Spatial analysis of cancer distribution in Gomel and Mogilev oblasts of Belarus as a preliminary stage for revealing the provoking local factors

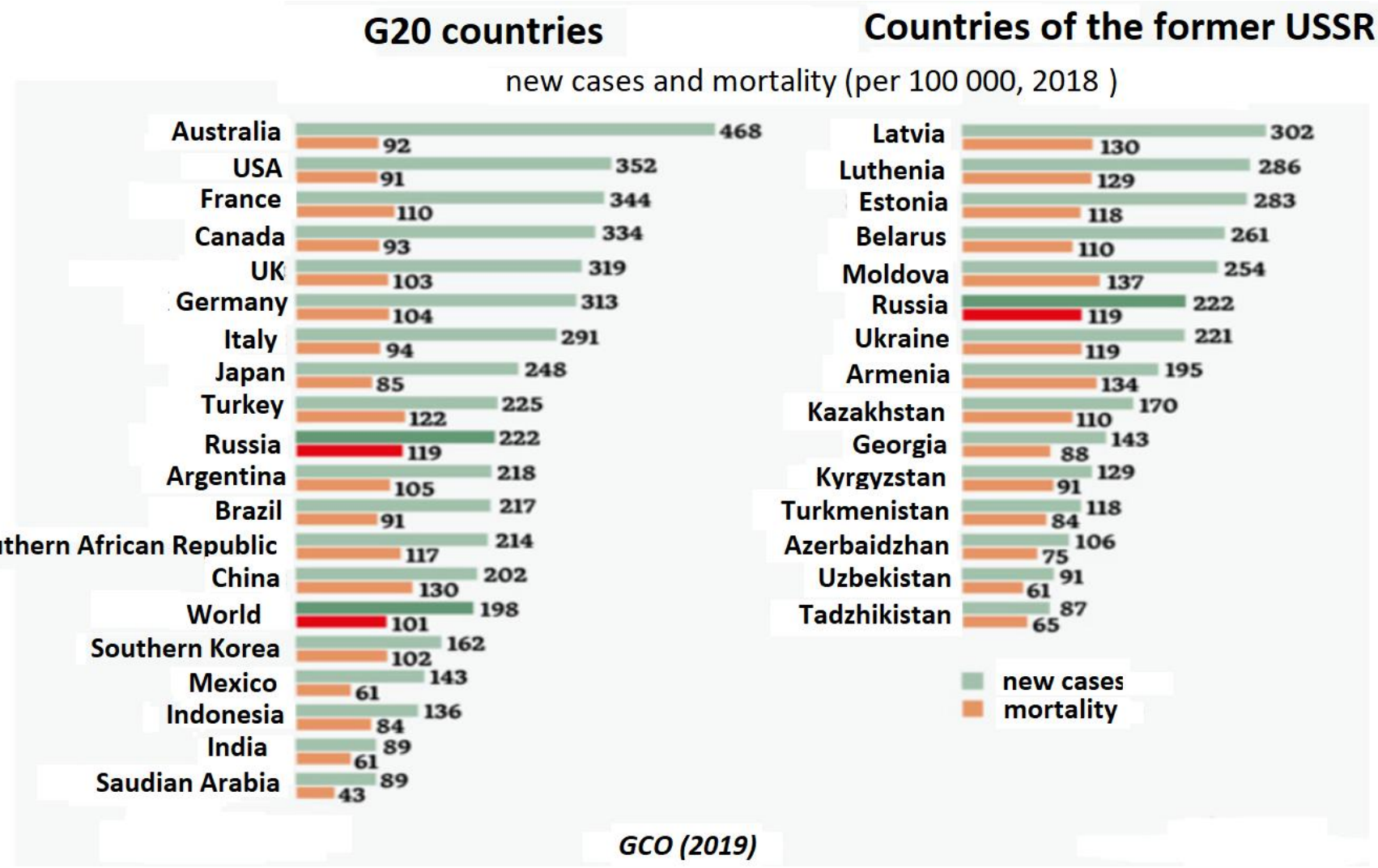
Sergey Romanov[1] , Aleksander Chervan[2] , and Elena Korobova[3]

[1]Unitary Enterprise "Geoinformation Systems", Minsk, Belarus (newromm@mail.ru)

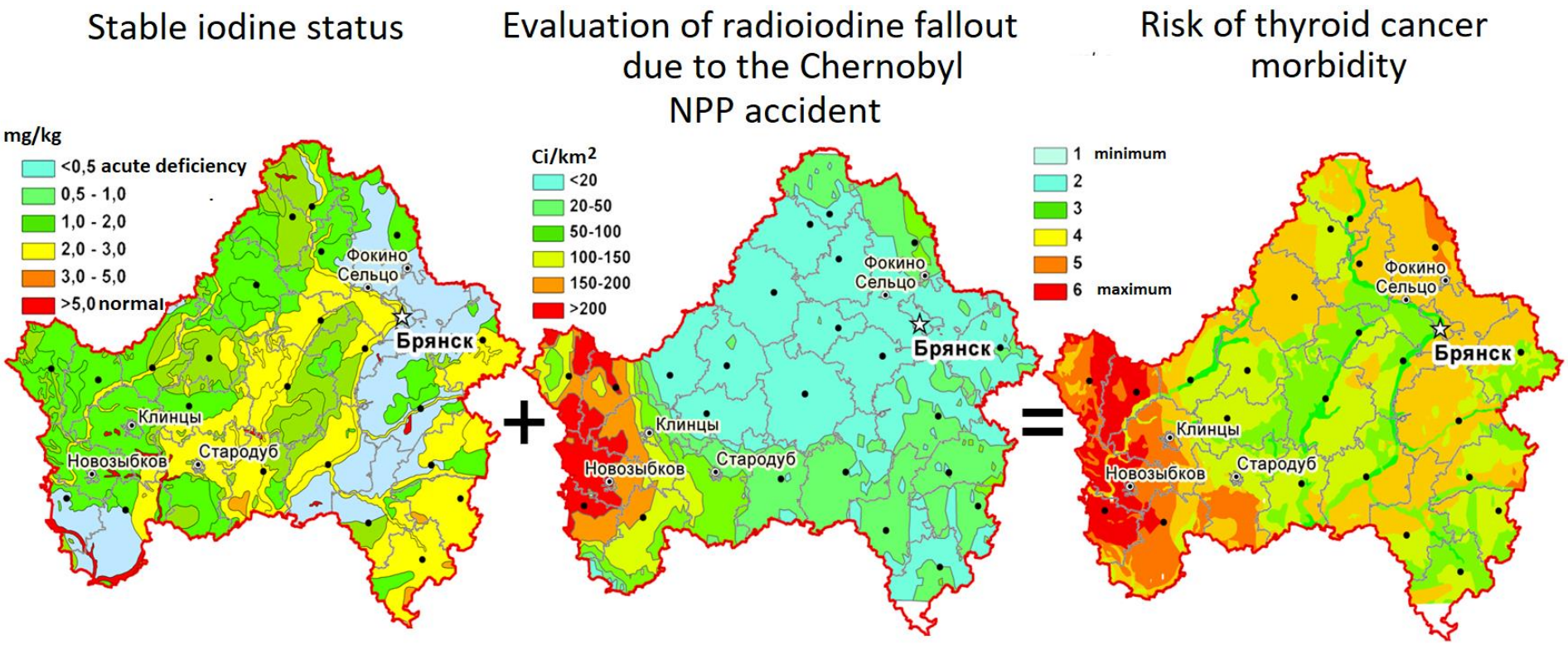
[2]Belarusian State University, Minsk, Belarus (Chervan@bsu.by)

[3] Vernadsky Institue of Geochemistry and Analytical Chemistry, Rus. Ac. of Sci., Moscow, Russia (korobova@geokhi.ru)

Level of occurrence of cancer morbidity worldwide and in the former Soviet Union in 2018



Principles for creating ecological and geochemical risk maps



The main goal and methods

A series of maps using different GIS spatial analysis techniques were constructed to perform spatial analysis of the distribution of oncological diseases in Belorussia.

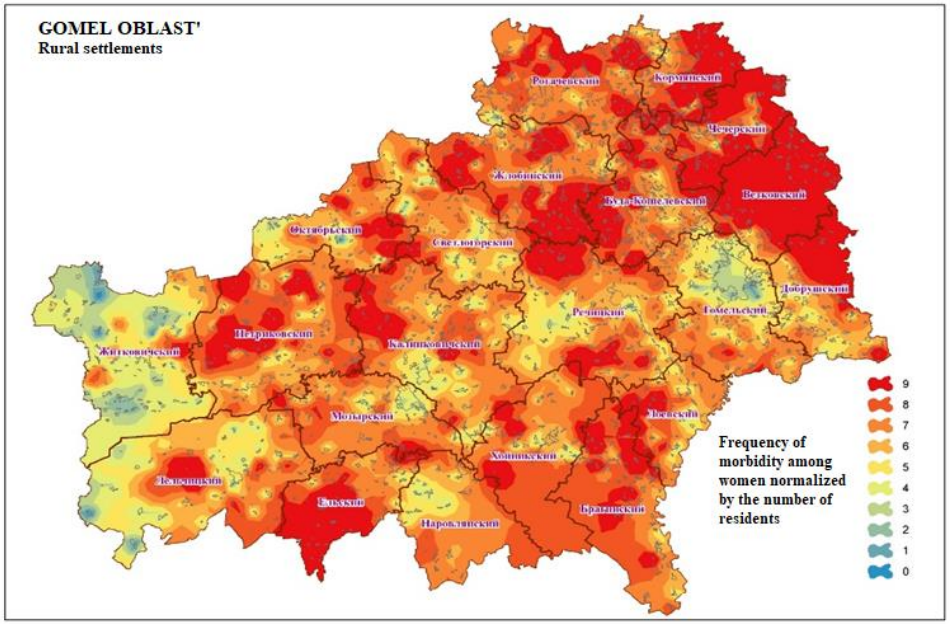
Mapping was based on the data of the national cancer register, which contains considerable information of all cancer cases of different localization and allows separation of different sex and age groups of the population. Preliminary data verification showed a high variation of cancer cases in different areas.

The second step of the research confirmed the high spatial heterogeneity of medical data when the maps characterizing different variation levels of cancer cases were made using a specialized GIS.

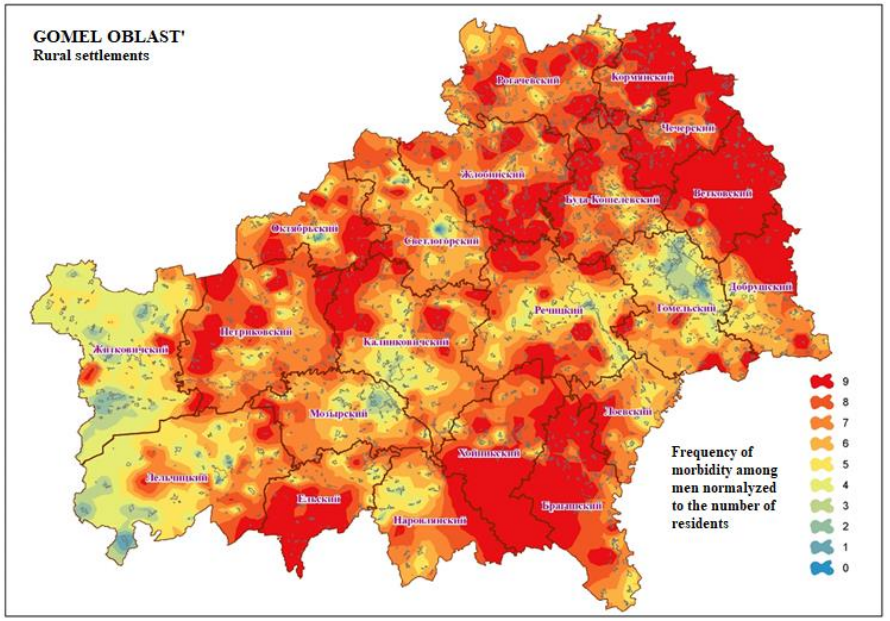
After that, the regional zoning was carried out for the Gomel and Mogilev regions most subjected to the Chernobyl radionuclides fallout in Belarus and the areas with a significant difference in the level of general and localized cancer rates were separated.

Total cancer morbidity among rural population in Gomel oblast' (women and men)

Frequency of morbidity among women normalized to the number of residents

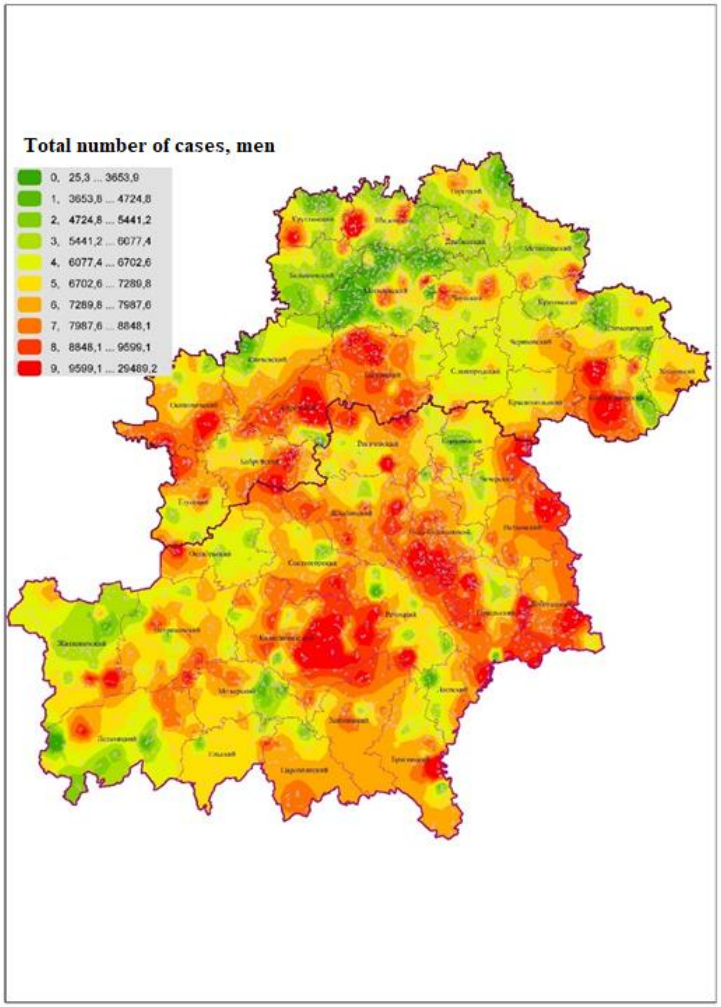


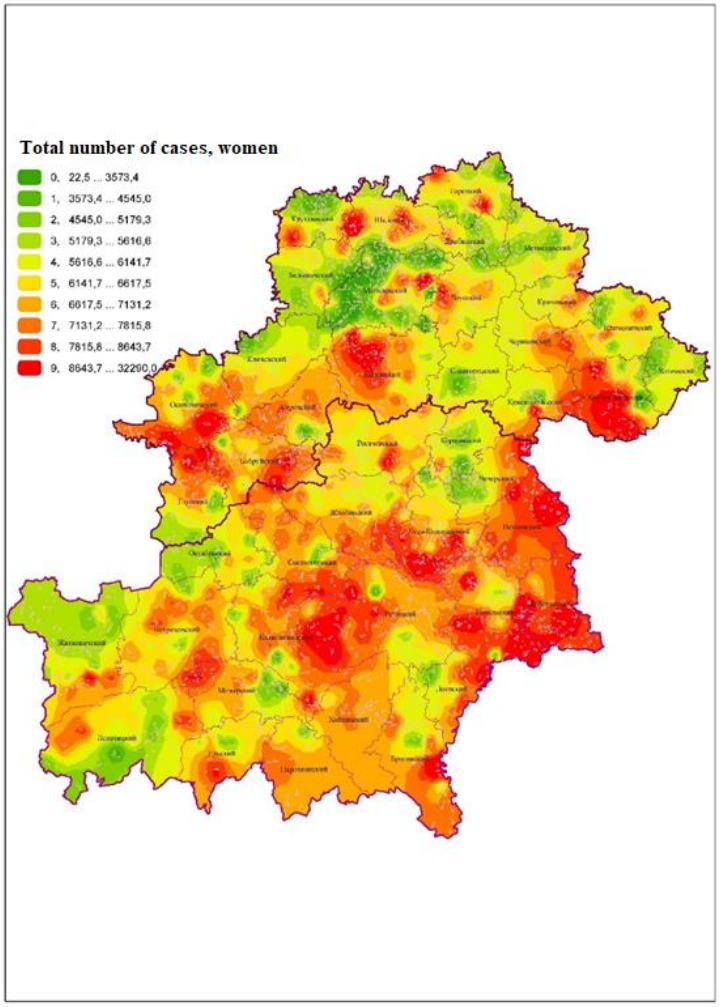
Frequency of morbidity among men normalized to the number of residents



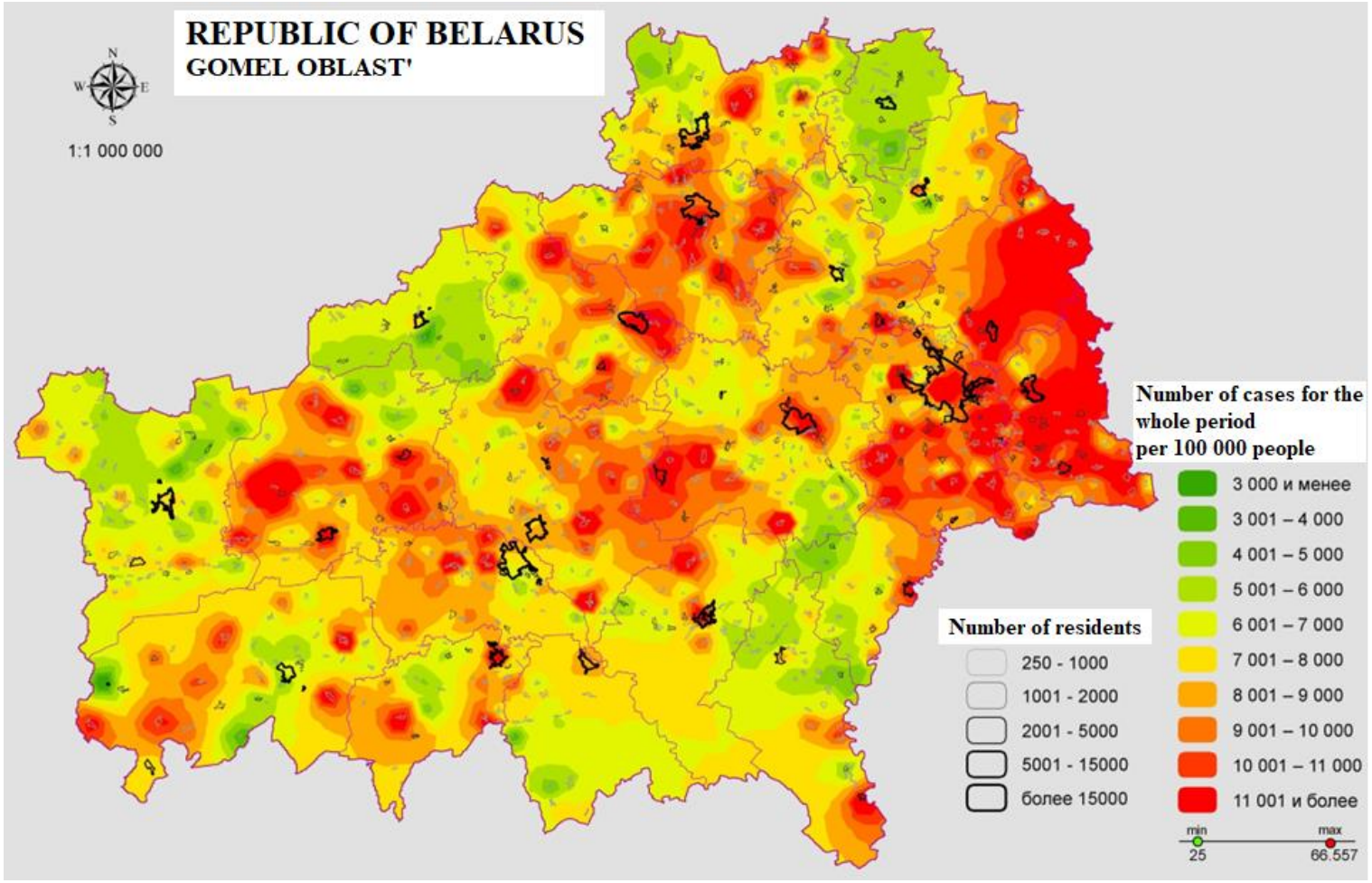
The general picture showed that the actual risk level of the oncological diseases (including those of different localization) spatially varies by four times or even more. Such a significant change in the frequency of occurrence of cancer cases of mans and women within limited areas univocally showed on the local factors that can provoke such an increase in morbidity.

Total level of cancer mobidity among men and women (Gomel and Mogilev oblast's)



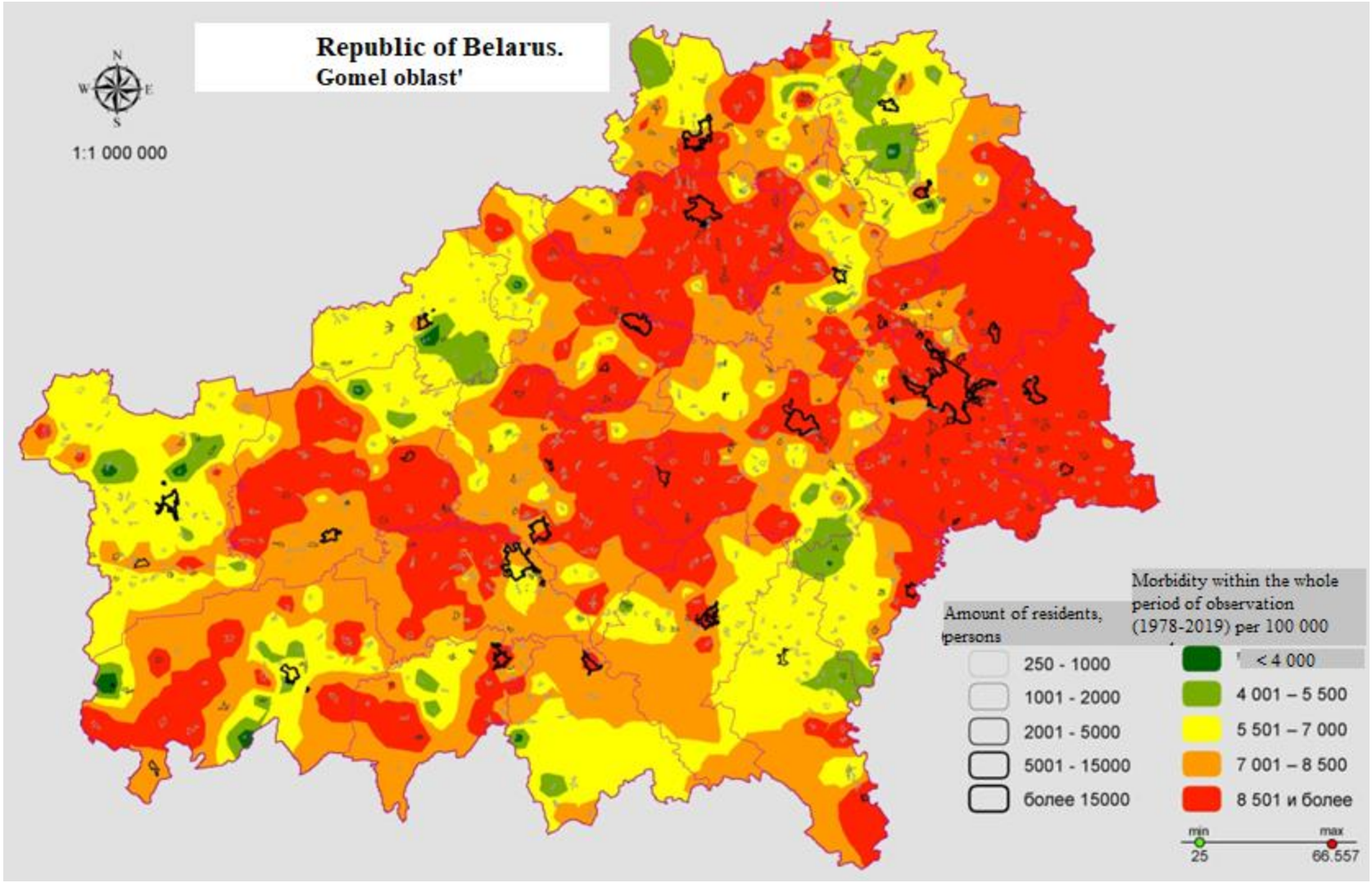


Total morbidity level in Gomel oblast’



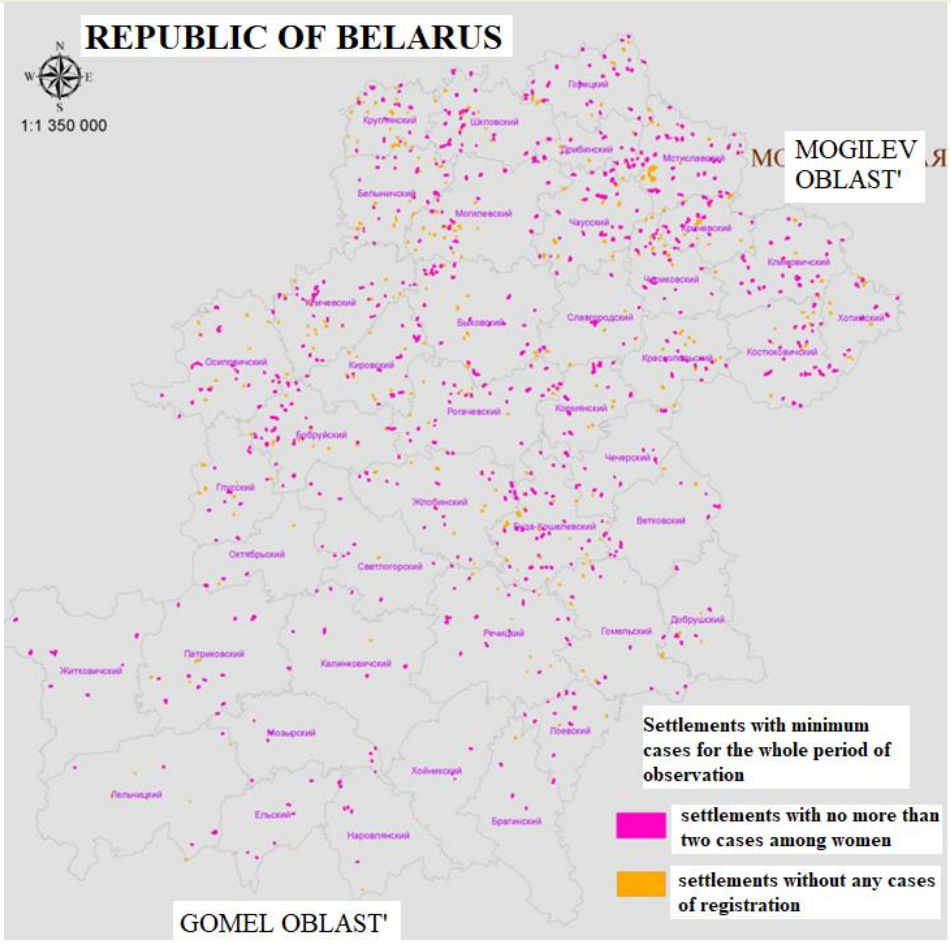
Spatial patterns of morbidity level do not depend upon the number of grouping. Case 1 – 10 groups.

Grouping of the total amount of persons subjected to cancer diseases for the whole period



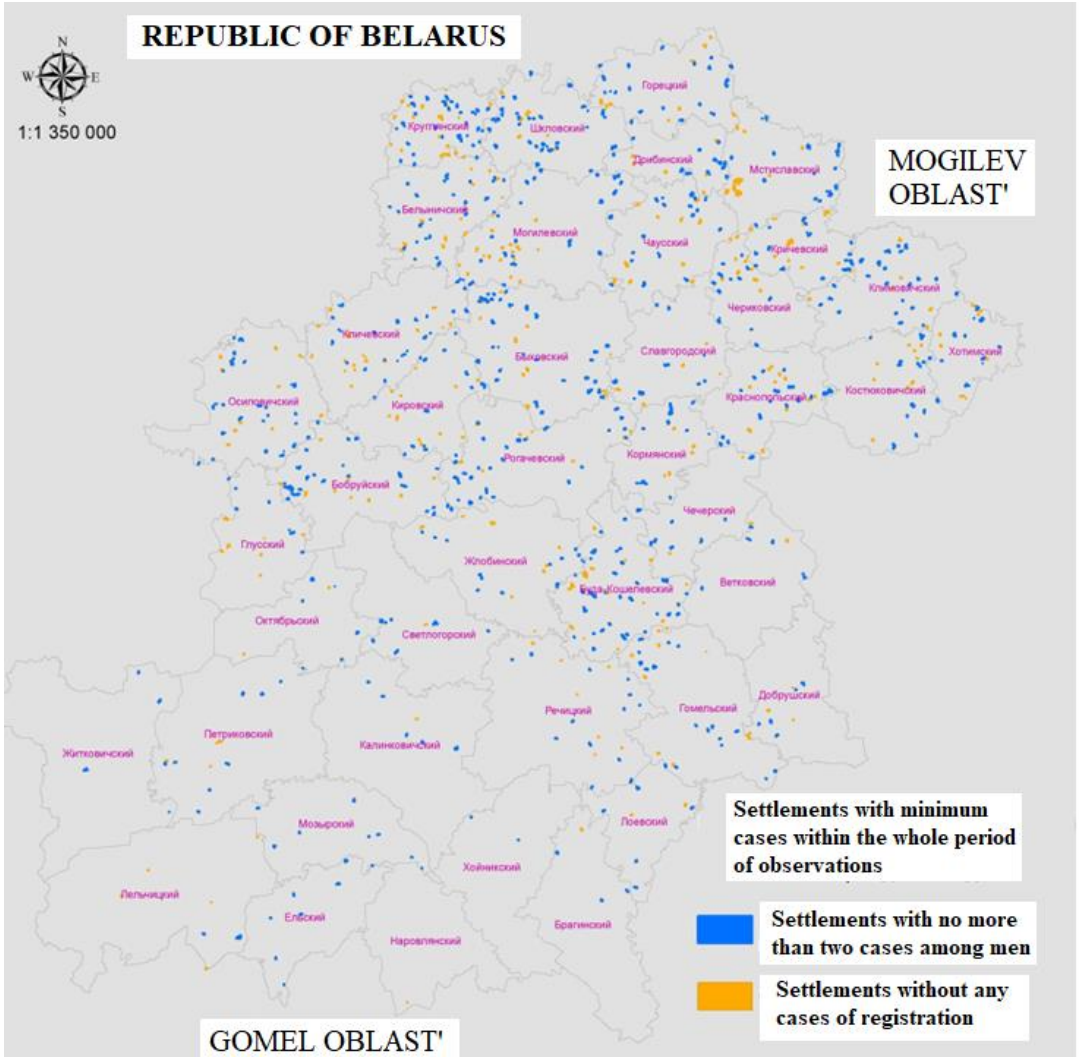
Spatial patterns of morbidity level do not depend upon the number of grouping. Case 2 – 5 groups.

SETTLEMENTS WITH MINIMUM AMOUNT OF CASES (WOMEN)



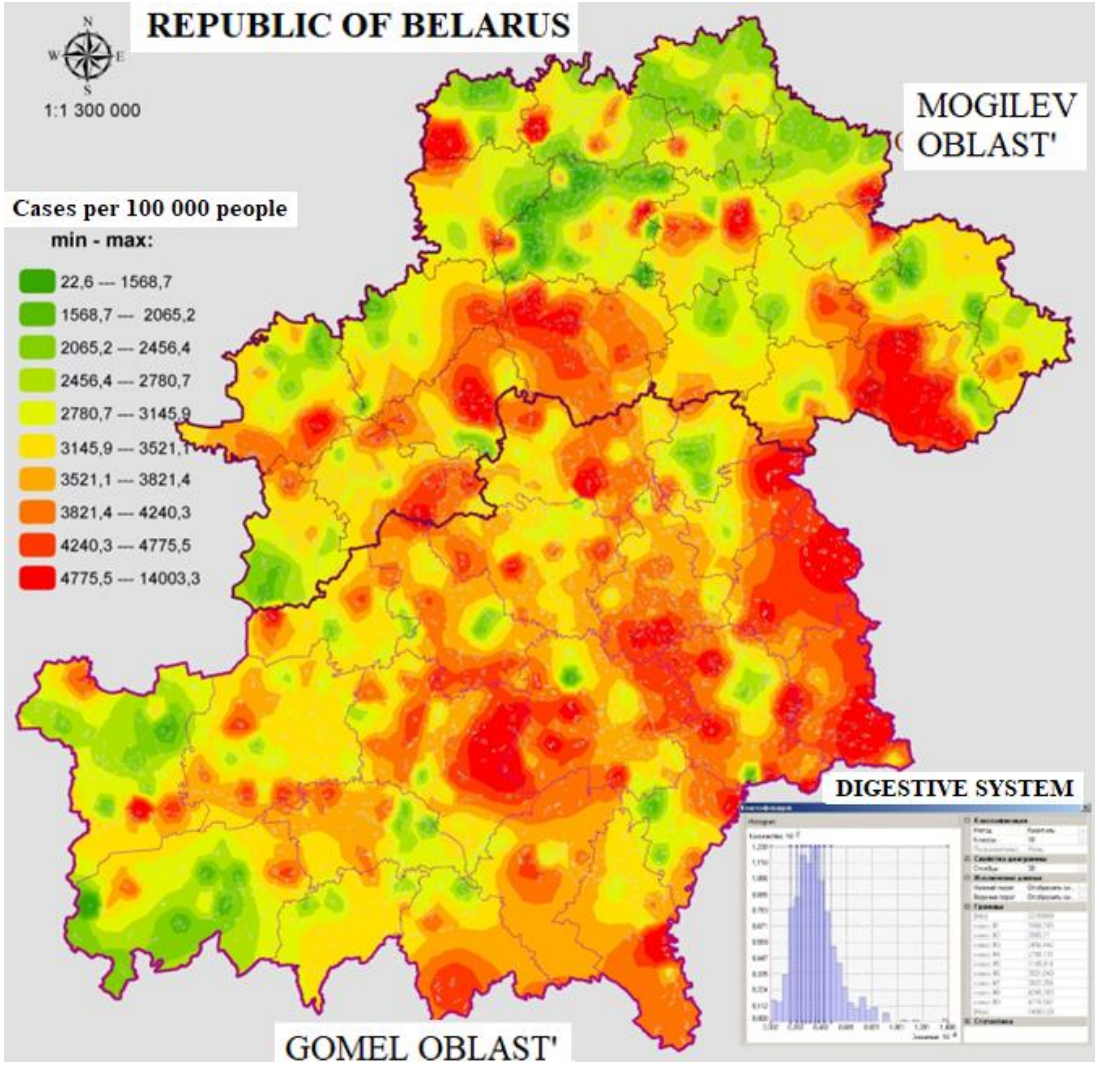
In our opinion, the revealed zones of enhanced cancer morbidity and those where the morbidity appeared to be minimal should become the objects of priority study. In Mogilev oblast' the number of settlements with minimum number of cases is higher in Mogilev oblast' compared to that of Gomel.

SETTLEMENTS WITH MINIMUM CASES AMONG MEN



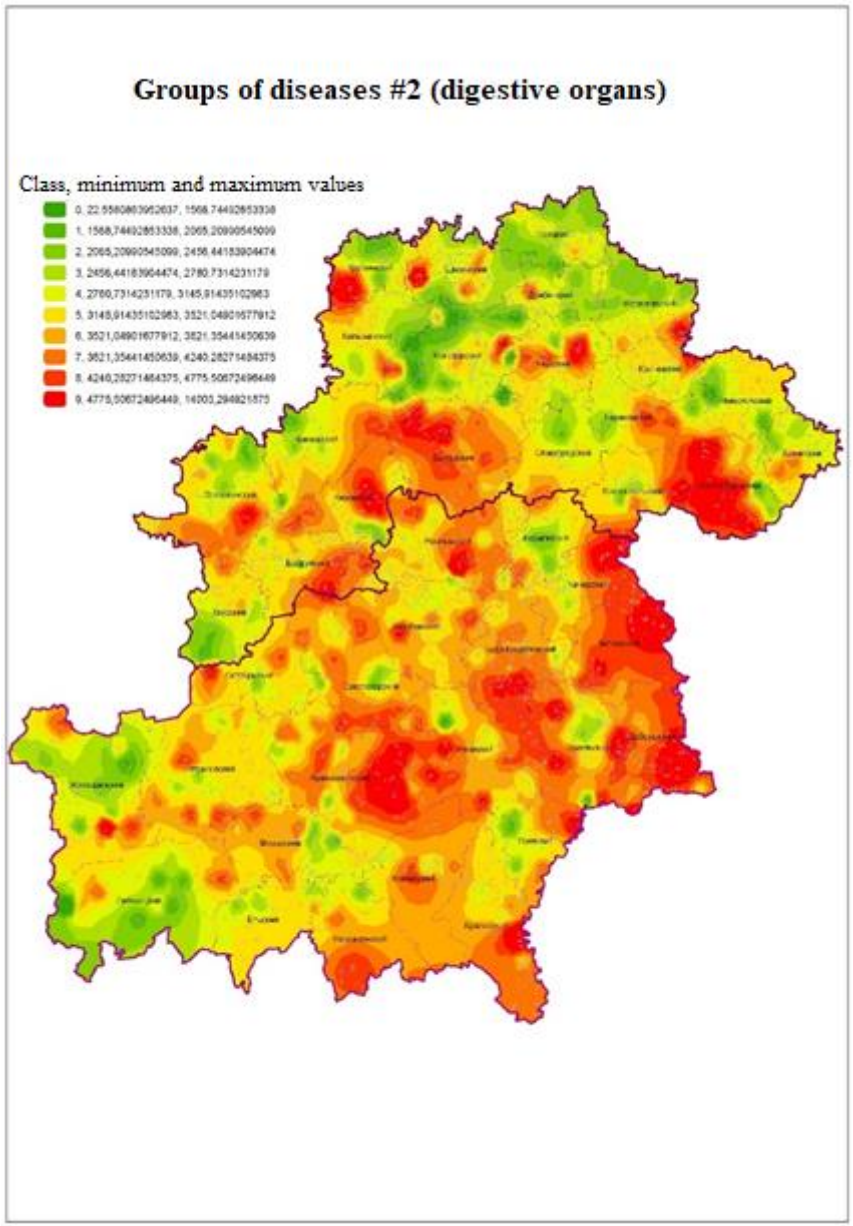
Those settlements and their groups which represent the highest density of cancer cases need priority examination and prevention.

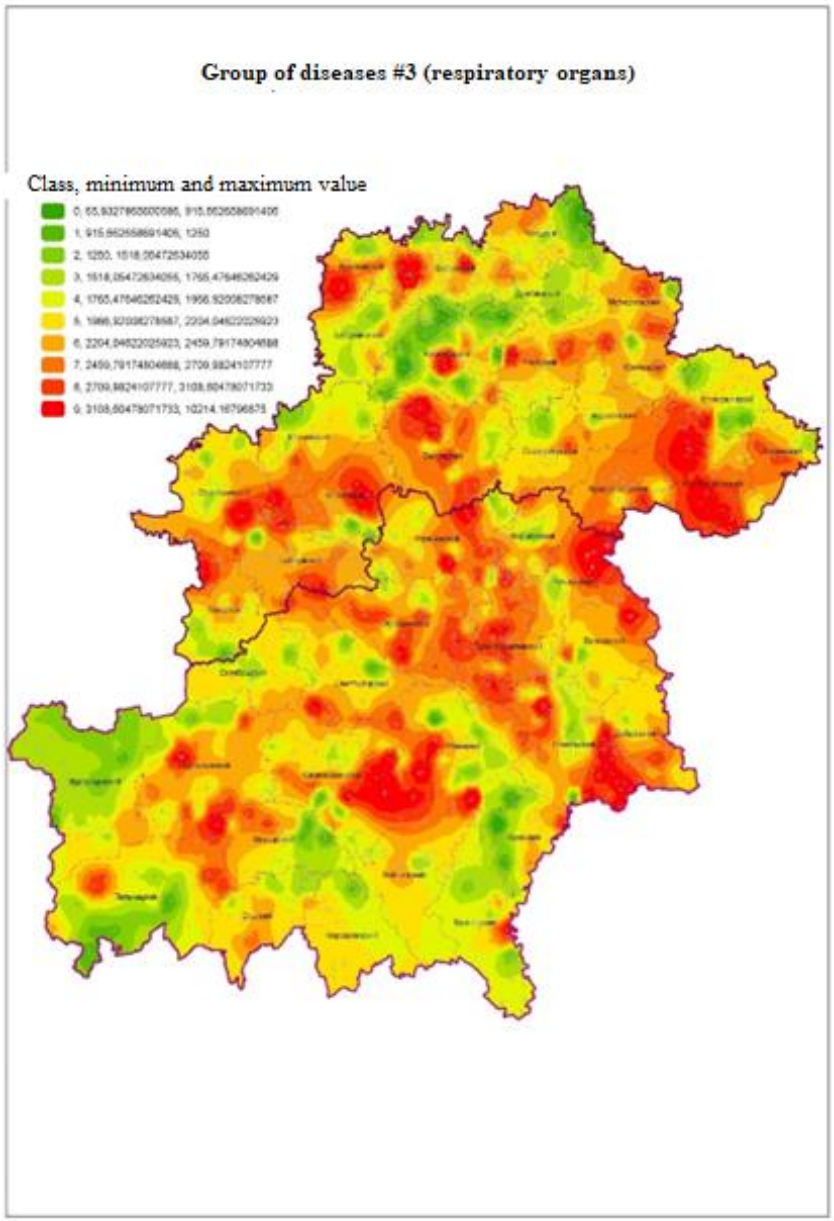
SECOND GROUP OF THE INTERNATIONAL CLASSIFICATION OF ONCODISEASES (ICD-O) (DIGESTIVE SYSTEM) FOR THE ENTIRE PERIOD OF REGISTRATION



Lognormal distribution of cancer cases reflects the polycentric spatial structure of cancer cases.

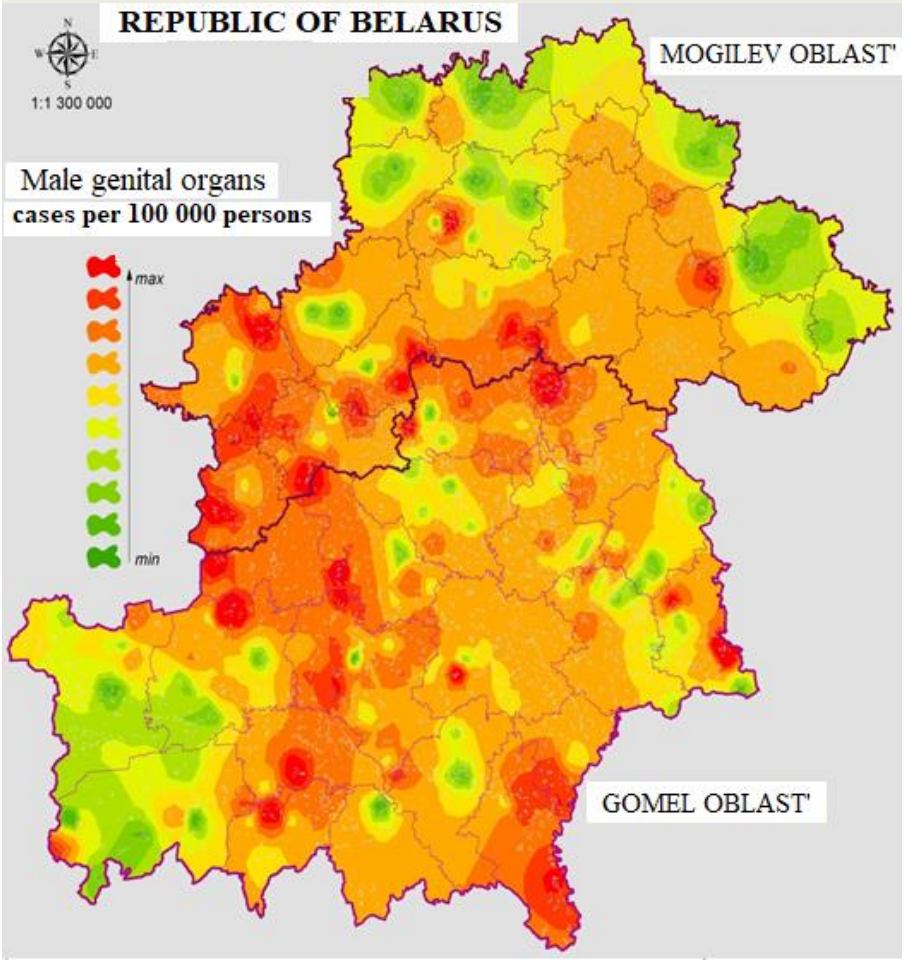
Level of cancer cases of different localizations



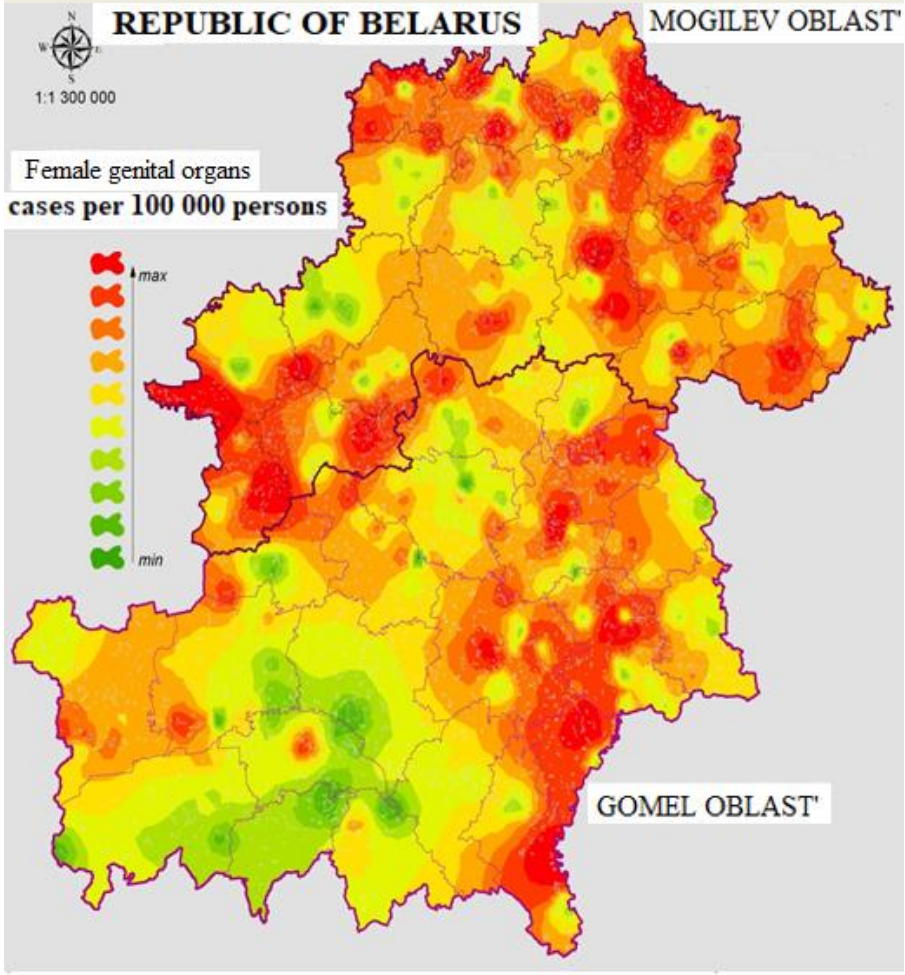


GRUOPING TOTAL NUMBER OF CASES WITHIN THE ENTIRE PERIOD (1978-2019)

Cancer cases among men

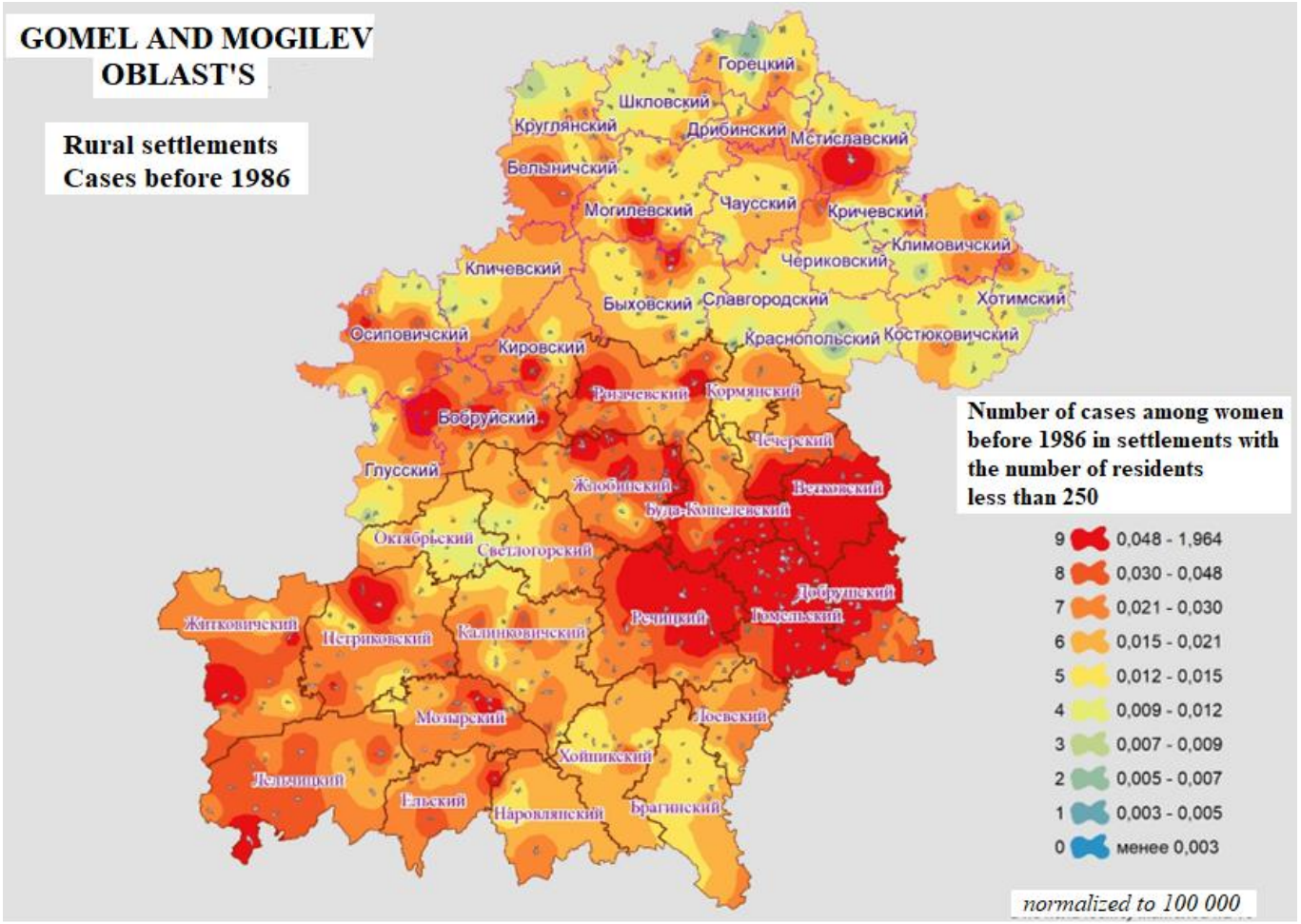


Cancer cases among women



Spatial distribution of cancer of genital organs among males and females has features of both – similarity and dissimilarity.

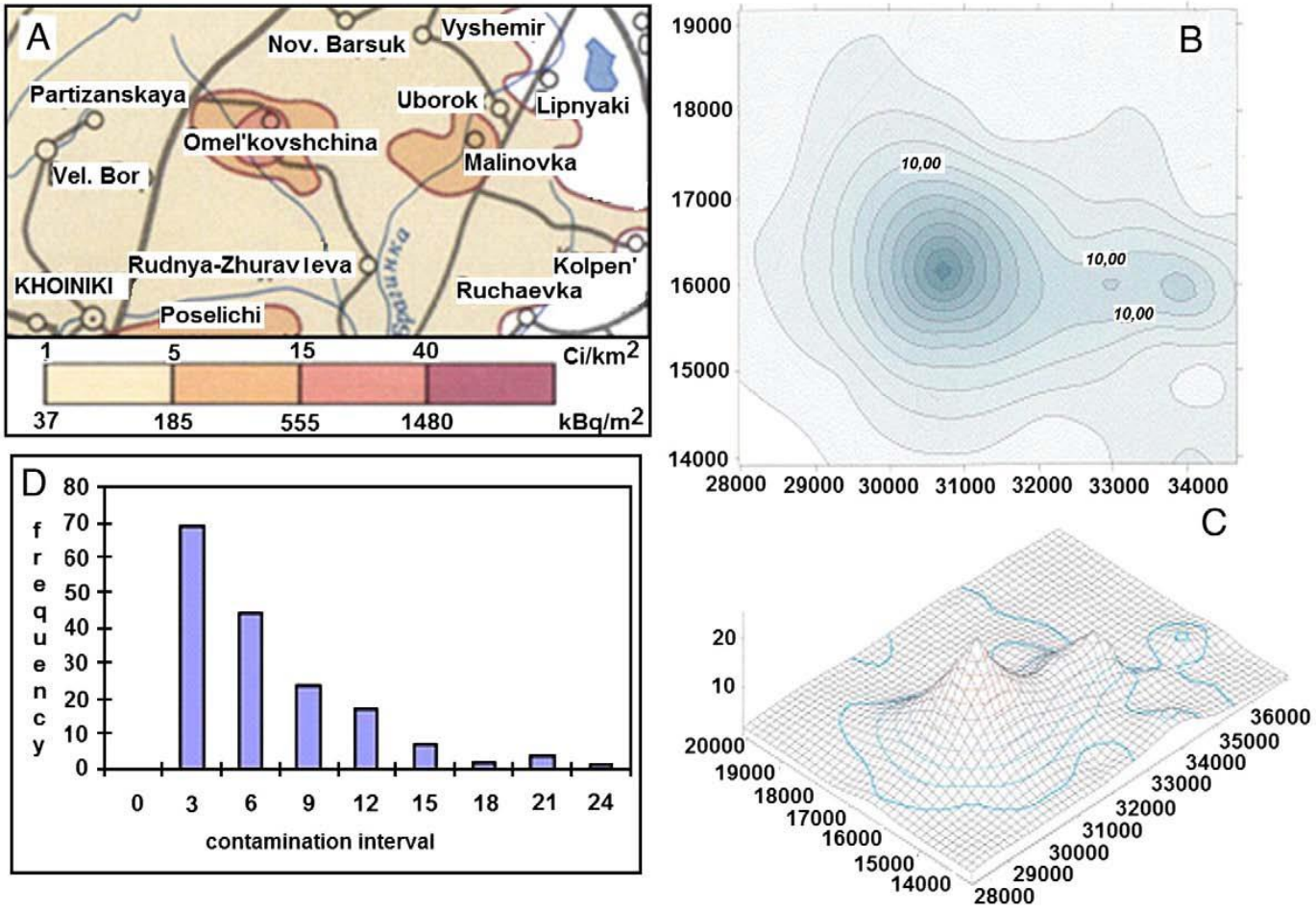
Total number of cases among women before 1986



Considerable radioactive contamination after the Chernobyl accident within this area could be a risk factor showing polycentricity.

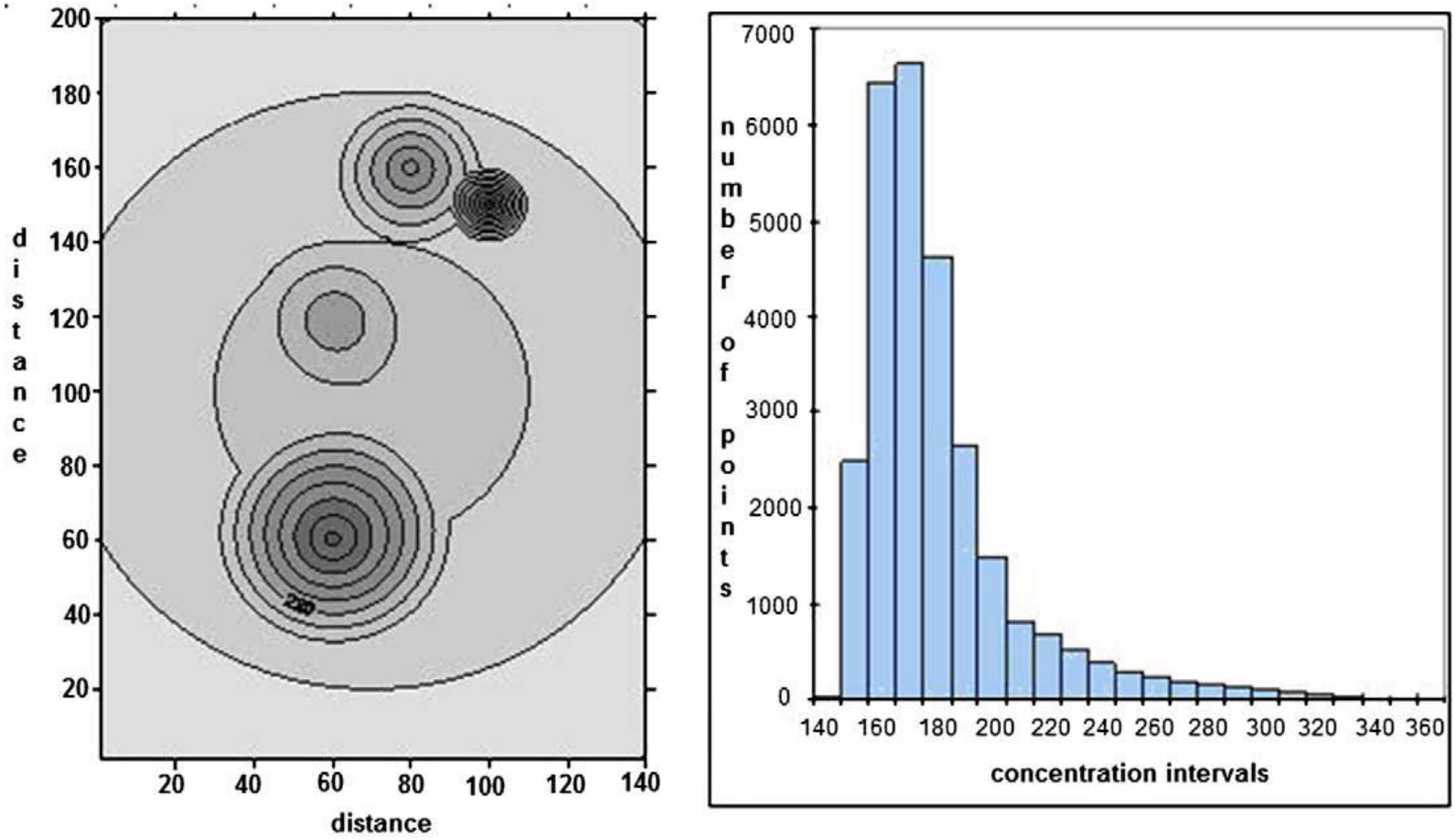
However, the obtained maps showed a high level of differentiation before the Chernobyl catastrophe and no definite correlation with radionuclide fallout maps.

Frequency histogram of local anomaly



Frequency histogram of local anomaly has a pronounced lognormal shape

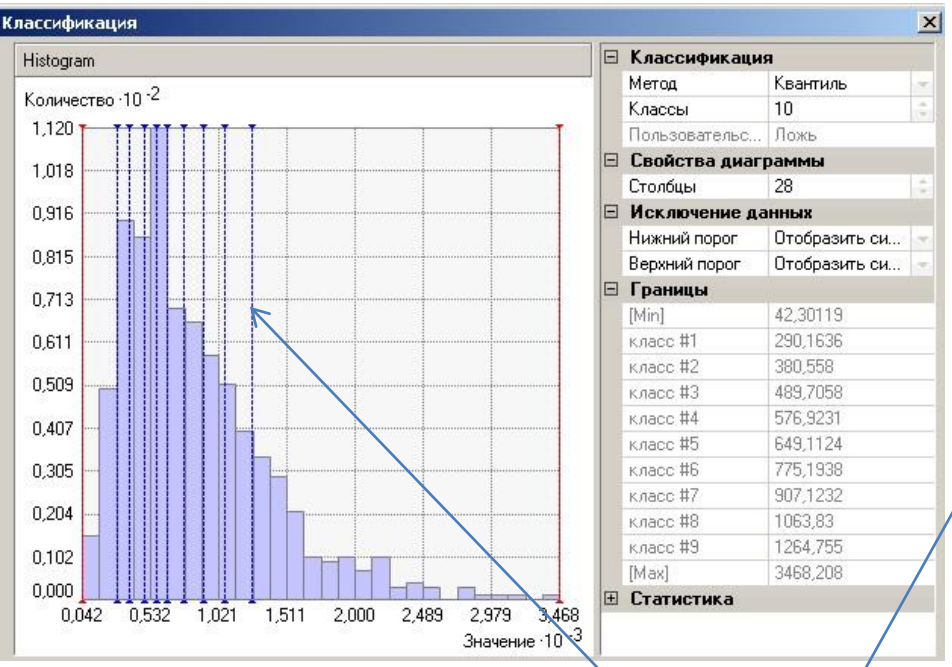
Criteria of lognormality



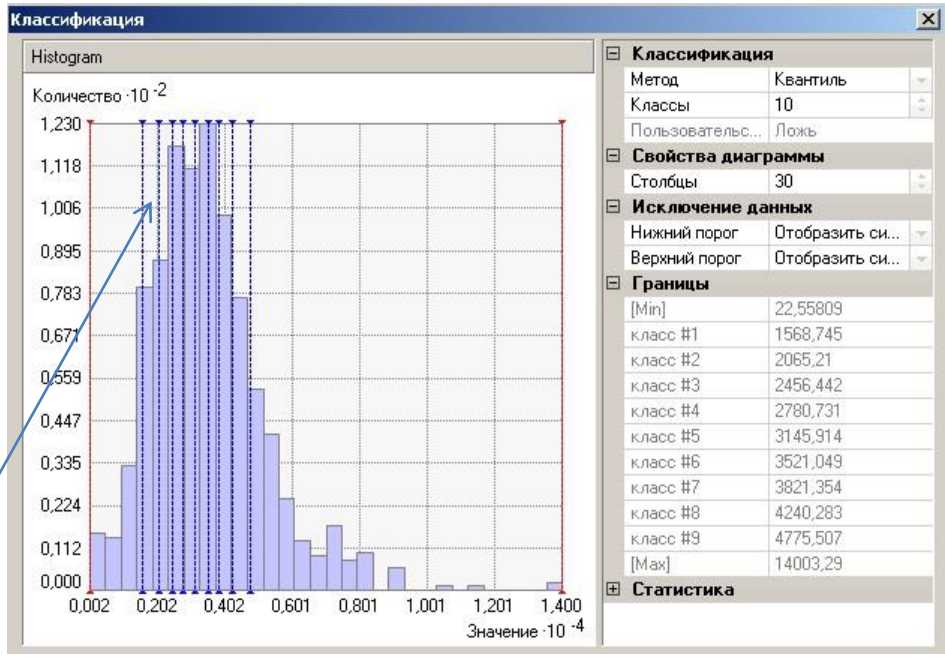
Modeling shows that the system of overlain polycentric anomalies produce lognormal frequency histograms.

GEOSTATISTICAL CLASSIFICATION OF CANCER DISEASES USING RECIPROCAL DISTRIBUTION

Lip, tongue, mouth, pharynx



Organs of the digestive system



Boundaries of 10 classes

Many thanks for your attention

Acknowledgements. The study was partly funded by RFBR and BRFBR project #20-55-00012 and BRFBR project # X20P-386.