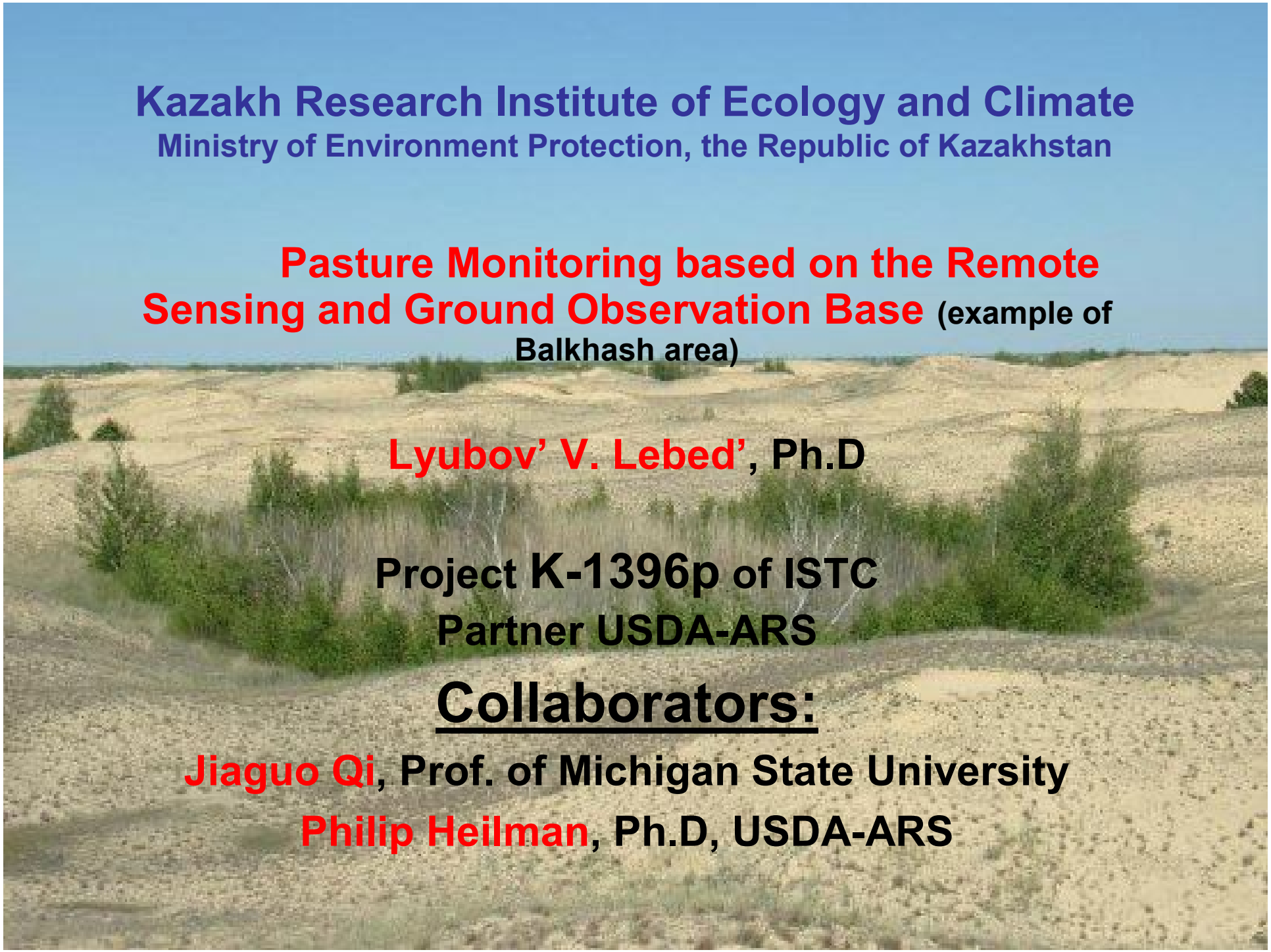


Kazakh Research Institute of Ecology and Climate

Ministry of Environment Protection, the Republic of Kazakhstan

Pasture Monitoring based on the Remote Sensing and Ground Observation Base (example of Balkhash area)

Lyubov' V. Lebed', Ph.D

Project K-1396p of ISTC

Partner USDA-ARS

Collaborators:

Jiaguo Qi, Prof. of Michigan State University

Philip Heilman, Ph.D, USDA-ARS

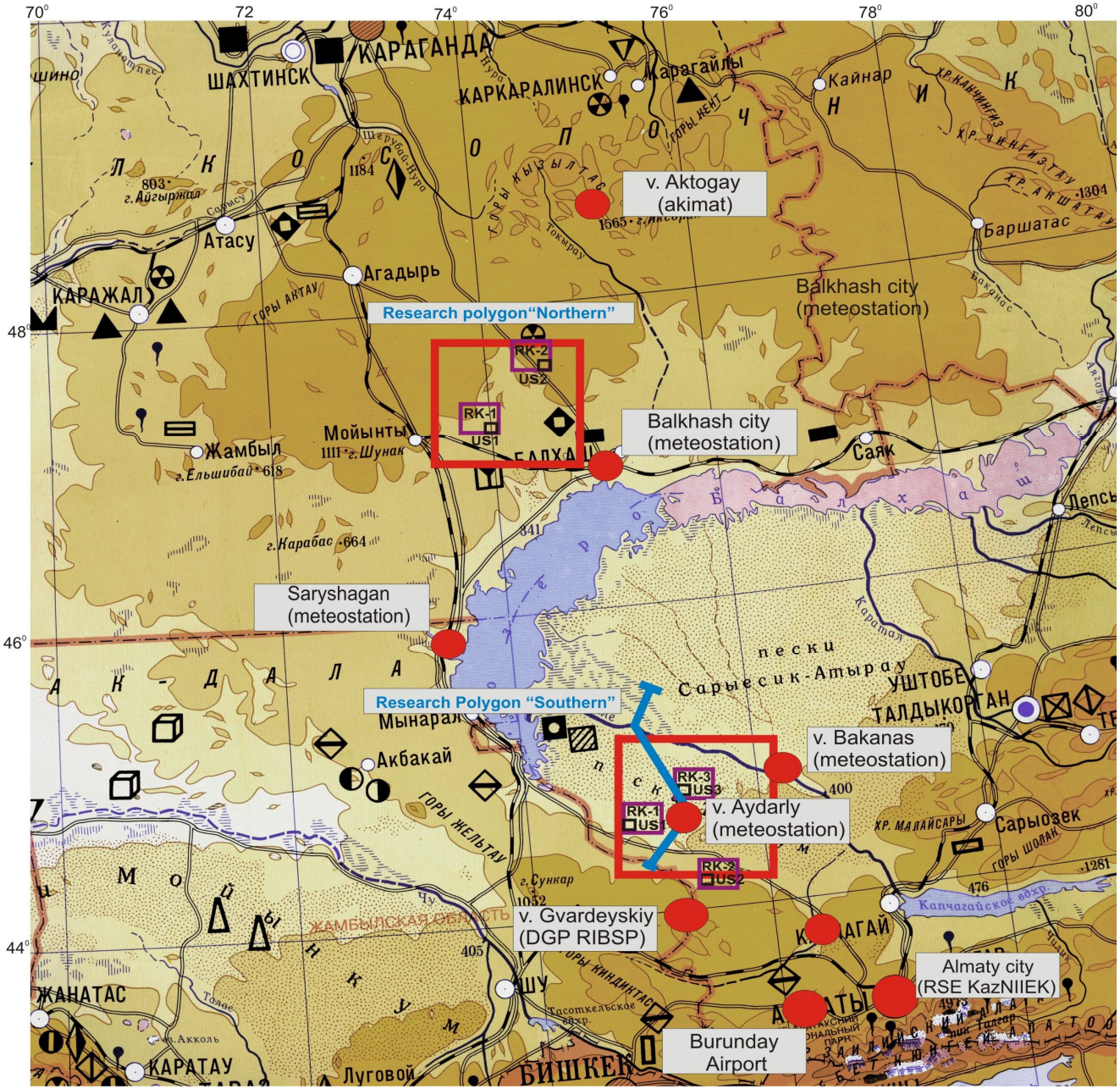
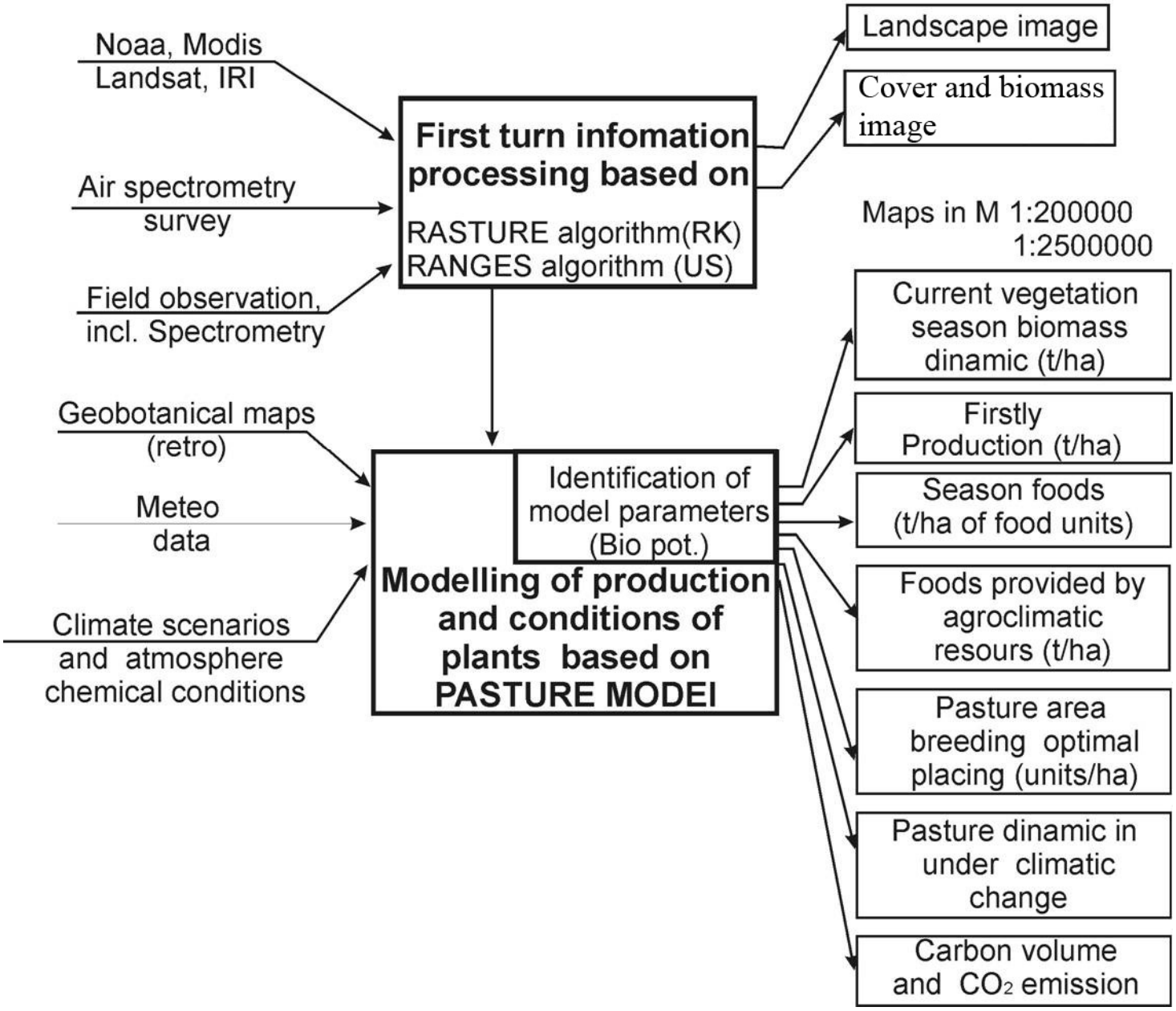
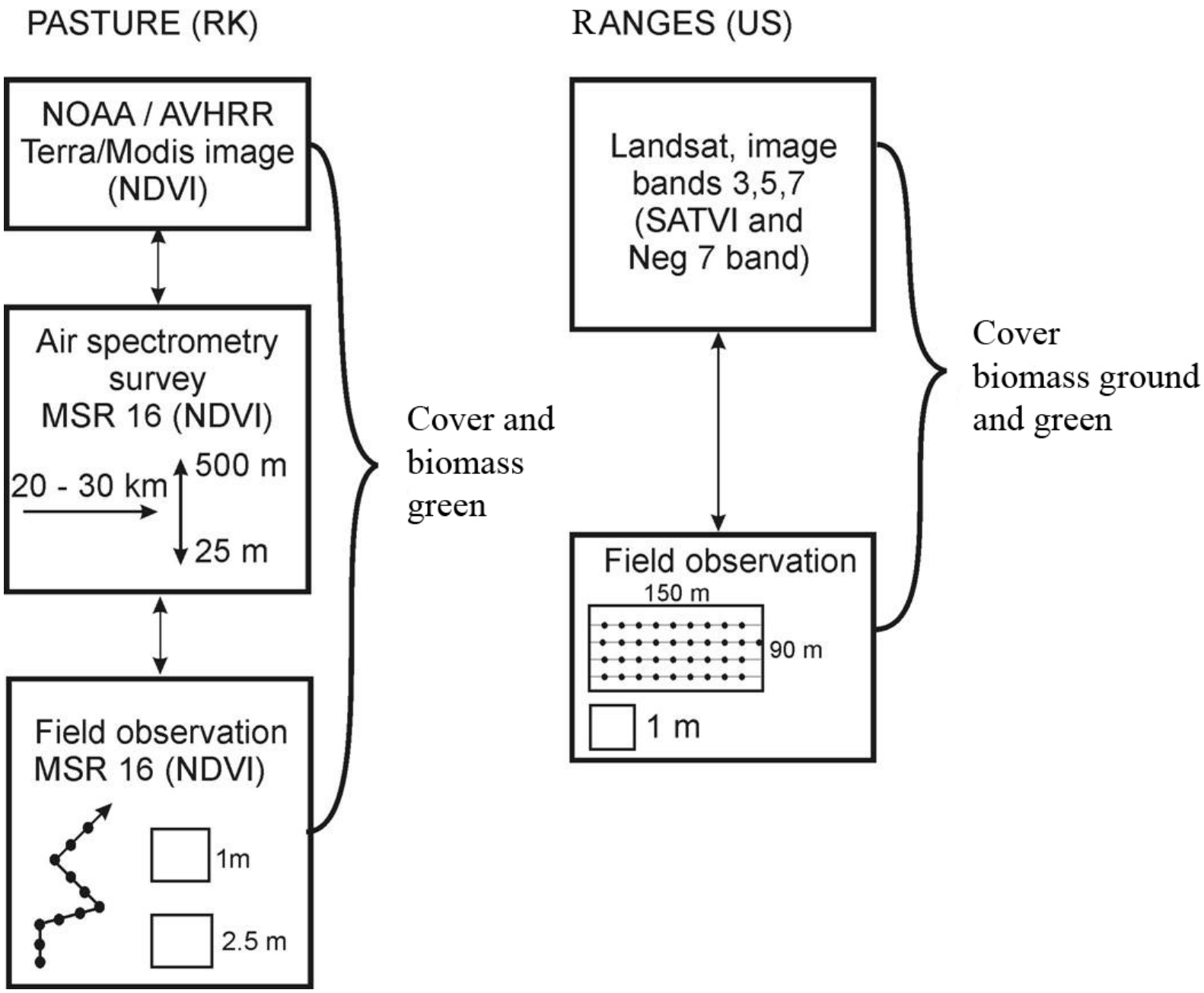


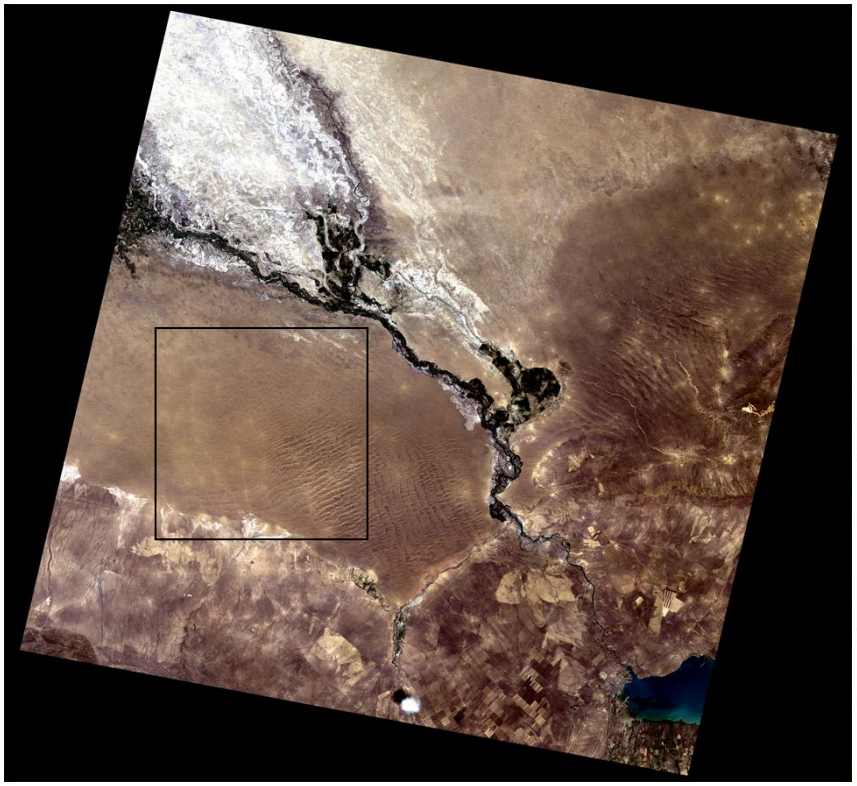
Fig. 1 Research region

A modern pasture monitoring based on ground, space and air information.

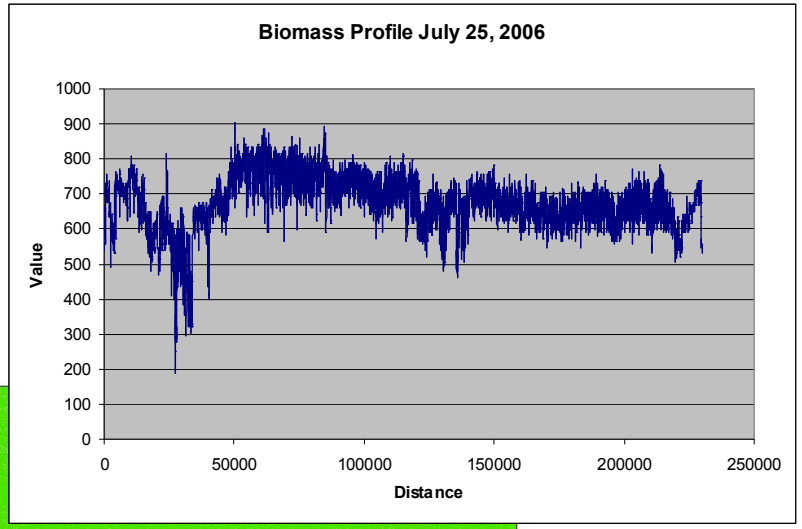


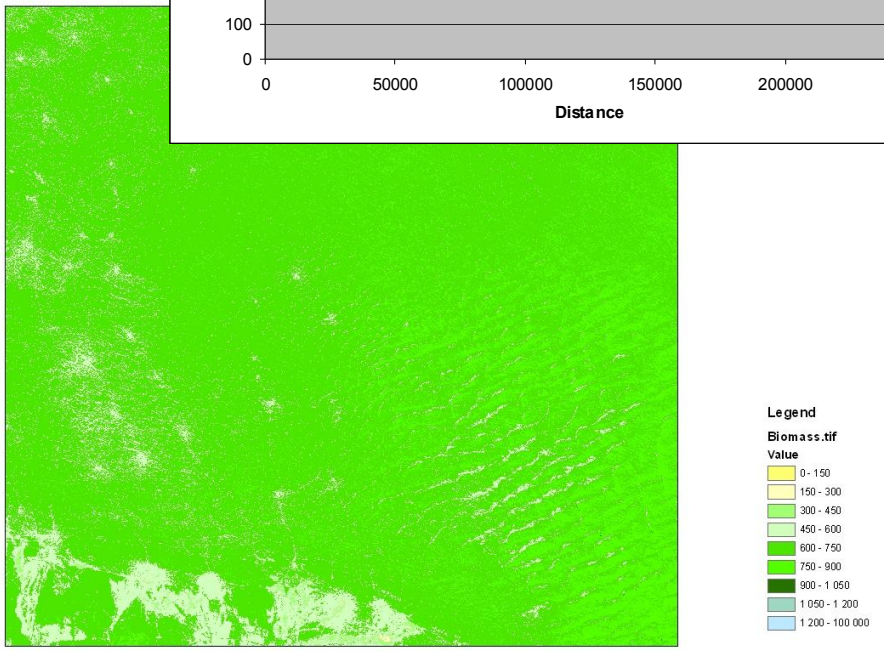
First turn information processing algorithms





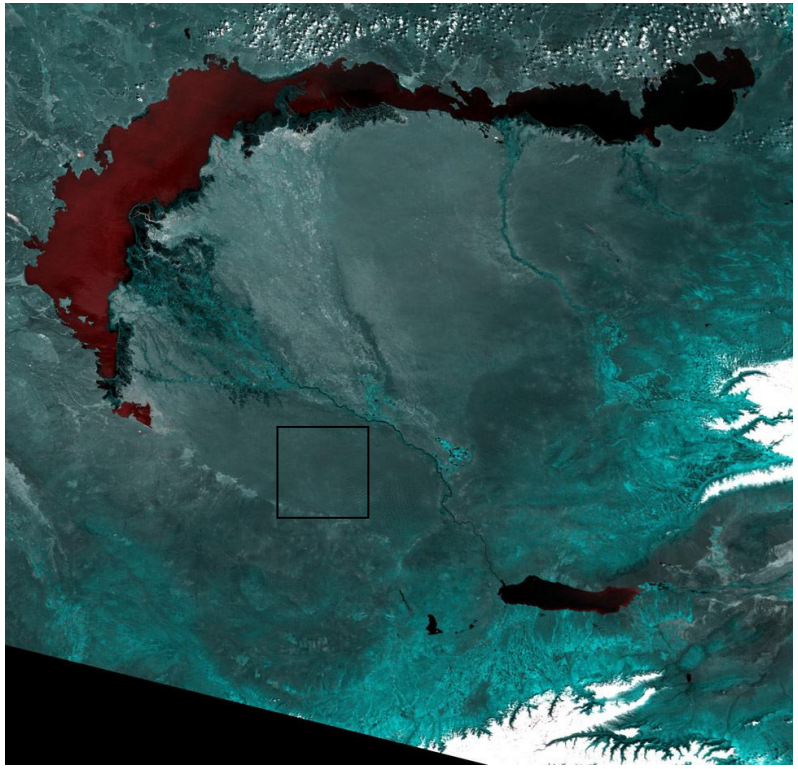
LANDSAT image of Balkhash area on July 25, 2006



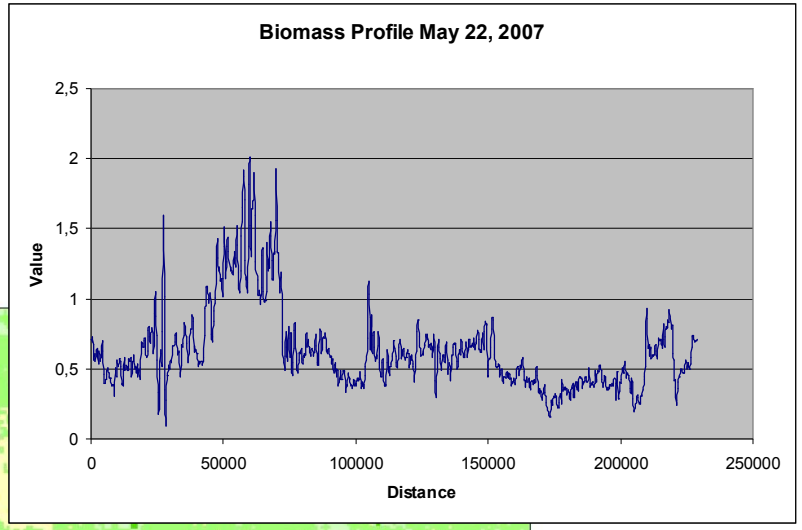


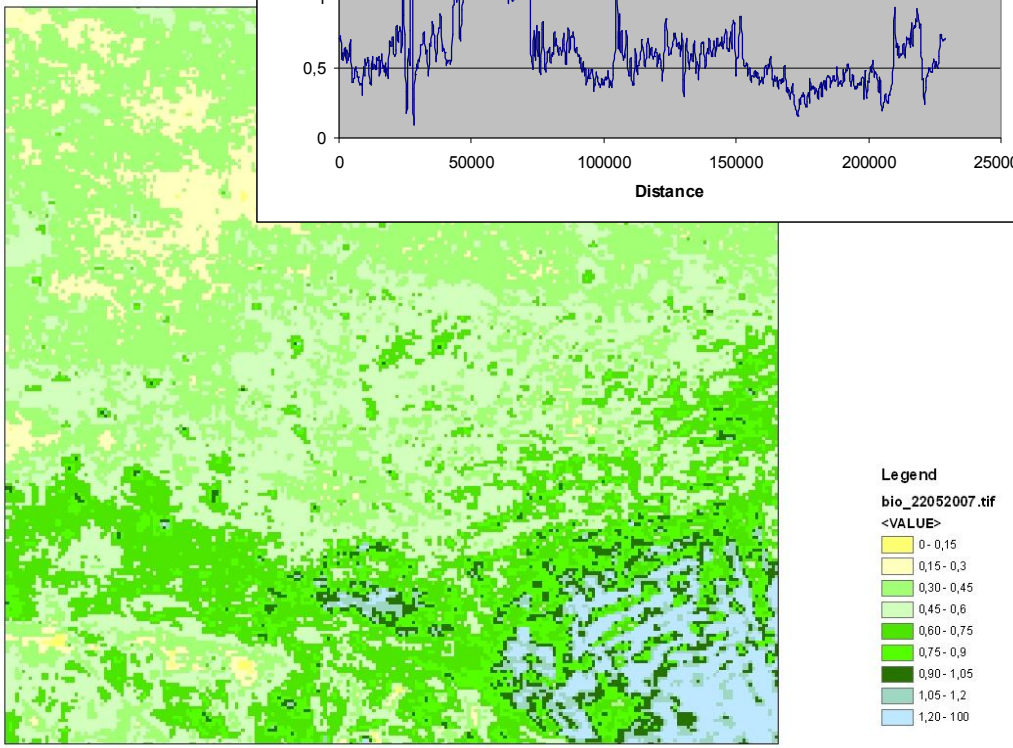
Number of points: 7684
Minimum value: 278.000000
Maximum value: 894.000000
Mean value: 675.583160
Variance: 5833.526469
Standard deviation: 76.377526

Biomass image for “Southern” pasture polygon on July 25, 2006



MODIS image of Balkhash area on May 22, 2007

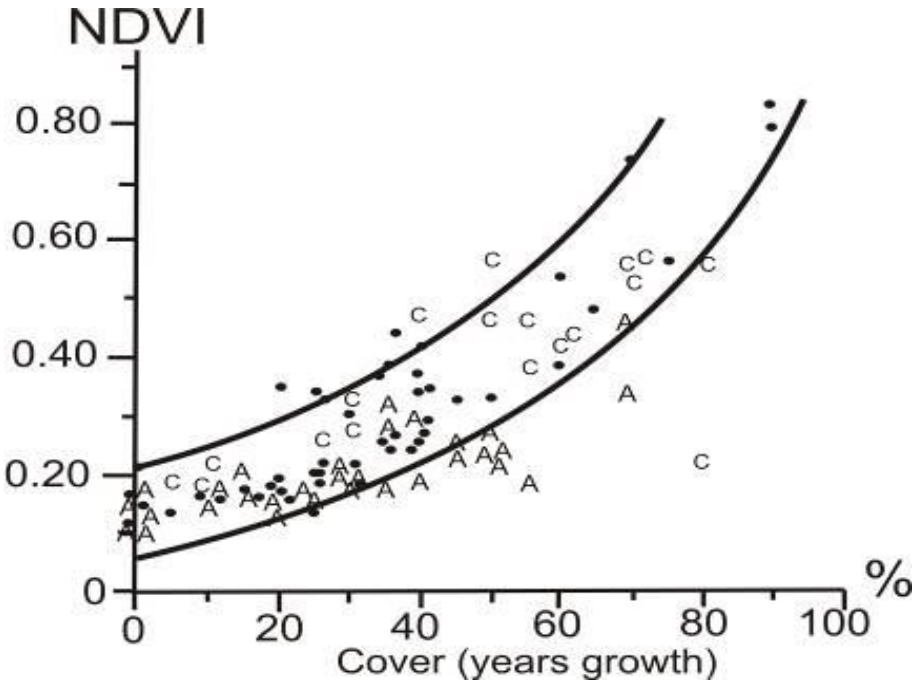




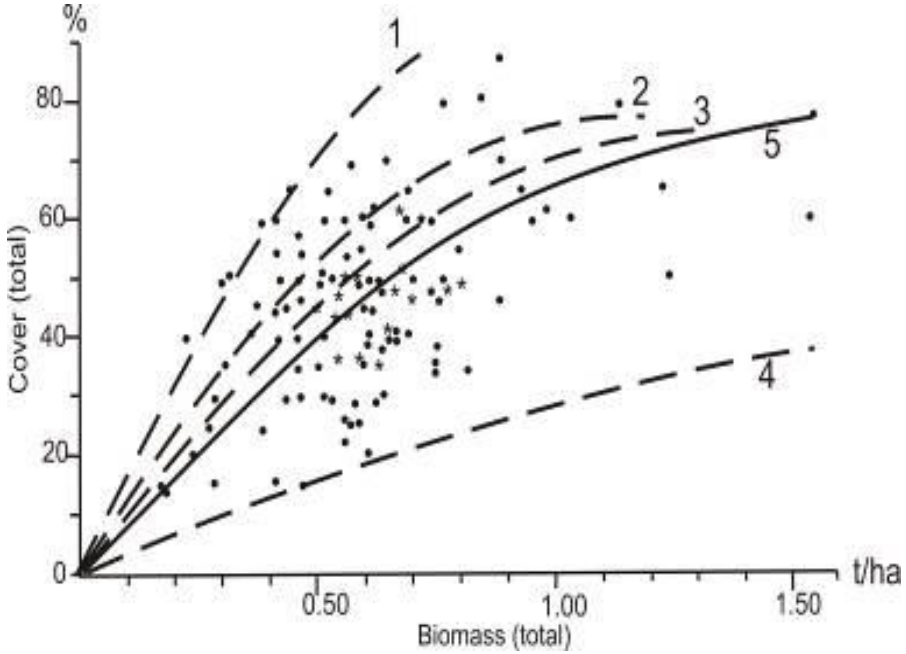
Number of points: 126
Minimum value: 0.167471
Maximum value: 0.213540
Mean value: 0.180770
Variance: 0.000324
Standard deviation: 0.018008

Biomass image for "Southern" polygon on May 22, 2007


SKY
SERVICE
SONY



Correlation between NDVI from MSR 16 radiometer and vegetation cover from field observation on polygon "Southern" in April - May 2007



Correlation between vegetation cover (%) and ground biomass (t/ha) from field observation on polygon "Southern"

1 – Ephemery – Artemisia of submontane plain in May 2007;

2. – Ephemery – Strubery of small-mountaine sands in May 2007;

3. - Grass- Strubery of heitgh-mound's sands in May 2007;

4. – Haloxylon of takyr-plain in Ile river delta in August 2007;

5. Grass- Strubery of heitgh-mound's sands in September 2007.

• - 1x1 m area; ⌂ - vegetation typ; x - 30x30 m area

PASTURE MODEL (RK)

This model simulates growth and destruction of nature pasture plants biomass.

$$Bt = \frac{Bpot}{1 + \left\{ \frac{Bpot}{B_o} - 1 \right\} \bullet \exp \int_0^t Rtdt} \quad (1)$$

$$Bpot=Ph-P \quad (2)$$

$$Ph=f\,(J,\ C) \quad (3)$$

$$P=f\,(Bo) \quad (4)$$

$$R\tau = Rpot \bullet Ar \quad (5)$$

$$Ar = f(J,T,W) \quad (6)$$

where Bt – current annual biomass growth, t/ha;

B pot – potentially possible biomass, t/ha;

Rt – plant growth function;

Rm - Rt volue under optimal agrometeorological conditions;

J, T, W, C – environmental indexes (solar radiation, warmth, moisture, CO_2);

Bt' – biomass in destruction period, t/ha;

Bt –biomass destruction index;

t – time from the beginning of vegetation period.

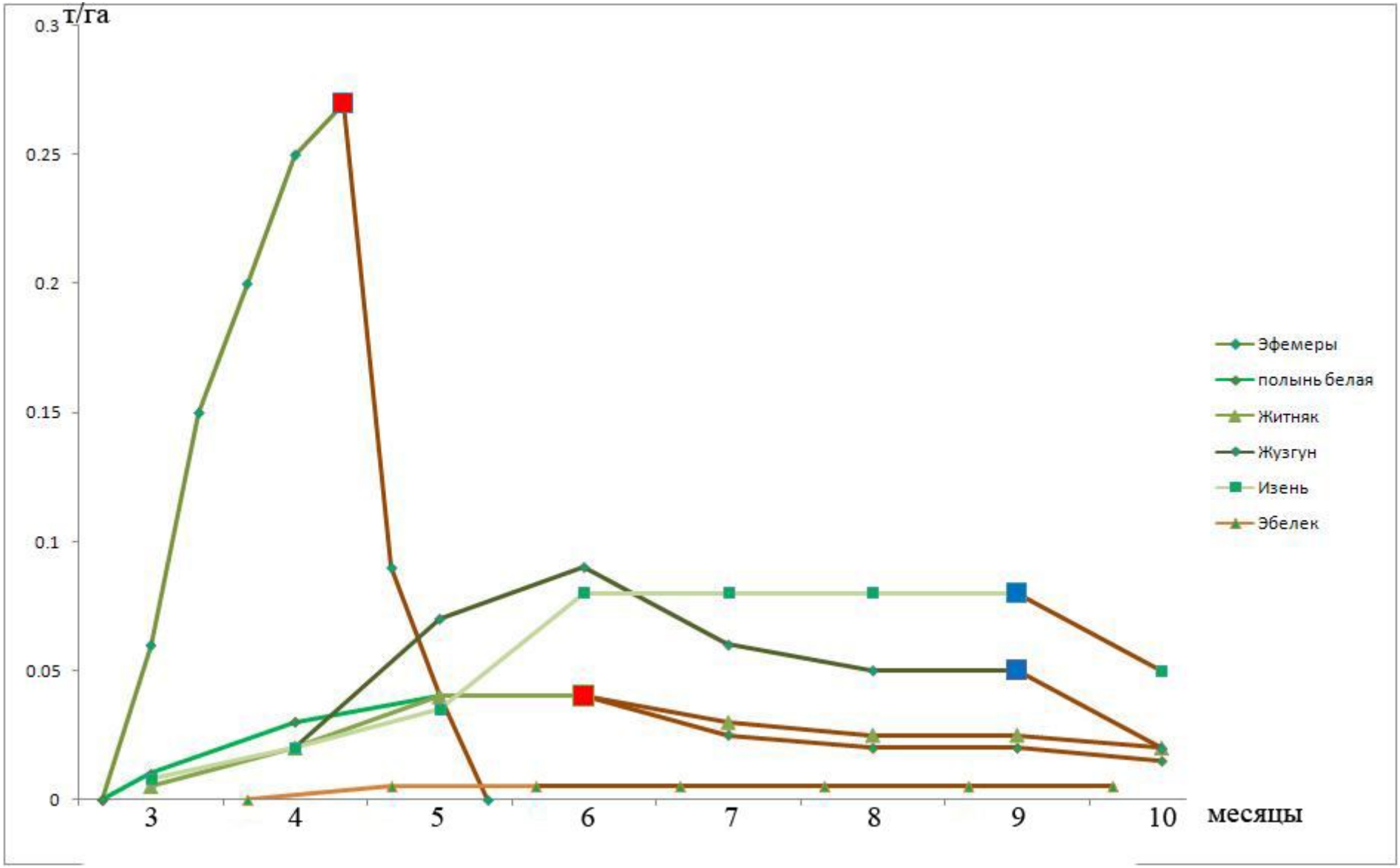


Fig. Modeling of ground biomass for pasture in 2007 agroclimatical condition on «Southern» polygon

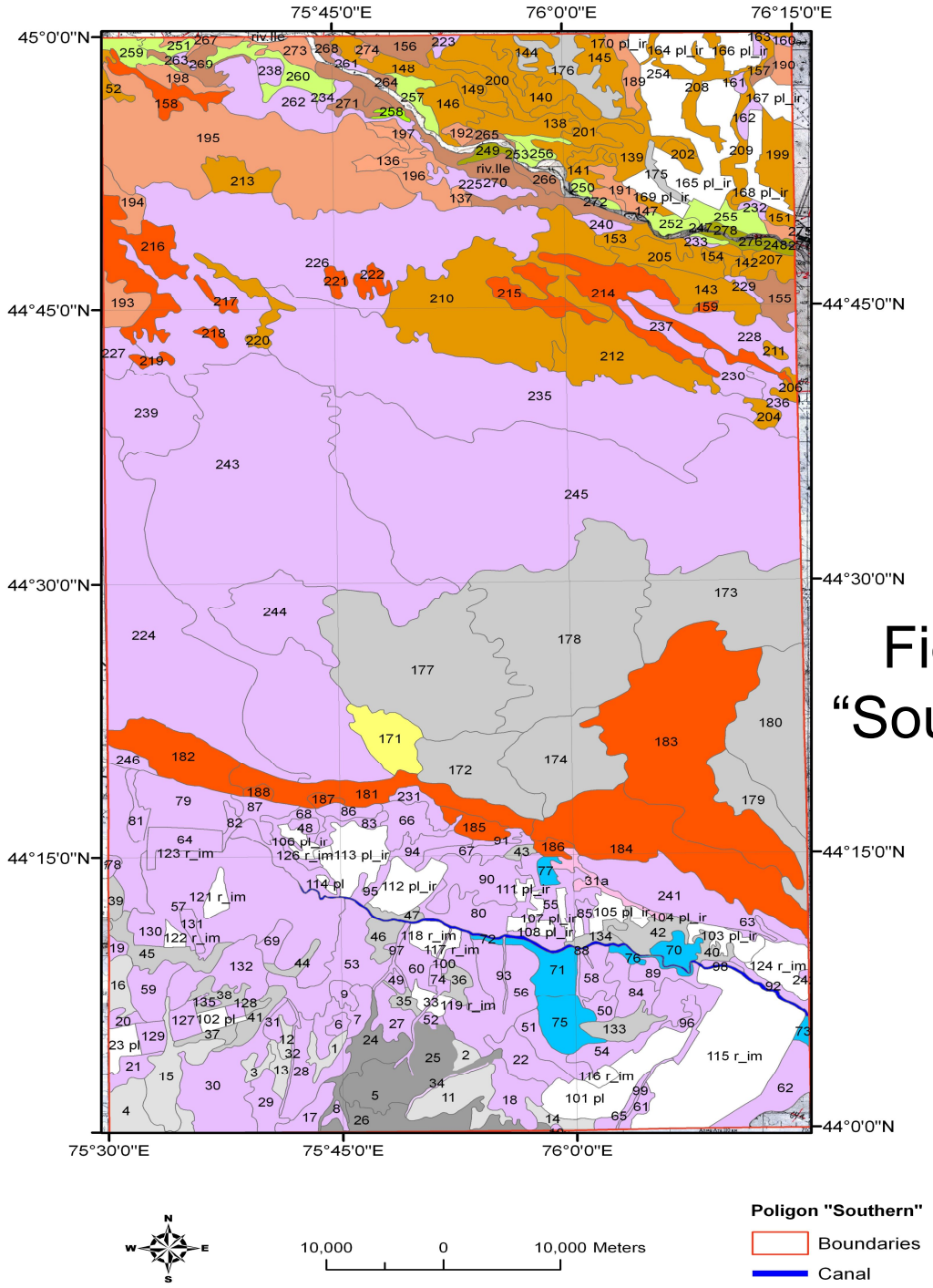


Fig. Geobotanic map on "Southern" research polygon 1:200 000

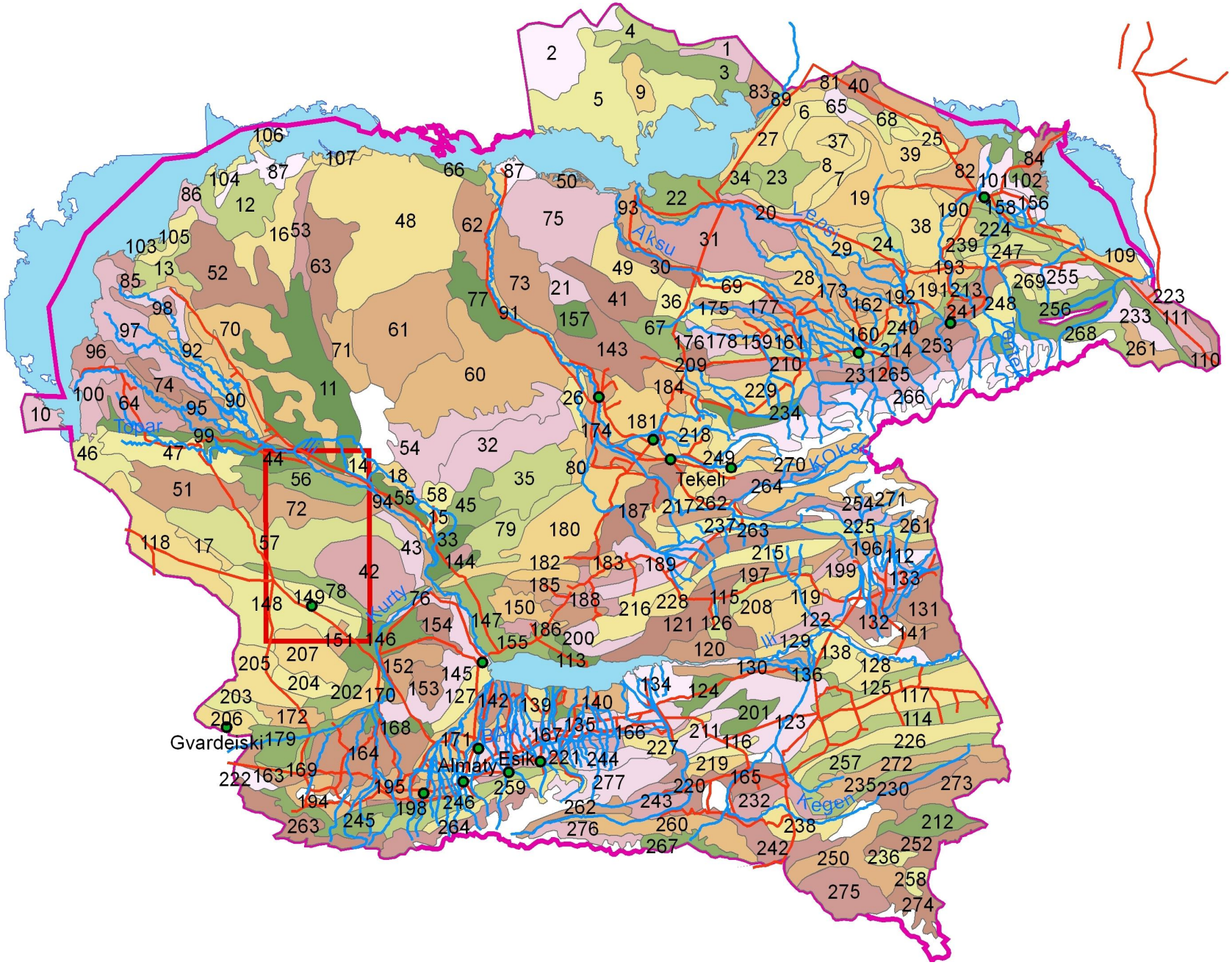


Fig. Geobotanic map on Almaty region. 1:2 500 000

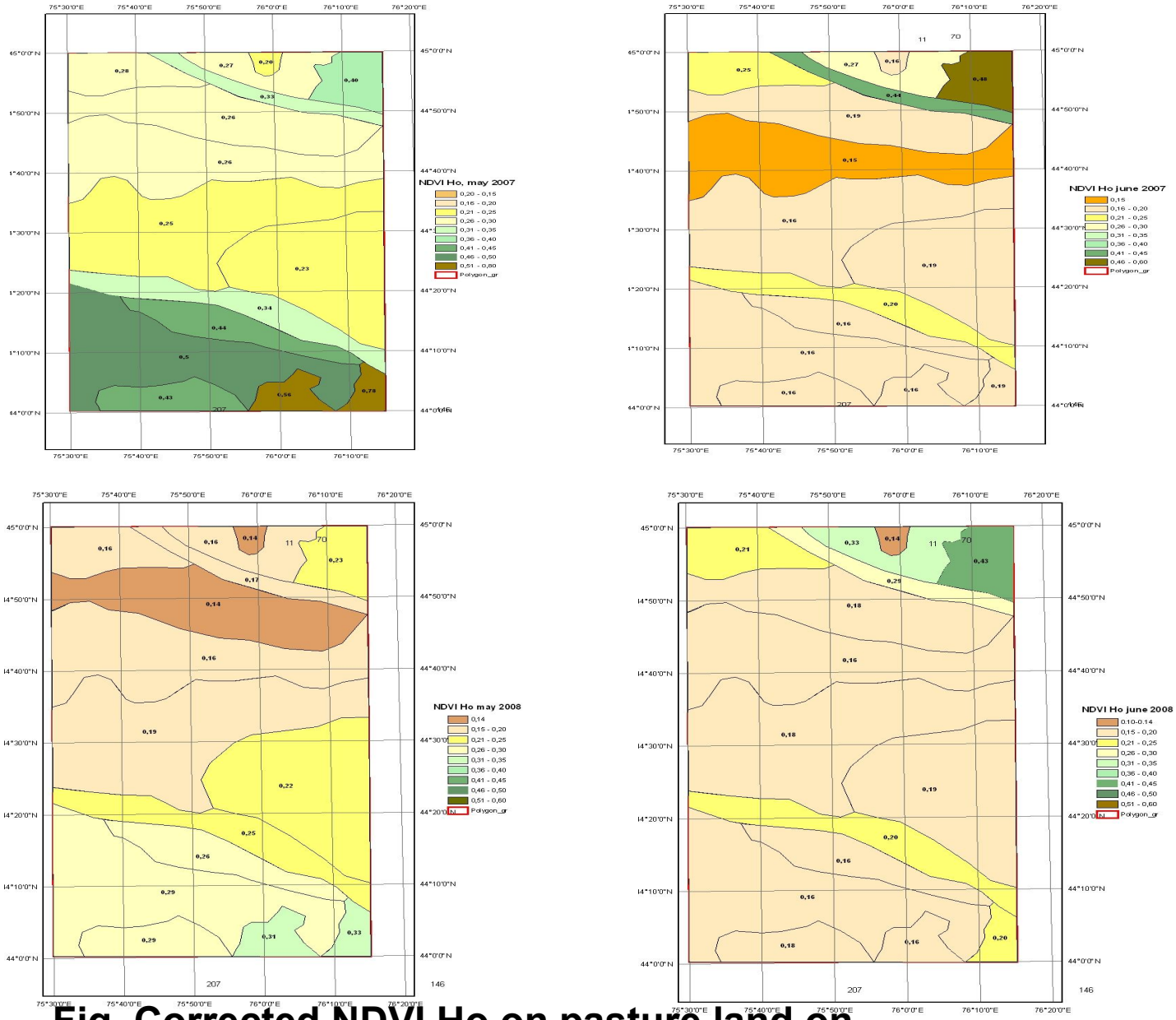


Fig. Corrected NDVI Ho on pasture land on "Southern" polygon in 2007-2008 spring and summer seasons from Modis image treatment. 1:2 500 000

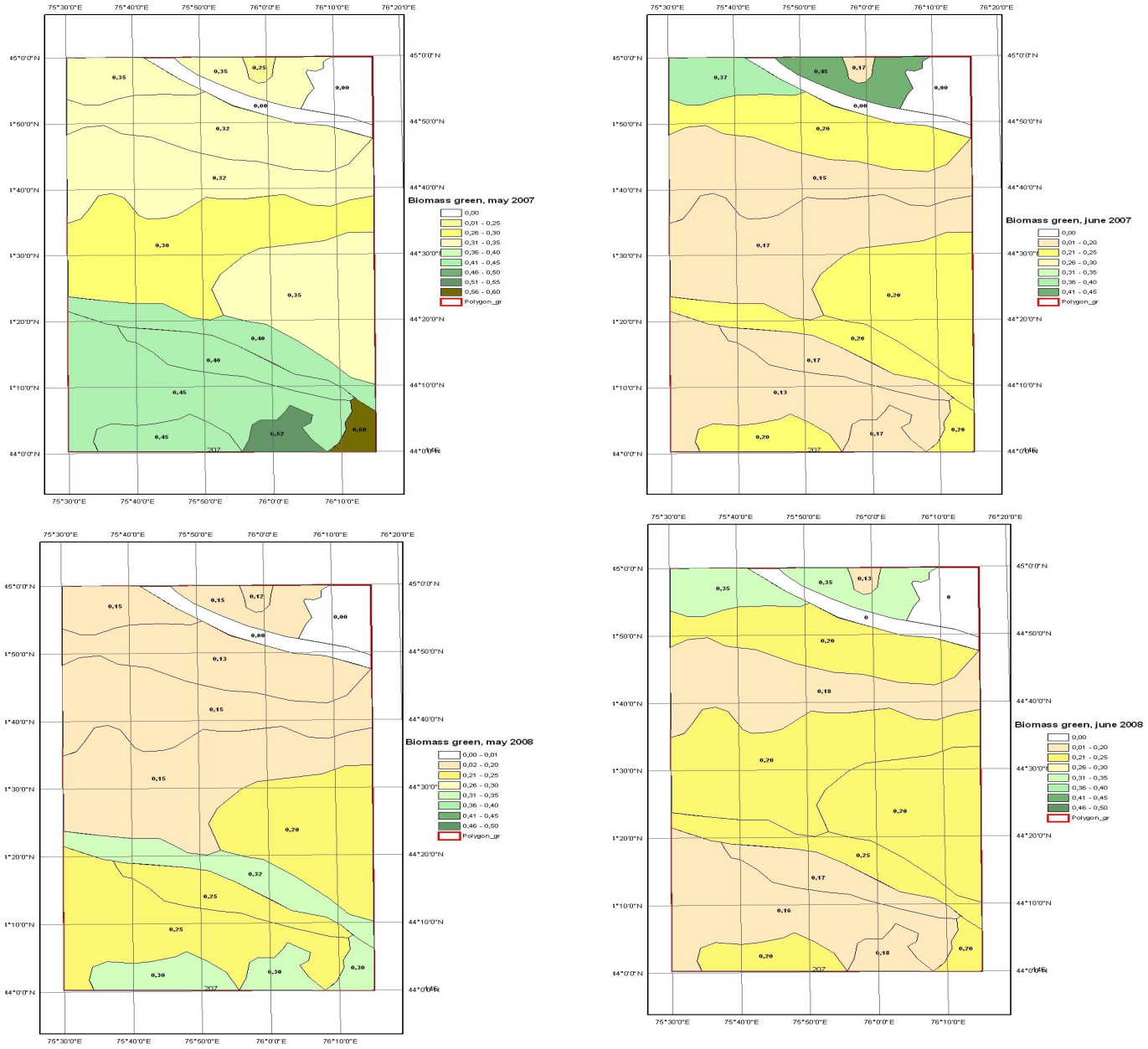
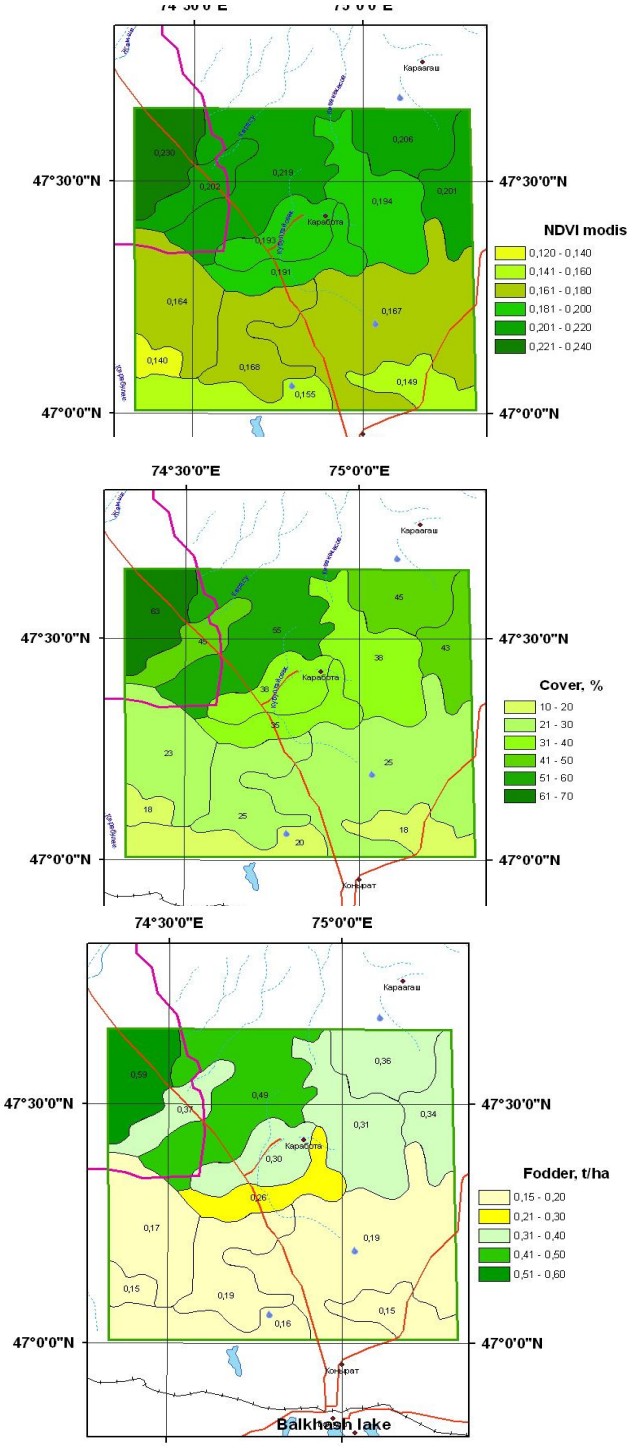


Fig. Corrected Green biomass (T/ha) on pasture land on “Southern” polygon in 2007-2008 spring and summer seasons from Modis image treatment.1:2500 000



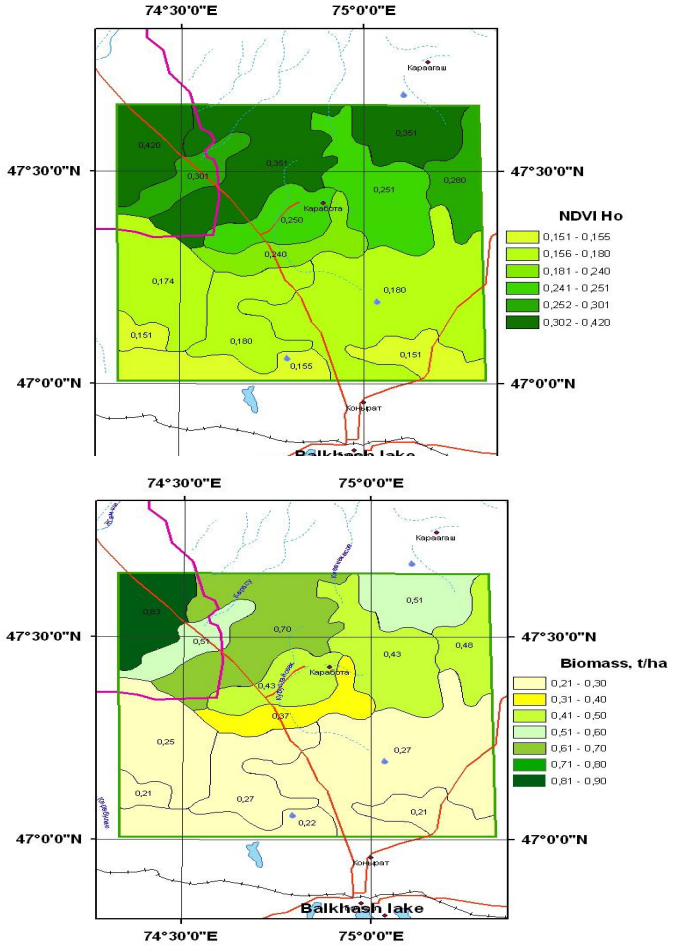


Fig. Results of treatment of Modis image for May 2008 for pasture lands for "Nothern" research polygon. 1:2 500 000

Ecological and agricultural index for pasture land using on "Southern" research polygon in change agroclimatic condition

Farm , Site F. "Mashan",		Spring					Summer					Autumn				
		Bio	F.U	EV	EV	EV	Bio	F.U	EV	EV	EV	Bio	F.u	EV	EV	EV
		T\ha	T\ha	T\ha	F.u\ha	H.-d T\ha	T\ha	T\ha	T\ha	F.u\ha	H.- d T\ha	T\ha	T\ha	T\ha	F.u\ha	H.-d T\ha
Site 1, c.24-35	**2007**	**0.38**	**778**	**0.66**	**465**	**232**	**0.2**	**1765**	**1.09**	**1059**	**530**	**0.08**	**543**	**0.9**	**366**	**183**
Beforemountain plaint	**2008**	**0.27**	**422**	**0.37**	**253**	**127**	**0.15**	**858**	**0.9**	**514**	**257**	**0.09**	**288**	**0.28**	**173**	**87**
4300 head-2007																
2000 head-2008																
Site 2, c. 181																
Small hilly sand	**2007**	**0.26**	**232**	**0.21**	**139**	**70**	**0.23**	**310**	**0.39**	**186**	**93**	**0.17**	**140**	**0.18**	**84**	**42**
500 head -2007	**2008**	**0.19**	**219**	**0.2**	**131**	**65**	**0.18**	**390**	**0.47**	**234**	**117**	**0.12**	**135**	**0.24**	**81**	**40**
750 head - 2008																
Site 3, c. 171																
Higth hilly sand	**2007**	**0.23**	**165**	**0.14**	**100**	**50**	**-**	**-**	**-**	**-**	**-**	**0.12**	**120**	**0.07**	**72**	**36**
Winter pasture	**2008**	**0.22**	**143**	**0.13**	**86**	**40**	**-**	**-**	**-**	**-**	**-**	**0.13**	**130**	**0.08**	**80**	**40**
Co. Camel																
C. 66	**2007**	**0.42**	**367**	**0.33**	**220**	**110**	**0.46**	**507**	**0.61**	**304**	**152**	**0.36**	**207**	**0.38**	**124**	**65**
18000 head -2007	**2008**	**0.31**	**295**	**0.26**	**177**	**90**	**0.14**	**347**	**0.42**	**208**	**104**	**0.11**	**122**	**0.23**	**73**	**38**

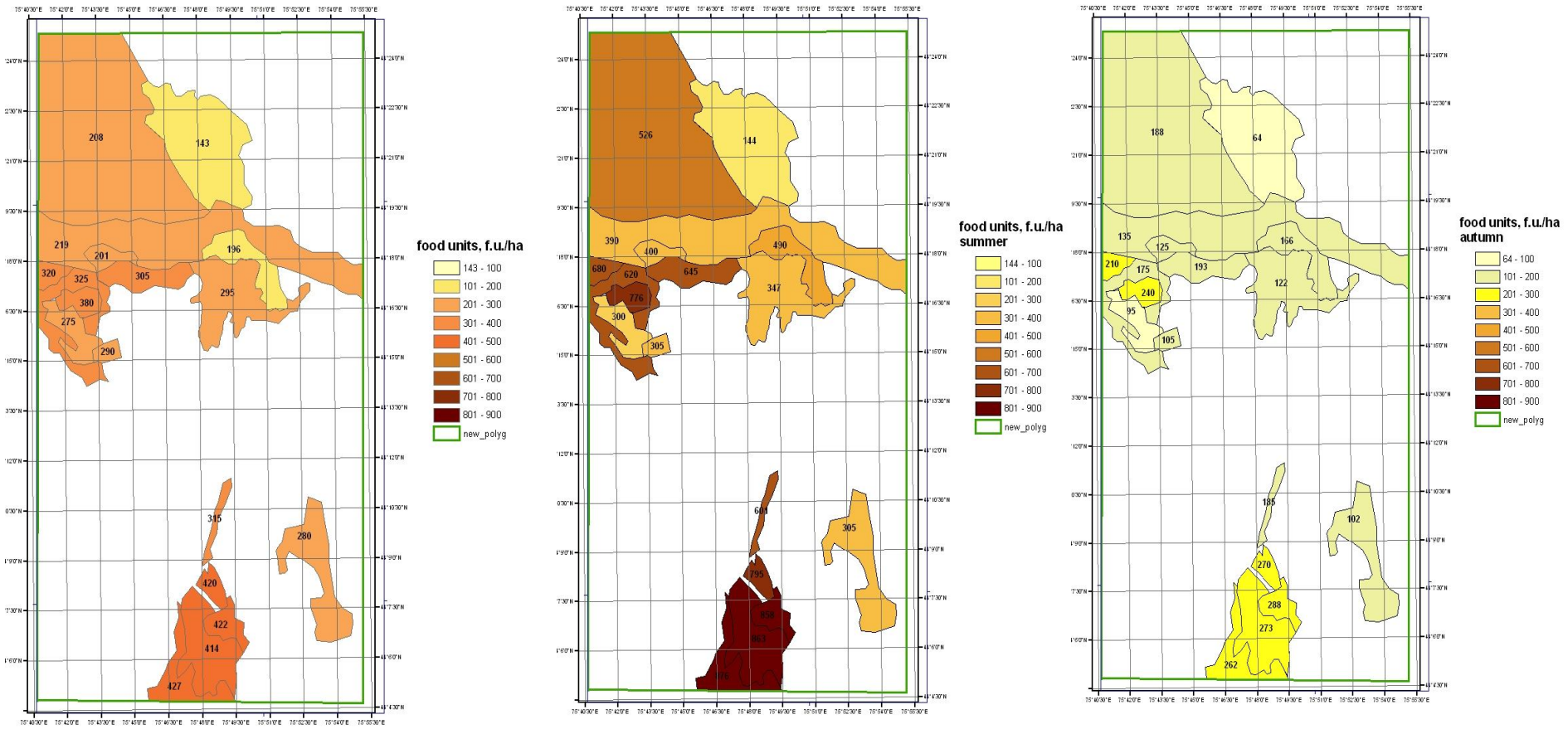


Fig. Agricultural index (food units/ha) for pasture use land on "Southern" research polygon by 70% probability and more 1:200 000

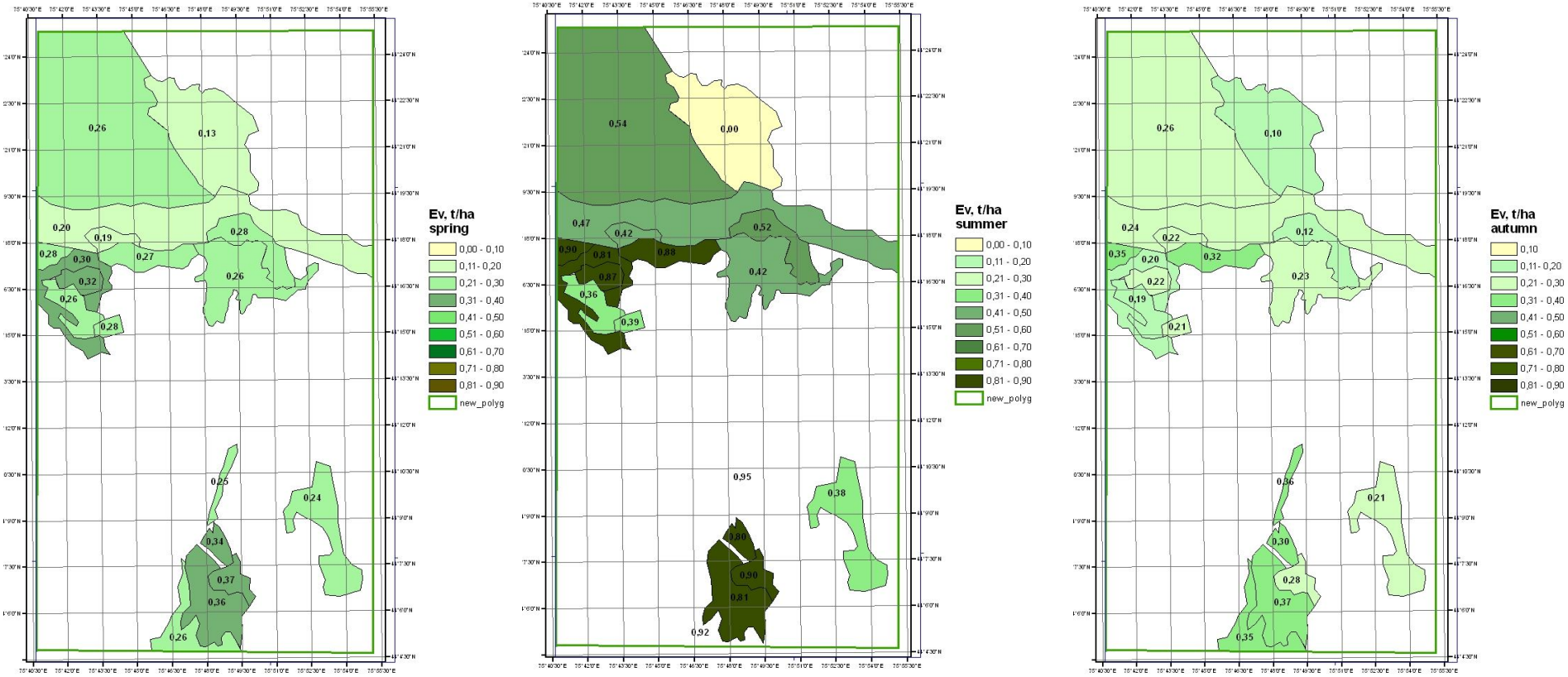


Fig. Ecological index (food, t/ha) for pasture use land on “Southern” research polygon by 70% probability and more 1:200 000

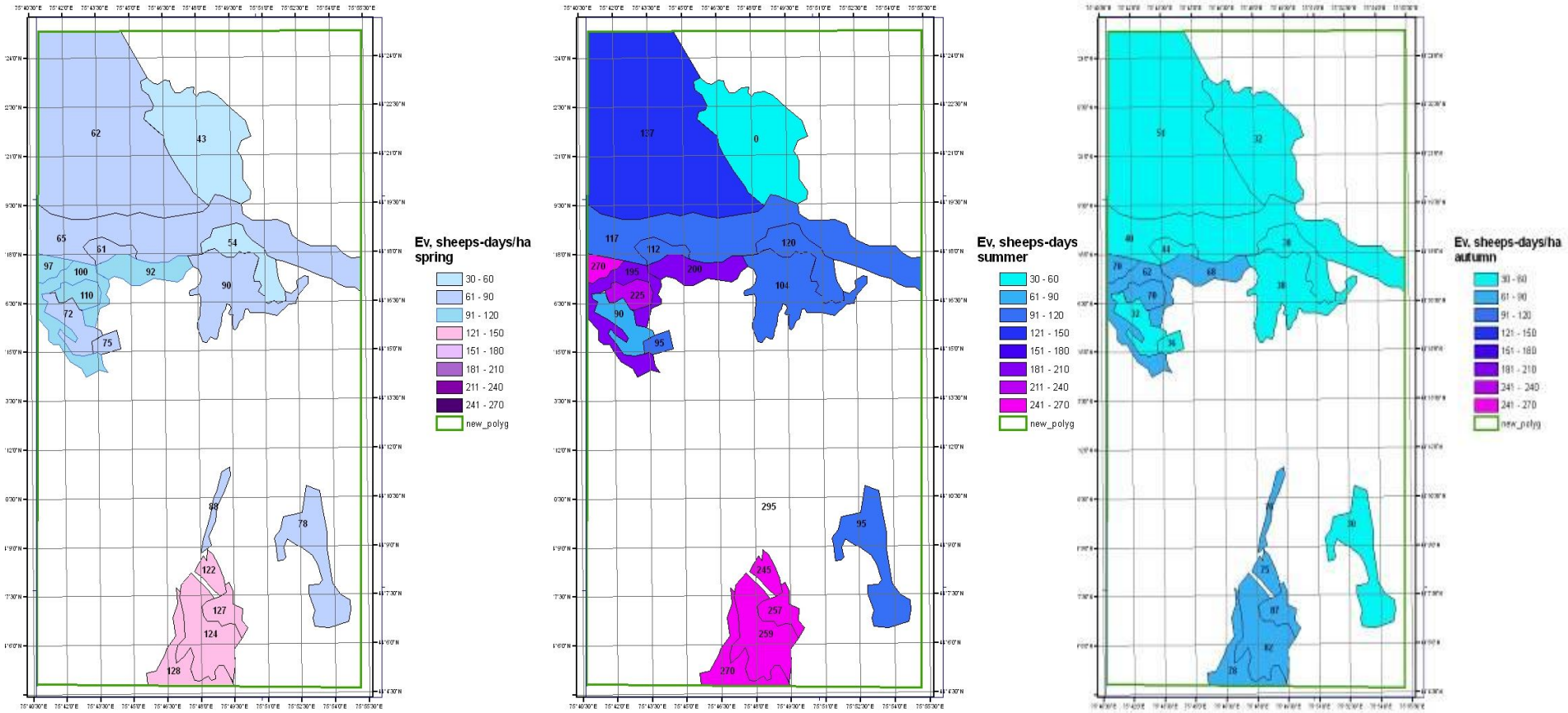
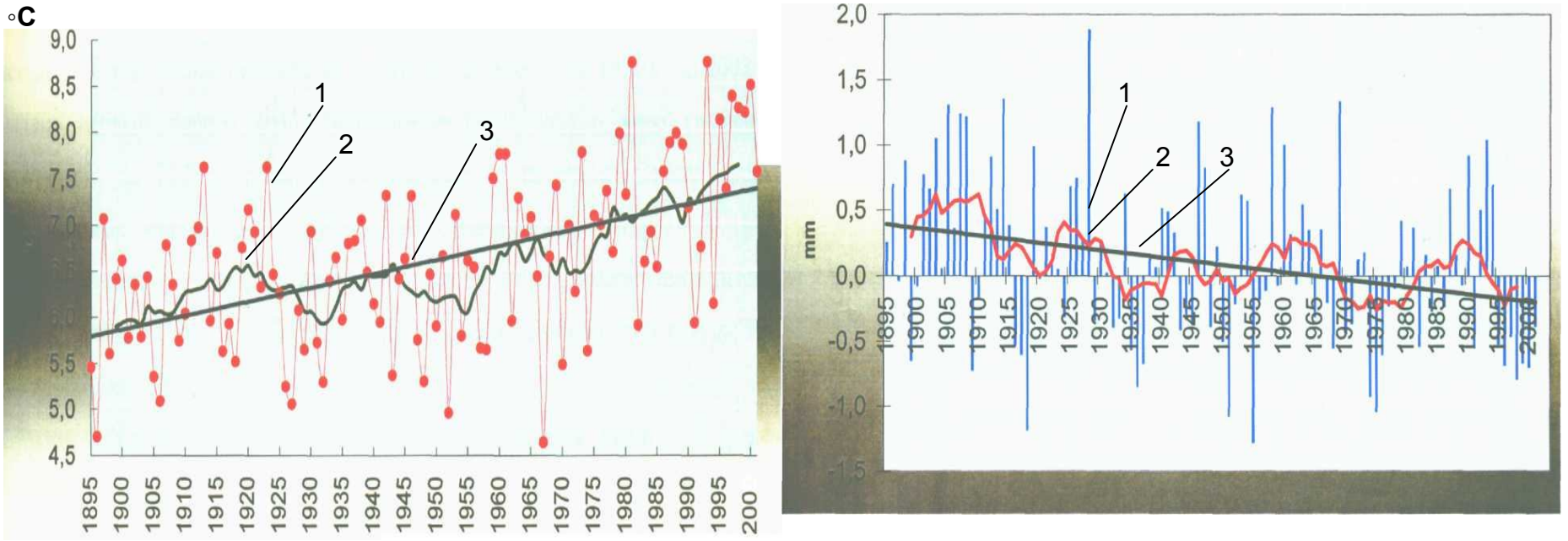


Fig. Ecological index (volume head-days/ha) for pasture use on "Southern" research polygon by 70% probability and more 1:200 000



The air temperature and precipitation dynamic in Kazakhstan area. (S. Dolgich. 2004)

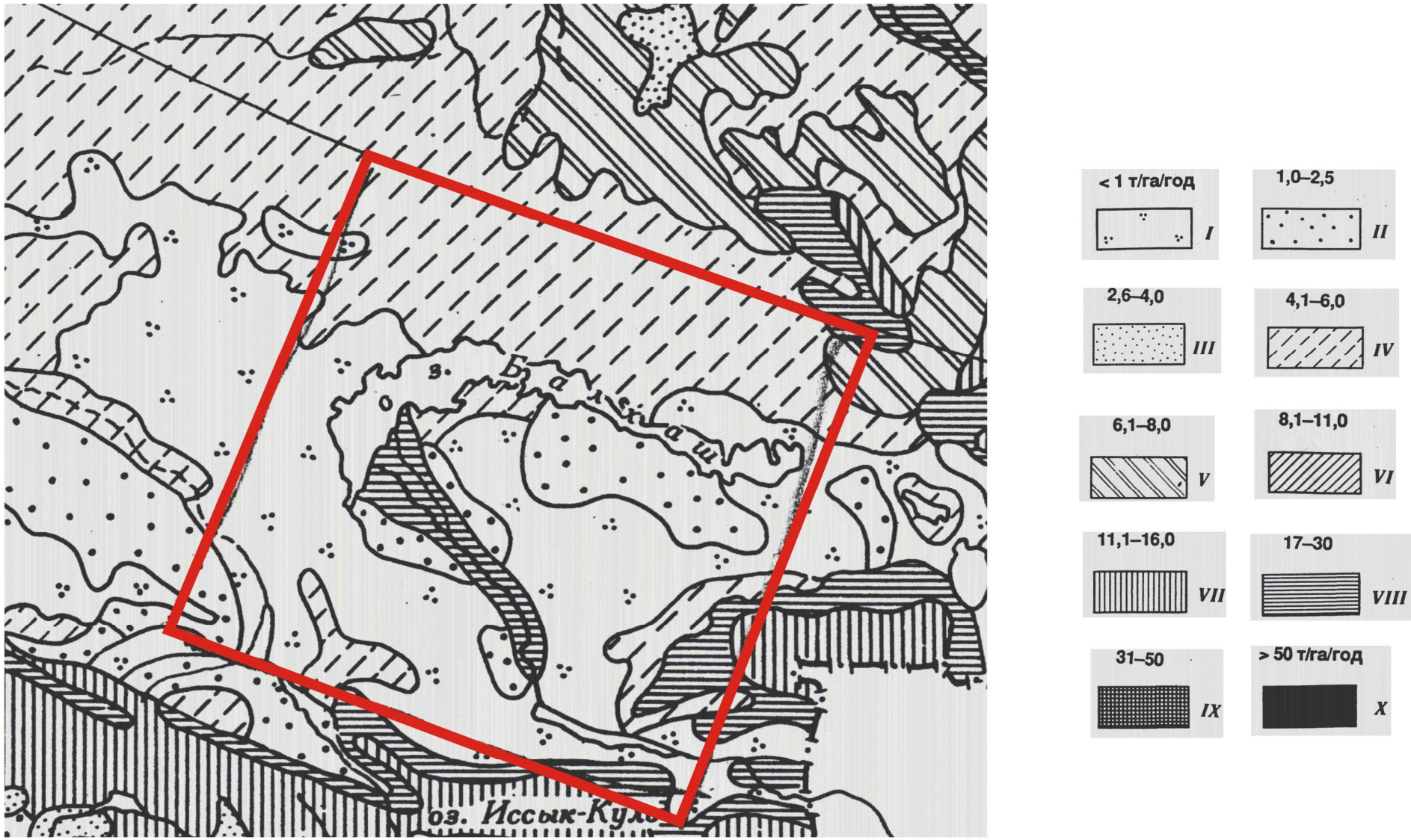
1 – annual volume

2 – sliding 11-years period average

3 - trend line

Agrometeorological condition for growth and accumulation of biomass on Pasture under influence of climate change in Southern Balkhash area

Climate scenarious		March		April			May			June		
		2	3	1	2	3	1	2	3	1	2	3
Basis 1976-2005	T°C	0,6	5,8	8,0	12,1	12,9	15,7	17,1	19,1	21,3	23,1	25,1
	K, un			≥1	>1	>1	0,76	0,63	0,51			0,30
	Bio, t/ha				0,12			0,3			*0,44*	
A2 2030	T°C	1,9	7,4	9,5	19,6	15,3	17,2	18,6	20,6	22,4	24,2	26,2
	K, un			>1	>1	0,98	0,75	0,62	0,52			0,30
	Bio, t/ha				0,11			0,34			*0,41*	
2050	T°C	3,1	8,6	10,6	14,7	16,4	18,4	19,8	21,8	23,7	25,5	27,5
	K, un		≥1	≥1	≥1	0,82	0,64	0,54	0,45			0,27
	Bio, t/ha				0,14			*0,41*			0,36	
2085	T°C	5,7	11,2	12,6	16,7	18,4	20,8	22,2	24,2	27,3	29,1	31,1
	K, un	≥1	≥1	≥1	0,84	0,65	0,53	0,45	0,37			0,21
	Bio, t/ha				0,18			*0,46*			0,41	
B2 2030	T°C	1,8	7,3	9,3	13,4	15,1	17,3	18,7	20,7	23,1	24,9	26,9
	K, un			≥1	≥1	0,97	0,74	0,62	0,50			0,30
	Bio, t/ha				0,10			*0,33*			0,29	
2050	T°C	2,6	8,1	10,0	14,1	15,8	18,2	19,6	21,6	22,4	26,2	28,2
	K, un		≥1	≥1	≥1	0,86	0,67	0,56	0,47			0,27
	Bio, t/ha				0,14			*0,40*			0,34	
2085	T°C	4,1	9,6	11,3	15,4	17,1	19,7	21,1	23,1	26,2	28,0	30,0
	K, un		≥1	≥1	≥1	0,82	0,57	0,48	0,40			0,23
	Bio, t/ha				0,12			*0,30*			0,26	



Production of aboveground and underground mass by N.I. Bazilevich

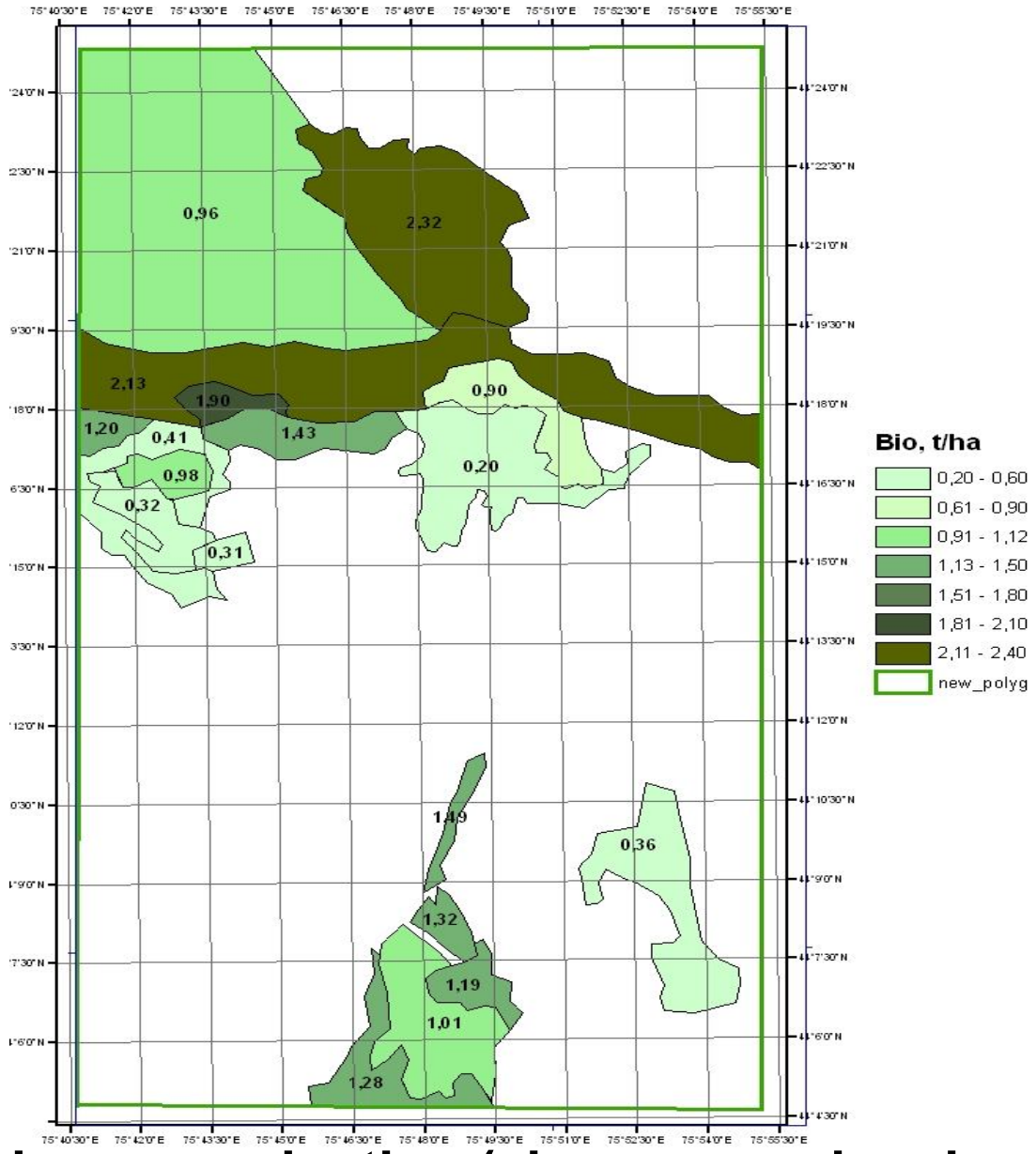


Fig. Volume of primary production (aboveground and underground) on pasture land on “Southern” research polygon 1:200 000