Using remote sensing and FAO methodology for the determination of irrigation water needs in a semi-arid climatic region

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Preface

This work presents a methodology that allows estimating irrigation water needs (IWN) for a for a given crop type, using high-resolution (10 m) multispectral products from the European Space Agency, such as the Sentinel 2 (scihub.copernicus.eu), and the FAO method (Brouwer and Heibloem, 1986). The objective is to assess how new data can contribute to better estimates of water abstraction, in a region where the effects of Climate Change are expected to impact water resources. Establishing the IWN may help the development of a sustainable irrigation schedule throughout the seasonal cycle and avoid unwanted consequences. The study area is Campina de Faro aquifer system (CF), (Faro, Algarve, South of Portugal) which has an extension of 86.4 km^2. However, the methodology can be applied to other case studies.

Methodology

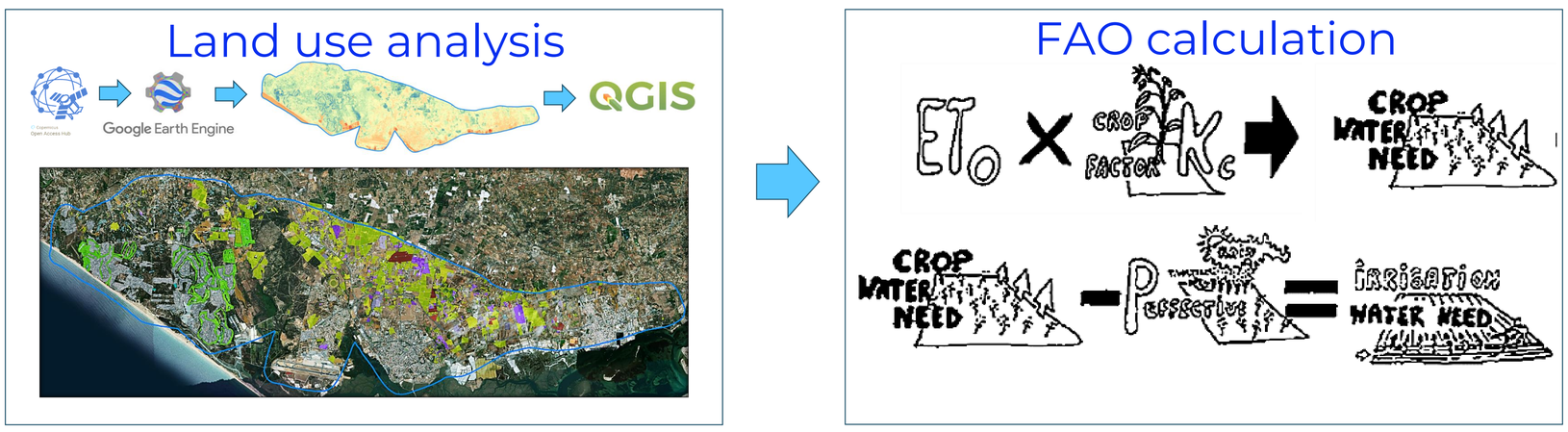

Figure 1: Land use analysis & the FAO calculation

- The methodology started with the **land use analysis** (Fig. 1) using remote sensing (the analyses were previously carried out under the eGROUNDWATER project (egroundwater.com). Most of all satellite vegetation indices employ a formula to quantify the characteristics of plants on Earth using near-infrared radiation (NIR) and red (Red) wavebands thus, defining the Normalized Difference Vegetation Index (NDVI) (earthobservatory.nasa.gov) as follow: NDVI=(NIR-Red)/(NIR+Red). The output from the land use analysis resulted in the delimitation of 1486 polygons in which the citrus crops, represents the 88 % of the agricultural sector.

- **The FAO calculation** (Fig. 1) was applied to citrus crops. Meteorological data such as total precipitation (**P**) and evapotranspiration ($\mathbf{ET_0}$) time-series were collected from the website of the Direção Regional de Agricultura e Pescas do Algarve, DRAP (drapalgarve.gov.pt). The crop factor ($\mathbf{K_C}$) for citrus was obtained from a list of predefined coefficients given at different stages of the year (Rosa, 2019). The effective precipitation (**Pe**) was calculated using the following formulas (Brouwer and Heibloem, 1986): Pe=0.8 P-25 if P>75mm/month or Pe=0.6 P-10 if P<75mm/month.

Estimates & Conclusions

Area Citrus	Averaging	Estimate IWN (Citrus)	Official estimate (agricultural sector)	Comparison of IWN estimate with the official estimate by APA (*Plano de gestão de região hidrográfica 3º Ciclo 2022–2027*)
11.19 km^2	Monthly	10.52 hm^3/year	9.74 hm^3/year	+ 8.0 %
	Weekly	11.70 hm^3/year		+ 20.1 %

- Although citrus crops does not represent the entire agricultural sector of CF, it can be observed that the IWN for this crop differ from abstraction estimates by + 8.0 % and + 20.1 % (**Table above**). It might be explained by the adoption of different databases for the representation of the actual land use.

- These outputs show the importance of having updated land use information when performing estimates. More complete information helps to reduce uncertainty in water balance estimates, which is necessary especially in region where drought periods are expected to increase due to the effect of Climate Change.

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