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## Wind and Stability Observations in the Húsavík Area

September 2002 - September 2003

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## 1. Introduction

In accordance with a contract between the **Invest in Iceland Agency - Energy Marketing** and the **Icelandic Meteorological Office** three automatic weather stations were established in the Húsavík area on 13 September 2002. The stations were to be operated to the end of September 2003. The purpose was to provide meteorological data for dispersion calculations for a possible industrial plant in the Húsavík area.

Stations for observing wind direction, wind velocity and temperature were to be located at Bakkahöfði north of Húsavík and at Gvendarbás south of Húsavík. The third station should only measure temperature at Skjólbrekka, a ridge extending northwest from Húsavíkurfjall, approx. 195 meter height above mean sea level.

The Icelandic Meteorological Office also operates an automatic weather station on the outskirts of Húsavík town.

Data from all the above mentioned stations are reported in the present report.

It should be mentioned that wind observations from the farm Héðinshöfði, approx. 2 km northeast of the station Bakkahöfði, are available from late September 1981 to late October 1983 and have been reported [Ref 1] (in Icelandic). General climatological information for the Húsavík area is included in the same report. Some information on climate, avalanches, earthquakes and sea ice can be found in the report: Húsavík. Náttúrufar og minjar [Ref 2] (in Icelandic).

## 2. Observation Sites and Instrumentation

The observation sites in the Húsavík area are shown by red filled circles on the map in Fig. 1. The former observation site Héðinshöfði is shown by a blue filled circle on the map. For photographs of the stations see Fig. 2-7.

For air temperature observations a platinum resistance thermometer Logan 100PRT with a 6-plate Gill radiation shield is used at all the stations. At Bakkahöfði, Gvendarbás and Húsavík a Wind Monitor-MA 05106-5, Marine Model, from R.M. Young is in use for observations of wind direction and wind velocity.

At all 4 stations a Measurement and Control Module CR10X from Campbell Scientific, Inc is used for collecting, storing and transmitting data to the Meteorological Office in Reykjavík. The stations Bakkahöfði, Gvendarbás and Húsavíkurfjall are powered by a solar-panel and the data are transmitted over a GSM communication module. At Húsavík the station is powered from the electricity mains and the data are transmitted over a telephone line.

At installation no thermometer corrections were found necessary for the Logan thermometers used in this report. At a test on 12 September 2003 this was still found the case at Bakkahöfði, Gvendarbás and Húsavíkurfjall. For all 4 stations eventual thermometer corrections are believed to be less than  $\pm 0.1^\circ\text{C}$ .



Fig. 1. The automatic stations in the Húsavík area are shown by red filled circles. Furthest north is Bakkahöfði, then Húsavíkurfjall, then Húsavík and Gvendarbás furthest south. Former station Héðinshöfði is indicated by a blue filled circle.



Fig. 2. Bakkahöfði. View towards N. The island Lunday is seen on the left. Photo: Þórður Arason



Fig. 3. Bakkahöfði. View towards SSE. The headland Húsavíkurhöfði is seen on the right. Photo: Sigvaldi Árnason





Fig. 4. Gvendarbás. View towards NNE and Húsavík.

Photo: Sigvaldi Árnason



Fig. 5. Húsavík station. View towards NE and Húsavíkurfjall.

Photo: Þórður Arason



Fig. 6. The station Húsavíkurfjall. View towards N. Lundey is seen on the left beyond the car.  
Photo: Þórður Arason



Fig. 7. The station Húsavíkurfjall. View towards S.  
Photo: Sigvaldi Árnason

## **Bakkahöfði**

The location of the station is 66° 04.6' N, 17° 21.7' W, elevation 15 m a.m.s.l. Height of anemometer above ground is 10.0 m. and of thermometer 2.1 m. A Vaisala temperature and relative humidity sensor HMP45A is also installed at the station at 2.1 m above the ground, but is not used in this report.

## **Gvendarbás**

The location of the station is 66° 01.4' N, 17° 22.8' W, station elevation 16 m a.m.s.l. Height of anemometer above ground is 10.0 m and of thermometer 2.1 m.

## **Húsavíkurfjall**

The station is located on top of Skjólbrekka a ridge extending northwest from the mountain Húsavíkurfjall. Station location is 66° 03.2' N, 17° 19.2' W, elevation 194 m. The only instrument in use is the platinum resistance thermometer at 2.0 m above ground.

## **Húsavík**

The Húsavík station location is 66° 02.5' N, 17° 19.7' W, elevation 28 m a.m.s.l. The height of the anemometer is 10.4 m above ground and of the thermometer 2.0 m. The station is also provided with a Vaisala HMP45A temperature and humidity sensor, and a Vaisala PTB101B barometer is installed at 29.8 m above mean sea level, but these instruments are not used in this report.

### **3. Wind Observations in the Húsavík Area**

#### **3.1 Frequency of Wind Directions**

The percentage frequency of the wind directions at **Bakkahöfði** is presented in Table 1 for each of the months October 2002 - September 2003 as well as in the form of wind roses in Annexes 1-3. Mean frequencies for the whole 12 month period, for the 6 month autumn and winter period, October-March, for the 6 month spring and summer period, April-September, and for the high summer period, June-August, are presented in Annex 4. Night and day values for the high summer period are shown in Annex 5 which also contains a wind rose for the period 16-30 September 2002.

The percentage frequency of the wind directions at **Gvendarbás** is similarly presented in Table 2 and Annexes 6-10, and for **Húsavík** in Table 3 and Annexes 11-15.

Calm is in Tables 1-3 and elsewhere in this report defined as a 10-minute average wind speed below or equal to 0.2 m/s. Bold letters in the tables indicate the highest value for each month.



Table 1. Percentage frequency of wind directions at Bakkahöfði, October 2002 - September 2003

		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
<b>N</b>	<b>360</b>	7.6	1.2	0.4	1.5	1.9	1.3	2.6	<b>8.9</b>	<b>9.1</b>	<b>9.3</b>	9.0	3.2	4.7
	<b>10</b>	<b>8.4</b>	2.3	0.6	2.2	1.6	0.9	2.9	<b>8.9</b>	7.9	9.2	<b>9.5</b>	3.9	4.9
	<b>20</b>	6.3	3.5	0.5	3.0	1.1	1.5	2.5	5.7	8.2	7.5	6.6	3.0	4.1
	<b>30</b>	2.5	2.8	0.6	4.9	0.9	5.6	2.5	7.5	7.1	5.0	4.9	1.9	3.9
	<b>40</b>	1.5	3.5	0.7	7.0	0.5	4.3	4.5	7.6	4.3	4.5	3.4	3.2	3.8
	<b>50</b>	2.1	4.4	1.1	5.3	0.5	4.1	5.8	4.3	3.5	3.7	3.3	2.4	3.4
	<b>60</b>	1.9	4.8	0.5	2.2	0.3	1.9	4.3	2.0	2.6	3.5	3.1	1.2	2.4
	<b>70</b>	1.5	3.9	0.5	2.1	0.2	1.0	3.5	1.1	2.0	2.4	1.6	0.6	1.7
	<b>80</b>	1.2	3.4	0.3	2.0	0.3	0.8	1.1	0.8	0.9	1.1	1.5	0.9	1.2
<b>E</b>	<b>90</b>	1.1	2.7	0.6	1.8	1.2	0.6	1.2	0.8	0.8	0.9	0.9	1.0	1.1
	<b>100</b>	1.8	2.3	0.7	2.7	1.2	0.9	1.1	0.6	0.7	0.6	1.1	0.8	1.2
	<b>110</b>	2.3	3.6	1.1	2.9	1.4	1.2	1.2	0.7	1.3	0.6	0.9	0.9	1.5
	<b>120</b>	2.1	2.8	1.8	2.4	1.9	1.4	1.9	1.1	2.2	0.9	0.7	0.7	1.6
	<b>130</b>	2.6	3.6	2.3	2.8	2.7	0.6	1.5	1.7	1.7	1.3	0.7	1.1	1.9
	<b>140</b>	4.2	4.5	3.3	1.6	3.1	0.8	3.4	2.0	1.7	1.2	0.7	1.7	2.3
	<b>150</b>	3.4	5.5	3.4	1.9	4.0	1.9	3.4	2.0	1.6	0.9	0.7	1.2	2.5
	<b>160</b>	3.0	4.7	12.5	6.9	7.7	6.3	5.1	2.2	1.5	0.9	1.7	5.3	4.8
	<b>170</b>	5.3	6.7	<b>20.1</b>	<b>18.7</b>	16.9	13.5	6.6	3.3	3.0	1.6	4.4	<b>16.4</b>	<b>9.7</b>
<b>S</b>	<b>180</b>	7.1	<b>7.6</b>	14.8	9.0	<b>18.3</b>	<b>18.5</b>	<b>9.4</b>	4.5	4.9	2.3	5.4	13.3	9.5
	<b>190</b>	7.4	6.2	10.6	6.9	9.2	11.6	7.1	3.6	4.6	2.8	6.0	8.5	7.0
	<b>200</b>	5.1	3.8	7.0	5.4	5.2	7.0	4.2	3.2	3.2	2.1	4.9	7.3	4.9
	<b>210</b>	1.9	2.7	3.9	1.5	2.6	3.5	2.4	2.0	2.3	1.6	3.6	3.8	2.7
	<b>220</b>	0.7	1.6	1.8	0.3	1.9	1.7	1.4	1.1	1.5	1.4	2.3	1.2	1.4
	<b>230</b>	0.5	1.3	1.1	0.2	0.7	0.9	0.7	0.7	1.1	1.1	1.5	0.6	0.9
	<b>240</b>	0.5	0.8	0.5	0.6	0.6	0.7	0.4	0.8	1.1	1.3	0.7	0.4	0.7
	<b>250</b>	0.2	0.6	0.6	0.3	0.5	0.6	0.5	0.7	0.9	1.5	0.4	0.6	0.6
	<b>260</b>	0.3	0.5	0.3	0.1	0.3	0.3	0.6	0.6	0.6	1.2	0.5	0.3	0.5
<b>W</b>	<b>270</b>	0.3	0.6	0.2	0.0	0.3	0.2	0.5	0.8	0.9	1.6	0.4	0.3	0.5
	<b>280</b>	0.3	0.5	0.5	0.1	0.2	0.1	0.5	0.5	0.5	1.4	0.5	0.3	0.4
	<b>290</b>	0.3	0.9	1.3	0.1	0.4	0.8	0.7	0.5	1.2	1.1	0.9	0.4	0.7
	<b>300</b>	0.3	1.3	1.4	0.0	0.8	0.7	1.1	1.4	0.7	1.1	1.0	1.0	0.9
	<b>310</b>	0.7	0.7	1.3	0.2	1.0	1.0	2.5	1.7	2.2	1.7	1.6	1.8	1.4
	<b>320</b>	0.7	0.6	1.0	0.2	1.7	0.9	3.5	2.2	2.1	2.9	2.0	1.9	1.6
	<b>330</b>	2.2	0.7	0.5	0.4	2.1	0.8	2.5	3.5	2.6	4.3	2.4	3.0	2.1
	<b>340</b>	4.7	0.6	0.3	1.3	2.5	0.8	3.5	3.8	3.7	4.9	2.9	2.8	2.6
	<b>350</b>	6.5	0.9	0.4	1.3	4.1	1.1	2.7	6.4	4.9	8.5	4.9	2.9	3.7
<b>Calm:</b>		1.3	1.7	1.2	0.3	0.1	0.3	0.7	0.8	1.3	2.3	3.3	0.3	1.1

As seen by Tables 1-3 and by the wind roses in Annexes 1-15 the frequency of the wind directions is variable from month to month, from winter to summer, from night to day during the summer, and to some extent from station to station.

For the year as a whole southerly winds are most common at Bakkahöfði, south-southeasterly winds at Gvendarbás and southeasterly winds at Húsavík station. This difference between the stations is largely explained by the contours of the land.

During the winter half of the year as well as during summer nights, winds blowing from the colder land towards the warmer sea are dominating. Southerly winds have then the highest frequency at Bakkahöfði, south-southeasterly winds at Gvendarbás and southeasterly winds at Húsavík.

During daytime in summer the land is usually warmer than the sea and northerly sea breeze is then dominating at Bakkahöfði and Gvendarbás while winds between northwest and north are most common at Húsavík.

Table 2. Percentage frequency of wind directions at Gvendarbás, October 2002 - September 2003

		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
<b>N</b>	<b>360</b>	7.0	1.9	0.5	1.5	2.5	1.4	4.4	<b>9.9</b>	<b>9.4</b>	12.1	<b>11.6</b>	4.4	5.6
	<b>10</b>	6.8	2.9	0.5	1.9	1.1	1.8	3.8	7.1	8.2	7.9	9.7	3.3	4.6
	<b>20</b>	6.3	1.5	0.6	4.3	0.7	4.5	4.0	4.5	4.0	4.0	4.0	1.7	3.4
	<b>30</b>	3.1	1.3	0.7	5.1	0.4	1.8	2.5	4.9	1.7	2.1	3.2	2.0	2.4
	<b>40</b>	1.4	2.3	0.5	4.1	0.1	2.2	1.9	5.9	1.0	1.6	2.1	1.7	2.1
	<b>50</b>	0.7	2.9	0.5	3.7	0.0	3.0	2.6	3.2	1.3	1.2	1.7	1.9	1.9
	<b>60</b>	0.7	3.5	0.4	1.8	0.1	2.0	1.9	1.4	1.3	1.1	1.4	1.1	1.4
	<b>70</b>	0.7	3.8	0.3	1.1	0.1	1.3	1.3	1.0	1.0	1.1	0.9	0.6	1.1
	<b>80</b>	0.6	2.1	0.7	1.6	0.2	0.7	2.4	0.8	2.1	1.8	0.7	0.6	1.2
<b>E</b>	<b>90</b>	1.0	2.2	0.6	2.8	0.6	0.5	1.8	0.9	1.5	1.7	0.6	0.2	1.2
	<b>100</b>	1.2	3.3	0.4	3.1	1.2	0.6	2.0	0.6	0.8	0.7	0.6	0.6	1.3
	<b>110</b>	2.1	3.5	1.5	4.0	2.5	1.4	1.9	1.3	1.3	0.6	0.9	0.8	1.8
	<b>120</b>	3.0	4.5	2.6	2.3	3.5	1.0	3.2	2.3	2.3	1.7	0.8	1.7	2.4
	<b>130</b>	4.5	7.1	3.1	1.4	3.8	2.1	3.2	2.2	2.6	1.7	1.2	1.4	2.8
	<b>140</b>	6.9	7.7	11.3	7.0	4.7	6.0	4.2	2.7	2.5	1.8	2.4	4.7	5.2
	<b>150</b>	8.4	<b>9.3</b>	<b>23.6</b>	<b>16.6</b>	13.0	10.5	6.5	4.5	2.5	2.2	5.1	<b>12.6</b>	<b>9.5</b>
	<b>160</b>	<b>8.7</b>	8.8	14.4	11.3	<b>16.3</b>	<b>12.3</b>	<b>8.0</b>	3.8	4.5	2.9	5.4	10.8	8.9
	<b>170</b>	5.6	6.1	9.6	6.0	13.4	11.3	6.6	2.4	3.0	2.0	3.9	7.6	6.4
<b>S</b>	<b>180</b>	4.4	5.2	7.4	5.5	9.7	10.3	6.2	2.4	2.7	1.9	3.2	6.1	5.4
	<b>190</b>	3.7	3.8	5.7	4.7	6.1	8.7	4.6	2.4	2.4	1.8	4.5	6.8	4.6
	<b>200</b>	2.1	2.1	4.2	2.8	3.8	4.9	2.5	1.5	2.1	1.7	2.7	4.9	2.9
	<b>210</b>	1.0	1.3	2.5	0.9	1.9	2.5	1.4	1.2	1.5	0.9	2.8	4.5	1.9
	<b>220</b>	0.6	1.5	1.3	0.5	1.2	1.7	1.5	0.7	1.5	0.7	1.8	1.8	1.2
	<b>230</b>	0.3	0.8	0.8	0.3	0.7	0.8	0.7	0.7	0.9	0.7	1.4	0.9	0.8
	<b>240</b>	0.2	0.7	0.3	0.4	0.4	0.4	0.5	0.5	0.8	0.6	1.0	0.3	0.5
	<b>250</b>	0.3	0.7	0.3	0.4	0.2	0.5	0.4	0.6	0.8	0.6	0.9	0.3	0.5
	<b>260</b>	0.3	0.7	0.1	0.0	0.1	0.3	0.6	0.5	0.6	0.6	0.8	0.4	0.4
<b>W</b>	<b>270</b>	0.2	0.5	0.1	0.3	0.2	0.2	0.7	0.6	0.9	0.8	0.6	0.3	0.4
	<b>280</b>	0.2	0.6	0.2	0.2	0.1	0.3	0.8	1.1	1.0	1.3	0.9	0.7	0.6
	<b>290</b>	0.2	0.8	0.2	0.2	0.1	0.4	0.4	1.0	1.6	1.6	0.9	0.3	0.7
	<b>300</b>	0.5	0.9	0.5	0.2	0.2	0.2	1.0	1.1	2.0	2.4	0.9	0.3	0.8
	<b>310</b>	0.6	1.0	0.7	0.2	0.7	0.3	0.9	1.4	2.2	3.1	1.4	0.7	1.1
	<b>320</b>	1.1	0.7	1.0	0.3	1.5	0.8	2.5	2.6	3.3	3.2	2.6	1.9	1.8
	<b>330</b>	2.1	0.9	1.0	0.3	1.7	0.6	3.2	4.9	5.0	6.1	2.6	3.3	2.6
	<b>340</b>	5.7	0.9	0.6	0.9	2.3	0.9	4.7	7.3	7.6	8.4	4.4	3.8	4.0
	<b>350</b>	6.9	1.0	0.3	1.8	4.4	1.2	4.7	9.3	<b>9.4</b>	<b>13.1</b>	7.5	4.2	5.3
<b>Calm:</b>		<b>1.2</b>	<b>1.1</b>	<b>0.7</b>	<b>0.2</b>	<b>0.1</b>	<b>0.6</b>	<b>0.9</b>	<b>1.2</b>	<b>2.7</b>	<b>2.1</b>	<b>3.1</b>	<b>0.6</b>	<b>1.2</b>

Table 3. Percentage frequency of wind directions at Húsavík,  
October 2002 - September 2003

		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
<b>N</b>	<b>360</b>	6.2	2.3	0.4	1.7	1.3	1.9	2.5	5.0	4.5	3.7	5.7	2.6	3.2
	<b>10</b>	5.2	1.2	0.3	2.4	1.2	2.7	2.2	6.1	4.1	3.3	4.8	2.2	3.0
	<b>20</b>	3.1	0.8	0.3	5.0	0.6	2.6	1.9	4.8	4.5	2.6	3.5	2.2	2.7
	<b>30</b>	2.5	1.5	0.5	4.3	0.9	2.2	1.6	3.4	1.8	1.3	1.4	1.8	1.9
	<b>40</b>	1.4	0.7	0.5	3.3	0.2	1.7	1.0	2.6	0.8	0.9	0.8	0.8	1.2
	<b>50</b>	1.5	0.6	0.2	1.6	0.2	0.6	0.4	1.9	0.6	0.6	0.7	0.6	0.8
	<b>60</b>	0.5	0.8	0.1	0.7	0.1	0.4	0.4	0.7	0.5	0.6	0.7	0.5	0.5
	<b>70</b>	0.4	1.2	0.2	0.3	0.1	0.5	1.1	0.6	0.7	2.3	1.1	0.4	0.7
	<b>80</b>	1.0	2.9	0.4	1.4	0.2	1.6	1.7	0.9	1.3	3.0	1.1	0.4	1.3
<b>E</b>	<b>90</b>	0.8	4.5	0.9	3.8	0.2	1.5	2.4	1.2	1.9	2.3	0.8	0.6	1.8
	<b>100</b>	1.5	5.6	3.6	7.5	2.2	3.9	3.3	2.1	2.4	1.9	1.3	2.8	3.2
	<b>110</b>	5.5	8.1	12.0	<b>14.6</b>	5.4	8.4	6.4	3.3	2.8	3.1	3.2	6.8	6.7
	<b>120</b>	10.0	10.6	15.7	12.7	9.5	8.0	10.1	6.6	5.9	4.1	5.0	8.3	8.9
	<b>130</b>	<b>14.2</b>	<b>17.1</b>	<b>20.4</b>	13.1	18.3	12.0	<b>10.9</b>	<b>8.7</b>	<b>8.4</b>	6.7	<b>8.8</b>	13.0	<b>12.6</b>
	<b>140</b>	10.8	14.7	17.7	8.4	<b>21.0</b>	<b>13.5</b>	9.0	6.5	7.3	5.2	7.6	<b>13.7</b>	11.2
	<b>150</b>	4.0	5.6	7.9	4.3	12.4	9.6	5.1	1.7	2.6	1.8	2.8	7.5	5.4
	<b>160</b>	1.8	2.6	2.7	2.8	4.1	5.8	4.8	1.0	1.7	1.2	1.9	4.1	2.8
	<b>170</b>	1.2	1.6	1.8	1.9	2.4	5.0	4.1	1.4	1.4	1.0	1.6	4.3	2.3
<b>S</b>	<b>180</b>	0.9	1.4	1.0	0.7	1.5	2.6	1.5	0.7	1.4	0.8	1.6	2.4	1.4
	<b>190</b>	0.5	1.2	0.9	0.4	1.1	1.8	1.2	0.6	1.3	0.6	1.3	1.8	1.1
	<b>200</b>	0.3	0.5	0.8	0.5	0.8	1.3	0.6	0.6	1.3	0.8	1.1	1.1	0.8
	<b>210</b>	0.2	0.7	0.5	0.3	0.6	0.7	0.6	0.5	0.9	0.6	0.8	0.8	0.6
	<b>220</b>	0.3	0.3	0.5	0.3	0.5	1.0	0.6	0.4	0.8	0.5	0.9	0.9	0.6
	<b>230</b>	0.3	0.5	0.5	0.3	0.5	1.1	0.5	0.3	0.9	0.7	0.8	0.4	0.6
	<b>240</b>	0.4	0.7	0.4	0.3	0.5	0.6	0.7	0.3	1.2	0.9	0.9	0.4	0.6
	<b>250</b>	0.2	0.7	0.3	0.1	0.4	0.4	0.5	0.5	1.5	1.3	1.3	0.2	0.6
	<b>260</b>	0.3	0.6	0.3	0.2	0.3	0.5	0.7	0.9	2.2	2.0	1.9	0.5	0.9
<b>W</b>	<b>270</b>	0.2	0.6	0.1	0.2	0.1	0.4	0.7	1.1	2.6	3.6	2.3	0.5	1.1
	<b>280</b>	0.2	0.6	0.2	0.2	0.1	0.3	0.8	1.5	2.5	3.6	2.2	0.5	1.1
	<b>290</b>	0.4	0.8	0.4	0.4	0.1	0.4	1.3	1.5	2.4	2.8	2.2	0.5	1.1
	<b>300</b>	0.5	0.6	0.8	0.3	0.2	0.5	1.1	1.9	2.5	3.1	2.4	0.8	1.2
	<b>310</b>	0.8	0.9	1.0	0.3	0.6	0.5	1.7	3.0	2.7	3.3	2.3	1.1	1.5
	<b>320</b>	1.8	1.1	1.4	0.4	2.1	1.5	3.9	5.2	4.9	5.8	3.4	3.3	2.9
	<b>330</b>	4.9	1.3	1.4	1.3	2.8	1.0	5.2	7.5	4.3	6.1	4.4	3.8	3.7
	<b>340</b>	7.4	1.1	0.8	1.6	4.6	1.1	4.6	7.3	6.0	<b>8.3</b>	6.3	3.7	4.4
	<b>350</b>	6.1	1.8	0.5	1.4	2.7	1.3	3.6	6.0	4.2	5.1	6.6	3.8	3.6
<b>Calm:</b>		<b>2.7</b>	<b>2.3</b>	<b>2.3</b>	<b>1.2</b>	<b>0.3</b>	<b>1.1</b>	<b>1.5</b>	<b>1.7</b>	<b>3.2</b>	<b>4.7</b>	<b>4.6</b>	<b>0.7</b>	<b>2.2</b>

Annual variation of the percentage frequency of six selected wind directions is presented for Bakkahöfði in Fig. 8, for Gvendarhöfði in Fig. 9, and for Húsavík in Fig. 10, and similarly diurnal variation during the high summer months June-August is presented in Fig. 11, Fig. 12 and Fig. 13.

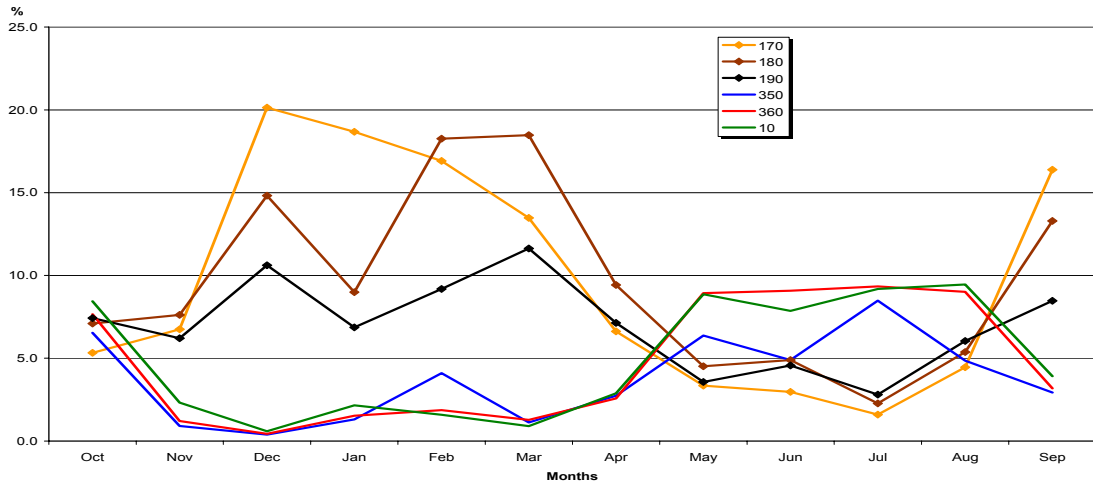


Fig. 8. Annual variation of percentage frequency of six selected wind directions, Bakkahöfði, October 2002 – September 2003.

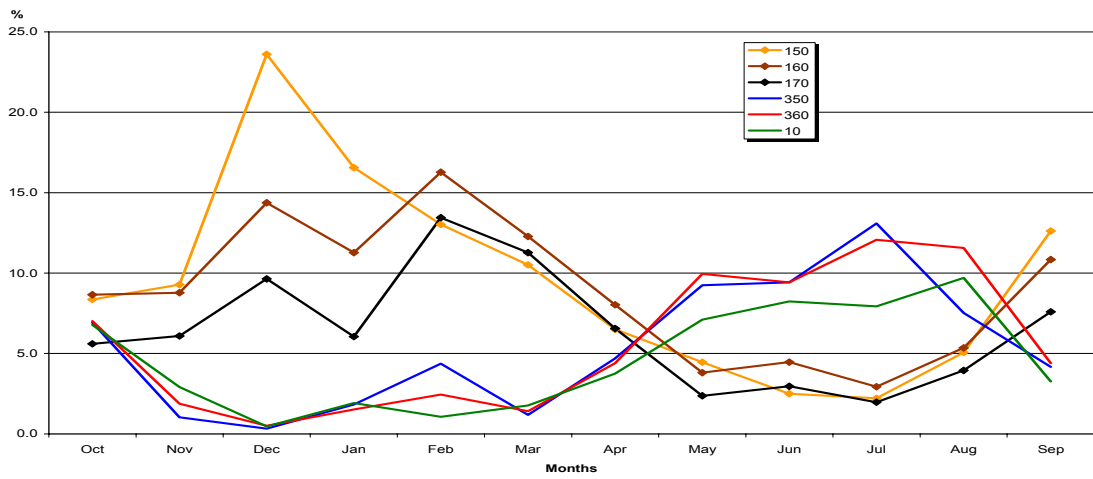


Fig.9. Annual variation of percentage frequency of six selected wind directions, Gvendarbás, October 2002 – September 2003.

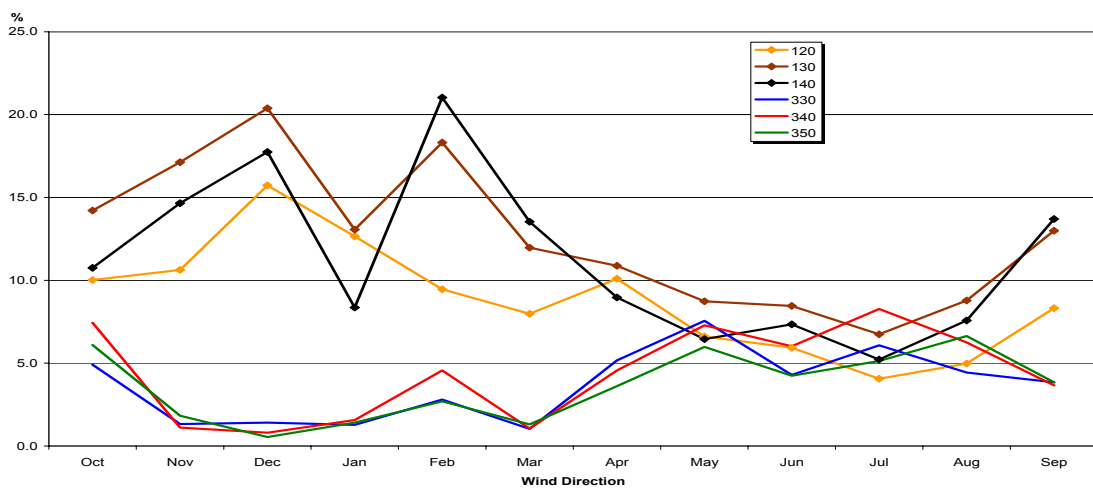


Fig. 10. Annual variation of percentage frequency of six selected wind directions, Húsavík, October 2002 – September 2003.



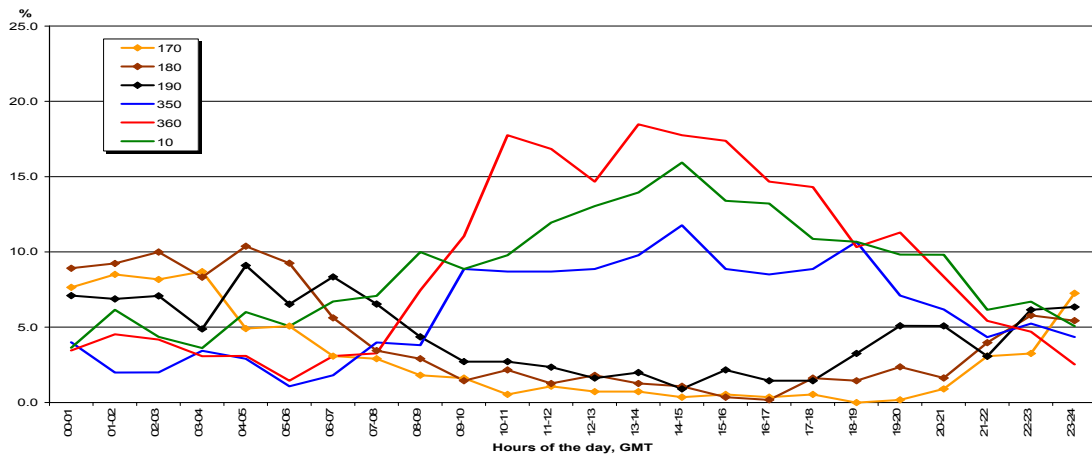


Fig. 11. Diurnal variation of percentage frequency of six selected wind directions, Bakkahöfði, June-August 2003.

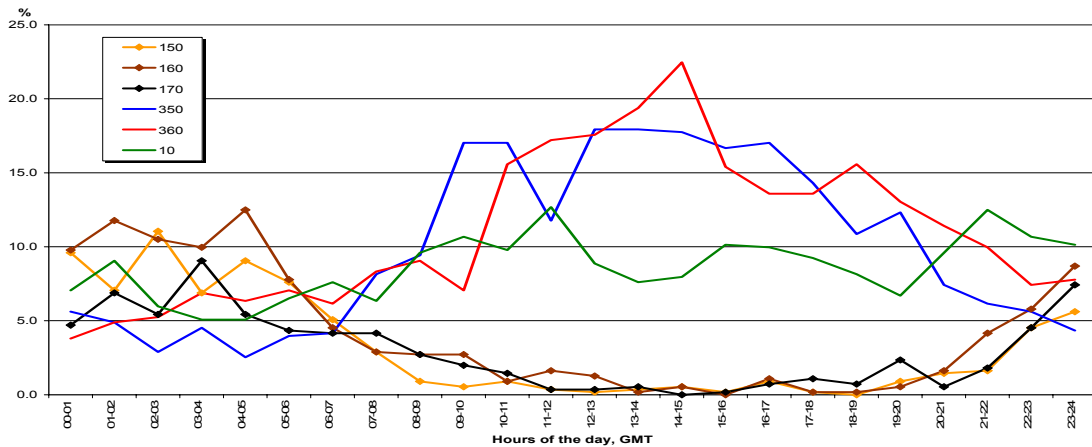


Fig. 12. Diurnal variation of percentage frequency of six selected wind directions, Gvendarbás, June-August 2003.

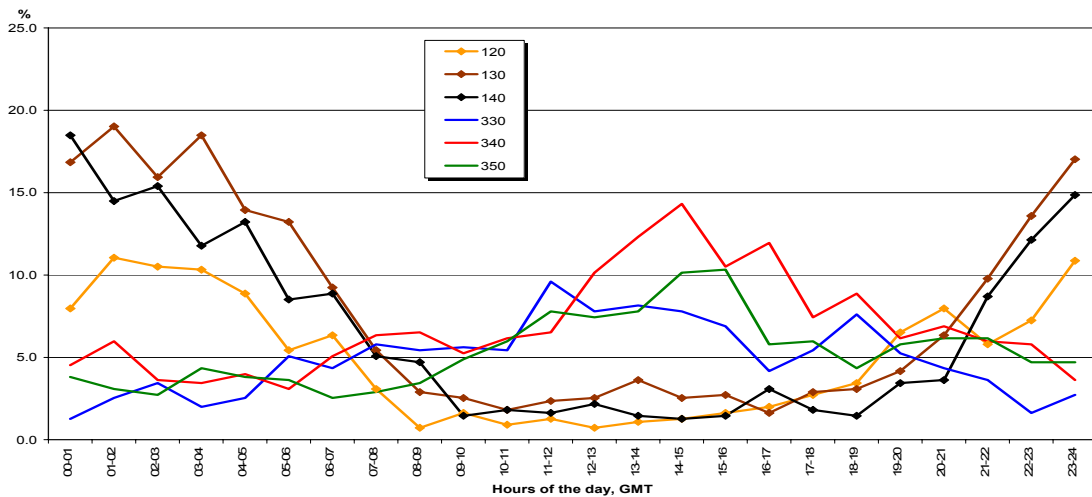


Fig. 13. Diurnal variation of percentage frequency of six selected wind directions, Húsavík, June-August 2003.

### 3.2 Wind Velocity

The average 10-minute wind velocity at Bakkahöfði, Gvendarbás and Húsavík for each month and for the twelve-month period October 2002 - September 2003 is listed in Table 4.

Table 4. Monthly average wind velocity at Bakkahöfði, Gvendarbás and Húsavík, October 2002 – September 2003

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
<b>Bakkahöfði</b>	7.4	5.7	6.8	7.8	9.4	8.3	6.3	5.0	4.5	3.7	3.6	7.2	6.3
<b>Gvendarbás</b>	7.3	5.6	6.7	7.2	9.1	7.5	6.3	4.8	4.2	3.6	3.7	6.9	6.0
<b>Húsavík</b>	5.4	5.1	5.4	5.9	7.7	5.6	5.0	3.6	3.3	2.8	2.6	4.6	4.7

Percentage frequency of 10-minute wind velocity for selected velocity intervals is presented for Bakkahöfði in Table 5, for Gvendarbás in Table 6 and for Húsavík in Table 7.

Table 5. Percentage frequency of 10-minute wind velocity for selected velocity intervals at Bakkahöfði, Október 2002 – September 2003.

m/s	0.0-0.9	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	0.0-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	>25.0
<b>Oct</b>	4.8	6.4	6.9	6.6	6.6	31.3	35.9	31.0	1.7		
<b>Nov</b>	8.8	11.6	9.9	10.5	10.5	51.4	32.4	13.7	2.5		
<b>Dec</b>	6.1	7.7	5.7	4.4	5.1	29.0	55.0	14.6	1.4		
<b>Jan</b>	2.2	5.1	5.3	4.4	5.9	22.8	54.2	17.4	5.3	0.3	0.0
<b>Feb</b>	1.2	3.5	4.2	4.3	5.1	18.5	39.6	28.1	11.8	1.9	0.1
<b>Mar</b>	2.6	6.0	5.9	5.0	5.1	24.6	40.4	27.6	7.0	0.3	
<b>Apr</b>	4.2	8.8	8.7	9.3	9.1	40.1	42.0	16.2	1.6		
<b>May</b>	4.5	10.7	12.0	11.3	12.0	50.4	46.2	3.3			
<b>Jun</b>	8.1	14.7	14.2	11.7	8.9	57.7	40.5	1.8			
<b>Jul</b>	12.7	19.3	15.6	14.1	9.2	70.9	26.6	2.5			
<b>Aug</b>	13.7	20.2	14.6	13.6	12.5	74.6	23.4	2.0			
<b>Sep</b>	2.6	6.1	7.3	8.0	8.5	32.5	45.9	15.7	4.2	1.2	0.5
<b>Year</b>	6.0	10.1	9.2	8.6	8.2	42.1	40.2	14.4	2.9	0.3	0.0

Table 6. Percentage frequency of 10-minute wind velocity for selected velocity intervals at Gvendarbás, Október 2002 – September 2003.

m/s	0.0-0.9	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	0.0-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	>25.0
<b>Oct</b>	4.6	6.7	4.8	7.4	7.3	30.7	40.0	28.6	0.7		
<b>Nov</b>	6.9	11.3	10.3	11.9	10.6	51.0	34.8	11.7	2.5	0.0	
<b>Dec</b>	4.9	6.2	5.5	6.5	7.9	31.1	54.2	13.6	1.1		
<b>Jan</b>	1.9	4.4	6.1	6.7	7.5	26.6	56.5	13.9	2.9	0.1	
<b>Feb</b>	1.2	2.3	2.9	3.8	5.5	15.7	47.5	26.1	9.6	1.0	0.0
<b>Mar</b>	2.9	5.8	5.2	4.5	5.9	24.3	51.6	21.1	3.0		
<b>Apr</b>	4.4	6.6	6.5	9.2	12.0	38.6	46.0	14.1	1.3		
<b>May</b>	4.8	9.6	10.8	12.1	14.2	51.5	47.0	1.5			
<b>Jun</b>	11.1	14.7	12.9	12.2	11.4	62.4	36.0	1.6			
<b>Jul</b>	10.8	19.0	18.0	15.3	11.8	74.9	23.2	1.9			
<b>Aug</b>	12.1	18.0	15.0	13.3	13.8	72.2	26.8	0.9			
<b>Sep</b>	3.0	7.1	7.6	8.7	9.9	36.3	44.1	13.9	4.3	1.2	0.1
<b>Year</b>	5.8	9.4	8.8	9.3	9.8	43.1	42.3	12.3	2.0	0.2	0.0

Table 7. Percentage frequency of 10-minute wind velocity for selected velocity intervals at Húsavík, Október 2002 – September 2003.

m/s	0.0-0.9	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	0.0-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	>25.0
Oct	8.8	8.0	7.4	9.3	11.1	44.6	46.6	8.6	0.2		
Nov	12.4	13.0	11.6	10.1	8.2	55.2	31.1	12.8	0.9	0.0	
Dec	8.1	7.0	9.4	8.7	8.7	41.8	52.0	5.6	0.6		
Jan	5.1	6.3	6.8	7.5	10.6	36.2	56.1	6.6	1.1		
Feb	2.3	2.9	4.1	5.8	8.4	23.5	52.6	19.1	4.5	0.3	
Mar	4.7	5.3	6.3	8.2	12.5	37.0	58.0	4.9	0.1		
Apr	6.6	8.9	9.8	14.0	14.0	53.3	42.2	4.5	0.0		
May	8.2	13.0	17.1	18.6	18.4	75.3	24.6	0.1			
Jun	15.6	19.2	14.2	15.1	15.4	79.5	19.0	1.5			
Jul	19.6	22.9	16.6	15.0	9.6	83.7	16.2	0.0			
Aug	20.0	22.0	18.6	17.3	11.6	89.5	10.5				
Sep	4.7	10.4	14.6	15.1	13.6	58.4	37.5	3.7	0.4	0.0	
Year	9.7	11.7	11.4	12.1	11.9	56.8	37.1	5.5	0.6	0.0	

As evident from Table 4 the average wind velocity is considerably lower at the relatively sheltered Húsavík than at Gvendarbás and Bakkahöfði. This is also evident from Tables 5-7 which show that 56.8 % of the velocity observations at Húsavík during the period October 2002 - September 2003 were below 5.0 m/s, while corresponding figures were 43.1 % for Gvendarbás and 42.1 % for Bakkahöfði.

Average wind velocity for each wind direction is presented for Bakkahöfði in the histograms below the wind roses in Annexes 1-5, for Gvendarbás in Annexes 6-10 and for Húsavík in Annexes 11-15.

The average wind velocity for each wind direction at Bakkahöfði is also shown in Fig. 14 for the whole year, for the winter half of the year and for the summer half; and similarly in Fig. 15 for Gvendarbás and in Fig. 16 for Húsavík.

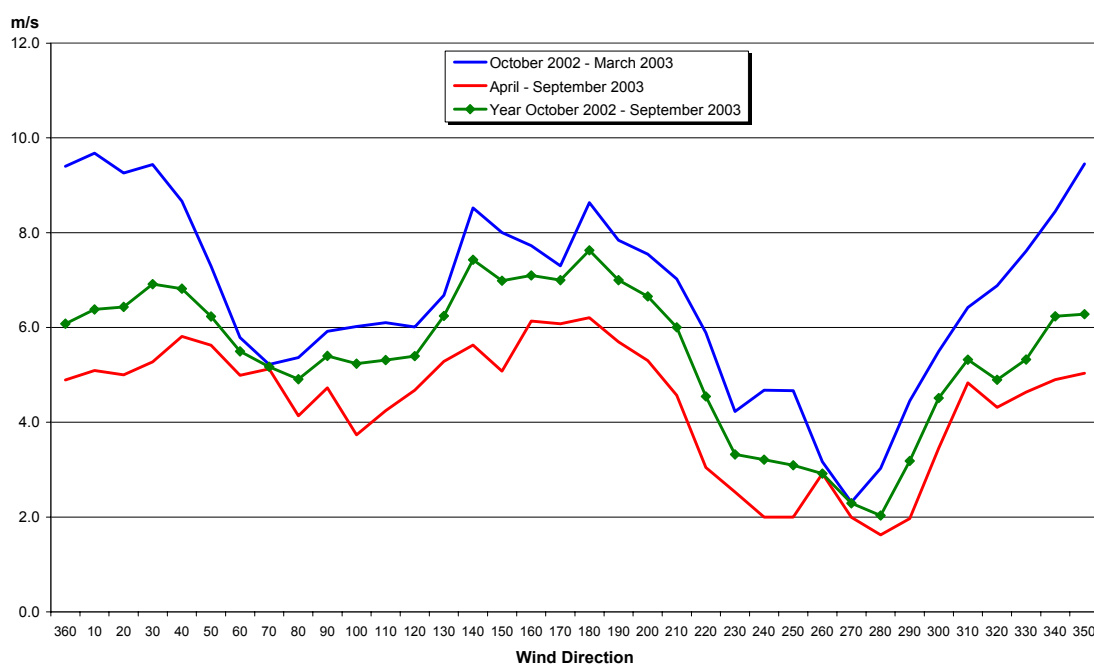


Fig. 14. Average wind velocity for each wind direction at Bakkahöfði during the winter half of the year, the summer half and the whole year.

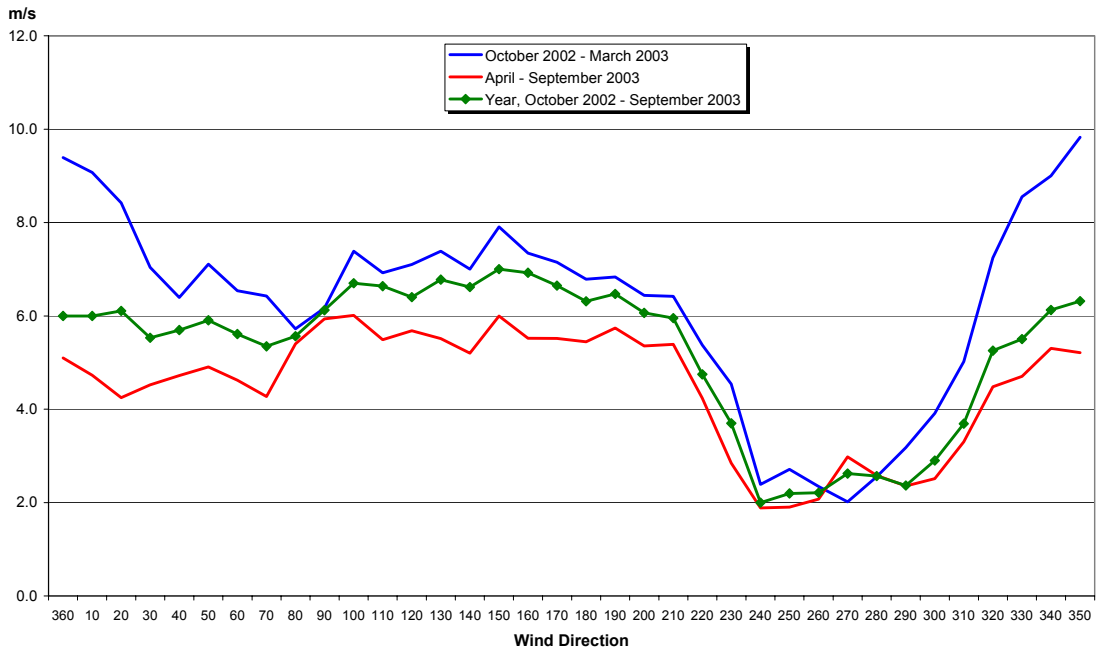


Fig. 15. Average wind velocity for each wind direction at Gvendarbás during the winter half of the year, the summer half and the whole year.

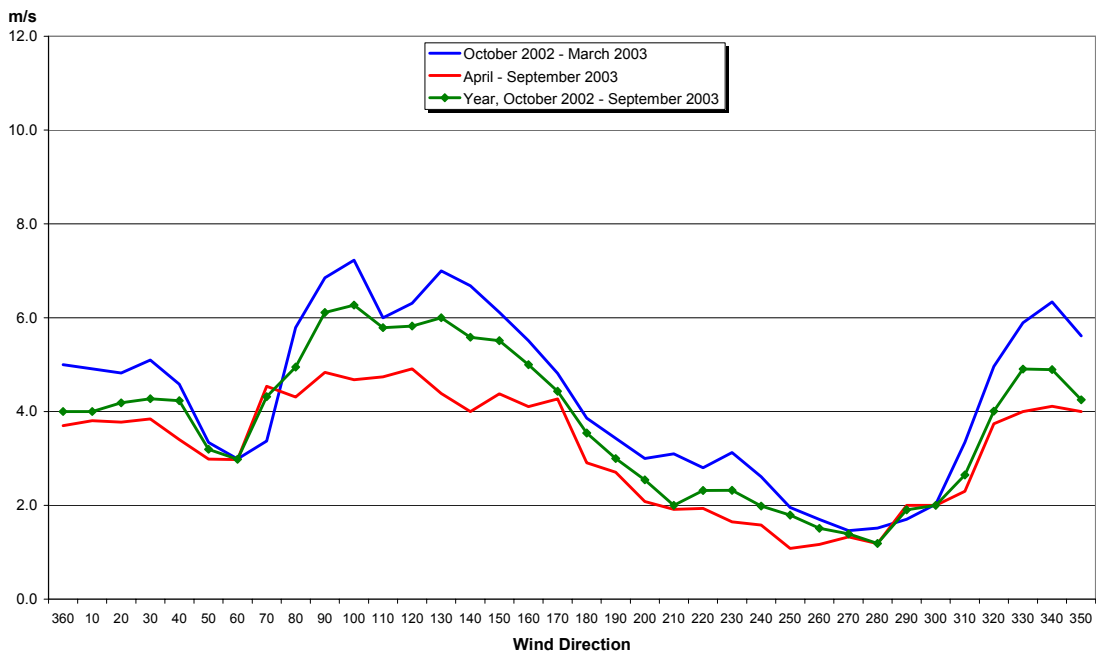


Fig. 16. Average wind velocity for each wind direction at Húsavík during the winter half of the year, the summer half and the whole year.

The distribution of 10-minute wind velocity in February and August 2003 is presented for Bakkahöfði in Fig. 17, for Gvendarbás in Fig. 18 and for Húsavík in Fig. 19.



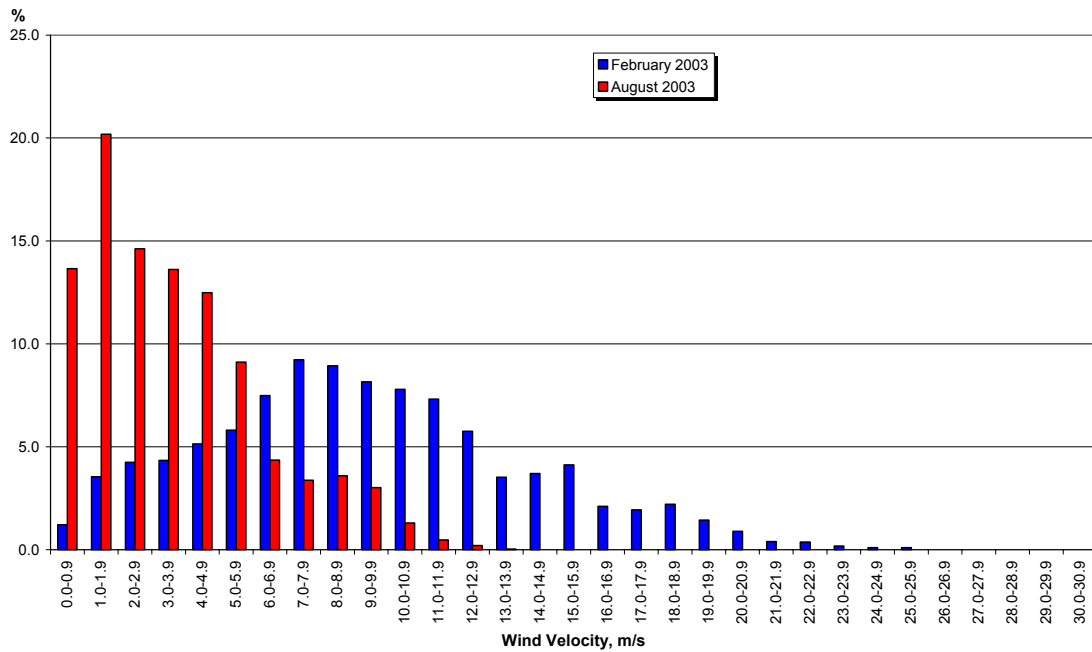


Fig. 17. Distribution of 10-minute wind velocity in February and August 2003 at Bakkahöfði.

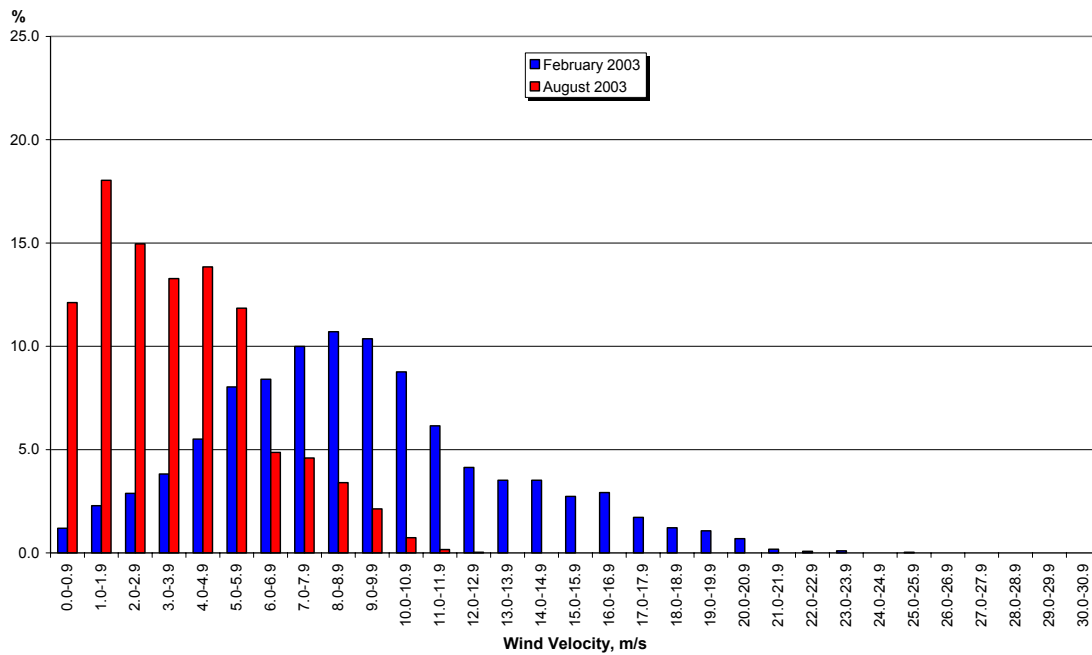


Fig. 18. Distribution of 10-minute wind velocity in February and August 2003 at Gvendarbás.

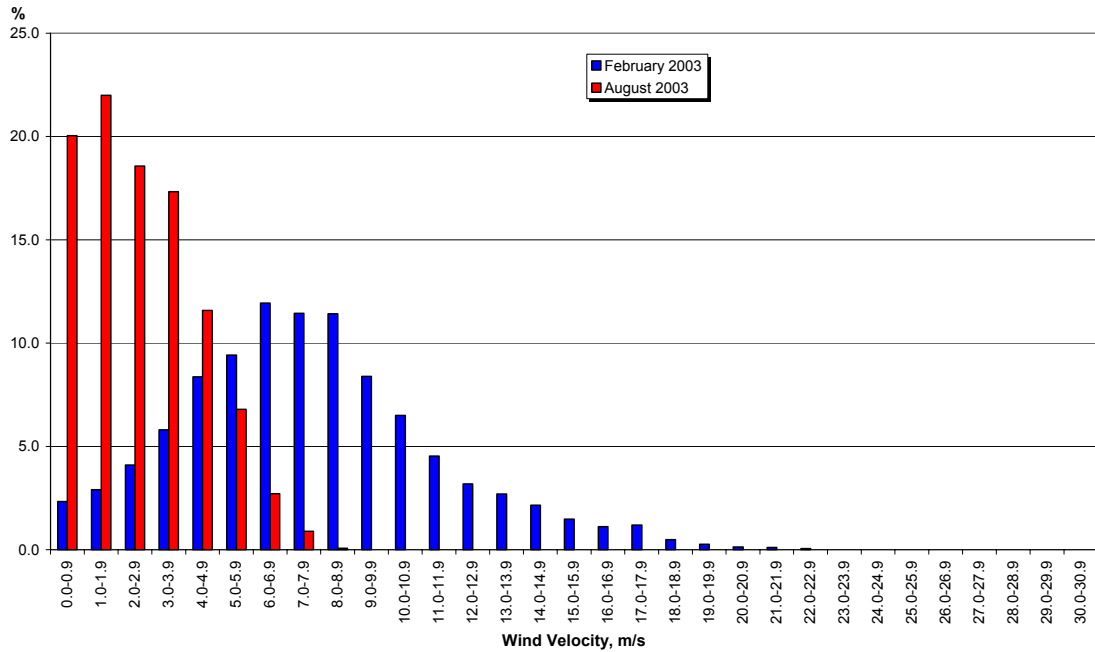


Fig. 19. Distribution of 10-minute wind velocity in February and August 2003 at Húsavík.

The diurnal variation of the 10-minute wind velocity is considerable during the summer half of the year. In Fig. 20 this is shown for the high summer months, June-August 2003, at Bakkahöfði, Gvendarbás and Húsavík.

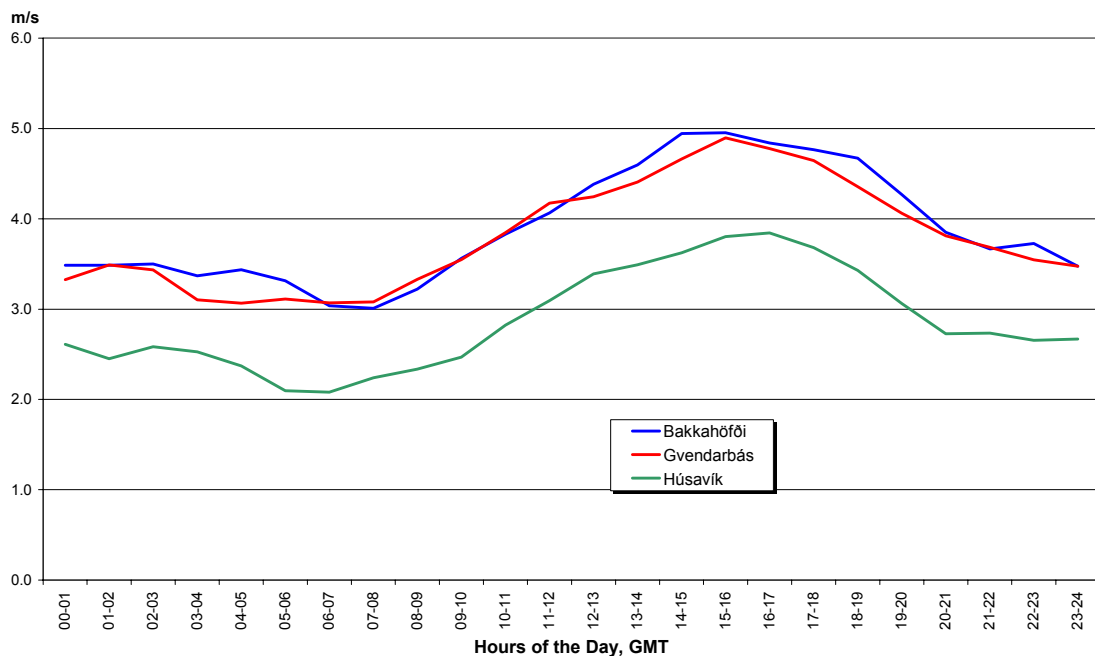


Fig. 20. Mean diurnal variation of 10-minute wind velocity at Bakkahöfði, Gvendarbás and Húsavík during the high summer months June- August 2003.

The highest 10-minute wind velocity observed at Bakkahöfði during the twelve-month period October 2002 – September 2003 was 27.4 m/s, observed on 21 September 2003 in a northerly wind direction. The highest gust 35.2 m/s was observed on the same day. So were also the highest 10-minute wind velocity and gust at Gvendarbás, respectively 26.0 m/s and 33.0 m/s, also observed in northerly wind. At Húsavík the highest observed 10-minute value was 22.8 m/s on 10 February 2003 and the highest gust 31.9 m/s on 17 January 2003, both in easterly wind direction.

#### 4. Air Temperature Observations in the Húsavík Area

The monthly mean temperature at the 4 observation stations is presented in Table 8 for the period October 2002 - September 2003. The sea has a warming influence during the winter but cooling during the summer. This influence is greatest at Bakkahöfði and smallest at the Húsavík station. Accordingly Bakkahöfði has higher monthly mean temperatures than the other stations during the winter half of the year, the months October-March, but Húsavík usually during the summer, especially for the high summer months, June-August.

Table 8. Monthly mean temperature, October 2002 – September 2003, °C.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
Bakkahöfði	5.3	3.9	3.8	-0.1	2.7	3.4	4.9	4.1	9.3	10.4	11.9	8.8	5.7
Gvendarbás	4.9	3.5	3.0	-0.9	2.0	3.1	5.0	4.1	9.4	10.5	12.0	8.4	5.4
Húsavík	4.7	3.4	3.0	-0.9	1.9	3.0	5.1	4.3	9.9	10.9	12.4	8.3	5.5
Húsavíkurfjall	4.1	2.9	3.0	-1.4	1.2	2.1	4.0	3.0	9.0	9.8	11.5	7.5	4.8

The diurnal temperature variation is considerable during the summer half of the year, especially on clear days. In Fig 21 the mean diurnal variation is shown for the high summer months, June-August 2003.

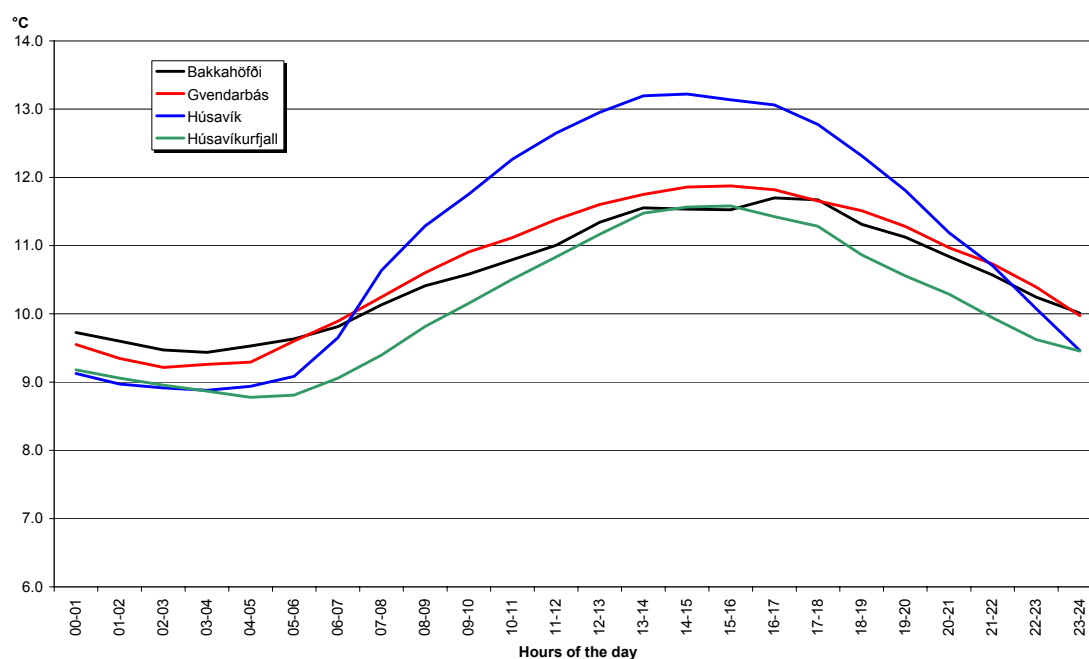


Fig. 21. Diurnal temperature variation in the Húsavík area during June-August 2003.

## **5. Stability Observations in the Húsavík Area**

The vertical temperature gradient between the stations Húsavíkurfjall and Bakkahöfði (height difference 179 m) is presented hour for hour and month for month in Annexes 16-21, between Húsavíkurfjall and Gvendarbás (height difference 178 m) in Annexes 22-27 and between Húsavíkurfjall og Húsavík (height difference 166 m) in Annexes 28-33.

The vertical temperature gradient is here expressed in degrees Celcius per 100 meters. It is a measure of the stability of the air. As seen in the graphs in Annexes 16-33 temperature inversions, i.e. higher temperature at Húsavíkurfjall than at the other stations, occur rather frequently, indicating moderate or strong stability of the lowest air layers.

## **6. Earlier Wind Observations at Héðinshöfði**

As mentioned in the introduction chapter wind direction and wind velocity observations are available from late September 1981 to late October 1983 from the farm Héðinshöfði, approx. 2 km northeast of the station Bakkahöfði. The observations were made with a mechanical wind recorder of the type Woelfle-Lambrecht, located west of the farmhouse. The observation height was 2 m above the ground. A new evaluation of the records has now been made. Hourly values are now available for wind direction for the two year period October 1981 – September 1983 instead of three hourly values before. The wind velocity values are means for 60 minutes instead of the usual 10 minutes, but 24 values are now available per day instead of 8 values before. These observations are valuable for comparison with the present observations in the Húsavík area, especially at Bakkahöfði. Average values for the year, for the winter half of the year and for the summer half of the year are presented in Annex 34.

## **7. Remarks**

The main purpose of the observations described in this report, is to provide a basis on which dispersion calculations can be based for an eventual industrial plant, possibly located at Héðinsvík north of Bakkahöfði or at Gvendarbás south of Húsavík. All data from the observation network are stored in the computerized data base of the Icelandic Meteorological Office and can be obtained as needed for dispersion calculations.

## **8. Stutt yfirlit á íslensku (Brief summary in Icelandic)**

Samkvæmt samningi við Fjárfestingarstofuna-orkusvið setti Veðurstofan þann 13. september 2002 upp þrjár sjálfvirkar veðurstöðvar í næsta nágrenni við Húsavík: á Bakkahöfða, við Gvendarbás og í 194 m hæð yfir sjó efst á Skjólbrekku. Skyldu stöðvar þessar, sem í skýrslunni kallast Bakkahöfði, Gvendarbás og Húsavíkurfjall, reknar til loka september 2003. Gera skyldi skýrslu um helstu niðurstöður mælinganna og þá einnig stuðst við mælingar á sjálfvirkri veðurstöð Veðuratofunnar á Húsavík. Á Skjólbrekku er aðeins mældur lofthiti, en á hinum stöðvunum einnig



vindátt og vindhraði. Gerð er grein fyrir þessu, staðsetningu stöðvanna og tækjabúnaði í 1. og 2. kafla skýrslunnar.

Í þriðja kafla og viðaukum 1-15 er fjallað ítarlega um niðurstöður vindáttar- og vindhraðamælinga á sjálfvirku veðurstöðvunum Bakkahöfða, Gvendarbási og Húsavík á 12 mánaða tímabilinu október 2002 - september 2003.

Í fjórða kafla er fjallað um niðurstöður hitamælinga á veðurstöðvunum, og í fimmta kafla um lóðréttan hitastigul milli stöðvarinnar á Skjólbrekku og hinna veðurstöðvanna. Hitastigullinn segir til um stöðugleika lofsins sem ásamt vindinum hefur afgerandi áhrif á dreifingu mengunarefna. Viðaukar 16-21 sýna hitastigulinn, og þar með stöðugleikann, dag fyrir dag og mánuð fyrir mánuð miðað við mælingar á Skjólbrekku og Bakkahöfða, en hæðarmunur stöðvanna er 179 metrar. Viðaukar 22-27 sýna á sama hátt hitastigul milli Skjólbrekku og Gvendarbáss, en hæðarmunur er 178 m. Loks sýna viðaukar 28-33 hitastigul milli Skjólbrekku og stöðvarinnar í jaðri Húsavíkur, en hæðarmunur er 166 m.

Í sjötta kafla er greint frá eldri vindmælingum sem gerðar voru um tveggja ára skeið á bænum Héðinshöfða, en nokkrar niðurstöður, einkum ætlaðar til samanburðar við mælingar á Bakkahöfða, er að finna í viðauka 34.

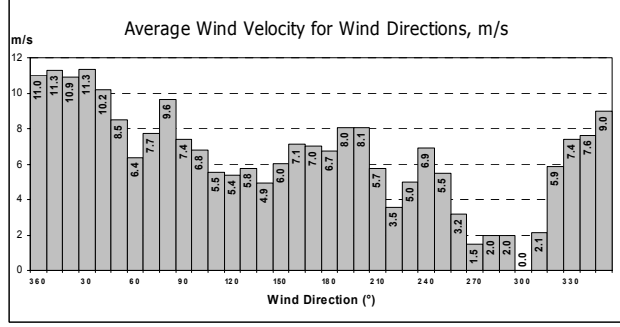
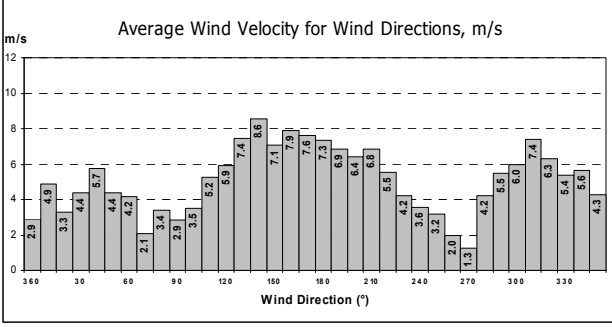
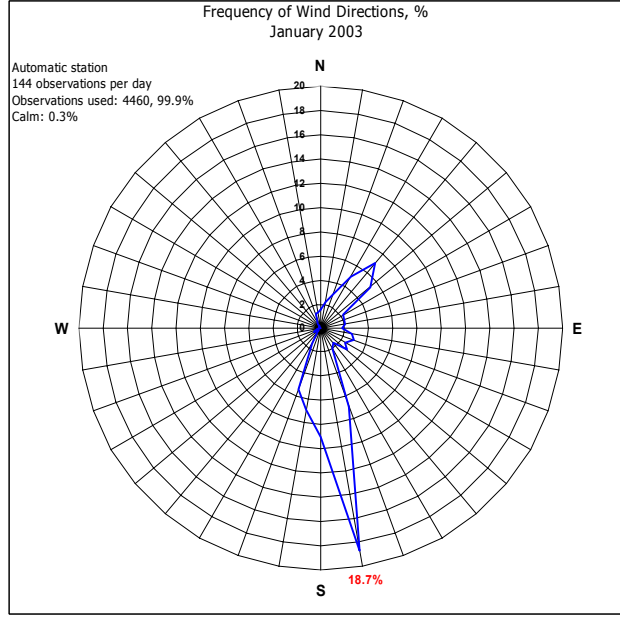
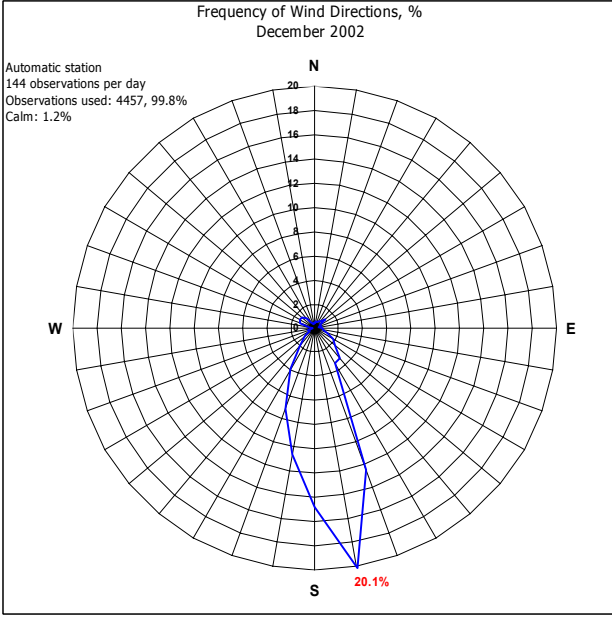
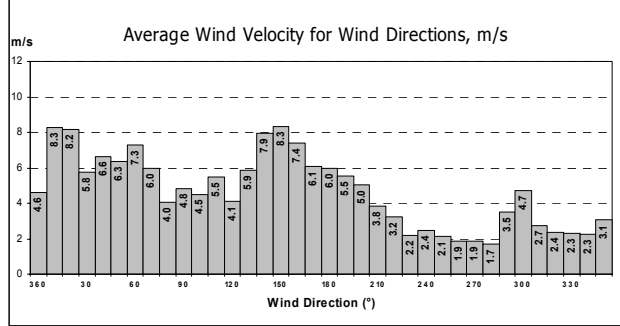
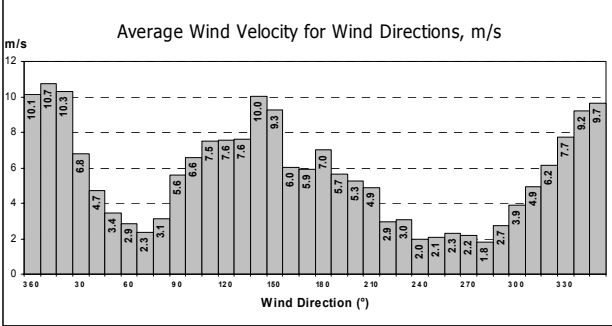
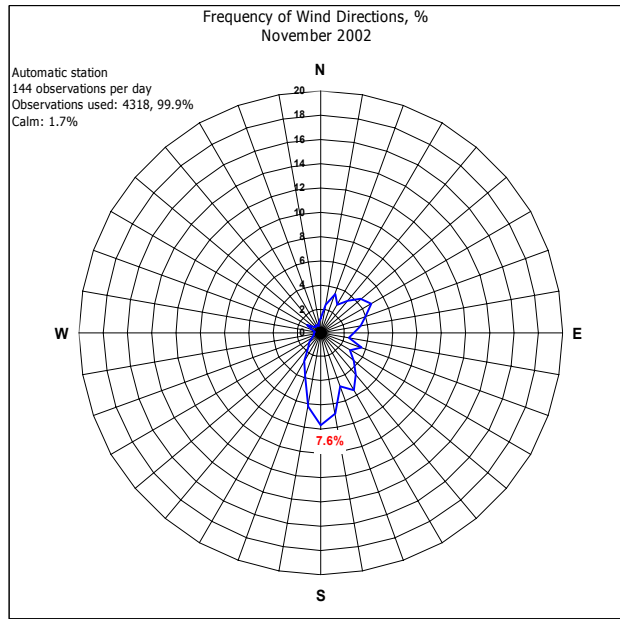
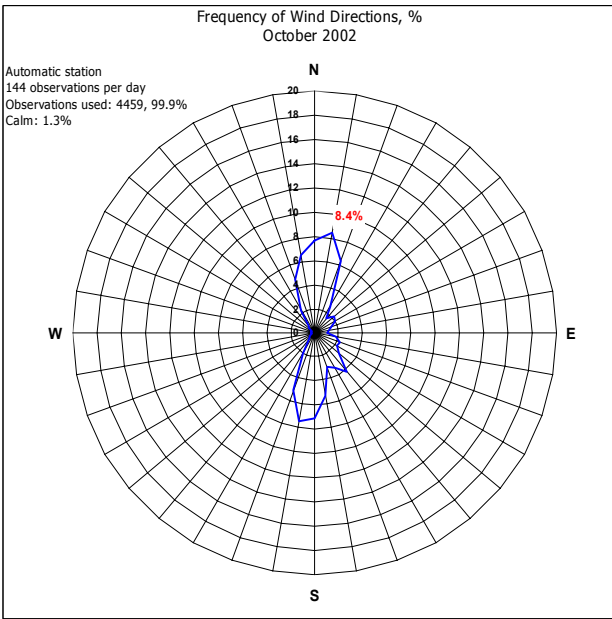
Í sjöunda kafla er greint frá tilgangi mælinganna sem er að afla gagna sem á má byggja útreikninga á dreifingu mengunarefna frá stóriðjufyrirtæki sem staðsett kynni að verða á Húsavíkursvæðinu, væntanlega í námunda við Bakkahöfða eða Gvendarbás. Jafnframt er sagt frá því að öll gögnin séu geymd í tölvuvæddum gagnabanka Veðurstofunnar og þar tiltæk þegar og ef gera þarf dreifingarútreikninga.

## 9. References

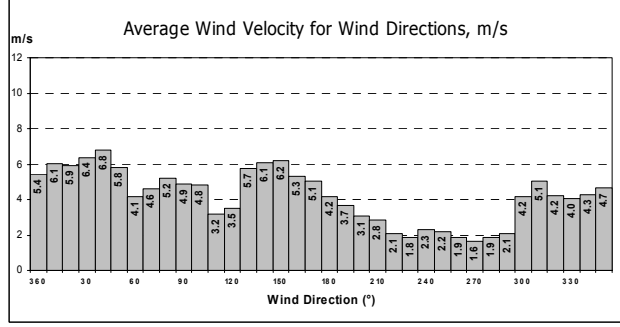
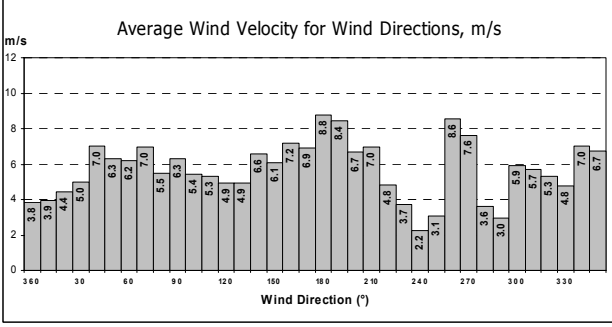
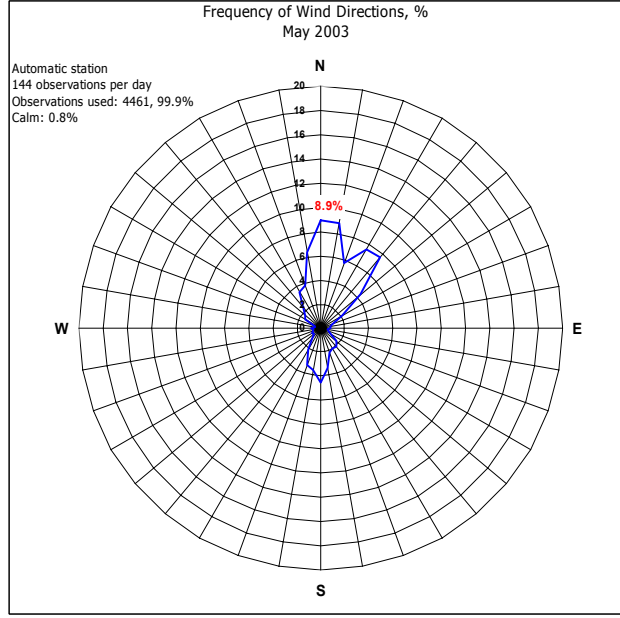
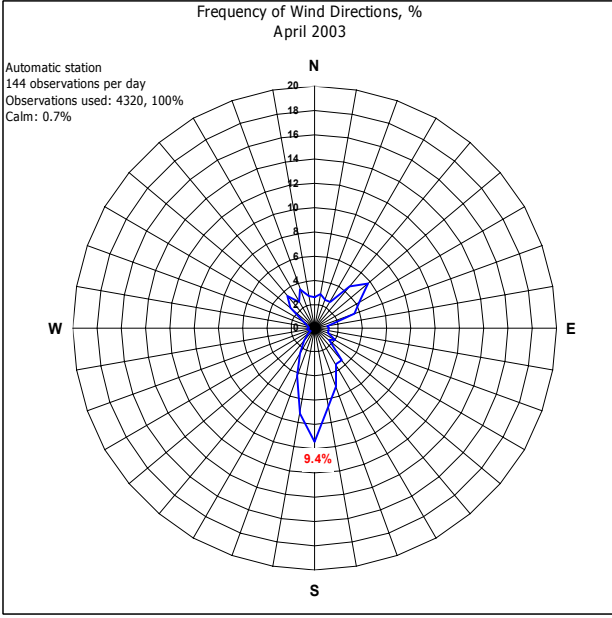
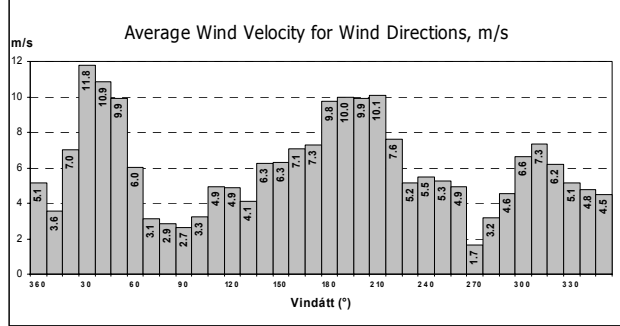
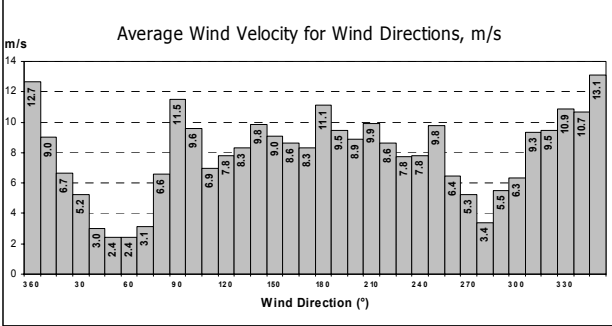
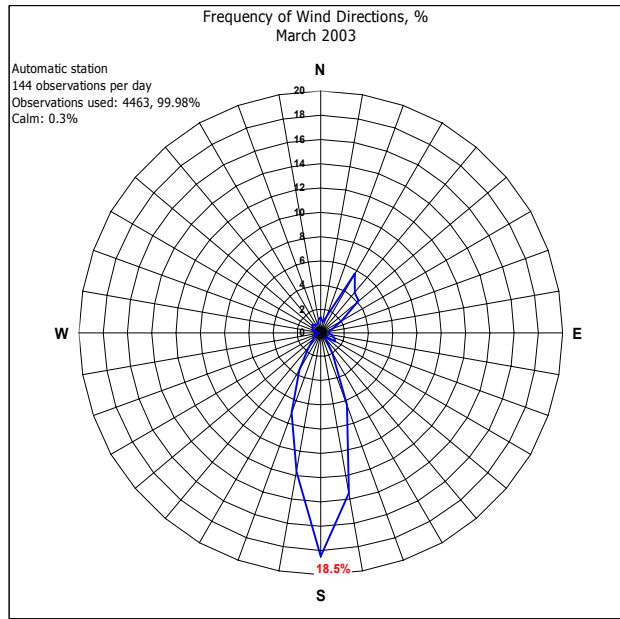
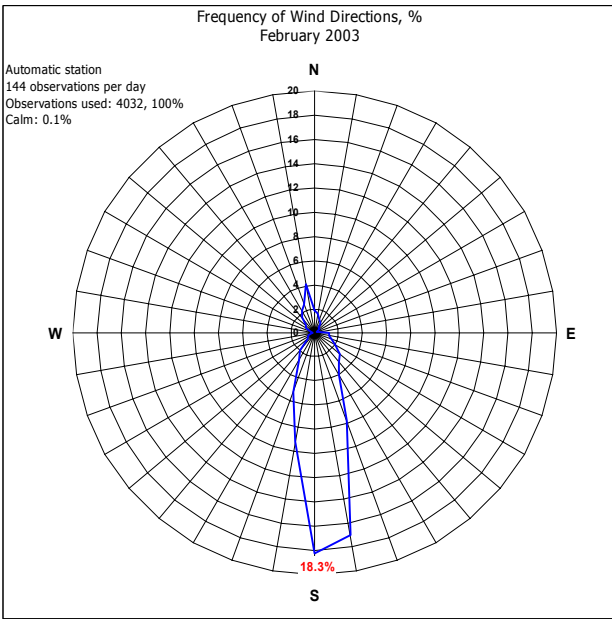
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## **Annexes 1 - 34**

# Bakkahöfði

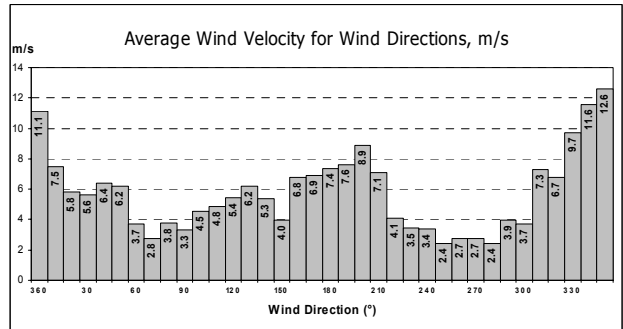
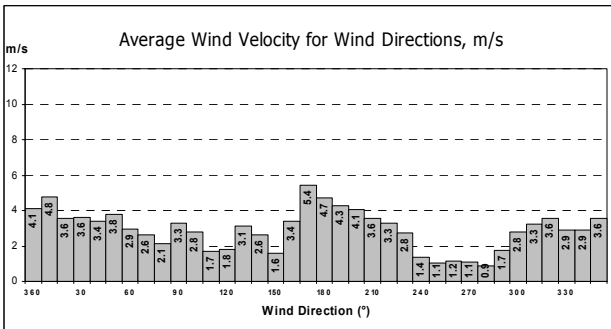
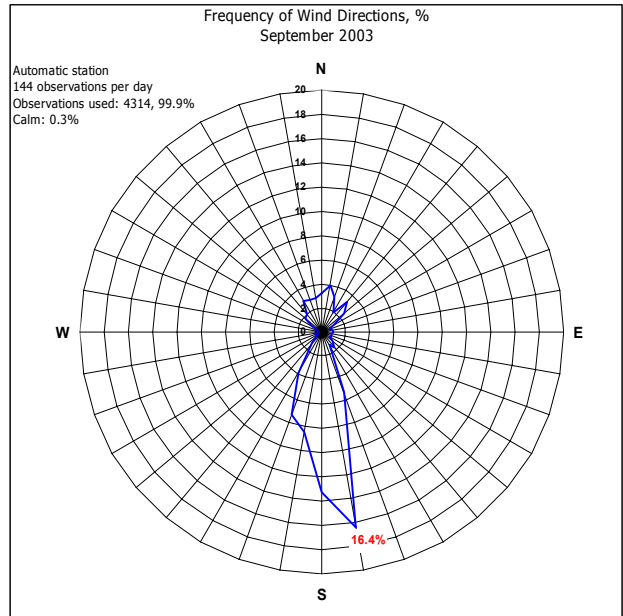
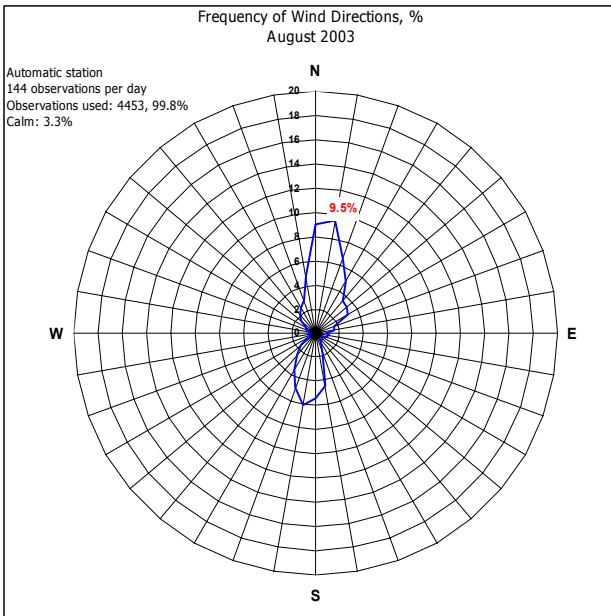
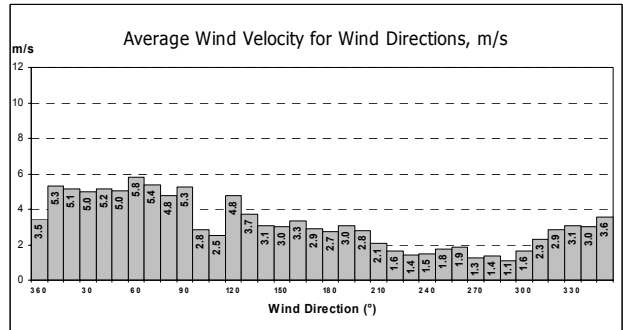
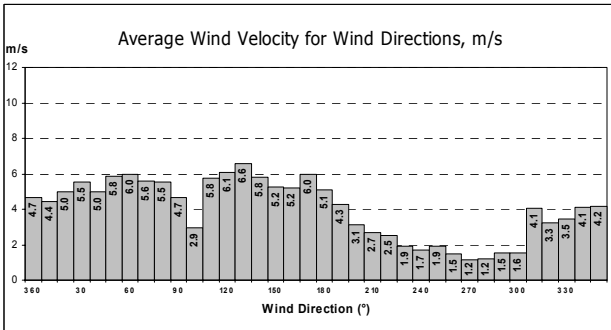
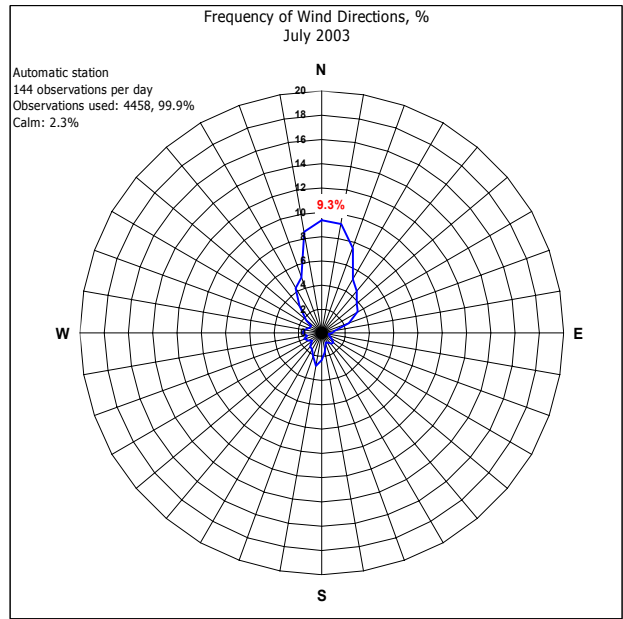
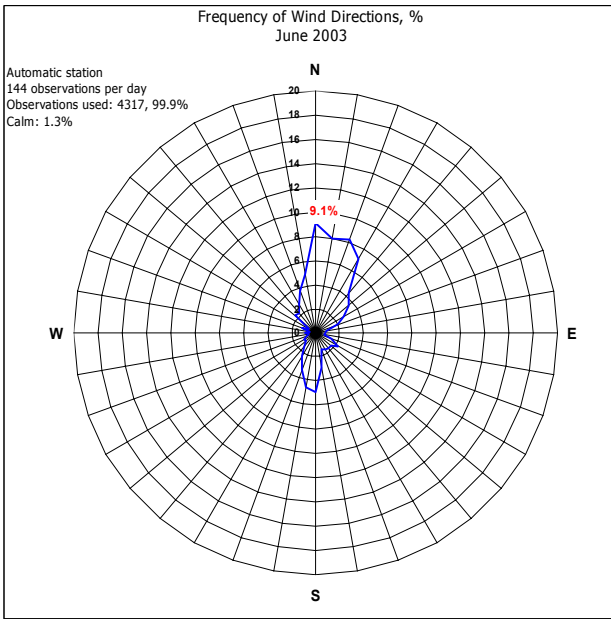


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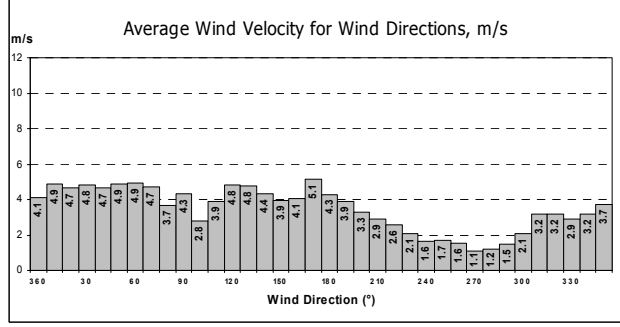
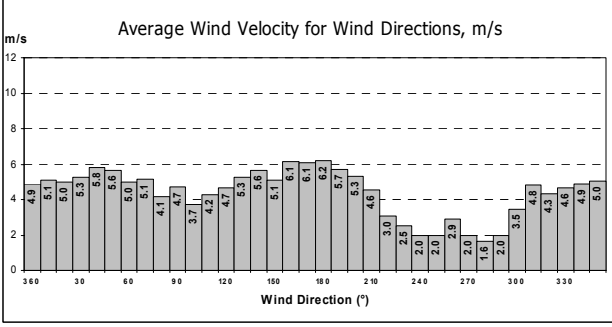
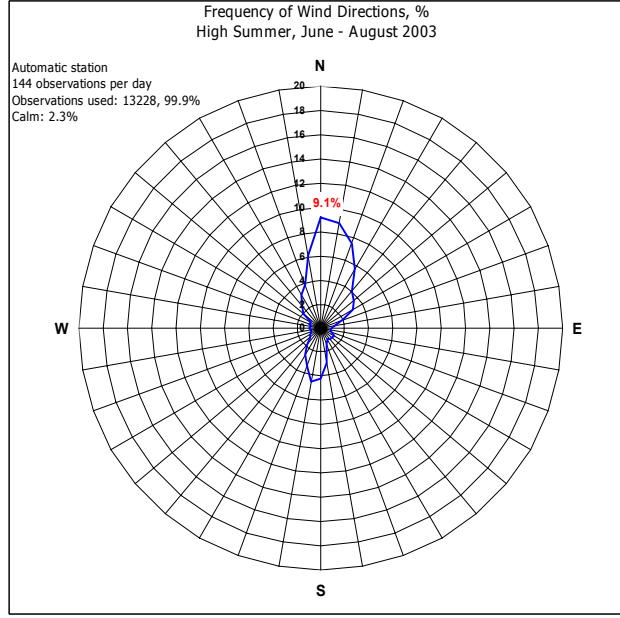
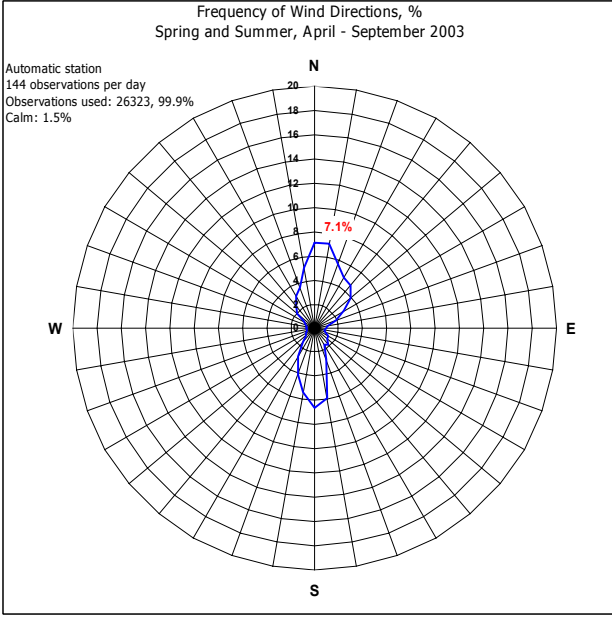
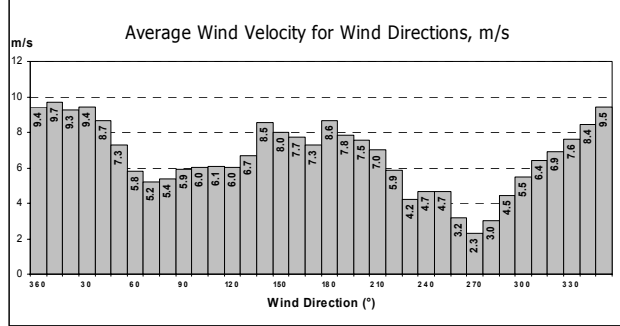
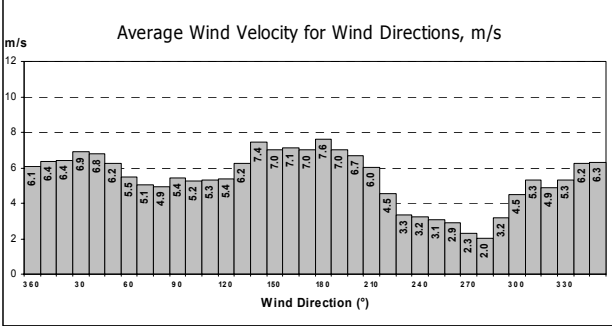
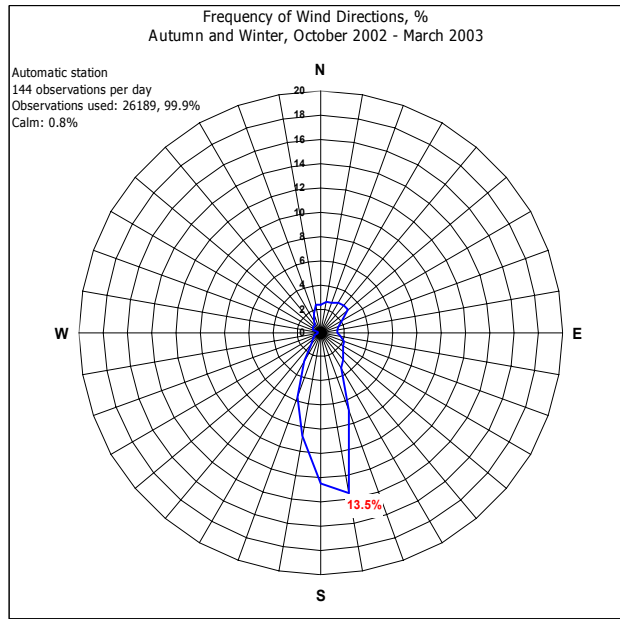
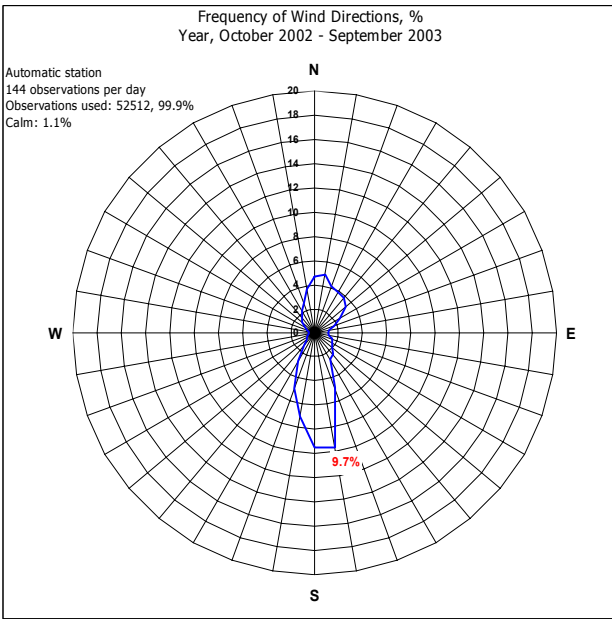




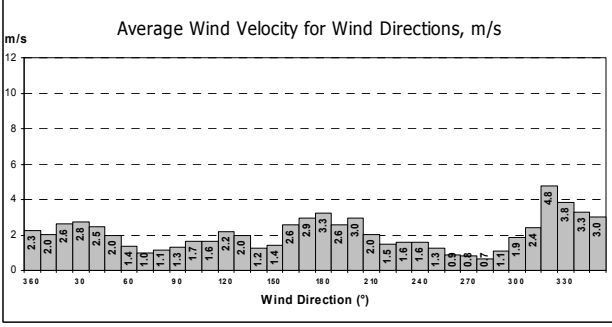
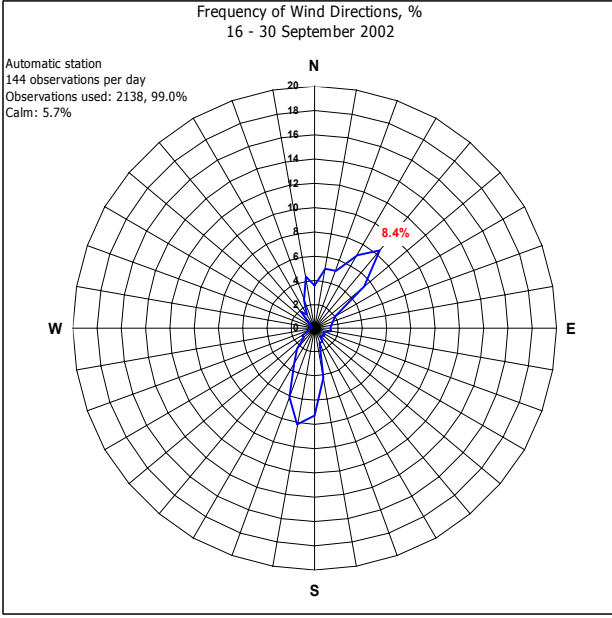
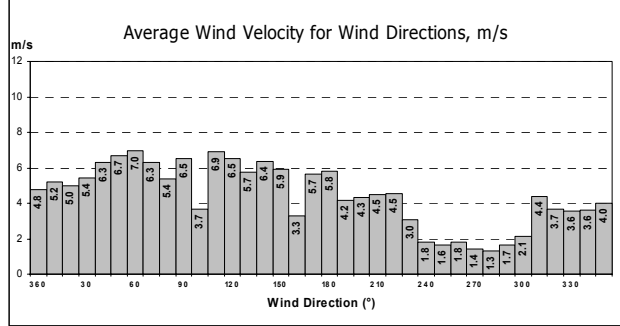
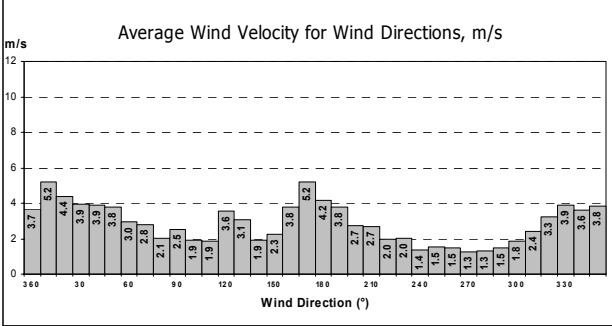
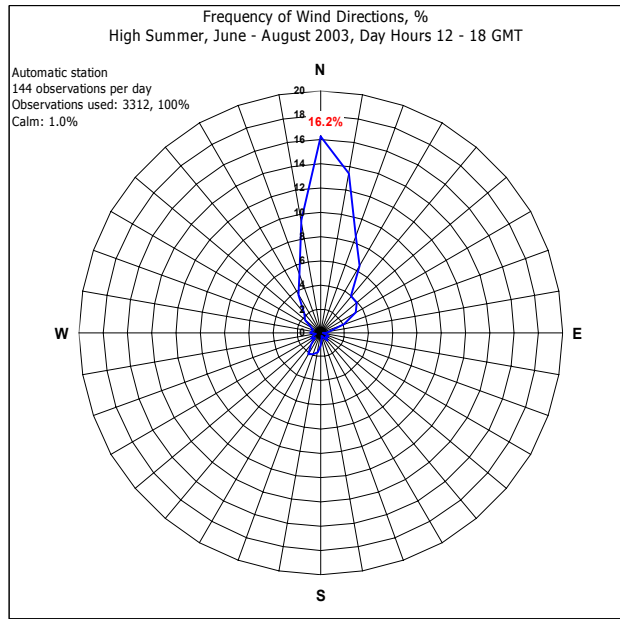
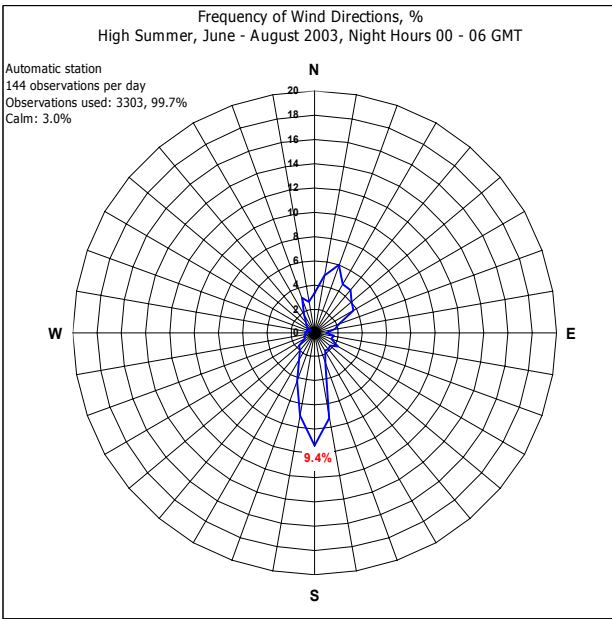
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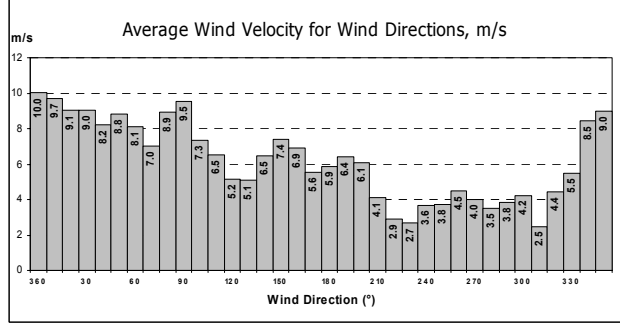
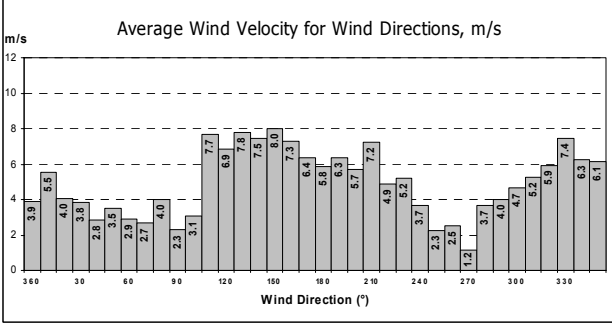
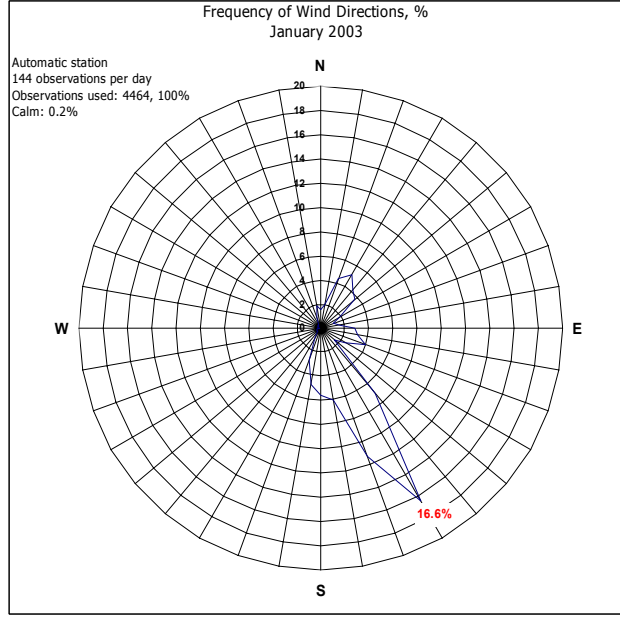
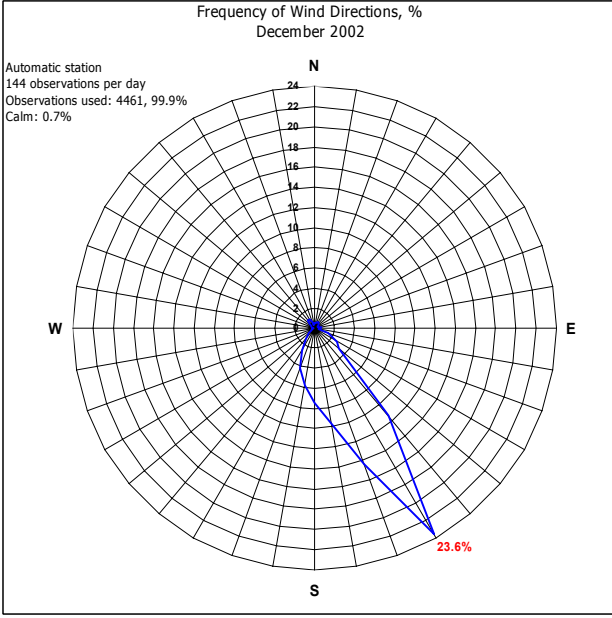
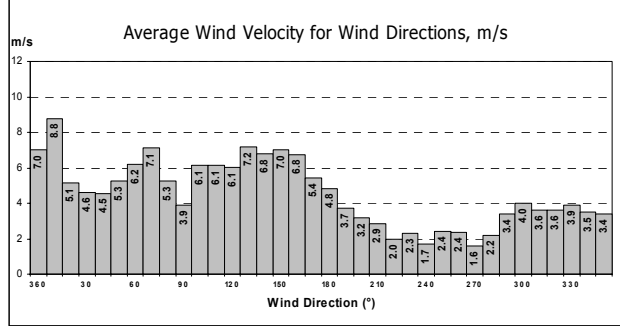
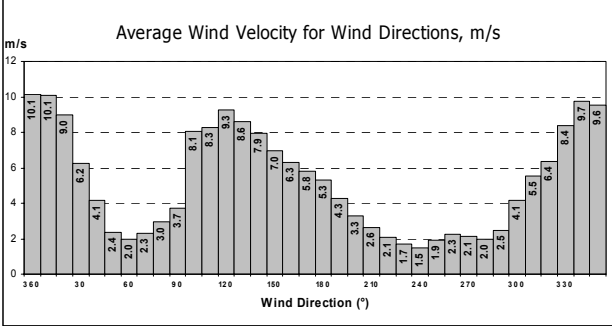
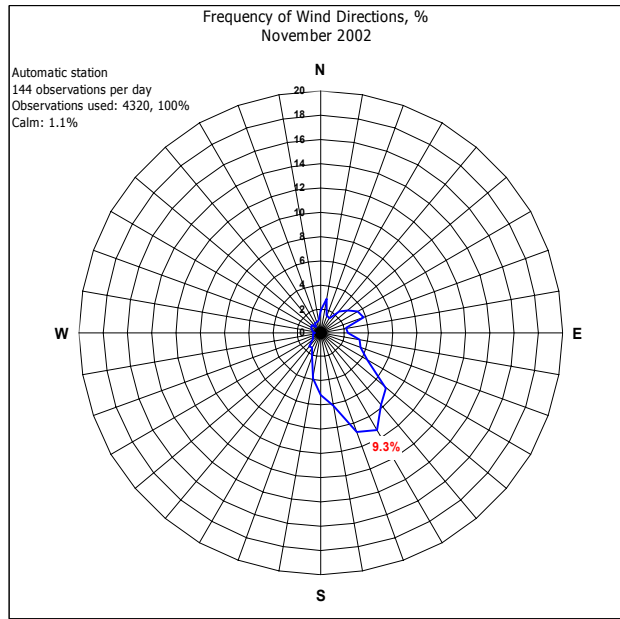
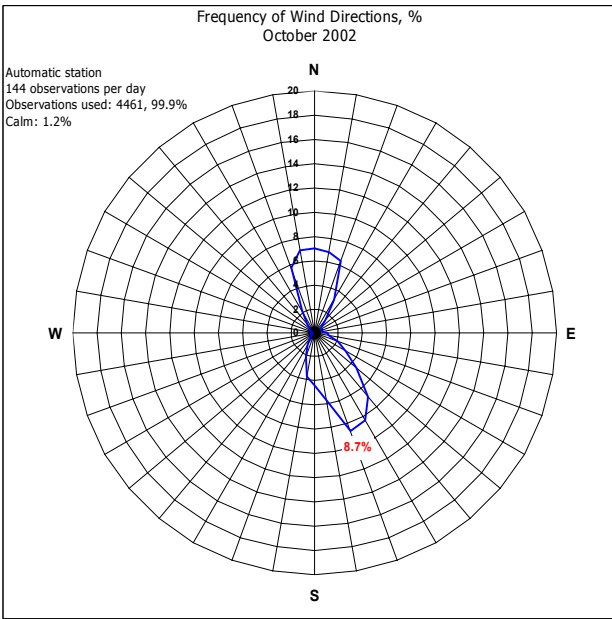
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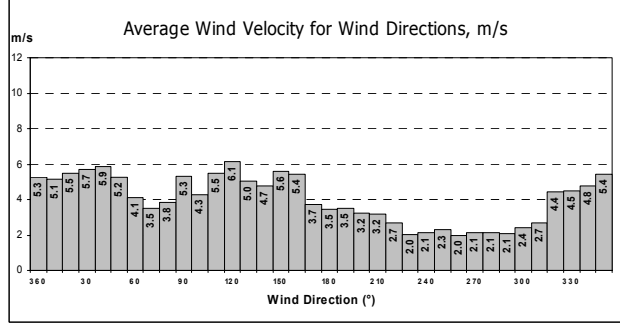
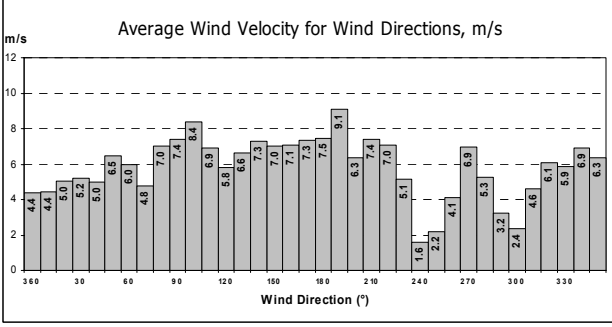
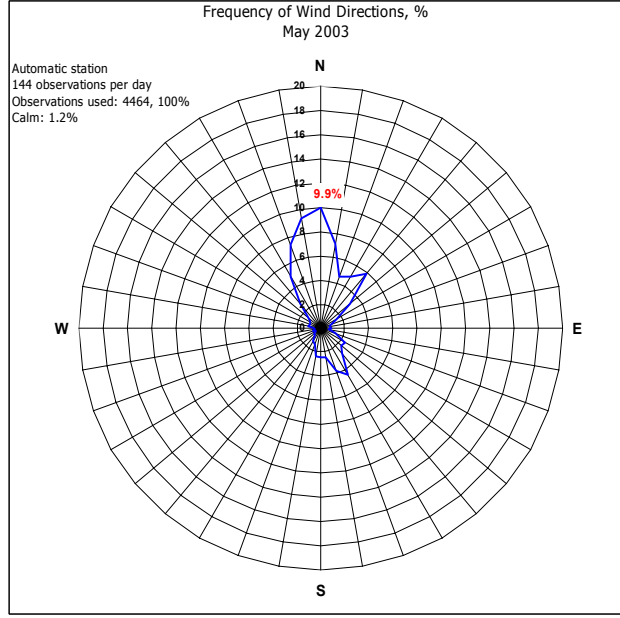
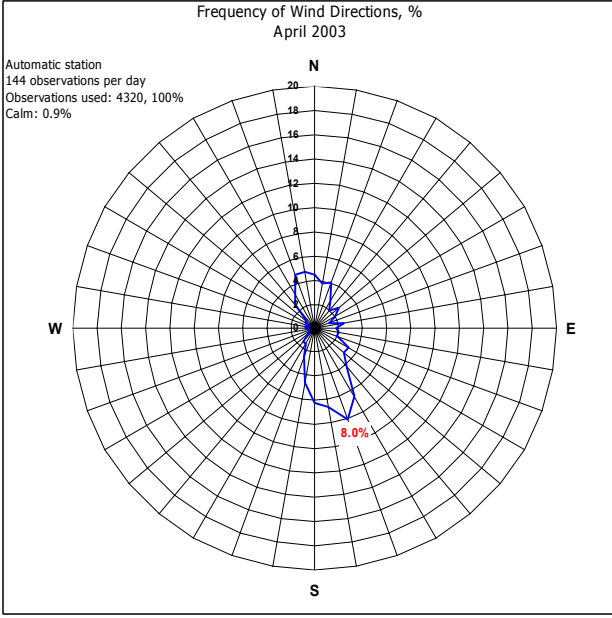
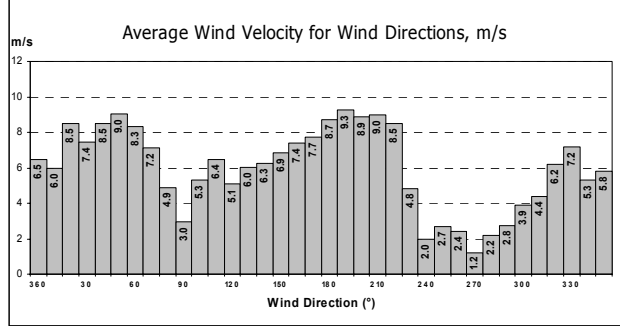
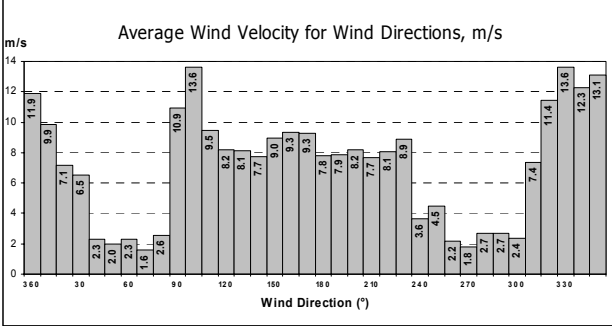
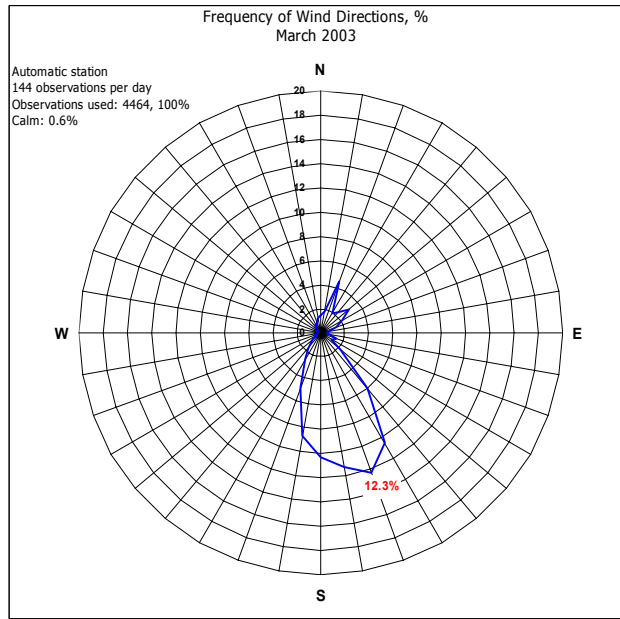
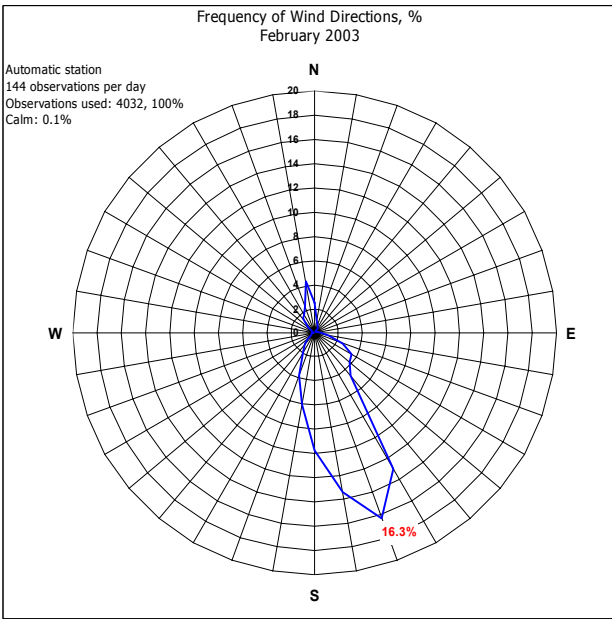
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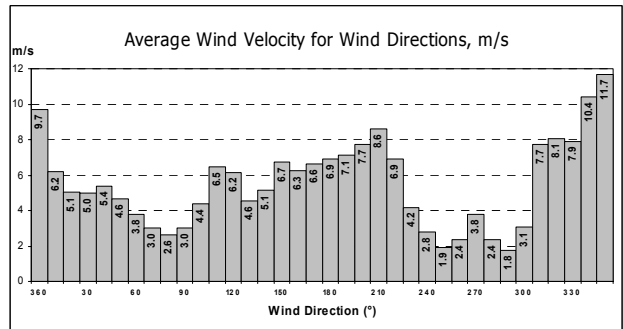
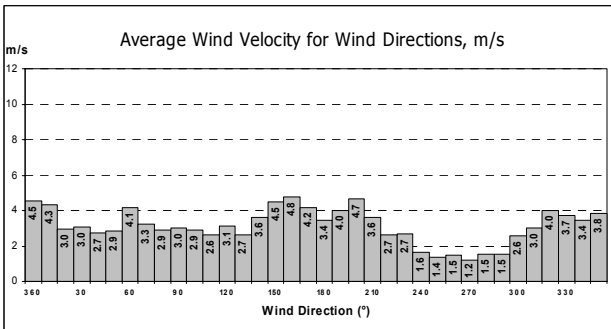
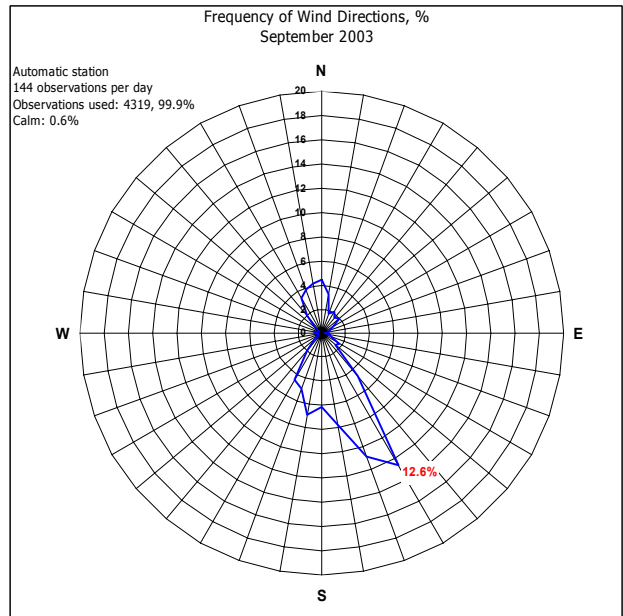
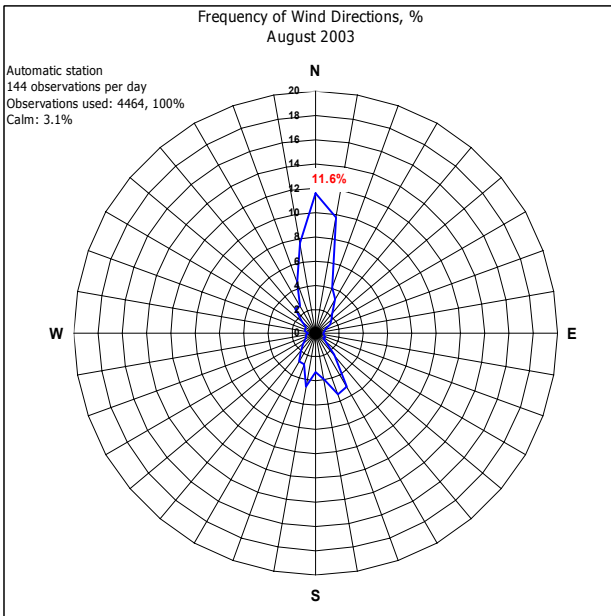
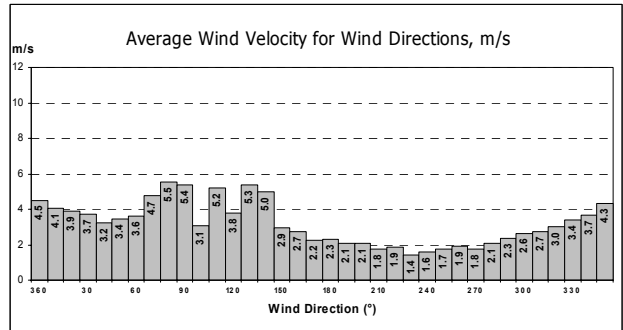
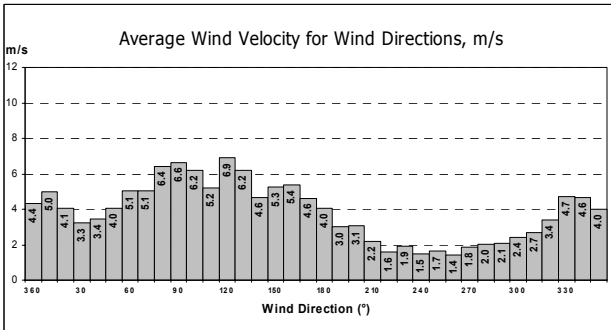
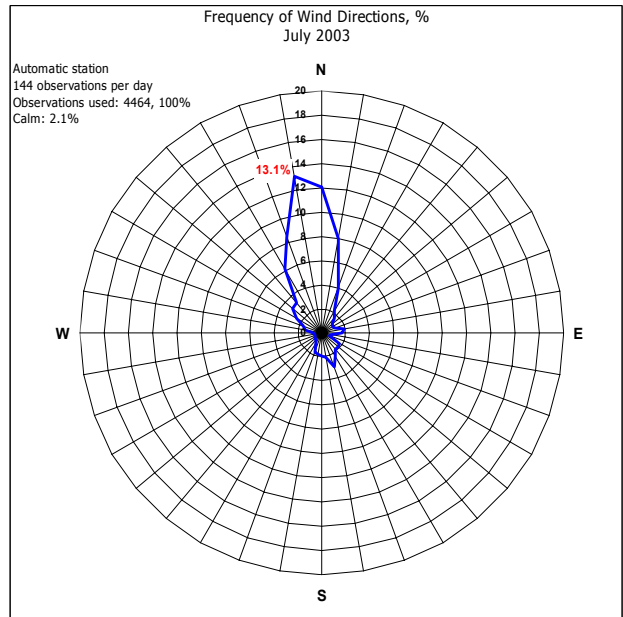
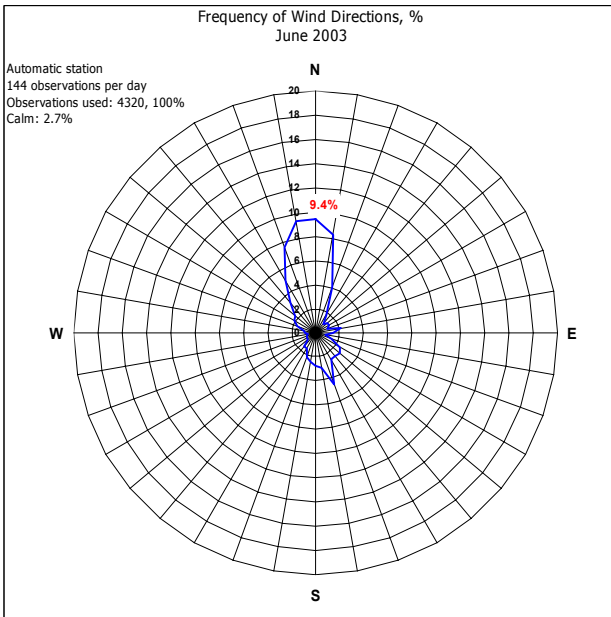


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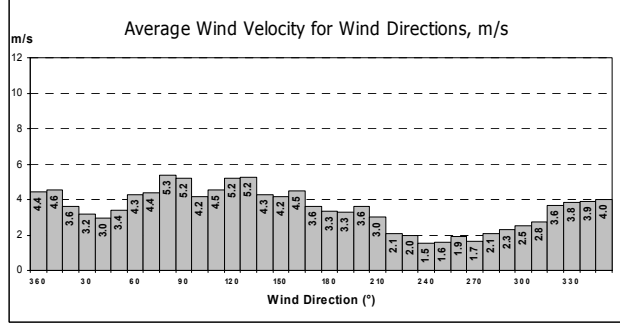
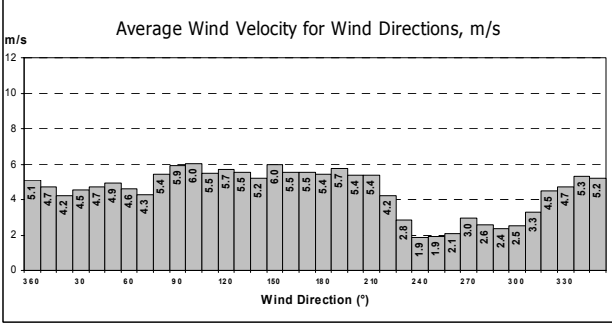
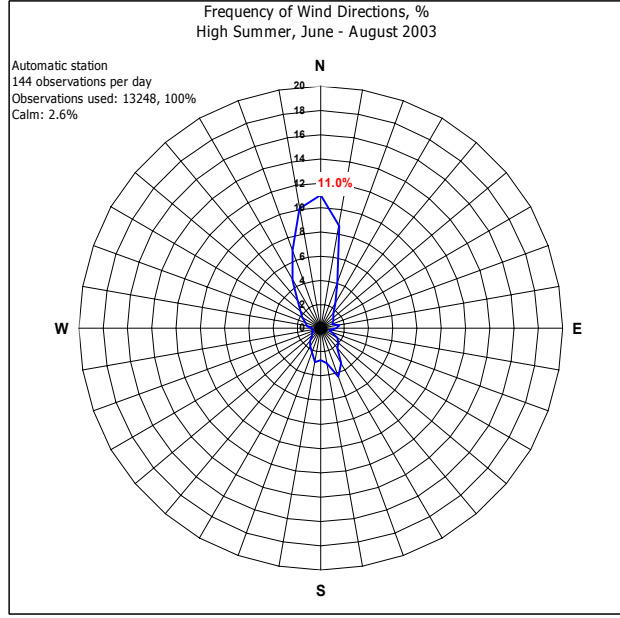
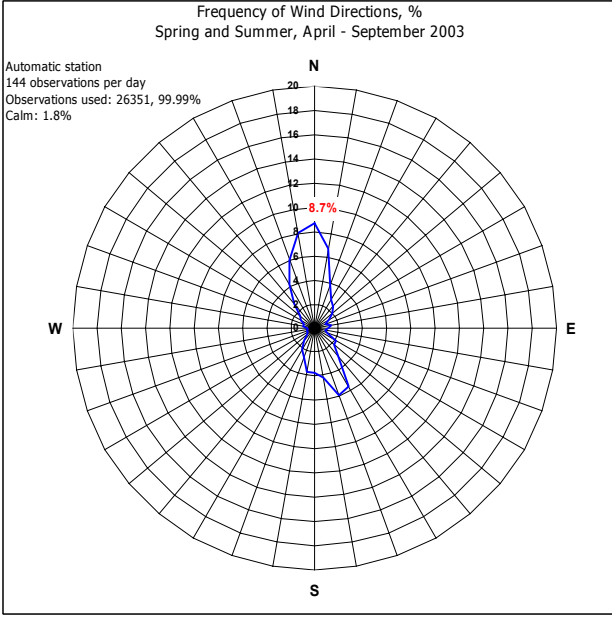
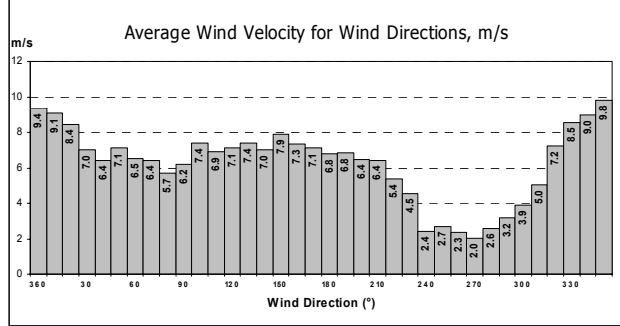
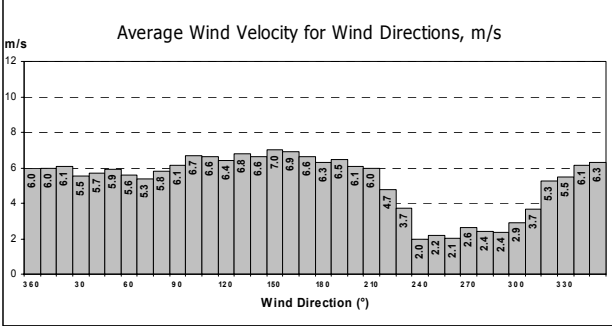
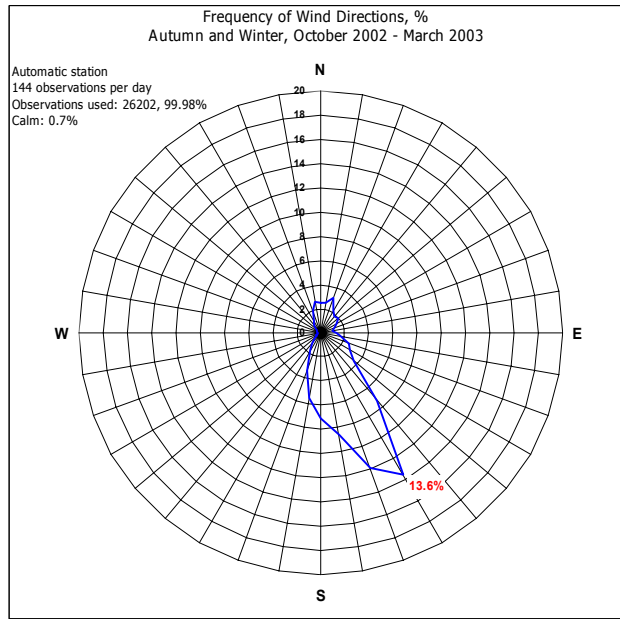
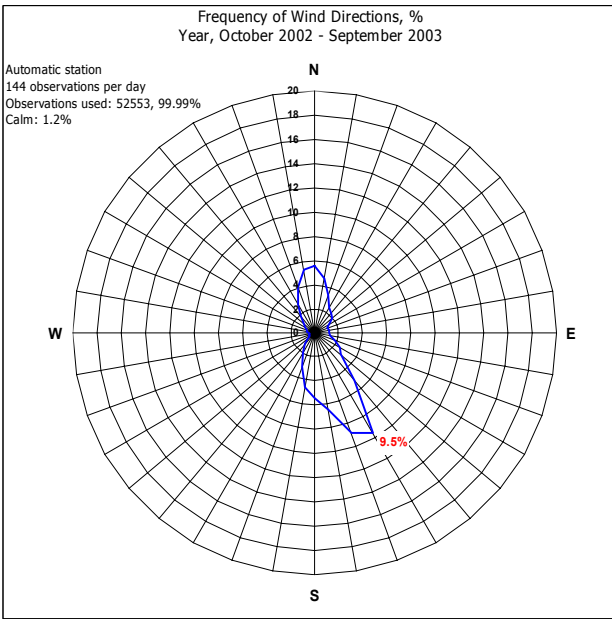




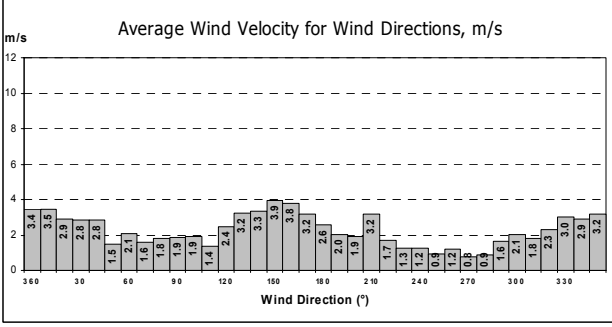
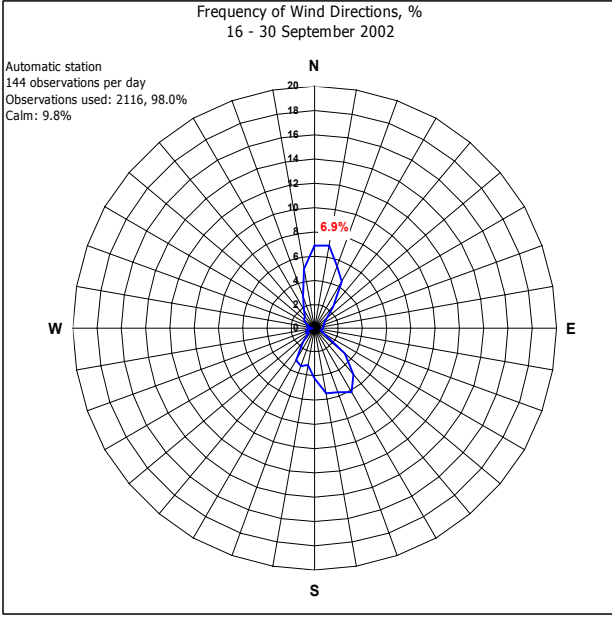
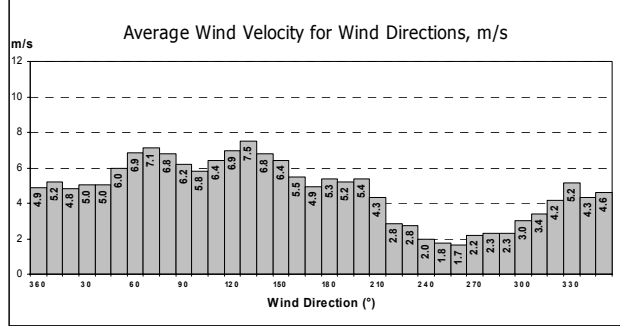
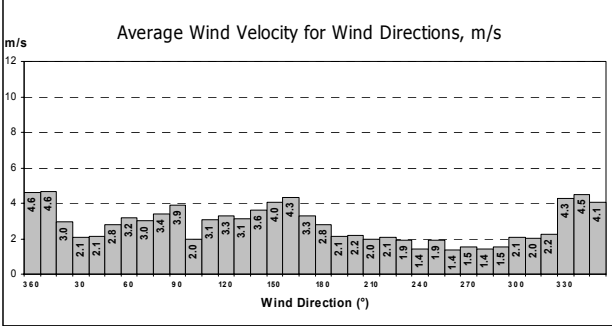
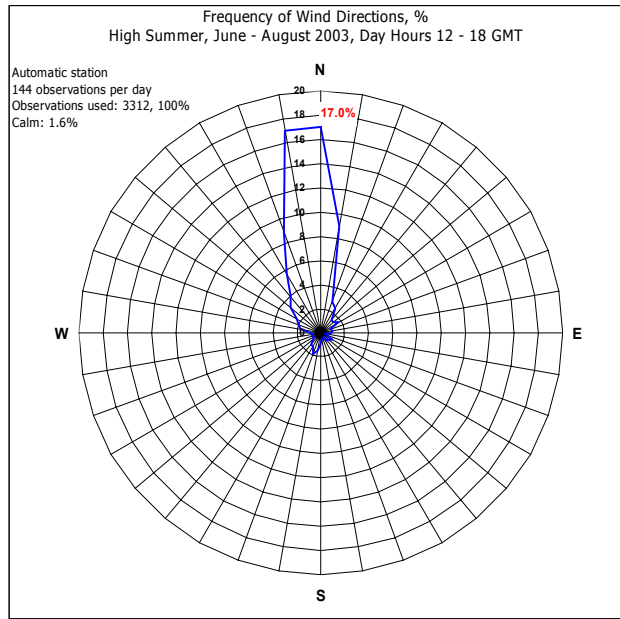
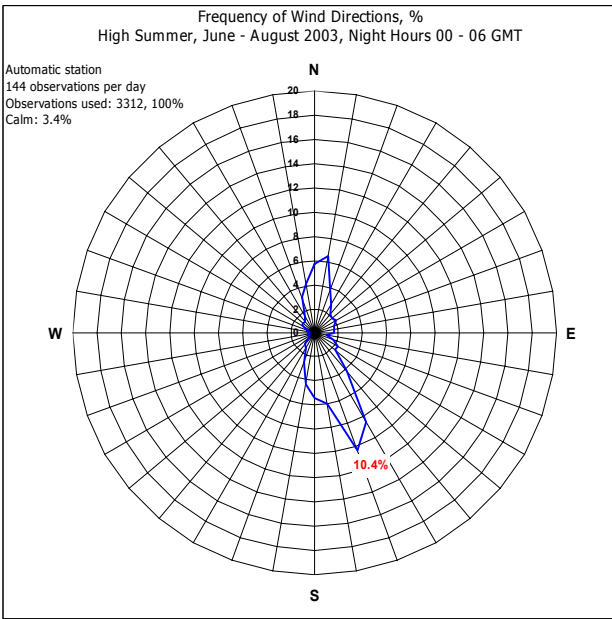
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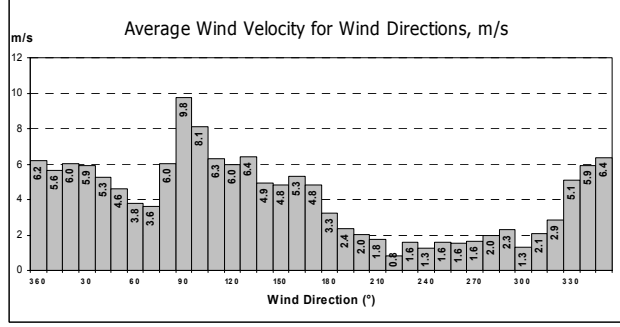
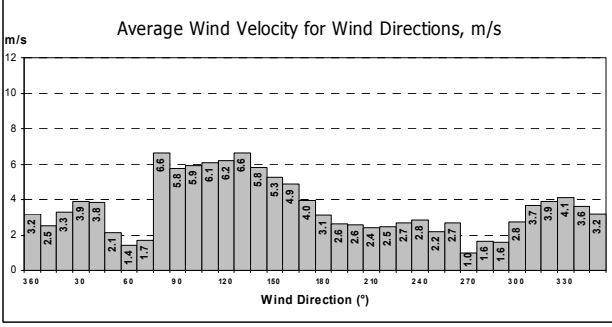
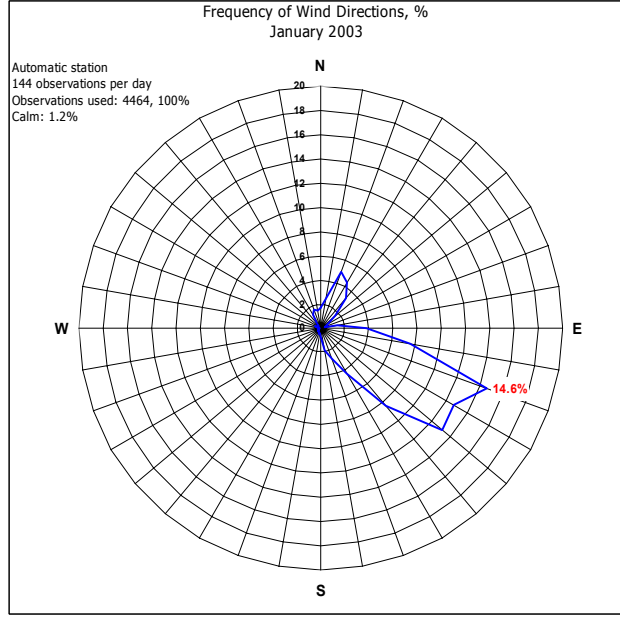
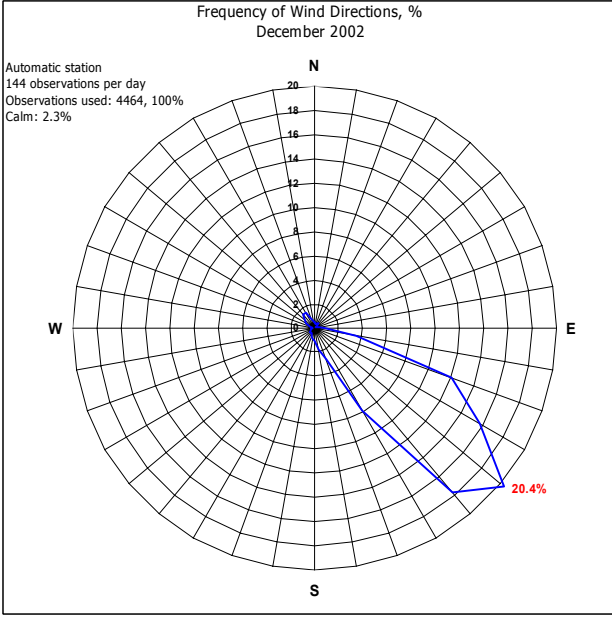
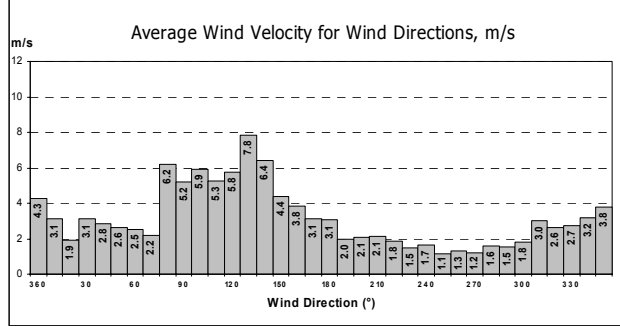
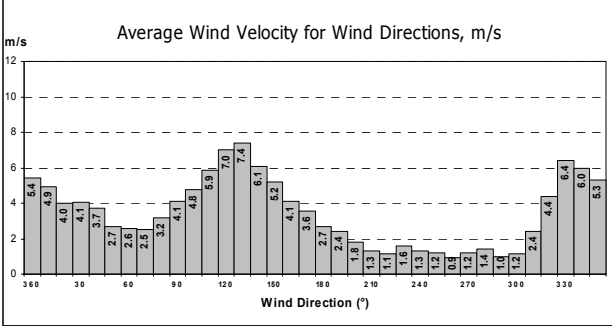
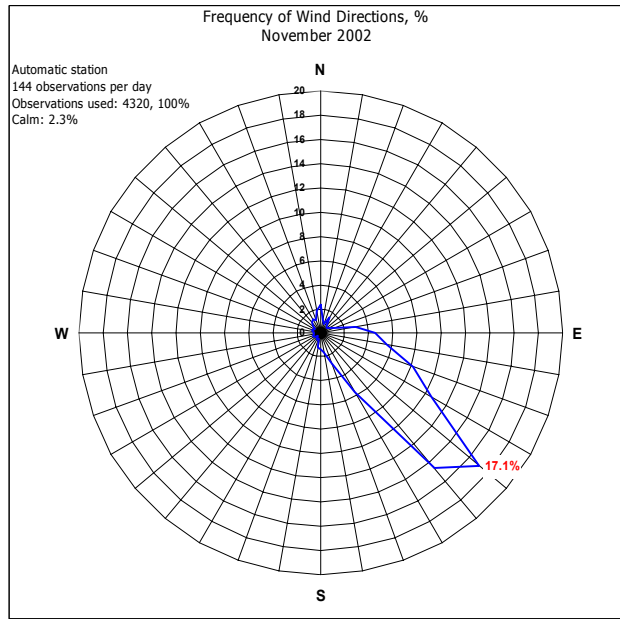
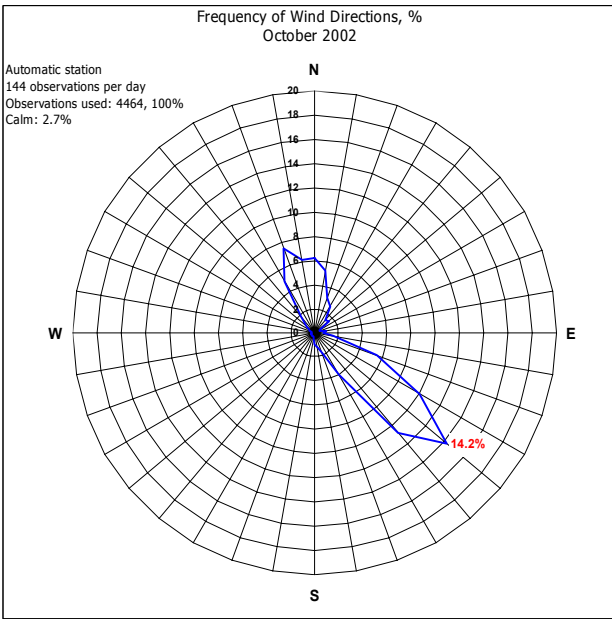
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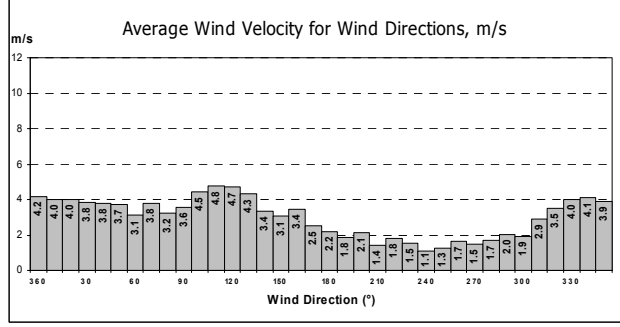
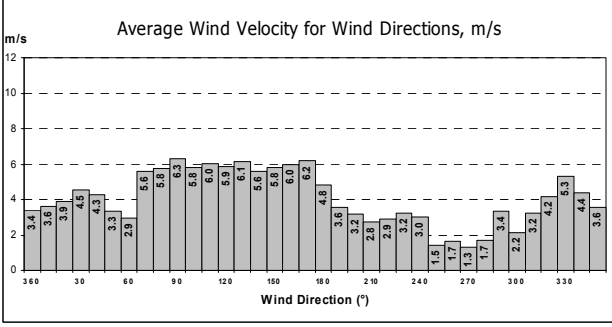
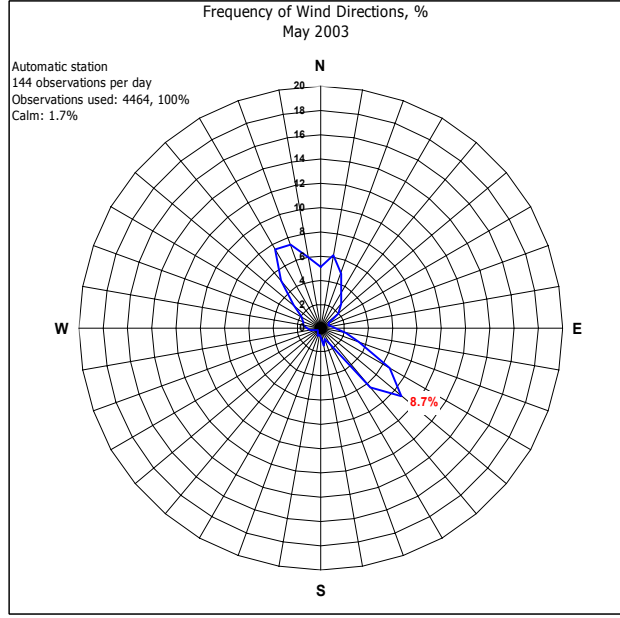
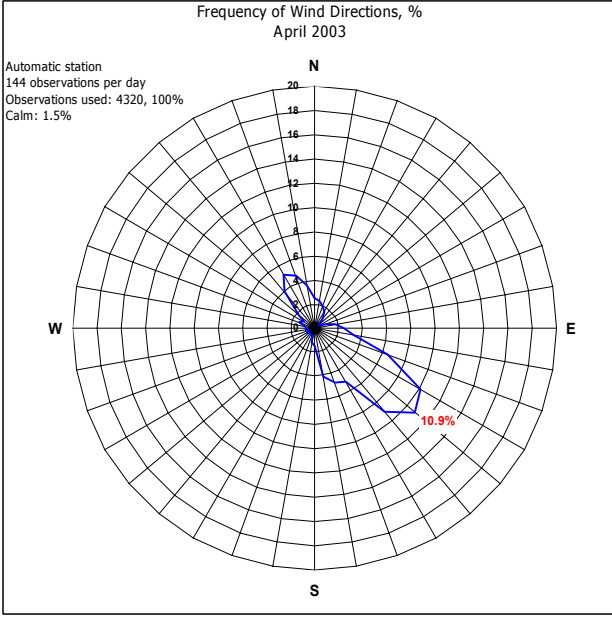
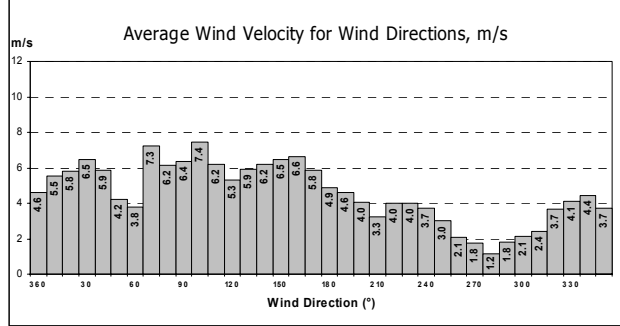
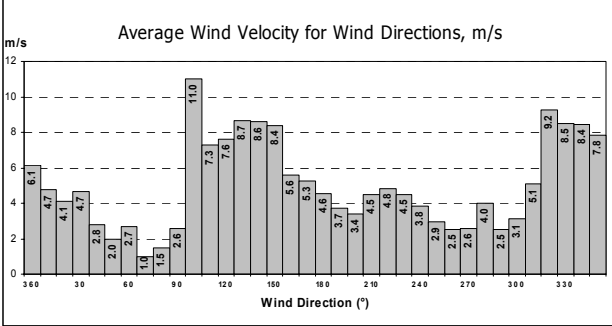
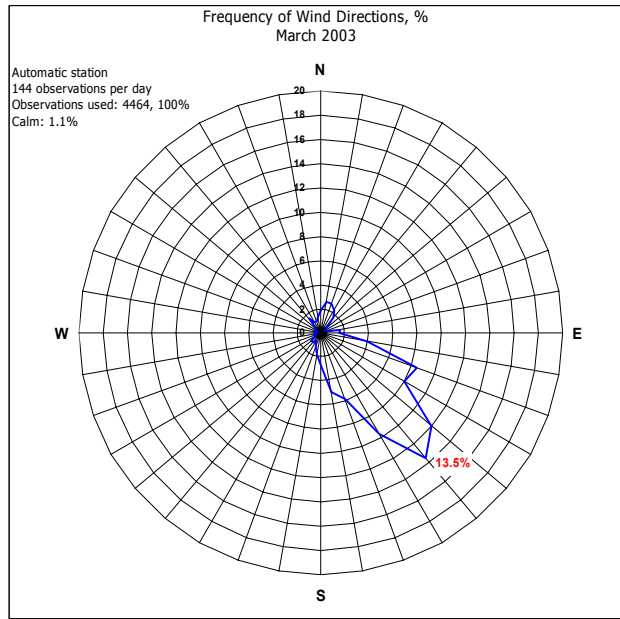
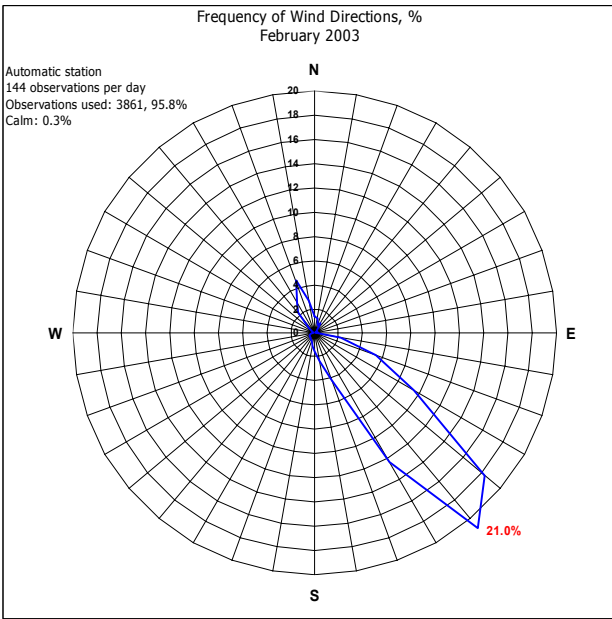
# Gvendarbás



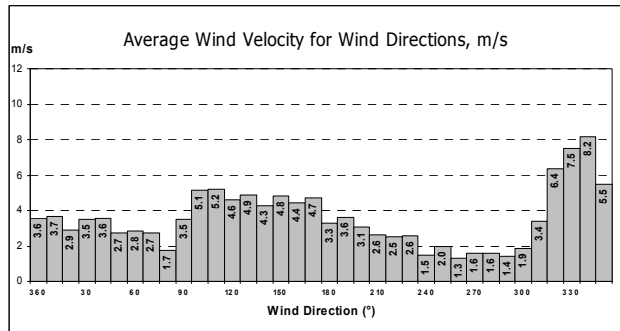
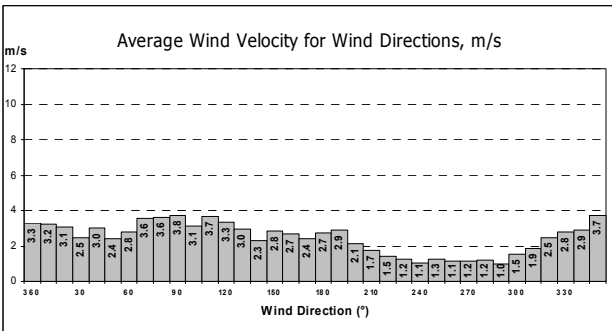
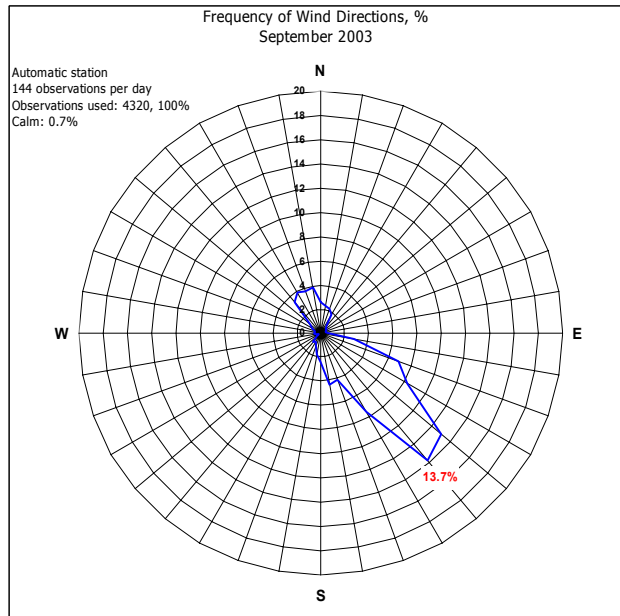
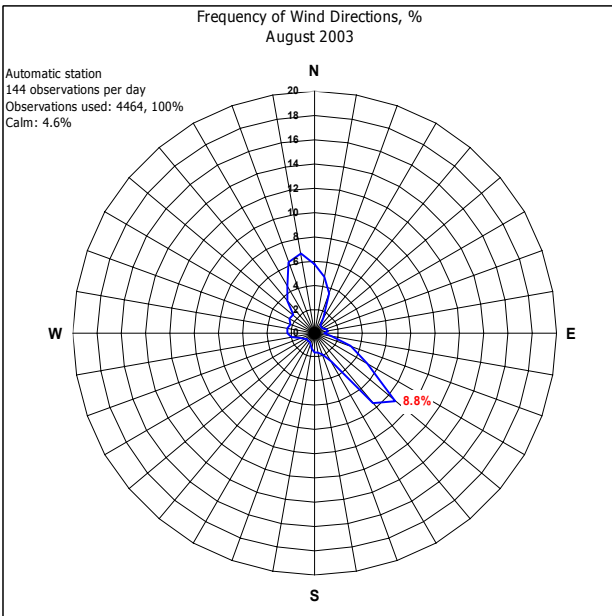
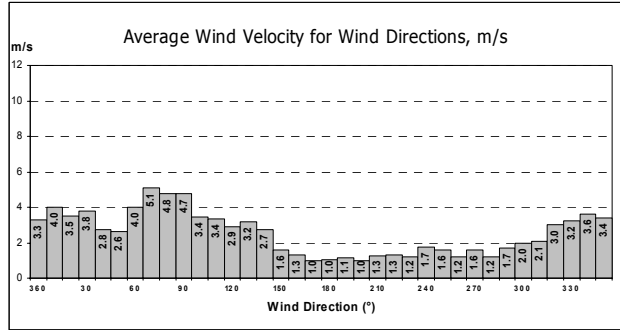
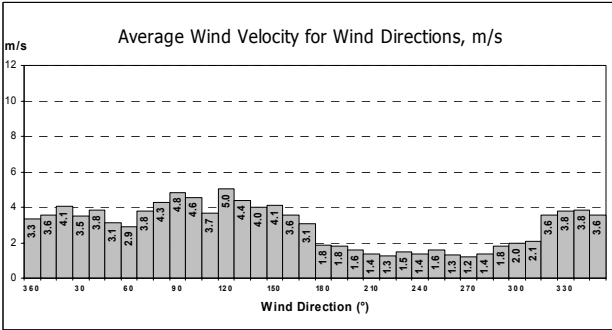
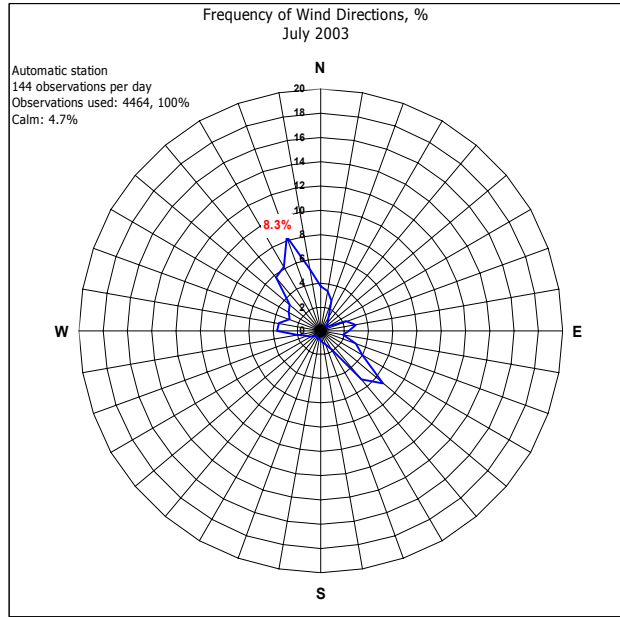
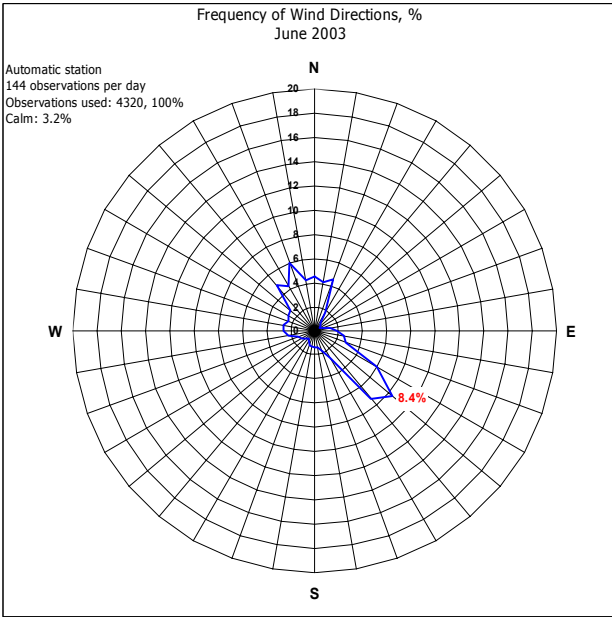
# Húsavík



# Húsavík

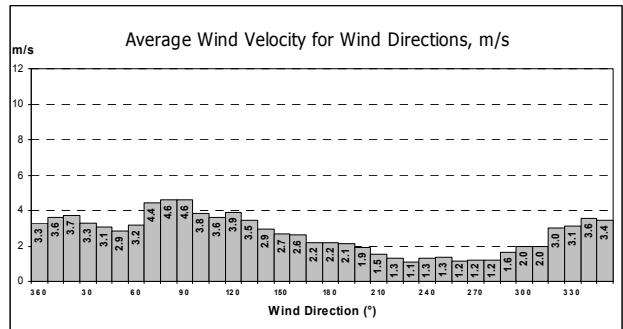
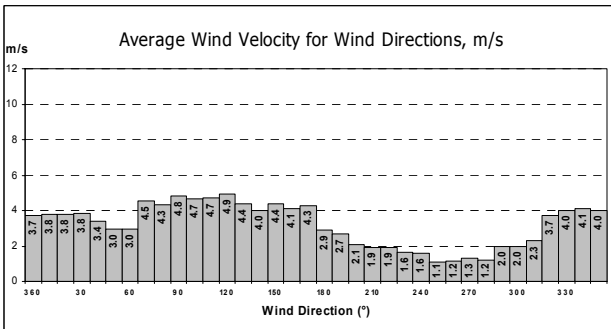
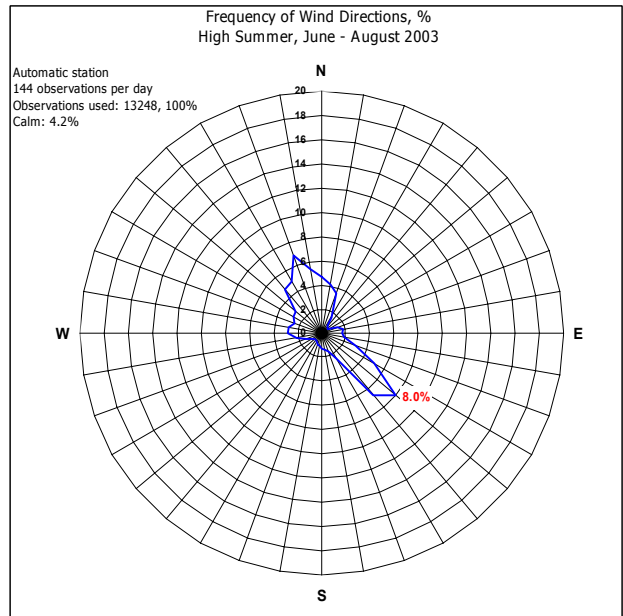
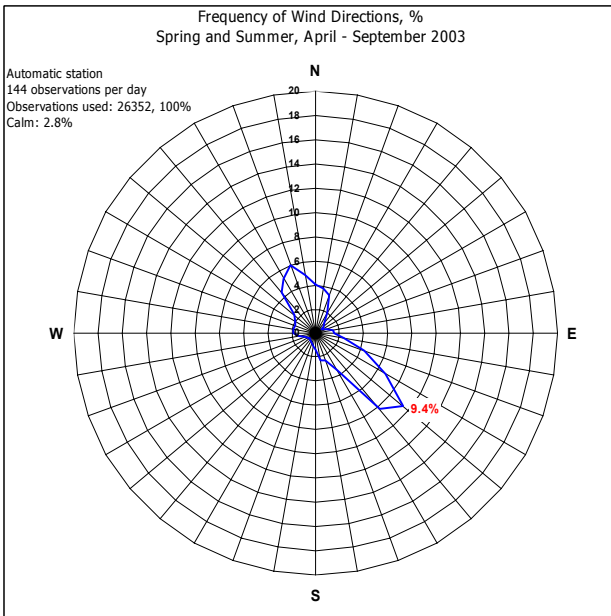
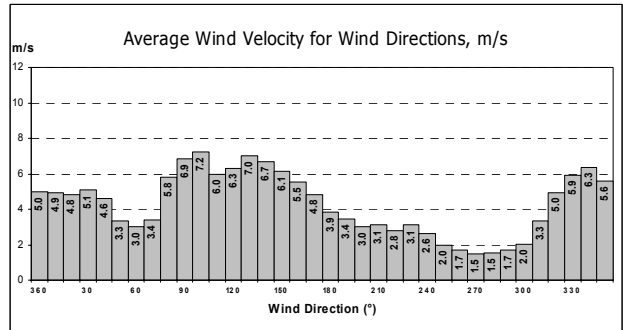
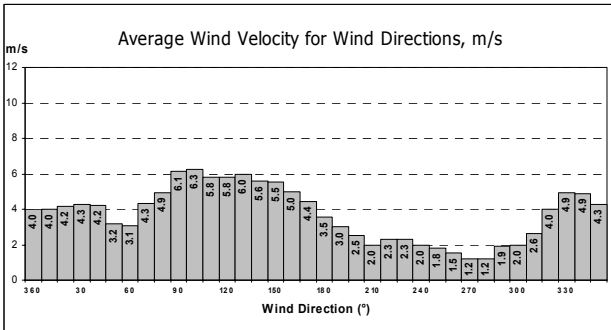
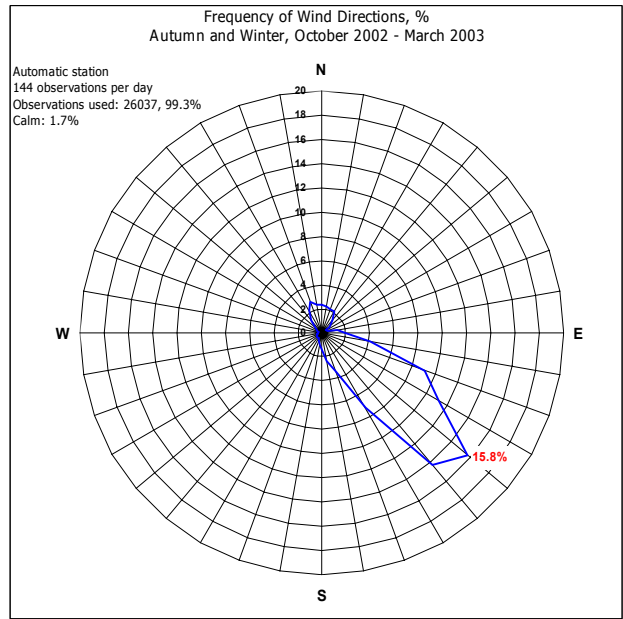
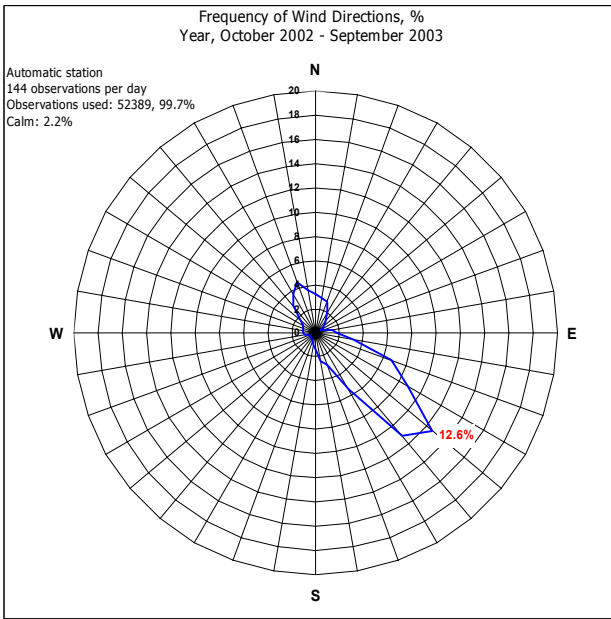


# Húsavík

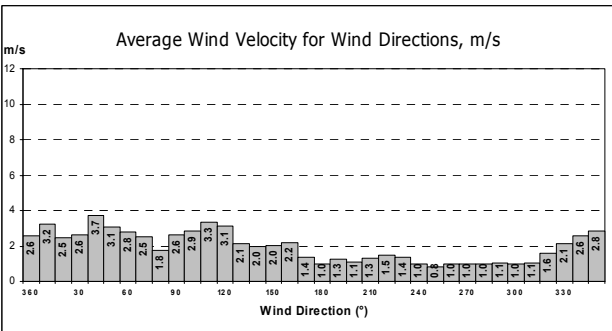
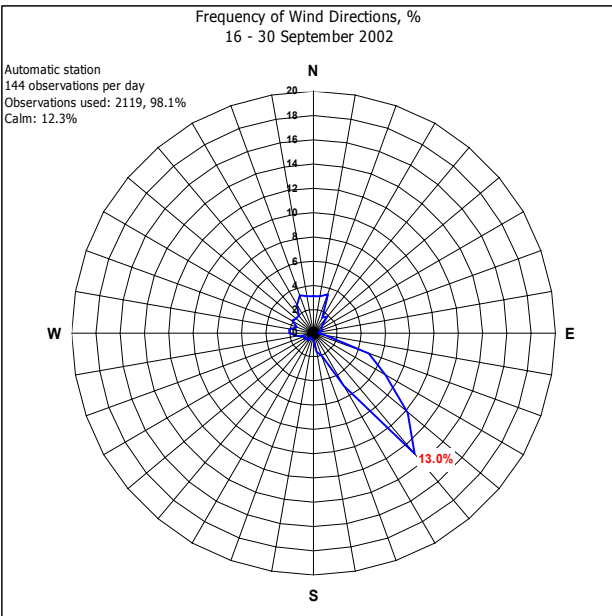
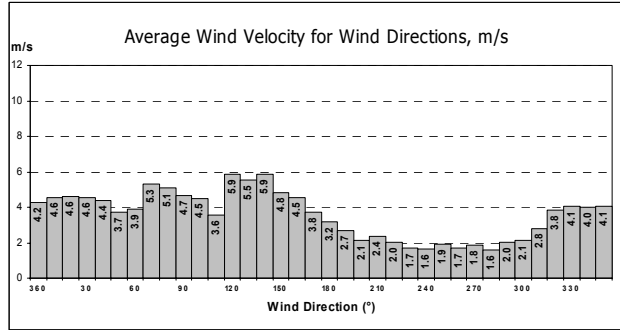
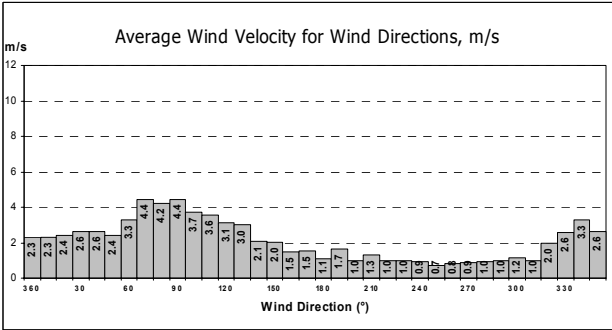
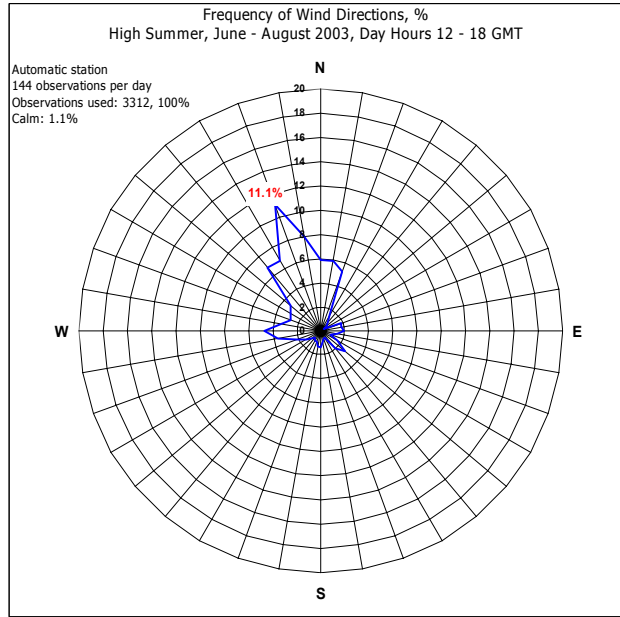
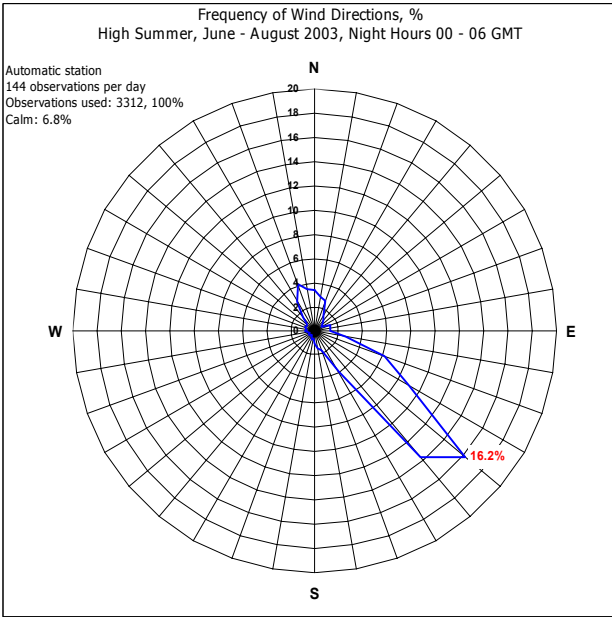




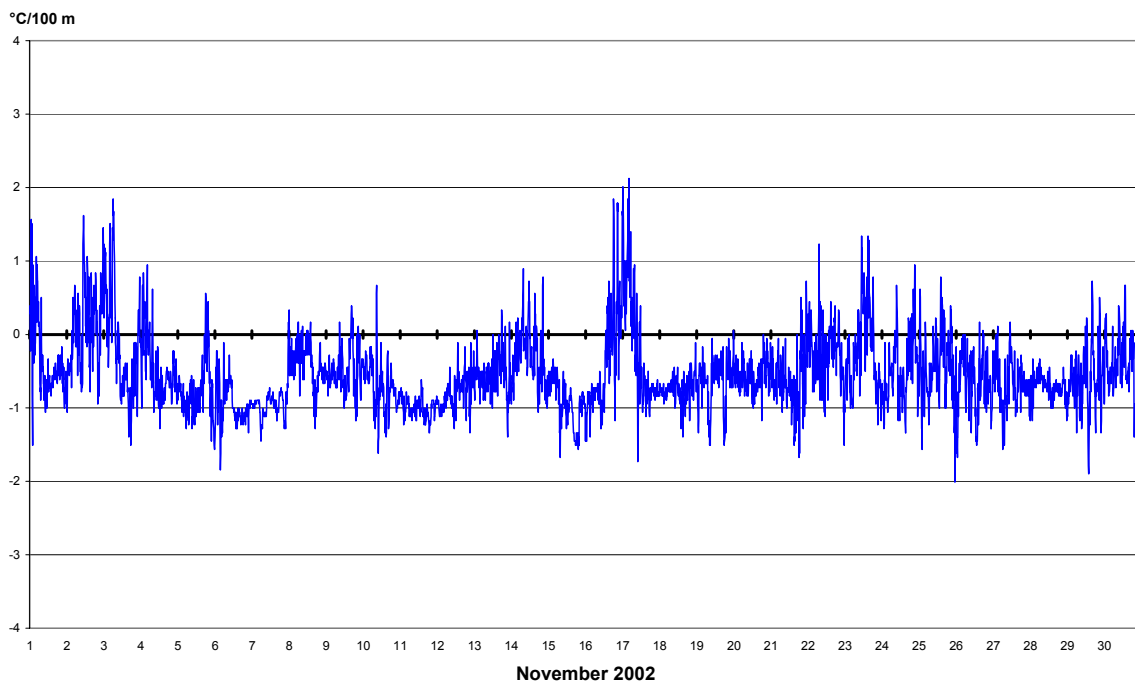
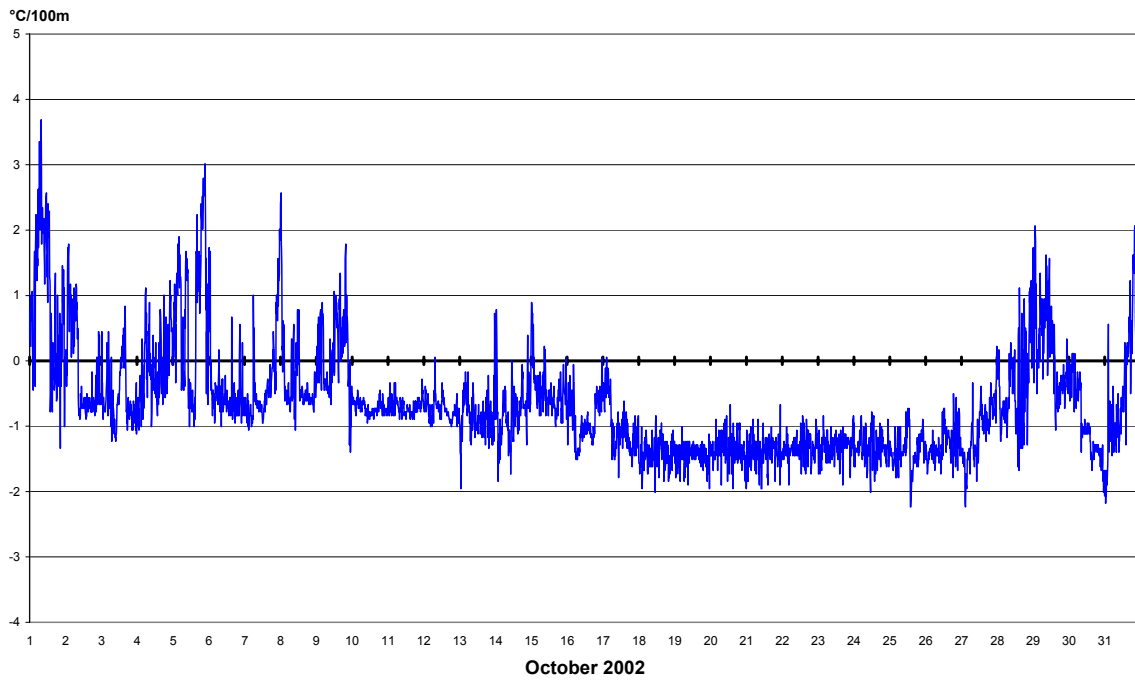
# Húsavík



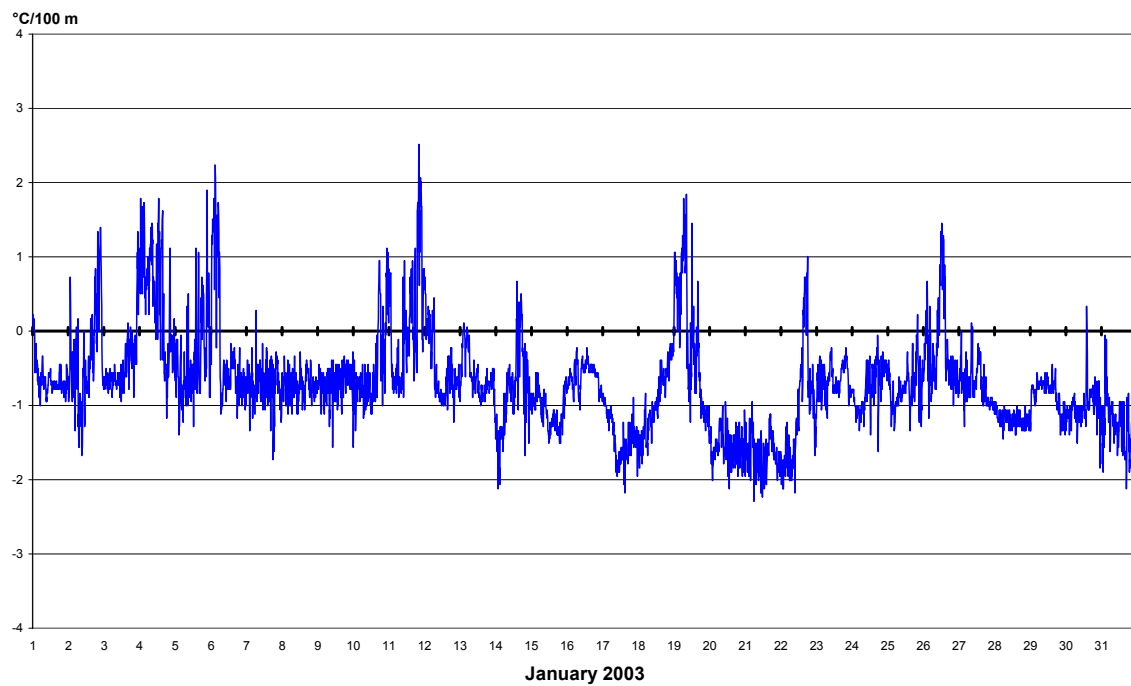
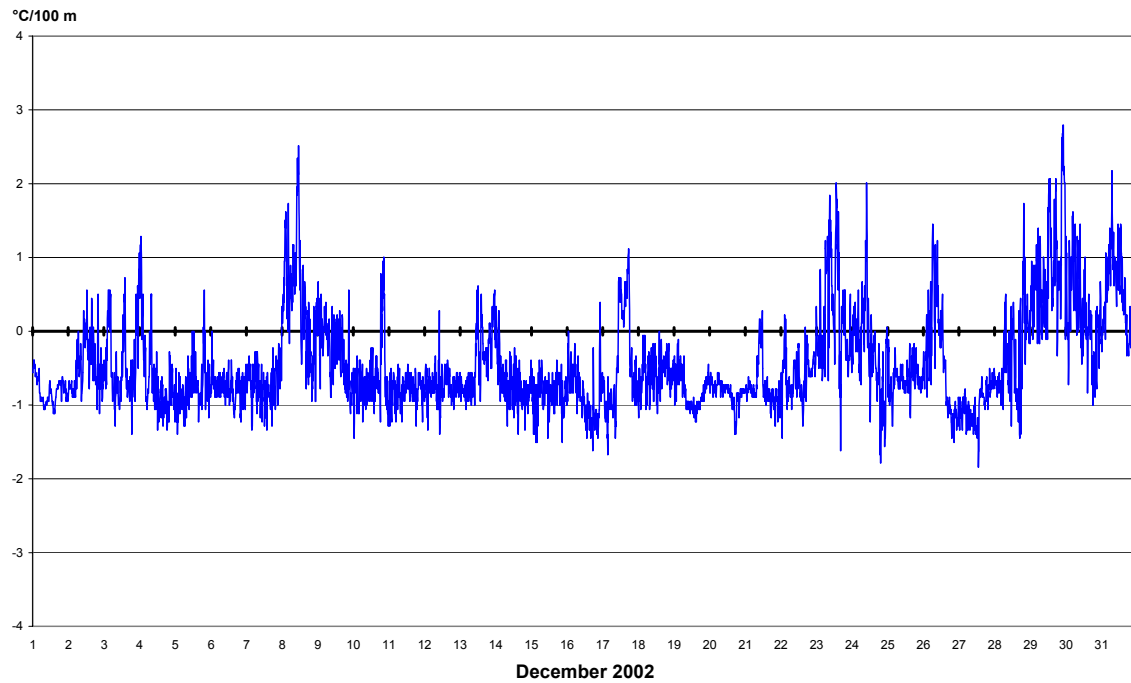
# Húsavík



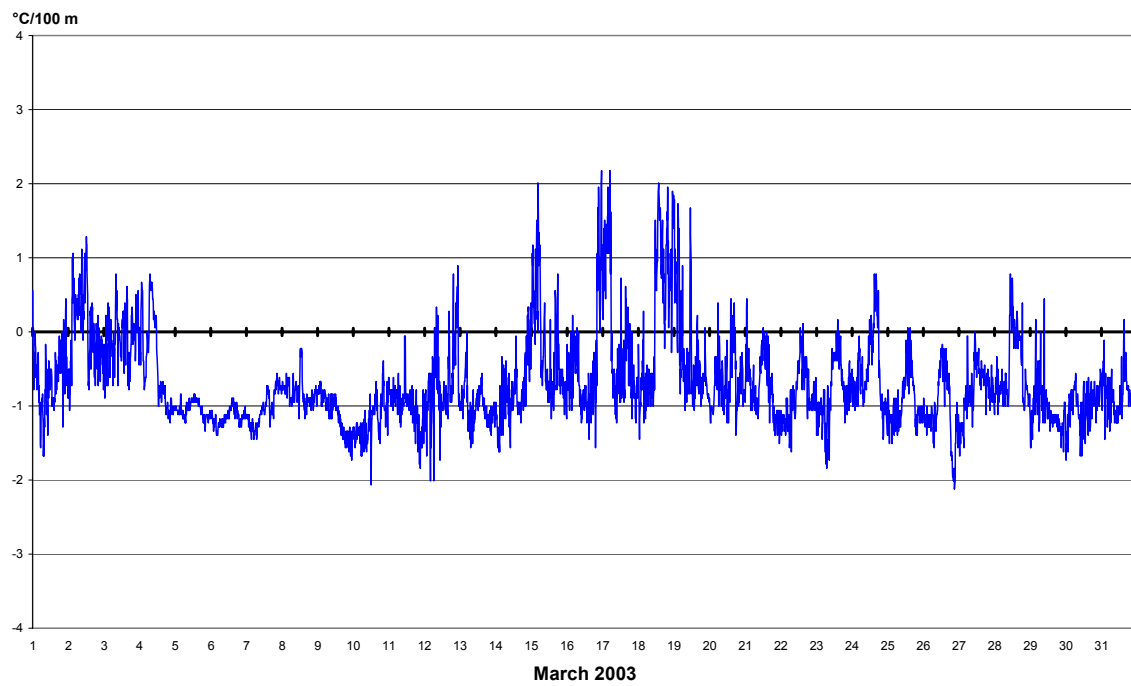
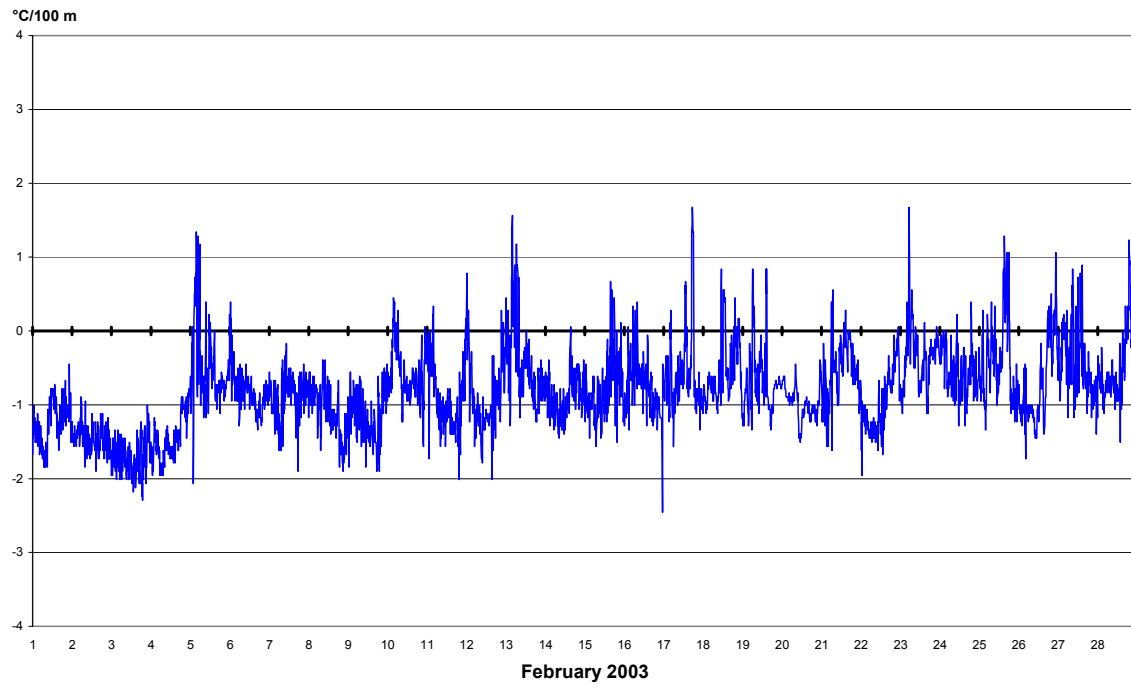
## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Bakkahöfði (height difference 179 m)



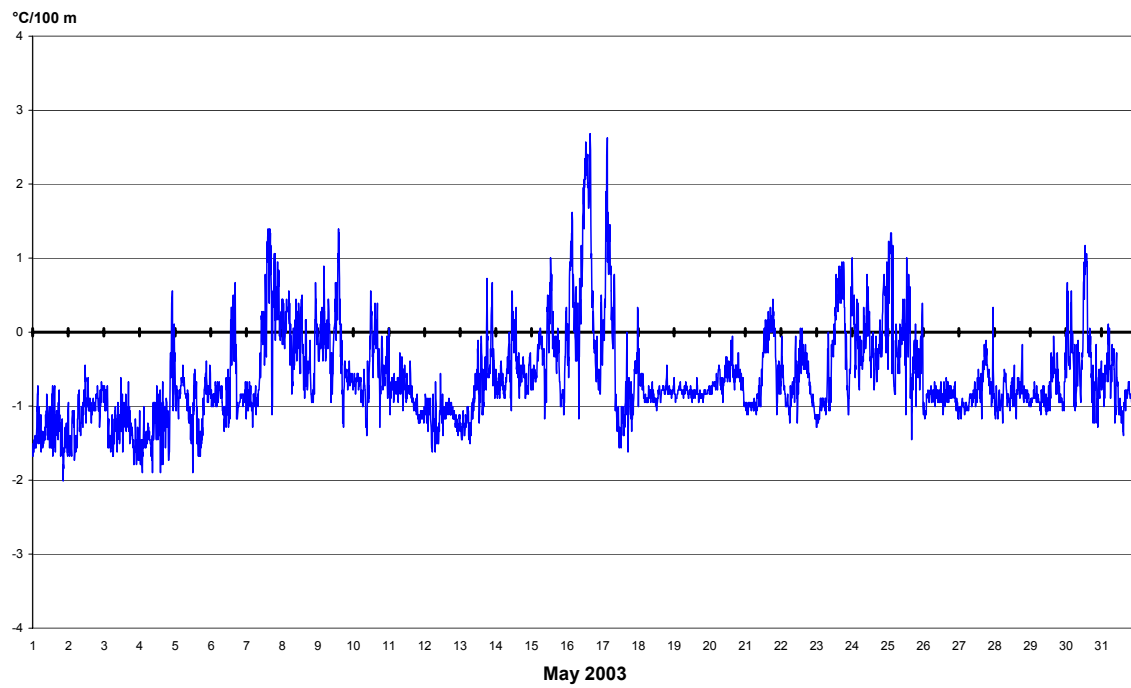
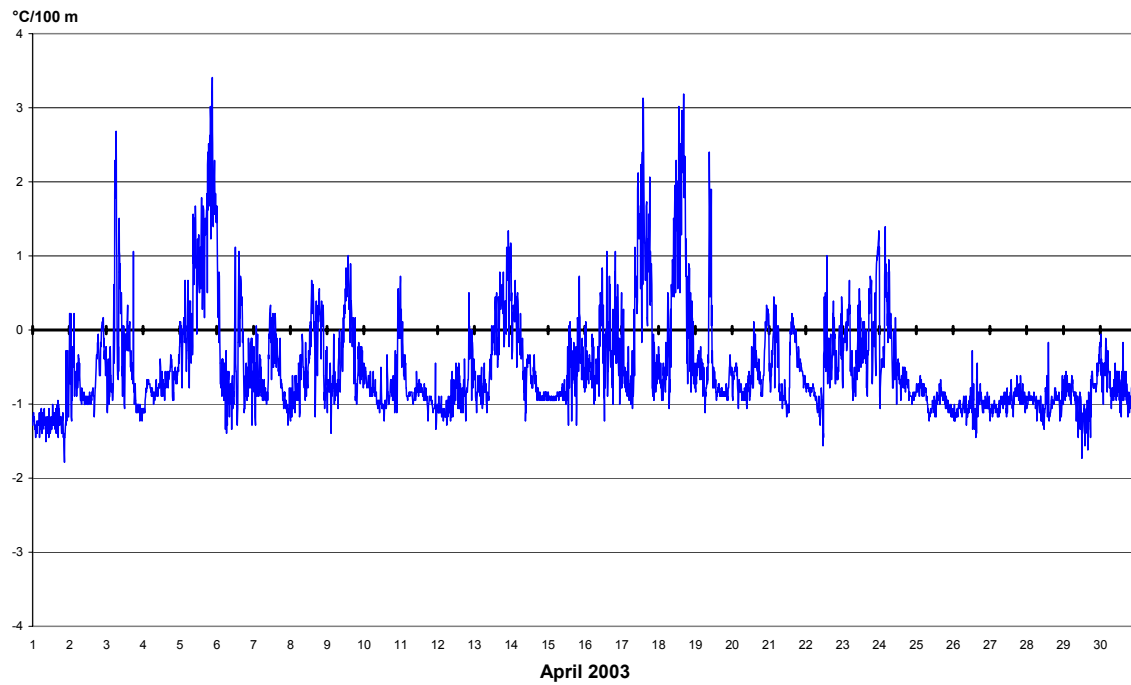
## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Bakkahöfði (height difference 179 m)



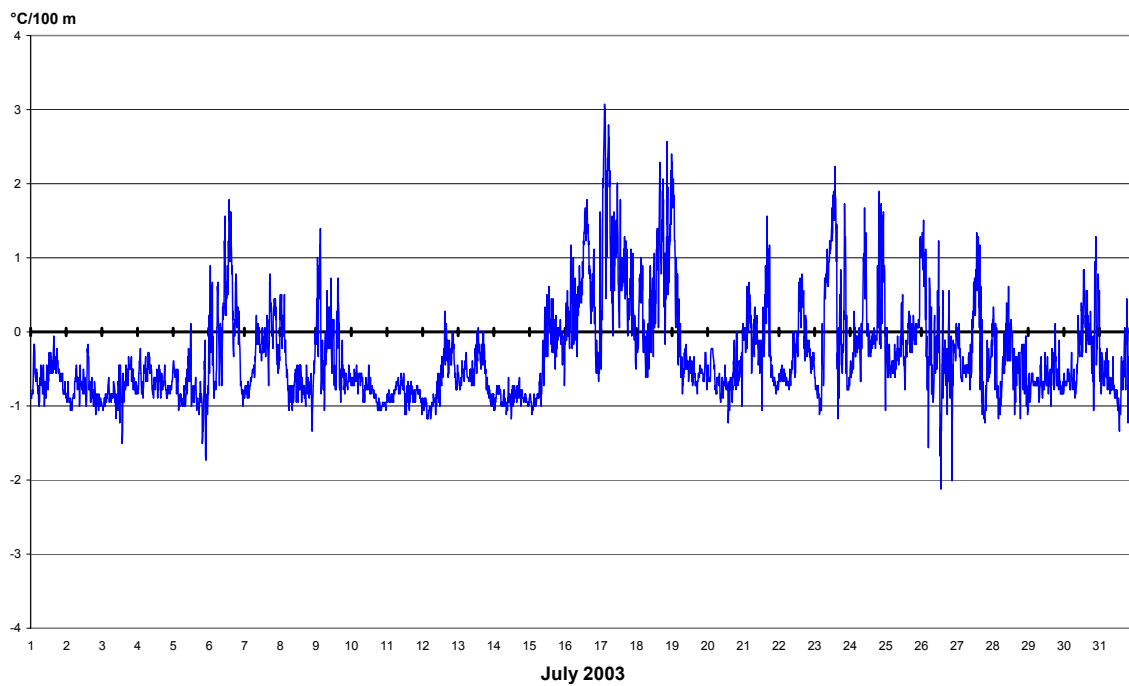
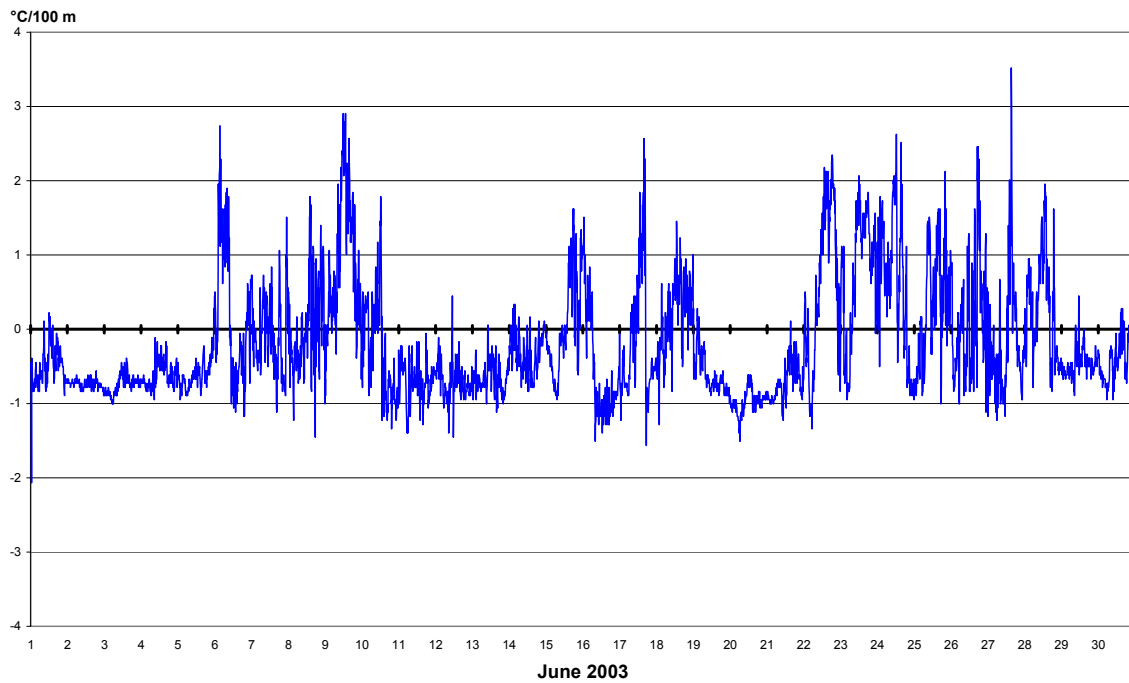
## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Bakkahöfði (height difference 179 m)



## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Bakkahöfði (height difference 179 m)

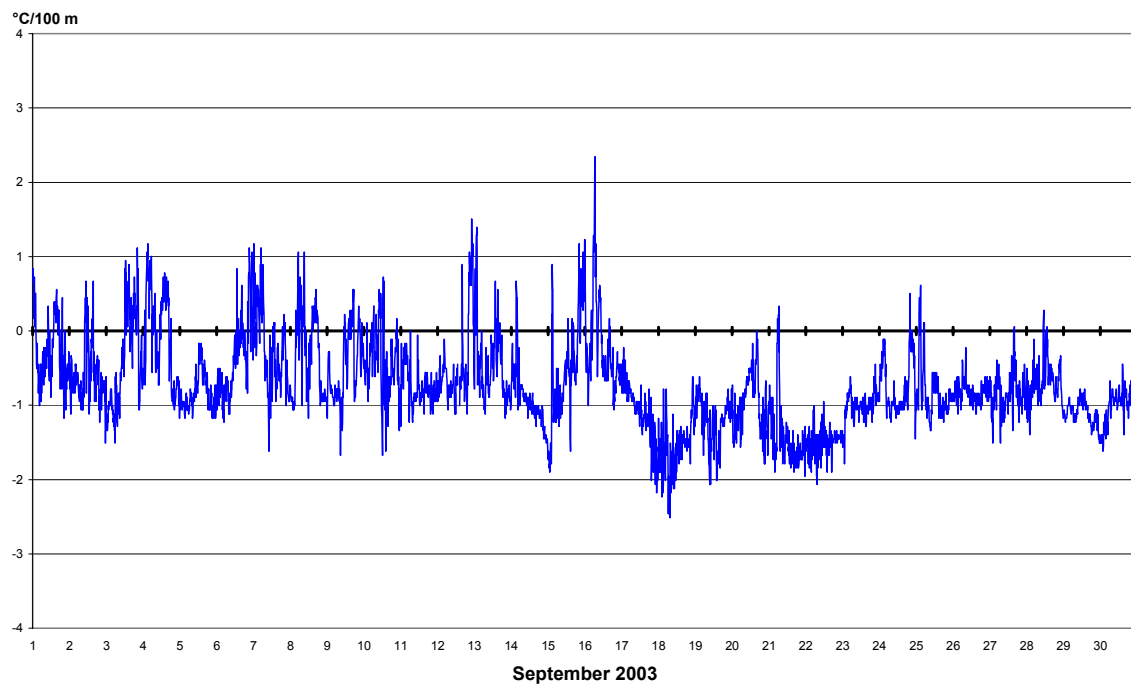
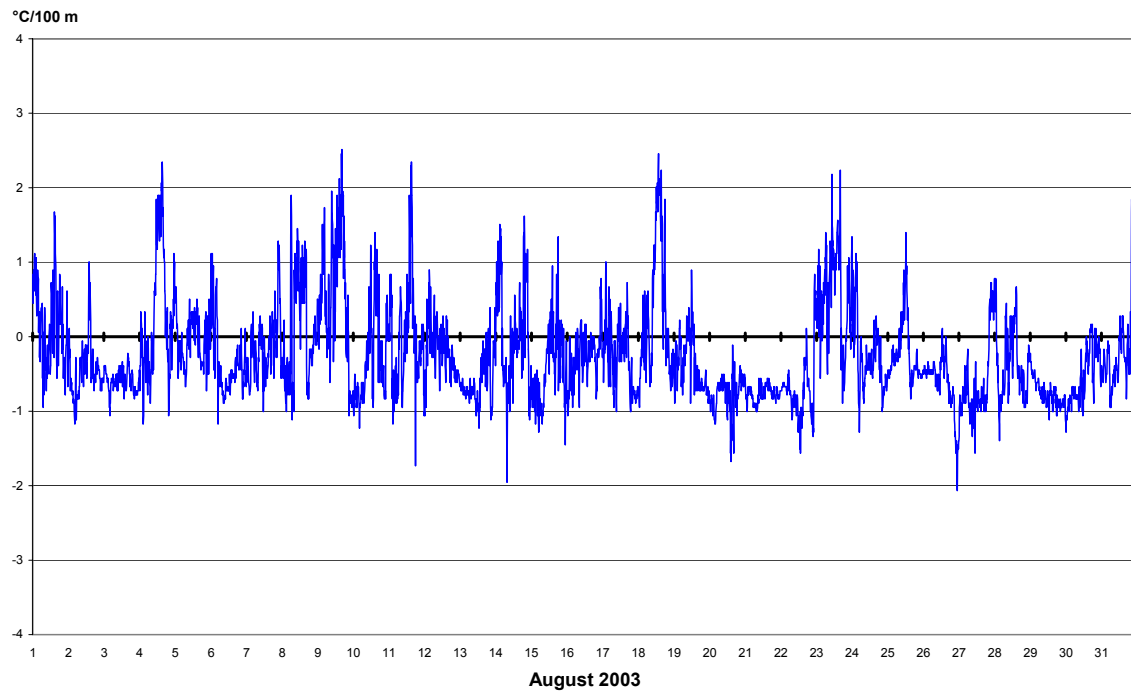


## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Bakkahöfði (height difference 179 m)

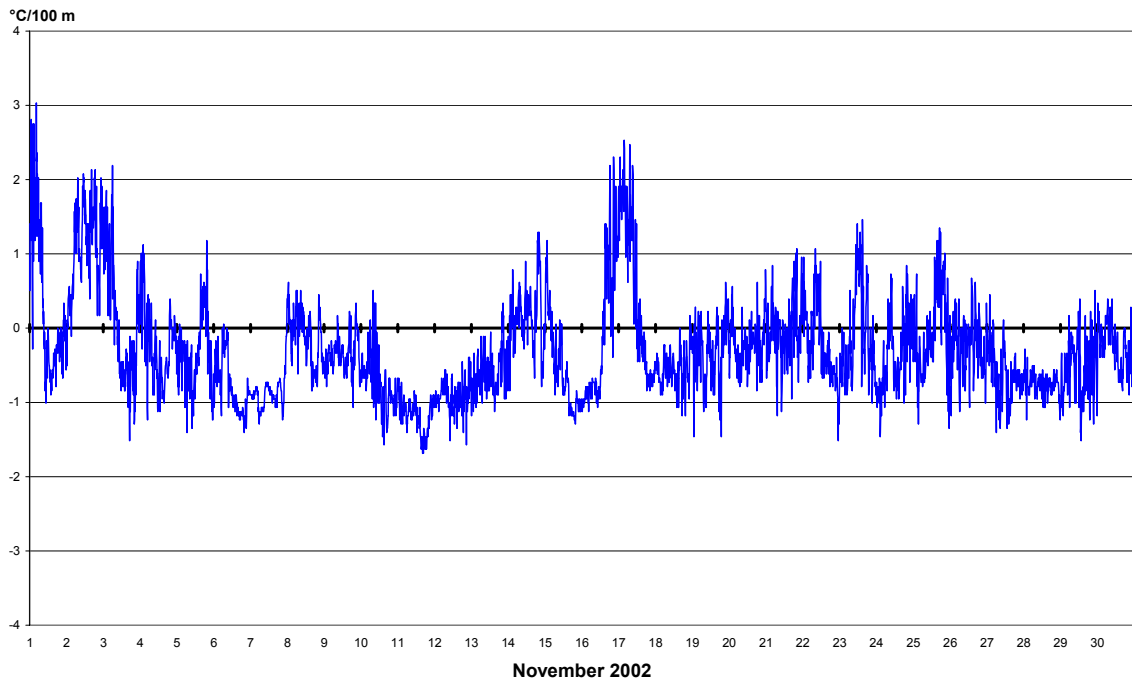
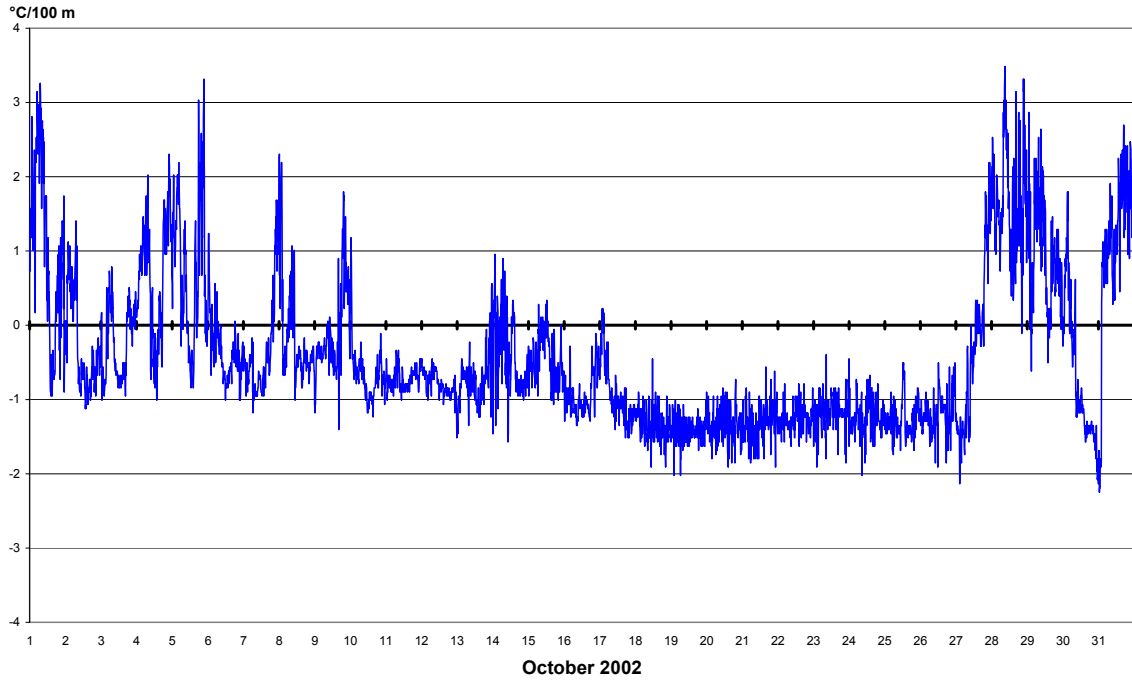




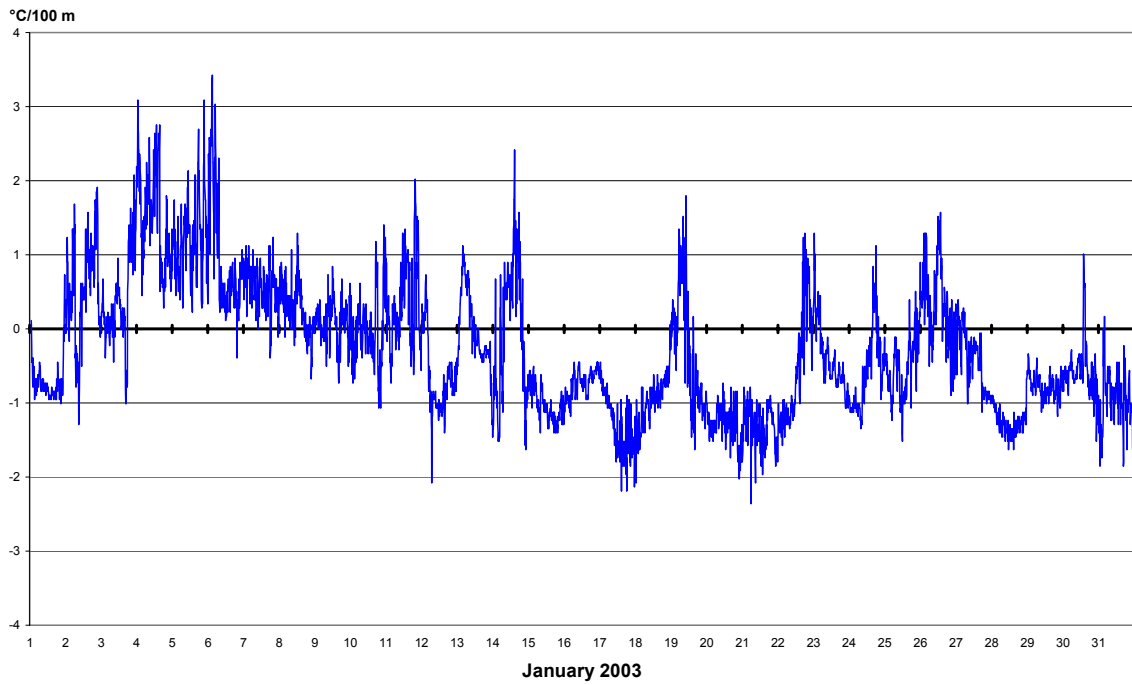
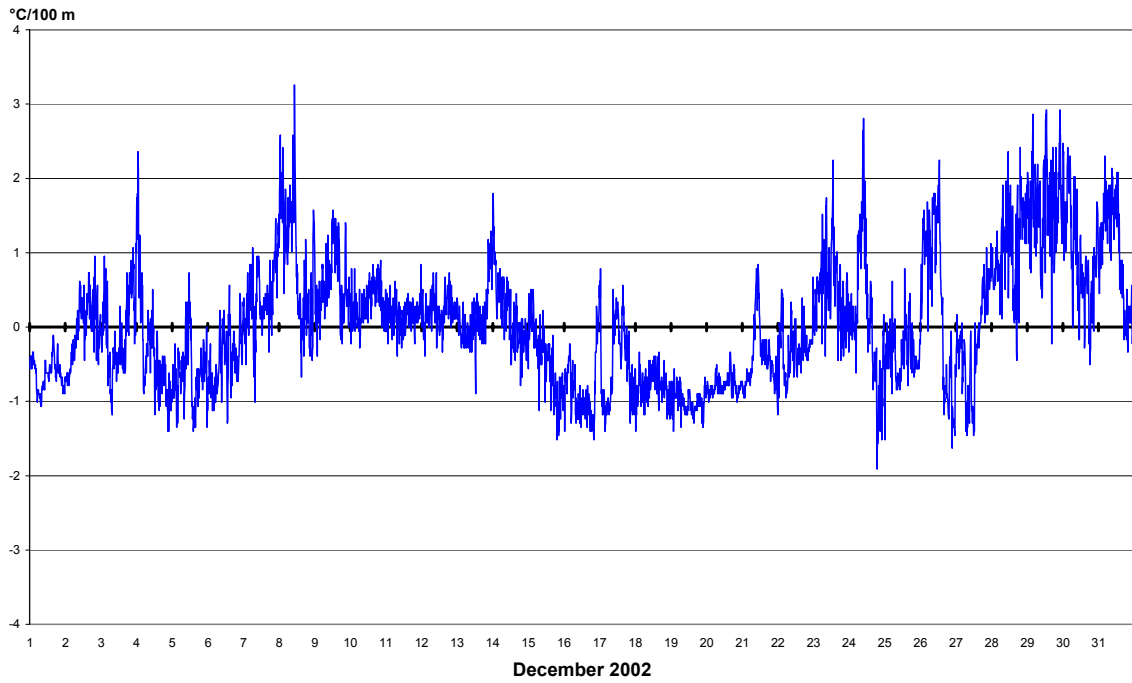
## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Bakkahöfði (height difference 179 m)



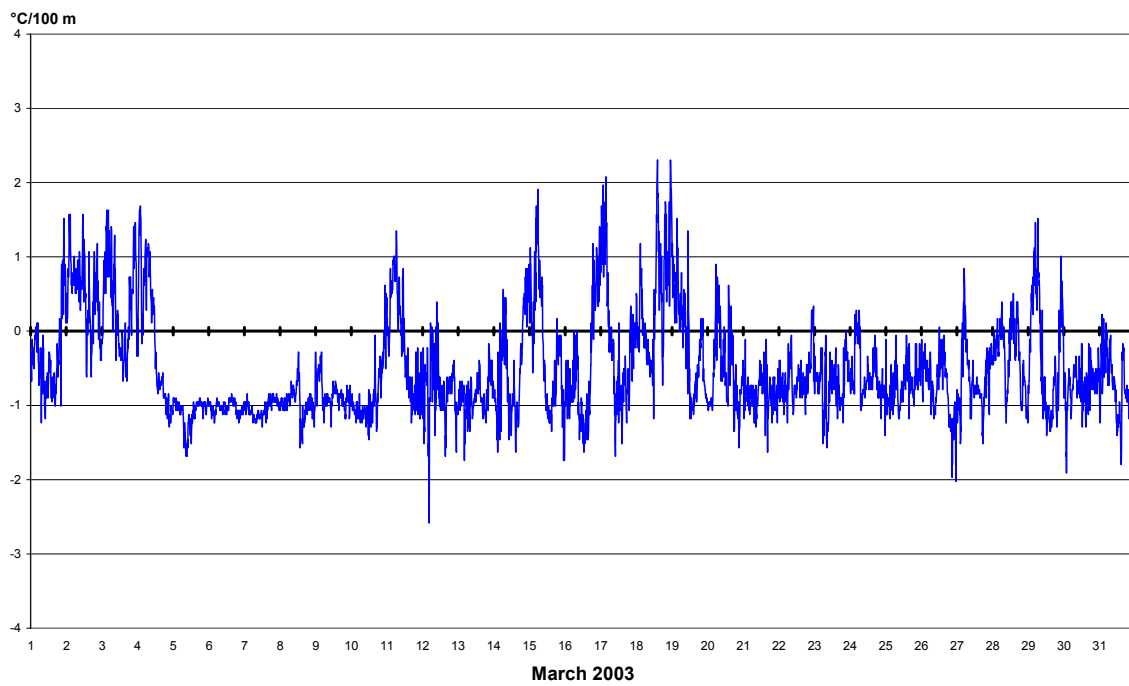
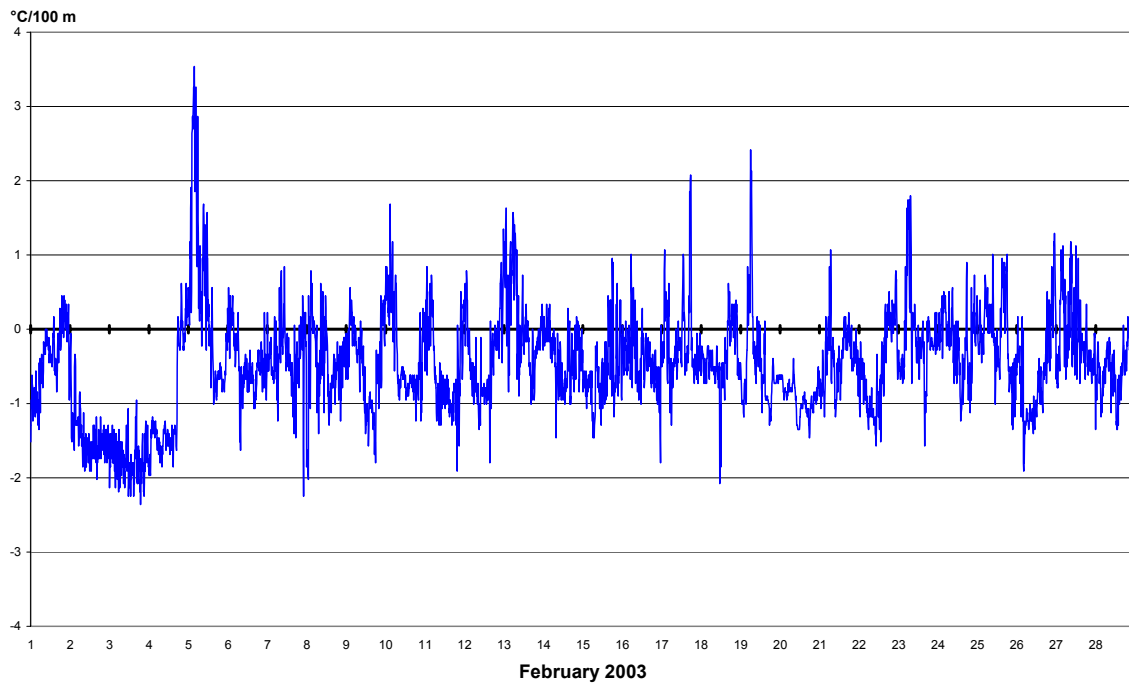
**Vertical temperature gradient, °C/100 m  
Húsavíkurfjall – Gvendarbás (height difference 178 m)**



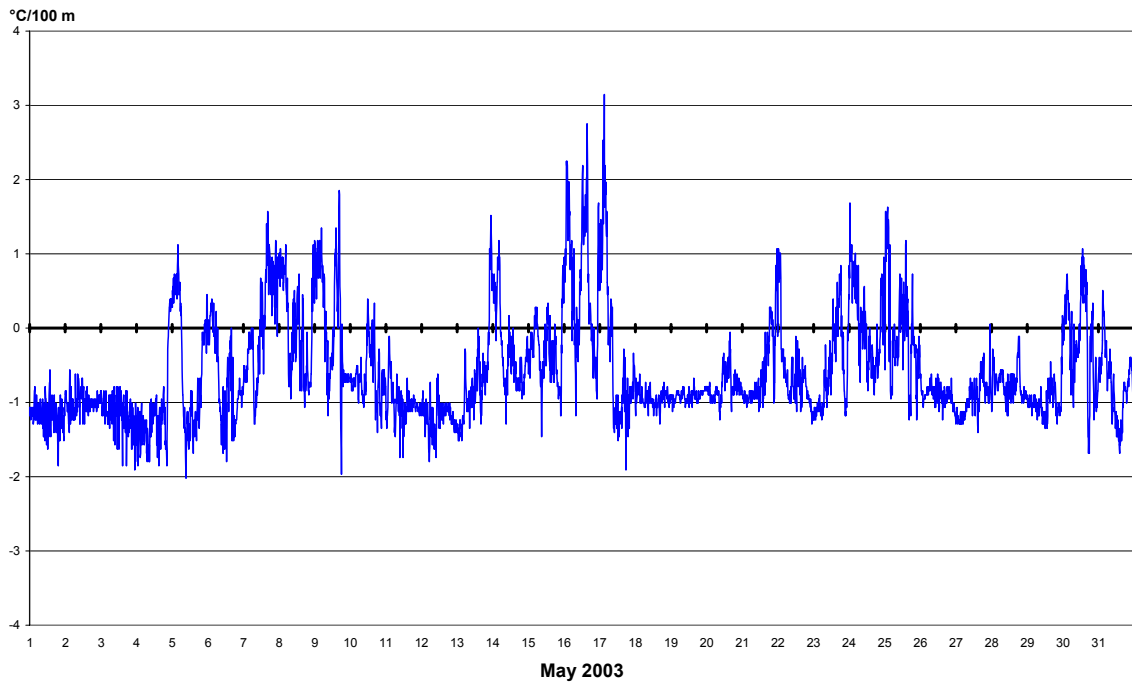
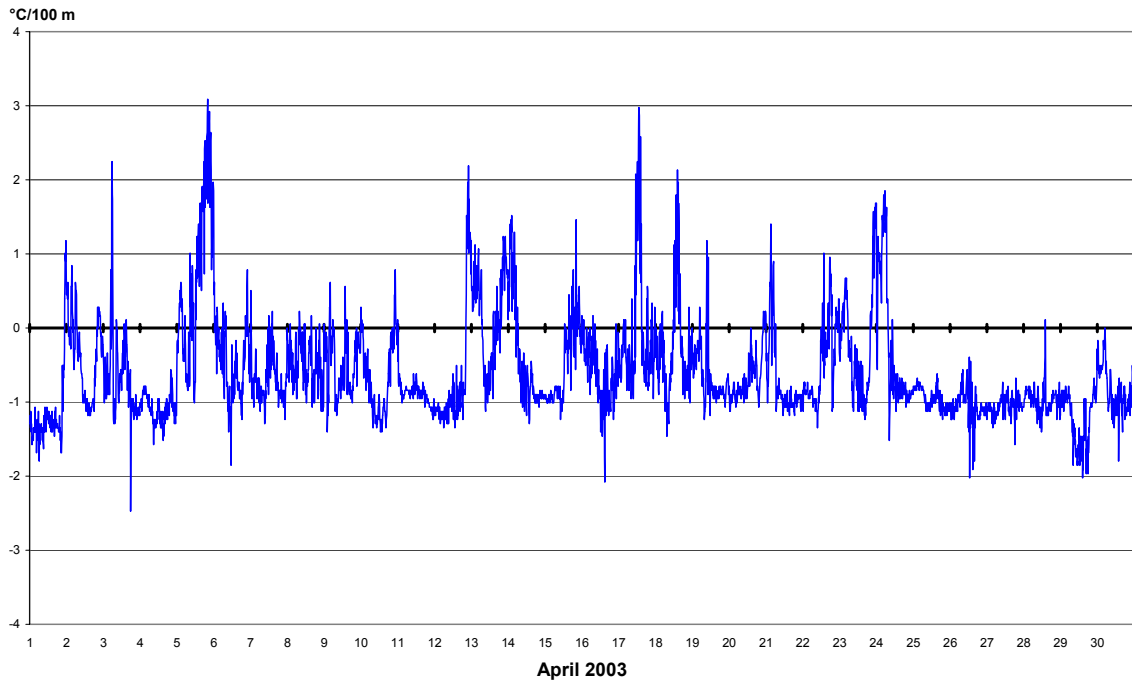
**Vertical temperature gradient, °C/100 m  
Húsavíkurfjall – Gvendarbás (height difference 178 m)**



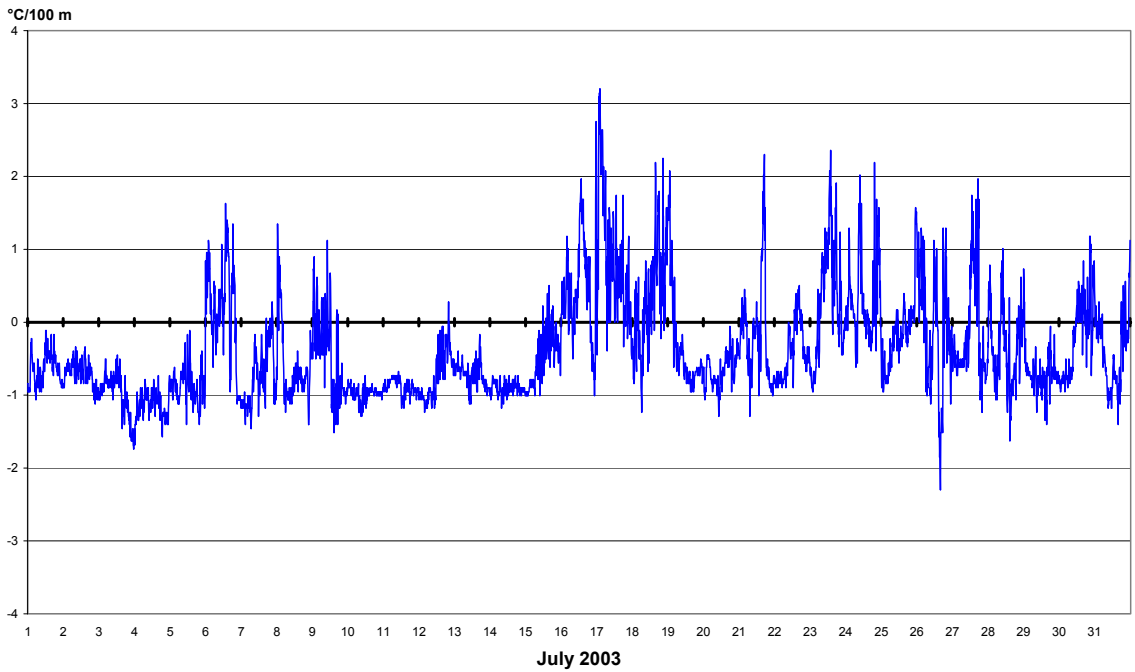
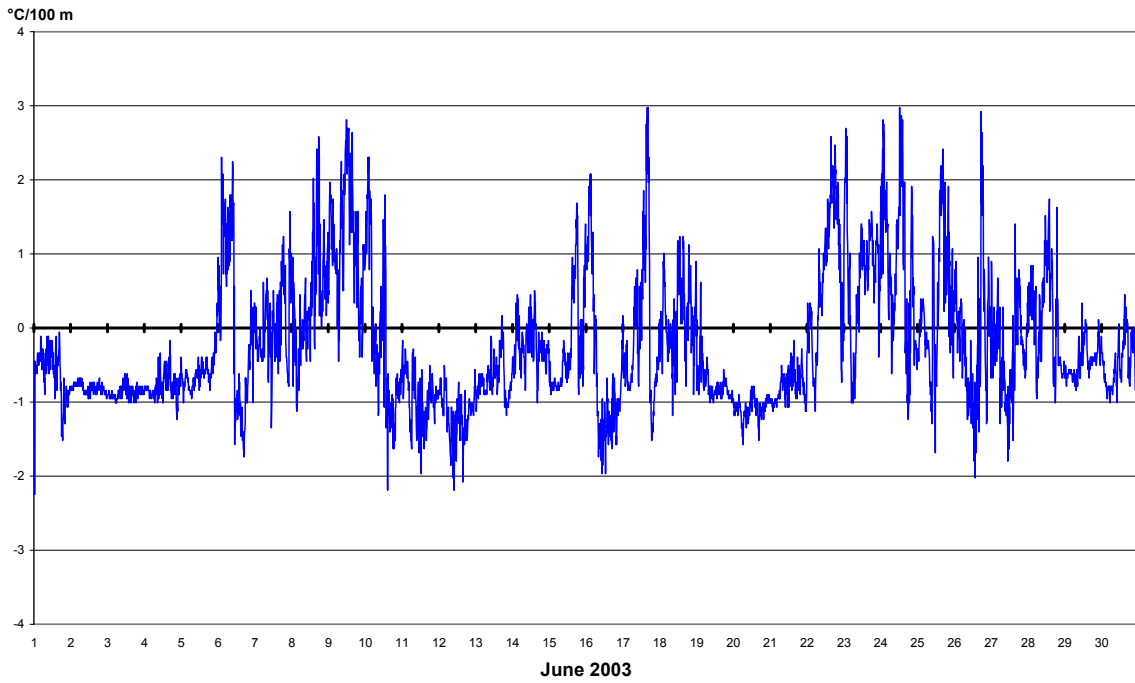
## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Gvendarbás (height difference 178 m)



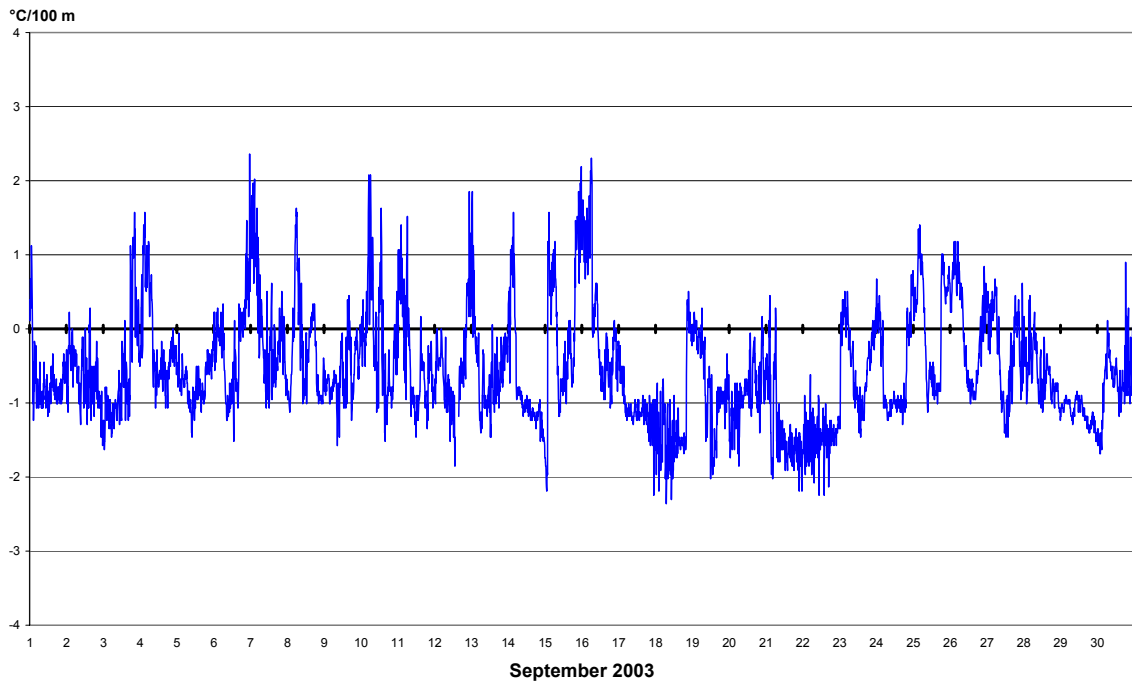
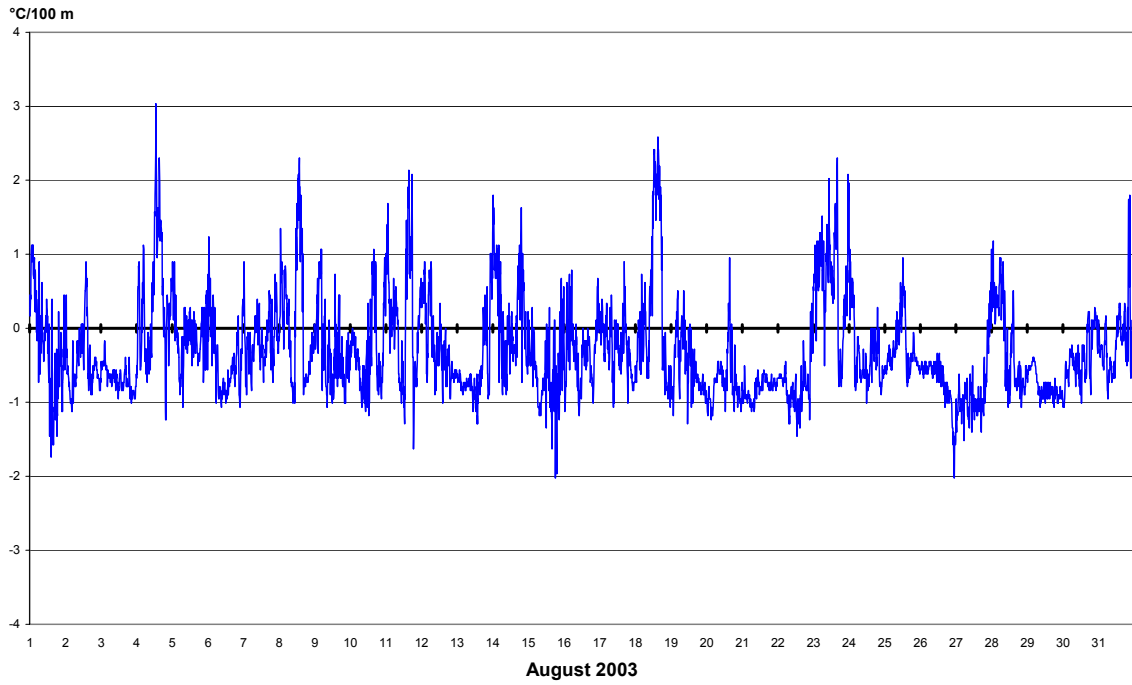
## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Gvendarbás (height difference 178 m)



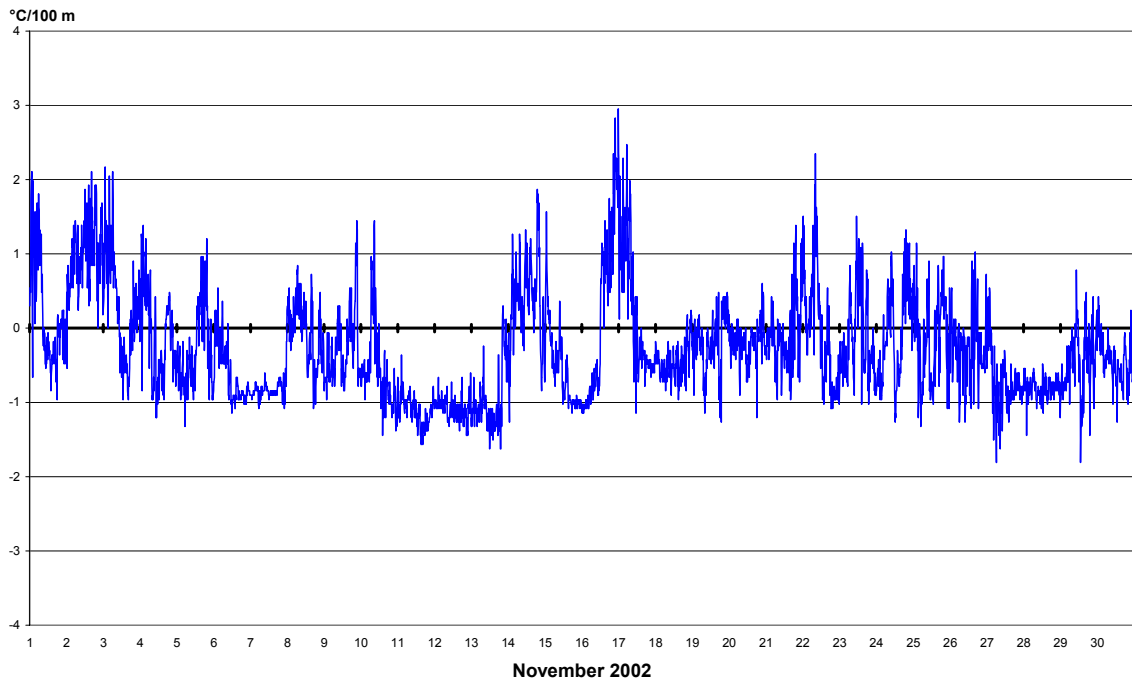
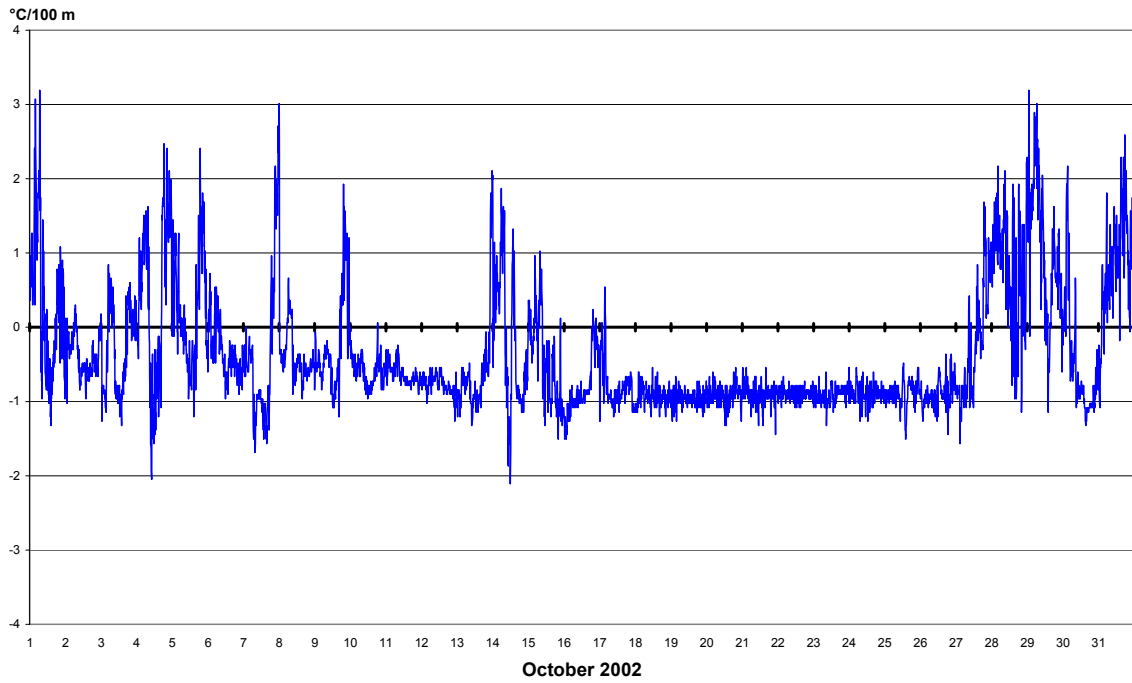
**Vertical temperature gradient, °C/100 m  
Húsavíkurfjall – Gvendarbás (height difference 178 m)**



# Vertical temperature gradient, °C/100 m Húsavíkurfjall – Gvendarbás (height difference 178 m)

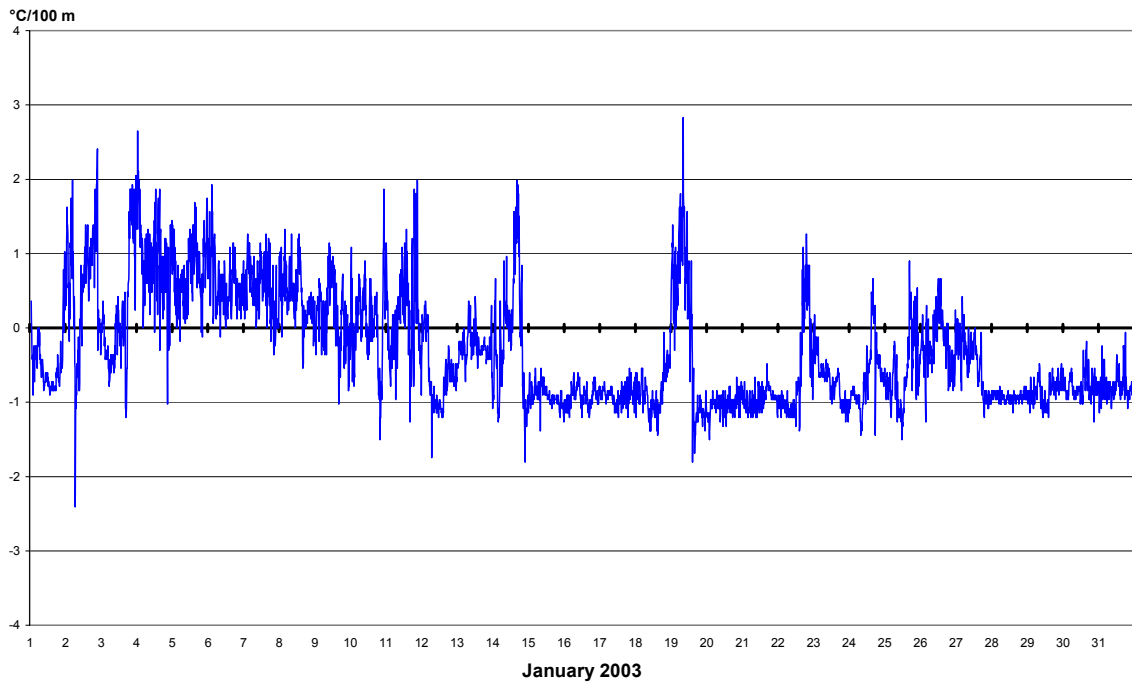
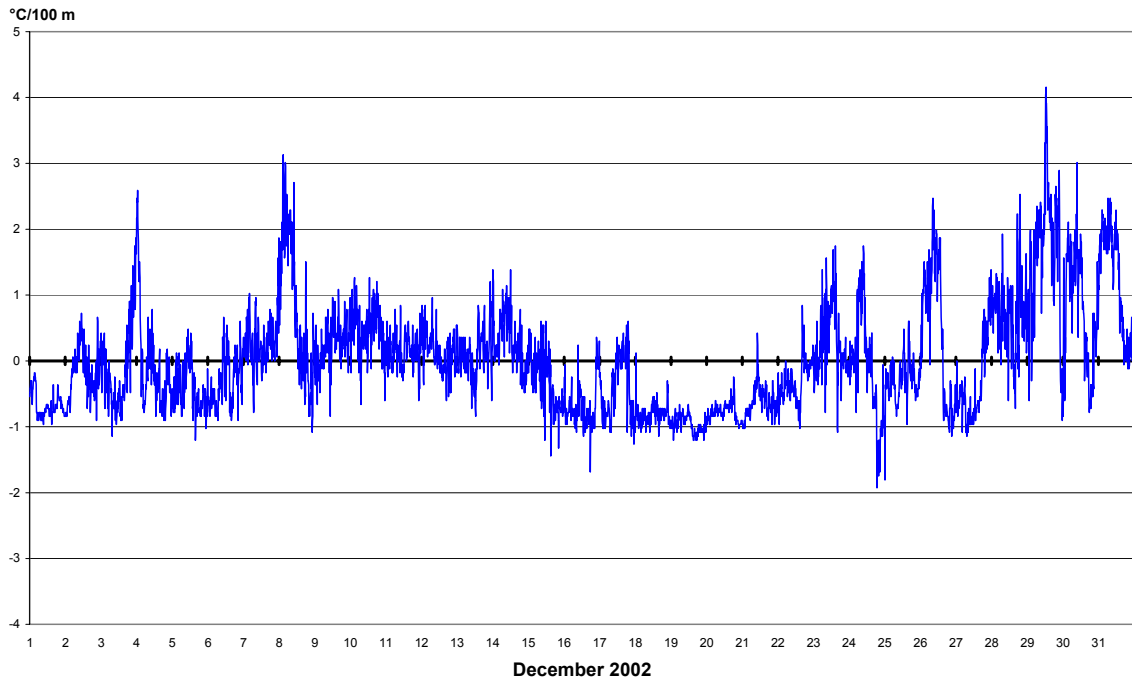


**Vertical temperature gradient, °C/100 m  
Húsavíkurfjall – Húsavík (height difference 166 m)**

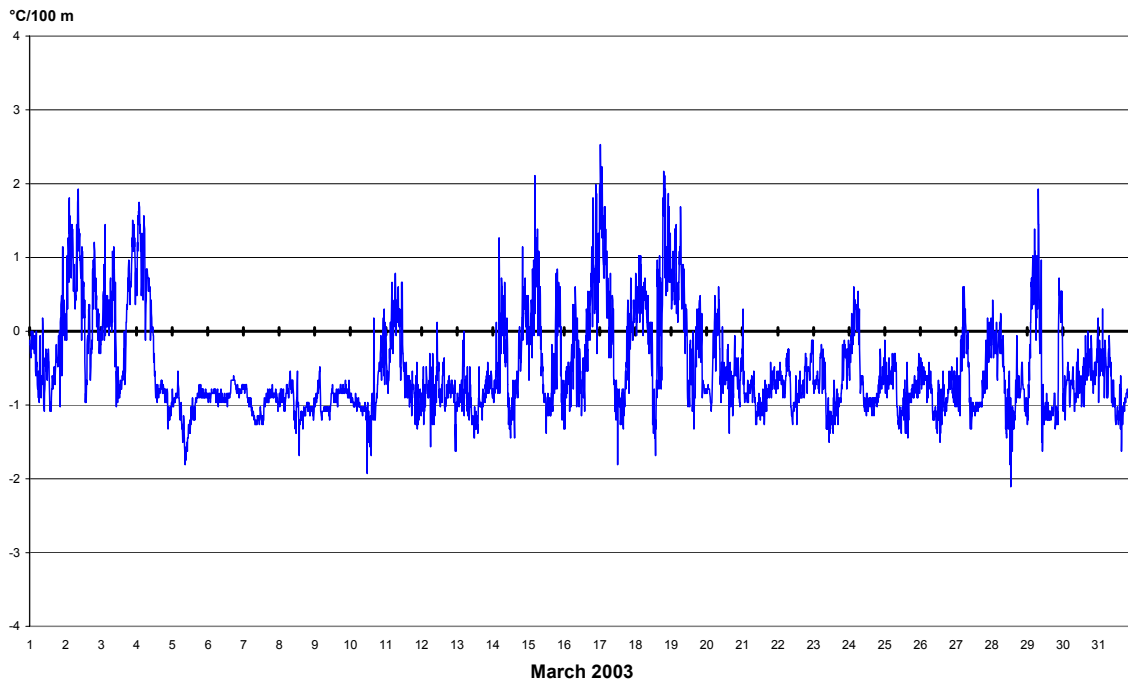
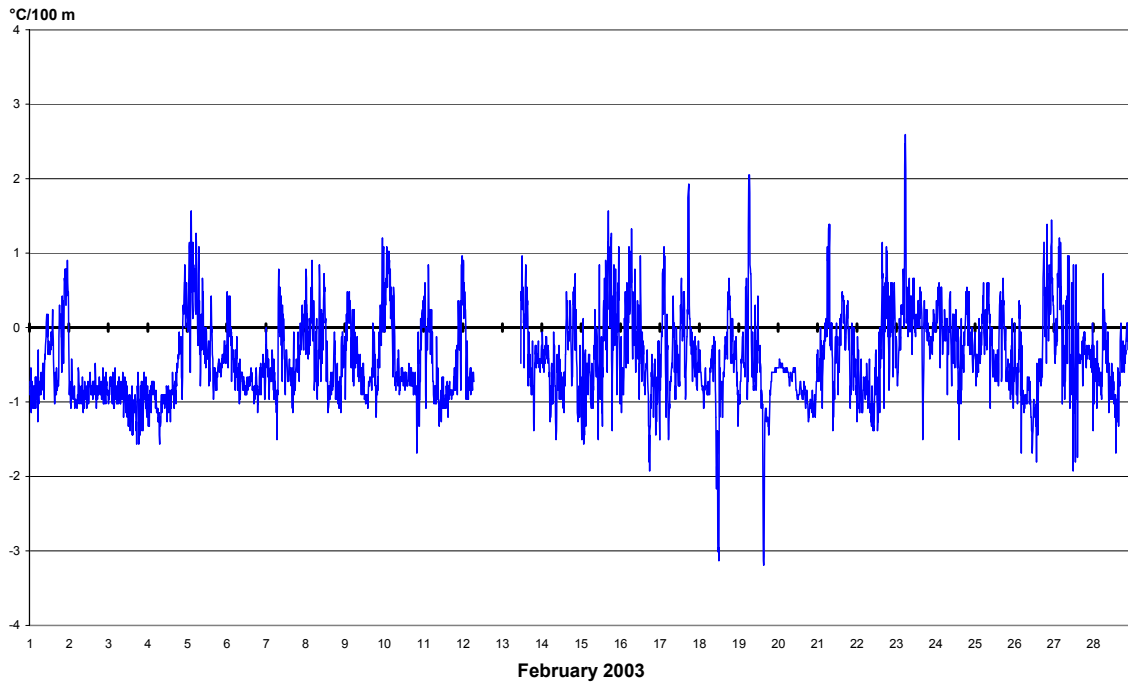




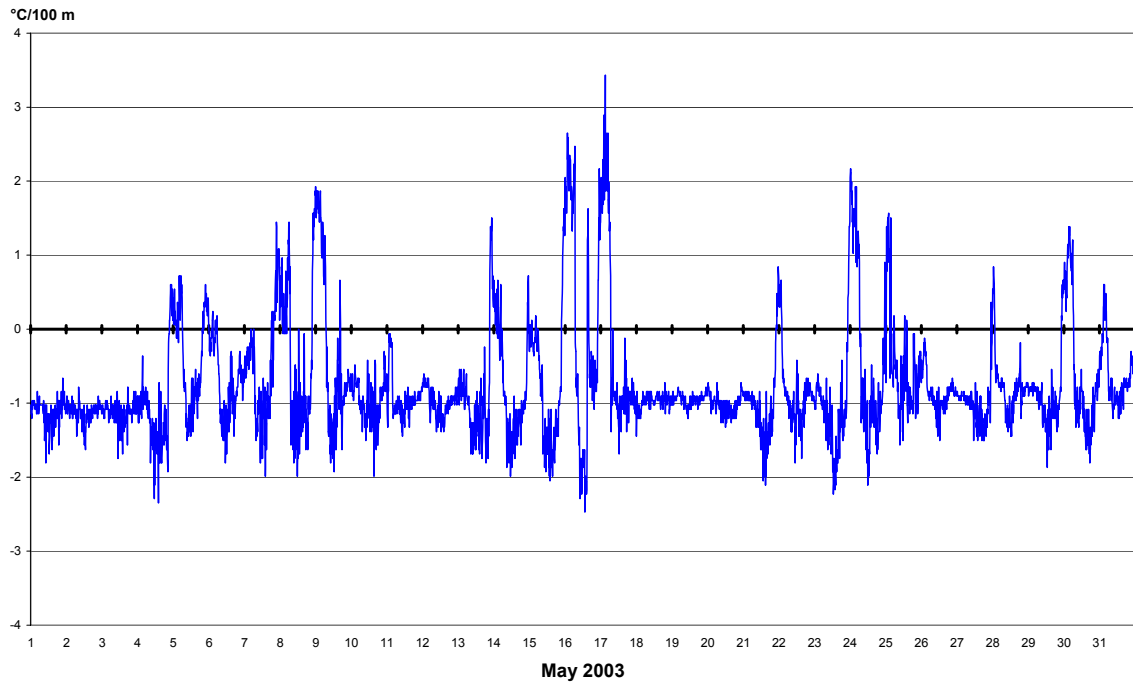
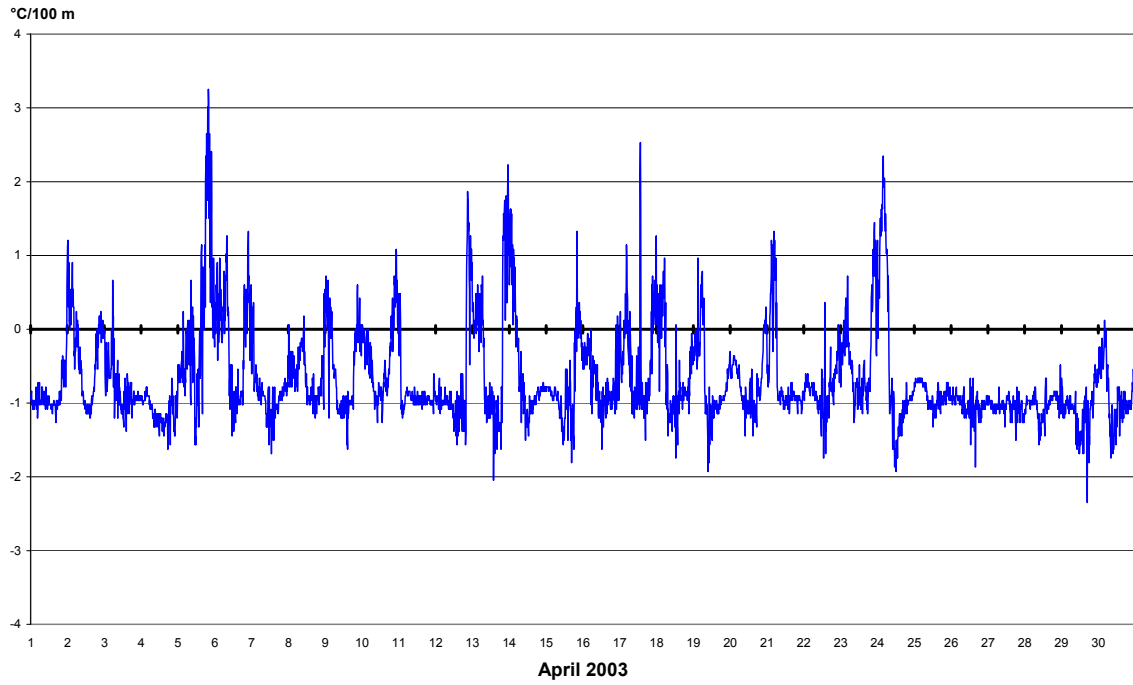
**Vertical temperature gradient, °C/100 m  
Húsavíkurfjall – Húsavík (height difference 166 m)**



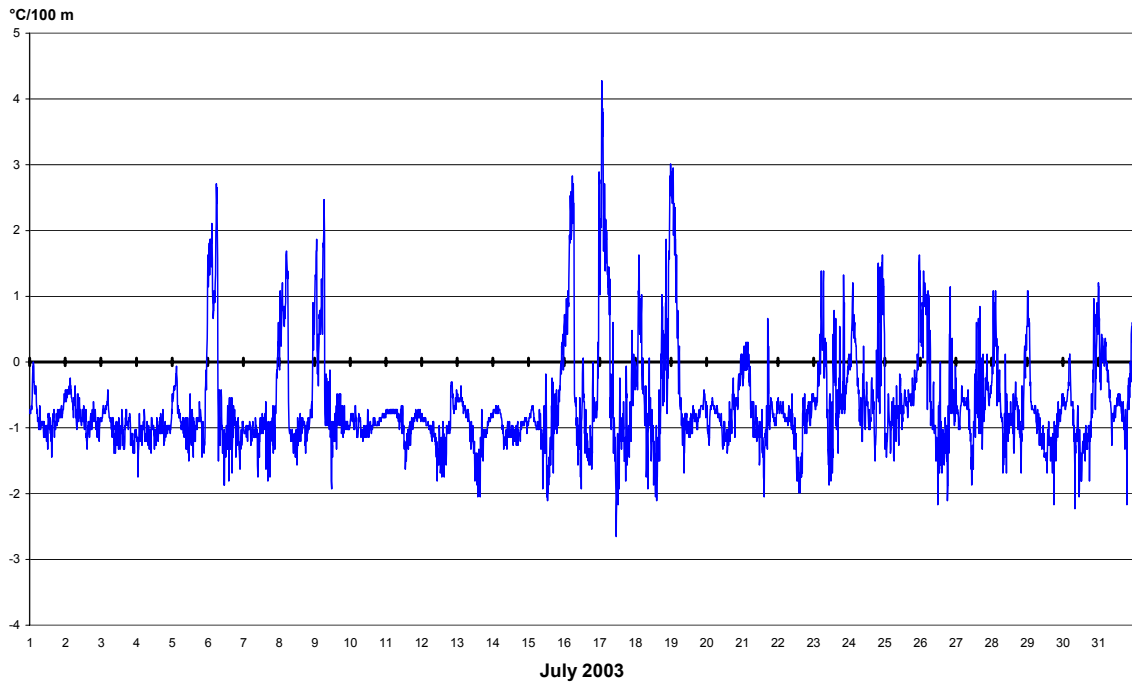
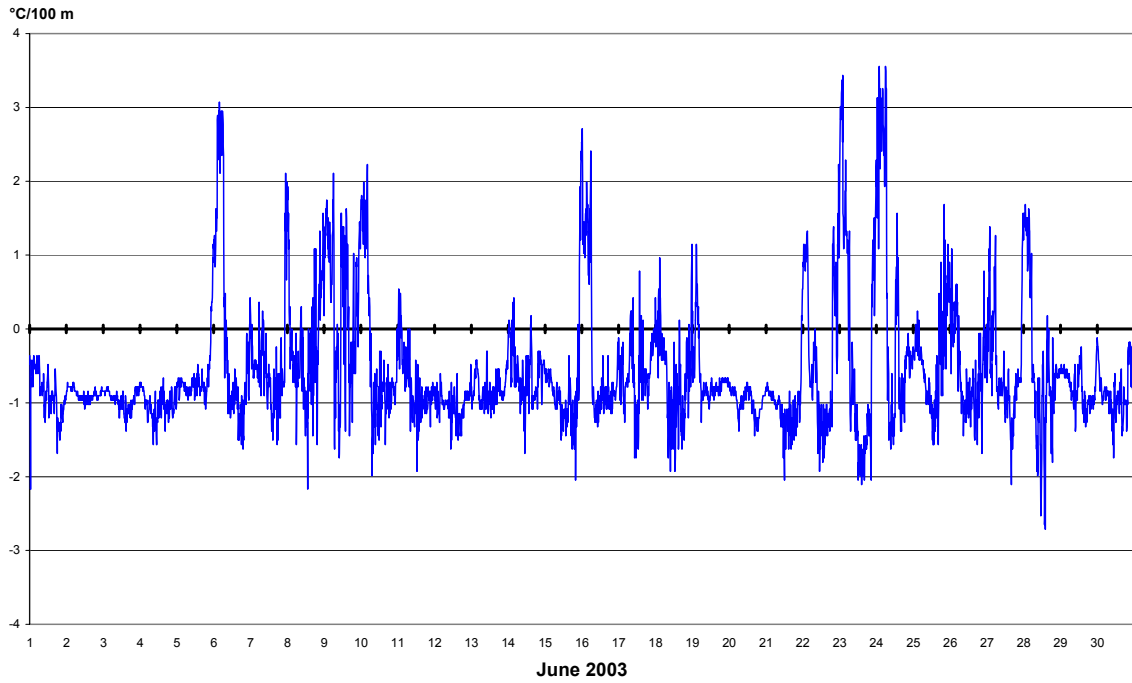
# Vertical temperature gradient, °C/100 m Húsavíkurfjall – Húsavík (height difference 166 m)



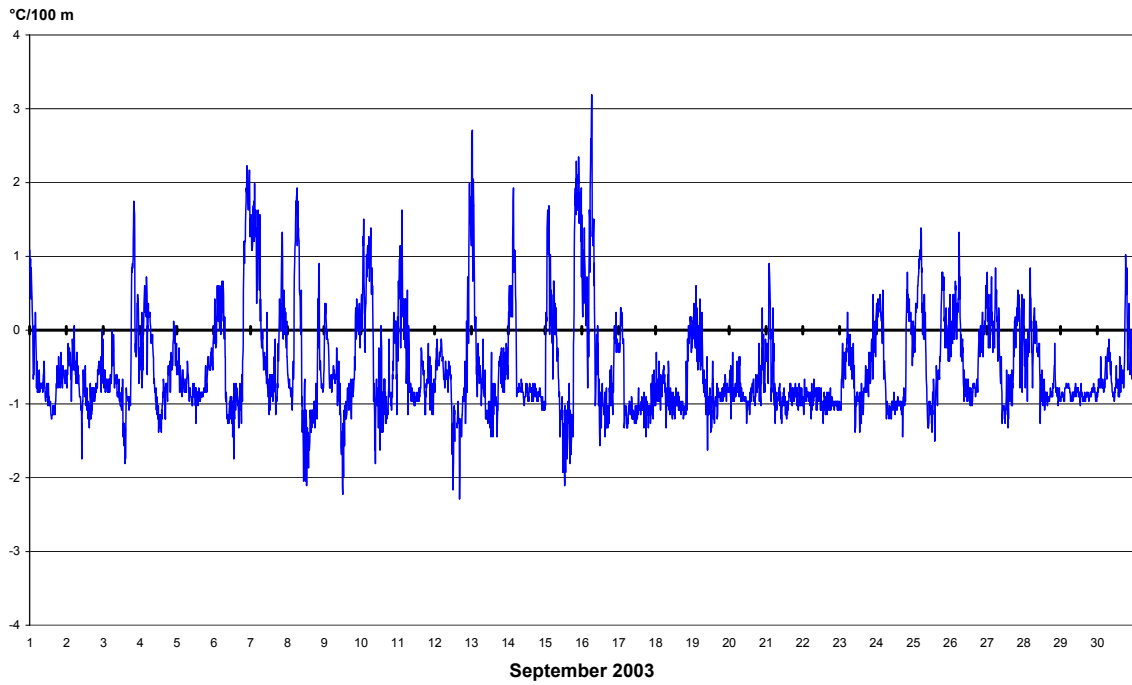
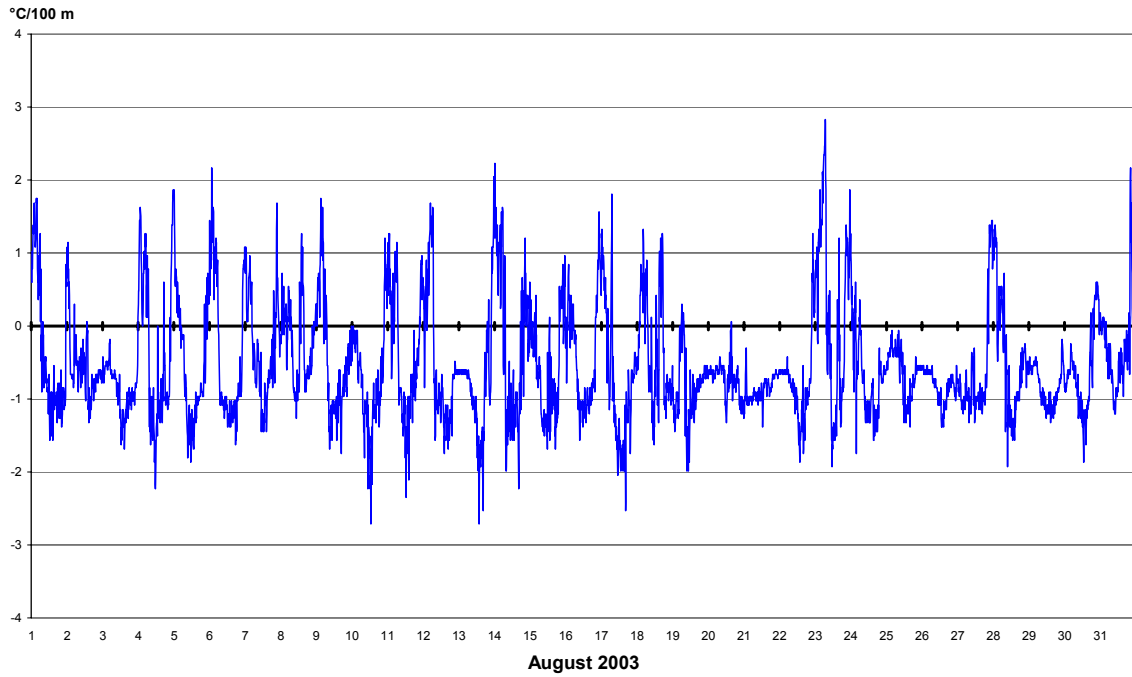
## Vertical temperature gradient, °C/100 m Húsavíkurfjall – Húsavík (height difference 166 m)



**Vertical temperature gradient, °C/100 m  
Húsavíkurfjall – Húsavík (height difference 166 m)**



**Vertical temperature gradient, °C/100 m  
Húsavíkurfjall – Húsavík (height difference 166 m)**



# Héðinshöfði

