User Manual

Version 1.0.0

September 2021

About SimStream-Web

SimStream-Web is a web service available at the url: https://mesohabsim.isprambiente.it/. It allows to obtain, for perennial and temporary rivers, the following outputs:

A. The habitat availability, over space and time, for target species (or life stages) of interest. In particular, the service generates the geo-referenced habitat maps in a shapefile format, the habitat-flow rating curves and the habitat time series.

B. The Habitat Integrity Index (IH) associated with one or more hydrological or morphological management scenarios at the reach, segment or catchment scale.

Contents

1. Accessing SimStream-Web

SimStream-Web can be run by accessing to the web page https://mesohabsim.isprambiente.it/. The first page (Figure 1) asks for personal login credentials. If personal login credentials are not available, please ask for registration by contacting the e-flow team at eflows@isprambiente.it.

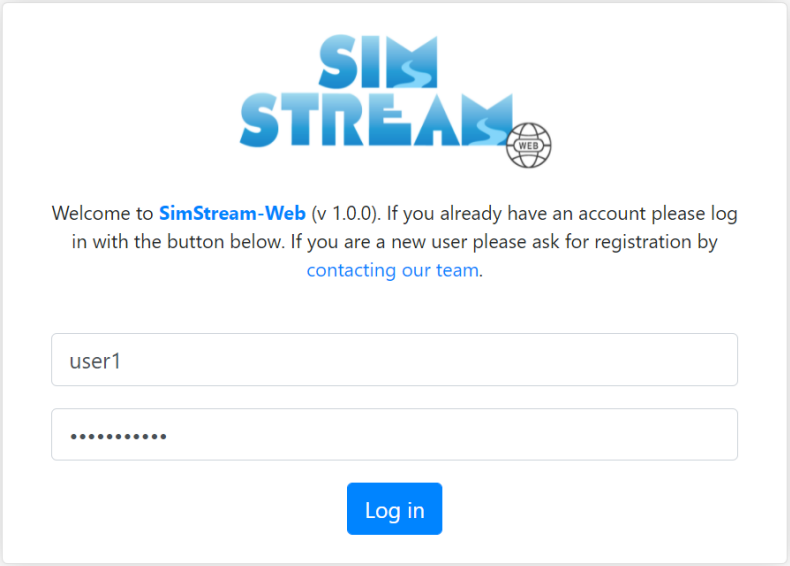

Figure 1: SimStream-Web login form.

After the first log in, the user has to read and accept the terms of service; in particular, the user needs

- To accept the terms of the GNU GPL v3 license;
- To use, for his/her own protection, the Creative Commons Attribution-Non Commercial-No Derivs 4.0 license (acronym: CC BY-NC-ND 4.0) to upload the data in the SimStream-Web service;
- To use the outputs of the SimStream-Web service under the terms of the Creative Commons Attribution-No Derivs 4.0 license (acronym: CC BY-ND 4.0);
- To provide feedbacks on the applications of the MesoHABSIM methodology and the use of the SimStream-Web service.

The SimStream-Web Homepage (Figure 2) shows two possible sessions: "*Calculate session*" and "*Download session*". The former allows the user to insert hydro-morphological information to evaluate river habitats, whereas the latter allows the user to download results from the SimStream-Web project database.

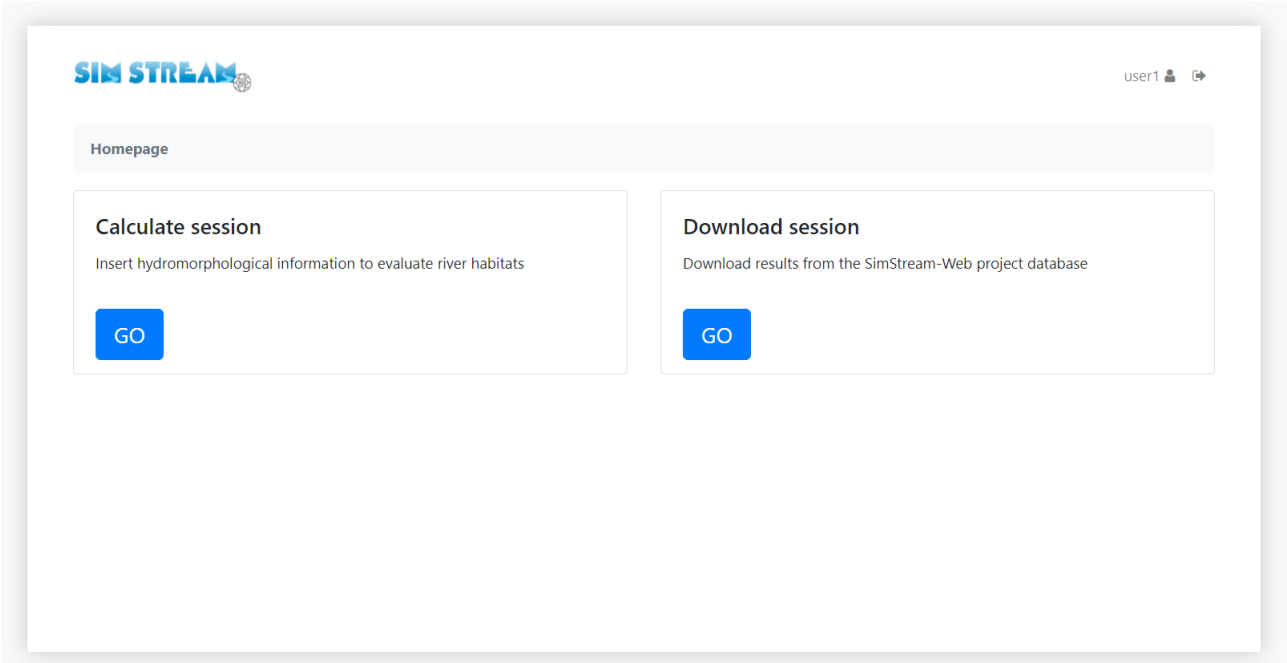

Figure 2: SimStream-Web Homepage.

By accessing the "*Calculate session*" (Figure 3), the user can:

(i) start compiling a "*New project*", by inserting hydro-morphological information to evaluate river habitats, or

(ii) calculate the Habitat Integrity Index (IH) at a river segment or at a catchment scale by merging results from previous projects (see section 9 of the present User Manual).

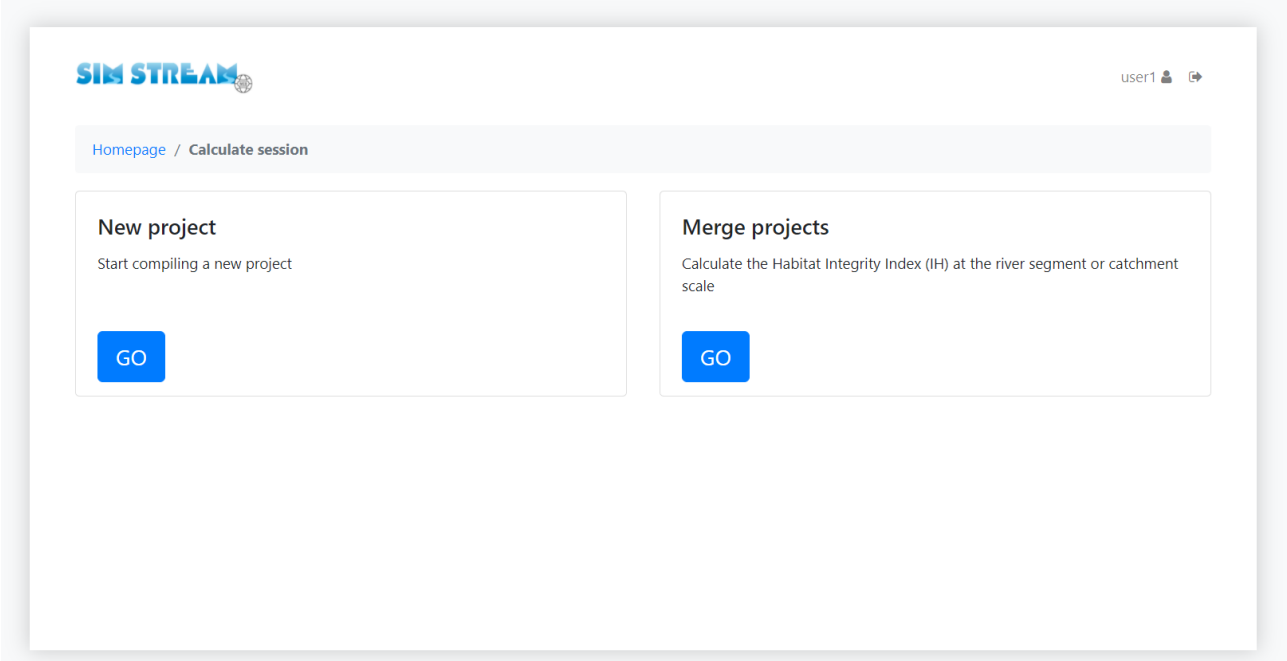

Figure 3: Calculate session page.

2. Perennial river: site data and project settings

Once the "*New project*" page has been opened, the project information can be set in the "*Site data and project settings*" section (Figure 4). It is important to highlight that, in every section, help pages are provided to show additional information on the data meaning and format. The help pages can be visualized by clicking on the *"Help?"* top-right button (see Figure 4).

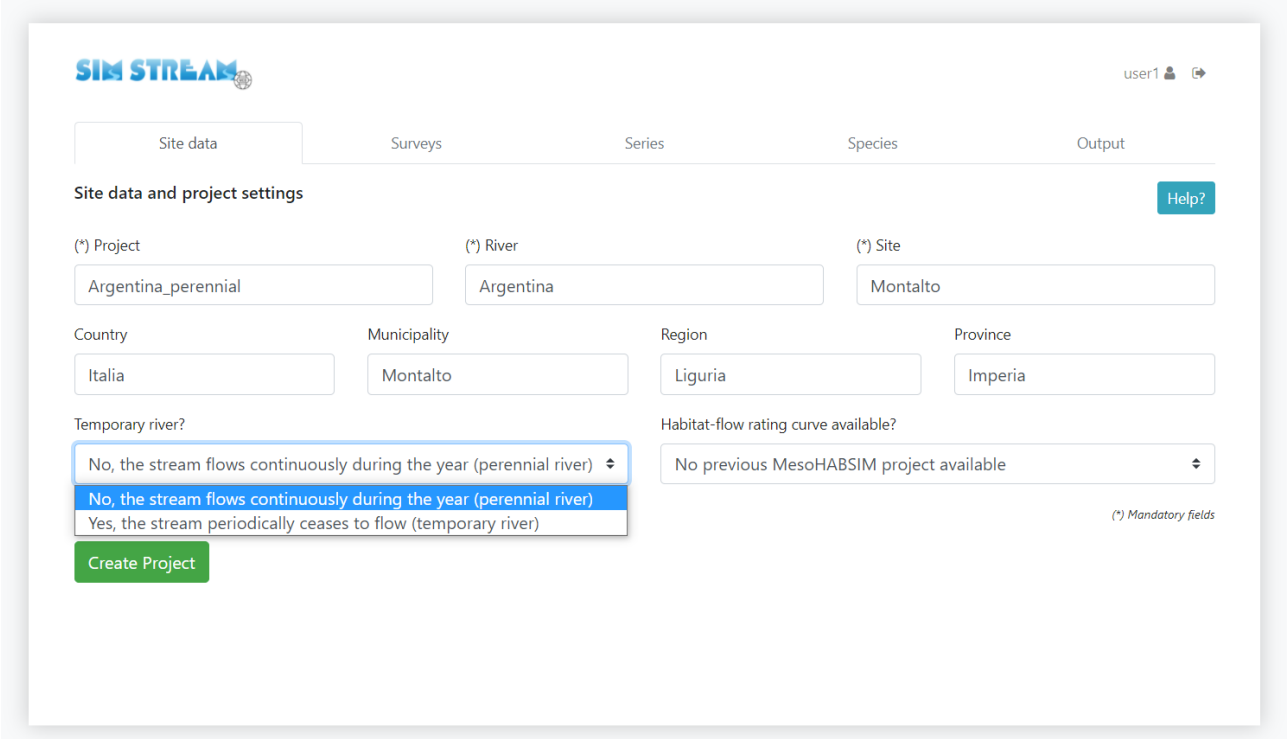

Figure 4: Site data and project settings (perennial river).

Project, River and Site names are mandatory fields and are required in Latin alphabet. Any special character, accent, apostrophe, or symbol must be avoided (e.g., the word "Démêlé" must be changed to "Demele"). Additional, non-mandatory data refer to the Country, Municipality, Region and Province of the study site.

From the drop-down menu at the bottom left (Figure 4), the user can select the river hydrological regime, distinguishing between "*perennial river*" and "*temporary river*". By setting the project type to the option "*perennial river*" (default setting), zero-discharge values are not allowed for both Hydro-Morphological Surveys and Streamflow Time Series. By setting the project type to the option "*temporary river*", the software allows to enter zero-discharge values and requires additional data inputs aimed at describing the riverbed drying process after flow cessation.

From the drop-down menu at the bottom right (Figure 5), the user has the possibility to create a new project from scratch or chose an existing, previous one. By selecting the option "*No previous MesoHABSIM project available*" (default setting), a new project will be created. If the option "*Yes, take the curve from a previous MesoHABSIM project*" is selected, the user can choose the project from which the habitat-flow rating curve will be extracted (Figure 6).

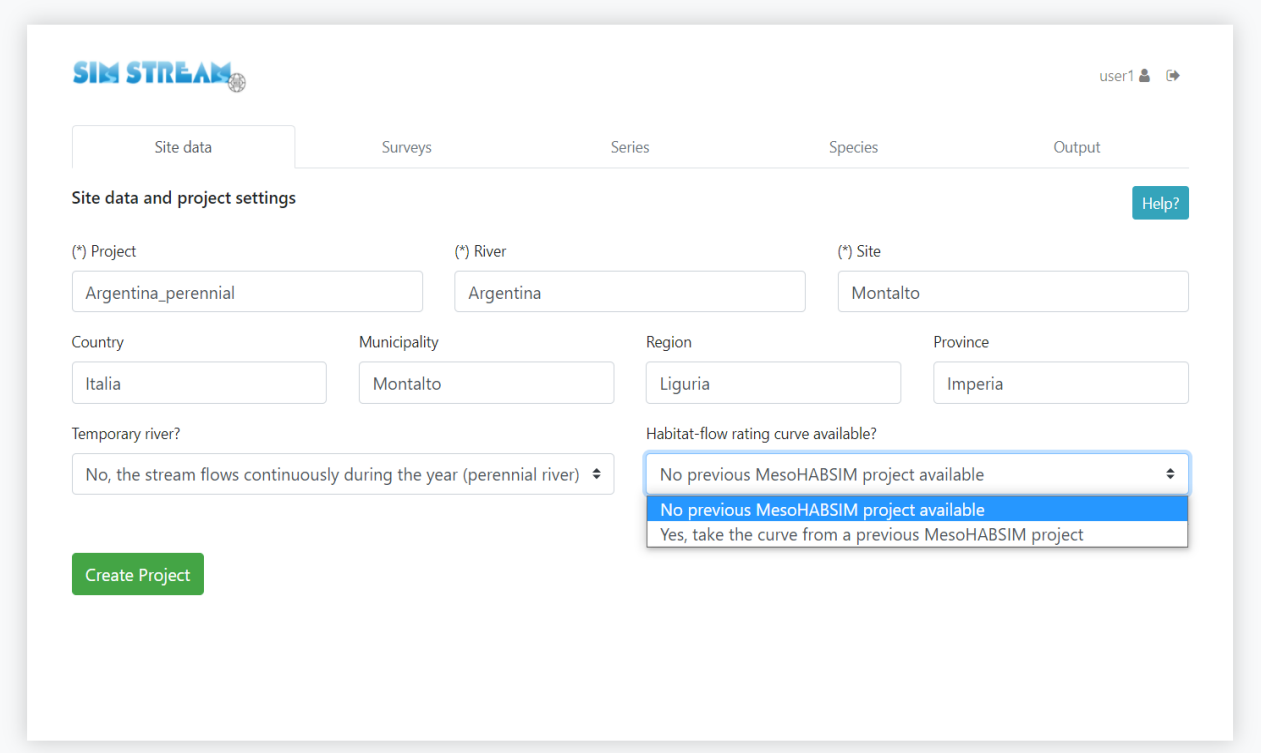

Figure 5: No habitat-flow rating curve available from previous projects.

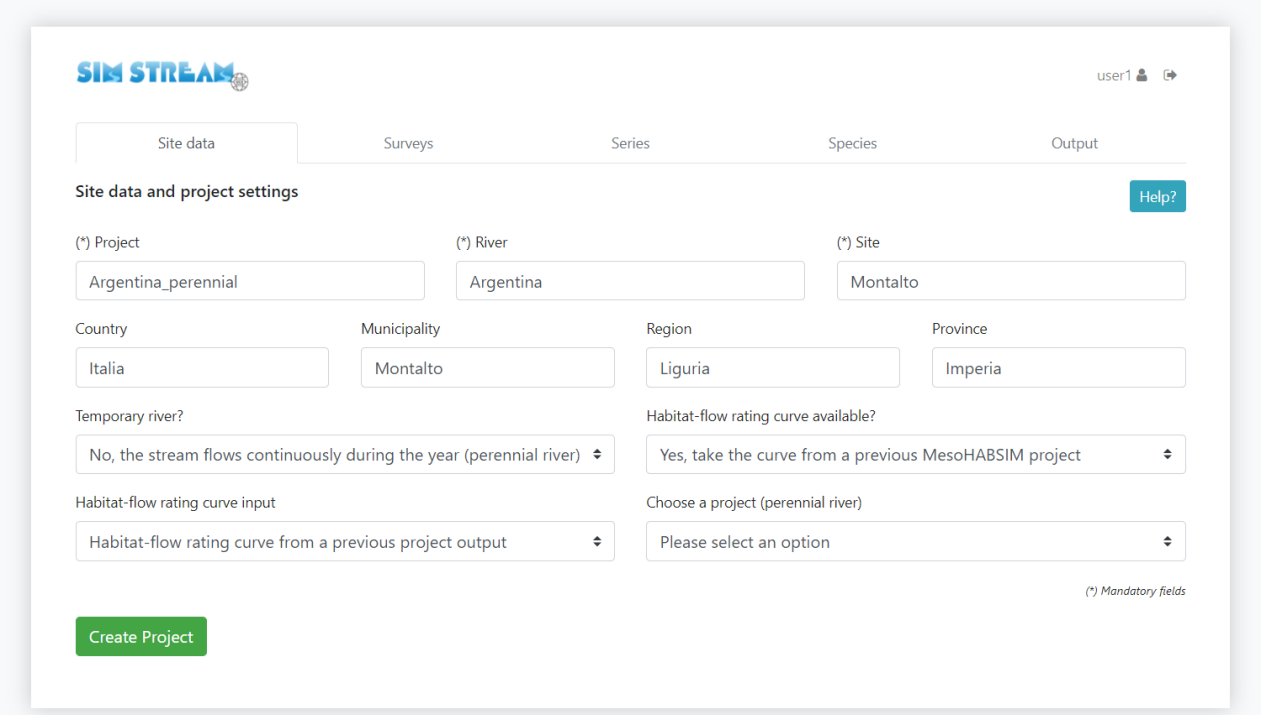

Figure 6: Habitat flow-rating curve available from previous projects.

After entering the required data, the user can create a new project by pressing the "*Create project*" button and confirm the data entry. The user can now click "*Next*" to proceed to the next page or click "*Delete*" to remove the entered data.

3. Perennial river: hydro-morphological data

For a perennial river, the data requested for each hydro-morphological survey are the following (see Figure 7):

i. Date of the survey.

ii. Discharge expressed in m^3/s. Inserted discharge values must be in increasing order.

iii. Hydro-Morphological Units (HMUs) as a shapefile, composed by a set of 4 files (file extensions: .shp, .shx, .dbf, and .prj).

iv. Point measurements as a tab-delimited text (.txt) composed by the measurements of depth, velocity and substrate taken in every HMU.

After entering all hydro-morphological data, a check on the physical consistency among all hydro-morphological surveys will be automatically performed. Simple rules must be respected:

- wetted area must increase as discharge increases;
- flow velocity distribution must reasonably increase as discharge increases;
- water depth distribution must reasonably increase as discharge increases;
- substrate frequency distribution must reasonably be similar among surveys with similar wetted area values.

If the previous rules are not respected warning logs will pop up. Warning logs, resulting from the data validation process, are important information provided for the user, and can be visualized by clicking on the *"Show warning logs"* yellow button (Figure 8).

To confirm surveys data entry, the user can click "*Save survey*" or "*Save survey and add new one*" and wait for data validation. The user can also modify the previously entered data and confirm the change with the "*Save survey*" button, as well as remove the files containing the entered data by clicking on the icon  (see Figure 8).

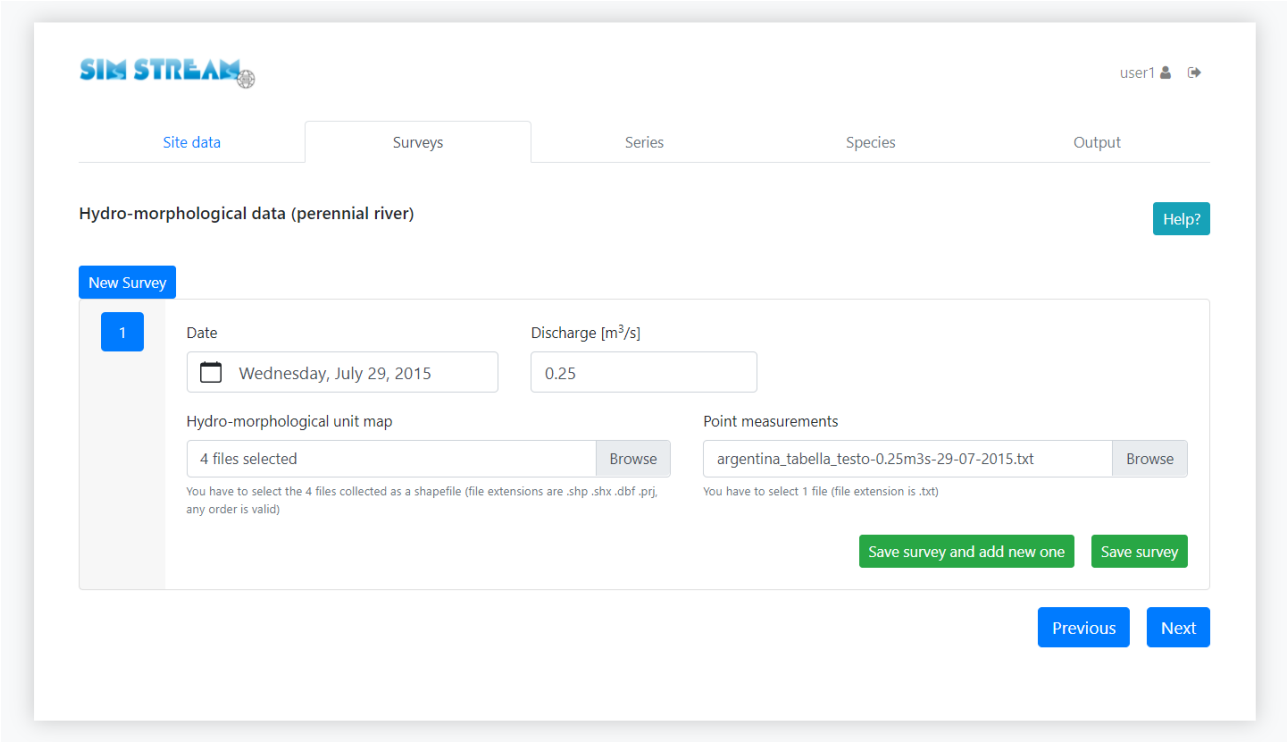

Figure 7: Hydro-morphological data entry (perennial river).

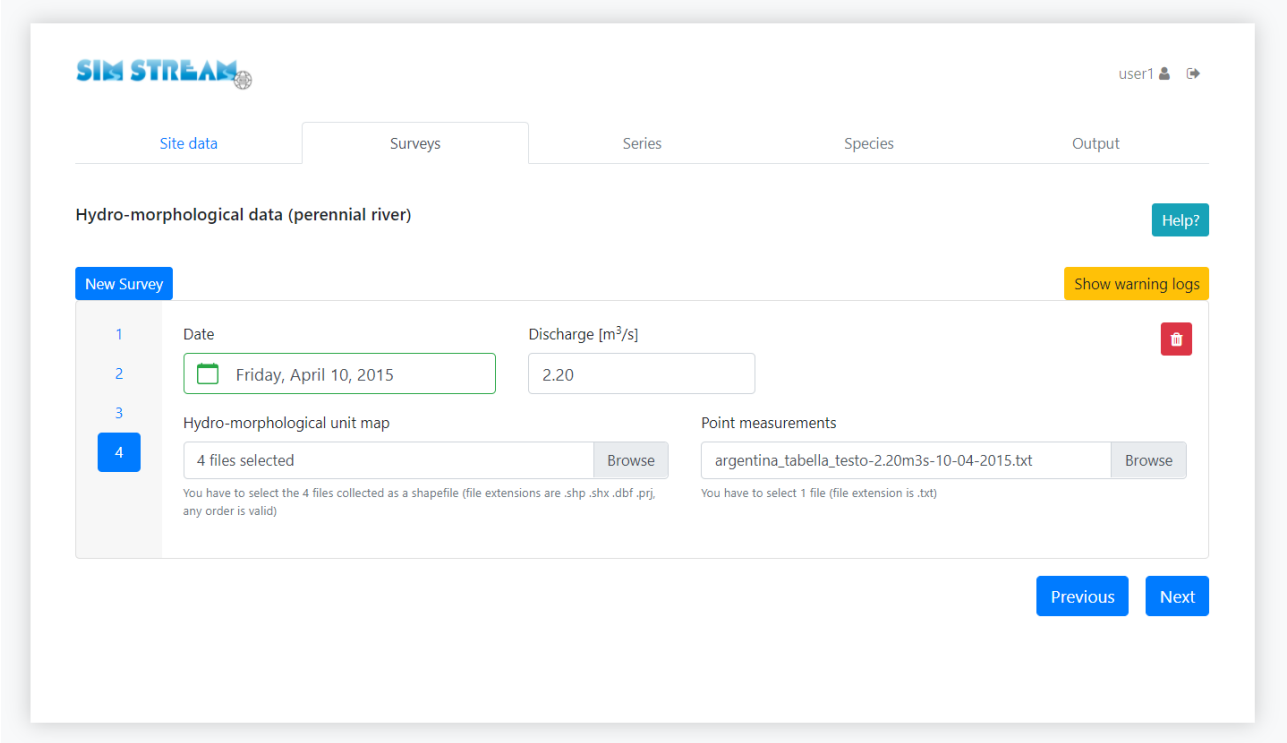

Figure 8: End of Hydro-morphological data entry (perennial river).

Once the hydro-morphological data are successfully uploaded, the user can click "*Next*" to continue to the next page ("*Series*") or click "*Previous*" to return to the previous page ("*Site data*").

4. Temporary river: site data and project settings

Temporary rivers are defined as watercourses that may dry up for some period of time within the year (EU Water Framework Directive – WFD 2000/60/CE). As for perennial rivers, Project, River and Site names are mandatory fields and are required in Latin alphabet. Any special character, accent, apostrophe, or symbol must be avoided (e.g., the word “Démêlé” must be changed to “Demele”). Additional, non-mandatory data refer to the Country, Municipality, Region and Province of the study site.

From the drop-down menu at the bottom left (Figure 9), the user can select the river hydrological regime, distinguishing between “*perennial river*” and “*temporary river*”. By setting the project type to the option “*temporary river*”, the software allows to enter zero-discharge values and requires additional data inputs aimed at describing the riverbed drying process after flow cessation.

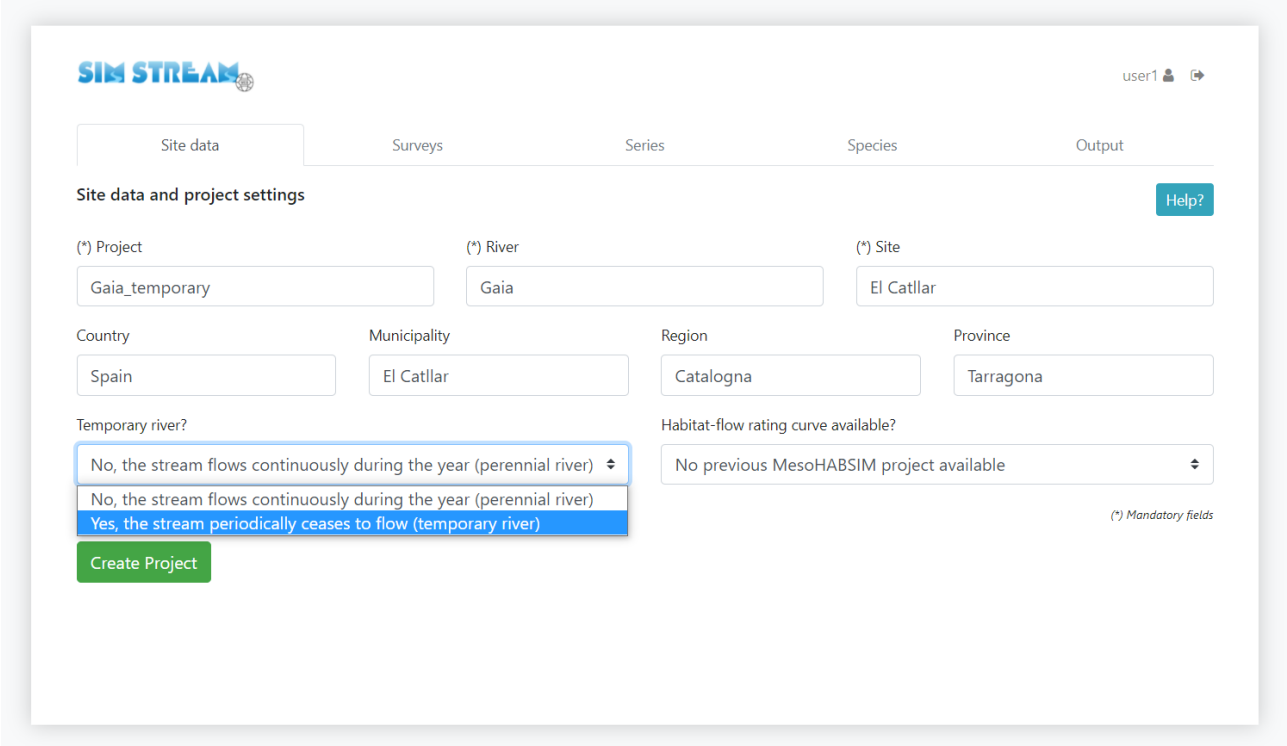

Figure 9: Site data and project settings (temporary river).

By setting the project type to the option “*temporary river*”, the river drying information is requested (Figure 10). From the drop-down menu, the user can:

(i) select “*river drying case*” if the wetted area, as well as the aquatic habitat availability, gradually reduces to zero;

(ii) select “*permanent ponding case*” if the ponding phase lasts indefinitely even if the surface flow rate is zero for a long time period. This situation can happen in reaches fed by groundwater and the analysed river reach can be characterized by a permanent ponding phase.

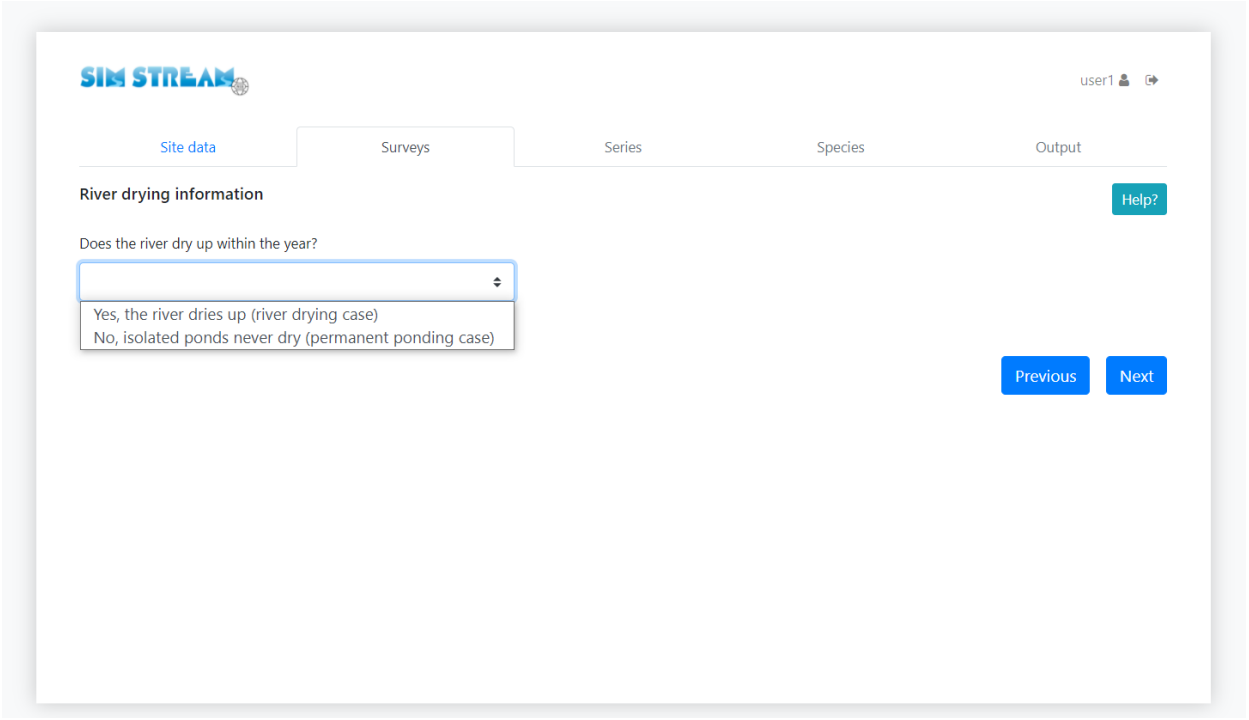

Figure 10: Selection between "river drying case" and "permanent ponding case".

After selecting the river drying information, the user has to insert:

(i) the "*Number of days to have a dry riverbed after flow ceased*" for a river drying case (Figure 11);

(ii) the "*Number of days to reach permanent ponding phase*" for a permanent ponding case (Figure 12).

To confirm river drying information entry, the user has to click "*Save information*".

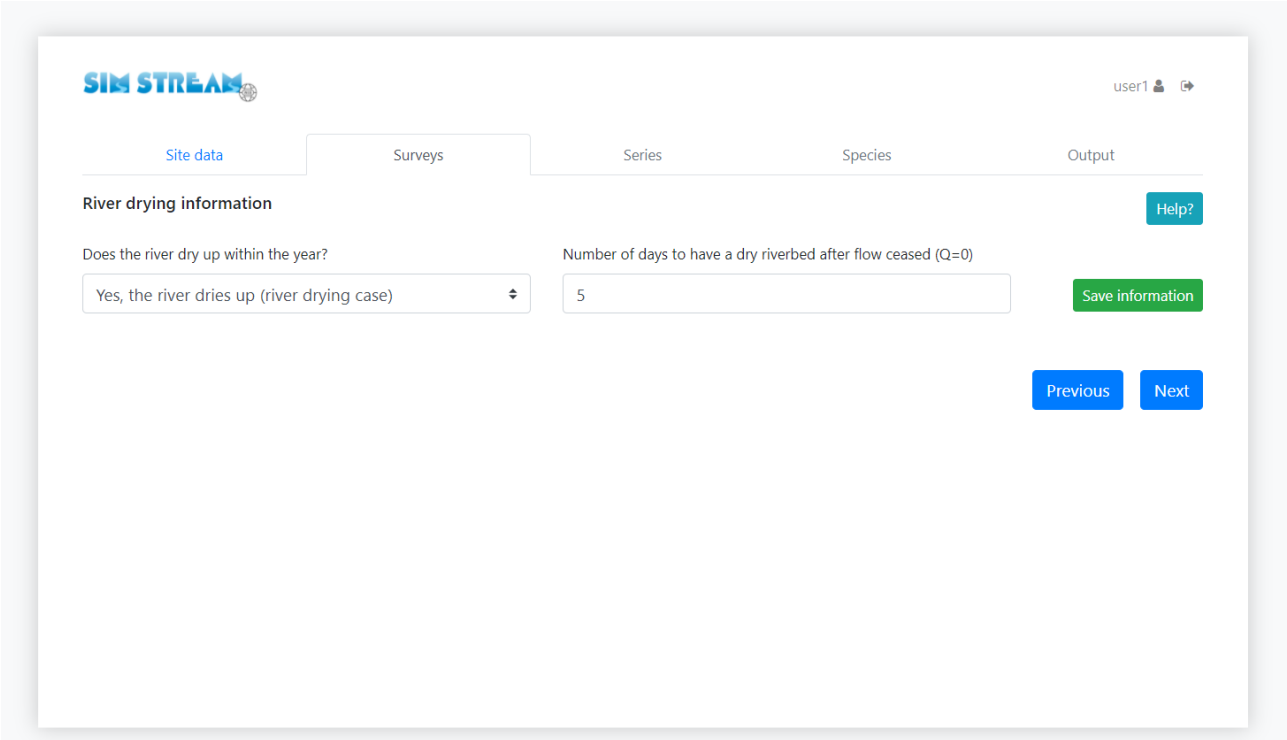

Figure 11: Setting the parameter "Number of days to have a dry riverbed after flow ceased" for a river drying case.

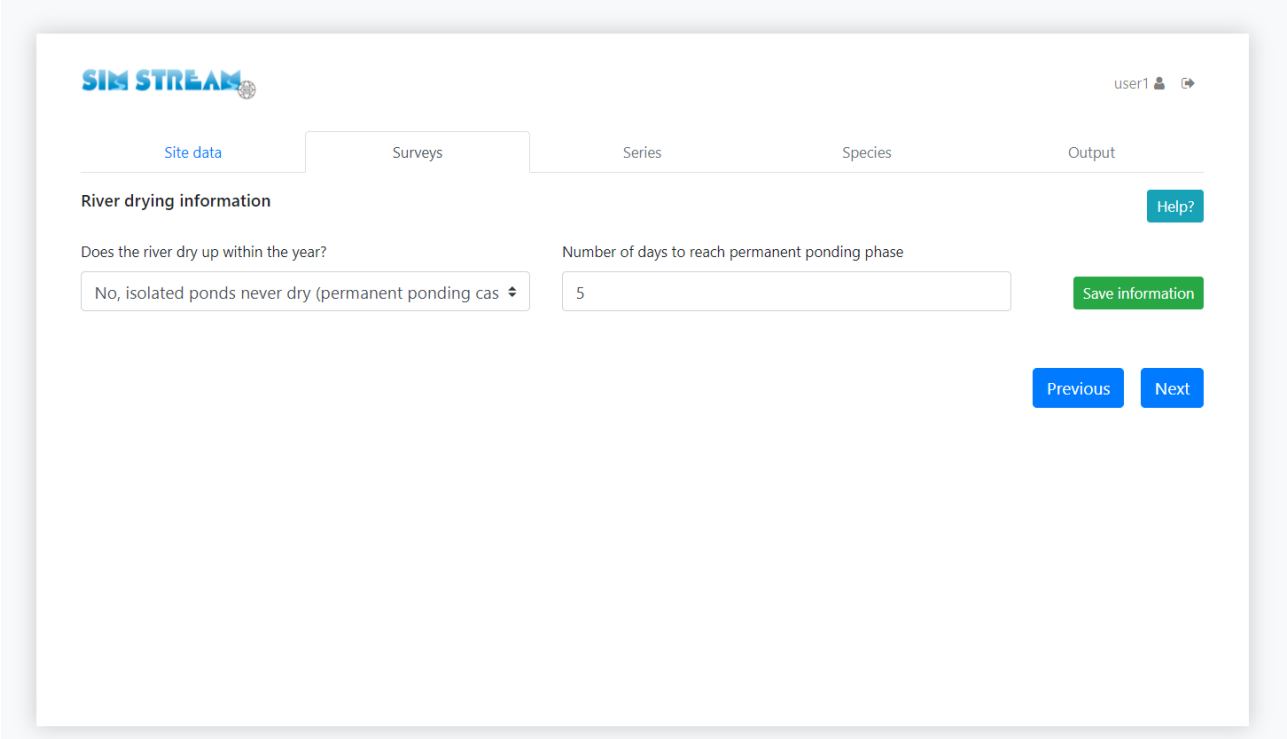

Figure 12: Setting the parameter "Number of days to reach permanent ponding phase" for a permanent ponding case

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5. Temporary river: hydro-morphological data

For a temporary river, the data requested for each hydro-morphological survey are the following (see Figure 13):

i. Date of the survey.

ii. Discharge expressed in m^3/s. For temporary rivers, zero-flow values (Q=0 m^3/s) are allowed. Inserted discharge values must be in increasing order.

iii. Number of days after Q=0 m^3/s. This input is only required when surveys are carried out at zero-flow conditions. This parameter represents the time period (expressed in days with a floating point number) between the date of the survey and the date in which the flow ceased. Surveys at zero-flow conditions must be entered before surveys at flow Q>0 m^3/s. It is compulsory to start inserting the data with the survey with the highest value of the number of days after Q=0 and the lower wetted area value.

iv. Hydro-Morphological Units (HMUs) as a shapefile, composed by a set of 4 files (file extensions: .shp, .shx, .dbf, and .prj).

v. Point measurements as a tab-delimited text (.txt) with the measurements taken in every HMU.

After entering all hydro-morphological data, it may be possible that the user needs to check the physical consistency of all hydro-morphological surveys. Specifically, the user can verify a few simple rules:

- wetted area must increase as discharge increases;
- flow velocity distribution must reasonably increase as discharge increases;
- water depth distribution must reasonably increase as discharge increases;
- substrate frequency distribution must reasonably be similar among surveys with similar wetted area values.

If the previous rules are not respected warning logs will pop up. Warning logs, resulting from the data validation process, are important information provided for the user, and can be visualized by clicking on the *"Show warning logs"* yellow button. To confirm surveys data entry, the user can click "*Save survey*" or "*Save survey and add new one*" and wait for data validation. The user can also modify the previously entered data and confirm the change with the "*Save survey*" button, as well as remove the files containing the entered data by clicking on the  icon.

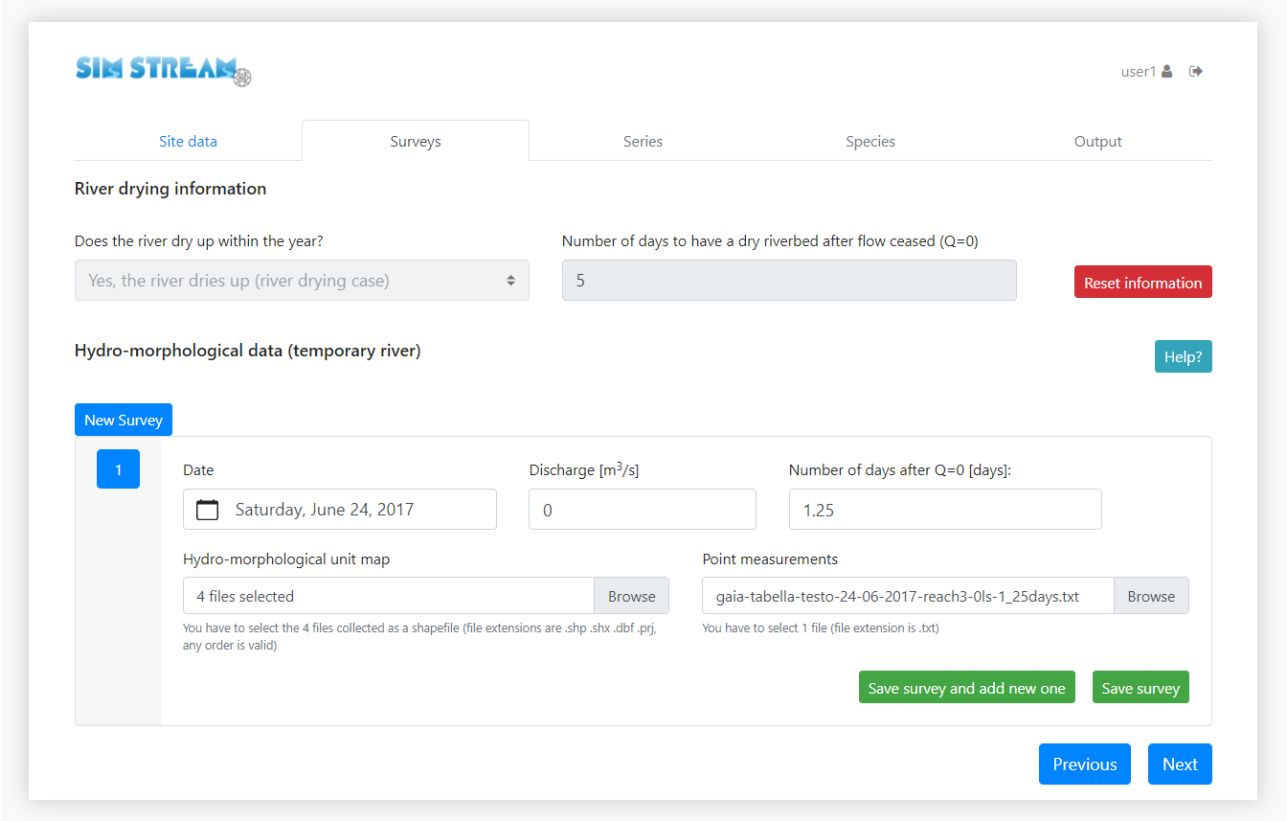


Figure 13: Hydro-morphological data entry (temporary river).

Once the hydro-morphological survey data are successfully uploaded, click "*Next*" to continue to the next page ("*Series*") or click "*Previous*" to return to the previous page ("*Site data*").

6. Streamflow time series

If the user has previously entered at least 3 hydro-morphological surveys with Q>0 m^3/s, it is possible to build habitat-flow rating curves and to carry out time series analysis. For temporary rivers, hydro-morphological surveys with zero-flow values (Q=0 m^3/s) do not count towards the aforementioned minimum amount of surveys.

By entering streamflow time series (Figure 14), Habitat Time Series, Uniform Continuous Under Threshold (UCUT) curves and the Habitat Integrity Index (IH) can be calculated. The format of the streamflow time series file is a tab-delimited text (.txt), containing discharge values at daily scale. Blank spaces (space characters given by the space bar), or empty rows, are not accepted. The tab-delimited text must contain; the date **(**format DD/MM/YYYY); the reference time series (reference hydrological conditions); and the altered time series (altered hydrological conditions, see the SimStream-Web help page for details, by clicking the *"Help?"* top-right button).

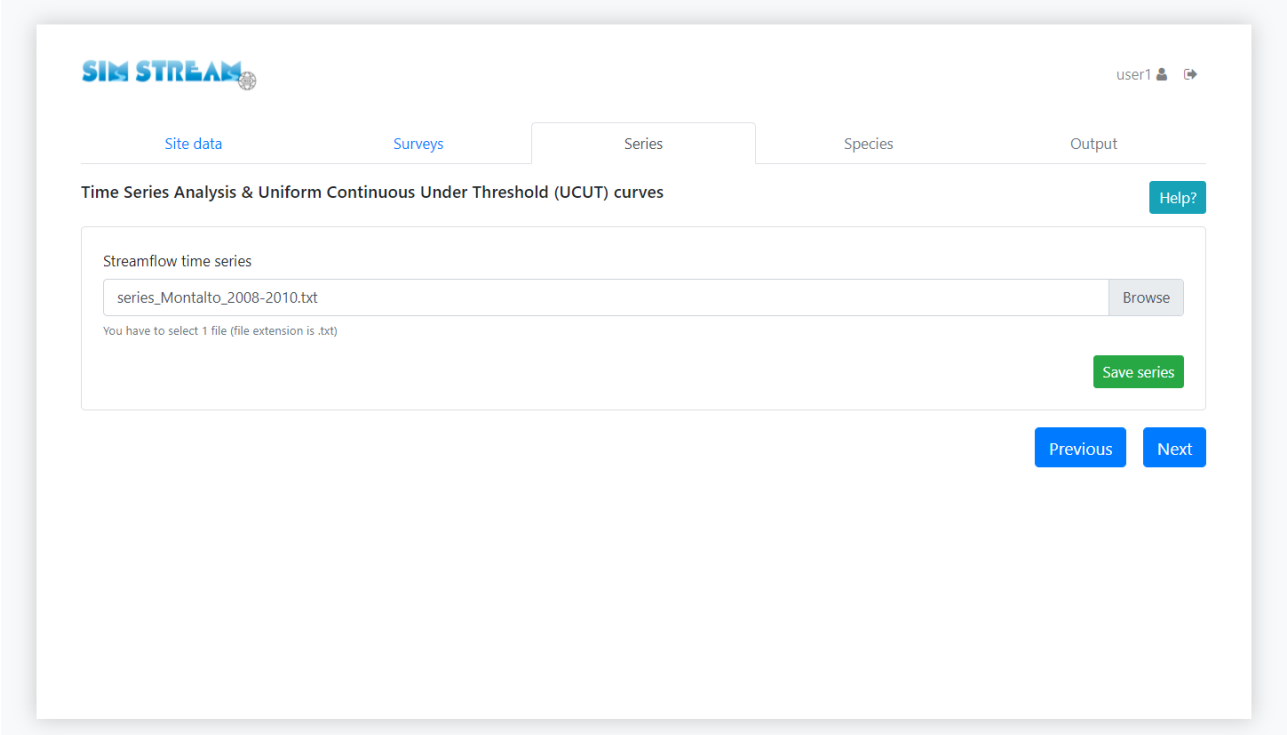


Figure 14: Streamflow time series entry.

To confirm streamflow time series file entry, the user has to click "*Save series*". Once the Streamflow Time Series files are successfully uploaded, the user can click "*Next*" to continue to the next page ("*Species*") or click "*Previous*" to return to the previous page ("*Surveys*").

7. Species and life stage selection

The species and life stage selection can be carried out from three drop-down menus (Figure 15), from which the user can select (i) the species, (ii) the life stage, and (iii) the biological model of interest. To confirm the choice the user has to click the "*Add*" button.

Once the species and the biological model is selected, by clicking "*Show model details*" (Figure 16) the user can visualize the statistical model that predicts habitat availability (i.e., species absence, presence and abundance, Figure 17). In the Partial Dependence Plot (PDP, e.g. in Figure 17), variable importance decreases from left to right and from top to bottom. Model's performance (Accuracy, Sensitivity, Specificity and True Skill Statistics) are shown next to the figure (e.g. Figure 17). The user can click on the icon  to remove the entered data. Lastly, the user can click "*Next*" to continue to the next page ("*Output*") or click "*Previous*" to return to the previous page ("*Series*").

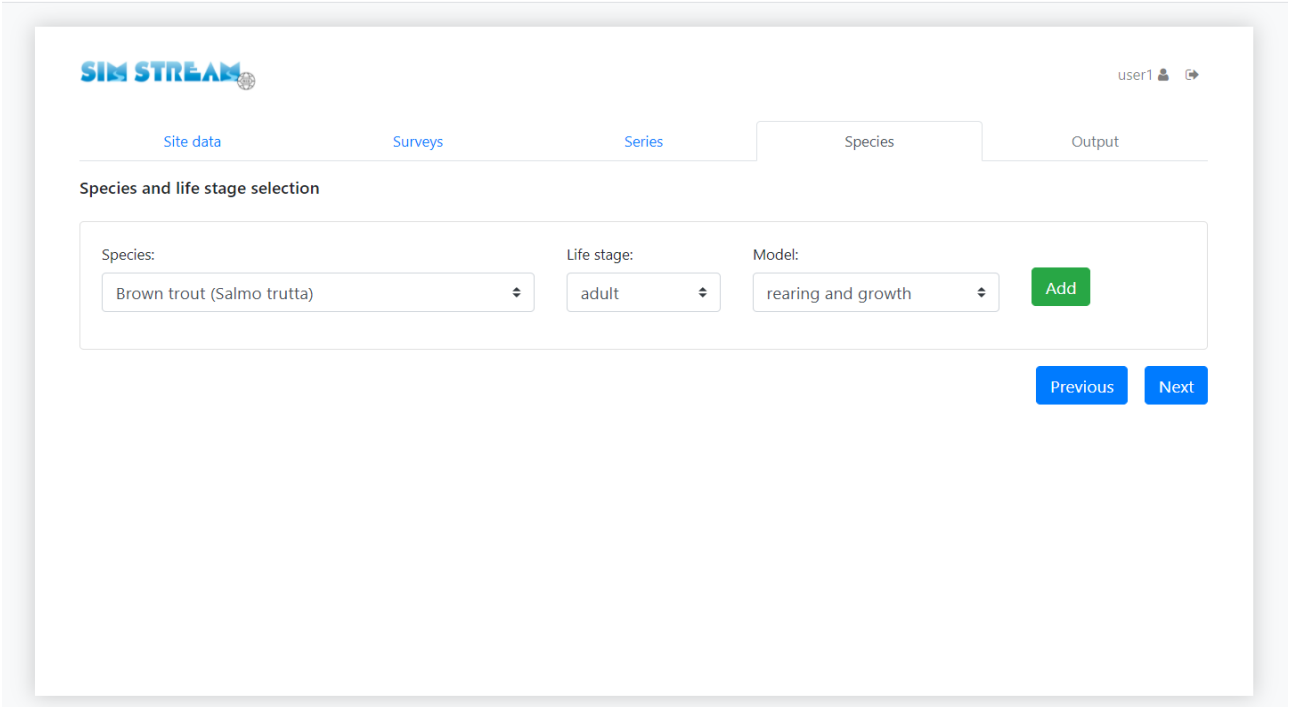


Figure 15: Species, life stage and biological model selection.

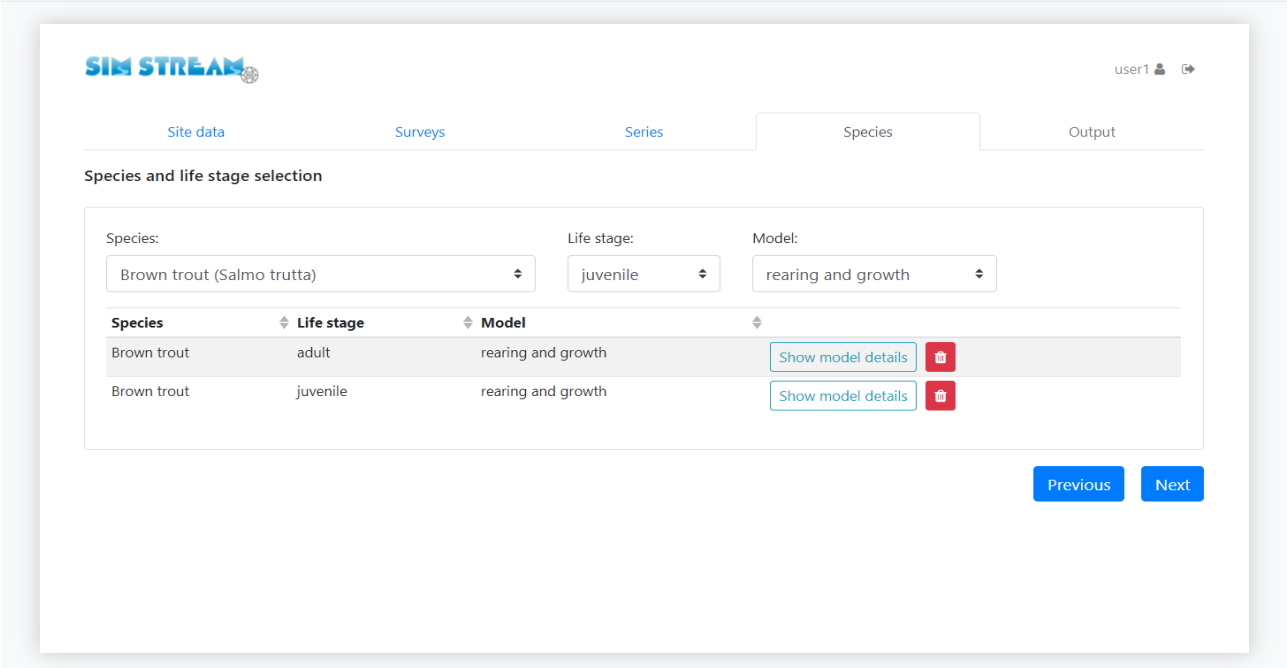


Figure 16: Selected information for species, life stage and biological models.

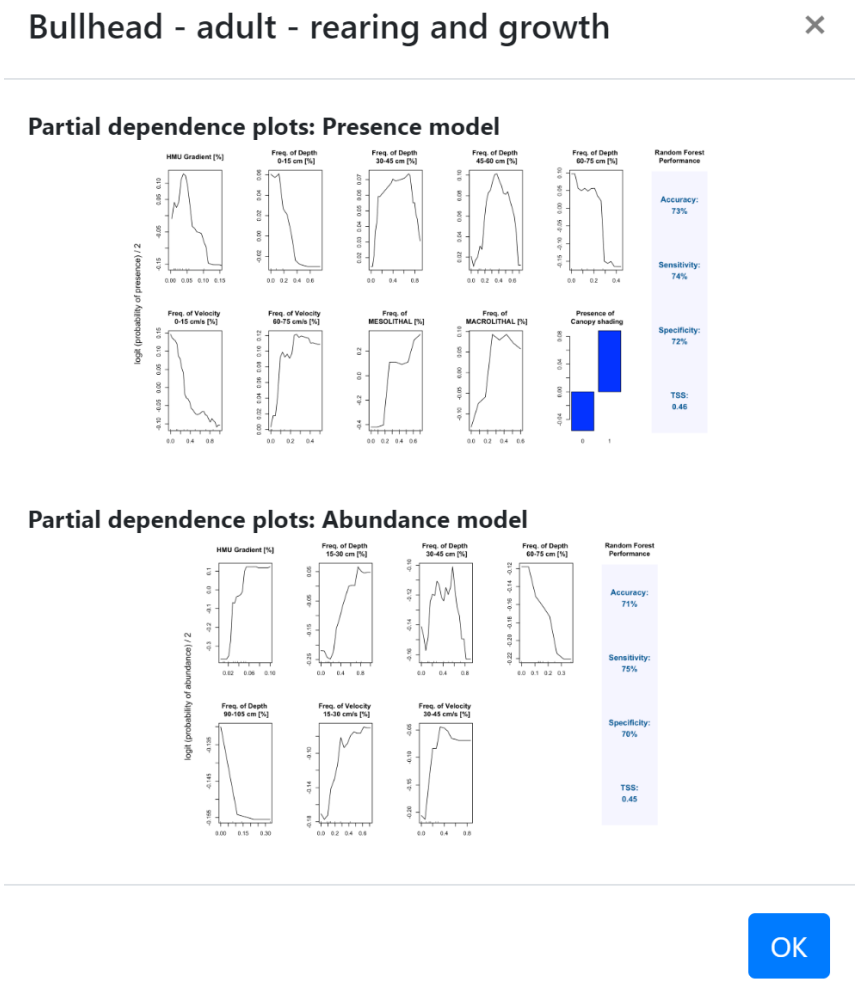


Figure 17: Biological model details.

8. Output selection

In the last section of the entry data procedure, the user can select the model output categories to be provided by SimStream-Web (Figure 18) or click "*Previous*" to return to the previous page ("*Species*").

By selecting at least one output category and clicking "*Submit*", the project data will be processed by SimStream-Web. In case of successful data submission, an e-mail will be sent and a message will be displayed (Figure 19).

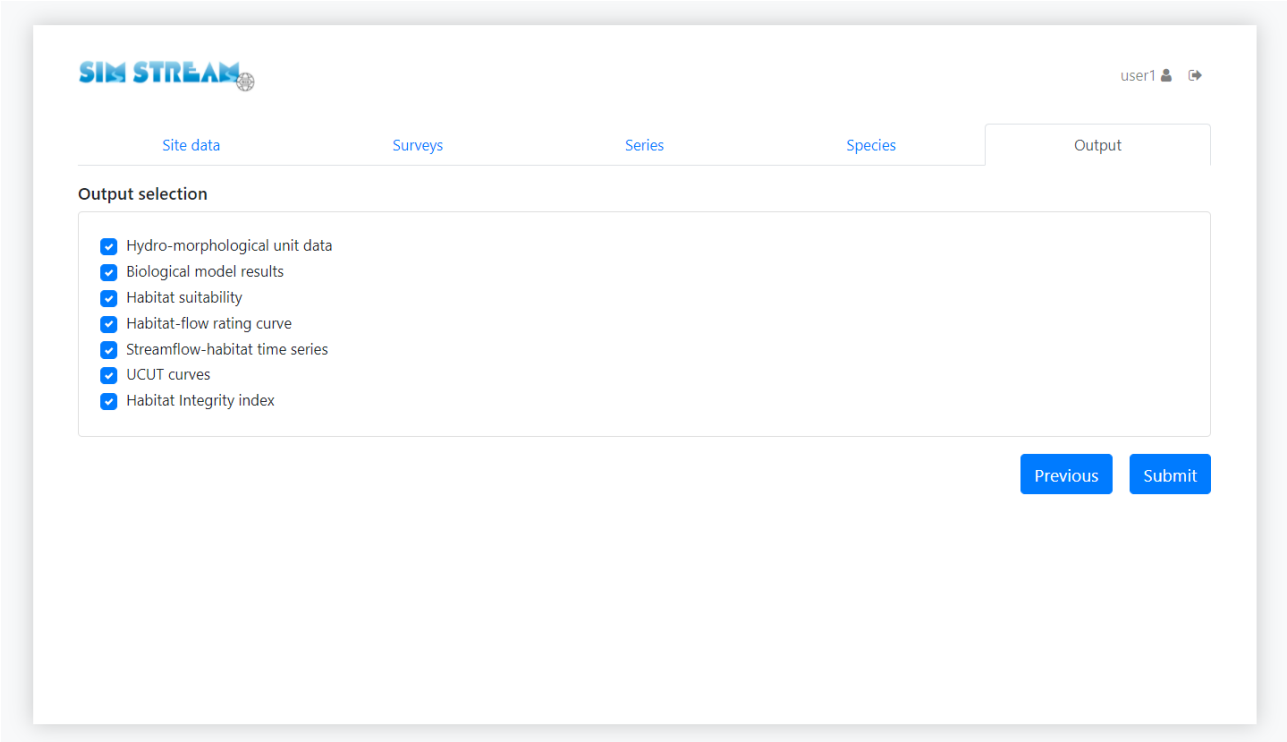


Figure 18: Output selection page.

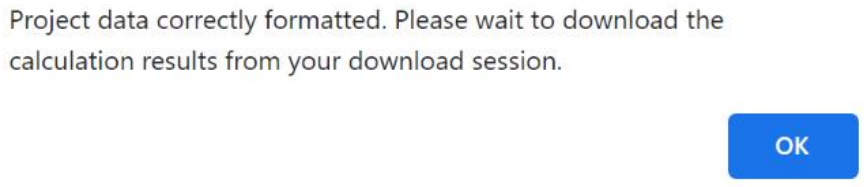


Figure 19: Successful project submission.

9. Merge Projects

If the habitat assessment involves more than one river reach within the same catchment, a global Habitat Integrity Index (IH_{glob}) can be calculated by merging previously uploaded projects. The IH_{glob} value can be calculated, at a river segment or at a catchment scale, as the weighted mean of IH values (IH_i). The weights of IH_i are given by the lengths of the river reaches (L_i, expressed in km), as shown in the formula [Eq. (1)] and in the illustrative figure below (Figure 20).

$$IH_{glob} = \frac{\sum_i (IH_i * L_i)}{\sum_i L_i} \qquad \text{Eq. (1)}$$

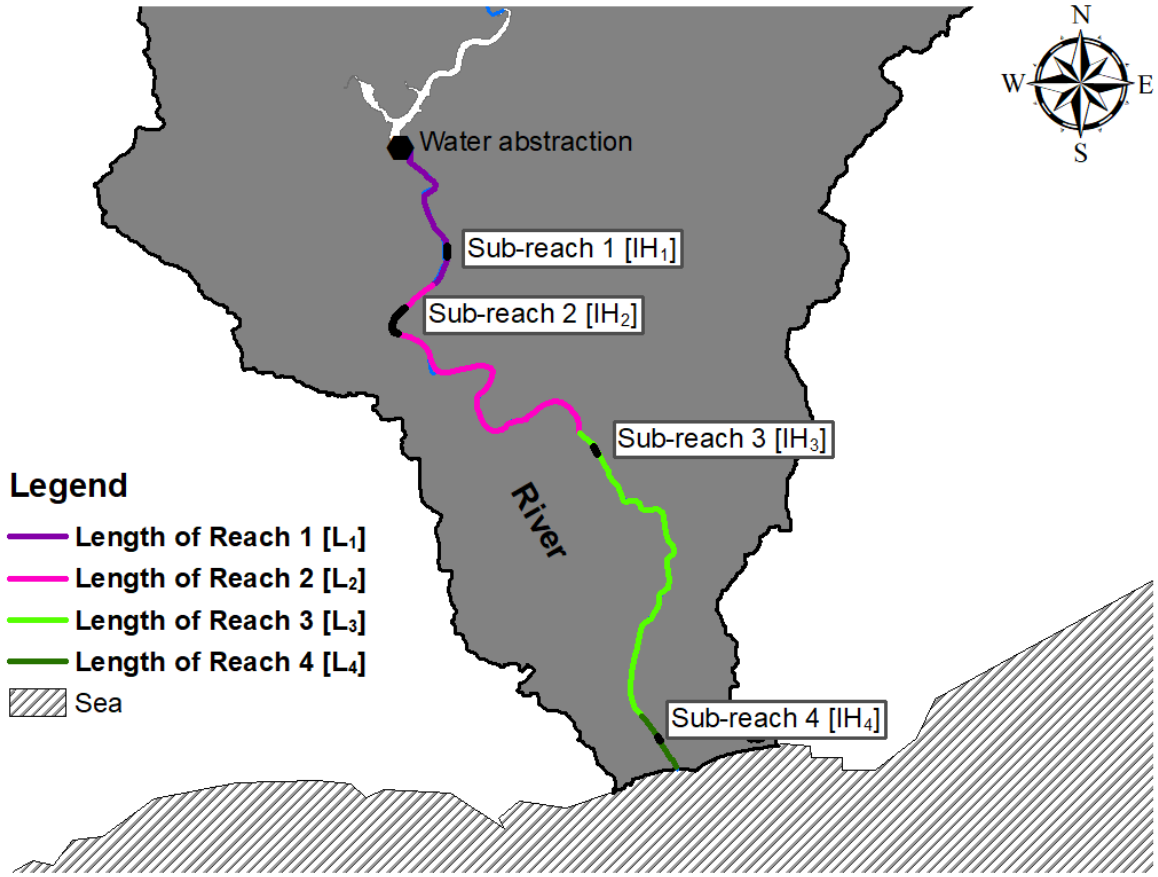


Figure 20: Example of habitat assessment involving more than one river reach within the same catchment.

To merge projects, the user can select previous results of the IH index from the two drop-down menus, which report the project ID, the name of the river, the study site and the desired hydrological scenario (Figure 21). In addition, the user has to insert the length of the hydro-morphological reach to be used as a weight parameter in the analysis. After entering this information, the user can click "*Add*" to confirm the choice or to click on the icon to remove the entered data. Once all projects have been selected, the user can click "*Merge projects*" and an output message will be displayed (Figure 22).

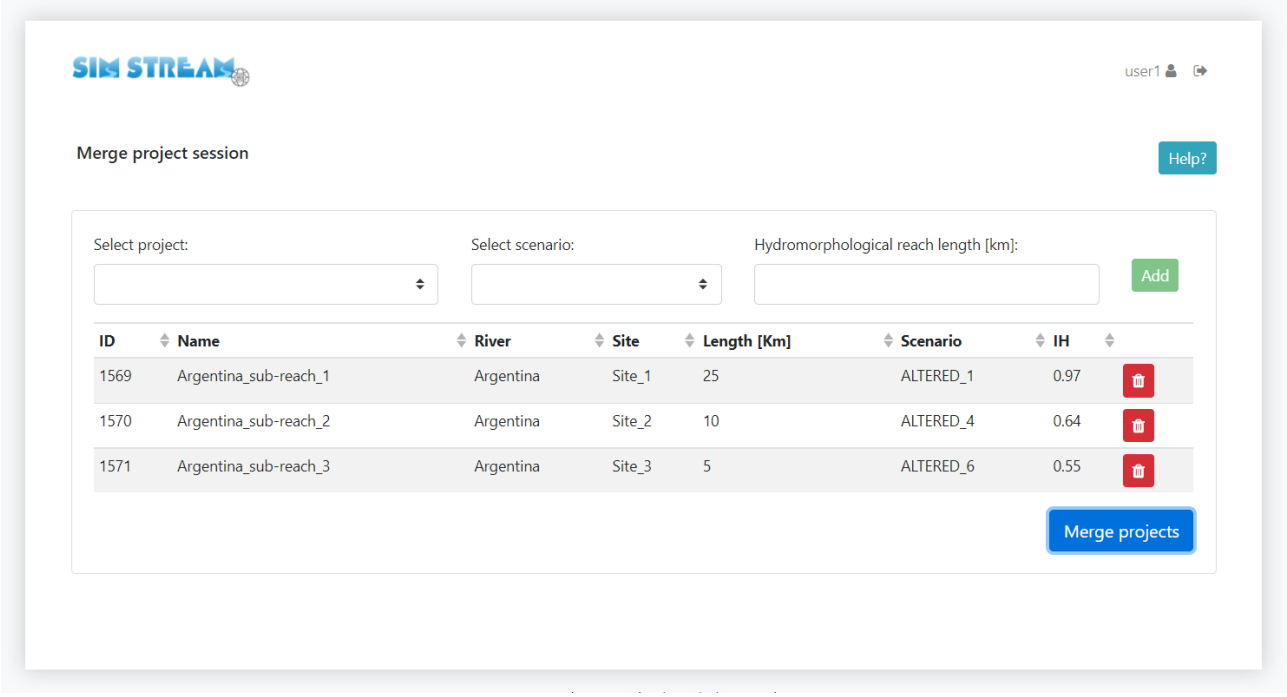


Figure 21: Merge project page.

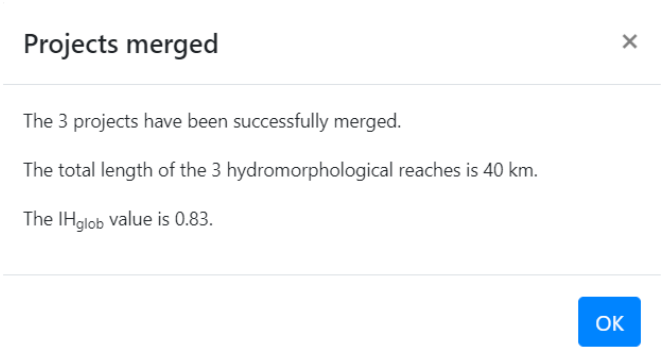


Figure 22: Output message of Merge Projects.

10. Download session

On the homepage, the user can navigate to the "*Download session*" (Figure 23) to download the project results in the form of a compressed folder. Within the download session all user project results are listed (Figure 24).

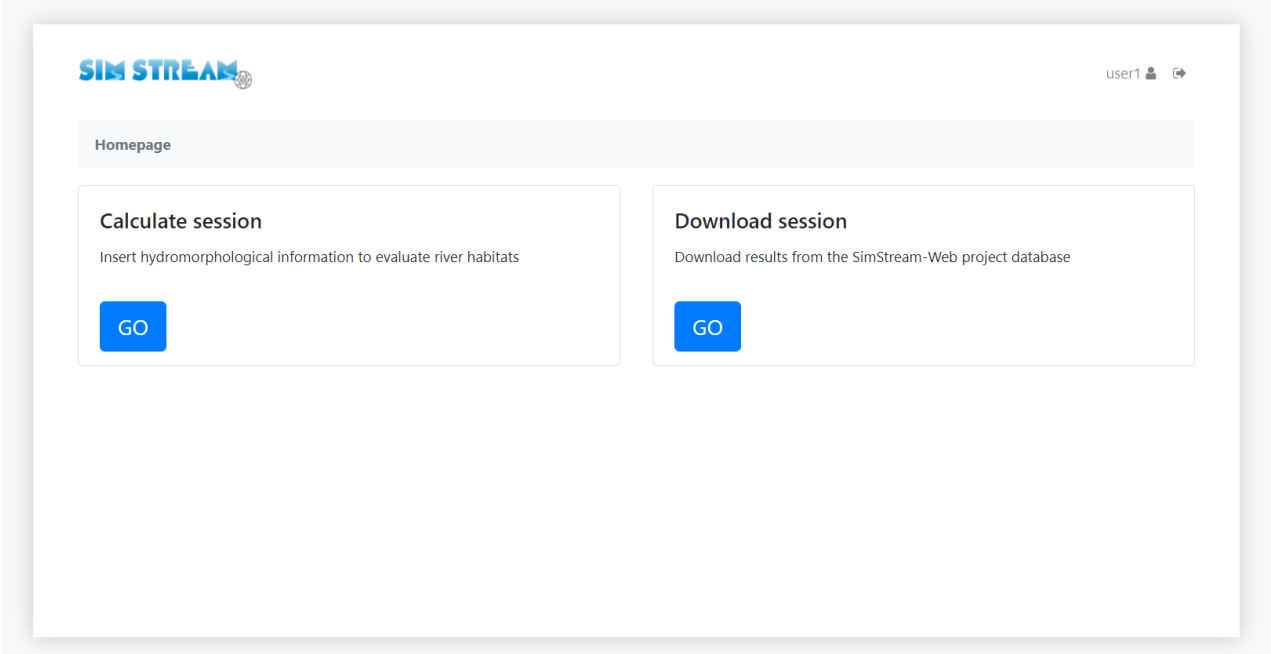


Figure 23:"Download session" on the SimStream Homepage.

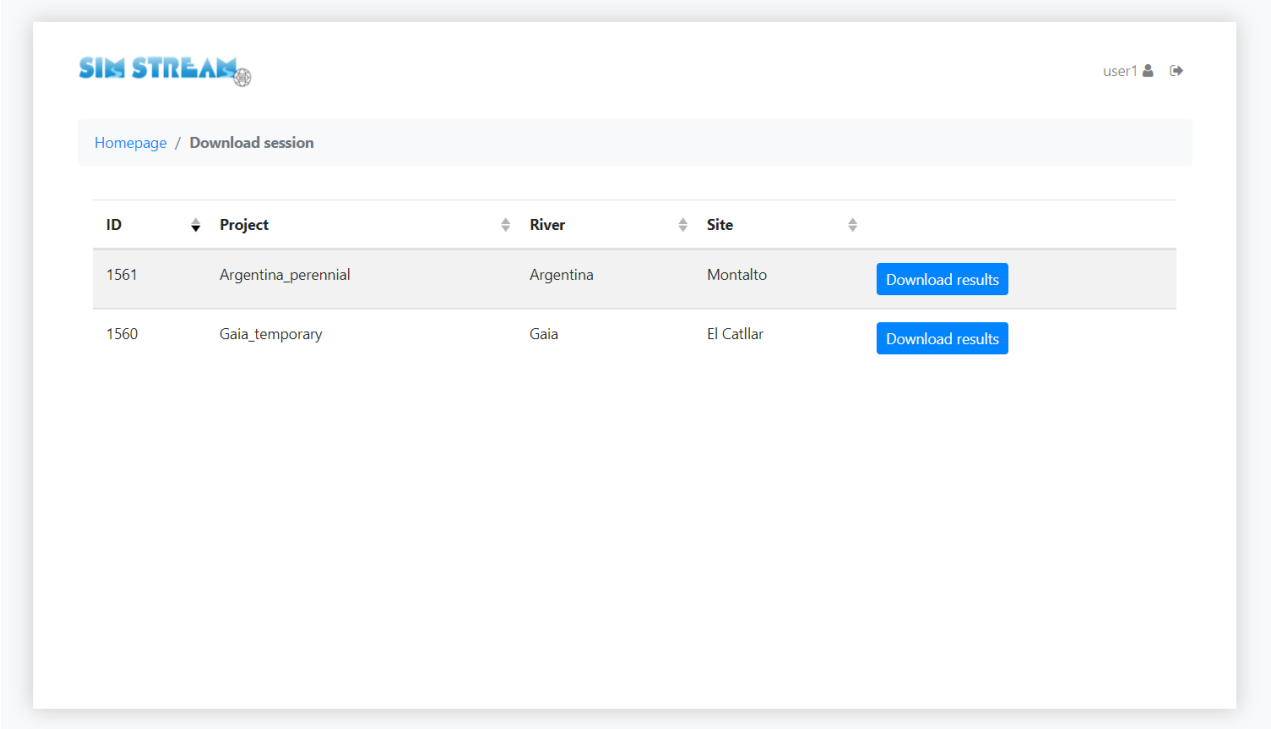


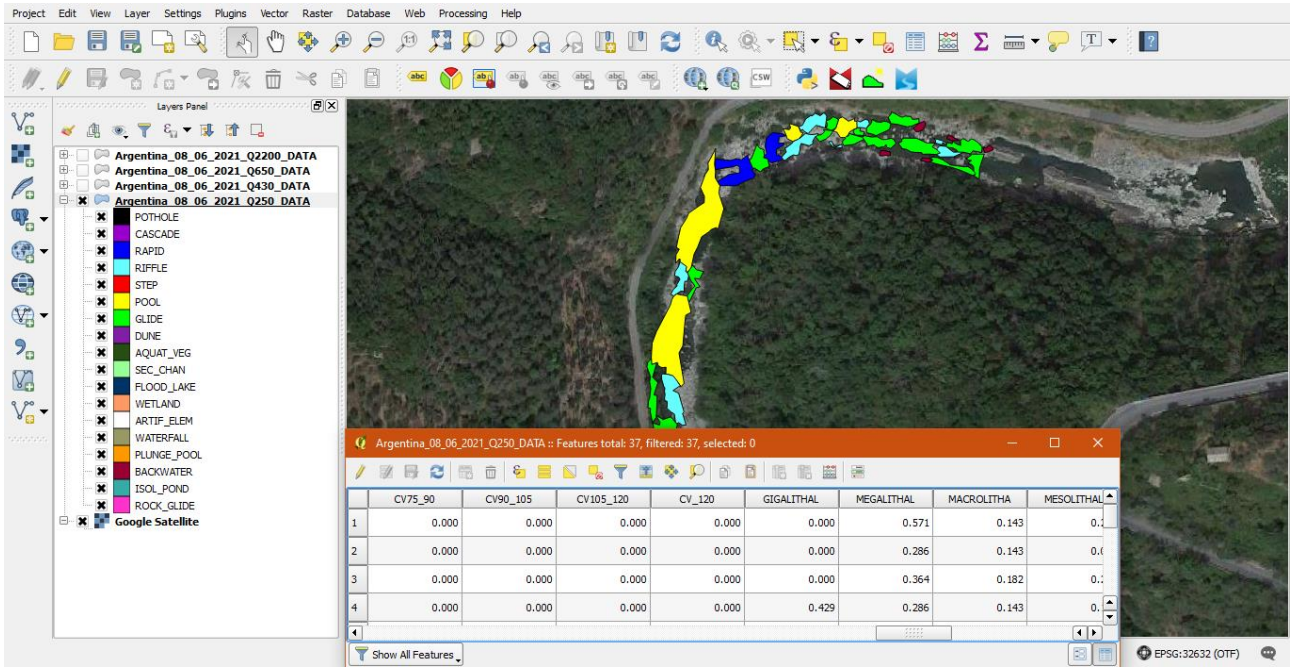
Figure 24: Download session.

The habitat model results are stored in a compressed folder, in which the user can find the following subfolders:

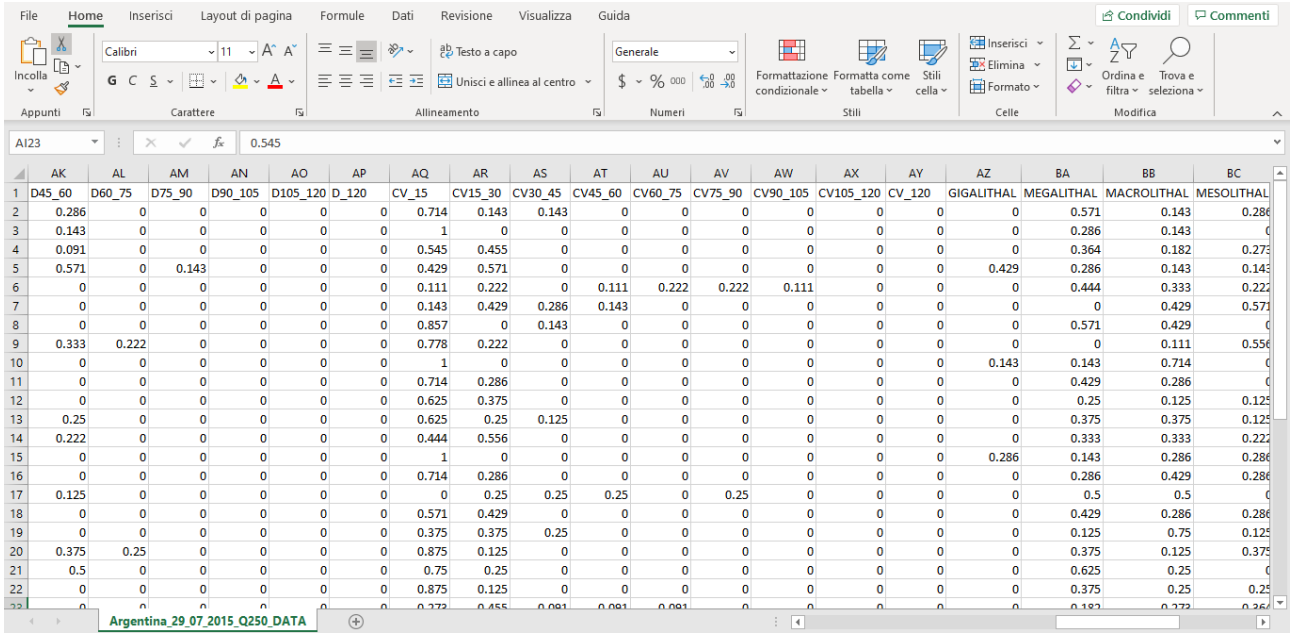
i. Hydro-morphological unit data
ii. Habitat suitability
iii. Biological models
iv. Habitat-flow rating curves
v. Streamflow-habitat time series
vi. UCUT curves
vii. Habitat Integrity Index

Below, a few examples of project results are reported for perennial and temporary rivers. Note that color formatting of shapefiles is automatic if the project outputs are opened in the QGIS software.

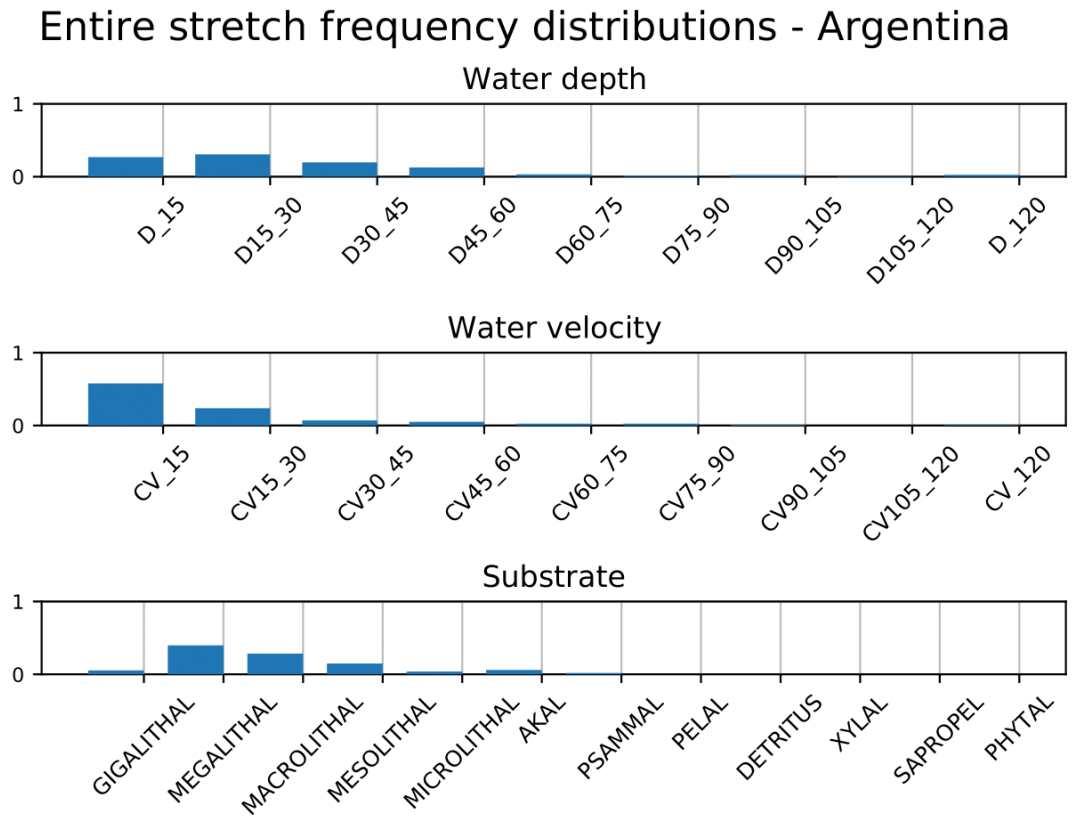
- *Hydro-morphological unit data* (GIS shapefile). Spatial distribution of the hydro-morphological units (HMUs) in the selected river reach, for every discharge condition.



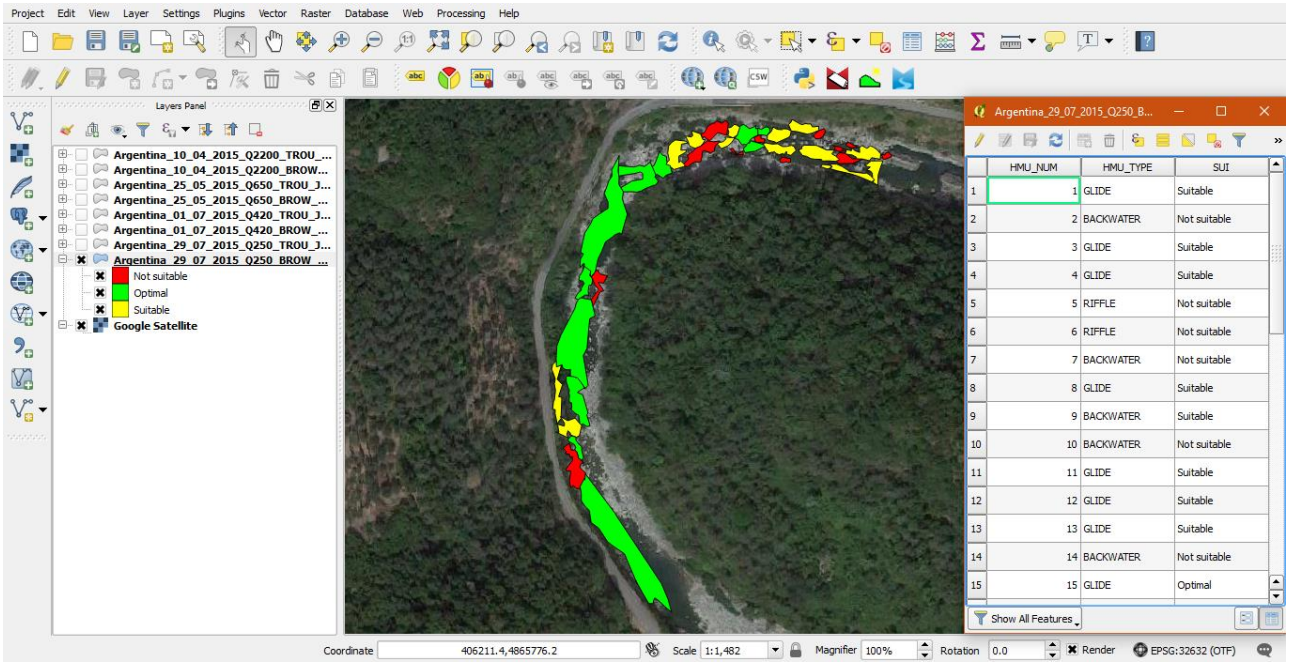
- *Hydro-morphological unit data* (txt file). Habitat attribute tables describing hydro-morphological units (e.g., frequency classes of depth, velocity, and substrate, HMU gradient, cover types), for every discharge condition.



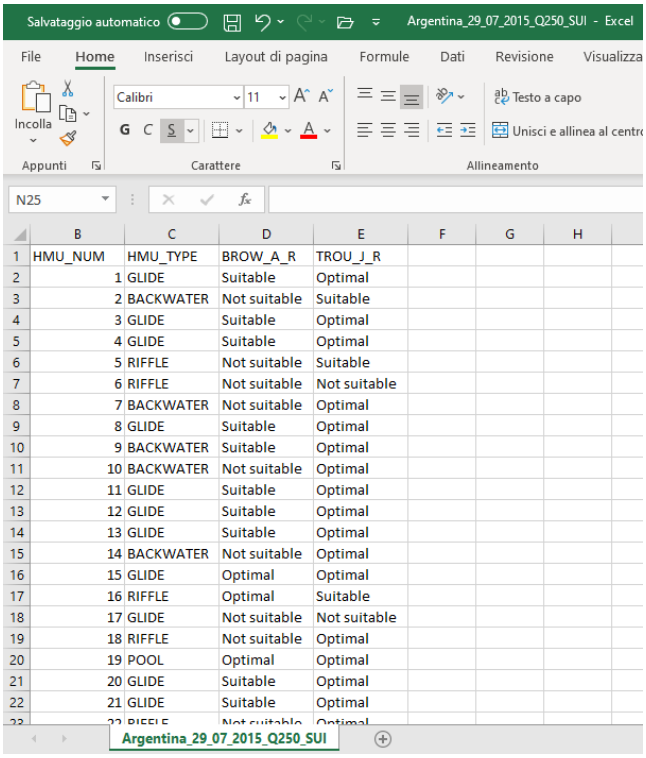
- *Hydro-morphological unit data* (PDF file). Summary charts of frequency distributions of water depth, flow velocity, and substrate classes, for every discharge condition.



- *Habitat suitability* (GIS shapefile). Habitat suitability maps for a certain species or life stage of interest and for every discharge condition.

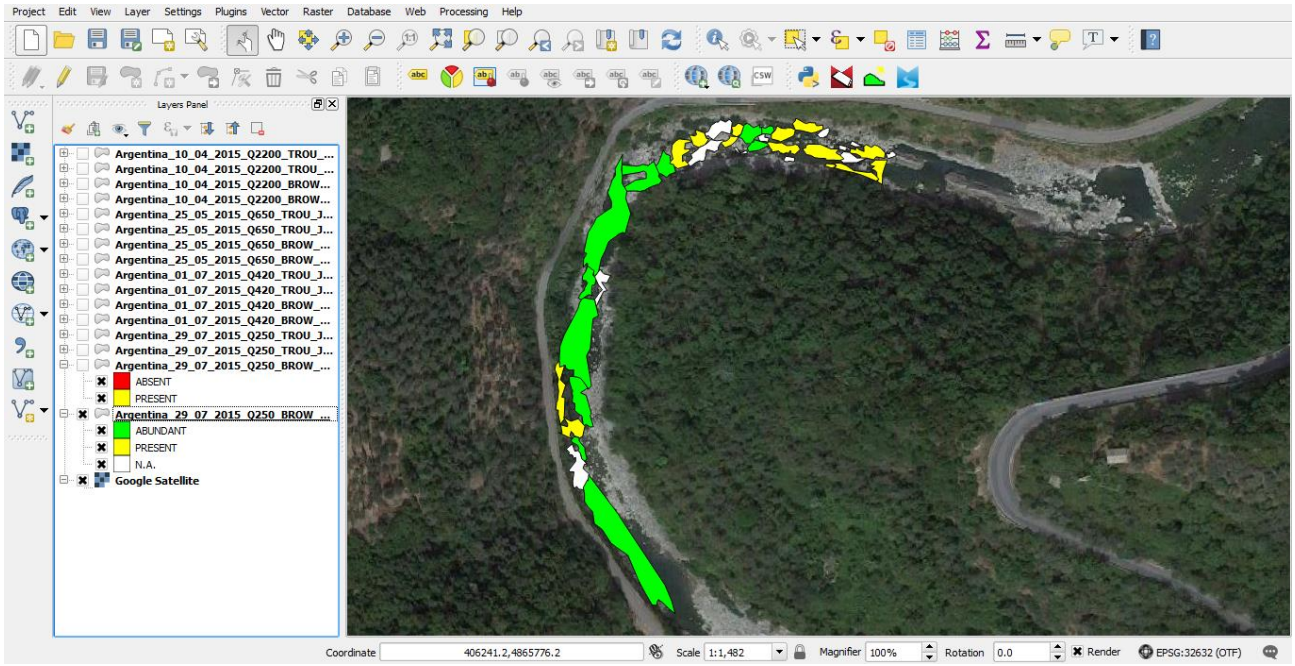


- *Habitat suitability* (txt file). Habitat suitability data for a certain species or life stage of interest and for every discharge condition.

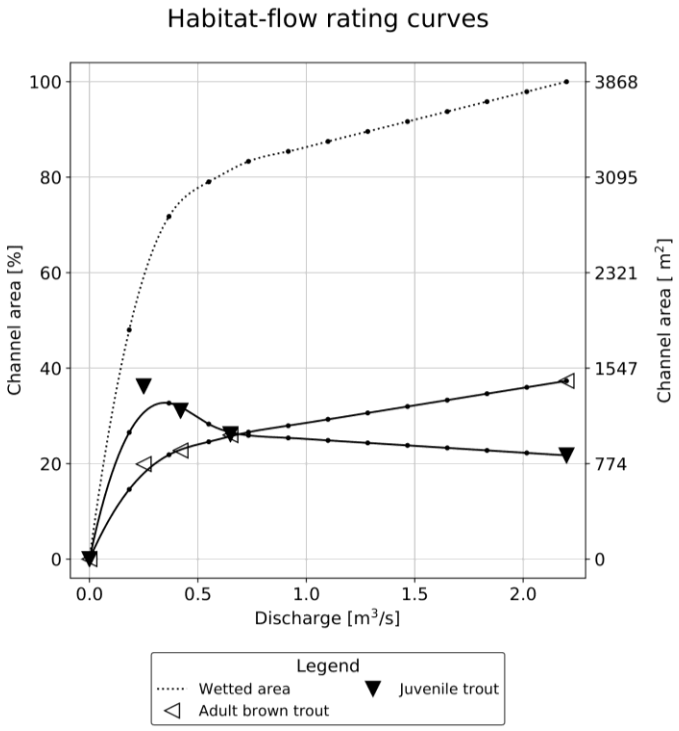


	B	C	D	E	F	G	H
1	HMU_NUM	HMU_TYPE	BROW_A_R	TROU_J_R			
2	1	GLIDE	Suitable	Optimal			
3	2	BACKWATER	Not suitable	Suitable			
4	3	GLIDE	Suitable	Optimal			
5	4	GLIDE	Suitable	Optimal			
6	5	RIFFLE	Not suitable	Suitable			
7	6	RIFFLE	Not suitable	Not suitable			
8	7	BACKWATER	Not suitable	Optimal			
9	8	GLIDE	Suitable	Optimal			
10	9	BACKWATER	Suitable	Optimal			
11	10	BACKWATER	Not suitable	Optimal			
12	11	GLIDE	Suitable	Optimal			
13	12	GLIDE	Suitable	Optimal			
14	13	GLIDE	Suitable	Optimal			
15	14	BACKWATER	Not suitable	Optimal			
16	15	GLIDE	Optimal	Optimal			
17	16	RIFFLE	Optimal	Suitable			
18	17	GLIDE	Not suitable	Not suitable			
19	18	RIFFLE	Not suitable	Optimal			
20	19	POOL	Optimal	Optimal			
21	20	GLIDE	Suitable	Optimal			
22	21	GLIDE	Suitable	Optimal			

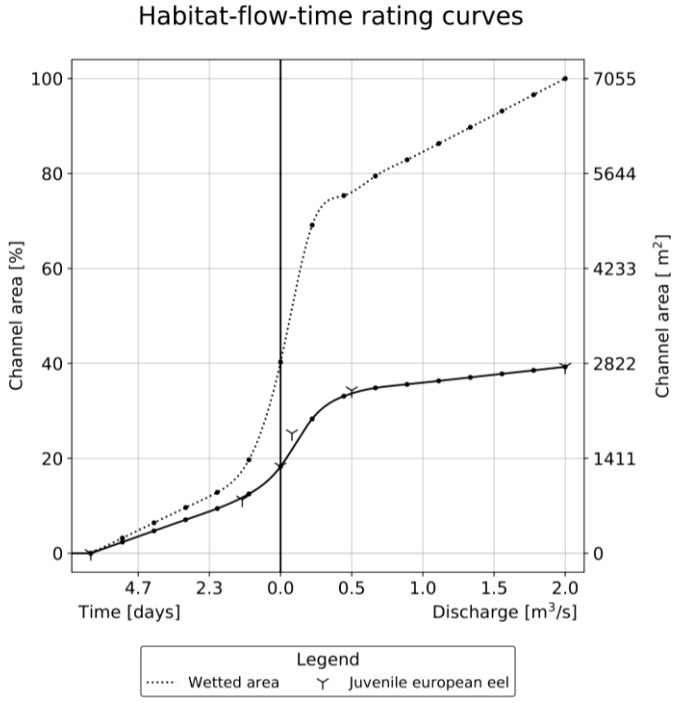
- *Biological model* (GIS shapefile). Biological model results for a certain species or life stage of interest and for every discharge condition. The results of two binary habitat suitability models are reported: (i) an absence/presence model, to distinguish between not suitable and suitable mesohabitats, and (ii) a presence/abundance model to distinguish between suitable and optimal mesohabitats.



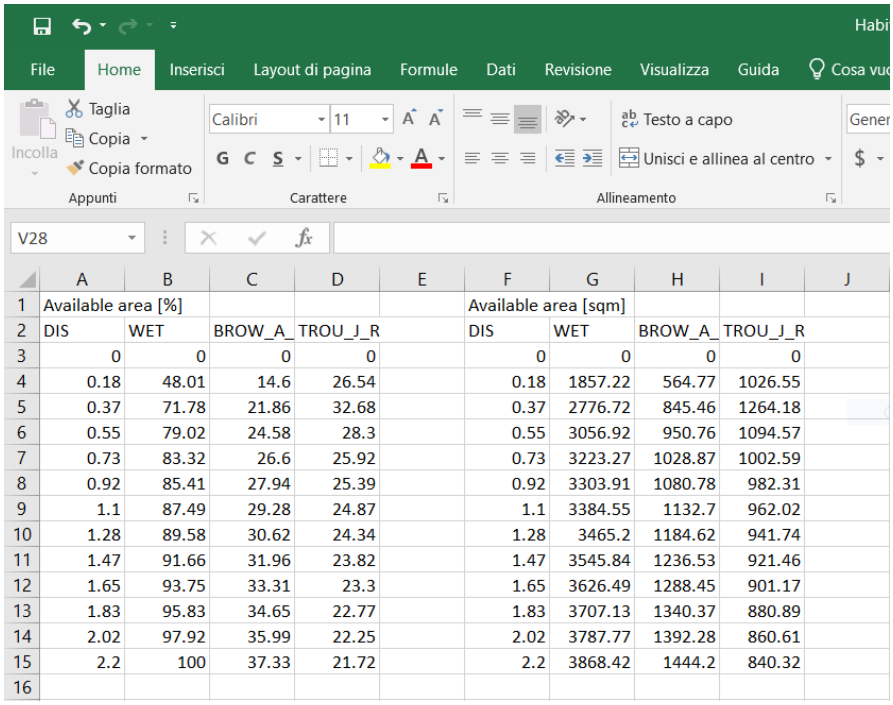
- *Habitat-flow rating curves* (*perennial river*, PDF file). Habitat-flow rating curves for a perennial river, reported as .pdf file, and representing habitat conditions in the selected river reach.



- *Habitat-flow-time rating curves* (*temporary river*, PDF file). Habitat-flow-time rating curves for a temporary river (drying case), reported as .pdf file, and representing habitat conditions in the selected river reach.

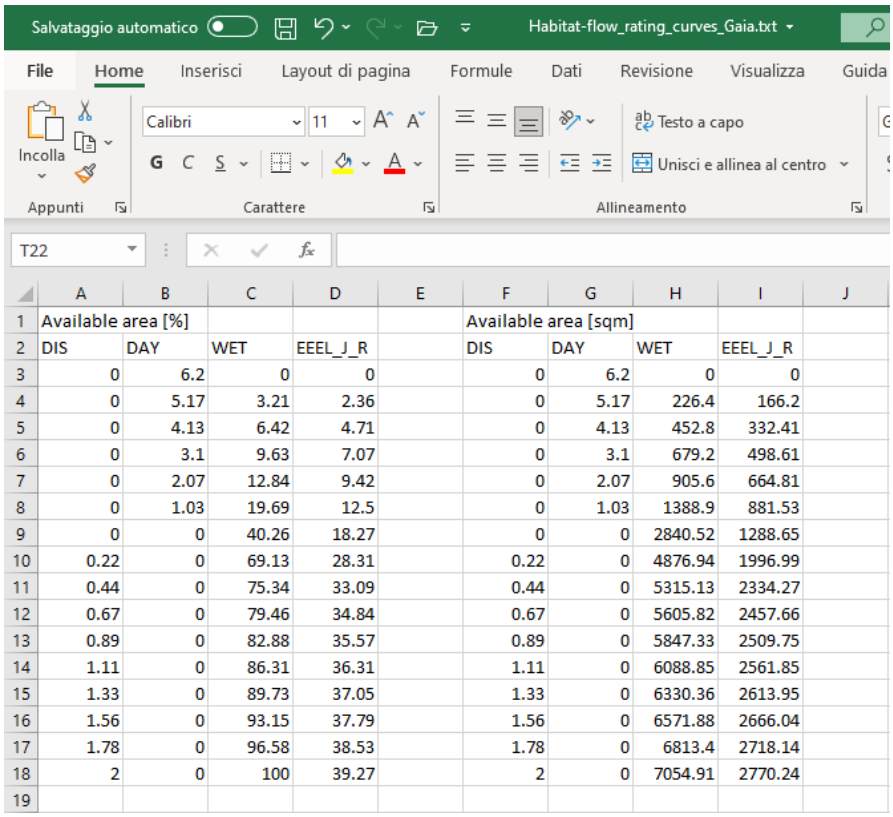


- *Habitat-flow rating curves* (*perennial river*, txt file). Row data of the habitat-flow rating curve for a perennial river, reported as .txt file.



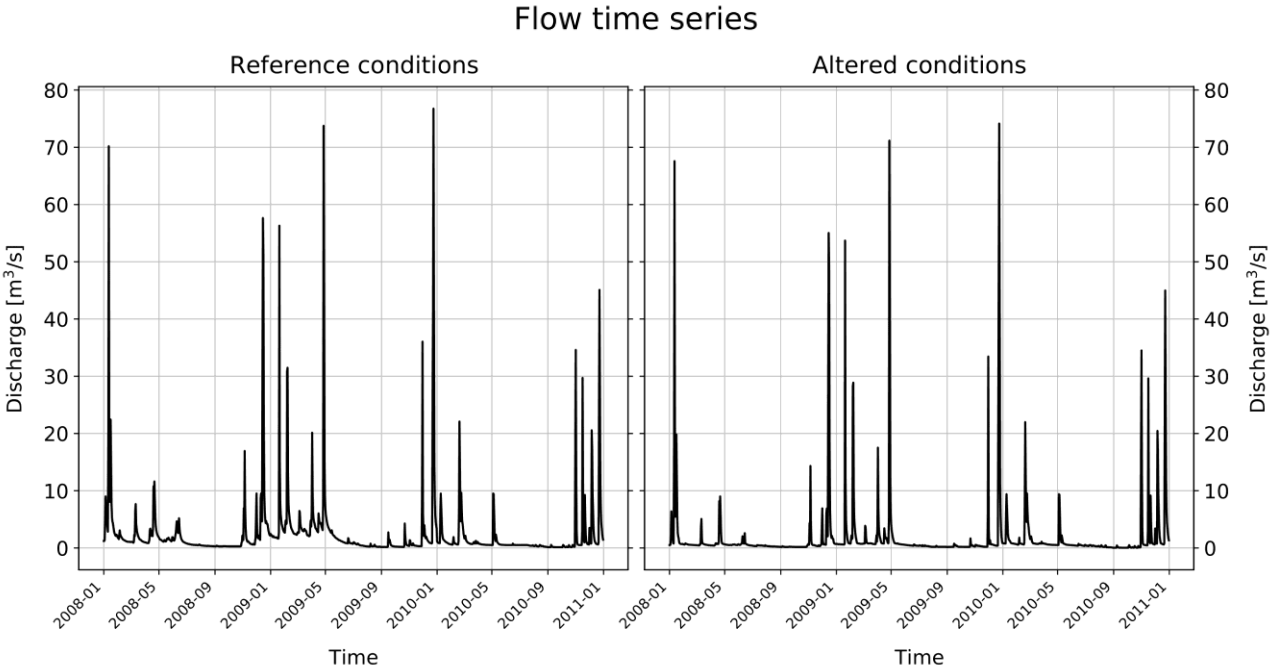
	A	B	C	D	E	F	G	H	I	J
1	Available area [%]					Available area [sqm]				
2	DIS	WET	BROW_A_	TROU_J_R		DIS	WET	BROW_A_	TROU_J_R	
3	0	0	0	0		0	0	0	0	
4	0.18	48.01	14.6	26.54		0.18	1857.22	564.77	1026.55	
5	0.37	71.78	21.86	32.68		0.37	2776.72	845.46	1264.18	
6	0.55	79.02	24.58	28.3		0.55	3056.92	950.76	1094.57	
7	0.73	83.32	26.6	25.92		0.73	3223.27	1028.87	1002.59	
8	0.92	85.41	27.94	25.39		0.92	3303.91	1080.78	982.31	
9	1.1	87.49	29.28	24.87		1.1	3384.55	1132.7	962.02	
10	1.28	89.58	30.62	24.34		1.28	3465.2	1184.62	941.74	
11	1.47	91.66	31.96	23.82		1.47	3545.84	1236.53	921.46	
12	1.65	93.75	33.31	23.3		1.65	3626.49	1288.45	901.17	
13	1.83	95.83	34.65	22.77		1.83	3707.13	1340.37	880.89	
14	2.02	97.92	35.99	22.25		2.02	3787.77	1392.28	860.61	
15	2.2	100	37.33	21.72		2.2	3868.42	1444.2	840.32	
16										

- *Habitat-flow-time rating curves* (*temporary river*, txt file). Row data of the habitat-flow-time rating curve for a temporary river (drying case), reported as .txt file.

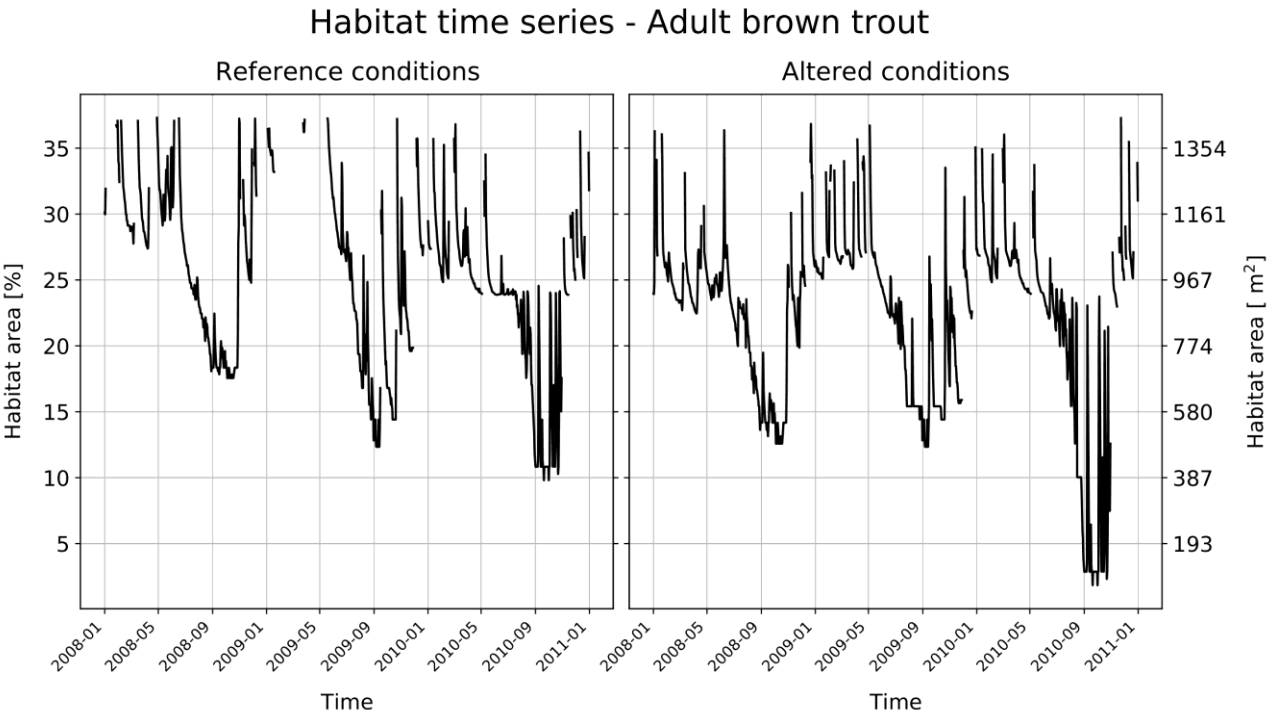


	A	B	C	D	E	F	G	H	I	J
1	Available area [%]					Available area [sqm]				
2	DIS	DAY	WET	EEEL_J_R		DIS	DAY	WET	EEEL_J_R	
3	0	6.2	0	0		0	6.2	0	0	
4	0	5.17	3.21	2.36		0	5.17	226.4	166.2	
5	0	4.13	6.42	4.71		0	4.13	452.8	332.41	
6	0	3.1	9.63	7.07		0	3.1	679.2	498.61	
7	0	2.07	12.84	9.42		0	2.07	905.6	664.81	
8	0	1.03	19.69	12.5		0	1.03	1388.9	881.53	
9	0	0	40.26	18.27		0	0	2840.52	1288.65	
10	0.22	0	69.13	28.31		0.22	0	4876.94	1996.99	
11	0.44	0	75.34	33.09		0.44	0	5315.13	2334.27	
12	0.67	0	79.46	34.84		0.67	0	5605.82	2457.66	
13	0.89	0	82.88	35.57		0.89	0	5847.33	2509.75	
14	1.11	0	86.31	36.31		1.11	0	6088.85	2561.85	
15	1.33	0	89.73	37.05		1.33	0	6330.36	2613.95	
16	1.56	0	93.15	37.79		1.56	0	6571.88	2666.04	
17	1.78	0	96.58	38.53		1.78	0	6813.4	2718.14	
18	2	0	100	39.27		2	0	7054.91	2770.24	
19										

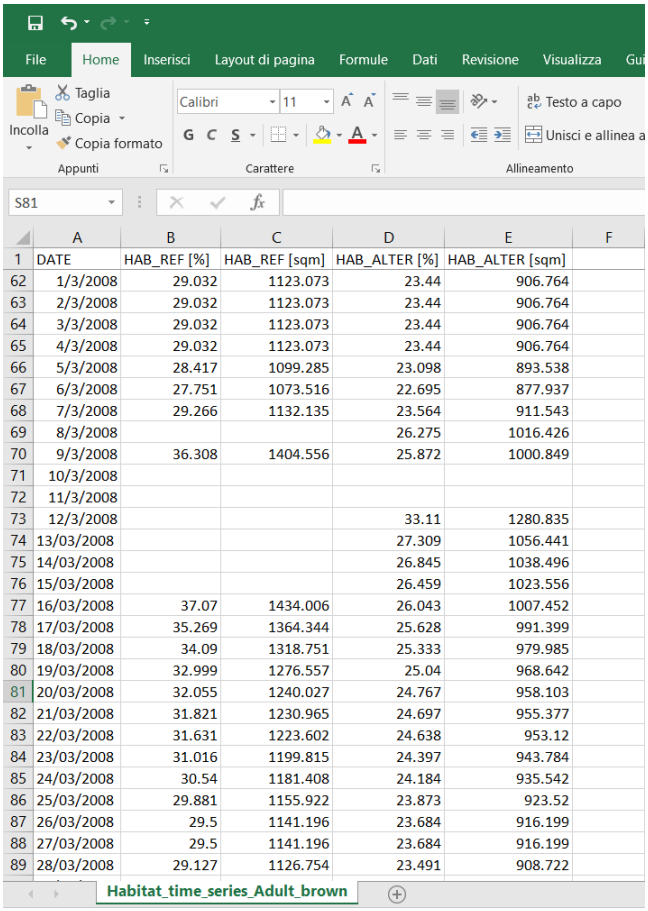
- *Streamflow time series* (PDF file). Reference (left) and altered (right) flow time series in the selected river reach.



- *Habitat time series* (PDF file). Habitat time series for (left) reference and (right) altered conditions for a certain species or life stage of interest.



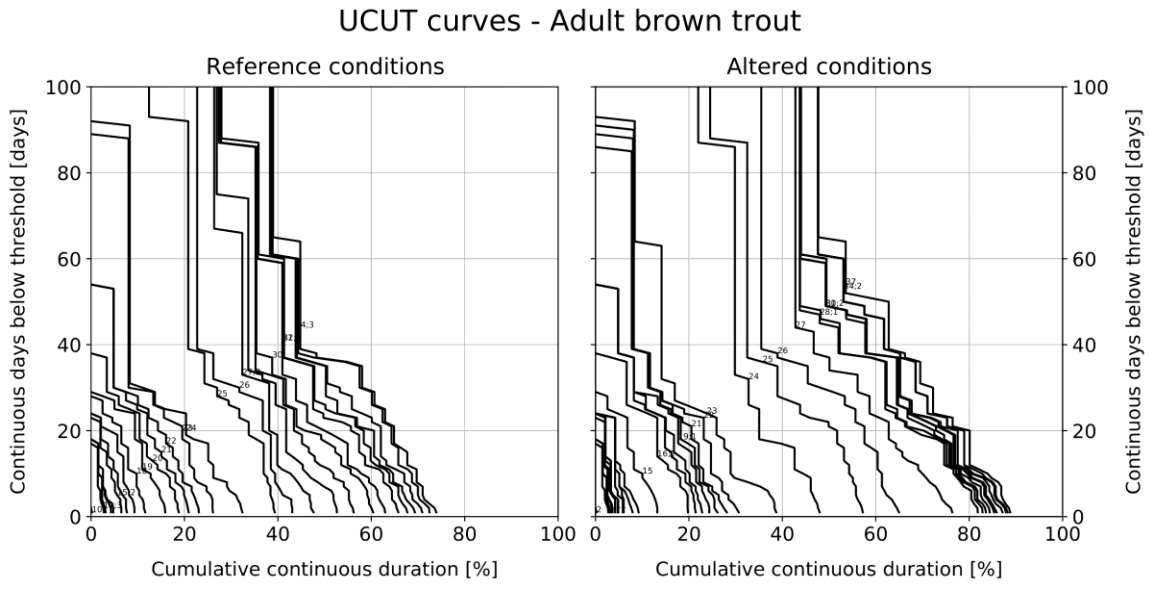
- *Habitat time series* (txt file). Row data of the habitat time series for reference and altered conditions for a certain species or life stage of interest.



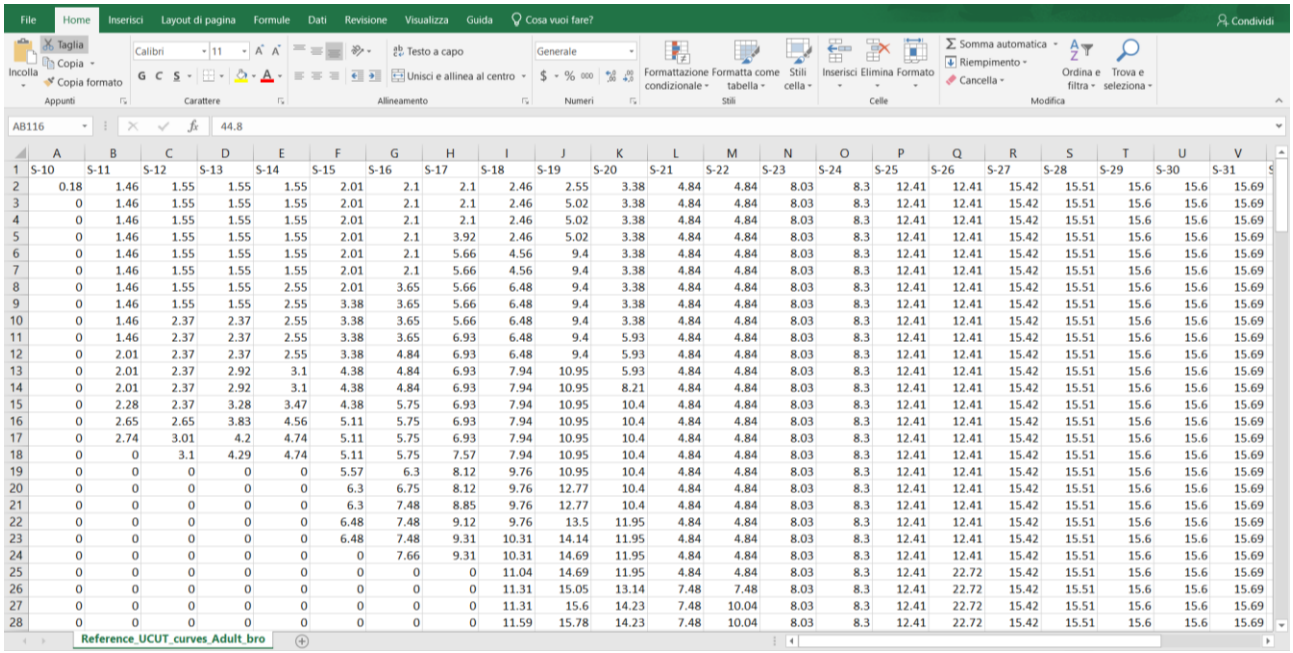
	A	B	C	D	E	F
1	DATE	HAB_REF [%]	HAB_REF [sqm]	HAB_ALTER [%]	HAB_ALTER [sqm]	
62	1/3/2008	29.032	1123.073	23.44	906.764	
63	2/3/2008	29.032	1123.073	23.44	906.764	
64	3/3/2008	29.032	1123.073	23.44	906.764	
65	4/3/2008	29.032	1123.073	23.44	906.764	
66	5/3/2008	28.417	1099.285	23.098	893.538	
67	6/3/2008	27.751	1073.516	22.695	877.937	
68	7/3/2008	29.266	1132.135	23.564	911.543	
69	8/3/2008			26.275	1016.426	
70	9/3/2008	36.308	1404.556	25.872	1000.849	
71	10/3/2008					
72	11/3/2008					
73	12/3/2008			33.11	1280.835	
74	13/03/2008			27.309	1056.441	
75	14/03/2008			26.845	1038.496	
76	15/03/2008			26.459	1023.556	
77	16/03/2008	37.07	1434.006	26.043	1007.452	
78	17/03/2008	35.269	1364.344	25.628	991.399	
79	18/03/2008	34.09	1318.751	25.333	979.985	
80	19/03/2008	32.999	1276.557	25.04	968.642	
81	20/03/2008	32.055	1240.027	24.767	958.103	
82	21/03/2008	31.821	1230.965	24.697	955.377	
83	22/03/2008	31.631	1223.602	24.638	953.12	
84	23/03/2008	31.016	1199.815	24.397	943.784	
85	24/03/2008	30.54	1181.408	24.184	935.542	
86	25/03/2008	29.881	1155.922	23.873	923.52	
87	26/03/2008	29.5	1141.196	23.684	916.199	
88	27/03/2008	29.5	1141.196	23.684	916.199	
89	28/03/2008	29.127	1126.754	23.491	908.722	

Habitat_time_series_Adult_brown

- *UCUT curves* (PDF file). UCUT (Uniform Continuous Under Threshold) curves for all possible thresholds for (left) reference and (right) altered habitat conditions and for a certain species or life stage of interest.

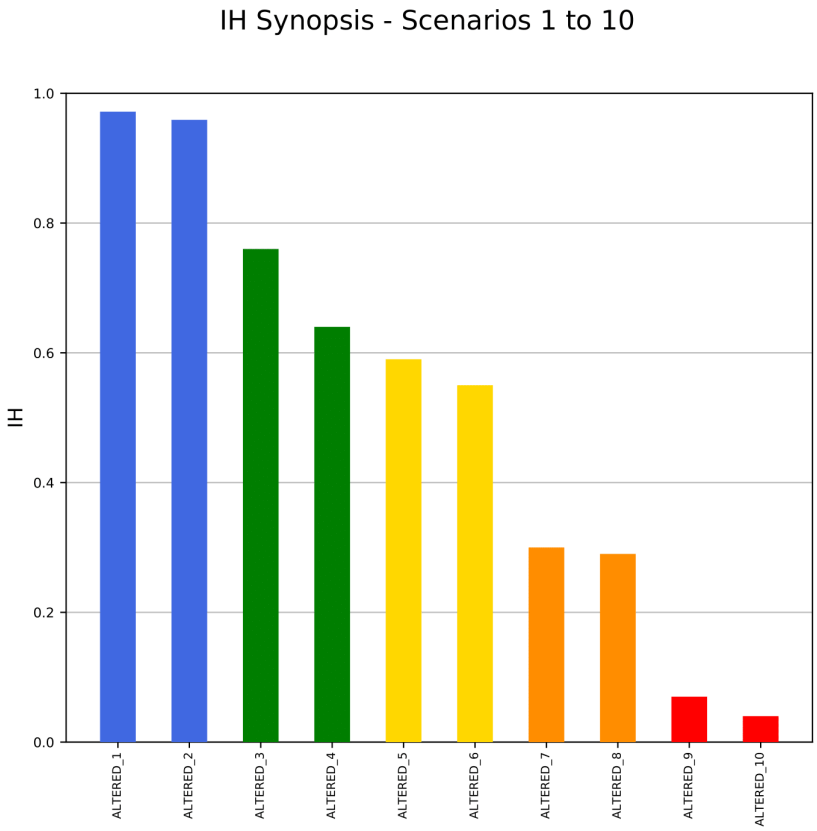


- *UCUT curves* (txt file). Row data of the UCUT (Uniform Continuous Under Threshold) curves for all possible thresholds for a certain species or life stage of interest.



	S-10	S-11	S-12	S-13	S-14	S-15	S-16	S-17	S-18	S-19	S-20	S-21	S-22	S-23	S-24	S-25	S-26	S-27	S-28	S-29	S-30	S-31
2	0.18	1.46	1.55	1.55	1.55	2.01	2.1	2.1	2.46	2.55	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
3	0	1.46	1.55	1.55	1.55	2.01	2.1	2.1	2.46	5.02	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
4	0	1.46	1.55	1.55	1.55	2.01	2.1	2.1	2.46	5.02	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
5	0	1.46	1.55	1.55	1.55	2.01	2.1	3.92	2.46	5.02	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
6	0	1.46	1.55	1.55	1.55	2.01	2.1	5.66	4.56	9.4	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
7	0	1.46	1.55	1.55	1.55	2.01	2.1	5.66	4.56	9.4	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
8	0	1.46	1.55	1.55	2.55	2.01	3.65	5.66	6.48	9.4	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
9	0	1.46	1.55	1.55	2.55	3.38	3.65	5.66	6.48	9.4	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
10	0	1.46	2.37	2.37	2.55	3.38	3.65	5.66	6.48	9.4	3.38	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
11	0	1.46	2.37	2.37	2.55	3.38	3.65	6.93	6.48	9.4	5.93	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
12	0	2.01	2.37	2.37	2.55	3.38	4.84	6.93	6.48	9.4	5.93	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
13	0	2.01	2.37	2.92	3.1	4.38	4.84	6.93	7.94	10.95	5.93	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
14	0	2.01	2.37	2.92	3.1	4.38	4.84	6.93	7.94	10.95	8.21	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
15	0	2.28	2.37	3.28	3.47	4.38	5.75	6.93	7.94	10.95	10.4	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
16	0	2.65	2.65	3.83	4.56	5.11	5.75	6.93	7.94	10.95	10.4	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
17	0	2.74	3.01	4.2	4.74	5.11	5.75	6.93	7.94	10.95	10.4	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
18	0	0	3.1	4.29	4.74	5.11	5.75	7.57	7.94	10.95	10.4	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
19	0	0	0	0	0	5.57	6.3	8.12	9.76	10.95	10.4	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
20	0	0	0	0	0	6.3	6.75	8.12	9.76	12.77	10.4	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
21	0	0	0	0	0	6.3	7.48	8.85	9.76	12.77	10.4	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
22	0	0	0	0	0	6.48	7.48	9.12	9.76	13.5	11.95	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
23	0	0	0	0	0	6.48	7.48	9.31	10.31	14.14	11.95	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
24	0	0	0	0	0	0	7.66	9.31	10.31	14.69	11.95	4.84	4.84	8.03	8.3	12.41	12.41	15.42	15.51	15.6	15.6	15.69
25	0	0	0	0	0	0	0	0	11.04	14.69	11.95	4.84	4.84	8.03	8.3	12.41	22.72	15.42	15.51	15.6	15.6	15.69
26	0	0	0	0	0	0	0	0	11.31	15.05	13.14	7.48	7.48	8.03	8.3	12.41	22.72	15.42	15.51	15.6	15.6	15.69
27	0	0	0	0	0	0	0	0	11.31	15.6	14.23	7.48	10.04	8.03	8.3	12.41	22.72	15.42	15.51	15.6	15.6	15.69
28	0	0	0	0	0	0	0	0	11.59	15.78	14.23	7.48	10.04	8.03	8.3	12.41	22.72	15.42	15.51	15.6	15.6	15.69

- *Habitat integrity index* (PDF file). Synopsis of the IH index results of all altered hydrological scenarios (from ALTERED_1 to ALTERED_6), reported as a bar chart. IH values are divided in 5 quality classes: High (blue), Good (green), Moderate (yellow), Poor (orange), Bad (red).



- *Habitat integrity index* (txt file). IH index and the related metrics and parameters for every altered hydrological scenario, and for every species or life stage of interest (below the results of the ALTERED_6 scenario, i.e. IH = 0.55, is reported).

*Habitat_integrity_index_Argentina.txt - Blocco note di Windows

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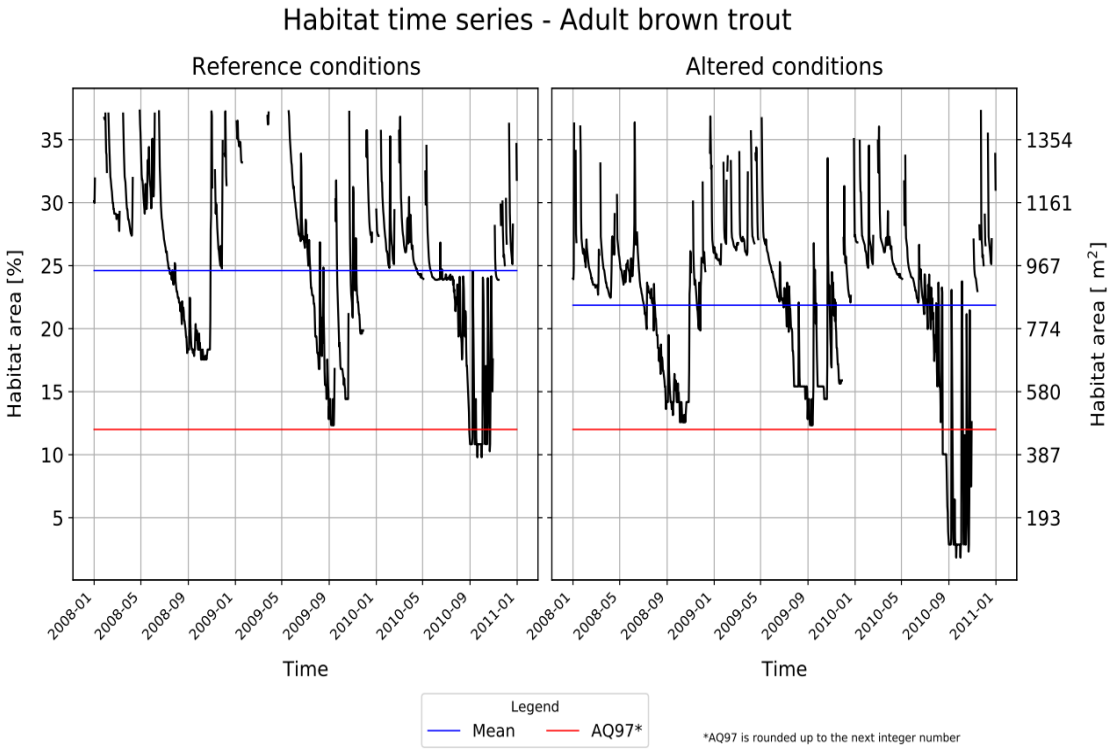
```
River        Argentina
Q97 [m3/s]   0.14
IH           0.55
-----------------------------------------------------
The Index of Spatial Habitat availability (ISH)
describes the average amount of habitat loss
due to a particular pressure.

The Index of Temporal Habitat availability (ITH)
measures the increase of continuous duration of
events below AQ97 [%]. To build UCUT curves and
to calculate ITH, AQ97 is rounded up to the next
integer number (rounded value is shown in brackets).
-----------------------------------------------------

Adult brown trout
AHdr [%]     24.61
AHd [%]      21.86
ISH          0.89
AQ97 [%]     11.31 - (12)
SDA [-]      1.48
ITH          0.57

Juvenile trout
AHdr [%]     26.75
AHd [%]      26.57
ISH          0.99
AQ97 [%]     20.55 - (21)
SDA [-]      1.59
ITH          0.55
```

- *Habitat integrity index* (PDF file). Habitat time series for (left) reference and (right) altered conditions for every altered hydrological scenario and for a given species or life stage of interest (the graph below refers to the ALTERED_6 scenario and adult brown trout). Blue solid lines represent average values of habitat availability used to calculate the Index of Spatial Habitat Availability (ISH). Red solid lines refer to the minimum habitat threshold during low flows (AQ97) in reference conditions, which is used to generate UCUT curves and calculate the Index of Temporal Habitat Availability (ITH).



- *Habitat integrity index* (PDF file). UCUT curves for the AQ97 threshold representing habitat condition during low flows for reference (black line) and altered (grey line) hydrological scenarios. AQ97 curves are reported for every hydrological scenario and for every species and life stage of interest (the graph below refers to the ALTERED_6 scenario and adult brown trout. The average distance between AQ97 curves represents the average increase of habitat stress days (Stress Day Alteration – SDA = 1.48) during low flows and allows comparative analysis among different scenarios.