

九州大学元岡キャンパスにおける風観測

—第一報 平均的な風況特性について—

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Wind Observation in the Motooka Campus of Kyushu University —Part 1. About mean wind characteristics—

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Abstract

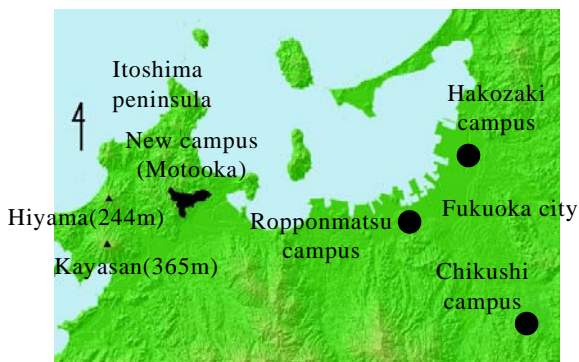
Wind observation by the “20 Meter NRG-NOW System” was conducted from 2003 to 2004 in the Motooka campus of Kyushu University. It is possible to acquire the data of a wind speed, a standard deviation of the wind speed, and a wind direction in height (20m and 10m) in this system. This report describes the mean wind characteristics, such as a frequency of appearance (%) and a mean wind speed (m/s). In addition, the monthly gust information, the monthly mean wind speed, and the annual mean wind speed are showed.

Key words : Motooka campus, Kyushu University, Mean wind characteristics, NRG-NOW Systems

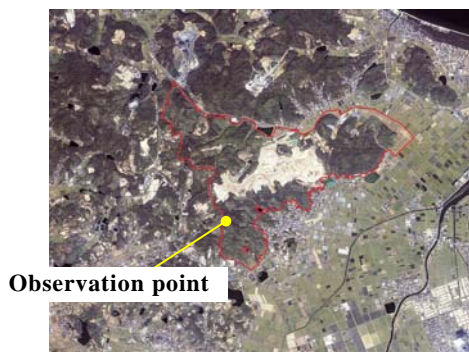
1. 緒言

我々は九州大学元岡キャンパスにて風観測を実施してきた(Fig.1を参照). 本報では, 第一報として2003年か

ら2004年における2年間の平均的な風況特性(風向別風速出現率とその平均風速, 月平均風速, 年平均風速)と, 各月における最大風速(ガスト)を報告する.



(a) Figure of a large domain



(b) Expanded figure

Fig.1 Location of the Motooka campus

2. 風観測システム

ここでは, 本研究で使用した風観測システムについて記述する. 風観測システムは“20 Meter NRG-NOW System”を使用した. Fig.2に示すように, 20mの観測タワー

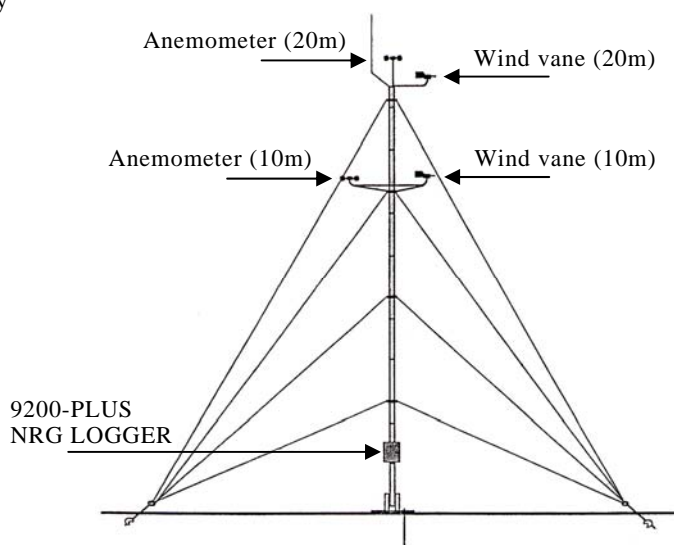


Fig.2 Typical figure of the wind observation system (20 Meter NRG-NOW System)

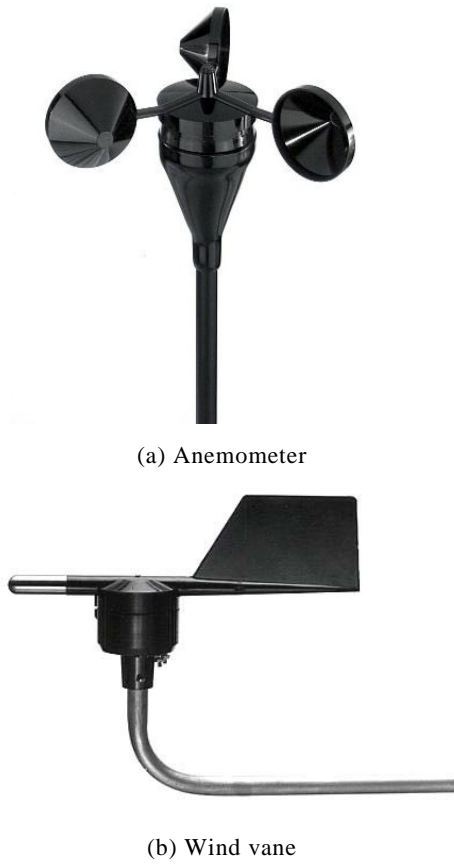


Fig.3 Measurement equipment

を立て、10mと20mの位置にFig.3に示す風速計と風向計を設置した。機械式の風速計には、一般に「風杯型(カップ式)風速計」と「風車型(プロペラ式)風速計」があるが、本研究では3杯型風速計を用いた。風向計にはベーン型風向計を用いた。データの取得には、Fig.4に示すNRGロガー9200プラス(自動記録器)を用いた。

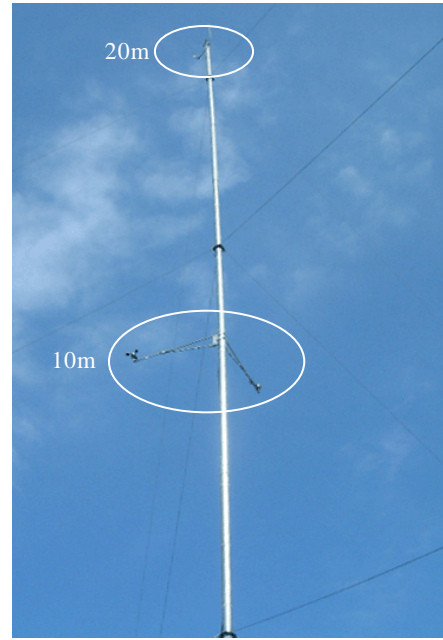


Photo.1 Situation of the observation tower

データの記録間隔は10分(600秒)、サンプリング間隔は0.5Hz(2秒)で、風速の平均値と標準偏差および風向の平均値が格納される。すなわち、300個のデータに基づいた統計処理の結果である。平均風速は0～97.4(m/s)まで取得可能であり、その精度は0.022(m/s)である。風向には補正值があり、10(m)は330度、20(m)は350度である。自動記録器には32kBのチップを2個搭載しており、9(V)の乾電池2個で56日間のデータ記録が可能である(Fig.4に矢印で表示)。同図に矢印で示す各種キーを操作することにより、(A)には以下の情報を表示することが可能である。Photo.1には計測システムを設置した実際の様子を示す。



Two data chips Fig.4 Automatic data recorder (9200-PLUS NRG LOGGER)

- ✓ 現在風速風向
- ✓ 現在記録間隔の平均風速風向
- ✓ 現在記録間隔の最大風速とその風向
- ✓ 現在アナログ入力値
- ✓ 現在年月日、時刻
- ✓ 記録間隔
- ✓ 記録モード
- ✓ 地点番号(ユーザーが入力)
- ✓ データチップ番号(ユーザーが入力)
- ✓ 電池電圧
- ✓ データチップの記録可能残存日数

3. 観測結果

Table.1にデータチップの出力例を示す。Table.2にはこれまでの観測の経緯を示す。

```

DL9210 Version 03   Filename = 00570121.N03   Metric   08:22:57   02-18-2003
----- Site Information -----
Site Number       :0057             # of Sensors      :2
Serial Number     :8242             Interval          :10
Model Number      :9210             Chip Socket       :2
Firmware Version  :03               Left Socket (1)  :32k chip
Chip ID           :00               Right Socket (2) :32k chip
SPD 1: Scale = 0.381846, Offset = 0.000000, M/S
SPD 2: Scale = 0.381846, Offset = 0.000000, M/S
SPD 3: Scale = 0.381846, Offset = 0.000000, M/S
DIR 1: Scale = 1.406250, Offset = 0.000000, Degrees
DIR 2: Scale = 1.406250, Offset = 0.000000, Degrees
ANLG : Scale = 1.000000, Offset = 0.000000, Counts
----- Start/Stop Information -----
Start Time        :02:20             Stop Time         :14:18
Start Date        :01/21/03 m/d/y    Stop Date         :02/13/03 m/d/y
Start Voltage     :8.0               Stop Voltage      :7.8
----- Gust Information -----
                SPD 1             SPD 2             SPD 3
Speed           : 28 M/S           26 M/S           0 M/S
Direction       : 326 Degrees      329 Degrees      37 Degrees
Time            : 01:20            01:20            20:30
Date            : 01/29/03 m/d/y    01/29/03 m/d/y    02/05/03 m/d/y
-----Raw Header Information-----
57 00 42 82 10 92 03 00 20 02 21 01 03 3F A0 4B
E8 20 01 29 01 03 46 EA 20 01 29 01 03 01 1B 30
20 05 02 03 18 14 13 02 03 9B 01 FF FF FF FF FF
FF FF FF FF FF FF FF 55
----- Data Information -----
  Spd1,  SD1,  Dir1,  Spd2,  SD2,  Dir2,  Anlg,  Time,  Date
  6.16,  1.72,  338,  5.13,  1.67,  352,   0,  0220,  012103
  5.97,  1.24,  340,  5.01,  1.19,  353,   0,  0230,  012103
  5.20,  1.36,  333,  4.61,  1.19,  346,   0,  0240,  012103
  6.59,  1.15,  328,  5.54,  1.34,  339,   0,  0250,  012103
  5.82,  1.19,  333,  4.92,  1.22,  347,   0,  0300,  012103
  6.42,  1.60,  330,  5.58,  1.55,  345,   0,  0310,  012103
  6.59,  1.77,  328,  5.51,  1.65,  340,   0,  0320,  012103
  5.73,  1.10,  325,  5.01,  1.03,  338,   0,  0330,  012103
  5.01,  0.98,  342,  4.22,  1.03,  354,   0,  0340,  012103
  6.59,  1.41,  338,  5.56,  1.48,  350,   0,  0350,  012103
  6.61,  1.72,  336,  5.51,  1.69,  349,   0,  0400,  012103
  6.56,  1.86,  339,  5.58,  1.98,  353,   0,  0410,  012103
  5.75,  1.65,  329,  4.99,  1.55,  347,   0,  0420,  012103
  6.59,  1.55,  338,  5.70,  1.46,  349,   0,  0430,  012103
  6.78,  1.43,  340,  5.87,  1.36,  352,   0,  0440,  012103
  5.58,  1.48,  338,  4.82,  1.69,  350,   0,  0450,  012103
  5.08,  1.46,  333,  4.49,  1.36,  347,   0,  0500,  012103
  4.99,  1.29,  330,  4.42,  1.12,  345,   0,  0510,  012103
  4.44,  1.15,  338,  3.89,  1.07,  352,   0,  0520,  012103
  3.68,  0.81,  350,  3.17,  0.72,   0,   0,  0530,  012103
  4.77,  0.98,  340,  3.87,  0.95,  350,   0,  0540,  012103
  5.23,  1.15,  332,  4.65,  1.15,  346,   0,  0550,  012103
  4.30,  0.98,  330,  3.70,  1.00,  345,   0,  0600,  012103
  3.75,  1.03,  336,  3.08,  0.84,  349,   0,  0610,  012103
  5.58,  0.95,  335,  4.61,  1.07,  347,   0,  0620,  012103
  5.06,  1.22,  332,  4.32,  1.17,  345,   0,  0630,  012103
  4.01,  0.76,  332,  3.22,  0.67,  346,   0,  0640,  012103
  {-----}
  20(m)                10(m)
  .
  . Speed (Spd)→Standard Deviation (SD)→Direction (Dir)
  .
  .
  .
  
```

Table.1 Example of an output

2001年	11月16日から観測開始, データ無し
2002年	計測機器の故障などによりデータ無し
2003年	落雷のため, 2-4月は10mのみ 1月と5月以降は10m, 20mのデータ有り
2004年	11月, 12月を除いて10m, 20mのデータ 有り, 観測終了

Table.2 Circumstances by present

3.1 月別の最大風速(ガスト)

ここでは, 月別の最大風速(ガスト)をTable.3に示す.

	Jan.	Feb.	Mar.	Apr.	May	Jun.
10(m)	16.5	10.9	19.1	31.6	12.0	16.2
20(m)	18.3	—	—	—	13.0	17.9

	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
10(m)	13.2	11.4	11.8	11.7	10.6	13.7
20(m)	14.5	12.3	16.2	12.5	11.9	15.2

(a) 2003

	Jan.	Feb.	Mar.	Apr.	May	Jun.
10(m)	14.9	16.7	17.6	15.4	12.1	10.2
20(m)	16.2	18.0	19.4	17.1	13.2	12.6

	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
10(m)	10.3	16.6	20.7	10.0	—	—
20(m)	11.6	21.6	22.8	19.0	—	—

(b) 2004

Table.3 Monthly gust information, unit (m/s)

3.2 風向別風速出現率とその平均風速

ここでは, 風向別風速出現率とその平均風速をFig.5~Fig.26に示す(次頁以降).

3.3 月平均風速

ここでは, 月平均風速をTable.4に示す.

	Jan.	Feb.	Mar.	Apr.	May	Jun.
10(m)	4.1	2.2	3.5	3.4	1.6	2.5
20(m)	5.1	—	—	—	3.8	3.6

	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
10(m)	2.3	1.5	1.7	2.0	1.8	3.9
20(m)	4.2	2.8	3.8	3.6	3.5	4.9

(a) 2003

	Jan.	Feb.	Mar.	Apr.	May	Jun.
10(m)	3.5	4.3	2.3	2.8	2.4	1.4
20(m)	4.5	5.1	3.9	3.6	3.1	2.8

	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
10(m)	2.7	1.7	1.6	1.3	—	—
20(m)	3.3	3.2	3.5	4.3	—	—

(b) 2004

Table.4 Monthly mean wind speed, unit (m/s)

3.4 年平均風速

ここでは, 年平均風速をTable.5に示す.

10(m)	2.5(m/s)
20(m)	3.9(m/s)

(a) 2003

10(m)	2.4(m/s)
20(m)	3.7(m/s)

(b) 2004

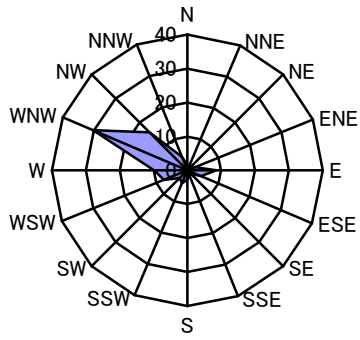
Table.5 Annual mean wind speed

4. 結言

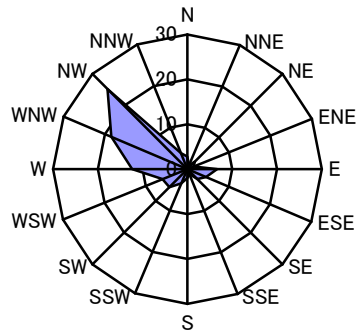
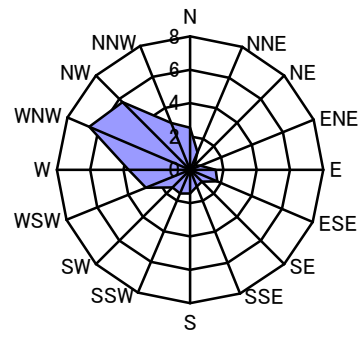
九州大学元岡キャンパスにて実施してきた風観測結果(2003年から2004年の2年分)に関して, 本報では第一報として, 平均的な風況特性(風向別風速出現率とその平均風速, 月平均風速, 年平均風速)と, 各月における最大風速(ガスト)を報告した. 第二報では, 乱れの影響などについて詳細な報告を行う予定である.

謝辞

本研究を行うに際し, (株)西島製作所風力発電技術部風力発電開発課の藤井直樹氏と小池紘司氏に多大な協力を頂いた. また, 当時研究室の大学院生であった, 田鍋義博君, 宮崎康伸君, 阿部光一君, 日置文章君にも多大な協力を頂いた. ここに記して感謝の意を表します.



(a)10m



(b)20m

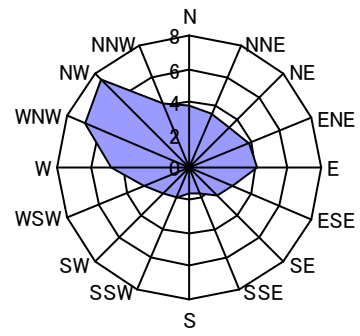
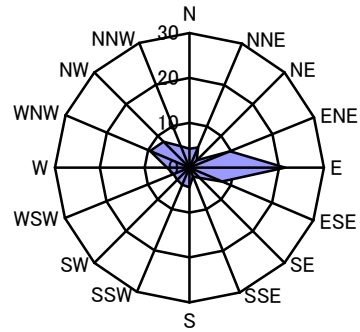


Fig.5 The wind observation result in January, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m

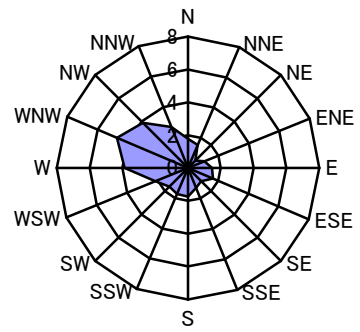
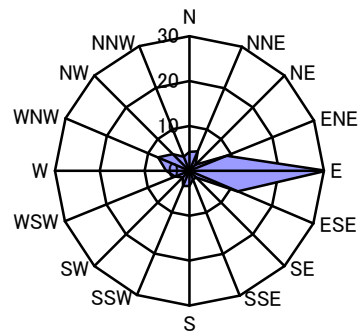


Fig.6 The wind observation result in February, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m

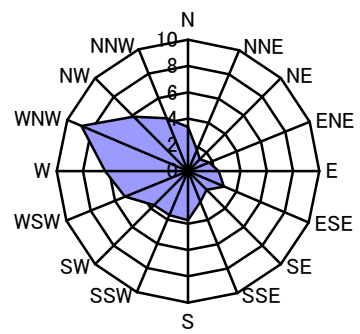
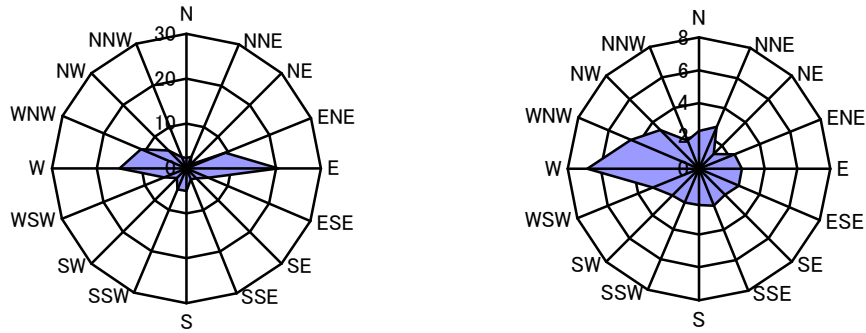
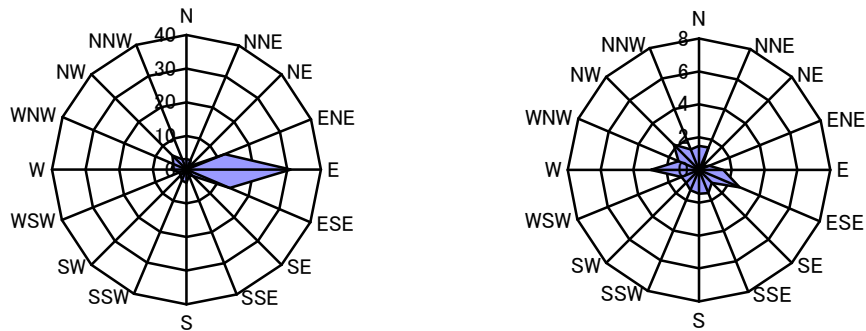


Fig.7 The wind observation result in March, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)

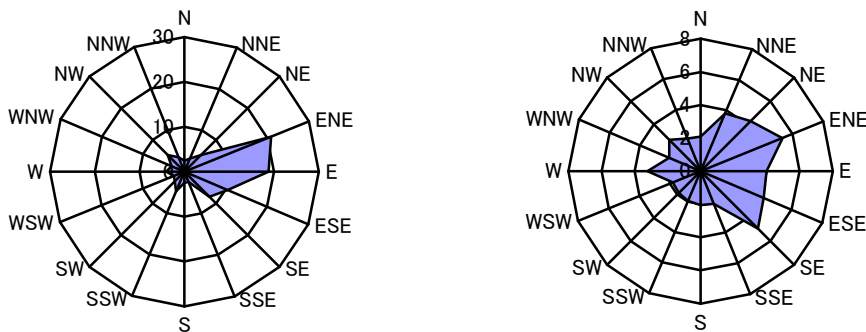


(a)10m

Fig.8 The wind observation result in April, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)

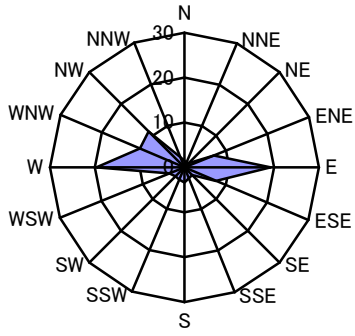


(a)10m

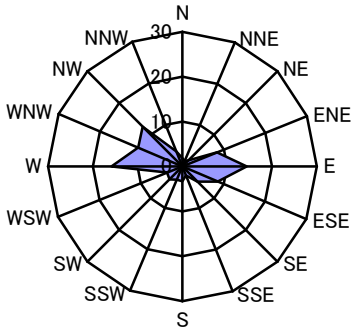
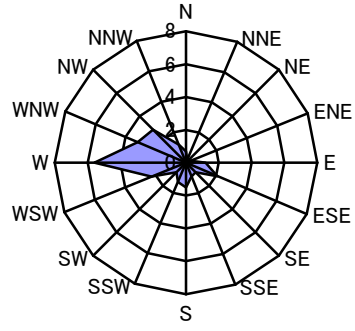


(b)20m

Fig.9 The wind observation result in May, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

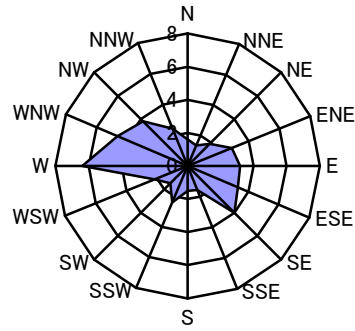
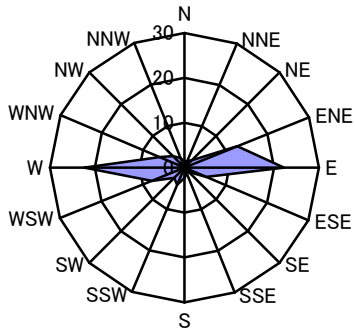
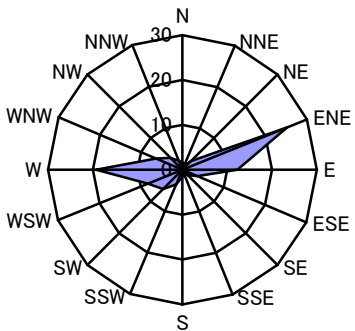
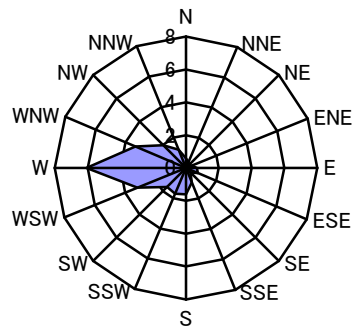


Fig.10 The wind observation result in June, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

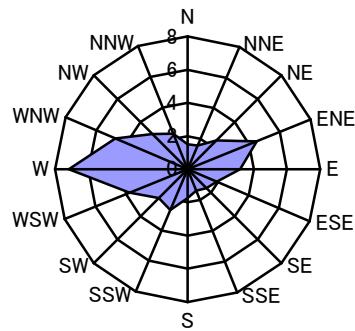
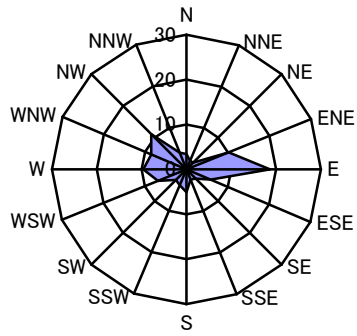
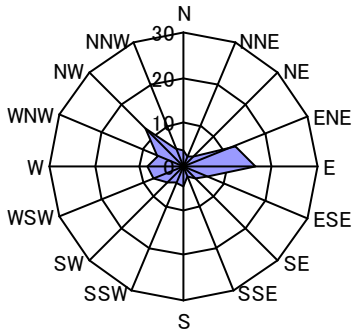
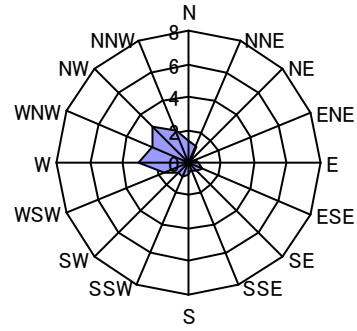


Fig.11 The wind observation result in July, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

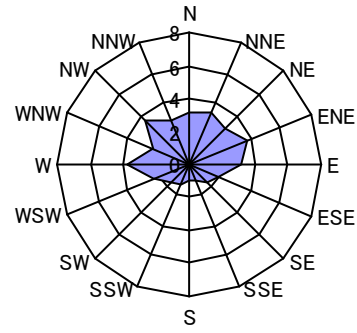
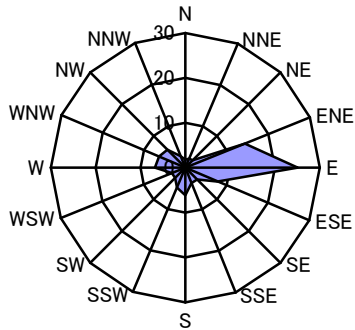
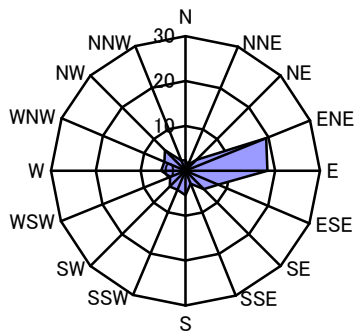
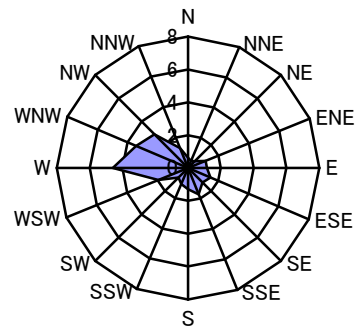


Fig.12 The wind observation result in August, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

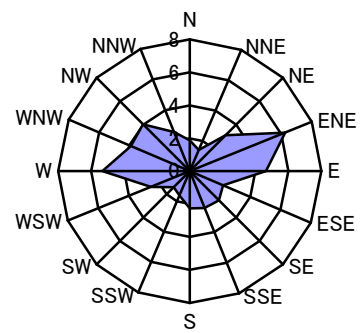
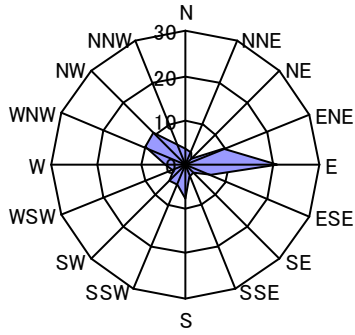
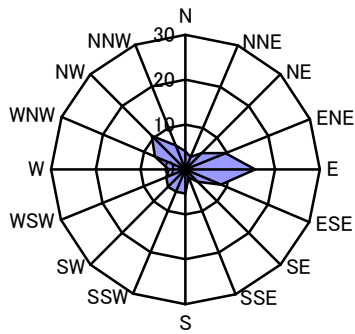
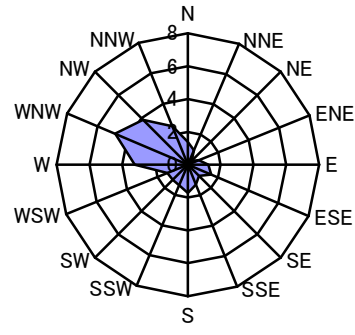


Fig.13 The wind observation result in September, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

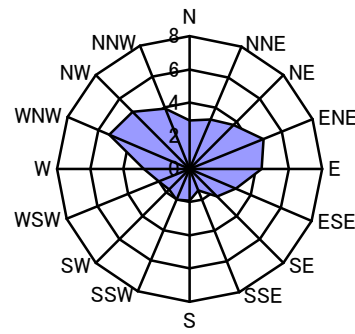
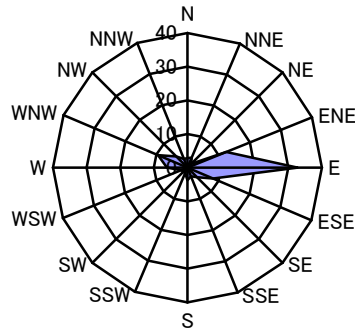
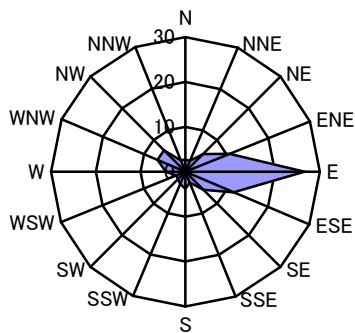
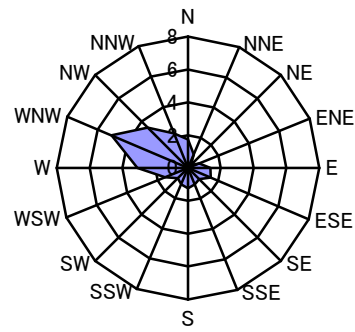


Fig.14 The wind observation result in October, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

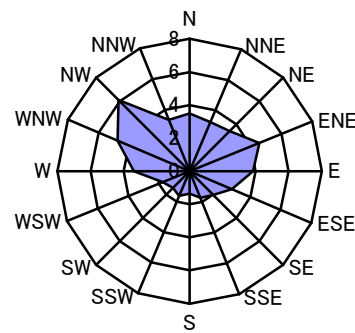
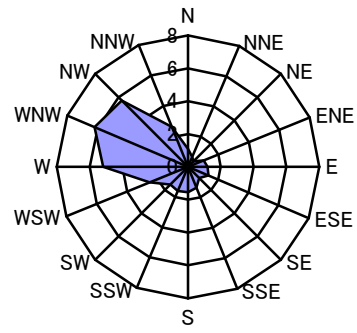
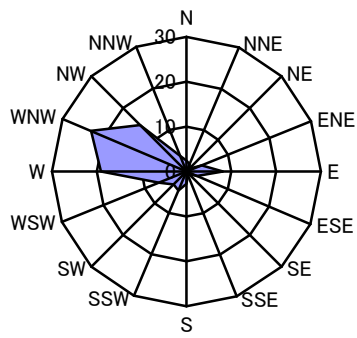
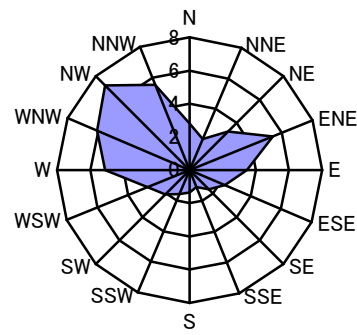
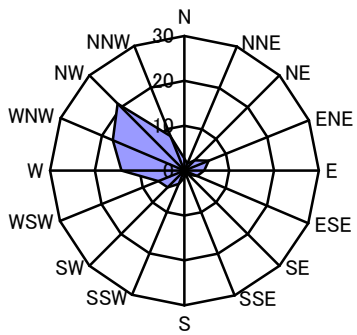


Fig.15 The wind observation result in November, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)

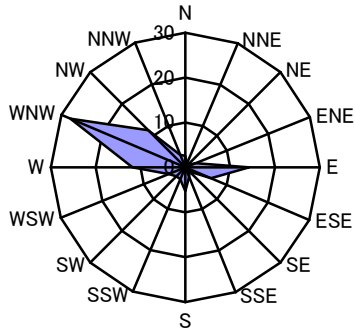


(a)10m

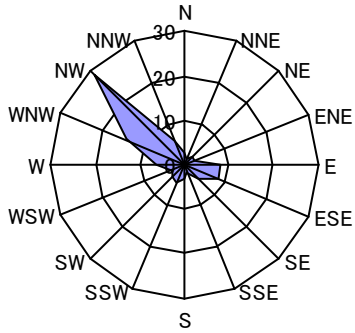
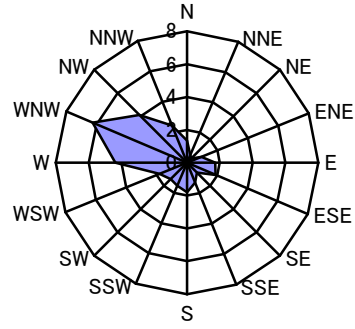


(b)20m

Fig.16 The wind observation result in December, 2003, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

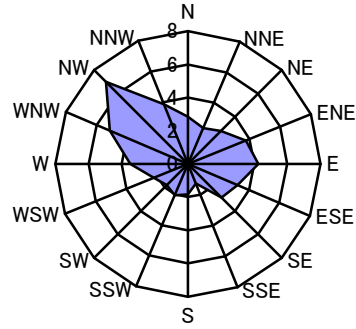
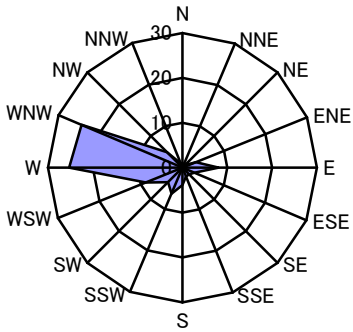
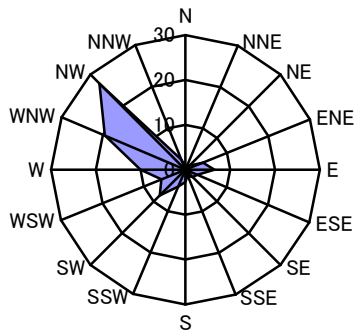
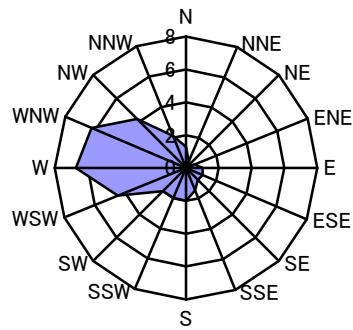


Fig.17 The wind observation result in January, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

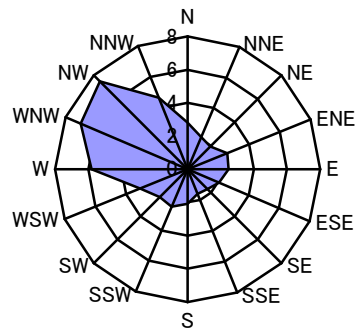
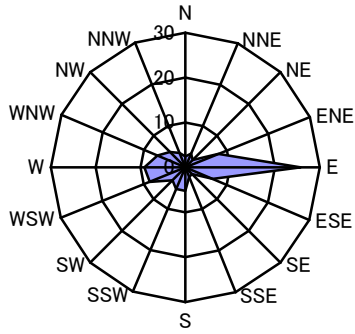
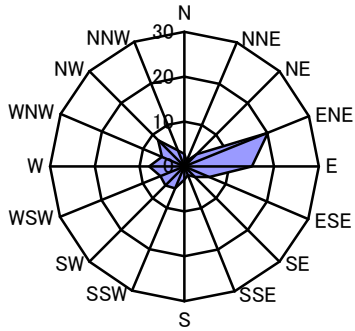
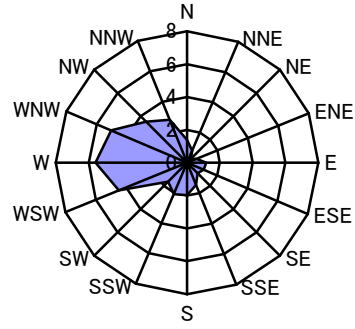


Fig.18 The wind observation result in February, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

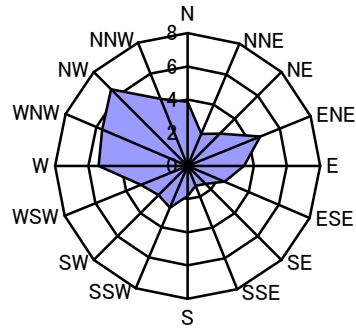
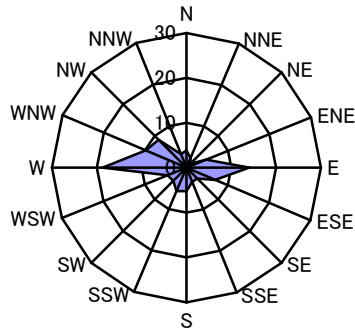
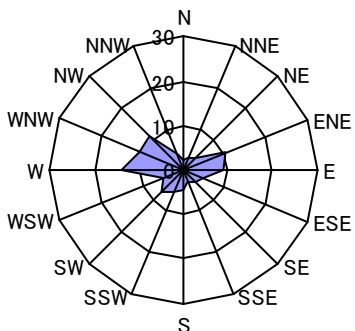
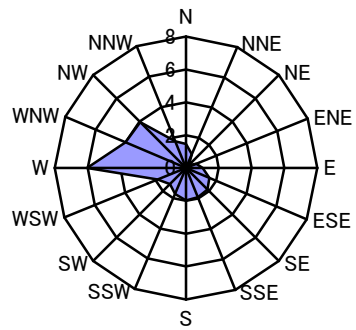


Fig.19 The wind observation result in March, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

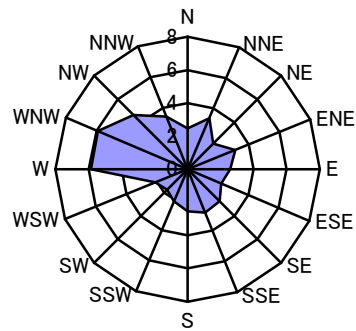
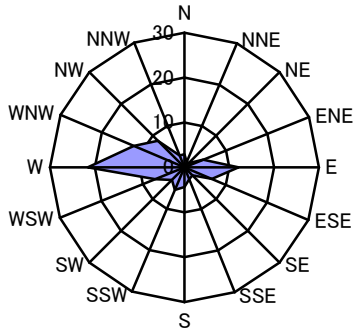
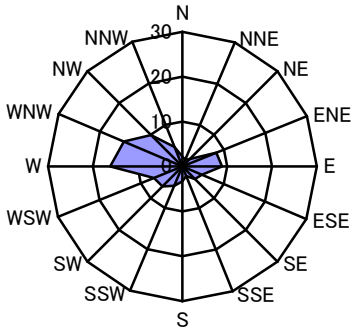
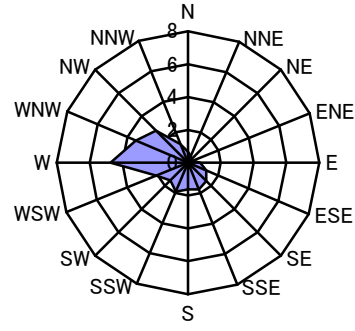


Fig.20 The wind observation result in April, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

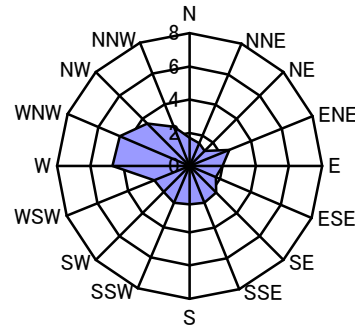
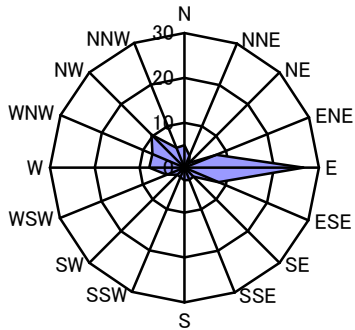
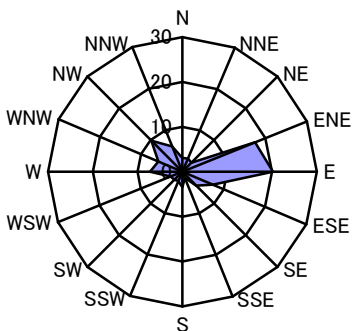
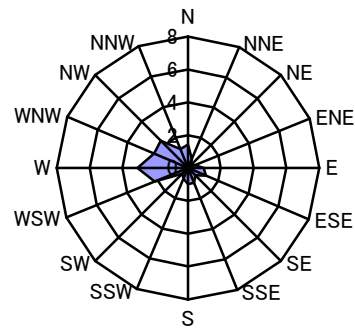


Fig.21 The wind observation result in May, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

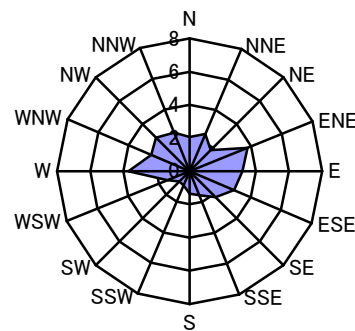
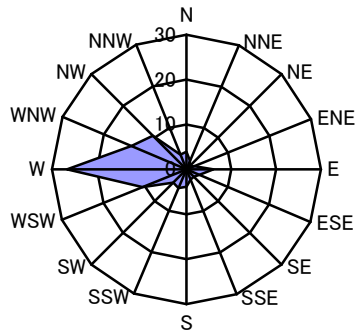
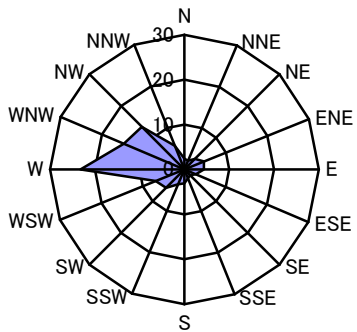
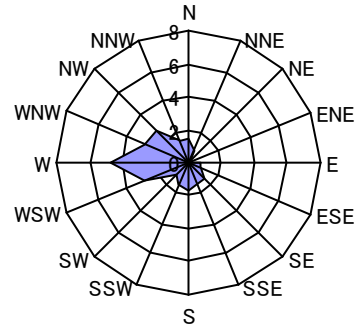


Fig.22 The wind observation result in June, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

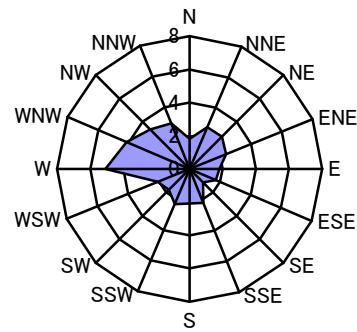
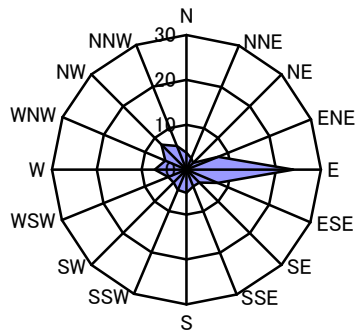
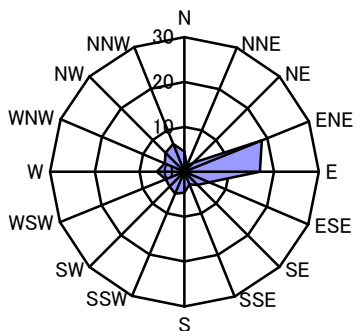
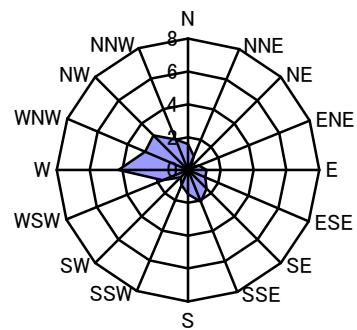


Fig.23 The wind observation result in July, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

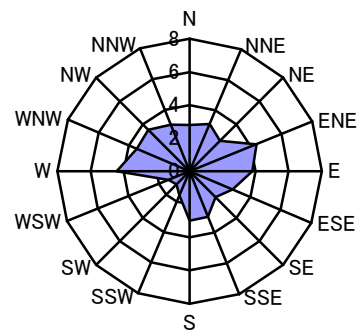
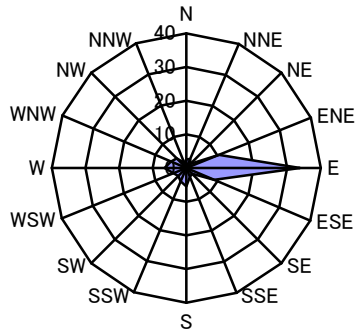
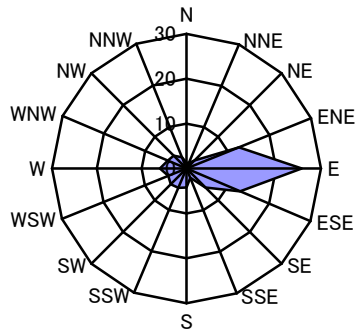
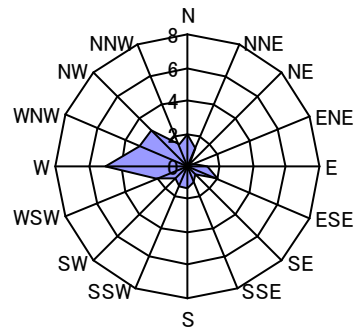


Fig.24 The wind observation result in August, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

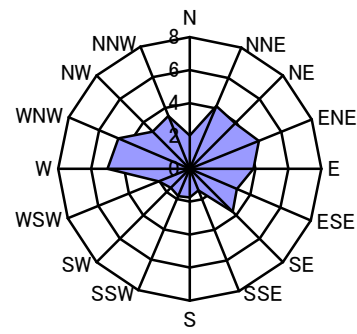
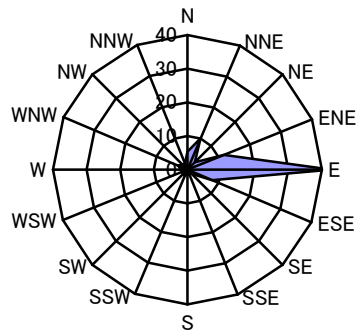
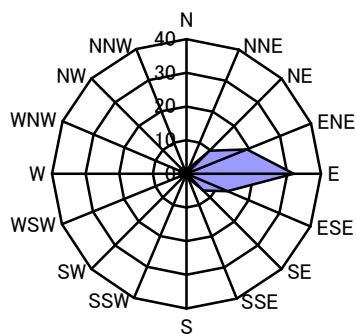
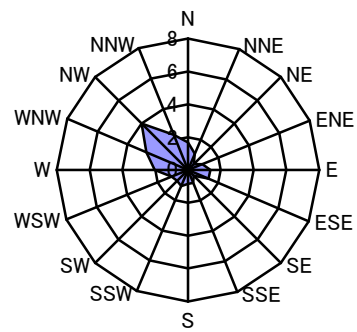


Fig.25 The wind observation result in September, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)



(a)10m



(b)20m

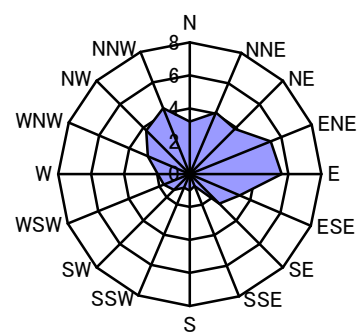


Fig.26 The wind observation result in October, 2004, left : Frequency of appearance(%), right : mean wind speed(m/s)