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Potential of remote sensing data for improving water resources management in semi-arid regions: a case study in Burkina Faso

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In this work we present the rationale and the first results of a Cosmo-SkyMed AO project devoted to use high resolution synthetic aperture radar data for water resource management in semi-arid regions. A case study was developed in Burkina Faso, one of the poorest countries of the world, where almost 80% of the population lives in rural areas depending from agriculture and livestock. It is characterized by the alternation of a rainy (3 months) and a dry (9 months) season, with extreme climate conditions (drought and floods). The project was approved by the Italian Space Agency, that provided Cosmo SkyMed Stripmap (3m resolution) and Spotligth (1m resolution) SAR images. The study area is in the northern part of Burkina Faso around the village of Bidi.
A first study is related on the identification of eroded areas, which are indicative of desertification processes. Eroded soils are no more able to absorb and drain water, so that their humidity and, as a consequence, their dielectric constant and conductivity are almost independent by the precipitation. By comparing SAR images acquired during the rainy and the dry seasons, the eroded soils do not change their reflectivity and they can be identified by change detection techniques. In this work we employ innovative fractal change detection techniques, based on the image spectrum evaluation and the comparison of the fractal dimension.
As the precipitations occur only during three months, it is crucial to collect water in the rainy season, by the means of artificial basins, in order to irrigate the fields in the dry season. The construction of little artificial basins is usually carried out under the initiative of small associations of farmers. The location, design and management of the basins sometimes is not rational, for the lack of all the information needed for the design.
The best location for the construction of a new artificial basin depends on the total volume of surface water that may be collected in one year in a particular position. This element should be compared with consideration about the distance of lands to be irrigated, the value of land and other socio-economical factors. We show how to design a map displaying the total amount of surface water that may be annually collected in each element of a digitalized landscape. This map may be used in GIS environment and superimposed to other maps displaying the others relevant factors. The DEM of the study area is derived by remote sensed SAR images. Series of total annual rainfall measured in 9 climatic stations of the region have been used to derive a map of rainfall spatial distribution. The total surface water volume flowing in the average year, in a particular position of the landscape, has been expressed in terms of the contributing area to that position, the average temperature and the annual rainfall over the contributing area. The map of annually available water volumes has been consequently derived.