

**Russian Institute of Agricultural Radiology and
Agroecology, Russia, Obninsk**



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SOIL POLLUTION WITH HEAVY METALS, RADIONUCLIDES AND PESTICIDES IN RUSSIA

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Industrial sources of agricultural land pollution



Types of sources (Branches of industry)	Radioac- tive substances	Chemical substances			Suspended particles	Exposu- re level
		Pesticides	Heavy metals	Oxides		
Metallurgy			+	+	+	h (m)
Chemical industry		+	+	+	+	m
Oil-chemical industry			+	+	+	m
Thermal power plants	+		+	+	+	m
Nuclear power engineering	+					m
Cellulose industry				+	+	l
Food industry					+	l
Automobile industry			+		+	l

h – heavy; m – medium; l – low



Contribution of main industrial sources in the total release of pollutants in Russia

- **heat power plants - 24.3%**
- **metallurgy – 30.5%**
- **building materials industry – 8.1%**
- **transport – 13.1%**

Sources of contamination of agricultural land connected with forestry and agricultural activities



Types of sources	Pesticides	Heavy metals	Other toxics	Exposure level*
Chemicals		+	+	l
Plant protection drugs	+	+		m
Processing industries			+	l
Chemicals storages	+	+	+	m (l)
Fertilizers storages		+	+	m (l)
Farms and animal complexes			+	m (l)

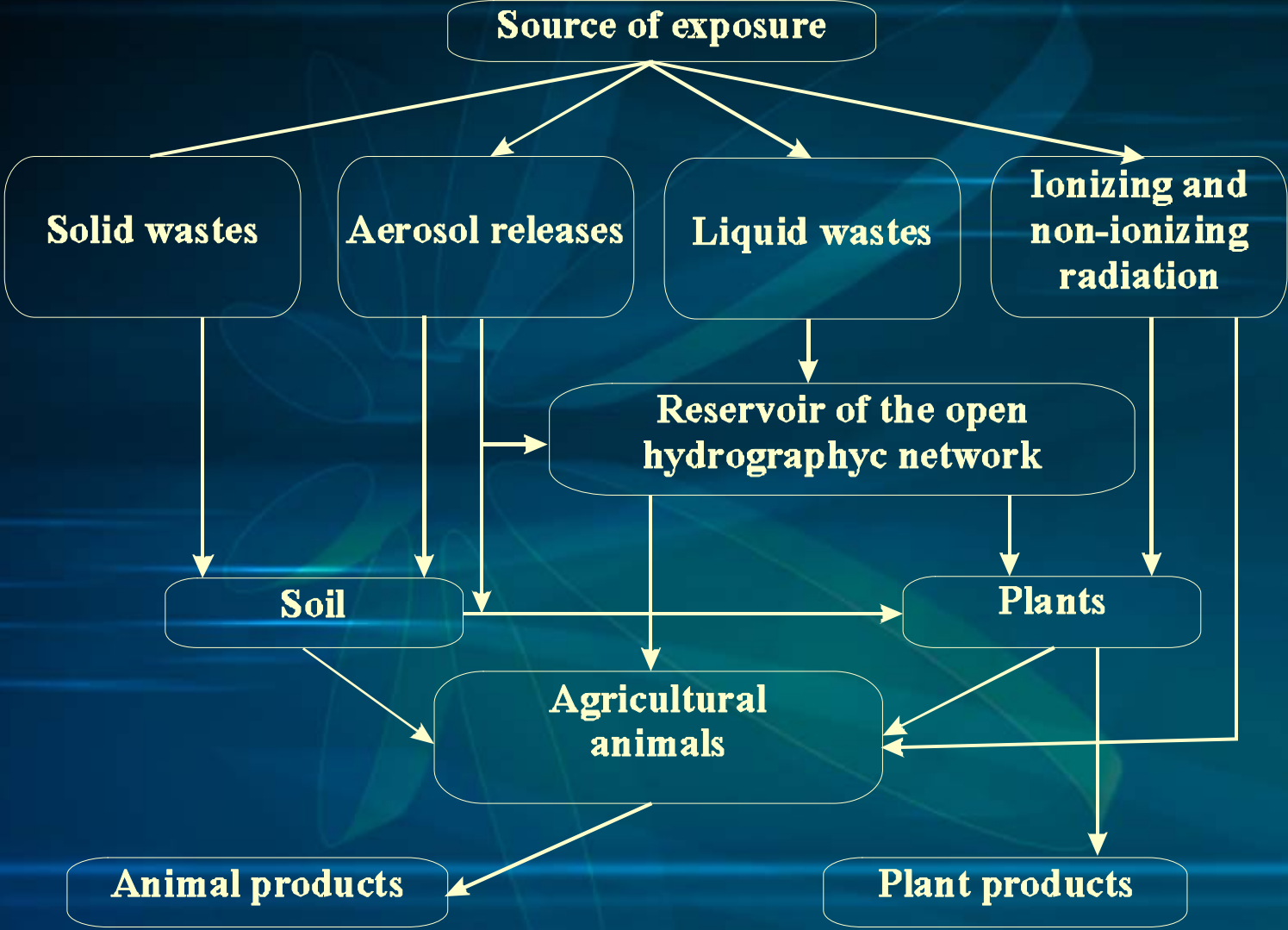
h - heavy; m - medium; l - low



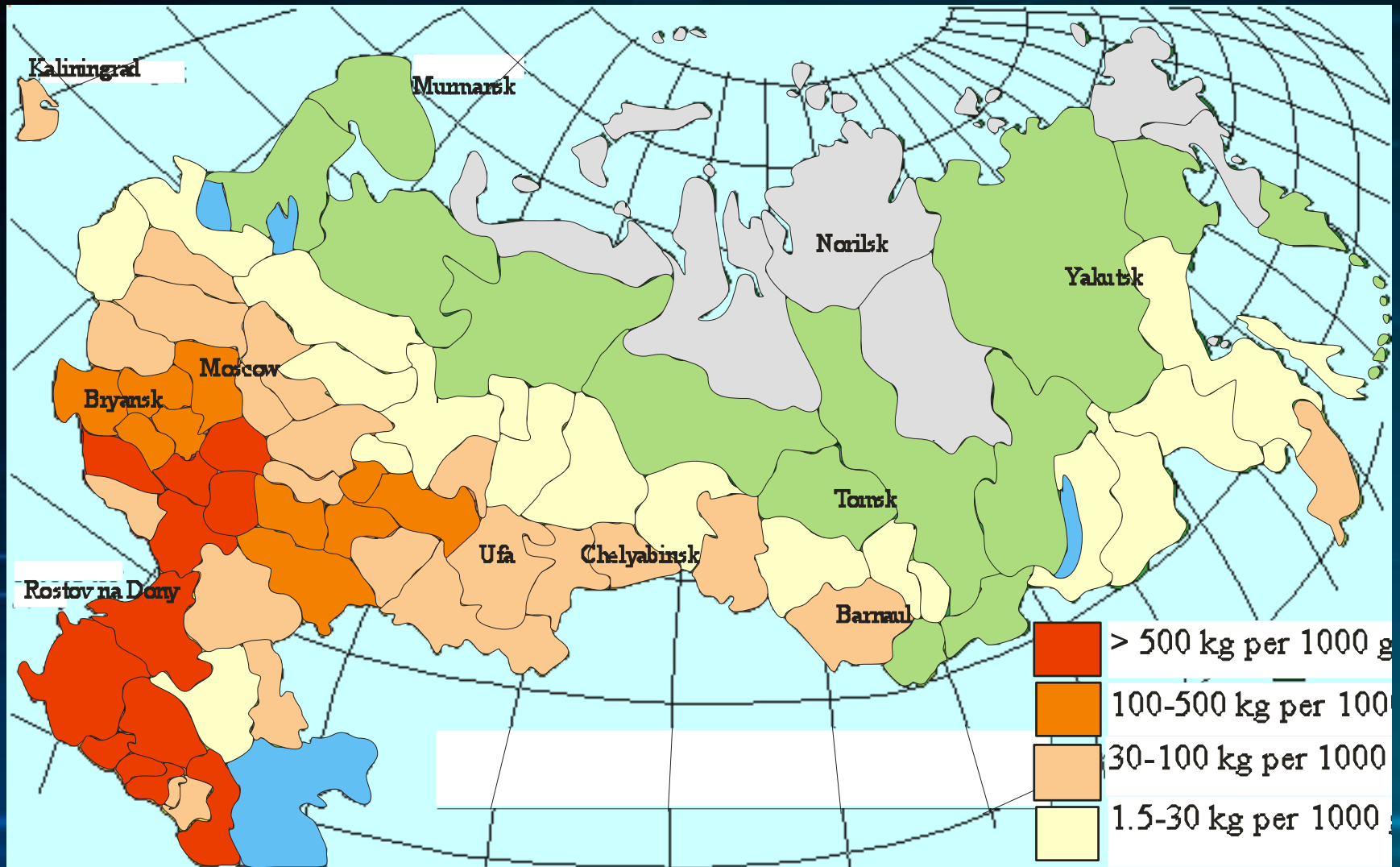
Contribution of main agromeliorants, %

Sources	Pb	Zn	Cu	Cd	Ni	Cr
Mineral fertilizer	4.3	2.4	8.4	5.4	3.4	11.2
Lime	42.4	12.1	16.5	31.8	27.1	34.8
Organic fertilizer	23.3	49.9	48.6	45.6	55.7	62.1

Exposure pathways of anthropogenic factors and migration of pollutants in agrosphere



Intensity of pesticides application in different regions of the Russian Federation





The scales of pesticides unsuitable for future use

Krasnodar territory – 2036.1 t

Altai territory – 1209.1 t

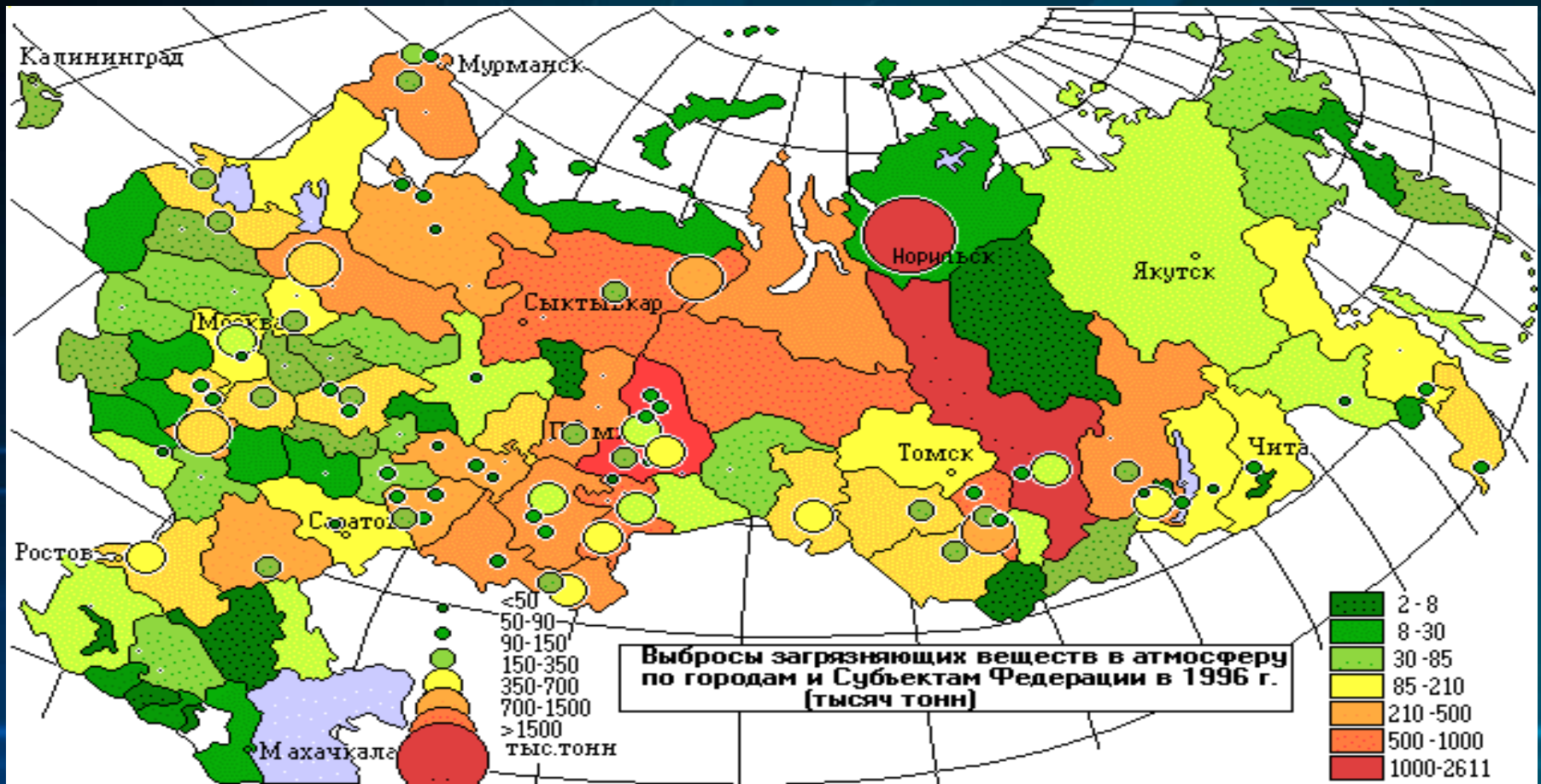
Rostov region – 1166.9 t

Kurgan region – 1025.7

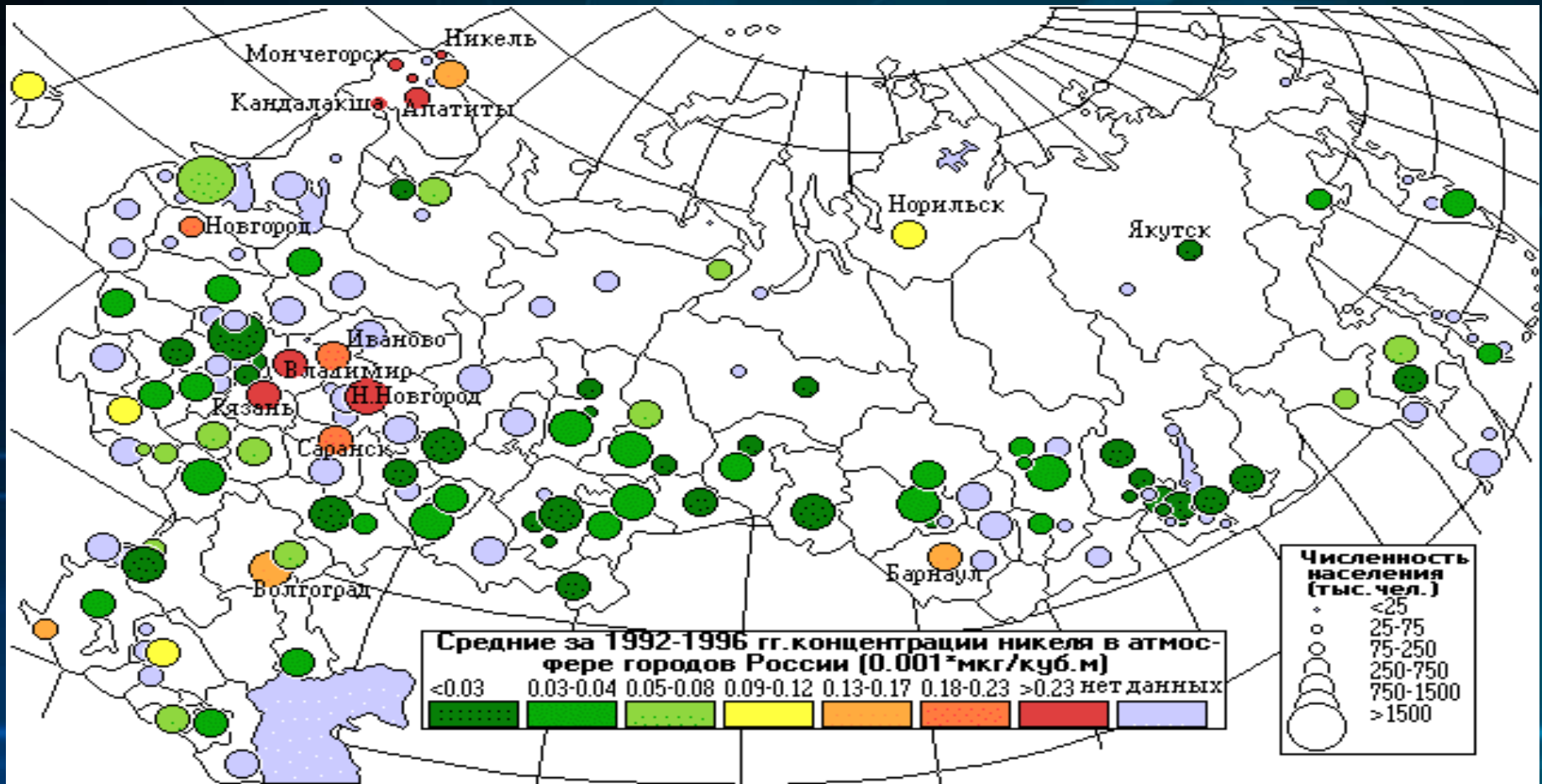
Kursk region – 658.1

Other regions – more than 3000 t

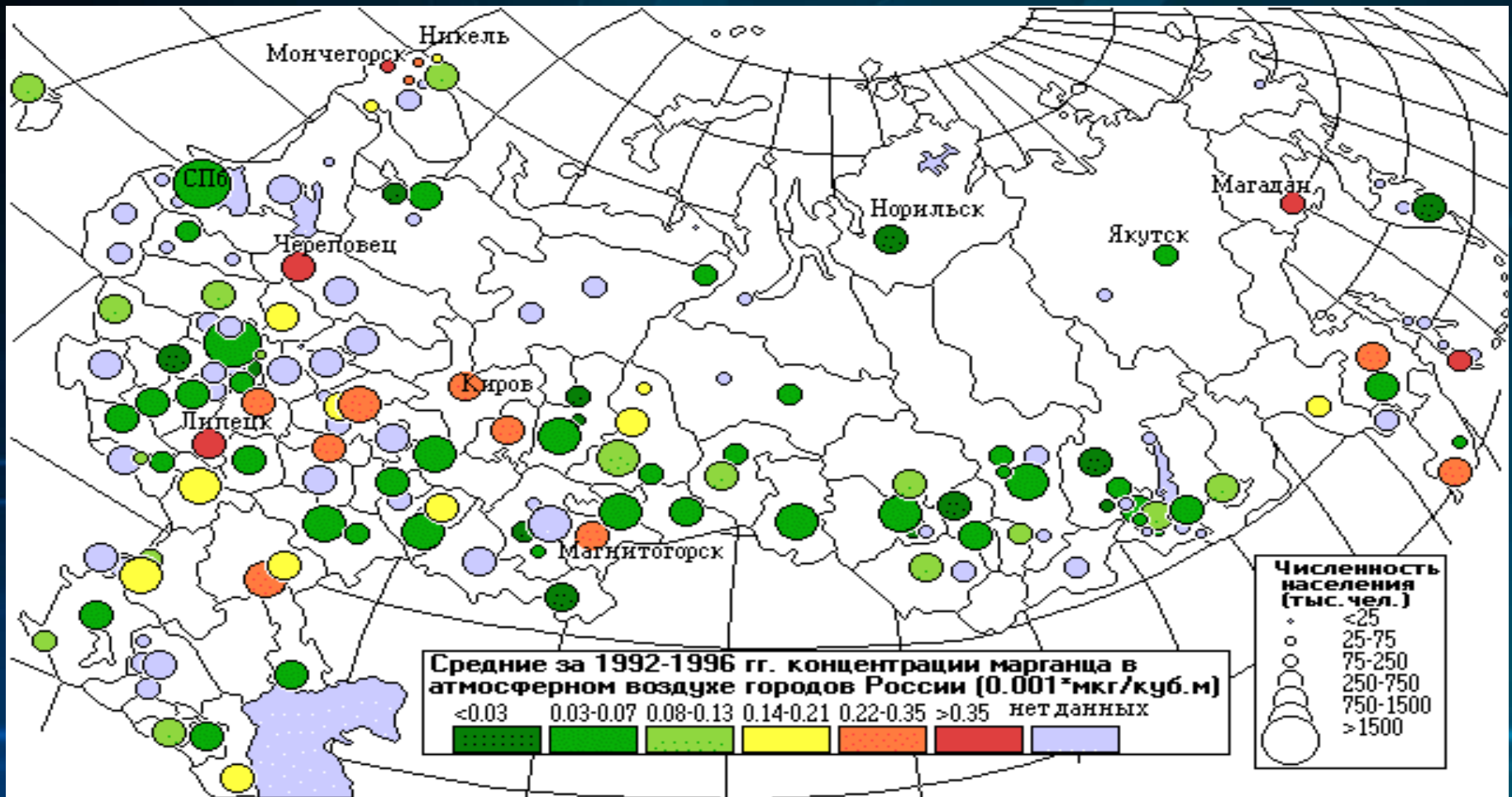
Pollutant releases in atmosphere (thousand tons)



Content Ni in air in industrial centers



Content Mn in air in industrial centers





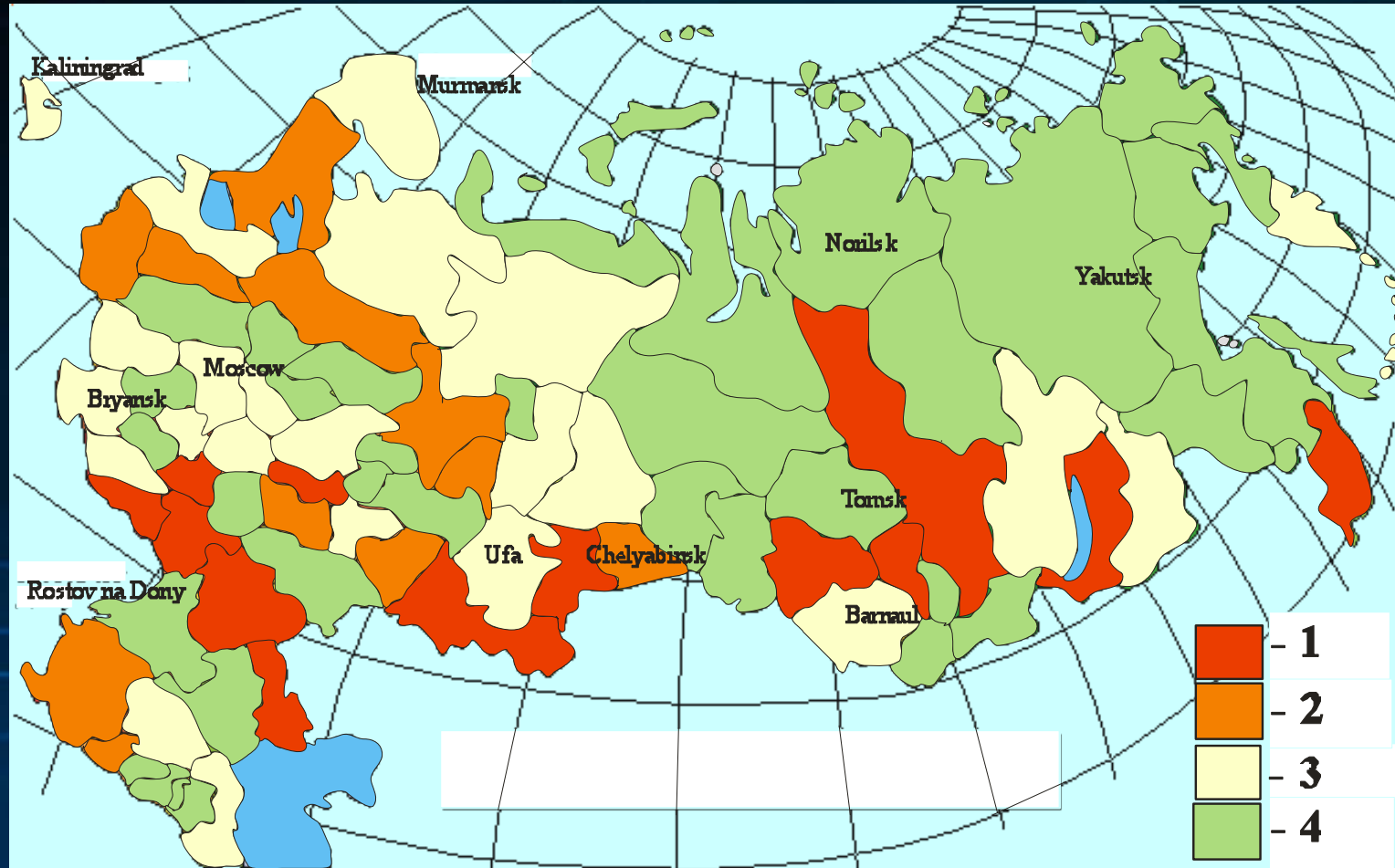
Classes of hazard of chemical elements

Class of hazard

Element

- **1** As, Cd, Hg, Se, Pb, Zn, F
- **2** B, Co, Ni, Mo, Cu, Sb, Cr
- **3** Ba, V, W, Mn, Sr

Pollution of arable land by chemicals of I and II class of hazard



1 - excess of MPC for individual elements of 1 class of danger; 2 - excess of MPC for individual elements of 2 class of danger; 3 - local contamination above MPC; 4 - non-surveyed areas or soils contamination below MPC



The most contaminated soils in Russia, % of the area surveyed

Region	Pb	Cd	Zn	Cu	Ni	As
Buryatia	25.1		3.0	9.6	1.2	
Mordovian	10.2		7.8	8.7	2.2	
Primorski territory	21.4					
Chita	44.2		21.1			23.0
Komi		5.6	3.2	22.2	2.9	29.6
Orenburg		4.2		39.4	7.0	
Novgorod			2.2	13.6		
Karelia				66.0		



Share of contaminated agricultural soils, % of area surveyed

Pb – 1.66

Cd – 0.62

Zn – 1.92

As – 0.05

Cr – 0.62

Ni - 2.84

Cu – 3.79

Co – 1.92

Distribution of agricultural lands by levels of radioactive contamination

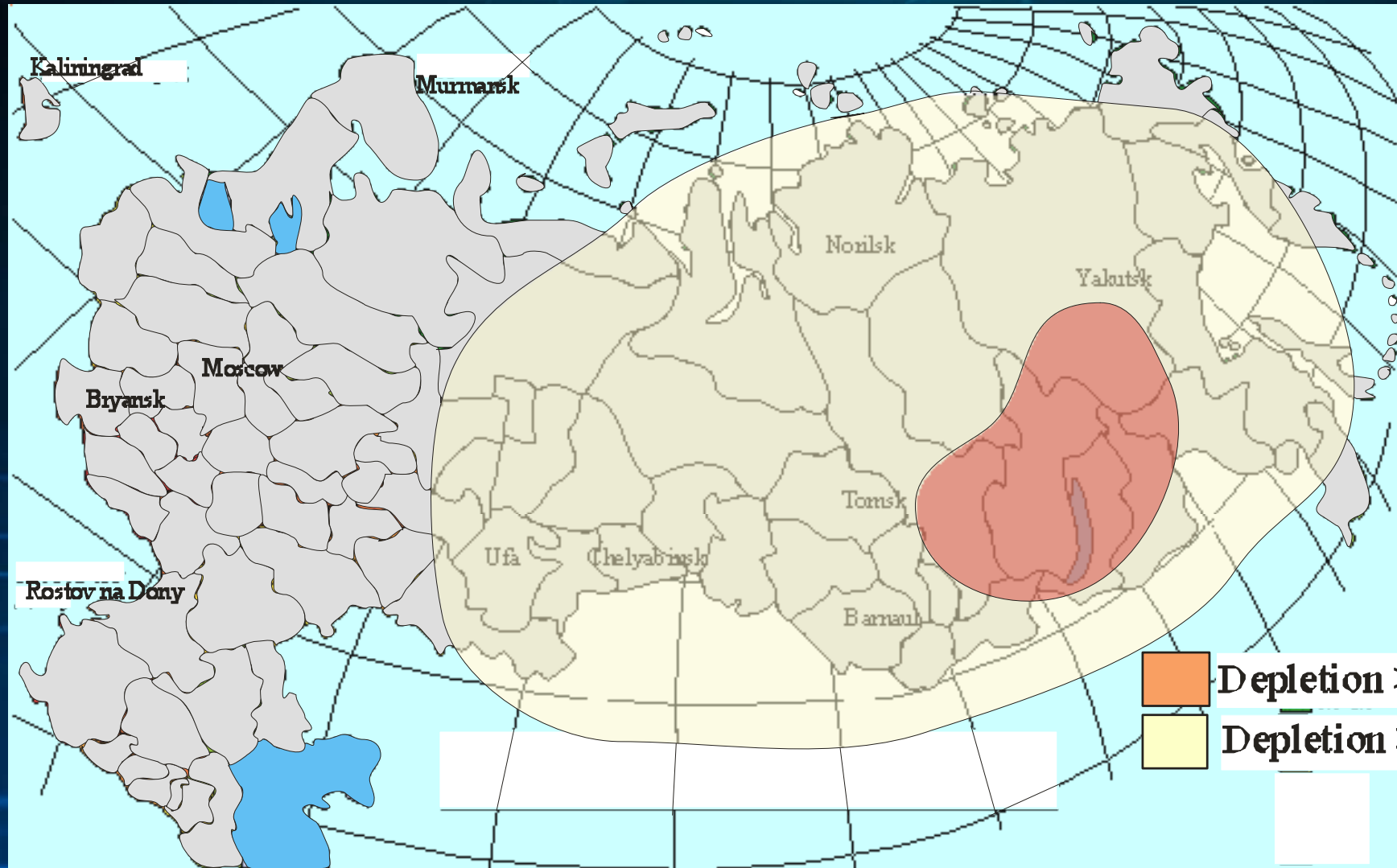




Distribution of agricultural lands by ^{137}Cs contamination density (ha)

Region	^{137}Cs contamination density, kBq/m ²				Total
	37-185	185-555	555-1480	>1480	
Bryansk	185482	180054	90615	17106	473257
Kaluga	-	22358	80	-	22438
Orel	-	14278,1	-	-	14278
Tula	-	87904	409	-	88313

Depletion of the ozone layer over the territory of Russia in 2001



Ranking of the most dangerous pollutants



- Heavy metals: Cd > Pb > Zn > Hg > Ni > Co > Se.
- Other toxic elements: As, Al, F.
- Pesticides: compounds of 2,4-D group, organophosphorous compounds (carbophos, metaphos).
- Radionuclides (^{90}Sr , ^{137}Cs).
- Nitrates.
- Organic synthetic and natural compounds (particularly dioxines).
- UV-B radiation and electromagnetic radiation (EMR) of non-ionising nature, primarily UHF.



MAIN DIRECTIONS OF THE ACTIVITY ON THE AGRICULTURAL SPHERE PROTECTION AGAINST TECHNOGENOUS EFFECTS

Improvement of the legal basis

Standardization of exposure

Examination of the sources

Development of monitoring of agroecosystems and control of agricultural products contamination

Protection of particularly valuable landscapes, agricultural plants and animals

Development of principles for damage compensation in agriculture



KEY DIRECTIONS OF RESEARCH

- Study of biological effects of anthropogenic factors on biological objects.
- Study of the behavior of anthropogenic pollutants in soil, soil-plant systems and farm animals.
- Development of a procedure for assessing environmental impacts of anthropogenic pollution of agroecosystems.
- Development of scientific foundations to provide sustainable development of agriculture in conditions of technogenesis.
- Development of technological principles for production of ecologically safe agricultural stuffs in polluted areas.



**THANK YOU
FOR YOUR
ATTENTION**