Instituto de Ingeniería del Agua y Medio Ambiente

UNIVERSIDAD POLITECNICA DE VALENCIA

Ribav Integration within Ripflow v.3

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iwrm-net

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1. Ribav conceptualization.
2. Ribav Parameters.
3. Ribav 1D.
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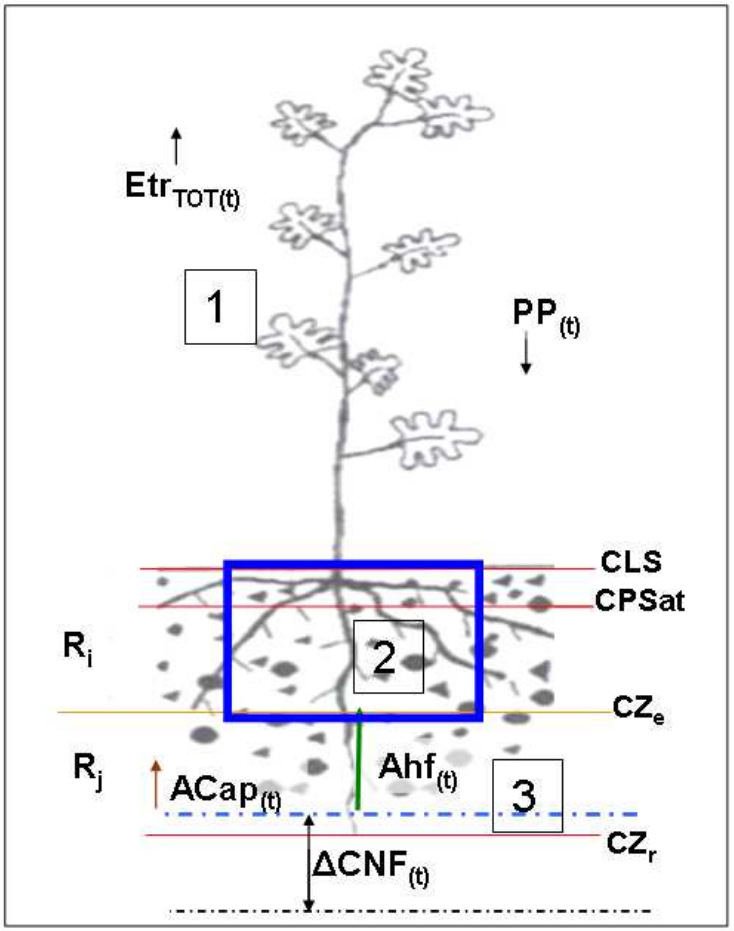
5. Methods to integrate Ribav 2D within Ripflow.

1. RibAV conceptualization

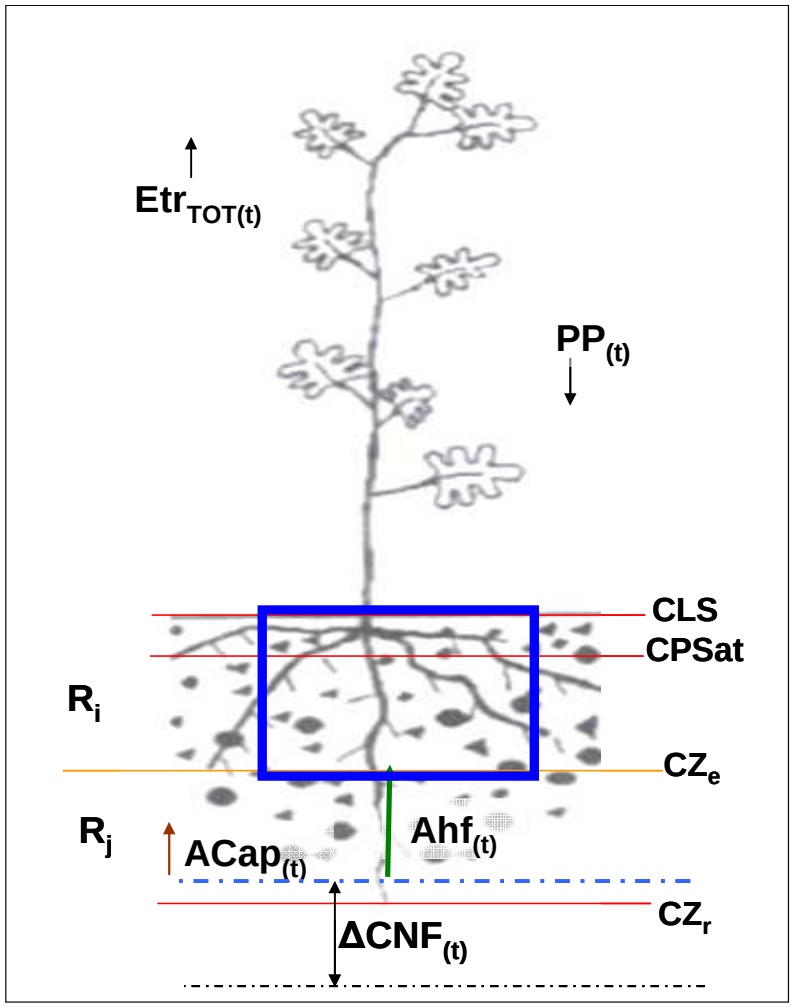
- Elements:
  - → 1.Vegetation
  - → 2. Static tank-unsaturated zone
  - → 3. Saturated zone

- Inputs (time series):
  - → $PP_{(t)}$: Precipitation
  - → $ETP_{(t)}$: Potential ET
  - → River daily discharges



1. RibAV conceptualization

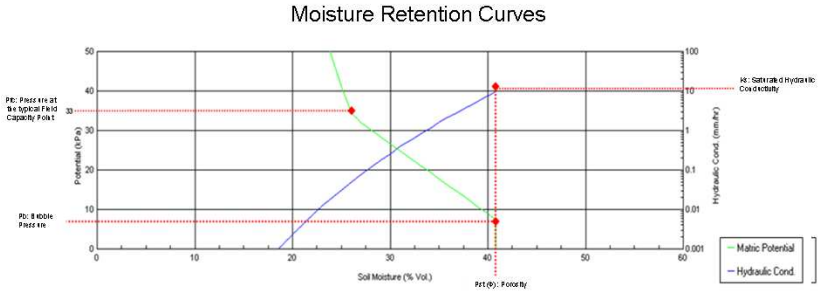
- Processes:
  - → Tank Water Excess (Runoff +percolation)
  - → Transpiration:
    - Saturated Soil
    - Non saturated Soil
    - Plant drowning (then ET=0)
  - → $Acap_{(t)}$: Soil capillary rise
  - → $Ahf_{(t)}$:Root hydraulic lift



2. Ribav Parameters

1. Ribav Basic Parameters

A. SOIL BASIC PARAMETERS						
SOIL Type	Φ Porosity [ ]	λ Porosity Index	Hb Bubble Pressure [Kpa]	Saturated Hydraulic Conductivity [mm/hr]	θCC Field Capacity Moisture at 33Kpa [ ]	Minimum Capillary Depth to be Considered [m]
	a.2	a.5	a.4	a.3	a.1	a.7
	Pst	lp	Pb	Ks	Mfc	ZCmin
1	0.401	0.4556	5.837	36.78	0.18	17
2	0.412	0.314	4.403	22.62	0.221	17
3	0.407	0.266	2.475	32	0.205	17
n	.....	.....	.....	.....	.....	17



B. VEGETATION BASIC PARAMETERS										
Vegetation Type	Maximum Root Depth [m]	Effective Root Depth [m]	Extinction at Saturation [m]	Transpiration Factor from Unsaturated Zone [ ]	Transpiration Factor from Saturated Zone [ ]	λv Plant Cover [ ]	Maximum Soil-Root Water Conductance [mmMpa^{-1}h^{-1}]	Wilting Point Pressure [Kpa]	Critical Point Pressure [Kpa]	Vegetation Type Description
	b.3	b.4	b.5	b.9	b.6	b.7	b.8	b.2	b.1	
	Zr	Ze	Zsat	Ri	Rj	Cov	Crt	Pwp	Pcrit	
1	0.8	0.7	-0.75	0.8	0.6	1	0.97	1500	500	Riparian Herbs (RH)
2	1.25	0.9	-0.1	0.9	0.35	0.8	0.97	1500	500	Riparian Juveniles and small Schrubs (RJ)
3	3.5	0.9	-0.3	0.9	0.35	1	0.97	1500	250	Riparian Adults Trees and Schrubs (RA)
4	2	1.9	0.3	1	0	1	0.97	1500	95	Terrestrial Vegetation (TV)

2. Ribav Parameters

2. Other Input Parameters

C. DAILY HYDROMETEOROLOGICAL INPUTS			
Date	Daily Precipitation [mm]	Potential Evapotranspiration [mm]	Daily Flow [m3/s]
	c.1	c.2	c.3
	PP	ETP	Q
01/01/1999	1.700	1.174	0.791
02/01/1999	0.717	1.17	0.783
03/01/1999	0	1.192	0.718
04/01/1999	0	1.172	0.672
05/01/1999	0	1.198	0.728
06/01/1999	0	1.18	0.865
07/01/1999	0	1.182	1.145
d	.....	.....	.....

D. RATING CURVES							
Flow Transect 1	Rivel Level Transect 1	Flow Transect 2	Rivel Level Transect 2	Flow Transect 3	Rivel Level Transect 3	Flow Transect t	Rivel Level Transect t
m3/s	m	m3/s	m	m3/s	m	m3/s	m
0	228.62	0	228.59	0	228.71	.....	.....
0.001	228.65	0.001	228.62	0.001	228.74	.....	.....
0.003	228.68	0.002	228.65	0.003	228.77	.....	.....
0.005	228.71	0.003	228.68	0.005	228.8	.....	.....
0.009	228.74	0.005	228.71	0.009	228.83	.....	.....
0.014	228.77	0.008	228.74	0.014	228.86	.....	.....
0.021	228.8	0.013	228.77	0.021	228.89	.....	.....
0.031	228.83	0.019	228.8	0.031	228.92	.....	.....
0.044	228.86	0.027	228.83	0.044	228.95	.....	.....
0.061	228.89	0.037	228.86	0.061	228.98	.....	.....
0.082	228.92	0.051	228.89	0.082	229.01	.....	.....
0.107	228.95	0.068	228.92	0.108	229.04	.....	.....
0.139	228.98	0.088	228.95	0.141	229.07	.....	.....
0.176	229.01	0.113	228.98	0.179	229.1	.....	.....
0.22	229.04	0.143	229.01	0.225	229.13	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
Q1	H1	Q2	H2	Q3	H3	Qt	Ht

Linear interpolation

Water Table Elevation [m]
WTE
229.193
229.191
229.19
229.188
229.187
229.19
229.185
.....

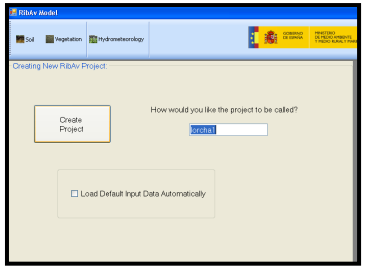
2. Ribav Parameters

3. Example of specific data of each simulation Point

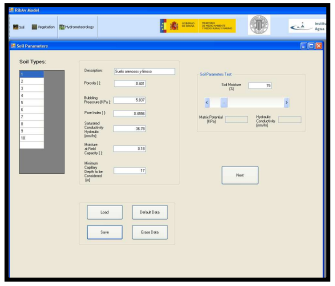
E. SIMULATION POINT DATA				
Point	Soil Surface Elevation	Soil Type	Pertaining Transect	Observed Vegetation Type
1	236.133	4	1	TV
2	232.898	4	1	TV
3	230.499	2	1	RA
4	230.697	1	1	TV
5	231.447	1	1	TV
6	232.197	1	1	TV
7	232.969	4	2	TV
8	232.219	4	2	TV
9	231.469	4	2	RA+TV
10	230.765	4	2	RA+TV
11	230.809	1	2	TV
12	231.611	1	2	TV
13	232.361	1	2	TV
14	233.135	4	3	TV
15	232.922	4	3	TV
16	232.172	4	3	RA+TV
17	230.31	4	3	RA+TV
p	.....	.....	.....	.....

3. RIBAV 1D

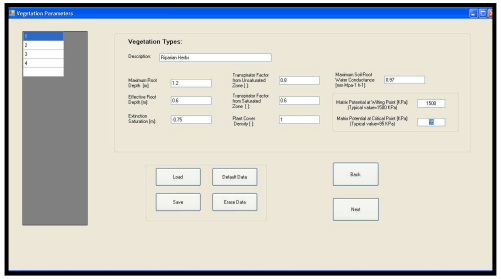
Ribav Program Forms



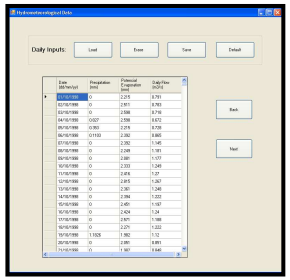
1.Main Menu



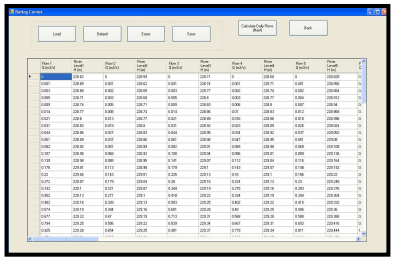
2. Soil Parameters



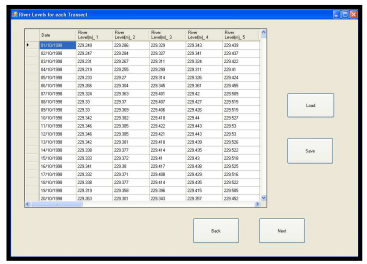
3. Vegetation Parameters



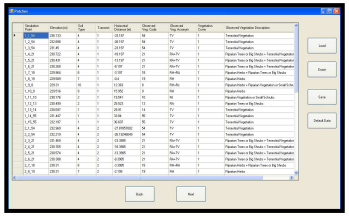
4. Hydro-meteorological Input Data



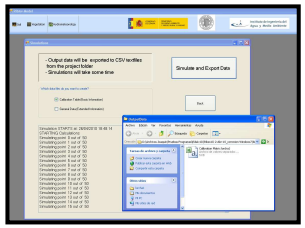
5. Rating Curves



6. Daily River Levels



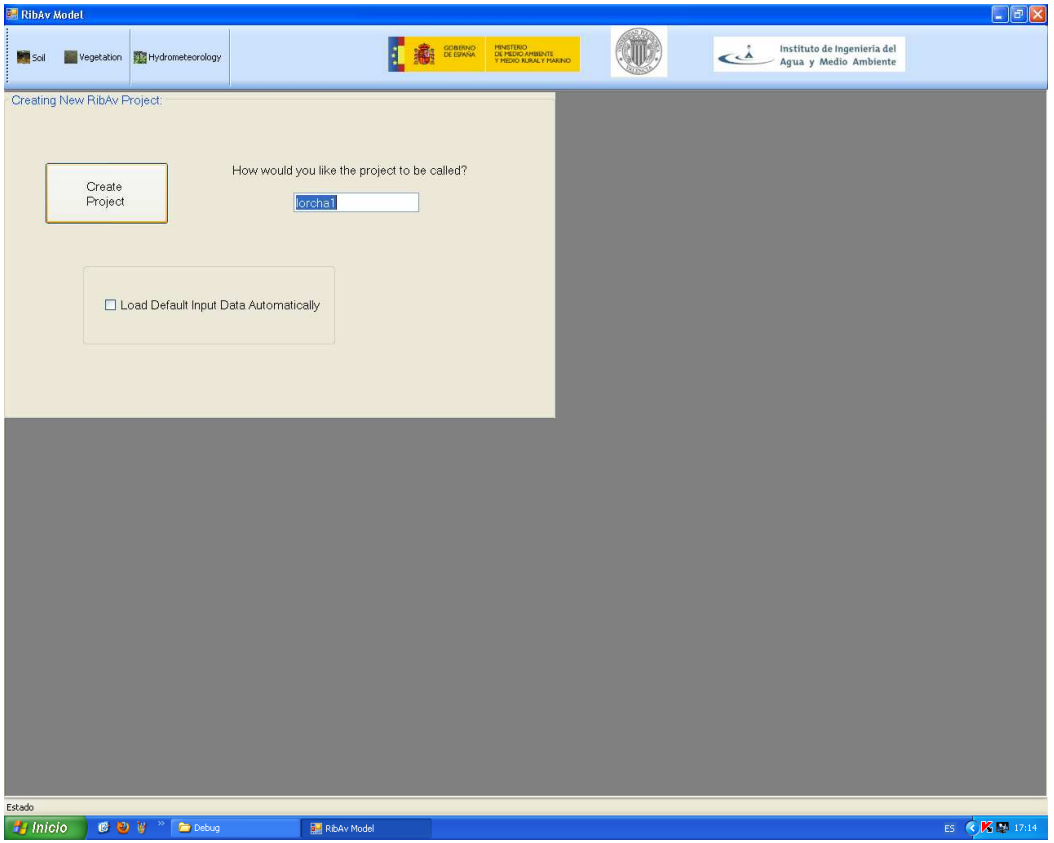
7. Simulation Point Data



8. Simulations Results Form

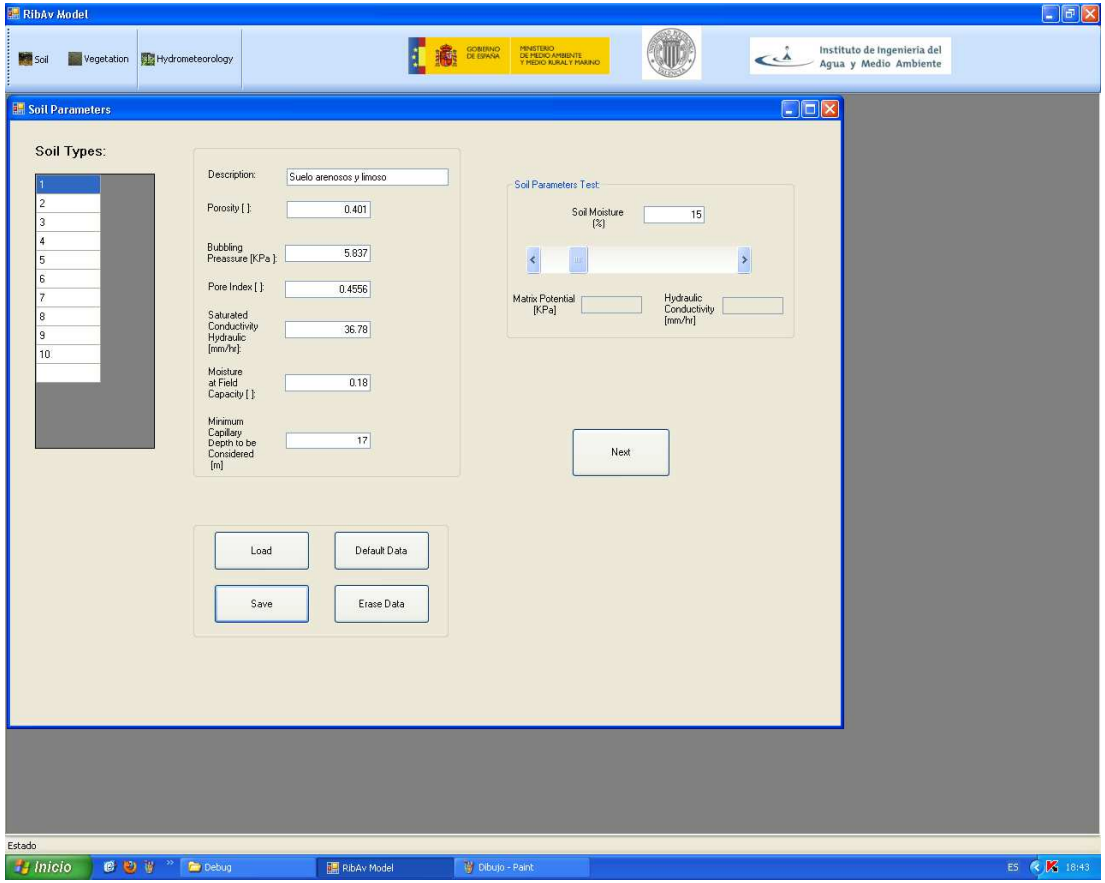
3. RIBAV 1D

1.Main Menu



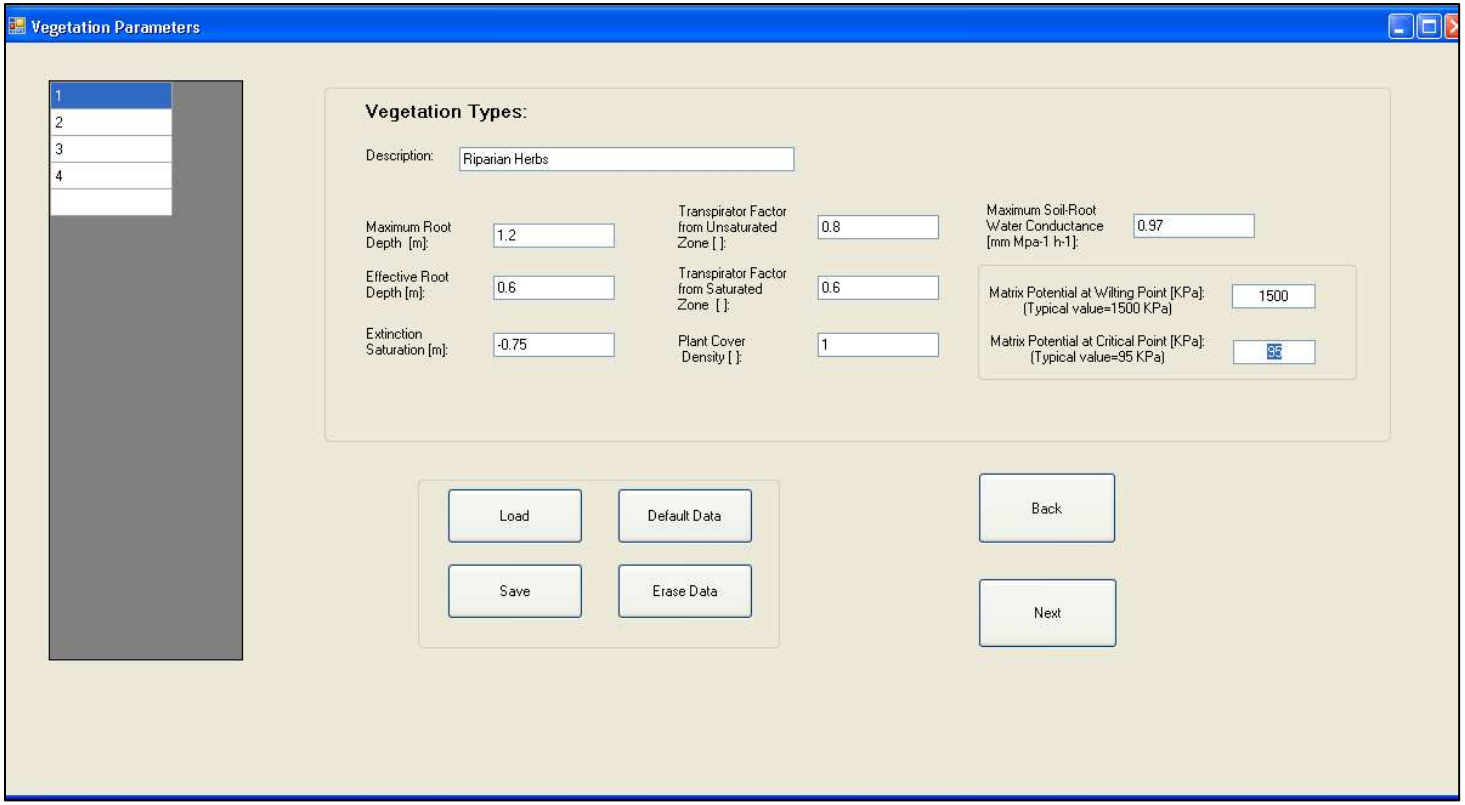
3. RIBAV 1D

2. Soil Parameters Form



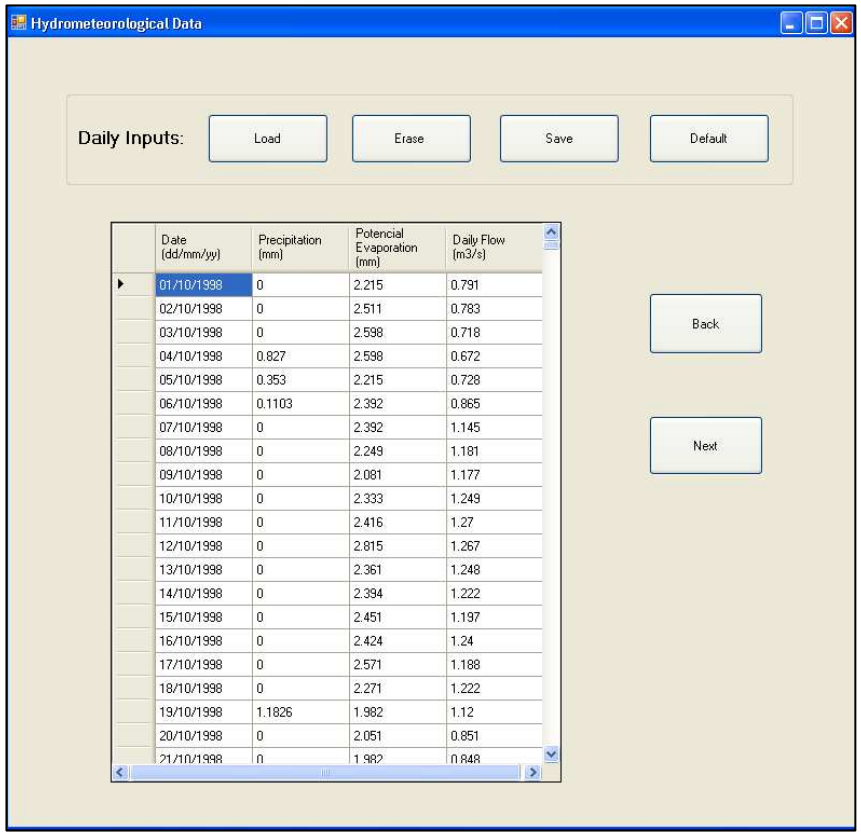
3. RIBAV 1D

3. Vegetation Parameters Form



3. RIBAV 1D

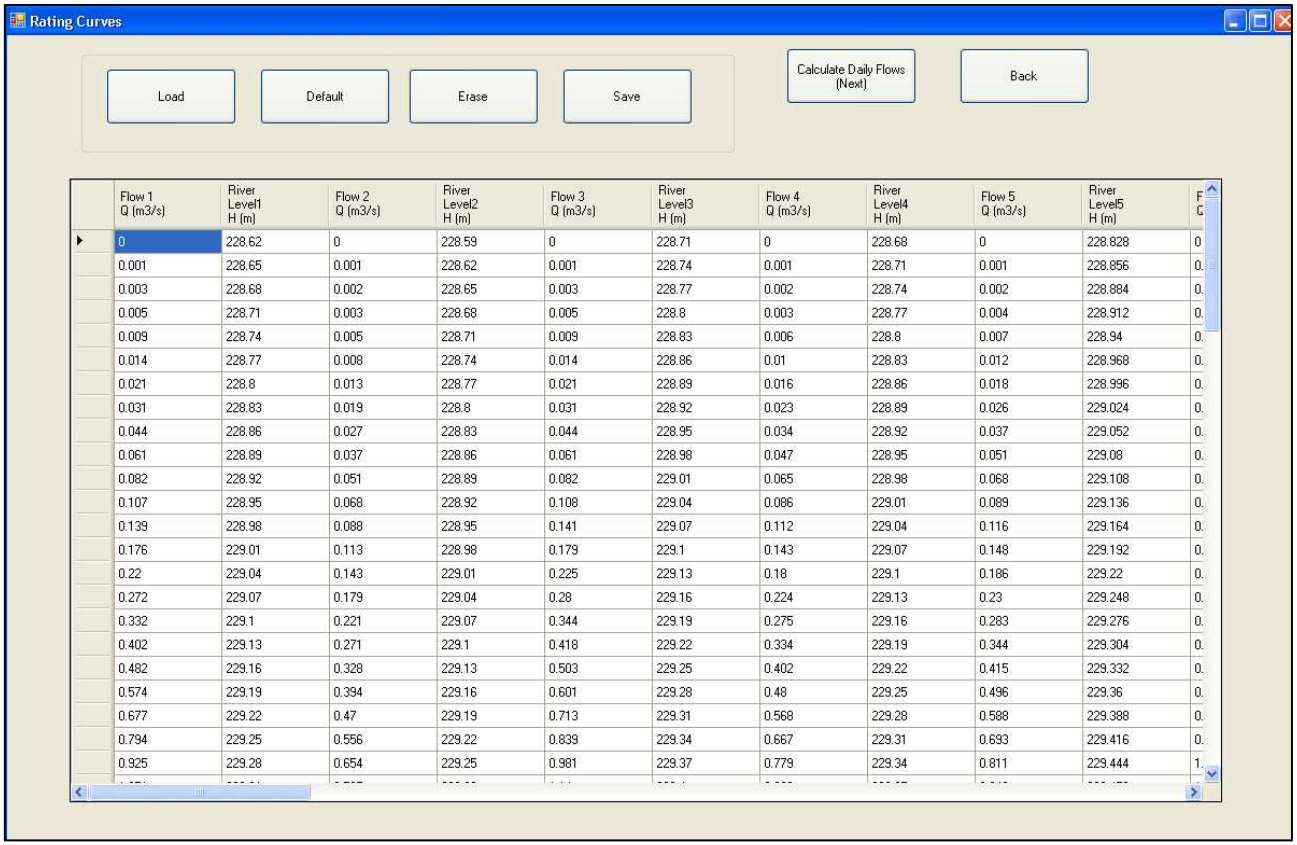
4. Hydro-meteorological Input Data



Date (dd/mm/yy)	Precipitation (mm)	Potencial Evaporation (mm)	Daily Flow (m3/s)
01/10/1998	0	2.215	0.791
02/10/1998	0	2.511	0.783
03/10/1998	0	2.598	0.718
04/10/1998	0.827	2.598	0.672
05/10/1998	0.353	2.215	0.728
06/10/1998	0.1103	2.392	0.865
07/10/1998	0	2.392	1.145
08/10/1998	0	2.249	1.181
09/10/1998	0	2.081	1.177
10/10/1998	0	2.333	1.249
11/10/1998	0	2.416	1.27
12/10/1998	0	2.815	1.267
13/10/1998	0	2.361	1.248
14/10/1998	0	2.394	1.222
15/10/1998	0	2.451	1.197
16/10/1998	0	2.424	1.24
17/10/1998	0	2.571	1.188
18/10/1998	0	2.271	1.222
19/10/1998	1.1826	1.982	1.12
20/10/1998	0	2.051	0.851
21/10/1998	0	1.982	0.848

3. RIBAV 1D

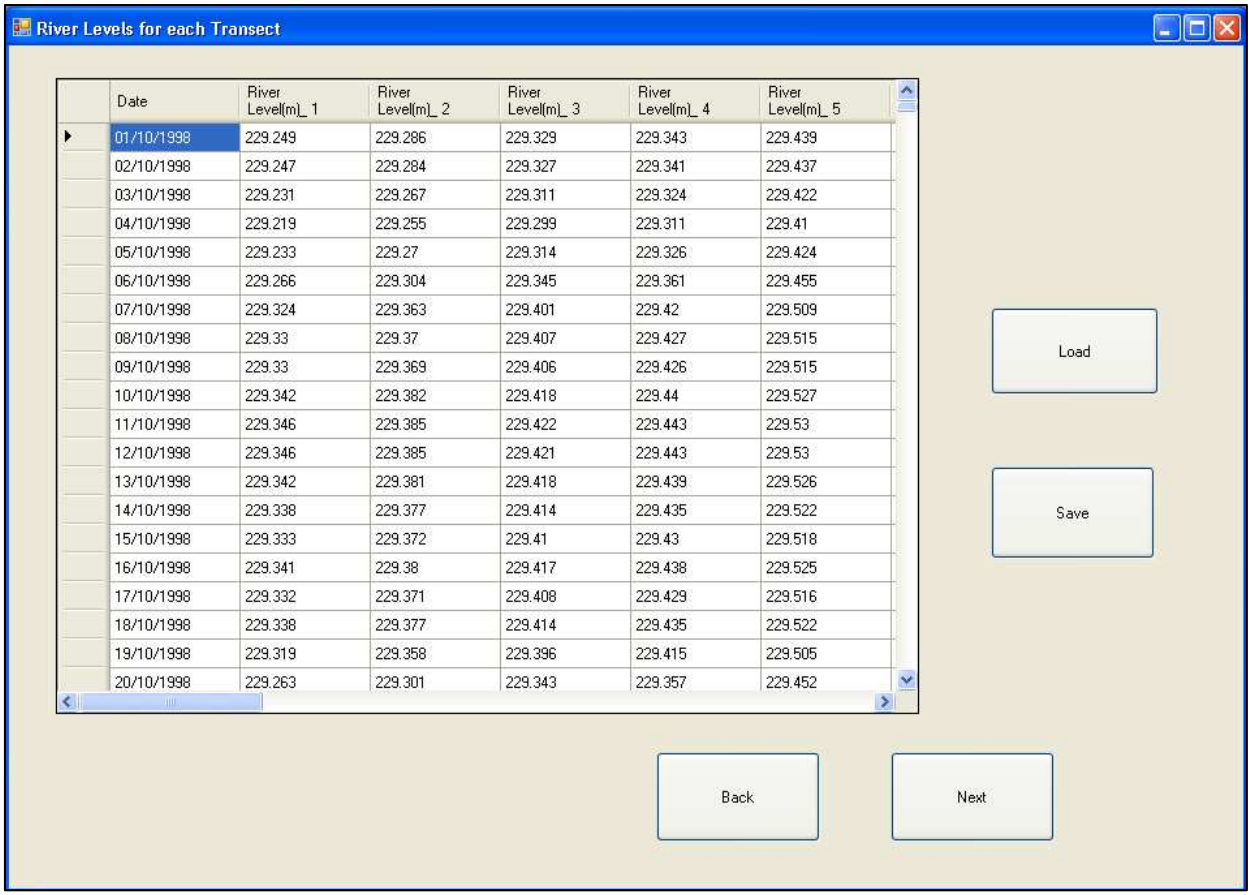
5. Rating Curves



Flow 1 Q (m3/s)	River Level1 H (m)	Flow 2 Q (m3/s)	River Level2 H (m)	Flow 3 Q (m3/s)	River Level3 H (m)	Flow 4 Q (m3/s)	River Level4 H (m)	Flow 5 Q (m3/s)	River Level5 H (m)
0	228.62	0	228.59	0	228.71	0	228.68	0	228.828
0.001	228.65	0.001	228.62	0.001	228.74	0.001	228.71	0.001	228.856
0.003	228.68	0.002	228.65	0.003	228.77	0.002	228.74	0.002	228.884
0.005	228.71	0.003	228.68	0.005	228.8	0.003	228.77	0.004	228.912
0.009	228.74	0.005	228.71	0.009	228.83	0.006	228.8	0.007	228.94
0.014	228.77	0.008	228.74	0.014	228.86	0.01	228.83	0.012	228.968
0.021	228.8	0.013	228.77	0.021	228.89	0.016	228.86	0.018	228.996
0.031	228.83	0.019	228.8	0.031	228.92	0.023	228.89	0.026	229.024
0.044	228.86	0.027	228.83	0.044	228.95	0.034	228.92	0.037	229.052
0.061	228.89	0.037	228.86	0.061	228.98	0.047	228.95	0.051	229.08
0.082	228.92	0.051	228.89	0.082	229.01	0.065	228.98	0.068	229.108
0.107	228.95	0.068	228.92	0.108	229.04	0.086	229.01	0.089	229.136
0.139	228.98	0.088	228.95	0.141	229.07	0.112	229.04	0.116	229.164
0.176	229.01	0.113	228.98	0.179	229.1	0.143	229.07	0.148	229.192
0.22	229.04	0.143	229.01	0.225	229.13	0.18	229.1	0.186	229.22
0.272	229.07	0.179	229.04	0.28	229.16	0.224	229.13	0.23	229.248
0.332	229.1	0.221	229.07	0.344	229.19	0.275	229.16	0.283	229.276
0.402	229.13	0.271	229.1	0.418	229.22	0.334	229.19	0.344	229.304
0.482	229.16	0.328	229.13	0.503	229.25	0.402	229.22	0.415	229.332
0.574	229.19	0.394	229.16	0.601	229.28	0.48	229.25	0.496	229.36
0.677	229.22	0.47	229.19	0.713	229.31	0.568	229.28	0.588	229.388
0.794	229.25	0.556	229.22	0.839	229.34	0.667	229.31	0.693	229.416
0.925	229.28	0.654	229.25	0.981	229.37	0.779	229.34	0.811	229.444

3. RIBAV 1D

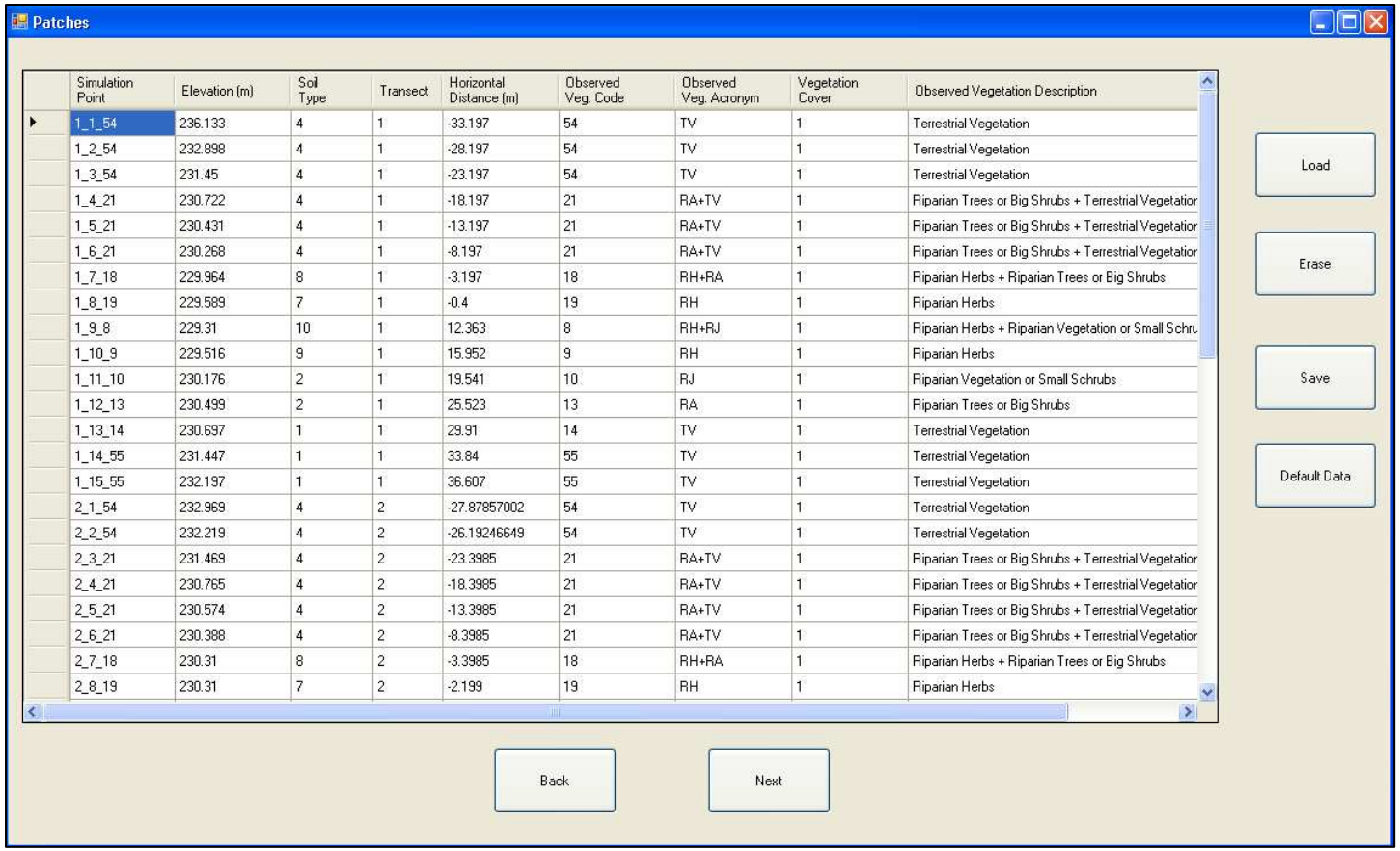
6. Daily River Levels



Date	River Level(m)_1	River Level(m)_2	River Level(m)_3	River Level(m)_4	River Level(m)_5
01/10/1998	229.249	229.286	229.329	229.343	229.439
02/10/1998	229.247	229.284	229.327	229.341	229.437
03/10/1998	229.231	229.267	229.311	229.324	229.422
04/10/1998	229.219	229.255	229.299	229.311	229.41
05/10/1998	229.233	229.27	229.314	229.326	229.424
06/10/1998	229.266	229.304	229.345	229.361	229.455
07/10/1998	229.324	229.363	229.401	229.42	229.509
08/10/1998	229.33	229.37	229.407	229.427	229.515
09/10/1998	229.33	229.369	229.406	229.426	229.515
10/10/1998	229.342	229.382	229.418	229.44	229.527
11/10/1998	229.346	229.385	229.422	229.443	229.53
12/10/1998	229.346	229.385	229.421	229.443	229.53
13/10/1998	229.342	229.381	229.418	229.439	229.526
14/10/1998	229.338	229.377	229.414	229.435	229.522
15/10/1998	229.333	229.372	229.41	229.43	229.518
16/10/1998	229.341	229.38	229.417	229.438	229.525
17/10/1998	229.332	229.371	229.408	229.429	229.516
18/10/1998	229.338	229.377	229.414	229.435	229.522
19/10/1998	229.319	229.358	229.396	229.415	229.505
20/10/1998	229.263	229.301	229.343	229.357	229.452

3. RIBAV 1D

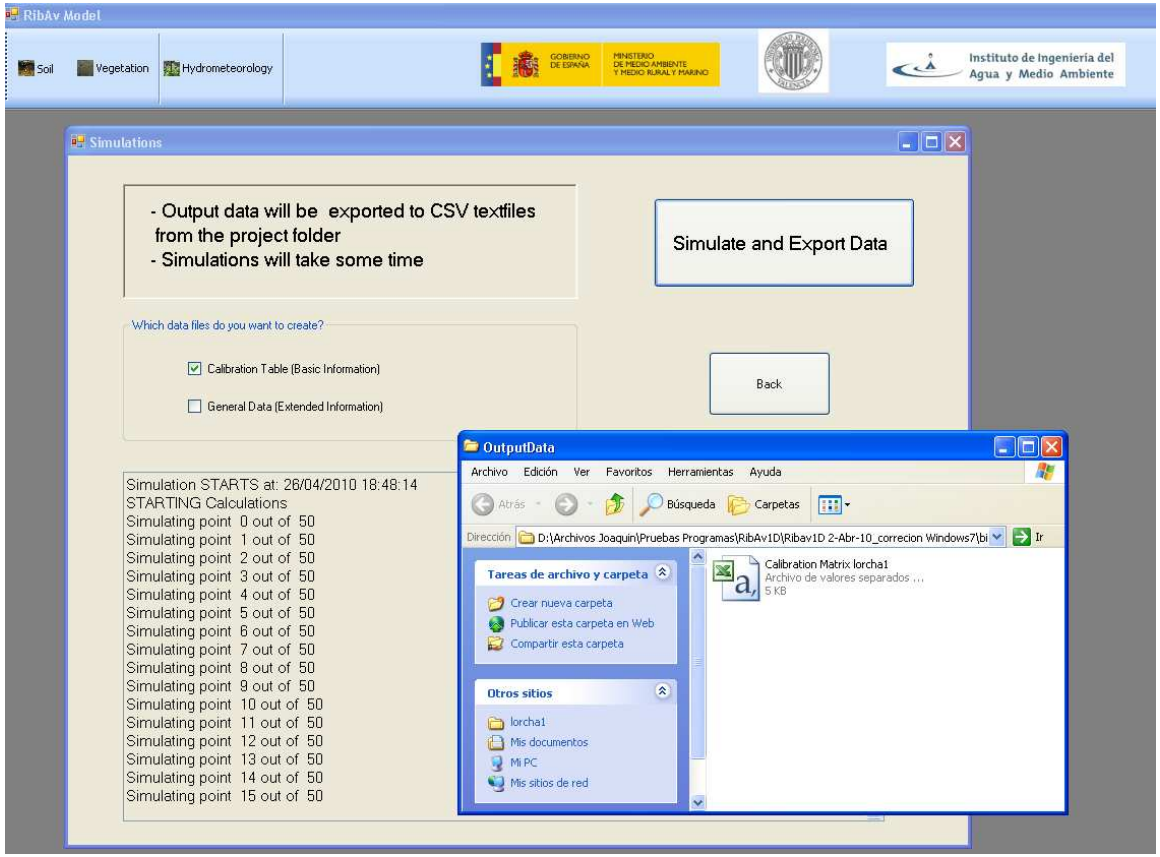
7. Simulation Point Data



Simulation Point	Elevation (m)	Soil Type	Transect	Horizontal Distance (m)	Observed Veg. Code	Observed Veg. Acronym	Vegetation Cover	Observed Vegetation Description
1_1_54	236.133	4	1	-33.197	54	TV	1	Terrestrial Vegetation
1_2_54	232.898	4	1	-28.197	54	TV	1	Terrestrial Vegetation
1_3_54	231.45	4	1	-23.197	54	TV	1	Terrestrial Vegetation
1_4_21	230.722	4	1	-18.197	21	RA+TV	1	Riparian Trees or Big Shrubs + Terrestrial Vegetatior
1_5_21	230.431	4	1	-13.197	21	RA+TV	1	Riparian Trees or Big Shrubs + Terrestrial Vegetatior
1_6_21	230.268	4	1	-8.197	21	RA+TV	1	Riparian Trees or Big Shrubs + Terrestrial Vegetatior
1_7_18	229.964	8	1	-3.197	18	RH+RA	1	Riparian Herbs + Riparian Trees or Big Shrubs
1_8_19	229.589	7	1	-0.4	19	RH	1	Riparian Herbs
1_9_8	229.31	10	1	12.363	8	RH+RJ	1	Riparian Herbs + Riparian Vegetation or Small Schru
1_10_9	229.516	9	1	15.952	9	RH	1	Riparian Herbs
1_11_10	230.176	2	1	19.541	10	RJ	1	Riparian Vegetation or Small Schrubs
1_12_13	230.499	2	1	25.523	13	RA	1	Riparian Trees or Big Shrubs
1_13_14	230.697	1	1	29.91	14	TV	1	Terrestrial Vegetation
1_14_55	231.447	1	1	33.84	55	TV	1	Terrestrial Vegetation
1_15_55	232.197	1	1	36.607	55	TV	1	Terrestrial Vegetation
2_1_54	232.969	4	2	-27.87857002	54	TV	1	Terrestrial Vegetation
2_2_54	232.219	4	2	-26.19246649	54	TV	1	Terrestrial Vegetation
2_3_21	231.469	4	2	-23.3985	21	RA+TV	1	Riparian Trees or Big Shrubs + Terrestrial Vegetatior
2_4_21	230.765	4	2	-18.3985	21	RA+TV	1	Riparian Trees or Big Shrubs + Terrestrial Vegetatior
2_5_21	230.574	4	2	-13.3985	21	RA+TV	1	Riparian Trees or Big Shrubs + Terrestrial Vegetatior
2_6_21	230.388	4	2	-8.3985	21	RA+TV	1	Riparian Trees or Big Shrubs + Terrestrial Vegetatior
2_7_18	230.31	8	2	-3.3985	18	RH+RA	1	Riparian Herbs + Riparian Trees or Big Shrubs
2_8_19	230.31	7	2	-2.199	19	RH	1	Riparian Herbs

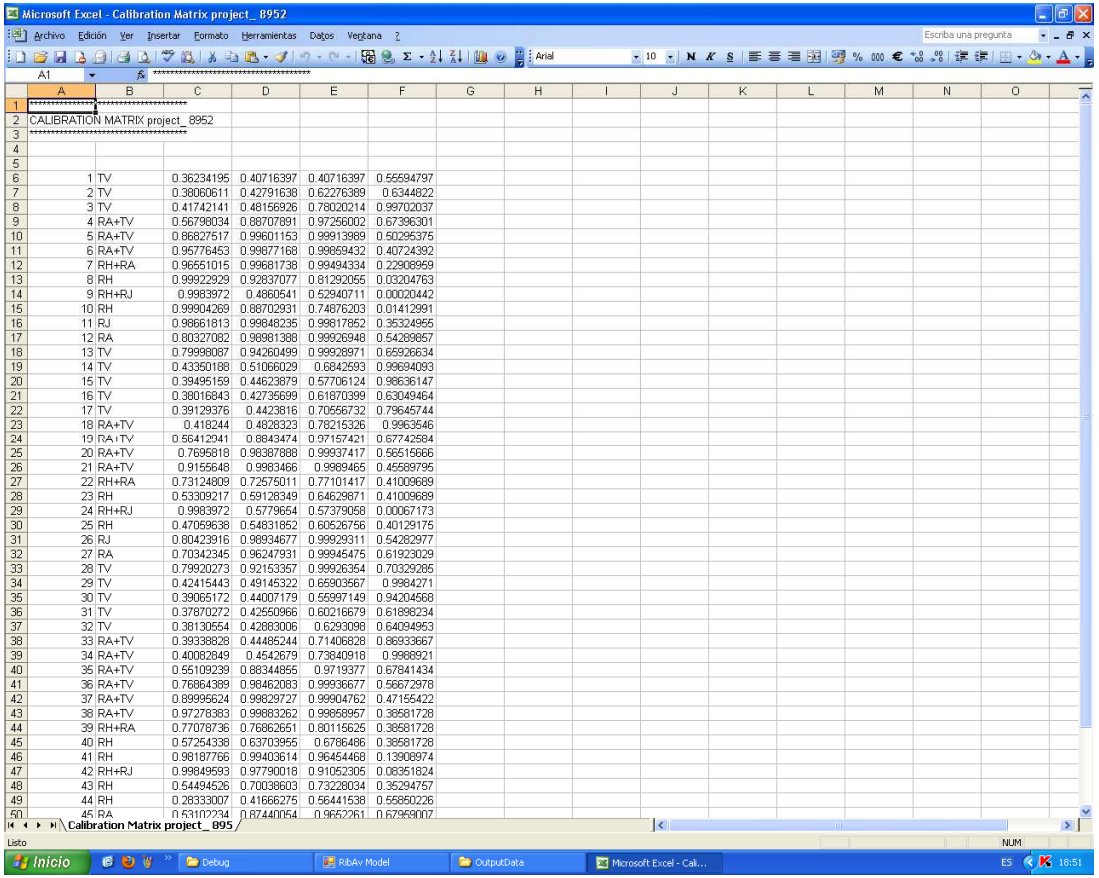
3. RIBAV 1D

8. Simulations Results Form



3. RIBAV 1D

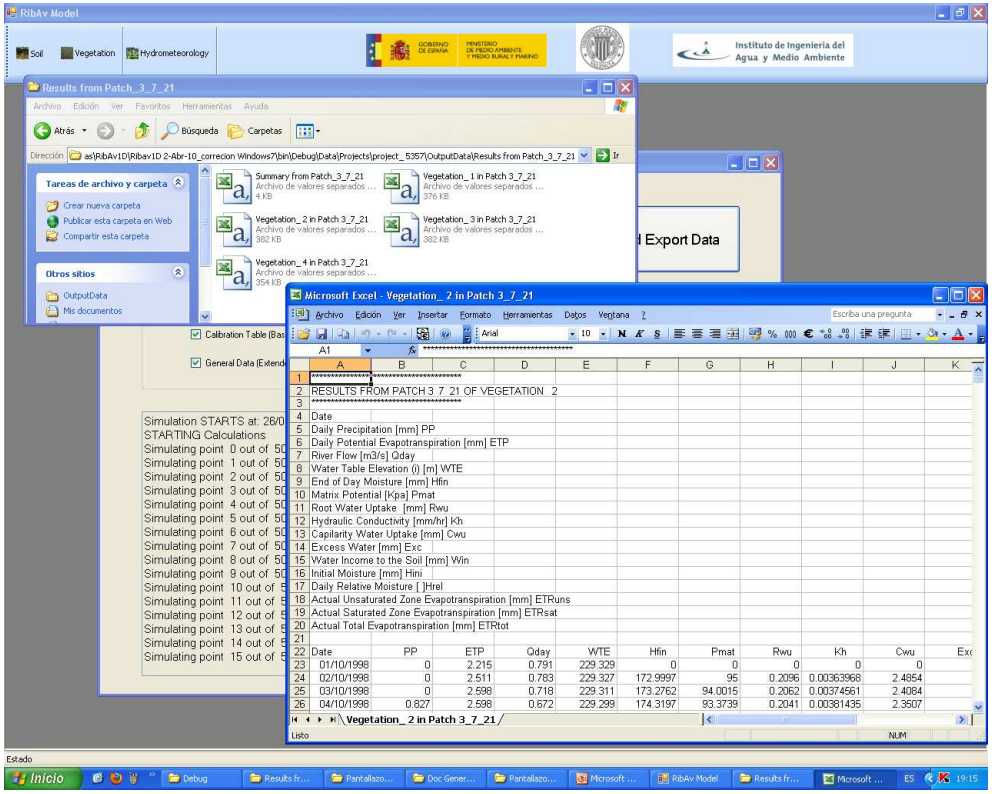
9.a. Calibration Table (Basic Information)



1	TV	0.36234195	0.40716397	0.40716397	0.55594797	
2	TV	0.38060611	0.42791638	0.62276389	0.6344822	
3	TV	0.41742141	0.48156926	0.78020214	0.99702037	
4	RA+TV	0.56798034	0.88707891	0.97256002	0.67396301	
5	RA+TV	0.86827517	0.99601153	0.99913989	0.50295375	
6	RA+TV	0.95776453	0.99877168	0.99859432	0.40724392	
7	RH+RA	0.96551015	0.99681738	0.99494334	0.22908959	
8	RH	0.99922929	0.92837077	0.81292055	0.03204763	
9	RH+RJ	0.9983972	0.4860541	0.52940711	0.00020442	
10	RH	0.99904269	0.88702931	0.74876203	0.01412991	
11	RJ	0.98661813	0.99848235	0.99817862	0.35324955	
12	RA	0.80327082	0.98981388	0.99926948	0.54289857	
13	TV	0.79998087	0.94260499	0.99928971	0.65926634	
14	TV	0.43350188	0.51066029	0.6842693	0.99694093	
15	TV	0.39495159	0.44623879	0.57706124	0.98636147	
16	TV	0.38016843	0.42735699	0.61870399	0.63049464	
17	TV	0.39129376	0.4423816	0.70556732	0.79645744	
18	RA+TV	0.418244	0.4828323	0.76215326	0.9963546	
19	RA+TV	0.56412941	0.8843474	0.97157421	0.67742584	
20	RA+TV	0.7695818	0.98387888	0.99937417	0.56515666	
21	RA+TV	0.9155648	0.9983466	0.9989465	0.45589795	
22	RH+RA	0.73124809	0.72575011	0.77101417	0.41009689	
23	RH	0.53309217	0.59128349	0.64629871	0.41009689	
24	RH+RJ	0.9983972	0.5779654	0.57379058	0.00067173	
25	RH	0.47059638	0.54831852	0.60526756	0.40129175	
26	RJ	0.80423916	0.98934677	0.99929311	0.54282977	
27	RA	0.70342345	0.96247931	0.99945475	0.61923029	
28	TV	0.79920273	0.92153357	0.99926354	0.70329285	
29	TV	0.42415443	0.49145322	0.65903567	0.9984271	
30	TV	0.39065172	0.44007179	0.55997149	0.94204568	
31	TV	0.37870272	0.42550966	0.60216679	0.61898234	
32	TV	0.38130554	0.42883006	0.6293098	0.64094953	
33	RA+TV	0.39338828	0.44485244	0.71406828	0.86933667	
34	RA+TV	0.40082849	0.4542679	0.73840918	0.9988921	
35	RA+TV	0.55109239	0.88344855	0.9719377	0.67841434	
36	RA+TV	0.76864389	0.98462083	0.99936677	0.56672978	
37	RA+TV	0.89996624	0.99829727	0.99904762	0.47155422	
38	RA+TV	0.97278383	0.99883262	0.99858967	0.38581728	
39	RH+RA	0.77078736	0.76862651	0.80115625	0.38581728	
40	RH	0.57254338	0.63703955	0.6786486	0.38581728	
41	RH	0.98187766	0.99403614	0.96454468	0.13908974	
42	RH+RJ	0.99849593	0.97790018	0.91052305	0.08351824	
43	RH	0.54494526	0.70038603	0.73228034	0.35294757	
44	RH	0.28333007	0.41666275	0.56441538	0.55850226	
45	RA	0.53107234	0.87440054	0.9662261	0.67959007	

3. RIBAV 1D

9.b General Data for a given simulation point for a given vegetation type



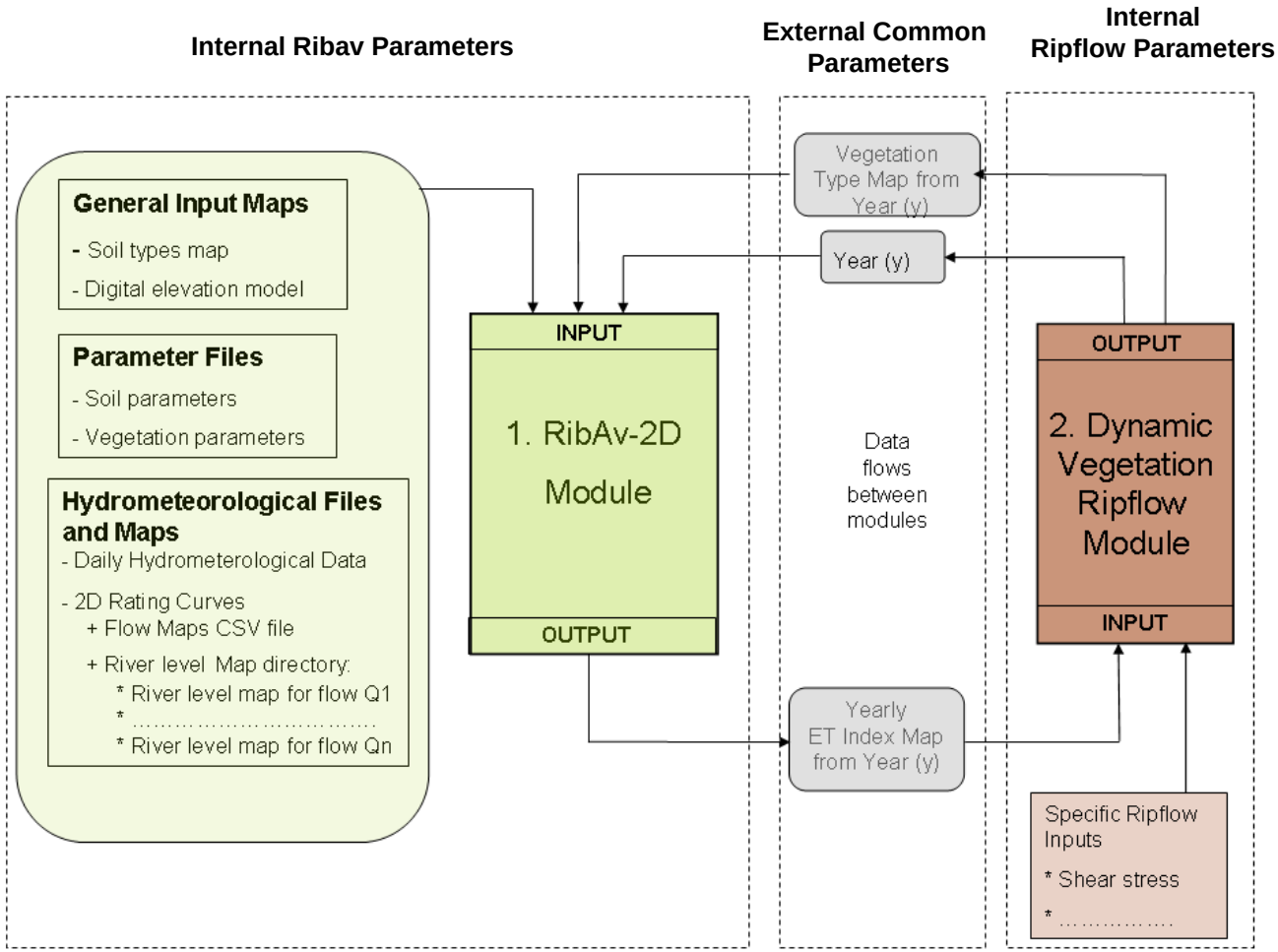
4. Ribav 2D

1. General Characteristics of Ribav 2D

Although the mathematical model conceptualization is the same as in Ribav 1D, It uses raster grids instead of using simulation points.

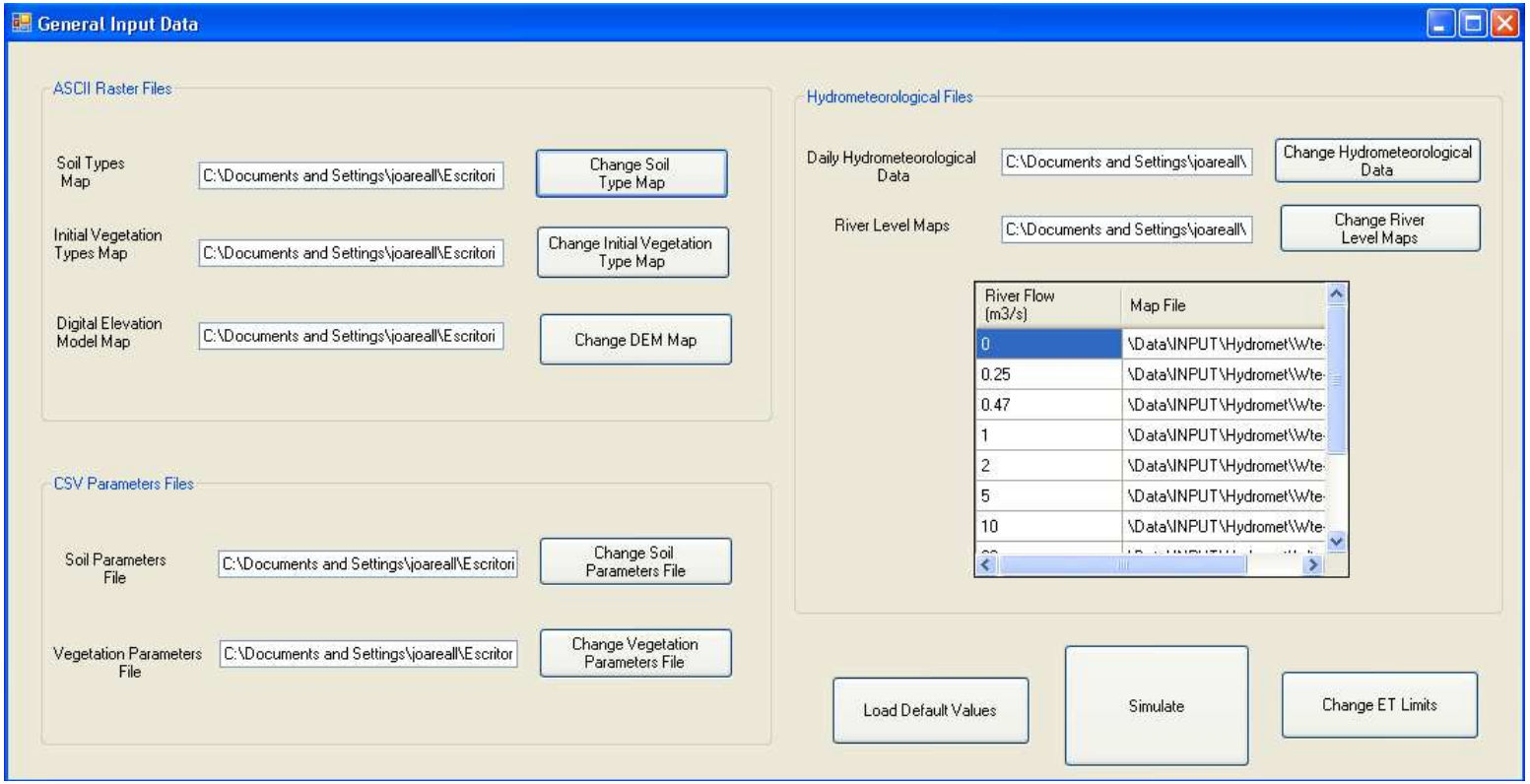
- It requires a greater quantity of data than Ribav 1D and it takes more time to carry out the simulations.
- It is able to integrate within Ripflow.

2. Internal and External Ribav Parameters



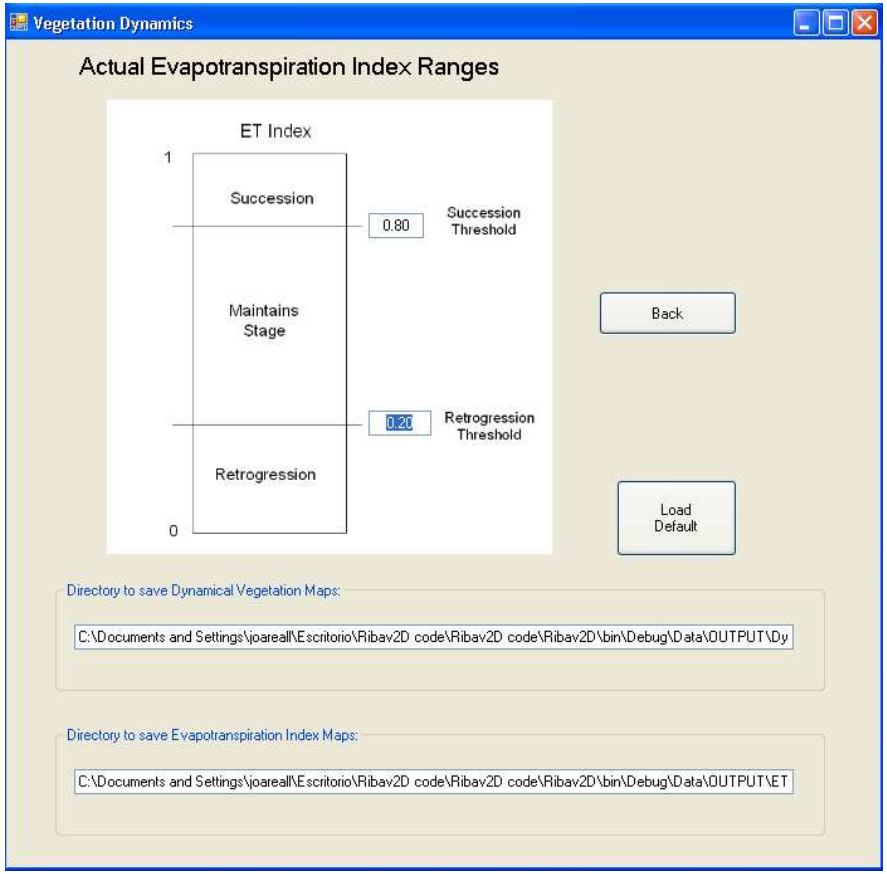
4. Ribav 2D

2. General Input Data



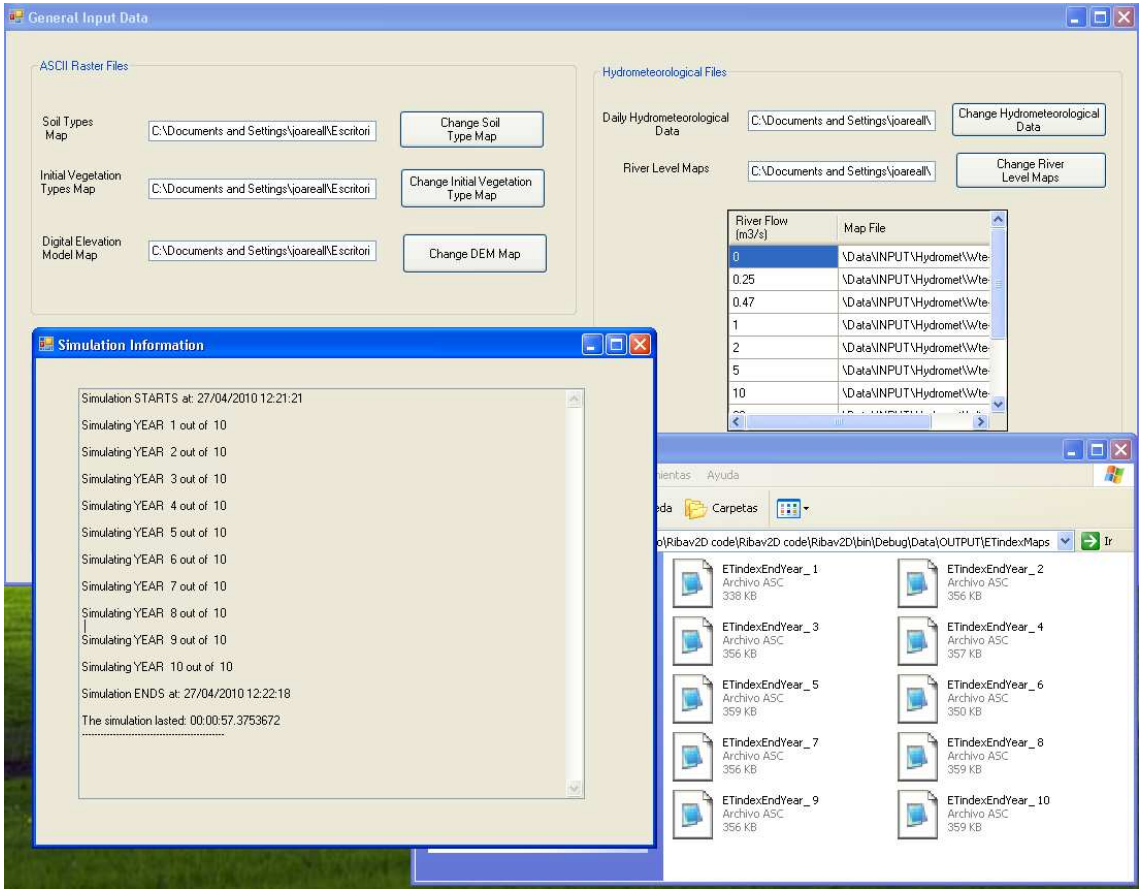
4. Ribav 2D

3. Vegetation Dynamics

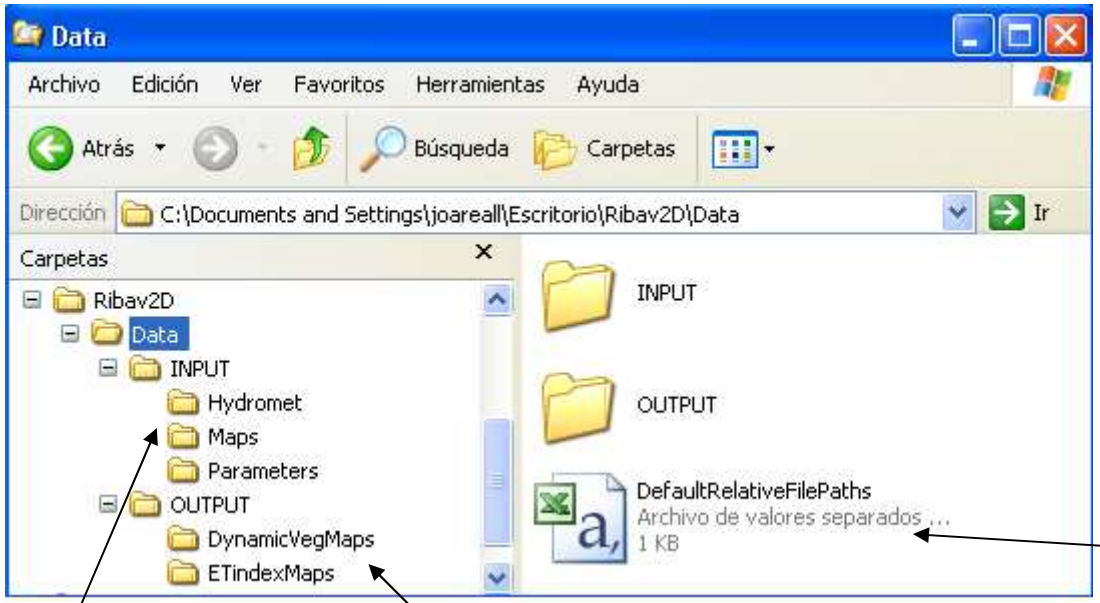


4. Ribav 2D

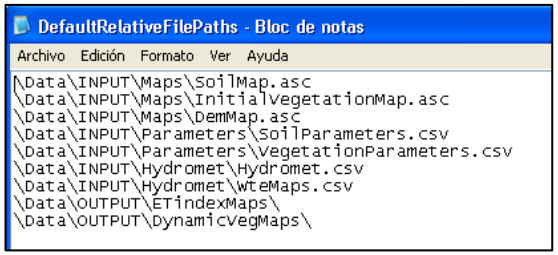
4. Simulation Screens



5. Directory Structure of Ribav 2D



This file points out to the paths of the input files that are going to appear as **Default**



Input files required for the simulation

Output files created by the simulation

4. Ribav 2D

6. Internal structure for the Ribav2D files

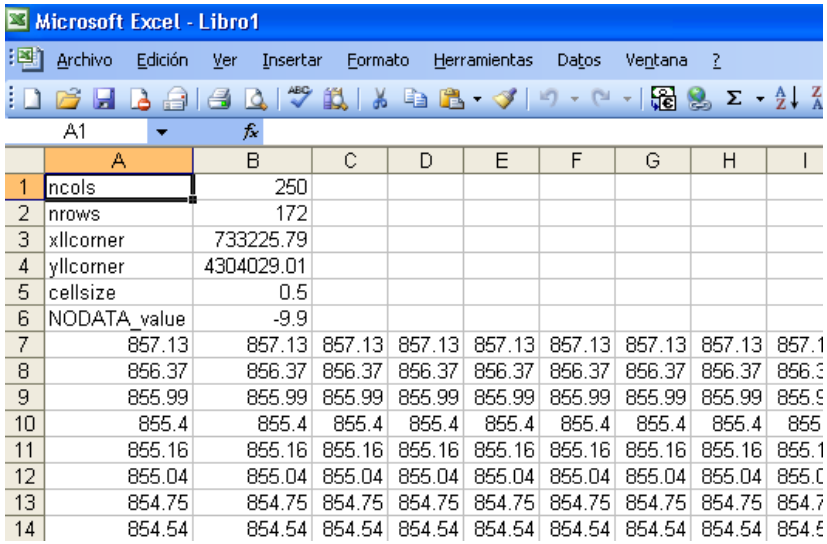
Types of files:

- ASCII files → I/O **maps**
- CSV files → Parameters (soil and vegetation)
  → Hydrometeorological series
  →File Paths

All files in the Ribav 2D module have a **relative path** (from the Ribav executable) to make more easy integration with RIPFLOW.

4. Ribav 2D

6.1 ASCII Map files



	A	B	C	D	E	F	G	H	I
1	ncols	250							
2	nrows	172							
3	xllcorner	733225.79							
4	yllcorner	4304029.01							
5	cellsize	0.5							
6	NODATA_value	-9.9							
7	857.13	857.13	857.13	857.13	857.13	857.13	857.13	857.13	857.1
8	856.37	856.37	856.37	856.37	856.37	856.37	856.37	856.37	856.3
9	855.99	855.99	855.99	855.99	855.99	855.99	855.99	855.99	855.9
10	855.4	855.4	855.4	855.4	855.4	855.4	855.4	855.4	855
11	855.16	855.16	855.16	855.16	855.16	855.16	855.16	855.16	855.1
12	855.04	855.04	855.04	855.04	855.04	855.04	855.04	855.04	855.0
13	854.75	854.75	854.75	854.75	854.75	854.75	854.75	854.75	854.7
14	854.54	854.54	854.54	854.54	854.54	854.54	854.54	854.54	854.5

Example of a Digital Elevation input file in ASCII format

Ncols: Number of columns in Map
Nrows: Number of rows in Map
Xllcorner: X coordinate of the bottom(south)- left(west) corner
Yllcorner: Y coordinate of the bottom(south)- left(west) corner
Cellsize: dimensions of the square cells
NODATA_value: value of the cells that are irrelevant and do not take part in the simulation

4. Ribav 2D

6.2 CSV File

Soil parameters

Key; Porosity; Porosity Index; Bubble Pressure; Saturated Conductivity; Field Capacity Moisture; Minimum Capillary Depth; Soil Description

Soil Type

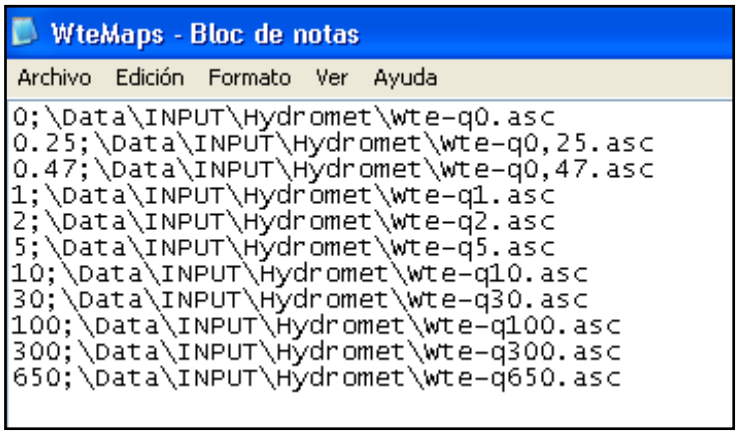
SoilParameters - Bloc de notas

Archivo Edición Formato Ver Ayuda

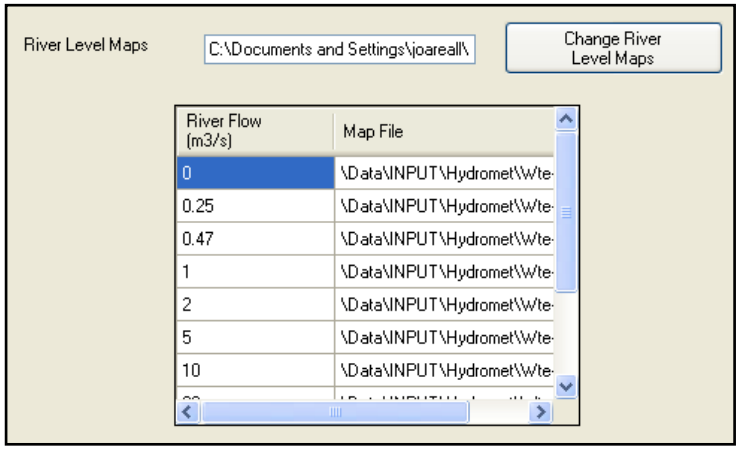
```
1;0.397;0.530167165;3.8475892;56.24;0.131;15;Suelo 1
2;0.436;0.208469336;0.341722491;22.65;0.168;15;Suelo 2
3;0.441;0.225872182;2.625401278;19.91;0.247;15;Suelo 3
4;0.406;0.277030515;1.036884215;42.76;0.154;15;Suelo 4
5;0.412;0.22005783;0.056949035;28.19;0.102;15;Suelo 5
6;0.432;0.183539035;0.245762728;37.09;0.174;15;Suelo 6
7;0.414;0.251033223;0.023664714;97.96;0.069;15;Suelo 7
8;0.435;0.238123083;0.983633766;40.39;0.189;15;Suelo8
9;0.398;0.278307418;2.370330035;26.83;0.19;15;Suelo 9
10;0.403;0.206462167;0.044614143;25.06;0.104;15;Suelo 10
```

4. Ribav 2D

Another example of CSV file → Flow-WTE File Map



Program reads the default river level map and loads it to the data table



Flow (m3/s); Map with Water Table Elevation related to that flow (m.a.s.l.)

5. Methods to integrate Ribav 2D within Ripflow

Three Methods:

1. Through text files
2. DLL Files
3. Using CLI from MS Visual Studio.net

5. Methods to integrate Ribav 2D within Ripflow

1. Integration through text files

Advantages:

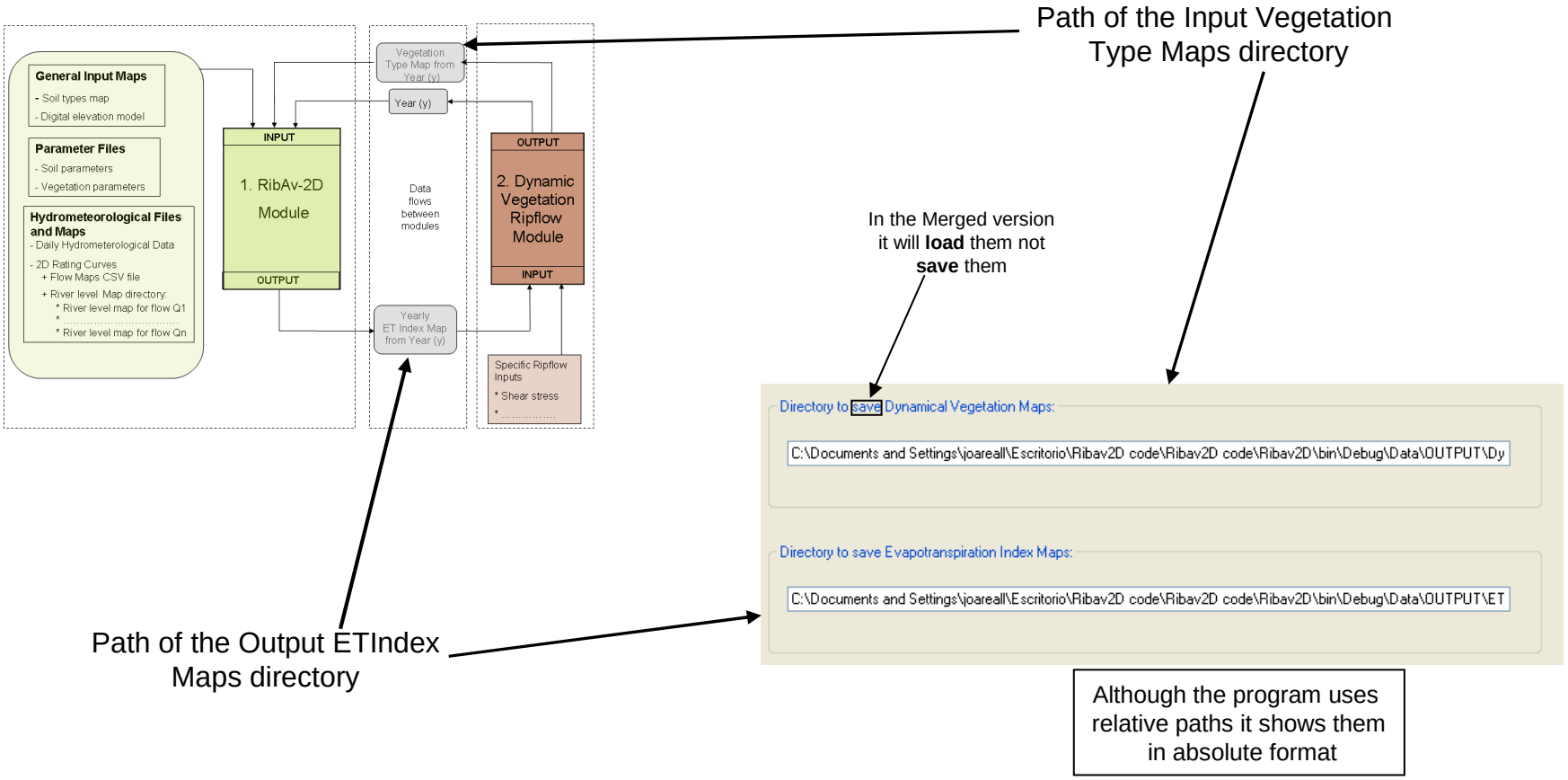
- Relatively easy to integrate with ArcGis and Python.
- Easier to carry out modifications.
- More easy to understand input and ouput flows within both modules.
- Recommended in the first version of Ribav.

Disadvantages:

- Less performance speed.
- Not very intuitive for a non-expert user

5.Methods to integrate Ribav 2D within Ripflow

Actual example of Textfile usage:



5. Methods to integrate Ribav 2D within Ripflow

2. DLL Files

- They stand for Dynamic Link Library and they are implemented for the Microsoft shared library for Windows.
- They are files that store functions and subroutines and can be created/loaded in different programming languages.
- The main characteristic is that they are "**Encapsulated**", so a programmer can use them without knowing their internal code, only by defining their parameter inputs and expecting the outputs.
- They normally have a .dll extension although they can have a .ocx if they are related to the Directx graphic library

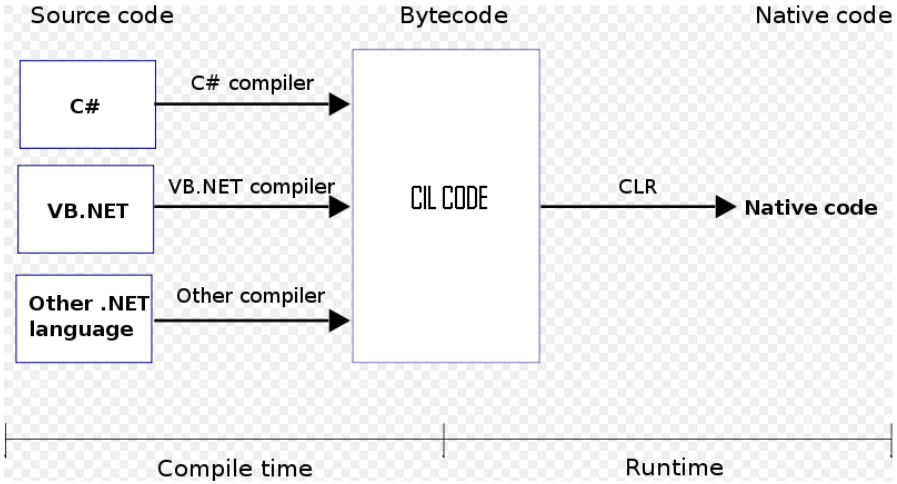
5. Methods to integrate Ribav 2D within Ripflow

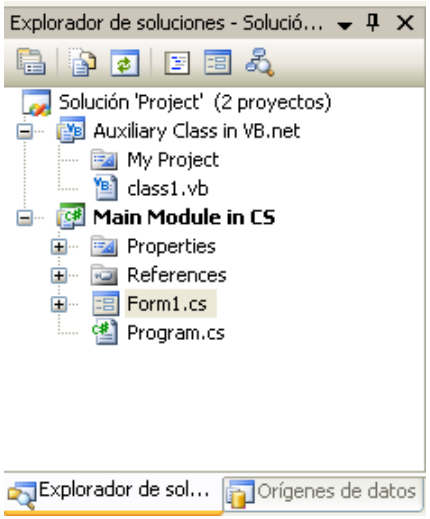
3. Microsoft studio CLI

- It stands for Common Language Infrastructure.
- It is a component of the .NET framework which permits the usage of **different programming languages** in the source code of a program.
- To do this it uses an intermediate language called CIL (Common Intermediate Language) to which the various source code languages (C#, C++, VBasic…) are translated during the compilation.
- At runtime the CIL language is converted to the native code that the operating system or the computer understands.

5. Methods to integrate Ribav 2D within Ripflow

CLI Flow Diagram





Example of a Project in Visual Studio 2008 with modules in different languages (C# and VB.net)