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Remote sensing and hydrogeological methodologies for irrigation canal leakage detection: the Osasco and Fossano test sites (NorthWestern Italy)

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Seventy percent of global fresh water is usually used for irrigation. This rate is three times the amount of water used by industry and ten times the amount used in domestic and urban environment (Hotchkiss et al., 2001). However, the average efficiency of the water transport for agricultural purposes in different contexts (at world scale) is variable between 30% and 80%. Studies conducted in Italy confirms that rates are similar from the case studies abroad.
In this research, satellite image analysis and hydrological-hydrogeological methods were used in two pilot sites (Osasco channel and Fossano channel, in the Noth-Western Italy) to identify the areas most prone to this problem and to quantify the losses. The aim of the study is to define a multidisciplinary approach in order to identify the critical situations of irrigation channels for a sustainable water resource use and management.
The use of remote sensing techniques can identify, on a regional scale and at relative low cost, the channels section potentially critical upon which focus the attention and perform in-situ investigation. The presence of leakage from the irrigation canals, indeed, tends to induce variations of moisture on the surface ground. These variations affect the vegetation (e.g. vegetation state), and certain physical characteristics of the soil (e.g. the capacity and thermal conductivity). The analysis of these anomalies, conducted with digital image processing techniques (with infrared spectrum bands particularly sensitive to the above indicators) help to identify those areas with anomalies related to increased losses (Huang and Fipps, 2002). The use of satellite imagery in the proposed approach is an innovative application of Earth Observation for land and water monitoring (Huang et al., 2005).
After the identification of anomalies, hydrological-hydrogeological methods were applied to evaluate the losses. At fist an hydrogeological characterisation of the study area and the bottom of the irrigation channel were conducted. Then the canals seepage rates were estimated using inflow–outflow tests and tests with double-tracer, an adaptation from QUEST method (Rieckermann and Gujer, 2002). This approach allowed an experimental calibration and validation of the satellite images analysis.
The applied multidisciplinary approach seem to be a promising way for a good general screening for a rapid detection of irrigation channels water losses.

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