EGNOS Success Story

Soil zoning using Copernicus and EGNOS

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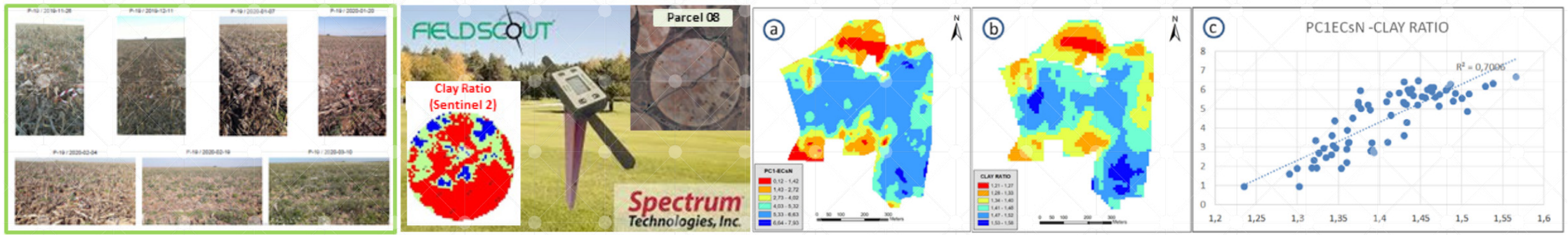

Figure 1: Analysis of a crop area in Setubal/Portugal ("parcel 08") using FIELDSCOUT TDR-350 sensor (EGNOS-enabled) and Sentinel data (Clay Ratio)

Figure 2: Relation between Principal Component of Ec derived from sensor (EGNOS-enabled) and Clay ratio derived from Sentinel: a) PC1-ECsN; b) Clay Ratio; c) Linear regression between PC1- ECsN and Clay Ratio

Effective agricultural zoning, also known as agricultural preservation zoning, is a land management tool that encourages farming while discouraging non-agricultural land uses that are incompatible with farm operations. It facilitates the planning and coordination process of agricultural sector activities, such as estimating which crops are the most recommended for certain areas and estimating potential yields. By zoning agricultural areas, smaller spaces of greater homogeneity are established with respect to their resources, allowing correlation with socio-economic factors and serving as support for the implementation of new development policies. Therefore, zoning soils is of great importance in precision agriculture practices.

Nowadays, one of the soil parameters most used to carry out zoning soils is the Apparent Electric Conductivity (ECa) measurements (https://www.mdpi.com/2077-0472/8/6/84). This is based on sensors partially buried in the soil that monitor relevant parameters such as humidity, apparent electrical conductivity and temperature; those sensors are also equipped with GNSS devices that provide the location of such measurements (see Figure). Unfortunately, having equipment that measures these parameters in extended areas is time consuming and expensive . Satellite images, however, which provide information over large areas, are the perfect solution for the creation of zoning soil maps in extended areas at low cost.

Copernicus, the European Earth Observation Programme , offers a free, full and open imagery policy: Sentinel-2, offers enough spatial resolution, and adequate range of spectral bands. In particular, it allows to analyse the moisture present in plants and soils by an estimation of the energy absorption of water in the short-wave infrared strip (SWIR). With such methodology it is possible for instance to derive clay ratio indexes during the crop cycle, related with zoning soils. Sentinel-1 (SAR sensor –Synthetic Aperture Radar) can penetrate cloud cover making it particularly valuable in frequently cloudy areas and complementing information of Sentinel-2. Therefore, Sentinel-1 can also be used to detect soil moisture and characterize types of soils (due to the response of SAR to roughness and dielectric constant).

CYCYTEX (Centro de Investigaciones Científicas y Tecnológicas de Extremadura), has developed a methodology for the zonal characterization of soils based on the use of Sentinel (1 and 2) images and precise local measurements taken by FIELDSCOUT TDR-350 sensor, using EGNOS. The study has carried out in an irrigated corn parcel in Setubal (Portugal) from 12/2019 to 04/2020.

Through the correlation of both in situ measurements (done using an EGNOS enabled equipment) and the Sentinels satellite images, it is possible to determine that both the ECa and moisture are adequate parameters for zoning soils and estimate the correlation between parameters related with clay soils and corn yields, allowing in addition, to determine areas with irrigation problems, which can cause water stress or flooding. Jose Maria Terrón, from CYCYTEX says: "the incorporation of EGNOS into on-site sensors, has allowed the evaluation of the spatial variability of the soil parameters with great accuracy and low cost in precision agriculture, at the same time that it has allowed the evaluation of Sentinel images".

This is a clear example that the combined use of EU space programs, in particular Copernicus and EGNOS, have made possible to obtain and validate a soil zoning methodology to be applied in other areas and other crops.