Long-term temperature changes at the Faraday/Vernadsky station and related atmospheric circulation factors

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Abstract

During the period of global warming, the greatest increase in air temperature over the Southern Hemisphere is observed at the Faraday/Vernadsky station (Turner et al., 2009). It is important to determine intra-annual aspects of the temperature increases. Recent studies devoted to climate change point out at a manifestation of the high frequency of extreme weather events including extreme temperatures (Franzke 2013, Marshall et al. 2011). In this study daily temperature data at Faraday/Vernadsky (given by National Antarctic Scientific Centre of Ukraine) was used. NCEP/NCAR reanalysis data was used for circulation analysis. The conclusion about temperature increasing has been made based on linear trend for the long time series of air temperature observations. However, the beginning and the end of time series determines parameters of the linear trend. A decrease in a number of observations may show a violation of the positive linear trend in some parts of the time series. There are time intervals when trend parameters change very insignificantly and amplitudes of oscillation are relatively low. Therefore, the question of the allocation of such time intervals arises. In this case significance of trend is not considered. Analysis of the temperature trends, dispersion and mean values have been made for a different combination of periods. The analysis made possible to distinguish the homogeneous time intervals of air temperature at the Faraday/Vernadsky station during the period 1951-2014 (Fig. 1). The first period (1951-1961) (supposed to be a part of previous larger period), in which the greatest temperature variability is observed; 1962-1969 – transition period; the second period of 1970-1990 is a period with notable temperature variability; 1991-1996 – second transition period; 1997-2014 is the third modern period characterized by low variability and high annual mean temperatures. Transitional periods supposed to indicate a reorganization of temperature regime to the subsequent regime. Between the periods there are changes in the intra-annual distribution of days with temperatures of different gradations. The most indicative is the cold season. The diagram in Fig. 2 shows that in the last period average daily temperatures below (-15) ^{0}C in winter were practically not observed, and the greatest number of days in the last period were concentrated in the temperature range from (-1) ^{0}C to (-7) ^{0}C. These periods have a good fit with global warming stages with related atmospheric circulation features (Martazinova et al., 2007, Martazinova, 2014). So, between the periods there is a restructuring of the large-scale atmospheric circulation. Changes in pressure patterns in the southern polar region between periods can be traced on averaged surface pressure maps and on space-time diagrams. In the third period, a low pressure over Bellingshausen see is prevailing especially during the winter season (Fig. 3). This explains high frequency of days with high temperature.

Keywords: climate, temperature changes, atmospheric circulation

References

Turner J. Antarctic Climate Change and the Environment / J. Turner, Bindschadler R, Convey P, di Prisco G, Fahrbach E, Gutt J, Hodgson D, Mayewsky P, Summeerhayes C. – Cambridge, 2009. – 526 p.

Franzke C.Significant reduction of cold temperature extremes at Faraday/Verndsky station in the Antarctic Peninsula / C. Franzke // Int. J. Climatol.: 2013. – 33. – p. 1070 – 1078

Marshall G.J. Analysis of a regional change in the sign of the SAM–temperature relationship in Antarctica /

G.J Marshall, S.Battista, S.S. Naik, M.Thamban // Climate Dynamics. – 2011. – 36. – P. 277-287.

Martazinova V., Tymofeyev V.E. Interdecadal changes of tropospheric circulation in Southern extratropics during the recent warming in the Antarctic Peninsula // The 10th International Symposium on Antarctic Earth Science, 10thISAES, Santa Barbara, Geological Survey and The National Academies, USGS OF-2007-1047. Ext. Abs.067, 2007

Martazinova, V.The change of the large-scale atmospheric circulation over the North Hemisphere during 1900-2010 // American Geophysical Union, Fall Meeting 2014, abstract #A32C-06

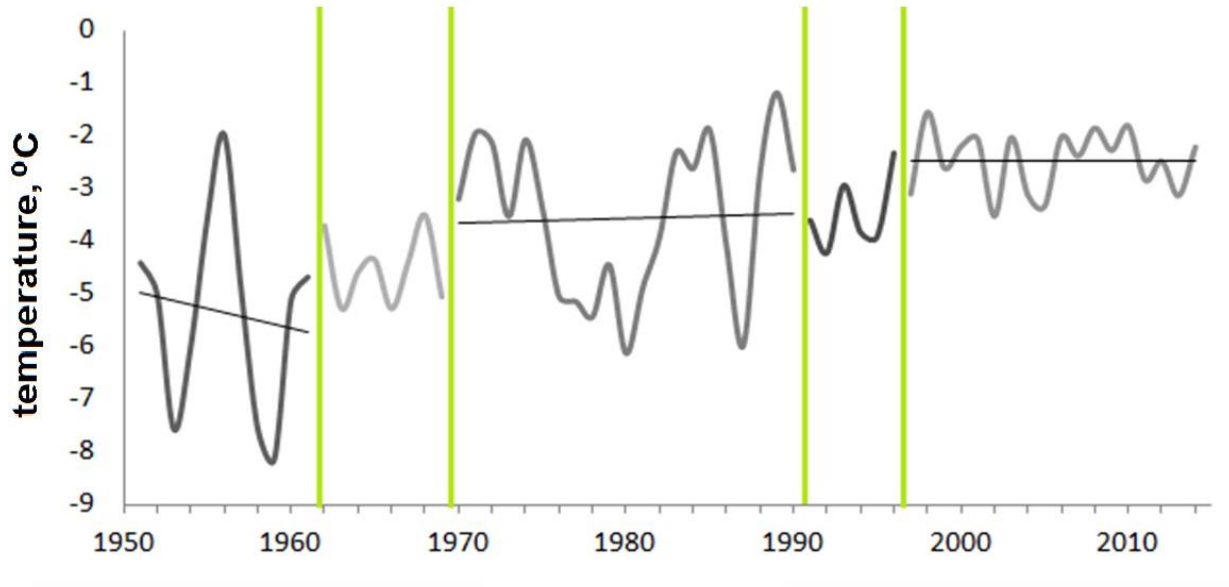

Fig. 1 The average annual air temperature at the Faraday / Vernadsky station and the highlighted periods

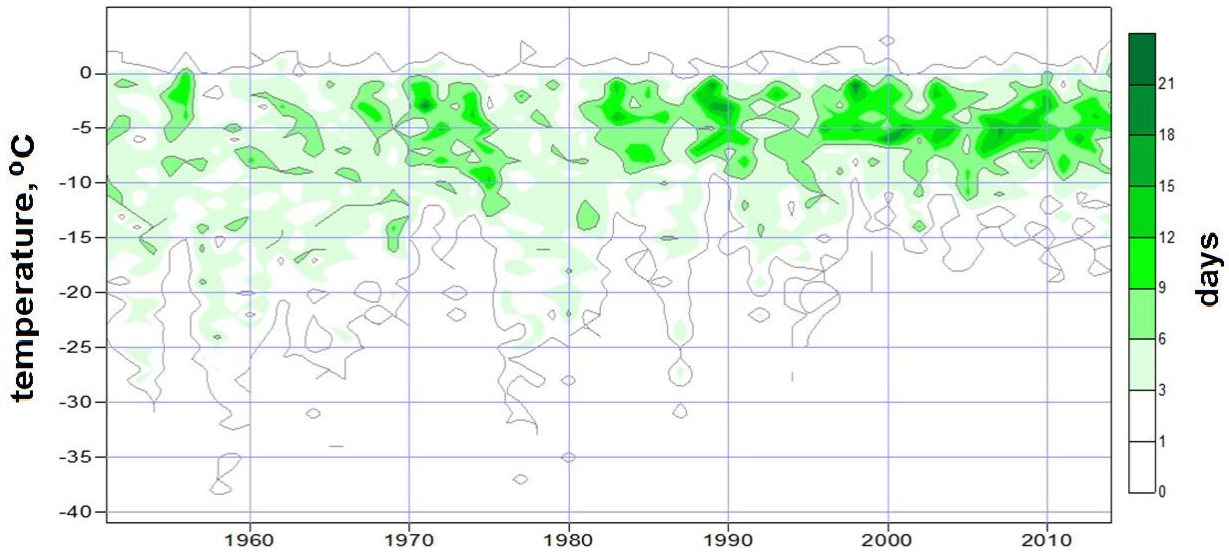

Fig. 2 Number of days (depicted by color) with daily temperature by gradations, JJA

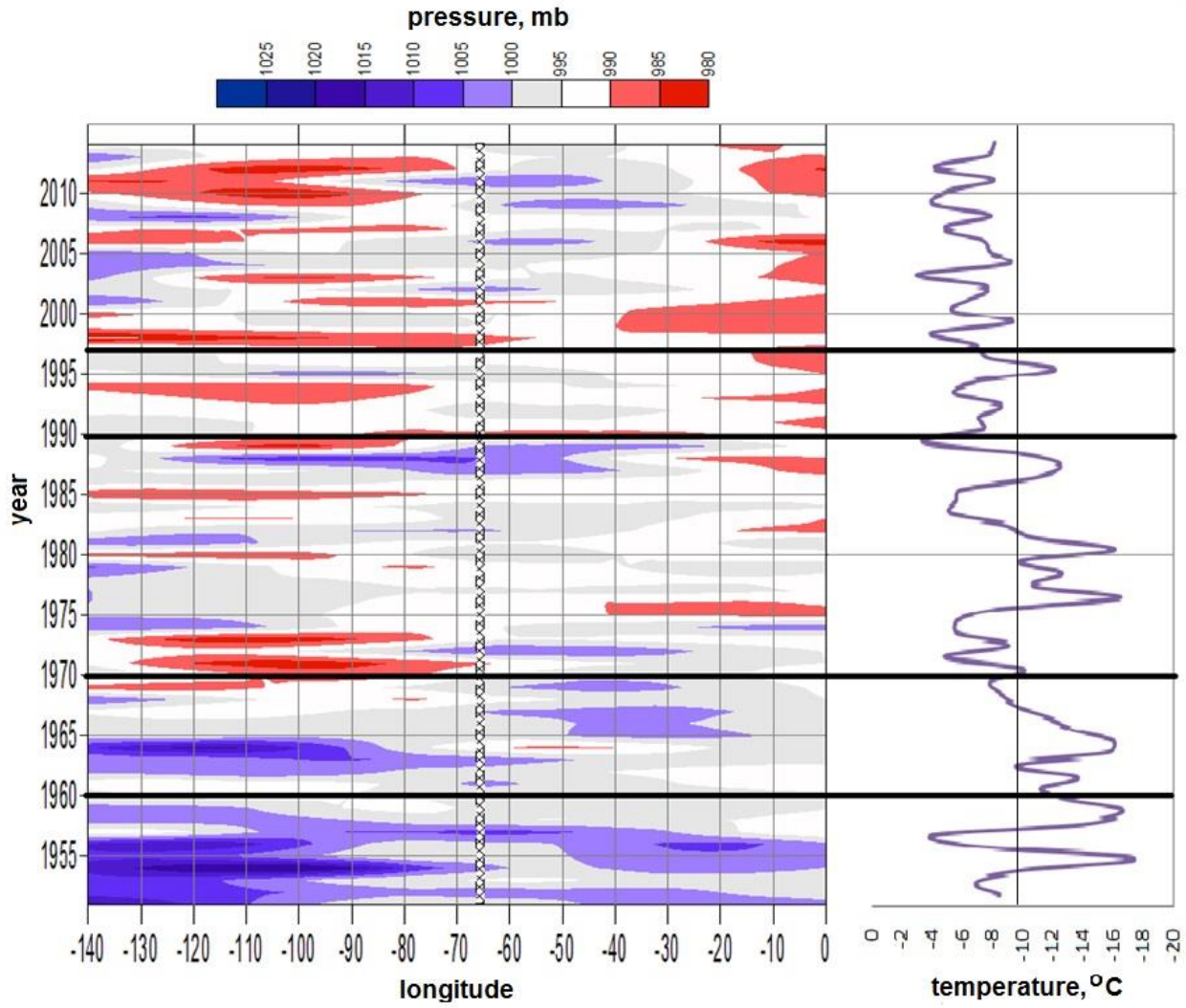

Fig. 3 A space-time diagram of averaged pressure fields in the 70-55 latitude zone (left) and average monthly temperatures (right) at the Faraday/Vernadsky station, August