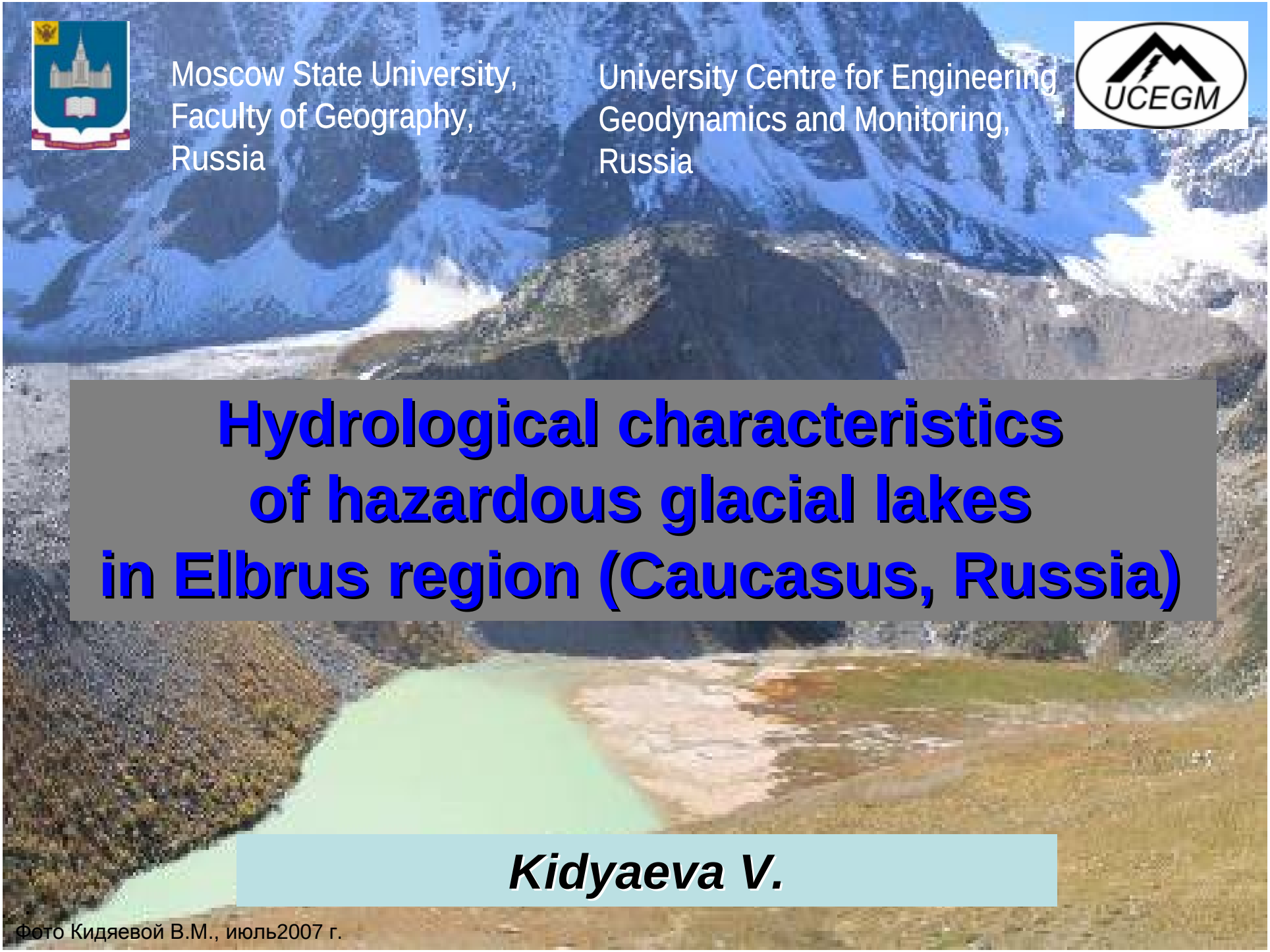


Moscow State University,
Faculty of Geography,
Russia

University Centre for Engineering
Geodynamics and Monitoring,
Russia

Hydrological characteristics of hazardous glacial lakes in Elbrus region (Caucasus, Russia)

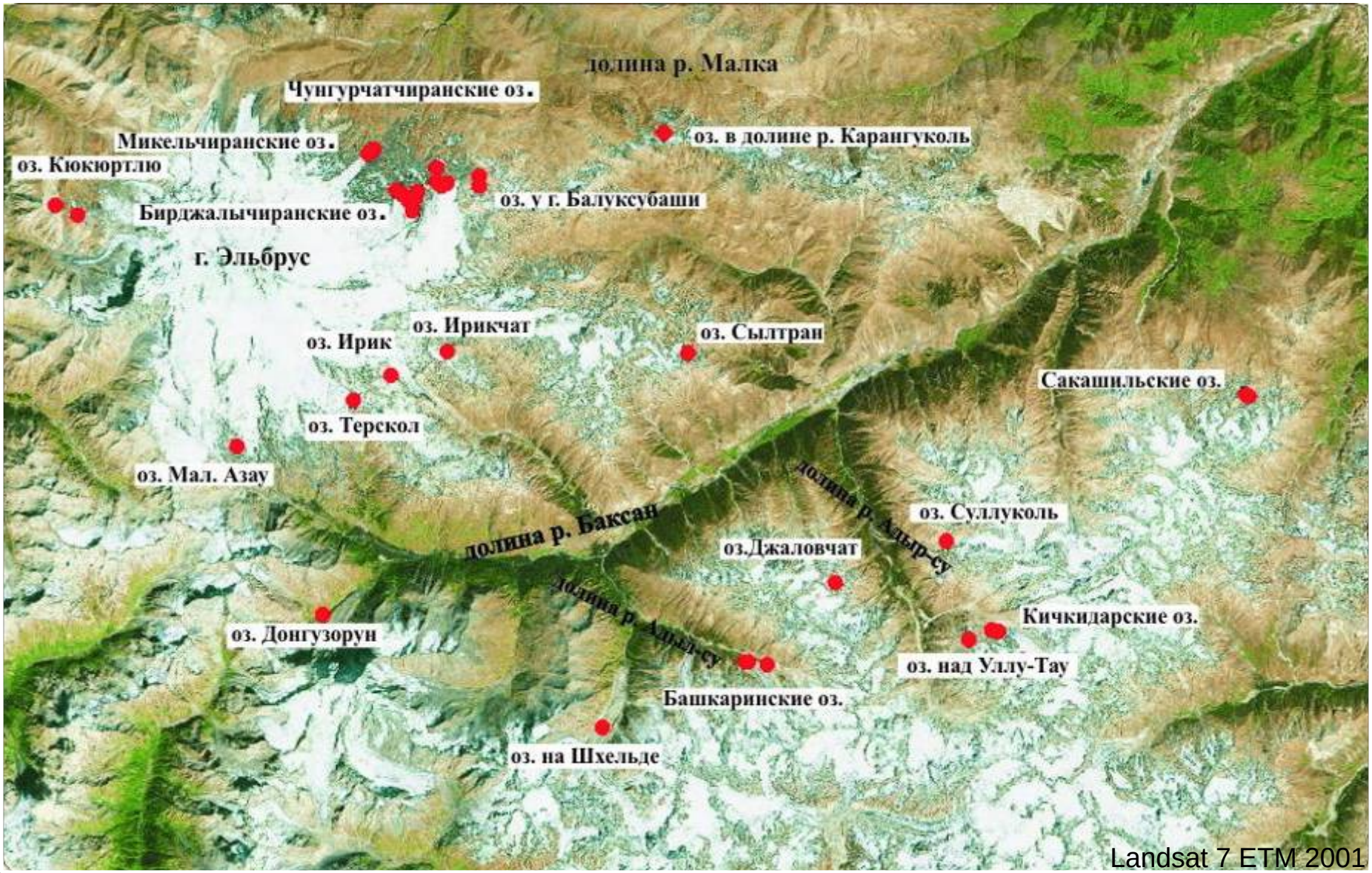
Kidyaeva V.

Фото Кидяевой В.М., июль2007 г.

Study area


Russia
Russian
Central Caucasus
Mt. Elbrus
Mt. Kazbek
Black Sea
Caspian Sea
Georgia
Armenia
Azerbaijan
Turkey
Iran
MODIS satellite image
2 November 2001

Glacial lakes of Elbrus region



Landsat 7 ETM 2001

Составитель Кидяева В.М.

Aims of the research

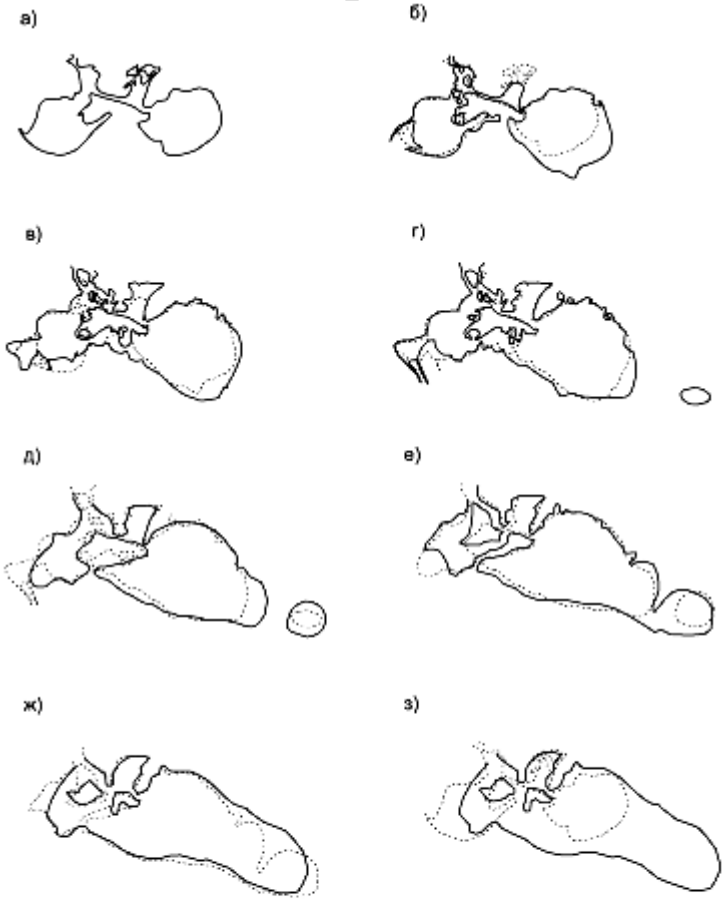
- morphometrical characteristics
- water level
- temperature regime
- distribution of water temperature and electroconductivity
- stages of glacial lakes development
- estimation of potential outbrust
- modeling of some outbursts

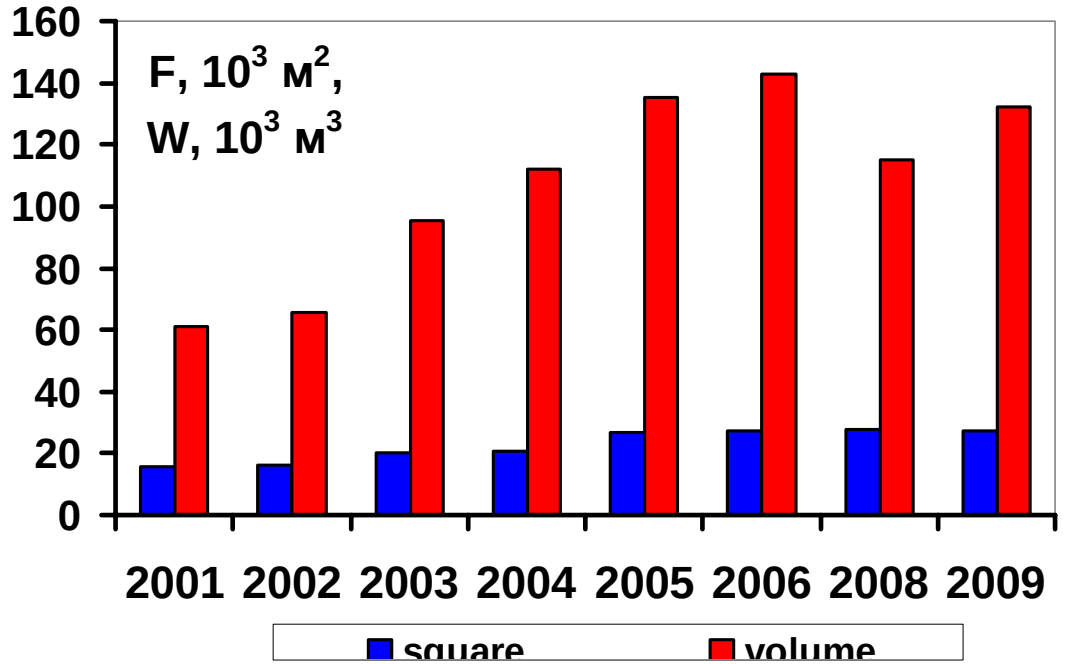
Фото Кидяевой В.М., авг.2009г.

Part of glacial lakes database with hydrological characteristics

Lake	True altitude	F, 10^3 m^2	l,m	W, 10^3 $м^3$	Date of measures	L	B	h_{cp}	h_{max}	C, h_{cp}/h_{max}
Малое Азау	3264	19,8	786	66,7	03.09.2005	254	78	3,4	8,3	0,41
Донгуз-Орун	2515	59,7	1369	440,6	29.09.2004	598	100	7,4	15,6	0,47
Башкара	2568	65	1500	814,2	03.08.2009	404	161	12,5	32,4	0,39
Лапа	2482	27,4	1190	132,2	04.08.2009	382	72	4,8	15,3	0,32
Сылтран	3186	149,4	1617	2114,8	26.08.2005	575	260	14,2	36,2	0,39
Азот	3197	20,6	644	128,1	06.08.2009	270	76	6,2	19,3	0,32
Юном	3219	9,2	410	18		163	56	2		
Микель	3262	10,3	576	17,9	13.08.2009	156	66	1,7	4,5	0,39
Бирджалы-1	3170	51,8	1251	184,6	11.08.2009	394	131	3,6	10,4	0,34
Бирджалы-2	3307	2,7	852	56,9	10.08.2009	298	9	2,1	6,3	0,33
Бирджалы-3	3307	7,5	344	12,7	25.07.2006	115	65	1,7	2,6	0,65
Чунгурчат-3	3305	3,1	357	2,8		170	18	0,9		
Чунгурчат-4	3320	0,3	76	0,1		31	12	0,2		

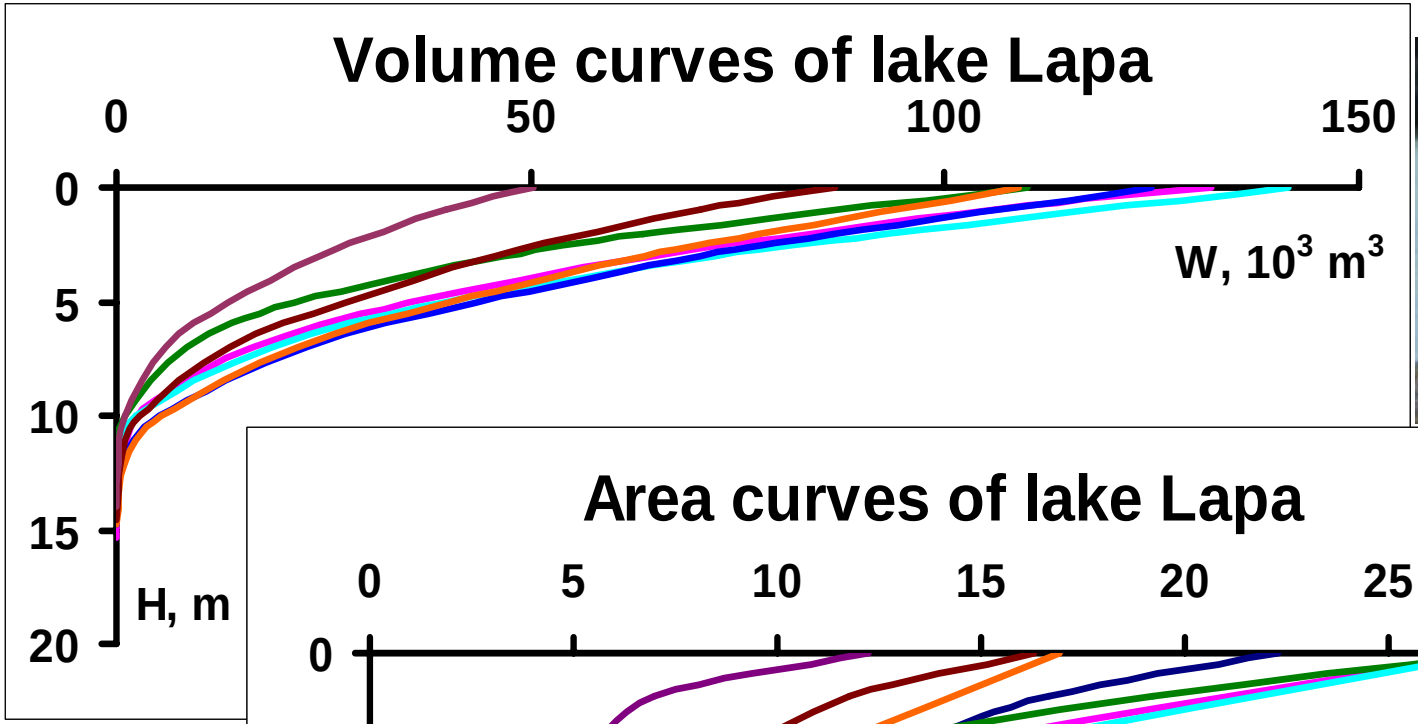
Lake Lapa. Area and volume in 2001-2009

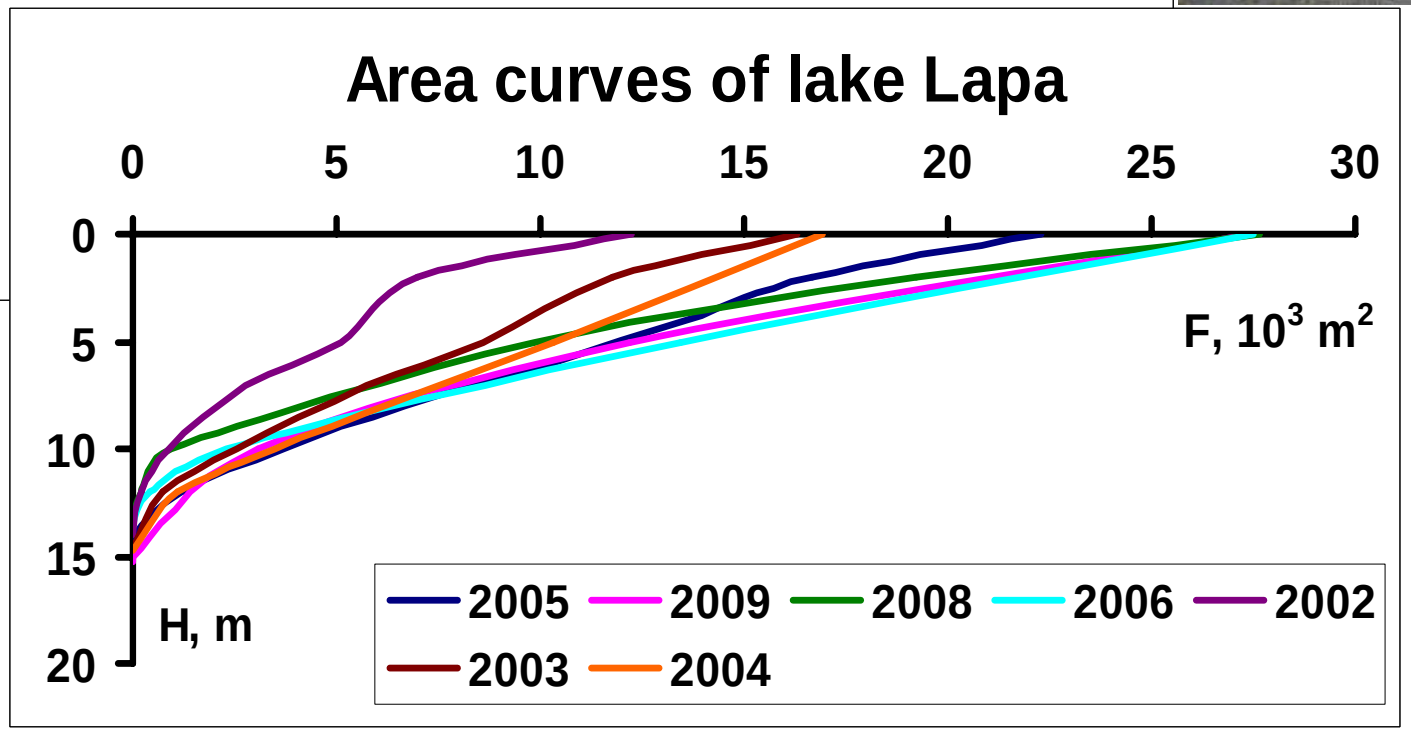




Changes of Lake Lapa and Lake Mizinchik as recorded by repeated geodetic surveys

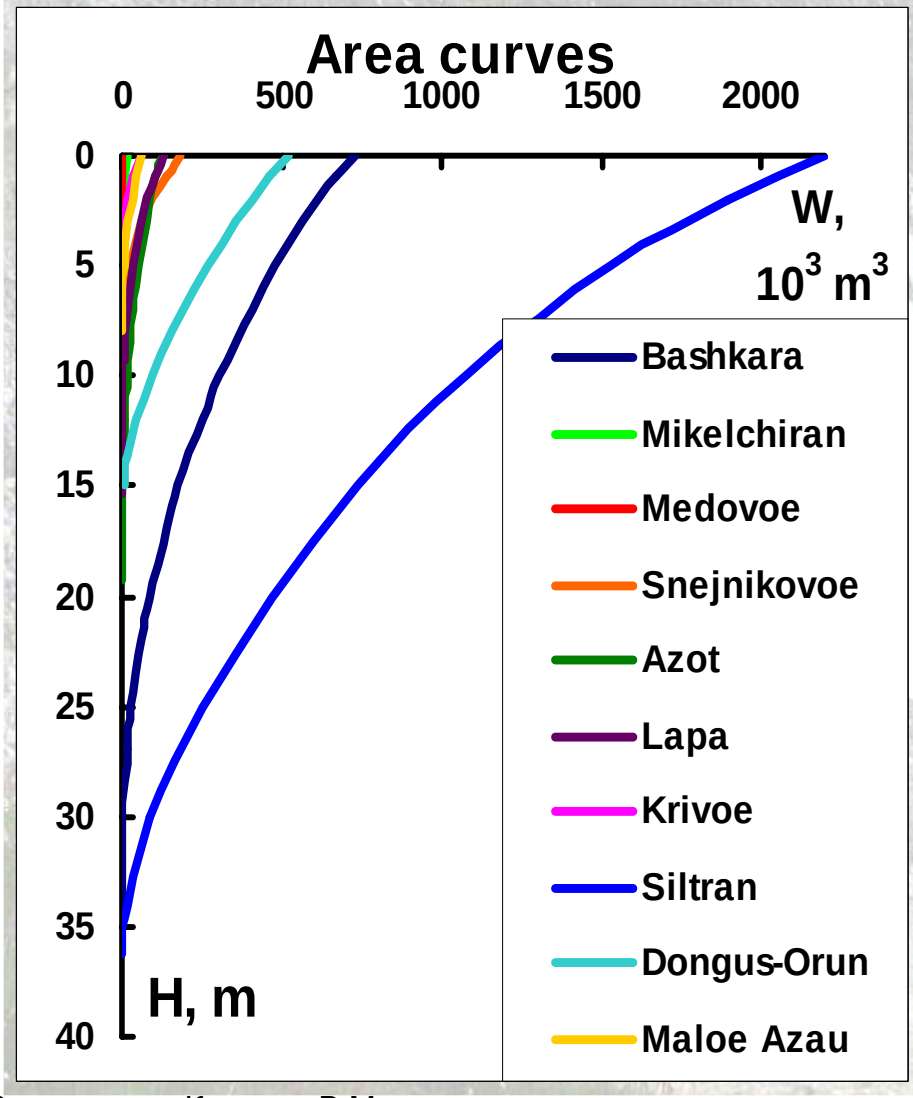
Morphometrical characteristics of lakes

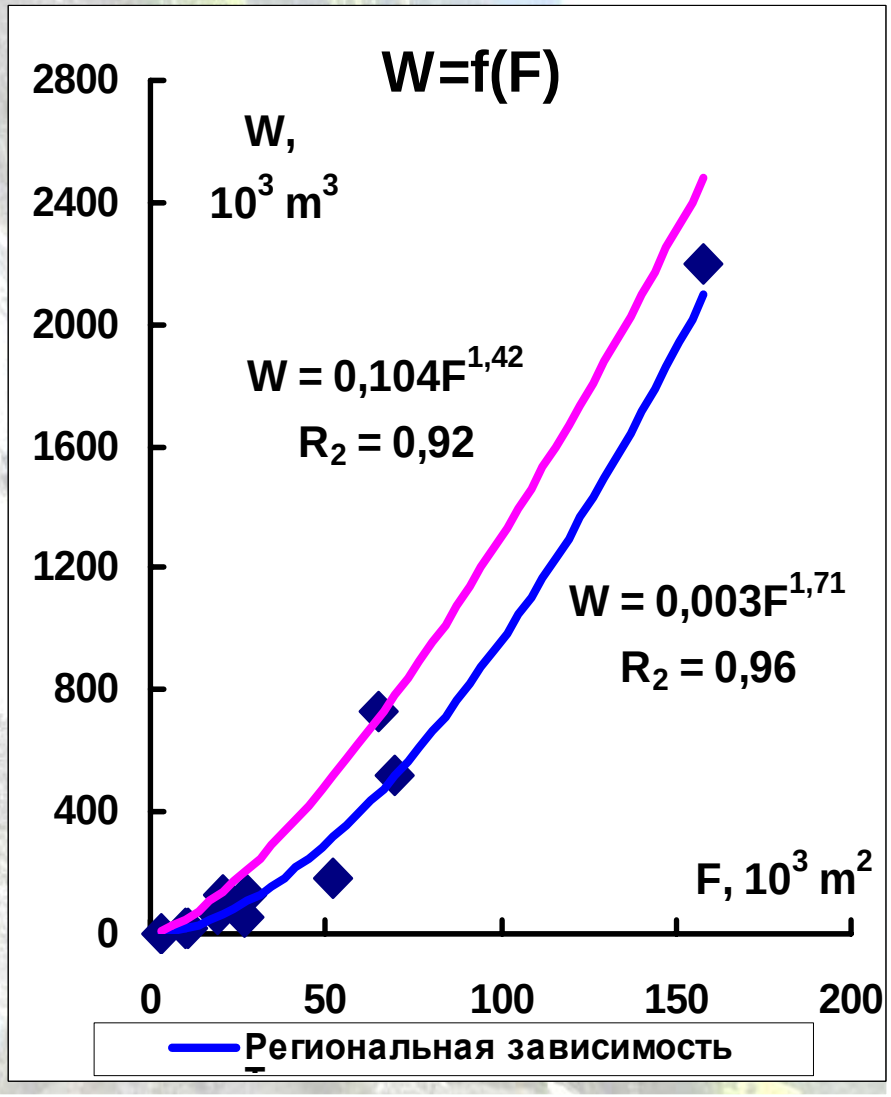




Author Kidyaeva V., based on data of msu

Area curves and dependence between area and volume

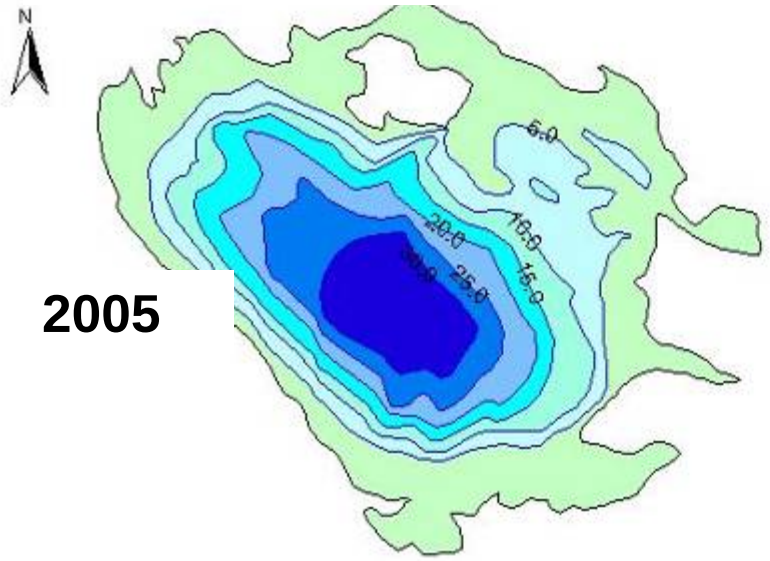




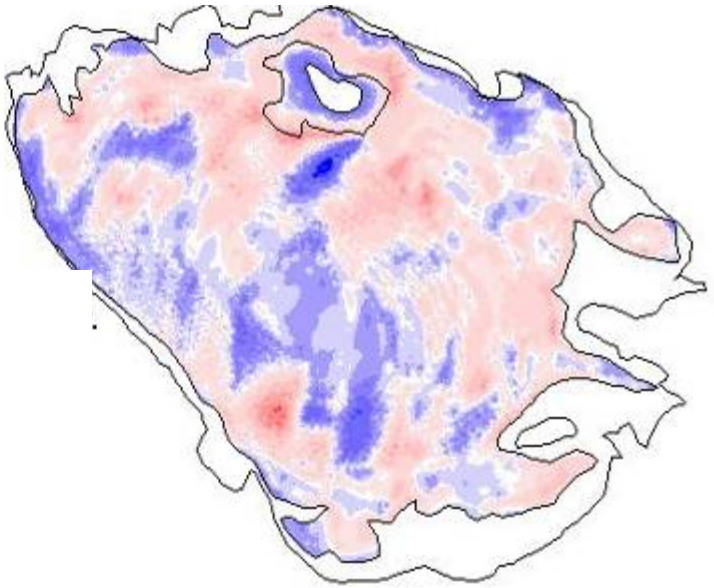
Составитель Кидяева В.М.

Bashkara and Lapa lakes in 2008

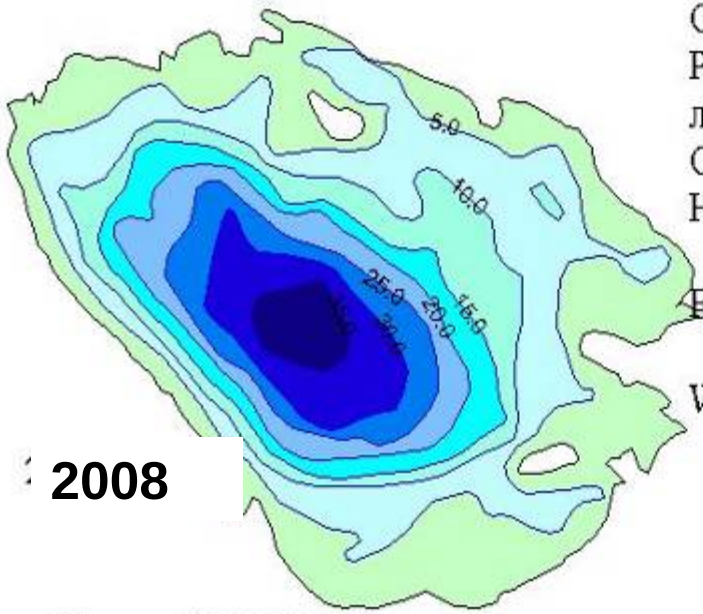
Depth changing of lake Bashkara, 2005-2008



2005



2008-2005



2008

Масштаб 1:4000

100 0 100 200 метры

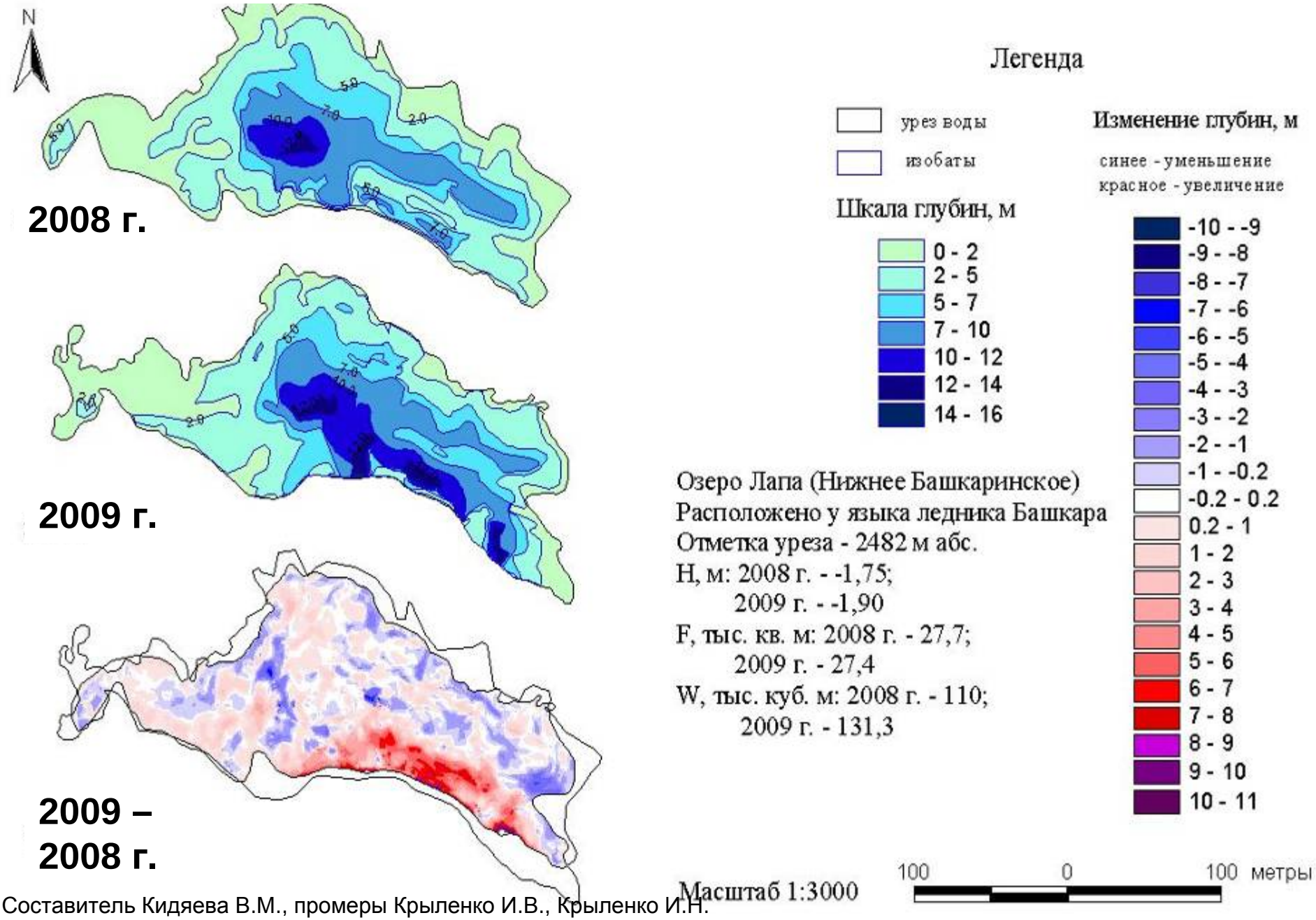
Озеро Башкара
Расположено у языка ледника Башкара
Отметка уреза - 2568 м. абс.
H, м : 2005 г. - +0,23;
2008 г. - +3,53
E, тыс. кв. м : 2005 г. - 72,3;
2008 г. - 90,6
W, тыс. куб. м : 2005 г. - 797;
2008 г. - 1069

Легенда
урез воды
изобаты
Шкала глубин, м
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 35
35 - 40

Изменение глубин, м
синее - уменьшение
красное - увеличение
-8 - -7
-7 - -6
-6 - -5
-5 - -4
-4 - -3
-3 - -2
-2 - -1
-1 - -0.2
-0.2 - 0.2
0.2 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7

Составитель Кидяева В.М., промеры Крыленко И.В., Крыленко И.Н.

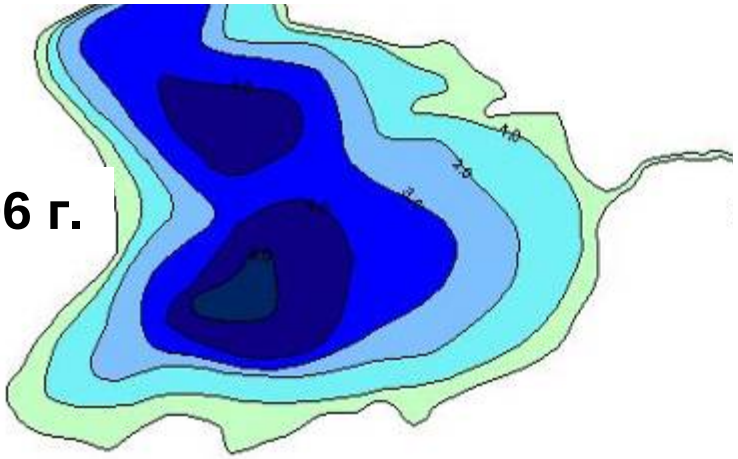
Depth changing of lake Lapa, 2008-2009



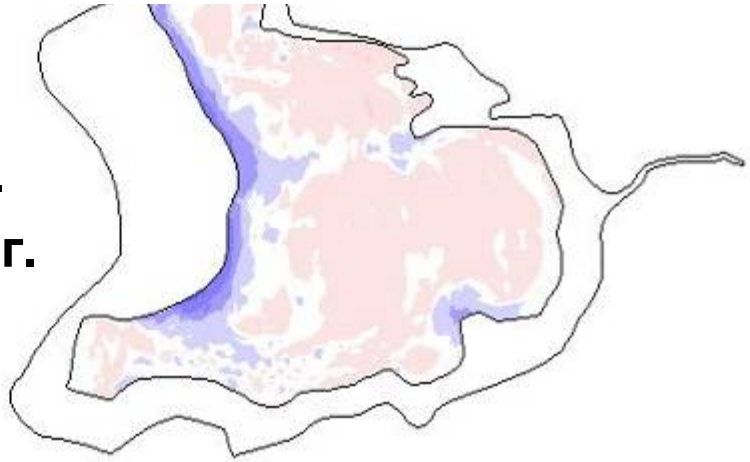
Составитель Кидяева В.М., промеры Крыленко И.В., Крыленко И.Н.

Depth changing of lake Mikelchiran, 2006-2009

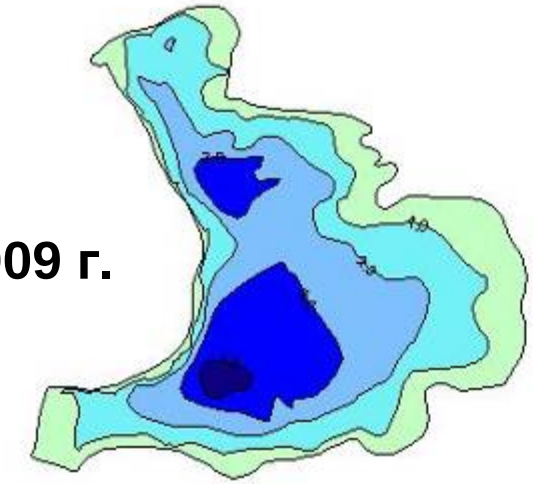
2006 г.



2006-
2009 г.



2009 г.



Озеро Микельчиран
Расположено у языка ледника Микельчиран
Прорвалось в 2007 г.
Отметка уреза 3262 м. абс.
H, м: 2006 г. - 0
2009 г. - - 1,3
F, тыс. кв. м: 2006 г. - 17,7
2009 г. - 10,3
W, тыс. куб. м: 2006 г. - 42,6
2009 г. - 17,9

Легенда

урез воды
изобаты

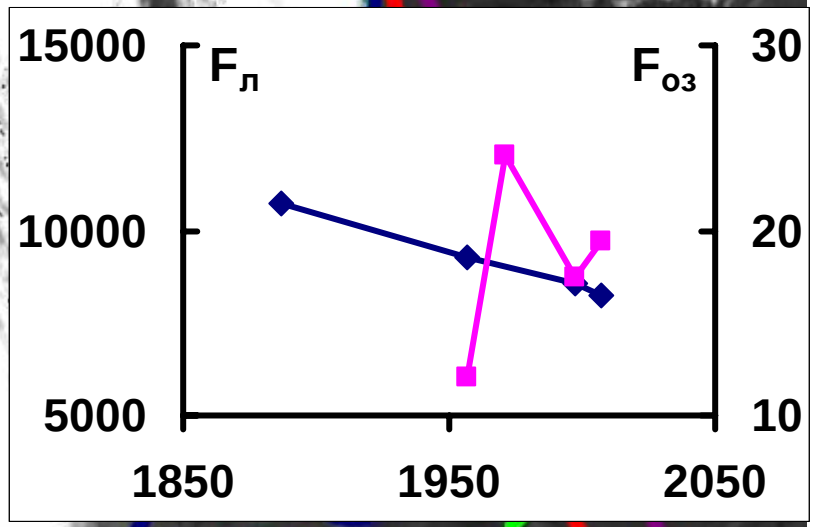
Шкала глубин, м
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6

Изменение глубин, м
синее - уменьшение
красное - увеличение
-4 - -3
-3 - -2
-2 - -1
-1 - -0.2
-0.2 - 0.2
0.2 - 1
1 - 2
2 - 3
3 - 4

Масштаб 1:2000 100 0 100 метры

Составитель Кидяева В.М., промеры Крыленко И.В., Кидяева В.М.

Area changing of Maliy Azau glacier and its lake complex in 1887, 1957, 1997, 2007



2007

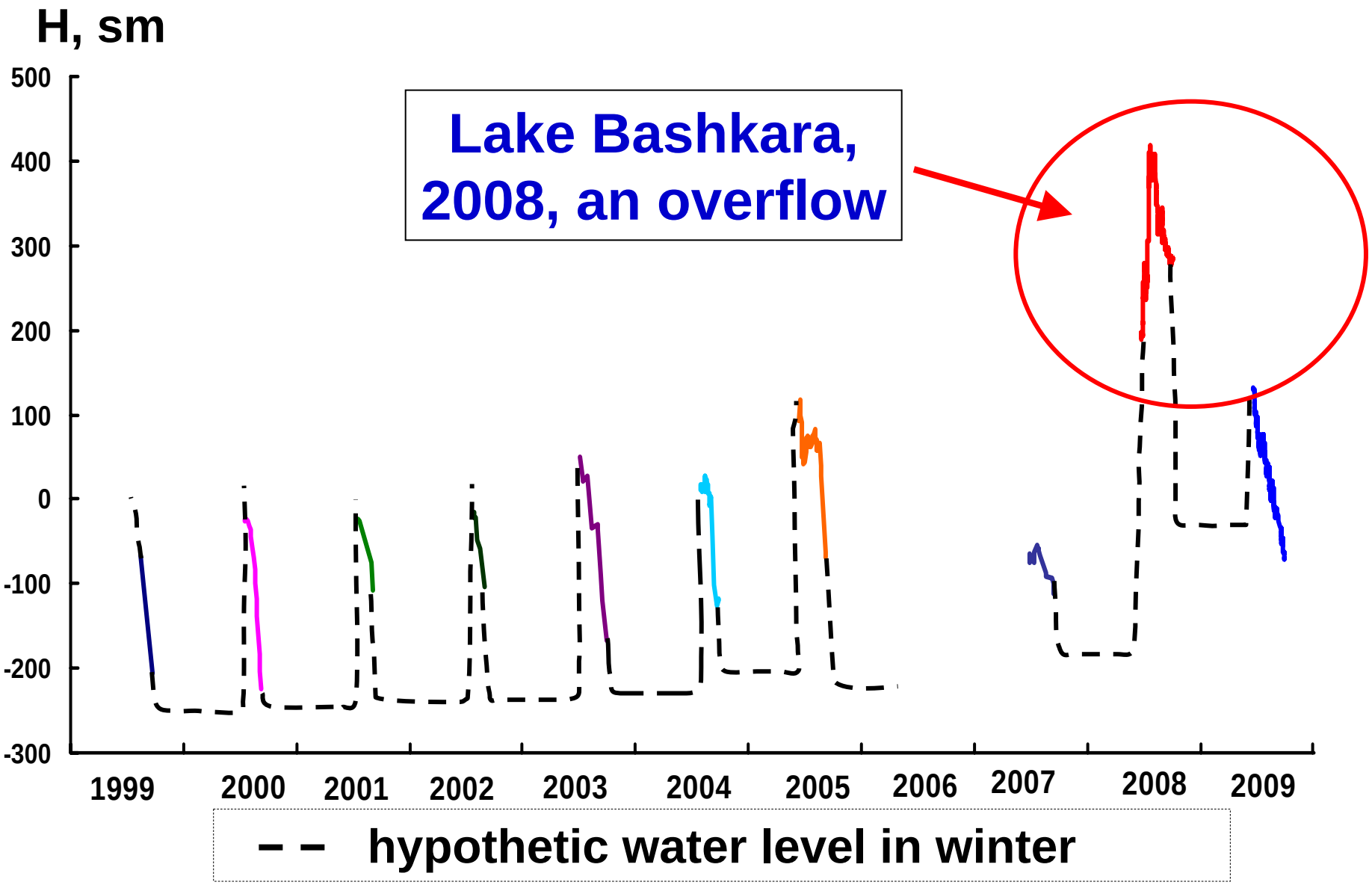
1957

1997

1887

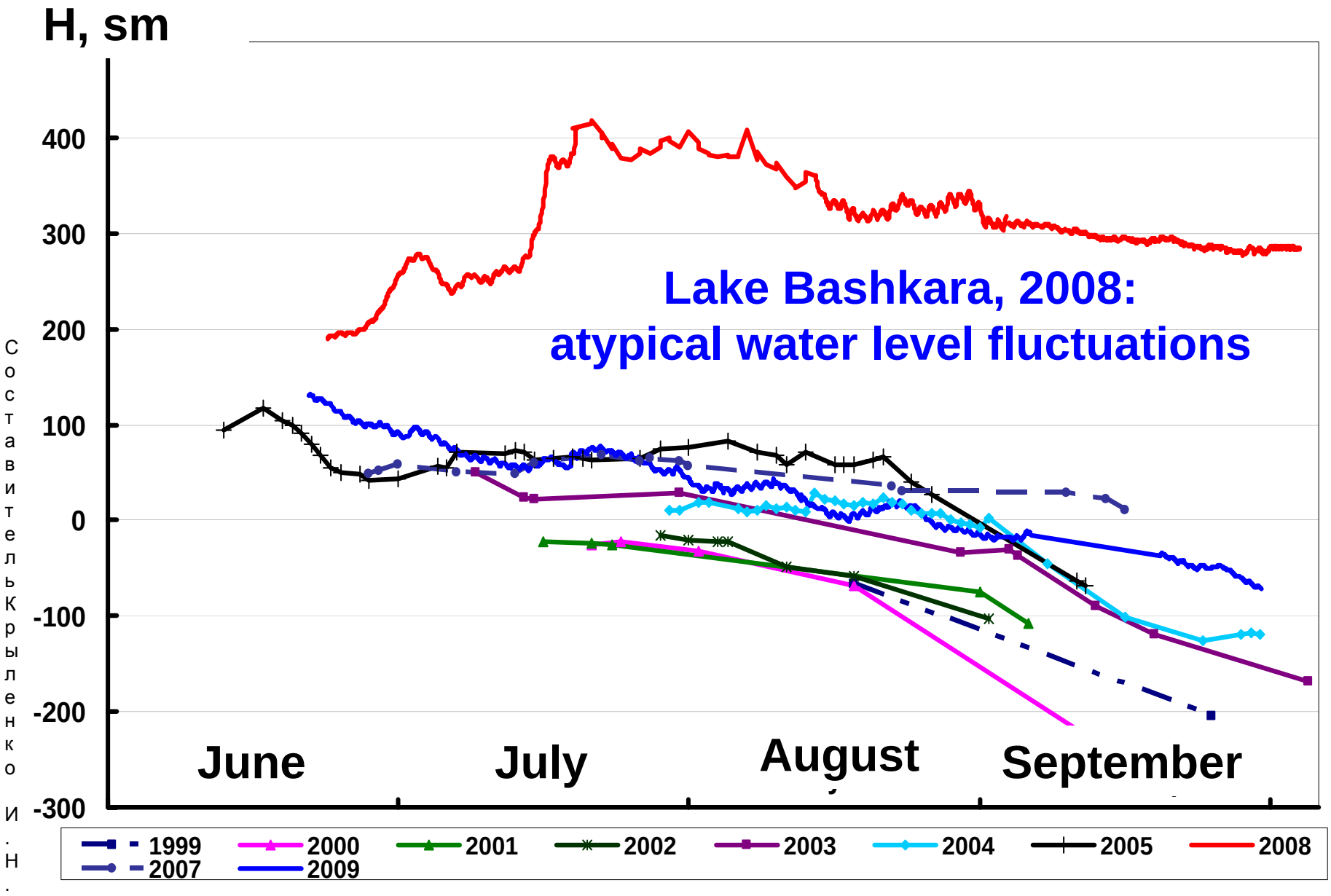
IRS P5 12/09/2007 снимок предоставлен ИТЦ «СканЭкс»

Long-term water level fluctuation



Составитель Кидяева В.М.

Seasonal water level fluctuations



Составитель Крыленко И.Н.

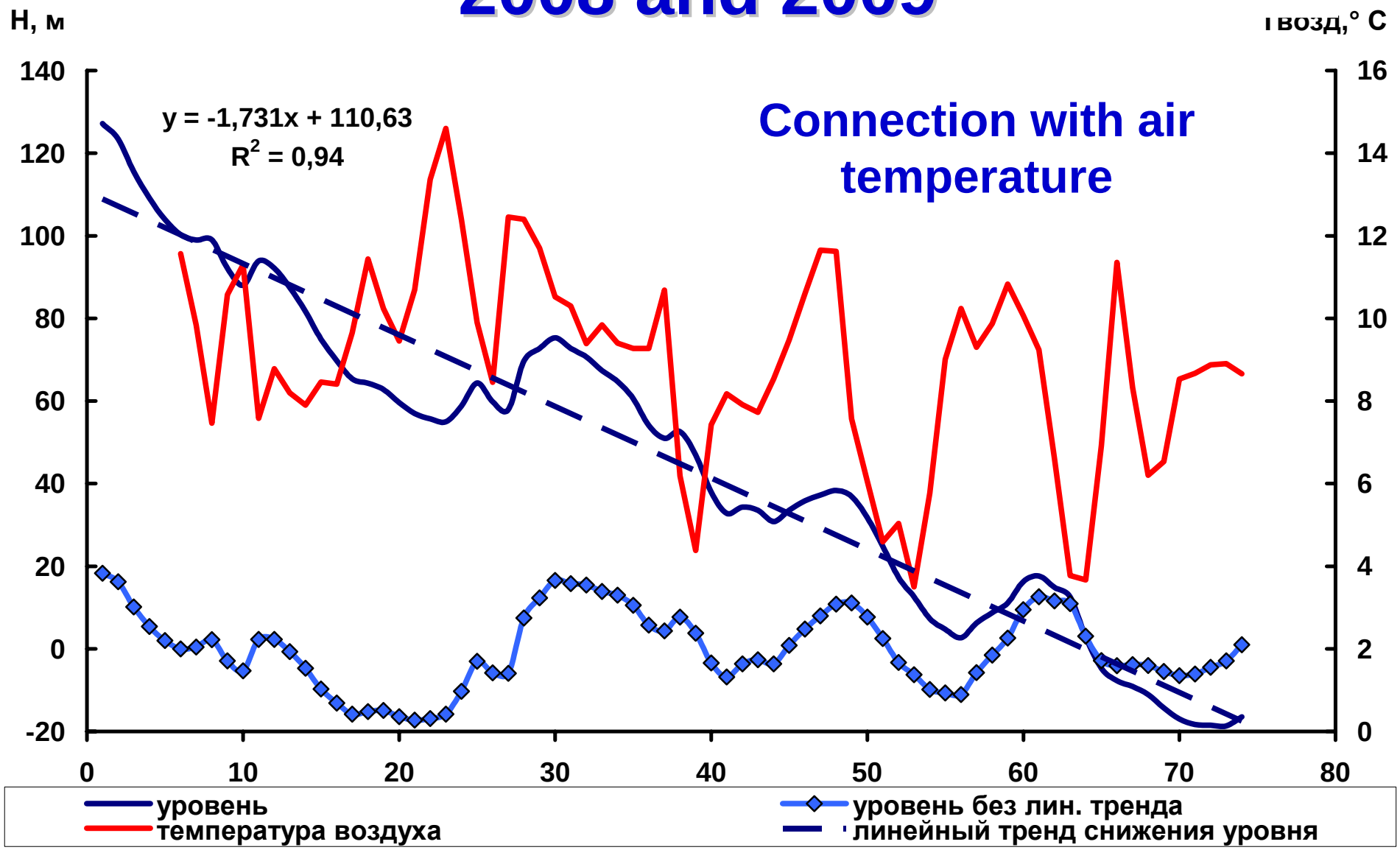
Bashkara lake

Volume 800 000 m^3 **Volume >1 000 000 m^3**

In July 2008 moraine dam with ice core was overtopped and overflow has started

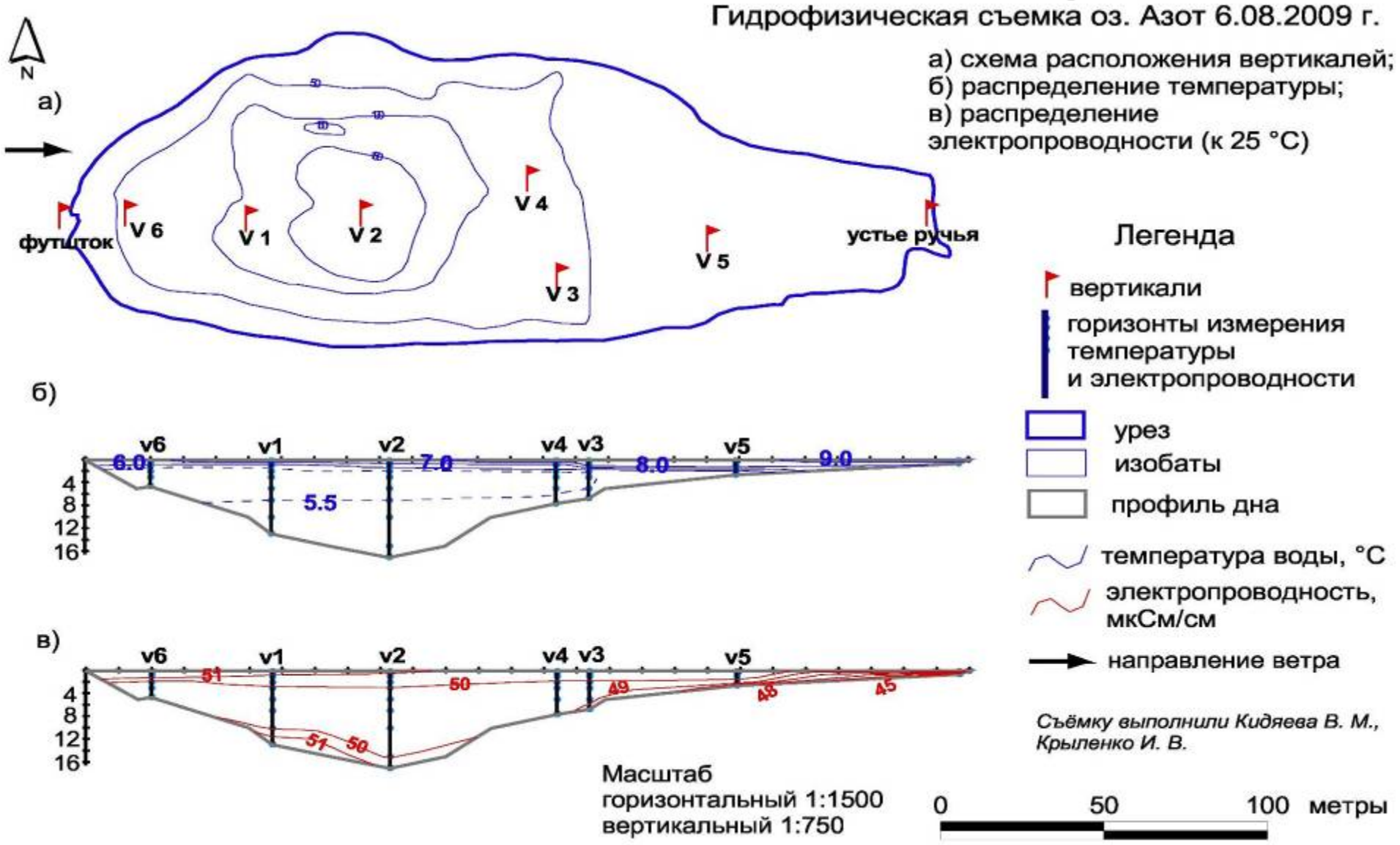
Image by Kidyaeva V

Seasonal water level fluctuations, 2008 and 2009

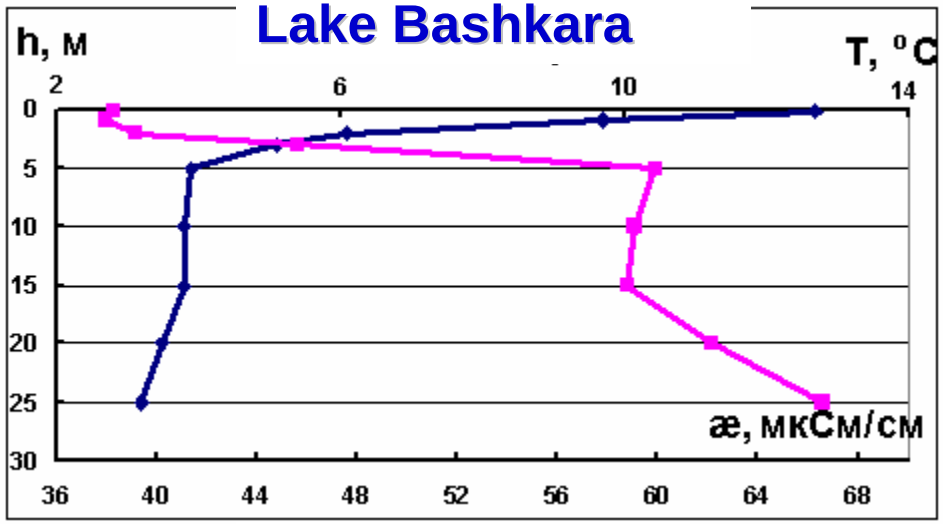


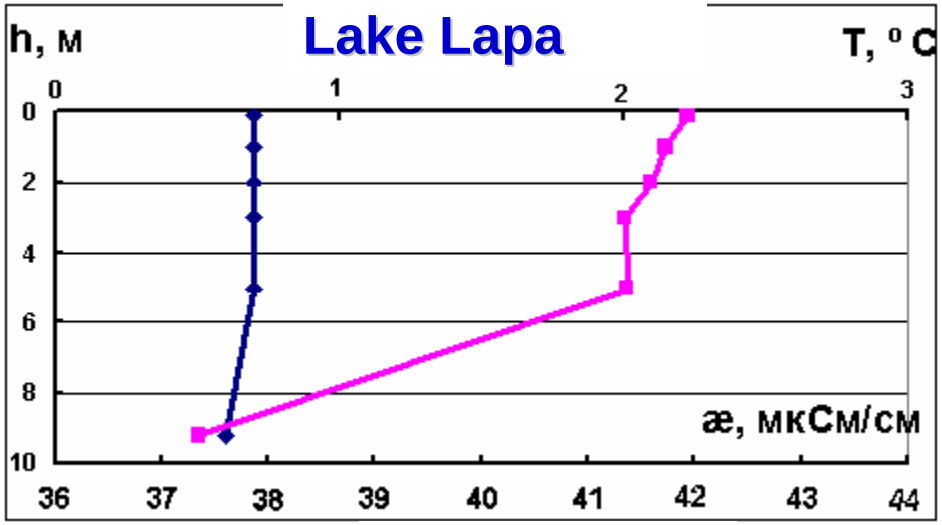
Составитель Кидяева В.М.

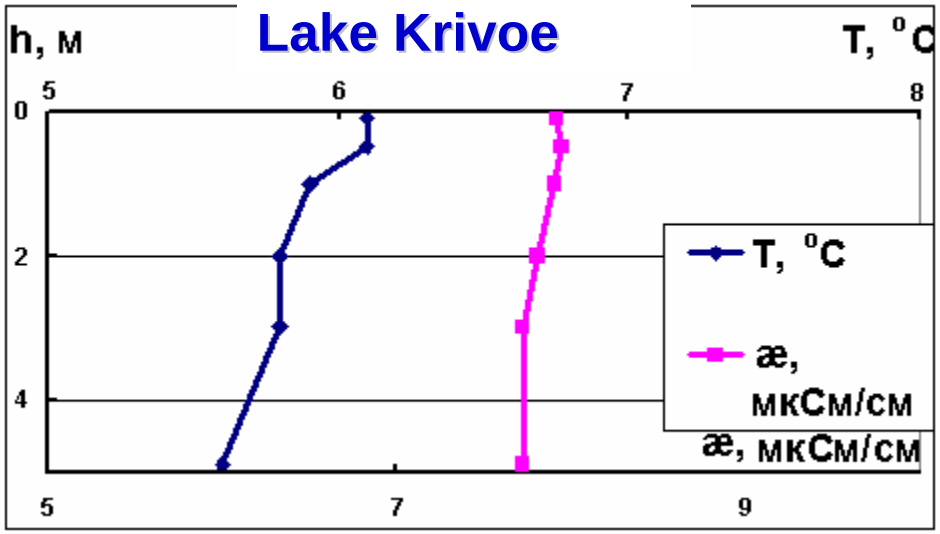
Distribution of water temperature and electroconductivity

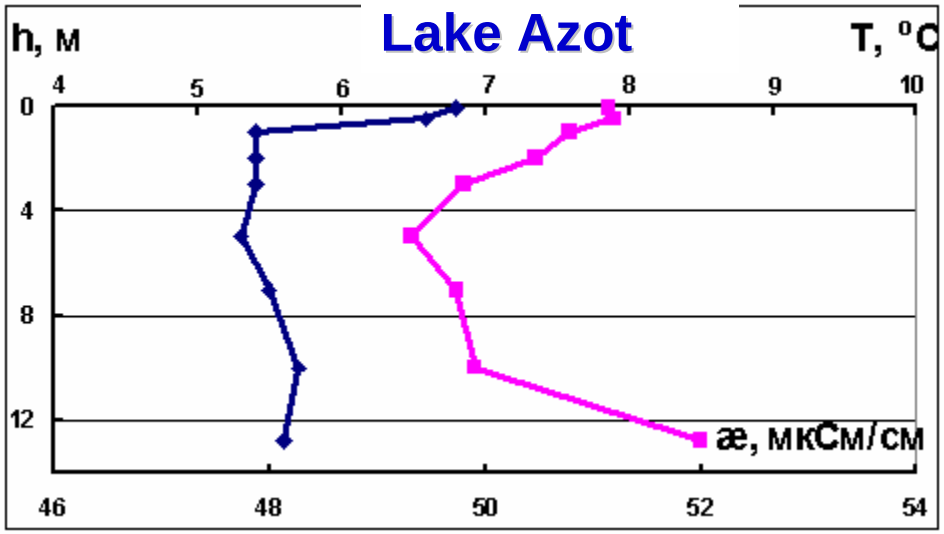


Features of thermic conditions









Составитель Кидяева В.М.

Stage of glacial lakes development

1 stage

Фото Кидяевой В.М., июнь2009г.

Lake Lapa:
active development,
outbrust danger

Lake Krivoe:
rapid growth
of area

Фото Кидяевой В.М., авг.2009г.

Stage of glacial lakes development

2 stage

Lake Snejnikovoe: stable condition of moraine-dammed lake

Фото Кидяевой В.М., авг.2009г.

Фото Крыленко И.В. авг.2005 г.

Lake Siltran: stable condition of circue lake

Stage of glacial lakes development

3 stage

Lake Birdgalichiran: outbrust, august 2008

Lake Azot: sediments alluvian - stable

Estimation of potential outbrust

LAKE	W, $10^3 m^3$	DRAIN	GLA-CIER BOR-DER	TYPE OF DAM	TYPE OF LAKE	DISTANCE OF INFRA-STRUCTURE	DEGREE OF OUTBRUAST POSSIBILITY
Mal. Azau	67	-	+	moraine and rock bar	circue-moraine	3 km	MIDDLE DANGEROUS
Bashkara	810	+	+	glacier and moraine	glacial-dammed	3 km	DANGEROUS
Lapa	132	+	+	moraine	moraine-dammed	3 km	DANGEROUS
Siltran	1600	+	-	rock bar	circue	7 km	UNDANGEROUS
Azot	640	-	-	moraine	moraine-dammed	2 km	MIDDLE DANGEROUS
Snejnikovoe	180	+	-	moraine	moraine-dammed	7 km	MIDDLE DANGEROUS
Krivoe	57	+	+	moraine	moraine-dammed	7 km	DANGEROUS

Составитель Кидяева В.М.

Dangerous glacial – objects for detailed monitoring

Фото Черноморца С.С., июль2008г.

Фото Крыленко И.Н. июль2008 г.

Фото Черноморца С.С., авг.2008г.

Фото Черноморца С.С., июль2008г.

Input data for simulation of glacial lake outbrust

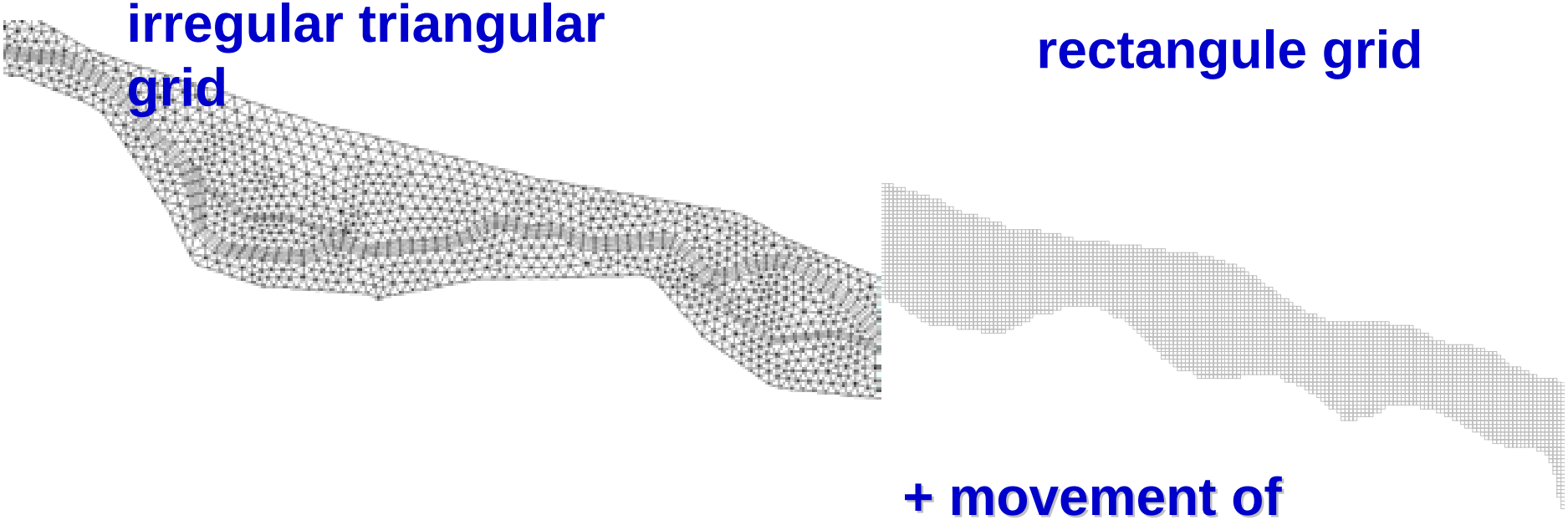
1. digital terrain model
2. outburst hydrograph

“River”

irregular triangular grid

“Flo-2D”

rectangule grid

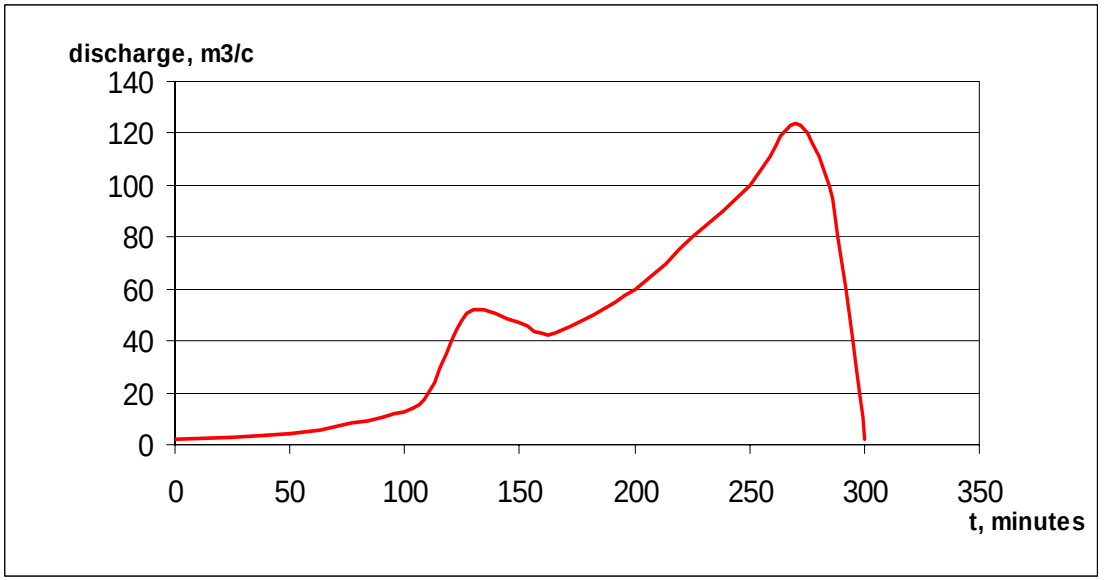


+ movement of mudflows

Modeling by S. Norin and I.Krylenko. Lake Bashkara 2008

Scenarios of outburst hydrograph

- **outburst hydrograph for case of englacial drainage channels formation** ***(calculated by Sevkavgiprovodhoz Institute on the base Vinogradov's model, Russia)***



- **empirical relationships for maximum discharge of outburst :**

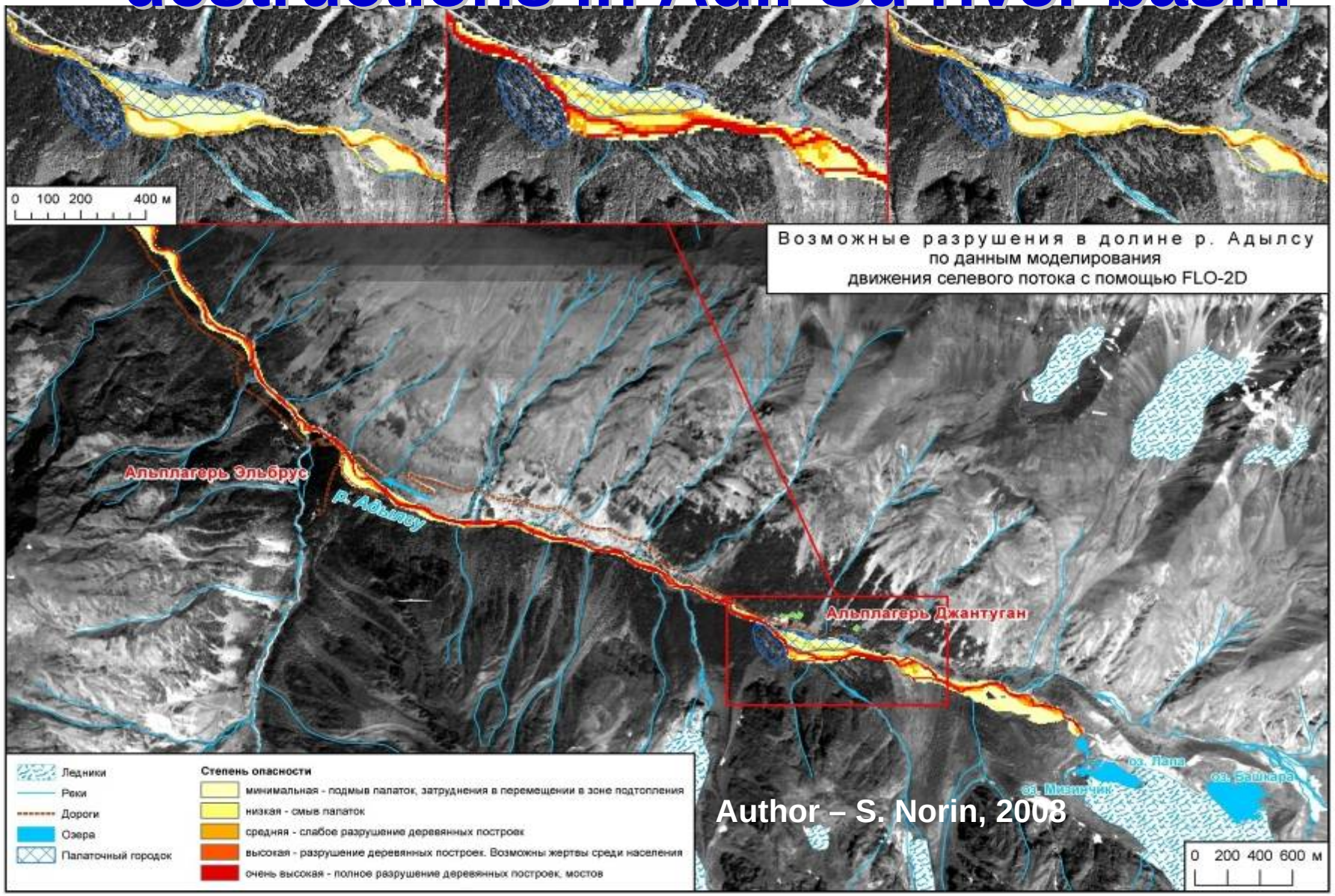
$$Q_{\max} = 46\left(W/10^6\right)^{0,66}$$ = 38,6 м³/с – *Walder, Costa*

$$Q_{\max} = 75\left(W/10^6\right)^{0,67}$$ = 63 м³/с – *Clague and Mathews*

W – volume of the lake

Modeling by S. Norin and I.Krylenko. Lake Bashkara 2008

Interpretation map of possible destructions in Adil-Su river basin




17 August 2006
Image by D.A. Petrakov

19 August 2006


19 August 2006

Thank you!

Kidyaeva Vera:
gromozec@mail.ru

Acknowledgements

I thank:
Chernomorets Sergey,
Krylenko Ivan, Krylenko Inna,
Petrakov Dmitry, Norin Sergey,
Nosan Vera, Aleinikov Aleksandr
for field and theoretic researches

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NATO OTAN
This activity is supported by: The NATO Science for Peace and Security Programme

NATO Science for Peace Programme

Russian Foundation for Basic Research