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The San Niccolo' experimental area for studying the hydrology of coastal Mediterranean peatlands

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Starting from 1930, a large part of the Massaciuccoli Lake coastal area (Tuscany, Italy) has been drained for agricultural purposes by a complex network of artificial drains and pumping stations. In the drained areas, peat soils, with values of organic matter up to 50% in some cases, are largely present (Pistocchi et al., 2012). As a consequence of the human impact, environmental problems arose in the last 50 years:

i. the eutrophication status of the Massaciuccoli lake caused by nutrient enrichment (N, P) in surface- and ground-water (Rossetto et al., 2010a);

ii. the subsidence (2-3 m in 70 years) of the lake bordering areas due to soil compaction and mineralization (Rossetto et al., 2010b).

As a potential solution to improve water quality and to decrease soil organic matter mineralization, a rewetted pilot experimental area of 15 ha with phyto-treatment functionalities has been set up. This pilot, adequately instrumented, now constitutes an open field lab to conduct research on the hydrology of coastal Mediterranean peatlands.

Site investigation was performed and data on stratigraphy (from top on average: 1/2 m thick peat layer, 1/3 m organic matter-rich silt, 1/3 m stiff blue-gray clay, up to 30 m thick sand layer) and water (ground- and surface-water) quantity and quality were gathered and related to both local and regional groundwater flows. The inferred hydrological conceptual model revealed the pilot is set in a regional discharge area and the ground-water dependent nature of the agro-ecosystem, with mixing of waters with different origins.

The site has been divided in three different phyto-treatment systems:

1. a constructed wetland system, internally and externally banked in order to force water flow to a convoluted pattern where *Phragmites australis L.* and *Thypha angustifolia L.* constitute the sparse natural vegetation;
2. a vegetation filter system based on the plantation of seven different no-food crops managed according to a periodic cutting and biomass harvesting (eg: *Populus spp.*, *Salix spp*., *Arundo donax L.*, *Miscanthus x giganteus*). The system is crossed by a dense network of ditches supplying water to the crops through lateral infiltration and partial submersion;
3. a wetland system consisting in a flooded area where the re-colonization of spontaneous vegetation takes place.

The designed monitoring system includes sensors in surface- and ground-water. The ground-water monitoring system consists of a set of 15 piezometer clusters. At each cluster three piezometers (3 inch diameter, screened in the last 30 cm) are set at about 3 m, 2 m and 1 m depth to allow multilevel monitoring and sampling so to investigate a large part of the aquifer and the relationships between the surface-water and ground-water systems. An unsaturated pilot monitoring station has been designed and it will be set in operation to gain information on infiltration and/or exfiltration processes and evapotranspiration. Ten sensors for continuously monitoring groundwater head, temperature and electrical conductivity are in operation.

Surface water are monitored by means of six gauging stations where sensors are recording at least head, temperature and electrical conductivity. At four of them continuous sampling takes place with a composite daily sample made up of four samples, each gathered every six hours.

A complete hydrological monitoring protocol has been set in place starting by meteorological data aquisition. As well as continuous monitoring with in-situ sensors and composite sampling with automatic samplers, discrete monitoring on monthly basis takes place. Main physico/chemical parameters (temperature, pH, dissolved oxygen,

electrical conductivity and redox potential) are routinely monitored. The experimental area is in operation since December 2013.

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