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Thessalia Plain, a Long Term Problem for Managing Water Resources with Multiple Versions

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As one of the world's largest users of fresh water resources, irrigated agriculture has a profound effect on the water cycle, water availability, distribution of water, and water quality. Irrigated croplands are essential contributors– they comprise 15% of arable land yet provide 36% of food (FAOSTAT Statistical Database, http://www.fao.org/statistics/en/). However, they are also large consumers of fresh water resources. Despite high yields and relatively low risk (relative to rain fed lands), the large amounts of water used for irrigation often conflict with competing demands. In semi-arid lands these conflicts are exacerbated by already strained resources, climate change, and population growth. Accurate information on agricultural water needs and withdrawals at appropriate spatial and temporal scales remains a key limitation to joint water and land management decision-making. Addressing these problems require assessments of irrigation practices to ensure that farms are currently using water efficiently and the development of tools to facilitated additional water saving strategies at farm to irrigation district scales. These assessments and tools could be implemented by using medium resolution remote sensing data, which are being increasingly used to monitor, manage, and forecast agriculture water use at different spatial scales.

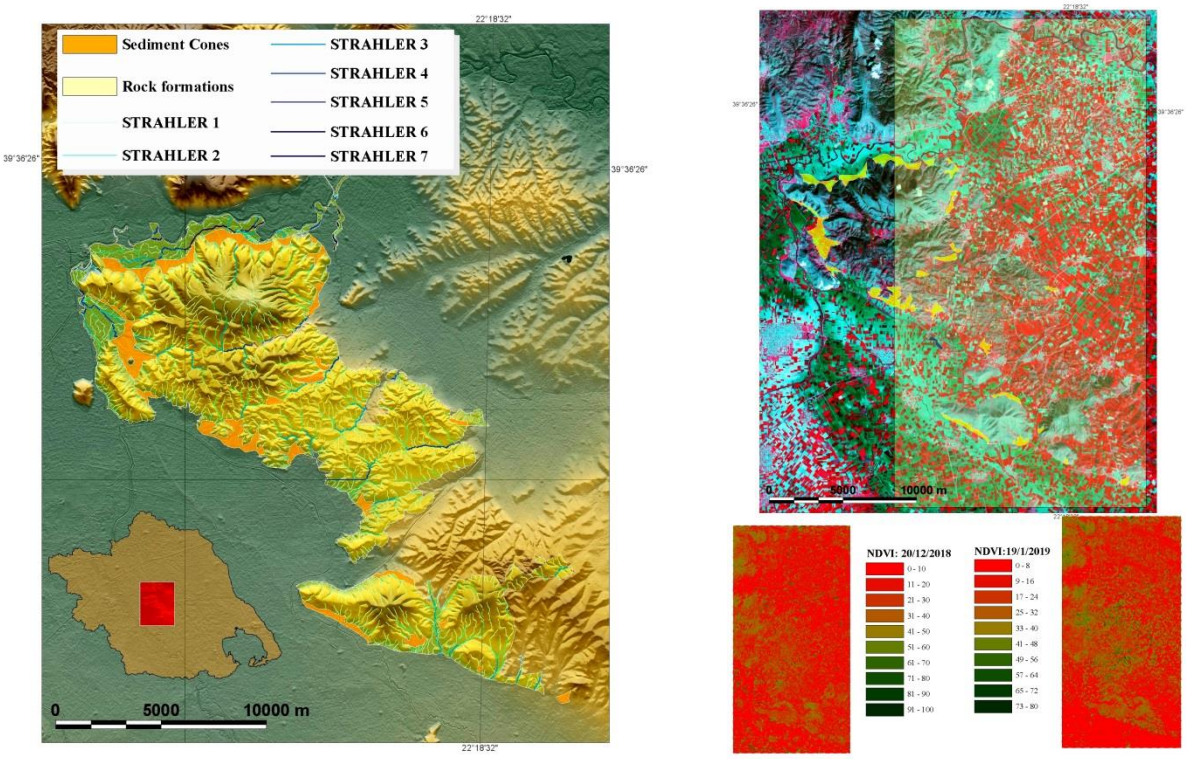
The coverage of the water needs of the Thessalia plain remains a landmark issue for the country and the local and central authorities. The area under consideration is unique: Numerous research programs and studies, concerning the management of water resources, have been realized. The major irrigation projects have been designed since 1925 up to contemporary times. The scientific community has presented different estimates in relation to the reserves and the real needs. This paper does not attempt to approximate the size of water needs, nor does a reassessment of inventories. It is undertaking a review of the possibility of further exploiting local water resources.

The most recent updates to the water balance carried out by IGME, add significant new results have been derived from the major hydraulic parameters. It must be emphasized that the above mentioned hydraulic parameters consist a vital criterion for the most suitable selection of the technical interventions which must be followed. The output will determine the technical interventions that can be carried out in order to upgrade the underground water reserves through artificial enrichment.

Summarizing, a key element of the present work is that underground aquifers are easily amenable to artificial enrichment at depths of <100 m in the selected region of Thessalia Basin. Aim of the study is to introduce the following points:

a) The selection of a pilot area is located in Thessalia plain, (Figure 1) which has high water permeability (region of the stream sediment cones). In addition, 23 cone areas are presented in the 1:50,000 scale IGME geological maps, of total surface area of 12.9 km^2 which have been analysed.
b) Applying mild forms of "artificial enrichment", utilizing the local hydrographic network and working in shallow aquifers, "peripheral hydraulic loading". Different hydrologic parameters have been estimated using the Digital Elevation Model of Ktimatologio S.A. with 5 m. resolution: Bifurcation Ratio, Length Ratio Drainage Density, Constant of Channel Maintenance, Length of Overland Flow Stream Frequency, Basin Length, Elongation Ratio, Basin Relief, Relief Ratio, Ruggedness Number and Mean Stream Slope. Furthermore, basins directly related with their outflow to the cones that have been selected. Actually, 62% of all basins have an altitude that varies between 138 to 414 meters, while 98.86% of the total area of the basin includes slopes that vary between 0 to 35 degrees.
c) A total length of 815 km for the streams running the area have been mapped and analysed, 190 km are directly related with their flow to cones (Figure 1). A number of basins of a total area of 73. 6 km^2 contribute to surface flows towards the sedimentary cones. Drainage density of basins varies between 0.0024 to 6.29.
d) No disturbance to existing land uses by the development of technical enrichment interventions. Land uses are effectively monitored using medium resolution satellite data.
e) Exploitation of surface run-offs in non-flood time periods to avoid accumulation of sediment within the enrichment channels.
f) Using a combination of satellite and vector data in appropriate and homogenized geospatial databases to monitor and support the operation of these mild technical projects. This is possible after the estimation of significant environmental indicators on a weekly basis (NDVI, NDWI, Chlorophyll A, e.t.c), which are directly related to the status of the crops.

It could be generally agreed that results of the present work are important and critical for the sustainable artificial enrichment of ground water aquifers. Furthermore, remote sensing techniques can be used to support watershed implementation plans to satisfy future water needs.



A **B**

Figure 1. A: Map of the study area located in Thessalia plain, in which sediment cones, rock formations and drainage network are presented. B: Landsat image of April 2017 of the pilot area of study. NDVI estimates of 20/12/2018 and 19/1/2019 Sentinel 2 images for the area (transparent polygon). Monitoring is supported.

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