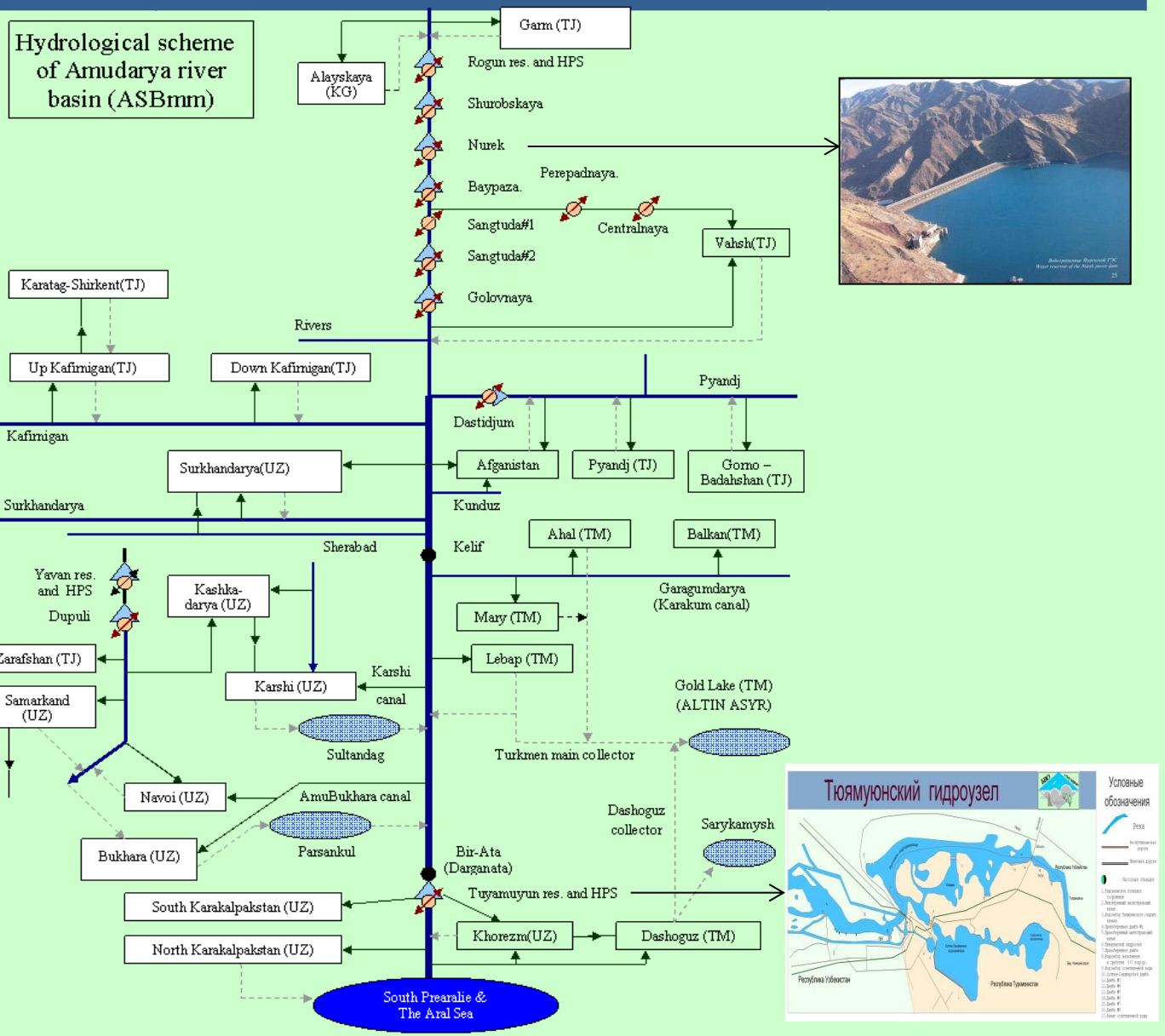
Transboundary water management in the Amudarya adaptation to climate change uncertainties (PEER project)

Scientific-Information Center of ICWC
Anatoly Sorokin, 2017, April, 3

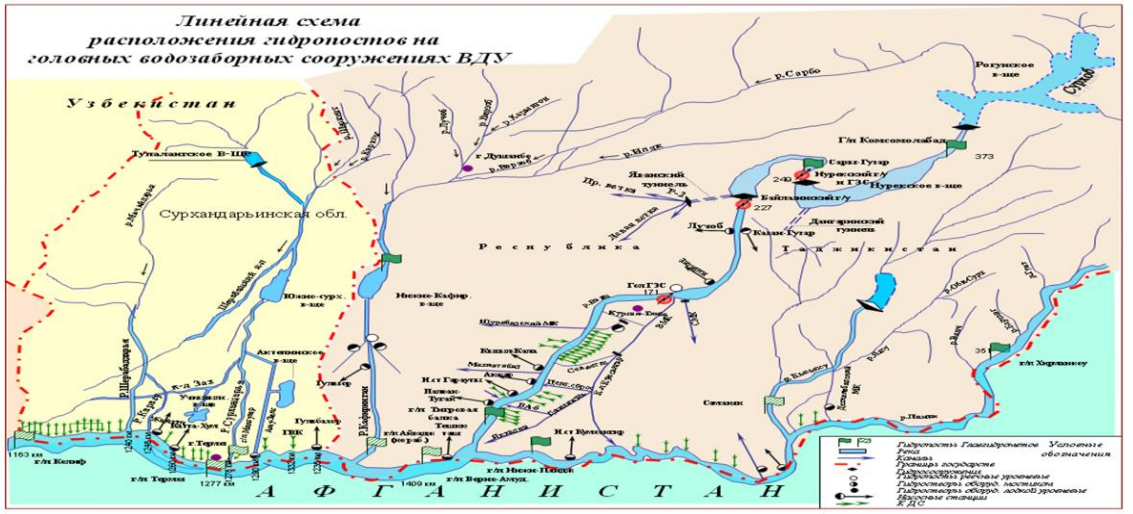
An overall goal of the PEER Project is to build adaptive capacity of the countries sharing the Amudarya basin to manage effectively their transboundary waters under climate change (CC) & other uncertainties.

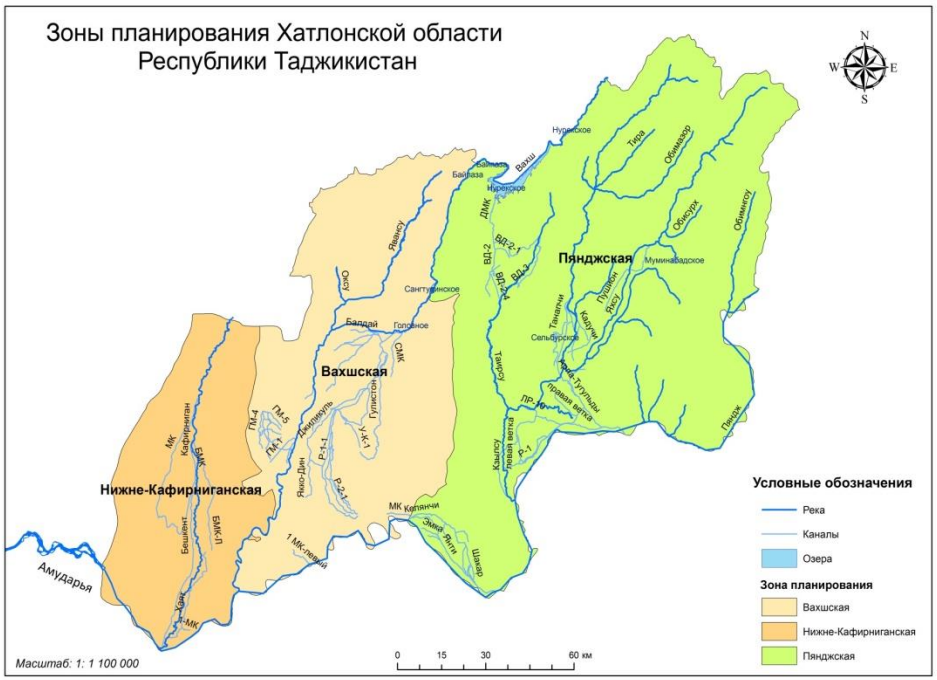
This goal is to be achieved by studying in a holistic manner transboundary water management (TWM) issues in the Amudarya basin for the long run under conditions of climatic & other changes along with national plans on irrigated agriculture & hydropower development.

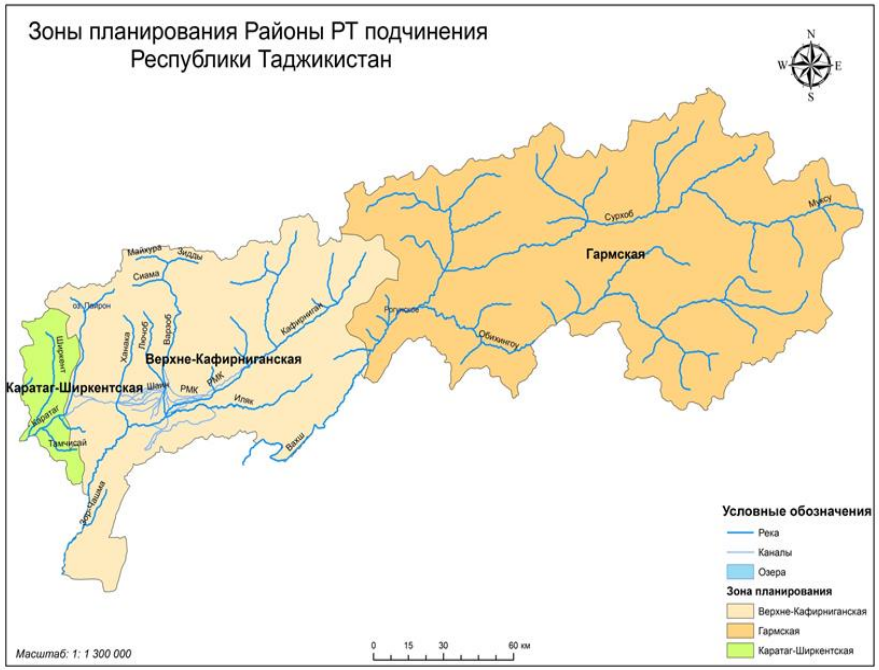
Research objects are river network, large canals and collectors, lakes, reservoirs, HEPS, and planning zones (provinces) of the riparian countries in the Amudarya basin



Upper reaches of the Amudarya River Basin: Tajikistan planning zones

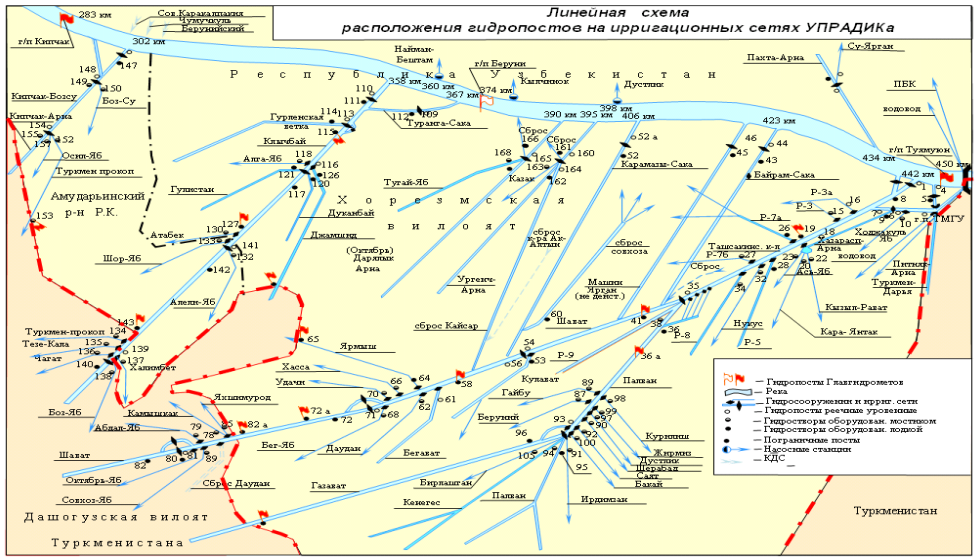






Middle reaches of the Amudarya River Basin: Uzbekistan and Turkmenistan planning zones

Lower reaches of the Amudarya River Basin: Uzbekistan and Turkmenistan planning zones



Main tasks :

- Assess possible changes in the hydrologic regime of Amudarya Basin rivers & future crop water requirements due to climate change
- Study scenarios of long-term flow regulation by a system of large hydropower reservoirs on the hydrology of rivers, available water supply for irrigated lands and for sustaining aquatic ecosystems in the basin

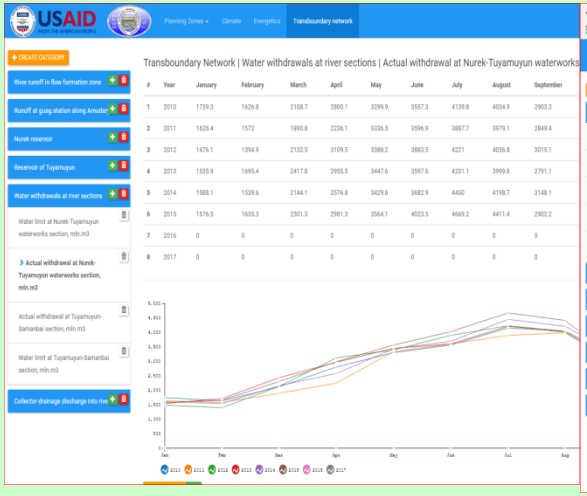
Main tasks:

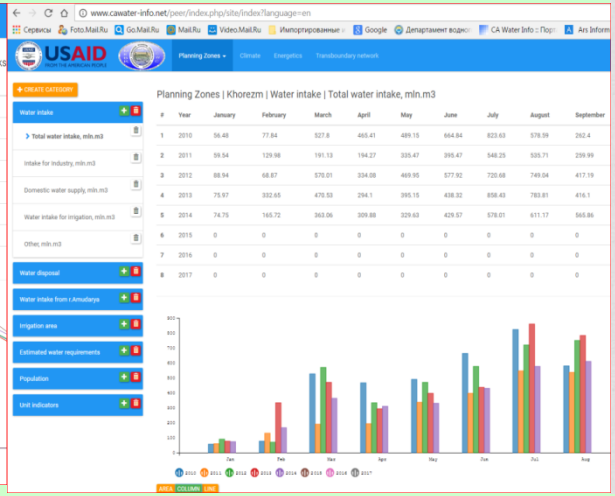
- Evaluate future crop water requirements for irrigated lands of the riparian countries under an array of future climate change & river flow regulation
- Elaborate possible tradeoff between national priorities & requirements at the basin level inter alia on the basis of legal analysis of transboundary water management in Amudarya basin

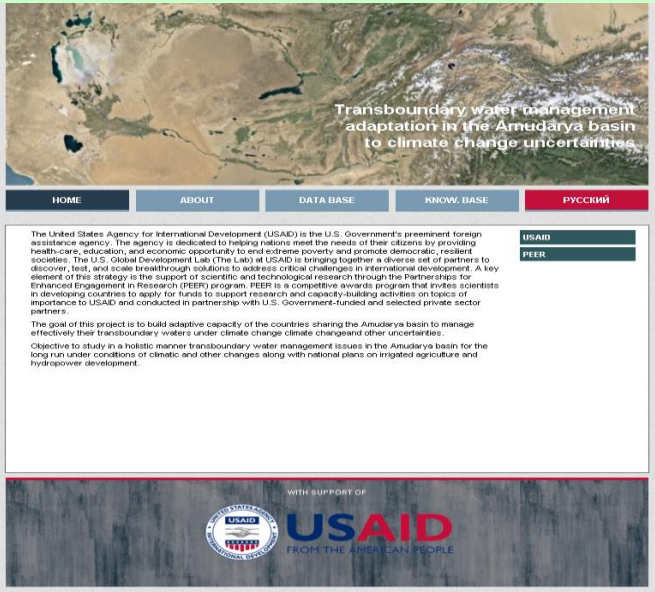
Information resource

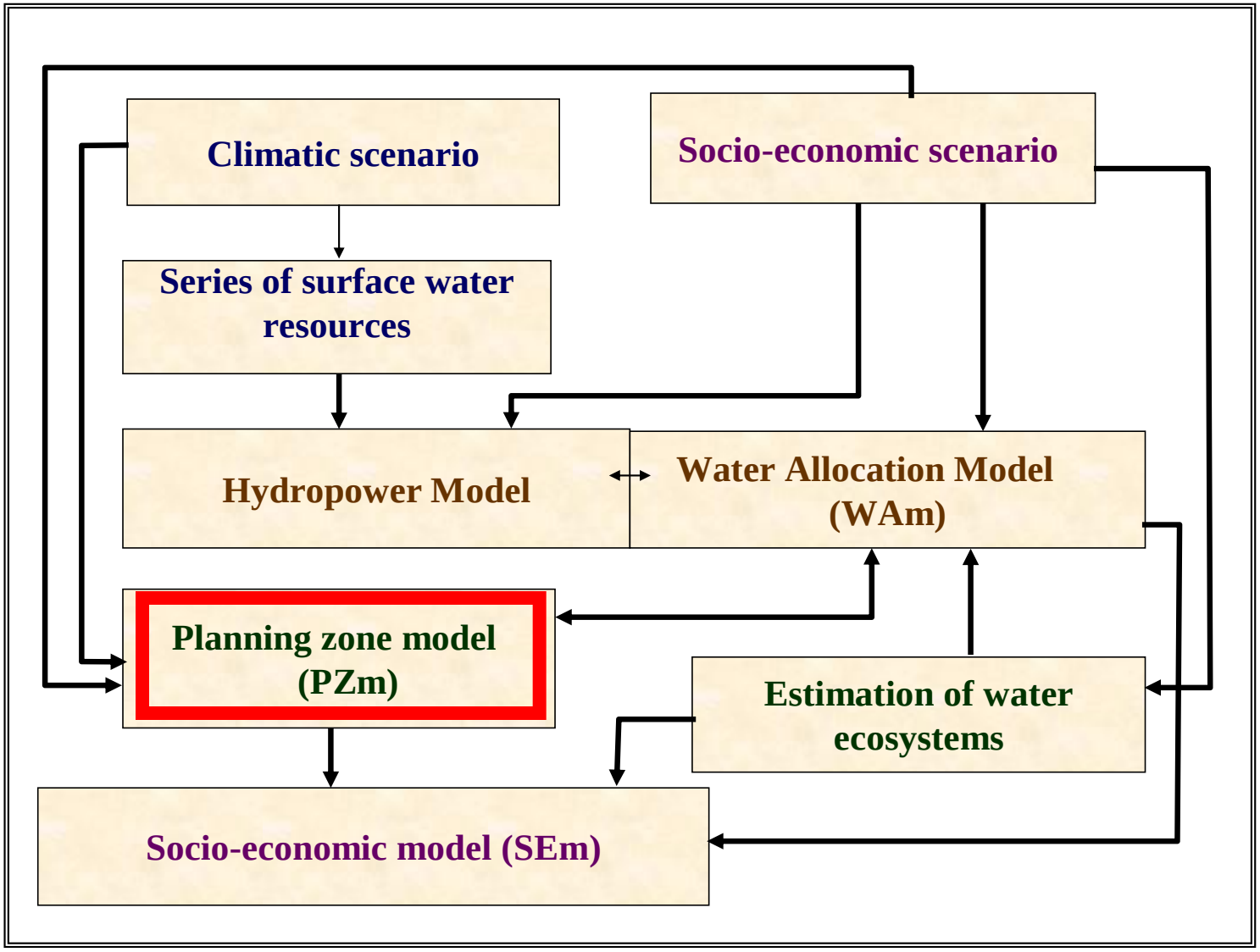
- The project PEER created **Database** and interface to **water indicators** in the context of Planning Zones, rivers, HPPs. **http://cawater-info.net/peer/**
- Project **Web-site.** **http://cawater-info.net/projects/peer-amudarya/**

Information resource located on the SIC ICWC servers and available in the internet: **http://cawater-info.net**









Planning Zone model is one of the PEER research tool

ASBmm

Login to the Interface
Registration

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ASBmm – integrated model for assessment of aral sea basin development scenarios.

Water sector, ecology, hydropower, agriculture, climate change, socio-economic assessment, new technologies in computer modeling and forecasting.

- If you are a journalist, student or a novice in hydrology, hydraulic engineering or energy who wants to know about characteristics, problems and prospects of development in the Aral Sea basin, please, focus attention on ASBmm.
- If you are a professional in the water sector area and water and energy resources management who is interested to know about alternative water sector development scenarios in riparian countries of the Aral Sea basin, with consideration of socio-economic, environmental, energy and climatic factors, optimization and trade-off solutions, please, focus attention on ASBmm.

This is a unique product in terms of wide coverage of water-related processes and tendencies in the Central Asian countries.

Authorization
With the authorization system you can always continue your work from your last action made .

Navigation system
Step-by-step navigation simplifies the calculation process and helps you to avoid "getting lost" in your projects .

Long-term forecasts
The forecasting system produces results up to 2035.

See also

28 february 2011
Regional training workshop →

1 november 2010
Round-table on ASBmm →

ASBmm

Здравствуйте, **ilhom**
Выйти

Выбор стратегии пользователя (Справка)

Рус / Eng

ПУТЕВОДИТЕЛЬ ПО СИСТЕМЕ

ВОЙТИ → ОТКРЫТЬ → ПОЛЬЗ. СЦЕНАРИЙ → ЗАПУСТИТЬ → ОБЪЕКТЫ → СРАВНИТЬ → ПРОСМОТРЕТЬ
СОЗДАТЬ → НАСТРОЙКА → ЭКСПЕРТНЫЙ СЦЕН. → ОЦЕНИТЬ → ИНТЕГРИРОВАННАЯ → ВЫЙТИ

« ШАГ НАЗАД

Информация о проекте

Название: ferg_lim
Задача 3: Оценка водообеспеченности..
Бассейн: Бассейн Сырдарьи
Зона планирования: Ферганская
Влияние климата: Без изменения
Водность рек 2010-2035: По сущ. циклу
Развития: пользовательский

Отчеты

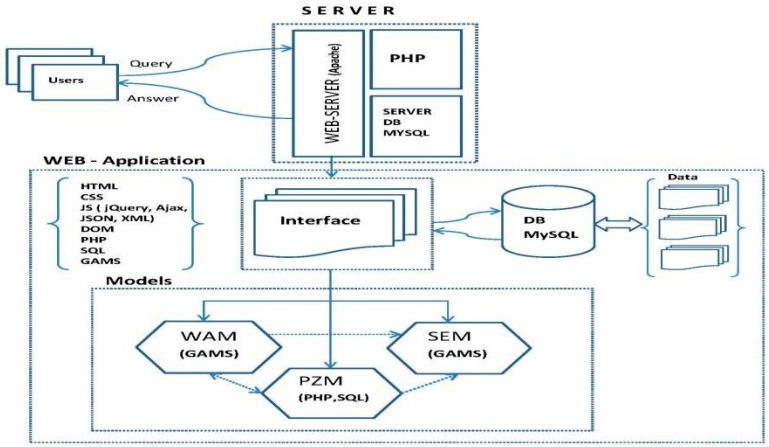
У вас еще нет отчетов.

Управление отчетами »

ВЫБОР БАССЕЙНА / ЗОНЫ ПЛАНИРОВАНИЯ	СЦЕНАРИИ		
	ВЛИЯНИЕ КЛИМАТА	ВОДНОСТЬ РЕК 2010-2035	РАЗВИТИЯ
Бассейн Амударьи? ○	Минимальный ○	Маловодная ○	Сохр.сущ.тенденций ○
Бассейн Сырдарьи? ●	Без изменения ●	Ср. водности ○	Нац. видение ○
	Максимальный ○	Многоводная ○	Региональный ○
Ферганская		По сущ. циклу ●	Пользовательский ●

Настройка пользовательского сценария

Structured – functional scheme of model ASBMM



ASBmm

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Выйти

Детальные результаты (по объектам)

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ПУТЕВОДИТЕЛЬ ПО СИСТЕМЕ

ВОЙТИ → ОТКРЫТЬ → ПОЛЬЗ. СЦЕНАРИЙ → ЗАПУСТИТЬ → ОБЪЕКТЫ → СРАВНИТЬ → ПРОСМОТРЕТЬ
СОЗДАТЬ → НАСТРОЙКА → ЭКСПЕРТНЫЙ СЦЕН. → ОЦЕНИТЬ → ИНТЕГРИРОВАННАЯ → ВЫЙТИ

« ШАГ НАЗАД

Информация о проекте

Название: reg_am_test
Задача 1: Оценка регулирования сток..
Бассейн: Бассейн Амударьи
Влияние климата: Без изменения
Водность рек 2010-2035: По сущ. циклу
Развития: пользовательский

Выбрать год:
2015 год | 2020 год | 2025 год | 2030 год | 2035 год

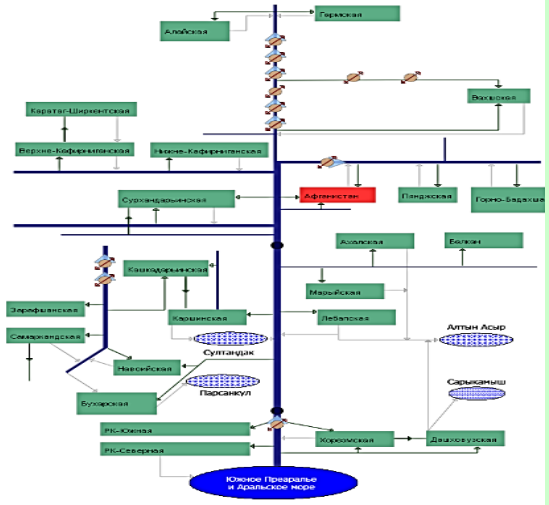
2016 год

Результаты объекта

Режим работы ГЭС: Выберите
Водохранилища: Выберите
Подача воды в ЗП: Выберите
Водный баланс рек: Выберите

Легенда

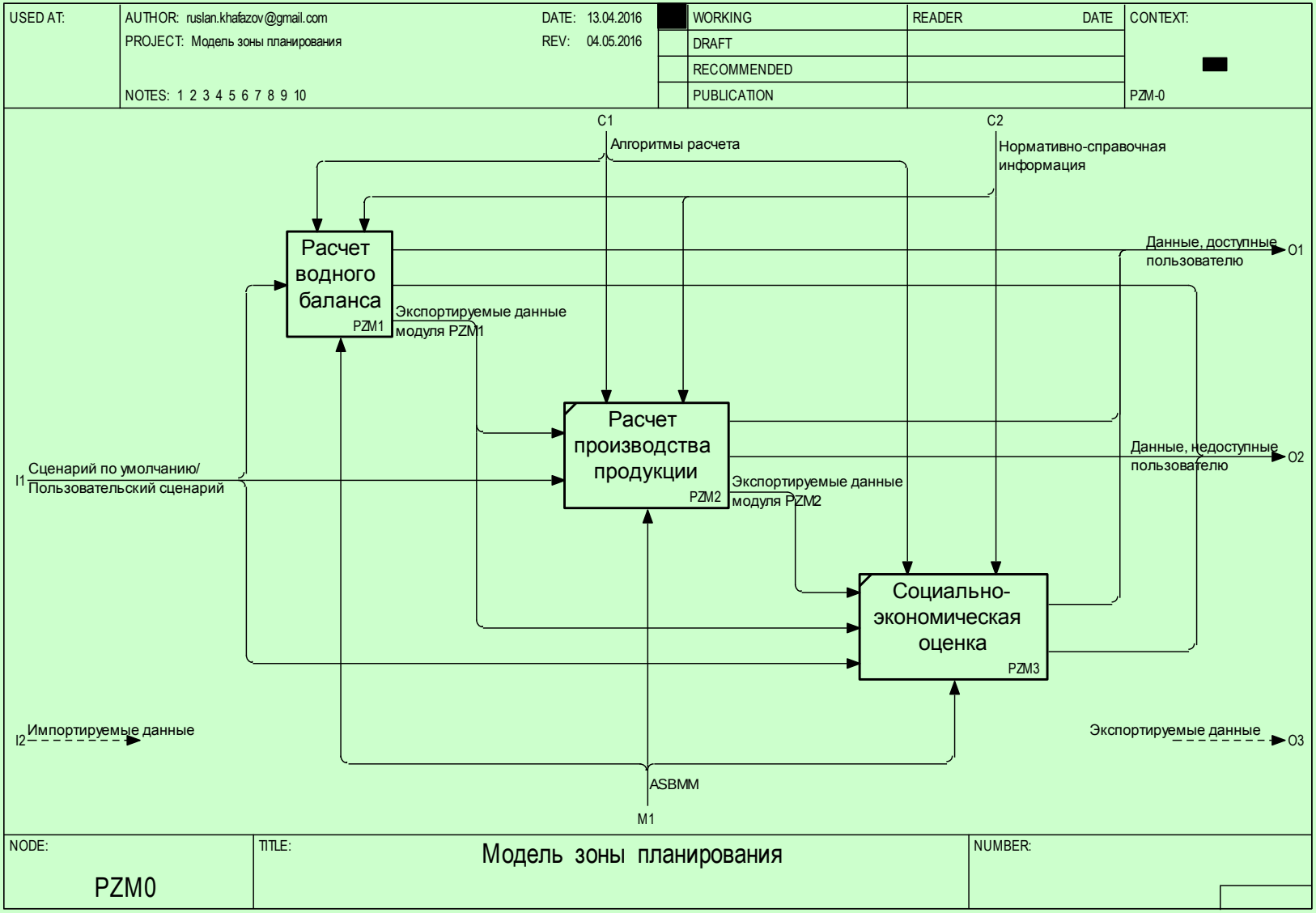
Rivers
Reservoirs(res)
HPS
Lakes
Planning zone (PZ)
PZ: water availability > 75%
PZ: water availability 50-75%
PZ: water availability < 50%
Gauging stations
Intakes
Transfers
Returns, Outflow



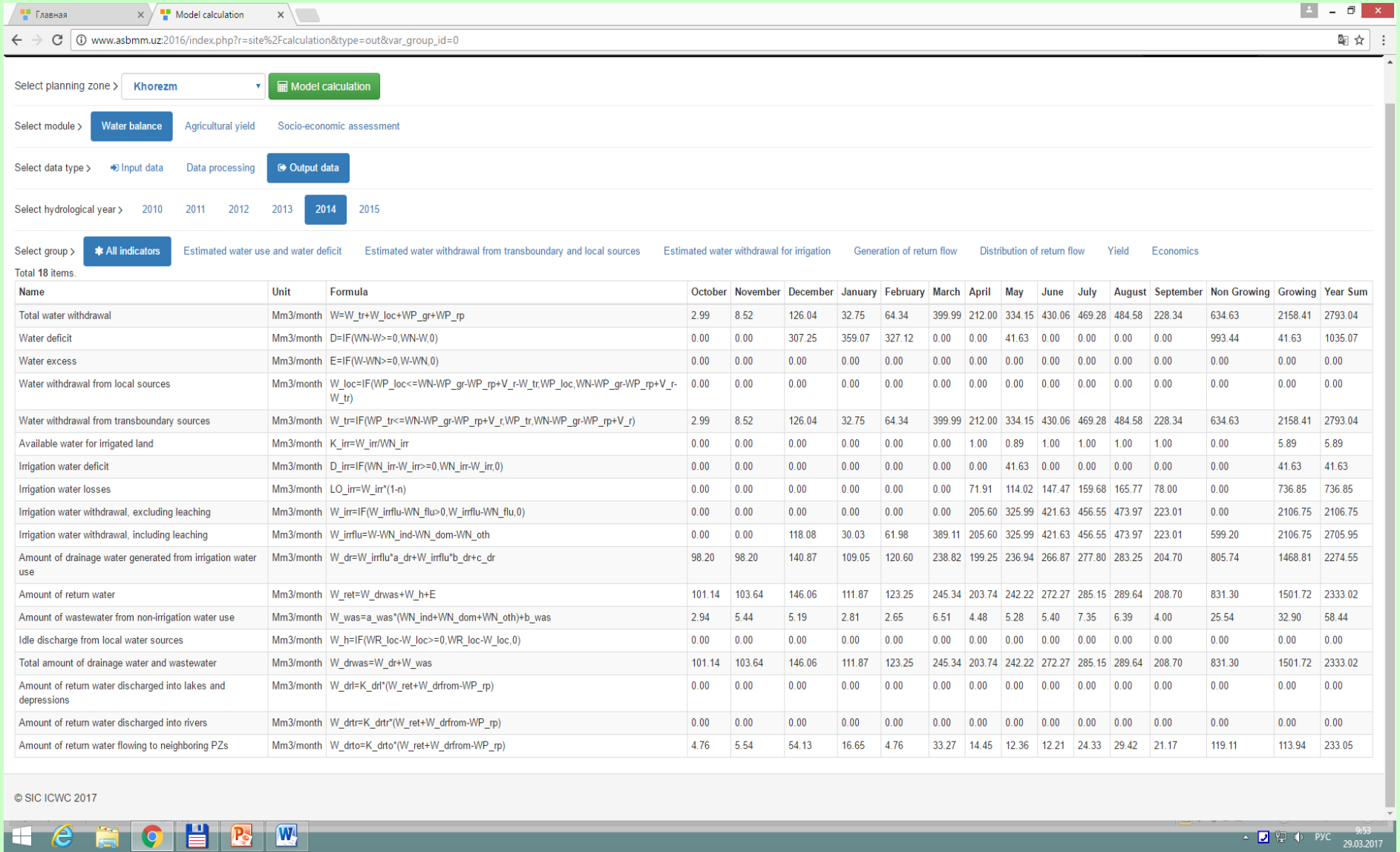
The basis of modeling:

- The General Algebraic Modeling System (GAMS), USA,was approved as the basis for modeling of optimization processes under the PEER Project
- Integrated DEFinition method (IDEF), was created as part of the USA program ICAM (Integrated Computer Aided Manufacturing); applied standards: Function Modeling (IDEF0), Information Modeling (IDEF 1)

Decomposition diagram for Planning Zone model (PZm)



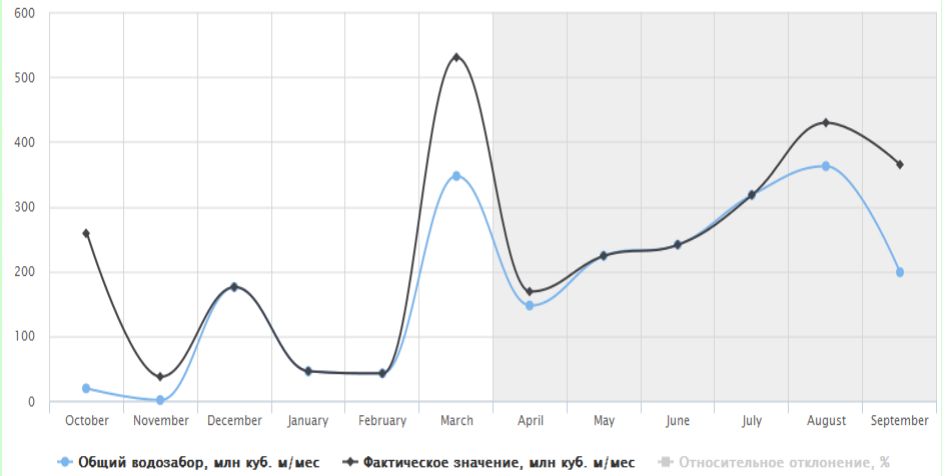
PZm Interface: output data, Water balance indicators, 2014



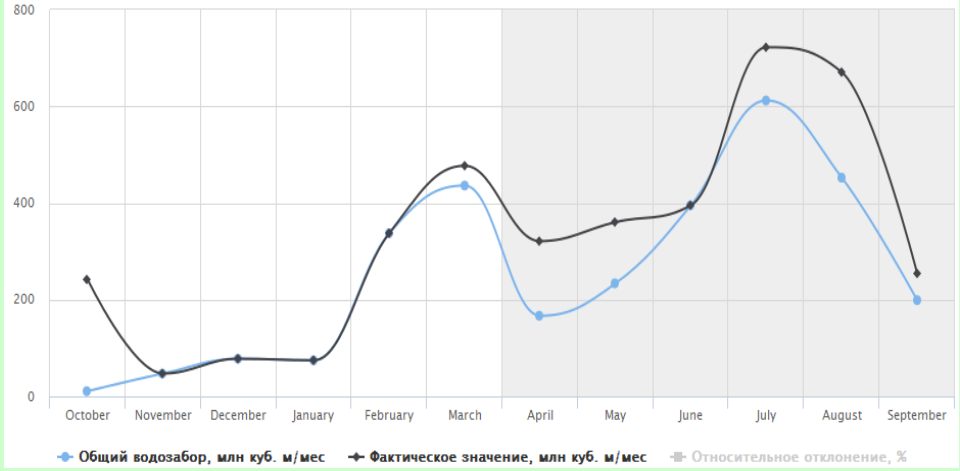
Name	Unit	Formula	October	November	December	January	February	March	April	May	June	July	August	September	Non Growing	Growing	Year Sum
Total water withdrawal	Mm3/month	W=W_tr+W_loc+WP_gr+WP_rp	2.99	8.52	126.04	32.75	64.34	399.99	212.00	334.15	430.06	469.28	484.58	228.34	634.63	2158.41	2793.04
Water deficit	Mm3/month	D=IF(WN-W>=0,WN-W,0)	0.00	0.00	307.25	359.07	327.12	0.00	0.00	41.63	0.00	0.00	0.00	0.00	993.44	41.63	1035.07
Water excess	Mm3/month	E=IF(W-WN>=0,W-WN,0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water withdrawal from local sources	Mm3/month	W_loc=IF(WP_loc<=WN-WP_gr-WP_rp+V_r-W_tr,WP_loc,WN-WP_gr-WP_rp+V_r-W_tr)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water withdrawal from transboundary sources	Mm3/month	W_tr=IF(WP_tr<=WN-WP_gr-WP_rp+V_r,WP_tr,WN-WP_gr-WP_rp+V_r)	2.99	8.52	126.04	32.75	64.34	399.99	212.00	334.15	430.06	469.28	484.58	228.34	634.63	2158.41	2793.04
Available water for irrigated land	Mm3/month	K_irr=W_irr/WN_irr	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.89	1.00	1.00	1.00	1.00	0.00	5.89	5.89
Irrigation water deficit	Mm3/month	D_irr=IF(WN_irr-W_irr>=0,WN_irr-W_irr,0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.63	0.00	0.00	0.00	0.00	0.00	41.63	41.63
Irrigation water losses	Mm3/month	LO_irr=W_irr*(1-n)	0.00	0.00	0.00	0.00	0.00	0.00	71.91	114.02	147.47	159.68	165.77	78.00	0.00	736.85	736.85
Irrigation water withdrawal, excluding leaching	Mm3/month	W_irr=IF(W_irrflu-WN_flu>0,W_irrflu-WN_flu,0)	0.00	0.00	0.00	0.00	0.00	0.00	205.60	325.99	421.63	456.55	473.97	223.01	0.00	2106.75	2106.75
Irrigation water withdrawal, including leaching	Mm3/month	W_irrflu=W-WN_ind-WN_dom-WN_oth	0.00	0.00	118.08	30.03	61.98	389.11	205.60	325.99	421.63	456.55	473.97	223.01	599.20	2106.75	2705.95
Amount of drainage water generated from irrigation water use	Mm3/month	W_dr=W_irrflu*a_dr+W_irrflu*b_dr+c_dr	98.20	98.20	140.87	109.05	120.60	238.82	199.25	236.94	266.87	277.80	283.25	204.70	805.74	1468.81	2274.55
Amount of return water	Mm3/month	W_ret=W_drwas+W_h+E	101.14	103.64	146.06	111.87	123.25	245.34	203.74	242.22	272.27	285.15	289.64	208.70	831.30	1501.72	2333.02
Amount of wastewater from non-irrigation water use	Mm3/month	W_was=a_was*(WN_ind+WN_dom+WN_oth)+b_was	2.94	5.44	5.19	2.81	2.65	6.51	4.48	5.28	5.40	7.35	6.39	4.00	25.54	32.90	58.44
Idle discharge from local water sources	Mm3/month	W_h=IF(WR_loc-W_loc>=0,WR_loc-W_loc,0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total amount of drainage water and wastewater	Mm3/month	W_drwas=W_dr+W_was	101.14	103.64	146.06	111.87	123.25	245.34	203.74	242.22	272.27	285.15	289.64	208.70	831.30	1501.72	2333.02
Amount of return water discharged into lakes and depressions	Mm3/month	W_drl=K_drl*(W_ret+W_drfrom-WP_rp)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Amount of return water discharged into rivers	Mm3/month	W_drtr=K_drtr*(W_ret+W_drfrom-WP_rp)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Amount of return water flowing to neighboring PZs	Mm3/month	W_drto=K_drto*(W_ret+W_drfrom-WP_rp)	4.76	5.54	54.13	16.65	4.76	33.27	14.45	12.36	12.21	24.33	29.42	21.17	119.11	113.94	233.05

Test result. Khorezm PZ, 2011, 2013 y, Water consumption (mln.m3). Comparison of actual data with calculated data.

Коэффициент корреляции		$r_{XY} = \frac{cov_{XY}}{\sigma_X \sigma_Y} = \frac{\sum(X-\bar{X})(Y-\bar{Y})}{\sqrt{\sum(X-\bar{X})^2}\sqrt{\sum(Y-\bar{Y})^2}}$.	0.83
Коэффициент детерминации		$R^2=(r_{XY})^2$.	0.69



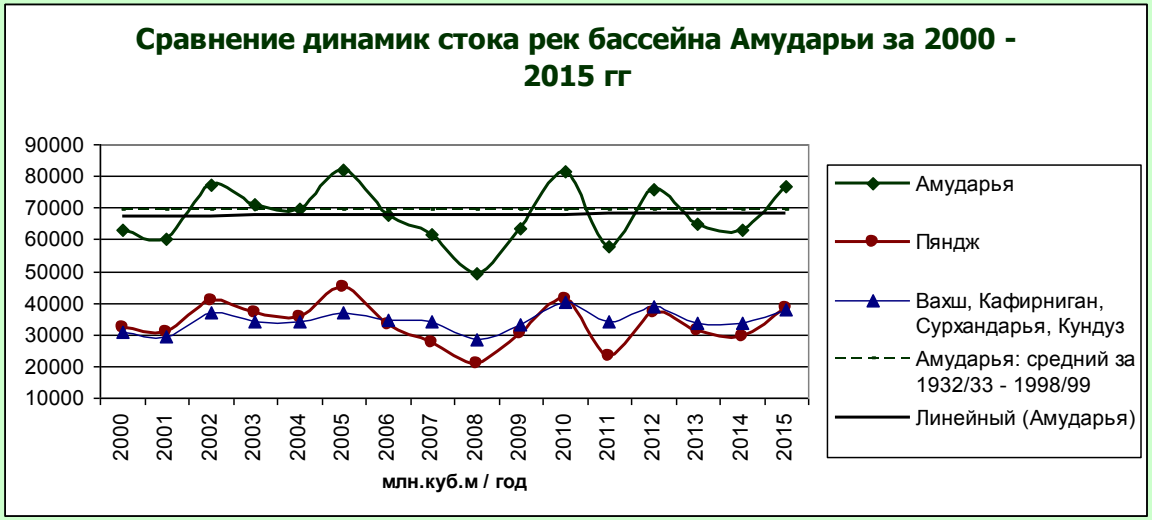
Коэффициент корреляции		$r_{XY} = \frac{cov_{XY}}{\sigma_X \sigma_Y} = \frac{\sum(X-\bar{X})(Y-\bar{Y})}{\sqrt{\sum(X-\bar{X})^2}\sqrt{\sum(Y-\bar{Y})^2}}$.	0.92
Коэффициент детерминации		$R^2=(r_{XY})^2$.	0.84

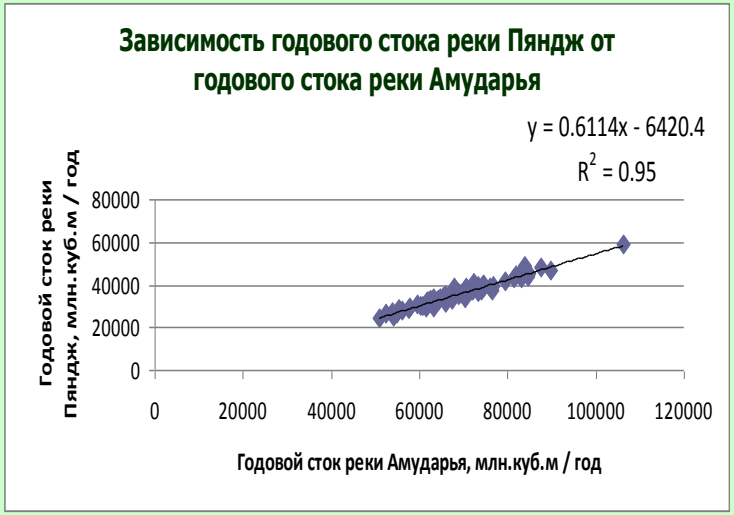


Scenarios

1. Climate change by 2050 and its impact on:
   - river flow regime
   - crop water requirements (water demand)
2. Socio-economic (scenarios of country development by 2050)
   - Agriculture (BAU, food security, export oriented)
   - Industry, municipal sector (BAU)
3. Distribution of crops by PZ according to national agricultural development scenarios by 2050, optimization
4. River flow regulation by reservoirs and HEPS by 2050:
   - energy-generation operation regime,
   - energy-irrigation operation regime.

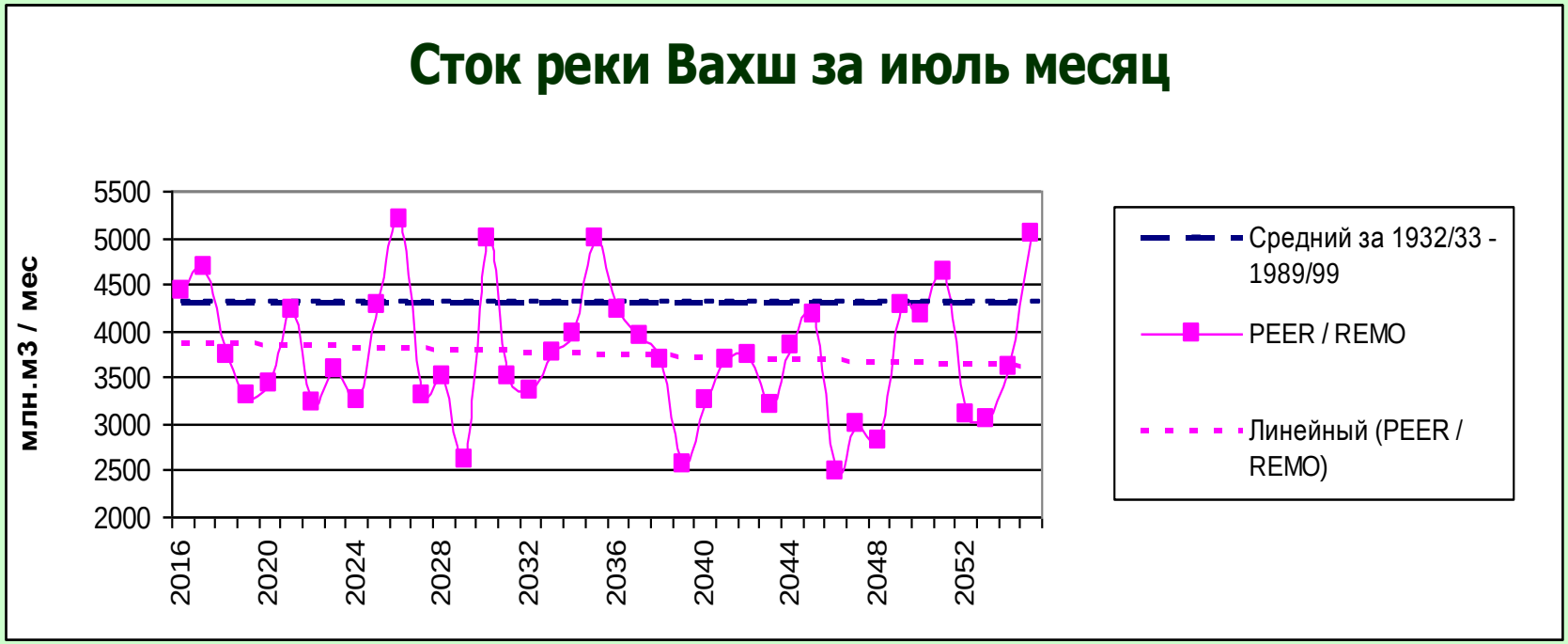
Reconstruction and analysis of river flow series in the Amudarya River Basin, Mm³ : PEER / ASBmm

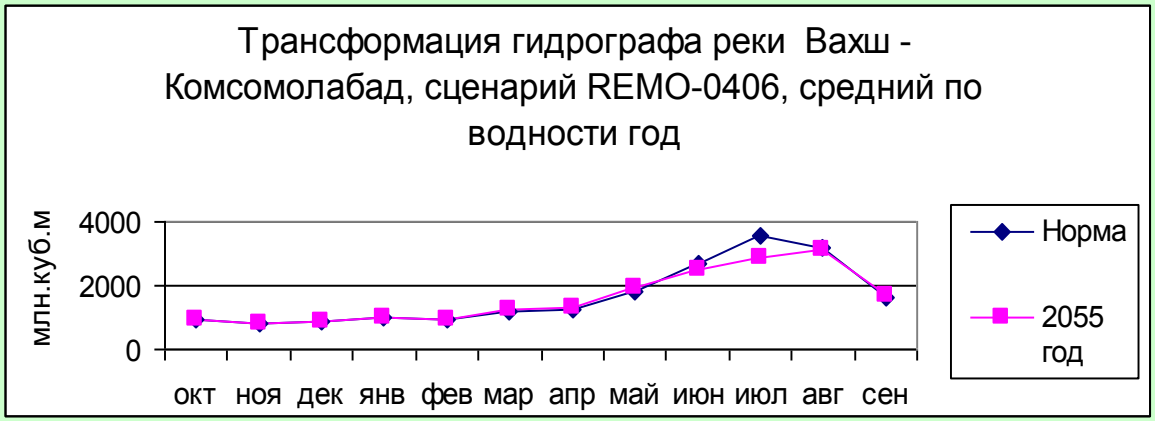




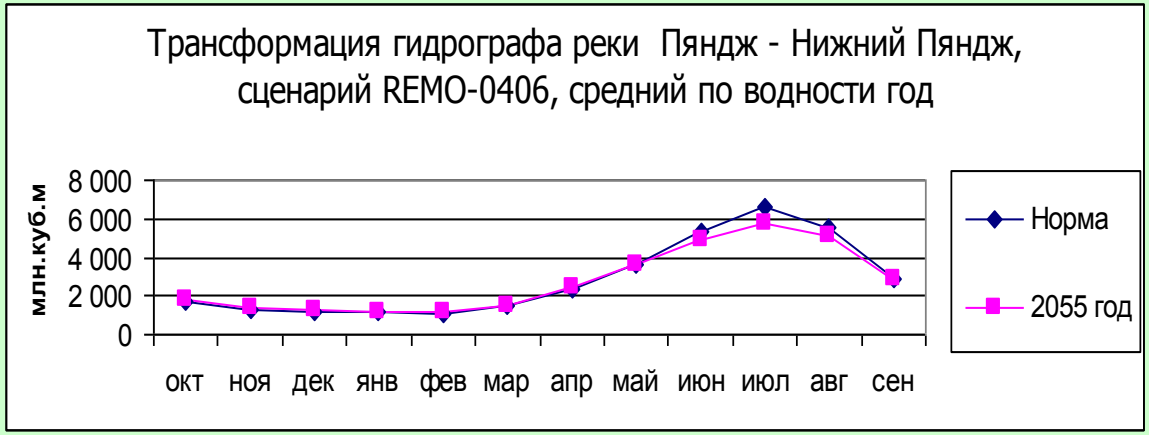
Assessment of climate change effect on river flow and plotting of river stream flow hydrographs for the Amudarya basin for 2016—2055: PEER / ASBmm / REMO 0406

Runoff of the Vakhsh River in July:
downward trend, comparison with average long-term value (1932-1999)

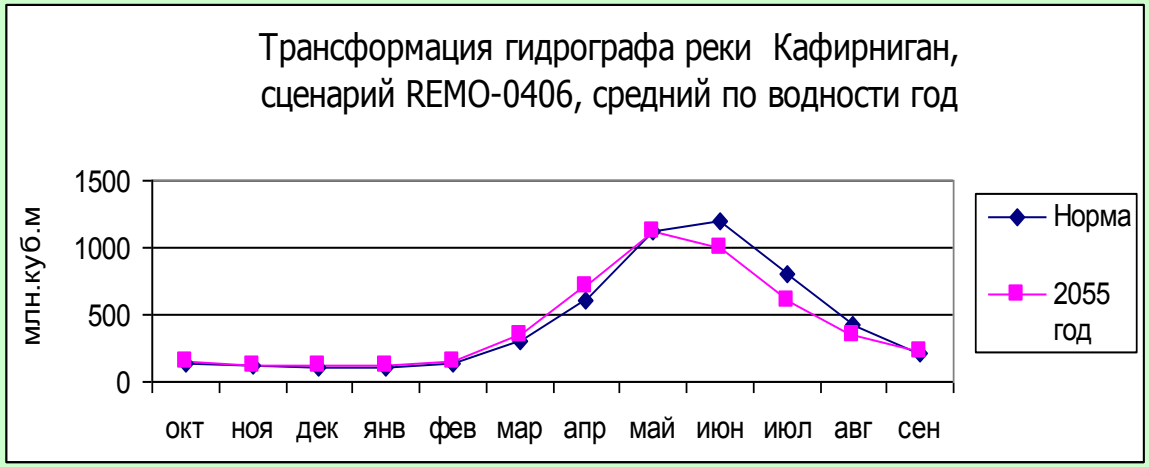




Transformation of Vakhsh river hydrograph for average flow conditions, 2055, comparisison with average long-term value, REMO-0406

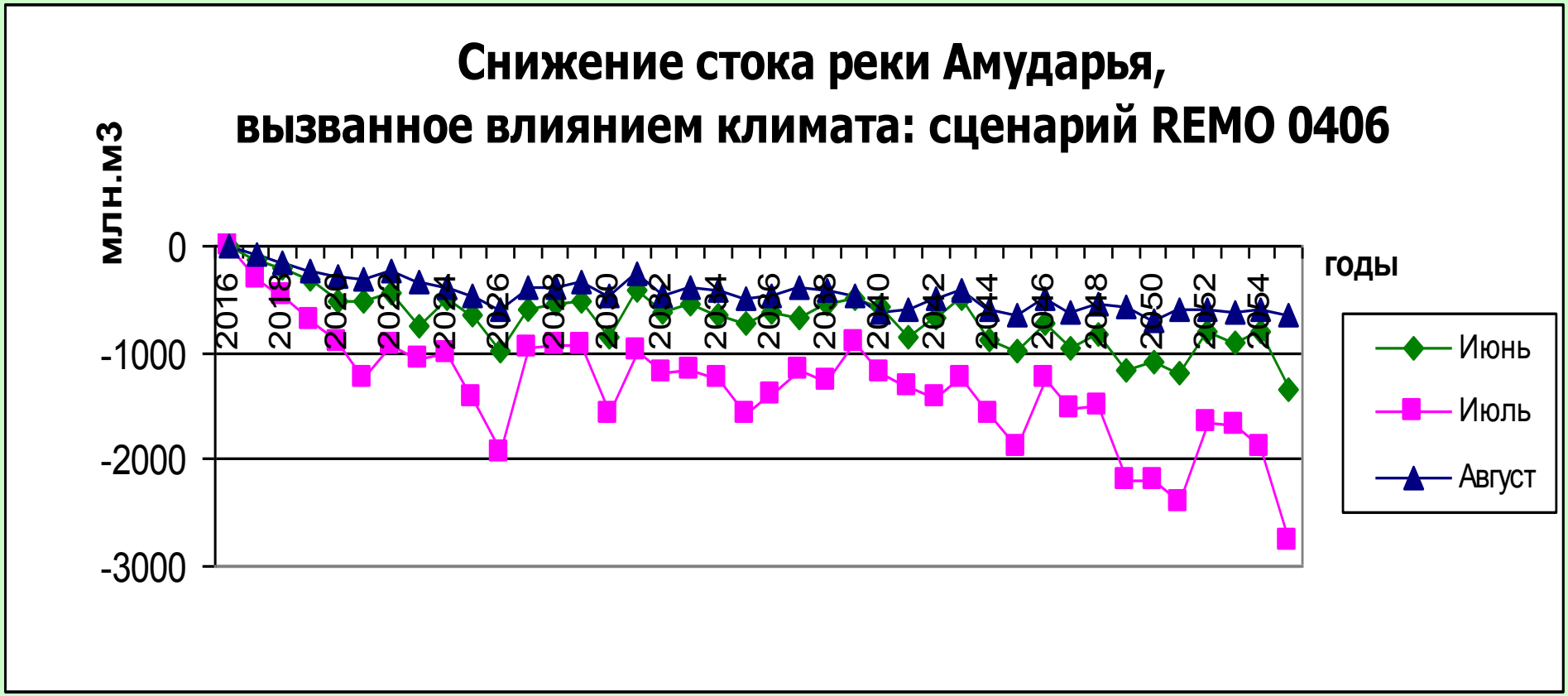


Transformation of Pyanj river hydrograph

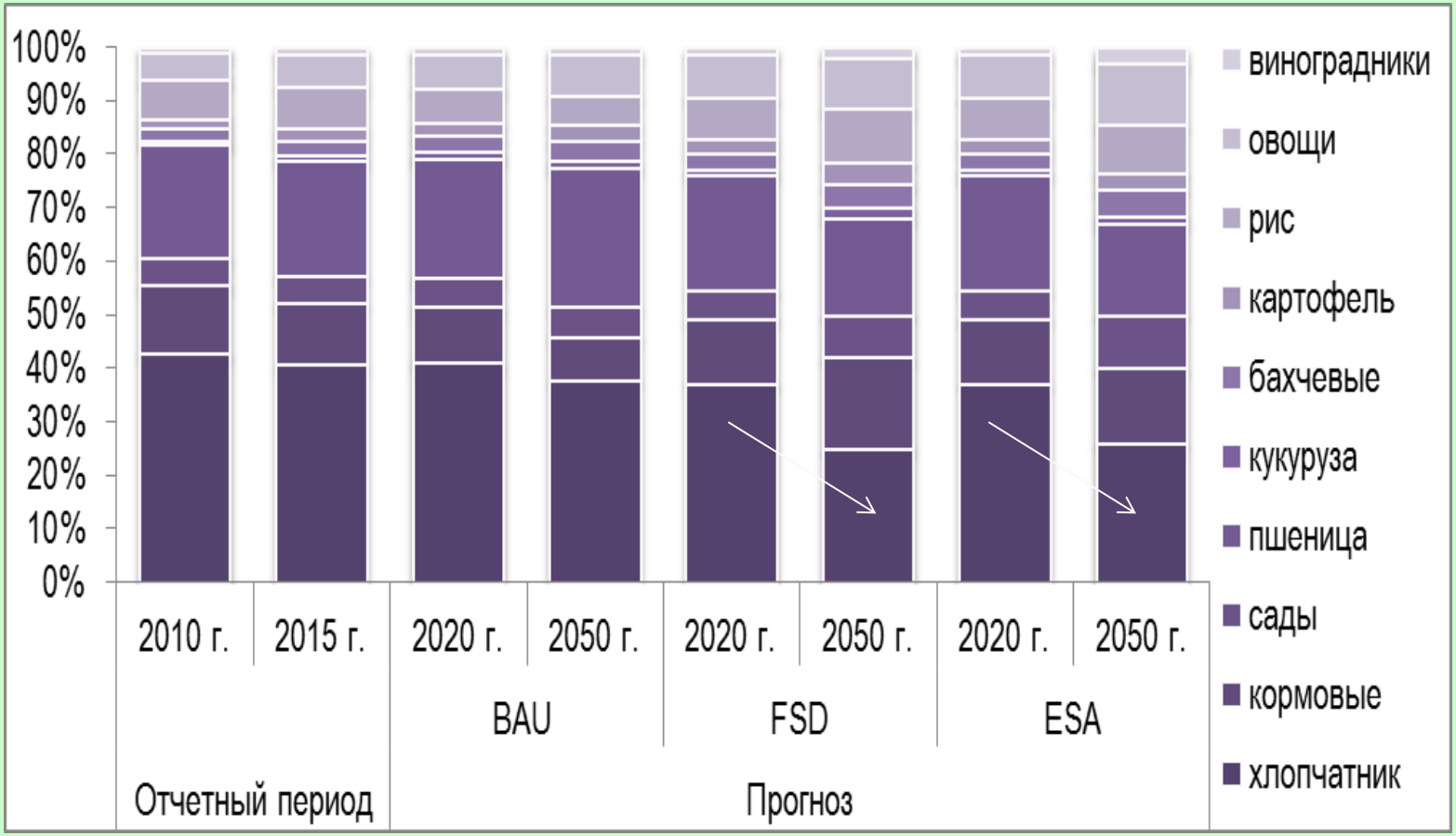


Transformation of Kafirnigan river hydrograph

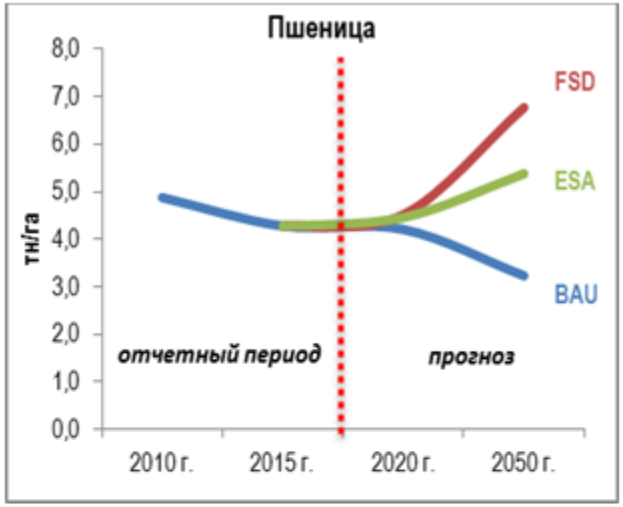
Decrease in Amudarya River runoff because of climate change for June, July, August, 2016-2055 - PEER / REMO

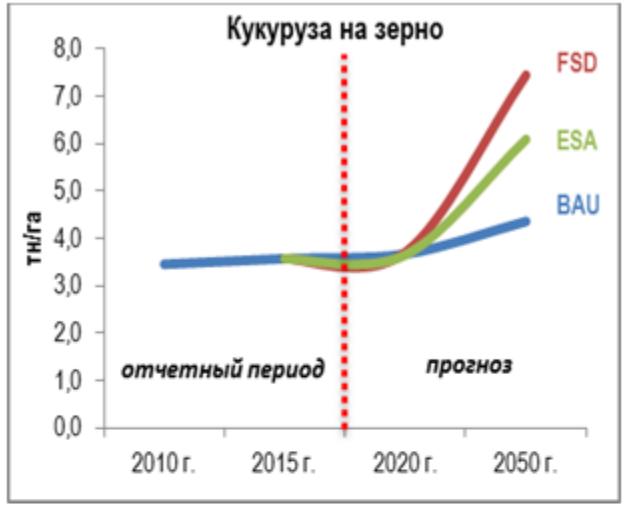


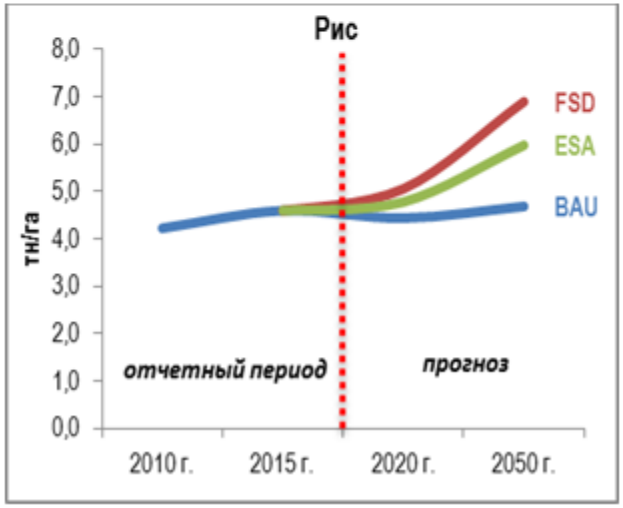
Forecast of change in crop land areas in the Khorezm planning zone by 2050

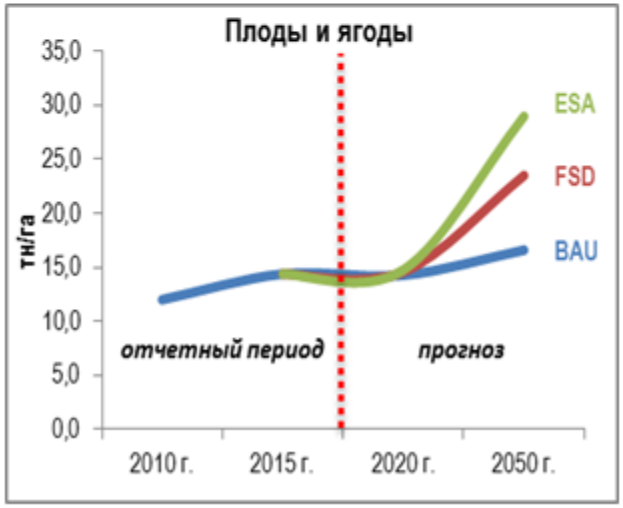


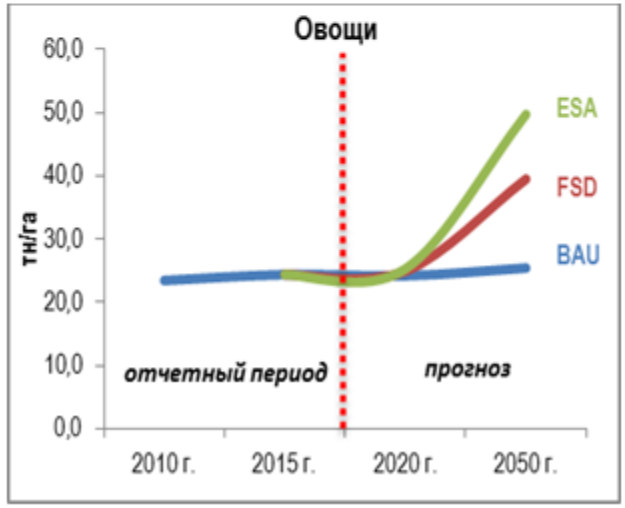
Forecast of changes in main crop yields in the Khorezm planning zone by 2050











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THANK YOU FOR ATTENTION