

ECOLOGICAL RISK ASSESSMENT IN MONITORING NATURAL ENVIRONMENT

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*Оценка экологических рисков в задачах
мониторинга природной среды*

General information

Экологический риск = Environmental risk / Ecological risk

Экологический риск – количественная мера опасности возникновения негативных изменений в природной среде (например, нарушение структуры или функционирования экосистем) под воздействием техногенных или природных факторов.

Оценки риска: вероятность (реализации риска) / средний ущерб (потери)

Для картографирования экологического риска удобно выделять 3 вида / уровня риска: пренебрежимый, неприемлемый, приемлемый.

Levels of ecological risk:

- ***negligible***
- ***acceptable***
- ***unacceptable***

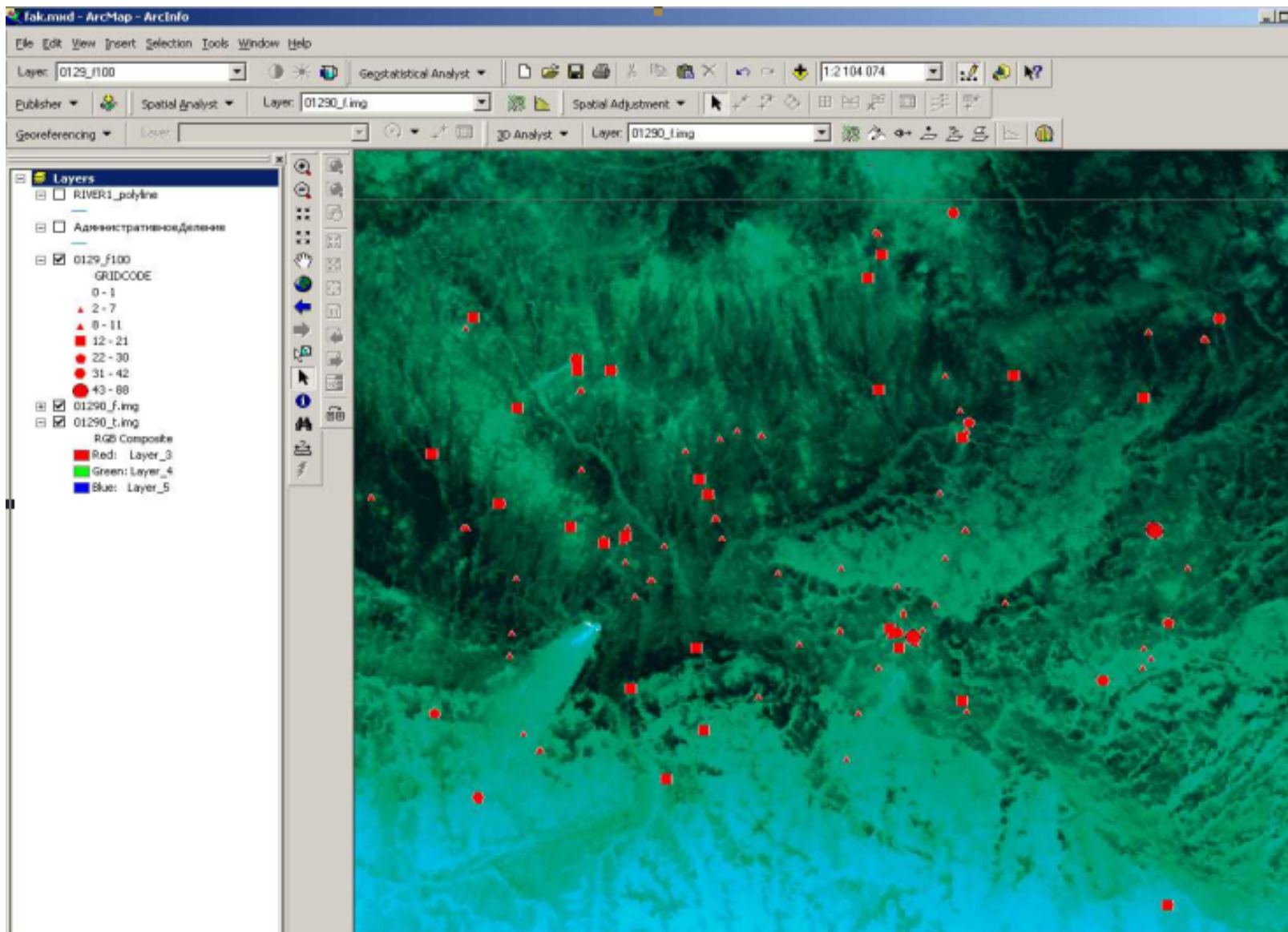
Factors of ecological risk in West-Siberian oil production region

- Western Siberia produces above 70% Russian oil
- Main factors:
 - soil pollution by oil spills (3 % - in Environment)
 - air pollution as a result of gas burning in torches in oil-fields (5%)
- **Gas burning causes air pollution by chemicals:**
 - - soot,
 - - nitrogen oxides,
 - - carbon oxides,
 - - hydrocarbons

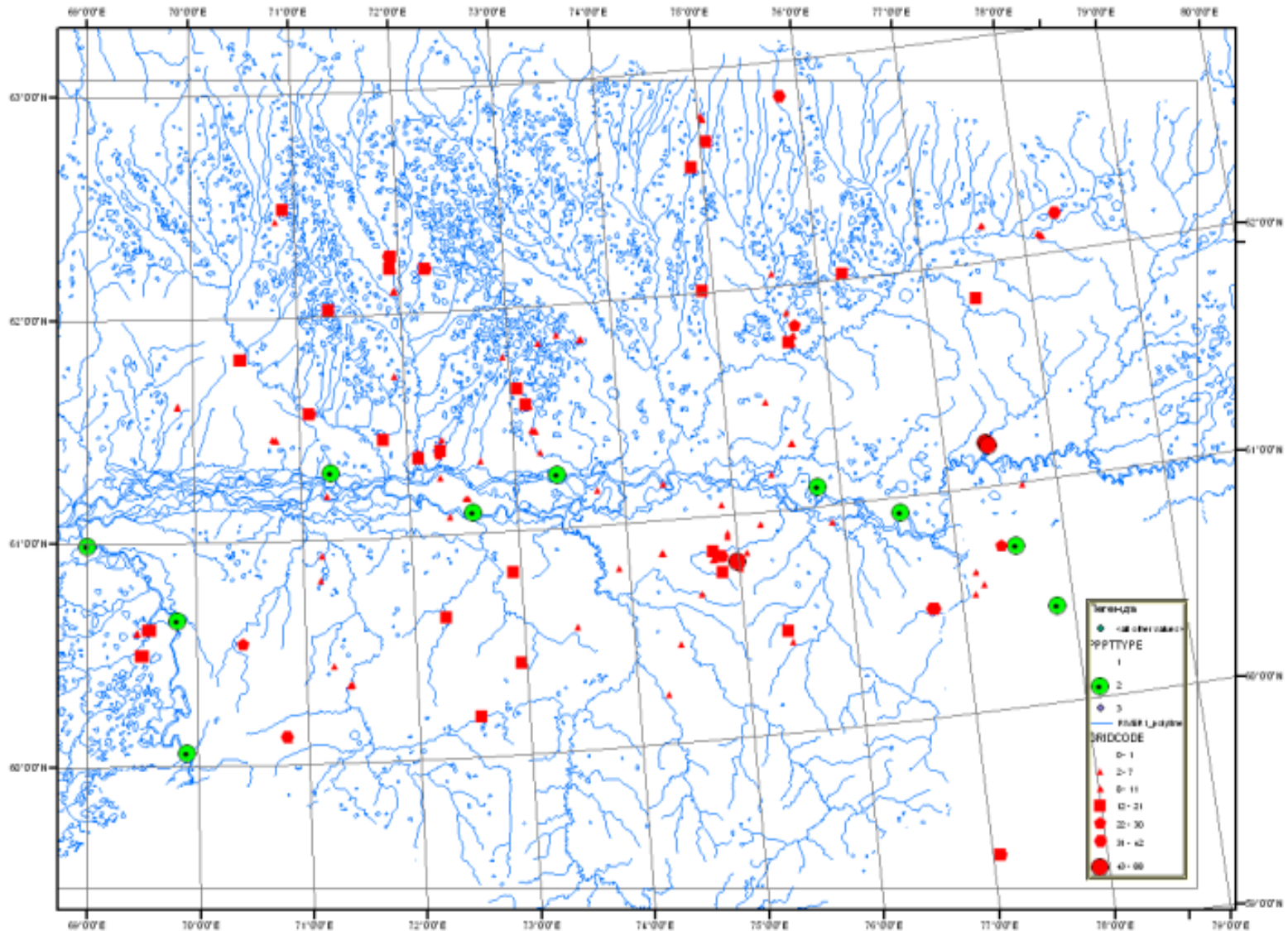
Main objectives

- Development of methodological approach to evaluating ecological risks using satellite imagery and pollution zones modeling (simulation) under oil-production impact on vegetative cover.
- Creation of ecological risk mapping procedure using GIS-technologies .

Space image NOAA of central part of Western Siberia with gas burning torches (V.Golomolzin)



Map of hydrological net in Western Siberia with gas burning torches (red)



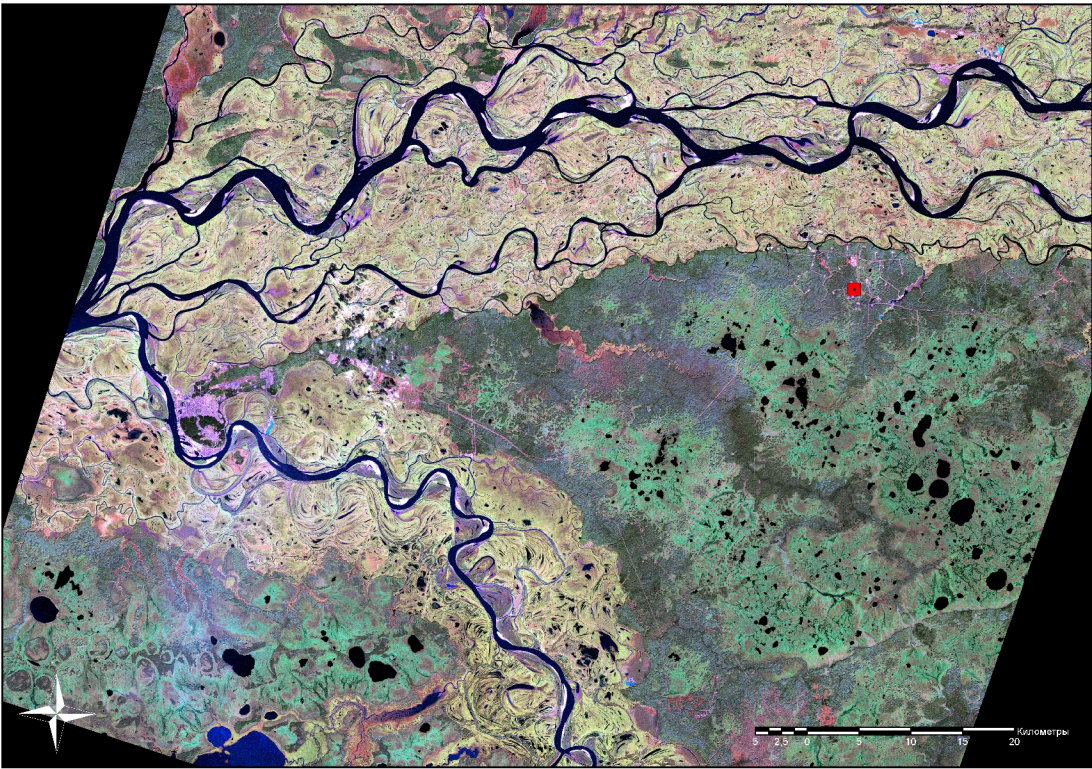
Study of air pollution impact on vegetation based on bioindication method

Test-objects:

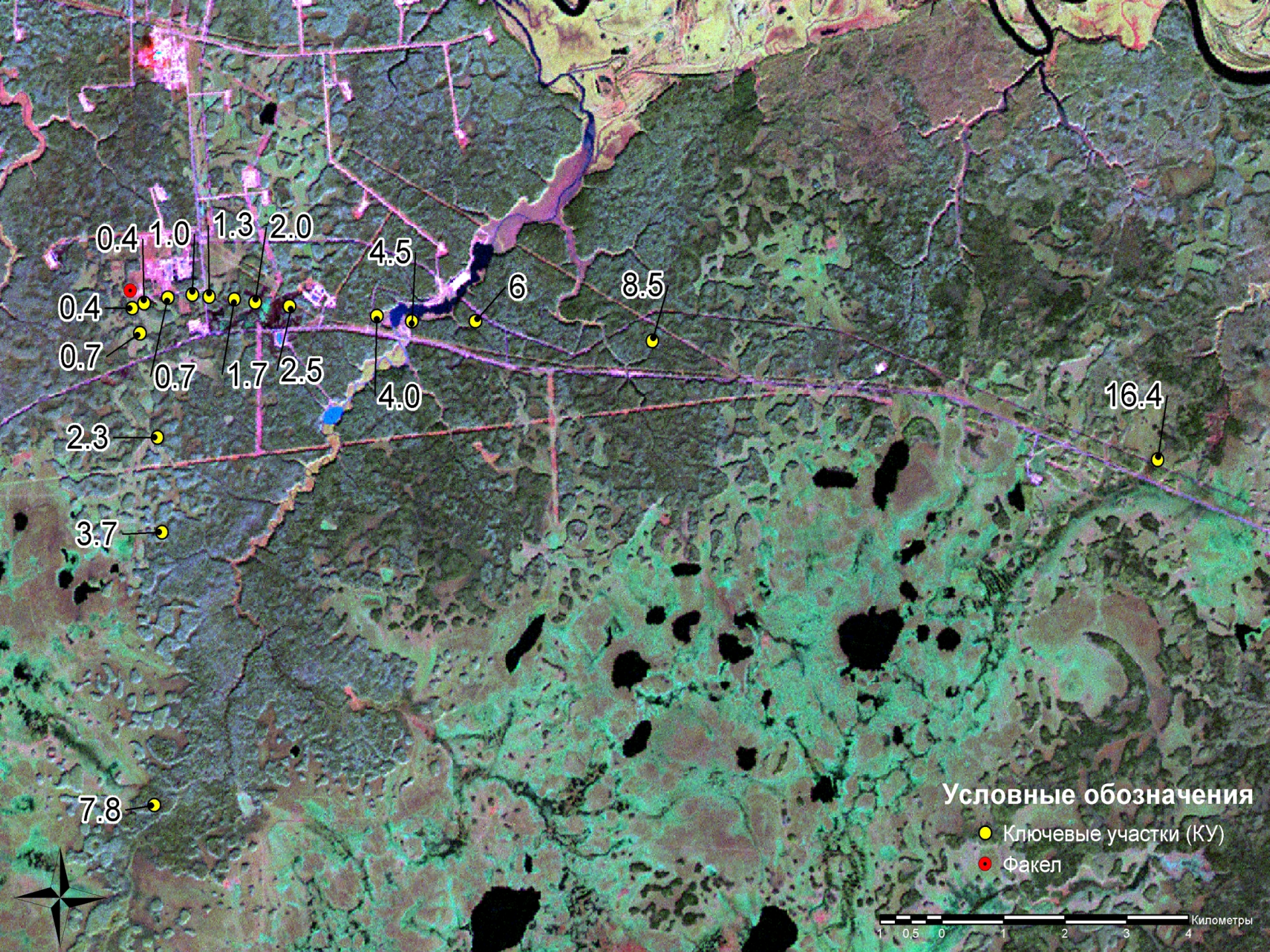
- cedar *Pinus sibirica* Du Tour
- Siberian fir *Picea obovata* Ledeb.

Biological indication characters used:

- *Needle mass, g;*
- *Defoliation degree, g/cm;*
- *Index of tree state (by Alexeev).*



**Объектом исследований
явились кедрово-еловые
древостои, находящиеся
в зоне воздействия
выбросов от установок по
сжиганию попутного
нефтяного газа,
расположенные на левом
берегу р. Обь в пределах
Приобского месторождения
нефти**



Tree state types for Siberian fir (by Alexeev)



(1) низовой



(2) подвершинный



(3) равномерная



(4) верхушечный



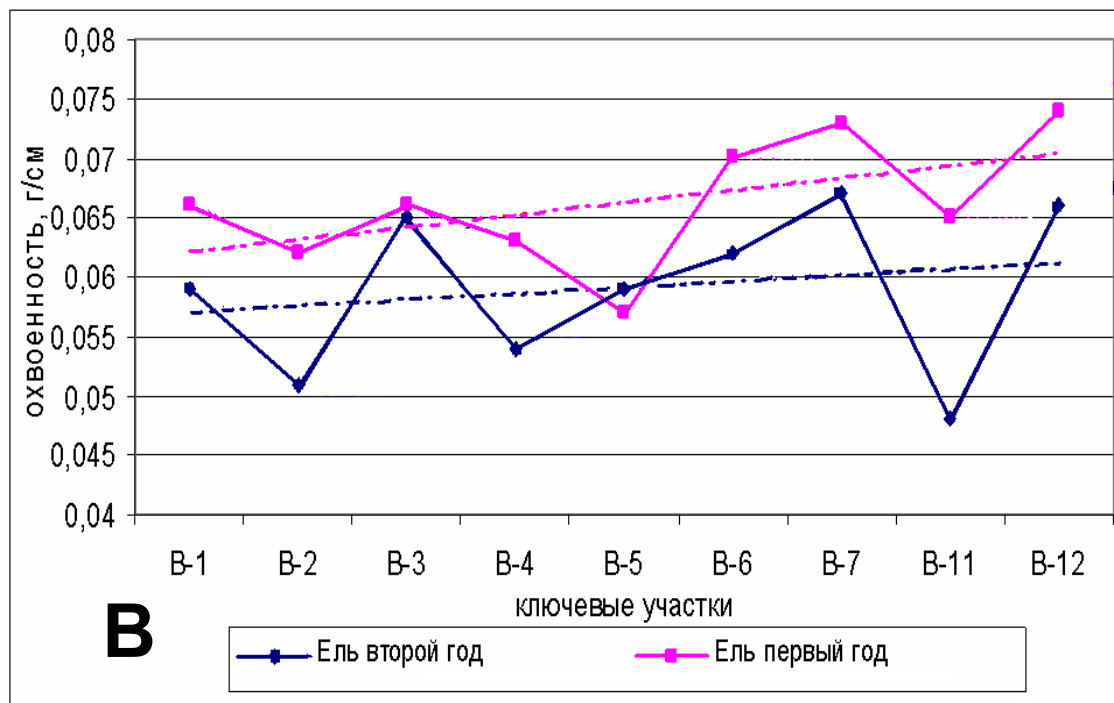
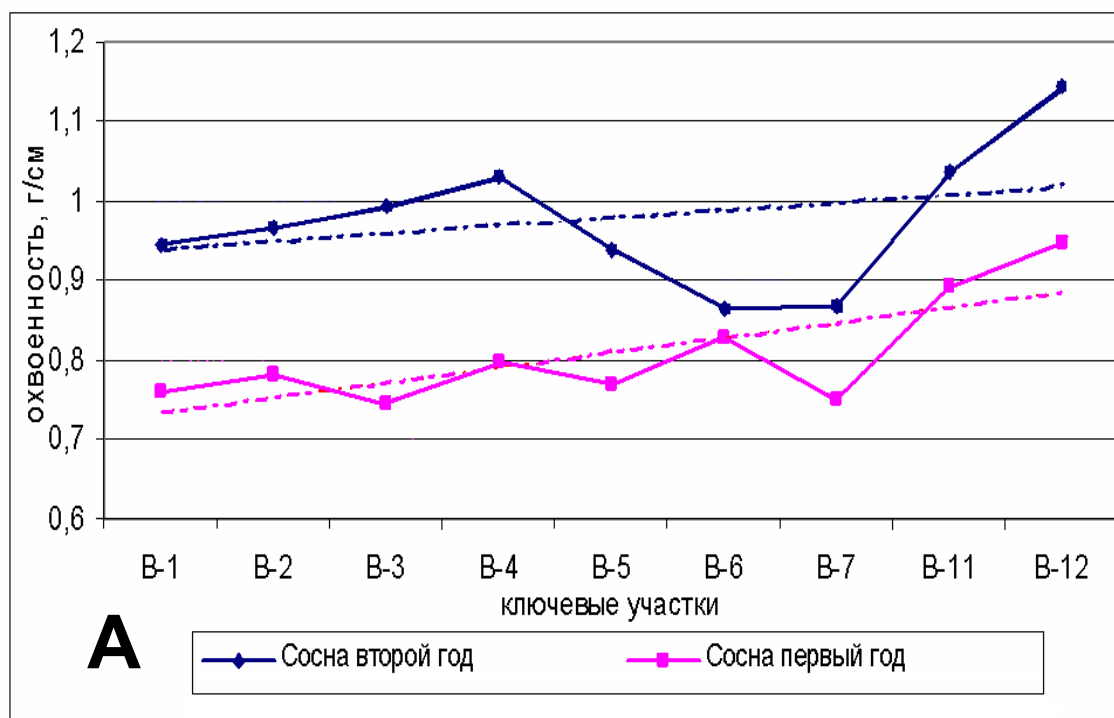
(5) периферийный



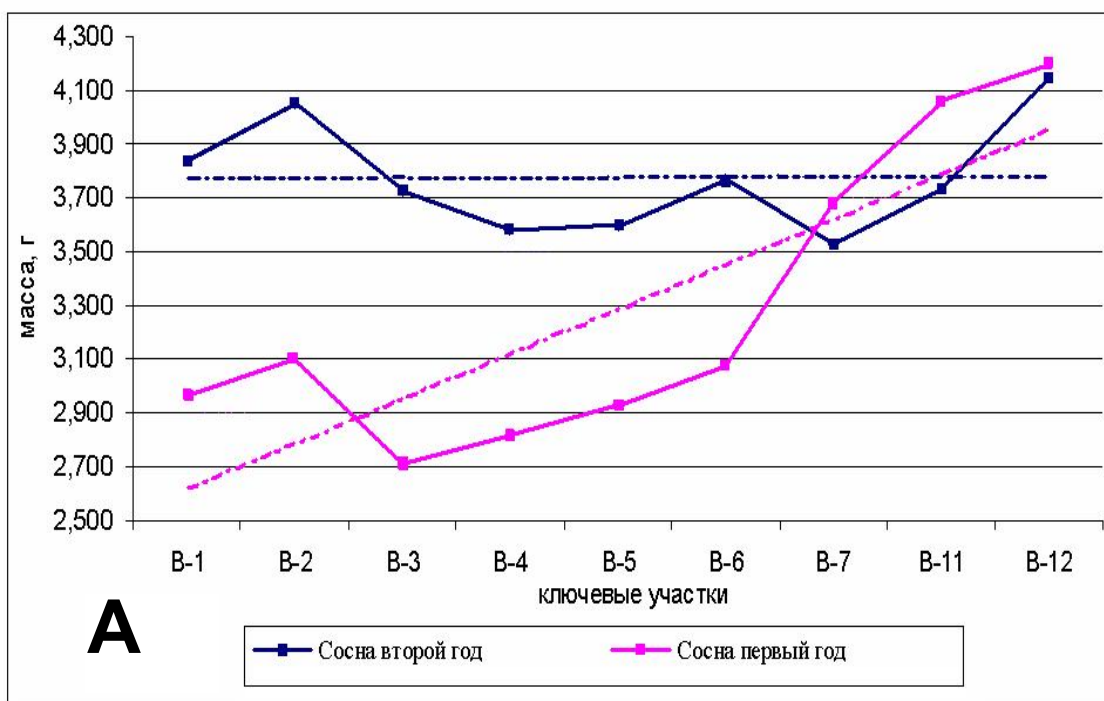
(6) верхушечно-периферийный

Defoliation degree depending on distance to pollution sources

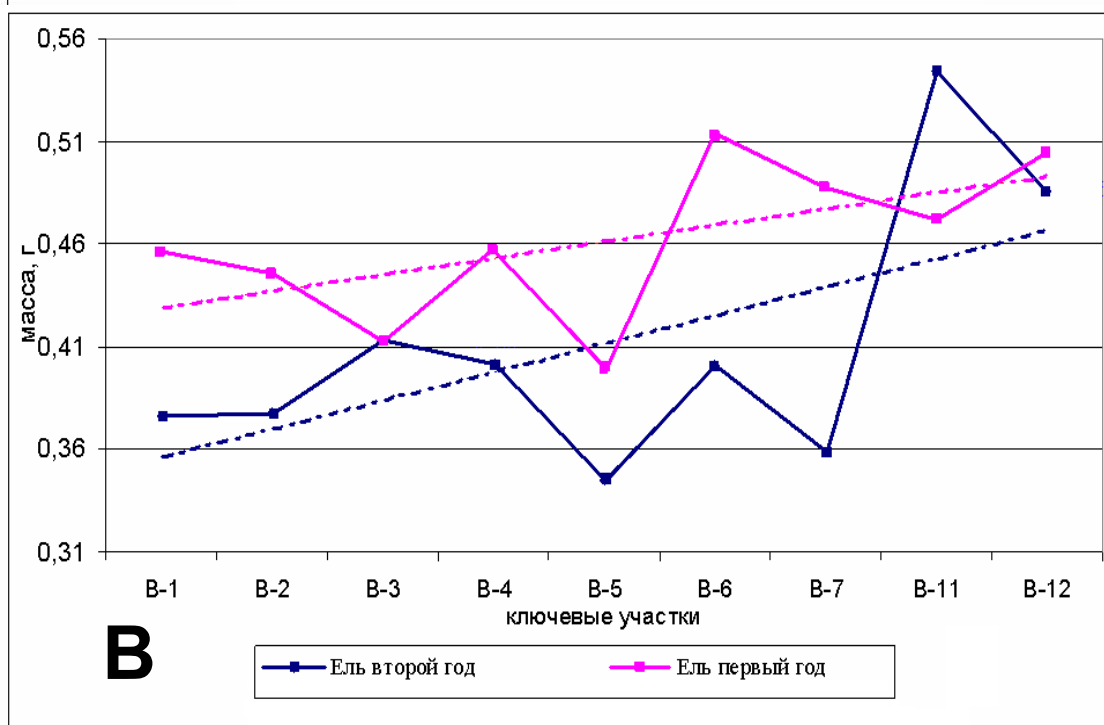
A - cedar;
B – Siberian fir



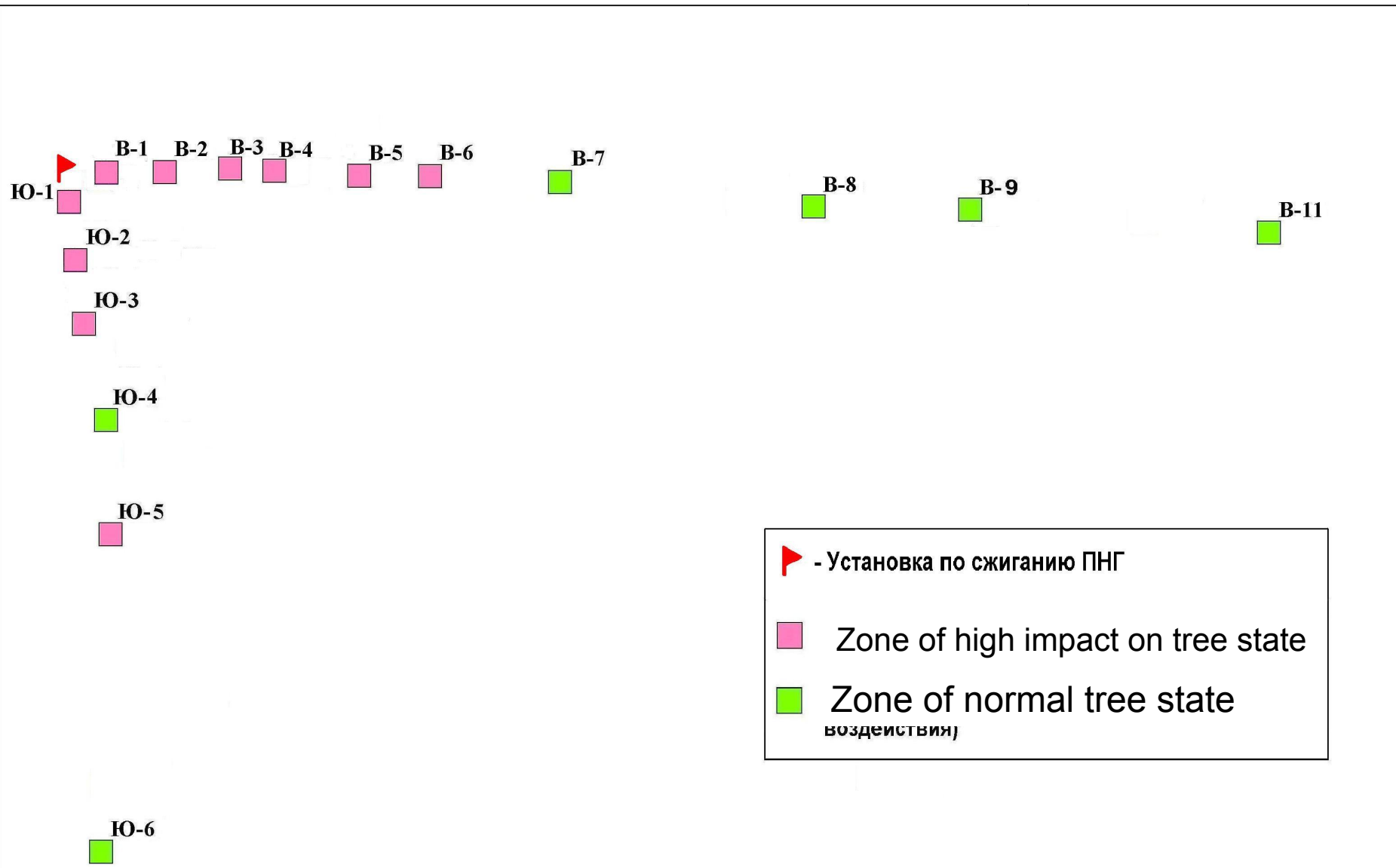
Needle mass depending on distance to pollution sources



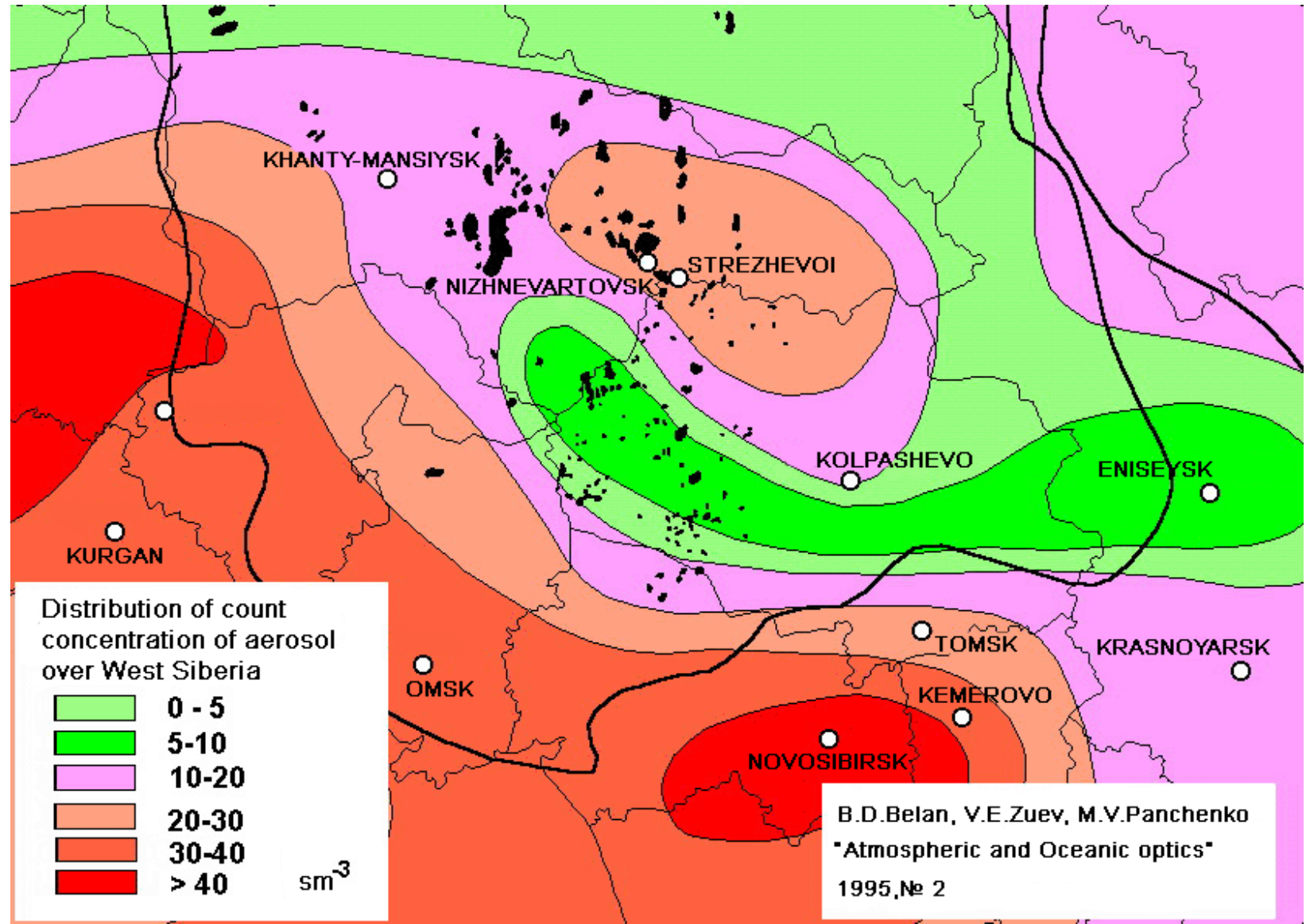
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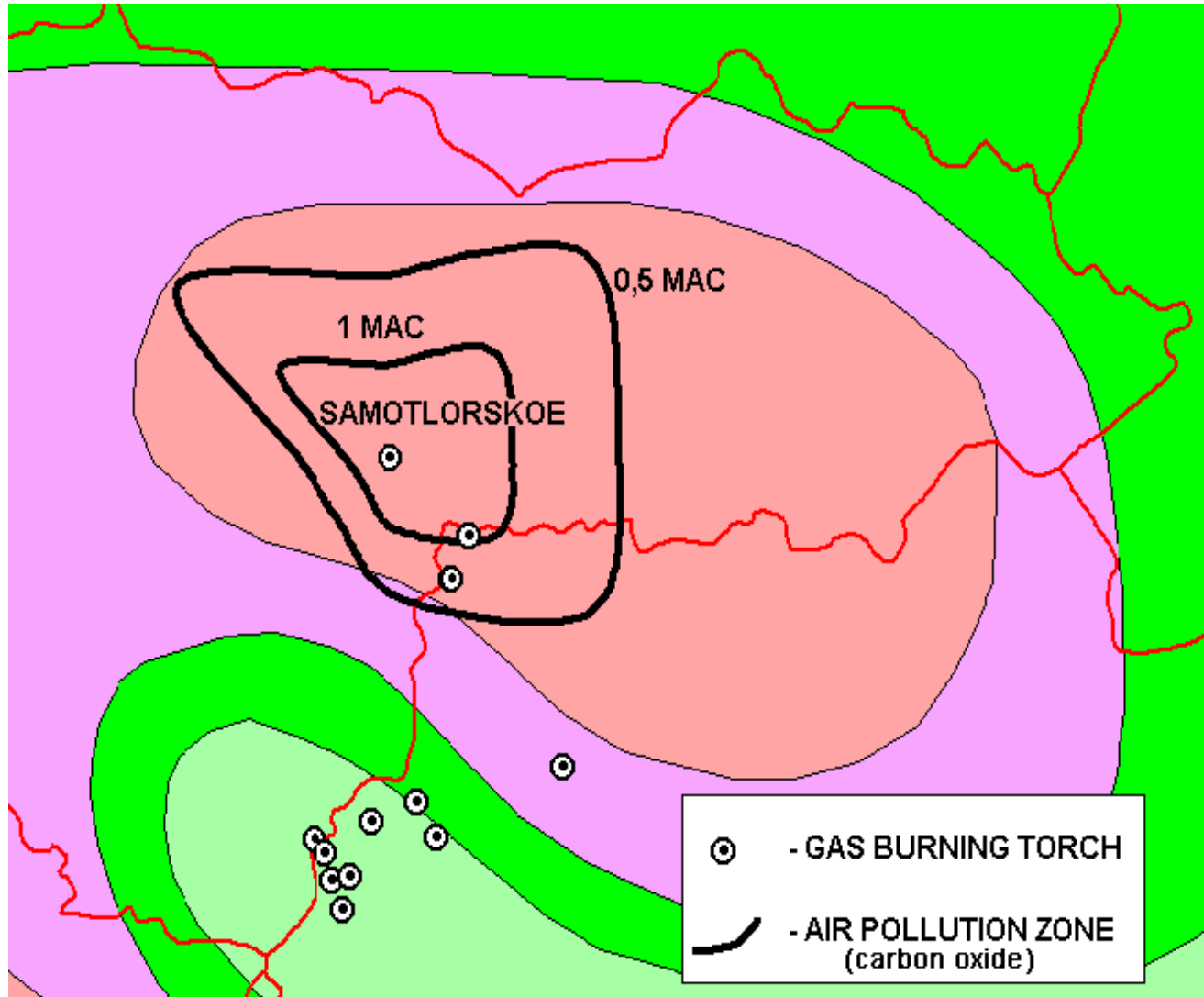
Determination of zone of high impact of gas burning on tree state



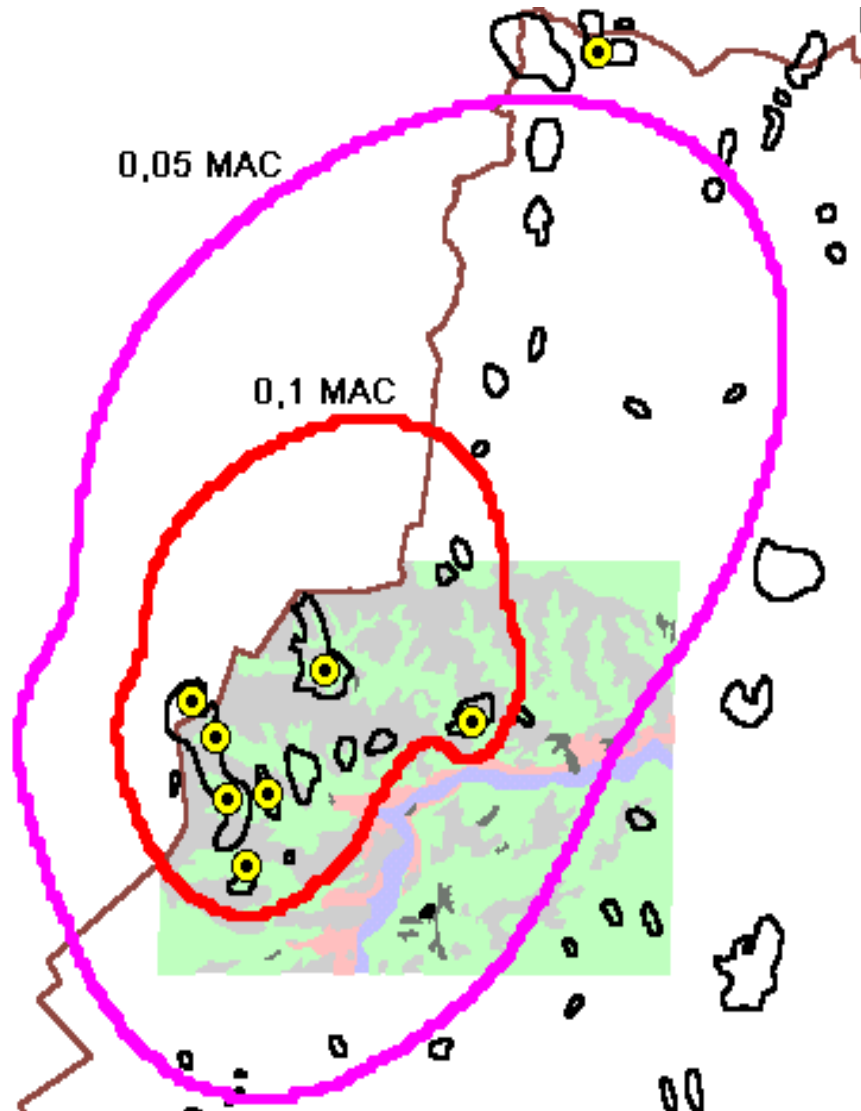
Map of air pollution based on aircraft measurements



Zones of air pollution caused by gas burning in Samotlorskoye oil field



Air pollution zones as a result of gas burning in torches



Determination of air pollution levels for ecological risk assessment

Levels of ecological risk: negligible, acceptable, unacceptable

Согласно Методике НИИ охраны атмосферного воздуха

Maximum allowed concentration:

$$MAC_{a/a} = a MAC_{a/d}$$

<i>Substance</i>	<i>Coefficient «a»</i>	<i>MAC_{a/d} mg/m³</i>	<i>MAC_{a/a} mg/m³</i>
soot	0,3	0,05	0,015
nitrogen dioxide	1	0,04	0,04
carbon oxide	0,34	3	1,02

Determination of atmospheric pollution level by soot to assess ecological risk

Согласно методике МПР РФ (1992г) уровень экологической ЧС определяется величиной 8 ПДК сг :

$$8 * MAC_{a/a} = 8 * (0,3 * MAC_{a/d}) = 2,4 MAC_{a/d}$$

It is proposed to take the risk value for people :

- unacceptable** - in zone with the level of soot pollution >2,4 MAC;
- acceptable** - in zone with the level of soot pollution 1-2,4 MAC;
- negligible** - in zone with the level of soot pollution <1 MAC.

However, sanitary and hygienic standards based on MAC for man aren't scientifically grounded for vegetative species. So it is necessary to use sensitivity coefficients (accordingly to Edige Zakarin).

Assessment of ecological risk levels

It is known that the degree of **sensitivity** to the effects of phytotoxic gases for all taxonomic groups of plants are located in the following order:

- Mosses, lichens and fungi;
- Coniferous tree species;
- Deciduous tree species;
- Herbaceous plants.

The calculations suggested the following values of the coefficients of sensitivity:

Meadow vegetation, bog – 1

Dark coniferous forest– 0,5

Small-leaved forest– 0,75.

In accordance with the sensitivity indices, levels of air pollution were determined for each taxonomic groups of plants .

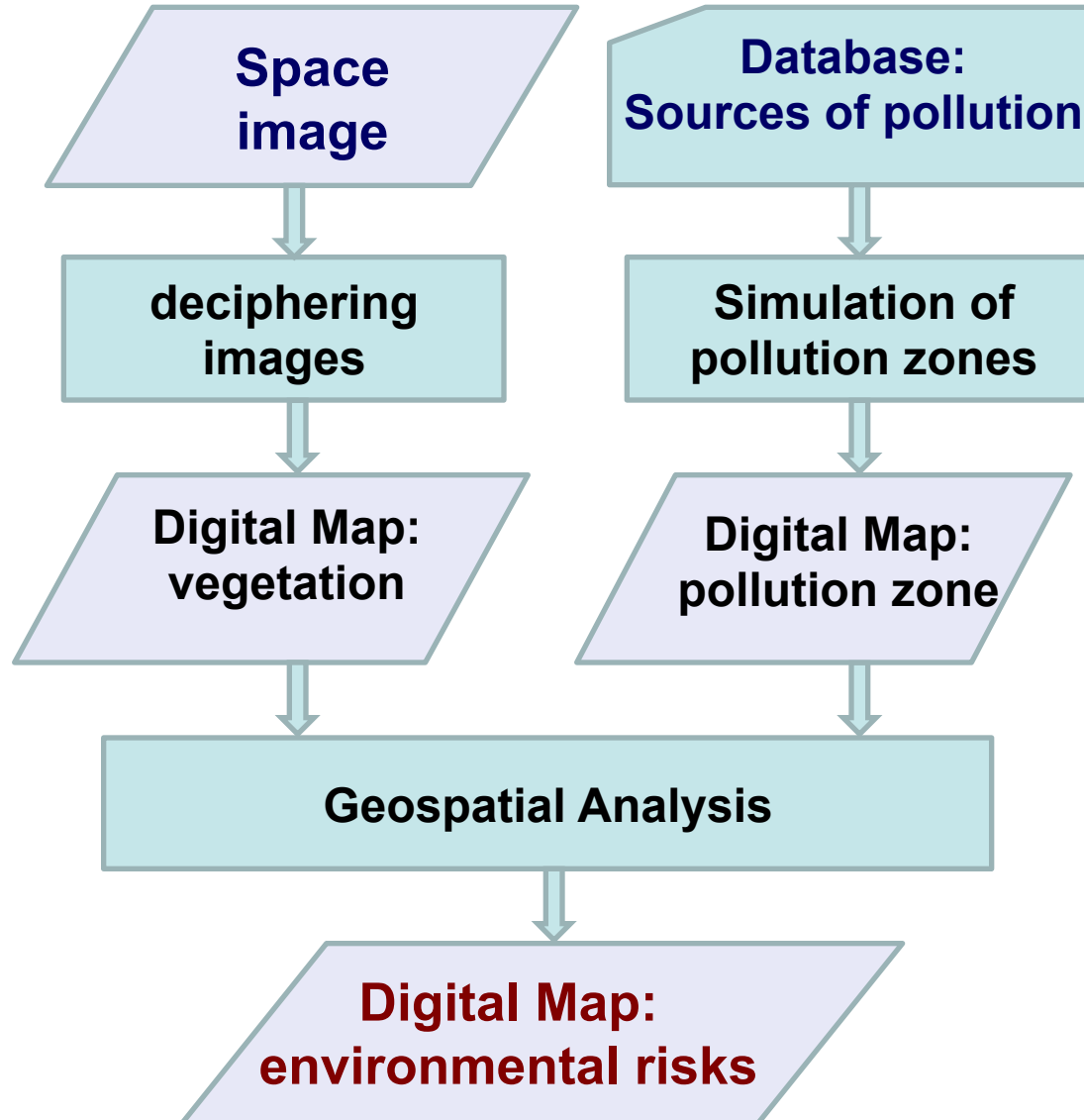
For dark-coniferous forest:

unacceptable - in the zone with the level of soot pollution $>1,2$ MAC;

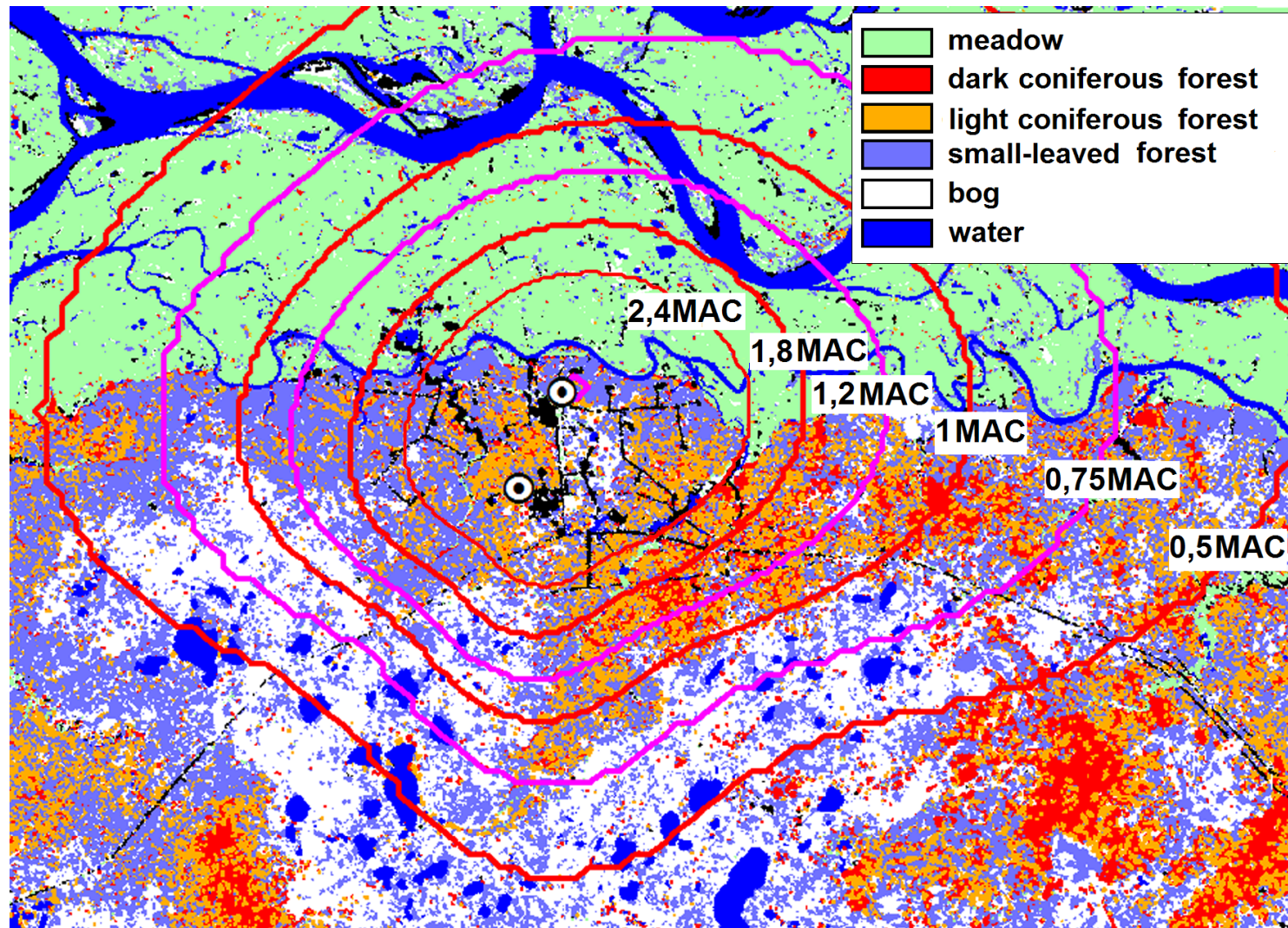
acceptable - in the zone with the level of soot pollution $0,5-1$ MAC;

negligible - in the zone with the level of soot pollution $<0,5$ MAC.

Stages of mapping ecological risk using GIS tools

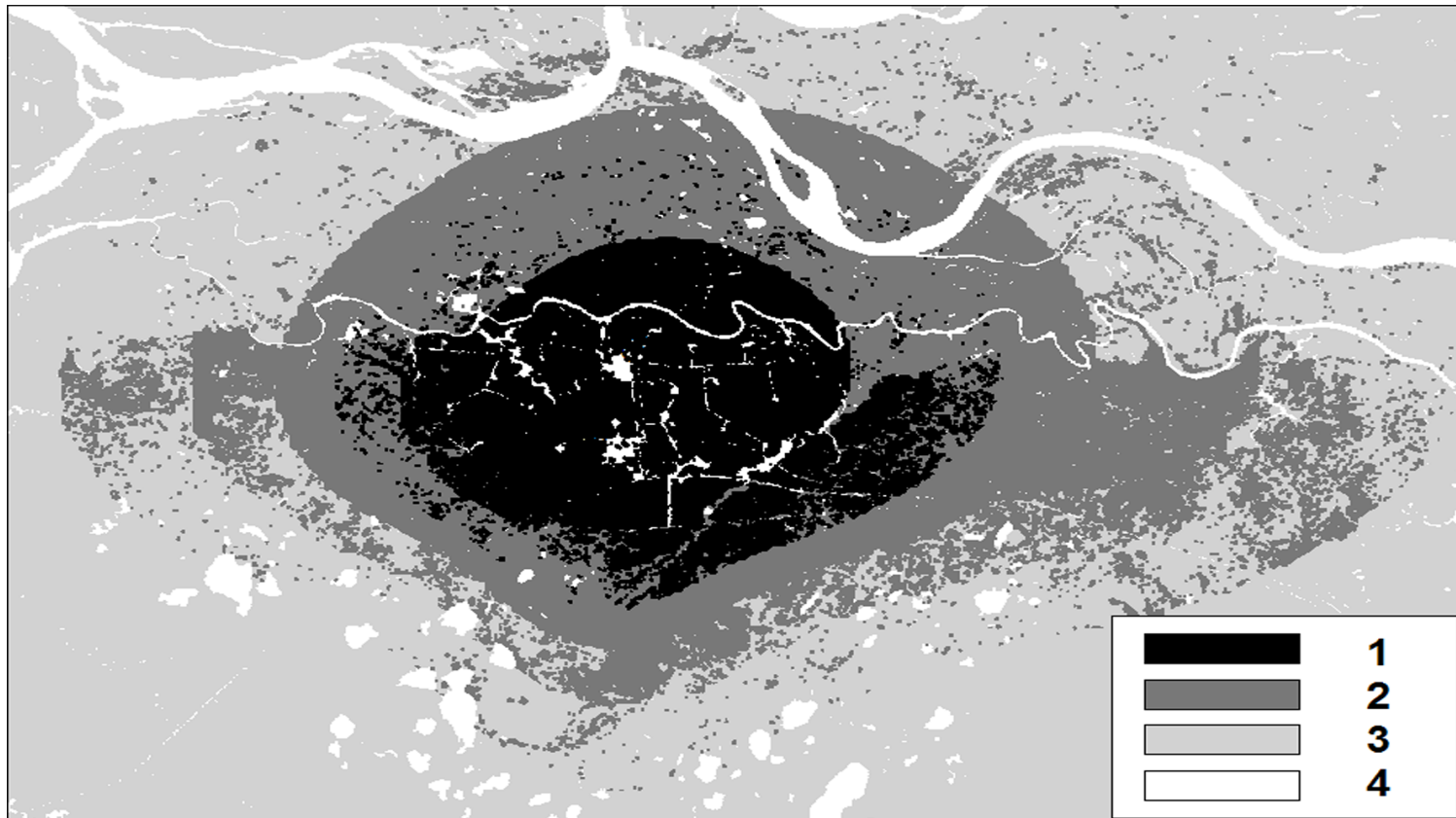


Overlaying pollution zones boundaries on digital map of vegetation cover structure



Results of mapping ecological risk

The map of ecological risks of soot pollution impact on vegetative cover in Priobskoe oil-field territory



Legend: Risk level: 1 - unacceptable, 2 – acceptable, 3 - negligible.
Risk is not evaluated: 4 - areas without vegetation and water bodies

THANK YOU FOR ATTENTION!