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A Web Interface To Write The Txtinout Files For Scenarios Development

The Center for advanced Studies Research and Development in Sardinia

CRS4 is an interdisciplinary research center promoting the study, development and application of innovative solutions to problems stemming from natural, social and industrial environments.

CRS4 Mission in the environmental sciences are:

- Development of physical and numerical models implemented on HPC platforms for high resolution simulations
- Software tools development for the analysis and management of environmental data, integration of information systems and numerical applications

Outline

- **Introduction To The BAsin Scale HYdrological Toolkit**
    - Features and Objectives
    - The User interface
- Importing SWAT Data Into BASHYT
    - SPRITE and SWATSL
    - XML Univocal Definition of SWAT Data and SWATSL Databases
- Managing and changing TxtInOut files From BASHYT
    - Tablesin Changes and Txtinout Rebuilding
    - Obtaining DPSIR Chains From Txtinout files

Introduction To BASHYT

BASHYT is a web interface for SWAT to manage and visualize on the WEB input and output of the model

It works with:

- AvSWAT and ArcSWAT
- gSWAT (A web autocalibration tool from UT Cluj)
- eGLE (web learning tool from UT Cluj)

Main features:

- It is optimized to manage many SWAT watersheds/scenarios
- Implements the conceptual **DPSIR paradigm** (***Driving forces-Pressures-States-Impacts-Responses)***
- Produces dynamic reports (e.g. GIS maps, tables, charts) on evironmental states
- It is fully programmable exploiting metalanguage such as XML, Velocity Template, etc.

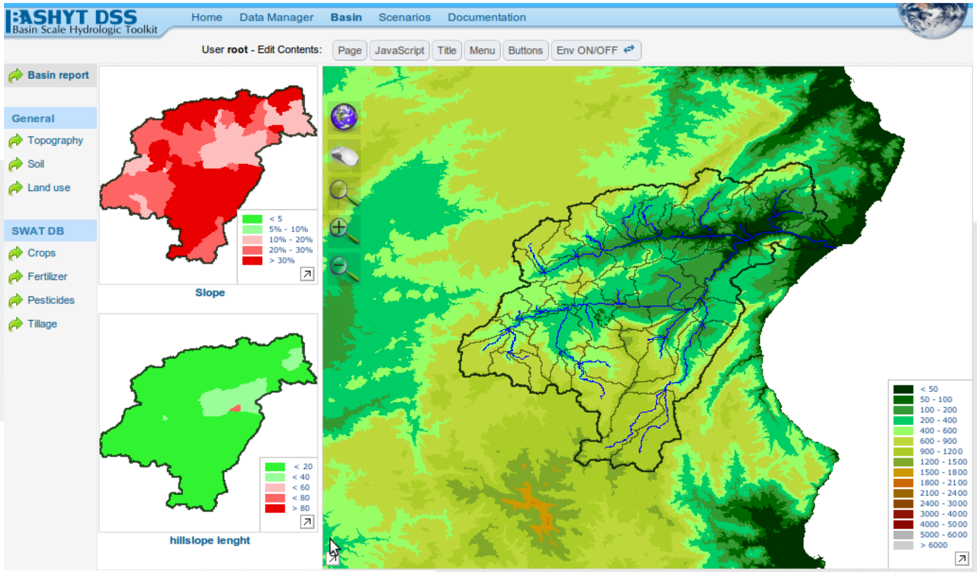
Introduction To BASHYT

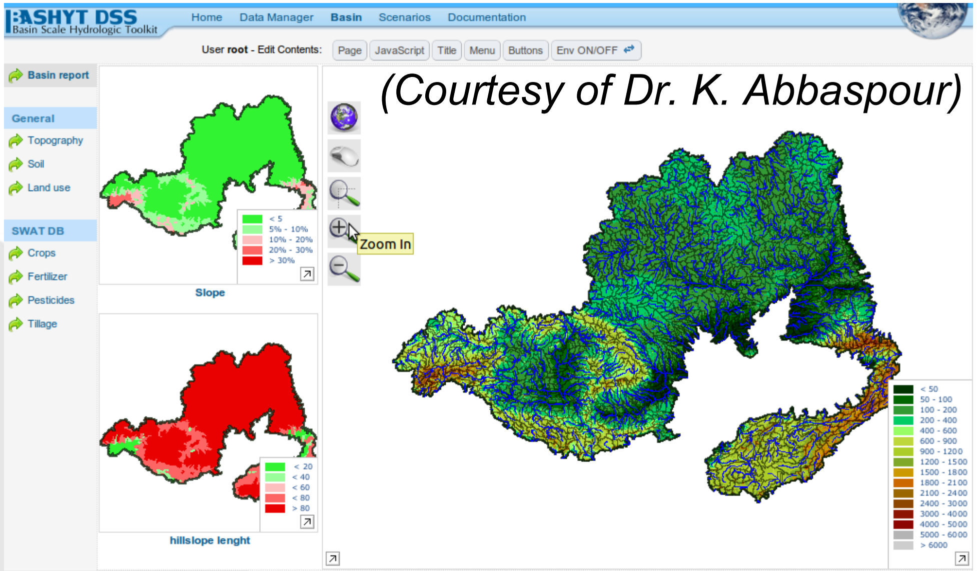
Objectives of the BASHYT framework:

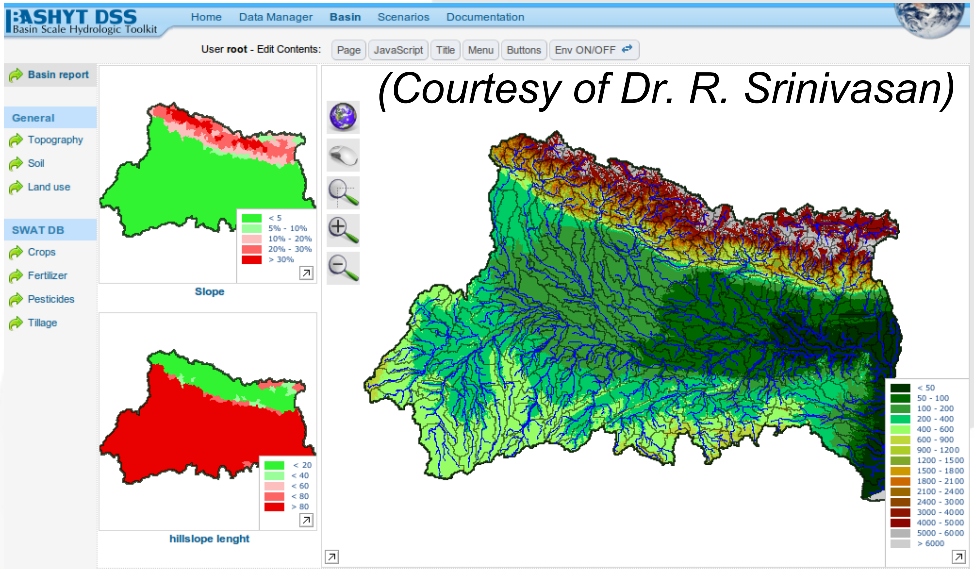
- Help earth scientists analyze complex environmental dynamics
- Through a rigorous conceptual framework demonstrate the interconnectedness and estimate the effectiveness of the actions aimed (responces) at solving environmental problems
- Share data, knowledge through a web based environment
- Expose **WEB based** tools **to analyze data** and to ease the **report production mechanism**
- **Expose methods and services** accessed through dedicated API

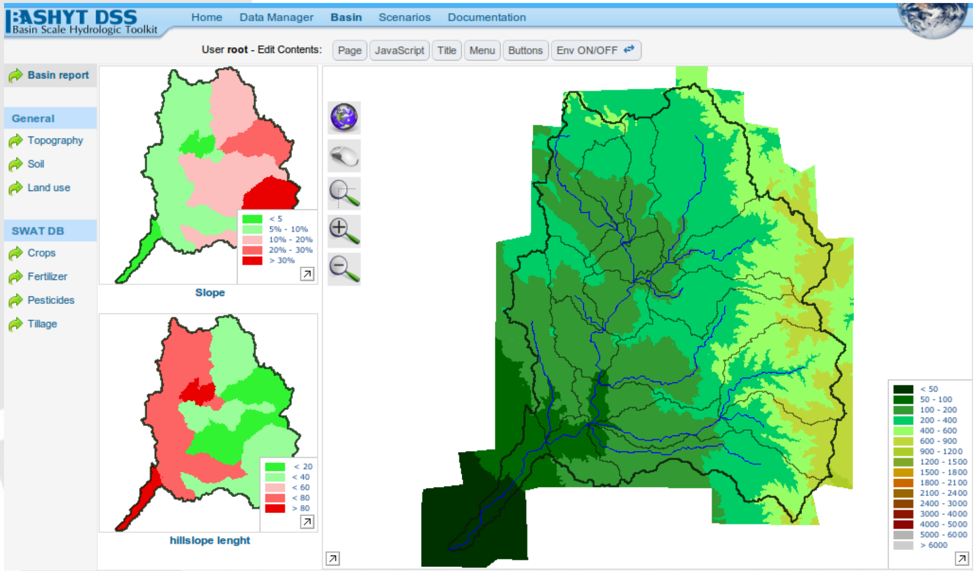
Introduction To BASHYT
The User Interface

Visualizations within BASHYT of different Basins around the world



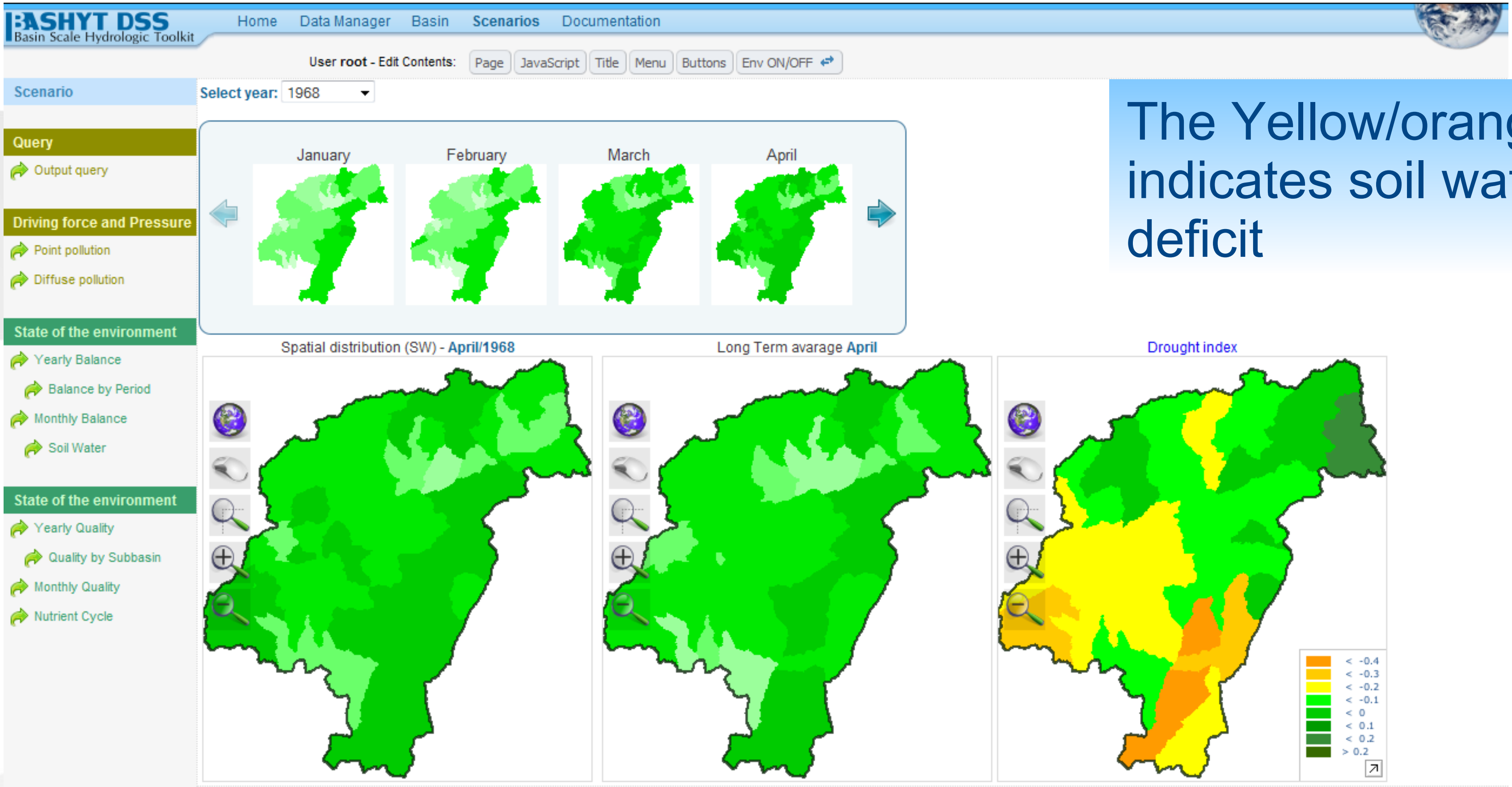

(Courtesy of Dr. K. Abbaspour)


(Courtesy of Dr. R. Srinivasan)



Introduction To BASHYT
The User Interface

GIS graphical analysis example – Soil Water

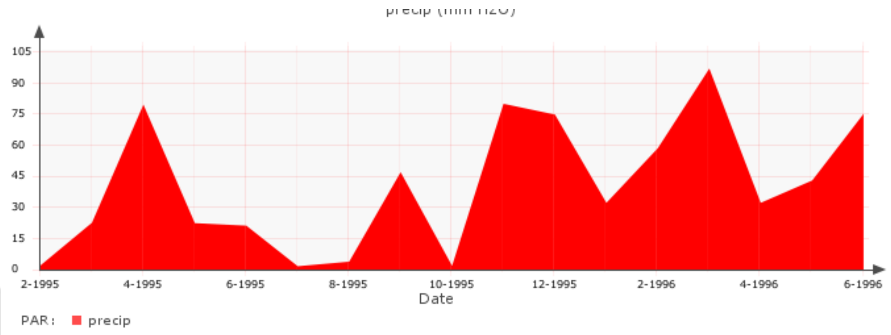


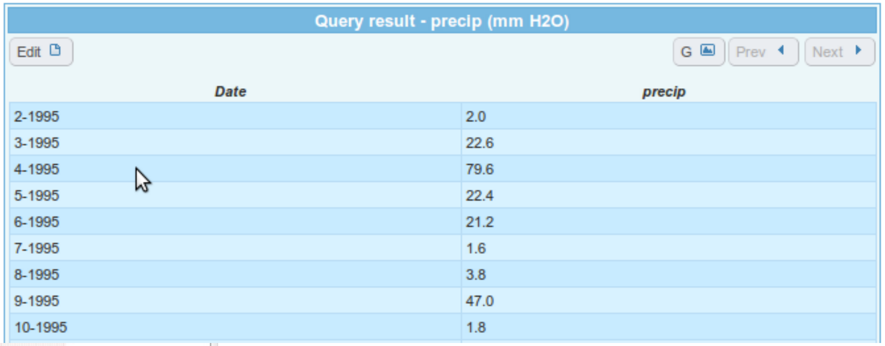
Select year: 1968

The Yellow/orange indicates soil water deficit

Introduction To BASHYT
The User Interface

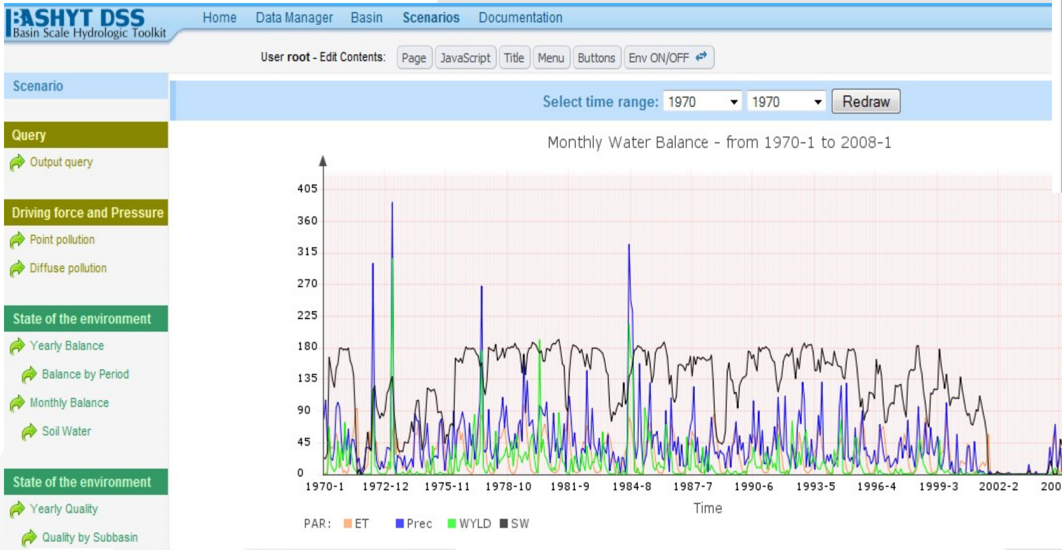
Numerical analysis through customizable charts and tables





Query result - precip (mm H2O)

Date	precip
2-1995	2.0
3-1995	22.6
4-1995	79.6
5-1995	22.4
6-1995	21.2
7-1995	1.6
8-1995	3.8
9-1995	47.0
10-1995	1.8



Monthly Water Balance - from 1970-1 to 2008-1

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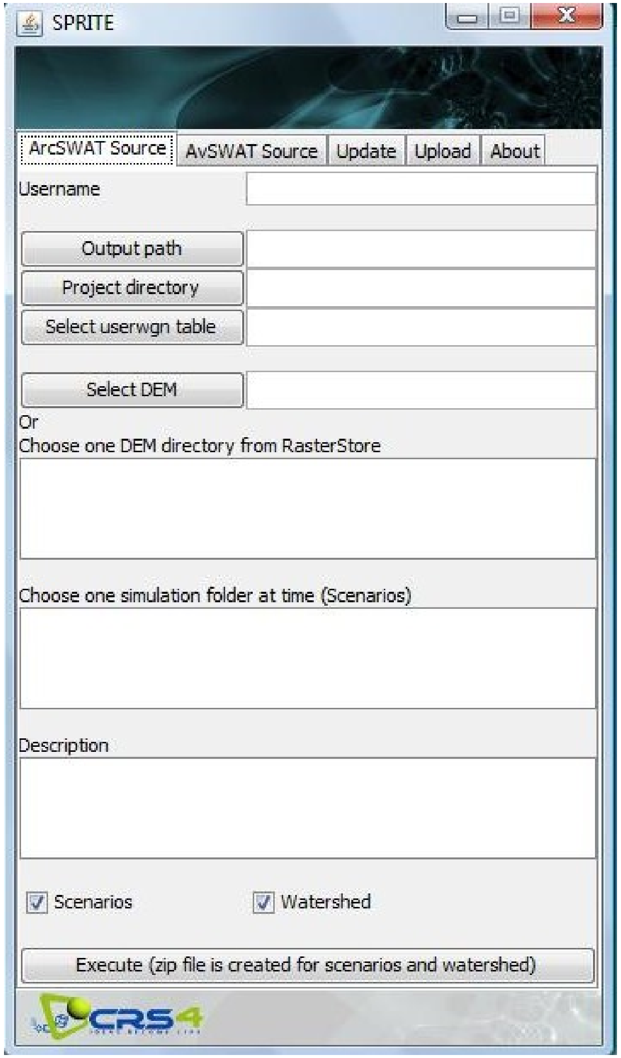
Importing SWAT Data: SPRITE

An *Export Transport Load* procedure (SPRITE+SWATSL) makes both the GIS data and the SWAT input and output available to the BASHYT users

Sprite is a stand alone Java program (ETL) that process AvSWAT/ArcSWAT projects to derive the necessary information (GIS data + SWAT I/O) to be uploaded to any BASHYT server reachable on a LAN or on the Internet.

Sprite archives data in zip files, and distinguish between Watershed data (GIS data) and Scenarios data (SWAT I/O), for indepentent uploads


SPRITE

Or
Choose one DEM directory from RasterStore

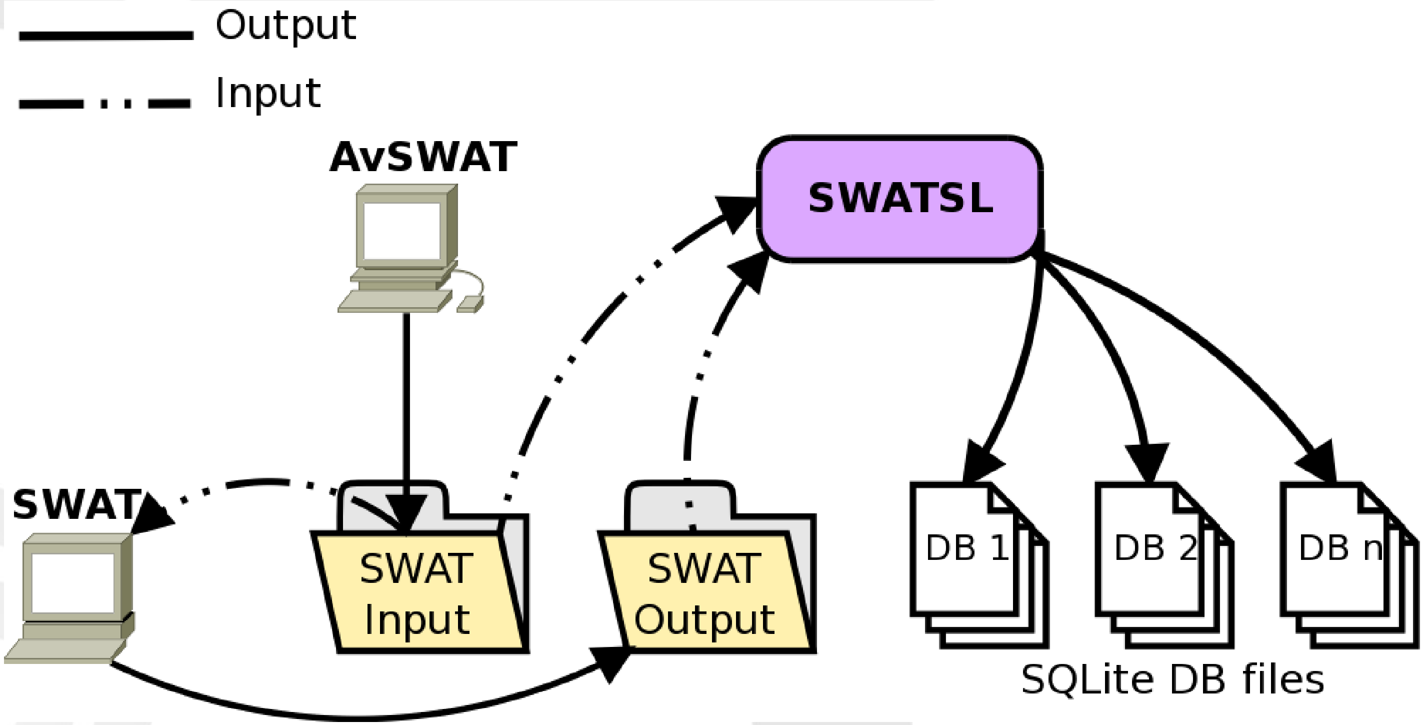
Choose one simulation folder at time (Scenarios)

Description

☑ Scenarios ☑ Watershed

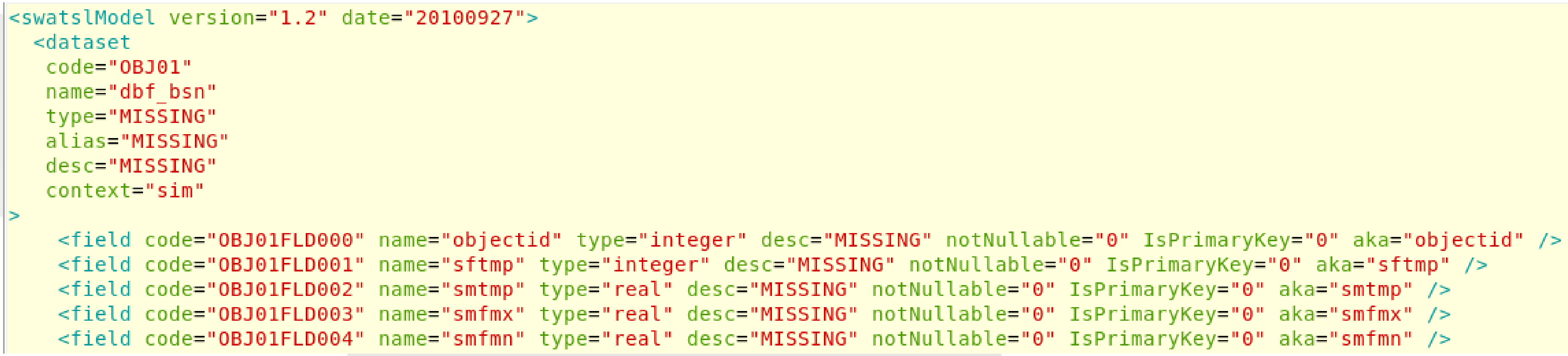
Importing SWAT Data: SWATSL

- SWATSL is a C++ library that hides the complexity of the SWAT files architecture providing a portable and structured SQLite database file
- After SWATSL has done its work, data can be accessed using standard SQL queries



Importing SWAT Data: SWATSL

ArcSWAT and *AvSWAT* produce different data structures; this could result in inconsistent BASHYT applications



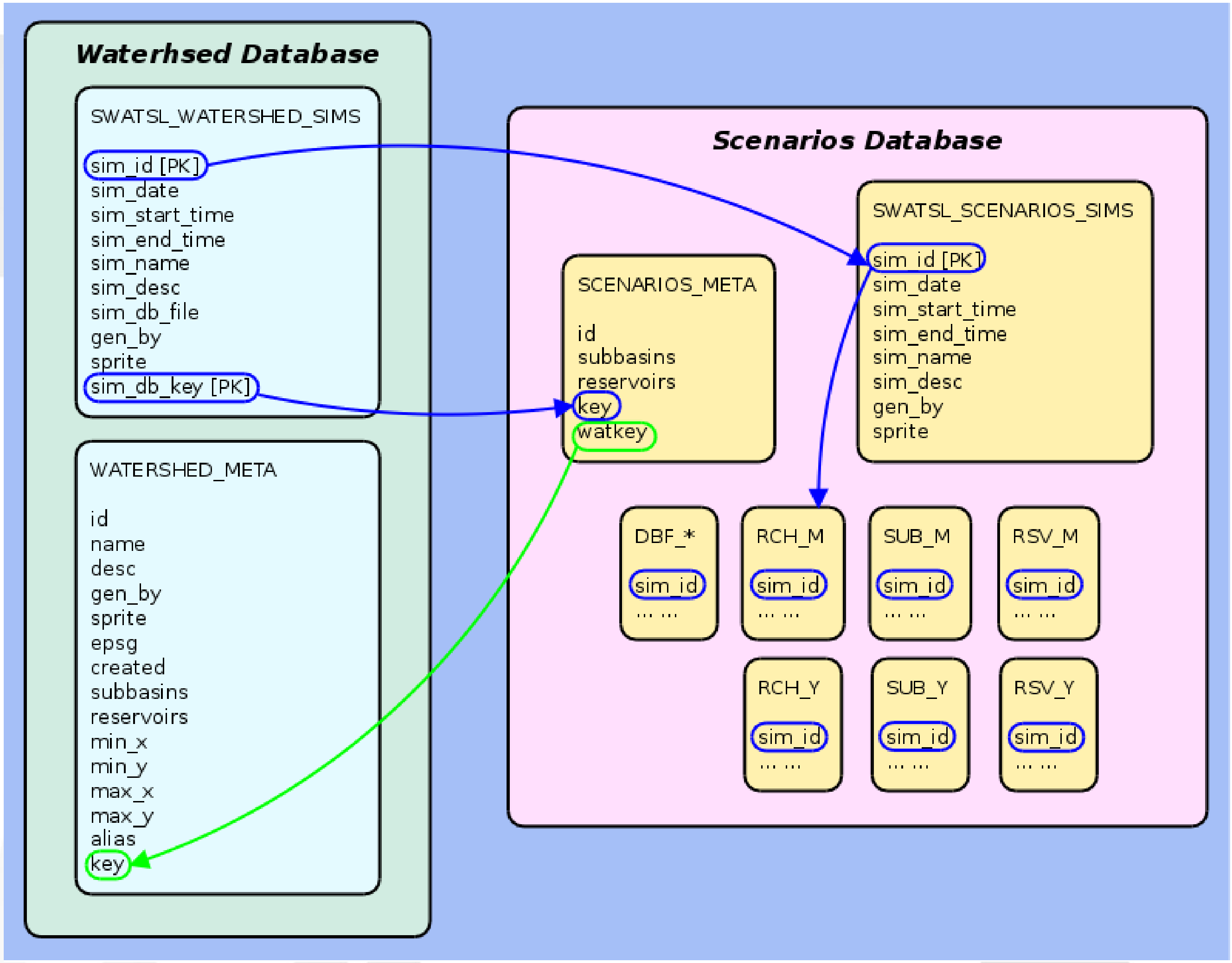
```
<swatslModel version="1.2" date="20100927">
  <dataset
   code="OBJ01"
   name="dbf_bsn"
   type="MISSING"
   alias="MISSING"
   desc="MISSING"
   context="sim"
>
    <field code="OBJ01FLD000" name="objectid" type="integer" desc="MISSING" notNullable="0" IsPrimaryKey="0" aka="objectid" />
    <field code="OBJ01FLD001" name="sftmp" type="integer" desc="MISSING" notNullable="0" IsPrimaryKey="0" aka="sftmp" />
    <field code="OBJ01FLD002" name="smtmp" type="real" desc="MISSING" notNullable="0" IsPrimaryKey="0" aka="smtmp" />
    <field code="OBJ01FLD003" name="smfmx" type="real" desc="MISSING" notNullable="0" IsPrimaryKey="0" aka="smfmx" />
    <field code="OBJ01FLD004" name="smfmn" type="real" desc="MISSING" notNullable="0" IsPrimaryKey="0" aka="smfmn" />
```

Solution:

- SWAT data to be imported, possible missing values and name aliases are defined in an XML file
- Conflicts and differences between ArcSWAT/AvSWAT projects are solved automatically using such information
- The BASHYT databases are always consistent to one another
- The database schema is fixed; it is populated on the basis of the available data

Importing SWAT Data: Databases

SWATSL produces one or more SQLite spatially enabled database files containing GIS data and several simulations



GIS data and simulations can be combined at the BASHYT application level through the relational schema of the database.

Databases are self-consistent and self-describing.

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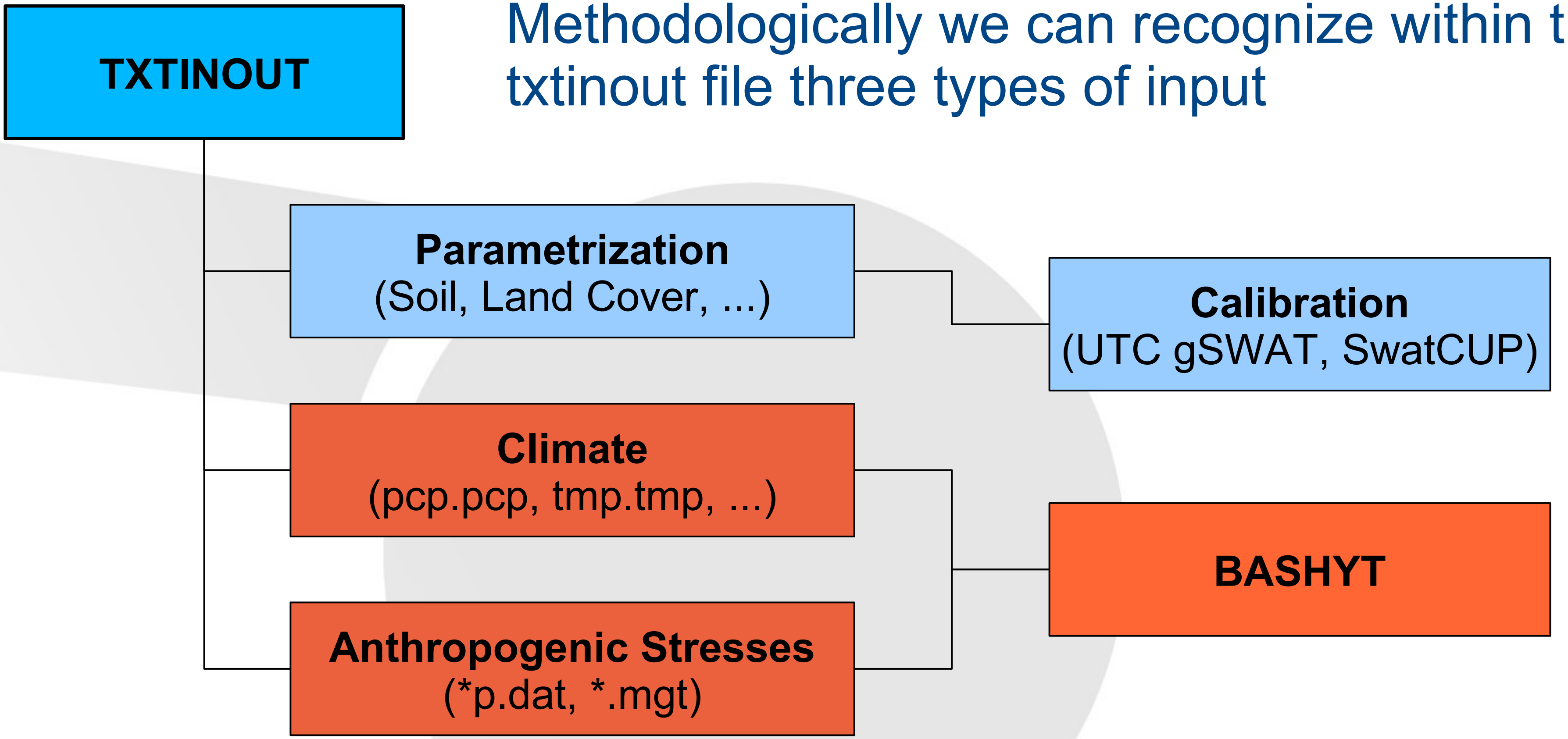
Managing and changing TxtInOut files From BASHYT

We aim at improving the BASHYT web-based analysis tool by giving the user the chance to:

- Design new scenarios
- Run the swat model on the new txtinout
- Access to powerful dedicated computing resources
- Compare scenarios through standardized procedures
- See the results directly on the web

Managing and changing TxtInOut files From BASHYT

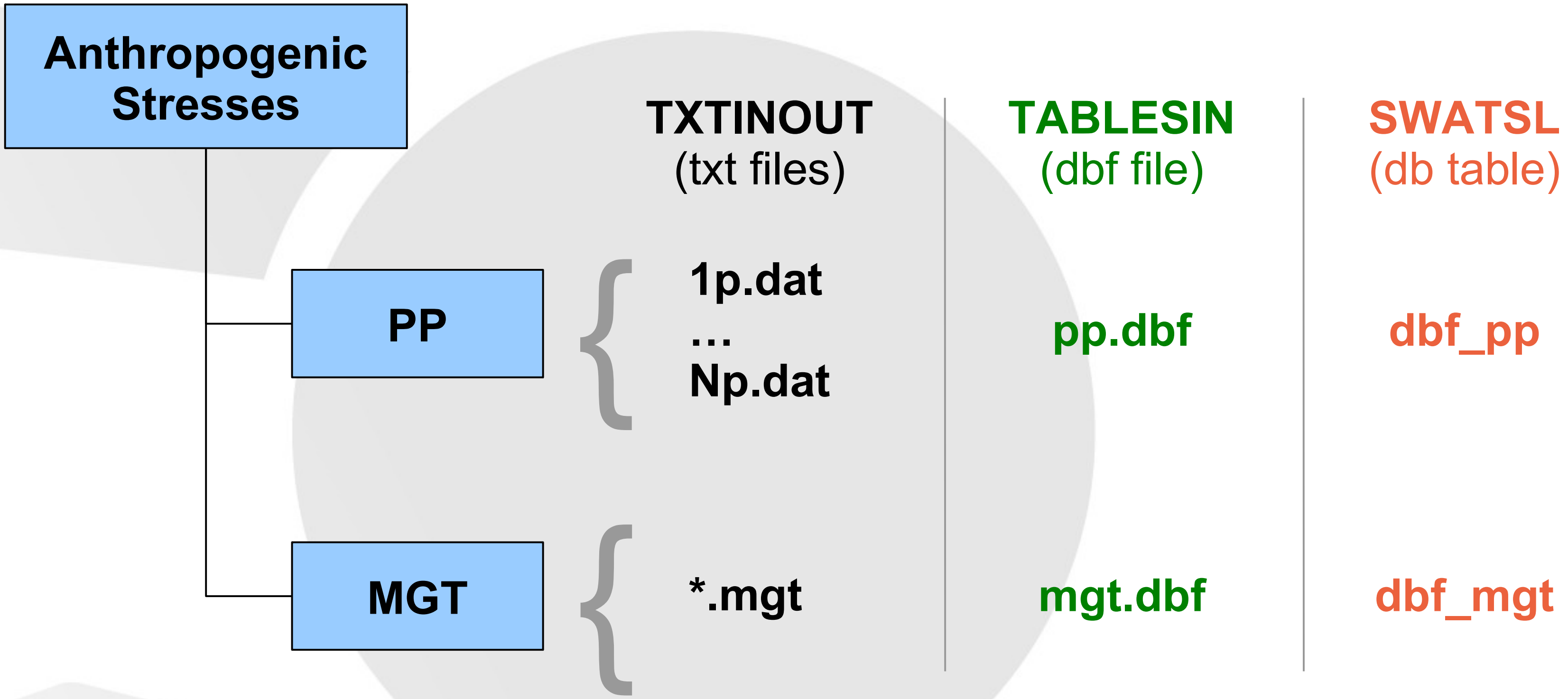
Methodologically we can recognize within the txtinout file three types of input



Starting from a calibrated txtinout, we plan to design/run scenarios of three types: **Climate Change, Land Management** and **Point Pollution**

Managing and changing TxtInOut files From BASHYT

Considering the anthropogenic stresses we can adjust parameters which regard **Point Pollution** or **Soil Management**



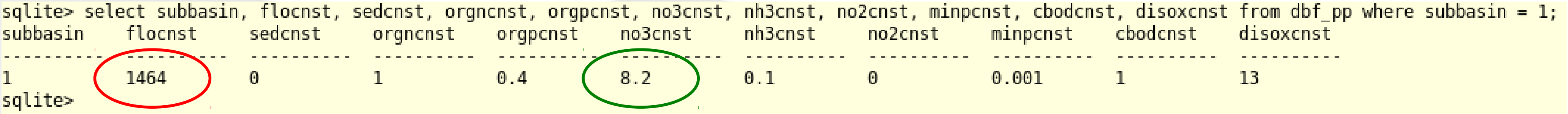
Anthropogenic Stresses

	TXTINOUT (txt files)	TABLESIN (dbf file)	SWATSL (db table)
PP	**1p.dat** **…** **Np.dat**	**pp.dbf**	**dbf_pp**
MGT	***.mgt**	**mgt.dbf**	**dbf_mgt**

There is always correspondence between data stored in txtinout files, tablesin tables and swatsl databases

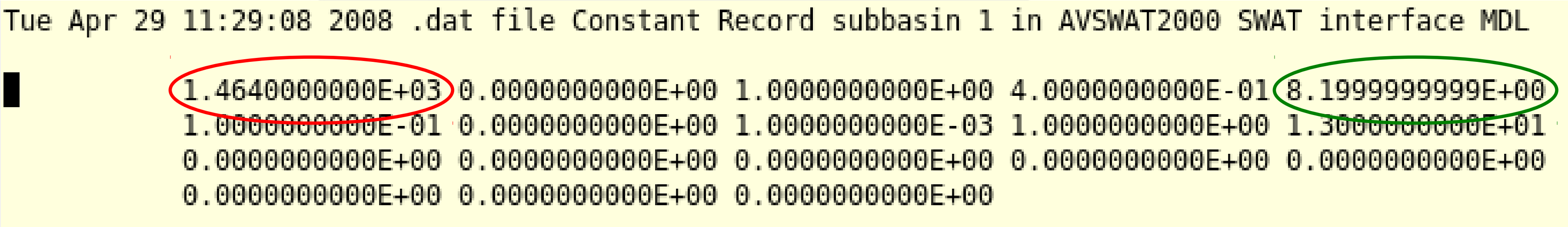
Managing and changing TxtInOut files From BASHYT

An SQL query on the **dbf_pp** table imported by SWATSL from the **pp.dbf** input table (query for subbasin 1)



```
sqlite> select subbasin, flocnst, sedcnst, orgncnst, orgpcnst, no3cnst, nh3cnst, no2cnst, minpcnst, cbodcnst, disoxcnst from dbf_pp where subbasin = 1;
subbasin    flocnst     sedcnst     orgncnst    orgpcnst    no3cnst     nh3cnst     no2cnst     minpcnst    cbodcnst    disoxcnst
----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------  ----------
1           1464        0           1           0.4         8.2         0.1         0           0.001       1           13
sqlite>
```

The same numbers are written in the **1p.dat** file in the **txtinout** directory



```
Tue Apr 29 11:29:08 2008 .dat file Constant Record subbasin 1 in AVSWAT2000 SWAT interface MDL

█          1.4640000000E+03 0.0000000000E+00 1.0000000000E+00 4.0000000000E-01 8.1999999999E+00
           1.0000000000E-01 0.0000000000E+00 1.0000000000E-03 1.0000000000E+00 1.3000000000E+01
           0.0000000000E+00 0.0000000000E+00 0.0000000000E+00 0.0000000000E+00 0.0000000000E+00
           0.0000000000E+00 0.0000000000E+00 0.0000000000E+00
```

The Procedure

To run new scenarios on BASHYT *(in progress)* **we need to:**

1. Extract the original settings (Anthrop. Stresses or Climate) of a calibrated scenarios from an imported SWATSL database
2. Edit these settings through a user-friendly web interface in a temporary database
3. Rebuild a server-side copy of a Txtinout directory with the user adjustments
4. Run the SWAT binary in such directory
5. Import the output as a new scenarios using SWATSL

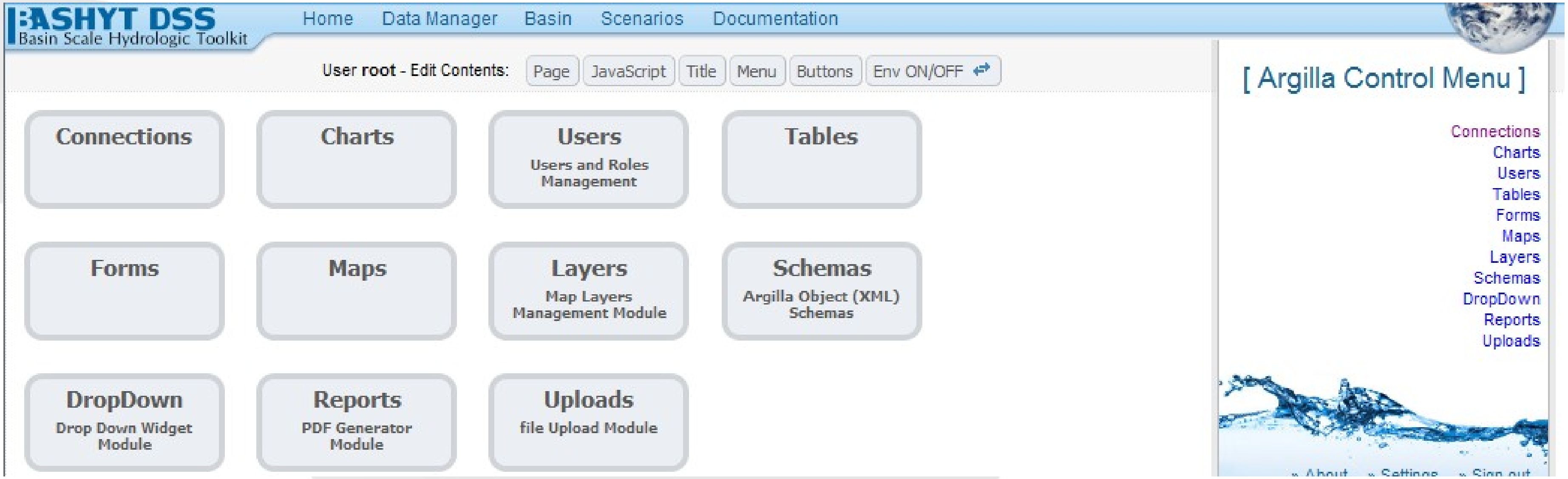
Conclusions

- Changing the TxtInOut directly from bashyt requires still a lot of effort both on the frontend and the backend of BASHYT
- Such improvement will provide a very easy and fast way for producing and sharing new scenarios
- The new interoperability services and API developed in BASHYT for enhancing communication with other SWAT tools (e.g. the gSWAT calibration tool) is expected to greatly improve data flow processes and the use of BASHYT

Optional Slides

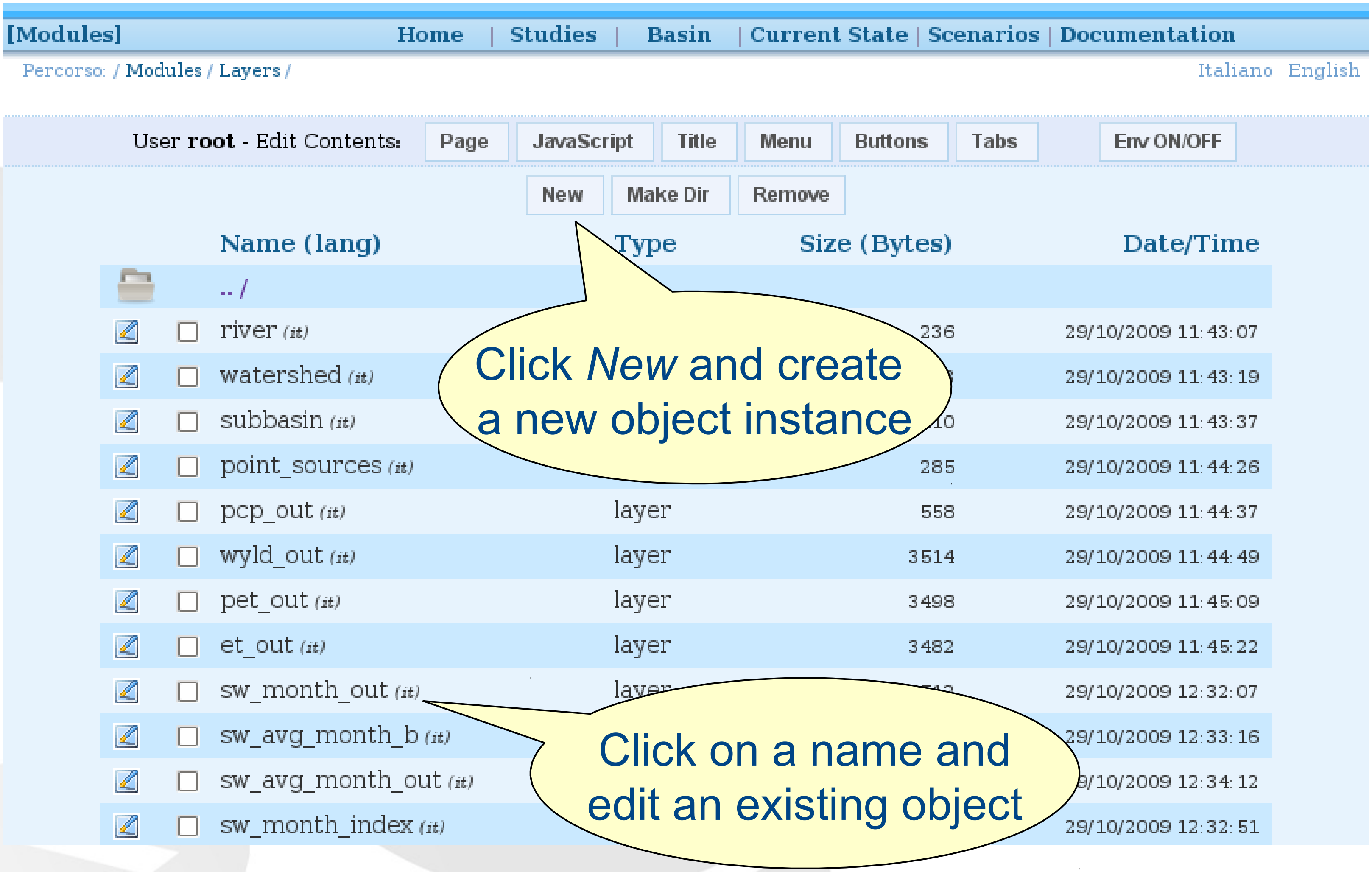
Introduction To BASHYT
The Developer Interface

The module section exposes though easy to use web interfaces a variety of services to shape XML objects for **charts, maps, tables, PDF, and forms production**.



Modules permit the massive use **of preset schemas** stored in the database in a structured XML form. Each object refer to its schema and describes parameters (e.g. to control layout) and data sources.

Introduction To BASHYT
The Developer Interface



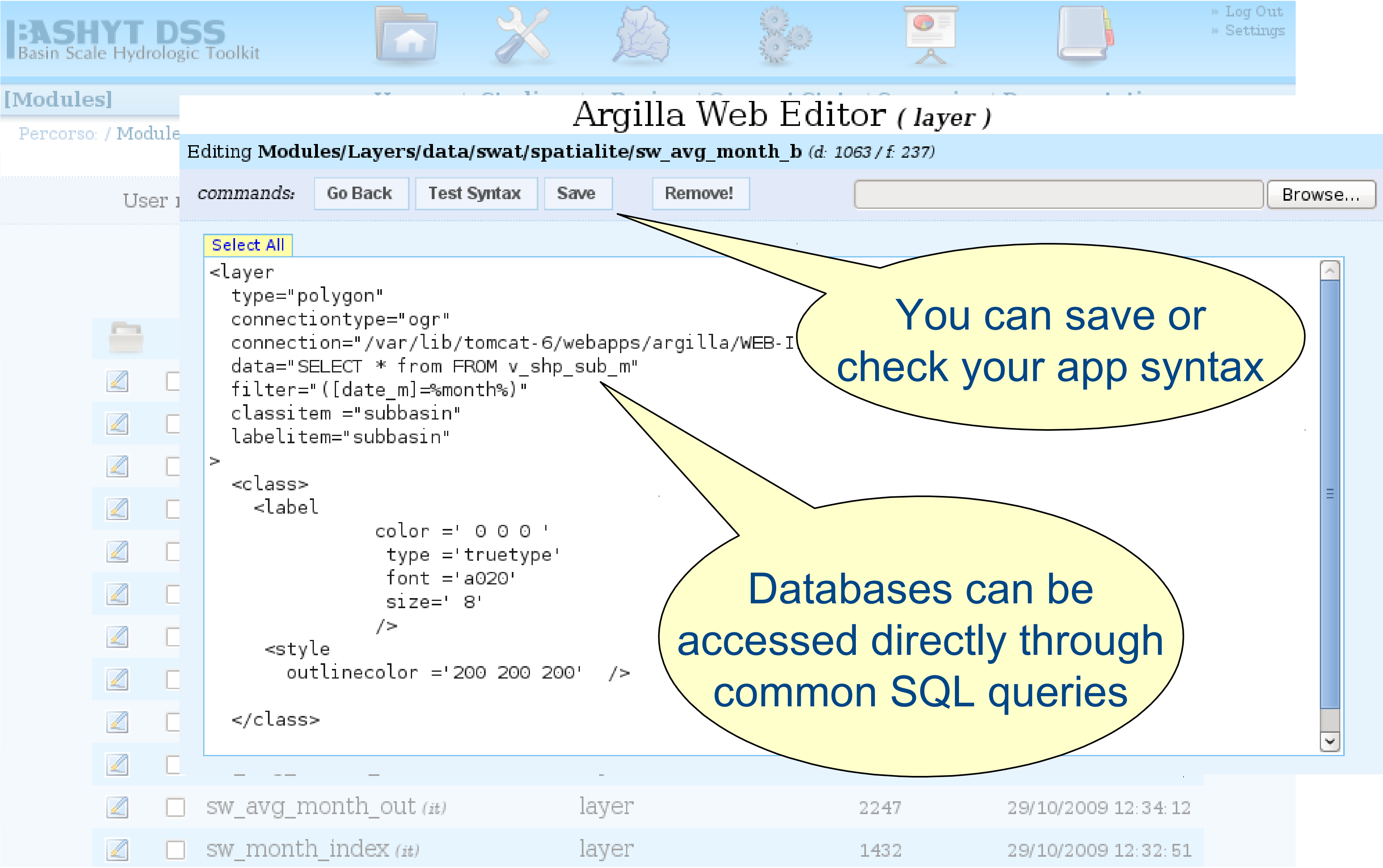
[Modules]
Home | Studies | Basin | Current State | Scenarios | Documentation
Percorso: / Modules / Layers /
Italiano English
User root - Edit Contents:
Page
JavaScript
Title
Menu
Buttons
Tabs
Env ON/OFF
New
Make Dir
Remove

Name (lang)	Type	Size (Bytes)	Date/Time
.. /			
river (it)		236	29/10/2009 11:43:07
watershed (it)			29/10/2009 11:43:19
subbasin (it)			29/10/2009 11:43:37
point_sources (it)		285	29/10/2009 11:44:26
pcp_out (it)	layer	558	29/10/2009 11:44:37
wyld_out (it)	layer	3514	29/10/2009 11:44:49
pet_out (it)	layer	3498	29/10/2009 11:45:09
et_out (it)	layer	3482	29/10/2009 11:45:22
sw_month_out (it)	layer		29/10/2009 12:32:07
sw_avg_month_b (it)			29/10/2009 12:33:16
sw_avg_month_out (it)			29/10/2009 12:34:12
sw_month_index (it)			29/10/2009 12:32:51

Click *New* and create a new object instance

Click on a name and edit an existing object

Introduction To BASHYT
The Developer Interface



BASHYT DSS
Basin Scale Hydrologic Toolkit

» Log Out
» Settings
[Modules]
Percorso: / Module
User

Argilla Web Editor *(layer)*

Editing **Modules/Layers/data/swat/spatialite/sw_avg_month_b** *(d: 1063 / f: 237)*

commands: Go Back | Test Syntax | Save | Remove! | Browse...
Select All

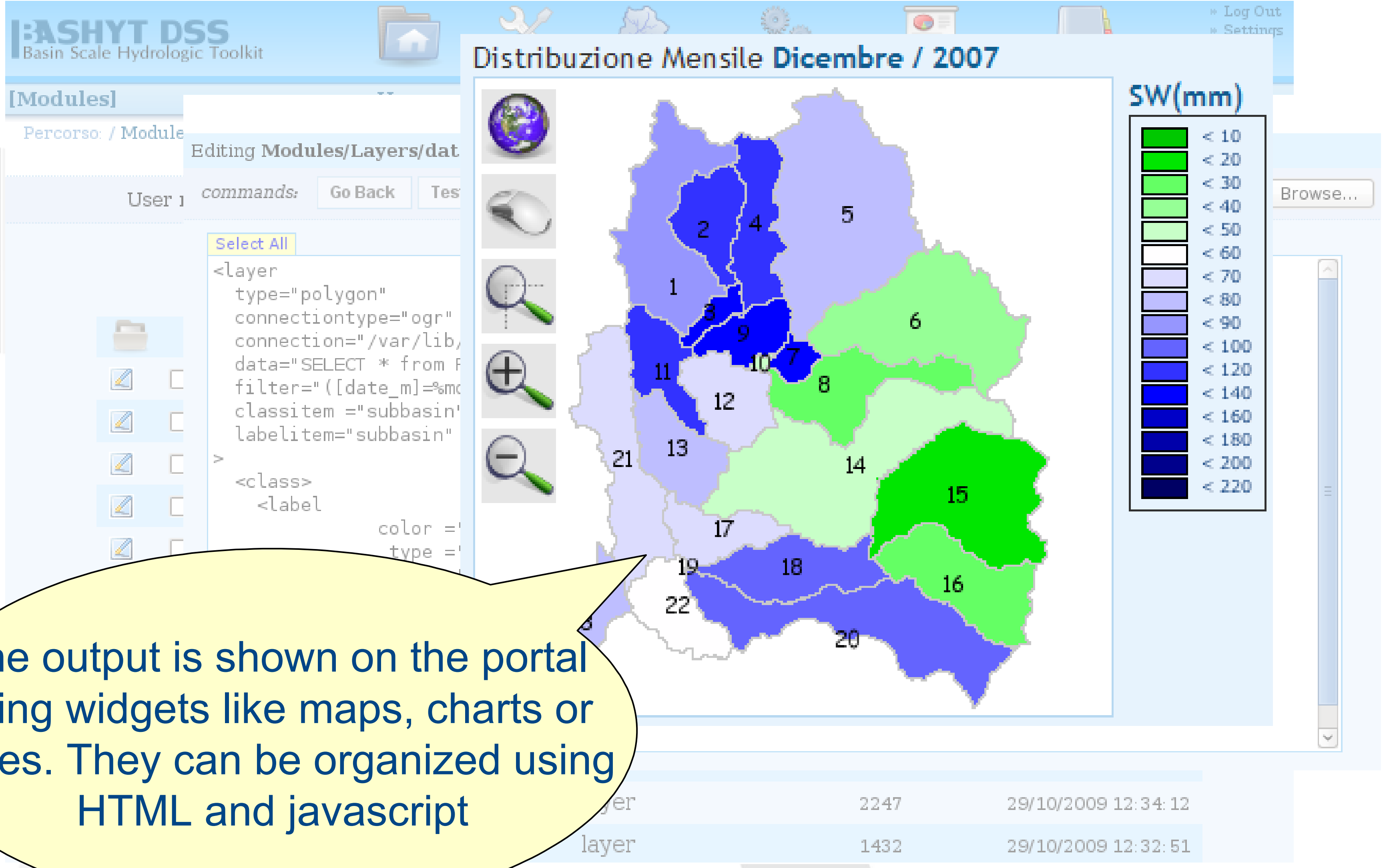
```
<layer
  type="polygon"
  connectiontype="ogr"
  connection="/var/lib/tomcat-6/webapps/argilla/WEB-I
  data="SELECT * from FROM v_shp_sub_m"
  filter="([date_m]=%month%)"
  classitem ="subbasin"
  labelitem="subbasin"
>
  <class>
    <label
             color =' 0 0 0 '
              type ='truetype'
              font ='a020'
              size=' 8'
             />
     <style
       outlinecolor ='200 200 200'  />

  </class>
```

sw_avg_month_out *(it)*	layer	2247	29/10/2009 12:34:12
sw_month_index *(it)*	layer	1432	29/10/2009 12:32:51

You can save or check your app syntax

Databases can be accessed directly through common SQL queries

Introduction To BASHYT
The Developer Interface



Editing **Modules/Layers/dat**

Distribuzione Mensile **Dicembre / 2007**

```
<layer
  type="polygon"
  connectiontype="ogr"
  connection="/var/lib/
  data="SELECT * from F
  filter="([date_m]=%mo
  classitem ="subbasin'
  labelitem="subbasin"
>
  <class>
    <label
           color ='
           type ='
```

...yer	2247	29/10/2009 12:34:12
layer	1432	29/10/2009 12:32:51

The output is shown on the portal using widgets like maps, charts or tables. They can be organized using HTML and javascript