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Convective potential of the atmosphere of Western Siberia in a changing climate

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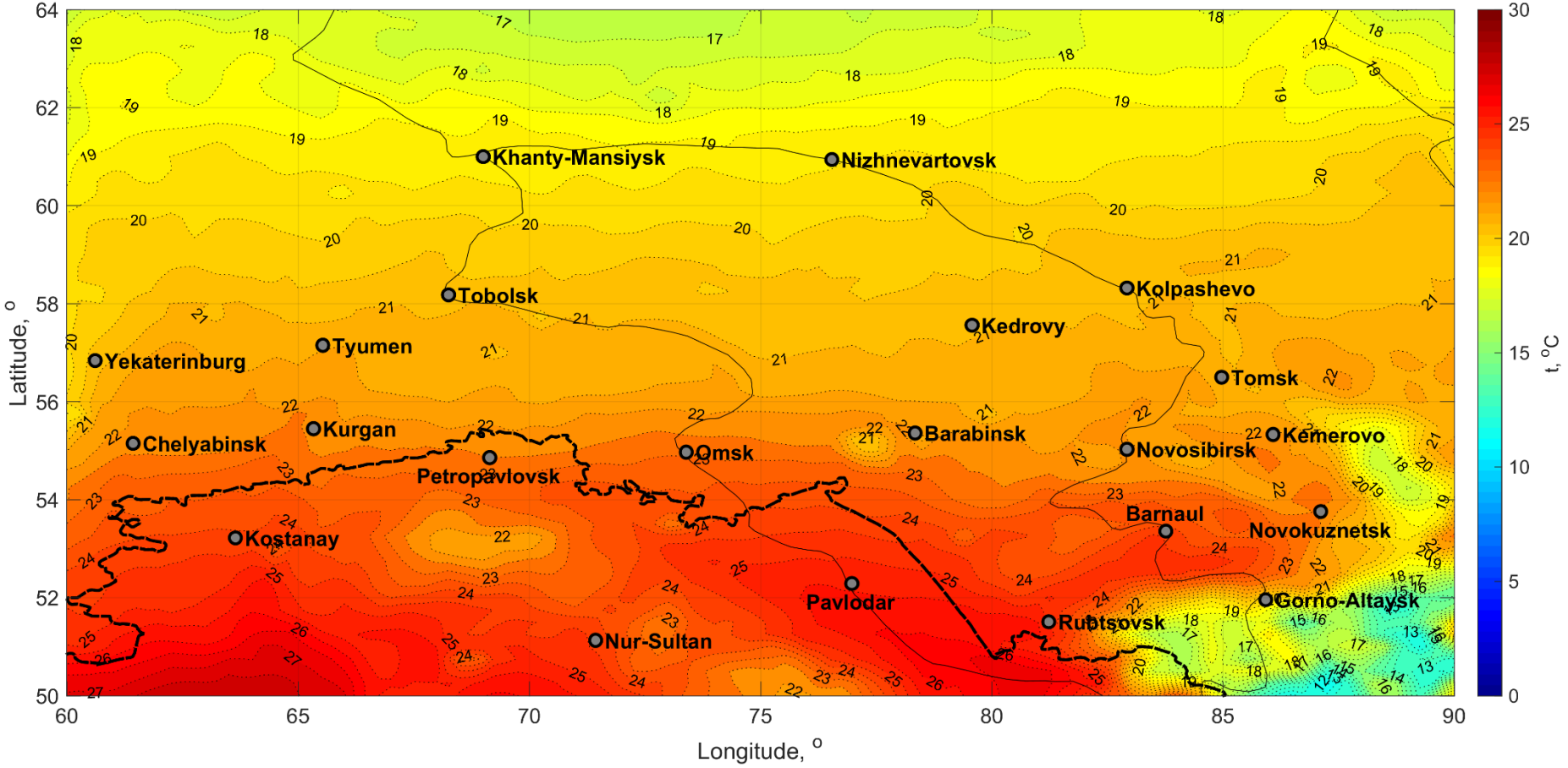
Introduction

- Against a background of the global warming hiatus observed in the recent decade, climate change in Russia is generally characterized with the ongoing warming. As for Western Siberia, a trend towards the warming slowdown is observed in winter only.
- The atmosphere over Western Siberia during the warm season generally becomes warmer and also wetter, due to local sources of moisture. This is accompanied by the intensification of convective processes and by an increase in the frequency of occurrence of extreme weather events.
- The objective of the present paper is to analyze trends in air temperature and the degree of atmospheric instability in summer in Western Siberia.

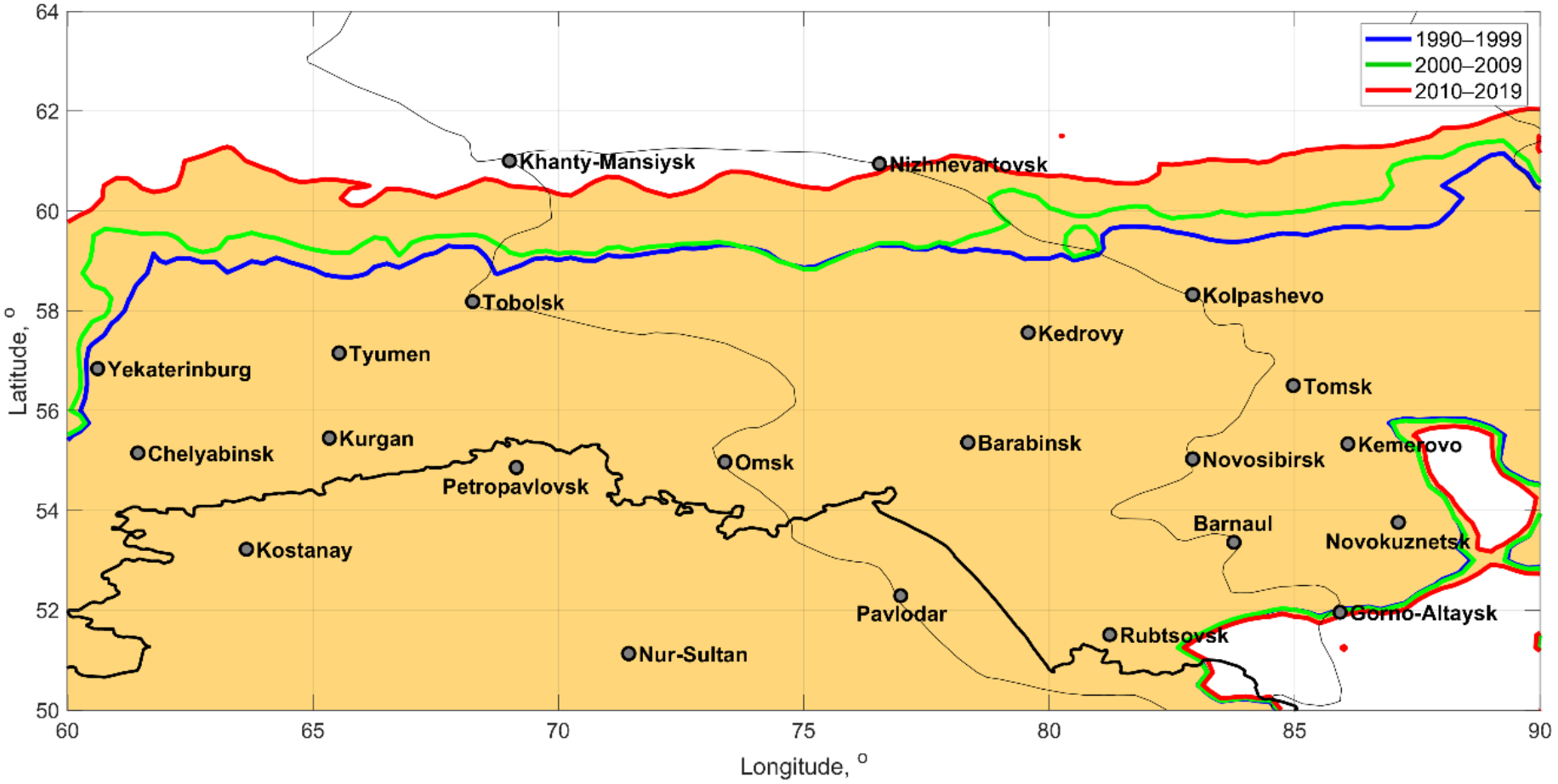
Used data and methods

- Air temperature and values of the K_{IND} of atmospheric instability for the summer months at the 0.25 ° × 0.25 ° grid points were determined from data of the ERA5 reanalysis. This reanalysis represents the fifth generation of the reanalysis of global atmospheric observations developed by ECMWF.
- Investigated territory located within the coordinates of 50°–64°N and 60°–90°E.
- Time period of research is June-August from 1990 to 2019.

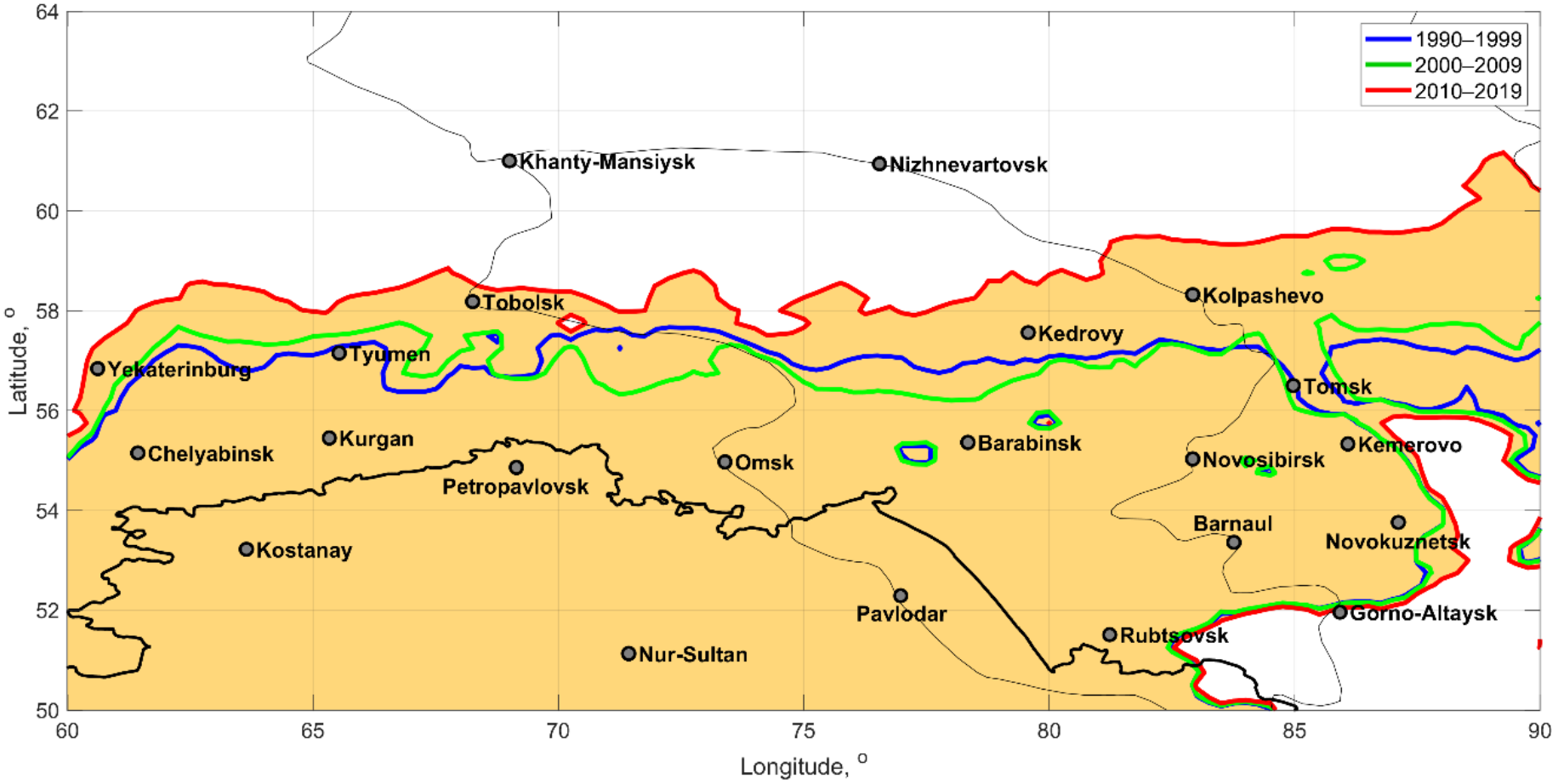
Mean air temperature at 9:00 UTC for summer months from 1990 to 2019



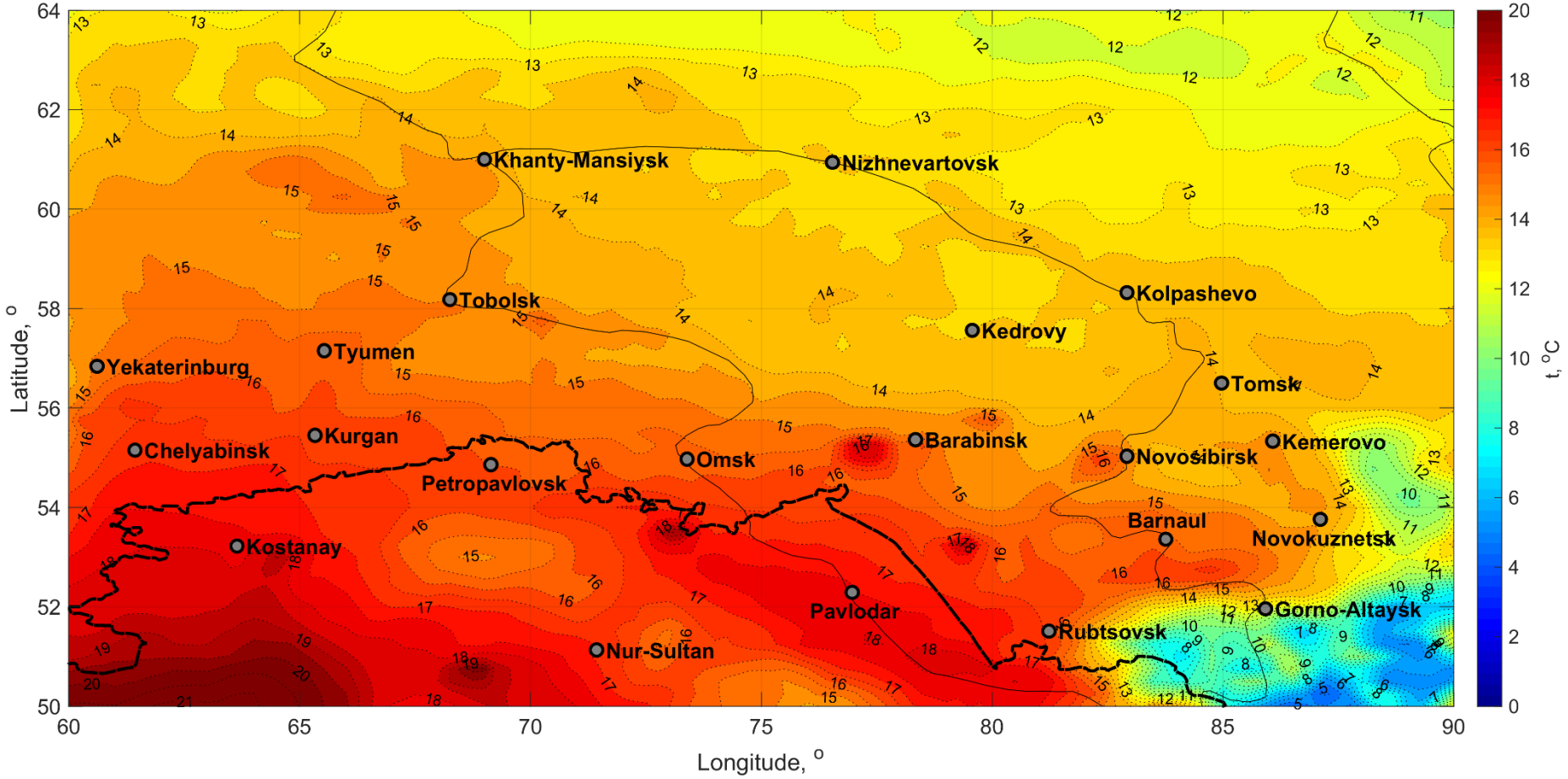
Inter-decadal changes of mean air temperature at 9:00 UTC for summer months: a case study on isoline 20 °C



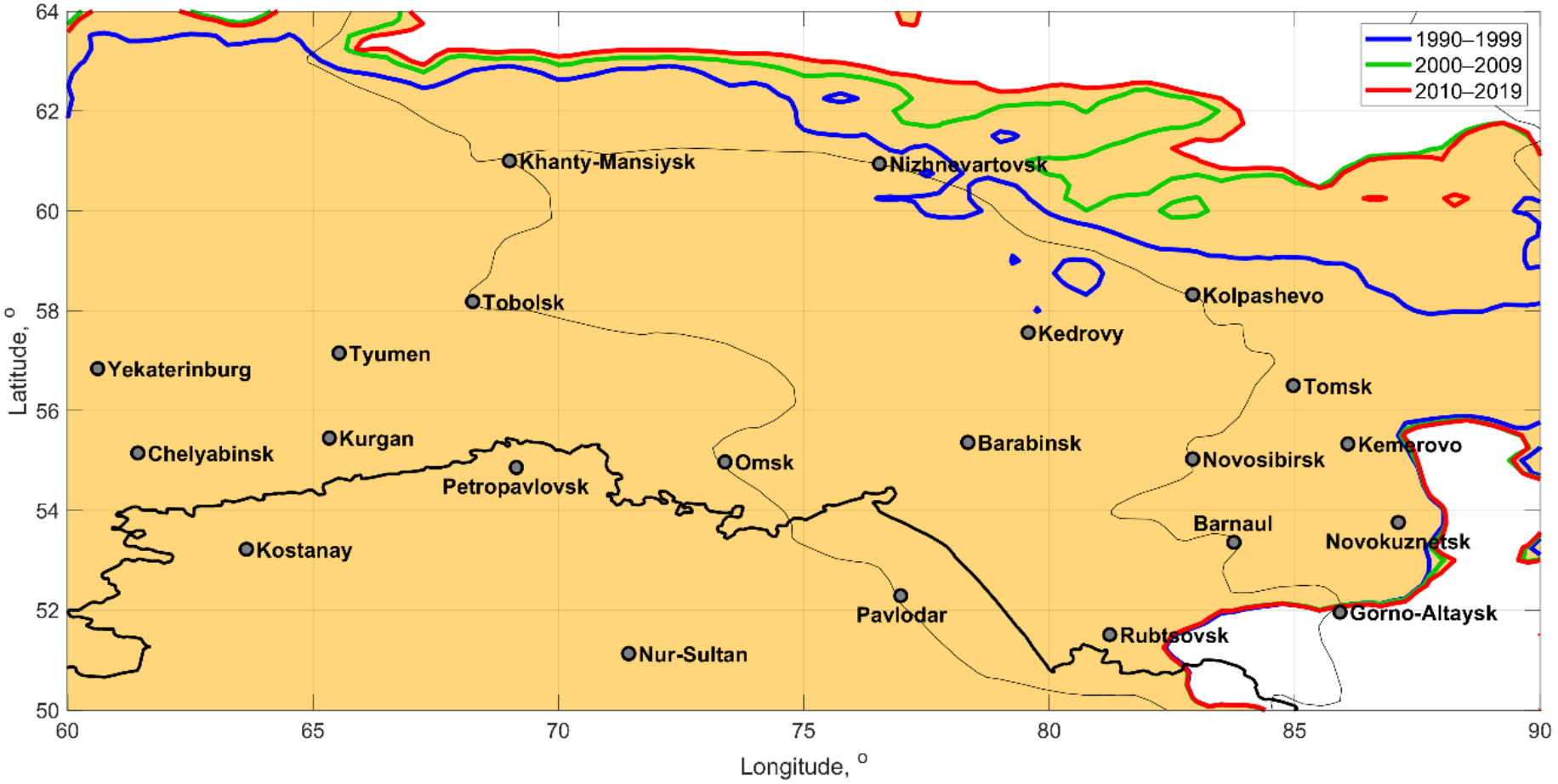
Inter-decadal changes of mean air temperature at 9:00 UTC for summer months: a case study on isoline 21 °C



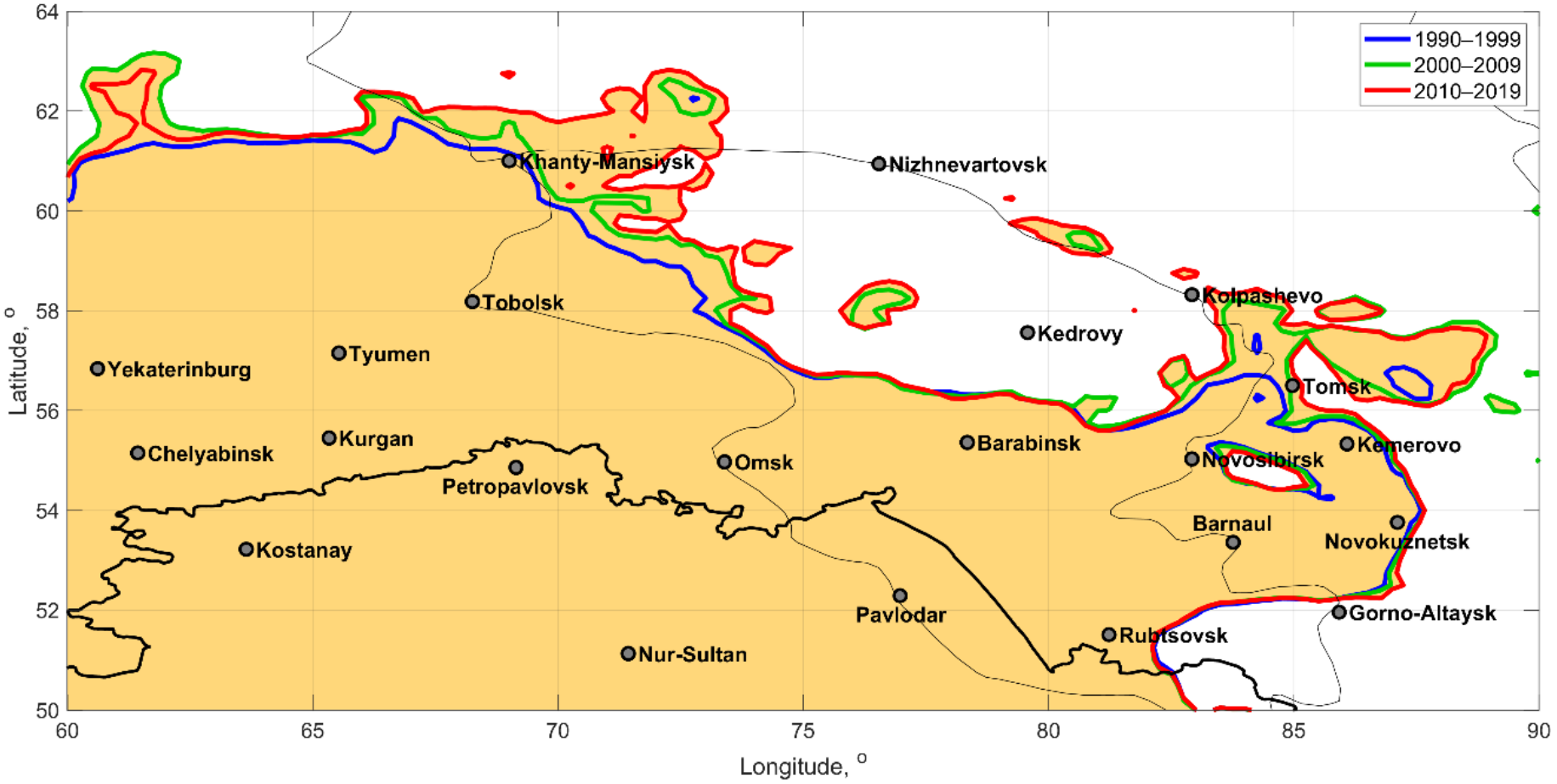
Mean air temperature at 18:00 UTC for summer months from 1990 to 2019



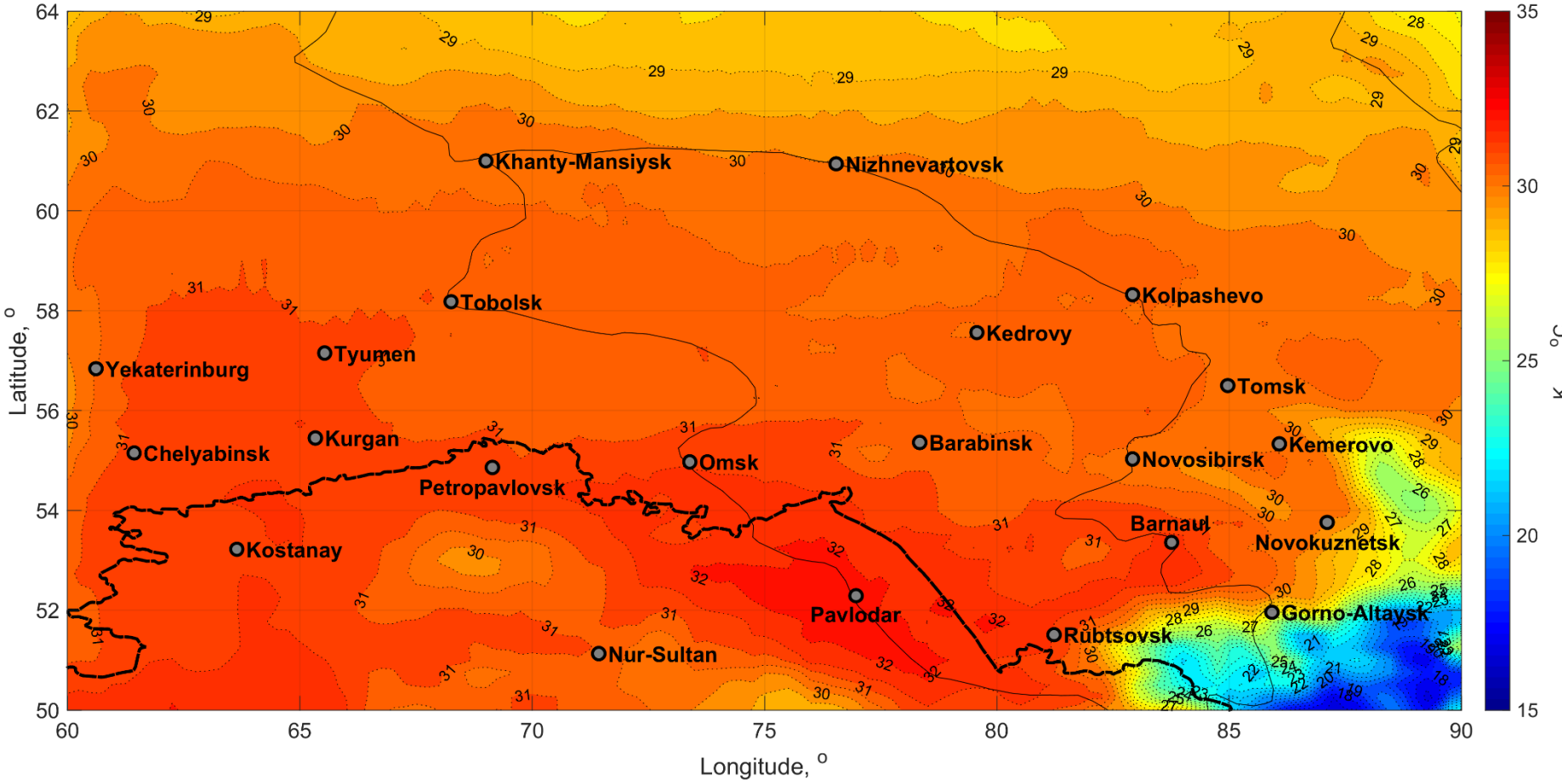
Inter-decadal changes of mean air temperature at 18:00 UTC for summer months: a case study on isoline 13 °C



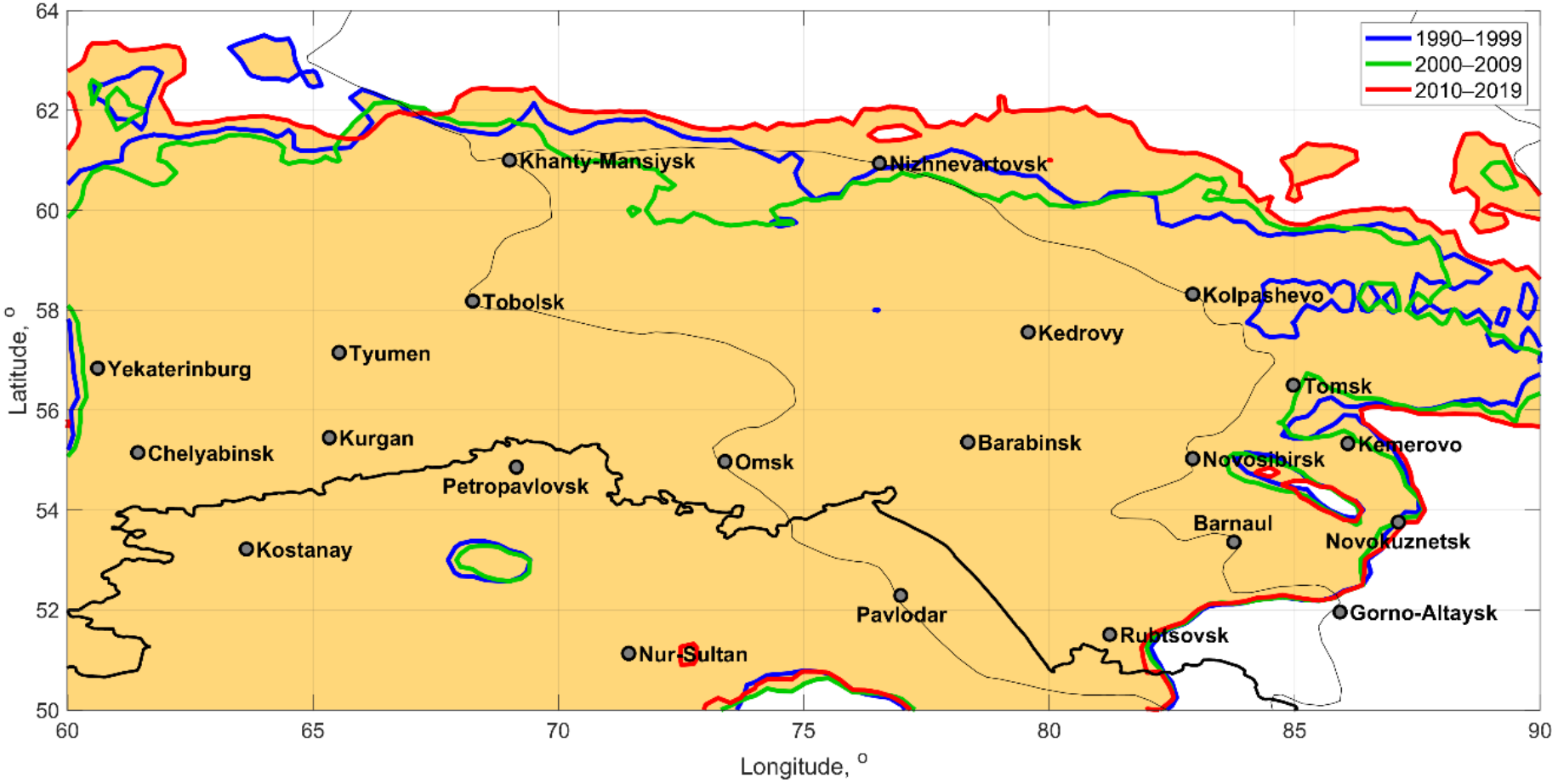
Inter-decadal changes of mean air temperature at 18:00 UTC for summer months: a case study on isoline 14 °C



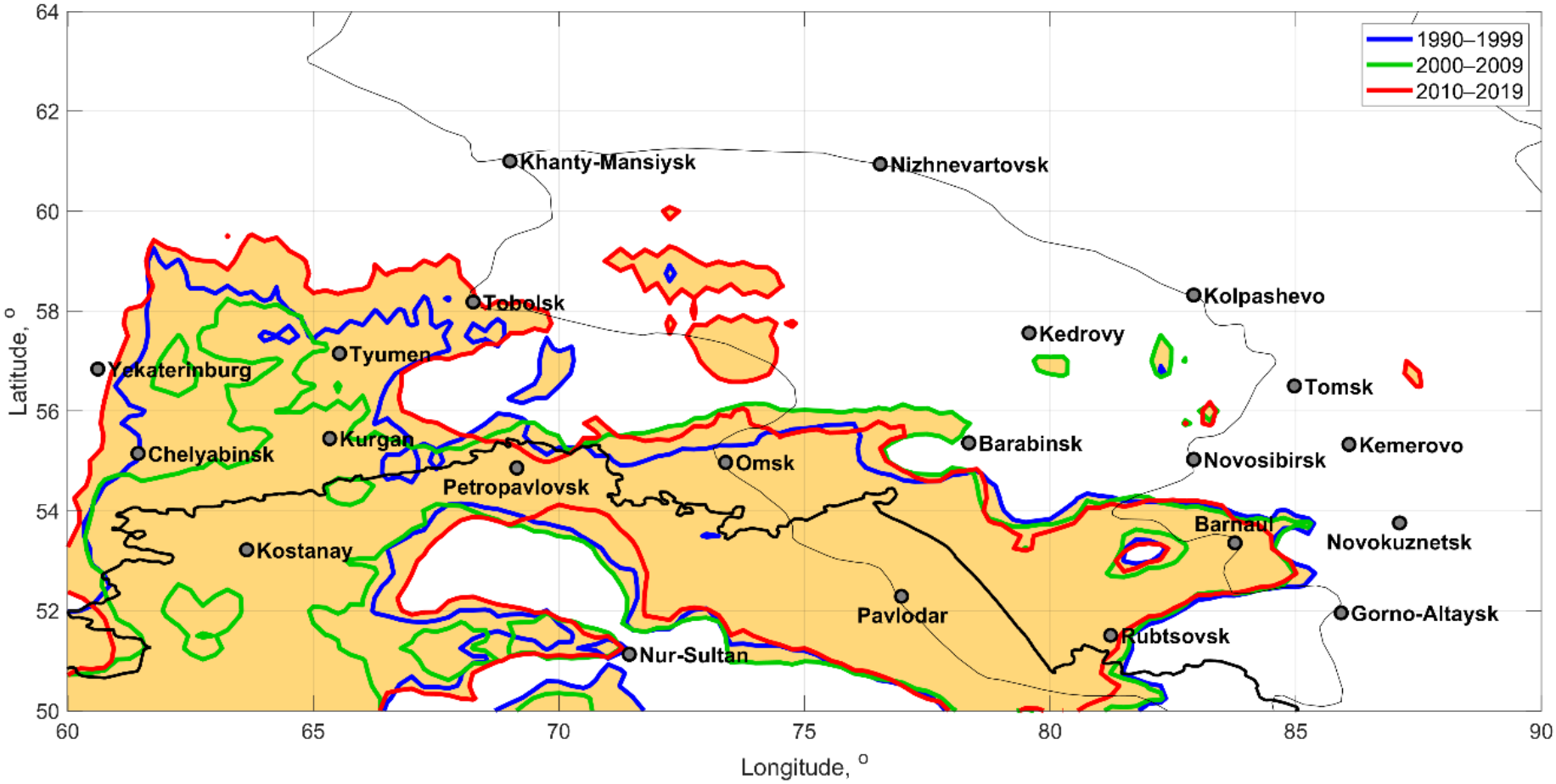
Mean K_{IND} at 9:00 UTC for summer months from 1990 to 2019, calculated by K_{IND} values ≥ 75th percentile



Inter-decadal changes of mean K_{IND} values at 9:00 UTC for summer months: a case study on isoline 30 °C



Inter-decadal changes of mean K_{IND} values at 9:00 UTC for summer months: a case study on isoline 31 °C



Main results

- The temperature zonality is broken by a hollow of the north-eastern direction, and heat spots have also appeared. The temperature of which is one or more degrees higher than the average background values for this territory, especially at night. This air temperature distribution over Western Siberia is probably due to the Great Vasyugan swamp. Note that the isotherm of 14 ºC almost outlines the swamp from its southern and western sides.
- The boundary of active convection estimated by the temperature and humidity characteristics in the layer up to 500 hPa (K_{IND}) is gradually moving northward and by 2019 reached a parallel of 62ºN.
- The greatest changes in the temperature regime of the atmosphere were observed in the Great Vasyugan swamp. The swamp boundaries are clearer distinguished on the maps of temperature isolines in the last decade, which indicates changes of the thermal radiation of the wetland surface. These changes of the heating heterogeneity and heat transfer are reflected in changes of atmospheric instability against the background of an increase in the moisture capacity of the atmosphere.

Thanks for attention!