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An end-user friendly web service for geomorphology-based hydrological Prediction in Ungauged Basins

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INTRODUCTION

River discharge is an essential hydrological information for decision-making. Yet it is often not available on the exact location(s) where the decision is to be made. It is possible to predict it with some hydrological models which require data, hardware, software and knowledge to execute them. However, most of decision makers who need this information do not have all the skills, nor data, nor tools. To allow them to get this information, an interoperable web service has been developed with a user-friendly web interface. Users can easily run the provided model thanks to the automation of processing. Moreover, this web service can be integrated inside a processing chain to allow calculate other discharge-based data, including advanced uses not yet foreseen.

INTEROPERABLE WEB SERVICE

A web service is a set of applications located on a server that can be accessed through the internet via standard protocols for machine-to-machine interaction. These standard protocols have been approved by the World Wide Web Consortium (W3C). An interoperable web service can be appended inside any workflow or stand-alone application. Web service delete many limits about models execution, hardware architecture (Operating System, performance), programming languages and because of his web access, it can be used from anywhere in the world. In addition, the update of the web service does not require any user intervention.

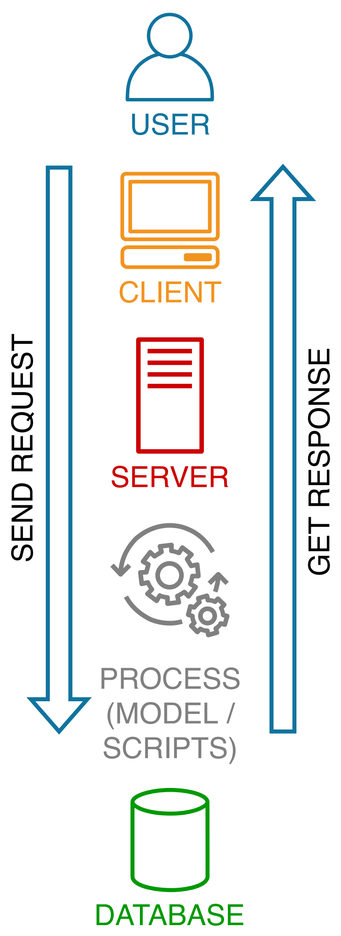
The only information needed to execute the modelling web service is the location in Britanny, France where one wants to simulate the water discharge during a specific period.

The user sends an OGC® Web Processing Service (WPS) request to the web service from his computer. The user can use a script, software, browser or the provided dedicated interface that can send GET/POST requests.

The calculation server receives the request which is interpreted by an implementation of the WPS standard, in this case PyWPS.

The process is a Python script (because of PyWPS) which run some functions or another scripts (from another language). In this work, the main process which is the simulation of water flow, many data has calculated and downloaded from information given by the user, like target watershed or measured flow used. When the process is finished, it sends the response (result) to the user.

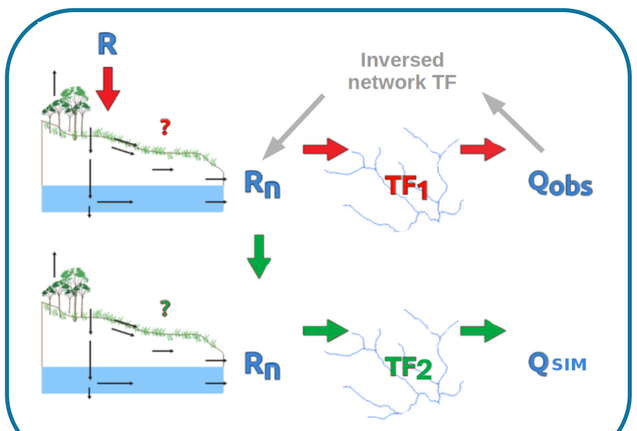
A database has used by some process because of pretreatment executed at once and called every time there needed. That is a Digital Elevation Model (DEM) hydrologically corrected to calculate target and sources watersheds, calculate the transfer function for the model, store data calculated from the model that can be calculated once (inversion step of model) and reduce the processing time of water flow simulation.



HYDROLOGICAL MODELING

The web service allows to run in the Brittany region, France, a geomorphological hydrological modelling developed in the course of research carried out since 1998 in different hydrological contexts, and which is part of the general problem of forecasting in ungauged basins (PUB - Prediction in Ungauged Basins).

A geomorphological transfer function is used to describe the transfer of water through the hydrographic network through a gauged or ungauged watershed, whatever it may be. The inversion of the transfer function of a gauged watershed allows the net rainfall to be calculated from the chronic flow observed at the outlet. The net rainfall can be transposed from one or more sources watersheds to a target watershed, based on similarity, if possible in a nesting or neighbourhood configuration, to simulate the chronic stream flow at the target outlet.

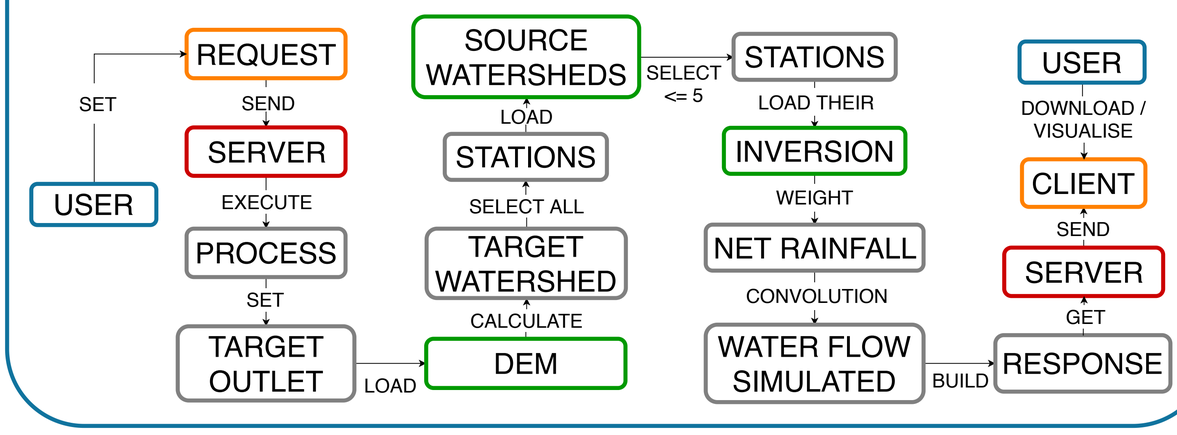


Principle of inversion / transposition. Source : de Lavenne A.

Model requirements :
- Source stations with chronic flow observed and their coordinates ;
- Digital Elevation Model (DEM) hydrologically corrected ;

WATER FLOW SIMULATION

There is main steps of the process to simulate a water flow with the web service :

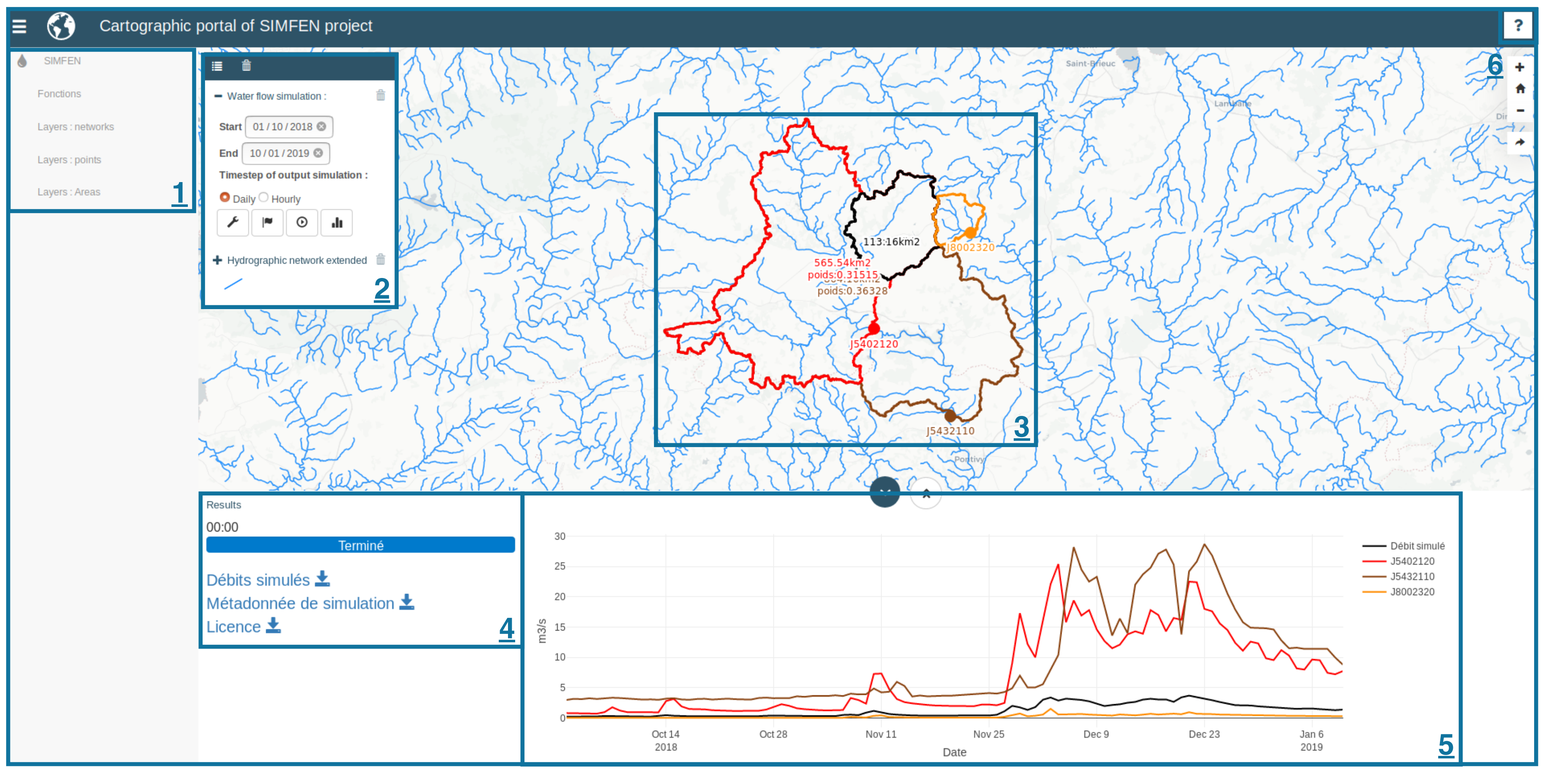


WEB INTERFACE

For a friendly web service, an interface based on the "Mviewer" (GéoBretagne) has been developed. This interface is composed of a map, some boxes and a form of each functions. This interface, mainly written in JavaScript, collect data given by user, build the request and send it to the server. Next, it "listen" to the processing of the function until the result is available to get it and allow the user to show and download it.

The web interface is mainly composed of :

1. Layers / Functions that can be added inside the viewer ;
2. Box with layers added. If it is a function, his form is here ;
3. The map with layers added. Here, target basin (black) and source basins (other) with their measurement stations are shown ;
4. Result box with a progress bar and links to download water flow simulation, metadata of simulation and the disclaimer ;
5. Data graph of water flow simulated and the measured flow of each stations used for the simulation ;
6. Documentation of the project, web interface, model and other information about this work.



The interface is very upgradeable and can be updated for another processes, another applications domains or append a dashboard and monitoring tools. This add-on is available on the GitHub of GeoSAS and the functions used to send and get WPS request can be re-used for another web service and web interface.

CONCLUSION

Finally, the user needs only a computer with a browser and the internet to simulate water flow everywhere in Brittany. The lack of knowledge about programming, hydrology, modelisation and hardware/software requirements are balanced by automation and friendly user interface. For researchers, use this web service with their processing chain can allow them new reflexion about modelisation of another flow that required water flow, like nutrients. The web interface can be accessed at this address http://bit.do/simfen