

# EnviroGRIDS - Gridifying the Black Sea catchment to support its sustainable development

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The Black Sea Catchment is recognized for its ecologically unsustainable development and inadequate resource management. The 4-year timeframe FP7-funded EnviroGRIDS project (start: April 2009, 27 partners) will address these issues by developing a Spatial Data Infrastructure (SDI) targeting this region which will be linked to the EGEE infrastructure. A large catalogue of environmental data sets (e.g. landuse, hydrology, climate) will be gathered and used to perform distributed spatially-explicit simulations to build scenarios of key environmental changes. A high resolution (sub-catchment spatial and daily temporal resolution) water balance model will be applied to the entire Black Sea catchment using the Soil Water Assessment Tool (SWAT) on the Grid. SWAT modules for uncertainty and sensitivity analysis on SWAT will also be gridified using the well established Ganga job management and submission tool for front-end job management.

## Soil Water Assessment Tool (SWAT)

is a program used for large scale hydrological simulations. This watershed-scale model performs simulations that integrate various processes such as hydrology, climate, chemical transport, soil erosion, pesticide dynamics, and agricultural management.

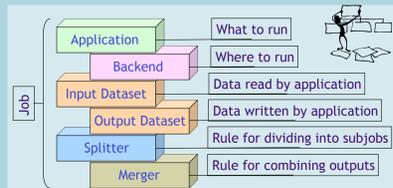
SWAT accounts for variable soil and land cover conditions by subdividing the simulated catchment into sub-areas. The model uses a daily to sub-hourly time step, and can perform continuous simulation for a 1- to 100-year period.

SWAT has an ArcGIS interface, which takes layers of information such as soil, land cover, elevation, and management, and calculates hydrology, erosion, and chemical transport both inland and in-stream.<sup>1</sup>

SWAT-CUP<sup>2</sup> is a public domain software for calibration of SWAT models. The program links GLUE, ParaSol, SUFI2, and MCMC procedures to SWAT. It enables sensitivity analysis, calibration, validation, and uncertainty analysis of a SWAT mode.

## Ganga

Ganga<sup>3</sup> is an easy-to-use frontend for the configuration, execution, and management of computational tasks. The implementation uses an object-oriented design in Python. It started as a project to serve as a Grid user interface for data analysis within the ATLAS and LHCb experiments in High Energy Physics access to Grid resources for data mining and simulation



tasks.

It is possible to make Ganga available to a user community with a high level of customisation. It allows the implementation of custom application classes describing the specific computational task. The class will encapsulate all low-level setup of the application, which is always the same, and only expose a few parameters for configuration of a particular task.

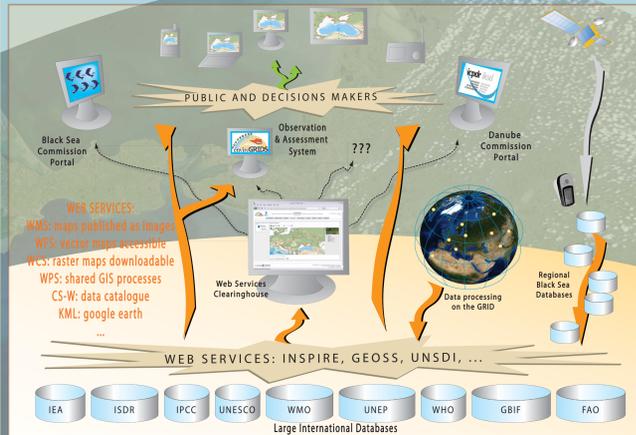
The plugin system provided means that the customisation will be integrated seamlessly with the core of Ganga at runtime, and can be used by an end-user to process tasks in a way that requires little knowledge about the interfaces of Grid or batch systems. Issues such as differences in data access between jobs executing locally and on the Grid are similarly hidden.

enviroGRIDS @ Black Sea Catchment



## Building Capacity for a Black Sea Catchment Observation and Assessment System supporting Sustainable Development

enviroGRIDS data flow through web services



- Remote sensing and sensor data
- Building regional capacities to publish web services
- Integration of existing regional and international databases
- Access of web services through INSPIRE, GEOS, UNSDI,...
- Development of a web services clearing house
- Creation of a new Black Sea Catchment Observation and Assessment System
- Improvement of existing data portals (BSC, ICPDR)
- Raising public and decision makers awareness through various communication technologies

Study area: Black Sea Catchment



UNEP GRID EUROPE UNIVERSITÉ DE GENÈVE  
 In collaboration with: ARXIT Switzerland; AZBOS Ukraine; BSC Turkey; BSREC Bulgaria; COSS Czech Republic; CERN Switzerland (Int.); CRS4 Italy; DDN Romania; DHMO Ukraine; EAWAG Switzerland; Geographic Georgia; IBSS Ukraine; ICPDR Austria; IGAR Romania; IHE The Netherlands (UN); INHA Romania; ITU Turkey; NIMH Bulgaria; ONU Ukraine; SCORRESMA Belgium; SFSU Russian Federation; TNU Ukraine; UAB Spain; USRIEP Ukraine; UTCN Romania; VITUKI Hungary

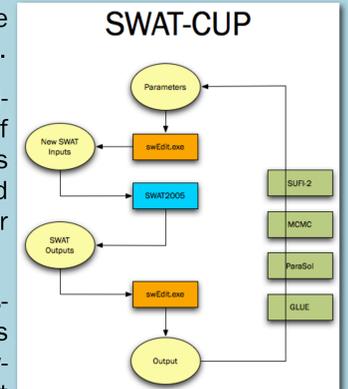
## Gridification of SWAT

- Gridification of SWAT will be performed using Ganga. Implementing both an application plugin for Grid job creation and possibilities for splitting and merging of results will allow users to perform large scale parameter sweeping running vast numbers of Grid jobs.

- Job splitting will be achieved by using SWAT-CUP<sup>2</sup>, a SWAT preprocessor for creating a large number of jobs for calibration of SWAT models.

- Splitting will enable sensitivity analysis, calibration, validation, and uncertainty analysis of a SWAT model. SWAT-CUP will create subjobs on behalf of Ganga based on criteria selected by the user. Ganga will then submit, monitor the jobs and merge the results.

- The actual job submission may be steered using the DIANE personal pilot factory which has been used in conjunction with Ganga in several other gridification projects such as Geant 4 (High Energy Physics event and detector simulation), Garfield (Field simulation for drift chamber designs) and Lattice QCD.



<sup>1</sup>S.L. Neitsch, J.G. Arnold, J.R. Kiniri, J.R. Williams, Soil and Water Assessment Tool. Theoretical Documentation, <http://www.brc.tamus.edu/swat/downloads/doc/swat2005/SWAT%202005%20theory%20final.pdf>, 2005

<sup>2</sup>K. C. Abbaspour, SWAT-CUP, [http://www.eawag.ch/organisation/abteilungen/siam/software/swat/index\\_EN](http://www.eawag.ch/organisation/abteilungen/siam/software/swat/index_EN)

<sup>3</sup>J.T.Mościcki et al, Ganga: a tool for computational-task management and easy access to Grid resources; arXiv:0902.2685v1