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Regional and International Cooperation in Central Asia and South Caucasus: Recent Developments in Agricultural Trade

2 - 4 November 2016 | Samarkand, Uzbekistan

Different Approaches to Evaluate the Condition of Irrigated Agricultural Areas Using Remotely Sensed Data

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JSC “National Center of Space Research and Technology”, Almaty, Kazakhstan



Samarkand, 2016

Background

Area of irrigated lands (85% or 1200000 ha) – Kzylorda, SKO, Jambyl, Almaty oblasts
Significant areas (20-30%) remained unusable in this zone

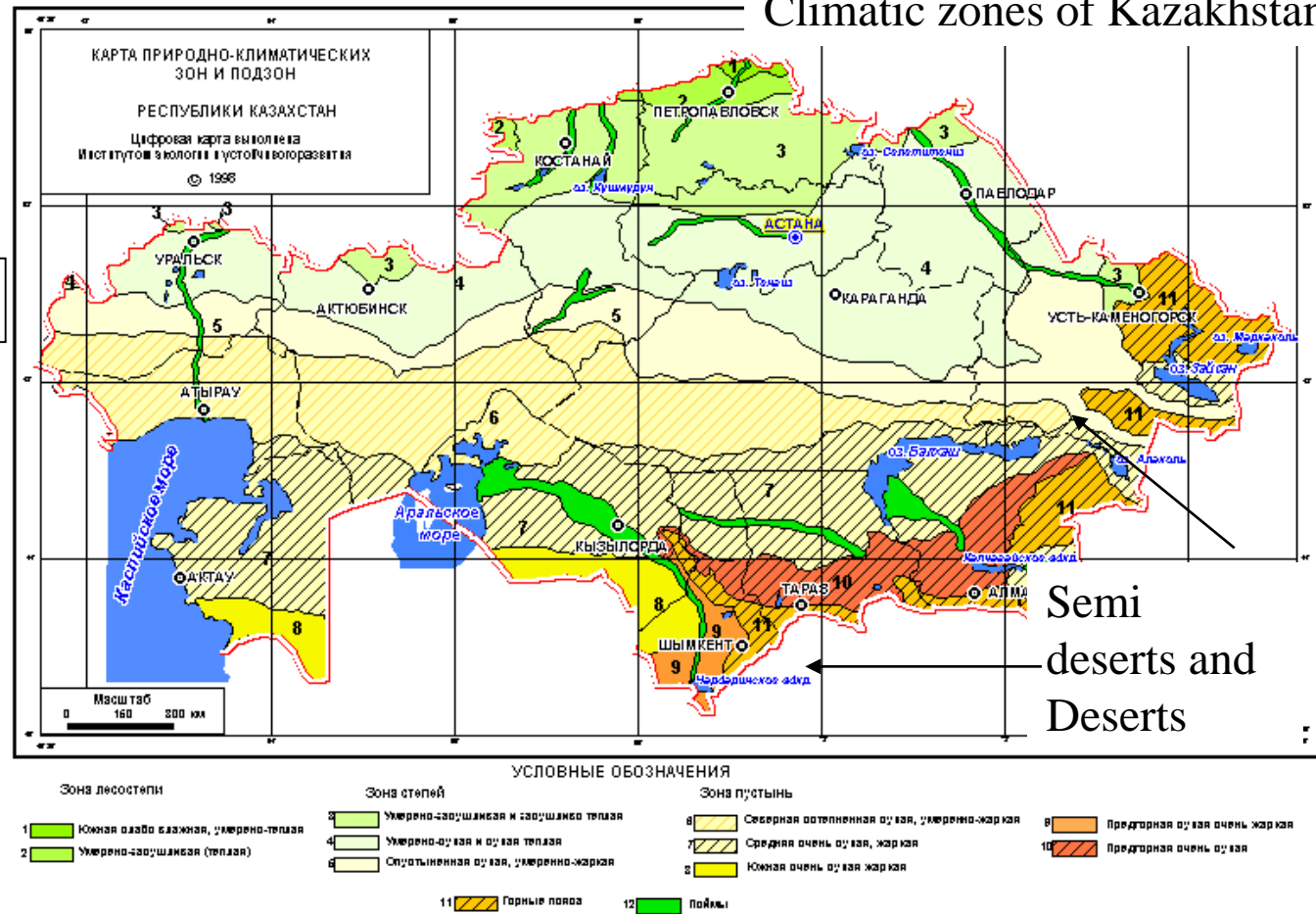
The information about
irrigated areas

Ministry of Agriculture

Akim
(head of the region)

Farmers

Climatic zones of Kazakhstan



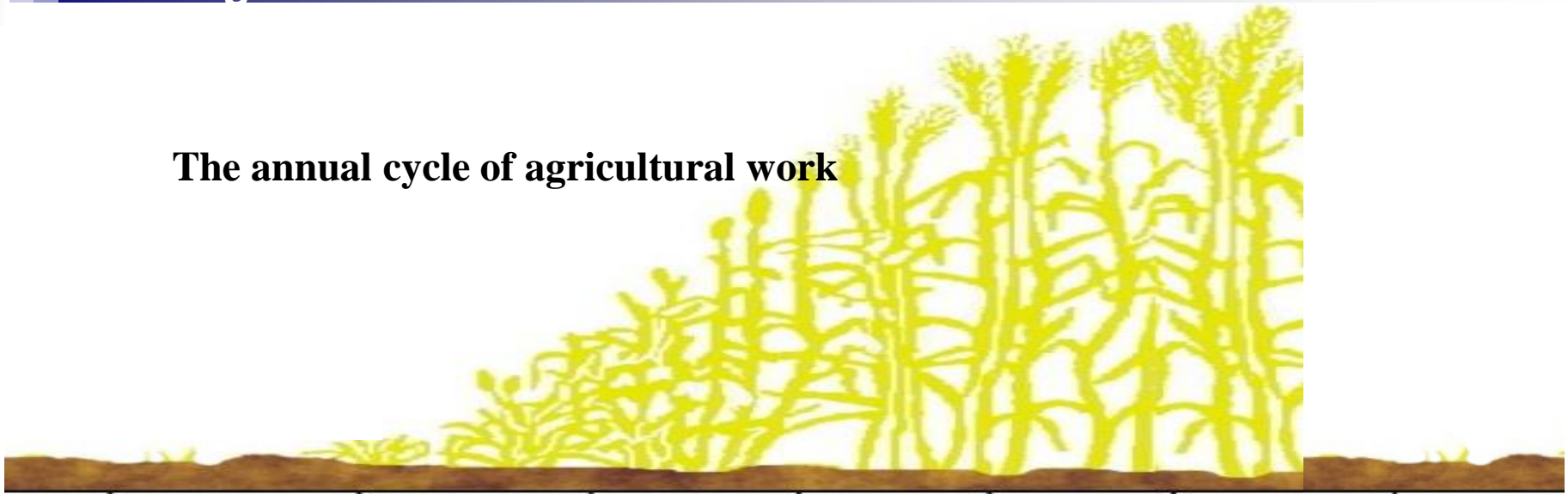
Zone of irrigated crop production

Main Aims

To create the monitoring system of irrigated lands in Kazakhstan using operative remote sensing data

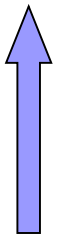
Project was fund by Kazakhstan State Budget Program 212 «Scientific development for consumption using of water resources and agricultural lands»

The annual cycle of agricultural work

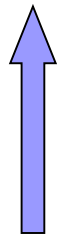


February/ March/ April/ May/ June / July/ August/ October / November/

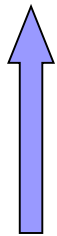
Registration of
leaching



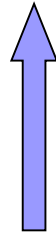
Registration of
sowing date



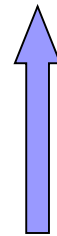
Registration of
Irrigation date



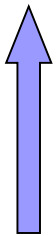
Current state
of vegetation



Registration of
harvesting date

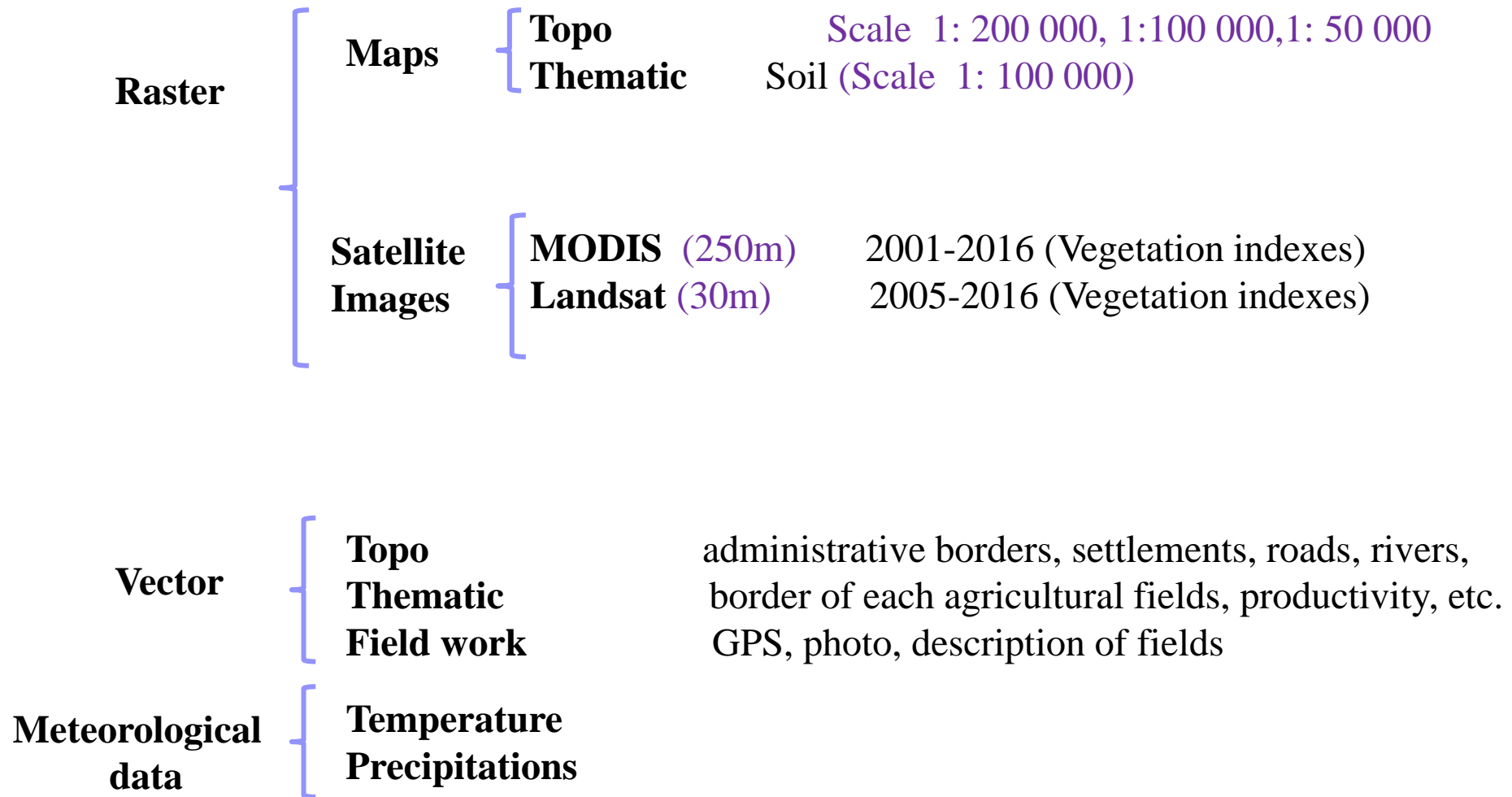


Registration of
salinity



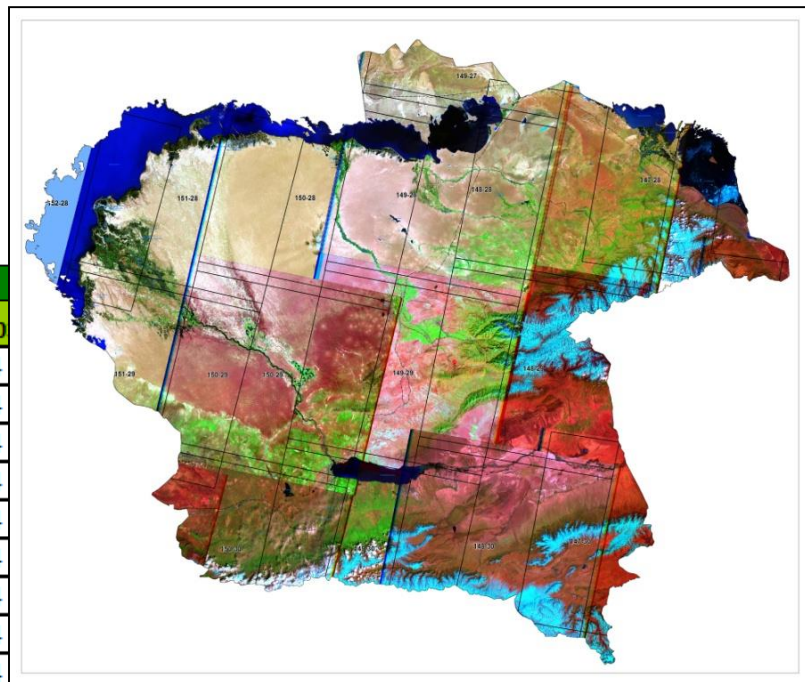
R e m o t e s e n s i n g m o n i t o r i n g

Geoinformation system (GIS)



Remote sensing data

Terra/MODIS (250 m resolution) - everyday,
Landsat-8 (30 m and 15 m resolution) - 16 day

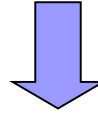


Almaty oblast Landsat images

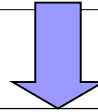
Catalog: Landsat-5-8 from 2005-2016

Область	Кызылординская	Южно-Казахстанская	Жамбылская	Алматинская область	
№ сцены	157029	155032	153030	149030	1500
1	05.01.2014	07.01.2014	09.01.2014	02.03.2014	29.01.2014
2	21.01.2014	23.01.2014	25.01.2014	18.03.2014	14.02.2014
3	10.03.2014	08.02.2014	10.02.2014	03.04.2014	02.03.2014
4	26.03.2014	24.02.2014	26.02.2014	19.04.2014	18.03.2014
5	11.04.2014	12.03.2014	30.03.2014	05.05.2014	03.04.2014
6	27.04.2014	28.03.2014	15.04.2014	21.05.2014	19.04.2014
7	13.05.2014	13.04.2014	01.05.2014	06.06.2014	05.05.2014
8	29.05.2014	15.05.2014	17.05.2014	22.06.2014	21.05.2014
9	14.06.2014	31.05.2014	02.06.2014	08.07.2014	06.06.2014
10	30.06.2014	16.06.2014	18.06.2014	24.07.2014	22.06.2014
11	16.07.2014	02.07.2014	04.07.2014	09.08.2014	08.07.2014
12	01.08.2014	18.07.2014	20.07.2014	25.08.2014	24.07.2014
13	17.08.2014	03.08.2014	05.08.2014	10.09.2014	09.08.2014
14	02.09.2014	19.08.2014	21.08.2014	26.09.2014	25.08.2014
15	18.09.2014	04.09.2014	06.09.2014	12.10.2014	10.09.2014
16	04.10.2014	20.09.2014	22.09.2014	28.10.2014	26.09.2014
17	21.11.2014	06.10.2014	08.10.2014	13.11.2014	12.10.2014
18	07.12.2014	22.10.2014	24.10.2014	29.11.2014	28.10.2014
19	23.12.2014	07.11.2014	09.11.2014	15.12.2014	13.11.2014
20	08.01.2015	23.11.2014	25.11.2014	31.12.2014	29.11.2014

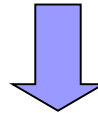
Space Images



Calculation of Vegetation Indexes (NDWI)
and Surface Temperature (LST)



Calculation of differences between LST and NDWI per each period



Creating of vector layers:

negative values of LSTdif – irrigated fields;

negative values of NDWIdif – non-irrigated fields



The list of spectral indexes for Landsat -8

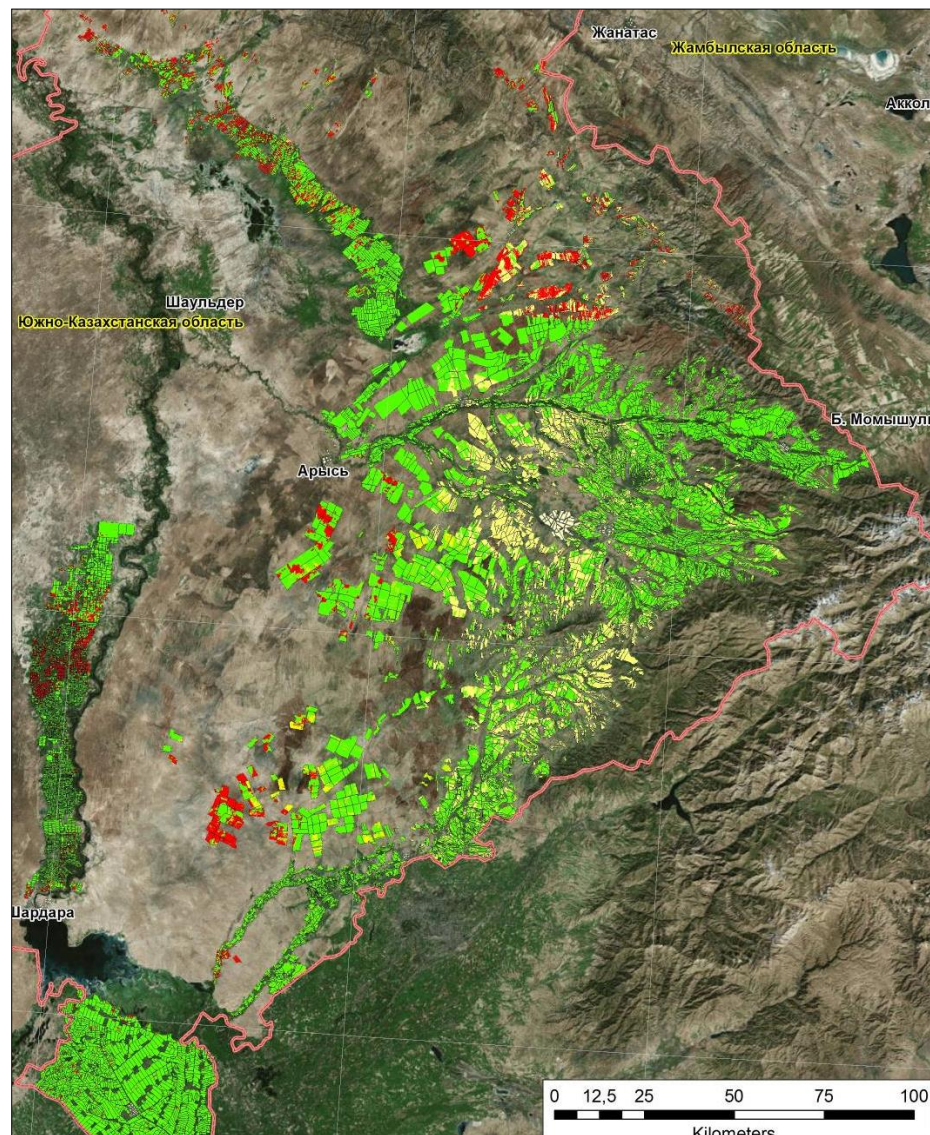
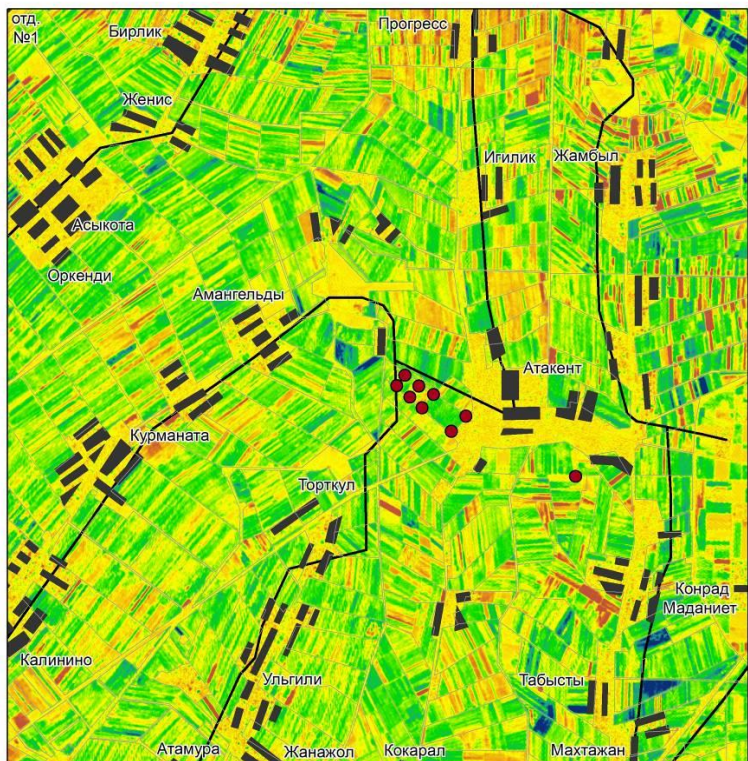
Index	Formula	Threshold
Salinity index	$NDSI = (b3 - b4) / (b3 + b4)$	-0,11 to 0
Water Index	$(b2 - b4) / (b2 + b4)$	>0.1
LST	$K2 / \log(K1 / b\# + 1)$; $B_{cels} = B_{kelv} - 273.15$	
SAVI	$SAVI = (NIR - Red) / (NIR + Red + 0.5) * (1 + 0.5)$	0.01-0.025
LST_{dif}	$LST_{dif} = LST \text{ latest date} - LST \text{ earliest date}$	<0
NDWI	$NDWI = (B5 - B6) / (B5 + B6)$	-1 to +1

Results

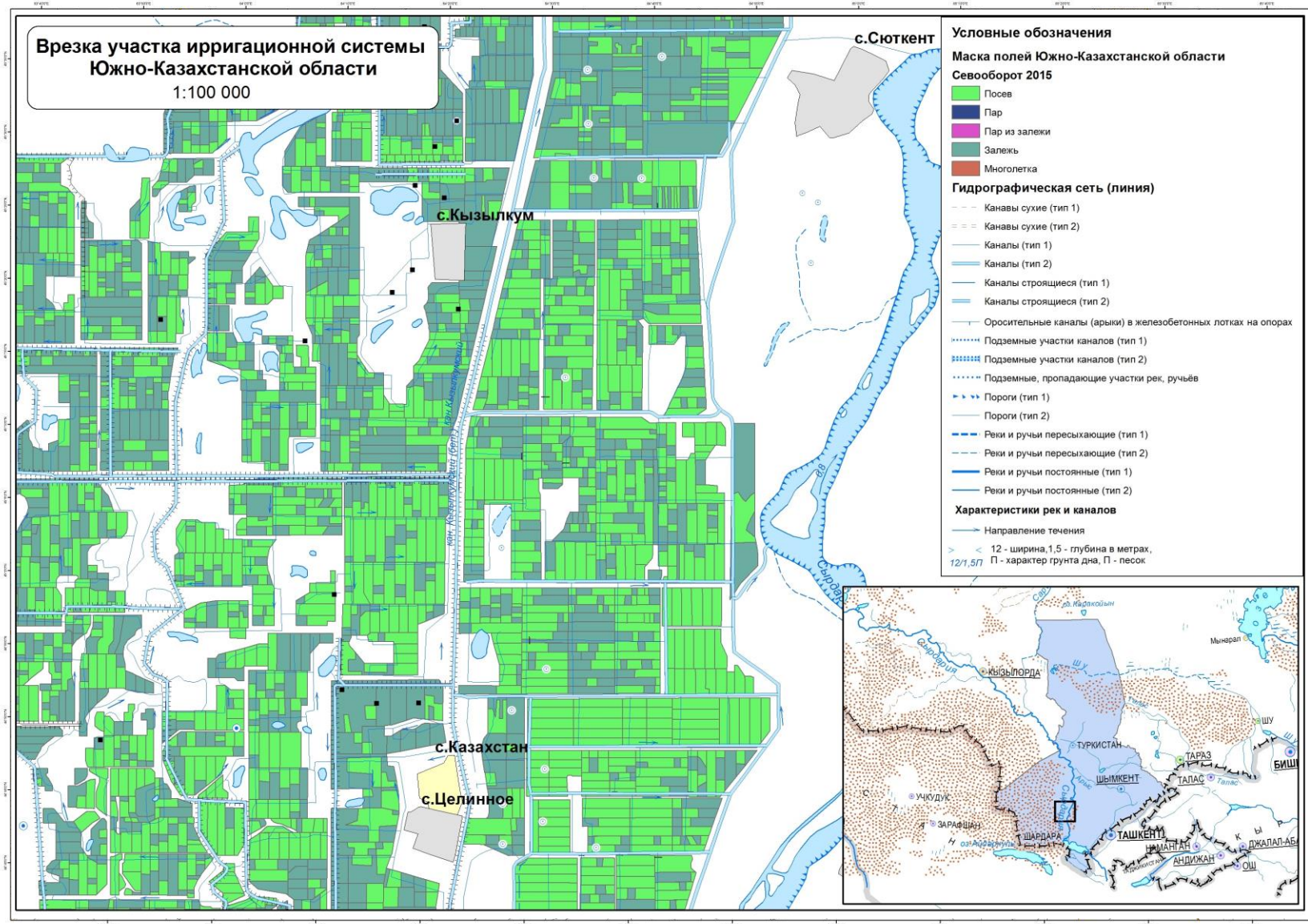
Map of irrigated and non-irrigated fields of South-Kazakhstan Oblast in July 2016

Classification of irrigated and non-irrigated fields of test polygon

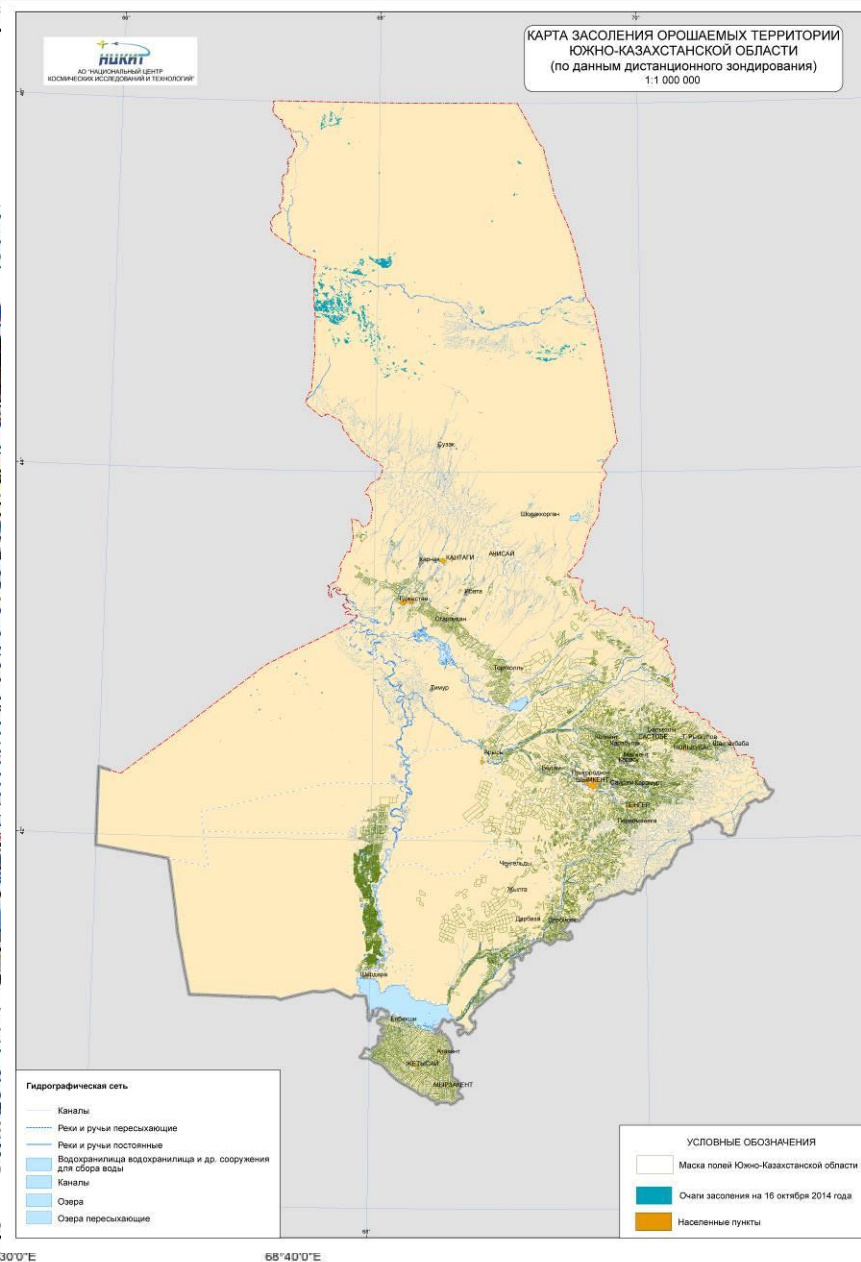
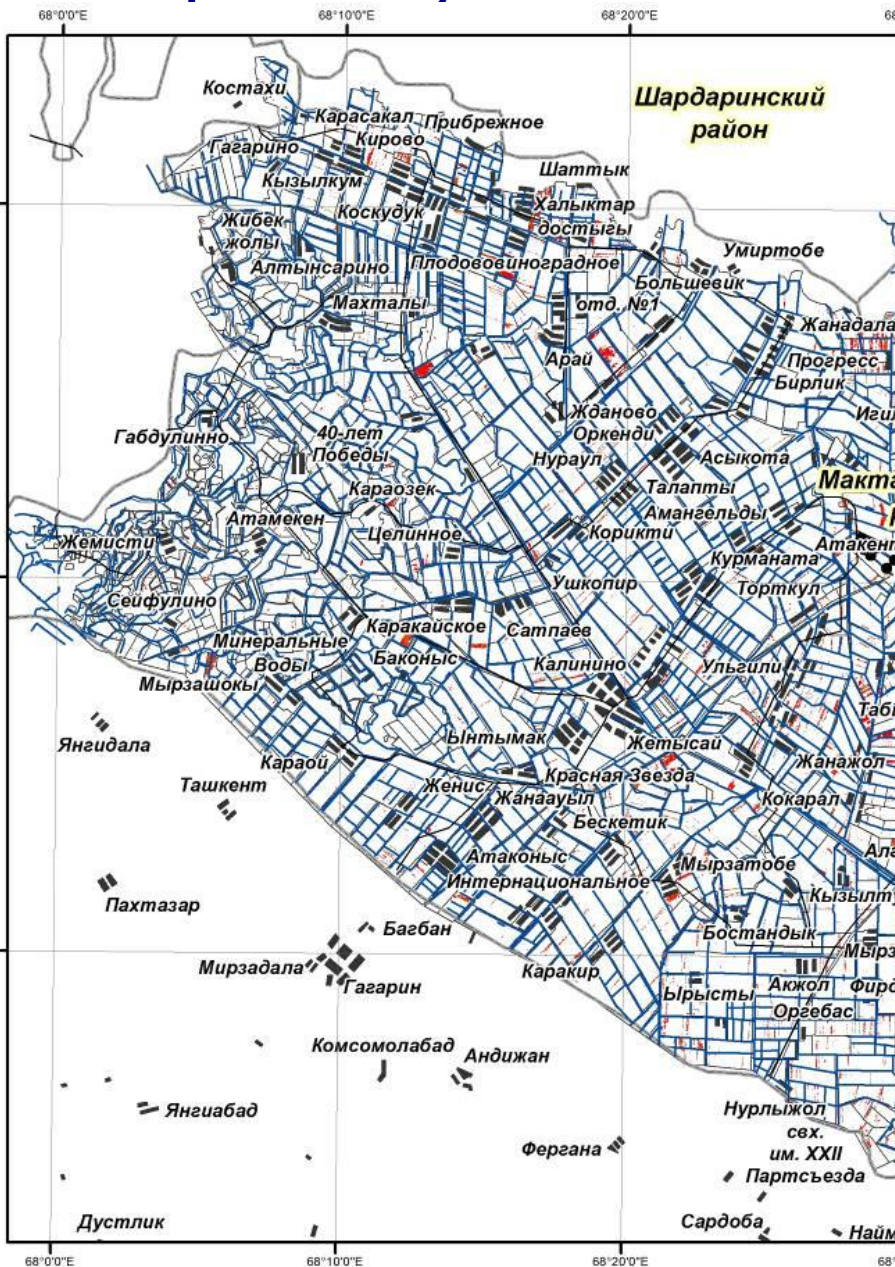
Irrigated fields 
Uncertainty 
Non-irrigated fields 



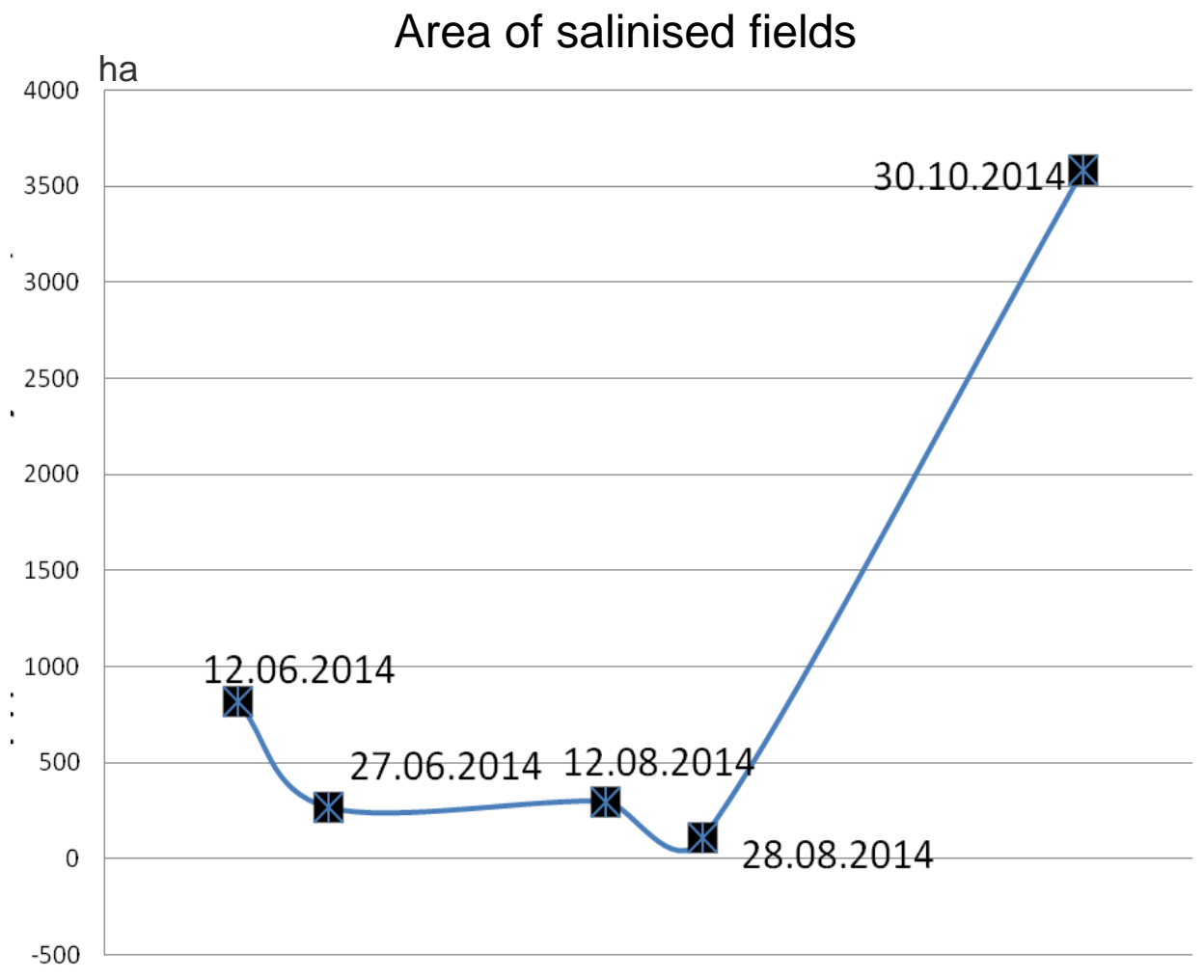
The mask of agricultural fields vectorized by space images



The Map of Salinity Areas



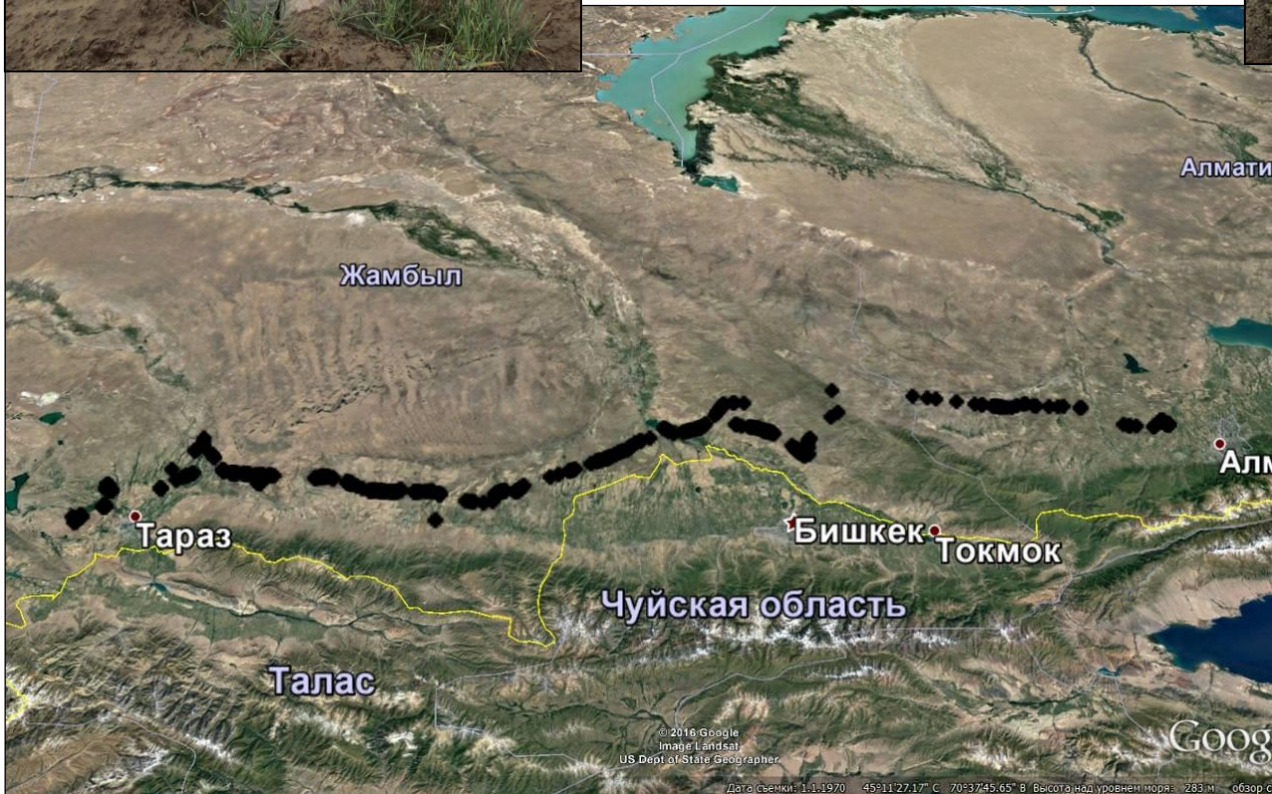
Irrigation areas analysis of salinity



Changing of salinised areas during vegetation period (test plot Atakent village)

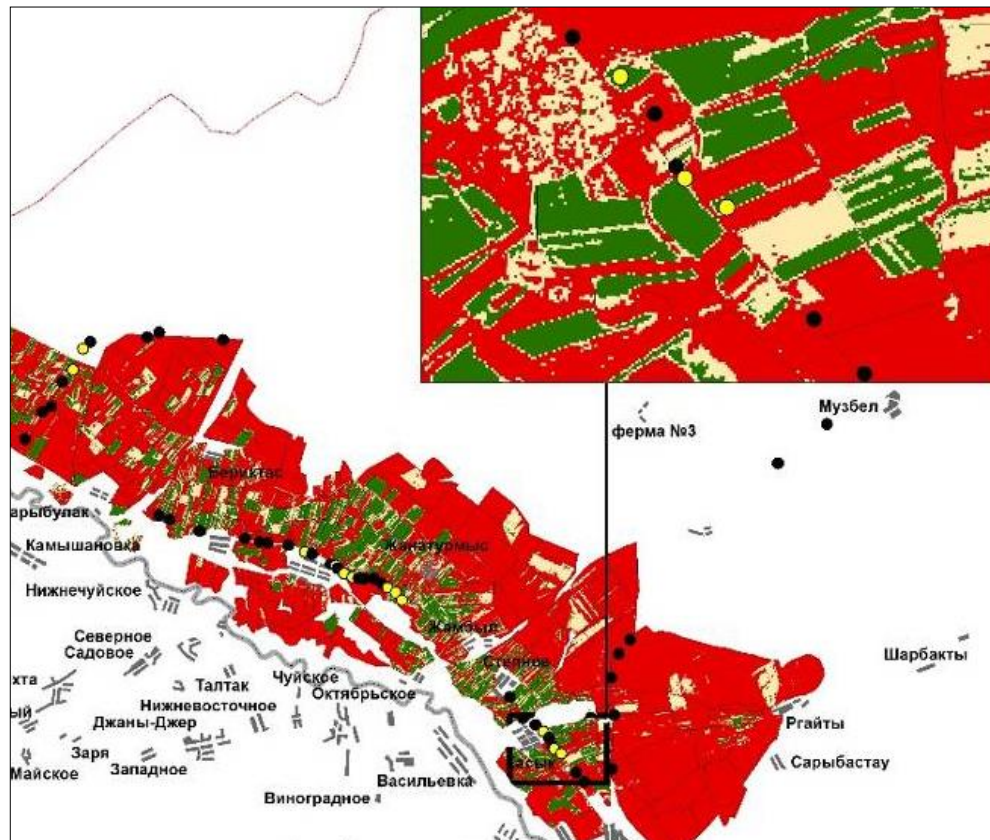
300 test fields

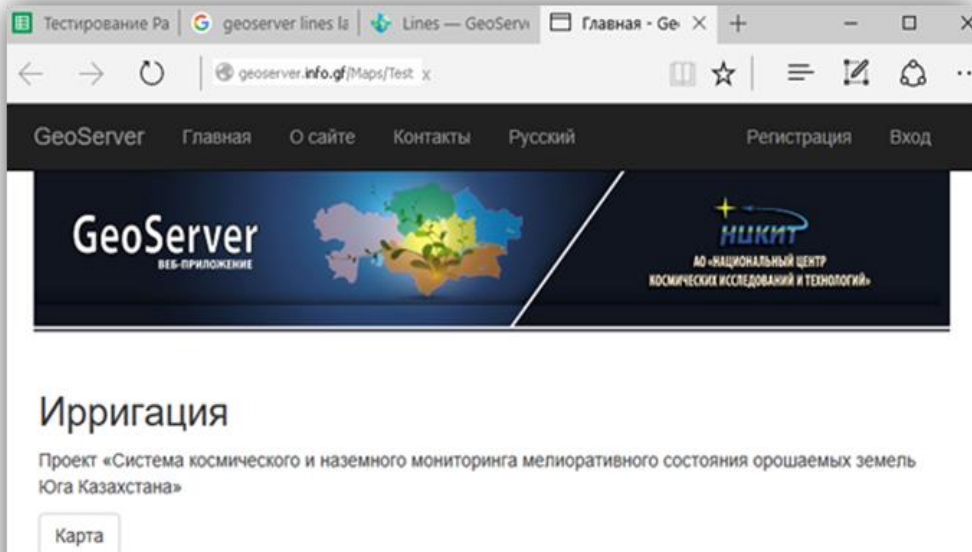
- Phenological description;
- Salinisation determination;
- Irrigation system description



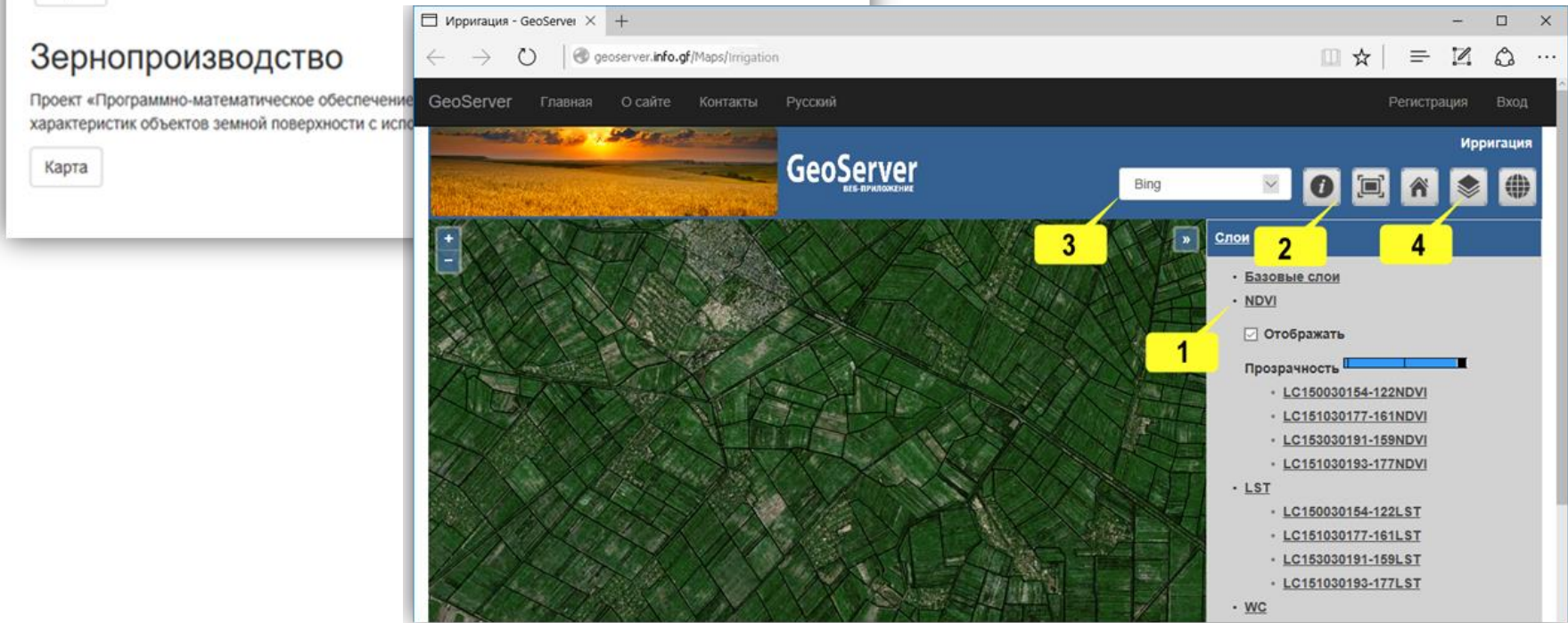
Verification

Index	Land Surface Temperature	NDWI	SAVI
Irrigated fields	100%	65%	75%
Non-irrigated fields	22.5%	81%	69%





Geoportal



You are welcome for questions!