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Implementation of a distributed model for the simulation of the past, present and future water balance of the NE Iberian Peninsula

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Due to the risks associated with the variability of the Iberian climate and the anthropogenic changes in the water cycle, including climate change, it is important to have a precise knowledge of the past, present and future water balance between the land surface (including soil and vegetation) and the atmosphere.

Currently, the scientific community is showing a strong interest in the Mediterranean water cycle, including the water balance on the continental surface. The HyMeX project (http://www.hymex.org) is instigating the development of systems that allow a better understanding of the hydrological cycle in the Mediterranean basins. The Ebro river basin, which is located in the NE of Spain, is our main study area. The Ebro constitutes a major basin in the Iberian Peninsula. 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 modelling system.

The Ebro Observatory, together with AEMET, is currently developing a system for simulating the water balance at high resolution in NE of the Iberian Peninsula, including the Ebro basin. The system in development consists of two main components:
1. The SAFRAN atmospheric analysis system (Durand et al. 1993, Quintana-Seguí et al 2008) was implemented into the study area. Using the output of a model and all available observations, SAFRAN analyses the screen-level atmospheric variables and creates a gridded dataset at spatial resolution of $\sim$5 km and a temporal resolution of 1h.
2. The physically based and distributed land-surface model SURFEX (http://www.cnrm.meteo.fr/surfex/), which includes the ISBA SVAT scheme (Noilhan and Planton 1989, Mahfouf and Noilhan 1996), is also to be applied. Forced by SAFRAN, SURFEX simulates the water and energy fluxes between the land surface (soil and vegetation) and the atmosphere. It also calculates the soil moisture and the runoff produced at each grid point. The resulting system will be validated using all available observations, including /in-situ/ remote-sensing data of soil moisture and data derived from SMOS.

In France, a very similar system was developed by Météo-France (Habets et al 2008, Quintana Seguí et al. 2009), which is being used in research and operations. The system is versatile: it is used to monitor the soil moisture in France, to forecast the river flows (Thirel et al 2010), to study the occurrence of droughts (Vidal et al. 2010) and also to assess the impact of climate change on the water resources in major river basins (Etchevers 2002, Boé 2007, Caballero et al. 2007) including the Mediterranean basins (Quintana Seguí et al. 2010, Quintana Seguí et al 2011).

The system described, once fully implemented, will also be used to study the impact of climate change. We are currently 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.).

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 hydrological 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.