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Hydrologic predictions in an experimental mediterranean water-limited basin, the Mulargia river basin

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Extensive field campaigns are fundamental for the understanding of the physical processes of the soil, vegetation and atmosphere interactions, and for testing hydrologic models. An experimental, highly instrumented basin, the Mulargia river basin (area of about 65 km^2) located in center-east Sardegna (Italy), was settled in April 2003. The outlet section of the basin is slightly upstream of the Mulargia Lake, which is part of the reservoir system of the Ente Autonomo del Flumendosa, which in turn constitutes the water supply for much of southern Sardinia, including the island's biggest city, Cagliari. Hence, the basin has a key role in the water resources management of Sardegna.

The soils in the basin are generally of modest thickness, the vegetation throughout the basin has been in part altered by human activities, with many areas (before covered by scrubs) converted to pasture. Urbanized areas are a minor component.

Two eddy-correlation towers were settled in different vegetation cover areas of the basin (one is a grass field and one is a typical Mediterranean environment with shrubs). The towers monitored continuously land-surface fluxes (latent and sensible heat fluxes), meteorological data (precipitation, air temperature and humidity, etc.) including 4-component radiations (incoming and outcoming longwave and short waves) and surface temperatures with infrared transducers, soil heat flux, and soil moisture.

At the outlet section discharge data are acquired hourly, and two other raingages are present in the basin. The observation period is April 2003-September 2005.

Periodically (weekly and monthly) field observations of soil moisture were collected extensively in the basin. In particular, surface soil moisture measurements were performed using TDR technique and gravimetric method in 8 fields of 1 ha each..

Finally, three remote sensing images were acquired for estimate LAI maps: one is an ASTER image (spatial resolution of 30 m) of June 2003, and two are Quickbird images (spatial resolution of 2.8 m) of August 2003 and May 2004.

A continuous distributed hydrologic model is developed. It couples mainly a three-component land surface model (LSM), which includes the force-restore method for the energy balance, the Philip's model for infiltration and the Penman-Monteith for the evapotranspiration and distinguish between bare soil, grass and woody vegetation cover, and the Muskingum-Cunge method for runoff propagation. The hydrologic model is applied at both local scale (at the two tower sites) and at the basin scale for hydrologic predictions (runoff, evapotranspiration, soil moisture, surface temperature, energy balance components). Comparison with observed data demonstrates that the model is able to well predict hydrologic processes spatially and locally. Moreover, several significant floods occurred during the observation period, and the model is able to well predict also these extreme events.