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Impact of flood events on stream water quality dynamics and water supply management strategies in Sardinia

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The island of Sardinia is a typical semiarid Mediterranean region, characterised by a dense network of temporary rivers and streams that play a crucial role in feeding water bodies such as reservoirs, lagoons or coastal areas.

In such ecosystems, which are extremely sensitive to point and diffuse sources of pollutants, the annual period of streamflow affects the water quality and quantity of downstream water resources, especially during the first flood events that follow the dry season. Moreover the high nutrient transport may lead to eutrophication phenomena in receiving water bodies.

The impact of flood events have been investigated in the Mulargia, a representative temporary river located in the south-eastern part of Sardinia. It is the largest natural tributary feeding the Mulargia reservoir which supplies most of the water supplied to the Campidano plain both for civil, agricultural and industrial purposes.

A field sampling campaign has been carried out for one year (Sept 2003-Aug 2004) in selected stream reaches, collecting hydrometric, meteorological, chemical-physical and biological data on water and sediment quality.

The installation of flow-switched automatic samplers, on line probes (pH, temperature, dissolved oxygen and conductivity) and rain gauges for continuous precipitation records, allowed the collection of numerous and frequent data within a well defined representative flood. The impact of the flood event on water quality dynamics has been investigated analysing the pollutant trends in relation to the flows patterns. Changes of sediment composition and in microbial communities have been also observed and related to hydrology.

Runoff events were strongly influenced by the geomorphology of the basin. Shale rocks, characterise the entire area, limiting permeability and giving very low infiltration losses and consequently high runoffs from all the basin, and particularly from cultivated lands. With regard to sediment and particulate matter transport, the importance of the first autumn flood event, occurred after the summer dry period, has been highlighted in this work. Winter and spring floods did not affect water quality as strongly, even when discharges were higher. Although in terms of flow the first flood only represented 10% of the annual runoff, it was responsible for exporting more than 30% of the annual suspended solids load.

Sediment characteristics, such as water content, AFDW, C, N and P content showed low variability in time. However, sediment composition in 2004 showed concentration values lower than in the previous drier year. Local inputs affected chemical composition and mainly bacterial abundance and activity. It is hypothesised that chemical and biological processes in river bed-sediments, although not influencing water quality during high floods, may significantly affect the characteristics of transported sediments after long dry periods.

The SWAT model has been applied to the catchment in order to simulate at basin scale the impact of pollution derived from diffuse and point sources during flood. The outputs from the simulation, evaluated against the measured data regarding flow and water quality, confirmed the quality of the simulation. Thanks to the semi-distributed approach, the application of the model allowed analysis of the different scenarios originating from different pollution levels and the simulation results have been interpreted to plan management strategies aimed at reducing pollution impacts.

Furthermore the simulation highlighted some peculiarities inherent in temporary rivers (i.e. related to sediment delivery, point source contribution to baseflow, rain data representativeness, etc) and also some limitations in the use of the SWAT model in these catchments, suggesting some new/modified approaches and features that could be useful to develop and include in the model.

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the efficiency of integrated water management in semiarid river catchments.

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