# ECOLOGICAL ASPECTS OF THE INTERACTION OF RIVER AND GROUND WATERS IN THE LOWER AMUR

*Institute of Water and Ecology Problems FEB RAS*
**Institute of Tectonics and Geophysics FEB RAS*

Kondratyeva L.M.,
Kulakov V.V., Stukova O.Yu., *Golubeva E. M.

**Khabarovsk, Russia**

E-mail:kondrlm@rambler.ru

# ECOLOGICAL PROBLEMS IN BASIN OF AMUR RIVER

- **1996- 2002 - “Phenol” pollution (smell of fish)**
- **2002-2006 - fish polytoxicosis**
- **2005-2006 - the technogenic accident in China (nitrobenzene, benzene and its isomers)**
- **2002-2009 - chronic pollution by persistent organic matter**

***Reliability of risk estimate is relative for every moment of time***

**All approaches need to be corrected with an account of advantages of fundamental science, experiences of extreme situations in various regions**

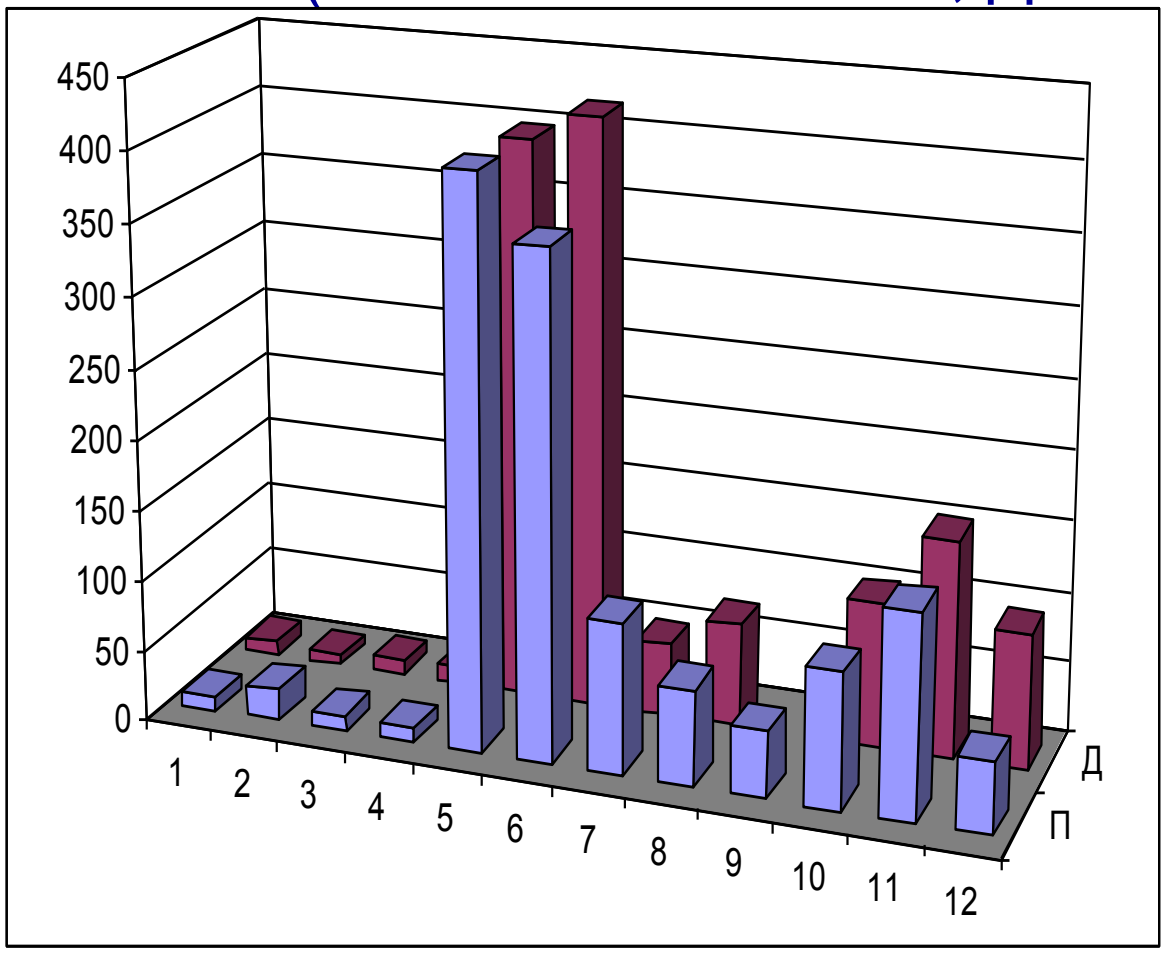
# AMUR RIVER

# Pollution of the Amur River



## by Suspended particles (mg/l)

(П –surface waters , Д – bottom waters)




(1-3) - 2 km lower Blagoveschensk city;

**(4-6) – 4 km lower the Songhua juncture;**

(7-9) – upper Fuyanj city

(10-12) - 4 km upper Khabarovsk city;

(1,4,7,10) - left bank;
(2,5,8, 11) - middle
(3,6,9,12) - right bank

# «high consumption, high input, high pollution, ……high risk»


# Pollution

## of the Amur and Songhua rivers after the technogenic accident in China

**13 November 2005**

100 tonns

**Nitrobenzene , Benzene and its derivatives**

# Toxic substances in various components of the Amur River ecosystem



## Freeze-up period (2005-2006)

- **Water:** Nitrobenzene, benzene, toluene, xylene, ethylbenzene, chloroform, dichloromethane, dichlorobenzene, PAH, heavy metals
- **Bottom sediments:** Chloroform, tetrachloromethane, chlorobenzenes, PAH, heavy metals
- **Fish:** Nitrobenzene, benzene, toluene, xylene, ethyl benzene, heavy metals, chlorine containing pesticides

# May, July 2006

- **Water: Phthalate, dibutyl phthalat, chlorphenols, pesticides: acetochlorine, atrazine, PAH, heavy metals**

- **Bottom sediments: Diethyl phthalate, dioctylphthalate, methylphenol, benzo(b)fluorantene, perylene, benzopyrene, benzene, xylene, toluene, chlorphenols, methylbenzene**

# China, July 2010

(«The Epoch Times»)

«Three Gorges Dam»

**Several tragic events happened in China in July, 2010. 11 provinces suffered the flood, most powerful for 100 years.**

# After floods destroyed two chemical plant warehouses in Jilin Province

- A total of 3,662 barrels were filled with colorless and highly explosive chemicals, mainly
- trimethyl chloro silicane
- hexamethyl disilazane


# Vice Minister of Environmental Protection Wu told Russia's Ministry of Natural Resources and Ecology:

- "China has adopted resolute measures to prevent these chemical barrels from floating into Heilongjiang Province, and **they won't affect Russia at all…"**
- 7,107 barrels had been collected and disposed of, including 3,633 that were filled with chemical materials.
- The monitoring results have shown **the pH** reading in the river water remains within the **normal range**
- **No reports on other substances were given.**

# Ecological risks

- the permanent transboundary flow of pollutants and their influence on hydrobionts in the Amur River;
- the problem of high-quality drinking water supplies for the population;
- the demand for alternative sources of water-supplies;
- the prevention of ground water pollution.

# Khabarovsk City

- Based on **bank filtration the Northern** water intake facility has been under operation **for over 70 years**. A water-bearing horizon made of coarse sands with gravel and pebbles.
- In natural conditions ground waters concentrations of iron (32 mg/l) and manganese (7.5 mg/l).
- Due to many years of intake facility operation **a zone of iron-free waters has been formed.** Chemical composition (iron, manganese) of ground waters in the wells satisfies drinking water requirements.

# The primary mission of researches

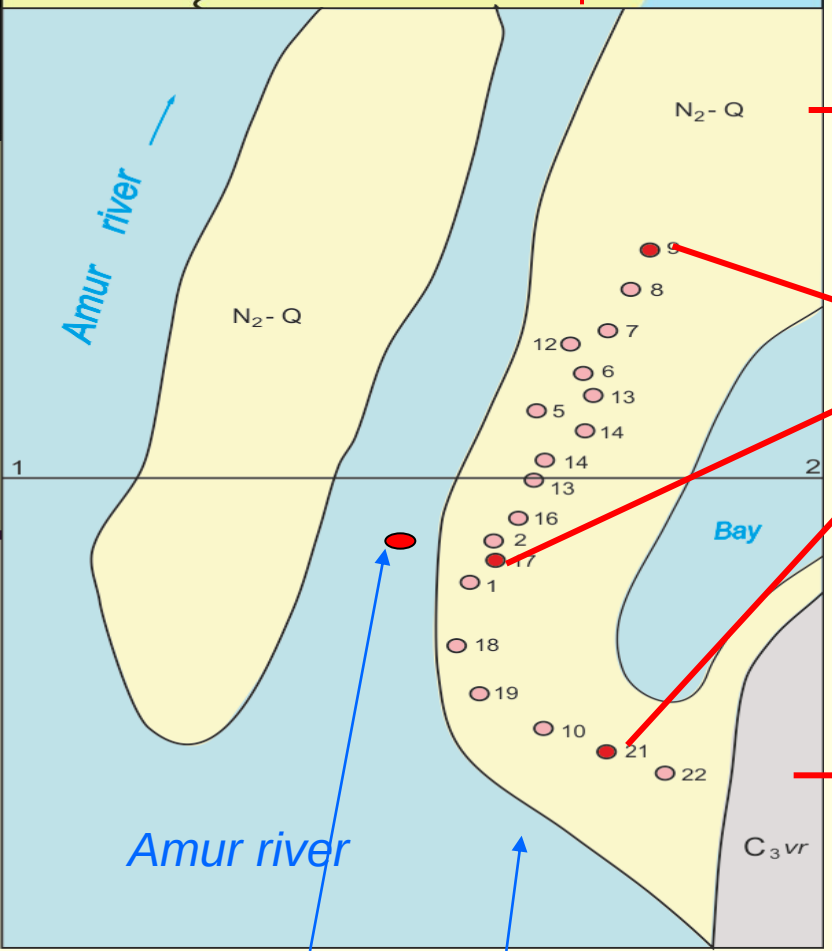
## to answer the following questions:



- When river waters get into the well?
- How do Fe and Mn concentrations in river and ground waters change?
- How do microbiological parameters of quality of water?

- A microbiological indication method was used to study penetration of organic matter from the Amur River into ground waters.
- Iron and manganese concentrations were measured with an ICP-MS method.

# The placing of production wells on Northern water supply points in a flood plain of the Amur river

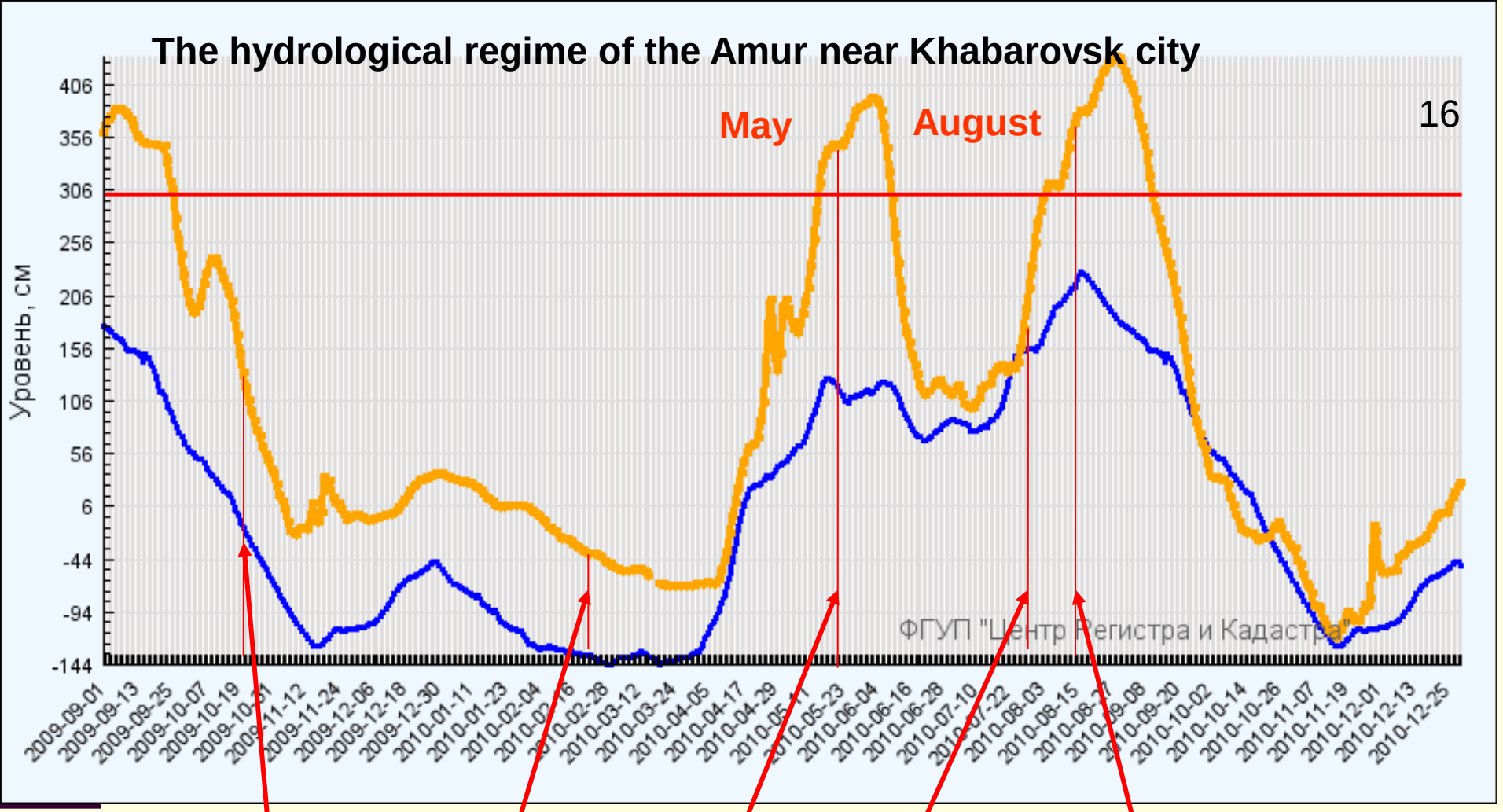




The area of distribution
a Pliocene-Quaternary alluvial sand-gravel sediments

**9, 17, 21- Investigated wells**

**Water samples were analyzed in October, 2009, and then in February, May, August and November, 2010**

The right slope of a valley of the Amur river, combined metamorphized slates and sandstones carbon age (bedrock)



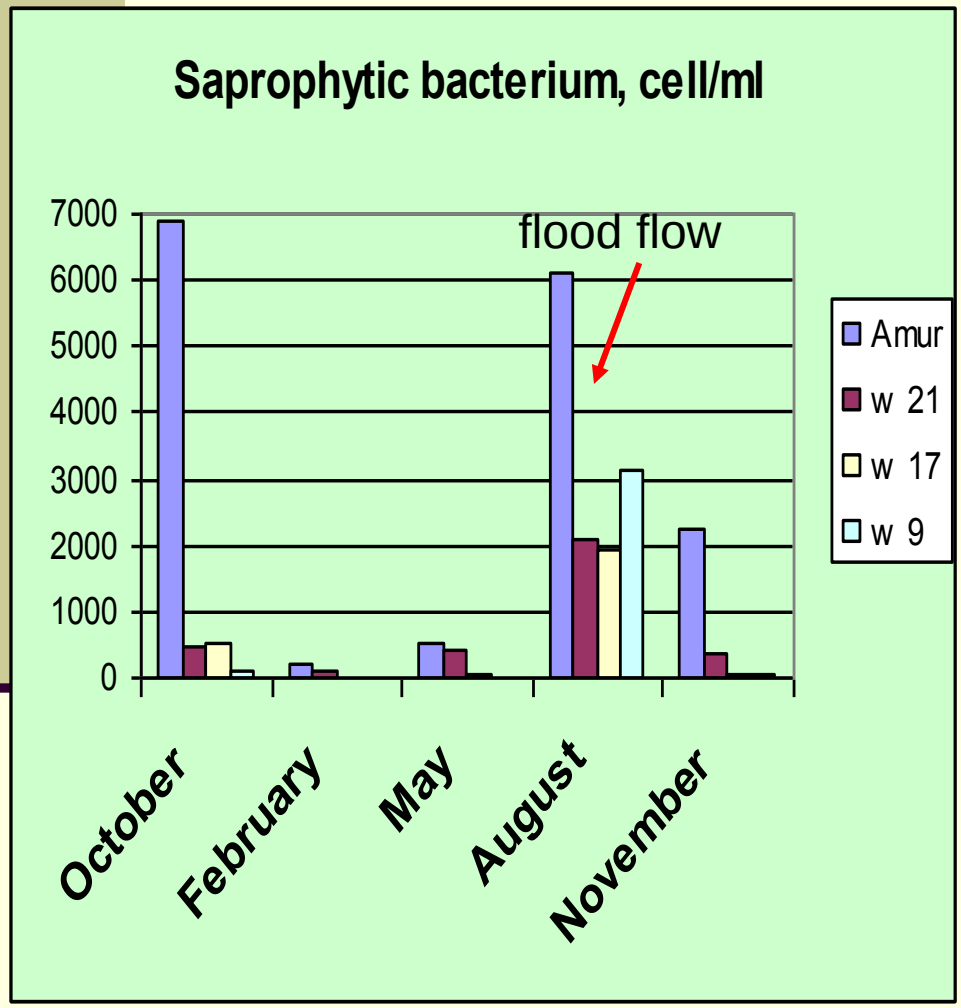

Red vertical lines is dates of selection of water tests on researches

**Yellow** – current level from September 2009 till December, 2010

**Blue** – average long-term 1/1/2001

# Seasonal change of number saprophytic bacterium





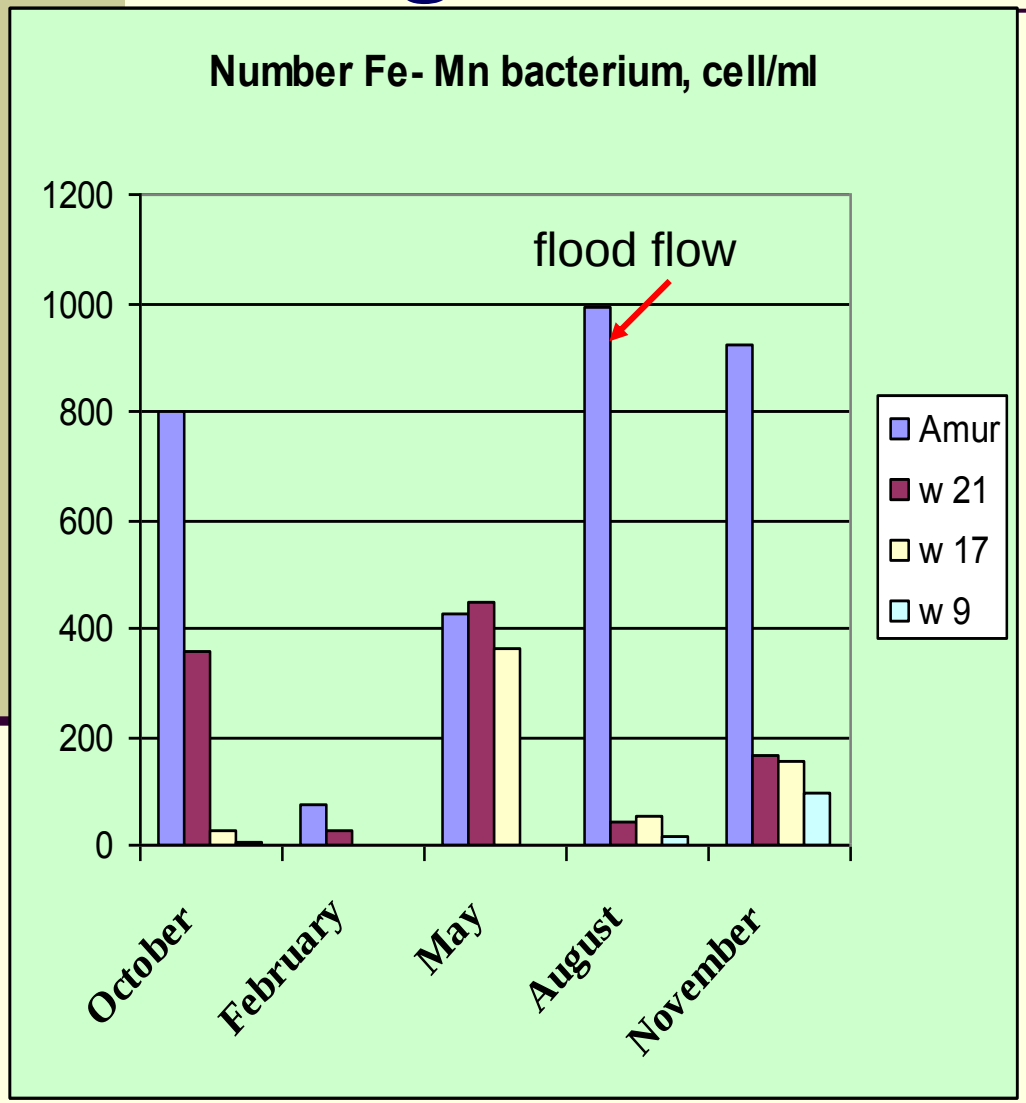

**The number of this group of bacteria reflects the total contents of organic substances in water.**

**In February and after the May-flood water was very clean.**

**In August after the flood in the Songhua basin the number of saprophytic bacteria increased in the Amur river and in all the wells. Even in the most distant well 9.**

# Seasonal change of number iron-manganese bacteria






**The high number of Fe- Mn bacteria in May can be explained with the Amur water inflow rich in oxygen and iron – humic complexes**

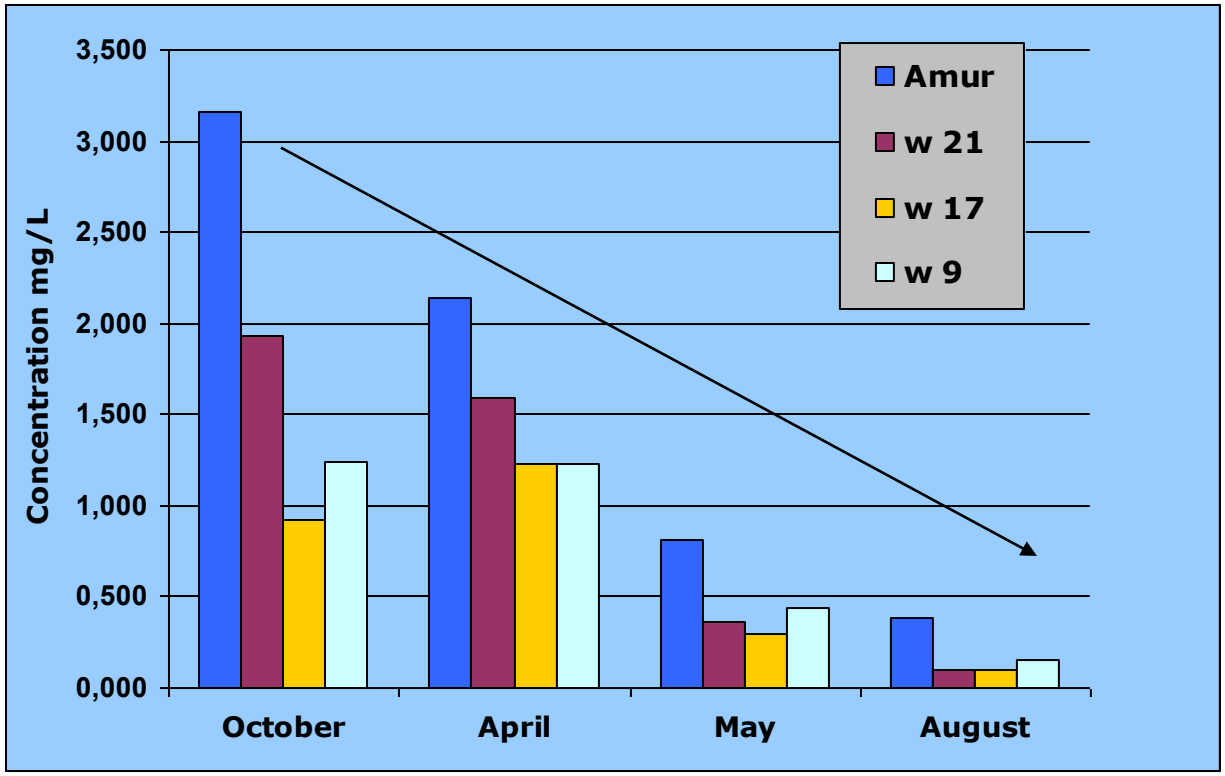
**August - ???**

**However in August such connection was not revealed. This question needs further studies.**

**It is possible to assume the inhibition of Fe-Mn bacteria growth by toxic substances which come with the Songhua river water.**

# Seasonal changes of iron concentration s in the Amur river and in the wells

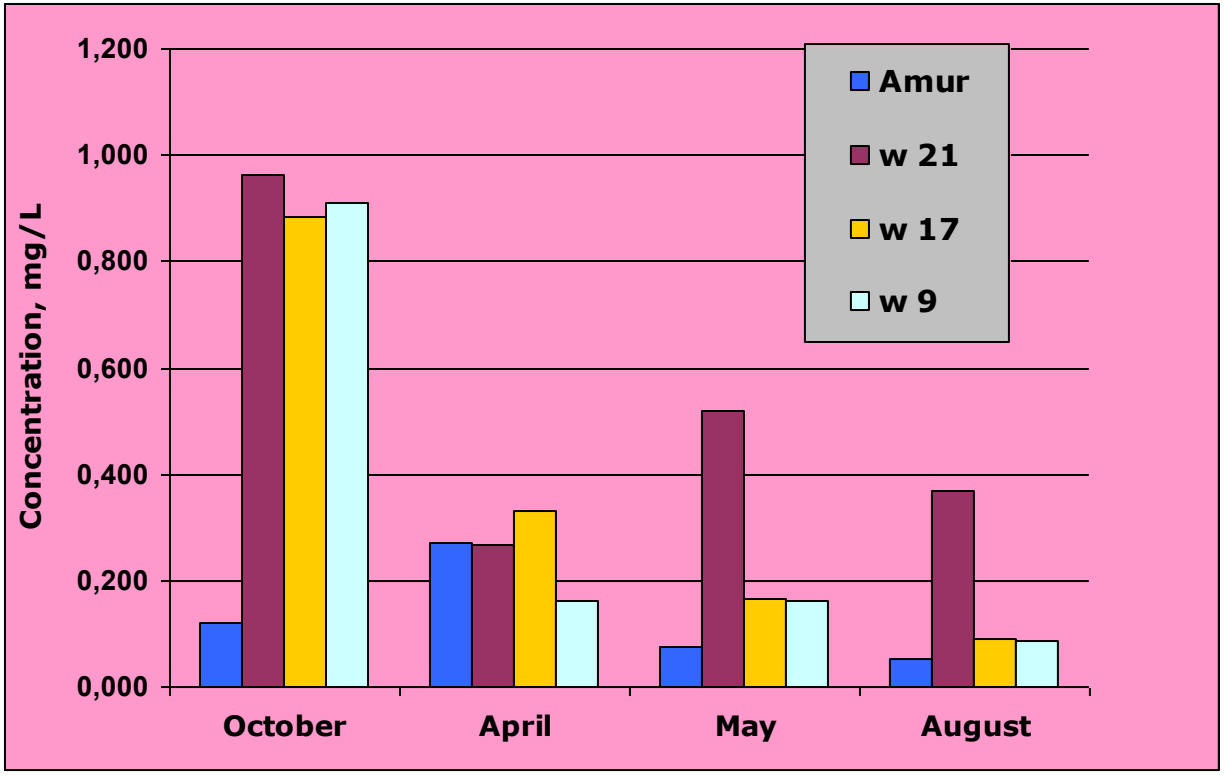





**Seasonal changes of iron concentrations in well 21 at the beginning of the infiltration row corresponded to iron concentrations in the Amur river.**

# Seasonal changes of manganese in water of the Amur river and in the wells






**Concentrations of manganese were high in the wells, especially in autumn. It can be connected with considerable inflow of organic substances.**

# Correlation analysis

- High positive correlation was found between
- water quality in Amur river and:
- October - **W 21** (r=0,92)
- February - **W 21** (r=0,99)
- May - **W 21** (r=0,96)
- **W 17** (r=0,94)
- August - **W 21** (r=0,94)
- **W 17** (r=0,97)
- **W 9** (r=0,90)

**In well 21 the influence of the Amur River was observed during the whole period of monitoring.**

**In May the Amur river influence reached well 17.**

**During the flood in China water quality in all wells highly depended on Amur water quality.**

# The conclusion



- **Our research showed that toxic organic substances should be analyzed in ground waters especially in time of river floods.**
- In flood time due to bank infiltration greater amounts of organic mater of different origin get into ground waters.
- Organic matter combined with oxygen that comes with river water **affects the activity of iron-manganese bacteria**, which cause the transformation of dissolved ion forms of iron and manganese into their non-dissolved compounds. Thus iron and manganese concentrations in ground waters are decreasing.


THANK You for
ATTANTION !