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A versatile and interoperable network sensors for water resources monitoring

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Monitoring systems to assess water resources quantity and quality require extensive use of in-situ measurements, that have great limitations like difficulties to access and share data, and to customise and easy reconfigure sensors network to fulfil end-users needs during monitoring or crisis phases. In order to address such limitations Sensor Web Enablement technologies for sensors management have been developed and applied to different environmental context under the EU-funded OSIRIS project (Open architecture for Smart and Interoperable networks in Risk management based on In-situ Sensors, www.osiris-fp6.eu). The main objective of OSIRIS was to create a monitoring system to manage different environmental crisis situations, through an efficient data processing chain where in-situ sensors are connected via an intelligent and versatile network infrastructure (based on web technologies) that enables end-users to remotely access multi-domain sensors information.

Among the project application, one was focused on underground fresh-water monitoring and management. With this aim a monitoring system to continuously and automatically check water quality and quantity has been designed and built in a pilot test, identified as a portion of the Amiata aquifer feeding the Santa Fiora springs (Grosseto, Italy). This aquifer present some characteristics that make it greatly vulnerable under some conditions. It is a volcanic aquifer with a fractured structure. The volcanic nature in Santa Fiora causes levels of arsenic concentrations that normally are very close to the threshold stated by law, but that sometimes overpass such threshold for reasons still not fully understood. The presence of fractures makes the infiltration rate very inhomogeneous from place to place and very high in correspondence of big fractures. In case of liquid-pollutant spills (typically hydrocarbons spills from tanker accidents or leakage from house tanks containing fuel for heating), these fractures can act as shortcuts to the heart of the aquifer, causing water contamination much faster than what inferable from average infiltration rates.

A new system has been set up, upgrading a legacy sensor network with new sensors to address the monitoring and emergency phase management. Where necessary sensors have been modified in order to manage the whole sensor network through SWE services.

The network manage sensors for water parameters (physical and chemical) and for atmospheric ones (for supporting the management of accidental crises). A main property of the developed architecture is that it can be easily reconfigured to pass from the monitoring to the alert phase, by changing sampling frequencies of interesting parameters, or deploying specific additional sensors on identified optimal positions (as in case of the hydrocarbon spill).

A hydrogeological model, coupled through a hydrological interface to the atmospheric forcing, has been implemented for the area. Model products (accessed through the same web interface than sensors) give a fundamental added value to the upgraded sensors network (e.g. for data merging procedures). Together with the available measurements, it is shown how the model improves the knowledge of the local hydrogeological system, gives a fundamental support to eventually reconfigure the system (e.g. support on transportable sensors position).

The network, basically conceived for real-time monitoring, allow to accumulate an unprecedent amount of information for the aquifer. The availability of such a large set of data (in terms of continuously measured water levels, fluxes, precipitation, concentrations, etc.) from the system, gives a unique opportunity for studying the influences of hydrogeological and geopedological parameters on arsenic and concentrations of other chemicals that are naturally present in water.