Crop yield forecast and the goals of remote sensing of croplands in Kazakhstan

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BACIS CROP REGION of KAZAKHSTAN

Kostanayskaya ~ 4700 thousand ha
Severo-Kazakhstanskaya ~ 4100 thousand ha
Pavlodarskaya ~ 1000 thousand ha
Akmolinskaya ~ 4500 thousand ha
Karagandinskaya ~ 970 thousand ha

Part in total area of Kazakhstan
Part of total sown areas of the Republic of Kazakhstan
Croplands of Northern Kazakhstan
Space images of crop lands

RADARSAT-1

IRS (23 m)

NOAA (1000 m)

MODIS (250 m)
Main goal of space monitoring of Northern Kazakhstan crop regions is *yield forecast* which depends from next factors:

*Quantity of soil moisture after snow melting,*

*Planting dates,*

*Weather conditions during vegetation season,*

*Sanitarian states of crop fields,*

*Timely harvesting.*

At present time all these parameters are controlled by remote sensing and ground data.
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Spring soil moisture map
Snow cover space monitoring
Depths of spring soil drenching on crop fields in Akmola oblast

Глубины весеннего промачивания почв под зерновыми культурами в Акмолинской области
Dependence of vegetation index WDVI on crop fields (EOS MODIS, 25 July 2006) from depths of spring soil drenching

Weighted Difference Vegetation Index:

\[ WDVI = Ch2 - K \times Ch1, \]

where \( K \) – relation of soil reflectance \( Ch2/ Ch1 \).
Summary results of snow cover melt process in 2009.

Multiyear earliest and latest snow melt time

70 - depths of spring soil drenching (cm)
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Relation between sowing dates and final yield

(Akmola oblast)
Examples of different phase of growth of spring wheat in the end of June
Calibration curve of MODIS band 2 reflectance (June 19, 2003) and test fields sowing dates

MODIS Band 2 reflectance

$y = -0.0045x + 0.2829$

$R^2 = 0.8351$
Map of planting dates for Akmola oblast
Planting dynamic in 2004

Areas (thousands ha)

- Akmola oblast
- Kostanai oblast

Dates:
- 28 April
- 3 May
- 8 May
- 13 May
- 18 May
- 23 May
- 28 May
- 2 June
- 7 June
- 12 June
Наземные данные х-во «Сарыагаш»

Результаты анализа спутниковой и наземной информации по срокам сева на территории действующих полигонов Северного Казахстана. Точность распознавания сроков сева составила 87%
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Agroclimatic zoning on the base of hydrothermal coefficient $\Gamma_{TK} = \frac{\sum R}{\sum t}/10$

$R$ - precipitation, $t$ - temperature

Seasonal NDVI for crop fields of Kostanai oblast
Distribution of Vegetation biomass in Kostanai oblast

Распределения зон с различной продуктивностью растительности по территории Костанайской области
Crop condition in 2008 (Akmola oblast)
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Different Degrees of Weed Infestation
Relative biomass for each field dynamics, July - August, 2002
Yield Response to Weed Infestation
2002 Crop Season

![Graph showing the relationship between weeds percentage and yield (T/H) x 10. The graph indicates a decrease in yield as the weeds percentage increases.]
Crop-fallow structure in Akmola oblast

In Northern Kazakhstan weed population is primarily controlled by maintaining about 20% of the fields as fallow.
An algorithm was developed to relate the degree of weed infestation to the proportion of fallow land in the region.
GROUND SURVEY
TEST POLYGONS for SPACE MONITORING

Сеть подспутниковых полигонов для задач космического мониторинга

DATA COLLECTION on TEST POLYGONS

Программа работ на подспутниковых полигонах Северного Казахстана включала сбор следующих данных:

- сроки и виды проведения сельскохозяйственных работ;
- метеорологические наблюдения;
- характеристика водно-физических свойств почв;
- наблюдения за ростом и развитием яровой пшеницы;
- информация по севооборотам и продуктивности посевов;
- параметры качества зерна.
ROUTE OBSERVATION on the TERRITORIES between TEST POLYGONS

Маршрутные обследования в районах подспутниковых полигонов в 2008 г.

- test polygons
Problem - selection fields with clear homogeneous crop
Selection of fields used first time after fallowing
Calibration of satellite data for crop yield forecast

Калибровка ДДЗ для определения продуктивности зерновых культур

урожайность

\[ y = 73.064x - 0.1374 \]

\[ R^2 = 0.6869 \]

УСЛОВНЫЕ ОБОЗНАЧЕНИЯ

прогнозная урожайность (ц/га)

- менее 7
- 7 - 9
- 9 - 11
- 11 - 13
- 13 - 15
- 15 - 17
- 17 - 19
- 19 - 21
- свыше 21
- не определено

КАРТА прогнозной урожайности яровой пшеницы в Северном Казахстане на 10 августа 2008 года
Прогнозная карта урожая зерна Акмолинской, Северо-Казахстанской и Костанайской областей
Результаты анализа спутниковой и наземной информации по урожайности на территории действующих полигонов Северного Казахстана

Разница в урожайности полей:
- Хозяйство "Зеленый гай": 0,3 ц/га (2%)
- Хозяйство "Новокубанка": 0,4 ц/га (6%)

Ошибки прогноза:
- Хозяйство "Зеленый гай": 18,9 ц/га
- Хозяйство "Новокубанка": 19,2 ц/га
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Verification of harvest time on the base of ground information

Анализ спутниковой и наземной информации по срокам уборки на территории действующих полигонов Северного Казахстана

Точность распознавания убранных площадей к сроку 14.09.08 составила 94%
FUTURE PLANS
Space monitoring of Kazakhstan south oblasts
Application of hyperspectral remote data for crop condition estimation

Сезонные гиперспектральные измерения участка 7
(пшеница озимая: 11 мая-колошение, 26 мая- цветение, 13 июня-молочно-восковой спелости, 13 июля-скошено)
Seasonal ground surveys of vegetation on the territory of Kazakhstan for land cover change detection
THANK YOU