

# A relational data paradigm to manage SWAT simulations on the GRID for the Black Sea Catchment observation and assessment system

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**BSC-OS Portal**  
enviroGRIDS  
Seventh Research Framework Programme (FP7)

PROJECT | BASHYT | DOCUMENTATION | REFERENCES | DOWNLOADS | FORUM

**BASHYT DSS**  
Basin Scale Hydrologic Toolkit

**EnviroGRIDS Project**  
The EnviroGRIDS @ Black Sea Catchment project

The Black Sea Catchment is internationally known as one of ecologically unsustainable development and inadequate resource management, which has led to severe environmental, social and economic problems. The EnviroGRIDS @ Black Sea Catchment project addresses these issues by bringing several emerging information technologies that are revolutionizing the way we are able to observe our planet. The Group on Earth Observation Systems of Systems (GEOSS) is building a data-driven view of our planet that feeds into models and scenarios to explore our past, present and future. EnviroGRIDS aims at building the capacity of scientist to assemble such a system in the Black Sea Catchment, the capacity of decision-makers to use it, and the capacity of the general public to understand the important environmental, social and economic issues at stake. EnviroGRIDS will particularly target the needs of the Black Sea Commission (BSC) and the International Commission for the Protection of the Danube River (ICPDR) in order to help bridging the gap between science and policy.

**Pages**

- EnviroGRIDS Project
- WP2: Spatial Data Infrastructure (SDI)
- WPI: Black Sea Basin Observation System
- BASHYT
- Documentation
- International factheets
- References
- Downloads

**Latest News**

- GEOSS capacity building workshops, Bucharest, Romania, May 3-4, 2010
- Full project meeting, Tulcea, Romania, May 4-7, 2010
- GEPIC workshop, Bucharest, Romania, May 3-4, 2010

**Events Calendar**  
April 2010

M	T	W	T	F	S	S
		1	2	3	4	
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

**Links**

- EnviroGRIDS Project



# The Context

The **EnviroGRIDS** (<http://www.envirogrids.net/>) project, funded in 2009 by the European Commission within the FP VII Program aims at building capacity for a **Black Sea Catchment observation and assessment system** supporting sustainable development. The ambition of the project is to improve transnational cooperation, develop and apply innovative, state of the art ICT technologies for monitoring states of the environment.

In the project, a Observation and Assessment System for the Black Sea Catchment will be developed (**BSC-OS portal**). This is a set of loosely coupled interoperable WEB applications.

**Our objective** within the project is to develop a Collaborative Working Environment (**CWE**) , based on integrating the watershed scale **SWAT** (Soil and Water Assessment Tool) model within a web based technological framework optimized for data management and report production (**BASHYT** – <http://www.eraprogetti.com>).



# The *B*Asin Scale *HY*drological Tool

is a **web based interface** to SWAT (input/output)

it works in tandem with ArcSWAT / AvSWAT.

relies on **web-GIS** and **RDBMS** technologies

produces reports in a easily fashion

can manage many watersheds/scenarios at once

expose on the web a templating environment to produce applications

applications can be edited directly through the browser

its own authentication and authorization layer



# The Black Sea basin

The Black Sea catchments is located in the eastern of Europe and drains its waters in the most isolated sea from the World Ocean. It is connected to the Oceans via the Mediterranean Sea through the Istanbul channel and to the Sea of Azov. The catchments draining area exceeds **2 000 000 km<sup>2</sup>** with a total shoreline of about **4 340 km**.

The ratio of the catchment draining area versus the Black Sea surface is higher then 4.5.

The Black Sea can be considered highly vulnerable to pressure from land based human activity such as land use, industrial activities, urban settlements, etc.





# Our Approach

Our approach is founded on centralizing all the model-related data into complex Relational DB infrastructures.

Shifting environmental application from the desktop oriented approach to the web based paradigm enhances flexibility in the whole system, extends the use of data and the sharing of experiences, fostering end user and citizen participation.

The Grid layer is expected to offer many advantages by which the management of computing and data storage resource, data and processing distribution, security, are just the most important.



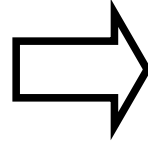
# Aim of the presentation

- present a web based interactive **interface for SWAT (Bashyt)**
  - the DPSIR conceptual framework and digest scenarios and watersheds
- show in a live demo the features of the report production mechanism of the CWE environment:
  - the web templating technology to compose new applications
- the challenges we are facing in the **enviroGRIDS** project



# BSC-OS Portal Vision

Virtually **thousands of SWAT simulations** are done by several *Virtual Organizations* around the grid; resulting data are shared with all the other partners

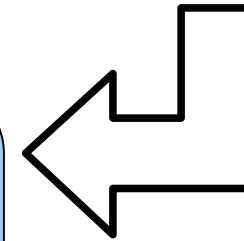


The BSC-OS portal must represent all those data making them available to decision makers in an organic and interactive web interface

**LONG TIME JOBS**

**SHORT TIME JOBS**

- ✓ Charts
- ✓ Database queries
- ✓ Text tables
- ✓ Interactive and navigable maps
- ✓ Printable reports

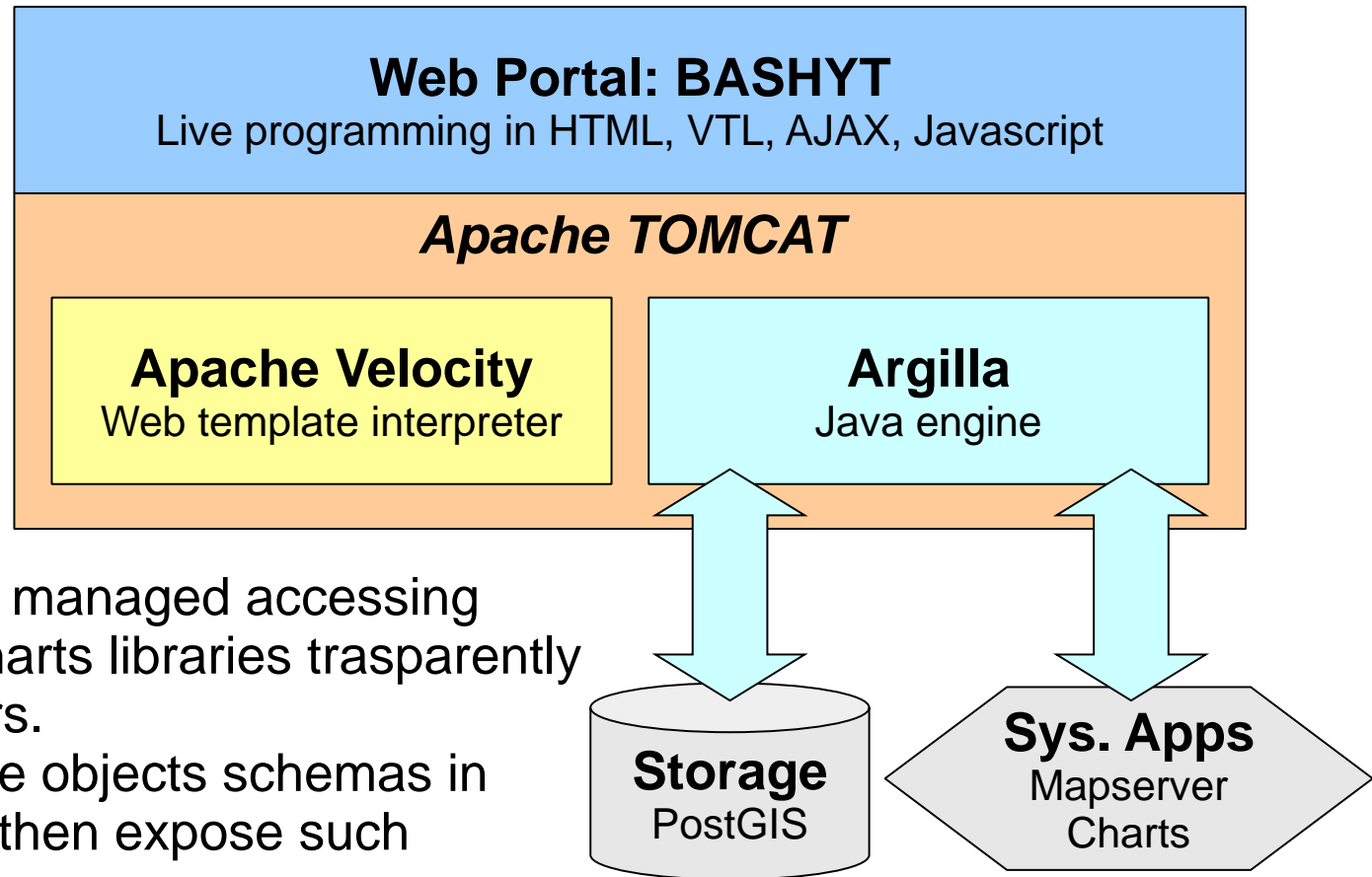


***The faster these tasks will be accomplished, the more usable the portal will get:***

# The WEB Templating paradigm

*It permits to create easily objects such as:*

Tables, Charts, Forms, Layers... these are created filling up XML modules using different schemas and then exposed in the web interfaces.



GIS and chart rendering is managed accessing the Mapserver and Timecharts libraries transparently to the web page developers.

Users need to complete the objects schemas in the dedicated section and then expose such objects in the web pages.



# USERS/ROLES

27 Partners participate in the consortium for 15 countries involved. The portal will be accessed by different users that can be grouped in the following roles described as follow:

1. read only role: public citizens – decision makers - stakeholders - private
2. insert role: these users, such as Earth Science (ES) specialist ,can upload SWAT scenarios and data
3. development role: development role from both the server and client side, such users can write pieces of codes and exploit the Velocity Template to write applications and add contents)
4. administrator role: such role manages user accounts, creates new users, updates information on the Web Portal, manages data resources



# Technologies

The BSC portal is being developed using state of the art technologies, such as:

Wordpress (CMS) – Argilla/Bashyt (for the report production)

Server and client side technologies (Apache Tomcat, Linux, Mapserver, PostgreSQL/SpatialITE and other RDBMS, AJAX technologies, msCross, etc.)

BASHYT is being used and further developed within the BSC-OS portal to expose virtually unlimited basins simulated with SWAT.

Open questions:

- unique authentication mechanism (OpenID, LDAP, ....)
- how to manage the interoperability with the GRID



# BASHYT Dev Interface: Objects

The screenshot shows the BASHYT DSS web interface. At the top, there is a blue header with the logo "BASHYT DSS Basin Scale Hydrologic Toolkit" and several icons: a folder with a house, crossed wrench and screwdriver, a map, gears, a presentation screen, and a book. On the right of the header are links for "Log Out" and "Settings". Below the header is a navigation bar with the following menu items: "[Modules]", "Home", "Studies", "Basin", "Current State", "Scenarios", and "Documentation". Below the navigation bar is a breadcrumb trail "Percorso: / Modules /" and language options "Italiano" and "English".

The main content area is titled "User root - Edit Contents:" and features a toolbar with buttons for "Page", "JavaScript", "Title", "Menu", "Buttons", "Tabs", and "Env ON/OFF". Below the toolbar is a list of objects: "Argilla Framework", "Explorer", "Connections", "Charts", "Users", "Tables", "Forms", "Images", "Maps", "Layers", "Schemas", and "DropDown".

Two yellow callout boxes provide additional information:

- A callout box pointing to the "Menu" button in the toolbar contains the text: "Users with the *administrator* role can access the page layout through the toolbar".
- A callout box pointing to the "Layers" object in the list contains the text: "Click on this object to show the list of available layers".

# BASHYT Dev Interface: Objects

**BASHYT DSS**  
Basin Scale Hydrologic Toolkit

Home | Studies | Basin | Current State | Scenarios | Documentation

Percorso: / Modules / Layers / Italiano English

» Log Out  
» Settings

User **root** - Edit Contents: Page JavaScript Title Menu Buttons Tabs Env ON/OFF

New Make Dir Remove

Name (lang)	Type	Size (Bytes)	Date/Time
.. /			
<input type="checkbox"/> river (it)		236	29/10/2009 11:43:07
<input type="checkbox"/> watershed (it)		263	29/10/2009 11:43:19
<input type="checkbox"/> subbasin (it)		410	29/10/2009 11:43:37
<input type="checkbox"/> point_sources (it)	layer	285	29/10/2009 11:44:26
<input type="checkbox"/> pcp_out (it)	layer	558	29/10/2009 11:44:37
<input type="checkbox"/> wyld_out (it)	layer	3514	29/10/2009 11:44:49
<input type="checkbox"/> pet_out (it)	layer	3498	29/10/2009 11:45:09
<input type="checkbox"/> et_out (it)	layer	3482	29/10/2009 11:45:22
<input type="checkbox"/> sw_month_out (it)	layer	2512	29/10/2009 12:32:07
<input type="checkbox"/> sw_avg_month_b (it)	layer		29/10/2009 12:33:16
<input type="checkbox"/> sw_avg_month_out (it)			29/10/2009 12:34:12
<input type="checkbox"/> 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



# BASHYT Dev Interface: Live Editor

Basin Scale Hydrology

Argilla Web Editor ( layer )

Editing Modules/Layers/data/swat/spatialite/sw\_avg\_month\_b (d: 1063 / f: 237)

commands:

User

Select All

```
<Layer
  type="polygon"
  connectiontype="ogr"
  connection="/var/lib/tomcat-6/webapps/argilla/WEB-INF/
  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>
</Layer>
```

You can save or check your app syntax

Databases can be accessed directly through common SQL queries

<input type="checkbox"/>	sw_month_out (it)	layer	2512	29/10/2009 12:32:07
<input type="checkbox"/>	sw_avg_month_b (it)	layer	462	29/10/2009 12:33:16
<input type="checkbox"/>	sw_avg_month_out (it)	layer	2247	29/10/2009 12:34:12
<input type="checkbox"/>	sw_month_index (it)	layer	1432	29/10/2009 12:32:51



# BASHYT Dev Interface: Output

Argilla Web Editor ( layer )

Distribuzione Mensile Dicembre / 2007

SW(mm)

< 10
< 20
< 30
< 40
< 50
< 60
< 70
< 80
< 90
< 100
< 120
< 140
< 160
< 180
< 200
< 220

layer 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

# Example of a Web Interactive Interface

**BASHYT DSS**  
Basin Scale Hydrologic Toolkit

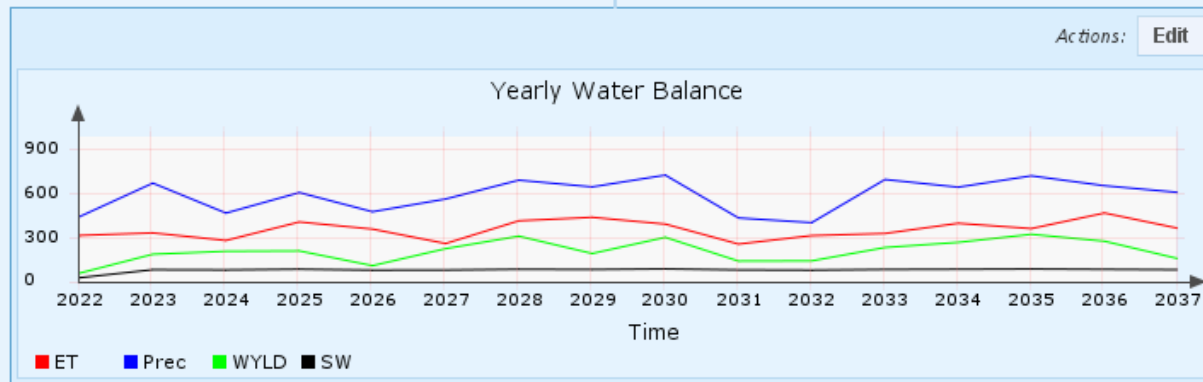
Home | Studies | Basin | Current State | Scenarios | Documentation

Percorso: / / Italiano English

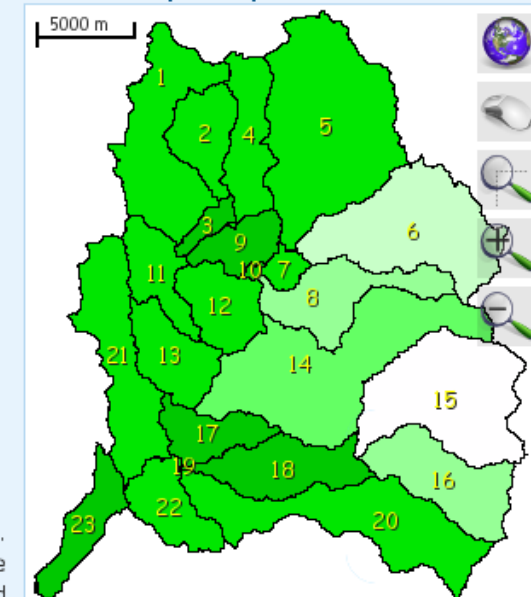
Log Out  
Settings

User **root** - Edit Contents: Page JavaScript Title Menu Buttons Tabs Env ON/OFF

Select time range: 2022 2037 Redraw



Potential Evapotranspiration



## The Water balance

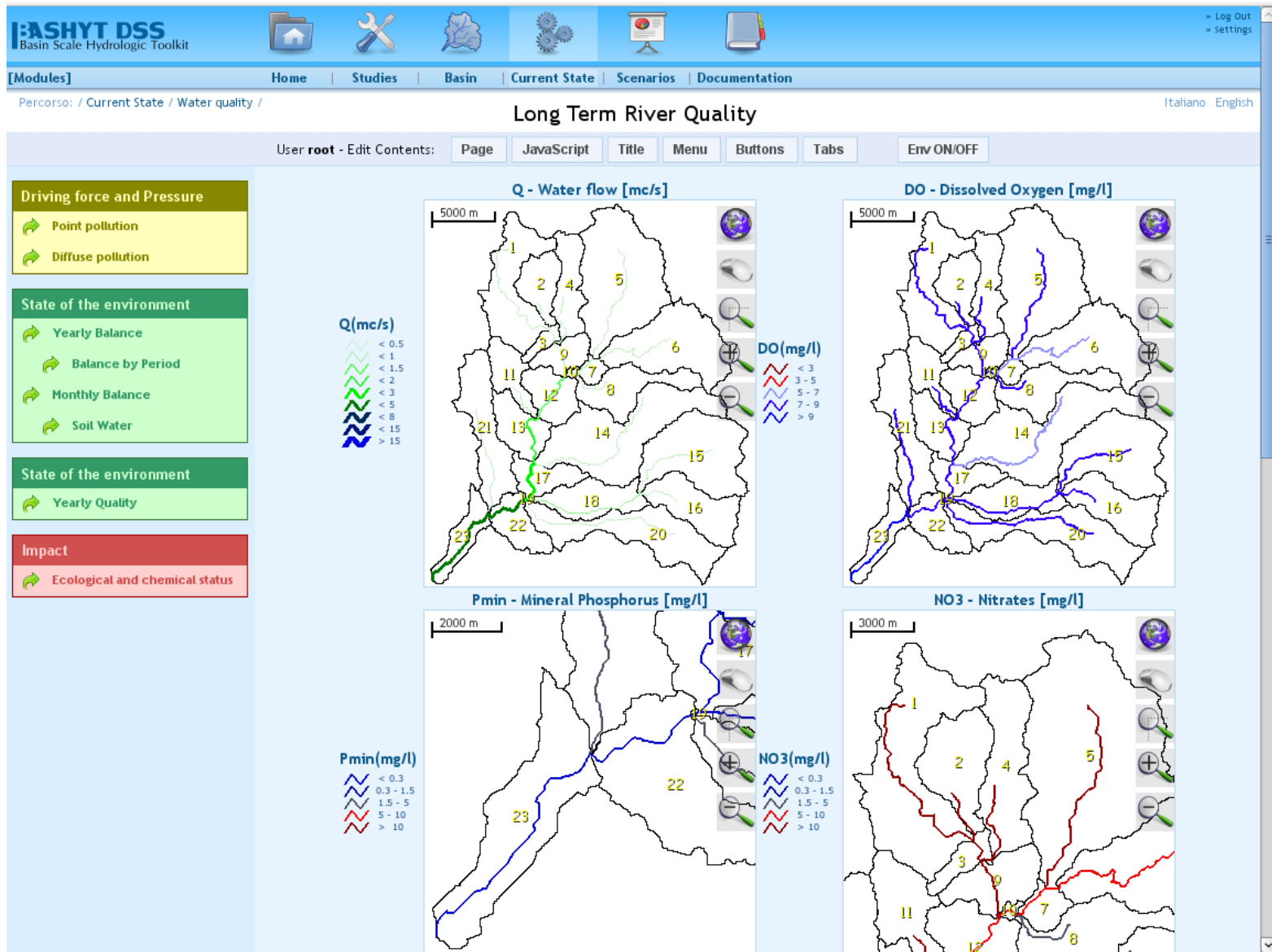
The climate of the area is Mediterranean with long hot dry breezy summers and short mild rainy winters. The temperature regime has been registered by the Donori S. Michele climatic gage, located close to the basin. Average monthly temperature ranges from 8 C (January and February) to 25 C (July and August). Precipitations are largely confined to the winter months, the rainfall regime is characterized by a peak rainfall in December (83 mm) and a minimum in July (8 mm), with an average value of 591 mm/year.

The spatial distribution of the water balance components is not homogeneous. Yearly average precipitation (standard deviation) values over a 70 year period simulation (22-92) range between **473.17 (120.78)** and **640.11 (163.28)**. Yearly average evapotraspiration (standard deviation) values range between **221.15 (45.79)** and **431.05 (87.27)**. Yearly average water yield (standard deviation) values range between **367.18 (120.78)** and **367.18 (163.28)** on the North-East.

Argilla Framework (c) ERA Progetti s.r.l. Contact us



# Example of a Web Interactive Interface



# Conclusions and Open Questions

Shifting environmental application from the desktop oriented approach to the web based paradigm **enhances flexibility** in the whole system, **extends the use of data and the sharing of experiences**, fostering end user and citizen participation.

The use of the WEB Templating paradigm in BASHYT enables user deploy complex applications in a easily fashion

## Future task and challenges:

- let the model be run directly from the WEB environment
- let the 27 partners (15 countries) involved in the ENviroGRIDS project (but not only) work on the CWE system

For any question:

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