A Web Interface To Write The Ttxtinout Files For Scenarios Development
**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 Ttxtinout Rebuilding
  • Obtaining DPSIR Chains From Ttxtinout files
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 environmental 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 (responses) 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
Visualizations within BASHYT of different Basins around the world

(Courtesy of Dr. R. Srinivasan)

(Courtesy of Dr. K. Abbaspour)
Introduction To BASHYT
The User Interface

GIS graphical analysis example – Soil Water

The Yellow/orange indicates soil water deficit
Introduction To BASHYT
The User Interface

Numerical analysis through customizable charts and tables
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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 independent uploads.
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

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

```xml
<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="smfxm" type="real" desc="MISSING" notNullable="0" IsPrimaryKey="0" aka="smfxm" />
  <field code="OBJ01FLD004" name="smfmn" type="real" desc="MISSING" notNullable="0" IsPrimaryKey="0" aka="smfmn" />
</dataset>
</swatslModel>
```
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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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
Methodologically we can recognize within the txtinout file three types of input:

- **Parametrization**
  - (Soil, Land Cover, ...)

- **Climate**
  - (pcp.pcp, tmp.tmp, ...)

- **Anthropogenic Stresses**
  - (*p.dat, *.mgt)

Starting from a calibrated txtinout, we plan to design/run scenarios of three types: **Climate Change**, **Land Management** and **Point Pollution**
Considering the anthropogenic stresses we can adjust parameters which regard **Point Pollution** or **Soil Management**

There is always correspondence between data stored in TXTINOUT files, TABLESIN tables and SWATSL databases.
An SQL query on the **dbf_pp** table imported by SWATSL from the **pp.dbf** input table (query for subbasin 1)

```sql
sqlite> select subbasin, flocnst, sedcnst, orgncnst, orgpcnst, no3cnst, nh3cnst, no2cnst, minpcnst, cbodcnst, disoxcnst from dbf_pp where subbasin = 1;
```

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<th>subbasin</th>
<th>flocnst</th>
<th>sedcnst</th>
<th>orgncnst</th>
<th>orgpcnst</th>
<th>no3cnst</th>
<th>nh3cnst</th>
<th>no2cnst</th>
<th>minpcnst</th>
<th>cbodcnst</th>
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</table>

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
```

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**

- **Click on a name and edit an existing object instance**
- **Click New and create a new object instance**

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<thead>
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<th>Size (Bytes)</th>
<th>Date/Time</th>
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<td></td>
<td></td>
</tr>
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</tr>
</tbody>
</table>
Introduction To BASHYT
The Developer Interface

You can save or check your app syntax.

Databases can be accessed directly through common SQL queries.
Introduction To BASHYT

The Developer Interface

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