FEDERAL SERVICE OF RUSSIA FOR HYDROMETEOROLOGY AND ENVIRONMENTAL MONITORING

Russian Federation State Research Center

Arctic and Antarctic Research Institute

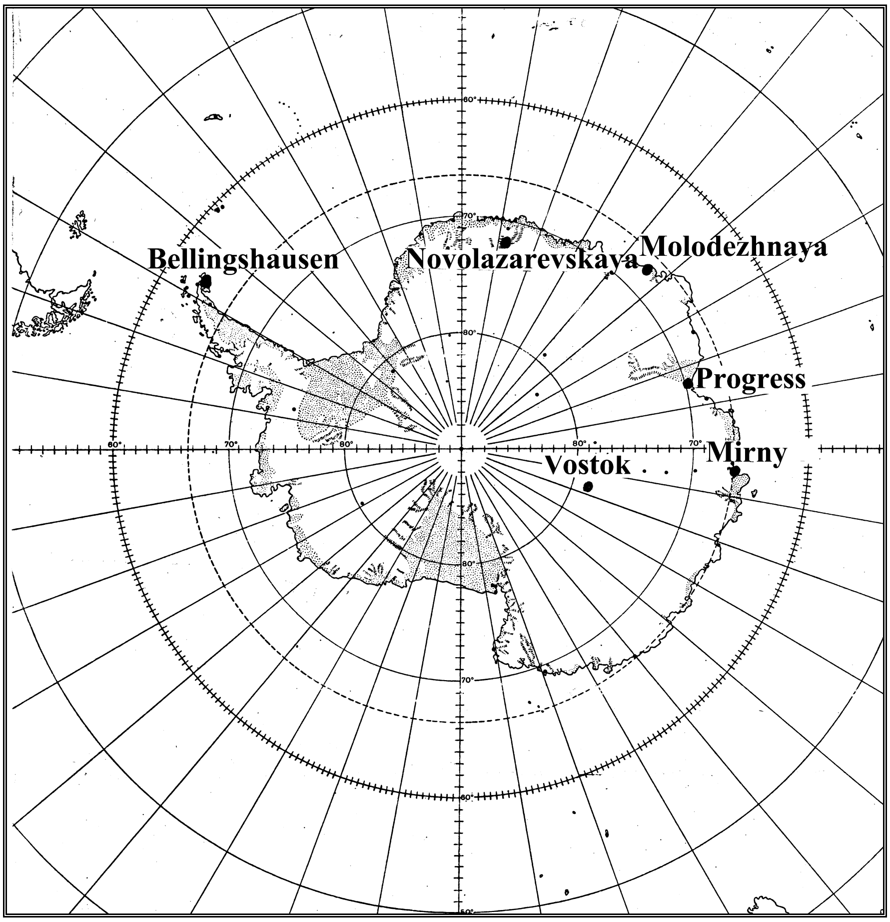
Russian Antarctic Expedition

STATE OF ANTARCTIC ENVIRONMENT

Operational data of Russian Antarctic stations

October - December 2001

№4 (17)



St. Petersburg

2002

CONTENTS

PREFACE

The Bulletin is prepared on the basis of data reported from the Russian Antarctic stations in real time via the communication channels. The Bulletin is published from 1998 on a quarterly basis.

Section I in this issue presents monthly averages of standard meteorological and actinometric observations and upper-air sounding at the Russian Antarctic stations for the fourth quarter of 2001.

Standard meteorological observations are carried out at present at Mirny, Novolazarevskaya, Bellingshausen and Vostok stations. The upper-air sounding is undertaken once a day at 00.00 UT at two stations - Mirny Observatory and Novolazarevskaya. More frequent sounding is conducted at both stations during the International Geophysical Intervals (IGI) in accordance with the International Geophysical Calendar.

In the meteorological tables, the atmospheric pressure is referenced to sea level for coastal stations and to the station level for the inland Vostok station located at a height of 3488 m.

Along with monthly averages of meteorological parameters, the tables also contain their deviations from multiyear averages (absolute anomalies), normalized anomalies (deviations in σ_f fractions - $(f-f_{avg})/\ \sigma_f$) and relative anomalies (f/f_{avg}) of the monthly sums of precipitation and total radiation. The statistical characteristics necessary for calculation of anomalies were derived at the AARI Department of Meteorology for the period 1961-1990 as recommended by the World Meteorological Organization.

The Bulletin contains brief overviews with an assessment of the anomalous state of the Antarctic environment based on actual data. Sections 2 and 3 are devoted to the meteorological and synoptic conditions. The analysis of ice conditions in the Southern Ocean (Section 4) is based on satellite data received at Bellingshausen, Novolazarevskaya and Mirny stations and observations conducted at the coastal Bellingshausen and Mirny stations. The anomalous character of ice conditions is evaluated against the multiyear averages of the drifting ice edge location and the onset of different ice phases in the coastal areas of the Southern Ocean adjoining the Antarctic stations. The multiyear averages were obtained at the AARI Department of Ice Regime and Forecasting over the period 1971-1995.

Section 5 presents as usual, an overview of total ozone (TO) based on measurements at the Russian Mirny, Novolazarevskaya and Vostok stations.

Data of geophysical observations published in Section 6 present a result of measurements in Mirny Observatory and at Vostok station under the geomagnetic and ionospheric programs (magnetic and riometer observations). Data of riometer observations are presented as plots of the maximum daily values of space radio-emission absorption at the 32 MHz frequency.

Geophysical information also includes the magnetic activity index (PC-index), which is calculated on the basis of geomagnetic observation data at Vostok station.

Sections 7, 8 and 9 of this issue present information on hydrochemical monitoring of water systems in the area of Bellingshausen Base during the summer season of the 46th RAE. These activities are undertaken in the framework of nature protection measures at the Russian Antarctic stations.

Section 10 describes the analysis of data on air temperature and pressure measurements at standard synoptic hours at Bellingshausen station to determine statistical structure parameters of meteorological characteristics necessary for estimating the climatic trends in the surface atmospheric layer. A quantitative assessment of the contribution of the different time scale processes (from daily to interannual variations) to the formation of the observed climatic variability in the Antarctic Peninsula area was made.

The last Section of the Bulletin is traditionally devoted to the main directions and events of the logistics activity of RAE during the period under consideration.

Russian Antarctic stations in operation in October - December 2001

MIRNY OBSERVATORY

STATION SYNOPTIC INDEX	**89592**
METEOROLOGICAL SITE HEIGHT ABOVE SEA LEVEL	**39.9 m**
GEOGRAPHICAL COORDINATES	**φ = 66°33′ S; λ = 93°01′ E**
GEOMAGNETIC COORDINATES	**Φ = -76.8°; Δ = 151.1°**
BEGINNING AND END OF POLAR DAY	**7 December – 5 January**
BEGINNING AND END OF POLAR NIGHT	**No**

NOVOLAZAREVSKAYA STATION

STATION SYNOPTIC INDEX	**89512**
METEOROLOGICAL SITE HEIGHT ABOVE SEA LEVEL	**119 m**
GEOGRAPHICAL COORDINATES	**φ = 70°46′ S; λ = 11°50′ E**
BEGINNING AND END OF POLAR DAY	**15 November - 28 January**
BEGINNING AND END OF POLAR NIGHT	**21 May - 23 July**

BELLINGSHAUSEN STATION

STATION SYNOPTIC INDEX	**89050**
METEOROLOGICAL SITE HEIGHT ABOVE SEA LEVEL	**14.3 m**
GEOGRAPHICAL COORDINATES	**φ = 62°12′ S; λ = 58°56′ W**
BEGINNING AND END OF POLAR DAY	**No**
BEGINNING AND END OF POLAR NIGHT	**No**

VOSTOK STATION

STATION SYNOPTIC INDEX	**89606**
METEOROLOGICAL SITE HEIGHT ABOVE SEA LEVEL	**3488 m**
GEOGRAPHICAL COORDINATES	**φ = 78°27′ S; λ = 106°52′ E**
GEOMAGNETIC COORDINATES	**Φ = -89.3°; Δ = 139.5°**
BEGINNING AND END OF POLAR DAY	**21 October - 21 February**
BEGINNING AND END OF POLAR NIGHT	**23 April - 21 August**

PROGRESS STATION

METEOROLOGICAL SITE HEIGHT ABOVE SEA LEVEL	**64 m**
GEOGRAPHICAL COORDINATES	**φ = 69°23′ S; λ = 76°23′ E**
BEGINNING AND END OF POLAR DAY	**21 November – 21 January**
BEGINNING AND END OF POLAR NIGHT	**28 May - 16 July**

1. DATA OF AEROMETEOROLOGICAL OBSERVATIONS AT THE RUSSIAN ANTARCTIC STATIONS

OCTOBER 2001

MIRNY OBSERVATORY

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

October 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Sea level pressure, hPa	983,4	1000,9	963,2	-2,6	-0,4	
Air temperature, °C	-14	-3,7	-29,2	2,7	1,0	
Relative humidity, %	84			9,8	1,9	
Total cloudiness (sky coverage), tenths	8			1,3	1,2	
Lower cloudiness(sky coverage),tenths	4,4			1,4	0,9	
Precipitation, mm	26,6			-43,5	-0,9	0,4
Mean wind speed, m/s	12,5	28		-0,2	-0,1	
Prevailing wind direction, deg	112					
Total radiation, MJ/m^2	11			1,5	0,7	1,2
Total ozone content, DU	No observations were done					

Results of aerological atmospheric sounding (from CLIMAT-TEMP messages)

October 2001

Isobaric surface, P, hPa	Isobaric surface height, H m	Temperature, T °C	Dew point deficit, D °C	Resulting wind direction, deg	Resulting wind speed, m/s	Wind stability parameter	Number of days without temperature data	Number of days without wind data
974	978	53	-13,4	2,9				
925	925	480	-13,8	3,6	92	14	99	3
850	850	1118	-16,9	2,9	86	13	96	3
700	700	2561	-22,3	4,4	78	9	85	3
500	500	4960	-36,5	5,3	76	6	60	3
400	400	6475	-46,8	5	69	5	44	3
300	300	8327	-59,2	4,3	54	3	22	3
200	200	10797	-68,9	3,9	305	5	40	3
150	150	12511	-70,7	3,9	290	8	65	4
100	100	14895	-75,2	3,7	288	14	86	13

Anomalies of standard isobaric surface heights and temperature

October 2001

P, hPa	$H-H_{avg}$, m	$(H-H_{avg})/\sigma_H$	$T-T_{avg}$, °C	$(T-T_{avg})/\sigma_T$
850	7	0,2	2,3	1,1
700	12	0,2	0,8	0,5
500	20	0,3	1,2	0,7
400	28	0,4	1,1	0,7
300	33	0,4	0,7	0,6
200	34	0,4	-0,6	-0,4
150	29	0,3	-1,1	-0,7
100	16	0,2	-2,1	-1,2

NOVOLAZAREVSKAYA STATION

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

October 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Sea level pressure, hPa	987,6	1010,5	967	0	0,0	
Air temperature, °C	-16,2	-6,8	-34,2	1,1	0,4	
Relative humidity, %	54			3,6	0,5	
Total cloudiness (sky coverage), tenths	5,7			0,2	0,1	
Lower cloudiness(sky coverage),tenths	1,4			0,3	0,3	
Precipitation, mm	93,9			55,6	1,2	2,5
Mean wind speed, m/s	12,3	36		1,7	0,7	
Prevailing wind direction, deg	135					
Total radiation, MJ/m^2	1			-1,2	-0,5	0,4

Results of aerological atmospheric sounding (from CLIMAT-TEMP messages)

October 2001

Isobaric surface, P, hPa	Isobaric surface height, H m	Temperature, T °C	Dew point deficit, D °C	Resulting wind direction, deg	Resulting wind speed, m/s	Wind stability parameter	Number of days without temperature data	Number of days without wind data
965	122	-16,4	8,1					
925	502	-16,3	7	104	14	98	2	2
850	1133	-20,6	7,3	95	14	94	2	2
700	2552	-26	5,5	77	4	43	2	2
500	4927	-38,9	5,3	326	2	16	2	2
400	6425	-49	4,7	306	4	27	2	2
300	8263	-60,6	4,2	297	8	42	2	2
200	10719	-70,2	4	291	11	64	2	2
150	12417	-72,7	3,7	291	12	75	3	3
100	14769	-77,5	3,7	281	15	86	3	3
70	16798	-80,5	3,5	280	18	93	3	3
50	18691	-81,9	3,5	279	22	96	4	4
30	21505	-82,5	3,7	275	27	97	8	8
20	23753	-80,8	3,5	273	31	97	12	9

Anomalies of standard isobaric surface heights and temperature

October 2001

P, hPa	$H-H_{avg}$, m	$(H-H_{avg})/\sigma_H$	$T-T_{avg}$, °C	$(T-T_{avg})/\sigma_T$
850	4	0,1	0,4	0,2
700	5	0,1	1,3	0,7
500	17	0,3	1,3	0,8
400	27	0,4	1,4	0,9
300	38	0,5	1,6	1,4
200	56	0,7	1,3	0,8
150	64	0,8	0,8	0,6
100	69	0,9	0,3	0,2
70	82	1,0	1,0	0,7
50	73	1,0	2,0	1,1
30	72	0,6	2,9	1,7
20	140	1,1	4,6	2,2

BELLINGSHAUSEN STATION

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

October 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$…	Relative anomaly f/f_{avg}
Sea level pressure, hPa	996	1015	997,6	2,1	0,4	
Air temperature, °C	-7	-0,6	-18,6	-0,4	-0,1	
Relative humidity, %	85			-3,4	-1,3	
Total cloudiness (sky coverage), tenths	9,1			0,7	1,2	
Lower cloudiness(sky coverage),tenths	8,4			1,3	1,2	
Precipitation, mm	29,5			-23,5	-0,8	0,6
Mean wind speed, m/s	6,6	16		-0,8	-0,6	
Prevailing wind direction, deg	112					
Total radiation, MJ/m^2	18			-5,7	-1,7	0,8

VOSTOK STATION

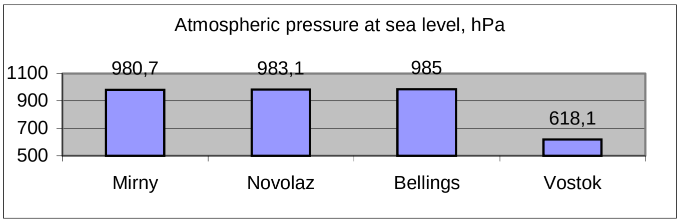
Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

October 2001

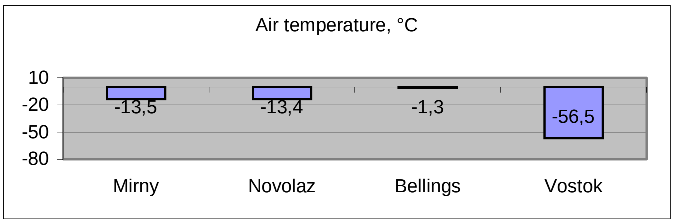
Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Station surface level pressure, hPa	625,8	643,3	610,9	4,7	0,8	
Air temperature, °C	-66,8	-41,4	-80,5	0,3	0,1	
Relative humidity, %	52*			-16,6	-3,9*	
Total cloudiness (sky coverage), tenths	1,7			-1,1	-1,1	
Lower cloudiness(sky coverage),tenths	0			0	0,0	
Precipitation, mm	0,7			-2,5	-1,0	0,2
Mean wind speed, m/s	3,7	8		-2	-2,2	
Prevailing wind direction, deg	247,5					
Total radiation, MJ/m^2						
Total ozone content, DU	No observations were done					

* Measurements of relative humidity at Vostok station in the wintertime are incorrect. The sensors applied are not to be used at such low temperatures.

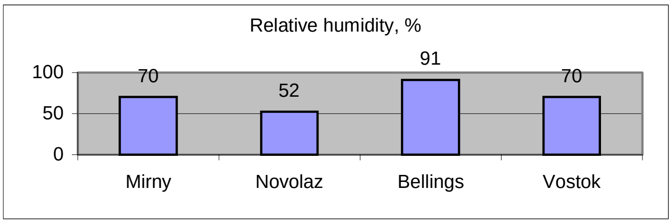
O c t o b e r 2001



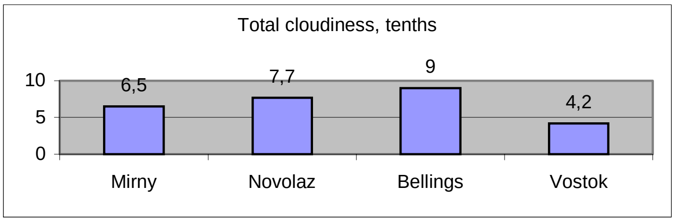
$(f-f_{avg})/\sigma_f$ -0,3 -0,2 -1,0 -0,3



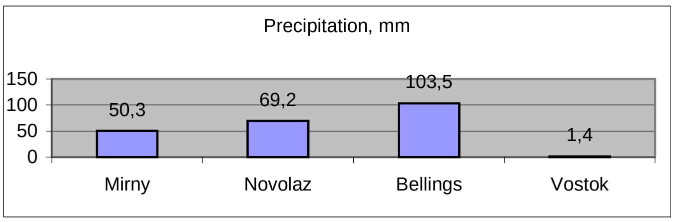
$(f-f_{avg})/\sigma_f$ 0,0 -0,5 1,3 0,3



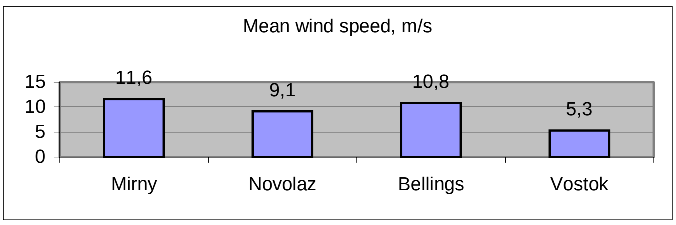
$(f-f_{avg})/\sigma_f$ 0,2 0,1 0,9 -0,1



$(f-f_{avg})/\sigma_f$ -0,3 2,1 0,0 -0,2



f/f_{avg} 1,2 2,4 2,1 0,7



$(f-f_{avg})/\sigma_f$ 0,6 -0,6 3,1 -0,2

Fig. 1.1. Comparison of monthly averages of meteorological parameters at the stations, October 2001.

NOVEMBER 2001

MIRNY OBSERVATORY

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

November 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Sea level pressure, hPa	980,8	1005,4	937,3	-3,6	-0,6	
Air temperature, ^0C	-18,4	-8,3	-31	-1,2	-0,4	
Relative humidity, %	74			1	0,2	
Total cloudiness (sky coverage), tenths	7,2			0,5	0,6	
Lower cloudiness(sky coverage),tenths	4,2			1,4	1,1	
Precipitation, mm	41,1			-26,3	-0,5	0,6
Mean wind speed, m/s	12,5	32		-0,4	-0,3	
Prevailing wind direction, deg	135					
Total radiation, MJ/m^2	66			0,3	0,0	1,0
Total ozone content, DU	240	269	219			

Results of aerological atmospheric sounding (from CLIMAT-TEMP messages)

November 2001

Isobaric surface, P, hPa	Isobaric surface height, H m	Temperature, T ^0C	Dew point deficit, D ^0C	Resulting wind direction, deg	Resulting wind speed, m/s	Wind stability parameter	Number of days without temperature data	Number of days without wind data
982	53	-19,5	4,2					
925	467	-19,1	5	92	11	98	1	1
850	1092	-21,8	4,6	89	10	92	1	1
700	2514	-24,7	5,7	83	3	36	1	1
500	4897	-38,6	5,8	258	3	31	1	1
400	6397	-48,6	5,2	259	6	51	1	1
300	8235	-60,8	4,7	263	10	70	1	1
200	10679	-71,3	4,1	265	13	81	1	1
150	12365	-73,7	4	268	16	92	1	1
100	14733	-76,9	3,8	269	22	94	5	6
70	16787	-78,3	3,7	271	29	96	9	9
50	18722	-78,7	3,4	275	35	98	14	9
30	21666	-77,9	3,5	277	45	99	19	9

Anomalies of standard isobaric surface heights and temperature

November 2001

P, hPa	$H-H_{avg}$, m	$(H-H_{avg})/\sigma_H$	$T-T_{avg}$, °C	$(T-T_{avg})/\sigma_T$
850	-3	-0,1	-2,0	-0,8
700	-20	-0,3	-1,1	-0,6
500	-27	-0,4	-0,6	-0,3
400	-36	-0,4	-0,4	-0,2
300	-35	-0,3	-0,3	-0,2
200	-54	-0,5	-0,9	-0,4
150	-63	-0,6	-1,2	-0,5
100	-55	-0,5	-1,8	-0,6
70	-56	-0,4	-1,5	-0,4
50	-84	-0,5	-1,6	-0,3
30	-91	-0,4	-1,8	-0,3

NOVOLAZAREVSKAYA STATION

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

November 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Sea level pressure, hPa	983,1	1003,9	948,6	-3,4	-0,6	
Air temperature, ^{0}C	-19,6	-9,1	-33,4	-1,3	-0,5	
Relative humidity, %	41			-9,7	-1,3	
Total cloudiness (sky coverage), tenths	4,7			-0,7	-0,5	
Lower cloudiness(sky coverage),tenths	0,2			-0,7	-0,9	
Precipitation, mm	19,3			-23,1	-0,5	0,5
Mean wind speed, m/s	10,5	32		-0,1	0,0	
Prevailing wind direction, deg	135					
Total radiation, MJ/m^2	38			4,3	0,9	1,1

Results of aerological atmospheric sounding (from CLIMAT-TEMP messages)

November 2001

Isobaric surface, P, hPa	Isobaric surface height, H m	Temperature, T ^{0}C	Dew point deficit, D ^{0}C	Resulting wind direction, deg	Resulting wind speed, m/s	Wind stability parameter	Number of days without temperature data	Number of days without wind data
973	122	-19,1	10,7					
925	482	-18,9	8,1	112	12	95	0	0
850	1106	-23	7,4	103	13	96	0	0
700	2530	-28,6	5,9	111	7	68	0	0
500	4858	-41,8	6,4	168	4	35	0	0
400	6337	-51,8	5,7	191	6	47	0	0
300	8154	-62,6	5	210	8	60	0	0
200	10588	-72,2	4,4	222	9	70	0	0
150	12261	-76,2	4,2	236	10	79	0	0
100	14577	-80,2	4	246	13	86	1	1
70	16573	-82,6	3,8	251	14	90	3	3
50	18444	-83,7	3,8	256	17	93	3	3
30	21276	-82,7	3,8	258	21	95	4	4
20	23567	-78,4	4,2	261	22	96	6	7

Anomalies of standard isobaric surface heights and temperature

November 2001

P, hPa	$H\text{-}H_{avg}$, m	$(H\text{-}H_{avg})/\sigma_H$	$T\text{-}T_{avg}$, °C	$(T\text{-}T_{avg})/\sigma_T$
850	-7	-0,1	-1,1	-0,6
700	5	0,1	-0,8	-0,4
500	-24	-0,3	-0,9	-0,6
400	-30	-0,4	-0,8	-0,6
300	-34	-0,4	0,0	0,0
200	-33	-0,4	0,3	0,2
150	-39	-0,4	-0,7	-0,5
100	-51	-0,5	-1,0	-0,7
70	-88	-0,8	-0,9	-0,5
50	-125	-0,9	-0,7	-0,3
30	-159	-0,8	0,1	0,0
20	-140	-0,7	2,2	0,6

BELLINGSHAUSEN STATION

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

November 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f\text{-}f_{avg}$	Normalized anomaly $(f\text{-}f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Sea level pressure, hPa	982,2	1002,2	952,3	-9,8	-1,6	
Air temperature, ^{0}C	-3,1	0,4	-11,2	3,6	1,5	
Relative humidity, %	91			3,1	1,1	
Total cloudiness (sky coverage), tenths	9,2			0,7	1,4	
Lower cloudiness(sky coverage),tenths	8,9			1,7	1,7	
Precipitation, mm	56,2			-12	-0,3	0,8
Mean wind speed, m/s	9,9	20		2,1	2,3	
Prevailing wind direction, deg	270					
Total radiation, MJ/m^2	58			-28,1	-3,5	0,7

VOSTOK STATION

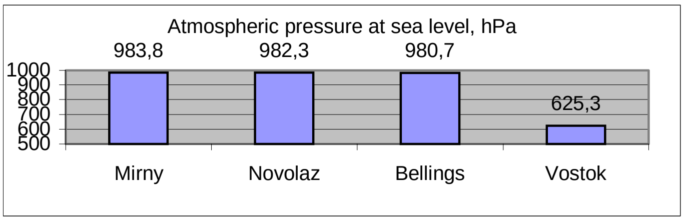
Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

November 2001

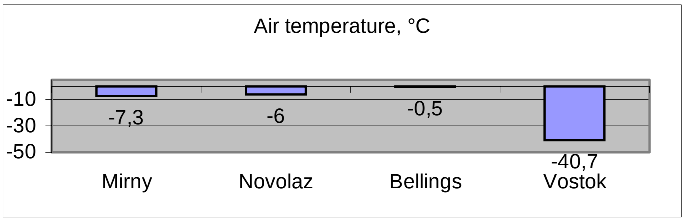
Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f\text{-}f_{avg}$	Normalized anomaly $(f\text{-}f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Station surface level pressure, hPa	615	627,7	601,6	-4,6	-0,6	
Air temperature, ^{0}C	-68,6	-37,5	-80,7	-0,6	-0,2	
Relative humidity, %	66*			-2,6	-0,6	
Total cloudiness (sky coverage), tenths	3,5			0,1	0,1	
Lower cloudiness(sky coverage),tenths	0			0	0,0	
Precipitation, mm	3,1			0	0,0	1,0
Mean wind speed, m/s	5,2	15		-0,4	-0,5	
Prevailing wind direction, deg	225					
Total radiation, MJ/m^2	3			0,7	0,4	1,4
Total ozone content, DU	No observations were done					

* Measurements of relative humidity at Vostok station in the wintertime are incorrect. The sensors applied are not to be used at such low temperatures.

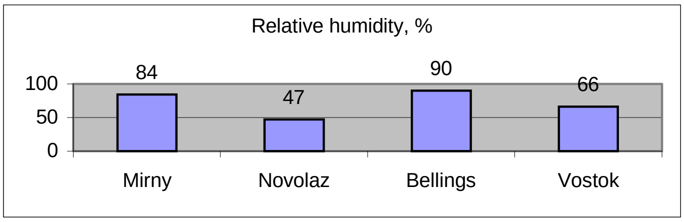
N o v e m b e r 2001



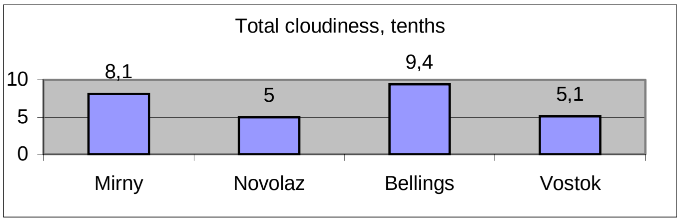
$(f-f_{avg})/\sigma_f$ -0,6 -0,9 -1,3 -0,1



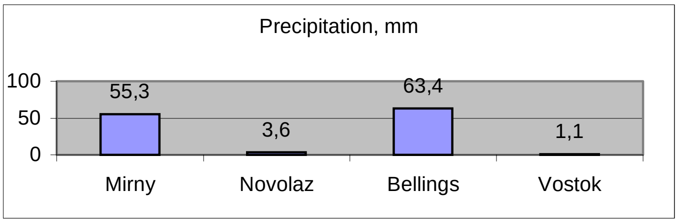
$(f-f_{avg})/\sigma_f$ 0,0 -0,1 0,9 1,6



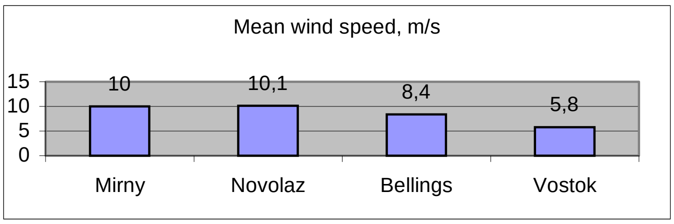
$(f-f_{avg})/\sigma_f$ 4,5 -1,4 0,7 -1,4



$(f-f_{avg})/\sigma_f$ 2,4 -1,2 0,5 2,3



f/f_{avg} 1,7 0,5 1,3 1,2



$(f-f_{avg})/\sigma_f$ 0,2 0,4 1,6 0,7

Fig. 1.2. Comparison of monthly averages of meteorological parameters at the stations, November 2001.

DECEMBER 2001

MIRNY OBSERVATORY

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

December 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Sea level pressure, hPa	976,8	993,3	948,2	-5,3	-1,1	
Air temperature, ^{0}C	-16,3	-5,8	-30,7	0,4	0,2	
Relative humidity, %	66			-5,4	-1,2	
Total cloudiness (sky coverage), tenths	6,2			-0,3	-0,3	
Lower cloudiness(sky coverage),tenths	2,8			0	0,0	
Precipitation, mm	13,6			-47,3	-0,9	0,2
Mean wind speed, m/s	11,1	31		-1	-0,7	
Prevailing wind direction, deg	135					
Total radiation, MJ/m^2	228			4,5	0,3	1,0
Total ozone content, DU	197	257	143			

Results of aerological atmospheric sounding (from CLIMAT-TEMP messages)

December 2001

Isobaric surface, P, hPa	Isobaric surface height, H m	Temperature, T ^{0}C	Dew point deficit, D ^{0}C	Resulting wind direction, deg	Resulting wind speed, m/s	Wind stability parameter	Number of days without temperature data	Number of days without wind data
973	53	-18	5,2					
925	430	-15,1	6,1	92	9	91	3	3
850	1065	-18,1	4,8	91	7	87	3	3
700	2501	-23,6	5,9	99	3	34	3	3
500	4892	-38,1	5,8	277	1	12	3	4
400	6394	-48,1	5,6	269	3	30	3	3
300	8238	-59,8	4,4	281	5	51	3	3
200	10703	-69,2	4,1	276	11	84	3	4
150	12410	-71,5	4,1	273	15	93	3	6
100	14790	-73,2	4,3	271	22	97	8	8
70	16872	-74	4	271	29	97	8	9
50	18863	-72,7	4,5	274	37	98	12	9
30	21854	-69,3	5,1	276	48	99	19	9
20	24310	-62,6	5,9	278	55	99	19	9
10	28744	-49,1						

Anomalies of standard isobaric surface heights and temperature

December 2001

P, hPa	$H-H_{avg}$, m	$(H-H_{avg})/\sigma_H$	$T-T_{avg}$, °C	$(T-T_{avg})/\sigma_T$
850	-24	-0,6	1,0	0,5
700	-26	-0,6	-0,4	-0,2
500	-30	-0,5	-0,4	-0,2
400	-32	-0,5	0,0	0,0
300	-36	-0,5	0,2	0,2
200	-32	-0,4	0,0	0,0
150	-37	-0,4	-1,0	-0,4

100	-55	-0,6	-2,8	-0,8
70	-87	-0,9	-5,3	-1,0
50	-141	-1,0	-6,3	-1,0
30	-289	-1,3	-8,5	-1,2
20	-409	-1,2	-7,6	-1,0
10	-561	-1,1	-7,1	-0,9

NOVOLAZAREVSKAYA STATION

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

December 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Sea level pressure, hPa	983,8	1004	942,1	-0,4	-0,1	
Air temperature, ^{0}C	-18,2	-5,7	-30,5	-1	-0,5	
Relative humidity, %	39			-12,1	-1,7	
Total cloudiness (sky coverage), tenths	4,6			-0,8	-0,8	
Lower cloudiness(sky coverage),tenths	0,5			-0,3	-0,3	
Precipitation, mm	1,1			-44	-0,8	0,0
Mean wind speed, m/s	9	31		-0,9	-0,5	
Prevailing wind direction, deg	135					
Total radiation, MJ/m^2	200			25,9	1,6	1,1

Results of aerological atmospheric sounding (from CLIMAT-TEMP messages)

December 2001

Isobaric surface, P, hPa	Isobaric surface height, H m	Temperature, T ^{0}C	Dew point deficit, D ^{0}C	Resulting wind direction, deg	Resulting wind speed, m/s	Wind stability parameter	Number of days without temperature data	Number of days without wind data
969	122	-18,4	10,9					
925	475	-17,7	8,9	112	12	93	0	0
850	1101	-22,3	8,2	106	12	93	0	0
700	2508	-28,3	5,7	101	7	74	0	0
500	4869	-40	6	180	4	39	0	0
400	6359	-50,2	5,4	212	6	46	0	0
300	8186	-62	4,8	222	7	54	0	0
200	10620	-72,4	4,2	227	11	76	0	0
150	12298	-75,3	4,1	234	11	83	0	0
100	14621	-79,1	4	244	13	86	1	1
70	16629	-81	4	249	15	92	2	2
50	18504	-81,1	4	256	19	94	4	4
30	21396	-77,1	4,4	261	24	97	8	8
20	23767	-70	4,9	264	28	97	11	9

Anomalies of standard isobaric surface heights and temperature

December 2001

P, hPa	$H-H_{avg}$, m	$(H-H_{avg})/\sigma_H$	$T-T_{avg}$, °C	$(T-T_{avg})/\sigma_T$
850	0	0,0	-1,2	-0,9
700	-8	-0,2	-0,9	-0,7
500	-12	-0,2	0,1	0,1
400	-11	-0,2	0,1	0,1
300	-12	-0,2	0,0	0,0
200	-15	-0,2	-0,1	-0,1
150	-17	-0,2	-0,4	-0,2
100	-35	-0,5	-1,8	-0,9
70	-66	-0,7	-2,8	-1,2
50	-129	-1,1	-2,9	-0,9
30	-210	-1,2	-2,1	-0,5
20	-295	-1,0	-1,2	-0,2

BELLINGSHAUSEN STATION

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

December 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Sea level pressure, hPa	991	1013,8	969,5	-0,1	0,0	
Air temperature, ^{0}C	-3	0,2	-11,6	1,4	0,8	
Relative humidity, %	91			2,3	0,9	
Total cloudiness (sky coverage), tenths	8,9			0,1	0,2	
Lower cloudiness(sky coverage),tenths	7,6			-0,3	-0,4	
Precipitation, mm	105,4			42,6	2,1	1,7
Mean wind speed, m/s	8,3	20		0,3	0,3	
Prevailing wind direction, deg	315					
Total radiation, MJ/m^2	185			-28,6	-1,6	0,9

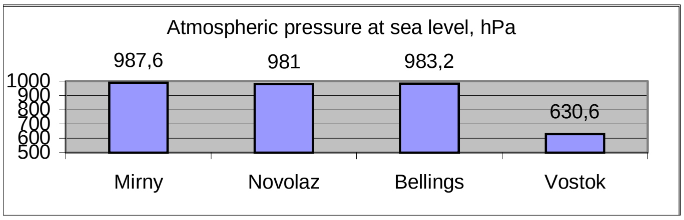
VOSTOK STATION

Monthly averages of meteorological parameters (f) and their deviations from multiyear averages (f_{avg})

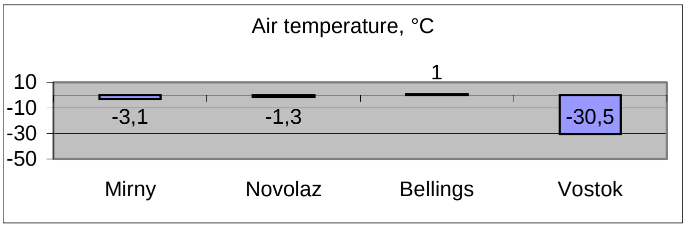
December 2001

Parameter	$f_{mon.avg}$	f_{max}	f_{min}	Anomaly $f-f_{avg}$	Normalized anomaly $(f-f_{avg})/\sigma_f$	Relative anomaly f/f_{avg}
Station surface level pressure, hPa	618,9	635,7	606	0,9	0,2	
Air temperature, ^{0}C	-65,7	-44,2	-77,2	0	0,0	
Relative humidity, %	69			0	0,0	
Total cloudiness (sky coverage), tenths	3,8			-0,1	-0,1	
Lower cloudiness(sky coverage),tenths	0			-0,1	-0,5	
Precipitation, mm	1,1			-1,9	-0,7	0,4
Mean wind speed, m/s	4,3	8		-1,2	-1,3	
Prevailing wind direction, deg	225					
Total radiation, MJ/m^2	111			11,8	1,0	1,1
Total ozone content, DU	No observations were done					

December 2001



(f-f$_{avg}$)/σ_f -0,5 -1,9 -1,6 -0,8



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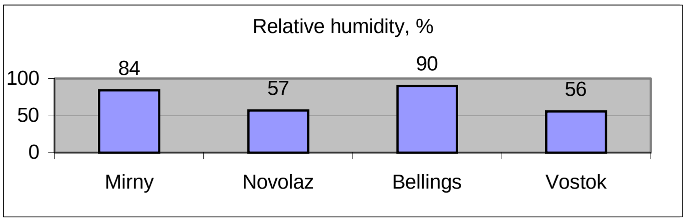
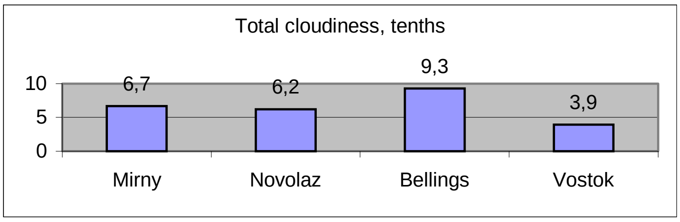
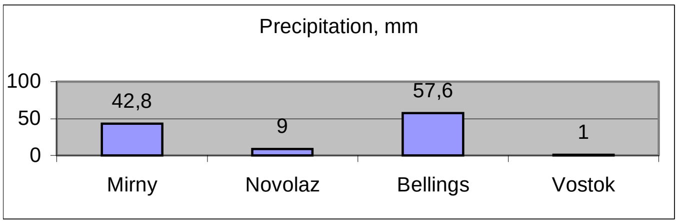


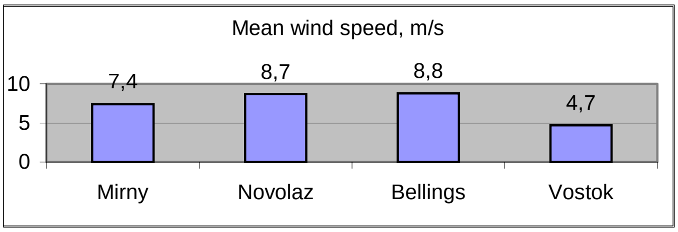
(f-f$_{avg}$)/σ_f 3,2 -0,2 0,6 -3,6



(f-f$_{avg}$)/σ_f -0,2 -0,1 0,5 0,7



f/f$_{avg}$ 1,7 1,2 1,2 1,7



(f-f$_{avg}$)/σ_f -0,8 0,8 2,8 0,2

Fig. 1.3. Comparison of monthly averages of meteorological parameters at the stations, December 2001.

2. ANOMALOUS METEOROLOGICAL CONDITIONS AT THE RUSSIAN ANTARCTIC STATIONS IN OCTOBER-DECEMBER 2001

Small below zero temperature anomalies were observed in October-December (except for November at Mirny station) at Novolazarevskaya and Mirny stations. The values of normalized anomalies at these stations were less than 1 σ. At the same time, the above zero anomalies were preserved at Vostok and Bellingshausen stations. The values of normalized anomalies at Vostok station in November and at Bellingshausen station in October and December were more than 1 σ. At Vostok station, November 2001 was the fourth warm November over the entire observation period (with November 1982 being the warmest).

Figure 2.1 characterizes temperature conditions in October-December for the entire continent. It presents monthly averages and the absolute and normalized surface temperature anomalies at the Russian and foreign meteorological stations. The actual data contained in /1/ and multiyear averages for the 1961-1990 period contained in /2/ were used.

The temperature distribution above the continent during the months under consideration was characterized by a pronounced heat center in the Antarctic Peninsula area and a cold center in the vicinity of the Wilkes Land and Adelie Land (Fig. 2.1).

In October, the area of the heat center that existed over much of the Antarctic territory in September has reduced. The above zero anomalies at the stations have decreased and the core of the heat center moved to the Antarctic Peninsula (Esperanza station, +3.5^0 C (1.6 σ). The cold centers formed in the South Pole area and in the coastal regions of East Antarctica (Queen Maud Land, Wilkes Land and Adelie Land). The cores of the main cold centers were located near the Amundsen-Scott (-2.3^{0}C (-1.0σ) and Syowa (-1.3^{0}C (-1.0σ) stations.

In November-December, an extensive heat center was formed again above the territory of Antarctica. In November, its center was in East Antarctica in the Polar Plateau area near Vostok station (+2.4^{0}C (+1.6σ). In December, the core of the heat center was located near McMurdo station (+2.1^{0}C (+1.7σ).

In the coastal areas of East-Antarctic, the below zero temperature anomalies were preserved in November-December. The core of the main cold center in these months was located in the vicinity of the Adelie Land near the Dumont D'Urville station (-1.2^{0}C (-1.4σ) in November and (-1.9^{0}C (-2.2σ) in December. At the Dumont D'Urville station, December 2001 was the second cold December over the entire observation period (with December 1961 being the coldest).

An assessment of long-period changes of mean monthly temperature of the months under consideration has revealed a positive trend at Bellingshausen and Novolazarevskaya stations and a negative trend at Mirny station (Figs. 2.2-2.4). At Vostok station, the trend sign is negative for October (statistically insignificant) whereas for November-December, it is positive and statistically significant.

During the last decade, the negative trends for October are observed at Novolazarevskaya, Mirny and Vostok stations and for December at Novolazarevskaya and Bellingshausen stations. For November, the linear trend sign at all stations is positive.

The atmospheric pressure at all Russian stations in October-December was less than a multiyear average. The largest negative anomaly was noted in December at Novolazarevskaya station (-9.9 hPa (-2.1σ), which is the third by value over the entire observation period (with the largest anomaly (-10.1 hPa (-2.2σ) observed in 1999).

The linear pressure trend sign at the Russian stations except for Vostok station is also negative for these months. A statistically significant negative trend for October at Mirny station comprises -3.5 hPa/45 years. The atmospheric pressure decrease for December is most pronounced at the Bellingshausen station comprising 7.3 hPa/34 years.

At the Vostok station, the pressure trend for October-November is positive.

The amount of precipitation in October-December at the Russian stations was in general higher than a multiyear average. In October, a more than a two-fold excess of the monthly multiyear average was recorded at Bellingshausen and Novolazarevskaya stations, by 2.1 and 2.4-times, respectively. At Bellingshausen station, this was the first case and at Novolazarevskaya the fourth case of abundant precipitation in October (after 1964, 1965 and 1967).

Considering the air temperature regime in general in 2001, it is noted that during the first three months (the second half of Antarctic summer and autumn), the center of negative anomalies in East Antarctic whose center was located near McMurdo station was preserved. The temperature anomaly at this station in January was -2.2^{0}C (-1.7σ). In February, the cold center has intensified, its core moving to the Wilkes Land area. The temperature anomaly at Casey station was -2.4^{0}C (-2.4σ). In March, the cold center has weakened.

In the western area of the Antarctic Peninsula, there was a pronounced heat center in January-March.

In April, the cold center in the Atlantic coastal zone has intensified. Its core was located near the Halley-Bay station where the temperature anomaly comprised -5.8^{0}C (-2.2σ). In May, the cold center in East Antarctica has attenuated and

the temperature here was close to a multiyear average. In June, the cold center moved to the coast of the Indian Ocean sector of East Antarctica and the nearby Polar Plateau areas. The cold anomalies in the core of the center were small comprising -1.9^{0}C (-0.8σ) at Vostok and -1.1^{0}C (-0.5σ) at Mirny stations.

In the Antarctic Peninsula area, the heat center has increased in May-June. The temperature anomalies for May at the British Rothera-Point station and for June at Bellingshausen station comprised +4.7^{0}C (+1.8σ) and +4.1^{0}C (+2.1σ), respectively.

In July-September (austral winter), the alternation of the heat and cold centers was preserved.

In July, the cold center in the eastern part of the Indian Ocean sector was replaced by the cold center. The temperature anomaly in the core of the center at the Australian station Casey was +4.3^{0}C (+1.4σ). Small negative temperature anomalies were observed in the vicinity of the Antarctic Peninsula and in the Weddell Sea.

In August, practically the entire East Antarctica was characterized by small negative temperature anomalies, whereas at the Antarctic Peninsula, a heat source has formed again with a temperature anomaly at Bellingshausen station comprising +3.6^{0}C (+1.5σ).

By September, the positive anomalies occupied the greatest portion of Antarctica. Two intense heat centers were observed, one with a core in the coastal zone of the Indian Ocean sector of the Antarctic (the temperature anomaly at Casey station comprising +3.5^{0}C (+1.3σ) and the other in the vicinity of the Antarctic Peninsula (with a temperature anomaly at the Argentine Esperanza station equal to +4.7^{0}C (+2.1σ).

The annual temperature and atmospheric pressure variations at the Russian stations in 2001 in comparison with a multiyear average over the period 1960-1991 are presented in Fig. 2.5.

As can be seen, there are significant differences between the temperature deviations at Bellingshausen station and at the other Russian stations. At Bellingshausen, predominantly large (more than 1σ) temperature anomalies were recorded. At the other Russian stations, the anomalies were typically less than 1σ. The only exception was the temperature anomaly in July in Mirny (+2.7^{0}C (+1.0σ) and in November at Vostok station (+2.4^{0}C (+1.6σ).

The positive anomalies mainly occurred during the cold months of the year.

It is of interest that the negative anomalies predominate in the annual atmospheric pressure variations at all Russian stations with large anomalies (more than 1σ) observed in the summer and transient seasons. Thus, in Mirny and at Novolazarevskaya station, the pressure anomalies in April comprised -2.7σ and -2.4σ.

An assessment of long-period temperature changes for all months of the year over the entire observation period has shown the dominance of a positive linear trend at the Russian stations (Table 2.1). However, a statistically significant trend occurs predominantly in the wintertime. Thus, at Bellingshausen station, the temperature increase for June comprised 3.2^{0}C/34 years and at Novolazarevskaya station for July it was 2.9^{0}C/41 years.

An assessment of linear trends for the last decade reveals the negative trends for most months at Novolazarevskaya station and for summer and autumn months at Mirny and Vostok stations. For the winter months the trend sign at the Russian stations is mainly positive, however, the statistically significant trends occur only at Bellingshausen station for May-June. A temperature increase for these months here was 5.8^{0}C/10 years and 5.5^{0}C/10 years.

An assessment of mean annual temperature over the period 1957-2001 indicates a statistically significant positive trend at Bellingshausen station. It is also present at Novolazarevskaya station in spite of the occurrence of a negative trend here for most months of the year during the last decade (Fig. 2.6).

References:

1. http://www.ncdc.noaa.gov/ol/climatedata.html
2. Atlas of the Oceans. Southern Ocean. RF Ministry of Defense (in press).

Table 2.1

Linear trend parameters of the monthly surface air temperature averages

Stations	Parameter	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
All period														
Novolazarevskaya 1961-2001	°C/10 years	0.15	0.19	0.18	0.20	–0.18	0.39	0.71	–0.02	0.44	0.14	0.10	0.07	0.2
	%	20	25	19	13	10	21	32	1	25	11	11	9	43
	P	–	–	–	–	–	–	95	–	–	–	–	–	99
Mirny 1957-2001	°C/10 years	–0.10	–0.01	–0.09	–0.20	–0.34	0.29	0.16	0.18	0.44	–0.06	–0.08	–0.11	0
	%	22	1	9	3	17	16	8	8	22	4	8	14	0
	P	–	–	–	–	–	–	–	–	–	–	–	–	–
Vostok 1957-2001	°C/10 years	0.11	–0.04	–0.16	–0.14	–0.40	0.00	0.16	0.15	–0.19	–0.27	0.38	0.41	–0.01
	%	10	3	10	8	21	0	7	6	8	21.1	33	33	0
	P	–	–	–	–	–	–	–	–	–	–	95	95	–
Bellingshausen 1968-2001	°C/10 years	0.40	0.23	0.31	0.32	0.80	0.94	0.43	0.78	–0.13	0.01	0.08	0.11	0.36
	%	60	27	36	23	36	42	14	33	8	1.2	11	20	45
	P	99	–	95	–	95	99	–	95	–	–	–	–	99
1992-2001														
Novolazarevskaya	°C/10years	–0.48	–0.62	–2.45	–1.73	–0.96	1.08	–0.62	–1.06	–0.01	–3.21	0.43	–1.18	–0.89
	%	28	22	54	26	14	19	8	21	0	53	21	39	51
	P	–	–	–	–	–	–	–	–	–	–	–	–	–
Mirny	°C/10years	–0.81	–1.64	–0.05	1.82	3.41	–0.36	3.69	1.00	2.22	–1.07	1.37	1.53	0.91
	%	29	50	2	32	54	5	44	13	27	24	34	43	39
	p	–	–	–	–	–	–	–	–	–	–	–	–	–
Vostok	°C/10years	–0.70	–0.97	–2.37	–0.52	0.20	1.96	1.46	–1.38	0.15	–2.52	1.71	1.30	–0.13
	%	19	21	60	5	19	32	21	18	2	45	44	23	5
	P	–	–	90	–	–	–	–	–	–	–	–	–	–
Bellingshausen	°C/10years	–0.36	0.44	1.34	0.32	5.78	5.50	2.79	0.51	–2.42	2.30	0.00	–0.49	1.30
	%	23	12	48	8	75	77	34	7	37	54	0	30	63
	P	–	–	–	–	99	99	–	–	–	–	–	–	95

Note: First line is the linear trend coefficient;
Second line - dispersion explained by the linear trend;
Third line - significance level (given if it exceeds 90%, 95% or 99 % confidence intervals).

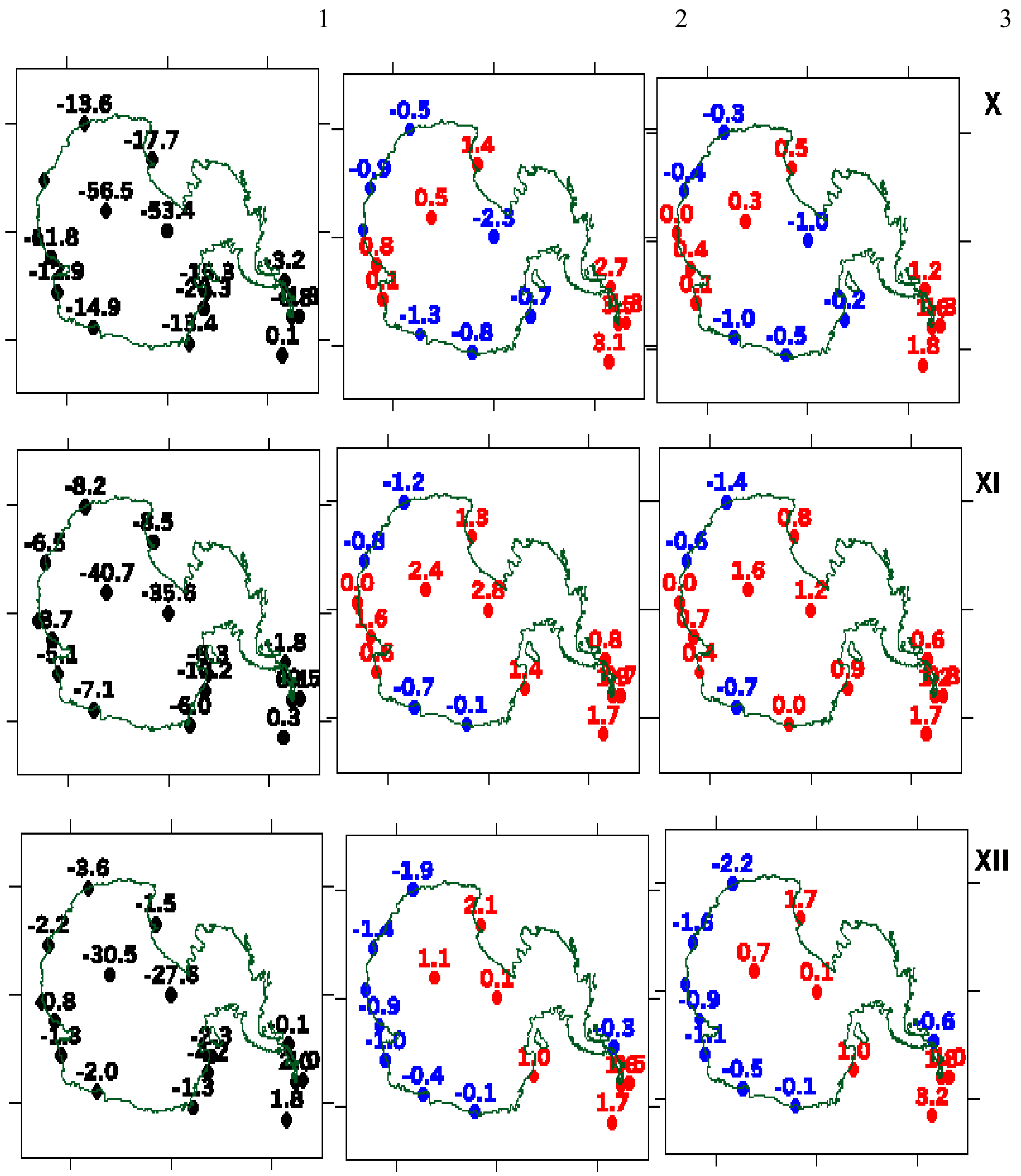


Fig. 2.1. Surface air temperatures (1) and their absolute (2) and normalized (3) anomalies in October (X), November (XI) and December (XII) 2001 based on data of stationary meteorological stations in the Southern Polar Area

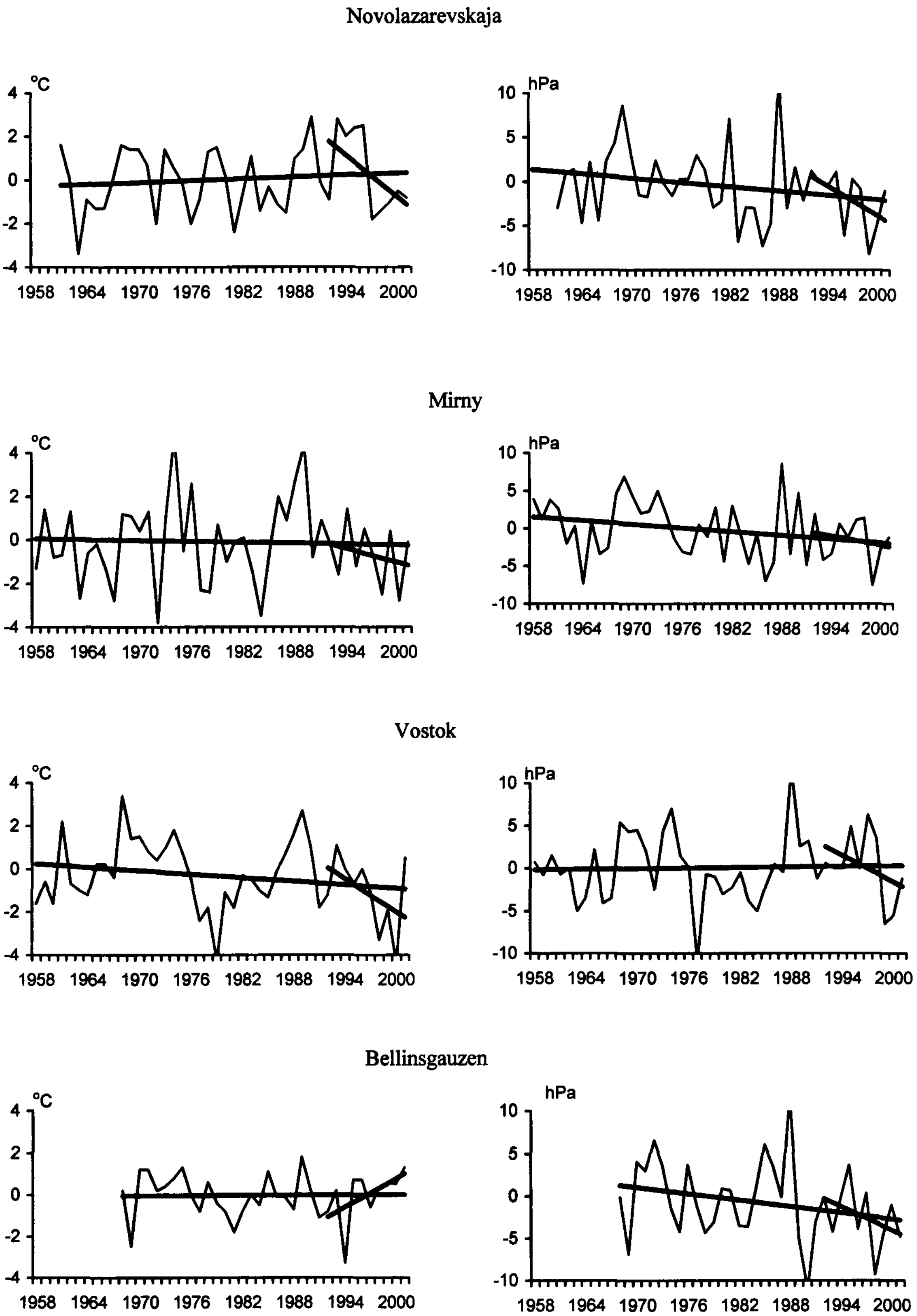


Fig. 2.2. Interannual variations of air temperature and atmospheric pressure anomalies at the Russian Antarctic stations. October.

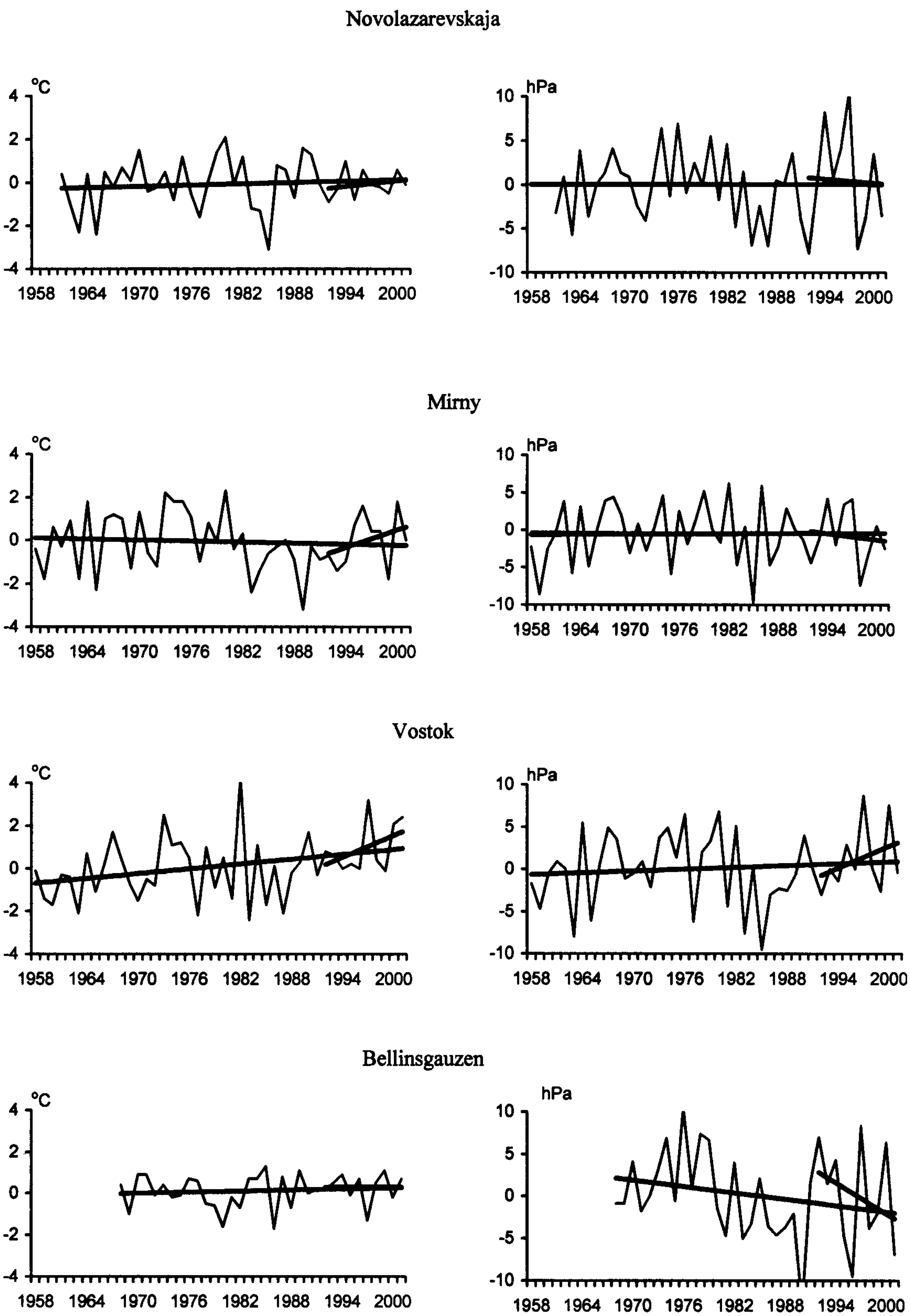


Fig. 2.3. Interannual variations of air temperature and atmospheric pressure anomalies at the Russian Antarctic stations. November.

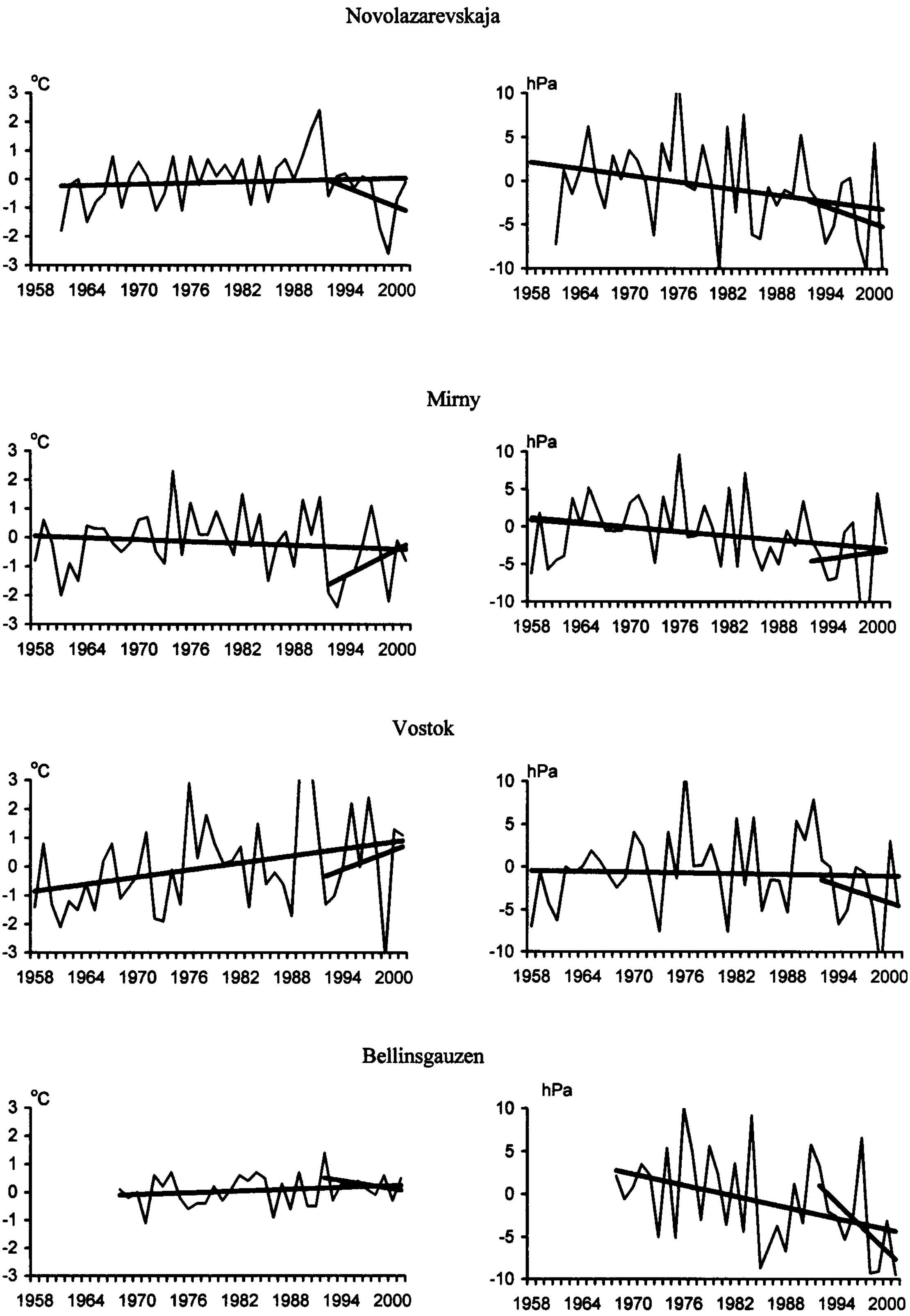


Fig. 2.4. Interannual variations of air temperature and atmospheric pressure anomalies at the Russian Antarctic stations. December.

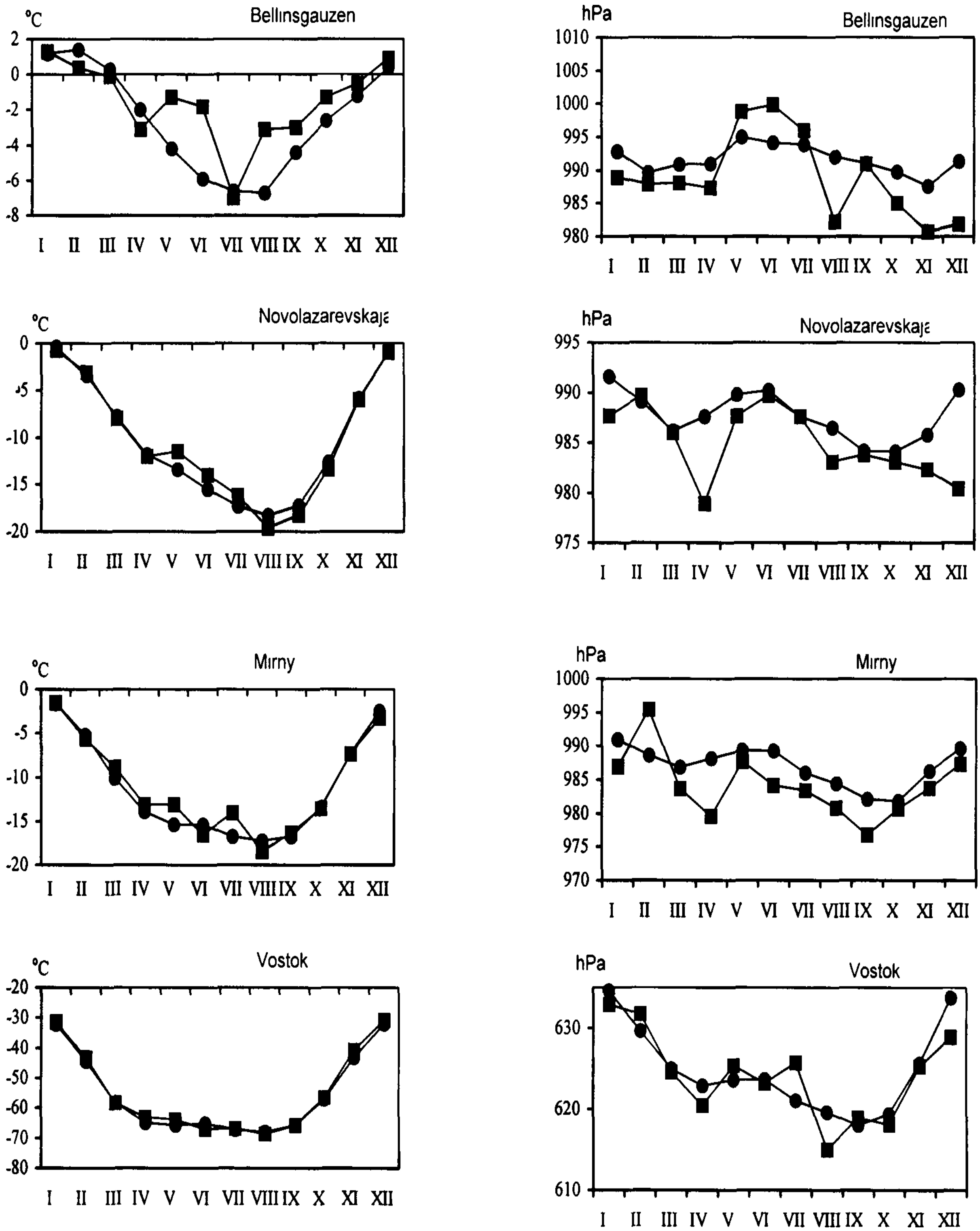


Fig. 2.5. Annual variations of air temperature and atmospheric pressure anomalies at the Russian Antarctic stations.

■-2001 , ●- 1961-1990

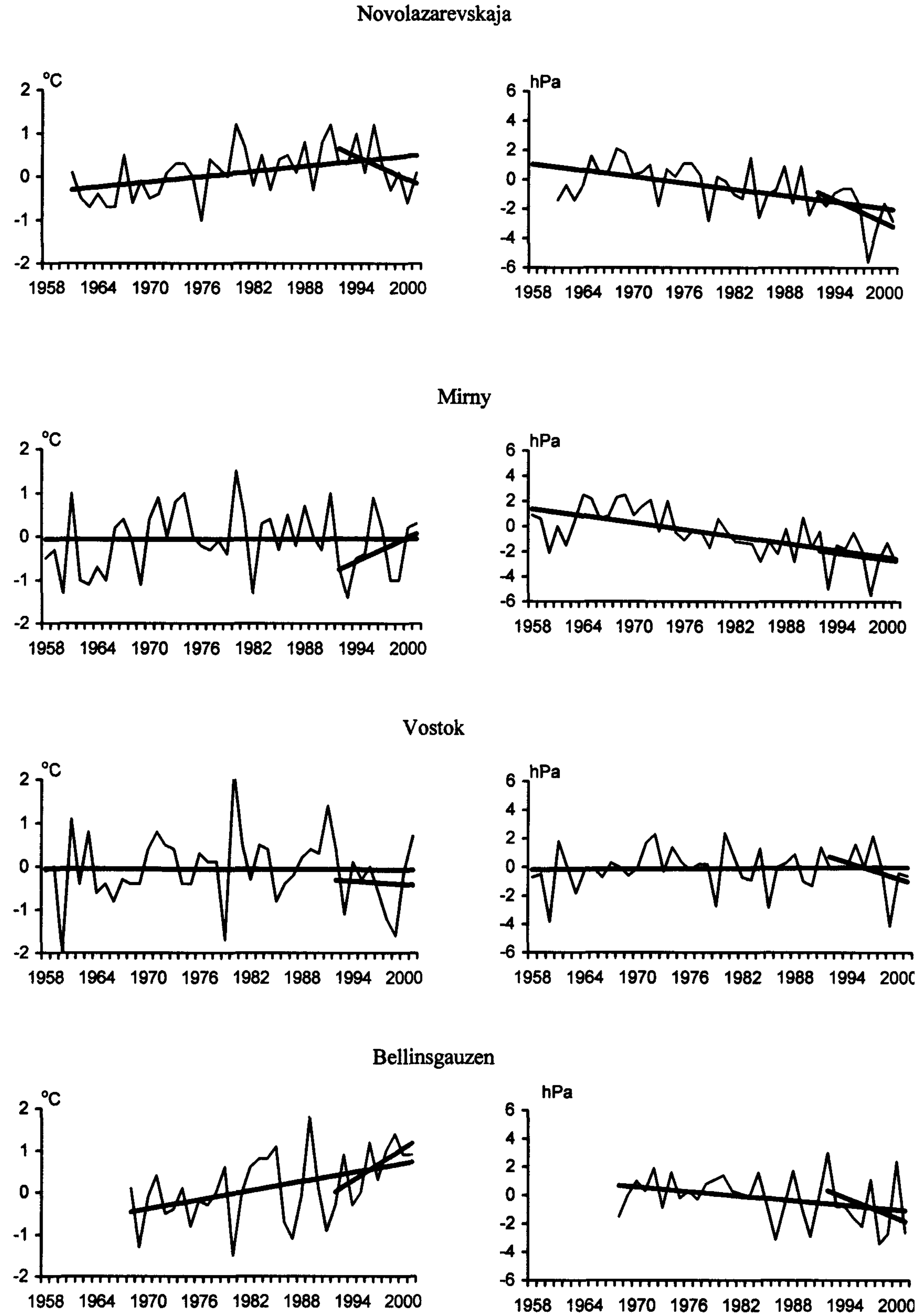


Fig. 2.6. Interannual variations of air temperature and atmospheric pressure anomalies at the Russian Antarctic stations.

Year.

3. ATMOSPHERIC PROCESSES ABOVE THE ANTARCTIC IN OCTOBER-DECEMBER 2001

The atmospheric circulation in the Southern Hemisphere in the first half of October 2001 was characterized by predominantly zonal processes. In the second half of the month, the circulation regime was determined by the blocking high-pressure ridges whose axes were slowly moving eastward.

The cyclones that exited along the western trajectories of pressure ridges towards the Antarctic coast caused long-term periods of storm weather, especially in the Mirny Observatory area where a storm easterly wind was observed on October 17 with an average speed of 33 – 37 m/s and gusts up to 42 m/s at strong drifting snow and visibility of less than 50 m. In the other cases, the easterly wind speed was 29 to 32 m/s and 37 m/s at gusts.

Table 3.1

Frequency of occurrence of the atmospheric circulation forms in the Southern Hemisphere and their anomalies in October-December 2001

Month	Frequency of occurrence (days)			Anomalies (days)		
	Z	M_a	M_b	Z	M_a	M_b
October	12	12	7	0	0	0
November	16	5	9	4	-6	2
December	14	6	11	1	-5	4

The most significant activity of cyclones was noted in the central Atlantic, Madagascar and New Zealand branches of the trajectories. The frequency of occurrence of zonal (Z) and meridional M_a forms [1] was the same (Table 3.1). The pressure and temperature anomalies were small and only in the Drake Passage area the surface pressure was significantly less than a multiyear average as a result of active cyclonic activity.

In the first half of November, the dominance of active meridional processes was preserved in the eastern West Antarctic area. Deep cyclones exited along the South American and Falkland trajectories to the Antarctic Peninsula and the Weddell Sea maintaining the storm conditions in these areas for a long time.

The second half of November, especially in the East Antarctic was distinguished by the developed zonal processes significantly displaced to high latitudes.

In December along with a large frequency of occurrence of zonal circulation, there were also the meridional processes of the M_b form that were characterized by the development of blocking ridges above the Indian sector of the Southern Ocean, which typically spread far to the south and combined with the Antarctic High [1]. As a result, the conditions for the formation of two centers of a negative surface pressure anomaly in the area of the Bellingshausen and Novolazarevskaya stations were created. Whereas the increased activity of cyclones in the Pacific Ocean branch of the trajectories produced the main influence on the formation of the former, the latter center was also generated due to the dominating zonal processes at high latitudes.

According to data of upper-air sounding in Mirny Observatory, the minimum tropopause temperature in December gradually increased from -75 to -66^{0}C.

The maximum tropopause height at this time was recorded in November (13.5 km) and the minimum in December (6.2 km). The greatest frequency of occurrence of jet currents was noted in December (11 days). The maximum wind speed in December was 59 m/s. The stratospheric vortex parameters had a character close to a multiyear average.

In general, the year 2001 is characterized by a slightly increased frequency of occurrence of zonal circulation. Another important feature was an unusually increased frequency of occurrence of the processes of the meridional M_b form that was higher than a multiyear average for more than half a year from June to December (except for October).

References:

1. Dydina L.A., Rabtsevich S.V., Ryzhakov L.Yu., Savitsky G.B. Atmospheric circulation forms in the Southern Hemisphere. – AARI Proceedings, 1976, V. 330, p. 5-16.

4. BRIEF REVIEW OF ICE PROCESSES IN THE SOUTHERN OCEAN BASED ON SATELLITE AND COASTAL OBSERVATION DATA AT THE RUSSIAN ANTARCTIC STATIONS IN 2001

The austral summer that has ended in February was again characterized by quite a mixed pattern of ice conditions in the Atlantic and the Indian sectors of the Southern Ocean. It was, to a great extent, directly opposite to the conditions in 2000.

Although the Atlantic ice massif was still distinguished by low mobility, it had a central western location at which its northern boundary was reaching the Antarctic Peninsula tip and the southern - 75^o S (i.e., the massif was pressed offshore from the southern coast of the Weddell Sea), while the eastern boundary passed everywhere along 40^o W. An anomalously increased development of the Prydz Bay polynya has determined complete ice clearance not only of the entire Commonwealth Sea, but also a minimum possible ice cover extent of the adjoining eastern half of the Cosmonauts Sea (Table 4.1). A similar anomalously early and rapid decay of the local landfast ice during the second half of January – first half of February has contributed to the latter. The landfast ice breakup in the vicinity of Progress Base also was of the same character (Table 4.2).

On the contrary, the drifting ice belt was preserved in the Davis, Mawson and western Cosmonauts Sea. Although it was not greater than its multiyear average size, the ice was not open having a maximum concentration of 10 tenths. In March, it has sharply increased due to a late breakup of the preserved large segment of last year fast ice. In this respect, an example of the coastal water area of the Treshnikov Bay in the vicinity of Mirny Observatory is quite illustrative where the final landfast ice decay and its export occurred about half a month later compared to mean multiyear dates.

The Balleny ice massif occupied the extreme western position and from its northern periphery, located near 65^o S, ice was constantly extending in the western direction. This ice band with an average width of about 30 miles hindered the usual ice clearance in January-February of the main area of the Dumont D'Urville Sea.

Autumn ice formation beginning everywhere in March was quite slack. As a result, in spite of the reconstruction by April of a solid circumpolar belt of drifting ice, its width was minimum and ice with a thickness of not more than 30 cm predominated. In the water area near Mirny Observatory, its establishment due to frequent landfast breakup continued for a month until April 24.

On the contrary near Progress station, landfast ice 30 km wide has already formed by 25 March achieving a thickness of 60 cm by the end of April (Table 4.3).

In May, a dramatic expansion of the ice belt was observed with its size sharply increasing to a multiyear average. However, in winter, the ice cover development, especially in the Indian sector, has again become slower. In September, its edge was located more southward than usually by 2^o of latitude, on average.

The primary cause of the decreased ice cover extent is probably a low intensity of the atmospheric processes observed during the entire period July to September. This has governed a significant attenuation in the indicated sectors of the main export branches of ice advection that provide for its spreading over the oceanic area north of 65^o S.

Thus, from mid-July, the export of thick second-year ice from the Atlantic massif core northward to the Scotia Sea observed in June has completely stopped. That is why, the exceptionally easy ice conditions by the type of warm winters beginning from 1996 were again formed here. In particular, the duration of the ice period in the area of Bellingshausen Base (the South Shetland Islands) similar to the previous year was only about 2.5 months.

The character of winter synoptic conditions of low activity has influenced in quite a peculiar way the regional weather and ice conditions. This can be illustrated by the Mirny Observatory area where in July, for example, fog was observed for many hours while the intensity of growth of landfast ice with a relatively thin snow cover was anomalously low throughout the entire winter (Table 4.4). In October, the cyclonic activity has sharply increased determining intense diverging and melting of the ice belt especially in its marginal zones. Thus, as early as November, a significantly decreased ice cover extent of the Scotia and Davis Seas was observed (Fig. 4.1). In December, a prolonged persistence of unusually displaced to high latitudes zonal atmospheric processes has formed an exceptionally rare ice situation in the Atlantic sector. The massif in the Weddell Sea occupied its southernmost position being pressed to the coast. The ice edge everywhere including the Antarctic Peninsula area has retreated on average to 67^o S. In the Lazarev, Riiser-Larsen and Cosmonauts Sea it was located near 65^o S.

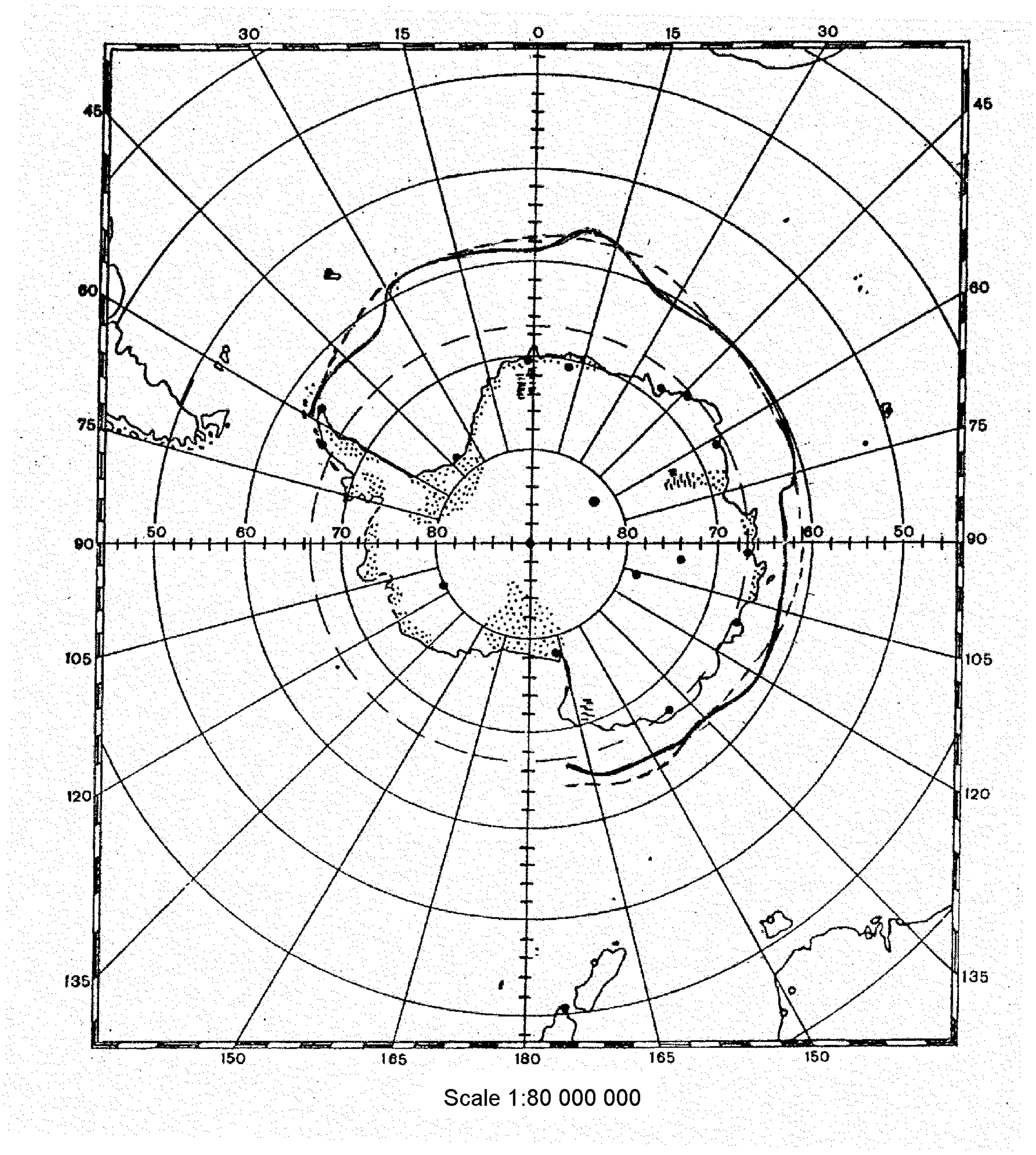


Fig. 4.1. Actual and mean multiyear location of the external, northern drifting ice edge in the Southern Ocean in May 2001.

Conventional designations:

——— Actual

- - - - - Multiyear average

Table 4.1

Latitudinal location of the external northern drifting ice edge in the Southern Ocean based on satellite data of Novolazarevskaya and Mirny stations in 2001

Meridians	February		May		September		November	
	Actual	Multiyear average	Actual	Multiyear average	Actual	Multiyear average	Actual	Multiyear average
60º W			64.2[1] S	63.1 S			63.2 S	63.2 S
50º W			62.0 S	60.5 S			62.0 S	62.0 S
40º W	67.8 S	69.3 S	61.0 S	61.2 S	59.0 S	58.1 S	62.2 S	60.1 S
30º W	76.0 S	73.1 S	61.4 S	62.6 S	57.5 S	57.0 S	59.6 S	58.4 S
20º W	71.6 S	72.5 S	62.0 S	64.6 S	56.9 S	56.9 S	58.2 S	58.5 S
10º W	69.6 S	70.4 S	66.0 S	66.2 S	-	56.6 S	58.5 S	58.1 S
0º	69.2 S	69.3 S	66.8 S	66.8 S	55.8 S	55.9 S	58.6 S	57.8 S
10º E	69.6 S	69.3 S	67.0 S	66.3 S	57.7 S	55.3 S	56.6 S	57.6 S
20º E	69.4 S	69.1 S	67.0 S	66.2 S	59.2 S	56.6 S	58.8 S	57.6 S
30º E	68.9 S	60.5 S	67.0 S	66.4 S	59.4 S	58.7 S	60.6 S	59.0 S
40º E	67.6 S	67.8 S	66.1 S	66.2 S	61.0 S	59.1 S	59.9 S	60.0 S
50º E	67.0 S	66.3 S	65.0 S	64.8 S	62.1 S	59.1 S	60.2 S	60.2 S
60º E	67.4[1] S	66.8 S	63.9 S	63.6 S	61.6 S	59.3 S	60.0 S	60.5 S
70º E	68.4[1] S	67.3 S	63.4 S	63.0 S	61.3 S	59.1 S	60.7 S	60.8 S
80º E	66.4 S	66.0 S	63.4 S	63.4 S	61.9 S	58.3 S	63.0 S	61.0 S
90º E	65.5 S	65.5 S	63.6 S	63.3 S	61.3 S	59.5 S	62.8 S	61.3 S
100º E	64.1 S	64.4 S	63.0 S	62.9 S	61.1 S	59.9 S	62.7 S	61.3 S
110º E	65.5 S	65.4 S	64.8 S	63.5 S	63.2 S	60.6 S	62.3 S	62.3 S
120º E	65.6 S	65.6 S	65.0 S	63.8 S	64.2 S	61.3 S	62.1 S	63.1 S
130º E	65.3 S	65.4 S	64.0 S	64.0 S	63.9 S	61.9 S	636.6 S	63.5 S
140º E	65.9 S	66.5 S	64.1 S	63.9 S	64.3 S	62.3 S	63.3 S	63.5 S
150º E	65.0 S	65.4 S	63.0 S	63.6 S			64.2 S	63.3 S
160º E	67.2 S	67.5 S					64.0 S	63.2 S
170º E	71.1 S	71.1 S					66.0 S	63.9 S

Note: [1] – clear, no ice – instead of the ice edge position, latitude of the Antarctic coast point is given at its crossover with the corresponding meridian.

Table 4.2

Dates of the main ice phases in the areas of Russian Antarctic stations in 2001

Station (water body)		Landfast ice breakup		Ice clearance		Ice formation		Landfast ice formation		Freeze up	
		Start	End	First	Final	First	Stable	First	Stable	First	Final
Mirny	Actual	21.12.2000	20.02	03.03	NO	10.03	10.03	23.03	07.04	17.04	24.04
	Multiyear average	23.12	05.02	12.02	NO	11.03	12.03	30.03	02.04	14.04	17.04
Progress (Vostochnaya Bay)	Actual	27.12.2000	31.12.2000	22.01	NO	07.02	07.02	27.02	27.02	25.03	25.03
	Multiyear average	30.12	13.01	NO	NO	16.02	17.02	06.03	08.03	26.03	26.03
Bellingshausen (Ardley Bay)	Actual	23.07	08.08	08.08	10.09	22.06	22.06	23.06	NO	24.06	NO
	Multiyear average	10.09	09.10	12.10	05.11	09.05	08.06	11.06	13.06	03.07	07.07

Note: NO – phenomenon not observed

Table 4.3

Landfast ice thickness (cm) in the areas of Russian Antarctic stations from data of profile measurements in 2001

Station		Months											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mirny	Actual					50	72	82	102	113	125	132	121
	Multiyear average				46	67	84	101	119	137	152	156	149
Progress	Actual[1]			40	61								

Note: [1] – from data of measurements at a permanent point

Table 4.4

Snow depth on landfast ice (cm) in the areas of Russian Antarctic stations from data of profile measurements in 2001

Station		Months											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Mirny	Actual					8	9	13	12	13	11	14	23
Progress	Actual[1]			0	24								

Note: [1] – from data of measurements at a permanent point

5. RESULTS OF TOTAL OZONE MEASUREMENTS AT THE RUSSIAN ANTARCTIC STATIONS IN 2001

In 2001, total ozone (TO) was measured using ozonometer M-124 at Mirny, Vostok and Novolazarevskaya stations. Annual variations of daily TO values at these stations are presented in Fig. 5.1. It is noted that data of Novolazarevskaya station require additional analysis, which is possible only after the return of the expedition. These data are however given to show a tendency of TO change at the indicated station.

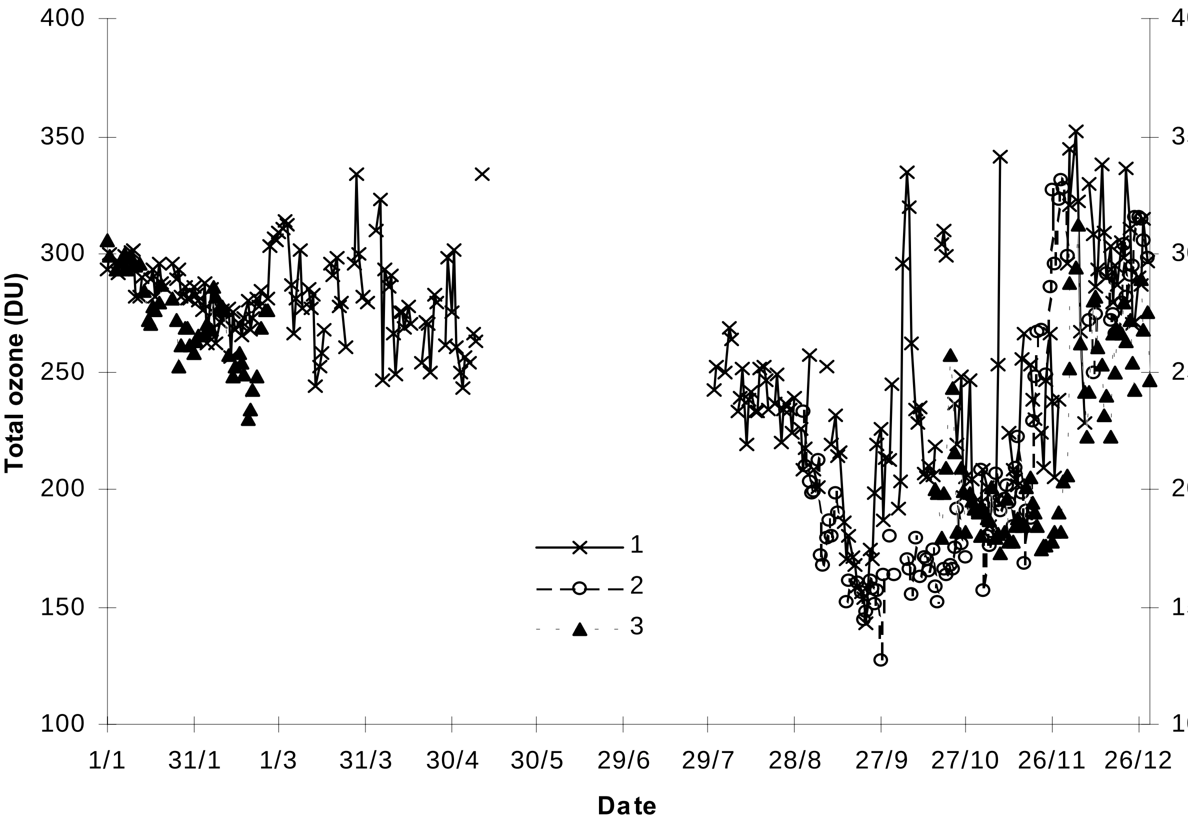


Fig. 5.1. Daily TO averages at Mirny (1), Vostok (2) and Novolazarevskaya (3) stations in 2001

The day-from-day variability of daily TO averages at Mirny is greater than at Vostok and Novolazarevskaya stations, especially in spring during the period of the winter stratospheric vortex decay, which is attributed to the geographic location of these stations relative to the circumpolar vortex center.

During the polar night (Fig. 5.1), the total ozone in Mirny has decreased insignificantly from 270 Dobson units in May to 240 Dobson units in August with daily averages not lower than 219 Dobson units. In general, the TO was steady, which can be probably explained by weak intensity of the atmospheric processes above Antarctica in August. In September, the ozone decrease was observed both in Mirny and at Novolazarevskaya stations. The lowest TO value of 134 Dobson units in the year under consideration in Mirny was recorded on September 23. It is the third in the rank of minimum daily TO averages over the entire time of ozone measurements in Mirny Observatory (with a minimum of 127 Dobson units recorded on September 29, 1994). At Novolazarevskaya station, the daily TO averages at this time of the year were even lower.

At Vostok station, the observations after the end of polar night began only on October 17. In Mirny sharp ozone changes related to the inflow of air masses from the north were observed in October-November. At Novolazarevskaya station in September-middle of November and at Vostok station in October-November the TO was quite stable remaining predominantly not less than 200 Dobson units.

Thus, data of Russian stations indicate the presence of the “ozone hole” above Antarctica in 2001. This is confirmed by satellite data (http..//toms.gsfc.nasa.gov/ozone/ozone.html) presented in Fig. 5.2. One can see that the “ozone hole” covered for a long time a very large area of about 25 million km^2. The decay of the “hole” was rather slow and was completed only in December (see Figs. 5.1 and 5.2).

The monthly TO averages in Mirny throughout almost the entire 2001 remained at a low level typical of the last years (Fig. 5.3). The least monthly TO average in Mirny this year was observed in September and comprised 197 Dobson units, which was the second minimum value in the rank for September in Mirny. In November, the lowest for this month value of 226 Dobson units was recorded, while in February and October – the second minimum values in the rank for these months (276 Dobson units in February and 239 Dobson units in October). The lowest monthly ozone average at Novolazarevskaya station was observed in October. The monthly TO averages at Vostok and Novolazarevskaya station were less than in Mirny practically throughout the entire observation period.

Figure 5.4 presents daily averages of ozone and air temperature in 20 km (a) and 15 km (b) heights for the period January 2000 to December 2001. As expected, the character of temperature change and that of TO change are interrelated. The correlation coefficient of TO with the air temperature in heights of 20 and 15 km is 0.67 and 0.65, respectively.

It is noted in general that according to data of measurements of the Russian Antarctic stations, the total ozone in 2001 remained at the level of the last few years. The lowest daily TO averages at Mirny and Novolazarevskaya stations were observed in late September.

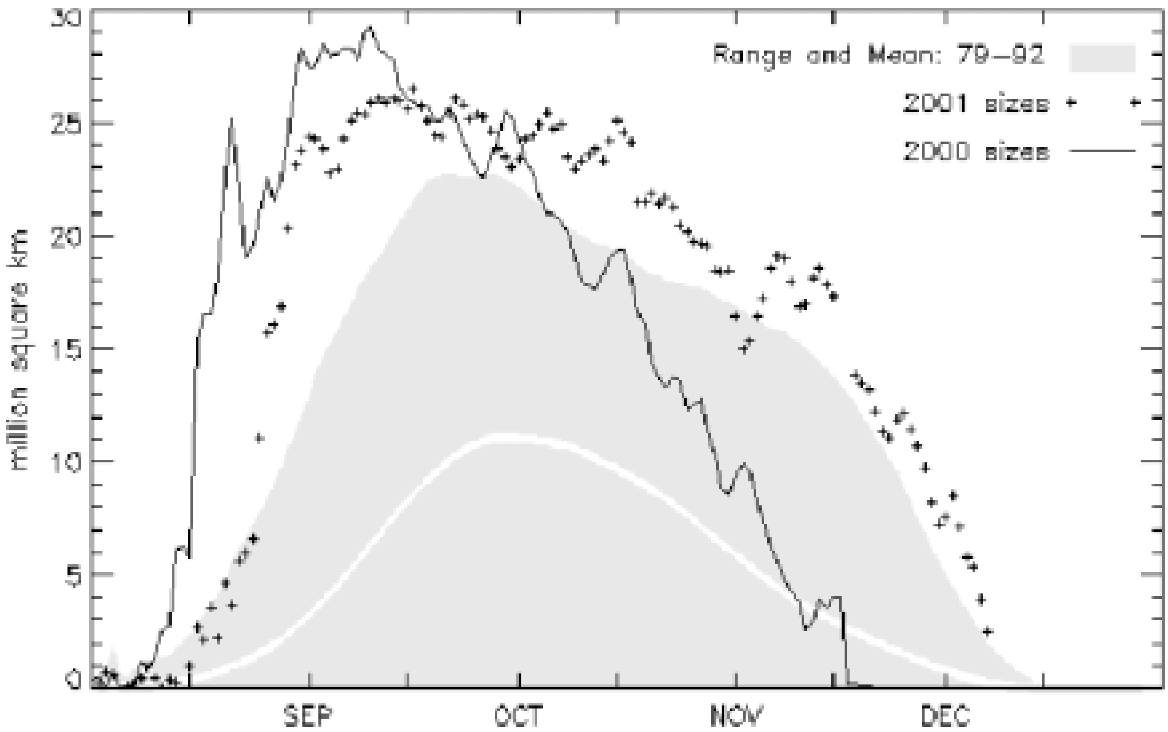


Fig. 5.2. Daily averages of the "ozone hole" area above Antarctica from satellite data in September-December 2001 (http..//toms.gsfc.nasa.gov/ozone/ozone.html)

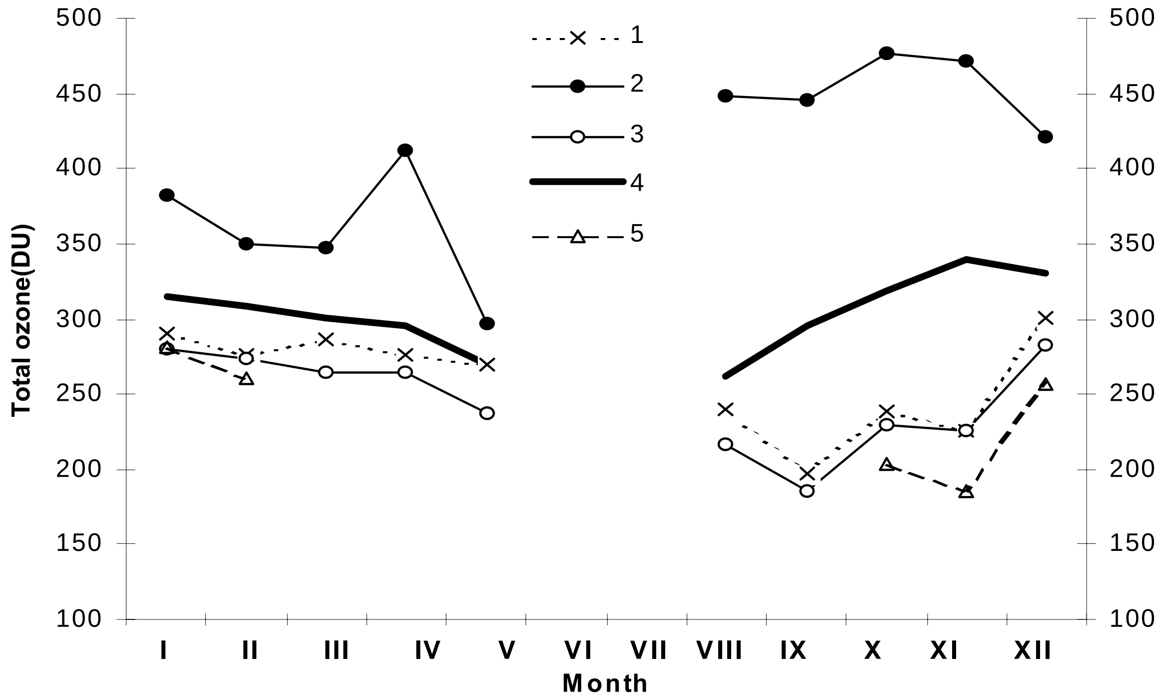


Fig. 5.3. Monthly TO averages at Mirny station in 2001 (1), monthly TO averages at Mirny station in 1975- 2001(2) and minimum (3), maximum (4) and monthly TO averages at Vostok station for 2001 (5)

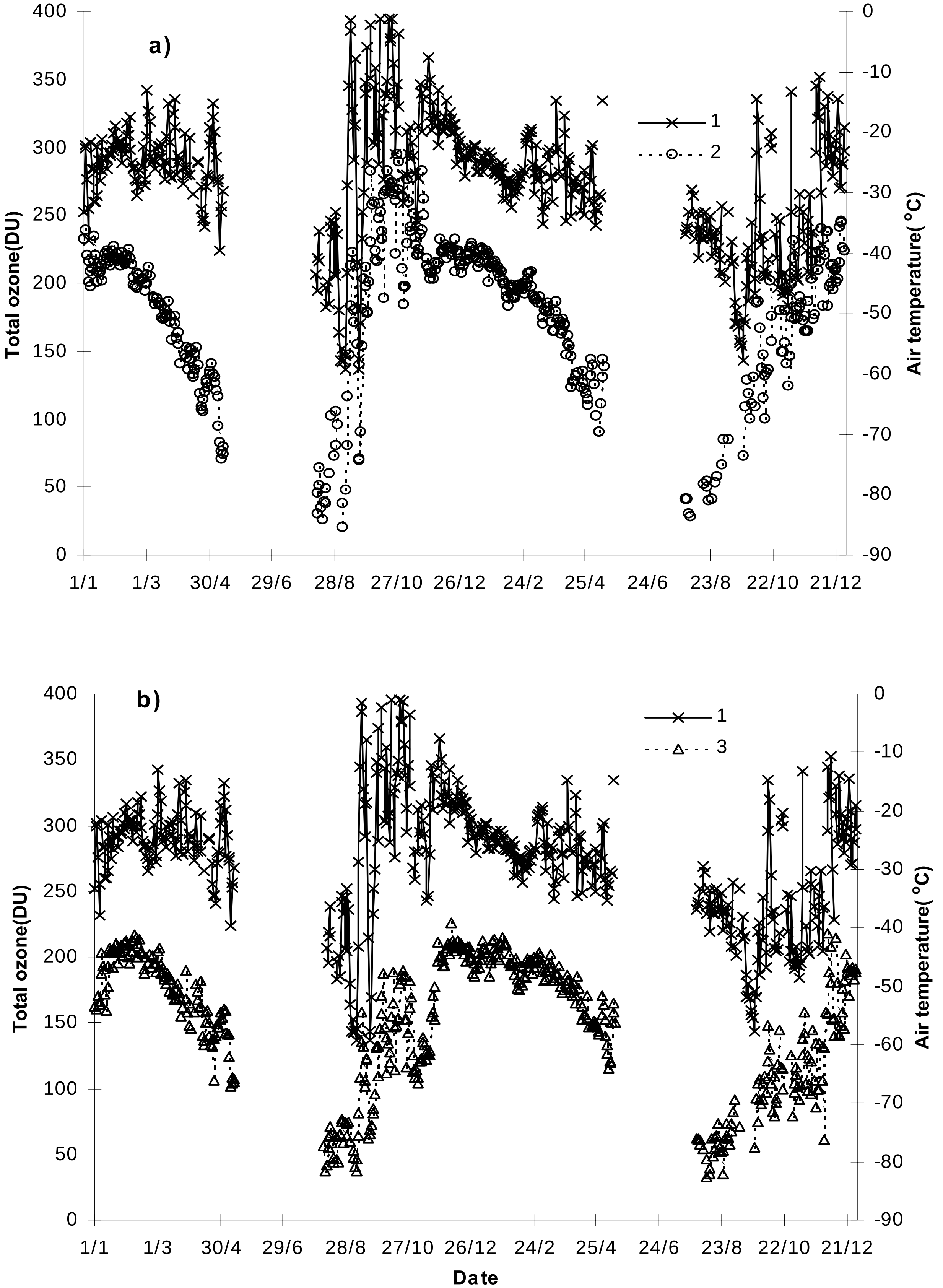


Fig. 5.4 Daily TO (1) and air temperature averages at a height of 20 km (2) and 15 km (3) at Mirny station for the period January 2000-December 2001

6. GEOPHYSICAL OBSERVATIONS AT RUSSIAN ANTARCTIC STATIONS IN OCTOBER – DECEMBER 2001

MIRNY OBSERVATORY

Mean monthly absolute geomagnetic field values

	October	*November*	*December*
Declination	*86°27.7'W*	*86°21.6'W*	*
Horizontal component	*13975 nT*	*13997 nT*	*
Vertical component	*-57520 nT*	*-57500 nT*	*

* Absolute measurements of geomagnetic components were not made in December.

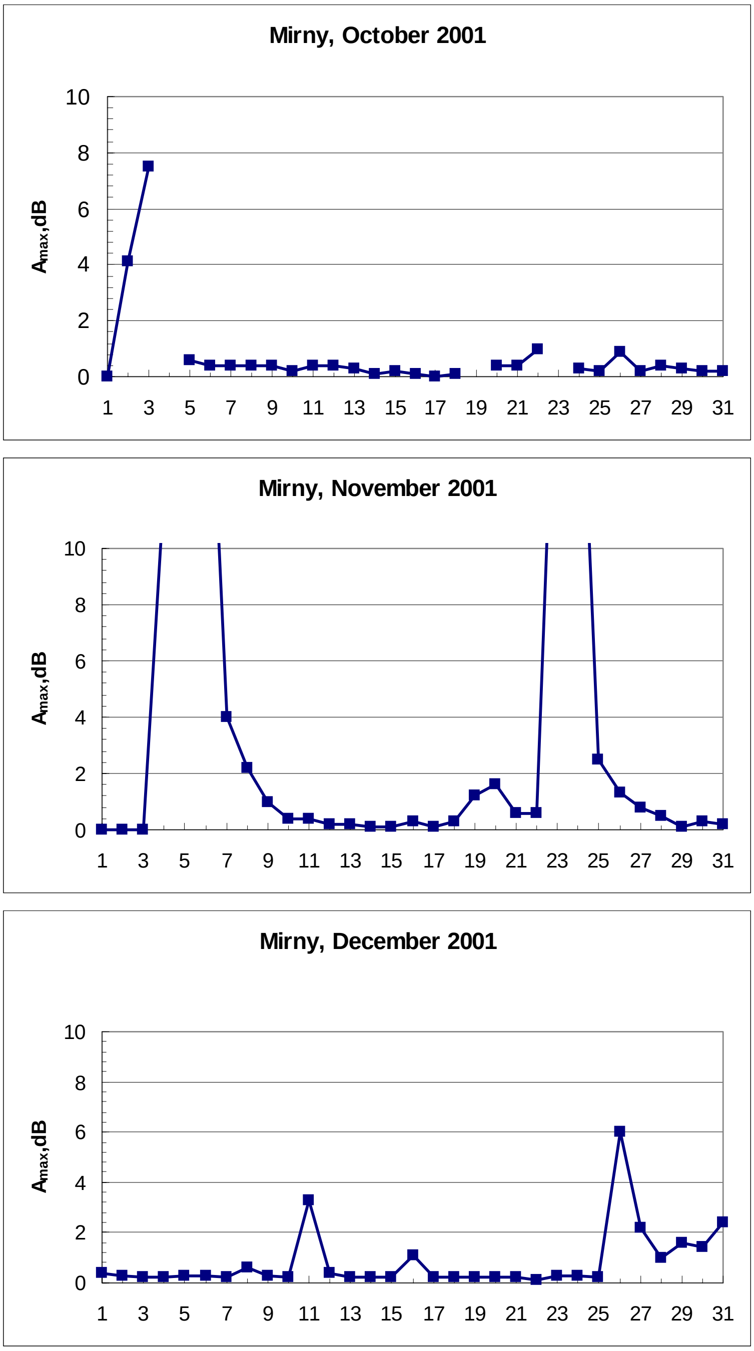
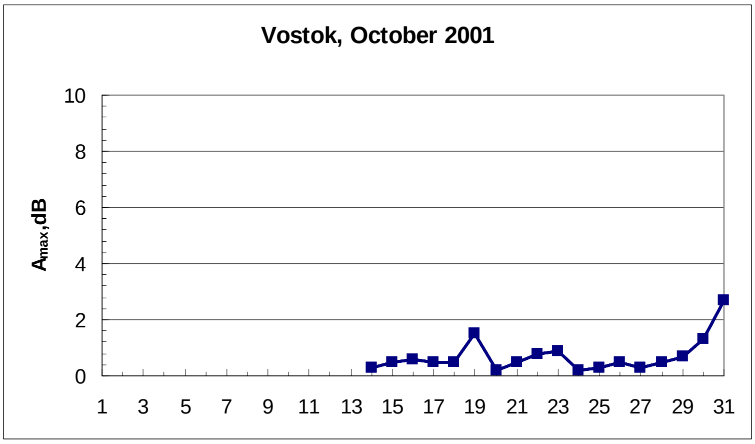


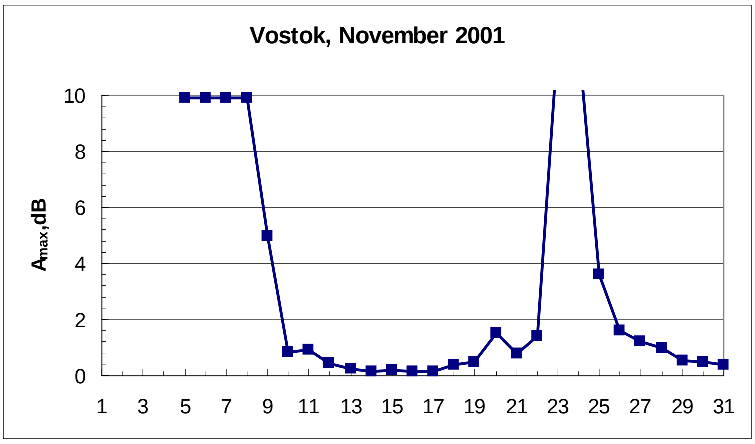
Fig. 6.1. Maximum daily space radio-emission absorption at the 32 MHz frequency from riometer observations in Mirny Observatory.

VOSTOK STATION

Mean monthly absolute geomagnetic field values

	October	*November*	*December*
Declination	*120°55.90'W*	*120°57.37'W*	*120°51.90'W*
Horizontal component	*13413 нT*	*13440 нT*	*13465.8 нT*
Vertical component	*-58162 нT*	*-58123 нT*	*-58107 нT*





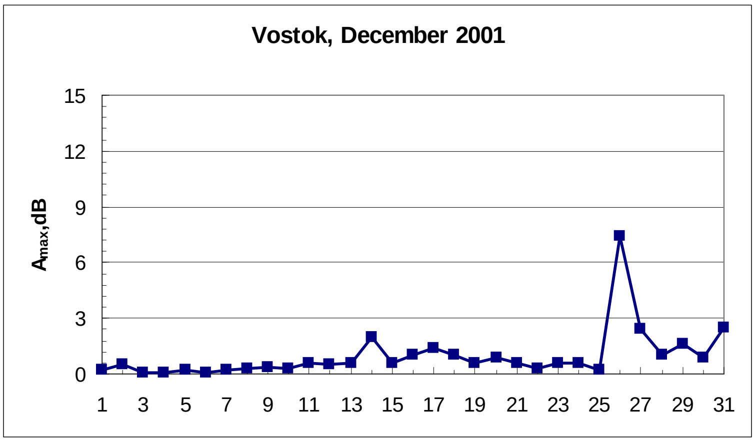


Fig. 6.2. Maximum daily space radio-emission absorption at the 32 MHz frequency from riometer observations at Vostok station.

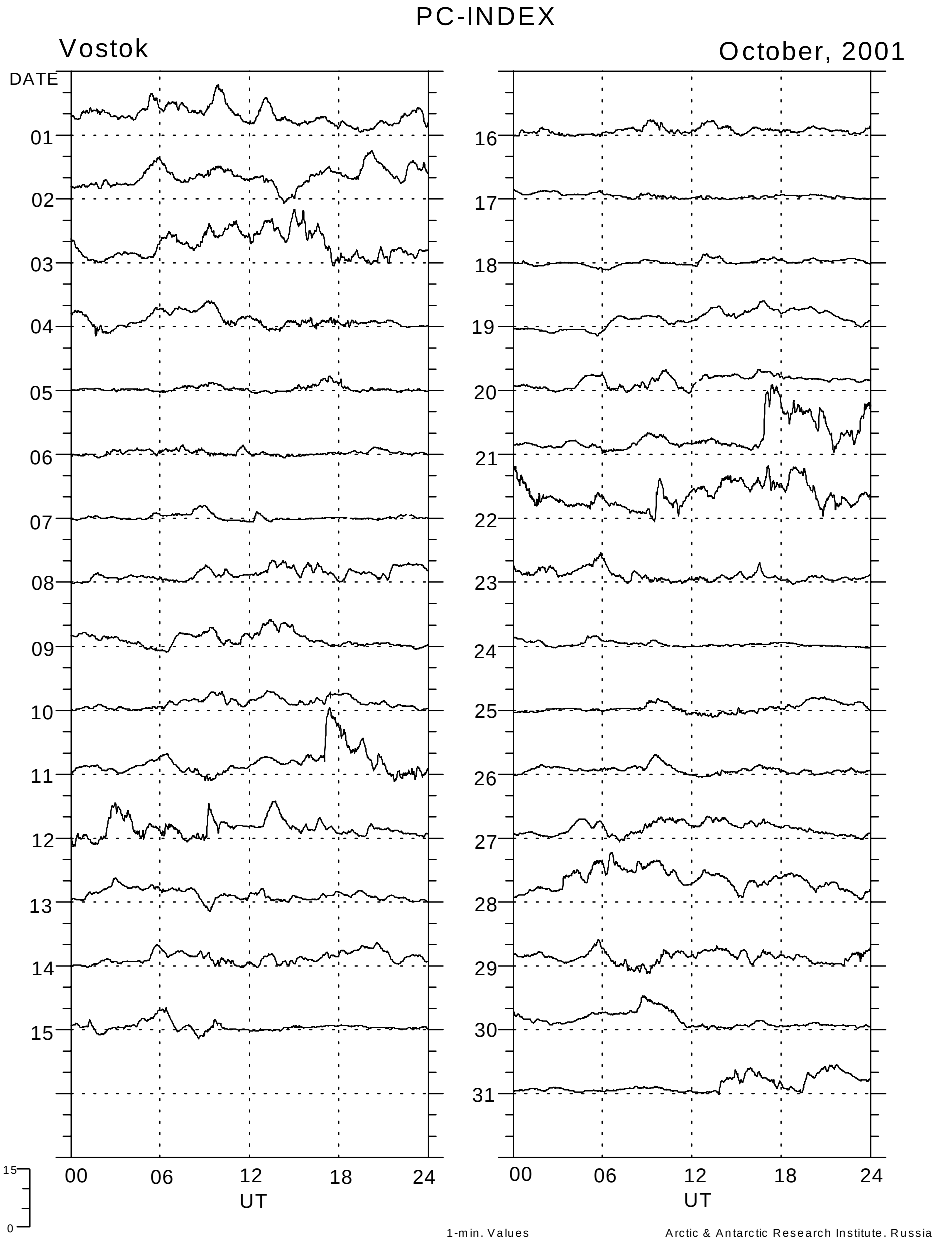

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Fig. 6.3.

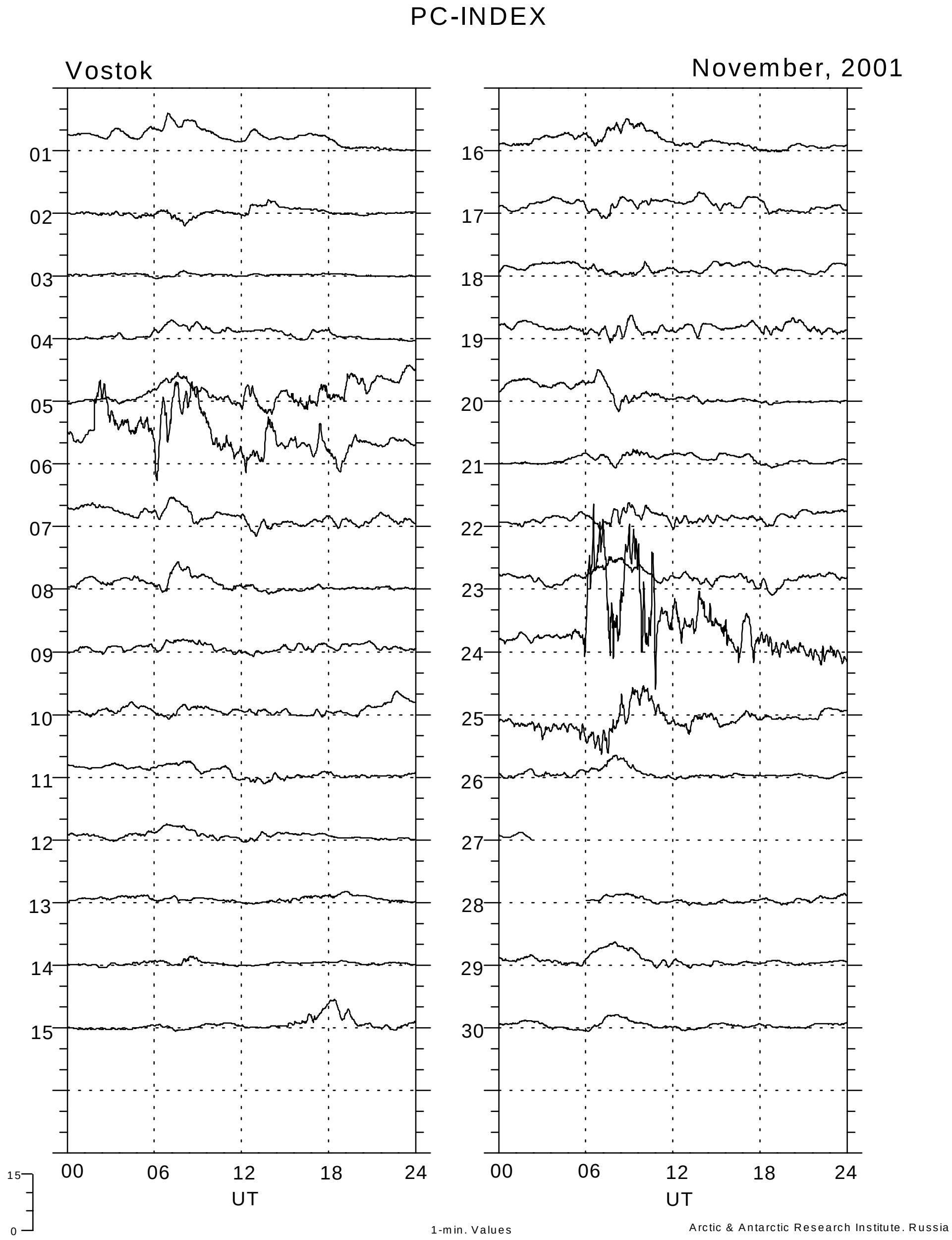
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Fig. 6.4.

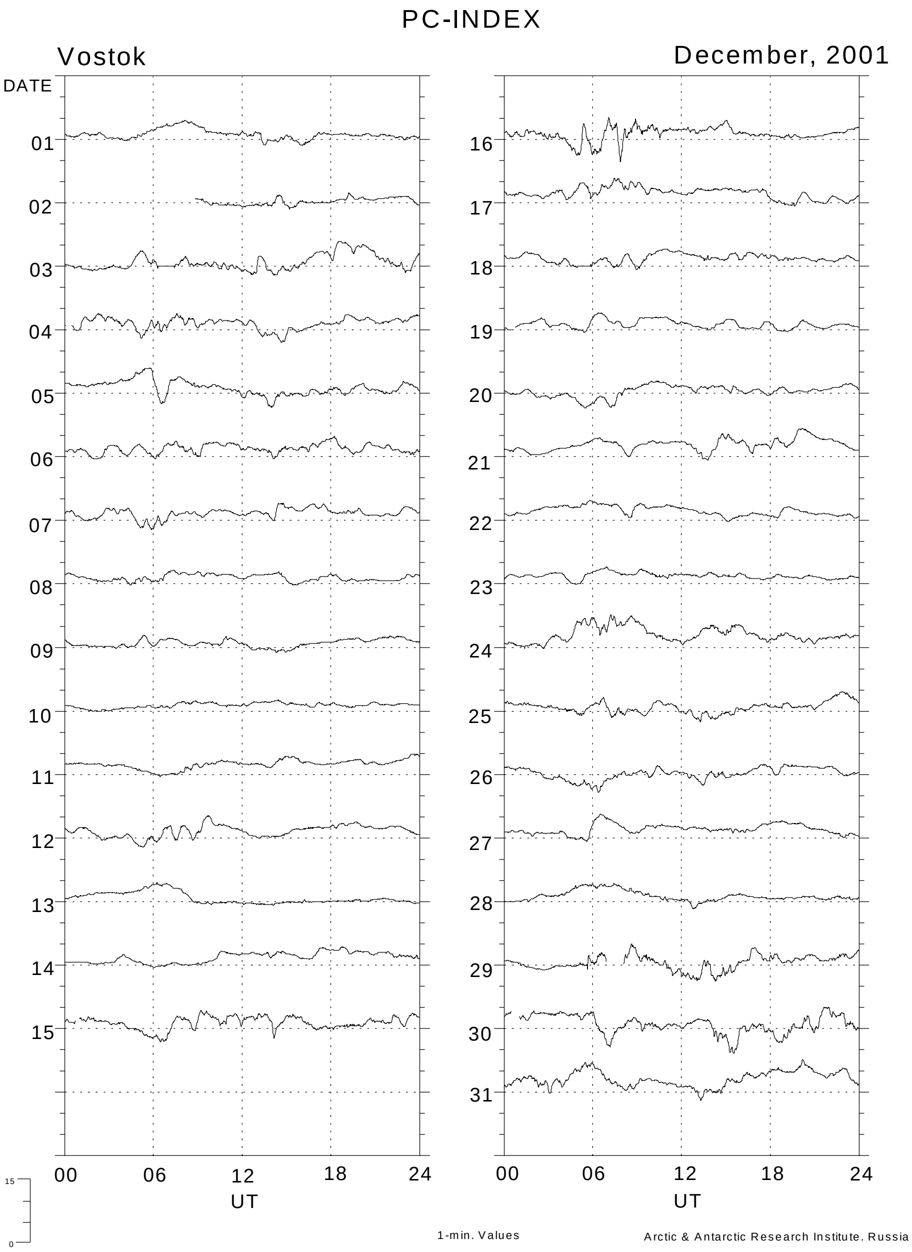
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Fig. 6.5.

Review of the state of the geomagnetic field and ionosphere above Antarctica in 2001

The year 2001 falls on the phase of decreasing solar activity, which is characterized by quite a high magnetic activity. In fact, intense magnetic perturbations were observed on March 1-5, 19-20 and 30-31, April 11-13, August 17, September 25-26, October 1-3, 10-11 and 21-22 and November 4-5, 24-25. The strongest among them were the magnetic storms of March 30-31, April 13, September 25-26 and November 24-25 when the PC-index was greater than 20. An absolute perturbation record in the polar cap (PC≈35) was reached at 16-17 UT on November 24. During the same periods, high-energy solar proton fluxes intruded to the upper atmosphere of the Antarctic. The effects of these intrusions, absorption events in the polar cap (PCA) were recorded by riometers at Mirny and Vostok stations and were accompanied with radio communication failures. The strongest PCA events were observed on March 29-30 (18 dB), August 15-17 (14 dB), September 24-27 and November 22-23 (>10 dB).
January, June and July were the most quite months of 2001 in the geomagnetic respect.

7. EXPERIENCE OF USING ARV TYPE HYDROCHEMICAL PROBES IN STUDY OF WATER BODIES IN THE AREAS OF ANTARCTIC STATIONS

Fomichev N.I.

During the 2000-2001 summer season, hydrochemical monitoring of water systems was undertaken at the Bellingshausen Base. This activity is a continuation of similar studies carried out earlier at the Russian Antarctic Novolazarevskaya and Molodezhnaya stations.

Lake Kitezh as a relatively immobile water medium where the results of the anthropogenic load should be manifested first of all and Ardley Bay, a place impacted by the products of life activity of the coastal stations were defined as study targets. They present different ecosystems of fresh- and seawaters.

During the period November 17, 2000 to February 16, 2001, a complex of measurements of temperature (T^o C), electrical conductivity (χ mCm m^{-1}), Redox potential (Eh mV), dissolved oxygen (O_2 mg/l), concentration of hydrogen ions (pH) and total solar radiation (Q W/m^2) was undertaken using a hydrochemical ARV-99 probe developed by CNII "Granit". As a result, the spatial-temporal series of the main parameters of the water medium of Lake Kitezh and Ardley Bay were obtained whose analysis has allowed an assessment of their variability, character of relations, degree of lake water eutrophication and determination of the representative measurement points in the automated information system (AIS) complex conducting monitoring of the state of lake and sea waters of this region.

The main characteristics of the ARV-99 instrument are described in Table 7.1. As a temperature sensor, a thermistor is used. A sensor of specific electrical conductivity presents a four-electrode cell of open structure in the form of axis-symmetric body. The concentration of hydrogen ions is measured by a two-electrode cell. The indicator-electrode presents a glass electrode whose membrane is made of special lithium-silicate glass with an auxiliary chlorine-silver electrode. The Redox measurement sensor is similar to pH sensor with the only exception that the membrane of the indicator electrode is made of special silicate glass with electronic conductivity. The concentration of oxygen dissolved in water is measured by a polarographic type sensor based on the classic "Clark cell". It presents a two-electrode cell isolated from the external environment by a fluoroplastic membrane consisting of cathode and anode. Measurement of total solar radiation is made by a photometric sensor whose sensitive element is a photo-diode closed by a correcting light filter. Within the cylindrical body, there is energy independent memory of 256 Kb sufficient for recording data of 16 000 readings. The time intervals between readings are set via PC and can vary between 1 to 256 min. The dimensions are 100 x 750 mm with a weight of 8 kg. A total of two probes – ARV-99 No. 1 and ARV-99 No. 2 were tested at Bellingshausen station.

Table 7.1

Main technical characteristics of ARV-99

Medium parameters	T^oC	(χ mCm m^{-1})	pH	Eh B	O_2 mg l^{-1}	Q W/m^2
Measurement range	-2…+35	0.2…100	2…12	-2…+2	0…15	0…30
Accuracy	± 0.1	±3% CMV*	± 0.1	± 0.01	±5% UML**	±5% CMV

* - current measurement value; ** - upper measurement limit.

It is known that hydrochemical sensors have sufficiently large inertia, hence, in addition to instrument calibration the probe was repeatedly tested before the work under the field conditions in order to clear up an optimal time interval for "in situ" readout. As a result of comparison, an optimal time interval of 12 min was determined during which the instrument has to be in the conventional horizon (Fig. 7.1).

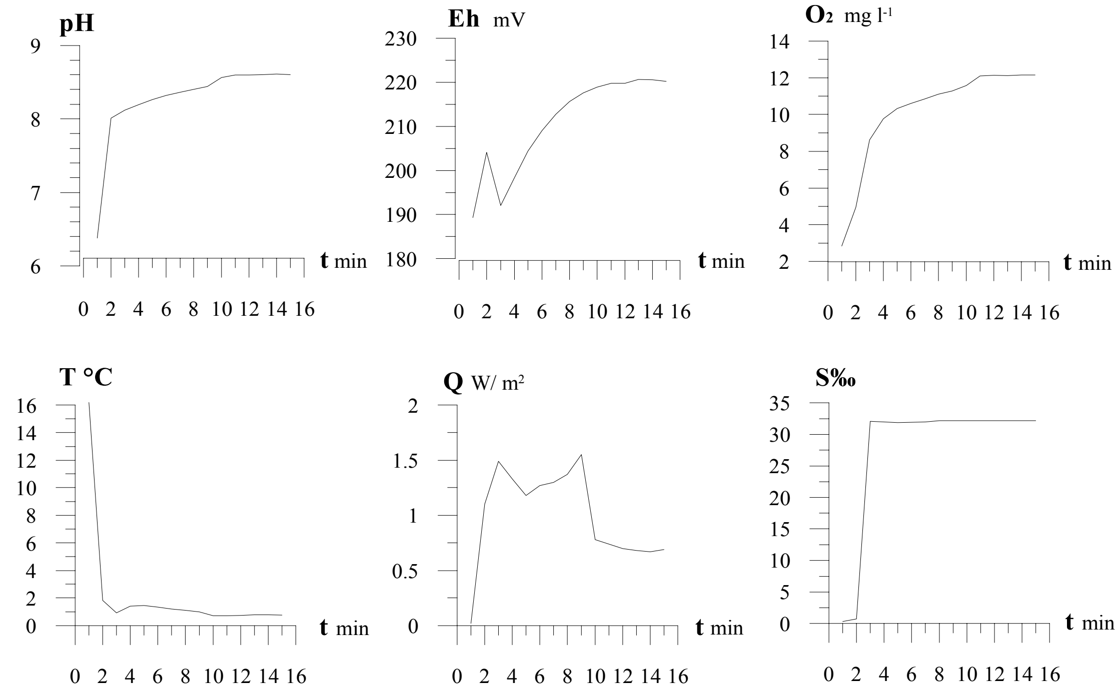


Fig. 7.1. Diagrams of inertia of ARV-99 sensors

Comparative characteristics of both probes have shown good consistency (within technical characteristics) by temperature, salinity and pH.

Table 7.2

Comparative characteristics of the sensors of probes

T°C		S‰		pH		*ΔT°C*	*ΔS‰*	*ΔpH*	*ΔEh B*
№ 1	№ 2	№ 1	№ 2	№ 1	№ 2	№ 1 - № 2			
18.49	18.39	12.82	12.71	7.92	8.09	+0.10	+0.11	-0.17	-0.193
18.73	18.67	12.85	12.73	7.91	8.07	+0.06	+0.12	-0.16	-0.196
18.75	18.74	10.70	10.63	7.92	8.10	+0.01	+0.07	-0.18	-0.199
18.71	18.72	10.72	10.65	7.94	8.11	-0.01	+0.07	-0.17	-0.200
18.60	18.59	10.72	10.67	7.96	8.14	+0.01	+0.05	-0.18	-0.201
18.84	18.84	9.16	9.08	7.96	8.14	0.00	+0.08	-0.18	-0.204
19.46	19.46	9.18	9.10	7.87	8.04	0.00	+0.08	-0.17	-0.216
19.50	19.51	8.04	7.97	7.85	8.02	-0.01	+0.07	-0.17	-0.215
19.52	19.52	8.03	7.96	7.81	7.96	0.00	+0.07	-0.15	-0.216

The difference between readings was not more than 0.12‰ for S‰ and not more than 0.10^{o} C for temperature. Thus, the deviations between readings by temperature and salinity of both instruments are not beyond the range of technical characteristics. The difference in determining the concentration of hydrogen ions was 0.17 pH in general at the instrument accuracy of 0.1 pH value (see Table 7.1). The results of comparison by Eh and O_2 were beyond the range of technical characteristics. Calibration of instruments using the adopted methodologies has revealed unstable operation of the oxygen sensor (ARV-99 probe No.2) and new calibration coefficients were calculated for Eh. The ARV-99 No.1 was assumed to be the main operating instrument. It was used for studies on Lake Kitezh and Ardley Bay and in the Stantsiony stream near the diesel electric station (DES). The ARV-99 probe No. 2 was deployed on mooring in Lake Kitezh for the entire season. In the course of operation the oxygen sensors of both probes have failed. The oxygen sensor on ARV-99 probe No.2 was in operation for only 10 days. This has been revealed after the mooring recovery on February 27, 2001 (87 days in operation) and information reading. The oxygen sensor of the ARV-99 No. 1 was in operation until January 9, 2001.

During the 2000-2001 season, the salinity in Lake Kitezh was not greater than 0.291‰ at an average of 0.153‰. This is a very low mineralizing for its determination using an electrometric method. As is known, the electrical conductivity of water is an additive property summed up of the properties of substances in the solution composition. In metamorphic seawater and land water, a disturbance of the relative content of the main salt-forming ions occurs as compared with “normal water”, which is used for instrument calibration. Even equally saline waters can have different electrical

conductivity due to inequality of their equivalent concentrations. That is why by the water salinity in Lake Kitezh is meant a qualitative change of water properties expressed through electrical conductivity.
The study of Ardley Bay began on November 17, 2000 with two transects (Fig. 7.2). The measurement points were chosen on the navigation chart No. 38903.

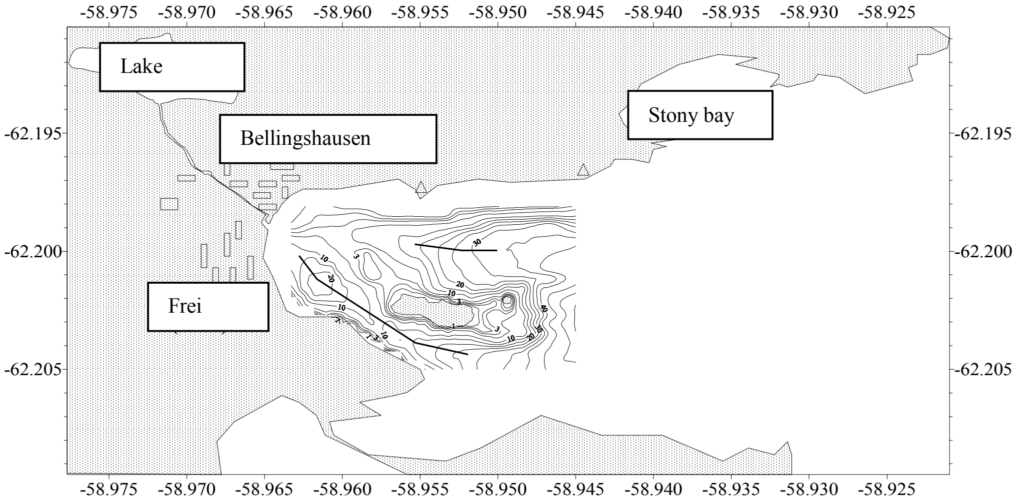


Fig. 7.2. Schematic depiction of transects in Ardley Bay during the 2000-2001season.

A total of 7 stations were made in these transects, with three stations in the first transect and 4 in the second transect. The horizons at the stations were located in 1 m, 5 m and below in accordance with standard horizons and near-bottom.
Due to the absence of reliable positioning (determination of coordinates of hydrological stations) equipment, local orientation marks had to be used at the initial stage, but then buoys were deployed. The transects were made every week using a "Zodiac" boat for going to sea with work performed all day (from 8.30 to 18.00) with a small break for lunch. February 16, 2001 when a submerged mooring was deployed can be considered a date of the end of observations in Ardley Bay in the 2000-2001 season. The sensors were extended in 1 m above the seabed. The location of the probe deployment was determined in terms of the variability of parameters and safety of the probe. There was a real danger of the instrument collision with large iceberg fragments observed at this time in large numbers. The instrument load was connected with a cable that passed along the seabed to Albatros Island and fixed to a large stone. The measurement interval was 180 min (3 hours). The probe was located in the vicinity of station No. 7 (see Fig. 7.2).
The hydrochemical observations in Lake Kitezh began only after the establishment of a strong ice cover on November 29, 2001. The matter is that upon arrival of the seasonal group to the base on November 12, 2000, much melt water and wet snow have accumulated in the lake on the ice and the melt water level was higher than 50 cm. The ice situation was unclear and that is why it was not advisable to exit on the ice. In some time after almost a week of frost weather, secondary ice 18 cm thick has formed on the lake creating a favorable opportunity for work.

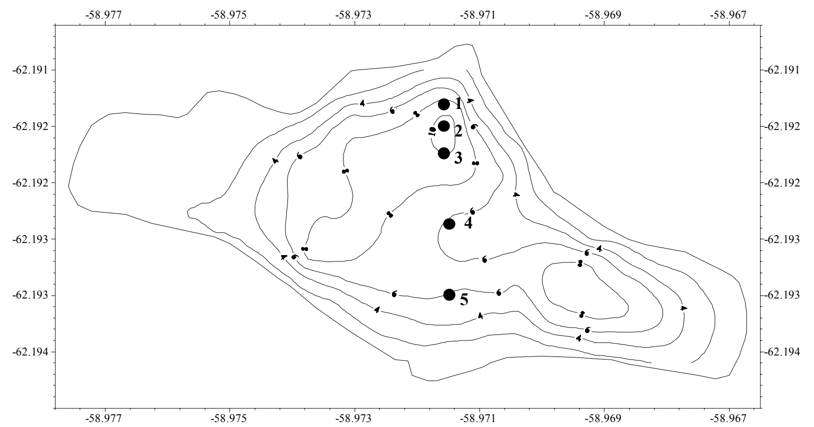


Fig. 7.3. Bathymetry chart and transect location in Lake Kitezh

The transect consisting of four stations was made on November 29, 2000 along the section from the northernmost lake point towards the source of Stantsionny stream approximately over a distance of 330 m (Fig. 7.3). Then, five stations were made on transect (due to the increase of the number of stations in the deepest part of the lake) once a week on Wednesdays. The horizons were located in one meter from the surface to the bottom. The near-bottom horizon was

located not closer than 70 cm from the bottom. The lake depth from the first to the fifth station comprised 8.2 m, 10.3 m, 10 m, 5.8 m and 6 m, respectively. On the first working day, the ice thickness at the first station was 53 cm in the main layer, 18 cm in the upper layer and 10 cm in the intermediate layer between them. Similar ice was observed at the second and third stations (they are located in 25 m from each other). The snow thickness was 5 cm. The fourth point was in the middle of the lake. Ice was solid with a thickness of 57 cm and the snow depth of 5 cm. The ice thickness at the fifth station the nearest to the source of the stream, was 10 cm and 59 cm. Ice was almost completely frozen together (water coming out at the boundary in the process of drilling but without a separate water space) with a snow depth of 9 cm. Ice on the lake was preserved until January 19, 2001. On January 16, 2001 ice occupied slightly more than half the area in the form of three-four fields and was loose (crumbling into large crystals in the form of different prisms at a strike with a ski pole). On the next day after the start of work on Lake Kitezh (November 30, 2000), one of the probes was deployed in a self-contained mode in a 3.5 m horizon at station No. 5 with a measurement interval of 1 h. For readouts the instrument was recovered on February 27, 2001 and deployed again on March 1, 2001 until next summer with a measurement interval of 180 in. The instrument is deployed at station No. 5 in the near-bottom horizon in 1 m from the seabed. A cable was laid from the instrument to the shore. After the end of the season, the second instrument was also deployed in the self-contained mode in Ardley Bay for a year with a measurement interval of 3 hours.

Thus, we hope to collect data that will contribute to our knowledge of the processes occurring not only during the short austral summer, but also the year-round.

8. DISSOLVED OXYGEN CONTENT IN WATER OF LAKE KITEZH DURING THE SUMMER PERIOD 2000-2001

Fomichev N.I.

One of criteria for determining the eutrophication level of the water bodies is a decrease of dissolved oxygen (DO) concentration in the hypolimnion. The results of studies of this and other parameters in Lake Kitezh (Fildes Peninsula, King George Island and South Shetland Islands) in the spring-summer period 2000-2001 are presented below. The dissolved oxygen was determined using a hydrochemical probe with a polarographic type sensor based on a classical "Clark cell".

Quite illustrative appears to be a relative level of dissolved oxygen expressed in percentage in relation to a normal dissolved oxygen level corresponding to the Henri-Dalton law. One can clearly trace a temporal variability of this parameter in transects (Fig. 8.1).

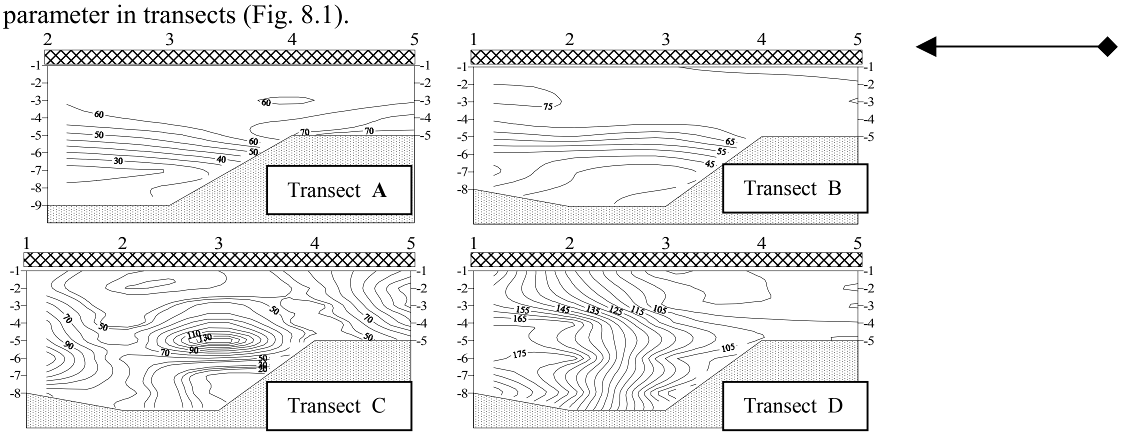


Fig. 8.1. Distribution of dissolved oxygen by transects (in percentage)

Transect A was made on November 29, 2000 (4 stations), transect B – on December 6, 2000 (5 stations), transect C – on December 14, 2000 (5 stations) and transect D – on December 20, 2000 (5 stations).

Transect A characterizes quite clearly the water state after winter stagnation. A low percentage of dissolved oxygen in the entire water column, especially in the local bottom depressions was recorded. Further, an insignificant increase of the relative level of dissolved oxygen (Transect B) in the upper layer occurs. Water aeration by oxygen in the upper layers of the water body is connected in our opinion with the inflow of melt water enriched with oxygen. Mixing occurs only in the upper horizon and only due to the energy of the inflowing jet as the temperature of melted water flowing to Lake Kitezh is about 0^o C, which is lower than the temperature of steadily stratified water of the water body. Due to this, a thermocline is created with lighter inflowing water (having a smaller density) "sliding" in the upper horizon not entraining the lower water layers of the lake.

At the general cooling of lake water (Fig. 8.2) by 0.7^o C, on average, the absolute concentration of dissolved oxygen has significantly increased. The "local bursts" of the increase of dissolved oxygen at transect C can be related to photosynthesizing organisms (their spring activity), especially diatom algae whose population reaches the maximum as a rule in spring. The development of diatom algae is limited by depletion of silicon supplies (the threshold is usually related to 0.5 g/m^3). According to the results /1/, the concentration of silicon in Lake Kitezh is much higher than this threshold. It is noted that the "local bursts" correspond to the places of largest water heating (Fig. 8.2). The values of other parameters (pH and Eh) also change, which characterizes the activity of biochemical processes.

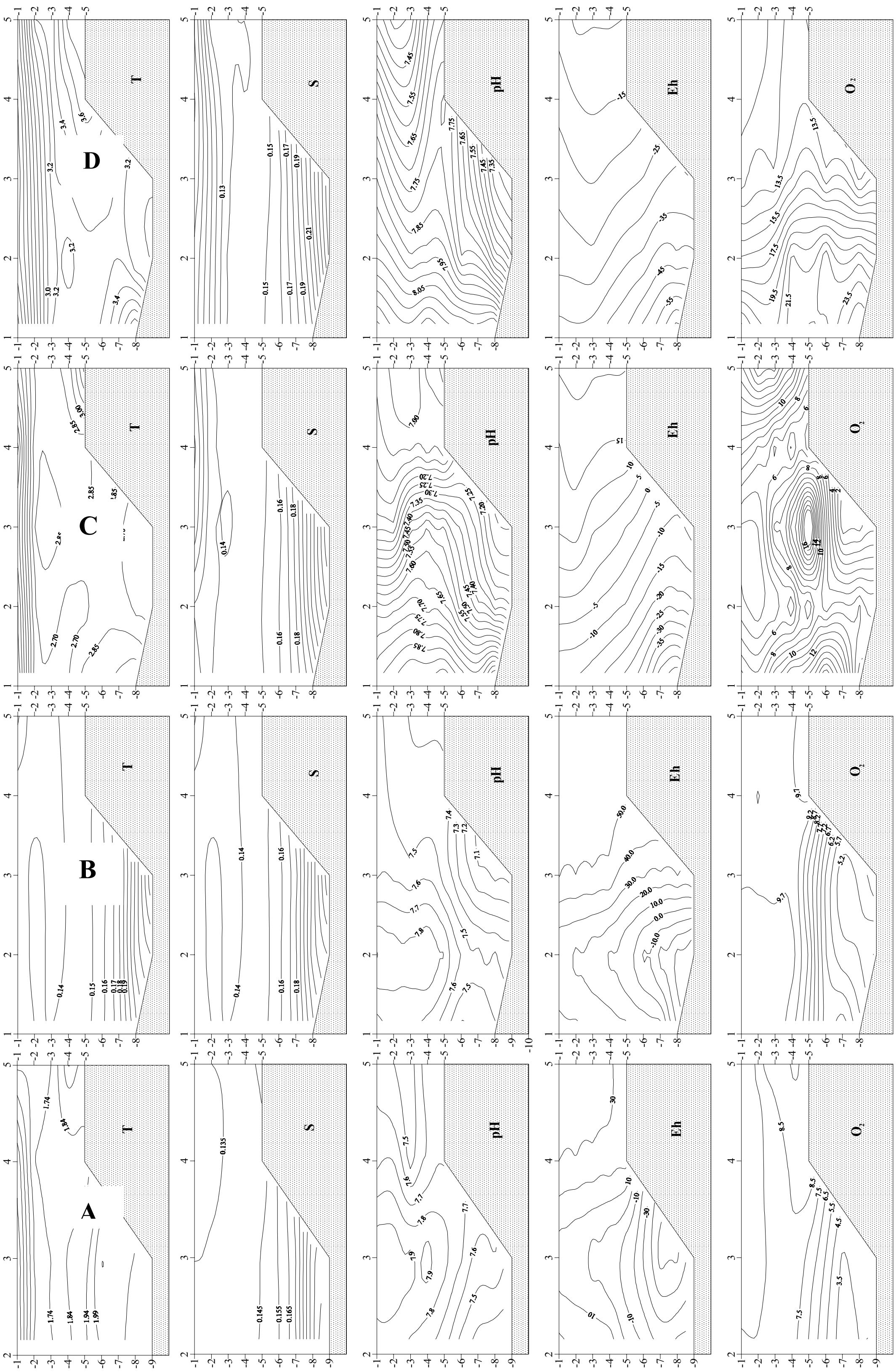


Fig. 8.2. Vertical temperature distribution (T^{o} C), general mineralizing (S‰), concentration of hydrogen ions (pH), Redox potential (Eh mV) and dissolved oxygen (O_2 mg l^{-1}) at the transect in Lake Kitezh

With increasing solar energy flux, water in the entire water column heats (almost by 2.6^{o} C, on average if one compares transects B and C (Fig. 8.2). On transect D (Figs. 8.1 and 8.2) one can see an increase in the concentration of dissolved oxygen both in percentage and in absolute units. Such hyper-saturation is possible only due to primary producers as the exchange with the atmosphere cannot be higher than 100% (the ice cover still prevents the exchange with the atmosphere). Due to the increased water temperature, the oxygen increase in percentage is justified not more than by 8-9%. In addition, there is also a large increase of dissolved oxygen in absolute units.

As can be seen from the obtained results, the oxygen regime of Lake Kitezh has a clearly pronounced seasonal character. The winter period is characterized by an acute oxygen deficit, especially in the near-bottom horizon and in local depressions. In the spring-summer period, an intense oxygen increase occurs due to its production by aquatic vegetation.

A distinguishing feature of the oxygen regime of Lake Kitezh in spring-summer is that water enrichment with oxygen occurs in the presence of ice, which hinders a free exchange with the atmosphere resulting in hyper-saturation of lake water with oxygen.

References

1. Orlov A.I. Geographical studies on Fildes Peninsula. SAE Proceedings, 1973, v. 58, p. 184-207.

9. DECREASE OF THE WATER TABLE AREA OF LAKE KITEZH

Fomichev N.I.

Lake Kitezh is located almost in the center of the Fildes Peninsula, which presents the ice-free southwestern tip (10 km in length and up to 2.5-3 km in width) of King George Island (Waterloo) in the group of the South Shetland Islands. In the second half of the summer when the mean monthly air temperature is above zero, all water bodies of the Fildes Peninsula are ice-free. The maximum ice thickness in Lake Kitezh comprises 80-120 cm /1/. By the alimentation conditions, the lake belongs to one snow-rain type. During the entire warm period of the year, Lake Kitezh has the runoff to the ocean. In winter, the water runoff almost completely stops. Lake Kitezh is the largest lake of the peninsula being the main freshwater source for supplying vital activity of the Chilean Frei station and the Russian Bellingshausen station. According to data /2/, the area of Lake Kitezh comprised 145000 m^2 in 1971, from data in /3/, it was 94800 m^2 in 1976 and during the 2000-2001 season, the area of Lake Kitezh was 92690 m^2 in the data of Vasiliev M.N. (State Enterprise "Aerogeodesia", Expedition 191).

A significant decrease in the lake area is related in our opinion to a large anthropogenic load that Lake Kitezh and the Fildes Peninsula in general have been experiencing during the last few decades. It is of interest that the main period during which the lake area has decreased by almost 35% falls on the time of active "colonization" of this region. The main mechanism of the area decrease was in "overgrowing" of the bottom of the coastal part of the lake with different sediments and a subsequent retreat of the coastline. Under the natural conditions, the rate of this process depends on the ratio of the watershed area to the lake area and on the composition and state of soil. The anthropogenic load contributing to a more intense export of suspended matter to the lake is in our opinion in the disturbance of the natural soil layer by transport vehicles and in the purposeful relief change during the construction of different types of facilities.

Lake Kitezh has two main watercourses in the northeastern and western parts of the lake. Each of the tributaries has its dissimilarities by the watershed area and the volume of water supplied to the lake. The watershed area of the northeastern inflow is small covering predominantly the slopes of the southwestern part of the Central massif of the Fildes Peninsula. Here, a system of non-stagnant lakes forms (Fig. 9.1), which contributes to deposition of suspended matter before approaching the lake. The streams flow in the formed channels that reduce the channel erosion to a minimum. There are no transport roads and construction activities in the Central massif area. That is why, the input of suspended matter by this watercourse is insignificant and reflects the natural processes.

A significant part of the western lake area is distinguished by its shallow character (depth of 1m and less). The main mass of the watercourse strongly loaded with rapidly depositing substance flows here. The lake has experienced an enormous load in the form of allochthonous substance during the construction of the ground airstrip located in direct proximity to it. The artificial relief change has contributed to the intense process of soil and rock destruction by sediments, melt water (erosion) and wind (deflation).

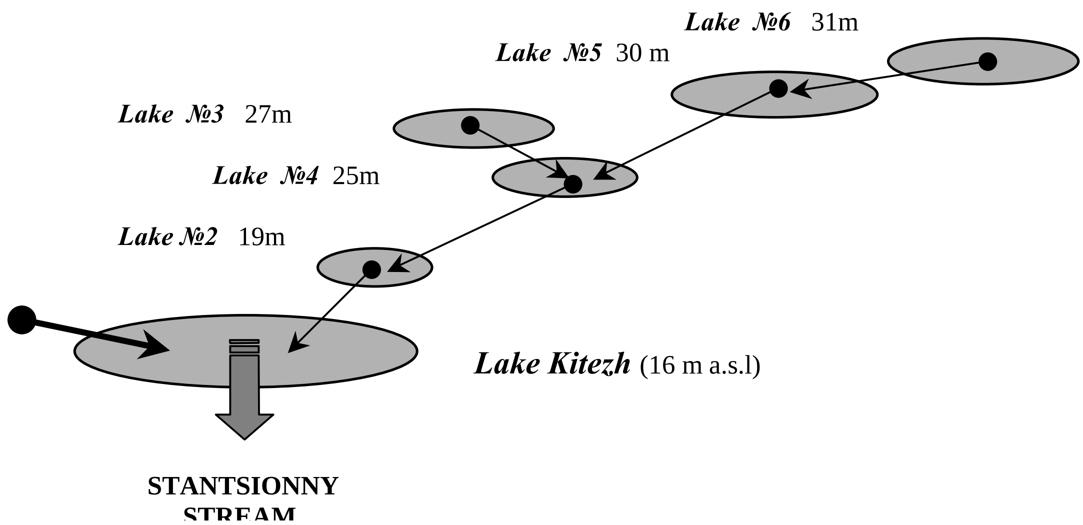


Fig. 9.1. Schematic depiction of the height location of the system of running water lakes on the Fildes Peninsula.

The watershed area includes the territory of the airstrip of the Chilean Frei Base. That is why the anthropogenic load on Lake Kitezh constantly increases due to the increase of the intensity of flights and practical activity. During the 2000-2001 season, oil slick was repeatedly observed on the water surface over the entire lake area. It is a question of a serious contamination of the water body. The extent of its impact can be determined only by special observations.

References

1. Orlov A.I. Geographical studies on the Fildes Peninsula. SAE Proceedings, 1973, v. 58, p. 184-207.
2. Simonov I.M., Govorukha L.S. Physical-geographical study. Report of the 15th SAE, 1971.
3. Orlov A.I., Shmideberg N.A. Comparative hydrological-hydrochemical characteristics of freshwater of the Antarctic and sub-Antarctic, AN SSSR, Interagency Commission on the Study of the Antarctic. Reports of the Commission. Issue 15, 1976, p. 93-114.

10. ON THE STATISTICAL STRUCTURE OF THE FIELD OF SURFACE AIR TEMPERATURE AND ATMOSPHERIC PRESSURE AT SEA LEVEL IN THE ANTARCTIC PENINSULA AREA

(from data of the Russian Bellingshausen station)

Lagun V.Ye., Ivanov N.Ye.

A quantitative study of the mechanisms of formation of the climatic variability in the Antarctic requires evidence on the statistical structure of the fields of meteorological parameters. Such study has become possible in relation to creating a database on climate of Antarctica /8, 9/ in the framework of the geo-information system (GIS) "The Antarctic" developed at the AARI.

Manifestation of the so-called "global warming" in the Southern Hemisphere is most clearly recorded in the vicinity of the Antarctic Peninsula both in the surface layer /6, 11, 12/ and in the free atmosphere /13/. The results of the probabilistic analysis of time series of surface air temperature and air pressure at sea level in this region undertaken for determining the interannual variability characteristics given the modulation of annual variations over the range of interannual and seasonal cycle of synoptic scale variability are briefly presented below.

The input data include uniform series of subsurface air temperature (T) and pressure at sea level (P) at Bellingshausen station over the period 1969-2000 with a time interval of 6 hours /9/. The data of measurements from March to December 1968 are not included to the analysis to avoid distortions in calculation of annual averages due to incompleteness of this annual series.

Table 10.1 presents estimates of P and T averages and their dispersions at different averaging scales of initial data.

Table 10.1

Estimates of mathematical expectation (m) and dispertion (D) of pressure at sea level (P,hPa) and subsurface air temperature (T, ^{o}C) at a different averaging interval of initial data of Bellingshausen station over the period 1969-2000 with a 6h time interval

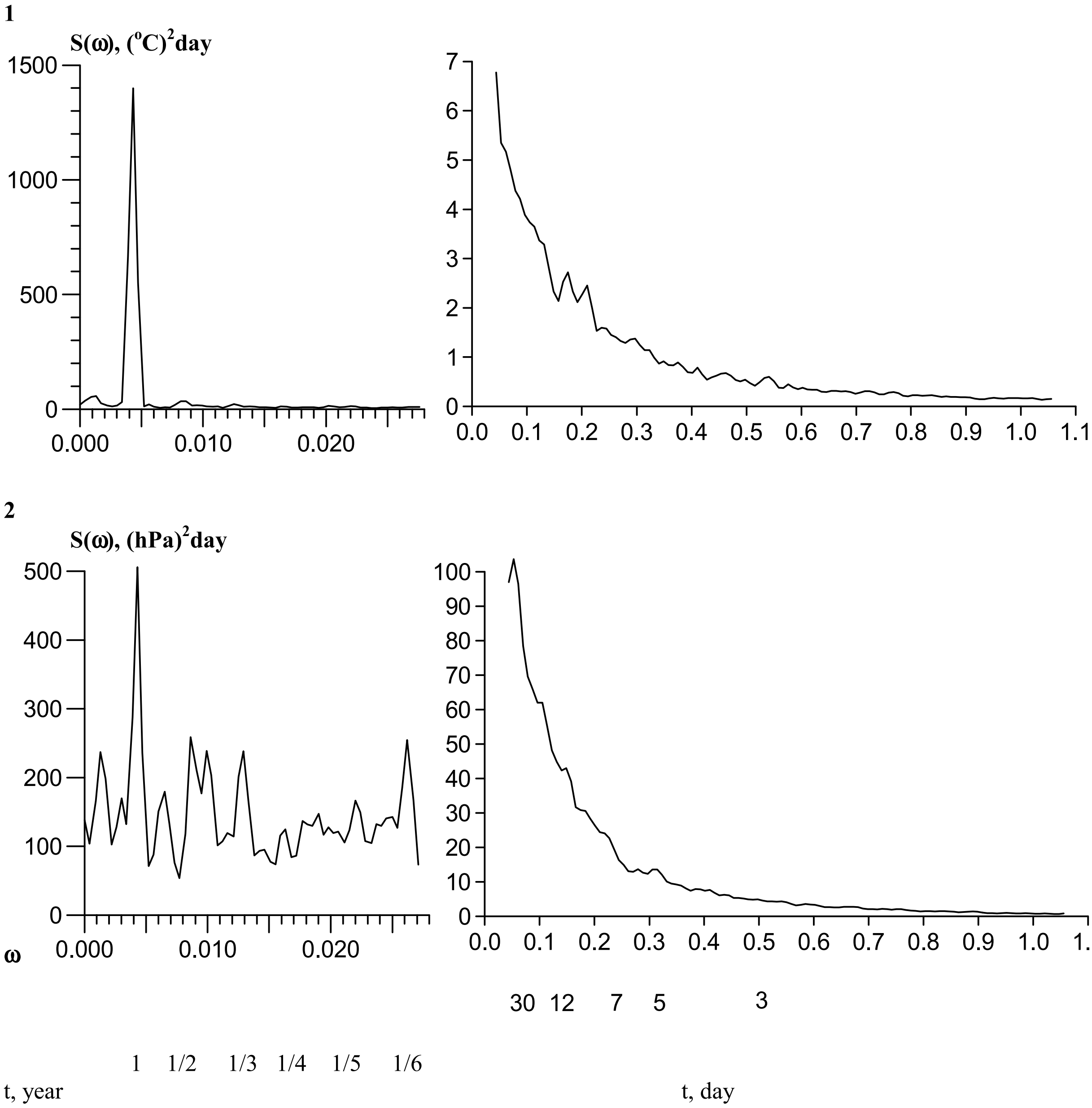
Estimate	6-hourly data			Daily averages			Monthly averages			Annual averages		
	N	M	D	n	D_d	$\frac{D_d}{D}$	N	D_m	$\frac{D_m}{D}$	n	D_y	$\frac{D_y}{D}$
T	46752	-2.4	21.89	11688	20.03	91.5	384	11.38	52.0	32	0.71	3.2
P	46752	991.5	152.45	11688	141.93	93.1	384	27.25	17.9	32	2.60	1.7

Designations: n – number of the series terms, D_d, D_m, D_y –dispersion for the corresponding averaging periods, dispersion dimension – (^{o}C)^2 and (hPa)^2.

As follows from the analysis of Table 10.1, the variability from day-to-day and within a year makes the main contribution to the total dispersion, and while for temperature, the variability within a year accounts for more than 50% of dispersion, it is less than 20% for pressure. The contribution of the variability of annual averages to the total dispersion comprises less than 5%. However, the interannual variability is not exhausted by the changes of annual averages. The contribution of daily variations and variability within a day to the total dispersion is also small comprising both for T and for P less than 10% of D. However, it is also advisable to consider the variability features over the low-frequency ranges relative to daily variations taking into account the time of the day. This can be useful for example, for formulation of hypotheses on the nature of the interannual variability trends.

Thus, it was noted during the analysis of climatic variability of surface temperature in the Northern Hemisphere (see, for example, /10/) that the pronounced warming trend is mainly governed by the increase of winter night temperatures. This suggests that the interannual changes of surface temperature are to a great extent determined by oscillations in the outgoing long-wave radiation flux.

Fig. 10.1 presents estimates of spectral density S(ω) of air temperature and pressure in the stationary approximation. For an illustrative presentation of the spectral structure features, the own scale was assumed over different temporal variability ranges.



а **б**

Fig. 10.1. Estimates of the spectral density of air temperature (1) and atmospheric pressure (2) over the ranges of interannual variability and annual variations (a), variability within a season, synoptic variability and daily variations (b).

The plots S(ω) (see Fig. 10.1) demonstrate a preliminary assessment of the contribution of different ranges to total dispersion $D_{(\bullet)}/D$ through spectral function

$$\frac{D_{(\bullet)}}{D} = \frac{\int_{\omega_1}^{\omega_2} S(\omega)d\omega}{\int_{0}^{\omega_N} S(\omega)d\omega}, \qquad (1)$$

where ω_N - Nyquist rate

The estimates of $D_{(\bullet)}/D$ value in accordance with determination (1) are given in Table 10.2.

Table 10.2

Contribution (%) to total dispersion D of air temperature (T) and atmospheric pressure (P) of variability $D_{(\bullet)}$ over different ranges, calculated from the spectral density estimate

	Interannual variability			Interannual variations and their overtones			Synoptic variability			Daily variations		
	ω	t, year	$\frac{D_{(\bullet)}}{D}$	ω	t, year	$\frac{D_{(\bullet)}}{D}$	ω	t, day	$\frac{D_{(\bullet)}}{D}$	ω	t, h	$\frac{D_{(\bullet)}}{D}$
T	≤0.003	≥1.5	3.7	0.0043	1	41.5	0.1308-0.7854	2 - 12	21.5	1.5708	24	0.3
				0.0085	1/2	1.5						
				0.0130	1/3	1.0						
				0.0170	1/4	0.6						
				0.0215	1/5	0.7						
				0.0254	1/6	0.5						
				Total		45.8						
P	≤0.003	≥1.5	2.5	0.0043	1	2.6	0.1308-0.7854	2 - 12	34.3	1.5708	24	<0.1
				0.0085	1/2	1.3						
				0.0130	1/3	1.6						
				0.0170	1/4	1.0						
				0.0215	1/5	1.2						
				0.0254	1/6	1.5						
				Total		9.2						

As follows from Table 10.2, the contribution of low-frequency oscillations with a period of more than 1.5 years to the total dispersion comprises less than 5% both for T and for P. The role of annual variations is quite significant comprising about 45% of the total dispersion of T and about 10% of dispersion of P. Whereas in T, the annual harmonic accounts for more than 90% of dispersion of annual rhythmics, in P, all six harmonics are significant. The synoptic scale variability is also significant accounting for more than 20% of dispersion of T and about 35% of dispersion of P. The contribution of daily variations to the total dispersion is small.

The frequency spectrum does not allow us to perform a full dispersion analysis of the different scale variability since in the stationary approximation, all oscillations are considered stochastic. Hence, such an estimate of the interannual variability dispersion is underestimated, as it does not take into account the low-frequency modulation of the annual rhythmics and synoptic fluctuations / 4 /. It is shown in / 1 / that at high and temperate latitudes of the Northern Hemisphere above the sea, the modulation component of the interannual variability determined only by the interannual changes in the annual variations even without taking into account the interannual changes of synoptic processes is greater by intensity than the additive component represented by a series of annual averages.

The results of the by-range probabilistic analysis presented below take into account the modulation of annual variations over the range of interannual variability and interannual and seasonal variations of synoptic scale variability. Daily variations as an independent range require special consideration (see, for example, Fig.10.2). This has become quantitatively possible after the installation of the Milos 500 measurement complex at the Russian Antarctic stations.

Time 00 h GMT

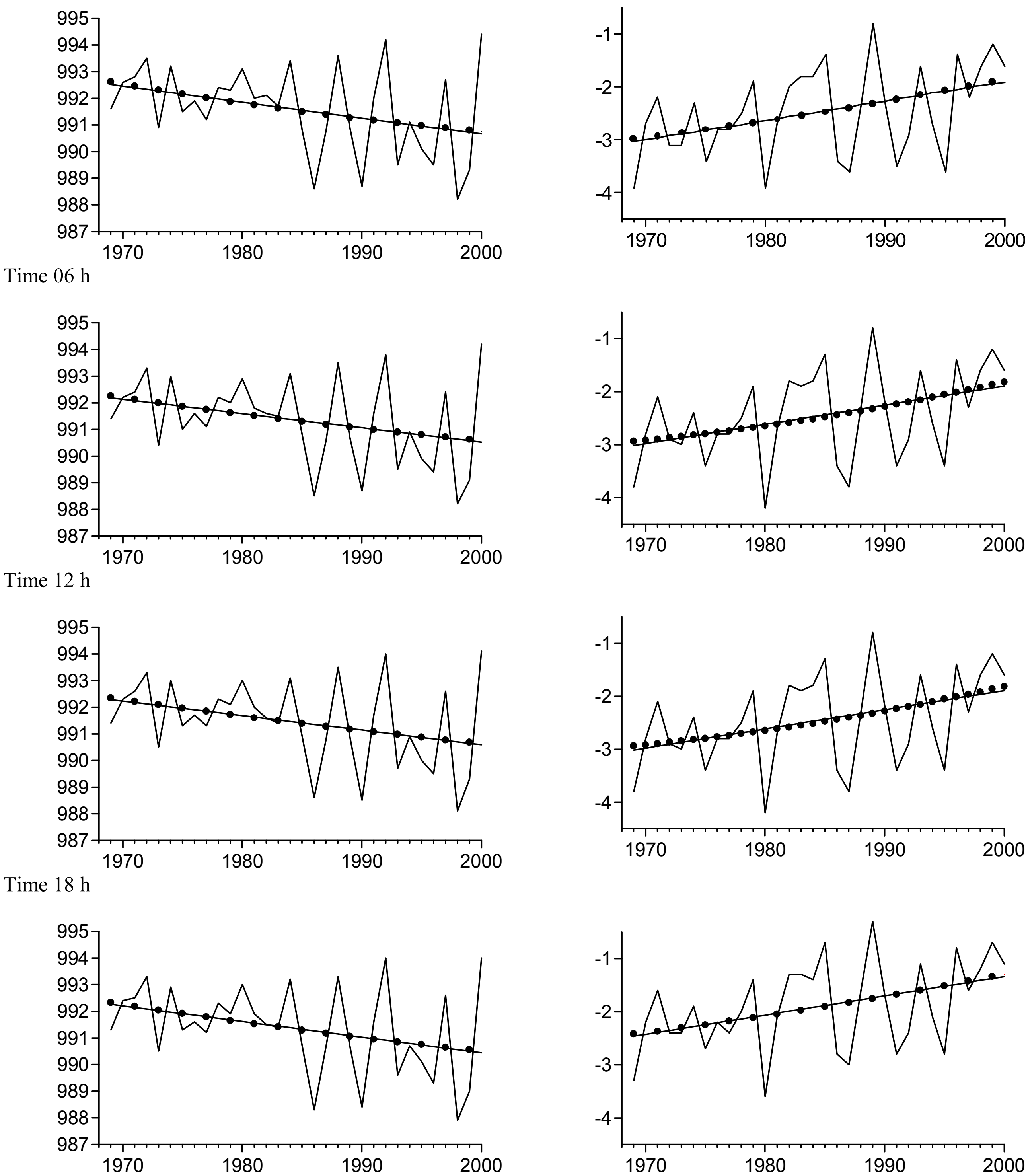


Fig. 10.2. Temporal variations of mean annual air pressure a.s.l. (left-hand column, hPa) and subsurface temperature (right-hand column, ^{0}C) for different measurement time and its approximation by linear (straight) and parabolic (points) components of the power polynomial.

We shall call the time series of annual averages $g(t_i)$ as an additive component (AC) of the interannual variability, which is presented in the form:

$$g(t_i) = G_M(t_i) + \overset{o}{g}_M(t_i), \qquad (2)$$

where $G_M(t_i)$ – mathematical expectation trend determined in / 2 / as a slowly changing smooth deterministic function, $g_M(t_i)$ – remainder not explained by the trend, which will be assumed in the first approximation to be a stationary process with a zero average and a correlation function $K(\tau)$.
Since $G_M(t_i)$ is defined as a deterministic process, it is reasonable to prescribe the form of this function based on the physical hypothesis on the trend nature. It is recommended in / 3 / to use for describing the trend the initial series approximation with a power polynomial

$$G_M(t_i) = g_o + \sum_{k=}^{m} a_k t_i^k \text{ ,} \qquad (3)$$

determining weight coefficients a_k by the least squares method or through orthogonal polynomials / 5 /

$$G_M(t_i) = g_o + \sum_{k=}^{m} a_k \Psi_k(t_i), \qquad (4)$$

which allow avoiding recalculation of parameters (4) at the change of the number of model components. As $\psi_k(t_i)$, it is convenient to use Chebyshev polynomials, orthogonal in the finite system of points that can be applied both for unequally distant data, in particular, in the presence of gaps.

We shall prescribe the number of components in (3) based on the trend determination as a slowly changing function. Since such interpretation does not restrict the trend only to a linear component k=1 in (3), we shall consider that it can also include the oscillation segment with a typical time scale much greater that the realization length. That is why the trend will always include a parabolic (k=2) component. It is reasonable to use the cubic term (k=3) of the model (3), characterized by a curve with inflection for describing the trend only in the presence of a sufficiently long (not less than 80-100 years) realization, for example, in the analysis of the sub-Antarctic Orcadas station (over the period 1903-2002).

In our case (n = 32 years), we shall use model (3) for describing the trend at m = 2, checking the need for taking into account a parabolic term in each specific case with the help of dispersion analysis. The plots of time series of annual P and T averages and their approximations by a linear trend and the power polynomial at m = 2 are given in Fig.10.3. As follows from Fig. 10.3, the contribution of the parabolic component is negligible and the trend analysis can take into account only the linear term of approximation (3).

The trends of surface temperature and pressure at sea level have a different direction: the $T(t_i)$ series contains a positive linear trend while the $P(t_i)$ series contains a negative linear trend, which account approximately for 10-15% of dispersion of annual averages. The linear pressure trend is insignificant at a 95% level while the linear temperature trend is statistically significant (see also / 7 /).
The obtained estimates need to be specified on the yearly basis since their stability should be treated with caution (see Fig.10.4). Fig.10.4 presents a series of annual averages of atmospheric pressure at Bellingshausen station from 1969 to 2000 and the linear trend estimates based on a full series and on a series of 1968-2000. Inclusion to the series of only one although an anomalous year, leads to a more than a 50% increase of the slope coefficient module a_1. That is why the term “trend” relative to the series of such small (32 years) duration is to some extent conventional.

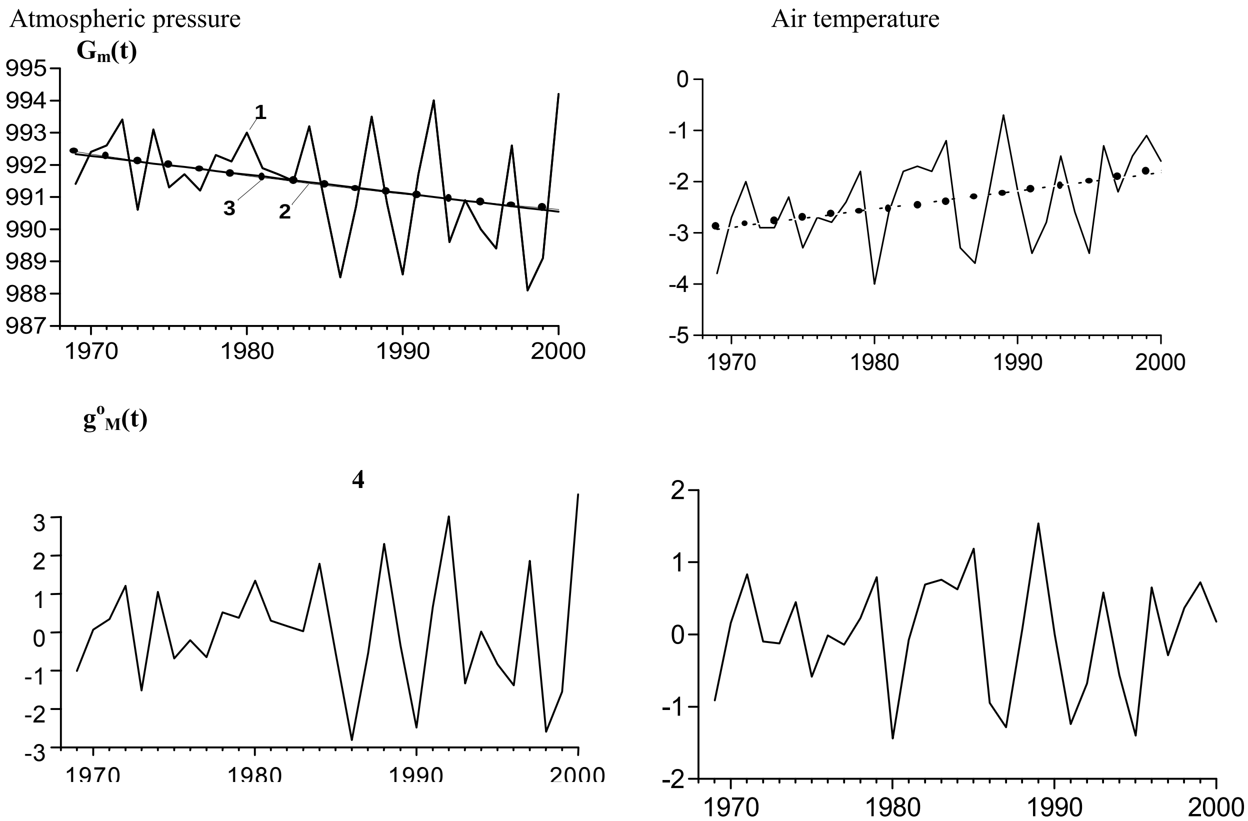


Fig. 10.3. Temporal variation (1) of annual P and T averages, linear trend (2), parabolic component of a power polynomial (3) and remainder (4).

It follows from Fig. 10.3 that the assumption of the stationary state of $\overset{o}{g}_M(t_i)$ in (3) is incorrect as in addition to the non-stationary state by mathematical expectation, there is also a non-stationary state by dispersion in the series of annual averages of $g(t_i)$. That is why, we shall replace model (2) by approximation:

$$g(t_i) = G_M(t_i) + G_D(t_i) + \overset{o}{g}_{MD}(t_i), \qquad (5)$$

where the dispersion trend value (i.e. of a regular, slow and smooth change of the module of anomalies relative to the mathematical expectation trend) $G_D(t_i) = b(t_i)\cdot \mathrm{sign}[\overset{o}{g}_M(t_i)]$ is determined by the polynomial trend $b(t_i)$ of the series $|\overset{o}{g}_M(t_i)|$ by model (3) at m=2, while the sign corresponds to the sign of anomaly relative to the mathematical expectation trend. The plots of the series $G_D(t_i)$ and "pure" remainder $g^o_{MD}(t_i)$ are presented in Fig. 10.5.

Exclusion of the dispersion trend (see Fig. 10.5), which accounts for about 65-70% of dispersion relative to the mathematical expectation trend practically eliminates the non-stationary state of the unaccounted for remainder in air temperature, however, in pressure, some stationary state by dispersion in a series $g^o_{MD}(t_i)$ is preserved, which is governed by the specific features of development of the atmospheric processes during the last three years (1998-2000) and also indicate instability of the derived estimates.

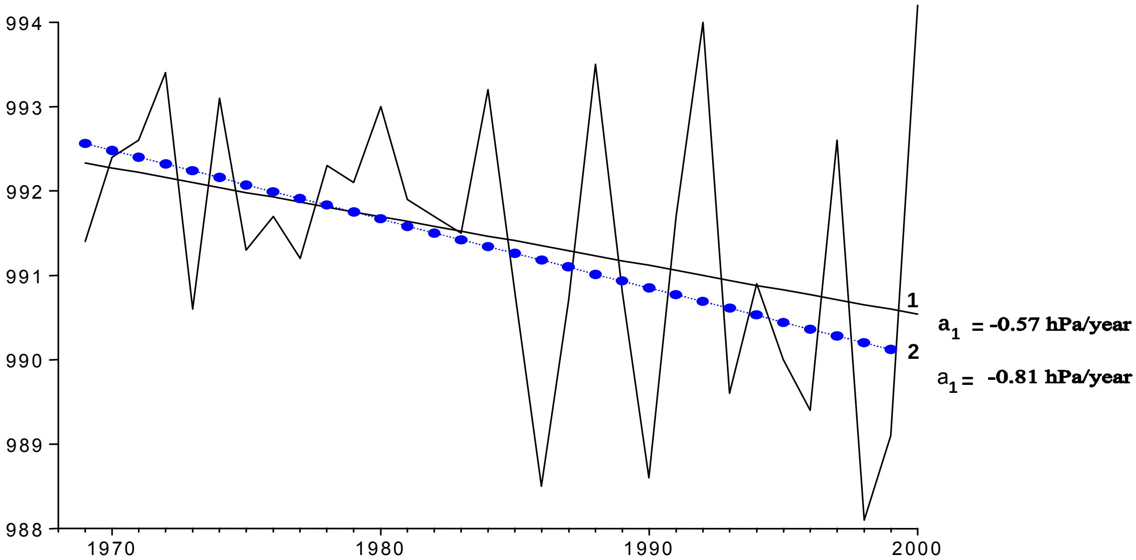


Fig. 10.4. Time series of atmospheric pressure at Bellingshausen station and estimates of the linear trend of mathematical expectation based on a full series (1) and on a series without data for 2000 (2).

Atmospheric pressure

Air temperature

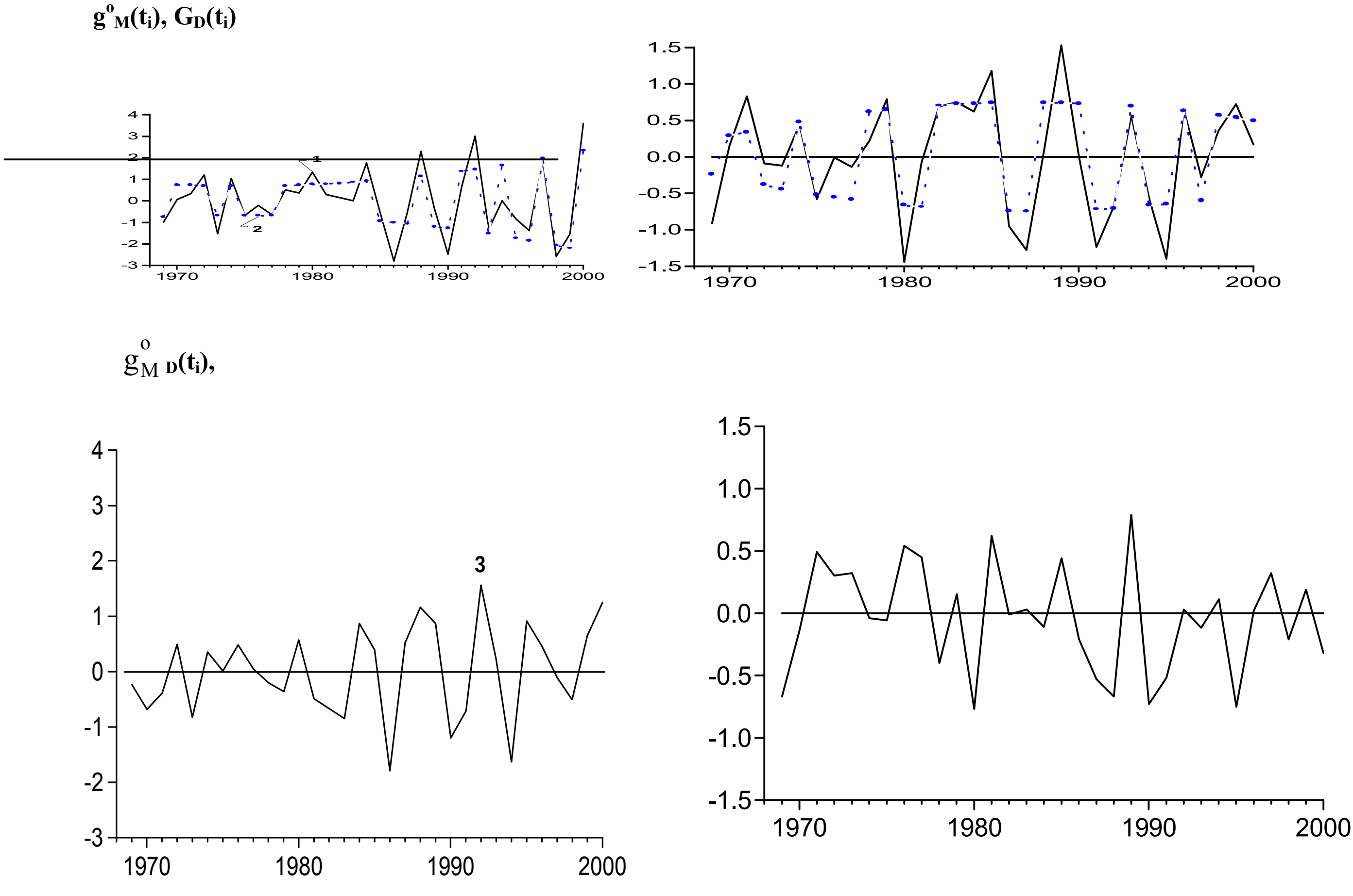


Fig. 10.5. Time series of anomalies relative to the mathematical expectation trend (1), dispersion trend (2) and "pure remainder" (3) of annual P and T averages.

The results of the analysis of temperature and pressure time series are reduced to the following:

The additive component of interannual variability represented by normal sequences of annual $g(t_i)$ averages of subsurface air temperature and atmospheric pressure at sea level during the period 1969-2000 at the Bellingshausen station makes a relatively small (less than 5%) contribution to dispersion of measurement data at standard synoptic hours.
The interannual variability contains an additive and modulation components. The AC is represented by a sequence of annual averages while the MC is manifested through the interannual variability of parameters of the annual variations and in the interannual variations of the synoptic variability characteristics.

The interannual variability trend is represented by a power polynomial that takes into account the linear and parabolic components. The most important feature of the AC is a linear trend of mathematical expectation (positive and significant at a 95% level for temperature and negative and insignificant at a 95% level for pressure) accounting for about 10-15% of dispersion of the annual averages. The time series of anomalies of the annual averages relative to the mathematical expectation trend are non-stationary by dispersion, but the contribution of the polynomial trend of mathematical expectation of these anomalies is small accounting for slightly more than 10 % of dispersion relative to the mathematical expectation of pressure and less than 5 % for temperature. The decrease of the background atmospheric pressure is accompanied with the increase in the amplitude of interannual oscillations, which can be partly attributed to a local increase of cyclonic activity.

The statistical analysis of data of meteorological observations at standard synoptic hours at Bellingshausen station has allowed a quantitative determination of the contribution of processes of a different time scale to the formation of observed changes in climatic regime parameters of the surface atmospheric layer in the vicinity of the Antarctic Peninsula. The obtained estimates show in particular, how much the dispersion of temperature and pressure changes (what part of variability is lost) when using data with a different averaging scale and how the climatic variability estimates on the basis of monthly and annual averages are statistically reliable.

References

1. Bokov V.N., Klevantsov Yu.P., Rozhkov V.A. Estimates of the interannual variability of the wind speed above the sea // Izvestiya RAN. Atmosphere and Ocean Physics. 1993. - V. 29. - p. 253–259.

2. Brelinger B. Time series. M., Mir, 1980. - 536 p.
Gruza G.V., Reitenbakh R.G. Statistics and analysis of hydrometeorological data. L., Gidrometeoizdat, 1982. - 216 p.

3. Dragan Ya.P., Rozhkov V.A., Yavorsky I.N. Methods of the probabilistic analysis of the rhythmics of oceanographic processes. L., Gidrometeoizdat, 1987. - 319 c.

4. Draper N., Smith G. Applied regression analysis. M., Finances and statistics, V. 1, 1986. - 366 p.

5. Lagun V.E. Climatology of the Antarctic Peninsula // Summary session of the AARI Scientific Council on the results of activity in 2000. Express-information. Issue 10. St. Petersburg. 2001. p. 13-14.

6. Lagun V.E., Marshall G.J. A definitive monthly surface temperature series for Bellinshausen station, Antarctica // Environmental state of the Antarctic. RAE Quarterly Bulletin. 2001. – No. 1. – P. 35 - 42. http://www.aari.nw.ru/projects/Antarctic
7. Lagun V.E. Database of observations of the atmosphere state in the South Polar Area/International Conference on modeling, databases and information systems for atmospheric sciences "MODAS-2001" 25-29 June, 2001. Institute of the Atmosphere Optics of the RAS Siberian Branch. Irkutsk. 2001. Abstract. P. 13 - 14, http://symp.iao.ru/russ/?dm=modas/1&fm=menu&dc=modas/1/h&fc=r013189
8. Lagun V.E. Database on climate of the Southern Polar Area. Summary session of the AARI Scientific Council on the results of activity in 2001. Express-information. Issue 12. St. Petersburg. 2002. P. 51.

9. Analysis of Climate Variability. Applications of Statistical Techniques. H. von Storch and A. Navara Eds. Second Edition. Springer. 1999. 380 p.

10. King J.C., Harangozo S.A. Climate change in the western Antarctic Peninsula since 1945: observations and possible causes// Ann. Glaciol. - 1998. – V. 27. - P. 571 – 575

11. Lagun V.E. Antarctic Peninsula warming: analysis of Bellingshausen station data/8th Scientific Assembly of International Association of Meteorology and Atmospheric Sciences (IAMAS) Innsbruck. July 10-18, 2001. Austria. Abstract. 2001. P. 24.
12. Marshall G.J., Lagun V.E., Lachlan-Cope T.A. Changes in Antarctic Peninsula tropospheric temperatures from 1956-99: a synthesis of observations and reanalysis data // International Journal of Climatology. – 2002. - V. 22. P. 291-310.

11. MAIN EVENTS OF RAE ACTIVITY IN OCTOBER-DECEMBER 2001

October 5	Installation of the radio-echo sounding station and radio-navigation equipment onboard the trucks prepared for the Mirny-Vostok traverse.
October 6	Manufacturing and establishment at Novolazarevskaya station of the lost runway marking that was not in operation for more than a decade.
October 7	Performance trials after a complex repair of the floating transporter at the Bellingshausen station. Disassembling and repair of the meteorological mast.
October 12	Working visit of a group of polar explorers from Novolazarevskaya station to Maitri station of the Indian Antarctic Expedition.
October 13	Delivery from Novolazarevskaya station to the airfield of repaired rollers DU-30 for operation on the airstrip.
October 18	Break of the panel in the diesel-electric station building at Mirny due to wind up to 42 m/s.
October 20	Loading of containers at Mirny station for delivering to Vostok station by a sledge-caterpillar traverse.
October 24	Departure from Novolazarevskaya station of the airfield group headed by P.A. Podkhalyuzin to the field camp for work on the airstrip.
October 29	Departure of the sledge-caterpillar traverse from Mirny station to Vostok station on 10 trucks with V.M. Babichev as Head of traverse.
November 4	Failure of transmission on two trucks of the Mirny-Vostok traverse and their replacement.
November 6	Extraction from under the snow at the 200th km of the Mirny-Vostok route of three tanks with fuel left by the preceding traverse. Flight from Pulkovo airport of the seasonal team of the 47th RAE along the Amsterdam-Sidney-Christchurch-McMurdo-Vostok route.
November 19	Arrival of the sledge-caterpillar traverse to the temporarily abandoned Pionerskaya station.
November 22	Arrival to Vostok station from McMurdo station onboard the US aircraft of the seasonal team of the 47th RAE headed by A.N. Sheremetiev and of specialists from France and Germany.
November 28	Stop of the sledge-caterpillar Mirny-Vostok traverse at the 502nd km of the route and re-equipment of tractor No. 2 to a navigator’s vehicle.
November 29	Two vehicles STT No. 3 and ATT No. 27 were left at the 510th km of the route.
December 4	Arrival of the sledge-caterpillar traverse to the temporarily abandoned Vostok-1 station.
December 6	First after a 10-year break landing of the Russian IL-76-D and the US DC-3 aircraft on the airfield of Novolazarevskaya station. Arrival of the international group of 56 scientists and specialists of the Commission of the Ministry of Transport of the RF on the airfield acceptance. The group includes 28 participants of the Scandinavian Antarctic Expedition.
December 7	Certification of the airfield at Novolazarevskaya station in accordance with the requirements of the Handbook on the state registration and admittance to operation of the civil airfields of the Russian Federation. Start of operations on personnel delivery at Troll and Wasa stations by the US DC-3 aircraft. Traverse from Vostok station along the S1-47 profile for a seismic survey under the program of studies of subglacial Lake Vostok with A.M. Popkov as Head of traverse. Installation of the equipment for measuring the ice core electrical conductivity at Vostok station.
December 8	Return to Cape Town of Russian IL-76D aircraft.
December 11	Arrival of the sledge-caterpillar traverse to the temporarily abandoned Komsomolskaya station.
December 12	Departure for Vostok station of three DT-30 vehicles in advance of the main traverse. An MTT tractor was left at Komsomolskaya station.
December 20	Landing of the US Twin-Otter aircraft at the airfield of Vostok station. A return flight to McMurdo station with a team of glaciologists onboard. Arrival of the first group of DT-30 vehicles (three) of the Mirny-Vostok traverse to Vostok station.
December 24	Arrival of the main Mirny-Vostok traverse on three vehicles. Departure of the scientific traverse with seismic equipment from Vostok station.
December 28	Departure of the traverse headed by A.N. Sheremetiev with a radio-echo sounding equipment along the eastern shore of Lake Vostok to specify the lake boundaries.