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Water quality assessment of a highly polluted Mediterranean River – Oued Fez (Morocco)

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In the South of the Mediterranean basin, many rivers are characterized by an alternation of very long dry periods only cut by short flood events. Currently, the socio-economical development of these zones is limited by water scarcity and poor quality of the water resources. Indeed human activities, generally concentrated in overpopulated cities, generate large quantity of domestic and industrial effluents which are directly rejected in the environment without any treatment. In Morocco, the well known city of Fez illustrates perfectly this situation, observed in most developing countries.

The oued Fez receives continuously the non-treated domestic and industrial effluents (90.000 m3/day) of the city and pollutes all the downstream water bodies. Indeed, it is a tributary of the Sebou River, a major body of great economical importance used for irrigation and freshwater supply. This study aims at characterising and quantifying the pollutant concentrations and fluxes in various points of oued Fez's hydrological network and assessing its impact on the Sebou River; this river's preservation being considered a national priority in Morocco.

A coupled water quality-water quantity monitoring scheme has been implemented on oued Fez since 2008. In addition to basic hydrological data, water quality samples are collected at regular intervals at 8 locations where discharge is simultaneously measured using an Acoustic Doppler Current Profiler (ADCP). Water samples are analysed for different forms of nitrogen (nitrates, nitrites, ammonium and total nitrogen), phosphorus (soluble reactive phosphorus and total phosphorus) but also total chromium which is used in the leather tanning processes, one of the most important industrial production of the city of Fez, using a photospectrometer (Hach Lange DR 2800 VIS-photometer (Germany).

The results of 17 sampling campaigns, carried out over 3 hydrological years, indicate that the rural areas contribute mostly to baseflow during the wet period while non-treated anthropogenic inputs constitute most of the flow during the dry period. The pollution levels are very high as the mean values reach 39 mg/l N, 5 mg/l P, 0.2mg/l Cr, for total nitrogen, total phosphorus and total chromium respectively at the most polluted sites. Even if the hydrological conditions induce important concentration variations, the pollution levels remain high all along the year.
The nitrogen, phosphorus and chromium fluxes calculated for steady state conditions, show that more than 500 kg/hour of nitrogen, 60 kg/hour of phosphorus and 2.5 kg/hour of chromium are flushed by the oued Sebou downstream of its confluence with the oued Fez. These fluxes are due to human activities and do not vary significantly with the hydrological conditions.

This study shows that a relatively limited observation network allows the characterization of the temporal and spatial variability of the pollution levels if the monitoring points are selected by taking into account the main pollution sources and the specificity of the hydrological conditions.