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Theme 2 | Advances in soil mapping and monitoring

Mapping different organic carbon fractions in soils affected by recurrent forest fires through an upscaling multispectral UAV - satellite imagery.

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1. INTRODUCTION

The impact of the **recurrence of wildfires** on soil organic carbon (**SOC**) dynamics cause the need for **rapid large-scale** territorial mapping to determine SOC. Traditional geochemical methods, while accurate, are costly and time-consuming. In contrast, **UAVs** equipped with advanced sensors capture high-resolution spatial data, providing greater flexibility and temporal resolution. These data are crucial for refining **remote sensing** algorithms, which are then applied to broader scales using satellite data. This hierarchical approach enhances the accuracy and scalability of SOC assessments, offering a robust framework for **soil carbon monitoring** and climate change mitigation. The study utilized the P4 Multispectral DJI UAV and **GEOSAT-2** satellite, both employing passive remote sensing in the VIS-NIR range, to analyze different carbon fractions within the soil.

2. METHODOLOGY

Fig. 1 illustrates the methodology, with step 1 involving the modeling between the collected geochemical data and the spectral data derived from UAV followed by mapping, and step 2 involving the modeling based on the mapping obtained with UAV and the spectral data from GEOSAT-2.

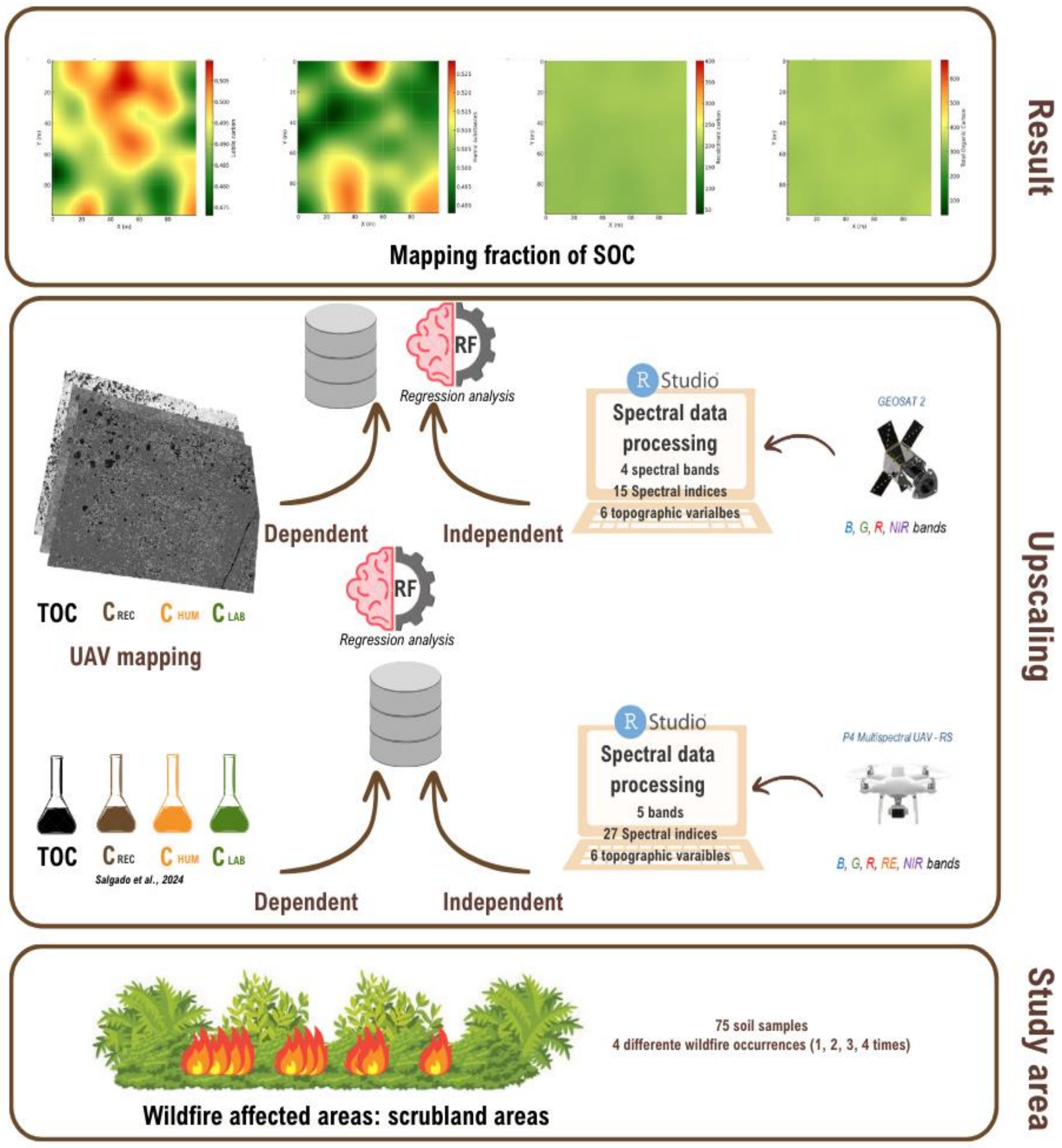

Fig 1. Methodology scheme

3. RESULTS

3.1 Adjustment of predictive models.

Table 1. Goodness-of-fit statistics given by ML for C_{LAB}, C_{HUM}, C_{REC} and TOC.

	UAV			GEOSAT 2		
	R^2	rRMSE	RPQ	R^2	rRMSE	RPQ
C_{LAB}	0.30	116.39%	0.56	0.83	65.04%	0.33
C_{HUM}	0.33	58.98%	0.69	0.20	28.62%	0.49
C_{REC}	**0.52**	**28.46%**	**1.42**	**0.79**	**28.14%**	0.66
TOC	**0.53**	**25.67%**	**1.45**	**0.91**	**33.18%**	0.33

- The **best** results are obtained for **TOC**, both in the geochemical-UAV estimation and in the upscaling process from UAV mapping to GEOSAT 2.
- Among the organic carbon fractions, the **best results** are obtained for the **recalcitrant fraction**, being the only fraction that presents an optimal goodness-of-fit for upscaling (Table 1).

3.2 Mapping.

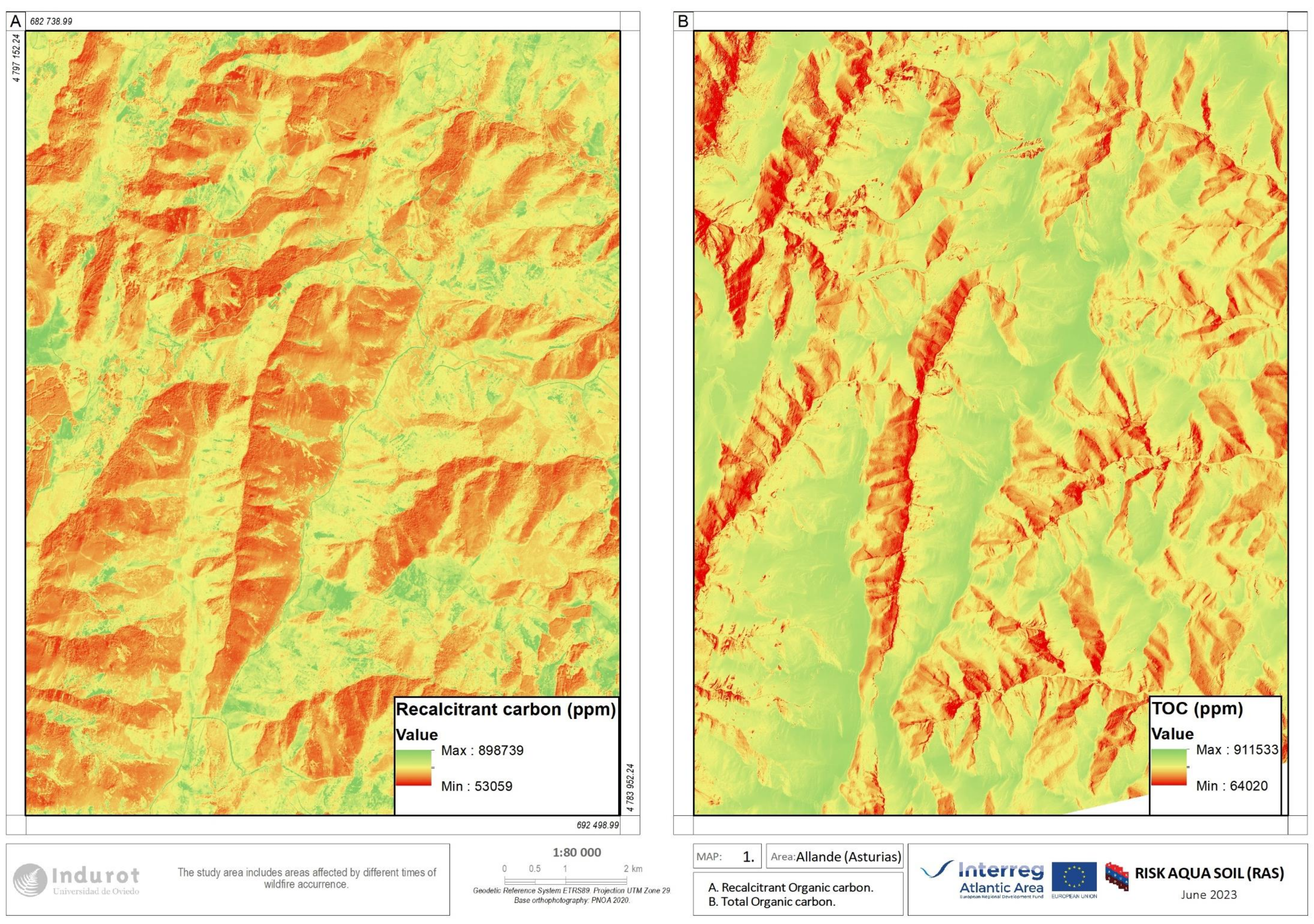

Fig 2. Mapping organic carbon in soil: A. Recalcitrant and B. Total

4. CONCLUSIONS

The use of **Remote Sensing** technologies, such as satellite as UAV, to **address organic carbon soil** are complementary, **reliable**, and **rapid alternatives** to classical geochemical methods.

The use of **UAV** techniques result on **spatial detailed** organic carbon **distribution**. The use of **satellite** data result on **spatial distribution** of organic carbon of **large areas**.

According to the results obtained, the proposed methodology, based on **UAV-satellite upscaling**, yields **acceptable results** for the **recalcitrant fraction and TOC**. However, for the less stable fractions, such as **labile carbon and humic substances**, the results obtained from the initial **UAV-derived model are poor**, which is consistent with the results later obtained from the **satellite data.**

REFERENCES

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