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USE OF HIGH RESOLUTION RADIOSONDE DATA FOR DETERMINATION OF REFRACTIVITY PARAMETERS

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TITLE

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AUTHORS

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PROJECT CONTRACTOR

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The Norwegian Meteorological Institute

SUMMARY

The modern sounding systems for meteorological purposes give resolutions in height for the observed parameters pressure, temperature and humidity down to about 10 m. That is so called "raw-data", but also filtered or smoothed data with a resolution of about 50 m. in height are an absolutely improvment in describing variations in the lower layers of the atmosphere. The report is a study of such a set of data with respect to radio refractivity parameters and duct statistics.

SIGNATURE

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Contents

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I also want to thank Mr Ola Guldberg at the radiosonde station at Gardermoen. Without his help to archive the data at the station besides his ordinary work, this report had not been possible.

For the standard set of radiosonde data I want to thank Mrs Ruth Arntzen at the climatology division of The Norwegian Meteorological Institute.

1. Introduction

In later years rapid improvements of both the sensors and the management of the data from radiosondes and rawinsondes, i.e. the hardware and the software, has given the opportunity to examine the fine structure of the atmosphere at far closer height intervals than before.

Some systems as for instance the Vaisala ones, allow storing of the data measured by the radio sonde taken down as often as every 2 seconds during the ascent. With an average ascent rate of about 5 metres pr. second this will give a resolution in height of about 10 metres. Identifying wave ducts in the atmosphere and their properties as height and intensity this will thus be greatly facilitated.

The Norwegian Meteorological Institute (NMI) has for several years utilised the Finish Vaisala sondes as RS80-15N and RS80-18N and the "DigiCORA" software system to manage the obtained data. At the Oslo-Gardermoen radiosonde station a special project with the aim of measuring also the ozone content of the troposphere as well as the stratosphere has been carried out with the necessary software to obtain high resolution data.

By special agreement with the radiosonde station at Gardermoen it was possible to obtain ascents with a resolution in time of 10 seconds. A focal person here is Ola Guldberg, who have made the following study possible by providing the necessary data available on diskettes for every month since September 1993.

Data consists of pressure, temperature, humidity and wind direction and speed as well as the height given in geopotential metres.

Identifying radio climatic parameters as refractivity, refractivity gradients, duct intensities and duct heights the use of such data will apparently be a great advantage in relation to the standard output of the WMO codes TEMP and PILOT.

A study of this kind has already been carried out at RAL based on 2 seconds data from the UK. radiosonde station at Hemsby. This report is the first Norwegian contribution of high resolution radiosonde data to the "radiosonde group" made up of members from of CRC, NMI, RAL and TRD.

In this respect it can also be mentioned that for the time being all Norwegian land based radiosonde stations archive their data in high resolution, Gardermoen every 10 seconds, the others every 2 seconds. Further study of this dataset, obtainable at the Norwegian Meteorological Institute, will be undertaken in the near future.

2. The modern radiosonde.

The modern radiosondes have had in the last years rapid improvements in both hardware (the different sensors and also systems for determination of the position of the sonde) and software (built in data editing programs).

The Norwegian Meteorological Institute uses the Finish Vaisala sondes with the DigiCORA system. Here we have an option to establish the so called raw data at two, five or ten second intervals. If we assume a mean ascent rate of about 5-6 m/s this gives from 10m-12 m up to 50m-60m in height resolution for the measured data.

The instrumentation or the sensors are built on a capacitive principle. In the Vaisala radiosonde family we have for the pressure the BAROCAP, for the temperature the THERMOCAP and lastly for the humidity the HUMICAP.

sensor type	range	resolution	accuracy	hysteresis
BAROCAP(hPa)	0 -1200	<0.005	<0.02	<0.005
HUMICAP(%)	0 -100	<0.1	<1.	##
TERMOCAP(K)	100-370	<0.02	<0.1	##

Table 1. Characteristics of the sonde sensors of Vaisala.

The software, called data editing , consists of four phases

1. coarse filtering
2. fine filtering
3. completion of the data set by interpolation
4. data smoothening between turning points

The purpose of data editing is to reject physically inconsistent data points. Editing is a non-linear, non-recursively method of data quality control. It is necessary because of the presence of telemetry noise which tends to distort the determination of the signal frequency. Data is thus checked for correctness and the significant and mandatory levels (viz. codes TEMP and PILOT) are selected automatically.

Description of the TEMP and PILOT codes can be found for instance in [3] and [4].

3. A short description of the ten seconds dataset.

By special agreement with the radiosonde station at Oslo-Gardermoen was obtained in addition to the ordinary upper-air reports also observations taken every ten seconds during the ascent. With an ascent rate of 5 to 6 metres pr second this should give an observation every 50 to 60 metres in height.

The radiosondes used was the ordinary Vaisala RS80-15N or a more specialised radiosonde for ozone research, the RS80-15NE (the letter N indicates "normal"). In some cases has also been used a type of radiosonde with a more stable frequency, the RS80-18N, but the observation programme is identical. Data was processed by the Vaisala hardware unit DigiCORA and by the Vaisala software Metgraph transferred to ASCII readable files, one pr. ascent.

Data was delivered on diskettes in "Metgraph-style". Each diskette contained a catalogue, or a library file yymmCAT.s, where yy is the year in two digits, mm is the month number and s is an identifier for the radiosonde station, in our case s=G for Gardermoen. The following information is taken from [1]. The first line in the file takes the form:

yymm III TRRBB ns stn

where

yymm is the year (last two numerals) and month of the sounding
III is the number of the station
T is the station type (0 for land station, 1 for sea station)
RR is the WMO Region Code
BB is the WMO Block Code
ns is the number of soundings with results stored
stn is the station name

In addition, the file contains a number ns of lines of the format:

yymmddhh.tts nl lat lon hhh rstyp rsn

where

yymm as explained above
ddhh is the date and hour of the day
tt is the minutes
s is the station code

this constitutes together the filename for the definite sounding.

nl is the number of pressure levels of the sounding
lat is the latitude of the sounding station expressed to 0.01 degrees
lon is the longitude of the sounding station expressed to 0.01 degrees
hhh is the elevation of the sounding station above mean sea level
rstyp is the radiosonde type used, 8 characters
rsn is the serial number of the radiosonde, 10 characters

The file yymmddhh.tts contains then data for one sounding, the meaning of the letters is given as above. The first line of the file has the format:

TRRBB iii lat lon hhh 19yy mmdd hhtt XXXXXXXXXX

where

TRRBB is as explained above
iii is as III
lon is as explained above
lat is as explained above
yy is as explained above
mmdd is as explained above
hhtt is as explained above
XXXXXXXXXX is the serial number of the radiosonde

The following lines of the file contain nine parameters each:

1: time from start of the sounding [s]
2: height (altitude) with respect to ground level (hhh) [gpm]
3: pressure [0.1 hPa]
4: temperature [0.1 °C]
5: relative humidity [%]
6: dew point temperature [0.1 °C]
7: wind direction [degrees]
8: wind speed [0.1 m/s]
9: type code of pressure level

Each parameter is represented by six characters, the leading zeros being replaced by space. Lack of data is indicated by the value -99999.

In our files is parameter 1 is n times 10 seconds, but in addition to this is given time and height level for the mandatory pressure levels. An example of the data file yymmddhh.mmg is given in table 3.1.

As mentioned above, several mandatory pressure levels are defined by WMO. Those are by the RS80/digiCORA system automatically inserted in-between the other data records thus "disturbing" the monotone increase by 10 seconds in the first column. We easily recognise the existence of the mandatory levels 925 and 850 hPa in table 3.1.

Since the 1000 hPa level also is a mandatory pressure level, the height of this level is always computed if the pressure at ground (the first pressure recognised by the radiosonde) is lower than 1000 hPa. The other parameters at this level are given the value "missing" as indicated above.

A short remark should be done about the observation time; since the whole ascent as shown in table 3.1 lasts for about 78 minutes, not included the time for computation of the mandatory codes, the actual launch time is about one hour before the stated mandatory hour. So the hours given in the final data archives are fixed at 00, 06, 12 and 18 hours, but the real launch time is given in the datafile.

601	384	6012	1106	201	1994	801	1101	264233853 43600 ///// ////.
-9999	145	10000	-9999	-9999	-9999	-9999	-9999	0
0	201	9936	262	40	116	120	15	57347
10	270	9859	248	44	118	149	17	0
20	338	9782	234	46	112	148	19	1
30	402	9711	231	47	112	138	22	0
40	457	9649	226	48	111	124	26	0
50	502	9600	220	49	108	115	29	0
60	544	9553	215	51	110	119	32	0
70	595	9498	209	52	107	117	37	0
80	650	9437	204	54	108	117	40	0
90	709	9373	198	56	108	122	34	0
100	766	9312	192	58	108	124	34	0
110	814	9259	187	59	106	126	38	0
112	823	9250	186	59	105	126	38	0
120	860	9210	183	60	104	134	30	0
130	902	9165	179	62	105	132	34	0
140	946	9118	175	63	104	131	38	0
150	987	9074	171	64	103	134	38	0
160	1031	9027	167	65	101	138	34	0
170	1075	8981	162	66	99	141	33	0
180	1123	8931	158	67	97	143	33	0
190	1160	8892	153	69	97	145	34	0
200	1199	8851	149	71	97	144	37	0
210	1243	8805	145	73	97	141	41	0
220	1290	8756	141	75	97	141	42	0
230	1342	8703	136	76	95	145	42	1
240	1393	8650	133	75	90	150	40	0
250	1445	8597	129	79	94	153	38	0
260	1496	8545	126	79	91	152	40	0
269	1540	8500	122	79	87	152	41	0
270	1545	8495	122	79	87	152	41	0
280	1592	8447	118	80	85	151	43	0
290	1635	8404	113	82	83	146	46	0
300	1680	8359	109	82	80	141	51	0
310	1731	8308	106	81	75	139	54	0
320	1784	8256	102	82	73	138	55	0
330	1835	8205	97	83	70	137	57	2
340	1884	8157	94	83	67	137	58	0
350	1930	8112	93	82	64	137	56	0
360	1981	8062	92	79	58	137	55	0
370	2034	8011	92	70	40	137	56	0
380	2084	7963	91	67	33	136	56	0
390	2135	7914	89	65	27	136	56	0
400	2184	7868	86	63	20	137	54	0
410	2234	7820	82	63	16	140	50	0
420	2284	7772	79	63	13	142	46	24576
430	2331	7729	76	52	-16	143	44	3
440	2377	7686	79	40	-49	140	46	0
450	2421	7645	83	26	-101	136	51	3
460	2466	7604	81	28	-93	133	56	0
470	2510	7563	78	31	-83	134	51	0
480	2554	7522	76	35	-69	134	53	0
490	2600	7480	73	42	-48	131	55	0
500	2645	7440	69	53	-20	135	53	0
510	2691	7398	64	57	-15	133	55	0
520	2741	7353	59	61	-10	129	59	2
530	2791	7309	54	64	-9	128	65	0
540	2839	7266	50	65	-10	127	69	0
...	....	....	..	..	...	...	..	.....
4670	24248	307	-476	1	-821	61	37	0
4680	24311	305	-475	1	-820	69	40	0
4690	24374	302	-474	1	-820	78	46	1
4696	24410	300	-475	1	-820	88	55	0
4700	24438	299	-476	1	-821	88	55	32771

Table 3.1 Example of an ascent with 10 second data

Our co-operation with Gardermoen started in September 1993 and is still going on. The mandatory observation hours are at 00, 06, 12 and 18 hours UTC, but if necessary observations in-between the mandatory hours are possible. In the following, please remember the difference between launch time and the mandatory observation hour.

It is then very regrettable from my point of view that in order to cut down costs, NMI has during the whole period steadily degraded the observation programme and from February 1995 the station regularly make only one observation pr. day at 06 hour UTC. This makes comparable statistics through the whole period more or less impossible. Comparison of the 06 observation with older statistics based on the hours 00 and 12 is also out of question.

In table 3.2 is given the total amount of ascents as indicated in the "yymmCAT.G" files, remember that the hour 11 in the table corresponds to the final archived data of hour 12 and 23 equals 00.

		hour (UTC)																							
yr	m	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	1																								
	..																								
	8																								
93	9											22												16	
	10										1	21		1	1	1								13	
	11											21												13	
	12											23												13	
	1											21												13	
	2											26												24	
	3											27			1	1	1							16	
	4											22												16	
	5											23												15	
	6					1						26												18	
94	7		1									27	1											18	
	8											27												17	
	9											26												18	
	10											26												17	
	11											26												17	
	12			1		1						21												22	
	1											26		1		1					1			8	
	2					27	1					4						1							
	3			1		30	1					6													
	4					21						3													
	5					13	2																		
	6					21						2													
95	7					30						3													
	8					31	1					1													
	9					31						2													
	10					30						3													
	11																								
	12																								

Table 3.2 Number of ascents at given hours and months for the period 1993-1995 with available 10 second data .

As seen from the table 3.2, we can compare the months from September 1993 to December 1994 with statistics of mean values of data taken prior to this period. The data recovery is not 100 %, but an acceptable number of both day and night observations exist. In January 1995 the night observation is not very well represented and the mean will have a bias towards day conditions and possibly not be representative as a daily mean. For the rest of the months in the year 1995 the night observations are not represented at all.

What is new is the early morning observation at hour 06 as mandatory observation time. The only other Norwegian radiosonde station making this observation is the weather ship M. The extreme maritime climate at this station do not permit any comparison of value. However, if we permit ourselves a comparison of the 06 hour data from 1995 with the 00 and 12 hour data from 1994 in spite of the danger in using different years, statistics from different hour of the day could be of value.

Most of the "in-between" observations mainly consist of temperature data only or have periodic faults in one or more parameters. This observations are therefore not considered in this report and we focus on the mandatory observation hours. The advantage of this is the possibility of comparison with other "standard" data from the radiosondes.

4. Results.

4.1 Refractivity statistics.

The refractivity in N-units was computed from the PTU values recorded pr 10 seconds at the reported heights by the common formula

$$N = 77.6\, P/T + 375\ 10^3\ e/T^2$$

where P is the atmospheric pressure in hPa, T is the air temperature in Kelvin degrees and e is the vapour pressure in hPa. For the computation of the vapour pressure, see appendix 1.

The heights given from the radiosonde for the ten seconds data are given in geopotential metres, gpm. The geopotential of a a point is defined as the work done in lifting a unit mass in the gravity field from an initial level (often defined as the undisturbed mean sea level) up to this point. The geopotential metre as an unit is defined as the work of lifting a unit mass one meter against gravity at 45° latitude from sea level.

The next step in the analysis is to convert the gpm's into metric metres (but not the station height itself as this is given in metres above mean sea level) according to the method and formulas given in appendix 2 and 3. We now have corresponding values of height in metres and refractivity in N-units and make a linear interpolation of the refractivity profile for each one hundred metres up to 2000 m.

To compare the results with long periodic data and standard sondes we have first the statistics from [2] as "long periodic" data for the refractivity at ground level in the period 1957 to 1991.

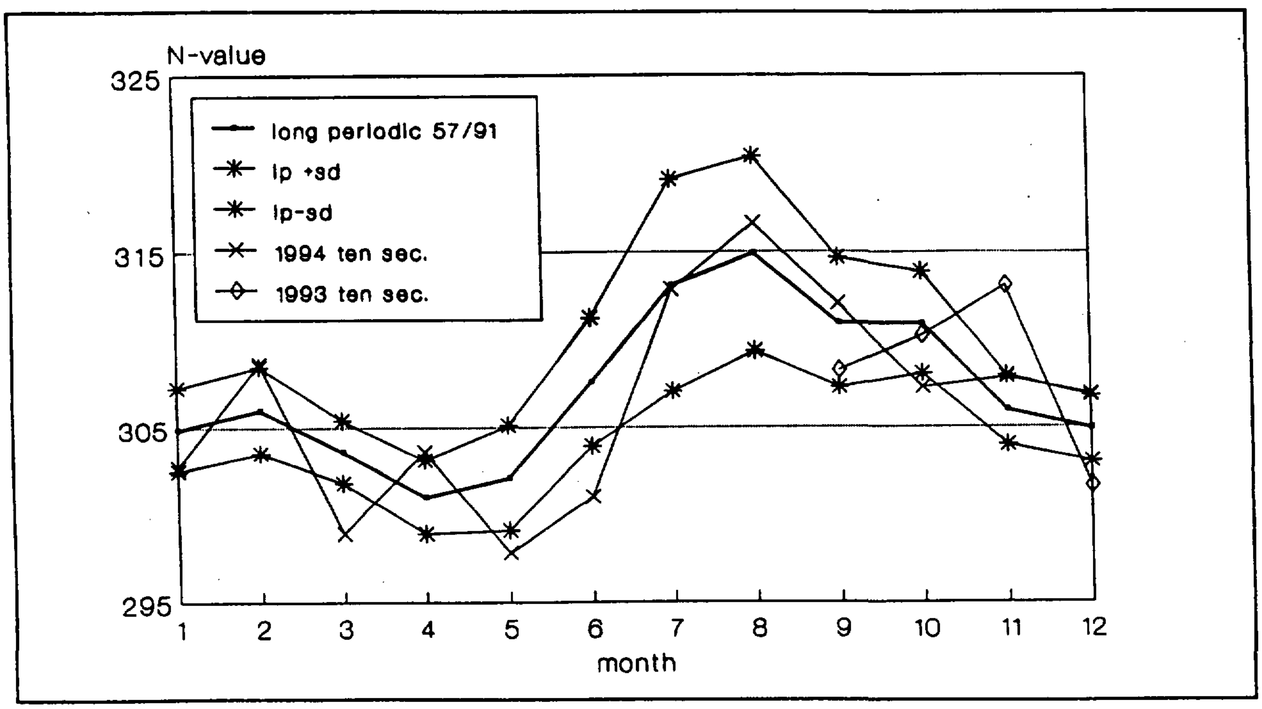
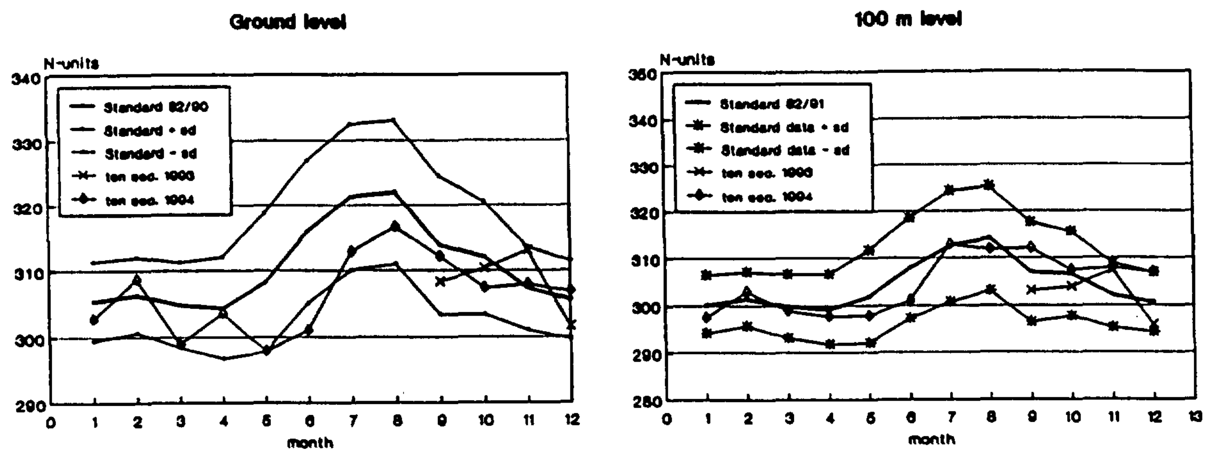


Figure 4.1.1 Refractivity in N-units at ground level

Data from the period 1957-1991 originate from the weather station at the airport Gardermoen and is not connected to the radiosonde station, data as such should the be unrelated. We observe that the ten seconds values, although undulating, has the same main course as the long periodic values and it is only November 1993 that has a value differing more than two standard deviations from the value of the long period. However, the overall correspondence must be seen as satisfactory.



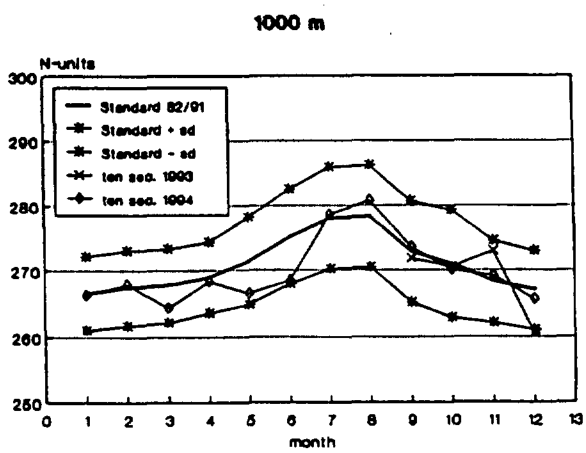


Figure 4.1.2 Comparison of refractivity in N-units at ground, 100 m and 1 km for the standard output (TEMP, PILOT etceteras) with the ten seconds data

In figure 4.1.2 we compare the mean monthly values of the refractivity in the period 1982-1991 obtained from the standard output, i.e. codes TEMP and PILOT and other mandatory levels from the radiosonde with the values obtained from the ten seconds data. We show both the years 1993 and 1994 with their monthly means. We observe a most satisfactory resemblance, most of the monthly means are well inside a deviation of one standard deviation from the means of the standard set. Only at ground level in June 1994 the ten seconds data have a greater deviation. From the weather records we see that this month was about 1.3 °C colder than the normal and slightly drier than normal. This is not "non-normal" weather and we also note that the deviation in refractivity is not grater than two standard deviations.

The year 1995 consists mainly on the early morning observation and since this is non-existing in the older data, no comparison with this year is done in the figures.

Mean values for each month in the period under consideration, pr hundred metres together with standard deviation and maximum and minimum values are given in table 4.1.1.

September 1993

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	305.2	8.7	320.9	290.1	23	313.4	5.2	322.8	303.2	14	308.3	8.5	322.8	290.1	37
100	301.1	7.4	313.4	290.6	23	306.2	6.0	316.0	297.6	14	303.0	7.3	316.0	290.6	37
200	298.5	7.4	310.4	288.2	23	301.6	6.1	311.2	294.2	14	299.7	7.0	311.2	288.2	37
300	295.5	7.1	307.3	285.4	23	297.3	6.1	307.4	286.7	14	296.2	6.7	307.4	285.4	37
400	292.5	7.0	304.7	281.4	23	293.8	5.5	302.6	285.5	14	293.0	6.4	304.7	281.4	37
500	289.3	7.0	302.2	278.0	23	290.1	4.9	296.9	283.6	14	289.6	6.2	302.2	278.0	37
600	286.0	6.3	298.9	275.5	23	285.7	4.8	295.4	280.2	14	285.9	5.7	298.9	275.5	37
700	282.7	6.0	296.1	272.6	23	282.3	6.1	293.5	272.5	14	282.6	5.9	296.1	272.5	37
800	279.4	5.9	293.8	270.1	23	278.6	6.4	289.6	267.5	14	279.1	6.0	293.8	267.5	37
900	275.0	5.2	289.8	268.0	23	275.3	6.8	286.0	262.7	14	275.1	5.7	289.8	262.7	37
1000	271.7	5.3	286.8	263.7	23	272.1	6.9	282.3	257.7	14	271.8	5.8	286.8	257.7	37
1100	268.9	4.7	282.4	258.8	23	268.9	6.7	278.7	253.8	14	268.9	5.5	282.4	253.8	37
1200	266.3	4.3	276.9	255.4	23	265.2	6.6	275.1	249.7	14	265.9	5.2	276.9	249.7	37
1300	263.3	5.0	273.8	252.8	23	261.2	7.6	271.6	242.3	14	262.5	6.1	273.8	242.3	37
1400	259.5	5.9	272.6	246.1	23	257.4	8.3	267.2	240.1	14	258.7	6.9	272.6	240.1	37
1500	254.8	7.3	269.4	237.8	23	255.1	7.8	265.7	238.5	14	254.9	7.4	269.4	237.8	37
1600	250.6	7.2	264.1	234.9	23	252.0	8.0	265.1	234.9	14	251.2	7.5	265.1	234.9	37
1700	246.1	6.7	260.3	231.9	23	248.6	7.8	260.2	231.5	14	247.1	7.1	260.3	231.5	37
1800	242.4	6.6	256.3	230.0	23	244.9	7.5	257.3	227.9	14	243.3	7.0	257.3	227.9	37
1900	238.5	6.9	252.5	225.3	23	241.5	7.4	253.8	225.2	14	239.7	7.1	253.8	225.2	37
2000	235.3	7.1	248.3	222.1	23	237.6	7.4	250.7	223.1	14	236.2	7.2	250.7	222.1	37

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

October 1993

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	309.2	10.5	327.0	288.6	23	312.4	5.7	325.0	303.5	12	310.3	9.2	327.0	288.6	35
100	303.5	8.8	321.3	288.0	23	304.8	6.7	318.9	294.6	12	303.9	8.1	321.3	288.0	35
200	299.8	8.9	317.3	285.2	23	300.8	7.6	315.0	288.4	12	300.2	8.3	317.3	285.2	35
300	296.1	8.4	313.0	283.1	23	296.8	7.8	310.7	282.4	12	296.3	8.1	313.0	282.4	35
400	292.3	7.9	309.1	280.3	23	292.6	7.3	306.5	279.1	12	292.4	7.6	309.1	279.1	35
500	288.9	7.5	304.9	278.0	23	288.8	7.1	302.4	276.2	12	288.8	7.3	304.9	276.2	35
600	285.4	7.3	300.8	275.6	23	284.7	6.8	298.2	273.0	12	285.2	7.1	300.8	273.0	35
700	281.7	6.8	296.2	271.6	23	281.3	6.8	294.7	270.4	12	281.6	6.7	296.2	270.4	35
800	278.1	6.8	292.3	267.4	23	277.0	6.4	290.5	268.2	12	277.7	6.6	292.3	267.4	35
900	274.8	6.9	287.9	259.7	23	272.9	6.7	286.3	264.3	12	274.1	6.8	287.9	259.7	35
1000	271.3	6.6	283.7	255.6	23	269.1	6.9	282.8	257.7	12	270.5	6.7	283.7	255.6	35
1100	267.6	6.6	280.1	252.6	23	265.0	7.7	279.1	249.2	12	266.7	7.0	280.1	249.2	35
1200	263.3	6.7	276.4	249.8	23	261.4	8.1	275.2	243.0	12	262.7	7.2	276.4	243.0	35
1300	259.3	7.0	272.5	247.3	23	257.7	8.4	271.2	238.2	12	258.8	7.4	272.5	238.2	35
1400	255.9	7.0	268.8	243.3	23	254.5	8.4	267.5	234.3	12	255.4	7.4	268.8	234.3	35
1500	252.6	7.3	265.4	240.0	23	252.0	8.2	264.0	231.7	12	252.4	7.5	265.4	231.7	35
1600	249.3	7.4	261.3	233.9	23	249.0	8.3	260.3	229.2	12	249.2	7.6	261.3	229.2	35
1700	246.1	7.5	257.2	231.2	23	246.4	8.2	258.5	227.0	12	246.2	7.6	258.5	227.0	35
1800	243.0	7.6	255.1	226.8	23	243.6	7.7	255.7	225.0	12	243.2	7.6	255.7	225.0	35
1900	239.9	7.5	253.0	223.1	23	240.9	7.6	252.9	222.2	12	240.2	7.5	253.0	222.2	35
2000	237.1	7.3	249.5	220.4	23	237.7	7.0	249.9	220.1	12	237.3	7.1	249.9	220.1	35

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

November 1993

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	313.4	2.5	317.6	309.3	21	312.5	2.3	317.6	308.8	13	313.1	2.4	317.6	308.8	34
100	307.7	2.7	313.1	302.4	21	306.8	2.8	311.7	302.4	13	307.4	2.7	313.1	302.4	34
200	304.4	2.8	309.3	299.5	21	303.4	3.1	308.4	298.7	13	304.0	2.9	309.3	298.7	34
300	300.8	2.8	305.4	294.6	21	299.7	3.2	304.5	294.9	13	300.4	3.0	305.4	294.6	34
400	297.3	2.6	301.5	291.1	21	295.4	4.0	300.7	286.1	13	296.6	3.3	301.5	286.1	34
500	293.8	2.5	300.4	288.4	21	291.4	5.0	296.3	276.6	13	292.9	3.8	300.4	276.6	34
600	289.6	2.3	294.9	285.6	21	287.2	6.5	292.8	266.7	13	288.7	4.5	294.9	266.7	34
700	285.2	4.4	289.9	270.5	21	283.5	7.1	289.2	260.9	13	284.6	5.6	289.9	260.9	34
800	281.4	5.5	288.0	262.8	21	280.2	7.1	285.6	257.6	13	281.0	6.1	288.0	257.6	34
900	277.4	6.2	284.1	256.6	21	276.6	7.3	281.9	253.3	13	277.1	6.5	284.1	253.3	34
1000	272.9	6.7	279.5	252.8	21	273.2	7.1	278.5	250.9	13	273.0	6.7	279.5	250.9	34
1100	268.6	7.0	275.4	249.7	21	269.2	7.1	275.0	248.9	13	268.8	7.0	275.4	248.9	34
1200	264.6	7.0	272.1	247.2	21	265.9	6.6	271.7	246.9	13	265.1	6.8	272.1	246.9	34
1300	260.4	8.0	269.0	244.1	21	261.6	6.8	267.3	244.2	13	260.8	7.5	269.0	244.1	34
1400	256.7	8.3	265.2	241.8	21	256.8	6.7	263.8	241.8	13	256.7	7.6	265.2	241.8	34
1500	253.3	8.1	261.9	239.4	21	252.3	7.6	260.5	238.8	13	252.9	7.8	261.9	238.8	34
1600	249.4	8.4	259.0	232.3	21	248.9	8.0	257.3	235.1	13	249.2	8.1	259.0	232.3	34
1700	245.7	8.2	256.0	228.8	21	245.1	8.1	254.5	232.6	13	245.5	8.0	256.0	228.8	34
1800	242.3	8.2	252.8	227.0	21	241.8	8.1	251.0	228.2	13	242.1	8.1	252.8	227.0	34
1900	239.2	8.0	249.4	225.3	21	238.5	8.5	247.7	225.3	13	239.0	8.1	249.4	225.3	34
2000	235.9	7.9	246.2	223.2	21	235.7	8.3	245.4	223.7	13	235.8	7.9	246.2	223.2	34

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

December 1993

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	301.8	5.6	308.1	284.3	23	301.4	3.3	306.1	296.4	13	301.6	4.8	308.1	284.3	36
100	296.4	5.3	303.8	282.9	23	295.2	3.7	301.2	289.6	13	295.9	4.7	303.8	282.9	36
200	292.0	5.8	300.8	280.2	23	291.4	3.8	297.6	285.2	13	291.8	5.1	300.8	280.2	36
300	288.1	5.9	297.3	277.0	23	287.8	3.9	294.0	282.2	13	288.0	5.2	297.3	277.0	36
400	284.5	5.9	293.8	274.1	23	284.4	4.0	290.7	279.5	13	284.4	5.2	293.8	274.1	36
500	281.1	6.0	290.2	271.6	23	280.8	4.3	287.7	274.9	13	281.0	5.4	290.2	271.6	36
600	277.7	6.1	286.5	268.3	23	277.3	4.4	284.4	270.7	13	277.5	5.5	286.5	268.3	36
700	274.3	5.9	283.1	265.8	23	274.0	4.5	281.3	267.1	13	274.2	5.4	283.1	265.8	36
800	270.8	5.6	279.0	262.7	23	270.6	4.5	277.9	263.5	13	270.7	5.2	279.0	262.7	36
900	267.2	5.2	275.2	259.0	23	267.0	4.3	274.5	261.1	13	267.2	4.8	275.2	259.0	36
1000	263.9	4.9	271.6	255.6	23	263.4	4.1	271.0	258.5	13	263.7	4.6	271.6	255.6	36
1100	260.7	4.8	268.2	252.8	23	260.2	3.9	267.6	254.9	13	260.5	4.4	268.2	252.8	36
1200	257.4	4.7	264.8	250.4	23	256.7	3.9	264.3	250.8	13	257.2	4.4	264.8	250.4	36
1300	254.0	4.7	261.5	246.6	23	253.6	3.7	260.9	247.8	13	253.8	4.3	261.5	246.6	36
1400	250.6	4.6	258.3	242.7	23	250.6	3.9	257.5	244.7	13	250.6	4.3	258.3	242.7	36
1500	247.3	4.5	255.0	238.9	23	246.9	4.3	254.2	239.9	13	247.1	4.4	255.0	238.9	36
1600	243.9	4.7	251.9	236.0	23	243.1	4.3	251.0	236.5	13	243.6	4.5	251.9	236.0	36
1700	240.9	4.6	248.9	233.1	23	240.0	4.3	247.8	232.5	13	240.6	4.4	248.9	232.5	36
1800	238.2	4.7	246.2	230.5	23	236.9	4.4	244.7	229.7	13	237.7	4.6	246.2	229.7	36
1900	235.3	4.8	243.8	228.3	23	234.0	4.5	241.7	225.8	13	234.8	4.6	243.8	225.8	36
2000	232.2	4.4	239.9	224.8	23	231.1	4.4	238.7	223.2	13	231.8	4.4	239.9	223.2	36

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

January 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	302.9	5.6	309.5	284.4	21	302.4	5.1	308.5	290.5	13	302.7	5.3	309.5	284.4	34
100	297.8	5.4	304.5	282.1	21	297.2	5.2	304.8	286.2	13	297.6	5.2	304.8	282.1	34
200	294.0	5.8	301.9	278.9	21	294.0	5.2	301.5	283.0	13	294.0	5.5	301.9	278.9	34
300	290.4	6.1	298.8	275.7	21	290.5	5.5	297.9	278.9	13	290.5	5.8	298.8	275.7	34
400	287.0	6.2	296.0	272.6	21	286.7	5.4	294.0	275.2	13	286.9	5.8	296.0	272.6	34
500	283.6	6.1	292.1	269.8	21	283.0	5.4	291.2	271.1	13	283.3	5.8	292.1	269.8	34
600	280.2	6.0	287.4	267.1	21	279.4	5.4	288.0	267.2	13	279.9	5.7	288.0	267.1	34
700	276.9	5.8	283.5	264.3	21	275.9	5.7	284.8	263.9	13	276.5	5.7	284.8	263.9	34
800	273.3	5.6	280.9	261.8	21	272.5	5.7	281.2	260.7	13	273.0	5.5	281.2	260.7	34
900	270.0	5.7	278.5	257.5	21	269.2	5.7	277.7	257.7	13	269.7	5.6	278.5	257.5	34
1000	266.5	5.6	275.4	252.9	21	266.0	5.6	274.3	254.5	13	266.3	5.5	275.4	252.9	34
1100	263.0	5.4	272.2	249.2	21	262.8	5.7	270.3	251.1	13	262.9	5.4	272.2	249.2	34
1200	259.8	5.2	268.9	246.5	21	259.4	5.9	269.2	248.0	13	259.7	5.4	269.2	246.5	34
1300	256.6	5.0	265.8	243.9	21	256.4	5.9	266.3	245.3	13	256.5	5.3	266.3	243.9	34
1400	253.4	5.1	262.5	241.3	21	253.3	5.8	263.1	242.8	13	253.4	5.3	263.1	241.3	34
1500	250.2	5.0	258.6	238.9	21	250.2	5.8	259.7	240.6	13	250.2	5.3	259.7	238.9	34
1600	247.0	4.8	255.4	236.6	21	247.0	6.0	256.1	237.8	13	247.0	5.2	256.1	236.6	34
1700	244.0	4.6	252.3	234.2	21	243.9	6.2	252.9	234.2	13	243.9	5.1	252.9	234.2	34
1800	240.9	4.4	249.0	231.9	21	240.9	6.1	249.6	231.8	13	240.9	5.0	249.6	231.8	34
1900	237.8	4.1	245.8	229.5	21	237.8	6.0	246.2	229.0	13	237.8	4.9	246.2	229.0	34
2000	234.3	4.2	241.3	226.9	21	234.9	5.7	243.0	226.4	13	234.5	4.7	243.0	226.4	34

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

February 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	307.0	5.0	319.8	297.5	26	310.5	5.0	322.9	303.4	24	308.7	5.2	322.9	297.5	50
100	302.5	4.8	314.3	294.7	26	303.3	5.0	313.1	293.5	24	302.9	4.8	314.3	293.5	50
200	298.6	5.0	308.7	289.1	26	298.4	4.9	307.3	288.4	24	298.5	4.9	308.7	288.4	50
300	294.7	4.9	302.5	284.5	26	294.5	4.8	303.3	284.5	24	294.6	4.8	303.3	284.5	50
400	291.0	4.7	297.9	279.4	26	290.8	4.8	300.1	281.7	24	290.9	4.7	300.1	279.4	50
500	287.2	4.9	294.9	275.1	26	287.4	5.3	296.3	279.3	24	287.3	5.0	296.3	275.1	50
600	283.4	5.1	292.0	271.5	26	283.6	5.2	292.1	273.8	24	283.5	5.1	292.1	271.5	50
700	279.4	5.7	289.1	268.3	26	279.8	5.1	289.2	269.5	24	279.6	5.3	289.2	268.3	50
800	276.2	5.7	285.4	264.4	26	276.1	4.9	286.2	266.2	24	276.2	5.3	286.2	264.4	50
900	271.6	5.4	279.8	259.5	26	272.0	5.0	282.9	263.4	24	271.8	5.1	282.9	259.5	50
1000	267.5	5.1	276.0	255.4	26	268.4	4.4	274.9	260.7	24	267.9	4.7	276.0	255.4	50
1100	263.5	5.3	272.3	251.7	26	264.9	4.3	272.1	257.6	24	264.2	4.9	272.3	251.7	50
1200	259.7	5.5	268.8	248.2	26	261.1	4.8	268.4	252.5	24	260.4	5.2	268.8	248.2	50
1300	256.5	5.2	265.8	246.5	26	257.2	5.2	265.3	248.3	24	256.8	5.1	265.8	246.5	50
1400	253.5	5.0	262.6	243.4	26	253.6	5.0	262.8	244.1	24	253.5	5.0	262.8	243.4	50
1500	250.2	5.2	259.3	240.3	26	250.6	5.1	260.3	241.1	24	250.4	5.1	260.3	240.3	50
1600	247.0	5.3	256.0	237.7	26	247.9	5.0	257.5	238.3	24	247.4	5.1	257.5	237.7	50
1700	243.8	5.1	251.0	234.7	26	245.3	4.9	254.5	235.4	24	244.5	5.0	254.5	234.7	50
1800	240.7	4.9	247.6	232.4	26	242.6	4.5	249.7	232.8	24	241.6	4.8	249.7	232.4	50
1900	237.6	4.7	244.9	229.7	26	239.6	4.3	246.5	230.1	24	238.6	4.6	246.5	229.7	50
2000	234.9	4.6	242.8	227.0	26	236.5	4.1	244.0	227.2	24	235.7	4.4	244.0	227.0	50

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

March 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	297.9	9.2	310.2	282.9	30	300.9	6.4	312.7	291.6	16	298.9	8.4	312.7	282.9	46
100	293.9	8.2	304.8	281.2	30	293.6	6.7	303.7	285.3	16	293.8	7.6	304.8	281.2	46
200	291.0	8.2	302.5	278.5	30	289.9	6.6	300.1	281.6	16	290.6	7.6	302.5	278.5	46
300	288.0	8.0	298.8	276.3	30	286.6	6.5	296.2	278.6	16	287.5	7.5	298.8	276.3	46
400	284.8	7.8	295.6	273.4	30	283.3	6.2	292.5	275.7	16	284.3	7.3	295.6	273.4	46
500	281.4	7.3	291.9	270.6	30	280.2	6.2	289.9	272.0	16	280.9	6.9	291.9	270.6	46
600	277.9	6.9	288.4	267.3	30	276.7	5.9	287.2	267.5	16	277.5	6.6	288.4	267.3	46
700	274.3	6.6	284.5	263.3	30	273.5	5.8	284.5	263.8	16	274.0	6.2	284.5	263.3	46
800	270.9	6.0	280.7	260.0	30	270.5	5.5	281.3	261.0	16	270.8	5.8	281.3	260.0	46
900	267.7	5.7	276.8	257.2	30	267.3	5.2	278.1	258.5	16	267.6	5.5	278.1	257.2	46
1000	264.5	5.4	273.3	254.8	30	264.4	5.0	275.1	256.0	16	264.4	5.2	275.1	254.8	46
1100	261.4	5.2	270.4	252.7	30	261.0	4.8	271.9	253.2	16	261.2	5.0	271.9	252.7	46
1200	257.9	4.7	266.7	248.6	30	257.5	5.0	268.7	250.9	16	257.7	4.7	268.7	248.6	46
1300	254.3	5.0	262.5	242.6	30	254.2	4.6	264.4	248.1	16	254.2	4.8	264.4	242.6	46
1400	250.9	5.2	259.2	238.1	30	250.9	4.3	259.1	245.0	16	250.9	4.9	259.2	238.1	46
1500	247.9	5.1	256.0	234.8	30	247.4	4.2	255.0	242.1	16	247.7	4.7	256.0	234.8	46
1600	244.9	4.8	252.8	232.4	30	244.6	3.9	251.7	239.0	16	244.8	4.5	252.8	232.4	46
1700	241.7	4.5	249.3	230.6	30	241.6	3.7	248.5	236.3	16	241.7	4.2	249.3	230.6	46
1800	238.9	4.3	246.1	228.5	30	238.7	3.3	245.4	234.0	16	238.8	4.0	246.1	228.5	46
1900	236.0	4.1	242.9	226.4	30	235.8	3.1	242.4	231.6	16	236.0	3.7	242.9	226.4	46
2000	233.0	3.9	239.9	223.7	30	232.8	3.0	239.2	229.1	16	233.0	3.6	239.9	223.7	46

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

April 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	299.8	8.6	322.7	288.6	22	308.8	6.0	321.5	297.8	16	303.6	8.8	322.7	288.6	38
100	296.1	7.3	316.6	287.3	22	299.9	7.8	316.6	291.1	16	297.7	7.6	316.6	287.3	38
200	293.1	7.3	312.9	284.6	22	295.4	7.1	308.0	286.8	16	294.1	7.3	312.9	284.6	38
300	290.1	7.0	308.9	282.2	22	291.5	6.7	304.3	283.5	16	290.7	6.8	308.9	282.2	38
400	287.1	6.8	304.7	279.1	22	287.9	6.7	301.3	279.1	16	287.5	6.7	304.7	279.1	38
500	284.2	6.4	300.5	276.3	22	284.5	6.5	297.6	274.7	16	284.3	6.4	300.5	274.7	38
600	281.0	6.2	296.6	273.3	22	281.3	6.1	293.0	271.5	16	281.1	6.1	296.6	271.5	38
700	277.9	6.3	294.0	271.1	22	277.6	5.3	288.0	268.7	16	277.8	5.8	294.0	268.7	38
800	275.1	6.3	290.4	266.6	22	274.1	4.8	282.2	265.2	16	274.7	5.7	290.4	265.2	38
900	271.9	6.3	287.9	261.7	22	270.7	4.3	277.8	262.2	16	271.4	5.5	287.9	261.7	38
1000	268.7	6.0	282.9	258.1	22	267.6	4.1	274.6	259.3	16	268.3	5.2	282.9	258.1	38
1100	265.6	5.5	278.6	255.2	22	264.3	4.0	271.4	256.6	16	265.1	4.9	278.6	255.2	38
1200	262.4	5.2	275.6	251.6	22	261.4	3.6	267.3	254.1	16	262.0	4.6	275.6	251.6	38
1300	259.1	5.1	271.5	247.1	22	258.0	3.5	263.4	251.6	16	258.7	4.5	271.5	247.1	38
1400	255.8	4.9	267.8	244.2	22	254.6	3.7	260.6	249.1	16	255.3	4.4	267.8	244.2	38
1500	253.0	4.8	264.3	241.7	22	251.2	4.8	257.9	242.5	16	252.2	4.8	264.3	241.7	38
1600	250.1	4.8	260.7	239.3	22	248.4	5.5	257.5	238.9	16	249.4	5.1	260.7	238.9	38
1700	247.0	5.0	257.6	234.4	22	246.1	5.3	254.7	235.8	16	246.6	5.0	257.6	234.4	38
1800	243.8	5.0	254.2	231.0	22	243.3	5.3	252.1	233.0	16	243.6	5.1	254.2	231.0	38
1900	240.4	5.1	250.5	227.9	22	239.6	6.0	250.5	229.6	16	240.0	5.4	250.5	227.9	38
2000	237.2	5.2	247.2	225.2	22	236.3	6.5	247.7	225.8	16	236.8	5.7	247.7	225.2	38

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

May 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	292.6	8.2	309.4	280.2	23	305.7	6.8	314.8	292.7	15	297.8	10.0	314.8	280.2	38
100	290.8	6.5	305.6	278.2	23	298.3	6.6	311.1	287.1	15	293.7	7.5	311.1	278.2	38
200	288.4	6.5	302.8	275.8	23	293.9	7.0	308.6	284.0	15	290.6	7.2	308.6	275.8	38
300	286.1	6.6	300.7	273.5	23	290.3	6.9	305.6	281.1	15	287.7	7.0	305.6	273.5	38
400	283.5	6.7	298.7	271.4	23	286.1	5.4	295.4	278.5	15	284.5	6.3	298.7	271.4	38
500	281.1	6.6	295.4	268.8	23	281.8	4.5	290.1	274.8	15	281.4	5.8	295.4	268.8	38
600	278.5	6.5	291.4	266.8	23	278.7	4.8	288.8	273.0	15	278.6	5.8	291.4	266.8	38
700	276.0	6.0	285.0	264.6	23	275.8	4.6	285.3	270.8	15	275.9	5.5	285.3	264.6	38
800	273.0	5.6	282.1	262.1	23	272.4	4.6	280.4	264.0	15	272.7	5.2	282.1	262.1	38
900	270.0	5.0	278.8	259.9	23	268.5	5.5	277.1	255.2	15	269.4	5.1	278.8	255.2	38
1000	267.3	4.5	275.9	257.6	23	265.2	6.0	273.4	251.0	15	266.5	5.2	275.9	251.0	38
1100	264.7	4.5	272.3	255.5	23	262.6	5.7	270.3	249.4	15	263.9	5.1	272.3	249.4	38
1200	262.0	4.8	273.7	252.9	23	260.3	5.4	267.2	247.5	15	261.3	5.0	273.7	247.5	38
1300	259.0	4.8	271.5	250.5	23	257.3	5.8	264.4	244.4	15	258.4	5.2	271.5	244.4	38
1400	256.6	4.6	268.3	248.6	23	254.3	6.1	260.8	241.3	15	255.7	5.3	268.3	241.3	38
1500	253.6	4.8	265.0	244.6	23	251.3	5.9	258.5	238.7	15	252.7	5.3	265.0	238.7	38
1600	250.2	5.6	261.9	235.7	23	248.1	5.9	256.5	236.4	15	249.4	5.8	261.9	235.7	38
1700	247.3	5.8	258.7	232.3	23	245.3	5.9	253.9	233.7	15	246.5	5.8	258.7	232.3	38
1800	244.4	6.6	255.8	229.7	23	242.0	6.4	251.9	231.0	15	243.5	6.6	255.8	229.7	38
1900	241.4	7.3	252.5	227.0	23	238.7	6.8	249.6	228.3	15	240.3	7.1	252.5	227.0	38
2000	237.6	6.7	249.1	225.8	23	236.3	6.8	247.4	226.7	15	237.1	6.7	249.1	225.8	38

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

June 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	295.9	10.4	327.1	283.4	26	307.9	10.2	329.2	291.8	19	301.0	11.8	329.2	283.4	45
100	292.7	8.8	318.6	277.7	26	301.3	9.6	320.9	289.6	19	296.3	10.0	320.9	277.7	45
200	290.4	8.8	315.1	275.8	26	297.0	9.3	316.9	285.9	19	293.2	9.5	316.9	275.8	45
300	287.7	8.7	311.2	273.8	26	293.2	9.1	313.0	282.4	19	290.0	9.2	313.0	273.8	45
400	284.9	8.5	308.1	270.9	26	288.7	9.1	307.6	277.0	19	286.5	8.9	308.1	270.9	45
500	282.2	8.3	304.5	269.0	26	284.9	8.6	301.5	274.5	19	283.4	8.4	304.5	269.0	45
600	279.3	8.3	300.2	266.5	26	281.4	8.1	297.0	270.4	19	280.2	8.2	300.2	266.5	45
700	276.4	8.7	296.2	257.5	26	278.6	7.9	292.4	267.6	19	277.3	8.3	296.2	257.5	45
800	273.3	8.2	292.2	254.0	26	275.8	7.5	287.4	264.9	19	274.4	8.0	292.2	254.0	45
900	270.7	7.9	288.3	250.1	26	272.5	7.4	283.2	261.3	19	271.4	7.7	288.3	250.1	45
1000	267.8	7.7	284.5	246.0	26	269.4	7.1	280.4	259.0	19	268.5	7.4	284.5	246.0	45
1100	265.0	7.3	280.7	244.8	26	266.1	6.8	277.7	255.1	19	265.4	7.0	280.7	244.8	45
1200	262.9	7.0	278.6	249.0	26	262.7	6.9	275.5	253.1	19	262.8	6.9	278.6	249.0	45
1300	260.7	6.9	281.2	249.8	26	259.8	7.2	273.1	247.1	19	260.3	7.0	281.2	247.1	45
1400	257.3	5.4	269.0	247.5	26	257.6	6.4	270.3	247.2	19	257.4	5.8	270.3	247.2	45
1500	254.4	5.1	265.5	245.4	26	254.5	6.0	264.7	244.8	19	254.5	5.5	265.5	244.8	45
1600	251.7	5.5	267.4	243.1	26	251.3	5.9	260.6	241.7	19	251.5	5.6	267.4	241.7	45
1700	248.7	5.5	264.1	241.0	26	248.5	5.3	255.8	239.2	19	248.6	5.3	264.1	239.2	45
1800	245.2	4.9	257.0	237.8	26	245.6	4.8	253.4	236.4	19	245.4	4.8	257.0	236.4	45
1900	241.5	5.8	255.9	230.2	26	242.2	5.5	249.8	230.3	19	241.8	5.6	255.9	230.2	45
2000	238.2	6.8	255.1	222.6	26	239.2	6.1	246.9	223.2	19	238.6	6.5	255.1	222.6	45

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

July 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	305.9	12.7	337.0	287.5	29	324.2	10.1	341.5	306.9	18	312.9	14.7	341.5	287.5	47
100	304.5	10.5	331.3	288.1	29	313.9	13.0	334.6	290.7	18	308.1	12.3	334.6	288.1	47
200	301.9	10.9	329.2	286.1	29	309.2	14.3	329.9	285.0	18	304.7	12.7	329.9	285.0	47
300	299.3	10.8	327.7	283.2	29	305.7	15.6	328.8	282.1	18	301.7	13.1	328.8	282.1	47
400	296.8	10.4	323.8	281.1	29	302.0	14.6	328.0	285.2	18	298.8	12.3	328.0	281.1	47
500	294.3	9.8	320.9	279.0	29	297.6	13.7	325.1	280.9	18	295.6	11.4	325.1	279.0	47
600	291.5	8.8	318.5	279.2	29	292.7	12.4	319.5	275.1	18	291.9	10.2	319.5	275.1	47
700	288.9	8.6	315.1	277.2	29	288.6	12.1	316.1	274.5	18	288.8	10.0	316.1	274.5	47
800	286.3	8.1	307.5	273.9	29	282.8	12.5	303.9	254.1	18	285.0	10.0	307.5	254.1	47
900	283.2	7.4	302.3	270.3	29	280.0	11.8	303.2	254.4	18	281.9	9.4	303.2	254.4	47
1000	280.0	7.7	298.2	266.8	29	276.3	10.5	293.3	255.1	18	278.6	8.9	298.2	255.1	47
1100	276.8	7.5	294.1	264.5	29	272.7	9.9	286.6	252.1	18	275.2	8.7	294.1	252.1	47
1200	273.9	6.9	289.3	262.9	29	269.4	9.1	282.2	248.9	18	272.2	8.0	289.3	248.9	47
1300	270.6	6.7	285.2	259.1	29	266.2	8.8	278.4	245.8	18	268.9	7.8	285.2	245.8	47
1400	266.9	6.7	282.5	256.1	29	263.0	9.1	276.3	239.9	18	265.4	7.9	282.5	239.9	47
1500	262.6	7.3	280.0	247.8	29	260.3	8.8	273.0	237.8	18	261.7	7.9	280.0	237.8	47
1600	256.9	9.9	276.3	234.8	29	257.8	7.8	269.7	239.4	18	257.2	9.1	276.3	234.8	47
1700	252.7	10.3	270.6	229.6	29	254.4	7.4	266.9	237.9	18	253.3	9.3	270.6	229.6	47
1800	248.4	10.5	267.5	228.1	29	251.6	6.6	262.7	235.2	18	249.6	9.2	267.5	228.1	47
1900	244.7	10.2	264.7	227.8	29	248.7	6.4	258.6	231.2	18	246.3	9.0	264.7	227.8	47
2000	242.5	9.2	260.3	224.5	29	245.5	7.2	254.0	221.7	18	243.6	8.6	260.3	221.7	47

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

August 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	311.0	12.0	332.5	294.5	27	325.4	11.6	348.9	307.7	17	316.6	13.7	348.9	294.5	44
100	308.6	9.6	326.4	295.9	27	316.7	12.3	341.0	298.2	17	311.8	11.3	341.0	295.9	44
200	306.0	9.3	322.2	294.0	27	312.2	12.8	337.8	293.7	17	308.4	11.1	337.8	293.7	44
300	303.2	9.0	319.6	291.1	27	308.1	12.4	334.5	290.2	17	305.1	10.6	334.5	290.2	44
400	300.7	8.8	318.1	289.3	27	302.9	10.4	326.1	287.0	17	301.5	9.4	326.1	287.0	44
500	297.8	8.5	314.0	286.9	27	297.9	10.2	320.2	282.1	17	297.8	9.1	320.2	282.1	44
600	294.6	8.3	312.6	284.5	27	294.4	10.3	316.9	278.2	17	294.5	9.0	316.9	278.2	44
700	291.2	8.4	310.1	280.4	27	290.5	9.5	311.1	275.9	17	290.9	8.7	311.1	275.9	44
800	288.3	8.4	306.9	276.1	27	286.2	8.3	301.2	273.3	17	287.5	8.3	306.9	273.3	44
900	285.2	8.2	303.9	273.7	27	282.8	7.9	299.0	271.0	17	284.3	8.1	303.9	271.0	44
1000	281.9	8.0	300.0	271.4	27	279.0	7.4	295.2	268.5	17	280.8	7.8	300.0	268.5	44
1100	278.2	7.5	295.0	265.7	27	276.3	6.6	291.1	266.5	17	277.5	7.1	295.0	265.7	44
1200	274.5	7.1	288.5	261.0	27	273.7	6.6	288.0	263.4	17	274.2	6.9	288.5	261.0	44
1300	270.8	7.2	285.7	256.7	27	270.4	6.9	285.7	259.6	17	270.7	7.0	285.7	256.7	44
1400	267.6	6.8	282.7	254.4	27	267.1	6.5	280.2	256.3	17	267.4	6.6	282.7	254.4	44
1500	263.9	6.8	279.3	252.1	27	263.4	6.5	275.9	251.8	17	263.7	6.7	279.3	251.8	44
1600	260.5	6.8	275.8	249.4	27	260.2	6.5	271.8	246.6	17	260.4	6.6	275.8	246.6	44
1700	256.3	6.9	272.2	244.4	27	256.7	6.0	267.8	242.5	17	256.5	6.5	272.2	242.5	44
1800	252.0	7.4	269.1	240.7	27	253.3	5.8	262.6	239.3	17	252.5	6.8	269.1	239.3	44
1900	247.3	8.3	265.9	231.4	27	249.9	5.9	260.2	235.8	17	248.3	7.5	265.9	231.4	44
2000	243.2	8.6	263.3	227.5	27	245.9	6.2	256.7	231.1	17	244.3	7.8	263.3	227.5	44

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

September 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	310.0	10.8	324.0	283.4	26	315.1	8.8	330.0	294.9	18	312.1	10.3	330.0	283.4	44
100	305.5	8.6	319.0	281.8	26	307.2	9.5	323.8	286.9	18	306.2	8.9	323.8	281.8	44
200	302.2	8.4	314.2	279.8	26	302.3	9.3	317.9	283.2	18	302.3	8.7	317.9	279.8	44
300	299.1	8.3	309.0	277.7	26	298.5	9.1	312.8	279.9	18	298.9	8.6	312.8	277.7	44
400	295.6	8.3	305.4	275.0	26	294.8	8.3	306.8	277.2	18	295.3	8.2	306.8	275.0	44
500	292.0	8.4	302.2	272.4	26	291.6	8.0	303.1	274.6	18	291.9	8.2	303.1	272.4	44
600	287.8	8.8	298.4	269.9	26	287.9	7.6	298.8	271.3	18	287.8	8.2	298.8	269.9	44
700	283.9	8.3	294.8	267.7	26	284.4	7.6	294.8	268.7	18	284.1	7.9	294.8	267.7	44
800	280.1	7.9	291.7	265.2	26	280.9	7.3	291.2	266.0	18	280.4	7.6	291.7	265.2	44
900	276.4	7.9	288.5	261.7	26	277.5	7.3	287.3	262.5	18	276.9	7.6	288.5	261.7	44
1000	273.3	7.5	285.1	259.4	26	274.0	7.3	283.4	259.5	18	273.6	7.3	285.1	259.4	44
1100	270.0	7.1	281.4	256.6	26	270.1	7.7	279.9	256.0	18	270.0	7.3	281.4	256.0	44
1200	266.5	7.3	277.6	251.4	26	266.8	8.3	279.4	250.5	18	266.6	7.6	279.4	250.5	44
1300	262.3	8.1	274.6	243.2	26	263.9	7.8	274.8	249.2	18	263.0	7.9	274.8	243.2	44
1400	258.7	8.3	270.8	239.8	26	260.5	7.7	270.5	246.3	18	259.4	8.0	270.8	239.8	44
1500	255.2	7.8	266.4	236.8	26	256.4	9.2	267.6	237.7	18	255.7	8.3	267.6	236.8	44
1600	251.5	7.4	262.7	236.8	26	252.3	9.0	264.5	232.8	18	251.9	8.0	264.5	232.8	44
1700	248.4	7.6	259.2	230.4	26	249.1	9.2	262.3	228.9	18	248.7	8.2	262.3	228.9	44
1800	245.4	7.5	255.5	226.8	26	246.0	9.2	259.5	225.4	18	245.7	8.1	259.5	225.4	44
1900	242.3	6.8	252.0	224.1	26	243.2	8.0	254.8	225.5	18	242.7	7.3	254.8	224.1	44
2000	239.2	6.9	248.7	221.7	26	240.3	7.7	248.7	222.2	18	239.7	7.1	248.7	221.7	44

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

October 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	306.4	9.1	319.3	288.3	26	308.8	7.5	319.4	290.6	17	307.3	8.5	319.4	288.3	43
100	301.3	8.2	314.6	285.7	26	302.6	7.9	314.3	289.1	17	301.8	8.0	314.6	285.7	43
200	298.4	8.0	310.4	283.1	26	298.7	8.1	311.4	285.1	17	298.5	8.0	311.4	283.1	43
300	295.2	7.8	306.6	280.6	26	294.4	7.6	306.9	281.4	17	294.9	7.7	306.9	280.6	43
400	291.8	7.4	303.4	278.2	26	290.6	7.4	304.8	278.5	17	291.3	7.3	304.8	278.2	43
500	288.0	7.0	300.9	275.5	26	286.9	7.6	303.2	274.9	17	287.6	7.2	303.2	274.9	43
600	284.3	6.9	297.6	273.1	26	283.5	7.6	300.6	271.7	17	284.0	7.1	300.6	271.7	43
700	280.8	6.3	293.6	270.1	26	280.7	6.9	296.1	268.8	17	280.7	6.4	296.1	268.8	43
800	277.3	5.8	290.2	267.5	26	277.5	6.5	291.7	265.6	17	277.4	6.0	291.7	265.6	43
900	273.6	5.5	285.4	264.3	26	274.2	5.9	286.7	263.2	17	273.8	5.6	286.7	263.2	43
1000	269.7	6.2	278.5	250.8	26	270.4	5.6	282.0	260.8	17	270.0	5.9	282.0	250.8	43
1100	266.1	6.0	274.5	246.1	26	265.8	6.1	278.1	256.1	17	266.0	6.0	278.1	246.1	43
1200	262.7	5.8	270.7	242.1	26	262.0	6.6	273.7	251.3	17	262.4	6.1	273.7	242.1	43
1300	259.2	5.6	267.0	239.2	26	257.5	6.6	266.7	244.3	17	258.6	6.0	267.0	239.2	43
1400	255.7	5.4	263.4	235.6	26	253.5	6.1	263.0	241.1	17	254.8	5.7	263.4	235.6	43
1500	252.1	5.4	259.9	232.5	26	249.5	6.8	259.8	237.4	17	251.1	6.0	259.9	232.5	43
1600	248.8	5.7	256.0	229.4	26	245.9	7.7	256.3	231.1	17	247.7	6.6	256.3	229.4	43
1700	245.7	5.8	253.2	226.8	26	242.9	7.5	252.1	227.3	17	244.6	6.6	253.2	226.8	43
1800	242.7	5.6	250.3	224.4	26	239.6	7.2	248.9	226.4	17	241.5	6.4	250.3	224.4	43
1900	240.1	5.2	247.5	224.9	26	236.5	6.9	245.8	224.4	17	238.6	6.1	247.5	224.4	43
2000	236.9	3.9	242.4	226.7	26	233.0	6.7	242.4	219.6	17	235.3	5.5	242.4	219.6	43

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

November 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	307.5	7.3	317.4	291.2	26	308.6	5.5	316.1	295.4	17	307.9	6.6	317.4	291.2	43
100	301.2	6.6	312.3	287.1	26	301.7	6.0	311.4	291.0	17	301.4	6.3	312.3	287.1	43
200	297.3	7.1	309.5	283.7	26	297.2	6.3	308.1	287.4	17	297.3	6.7	309.5	283.7	43
300	293.4	7.1	305.6	281.1	26	293.1	6.6	304.7	284.4	17	293.3	6.8	305.6	281.1	43
400	289.8	7.1	302.0	278.0	26	289.1	6.7	301.0	281.1	17	289.5	6.9	302.0	278.0	43
500	286.1	6.7	297.5	274.6	26	285.4	6.4	297.1	276.0	17	285.8	6.5	297.5	274.6	43
600	282.7	6.6	293.6	272.1	26	282.0	6.2	293.4	271.8	17	282.5	6.3	293.6	271.8	43
700	279.3	6.5	289.7	269.3	26	278.8	6.0	289.7	268.8	17	279.1	6.3	289.7	268.8	43
800	276.1	6.5	285.9	265.7	26	275.4	5.9	285.9	265.8	17	275.8	6.2	285.9	265.7	43
900	272.8	6.1	282.8	262.9	26	272.1	6.0	283.8	262.5	17	272.5	6.0	283.8	262.5	43
1000	269.7	5.8	280.1	260.2	26	268.5	5.9	280.8	259.7	17	269.2	5.8	280.8	259.7	43
1100	266.1	5.7	275.9	257.8	26	265.5	6.2	278.1	256.8	17	265.9	5.8	278.1	256.8	43
1200	262.5	5.9	273.8	254.2	26	262.8	6.2	275.3	252.0	17	262.6	5.9	275.3	252.0	43
1300	258.6	6.1	270.7	247.1	26	260.2	6.8	273.0	247.0	17	259.2	6.3	273.0	247.0	43
1400	255.0	6.0	266.9	243.6	26	257.3	6.8	269.8	243.2	17	255.9	6.3	269.8	243.2	43
1500	251.1	6.8	263.3	238.1	26	253.9	7.1	266.6	239.7	17	252.2	7.0	266.6	238.1	43
1600	247.9	7.2	259.7	234.2	26	249.9	6.8	263.1	236.6	17	248.7	7.0	263.1	234.2	43
1700	244.6	7.2	256.2	231.6	26	246.1	7.3	259.5	230.8	17	245.2	7.2	259.5	230.8	43
1800	241.4	7.4	255.6	227.2	26	242.7	7.6	256.0	225.4	17	241.9	7.4	256.0	225.4	43
1900	238.0	7.2	249.9	224.1	26	239.8	7.6	252.6	222.9	17	238.7	7.4	252.6	222.9	43
2000	234.5	7.0	245.7	220.0	26	236.6	7.4	249.6	221.5	17	235.3	7.1	249.6	220.0	43

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

December 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	307.5	4.8	315.3	296.2	22	306.3	5.1	315.3	294.9	23	306.9	5.0	315.3	294.9	45
100	301.4	5.3	308.4	288.4	22	299.6	5.4	308.9	286.8	23	300.5	5.4	308.9	286.8	45
200	297.1	6.0	306.2	282.5	22	296.0	5.7	306.5	282.8	23	296.5	5.8	306.5	282.5	45
300	292.8	6.3	302.9	278.7	22	292.2	5.9	303.5	278.6	23	292.5	6.0	303.5	278.6	45
400	288.4	6.2	300.7	275.8	22	288.2	6.4	299.9	274.5	23	288.3	6.2	300.7	274.5	45
500	284.5	6.3	297.2	272.7	22	284.1	6.6	295.9	270.5	23	284.3	6.4	297.2	270.5	45
600	280.8	6.2	293.5	269.5	22	280.0	6.4	292.1	267.1	23	280.4	6.2	293.5	267.1	45
700	277.3	5.9	289.6	266.1	22	276.1	6.3	288.3	263.1	23	276.7	6.1	289.6	263.1	45
800	273.5	5.9	285.8	262.5	22	272.3	6.4	284.6	259.3	23	272.9	6.1	285.8	259.3	45
900	269.8	6.2	282.1	257.0	22	268.8	6.4	280.8	256.1	23	269.3	6.2	282.1	256.1	45
1000	266.3	6.3	278.4	251.8	22	264.9	6.1	274.1	252.8	23	265.6	6.2	278.4	251.8	45
1100	262.3	5.7	269.4	248.6	22	261.0	5.8	270.4	250.3	23	261.7	5.7	270.4	248.6	45
1200	258.8	6.1	266.0	245.0	22	257.1	5.6	266.7	247.9	23	257.9	5.8	266.7	245.0	45
1300	255.1	6.5	263.1	242.4	22	253.9	5.6	263.5	245.1	23	254.4	6.0	263.5	242.4	45
1400	251.4	6.4	259.7	239.2	22	251.0	5.4	260.3	242.7	23	251.2	5.8	260.3	239.2	45
1500	247.9	6.8	257.7	234.7	22	247.8	5.3	257.6	240.0	23	247.9	6.0	257.7	234.7	45
1600	245.0	6.7	255.4	232.9	22	244.8	5.2	254.6	237.0	23	244.9	5.9	255.4	232.9	45
1700	241.9	6.4	252.5	230.5	22	242.0	5.4	251.5	232.9	23	242.0	5.9	252.5	230.5	45
1800	238.6	6.3	249.3	227.5	22	239.1	5.4	248.3	229.1	23	238.9	5.8	249.3	227.5	45
1900	235.7	6.2	247.1	224.9	22	236.2	5.6	245.8	226.0	23	236.0	5.8	247.1	224.9	45
2000	232.6	6.1	245.0	222.7	22	233.2	5.7	243.6	224.2	23	232.9	5.9	245.0	222.7	45

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

January 1995

hour			12					00					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	304.2	5.7	312.7	295.2	29	306.3	8.2	313.3	292.9	8	304.7	6.2	313.3	292.9	37
100	298.8	6.1	308.1	288.8	29	301.0	7.4	307.5	289.2	8	299.3	6.3	308.1	288.8	37
200	294.6	7.0	304.8	282.8	29	296.7	6.9	303.5	286.1	8	295.0	6.9	304.8	282.8	37
300	290.7	7.2	301.4	277.8	29	292.8	6.8	301.5	283.0	8	291.1	7.1	301.5	277.8	37
400	287.0	7.2	297.5	273.9	29	289.0	6.5	297.0	279.7	8	287.4	7.0	297.5	273.9	37
500	283.3	6.9	294.0	270.9	29	285.0	5.8	293.2	276.7	8	283.7	6.6	294.0	270.9	37
600	279.7	7.0	290.2	267.9	29	282.0	5.6	289.5	273.8	8	280.2	6.7	290.2	267.9	37
700	276.1	6.9	286.4	264.8	29	278.9	5.4	286.0	270.9	8	276.7	6.6	286.4	264.8	37
800	272.6	6.7	282.5	261.4	29	275.5	5.2	282.4	267.9	8	273.2	6.4	282.5	261.4	37
900	269.0	6.4	279.0	258.4	29	272.0	5.1	278.6	264.1	8	269.7	6.2	279.0	258.4	37
1000	265.5	6.6	275.5	254.1	29	268.1	4.8	273.0	259.4	8	266.0	6.3	275.5	254.1	37
1100	261.9	6.6	272.7	249.2	29	264.6	5.4	269.6	254.1	8	262.5	6.4	272.7	249.2	37
1200	258.5	6.2	269.0	246.1	29	260.9	5.8	266.5	249.2	8	259.1	6.1	269.0	246.1	37
1300	254.9	5.7	265.6	243.7	29	257.3	5.5	263.2	247.4	8	255.4	5.6	265.6	243.7	37
1400	251.2	5.8	262.4	241.4	29	254.4	5.1	260.2	246.2	8	251.9	5.8	262.4	241.4	37
1500	247.6	5.8	259.4	235.0	29	250.3	4.6	257.3	243.2	8	248.2	5.6	259.4	235.0	37
1600	244.4	5.7	256.2	231.6	29	247.1	4.1	254.5	242.9	8	245.0	5.5	256.2	231.6	37
1700	241.6	5.5	253.5	230.4	29	243.5	4.3	251.7	239.9	8	242.0	5.3	253.5	230.4	37
1800	238.5	5.7	250.7	227.1	29	240.2	4.7	248.6	234.8	8	238.9	5.5	250.7	227.1	37
1900	235.5	5.8	247.2	222.7	29	237.4	5.1	245.7	230.2	8	235.9	5.6	247.2	222.7	37
2000	232.7	5.6	243.8	220.1	29	234.8	5.5	243.4	226.7	8	233.1	5.6	243.8	220.1	37

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

February 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	300.8	5.5	305.6	293.3	4	301.1	4.5	309.0	291.8	28	301.1	4.6	309.0	291.8	32
100	296.0	7.8	305.1	286.6	4	295.2	5.0	304.5	285.1	28	295.3	5.3	305.1	285.1	32
200	292.8	8.2	302.8	283.3	4	291.0	5.3	300.7	282.0	28	291.2	5.6	302.8	282.0	32
300	289.1	8.2	299.3	280.2	4	287.1	5.4	297.1	279.2	28	287.3	5.7	299.3	279.2	32
400	285.5	8.1	295.7	277.2	4	283.1	5.4	293.3	274.8	28	283.4	5.7	295.7	274.8	32
500	282.0	7.9	291.9	273.8	4	279.6	5.6	289.6	271.1	28	279.9	5.8	291.9	271.1	32
600	278.6	7.6	288.2	270.7	4	276.2	5.4	285.9	268.1	28	276.5	5.6	288.2	268.1	32
700	274.8	7.4	284.4	267.6	4	272.6	5.0	282.8	264.5	28	272.9	5.3	284.4	264.5	32
800	271.0	7.3	280.7	264.2	4	269.2	5.0	279.4	261.2	28	269.4	5.3	280.7	261.2	32
900	267.4	7.4	276.9	260.3	4	266.0	5.1	276.2	256.7	28	266.2	5.3	276.9	256.7	32
1000	264.1	7.1	273.3	257.5	4	263.0	4.9	273.2	254.2	28	263.1	5.1	273.3	254.2	32
1100	261.1	6.6	269.8	255.1	4	259.7	4.7	269.9	251.6	28	259.9	4.8	269.9	251.6	32
1200	257.9	6.2	266.2	252.4	4	256.5	4.6	266.7	248.6	28	256.6	4.7	266.7	248.6	32
1300	254.9	5.9	262.9	249.9	4	253.1	4.4	263.3	245.9	28	253.3	4.5	263.3	245.9	32
1400	251.6	5.6	259.5	247.4	4	249.9	4.3	259.8	243.2	28	250.1	4.4	259.8	243.2	32
1500	248.4	5.4	256.1	244.7	4	247.1	3.9	256.6	240.8	28	247.3	4.0	256.6	240.8	32
1600	245.5	4.8	252.5	242.2	4	244.1	3.7	253.6	237.9	28	244.3	3.8	253.6	237.9	32
1700	242.8	4.4	249.2	239.7	4	241.0	3.6	250.5	234.6	28	241.3	3.7	250.5	234.6	32
1800	239.9	4.5	246.4	236.9	4	237.5	3.9	247.4	230.9	28	237.8	4.0	247.4	230.9	32
1900	237.0	4.4	243.4	234.1	4	234.3	3.4	242.0	227.5	28	234.6	3.5	243.4	227.5	32
2000	234.2	4.4	240.5	231.2	4	231.2	2.9	238.7	224.6	28	231.6	3.2	240.5	224.6	32

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

March 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	302.5	6.3	312.1	293.2	6	302.5	6.5	316.5	290.7	31	302.5	6.4	316.5	290.7	37
100	298.0	5.5	307.4	290.8	6	296.5	7.1	312.1	285.6	31	296.7	6.9	312.1	285.6	37
200	294.9	5.2	303.5	287.9	6	292.8	7.2	308.4	282.6	31	293.2	6.9	308.4	282.6	37
300	291.7	5.3	300.5	285.1	6	289.3	7.1	304.4	278.8	31	289.7	6.9	304.4	278.8	37
400	288.2	5.0	296.6	282.7	6	285.7	7.1	300.7	274.2	31	286.2	6.8	300.7	274.2	37
500	284.9	4.9	292.8	279.9	6	282.2	7.1	297.3	270.8	31	282.7	6.8	297.3	270.8	37
600	281.7	4.9	289.3	277.5	6	278.6	6.8	292.3	267.2	31	279.1	6.6	292.3	267.2	37
700	277.7	5.5	285.7	272.2	6	275.2	6.4	286.8	264.0	31	275.6	6.3	286.8	264.0	37
800	274.1	5.1	280.7	268.3	6	271.8	6.2	281.8	260.5	31	272.1	6.0	281.8	260.5	37
900	270.6	4.6	276.4	265.4	6	268.2	6.3	278.9	257.4	31	268.6	6.0	278.9	257.4	37
1000	267.2	3.9	273.3	262.9	6	264.9	6.5	275.8	254.5	31	265.3	6.2	275.8	254.5	37
1100	264.4	3.9	270.8	260.6	6	261.6	6.4	272.6	250.9	31	262.0	6.1	272.6	250.9	37
1200	261.6	4.0	268.2	258.2	6	258.5	6.4	269.6	247.1	31	259.0	6.2	269.6	247.1	37
1300	258.9	4.0	265.5	255.6	6	255.7	6.6	269.1	244.5	31	256.2	6.3	269.1	244.5	37
1400	255.8	4.1	261.8	251.5	6	252.4	6.3	266.1	242.2	31	253.0	6.1	266.1	242.2	37
1500	252.6	4.9	258.9	245.9	6	249.2	6.0	260.6	239.4	31	249.8	5.9	260.6	239.4	37
1600	249.3	5.8	256.1	241.1	6	245.9	5.9	259.5	236.4	31	246.5	5.9	259.5	236.4	37
1700	246.1	5.8	253.1	238.1	6	242.4	5.5	255.3	233.4	31	243.0	5.6	255.3	233.4	37
1800	242.1	6.0	250.5	235.1	6	239.0	5.2	251.2	230.5	31	239.5	5.4	251.2	230.5	37
1900	238.9	5.8	246.8	232.1	6	235.9	5.3	251.3	228.9	31	236.4	5.4	251.3	228.9	37
2000	235.4	4.8	242.5	229.9	6	233.0	5.5	250.6	225.6	31	233.4	5.4	250.6	225.6	37

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

April 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	301.4	8.3	307.3	295.5	2	305.1	7.4	315.8	292.5	21	304.8	7.4	315.8	292.5	23
100	296.0	6.4	300.5	291.5	2	298.2	7.6	310.2	287.6	21	298.0	7.4	310.2	287.6	23
200	293.1	5.8	297.2	289.0	2	294.3	7.8	307.8	283.8	21	294.2	7.6	307.8	283.8	23
300	289.8	4.7	293.1	286.5	2	290.7	7.8	303.0	280.2	21	290.7	7.5	303.0	280.2	23
400	287.0	4.2	290.0	284.0	2	287.0	7.3	298.7	276.9	21	287.0	7.0	298.7	276.9	23
500	284.0	3.6	286.6	281.5	2	283.3	7.0	296.5	273.9	21	283.3	6.7	296.5	273.9	23
600	281.0	3.5	283.5	278.6	2	280.0	7.0	293.2	270.5	21	280.1	6.7	293.2	270.5	23
700	277.9	2.6	279.7	276.0	2	276.8	7.0	291.1	267.5	21	276.9	6.7	291.1	267.5	23
800	274.7	1.9	276.1	273.4	2	273.7	7.0	289.8	264.4	21	273.8	6.7	289.8	264.4	23
900	271.8	1.1	272.6	271.0	2	270.8	7.2	288.9	261.2	21	270.9	6.9	288.9	261.2	23
1000	268.5	0.8	269.1	267.9	2	267.7	7.4	287.1	258.1	21	267.8	7.1	287.1	258.1	23
1100	265.7	0.1	265.7	265.7	2	264.4	7.6	282.2	254.4	21	264.5	7.2	282.2	254.4	23
1200	262.6	0.3	262.8	262.4	2	261.0	7.4	279.7	251.0	21	261.1	7.1	279.7	251.0	23
1300	259.4	0.9	260.0	258.8	2	257.5	7.1	276.4	248.4	21	257.7	6.8	276.4	248.4	23
1400	256.4	1.3	257.3	255.5	2	254.3	7.0	273.2	245.5	21	254.5	6.7	273.2	245.5	23
1500	253.4	1.7	254.6	252.2	2	251.3	6.8	269.5	243.1	21	251.4	6.5	269.5	243.1	23
1600	249.7	1.3	250.6	248.8	2	248.2	6.8	265.6	239.9	21	248.3	6.5	265.6	239.9	23
1700	246.2	0.9	246.9	245.6	2	245.4	6.6	262.3	237.9	21	245.5	6.3	262.3	237.9	23
1800	243.6	1.8	244.9	242.4	2	242.4	6.5	257.6	234.9	21	242.5	6.3	257.6	234.9	23
1900	241.1	2.9	243.1	239.0	2	239.3	6.5	253.6	231.9	21	239.5	6.3	253.6	231.9	23
2000	238.2	3.3	240.5	235.9	2	236.5	6.3	249.8	229.4	21	236.6	6.1	249.8	229.4	23

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

May 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0					0	314.9	12.7	336.8	299.4	15	314.9	12.7	336.8	299.4	15
100					0	306.3	12.0	328.4	294.8	15	306.3	12.0	328.4	294.8	15
200					0	303.2	12.4	326.9	291.3	15	303.2	12.4	326.9	291.3	15
300					0	299.5	11.8	321.8	285.8	15	299.5	11.8	321.8	285.8	15
400					0	296.1	11.3	318.0	281.9	15	296.1	11.3	318.0	281.9	15
500					0	291.8	11.6	313.6	277.5	15	291.8	11.6	313.6	277.5	15
600					0	288.5	11.6	308.3	275.8	15	288.5	11.6	308.3	275.8	15
700					0	285.4	11.6	304.4	272.8	15	285.4	11.6	304.4	272.8	15
800					0	281.8	11.7	301.1	269.4	15	281.8	11.7	301.1	269.4	15
900					0	277.8	10.7	296.2	266.7	15	277.8	10.7	296.2	266.7	15
1000					0	274.5	10.7	295.4	263.4	15	274.5	10.7	295.4	263.4	15
1100					0	272.1	10.0	292.4	260.0	15	272.1	10.0	292.4	260.0	15
1200					0	269.5	9.1	286.2	257.4	15	269.5	9.1	286.2	257.4	15
1300					0	266.1	8.9	282.1	253.7	15	266.1	8.9	282.1	253.7	15
1400					0	261.5	9.5	278.4	250.2	15	261.5	9.5	278.4	250.2	15
1500					0	257.4	10.4	274.4	244.8	15	257.4	10.4	274.4	244.8	15
1600					0	253.9	10.2	271.1	244.1	15	253.9	10.2	271.1	244.1	15
1700					0	250.9	9.7	268.5	240.1	15	250.9	9.7	268.5	240.1	15
1800					0	248.1	9.6	264.5	237.0	15	248.1	9.6	264.5	237.0	15
1900					0	245.1	9.7	261.7	230.4	15	245.1	9.7	261.7	230.4	15
2000					0	241.8	9.8	258.0	225.0	15	241.8	9.8	258.0	225.0	15

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

June 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	304.7	0	304.7	304.7	1	319.7	8.9	332.7	303.9	21	319.0	9.3	332.7	303.9	22
100	297.0	0	297.0	297.0	1	308.8	8.9	324.1	292.6	21	308.3	9.1	324.1	292.6	22
200	292.2	0	292.2	292.2	1	304.6	9.5	320.5	287.3	21	304.1	9.7	320.5	287.3	22
300	289.1	0	289.1	289.1	1	300.5	9.4	315.7	282.8	21	299.9	9.5	315.7	282.8	22
400	286.1	0	286.1	286.1	1	296.2	9.2	309.5	280.0	21	295.7	9.2	309.5	280.0	22
500	283.9	0	283.9	283.9	1	291.4	8.3	303.8	277.1	21	291.0	8.3	303.8	277.1	22
600	280.2	0	280.2	280.2	1	287.1	7.9	300.7	273.8	21	286.8	7.8	300.7	273.8	22
700	277.8	0	277.8	277.8	1	282.7	7.4	295.1	271.3	21	282.5	7.3	295.1	271.3	22
800	275.9	0	275.9	275.9	1	278.9	6.7	291.8	267.7	21	278.7	6.5	291.8	267.7	22
900	273.7	0	273.7	273.7	1	275.7	6.4	288.7	264.8	21	275.6	6.3	288.7	264.8	22
1000	271.8	0	271.8	271.8	1	272.9	6.4	285.1	262.1	21	272.8	6.2	285.1	262.1	22
1100	269.4	0	269.4	269.4	1	270.5	6.2	281.7	260.1	21	270.5	6.1	281.7	260.1	22
1200	262.9	0	262.9	262.9	1	267.8	6.5	279.9	257.2	21	267.6	6.4	279.9	257.2	22
1300	257.0	0	257.0	257.0	1	264.5	6.4	277.8	252.5	21	264.2	6.4	277.8	252.5	22
1400	251.1	0	251.1	251.1	1	261.1	6.4	274.9	248.5	21	260.7	6.6	274.9	248.5	22
1500	246.1	0	246.1	246.1	1	258.1	6.4	272.0	245.1	21	257.5	6.8	272.0	245.1	22
1600	242.2	0	242.2	242.2	1	255.2	6.6	268.7	239.8	21	254.7	7.1	268.7	239.8	22
1700	239.2	0	239.2	239.2	1	252.4	7.2	265.3	233.5	21	251.8	7.6	265.3	233.5	22
1800	236.0	0	236.0	236.0	1	248.5	7.4	261.7	229.8	21	248.0	7.7	261.7	229.8	22
1900	230.5	0	230.5	230.5	1	245.5	6.5	258.2	233.2	21	244.8	7.1	258.2	230.5	22
2000	224.1	0	224.1	224.1	1	242.5	6.3	254.8	228.2	21	241.6	7.3	254.8	224.1	22

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

July 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	311.4	12.3	323.3	298.8	3	320.7	11.7	341.2	295.2	30	319.8	11.9	341.2	295.2	33
100	301.3	10.2	311.5	291.1	3	311.1	12.4	335.1	286.1	30	310.2	12.5	335.1	286.1	33
200	298.8	10.1	308.6	288.4	3	306.5	12.3	335.3	283.4	30	305.8	12.2	335.3	283.4	33
300	296.0	8.9	303.9	286.3	3	302.0	12.3	334.8	280.8	30	301.4	12.1	334.8	280.8	33
400	293.3	8.1	300.1	284.4	3	298.3	11.8	328.1	278.8	30	297.8	11.5	328.1	278.8	33
500	291.7	8.0	298.0	282.7	3	294.1	11.5	323.2	276.0	30	293.9	11.1	323.2	276.0	33
600	289.4	8.1	296.4	280.5	3	289.1	11.5	318.0	272.6	30	289.1	11.1	318.0	272.6	33
700	286.5	8.0	292.1	277.4	3	285.1	11.0	311.3	266.7	30	285.3	10.7	311.3	266.7	33
800	282.9	8.1	288.7	273.7	3	281.7	11.4	303.8	260.0	30	281.8	11.1	303.8	260.0	33
900	278.0	12.4	285.9	263.7	3	278.7	12.3	301.5	250.9	30	278.6	12.2	301.5	250.9	33
1000	273.3	10.2	281.9	262.1	3	276.0	12.0	298.6	246.9	30	275.7	11.7	298.6	246.9	33
1100	269.0	9.0	279.0	261.4	3	272.9	11.6	294.5	243.2	30	272.6	11.3	294.5	243.2	33
1200	266.9	8.0	275.7	259.9	3	269.8	11.4	290.4	240.6	30	269.5	11.1	290.4	240.6	33
1300	263.3	5.2	268.1	257.7	3	266.3	11.0	286.4	237.8	30	266.0	10.6	286.4	237.8	33
1400	260.9	3.0	262.9	257.5	3	263.3	10.7	282.3	235.3	30	263.1	10.2	282.3	235.3	33
1500	256.3	3.3	260.1	253.7	3	259.3	10.5	279.6	234.5	30	259.0	10.0	279.6	234.5	33
1600	252.1	5.8	257.7	246.1	3	255.8	10.7	275.4	231.9	30	255.5	10.3	275.4	231.9	33
1700	252.8	1.3	254.3	252.0	3	252.1	11.0	270.1	224.4	30	252.1	10.4	270.1	224.4	33
1800	251.1	0.7	251.7	250.4	3	248.7	11.0	265.8	221.3	30	248.9	10.5	265.8	221.3	33
1900	249.1	0.7	249.9	248.4	3	245.1	11.5	263.1	218.2	30	245.5	11.0	263.1	218.2	33
2000	246.3	2.4	248.0	243.6	3	241.4	11.4	261.7	217.3	30	241.9	11.0	261.7	217.3	33

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

August 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	313.3	0	313.3	313.3	1	322.9	13.1	351.8	300.0	32	322.6	13.0	351.8	300.0	33
100	316.9	0	316.9	316.9	1	312.5	12.7	338.9	294.2	32	312.6	12.6	338.9	294.2	33
200	313.3	0	313.3	313.3	1	307.8	12.5	334.0	291.6	32	308.0	12.3	334.0	291.6	33
300	309.3	0	309.3	309.3	1	303.0	11.2	328.6	288.1	32	303.2	11.1	328.6	288.1	33
400	306.4	0	306.4	306.4	1	297.8	10.0	324.5	284.2	32	298.0	9.9	324.5	284.2	33
500	304.0	0	304.0	304.0	1	292.9	9.6	316.2	280.1	32	293.3	9.7	316.2	280.1	33
600	302.0	0	302.0	302.0	1	289.2	11.1	319.0	274.0	32	289.6	11.2	319.0	274.0	33
700	299.3	0	299.3	299.3	1	285.5	11.8	311.7	265.3	32	286.0	11.9	311.7	265.3	33
800	296.6	0	296.6	296.6	1	282.1	12.5	310.5	258.2	32	282.5	12.6	310.5	258.2	33
900	293.8	0	293.8	293.8	1	278.7	12.8	308.0	256.9	32	279.1	12.8	308.0	256.9	33
1000	291.3	0	291.3	291.3	1	274.7	12.2	302.9	254.0	32	275.2	12.3	302.9	254.0	33
1100	289.1	0	289.1	289.1	1	271.0	11.9	297.7	249.5	32	271.5	12.1	297.7	249.5	33
1200	285.4	0	285.4	285.4	1	267.7	11.1	291.7	247.2	32	268.2	11.3	291.7	247.2	33
1300	281.6	0	281.6	281.6	1	263.9	11.0	288.0	245.5	32	264.5	11.3	288.0	245.5	33
1400	278.1	0	278.1	278.1	1	259.1	11.5	284.2	234.2	32	259.7	11.8	284.2	234.2	33
1500	274.8	0	274.8	274.8	1	256.1	11.2	280.2	233.9	32	256.7	11.5	280.2	233.9	33
1600	270.4	0	270.4	270.4	1	252.9	10.6	276.1	232.2	32	253.5	10.9	276.1	232.2	33
1700	264.4	0	264.4	264.4	1	249.5	10.2	270.7	229.7	32	250.0	10.4	270.7	229.7	33
1800	259.4	0	259.4	259.4	1	246.0	10.0	266.2	227.5	32	246.4	10.1	266.2	227.5	33
1900	254.2	0	254.2	254.2	1	242.9	9.7	262.0	226.4	32	243.2	9.7	262.0	226.4	33
2000	250.5	0	250.5	250.5	1	239.5	9.5	258.2	224.5	32	239.8	9.6	258.2	224.5	33

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

September 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	322.1	13.7	331.8	312.4	2	317.7	9.7	334.7	299.4	31	318.0	9.7	334.7	299.4	33
100	315.0	10.9	322.7	307.3	2	310.4	9.7	324.0	293.8	31	310.7	9.6	324.0	293.8	33
200	312.4	10.1	319.5	305.2	2	306.3	9.6	319.8	289.6	31	306.6	9.6	319.8	289.6	33
300	307.1	12.9	316.2	298.0	2	302.1	9.7	315.2	284.9	31	302.4	9.7	316.2	284.9	33
400	302.1	11.8	310.5	293.8	2	298.3	9.8	312.7	280.8	31	298.5	9.7	312.7	280.8	33
500	294.8	12.1	303.4	286.3	2	293.7	9.8	307.8	271.4	31	293.8	9.7	307.8	271.4	33
600	287.0	14.1	297.0	277.0	2	289.9	9.9	304.4	263.9	31	289.8	10.0	304.4	263.9	33
700	286.8	9.3	293.4	280.2	2	286.1	10.5	301.0	257.8	31	286.1	10.3	301.0	257.8	33
800	285.0	7.7	290.5	279.6	2	281.8	11.3	296.8	255.0	31	282.0	11.0	296.8	255.0	33
900	281.1	9.1	287.5	274.7	2	278.1	11.4	292.7	252.8	31	278.3	11.1	292.7	252.8	33
1000	277.6	10.9	285.3	269.9	2	274.3	11.3	288.6	249.6	31	274.5	11.1	288.6	249.6	33
1100	277.2	7.3	282.4	272.1	2	270.6	11.0	285.4	247.4	31	271.0	10.8	285.4	247.4	33
1200	273.9	6.9	278.8	269.0	2	266.9	10.3	282.0	243.7	31	267.4	10.2	282.0	243.7	33
1300	269.3	8.4	275.3	263.4	2	262.9	10.3	277.7	241.6	31	263.3	10.2	277.7	241.6	33
1400	266.0	7.1	271.0	261.0	2	259.3	10.0	272.9	238.7	31	259.7	9.9	272.9	238.7	33
1500	261.9	5.2	265.5	258.2	2	256.3	9.5	268.7	235.8	31	256.6	9.3	268.7	235.8	33
1600	258.4	4.4	261.5	255.3	2	252.9	9.5	265.5	232.3	31	253.2	9.3	265.5	232.3	33
1700	255.2	4.4	258.3	252.1	2	249.4	10.0	262.7	228.6	31	249.7	9.8	262.7	228.6	33
1800	251.2	4.1	254.1	248.3	2	246.0	9.9	260.2	224.9	31	246.4	9.7	260.2	224.9	33
1900	246.9	5.7	250.9	242.9	2	242.7	9.4	256.8	223.8	31	243.0	9.2	256.8	223.8	33
2000	242.0	6.2	246.4	237.7	2	239.5	9.0	253.3	223.8	31	239.7	8.8	253.3	223.8	33

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

October 1995

hour			12					05					total		
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
0	307.1	19.6	326.7	287.5	3	313.9	10.6	331.5	291.7	30	313.3	11.4	331.5	287.5	33
100	303.5	16.3	319.9	287.3	3	306.5	10.9	324.1	288.5	30	306.2	11.2	324.1	287.3	33
200	300.3	15.6	316.2	285.0	3	302.7	11.3	320.7	284.9	30	302.5	11.5	320.7	284.9	33
300	297.2	15.0	312.5	282.5	3	299.0	11.4	317.7	281.7	30	298.8	11.5	317.7	281.7	33
400	294.0	14.1	308.4	280.3	3	294.9	11.1	314.3	278.6	30	294.9	11.1	314.3	278.6	33
500	290.7	13.3	304.3	277.7	3	290.5	10.6	310.6	275.7	30	290.5	10.6	310.6	275.7	33
600	288.1	13.1	301.4	275.2	3	286.2	10.3	306.8	272.2	30	286.4	10.4	306.8	272.2	33
700	285.4	12.5	297.7	272.8	3	282.6	9.7	303.5	269.6	30	282.8	9.8	303.5	269.6	33
800	282.4	11.9	294.0	270.3	3	278.8	9.3	299.2	267.0	30	279.2	9.4	299.2	267.0	33
900	278.7	11.8	290.4	266.9	3	275.0	9.6	295.0	261.0	30	275.4	9.6	295.0	261.0	33
1000	274.2	11.2	286.5	264.5	3	271.5	9.6	291.0	254.4	30	271.7	9.6	291.0	254.4	33
1100	272.8	10.8	282.0	260.9	3	267.3	9.6	287.0	250.3	30	267.8	9.6	287.0	250.3	33
1200	268.4	14.2	278.4	252.1	3	263.2	10.4	283.0	241.5	30	263.6	10.6	283.0	241.5	33
1300	263.7	14.0	274.7	247.9	3	260.8	10.7	278.9	237.1	30	261.1	10.8	278.9	237.1	33
1400	259.6	14.4	270.5	243.3	3	256.5	10.9	275.3	233.4	30	256.8	11.0	275.3	233.4	33
1500	256.4	14.5	267.1	239.9	3	252.6	10.9	272.1	230.0	30	252.9	11.1	272.1	230.0	33
1600	253.4	13.6	263.0	237.9	3	248.1	11.5	268.8	227.6	30	248.6	11.6	268.8	227.6	33
1700	250.9	12.9	260.5	236.2	3	244.5	11.7	265.0	225.2	30	245.1	11.8	265.0	225.2	33
1800	247.6	12.6	257.3	233.3	3	241.2	11.4	261.3	222.7	30	241.8	11.4	261.3	222.7	33
1900	244.0	12.6	253.4	229.7	3	237.7	11.1	257.6	220.2	30	238.3	11.1	257.6	220.2	33
2000	240.2	13.6	249.7	224.6	3	234.5	10.6	253.4	217.1	30	235.0	10.8	253.4	217.1	33

Table 4.1.1 Mean refractivity values in N-units pr 100 m, standard deviation and extremes.

4.2 Gradient statistics

Once we have computed the refractivity values at chosen altitudes as given in section 4.1, it is a straight foreword task to compute the gradient of the refractivity between those levels as

$$dN/dz = (N_{i+1}-N_i)/(z_{i+1}-z_i)$$

where the index i indicates the levels in altitude i.e. 0,100,200,... .

Table 4.2.1 shows pr month and for given observation hour the mean values, the standard deviation, the maximum and minimum values and the number of observations of the refractivity gradient in the height interval 0 m to 2000 m above station level.

In the tables the "heights" are associated with the mean value of the height interval, i.e. the value 50 indicates the interval between 0 m and 100 m, 150 the interval between 100 m and 200 m and so on.

Please observe the shift in observation hour occurring in February 1995 according to section 3, table 3.2.

We recognise absolute minimum values less than minus 100 N-units in the lowest layers, but also in layers around 500 m and 1 km. As mentioned above the possibility to have at least one point between each one hundred meters will make the gradients much more "sharp" than in the "standard set", i.e. the common TEMP and PILOT codes.

The observation hours 00 and 12 are different from the observation hour 06 in that respect that the 06 observation shows values less than minus 100 N-units nearly all months in the period under consideration, i.e. 1995, see also section 4.4 concerning ducting.

The local weather and climatic conditions at Gardermoen linked to the radio refractive climate may give an explanation as follows. Norwegian weather and climate is mainly governed by the wandering lows passing over from the Atlantic sea. The climate as such is then predominant maritime, except for the inner eastern parts where local energy balance conditions also will play a role.

During the night the energy balance of the surface and very lowest air layers is negative, i.e. the surface looses heat which is lost upwards through the atmosphere. Temperature will diminish and the air will release parts of its humidity. When the sun rises in the morning we have the converse situation, the surface will gain net heat and after a while be the "warmest part" of the earth-atmosphere system. Air layers start to warm up from below and this again gives rise to convectional currents with subsequent mixing of the air layers.

If we compare the three observation hours 00, 06 and 12 with the reasoning above, we should find 00 as the most stable atmospheric situation with the common nocturnal cooling in the bottom layers. At twelve o'clock the local positive energy balance should have mixed the lowest air layers so sharp discontinuities should have been brought to greater altitudes, highest in summer.

The 06 observation, however, falls in-between this two situations and it is significant that the only observed elevated surface duct in the total amount of ten seconds data is recorded at this hour, see section 4.4. Depending on the magnitude of the local energy balance the smaller or greater parts of lower atmosphere will be mixed, bringing the possible discontinuities to different heights.

In the middle of the summer when the solar energy input is greatest we would expect the strongest gradients at greater heights at twelve o'clock, the very few observational hours taken into account, and that is quite in accordance with the values shown below.

The lowest value of the gradient pr. one hundred meters was found at 06 hours at 1450 metres as -276.8 N/km pr km in July 1995, the next lowest was found in July 1994 at an altitude of 650 m as 240.6 N-units pr. km. The lowest value in the surface layer is -224.7 in July 1994 , a rather unusual warm and dry month. The mean temperature for the month was 4.7 °C above the normal and the monthly sum of precipitation was only 7 mm, that is only 9% of normal precipitation.

In comparison with the statistics for the period 1982-1991 [2] the magnitude of the mentioned gradients are not unexpected, the greatest minimum values in the lowest one hundred metres layer are recorded as great as about -430 N/km in July, at the 1 km level again July has the greatest minimum value as about -340 N/km.

In figures 4.2.1 and 4.2.2 mean values of the refractivity gradient versus height plus/minus one standard deviation for the months March and August in the period 1982-1991 together with mean values for the year 1994 based on the ten seconds data. We observe a satisfactory similitude, although the difference in the lowest layer is of its greatest magnitude as 30 N/km in August, is well inside the curves for one standard deviation for the 82/91 period.

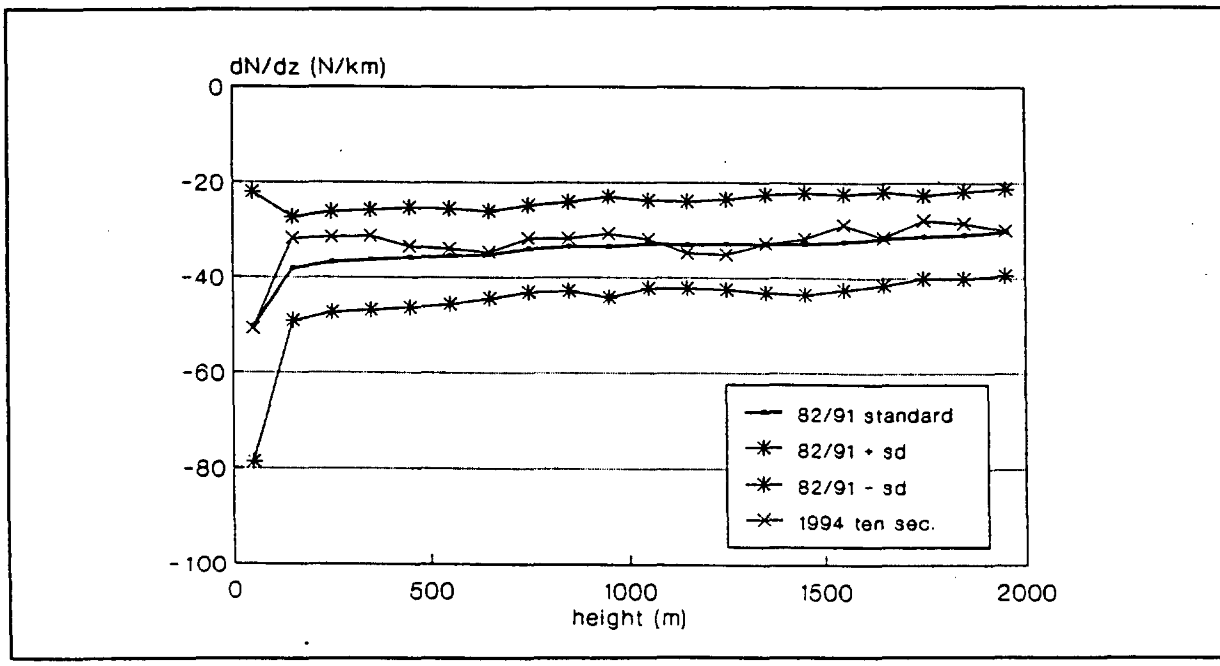


Figure 4.2.1 Refractivity gradients versus height for the period 1982-1991 and 1994 Means of hours 00 and 12. for the month of March.

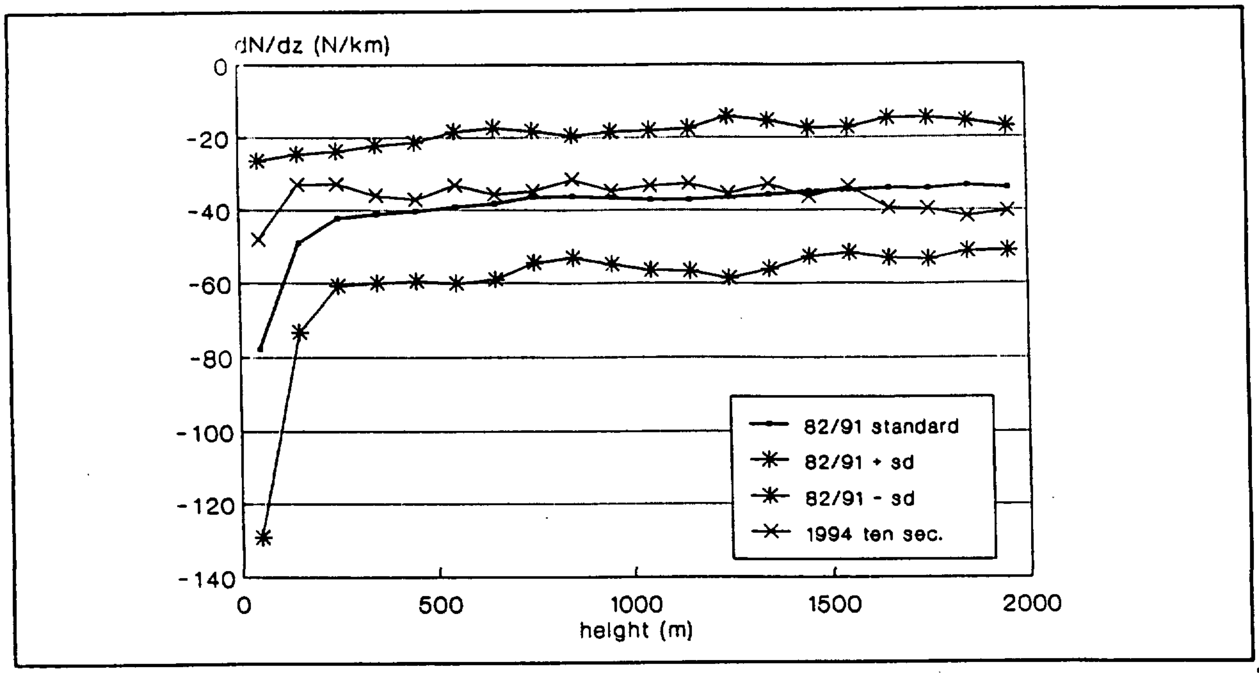


Figure 4.2.2 Refractivity gradients versus height for the period 1982-1991 and 1994 Means of hours 00 and 12. for the month of August.

The mean curve of the longer period is naturally a more smooth curve than for a single year, but it must also be remembered that for interpolation points "far apart" as is the situation of the standard data, this also will have a smoothing effect on the interpolation. It is the very satisfactory to observe the rather small difference between the standard data gradients and the ten second computations.

This imply that the radiosonde is able to record and archive enough "significant" points of temperature and humidity with enough accuracy to reconstruct the profiles of these parameters within the information given in the codeforms TEMP and PILOT which in fact is a requirement from WMO.

The gradient in the lowest one hundred metres is still the most varying, but from the above meteorological considerations this should not be unexpected. Another problem is how well and fast the radiosonde adjust itself to the atmospheric conditions at the time of launch and also how stable these conditions are in time so that a real adjustment is possible.

The comparison of the two figures show that in March the lowest gradient is more or less identical for the standard and the ten seconds, but in August the difference is of greatest magnitude. This can have as explanation that the sondes are stored in an unheated building at the launch site. In March is probably the inside and outside temperature more or less equal, but in August the outside temperature should be greater to a certain extent than the inside temperature. This may be the reason for the different magnitude of the difference between the two sets of data.

September 1993

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-40.1	31.2	5.4	-134.9	22	-71.2	38.0	-2.5	-126.4	14	-52.2	36.8	5.4	-134.9	36
150	-25.7	9.3	-11.9	-58.2	22	-46.3	19.6	-17.8	-90.1	14	-33.7	17.2	-11.9	-90.1	36
250	-30.2	10.2	-20.0	-57.7	22	-43.2	14.9	-27.5	-75.9	14	-35.3	13.6	-20.0	-75.9	36
350	-30.0	12.6	-16.8	-74.6	22	-34.7	11.4	-11.5	-54.2	14	-31.8	12.2	-11.5	-74.6	36
450	-32.2	22.5	-17.7	-123.9	22	-37.1	12.5	-9.8	-63.4	14	-34.1	19.2	-9.8	-123.9	36
550	-34.3	20.9	-18.6	-120.5	22	-44.2	35.4	-2.7	-134.7	14	-38.2	27.4	-2.7	-134.7	36
650	-32.9	16.3	-17.9	-78.8	22	-33.4	25.5	8.8	-102.3	14	-33.1	20.0	8.8	-102.3	36
750	-33.4	15.3	-22.4	-86.8	22	-37.0	8.5	-23.1	-56.3	14	-34.8	13.1	-22.4	-86.8	36
850	-44.2	28.9	-18.4	-120.8	22	-33.9	10.8	-17.9	-58.5	14	-40.2	23.9	-17.9	-120.8	36
950	-32.9	11.6	-17.9	-64.3	22	-31.6	8.8	-22.8	-50.3	14	-32.4	10.5	-17.9	-64.3	36
1050	-27.2	22.1	45.8	-73.7	22	-31.8	9.3	-18.8	-56.4	14	-29.0	18.1	45.8	-73.7	36
1150	-26.7	14.4	6.8	-55.1	22	-37.6	27.5	-18.7	-129.7	14	-30.9	20.9	6.8	-129.7	36
1250	-29.7	17.2	9.9	-77.9	22	-39.7	22.2	-15.5	-100.6	14	-33.6	19.6	9.9	-100.6	36
1350	-36.1	19.1	-12.3	-100.3	22	-37.7	25.3	4.5	-106.9	14	-36.7	21.4	4.5	-106.9	36
1450	-45.7	38.0	-20.2	-181.2	22	-23.9	24.4	41.6	-67.4	14	-37.2	34.7	41.6	-181.2	36
1550	-41.9	33.2	68.3	-116.9	22	-30.1	17.7	7.6	-66.4	14	-37.4	28.5	68.3	-116.9	36
1650	-44.8	28.5	4.4	-124.1	22	-34.4	21.2	8.3	-80.9	14	-40.8	26.1	8.3	-124.1	36
1750	-37.0	34.7	43.7	-136.5	22	-37.5	16.6	-21.7	-89.1	14	-37.2	28.7	43.7	-136.5	36
1850	-39.3	26.8	39.8	-83.5	22	-33.2	7.1	-20.9	-44.8	14	-37.0	21.4	39.8	-83.5	36
1950	-30.6	29.2	69.6	-81.0	22	-39.8	25.6	-20.9	-111.9	14	-34.2	27.8	69.6	-111.9	36

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

October 1993

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-56.1	37.5	-6.4	-178.0	21	-75.6	34.4	-27.9	-136.3	12	-63.2	37.1	-6.4	-178.0	33
150	-34.9	12.9	-22.6	-79.6	21	-40.2	12.6	-22.7	-62.2	12	-36.9	12.9	-22.6	-79.6	33
250	-38.1	14.3	-21.1	-79.6	21	-39.8	7.6	-30.8	-59.6	12	-38.7	12.2	-21.1	-79.6	33
350	-38.6	13.6	-16.6	-78.2	21	-41.4	15.7	-23.4	-87.1	12	-39.6	14.2	-16.6	-87.1	33
450	-35.4	8.7	-23.1	-50.5	21	-38.7	9.0	-21.8	-55.4	12	-36.6	8.8	-21.8	-55.4	33
550	-35.3	8.9	-22.6	-53.3	21	-40.9	14.2	-20.5	-72.8	12	-37.3	11.2	-20.5	-72.8	33
650	-38.7	16.3	-22.8	-84.5	21	-33.8	19.6	12.7	-73.2	12	-36.9	17.4	12.7	-84.5	33
750	-36.6	15.1	-22.1	-86.9	21	-43.2	27.1	-21.5	-117.6	12	-39.0	20.1	-21.5	-117.6	33
850	-34.3	14.7	-12.9	-81.4	21	-40.7	17.4	-17.8	-78.3	12	-36.6	15.8	-12.9	-81.4	33
950	-35.2	10.5	-21.6	-57.3	21	-38.6	18.8	-3.2	-78.0	12	-36.5	13.9	-3.2	-78.0	33
1050	-37.0	8.8	-21.4	-52.6	21	-40.8	16.5	-26.3	-84.7	12	-38.4	12.1	-21.4	-84.7	33
1150	-44.1	23.1	-22.7	-106.7	21	-35.9	9.2	-27.3	-62.2	12	-41.1	19.4	-22.7	-106.7	33
1250	-40.2	26.6	-23.0	-151.4	21	-37.1	8.7	-27.3	-51.3	12	-39.1	21.7	-23.0	-151.4	33
1350	-34.6	11.7	-17.8	-66.2	21	-32.0	10.2	-20.8	-58.9	12	-33.7	11.1	-17.8	-66.2	33
1450	-33.2	17.3	-6.0	-99.9	21	-24.8	9.1	-0.2	-35.9	12	-30.1	15.2	-0.2	-99.9	33
1550	-34.2	16.4	2.9	-69.6	21	-29.8	10.3	-17.1	-57.2	12	-32.6	14.5	2.9	-69.6	33
1650	-32.8	13.3	-0.7	-62.2	21	-26.2	7.1	-14.3	-36.1	12	-30.4	11.8	-0.7	-62.2	33
1750	-30.8	6.8	-20.3	-44.2	21	-28.3	9.6	-19.1	-53.8	12	-29.9	7.9	-19.1	-53.8	33
1850	-31.5	9.6	-14.2	-57.9	21	-26.8	5.9	-12.4	-32.8	12	-29.8	8.6	-12.4	-57.9	33
1950	-27.7	6.6	-16.1	-43.6	21	-32.0	18.2	-15.1	-83.6	12	-29.3	12.0	-15.1	-83.6	33

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

November 1993

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-57.0	15.5	-37.2	-94.7	21	-57.2	13.9	-36.3	-83.5	13	-57.1	14.7	-36.3	-94.7	34
150	-33.2	5.2	-21.9	-46.1	21	-34.0	5.9	-29.8	-52.1	13	-33.5	5.4	-21.9	-52.1	34
250	-36.3	8.6	-26.2	-68.8	21	-36.4	5.3	-28.6	-46.2	13	-36.4	7.4	-26.2	-68.8	34
350	-35.1	4.6	-25.7	-43.5	21	-43.4	34.3	-23.1	-156.6	13	-38.3	21.4	-23.1	-156.6	34
450	-34.6	8.0	-10.7	-54.0	21	-39.9	18.6	-18.7	-95.0	13	-36.6	13.1	-10.7	-95.0	34
550	-42.0	20.0	-23.3	-109.7	21	-42.3	20.4	-24.1	-99.0	13	-42.1	19.9	-23.3	-109.7	34
650	-43.9	29.2	-27.9	-150.8	21	-36.5	8.7	-24.3	-58.2	13	-41.0	23.6	-24.3	-150.8	34
750	-37.7	13.0	-13.1	-76.9	21	-33.5	3.3	-28.8	-38.1	13	-36.1	10.5	-13.1	-76.9	34
850	-40.1	11.9	-25.2	-66.4	21	-35.5	3.0	-31.5	-43.0	13	-38.4	9.7	-25.2	-66.4	34
950	-45.7	29.4	-30.4	-141.6	21	-34.2	9.1	-24.3	-62.0	13	-41.3	24.2	-24.3	-141.6	34
1050	-43.1	21.8	-26.5	-128.4	21	-39.8	22.5	-19.4	-111.5	13	-41.9	21.8	-19.4	-128.4	34
1150	-39.7	18.9	-18.9	-109.9	21	-33.6	8.2	-20.5	-55.1	13	-37.4	15.8	-18.9	-109.9	34
1250	-42.3	22.8	-30.5	-130.3	21	-43.1	25.4	-26.1	-121.1	13	-42.6	23.5	-26.1	-130.3	34
1350	-36.5	13.0	-18.8	-82.3	21	-47.5	30.0	-8.4	-108.2	13	-40.7	21.4	-8.4	-108.2	34
1450	-34.3	12.9	-5.2	-63.7	21	-45.3	18.8	-29.7	-79.7	13	-38.5	16.1	-5.2	-79.7	34
1550	-38.6	13.6	-25.6	-90.1	21	-33.4	13.0	-7.0	-64.1	13	-36.6	13.4	-7.0	-90.1	34
1650	-37.4	14.3	-24.3	-93.5	21	-38.1	17.6	-20.9	-74.9	13	-37.7	15.4	-20.9	-93.5	34
1750	-33.3	9.9	-18.1	-62.6	21	-33.0	11.9	-9.2	-51.5	13	-33.2	10.5	-9.2	-62.6	34
1850	-31.1	8.1	-16.8	-52.6	21	-32.6	10.4	-23.0	-63.9	13	-31.7	8.9	-16.8	-63.9	34
1950	-33.4	17.6	5.0	-78.7	21	-28.8	10.6	-5.5	-44.6	13	-31.6	15.3	5.0	-78.7	34

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

December 1993

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-53.8	17.4	-14.6	-86.4	23	-62.1	18.4	-40.0	-114.9	13	-56.8	18.0	-14.6	-114.9	36
150	-43.6	16.4	-27.2	-79.8	23	-37.9	7.7	-27.5	-53.0	13	-41.6	14.1	-27.2	-79.8	36
250	-39.3	9.0	-30.0	-62.2	23	-35.7	7.0	-26.2	-55.0	13	-38.0	8.4	-26.2	-62.2	36
350	-36.2	12.3	-17.5	-77.4	23	-34.5	6.7	-26.1	-48.5	13	-35.6	10.5	-17.5	-77.4	36
450	-33.3	9.5	-12.0	-61.7	23	-35.6	9.3	-26.9	-61.6	13	-34.1	9.3	-12.0	-61.7	36
550	-34.4	5.9	-24.1	-56.4	23	-34.9	6.8	-26.1	-49.1	13	-34.6	6.2	-24.1	-56.4	36
650	-33.9	6.9	-21.4	-50.0	23	-33.4	6.8	-26.7	-51.2	13	-33.7	6.8	-21.4	-51.2	36
750	-34.8	8.9	-20.9	-65.7	23	-33.7	4.8	-25.5	-43.3	13	-34.4	7.6	-20.9	-65.7	36
850	-35.7	11.4	-18.7	-78.1	23	-35.6	6.9	-24.4	-46.5	13	-35.6	9.9	-18.7	-78.1	36
950	-33.5	7.7	-19.6	-49.6	23	-36.0	11.2	-24.7	-68.0	13	-34.4	9.1	-19.6	-68.0	36
1050	-32.4	5.5	-20.0	-46.0	23	-32.3	6.4	-21.1	-43.5	13	-32.4	5.8	-20.0	-46.0	36
1150	-32.3	6.9	-20.6	-46.8	23	-35.2	7.7	-23.0	-48.9	13	-33.3	7.2	-20.6	-48.9	36
1250	-34.6	10.0	-17.8	-62.9	23	-31.0	10.4	-2.9	-47.6	13	-33.3	10.2	-2.9	-62.9	36
1350	-33.9	11.3	-10.5	-64.5	23	-30.0	9.3	-9.9	-52.6	13	-32.5	10.7	-9.9	-64.5	36
1450	-33.3	7.9	-23.5	-63.0	23	-37.2	16.7	-24.0	-88.7	13	-34.7	11.8	-23.5	-88.7	36
1550	-34.1	9.0	-23.1	-64.0	23	-37.4	11.5	-19.8	-55.6	13	-35.3	9.9	-19.8	-64.0	36
1650	-29.1	8.4	-0.9	-47.2	23	-31.3	9.6	-10.4	-53.7	13	-29.9	8.8	-0.9	-53.7	36
1750	-27.0	18.0	49.8	-48.5	23	-31.4	7.0	-24.7	-51.9	13	-28.6	15.0	49.8	-51.9	36
1850	-29.4	6.3	-10.4	-40.0	23	-29.0	8.1	-17.7	-51.6	13	-29.3	6.9	-10.4	-51.6	36
1950	-30.5	10.8	-14.2	-71.9	23	-29.1	7.0	-20.8	-44.3	13	-30.0	9.5	-14.2	-71.9	36

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

January 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-50.5	12.8	-23.1	-76.4	21	-51.7	19.6	-27.8	-105.2	13	-51.0	15.5	-23.1	-105.2	34
150	-38.9	15.8	-25.9	-89.7	21	-32.1	13.1	-14.3	-72.7	13	-36.3	15.0	-14.3	-89.7	34
250	-35.2	7.7	-27.2	-55.3	21	-35.1	7.4	-27.3	-54.7	13	-35.1	7.5	-27.2	-55.3	34
350	-34.5	7.7	-25.4	-61.0	21	-37.4	9.3	-26.0	-55.5	13	-35.6	8.3	-25.4	-61.0	34
450	-34.2	6.1	-25.4	-52.3	21	-38.1	8.9	-28.1	-60.7	13	-35.7	7.4	-25.4	-60.7	34
550	-34.0	9.2	-24.3	-65.9	21	-35.4	8.2	-21.6	-51.1	13	-34.6	8.8	-21.6	-65.9	34
650	-32.6	7.7	-13.0	-47.9	21	-35.4	11.7	-22.1	-67.2	13	-33.7	9.4	-13.0	-67.2	34
750	-35.7	10.0	-25.3	-61.0	21	-33.5	5.3	-24.6	-44.8	13	-34.9	8.5	-24.6	-61.0	34
850	-33.7	5.2	-24.6	-43.2	21	-32.9	3.1	-26.2	-37.5	13	-33.4	4.5	-24.6	-43.2	34
950	-34.5	5.5	-26.1	-45.6	21	-32.2	2.7	-26.7	-37.5	13	-33.6	4.7	-26.1	-45.6	34
1050	-34.8	4.8	-25.2	-45.7	21	-32.3	7.9	-15.2	-49.5	13	-33.8	6.2	-15.2	-49.5	34
1150	-32.4	5.3	-23.2	-40.8	21	-33.2	12.2	-5.0	-51.9	13	-32.7	8.4	-5.0	-51.9	34
1250	-31.8	5.5	-23.4	-41.7	21	-30.2	3.8	-22.7	-36.5	13	-31.2	4.9	-22.7	-41.7	34
1350	-31.9	5.7	-20.3	-42.9	21	-30.7	4.4	-23.7	-38.7	13	-31.4	5.2	-20.3	-42.9	34
1450	-32.3	7.0	-23.3	-53.7	21	-31.4	4.8	-21.8	-39.0	13	-32.0	6.2	-21.8	-53.7	34
1550	-31.8	4.7	-23.7	-42.7	21	-31.9	7.3	-24.8	-51.8	13	-31.8	5.7	-23.7	-51.8	34
1650	-30.6	4.4	-23.3	-41.5	21	-31.2	5.1	-22.2	-39.0	13	-30.8	4.6	-22.2	-41.5	34
1750	-30.8	10.7	-5.3	-61.6	21	-30.3	5.8	-16.9	-37.5	13	-30.6	9.0	-5.3	-61.6	34
1850	-31.2	6.9	-23.9	-48.9	21	-30.3	3.8	-24.2	-35.0	13	-30.9	5.8	-23.9	-48.9	34
1950	-34.8	10.5	-22.2	-69.6	21	-29.7	7.1	-16.9	-47.6	13	-32.8	9.6	-16.9	-69.6	34

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

February 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-45.1	11.0	-27.9	-79.4	26	-72.5	30.9	-34.2	-158.4	24	-58.2	26.5	-27.9	-158.4	50
150	-39.5	12.4	-25.2	-67.0	26	-48.8	17.1	-23.9	-86.9	24	-44.0	15.4	-23.9	-86.9	50
250	-38.9	11.7	-19.1	-67.2	26	-39.5	11.9	-22.3	-72.4	24	-39.2	11.7	-19.1	-72.4	50
350	-37.1	13.8	-17.0	-85.9	26	-36.9	11.5	-18.7	-79.6	24	-37.0	12.6	-17.0	-85.9	50
450	-37.8	13.9	-26.6	-98.7	26	-33.3	17.6	25.8	-84.5	24	-35.6	15.8	25.8	-98.7	50
550	-38.0	10.7	-28.5	-65.0	26	-38.7	13.0	-27.2	-84.4	24	-38.3	11.7	-27.2	-84.4	50
650	-39.9	17.4	-22.2	-97.6	26	-37.4	21.0	16.9	-97.7	24	-38.7	19.1	16.9	-97.7	50
750	-31.7	11.3	9.4	-57.1	26	-37.1	15.3	-3.4	-83.1	24	-34.3	13.5	9.4	-83.1	50
850	-45.8	26.8	-24.1	-124.8	26	-41.3	19.8	-6.6	-99.5	24	-43.7	23.6	-6.6	-124.8	50
950	-41.9	15.3	-18.5	-83.6	26	-35.6	24.2	57.9	-94.3	24	-38.9	20.1	57.9	-94.3	50
1050	-39.3	25.7	-14.2	-160.9	26	-35.4	13.3	-12.0	-78.1	24	-37.4	20.6	-12.0	-160.9	50
1150	-38.5	16.7	-17.0	-96.5	26	-37.8	18.3	-15.0	-104.8	24	-38.2	17.3	-15.0	-104.8	50
1250	-32.4	13.3	8.9	-63.7	26	-38.5	10.3	-21.9	-58.0	24	-35.3	12.2	8.9	-63.7	50
1350	-29.6	14.7	9.3	-77.3	26	-36.6	14.1	2.5	-80.6	24	-33.0	14.7	9.3	-80.6	50
1450	-32.8	11.9	0.3	-60.1	26	-29.5	15.4	28.8	-50.5	24	-31.2	13.7	28.8	-60.1	50
1550	-32.3	11.2	-8.0	-70.6	26	-26.9	8.5	-7.2	-43.0	24	-29.7	10.3	-7.2	-70.6	50
1650	-31.9	10.9	-0.4	-53.1	26	-26.8	11.4	12.6	-39.9	24	-29.4	11.3	12.6	-53.1	50
1750	-30.7	9.6	-22.6	-67.2	26	-26.4	11.9	9.5	-48.2	24	-28.7	10.9	9.5	-67.2	50
1850	-31.5	10.6	-7.6	-55.6	26	-29.8	7.0	-18.8	-53.6	24	-30.7	9.0	-7.6	-55.6	50
1950	-26.3	6.2	-7.3	-37.0	26	-31.1	8.6	-22.0	-64.4	24	-28.6	7.8	-7.3	-64.4	50

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

March 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-37.2	15.0	-10.8	-74.2	27	-72.8	33.4	-31.4	-131.0	16	-50.5	29.0	-10.8	-131.0	43
150	-29.0	6.5	-18.2	-47.0	27	-36.9	8.1	-27.1	-58.4	16	-31.9	8.0	-18.2	-58.4	43
250	-30.3	5.8	-21.9	-47.8	27	-33.9	5.6	-25.0	-43.3	16	-31.6	5.9	-21.9	-47.8	43
350	-30.9	6.1	-21.0	-44.3	27	-32.2	5.1	-25.9	-42.8	16	-31.4	5.7	-21.0	-44.3	43
450	-34.6	14.5	-23.0	-83.7	27	-31.8	7.2	-17.6	-49.1	16	-33.6	12.3	-17.6	-83.7	43
550	-34.0	10.4	-22.5	-75.7	27	-34.3	10.9	-22.0	-68.8	16	-34.1	10.4	-22.0	-75.7	43
650	-36.5	12.8	-23.3	-82.5	27	-32.0	8.0	-24.7	-59.0	16	-34.8	11.4	-23.3	-82.5	43
750	-32.7	11.5	-5.6	-65.4	27	-30.7	4.0	-26.7	-40.3	16	-31.9	9.4	-5.6	-65.4	43
850	-32.0	8.6	-17.4	-55.4	27	-31.4	6.4	-24.6	-49.7	16	-31.8	7.8	-17.4	-55.4	43
950	-31.8	7.0	-20.7	-46.1	27	-29.4	5.2	-17.9	-36.9	16	-30.9	6.4	-17.9	-46.1	43
1050	-30.7	7.0	-20.0	-50.5	27	-34.2	8.7	-21.0	-52.8	16	-32.0	7.8	-20.0	-52.8	43
1150	-34.9	16.5	-6.0	-90.6	27	-34.9	10.9	-22.8	-65.3	16	-34.9	14.5	-6.0	-90.6	43
1250	-36.6	21.3	-14.3	-116.5	27	-33.0	7.8	-23.2	-48.8	16	-35.2	17.5	-14.3	-116.5	43
1350	-33.1	8.9	-22.5	-62.7	27	-32.8	9.5	-19.4	-52.3	16	-33.0	9.0	-19.4	-62.7	43
1450	-30.0	7.5	-16.1	-46.1	27	-34.8	17.6	-19.0	-95.5	16	-31.8	12.3	-16.1	-95.5	43
1550	-29.4	8.6	1.6	-41.6	27	-28.1	4.4	-18.4	-35.7	16	-28.9	7.3	1.6	-41.6	43
1650	-32.3	9.7	-17.9	-56.0	27	-30.6	7.3	-20.9	-46.5	16	-31.6	8.8	-17.9	-56.0	43
1750	-27.6	10.5	6.4	-49.1	27	-28.5	6.9	-11.9	-38.9	16	-27.9	9.2	6.4	-49.1	43
1850	-28.5	6.9	-14.2	-49.9	27	-28.7	5.9	-18.2	-40.6	16	-28.6	6.5	-14.2	-49.9	43
1950	-29.8	10.9	8.0	-53.7	27	-30.4	5.7	-22.3	-42.3	16	-30.0	9.2	8.0	-53.7	43

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

April 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-37.0	21.8	17.7	-93.4	22	-89.0	45.5	-45.9	-182.5	16	-58.9	42.2	17.7	-182.5	38
150	-29.8	9.3	-18.6	-58.6	22	-44.9	23.3	-26.8	-111.1	16	-36.1	18.1	-18.6	-111.1	38
250	-30.2	7.2	-22.3	-44.3	22	-39.2	15.0	-24.7	-82.9	16	-34.0	11.9	-22.3	-82.9	38
350	-29.5	8.0	-19.8	-47.9	22	-35.9	7.7	-21.1	-46.3	16	-32.2	8.4	-19.8	-47.9	38
450	-29.2	7.7	-20.5	-47.6	22	-34.7	6.0	-27.4	-44.8	16	-31.5	7.5	-20.5	-47.6	38
550	-31.5	8.5	-20.7	-52.6	22	-32.0	7.9	-23.4	-46.3	16	-31.7	8.1	-20.7	-52.6	38
650	-31.7	15.3	-20.2	-90.3	22	-36.6	18.0	-23.5	-84.4	16	-33.7	16.5	-20.2	-90.3	38
750	-27.7	13.3	15.9	-58.0	22	-34.9	12.5	-17.3	-60.2	16	-30.7	13.3	15.9	-60.2	38
850	-31.7	8.3	-18.1	-48.7	22	-34.5	17.9	-17.4	-88.0	16	-32.9	13.1	-17.4	-88.0	38
950	-32.0	12.9	-13.6	-74.6	22	-30.7	7.2	-20.7	-45.5	16	-31.5	10.7	-13.6	-74.6	38
1050	-31.6	10.7	-23.5	-73.1	22	-32.4	8.4	-22.7	-52.8	16	-31.9	9.7	-22.7	-73.1	38
1150	-31.9	11.5	-16.0	-63.5	22	-29.3	8.5	-15.2	-44.1	16	-30.8	10.3	-15.2	-63.5	38
1250	-32.7	12.4	-18.8	-72.0	22	-33.8	9.5	-21.7	-56.1	16	-33.1	11.2	-18.8	-72.0	38
1350	-32.9	14.3	-18.0	-83.8	22	-34.2	15.3	-21.7	-84.1	16	-33.4	14.5	-18.0	-84.1	38
1450	-28.5	7.2	-15.0	-43.7	22	-34.2	19.9	-17.8	-88.0	16	-30.9	14.1	-15.0	-88.0	38
1550	-28.6	5.4	-18.9	-37.8	22	-28.0	10.3	-3.8	-50.6	16	-28.3	7.7	-3.8	-50.6	38
1650	-31.7	8.7	-15.3	-52.6	22	-23.5	11.0	14.2	-33.3	16	-28.3	10.4	14.2	-52.6	38
1750	-31.3	12.0	-14.2	-76.9	22	-27.6	5.3	-16.4	-37.0	16	-29.7	9.9	-14.2	-76.9	38
1850	-34.3	14.4	-18.3	-73.4	22	-37.1	20.1	-15.7	-86.9	16	-35.5	16.8	-15.7	-86.9	38
1950	-31.4	12.0	-15.9	-73.7	22	-32.9	9.3	-21.5	-56.0	16	-32.0	10.9	-15.9	-73.7	38

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

May 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-18.6	31.9	67.6	-82.7	23	-73.6	35.8	-23.8	-148.3	15	-40.3	42.8	67.6	-148.3	38
150	-23.0	9.0	9.4	-41.1	23	-43.7	18.6	-24.4	-97.6	15	-31.2	16.9	9.4	-97.6	38
250	-23.9	5.3	-15.0	-37.2	23	-36.2	8.4	-24.5	-52.1	15	-28.7	9.0	-15.0	-52.1	38
350	-26.0	4.6	-19.9	-38.8	23	-42.6	23.2	-15.4	-101.6	15	-32.6	16.8	-15.4	-101.6	38
450	-24.1	4.9	-16.1	-37.9	23	-42.2	29.8	-19.4	-143.8	15	-31.2	20.8	-16.1	-143.8	38
550	-25.7	4.5	-17.8	-39.7	23	-31.3	10.6	-13.6	-51.1	15	-27.9	7.9	-13.6	-51.1	38
650	-25.4	13.9	3.8	-75.7	23	-28.8	11.8	-0.9	-46.4	15	-26.8	13.0	3.8	-75.7	38
750	-29.9	20.1	8.8	-106.7	23	-34.1	19.9	-12.7	-79.2	15	-31.6	19.9	8.8	-106.7	38
850	-29.9	14.8	-6.3	-74.5	23	-38.4	26.8	-18.8	-93.5	15	-33.3	20.5	-6.3	-93.5	38
950	-26.8	26.5	36.8	-98.2	23	-33.8	18.7	-12.7	-85.3	15	-29.6	23.7	36.8	-98.2	38
1050	-25.9	17.3	29.0	-55.9	23	-25.3	7.4	-11.9	-43.2	15	-25.6	14.1	29.0	-55.9	38
1150	-26.6	13.7	25.7	-49.8	23	-23.7	15.0	22.7	-40.1	15	-25.4	14.1	25.7	-49.8	38
1250	-30.1	16.4	-5.6	-86.0	23	-29.4	14.1	-8.2	-72.4	15	-29.9	15.4	-5.6	-86.0	38
1350	-24.1	5.3	-15.5	-37.7	23	-30.5	8.0	-15.3	-45.9	15	-26.7	7.1	-15.3	-45.9	38
1450	-29.5	13.4	7.2	-59.4	23	-29.6	6.4	-20.7	-39.7	15	-29.6	11.1	7.2	-59.4	38
1550	-34.7	18.2	-20.3	-88.6	23	-31.9	10.3	-18.1	-52.7	15	-33.6	15.4	-18.1	-88.6	38
1650	-28.9	10.9	-7.0	-57.0	23	-28.4	9.1	-15.1	-54.0	15	-28.7	10.1	-7.0	-57.0	38
1750	-28.8	27.3	39.9	-123.5	23	-33.1	19.4	-20.2	-100.8	15	-30.5	24.3	39.9	-123.5	38
1850	-30.7	22.0	-9.8	-127.6	23	-32.9	13.9	-17.2	-59.3	15	-31.5	19.0	-9.8	-127.6	38
1950	-37.5	30.9	-10.2	-149.1	23	-24.3	7.4	-11.2	-37.4	15	-32.3	25.1	-10.2	-149.1	38

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

June 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-31.9	31.8	49.4	-96.9	26	-66.0	37.7	-17.9	-177.8	18	-45.8	38.0	49.4	-177.8	44
150	-23.5	8.6	7.7	-35.3	26	-43.5	14.4	-21.1	-88.2	18	-31.7	14.9	7.7	-88.2	44
250	-27.1	6.2	-16.6	-41.4	26	-37.9	12.2	-16.7	-62.6	18	-31.5	10.5	-16.6	-62.6	44
350	-27.3	5.3	-16.4	-41.3	26	-45.4	26.3	-25.8	-122.4	18	-34.7	19.3	-16.4	-122.4	44
450	-26.9	5.4	-19.4	-36.3	26	-39.3	12.7	-25.1	-77.9	18	-32.0	10.9	-19.4	-77.9	44
550	-29.3	17.3	-20.1	-109.6	26	-34.6	24.6	34.2	-80.1	18	-31.5	20.5	34.2	-109.6	44
650	-29.1	17.2	-14.7	-98.1	26	-28.5	12.8	4.9	-45.7	18	-28.8	15.4	4.9	-98.1	44
750	-30.6	11.0	-19.7	-68.7	26	-28.1	10.7	-8.3	-50.3	18	-29.6	10.8	-8.3	-68.7	44
850	-26.7	10.9	-5.6	-64.2	26	-33.6	15.9	-14.8	-68.8	18	-29.5	13.5	-5.6	-68.8	44
950	-28.9	10.5	-19.5	-65.6	26	-30.9	9.8	-15.9	-49.9	18	-29.7	10.2	-15.9	-65.6	44
1050	-28.2	9.2	-11.9	-50.3	26	-33.0	13.2	-15.7	-70.1	18	-30.2	11.1	-11.9	-70.1	44
1150	-20.6	21.9	59.3	-42.3	26	-33.7	16.5	-12.2	-91.8	18	-26.0	20.7	59.3	-91.8	44
1250	-21.9	17.9	37.1	-57.9	26	-28.3	11.3	-6.7	-60.1	18	-24.5	15.7	37.1	-60.1	44
1350	-34.7	24.7	-3.7	-139.6	26	-22.1	25.8	78.4	-41.1	18	-29.5	25.6	78.4	-139.6	44
1450	-28.3	12.4	-13.0	-71.3	26	-30.7	8.3	-20.8	-56.6	18	-29.2	10.9	-13.0	-71.3	44
1550	-27.5	18.6	25.4	-92.6	26	-33.5	13.3	-20.9	-80.4	18	-30.0	16.8	25.4	-92.6	44
1650	-29.9	9.8	-18.7	-62.6	26	-27.8	9.9	-11.2	-51.5	18	-29.1	9.8	-11.2	-62.6	44
1750	-35.2	20.1	12.2	-79.8	26	-28.8	20.2	8.3	-99.1	18	-32.6	20.1	12.2	-99.1	44
1850	-36.6	26.8	14.8	-93.0	26	-33.9	30.9	3.9	-152.0	18	-35.5	28.2	14.8	-152.0	44
1950	-32.9	19.3	10.5	-75.8	26	-30.8	13.4	-1.6	-71.3	18	-32.0	17.0	10.5	-75.8	44

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

July 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-12.4	32.2	42.9	-84.2	27	-102.4	59.3	13.3	-224.7	18	-48.4	62.9	42.9	-224.7	45
150	-25.4	8.9	-8.9	-42.2	27	-47.4	21.8	-15.8	-79.2	18	-34.2	18.7	-8.9	-79.2	45
250	-25.3	6.8	-12.3	-39.1	27	-35.3	20.5	-0.1	-71.6	18	-29.3	14.6	-0.1	-71.6	45
350	-25.0	7.1	-8.8	-45.1	27	-37.0	35.2	46.1	-126.4	18	-29.8	23.3	46.1	-126.4	45
450	-22.9	8.4	-5.4	-51.1	27	-43.9	35.9	3.5	-151.2	18	-31.3	25.5	3.5	-151.2	45
550	-28.4	23.6	1.3	-127.8	27	-49.4	40.3	6.5	-135.3	18	-36.8	32.6	6.5	-135.3	45
650	-25.2	8.8	-11.3	-49.8	27	-40.6	19.8	-6.1	-90.7	18	-31.3	16.0	-6.1	-90.7	45
750	-25.4	14.5	3.8	-76.3	27	-57.3	53.2	-20.1	-240.6	18	-38.2	38.3	3.8	-240.6	45
850	-29.5	17.8	1.4	-102.5	27	-28.4	21.0	2.7	-75.9	18	-29.1	18.9	2.7	-102.5	45
950	-28.9	18.3	14.8	-92.9	27	-36.6	32.7	6.5	-134.9	18	-32.0	25.0	14.8	-134.9	45
1050	-33.2	16.9	-12.1	-76.1	27	-36.7	22.5	17.9	-88.3	18	-34.6	19.2	17.9	-88.3	45
1150	-30.0	20.1	15.4	-96.9	27	-33.3	16.6	-15.7	-79.7	18	-31.3	18.7	15.4	-96.9	45
1250	-33.4	17.5	-14.5	-102.9	27	-32.1	19.3	-0.3	-88.4	18	-32.9	18.0	-0.3	-102.9	45
1350	-38.8	28.1	-16.9	-162.8	27	-31.5	18.5	-0.4	-66.9	18	-35.9	24.7	-0.4	-162.8	45
1450	-43.8	30.6	-12.2	-160.1	27	-26.3	25.3	36.4	-100.7	18	-36.8	29.6	36.4	-160.1	45
1550	-57.8	47.6	-7.5	-211.5	27	-26.0	22.4	15.5	-70.5	18	-45.1	42.2	15.5	-211.5	45
1650	-44.7	53.5	64.2	-215.6	27	-33.6	27.3	-1.8	-125.7	18	-40.3	44.8	64.2	-215.6	45
1750	-43.8	38.4	24.8	-134.9	27	-28.4	23.0	4.2	-105.3	18	-37.7	33.7	24.8	-134.9	45
1850	-36.0	26.7	21.4	-132.5	27	-28.4	23.4	-8.8	-114.0	18	-32.9	25.4	21.4	-132.5	45
1950	-21.8	29.3	105.7	-51.6	27	-32.1	30.2	42.3	-95.0	18	-25.9	29.8	105.7	-95.0	45

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

August 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-23.8	38.0	39.2	-102.7	27	-86.3	53.4	38.7	-170.5	17	-48.0	53.7	39.2	-170.5	44
150	-25.7	9.8	-6.2	-52.7	27	-45.5	17.7	-1.3	-70.7	17	-33.3	16.4	-1.3	-70.7	44
250	-28.0	9.3	-17.6	-64.6	27	-40.4	27.1	-4.4	-130.4	17	-32.8	19.1	-4.4	-130.4	44
350	-25.7	8.7	-15.0	-53.8	27	-52.7	44.8	-6.9	-192.5	17	-36.1	31.1	-6.9	-192.5	44
450	-29.1	8.2	-14.1	-46.8	27	-50.0	25.4	-15.6	-123.8	17	-37.2	19.6	-14.1	-123.8	44
550	-31.6	14.0	-14.2	-74.6	27	-35.4	28.7	58.3	-83.6	17	-33.1	20.7	58.3	-83.6	44
650	-34.2	19.5	-7.0	-94.3	27	-38.1	22.1	5.0	-85.6	17	-35.7	20.4	5.0	-94.3	44
750	-29.1	12.2	1.6	-59.0	27	-43.9	23.6	-23.8	-99.6	17	-34.8	18.7	1.6	-99.6	44
850	-30.3	7.2	-16.9	-45.0	27	-33.7	25.3	0.3	-122.6	17	-31.6	16.5	0.3	-122.6	44
950	-32.8	17.6	0.7	-104.0	27	-37.9	32.8	-4.6	-149.9	17	-34.8	24.4	0.7	-149.9	44
1050	-37.3	24.2	-14.2	-144.9	27	-27.0	20.9	25.5	-60.2	17	-33.3	23.3	25.5	-144.9	44
1150	-37.1	15.7	-12.5	-76.7	27	-25.9	24.1	52.6	-58.3	17	-32.7	19.9	52.6	-76.7	44
1250	-36.9	16.1	1.2	-71.6	27	-33.0	10.5	-17.6	-60.0	17	-35.4	14.2	1.2	-71.6	44
1350	-32.8	13.4	-6.0	-75.7	27	-33.1	10.6	-11.0	-55.0	17	-32.9	12.3	-6.0	-75.7	44
1450	-36.1	11.5	-6.1	-68.0	27	-36.6	22.4	-3.0	-108.6	17	-36.3	16.3	-3.0	-108.6	44
1550	-34.5	11.0	-15.9	-65.0	27	-32.0	16.1	5.3	-69.0	17	-33.5	13.1	5.3	-69.0	44
1650	-41.7	17.1	-13.2	-93.8	27	-35.8	11.4	-19.1	-64.8	17	-39.4	15.3	-13.2	-93.8	44
1750	-43.2	19.5	-18.3	-99.7	27	-34.1	8.9	-21.5	-52.5	17	-39.7	16.8	-18.3	-99.7	44
1850	-46.8	24.4	-18.3	-109.6	27	-33.8	7.2	-16.9	-44.8	17	-41.8	20.5	-16.9	-109.6	44
1950	-40.8	16.1	-5.0	-87.0	27	-39.4	14.9	-24.8	-92.0	17	-40.3	15.5	-5.0	-92.0	44

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

September 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-44.4	30.4	14.9	-98.4	26	-78.6	40.3	21.0	-180.7	18	-58.4	38.3	21.0	-180.7	44
150	-33.3	13.3	-11.3	-64.5	26	-49.3	19.4	-27.7	-85.7	18	-39.8	17.7	-11.3	-85.7	44
250	-31.0	12.4	-17.4	-74.2	26	-38.3	14.9	-20.8	-75.4	18	-34.0	13.8	-17.4	-75.4	44
350	-34.8	23.4	-18.7	-139.2	26	-37.3	18.9	-19.3	-95.6	18	-35.8	21.5	-18.7	-139.2	44
450	-36.0	18.9	-19.6	-103.9	26	-31.3	12.7	-2.7	-63.4	18	-34.1	16.6	-2.7	-103.9	44
550	-42.8	24.0	-21.2	-138.7	26	-37.3	16.7	-16.6	-83.9	18	-40.6	21.3	-16.6	-138.7	44
650	-38.5	19.9	-1.4	-114.7	26	-35.4	9.3	-10.8	-49.1	18	-37.2	16.3	-1.4	-114.7	44
750	-38.5	17.1	-11.7	-94.0	26	-34.6	9.1	-24.4	-57.3	18	-36.9	14.4	-11.7	-94.0	44
850	-36.2	10.3	-22.2	-74.5	26	-34.1	13.9	-16.6	-74.7	18	-35.3	11.8	-16.6	-74.7	44
950	-31.3	9.7	-13.3	-52.8	26	-35.2	12.5	-21.5	-75.9	18	-32.9	11.0	-13.3	-75.9	44
1050	-33.3	18.4	-0.5	-99.7	26	-38.5	20.5	-14.4	-98.9	18	-35.4	19.2	-0.5	-99.7	44
1150	-34.8	10.1	-11.9	-55.7	26	-33.8	11.8	-5.5	-62.7	18	-34.4	10.7	-5.5	-62.7	44
1250	-41.9	22.5	10.4	-91.5	26	-28.9	12.3	2.2	-45.4	18	-36.5	19.9	10.4	-91.5	44
1350	-35.6	17.3	28.5	-65.8	26	-34.2	16.6	-4.9	-81.1	18	-35.0	16.8	28.5	-81.1	44
1450	-35.2	21.0	42.1	-69.3	26	-40.8	30.5	-9.9	-132.0	18	-37.5	25.1	42.1	-132.0	44
1550	-36.7	24.5	6.1	-133.2	26	-40.6	26.1	-12.3	-136.9	18	-38.3	25.0	6.1	-136.9	44
1650	-31.8	10.3	-6.1	-68.3	26	-31.8	9.5	-7.1	-47.5	18	-31.8	9.9	-6.1	-68.3	44
1750	-29.7	9.9	6.7	-45.7	26	-31.4	10.0	-12.5	-61.5	18	-30.4	9.8	6.7	-61.5	44
1850	-31.1	14.9	12.5	-74.9	26	-27.8	26.5	71.2	-51.9	18	-29.7	20.2	71.2	-74.9	44
1950	-30.6	14.5	-2.6	-83.7	26	-28.9	18.3	6.1	-77.9	18	-29.9	16.0	6.1	-83.7	44

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

October 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-50.4	23.7	-10.7	-121.7	26	-61.9	30.2	-7.5	-121.6	17	-54.9	26.7	-7.5	-121.7	43
150	-29.6	7.9	-11.9	-42.2	26	-39.0	12.9	-18.9	-66.9	17	-33.3	11.0	-11.9	-66.9	43
250	-31.6	7.7	-20.0	-58.4	26	-43.6	21.6	-23.2	-113.2	17	-36.3	15.8	-20.0	-113.2	43
350	-34.3	13.0	-19.5	-88.6	26	-37.6	18.7	-21.3	-100.8	17	-35.6	15.4	-19.5	-100.8	43
450	-37.3	14.6	-22.2	-95.4	26	-37.2	13.1	-15.6	-63.5	17	-37.3	13.9	-15.6	-95.4	43
550	-37.9	14.5	-23.7	-88.7	26	-33.5	7.3	-23.3	-53.1	17	-36.2	12.3	-23.3	-88.7	43
650	-35.0	12.7	-22.4	-85.4	26	-28.6	15.8	13.8	-54.8	17	-32.5	14.2	13.8	-85.4	43
750	-35.1	11.9	-23.9	-76.3	26	-31.2	10.5	-5.3	-47.1	17	-33.5	11.4	-5.3	-76.3	43
850	-36.8	23.8	-2.9	-143.2	26	-33.9	13.3	-18.4	-69.9	17	-35.6	20.1	-2.9	-143.2	43
950	-38.7	31.4	-22.4	-182.2	26	-37.1	15.3	-22.0	-84.1	17	-38.0	26.0	-22.0	-182.2	43
1050	-35.7	13.1	-22.2	-74.6	26	-46.2	27.3	-24.2	-127.4	17	-39.9	20.3	-22.2	-127.4	43
1150	-34.3	12.3	-18.3	-82.8	26	-38.7	14.3	-22.6	-80.1	17	-36.0	13.1	-18.3	-82.8	43
1250	-34.8	11.7	-17.0	-66.2	26	-44.1	18.9	-24.9	-87.3	17	-38.5	15.4	-17.0	-87.3	43
1350	-35.5	12.0	-17.4	-64.9	26	-40.3	21.5	0.3	-88.6	17	-37.4	16.3	0.3	-88.6	43
1450	-35.4	19.6	-20.1	-124.3	26	-40.3	21.0	-19.7	-102.2	17	-37.4	20.1	-19.7	-124.3	43
1550	-33.3	14.5	-17.4	-95.4	26	-35.3	14.9	-22.8	-73.7	17	-34.1	14.5	-17.4	-95.4	43
1650	-31.4	8.4	-18.3	-51.2	26	-30.7	18.4	-5.2	-90.9	17	-31.2	13.1	-5.2	-90.9	43
1750	-29.6	6.9	-14.8	-48.8	26	-33.1	17.7	-9.6	-85.7	17	-31.0	12.3	-9.6	-85.7	43
1850	-26.3	15.4	34.9	-42.8	26	-31.1	8.1	-18.5	-54.4	17	-28.2	13.1	34.9	-54.4	43
1950	-31.9	21.3	17.8	-84.2	26	-34.8	13.9	-14.0	-70.1	17	-33.0	18.6	17.8	-84.2	43

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

November 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-63.1	24.9	-16.2	-137.4	26	-69.1	34.4	-34.6	-187.8	17	-65.5	28.8	-16.2	-187.8	43
150	-38.6	13.8	-19.6	-74.2	26	-44.9	17.7	-21.8	-89.3	17	-41.1	15.6	-19.6	-89.3	43
250	-38.7	11.4	-26.5	-79.1	26	-41.8	12.7	-28.9	-70.9	17	-39.9	11.9	-26.5	-79.1	43
350	-36.7	10.8	-19.2	-63.4	26	-39.5	10.2	-27.2	-62.1	17	-37.8	10.5	-19.2	-63.4	43
450	-36.5	10.5	-21.6	-63.6	26	-37.3	10.0	-16.3	-54.4	17	-36.8	10.2	-16.3	-63.6	43
550	-34.0	6.3	-23.2	-47.5	26	-33.3	8.2	-18.5	-48.8	17	-33.7	7.1	-18.5	-48.8	43
650	-33.8	8.4	-21.6	-58.8	26	-32.1	8.5	-18.1	-48.0	17	-33.1	8.4	-18.1	-58.8	43
750	-32.7	7.4	-22.3	-49.7	26	-34.0	8.1	-22.2	-58.6	17	-33.2	7.6	-22.2	-58.6	43
850	-33.0	9.4	-13.8	-50.0	26	-33.3	11.7	-13.4	-66.8	17	-33.1	10.2	-13.4	-66.8	43
950	-30.6	8.7	-13.6	-52.2	26	-35.8	14.8	-9.6	-71.6	17	-32.6	11.7	-9.6	-71.6	43
1050	-35.8	15.6	-18.2	-80.6	26	-29.9	12.4	-1.9	-52.2	17	-33.5	14.6	-1.9	-80.6	43
1150	-36.4	17.0	-21.3	-90.6	26	-27.4	20.2	35.2	-68.8	17	-32.9	18.7	35.2	-90.6	43
1250	-39.0	25.3	-18.2	-139.5	26	-26.3	23.4	53.0	-64.8	17	-34.0	25.1	53.0	-139.5	43
1350	-35.7	19.8	4.5	-112.8	26	-28.2	7.6	-13.9	-42.1	17	-32.7	16.4	4.5	-112.8	43
1450	-39.8	19.1	-11.3	-88.9	26	-34.7	17.8	-21.4	-95.5	17	-37.8	18.6	-11.3	-95.5	43
1550	-31.3	12.4	23.5	-44.3	26	-39.8	23.3	-22.9	-121.4	17	-34.7	17.8	23.5	-121.4	43
1650	-33.0	6.7	-19.6	-45.2	26	-37.6	14.9	-15.9	-73.1	17	-34.9	10.8	-15.9	-73.1	43
1750	-31.7	8.5	-6.2	-53.1	26	-33.9	9.0	-22.4	-54.0	17	-32.6	8.7	-6.2	-54.0	43
1850	-34.6	7.8	-23.7	-56.4	26	-29.4	9.1	-13.4	-59.1	17	-32.5	8.6	-13.4	-59.1	43
1950	-35.1	10.7	-13.7	-64.1	26	-32.2	17.0	13.6	-58.9	17	-34.0	13.4	13.6	-64.1	43

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

December 1994

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-60.7	18.1	-41.9	-125.9	21	-67.5	21.0	-44.3	-120.7	22	-64.2	19.7	-41.9	-125.9	43
150	-44.3	22.0	-18.8	-85.3	21	-36.1	13.4	-18.5	-70.6	22	-40.1	18.4	-18.5	-85.3	43
250	-42.9	19.2	-20.0	-93.3	21	-37.7	12.0	-22.8	-73.1	22	-40.2	15.9	-20.0	-93.3	43
350	-44.1	19.0	-22.3	-93.5	21	-37.9	14.8	-25.2	-86.4	22	-40.9	17.0	-22.3	-93.5	43
450	-39.6	10.4	-21.4	-62.0	21	-40.2	13.9	-23.2	-78.6	22	-39.9	12.2	-21.4	-78.6	43
550	-36.9	8.6	-24.0	-57.6	21	-41.4	11.9	-30.0	-76.4	22	-39.2	10.6	-24.0	-76.4	43
650	-36.1	9.8	-22.9	-62.3	21	-39.4	10.9	-21.7	-63.9	22	-37.8	10.4	-21.7	-63.9	43
750	-38.4	23.6	-21.6	-136.5	21	-38.8	9.5	-28.6	-61.0	22	-38.6	17.6	-21.6	-136.5	43
850	-37.0	18.6	-22.5	-111.7	21	-34.6	6.5	-24.2	-56.6	22	-35.8	13.7	-22.5	-111.7	43
950	-35.2	9.3	-21.6	-54.9	21	-39.8	17.9	-26.8	-100.5	22	-37.6	14.4	-21.6	-100.5	43
1050	-39.9	24.2	-18.6	-132.9	21	-39.5	20.9	-18.4	-127.0	22	-39.7	22.3	-18.4	-132.9	43
1150	-35.7	12.4	-24.0	-72.9	21	-40.2	20.8	-24.0	-126.7	22	-38.0	17.2	-24.0	-126.7	43
1250	-37.6	22.0	28.1	-94.8	21	-32.5	9.8	-16.2	-66.3	22	-35.0	16.9	28.1	-94.8	43
1350	-36.3	10.8	-12.5	-60.0	21	-28.6	8.0	-4.1	-36.8	22	-32.4	10.1	-4.1	-60.0	43
1450	-35.5	14.1	-1.1	-67.7	21	-31.2	5.0	-23.5	-41.4	22	-33.3	10.6	-1.1	-67.7	43
1550	-29.5	7.5	-12.6	-43.8	21	-30.3	5.1	-14.1	-41.6	22	-29.9	6.3	-12.6	-43.8	43
1650	-31.0	10.9	-15.2	-61.5	21	-27.3	9.3	1.6	-41.8	22	-29.1	10.2	1.6	-61.5	43
1750	-33.3	12.6	-21.8	-73.6	21	-28.6	7.8	-7.0	-45.3	22	-30.9	10.6	-7.0	-73.6	43
1850	-28.3	12.2	13.4	-48.4	21	-29.0	7.8	-12.4	-46.1	22	-28.7	10.0	13.4	-48.4	43
1950	-31.9	10.6	-20.8	-65.2	21	-29.9	11.4	-12.0	-60.0	22	-30.9	10.9	-12.0	-65.2	43

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

January 1995

hour	12					00					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-52.0	18.6	-25.7	-99.1	26	-54.0	14.9	-37.6	-77.8	8	-52.5	17.6	-25.7	-99.1	34
150	-41.2	14.9	-25.7	-74.6	26	-42.0	13.9	-31.2	-66.6	8	-41.4	14.5	-25.7	-74.6	34
250	-38.8	12.0	-25.3	-71.1	26	-40.0	18.6	-20.6	-78.6	8	-39.1	13.5	-20.6	-78.6	34
350	-37.3	10.2	-28.2	-81.7	26	-37.7	8.1	-30.8	-53.8	8	-37.4	9.7	-28.2	-81.7	34
450	-37.1	10.5	-21.3	-77.7	26	-39.5	14.8	-28.7	-74.5	8	-37.6	11.4	-21.3	-77.7	34
550	-36.1	7.9	-24.8	-59.1	26	-30.8	3.7	-26.0	-37.4	8	-34.8	7.4	-24.8	-59.1	34
650	-36.9	8.8	-26.3	-63.5	26	-30.3	2.9	-25.1	-34.9	8	-35.3	8.3	-25.1	-63.5	34
750	-35.7	9.9	-25.8	-74.5	26	-34.3	5.9	-28.5	-47.2	8	-35.4	9.0	-25.8	-74.5	34
850	-35.7	12.9	-26.0	-84.5	26	-34.9	6.8	-24.9	-47.7	8	-35.5	11.6	-24.9	-84.5	34
950	-35.4	14.5	-13.0	-99.8	26	-39.0	14.3	-29.6	-71.8	8	-36.3	14.3	-13.0	-99.8	34
1050	-35.5	8.6	-17.3	-50.6	26	-34.5	9.8	-18.3	-53.4	8	-35.3	8.8	-17.3	-53.4	34
1150	-34.5	9.3	-19.0	-62.6	26	-37.4	6.2	-31.3	-49.1	8	-35.2	8.6	-19.0	-62.6	34
1250	-37.8	22.7	-13.1	-127.0	26	-36.4	10.6	-17.6	-53.5	8	-37.5	20.4	-13.1	-127.0	34
1350	-37.6	23.1	-11.6	-129.5	26	-29.4	10.5	-12.5	-49.3	8	-35.7	20.9	-11.6	-129.5	34
1450	-36.5	20.1	-16.2	-116.5	26	-40.3	16.3	-22.8	-74.0	8	-37.4	19.1	-16.2	-116.5	34
1550	-32.3	12.0	-20.4	-80.4	26	-32.1	15.4	-3.0	-58.2	8	-32.3	12.6	-3.0	-80.4	34
1650	-28.5	13.6	21.9	-52.6	26	-35.5	10.2	-28.1	-59.2	8	-30.1	13.1	21.9	-59.2	34
1750	-31.7	13.6	-3.6	-84.2	26	-33.6	10.3	-23.6	-54.1	8	-32.1	12.8	-3.6	-84.2	34
1850	-30.4	7.3	-14.8	-43.3	26	-28.2	8.4	-19.3	-46.0	8	-29.9	7.5	-14.8	-46.0	34
1950	-27.9	3.7	-20.8	-34.9	26	-25.9	5.2	-21.0	-35.1	8	-27.5	4.1	-20.8	-35.1	34

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

February 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-48.3	29.3	-5.0	-66.9	4	-59.6	25.4	-26.0	-131.8	28	-58.2	25.7	-5.0	-131.8	32
150	-31.7	6.2	-22.5	-35.5	4	-42.0	13.6	-22.7	-72.1	28	-40.7	13.3	-22.5	-72.1	32
250	-37.1	7.0	-30.2	-46.9	4	-38.7	9.7	-26.1	-67.0	28	-38.5	9.4	-26.1	-67.0	32
350	-36.5	5.3	-30.3	-43.1	4	-39.6	11.3	-27.8	-86.0	28	-39.2	10.7	-27.8	-86.0	32
450	-34.5	2.4	-33.0	-38.0	4	-35.5	7.9	-15.2	-50.4	28	-35.4	7.4	-15.2	-50.4	32
550	-34.4	4.2	-30.6	-38.5	4	-34.2	8.6	-17.5	-58.4	28	-34.2	8.2	-17.5	-58.4	32
650	-37.8	4.9	-31.0	-42.6	4	-35.5	10.5	-22.9	-66.3	28	-35.8	9.9	-22.9	-66.3	32
750	-38.1	2.8	-34.6	-40.8	4	-34.5	8.3	-11.9	-56.3	28	-34.9	7.9	-11.9	-56.3	32
850	-36.3	2.9	-32.4	-39.3	4	-31.1	8.1	-10.2	-47.3	28	-31.8	7.8	-10.2	-47.3	32
950	-32.4	3.8	-27.7	-36.4	4	-30.5	5.8	-20.7	-43.3	28	-30.8	5.6	-20.7	-43.3	32
1050	-30.4	5.2	-24.3	-34.8	4	-32.9	10.2	-20.4	-78.5	28	-32.6	9.7	-20.4	-78.5	32
1150	-31.8	5.7	-26.8	-37.4	4	-32.6	8.1	-10.8	-59.3	28	-32.5	7.8	-10.8	-59.3	32
1250	-30.6	4.0	-25.1	-33.9	4	-33.3	5.9	-24.6	-45.3	28	-33.0	5.7	-24.6	-45.3	32
1350	-32.1	5.8	-24.3	-38.2	4	-32.4	9.7	-15.6	-64.1	28	-32.3	9.2	-15.6	-64.1	32
1450	-32.8	5.3	-26.1	-39.0	4	-27.5	9.8	10.4	-41.5	28	-28.2	9.5	10.4	-41.5	32
1550	-28.3	5.3	-24.6	-36.1	4	-30.0	7.8	-12.4	-56.7	28	-29.8	7.5	-12.4	-56.7	32
1650	-27.3	4.4	-23.3	-33.6	4	-30.9	5.9	-23.2	-47.4	28	-30.5	5.8	-23.2	-47.4	32
1750	-28.7	1.4	-27.4	-30.3	4	-35.1	15.8	-23.0	-103.4	28	-34.3	14.9	-23.0	-103.4	32
1850	-28.5	1.4	-26.9	-30.2	4	-32.6	13.1	-20.1	-92.1	28	-32.1	12.3	-20.1	-92.1	32
1950	-29.1	0.4	-28.8	-29.6	4	-30.8	8.7	-15.6	-55.9	28	-30.6	8.1	-15.6	-55.9	32

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.
note change in observation hours from this month on

March 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-44.2	17.5	-24.0	-69.9	6	-60.6	23.6	-34.5	-146.0	31	-57.9	23.3	-24.0	-146.0	37
150	-31.4	4.8	-26.8	-39.4	6	-36.5	9.3	-24.4	-62.2	31	-35.7	8.9	-24.4	-62.2	37
250	-32.0	4.5	-27.1	-38.5	6	-34.8	7.4	-23.8	-58.3	31	-34.3	7.0	-23.8	-58.3	37
350	-34.5	6.2	-24.3	-42.3	6	-36.0	11.3	-21.8	-74.4	31	-35.7	10.6	-21.8	-74.4	37
450	-33.1	6.2	-23.4	-38.6	6	-35.3	8.4	-18.7	-58.6	31	-35.0	8.0	-18.7	-58.6	37
550	-32.2	6.4	-23.9	-39.1	6	-35.6	8.7	-9.8	-55.7	31	-35.1	8.4	-9.8	-55.7	37
650	-40.0	21.7	-27.3	-83.4	6	-34.0	7.6	-19.3	-55.0	31	-35.0	10.9	-19.3	-83.4	37
750	-35.9	8.1	-25.5	-49.5	6	-34.7	10.2	-18.3	-71.6	31	-34.9	9.8	-18.3	-71.6	37
850	-34.8	6.9	-25.2	-43.6	6	-35.4	10.5	-14.4	-71.2	31	-35.3	10.0	-14.4	-71.2	37
950	-35.0	13.7	-24.2	-61.4	6	-33.0	9.6	-19.5	-65.9	31	-33.3	10.2	-19.5	-65.9	37
1050	-27.4	4.5	-23.2	-33.8	6	-33.7	7.4	-21.9	-57.0	31	-32.6	7.4	-21.9	-57.0	37
1150	-28.2	4.3	-24.6	-36.4	6	-31.0	4.1	-22.1	-39.5	31	-30.5	4.2	-22.1	-39.5	37
1250	-27.0	1.9	-25.4	-30.7	6	-28.0	10.7	25.6	-39.7	31	-27.8	9.8	25.6	-39.7	37
1350	-31.3	6.8	-25.3	-40.6	6	-32.4	12.7	-17.3	-94.3	31	-32.2	11.8	-17.3	-94.3	37
1450	-32.2	12.3	-23.0	-56.0	6	-32.1	7.4	-23.1	-56.5	31	-32.1	8.2	-23.0	-56.5	37
1550	-32.4	11.8	-18.7	-48.0	6	-33.2	14.7	-11.6	-105.9	31	-33.1	14.1	-11.6	-105.9	37
1650	-32.2	6.9	-21.8	-43.0	6	-35.3	18.0	-20.3	-121.3	31	-34.8	16.7	-20.3	-121.3	37
1750	-39.8	19.5	-24.0	-76.1	6	-33.4	7.9	-23.0	-53.4	31	-34.4	10.5	-23.0	-76.1	37
1850	-32.5	3.3	-28.2	-36.8	6	-30.9	10.2	0.8	-59.3	31	-31.2	9.4	0.8	-59.3	37
1950	-35.0	12.4	-22.8	-56.1	6	-29.1	7.4	-6.8	-46.3	31	-30.0	8.5	-6.8	-56.1	37

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

April 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-54.1	20.4	-39.7	-68.5	2	-69.6	25.0	-34.2	-119.8	21	-68.3	24.6	-34.2	-119.8	23
150	-29.0	5.7	-25.0	-33.0	2	-38.9	11.8	-24.6	-70.4	21	-38.1	11.7	-24.6	-70.4	23
250	-33.2	10.5	-25.7	-40.6	2	-35.4	5.0	-26.5	-47.8	21	-35.2	5.3	-25.7	-47.8	23
350	-28.1	4.5	-24.9	-31.3	2	-37.2	14.1	-9.3	-81.5	21	-36.4	13.8	-9.3	-81.5	23
450	-29.4	6.6	-24.7	-34.1	2	-37.5	18.5	-11.8	-78.6	21	-36.8	17.9	-11.8	-78.6	23
550	-29.7	1.3	-28.8	-30.6	2	-33.1	13.0	-6.2	-62.8	21	-32.8	12.4	-6.2	-62.8	23
650	-32.2	8.2	-26.4	-38.0	2	-31.9	15.1	6.7	-79.5	21	-31.9	14.5	6.7	-79.5	23
750	-30.6	7.3	-25.5	-35.8	2	-30.5	11.7	-12.7	-72.0	21	-30.5	11.3	-12.7	-72.0	23
850	-30.0	7.4	-24.8	-35.3	2	-29.4	10.2	-9.3	-59.8	21	-29.4	9.8	-9.3	-59.8	23
950	-32.7	2.6	-30.8	-34.5	2	-30.6	5.4	-18.0	-39.4	21	-30.8	5.3	-18.0	-39.4	23
1050	-28.3	9.1	-21.9	-34.7	2	-33.1	12.5	-4.1	-65.3	21	-32.7	12.1	-4.1	-65.3	23
1150	-30.9	2.7	-29.0	-32.8	2	-34.2	12.0	-23.2	-71.4	21	-33.9	11.5	-23.2	-71.4	23
1250	-31.7	5.7	-27.7	-35.7	2	-34.5	10.0	-13.7	-59.7	21	-34.3	9.6	-13.7	-59.7	23
1350	-30.3	4.1	-27.4	-33.2	2	-32.3	7.3	-18.7	-52.2	21	-32.2	7.1	-18.7	-52.2	23
1450	-29.7	4.0	-26.9	-32.6	2	-30.4	7.0	-14.6	-43.7	21	-30.4	6.7	-14.6	-43.7	23
1550	-37.3	3.9	-34.6	-40.1	2	-30.5	6.0	-19.8	-41.1	21	-31.1	6.1	-19.8	-41.1	23
1650	-33.8	3.5	-31.4	-36.3	2	-28.3	4.7	-19.4	-38.2	21	-28.8	4.8	-19.4	-38.2	23
1750	-26.7	8.5	-20.7	-32.7	2	-30.1	6.8	-21.0	-46.9	21	-29.8	6.8	-20.7	-46.9	23
1850	-25.9	11.2	-18.0	-33.8	2	-30.5	6.1	-18.4	-43.6	21	-30.1	6.4	-18.0	-43.6	23
1950	-28.5	3.9	-25.7	-31.2	2	-28.6	5.2	-15.6	-38.4	21	-28.6	5.0	-15.6	-38.4	23

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

May 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50					0	-86.1	21.9	-32.9	-121.1	15	-86.1	21.9	-32.9	-121.1	15
150					0	-31.2	11.9	-14.9	-55.2	15	-31.2	11.9	-14.9	-55.2	15
250					0	-36.6	14.7	-22.8	-76.6	15	-36.6	14.7	-22.8	-76.6	15
350					0	-34.8	10.7	-19.6	-56.8	15	-34.8	10.7	-19.6	-56.8	15
450					0	-42.6	30.2	-20.0	-140.0	15	-42.6	30.2	-20.0	-140.0	15
550					0	-32.6	19.5	-7.0	-85.0	15	-32.6	19.5	-7.0	-85.0	15
650					0	-31.6	12.9	-13.3	-68.0	15	-31.6	12.9	-13.3	-68.0	15
750					0	-35.9	7.1	-24.0	-52.1	15	-35.9	7.1	-24.0	-52.1	15
850					0	-40.3	13.2	-18.0	-72.0	15	-40.3	13.2	-18.0	-72.0	15
950					0	-32.5	16.7	14.8	-52.2	15	-32.5	16.7	14.8	-52.2	15
1050					0	-24.2	17.3	10.6	-45.1	15	-24.2	17.3	10.6	-45.1	15
1150					0	-25.8	22.8	20.0	-62.4	15	-25.8	22.8	20.0	-62.4	15
1250					0	-34.0	7.6	-16.3	-46.0	15	-34.0	7.6	-16.3	-46.0	15
1350					0	-45.9	21.8	-19.3	-99.2	15	-45.9	21.8	-19.3	-99.2	15
1450					0	-41.7	22.0	-16.0	-95.8	15	-41.7	22.0	-16.0	-95.8	15
1550					0	-35.0	23.2	20.8	-87.0	15	-35.0	23.2	20.8	-87.0	15
1650					0	-29.9	15.9	12.8	-52.5	15	-29.9	15.9	12.8	-52.5	15
1750					0	-28.1	11.6	5.3	-39.3	15	-28.1	11.6	5.3	-39.3	15
1850					0	-29.6	13.5	-4.7	-66.1	15	-29.6	13.5	-4.7	-66.1	15
1950					0	-33.6	13.4	1.3	-57.8	15	-33.6	13.4	1.3	-57.8	15

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

June 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-77.5	0	-77.5	-77.5	1	-109.0	35.5	-55.1	-192.5	21	-107.6	35.3	-55.1	-192.5	22
150	-47.1	0	-47.1	-47.1	1	-42.1	14.3	-21.4	-76.3	21	-42.3	14.0	-21.4	-76.3	22
250	-31.2	0	-31.2	-31.2	1	-41.6	12.4	-23.7	-65.7	21	-41.1	12.3	-23.7	-65.7	22
350	-29.9	0	-29.9	-29.9	1	-42.9	19.9	-5.4	-99.2	21	-42.3	19.7	-5.4	-99.2	22
450	-22.1	0	-22.1	-22.1	1	-48.1	20.1	-17.3	-83.6	21	-46.9	20.4	-17.3	-83.6	22
550	-37.3	0	-37.3	-37.3	1	-43.0	25.5	-15.0	-117.5	21	-42.7	24.9	-15.0	-117.5	22
650	-24.3	0	-24.3	-24.3	1	-43.8	26.1	-19.0	-115.7	21	-42.9	25.8	-19.0	-115.7	22
750	-18.5	0	-18.5	-18.5	1	-38.2	28.7	-3.0	-137.0	21	-37.3	28.3	-3.0	-137.0	22
850	-21.7	0	-21.7	-21.7	1	-32.1	11.1	-17.3	-63.1	21	-31.6	11.1	-17.3	-63.1	22
950	-19.0	0	-19.0	-19.0	1	-27.7	20.6	40.2	-79.3	21	-27.3	20.2	40.2	-79.3	22
1050	-24.1	0	-24.1	-24.1	1	-23.6	14.8	19.8	-46.3	21	-23.6	14.4	19.8	-46.3	22
1150	-64.9	0	-64.9	-64.9	1	-27.3	18.0	19.5	-73.3	21	-29.0	19.3	19.5	-73.3	22
1250	-59.7	0	-59.7	-59.7	1	-32.8	13.6	-10.9	-67.3	21	-34.0	14.5	-10.9	-67.3	22
1350	-59.1	0	-59.1	-59.1	1	-33.7	21.9	-7.0	-111.3	21	-34.9	22.0	-7.0	-111.3	22
1450	-49.4	0	-49.4	-49.4	1	-30.8	11.0	8.8	-48.7	21	-31.6	11.4	8.8	-49.4	22
1550	-39.7	0	-39.7	-39.7	1	-28.3	22.6	56.0	-52.6	21	-28.9	22.2	56.0	-52.6	22
1650	-29.4	0	-29.4	-29.4	1	-28.1	17.8	26.8	-63.7	21	-28.1	17.4	26.8	-63.7	22
1750	-32.5	0	-32.5	-32.5	1	-39.1	37.0	-4.5	-193.1	21	-38.8	36.1	-4.5	-193.1	22
1850	-54.4	0	-54.4	-54.4	1	-30.3	19.7	44.6	-61.3	21	-31.4	19.9	44.6	-61.3	22
1950	-63.8	0	-63.8	-63.8	1	-30.3	19.8	49.2	-50.2	21	-31.9	20.6	49.2	-63.8	22

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

July 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-101.2	21.9	-76.3	-117.5	3	-95.7	31.5	-15.8	-167.2	30	-96.2	30.5	-15.8	-167.2	33
150	-24.8	6.6	-17.2	-29.4	3	-45.8	28.7	2.7	-120.2	30	-43.9	28.1	2.7	-120.2	33
250	-28.6	16.0	-18.2	-47.1	3	-45.5	22.4	-5.8	-119.2	30	-43.9	22.3	-5.8	-119.2	33
350	-26.3	10.2	-19.3	-38.0	3	-37.4	28.3	38.4	-126.4	30	-36.4	27.3	38.4	-126.4	33
450	-16.9	4.1	-12.8	-20.9	3	-41.2	19.5	-20.2	-108.3	30	-39.0	19.9	-12.8	-108.3	33
550	-21.9	6.5	-15.7	-28.6	3	-50.3	29.3	-13.9	-145.5	30	-47.7	29.1	-13.9	-145.5	33
650	-29.0	15.3	-12.6	-42.8	3	-39.6	26.9	26.8	-133.4	30	-38.7	26.0	26.8	-133.4	33
750	-36.7	2.3	-34.2	-38.7	3	-34.4	30.2	24.0	-131.7	30	-34.6	28.8	24.0	-131.7	33
850	-49.2	43.7	-20.0	-99.4	3	-30.0	24.1	11.1	-96.9	30	-31.8	26.0	11.1	-99.4	33
950	-45.9	33.7	-15.7	-82.2	3	-27.2	30.0	88.5	-75.6	30	-28.9	30.3	88.5	-82.2	33
1050	-43.6	45.2	-7.7	-94.4	3	-30.6	16.6	17.8	-81.0	30	-31.8	19.8	17.8	-94.4	33
1150	-20.7	10.7	-13.9	-33.0	3	-31.3	10.5	-9.0	-50.6	30	-30.3	10.8	-9.0	-50.6	33
1250	-36.8	34.5	-12.5	-76.3	3	-35.2	17.0	-8.2	-88.8	30	-35.3	18.3	-8.2	-88.8	33
1350	-23.5	25.9	-1.6	-52.1	3	-29.8	18.3	9.7	-71.4	30	-29.2	18.7	9.7	-71.4	33
1450	-45.7	35.0	-23.3	-86.0	3	-40.3	47.1	14.3	-276.8	30	-40.8	45.7	14.3	-276.8	33
1550	-42.5	28.9	-23.8	-75.8	3	-34.5	16.9	-1.8	-101.6	30	-35.2	17.8	-1.8	-101.6	33
1650	7.5	48.5	60.6	-34.4	3	-37.4	21.8	-3.8	-92.5	30	-33.3	27.3	60.6	-92.5	33
1750	-17.2	8.9	-8.1	-25.9	3	-34.0	23.5	17.2	-115.6	30	-32.5	23.0	17.2	-115.6	33
1850	-19.5	6.4	-13.0	-25.8	3	-35.5	28.7	1.4	-132.1	30	-34.1	27.8	1.4	-132.1	33
1950	-28.5	17.0	-18.3	-48.1	3	-37.1	30.9	-6.4	-157.5	30	-36.3	29.8	-6.4	-157.5	33

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

August 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	36.2	0	36.2	36.2	1	-104.7	47.2	11.5	-212.3	32	-100.5	52.5	36.2	-212.3	33
150	-36.2	0	-36.2	-36.2	1	-46.2	27.8	-11.3	-129.5	32	-45.9	27.5	-11.3	-129.5	33
250	-39.7	0	-39.7	-39.7	1	-47.9	31.8	-14.9	-174.3	32	-47.6	31.3	-14.9	-174.3	33
350	-29.2	0	-29.2	-29.2	1	-52.8	33.1	-3.6	-140.2	32	-52.1	32.9	-3.6	-140.2	33
450	-23.3	0	-23.3	-23.3	1	-48.4	39.1	-0.3	-209.5	32	-47.6	38.7	-0.3	-209.5	33
550	-20.6	0	-20.6	-20.6	1	-37.7	26.9	28.1	-88.9	32	-37.1	26.7	28.1	-88.9	33
650	-27.4	0	-27.4	-27.4	1	-36.1	28.0	62.2	-100.0	32	-35.8	27.6	62.2	-100.0	33
750	-26.4	0	-26.4	-26.4	1	-34.7	18.7	-5.6	-71.5	32	-34.5	18.5	-5.6	-71.5	33
850	-28.1	0	-28.1	-28.1	1	-34.1	33.1	16.1	-131.7	32	-33.9	32.5	16.1	-131.7	33
950	-24.9	0	-24.9	-24.9	1	-39.4	29.1	4.1	-140.2	32	-38.9	28.7	4.1	-140.2	33
1050	-21.9	0	-21.9	-21.9	1	-37.4	20.3	19.8	-78.2	32	-36.9	20.2	19.8	-78.2	33
1150	-37.3	0	-37.3	-37.3	1	-33.2	24.3	21.7	-98.1	32	-33.3	24.0	21.7	-98.1	33
1250	-37.9	0	-37.9	-37.9	1	-37.6	29.3	31.3	-130.7	32	-37.6	28.9	31.3	-130.7	33
1350	-34.9	0	-34.9	-34.9	1	-47.8	30.4	-15.7	-139.0	32	-47.4	30.0	-15.7	-139.0	33
1450	-33.4	0	-33.4	-33.4	1	-29.9	26.1	58.8	-80.2	32	-30.0	25.7	58.8	-80.2	33
1550	-43.4	0	-43.4	-43.4	1	-32.2	31.8	54.8	-119.0	32	-32.6	31.3	54.8	-119.0	33
1650	-60.5	0	-60.5	-60.5	1	-33.8	37.6	96.5	-172.7	32	-34.6	37.3	96.5	-172.7	33
1750	-49.8	0	-49.8	-49.8	1	-35.3	26.3	9.3	-118.5	32	-35.7	26.1	9.3	-118.5	33
1850	-51.8	0	-51.8	-51.8	1	-31.2	26.6	27.2	-145.5	32	-31.8	26.4	27.2	-145.5	33
1950	-37.1	0	-37.1	-37.1	1	-34.0	32.5	-0.6	-186.9	32	-34.1	32.0	-0.6	-186.9	33

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

September 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-71.0	28.4	-50.9	-91.1	2	-73.2	24.1	-13.2	-107.1	31	-73.1	23.8	-13.2	-107.1	33
150	-26.3	8.6	-20.2	-32.4	2	-41.4	11.7	-22.8	-73.1	31	-40.5	12.0	-20.2	-73.1	33
250	-52.7	28.6	-32.5	-72.9	2	-42.1	12.5	-28.7	-83.8	31	-42.7	13.4	-28.7	-83.8	33
350	-49.7	11.2	-41.7	-57.6	2	-37.9	20.3	-19.9	-132.3	31	-38.6	19.9	-19.9	-132.3	33
450	-72.9	2.5	-71.2	-74.7	2	-45.5	24.5	-24.3	-141.9	31	-47.2	24.6	-24.3	-141.9	33
550	-78.5	21.1	-63.6	-93.4	2	-38.0	11.7	-14.0	-75.2	31	-40.5	15.4	-14.0	-93.4	33
650	-1.6	48.3	32.6	-35.7	2	-38.6	16.3	-4.6	-91.0	31	-36.3	20.1	32.6	-91.0	33
750	-18.0	15.8	-6.8	-29.2	2	-42.2	26.3	-20.6	-129.9	31	-40.8	26.3	-6.8	-129.9	33
850	-39.7	12.9	-30.5	-48.8	2	-37.7	14.7	-6.8	-81.1	31	-37.8	14.4	-6.8	-81.1	33
950	-34.5	18.8	-21.2	-47.8	2	-37.8	17.1	10.8	-106.8	31	-37.6	16.9	10.8	-106.8	33
1050	-3.6	36.3	22.0	-29.3	2	-37.1	15.7	-0.6	-78.2	31	-35.1	18.4	22.0	-78.2	33
1150	-33.7	3.4	-31.3	-36.1	2	-36.2	21.2	9.3	-115.0	31	-36.1	20.5	9.3	-115.0	33
1250	-45.5	15.1	-34.8	-56.2	2	-40.5	41.1	-0.8	-249.2	31	-40.8	39.9	-0.8	-249.2	33
1350	-33.5	13.9	-23.7	-43.3	2	-36.3	15.8	-17.4	-79.5	31	-36.2	15.5	-17.4	-79.5	33
1450	-41.4	18.8	-28.1	-54.7	2	-29.7	11.9	-2.9	-50.9	31	-30.4	12.3	-2.9	-54.7	33
1550	-34.7	7.8	-29.2	-40.2	2	-34.4	30.1	29.0	-172.5	31	-34.4	29.2	29.0	-172.5	33
1650	-31.9	0.7	-31.4	-32.4	2	-34.9	19.3	5.6	-118.5	31	-34.7	18.7	5.6	-118.5	33
1750	-39.5	2.2	-38.0	-41.1	2	-33.4	20.9	56.9	-60.6	31	-33.8	20.3	56.9	-60.6	33
1850	-43.1	15.1	-32.4	-53.8	2	-33.3	30.8	3.4	-176.6	31	-33.9	30.1	3.4	-176.6	33
1950	-48.6	5.4	-44.8	-52.4	2	-32.1	16.0	13.9	-67.4	31	-33.1	16.0	13.9	-67.4	33

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

October 1995

hour	12					05					total				
h (m)	mean	sd	max	min	num	mean	sd	max	min	num	mean	sd	max	min	num
50	-36.9	33.3	-2.3	-68.7	3	-74.4	28.4	-31.2	-158.3	30	-71.0	30.3	-2.3	-158.3	33
150	-31.2	7.2	-23.1	-37.0	3	-37.8	15.6	-16.0	-85.9	30	-37.2	15.1	-16.0	-85.9	33
250	-31.6	5.8	-25.1	-36.4	3	-37.0	17.2	2.4	-109.5	30	-36.5	16.5	2.4	-109.5	33
350	-31.6	9.5	-22.0	-40.9	3	-40.4	14.0	-21.9	-97.5	30	-39.6	13.8	-21.9	-97.5	33
450	-32.8	7.9	-25.7	-41.3	3	-44.9	20.4	-26.3	-125.0	30	-43.8	19.8	-25.7	-125.0	33
550	-26.1	2.7	-24.0	-29.1	3	-42.4	16.3	-25.1	-98.7	30	-40.9	16.2	-24.0	-98.7	33
650	-27.4	8.2	-21.3	-36.8	3	-36.2	15.6	3.6	-77.3	30	-35.4	15.2	3.6	-77.3	33
750	-30.0	6.2	-25.0	-36.9	3	-37.5	18.2	-5.3	-97.6	30	-36.8	17.5	-5.3	-97.6	33
850	-36.9	3.7	-33.4	-40.8	3	-38.2	21.0	9.2	-99.6	30	-38.1	20.0	9.2	-99.6	33
950	-45.5	24.9	-24.8	-73.1	3	-35.5	15.2	-2.9	-67.8	30	-36.4	16.0	-2.9	-73.1	33
1050	-13.3	46.8	40.4	-45.1	3	-41.7	32.3	0.7	-180.5	30	-39.2	33.9	40.4	-180.5	33
1150	-44.2	41.1	-7.7	-88.8	3	-41.3	25.9	-9.5	-134.7	30	-41.6	26.7	-7.7	-134.7	33
1250	-47.4	14.5	-36.8	-63.9	3	-23.4	55.3	260.1	-72.4	30	-25.5	53.2	260.1	-72.4	33
1350	-40.9	6.5	-33.7	-46.5	3	-42.9	27.6	1.5	-144.0	30	-42.7	26.3	1.5	-144.0	33
1450	-31.5	3.3	-27.7	-33.6	3	-39.6	24.8	19.4	-124.8	30	-38.9	23.8	19.4	-124.8	33
1550	-29.6	10.4	-20.3	-40.9	3	-45.1	43.2	-2.5	-239.3	30	-43.7	41.4	-2.5	-239.3	33
1650	-26.0	9.0	-17.3	-35.3	3	-35.3	14.3	-5.3	-73.4	30	-34.4	14.1	-5.3	-73.4	33
1750	-33.1	4.6	-28.8	-38.0	3	-33.3	13.6	10.8	-62.7	30	-33.3	13.0	10.8	-62.7	33
1850	-35.1	3.8	-31.1	-38.7	3	-35.2	29.5	29.8	-151.3	30	-35.2	28.1	29.8	-151.3	33
1950	-37.8	12.9	-25.7	-51.3	3	-31.8	21.4	52.3	-83.2	30	-32.4	20.7	52.3	-83.2	33

Table 4.2.1 Mean refractivity gradients in N-units pr km, standard deviation and extremes.

4.3 Ray bending statistics

By Snell's rule, the curvature of a ray r" can be expressed to the necessary accuracy for most practical purposes as

$$1/r'' = 10^{-6}(dN/dz)$$

where N is the refractivity in N-units.

The condition dN/dz=0 implies a constant refractivity and no ray bending. In a well-mixed atmosphere, the value of dN/dz is such that a horizontal ray is bent downwards with a curvature roughly equal to one quarter that of the earth's surface. In such a well-mixed atmosphere the refractivity gradient is about -39. to -40 N-units pr kilometre.

If initially horizontally propagated rays are deflected upward the condition is called "Subrefractive" and if they suffer more than average downward deflection the term "superrefractive" is applied in this situation.

We can thus make the following definitions as we write, where the gradient is given in N-units pr. km.

Subrefractive:	$dN/dz > 0.$
Normal deflection:	$0. > dN/dz > -79.$
Superrefractive:	$-79. > dN/dz > -157.$
Ducting	$-157. > dN/dz$

In table 4.3.1 we have made another distinction to split the classes into a finer division, we keep the class "subrefractive as above, the normal class we split into one class from 0 to -39 N-units pr km. Since the value of dN/dz < -100 N-units pr km is a warning sign for anomalous propagation we extend the next class from -39 N-units pr. km to -100 N-units pr. km and one class for gradients less than -100 N-units pr. km and one class with gradients less than -157 N-units pr. km. The above class "subrefractive" is identical and the next class is about half of the normal refraction, but a part of both normal and super refraction is given in class 3. Grave superrefraction is then given in class 4 and cases with real ducting conditions is then shown in the last class. Ducting conditions (class 4) are also included in class 3.

We observe here obviously the same facts as for the gradients, the 06 observation shows a lot more occurrences in the interval less than minus 100 N-units pr. km than the observation hours 00 and 12. Also occurrences of values less than -157. N-units pr. km are greater.

The months of July and August are "worst month" as usual, if we compare for August the percentage values to remove the effect of different numbers in ascents, we have for the 06 observation of 1995 values for occurrences less than -157. N-units pr. km 0.93 % and for values less than -100. N-units pr. km 5.73 %. For the combined result of the 00 and 12 observation hours for the same classes we obtain 0.47 % and 2.11 % respectively. The 06 observation has then the double chance of an occurrence of gradients both less than -100. N-units pr. km and -157 N-units pr. km than the 00 and 12 observation hour as a mean.

It must be emphasised that this is results based on only two different years, but combined with pure meteorological reasoning, the results seem to make sense.

hour		12					00				
year	month	<-157	<-100	n+sup	norm.	sub r.	<-157	<-100	n+sup	norm.	sub r.
1993	9	1	11	109	299	9	0	10	86	174	6
1993	10	1	4	130	267	1	0	4	70	157	1
1993	11	0	8	104	295	0	0	4	58	189	0
1993	12	0	0	87	349	1	0	1	60	187	0
1994	1	0	0	74	325	0	0	1	36	211	0
1994	2	1	4	137	352	4	1	5	128	320	7
1994	3	0	1	85	483	2	0	4	55	249	0
1994	4	0	0	70	346	2	2	7	73	228	1
1994	5	0	3	48	376	13	0	6	72	212	1
1994	6	0	2	67	415	12	1	3	87	268	5
1994	7	4	19	108	418	21	5	22	126	199	12
1994	8	0	6	143	362	8	4	12	122	189	8
1994	9	0	5	138	347	9	1	6	103	235	3
1994	10	1	4	121	370	2	0	7	107	214	2
1994	11	0	4	133	359	2	1	2	88	232	2
1994	12	0	4	122	294	2	0	5	113	323	1
1995	1	0	3	119	374	1	0	0	38	114	0

Table 4.3.1 Occurrence of subrefractive, normal and superrefractive gradients, 00 and 12 hour.

hour		12					06				
year	month	<-157	<-100	n+sup	norm.	sub r.	<-157	<-100	n+sup	norm.	sub r.
1995	2	0	0	10	66	0	0	4	114	417	1
1995	3	0	0	20	94	0	0	5	119	468	2
1995	4	0	0	4	34	0	0	2	77	321	1
1995	5	0	0	0	0	0	0	3	90	187	8
1995	6	0	0	8	11	0	3	17	123	263	10
1995	7	0	2	13	43	1	2	31	209	338	21
1995	8	0	0	5	13	1	6	37	256	317	29
1995	9	0	0	17	19	2	3	15	214	364	8
1995	10	0	0	13	43	1	3	13	195	363	9

Table 4.3.1 Occurrence of subrefractive, normal and superrefractive gradients, 06 and 12 hour.

4.4 Duct statistics

To facilitate the identification of ducts in a refractivity profile it is customary to transform the refractivity values over the spherical surface of the earth to a flat surface by the transformation

$$M(z) = N(z) + 10^6 z/R$$

Here the refractivity in N-units at height z above ground is transformed into refractivity in M-units, and this will remove the systematic decrease in the N-values with height.

Referring to the section 4.3 the identification of ducts will be given by $dN/dz \leq -157$ N-units pr km. or $dM/dz \leq 0$ and the value $dM/dz = 0$ will thus imply an infinite range for the radio signals.

We can also differentiate in three types of ducts as shown in figure 4.4.1

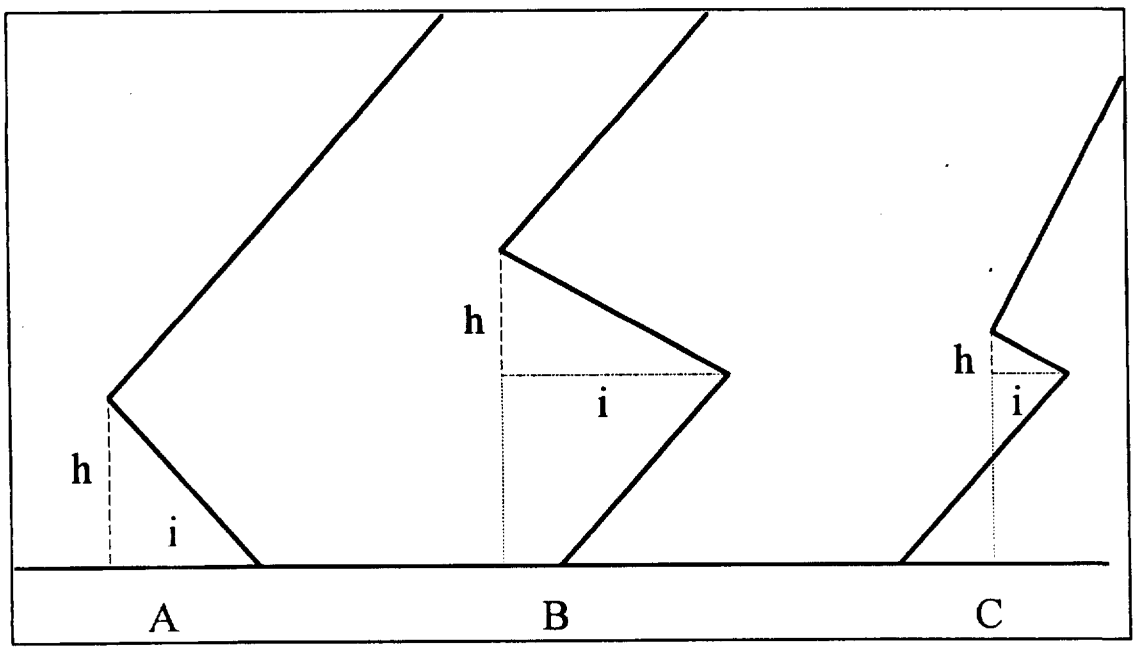


Figure 4.4.1 The three types of ducts, A: surface based or ground duct, B: elevated surface duct, C: elevated duct. Both for A and B is the minimum in the M-profile less than the M value at the ground, i.e. surface based duct types. In the figure h is the duct height and i is the duct intensity.

Formulation of the conditions for ducting are according to the above figure the following:

surface duct	$(dM/dz)_{z=0} \leq 0$	
elevated surface duct	$(dM/dz)_{z=0} \leq 0$	$M(z)_{z>0} < M(z)_{z=0}$
elevated duct	$(dM/dz)_{z=0} \leq 0$	$M(z)_{z>0} > M(z)_{z=0}$

Transforming the obtained N-units to M-units and applying the above conditions give rise to the summarised monthly mean values in table 4.4.1

Examining the tables we first recognise the significance of the 06 hour observation with substantial more incidents of ducting than observations at hours 00 and 12. This is quite in accordance with the results both from section 4.2 and 4.3. and the theoretical reasoning contained here.

If we for instance compare the months of July and August for 1994 and 1995 we notice in 1994 14 elevated ducts in July with altitudes between 542m and 3547 m above station level, surely a result of strong convective currents due to mean temperature at ground nearly 5°C above the normal. The mean altitude is about 1187 metres with a mean duct height of about 52 metres. The intensity is 3.4 M-units. In July the 12 observation shows no surface or elevated surface based ducts. Nine surface based ducts appear at the hour 00 and five elevated ducts. In July of 1995 the 06 observation alone gives 16 surface based ducts and also 4 elevated ducts, a possible effect of the variable conditions in the intermediate phase between night and day. That the 12 hour observation shows 3 surface ducts in 1995 is a number of little significance, since only 3 ascents (see table 3.2) was made at this hour in the whole month.

In August 1995 the 06 observation shows up twenty seven duct occurrences of which 20 are surface based, 6 are elevated and the last as the only elevated surface based duct in the whole period under consideration. In 1994 the August shows a total of 13 duct occurrences, 6 at hour 12 of which, as expected, 5 are elevated, and 7 at 00 hour again not surprisingly 5 as surface based. The greatest duct intensities are also found at the hour 06, mean values of the order 20 to 30 M-units with an extreme maximum of 110 M-units in July 1995.

The above mentioned results shows clearly that at inland stations or least at stations with a certain degree of continentality we possibly underestimates the duct occurrence with use of only the 00 and 12 hour observation and stations with 06 and 18 hour observation time should be examined to investigate the possible underestimation.

This effect is not so critical in coastal areas as the pronounced maritimity tends to suppress the effect of the shift from night to day conditions. As an example we have the data from the weather ship M where in the period 1982 to 1991 ducting conditions were investigated [2]. This is a rather extreme station that exhibits lots of surface based ducts possibly as pure evaporation ducts through the whole day, the elevated ducts was of roughly the same number for hours 00/12 and 06/18 but the number of elevated surface based ducts was greater at hours 06/18 which is in accordance with the above results. The yearly numbers for the weather ship are shown in table 4.4.2

	00/12			06/18	
surface	e. surface	elevated	surface	e. surface	elevated
44	2	413	43	7	384

Table 4.3.2 Total number of ducts in the period 1982-1991 at the weather ship M

				surface based duct			elevated surface duct			elevated duct		
year	mth	h		inten.	height	altit.	inten.	height	altit.	inten.	height	altit.
1993		12	me	-4.17	39.19	39.20				-1.77	60.62	1714.25
1993		12	sd	1.99	9.18	9.19				1.84	46.21	775.58
1993	9	12	ma	-2.76	45.68	45.70				-0.24	152.88	3004.30
1993		12	mi	-5.58	32.70	32.70				-5.37	27.99	577.10
1993		12	no	2	2	2	0	0	0	6	6	6
1993		0	me	-1.45	31.70	31.70				-1.72	44.62	782.90
1993		0	sd							0.75	3.05	851.07
1993	9	0	ma	-1.45	31.70	31.70				-0.96	47.95	1732.00
1993		0	mi	-1.45	31.70	31.70				-2.46	41.95	87.60
1993		0	no	1	1	1	0	0	0	3	3	3
1993		12	me	-7.86	54.67	54.70						
1993		12	sd									
1993	10	12	ma	-7.86	54.67	54.70						
1993		12	mi	-7.86	54.67	54.70						
1993		12	no	1	1	1	0	0	0	0	0	0
1993		0	me	-1.23	44.68	44.70				-1.30	54.94	761.90
1993		0	sd	0.23	2.83	2.83						
1993	10	0	ma	-1.07	46.68	46.70				-1.30	54.94	761.90
1993		0	mi	-1.39	42.68	42.70				-1.30	54.94	761.90
1993		0	no	2	2	2	0	0	0	1	1	1
1993		12	me	-0.43	44.68	44.70				-3.28	49.16	1221.26
1993		12	sd							2.21	24.49	548.16
1993	11	12	ma	-0.43	44.68	44.70				-0.13	85.91	2110.80
1993		12	mi	-0.43	44.68	44.70				-6.16	17.98	646.00
1993		12	no	1	1	1	0	0	0	5	5	5
1993		0	me							-0.94	46.45	911.25
1993		0	sd							0.30	3.52	732.49
1993	11	0	ma							-0.73	48.94	1429.20
1993		0	mi							-1.15	43.96	393.30
1993		0	no	0	0	0	0	0	0	2	2	2
1993		12	me									
1993		12	sd									
1993	12	12	ma									
1993		12	mi									
1993		12	no	0	0	0	0	0	0	0	0	0
1993		0	me	-0.35	48.68	48.70						
1993		0	sd									
1993	12	0	ma	-0.35	48.68	48.70						
1993		0	mi	-0.35	48.68	48.70						
1993		0	no	1	1	1	0	0	0	0	0	0

Table 4.4.1 Values for duct intensity, duct height and altitude above ground for surface based, elevated surface and elevated ducts.
me: mean value, sd: standard deviation, ma: maximum value, mi minimum value and no: number of occurrences.

				surface based duct			elevated surface duct			elevated duct		
year	mth	h		int	height	altit	int	height	altit	int	height	altit
1994	1			nil			nil			nil		
1994		12	me							-1.44	54.94	999.10
1994		12	sd							0.07	4.24	163.20
1994	2	12	ma							-1.39	57.94	1114.50
1994		12	mi							-1.49	51.95	883.70
1994		12	no	0	0	0	0	0	0	2	2	2
1994		0	me	-3.29	57.66	57.70				-1.90	44.95	857.80
1994		0	sd									
1994	2	0	ma	-3.29	57.66	57.70				-1.90	44.95	857.80
1994		0	mi	-3.29	57.66	57.70				-1.90	44.95	857.80
1994		0	no	1	1	1	0	0	0	1	1	1
1994		12	me									
1994		12	sd									
1994	3	12	ma									
1994		12	mi									
1994		12	no	0	0	0	0	0	0	0	0	0
1994		0	me	-1.21	43.68	43.70						
1994		0	sd	1.01	5.29	5.29						
1994	3	0	ma	-0.38	47.68	47.70						
1994		0	mi	-2.33	37.69	37.70						
1994		0	no	3	3	3	0	0	0	0	0	0
1994		12	me	-0.68	47.68	47.70				-0.42	48.98	2709.40
1994		12	sd									
1994	4	12	ma	-0.68	47.68	47.70				-0.42	48.98	2709.40
1994		12	mi	-0.68	47.68	47.70				-0.42	48.98	2709.40
1994		12	no	1	1	1	0	0	0	1	1	1
1994		0	me	-2.15	48.48	48.50				-0.30	36.95	130.60
1994		0	sd	1.06	8.54	8.56				0.14	18.36	110.17
1994	4	0	ma	-0.95	54.67	54.70				-0.20	49.94	208.50
1994		0	mi	-3.64	33.70	33.70				-0.40	23.97	52.70
1994		0	no	5	5	5	0	0	0	2	2	2
1994		12	me	-0.25	44.68	44.70				-2.30	55.34	1997.21
1994		12	sd							1.68	21.02	303.59
1994	5	12	ma	-0.25	44.68	44.70				-0.47	105.93	2519.50
1994		12	mi	-0.25	44.68	44.70				-5.15	40.97	1530.20
1994		12	no	1	1	1	0	0	0	8	8	8
1994		0	me	-1.19	47.68	47.70				-0.51	51.94	524.10
1994		0	sd									
1994	5	0	ma	-1.19	47.68	47.70				-0.51	51.94	524.10
1994		0	mi	-1.19	47.68	47.70				-0.51	51.94	524.10
1994		0	no	1	1	1	0	0	0	1	1	1

Table 4.4.1 Values for duct intensity, duct height and altitude above ground for surface based , elevated surface and elevated ducts.
me: mean value sd: standard deviation, ma: maximum value, mi: minimum value and no: number of occurrences.

				surface based duct			elevated surface duct			elevated duct		
year	mth	h		int	height	altit	int	height	altit	int	height	altit
1994		12	me	-1.79	42.68	42.70				-34.96	64.24	4099.42
1994		12	sd							66.78	23.80	4843.59
1994	6	12	ma	-1.79	42.68	42.70				-0.23	99.891	1273.30
1994		12	mi	-1.79	42.68	42.70				-135.10	51.12	649.00
1994		12	no	1	1	1	0	0	0	4	4	4
1994		0	me	-6.96	48.68	48.70				-1.43	63.96	2084.87
1994		0	sd							1.39	12.16	948.49
1994	6	0	ma	-6.96	48.68	48.70				-0.20	71.98	3108.30
1994		0	mi	-6.96	48.68	48.70				-2.94	49.97	1235.40
1994		0	no	1	1	1	0	0	0	3	3	3
1994		12	me			-				-3.39	52.75	1768.09
1994		12	sd							4.79	18.51	542.18
1994	7	12	ma							-0.02	104.92	3547.20
1994		12	mi							-15.89	35.97	1187.40
1994		12	no	0	0	0	0	0	0	14	14	14
1994		0	me	-4.04	51.56	51.58				-3.45	52.76	1370.40
1994		0	sd	3.45	16.01	16.00				4.06	19.31	971.63
1994	7	0	ma	-0.30	92.62	92.60				-0.70	85.91	2735.40
1994		0	mi	-10.48	36.69	36.70				-10.54	37.98	465.20
1994		0	no	9	9	9	0	0	0	5	5	5
1994		12	me	-1.55	50.67	50.70				-1.66	40.77	1873.82
1994		12	sd							1.42	3.11	812.75
1994	8	12	ma	-1.55	50.67	50.70				-0.05	43.97	2691.50
1994		12	mi	-1.55	50.67	50.70				-3.60	36.98	948.70
1994		12	no	1	1	1	0	0	0	5	5	5
1994		0	me	-2.29	53.07	53.10				-5.52	71.42	261.90
1994		0	sd	2.86	3.43	3.44				7.08	40.26	232.36
1994	8	0	ma	-0.13	57.66	57.70				-0.52	99.88	426.20
1994		0	mi	-6.09	49.67	49.70				-10.53	42.95	97.60
1994		0	no	5	5	5	0	0	0	2	2	2
1994		12	me	-1.47	44.18	44.20				-1.80	56.55	879.96
1994		12	sd	1.54	12.01	12.02				0.81	22.82	540.94
1994	9	12	ma	-0.38	52.67	52.70				-0.90	96.93	1637.10
1994		12	mi	-2.56	35.69	35.70				-2.71	42.95	336.30
1994		12	no	2	2	2	0	0	0	5	5	5
1994		0	me	-2.25	48.17	48.20				-4.84	43.97	1507.65
1994		0	sd	2.85	2.11	2.12				3.78	1.41	110.95
1994	9	0	ma	-0.23	49.67	49.70				-2.16	44.96	1586.10
1994		0	mi	-4.26	46.68	46.70				-7.51	42.97	1429.20
1994		0	no	2	2	2	0	0	0	2	2	2

Table 4.4.1 Values for duct intensity, duct height and altitude above ground for surface based , elevated surface and elevated ducts.
me: mean value sd: standard deviation, ma: maximum value, mi: minimum value and no: number of occurrences.

				surface based duct			elevated surface duct			elevated duct		
year	mth	h		int	height	altit	int	height	altit	int	height	altit
1994		12	me	-1.60	59.66	59.70				-1.84	69.94	1564.65
1994		12	sd							2.09	32.48	809.00
1994	10	12	ma	-1.60	59.66	59.70				-0.36	92.91	2136.70
1994		12	mi	-1.60	59.66	59.70				-3.31	46.97	992.60
1994		12	no	1	1	1	0	0	0	2	2	2
1994		0	me	-0.93	47.68	47.70				-1.87	38.30	889.80
1994		0	sd							2.54	18.16	75
1994	10	0	ma	-0.93	47.68	47.70				-0.01	52.96	1511.20
1994		0	mi	-0.93	47.68	47.70				-4.77	17.98	56.70
1994		0	no	1	1	1	0	0	0	3	3	3
1994		12	me	-2.71	58.66	58.70				-1.93	40.96	1168.95
1994		12	sd							2.11	1.41	89.73
1994	11	12	ma	-2.71	58.66	58.70				-0.43	41.96	1232.40
1994		12	mi	-2.71	58.66	58.70				-3.42	39.96	1105.50
1994		12	no	1	1	1	0	0	0	2	2	2
1994		0	me	-3.36	55.67	55.65				-0.92	42.97	2104.80
1994		0	sd	4.32	21.18	21.14						
1994	11	0	ma	-0.30	70.65	70.60				-0.92	42.97	2104.80
1994		0	mi	-6.41	40.69	40.70				-0.92	42.97	2104.80
1994		0	no	2	2	2	0	0	0	1	1	1
1994		12	me							-1.31	47.95	1061.60
1994		12	sd									
1994	12	12	ma							-1.31	47.95	1061.60
1994		12	mi							-1.31	47.95	1061.60
1994		12	no	0	0	0	0	0	0	1	1	1
1994		0	me							-3.10	31.47	537.15
1994		0	sd							4.31	17.66	682.29
1994	12	0	ma							-0.05	43.96	1019.60
1994		0	mi							-6.15	18.98	54.70
1994		0	no	0	0	0	0	0	0	2	2	2

Table 4.4.1 Values for duct intensity, duct height and altitude above ground for surface based , elevated surface and elevated ducts.
me: mean value sd: standard deviation, ma: maximum value, mi: minimum value and no: number of occurrences.

				surface based duct			elevated surface duct			elevated duct		
year	mth	h		int	height	altit	int	height	altit	int	height	altit
1995	1			nil			nil			nil		
1995	2			nil			nil			nil		
1995		12	me									
1995		12	sd									
1995	3	12	ma									
1995		12	mi									
1995		12	no	0	0	0	0	0	0	0	0	0
1995		6	me	-4.43	45.68	45.70				-1.19	44.99	3170.30
1995		6	sd									
1995	3	6	ma	-4.43	45.68	45.70				-1.19	44.99	3170.30
1995		6	mi	-4.43	45.68	45.70				-1.19	44.99	3170.30
1995		6	no	1	1	1	0	0	0	1	1	1
1995		12	me									
1995		12	sd									
1995	4	12	ma									
1995		12	mi									
1995		12	no	0	0	0	0	0	0	0	0	0
1995		6	me	-1.33	49.17	49.20						
1995		6	sd	0.49	2.11	2.12						
1995	4	6	ma	-0.98	50.67	50.70						
1995		6	mi	-1.68	47.68	47.70						
1995		6	no	2	2	2	0	0	0	0	0	0
1995		12	me									
1995		12	sd									
1995	5	12	ma									
1995		12	mi									
1995		12	no	0	0	0	0	0	0	0	0	0
1995		6	me	-0.99	55.00	55.03						
1995		6	sd	0.73	8.49	8.50						
1995	5	6	ma	-0.50	63.66	63.70						
1995		6	mi	-1.83	46.68	46.70						
1995		6	no	3	3	3	0	0	0	0	0	0
1995		12	me									
1995		12	sd									
1995	6	12	ma									
1995		12	mi									
1995		12	no	0	0	0	0	0	0	0	0	0
1995		6	me	-2.61	52.36	52.39				-1.40	34.31	1684.80
1995		6	sd	2.28	4.67	4.68				1.90	26.29	990.76
1995	6	6	ma	-0.69	60.65	60.70				-0.09	50.97	2280.60
1995		6	mi	-8.99	44.67	44.70				-3.58	4.00	541.10
1995		6	no	13	13	13	0	0	0	3	3	3

Table 4.x.x Values for duct intensity, duct height and altitude above ground for surface based, elevated surface and elevated ducts.
me: mean value, sd: standard deviation, ma: maximum value, mi: minimum value and no: number of occurrences.

				surface based duct			elevated surface duct			elevated duct		
year	mth	h		int	height	altit	int	height	altit	int	height	altit
1995		12	me	-5.18	39.01	39.03						
1995		12	sd	1.25	6.10	6.11						
1995	7	12	ma	-3.99	45.67	45.70						
1995		12	mi	-6.49	33.69	33.70						
1995		12	no	3	3	3	0	0	0	0	0	0
1995		6	me	-2.41	49.73	49.76				-29.75	46.99	3204.70
1995		6	sd	1.87	5.93	5.94				53.74	1.79	4338.86
1995	7	6	ma	-0.37	57.66	57.70				-0.51	48.97	9651.00
1995		6	mi	-6.93	32.69	32.70				-110.30	45.08	599.00
1995		6	no	16	16	16	0	0	0	4	4	4
1995		12	me							-24.25	47.14	13617.40
1995		12	sd									
1995	8	12	ma							-24.25	47.14	13617.40
1995		12	mi							-24.25	47.14	13617.40
1995		12	no	0	0	0	0	0	0	1	1	1
1995		6	me	-3.68	43.98	44.00	-0.26	18.98	46.70	-2.01	53.12	813.37
1995		6	sd	2.99	10.24	10.26				2.23	43.04	752.22
1995	8	6	ma	-0.70	53.66	53.70	-0.26	18.98	46.70	-0.17	137.91	2037.80
1995		6	mi	-12.38	17.71	17.70	-0.26	18.98	46.70	-5.53	13.98	98.60
1995		6	no	20	20	20	1	1	1	6	6	6
1995		12	me									
1995		12	sd									
1995	9	12	ma									
1995		12	mi									
1995		12	no	0	0	0	0	0	0	0	0	0
1995		6	me	-1.05	48.67	48.70				-4.19	57.59	2444.93
1995		6	sd	0.62	4.32	4.32				4.15	28.68	3035.14
1995	9	6	ma	-0.16	54.66	54.70				-0.63	125.26	10820.20
1995		6	mi	-1.58	44.67	44.70				-11.61	34.97	456.20
1995		6	no	4	4	4	0	0	0	10	10	10
1995		12	me								8.99	1181.40
1995		12	sd									
1995	10	12	ma								8.99	1181.40
1995		12	mi								8.99	1181.40
1995		12	no	0	0	0	0	0	0	1	1	1
1995		6	me	-2.36	49.17	49.20				-3.69	75.06	1871.26
1995		6	sd	2.11	5.50	5.51				3.71	49.74	1016.43
1995	10	6	ma	-0.13	55.66	55.70				-0.27	162.85	3293.20
1995		6	mi	-4.35	43.68	43.70				-11.39	13.98	46.70
1995		6	no	4	4	4	0	0	0	9	9	9

Table 4.4.1 Values for duct intensity, duct height and altitude above ground for surface based, elevated surface and elevated ducts.
me: mean value, sd: standard deviation, ma: maximum value, mi: minimum value and no: number of occurrences.

5. Ten seconds data versus standard data

One of the basic describing refractivity parameters is the gradient dN_{100} or β_0, i.e. the refractivity gradient between ground and one hundred metres. Since we by the ten seconds data, with a mean ascent rate about 5-6 metres pr. second surely would have at least one observational point between each one hundred metres, it is tempting to make a small study of the similarity between the ten second data and the "standard data", defined as the mandatory WMO output from the rawinsonde, i.e. the TEMP and PILOT codes, see for instance [3] or [4].

The standard data is here defined as the total output as the mandatory pressure levels as well as the significant levels together with tropopauses, freezing levels and wind minutes, all given in the above mentioned codes.

Since some of the international databases, for instance the NCAR database of upper air measurements, do not contain the PTU values for the PILOT levels, it is also interesting to divide those cases. I.e. we make a division between the ten second data, the standard output (here defined as the maximum information contained in the upper air data base of the NMI) and the standard output minus the PILOT levels, that is three "different" data sets. The data sets are in fact not different since they all originates from the same observation set, but as a data base they look different since the PTU data are given for different height levels which will have a pronounced impact on the interpolated values.

The refractivity value at ground level will always be the same, but to obtain the value at one hundred metres we have to apply some method of interpolation. The most common is a linear interpolation, but an interpolation based on qubic splines could also be a possibility. The last mentioned method would give a more smooth profile for the refractivity values, but we apply the most common method, the linear approximation. This method has for instance also been used in [2] and as such give a more sure base for comparisons.

The interpolated values will, inevitably depend on the number of reported height levels from the radiosonde. But, the more complex the structure of the atmosphere is, the radiosonde should report more "significant" levels. Looking upon the ten second data set as the "most real description" of the atmosphere we should expect a rather close similarity to the standard data, but possible differences from the reduced standard set.

The gradient statistics is carried out as usual for all three sets of data; determine the two nearest points respectively under and above each hundred metres level and use those in the linear interpolation for the refractivity value at the hundred metres level in-between. Having so obtained values of the refractivity at each level of n times one hundred metres, the gradients are easily obtained.

In figure 5.1 is shown the difference in refractivity gradients pr. hundred meters between the ten second data and the standard data respectively the reduced standard data, from this point of called case 1 respectively case 2.

In all months except for May we have a lesser gradient, β_0 computed for case 2, the greatest differences in the month of September and October with difference in β_0 of the order ten N-units pr kilometre. Except for the lowest gradient between the surface and the one hundred meters level it is interesting to note that in most cases both the course and magnitude of the deviation from gradients originating from the ten seconds data are more or less the same. In August, however, we have a more complex picture with rather diverging curves, the most pronounced difference showing up around 500 metres where the two differences partly have opposite sign. The reason for this has not been found.

It is however reassuring that for case 1 (difference between the ten seconds data and the standard data) deviations are approximately 1 N-unit pr. kilometre or less, the month of March gives here the greatest deviation of 2 N-units/km.

Computation of gradients using the standard output from the rawinsonde should according to the analysis done here give rather good results.

In figure 5.2 are shown the mean gradients computed by the three sets of data and naturally August but also July show the greatest spread in curves. The gradients in the bottom layer have in all cases the greatest negative value but tends all rather rapidly to values corresponding to a "well mixed" atmosphere, about -40 N-units pr. km. The month of August is in this respect also interesting since the gradient values are slightly shifted to the subrefractive side for the normal value -40 N-units pr. km, and jumps back to this value at an altitude of about 1700 metres

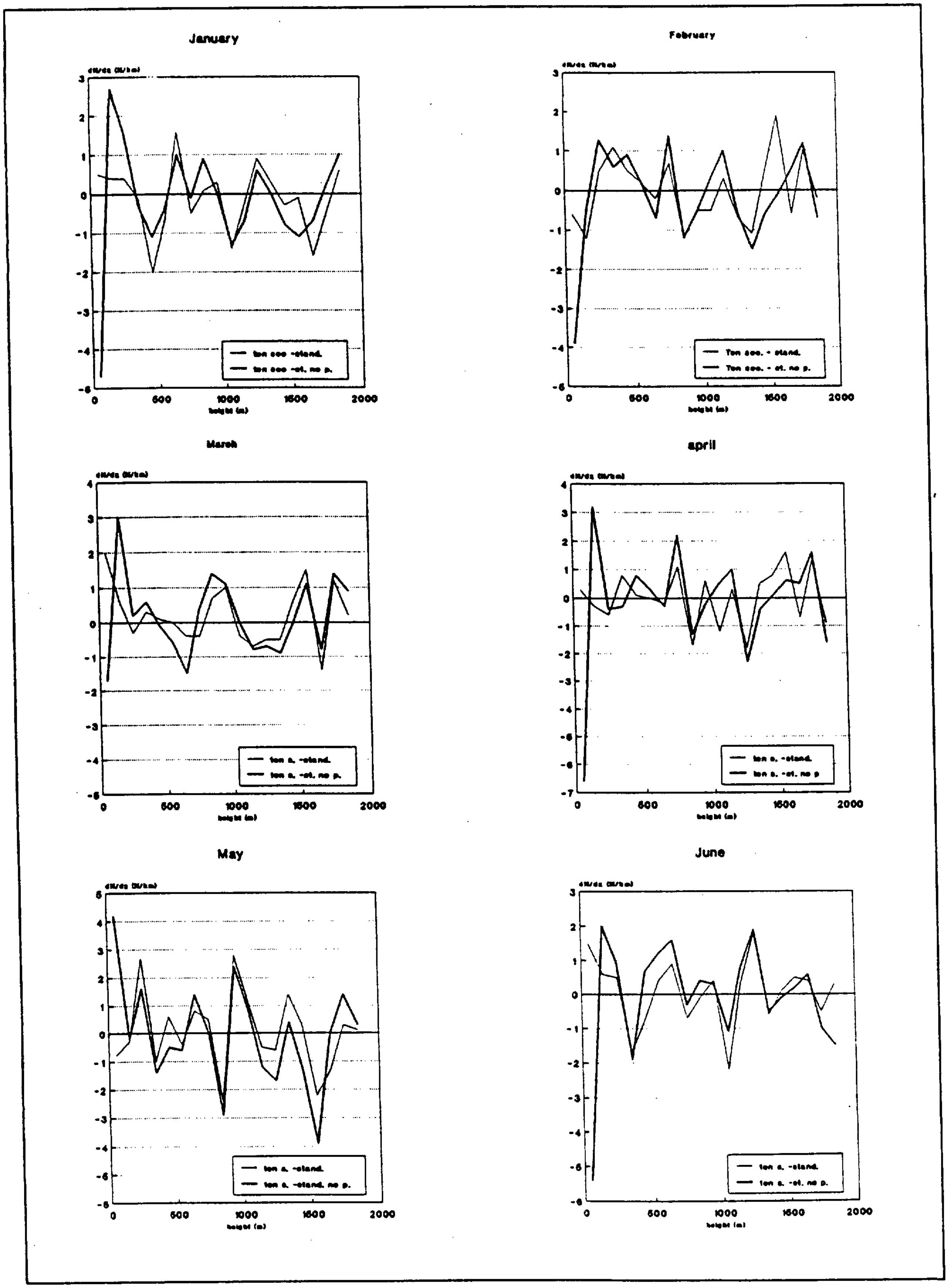


Figure 5.1 Difference in refractivity gradients between the set of ten seconds data and the standard data respectively the standard data without PILOT.

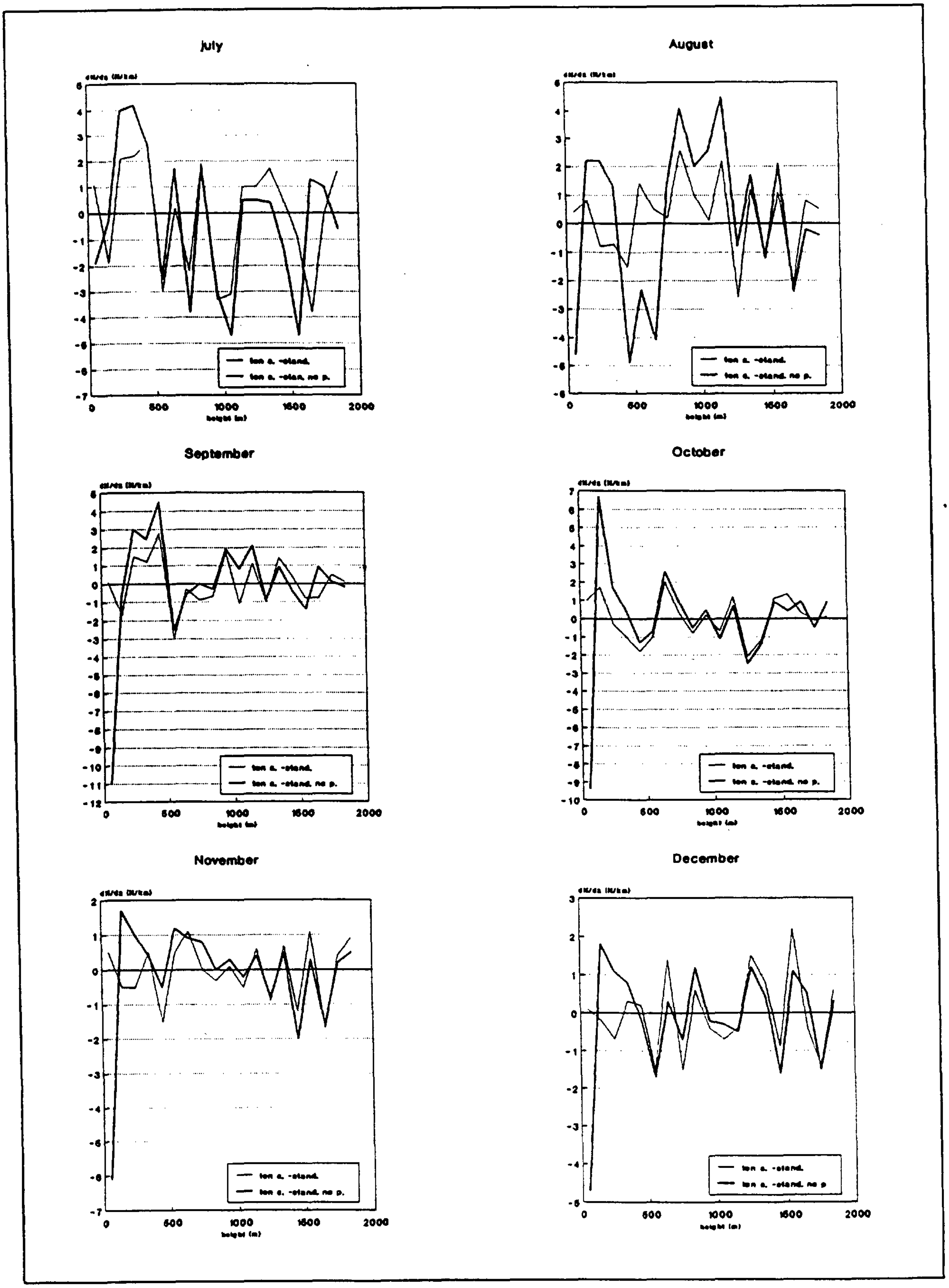


Figure 5.1 Difference in refractivity gradients between the set of ten seconds data and the standard data respectively the standard data without PILOT.

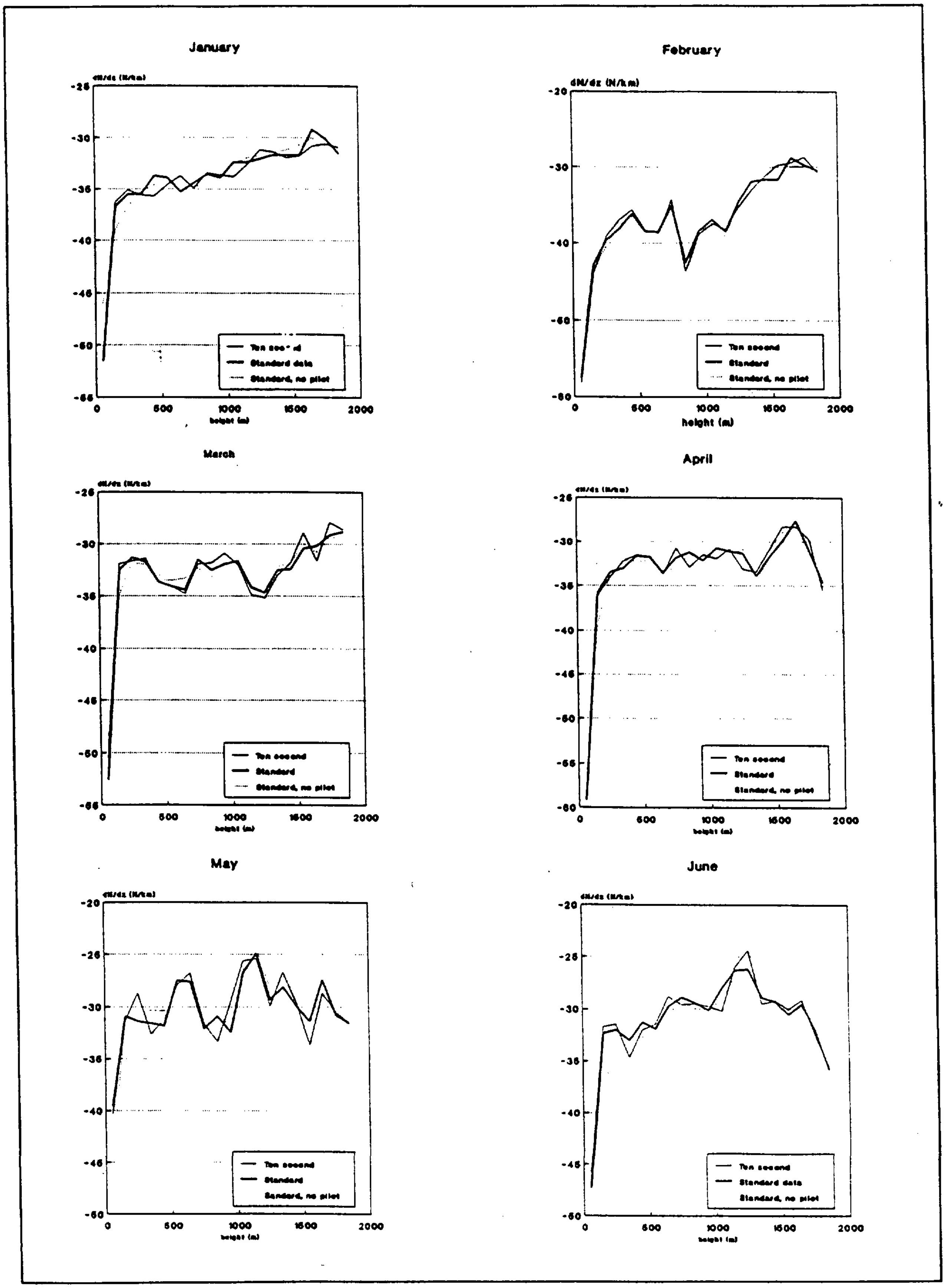


Figure 5.2 Mean refractivity gradients for the set of ten seconds data and the standard data and the standard data without PILOT respectively.

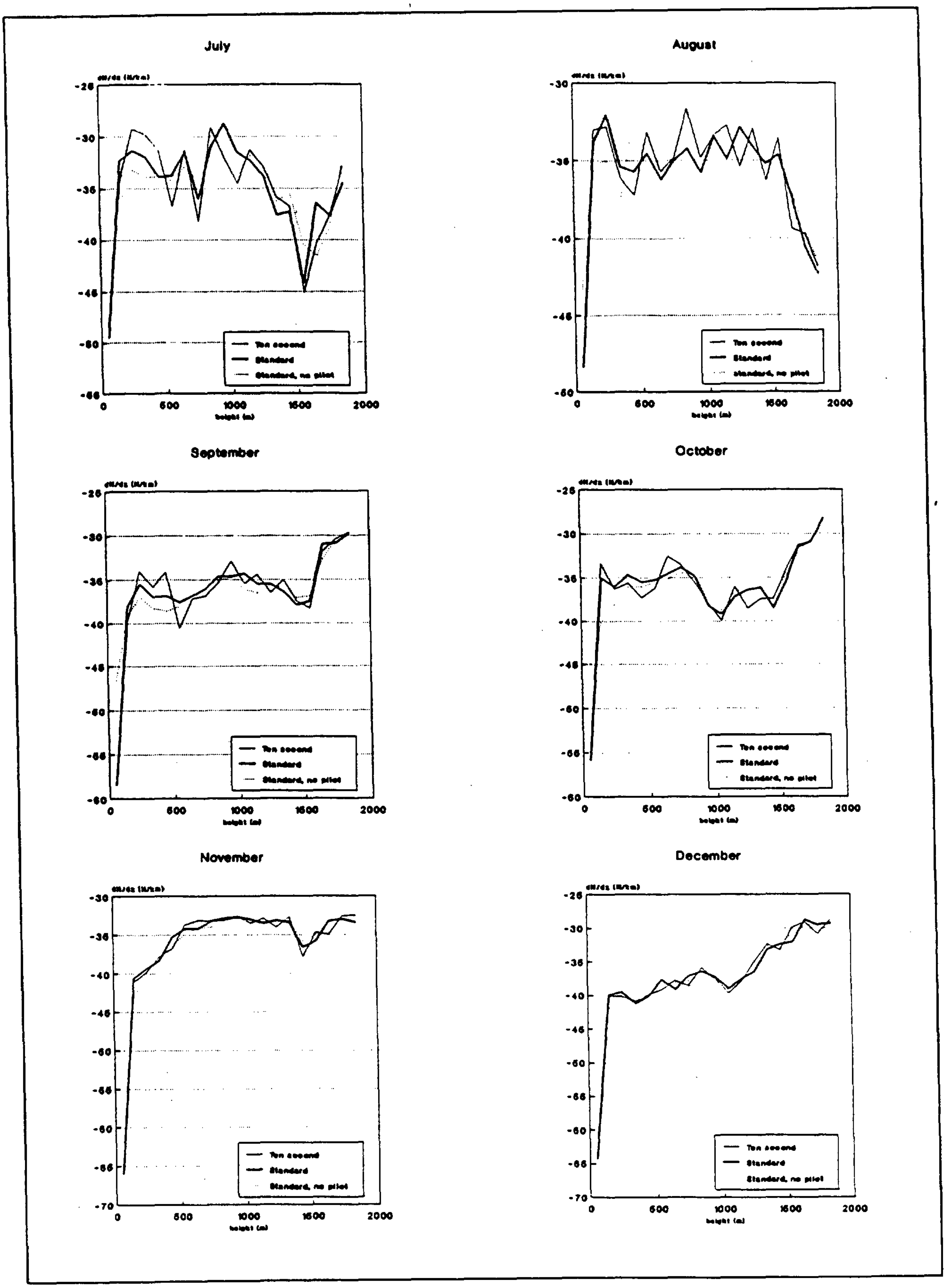


Figure 5.2 Mean refractivity gradients for the set of ten seconds data and the standard data and the standard data without PILOT respectively.

6. Conclusions

High resolution data of 10 seconds from a radiosonde are examined with respect to radioclimatic results. We find that if the full information of both TEMP and PILOT codes with additional mandatory levels are used (total amount of standard data), no substantial difference in results are recognised.

With the use of only the outcome from the TEMP code some differences are detected.

Examination of a short period with observations taken at hour 06 clearly show the necessity to differentiate between the mandatory observation hours and that substantial new information with respect to for instance duct occurrence, would be obtained if also the morning and the afternoon observations could be included.

High resolution data constitute an absolute improvement with respect to detection of duct occurrence, intensity and height.

References

1 Vaisala — METGRAPH & CLIGRAPH
sounding database software for personal computers
ed. METCL-P0037-1.1
Vaisala OY Finland

2 Lystad S.L. — Surface refractivity and refractive gradients in lower atmosphere of Norway.
report no. 04/94 Klima
NMI Norway

3 WMO — Manual on Codes vol 1&2
WMO Geneva

4 Lystad S.L. — Bibliography of radiosondes
report no. 02/95 Klima
NMI Norway

Appendix 1

Computation of the vapour pressure.

In the formula for the refractive index expressed in N-units appear the partial pressure of the water vapour. The vapour pressure is also needed in establishing a proper hydrostatic balace for the different layers of air. The actual vapour pressure of water may be considered as a function of relative humidity or dewpoint temperature and air temperature, the saturation vapour pressure is a function of air temperature alone.

The relation between actual vapour pressure VP, saturation vapour pressure SVP and relative humidity RH is given as:

$$VP = RH*SVP(T)$$

i.e. if RH is given as 100.% or 1.0 then AVP = SVP

If dewpoint DT or dewpoint depression is given follows imediately

$$VP = SVP(DT)$$

To compute SVP several formulas is available, the most accurate looked upon is the Goff-Gratch formula used in the Smithsonian tables, a most elaborate and computer consuming formula. We have, however chosen a formula adopted by "Deutschen Wetterdienst" attributed to Magnus-Tetens given in "Aspirations Psychrometer Tafelen".

The formula is as follows

$$SVP = C_1 \cdot \exp(arg)$$

$$arg = (C_2 \cdot T)/(C_3 + T)$$

where SVP is the saturation vapour pressure in hPa and T is the temperature i Celsius degrees and the constants C_1, C_2, C_3 are as given below:

phase	range of T C^o	C_1 (hPa)	C_2	C_3
ice	-50.9 - 0.0	6.10714	22.44294	272.440
water	-50.9 - 0.0	6.10780	17.84362	245.425
water	0.0 - 100.9	6.10780	17.08085	234.175

Constants in the modified Magnus-Tetens formula for computation of vapour pressure.

By definition SVP is here always computed for the liquid phase, i.e. over water.

Appendix 2.

Relation between geopotential and geometric height.

The definition of geopotential Φ is:

1. $\Phi = (1/g_0) \int g(z)dz$

where

g_0	: "standard" acceleration of gravity	[m/s^2]
$g(z)$	: acceleration of gravity at height z	[m/s^2]
z	: geometric height above mean sea level	[m]
Φ	: geopotential height	[gpm]

and the integration taken from 0 to z.

In the so-called "meteorological gravity system" was until 1971 a value of 9.8 m/s^2 used for g_0, from this year of a value of 9.80616 m/s^2 was adopted. It can be mentioned that values given by the meteorological gravity system are slightly different from corresponding values from the "Potsdam system", widely used in geodesy.

Using Newton's inverse-square rule for gravitation we obtain

2. $g(z) = g(0)_\phi R^2 / (R+z)^2$

where

$g(z)$	: acceleration of gravity at latitude ϕ and height z	[m/s^2]
$g(0)_\phi$	: acceleration of gravity at latitude ϕ and height 0	[m/s^2]
R	: appropriate value of radius of earth at given latitude	[m]

The variation of the acceleration of gravity at mean sea level $g(0)_\phi$ is given (based on the International Ellipsoid of Reference) by

3. $g(0)_\phi = 9.806160\ (1.-0.0026373 \cos 2\phi + 0.0000059 \cos^2 2\phi)$

Integration of (1) after (2) is inserted yields

4. $\Phi = (g_\phi R/9.8)\ (z/(R+z)$ [gpm]

or

5. $z = R\Phi/((g_\phi R/9.8) - \Phi)$ [m]

Equations 3 and 4 are strictly valid for a non rotating sphere composed of spherical shells of equal density. These conditions are not fulfilled for the earth, and since the centrifugal acceleration does not diminish according to the inverse-square rule, but rather increase with the distance from the centre, it is, strictly speaking necessary to make some allowance for the simple conditions assumed. Taking the partial derivative of g with respect to z in equation 2 for z=0 we obtain for the corresponding value of R

6. $R = -2g_\phi/(dg/dz)_{z=0}$

The quantity in the denominator is a function of latitude given by

7. $-(dg/dz)_{z=0} = 3.085462\ 10^{-6} + 2.27\ 10^{-9}\cos 2\phi - 2.\ 10^{-12}\cos 4\phi$

Computation is done as follows:

1. by given latitude ϕ are evaluated equations 3 and 7

2. equation 6 is then evaluated

3. by given geopotential Φ and computed R gives equation 5 the desired result

Appendix 3

Formulas for interpolation of geopotential height.

The starting point is the hydrostatic equation or the balance of pressure forces and gravity forces in the vertical

1. $dP/dz = -g\rho$

The general definition of the geopotential Φ is given as

$$d\Phi = -\int \mathbf{g}\cdot d\mathbf{r}$$

or

2. $d\Phi = -\int g\, dz$

If z is measured along a line of gravity force, i.e. along a line parallel at every point to **g**, it will follow a sligthly curved line. This deviation from a stright line is however negligible for most purposes.

Combination of equations 1 and 2 gives

3. $\delta\Phi = -\int RTd(\ln P)$

4. $\delta\Phi = -R_d\int T_v d(\ln P)$

Here is R the spesific gas constant, R_d the gas constant for dry air (287.05 $Jkg^{-1}K^{-1}$) defined for an atmosphere with a mean molecular weight of 28.964 g mol^{-1}.

T_v is the virtual temperature defined as

5. $T_v = (1+0.61q)T$

Here is T "air temperature" and q the spesific humidity of the air given as the mass of water vapour per unit mass of moist air. By definition q can be evaluated by the formula

6. $$q = \frac{1000}{R_v}\frac{R_d VP}{P + \frac{R_v - R_d}{R_v}VP}$$

P is here total air pressure and VP is the partial pressure of water vapour and R_v is the gas constant for water vapour (461.51 $Jkg^{-1}K^{-1}$).

Integration of equation 4 by the mean isotherm yields for the difference in geopotential

7. $\delta\Phi = -R_d T_v \ln(P_2/P1)$

For practical considerations R_d and T_v may be taken as the mean values over the layer in consideration.

Computational procedure :

1. Obtain pressure,temperature and dewpoint depression for two adjacent layers where the geopotential for one of the layers is reported

2. Compute dewpoint temperature and vapour pressure for both layers

3. Compute mean virtual temperature for the layer

4. By equation 7 we obtain the difference in geopotential.

References :

Aspirations-Psychrometer-Tafeln
6., durchgesehene und erweiterte Auflage
Herausgegeben vom Deutschen Wetterdienst
Friedr. Vieweg & Sohn
Braunschweig/Wiesbaden 1979

List R.J   Smithsonian meteorological tables, sixth revised edition
Smithsonian institution press
City of Washington

WMO   Guide to meteorological instruments and methods of observation.
WMO no 8 fifth edition
Geneva 1983