Simulation of the water balance of the NE Iberian Peninsula

P. Quintana Seguí[1], M. Turco[2] and M.C. Llasat[2]
1: Observatori de l'Ebre (Universitat Ramon Llull – CSIC)
2: GAMA Team, Dept. of Astronomy and Meteorology, Fac. of Physics, Universitat de Barcelona.

Introduction

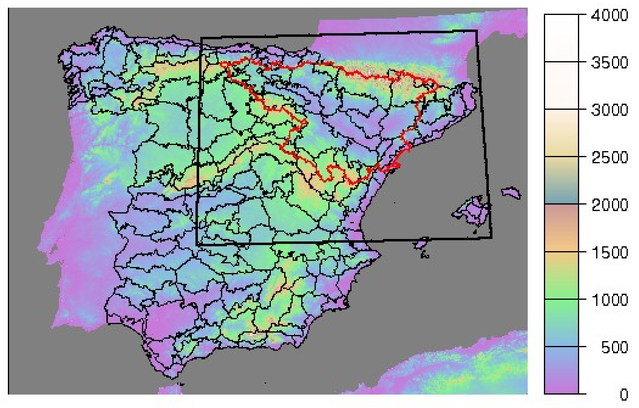
Due to the risks associated with the variability of the Iberian climate (flash floods, droughts, forest fires, etc.) and the strong stresses caused by the anthropogenic changes in the water cycle, it is important to have a precise knowledge of the water balance between the land surface (including soil and vegetation) and the atmosphere at high resolution.

Currently, the scientific community is showing a strong interest in the Mediterranean water cycle, including the water balance on the continental surface. The HyMeX (http://www.hymex.org) project is instigating the development of systems that allow a better understanding of the hydrological cycle in the Mediterranean basin, in fact, the simulation of the water balance of Mediterranean basins at different scales (from the whole Mediterranean, to single basins) is already planned. In this context we will apply a distributed and physically based model (SURFEX) in the NE of the Iberan Peninsula, including the Ebro river basin..

Area of study

Under this Mediterranean perspective, the Ebro river basin is a very suitable study area. The Ebro river constitutes a major basin in the Iberian Peninsula and the western Mediterranean, along with the Rhône and the Po. Both the landscape and the precipitation regime of the Ebro show a great variability. In addition, snow plays an important role in the functioning of the basin. Due to these features, the Ebro basin is a demanding test for any hydrological modeling system.

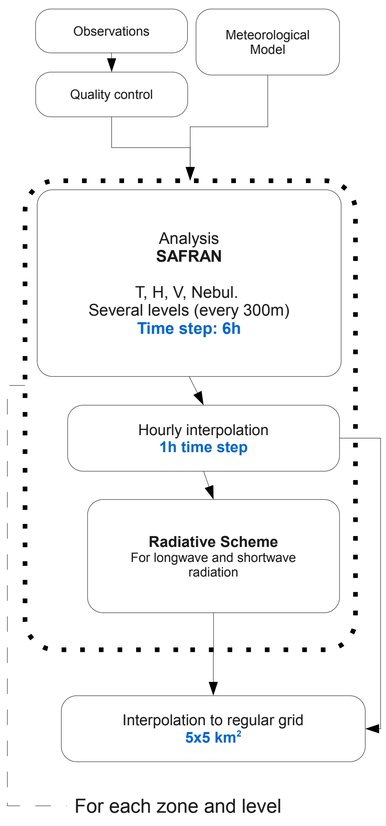
The SCARCE project has selected the Ebro and the Llobregat rivers (among others) as case studies aiming at describing and predicting the relevance of global change impacts on water availability, water quality and ecosystem services, as well as their impacts on the human society and economy.



•NE of the Iberian Peninsula (black square)
•Focus on
- the Ebro river basin (red line)
- Internal basins of Catalonia

• The black borders show the meteorological alert-zones of AEMET, which are the spatial units of analysis used by SAFRAN.

SAFRAN Meteorological Analysis



SAFRAN (Durand et al. 1993, Quintana Seguí et al. 2008) provides the meteorological forcing to the system.

It uses:
•All available observations
•First guess (HIRLAM)

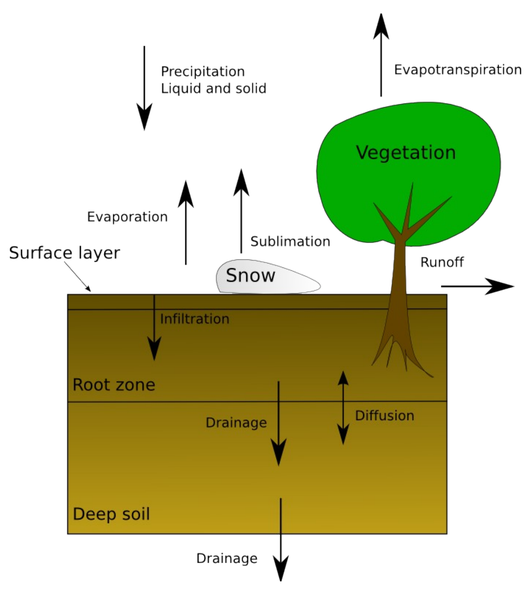
It provides:
• A gridded dataset of screen-level atmospheric observations, for all variables necessary to force a land-surface model.
• High resolution: temporal and spatial.

The analysis is done over irregular zones which are "climatically homogeneous". The method is very well adapted to mountainous areas (common in the Iberian Peninsula).

SAFRAN was developed at Météo-France and it is operational in France.

The Spanish implementation is currently a work in progress. It is implemented by the OE in collaboration with AEMET.

SURFEX Land Surface Model



SURFEX is a modular land-surface model. It can be used coupled to a meteorological/climate model or standalone.

We will use the ISBA scheme (Noilhan and Planton, 1989) offline, forced by SAFRAN.

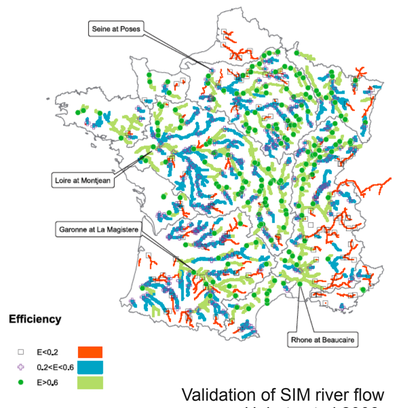
ISBA calculates the water and energy balances.

We will use the simple force-restore method with three layers. In the future we might use a multi-layer difusion version.

ISBA was first developed as a scheme for meteorological models, but it has been improved for hydrological contexts (Quintana Seguí et al. 2009).

To be implemented in 2011.

SAFRAN-ISBA-MODCOU



Validation of SIM river flow
Habets et al 2008.

Our approach is derived from the experience of SAFRAN-ISBA-MODCOU (SIM) at Météo-France (Habets et al. 2008).

SIM is a distributed hydrometeorological suite developed at Météo-France.

It is used the calculate the water balance and river discharge all over mainland France.

Applications include the study of soil wetness and drought, snowpack, river discharge, impacts of climate change, etc.

Future work

The system described, will also be used to study the impact of climate change. This work is done in collaboration with the GAMA group at the University of Barcelona, who are developing a statistical downscaling system especially suited to the Mediterranean region of the Iberian Peninsula. The downscaling system, will use the SAFRAN database as the observational database and will create forcing data suitable for use with SURFEX and any other distributed surface model (including hydrology, agronomy, etc.).

We believe that the SAFRAN gridded database (which include many atmospheric variables of interest), the simulations of the water balance (in the present and future climate) and the atmospheric scenarios described in this summary, may be very useful for the SCARCE community. In addition, the system described, provides the basis for future developments, which may include the simulation of river flows (in present and future climate) and the study of the impact of the changes in land use.

References

Durand, Y et al. 1993. "A meteorological estimation of relevant parameters for snow models." Annals of Glaciology 18:65-71.
Noilhan, J, and S Planton. 1989. "A Simple Parameterization of Land Surface Processes for Meteorological Models." Monthly Weather Review 117:536-549.
Habets, F. et al. 2008. "The SAFRAN-ISBA-MODCOU hydrometeorological model applied over France." Journal of Geophysical Research 113.
Quintana-Seguí, P. et al. 2008. "Analysis of Near-Surface Atmospheric Variables: Validation of the SAFRAN Analysis over France." Journal of Applied Meteorology and Climatology 47:92.
Quintana Seguí, P, E Martin, F Habets, and J Noilhan. 2009. "Improvement, calibration and validation of a distributed hydrological model over France." Hydrol. Earth Syst. Sci. 13:163-181.
Quintana Seguí, P., A. Ribes, E. Martin, F. Habets, and J. Boé. 2010. "Comparison of three downscaling methods in simulating the impact of climate change on the hydrology of Mediterranean basins." Journal of Hydrology 383:111-124. http://linkinghub.elsevier.com/retrieve/pii/S0022169409006246.

1st SCARCE Workshop, December 2-3, 2010, Girona (Spain).
Contact: Pere Quintana Seguí (pquintana@obsebre.es, http://pere.quintanasegui.com, http://www.obsebre.es)
Download: http://pere.quintanasegui.com/coses/quintana-scarce-poster-2010.pdf