Combined use of Sentinel-2 images and Sentinel-1-derived moisture maps for soil organic carbon content mapping in croplands, South-western France

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COMBINED USE OF SENTINEL-2 IMAGES AND SENTINEL-1/2 DERIVED MOISTURE MAPS FOR SOIL ORGANIC CARBON CONTENT MAPPING IN CROPLANDS, SOUTH-WESTERN FRANCE

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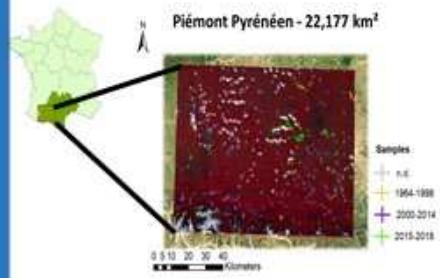
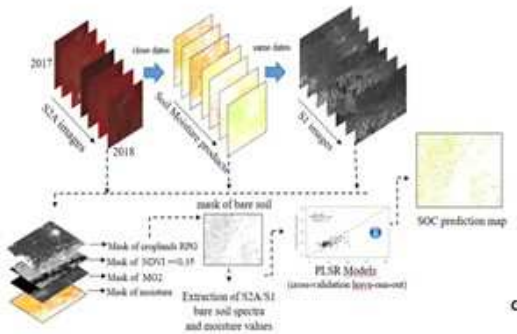
Study area / objective



Study Aim: Predict topsoil organic carbon (SOC) content over croplands, addressing : (i) the influence of the sentinel image date , and (ii) the use of soil moisture products derived from the S1 & S2 satellites in the spectral models.

Material & methods

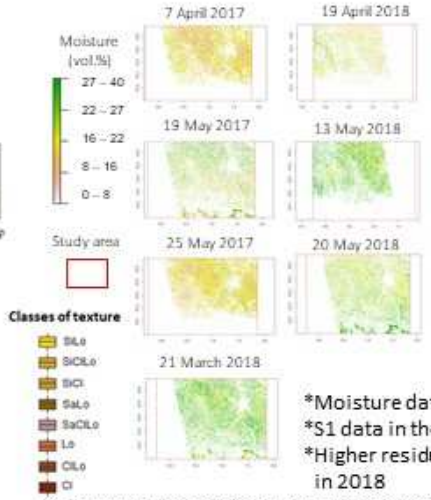
General flowchart



Sentinel-2 (S2A) images and soil moisture products were acquired from the Theia platform (https://www.theia-land.fr/) and Sentinel-1 images from the European Space Agency's Copernicus platform.

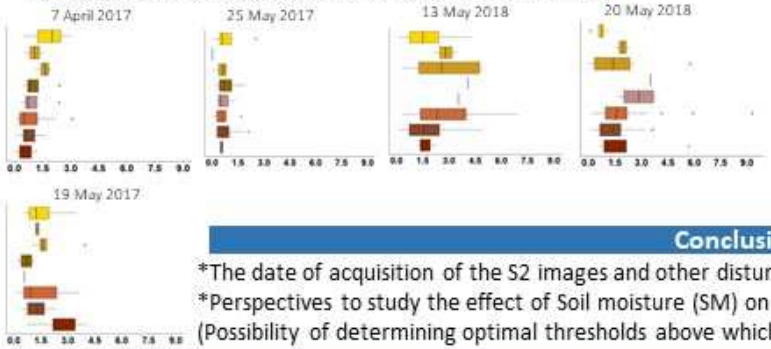
Bare soil reflectance spectra were extracted then centered and PLSR with leave-one-out cross-validation was used on the bands to construct prediction models for SOC content.

Soil moisture products (SMP)



*Moisture data in drier periods improved performance
*S1 data in the models did not improve performance
*Higher residues were associated with loamy textures in 2018

Relationship between texture classes and SOC prediction residuals



Results & discussion

S2 prediction performance using surface soil moisture (SM) from (SMP) as a covariate (in bold characters, models using SM as a covariate)

Imaging Date S2	SMP	NS	MD	R^2cv	RMSEcv (g.kg-1)	RPDcv	NC	Soil Moisture (mv Vol.%) Min	Me	x̄	Max
6 April 2017	7 April 2017	59	No	0.08	1.69	1.05	1				
			Yes	**0.3**	**1.48**	**1.2**	**3**	6.8	17.8	17.38	24.6
16 May 2017	19 May 2017	50	No	0.47	2.06	1.39	4				
			Yes	**0.5**	**2.01**	**1.43**	**3**	9	20.6	20.4	28
26 May 2017	25 May 2017	58	No	0.46	1.33	1.38	4				
			Yes	**0.6**	**1.13**	**1.57**	**5**	5.4	13.2	13.02	18.8
22 March 2018	21 March 2018	55	No	0.1	2.42	1.07	2				
			Yes	**0.1**	**2.42**	**1.06**	**2**	22	26.4	26.24	31.4
21 April 2018	19 April 2018	47	No	0.09	3.58	1.06	2				
			Yes	**0.03**	**3.68**	**1.03**	**2**	11.2	19.8	19.88	26.4
11 May 2018	13 May 2018	58	No	0.44	3.06	1.35	3				
			Yes	**0.48**	**2.95**	**1.4**	**3**	21.4	28.4	28.21	33.4
21 May 2018	20 May 2018	73	No	0.48	2.91	1.4	7				
			Yes	**0.47**	**2.91**	**1.38**	**8**	20.8	22.6	23.66	29

S2 prediction performance using raw S1

Imaging Date S1	NS	P	R^2cv	RMSEcv (g.kg-1)	RPDcv	NC
7 April 2017	59	VII	0.13	1.64	1.08	3
		VV	0.09	1.68	1.06	1
19 May 2017	50	VII	0.6	2.08	1.38	5
		VV	0.44	2.12	1.35	5
25 May 2017	58	VII	0.45	1.31	1.36	5
		VV	0.45	1.31	1.36	5
21 March 2018	55	VII	0.09	2.44	1.05	2
		VV	0.3	2.08	1.24	2
19 April 2018	47	VII	0.05	3.64	1.04	2
		VV	0.08	3.58	1.06	2
13 May 2018	58	VII	0.46	3.01	1.37	2
		VV	0.46	2.9	1.37	2
20 May 2018	73	VII	0.46	2.97	1.37	9
		VV	0.45	3	1.36	9

Conclusion

*The date of acquisition of the S2 images and other disturbing factors affect SOC prediction
*Perspectives to study the effect of Soil moisture (SM) on more dates and under different conditions (Possibility of determining optimal thresholds above which the SM can be included in prediction models).

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