Caution

POLLUTION OF THE AMUR RIVER DURING AN ICE COVER:

PRIMARY FACTORS OF ECOLOGICAL RISK

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Actual ecologic risk – negative impacts on organisms and systems, which are registered at present time.

Potential ecologic risk – **aftereffect can be prolonged for many days, weeks and years. This risk can be connected with biogeochemical processes in water ecosystems and appears in the form of mutagenic, carcinogenic and teratogenic changes.**

Ecological risks for Amur hydrobionts caused by **the regular pollution, it is connected with a superficial drain, receipt of sewage and with large inflows (Zeya, Bureya, Songhua).**

ECOLOGICAL PROBLEMS IN BASIN OF AMUR RIVER

- **1996- 2002 - “Phenol” pollution (smell of fish in winter)**
- **2002-2004 - fish polytoxicosis (ClP,NA,HM)**
- **2005-2006 - the technogenic accident in China (nitrobenzene, benzene and its isomers)**
- **2002-2011 - chronic pollution by persistent organic matter and HM**

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

Polytoxicosis of the Fish in the Amur River (winter 2002)

- Smell intensive – Acrid
- Bacteria – 2000 - 6000 cells/g
- 3-methyl-amine – 2,4 - 6,2 mg/kg
- Volatile azoth substances – 290 - 410 mg/kg
- Hg (Heavy metal) – 0,56 – 0,72 mg/kg

Lindan (HClCH) - 0,023–0,025 mkg/kg

Chlororganic pesticides- 0,06–0,07 mkg/kg

Kondratyeva et all., 2005

Organic mater in water of Amur river at Khabarovsk water-supply point in seasonal time (Rapoport, Kondratyeva, 2008)

Hydrocarbons n-paraffine, Pentacyclohexane Squalene Different of 16 PAHs	January - November February - July March, May **January - November**
Phthalate Dibuthylphthalate Diocthylphthalate	**January - November** February - July March, April
Phenols **Chlorine phenols**	**January - December** March - May, September
Pesticides DDT, HClCH Acetochlore, Atrazine	**March - November** May, July, September March, May, November

Pollution

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

13 November 2005

100 tonns

Nitrobenzene , Benzene and its derivatives

Benzene by +5

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

*Analyses are executed at support of the Ministry of natural resources of Khabarovsk territory

Concentrating of PAHs in ice of Songua R. and Amur R. along right bank

PAHs, mkg/l	Songua		Amur
	Jiamusi	Tunjan	N. Leninskoe
Naphthalene (2)	**3**	**2,7**	**0,006**
Phenanthrene (3)	**0,131**	**0,072**	**0,076**
Fluorene(3)	0,03	0,014	0,018
Pyrene(4)	0,038	0,029	0,027
Fluoranthene(4)	0,05	0,034	0,028
Benzo(a)anthracene (4)	0,013	0,006	0,002
Benzo(a)pyrene(5)	0,008	0,006	0,001
Benzo(b)Fluoranthene(5)	0,021	0,008	0,003

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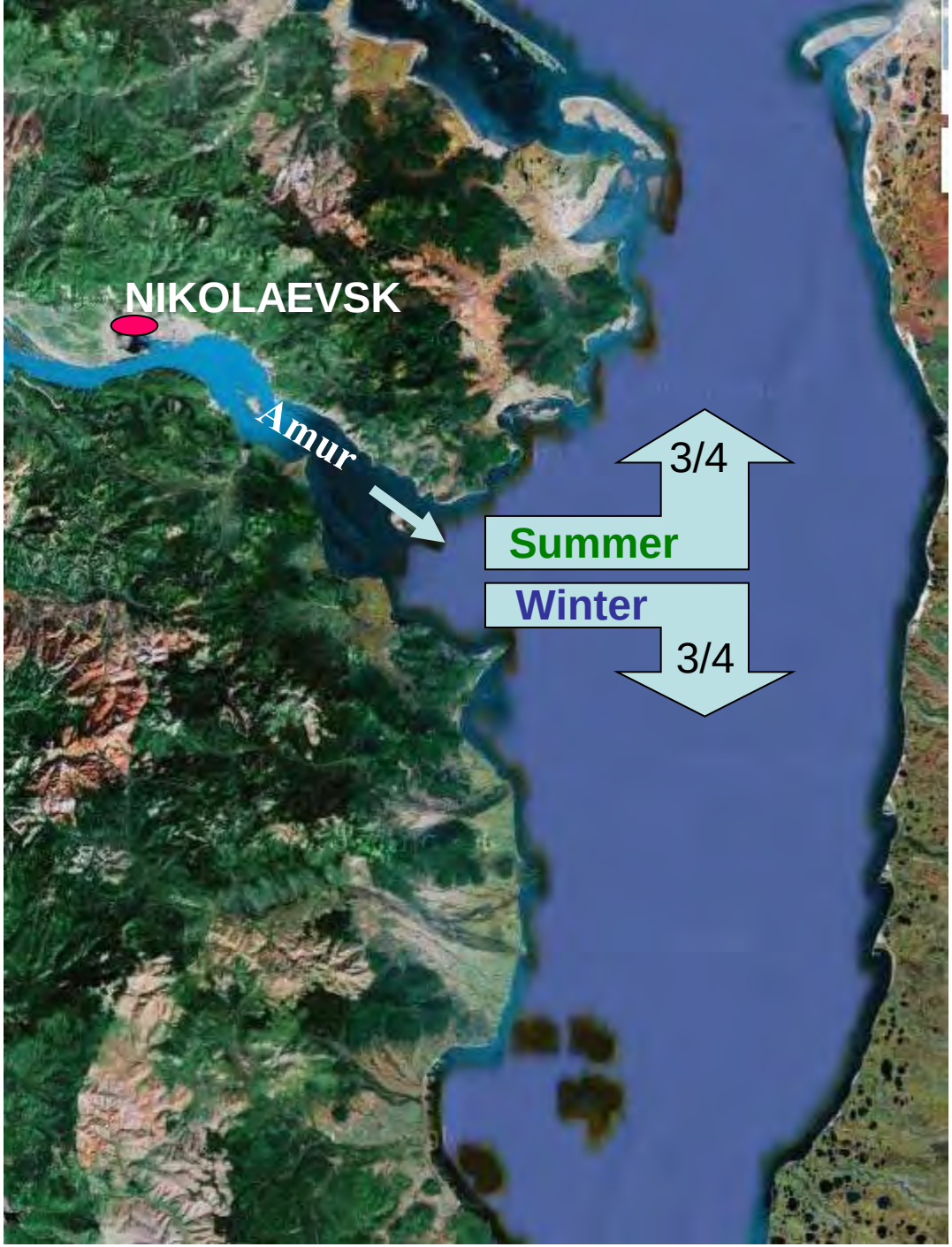
Ice near Jiamusi city (China) 20-39 cm

- This ice contained many clay particles and had a strong smell.
- In this ice the highest concentration of total **PAH - 348 ng /L** (in water 56 ng/ L)
- **benz(a)pyrene - exceeded the norm 8 times**
- **Cresols exceeded the norm 4 times**

Components that were present in water during the nitrobenzene spill participated in the chemical composition of this ice.

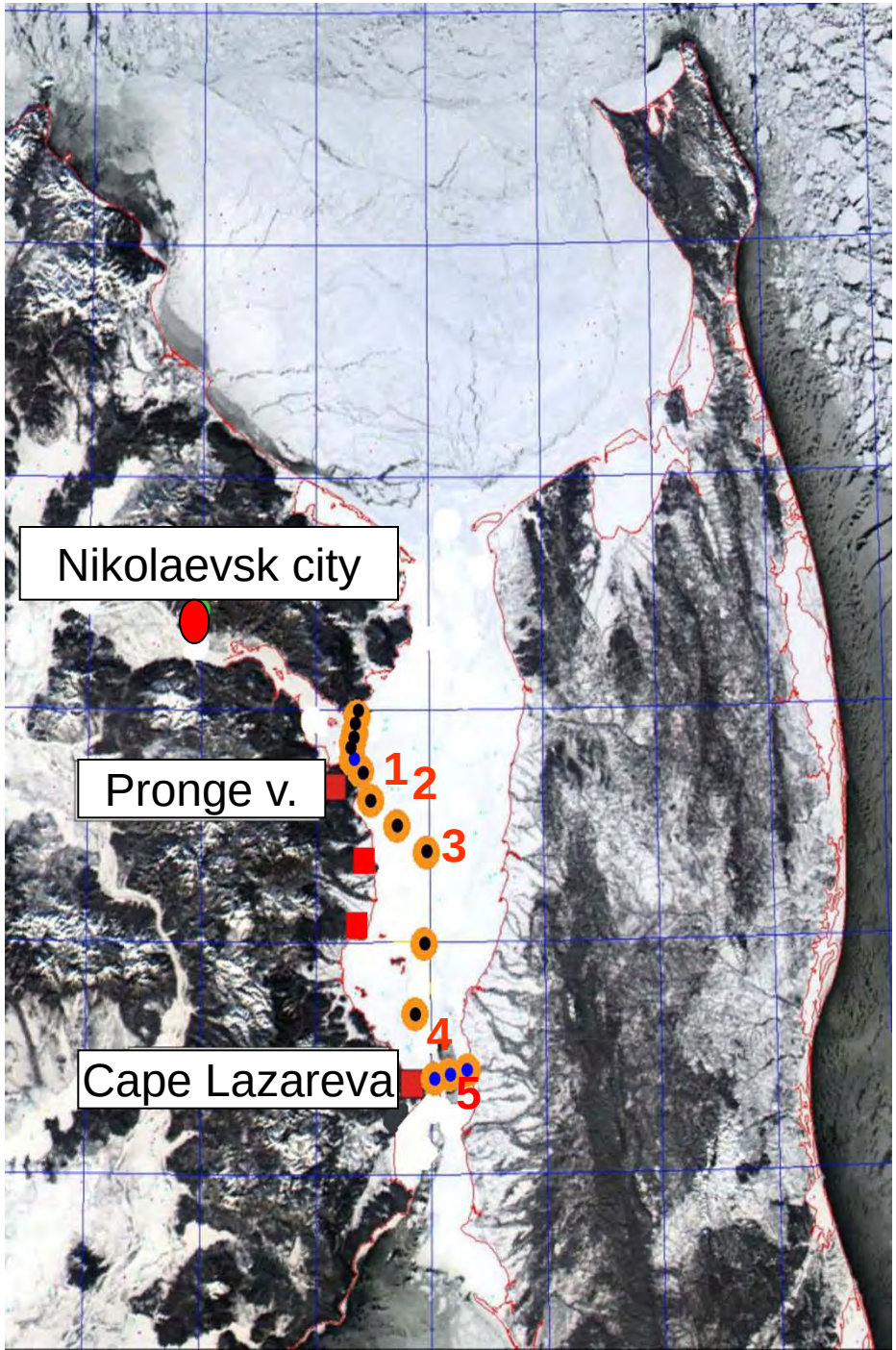


Seasonal distribution of runoff of the Amur river

In the summer - 3/4 drains arrive to sea of Okhotsk

In the winter - 3/4 drains arrive to sea of Japan

Quality of water is connected with various factors (superficial drain, sewage, influence of large inflows, biogeochemical processes in a water column and bottom sediments)

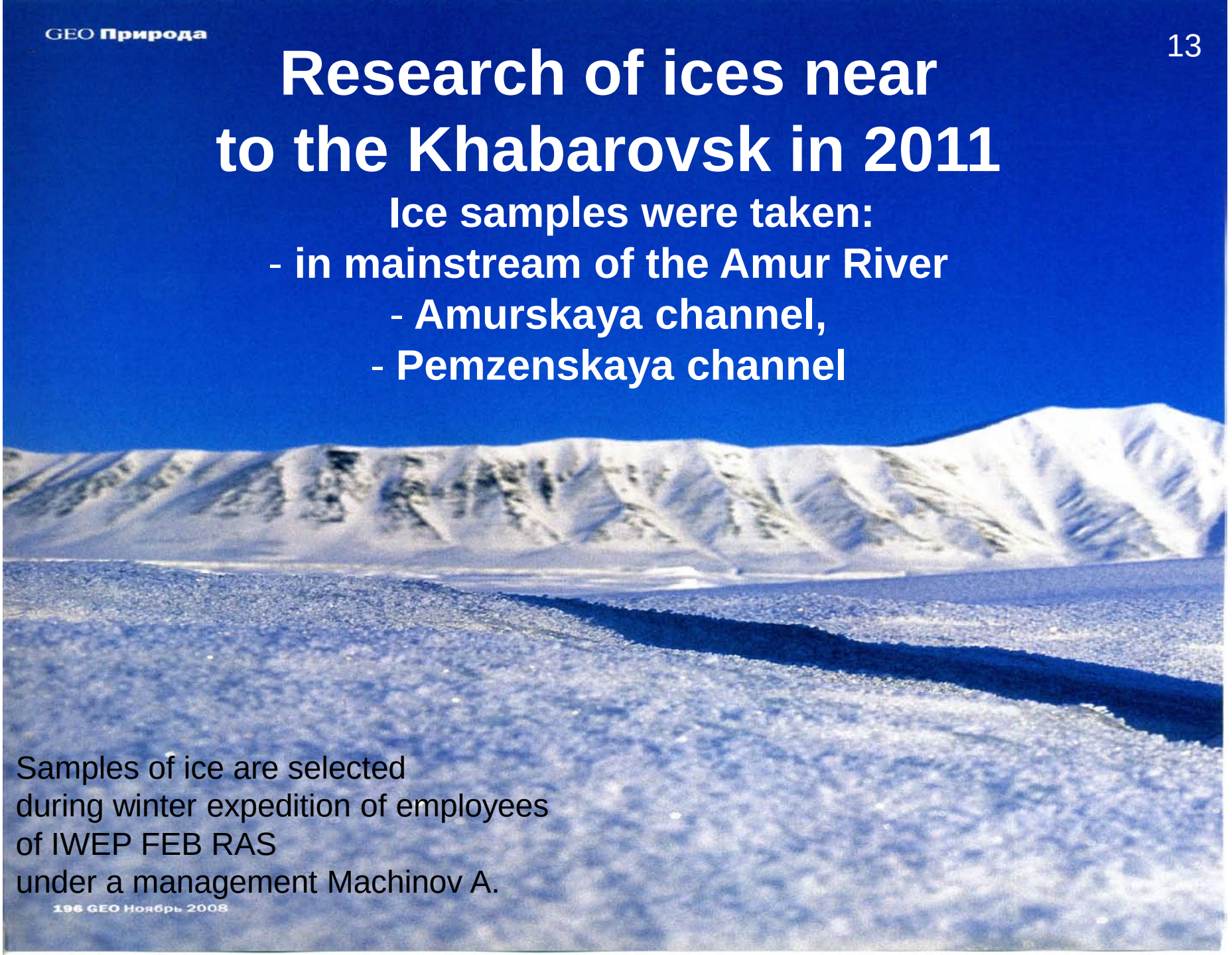


Sampling station in Amur-Liman in April 2008

Samples of water are selected of employees of POI FEB RAS under a management Dudarev O. and Tischenko P.

Organic mater in Amur-Liman in April 2008 (chromato-mass-spectrometry – Papoport V.L.)

Sampling station	Total, components	Dominants components	Total, Phthalate, %
Sakhalin traverse	**18**	**benzene**, Organic acid	13,82
Low v. Pronge (**shallow waters**)	**76**	Organic acid **benzene**, **Phenanthrene** **Cresols**	5,87
M. Pronge	**43**	**Phenols**, **Naphthalene** **xylene**, 3-methylbenzene, ethylbenzene, 2,4-D	9,57
M. Lazareva	**39**	**benzene, toluene**, ethylbenzene	10



Research of ices near to the Khabarovsk in 2011

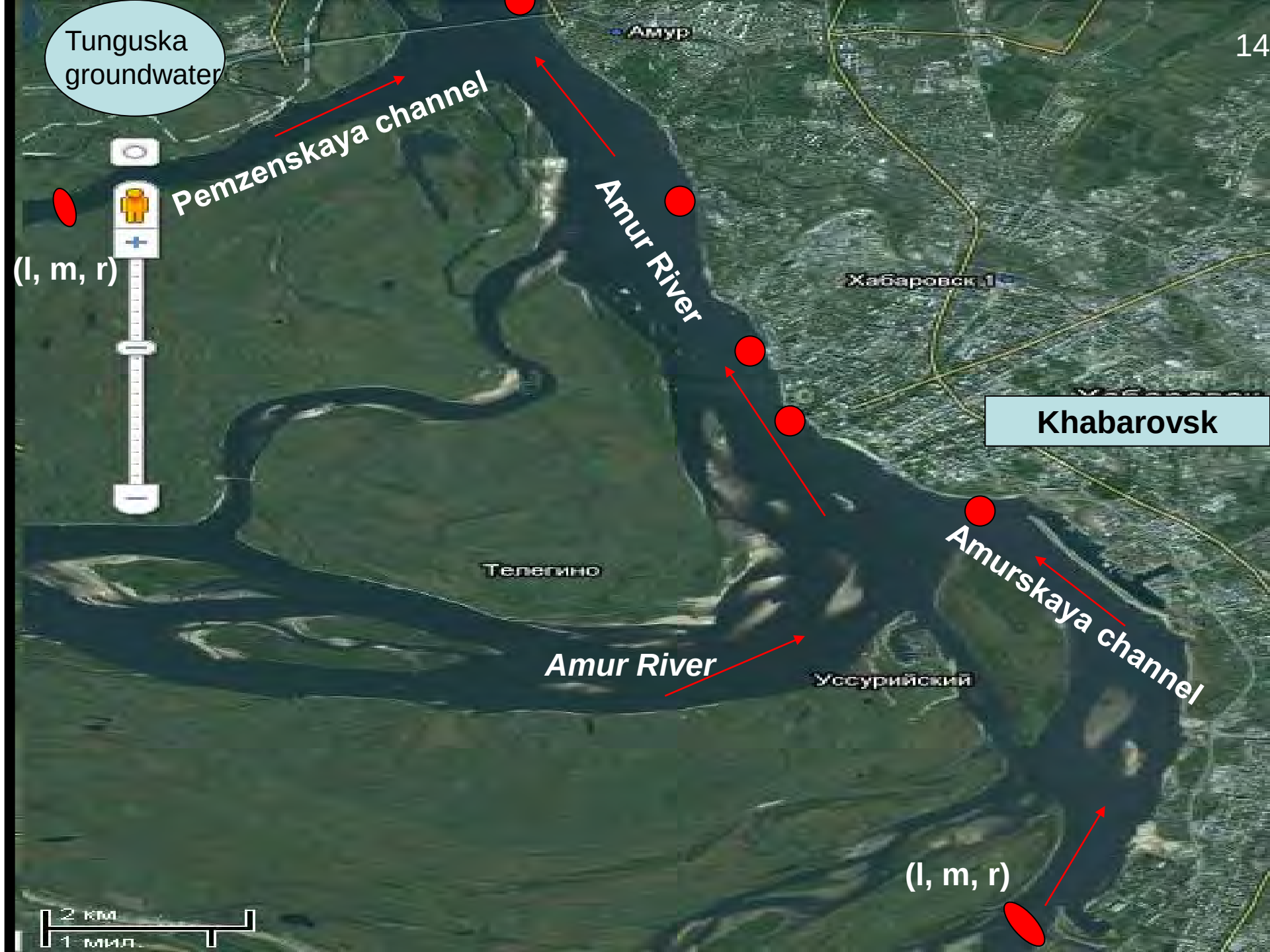
Ice samples were taken:

- in mainstream of the Amur River

- Amurskaya channel,

- Pemzenskaya channel

Samples of ice are selected
during winter expedition of employees
of IWEP FEB RAS
under a management Machinov A.


Tunguska groundwater
Pemzenskaya channel
Amur River
(l, m, r)
Амур
Хабаровск 1
Khabarovsk
Телегино
Amurskaya channel
Amur River
Уссурийский
(l, m, r)
2 км
1 мил.

Ice- 2011

- **Volatile hydrocarbons** - gas chromatography (Zhukov A.)
- **Heavy metals** - ICP-MS (Avdeev D., Pan E.)

The thickness of ice made:

Amur river - along the right bank : 0,8 – 1,0 m

Amurskaya channels – 1,05 - 0,8 - 0,7 m (l,m,r)

Pemzenskaya channel - 0,8 – 0,7 – 0,9 m (l,m,r)

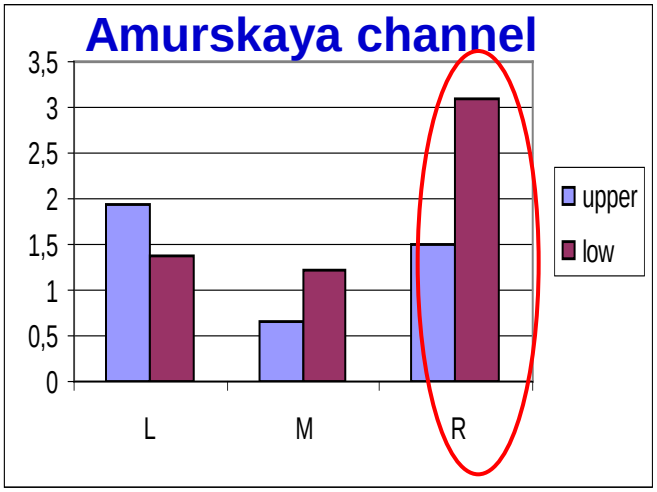
- **Investigated upper (20 cm) and low (20cm) ice layers**

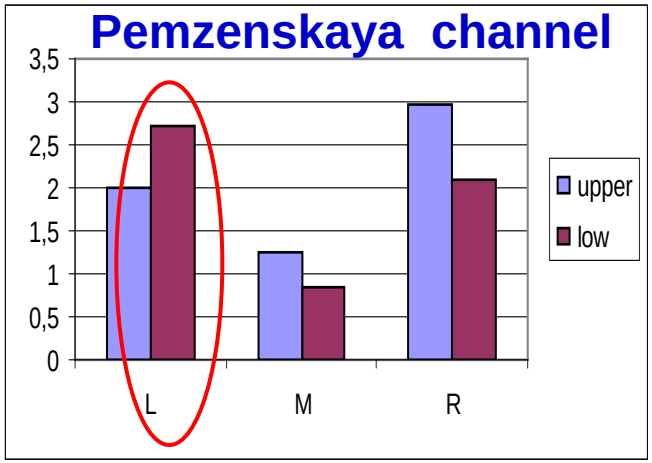
Chemical composition of upper and lower ice layers reflects on an ecological situation of river ecosystem in the beginning and in the end of freeze-up.

The maximum content of volatile substances (right bank)

Chemical composition, mkg/L	Amur River, near stadium (upper /low)	Amurskaya channel (upper /low)	Pemzenskaya channel (upper /low)
Butylacetate	**1,0 / 2,5**	0,7/ **< 0,1**	**< 0,1/ < 0,1**
Isopropylbenzene	1,5/1,5	1,0/ **< 0,1**	1,1/ **< 0,1**
***p*-Methylbenzene (*p*-xylene)**	**0,7 / 3,1**	0,3/ **< 0,1**	**< 0,1 / < 0,1**
***o*-Methylbenzene (*o*-xylene)**	0,1/0,3	0,5/ 0,5	0,5/0,5

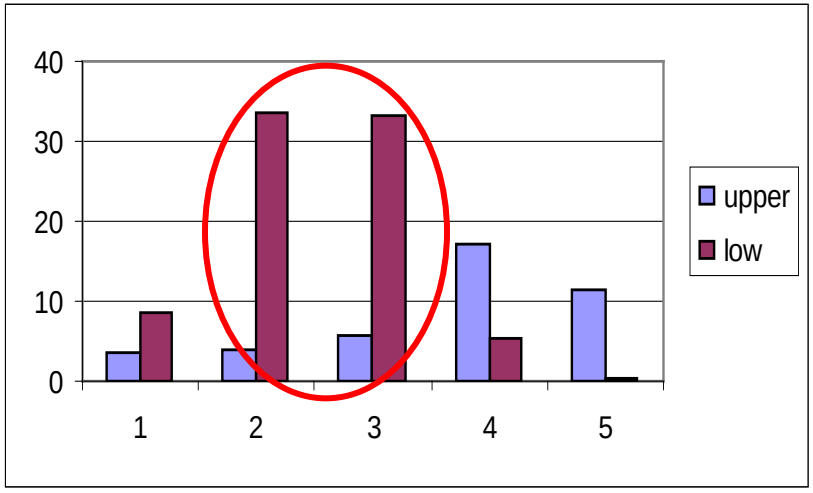
Content of methylene chloride in ice, mkg/L





L – left,
M –middle ,
R - right

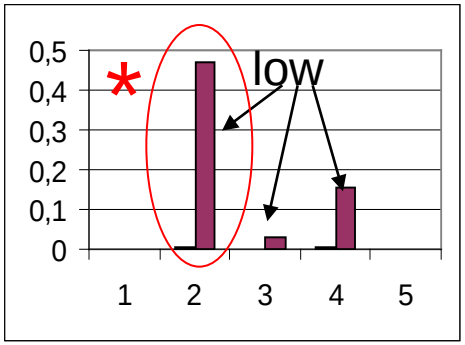
Amur River (right bank**)**

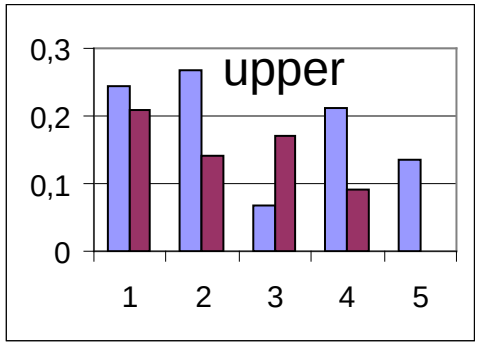


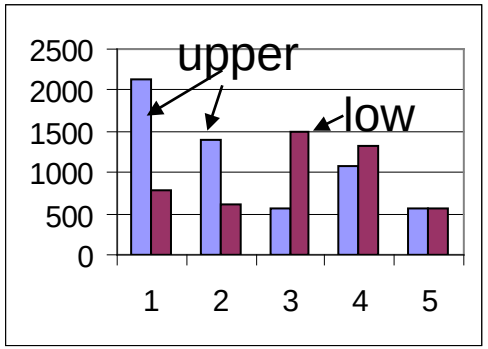
1. Upper Khabarovsk
2. Opposite to central quay
3. Opposite to stadium
4. Below the bridge the railway
5. Dump of sewage

Content of Heavy metals in ice (mkg/L)

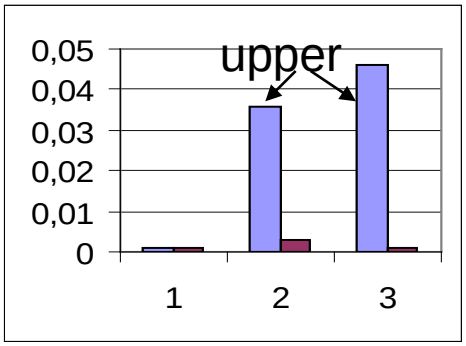
Hg | **Cd** | **Fe**

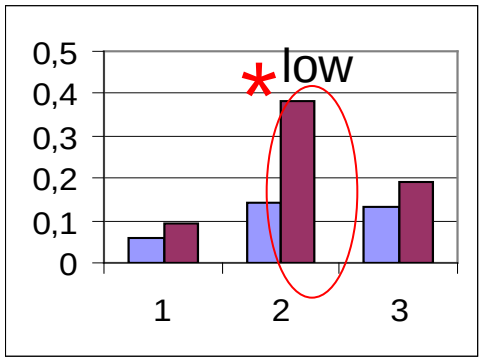


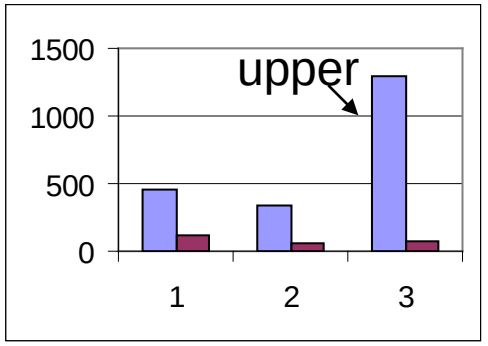




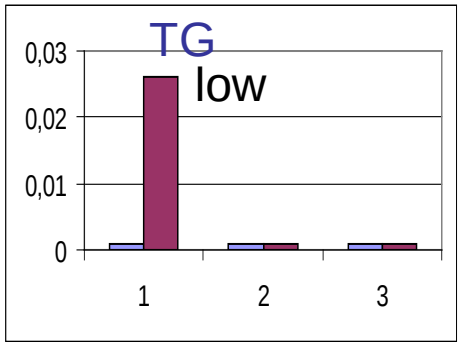
Amur river

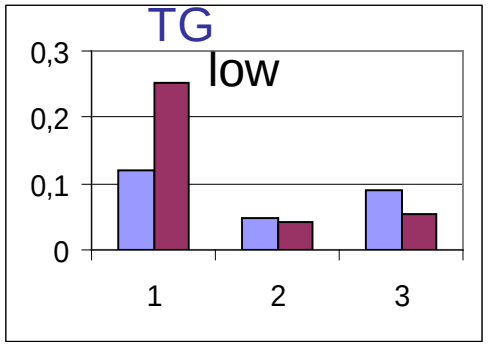


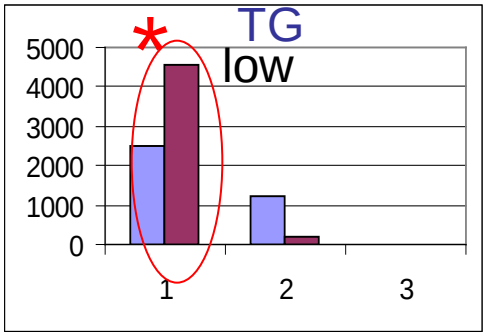




Amursk. channel







Pemzen. channel

1 – left, 2 –middle ,3 – right bank

*- max

Coefficient of correlation

- between methylene chloride and Hg

All tests of ice: upper K=- 0,27, low K=0,66

Amur river: upper K=0,68, low K=0,54

Amurskaya channel: no positive connection

Pemzenskaya channel: upper K=- 0,82, low K=0,79

- between Hg and Cd

Amur river: no positive connection

Amurskaya channel: upper K= 0,95, low K=0,94 (Ussuri river)

Pemzenskaya channel: upper K=- 0,91, low K=0,99

High coefficien correlation between Hg and Cd in low ice layers can be connected with spring pollution of water in channels from bottom sediments

The following priorities for the Amur research:

- **Research of mechanisms of transformation of organic matter of natural and anthropogenic origin, which accumulates in bottom sediments and in ice;**
- **Analysis of long-life dynamics of biocomplex population in the freeze up period;**
- **Level-by-level research of ice at various sites of the Amur River and coastal sea water areas;**
- **Studies of accumulation of derivatives of benzene and heavy metals in fish and molluscs;**
- **The Amur River discharge impact on coastal marine bioresources;**
- **Revealing ecological and social factors that influence of population health**

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THANK You

for ATTANTION !