The Meteorological Data of the Georg-von-Neumayer-Station (Antarctica) for 1985, 1986 and 1987

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I. INTRODUCTION

This report presents an overview of the meteorological conditions at the Georg-von-Neumayer-Station ("GvN", 70°37'S, 8°22'W) during the years 1985, 1986 and 1987. Its format differs in some respect from the schemes of the previous years (Gube and Obleitner, 1986; Gube-Lenhardt, 1987).

The meteorological observatory was operated by :

Peter Wachs and Bernd Wortmann in 1985/86,
Karl Bumke and Andreas Löbe in 1986/87,
Andreas Löbe and Klaus Sturm in 1987/88.

II. MEASUREMENTS, OBSERVATIONS and INSTRUMENTATION

Measurements and observations can be divided into four groups:

2.1) Synoptic Observations

Routine observations were carried out 3-hourly. They consist of surface measurements of air temperature (at 2 m height), air pressure (values are reduced to mean sea level), wind vector (at 10 m height), dew point temperature and observations of cloud characteristics (cloud amount, type and height), horizontal visibility, present and past weather, snowdrift and optical phenomena.
These data were coded (SYNOP) and transferred to the Global Telecommunication System (GTS) by a Data Collecting Platform (DCP).

2.2) Upper Air Soundings

At least once a day (around 12:00 GMT) a radiosonde was launched. Vertical profiles of air pressure, temperature, relative humidity and wind vector were measured.
The resulting TEMP message was also transferred to the GTS.

2.3) Radiation Measurements

The following radiation quantities were measured and stored as 10 min mean values:
- global (solar) radiation
- reflected solar radiation
- downward and upward (total) radiation.

From these quantities other radiation components such as downward and upward long-wave radiation and albedo have been derived.

Additionally, the duration of sunshine was recorded.

2.4) Mast Measurements

During the years 1985 and 1986 air temperature had been measured at 6 heights and the wind vector at 5 different heights between 2 m and 45 m. In 1987 air temperature and wind vector were recorded at 2 m and 10 m height. The firn temperature was measured at 6 different depths between 0.25 m and 5.0 m during the year 1986.

Instrumentation:

Temperature measurements were carried out with PT-100 platinum resistance sensors.
For air temperature measurements they were ventilated artificially and they were protected against radiation effects. In order to determine the firn temperature they were covered with metal boxes.

The relative humidity was measured with a hair hygrometer. The surface air pressure was obtained with the aid of a precision barometer (reduced to mean sea level). The wind vector was determined by a combined instrument (cup anemometer and wind vane).

Upper air soundings were carried out with RS80 radiosondes which measure air pressure, air temperature and relative humidity. The wind vector was determined by correlating the OMEGA signals. These and further calculations were done by the so-called Micro Cora System (VAISALA Oy, Finland).

The radiation measurements were carried out with

- pyranometers (Eppley Laboratory, U.S.A.) for global and reflected solar radiation;
- pyrradiometers (Lange GmbH, F.R.G.) for upward and downward total radiation;
- a photoelectric sunshine recorder (Solar 111, Haenni and Cie.,Switzerland).

III. DATA PROCESSING and ARCHIVING

There have been several changes not only in data sampling and storing at the station itself but also in controlling and archiving the data at the institute during the last years.
All routinely measured meteorological data of the GvN-Station are archived in the so-called ´synoptic´ and ´upper air´ databases.

A database is a collection of information, a database management system is a set of software tools that provides a single environment for storing, retrieving, changing and protecting data.
A database system allows continuous access to the different data and one is no longer concerned about the structure of the files or about how to access any single value within a record. The user needs only to supply the identification of that piece of information (date, hour, element name,...) he wants to select or work with. A database also allows its structure to be changed without affecting application programs.

While the raw data are loaded into the database system they are subject to quality-control procedures by the database management system. The data are examined and checked under pre-defined conditions and all suspect cases are flagged for manual review, correction (if required) and updating of the data set.
There are, for example:

- checks for impossible format codes;
- tolerance tests: many parameters which are reported by code have defined limits, e.g. wind direction, cloud amount, visibility. Other parameters may have implied upper or lower limits. For parameters with no definite limits, such as air temperature and atmospheric pressure, a table is established, according to location and time, of

approximate limits beyond which the occurence of a value is unlikely;
- internal consistency tests: some parameters are checked for consistency against associated parameters within each observation;

Finally, a graphic quick-look helps to detect unreliable values.

After correction the data are restored into the database and various computations are made:
- evaluation of related parameters;
- evaluation of mean values, extremes;
- interpolations.

All original (corrected) and a part of the derived values are stored in the database. It is possible to establish relations between the different databases in order to increase the amount of information. These relations may be established not only between the meteorological databases but also to existing databases of the other disciplines.

IV. RESULTS

4.1) Synoptic Observations

Monthly and annual means, extremes and frequencies for the years 1985, 1986 and 1987 are listed in Tabs. 1 to 3. These values are permanently available in the synoptic database and they can be used for further calculations. It is also possible to choose special layouts for example for monthly means, delivering quickly information about the climatological conditions during different months. Here only extracts of these tables are shown in order to simplify comparisons with data published in the previous reports.

Some remarks on the values listed in Tabs.1 to 3 (see also WMO, 1983a) :

The 3-hourly records form the basis for daily means; these are used to calculate the monthly averages. Yearly means are based on 12 monthly values.

Clear days are days with mean cloud amount of less than 2/10; *cloudy* days are defined as days with mean cloud amount of more than 8/10. In all the other cases, days are characterized as *partly cloudy*.

In the presentation of wind statistics it is important to distinguish between the *mean wind speed* and the *resultant wind speed.* The mean wind speed is computed like the mean of any quantity (arithmetic mean of the single values) and often appears with the *prevailing wind direction*, the most frequent or modal direction. The resultant wind speed is computed from the two horizontal components of the wind vector and is also called *vector mean speed.* It is related with the *resultant wind direction,* also calculated from the components of the wind vector. In Tabs. 1a-1c, where monthly means are listed, the mean wind speed and the resultant wind direction are shown. In section 4.14 the other wind characteristics are also calculated.

Relative frequencies of visibility and snowdrift refer to the total number of the 3-hourly observations, according to Schwerdtfeger (1984).

Year	Month	Temperature (°C)		Max.Temp. (°C)		Min.Temp. (°C)		Relative Humidity (%)		Pressure (hpa)		Wind speed (m/s)		Wind dir (deg)	Cloud amount (tenths)
1985	1	- 4,1	1,88	- 1,9	1,33	- 6,6	3,59	72	7,2	994	4,2	4,9	2,80	130	7,0
1985	2	-10,0	3,92	- 6,8	3,16	-13,9	4,88	72	8,2	987	6,3	4,7	2,38	135	5,5
1985	3	- 9,2	4,63	- 7,3	4,15	-11,3	5,46	77	7,9	983	7,8	10,2	6,54	90	7,8
1985	4	-16,4	6,76	-13,9	6,43	-18,8	8,00	71	7,4	986	6,7	9,3	5,80	100	6,2
1985	5	-20,4	6,20	-18,4	5,62	-22,9	7,32	73	7,8	988	8,5	9,5	5,61	95	7,8
1985	6	-20,1	6,87	-18,1	6,56	-22,6	8,31	68	9,0	988	10,7	8,9	4,81	95	6,6
1985	7	-24,3	5,16	-21,6	5,27	-27,2	5,93	71	5,8	973	7,7	9,1	6,30	100	6,4
1985	8	-24,8	5,15	-22,0	5,07	-27,8	5,84	69	3,2	988	11,0	6,3	5,30	110	5,9
1985	9	-21,3	6,08	-18,9	5,70	-24,2	6,87	69	5,2	977	10,2	10,0	6,04	95	6,9
1985	10	-18,7	5,25	-16,2	4,46	-22,2	6,77	65	7,9	980	8,2	8,3	5,54	100	6,1
1985	11	-12,9	4,47	-10,4	3,97	-15,9	6,07	66	7,0	978	7,5	6,5	3,35	110	7,2
1985	12	- 5,2	3,19	- 3,3	2,15	- 7,3	4,76	81	13,2	980	6,4	7,9	4,62	85	7,5
whole year		-15,6	7,2	-13,2	7,07	-18,4	7,32	71	4,4	984	6,0	8,0	1,92	100	6,7

Tab.1a Monthly means for the year 1985 from synoptic observations.

First value = mean, second value = standard deviation

Year	Month	Temperature (°C)		Max.Temp. (°C)		Min.Temp. (°C)		Relative Humidity (%)		Pressure (hpa)		Wind speed (m/s)		Wind dir (deg)	Cloud amount (tenths)
1986	1	*- 4,6*	1,64	*- 2,6*	1,43	*- 7,3*	3,16	*83*	6,5	*989*	5,2	*6,2*	3,30	*95*	*6,5*
1986	2	*- 5,1*	2,63	*- 3,0*	2,13	*- 7,5*	3,80	*84*	8,1	*996*	5,7	*8.0*	6,13	*100*	*7,5*
1986	3	*-12,8*	5,13	*-10,1*	4,98	*-16,6*	6,42	*79*	7,8	*994*	9,5	*7,4*	3,65	*110*	*6,6*
1986	4	*-15,9*	6,05	*-13,5*	5,91	*-19,2*	7,80	*80*	9,8	*985*	7,1	*11,1*	6,29	*100*	*7,3*
1986	5	*-23,4*	6,71	*-20,6*	6,47	*-26,1*	7,57	*67*	7,7	*997*	8,5	*7,9*	4,33	*110*	*5,6*
1986	6	*-25,4*	7,58	*-20,9*	6,92	*-27,6*	8,03	*70*	5,6	*996*	9,7	*7,8*	5,10	*105*	*5,7*
1986	7	*-26,2*	7,77	*-22,4*	7,57	*-29.0*	8,43	*66*	8,6	*989*	11,2	*9,3*	4,80	*105*	*5,1*
1986	8	*-21,8*	5,19	*-18,5*	5,34	*-24,2*	6,35	*74*	4,6	*984*	11,7	*11,9*	5,97	*95*	*7,3*
1986	9	*-22,1*	4,92	*-19,9*	5,12	*-24,5*	5,72	*72*	3,1	*978*	5,7	*10,4*	5,55	*110*	*7,1*
1986	10	*-19,8*	4,22	*-17,4*	4,18	*-22,8*	5,50	*68*	7,6	*978*	8,2	*9,8*	4,75	*115*	*6,7*
1986	11	*- 8,8*	2,28	*- 6,6*	2,19	*-10,8*	2,94	*76*	9,5	*984*	6,5	*10,2*	4,90	*95*	*7,7*
1986	12	*- 5,7*	2,39	*- 2,7*	2,20	*- 8,6*	3,92	*72*	10,3	*986*	5,4	*7,3*	4,34	*120*	*5,3*
whole year		*-16,0*	8,27	*-13,2*	7,81	*-18,7*	8,23	*74*	6,0	*988*	6,5	*8,9*	1,75	*105*	*6,5*

Tab.1b Monthly means for the year 1986 from synoptic observations.

First value = mean, second value = standard deviation

Year	Month	Temperature (°C)		Max.Temp. (°C)		Min.Temp. (°C)		Relative Humidity (%)		Pressure (hpa)		Wind speed (m/s)		Wind dir (deg)	Cloud amount (tenths)
1987	1	*-2,9*	2,04	*- 2,0*	1,66	*- 5,7*	3,29	*78*	7,3	*996*	8,9	*6,0*	4,67	*90*	*8,1*
1987	2	*- 8,8*	2,88	*- 6,2*	2,42	*-12,0*	4,39	*72*	8,5	*989*	13,1	*5,6*	3,56	*120*	*7,2*
1987	3	*-10,8*	4,39	*- 8,1*	3,79	*-13,2*	5,71	*75*	8,3	*983*	8,7	*9,4*	5,11	*105*	*7,2*
1987	4	*-16,3*	5,33	*-13,7*	5,47	*-18,8*	6,42	*74*	9,8	*985*	6,2	*10,3*	6,52	*110*	*6,8*
1987	5	*-22,4*	8,34	*-20,0*	8,11	*-25,4*	9,16	*76*	6,5	*990*	6,2	*7,5*	4,53	*130*	*6,4*
1987	6	*-23,2*	8,95	*-20,1*	8,72	*-26,5*	9,12	*71*	7,9	*990*	5,9	*7,5*	4,81	*115*	*5,7*
1987	7	*-20,3*	6,05	*-17,9*	5,61	*-22,9*	7,01	*76*	7,1	*988*	9,4	*12,1*	6,67	*100*	*6,9*
1987	8	*-26,7*	6,07	*-23,2*	5,55	*-28,6*	7,06	*75*	4,5	*976*	9,0	*9,4*	5,28	*115*	*6,6*
1987	9	*-26,6*	7,51	*-23,6*	6,80	*-28,4*	8,05	*73*	6,1	*984*	14,6	*11,3*	6,75	*100*	*7,5*
1987	10	*-21,5*	5,10	*-17,9*	4,50	*-25,0*	6,39	*68*	8,4	*978*	10,4	*7,4*	3,75	*120*	*5,5*
1987	11	*- 8,9*	4,47	*- 6,5*	3,89	*-11,2*	5,19	*78*	10,1	*976*	6,8	*9,1*	4,04	*100*	*6,9*
1987	12	*- 5,3*	3,20	*- 3,2*	2,31	*-8,0*	5,12	*75*	10,1	*988*	6,2	*6,8*	4,45	*105*	*7,3*
whole year		*-16,2*	8,44	*-13,5*	7,92	*-18,8*	8,36	*74*	2,8	*985*	6,3	*8,6*	2,05	*105*	*6,8*

Tab.1c Monthly means for the year 1987 from synoptic observations.

First value = mean, second value = standard deviation

Month		Temperature (°C) *Maximum*		Temperature (°C) *Minimum*		Pressure (hpa) *Maximum*		Pressure (hpa) *Minimum*		*Maximum* Windspeed (m/s)	(deg)	
1985	1	*1,8*	11.1	*-15,3*	26.1	*1002*	4.1	*985*	18.1	*16,5*	*90*	7.1
1985	2	*-0,3*	2.2	*-21,4*	24.2	*1002*	6.2	*976*	13.2	*17,5*	*90*	28.2
1985	3	*-0,8*	1.3	*-25,6*	11.3	*996*	23.3	*963*	5.3	*24,2*	*90*	5.3
1985	4	*-4,5*	17.4	*-33,9*	6.4	*1002*	23.4	*974*	6.4	*27,3*	*90*	19.4
1985	5	*-7,7*	29.5	*-36,1*	27.5	*1010*	18.5	*965*	13.5	*24,7*	*90*	31.5
1985	6	*-6,5*	24.6	*-37,7*	9.6	*1001*	19.6	*942*	30.6	*21,6*	*90*	24.6
1985	7	*-13,6*	23.7	*-39,2*	10.7	*995*	10.7	*954*	18.7	*25,2*	*90*	6.7
1985	8	*-13,3*	9.8	*-38,7*	14.8	*1009*	3.8	*963*	29.8	*25,8*	*80*	26.8
1985	9	*-8,4*	30.9	*-39,3*	13.9	*1002*	8.9	*949*	28.9	*25,8*	*80*	10.9
1985	10	*-7,6*	29.10	*-37,8*	11.10	*994*	28.10	*952*	13.10	*26,3*	*90*	13.10
1985	11	*-3,1*	22.11	*-28,2*	8.11	*992*	6.11	*958*	18.11	*17*	*240*	11.11
1985	12	*-0,5*	28.12	*-18,7*	3.12	*995*	2.12	*961*	30.12	*22,1*	*80*	30.12
whole year		*1,8*	11.1	*-39,3*	13.9.	*1010*	18.5	*942*	30.6	*27,3*	*90*	19.4

Tab. 2a Monthly extremes for the year 1985 from synoptic observations.

First value = extreme, second value = date. Maximum windspeed is shown with the associated wind direction.

Month	Temperature (°C) *Maximum*		Temperature (°C) *Minimum*		Pressure (hpa) *Maximum*		Pressure (hpa) *Minimum*		*Maximum* Windspeed (m/s)	(deg)	
1986 1	*-0,1*	8.1	*-13,9*	10.1	*1003*	13.1	*979*	27.1	*15,4*	*80*	28.1
1986 2	*0,4*	14.2	*-16,3*	12.2	*1009*	19.2	*983*	2.2	*25,2*	*80*	27.2
1986 3	*-2,1*	10.3	*-31,8*	28.3	*1014*	14.3	*965*	30.3	*19,6*	*90*	11.3
1986 4	*0,8*	5.4	*-32,9*	15.4	*996*	13.4	*964*	22.4	*27,3*	*100*	21.4
1986 5	*-7,3*	10.5	*-39,5*	16.5	*1015*	14.5	*976*	27.5	*26,8*	*90*	29.5
1986 6	*-5,2*	9.6	*-43,4*	28.6	*1019*	13.6	*971*	30.6	*25,2*	*90*	9.6
1986 7	*-5,5*	30.7	*-43,4*	8.7	*1007*	18.7	*955*	30.7	*25,8*	*100*	21.7
1986 8	*-4,5*	15.8	*-38,8*	30.8	*1006*	26.8	*952*	13.8	*29,9*	*100*	9.8
1986 9	*-9,3*	26.9	*-35,4*	8.9	*995*	2.9	*963*	24.9	*26,3*	*240*	23.9
1986 10	*-8,8*	13.10	*-34,4*	8.10	*993*	20.10	*960*	5.10	*26,8*	*100*	4.10
1986 11	*-0,6*	3.11	*-16,9*	25.11	*1002*	3.11	*972*	14.11	*22,1*	*90*	8.11
1986 12	*2,0*	30.12	*-17,2*	3.12	*997*	8.12	*970*	28.12	*22,1*	*90*	14.12
whole year	*2,0*	30.12	*-43,4*	28.6	*1019*	13.6	*952*	13.8	*29,9*	*100*	9.8

Tab. 2b Monthly extremes for the year 1986 from synoptic observations.

First value = extreme, second value = date. Maximum windspeed is shown with the associated wind direction.

Month		Temperature (°C) Maximum		Temperature (°C) Minimum		Pressure (hpa) Maximum		Pressure (hpa) Minimum		*Maximum* Windspeed (m/s)	(deg)	
1987	1	*0,6*	3.1	*-15,6*	31.1	*1009*	20.1	*970*	9.1	*25,8*	*90*	8.1
1987	2	*-2,2*	11.2	*-21,2*	15.2	*1012*	4.2	*966*	17.2	*17*	*110*	18.2
1987	3	*-2,2*	7.3	*-26,3*	17.3	*1001*	28.3	*956*	6.3	*25,2*	*90*	25.3
1987	4	*-2,7*	14.4	*-32,3*	27.4	*997*	15.4	*965*	24.4	*30,4*	*100*	4.4
1987	5	*-3,6*	16.5	*-40,1*	11.5	*1000*	18.5	*971*	31.5	*24,7*	*100*	14.5
1987	6	*-3,1*	3.6	*-42,9*	19.6	*1003*	23.6	*977*	2.6	*23,7*	*70*	3.6
1987	7	*-7,5*	20.7	*-37,9*	11.7	*1007*	21.7	*964*	3.7	*30,9*	*100*	2.7
1987	8	*-14,7*	25.8	*-42,7*	23.8	*990*	8.8	*949*	3.8	*29,9*	*90*	24.8
1987	9	*-13,2*	28.9	*-45,2*	5.9	*1009*	10.9	*945*	27.9	*29,4*	*90*	27.9
1987	10	*-8,0*	26.10	*-37,4*	14.10	*998*	14.10	*944*	2.10	*22,1*	*100*	25.10
1987	11	*0,0*	10.11	*-28,8*	4.11	*989*	30.11	*955*	10.11	*21,6*	*90*	10.11
1987	12	*0,0*	26.12	*-24,2*	3.12	*998*	9.12	*971*	13.12	*22,1*	*100*	17.12
whole year		*0,6*	3.1	*-45,2*	5.9	*1012*	4.2	*944*	2.10	*30,9*	*100*	2.7

Tab. 2c Monthly extremes for the year 1987 from synoptic observations.

First value = extreme, second value = date. Maximum windspeed is shown with the associated wind direction.

Year	Month	Number of days clear	partly cloudy	cloudy	Rel.frequencies (%) visibility <200m	200m-1000m	Rel.frequencies (%) snowdrift moderate	strong
1985	1	2	15	14	0	6	42	3
1985	2	3	19	6	0	2	41	6
1985	3	0	13	18	16	17	52	22
1985	4	5	12	10	9	6	43	19
1985	5	1	13	16	13	16	43	13
1985	6	1	16	13	12	10	36	16
1985	7	1	20	10	7	3	25	20
1985	8	5	15	10	9	12	44	16
1985	9	4	12	13	12	13	36	34
1985	10	8	10	13	12	12	38	28
1985	11	2	11	17	3	11	56	3
1985	12	2	11	18	5	11	39	16
whole year		34	167	158	8	10	41	16

Tab.3a Monthly frequencies for the year 1985 from synoptic observations.

Frequencies of visibility and snowdrift refer to the total number of observations during the respective month.

Year	Month	Number of days clear	Number of days partly cloudy	Number of days cloudy	Rel.frequencies (%) visibility <200m	Rel.frequencies (%) visibility 200m-1000m	Rel.frequencies (%) snowdrift moderate	Rel.frequencies (%) snowdrift strong
1986	1	2	18	11	0	2	28	0
1986	2	1	10	17	4	10	30	13
1986	3	5	12	14	0	7	24	1
1986	4	0	16	12	8	13	29	10
1986	5	3	22	6	1	4	17	8
1986	6	5	19	6	7	8	27	11
1986	7	7	16	8	8	9	39	8
1986	8	1	17	12	8	13	43	26
1986	9	0	16	13	10	9	43	14
1986	10	0	19	12	4	11	42	7
1986	11	2	12	16	5	21	58	5
1986	12	3	20	8	1	9	28	1
whole year		29	197	135	5	10	34	9

Tab.3b Monthly frequencies for the year 1986 from synoptic observations.

Frequencies of visibility and snowdrift refer to the total number of observations during the respective month.

Year	Month	Number of days clear	partly cloudy	cloudy	Rel.frequencies (%) visibility <200m	200m-1000m	Rel.frequencies (%) snowdrift moderate	strong
1987	1	1	8	22	2	5	13	5
1987	2	0	15	13	0	8	20	0
1987	3	1	17	13	0	9	46	3
1987	4	2	13	13	10	17	33	12
1987	5	6	13	12	0	26	43	2
1987	6	6	18	6	9	9	25	8
1987	7	2	12	15	9	14	43	18
1987	8	0	18	12	4	23	50	7
1987	9	4	10	15	16	17	41	16
1987	10	4	20	7	1	12	38	0
1987	11	2	14	14	3	13	63	2
1987	12	3	13	15	3	8	33	3
whole year		31	171	157	5	13	37	6

Tab.3c Monthly frequencies for the year 1987 from synoptic observations.

Frequencies of visibility and snowdrift refer to the total number of observations during the respective month.

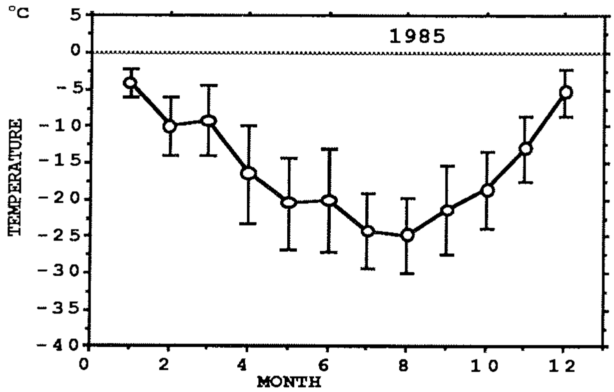
4.1.1) Surface Air Temperature

The mean temperatures of -15,6°C for 1985,
-16,0°C for 1986,
-16,2°C for 1987

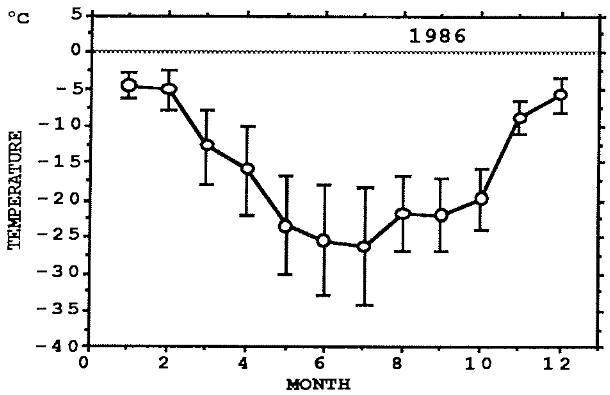
do not differ significantly from the values of the previous years:

-16,5°C for 1981,
-15,9°C for 1982,
-15,6°C for 1983,
-16,6°C for 1984.

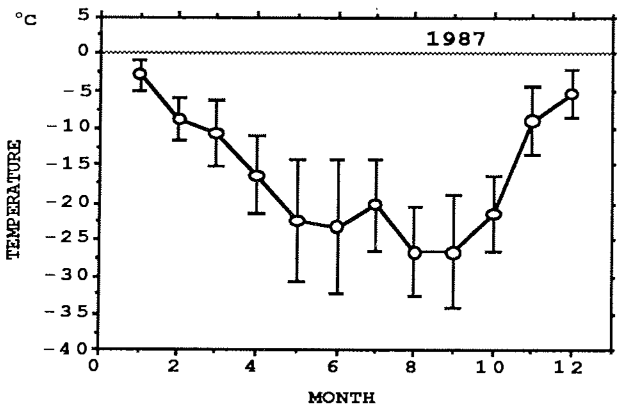
Figs. 1a-1c show the annual course of surface temperature for 1985, 1986 and 1987. The standard deviations indicate a large temperature variability during the winter months. The coldest months are August in 1985 and 1987 and July in 1986. In 1987 July shows a secondary maximum in contrast to the other years. Temperature variations are composed of periodic and non-periodic components. Periodic changes are generated by the incoming solar radiation. The non-periodic variations are mainly due to advection of different air masses, changes of cloud conditions and to vertical motion and mixing in the atmospheric boundary layer (Schwerdtfeger, 1970).



1a

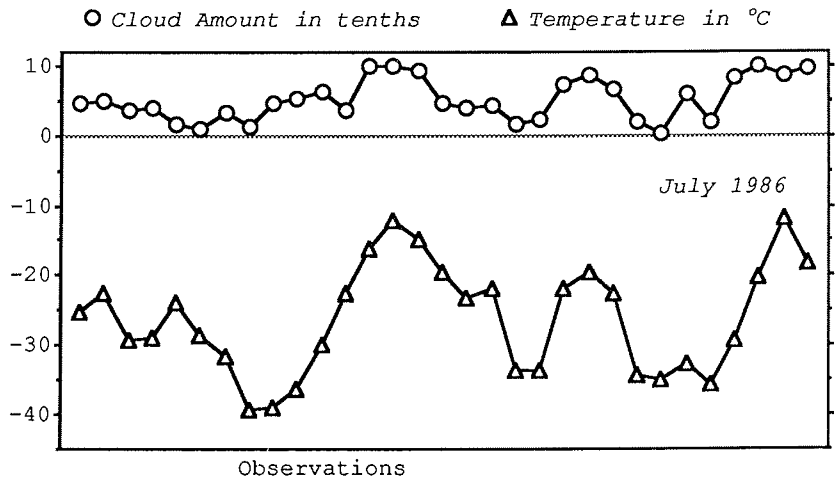


1b



1c

Figs 1a-1c — *Annual course of monthly mean values of surface air temperature. Mean values are plotted with standard deviation.*



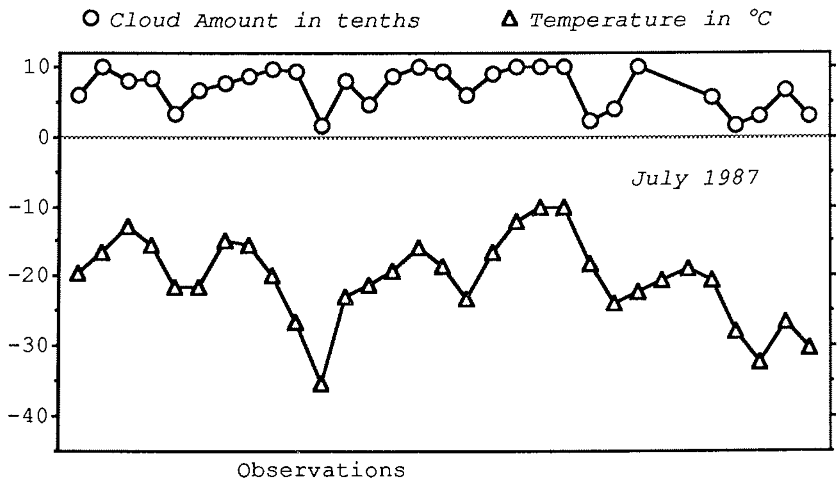


Fig.2 *Mean daily values of cloud amount and surface air temperature during July 1986 and 1987.*

In Fig. 2 the mean daily values of cloud amount and air temperature are plotted for July 1986 and July 1987.

To a certain extent both quantities seem to be positively correlated, which might be an explanation for the relatively warm temperatures in July 1987.

The range of the day-to-day variability of surface air temperature is shown for the year 1987 (Fig.3): the variability is largest during winter and relatively small around mid summer.

The annual mean day to day variability is 3,2 °C with a maximum value of 16,9 °C in June.

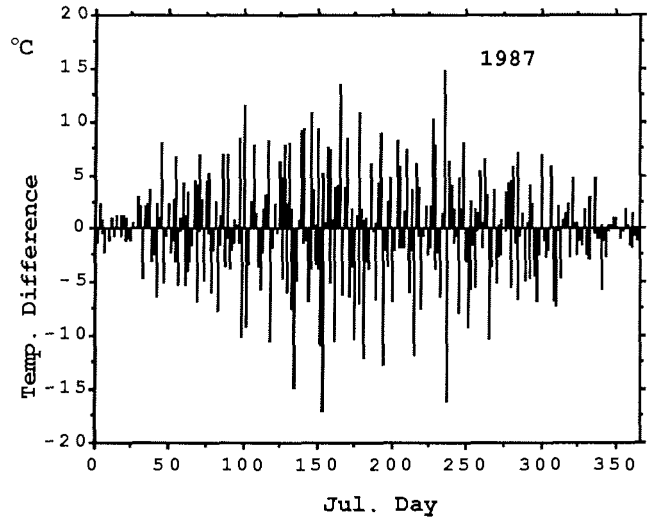


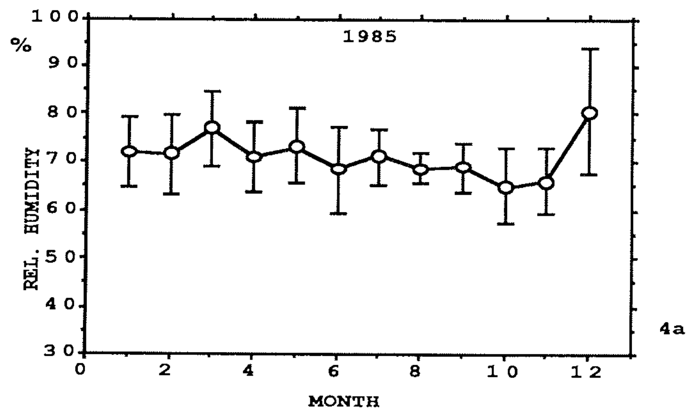
Fig.3 *Day-to-day variation of surface air temperature (calculated from mean daily values) for the year '1987*

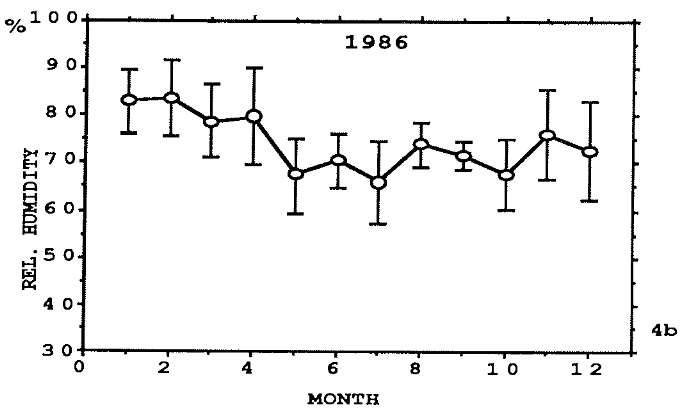
4.1.2) Relative Humidity

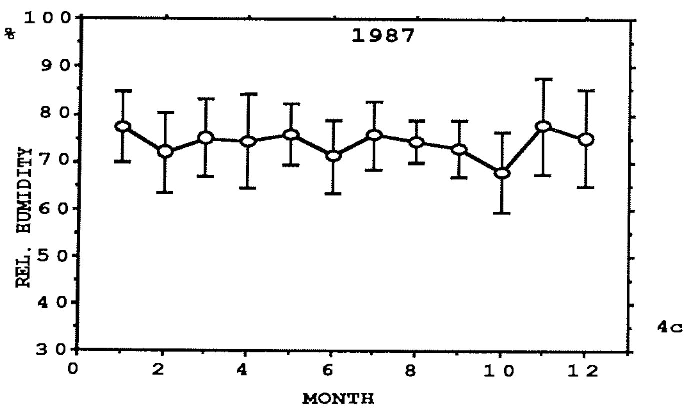
The annual variation of relative humidity (Fig.4) is rather small: monthly means range between 65 % and 84 %. Yearly mean values do not differ significantly (71 % in 1985, 74 % in 1986 and 1987). The currently existing methods of measuring humidity yield large uncertainties at low air temperatures. Therefore, special attention has been given to humidity data at low (< -25°C) temperatures.

4.1.3) Air Pressure

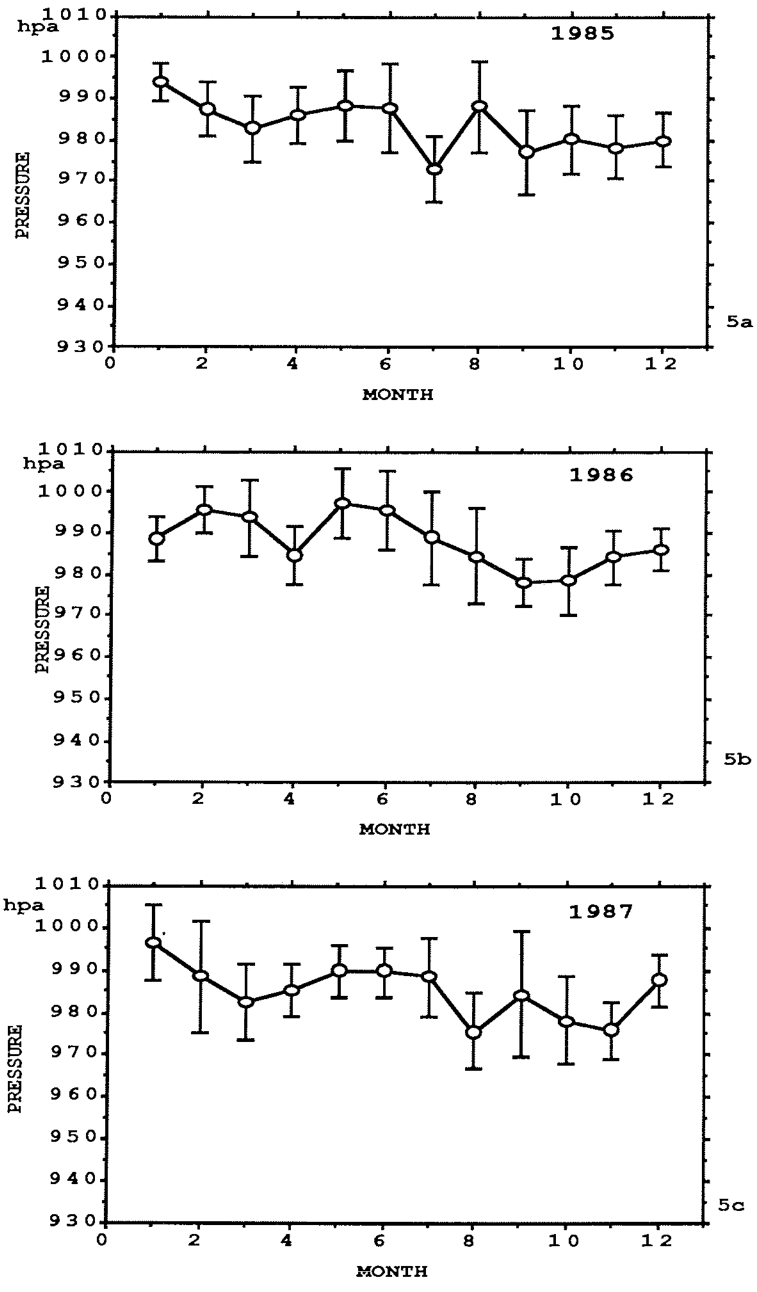
Fig.5 presents the annual course of the monthly mean pressure data. The yearly mean sea level pressure values of 984 hpa in 1985, 988 hpa in 1986 and 985 hpa in 1987 are in good agreement with those of the earlier years. The absolute extreme values are 1010 hpa and 942 hpa for 1985, 1019 hpa and 952 hpa for 1986, 1012 hpa and 944 hpa for 1987.
The mean day-to-day variation is found to be 5 hpa, with a maximum of 20 hpa.







<u>*Figs 4a-4c*</u> *Annual course of monthly mean values of relative humidity. Mean values are plotted with standard deviation.*



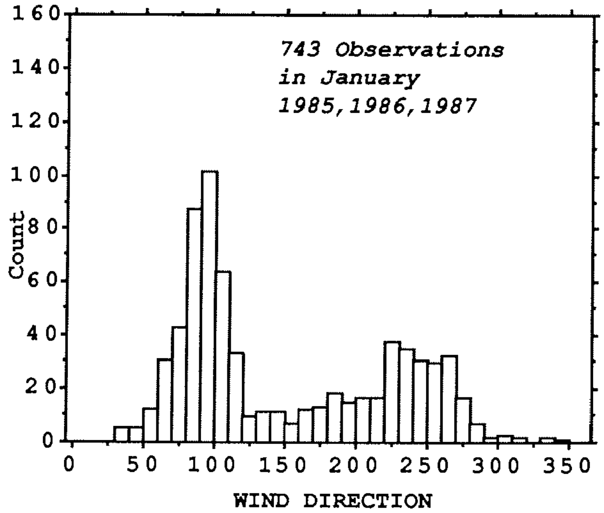
Figs. 5a-5c *Annual course of monthly mean values of air pressure. Mean values are plotted with standard deviation.*

4.1.4) Wind

As mentioned in section 4.1, average conditions of wind velocity can be characterized by different parameters.
Tab.1 contains monthly and annual averages of wind speed and resultant wind direction. The mean annual wind speeds of 8,0 m/s (1985), 8,9 m/s (1986) and 8,6 m/s (1987) do not differ significantly from the values determined for the earlier years considering the standard deviations (around 2 m/s). The resultant wind directions from all three years range between 85° and 135°. The absolute maximum windspeeds of 27,3 m/s (1985), 29,9 m/s (1986) and 30,9 m/s (1987) were always associated with easterlies (95°).
Fig.6 shows the frequency distribution of wind direction for observations from all three years for the months of January and July. The pronounced maximum at 90° and secondary ones near 240° in summer and near 240° and 170° in winter are consistent with earlier findings.
Tab.4 summarizes the mean wind characteristics for the months of January and July. In addition, the *directional constancy* of the wind is calculated. It is defined as the magnitude of the resultant wind speed divided by the mean wind speed. A value of 1 means that all wind measurements in the examined time period indicate the same direction, only the speed could have varied. The more pronounced maximum in the frequency distribution during July results in a greater constancy factor than in January.

	Mean speed	Prevailing direction	Resultant speed	Resultant direction	Directional constancy
	m/s	deg	m/s	deg	
JAN	5,7	90	3,0	100	0,53
JUL	10,2	90	7,3	105	0,72

Tab.4 *Wind characteristics from synoptic measurements during January and July 1985, 1986 and 1987.*



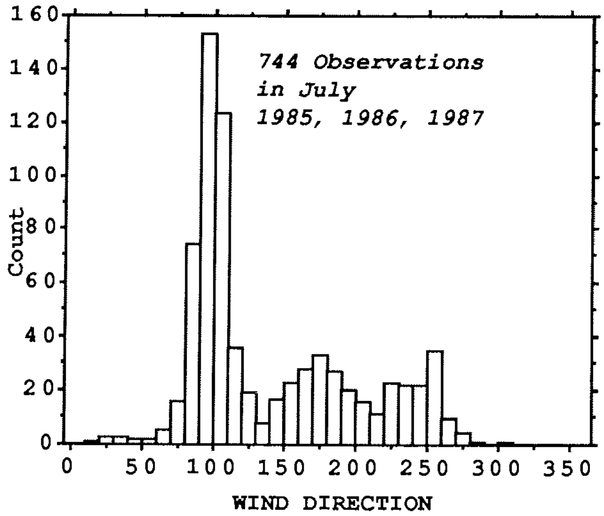
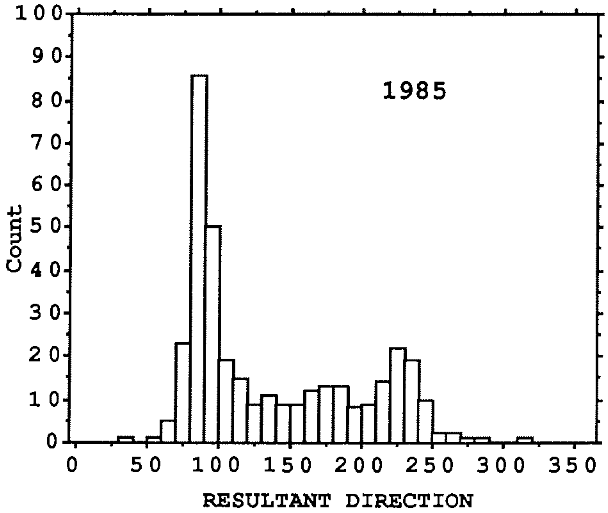
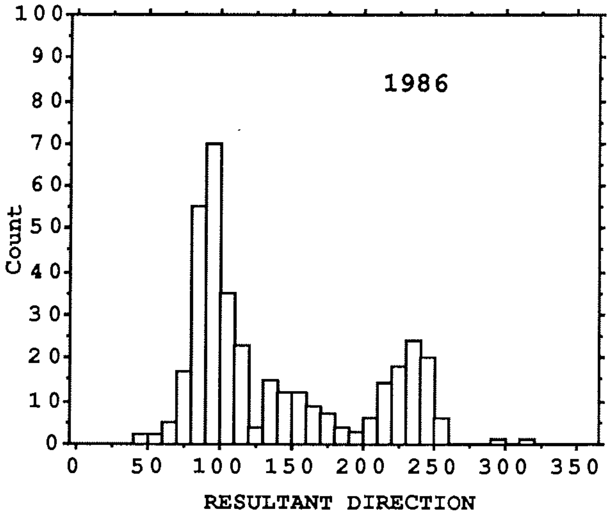


Fig. 6 *Frequency distributions of wind direction (from 3-hourly observations) for measurements in the months of January and July.*

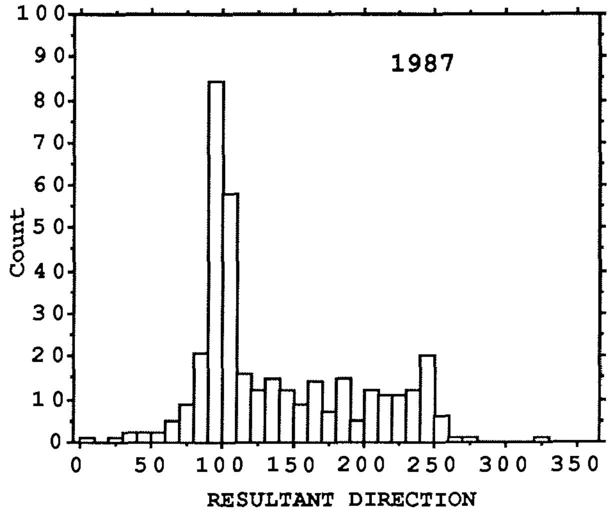
(*Fig.7*)


100
90
80
70
60
50
40
30
20
10
0
Count
1985
0
50
100
150
200
250
300
350
RESULTANT DIRECTION

7a


100
90
80
70
60
50
40
30
20
10
0
Count
1986
0
50
100
150
200
250
300
350
RESULTANT DIRECTION

7b



7c

Fig. 7 *Frequency distributions of resultant wind direction (daily means)*

The frequency distributions of the daily mean values of the resultant wind direction (Fig.7) reflect the same pattern as seen in Fig.6. As has already been discussed in the previous reports, easterly winds dominate because the centres of most of the low-pressure areas passing the station lie to the north.

The horizontal components of the wind vector (u = zonal, positive to the east; v = meridional, positive to the north) in Fig.8. clearly indicate that the monthly means are governed by a southerly meridional and an easterly zonal direction, with an always dominant zonal component.

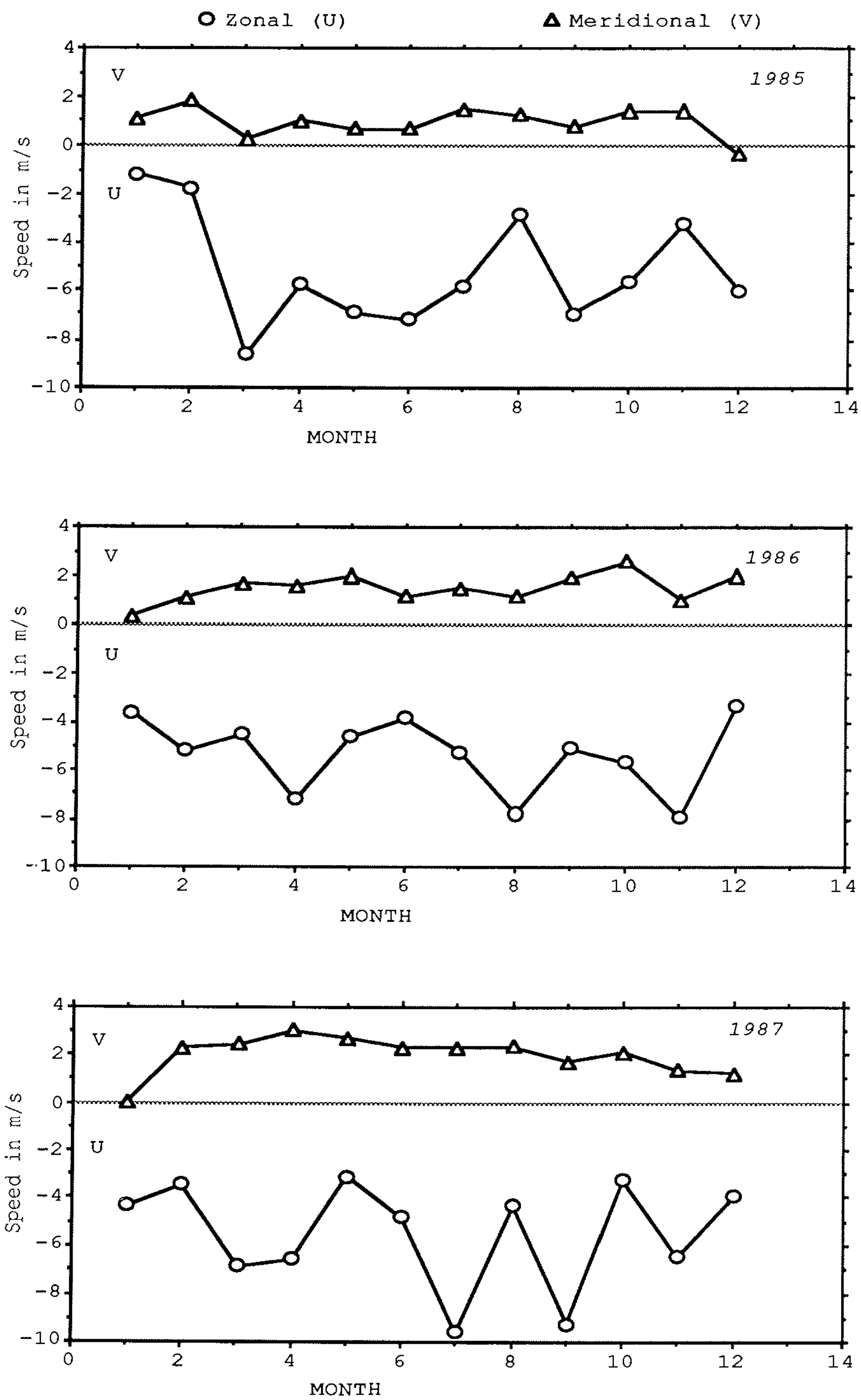


Fig.8 *Zonal and meridional components of the wind vector (monthly means).*

The ranges of the 3-hourly wind speeds are similar for the three years of observations:

	1985	1986	1987
range: 0 to 10 m/s	68,4%	64,9%	68,0%
range: 10 to 20 m/s	25,7%	28,3%	25,8%
range: greater than 20m/s	5,9%	6,8%	6,2%

Fig.9 and Fig.10 show a close correlation between wind speed and the occurence of drifting and blowing snow and of bad visibility conditions, respectively.

The intensity of snowdrift versus the actual wind speed for the 3-hourly observations of August 1986 is depicted in Fig.11. This month was selected because of the exceptionally high wind speeds and thus also enhanced snowdrifts (Tabs.1-3).

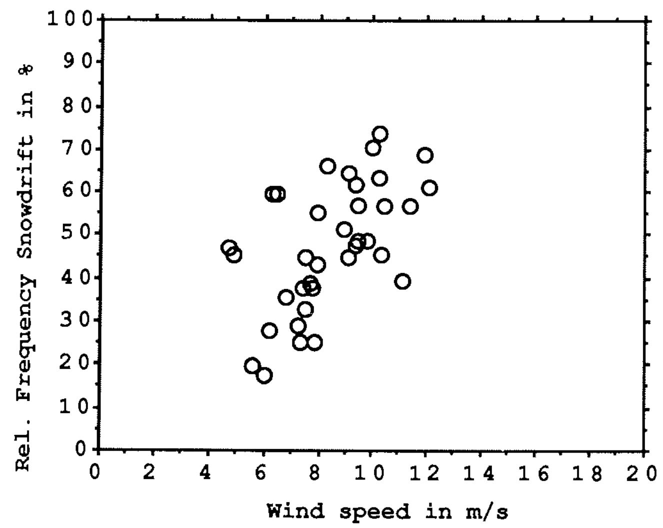


Fig.9 *Relative frequencies of 'snowdrift' observations as function of wind speed (based on the monthly means 1985-1987).*

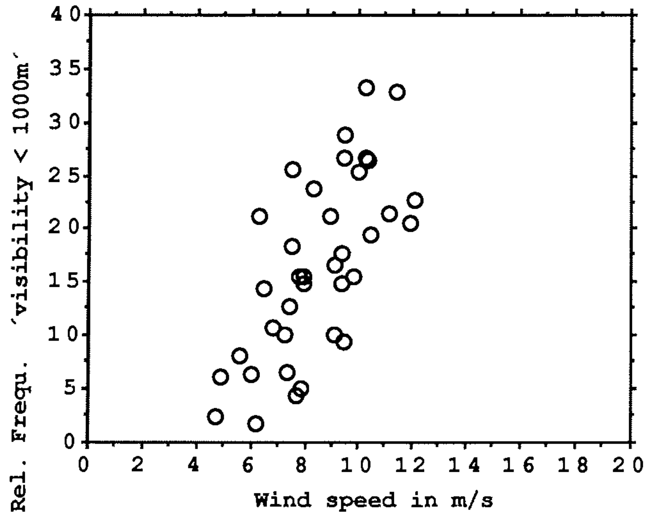


Fig.10 *Relative frequencies of 'visibility less than 1000m' as function of wind speed (based on the monthly means 1985-1987).*

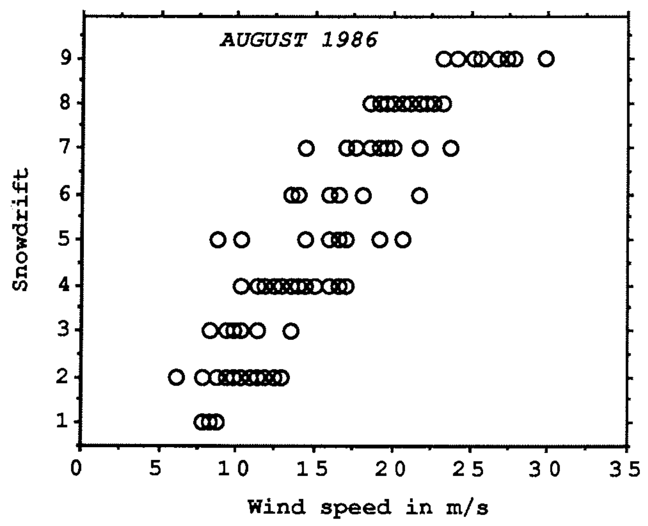


Fig.11 *Intensity of snowdrift (coded) as a function of wind speed (based on 3-hourly observations during August 1986). Numbers 0-5 signify slight to moderate snowdrift, numbers 6-9 signify heavy snowdrift).*

4.1.5) Clouds

The yearly mean cloud amounts (in tenths) of 6,7 (1985), 6,5 (1986) and 6,8 (1987) are rather stable. They compare well with the values of the previous years (which after correction are: 6,6 (1981), 6,6 (1982), 6,4 (1983) and 6,7 (1984)) and the climatological data of Schwerdtfeger (1970) for coastal stations.
As generally known, data on cloud amount are U-shape distributed, making values around the arithmetic mean not very frequent to occur (Fig.12). Calculating mean values approximates to normally distributed data. This is demonstrated in Figs.13a-c, where monthly mean cloud amounts and relative frequencies of different sky-conditions are plotted for the three years. As has been mentioned already, *clear* days are days with mean cloud amount of less than 20 % and *cloudy* days are characterized by mean cloud amount greater than 80 %. In all the other cases, days are characterized as *partly cloudy*. The case of *partly cloudy* turns out to be the most frequent during the greatest part of the year.

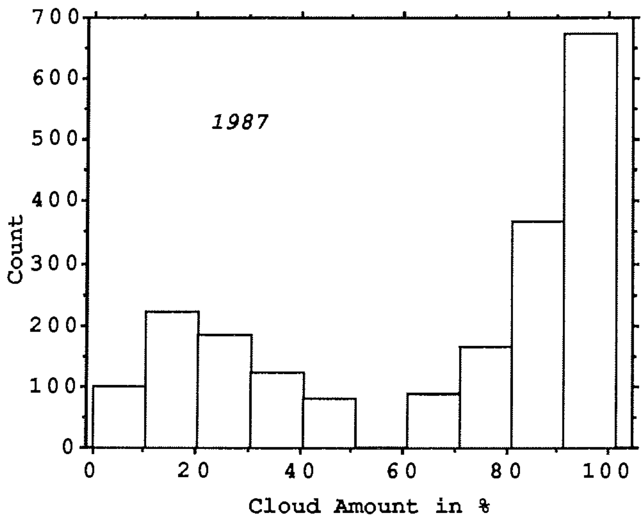
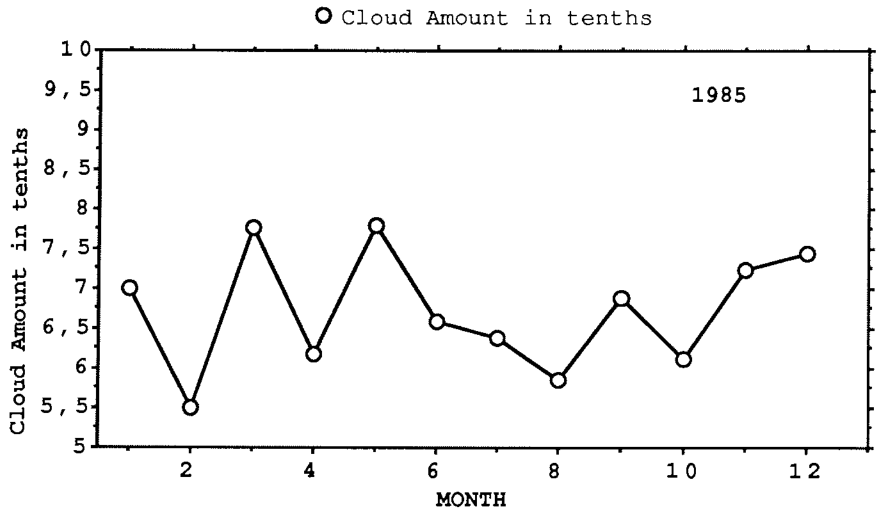


Fig.12 *Frequency distribution of 3-hourly cloud amounts for the year 1987 (2160 observations). In 161 cases cloud observations were not possible, mostly because of blowing snow or bad light conditions.*



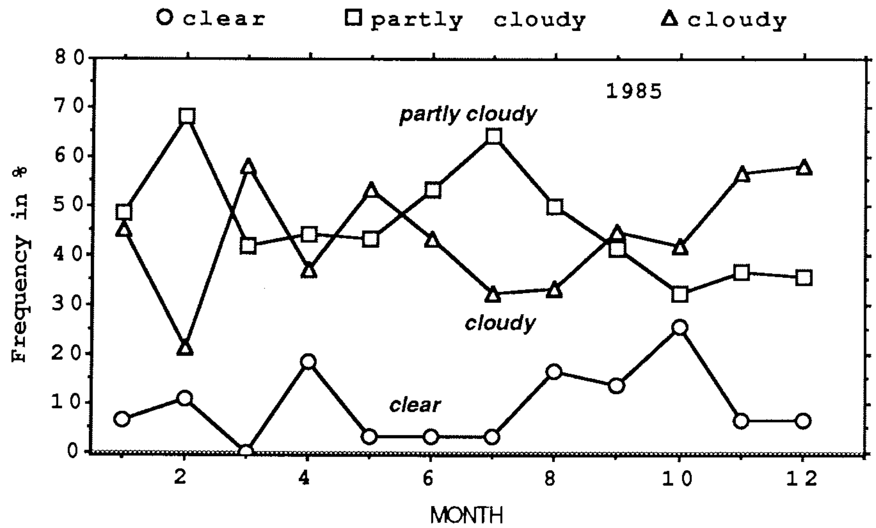


Fig.13a *Monthly mean cloud amounts and relative frequencies of 'clear', 'partly cloudy' and 'cloudy' conditions during the year 1985.*

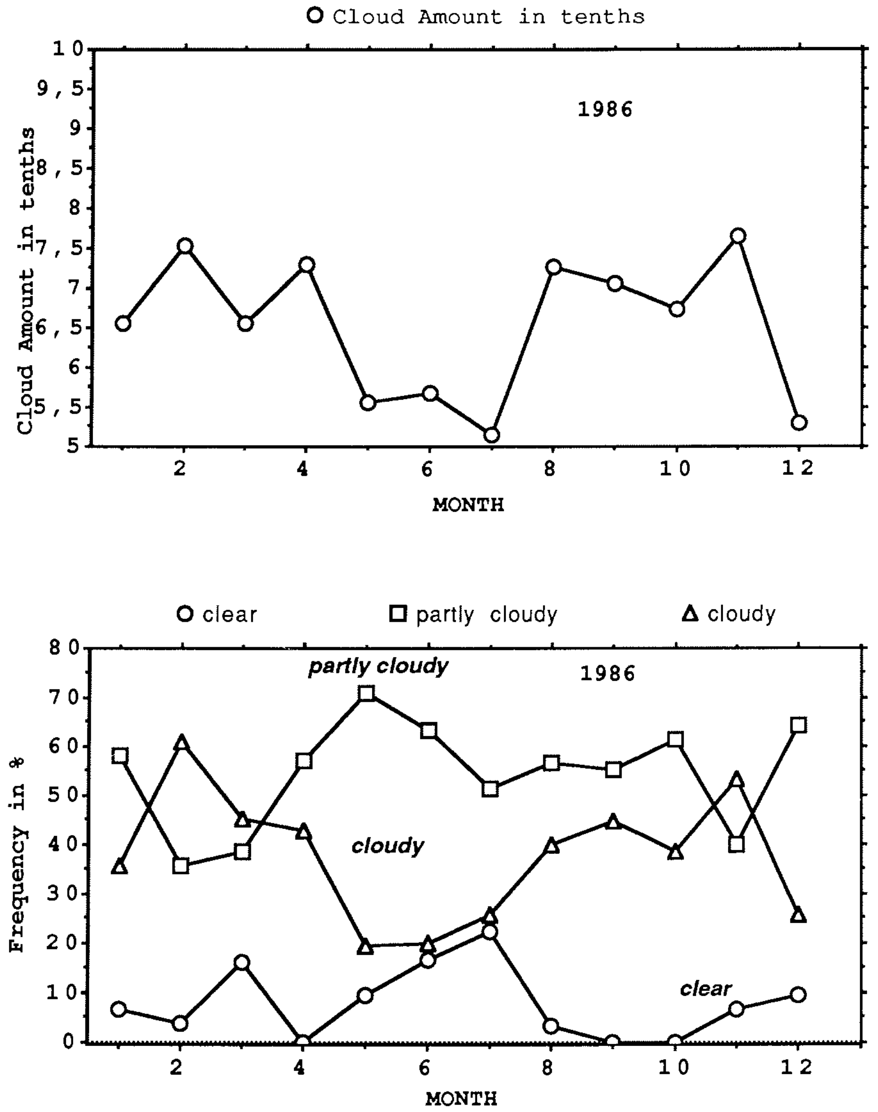
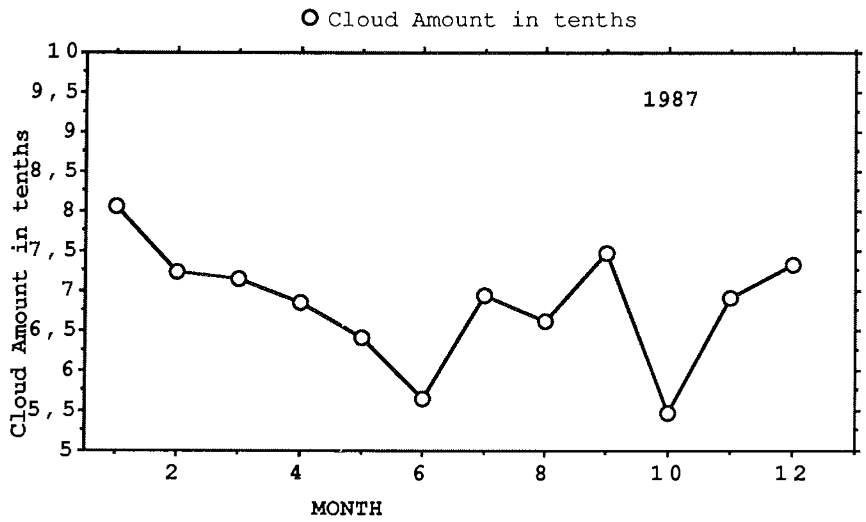


Fig.13b *Monthly mean cloud amounts and relative frequencies of 'clear', 'partly cloudy' and 'cloudy' conditions during the year 1986.*



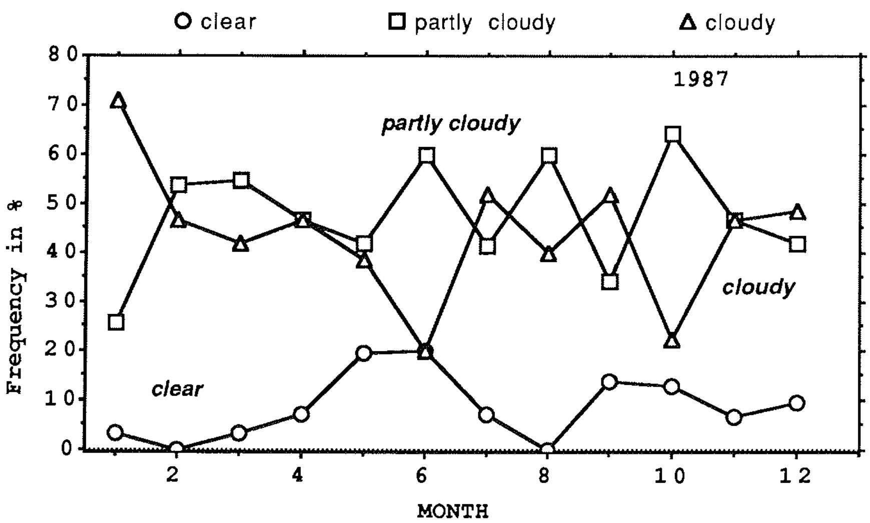


Fig.13c *Monthly mean cloud amounts and relative frequencies of 'clear', 'partly cloudy' and 'cloudy' conditions during the year 1987.*

4.2) Upper Air Soundings

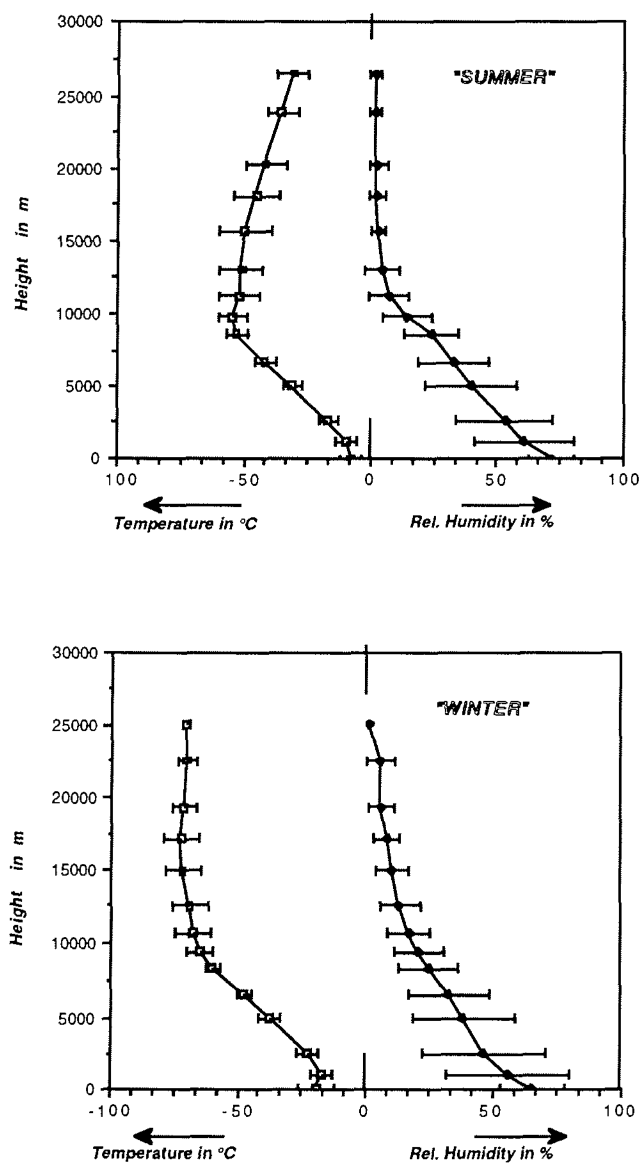
At least once a day a radiosonde was launched. Because of a failure of the Micro Cora system there had been no measurements in the period between 15 August 1987 and 22 December 1987. Fig.21 shows mean profiles of temperature, relative humidity and wind components for every month. The averages are based on the single rawinsonde observations, interpolated to the standard pressure levels. Mean seasonal profiles for summer and winter are also plotted (Fig.14).

Mean *temperature* profiles show a well-defined tropopause in summer (Figs.14,15) and the surface inversion in winter months. The lowest temperatures are found during winter in the stratosphere: -86,9°C at 12219 m height at 10 August 1985, -88,2°C at a height of 19974 m at 4 September 1986 and -85,8°C at 18382 m height at 6 August 1987 (bearing in mind that no data are available for the period between 15 August and 22 December 1987).

The height of the *tropopause* is determined in the database and is defined as the lowest height above which temperature decrease with height is less than 0,2°C per 100 m. This condition must be fulfilled in a range of at least 2000m. Fig.15 presents the results of these computations for the three years. During summer, when the tropopause is well-defined, the heights vary around 9000 m. During winter months, there are many days where no tropopause-height can be determined, because temperature change with height is less than -0,2°C per 100 m at all levels.

Year	*Height in m*	*std.dev.*	*Min. (date,temp.)*	*Max. (date,temp.)*
1985	10075	1999	7033 (15May,-53)	18086 (14Sep,-81)
1986	10267	1834	7202 (15Jan,-46)	17807 (12Oct,-72)
1987	9431	1207	7081 (31May,-56)	15815 (5Apr,-54)
Year	*Temp. in °C*	*std.dev.*	*Min.(date,height)*	*Max.(date,height)*
1985	-63	10	-87 (10Aug,12219)	-43 (30Dec,7760)
1986	-64	9	-83 (25Jul,11921)	-45 (4Mar,7306)
1987	-59	8	-80 (30Jun,11532)	-44 (26Jan,8852)

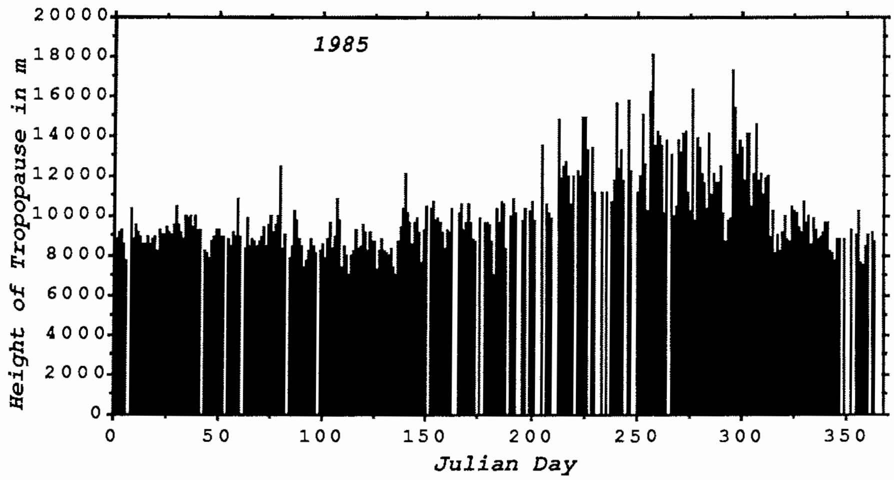
Tab.5 *Annual means and extremes of tropopause-height and -temperature. No measurements between 15 Aug.1987 and 22 Dec.1987.*

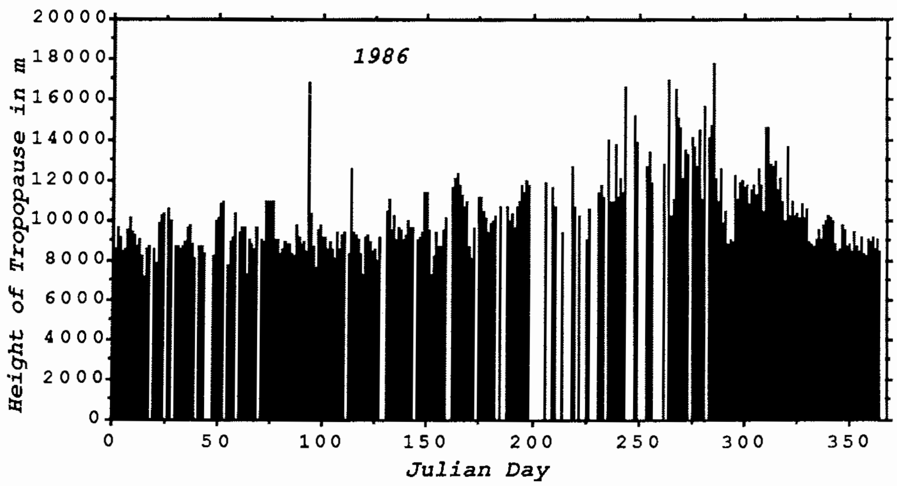


<u>*Fig.14*</u> *Mean vertical variation of temperature and relative humidity with standard deviation, from daily radiosonde data of the years 1985-1987. 'Summer' = November, December, January, February (228 soundings); Winter' = May, June, July, August (363 soundings).*

In general, during end of winter and in spring, the tropopause lies higher than during the rest of the year, but it is defined by very small lapse rates. Tab.5 shows annual means and extremes of tropopause -height and -temperature.

(Fig.15)





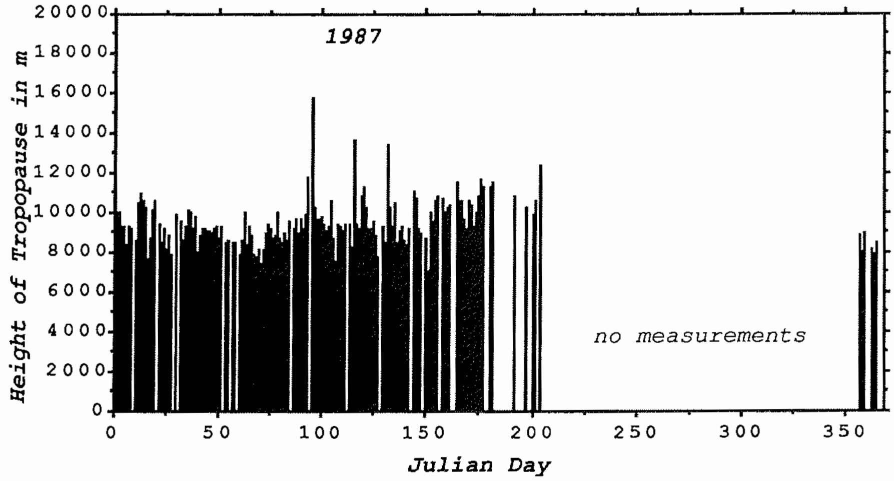


Fig.15 *Height of tropopause, calculated from daily radiosonde data for the years 1985,1986 and 1987. If there are gaps in the bar charts, tropopause could not be determined.*

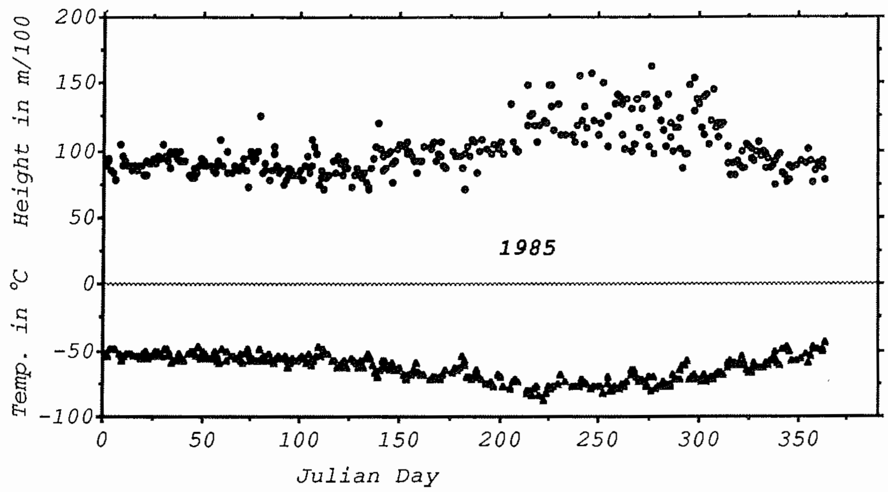
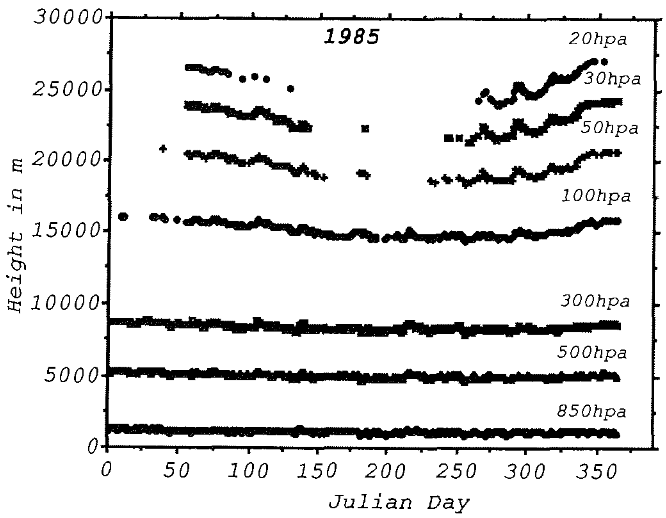


Fig.16 *Annual change of tropopause-height and -temperature, based on daily radiosonde data of the year 1985.*

It is obvious, that tropopause is the colder the higher it shows up (Fig.16); annual mean temperatures at tropopause vary around -60°C.

Fig.17 depicts the annual variation of the *heights at different standard pressure levels.* There are no marked variations at the levels greater than 300 hpa. The annual trend at levels less than 100 hpa is caused by the strong stratospheric cooling in winter (see also Fig.18).

(Fig.17)



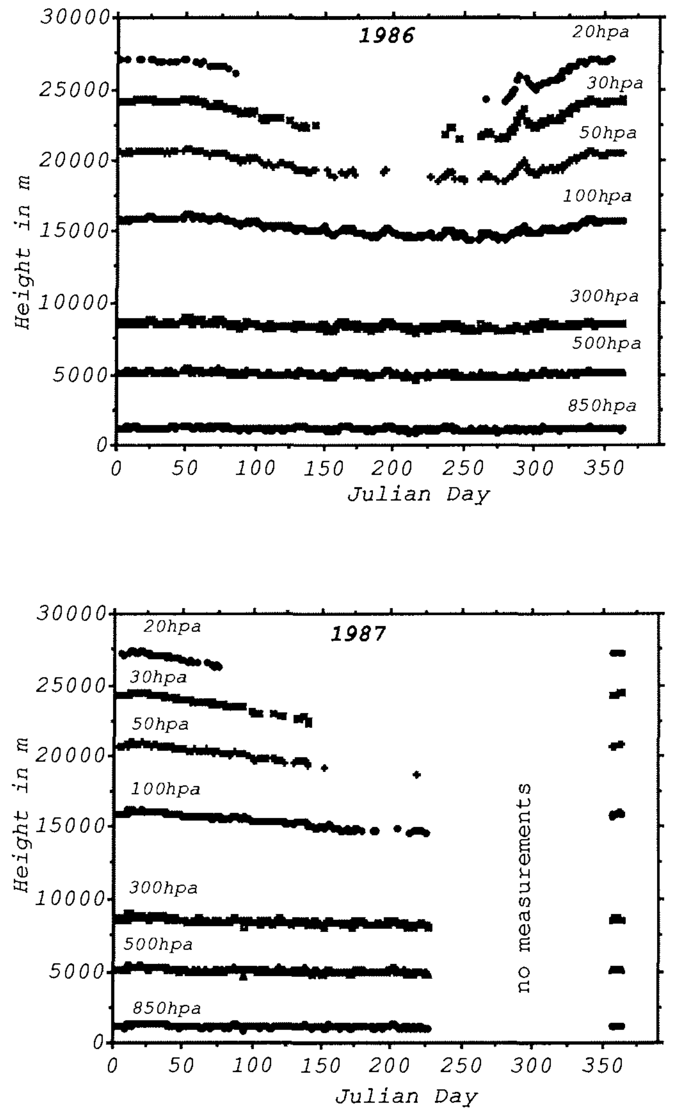
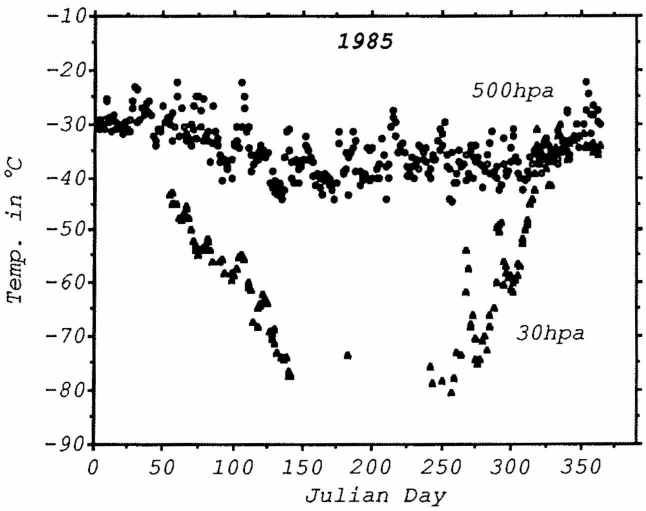
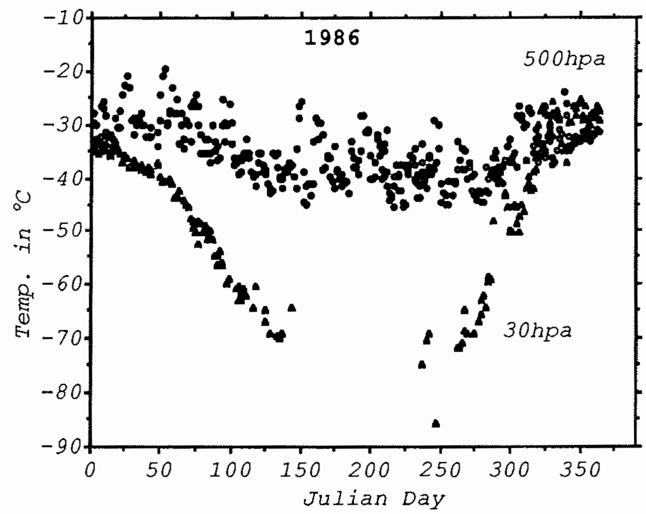


Fig.17 *Annual variation of heights at different standard pressure levels.*

(Fig.18)


1985
500hpa
30hpa
Temp. in °C
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
50
100
150
200
250
300
350
Julian Day


1986
500hpa
30hpa
Temp. in °C
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
50
100
150
200
250
300
350
Julian Day

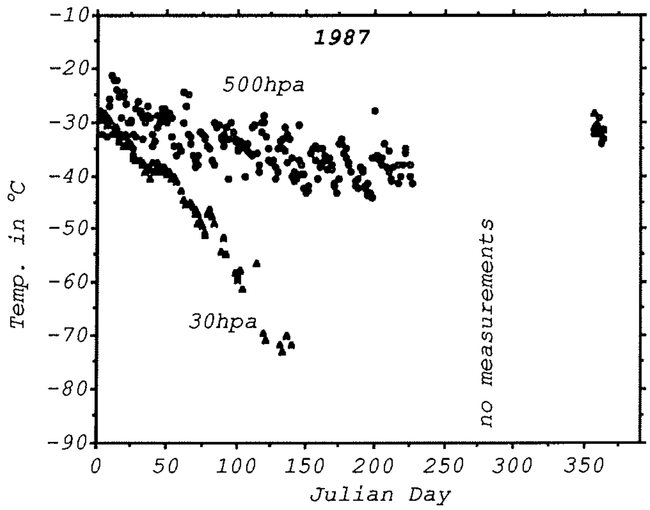


Fig.18 *Annual variation of temperature at 500 hpa and 30 hpa levels. In winter, 30 hpa are mostly not reached (the extreme low stratospheric temperatures cause balloons to burst early).*

Mean profiles of *zonal and meridional wind components* for summer and winter are shown in Fig.19. An easterly wind flow dominates the lower tropospheric wind field and extends up to a height of 3000 m during winter and around 5000 m during summer. In upper levels the easterlies are replaced by westerlies due to the influence of the higher latitude circulation. Whereas westwinds continue to increase with height in winter, the stratospheric summer circulation reduces the westerlies at heights above 20000m.

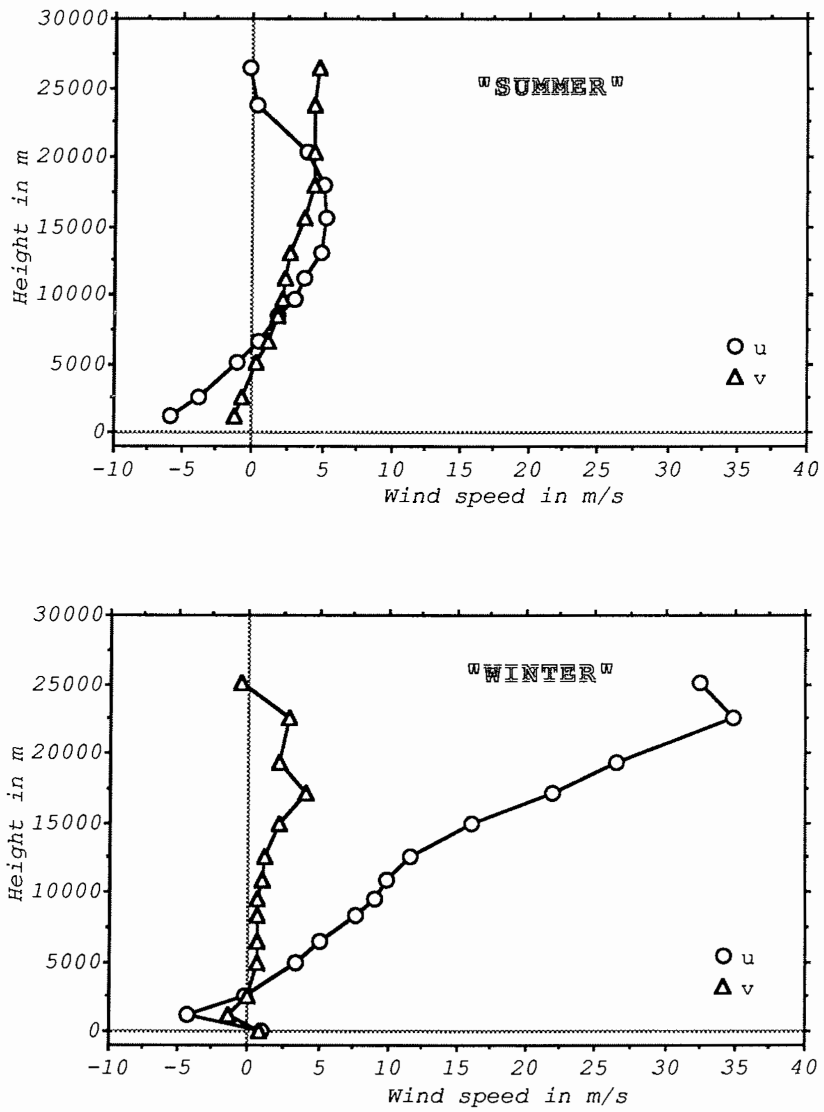
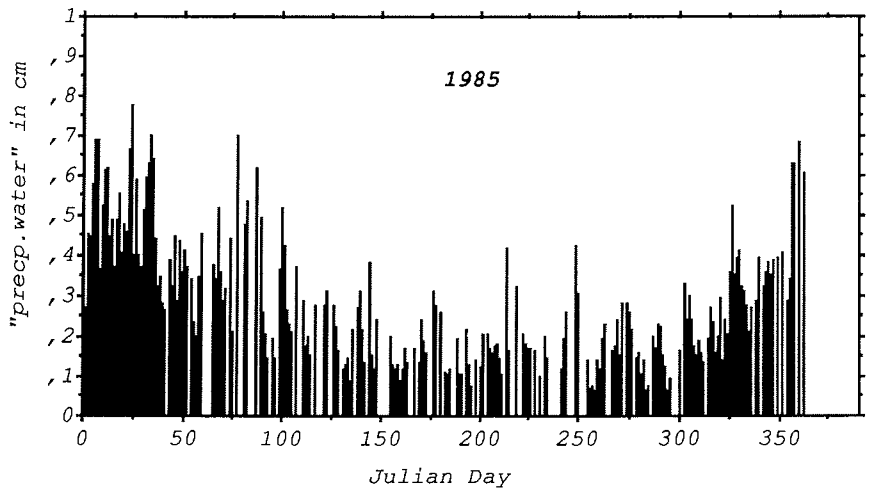


Fig.19 *Mean vertical variation of zonal (u) and meridional (v) wind components, from daily radiosonde data of the years 1985-1987. Summer´ = November, December, January, February (228 soundings); ´Winter´= May, June, July, August (363 soundings).*

Looking at the monthly and seasonal profiles (Fig.21, Fig.14), distinct features of relative *humidity* cannot be detected. The moisture content of the air decreases with height in the troposphere and approximates to zero in the stratosphere, where uncertainties of measurements because of the low temperatures must be taken into account. Fig.20 presents the annual change of "precipitable water" (ppw), the total amount of water vapour in a vertical column (over a horizontal reference area); 1cm ppw is equivalent to 1g H_2O/cm^2.
Approximate average values of "precipitable water" in summer and winter (based on the measurements in 1985-1987) are :

0,4 cm ppw in summer (std.dev.=0,17);
0,2 cm ppw in winter (std.dev.=0,13).

(Fig.20)



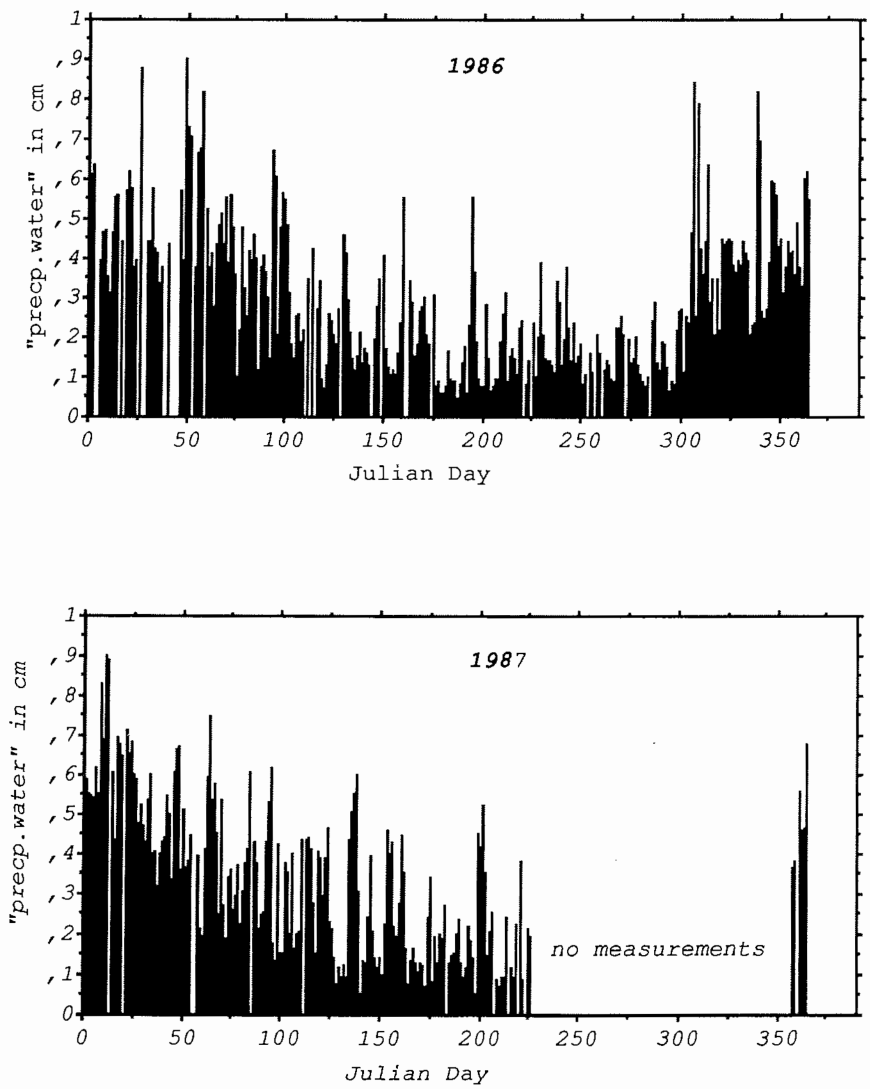
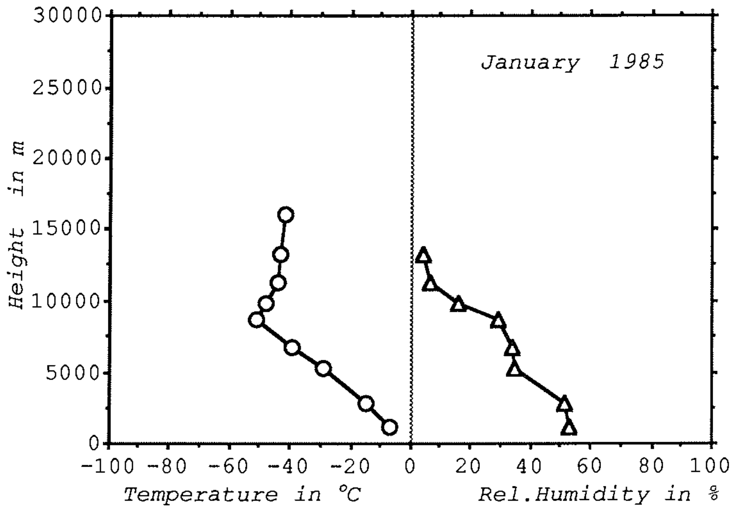
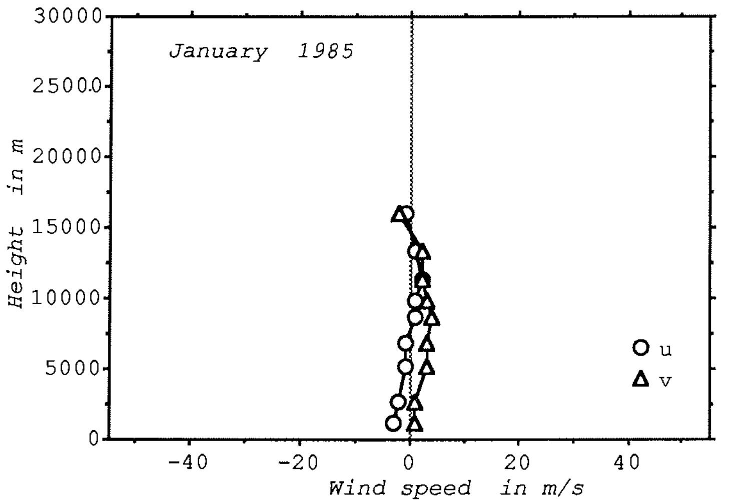
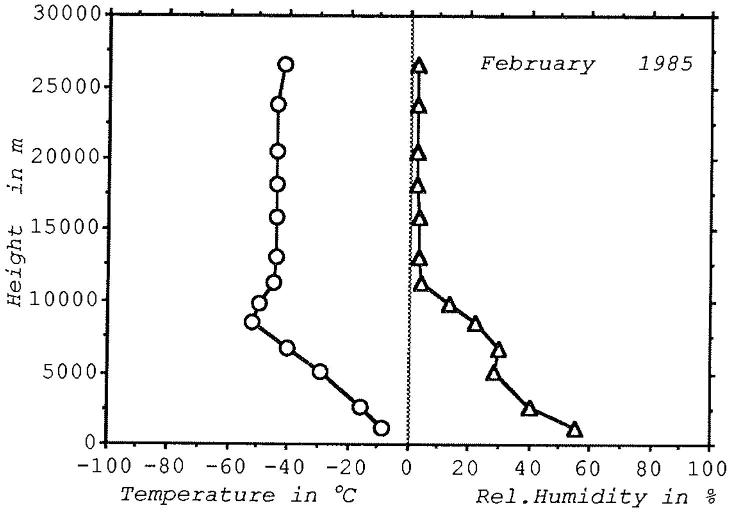


Fig.20 *Annual change of "precipitable water" (content of water vapour in a vertical column).*

(*Fig.21*)


January 1985
Height in m
30000
25000
20000
15000
10000
5000
0
-100 -80 -60 -40 -20 0 20 40 60 80 100
Temperature in °C
Rel.Humidity in %


January 1985
Height in m
30000
25000
20000
15000
10000
5000
0
-40 -20 0 20 40
Wind speed in m/s
u
v


February 1985
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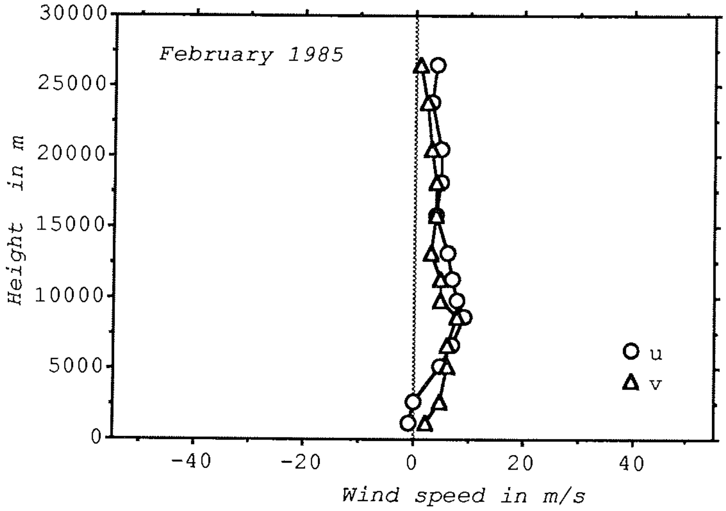
Temperature in °C
Rel.Humidity in %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0
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Wind speed in m/s
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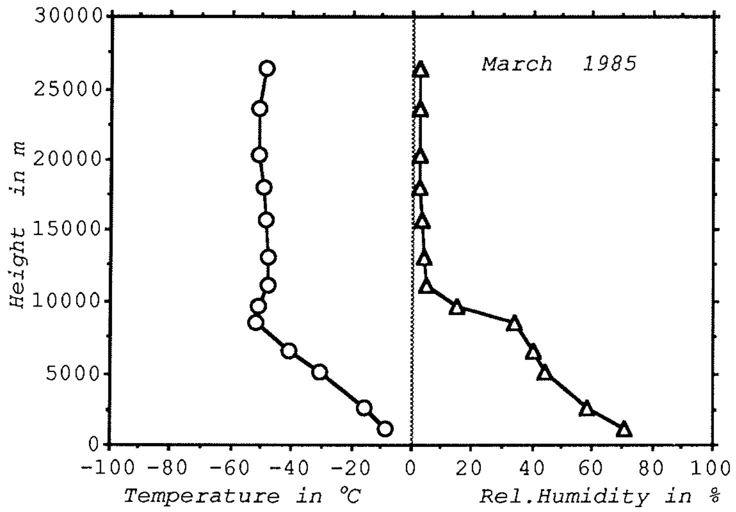

March 1985
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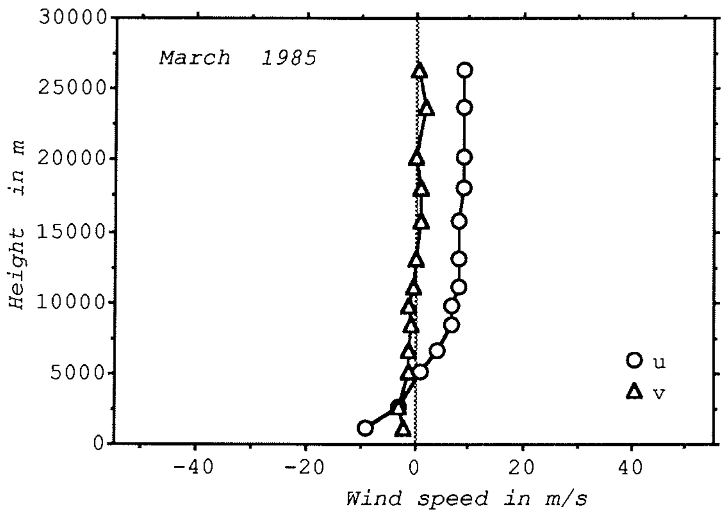
Temperature in °C
Rel.Humidity in %



March 1985
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Wind speed in m/s
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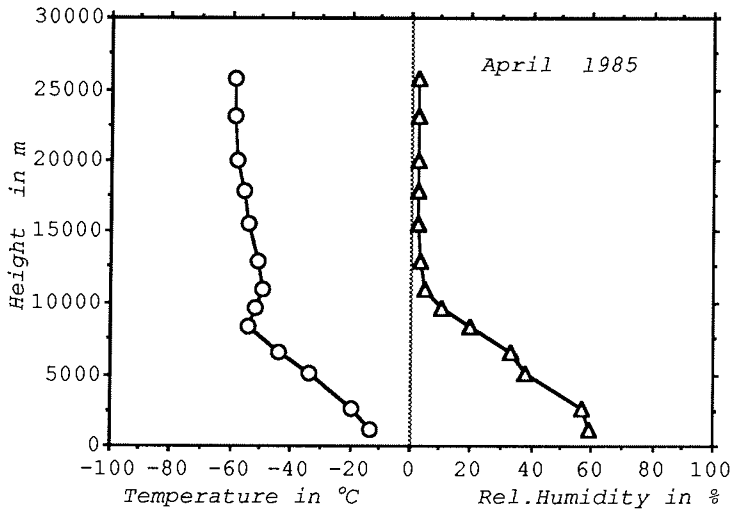

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Height in m
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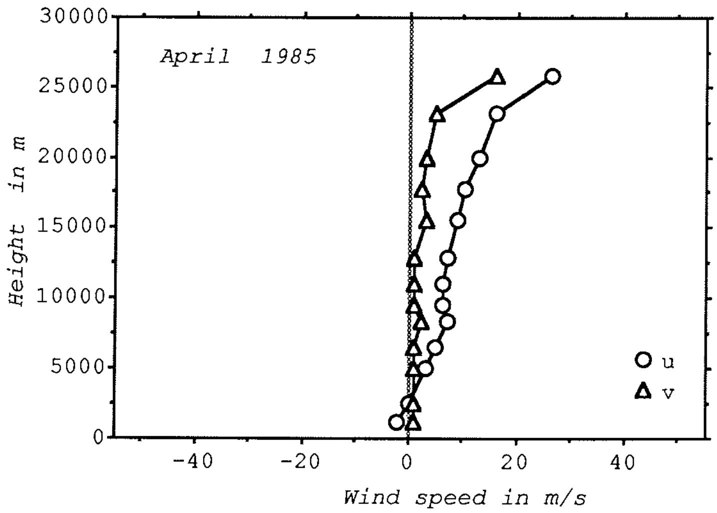
Temperature in °C
Rel.Humidity in %



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Height in m
April 1985
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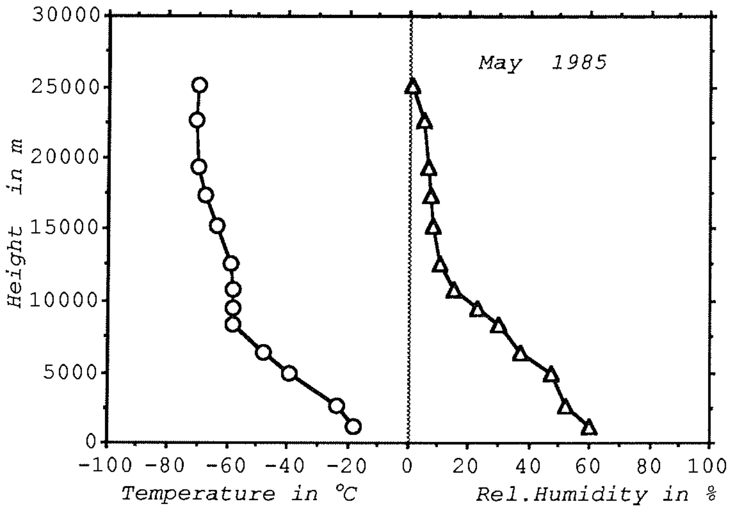
Wind speed in m/s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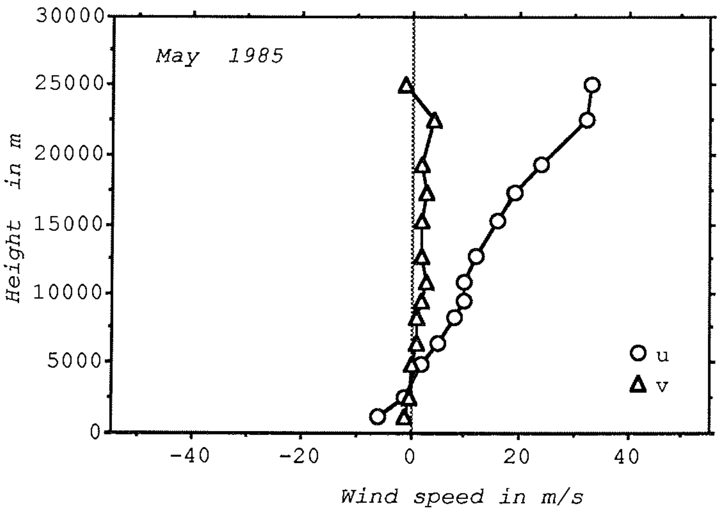
Temperature in °C
Rel.Humidity in %


May 1985
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Wind speed in m/s
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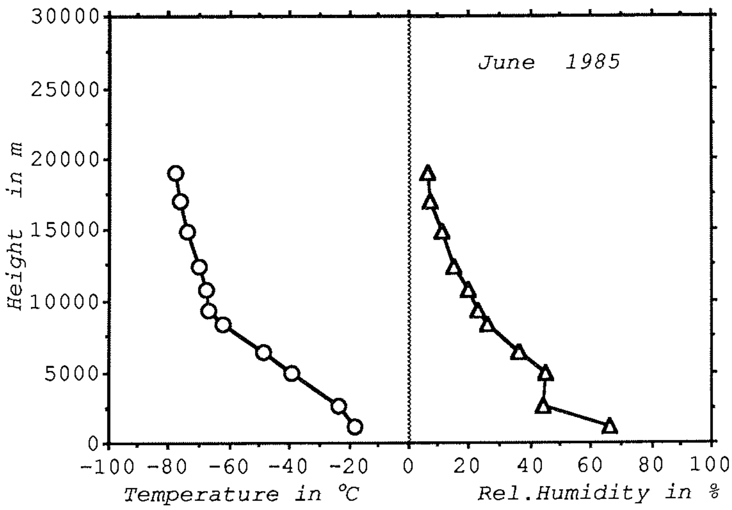
June 1985
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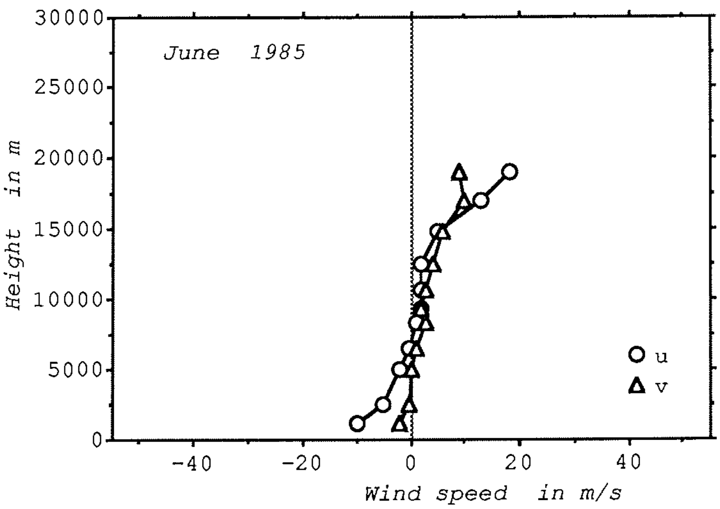
Temperature in °C
Rel.Humidity in %


June 1985
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Wind speed in m/s
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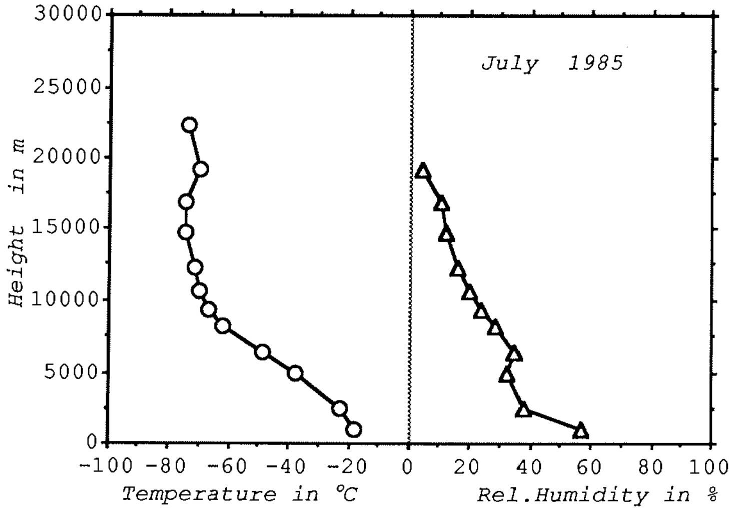
July 1985
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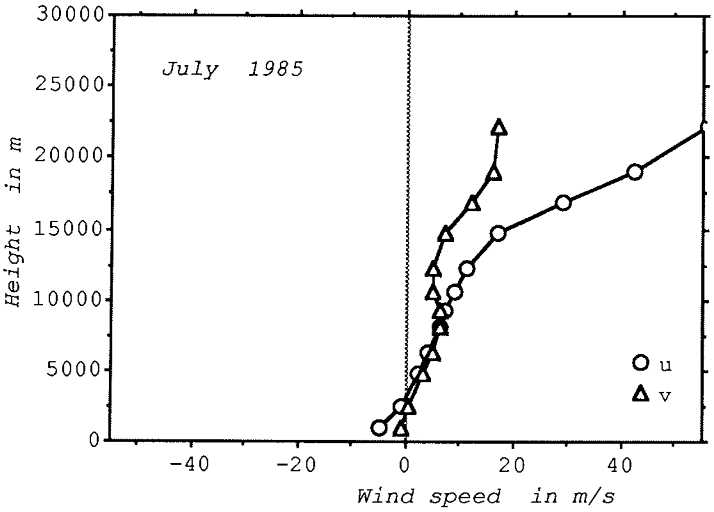
Temperature in °C
Rel.Humidity in %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-40 -20 0 20 40
Wind speed in m/s
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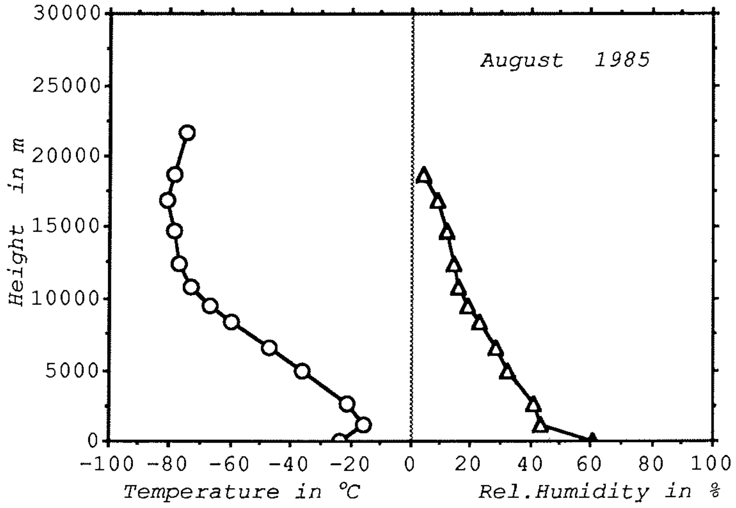
August 1985
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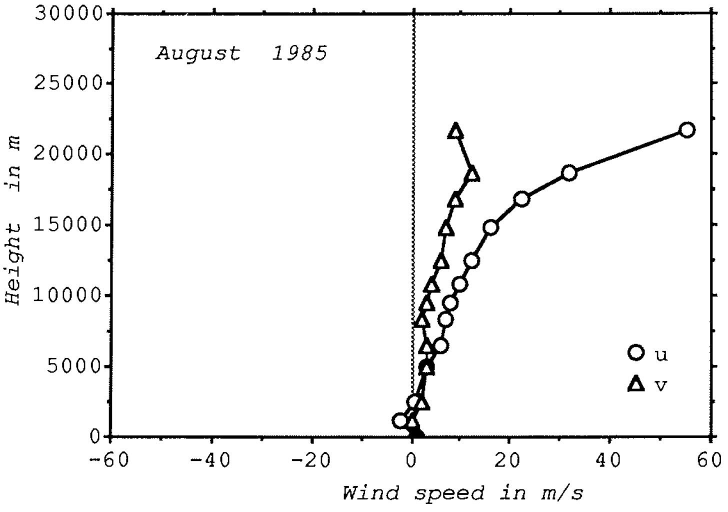
-100 -80 -60 -40 -20 0 20 40 60 80 100
Temperature in °C
Rel.Humidity in %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Wind speed in m/s
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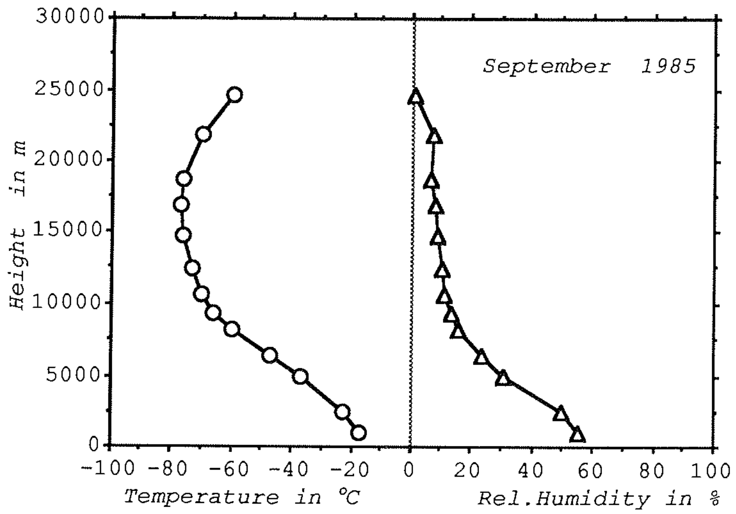
September 1985
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Temperature in °C
Rel.Humidity in %
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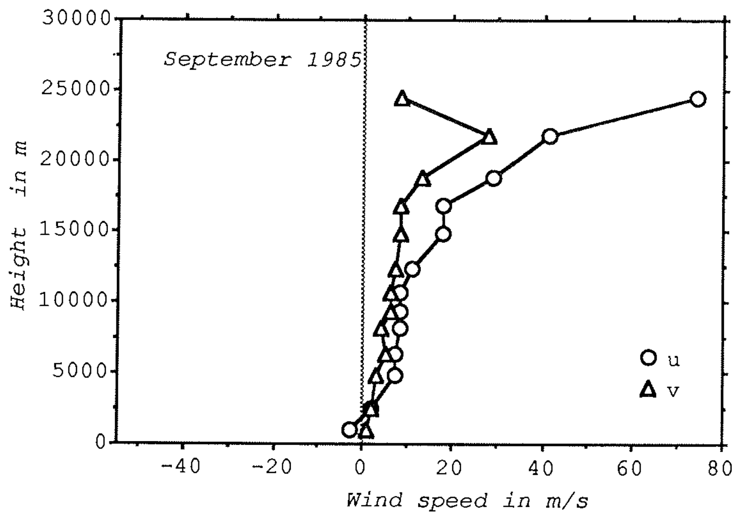
September 1985
Height in m
Wind speed in m/s
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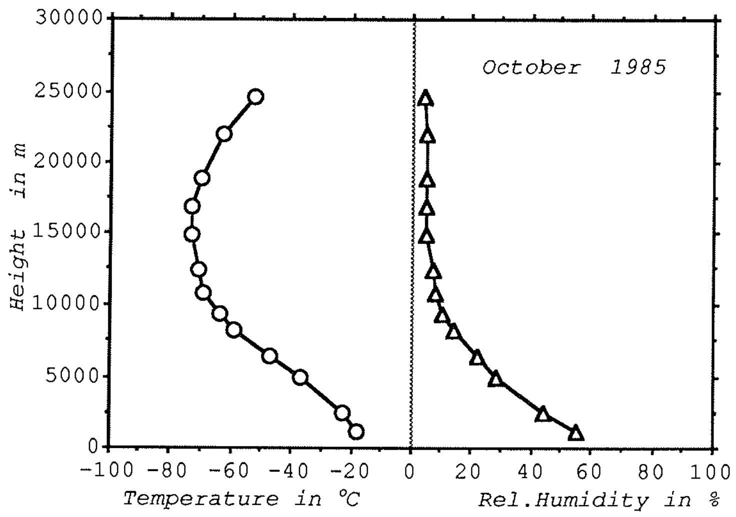
October 1985
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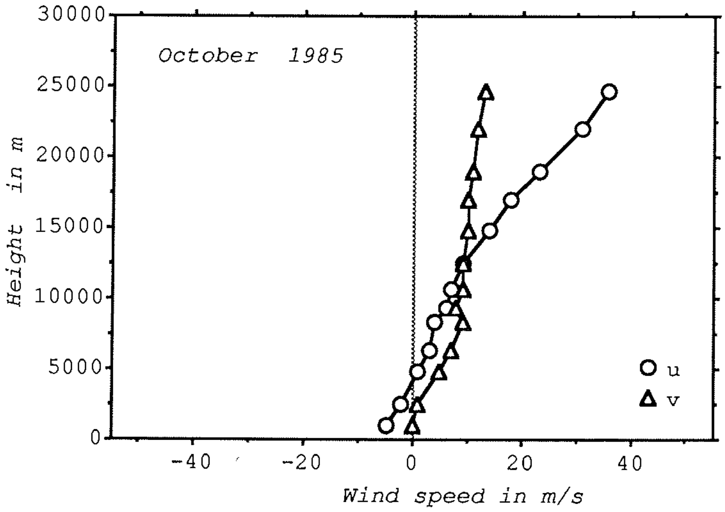
Temperature in °C
Rel.Humidity in %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Wind speed in m/s
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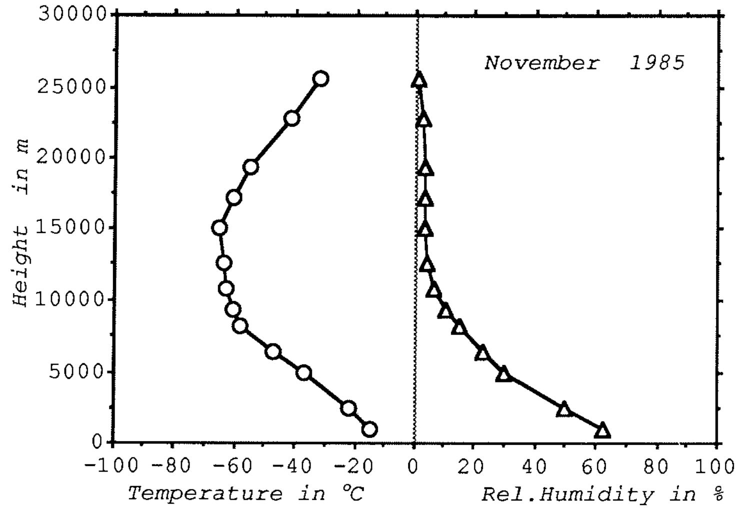
November 1985
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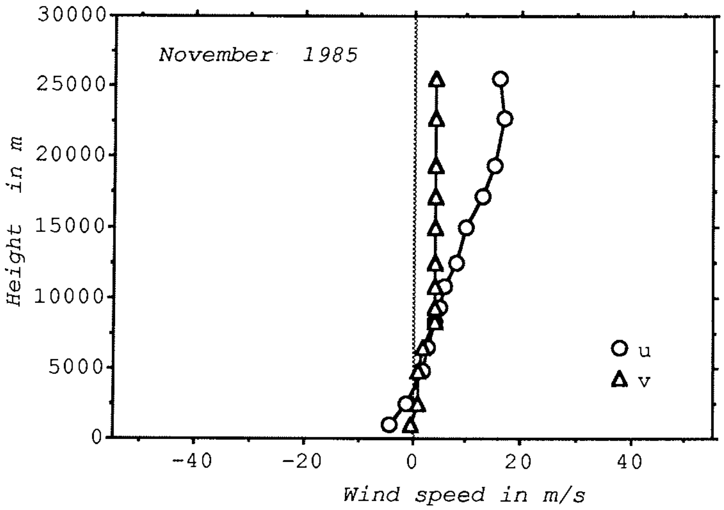
Temperature in °C
Rel.Humidity in %


November 1985
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Wind speed in m/s
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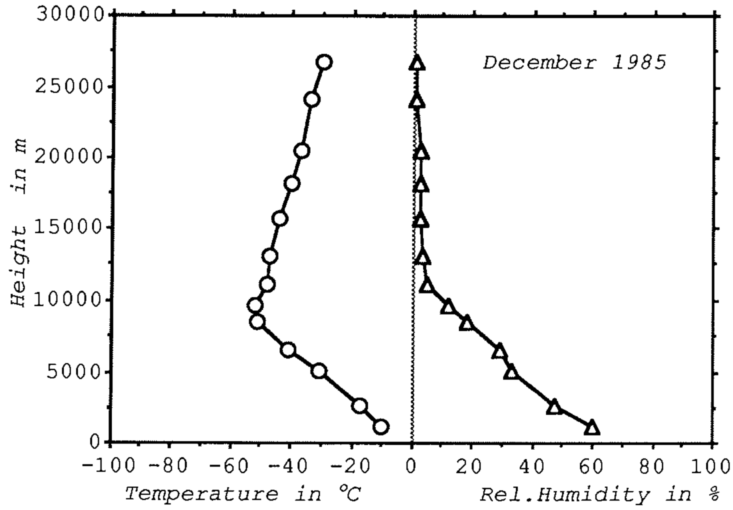
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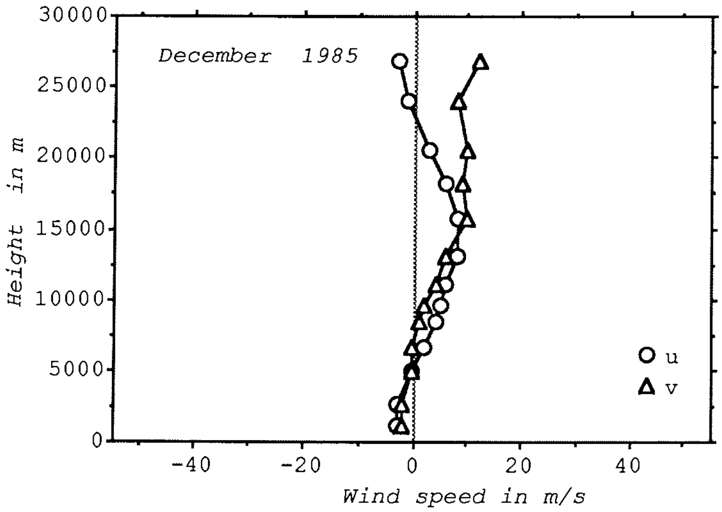
Temperature in °C
Rel.Humidity in %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Wind speed in m/s
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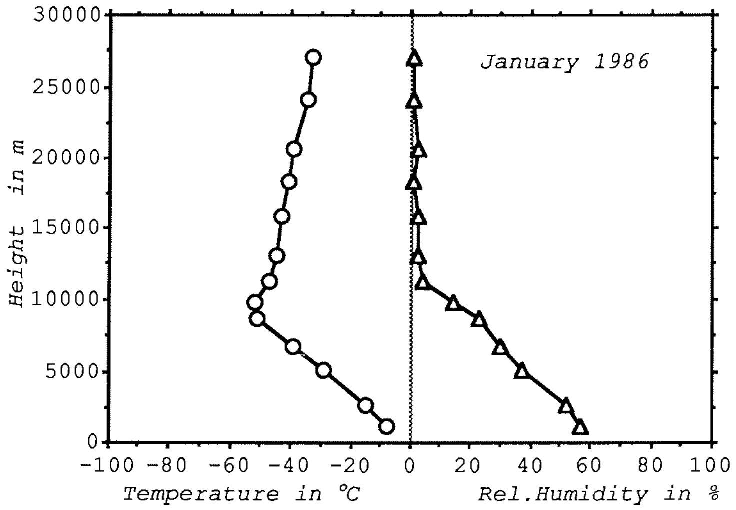
January 1986
Height in m
Temperature in °C
Rel.Humidity in %
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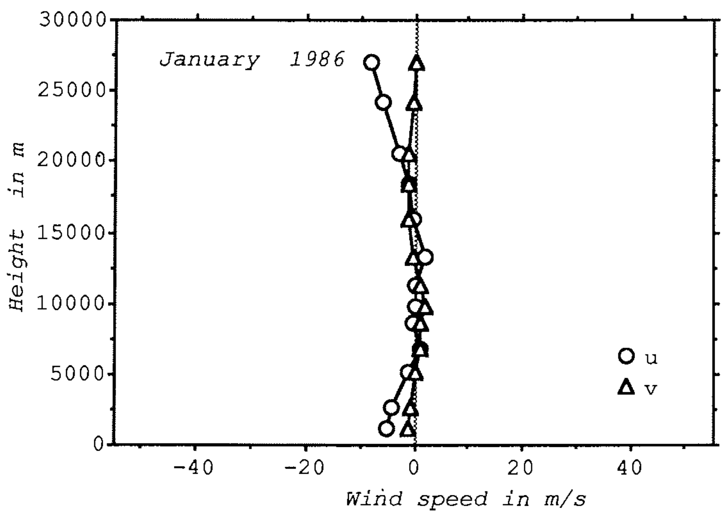
January 1986
Height in m
Wind speed in m/s
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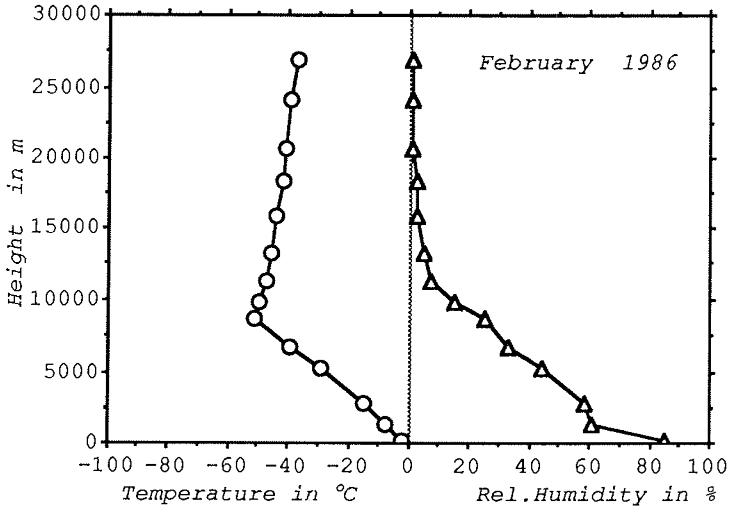
February 1986
Height in m
Temperature in °C
Rel.Humidity in %
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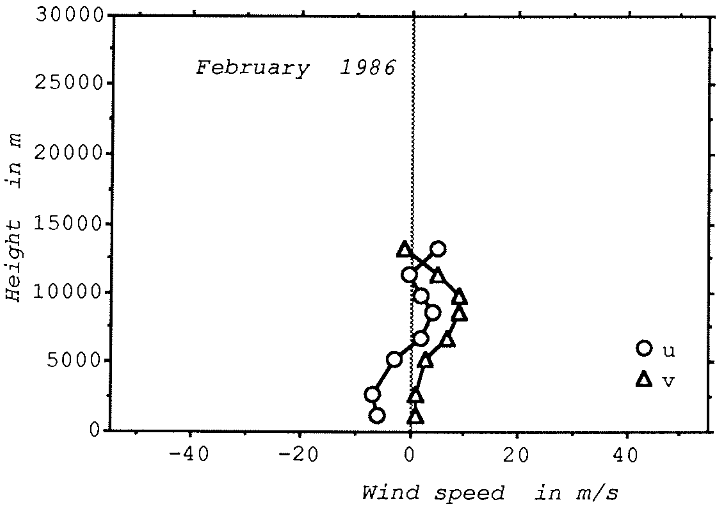
February 1986
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Wind speed in m/s
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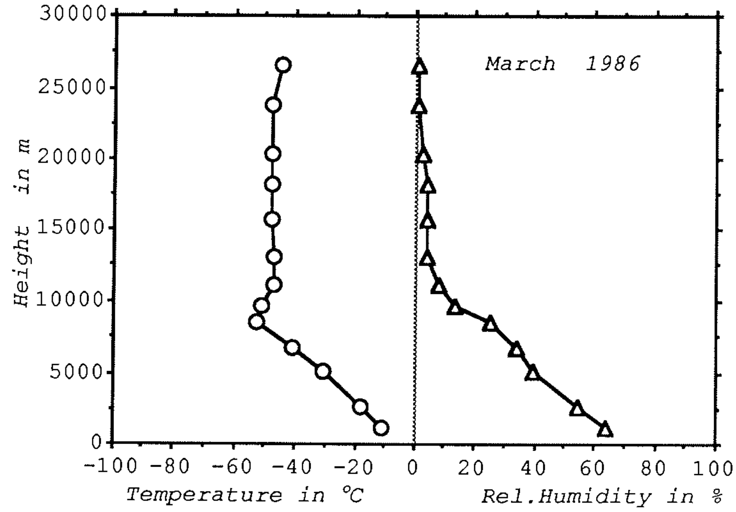
March 1986
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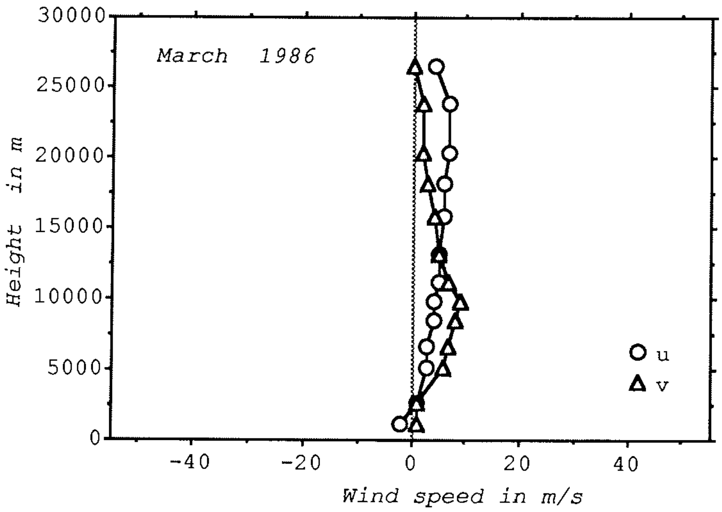
Temperature in °C
Rel.Humidity in %


March 1986
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Wind speed in m/s
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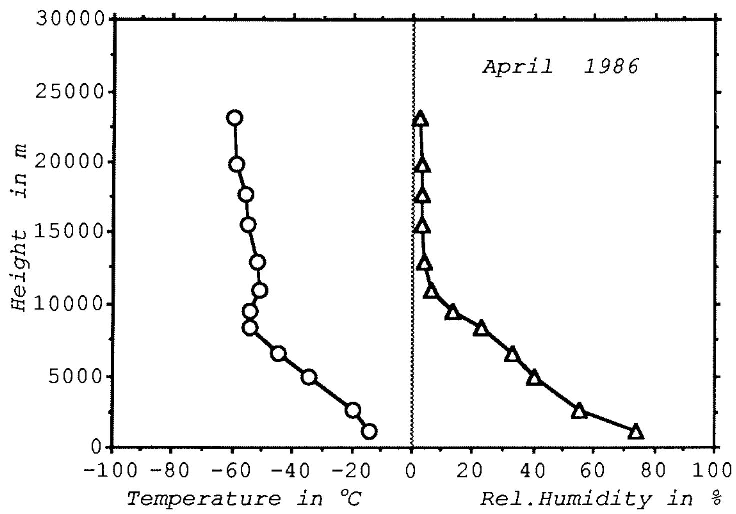
April 1986
Height in m
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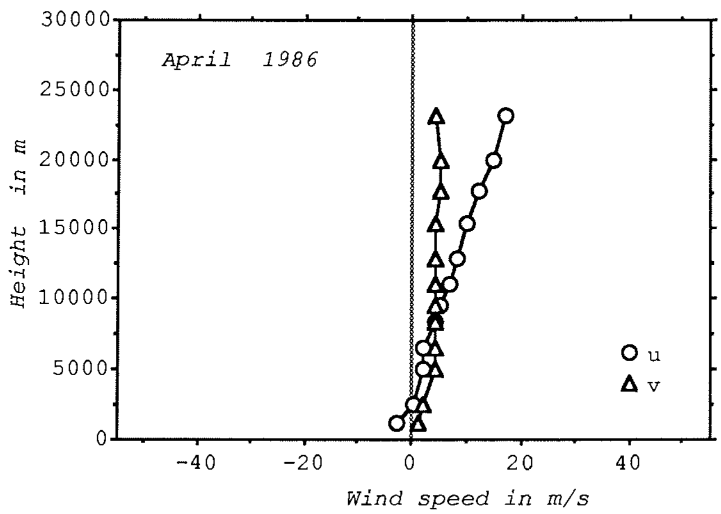
Temperature in °C
Rel.Humidity in %


April 1986
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Wind speed in m/s
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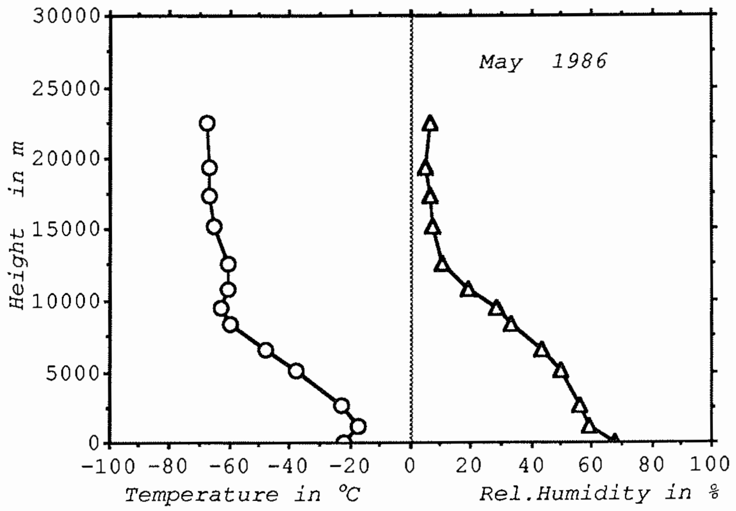
May 1986
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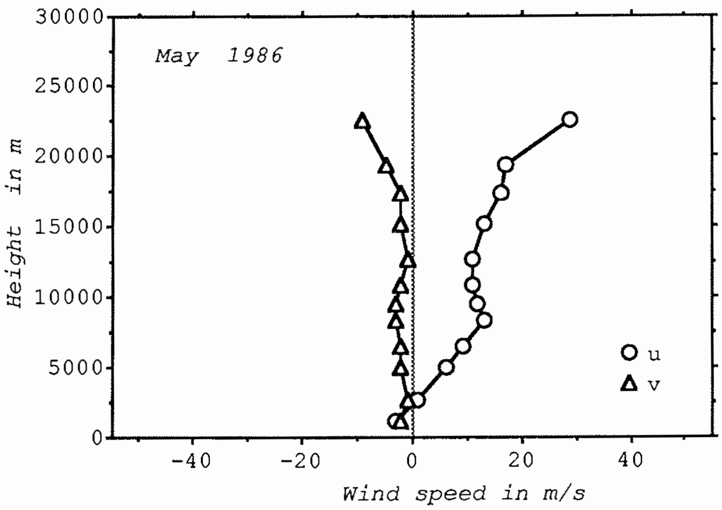
Temperature in °C
Rel.Humidity in %


May 1986
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Wind speed in m/s
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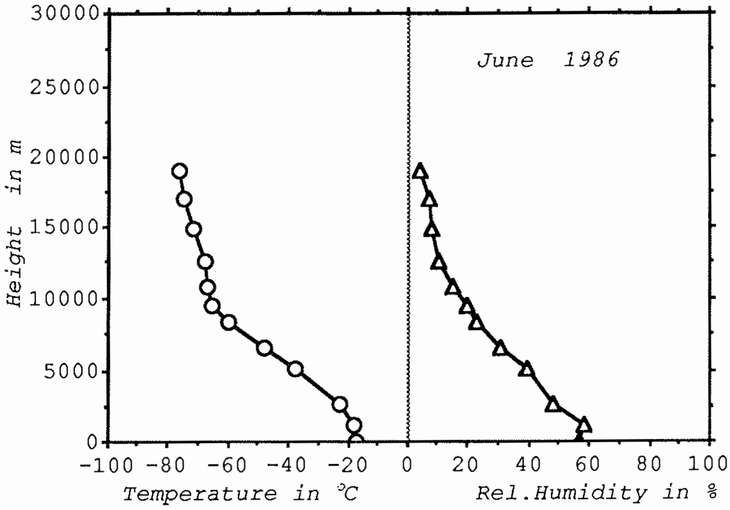
June 1986
Height in m
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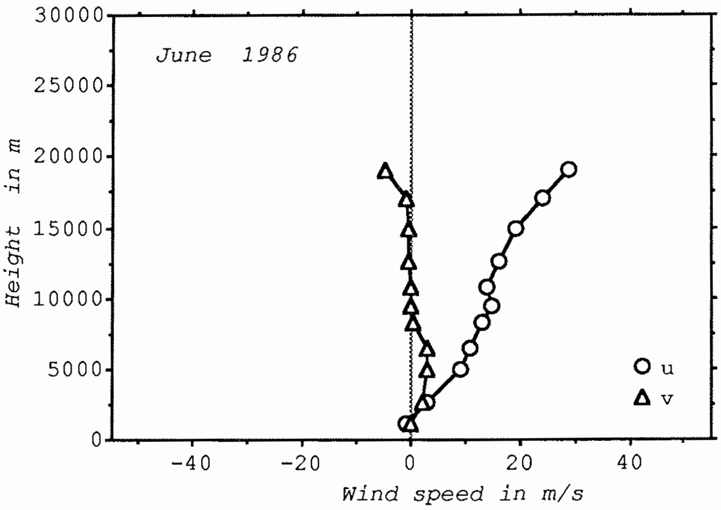
Temperature in °C
Rel.Humidity in %


June 1986
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-40 -20 0 20 40
Wind speed in m/s
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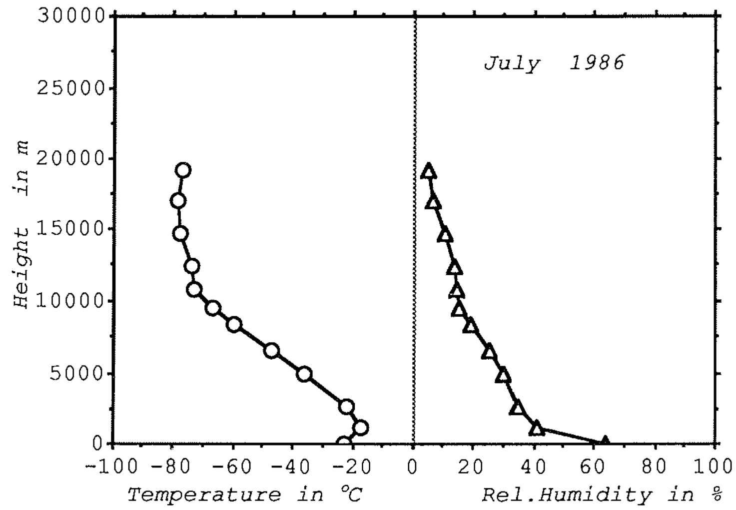
July 1986
Height in m
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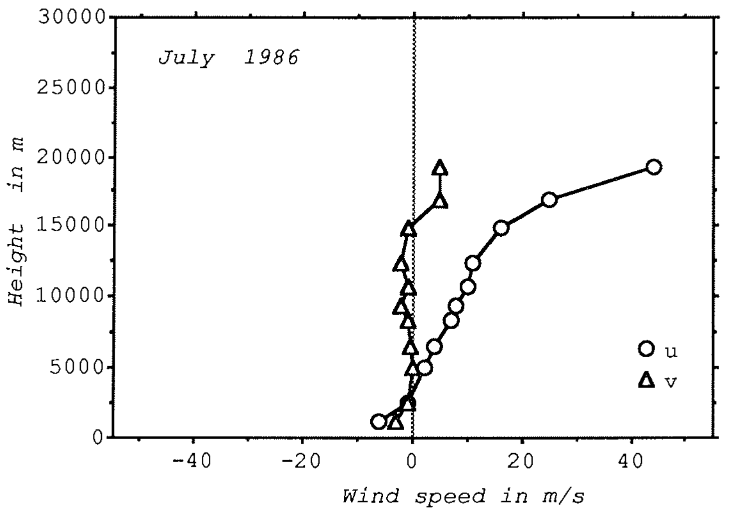
Temperature in °C
Rel.Humidity in %


July 1986
Height in m
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Wind speed in m/s
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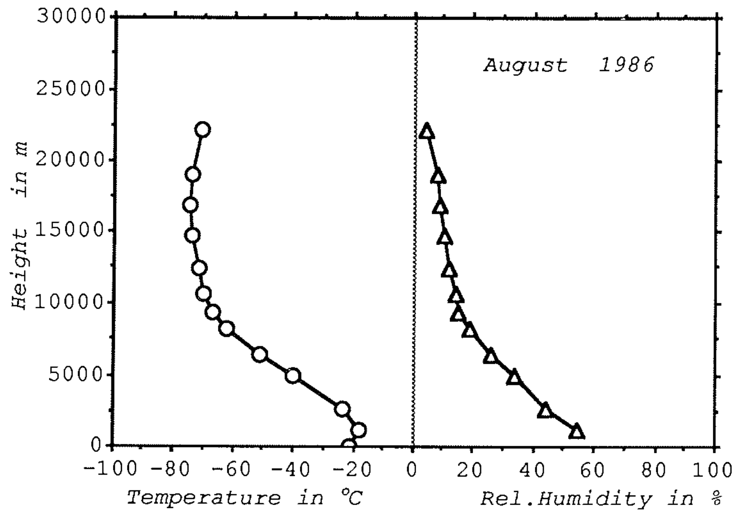
August 1986
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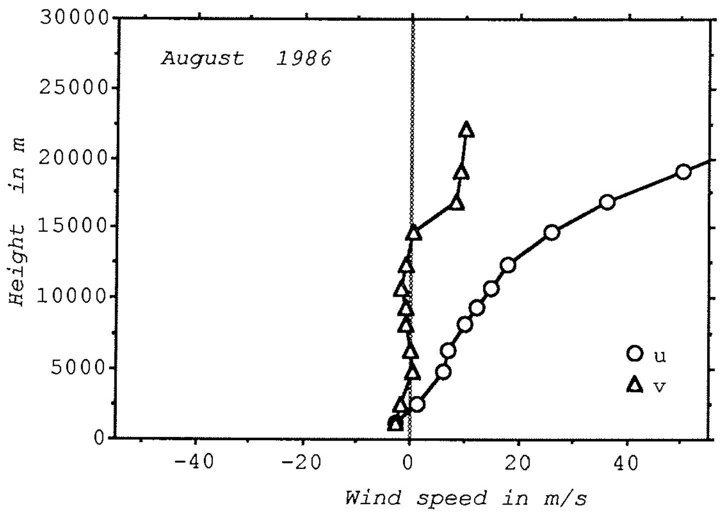
Temperature in °C
Rel.Humidity in %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Wind speed in m/s
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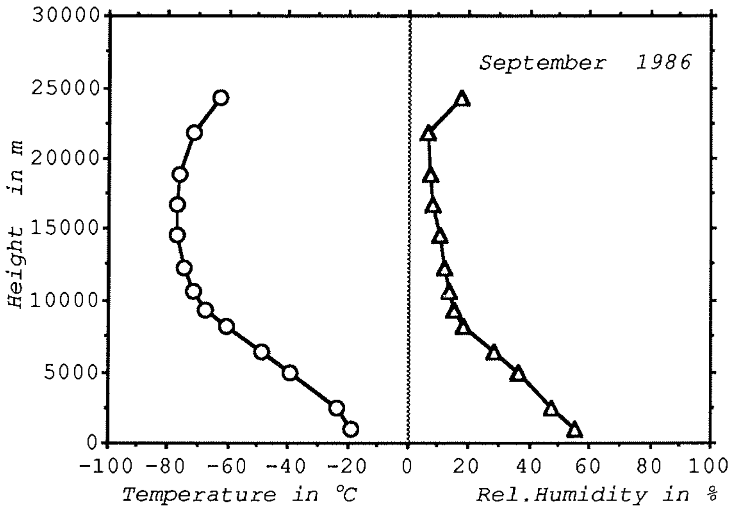
September 1986
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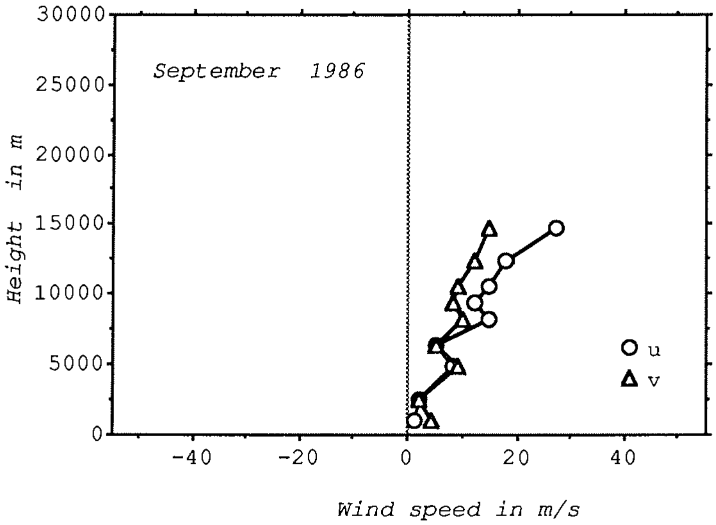
Temperature in °C
Rel.Humidity in %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Wind speed in m/s
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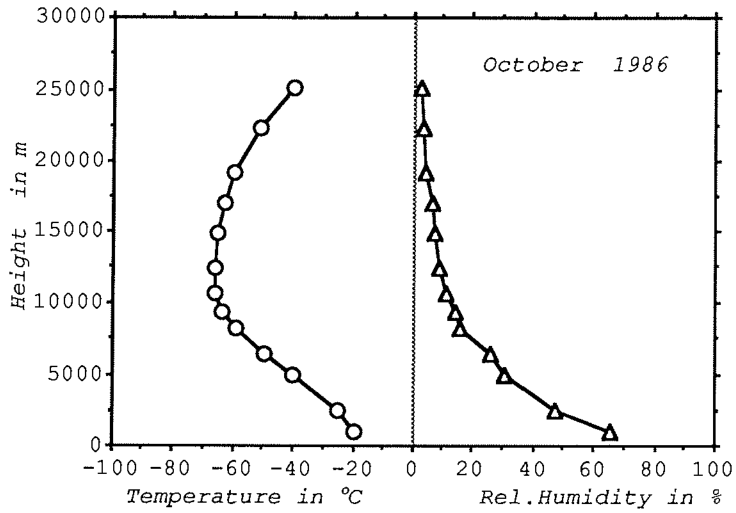
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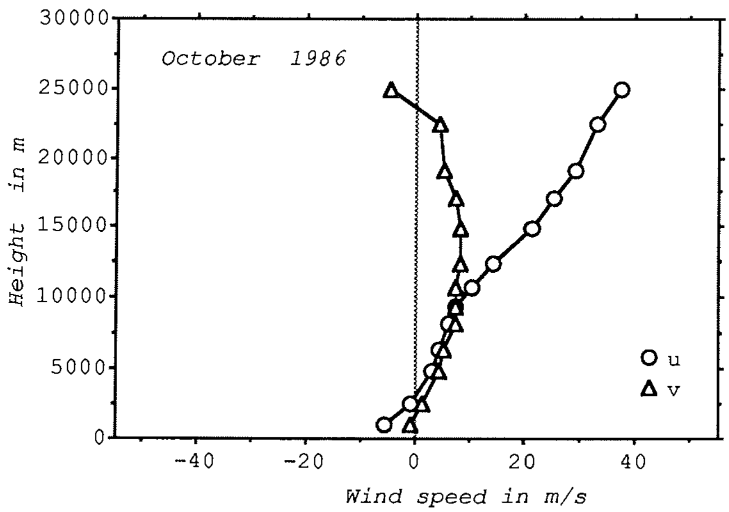
Height in m
Temperature in °C
Rel.Humidity in %


October 1986
Height in m
Wind speed in m/s
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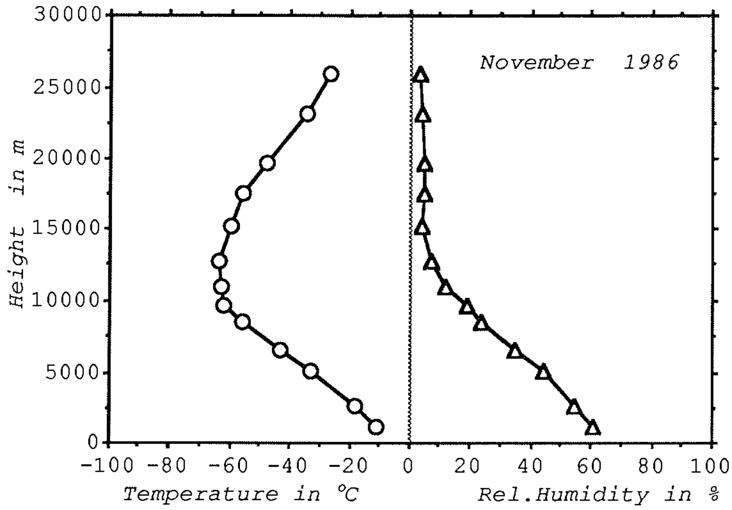
November 1986
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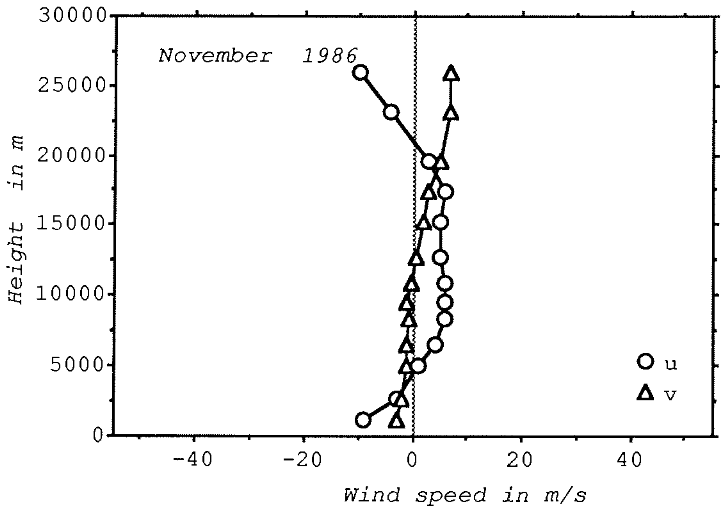
Temperature in °C
Rel.Humidity in %


November 1986
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Wind speed in m/s
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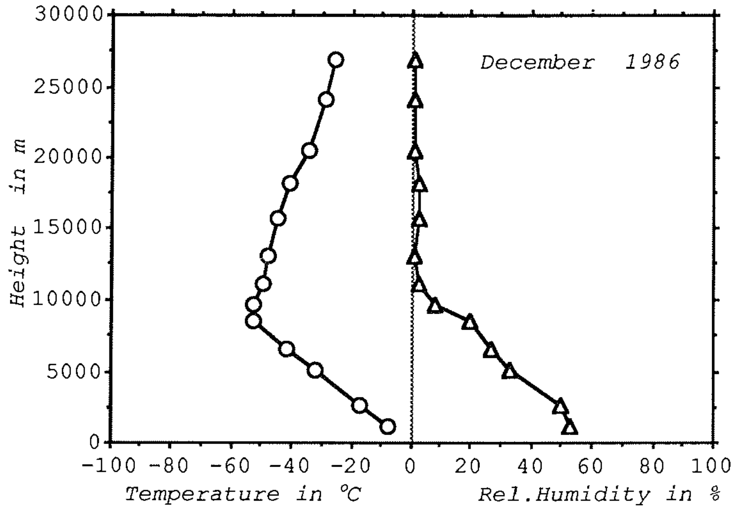
December 1986
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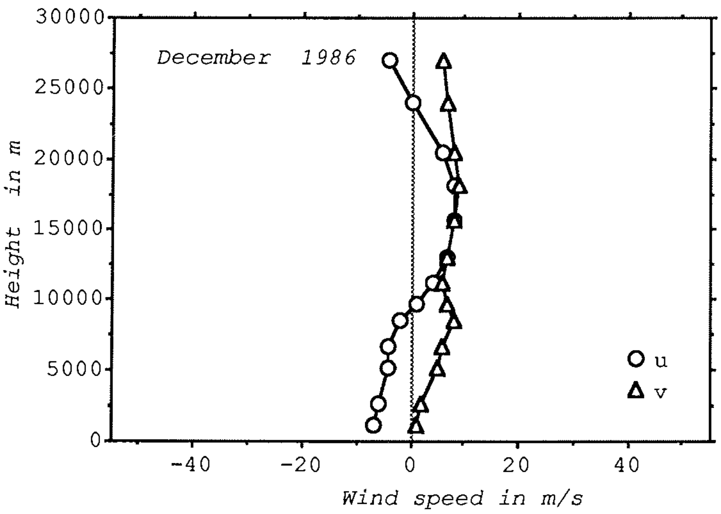
Temperature in °C
Rel.Humidity in %


December 1986
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-40 -20 0 20 40
Wind speed in m/s
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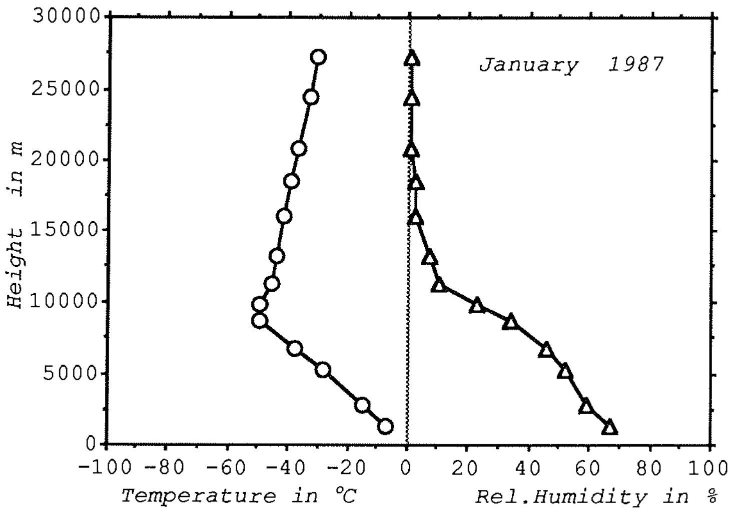
January 1987
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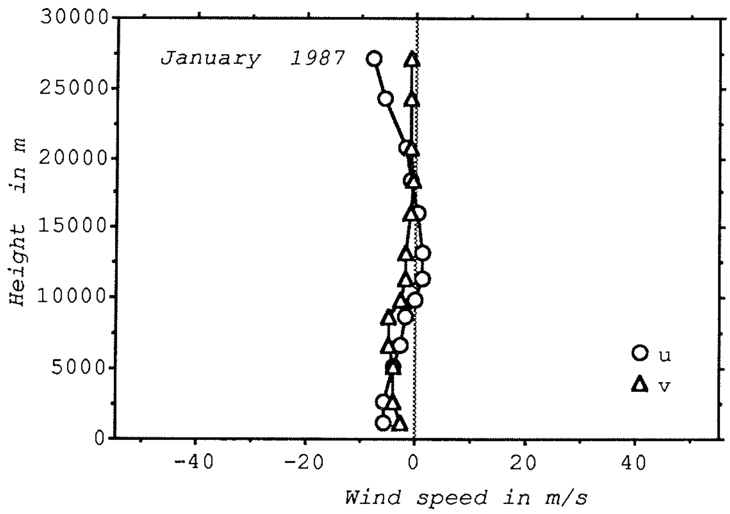
Temperature in °C
Rel.Humidity in %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Wind speed in m/s
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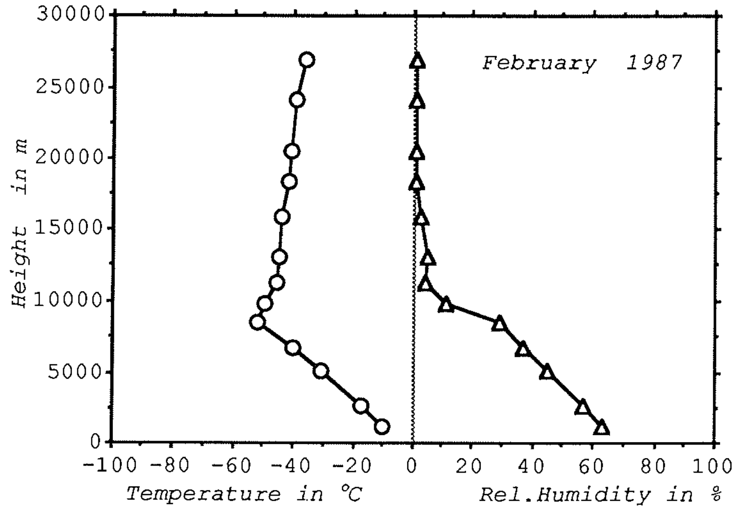
February 1987
Height in m
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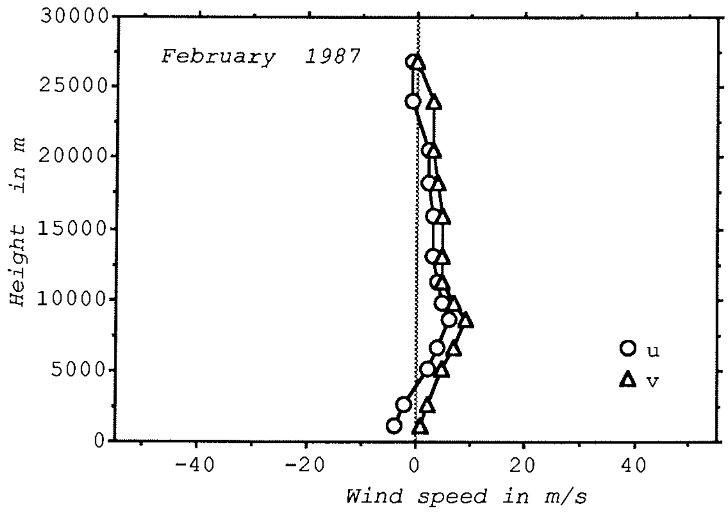
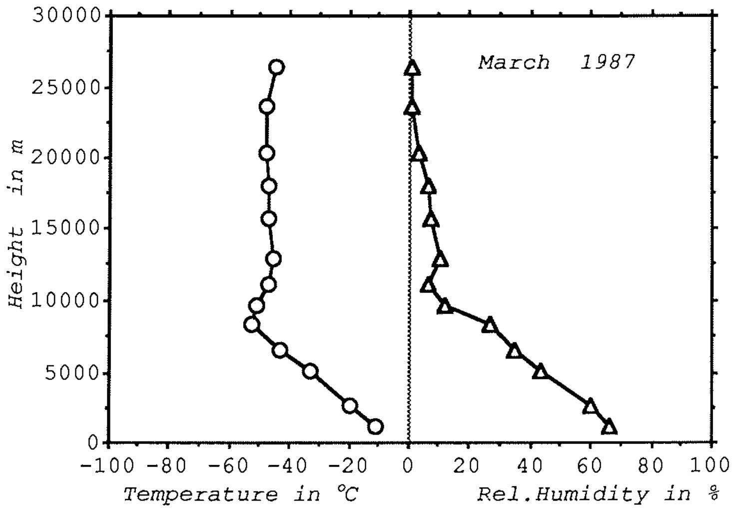
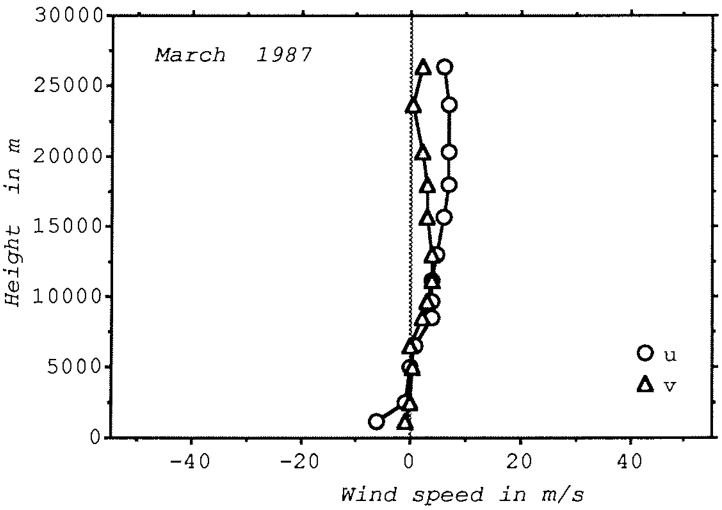
-100 -80 -60 -40 -20 0 20 40 60 80 100
Temperature in °C
Rel.Humidity in %

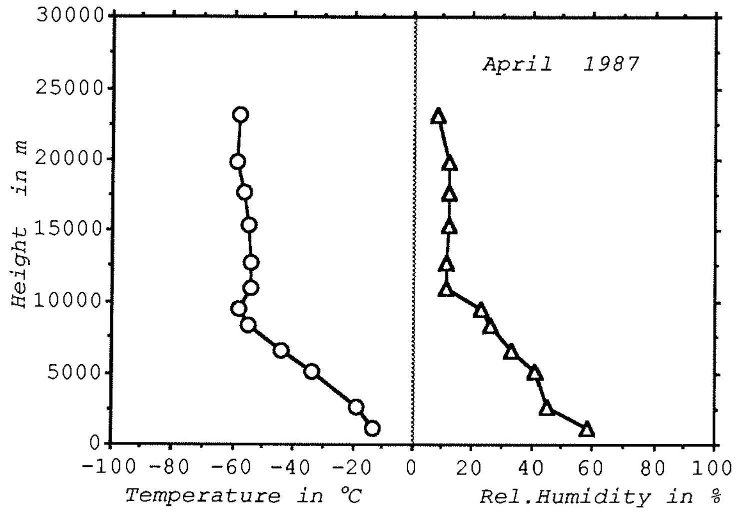

February 1987
Height in m
30000
25000
20000
15000
10000
5000
0
-40 -20 0 20 40
Wind speed in m/s
u
v

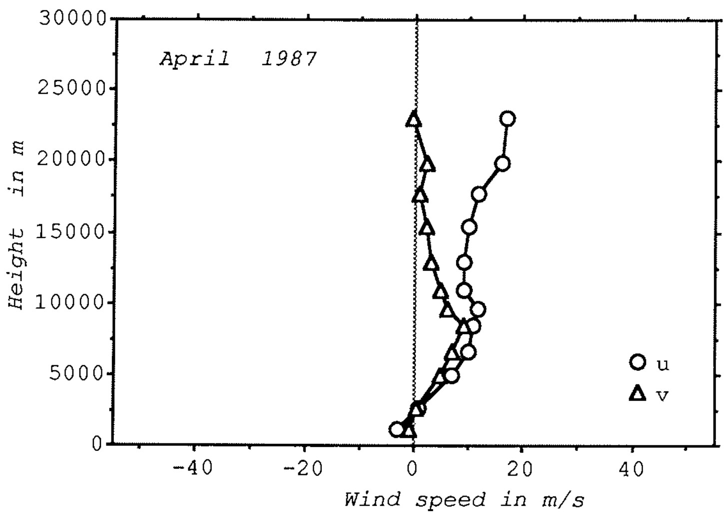


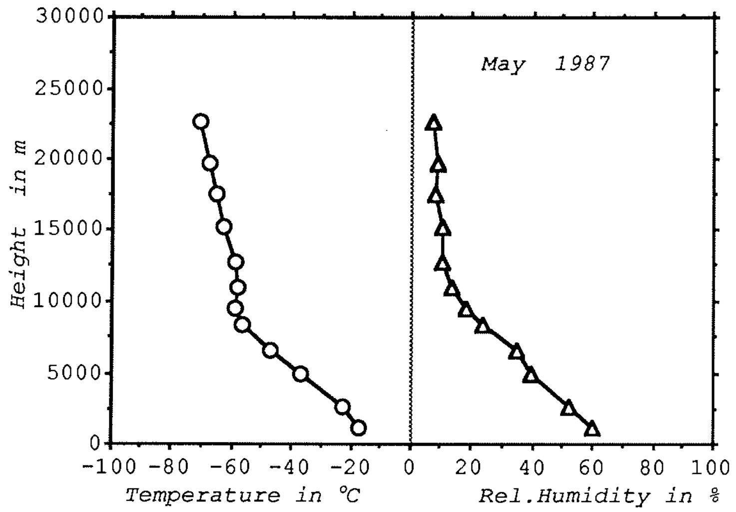
March 1987
Height in m
30000
25000
20000
15000
10000
5000
0
-100 -80 -60 -40 -20 0 20 40 60 80 100
Temperature in °C
Rel.Humidity in %

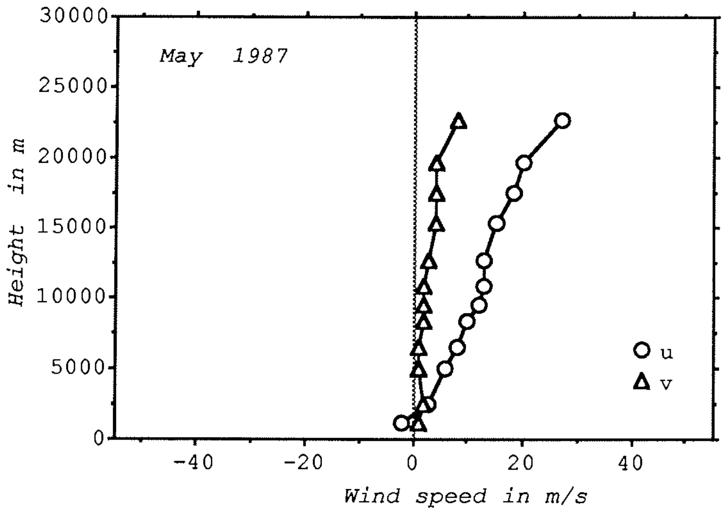


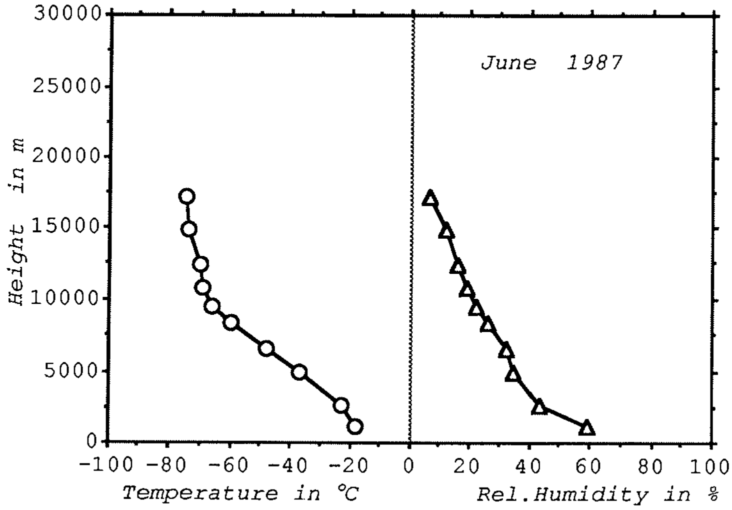
March 1987
Height in m
30000
25000
20000
15000
10000
5000
0
-40 -20 0 20 40
Wind speed in m/s
u
v

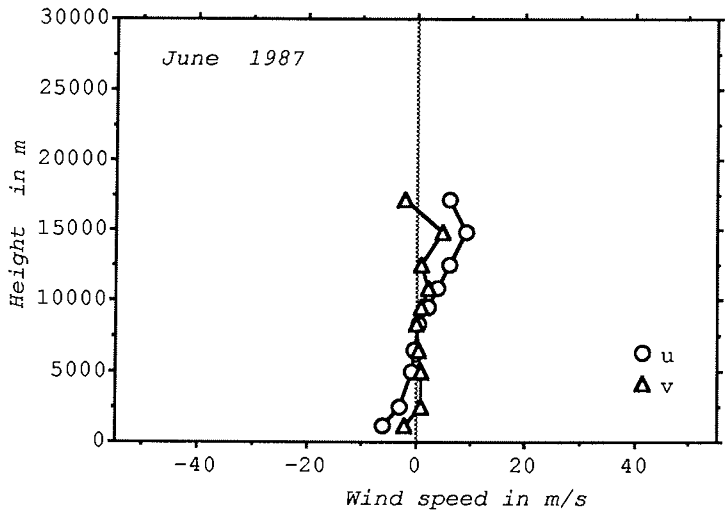

April 1987
Height in m
30000
25000
20000
15000
10000
5000
0
-100 -80 -60 -40 -20 0 20 40 60 80 100
Temperature in °C
Rel.Humidity in %

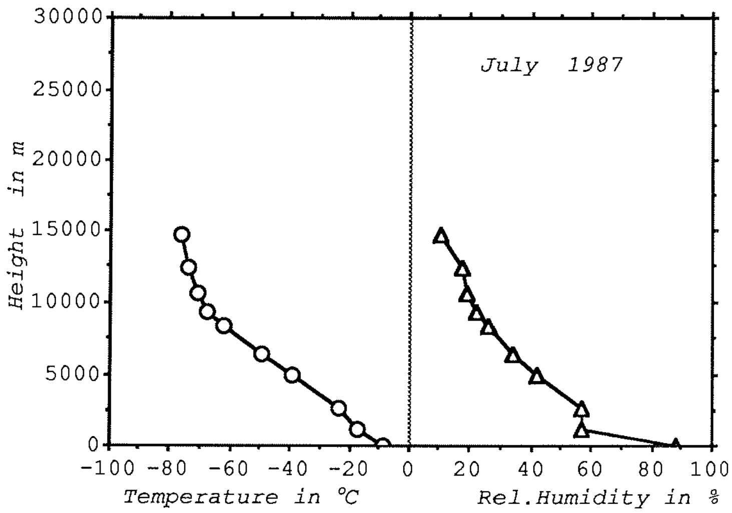

April 1987
Height in m
30000
25000
20000
15000
10000
5000
0
-40 -20 0 20 40
Wind speed in m/s
u
v

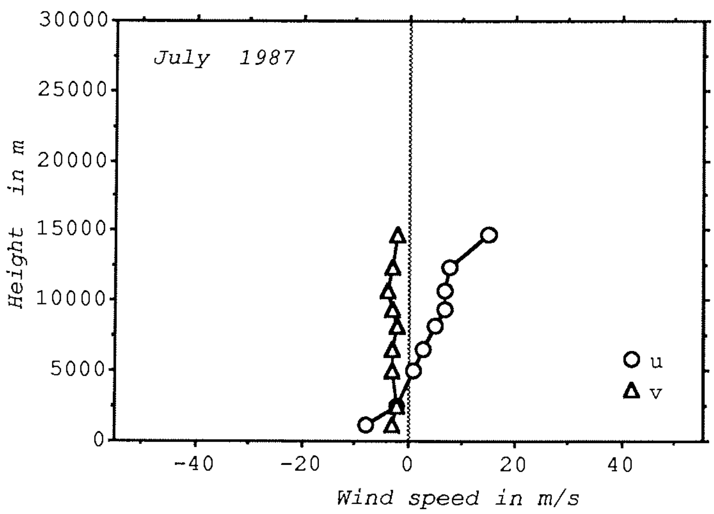

May 1987
30000
25000
20000
15000
10000
5000
0
Height in m
-100 -80 -60 -40 -20 0 20 40 60 80 100
Temperature in °C
Rel.Humidity in %

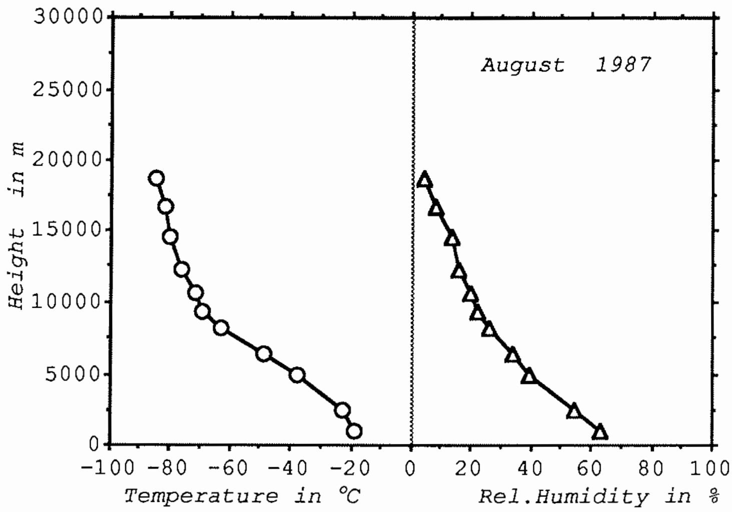

May 1987
30000
25000
20000
15000
10000
5000
0
Height in m
-40 -20 0 20 40
Wind speed in m/s
u
v


June 1987
Height in m
30000
25000
20000
15000
10000
5000
0
-100 -80 -60 -40 -20 0 20 40 60 80 100
Temperature in °C
Rel.Humidity in %


June 1987
Height in m
30000
25000
20000
15000
10000
5000
0
-40 -20 0 20 40
Wind speed in m/s
u
v


July 1987
Height in m
Temperature in °C
Rel.Humidity in %


July 1987
Height in m
Wind speed in m/s
u
v



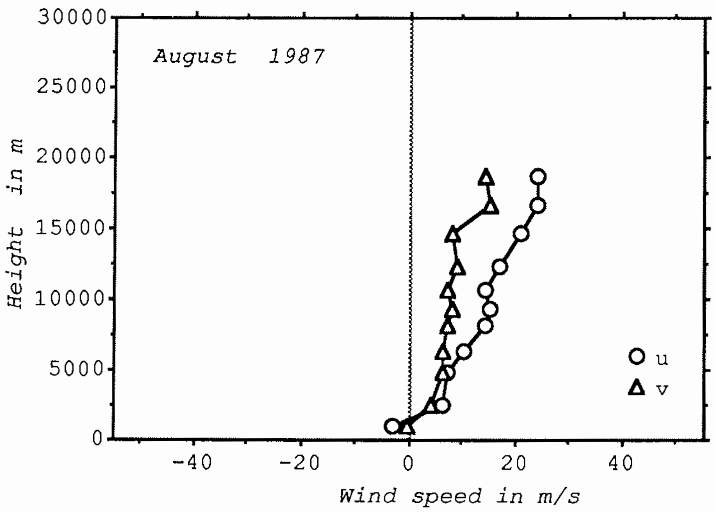


Fig.21 *Mean monthly profiles of temperature, relative humidity, zonal (u) and meridional (v) wind component.*

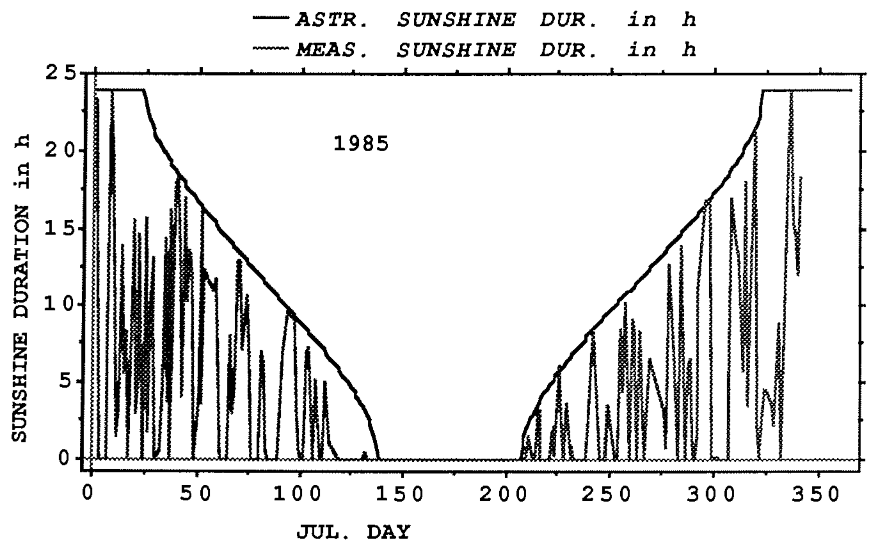
4.3) Radiation Measurements

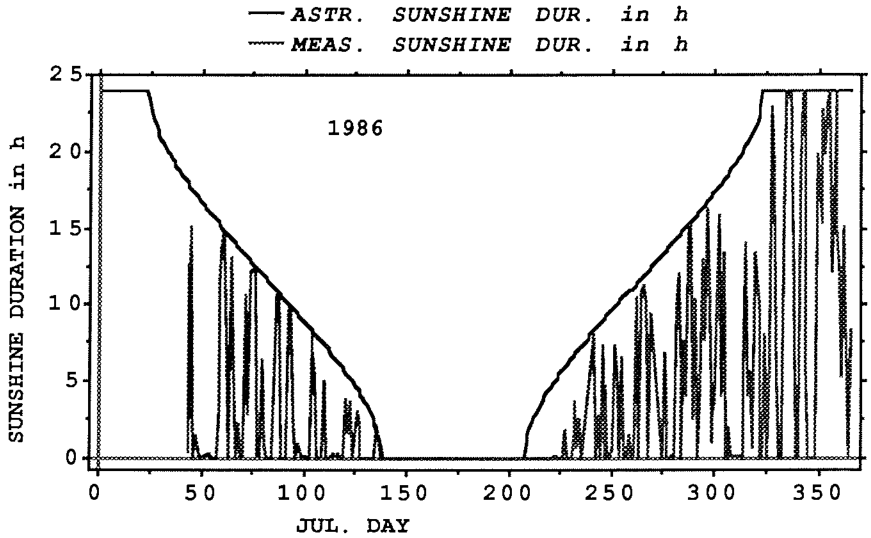
The following radiation quantities were measured: global radiation, reflected solar radiation, downward and upward (total) radiation. These quantities all indicate *irradiances*.
(Irradiance = radiant flux of any origin incident onto an area element; unit: W/m^2 (WMO,1983b)).
Additionally sunshine duration was recorded, giving a general impression of the radiation conditions at the station.

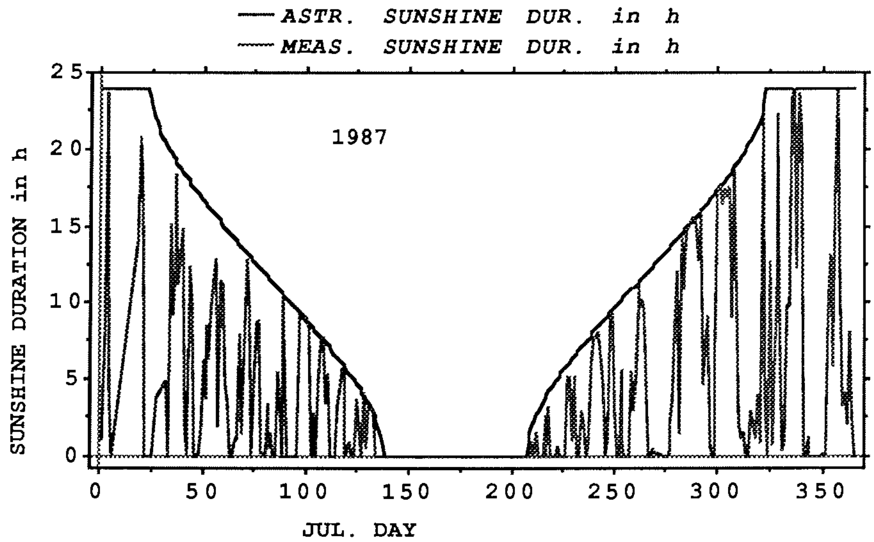
4.3.1) Sunshine Duration

Sunshine duration was measured by a photoelectric device which is recording when the direct radiation exceeds the value of 120 W/m^2. Fig.22 shows the daily values of the measured and the calculated astronomical sunshine duration. In fact there are some days during which the measured duration reaches the theoretical value due to the clean and dry polar atmosphere and therefore low extinction of the solar beam.

(Fig.22)







<u>*Fig. 22*</u> *Daily measured and astronomical (theoretically possible) sunshine duration as function of Julian Day for 1985, 1986 and 1987. There were no measurements between 18 Dec 1985 and 14 Feb 1986.*
Sun is below the horizon during the time between 17 May (Jul.Day=137) and 27 July (Jul.Day=208).

Tab.6 displays the yearly means of relative sunshine duration (ratio of observed to theoretical value). The average for the three years of 34% (approx.1600h) corresponds well with data published by Pertrov(1987), showing the distribution of sunshine duration for the whole Antarctic region.
The cloud amount for this period is about 67% (Tab.1), indicating that in this clean and dry atmosphere the extinction of the direct solar beam is caused mainly by clouds.

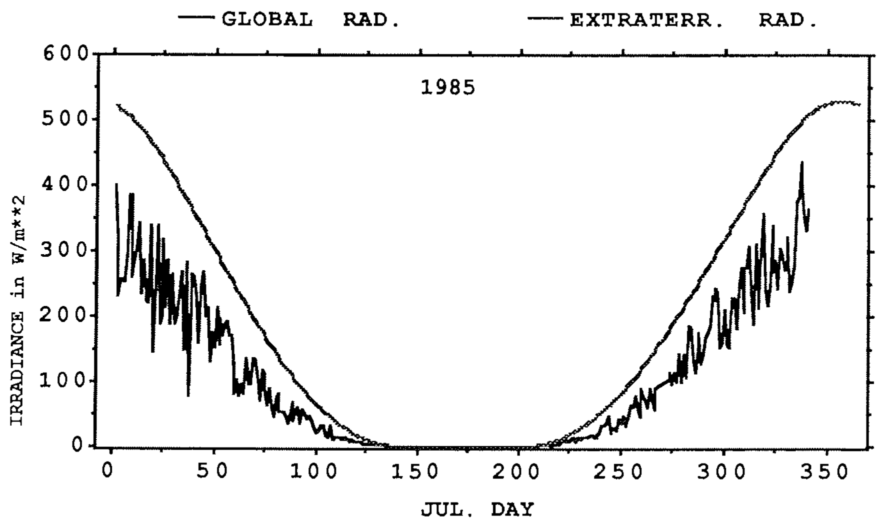
4.3.2) Short- and long-wave irradiances

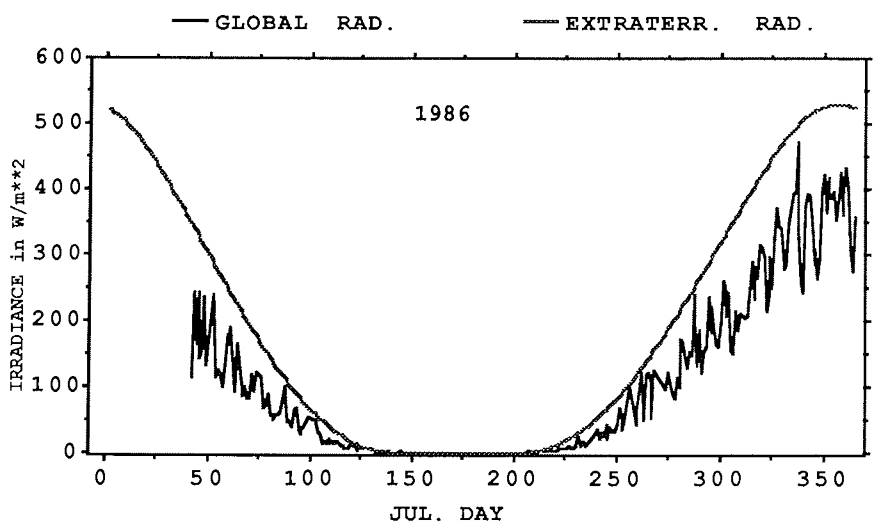
Daily mean values of global radiation and calculated extraterrestrial irradiance for the years 1985, 1986 and 1987 are reproduced in Fig.23. The measured global radiation quite frequently approaches the extraterrestrial value. This shows again that the atmosphere in Antarctica is not only very clear but contains only small amounts of water vapor. The relative global radiation (measured global radiation divided by calculated extraterrestrial radiation) on Fig.24 increases with increasing sunshine duration (decreasing cloud amount) to values near 90% for days with 100% relative sunshine. On the other hand, there are also high relative irradiances in the case of partly cloudy skies because of multiple reflection between the snow surface and the cloudbase. The scatter of the data is mainly caused by variations in the opacity of clouds.
The mean values of the relative global radiation between 47% and 67% (see Tab.6) cover a slightly wider range than Schwerdtfeger's (1984) values (55% to 65%) for Antarctic stations near sea level.

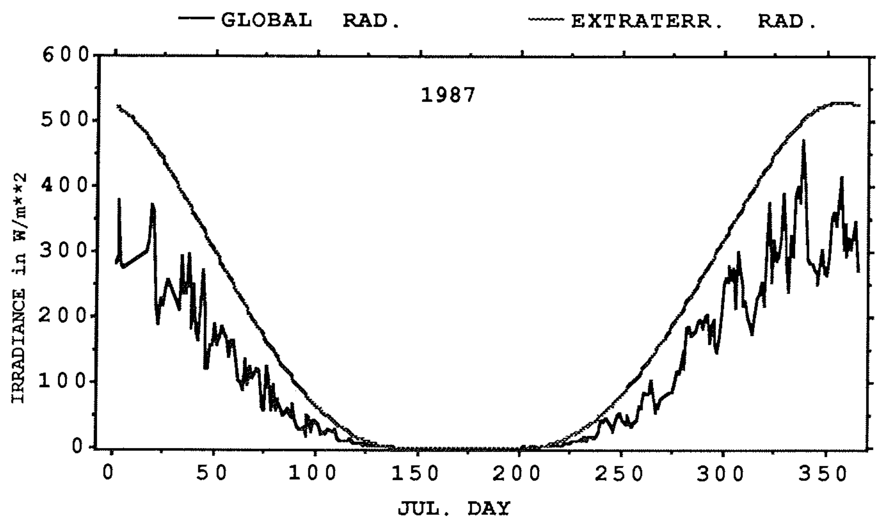
	Sunshine Dur.		Global Rad.		Albedo	Net Short-Wave Rad.	Net Long-Wave Rad.	Net Total Rad.
	h	%	W/m ^{2}	%	%	W/m ^{2}	W/m ^{2}	W/m ^{2}
1	7,6	32	271	57	80	56	.	.
2	7,7	44	188	59	83	34	-34	0
3	4,0	31	85	50	87	12	-18	-6
4	2,8	34	26	48	87	4	-18	-14
5	0,4	12	.	.	.	.	-16	-16
6	.	.	.	.	.	.	-19	-19
7	.	.	.	.	.	.	-19	-19
8	1,5	23	11	47	88	2	-15	-13
9	3,7	34	59	54	87	9	-17	-8
10	7,1	45	166	63	85	26	-31	-5
11	7,1	33	266	63	86	38	-29	9
12	11,3	47	348	67	83	63	-36	27

Tab. 6 *Daily mean values of radiation quantities for the months January-December, based on measurements during the years 1985, 1986 and 1987. Percentage values of sunshine duration and global radiation are relative to the calculated extraterrestrial data.*

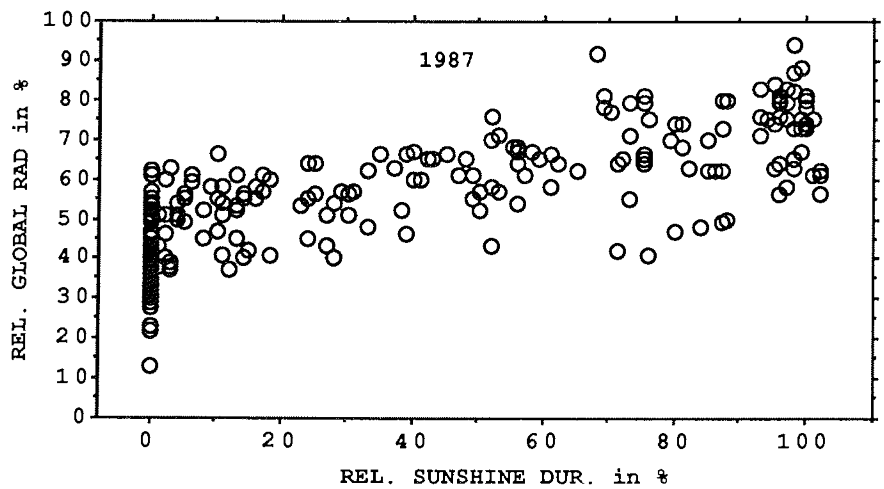
(*Fig.23*)


GLOBAL RAD.
EXTRATERR. RAD.
1985
IRRADIANCE in W/m**2
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
JUL. DAY


GLOBAL RAD.
EXTRATERR. RAD.
1986
IRRADIANCE in W/m**2
600
500
400
300
200
100
0
0
50
100
150
200
250
300
350
JUL. DAY



<u>*Fig. 23*</u> *Daily mean values of measured global radiation and calculated extraterrestrial irradiance for 1985, 1986 and 1987. There were no measurements in the time between 18 Dec. 1985 and 14 Feb. 1986.*



<u>*Fig. 24*</u> *Relative global radiation (ratio of measured global radiation to calculated extraterrestrial irradiance) as function of relative sunshine duration (daily means).*

The global radiation (January and whole year) derived by Budyko (1974) for the region at 70°S and 10°W of 285 W/m^2 for January and 120 W/m^2 for the annual average are confirmed by our values of 271 W/m^2 for January and of 118 W/m^2 for the annual average.

The albedo (ratio of reflected solar to global radiation) value of 85% (annual average) is typical for snow covered ice shelves (Schwerdtfeger,1984). Tab.6 indicates slight annual variations of the surface albedo with lowest values in summer. This may be evidence for the dependence of albedo on solar elevation angle. However many other factors have to be considered, mainly the snow characteristics but also cloudiness and spectral distribution of incident light. Although the measurement concept is simple (upward und downward looking pyranometer), the measurements are subject to the same errors as are pyranometers in general plus some additional errors due to the combination of instruments. For instance the response characteristics must be the same for the two orientations, a criterion which is not necessarily fulfilled by the available instruments. A detailled discussion of these and other problems concerning radiation measurements can be found in the WCRP (1986) manual. It is evident that some errors have large effects on albedo, particularly during periods of small irradiances. Therefore a considerable part of the data of the global and reflected solar radiation measurements have not been included into the albedo calculations. Consequently the data samples are sparse for April and August.

The same considerations must be applied to data of net short-wave radiation. There are two reasons for its annual course:
first, it is determined by the incoming global radiation. But as mentioned above, while global radiation declines, albedo tends to increase, favoring the decrease of the net short-wave radiation.

The net long-wave radiation is calculated from the net total and the net short-wave radiation. There were only a few measurements available for January so that this month could not be documented satisfactorily. Accurate measurements of the long-wave radiation are very difficult to obtain in Antarctic regions, especially as long as the sun is above the horizon and during periods of high windspeed (Schwerdtfeger, 1984).
The net total radiation is negative except for November and December. Its annual mean of -6 W/m ^{2} agrees well with the value found in Budyko's (1974) radiation balance chart of Antarctica.

4.4) Mast Measurements

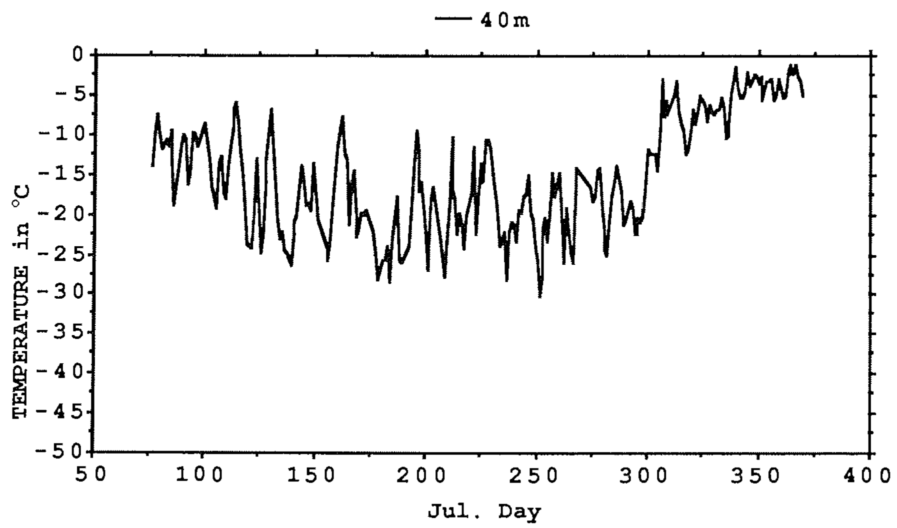
Vertical profiles of air temperature at a 45 m heigh mast and of snow temperature down to 5 m depth had been acquired during certain time periods. The phenomenon of the temperature inversion near the earth´s surface was discussed in the previous reports. Some features reflected in these measurements during the time period 17.3.1986 - 5.1.1987 are described in the following.

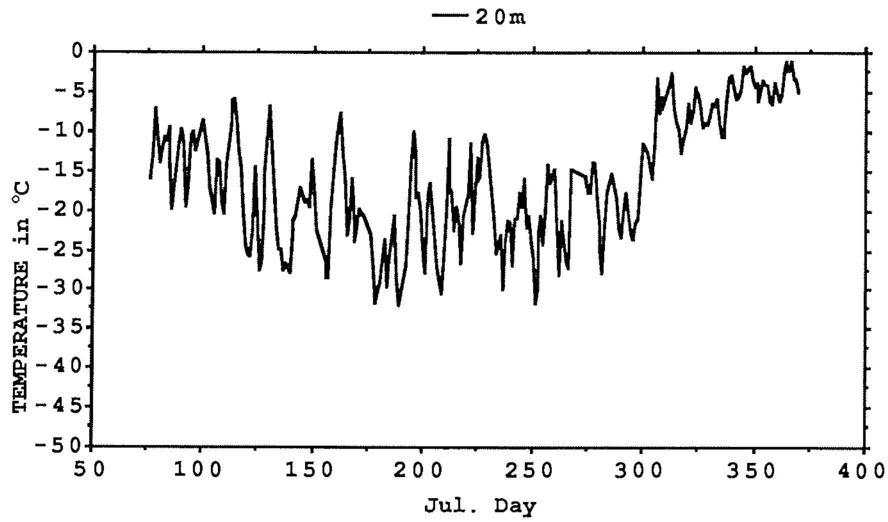
Records of temperature measurements at heights of 40, 30, 20, 10, 5, 2 m and at depths of 0,25, 0,50, 1,50, 2,25, 3,00 and 5,00 m are available. The depths for the firn thermometers refer to the start of the time period. A mean snow accumulation of approximately 1 m per year must be taken into consideration.

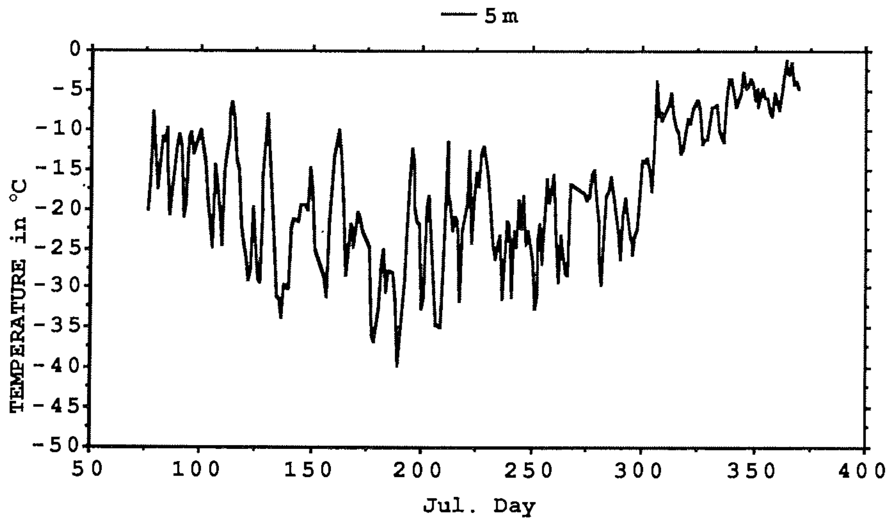
All results are based on daily means.
The days 17.3.1986 - 5.1.1987 are identified by the Julian day number, starting with 76 and ending with the number 370 (the five days in January 1987 are associated with the numbers 366-370).

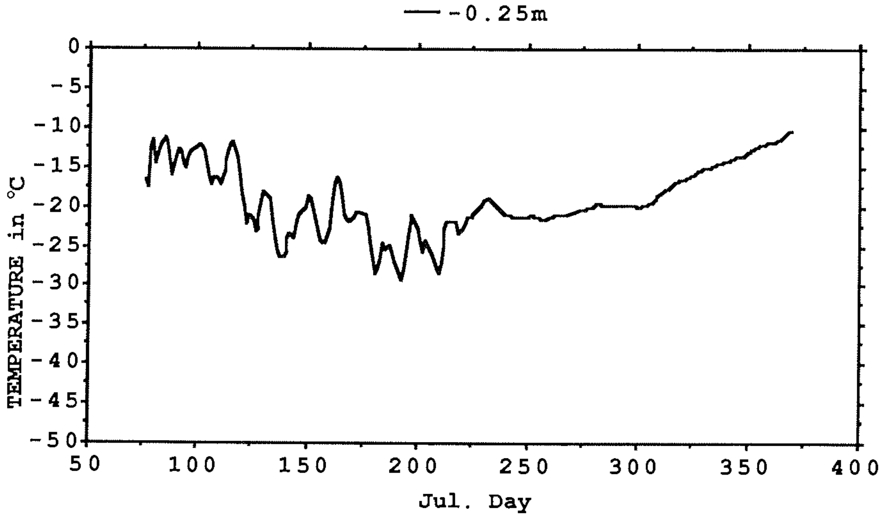
The course of the mean daily temperatures at selected heights and depths are presented on Fig.25.

(Fig.25)

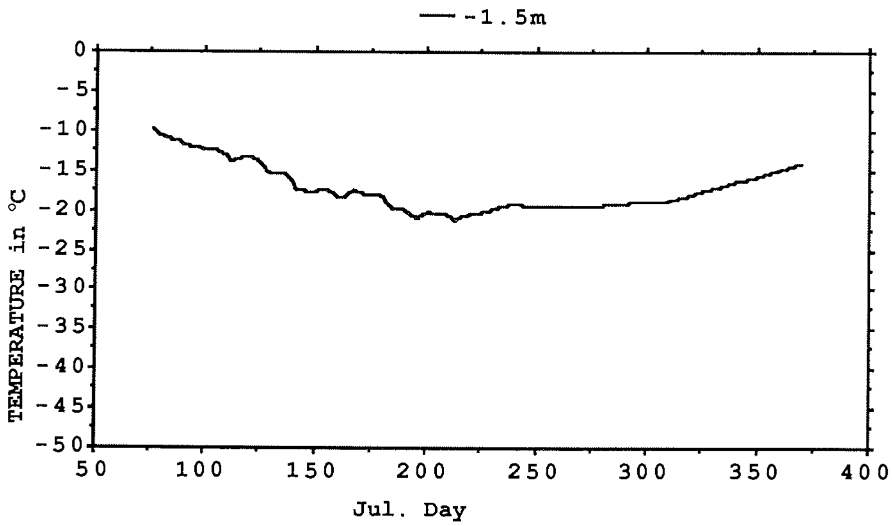



20m
TEMPERATURE in °C
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
50
100
150
200
250
300
350
400
Jul. Day

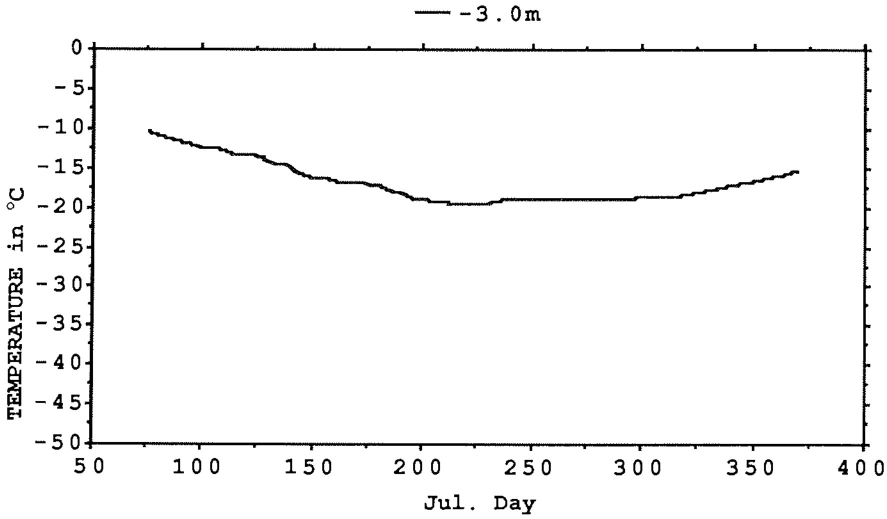

5m
TEMPERATURE in °C
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
50
100
150
200
250
300
350
400
Jul. Day



— -0.25m
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
50
100
150
200
250
300
350
400
Jul. Day
TEMPERATURE in °C



— -1.5m
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
50
100
150
200
250
300
350
400
Jul. Day
TEMPERATURE in °C



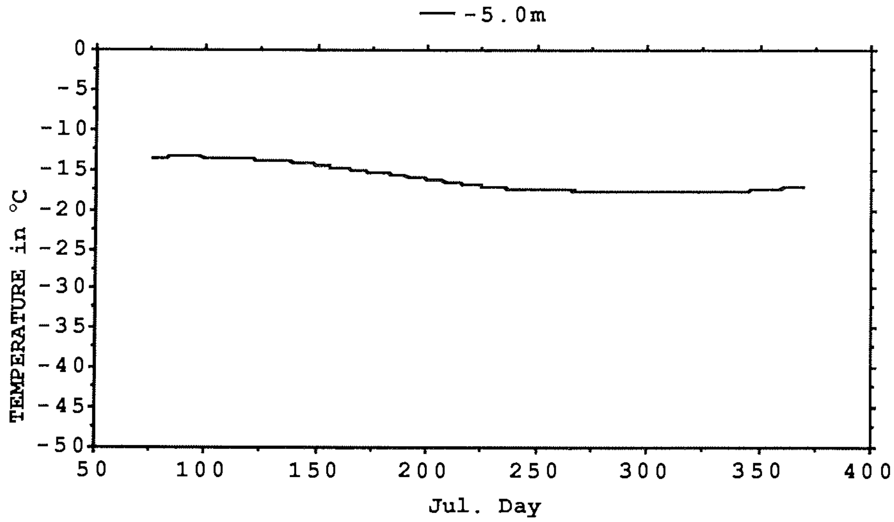


Fig. 25 *Mean daily temperature at different levels for the time period 17.3.1986 - 5.1.1987.*

The variation of air temperature is rather similar at the different heights with standard deviations of 7,3°C, 7,9°C and 8,7°C at 40 m, 20 m and 2 m height, respectively. The variations of the firn temperatures, however, decrease with increasing depth. The day-to-day variations as well as the annual cycle are attenuated. The temperature at 5 m depth is nearly constant throughout the year at the mean value of -16,2 °C (standard deviation = 1,7 °C) which compares well with the annual mean air temperature of -16,0 °C (Tab. 1b).

These features are also exhibited if the twelve temperature series are correlated (Tab.7). Whereas the air temperatures are significantly correlated one with another, their correlations with firn temperatures are only apparent for the first two depths. Firn temperatures are also correlated among themselves, but over much smaller distances than is the case for measurements above the surface.
The correlation coefficient for the series at 2 m and at -1,5 m is 0,36. If the -1,5 m series is time lagged, the coefficient increases:

time lag in days (between mean daily temp. at 2m and at -1,5m)	*correlation coefficient*
0	0,36
5	0,52
10	0,59
15	0,65
20	0,70
25	0,72
30	0,74

For greater time lags, the correlation coefficient decreases again. This demonstrates the time delay with which (daily) changes in air temperature are transfered to the firn which is a fairly good insolator.

Correlation Matrix for Variables: X_1 ... X_{12}

	40m	30m	20m	10m	5m	2m	-0.25m	-0.5m
40m	1							
30m	,998	1						
20m	,991	,997	1					
10m	,974	,985	,993	1				
5m	,968	,979	,986	,997	1			
2m	,96	,972	,98	,992	,998	1		
-0.25m	,744	,75	,742	,737	,75	,752	1	
-0.5m	,718	,723	,711	,701	,714	,716	,99	1
-1.5m	,391	,386	,366	,344	,356	,357	,694	,737
-2.25m	,385	,379	,359	,337	,348	,35	,685	,729
-3.0m	,211	,205	,186	,166	,174	,174	,492	,538
-5.0m	-,18	-,187	-,198	-,212	-,216	-,221	,023	,066

Correlation Matrix for Variables: X_1 ... X_{12}

	-1.5m	-2.25m	-3.0m	-5.0m
-1.5m	1			
-2.25m	1	1		
-3.0m	,954	,957	1	
-5.0m	,636	,645	,832	1

Tab. 7 *Linear Correlation coefficients for time series of daily mean temperatures at 12 different heights (depths).*

Acknowledgements

Thanks are due to B. Loose for his help in programming and data processing and to J. Weiss and S. Westerwick for the development of the database management system.

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