SENTINEL-2 INDICES FOR ENHANCED PREDICTION OF SOIL ROCK FRAGMENTS COVER IN A SPANISH VINEYARD

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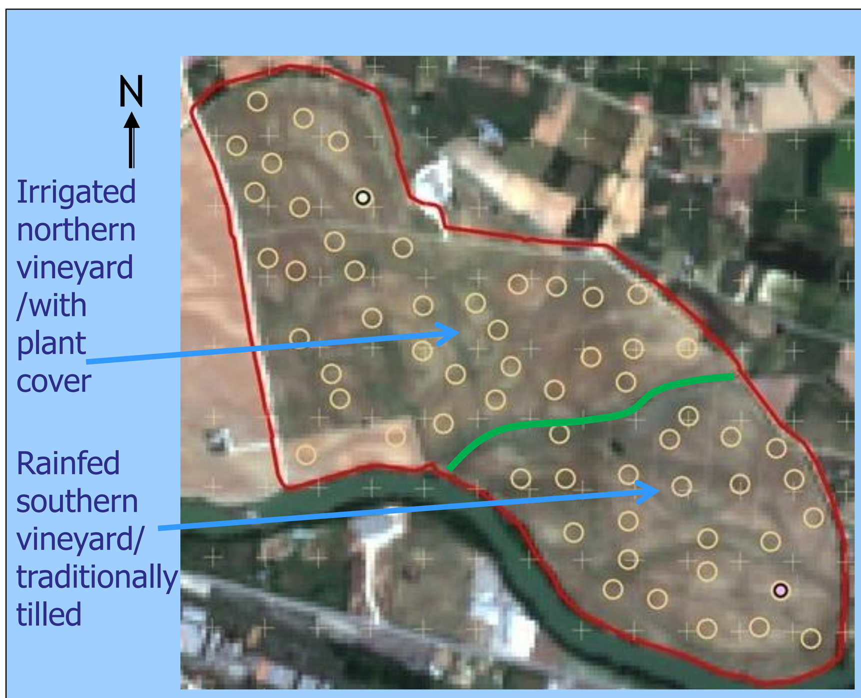
Objectives – study zone

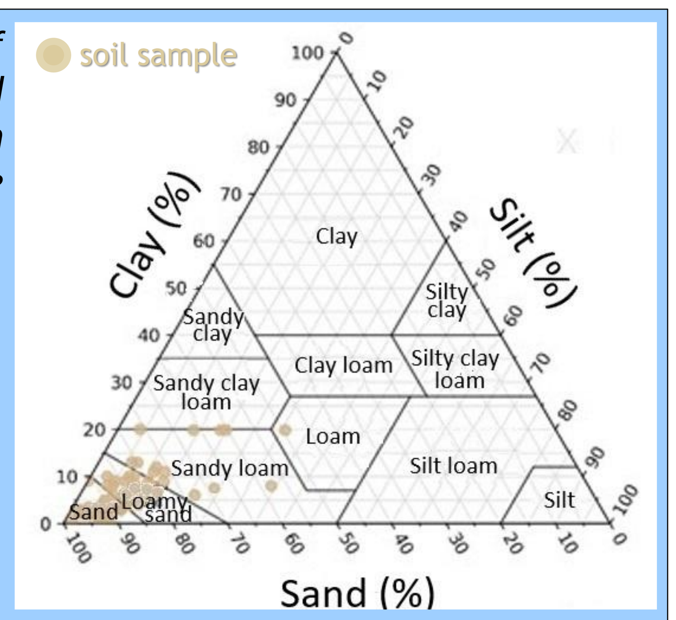


⮙ Map of the Aranda vineyard

82 ha – trellis-trained vineyard in Aranda de Duero (Castilla y León, Spain)
warm-summer Mediterranean climate (P = 493 mm)
Calcaric Arenosols or Aeolic Arenosols

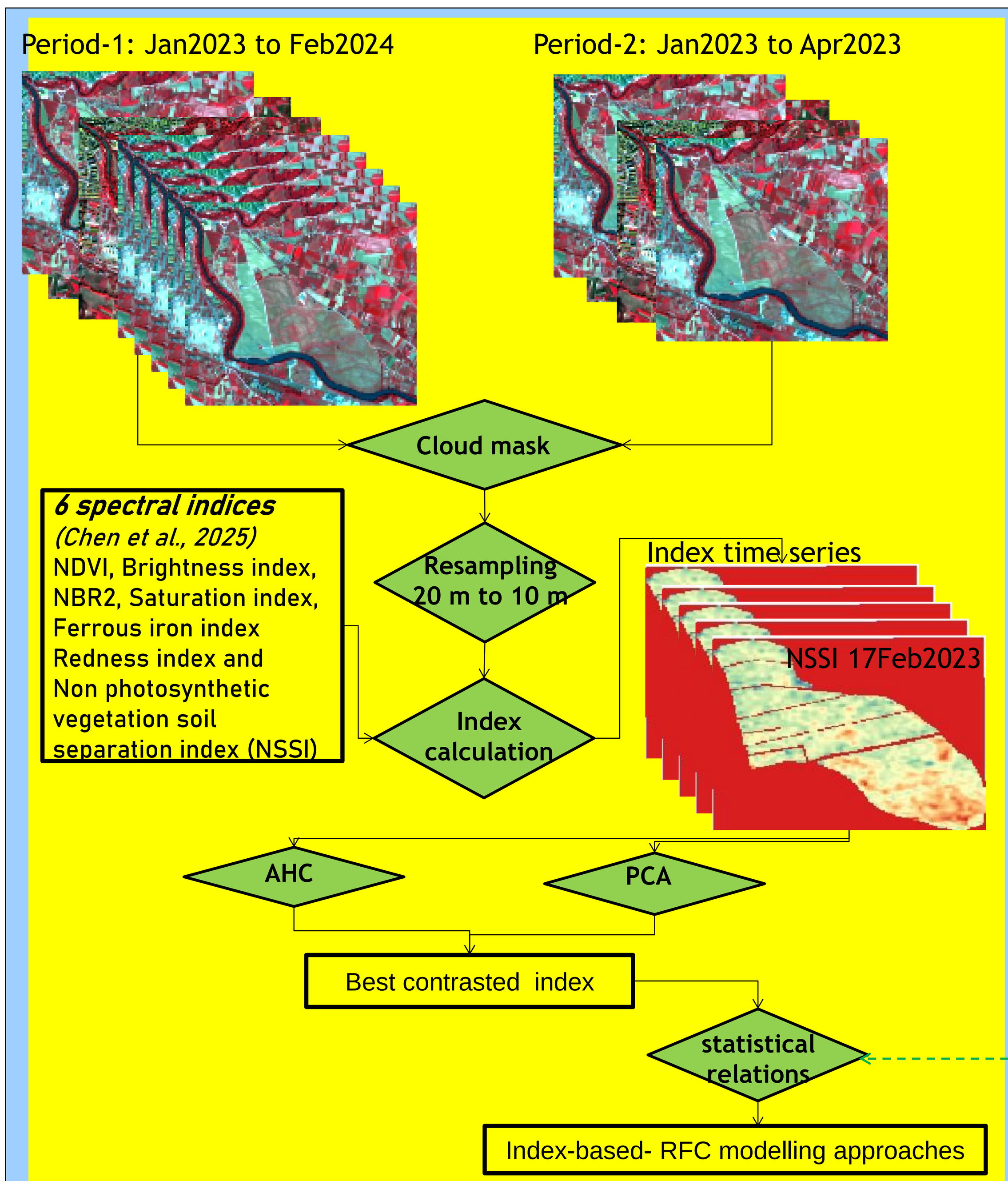
Soil rock fragments strongly influence soil properties, nutrient contents and erosion. Rock fragment cover (RFC) on soil surface affects soil reflectance thus may impact the accuracy of remotely sensed predictions of soil properties. Yet RFC is rarely quantified.

Location of the collected soil samples in the texture triangle ➢



STUDY AIM: assessing the ability of Sentinel-2 (S2) indices to capture variability in RFC and their potential to derive RFC from S2 spectral models.

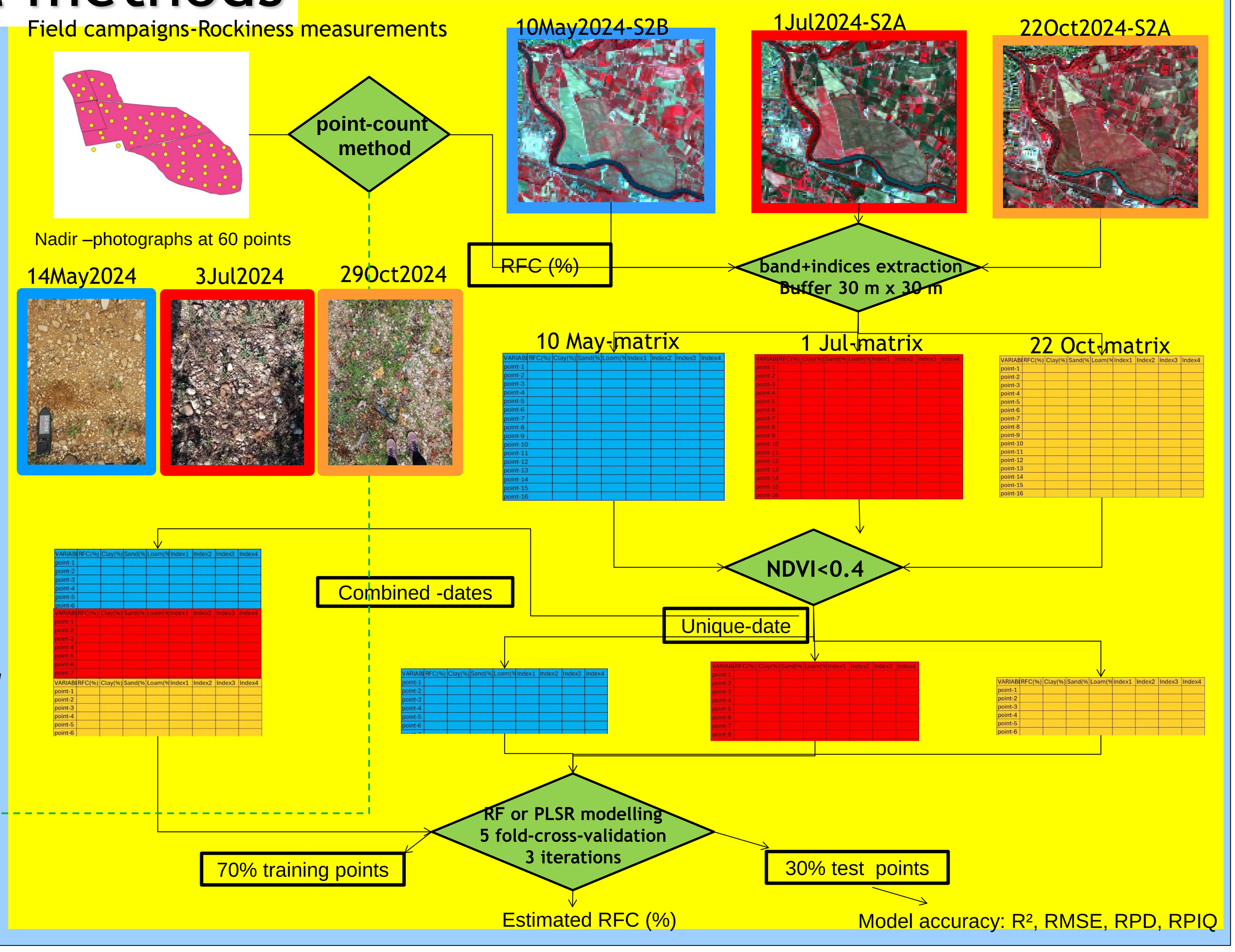
Material & methods



RFC(%) was measured across three field campaigns at 60 points from nadir photographs taken ~1 m above the soil according to the point-count method (Booth et al., 2007).

⮜ Approach for selecting best-suited S2 spectral indices for deriving RFC

Flowchart of RFC modelling from the images closest to field campaigns➢



Results-discussion

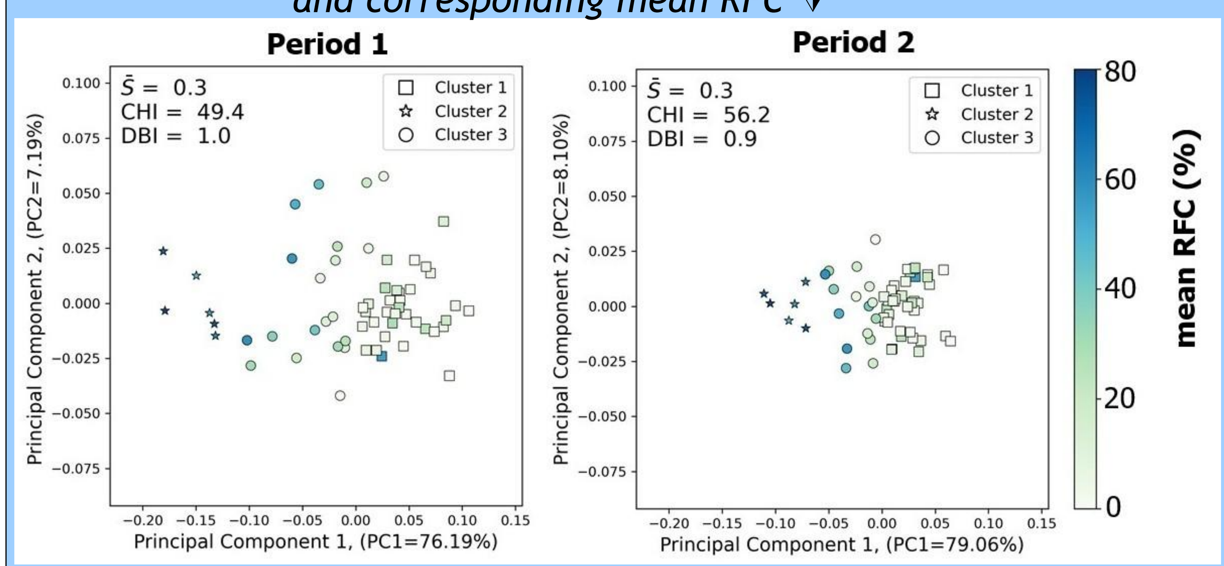
Descriptive statistics of RFC(%) for the 3 field campaigns ⮛

Campaign date	n	μ	std	min	25%	50%	75%	max
14 May 2024	57	16.1	18.4	0.0	0.9	8.4	28.0	57.3
03 July 2024	59	20.2	26.9	0.0	0.9	4.4	28.4	88.0
29 October 2024	59	23.8	27.8	0.0	1.1	12.0	43.4	94.7
All campaigns	60	19.9	21.9	0.0	3.1	11.9	29.5	77.3

std: Standard deviation

→wide range of variation in RFC
→because of vegetation cover, RFC varies across campaigns

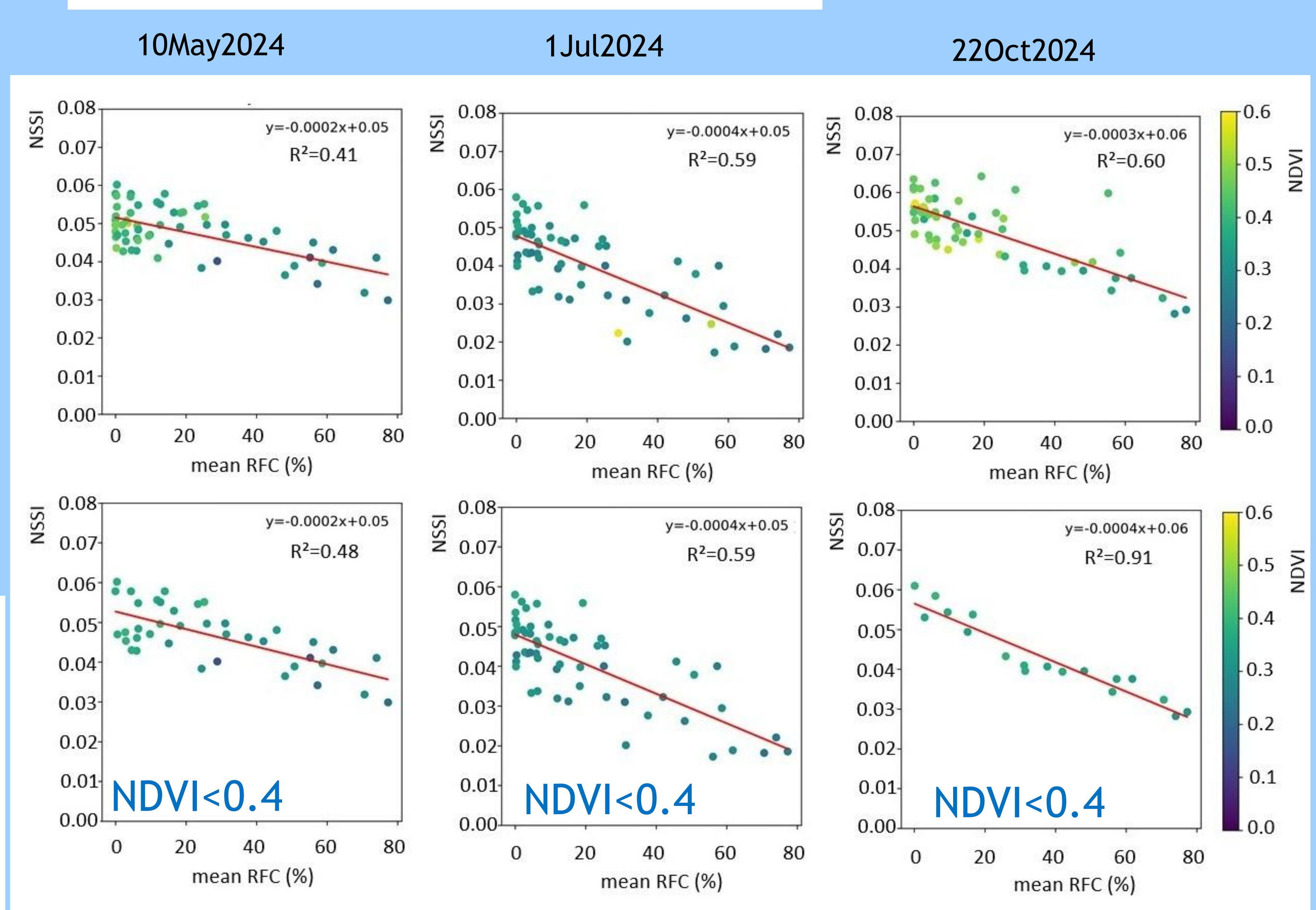
1st factorial planes of the PCA showing the HAC-derived clusters and corresponding mean RFC ⮛



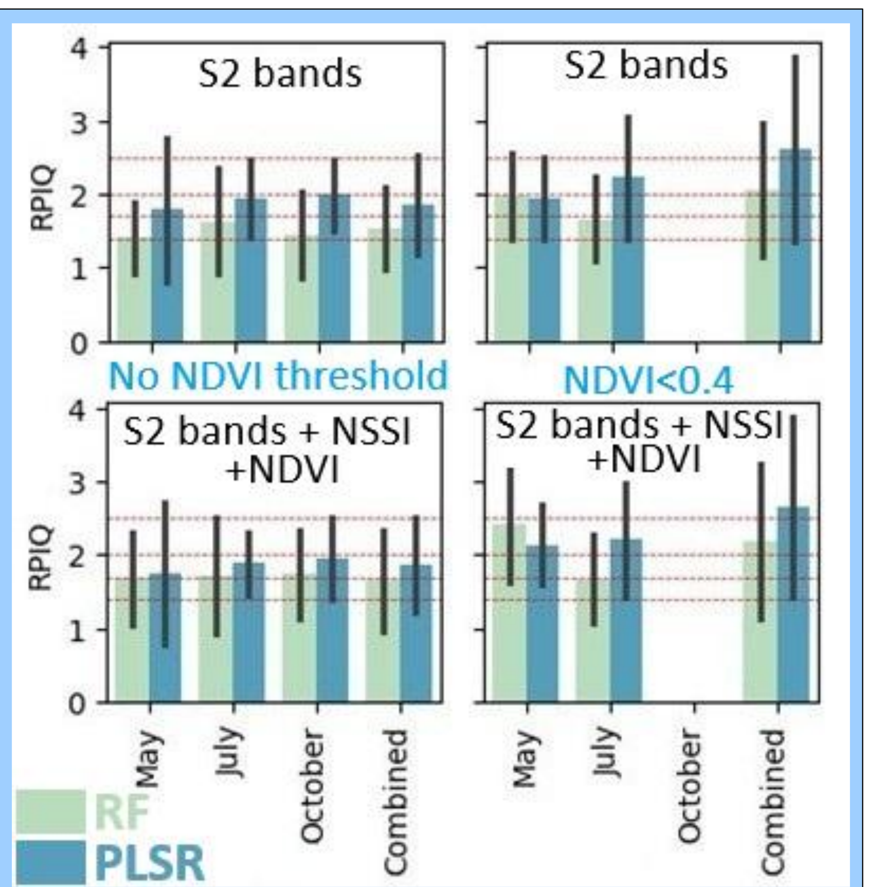
Basic stats of RFC (%) within HAC-clusters according to period ⮛

Cluster	Period 1								Period 2							
	n	μ	std	min	25%	50%	75%	max	n	μ	std	min	25%	50%	75%	max
1	34	8.7	11.8	0.0	0.5	4.3	12.0	55.2	38	9.1	11.5	0.0	0.9	4.5	12.5	55.2
2	6	64.7	11.3	48.1	57.5	66.2	73.2	77.3	6	64.7	11.3	48.1	57.5	66.2	73.2	77.3
3	20	25.7	17.9	0.3	12.0	21.5	38.8	58.7	16	28.9	18.3	0.3	14.5	27.8	42.9	58.7

μ, mean; std, standard deviation



⮙ Linear relationships between NSSI values extracted from the S2 images closest to field campaigns dates, and the mean measured RFC (%) over these three campaigns



⮙ Validation performance of the RFC prediction models

→ negative linear relationship between NSSI and measured RFC, stronger for NDVI < 0.4
→moderate to good performance of RFC-spectral prediction models depending on the acquisition dates
→higher performance for Combined dates, NDVI<0.4 and both NDVI and NSSI co-variables
→variability of soil surface conditions such as soil moisture, and roughness = a major source of uncertainty

References

Booth, D. T., Cox, S.E., Berryman, R, D. 2006. 'Point Sampling Digital Imagery with "Samplepoint"'. Environmental Monitoring and Assessment 123 (1–3): 97–108. https://doi.org/10.1007/s10661-005-9164-7

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Conclusion

NSSI times series analysis enabled RFC clusters identification. NSSI showed a linear relationship with mean RFC, especially with NDVI < 0.4. Future research could integrate multi- and hyperspectral data with geophysical approaches to improve RFC prediction.

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