Temperature Trends in Troposphere over North-West of Siberia Detected by the Method Based on the Using of Hourly Observations

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Radiosonde sounding data from dataset CARDS [Eskridge et al, 1995] for two stations: coastal station Ostrov Dikson and continental station Salehard, placed in North-West of Siberia were used for research of climatic changes of temperature (T) at the standard isobaric levels in Arctic troposphere over period 1964-10.2007 years.

Distribution of observations number used for researches for standard isobaric levels is different for different months due different height of sound rising and different historical request for reporting of sounding results. (For example, data for 1000 hPa and 925 hPa are including in aerological telegram after 1967 year.) Number of observations for 00 GMT and 12 GMT is practically the same for both stations. Partly estimations of trends are dependent from quality data. For example, numbers of observations before and after running of complex quality control procedure [Alduchov and Eskridge, 1996] are presented in tables 1 and 2 for different months, seasons and year for level 850 hPa. Number of rejected observations foot up to 1.1% (Ostrov Dikson) and 1.4% (Salehard) from all soundings (table 2 for year).

TABLE 1. Number of T observations before and after complex quality control for level 850 hPa for different months.

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Ostrov Dikson	1975 1961	1836 1822	2068 2050	1937 1915	2065 2035	1971 1944	2031 2009	1849 1832	1835 1817	1911 1889	1936 1911	1987 1966
Salehard	2347 2325	2139 2120	2440 2409	2411 2398	2384 2334	2269 2216	2158 2129	2238 2204	2267 2239	2274 2244	2106 2083	2250 2210

TABLE 2. The same as TABLE 1 for seasons and for year.

Station		Winter	Spring	Summer	Autumn	Year	Year (%)
Ostrov Dikson	Before control After control	5798 5749	6070 6000	5851 5785	5682 5617	23401 23151	100 98.9
Salehard	Before control After control	6736 6655	7235 7141	6665 6549	6647 6566	27283 26911	100 98.6

The multiannual monthly means of temperature are presented for different months, seasons and for year at figure 1a. Corresponding linear trends in time series of temperature anomalies at the standard isobaric levels in troposphere, calculated by the method based on the using of hourly observations with taking into account the possible time correlations of observations [Alduchov and Chernykh, 2008], are presented at figure 1b-1d. Due continuity of climatic changes in atmosphere all detected trends (with different significance), trends with significance not less than 50% and trends with significance not less than 95% are presented at the figure 1b, 1c, 1d correspondently.

Figure 1b shows that climatic changes in Arctic troposphere are inhomogeneous in time and space. Warming is detected at all levels in troposphere over Salehard for all months (with exception December), seasons and year in total. Over Ostrov Dikson warming is detected for all months, seasons and year only in low troposphere. Only for March, May and July warming is detected for middle and high troposphere too. Cooling is detected in middle and/or high troposphere for other mounths, for winter, summer and autumn. Small cooling was detected in high levels of troposphere for year in total. Figure 1c shows that not all determined trends were detected with significance more than 50% for both stations.

Figure 1d shows that warming with significance not less than 95% was detected only for January, May and June, spring, summer and autumn and year for both stations. But the warming was detected at most levels of troposphere over Salehard and only in low troposphere over Ostrov Dikson.

Linear trends values for temperature anomalies for levels 850 hPa, 700 hPa and 500 hPa are presented in Table 3 for January, May, June and year. Largest warming for both stations was detected at level 850 hPa. For Ostrov Dikson it was detected for January with decadal changes 0.97ºC/Dec. For Salehard it was detected for June with decadal changes 0.90ºC/Dec. For year largest warming was detected at level 850 hPa for Ostrov Dikson and for Salehard with decadal changes 0.36ºC/Dec. and 0.38 ºC/Dec. correspondently.

The results can be used for modeling of climate change.

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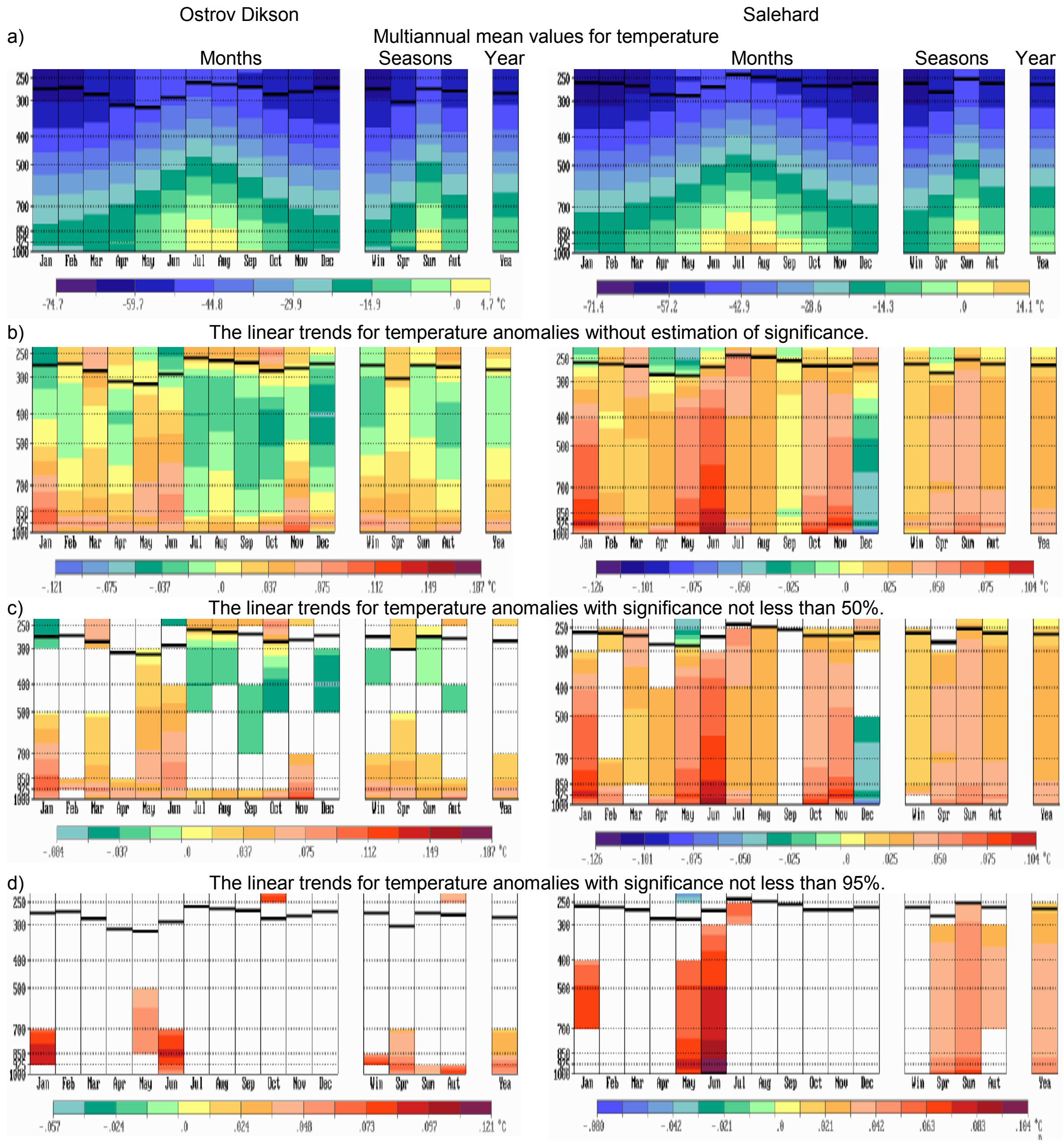

Fig. 1. Multiannual mean values for temperature (a) and linear trends for temperature anomalies (ºC/Year) for the isobaric levels calculated on the base of hourly observations with taking into account the time correlations of observations for different months (in the left), seasons (in the center) and for year (in the right) without estimation of significance (b), with significance not less than 50% (c) and 95% (d). The first tropopause is marked by black line. Stations: Ostrov Dikson (left column) and Salehard (right column). CARDS. 1964 – 10.2007.

TABLE 3. Linear trends for temperature anomalies (ºC/Decade) for standard isobaric levels 850 hPa, 700 hPa, 500 hPa calculated on the base of hourly observations with taking into account the time correlations of observations, for January, May, June and year. Trends with significance 99% are marked by Italic. Significance of other trend is not less than 93%.

Station	**January**			**May**			**June**			**Year**		
	Standard isobaric levels, hPa											
	500	**700**	**850**	**500**	**700**	**850**	**500**	**700**	**850**	**500**	**700**	**850**
Ostrov Dikson	-	.69	*.97*	.40	*.58*	*.59*	.46	.69	*.89*	-	.22	*.36*
Salehard	.64	.72	.79	*.63*	*.59*	*.69*	*.73*	*.78*	*.90*	*.36*	*.35*	*.38*

REFERENCES

Alduchov O.A., Chernykh I.V. About changes of temperature-humidity regime in troposphere over Antarctic Peninsula // Proc. RIHMI-WDC. 2008, 173, 270-294.

Alduchov O.A., Eskridge R.E. Complex quality control of upper air parameters at mandatory and significant levels for the CARDS dataset. NCDC Report. 1996. 151pp.

Eskridge R.E., Alduchov O.A., Chernykh I.V., Zhai P., Doty S.R., Polansky A.C. A Comprehensive Aerological Reference Data Set (CARDS): Rough and systematic errors // Bull. Amer. Meteor. Soc. 1995, **76**, 1959-1775.