Tools for the SWAT model

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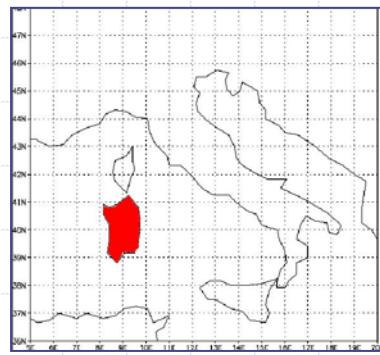


Center for Advanced Studies, Research and Development in Sardinia

Some insight

A large variety of catchments are found in regions such as Sardinia, Sicily, Portugal, etc..

Catchments are, generally, characterized by a large variety of soils, land covers, ecosystems, etc..

Water policy managers assess water management in an integrated way (management strategies and political boundaries vary from physical boundaries).

Time and spatial resolution analysis vary with each problem we face.

Using the SWAT model

Water budget calculations, nutrients and pesticides mass balance are efficiently computed.

Pre and pot processing is also easily performed with the AVS2000 interface at the catchment's scale.

A big effort is to be made, when many catchments are simulated and must be analysed together, to gather spatial and temporal analysis of the integrated system.

Some Tools (hopefully useful!!)

Multi_catch.avx
It is an ArcView extension to dynamically compute analysis of many catchments at a time. It is a user friendly interface to ease the post processing.

SWAT-DB-processor
It is a Visual basic application to build a geo-database of the SWAT outputs in the Access environment.

The informatics Technologies

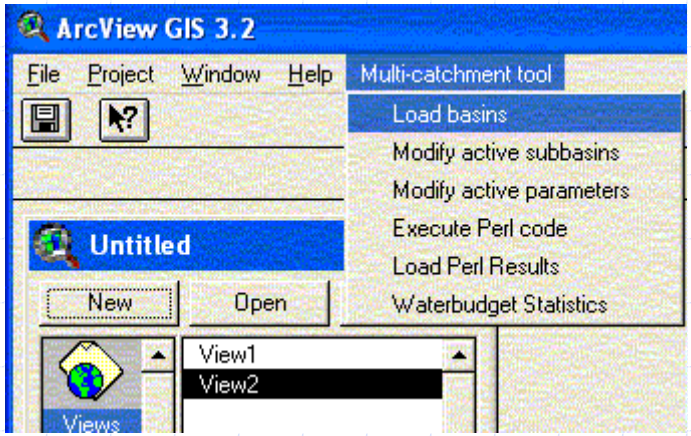
- Avenue programming language
- Perl scripting language (5.8 release of ActivePerl environment)
- Visual basic
- Access db management system

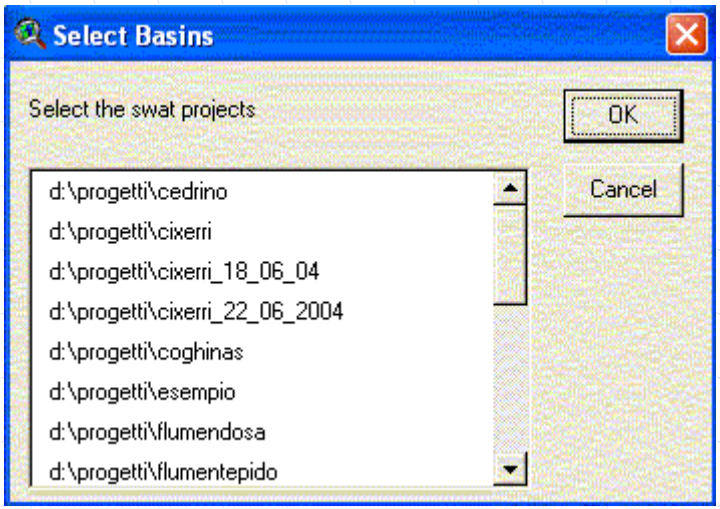
Multi_catch.avx

How the Multi_catch.avx works

Load basins

the user is asked to chose the SWAT projects to be analyzed. Once the projects are chosen, the Waters and Watersub shapefiles are loaded from



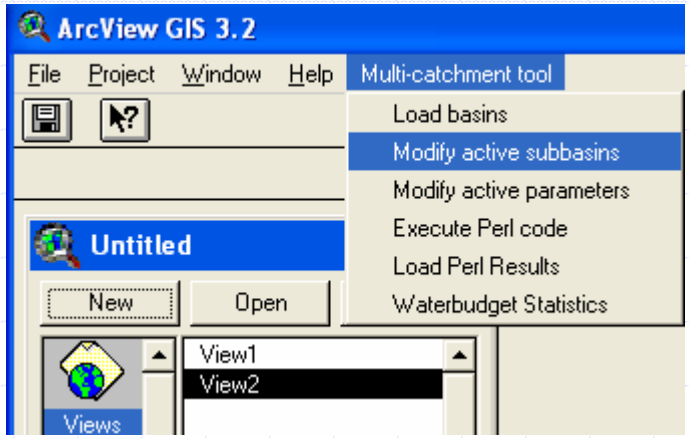


the projects directory (*\watershed\shapes*) in the Arcview project, along with the relative bsb tables

How the Multi_catch.avx works

Modify active subbasins

the user can select which subbasins must be considered active in terms of contribution to the water balance XXthrough the editing of an Arcview table



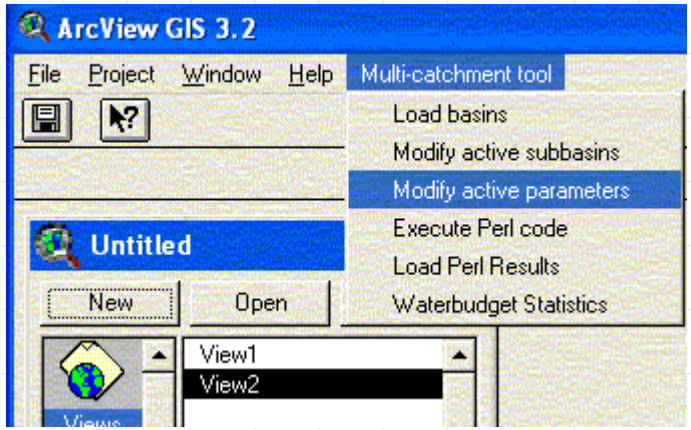
define_bsb.dbf

Basin	Subbasin	Area	Active
riu-mogoro	2	11664.0000	1
riu-mogoro	3	5616.0000	1
riu-mogoro	1	2464.0000	1
riu-mogoro	4	8864.0000	1
fluminimaggiore	1	2560.0000	1
fluminimaggiore	2	10224.0000	1

How the Multi_catch.avx works

Modify active parameters

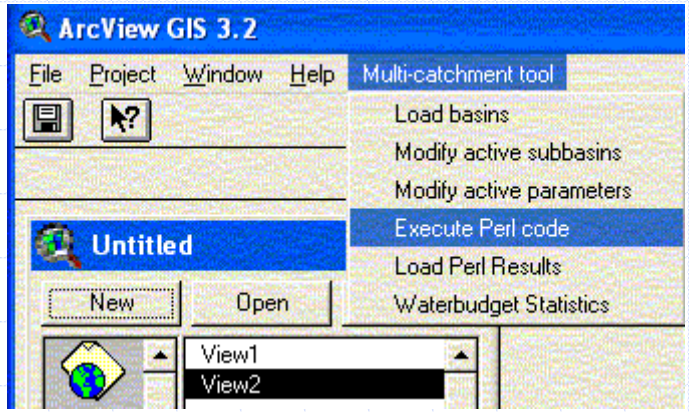
the user can XXchose which parameters are significant for the statistics



How the Multi_catch.avx works

Execute Perl code

for each selected SWAT project two files are created, having the same format as the bsb table but just referring to the chosen active subbasins and parameters



yearly_waterbudget_fluminimaggiore.dbf

Date	Area	Et	Surq	Wyld	Precip	Gw_q	Sw	Perc	Snomelt	Pet	Spld
2022	2784.000	366.505	0.000	160.473	611.100	0.000	255.035	28.397	0.000	1159.141	0.000
2023	2784.000	370.898	0.001	285.125	804.500	0.000	283.741	147.154	0.000	1174.412	0.000
2024	2784.000	330.194	0.000	154.237	533.500	0.000	246.693	51.071	0.000	1177.722	0.000
2025	2784.000	406.615	0.000	18							

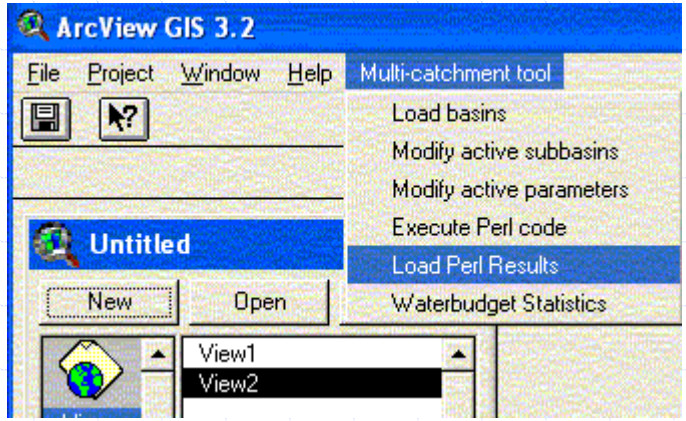
monthly_waterbudget_fluminimaggiore.dbf

Area	Et	Surq	Wyld	Precip	Gw_q	Sw	Perc	Snomelt	Pet	Spld	Year	Month
12784.000	24.371	0.000	41.849	125.100	0.000	51.814	6.979	0.000	30.400	0.000	2022	1
12784.000	37.745	0.000	23.204	71.000	0.000	50.657	11.249	0.000	37.746	0.000	2022	2
12784.000	59.861	0.000	13.523	61.800	0.000	37.039	1.897	0.000	59.862	0.000	2022	3

How the Multi_catch.avx works

Load Perl results

the results are loaded into the Arcview project in a format XXcapable to show the hydrological regime

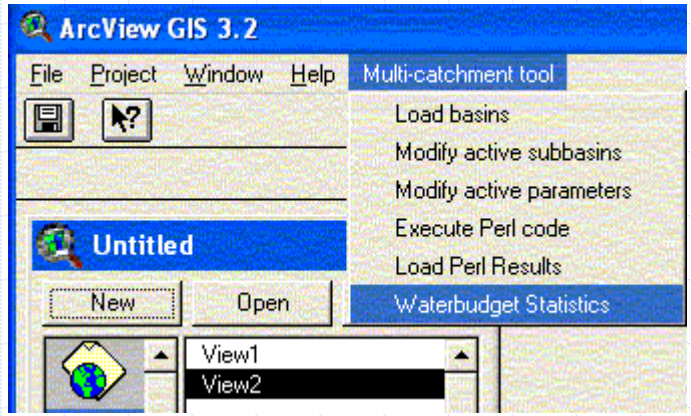


trasp_fluminimaggiore

Parameters	Year	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Perc	2088	44.14600	8.04800	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Perc	2089	0.00000	0.00000	0.00000	1.63300	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Perc	2090	0.00000	0.00000	0.00000	10.82400	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	24.30800	54.68200
Perc	2091	0.00000	11.79800	0.79900	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	18.69200	39.95800	0.00000
Perc	2092	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	46.23900	6.95400	0.00000
Sw	2022	51.81400	50.65700	37.03900	15.09100	0.77900	0.00000	0.00400	0.00000	9.21600	17.08800	18.81400	54.53300
Sw	2023	50.87000	52.51800	29.43400	22.13100	0.00400	2.53900	0.00100	0.00000	7.00800	10.80500	54.27100	54.16000
Sw	2024	54.24300	48.51300	23.79400	9.10100	0.00000	0.08100	0.00000	0.00000	0.00700	19.62700	37.05600	54.27100
Sw	2025	31.95100	53.59400	51.19300	15.63600	4.72600	0.73800	0.00000	0.02600	10.48100	39.36800	50.41000	54.38800

How the Multi_catch.avx works

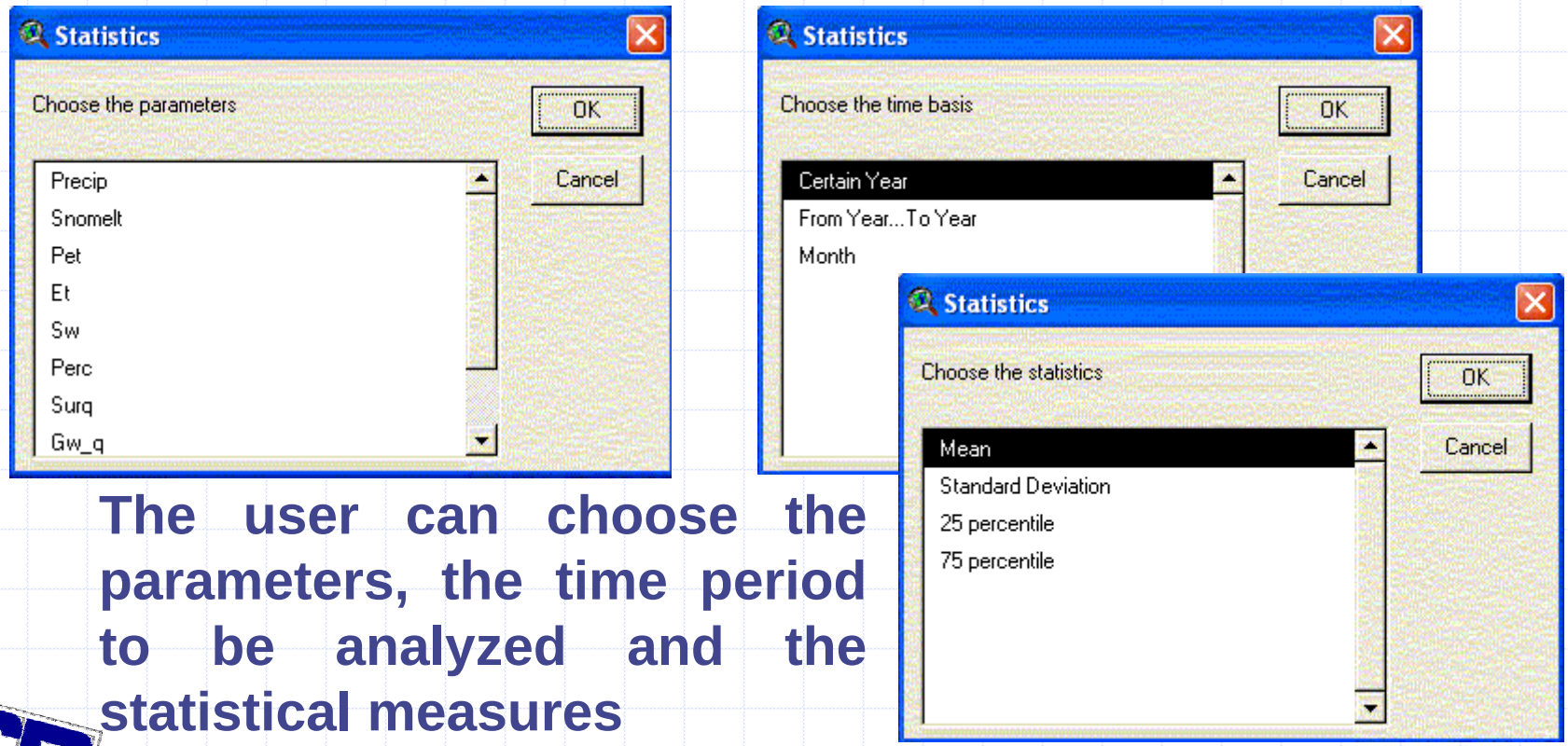
Waterbudget statistics (I)



the user is asked to choose which statistics is to be calculated, the time period for statistical evaluation and the required statistical measures such as mean, standard deviation, 25th percentile, or 75th percentile. The results are displayed as a new Arcview theme, visualized by a graduated legend

How the Multi_catch.avx works

Waterbudget statistics (II)



The user can choose the parameters, the time period to be analyzed and the statistical measures

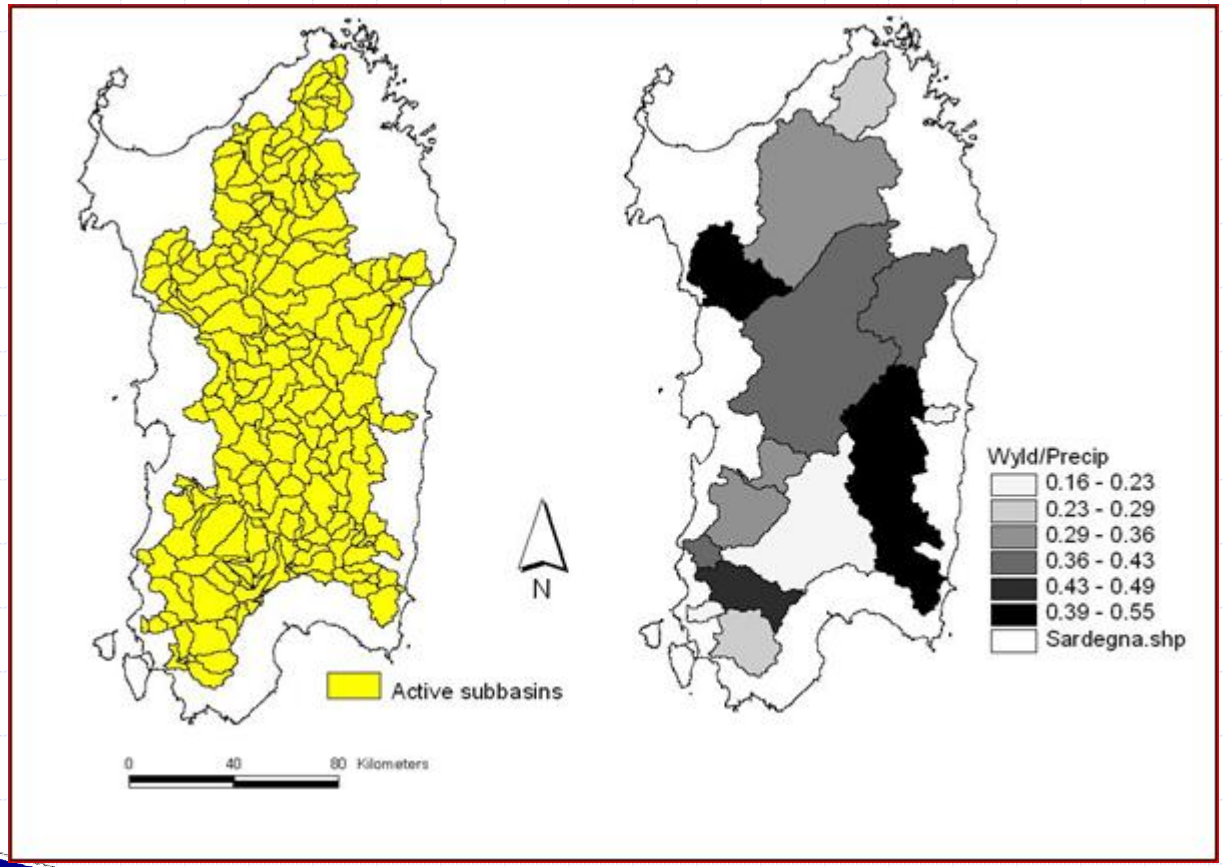
Application of the extension Multi_catch.avx

One of the main topics of the project "Piano di Tutela delle Acque della Regione Sardegna" has been the development of a multisectorial, integrated and operational Decision Support System (DSS) for the sustainable use of water resources at the catchment scale.

SWAT has been chosen as one of the tool of the DSS.

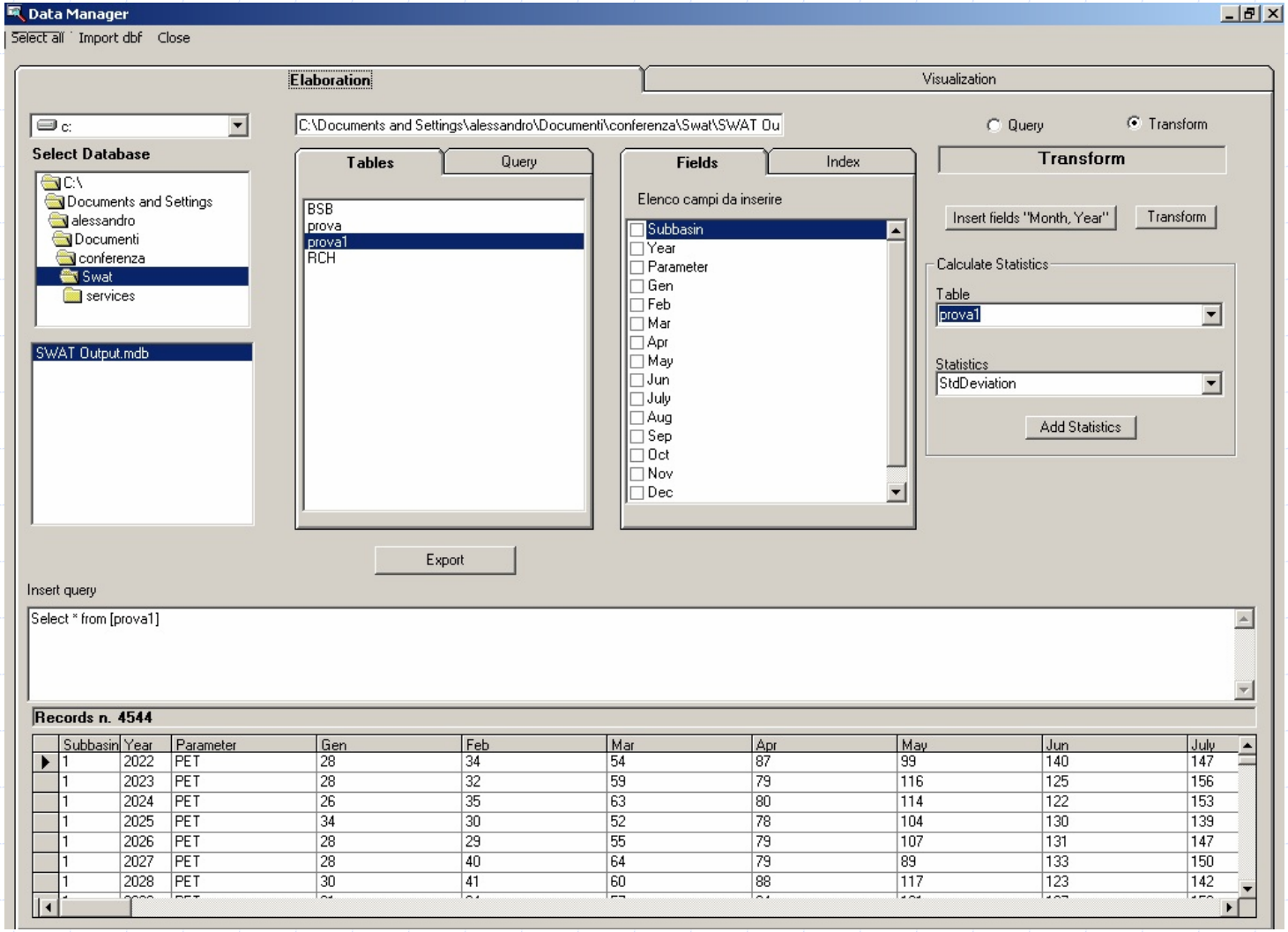
The *Multi_catch.avx* program has been used in this project to analyse and map the SWAT results

Representation of Sardinia catchments using the extension



The main watersheds (16) of the island with 244 subbasins have been analyzed in less then one hour.

The SWAT-db-processor interface



Subbasin	Year	Parameter	Gen	Feb	Mar	Apr	May	Jun	July
1	2022	PET	28	34	54	87	99	140	147
1	2023	PET	28	32	59	79	116	125	156
1	2024	PET	26	35	63	80	114	122	153
1	2025	PET	34	30	52	78	104	130	139
1	2026	PET	28	29	55	79	107	131	147
1	2027	PET	28	40	64	79	89	133	150
1	2028	PET	30	41	60	88	117	123	142

The SWAT-db-processor output

Data Manager

Select all Import dbf Close

Elaboration | Visualization

Records n. 4576

Subbasin	Year	Parameter	Gen	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	AvgYear
9	2086	WYLD	27	22	16	6	2	2	10	0	3	53	31	31	17
9	2087	WYLD	39	26	12	2	0	0	0	0	0	1	4	3	7
9	2088	WYLD	11	11	10	6	6	1	0	0	21	3	59	31	13
9	2089	WYLD	21	20	15	5	1	2	0	0	6	3	58	51	15
9	2090	WYLD	39	21	5	5	8	0	5	3	1	23	27	76	18
9	2091	WYLD	50	54	38	18	4	0	0	0	2	3	9	7	15
9	2092	WYLD	38	30	22	10	7	18	4	0	2	1	2	3	12
1	0	Std_PRECIP	79	68	66	37	54	23	16	19	33	138	82	92	20
2	0	Std_PRECIP	79	68	66	37	54	23	16	19	33	138	82	92	20
3	0	Std_PRECIP	105	75	78	45	46	23	23	22	36	146	89	117	27
4	0	Std_PRECIP	79	68	66	37	54	23	16	19	33	138	82	92	20
5	0	Std_PRECIP	105	75	78	45	46	23	23	22	36	146	89	117	27
6	0	Std_PRECIP	79	68	66	37	54	23	16	19	33	138	82	92	20
7	0	Std_PRECIP	64	60	47	43	44	25	12	19	29	72	92	60	17
8	0	Std_PRECIP	64	60	47	43	44	25	12	19	29	72	92	60	17
9	0	Std_PRECIP	45	47	55	36	31	26	13	15	37	97	73	86	19
10	0	Std_PRECIP	89	66	68	46	42	23	11	18	45	149	92	109	22
11	0	Std_PRECIP	90	103	120	49	62	31	11	20	47	201	111	130	29
12	0	Std_PRECIP	89	66	68	46	42	23	11	18	45	149	92	109	22
13	0	Std_PRECIP	110	106	100	66	67	32	18	32	53	180	151	186	35
14	0	Std_PRECIP	66	60	53	39	41	23	11	15	30	59	65	84	16
15	0	Std_PRECIP	50	51	47	37	32	21	14	20	32	85	62	79	14
16	0	Std_PRECIP	90	103	120	49	62	31	11	20	47	201	111	130	29
1	0	Std_WYLD	50	37	33	22	20	8	3	1	2	70	30	49	15
2	0	Std_WYLD	52	38	33	22	22	7	3	1	1	81	34	57	16
3	0	Std_WYLD	65	44	46	27	17	5	4	3	6	78	47	70	20
4	0	Std_WYLD	49	38	33	26	19	11	6	1	1	50	29	42	15
5	0	Std_WYLD	61	42	44	30	18	6	3	2	4	78	46	68	20
6	0	Std_WYLD	54	40	37	23	27	9	5	2	9	97	46	62	17
7	0	Std_WYLD	41	35	28	25	21	7	2	3	5	29	59	39	13
8	0	Std_WYLD	38	32	29	25	22	9	2	2	3	17	44	35	13
9	0	Std_WYLD	30	27	29	23	13	9	3	2	12	59	44	57	15
10	0	Std_WYLD	52	38	39	34	9	2	1	2	12	96	47	57	15
11	0	Std_WYLD	58	60	68	40	31	12	2	2	9	136	53	79	23
12	0	Std_WYLD	66	47	46	33	19	9	4	7	25	121	69	82	17
13	0	Std_WYLD	78	78	73	47	38	11	5	11	25	133	115	152	29
14	0	Std_WYLD	39	38	32	23	10	1	0	1	2	11	18	38	11
15	0	Std_WYLD	28	31	28	22	9	3	2	3	5	37	25	37	9
16	0	Std_WYLD	59	64	72	38	33	11	2	2	11	144	58	84	23

How to get the tools

Go to the web site: www.crs4.it/EIS/gisapplication/.

Email:

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Pierluigi Cau: plcau@crs4.it

Further developments

Multi_catch.avx

Further work will be done to add new functionalities to the present extension

SWAT-db-processor

Spatial analysis and visualization (at the subbasin scale) will be implemented.