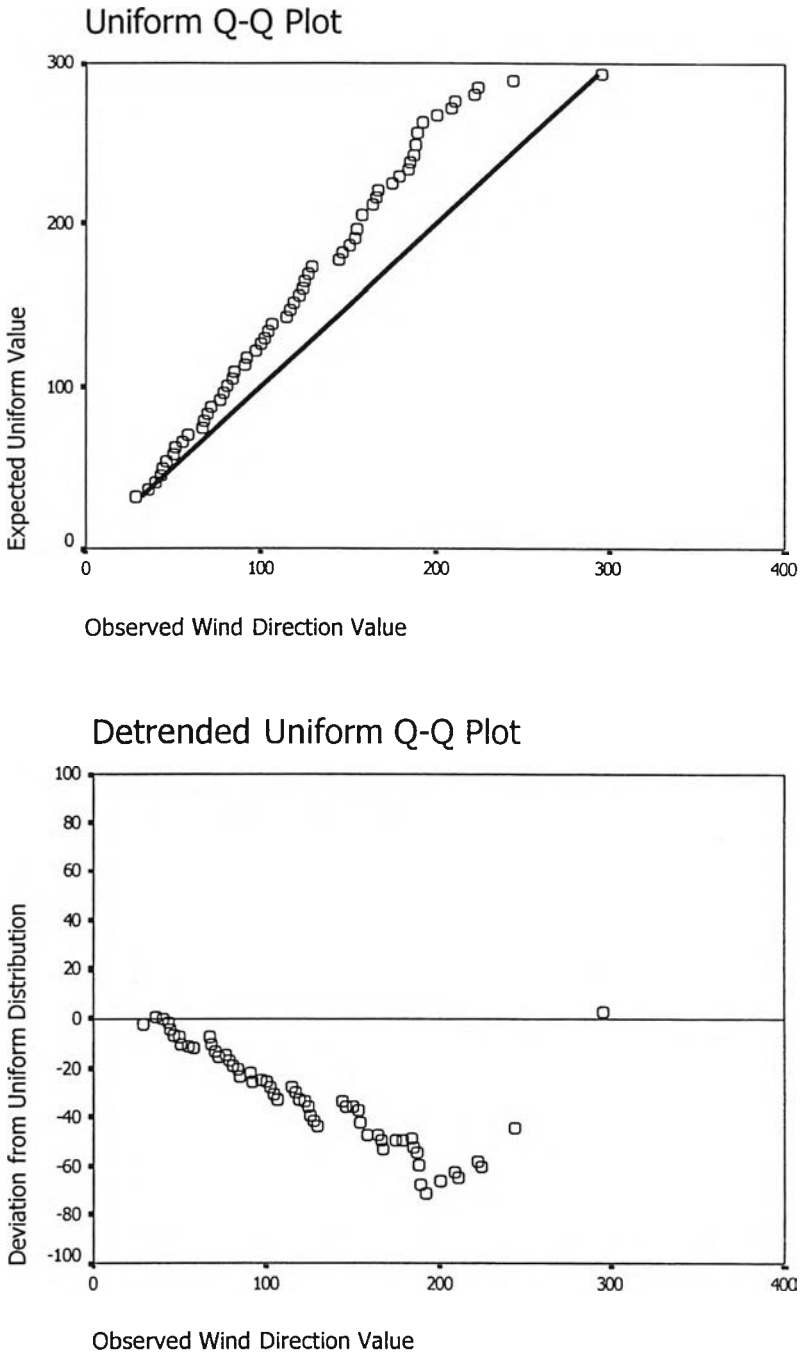


Figure C.2 (c) Comparison of uniform Q-Q probability distribution plot and detrended plot with historical wind direction data at 1:00 A.M. for January of 1995 – 2000.

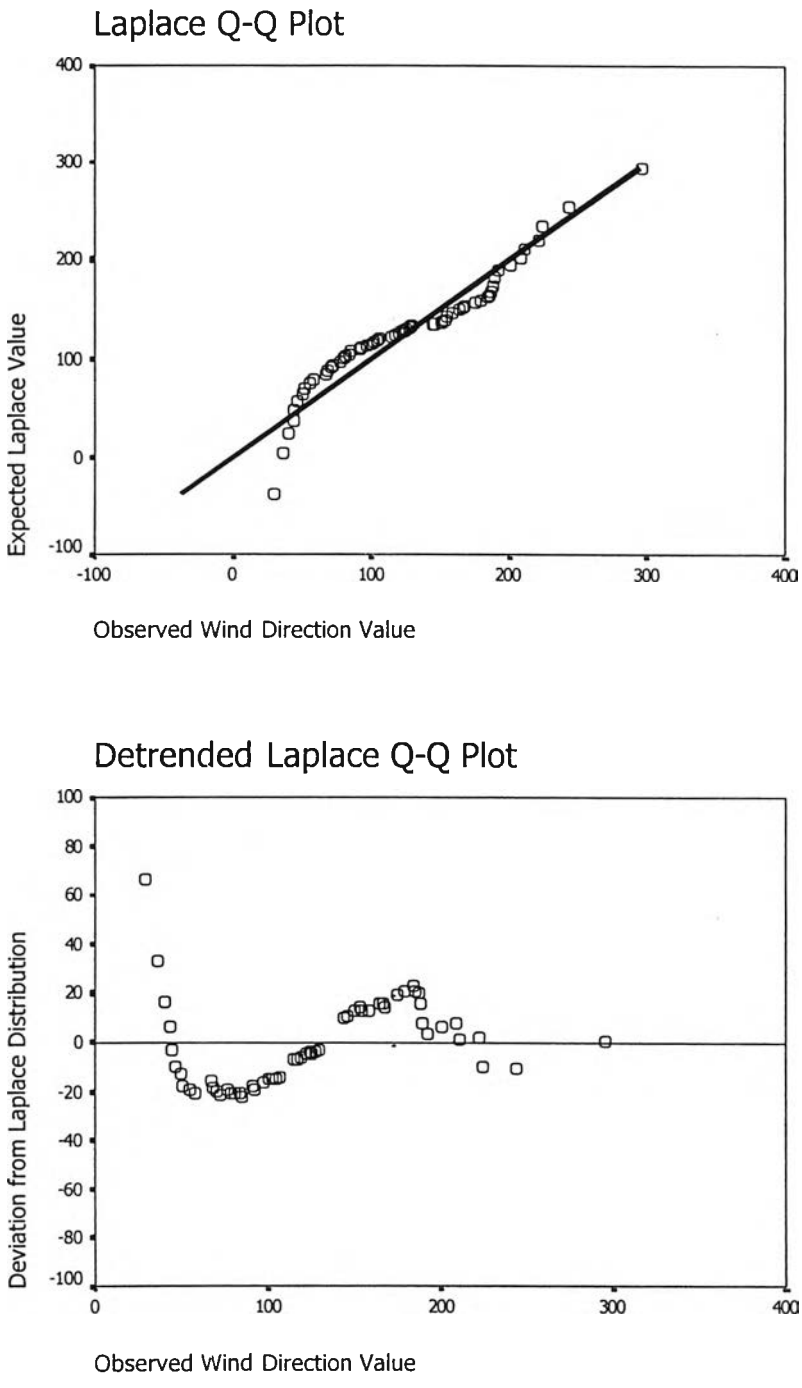


Figure C.2 (d) Comparison of Laplace Q-Q probability distribution plot and detrended plot with historical wind direction data at 1:00 A.M. for January of 1995 – 2000.

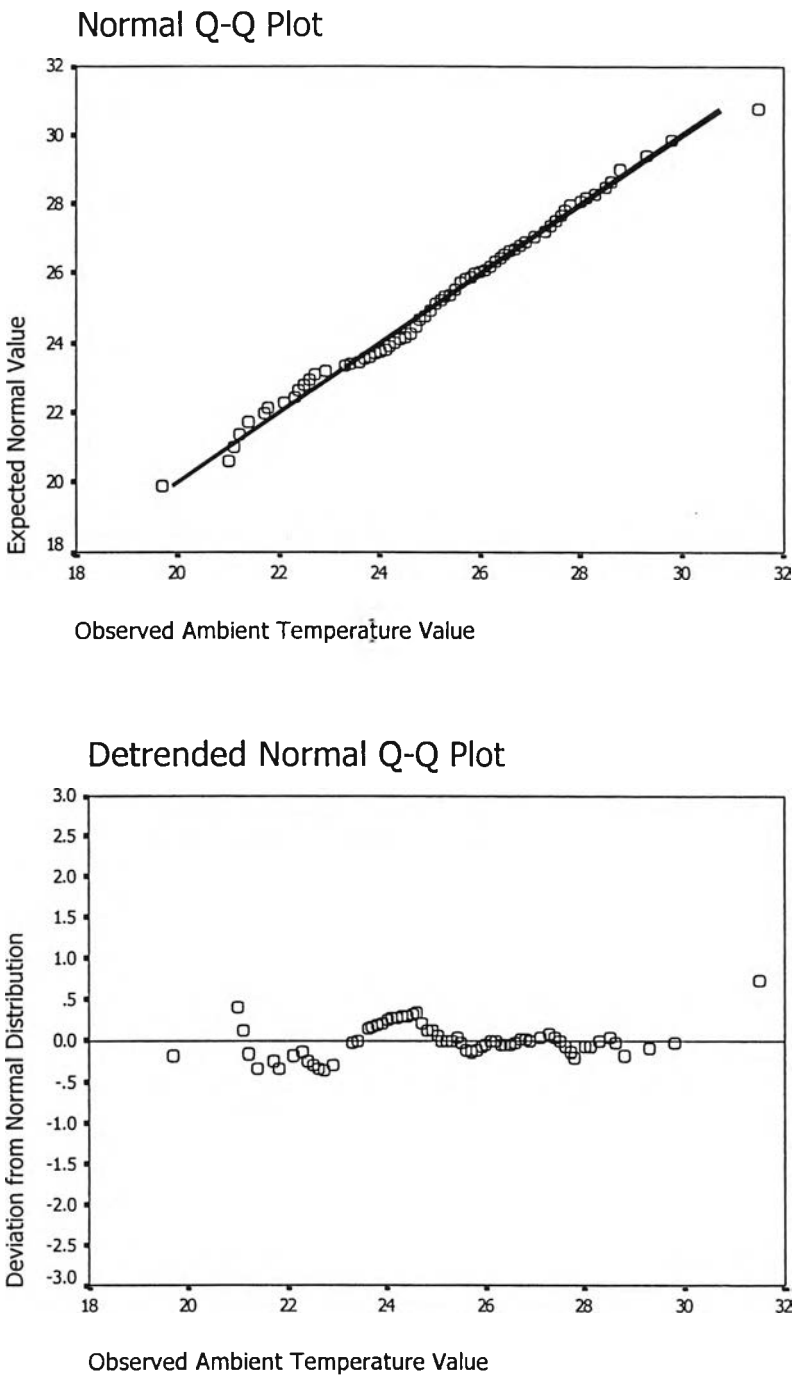


Figure C.3 (a) Comparison of normal Q-Q probability distribution plot and detrended plot with historical ambient temperature data at 1:00 A.M. for January of 1995 – 2000.

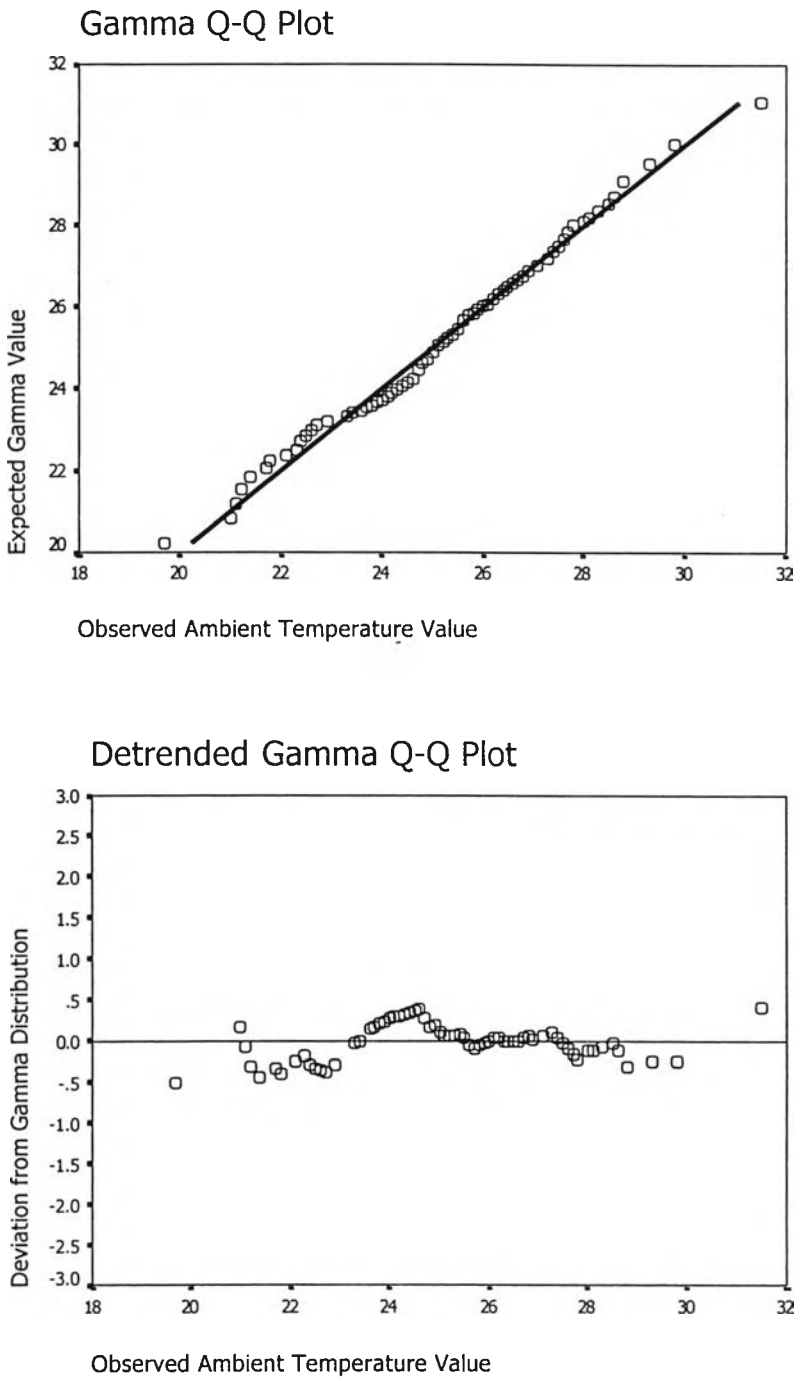


Figure C.3 (b) Comparison of gamma Q-Q probability distribution plot and detrended plot with historical ambient temperature data at 1:00 A.M. for January of 1995 – 2000.

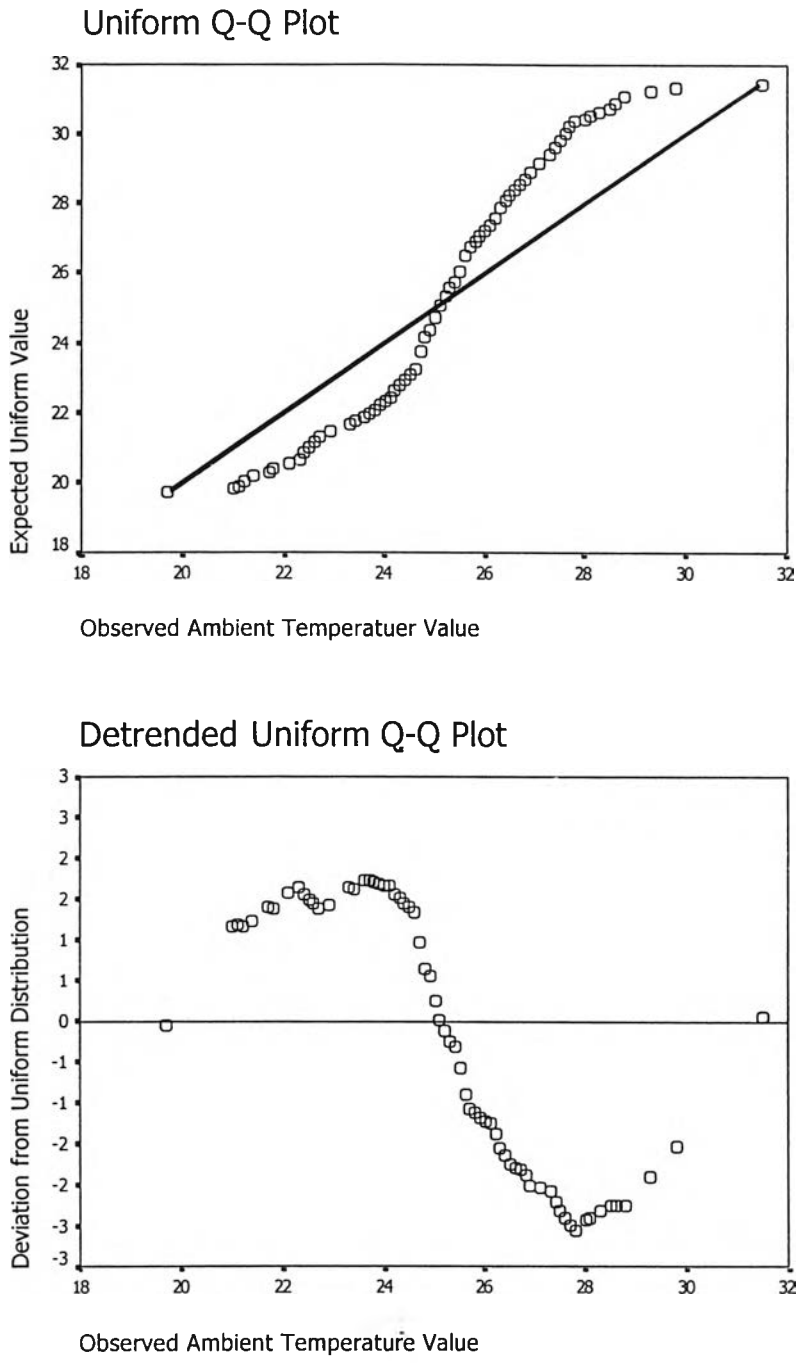


Figure C.3 (c) Comparison of uniform Q-Q probability distribution plot and detrended plot with historical ambient temperature data at 1:00 A.M. for January of 1995 – 2000.

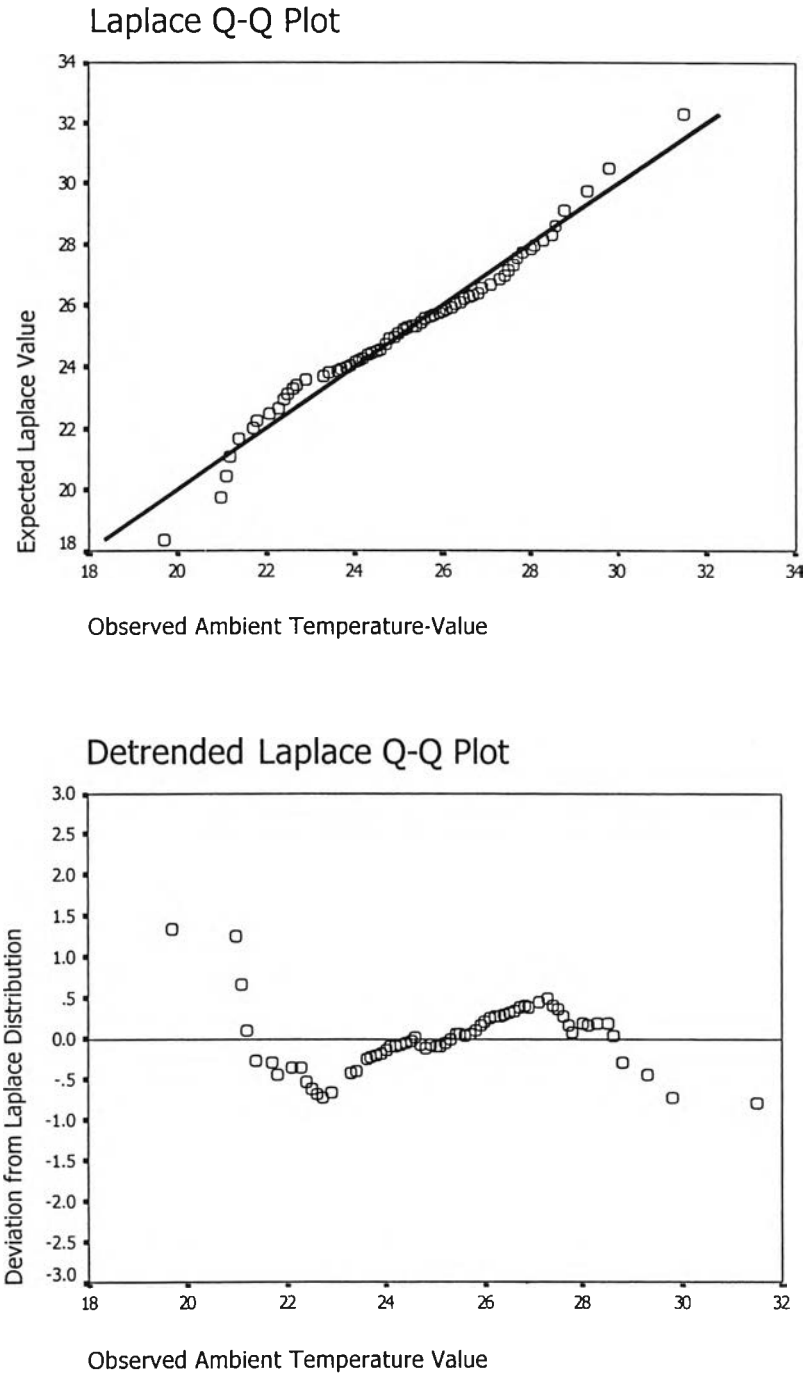
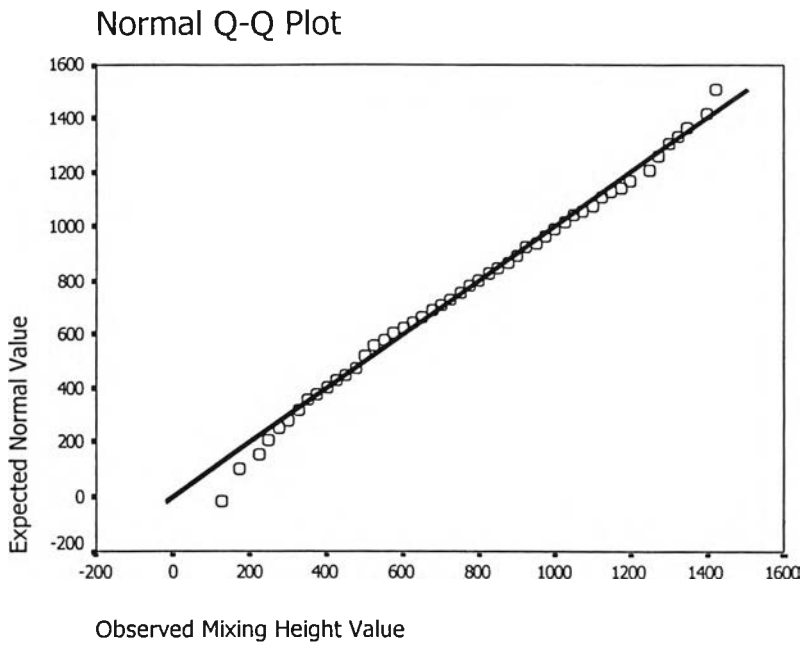


Figure C.3 (d) Comparison of Laplace Q-Q probability distribution plot and detrended plot with historical ambient temperature data at 1:00 A.M. for January of 1995 – 2000.



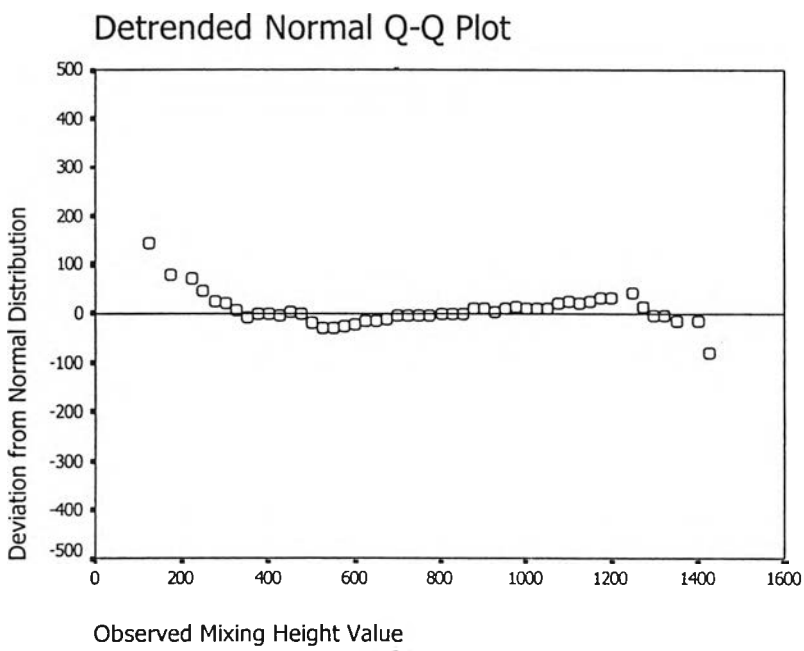


Figure C.4 (a) Comparison of normal Q-Q probability distribution plot and detrended plot with historical mixing height data at 1:00 A.M. for January of 1993 – 2000.

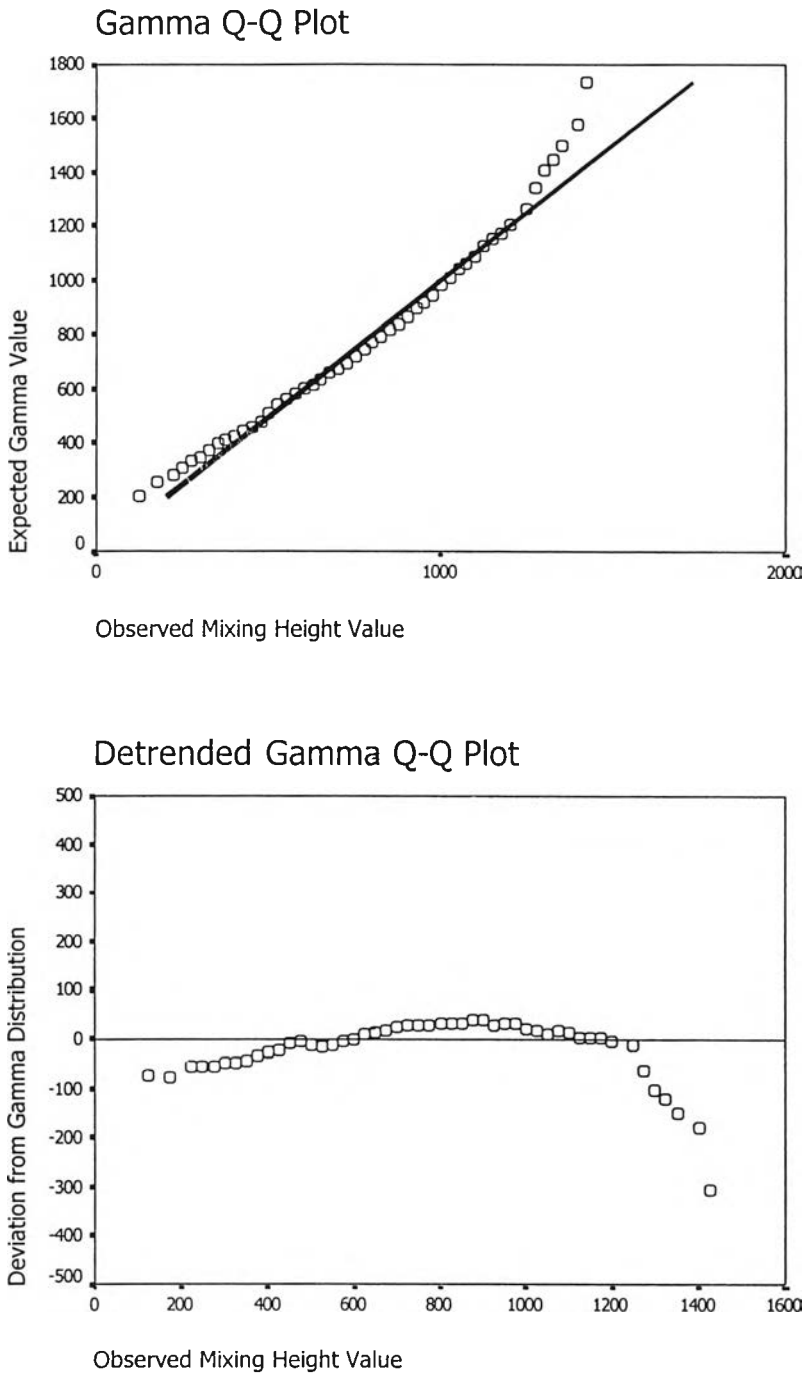


Figure C.4 (b) Comparison of gamma Q-Q probability distribution plot and detrended plot with historical mixing height data at 1:00 A.M. for January of 1993 – 2000.

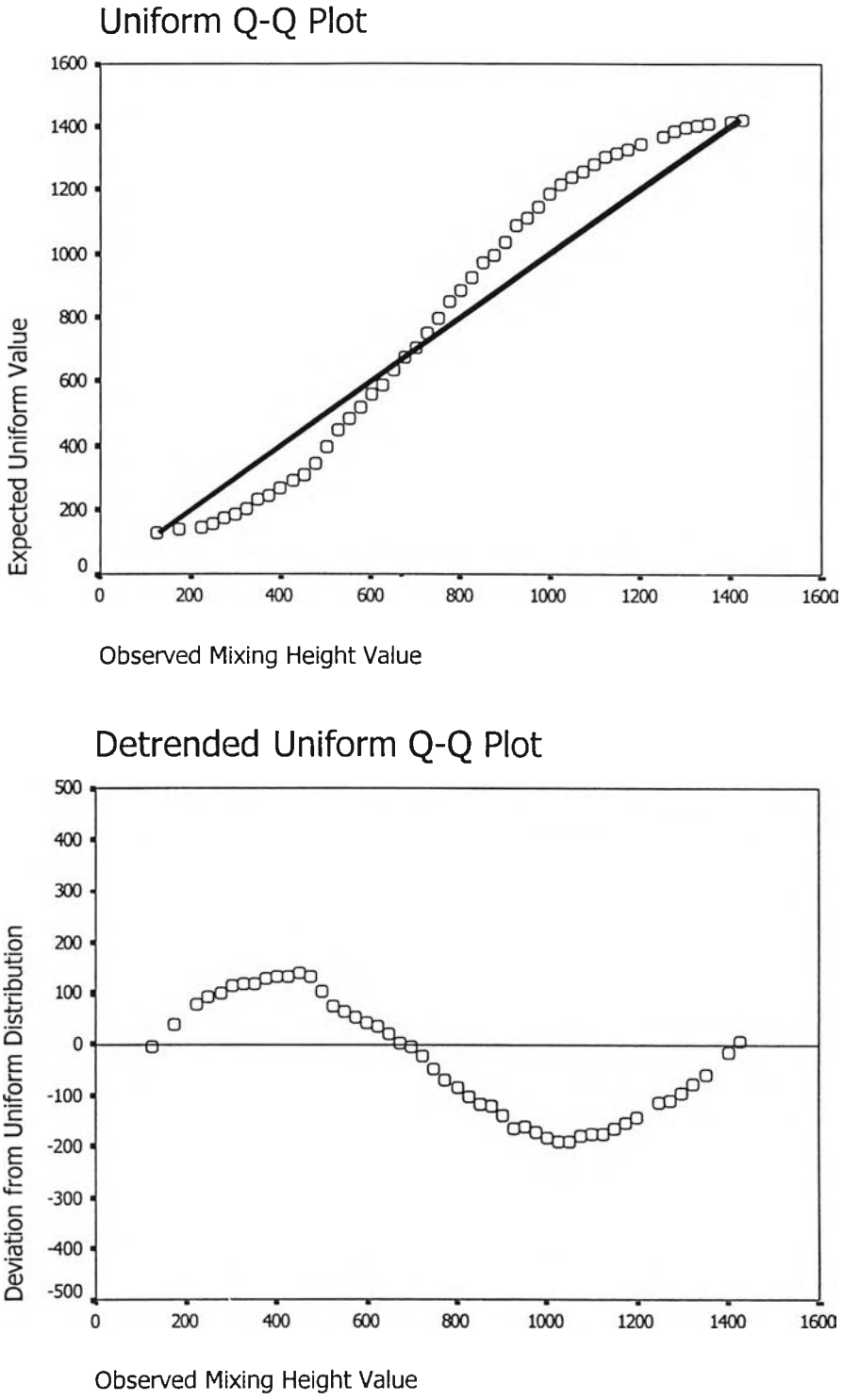
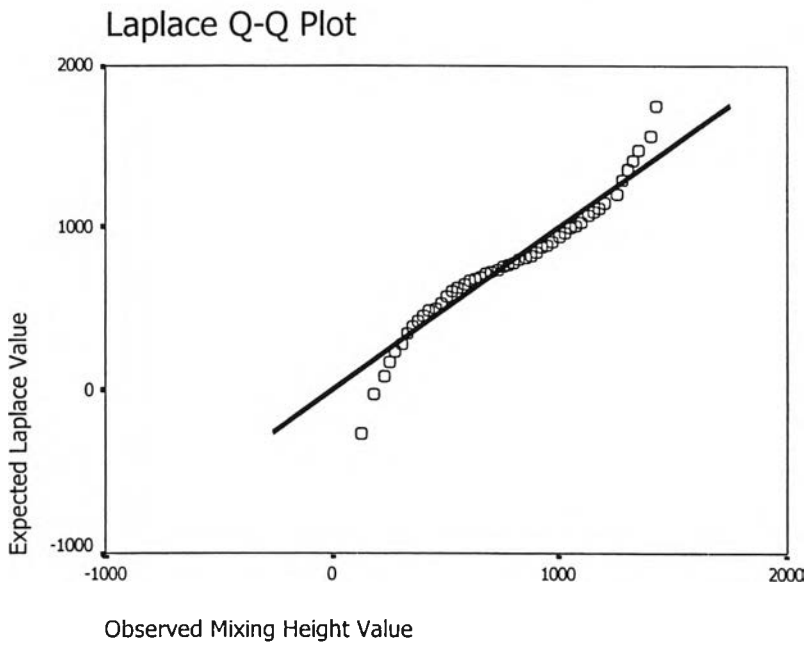


Figure C.4 (c) Comparison of uniform Q-Q probability distribution plot and detrended plot with historical mixing height data at 1:00 A.M. for January of 1993 – 2000.



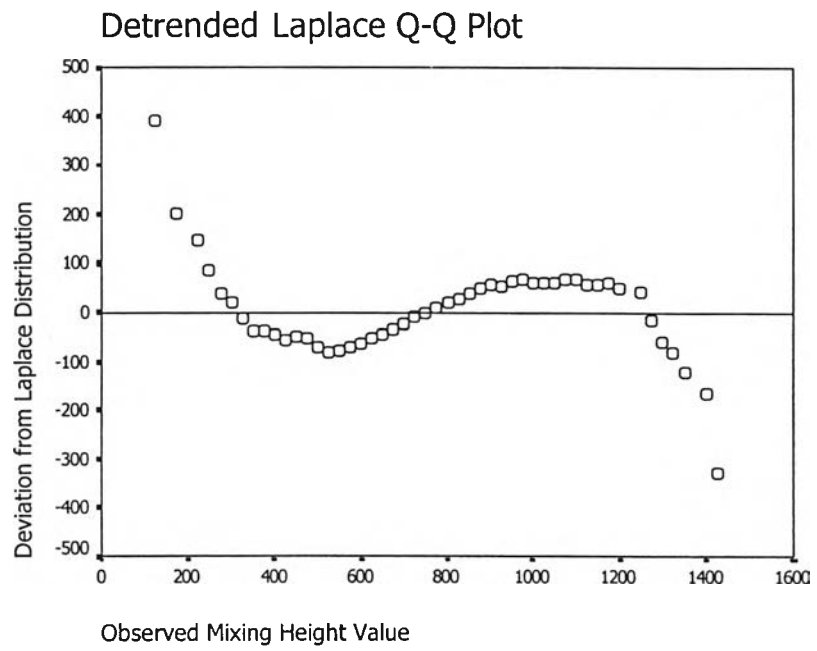


Figure C.4 (d) Comparison of gamma Q-Q probability distribution plot and detrended plot with historical mixing height data at 1:00 A.M. for January of 1993 – 2000.

APPENDIX D

GENERATED GAMMA RANDOM WIND DATA

Table D.1 The frequency value of occurrence of three different wind speeds in each wind direction sector

Wind Direction Sector (^{o})	Frequency of Wind Speed (m/s)		
	0 – 1.5	1.5 – 2.0	> 2.0
0 – 22.5	0	0	0
22.5 – 45	133	43	39
45 – 67.5	4,221	1,378	1,616
67.5 – 90	19,358	6,666	7,593
90 – 112.5	33,596	9,448	9,790
112.5 – 135	44,475	8,612	7,145
135 – 157.5	63,367	8,485	4,531
157.5 – 180	75,317	12,595	3,999
180 – 202.5	54,385	15,133	4,342
202.5 – 225	22,246	7,516	2,023
225 – 247.5	5,662	1,804	477
247.5 – 270	1,146	312	79
270 – 292.5	252	53	29
292.5 - 315	79	12	6
315 – 337.5	19	5	3
337.5 - 360	8	1	1

APPENDIX E

GAMMA DISTRIBUTION AND ITS PARAMETERS FOR THE GAMMA RANDOM VARIABLE GENERATION

The Probability distribution function of the gamma distribution is

$$f_x(x) = \frac{\nu(\nu x)^{k-1} e^{-\nu x}}{\Gamma(k)} \quad ; \quad x \geq 0 \qquad \text{(E.1)}$$

with shape parameter ν and scale parameter k

and $$\Gamma(k) = \int_0^\infty x^{k-1} e^{-x} dx \quad ; \quad k > 0 \qquad \text{(E.2)}$$

By integration-by-part, for $k > 0$, it yields

$$\Gamma(k) = (k-1)\,\Gamma(k-1) \qquad \text{(E.3)}$$

For the value of the hourly shape parameter and scale parameter for generating the gamma variable of meteorological inputs, which are wind speed, wind direction, ambient temperature, mixing height and cloudiness used in the present study are shown in Table E.1 – E.60.

Table E.1 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in January

Hour	Shape Parameter	Scale Parameter
1	1.113923	1.735025
2	0.969121	1.641098
3	0.986826	1.417507
4	0.889326	1.18749
5	0.862265	1.053917
6	0.810646	0.945599
7	0.788165	0.861538
8	0.929505	0.85412
9	1.539975	1.113038
10	2.344473	1.621114
11	2.783974	1.912485
12	2.750436	1.903347
13	3.181031	2.214391
14	3.342619	2.49999
15	4.454736	3.395378
16	3.682885	2.918049
17	3.390977	2.787426
18	2.297117	2.191466
19	1.22099	1.481028
20	0.90735	1.212864
21	1.113514	1.66144
22	1.173611	1.882375
23	0.926006	1.448114
24	0.99443	1.47323

Table E.2 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in February

Hour	Shape Parameter	Scale Parameter
1	1.134962	1.02466
2	1.090328	1.017321
3	0.832143	0.714108
4	0.712052	0.602652
5	0.703878	0.610009
6	0.60185	0.55739
7	0.610616	0.50254
8	0.880617	0.652537
9	1.699226	1.005669
10	2.423359	1.199683
11	2.56048	1.347788
12	2.371757	1.347322
13	2.204332	1.319133
14	2.40644	1.448851
15	3.247562	1.987124
16	3.202907	1.982368
17	2.775398	1.802206
18	2.650466	1.880538
19	1.483916	1.389102
20	1.06545	1.09329
21	1.110604	1.069323
22	0.953699	0.973509
23	1.083972	1.109869
24	1.129085	1.099584

Table E.3 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in March

Hour	Shape Parameter	Scale Parameter
1	2.350445	2.699305
2	2.213273	2.446804
3	1.870966	2.122739
4	1.55658	2.031888
5	1.334158	1.989026
6	1.468018	2.423688
7	1.420639	2.165775
8	2.181713	2.121296
9	5.483566	3.476181
10	7.706642	4.197923
11	5.114833	2.89678
12	5.106963	3.120746
13	6.271667	4.264971
14	6.599857	4.575592
15	5.819792	4.138658
16	5.814729	3.836342
17	5.62703	3.862066
18	3.143967	2.328002
19	2.145413	1.922413
20	2.084122	2.098199
21	1.955013	2.110783
22	2.382446	2.403317
23	2.73627	2.805674
24	2.413826	2.593311

Table E.4 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in April

Hour	Shape Parameter	Scale Parameter
1	1.473365	1.834445
2	1.277853	1.834239
3	0.992026	1.62043
4	1.009258	1.62043
5	0.642435	1.137389
6	0.610283	1.03321
7	0.90098	1.499551
8	1.51141	1.647912
9	3.24585	2.471672
10	3.166213	2.184872
11	3.443403	2.349223
12	6.495696	4.276767
13	7.093645	4.777938
14	6.987712	4.857638
15	4.677659	3.676923
16	5.407681	4.405442
17	4.129711	3.393818
18	2.520234	2.404039
19	1.750647	1.846674
20	1.520771	2.086583
21	1.382113	1.856846
22	1.202169	1.627909
23	1.134625	1.491597
24	1.293694	1.609486

Table E.5 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in May

Hour	Shape Parameter	Scale Parameter
1	0.757309	2.181547
2	1.071124	3.825444
3	0.942905	3.763018
4	1.866058	7.821799
5	0.620244	2.744443
6	1.394211	8.516126
7	1.414721	6.009129
8	2.013571	3.6744
9	4.088526	3.967242
10	3.900178	3.214937
11	3.668413	2.843731
12	4.7054	3.633914
13	5.412691	4.007704
14	6.045449	4.320823
15	5.148755	3.826039
16	3.679566	2.87723
17	5.082511	4.035569
18	3.069953	2.591615
19	2.696089	2.991856
20	1.889834	3.018904
21	1.28893	2.26355
22	1.00373	2.149972
23	1.136942	2.602548
24	0.940824	3.106495

Table E.6 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in June

Hour	Shape Parameter	Scale Parameter
1	0.757309	2.181547
2	1.071124	3.825444
3	0.942905	3.763018
4	1.866058	7.821799
5	0.620244	2.744443
6	1.394211	8.516126
7	1.414721	6.009129
8	2.013571	3.6744
9	4.088526	3.967242
10	3.900178	3.214937
11	3.668413	2.843731
12	4.7054	3.633914
13	5.412691	4.007704
14	6.045449	4.320823
15	5.148755	3.826039
16	3.679566	2.87723
17	5.082511	4.035569
18	3.069953	2.591615
19	2.696089	2.991856
20	1.889834	3.018904
21	1.28893	2.26355
22	1.00373	2.149972
23	1.136942	2.602548
24	0.940824	3.106495

Table E.7 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in July

Hour	Shape Parameter	Scale Parameter
1	2.901062	4.212918
2	3.165509	5.053584
3	2.612524	4.972397
4	1.870281	3.486167
5	2.245553	4.291605
6	1.975703	4.165299
7	2.459389	4.536261
8	3.753086	4.689773
9	4.54489	3.838415
10	8.607703	5.362604
11	9.179608	5.118998
12	9.898948	5.418063
13	9.71599	5.224409
14	10.67383	5.943292
15	10.65851	5.845909
16	10.44393	6.172931
17	6.461007	4.260511
18	4.766174	3.27177
19	3.9987	3.266467
20	2.613585	2.637025
21	2.988725	3.206978
22	3.805947	4.120725
23	2.057672	2.493309
24	2.444879	3.481317

Table E.8 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in August

Hour	Shape Parameter	Scale Parameter
1	1.839184	3.390549
2	1.610528	3.145562
3	1.589962	3.059538
4	1.475734	2.963062
5	1.186735	2.572564
6	1.499672	3.399109
7	1.470842	2.937213
8	2.296976	2.824402
9	5.729589	4.589658
10	7.932616	5.23793
11	7.912482	4.923659
12	10.49134	6.392447
13	10.7298	6.447514
14	9.886926	6.122144
15	7.258431	4.855316
16	5.030928	3.753193
17	4.596579	3.636345
18	4.010185	3.677956
19	2.109464	2.283078
20	1.657804	2.234634
21	1.975935	2.592792
22	1.76668	2.81917
23	2.085651	3.437462
24	1.827549	3.078945

Table E.9 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in September

Hour	Shape Parameter	Scale Parameter
1	1.883553	4.464621
2	1.627249	3.633662
3	1.196233	2.344202
4	1.09709	2.259986
5	0.881619	1.596214
6	1.098585	2.03387
7	1.400741	2.250841
8	2.477729	2.687679
9	4.802683	4.017763
10	4.925173	3.484078
11	4.385651	3.040694
12	4.993372	3.345643
13	6.056259	4.122791
14	4.029758	2.927289
15	4.186791	3.34788
16	4.425729	3.601973
17	4.005544	4.07567
18	2.378589	2.587491
19	2.341258	3.205266
20	1.618754	2.190078
21	1.834667	2.573377
22	1.341186	2.430605
23	1.590439	3.187744
24	1.220589	2.821645

Table E.10 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in October

Hour	Shape Parameter	Scale Parameter
1	0.935299	1.443946
2	0.846918	1.123339
3	0.690563	0.778831
4	0.787937	0.946848
5	0.784773	0.928394
6	0.86075	0.920767
7	0.882036	0.814493
8	1.190137	0.891727
9	1.684352	1.051624
10	1.987794	1.179944
11	2.476589	1.348529
12	2.50863	1.465441
13	3.0586	1.814567
14	3.302012	1.99137
15	3.257429	2.133952
16	2.700964	1.933812
17	2.520233	2.038424
18	1.469622	1.423049
19	1.225909	1.499004
20	1.15796	1.5506
21	1.110493	1.517357
22	1.158737	1.618347
23	1.211056	1.710014
24	1.206974	1.860373

Table E.11 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in November

Hour	Shape Parameter	Scale Parameter
1	1.272119	1.202255
2	1.408678	1.16591
3	1.665318	1.269083
4	1.674466	1.158711
5	1.647365	1.070103
6	1.760994	1.104764
7	2.018867	1.206174
8	2.544616	1.333967
9	3.474208	1.552834
10	3.805072	1.595269
11	4.406878	1.901794
12	5.349746	2.373094
13	5.114636	2.306892
14	4.815845	2.286002
15	5.229573	2.614351
16	4.086467	2.344203
17	3.809714	2.371027
18	2.630979	1.998887
19	1.775688	1.70648
20	1.469605	1.428342
21	1.620535	1.581696
22	1.389561	1.464237
23	1.259967	1.263944
24	1.060502	1.027573

Table E.12 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind speed in December

Hour	Shape Parameter	Scale Parameter
1	1.82032	1.531485
2	1.761052	1.330457
3	1.624301	1.155663
4	1.661084	1.052377
5	1.759828	1.084
6	2.111394	1.172816
7	2.418234	1.274059
8	3.079293	1.504133
9	3.670172	1.633585
10	3.850432	1.583876
11	4.016892	1.674351
12	4.728147	2.06628
13	4.559106	2.084428
14	4.401518	2.104404
15	4.30874	2.133137
16	3.921625	2.101392
17	3.601682	2.118868
18	2.836655	2.00169
19	2.323017	1.865184
20	1.79759	1.587406
21	2.056214	1.932667
22	1.855478	1.648698
23	1.749699	1.5071
24	1.781449	1.550554

Table E.13 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in January

Hour	Shape Parameter	Scale Parameter
1	4.561527	0.035432
2	4.8927	0.038258
3	5.22893	0.040178
4	5.428462	0.04316
5	5.599833	0.043732
6	5.42317	0.043185
7	5.347257	0.043969
8	6.464491	0.058648
9	5.587885	0.049338
10	6.409049	0.049939
11	5.588447	0.03968
12	7.962465	0.052169
13	8.977449	0.056285
14	10.58224	0.062148
15	10.93403	0.064754
16	9.172444	0.051969
17	6.83498	0.038871
18	5.256852	0.029597
19	4.459753	0.025745
20	4.34928	0.028145
21	3.50746	0.025289
22	4.927718	0.037653
23	6.350052	0.051851
24	5.692798	0.045589

Table E.14 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in February

Hour	Shape Parameter	Scale Parameter
1	4.541984	0.036285
2	4.587889	0.036963
3	4.061584	0.032894
4	5.286158	0.045351
5	4.27689	0.038403
6	4.846914	0.0455
7	4.28286	0.040789
8	4.918017	0.048668
9	6.212686	0.058707
10	5.148333	0.044864
11	4.874114	0.037722
12	6.156408	0.043195
13	7.249183	0.048013
14	7.588871	0.047498
15	8.231157	0.050498
16	7.816487	0.04928
17	6.434475	0.039382
18	4.979823	0.032344
19	4.295354	0.03111
20	4.845491	0.036988
21	4.37121	0.03599
22	4.360046	0.034768
23	4.653264	0.03661
24	5.204235	0.039536

Table E.15 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in March

Hour	Shape Parameter	Scale Parameter
1	24.89993	0.146245
2	18.54597	0.113255
3	21.89197	0.134849
4	21.16846	0.137087
5	17.59921	0.121276
6	18.0369	0.126015
7	13.81984	0.098264
8	10.82255	0.080187
9	18.67663	0.127893
10	20.2355	0.1279
11	23.36239	0.140211
12	29.03215	0.167025
13	35.38063	0.192922
14	42.80014	0.230902
15	28.76198	0.152803
16	21.77233	0.116266
17	26.58881	0.14111
18	22.82712	0.128077
19	17.01646	0.100543
20	17.43729	0.100262
21	25.05784	0.14588
22	34.23882	0.199443
23	24.73601	0.145268
24	34.56589	0.204195

Table E.16 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in April

Hour	Shape Parameter	Scale Parameter
1	18.1526	0.107261
2	14.62545	0.090196
3	17.51514	0.105729
4	16.27912	0.104672
5	10.70716	0.07162
6	9.416066	0.061871
7	11.72397	0.078381
8	10.31662	0.073646
9	13.7048	0.093543
10	18.48231	0.111442
11	18.91361	0.107557
12	22.77906	0.121122
13	37.96514	0.196676
14	33.53012	0.166929
15	32.88297	0.166518
16	23.03415	0.115171
17	18.69042	0.095773
18	13.61982	0.075311
19	14.12981	0.079419
20	17.52107	0.102503
21	16.65519	0.098958
22	19.25144	0.109658
23	14.63041	0.08324
24	21.04747	0.120353

Table E.17 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in May

Hour	Shape Parameter	Scale Parameter
1	20.24831	0.12593
2	16.82508	0.106946
3	21.8884	0.131335
4	17.06525	0.106895
5	16.04189	0.102599
6	17.35644	0.109817
7	11.67973	0.079954
8	11.97413	0.079189
9	19.23156	0.114981
10	31.61573	0.175125
11	39.0356	0.205033
12	39.02454	0.198517
13	69.47926	0.34153
14	55.78158	0.271252
15	34.23725	0.168002
16	23.29259	0.115744
17	17.86158	0.089786
18	13.93607	0.073106
19	10.03997	0.058024
20	17.4117	0.105577
21	18.65945	0.113565
22	17.84814	0.10631
23	15.5753	0.095781
24	22.2193	0.135257

Table E.18 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in June

Hour	Shape Parameter	Scale Parameter
1	25.92687	0.150873
2	25.31663	0.14719
3	19.80428	0.117025
4	13.18313	0.080669
5	12.58852	0.081764
6	16.61797	0.102071
7	16.08935	0.098522
8	21.26158	0.128528
9	55.31129	0.313652
10	119.9041	0.647861
11	133.9943	0.683913
12	83.95955	0.422724
13	57.59112	0.289571
14	51.03878	0.251518
15	23.82273	0.120951
16	30.22332	0.154261
17	37.21643	0.194576
18	32.53148	0.17251
19	31.26905	0.167905
20	12.79937	0.067694
21	20.58966	0.110628
22	16.15345	0.087829
23	23.05136	0.127949
24	19.73375	0.119686

Table E.19 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in July

Hour	Shape Parameter	Scale Parameter
1	20.6378	0.122445
2	28.73831	0.165436
3	25.56777	0.152041
4	31.33776	0.182911
5	21.97769	0.133536
6	20.25455	0.122844
7	20.23803	0.119964
8	33.7146	0.184489
9	49.99996	0.284815
10	79.20851	0.432382
11	102.9968	0.535007
12	87.6251	0.436425
13	81.54518	0.399415
14	67.78993	0.32052
15	52.48334	0.250597
16	39.65958	0.193447
17	30.09055	0.15452
18	25.49474	0.133637
19	25.93163	0.13526
20	28.81716	0.150288
21	27.64171	0.148564
22	46.52322	0.258528
23	34.22725	0.187019
24	35.60636	0.203606

Table E.20 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in August

Hour	Shape Parameter	Scale Parameter
1	17.57729	0.108905
2	25.31185	0.154955
3	23.31508	0.144888
4	17.56735	0.114122
5	16.25953	0.106878
6	15.50441	0.105045
7	13.16464	0.087721
8	17.3556	0.110649
9	28.19443	0.166106
10	48.89824	0.271607
11	55.0903	0.287572
12	51.74057	0.263716
13	57.17654	0.2803
14	47.01355	0.226838
15	36.81129	0.179293
16	26.87284	0.134701
17	24.37804	0.124762
18	18.9102	0.102644
19	16.16921	0.090065
20	16.72898	0.096327
21	15.23686	0.090482
22	16.31708	0.101108
23	15.15619	0.094971
24	13.62306	0.085852

Table E.21 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in September

Hour	Shape Parameter	Scale Parameter
1	11.07395	0.074311
2	9.718283	0.068055
3	10.56671	0.075244
4	8.337546	0.058932
5	10.92219	0.074261
6	7.736358	0.057734
7	7.136347	0.052849
8	5.630031	0.04231
9	7.627956	0.052748
10	9.386073	0.05861
11	10.40381	0.062319
12	12.56069	0.070465
13	12.86774	0.068896
14	14.7059	0.077079
15	16.43248	0.08573
16	12.2172	0.063353
17	10.87848	0.059819
18	9.739881	0.059171
19	8.112095	0.05092
20	8.022794	0.051097
21	8.469246	0.055486
22	8.924891	0.056462
23	9.520588	0.061194
24	11.25241	0.075936

Table E.22 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in October

Hour	Shape Parameter	Scale Parameter
1	6.517004	0.056157
2	6.107389	0.051898
3	5.156486	0.043788
4	5.334595	0.045361
5	5.43869	0.046552
6	4.960671	0.043668
7	5.396977	0.050755
8	4.874292	0.0495
9	5.209155	0.047803
10	5.071291	0.044241
11	4.977887	0.039317
12	5.271117	0.038659
13	5.408629	0.037923
14	5.538765	0.039204
15	6.000639	0.043599
16	5.840009	0.045129
17	4.740508	0.039947
18	4.973927	0.042879
19	4.290362	0.036815
20	5.384858	0.049203
21	6.737436	0.064635
22	7.532159	0.071071
23	6.357101	0.055085
24	5.810358	0.04688

Table E.23 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in November

Hour	Shape Parameter	Scale Parameter
1	4.929154	0.049711
2	6.296635	0.065325
3	5.813597	0.059907
4	6.908658	0.072962
5	5.968623	0.063927
6	5.577563	0.061068
7	7.88133	0.086884
8	8.723801	0.098562
9	7.087834	0.082866
10	6.135437	0.06772
11	5.890829	0.061785
12	5.882305	0.057897
13	6.580309	0.060468
14	5.232619	0.046697
15	5.717811	0.05082
16	4.562689	0.040157
17	3.859592	0.035521
18	3.766272	0.035042
19	3.728447	0.03513
20	3.397338	0.037535
21	4.204075	0.045647
22	4.241733	0.043352
23	4.359697	0.044966
24	4.206203	0.044302

Table E.24 Value of the hourly shape parameter and scale parameter of gamma random variable generation of wind direction in December

Hour	Shape Parameter	Scale Parameter
1	5.481024	0.053847
2	4.224644	0.038771
3	4.980412	0.0496
4	4.297662	0.039928
5	5.086258	0.048945
6	5.445571	0.053691
7	5.546367	0.057381
8	5.698833	0.058573
9	7.186474	0.079164
10	6.170989	0.064618
11	7.3205	0.074381
12	7.117643	0.067052
13	7.308323	0.067604
14	8.870519	0.079731
15	8.516264	0.072222
16	7.248161	0.060784
17	5.87896	0.053649
18	4.470885	0.042781
19	4.049864	0.038334
20	4.065242	0.04193
21	4.500805	0.047692
22	4.495796	0.046415
23	3.981488	0.039129
24	4.901928	0.049426

Table E.25 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in January

Hour	Shape Parameter	Scale Parameter
1	151.5051	5.982549
2	143.4135	5.774166
3	125.726	5.139729
4	113.9185	4.740325
5	99.89817	4.218295
6	95.58012	4.07931
7	95.74464	4.118108
8	86.91757	3.647634
9	81.81093	3.201615
10	82.72612	3.008223
11	92.60135	3.170411
12	104.7676	3.4044
13	116.0224	3.635557
14	119.6118	3.651079
15	125.1275	3.771233
16	123.7145	3.732261
17	120.377	3.699936
18	123.8479	3.961613
19	155.4164	5.219028
20	163.577	5.695736
21	164.2732	5.901517
22	152.7617	5.640685
23	147.9548	5.618867
24	154.0659	5.979373

Table E.26 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in February

Hour	Shape Parameter	Scale Parameter
1	145.992	5.558762
2	138.0898	5.350836
3	125.971	4.947661
4	114.3621	4.566166
5	98.96028	4.004897
6	95.06066	3.881169
7	87.37572	3.583595
8	88.57431	3.53118
9	77.29377	2.889049
10	78.3693	2.741127
11	86.58217	2.868414
12	96.48509	3.054189
13	107.9552	3.2883
14	110.64	3.292509
15	105.9572	3.1172
16	104.6577	3.078331
17	93.56297	2.788614
18	93.39164	2.871853
19	113.8322	3.644228
20	129.9203	4.331698
21	140.591	4.853148
22	138.0479	4.904703
23	144.6503	5.27529
24	143.0368	5.334552

Table E.27 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in March

Hour	Shape Parameter	Scale Parameter
1	237.3796	8.621279
2	240.7236	8.849603
3	245.4273	9.120658
4	248.7258	9.344258
5	246.4732	9.361392
6	256.0338	9.795571
7	277.369	10.55255
8	214.6429	7.887748
9	187.2397	6.459671
10	184.8795	6.02475
11	194.4663	6.025715
12	190.7582	5.653411
13	198.2857	5.669859
14	206.7785	5.76903
15	209.1519	5.753704
16	161.2264	4.457077
17	127.2981	3.585273
18	129.4851	3.775798
19	146.2666	4.475767
20	170.3252	5.436475
21	199.1672	6.580768
22	244.4853	8.32273
23	279.0802	9.735908
24	262.1198	9.35246

Table E.28 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in April

Hour	Shape Parameter	Scale Parameter
1	222.4713	7.968071
2	248.4129	9.002954
3	260.7185	9.547461
4	301.5238	11.14865
5	320.6133	11.93502
6	331.6568	12.38394
7	313.0375	11.52849
8	271.4439	9.627118
9	234.7873	7.89099
10	244.5131	7.843618
11	247.2003	7.604163
12	211.6427	6.287695
13	159.7276	4.628638
14	107.5858	3.08974
15	79.71283	2.280517
16	74.93944	2.147575
17	77.28104	2.24373
18	77.91667	2.332953
19	88.65267	2.766297
20	102.6568	3.320848
21	124.3182	4.138212
22	152.3257	5.186527
23	175.7927	6.112006
24	191.9579	6.786013

Table E.29 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in May

Hour	Shape Parameter	Scale Parameter
1	154.3236	5.608032
2	166.536	6.103997
3	179.1365	6.62225
4	192.4039	7.152188
5	208.4658	7.788808
6	236.4478	8.881021
7	250.9281	9.33943
8	197.8311	7.080712
9	187.8732	6.40805
10	204.0022	6.653571
11	209.2351	6.546378
12	187.5037	5.668142
13	168.2583	4.947749
14	140.5685	4.077611
15	94.81522	2.743563
16	78.32603	2.272484
17	72.02693	2.118168
18	69.30356	2.114876
19	71.49436	2.295059
20	75.25864	2.515209
21	92.26205	3.174725
22	102.8146	3.611814
23	123.0396	4.384125
24	151.7701	5.469609

Table E.30 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in June

Hour	Shape Parameter	Scale Parameter
1	259.3484	9.294532
2	288.6018	10.42762
3	297.2085	10.81632
4	324.0413	11.8827
5	365.1229	13.50251
6	431.8177	16.0527
7	485.3789	17.89804
8	313.0765	11.06146
9	284.9908	9.617116
10	313.6567	10.13522
11	311.4284	9.685545
12	263.327	7.950427
13	218.0403	6.443059
14	181.231	5.287339
15	150.5325	4.366876
16	151.7744	4.387099
17	138.0864	4.024393
18	127.8135	3.80792
19	143.7632	4.457997
20	155.9579	5.024956
21	157.9727	5.281832
22	182.9996	6.266168
23	199.9172	6.979235
24	227.8532	8.064359

Table E.31 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in July

Hour	Shape Parameter	Scale Parameter
1	409.3673	15.54112
2	408.9512	15.63813
3	502.7005	19.32872
4	560.8695	21.66482
5	566.2765	21.95849
6	677.8191	26.35885
7	678.7361	26.03611
8	436.0052	16.18335
9	321.3663	11.45348
10	296.8695	10.14095
11	300.8703	9.932641
12	299.795	9.624656
13	258.3081	8.103503
14	227.8703	7.066705
15	207.6389	6.41071
16	176.0481	5.476898
17	154.8517	4.868745
18	174.1301	5.61496
19	187.0096	6.260537
20	186.4957	6.486808
21	209.5929	7.492802
22	259.3852	9.442304
23	303.2201	11.23553
24	369.0674	13.84173

Table E.32 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in August

Hour	Shape Parameter	Scale Parameter
1	443.6825	17.16041
2	499.9064	19.45864
3	529.8472	20.72887
4	596.719	23.45478
5	627.396	24.74082
6	734.2081	28.98323
7	685.2565	26.68049
8	416.2021	15.65415
9	321.2324	11.55948
10	303.7724	10.45978
11	272.4463	9.045446
12	242.3841	7.832101
13	242.4084	7.669957
14	204.3281	6.419156
15	177.9166	5.580747
16	165.8883	5.222788
17	147.2253	4.752573
18	137.4846	4.60563
19	152.3188	5.310112
20	176.9526	6.37651
21	206.9597	7.61684
22	247.6082	9.270072
23	315.2599	11.95274
24	381.3989	14.62082

Table E.33 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in September

Hour	Shape Parameter	Scale Parameter
1	535.7963	20.93954
2	568.3057	22.30594
3	641.4271	25.2663
4	749.1226	29.61999
5	820.3709	32.49566
6	846.8888	33.58449
7	637.6208	25.12846
8	332.2892	12.7211
9	219.7664	8.063178
10	194.9191	6.855303
11	184.3544	6.250987
12	209.6303	6.954337
13	215.2785	7.042829
14	200.1154	6.522903
15	149.1142	4.869166
16	132.1372	4.351336
17	137.756	4.629761
18	154.0305	5.323499
19	198.5714	7.089023
20	263.11	9.646758
21	299.107	11.20434
22	327.9115	12.46451
23	374.348	14.41186
24	425.745	16.54426

Table E.34 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in October

Hour	Shape Parameter	Scale Parameter
1	479.3064	18.64216
2	488.9361	19.16875
3	504.1108	19.88331
4	473.6028	18.77331
5	543.2496	21.68447
6	592.0164	23.80794
7	625.448	25.1659
8	571.1566	22.1455
9	304.8608	11.18836
10	260.8457	9.141365
11	249.5202	8.430305
12	251.7064	8.252395
13	201.5811	6.501769
14	168.1853	5.405975
15	102.6746	3.358965
16	102.7991	3.410512
17	101.7286	3.431223
18	125.1013	4.35256
19	185.086	6.672595
20	262.5686	9.658129
21	317.9953	11.87295
22	360.8543	13.63957
23	377.4524	14.41039
24	442.2096	17.05694

Table E.35 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in November

Hour	Shape Parameter	Scale Parameter
1	151.941	6.056582
2	138.8912	5.58929
3	135.996	5.522418
4	137.7828	5.653766
5	136.0977	5.654442
6	129.5337	5.430439
7	130.0515	5.471868
8	149.8221	6.094729
9	116.0665	4.438728
10	103.7127	3.761402
11	104.1391	3.612775
12	106.0096	3.5518
13	110.0326	3.594966
14	100.1704	3.226868
15	99.20362	3.181208
16	101.9044	3.288221
17	111.2623	3.646947
18	146.6333	4.985957
19	175.5275	6.223563
20	176.7243	6.426771
21	179.8015	6.693747
22	164.7518	6.266976
23	154.3885	5.975472
24	151.8187	5.967544

Table E.36 Value of the hourly shape parameter and scale parameter of gamma random variable generation of ambient temperature in December

Hour	Shape Parameter	Scale Parameter
1	110.7174	4.456788
2	100.6577	4.10353
3	89.05896	3.692723
4	87.35067	3.674439
5	87.7732	3.742134
6	86.12088	3.715335
7	90.0192	3.897462
8	73.3976	3.12452
9	58.42963	2.357512
10	52.90594	2.016745
11	60.01203	2.159933
12	64.83321	2.229875
13	67.06759	2.230106
14	72.51601	2.353635
15	73.0718	2.348583
16	70.31512	2.266415
17	63.0934	2.079953
18	72.74106	2.486493
19	85.77086	3.057703
20	89.08239	3.269911
21	87.89157	3.298582
22	84.35876	3.231684
23	93.48368	3.652441
24	105.1465	4.195419

Table E.37 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in January

Hour	Shape Parameter	Scale Parameter
1	7.234155	0.009726
2	6.963724	0.009562
3	6.42963	0.009021
4	5.717923	0.008201
5	4.934212	0.007238
6	4.166826	0.006255
7	3.421072	0.005288
8	4.011563	0.005837
9	4.268904	0.005868
10	4.177842	0.005442
11	8.903778	0.008808
12	12.79264	0.010201
13	13.53928	0.009043
14	15.33238	0.00999
15	16.26586	0.010346
16	16.1336	0.010023
17	14.24045	0.010532
18	9.733516	0.008893
19	4.840776	0.005784
20	5.379283	0.006549
21	5.94098	0.007372
22	6.482245	0.008202
23	6.934653	0.00895
24	7.211925	0.009498

Table E.38 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in February

Hour	Shape Parameter	Scale Parameter
1	8.03007	0.009509
2	7.914159	0.009443
3	7.352978	0.008841
4	6.500799	0.007877
5	5.548726	0.006776
6	4.638601	0.005709
7	3.827604	0.00475
8	4.237059	0.005107
9	4.550099	0.005332
10	4.73451	0.005398
11	8.074751	0.007413
12	10.35226	0.007954
13	10.76236	0.00712
14	12.15123	0.007876
15	12.16806	0.007731
16	10.94234	0.006817
17	9.597026	0.007034
18	6.904168	0.006145
19	3.856085	0.004368
20	4.524121	0.005162
21	5.299663	0.006091
22	6.151195	0.007122
23	6.994738	0.008159
24	7.681721	0.009028

Table E.39 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in March

Hour	Shape Parameter	Scale Parameter
1	9.731957	0.012292
2	9.57467	0.011938
3	9.082814	0.111816
4	8.373492	0.01018
5	7.567368	0.009086
6	6.756369	0.008013
7	7.056919	0.008253
8	7.703391	0.008706
9	7.825682	0.008556
10	7.482493	0.007933
11	11.20711	0.010002
12	12.66569	0.00976
13	11.37558	0.007771
14	12.10347	0.008218
15	11.63821	0.007853
16	9.958793	0.006705
17	9.916683	0.008039
18	8.425751	0.008582
19	5.105017	0.006992
20	6.023085	0.008135
21	7.017303	0.009348
22	8.010281	0.105272
23	8.881646	0.011517
24	9.491711	0.012146

Table E.40 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in April

Hour	Shape Parameter	Scale Parameter
1	9.296695	0.011185
2	9.444707	0.011185
3	9.289436	0.01083
4	8.883927	0.010199
5	8.310017	0.009397
6	7.6504	0.008523
7	7.205711	0.007793
8	8.129936	0.008406
9	8.38953	0.008308
10	8.021204	0.007622
11	10.20039	0.00868
12	10.89738	0.008396
13	8.716024	0.006256
14	9.760958	0.007009
15	10.1838	0.007316
16	9.804926	0.007046
17	9.273496	0.007871
18	7.521066	0.007796
19	4.715872	0.006276
20	5.521989	0.007221
21	6.400072	0.008226
22	7.301719	0.009228
23	8.149517	0.010129
24	8.845751	0.010816

Table E.41 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in May

Hour	Shape Parameter	Scale Parameter
1	13.1189	0.015387
2	12.80836	0.01491
3	11.87369	0.01372
4	10.58498	0.01214
5	9.203582	0.010479
6	7.89978	0.008929
7	6.99942	0.007765
8	8.346932	0.008726
9	8.934732	0.008833
10	8.742901	0.008204
11	11.96961	0.010093
12	12.707	0.009728
13	10.86309	0.007642
14	12.90806	0.009168
15	12.27197	0.008801
16	9.504543	0.006883
17	9.989578	0.008381
18	8.960037	0.008933
19	5.981418	0.007348
20	7.207942	0.008785
21	8.626299	0.010432
22	10.15218	0.012183
23	11.59733	0.01381
24	12.67841	0.014983

Table E.42 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in June

Hour	Shape Parameter	Scale Parameter
1	11.52015	0.013274
2	11.77635	0.013441
3	11.5323	0.013039
4	10.87049	0.012177
5	9.944149	0.011037
6	8.909508	0.009798
7	8.015528	0.008704
8	9.623274	0.01005
9	10.35282	0.010413
10	10.03641	0.009728
11	12.97368	0.011273
12	13.77129	0.010844
13	12.38514	0.008944
14	12.83803	0.009348
15	11.62115	0.008534
16	9.454038	0.007001
17	9.666458	0.008241
18	8.252636	0.008289
19	5.304856	0.006484
20	6.268955	0.007585
21	7.368714	0.008828
22	8.561839	0.010156
23	9.755079	0.001459
24	10.7999	0.012564

Table E.43 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in July

Hour	Shape Parameter	Scale Parameter
1	9.779382	0.01082
2	10.35819	0.011366
3	10.54614	0.011477
4	10.31961	0.01114
5	9.746214	0.010436
6	8.948458	0.009505
7	8.181702	0.008595
8	9.295098	0.009453
9	9.739887	0.009599
10	9.44821	0.009033
11	11.69884	0.010159
12	12.33785	0.009815
13	11.64179	0.008546
14	11.64239	0.008646
15	10.25161	0.007703
16	8.217418	0.006248
17	7.900805	0.006793
18	6.460749	0.006391
19	4.302575	0.005011
20	5.046942	0.005826
21	5.90922	0.006763
22	6.876532	0.007803
23	7.906438	0.008896
24	8.915472	0.009947

Table E.44 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in August

Hour	Shape Parameter	Scale Parameter
1	10.46671	0.012989
2	10.66328	0.013108
3	10.37485	0.012635
4	9.697291	0.0117
5	8.790725	0.010509
6	7.807877	0.009249
7	6.97473	0.008152
8	8.187258	0.009258
9	8.949397	0.009802
10	9.063095	0.009624
11	12.96296	0.012286
12	14.72317	0.0126
13	13.57303	0.010615
14	14.20625	0.011309
15	12.08583	0.009796
16	8.889765	0.007339
17	9.266041	0.008735
18	7.711634	0.008472
19	4.69016	0.006173
20	5.57624	0.007266
21	6.596561	0.008511
22	7.712615	0.009853
23	8.833743	0.011176
24	9.811109	0.012293

Table E.45 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in September

Hour	Shape Parameter	Scale Parameter
1	8.203865	0.01042
2	8.817512	0.011041
3	9.107813	0.011246
4	9.03662	0.011005
5	8.646906	0.010388
6	8.036699	0.009526
7	7.281778	0.008522
8	7.899876	0.008894
9	7.980832	0.008657
10	7.599324	0.007952
11	10.32802	0.009753
12	11.10121	0.009552
13	10.0417	0.007935
14	10.85603	0.00881
15	8.98876	0.007498
16	6.18584	0.005307
17	6.374608	0.006269
18	5.343924	0.006154
19	3.316362	0.004608
20	3.944521	0.005396
21	4.682856	0.006309
22	5.525801	0.007333
23	6.443614	0.008425
24	7.370953	0.009498

Table E.46 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in October

Hour	Shape Parameter	Scale Parameter
1	10.11881	0.012387
2	10.28775	0.012428
3	10.08564	0.012026
4	9.578682	0.011275
5	8.873501	0.010313
6	8.07698	0.00927
7	7.343305	0.008305
8	8.189827	0.008891
9	8.364178	0.008729
10	7.927971	0.007967
11	10.40912	0.009344
12	11.49477	0.009324
13	11.14561	0.008246
14	11.33413	0.008676
15	9.651246	0.007653
16	7.156472	0.005887
17	7.35652	0.006934
18	6.722322	0.007417
19	4.954959	0.006593
20	5.825038	0.00764
21	6.790128	0.00878
22	7.801679	0.009948
23	8.773304	0.011034
24	9.586531	0.011894

Table E.47 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in November

Hour	Shape Parameter	Scale Parameter
1	8.614032	0.010657
2	8.752863	0.010805
3	8.561734	0.010547
4	8.085072	0.009938
5	7.415608	0.009096
6	6.655936	0.008147
7	5.848145	0.007152
8	6.727509	0.007806
9	7.054606	0.007788
10	6.843041	0.007189
11	9.637792	0.008764
12	11.04021	0.008849
13	10.88458	0.0078
14	11.76331	0.008511
15	11.65046	0.00851
16	10.54864	0.007781
17	10.75847	0.009197
18	8.319092	0.008456
19	4.492196	0.00563
20	5.17616	0.006473
21	5.93389	0.007405
22	6.732292	0.008383
23	7.508843	0.00933
24	8.171286	0.010131

Table E.48 Value of the hourly shape parameter and scale parameter of gamma random variable generation of mixing height in December

Hour	Shape Parameter	Scale Parameter
1	7.426759	0.00937
2	6.924645	0.008877
3	6.27187	0.008171
4	5.54778	0.007348
5	4.821433	0.006494
6	4.140278	0.005672
7	3.533142	0.00491
8	4.105878	0.005432
9	4.456367	0.005626
10	4.528919	0.005468
11	7.803738	0.007548
12	10.56336	0.008522
13	11.59699	0.008045
14	12.67744	0.008728
15	12.90585	0.008818
16	12.2285	0.008292
17	11.85639	0.009318
18	9.683416	0.009049
19	6.125022	0.007058
20	6.671503	0.0078
21	7.166491	0.008503
22	7.547176	0.00909
23	7.746057	0.009473
24	7.710984	0.009577

Table E.49 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in January

Hour	Shape Parameter	Scale Parameter
1	0.327801	0.214766
2	0.432416	0.256531
3	0.471855	0.255757
4	0.444591	0.221825
5	0.828106	0.33158
6	1.153417	0.385673
7	1.250946	0.359068
8	1.329504	0.404831
9	1.202846	0.389987
10	0.91515	0.317259
11	1.14711	0.393581
12	1.282311	0.435488
13	1.235575	0.415385
14	1.390944	0.474478
15	1.413686	0.489417
16	1.278818	0.449417
17	1.236593	0.466196
18	1.042206	0.423741
19	0.769578	0.339537
20	0.703174	0.353437
21	0.561905	0.328119
22	0.378396	0.263601
23	0.428929	0.292632
24	0.402352	0.268945

Table E.50 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in February

Hour	Shape Parameter	Scale Parameter
1	0.452979	0.224815
2	0.603682	0.275427
3	0.667273	0.281702
4	0.628254	0.246798
5	1.107679	0.37481
6	1.484413	0.441134
7	1.492848	0.395491
8	1.73808	0.476685
9	1.70246	0.483971
10	1.367079	0.403363
11	1.648069	0.496826
12	1.736583	0.535125
13	1.533731	0.483341
14	1.673864	0.535464
15	1.634945	0.531028
16	1.426082	0.470397
17	1.465314	0.519046
18	1.256077	0.480423
19	0.896866	0.372769
20	0.798318	0.374299
21	0.610936	0.328511
22	0.396873	0.250142
23	0.509107	0.29439
24	0.519423	0.277451

Table E.51 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in March

Hour	Shape Parameter	Scale Parameter
1	0.550072	0.226727
2	0.65759	0.26191
3	0.701354	0.270234
4	0.667857	0.249204
5	1.149991	0.365671
6	1.596003	0.442132
7	1.75755	0.431332
8	1.984708	0.510477
9	1.864909	0.503868
10	1.430439	0.407019
11	1.672671	0.478099
12	1.714195	0.492197
13	1.519668	0.438337
14	1.733525	0.496537
15	1.773547	0.504484
16	1.62283	0.45844
17	1.671923	0.486063
18	1.47872	0.442789
19	1.1509	0.355283
20	1.040394	0.361707
21	0.821559	0.326885
22	0.555233	0.258218
23	0.653046	0.291397
24	0.640861	0.274821

Table E.52 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in April

Hour	Shape Parameter	Scale Parameter
1	1.262644	0.308755
2	1.35961	0.340052
3	1.344376	0.344093
4	1.209783	0.317046
5	1.738812	0.41849
6	2.143964	0.477056
7	2.222388	0.459804
8	2.577486	0.555731
9	2.534519	0.570492
10	2.041486	0.480647
11	2.513573	0.5836
12	2.708081	0.620171
13	2.505504	0.566047
14	2.821855	0.615952
15	2.806472	0.592551
16	2.522174	0.515653
17	2.769096	0.562704
18	2.671835	0.539669
19	2.303132	0.462411
20	2.104787	0.444509
21	1.76004	0.392037
22	1.367642	0.322264
23	1.491799	0.356033
24	1.449405	0.350415

Table E.53 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in May

Hour	Shape Parameter	Scale Parameter
1	3.220589	0.520419
2	3.408906	0.559366
3	3.38111	0.563518
4	3.128409	0.529721
5	4.155893	0.682541
6	4.941326	0.787848
7	5.039075	0.780646
8	5.386272	0.866649
9	4.984445	0.834203
10	3.990446	0.695788
11	4.793804	0.831761
12	5.223813	0.901942
13	5.041151	0.866172
14	6.552217	1.070232
15	7.21071	1.122386
16	6.723735	0.999566
17	7.985541	1.1565
18	7.897254	1.114929
19	6.693935	0.921844
20	6.838472	0.95814
21	6.050319	0.862727
22	4.785456	0.694672
23	4.726987	0.710375
24	4.105909	0.639586

Table E.54 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in June

Hour	Shape Parameter	Scale Parameter
1	8.153198	1.051907
2	8.966872	1.166389
3	8.765044	1.14958
4	7.630729	1.009168
5	9.507637	1.249083
6	10.11047	1.319563
7	8.970415	1.163134
8	9.824835	1.309059
9	9.252081	1.267713
10	7.503419	1.058127
11	9.360601	1.312557
12	10.30932	1.437454
13	9.687276	1.343164
14	11.72918	1.611642
15	12.19687	1.660958
16	10.79302	1.456789
17	14.09721	1.837645
18	15.20628	1.916617
19	13.48868	1.645665
20	15.01289	1.84194
21	13.81154	1.704144
22	10.87243	1.349143
23	11.362	1.427975
24	10.22396	1.30164

Table E.55 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in July

Hour	Shape Parameter	Scale Parameter
1	9.030461	1.128568
2	9.347081	1.180283
3	8.954144	1.142546
4	7.976746	1.028638
5	9.682347	1.239312
6	10.2179	1.298223
7	9.224877	1.16348
8	9.31811	1.206234
9	8.385758	1.114946
10	6.830228	0.933412
11	8.648443	1.166283
12	10.1072	1.345242
13	10.49398	1.378754
14	12.69329	1.655891
15	13.61584	1.763741
16	12.68761	1.632017
17	17.48261	2.183473
18	19.39516	2.353957
19	16.83566	1.987216
20	17.42584	2.07959
21	15.13954	1.826919
22	11.611	1.416944
23	12.14032	1.492829
24	11.07071	1.371757

Table E.56 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in August

Hour	Shape Parameter	Scale Parameter
1	15.32811	1.760923
2	16.54592	1.909705
3	15.76847	1.828513
4	13.4408	1.565944
5	17.28279	2.008464
6	18.90282	2.191182
7	16.84932	1.948223
8	16.46451	1.963076
9	13.93273	1.714663
10	10.59237	1.346914
11	13.08285	1.657636
12	14.68126	1.853514
13	14.44305	1.816949
14	18.61408	2.326266
15	20.07818	2.492843
16	17.53196	2.162581
17	24.48538	2.931874
18	27.72351	3.225193
19	24.43056	2.763511
20	26.82245	3.042937
21	24.21283	2.75493
22	18.82438	2.148128
23	20.85196	2.385434
24	19.22125	2.204377

Table E.57 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in September

Hour	Shape Parameter	Scale Parameter
1	12.27365	1.461759
2	12.71562	1.535735
3	11.75486	1.43999
4	9.845085	1.223525
5	12.42178	1.536659
6	13.20098	1.625584
7	11.51066	1.410985
8	12.02098	1.518046
9	10.90094	1.419479
10	8.700294	1.169339
11	11.08639	1.490388
12	12.40038	1.667426
13	11.58935	1.558737
14	16.02674	2.126287
15	17.671	2.313029
16	14.82166	1.914423
17	18.08326	2.27521
18	17.72375	2.173679
19	14.50562	1.735195
20	17.11407	2.036114
21	17.1477	2.029102
22	14.64922	1.72415
23	16.73452	1.976791
24	15.62633	1.852668

Table E.58 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in October

Hour	Shape Parameter	Scale Parameter
1	3.397419	0.531072
2	3.639463	0.571943
3	3.62491	0.572712
4	3.352049	0.532459
5	4.192912	0.652305
6	4.733655	0.721564
7	4.696995	0.701809
8	5.028201	0.773199
9	4.804526	0.760989
10	4.079123	0.666095
11	4.991699	0.800902
12	5.638913	0.889242
13	5.74517	0.890736
14	6.860502	1.036466
15	7.204136	1.061251
16	6.656703	0.956759
17	6.416525	0.932785
18	5.461801	0.803179
19	4.283142	0.637224
20	4.457332	0.671507
21	4.236491	0.646393
22	3.701031	0.572004
23	4.035559	0.626281
24	3.912007	0.609623

Table E.59 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in Novemebr

Hour	Shape Parameter	Scale Parameter
1	0.824582	0.254198
2	0.895387	0.276974
3	0.896164	0.27817
4	0.825209	0.257032
5	1.279795	0.351558
6	1.68777	0.414668
7	1.862483	0.413885
8	1.935982	0.452691
9	1.827876	0.450969
10	1.544813	0.403364
11	1.875077	0.473826
12	2.081522	0.509578
13	2.090554	0.4963
14	2.393585	0.549991
15	2.481218	0.552387
16	2.346104	0.506545
17	2.178518	0.494855
18	1.800171	0.431375
19	1.355278	0.343643
20	1.330105	0.353867
21	1.190488	0.333126
22	0.973612	0.28732
23	1.027332	0.307337
24	0.968608	0.293804

Table E.60 Value of the hourly shape parameter and scale parameter of gamma random variable generation of cloudiness in December

Hour	Shape Parameter	Scale Parameter
1	0.349913	0.197982
2	0.383627	0.220625
3	0.382315	0.223544
4	0.34342	0.204214
5	0.616324	0.289563
6	0.859253	0.333656
7	0.978043	0.323633
8	0.980209	0.347379
9	0.88121	0.336161
10	0.700865	0.289488
11	0.852624	0.341088
12	0.952894	0.36957
13	0.966135	0.363613
14	1.108869	0.397519
15	1.143878	0.391484
16	1.0789	0.353236
17	0.997331	0.350913
18	0.833358	0.31688
19	0.632102	0.261452
20	0.5992	0.271728
21	0.511445	0.256666
22	0.386836	0.217307
23	0.41971	0.237093
24	0.40376	0.229366

VITA

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