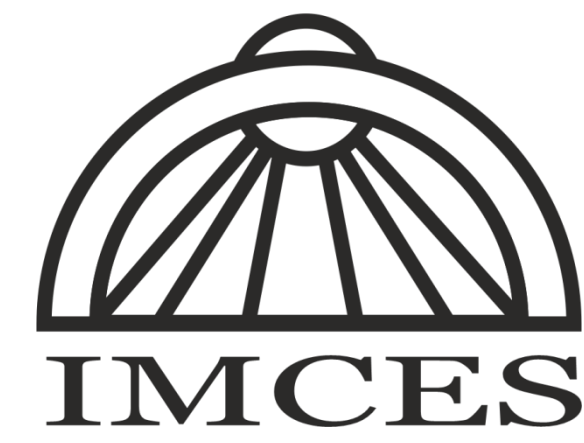


Correlation of lightning frequency and convective thermodynamic parameters of the atmosphere over of Western Siberia



Olga E. Nechepurenko¹, Konstantin K. Pustovalov^{1,2}, Valentina P. Gorbatenko¹ | 1 TSU, Tomsk, 2 IMCES SB RAS, Tomsk

ACTUALITY

Studies of correlation relations between lightning discharge density and atmospheric instability characteristics are relevant for two reasons:

1. At present, parametrization of lightning activity (eg, frequency, polarity) is being implemented into climate models, which integrates the lightning frequency with the characteristics of convective cloudiness. The findings of the proposed study may be informative and important in this aspect as well.
2. Forecasting the development of hazardous phenomena associated with convective clouds (thunderstorms, hail, and tornados) remains a critical issue, particularly in territories where there are no weather radar network and / or lightning detection systems.

AIM and METHODOLOGY

To study the spatial correlation between the characteristics of the atmospheric stability and the density of lightning discharges registered by the satellite over the southeast of Western Siberia.

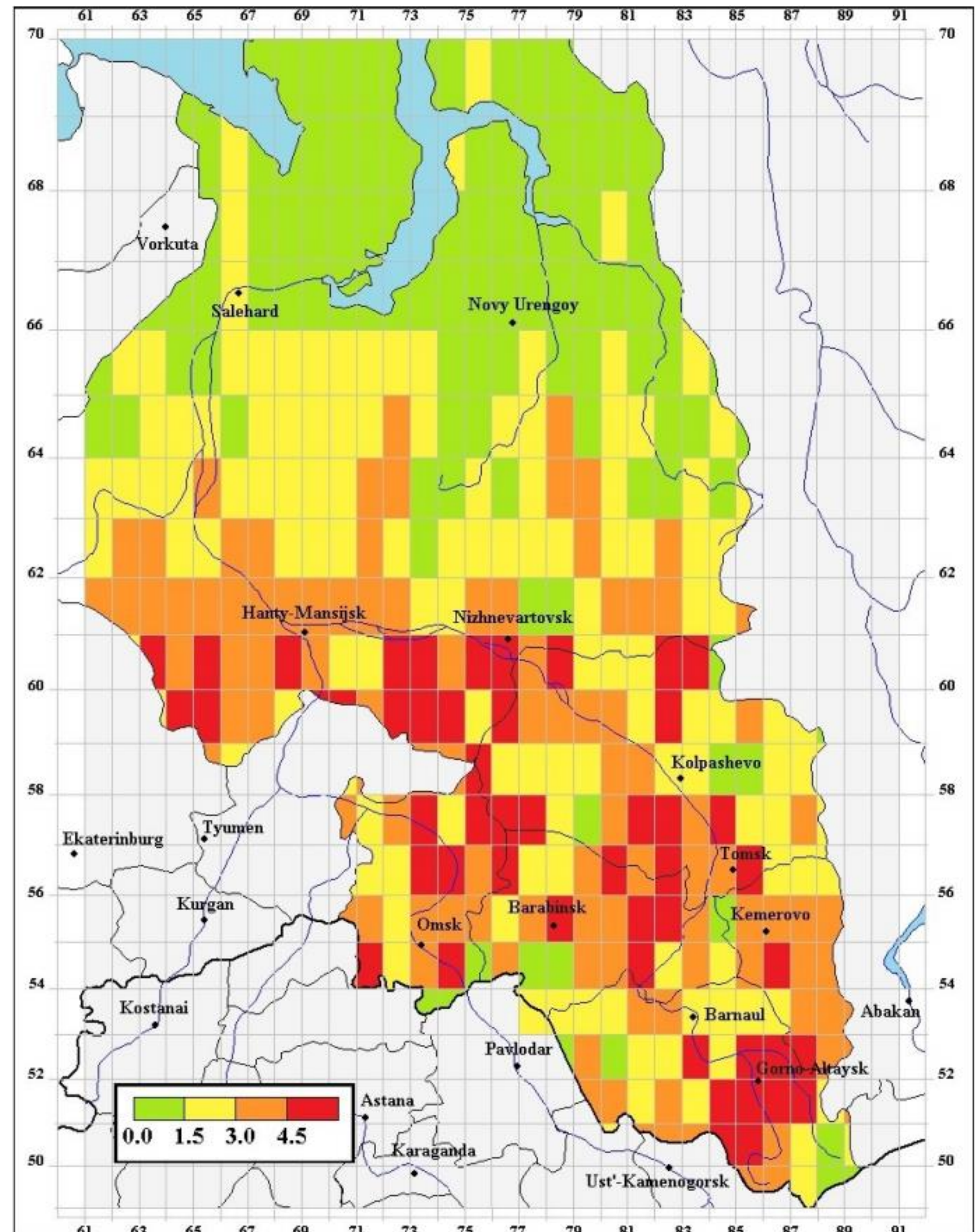
The estimation of atmospheric stability is based on the average spatial pattern of KIND index (see below) according to the ERA5 reanalysis, for the days when the centers of lightning activity were located over different regions of study area.

$$KIND = (T_{850} - T_{500}) + TD_{850} - (T_{700} - TD_{700})$$

T_{850} , T_{700} - temperature at 850 and 700 hPa, respectively, °C;
 TD_{850} , TD_{700} - dew point temperature at 850 and 700 hPa, respectively, °C.

Lightning discharge density has been recorded by OTD (Optical Transient Detector) aboard the Microlab-1 satellite (NASA) during the summer seasons of 1995–1999.

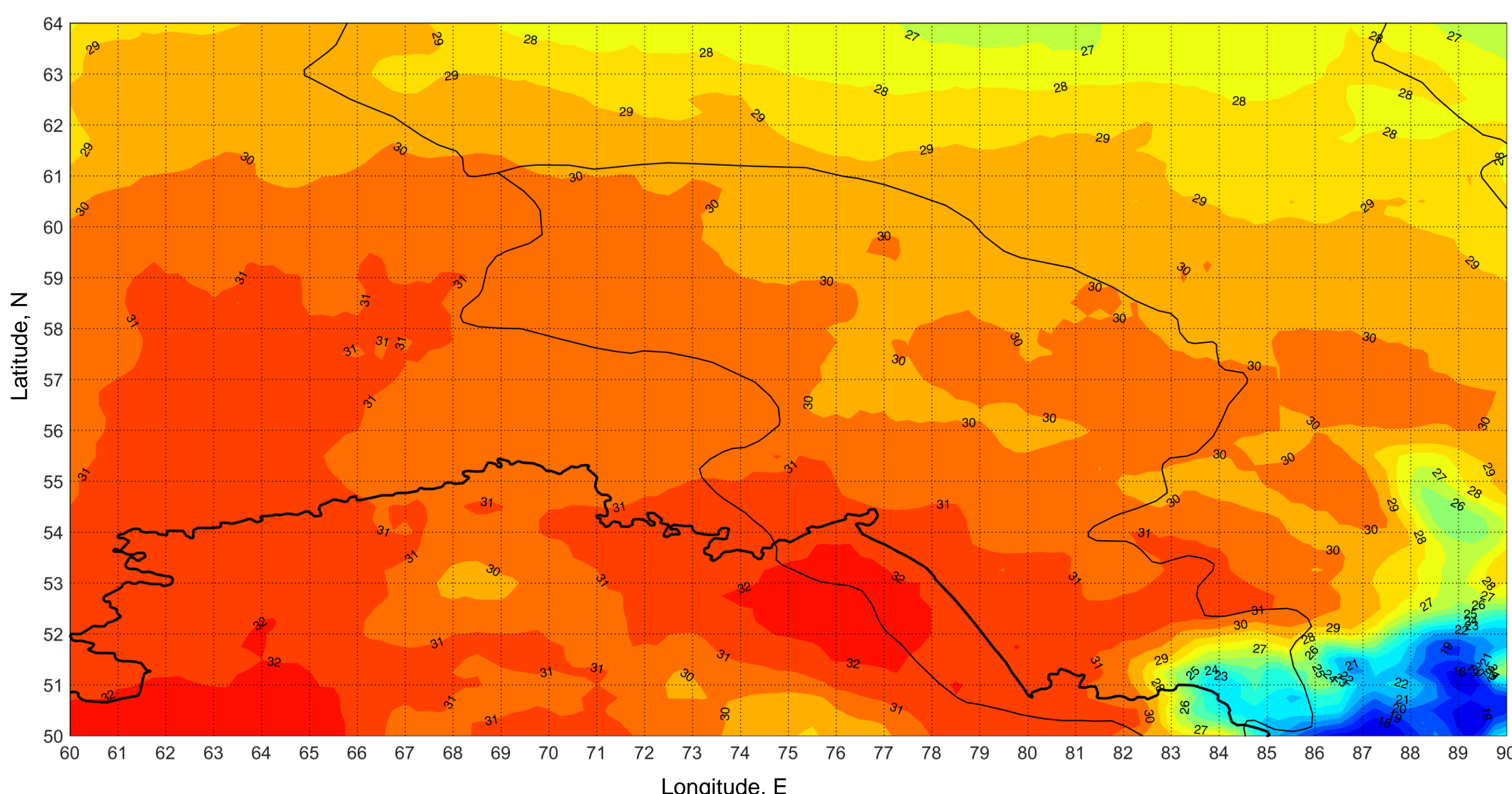
The values of lightning discharge density and KIND index are determined for a same single square of 1 x 1° in the range of 50–64 N and 61–90 E (total 420 squares).



Spatial distribution of the lightning discharges density for the territory of Western Siberia [1]

RESULTS

To check relationship between the two samples, the Fechner correlation coefficient and Pearson's chi-squared test were used.



Average KI, calculated by values equal to and greater than 75th percentile, at 0900 UTC for the summer months 1995-1999

The Fechner coefficient signed a potential direct correlation between the lightning discharge density and KIND values ($F = 0.17$).

Based on the Pearson's chi-squared test, longitude groups were determined where a significant positive correlation (> 0.4) was observed at a confidence level of 95%: 69–71 E (Ob-Irtysh interfluve, Siberian ridges, Ishim plain, Kazakh small hills) and 82–88 E (southeastern part of the West Siberian Plain, Vasyugan, Salair Ridge, Kuznetsk Alatau and Altai-Sayan Mountain System).