RIVERTWIN

Agricultural water consumption module

Akkurgan
Akhangaran
Bostanlyk
Buka
Zangiata
Kibray
Kuyichirchik
Parkent
Pskent
Tashkent
Urtachirchik
Chinaz
Yukorichirchik
Yangiyul

WATER CONSUMPTION COMPUTATION

- Problem statement
- Methodological basis
- Retrospective
- Perspective
- Damage from underirrigation
- Software implementation
- Interface
- Calibration

PROBLEM STATEMENT

Develop module of agricultural water consumption in districts of Tashkent province, based on the following settings:

1. Computation is made on the basis of crop evapotranspiration
2. Soil texture of any selected point in irrigated area replicates soil texture of district
3. GW dynamics of any selected point in irrigated area replicates GW dynamics of district
4. Crops are distributed uniformly throughout the irrigated area

METHODOLOGICAL BASIS

FAO's methods (publications №24 and №56) serve as the methodological basis for the model. Reference water consumption was computed using the Penmann-Montheit formula, effective precipitation was derived from method of US Reserve Land Fund (documentation to CROPWAT program), and groundwater contribution was computed by Kharchenko's formula adapted by M.G.Horst to FAO's classification.

METHODOLOGICAL BASIS

Groundwater contribution is computed by Kharchenko's formula adapted to FAO by M.G.Horst

$$Dop = a*ETo/exp(b*(abs(H - h)))$$

where:

Dop – groundwater contribution, mm

a – soil-related coefficient

ETo – reference evapotranspiration

b – soil-related coefficient

H - if (H – h) < 0.6 – root system depth in m, else H = 0

h - GWT (m)

Source:

RETROSPECTIVE

Water consumption for previous years, for which information is available in project Database, is computed. Thus, the model was verified. Computations were made for all 14 districts in Tashkent province for 1981, 1985, 1990, 1995, 2000, 2001, 2002, 2003. Computation results were inputted into DB. Here, we used observed climate data, GWT data, soil texture and crop area data for districts in Tashkent province.

PERSPECTIVE

Here, agricultural water consumption is computed for given year. Climate data are computed, as far as possible, by one of adopted algorithms and scenario is established for agricultural development and irrigated area change. The starting point for forecasting climatic parameters are the mean climatic parameters for selected historical observation years. Two climate change models, such as ECHAM4 and HadCM2 – were inputted into the module.

JUSTIFICATION OF YIELD LOSS ESTIMATION

$$\left(1-\frac{Yr}{Yp}\right)=k_c\left(1-\frac{ETr}{ETc}\right)$$

Where

Yr - actual crop yields
Yp – potential crop yields
ETr – actual evapotranspiration
Etc – potential evapotranspiration
Kc – crop-related coefficient

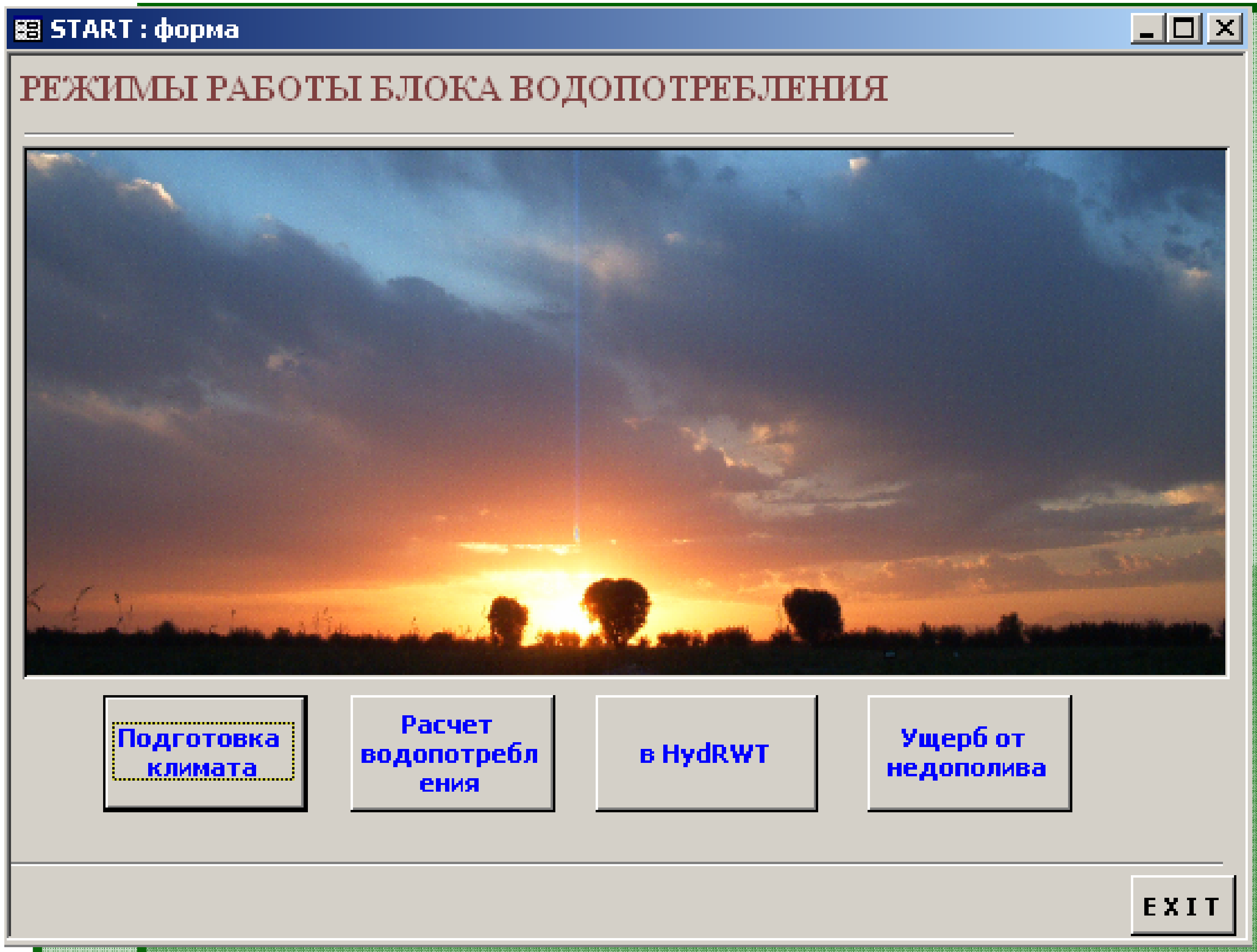
ETr represents water available for crop. In our case, these are effective precipitation EffRain, groundwater contribution Dop and share of water from irrigation ETirr.

Source: FAO Recommendations, issues №№ 33,56

SOFTWARE IMPLEMENTATION

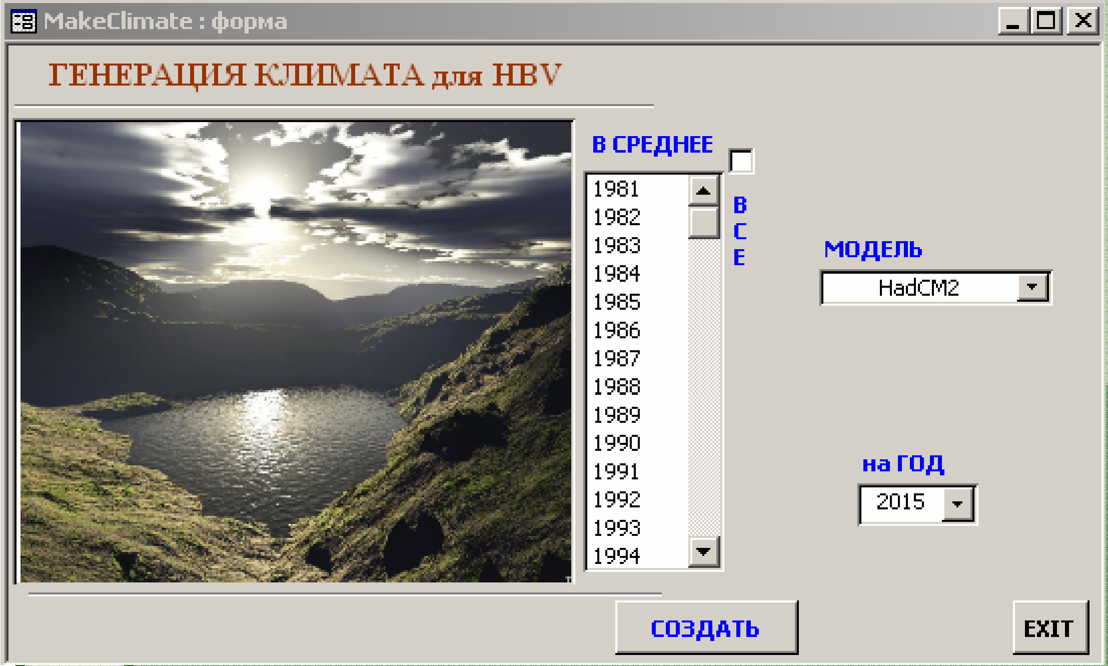
Computation block is developed in ACCESS environment in form of separated DB linked with the project DB. Software component is written in VBA. The block creates a text file with climate data for HBV model, text file with irrigation water requirements for HydRWT model, reads response of HydRWT model and compute yield damage from under-irrigation. Computation results are inputted into the project DB. Besides, the block contains a tool for inputting and servicing of agricultural scenarios.

INTERFACE



Main form contains module function call buttons

INTERFACE



The form creates climate date for the future by using one of climate change models and the selected average

INTERFACE

The form computed water consumption in one district in Tashkent province and inputs the results into the project DB

INTERFACE

The form allows user to select district and year for processing, adjust previous form for operation for perspective or retrospective.

Setup

УСТАНОВКА ПАРАМЕТРОВ РАСЧЕТА

ПРОСМОТР

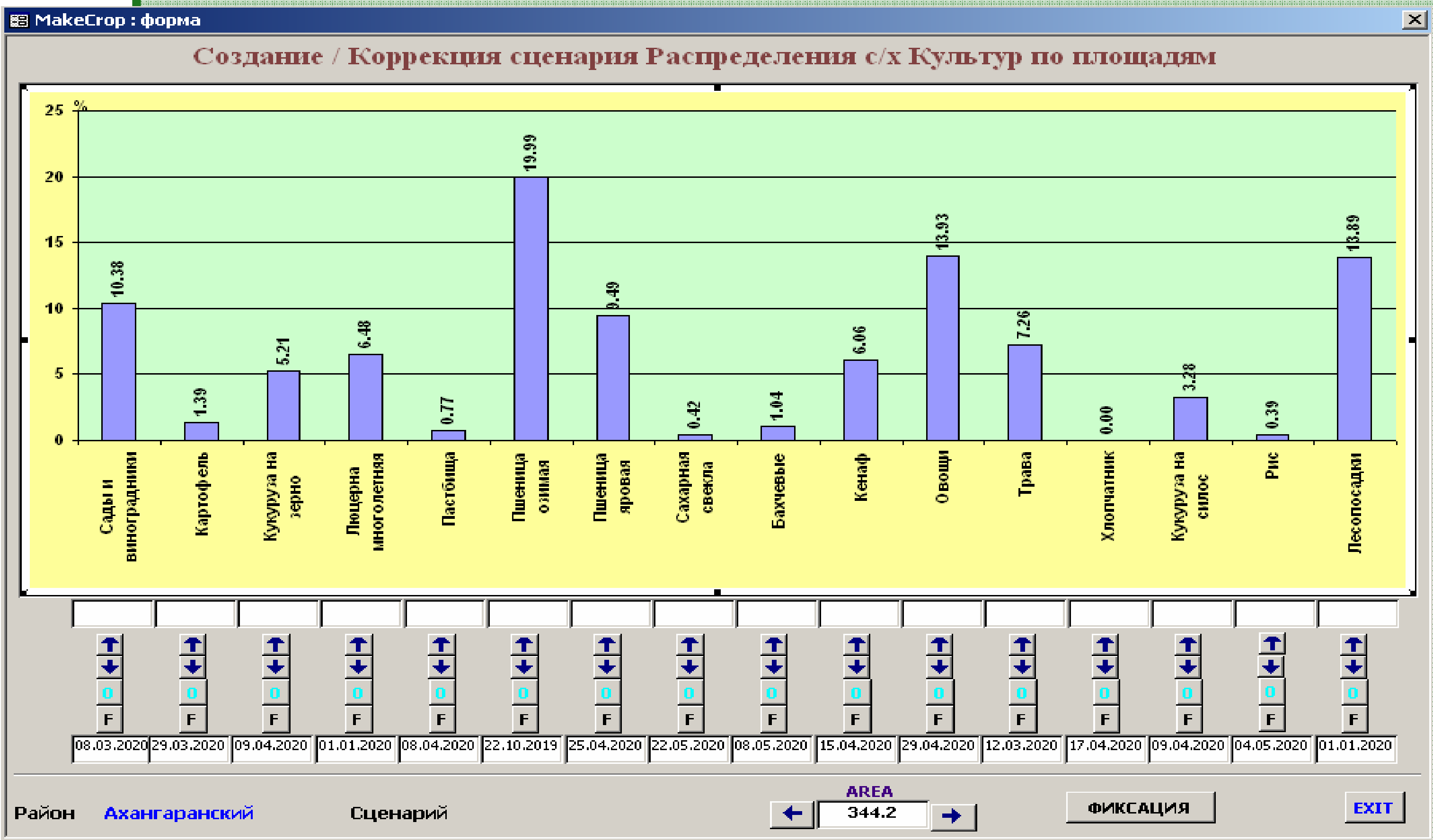
КОНТУР | КЛИМАТ | УГВ | ПОЧВЫ | КУЛЬТУРЫ | ОСАДКИ | ПАРАМЕТРЫ

Контур орошения	Метеостанция	Площадь т.га.
Аккурганский	Сырдарья	29.4
Ахангаранский	Ангрен	25.6
Бостанлыкский	Дукант	15.5
Букинский	Сырдарья	39.7
Зингиатинский	Ташкент	12.9
Кибрайский	Ташкент	19.3
Куйичирчикский	Сырдарья	39.4
Паркентский	Ташкент	15.2
Пскентский	Сырдарья	24.9
Ташкентский	Ташкент	11.4
Уртачирчикский	Ташкент	33.3
Чиназский	Сырдарья	21.8

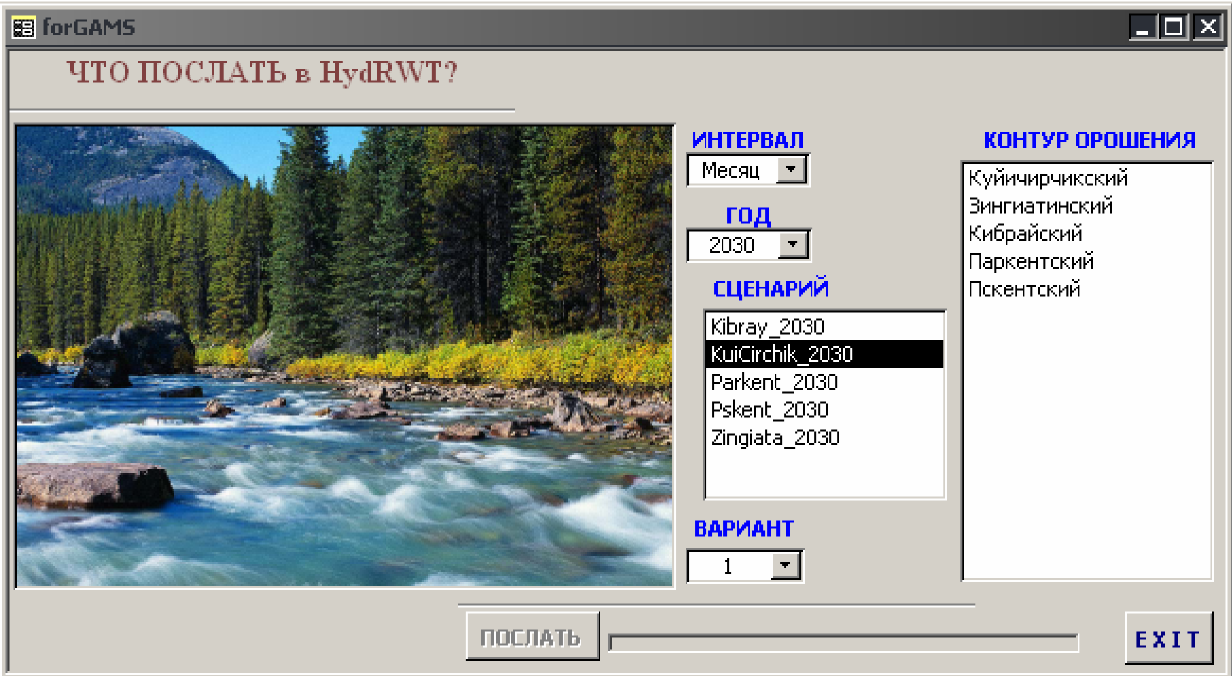
ВЫХОД

INTERFACE

The form allows user to input and correct district agricultural scenarios for the future



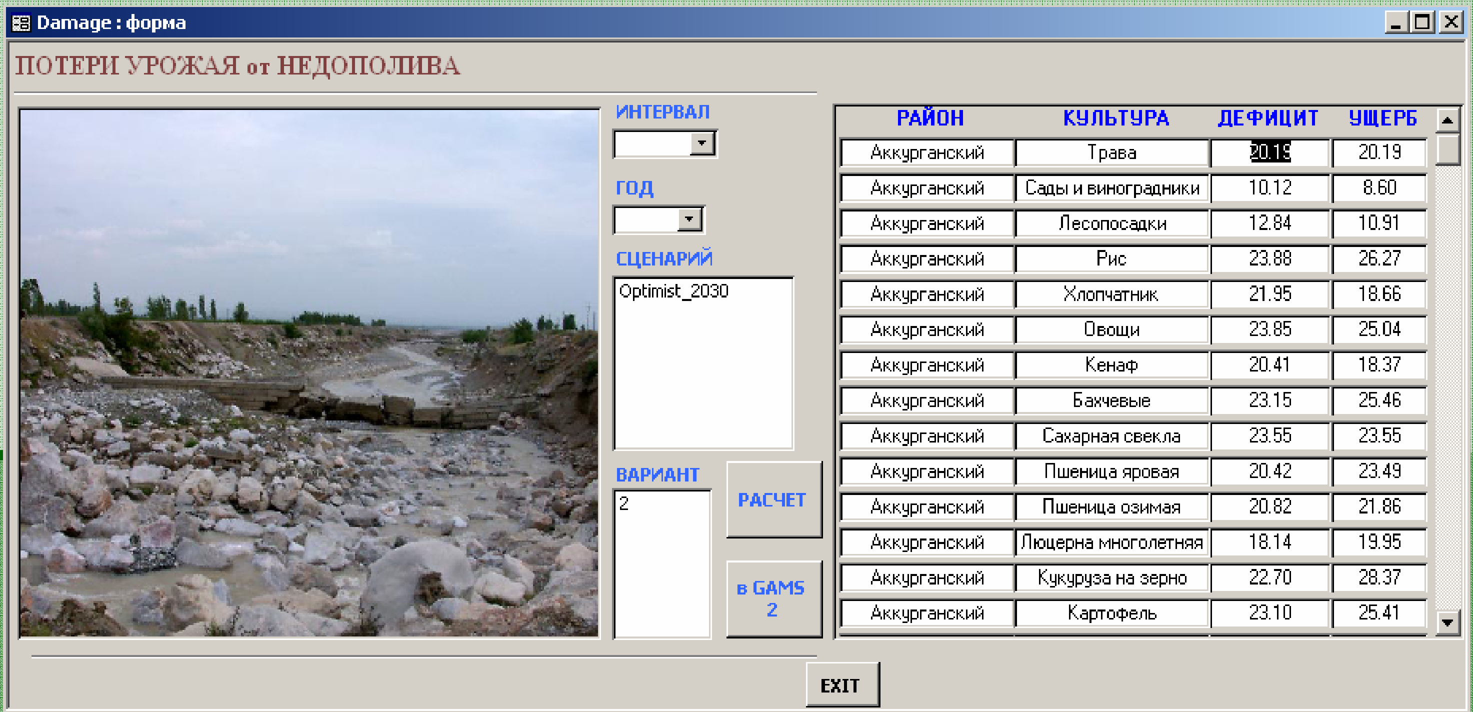
INTERFACE



forGAMS
ЧТО ПОСЛАТЬ в HydRWT?
ИНТЕРВАЛ
Месяц
ГОД
2030
СЦЕНАРИЙ
Kibray_2030
KuiCirchik_2030
Parkent_2030
Pskent_2030
Zingiata_2030
ВАРИАНТ
1
КОНТУР ОРОШЕНИЯ
Куйичирчикский
Зингиатинский
Кибрайский
Паркентский
Пскентский
ПОСЛАТЬ
EXIT

INTERFACE

The form allows user to read-out file on available irrigation water quantities and estimate damage from under-irrigation. The results are inputted into DB.


Damage : форма

ПОТЕРИ УРОЖАЯ от НЕДОПОЛИВА

ИНТЕРВАЛ

ГОД

СЦЕНАРИЙ

Optimist_2030

ВАРИАНТ

2

РАСЧЕТ

в GAMS 2

РАЙОН	КУЛЬТУРА	ДЕФИЦИТ	УЩЕРБ
Аккурганский	Трава	20.19	20.19
Аккурганский	Сады и виноградники	10.12	8.60
Аккурганский	Лесопосадки	12.84	10.91
Аккурганский	Рис	23.88	26.27
Аккурганский	Хлопчатник	21.95	18.66
Аккурганский	Овощи	23.85	25.04
Аккурганский	Кенаф	20.41	18.37
Аккурганский	Бахчевые	23.15	25.46
Аккурганский	Сахарная свекла	23.55	23.55
Аккурганский	Пшеница яровая	20.42	23.49
Аккурганский	Пшеница озимая	20.82	21.86
Аккурганский	Люцерна многолетняя	18.14	19.95
Аккурганский	Кукурузa на зерно	22.70	28.37
Аккурганский	Картофель	23.10	25.41

EXIT

STATISTICAL CHARACTERISTICS OF WATER CONSUMPTION MODULE CALIBRATION

Parameters	Akkur gan	Ahan garan	Bost onlyk	Buka	Kuichi rchic	Zengiata	Ukoryc hirchik	Kibray	Parkent	Pskent	Urtac hirchk	Tash kent	Chinaz	Yangiul
Average	-293	-347	-123	-336	-553	1707	475	-246	-104	-238	-342	-166	-220	518
Dispersion	406	484	178	471	661	3090	1400	338	229	390	526	243	310	1416
Variation coeff.	-72	-72	-69	-71	-84	55	34	-73	-45	-61	-65	-68	-71	37
Correlation coeff.	0.968	0.963	0.965	0.971	0.885	0.836	0.965	0.945	0.983	0.967	0.962	0.907	0.910	0.936
Average	-1018	-1058	-676	-930	-1307	732	-64	-1363	-524	-848	-942	-1201	-1116	-215
Dispersion	1209	1297	872	1140	1433	3535	2081	1623	789	1080	1217	1367	1283	2137
Variation coeff.	-84	-82	-78	-82	-91	21	-3	-84	-66	-79	-77	-88	-87	-10
Correlation coeff.	0.898	0.932	0.898	0.926	0.855	0.932	0.891	0.940	0.976	0.862	0.912	0.871	0.935	0.943
Average	-271	-239	-85	-403	-509	716	-179	-212	-63	-233	-235	-126	-207	-283
Dispersion	380	368	148	500	568	1315	282	309	203	330	323	175	256	371
Variation coeff.	-71	-65	-57	-81	-90	54	-63	-69	-31	-70	-73	-72	-81	-76
Correlation coeff.	0.974	0.945	0.941	0.946	0.833	0.932	0.960	0.907	0.950	0.949	0.975	0.896	0.887	0.911
Average	518	393	599	246	-294	-116	599	61	651	491	439	-265	8	-43
Dispersion	2462	3332	2175	2306	2035	2150	2644	2061	2371	2816	2378	2060	2288	2291
Variation coeff.	21	12	28	11	-14	-5	23	3	27	17	18	-13	0	-2
Correlation coeff.	0.857	0.850	0.808	0.791	0.814	0.850	0.896	0.939	0.980	0.753	0.807	0.888	0.774	0.878
Average	971	523	527	857	477	453	716	215	694	986	891	-476	534	659
Dispersion	3359	3628	1993	3377	3233	3291	3433	3179	2682	3247	3292	2360	3135	3249
Variation coeff.	29	14	26	25	15	14	21	7	26	30	27	-20	17	20
Correlation coeff.	0.919	0.857	0.933	0.882	0.854	0.908	0.907	0.936	0.996	0.806	0.926	0.804	0.770	0.910
Average	843	535	622	460	234	311	825	418	913	1090	863	225	426	498
Dispersion	2467	3414	2136	2332	2173	2611	2995	2439	2808	2526	2732	2283	2466	2531
Variation coeff.	34	16	29	20	11	12	28	17	33	43	32	10	17	20
Correlation coeff.	0.976	0.836	0.973	0.915	0.905	0.921	0.927	0.952	0.965	0.927	0.975	0.781	0.798	0.935
Average	1261	787	584	985	1116	957	1220	947	895	1114	1240	390	929	715
Dispersion	3160	2991	1863	3022	3160	3342	3316	3003	2639	3069	3217	2231	3200	3073
Variation coeff.	40	26	31	33	35	29	37	32	34	36	39	17	29	23
Correlation coeff.	0.988	0.933	0.956	0.969	0.925	0.953	0.973	0.974	0.964	0.992	0.989	0.941	0.940	0.919

Worst and better options from comparison of actual and simulated values